Sirius XM-7

SpaceX Emissions Question

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Summary

- Question regarding S-band emissions and compliance to operations in the WCS bands, while processing the SXM7 SC in the SpaceX Launch Base facilities
- Question

  Another follow up request from the FCC. Given that the S band tests will occur in the PPF, we need to confirm that we have sufficient out of band attenuation (appx 90dB worth). We do get some shielding from PPF (appx 15-20dB) but I know you guys also radiate into hats. Do you think you could provide some more details on the test set up and intended attenuation for these tests? This will help us collectively make an argument for how we will attenuate these out of band signals. For reference, here is the wording FCC is asking us to comply with.

§27.53 Emission limits.

(a) For operations in the bands 2305–2320 MHz and 2345–2360 MHz, the power of any emission outside the licensee's frequency band(s) of operation shall be attenuated below the transmitter power (P) within the licensed band(s) of operation, measured in watts, by the following amounts:

(1) *For fixed, land, and radiolocation land stations:* By a factor not less than 80 + 10 log (p) dB on all frequencies between 2320 and 2345 MHz;

(2) *For mobile and radiolocation mobile stations:* By a factor not less than 110 + 10 log (p) dB on all frequencies between 2320 and 2345 MHz;

(3) *For fixed, land, mobile, radiolocation land and radiolocation mobile stations:* By a factor not less than 70 + 10 log (p) dB on all frequencies below 2300 MHz and on all frequencies above 2370 MHz; and not less than 43 + 10 log (p) dB on all frequencies between 2300 and 2320 MHz and on all frequencies between 2345 and 2370 MHz that are outside the licensed bands of operation;

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Response

- The SXM7 SC will not be operating in the WCS band
  - The S-band Frequencies it is licensed for are 2320 to 2345MHz
- The SXM7 SC payloads are not going to be tested at the SpaceX facility with any RF uplinks, and no downlinks will be generated by any command functional testing that is planned to be performed
  - No communications payload emissions in WCS band nor in 2320 to 2345MHz
- The TCR subsystem utilizes frequencies in the above S-band and will be operational and emitting at various points in payload processing and on the pad
- The following slides document the out-of-band emissions of the TCR transmitter planned to be operational during the payload processing
  - Analysis assumes no attenuation from absorber, hat-couplers or facility walls
  - Analysis assumes worst case frequency (closest to WCS band)
  - Compliance to FCC 47 is based upon the licensed frequency range of 2320 to 2345 and based on 27.53, section 4 – as the SC is not 'fixed' nor Customer Premises Equipment (sections 1,2,3) when processed in the Launch Base facility.

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FCC 47 - WCS Band Compliance

- The FCC WCS band covers the following two frequency ranges:
  - 2305-2320 MHz
  - 2345-2360 MHz

- There are two TC&R S-Band frequencies that are near the WCS bands and are required to meet out-of-band emission limits.
  - XMTR#1 Freq: 2323.1 MHz
  - XMTR#2 Freq: 2325.5 MHz

Frequency	2323.1	2325.5
Output Power (dBW)	12.5	12
Output Power (W)	17.8	15.8
Frequency Tolerance	±400kHz	±400kHz
Emission Designator(s)	1M50G8DAN	1M50G8DAN
Modulation Signal	PM	PM

- Emission limits were calculated based on FCC Title 47 Part 27 Technical Standards and highest measured transmitter power.

Frequency Range	Formula	Emission Limit (dBc)
2320-2324 MHz	55+10log(P)	-67.5
2324-2328 MHz	61+10log(P)	-73

Note: P is the transmitted power in watts

- Analysis of final performance ambient was used to determine the approximate bandwidth and found worst case lower and upper edges of channel with frequency tolerance included. Results were compliant.

