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BlueCore® CSR8675 BGA

Production Information

Performance Specification

Issue 1

Document History

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1 Introduction

This document describes characterisation data for a production status BlueCore® CSR8675 BGA IC. Read this in conjunction with the *CSR8675 BGA Data Sheet*.

This document includes:

- RF characterisation for basic rate, EDR and Bluetooth low energy based on Bluetooth v4.1 test specification
- RF typical performance graphs for basic rate, EDR and Bluetooth low energy
- Audio typical performance graphs for stereo codec ADC and DAC

1.1 Conditions

The CSR8675 BGA is designed to meet the Bluetooth v4.1 specification when used in a suitable circuit between -40°C and 85°C. The transmitter output is designed to be unconditionally stable over a guaranteed temperature range.

Results were obtained using CSR's evaluation circuit.

All Bluetooth results are referenced to the output of the CSR8675 BGA.

All Bluetooth measurement methods are in accordance with Bluetooth v4.1 test specification.

2 Radio Characteristics: Basic Data Rate

2.1 Transmitter Performance

2.1.1 Temperature 20°C

RF Characteristics, VDD = 1.35V		Notes	Min	Typ	Max	Bluetooth Specification	Unit
Maximum RF transmit power		(1) (2) (3)	6	10	-	-6 to 4	dBm
RF power variation over temperature range with compensation enabled		(4)	-	±0.5	-	-	dB
RF power variation over temperature range with compensation disabled		(4)	-	±1.5	-	-	dB
20dB bandwidth for modulated carrier		-	-	925	1000	≤1000	kHz
ACP	$F = F_0 \pm 2MHz$	(5) (6)	-	-23	-20	≤-20	dBm
	$F = F_0 \pm 3MHz$	(5) (6)	-	-32	-28	≤-40	dBm
	$F = F_0 \pm > 3MHz$	(5) (6)	-	-65	-40	≤-40	dBm
Δf_{1avg} maximum modulation		-	140	165	175	140	kHz
Δf_{2max} minimum modulation		-	115	137	-	≥115	kHz
$\Delta f_{2avg}/\Delta f_{1avg}$		-	0.8	0.9	-	≥0.80	-
ICFT		(7)	-75	15	75	±75	kHz
Drift rate		-	-	7	20	≤20	kHz/50µs
Drift (single slot packet)		-	-	15	25	≤25	kHz
Drift (five slot packet)		-	-	15	40	≤40	kHz
2nd harmonic content		(8)	-	-40	-	≤-30	dBm
3rd harmonic content		(8)	-	-55	-	≤-30	dBm

Table 2.1: Basic Rate Transmitter Performance at 20°C

Note:

For Table 2.1:

(1) The firmware maintains the transmit power within Bluetooth v4.1 specification limits.

(2) Measurement made using appropriate PS Key settings.

(3) Class 2 RF transmit power range, Bluetooth v4.1 specification.

(4) Parameters depend on matching circuit used, and behaviour over temperature. These parameters may be beyond CSR's direct control.

(5) Measured at F_0 = 2441MHz.

(6) CSR8675 BGA guaranteed to meet ACP performance in Bluetooth v4.1 specification. Exceptions in 3 bands permitted in Bluetooth v4.1 test specification. For exceptions $P_{TX} \leq$ -20dBm.

(7) Ignores any frequency error in the reference.

(8) Filter will attenuate the harmonics.

2.1.2 Emissions at 20°C

Emissions, VDD = 1.35V	Frequency (GHz)	Notes	Min	Typ	Max	Cellular Band	Unit
Emitted power in cellular bands measured at the output of the CSR8675 BGA. Output power ≤ 10dBm.	0.746 - 0.764	(1)	-	-155	-	CDMA700	dBm / Hz
	0.869 - 0.894	(2)	-	-130	-	GSM 850	
	0.869 - 0.894	(1)	-	-135	-	CDMA 800	
	0.925 - 0.960	(2)	-	-150	-	GSM 900	
	1.570 - 1.580	(3)	-	-142	-	GPS	
	1.805 - 1.880	(2)	-	-135	-	GSM 1800	
	1.800 – 1.880	(2)	-	-145	-	WCDMA1800	
	1.930 - 1.990	(1)	-	-140	-	GSM 1900	
	1.910 - 1.990	(1)	-	-145	-	W-CDMA 1900	
	2.110 - 2.170	(4)	-	-130	-	W-CDMA 2100	

Table 2.2: Basic Rate Emissions Performance at 20°C

Note:

For Table 2.2:

(1) Maximum of average burst power in 1.2MHz bandwidth normalised to 1Hz. Hopping on.
(2) Maximum of average burst power in 200kHz bandwidth normalised to 1Hz. Hopping on.
(3) Maximum of average burst power in 1MHz bandwidth normalised to 1Hz. Hopping on.
(4) Maximum of average burst power in 5MHz bandwidth normalised to 1Hz. Hopping on.

2.1.3 Temperature -40°C

RF Characteristics, VDD = 1.35V		Notes	Min	Typ	Max	Bluetooth Specification	Unit
Maximum RF transmit power		(1) (2) (3)	5	9	-	-6 to 4	dBm
20dB bandwidth for modulated carrier		-	-	925	1000	≤1000	kHz
ACP	$F = F_0 \pm 2MHz$	(4)(5)	-	-23	-20	≤-20	dBm
	$F = F_0 \pm 3MHz$	(4)(5)	-	-30	-26	≤-40	dBm
Δf_{1avg} maximum modulation		-	140	165	175	140	kHz
Δf_{2max} minimum modulation		-	115	140	-	≥115	kHz
$\Delta f_{2avg}/\Delta f_{1avg}$		-	0.8	0.9	-	≥0.80	-
ICFT		(6)	-75	15	75	±75	kHz
Drift rate		-	-	8	20	≤20	kHz/50µs
Drift (single slot packet)		-	-	12	25	≤25	kHz
Drift (five slot packet)		-	-	12	40	≤40	kHz

Table 2.3: Basic Rate Transmitter Performance at -40°C

Note:

For Table 2.3:

(1) The firmware maintains the transmit power within Bluetooth v4.1 specification limits.

(2) Measurement made using appropriate PS Key settings.

(3) Class 2 RF transmit power range, Bluetooth v4.1 specification.

(4) Measured at F_0 = 2441MHz.

(5) CSR8675 BGA guaranteed to meet ACP performance in Bluetooth v4.1 specification. Exceptions in 3 bands permitted in Bluetooth v4.1 test specification. For exceptions P_{TX} ≤ -20dBm.

(6) Ignores any frequency error in the reference.

2.1.4 Temperature 85°C

RF Characteristics, VDD = 1.35V		Notes	Min	Typ	Max	Bluetooth Specification	Unit
Maximum RF transmit power		(1) (2)(3)	5	9	-	-6 to 4	dBm
20dB bandwidth for modulated carrier		-	-	925	1000	≤1000	kHz
ACP	$F = F_0 \pm 2MHz$	(4)(5)	-	-30	-20	≤-20	dBm
	$F = F_0 \pm 3MHz$	(4)(5)	-	-38	-34	≤-40	dBm
Δf_{1avg} maximum modulation		-	140	165	175	140	kHz
Δf_{2max} minimum modulation		-	115	137	-	≥115	kHz
$\Delta f_{2avg}/\Delta f_{1avg}$		-	0.8	0.9	-	≥0.80	-
ICFT		(6)	-75	15	75	±75	kHz
Drift rate		-	-	6	20	≤20	kHz/50µs
Drift (single slot packet)		-	-	12	25	≤25	kHz
Drift (five slot packet)		-	-	12	40	≤40	kHz

Table 2.4: Basic Rate Transmitter Performance at 85°C

Note:

For Table 2.4:

(1) The firmware maintains the transmit power within Bluetooth v4.1 specification limits.

(2) Measurement made using appropriate PS Key settings.

(3) Class 2 RF transmit power range, Bluetooth v4.1 specification.

(4) Measured at F_0 = 2441MHz.

(5) CSR8675 BGA guaranteed to meet ACP performance in Bluetooth v4.1 specification. Exceptions in 3 bands permitted in Bluetooth v4.1 test specification. For exceptions $P_{TX} \le$ -20dBm.

(6) Ignores any frequency error in the reference.

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2.2 Receiver Performance

2.2.1 Temperature 20°C

RF Characteristics, VDD = 1.35V	Frequency (GHz)	Notes	Min	Typ	Max	Bluetooth Specification	Unit
Sensitivity at 0.1% BER for all basic rate packet types	2.402	-	-	-87	-83	≤-70	dBm
	2.441	-	-	-90	-86		
	2.48	-	-	-90	-86		
Maximum received signal at 0.1% BER		-	-20	>-10	-	≥-20	dBm
Continuous power required to block Bluetooth reception (for input power of -67dBm with 0.1% BER) measured at the output of the CSR8675 BGA	0.030 - 2.000	-	-10	1	-	-10	dBm
	2.000 - 2.400	-	-27	-7	-	-27	
	2.500 - 3.000	-	-27	-6	-	-27	
	3.000 - 12.75	-	-10	3	-	-10	
C/I co-channel		(1) (2) (3)	-	5	11	≤11	dB
Adjacent channel selectivity C/I	$F = F_0 + 1MHz$	(1) (2) (3)	-	-5	0	≤0	dB
	$F = F_0 - 1MHz$	(1) (2) (3)	-	-3	0	≤0	dB
	$F = F_0 + 2MHz$	(1) (2) (3)	-	-35	-30	≤-30	dB
	$F = F_0 - 2MHz$	(1) (2) (3)	-	-25	-20	≤-20	dB
	$F = F_0 + 3MHz$	(1) (2) (3)	-	-45	-40	≤-40	dB
	$F = F_0 - 5MHz$	(1) (2) (3)	-	-45	-40	≤-40	dB
	$F = F_{Image}$	(1) (2) (3)	-	-20	-9	≤-9	dB
Maximum level of intermodulation interferers		(4)	-39	-23	-	≥-39	dBm
Spurious output level		(5)	-	-155	-	-	dBm/Hz

Table 2.5: Basic Rate Receiver Performance at 20°C

Note:

For Table 2.5:

(1) CSR8675 BGA is guaranteed to meet the C/I performance as specified by the Bluetooth v4.1 specification.

(2) Measured at F_0 = 2441MHz.

(3) $F_{Image} = F_0$ + 3MHz. However, depending on crystal frequency and channel number, the image may switch to the opposite side of the carrier. When this occurs, $F_{Image} = F_0$ - 3MHz and the offsets in the table equations associated with C/I are also reversed.

(4) Measured at $f_1 - f_2$ = 5MHz. Measurement is performed in accordance with Bluetooth RF test RCV/CA/05/c, i.e. wanted signal at -64dBm.

(5) Measured at unbalanced port of the balun. Integrated in 100kHz bandwidth and normalised to 1Hz. Actual figure is typically -155dBm/Hz except for peaks of -77dBm at 1600MHz and -77dBm in-band at 2.4GHz.

2.2.2 Temperature -40°C

RF Characteristics, VDD = 1.35V	Frequency (GHz)	Notes	Min	Typ	Max	Bluetooth Specification	Unit
Sensitivity at 0.1% BER for all basic rate packet types	2.402	-	-	-88	-84	≤-70	dBm
	2.441	-	-	-90	-86		
	2.48	-	-	-90	-86		
Maximum received signal at 0.1% BER		-	-20	>-10	-	≥-20	dBm

Table 2.6: Basic Rate Receiver Performance at -40°C

2.2.3 Temperature 85°C

RF Characteristics, VDD = 1.35V	Frequency (GHz)	Notes	Min	Typ	Max	Bluetooth Specification	Unit
Sensitivity at 0.1% BER for all basic rate packet types	2.402	-	-	-86	-82	≤-70	dBm
	2.441	-	-	-88	-84		
	2.48	-	-	-88	-84		
Maximum received signal at 0.1% BER		-	-20	>-10	-	≥-20	dBm

Table 2.7: Basic Rate Receiver Performance at 85°C

3 Radio Characteristics: Enhanced Data Rate

3.1 Transmitter Performance

3.1.1 Temperature 20°C

RF Characteristics, VDD = 1.35V		Notes	Min	Typ	Max	Bluetooth Specification	Unit
Relative transmit power		-	-4	-1	1	-4 to 1	dB
π/4 DQPSK max carrier frequency stability	$\| \omega_o \|$	-	-	1.5	10	≤10 for all blocks	kHz
	$\| \omega_i \|$	-	-	4	75	≤75 for all packets	kHz
	$\| \omega_o + \omega_i \|$	-	-	4	75	≤75 for all blocks	kHz
8DPSK max carrier frequency stability	$\| \omega_o \|$	-	-	1.5	10	≤10 for all blocks	kHz
	$\| \omega_i \|$	-	-	4	75	≤75 for all packets	kHz
	$\| \omega_o + \omega_i \|$	-	-	4	75	≤75 for all blocks	kHz
π/4 DQPSK modulation accuracy	RMS DEVM	(1)	-	8	20	≤20	%
	99% DEVM	(1)	-	15	30	≤30	%
	Peak DEVM	(1)	-	17	35	≤35	%
8DPSK modulation accuracy	RMS DEVM	(1)	-	6	13	≤13	%
	99% DEVM	(1)	-	12	20	≤20	%
	Peak DEVM	(1)	-	17	25	≤25	%
In-band spurious emissions	$F > F_0 + 3MHz$	(2)(3)	-	-58	-40	≤-40	dBm
	$F < F_0 - 3MHz$	(2)(3)	-	-58	-40	≤-40	dBm
	$F = F_0 - 3MHz$	(2)(3)	-	-28	-24	≤-40	dBm
In-band spurious emissions	$F = F_0 - 2MHz$	(2)(3)	-	-22	-20	≤-20	dBm
	$F = F_0 - 1MHz$	(2)(3)	-	-32	-26	≤-26	dB
	$F = F_0 + 1MHz$	(2)(3)	-	-32	-26	≤-26	dB
	$F = F_0 + 2MHz$	(2)(3)	-	-25	-20	≤-20	dBm
	$F = F_0 + 3MHz$	(2)(3)	-	-42	-40	≤-40	dBm
EDR differential phase encoding		-	99	No Errors	-	≥99	%

Table 3.1: EDR Transmitter Performance at 20°C

Note:

For Table 3.1:

(1) Modulation accuracy utilises differential error vector magnitude with tracking of the carrier frequency drift.

(2) Bluetooth specification values are for 8DPSK.

(3) CSR8675 BGA guaranteed to meet in-band spurious performance in Bluetooth v4.1 specification. Exceptions in 3 bands permitted in Bluetooth v4.1 test specification. For exceptions P_{TX} ≤ -20dBm.

3.1.2 Temperature -40°C

RF Characteristics, VDD = 1.35V		Notes	Min	Typ	Max	Bluetooth Specification	Unit
Relative transmit power		-	-4	-1	1	-4 to 1	dB
π/4 DQPSK max carrier frequency stability	$\| \omega_o \|$	-	-	2	10	≤10 for all blocks	kHz
	$\| \omega_i \|$	-	-	6	75	≤75 for all packets	kHz
	$\| \omega_o + \omega_i \|$	-	-	10	75	≤75 for all blocks	kHz
8DPSK max carrier frequency stability	$\| \omega_o \|$	-	-	2	10	≤10 for all blocks	kHz
	$\| \omega_i \|$	-	-	6	75	≤75 for all packets	kHz
	$\| \omega_o + \omega_i \|$	-	-	10	75	≤75 for all blocks	kHz
π/4 DQPSK modulation accuracy	RMS DEVM	(1)	-	8	20	≤20	%
	99% DEVM	(1)	-	12	30	≤30	%
	Peak DEVM	(1)	-	20	35	≤35	%
8DPSK modulation accuracy	RMS DEVM	(1)	-	6	13	≤13	%
	99% DEVM	(1)	-	12	20	≤20	%
	Peak DEVM	(1)	-	20	25	≤25	%
In-band spurious emissions	$F > F_0 + 3MHz$	(2)(3)	-	-58	-40	≤-40	dBm
	$F < F_0 - 3MHz$	(2)(3)	-	-58	-40	≤-40	dBm
	$F = F_0 - 3MHz$	(2)(3)	-	-27	-23	≤-40	dBm
	$F = F_0 - 2MHz$	(2)(3)	-	-21	-20	≤-20	dBm
	$F = F_0 - 1MHz$	(2)(3)	-	-32	-26	≤-26	dB
	$F = F_0 + 1MHz$	(2)(3)	-	-34	-26	≤-26	dB
	$F = F_0 + 2MHz$	(2)(3)	-	-30	-20	≤-20	dBm
	$F = F_0 + 3MHz$	(2)(3)	-	-42	-40	≤-40	dBm
EDR differential phase encoding		-	99	No Errors	-	≥99	%

Table 3.2: EDR Transmitter Performance at -40°C

Note:

For Table 3.2:

(1) Modulation accuracy utilises differential error vector magnitude with tracking of the carrier frequency drift.

(2) Bluetooth specification values are for 8DPSK.

(3) CSR8675 BGA guaranteed to meet in-band spurious performance in Bluetooth v4.1 specification. Exceptions in 3 bands permitted in Bluetooth v4.1 test specification. For exceptions $P_{TX} \leq$ -20dBm.

3.1.3 Temperature 85°C

RF Characteristics, VDD = 1.35V		Notes	Min	Typ	Max	Bluetooth Specification	Unit
Relative transmit power		-	-4	-1	1	-4 to 1	dB
π/4 DQPSK max carrier frequency stability	$\lvert \omega_o \rvert$	-	-	1.5	10	≤10 for all blocks	kHz
	$\lvert \omega_i \rvert$	-	-	4	75	≤75 for all packets	kHz
	$\lvert \omega_o + \omega_i \rvert$	-	-	4	75	≤75 for all blocks	kHz
8DPSK max carrier frequency stability	$\lvert \omega_o \rvert$	-	-	1.2	10	≤10 for all blocks	kHz
	$\lvert \omega_i \rvert$	-	-	4	75	≤75 for all packets	kHz
	$\lvert \omega_o + \omega_i \rvert$	-	-	4	75	≤75 for all blocks	kHz
π/4 DQPSK modulation accuracy	RMS DEVM	(1)	-	6	20	≤20	%
	99% DEVM	(1)	-	12	30	≤30	%
	Peak DEVM	(1)	-	17	35	≤35	%
8DPSK modulation accuracy	RMS DEVM	(1)	-	6	13	≤13	%
	99% DEVM	(1)	-	11	20	≤20	%
	Peak DEVM	(1)	-	17	25	≤25	%
In-band spurious emissions	$F > F_0 + 3MHz$	(2)(3)	-	-60	-40	≤-40	dBm
	$F < F_0 - 3MHz$	(2)(3)	-	-60	-40	≤-40	dBm
	$F = F_0 - 3MHz$	(2)(3)	-	-35	-31	≤-40	dBm
	$F = F_0 - 2MHz$	(2)(3)	-	-26	-20	≤-20	dBm
	$F = F_0 - 1MHz$	(2)(3)	-	-35	-26	≤-26	dB
	$F = F_0 + 1MHz$	(2)(3)	-	-35	-26	≤-26	dB
	$F = F_0 + 2MHz$	(2)(3)	-	-30	-20	≤-20	dBm
	$F = F_0 + 3MHz$	(2)(3)	-	-46	-40	≤-40	dBm
EDR differential phase encoding		-	99	No Errors	-	≥99	%

Table 3.3: EDR Transmitter Performance at 85°C

Note:

For Table 3.3:

(1) Modulation accuracy utilises differential error vector magnitude with tracking of the carrier frequency drift.

(2) Bluetooth specification values are for 8DPSK.

(3) CSR8675 BGA guaranteed to meet in-band spurious performance in Bluetooth v4.1 specification. Exceptions in 3 bands permitted in Bluetooth v4.1 test specification. For exceptions $P_{TX} \leq -20dBm$.

3.2 Receiver Performance

3.2.1 Temperature 20°C

RF Characteristics, VDD = 1.35V		Modulation	Notes	Min	Typ	Max	Bluetooth Specification	Unit
Sensitivity at 0.01% BER	Ch 0	π/4 DQPSK	(1)	-	-88	-70	≤-70	dBm
	Ch 39	π/4 DQPSK	(1)	-	-92	-70		
	Ch 78	π/4 DQPSK	(1)	-	-92	-70		
	Ch 0	8DPSK	(1)	-	-80	-70	≤-70	dBm
	Ch 39	8DPSK	(1)	-	-84	-70		
	Ch 78	8DPSK	(1)	-	-84	-70		
Maximum received signal at 0.1% BER		π/4 DQPSK	-	-20	>-8	-	≥-20	dBm
		8DPSK	-	-20	>-10	-	≥-20	dBm
C/I co-channel at 0.1% BER		π/4 DQPSK	(2) (3)	-	10	13	≤13	dB
		8DPSK	(2) (3)	-	17	21	≤21	dB
Adjacent channel selectivity C/I	$F = F_0 + 1MHz$	π/4 DQPSK	(2) (3)	-	-10	0	≤0	dB
		8DPSK	(2) (3)	-	-5	5	≤5	dB
	$F = F_0 - 1MHz$	π/4 DQPSK	(2) (3)	-	-5	0	≤0	dB
		8DPSK	(2) (3)	-	-2	5	≤5	dB
	$F = F_0 + 2MHz$	π/4 DQPSK	(2) (3)	-	-40	-30	≤-30	dB
		8DPSK	(2) (3)	-	-28	-25	≤-25	dB
	$F = F_0 - 2MHz$	π/4 DQPSK	(2) (3)	-	-22	-20	≤-20	dB
		8DPSK	(2) (3)	-	-22	-13	≤-13	dB
	$F = F_0 + 3MHz$	π/4 DQPSK	(2) (3)	-	-50	-40	≤-40	dB
		8DPSK	(2) (3)	-	-40	-33	≤-33	dB
	$F = F_0 - 5MHz$	π/4 DQPSK	(2) (3)	-	-50	-40	≤-40	dB
		8DPSK	(2) (3)	-	-45	-33	≤-33	dB
	$F = F_{Image}$	π/4 DQPSK	(2) (3)	-	-20	-7	≤-7	dB
		8DPSK	(2) (3)	-	-10	0	≤0	dB

Table 3.4: EDR Receiver Performance at 20°C

Note:

For Table 3.4:

(1) Dirty transmitter used.

(2) CSR8675 BGA is guaranteed to meet the C/I performance as specified by the Bluetooth v4.1 specification.

(3) Measured at F_0 = 2441MHz. However, depending on crystal frequency and channel number, the image may switch to the opposite side of the carrier. When this occurs, F_{Image} = F_0 - 3MHz and the offsets in the table equations associated with C/I are also reversed.

3.2.2 Temperature -40°C

RF Characteristics, VDD = 1.35V		Modulation	Notes	Min	Typ	Max	Bluetooth Specification	Unit
Sensitivity at 0.01% BER	Ch 0	π/4 DQPSK	(1)	-	-88	-70	≤-70	dBm
	Ch 39	π/4 DQPSK	(1)	-	-92	-70		
	Ch 78	π/4 DQPSK	(1)	-	-93	-70		
	Ch 0	8DPSK	(1)	-	-82	-70	≤-70	dBm
	Ch 39	8DPSK	(1)	-	-84	-70		
	Ch 78	8DPSK	(1)	-	-84	-70		
Maximum received signal at 0.1% BER		π/4 DQPSK	-	-20	>-8	-	≥-20	dBm
		8DPSK	-	-20	>-10	-	≥-20	dBm

Table 3.5: EDR Receiver Performance at -40°C

Note:

For Table 3.4:

(1) Dirty transmitter used.

3.2.3 Temperature 85°C

RF Characteristics, VDD = 1.35V		Modulation	Notes	Min	Typ	Max	Bluetooth Specification	Unit
Sensitivity at 0.01% BER	Ch 0	π/4 DQPSK	(1)	-	-88	-70	≤-70	dBm
	Ch 39	π/4 DQPSK	(1)	-	-91	-70		
	Ch 78	π/4 DQPSK	(1)	-	-91	-70		
	Ch 0	8DPSK	(1)	-	-80	-70	≤-70	dBm
	Ch 39	8DPSK	(1)	-	-83	-70		
	Ch 78	8DPSK	(1)	-	-83	-70		
Maximum received signal at 0.1% BER		π/4 DQPSK	-	-20	>-8	-	≥-20	dBm
		8DPSK	-	-20	>-10	-	≥-20	dBm

Table 3.6: EDR Receiver Performance at 85°C

Note:

For Table 3.6:

(1) Dirty transmitter used.

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4 Radio Characteristics: Bluetooth low energy

4.1 Transmitter Performance

4.1.1 Temperature 20°C

RF Characteristics, VDD = 1.35V		Notes	Min	Typ	Max	Bluetooth Specification	Unit
Maximum RF transmit power		(1)	5.0	9.0	10.0	-20 to 10	dBm
ACP	$F = F_0 \pm 2MHz$	(2)(3)	-	-27	-20	≤-20	dBm
	$F = F_0 \pm 3MHz$	(2)(3)	-	-35	-23	≤-30	dBm
	$F = F_0 \pm > 3MHz$	(2)(3)	-	<-60	-30	≤-30	dBm
Δf_{1avg} maximum modulation		-	225	263	275	$225 < f_{1avg} < 275$	kHz
Δf_{2max} minimum modulation		-	185	206	-	≥185	kHz
$\Delta f_{2avg}/\Delta f_{1avg}$		-	0.8	0.83	-	≥0.80	-
ICFT		(4)	-20	3	20	±150	kHz
Carrier drift rate		-	-	4	20	≤20	kHz/50µs
Carrier drift		-	-	5	50	≤50	kHz
2nd harmonic content		(5)	-	-22	-	-	dBm
3rd harmonic content		(5)	-	-31	-	-	dBm

Table 4.1: Bluetooth low energy Transmitter Performance at 20°C

Note:

For Table 4.1:

(1) Typically, an external filter attenuates the transmit power to maintain the transmit power within Bluetooth v4.1 specification limits. Alternatively, change the power table PS Keys to reduce the transmit limits. Alternatively, change the power table PS Keys to reduce the transmit power.

(2) Measured at $F_0 = 2440MHz$.

(3) CSR8675 BGA guaranteed to meet ACP performance in Bluetooth v4.1 specification.

(4) Ignores any frequency error in the reference.

(5) Addition of a filter attenuates the harmonics.

4.1.2 Temperature -40°C

RF Characteristics, VDD = 1.35V		Notes	Min	Typ	Max	Bluetooth Specification	Unit
Maximum RF transmit power		(1)	2.0	6.0	10.0	-20 to 10	dBm
ACP	$F = F_0 \pm 2MHz$	(2)(3)	-	-30	-20	≤-20	dBm
	$F = F_0 \pm 3MHz$	(2)(3)	-	-37	-25	≤-30	dBm
	$F = F_0 \pm > 3MHz$	(2)(3)	-	<-60	-30	≤-30	dBm
Δf_{1avg} maximum modulation		-	225	264	275	$225 < f_{1avg} < 275$	kHz
Δf_{2max} minimum modulation		-	185	212	-	≥185	kHz
$\Delta f_{2avg}/\Delta f_{1avg}$		-	0.8	0.84	-	≥0.80	-
ICFT		(4)	-20	6	20	±150	kHz
Carrier drift rate		-	-	5	20	≤20	kHz/50µs
Carrier drift		-	-	7	50	≤50	kHz

Table 4.2: Bluetooth low energy Transmitter Performance at -40°C

Note:

For Table 4.2:

(1) Typically, an external filter attenuates the transmit power to maintain the transmit power within Bluetooth v4.1 specification limits. Alternatively, change the power table PS Keys to reduce the transmit limits. Alternatively, change the power table PS Keys to reduce the transmit power.

(2) Measured at F_0 = 2440MHz.

(3) CSR8675 BGA guaranteed to meet ACP performance in Bluetooth v4.1 specification.

(4) Ignores any frequency error in the reference.

4.1.3 Temperature 85°C

RF Characteristics, VDD = 1.35V		Notes	Min	Typ	Max	Bluetooth Specification	Unit
Maximum RF transmit power		(1)	4.0	8.0	10.0	-20 to 10	dBm
ACP	$F = F_0 \pm 2MHz$	(2)(3)	-	-31	-20	≤-20	dBm
	$F = F_0 \pm 3MHz$	(2)(3)	-	-39	-30	≤-30	dBm
	$F = F_0 \pm > 3MHz$	(2)(3)	-	<-60	-30	≤-30	dBm
Δf_{1avg} maximum modulation		-	225	264	275	$225 < f_{1avg} < 275$	kHz
Δf_{2max} minimum modulation		-	185	202	-	≥185	kHz
$\Delta f_{2avg}/\Delta f_{1avg}$		-	0.8	0.83	-	≥0.80	-
ICFT		(4)	-20	5	20	±150	kHz
Carrier drift rate		-	-	5	20	≤20	kHz/50µs
Carrier drift		-	-	6	50	≤50	kHz

Table 4.3: Bluetooth low energy Transmitter Performance at 85°C

Note:

For Table 4.3:

(1) Typically, an external filter attenuates the transmit power to maintain the transmit power within Bluetooth v4.1 specification limits. Alternatively, change the power table PS Keys to reduce the transmit limits. Alternatively, change the power table PS Keys to reduce the transmit power.

(2) Measured at $F_0 = 2440MHz$.

(3) CSR8675 BGA guaranteed to meet ACP performance in Bluetooth v4.1 specification.

(4) Ignores any frequency error in the reference.

4.2 Receiver Performance

4.2.1 Temperature 20°C

RF Characteristics, VDD = 1.35V	Frequency (GHz)	Notes	Min	Typ	Max	Bluetooth Specification	Unit
Sensitivity at 30.8% PER for all basic rate packet types	2.402	-	-	-91.0	-87.0	≤-70	dBm
	2.440	-	-	-93.0	-89.0		
	2.480	-	-	-93.0	-89.0		
Reported PER during PER report integrity test	2.426	(1)	50	50	65.4	50 < PER < 65.4	%
Maximum received signal at 30.8% PER		-	-10	>-10	-	≥-10	dBm
Continuous power required to block Bluetooth reception (for input power of -67dBm with 30.8% PER) measured at the output of the CSR8675 BGA	0.030 - 2.000	(2)	-30	>3	-	-30	dBm
	2.000 - 2.400	(2)	-35	-3	-	-35	
	2.500 - 3.000	(2)	-35	-3	-	-35	
	3.000 - 12.75	(2)	-30	>3	-	-30	
C/I co-channel		(3)(4)(5)	-	5	21	≤21	dB
Adjacent channel selectivity C/I	$F = F_0 + 1MHz$	(3)(4)(5)	-	2	15	≤15	dB
	$F = F_0 - 1MHz$	(3)(4)(5)	-	-12	15	≤15	dB
	$F = F_0 + 2MHz$	(3)(4)(5)	-	-29	-17	≤-17	dB
	$F = F_0 - 2MHz$	(3)(4)(5)	-	-23	-15	≤-15	dB
	$F = F_0 + 3MHz$	(3)(4)(5)	-	-44	-27	≤-27	dB
	$F = F_0 - 5MHz$	(3)(4)(5)	-	-51	-27	≤-27	dB
	$F = F_{Image}$	(3)(4)(5)	-	-26	-9	≤-9	dB
Maximum level of intermodulation interferers		(6)	-50	-16	-	≥-50	dBm
Spurious output level		(7)	-	-155	-	-	dBm/Hz

Table 4.4: Bluetooth low energy Receiver Performance at 20°C

Note:

For Table 4.4:

(1) Measured in accordance with the RCV-LE/CA/07/C test. Random number of packets transmitted by tester of which 50% have corrupted CRCs. Wanted signal level is -30dBm.

(2) CSR8675 BGA is guaranteed to meet the blocking performance as specified by the Bluetooth v4.1 specification.

(3) CSR8675 BGA is guaranteed to meet the C/I performance as specified by the Bluetooth v4.1 specification.

(4) Measured at F_0 = 2440MHz.

(5) F_{Image} = F_0 - 3MHz. However, depending on crystal frequency and channel number, the image may switch to the opposite side of the carrier. When this occurs, F_{Image} = F_0 + 3MHz and the offsets in the table equations associated with C/I are also reversed.

(6) Measured at $f_1 - f_2$ = ±3, 4 and 5MHz. Measurement is performed in accordance with Bluetooth RF test RCV-LE/CA/05/C, i.e. wanted signal at -64dBm.

(7) Integrated in 100kHz bandwidth and normalised to 1Hz. Actual figure is typically -155dBm/Hz except for peaks of -83dBm at 1600MHz and -77dBm in-band at 2.4GHz.

4.2.2 Temperature -40°C

RF Characteristics, VDD = 1.35V	Frequency (GHz)	Notes	Min	Typ	Max	Bluetooth Specification	Unit
Sensitivity at 30.8% PER for all basic rate packet types	2.402	-	-	-92.0	-88.0	≤-70	dBm
	2.440	-	-	-93.0	-89.0		
	2.480	-	-	-93.0	-89.0		
Reported PER during PER report integrity test	2.426	(1)	50	50	65.4	50 < PER < 65.4	%
Maximum received signal at 30.8% PER		-	-10	>-10	-	≥-10	dBm

Table 4.5: Bluetooth low energy Receiver Performance at -40°C

Note:

For Table 4.5:

(1) Measured in accordance with the RCV-LE/CA/07/C test. Random number of packets transmitted by tester of which 50% have corrupted CRCs. Wanted signal level is -30dBm.

4.2.3 Temperature 85°C

RF Characteristics, VDD = 1.35V	Frequency (GHz)	Notes	Min	Typ	Max	Bluetooth Specification	Unit
Sensitivity at 30.8% PER for all basic rate packet types	2.402	-	-	-90.0	-86.0	≤-70	dBm
	2.440	-	-	-92.5	-88.5		
	2.480	-	-	-92.5	-88.5		
Reported PER during PER report integrity test	2.426	(1)	50	50	65.4	50 < PER < 65.4	%
Maximum received signal at 30.8% PER		-	-10	>-10	-	≥-10	dBm

Table 4.6: Bluetooth low energy Receiver Performance at 85°C

Note:

For Table 4.6:

(1) Measured in accordance with the RCV-LE/CA/07/C test. Random number of packets transmitted by tester of which 50% have corrupted CRCs. Wanted signal level is -30dBm.

5 Typical Radio Performance: Basic Data Rate

5.1 Transmitter Performance

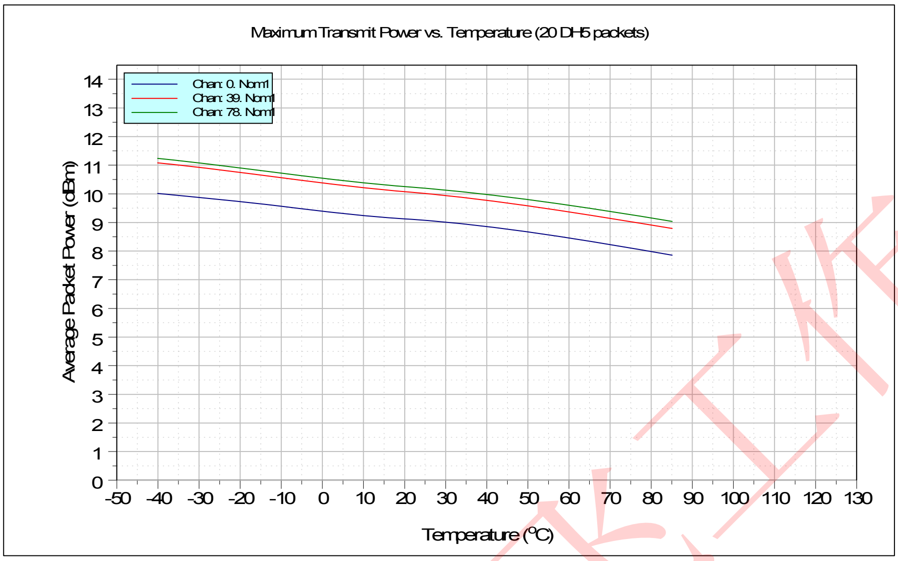

Figure 5.1: Maximum Transmit Power vs Temperature (20 DH5 Packets)

Note:

Output power temperature compensation was disabled. Performance measured at output of the CSR8675 BGA.

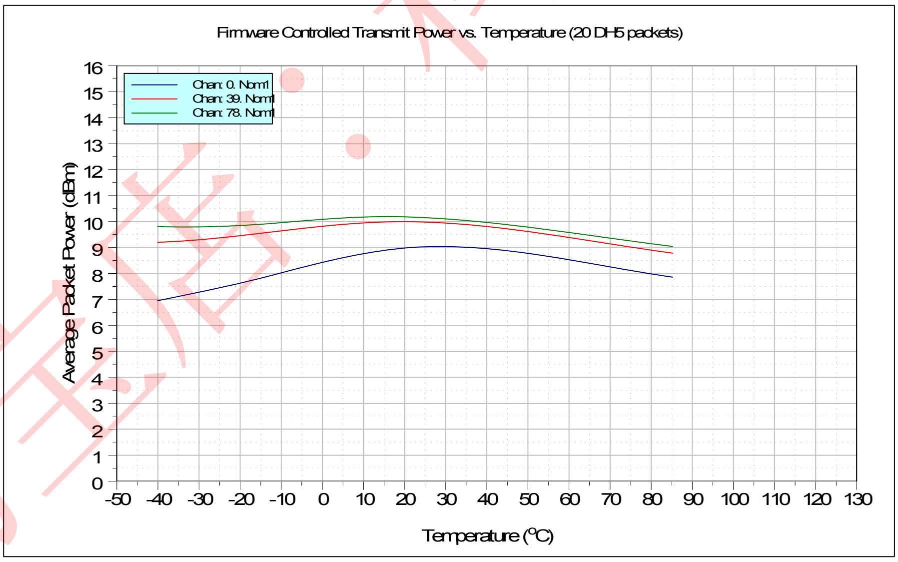

Figure 5.2: Firmware Controlled Transmit Power vs Temperature (20 DH5 Packets)

Note:

Output power temperature compensation was enabled.

