



**Federal Communications Commission
Office of Engineering and Technology
Laboratory Division**

April 12, 2019

**EQUIPMENT AUTHORIZATION GUIDANCE
FOR 76-81 GHz RADAR DEVICES**

1. INTRODUCTION

Radar operations involve the transmission of radio-frequency (RF) signals and analysis of the reflections from objects or people to determine their speed, range, and direction.¹ Information regarding the speed, range, and direction of nearby objects can facilitate a host of applications that are beneficial to the public. In the *Report and Order* in ET Docket No. 15-26 (FCC 17-94), the Commission established rules for licensed radar applications that operate in the 76-81 GHz band.²

The Commission added Subpart M to Part 95 of the rules for 76-81 GHz vehicular radar operations, as well as fixed and mobile radar operations used exclusively in airport air operations areas (*e.g.*, foreign object debris detection radars and wingtip-mounted radars).

2. VEHICULAR RADAR

While the rules in Parts 15 and 95 do not specifically define vehicles, Sections 15.252 and 15.515 of the Commission's rules (which specify technical requirements for vehicular radar systems) do permit the use of sensors mounted in terrestrial transportation vehicles. This supports an expanded rather than narrow view of a vehicle, and the new Part 95 Subpart M rules may be interpreted in a consistent manner.

Therefore, sensors certified under Part 15 and Part 95 Subpart M for use on vehicles can be deployed on: automobiles,³ trucks, railroad train locomotives, train cars, monorails or trams, construction vehicles, farming vehicles such as tractors and harvesters, motorcycles, scooters and motorbikes, mobile scissor-lifts and mobile work platforms, and boats and ships operated within territorial waters of the United States. The overall installation must comply with all the conditions of a grant of certification and the relevant technical standards for such operation. It is not necessary to obtain a new grant of certification for approved sensors to be used on different types of vehicles.

¹ See 47 CFR § 2.1(c) (radar is “[a] Radiodetermination system based on the comparison of reference signals with radio signals reflected, or retransmitted, from the position to be determined.”); ITU Radio Regulations 1.100-100.102 (2012).

² See *Amendment of Parts 1, 2, 15, 90 and 95 of the Commission's Rules to Permit Radar Services in the 76-81 GHz Band*, ET Docket No. 15-26, Report and Order, 32 FCC Rcd 8822 (2017). The 76-81 GHz band is part of the “millimeter-wave” spectrum. The term “millimeter-wave” derives from the wavelength of radio signals on frequencies between 30 GHz and 300 GHz, which ranges between 10 mm and 1 mm.

³ Radar devices intended solely for automotive in-cabin usage are not permitted under these rules.

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3. GENERAL EQUIPMENT CERTIFICATION RULES AND POLICES

- a) All Part 95 radar equipment requires certification (Section 95.3361) using Form-731 equipment class “VRD”.
- b) Prohibited applications of radar equipment under this service rule include fixed radar use outside of airport areas and airborne radar operations.⁴
- c) Radars previously certified under Section 15.253 need not be recertified under Part 95. Permissive changes and operation of such equipment shall be under Part 95.
- d) Transition provisions for unlicensed 24 GHz wideband (Section 15.252) and ultra-wideband (UWB) (Section 15.515) vehicular radars include⁵:
 - 1) Class II permissive changes will not be permitted after January 1, 2022.
 - 2) Manufacture, importation, marketing, sale, and installation are not permitted after January 1, 2022, except the continued sale and installation of unlicensed 24 GHz wideband and UWB radar devices is permitted for the exclusive purpose of repairing or replacing defective, damaged, or potentially malfunctioning equipment installed on or before January 1, 2022. This exception is available only when it is not possible to repair or replace the radar equipment designed to operate in the 24 GHz band with radar equipment designed to operate in the 76-81 GHz band, and the exception is limited to the repair and replacement of unlicensed 24 GHz wideband and UWB vehicular radar equipment that has been certified for operation in the 24 GHz band. The Commission expects manufacturers to draw on existing stock of equipment that has been approved before January 1, 2022, and will address requests for additional relief (*e.g.*, manufacture, importation, or product redesign) if any on a case-by-case basis.
- e) The general technical parameters to be measured and provided in an application for certification are listed in Sections 2.1046 through 2.1057, along with Sections 95.3367 and 95.3379. Mobile and portable radar devices that operate in the 76-81 GHz band are subject to routine environmental evaluation for radio-frequency exposure prior to equipment authorization or use (Sections 2.1091 and 2.1093).
- f) The Form-731 shall list the applicable emission designators and output power(s).
- g) Concerning the Section 2.1047 modulation characteristics requirement, the following information should be provided:
 - 1) Pulsed radar: pulse width and pulse repetition frequency (if PRF is variable, then report maximum and minimum values).
 - 2) Non-pulsed radar (*e.g.*, FMCW): modulation type (*i.e.*, sawtooth, sinusoid, triangle, or square wave) and sweep characteristics (sweep bandwidth, sweep rate, sweep time).
- h) No specific sub-bands or channel bandwidths are designated or required within the 76-81 GHz frequency range.

