



Engineering Solutions & Electromagnetic Compatibility Services

RF Maximum Permissible Exposure (MPE) Report for Controlled and Uncontrolled Environments

L3Harris Technologies
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Model: XL-90D

FCC ID: OWDTR-0167-E
IC: 3636B-0167

November 2, 2022

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I, the undersigned, hereby declare that the equipment tested and referenced in this report conforms to the identified standard(s) as described in this test report. No modifications were made to the equipment during testing in order to achieve compliance with these standards. Furthermore, there was no deviation from, additions to, or exclusions from the standards referenced above.

Signature: 

Date: November 2, 2022

Typed/Printed Name: Desmond A. Fraser

Position: President

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This report replaces R1.1.*

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Table of Contents

1	MPE Measurements and Applicable Regulations	3
2	Modifications	3
3	Test Laboratory	3
4	Test Dates	3
5	Antenna Information	4
6	Test Equipment, Accessories and Test Setup	5
7	Justification of Transmitting Mode and Frequency	5
8	MPE Limits for the EUT	6
9	Calculating the Safe Distance from the EUT's Antenna	7
10	Standard Test Conditions and Engineering Practices	8
11	Measurement Procedure	8
12	Test Results	9
13	Conclusion	13

1 MPE Measurements and Applicable Regulations

This test report presents the results of Maximum Permissible Exposure (MPE) measurements performed on the L3Harris Technologies XL-90D Radio, which operates in the 700 MHz, 800 MHz and 900 MHz frequency bands. The tests were performed in accordance with TCB training material and the following FCC Rules and Regulations and ISED Radio Standard Specifications:

- IEEE Std C95.1: 2005: "IEEE Standard for Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz – 300 GHz",
- IEEE Std C95.3: 2002: "IEEE Recommended Practice for Measurements and Computations of Radio Frequency Electromagnetic Fields with Respect to Human Exposure to Such Fields, 100 kHz – 300 GHz",
- FCC OET Bulletin 65, Edition 97-01: "Evaluating Compliance with FCC Guidelines for Human Exposure to Radiofrequency Electromagnetic Fields",
- FCC Supplement C to OET Bulletin 65, Edition 01-01: "Additional Information for Evaluating Compliance of Mobile and Portable Devices with FCC Limits for Human Exposure to Radiofrequency Emission",
- Subpart I, Part 1 of 47 CFR FCC Rules and Regulations, Edition 10-01-21: "Procedures Implementing the National Environmental Policy Act of 1969." Specifically, Paragraph 1.1310: "Radiofrequency Radiation Exposure Limits",
- Subpart J, Part 2 of 47 CFR FCC Rules and Regulations, Edition 10-01-21: "Equipment Authorization Procedures." Specifically, Paragraph 2.1091: "Radiofrequency Radiation Exposure Evaluation: Mobile Devices",
- RSS-102, Issue 5: Radio Frequency (RF) Exposure Compliance of Radiocommunication Apparatus (All Frequency Bands)

2 Modifications

No modifications were made to the EUT during testing.

3 Test Laboratory

Testing was performed at the Rhein Tech Laboratories (RTL) test facility located at 360 Herndon Parkway, Suite 1400, Herndon, VA, 20170, by RTL personnel.

ISED CAB ID: US0079, Company Number: 2956A

4 Test Dates

Testing was performed September 8 – 13 and October 26 - 31, 2022.

5 Antenna Information

The following antennas/mounts were tested for the MPE investigation.

Band	Description	Gain	Part #
700/800 MHz	Dual-band low profile roof mount antenna with 15' ProFlex Plus 195 cable	2 dBd (4.15 dBi)	AN-225001-004
	Dual-band roof mount antenna with 15' ProFlex Plus 195 cable	5 dBd (7.15 dBi)	AN-225001-005
900 MHz	Roof mount antenna with 15' ProFlex Plus 195 cable	3 dBd (5.15 dBi)	AN-225005-001
	Low profile roof mount antenna with 15' ProFlex Plus 195 cable	2 dBd (4.15 dBi)	AN-225005-004
All	Standard roof mount low loss	N/A	AN-125001-002
	Magnetic roof mount low loss	N/A	AN-125001-008

The following antennas/mounts are also intended for use with this radio.