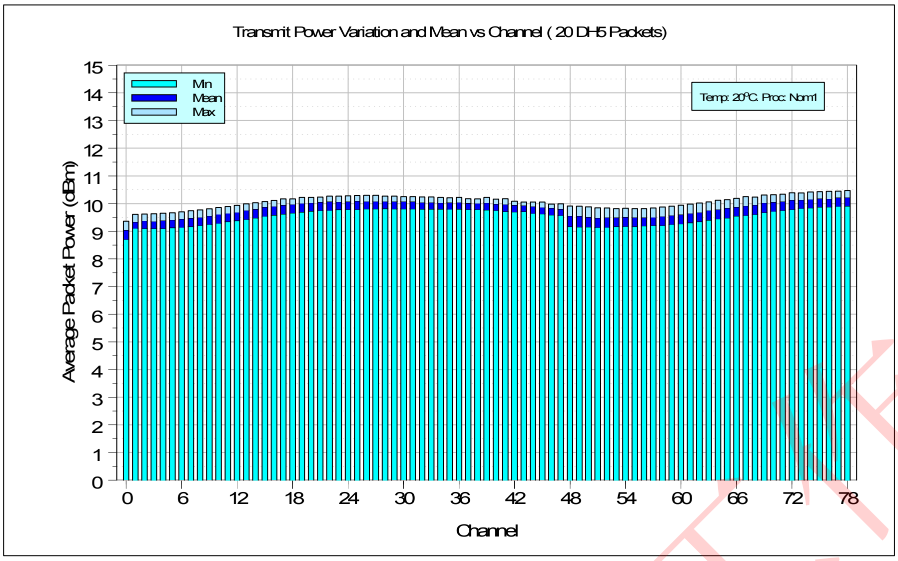

Figure 5.3: Transmit Power Variation and Mean vs Channel (20 DH5 Packets)

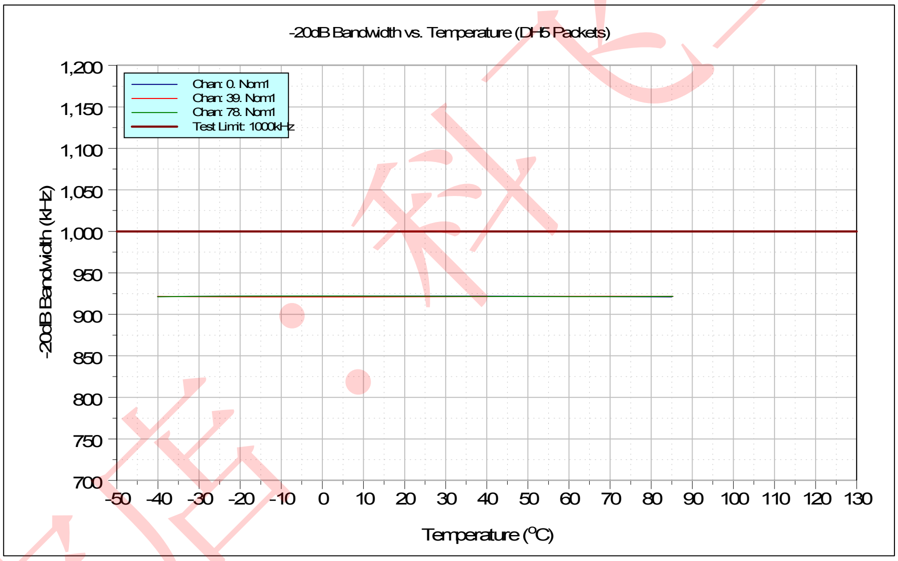

Figure 5.4: -20dB Bandwidth vs Temperature (DH5 Packets)

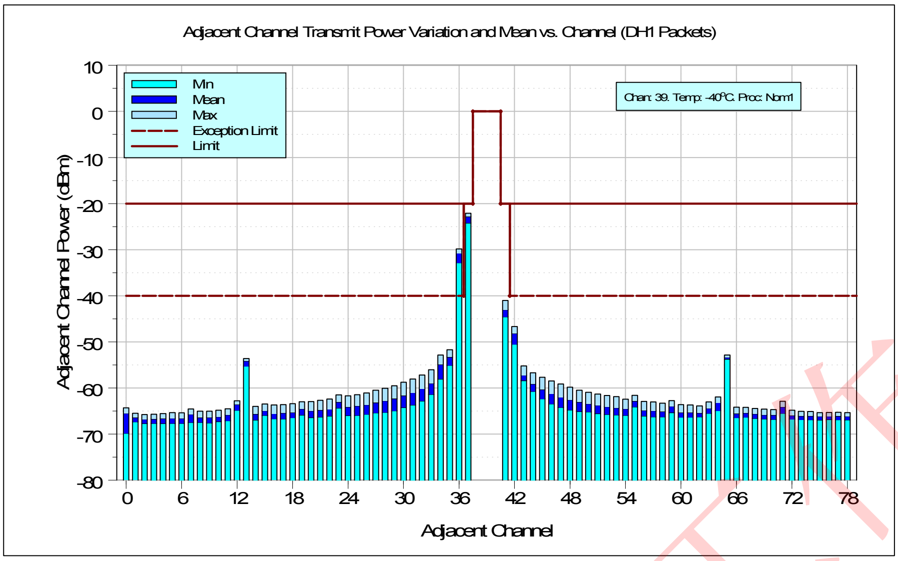

Figure 5.5: Adjacent Channel Transmit Power Variation and Mean vs Channel (DH1 Packets) at -40°C

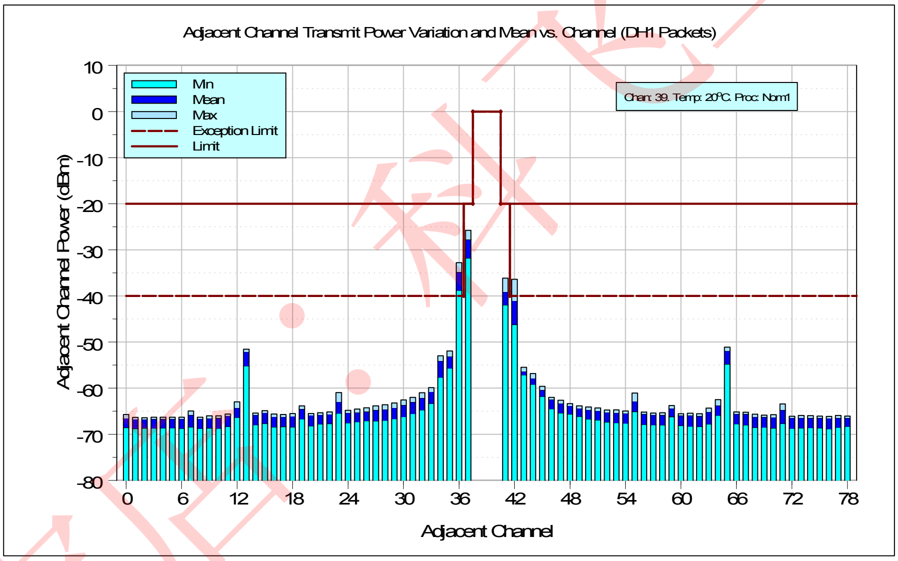

Figure 5.6: Adjacent Channel Transmit Power Variation and Mean vs Channel (DH1 Packets) at 20°C

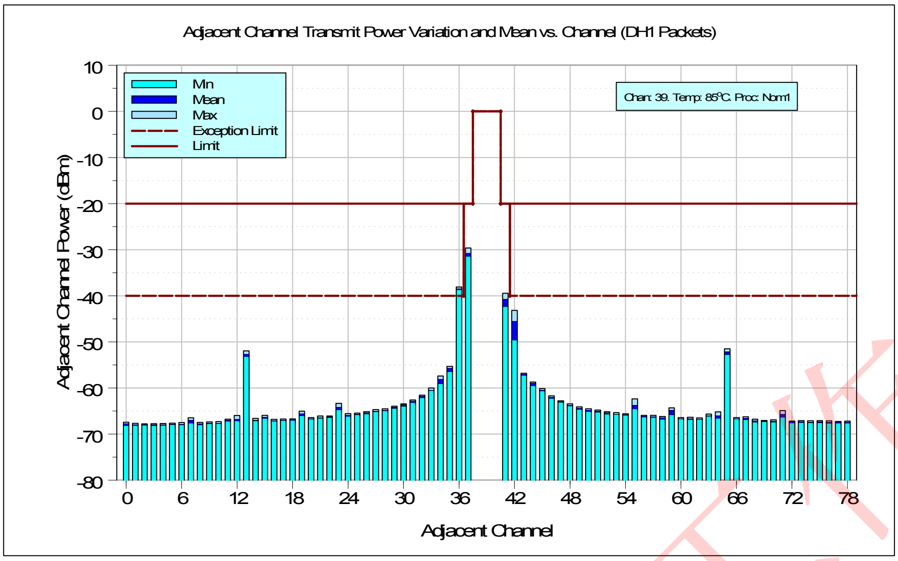

Figure 5.7: Adjacent Channel Transmit Power Variation and Mean vs Channel (DH1 Packets) at 85°C

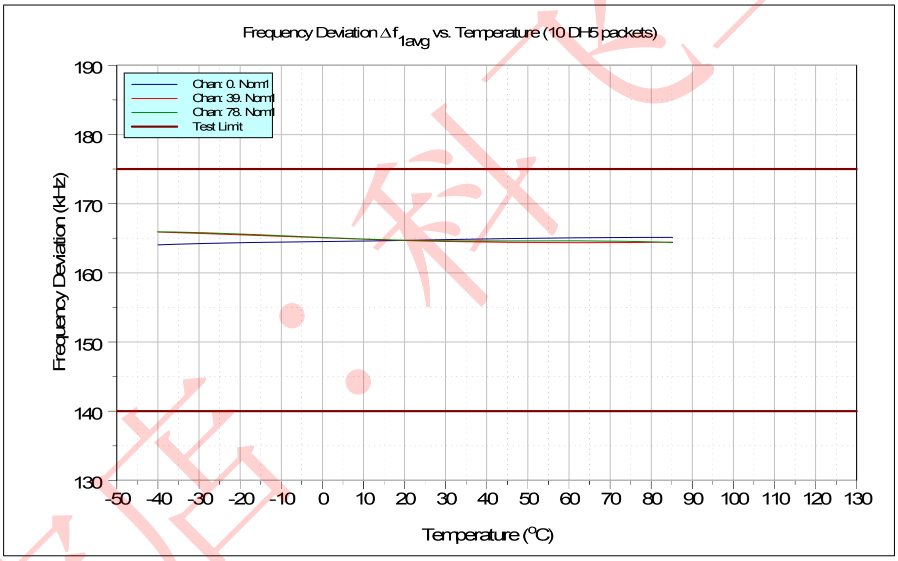

Figure 5.8: Frequency Deviation Δf_{1avg} vs Temperature (10 DH5 Packets)

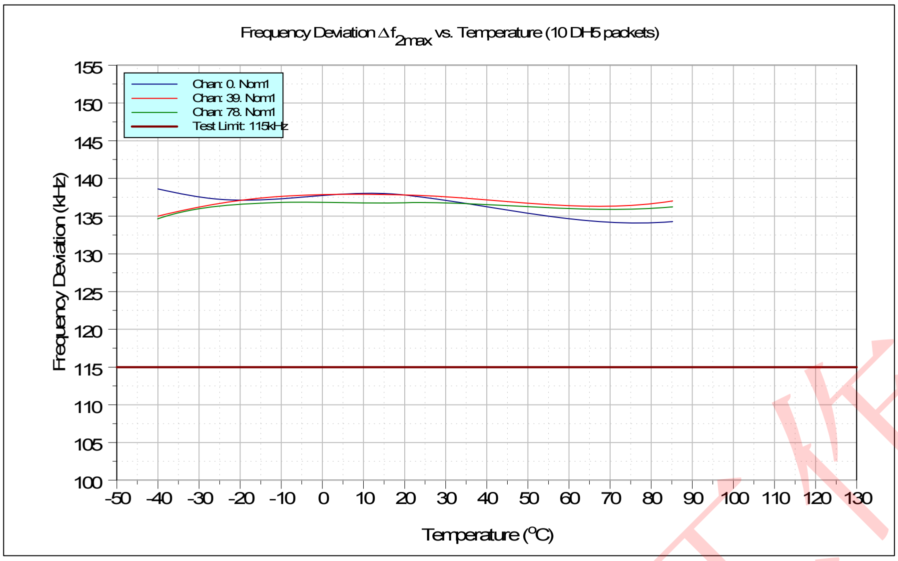

Figure 5.9: Frequency Deviation Δf_{2max} vs Temperature (10 DH5 Packets)

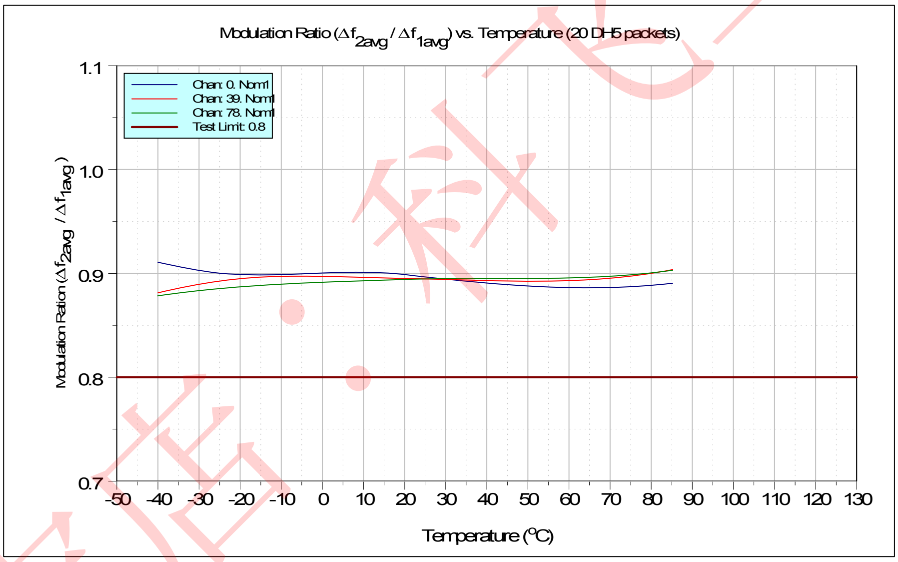

Figure 5.10: Modulation Ratio ($\Delta f_{2avg}/\Delta f_{1avg}$) vs Temperature (20 DH5 Packets)

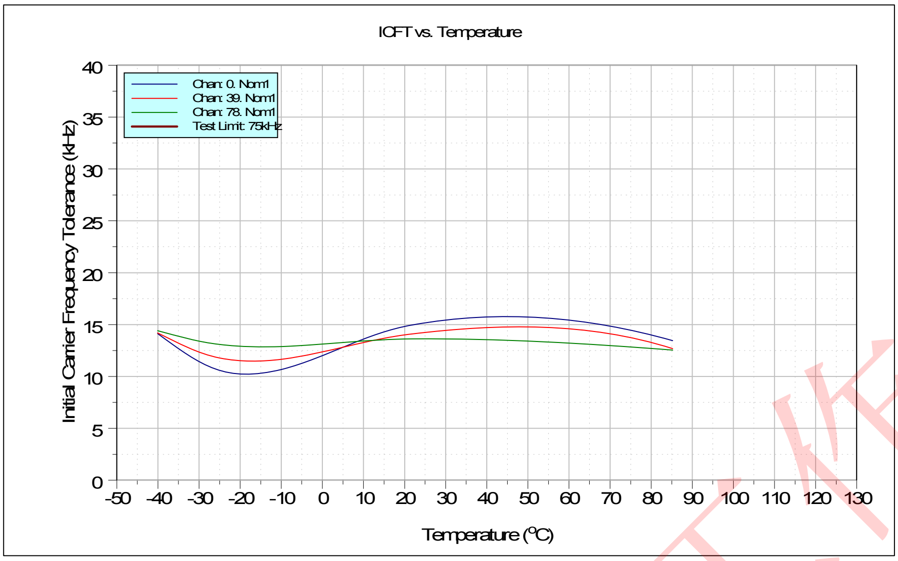

Figure 5.11: ICFT vs Temperature

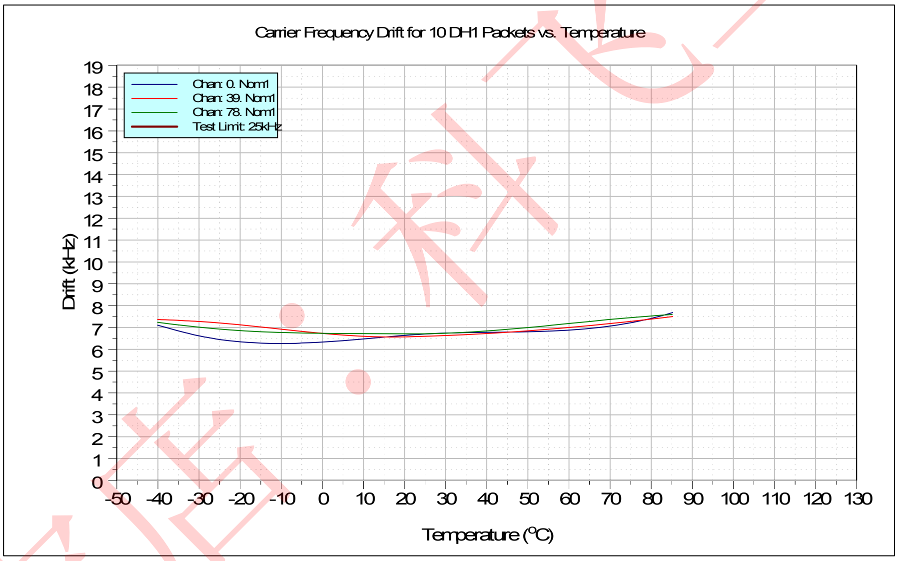

Figure 5.12: Carrier Frequency Drift for 10 DH1 Packets vs Temperature

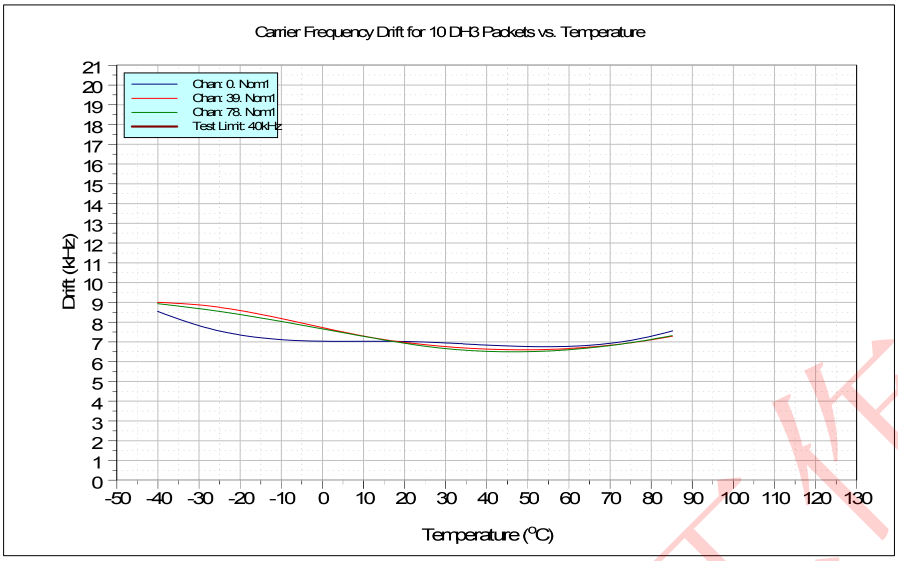

Figure 5.13: Carrier Frequency Drift for 10 DH3 Packets vs Temperature

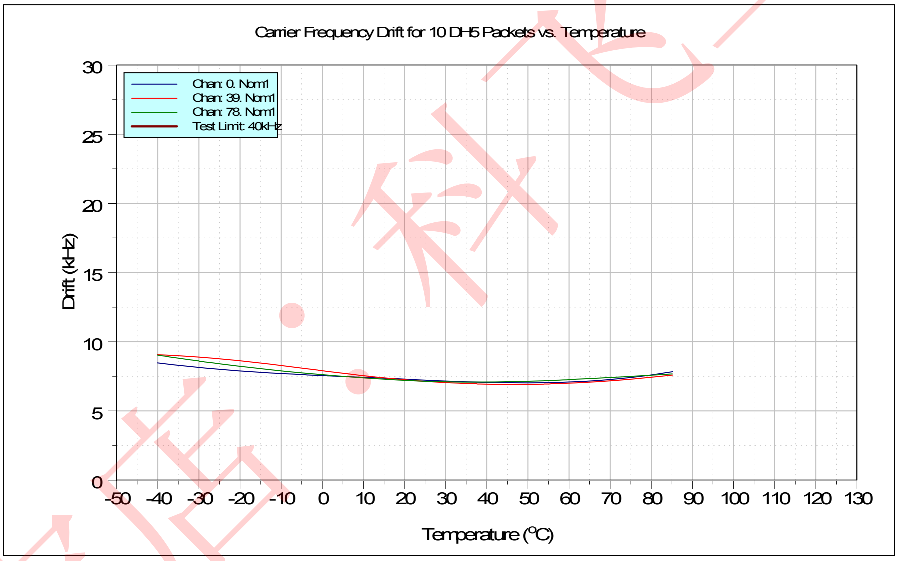

Figure 5.14: Carrier Frequency Drift for 10 DH5 Packets vs Temperature

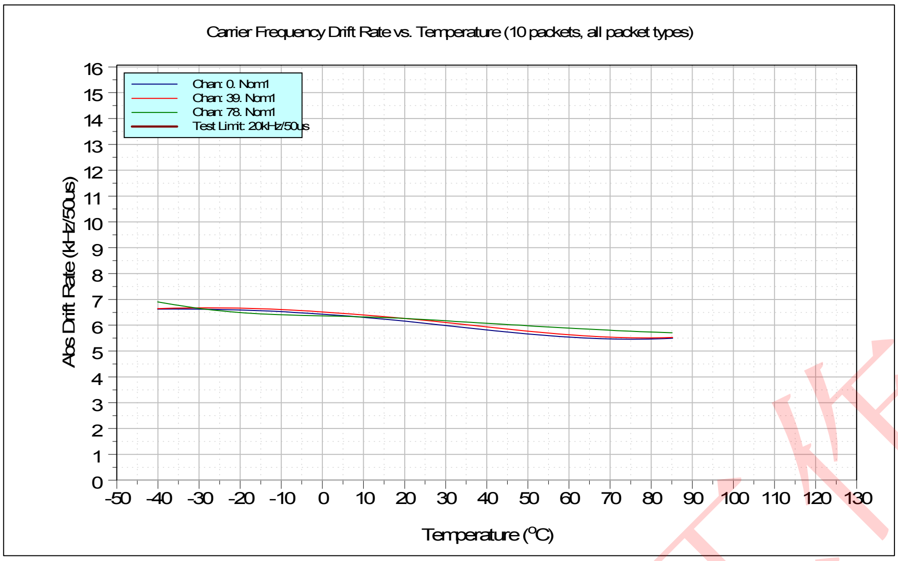

Figure 5.15: Carrier Frequency Drift Rate vs Temperature (10 Packets, All Packet Types)

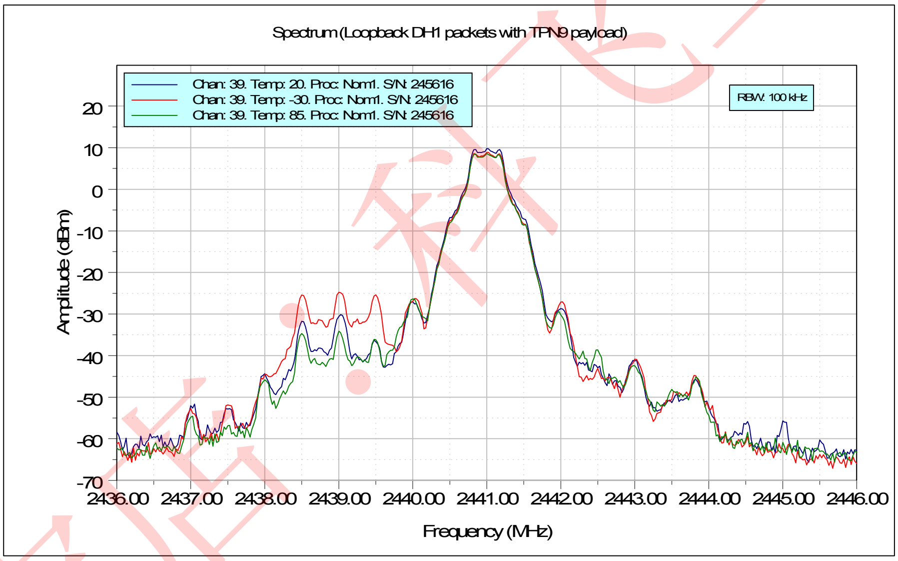

Figure 5.16: Spectrum (Loopback DH1 Packets with TPN9 Payload)

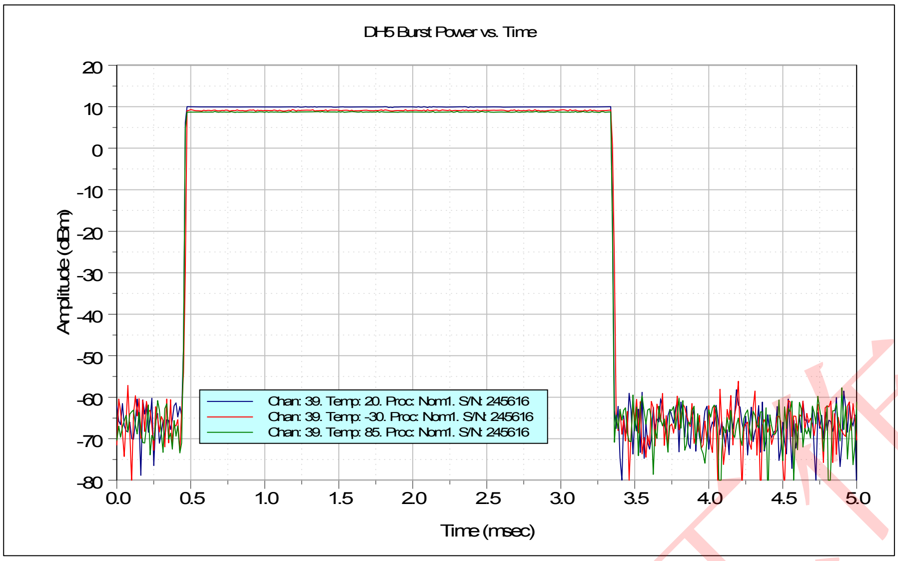

Figure 5.17: DH5 Burst Power vs Time

5.2 Receiver Performance

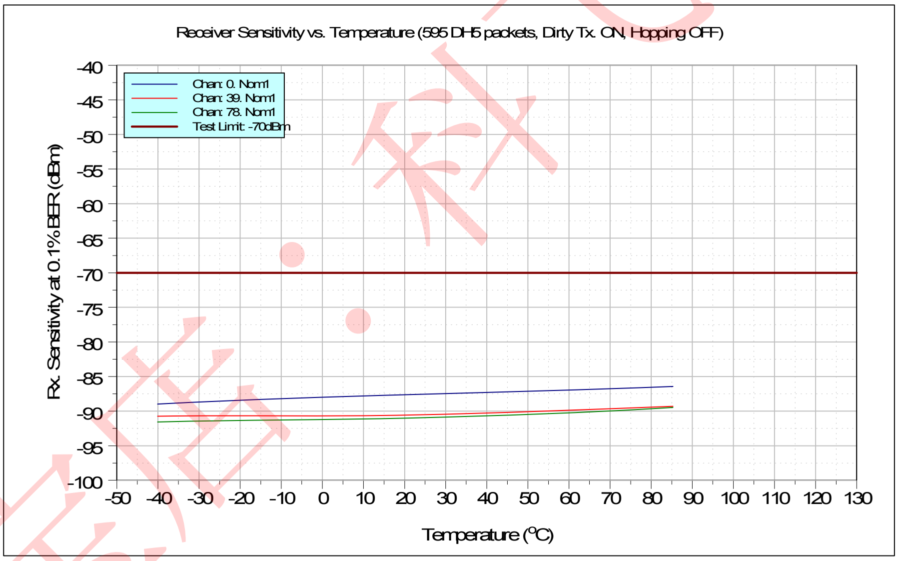

Figure 5.18: Receive Sensitivity vs Temperature (595 DH5 Packets, Dirty Tx. ON, Hopping OFF)

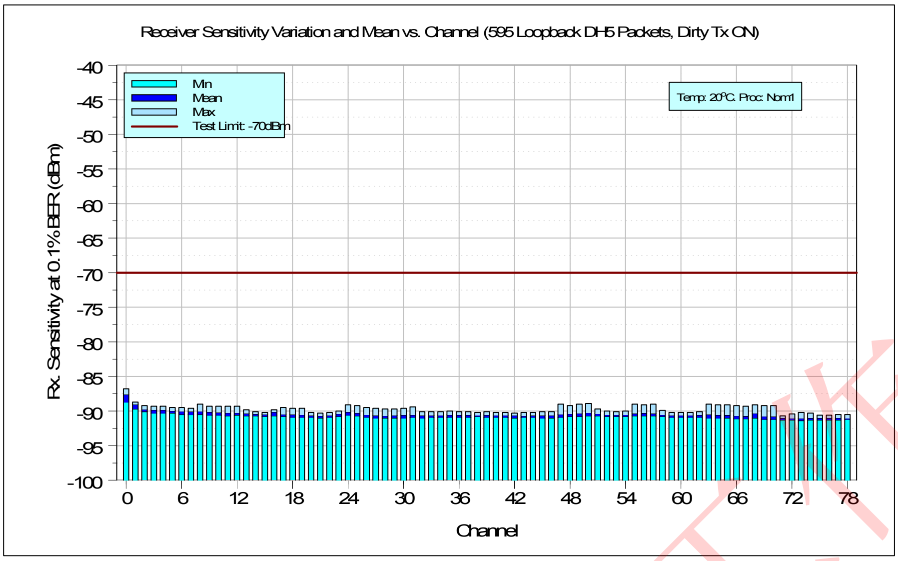

Figure 5.19: Receive Sensitivity Variation and Mean vs Channel

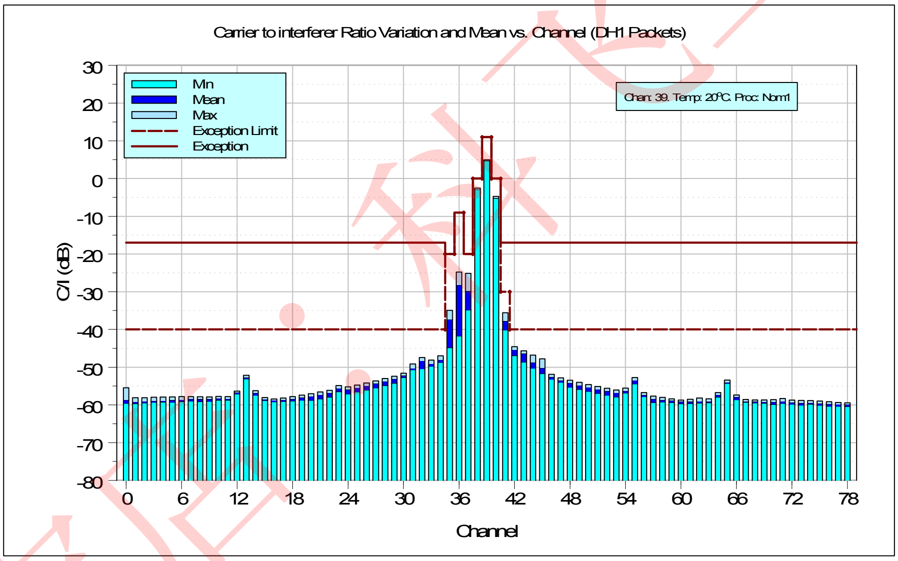

Figure 5.20: Carrier to Interferer Ratio and Mean vs Channel (DH1 Packets), 20°C

6 Typical Radio Performance: Enhanced Data Rate

6.1 Transmitter Performance

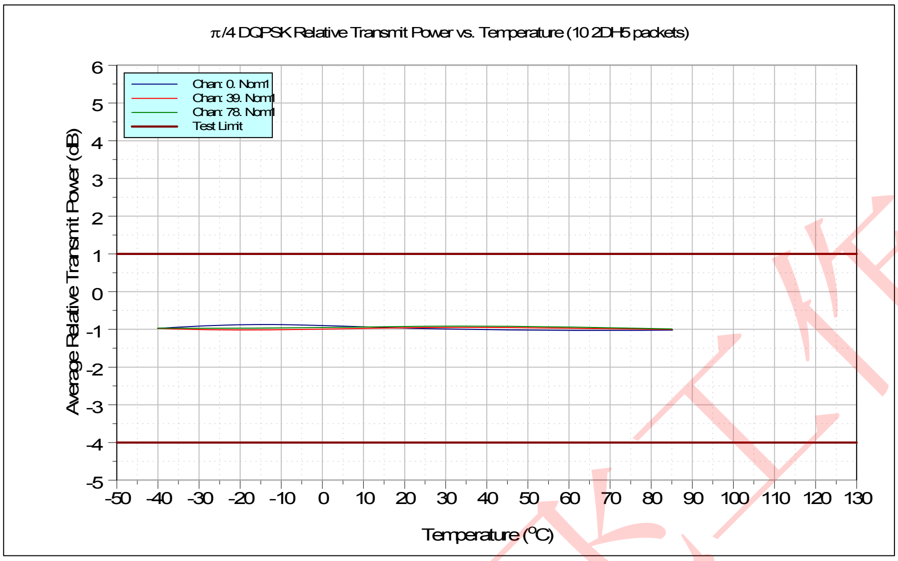

Figure 6.1: π/4DQPSK Relative Transmit Power vs Temperature (10 2-DH5 Packets)

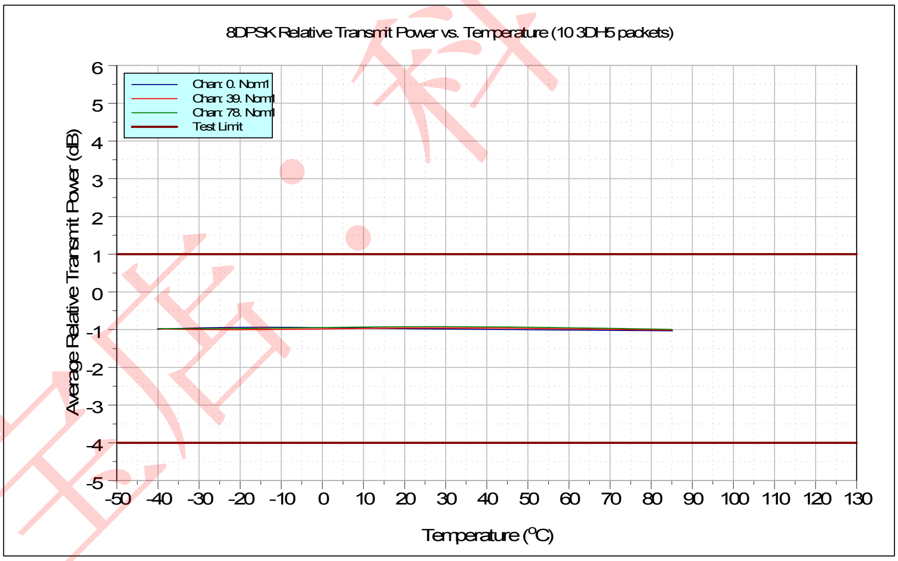

Figure 6.2: 8DPSK Relative Transmit Power vs Temperature (10 3-DH5 Packets)

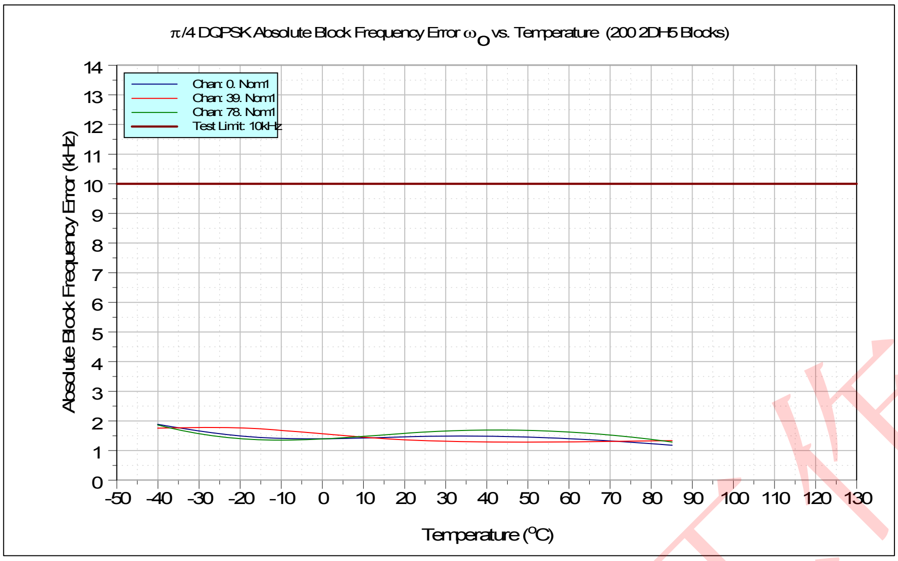

Figure 6.3: π/4DQPSK Absolute Block Frequency Error, ω_o vs Temperature (200 2-DH5 Blocks)

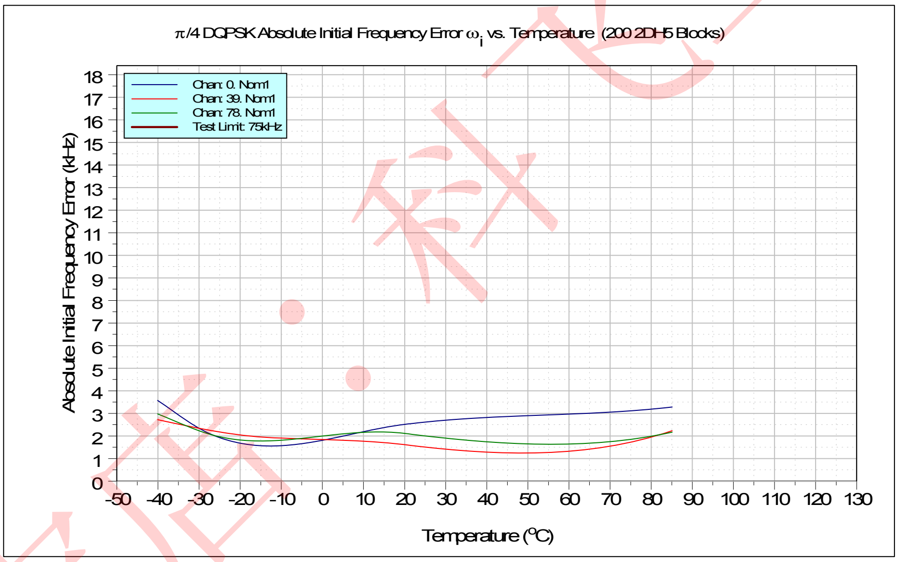

Figure 6.4: π/4DQPSK Absolute Initial Frequency Error, ω_i vs Temperature (200 2-DH5 Blocks)

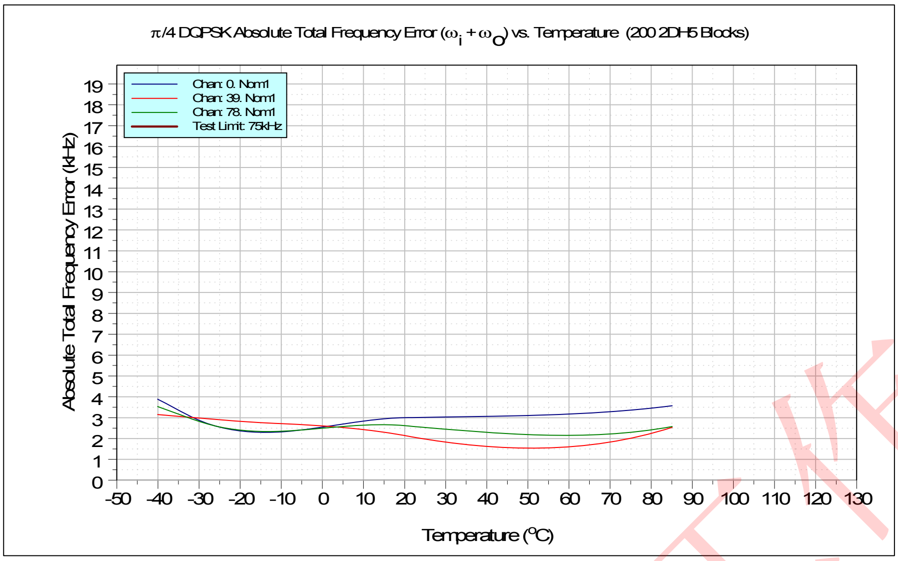

Figure 6.5: π/4DQPSK Absolute Total Frequency Error, (ω_o+ω_i) vs Temperature (200 2-DH5 Blocks)

