Bluetooth DVT REPORT

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Amkor_CU_2#
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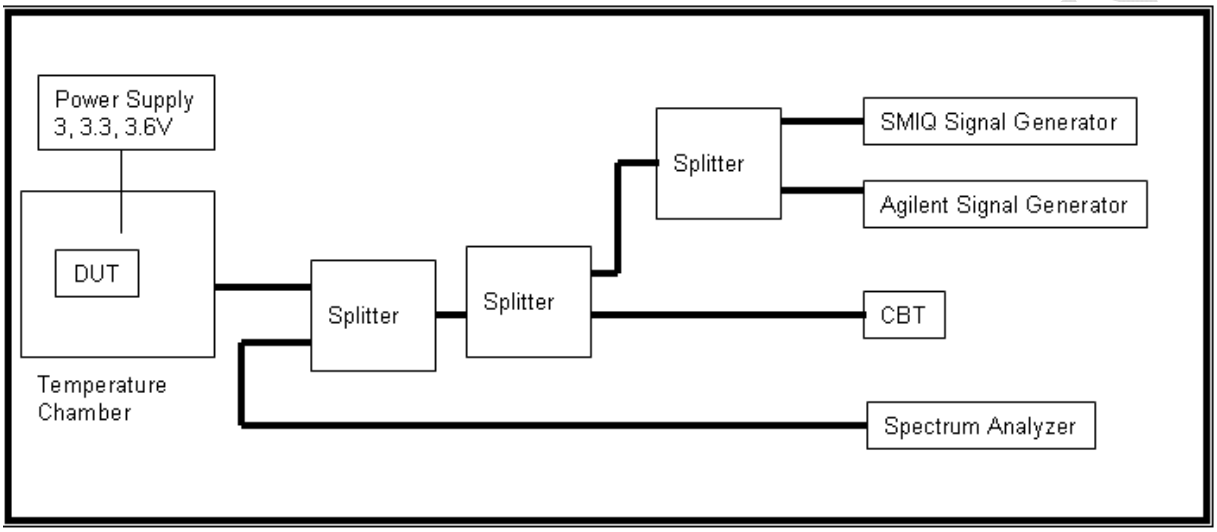
1 INTRODUCTION

This document describes the Bluetooth design verification test (DVT) for Atheros Communications, Inc. Included are statements of test purpose, test methodologies, applicable specifications, and performance results for a typical part. For the all tests, either normal or extreme conditions are specified. For normal conditions, 3.3V is used at 25ºC. At extreme tests, the voltages tested are 3.0V and 3.6V, and the temperatures tested are -40ºC and 85ºC.

2 TEST SETUP



Screen Room / Anechoic chamber

All tests are performed using the setup shown in the above figure. All the equipment is placed inside a screen room or anechoic chamber. The DUT is placed inside a temperature chamber, which is connected to the CBT Tester and signal generators through a series of 50Ω SMA cables and splitters. The DUT is powered using a power supply.

For Bluetooth 3.0 RF testing, the CBT will communicate with the DUT over the air, using loopback mode. For Bluetooth 4.0 low energy RF testing, the CBT will communicate with the DUT directly via HCI commands.

3 DVT RESULTS - Transmitter

The results of the transmitter performance tests are presented in this section.

3.1 TX Output Power (TRM/CA/01/C)

3.1.1 Purpose of Test:

This test measures the transmitted power of the DUT at channels 0, 39, and 78. This test is performed at normal and extreme conditions.

3.1.2 Test Methodology:

The DUT is configured to be in loopback test mode. The output powers for the longest supported basic rate packet length at channels 0, 39, and 78 are measured.

3.1.3 Test Modes and Parameters

Packet Type: DH5
Channels: 0, 39, 78
Temperatures: -40ºC, 25ºC, 85ºC
Supply Voltages: 3.0V, 3.3V, 3.6V

3.1.4 Bluetooth Specifications

For Class 1 device, output power needs to be greater than 0dBm. The packet type is chosen to be the longest support packet type. For more information, please refer to the Bluetooth RF Test Specification, section 5.1.3 entitled "TRM/CA/01/C Output Power".

3.1.5 Results: PASS

Table 1 – TX Output Power (dBm), Amkor_Cu_1#

	3.0 V			3.3 V			3.6 V		
Channel	-40˚C	25˚C	85˚C	-40˚C	25˚C	85˚C	-40˚C	25˚C	85˚C
0	11.3	11.9	11.7	11.9	12.4	12.2	12.4	12.8	12.6
39	10.8	11.6	11.6	11.4	12.1	12.1	11.8	12.5	12.5
78	10.4	11.4	11.5	11	11.8	12	11.4	12.2	12.4

Table 2 – TX Output Power (dBm), Amkor_Cu_2#

	3.0 V			3.3 V			3.6 V		
Channel	-40˚C	25˚C	85˚C	-40˚C	25˚C	85˚C	-40˚C	25˚C	85˚C

0	12.1	11.2	11.7	12.7	11.7	12.2	13.1	12.1	12.5
39	12.3	11.5	12.1	12.8	12	12.6	13.2	12.4	12.9
78	12.7	12	12.6	13.2	12.5	13.1	13.6	12.8	13.4

Table 3 – TX Output Power (dBm), Amkor_Cu_3#

	3.0 V			3.3 V			3.6 V		
Channel	-40˚C	25˚C	85˚C	-40˚C	25˚C	85˚C	-40˚C	25˚C	85˚C
0	10.2	10.1	10.7	10.7	10.6	11.2	11.2	11	11.5
39	10.4	10.4	11.1	10.9	10.9	11.6	11.3	11.3	11.9
78	10.9	11	11.7	11.3	11.4	12.1	11.7	11.7	12.4

3.2 TX Power Control (TRM/CA/03/C)

3.2.1 Purpose of Test

This test verifies the power control feature of the DUT of basic rate signals. The transmitted power at each power step is measured. This test is performed under normal conditions.

3.2.2 Test Methodology

The DUT is configured to be in loopback test mode. The power is measured at channels 0, 39, and 78 for each supported power step.

3.2.3 Test Modes and Parameters

Operation Modes: DH5
Channels: 0, 39, 78
Temperatures: 25ºC
Supply Voltages: 3.3V

3.2.4 Bluetooth Specifications

The expected step size of the power control is between 2dB and 8dB. Please refer to the Bluetooth RF Test Specification, section 5.1.5 entitled "TRM/CA/03/C Power Control" for more information.

3.2.5 Results: PASS

Table 4 – Power at each Power Control Step (dBm), Amkor_Cu_1#

Step	Channel		
	0	39	78
0	12	11.8	11.6
1	7.6	7.8	7.9
2	2.6	2.5	2.3
3	-1.1	-1.1	-1.3
4	-4.6	-4.5	-4.6
5	-8.8	-8.8	-8.8
6	-13.4	-13.3	-13.1
7	-17.3	-17	-16.8
8	-21.1	-20.8	-20.7
9	-24.6	-24.4	-24.3
10	-29.1	-28.9	-28.8

Table 5 – Step Size (dB), Amkor_Cu_1#

Step Size	Channel		
	0	39	78
1	4.4	4	3.7
2	5	5.3	5.6
3	3.7	3.6	3.6
4	3.5	3.4	3.3
5	4.2	4.3	4.2
6	4.6	4.5	4.3
7	3.9	3.7	3.7
8	3.8	3.8	3.9
9	3.5	3.6	3.6
10	4.5	4.5	4.5

Table 6 – Power at each Power Control Step (dBm), Amkor_Cu_2#

Step	Channel		
	0	39	78
0	11.8	12.2	12.6
1	7.1	7.9	8.6
2	2.2	2.3	2.6
3	-1.4	-1.3	-1
4	-4.9	-4.8	-4.3
5	-9	-8.8	-8.3
6	-13.4	-13.2	-12.7
7	-17.4	-17.1	-16.6
8	-21.5	-21.2	-20.6
9	-25	-24.6	-24.1
10	-29.4	-29.1	-28.6

Table 7 – Step Size (dB), Amkor_Cu_2#

Step Size	Channel		
	0	39	78
1	4.7	4.3	4
2	4.9	5.6	6
3	3.6	3.6	3.6
4	3.5	3.5	3.3
5	4.1	4	4
6	4.4	4.4	4.4
7	4	3.9	3.9
8	4.1	4.1	4
9	3.5	3.4	3.5
10	4.4	4.5	4.5

Table 8 – Power at each Power Control Step (dBm), Amkor_Cu_3#

Step	Channel		
	0	39	78
0	10.7	11	11.6
1	5.9	6.7	7.4
2	1.1	1.2	1.5
3	-2.5	-2.4	-2
4	-6	-5.9	-5.5
5	-9.9	-9.8	-9.3
6	-14.4	-14.2	-13.7
7	-18.4	-18.1	-17.7
8	-22.4	-22	-21.5
9	-25.8	-25.5	-25
10	-30.3	-29.9	-29.5

Table 9 – Step Size (dB), Amkor_Cu_3#

Step Size	Channel		
	0	39	78
1	4.8	4.3	4.2
2	4.8	5.5	5.9
3	3.6	3.6	3.5
4	3.5	3.5	3.5
5	3.9	3.9	3.8
6	4.5	4.4	4.4
7	4	3.9	4
8	4	3.9	3.8
9	3.4	3.5	3.5
10	4.5	4.4	4.5

3.3 TX Output Spectrum – Frequency Range (TRM/CA/04/C)

3.3.1 Purpose of Test

This test measures the operating frequency range of the DUT. This test is performed under normal and extreme test conditions.

3.3.2 Test Methodology

The DUT is configured to be in loopback test mode. The frequency at which the spectral power density drops below -30dB (measured with a 100kHz bandwidth) is noted. This test is performed at channel 0 and channel 78, and the -30dB frequencies below channel 0 and above channel 78 are measured.

3.3.3 Test Modes and Parameters

Operation Modes: DH5
Channels: 0, 78
Temperatures: -40ºC, 25ºC, 85ºC
Supply Voltages: 3.0V, 3.3V, 3.6V

3.3.4 Bluetooth Specifications

All values measured are expected to be between 2.4GHz and 2.4835GHz. Please refer to the Bluetooth RF Test Specification, section 5.1.6 entitled "TRM/CA/04/C TX Output Spectrum – Frequency Range" for more information.

3.3.5 Results: PASS

Table 10 - -30dB Frequencies (MHz), Amkor_Cu_1#

	3.0 V			3.3 V			3.6 V		
Channel	-40˚C	25˚C	85˚C	-40˚C	25˚C	85˚C	-40˚C	25˚C	85˚C
0	2400.93	2400.93	2400.94	2400.93	2400.92	2400.95	2400.92	2400.92	2400.95
78	2481.01	2481.05	2481.07	2481.04	2481.05	2481.08	2481.05	2481.05	2481.09

Table 11 - -30dB Frequencies (MHz), Amkor_Cu_2#

	3.0 V			3.3 V			3.6 V		
Channel	-40˚C	25˚C	85˚C	-40˚C	25˚C	85˚C	-40˚C	25˚C	85˚C
0	2400.9	2400.93	2400.95	2400.9	2400.93	2400.95	2400.89	2400.92	2400.95
78	2481.03	2481.06	2481.09	2481.04	2481.06	2481.1	2481.06	2481.06	2481.11

Table 12 - -30dB Frequencies (MHz), Amkor_Cu_3#

	3.0 V			3.3 V			3.6 V		
Channel	-40˚C	25˚C	85˚C	-40˚C	25˚C	85˚C	-40˚C	25˚C	85˚C
0	2400.97	2400.95	2400.95	2400.95	2400.95	2400.95	2400.94	2400.94	2400.94
78	2481.03	2481.05	2481.07	2481.06	2481.05	2481.08	2481.06	2481.06	2481.08

3.4 TX Output Spectrum – 20dB Bandwidth (TRM/CA/05/C)

3.4.1 Purpose of Test

This test measures the transmitted spectrum of the DUT for basic rate signals. The 20dB bandwidth is measured. This test is performed under normal and extreme test conditions.

3.4.2 Test Methodology

The DUT is configured to be in loopback test mode. The frequencies at which the spectral power density drops below -20dB (measured with a 100kHz bandwidth) are noted. This test is performed at channels 0, 39, and 78.

3.4.3 Test Modes and Parameters

Operation Modes: DH5
Channels: 0, 39, 78
Temperatures: -40ºC, 25ºC, 85ºC
Supply Voltages: 3.0V, 3.3V, 3.6V

3.4.4 Bluetooth Specifications

All measured spectrum bandwidths must be less than or equal to 1MHz. Please refer to the Bluetooth RF Test Specification, section 5.1.7 entitled "TRM/CA/05/C TX Output Spectrum – 20dB Bandwidth" for more information.

3.4.5 Results: PASS

Table 13 – 20dB Bandwidth (Hz), Amkor_Cu_1#

	3.0 V			3.3 V			3.6 V		
Channel	-40˚C	25˚C	85˚C	-40˚C	25˚C	85˚C	-40˚C	25˚C	85˚C
0	951252	949951	950612	950539	950158	949549	950807	950164	949502
39	950923	949694	950132	950396	949897	949383	950810	949802	949706
78	950605	949720	949770	950438	949820	949482	951025	949783	950501

Table 14 – 20dB Bandwidth (Hz), Amkor_Cu_2#

	3.0 V			3.3 V			3.6 V		
Channel	-40˚C	25˚C	85˚C	-40˚C	25˚C	85˚C	-40˚C	25˚C	85˚C
0	950617	949993	951346	949680	949927	949737	949888	950100	949985
39	949705	950331	950720	950378	950257	949855	949894	950637	950536
78	951173	950902	950497	951330	951254	950369	949781	951207	951220

Table 15 – 20dB Bandwidth (Hz), Amkor_Cu_3#

	3.0 V			3.3 V			3.6 V		
Channel	-40˚C	25˚C	85˚C	-40˚C	25˚C	85˚C	-40˚C	25˚C	85˚C
0	951280	949784	950322	950813	949712	950148	951090	949773	949830
39	951129	949704	949727	950850	949638	949978	951324	949923	949657
78	950873	949897	949785	951003	949775	949701	951388	950314	949984

3.5 TX Output Spectrum – Adjacent Channel Power (TRM/CA/06/C)

3.5.1 Purpose of Test

This test measures the power in the channels adjacent to the desired transmit channel. This test is performed at normal and extreme conditions.

3.5.2 Test Methodology:

The DUT is configured to be in loopback test mode. At each transmit channel (0, 39, and 78), the power in the adjacent channels, separated by 1MHz, are measured.

3.5.3 Test Modes and Parameters

Operation Modes: DH1
Channels: 3, 39, 75
Temperatures: -40ºC, 25ºC, 85ºC
Supply Voltages: 3.0V, 3.3V, 3.6V

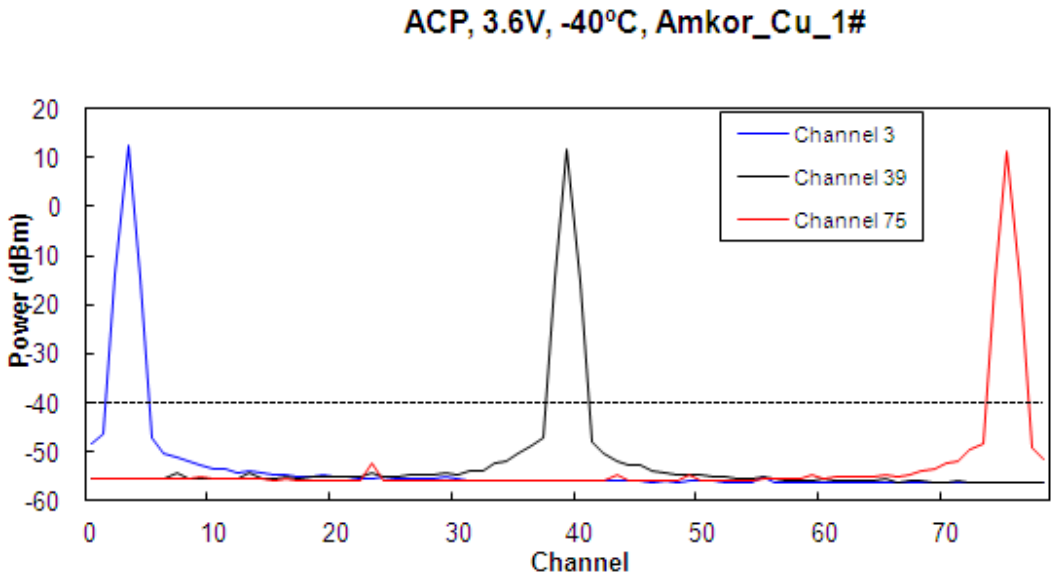
3.5.4 Bluetooth Specifications:

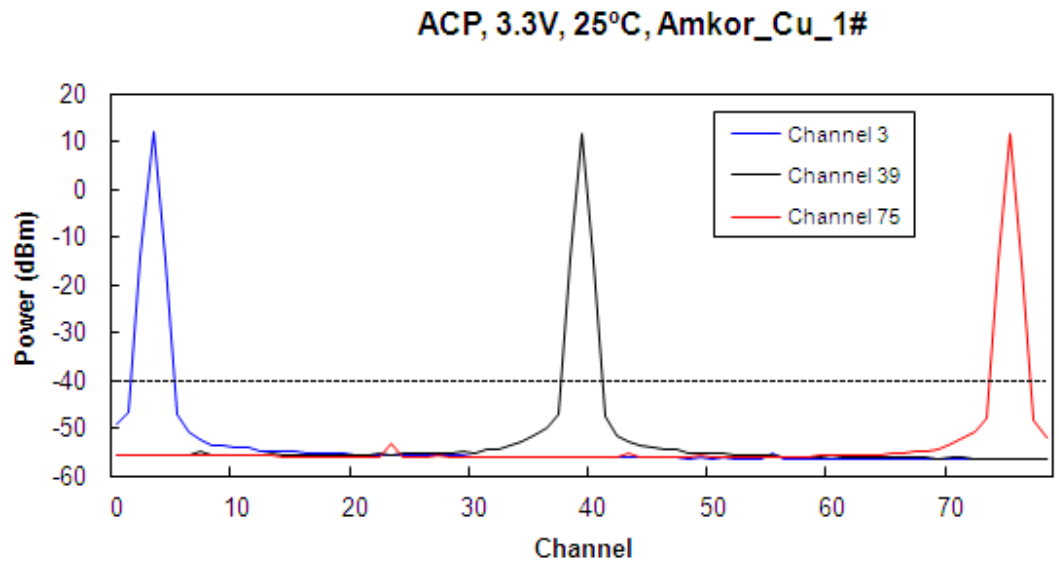
More information can be found in the Bluetooth RF Test Specification, section 5.1.8 "TRM/CA/06/C TX Output Spectrum – Adjacent Channel Power".

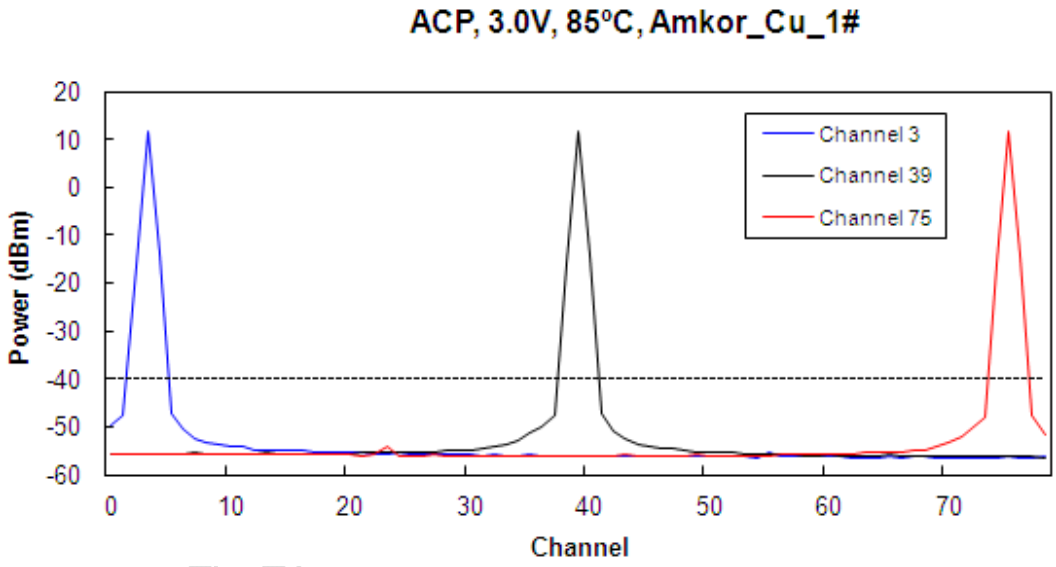
Adjacent Channel	Bluetooth RF Specification
≥ ± 3 MHz Offset	-40 dBm
± 2 MHz Offset	-20 dBm

3.5.5 Results: PASS

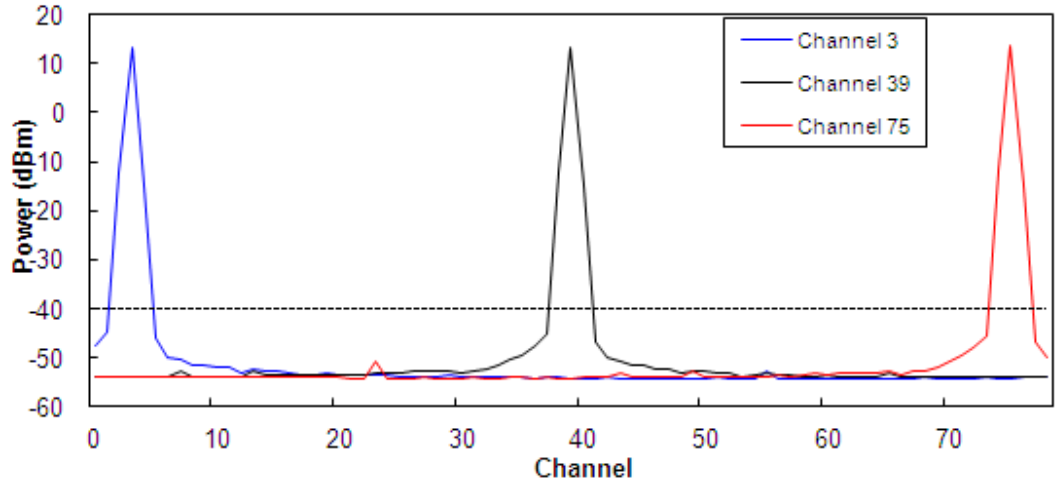
For these results, the 3 colored curves represent the ACP at channel 3 (blue), channel 39 (black) and channel 75 (red). The black dotted line is the limit for channels ≥+3MHz.