⁴ Aircraft-mounted radars must include an automatic shut-off capability that discontinues all 76-81 GHz radar functions while the aircraft is airborne.

⁵ See Section 15.37(l) – (n). The certification of wideband radars designed to operate in the 23.12 – 29 GHz band under Section 15.252 and ultra-wideband vehicular radars designed to operate in the 22 – 29 GHz band under Section 15.515 is no longer permitted.

4. TECHNICAL REQUIREMENTS

- a) *Radiated Power Limits*: The radiated power limits associated with the fundamental-frequency emissions of radars intended for operation within the 76-81 GHz frequency band under Part 95, Subpart M of the FCC rules, including but not limited to short-range vehicular radars, are specified in Section 95.3367 as:
- 1) The maximum power (EIRP) within the 76-81 GHz band shall not exceed 50 dBm, based on measurements employing a power averaging detector with a 1 MHz resolution bandwidth (RBW).
 - 2) The maximum peak power (EIRP) within the 76-81 GHz band shall not exceed 55 dBm, based on measurements employing a peak detector with a 1 MHz RBW.
- b) The maximum fundamental emission power (EIRP) shall be measured using a power averaging (rms) detector with a 1 MHz resolution bandwidth (RBW) and integrated over the full 99% occupied bandwidth (OBW) to obtain the data necessary to demonstrate compliance to the 50 dBm limit.
- c) The maximum peak fundamental emission power (EIRP) measurement shall be performed by sweeping over the transmitted occupied bandwidth using a positive peak power detector with peak hold activated, and a 1 MHz RBW. Power integration is not to be used in performing this measurement. The resultant peak power spectral density (maximum in any 1 MHz) data shall be used to demonstrate compliance to the 55 dBm/MHz limit.
- 1) Peak power measurements of swept frequency radar implementations (e.g., high sweep rate FMCW) may require a desensitization correction factor to be applied to the measurement results. See relevant Application Note(s) from the measurement instrumentation vendor for details.
 - 2) A pulse desensitization factor may have to be applied to peak power measurement results depending on the pulse width and/or period. See relevant Application Note(s) from the measurement instrumentation vendor for details.
- d) The occupied bandwidth of the radar device shall be measured, reported, and shown to be fully contained within the designated 76-81 GHz frequency band under normal operating conditions as well as under those extreme ambient temperature and input voltage conditions as described in Section 2.1057.
- The OBW measurement of an FMCW radar shall be performed with the transmitter operating in normal mode (*i.e.*, with frequency sweep or step active).
- e) Unwanted emissions in both the out-of-band and spurious emission domains shall be measured and shown to be compliant to those limits specified in Section 95.3379. Unwanted emissions shall be examined from the lowest radio frequency signal generated by the EUT, without going below 9 kHz, up to at least 231 GHz (preferably 243 GHz), notwithstanding the upper frequency limit defined in Section 2.1057(a)(3).

Change Notice

04/12/2019: 653005 D01 76-81 GHz Radars v01r01 replaces 653005 D01 76-81 GHz Radars v01.

Changes to the document include the following:

- Added policy limitation regarding automotive in-cabin radar usage in Section 2.
- Updated transition deadlines in Section 3.
- Clarified that the radiated “peak” power limit applies to power spectral density in Section 4.
- Expanded guidance in Section 4 to include occupied bandwidth (OBW) and unwanted emissions measurements.