Transmitter Center Frequency, MHz	Worst Case Lower Edge, MHz	Worst Case Upper Edge, MHz	Out-of-Spec within WCS Band	Compliance
2323.1	2322.4	2323.8	No	Compliant
2325.5	2324.2	2326.5	No	Compliant

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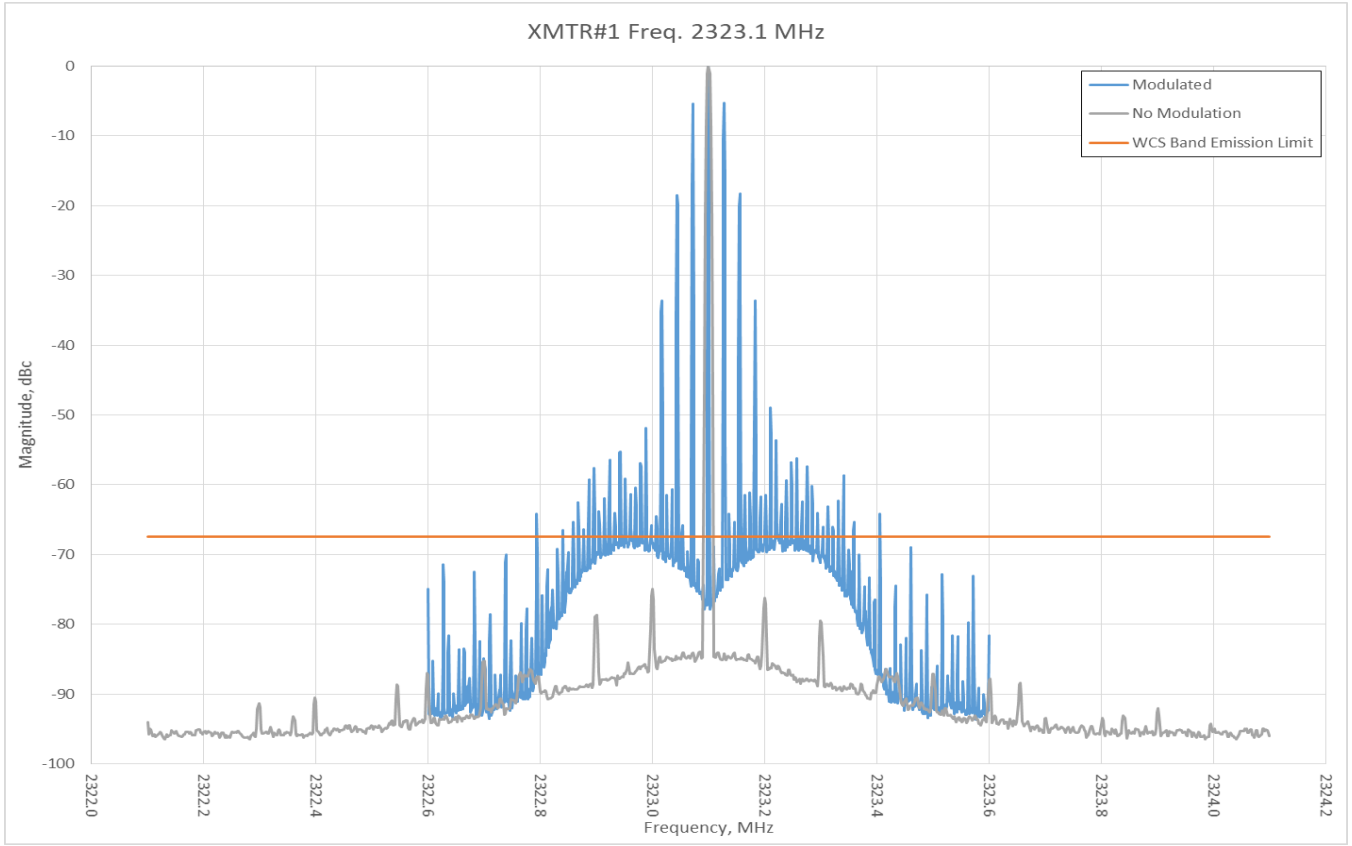
Transmitter #1 Spectrum Plot



