

Reference trace designs

RF traces from OSDI module pads W10 and W16 to the antenna must be made using micro-strip traces. This micro-strip trace must respect the design of the Gerber files associated with the following designs in order to obtain a uniform transmission line with a characteristic impedance of 50 ohms. The reference trace designs are shown in the following sections.

Layout and parts for M antenna (From Original Grant)

The reference trace for this antenna is the green traces along with the side copper filled with vias on the left side of Figure 1 where components G8, G9, G11 and G12 are not installed. As preliminary information the traces width of all sections are 0.27mm and the length of each section, starting from the LGA pad to the M antenna are: LGA pad to G7: 15.38mm; G7 to G10: 12.37mm; G10 to R50: 2.3mm; R50 to M antenna: 4.85mm. However, refer to associated Gerber files for more accurate details on dimensions and refer to Trilliant Networks Inc for more details on the Gerber files. Table 1 shows the parts used in this reference trace design.

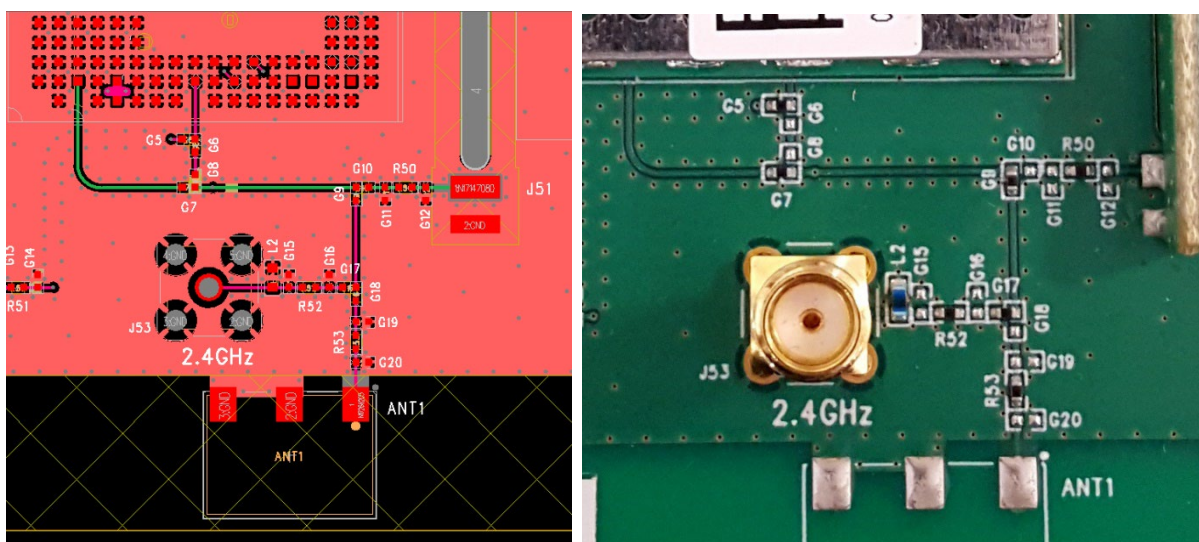


Figure 1 FCC and ISED approved trace design layout and picture for the M antenna.

Table 1 Antenna micro-strip trace parts for M antenna

Part Number	Designator	Description	Manufacturer
N/A	G8, G9, G11, G12	Not installed	N/A
RK73Z1ETTP	G7, G10, R50	RESISTOR 0.0 OHMS 1/16W 5% 0402 SMT	KOA Speer Electronics
CP-0299A	J51	Trilliant M antenna	Trilliant

Layout and parts for uSplash antenna (from C2PC of August 2016)

The reference trace for this antenna is the green traces along with the side copper filled with vias on the left side of Figure 2 where components G8, G10, G17, G19 and G20 are not installed. As preliminary information the traces width of all sections are 0.27mm and the length of each section, starting from the LGA pad to the uSplash are: LGA pad to G7: 15.38mm; G7 to G9: 12.37mm; G9 to G17: 6.7mm; G17 to R53: 2.1mm and R53 to uSplash antenna: 7.2mm. However, refer to associated Gerber files for more accurate details on dimensions and refer to Trilliant Networks Inc for more details on the Gerber files. Table 2 shows the parts used in this reference trace design.