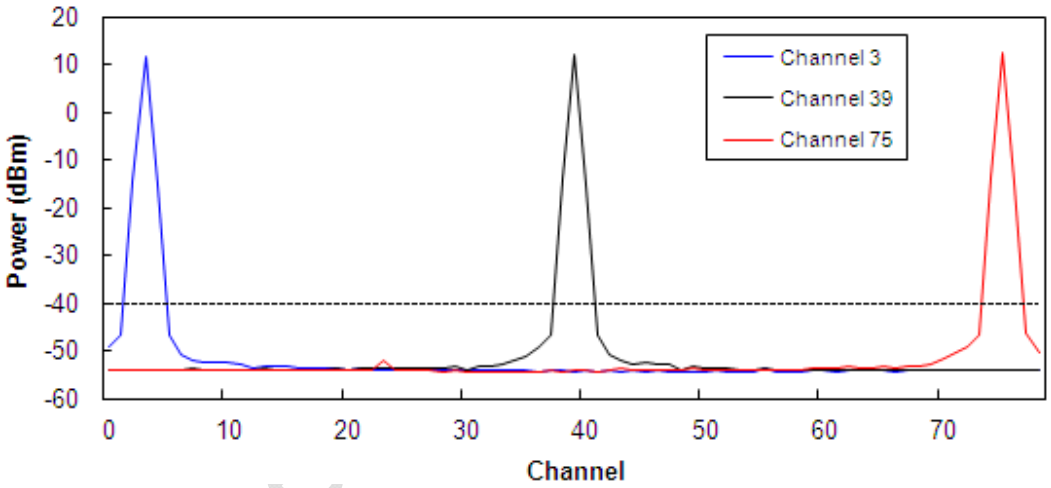

ACP, 3.3V, 25°C, Amkor_Cu_1#
Power (dBm)
Channel
Channel 3
Channel 39
Channel 75
20
10
0
-10
-20
-30
-40
-50
-60
0
10
20
30
40
50
60
70


ACP, 3.0V, 85°C, Amkor_Cu_1#
Power (dBm)
Channel
Channel 3
Channel 39
Channel 75
20
10
0
-10
-20
-30
-40
-50
-60
0
10
20
30
40
50
60
70

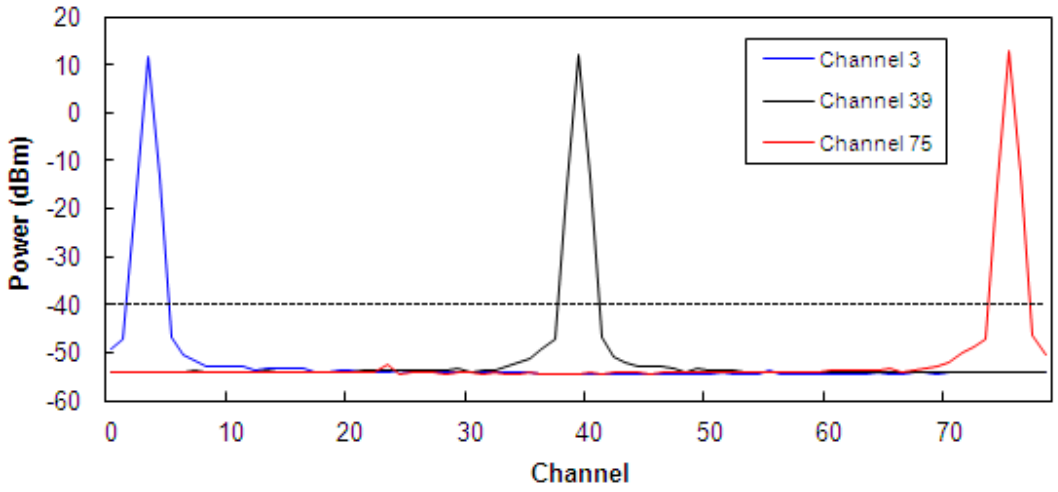
ACP, 3.6V, -40°C, Amkor_Cu_2#



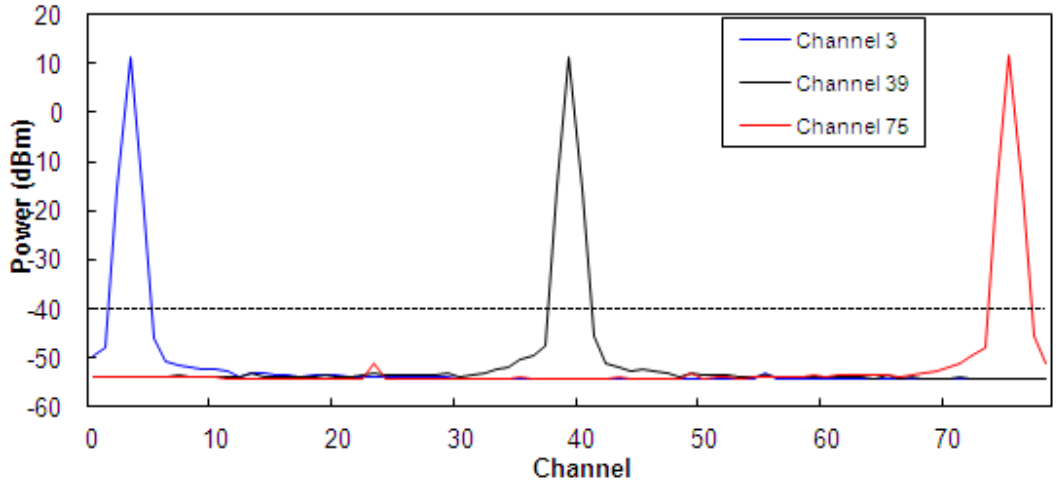
ACP, 3.3V, 25°C, Amkor_Cu_2#



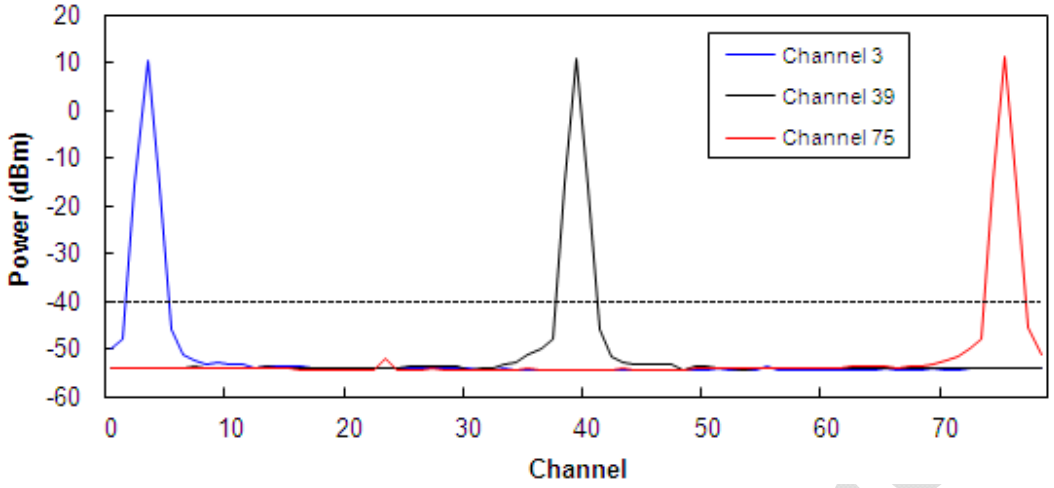
ACP, 3.0V, 85°C, Amkor_Cu_2#



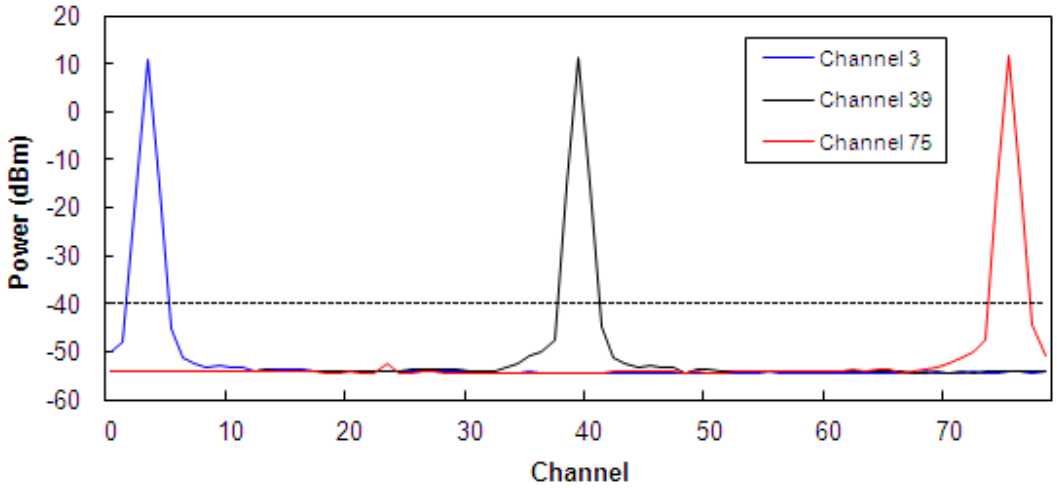
ACP, 3.6V, -40°C, Amkor_Cu_3 #



ACP, 3.3V, 25°C, Amkor_Cu_3#



ACP, 3.0V, 85°C, Amkor_Cu_3#



3.6 TX Basic Rate Modulation Characteristics (TRM/CA/07/C)

3.6.1 Purpose of Test

This test measures the transmitted signal quality of the DUT of basic rate signals. This test is performed at normal and extreme conditions.

3.6.2 Test Methodology

The DUT is configured to be in loopback test mode, and the GFSK modulation characteristics at channels 0, 39, and 78 are measured.

3.6.3 Test Modes and Parameters

Operation Modes: DH5
Channels: 0, 39, 78
Temperatures: -40ºC, 25ºC, 85ºC
Supply Voltages: 3.0V, 3.3V, 3.6V

3.6.4 Bluetooth Specifications

1. 140kHz ≤ f1avg ≤ 175kHz
2. f2max ≥ 115kHz for at least 99.9% of all f2max
3. f2avg / f1avg ≥ 0.8

Please refer to the Bluetooth RF Test Specification, section 5.1.9 entitled "TRM/CA/07/C Modulation Characteristics" for more information.

3.6.5 Results: PASS

Table 16 – Modulation Characteristics, Amkor_Cu_1#

		3.0 V			3.3 V			3.6 V		
Channel		-40˚C	25˚C	85˚C	-40˚C	25˚C	85˚C	-40˚C	25˚C	85˚C
F1avg (kHz)	0	154.55	154.99	154.37	155.12	155.33	155.03	155.84	155.73	155.7
	39	155.58	154.78	153.94	156.12	155.82	154.8	155.87	155.63	155.55
	78	157.01	155.1	154.78	155.98	155.53	155.31	155.54	154.94	155.95
% F2max >115kHz	0	100	100	100	100	100	100	100	100	100
	39	100	100	100	100	100	100	100	100	100
	78	100	100	100	100	100	100	100	100	100
F2/F1	0	0.97	0.97	0.98	0.97	0.96	0.97	0.96	0.96	0.97
	39	0.96	0.97	0.97	0.97	0.97	0.96	0.97	0.97	0.96
	78	0.96	0.97	0.96	0.97	0.97	0.95	0.97	0.97	0.95

Table 17 – Modulation Characteristics, Amkor_Cu_2#

		3.0 V			3.3 V			3.6 V		
Channel		-40˚C	25˚C	85˚C	-40˚C	25˚C	85˚C	-40˚C	25˚C	85˚C
F1avg (kHz)	0	156.88	155.25	155.4	157.08	156.71	155.9	156.2	155.83	156.77
	39	157.06	155.33	156.61	156.86	157.13	156.07	157.3	157.15	156.86
	78	155.88	156.11	156.89	155.24	156.68	156.69	158.08	156.15	157.49
% F2max >115kHz	0	100	100	100	100	100	100	100	100	100
	39	100	100	100	100	100	100	100	100	100
	78	100	100	100	100	100	100	100	100	100
F2/F1	0	0.97	0.98	0.95	0.94	0.94	0.95	0.98	0.98	0.96
	39	0.93	0.95	0.94	0.94	0.94	0.94	0.93	0.94	0.96
	78	0.97	0.95	0.94	0.98	0.94	0.96	0.93	0.95	0.96

Table 18 – Modulation Characteristics, Amkor_Cu_3#

		3.0 V			3.3 V			3.6 V		
Channel		-40˚C	25˚C	85˚C	-40˚C	25˚C	85˚C	-40˚C	25˚C	85˚C
F1avg (kHz)	0	154.3	153.23	154.05	157.08	153.61	154.49	155.01	153.86	154.96
	39	155.13	153.88	152.35	156.38	154.32	155.86	155.97	154.72	155.92
	78	156.58	154.64	156.27	156.89	155.75	155.78	157.11	155.47	155.39
% F2max >115kHz	0	100	100	100	100	100	100	100	100	100
	39	100	100	100	100	100	100	100	100	100
	78	100	100	100	100	100	100	100	100	100
F2/F1	0	0.99	0.99	0.97	0.95	0.99	0.98	0.98	0.98	0.96
	39	0.96	0.97	0.98	0.95	0.98	0.97	0.96	0.98	0.97
	78	0.95	0.97	0.96	0.95	0.96	0.96	0.95	0.97	0.96

3.7 Initial Carrier Frequency Tolerance (TRM/CA/08/C)

3.7.1 Purpose of Test

This test measures the initial carrier frequency of the DUT of basic rate (GFSK modulated) signals, and verifies it is within specification. This test is performed at normal and extreme conditions.

3.7.2 Test Methodology

The DUT is configured to be in loopback test mode, and the GFSK carrier frequency tolerance at channels 0, 39, and 78 are measured.

3.7.3 Test Modes and Parameters

Operation Modes: DH1
Channels: 0, 39, 78
Temperatures: -40ºC, 25ºC, 85ºC
Supply Voltages: 3.0V, 3.3V, 3.6V

3.7.4 Bluetooth Specifications

All values must be between -75kHz and +75kHz. Please refer to the Bluetooth RF Test Specification, section 5.1.10 entitled TRM/CA/08/C Initial Carrier Frequency Tolerance for more information.

3.7.5 Results: PASS

Table 19 – Carrier Frequency Offset From Desired TX Frequency (kHz), Amkor_Cu_1#

	3.0 V			3.3 V			3.6 V		
Channel	-40˚C	25˚C	85˚C	-40˚C	25˚C	85˚C	-40˚C	25˚C	85˚C
0	-2.94	-10.81	33.25	-5.67	-9.89	27.66	-6.54	-8.86	25.04
39	-4.26	-10.64	31.55	-6.21	-10.08	26.73	-6.99	-9.78	25.69
78	-5.09	-10.28	30.5	-6.21	-9.46	27.25	-6.97	-9.71	25.89

Table 20 – Carrier Frequency Offset From Desired TX Frequency (kHz), Amkor_Cu_2#

	3.0 V			3.3 V			3.6 V		
Channel	-40˚C	25˚C	85˚C	-40˚C	25˚C	85˚C	-40˚C	25˚C	85˚C
0	-28.25	-11.16	31.15	-32.05	-10.88	25.76	-32.83	-10.59	23.65
39	-30.49	-11.5	29.05	-32.9	-11.16	25.6	-33.06	-10.71	24.52
78	-32.76	-10.77	28.26	-33.06	-10.98	25.84	-33.19	-10.75	24.71

Table 21 – Carrier Frequency Offset From Desired TX Frequency (kHz), Amkor_Cu_3#

	3.0 V			3.3 V			3.6 V		
Channel	-40˚C	25˚C	85˚C	-40˚C	25˚C	85˚C	-40˚C	25˚C	85˚C
0	-3.35	-7.5	13.92	-6.62	-6.34	8.75	-7.25	-5.79	7.05
39	-4.77	-7.15	12.19	-6.75	-6.18	8.98	-7.06	-5.85	8.32
78	-6.29	-6.76	11.19	-7.35	-6.34	8.88	-7.51	-5.73	8.58

3.8 Carrier Frequency Drift (TRM/CA/09/C)

3.8.1 Purpose of Test

This test measures the carrier frequency drift of the DUT of basic rate signals. This test is performed at normal and extreme conditions.

3.8.2 Test Methodology

The DUT is configured to be in loopback test mode, and the GFSK carrier frequency drift at channels 0, 39, and 78 are measured.

3.8.3 Test Modes and Parameters

Operation Modes: DH1, DH3, DH5
Channels: 0, 39, 78
Temperatures: -40ºC, 25ºC, 85ºC
Supply Voltages: 3.0V, 3.3V, 3.6V

3.8.4 Bluetooth Specifications

Frequency drift values must follow the table below:

Type of Packet	Frequency Drift
One slot packet	±25 kHz
Three slot packet	±40 kHz
Five slot packet	±40 kHz

In addition, the maximum drift rate values must be below 20kHz/50µs. Please refer to the Bluetooth RF Test Specification, section 5.1.11 entitled "TRM/CA/09/C Carrier Frequency Drift" for more information.

3.8.5 Results: PASS

Table 22 – Carrier Frequency Drift (kHz), Amkor_Cu_1#

	DH1, 3.0 V			DH1, 3.3 V			DH1, 3.6 V		
Channel	-40˚C	25˚C	85˚C	-40˚C	25˚C	85˚C	-40˚C	25˚C	85˚C
0.00	1.5	-0.37	-1.59	0.92	-1.21	-1.57	0.64	-0.13	-1.41
39.00	0.68	-0.61	-1.31	1.14	-1.38	-2.37	0.73	-0.7	-2
78.00	1.47	-0.53	-2.1	0.56	-1.09	-2.2	1.32	-0.31	-1.58
	DH3, 3.0 V			DH3, 3.3 V			DH3, 3.6 V		
Channel	-40˚C	25˚C	85˚C	-40˚C	25˚C	85˚C	-40˚C	25˚C	85˚C
0.00	1.41	0.21	-1.8	0.09	-0.14	-1.78	1.4	-1.03	-2.41
39.00	0.7	-1.25	-1.45	1.43	-1.09	-1.88	0.93	-0.93	-2.37
78.00	1.56	-0.94	-2.14	0.45	-0.97	-1.97	0.95	-1.11	-2
	DH5, 3.0 V			DH5, 3.3 V			DH5, 3.6 V		
Channel	-40˚C	25˚C	85˚C	-40˚C	25˚C	85˚C	-40˚C	25˚C	85˚C
0.00	1.89	-1.03	-2.06	0.15	-0.45	-1.69	0.49	-0.29	-2.18
39.00	1.01	-0.35	-1.98	1.38	-0.29	-1.81	0.7	-0.51	-1.65
78.00	1.74	-0.83	-2.07	1.04	-0.78	-1.6	0.91	0.18	-1.53

Table 23 – Maximum Drift Rate (kHz), Amkor_Cu_1#

	DH1, 3.0 V			DH1, 3.3 V			DH1, 3.6 V		
Channel	-40˚C	25˚C	85˚C	-40˚C	25˚C	85˚C	-40˚C	25˚C	85˚C
0.00	0.03	0.07	-0.21	-0.13	0.02	-0.06	0.52	0.32	0.25
39.00	0.16	-0.19	-0.42	-0.24	0.54	0.26	-0.43	-0.04	-0.01
78.00	-0.09	-0.27	-0.09	-0.47	0.16	-0.32	0.28	0.09	-0.04
	DH3, 3.0 V			DH3, 3.3 V			DH3, 3.6 V		
Channel	-40˚C	25˚C	85˚C	-40˚C	25˚C	85˚C	-40˚C	25˚C	85˚C
0.00	-0.96	-0.5	0.73	0.3	-0.72	-0.47	0.03	0	-0.03
39.00	0.57	-0.02	-0.3	0.05	0.25	-0.29	-0.03	-0.31	0.01
78.00	0.56	0.25	-0.42	0.28	0.12	0.1	0.5	0.47	-0.52
	DH5, 3.0 V			DH5, 3.3 V			DH5, 3.6 V		
Channel	-40˚C	25˚C	85˚C	-40˚C	25˚C	85˚C	-40˚C	25˚C	85˚C
0.00	0	-0.05	0.28	0.01	0.43	-0.51	-0.31	0.28	-0.25
39.00	-0.3	0.23	0.24	-0.25	0.51	-0.31	0.31	0.17	0.15
78.00	-0.52	-0.02	0.36	-0.28	0.06	-1.1	-0.16	-0.98	0.48

Table 24 – Carrier Frequency Drift (kHz), Amkor_Cu_2#

	DH1, 3.0 V			DH1, 3.3 V			DH1, 3.6 V		
Channel	-40˚C	25˚C	85˚C	-40˚C	25˚C	85˚C	-40˚C	25˚C	85˚C
0.00	0.67	-0.83	-1.55	1.02	-0.06	-0.86	0.96	-0.3	-1.84
39.00	0.12	-0.46	-1.48	0.81	-1.38	-1.55	0.72	-0.65	-1.5
78.00	-0.15	-0.18	-1.22	0.52	-1.16	-1.21	0.15	-0.88	-1.6
	DH3, 3.0 V			DH3, 3.3 V			DH3, 3.6 V		
Channel	-40˚C	25˚C	85˚C	-40˚C	25˚C	85˚C	-40˚C	25˚C	85˚C
0.00	1.08	-1.03	-1.74	0.88	-1.16	-1.28	0.58	-0.7	-2.17
39.00	0.34	-0.31	-1.74	0.7	-0.92	-1.76	1.52	-0.62	-1.61
78.00	1.51	-0.45	-1.93	1.2	-0.52	-1.35	0.08	-0.5	-1.73
	DH5, 3.0 V			DH5, 3.3 V			DH5, 3.6 V		
Channel	-40˚C	25˚C	85˚C	-40˚C	25˚C	85˚C	-40˚C	25˚C	85˚C
0.00	0.86	-1.45	-1.66	0.4	-1.2	-1.5	0.34	-1.06	-1.68
39.00	0.86	-0.97	-1.1	0.83	-0.8	-1.39	-0.38	-0.49	-2.35
78.00	0.68	-1.34	-1.69	0.17	-0.89	-2.21	1.16	-1.09	-0.8

Table 25 – Maximum Drift Rate (kHz), Amkor_Cu_2#

	DH1, 3.0 V			DH1, 3.3 V			DH1, 3.6 V		
Channel	-40˚C	25˚C	85˚C	-40˚C	25˚C	85˚C	-40˚C	25˚C	85˚C
0.00	0.02	0.09	-0.03	0.21	0.17	0.23	0.58	-0.21	-0.27
39.00	0.62	-0.44	-0.36	0.33	-0.04	-0.47	0.29	-0.02	0.3
78.00	-0.27	-0.12	0.14	0.59	-0.61	0.26	0.61	0.11	0.22
	DH3, 3.0 V			DH3, 3.3 V			DH3, 3.6 V		
Channel	-40˚C	25˚C	85˚C	-40˚C	25˚C	85˚C	-40˚C	25˚C	85˚C
0.00	0.21	0.27	0.93	0.27	-0.29	0.24	-0.02	0.06	0.14
39.00	-0.05	0.26	0.66	-0.14	-0.4	0.27	0.02	0.21	-0.23
78.00	0.45	-0.27	0.27	0.12	-0.88	0.55	-0.2	-0.22	-0.5
	DH5, 3.0 V			DH5, 3.3 V			DH5, 3.6 V		
Channel	-40˚C	25˚C	85˚C	-40˚C	25˚C	85˚C	-40˚C	25˚C	85˚C
0.00	-0.38	-0.61	-0.21	-0.63	0.06	-0.5	0.02	-0.03	-0.03
39.00	-0.05	0.26	0.54	0.29	0.27	-0.24	-0.2	0.34	0.2
78.00	0.5	0.2	-0.26	-0.25	-0.07	-0.02	-0.01	-0.08	0.2

Table 26 – Carrier Frequency Drift (kHz), Amkor_Cu_3#

	DH1, 3.0 V			DH1, 3.3 V			DH1, 3.6 V		
Channel	-40˚C	25˚C	85˚C	-40˚C	25˚C	85˚C	-40˚C	25˚C	85˚C
0.00	0.88	-1.51	-2.12	0.57	-1.42	-2.22	0.85	-0.74	-1.49
39.00	1.45	-1.15	-1.81	0.32	-1.44	-1.98	1.09	-1.31	-2.02
78.00	0.73	-0.75	-1.37	0.72	-1.16	-2.15	0.89	-0.8	-2.14
	DH3, 3.0 V			DH3, 3.3 V			DH3, 3.6 V		
Channel	-40˚C	25˚C	85˚C	-40˚C	25˚C	85˚C	-40˚C	25˚C	85˚C
0.00	1.16	-0.43	-2.21	1.18	-0.95	-2.32	0.16	-0.96	-2.43
39.00	1.21	-0.98	-1.7	1.35	-1.21	-2.19	0.69	-0.98	-2.19
78.00	0.91	-1.04	-1.99	1.7	-0.52	-2.24	1.12	-0.63	-2.12
	DH5, 3.0 V			DH5, 3.3 V			DH5, 3.6 V		
Channel	-40˚C	25˚C	85˚C	-40˚C	25˚C	85˚C	-40˚C	25˚C	85˚C
0.00	0.87	-1.47	-1.9	1.36	-1	-2.43	-0.09	-0.9	-2.84
39.00	1.29	-1.78	-2.12	1.41	-0.17	-2.15	0.48	-0.77	-1.64
78.00	0.43	-0.76	-2.12	1.16	-0.16	-2.29	0.9	-1.1	-2.2

Table 27 – Maximum Drift Rate (kHz), Amkor_Cu_3#

	DH1, 3.0 V			DH1, 3.3 V			DH1, 3.6 V		
Channel	-40˚C	25˚C	85˚C	-40˚C	25˚C	85˚C	-40˚C	25˚C	85˚C
0.00	-0.08	-0.18	0.65	0.42	-0.17	0.42	0.32	0.55	-0.05
39.00	-0.21	0.18	0.25	0.28	0.34	-0.06	0.17	0.2	-0.34
78.00	-0.05	-0.19	0.03	0.51	0.22	0.55	-0.12	0.56	-0.02
	DH3, 3.0 V			DH3, 3.3 V			DH3, 3.6 V		
Channel	-40˚C	25˚C	85˚C	-40˚C	25˚C	85˚C	-40˚C	25˚C	85˚C
0.00	0.05	0.14	0.04	0.48	0.2	0.51	0.42	-0.2	0.07
39.00	0.39	-0.06	0.27	0.45	-0.2	-0.21	-0.49	0.06	-0.74
78.00	-0.66	0.09	-0.17	0.44	-0.22	0	-0.26	0.47	0.04
	DH5, 3.0 V			DH5, 3.3 V			DH5, 3.6 V		
Channel	-40˚C	25˚C	85˚C	-40˚C	25˚C	85˚C	-40˚C	25˚C	85˚C
0.00	0.02	0.47	-0.22	-0.76	0.01	0.52	0	-0.27	-0.26
39.00	-0.22	-0.69	0.2	0.7	-0.23	-0.25	-0.02	0.7	-0.5
78.00	0.24	-0.5	-0.34	0.47	0.52	-0.28	-0.47	0.05	-0.25

3.9 EDR Relative Transmit Power (TRM/CA/10/C)

3.9.1 Purpose of Test

This test measures the difference between the average transmit power during the GFSK and DPSK modulated portions of a packet. This test is performed at normal and extreme conditions.

3.9.2 Test Methodology

The DUT is configured to be in loopback test mode, and the average transmit power in the GFSK and DPSK portions of the packet at channels 0, 39, and 78 are measured.

3.9.3 Test Modes and Parameters

Operation Modes: 2DH5 and 3DH5
Channels: 0, 39, 78
Temperatures: -40ºC, 25ºC, 85ºC
Supply Voltages: 3.0V, 3.3V, 3.6V

3.9.4 Bluetooth Specifications

The difference in the power between the GFSK and DPSK modulated portions of a packet must be between -4dB and +1dB. Please refer to the Bluetooth RF Test Specification, section 5.1.12 entitled "TRM/CA/10/C EDR Relative Transmit Power" for more information.

