

Test Report – Transmitter Conducted Spurious Emissions FCC/IC

Equipment under test (EUT):

50W PEP Locomotive Transceiver Model 63020, S/N 63LR000106BK

Equipment Identifiers:

FCC ID: BIB63020

IC: 1300A-63020

Occupied Bandwidths:

8.9 kHz, 17.8 kHz

Test Results: See data in Table 1. All spurious emissions comply with -25 dBm limit.

Test date and location:

December 6, 2012

Meteorcomm LLC, 1201 W. 7th St., Renton, WA 98057

Test Method: ANSI/TIA-603-C-2004 §2.2.13

47CFR§2.1051, RSS-Gen §4.9

Test Limits: 47CFR§90.210 Mask F. Mask F floor = -25 dBm

RSS-119 §5.8 Mask F. Mask F floor = -25 dBm.

Frequency range of spurious search:

30 MHz to 2.5 GHz, excluding frequencies within ± 61.75 kHz of the transmitter carrier frequency.

Transmitter test conditions:

Power Supply Voltage: 74 Vdc

Ambient temperature: 22°C.

Duty cycle: 100%

Eight operational variations were scanned for spuri based on permutations of the transmitter frequency limits, power limits and modulation types:

Transmitter carrier frequencies (fo): 220.0125 MHz and 221.9875 MHz

Maximum and minimum rated power: 47 dBm PEP, 41 dBm PEP

Modulation: DQPSK 32 kbps and DQPSK 16 kbps

Procedure:

The ANSI/TIA-603-C-2004 §2.2.13 unwanted emissions test procedure was adapted to meet specific FCC and IC search range, bandwidth and detector requirements. Preliminary scans were conducted at broad search ranges to identify signals of interest ≥ -45 dBm, followed by close inspection of those signals at narrow search ranges. CISPR Quasi-peak detection was used as the final detector on signals of interest where possible below 1 GHz and average detector was used above 1 GHz. Quasi-peak detection is not available for the close-in integrated measurements.

Because test bandwidths ranged up to 1MHz and peak detection was used, radio frequency filters were inserted to suppress the carrier so that the test apparatus sensitivity could be increased adequately to identify transmitter spuri down to the reporting limit of -45 dBm, excluding close-in measurements. See the list of test parameters in the frequency search range table at the end of this exhibit for more details.

The test apparatus loss was pre-measured across the test frequency range eliminating the need for substituting a signal generator with calibrated output power.

Results:

Since Industry Canada spurious emission measurement test bandwidth requirements are more stringent than FCC requirements below 1 GHz, only Industry Canada compliant measurements are reported in Table 1. Example signal analyzer plots are shown for some of the entries in Table 1.

Please note that the internal phase noise of the signal analyzer limits the close-in measurement sensitivity of the test setup to approximately -27 dBm at ± 111.8 kHz offset from the carrier at the IC specified 100 kHz integration bandwidth and 47 dBm carrier power.

Table 1. Unwanted Spurious Emissions. Compliance limit = -25 dBm.

Carrier Frequency, MHz	Power Output, dBm	Bit Rate, kbps	Search Range, MHz	Spur Freq, MHz	Measured Level, dBm	Corrected Level, dBm	dBc	Plot Figure
220.0125	47	32	Close-in	219.901	-26.83	-26.63	-73.63	3
221.9875	47	16	Close-in	221.763	-26.86	-26.66	-73.66	
220.0125	47	16	Close-in	219.901	-26.98	-26.78	-73.78	
221.9875	47	32	Close-in	222.099	-27.00	-26.80	-73.80	
220.0125	41	32	Close-in	219.901	-29.22	-29.02	-70.02	
221.9875	41	16	Close-in	221.876	-29.28	-29.08	-70.08	
220.0125	41	16	Close-in	219.901	-29.33	-29.13	-70.13	
221.9875	47	32	100-221.4875	221.560	-31.13	-29.93	-76.93	2
220.0125	47	16	220.513-500	220.426	-31.36	-30.26	-77.26	4
221.9875	47	16	222.48-500	222.401	-31.71	-30.41	-77.41	
221.9875	47	16	100-221.4875	221.528	-31.76	-30.56	-77.56	
220.0125	47	32	220.513-500	220.468	-31.94	-30.84	-77.84	
220.0125	47	32	100-219.510	219.547	-32.17	-30.87	-77.87	
220.0125	41	32	220.513-500	220.809	-34.73	-33.63	-74.63	
220.0125	41	16	220.513-500	220.785	-34.82	-33.72	-74.72	
221.9875	41	16	100-221.49	221.488	-35.05	-33.85	-74.85	
221.9875	41	32	100-221.49	221.230	-35.19	-33.99	-74.99	
221.9875	47	32	2nd harm	443.974	-35.56	-34.16	-81.16	5