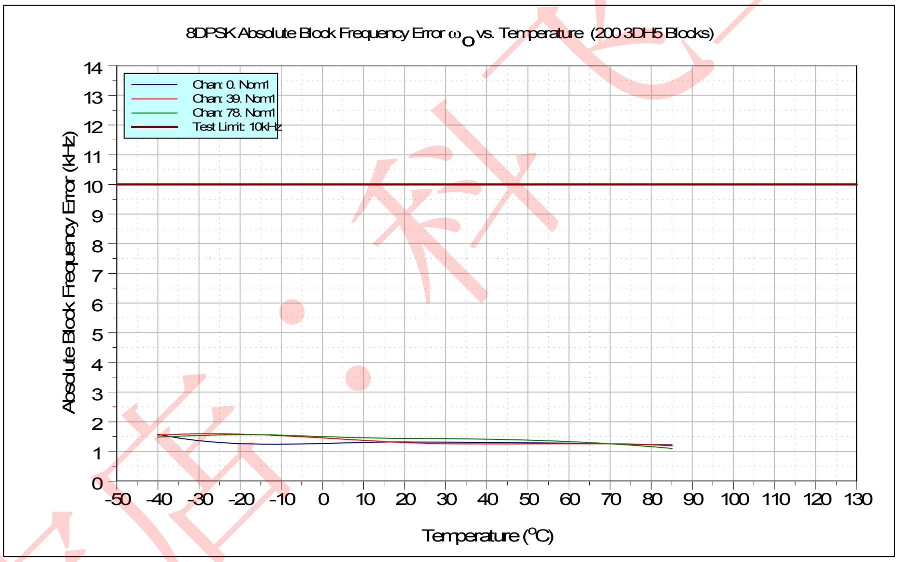

Figure 6.6: 8DPSK Absolute Block Frequency Error, ω_o vs Temperature (200 3-DH5 Blocks)

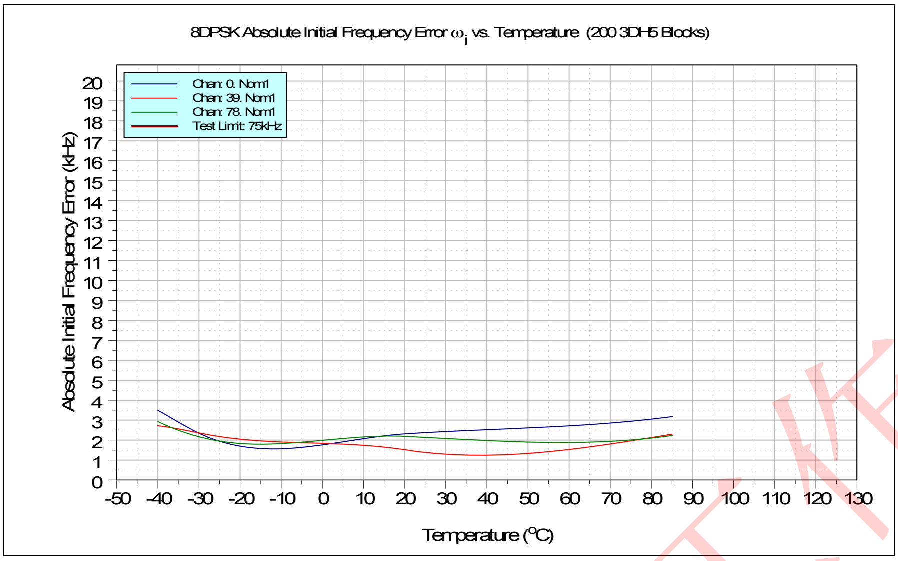

Figure 6.7: 8DPSK Absolute Initial Frequency Error, ω_i vs Temperature (200 3-DH5 Blocks)

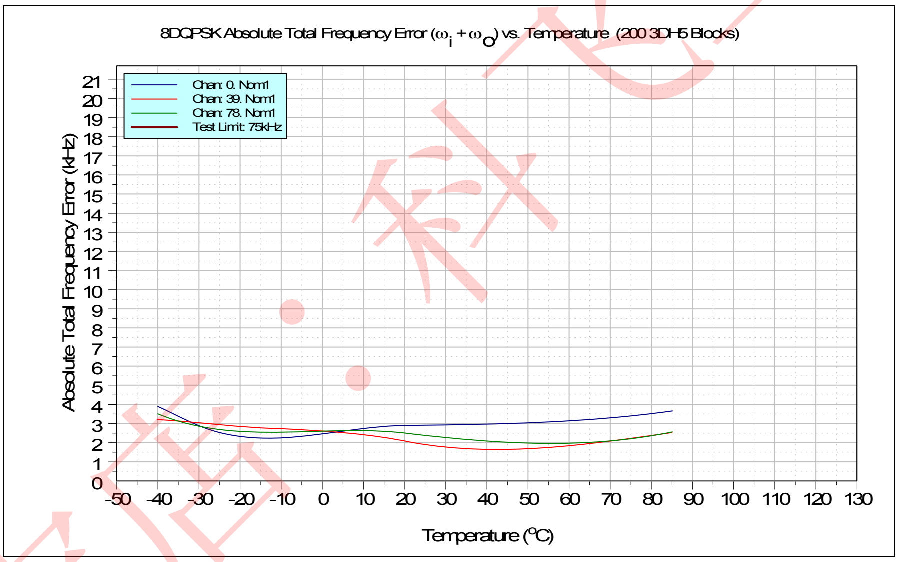

Figure 6.8: 8DPSK Absolute Total Frequency Error, (ω_o+ω_i) vs Temperature (200 3-DH5 Blocks)

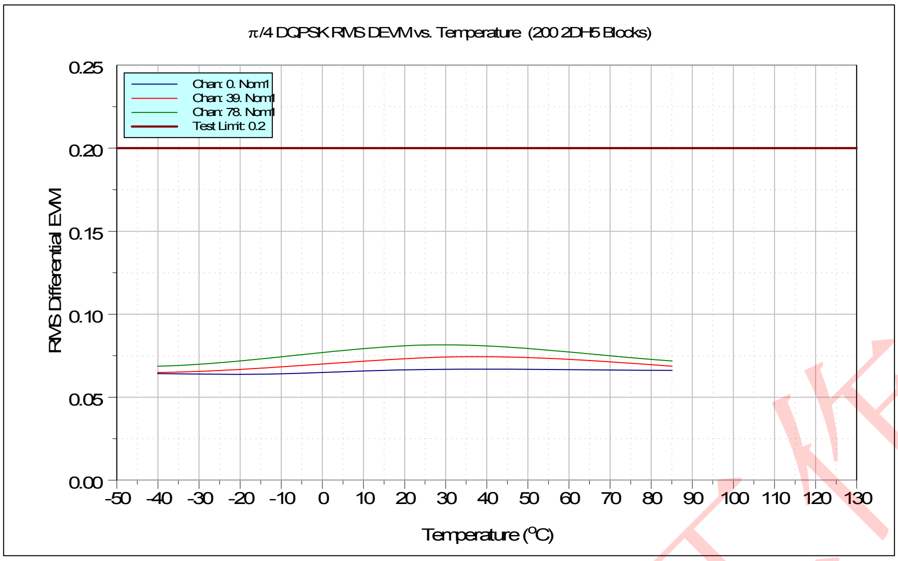

Figure 6.9: π/4DQPSK RMS DEVM vs Temperature (200 2-DH5 Blocks)

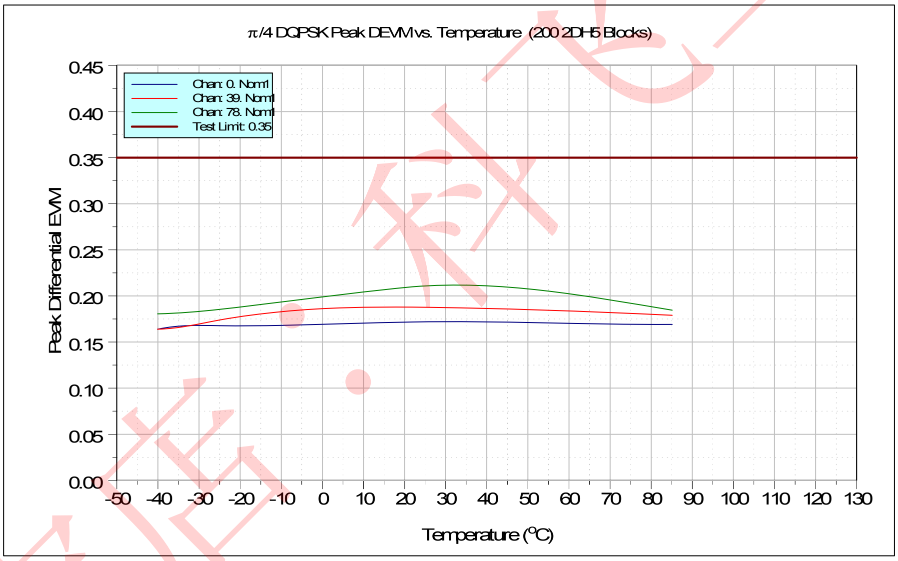

Figure 6.10: π/4DQPSK Peak DEVM vs Temperature (200 2-DH5 Blocks)

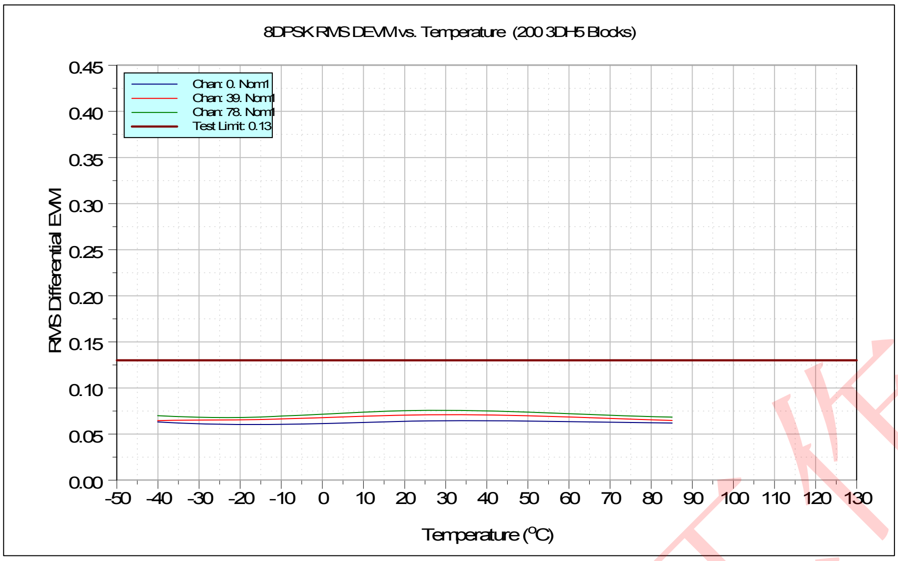

Figure 6.11: 8DPSK RMS DEVM vs Temperature (200 3-DH5 Blocks)

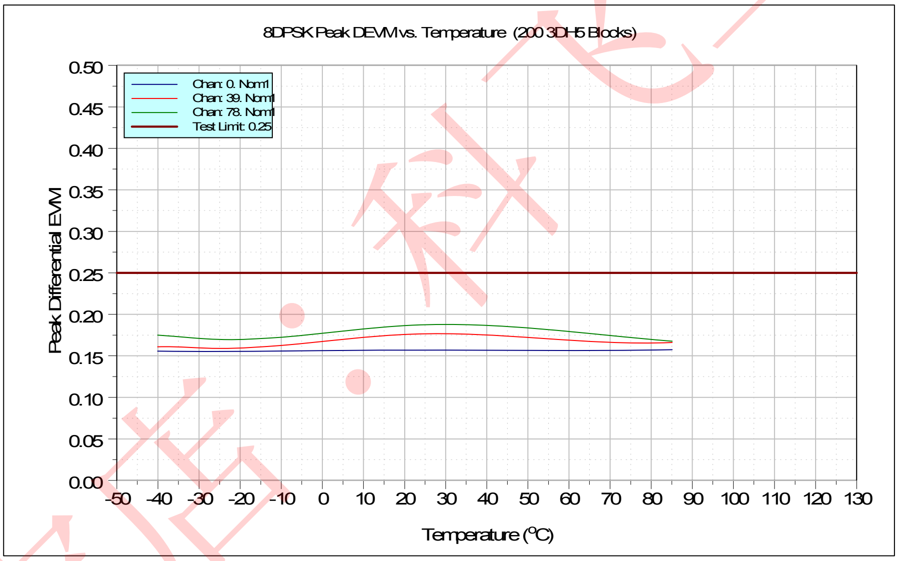

Figure 6.12: 8DPSK Peak DEVM vs Temperature (200 3-DH5 Blocks)

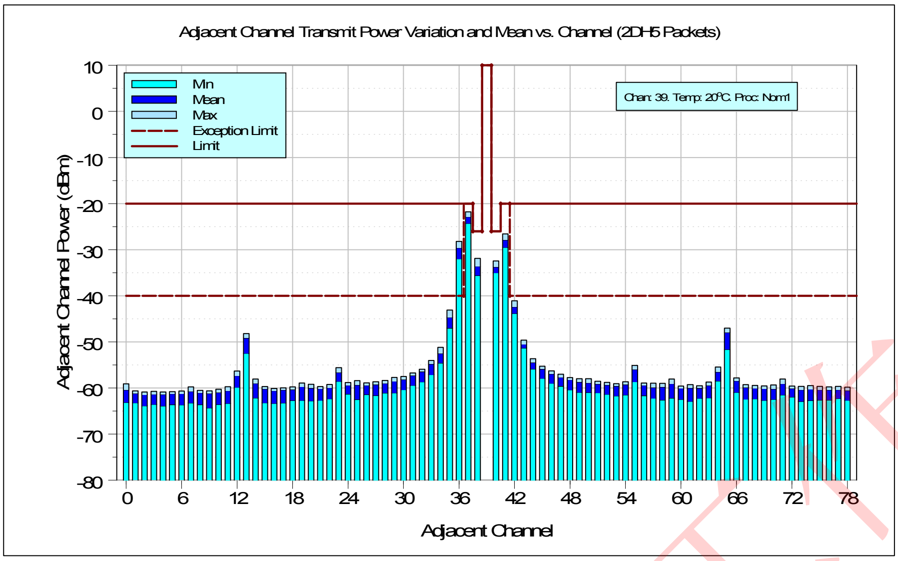

Figure 6.13: Adjacent Channel Transmit Power Variation and Mean vs Channel (2-DH5 Packets) at 20°C

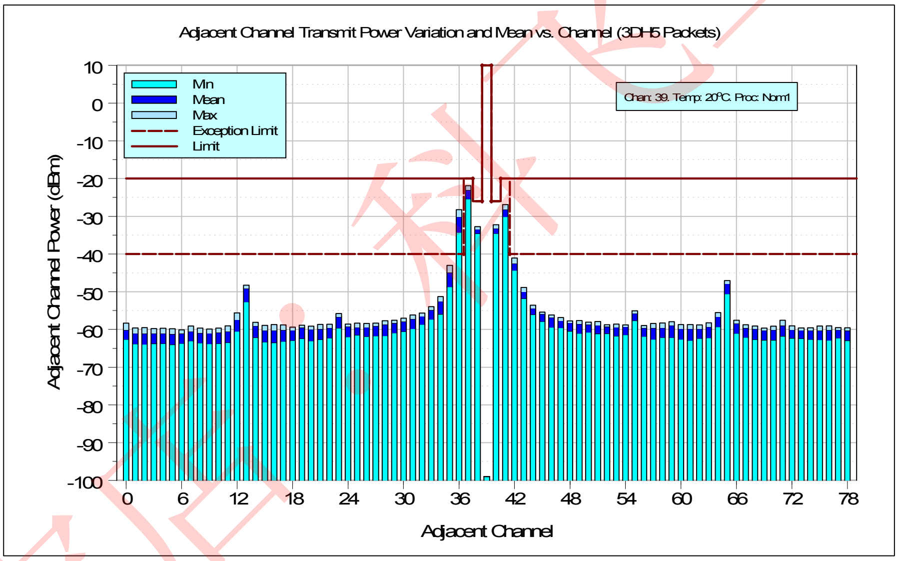

Figure 6.14: Adjacent Channel Transmit Power Variation and Mean vs Channel (3-DH5 Packets) at 20°C

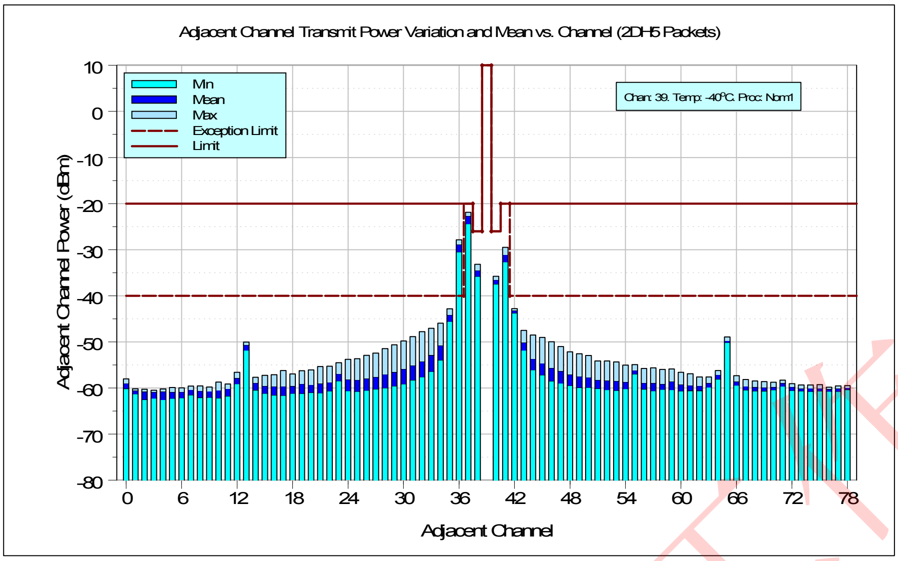

Figure 6.15: Adjacent Channel Transmit Power Variation and Mean vs Channel (2-DH5 Packets) at -40°C

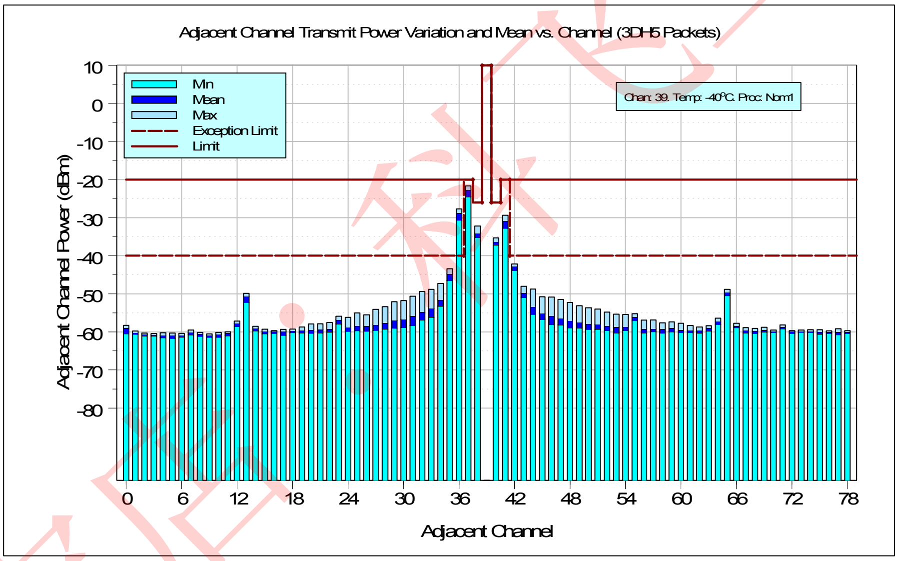

Figure 6.16: Adjacent Channel Transmit Power Variation and Mean vs Channel (3-DH5 Packets) at -40°C

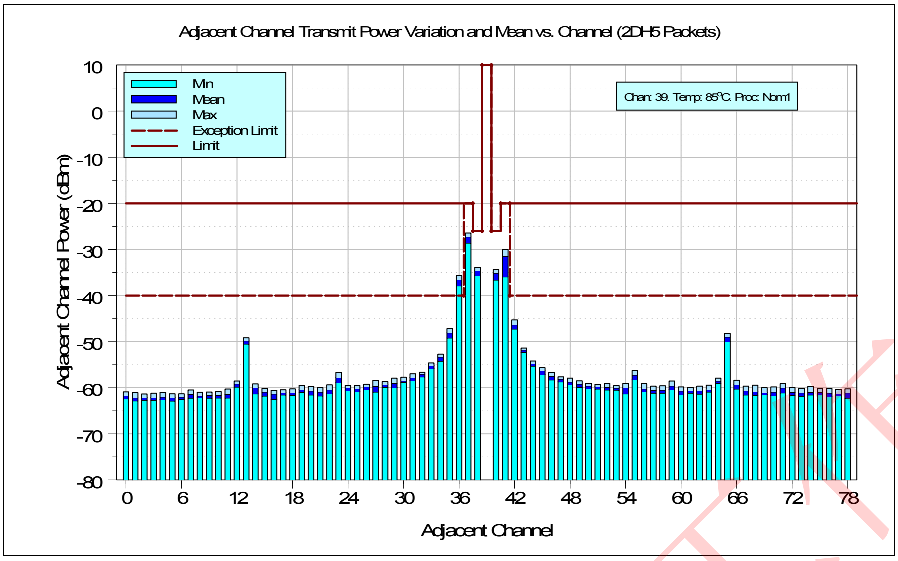

Figure 6.17: Adjacent Channel Transmit Power Variation and Mean vs Channel (2-DH5 Packets) at 85°C

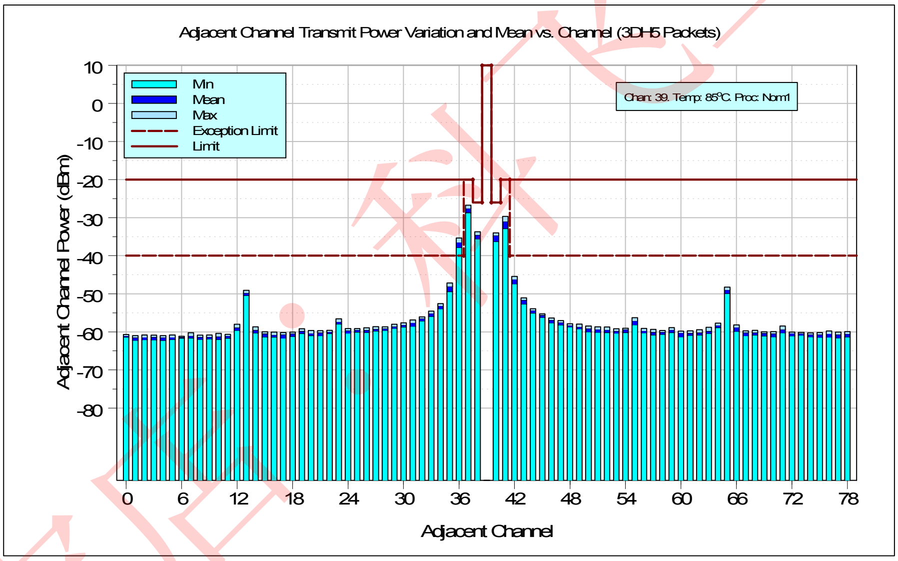

Figure 6.18: Adjacent Channel Transmit Power Variation and Mean vs Channel (3-DH5 Packets) at 85°C

CSR

6.2 Receiver Performance

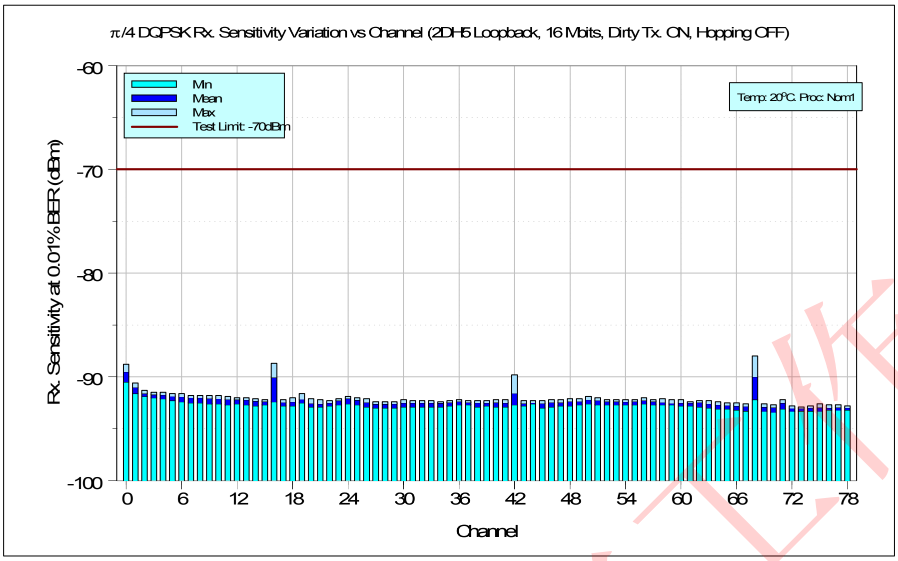

Figure 6.19: π/4DQPSK Receive Sensitivity Variation vs Channel (2-DH5 Loopback, 16Mbits, Dirty Tx. ON, Hopping OFF)

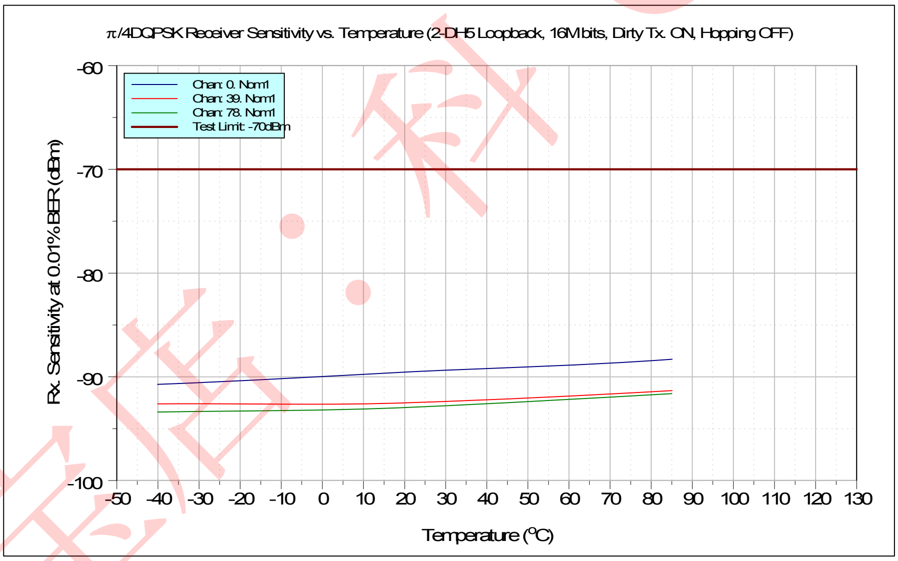

Figure 6.20: π/4DQPSK Receive Sensitivity vs Temperature (2-DH5 Loopback, 16Mbits, Dirty Tx. ON, Hopping OFF)

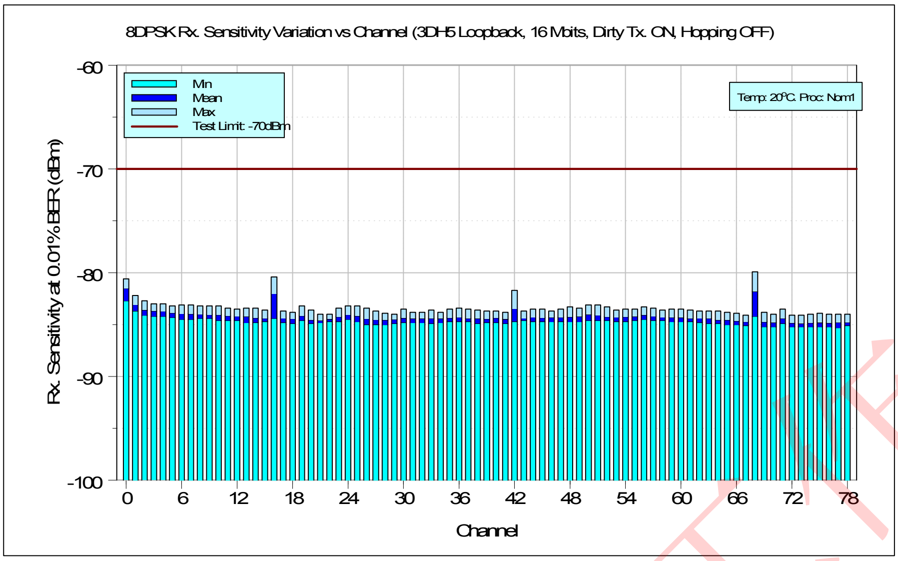

Figure 6.21: 8DPSK Receive Sensitivity Variation vs Channel (3-DH5 Loopback, 16Mbits, Dirty Tx. ON, Hopping OFF)

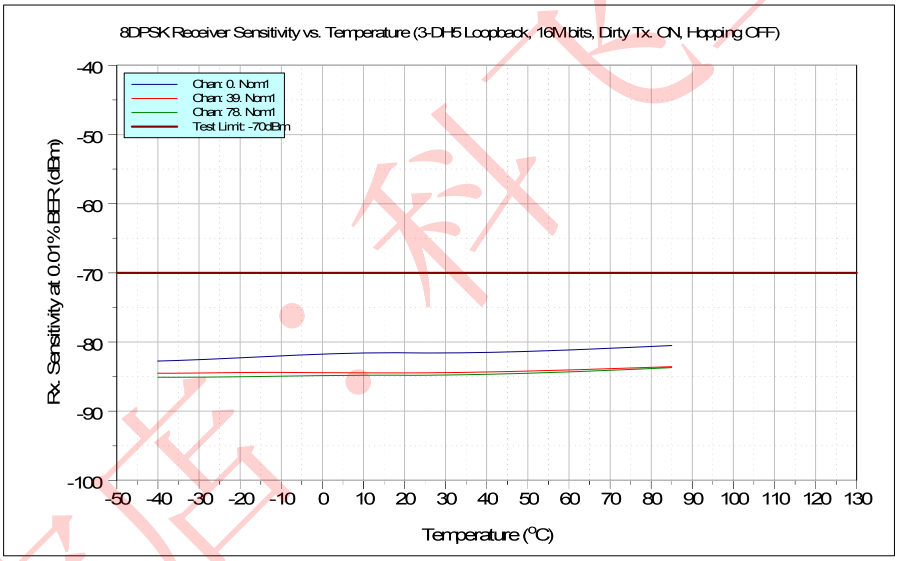

Figure 6.22: 8DPSK Receive Sensitivity vs Temperature (3-DH5 Loopback, 16Mbits, Dirty Tx. ON, Hopping OFF)