3.9.5 Results: PASS

Table 28 – EDR Relative Transmit Power (dBm), Amkor_Cu_1#

	2DH5: 3.0 V			2DH5: 3.3 V			2DH5: 3.6 V		
Channel	-40˚C	25˚C	85˚C	-40˚C	25˚C	85˚C	-40˚C	25˚C	85˚C
0	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
39	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
78	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
	3DH5: 3.0 V			3DH5: 3.3 V			3DH5: 3.6 V		
Channel	-40˚C	25˚C	85˚C	-40˚C	25˚C	85˚C	-40˚C	25˚C	85˚C
0	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
39	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
78	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2

Table 29 – EDR Relative Transmit Power (dBm), Amkor_Cu_2#

	2DH5: 3.0 V	2DH5: 3.3 V	2DH5: 3.6 V

Channel	-40˚C	25˚C	85˚C	-40˚C	25˚C	85˚C	-40˚C	25˚C	85˚C
0	0.2	0.2	0.2	0.2	0.2	0.1	0.2	0.2	0.1
39	0.2	0.2	0.1	0.2	0.2	0.1	0.2	0.2	0.1
78	0.2	0.2	0.1	0.2	0.2	0.1	0.2	0.2	0.1
	3DH5: 3.0 V			**3DH5: 3.3 V**			**3DH5: 3.6 V**		
Channel	-40˚C	25˚C	85˚C	-40˚C	25˚C	85˚C	-40˚C	25˚C	85˚C
0	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
39	0.2	0.2	0.1	0.2	0.2	0.1	0.2	0.2	0.1
78	0.2	0.2	0.1	0.2	0.2	0.1	0.2	0.2	0.1

Table 30 – EDR Relative Transmit Power (dBm), Amkor_Cu_3#

	2DH5: 3.0 V			**2DH5: 3.3 V**			**2DH5: 3.6 V**		
Channel	-40˚C	25˚C	85˚C	-40˚C	25˚C	85˚C	-40˚C	25˚C	85˚C
0	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
39	0.2	0.2	0.1	0.2	0.2	0.1	0.2	0.2	0.1
78	0.2	0.2	0.1	0.2	0.2	0.1	0.2	0.2	0.1
	3DH5: 3.0 V			**3DH5: 3.3 V**			**3DH5: 3.6 V**		
Channel	-40˚C	25˚C	85˚C	-40˚C	25˚C	85˚C	-40˚C	25˚C	85˚C
0	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
39	0.2	0.2	0.1	0.2	0.2	0.1	0.2	0.2	0.1
78	0.2	0.2	0.1	0.2	0.2	0.1	0.2	0.2	0.1

3.10 EDR Carrier Frequency Stability and Modulation Accuracy (TRM/CA/11/C)

3.10.1 Purpose of Test

This test measures the transmitter carrier frequency stability, and modulation accuracy of EDR signals. This test is performed at normal and extreme conditions.

3.10.2 Test Methodology

The DUT is configured to be in loopback test mode, and the frequency stability and DEVM of the EDR signals at channels 0, 39, and 78 are measured.

3.10.3 Test Modes and Parameters

Operation Modes: 2DH5 and 3DH5
Channels: 0, 39, 78
Temperatures: -40ºC, 25ºC, 85ºC
Supply Voltages: 3.0V, 3.3V, 3.6V

3.10.4 Bluetooth Specifications

1. Carrier frequency stability:
   - -75 kHz < ωi < +75 kHz, for all packets
   - -75 kHz < (ωi + ω0) < +75 kHz, for all blocks
   - -10 kHz <ω0 < +10 kHz, for all blocks
2. RMS DEVM:
   - < 0.20, for all π/4-DQPSK blocks
   - < 0.13, for all 8DPSK blocks
3. Peak DEVM:
   - < 0.35 for all π/4-DQPSK symbols
   - < 0.25 for all 8DPSK symbols
4. 99% DEVM:
   - < 0.30, for 99% of π/4-DQPSK symbols
   - < 0.20, for 99% of 8DPSK symbols

Please refer to the Bluetooth RF Test Specification, section 5.1.13 entitled "TRM/CA/11/C EDR Carrier Frequency Stability and Modulation Accuracy" for more information.

3.10.5 Results: PASS

Table 31 - Results for 2DH5, Amkor_Cu_1#

	Avg DEVM, 3.0 V			Avg DEVM, 3.3V			Avg DEVM, 3.6V		
Channel	-40˚C	25˚C	85˚C	-40˚C	25˚C	85˚C	-40˚C	25˚C	85˚C
0	0.036	0.039	0.052	0.038	0.04	0.051	0.041	0.043	0.054
39	0.038	0.04	0.051	0.038	0.04	0.05	0.039	0.041	0.051
78	0.04	0.044	0.056	0.039	0.043	0.052	0.039	0.043	0.053
	Peak DEVM, Max,3.0 V			**Peak DEVM, Max,3.3V**			**Peak DEVM, Max 3.6V**		
Channel	-40˚C	25˚C	85˚C	-40˚C	25˚C	85˚C	-40˚C	25˚C	85˚C
0	0.086	0.089	0.105	0.092	0.094	0.109	0.097	0.104	0.114
39	0.095	0.092	0.116	0.092	0.099	0.113	0.1	0.091	0.112
78	0.106	0.102	0.132	0.096	0.103	0.122	0.095	0.099	0.119
	% DEVM <0.3, 3.0 V			**% DEVM <0.3, 3.3V**			**% DEVM <0.3, 3.6V**		
Channel	-40˚C	25˚C	85˚C	-40˚C	25˚C	85˚C	-40˚C	25˚C	85˚C
0	100	100	100	100	100	100	100	100	100
39	100	100	100	100	100	100	100	100	100
78	100	100	100	100	100	100	100	100	100
	ωi, 3.0 V (kHz)			**ωi, 3.3V (kHz)**			**ωi, 3.6V (kHz)**		
Channel	-40˚C	25˚C	85˚C	-40˚C	25˚C	85˚C	-40˚C	25˚C	85˚C
0	-2.993	-10.748	27.597	-3.657	-10.586	27.574	-3.242	-10.643	28.551
39	-3.574	-11.028	27.599	-3.775	-11.157	27.886	-3.664	-10.796	28.981
78	-3.522	-11.438	28.213	-3.233	-11.062	28.813	-2.95	-10.954	30.138
	ωo, 3.0 V (kHz)			**ωo, 3.3V (kHz)**			**ωo, 3.6V (kHz)**		
Channel	-40˚C	25˚C	85˚C	-40˚C	25˚C	85˚C	-40˚C	25˚C	85˚C
0	0.196	0.846	0.753	0.506	0.726	0.342	0.008	0.734	-0.042
39	0.532	0.892	0.952	0.374	0.973	0.664	0.7	0.468	0.331
78	0.046	1.153	0.848	-0.446	0.724	0.391	-0.152	0.066	0.168

Table 32 - Results for 3DH5, Amkor_Cu_1#

	Avg DEVM, 3.0 V			Avg DEVM, 3.3V			Avg DEVM, 3.6V		
Channel	-40˚C	25˚C	85˚C	-40˚C	25˚C	85˚C	-40˚C	25˚C	85˚C
0	0.034	0.037	0.045	0.037	0.038	0.044	0.04	0.04	0.046
39	0.037	0.037	0.048	0.036	0.036	0.046	0.037	0.038	0.045
78	0.039	0.041	0.053	0.039	0.038	0.05	0.038	0.038	0.048
	Peak DEVM, 3.0 V			**Peak DEVM, 3.3V**			**Peak DEVM, 3.6V**		
Channel	-40˚C	25˚C	85˚C	-40˚C	25˚C	85˚C	-40˚C	25˚C	85˚C
0	0.081	0.086	0.1	0.092	0.086	0.102	0.09	0.092	0.105
39	0.09	0.086	0.11	0.096	0.085	0.109	0.097	0.092	0.106
78	0.092	0.103	0.124	0.088	0.094	0.122	0.086	0.095	0.117
	% DEVM <0.2, 3.0 V			**% DEVM <0.2, 3.3V**			**% DEVM <0.2, 3.6V**		
Channel	-40˚C	25˚C	85˚C	-40˚C	25˚C	85˚C	-40˚C	25˚C	85˚C
0	100	100	100	100	100	100	100	100	100
39	100	100	100	100	100	100	100	100	100
78	100	100	100	100	100	100	100	100	100
	ωi, 3.0 V (kHz)			**ωi, 3.3V (kHz)**			**ωi, 3.6V (kHz)**		
Channel	-40˚C	25˚C	85˚C	-40˚C	25˚C	85˚C	-40˚C	25˚C	85˚C
0	-3.359	-10.27	27.771	-3.753	-10.372	27.4	-3.403	-10.95	28.737
39	-3.515	-10.513	28.022	-3.693	-10.665	27.935	-3.025	-10.79	29.403
78	-3.569	-10.951	28.009	-3.258	-10.802	29.04	-2.781	-11.043	30.05
	ωo, 3.0 V (kHz)			**ωo, 3.3V (kHz)**			**ωo, 3.6V (kHz)**		
Channel	-40˚C	25˚C	85˚C	-40˚C	25˚C	85˚C	-40˚C	25˚C	85˚C
0	0.31	0.284	0.365	0.594	0.354	0.641	0.196	0.911	-0.15
39	0.243	0.278	0.163	0.289	0.361	0.731	-0.117	0.356	0.105
78	0.063	0.677	0.983	-0.459	0.305	0.465	-0.223	0.08	0.812

Table 33 - Results for 2DH5, Amkor_Cu_2#

	Avg DEVM, 3.0 V			Avg DEVM, 3.3V			Avg DEVM, 3.6V		
Channel	-40˚C	25˚C	85˚C	-40˚C	25˚C	85˚C	-40˚C	25˚C	85˚C
0	0.055	0.045	0.054	0.057	0.046	0.054	0.057	0.047	0.056
39	0.056	0.046	0.054	0.058	0.046	0.055	0.06	0.047	0.057
78	0.057	0.047	0.056	0.057	0.047	0.057	0.057	0.048	0.058
	Peak DEVM, 3.0 V			**Peak DEVM, 3.3V**			**Peak DEVM, 3.6V**		
Channel	-40˚C	25˚C	85˚C	-40˚C	25˚C	85˚C	-40˚C	25˚C	85˚C
0	0.126	0.104	0.137	0.129	0.106	0.13	0.144	0.117	0.13
39	0.136	0.118	0.141	0.13	0.115	0.129	0.139	0.12	0.133
78	0.138	0.119	0.142	0.145	0.117	0.132	0.137	0.111	0.128
	% DEVM <0.3, 3.0 V			**% DEVM <0.3, 3.3V**			**% DEVM <0.3, 3.6V**		
Channel	-40˚C	25˚C	85˚C	-40˚C	25˚C	85˚C	-40˚C	25˚C	85˚C
0	100	100	100	100	100	100	100	100	100
39	100	100	100	100	100	100	100	100	100
78	100	100	100	100	100	100	100	100	100
	ωi, 3.0 V (kHz)			**ωi, 3.3V (kHz)**			**ωi, 3.6V (kHz)**		
Channel	-40˚C	25˚C	85˚C	-40˚C	25˚C	85˚C	-40˚C	25˚C	85˚C
0	-28.625	-11.5	27.371	-29.111	-11.808	26.939	-28.624	-11.365	28.193
39	-30.004	-11.787	27.469	-30.147	-12.149	27.662	-29.086	-11.979	28.872
78	-29.871	-11.949	27.81	-29.907	-11.691	28.606	-27.888	-12.097	30.274
	ωo, 3.0 V (kHz)			**ωo, 3.3V (kHz)**			**ωo, 3.6V (kHz)**		
Channel	-40˚C	25˚C	85˚C	-40˚C	25˚C	85˚C	-40˚C	25˚C	85˚C
0	0.528	0.65	0.794	0.292	1.085	0.635	0.369	0.301	0.59
39	1.078	0.666	0.602	0.984	1.156	0.798	1.05	0.643	0.975
78	0.233	0.673	0.806	0.498	0.399	0.556	-0.821	0.512	0.641

Table 34 - Results for 3DH5, Amkor_Cu_2#

	Avg DEVM, 3.0 V			Avg DEVM, 3.3V			Avg DEVM, 3.6V		
Channel	-40˚C	25˚C	85˚C	-40˚C	25˚C	85˚C	-40˚C	25˚C	85˚C
0	0.051	0.041	0.055	0.054	0.043	0.054	0.056	0.043	0.054
39	0.053	0.043	0.054	0.054	0.043	0.054	0.056	0.045	0.054
78	0.052	0.044	0.057	0.053	0.044	0.056	0.054	0.045	0.056
	Peak DEVM, 3.0 V			**Peak DEVM, 3.3V**			**Peak DEVM, 3.6V**		
Channel	-40˚C	25˚C	85˚C	-40˚C	25˚C	85˚C	-40˚C	25˚C	85˚C
0	0.112	0.101	0.12	0.117	0.11	0.118	0.131	0.1	0.124
39	0.133	0.105	0.128	0.13	0.104	0.119	0.132	0.113	0.126
78	0.122	0.107	0.131	0.14	0.108	0.135	0.135	0.112	0.149
	% DEVM <0.2, 3.0 V			**% DEVM <0.2, 3.3V**			**% DEVM <0.2, 3.6V**		
Channel	-40˚C	25˚C	85˚C	-40˚C	25˚C	85˚C	-40˚C	25˚C	85˚C
0	100	100	100	100	100	100	100	100	100
39	100	100	100	100	100	100	100	100	100
78	100	100	100	100	100	100	100	100	100
	ωi, 3.0 V (kHz)			**ωi, 3.3V (kHz)**			**ωi, 3.6V (kHz)**		
Channel	-40˚C	25˚C	85˚C	-40˚C	25˚C	85˚C	-40˚C	25˚C	85˚C
0	-29.033	-11.297	27.406	-29.484	-11.408	27.537	-28.753	-12.007	28.078
39	-29.941	-11.547	27.379	-30.093	-12.002	28.071	-28.768	-12.051	29.073
78	-30.696	-11.717	28.219	-30.205	-12.206	29.258	-28.423	-11.876	30.55
	ωo, 3.0 V (kHz)			**ωo, 3.3V (kHz)**			**ωo, 3.6V (kHz)**		
Channel	-40˚C	25˚C	85˚C	-40˚C	25˚C	85˚C	-40˚C	25˚C	85˚C
0	0.721	0.62	0.471	0.745	0.498	-0.014	0.867	1.185	0.842
39	0.803	0.447	0.693	1.034	0.832	0.638	0.761	0.79	1.095
78	0.979	0.534	0.024	0.702	0.857	-0.174	0.276	0.059	0.555

Table 35 - Results for 2DH5, Amkor_Cu_3#

	Avg DEVM, 3.0 V			Avg DEVM, 3.3V			Avg DEVM, 3.6V		
Channel	-40˚C	25˚C	85˚C	-40˚C	25˚C	85˚C	-40˚C	25˚C	85˚C
0	0.04	0.046	0.047	0.042	0.047	0.047	0.044	0.048	0.049
39	0.043	0.045	0.049	0.044	0.045	0.049	0.046	0.046	0.049
78	0.044	0.047	0.053	0.045	0.046	0.052	0.046	0.048	0.051
	Peak DEVM, 3.0 V			**Peak DEVM, 3.3V**			**Peak DEVM, 3.6V**		
Channel	-40˚C	25˚C	85˚C	-40˚C	25˚C	85˚C	-40˚C	25˚C	85˚C
0	0.104	0.104	0.111	0.107	0.11	0.113	0.106	0.113	0.107
39	0.113	0.111	0.13	0.104	0.11	0.113	0.111	0.118	0.124
78	0.114	0.112	0.124	0.108	0.112	0.124	0.112	0.12	0.114
	% DEVM <0.3, 3.0 V			**% DEVM <0.3, 3.3V**			**% DEVM <0.3, 3.6V**		
Channel	-40˚C	25˚C	85˚C	-40˚C	25˚C	85˚C	-40˚C	25˚C	85˚C
0	100	100	100	100	100	100	100	100	100
39	100	100	100	100	100	100	100	100	100
78	100	100	100	100	100	100	100	100	100
	ωi, 3.0 V (kHz)			**ωi, 3.3V (kHz)**			**ωi, 3.6V (kHz)**		
Channel	-40˚C	25˚C	85˚C	-40˚C	25˚C	85˚C	-40˚C	25˚C	85˚C
0	-4.185	-7.545	10.297	-4.63	-7.685	10.577	-3.918	-8.186	10.648
39	-4.22	-7.512	10.237	-4.31	-7.63	9.929	-3.767	-8.187	11.735
78	-4.143	-7.756	10.453	-3.486	-7.549	10.97	-2.874	-8.088	12.531
	ωo, 3.0 V (kHz)			**ωo, 3.3V (kHz)**			**ωo, 3.6V (kHz)**		
Channel	-40˚C	25˚C	85˚C	-40˚C	25˚C	85˚C	-40˚C	25˚C	85˚C
0	1.236	0.62	1.067	0.987	0.986	0.234	0.902	1.252	1.133
39	0.809	0.448	0.717	0.435	0.697	1.214	0.634	0.912	0.536
78	0.37	0.761	0.621	-0.722	0.129	0.534	-0.29	0.417	0.456

Table 36 - Results for 3DH5, Amkor_Cu_3#

	Avg DEVM, 3.0 V			Avg DEVM, 3.3V			Avg DEVM, 3.6V		
Channel	-40˚C	25˚C	85˚C	-40˚C	25˚C	85˚C	-40˚C	25˚C	85˚C
0	0.039	0.045	0.049	0.04	0.045	0.047	0.042	0.045	0.048
39	0.042	0.044	0.049	0.044	0.044	0.047	0.044	0.044	0.047
78	0.044	0.044	0.049	0.044	0.045	0.048	0.045	0.045	0.048
	Peak DEVM, 3.0 V			**Peak DEVM, 3.3V**			**Peak DEVM, 3.6V**		
Channel	-40˚C	25˚C	85˚C	-40˚C	25˚C	85˚C	-40˚C	25˚C	85˚C
0	0.09	0.102	0.111	0.094	0.102	0.107	0.106	0.105	0.102
39	0.105	0.106	0.116	0.103	0.11	0.109	0.104	0.099	0.104
78	0.098	0.097	0.121	0.106	0.11	0.12	0.111	0.103	0.115
	% DEVM <0.2, 3.0 V			**% DEVM <0.2, 3.3V**			**% DEVM <0.2, 3.6V**		
Channel	-40˚C	25˚C	85˚C	-40˚C	25˚C	85˚C	-40˚C	25˚C	85˚C
0	100	100	100	100	100	100	100	100	100
39	100	100	100	100	100	100	100	100	100
78	100	100	100	100	100	100	100	100	100
	ωi, 3.0 V (kHz)			**ωi, 3.3V (kHz)**			**ωi, 3.6V (kHz)**		
Channel	-40˚C	25˚C	85˚C	-40˚C	25˚C	85˚C	-40˚C	25˚C	85˚C
0	-3.586	-7.236	10.712	-4.319	-6.744	10.067	-3.259	-7.65	11.085
39	-4.127	-7.342	10.321	-4.28	-7.662	10.831	-3.141	-8.459	11.919
78	-4.173	-7.722	10.796	-3.274	-7.987	11.663	-3.185	-7.89	12.779
	ωo, 3.0 V (kHz)			**ωo, 3.3V (kHz)**			**ωo, 3.6V (kHz)**		
Channel	-40˚C	25˚C	85˚C	-40˚C	25˚C	85˚C	-40˚C	25˚C	85˚C
0	0.295	0.234	0.152	0.39	-0.3	0.925	0.038	0.487	0.973
39	0.363	0.331	0.467	0.568	0.571	0.128	-0.455	1.075	0.657
78	0.096	0.748	0.099	-0.555	0.615	-0.076	0.115	-0.232	0.45

3.11 EDR Differential Phase Encoding (TRM/CA/12/C)

3.11.1 Purpose of Test

This test measures the transmitter's ability to correctly modulate the differential phase encoding for EDR signals. This test is performed at normal conditions.

3.11.2 Test Methodology

The DUT is configured to be in loopback test mode, and data in the EDR signals at channels 0 are compared with a known data, and the % of packets with zero-errors is measured.

3.11.3 Test Modes and Parameters

Operation Modes: 2DH1 and 3DH1
Channels: 0
Temperatures: 25ºC
Supply Voltages: 3.3V

3.11.4 Bluetooth Specifications

The % of packets with zero errors should be greater than 99%. Please refer to the Bluetooth RF Test Specification, section 5.1.14 entitled "TRM/CA/12/C EDR Differential Phase Encoding" for more information.

3.11.5 Results: PASS

Table 37 – EDR Differential Phase Encoding, Amkor_Cu_1#

Packet Type	% of packets with zero error
2DH1	100
3DH1	100

Table 38 – EDR Differential Phase Encoding, Amkor_Cu_2#

Packet Type	% of packets with zero error
2DH1	100
3DH1	100

Table 39 – EDR Differential Phase Encoding, Amkor_Cu_3#

Packet Type	% of packets with zero error
2DH1	100
3DH1	100

3.12 EDR Adjacent Channel Power (TRM/CA/13/C)

3.12.1 Purpose of Test

This test measures in-band spurious emissions of the EDR signals, also known as Adjacent Channel Power measurements. This test is performed at normal and extreme conditions.

3.12.2 Test Methodology

The DUT is configured to be in test mode. At each transmit channel (3, 39, and 75), the power in each of the neighboring 78 channels are measured.

3.12.3 Test Modes and Parameters

Operation Modes: 2DH5 and 3DH5
Channels: 3, 39, 75
Temperatures: -40ºC, 25ºC, 85ºC
Supply Voltages: 3.0V, 3.3V, 3.6V

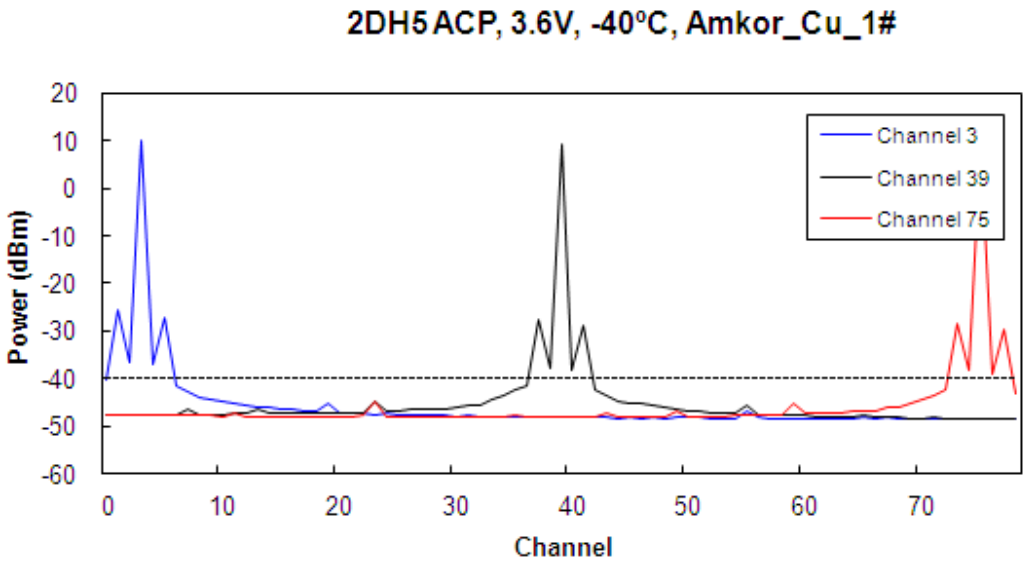
3.12.4 Bluetooth Specifications

1. For ±1MHz offset, the value must be less than -26dB.
2. For ±2MHz offset, the power must be less than -20 dBm.
3. For all offsets ≥+3MHz and ≤-3MHz, the power must be less than -40dBm.

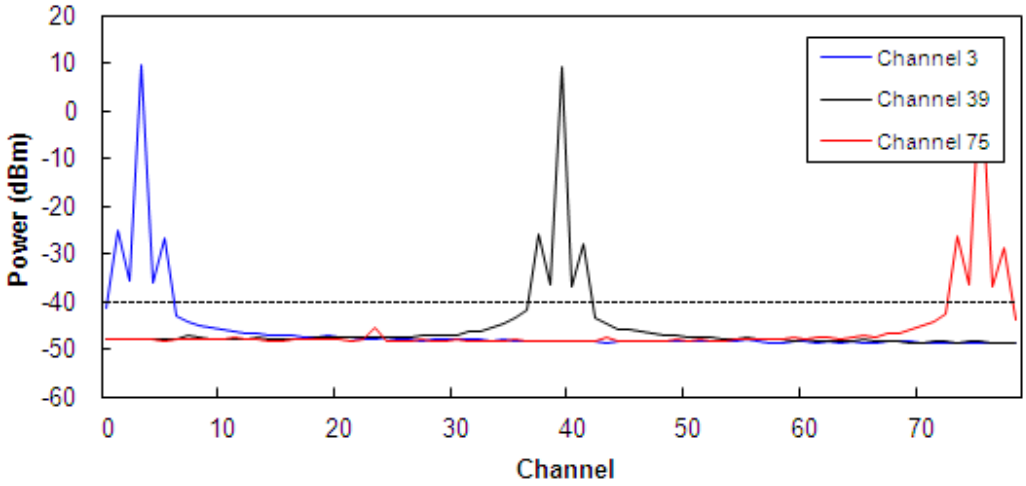
Please refer to the Bluetooth RF Test Specification, section 5.1.15 entitled "TRM/CA/13/C EDR In-band Spurious Emissions" for more information.

