

5. Periodic Operation

5.1 Requirement

5.1.1 Section 15.231(a) Rules

47 CFR Section 15.231 Periodic operation in the band 40.66 - 40.70 MHz and above 70 MHz.

(a) The provisions of this Section are restricted to periodic operation within the band 40.66 - 40.70 MHz and above 70 MHz. Except as shown in paragraph (e) of this Section, the intentional radiator is restricted to the transmission of a control signal such as those used with alarm systems, door openers, remote switches, etc. Continuous transmissions, voice, video and the radio control of toys are not permitted. Data is permitted to be sent with a control signal. The following conditions shall be met to comply with the provisions for this periodic operation:

(1) A manually operated transmitter shall employ a switch that will automatically deactivate the transmitter within not more than 5 seconds of being released.

(2) A transmitter activated automatically shall cease transmission within 5 seconds after activation.

(3) Periodic transmissions at regular predetermined intervals are not permitted. However, polling or supervision transmissions, including data, to determine system integrity of transmitters used in security or safety applications are allowed if the total duration of transmissions does not exceed more than two seconds per hour for each transmitter. There is no limit on the number of individual transmissions, provided the total transmission time does not exceed two seconds per hour.

(4) Intentional radiators, which are employed for radio control purposes during emergencies involving fire, security, and safety of life, when activated to signal an alarm, may operate during the pendency of the alarm condition.

5.1.2 Applicability of Subsection of 15.231(a) to the EUT

Section 15.231(a)(1): Was applicable. (The EUT was a manually operated transmitter).

Section 15.231(a)(2): Was not applicable. (The EUT was not capable of automatic operation).

Section 15.231(a)(3): Was not applicable. (The EUT did not have the capability to make periodic transmissions. In addition, the EUT did not make polling or supervision transmissions).

Section 15.231(a)(4): Was not applicable. (The EUT was not designed to signal alarms).

5.2 Test Equipment

- ⇒ Portable Spectrum Analyzer: Hewlett Packard E7401, Serial Number US39150147 Conditional Use Only
- ⇒ Spectrum Analyzer (yellow): Hewlett-Packard 8566B, Serial Number 2410A00139, Calibrated: 25 November 2002, Calibration Due Date: 25 November 2003
- ⇒ RF Preselector (yellow): Hewlett-Packard 85685A, Serial Number 2648A00392, Calibrated: 25 November 2002, Calibration Due Date: 25 November 2003
- ⇒ Quasi Peak Adapter (yellow): Hewlett-Packard 85650A, Serial Number 2521A00689, Calibrated: 25 November 2002, Calibration Due Date: 25 November 2003
- ⇒ Log Periodic Antenna (white) (200 MHz to 1000 MHz): EMCO 3146, Serial Number 9402-3773, Calibrated: 13 January 2003, Calibration Due Date: 13 January 2004
- ⇒ Antenna Mast and Controller: EMCO 1051, Serial Number 9002-1457, No Calibration Required
- ⇒ Turntable and Position Controller: EMCO 1061, Serial Number 9003-1440, No Calibration Required
- ⇒ Open Area Test Site: Acme Testing Co., Test Site Number 2, Normalized Site Attenuation [NSA] Calibrated: 22 June 2003, Calibration Due Date: 22 June 2004

5.3 Test Procedures

The unmodified EUT (i.e. the normal Wireless Control unit) was placed on a 1.5 metre long by 1.0 metre wide by 80 cm high non-conductive (wood) table, which was, in turn, placed on the flush-mounted metal turntable. The unmodified EUT was powered “ON”, and operation was verified using a portable Spectrum analyzer and Log Periodic Antenna. Then, the Log Periodic antenna was mounted on the mast, and the mast was positioned for 3 metre distance measurements. The HP8566B-based CISPR 16 EMI Receiver System was attached to the Log Periodic Antenna, and was tuned to the EUT’s fundamental frequency, and was then placed in zero span mode so as to allow the EUT’s transmission timeline to be measured. Note that the Pre-scans were performed on the EUT while in each of its four “Extreme Condition” states – i.e.:

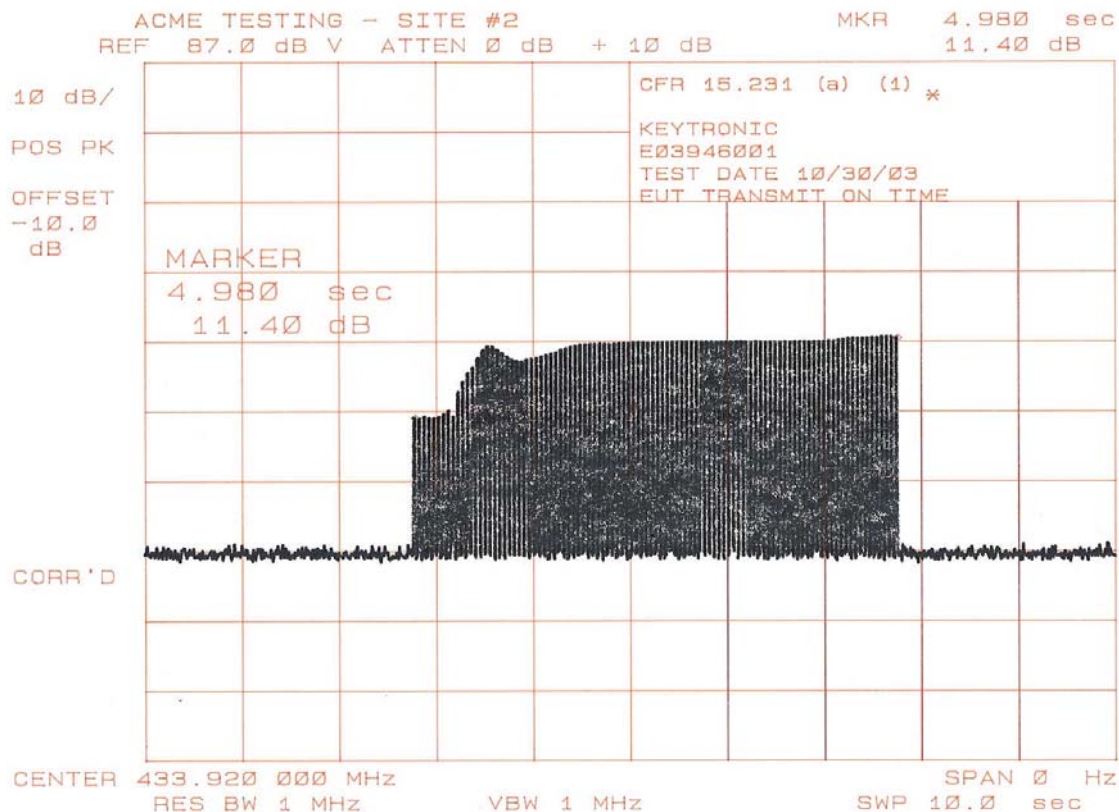
- EUT set to 12.5 Hz acoustic pulse rate and 2 Volts output;
- EUT set to 12.5 Hz acoustic pulse rate and 35 Volts output;
- EUT set to 50.0 Hz acoustic pulse rate and 2 Volts output;
- EUT set to 50.0 Hz acoustic pulse rate and 35 Volts output.

From these Pre-scans, it was determined that the worst-case EUT operational state was with the EUT set to 12.5 Hz acoustic pulse rate and 2 Volts output. This EUT operational state was used when the final “Periodic Operation” measurement was made.

5.4 Test Results

Date of Test: 30 October 2003

Test Result: Manually initiated transmissions ceased in 4.980 seconds. (See the plot below).



5.5 Test Setup Photograph



6. Signal Strength of Fundamental

6.1 Requirement

47 CFR Section 15.231(b)

In addition to the provisions of §15.205, the field strength of emissions from intentional radiators operated under this section shall not exceed the following:

Fundamental frequency (MHz)	Field strength of fundamental (microvolts/meter)	Field strength of spurious emissions (microvolts/meter)
40.66-40.70.....	2,250.....	225
70-130.....	1,250.....	125
130-174.....	\1\1,250 to 3,750.	\1\125 to 375
174-260.....	3,750.....	375
260-470.....	\1\3,750 to 12,500	\1\375 to 1,250
Above 470.....	12,500.....	1,250
\1\Linear interpolations.		

(1) The above field strength limits are specified at a distance of 3 meters. The tighter limits apply at the band edges.