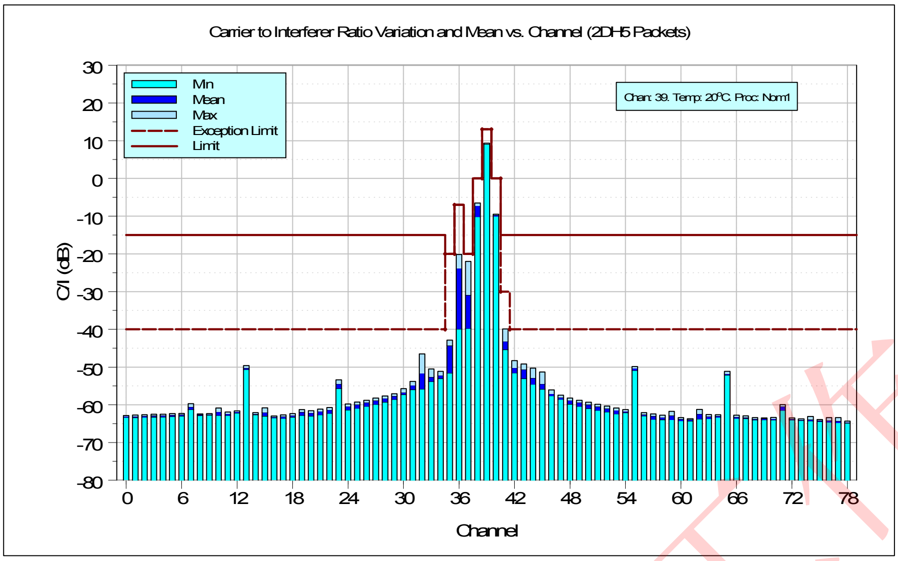

Figure 6.23: π/4DQPSK Receive C/I at 20°C

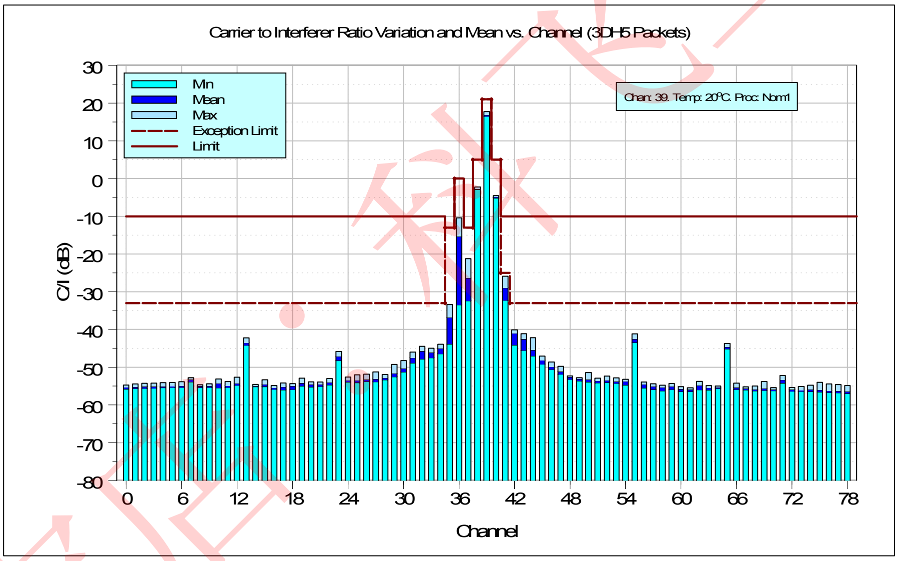

Figure 6.24: 8DPSK Receive C/I at 20°C

7 Typical Radio Performance: Bluetooth low energy

7.1 Transmitter Performance

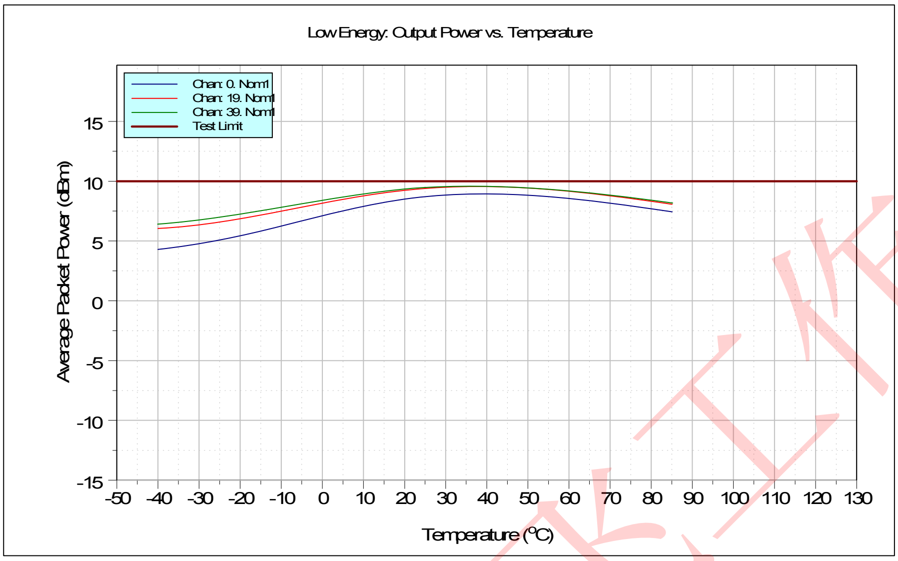

Figure 7.1: Transmit Power vs. Temperature

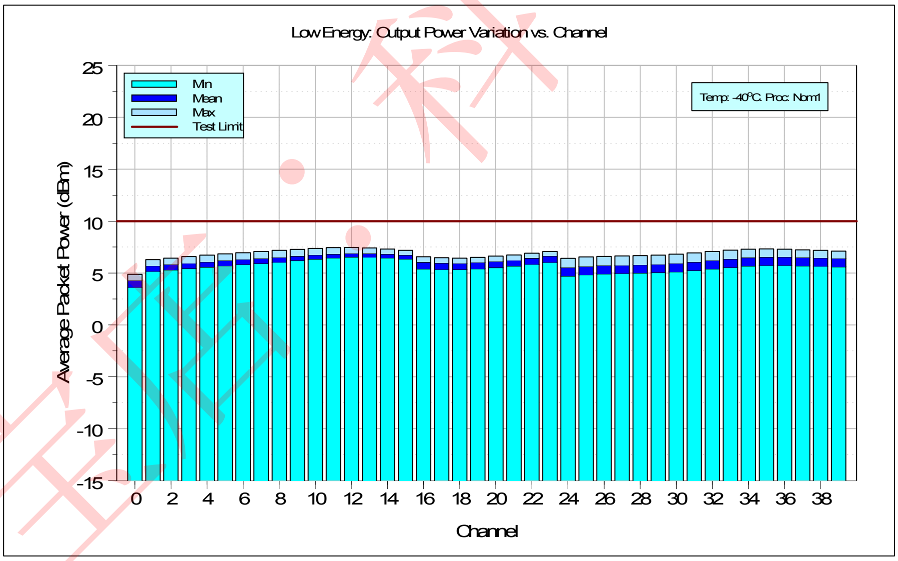

Figure 7.2: Transmit Power Variation and Mean vs. Channel at -40°C

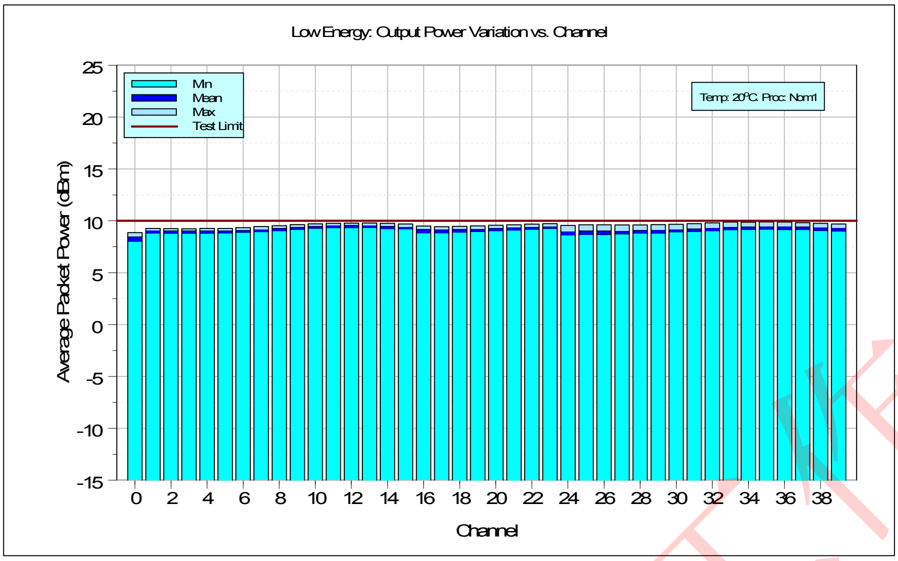

Figure 7.3: Transmit Power Variation and Mean vs. Channel at 20°C

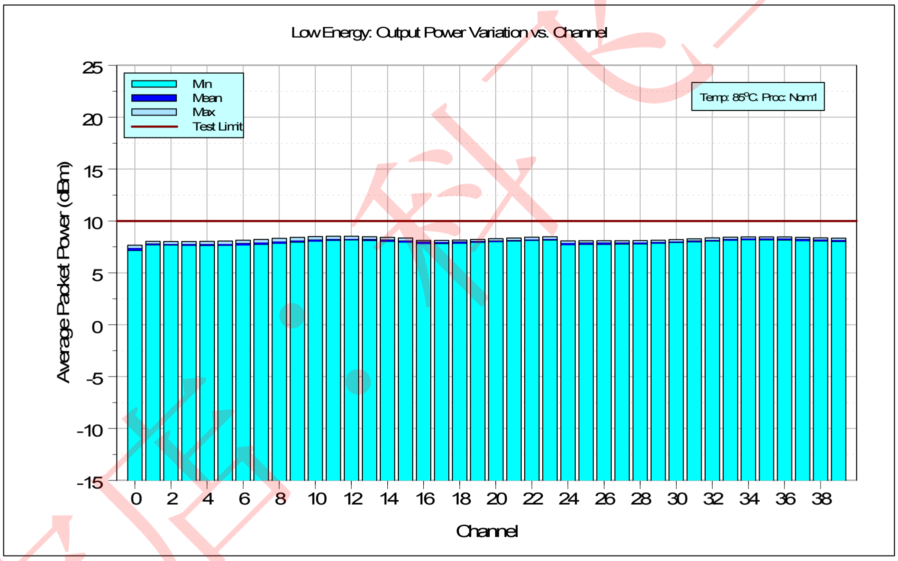

Figure 7.4: Transmit Power Variation and Mean vs. Channel at 85°C

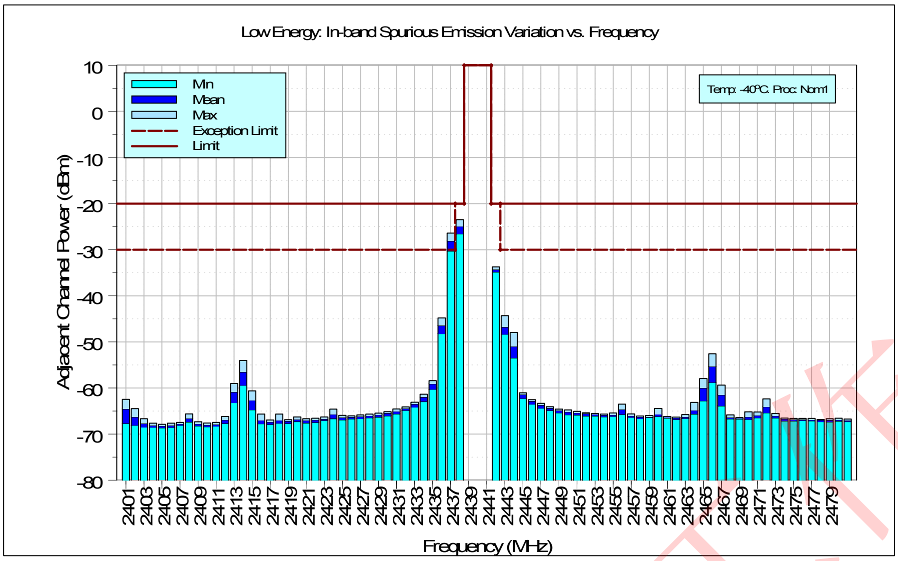

Figure 7.5: In-band Spurious Emissions vs. Frequency at -40°C

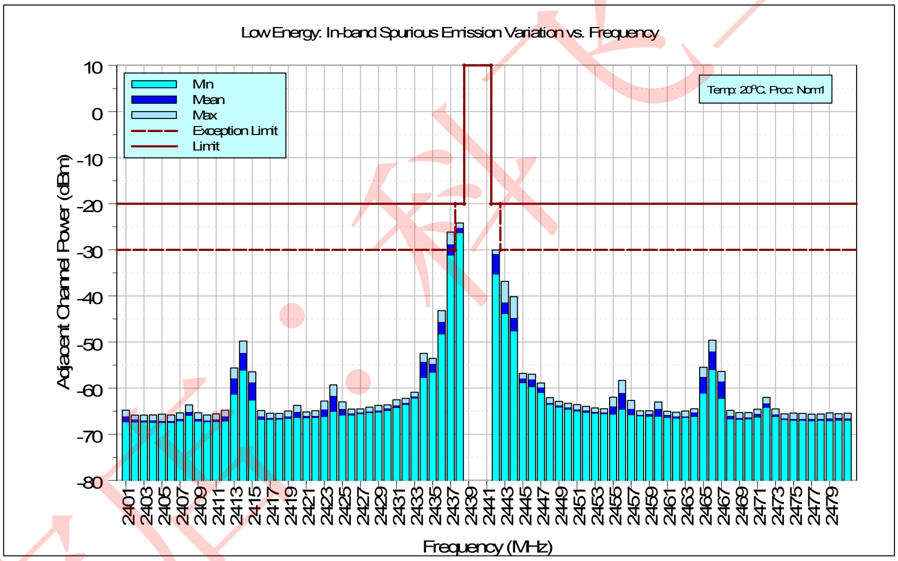

Figure 7.6: In-band Spurious Emissions vs. Frequency at 20°C

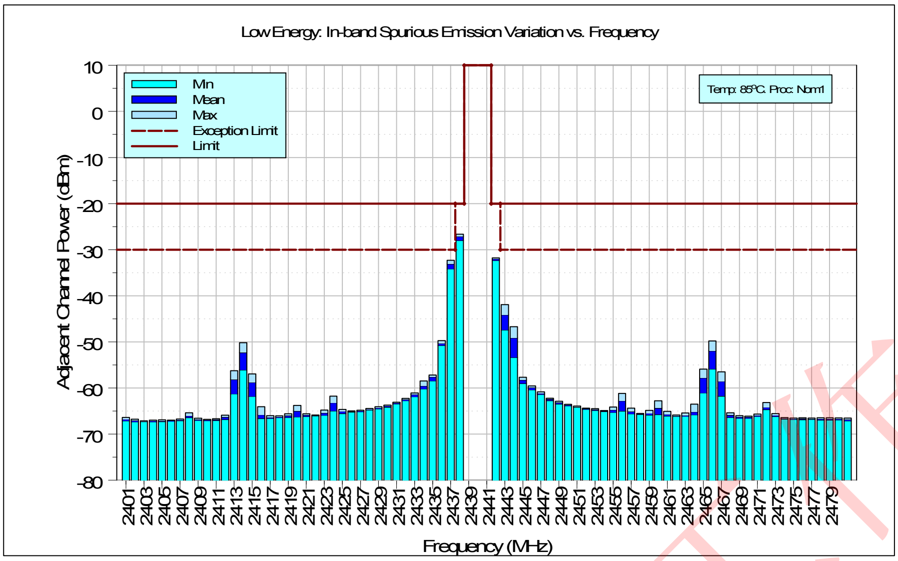

Figure 7.7: In-band Spurious Emissions vs. Frequency at 85°C

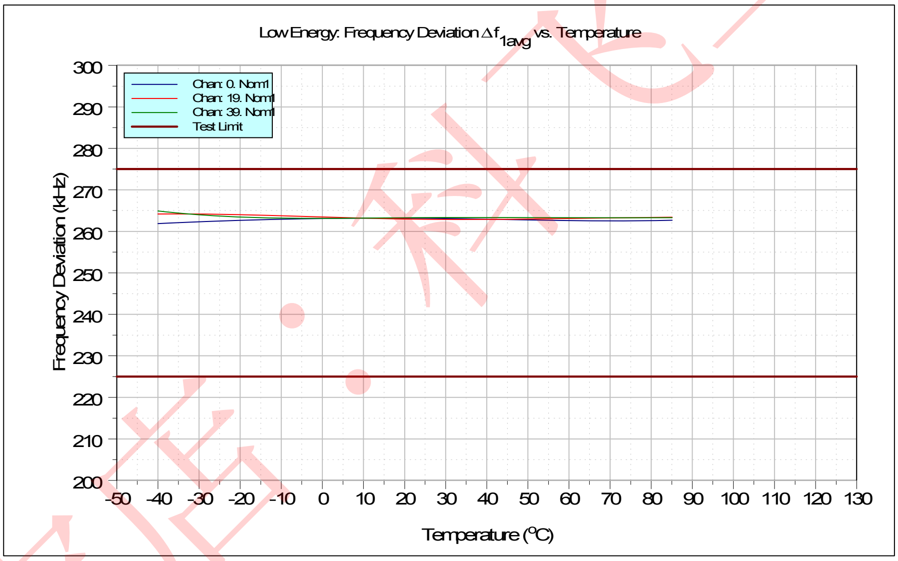

Figure 7.8: Frequency Deviation Δf_{1avg} vs. Temperature

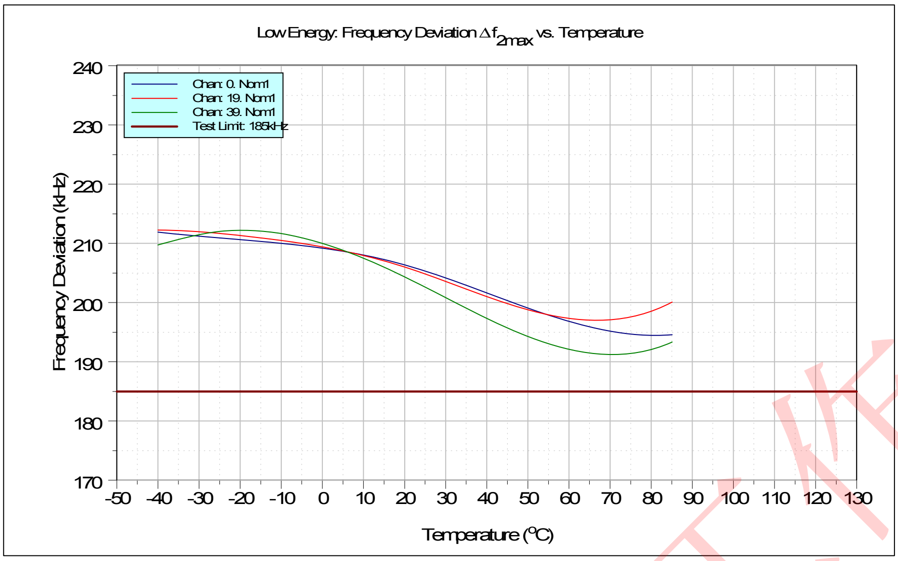

Figure 7.9: Frequency Deviation Δf_{2max} vs. Temperature

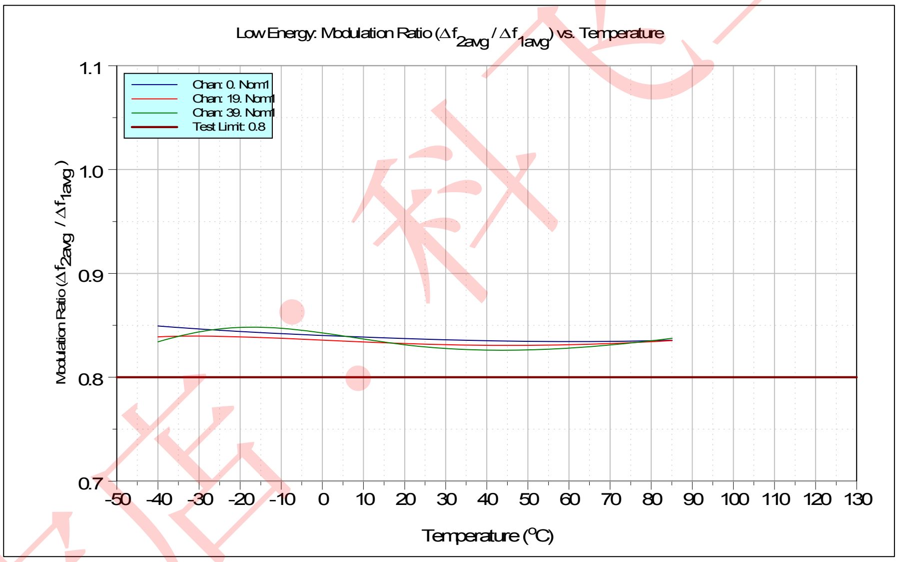

Figure 7.10: Modulation Ratio ($\Delta f_{2avg}/\Delta f_{1avg}$) vs. Temperature

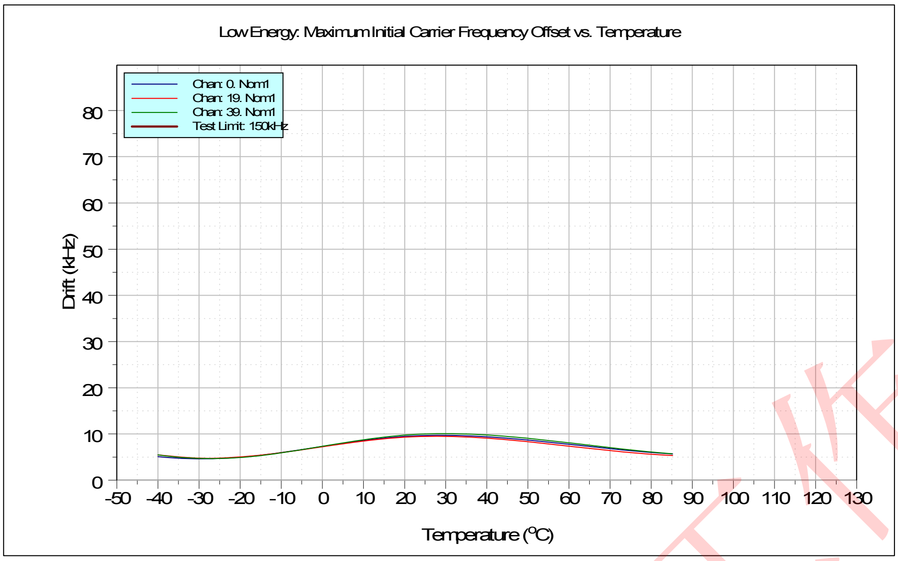

Figure 7.11: Initial Carrier Frequency Offset vs. Temperature

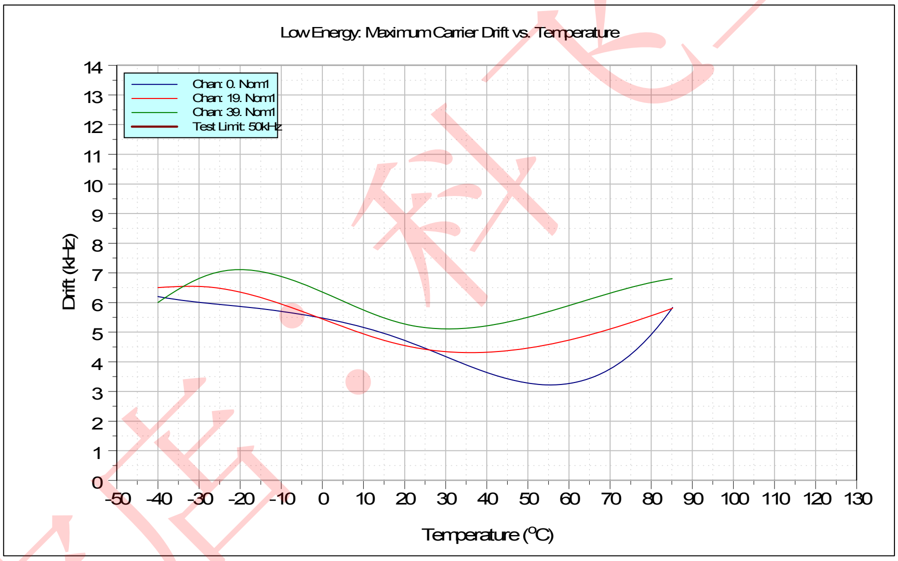

Figure 7.12: Carrier Frequency Drift vs. Temperature

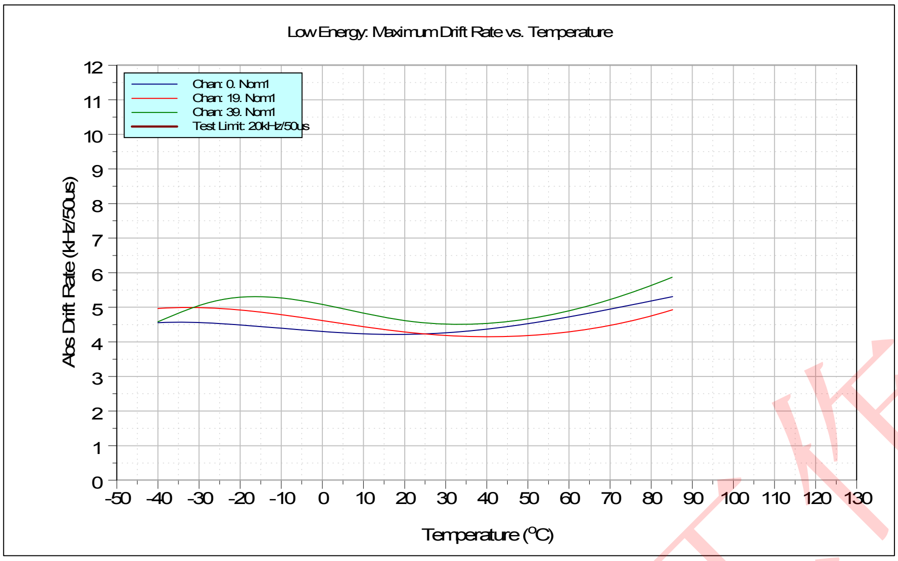

Figure 7.13: Carrier Frequency Drift Rate vs. Temperature

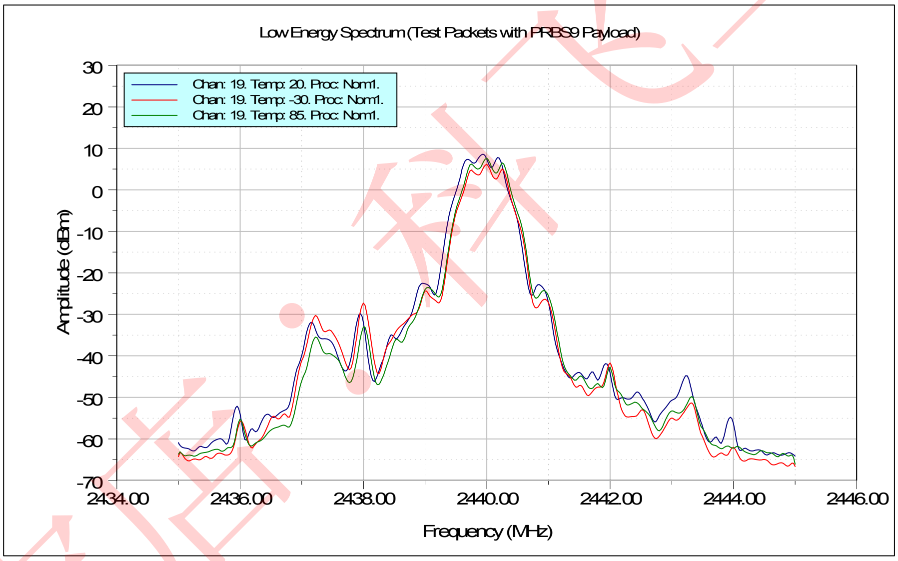

Figure 7.14: Spectrum

7.2 Receiver Performance

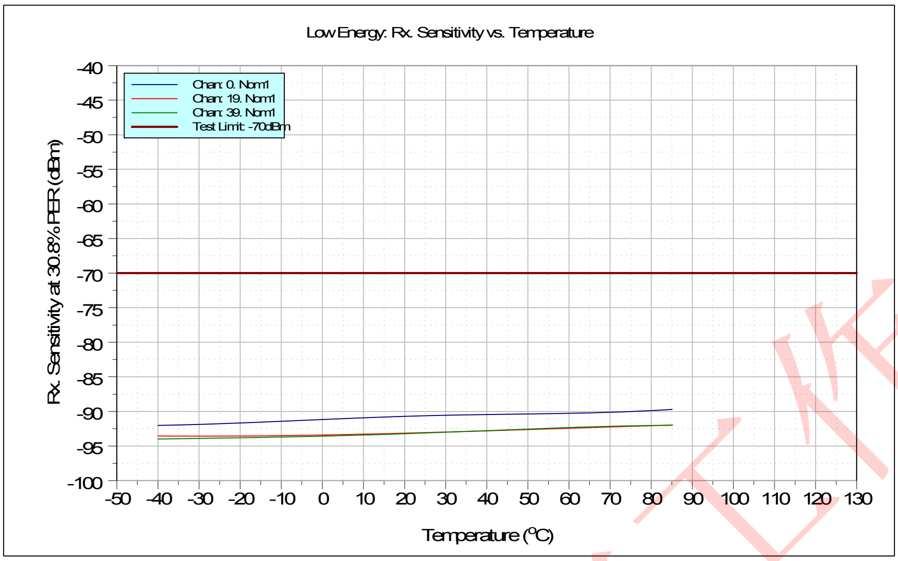

Figure 7.15: Receive Sensitivity vs. Temperature

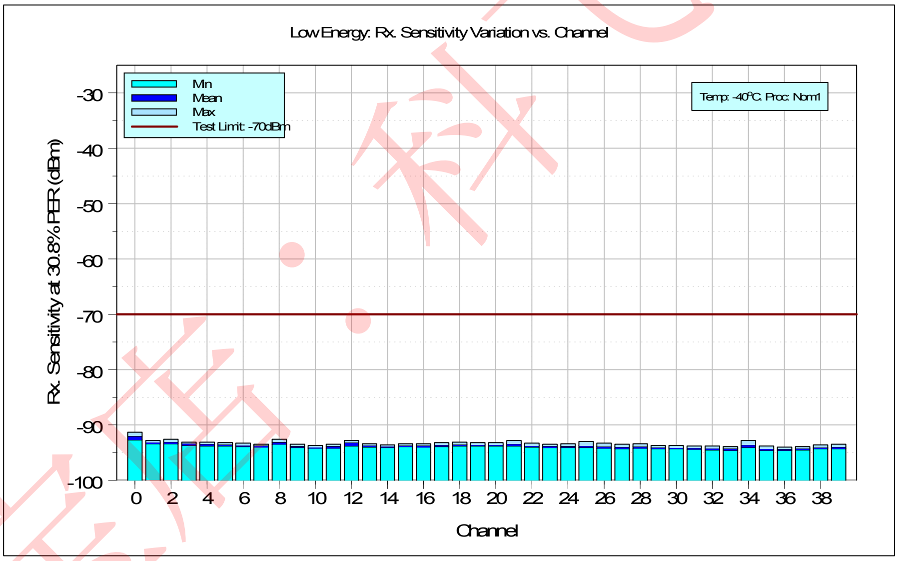

Figure 7.16: Receive Sensitivity Variation and Mean vs. Channel at -40°C

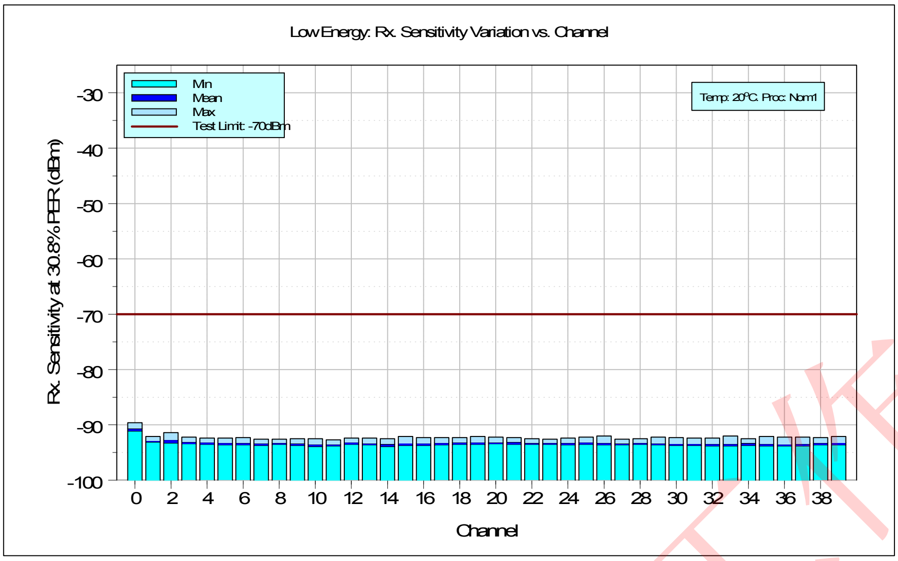

Figure 7.17: Receive Sensitivity Variation and Mean vs. Channel at 20°C

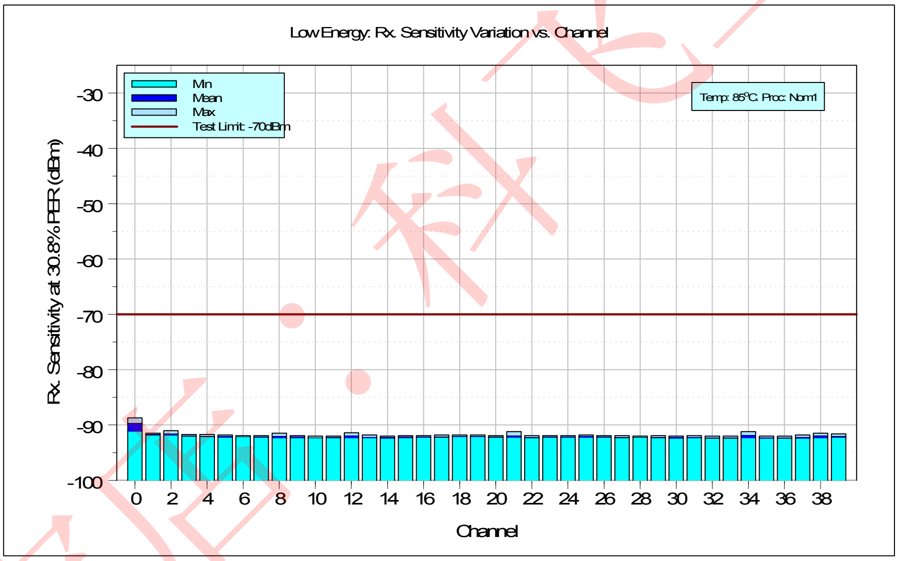

Figure 7.18: Receive Sensitivity Variation and Mean vs. Channel at 85°C

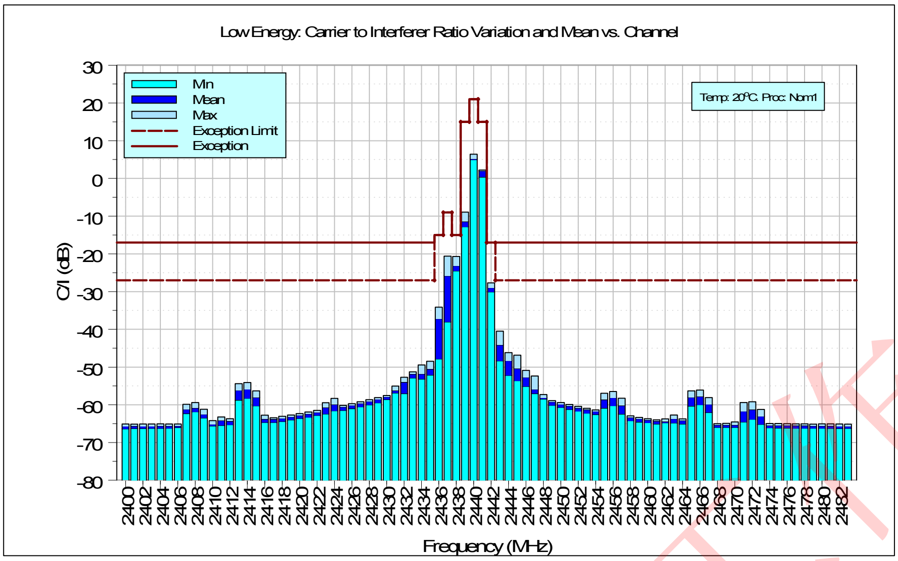

Figure 7.19: Carrier to Interferer Ratio and Mean vs. Frequency at 20°C

CSR8675 BGA Performance Specification

CSR

8 Typical Audio Performance: ADC

The audio graphs in this section were produced in the following conditions:

General

- At room temperature
- Using a single typical part mounted on a CSR development board (R13072v4)

Amplitude and Left/Right Balance vs. Analogue Gain

- Measurement bandwidth = 20Hz to 20kHz
- Amplitude response = RMS
- No weighting applied
- 1kHz input signal

Linearity

- Measurement bandwidth = 20Hz to 20kHz
- Amplitude response = RMS
- No weighting applied
- 1kHz input signal

Distortion (THD+N) vs. Frequency

- Measurement bandwidth = 20Hz to $F_S/2$, capped to 20kHz
- Amplitude response = RMS
- No weighting applied
- Input amplitude = 300mVrms
- Analogue gain set to 2, digital gain set to 0
- Roll off at low frequencies due to AC coupling capacitors on PCB

Noise Floor (Idle Noise) and SNR

- Measurement bandwidth = 20Hz to $F_S/2$, capped to 20kHz
- Amplitude response = RMS
- Weighting as stated on graph
- Input signal = 1kHz 0dBFS for SNR, muted for noise floor
- Analogue gain varied, digital gain set to 0

Output Spectrum

- Measurement bandwidth = 20Hz to 20kHz
- Amplitude response = RMS
- No weighting
- Input signal = 300mVrms
- Analogue gain set to 2, digital gain set to 0

8.1 Amplitude and Left/Right Balance vs Analogue Gain

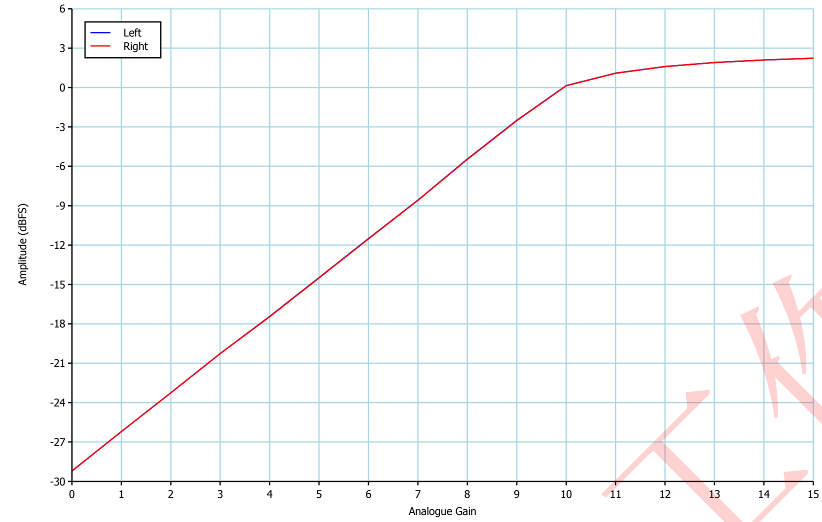

Figure 8.1: Amplitude vs. Analogue Gain at F_s = 48kHz and Input = 30mV

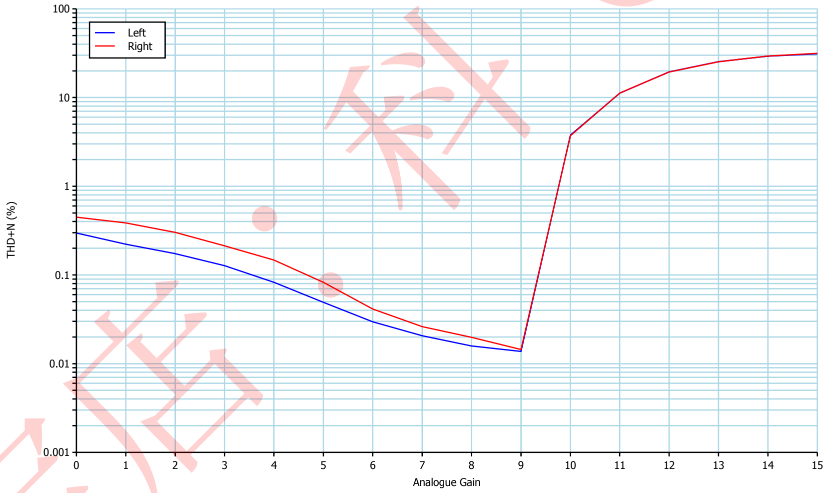

Figure 8.2: THD+N vs. Analogue Gain at F_s = 48kHz and Input = 30mV, Signal Starts Clipping above Analogue Gain 9

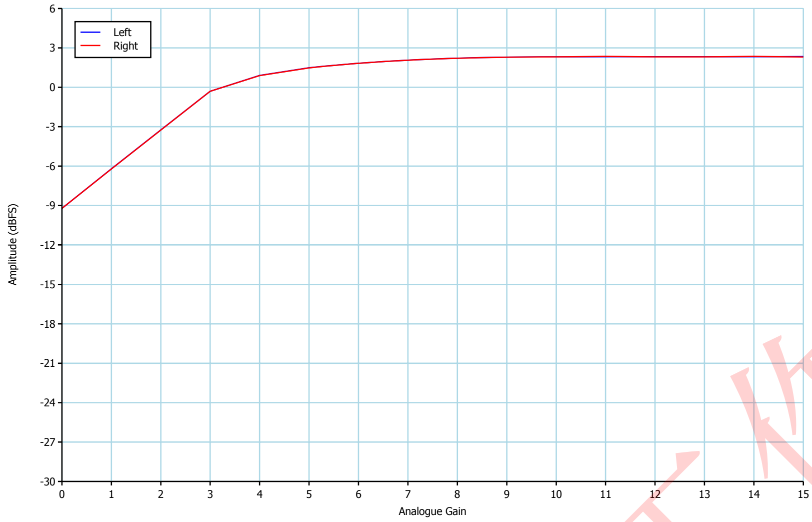

Figure 8.3: Amplitude vs. Analogue Gain at F_s = 48kHz and Input = 300mV

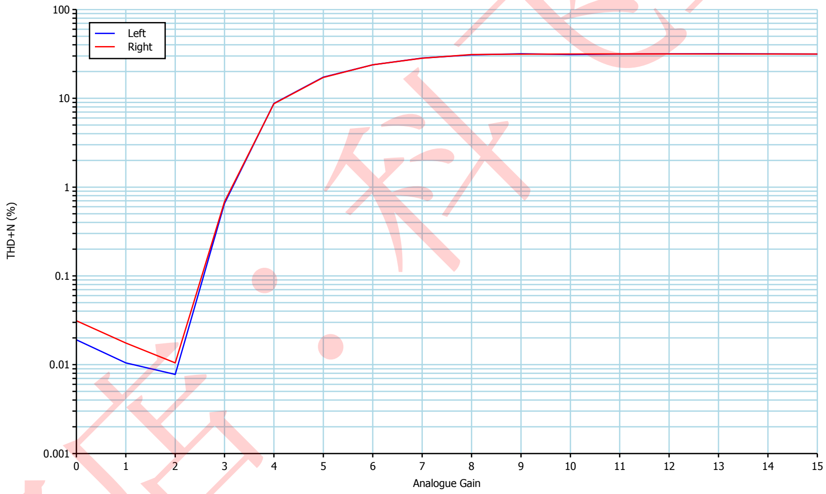

Figure 8.4: THD+N vs. Analogue Gain at F_s = 48kHz and Input = 300mV, Signal Starts Clipping above Analogue Gain 2