3.12.5 Results: PASS

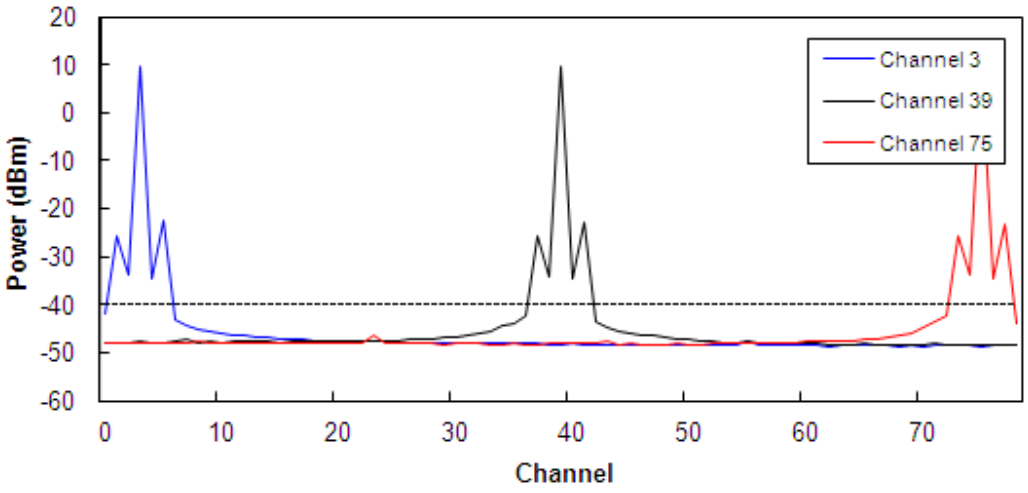
For these results, the 3 colored curves represent the ACP at channel 3 (blue), channel 39 (black) and channel 75 (red). The black dotted line is the limit for channels ≥+3MHz.



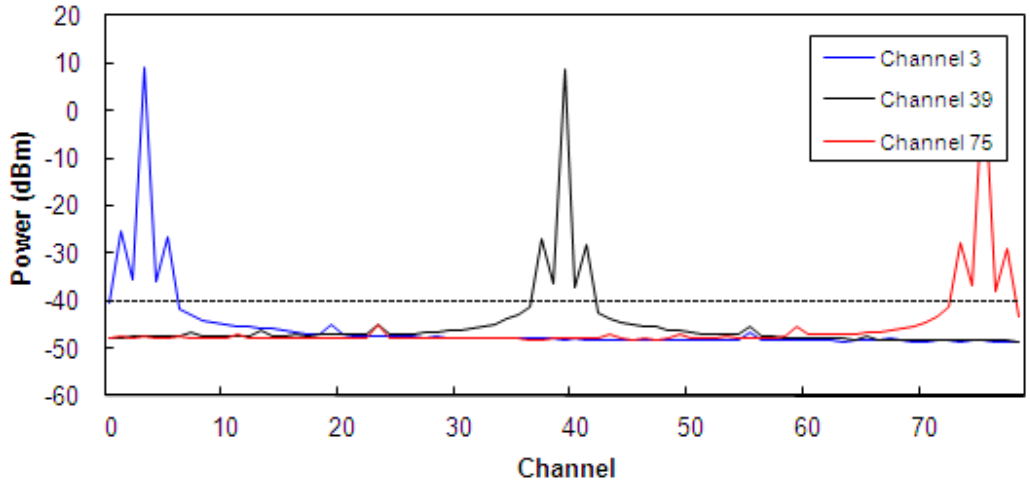
2DH5 ACP, 3.3V, 25°C, Amkor_Cu_1#



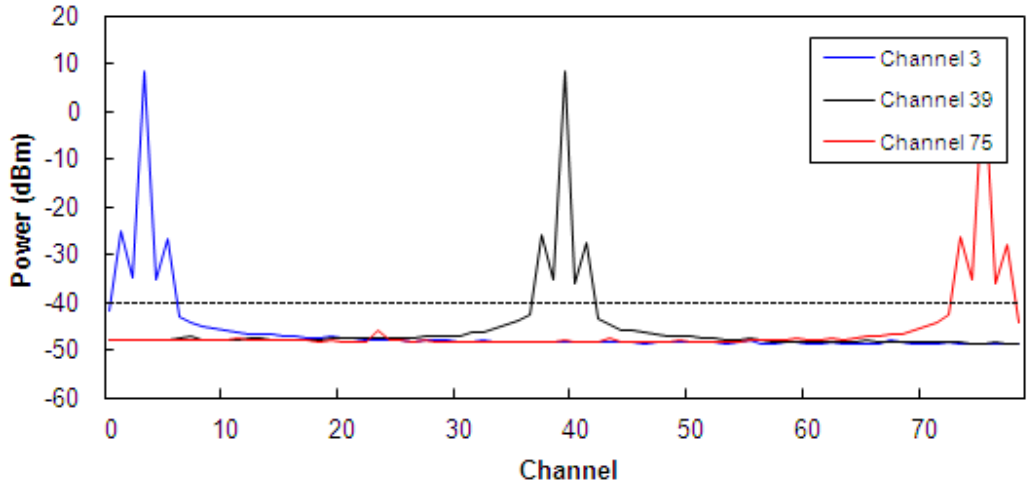
2DH5 ACP, 3.0V, 85°C, Amkor_Cu_1#



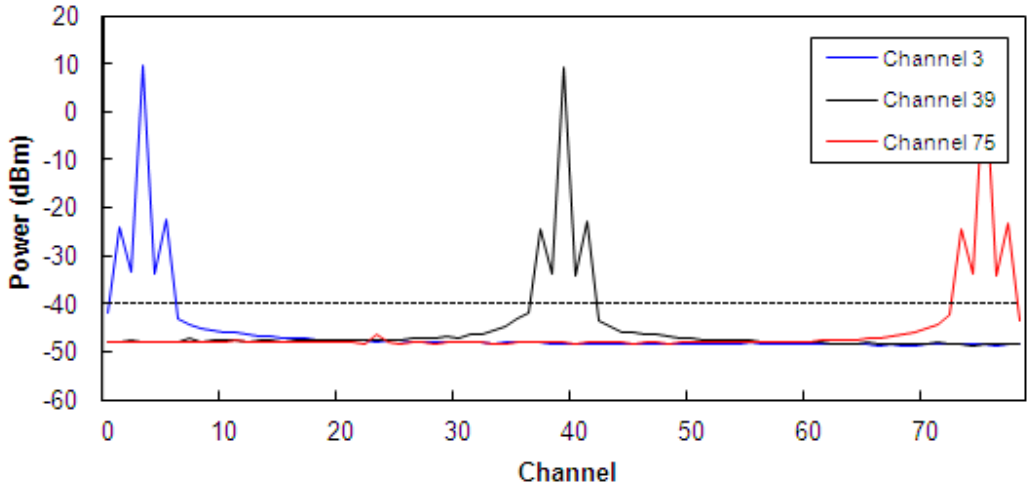
3DH5 ACP, 3.6V, -40°C, Amkor_Cu_1#



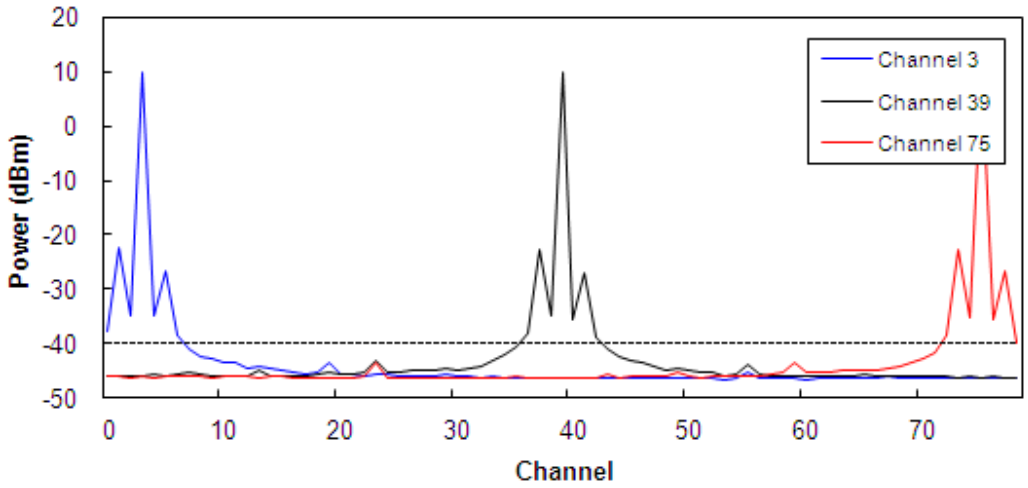
3DH5 ACP, 3.3V, 25°C, Amkor_Cu_1#



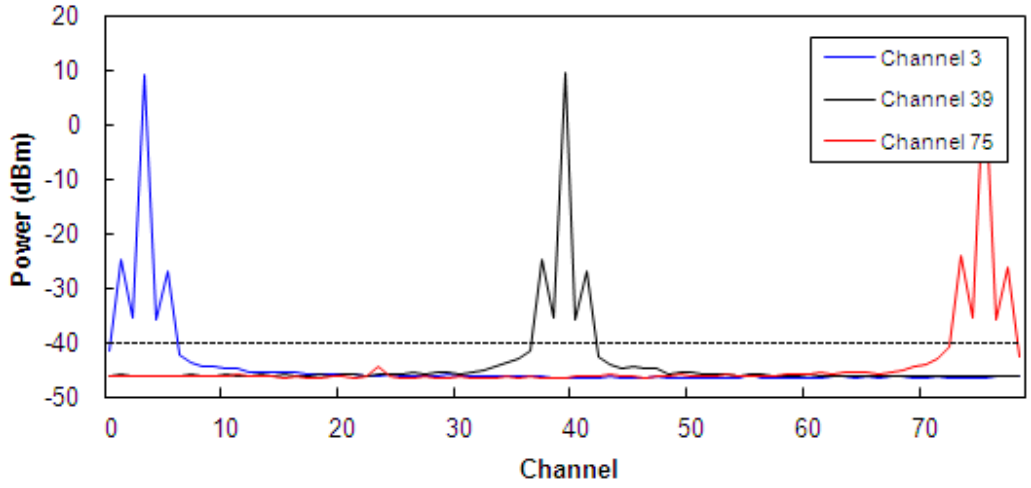
3DH5 ACP, 3.0V, 85°C, Amkor_Cu_1#



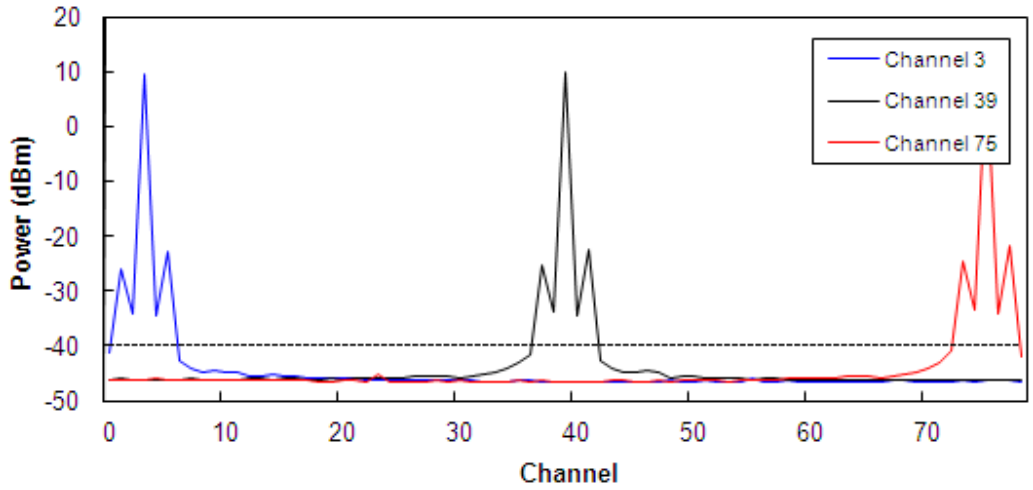
2DH5 ACP, 3.6V, -40°C, Amkor_Cu_2#



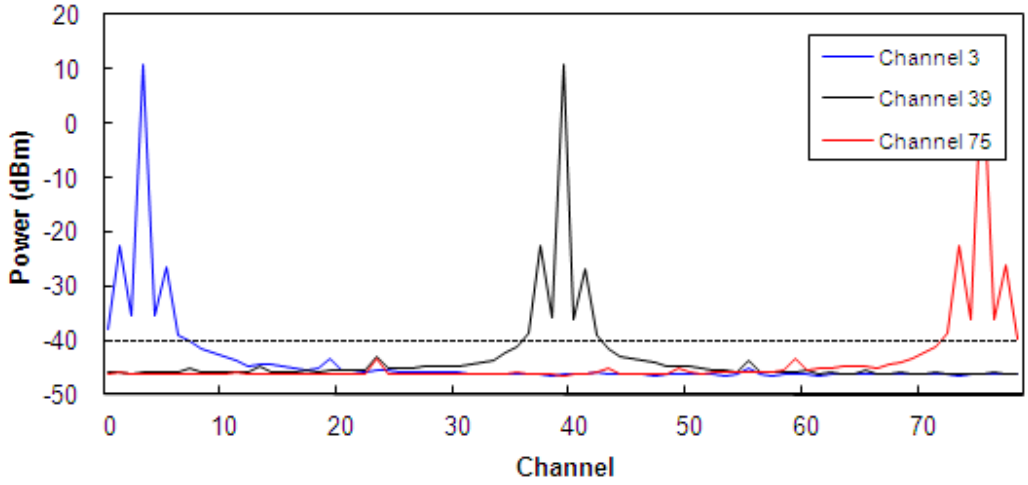
2DH5 ACP, 3.3V, 25°C, Amkor_Cu_2#



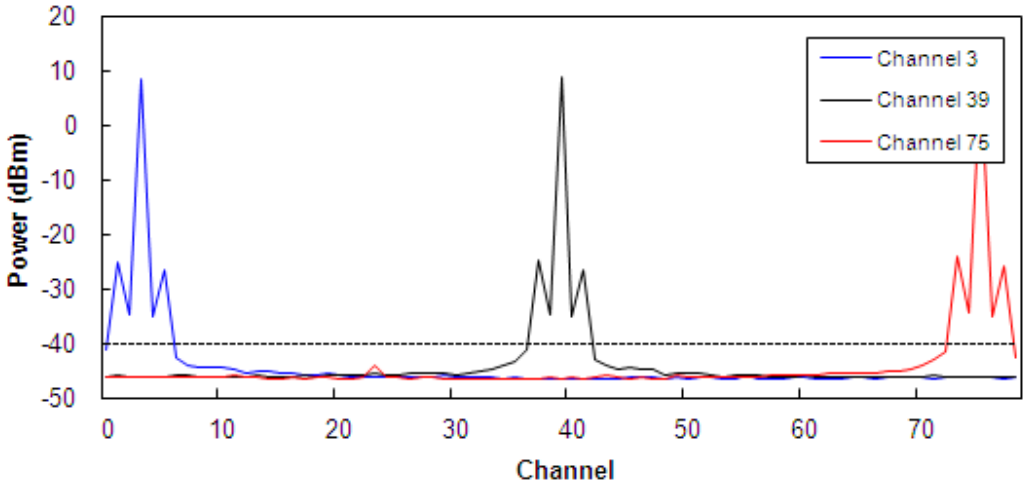
2DH5 ACP, 3.0V, 85°C, Amkor_Cu_2#



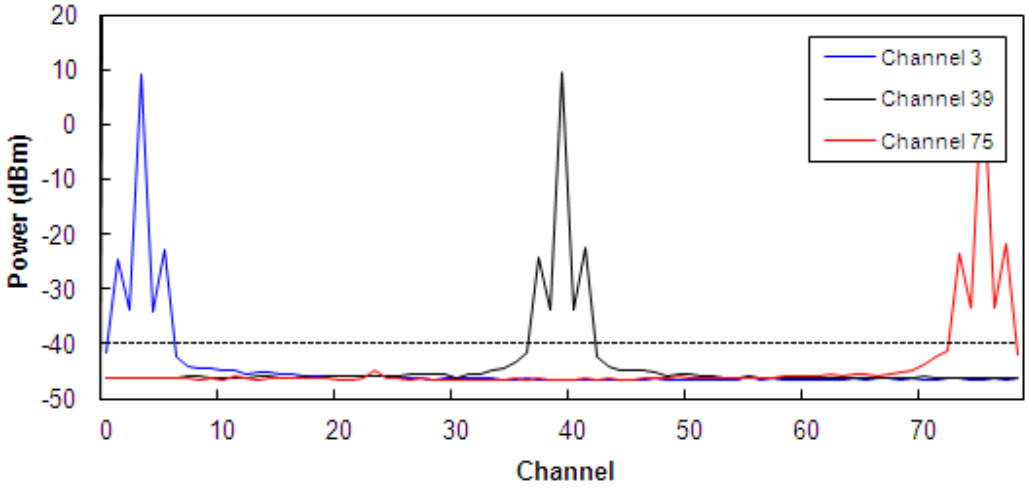
3DH5 ACP, 3.6V, -40°C, Amkor_Cu_2#



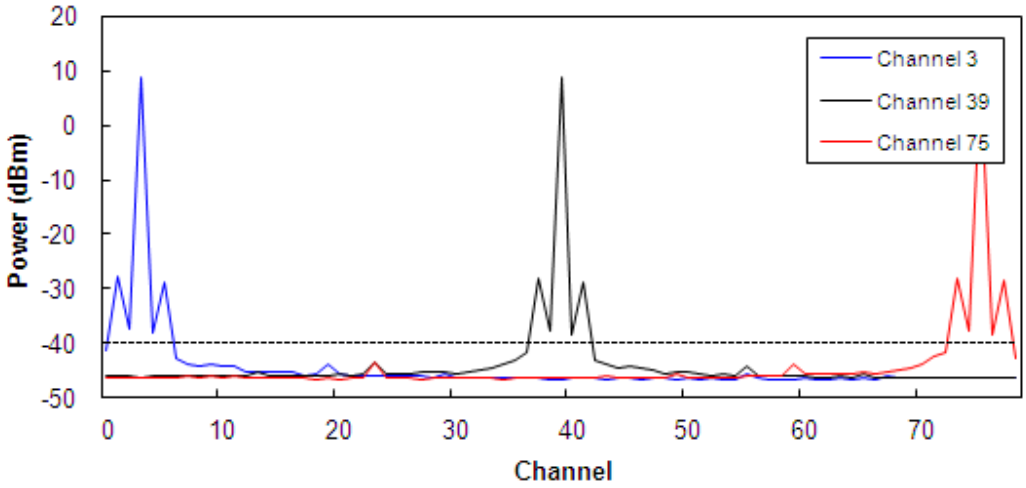
3DH5 ACP, 3.3V, 25°C, Amkor_Cu_2#



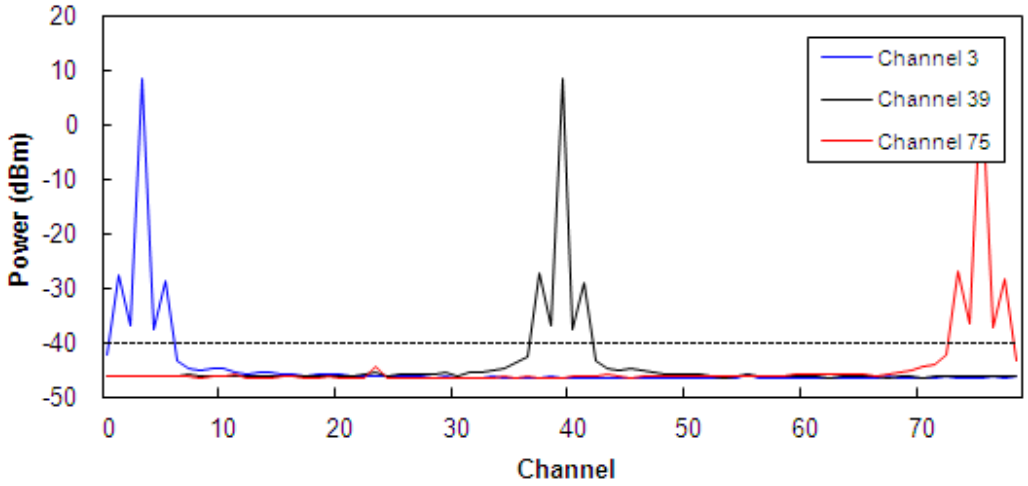
3DH5 ACP, 3.0V, 85°C, Amkor_Cu_2#



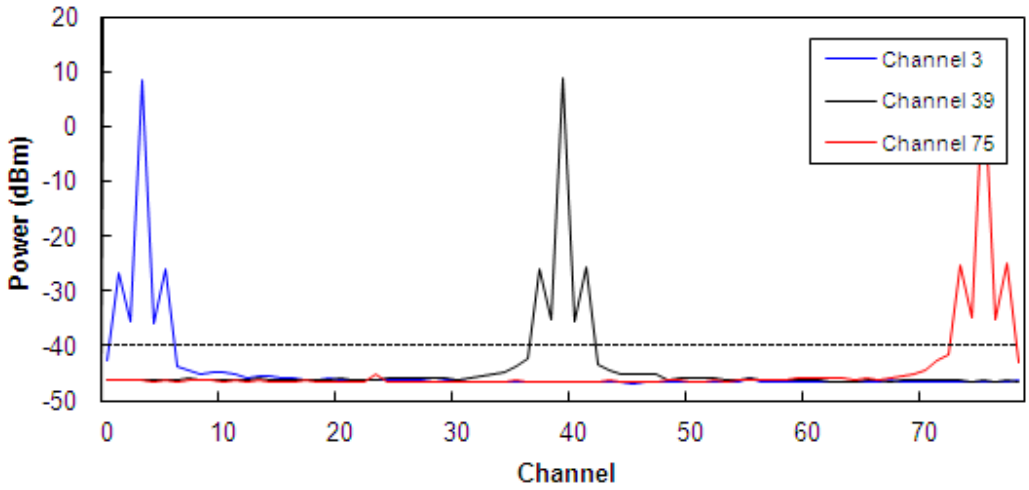
2DH5 ACP, 3.6V, -40°C, Amkor_Cu_3#

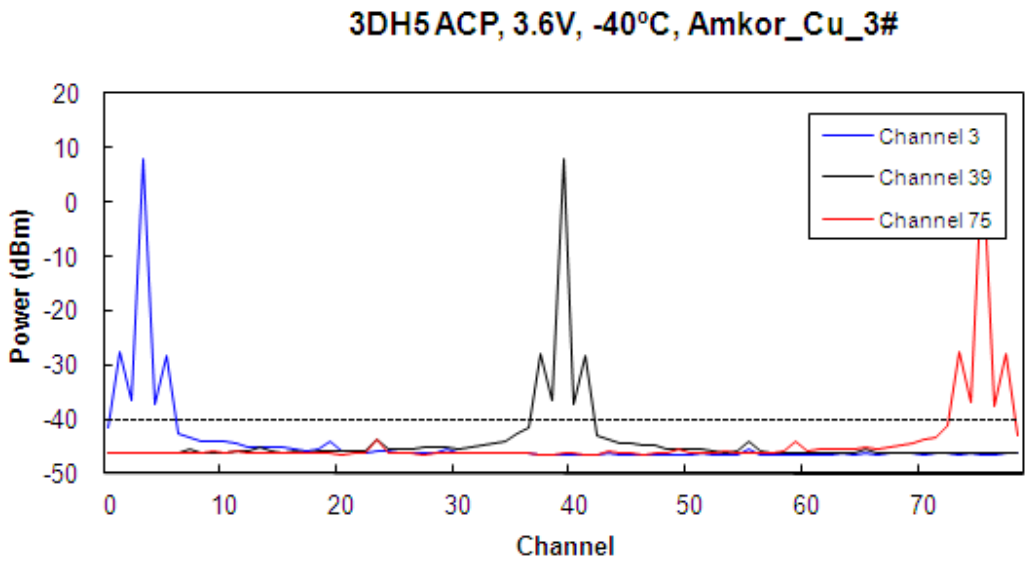


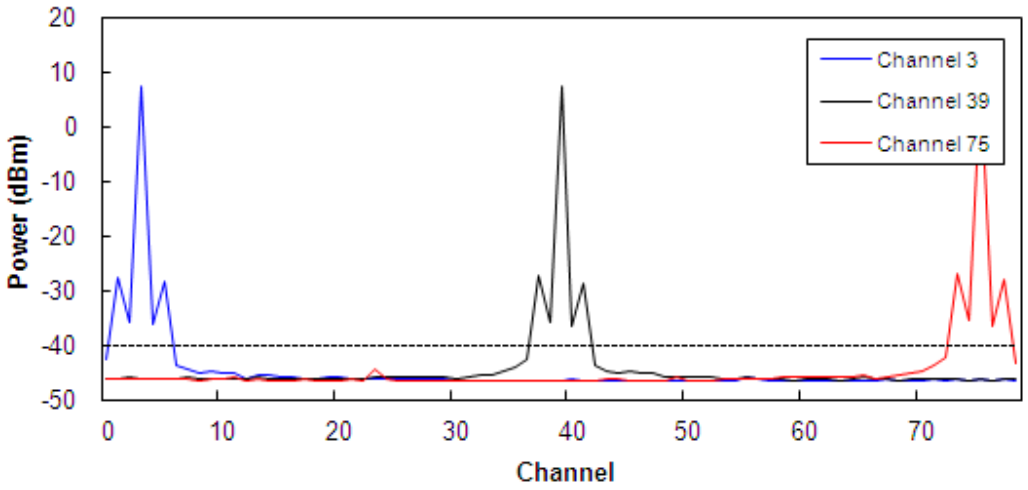
2DH5 ACP, 3.3V, 25°C, Amkor_Cu_3#

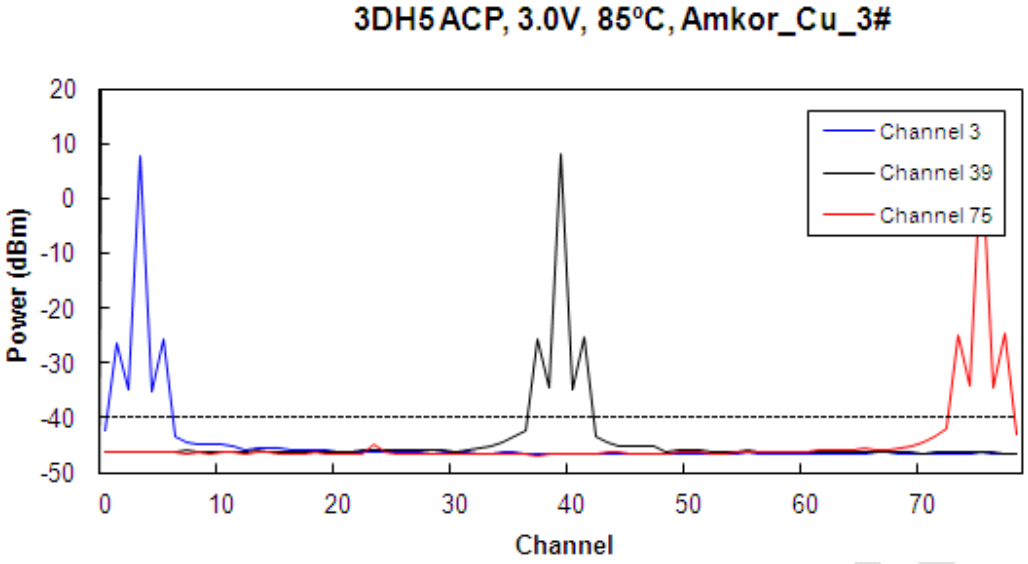


2DH5 ACP, 3.0V, 85°C, Amkor_Cu_3#




3DH5 ACP, 3.6V, -40°C, Amkor_Cu_3#
Power (dBm)
Channel
Channel 3
Channel 39
Channel 75
20
10
0
-10
-20
-30
-40
-50
0
10
20
30
40
50
60
70


3DH5 ACP, 3.3V, 25°C, Amkor_Cu_3#
Power (dBm)
Channel
Channel 3
Channel 39
Channel 75
20
10
0
-10
-20
-30
-40
-50
0
10
20
30
40
50
60
70



4 DVT Results – Receiver

4.1 Sensitivity – Single Slot (RCV/CA/01/C)

4.1.1 Purpose of Test:

This test measures the bit error rate (BER) of the DUT at a receive power of -70dBm. This test is performed at normal and extreme conditions.