221.9875	47	16	2nd harm	443.975	-35.65	-34.25	-81.25	
220.0125	41	32	100-219.510	219.461	-36.10	-34.80	-75.80	
221.9875	41	16	222.48-500	222.520	-36.20	-34.90	-75.90	
220.0125	41	16	100-219.510	219.408	-36.30	-35.00	-76.00	
221.9875	41	32	222.48-500	222.771	-36.47	-35.17	-76.17	
220.0125	47	32	500-1G	659.988	-37.56	-36.56	-83.56	
220.0125	47	32	3rd harm	660.039	-38.08	-37.08	-84.08	5
220.0125	47	16	3rd harm	660.038	-38.10	-37.10	-84.10	
220.0125	47	16	500-1G	660.013	-38.99	-37.99	-84.99	6
221.9875	47	16	3rd harm	665.961	-39.16	-38.16	-85.16	
221.9875	47	32	3rd harm	665.965	-39.88	-38.88	-85.88	
220.0125	47	32	2nd harm	440.028	-41.12	-39.62	-86.62	
220.0125	47	16	2nd harm	440.026	-41.14	-39.64	-86.64	
221.9875	47	32	222.48-500	235.504	-41.40	-40.90	-87.90	
221.9875	47	16	222.48-500	235.499	-41.48	-40.98	-87.98	
221.9875	47	32	500-1G	665.963	-42.21	-41.21	-88.21	
220.0125	47	16	220.513-500	233.770	-42.28	-41.78	-88.78	
220.0125	47	32	220.513-500	233.968	-42.58	-42.08	-89.08	
221.9875	47	16	500-1G	665.963	-43.86	-42.86	-89.86	
221.9875	47	32	30-100	52.463	-43.22	-43.02	-90.02	1
220.0125	47	16	100-219.510	183.832	-43.81	-43.41	-90.41	
221.9875	47	16	30-100	51.355	-43.70	-43.50	-90.50	
220.0125	47	32	30-100	52.815	-43.86	-43.66	-90.66	
220.0125	47	16	30-100	54.513	-44.53	-44.33	-91.33	
221.9875	47	32	100-221.4875	182.908	-45.02	-44.62	-91.62	
221.9875	47	16	100-221.4875	182.939	-45.12	-44.72	-91.72	
221.9875	47	32	1G-2.5G	2458.338	-53.06	-50.76	-97.76	6

Example calculation for first entry in Table 1:

Measured Amplitude (Figure 1) -26.83 dBm
Offset correction: + 0.20 dB
Corrected spur amplitude: -26.63 dBm

Limit: -25 dBm

Spur power -26.63 dBm
Subtract carrier power -47.00 dBm
Spur level -73.63 dBc

Statement of Test Supervisor:

All tests were conducted by me or under my supervision.



John F. "Fred" Cleveland, Principal Engineer

Test setup:

The test equipment list, test setup block diagram, test setup photograph and equipment calibration information is submitted in a separate exhibit.

See Table 2 for the parameters of the unwanted emission search followed by some example plots.

Table 2. Frequency Search Table							
Search Frequencies		Note: fo = carrier frequency					
Low, MHz	High, MHz	Carrier Filter	Initial Detector	Final Detector	FCC Final BW, kHz	IC Final BW, kHz	Example Scan
30	100	Low Pass	Peak	Quasi-Peak	10	120	Fig. 1
100	fo-0.5	Notch	Peak	Quasi-Peak	10	120	Fig. 2
fo-0.5	fo+0.5	None	Peak	Integrated Peak	10	100	Fig. 3
fo+ 0.5	500	Notch	Peak	Quasi-Peak	10	120	Fig. 4
500	1000	High Pass	Peak	Quasi-Peak	10	120	Fig. 5
1000	2500	High Pass	Average	Average	1000	1000	Fig. 6