8.2 Linearity

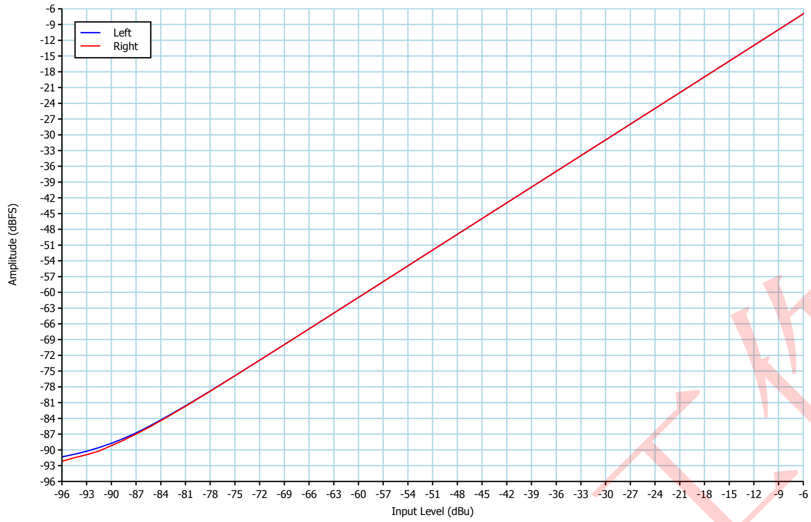

Figure 8.5: Amplitude vs. Input Level at F_S = 48kHz

8.3 Distortion (THD+N) vs. Frequency

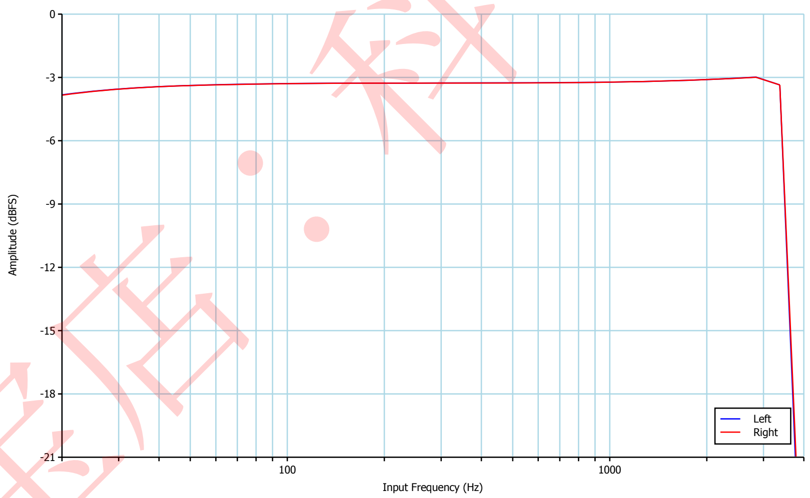

Figure 8.6: Amplitude vs. Input Frequency at F_S = 8kHz

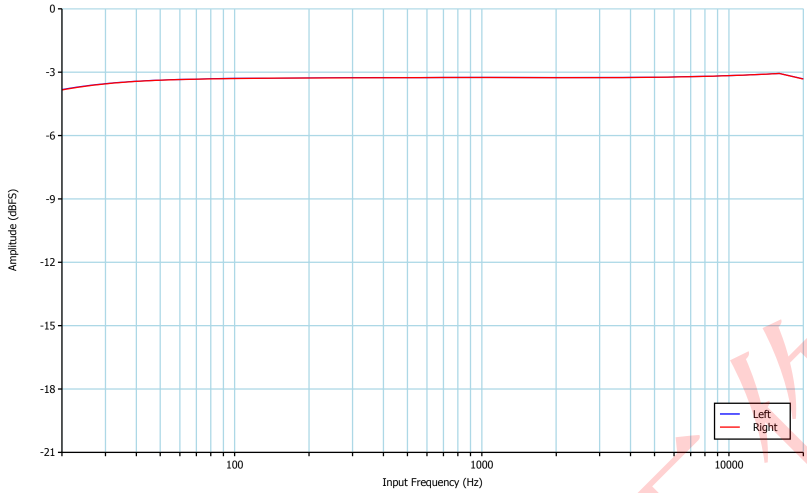

Figure 8.7: Amplitude vs. Input Frequency at F_s = 48kHz

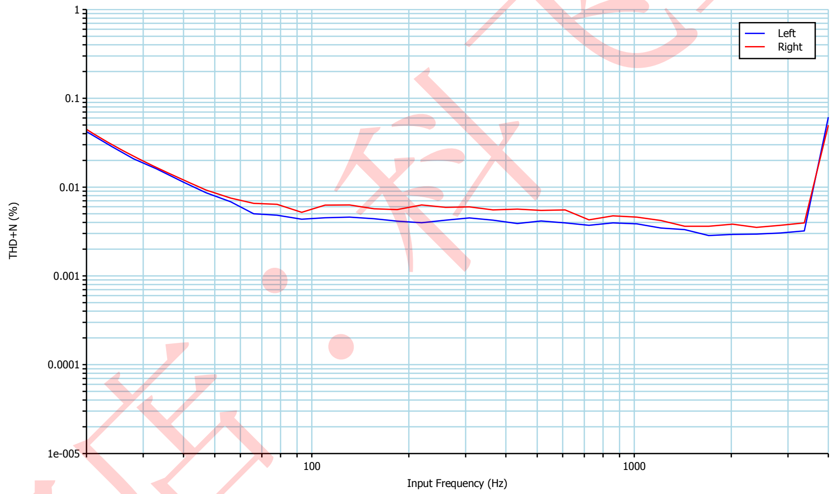

Figure 8.8: THD+N vs. Input Frequency at F_s = 8kHz

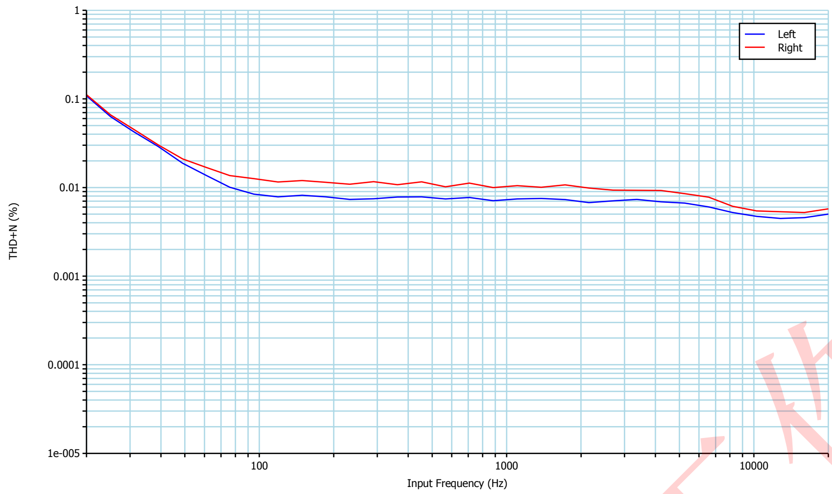

Figure 8.9: THD+N vs. Input Frequency at F_s = 48kHz

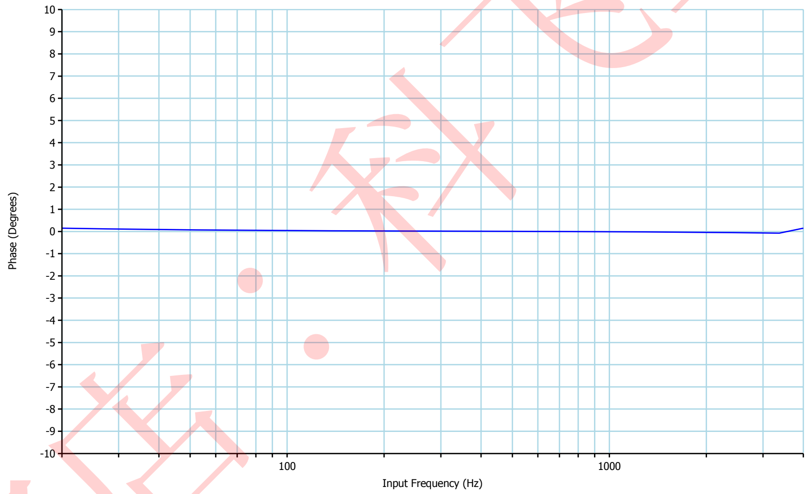

Figure 8.10: Phase vs. Input Frequency at F_s = 8kHz

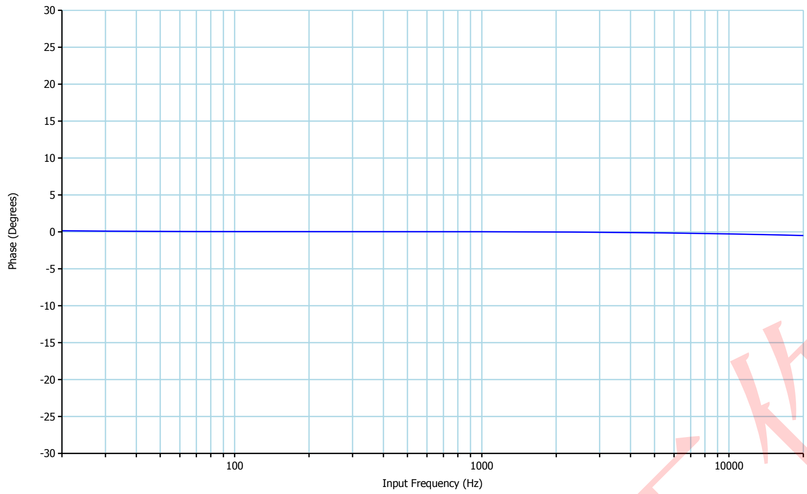

Figure 8.11: Phase vs. Input Frequency at F_s = 48kHz

8.4 Noise Floor (Idle Noise) and SNR

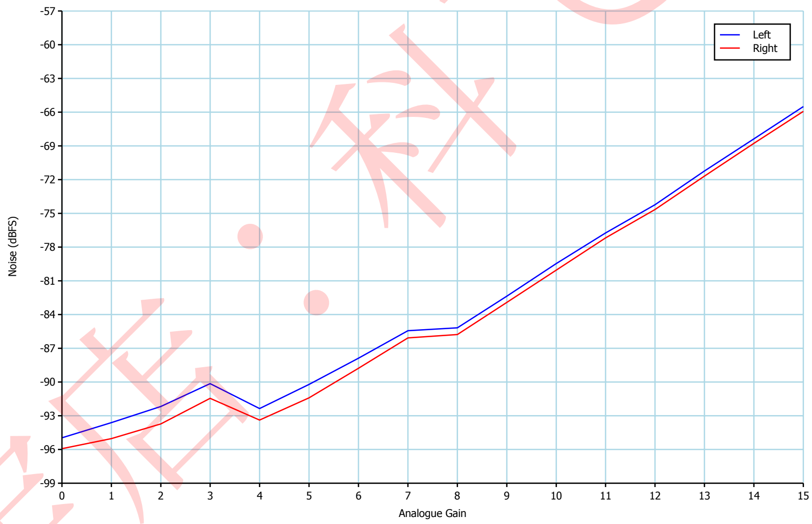

Figure 8.12: Noise Floor at F_s = 48kHz, Bluetooth Inquiry Off, A-Weighting

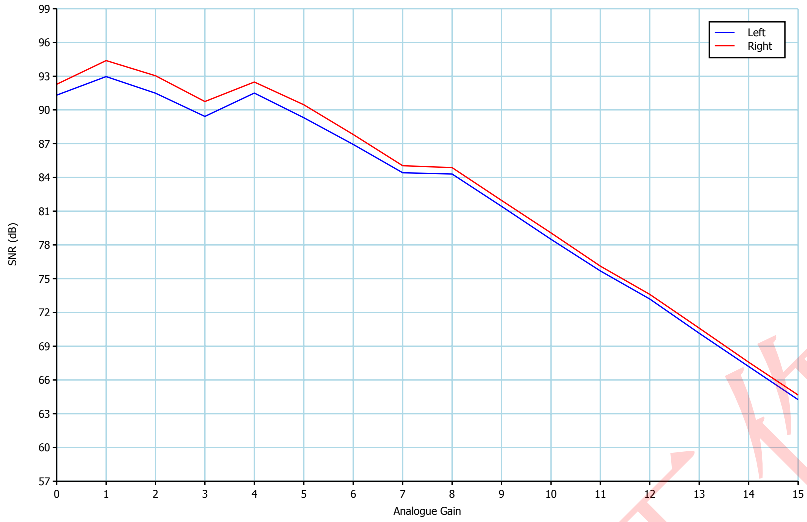

Figure 8.13: SNR at F_s = 48kHz, Bluetooth Inquiry Off, A-Weighting

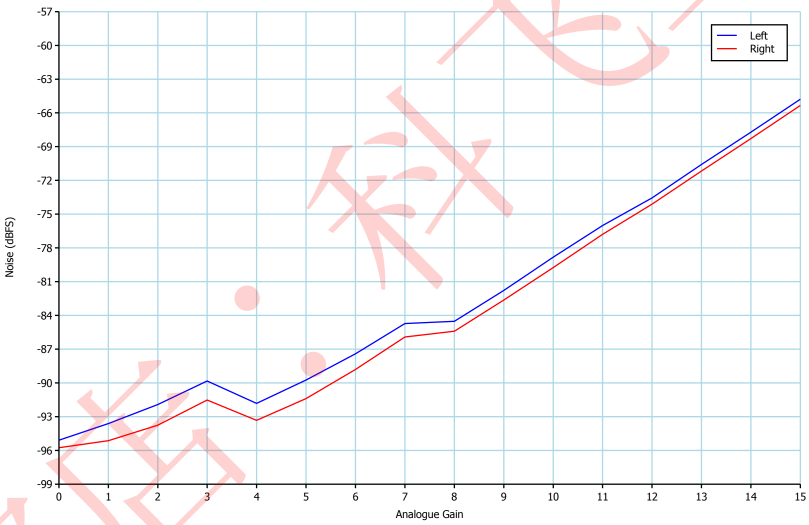

Figure 8.14: Noise Floor at F_s = 48kHz, Bluetooth Inquiry On, A-Weighting

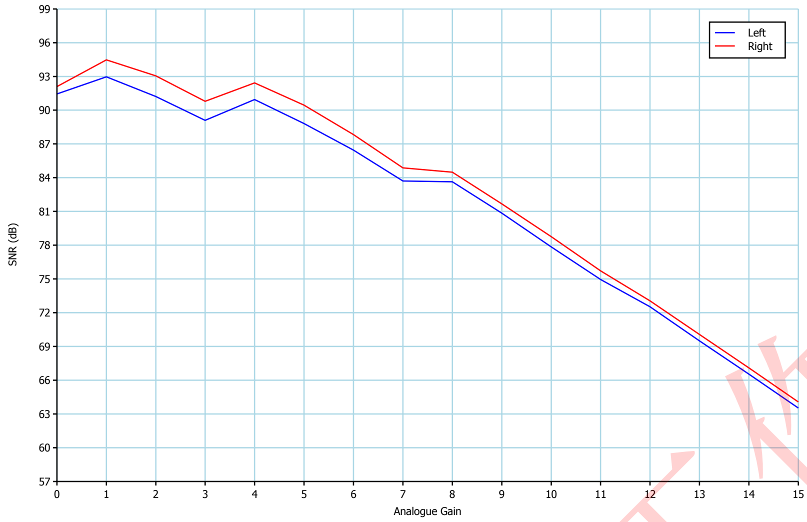

Figure 8.15: SNR at F_s = 48kHz, Bluetooth Inquiry On, A-Weighting

8.5 FFT at 1kHz

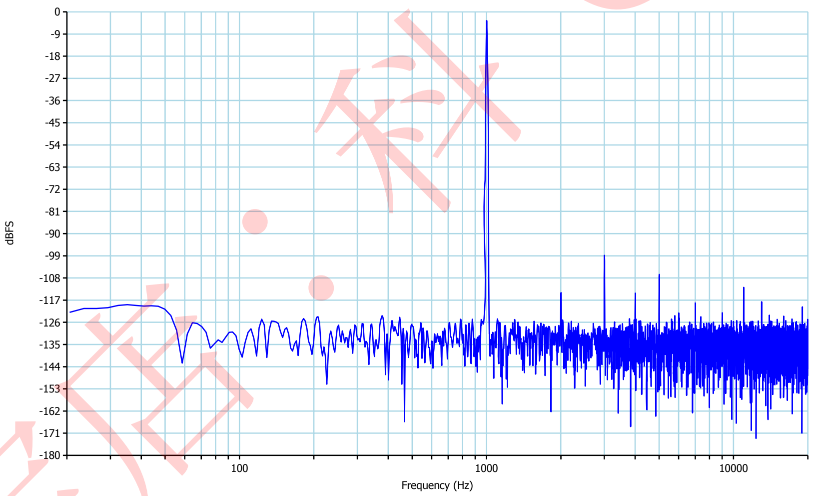

Figure 8.16: 1 KHz FFT at F_s = 48kHz, Bluetooth Inquiry Off, Left Channel

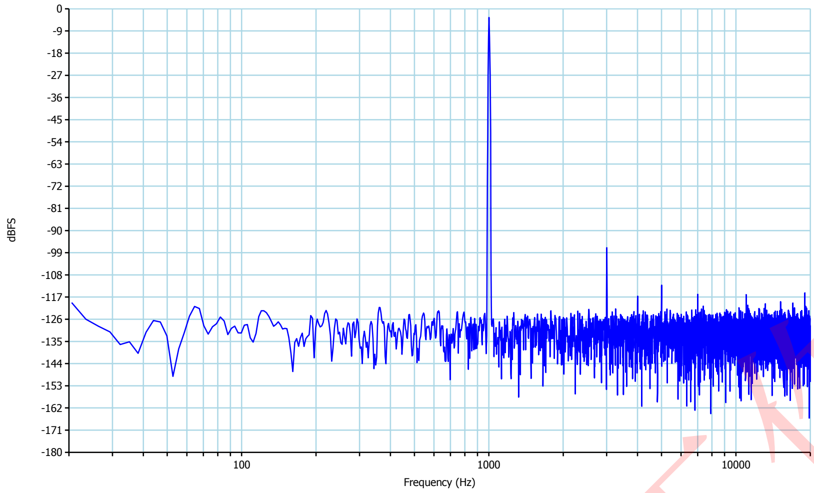

Figure 8.17: 1 KHz FFT at F_s = 48kHz, Bluetooth Inquiry Off, Right Channel

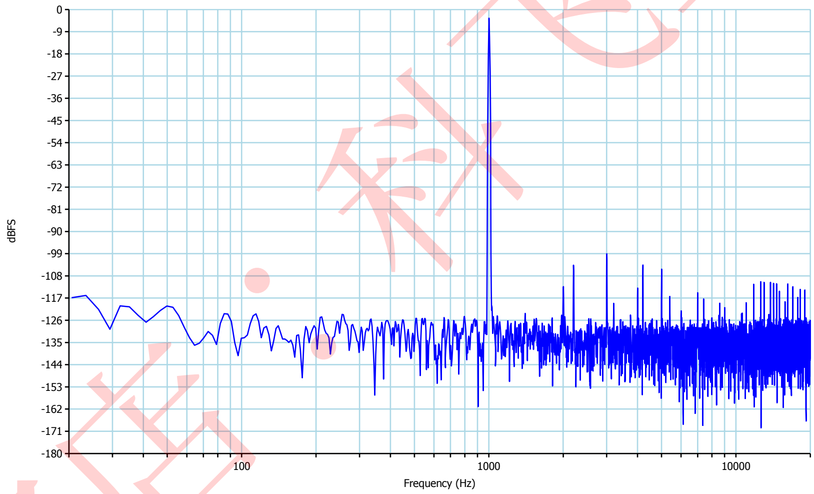

Figure 8.18: 1 KHz FFT at F_s = 48kHz, Bluetooth Inquiry On, Left Channel

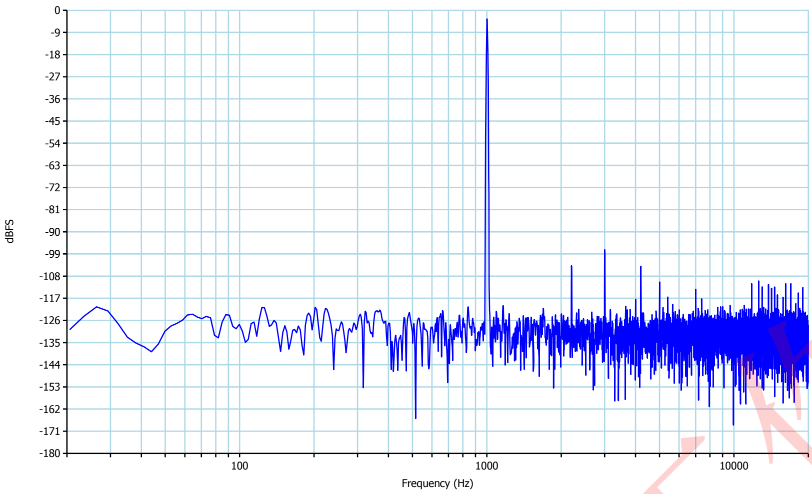

Figure 8.19: 1 KHz FFT at F_S = 48kHz, Bluetooth Inquiry On, Right Channel

9 Typical Audio Performance: DAC

The audio graphs in this section were produced in the following conditions:

General

- At room temperature
- Using a single typical part mounted on a CSR development board (R13072v4)

Amplitude and Left/Right Balance vs. Analogue Gain

- Measurement bandwidth = 20Hz to 20kHz
- Amplitude response = RMS
- No weighting applied
- Input signal = 0dBFS, 1kHz
- Analogue gain varied, digital gain set to 0

Linearity

- Measurement bandwidth = 20Hz to 20kHz
- Amplitude response = RMS
- No weighting applied
- Input signal = 1kHz
- Analogue gain varied, digital gain set to 0

Distortion (THD+N) vs. Frequency

- Measurement bandwidth = 20Hz to 20kHz
- Amplitude response = RMS
- No weighting applied
- Input signal = 0dBFS, 1kHz
- Analogue gain set to 15, digital gain set to 0

Noise Floor (Idle Noise) and SNR

- Measurement bandwidth = 20Hz to 20kHz
- Amplitude response = RMS
- Weighting as stated on graph
- Input signal = 0dBFS, 1kHz
- Analogue gain varied, digital gain set to 0

Output Spectrum

- Measurement bandwidth = 20Hz to 20kHz
- Amplitude response = RMS
- No weighting
- Input signal = -60dBFS, 1kHz
- Analogue gain set to 7, digital gain set to 0

Digital Microphone

- Measurement bandwidth = 20Hz to 20kHz
- Amplitude response = RMS
- No weighting
- Input signal = 2nd order PCM to sigma-delta modulator, 1kHz
- Microphone clock frequency = 4MHz