4.1.2 Test Methodology:

The DUT is configured to be in loopback test mode. The tester is configured to transmit basic rate data at -70dBm as seen at the DUT's antenna port. The tester uses a "dirty transmitter," as specified in the Bluetooth RF Test Specification.

4.1.3 Test Modes and Parameters

Operation Modes: DH1
RX Channels: 0, 39, 78
Temperatures: -40ºC, 25ºC, 85ºC
Supply Voltages: 3.0V, 3.3V, 3.6V

4.1.4 Bluetooth Specification

Requirement: BER ≤ 0.1%.
More information can be found in the Bluetooth RF Test Specification, section 5.1.16 "RCV/CA/01/C Sensitivity – Single Slot"

4.1.5 Results: PASS

Table 40 – Sensitivity – Single Slot BER (%), Amkor_Cu_1#

	3.0 V			3.3 V			3.6 V		
Channel	-40˚C	25˚C	85˚C	-40˚C	25˚C	85˚C	-40˚C	25˚C	85˚C
0	0	0	1.25E-04	0	0	0	0	0	6.25E-05
39	0	0	0	0	0	0	0	0	1.25E-04
78	0	0	0	0	0	1.25E-04	0	0	0

Table 41 – Sensitivity – Single Slot BER (%), Amkor_Cu_2#

	3.0 V			3.3 V			3.6 V		
Channel	-40˚C	25˚C	85˚C	-40˚C	25˚C	85˚C	-40˚C	25˚C	85˚C
0	0	0	0	0	0	0	0	0	0
39	0	0	0	0	0	0	0	0	0
78	0	0	0	0	0	0	0	0	0

Table 42 – Sensitivity – Single Slot BER (%), Amkor_Cu_3#

	3.0 V			3.3 V			3.6 V		
Channel	-40˚C	25˚C	85˚C	-40˚C	25˚C	85˚C	-40˚C	25˚C	85˚C
0	0	0	0	0	0	0	0	0	0
39	0	0	0	0	0	0	0	0	0
78	0	0	0	0	0	0	0	0	0

4.2 Sensitivity – Multiple Slots (RCV/CA/02/C)

4.2.1 Purpose of Test:

This test measures the bit error rate (BER) of the DUT at a receive power of -70dBm. This test is performed at normal and extreme conditions.

4.2.2 Test Methodology:

The DUT is configured to be in loopback test mode. The tester is configured to transmit basic rate data at -70dBm as seen at the DUT's antenna port. The tester uses a "dirty transmitter," as specified in the Bluetooth RF Test Specification.

4.2.3 Test Modes and Parameters

Operation Modes: DH5
RX Channels: 0, 39, 78
Temperatures: -40ºC, 25ºC, 85ºC
Supply Voltages: 3.0V, 3.3V, 3.6V

4.2.4 Bluetooth Specification

Requirement: BER ≤ 0.1%.
More information can be found in the Bluetooth RF Test Specification, section 5.1.17 "RCV/CA/02/C Sensitivity – Multi-Slot Packets"

4.2.5 Results: PASS

Table 43 – Sensitivity – Multiple Slot BER (%), Amkor_Cu_1#

	3 V			3.3 V			3.6 V		
Channel	-40˚C	25˚C	85˚C	-40˚C	25˚C	85˚C	-40˚C	25˚C	85˚C
0	0	0	0	0	0	2.50E-04	0	0	6.25E-05
39	0	0	6.25E-05	0	0	6.25E-05	0	0	6.25E-05
78	0	0	3.13E-04	0	0	0	0	0	2.50E-04

Table 44 – Sensitivity – Multiple Slot BER (%), Amkor_Cu_2#

	3 V			3.3 V			3.6 V		
Channel	-40˚C	25˚C	85˚C	-40˚C	25˚C	85˚C	-40˚C	25˚C	85˚C
0	0	0	0	0	0	0	0	0	0
39	0	0	0	0	0	0	0	0	0
78	0	0	0	0	0	0	0	0	0

Table 45 – Sensitivity – Multiple Slot BER (%), Amkor_Cu_3#

	3 V	3.3 V	3.6 V

Channel	-40˚C	25˚C	85˚C	-40˚C	25˚C	85˚C	-40˚C	25˚C	85˚C
0	0	0	0	0	0	0	0	0	0
39	0	0	0	0	0	0	0	0	0
78	0	0	0	0	0	0	0	0	0

4.3 In-Band Blocker (RCV/CA/03/C)

4.3.1 Purpose of Test:

This test measures the bit error rate (BER) of the DUT with the presence of a co-channel and adjacent channel interfering signal.. This test is performed at normal conditions.

4.3.2 Test Methodology:

The DUT is configured to be in loopback test mode. The tester is configured to transmit basic rate data at -67dBm, or -60dBm for a interfering signal at ±1MHz and ±2MHz, as seen at the DUT's antenna port. The interfering signal is modulated with a GFSK modulation, with PRBS as the payload, and transmits at the following power levels:

- Co-channel: -71dBm (C/I = 11dB)
- 1MHz adjacent: -60dBm (C/I = 0dB)
- 2MHz adjacent: -30dBm (C/I = -30dB)
- ≥ 3MHz: -27dBm (C/I = -40dB)

4.3.3 Test Modes and Parameters

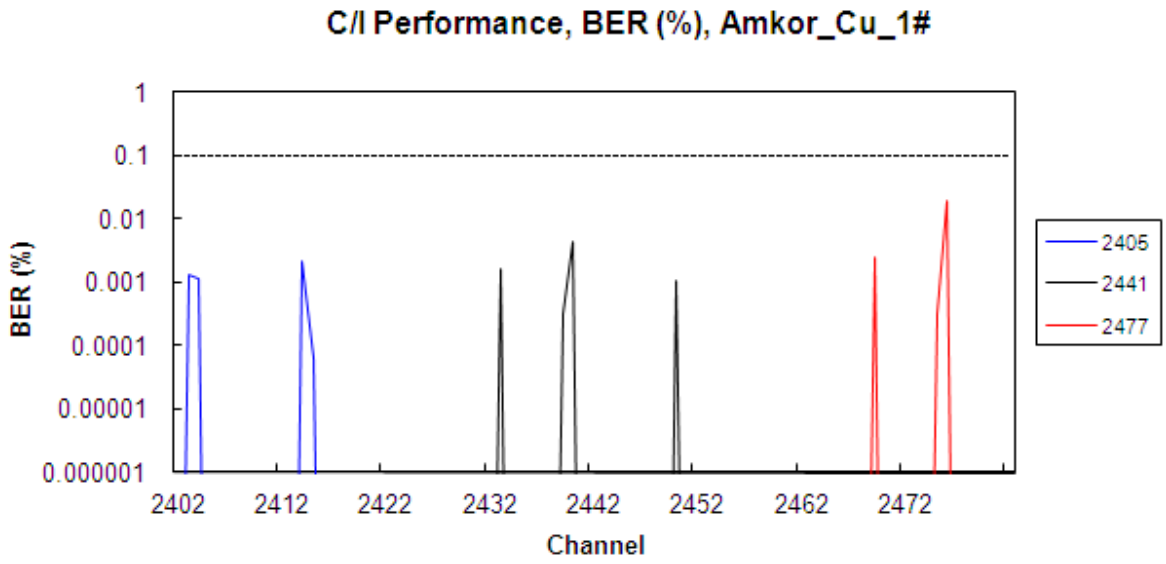
Operation Modes: DH1
RX Channels: 3, 39, 75
Temperatures: 25ºC
Supply Voltages: 3.3V

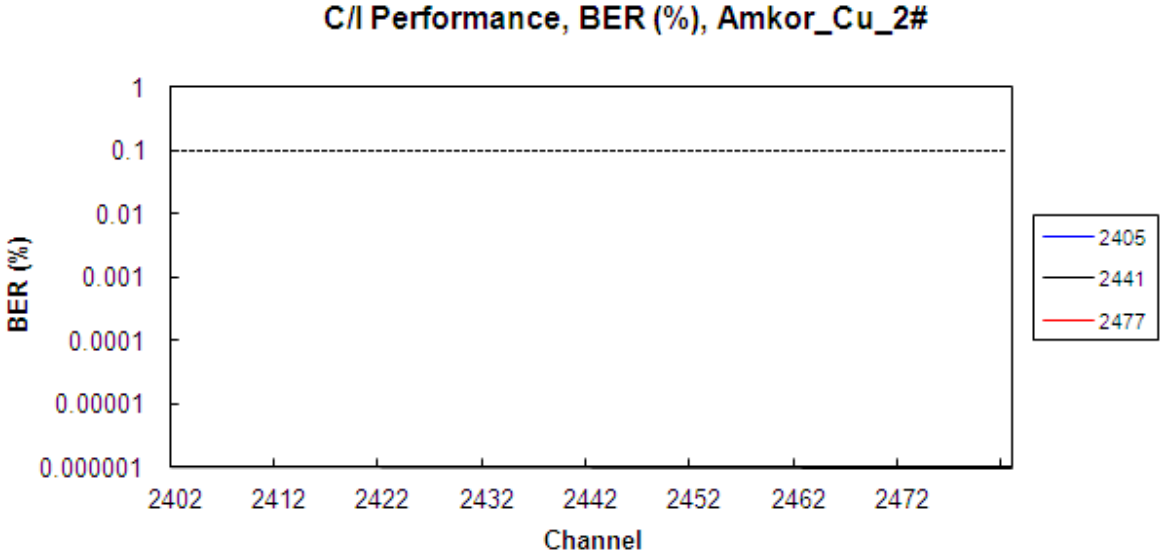
4.3.4 Bluetooth Specification

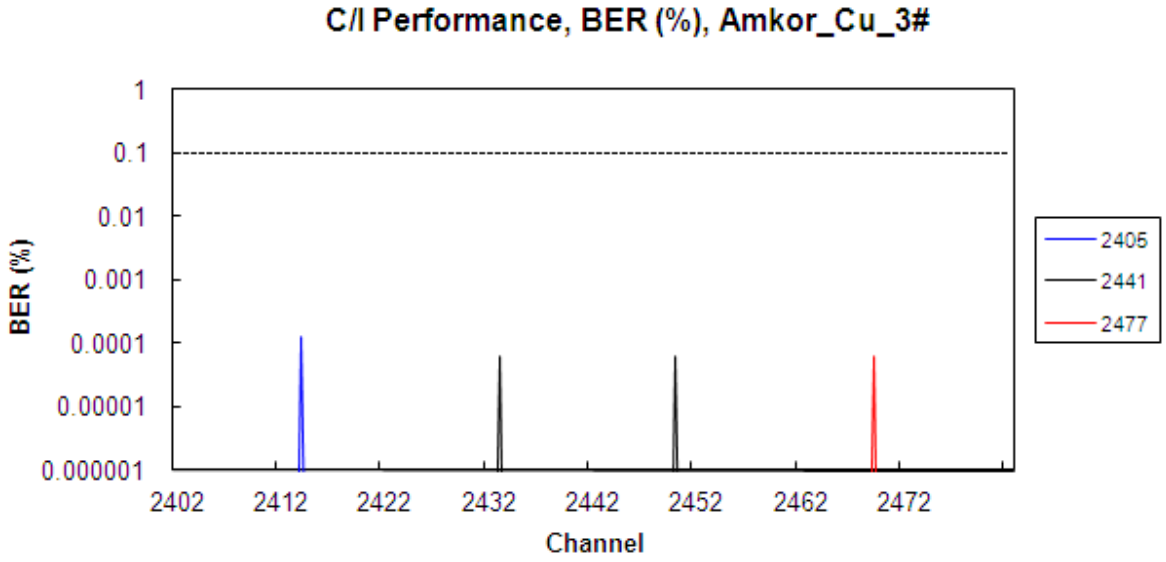
Requirement: BER ≤ 0.1%. There can be up to 3 frequencies at which the BER is greater than 0.1%, at which case, the BER must be less than 0.1% at a C/I of -20dB.
More information can be found in the Bluetooth RF Test Specification, section 5.1.18 "RCV/CA/03/C C/I Performance"

4.3.5 Results: PASS

Black dotted line is the limit, and the 3 colored curves represent the 3 RX channels at which this test is performed.


C/I Performance, BER (%), Amkor_Cu_1#
BER (%)
1
0.1
0.01
0.001
0.0001
0.00001
0.000001
2402
2412
2422
2432
2442
2452
2462
2472
Channel
2405
2441
2477


C/I Performance, BER (%), Amkor_Cu_2#
BER (%)
1
0.1
0.01
0.001
0.0001
0.00001
0.000001
2402
2412
2422
2432
2442
2452
2462
2472
Channel
2405
2441
2477



4.4 Out-of-Band Blocker (RCV/CA/04/C)

4.4.1 Purpose of Test:

This test measures the bit error rate (BER) of the DUT with the presence of interfering signals from 30MHz to 12.75GHz. This test is performed at normal conditions.

4.4.2 Test Methodology:

The DUT is configured to be in loopback test mode. The tester is configured to transmit basic rate data to the DUT. The interfering signal is generated by the signal generators, and is unmodulated signal

4.4.3 Test Modes and Parameters

Operation Modes: DH1
RX Channels: 58
Temperatures: 25ºC
Supply Voltages: 3.3V

4.4.4 Bluetooth Specification

Requirement: BER ≤ 0.1%. For the "Regular Test," the interfering signal power levels are defined as follows:

Frequency	Power Level
30MHz-2GHz, 3GHz-12.75GHz	-10dBm
2GHz-2.4GHz, 2.5GHz-3GHz	-27dBm

There can be up to 24 exceptions (frequencies with BER > 0.1%). Of the 24 exceptions, up to 5 frequencies can fail the relaxed requirement of -50dBm for the blocker power. More information can be found in the Bluetooth RF Test Specification, section 5.1.19 "RCV/CA/04/C Blocking Performance"

4.4.5 Results: PASS

The BER is zero at all frequencies except at the following frequencies:

Table 46 – Blocking Performance BER for Frequencies with non-zero BER, Amkor_Cu_1#

Frequency (MHz)	Regular Test BER (%) (-10dBm/27dBm)	Relaxed Test BER (%) (-50dBm)
820	100	0
1229	0.6072639	0
1230	100	0
1278	100	0
1326	0.1444259	0
2556	100	0

Table 47 – Blocking Performance BER for Frequencies with non-zero BER, Amkor_Cu_2#

Frequency (MHz)	Regular Test BER (%) (-10dBm/27dBm)	Relaxed Test BER (%) (-50dBm)
615	100	0
820	0.7943115	0
1230	100	0

Table 48 – Blocking Performance BER for Frequencies with non-zero BER, Amkor_Cu_3#

Frequency (MHz)	Regular Test BER (%) (-10dBm/27dBm)	Relaxed Test BER (%) (-50dBm)
615	8.329271	0
820	0.249605	0
1230	100	0
1278	0.2634789	0

4.5 Intermodulation Performance (RCV/CA/05/C)

4.5.1 Purpose of Test:

This test measures the bit error rate (BER) of the DUT with the presence of a pair of interfering signals. This test is performed at normal conditions.

4.5.2 Test Methodology:

The DUT is configured to be in loopback test mode. The tester is configured to transmit basic rate data to the DUT. Two interfering signals are generated by the signal generators, and the BER is measured.

4.5.3 Test Modes and Parameters

Operation Modes: DH1
RX Channels: 0, 39, 78
Temperatures: 25ºC
Supply Voltages: 3.3V

4.5.4 Bluetooth Specification

Requirement: BER ≤ 0.1%. The GFSK modulated signal f1 and the unmodulated single tone signal f2 are set at 3MHz, 4MHz, and 5MHz apart. More information can be found in the Bluetooth RF Test Specification, section 5.1.20 "RCV/CA/05/C Intermodulation Performance"

4.5.5 Results: PASS

Table 49 – Intermodulation Performance, Amkor_Cu_1#

RX Frequency: 2402 MHz			RX Frequency: 2441 MHz			RX Frequency: 2480 MHz		
f1 (MHz)	f2 (MHz)	BER (%)	f1 (MHz)	f2 (MHz)	BER (%)	f1(MHz)	f2 (MHz)	BER (%)
2405	2408	0	2444	2447	0	2483	2486	0
2408	2405	0	2447	2444	0	2486	2483	0
2406	2410	0	2445	2449	0	2484	2488	0
2410	2406	0	2449	2445	0	2488	2484	0
2407	2412	0	2446	2451	0	2485	2490	0
2412	2407	0	2451	2446	0	2490	2485	0
2396	2399	0	2435	2438	0	2474	2477	0
2399	2396	0	2438	2435	0	2477	2474	0
2394	2398	0	2433	2437	0	2472	2476	0
2398	2394	0	2437	2433	0	2476	2472	0
2392	2397	0	2431	2436	0	2470	2475	0
2397	2392	0	2436	2431	0	2475	2470	0

Table 50 – Intermodulation Performance, Amkor_Cu_2#

RX Frequency: 2402 MHz			RX Frequency: 2441 MHz			RX Frequency: 2480 MHz		
f1 (MHz)	f2 (MHz)	BER (%)	f1 (MHz)	f2 (MHz)	BER (%)	f1(MHz)	f2 (MHz)	BER (%)

2405	2408	0	2444	2447	0	2483	2486	0
2408	2405	0	2447	2444	0	2486	2483	0
2406	2410	0	2445	2449	0	2484	2488	0
2410	2406	0	2449	2445	0	2488	2484	0
2407	2412	0	2446	2451	0	2485	2490	0
2412	2407	0	2451	2446	0	2490	2485	0
2396	2399	0	2435	2438	0	2474	2477	0
2399	2396	0	2438	2435	0	2477	2474	0
2394	2398	0	2433	2437	0	2472	2476	0
2398	2394	0	2437	2433	0	2476	2472	0
2392	2397	0	2431	2436	0	2470	2475	0
2397	2392	0	2436	2431	0	2475	2470	0

Table 51 – Intermodulation Performance, Amkor_Cu_3#

RX Frequency: 2402 MHz			RX Frequency: 2441 MHz			RX Frequency: 2480 MHz		
f1 (MHz)	f2 (MHz)	BER (%)	f1 (MHz)	f2 (MHz)	BER (%)	f1(MHz)	f2 (MHz)	BER (%)
2405	2408	0	2444	2447	0	2483	2486	0
2408	2405	0	2447	2444	0	2486	2483	0
2406	2410	0	2445	2449	0	2484	2488	0
2410	2406	0	2449	2445	0	2488	2484	0
2407	2412	0	2446	2451	0	2485	2490	0
2412	2407	0	2451	2446	0	2490	2485	0
2396	2399	0	2435	2438	0	2474	2477	0
2399	2396	0	2438	2435	0	2477	2474	0
2394	2398	0	2433	2437	0	2472	2476	0
2398	2394	0	2437	2433	0	2476	2472	0
2392	2397	0	2431	2436	0	2470	2475	0
2397	2392	0	2436	2431	0	2475	2470	0

4.6 Maximum Input Level (RCV/CA/06/C)

4.6.1 Purpose of Test:

This test measures the bit error rate (BER) of the DUT at a maximum input level. This test is performed at normal conditions.

4.6.2 Test Methodology:

The DUT is configured to be in loopback test mode. The tester is configured to transmit basic rate data to the DUT at 0dBm, and the BER is measured. The specification requires the signal to be at -20dBm, so this is a stricter specification.

4.6.3 Test Modes and Parameters

Operation Modes: DH1
RX Channels: 0, 39, 78
Temperatures: 25ºC
Supply Voltages: 3.3V

4.6.4 Bluetooth Specification

Requirement: BER ≤ 0.1%. More information can be found in the Bluetooth RF Test Specification, section 5.1.21 "RCV/CA/06/C Maximum Input Level"

4.6.5 Results: PASS

Table 52 – Maximum Input Level BER (%), Amkor_Cu_1#

Channel	BER (%)
0	0
39	0
78	0

Table 53 – Maximum Input Level BER (%), Amkor_Cu_2#

Channel	BER (%)
0	0
39	0
78	0

Table 54 – Maximum Input Level BER (%), Amkor_Cu_3#

Channel	BER (%)
0	0
39	0
78	0

4.7 EDR Sensitivity (RCV/CA/07/C)

4.7.1 Purpose of Test:

This test measures the bit error rate (BER) of the DUT at a receive power of -70dBm. This test is performed at normal and extreme conditions.

4.7.2 Test Methodology:

The DUT is configured to be in loopback test mode. The tester is configured to transmit EDR signal at -70dBm as seen at the DUT's antenna port. The tester uses a "dirty transmitter," as specified in the Bluetooth RF Test Specification. The BER is measured.