(2) Intentional radiators operating under the provisions of this section shall demonstrate compliance with the limits on the field strength of emissions, as shown in the above table, based on the average value of the measured emissions. As an alternative, compliance with the limits in the above table may be based on the use of measurement instrumentation with a CISPR quasi-peak detector. The specific method of measurement employed shall be specified in the application for equipment authorization. If average emission measurements are employed, the provisions in §15.35 for averaging pulsed emissions and for limiting peak emissions apply. Further, compliance with the provisions of §15.205 shall be demonstrated using the measurement instrumentation specified in that section.

(3) The limits on the field strength of the spurious emissions in the above table are based on the fundamental frequency of the intentional radiator. Spurious emissions shall be attenuated to the average (or, alternatively, CISPR quasi-peak) limits shown in this table or to the general limits shown in §15.209, whichever limit permits a higher field strength.

6.2 Determination of the Applicable Limit

The EUT's fundamental frequency was 433.94 MHz. The maximum permitted field strength of the fundamental at 3 metres was: $41.667 (F) - 708.3333$, where F is in MHz. The resultant field strength limit at 433.94 MHz in $\mu\text{V/m}$ at 3 metres was: 10,997.52 $\mu\text{V/m}$ or 80.8 dBuV/m (Quasi-Peak or Average); if Average, then the fundamental Peak limit was 20 dB higher (per Section 15.35(b)) i.e. was equal to 100.8 dBuV/m (Peak) at 3 metres.

6.3 Test Equipment

- ⇒ Spectrum Analyzer (yellow): Hewlett-Packard 8566B, Serial Number 2410A00139, Calibrated: 25 November 2002, Calibration Due Date: 25 November 2003
- ⇒ RF Preselector (yellow): Hewlett-Packard 85685A, Serial Number 2648A00392, Calibrated: 25 November 2002, Calibration Due Date: 25 November 2003
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- ⇒ Open Area Test Site: Acme Testing Co., Test Site Number 2, Normalized Site Attenuation [NSA] Calibrated: 22 June 2003, Calibration Due Date: 22 June 2004

6.4 Test Procedures

The modified EUT was placed on 1 metre long by 1.5 metre wide by 80 cm high non-conductive (wood) table, which was, in turn, placed on the flush mounted turntable. The modified EUT was powered "ON". The Log Periodic Antenna was mounted on the mast, and the mast was placed at the 3 metre position. The HP8566B-based CISPR 16 EMI Receiver System was attached to the Log Periodic Antenna, and the signal was maximized in turntable azimuth, test antenna height, test antenna polarization, EUT operational state, and in EUT orientation. Pre-scans were performed on the EUT while in each of its four "Extreme Condition" states – i.e.:

- EUT set to 12.5 Hz acoustic pulse rate and 2 Volts output;
- EUT set to 12.5 Hz acoustic pulse rate and 35 Volts output;
- EUT set to 50.0 Hz acoustic pulse rate and 2 Volts output;
- EUT set to 50.0 Hz acoustic pulse rate and 35 Volts output.

From these pre-scans, it was determined that the worst-case EUT operational state was with the EUT set to 12.5 Hz acoustic pulse rate and 2 Volts output.