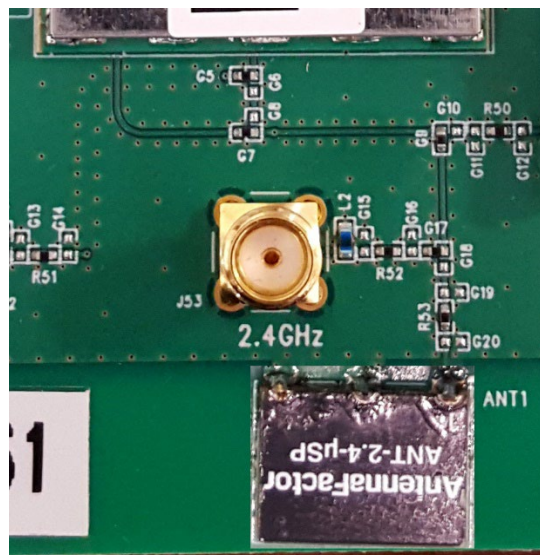
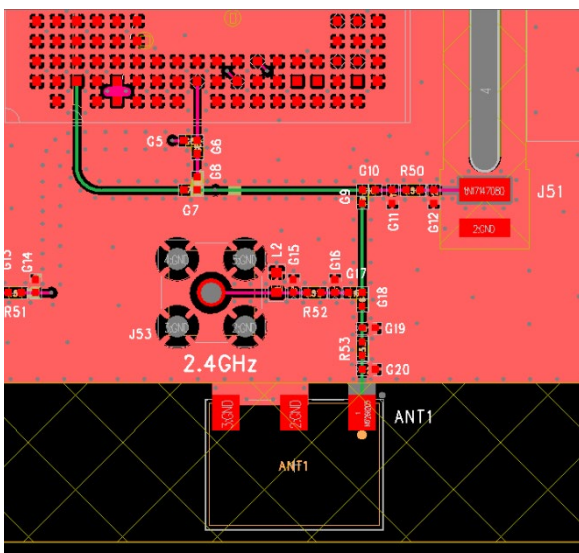


Figure 2 FCC and ISED approved trace design layout and picture for the uSplash antenna.

Table 2 Antenna micro-strip trace parts for uSplash antenna

Part Number	Designator	Description	Manufacturer
N/A	G8, G9, G11, G12	Not installed	N/A
RK73Z1ETTP	G7, G9, G18, R53	RESISTOR 0.0 OHMS 1/16W 5% 0402 SMT	KOA Speer Electronics
ANT-2.4-uSP	ANT1	PC mount quarter-wave antenna	Linx

Layout and parts for Spring antenna (Application of February, 2025)

The reference trace for this antenna is the trace going up with an S shape in Figure 3, where components L4, C21 and C29 are not installed. As preliminary information the traces width of all sections are 0.64 mm and the length of each section, starting from the LGA pad to the pad called SMA1: LGA pad to R11: 8.4 mm; R11 to R13: 5.7 mm; R13 to connector of Spring antenna SMA1: 3.2mm. However, refer to associated Gerber files for more accurate details on dimensions and refer to Trilliant Networks Inc for more details on the Gerber files. Table 3 shows the parts used in this reference trace design.