9.1 Amplitude and Left/Right Balance vs Analogue Gain

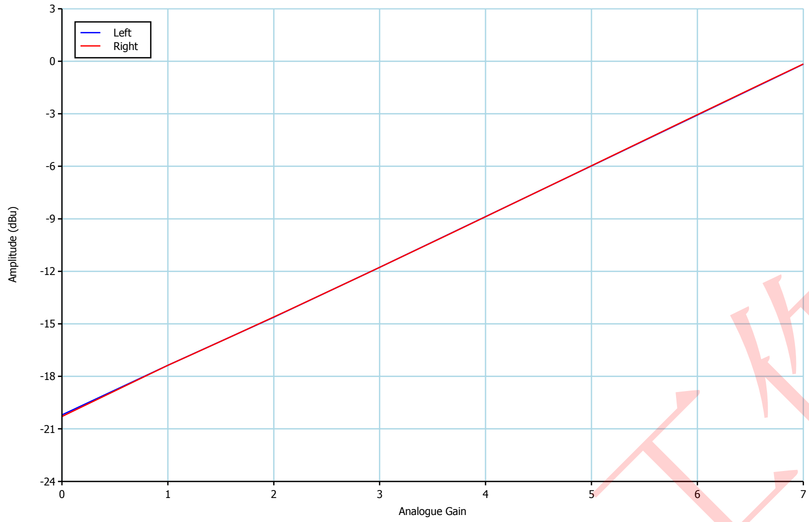

Figure 9.1: Amplitude vs. Analogue Gain: F_s = 48kHz, Load = 100kΩ

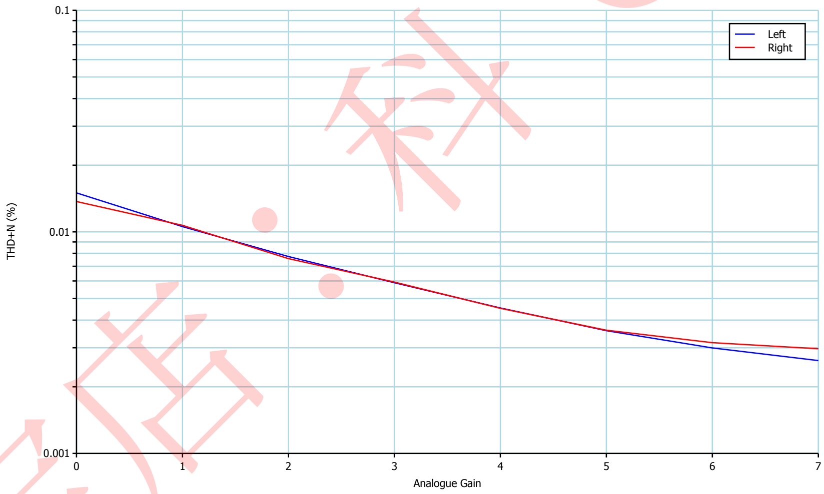

Figure 9.2: THD+N vs. Analogue Gain: F_s = 48kHz, Load = 100kΩ

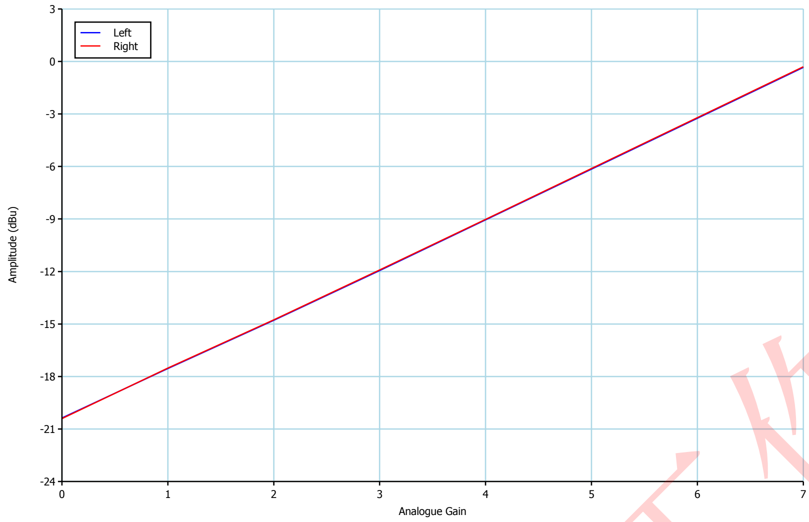

Figure 9.3: Amplitude vs. Analogue Gain: F_S = 48kHz, Load = 32Ω

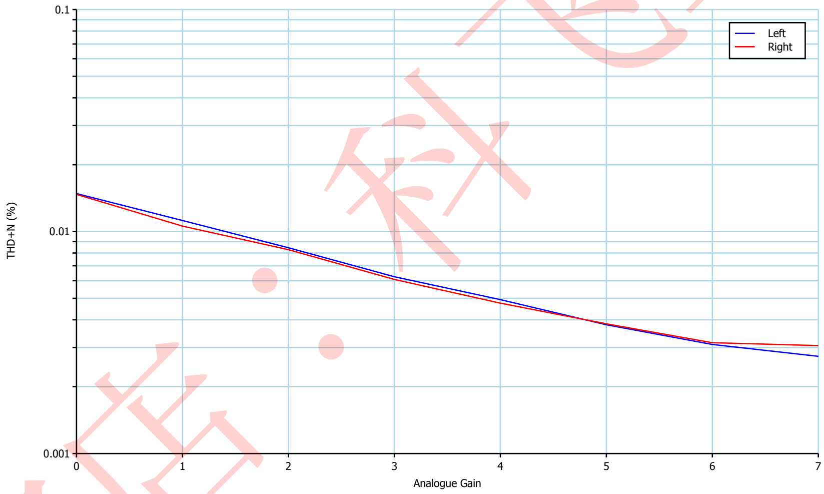

Figure 9.4: THD+N vs. Analogue Gain: F_S = 48kHz, Load = 32Ω

CSR

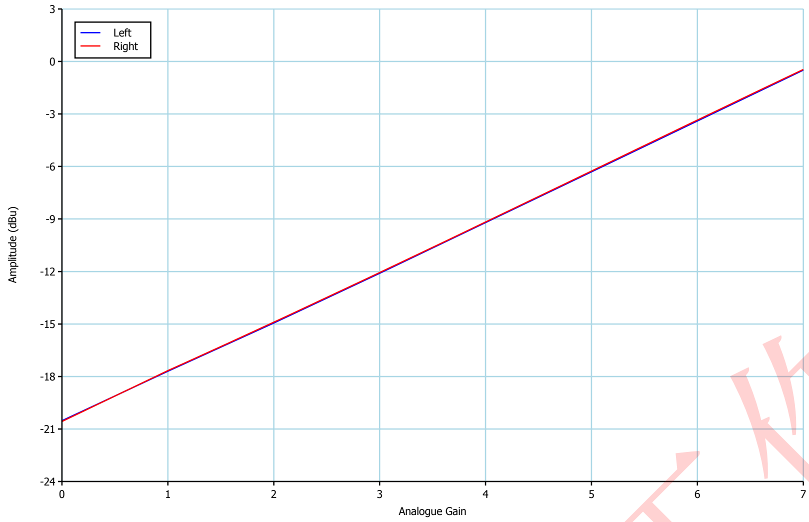

Figure 9.5: Amplitude vs. Analogue Gain: F_S = 48kHz, Load = 16Ω

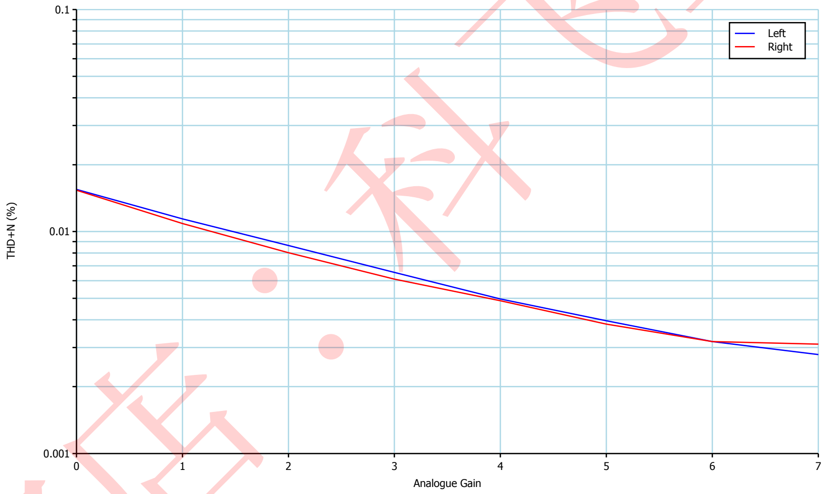

Figure 9.6: THD+N vs. Analogue Gain: F_S = 48kHz, Load = 16Ω

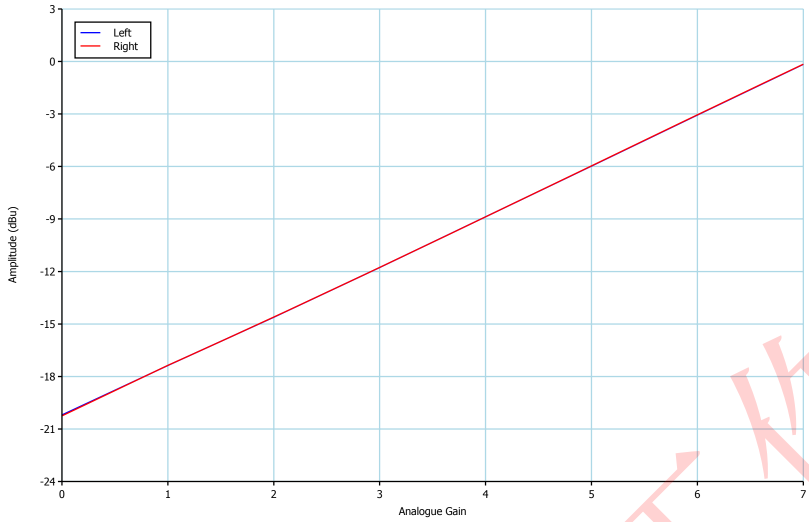

Figure 9.7: Amplitude vs. Analogue Gain: F_s = 96kHz, Load = 100kΩ

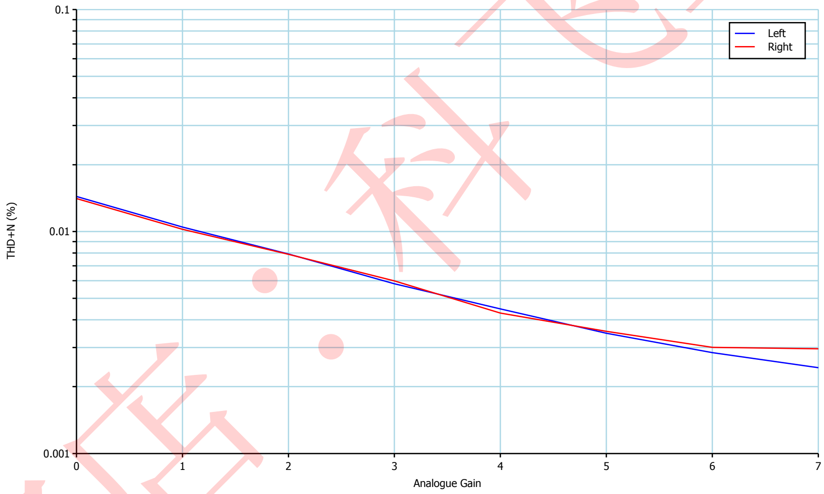

Figure 9.8: THD+N vs. Analogue Gain: F_s = 96kHz, Load = 100kΩ

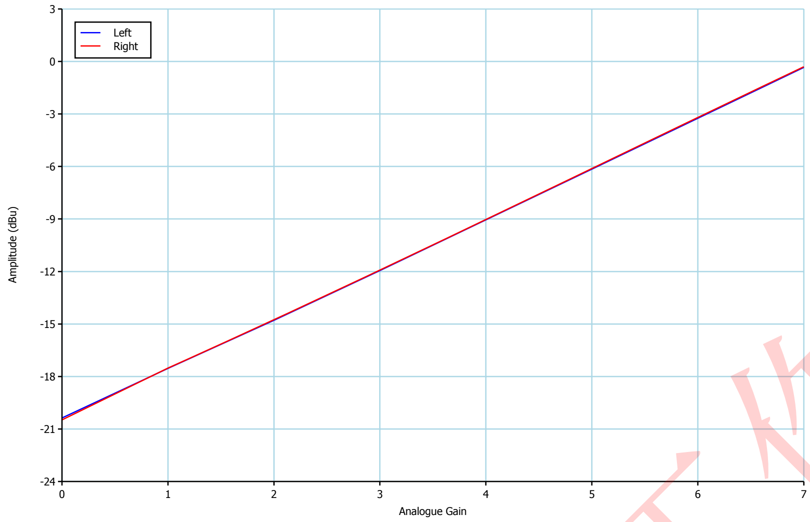

Figure 9.9: Amplitude vs. Analogue Gain: F_s = 96kHz, Load = 32Ω

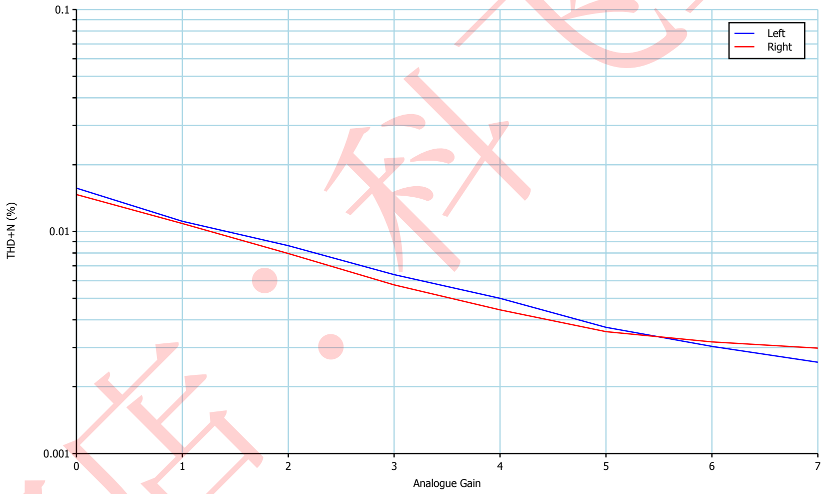

Figure 9.10: THD+N vs. Analogue Gain: F_s = 96kHz, Load = 32Ω

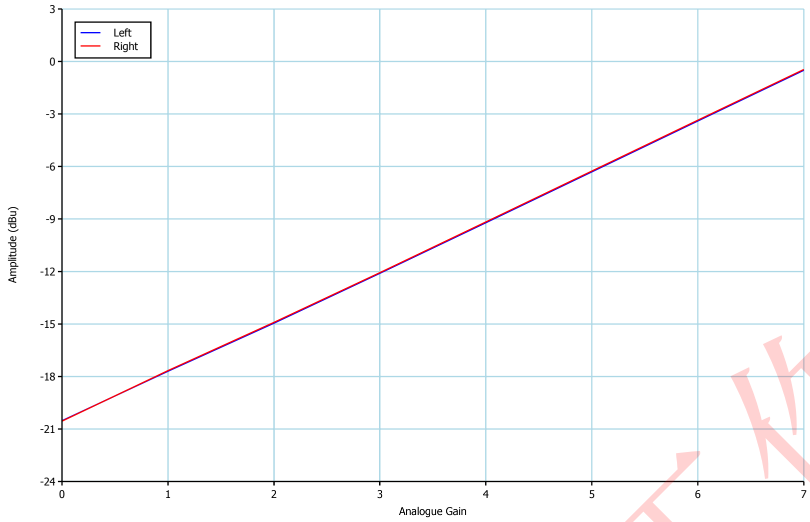

Figure 9.11: Amplitude vs. Analogue Gain: F_s = 96kHz, Load = 16Ω

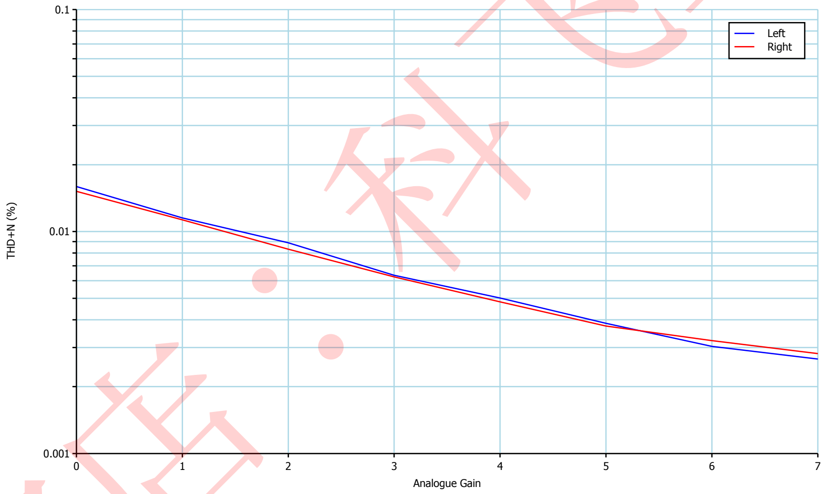

Figure 9.12: THD+N vs. Analogue Gain: F_s = 96kHz, Load = 16Ω

9.2 Linearity and THD+N

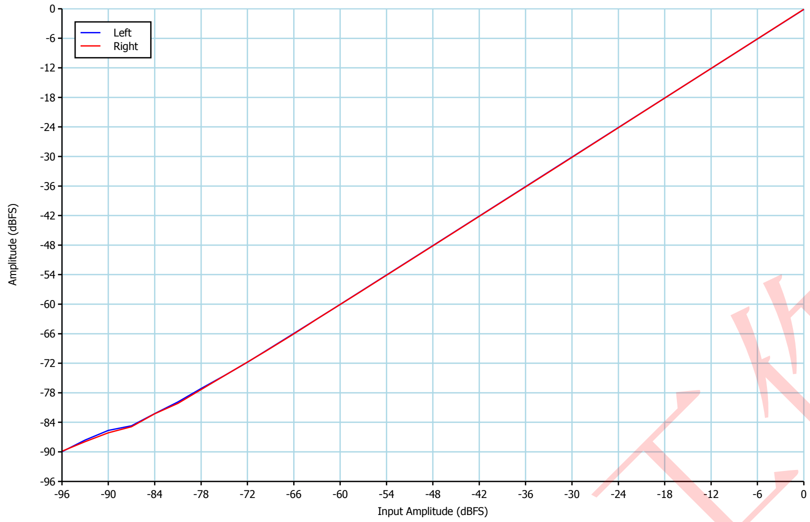

Figure 9.13: Output Amplitude vs. Input Amplitude: F_s = 48kHz, Load = 100kΩ

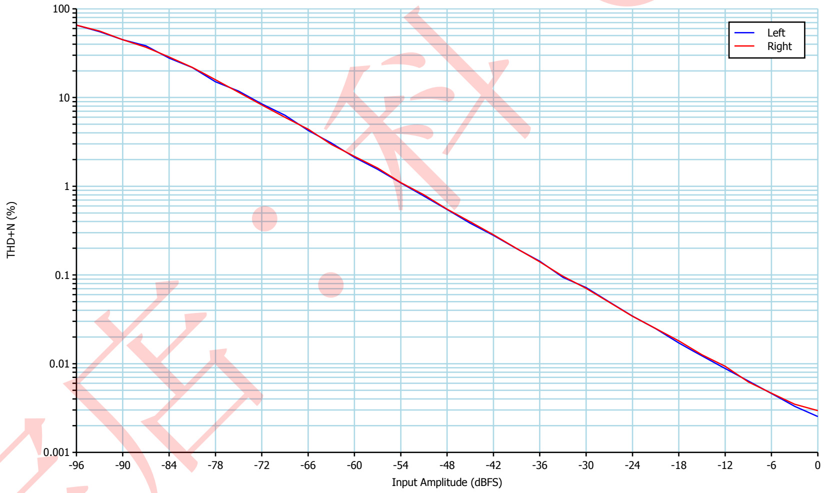

Figure 9.14: THD+N vs. Input Amplitude: F_s = 48kHz, Load = 100kΩ

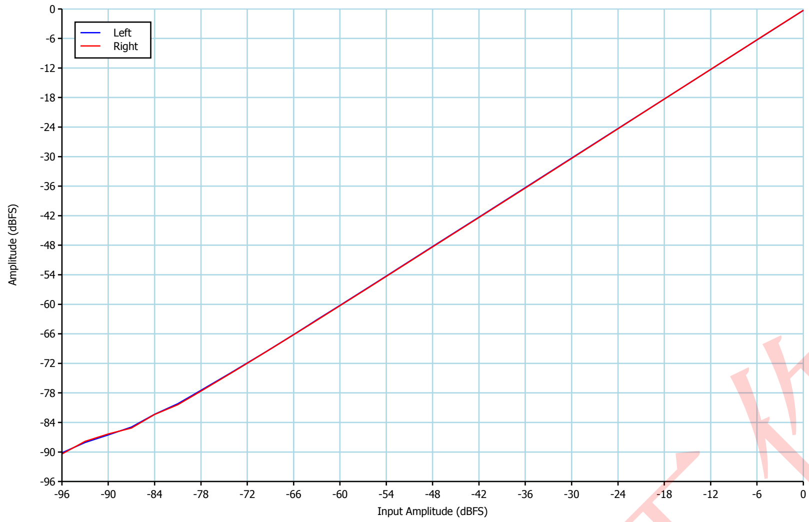

Figure 9.15: Output Amplitude vs. Input Amplitude: F_s = 48kHz, Load = 32Ω

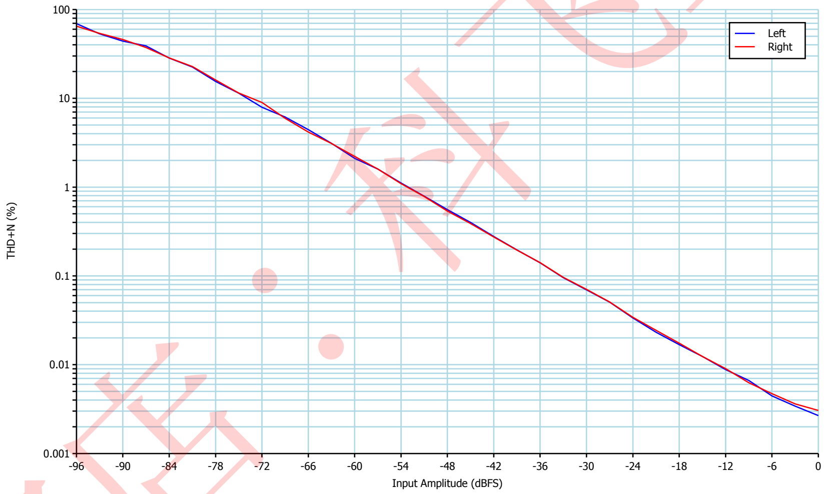

Figure 9.16: THD+N vs. Input Amplitude: F_s = 48kHz, Load = 32Ω

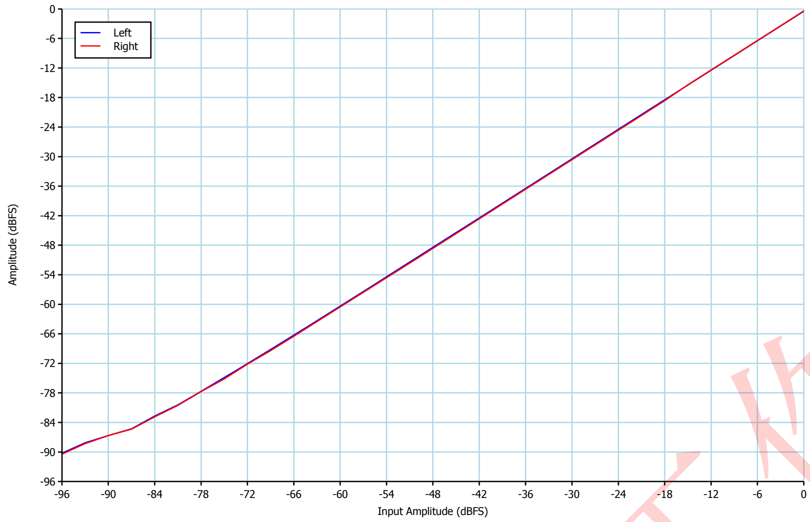

Figure 9.17: Output Amplitude vs. Input Amplitude: F_s = 48kHz, Load = 16Ω

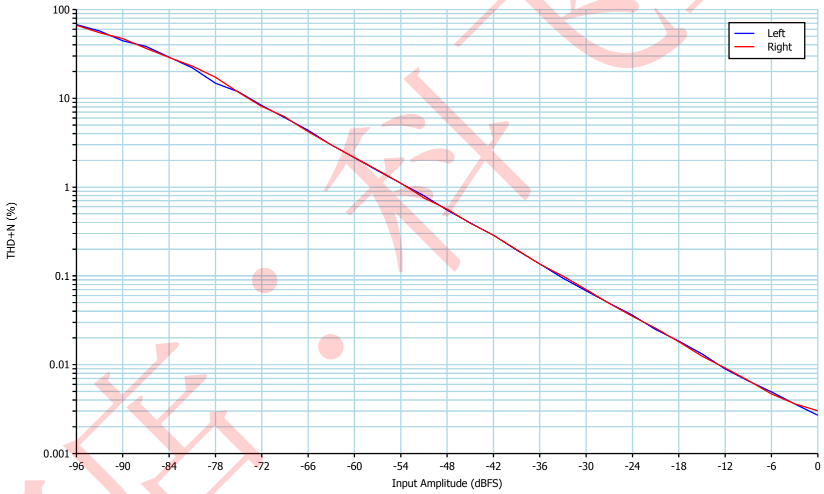

Figure 9.18: THD+N vs. Input Amplitude: F_s = 48kHz, Load = 16Ω

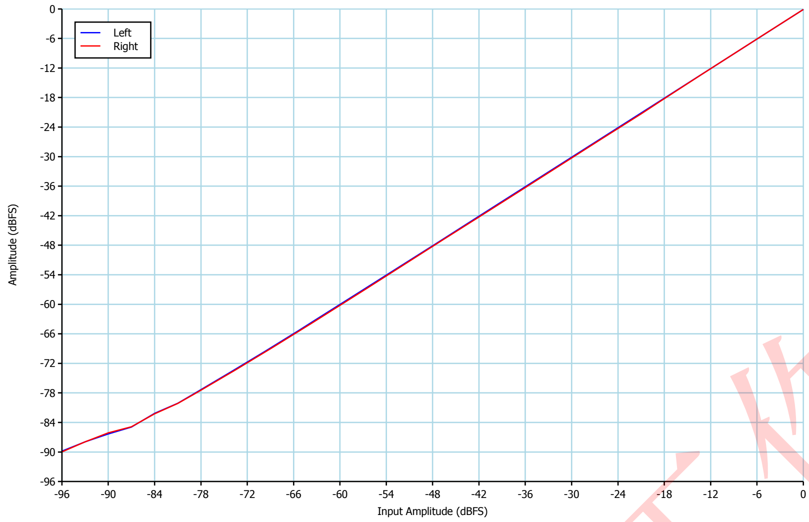

Figure 9.19: Output Amplitude vs. Input Amplitude: F_s = 96kHz, Load = 100kΩ

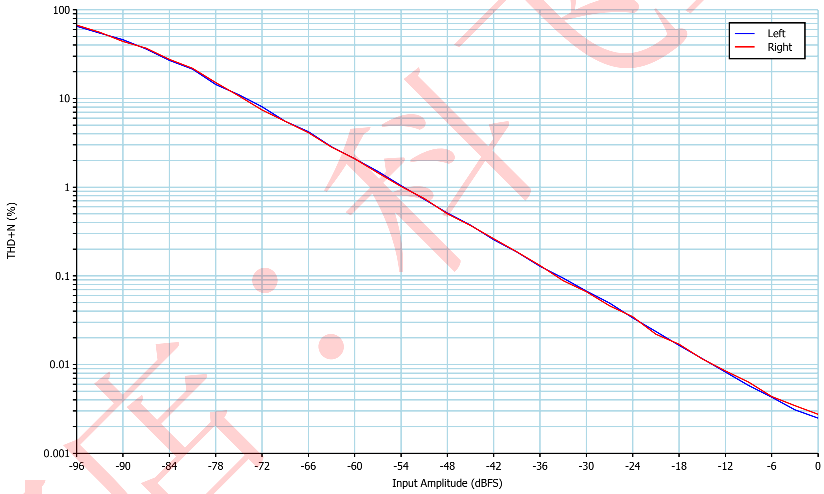

Figure 9.20: THD+N vs. Input Amplitude: F_s = 96kHz, Load = 100kΩ

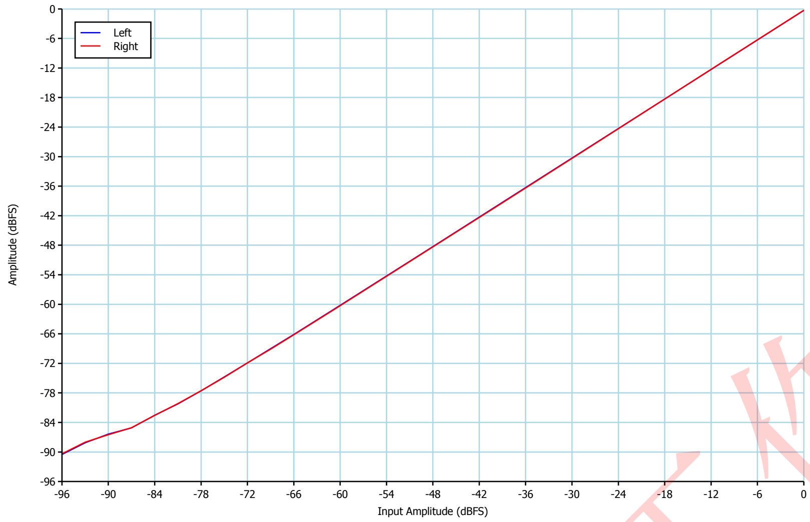

Figure 9.21: Output Amplitude vs. Input Amplitude: F_s = 96kHz, Load = 32Ω

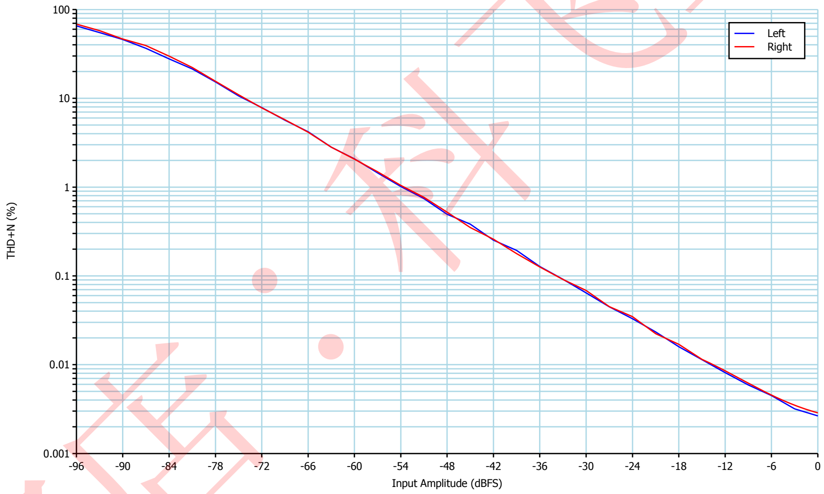

Figure 9.22: THD+N vs. Input Amplitude: F_s = 96kHz, Load = 32Ω

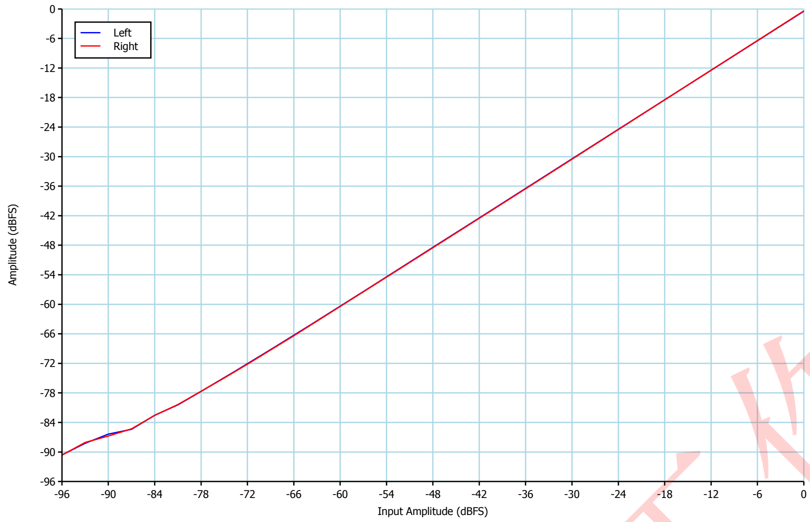

Figure 9.23: Output Amplitude vs. Input Amplitude: F_s = 96kHz, Load = 16Ω

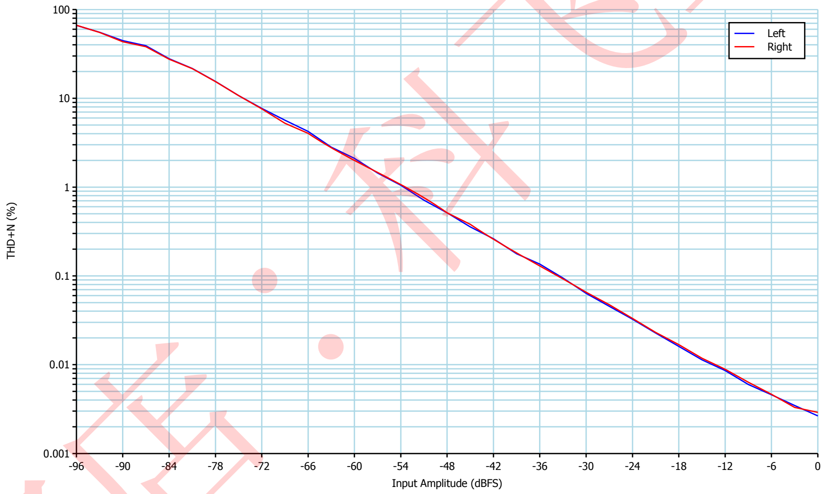

Figure 9.24: THD+N vs. Input Amplitude: F_s = 96kHz, Load = 16Ω

9.3 Distortion (THD+N) vs. Frequency

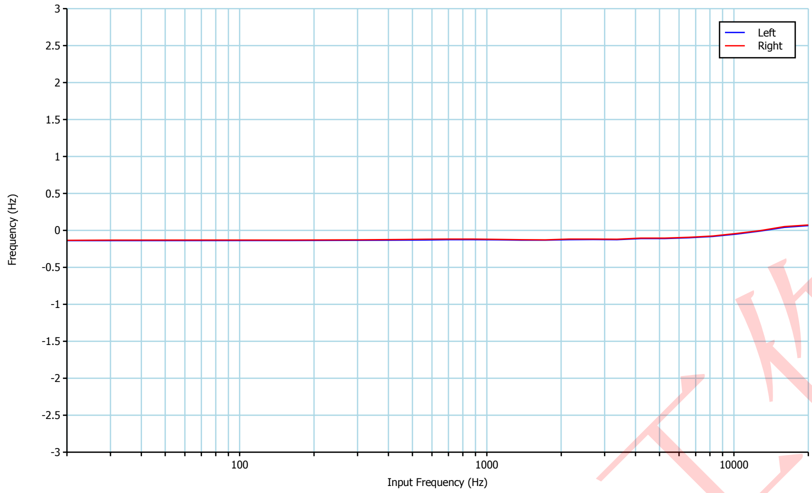

Figure 9.25: Output Amplitude vs. Input Frequency: F_s = 48kHz, Load = 100kΩ

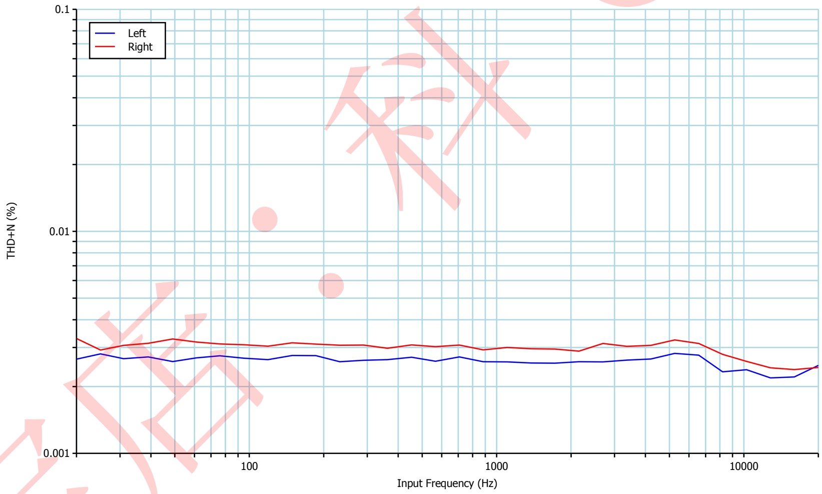

Figure 9.26: THD+N vs. Input Frequency: F_s = 48kHz, Load = 100kΩ

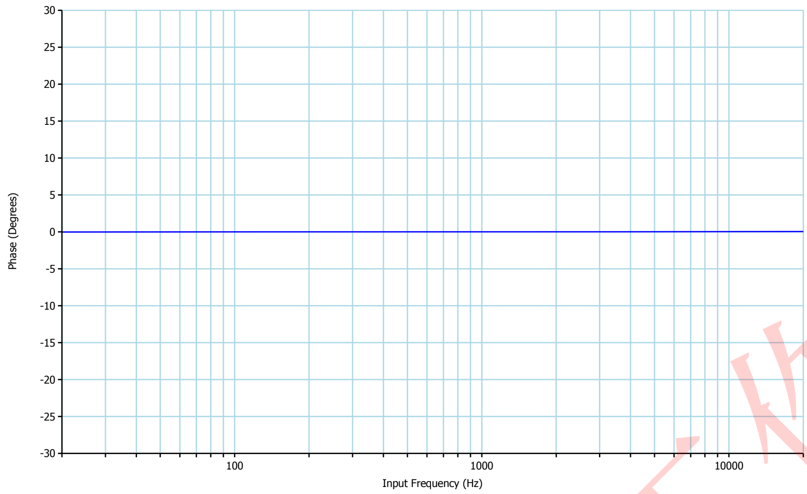

Figure 9.27: Phase vs. Frequency: F_s = 48kHz, Load = 100kΩ

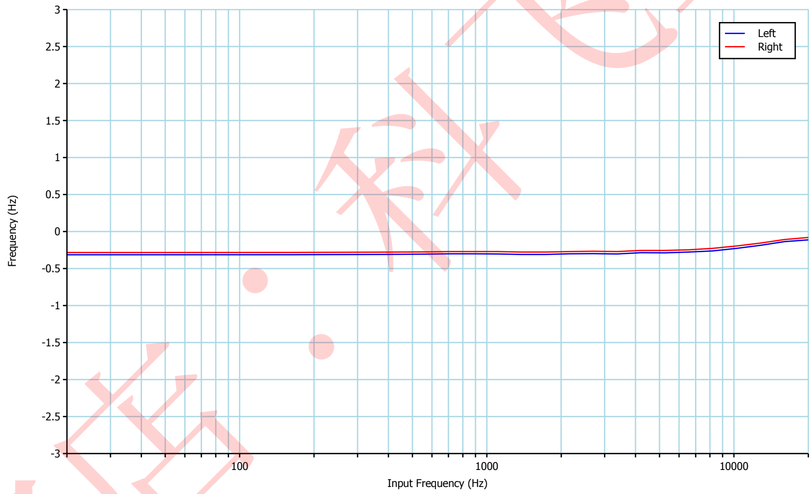

Figure 9.28: Output Amplitude vs. Input Frequency: F_s = 48kHz, Load = 32Ω

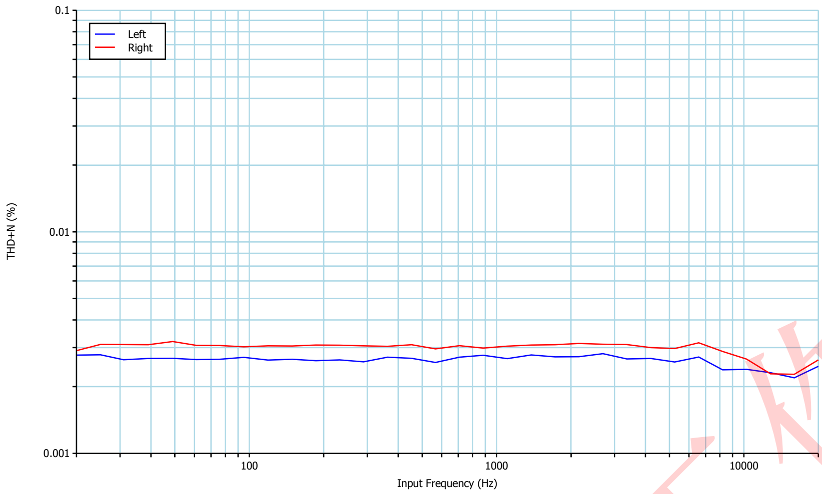

Figure 9.29: THD+N vs. Input Frequency: F_s = 48kHz, Load = 32Ω

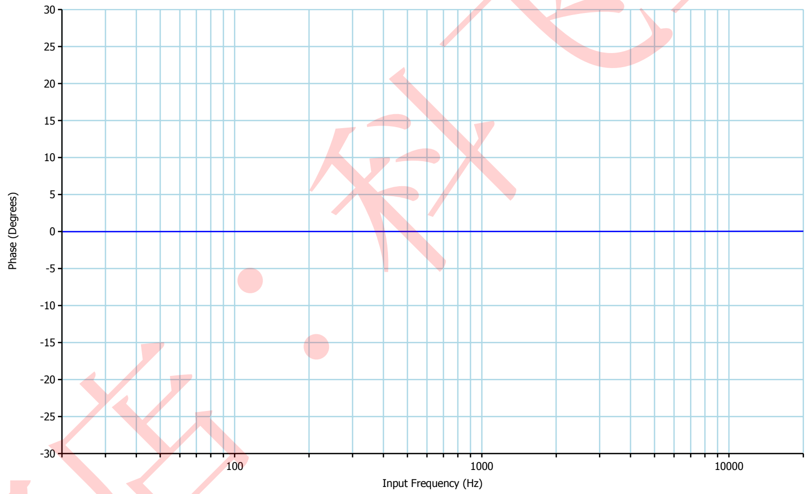

Figure 9.30: Phase vs. Frequency: F_s = 48kHz, Load = 32Ω

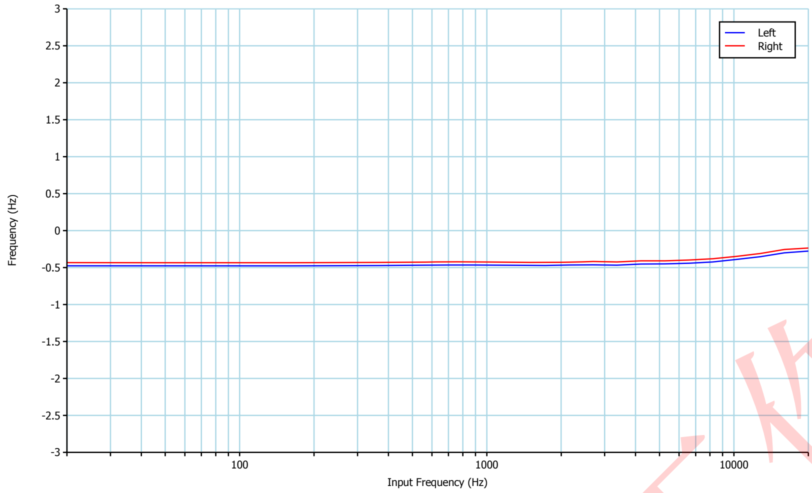

Figure 9.31: Output Amplitude vs. Input Frequency: F_S = 48kHz, Load = 16Ω

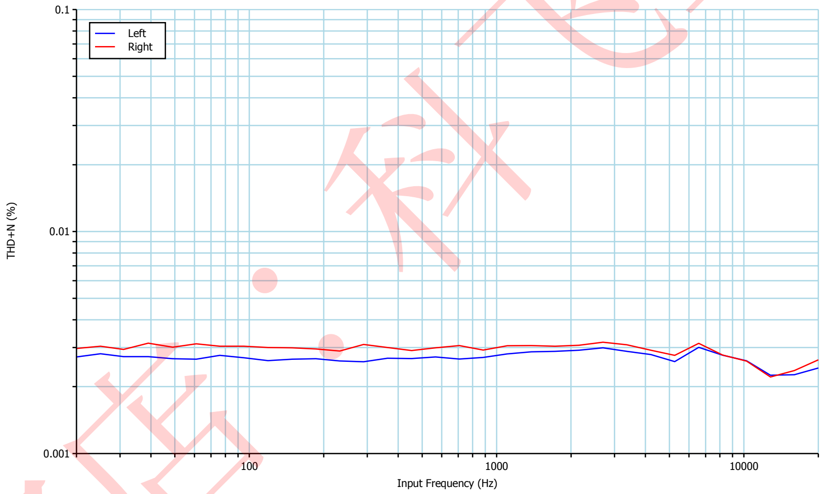

Figure 9.32: THD+N vs. Input Frequency: F_S = 48kHz, Load = 16Ω

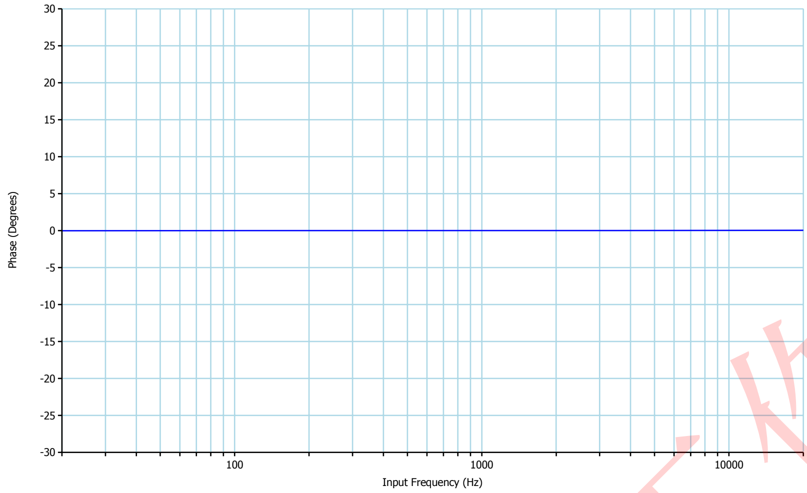

Figure 9.33: Phase vs. Frequency: F_s = 48kHz, Load = 16Ω

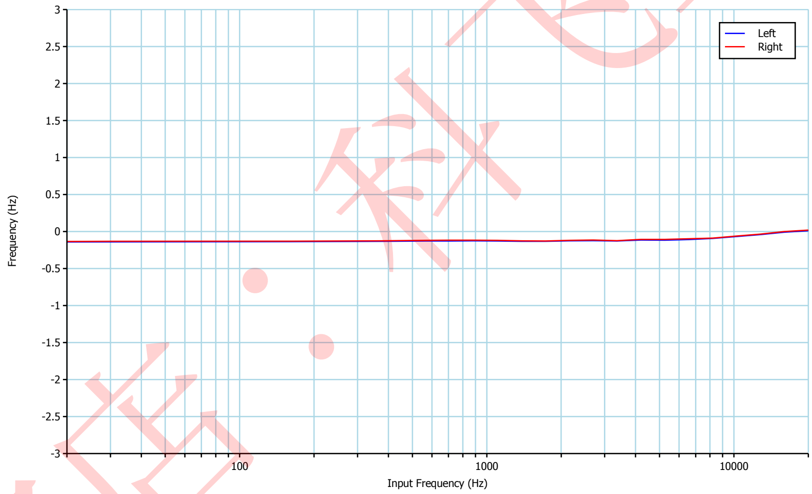

Figure 9.34: Output Amplitude vs. Input Frequency: F_s = 96kHz, Load = 100kΩ

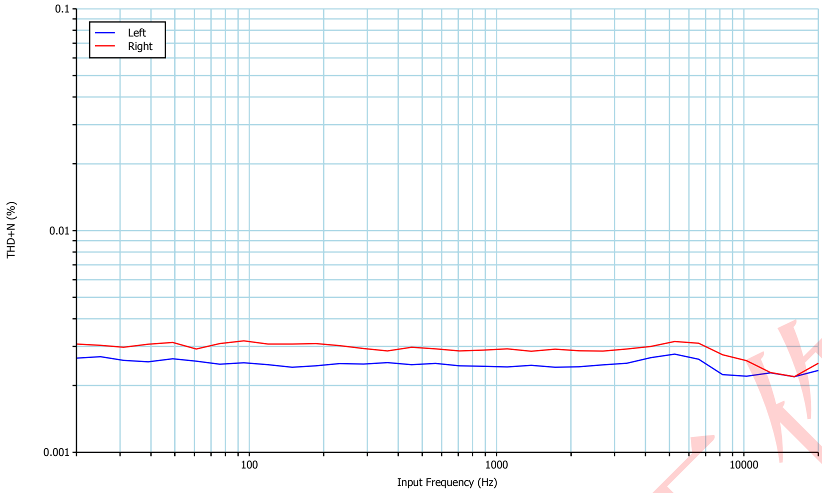

Figure 9.35: THD+N vs. Input Frequency: F_s = 96kHz, Load = 100kΩ

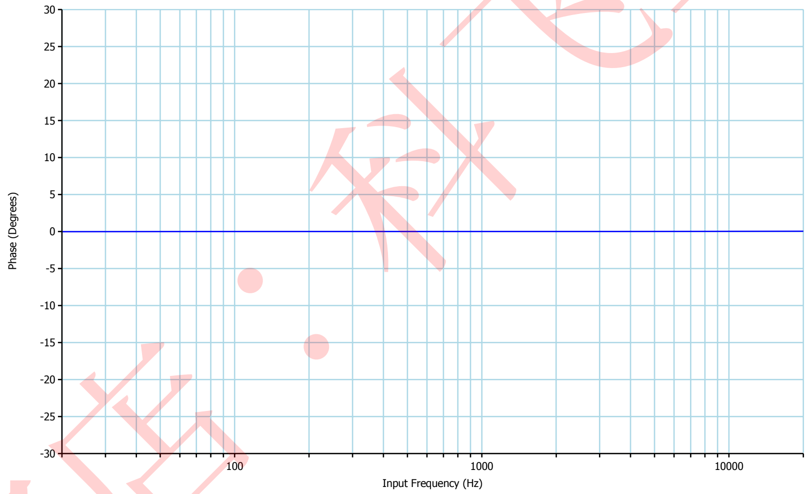

Figure 9.36: Phase vs. Frequency: F_s = 96kHz, Load = 100kΩ

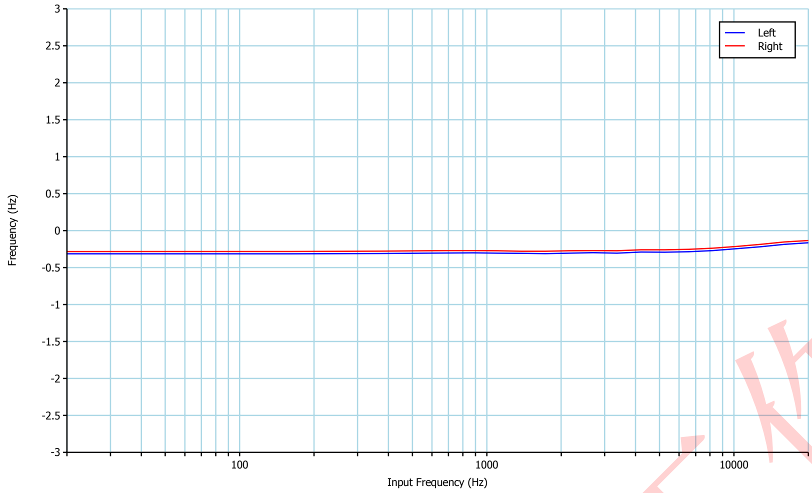

Figure 9.37: Output Amplitude vs. Input Frequency: F_S = 96kHz, Load = 32Ω

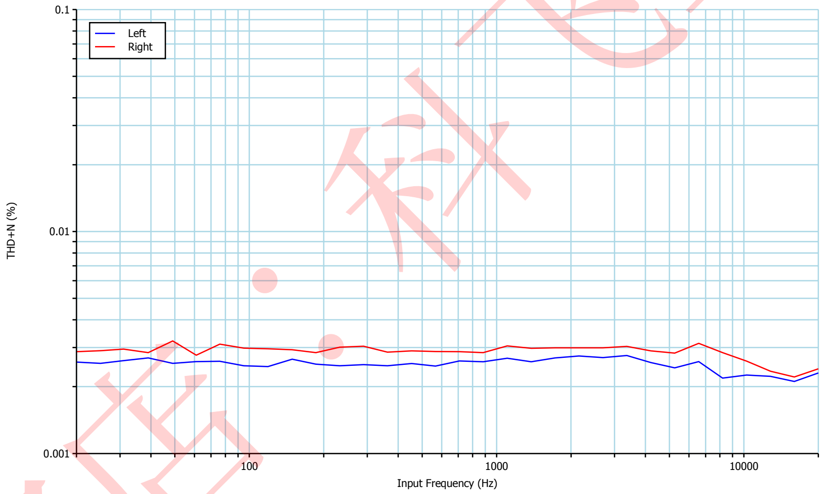

Figure 9.38: THD+N vs. Input Frequency: F_S = 96kHz, Load = 32Ω

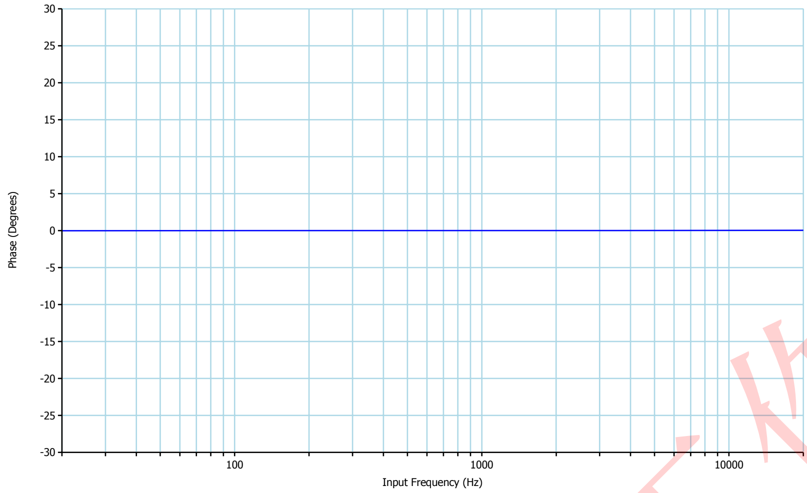

Figure 9.39: Phase vs. Frequency: F_s = 96kHz, Load = 32Ω

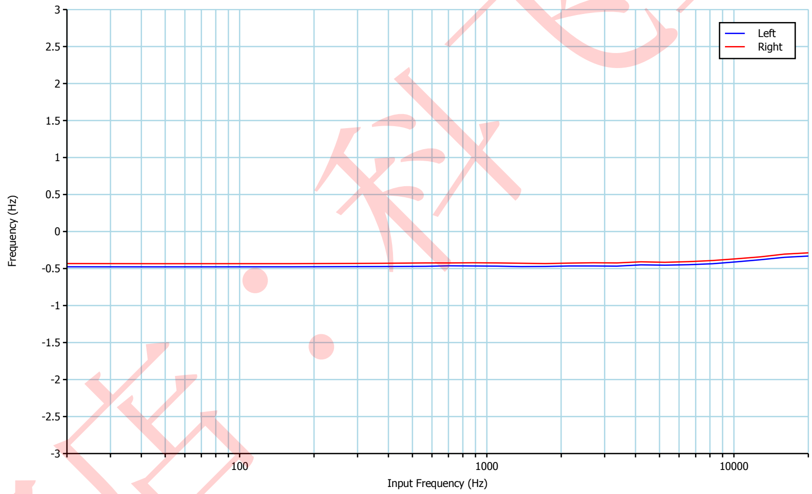

Figure 9.40: Output Amplitude vs. Input Frequency: F_s = 96kHz, Load = 16Ω

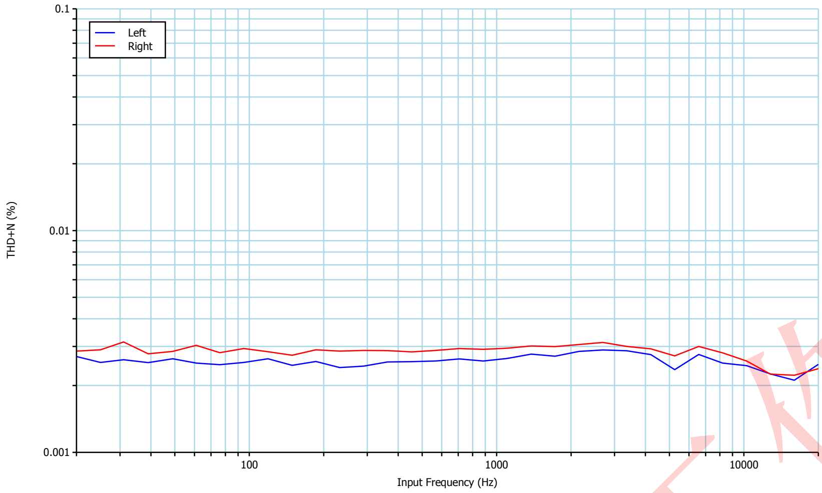

Figure 9.41: THD+N vs. Input Frequency: F_S = 96kHz, Load = 16Ω

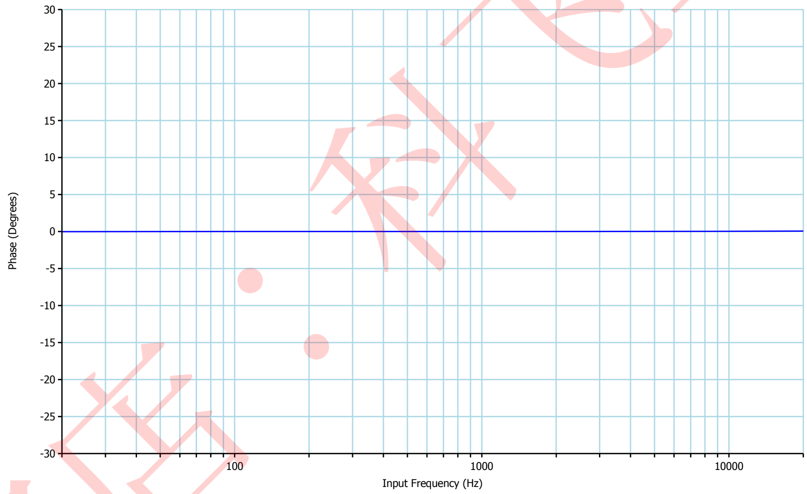

Figure 9.42: Phase vs. Frequency: F_S = 96kHz, Load = 16Ω

9.4 Noise Floor (Idle Noise) and SNR

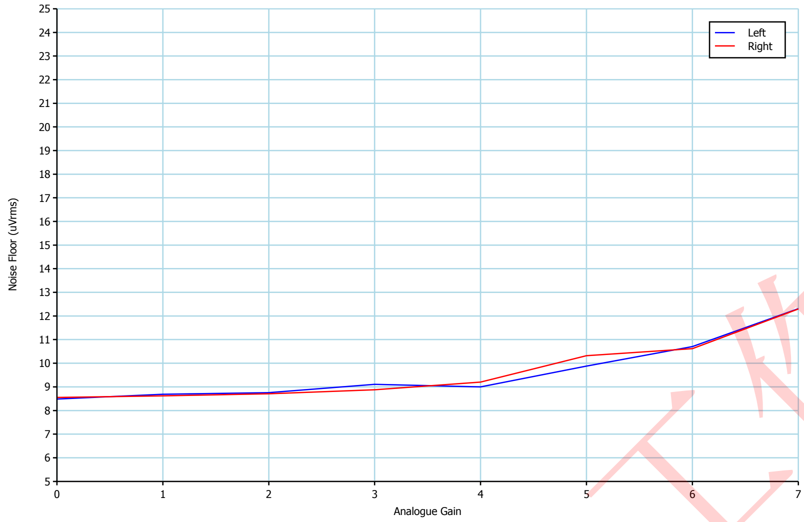

Figure 9.43: Noise floor: F_S = 48kHz, Load = 100kΩ, Bluetooth Inquiry On, A-Weighting