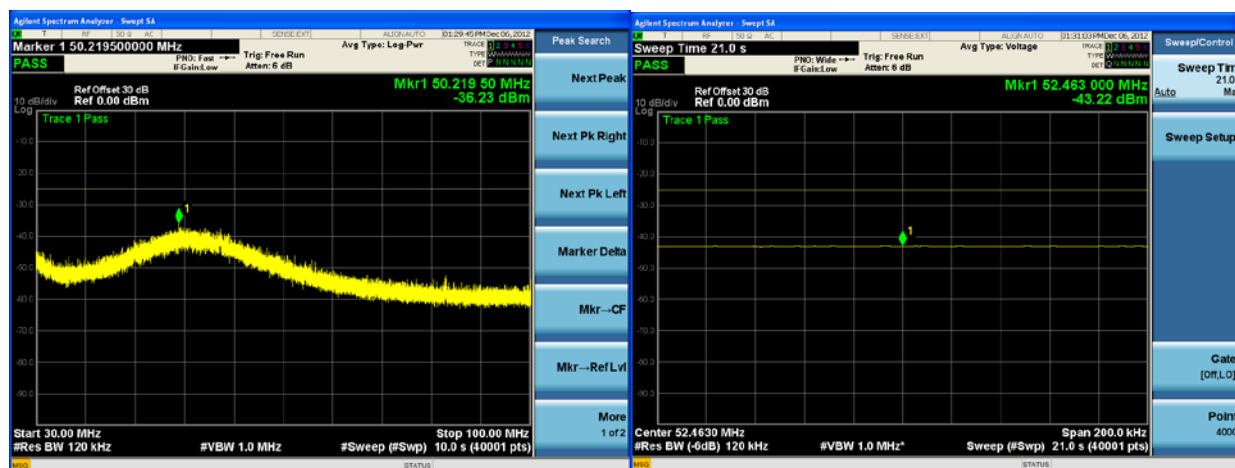


Figure 1. 221.9875 MHz, 50W, 32 kbps, 30 to 100 MHz plus Quasi-Peak zoom.

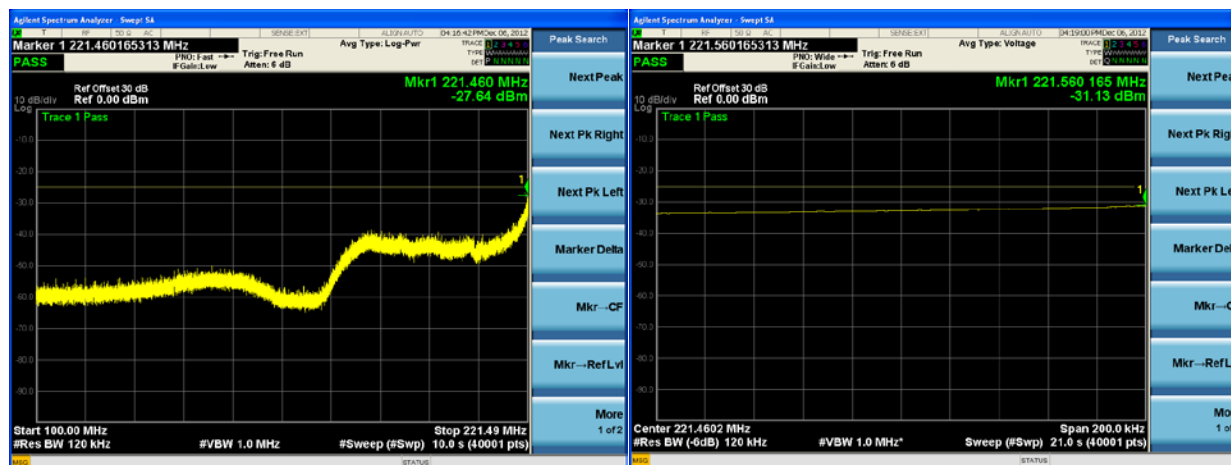


Figure 2. 221.9875 MHz, 50W, 32 kbps, 100 to 221.49 MHz plus Quasi-Peak zoom.