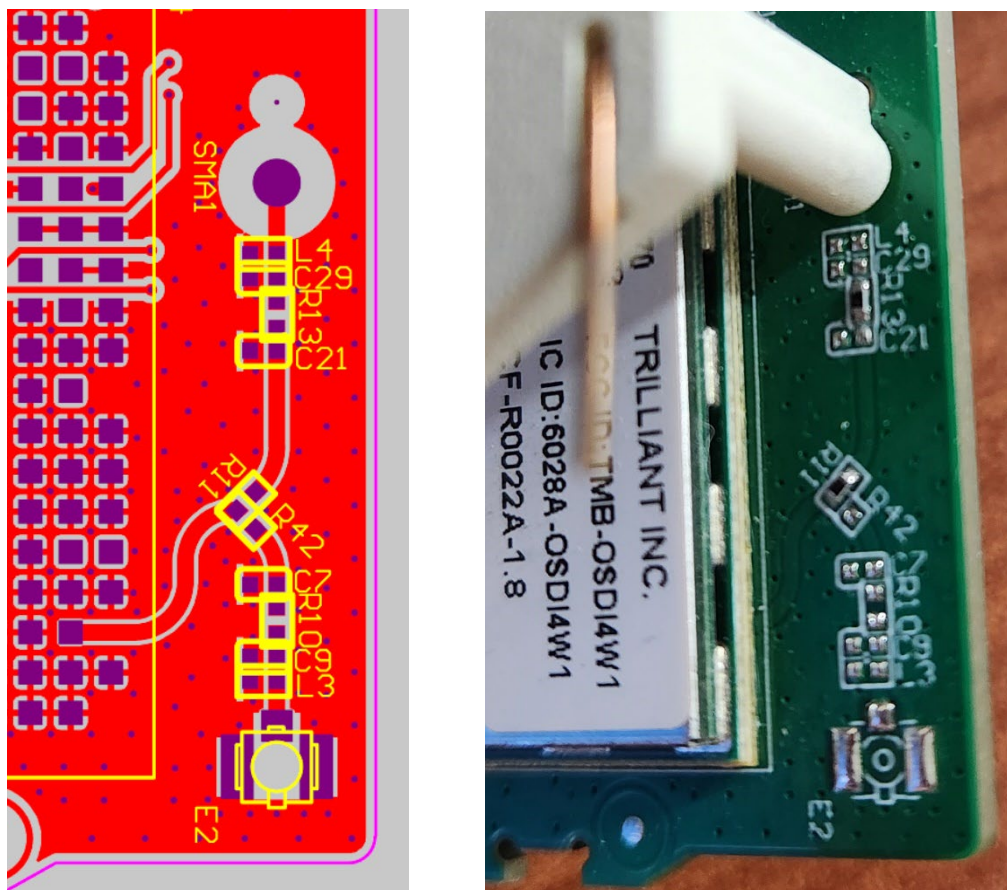


Figure 3 FCC and ISED approved trace design layout and picture for the Spring antenna

Table 3 Antenna micro-strip trace parts for Spring antenna

Part Number	Designator	Description	Manufacturer
N/A	L4, C21, C29	Not installed	N/A
R00041S1	R11, R13	RESISTOR 0.0 OHMS 1/16W 5% 0402 SMT	Guangdong Fenghua Advanced Technology Holding Co.,Ltd
DD100006143	SMA1	Spring Antenna	TopPoint Technology

Layout and parts for external antennas with SMA connector 4 legs (from C2PC of August 2016)

The reference traces for these antennas are the green traces along with the side copper filled with vias on the left side of Figure 4 where components G8, G10, G15, G16 and G18 are not installed, the left side of Figure 5 where G4 is not install, the pink trace on the left side of Figure 6 where R13 and R15 are not installed and the left side of Figure 7 where G1 and G2 are not installed.

As preliminary information for Figure 4 the traces width of all sections are 0.27mm and the length of each section, starting from the LGA pad to J53 connector are: LGA pad to G7: 15.38mm; G7 to G9: 12.37mm; G9 to G17: 6.7mm; G17 to R52: 2.1mm; R52 to J53: 7.2mm. However, refer to associated Gerber files for more accurate details on dimensions and refer to Trilliant Networks Inc for more details on the Gerber files. Table 4 shows the parts used in the reference trace design.

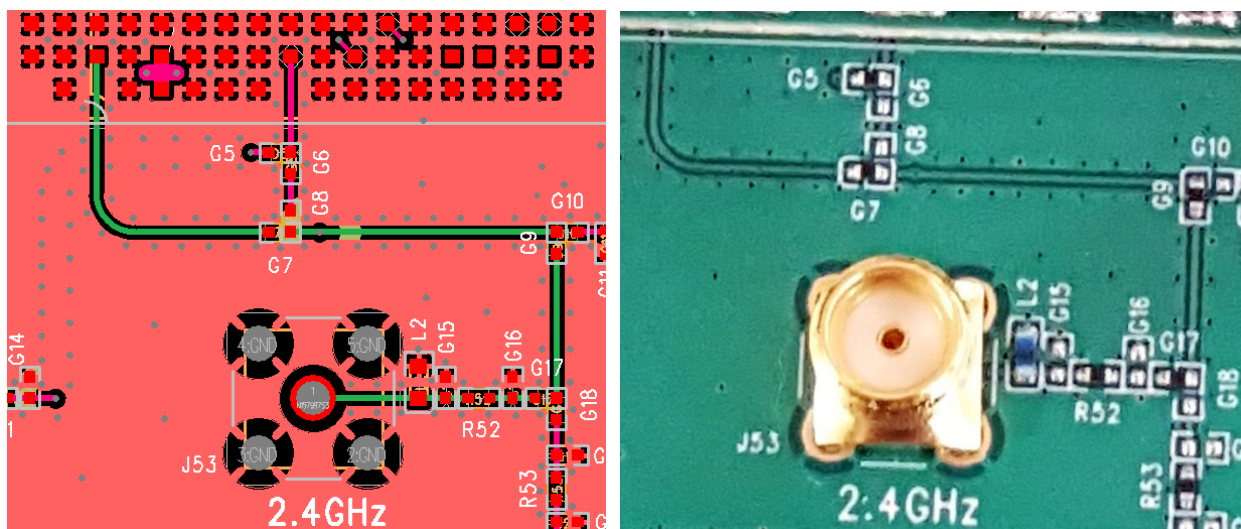


Figure 4 FCC and ISED approved trace design layout and picture for external antennas with SMA connector 4 legs.