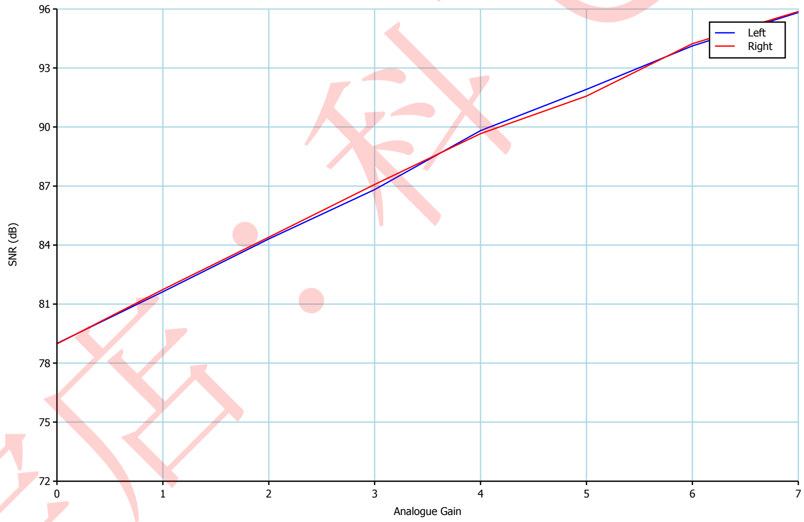

Figure 9.44: SNR: F_S = 48kHz, Load = 100kΩ, Bluetooth Inquiry On, A-Weighting

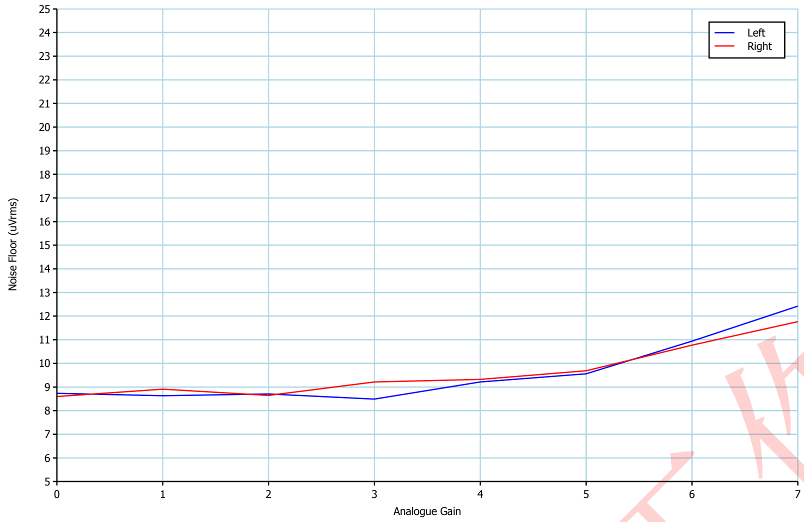

Figure 9.45: Noise floor: F_S = 48kHz, Load = 100kΩ, Bluetooth Inquiry Off, A-Weighting

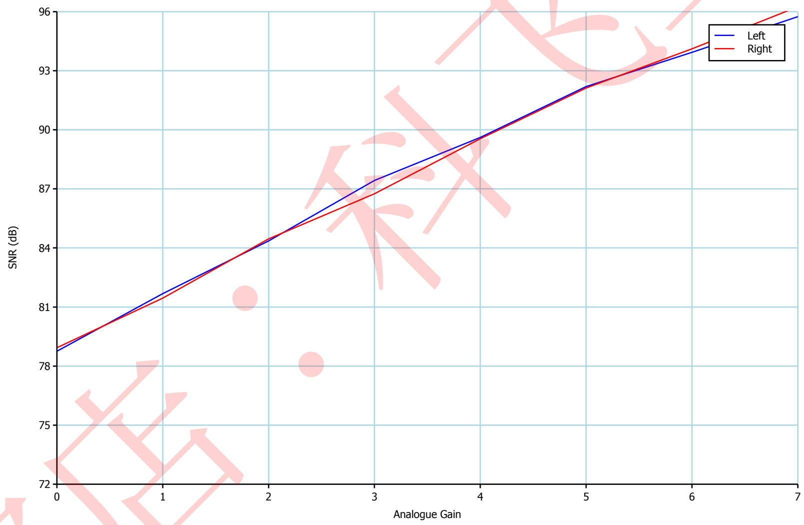

Figure 9.46: SNR: F_S = 48kHz, Load = 100kΩ, Bluetooth Inquiry Off, A-Weighting

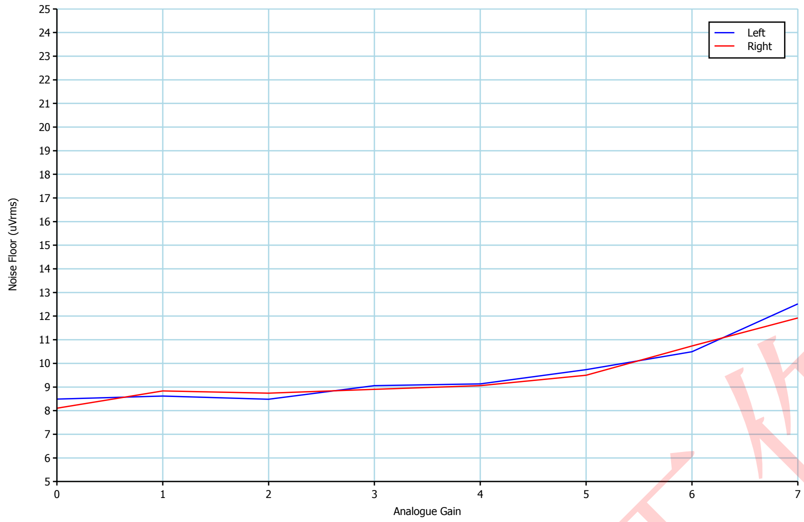

Figure 9.47: Noise floor: F_s = 48kHz, Load = 32Ω, Bluetooth Inquiry On, A-Weighting

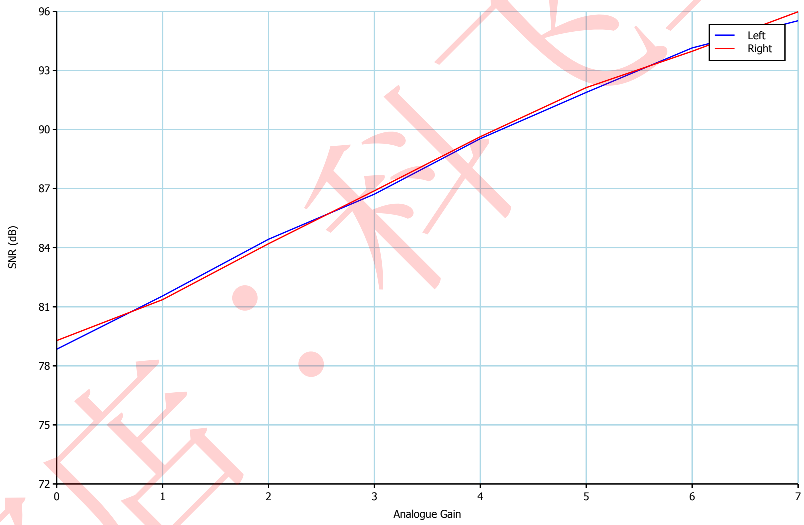

Figure 9.48: SNR: F_s = 48kHz, Load = 32Ω, Bluetooth Inquiry On, A-Weighting

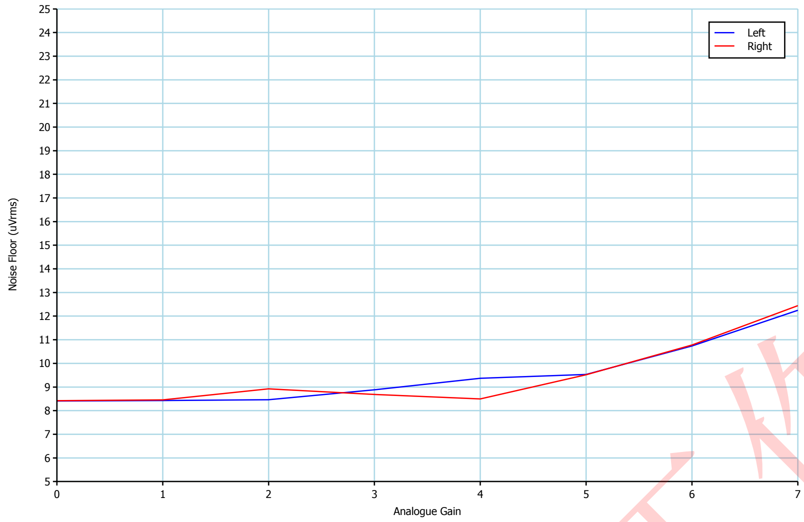

Figure 9.49: Noise floor: F_S = 48kHz, Load = 32Ω, Bluetooth Inquiry Off, A-Weighting

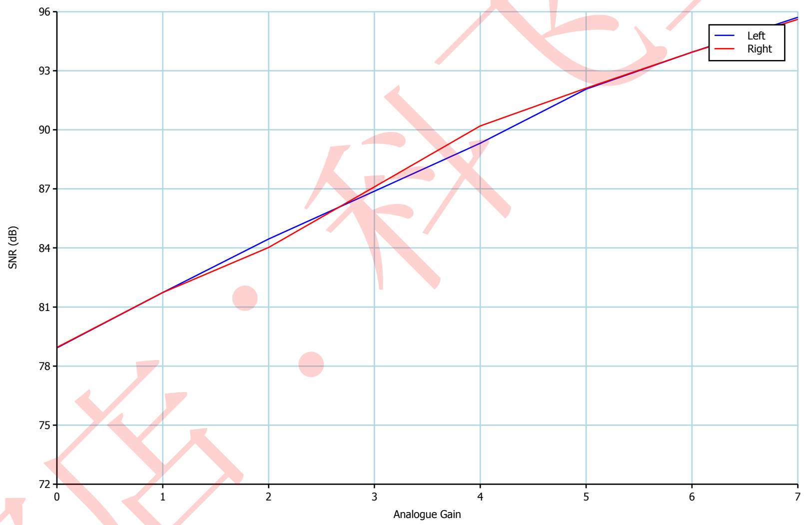

Figure 9.50: SNR: F_S = 48kHz, Load = 32Ω, Bluetooth Inquiry Off, A-Weighting

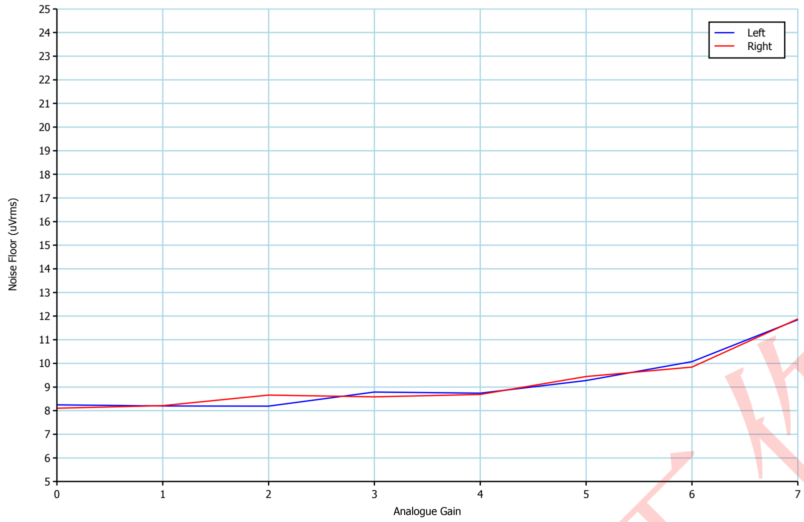

Figure 9.51: Noise floor: F_S = 48kHz, Load = 16Ω, Bluetooth Inquiry On, A-Weighting

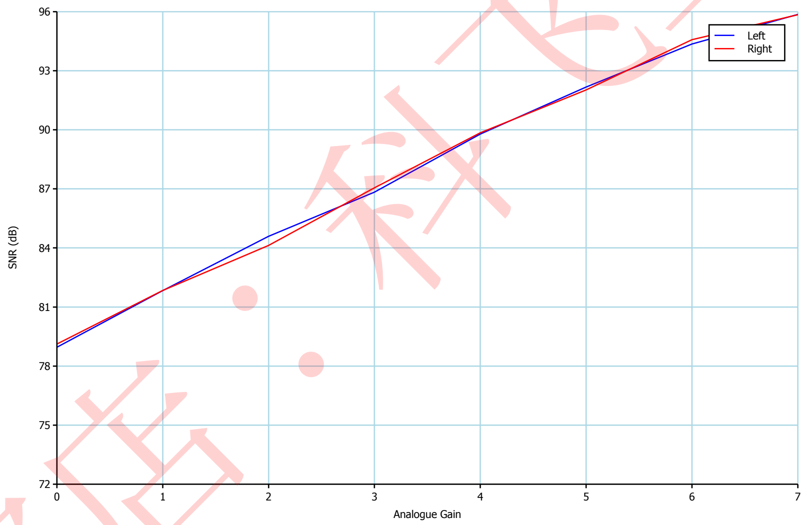

Figure 9.52: SNR: F_S = 48kHz, Load = 16Ω, Bluetooth Inquiry On, A-Weighting

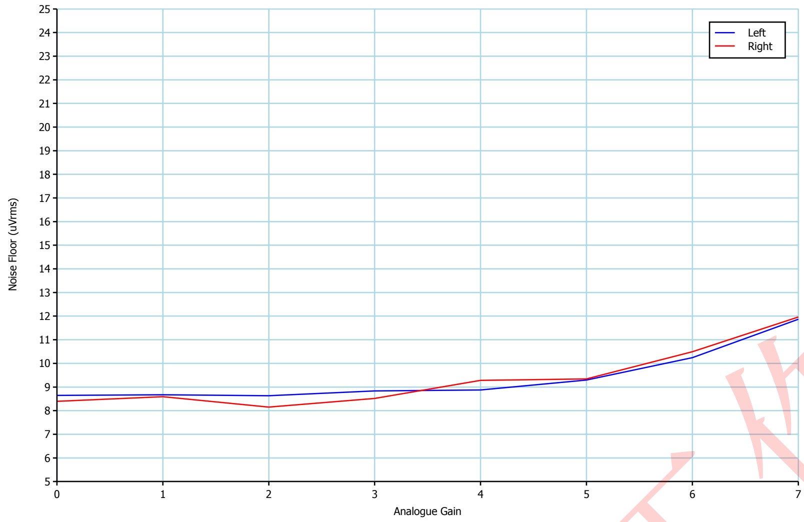

Figure 9.53: Noise floor: F_s = 48kHz, Load = 16Ω, Bluetooth Inquiry Off, A-Weighting

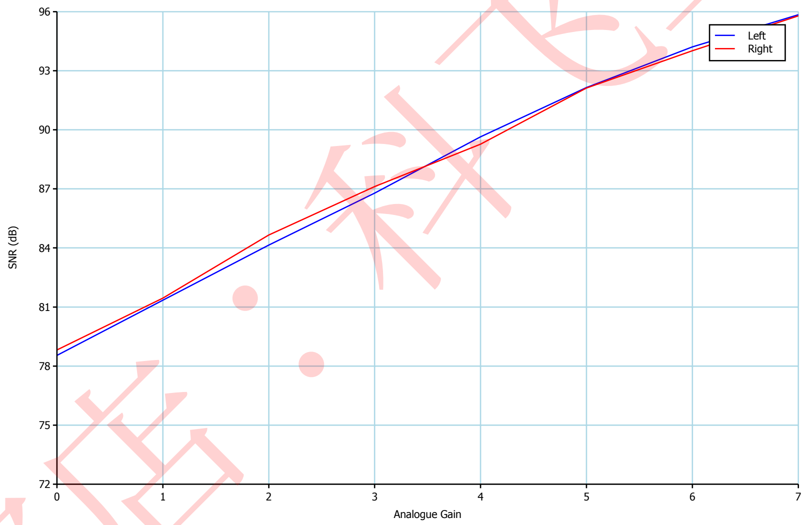

Figure 9.54: SNR: F_s = 48kHz, Load = 16Ω, Bluetooth Inquiry Off, A-Weighting

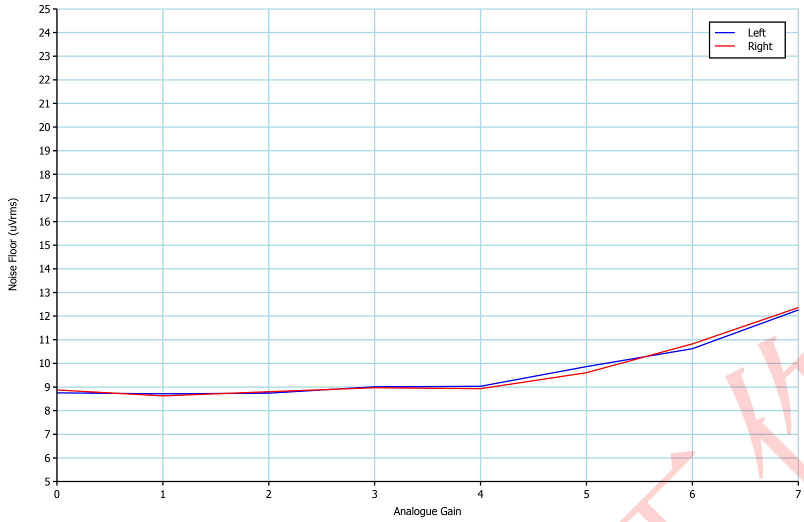

Figure 9.55: Noise floor: F_s = 96kHz, Load = 100kΩ, Bluetooth Inquiry On, A-Weighting

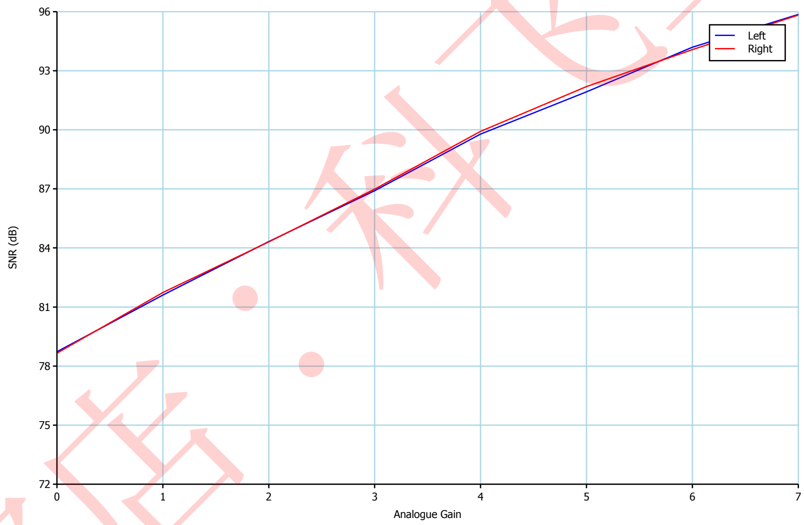

Figure 9.56: SNR: F_s = 96kHz, Load = 100kΩ, Bluetooth Inquiry On, A-Weighting

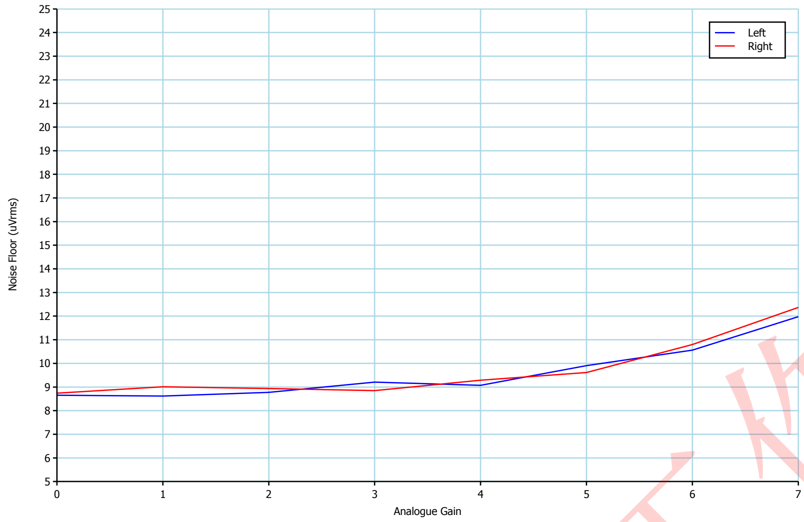

Figure 9.57: Noise floor: F_S = 96kHz, Load = 100kΩ, Bluetooth Inquiry Off, A-Weighting

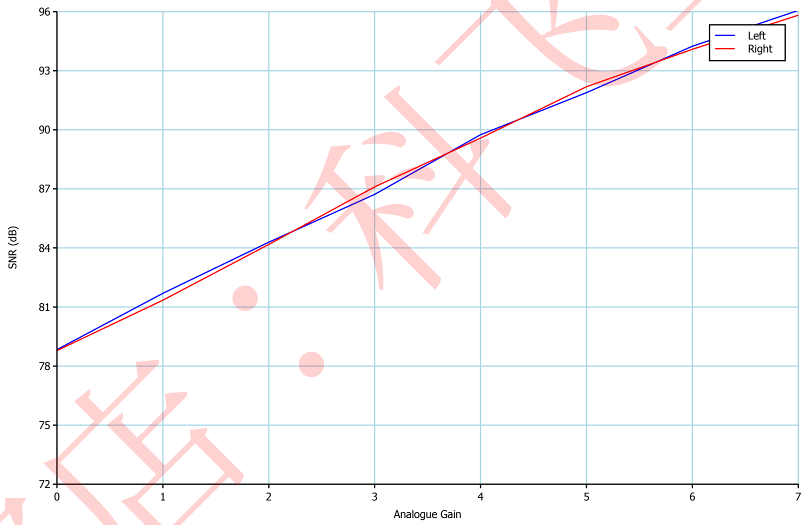

Figure 9.58: SNR: F_S = 96kHz, Load = 100kΩ, Bluetooth Inquiry Off, A-Weighting

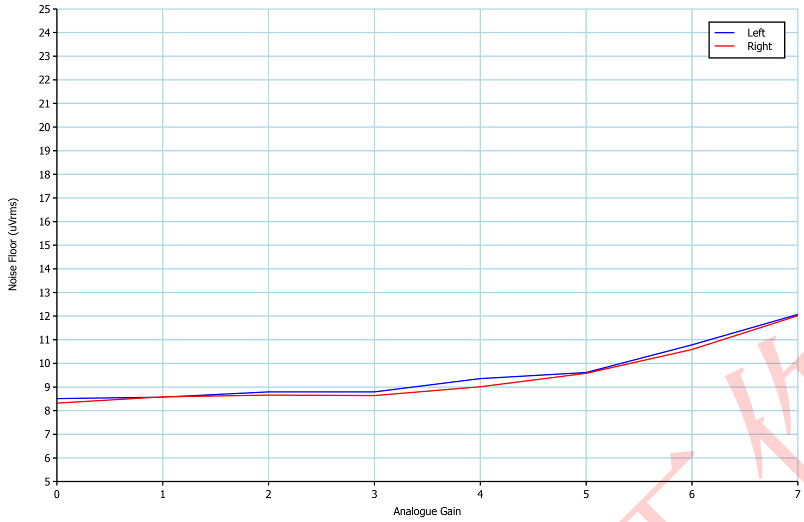

Figure 9.59: Noise floor: F_s = 96kHz, Load = 32Ω, Bluetooth Inquiry On, A-Weighting

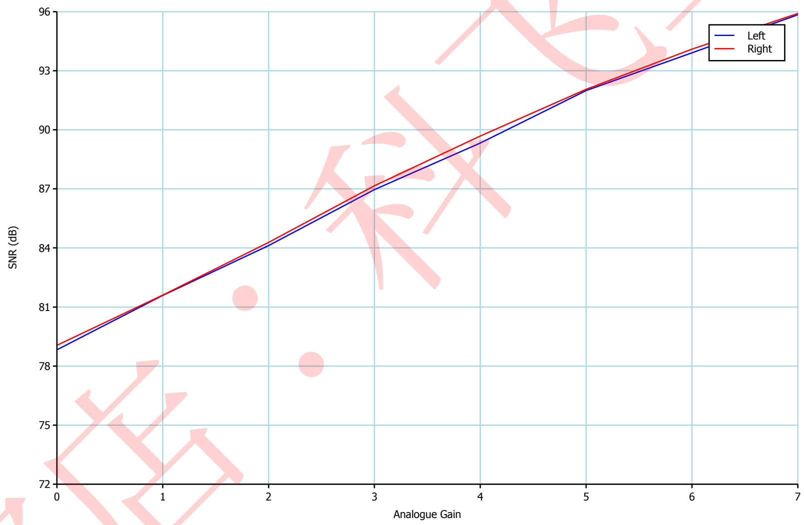

Figure 9.60: SNR: F_s = 96kHz, Load = 32Ω, Bluetooth Inquiry On, A-Weighting

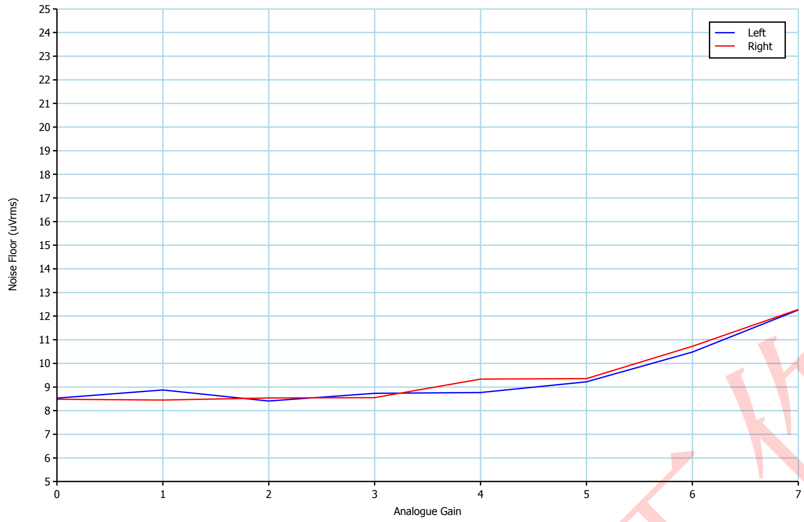

Figure 9.61: Noise floor: F_s = 96kHz, Load = 32Ω, Bluetooth Inquiry Off, A-Weighting

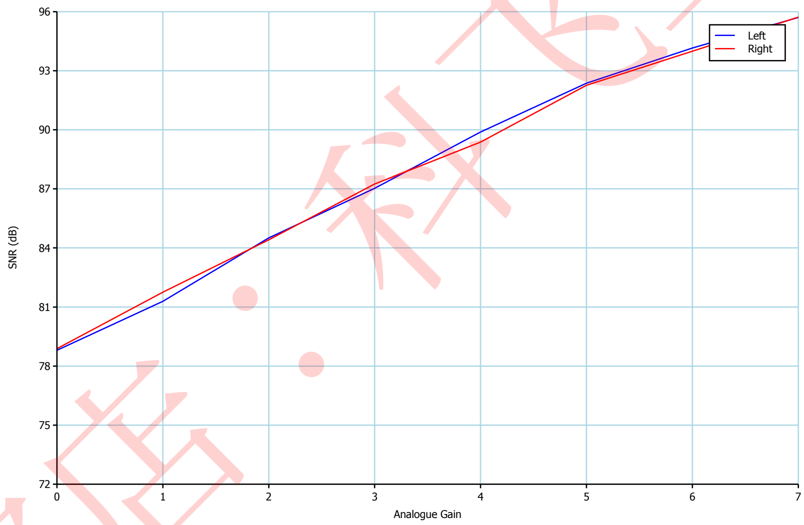

Figure 9.62: SNR: F_s = 96kHz, Load = 32Ω, Bluetooth Inquiry Off, A-Weighting

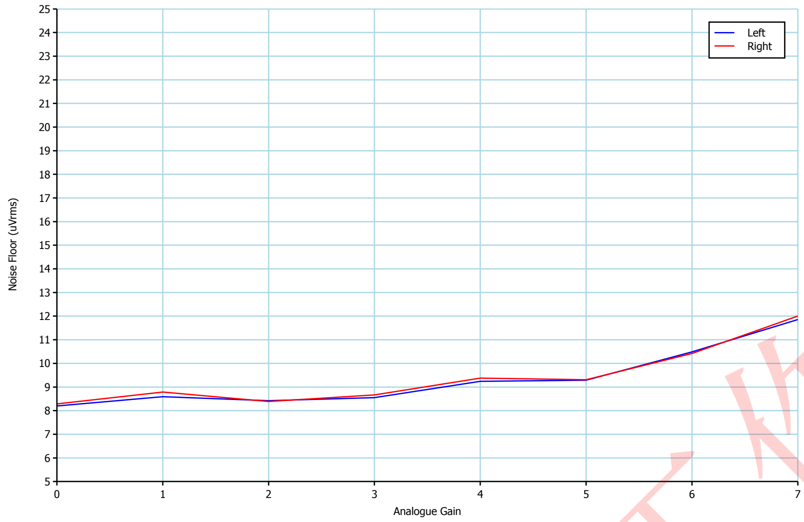

Figure 9.63: Noise floor: F_s = 96kHz, Load = 16Ω, Bluetooth Inquiry On, A-Weighting

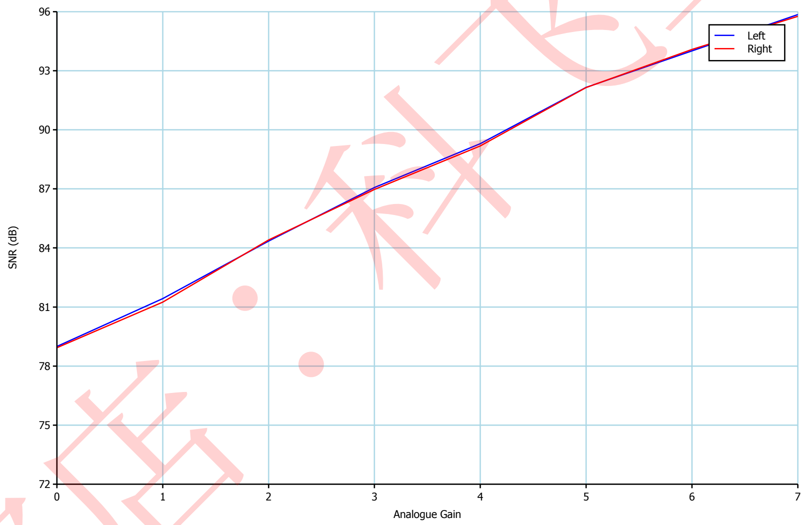

Figure 9.64: SNR: F_s = 96kHz, Load = 16Ω, Bluetooth Inquiry On, A-Weighting

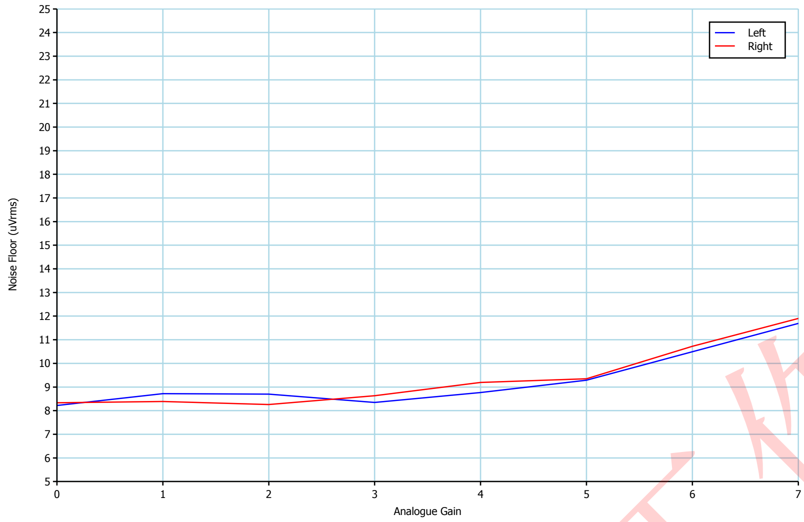

Figure 9.65: Noise floor: F_s = 96kHz, Load = 16Ω, Bluetooth Inquiry Off, A-Weighting

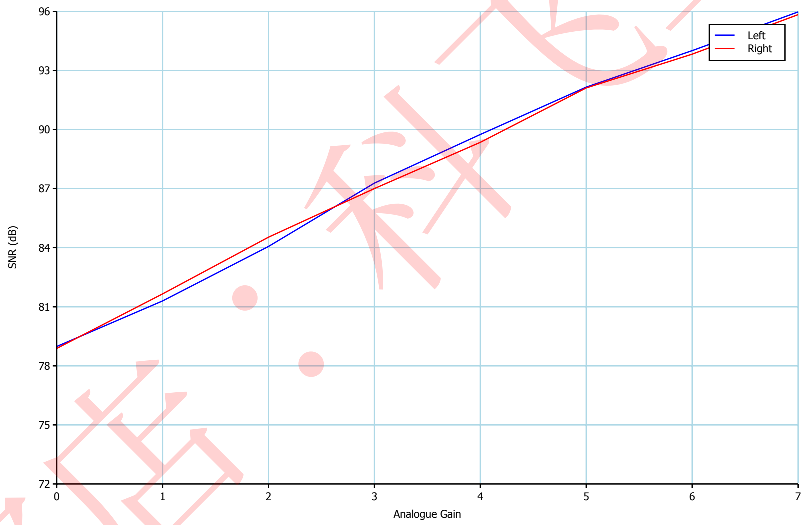

Figure 9.66: SNR: F_s = 96kHz, Load = 16Ω, Bluetooth Inquiry Off, A-Weighting

9.5 FFT at 1kHz

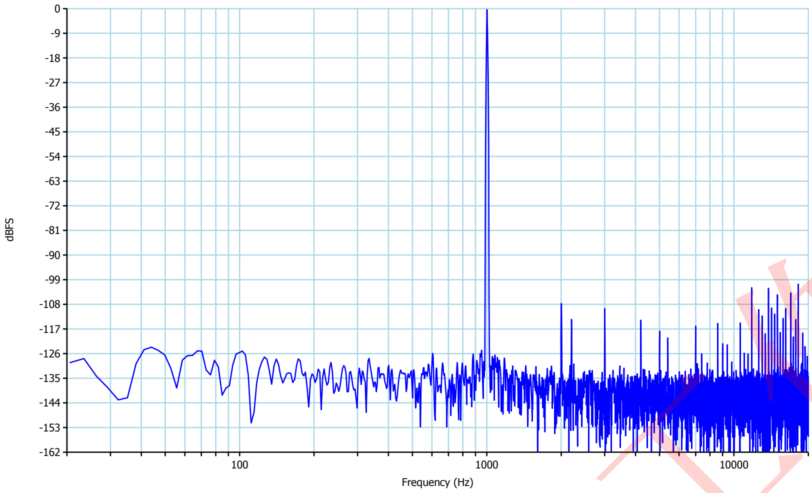

Figure 9.67: 1 KHz FFT: F_s = 48kHz, Load = 100kΩ, Bluetooth Inquiry On, No Weighting, Left Channel

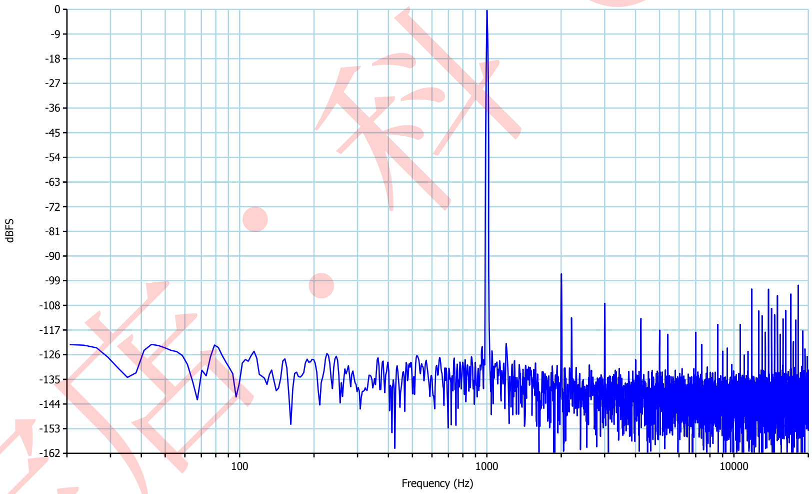

Figure 9.68: 1 KHz FFT: F_s = 48kHz, Load = 100kΩ, Bluetooth Inquiry On, No Weighting, Right Channel