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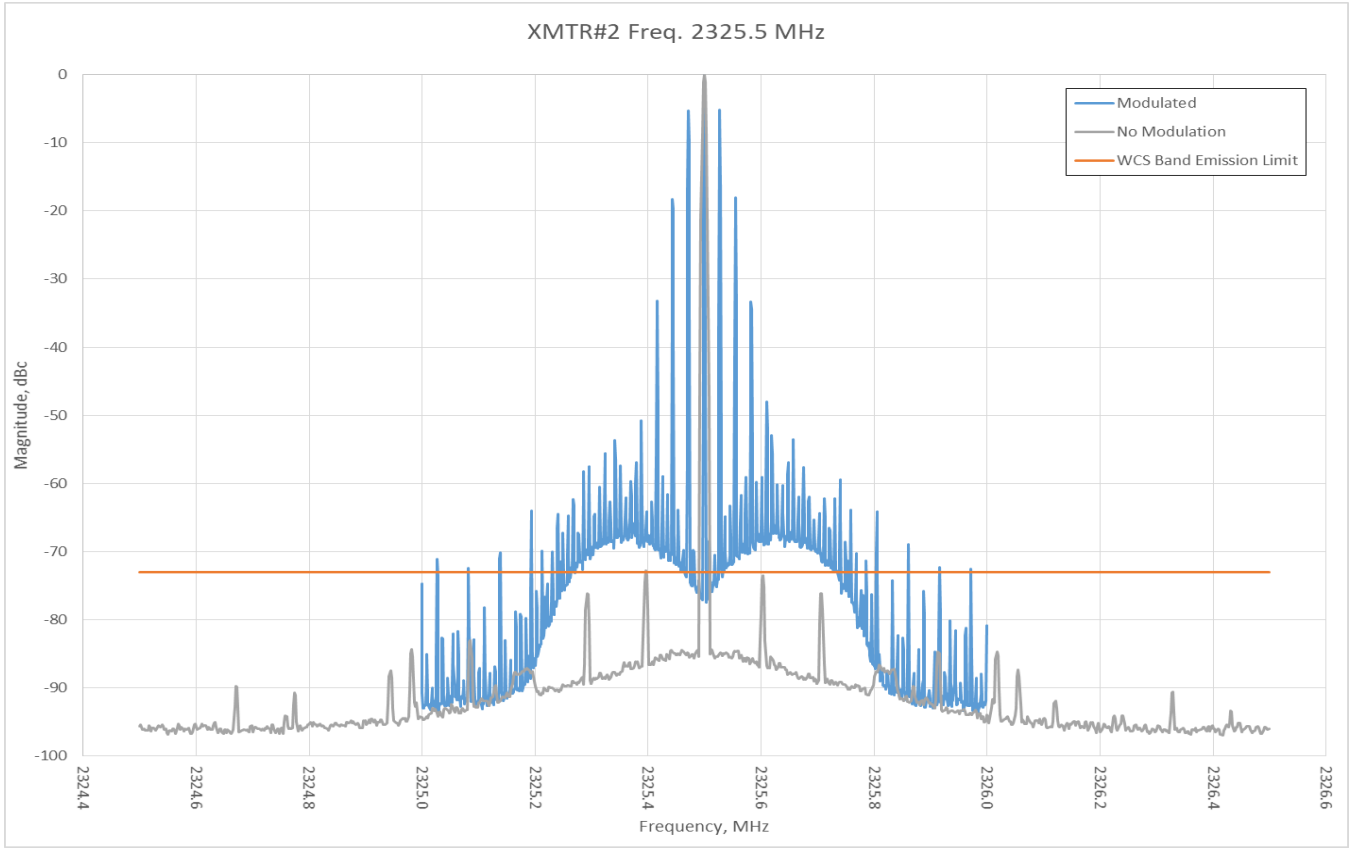
Transmitter #2 Spectrum Plot



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Conclusion

- Measured emissions for both TC&R transmitters remain below the WCS band limit of section 4i

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