4.7.3 Test Modes and Parameters

Operation Modes: 2DH5 and 3DH5
RX Channels: 0, 39, 78
Temperatures: -40ºC, 25ºC, 85ºC
Supply Voltages: 3.0V, 3.3V, 3.6V

4.7.4 Bluetooth Specification

Requirement: BER ≤ 0.007% at 1.6 million bits, or BER ≤ 0.01% after 16 million bits.
More information can be found in the Bluetooth RF Test Specification, section 5.1.22 "RCV/CA/07/C EDR Sensitivity"

4.7.5 Results: PASS

Table 55 – EDR Sensitivity (%), Amkor_Cu_1#

	2DH5, 3.0 V			2DH5, 3.3 V			2DH5, 3.6 V		
Channel	-40˚C	25˚C	85˚C	-40˚C	25˚C	85˚C	-40˚C	25˚C	85˚C
0	0	0	0	0	0	0	0	0	0
39	0	0	0	0	0	0	0	0	0
78	0	0	0	0	0	0	0	0	0
	3DH5, 3.0 V			3DH5, 3.3 V			3DH5, 3.6 V		
Channel	-40˚C	25˚C	85˚C	-40˚C	25˚C	85˚C	-40˚C	25˚C	85˚C
0	0	0	3.75E-04	0	6.25E-05	1.25E-04	0	0	1.25E-04
39	0	0	1.87E-04	0	0	2.50E-04	0	0	3.12E-04
78	0	0	3.12E-04	0	0	1.25E-04	0	6.25E-05	2.50E-04

Table 56 – EDR Sensitivity (%), Amkor_Cu_2#

	2DH5, 3.0 V			2DH5, 3.3 V			2DH5, 3.6 V		
Channel	-40˚C	25˚C	85˚C	-40˚C	25˚C	85˚C	-40˚C	25˚C	85˚C

0	0	0	0	0	0	0	0	0	0
39	0	0	0	0	0	0	0	0	0
78	0	0	0	0	0	0	0	0	0
	3DH5, 3.0 V			**3DH5, 3.3 V**			**3DH5, 3.6 V**		
Channel	-40˚C	25˚C	85˚C	-40˚C	25˚C	85˚C	-40˚C	25˚C	85˚C
0	0	0	2.50E-04	0	0	1.25E-04	0	0	0
39	0	0	1.25E-04	0	0	0	0	0	1.87E-04
78	0	0	6.25E-05	0	0	0	0	0	1.25E-04

Table 57 – EDR Sensitivity (%), Amkor_Cu_3#

	2DH5, 3.0 V			**2DH5, 3.3 V**			**2DH5, 3.6 V**		
Channel	-40˚C	25˚C	85˚C	-40˚C	25˚C	85˚C	-40˚C	25˚C	85˚C
0	0	0	0	0	0	0	0	0	0
39	0	0	0	0	0	0	0	0	0
78	0	0	0	0	0	0	0	0	0
	3DH5, 3.0 V			**3DH5, 3.3 V**			**3DH5, 3.6 V**		
Channel	-40˚C	25˚C	85˚C	-40˚C	25˚C	85˚C	-40˚C	25˚C	85˚C
0	0	1.25E-04	6.25E-05	0	0	0	0	0	1.25E-04
39	0	0	0	0	0	6.25E-05	0	0	6.25E-05
78	0	0	0	0	0	1.25E-04	0	0	1.25E-04

4.8 EDR BER Floor (RCV/CA/08/C)

4.8.1 Purpose of Test:

This test measures the bit error rate (BER) of the DUT at a receive power of -60dBm. This test is performed at normal conditions.

4.8.2 Test Methodology:

The DUT is configured to be in loopback test mode. The tester is configured to transmit EDR signal at -60dBm as seen at the DUT's antenna port. The BER is measured.

4.8.3 Test Modes and Parameters

Operation Modes: 2DH5 and 3DH5
RX Channels: 0, 39, 78
Temperatures: 25ºC
Supply Voltages: 3.3V

4.8.4 Bluetooth Specification

Requirement: BER ≤ 0.0007% at 8 million bits, or BER ≤ 0.001% after 160 million bits.
More information can be found in the Bluetooth RF Test Specification, section 5.1.23 "RCV/CA/08/C EDR BER Floor"

4.8.5 Results: PASS

Table 58 – EDR BER Floor, BER (%), Amkor_Cu_1#

Channel	2DH5	3DH5
0	0	0
39	0	0
78	0	0

Table 59 – EDR BER Floor, BER (%), Amkor_Cu_2#

Channel	2DH5	3DH5
0	0	0
39	0	0
78	0	0

Table 60 – EDR BER Floor, BER (%), Amkor_Cu_3#

Channel	2DH5	3DH5
0	0	0
39	0	0
78	0	0

4.9 EDR In-Band Blocker Performance (RCV/CA/09/C)

4.9.1 Purpose of Test:

This test measures the bit error rate (BER) of the DUT in the presence of interfering signals. This test is performed at normal conditions.

4.9.2 Test Methodology:

The DUT is configured to be in loopback test mode. The tester is configured to transmit EDR signal at -60dBm as seen at the DUT's antenna port. A signal generator is used to generate the interfering signal, as specified in the Bluetooth RF Test Specification. The BER is measured.

4.9.3 Test Modes and Parameters

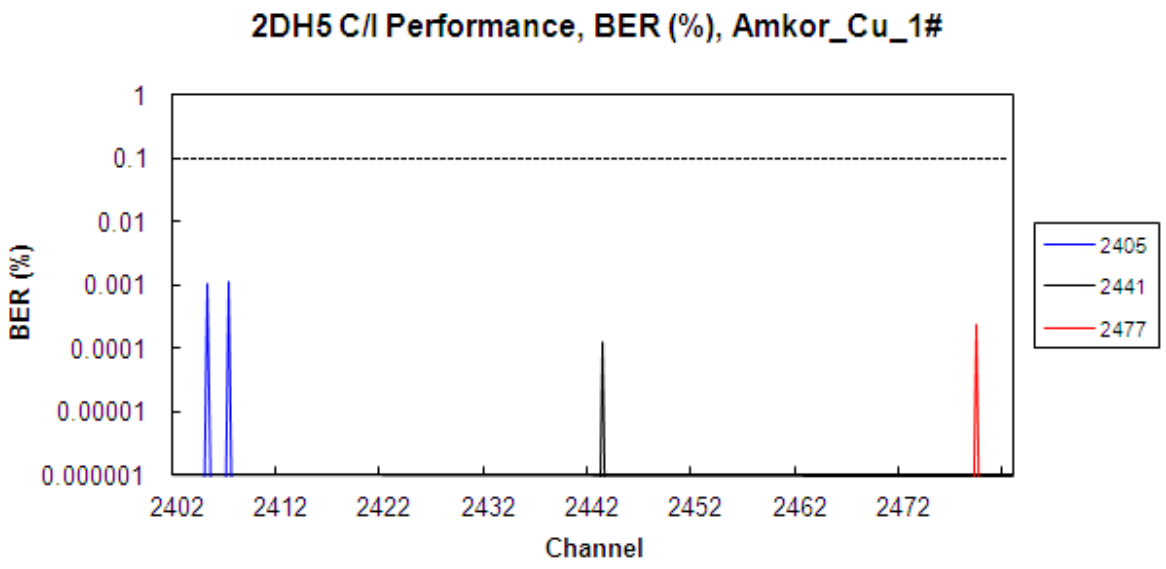
Operation Modes: 2DH5 and 3DH5
RX Channels: 3, 39, 75
Temperatures: 25ºC
Supply Voltages: 3.3V

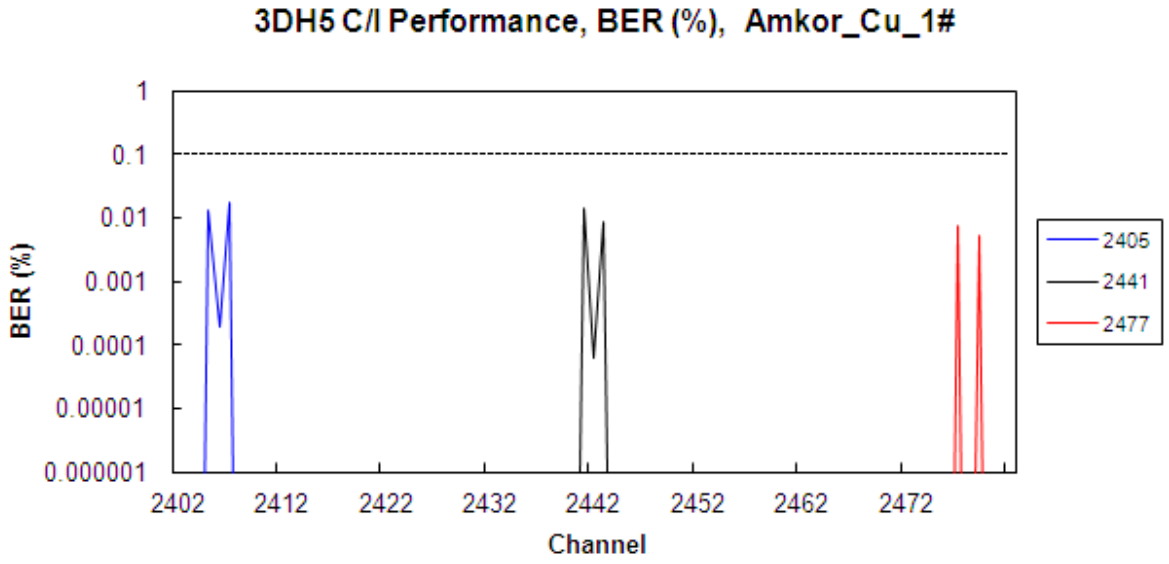
4.9.4 Bluetooth Specification

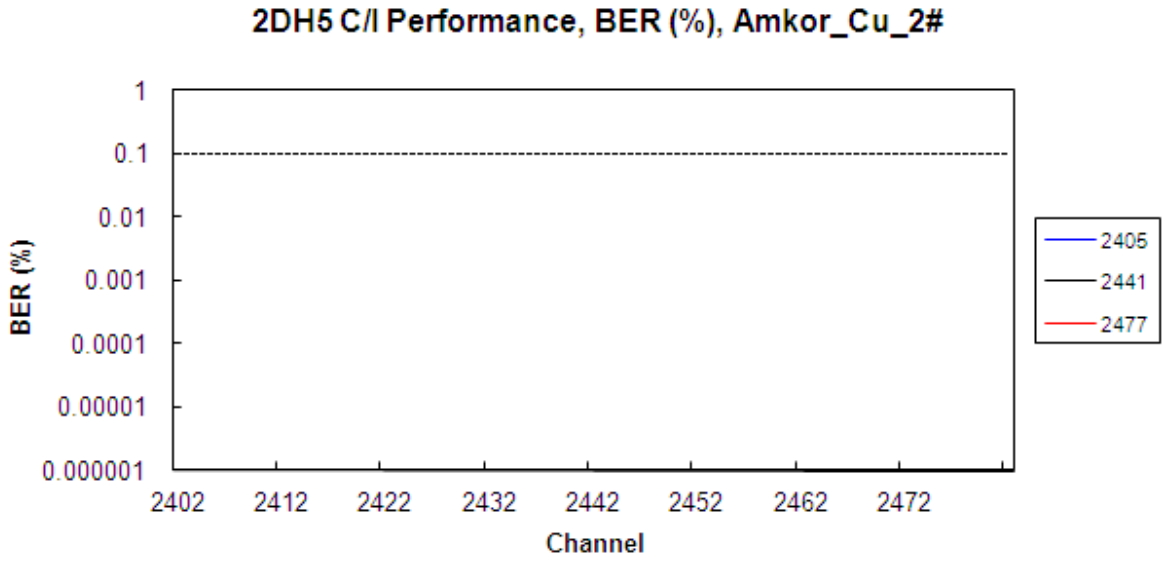
Requirement: BER ≤ 0.1%.
More information can be found in the Bluetooth RF Test Specification, section 5.1.24 "RCV/CA/09/C EDR C/I Performance"

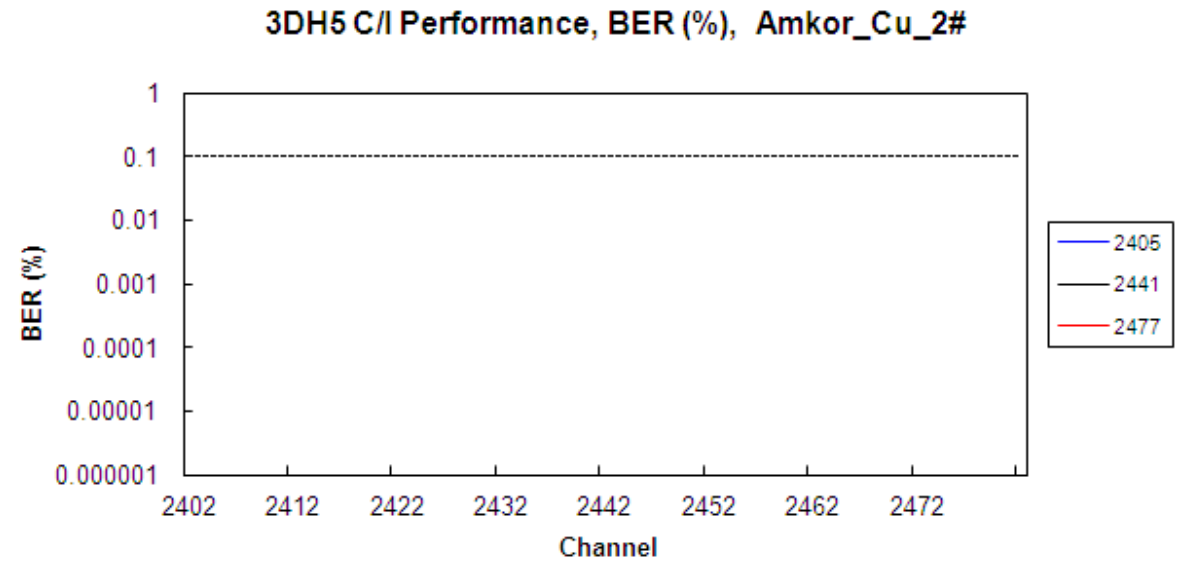
4.9.5 Results: PASS

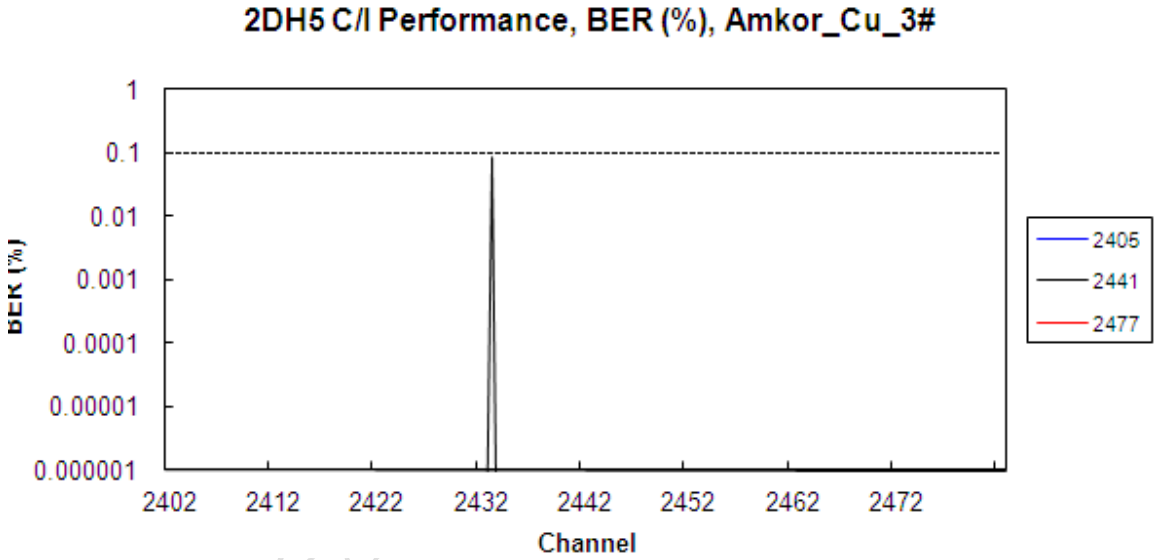
Black dotted line is the BER limit, and the 3 colored curves represent the 3 RX channels at which this test is performed.

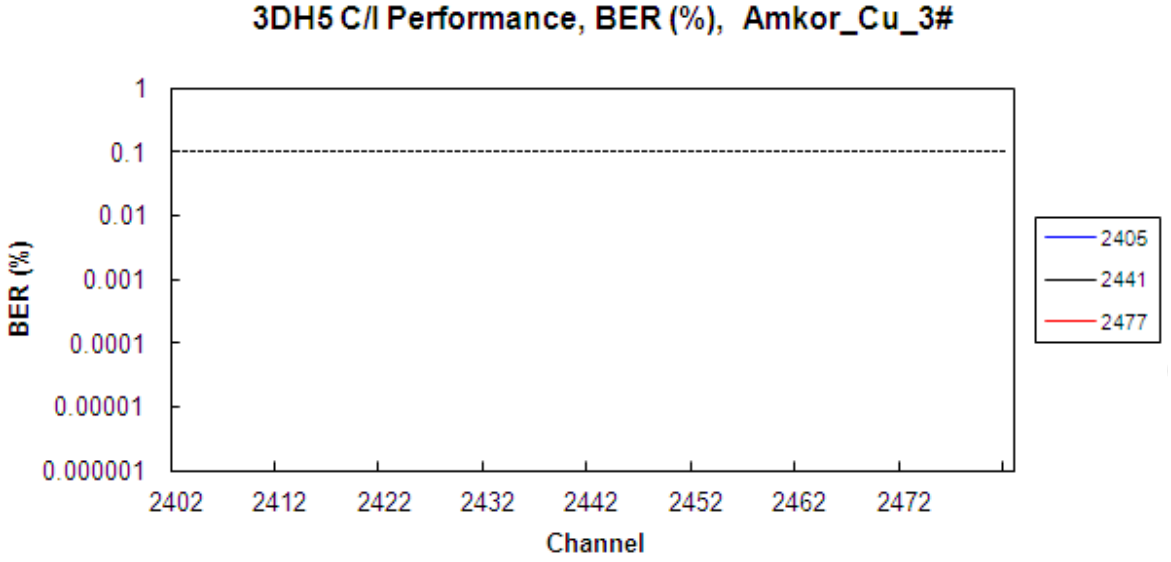



3DH5 C/I Performance, BER (%), Amkor_Cu_1#
BER (%)
1
0.1
0.01
0.001
0.0001
0.00001
0.000001
2402
2412
2422
2432
2442
2452
2462
2472
Channel
2405
2441
2477


2DH5 C/I Performance, BER (%), Amkor_Cu_2#
BER (%)
1
0.1
0.01
0.001
0.0001
0.00001
0.000001
2402
2412
2422
2432
2442
2452
2462
2472
Channel
2405
2441
2477


3DH5 C/I Performance, BER (%), Amkor_Cu_2#
BER (%)
1
0.1
0.01
0.001
0.0001
0.00001
0.000001
2402
2412
2422
2432
2442
2452
2462
2472
Channel
2405
2441
2477


2DH5 C/I Performance, BER (%), Amkor_Cu_3#
BER (%)
1
0.1
0.01
0.001
0.0001
0.00001
0.000001
2402
2412
2422
2432
2442
2452
2462
2472
Channel
2405
2441
2477



4.10 EDR Maximum Input Level (RCV/CA/10/C)

4.10.1 Purpose of Test:

This test measures the bit error rate (BER) of the DUT at a maximum input level. This test is performed at normal conditions.

4.10.2 Test Methodology:

The DUT is configured to be in loopback test mode. The tester is configured to transmit basic rate data to the DUT at 0dBm, and the BER is measured. The Bluetooth RF specification requires the signal to be at -20dBm, so this is a stricter specification.

4.10.3 Test Modes and Parameters

Operation Modes: DH5
RX Channels: 0, 39, 78
Temperatures: 25ºC
Supply Voltages: 3.3V

4.10.4 Bluetooth Specification

Requirement: BER ≤ 0.1%.
More information can be found in the Bluetooth RF Test Specification, section 5.1.25 "RCV/CA/10/C EDR Maximum Input Level"

4.10.5 Results: PASS

Table 61 – EDR Maximum Input Level BER (%), Amkor_Cu_1#

Channel	2DH5	3DH5
0	0	0
39	0	0
78	0	0

Table 62 – EDR Maximum Input Level BER (%), Amkor_Cu_2#

Channel	2DH5	3DH5
0	0	0
39	0	0
78	0	0

Table 63 – EDR Maximum Input Level BER (%), Amkor_Cu_3#

Channel	2DH5	3DH5

0	0	0
39	0	0
78	0	0

4.11 Receive Minimum Sensitivity

4.11.1 Purpose of Test

This test measures the minimum receiver sensitivity of the DUT at specified channels.

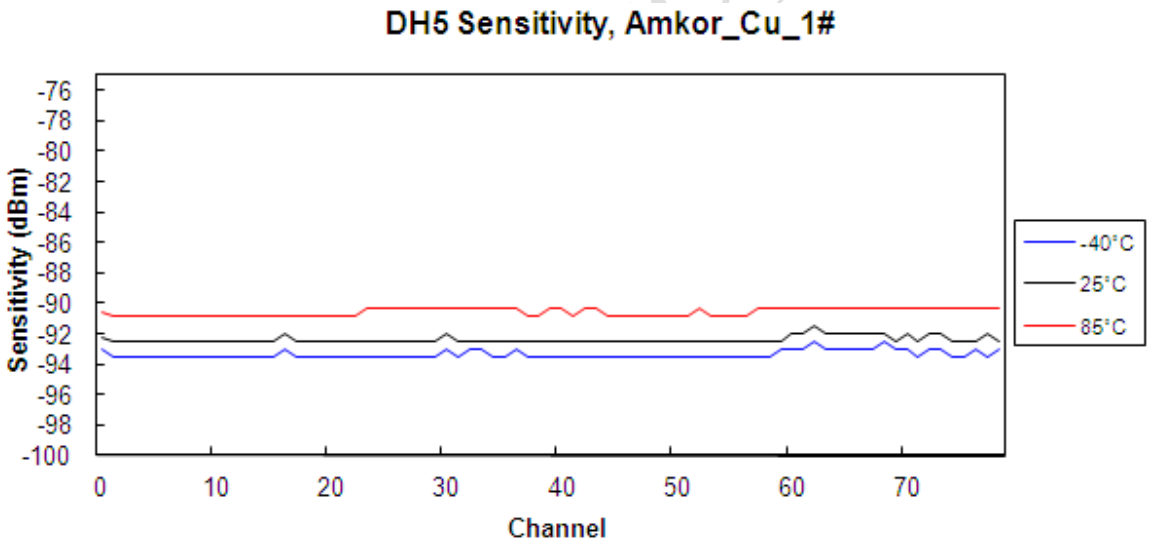
4.11.2 Test Methodology:

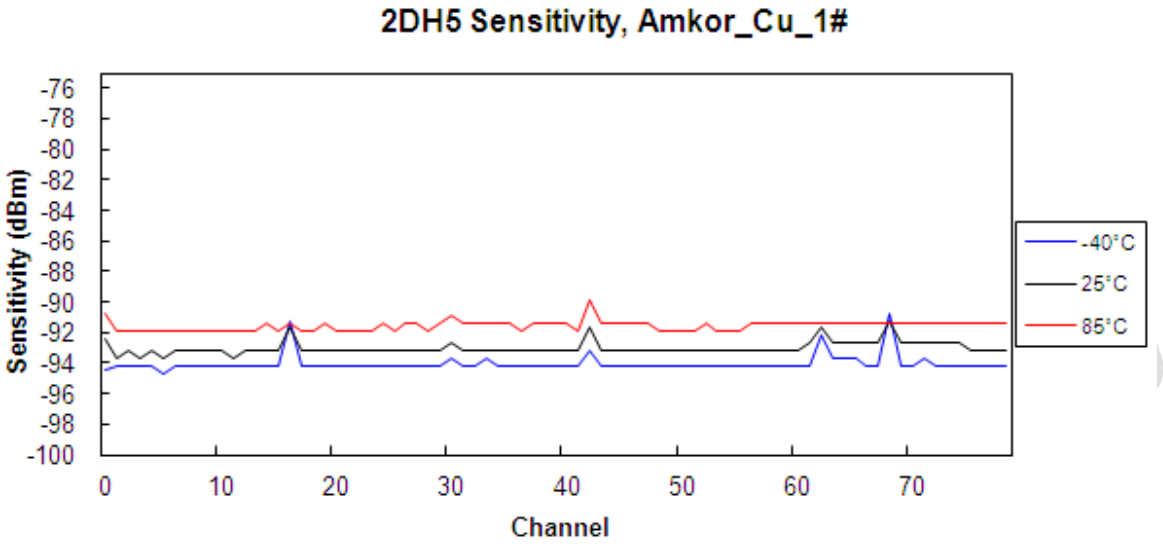
The DUT is placed inside a temperature chamber. The DUT's antenna port is connected through a series of 50Ω SMA cables and splitters to the Rohde-Schwarz CBT tester. The DUT is configured to be in loopback test mode. The tester is configured to transmit at decreasing power levels (as seen at the DUT antenna port) until the BER is over 0.1%, and the power level at which the BER is less than 0.1% is recorded. For EDR data rates, the BER limit is set at 0.01%, and the power level at which the BER is less than 0.01% is recorded.