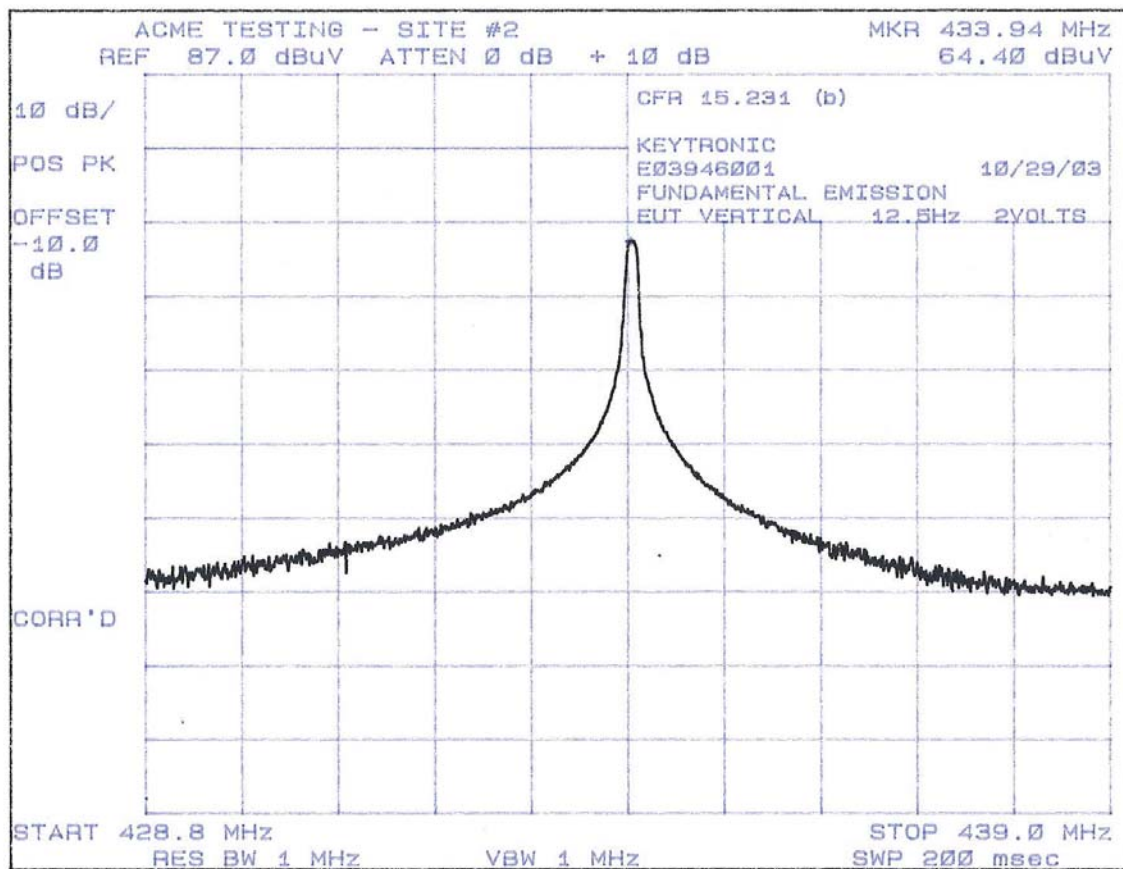
Also, all three EUT orientations were examined. The worst-case was "EUT vertical" [i.e. standing upright].

6.5 Test Results

Test Date: 29 October 2003

Fundamental Emissions
Worst-Case: EUT set to 12.5 Hz Acoustic Pulse Rate, 2 Volts Output,
with EUT Orientation = Vertical

No	EMISSION	SPEC	PEAK MEASUREMENTS				SITE	CORR
	FREQUENCY MHz	LIMIT dBuV/m	ABS	dLIM dB	MODE	POL	HGT cm	FACTOR dB
1	433.940	100.8	85.2	-15.6	PK	V	100	20.4



The EUT complied with the applicable Section 15.231(b) Peak Limit for the fundamental emissions (i.e. 100.8 dBuV/m at 3 meters) with a margin of -15.6 dB.

(Continued on the next page)

As stated above, the AVERAGE Fundamental limit was 80.8 dBuV/m at 3 meters.

The EUT's Duty Cycle was measured in its four "extreme condition" states, i.e.:

- EUT set to 12.5 Hz acoustic pulse rate and 2 Volts output,
- EUT set to 12.5 Hz acoustic pulse rate and 35 Volts output,
- EUT set to 50.0 Hz pulse rate and 2 Volts output,
- EUT set to 50.0 Hz pulse rate and 35 Volts output

(See the plots on the next four pages for details).

In each case, the length of the complete pulse train was ~ 50.5 milliseconds, and the worst-case "on time" of the pulse train was 11.8 milliseconds (with the worst-case being at 2 Volts output and 12.5 Hz acoustic pulse rate).

Thus: For on-time = 11.8 milliseconds, and pulse train length = 50.5 milliseconds:

$$\begin{aligned}\text{Duty Cycle} &= \frac{11.8}{50.5} = 0.2336 = 23.36\% \\ &= 20 \text{ Log}_{10} [0.2336] = -12.63 \text{ dB}\end{aligned}$$

Consequently, the Average (Duty Cycle corrected) fundamental emission from the EUT was:

$$\begin{aligned}&= 85.2 \text{ dBuV/m at 3 meter (Peak)} + (-12.6 \text{ dB Duty Cycle Correction}) \\ &= + 72.6 \text{ dBuV/m at 3 meter (Average)}\end{aligned}$$

Recall that the Average limit for the EUT was 80.8 dBuV/m at 3 meters, so: The EUT complied with the applicable Section 15.231(b) Average limit for the fundamental emissions (i.e. 80.8 dBuV/m at 3 meters) with a margin of -8.2 dB.

Test Date: 30 October 2003