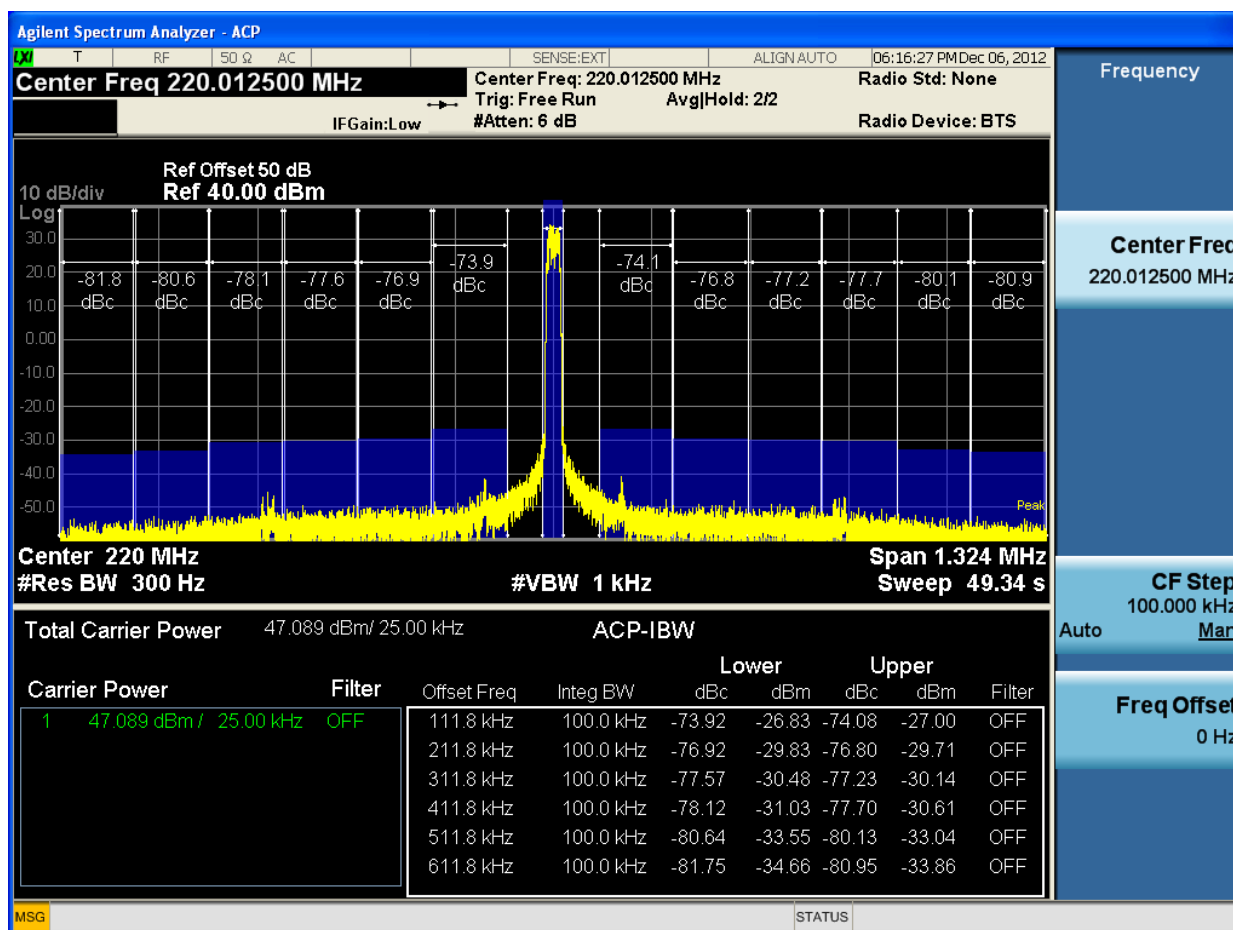


Figure 3. 220.0125 MHz, 50W, 32kbps, Close-in.

