

LR560 Compliance with 47CFR15.256

Version V2, updated with Average power in clause (g)(3)

The following pages provide detail as to how compliance with 15.256 is demonstrated.

Clause	Tests	Comments
(a)	Operation under this section is limited to level probing radar (LPR) devices.	LR560 is Level Probing Radar as per 15.3(ii)
(b)	LPR devices operating under the provisions of this section shall utilize a dedicated or integrated transmit antenna, and the system shall be installed and maintained to ensure a vertically downward orientation of the transmit antenna's main beam.	Antenna is fully integrated into the LR560 housing during manufacture.
(c)	LPR devices operating under the provisions of this section shall be installed only at fixed locations. The LPR device shall not operate while being moved or while inside a moving container.	User Manual Statement
(d)	Hand-held applications are prohibited.	User Manual Statement
(e)	Marketing to residential consumers is prohibited.	Device is only marketed to business users and will only function when connected to an industrial interface (HartBus, Profibus or Fieldbus)
(f)	The fundamental bandwidth of an LPR emission is defined as the width of the signal between two points, one below and one above the center frequency, outside of which all emissions are attenuated by at least 10 dB relative to the maximum transmitter output power when measured in an equivalent resolution bandwidth.	Noted
	(1) The minimum fundamental emission bandwidth shall be 50 MHz for LPR operation under the provisions of this section.	Emission bandwidth is 1300 MHz
	(2) LPR devices operating under this section must confine their fundamental emission bandwidth within the 5.925-7.250 GHz, 24.05-29.00 GHz, and 75-85 GHz bands under all conditions of operation.	Frequency range of operation is 78.0 to 79.3 MHz.

Clause	Tests	Comments
	Fundamental Emissions limits	Noted
	(1) All emission limits provided in this section are expressed in terms of Equivalent Isotropic Radiated Power (EIRP).	Noted
	(2) The EIRP level is to be determined from the maximum measured power within a specified bandwidth.	Noted
	(i) The EIRP in 1 MHz is computed from the maximum power level measured within any 1-MHz bandwidth using a power averaging detector	RFI-RPT-RP78054JD01B_V2.0, section 5.2.7
(g)	(ii) The EIRP in 50 MHz is computed from the maximum power level measured with a peak detector in a 50-MHz bandwidth centered on the frequency at which the maximum average power level is realized and this 50 MHz bandwidth must be contained within the authorized operating bandwidth. For a RBW less than 50 MHz, the peak EIRP limit (in dBm) is reduced by $20 \log(\text{RBW}/50)$ dB where RBW is the resolution bandwidth in megahertz. The RBW shall not be lower than 1 MHz or greater than 50 MHz. The video bandwidth of the measurement instrument shall not be less than the RBW. If the RBW is greater than 3 MHz, the application for certification filed shall contain a detailed description of the test procedure, calibration of the test setup, and the instrumentation employed in the testing.	The device is FMCW. FMCW EIRP may be measured using any suitable measurement bandwidth, such as 1 MHz, without scaling the measurement. Reference: "Response to Inquiry to FCC (Tracking Number 676195)"
	(3) The EIRP limits for LPR operations in the bands authorized by this rule section are provided in Table 1. The emission limits in Table 1 are based on boresight measurements (<i>i.e.</i> , measurements performed within the main beam of an LPR antenna).	LR560 operates in the 75-85 GHz band and has peak EIRP is 30.2 dBm (1.04W). Average EIRP is -32.3 dBm (see calculation on page 4)
(h)	Unwanted emissions limits. Unwanted emissions from LPR devices shall not exceed the general emission limit in §15.209 of this chapter.	RFI-RPT-RP78054JD01B_V2.0, sections 5.2.5, 5.2.6, and 5.2.7
(i)	(i) Antenna beamwidth. (B) LPR devices operating under the provisions of this section within the 75-85 GHz band must use an antenna with a -3 dB beamwidth no greater than 8 degrees.	Antenna beamwidth is $< 8^\circ$. See "LPR Operation description for LR560"
(j)	Antenna side lobe gain. LPR devices operating under the provisions of this section must limit the side lobe antenna gain relative to the main beam gain for off-axis angles from the main beam of greater than 60 degrees to the levels provided in Table 2.	See "LPR Operation description for LR560"

Clause	Tests	Comments
(k)	Emissions from digital circuitry used to enable the operation of the transmitter may comply with the limits in §15.209 of this chapter provided it can be clearly demonstrated that those emissions are due solely to emissions from digital circuitry contained within the transmitter and the emissions are not intended to be radiated from the transmitter's antenna. Emissions from associated digital devices, as defined in §15.3(k) of this part, e.g., emissions from digital circuitry used to control additional functions or capabilities other than the operation of the transmitter, are subject to the limits contained in subpart B, part 15 of this chapter. Emissions from these digital circuits shall not be employed in determining the -10 dB bandwidth of the fundamental emission or the frequency at which the highest emission level occurs	Highest frequency used in digital circuits is < 108 MHz, so testing required to 1 GHz. Results are presented in RFI-RPT-RP78054JD01B_V2.0 against 15.209(a) limits which are same as 15.109(a) limits. See section 5.2.3 and 5.2.5 for results data and table below for comparison of 5.2.5 results against 15.109 limit. (It should be noted that the LPR is a Class A device so only has to comply with 15.109(b), so has been tested against a more stringent limit.)

Extract from RFI-RPT-RP78054JD01B_V2.0: Table in section 5.2.5 with results against 15.109

Frequency (MHz)	Quasi-Peak level (dBµV/m)	Quasi-Peak limit (dBµV/m)	Margin	Result
53.124	19.3	40.0	20.7	Pass
107.578	22.0	43.0	21.0	Pass
153.305	25.1	43.0	17.9	Pass
162.489	33.0	43.0	10.0	Pass
187.488	34.0	43.0	9.0	Pass
212.486	35.0	46.0	11.0	Pass
237.463	3.0	46.0	43.0	Pass
262.474	36.0	46.0	10.0	Pass
299.944	29.0	46.0	17.0	Pass
649.949	29.0	46.0	17.0	Pass
624.987	30.0	46.0	16.0	Pass
974.983	28.1	54.0	25.9	Pass

Average Power Calculation.

Average power of FMCW signal is determined in accordance with proposed revision to KDB890966 as per KDB enquiry Tracking Number 676195.

$$\text{Avg factor} = (T_s/F_s)/\text{cycle time}$$

Where:

$$T_s = 0.0036^i \text{ s}$$

$$F_s = 1300 \text{ MHz}$$

$$\text{cycle time} = 5^{\text{ii}} \text{ s}$$

$$\begin{aligned} \text{Avg factor} &= (0.0036/1300)/5 \\ &= 5.54 \text{ E-7, or } -61.1 \text{ dB} \end{aligned}$$

$$\begin{aligned} \text{Average power} &= \text{Peak power} * \text{Avg Factor} \\ &= 30.2 \text{ dBm} - 62.5 \text{ dB} \\ &= \mathbf{-32.3 \text{ dBm}} \end{aligned}$$

ⁱ Transmit time of 3.6 ms includes PLL lock time, so is worst case

ⁱⁱ 5 seconds is minimum operational cycle time so is worst case. (2.5 second cycle time used for testing is an Engineering Operational Mode and not available to the end user)