Band	Description	Gain	Part #
700/800 MHz	Dual-band roof mount antenna with 15' ProFlex Plus 195 cable	3 dBd (5.15 dBi)	AN-225001-001
	Dual-band elevated feed point antenna with 15' ProFlex Plus 195 cable	3 dBd (5.15 dBi)	AN-225001-002
	Dual-band elevated feed point antenna with 15' ProFlex Plus 195 cable	3 dBd (5.15 dBi)	AN-225001-003
900 MHz	Elevated feed roof mount antenna with 15' ProFlex Plus 195 cable	3 dBd (5.15 dBi)	AN-225005-002
	Elevated feed roof mount antenna with 15' ProFlex Plus 195 cable	3 dBd (5.15 dBi)	AN-225005-003
All	Thick roof mount low loss	N/A	AN-125001-004

6 Test Equipment, Accessories and Test Setup

Test equipment used for the measurements is shown in Table 6-1.

Table 6-1: Test Equipment

RTL Asset	Manufacturer	Model	Equipment Type	Serial Number	Calibration Due Date
901676	ETS Lindgren	HI-6053	Electric Field Probe	00200468	7/26/2025

Table 6-2: EUT and Accessories

Part	Manufacturer	Model/HVIN	Serial Number	FCC ID	RTL Bar Code
Data Radio	L3Harris Technologies	XL-90D	A40333E1C002	OWDTR-0167-E	24116

Details of the test setup are as follows:

- The EUT was mounted on a Styrofoam table 80 cm tall.
- The antenna was mounted on a metal plate (roof mount only) with azimuth indicators and placed in the middle of a separate table.
- The control unit and power supply were located at a distance of at least 1.5 meters from the EUT's antenna to minimize interference.
- The test probe was solidly connected to the radiation meter, and then attached to the plastic mast in front of the EUT's antenna.
- During the MPE measurements, the EUT was set to transmit at maximum RF power with a 50% duty cycle.

7 Justification of Transmitting Mode and Frequency

The EUT is able to transmit with C4FM and H-CPM (TDMA) modulation modes at a maximum rated power of 3.1 W. Tune up tolerance is +0.1 dB, giving a maximum power of 3.3 W. Power was set to 3.3 W for the MPE measurements. C4FM modulation was chosen to represent worst-case for the MPE measurements. The MPE distance measurements were conducted at two representative carrier frequencies as each of the antenna options covers a distinct frequency band of operation. The frequencies chosen had the highest actual measured conducted powers in each of the bands.

8 MPE Limits for the EUT

The FCC and ISED MPE limits, are shown below for uncontrolled and controlled environments in Tables 8-1 and 8-2 respectively. The limits are based on the recommended MPE Guidelines published by the National Council on Radiation Protection and Measurements in "Biological Effects and Exposure Criteria for Radiofrequency Electromagnetic Fields."

Table 8-1: FCC MPE Limit and Averaging Time in an Uncontrolled Environment

Frequency Range, MHz	Power Density (S), mW/cm ²	Averaging Time, min
300-1500	$f/1500$, where "f" is the frequency in MHz	30

Table 8-2: FCC MPE Limit and Averaging Time in a Controlled Environment

Frequency Range, MHz	Power Density (S), mW/cm ²	Averaging Time, min
300-1500	$f/300$, where "f" is the frequency in MHz	6

Table 8-3: ISED MPE Limit and Averaging Time in an Uncontrolled Environment

Frequency Range (MHz)	Electric Field (V/m rms)	Magnetic Field (A/m rms)	Power Density (W/m ²)	Reference Period (minutes)
0.003-10 ²¹	83	90	-	Instantaneous*
0.1-10	-	$0.73/f$	-	6**
1.1-10	$87/f^{0.5}$	-	-	6**
10-20	27.46	0.0728	2	6
20-48	$58.07/f^{0.25}$	$0.1540/f^{0.25}$	$8.944/f^{0.5}$	6
48-300	22.06	0.05852	1.291	6
300-6000	$3.142 f^{0.3417}$	$0.008335 f^{0.3417}$	$0.02619 f^{0.6834}$	6
6000-15000	61.4	0.163	10	6
15000-150000	61.4	0.163	10	$616000/f^{1.2}$
150000-300000	$0.158 f^{0.5}$	$4.21 \times 10^{-4} f^{0.5}$	$6.67 \times 10^{-5} f$	$616000/f^{1.2}$

Note: f is frequency in MHz.
 *Based on nerve stimulation (NS).
 ** Based on specific absorption rate (SAR).