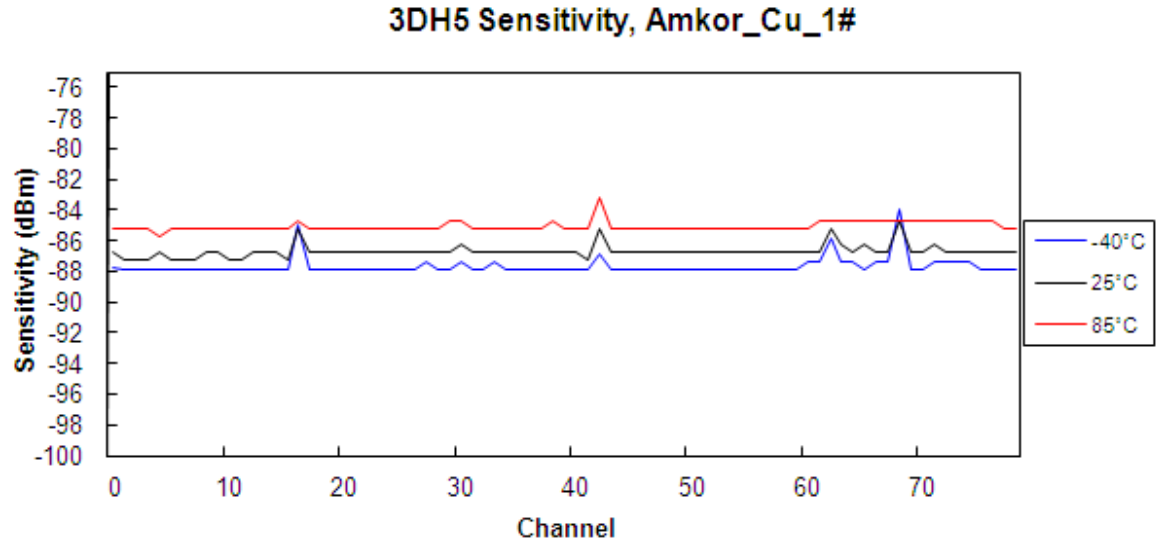
4.11.3 Test Modes and Parameters

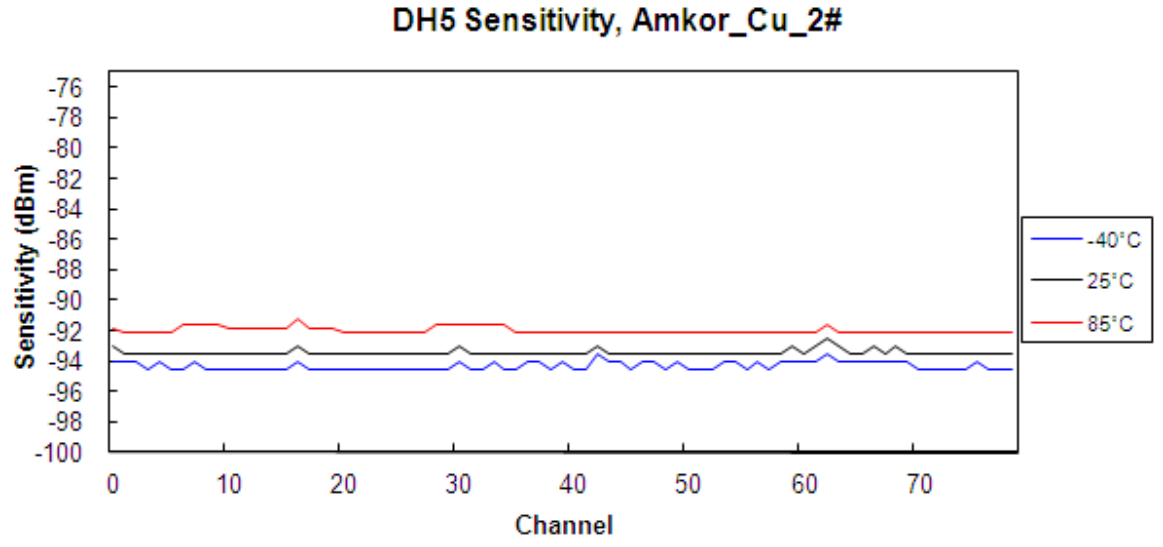
Operation Modes: DH5, 2DH5, 3DH5
Temperatures: 25ºC
Supply Voltages: 3.3V

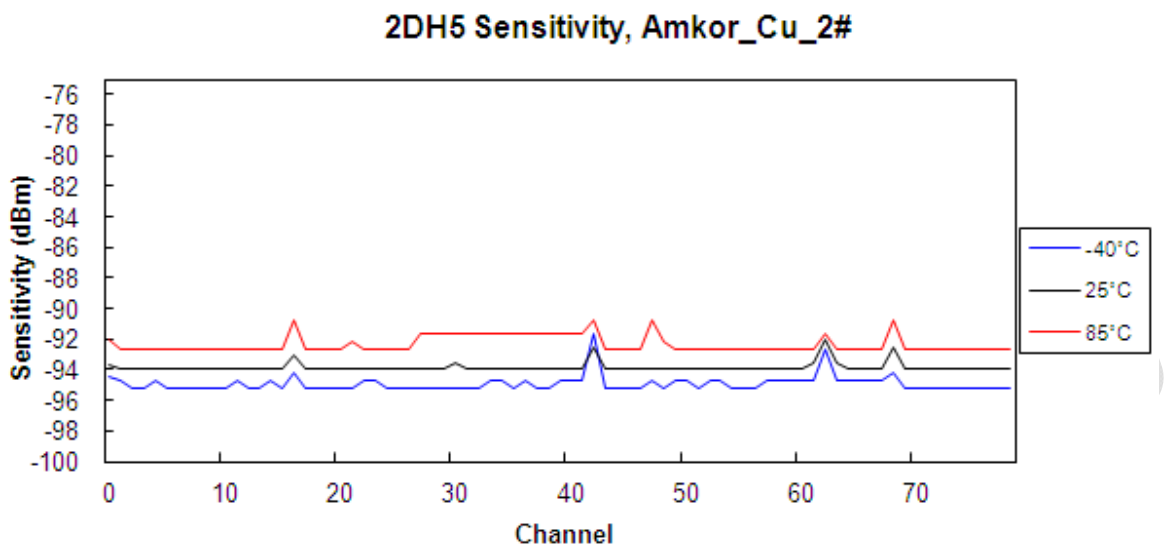
4.11.4 Results:

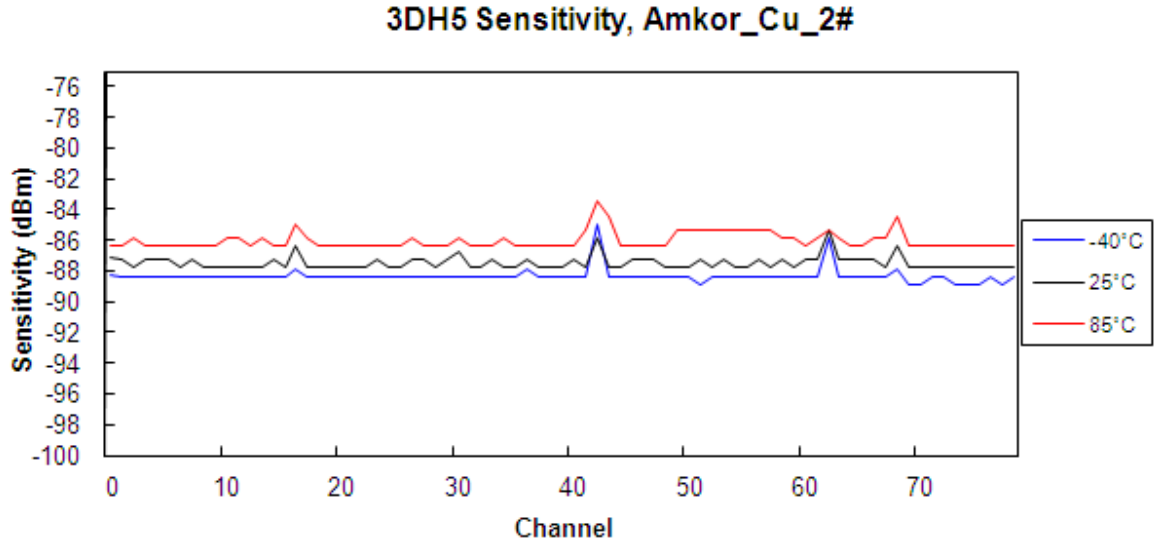


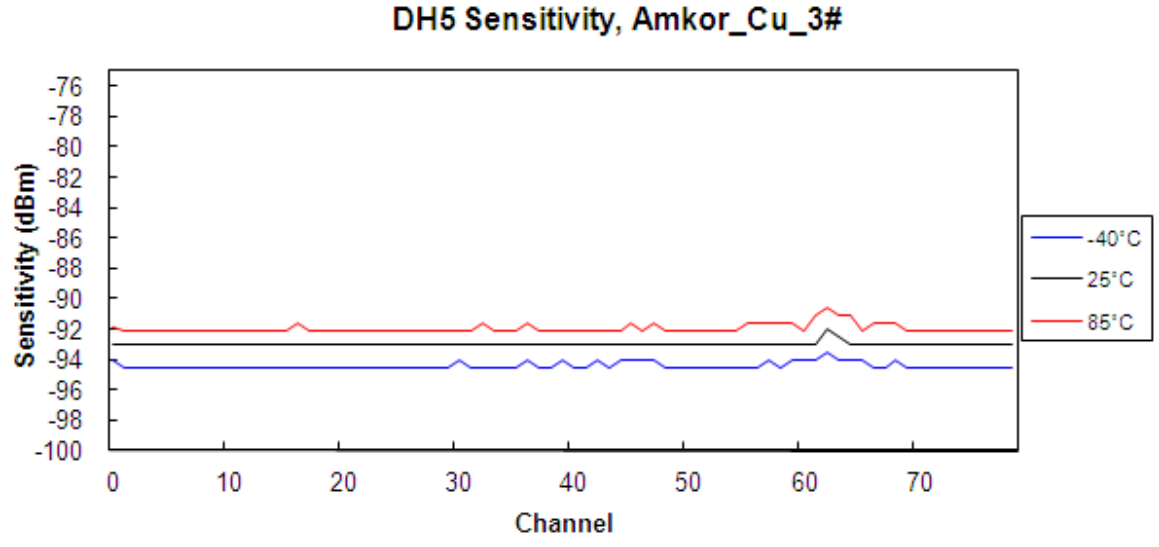

2DH5 Sensitivity, Amkor_Cu_1#
Sensitivity (dBm)
-76
-78
-80
-82
-84
-86
-88
-90
-92
-94
-96
-98
-100
0
10
20
30
40
50
60
70
Channel
-40°C
25°C
85°C

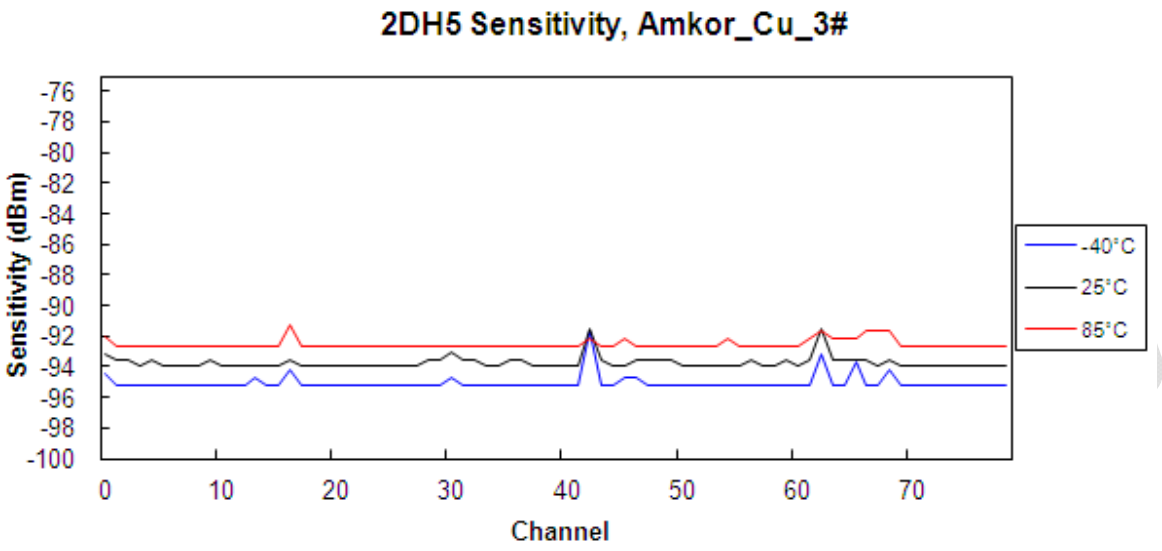

3DH5 Sensitivity, Amkor_Cu_1#
Sensitivity (dBm)
-76
-78
-80
-82
-84
-86
-88
-90
-92
-94
-96
-98
-100
0
10
20
30
40
50
60
70
Channel
-40°C
25°C
85°C

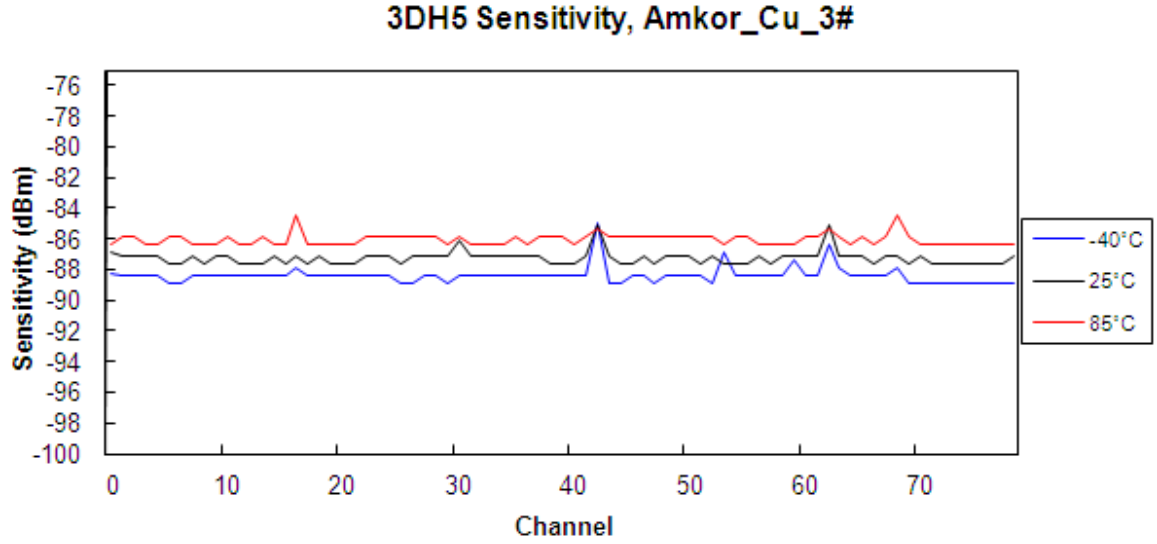

DH5 Sensitivity, Amkor_Cu_2#
Sensitivity (dBm)
-76
-78
-80
-82
-84
-86
-88
-90
-92
-94
-96
-98
-100
0
10
20
30
40
50
60
70
Channel
-40°C
25°C
85°C


2DH5 Sensitivity, Amkor_Cu_2#
Sensitivity (dBm)
-76
-78
-80
-82
-84
-86
-88
-90
-92
-94
-96
-98
-100
0
10
20
30
40
50
60
70
Channel
-40°C
25°C
85°C


3DH5 Sensitivity, Amkor_Cu_2#
Sensitivity (dBm)
-76
-78
-80
-82
-84
-86
-88
-90
-92
-94
-96
-98
-100
0
10
20
30
40
50
60
70
Channel
-40°C
25°C
85°C


DH5 Sensitivity, Amkor_Cu_3#
Sensitivity (dBm)
-76
-78
-80
-82
-84
-86
-88
-90
-92
-94
-96
-98
-100
0
10
20
30
40
50
60
70
Channel
-40°C
25°C
85°C


2DH5 Sensitivity, Amkor_Cu_3#
Sensitivity (dBm)
-76
-78
-80
-82
-84
-86
-88
-90
-92
-94
-96
-98
-100
0
10
20
30
40
50
60
70
Channel
-40°C
25°C
85°C


3DH5 Sensitivity, Amkor_Cu_3#
Sensitivity (dBm)
-76
-78
-80
-82
-84
-86
-88
-90
-92
-94
-96
-98
-100
0
10
20
30
40
50
60
70
Channel
-40°C
25°C
85°C

5 DVT Results – Low Energy Transmitter

5.1 Low Energy TX Output Power (TRM-LE/CA/01/C and TRM-LE/CA/02/C)

5.1.1 Purpose of Test:

This test measures the transmitted power of the DUT at channels 0, 19, and 39. This test is performed at normal and extreme conditions.

5.1.2 Test Methodology:

The DUT is configured to be in direct TX test mode. The maximum peak and average output powers at channels 0, 19, and 39 are measured.

5.1.3 Test Modes and Parameters

Packet Type: Test packets with PRBS9 payload (37 octets)
Channels: 0, 19, 39
Temperatures: -40ºC, 25ºC, 85ºC
Supply Voltages: 3.0V, 3.3V, 3.6V

5.1.4 Bluetooth Low Energy Specifications

The average output power needs to be greater than -20dBm and less than +10dBm. In this BU22 DVT result, to comply with the LC result (target power is 12dBm), we also set the target power to 12dBm during LE test. The peak output power cannot exceed 3dBm of the average output power. For more information, please refer to the Bluetooth Low Energy RF Test Specification, sections 6.2.1-6.2.2 entitled "TRM-LE/CA/01/C and TRM-LE/CA/02/C Output Power".

5.1.5 Results: PASS

Table 1 – Low Energy TX Average Output Power (dBm), Amkor_Cu_1 #

	3.0 V			3.3 V			3.6 V		
Channel	-40˚C	25˚C	85˚C	-40˚C	25˚C	85˚C	-40˚C	25˚C	85˚C
0	11.1161	11.93719	11.61848	12.02435	12.34343	12.41231	12.46777	12.69232	12.69643
19	11.11438	11.60222	11.42867	12.01213	12.00111	12.22876	12.35686	12.30551	12.50548
39	11.40526	11.33669	11.28156	12.29253	11.72964	12.08488	12.593	12.09511	12.38217

Table 2 – Low Energy TX (Peak Output Power- Avg Output power)(dBm), Amkor_Cu_1#

	3.0 V			3.3 V			3.6 V		
Channel	-40˚C	25˚C	85˚C	-40˚C	25˚C	85˚C	-40˚C	25˚C	85˚C
0	0.64	0.66	0.73	0.67	0.71	0.74	0.63	0.7	0.7
19	0.65	0.68	0.67	0.62	0.72	0.68	0.67	0.69	0.68
39	0.66	0.69	0.71	0.66	0.75	0.72	0.65	0.69	0.7

Table 3 – Low Energy TX Average Output Power (dBm), Amkor_Cu_2 #

	3.0 V			3.3 V			3.6 V		
Channel	-40˚C	25˚C	85˚C	-40˚C	25˚C	85˚C	-40˚C	25˚C	85˚C
0	11.90442	11.70909	11.67047	12.28552	12.04993	11.9502	12.68707	12.34038	12.63683
19	11.98445	11.90038	11.92174	12.38916	12.25806	12.24338	12.74075	12.56836	12.93954
39	12.3568	12.30338	12.31364	12.7484	12.66542	13.09349	13.03409	12.98021	13.34009

Table 4 – Low Energy TX (Peak Output Power- Avg Output power)(dBm), Amkor_Cu_2 #

	3.0 V			3.3 V			3.6 V		
Channel	-40˚C	25˚C	85˚C	-40˚C	25˚C	85˚C	-40˚C	25˚C	85˚C
0	0.64	0.66	0.71	0.64	0.64	0.74	0.65	0.75	0.75
19	0.61	0.66	0.7	0.61	0.7	0.68	0.65	0.71	0.73
39	0.65	0.71	0.73	0.63	0.74	0.76	0.61	0.73	0.71

Table 5 – Low Energy TX Average Output Power (dBm), Amkor_Cu_3 #

	3.0 V			3.3 V			3.6 V		
Channel	-40˚C	25˚C	85˚C	-40˚C	25˚C	85˚C	-40˚C	25˚C	85˚C
0	10.40836	10.44176	10.49788	10.82199	10.79384	11.24464	11.20781	11.1011	11.54115
19	10.62737	10.69078	10.83098	10.9743	11.06209	11.5731	11.31059	11.3532	11.8726
39	11.06541	11.21962	11.78136	11.43973	11.53296	12.07246	11.70287	11.83504	12.30466

Table 6 – Low Energy TX (Peak Output Power- Avg Output power)(dBm), Amkor_Cu_3 #

	3.0 V			3.3 V			3.6 V		
Channel	-40˚C	25˚C	85˚C	-40˚C	25˚C	85˚C	-40˚C	25˚C	85˚C
0	0.55	0.58	0.63	0.58	0.62	0.69	0.57	0.64	0.62
19	0.54	0.61	0.6	0.55	0.65	0.68	0.58	0.63	0.63
39	0.57	0.58	0.64	0.56	0.66	0.71	0.58	0.62	0.67

5.2 Low Energy In-band Emissions (TRM-LE/CA/03/C and TRM-LE/CA/04/C)

5.2.1 Purpose of Test

This test measures the power in the channels adjacent to the desired transmit channel. This test is performed at normal and extreme conditions.

5.2.2 Test Methodology:

The DUT is configured to be in direct TX test mode. At each transmit channel (2, 19, and 37), the power in the adjacent channels, separated by 1MHz, are measured.

5.2.3 Test Modes and Parameters

Operation Modes: Test packets with PRBS9 payload (37 octets)
Channels: 2, 19, 37
Temperatures: -40ºC, 25ºC, 85ºC
Supply Voltages: 3.0V, 3.3V, 3.6V

5.2.4 Bluetooth Low Energy Specifications:

More information can be found in the Bluetooth Low Energy RF Test Specification, sections 6.2.3-6.2.4 "TRM-LE/CA/03/C and TRM-LE/CA/04/C TX In-band Emissions".

Adjacent Channel	Bluetooth Low Energy RF Specification
≥ ± 3 MHz Offset	-30 dBm
± 2 MHz Offset	-20 dBm

5.2.5 Results:

Currently, the CBT does not support LE ACP test, we can only finish this test in the future.

For these results, the 3 colored curves represent the ACP at channel 2 (blue), channel 19 (black) and channel 37 (red). The black dotted line is the limit for channels ≥ +3MHz.

5.3 Low Energy Modulation Characteristics (TRM-LE/CA/05/C)

5.3.1 Purpose of Test

This test measures the transmitted signal quality of the DUT of low energy signals. This test is performed at normal conditions.

5.3.2 Test Methodology

The DUT is configured to be in direct TX test mode and the GFSK modulation characteristics at channels 0, 19, and 39 are measured.

5.3.3 Test Modes and Parameters

Operation Modes: Test packets with PRBS9 payload (37 octets)
Channels: 0, 19, 39
Temperatures: 25ºC
Supply Voltages: 3.3V

5.3.4 Bluetooth Low Energy Specifications

1. 225kHz ≤ f1avg ≤ 275kHz
2. f2max ≥ 185kHz for at least 99.9% of all f2max
3. f2avg / f1avg ≥ 0.8

Please refer to the Bluetooth Low Energy RF Test Specification, section 6.2.5 entitled "TRM-LE/CA/05/C Modulation Characteristics" for more information.

5.3.5 Results: PASS

Table 7 – Modulation Characteristics, Amkor_Cu_1 #

		3.3 V
Channel		25˚C
F1avg (kHz)	0	247
	19	246.93
	39	246
% F2max >185kHz	0	100
	19	100
	39	100
F2/F1	0	1.004798063
	19	1.005685937
	39	1.018321776

Table 8 – Modulation Characteristics, Amkor_Cu_2 #

		3.3 V
Channel		25˚C
F1avg (kHz)	0	245.65
	19	245.14
	39	245.36
% F2max >185kHz	0	100
	19	100
	39	100
F2/F1	0	1.020259246
	19	1.020560686
	39	1.020257729

Table 9 – Modulation Characteristics, Amkor_Cu_3 #

		3.3 V
Channel		25˚C
F1avg (kHz)	0	248.02
	19	247.72
	39	246.03
% F2max >185kHz	0	100
	19	100
	39	100
F2/F1	0	1.0093625
	19	1.0051275
	39	1.0138768

5.4 Low Energy Carrier Frequency Offset and Drift (TRM-LE/CA/06/C and TRM-LE/CA/07/C)

5.4.1 Purpose of Test

This test measures the carrier frequency offset and drift of the DUT of low energy signals. This test is performed at normal and extreme conditions.

5.4.2 Test Methodology

The DUT is configured to be in direct TX test mode, and the GFSK carrier frequency offset and drift at channels 0, 19, and 39 are measured.

5.4.3 Test Modes and Parameters

Operation Modes: Test packets with PRBS9 payload (37 octets)
Channels: 0, 19, 39
Temperatures: -40ºC, 25ºC, 85ºC
Supply Voltages: 3.0V, 3.3V, 3.6V

5.4.4 Bluetooth Low Energy Specifications

All frequency offset values must be between -150kHz and +150kHz. All frequency drift values must be between -50kHz and +50kHz. In addition, the maximum drift rate values must be below 20kHz/50µs. Please refer to the Bluetooth Low Energy RF Test Specification, sections 6.2.6-6.2.7 entitled "TRM-LE/CA/06/C and TRM-LE/CA/07/C Carrier Frequency Offset and Drift" for more information.