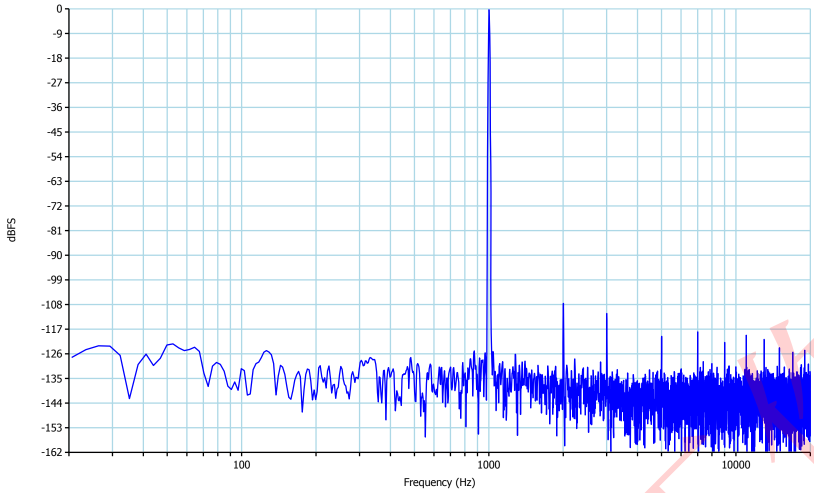

Figure 9.69: 1 KHz FFT: F_S = 48kHz, Load = 100kΩ, Bluetooth Inquiry Off, No Weighting, Left Channel

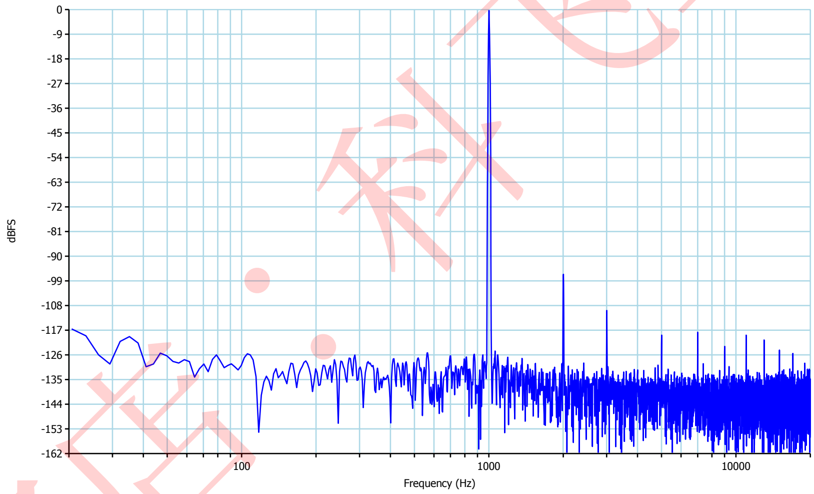

Figure 9.70: 1 KHz FFT: F_S = 48kHz, Load = 100kΩ, Bluetooth Inquiry Off, No Weighting, Right Channel

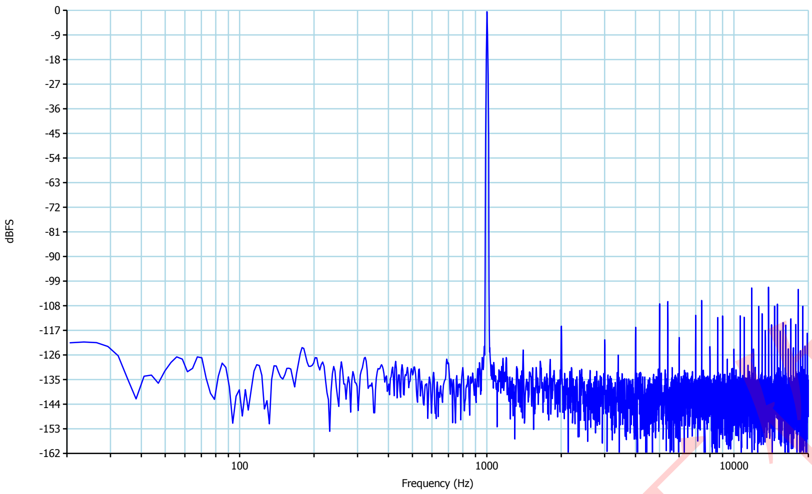

Figure 9.71: 1 KHz FFT: F_S = 48kHz, Load = 32Ω, Bluetooth Inquiry On, No Weighting, Left Channel

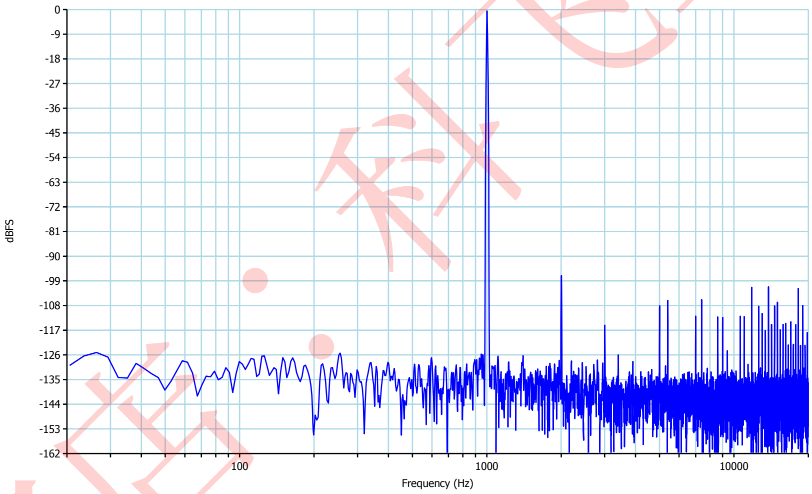

Figure 9.72: 1 KHz FFT: F_S = 48kHz, Load = 32Ω, Bluetooth Inquiry On, No Weighting, Right Channel

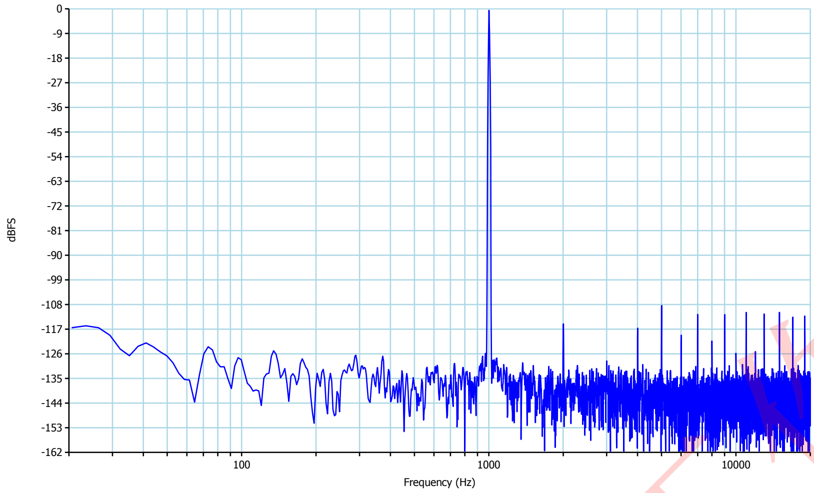

Figure 9.73: 1 KHz FFT: F_s = 48kHz, Load = 32Ω, Bluetooth Inquiry Off, No Weighting, Left Channel

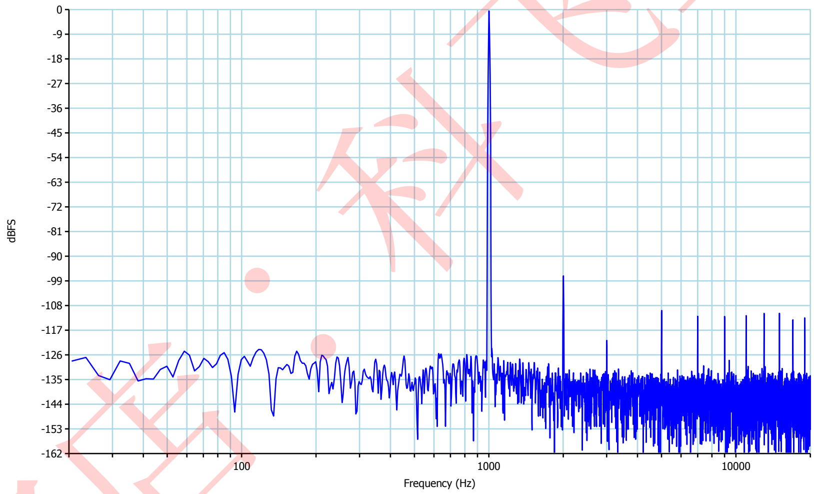

Figure 9.74: 1 KHz FFT: F_s = 48kHz, Load = 32Ω, Bluetooth Inquiry Off, No Weighting, Right Channel

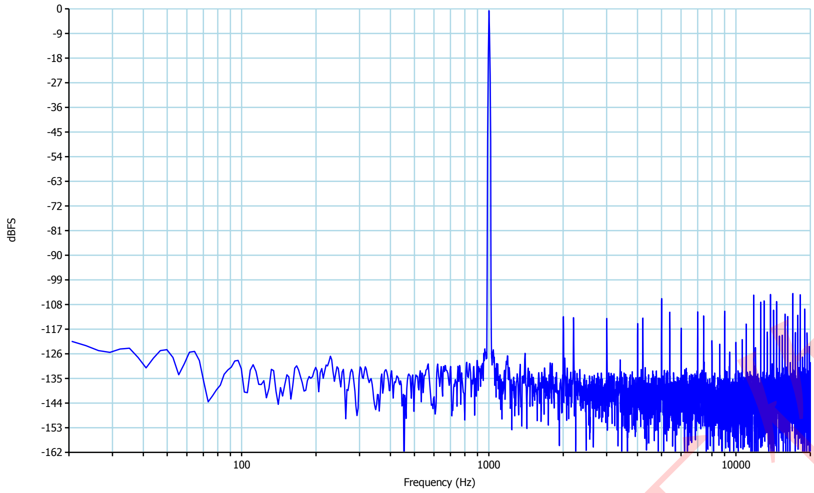

Figure 9.75: 1 KHz FFT: F_s = 48kHz, Load = 16Ω, Bluetooth Inquiry On, No Weighting, Left Channel

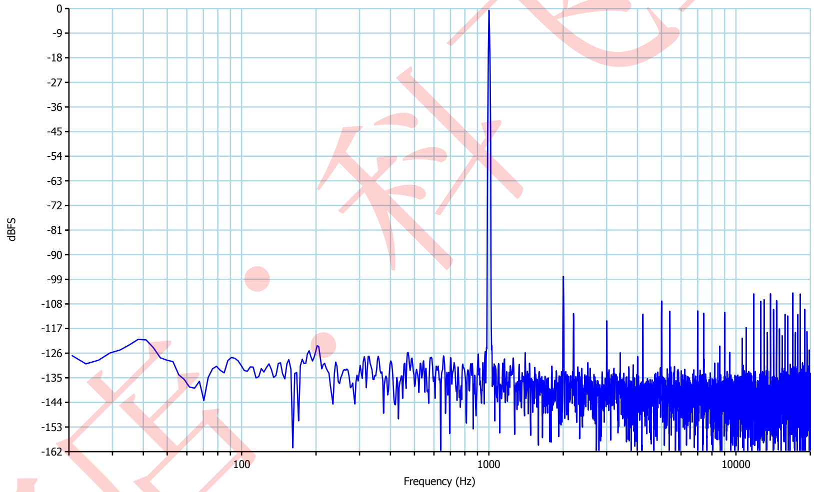

Figure 9.76: 1 KHz FFT: F_s = 48kHz, Load = 16Ω, Bluetooth Inquiry On, No Weighting, Right Channel

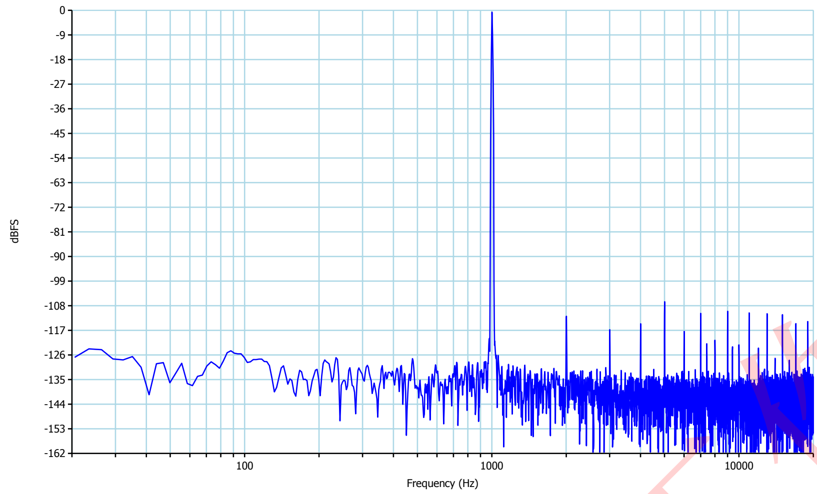

Figure 9.77: 1 KHz FFT: F_s = 48kHz, Load = 16Ω, Bluetooth Inquiry Off, No Weighting, Left Channel

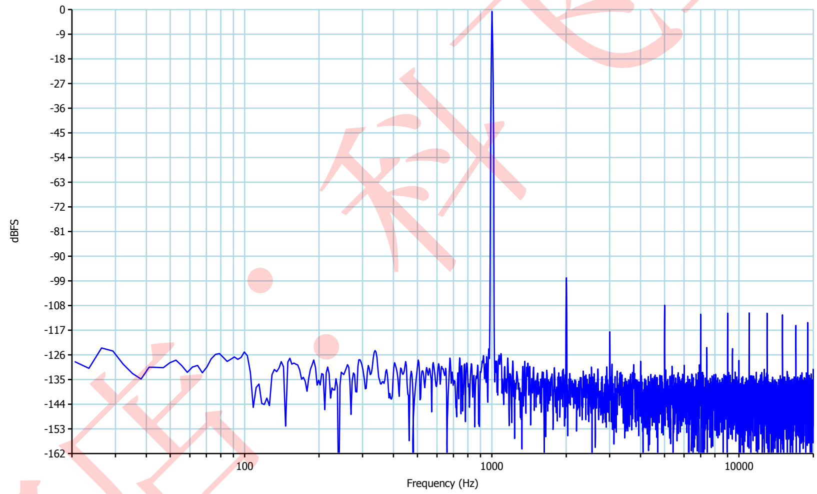

Figure 9.78: 1 KHz FFT: F_s = 48kHz, Load = 16Ω, Bluetooth Inquiry Off, No Weighting, Right Channel

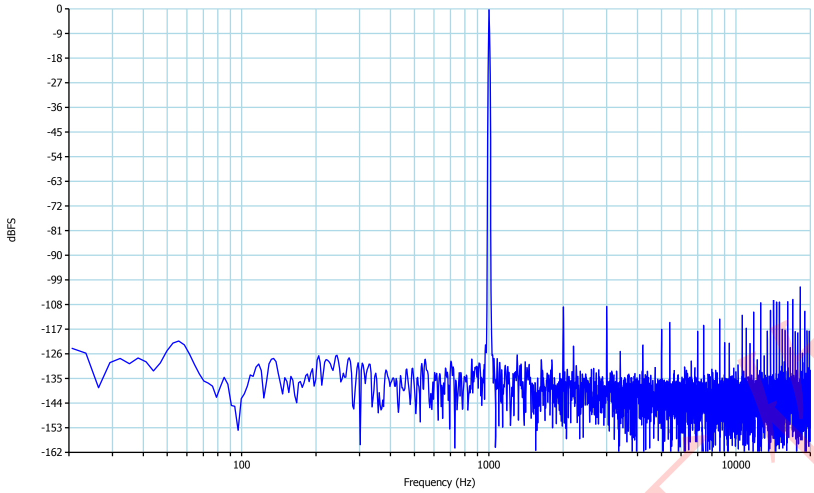

Figure 9.79: 1 KHz FFT: F_S = 96kHz, Load = 100kΩ, Bluetooth Inquiry On, No Weighting, Left Channel

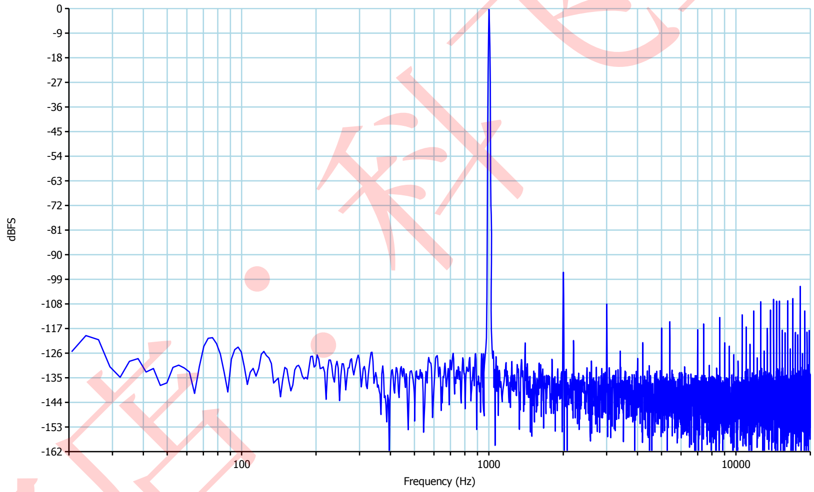

Figure 9.80: 1 KHz FFT: F_S = 96kHz, Load = 100kΩ, Bluetooth Inquiry On, No Weighting, Right Channel

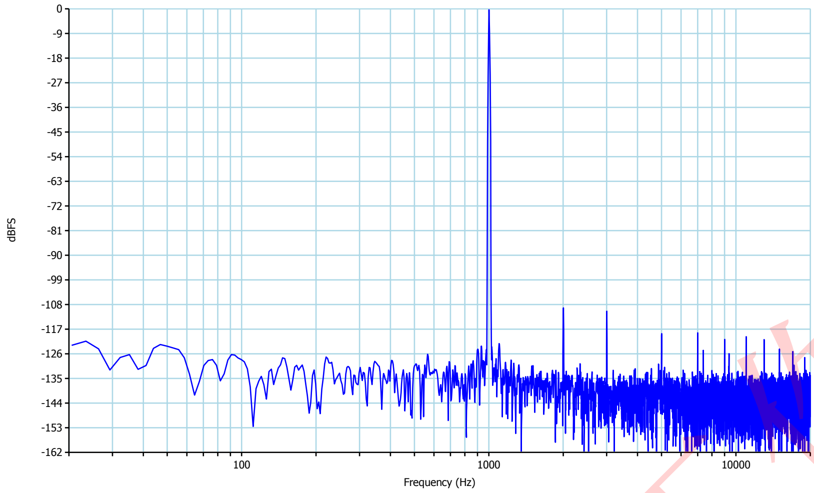

Figure 9.81: 1 KHz FFT: F_S = 96kHz, Load = 100kΩ, Bluetooth Inquiry Off, No Weighting, Left Channel

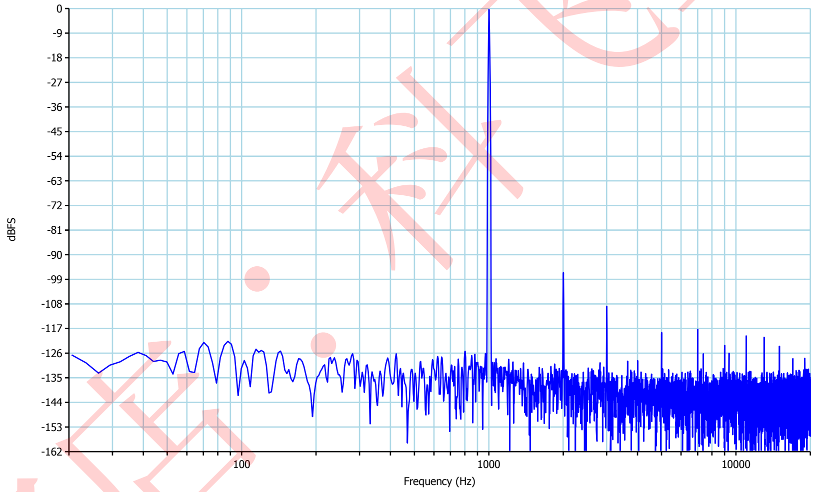

Figure 9.82: 1 KHz FFT: F_S = 96kHz, Load = 100kΩ, Bluetooth Inquiry Off, No Weighting, Right Channel

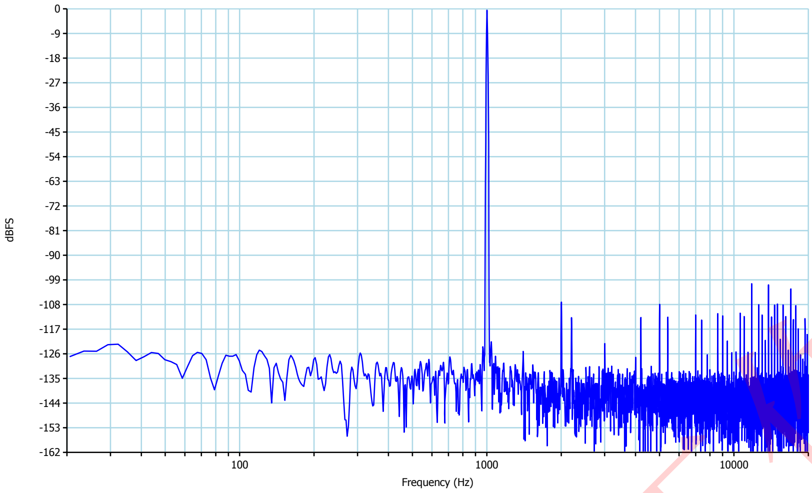

Figure 9.83: 1 KHz FFT: F_s = 96kHz, Load = 32Ω, Bluetooth Inquiry On, No Weighting, Left Channel

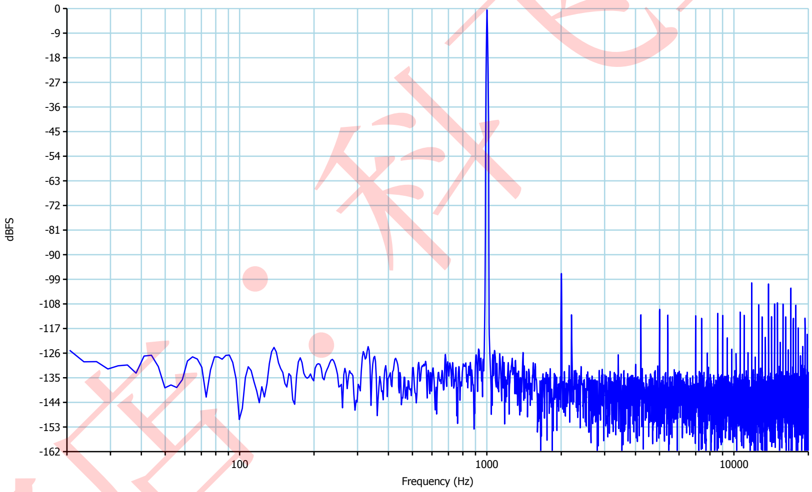

Figure 9.84: 1 KHz FFT: F_s = 96kHz, Load = 32Ω, Bluetooth Inquiry On, No Weighting, Right Channel

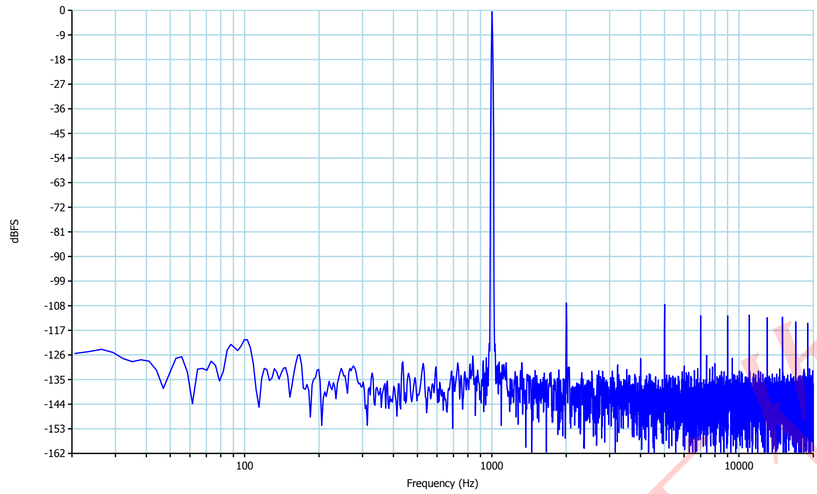

Figure 9.85: 1 KHz FFT: F_s = 96kHz, Load = 32Ω, Bluetooth Inquiry Off, No Weighting, Left Channel

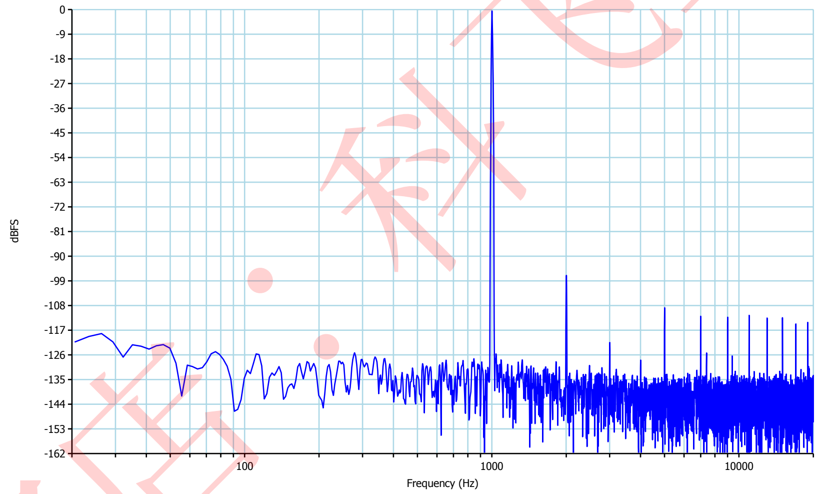

Figure 9.86: 1 KHz FFT: F_s = 96kHz, Load = 32Ω, Bluetooth Inquiry Off, No Weighting, Right Channel

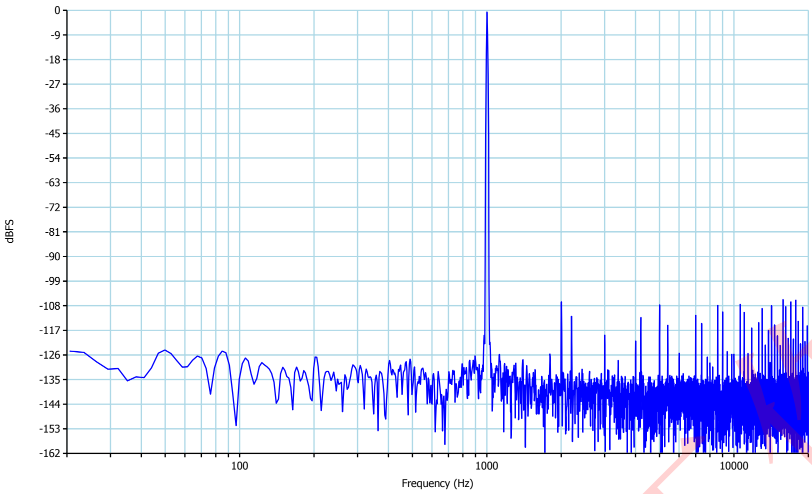

Figure 9.87: 1 KHz FFT: F_s = 96kHz, Load = 16Ω, Bluetooth Inquiry On, No Weighting, Left Channel

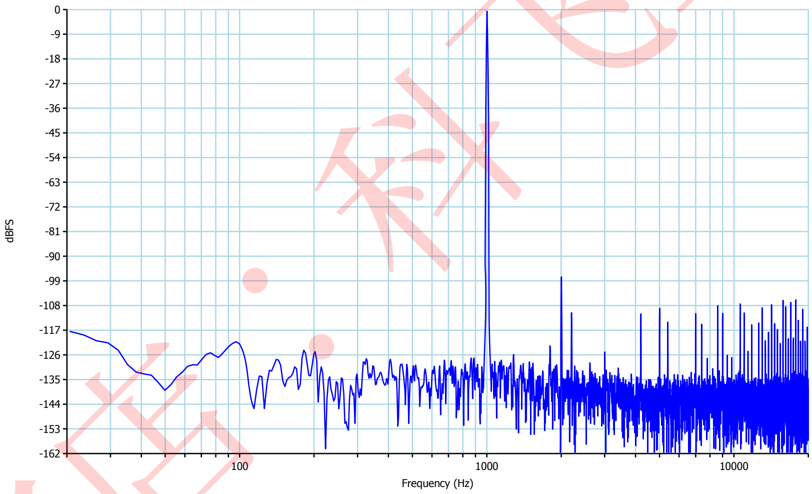

Figure 9.88: 1 KHz FFT: F_s = 96kHz, Load = 16Ω, Bluetooth Inquiry On, No Weighting, Right Channel

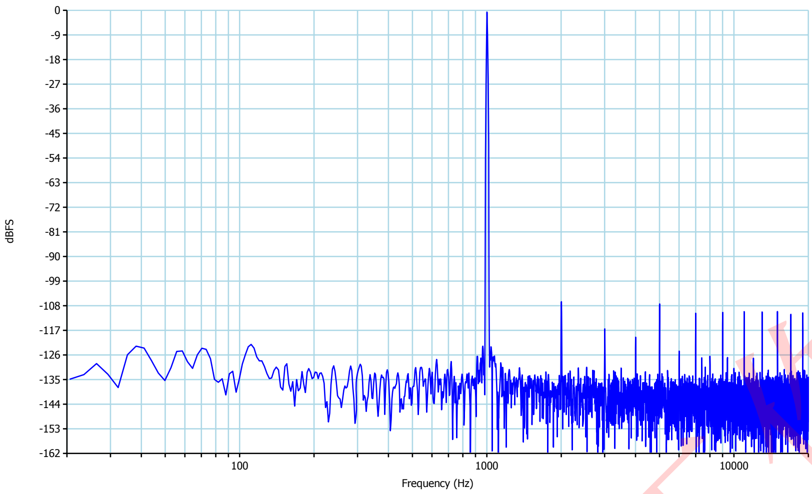

Figure 9.89: 1 KHz FFT: F_S = 96kHz, Load = 16Ω, Bluetooth Inquiry Off, No Weighting, Left Channel

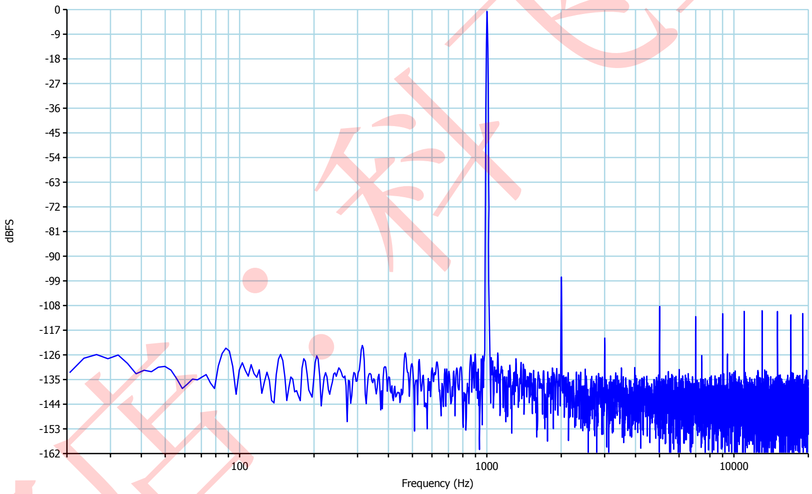

Figure 9.90: 1 KHz FFT: F_S = 96kHz, Load = 16Ω, Bluetooth Inquiry Off, No Weighting, Right Channel

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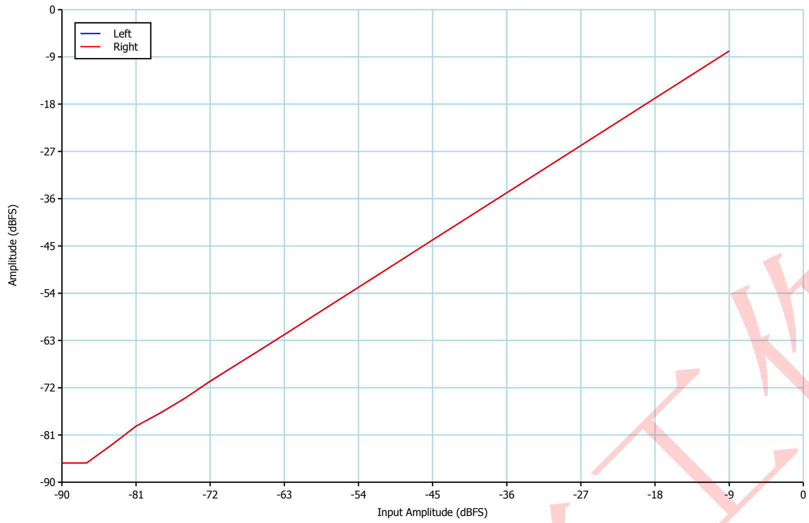

Figure 10.1: Output Amplitude vs. Input Amplitude: Sample Rate = 8 kHz

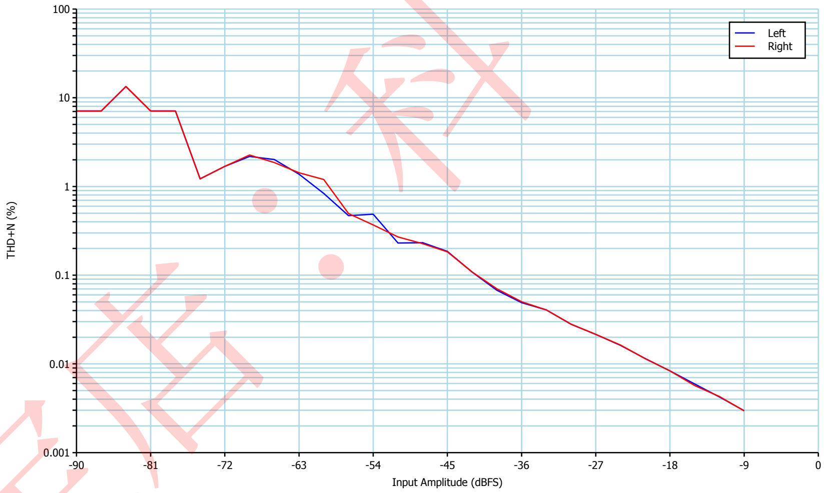

Figure 10.2: THD+N vs. Input Amplitude: Sample Rate = 8 kHz

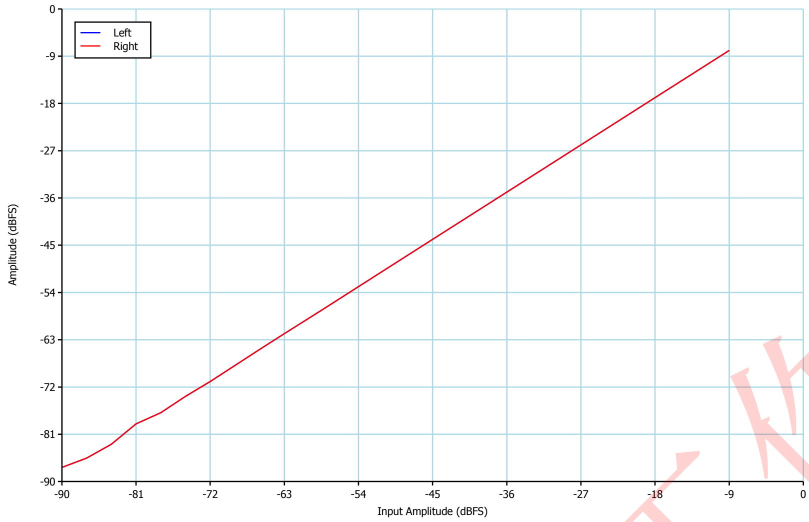

Figure 10.3: Output Amplitude vs. Input Amplitude: Sample Rate = 16 kHz

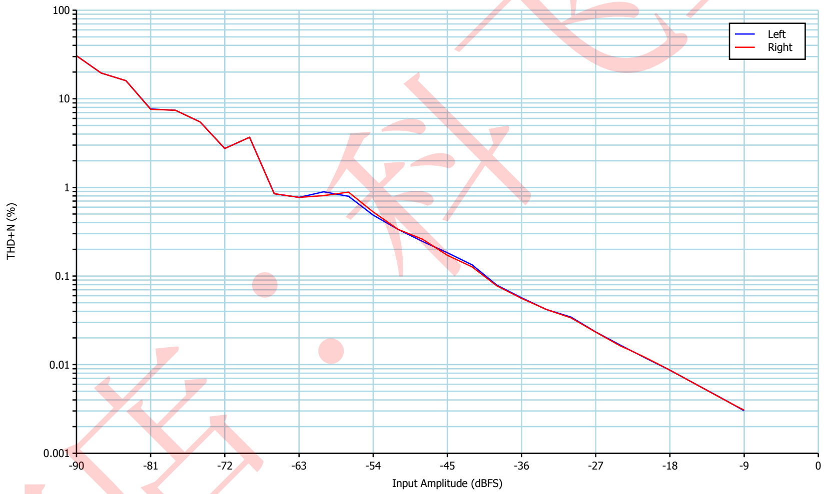

Figure 10.4: THD+N vs. Input Amplitude: Sample Rate = 16 kHz

11 Document References

Document	Reference, Date
Bluetooth v4.1 RF-PHY test specification	RF-PHY.TS.4.1.0, 03 December 2013
Bluetooth v4.1 Test Specification	TS.4.1.0, 03 December 2013
Core Specification of the Bluetooth System	Bluetooth Specification Version 4.1, 03 December 2013
CSR8675 BGA Data Sheet	CS-232426-DS

Terms and Definitions

Term	Definition
8DPSK	8-phase Differential Phase Shift Keying
π/4 DQPSK	π/4 rotated Differential Quaternary Phase Shift Keying
ACP	Adjacent Channel Power
ADC	Analogue to Digital Converter
BER	Bit Error Rate
BlueCore®	Group term for CSR's range of Bluetooth wireless technology ICs
Bluetooth®	Set of technologies providing audio and data transfer over short-range radio connections
C/I	Carrier over Interferer
CDMA	Code Division Multiple Access
codec	Coder decoder
CSR	Cambridge Silicon Radio
DAC	Digital to Analogue Converter
dBm	Decibels relative to 1 mW
DCS	Digital Communications System
DEVM	Differential Error Vector Magnitude
EDR	Enhanced Data Rate
GPS	Global Positioning System
GSM	Global System for Mobile communications
IC	Integrated Circuit
ICFT	Initial Carrier Frequency Tolerance
PER	Packet Error Rate
RF	Radio Frequency
rms	root mean squared
W-CDMA	Wideband Code Division Multiple Access