Table 8-4: ISED MPE Limit and Averaging Time in a Controlled Environment

Frequency Range (MHz)	Electric Field (V/m rms)	Magnetic Field (A/m rms)	Power Density (W/m ²)	Reference Period (minutes)
0.003-10 ²³	170	180	-	Instantaneous*
0.1-10	-	$1.6/f$	-	6**
1.29-10	$193/f^{0.5}$	-	-	6**
10-20	61.4	0.163	10	6
20-48	$129.8/f^{0.25}$	$0.3444/f^{0.25}$	$44.72/f^{0.5}$	6
48-100	49.33	0.1309	6.455	6
100-6000	$15.60 f^{0.25}$	$0.04138 f^{0.25}$	$0.6455 f^{0.5}$	6
6000-15000	137	0.364	50	6
15000-150000	137	0.364	50	$616000/f^{1.2}$
150000-300000	$0.354 f^{0.5}$	$9.40 \times 10^{-4} f^{0.5}$	$3.33 \times 10^{-4} f$	$616000/f^{1.2}$

Note: f is frequency in MHz.
 *Based on nerve stimulation (NS).
 ** Based on specific absorption rate (SAR).

The MPE limits for the EUT are shown in Table 8-5.

Table 8-5: MPE Limits for the Investigated Frequencies

Transmit Frequencies (MHz)	Uncontrolled Exposure		Controlled Exposure	
	FCC Limit (mW/cm ²)	ISED Limit (mW/cm ²)	FCC Limit (mW/cm ²)	ISED Limit (mW/cm ²)
806.0125	0.54	0.25	2.7	1.8
900.9875	0.60	0.27	3.0	1.9

9 Calculating the Safe Distance from the EUT's Antenna

Before starting MPE measurements, we calculated the safe distance, R_{safe} using the following formula:

$$R_{safe} = \sqrt{\frac{P_{max} \cdot G_n \cdot \eta}{4\pi \cdot S}}$$

G_n : antenna gain (numeric)

P_{max} : maximum power input to the antenna (W)

S : power density limit (W/m²) respectively

η : duty cycle (decimal number), for these measurements $\eta = 1$

The cable loss of the RF cable connecting the EUT and the antenna under test decreases the RF power delivered to the antenna and influences the value of the safe distance.

Cable loss is typically used to reduce the effective antenna gain to determine the calculated R_{safe} . However, in this case since the cable loss is relatively low and the safe distances for the controlled environment are close to 20 cm, the cable loss is ignored when calculating R_{safe} , which is the starting point of the actual MPE measurements.

The calculated safe distances (R_{safe}) serve as a starting point for the MPE measurements, though it is acknowledged that the measured safe distances will be smaller. Note that if calculated R_{safe} is < 20 cm, the starting distance shall be 20 cm. Table 9-1 presents the results of R_{safe} calculations:

Table 9-1: Calculated Rsafe

Calculated Minimum Safe Distance from LMR Antenna

Antenna Gain (dBi)	Transmit Frequencies (MHz)	Uncontrolled Exposure		Controlled Exposure	
		United States (cm)	Canada (cm)	United States (cm)	Canada (cm)
4.15	806.0125	36	52	16	19
7.15	806.0125	50	74	23	28
4.15	900.9875	34	50	15	19
5.15	900.9875	39	56	17	21

10 Standard Test Conditions and Engineering Practices

Except as noted herein, the following conditions and procedures were fulfilled during the testing:

1. ANSI C63.4 requires the ambient temperature and relative humidity to be within the ranges of 10°C to 40°C and 10% to 90%, respectively. With respect to the narrower ranges recommended for the power meter used for the measurements, ambient conditions shall be in line with the power meter ranges. Actual values of ambient temperature and relative humidity are shown in Section 13 of this test report.
2. Measurement results presented in Section 13, Test Results, unless otherwise noted, show the highest measured level of MPE.

