Simultaneous Transmit of Co-located Transmitters

Applicant: Motorola, Inc.

FCC ID: AZ489FT7008

Model: Enhanced PowerPad

FCC REQUIREMENT FOR SIMULTANEOUS TRANSMISSION

Excerpt below from TCB Question 7 for FCC, FCC / TCB Workshop 10-23-02 Day 2.

"The radios must be tested individually. Assuming that the radios do not share an antenna, only radiated tests for simultaneous transmission is required. If the radios share an antenna, antenna conducted measurements would also be required. Only one set of worst case simultaneous transmission data is going to be requested to be submitted at this time. The test engineer should indicate the worst case condition and provide justification as to why the worst case condition was chosen. The grantee should be reminded that even if the FCC requests one set of data, they are responsible for compliance for all modes of simultaneous transmission.

Aggregate power must be considered in RF exposure evaluation."

DISCUSSION:

The Enhanced PowerPad contains a Dual band GPRS transmitter co-located with a FHSS Bluetooth Intentional Radiator. The two radios can transmit simultaneously. Therefore, while simultaneously transmitting the spurious emissions from the above referenced device were compared to the Part 22.917(e) and 24.238(a) limits for the GPRS transmitter and to the Part 15.247(c) limit for the Bluetooth Intentional Radiator. The radios do not share an antenna. Each radio has it's own antenna internally integrated within the terminal.

Initially measurements were made with the cellular and Bluetooth simultaneously transmitting on the respective low, mid and high channels. Then measurements were made with the PCS and the Bluetooth simultaneously transmitting on the low, mid, and high channels. The measurement results are reported on pages 3 to 5 following.

The various channel combinations for the cellular and PCS bands used by the GPRS transmitter and the Bluetooth Intentional Radiator channels were mathematically compared for any harmonic frequency combinations that happen to fall on exactly the same frequency. Additional measurements were made on

these specific channel combinations to investigate the possibility of increased emission level with the simultaneous transmit. We expect that the likelihood of a increase in the harmonic emission level would exist when the combined harmonic energy from two sources is present on the same frequency.

It appears that this situation could occur with at least the following two frequency combinations noted below. In this case however, levels are too low to be measurable.

Bluetooth set to 2412 MHz ($7^{th\ harmonic}$), with the PCS set to 1876 MHz ($9^{th\ harmonic}$)

16844 MHz No emission was measurable at one half meter EUT to antenna distance, more than 20 below the 15.247 (c) limit.

Bluetooth set to 2437 MHz ($7^{th\ harmonic}$), with the PCS set to 1896 MHz ($9^{th\ harmonic}$)

17066 MHz No emission was measurable at one half meter EUT to antenna distance, more than 20 below the 15.247 (c) limit.

The following three pages report the other simultaneous transmission emissions findings discussed previously on page one.

Pages 3 to 5.

3.) **Simultaneous Test Frequencies:**	**Bluetooth**	**2402, 2440, & 2480**	**MHz**
Part 15.247(c)	**PCS band**	**1850.2, 1880, & 1909.8**	**MHz**
4.) **Simultaneous Test Frequencies:**	**Cellular**	**824.2, 836.6, & 848.8**	**MHz**
Part 22.917(e)	**Bluetooth**	**2402, 2440, & 2480**	**MHz**
5.) **Simultaneous Test Frequencies:**	**PCS band**	**1850.2, 1880, & 1909.8**	**MHz**
Part 24.238(a)	**Bluetooth**	**2402, 2440, & 2480**	**MHz**

EXHIBIT 6G TEST: Field Strength Of Spurious Radiation Emissions with Simultaneous Transmit of Co-located Transmitters

FCC ID:	AZ489FT7008
Applicant:	Motorola, Inc.
Model:	F4421A
Minimum Standard Specified:	Part 15.247(c)
Authorization Procedure:	Part 2.1053
Test Equipment Set Up:	See Block Diagram in Exhibit 7
Frequency Range Observed:	0 to 25 GHz
Location: OATS Fluke Park II Everett, WA	Test date: 12/12/03

Note: The reported results below were the worst case levels measured with g20 simultaneously transmitting in the PCS band on 1850.2, 1880, & 1909.8 MHz corresponding to 2402, 2440, & 2480 MHz respectively. The difference between Cellular or PCS simultaneous transmit with Bluetooth or the Bluetooth stand alone are of little significance. The results below show little change compared to the original measurement.

SIMULTANEOUS TX RADIATED HARMONIC AND SPURIOUS EMISSIONS & RESTRICTED BANDS										
Frequency GHz	SA Rdg. dBu/V	Ant. Vert. or Horz.	Peak or Average Reading	Antenna Factor dB	Cable & filter loss dB	Amp Gain	Corrected Reading dBuV/m	Corrected Reading uV/m	Peak Limit dBuV	Avg Limit dBuV
Fo - 2.402										
4.804	38.62	V	Peak	32.83	3.95	23.2	52.20	407.38	74	---
4.804	38.71	H	Peak	32.83	3.95	23.2	52.29	411.63	74	---
4.804	26.52	V	Average	32.83	3.95	23.2	40.10	101.16	---	54
4.804	26.59	H	Average	32.83	3.95	23.2	40.17	101.97	---	54
Fo - 2.440										
4.880	38.25	V	Peak	33.33	3.95	23.2	52.33	413.53	74	---
4.880	38.04	H	Peak	33.33	3.95	23.2	52.12	403.65	74	---
4.880	26.60	V	Average	33.33	3.95	23.2	40.68	108.14	---	54
4.880	26.68	H	Average	33.33	3.95	23.2	40.76	109.14	---	54
Fo - 2.480										
4.960	38.50	V	Peak	33.33	3.95	23.2	52.58	425.60	74	---
4.960	39.17	H	Peak	33.33	3.95	23.2	53.25	459.73	74	---
4.960	26.55	V	Average	33.33	3.95	23.2	40.63	107.52	---	54
4.960	26.69	H	Average	33.33	3.95	23.2	40.77	109.27	---	54