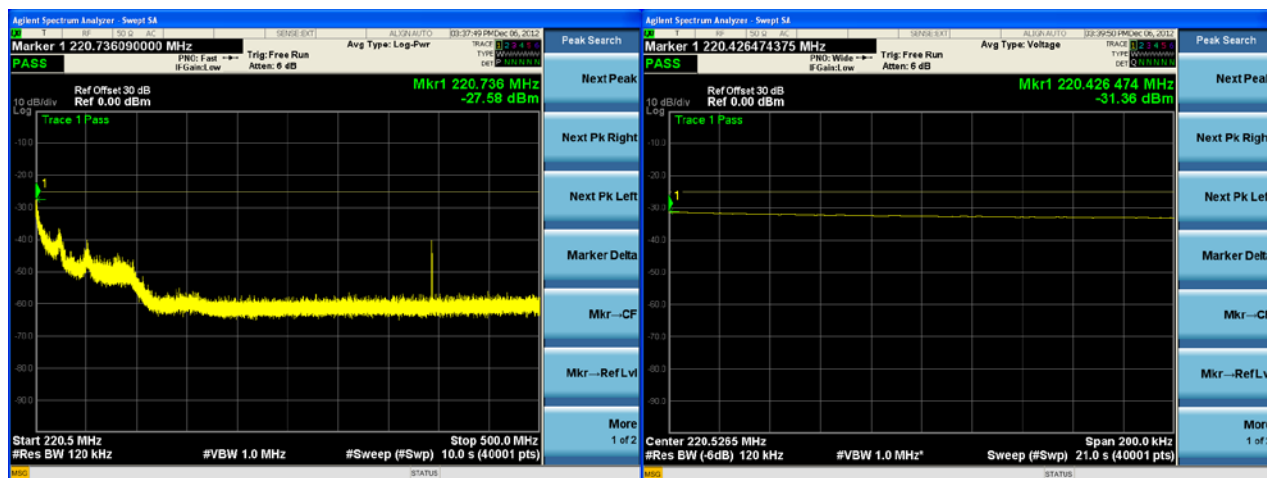


Figure 4. 220.0125 MHz, 50W, 16 kbps, 222.5 to 500 MHz plus quasi-peak zoom.



Figure 5. 50W, 32 kbps, 2nd harmonic of 221.9875 MHz and 3rd harmonic of 220.0125 MHz.

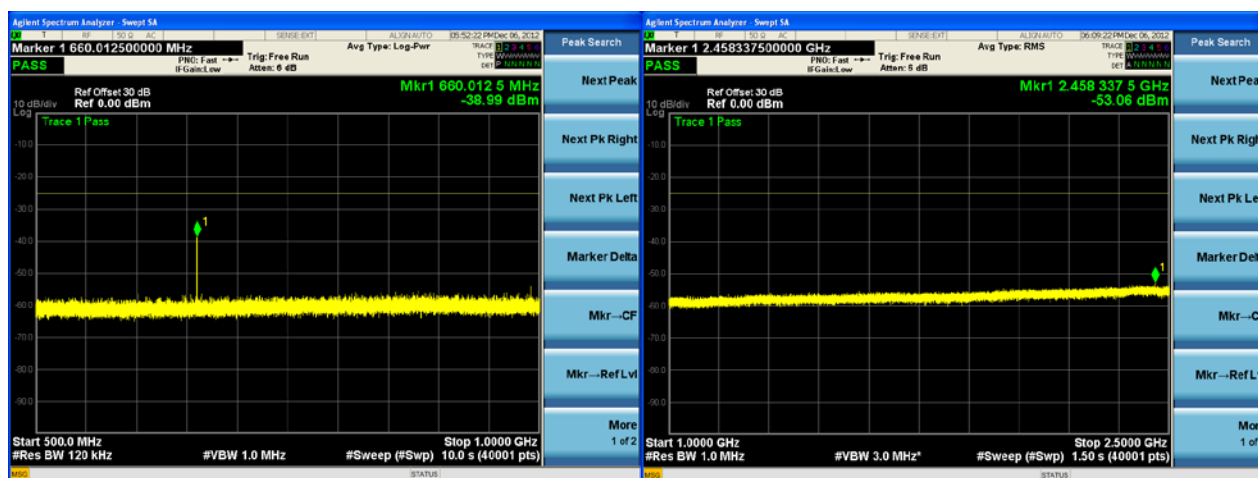


Figure 6. 220.0125 MHz, 50W, 16 kbps 500 to 1000 MHz peak and 1GHz to 2.5 GHz avg.