11 Measurement Procedure

1. The test setup was as described in Section 6 of this test report.
2. Polarization of the EUT's antenna was vertical, which is its polarization in actual use.
3. The EUT was set to transmit at the chosen frequency at maximum RF power (rated power plus tune-up tolerance) and at 100% duty cycle. During preliminary measurements, we set the distance between the power density probe and the investigated EUT's antenna equal to the average calculated R_{safe} (Table 10-1) applicable either for controlled or uncontrolled environments.
4. Power density measurements were taken at different heights of the probe from the ground (0.1 to 2 meters) while rotating versus azimuth (from 0° to 360°) the antenna.
5. The azimuth between the probe and the antenna position corresponding to the highest MPE level was chosen as the "worst case" position for the final measurements.
6. For the final measurements, we adjusted the distance between the test probe and the tested antenna to the real safe distance, R_{real} , such that the measured highest power density in the "worst case" position was the same or slightly less than the test limit.
7. The measurement results of final measurements conducted at the chosen azimuth and different heights of the probe above the ground are shown in Section 13.

12 Test Results

Ambient conditions during the MPE investigation were as follows:

- Temperature: 24.8°C
- Relative humidity: 22%

The MPE measurement procedure was performed per the description in Section 11. Tables 12-1 through 12-4 demonstrate the test results.

Table 12-1: MPE Data General Population/Uncontrolled Environment - Magnetic Mount

Measuring Antenna Height (cm)	FCC	FCC	FCC	FCC	ISED	ISED	ISED	ISED
	4.15 dBi 806.0125 MHz 22 cm (mW/cm ²)	7.15 dBi 806.0125 MHz 21 cm (mW/cm ²)	4.15 dBi 900.9875 MHz 22 cm (mW/cm ²)	5.15 dBi 900.9875 MHz 23 cm (mW/cm ²)	4.15 dBi 806.0125 MHz 26 cm (mW/cm ²)	7.15 dBi 806.0125 MHz 31 cm (mW/cm ²)	4.15 dBi 900.9875 MHz 33 cm (mW/cm ²)	5.15 dBi 900.9875 MHz 39 cm (mW/cm ²)
10	0.022	0.020	0.005	0.006	0.023	0.019	0.007	0.013
20	0.009	0.005	0.002	0.004	0.008	0.007	0.004	0.004
30	0.030	0.019	0.012	0.015	0.024	0.021	0.011	0.010
40	0.011	0.006	0.005	0.005	0.011	0.008	0.008	0.004
50	0.043	0.025	0.015	0.014	0.023	0.029	0.016	0.011
60	0.023	0.015	0.012	0.012	0.017	0.018	0.016	0.016
70	0.047	0.028	0.026	0.029	0.032	0.030	0.018	0.027
80	0.075	0.038	0.025	0.023	0.075	0.058	0.067	0.099
90	0.539	0.535	0.590	0.597	0.249	0.246	0.250	0.268
100	0.456	0.450	0.396	0.537	0.221	0.226	0.266	0.240
110	0.269	0.223	0.155	0.187	0.170	0.156	0.193	0.166
120	0.116	0.060	0.044	0.011	0.115	0.080	0.092	0.043
130	0.048	0.040	0.022	0.026	0.076	0.029	0.044	0.012
140	0.028	0.056	0.005	0.030	0.054	0.032	0.018	0.013
150	0.020	0.031	0.003	0.021	0.031	0.032	0.013	0.019
160	0.013	0.007	0.002	0.015	0.019	0.011	0.005	0.016
170	0.009	0.007	0.002	0.008	0.015	0.007	0.003	0.012
180	0.007	0.008	0.002	0.005	0.012	0.009	0.002	0.008
190	0.006	0.007	0.087	0.004	0.011	0.012	0.002	0.005
200	0.005	0.005	0.001	0.002	0.010	0.009	0.002	0.002
Limit	0.54	0.54	0.60	0.60	0.25	0.25	0.27	0.27