5.4.5 Results: PASS

Table 10 – Carrier Frequency Offset Max (kHz), Amkor_Cu_1 #

	3.0 V			3.3 V			3.6 V		
Channel	-40˚C	25˚C	85˚C	-40˚C	25˚C	85˚C	-40˚C	25˚C	85˚C
0	-15.22021	-11.03101	-4.792786	-10.79578	-12.27063	-0.6570435	-9.528748	-13.16571	3.529419
19	-13.0365	-11.61963	-3.303223	-10.43567	-12.82874	1.605774	-9.169312	-13.72009	4.461243
39	-11.96826	-12.37177	-2.015625	-10.32922	-13.45862	2.604614	-9.04425	-14.14465	5.476074

Table 11 – Carrier Frequency Drift ,Max(kHz), Amkor_Cu_1 #

	3.0 V			3.3 V			3.6 V		
Channel	-40˚C	25˚C	85˚C	-40˚C	25˚C	85˚C	-40˚C	25˚C	85˚C
0	2.759155	2.067017	1.780701	2.480652	2.07312	1.945862	2.550476	1.916199	1.732178
19	3.041565	1.936279	1.409119	2.832825	2.020081	1.667908	3.150757	2.115784	1.740479
39	3.384399	2.084351	1.297241	2.746033	2.037964	1.493347	3.096191	2.219421	1.367615

Table 12 – Maximum Drift Rate (kHz/uS), Max ,Amkor_Cu_1 #

	3.0 V			3.3 V			3.6 V		
Channel	-40˚C	25˚C	85˚C	-40˚C	25˚C	85˚C	-40˚C	25˚C	85˚C
0	1.843262	1.16272	1.367188	1.522827	1.324463	1.419067	1.358032	1.449585	1.449585
19	1.620483	1.422119	1.657104	1.663208	1.376343	1.66626	1.675415	1.620483	1.287842
39	1.99585	1.290894	1.71814	1.565552	1.525879	1.919556	1.690674	1.248169	1.61438

Table 13 – Carrier Frequency Offset Max (kHz), Amkor_Cu_2 #

	3.0 V			3.3 V			3.6 V		
Channel	-40˚C	25˚C	85˚C	-40˚C	25˚C	85˚C	-40˚C	25˚C	85˚C
0	-39.31201	-12.94623	-7.634094	-34.23138	-13.58246	-3.229065	-32.47504	-13.91547	-1.05011
19	-37.24817	-13.43109	-5.361145	-33.93628	-14.01575	-2.585815	-32.61066	-14.32562	0.7858276
39	-36.57556	-13.94574	-4.296326	-34.03247	-14.39734	-1.812988	-32.73877	-14.67438	1.454224

Table 14 – Carrier Frequency Drift ,Max(kHz), Amkor_Cu_2 #

	3.0 V			3.3 V			3.6 V		
Channel	-40˚C	25˚C	85˚C	-40˚C	25˚C	85˚C	-40˚C	25˚C	85˚C
0	2.438293	2.240662	1.765503	2.266357	2.057251	1.65741	2.488403	1.838745	1.672424
19	2.573853	2.296753	1.831787	2.353149	2.082153	1.669067	2.524963	2.319702	1.650513
39	2.702148	2.3078	1.15155	2.609924	2.064514	1.569946	3.112976	2.382141	1.760193

Table 15 – Maximum Drift Rate (kHz/uS), Max ,Amkor_Cu_2 #

	3.0 V			3.3 V			3.6 V		
Channel	-40˚C	25˚C	85˚C	-40˚C	25˚C	85˚C	-40˚C	25˚C	85˚C
0	1.577759	1.333618	1.504517	1.626587	1.391602	1.245117	1.455688	1.239014	1.464844
19	1.782227	1.446533	1.367188	1.831055	1.364136	1.51062	1.855469	1.519775	1.174927
39	1.669312	1.333618	1.464844	1.477051	1.400757	1.263428	2.008057	1.403809	1.651001

Table 16 – Carrier Frequency Offset Max (kHz), Amkor_Cu_3 #

	3.0 V	3.3 V	3.6 V

Channel	-40˚C	25˚C	85˚C	-40˚C	25˚C	85˚C	-40˚C	25˚C	85˚C
0	-11.80597	-4.911011	-14.53192	-7.385559	-6.394714	-11.20166	-5.722473	-7.093018	-9.267517
19	-9.745239	-5.671509	-13.47168	-6.763855	-6.831116	-10.62848	-5.473694	-7.501465	-8.807312
39	-8.564453	-6.329102	-12.58435	-6.369995	-7.264099	-10.12421	-5.341431	-7.791504	-8.498779

Table 17 – Carrier Frequency Drift ,Max(kHz), Amkor_Cu_3 #

	3.0 V			3.3 V			3.6 V		
Channel	-40˚C	25˚C	85˚C	-40˚C	25˚C	85˚C	-40˚C	25˚C	85˚C
0	2.416931	1.920654	1.602539	2.303894	1.706787	1.699036	2.508545	2.06311	1.949646
19	2.397034	1.604553	1.362732	2.662537	2.076843	1.44696	2.564697	1.953369	1.407104
39	2.802246	1.793396	1.509644	2.916443	2.168091	1.63855	2.804688	2.028931	1.819519

Table 18 – Maximum Drift Rate (kHz/uS), Max , Amkor_Cu_3 #

	3.0 V			3.3 V			3.6 V		
Channel	-40˚C	25˚C	85˚C	-40˚C	25˚C	85˚C	-40˚C	25˚C	85˚C
0	1.379395	1.260376	1.461792	1.837158	1.306152	1.275635	1.885986	1.422119	1.150513
19	1.818848	1.177979	1.33667	1.657104	1.275635	1.28479	1.904297	1.290894	1.293945
39	1.635742	1.480103	1.382446	1.809692	1.449585	1.553345	2.313232	1.446533	1.641846

6 DVT Results – Low Energy Receiver

6.1 Low Energy RX Sensitivity (RCV-LE/CA/01/C and RCV-LE/CA/02/C)

6.1.1 Purpose of Test:

This test measures the packet error rate (PER) of the DUT at a receive power of -70dBm. This test is performed at normal and extreme conditions.

6.1.2 Test Methodology:

The DUT is configured to be in direct RX test mode. The tester is configured to transmit low energy test packets at -70dBm as seen at the DUT's antenna port. The tester uses a "dirty transmitter," as specified in the Bluetooth Low Energy RF Test Specification.

6.1.3 Test Modes and Parameters

Operation Modes: Test packets with PRBS9 payload (37 octets)
RX Channels: 0, 19, 39
Temperatures: -40ºC, 25ºC, 85ºC
Supply Voltages: 3.0V, 3.3V, 3.6V

6.1.4 Bluetooth Low Energy Specification

Requirement: PER ≤ 30.8% with a minimum of 1500 packets transmitted by the tester.
More information can be found in the Bluetooth Low Energy RF Test Specification, sections 6.3.1-6.3.2 "RCV-LE/CA/01/C and RCV-LE/CA/02/C RX Sensitivity"

6.1.5 Results: PASS

Table 19 – Low Energy RX Sensitivity – PER (%), Amkor_Cu_1 #

	3.0 V			3.3 V			3.6 V		
Channel	-40˚C	25˚C	85˚C	-40˚C	25˚C	85˚C	-40˚C	25˚C	85˚C
0	0.1333333	0	0	0	0	6.67E-02	0	0	6.67E-02
19	0	0	0	0	0	0	0	0	0
39	0	0	0	0	0	0	0	0	0

Table 20 – Low Energy RX Sensitivity – PER (%), Amkor_Cu_2 #

	3.0 V			3.3 V			3.6 V		
Channel	-40˚C	25˚C	85˚C	-40˚C	25˚C	85˚C	-40˚C	25˚C	85˚C
0	0	0	0	6.67E-02	0	6.67E-02	0	0	0
19	0	0	0	0	0	0	0	0	0
39	0	0	0	0	0	0	0	0	0

Table 21 – Low Energy RX Sensitivity – PER (%), Amkor_Cu_3 #

	3.0 V			3.3 V			3.6 V		
Channel	-40˚C	25˚C	85˚C	-40˚C	25˚C	85˚C	-40˚C	25˚C	85˚C
0	0	0	0	0	0	0	0	0	0
19	0	0	0	0	0	0	0	0	0
39	0	0	0	0	0	0	0	0	0

6.2 Low Energy C/I and Receiver Selectivity Performance (RCV-LE/CA/03/C)

6.2.1 Purpose of Test:

This test measures the packet error rate (PER) of the DUT with the presence of a co-channel and adjacent channel interfering signal. This test is performed at normal conditions.

6.2.2 Test Methodology:

The DUT is configured to be in direct RX test mode. The tester is configured to transmit low energy test packets at -67dBm, as seen at the DUT's antenna port. The interfering signal is modulated with a GFSK modulation, with PRBS as the payload, and transmits at the following power levels:

- Co-channel: -88dBm (C/I = 21dB)
- 1MHz adjacent: -82dBm (C/I = 15dB)
- 2MHz adjacent: -50dBm (C/I = -17dB)
- 3MHz adjacent: -40dBm (C/I = -27dB)

6.2.3 Test Modes and Parameters

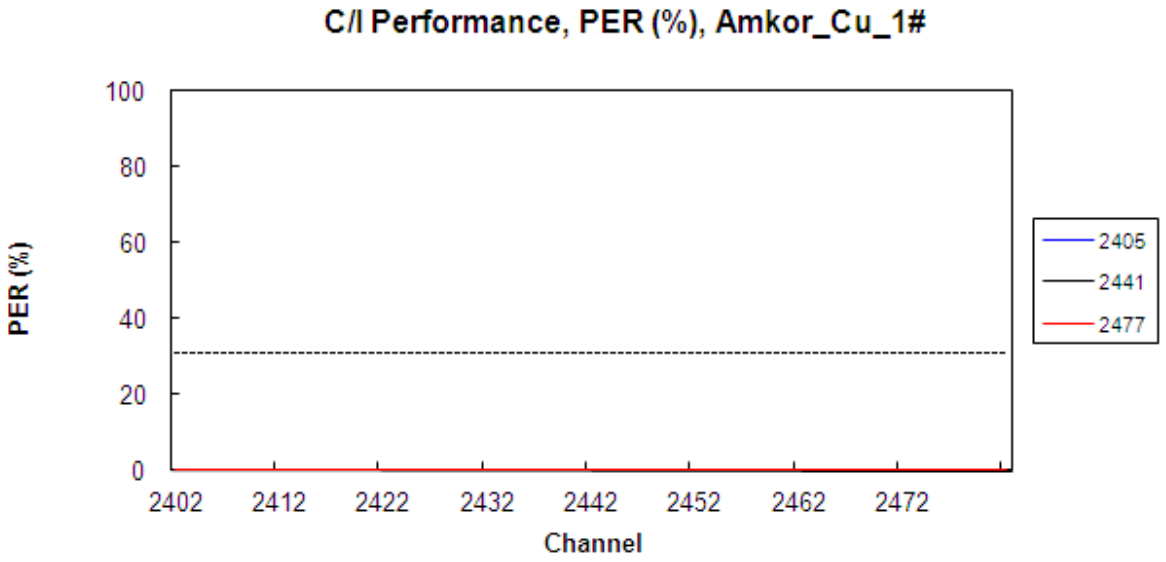
Operation Modes: Test packets with PRBS9 payload (37 octets)
RX Channels: 2, 19, 37
Temperatures: 25ºC
Supply Voltages: 3.3V

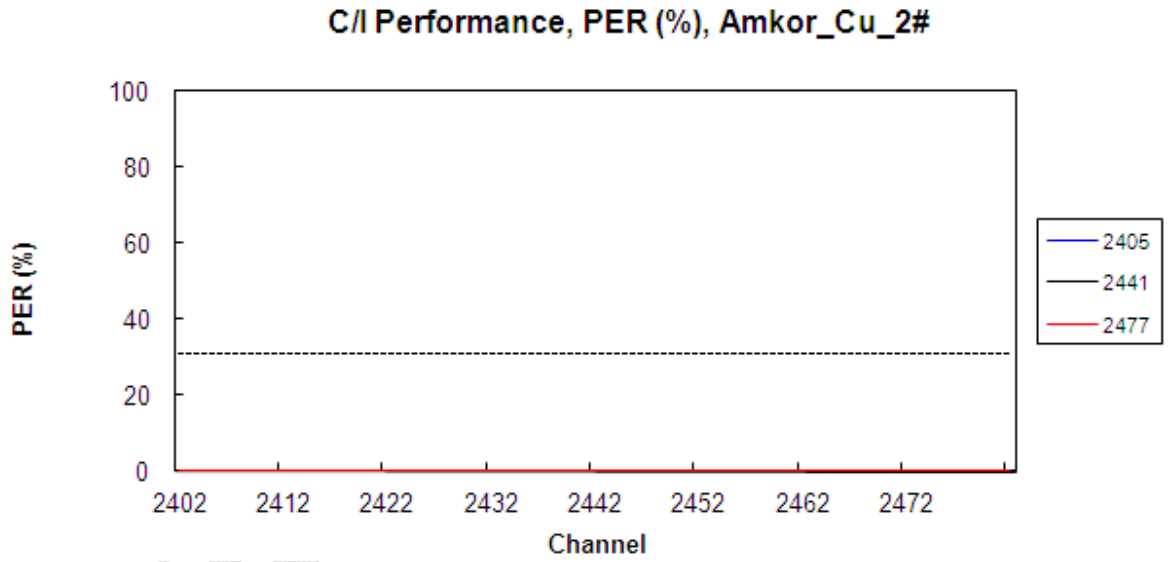
6.2.4 Bluetooth Low Energy Specification

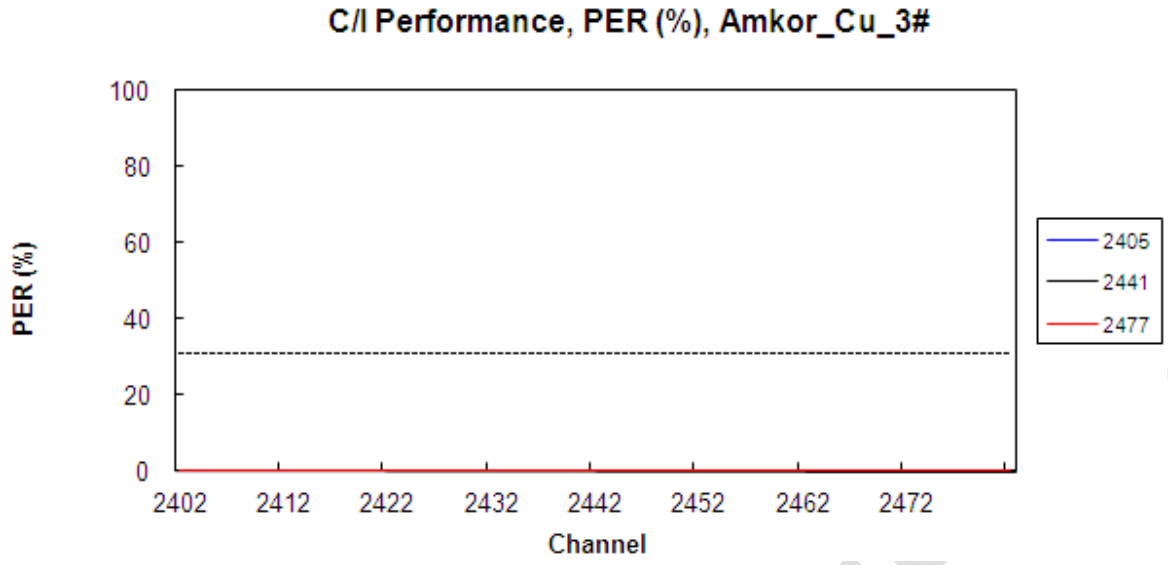
Requirement: PER ≤ 30.8% with a minimum of 1500 packets transmitted by the tester. There can be up to 5 frequencies at which the PER is greater than 30.8%, at which case, the PER must be less than 30.8% at a C/I of -17dB. More information can be found in the Bluetooth Low Energy RF Test Specification, section 6.3.3 "RCV-LE/CA/03/C C/I Performance"

6.2.5 Results: PASS

Black dotted line is the limit, and the 3 colored curves represent the 3 RX channels at which this test is performed.


C/I Performance, PER (%), Amkor_Cu_1#
PER (%)
100
80
60
40
20
0
2402
2412
2422
2432
2442
2452
2462
2472
Channel
2405
2441
2477


C/I Performance, PER (%), Amkor_Cu_2#
PER (%)
100
80
60
40
20
0
2402
2412
2422
2432
2442
2452
2462
2472
Channel
2405
2441
2477



6.3 Low Energy Blocking Performance (RCV-LE/CA/04/C)

6.3.1 Purpose of Test:

This test measures the packet error rate (PER) of the DUT with the presence of interfering signals from 30MHz to 12.75GHz. This test is performed at normal conditions.

6.3.2 Test Methodology:

The DUT is configured to be in direct RX test mode. The tester is configured to transmit low energy test packets to the DUT. The interfering signal is an unmodulated signal generated by the signal generators.

6.3.3 Test Modes and Parameters

Operation Modes: Test packets with PRBS9 payload (37 octets)
RX Channels: 12
Temperatures: 25ºC
Supply Voltages: 3.3V

6.3.4 Bluetooth Low Energy Specification

Requirement: PER ≤ 30.8% with a minimum of 1500 packets transmitted by the tester. For the "Regular Test," the interfering signal power levels are defined as follows:

Frequency	Power Level
30MHz-2GHz, 3GHz-12.75GHz	-30dBm
2003MHz-2399MHz, 2484MHz-2997MHz	-35dBm

There can be up to 10 exceptions (frequencies with PER > 30.8%). Of the 10 exceptions, up to 3 frequencies can fail the relaxed requirement of -50dBm for the blocker power. More information can be found in the Bluetooth Low Energy RF Test Specification, section 6.3.4 "RCV-LE/CA/04/C Blocking Performance"

6.3.5 Results: PASS

The PER is zero at all frequencies except at the following frequencies:

Table 22–Blocking Performance PER for Frequencies with non-zero PER, Amkor_Cu_1 #

No fail point.

Frequency (MHz)	Regular Test PER (%)	Relaxed Test PER (%)

Table 23 – Blocking Performance PER for Frequencies with non-zero PER, Amkor_Cu_2 #

No fail point.

Frequency (MHz)	Regular Test PER (%)	Relaxed Test PER (%)

Table 24 – Blocking Performance PER for Frequencies with non-zero PER, Amkor_Cu_3 #

No fail point.

Frequency (MHz)	Regular Test PER (%)	Relaxed Test PER (%)

6.4 Low Energy Intermodulation Performance (RCV-LE/CA/05/C)

6.4.1 Purpose of Test:

This test measures the packet error rate (PER) of the DUT with the presence of a pair of interfering signals. This test is performed at normal conditions.

6.4.2 Test Methodology:

The DUT is configured to be in direct RX test mode. The tester is configured to transmit low energy test packets to the DUT. Two interfering signals are generated by the signal generators, and the PER is measured.

6.4.3 Test Modes and Parameters

Operation Modes: Test packets with PRBS9 payload (37 octets)
RX Channels: 0, 19, 39
Temperatures: 25ºC
Supply Voltages: 3.3V

6.4.4 Bluetooth Low Energy Specification

Requirement: PER ≤ 30.8% with a minimum of 1500 packets transmitted by the tester. The GFSK modulated signal f1 and the unmodulated single tone signal f2 are set at 3MHz, 4MHz, and 5MHz apart. More information can be found in the Bluetooth Low Energy RF Test Specification, section 6.3.5 "RCV-LE/CA/05/C Intermodulation Performance"

6.4.5 Results: PASS

Table 25 – Inter modulation Performance, Amkor_Cu_1 #

RX Frequency: 2402 MHz			RX Frequency: 2440 MHz			RX Frequency: 2480 MHz		
f1 (MHz)	f2 (MHz)	PER (%)	f1 (MHz)	f2 (MHz)	PER (%)	f1(MHz)	f2 (MHz)	PER (%)
2405	2408	0	2444	2447	0.0666667	2483	2486	0
2408	2405	0	2447	2444	0	2486	2483	0
2406	2410	0	2445	2449	0	2484	2488	0
2410	2406	0	2449	2445	0	2488	2484	0
2407	2412	0.1333333	2446	2451	0	2485	2490	0
2412	2407	0.2	2451	2446	0.0666667	2490	2485	0
2396	2399	0	2435	2438	0	2474	2477	0
2399	2396	0	2438	2435	0	2477	2474	0
2394	2398	0	2433	2437	0	2472	2476	0
2398	2394	0	2437	2433	0	2476	2472	0
2392	2397	0	2431	2436	0	2470	2475	0
2397	2392	0	2436	2431	0	2475	2470	0

Table 26 – Inter modulation Performance, Amkor_Cu_2 #

RX Frequency: 2402 MHz	RX Frequency: 2440 MHz	RX Frequency: 2480 MHz

f1 (MHz)	f2 (MHz)	PER (%)	f1 (MHz)	f2 (MHz)	PER (%)	f1(MHz)	f2 (MHz)	PER (%)
2405	2408	0.0666667	2444	2447	0	2483	2486	0
2408	2405	0	2447	2444	0	2486	2483	0
2406	2410	0	2445	2449	0	2484	2488	0
2410	2406	0	2449	2445	0	2488	2484	0
2407	2412	0.0666667	2446	2451	0.0666667	2485	2490	0.0666667
2412	2407	0	2451	2446	0.0666667	2490	2485	0.1333333
2396	2399	0	2435	2438	0	2474	2477	0
2399	2396	0	2438	2435	0	2477	2474	0
2394	2398	0	2433	2437	0.0666667	2472	2476	0
2398	2394	0	2437	2433	0	2476	2472	0
2392	2397	0	2431	2436	0	2470	2475	0
2397	2392	0	2436	2431	0	2475	2470	0

Table 27 – Inter modulation Performance, Amkor_Cu_3 #

RX Frequency: 2402 MHz			RX Frequency: 2440 MHz			RX Frequency: 2480 MHz		
f1 (MHz)	f2 (MHz)	PER (%)	f1 (MHz)	f2 (MHz)	PER (%)	f1(MHz)	f2 (MHz)	PER (%)
2405	2408	0.133333	2444	2447	0	2483	2486	0
2408	2405	0	2447	2444	0	2486	2483	0
2406	2410	0	2445	2449	0	2484	2488	0
2410	2406	0	2449	2445	0	2488	2484	0
2407	2412	0.066667	2446	2451	0.133333	2485	2490	0.133333
2412	2407	0	2451	2446	0.066667	2490	2485	0.133333
2396	2399	0	2435	2438	0	2474	2477	0
2399	2396	0	2438	2435	0	2477	2474	0
2394	2398	0	2433	2437	0	2472	2476	0
2398	2394	0	2437	2433	0	2476	2472	0
2392	2397	0	2431	2436	0	2470	2475	0
2397	2392	0	2436	2431	0	2475	2470	0

6.5 Low Energy Maximum Input Level (RCV-LE/CA/06/C)

6.5.1 Purpose of Test:

This test measures the packet error rate (PER) of the DUT at a maximum input level. This test is performed at normal conditions.

6.5.2 Test Methodology:

The DUT is configured to be in direct RX test mode. The tester is configured to transmit low energy test packets to the DUT at -10dBm, and the PER is measured.

6.5.3 Test Modes and Parameters

Operation Modes: Test packets with PRBS9 payload (37 octets)
RX Channels: 0, 19, 39
Temperatures: 25ºC
Supply Voltages: 3.3V

6.5.4 Bluetooth Low Energy Specification

Requirement: PER ≤ 30.8% with a minimum of 1500 packets transmitted by the tester. More information can be found in the Bluetooth Low Energy RF Test Specification, section 6.3.6 "RCV-LE/CA/06/C Maximum Input Level"

6.5.5 Results: PASS

Table 28 – Maximum Input Level PER (%),Amkor_Cu_1 #

Channel	PER (%)
0	0
19	0
39	0

Table 29 – Maximum Input Level PER (%),Amkor_Cu_2 #

Channel	PER (%)
0	0
19	0
39	0

Table 30 – Maximum Input Level PER (%),Amkor_Cu_3 #

Channel	PER (%)
0	0
19	0
39	0

6.6 Low Energy PER Report Integrity (RCV-LE/CA/07/C)

6.6.1 Purpose of Test:

This test verifies that the packet error rate (PER) report mechanism of the DUT reports the correct number of received packets to the tester. This test is performed at normal conditions.

6.6.2 Test Methodology:

The DUT is configured to be in direct RX test mode. The tester is configured to transmit low energy test packets to the DUT with every alternating packet transmit with an intentionally corrupted CRC value, and the PER is measured.

6.6.3 Test Modes and Parameters

Operation Modes: Test packets with PRBS9 payload (37 octets)
RX Channels: 19
Temperatures: 25ºC
Supply Voltages: 3.3V

6.6.4 Bluetooth Low Energy Specification

Requirement: 50% ≤ PER ≤ 65.4% with 100 to 1500 packets transmitted by the tester. Three PER measurements are made. More information can be found in the Bluetooth Low Energy RF Test Specification, section 6.3.7 "RCV-LE/CA/07/C PER Report Integrity"

6.6.5 Results: PASS

Table 31 – PER Report Integrity PER (%), Amkor_Cu_1 #

Channel	PER (%)	PER (%)	PER (%)
19	50	50	50

Table 32 – PER Report Integrity PER (%), Amkor_Cu_2 #

Channel	PER (%)	PER (%)	PER (%)
19	50	50	50

Table 33 – PER Report Integrity PER (%), Amkor_Cu_3 #

Channel	PER (%)	PER (%)	PER (%)
19	50	50	50