Emissions on all three channels 3Fo – 10 Fo at or below noise floor			
Channel	**Frequency in GHz**	**Harmonics Observed**	**Limit 74 dBuV/m Peak & 54 dBuV/m Average**
Low Ch.	2.402		
3Fo – 10Fo	7.206 – 24.020	**None** -at or < noise floor @3m	All emissions < 54 dBuV/m or 500 uV/m
Mid Ch.	2.440		
3Fo – 10Fo	7.320 – 24.800	**None** -at or < noise floor @3m	All emissions < 54 dBuV/m or 500 uV/m
High Ch.	2.480		
3Fo - 10Fo	7.440 – 24.480	**None** -at or < noise floor @3m	All emissions < 54 dBuV/m or 500 uV/m

EXHIBIT 6G TEST: Transmitter Radiated Spurious Emissions With Simultaneous Transmit of Co-located Transmitters

FCC ID:	AZ489FT7008
Grantee:	Motorola, Inc.
Model:	F4421A
Serial No.:	ESN
Minimum Standard Specified:	Part 22.917(e)
Test Results:	Compliant with Standard
Authorization Procedure:	Part 2.1053
Test Equipment Set Up:	See Block Diagram in Exhibit 7
Frequency Range Observed:	0 to 8.5 GHz
Simultaneous Test Frequencies:	**Cellular 824.2, 836.6, & 848.8 MHz** **Bluetooth 2402, 2440, & 2480 MHz**

Note: The low mid and high channel combinations were tested in the pairs above.

Power Output:	0.631 Watts
Spurious Limit = 43 + 10Log_{10} PO =	= 41 dB below the carrier
Location: OATS Fluke Park II Everett, WA	Test date: 12/12/03

Channel	Frequency in MHz	Level (dB below carrier)	Harmonics observed within 20 dB of Limit
Fo	824.20	-0-	
2Fo - 10Fo	16484 - 8242	> 63	**All harmonics > 20 below limit**
Fo	836.60	-0-	
2Fo - 10Fo	1673.2 - 8366	> 63	**All harmonics > 20 below limit**
Fo	848.80	-0-	
2Fo - 10Fo	1697.6 - 8488	> 63	**All harmonics > 20 below limit**

At 3 meters EUT to antenna distance, using 1 MHz RBW and VBW all harmonic and spurious emissions up to 8.5 GHz were at least 20 dB below the limit. Only the second and third harmonics were just visible at .5 meters and 120 kHz RBW & VBW. A high pass filter was used during the measurements of the harmonics to reduce the fundamental signal and avoid overloading the front end of the analyzer.

EXHIBIT 6G TEST: Transmitter Radiated Spurious Emissions With Simultaneous Transmit of Co-located Transmitters

FCC ID:	AZ489FT7008
Grantee:	Motorola, Inc.
Model:	F4421A
Serial No.:	ESN
Minimum Standard Specified:	Part 24.238(a)
Test Results:	Compliant with standard
Authorization Procedure:	Part 2.1053
Test Equipment Set Up:	See Block Diagram in Exhibit 7
Frequency Range Observed:	0 to 20 GHz
Simultaneous Test Frequencies:	**PCS 1850.2, 1880, & 1909.8 MHz** **Bluetooth 2402, 2440, & 2480 MHz**

Note: The low mid and high channel combinations were tested in the pairs above.

Power Output: 0.809 Watts

Spurious Limit = 43 + 10Log$_{10}$ PO = = 42 dB below the carrier

Location: OATS Fluke Park II Everett, WA Test date: 12/12/03

Channel	Frequency in MHz	Level (dB below carrier)	Harmonics observed within 20 dB of Limit
Ch. 512	1850.20	-0-	
2Fo – 10Fo	3700.40 – 18502.0	> 63	**All harmonics > 20 below limit**
Ch. 661	1880.00	-0-	
2Fo – 10Fo	3760.00 – 18800.0	> 63	**All harmonics > 20 below limit**
Ch. 810	1909.80	-0-	
2Fo – 10Fo	381960 – 19098.0	> 63	**All harmonics > 20 below limit**

At 3 meters EUT to antenna distance, using 1 MHz RBW and VBW. all harmonic and spurious emissions up to 20 GHz were at least 20 dB below the limit. The second harmonic was barely measurable at .5 meter with1 MHz RBW & VBW however, not a 3 meters. A high pass filter was used during the measurements of the harmonics to reduce the fundamental signal and avoid overloading the front end of the analyzer.