Table 12-2 MPE Data Occupational/Controlled Environment - Magnetic Mount

Measuring Antenna Height (cm)	FCC 4.15 dBi 806.0125 MHz 20 cm (mW/cm ²)	FCC 7.15 dBi 806.0125 MHz 20 cm (mW/cm ²)	FCC 4.15 dBi 900.9875 MHz 20 cm (mW/cm ²)	FCC 5.15 dBi 900.9875 MHz 20 cm (mW/cm ²)	ISED 4.15 dBi 806.0125 MHz 20 cm (mW/cm ²)	ISED 7.15 dBi 806.0125 MHz 20 cm (mW/cm ²)	ISED 4.15 dBi 900.9875 MHz 20 cm (mW/cm ²)	ISED 5.15 dBi 900.9875 MHz 20 cm (mW/cm ²)
10	0.024	0.024	0.005	0.006	0.024	0.024	0.005	0.006
20	0.011	0.006	0.002	0.001	0.011	0.006	0.002	0.001
30	0.015	0.024	0.008	0.009	0.015	0.024	0.008	0.009
40	0.010	0.011	0.003	0.005	0.010	0.011	0.003	0.005
50	0.022	0.039	0.014	0.020	0.022	0.039	0.014	0.020
60	0.008	0.011	0.007	0.011	0.008	0.011	0.007	0.011
70	0.025	0.027	0.018	0.021	0.025	0.027	0.018	0.021
80	0.035	0.035	0.016	0.014	0.035	0.035	0.016	0.014
90	0.949	0.740	0.853	0.809	0.949	0.740	0.853	0.809
100	0.556	0.481	0.427	0.481	0.556	0.481	0.427	0.481
110	0.262	0.199	0.131	0.125	0.262	0.199	0.131	0.125
120	0.095	0.054	0.031	0.026	0.095	0.054	0.031	0.026
130	0.045	0.069	0.007	0.041	0.045	0.069	0.007	0.041
140	0.026	0.077	0.006	0.025	0.026	0.077	0.006	0.025
150	0.015	0.019	0.006	0.013	0.015	0.019	0.006	0.013
160	0.016	0.013	0.004	0.008	0.016	0.013	0.004	0.008
170	0.011	0.015	0.002	0.004	0.011	0.015	0.002	0.004
180	0.007	0.010	0.001	0.003	0.007	0.010	0.001	0.003
190	0.004	0.007	0.001	0.002	0.004	0.007	0.001	0.002
200	0.003	0.005	0.001	0.002	0.003	0.005	0.001	0.002
Limit	2.7	2.7	3.0	3.0	1.8	1.8	1.9	1.9

Table 12-3: MPE Data General Population/Uncontrolled Environment - Roof Mount

Measuring Antenna Height (cm)	FCC 4.15 dBi 806.0125 MHz 27 cm (mW/cm ²)	FCC 7.15 dBi 806.0125 MHz 26 cm (mW/cm ²)	FCC 4.15 dBi 900.9875 MHz 28 cm (mW/cm ²)	FCC 5.15 dBi 900.9875 MHz 28 cm (mW/cm ²)	ISED 4.15 dBi 806.0125 MHz 41 cm (mW/cm ²)	ISED 7.15 dBi 806.0125 MHz 41 cm (mW/cm ²)	ISED 4.15 dBi 900.9875 MHz 44 cm (mW/cm ²)	ISED 5.15 dBi 900.9875 MHz 47 cm (mW/cm ²)
10	0.030	0.026	0.013	0.016	0.028	0.021	0.007	0.005
20	0.007	0.014	0.005	0.007	0.006	0.009	0.004	0.001
30	0.029	0.030	0.017	0.024	0.022	0.026	0.014	0.009
40	0.012	0.014	0.011	0.005	0.008	0.009	0.009	0.007
50	0.037	0.028	0.025	0.025	0.026	0.022	0.025	0.028
60	0.039	0.011	0.024	0.027	0.024	0.012	0.023	0.039
70	0.045	0.034	0.048	0.045	0.041	0.034	0.037	0.063
80	0.040	0.044	0.030	0.045	0.121	0.117	0.067	0.113
90	0.537	0.538	0.590	0.598	0.232	0.242	0.268	0.266
100	0.429	0.518	0.526	0.521	0.247	0.204	0.261	0.260
110	0.318	0.289	0.277	0.166	0.188	0.170	0.244	0.184
120	0.140	0.107	0.128	0.020	0.124	1.371	0.181	0.087
130	0.075	0.036	0.035	0.023	0.103	0.046	0.109	0.022
140	0.050	0.055	0.013	0.022	0.057	0.026	0.062	0.014
150	0.024	0.027	0.005	0.018	0.058	0.042	0.032	0.033
160	0.024	0.009	0.002	0.010	0.034	0.023	0.023	0.017
170	0.022	0.014	0.002	0.008	0.026	0.014	0.008	0.019
180	0.015	0.014	0.002	0.006	0.016	0.006	0.006	0.013
190	0.016	0.014	0.001	0.004	0.017	0.006	0.004	0.009
200	0.008	0.011	0.002	0.002	0.011	0.008	0.003	0.006
Limit	0.54	0.54	0.60	0.60	0.25	0.24	0.27	0.27

Table 12-4: MPE Data Occupational/Controlled Environment - Roof Mount

Measuring Antenna Height (cm)	FCC 4.15 dBi 806.0125 MHz 20 cm (mW/cm ²)	FCC 7.15 dBi 806.0125 MHz 20 cm (mW/cm ²)	FCC 4.15 dBi 900.9875 MHz 20 cm (mW/cm ²)	FCC 5.15 dBi 900.9875 MHz 20 cm (mW/cm ²)	ISED 4.15 dBi 806.0125 MHz 20 cm (mW/cm ²)	ISED 7.15 dBi 806.0125 MHz 20 cm (mW/cm ²)	ISED 4.15 dBi 900.9875 MHz 20 cm (mW/cm ²)	ISED 5.15 dBi 900.9875 MHz 20 cm (mW/cm ²)
10	0.026	0.014	0.004	0.007	0.026	0.014	0.004	0.007
20	0.011	0.005	0.003	0.008	0.011	0.005	0.003	0.008
30	0.034	0.026	0.008	0.018	0.034	0.026	0.008	0.018
40	0.012	0.013	0.001	0.004	0.012	0.013	0.001	0.004
50	0.035	0.037	0.013	0.011	0.035	0.037	0.013	0.011
60	0.025	0.015	0.016	0.009	0.025	0.015	0.016	0.009
70	0.031	0.023	0.025	0.027	0.031	0.023	0.025	0.027
80	0.049	0.040	0.021	0.008	0.049	0.040	0.021	0.008
90	1.021	0.761	1.169	0.702	1.021	0.761	1.169	0.702
100	0.600	0.650	0.717	0.553	0.600	0.650	0.717	0.553
110	0.344	0.293	0.232	0.139	0.344	0.293	0.232	0.139
120	0.128	0.064	0.076	0.045	0.128	0.064	0.076	0.045
130	0.053	0.101	0.016	0.039	0.053	0.101	0.016	0.039
140	0.046	0.074	0.010	0.022	0.046	0.074	0.010	0.022
150	0.020	0.024	0.003	0.018	0.020	0.024	0.003	0.018
160	0.021	0.010	0.010	0.010	0.021	0.010	0.010	0.010
170	0.018	0.009	0.006	0.006	0.018	0.009	0.006	0.006
180	0.012	0.013	0.001	0.002	0.012	0.013	0.001	0.002
190	0.012	0.008	0.005	0.004	0.012	0.008	0.005	0.004
200	0.008	0.011	0.002	0.001	0.008	0.011	0.002	0.001
Limit	2.7	2.7	3.0	3.0	1.8	1.8	1.9	1.9

13 Conclusion

1. The MPE measurements for controlled and uncontrolled environments shown in this report were conducted per the applicable FCC & ISED Rules, Regulations and Guidance, and determined the minimum safe distances between a user and the EUT antennas with different gains.
2. As is shown in Section 12, the measured MPE are below the maximum allowed limits.
3. The User Manual shall include RF radiation safety warnings and the following table:

Table 13-1: Safe Distances

Mount	Antenna	Gain (dBi)	Part #	Band (MHz)	Minimum Safe Distance Between User and Antenna			
					Uncontrolled Exposure		Controlled Exposure	
					United States (cm)	Canada (cm)	United States (cm)	Canada (cm)
Magnetic	Dual-band low profile roof-mount	4.15	AN-225001-004	700/800	22	26	20	20
Magnetic	Dual-band roof-mount	7.15	AN-225001-005	700/800	21	31	20	20
Magnetic	Low profile roof-mount	4.15	AN-225005-004	900	22	33	20	20
Magnetic	Roof-mount	5.15	AN-225005-001	900	23	39	20	20
Standard	Dual-band low profile roof-mount	4.15	AN-225001-004	700/800	27	41	20	20
Standard	Dual-band roof-mount	7.15	AN-225001-005	700/800	26	41	20	20
Standard	Low profile roof-mount	4.15	AN-225005-004	900	28	44	20	20
Standard	Roof-mount	5.15	AN-225005-001	900	28	47	20	20