Table 4 Antenna micro-strip trace parts for external antennas SMA connector 4 legs

Part Number	Designator	Description	Manufacturer
N/A	G8, G10, G15, G16, G18	Not installed	N/A
RK73Z1ETTP	G7, G9, G17, R52	RESISTOR 0.0 OHMS 1/16W 5% 0402 SMT	KOA Speer Electronics
LQW18AN75NG00D	L2	INDUCTOR 75nH, 2%, 270mA 560mΩ, 0603 SMT	Murata Manufacturing
1-1478979-0	J53	SMA JACK CONNECTOR (FEMALE) PCB Mount 4 legs, SS/Gold pl.	TE Connectivity

Layout and parts for external antennas with SMA connector on side (from C2PC of August 2016)

As preliminary information for Figure 5, the traces width of all sections are 1mm and the length of each section, starting from the LGA pad to J5 connector are: LGA pad to G3: 14.18mm; G3 to J5: 5.05mm. However, refer to associated Gerber files for more accurate details on dimensions and refer to Trilliant Networks Inc for more details on the Gerber files. Table 5 shows the parts used in the reference trace design.

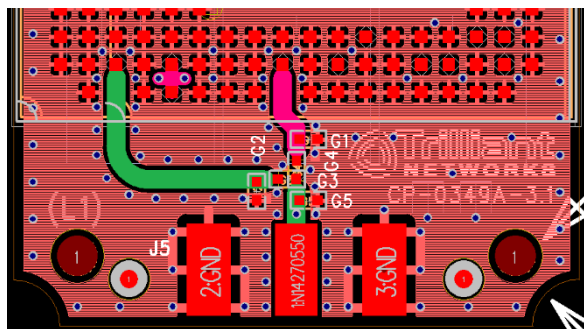


Figure 5 FCC and ISED approved trace design layout and picture for external antennas with SMA connector on side.

Table 5 Antenna micro-strip trace parts for external antennas SMA on side

Part Number	Designator	Description	Manufacturer
N/A	G4	Not installed	N/A
RK73Z1ETTP	G3	RESISTOR 0.0 OHMS 1/16W 5% 0402 SMT	KOA Speer Electronics
142-0701-801	J5	SMA End Launch Jack receptacle (FEMALE) Round Contact, Gold pl.	Johnson Components

Layout and parts for external antennas with u.fl (from C2PC of July 2017)

As preliminary information for Figure 6, the traces width of all sections is 0.6mm and the length of each section, starting from the LGA pad to J4 connector are: LGA pad to R14: 14.7mm; R14 to J4: 2.1mm. However, refer to associated Gerber files for more accurate details on dimensions and refer to Trilliant Networks Inc for more details on the Gerber files. Table 6 shows the parts used in the reference trace design.

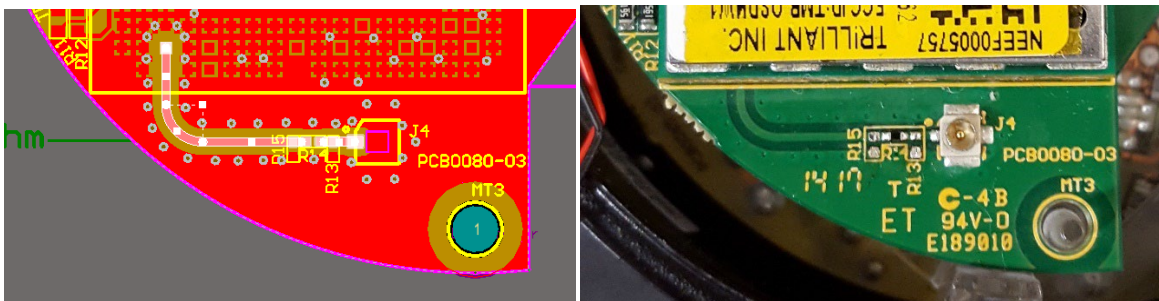


Figure 6 FCC and ISED approved trace design layout and picture for external antennas with u.fl connector

Table 6 Antenna micro-strip trace parts for external antennas u.fl

Part Number	Designator	Description	Manufacturer
ESR01MZPJ391	R13, R15	RES SMD 390 OHM 5% 1/5W 0402	Rohm Semiconductor
CRCW040210R7FKEDHP	R14	RES SMD 10.7 OHM 1% 1/5W 0402	Vishay
73412-0110	J4	JACK, U.FL, Straight, PCB, SMT	Molex

Layout and parts for external antennas with MMCX female (from C2PC of March 2018)

As preliminary information for Figure 7, the traces width of all sections is 0.2mm and the length of each section, starting from the LGA pad to J7 connector are: LGA pad to R18: 11.82mm; R18 to J7: 5.2mm. However, refer to associated Gerber files for more accurate details on dimensions and refer to Trilliant Networks Inc for more details on the Gerber files. Table 7 shows the parts used in the reference trace design.

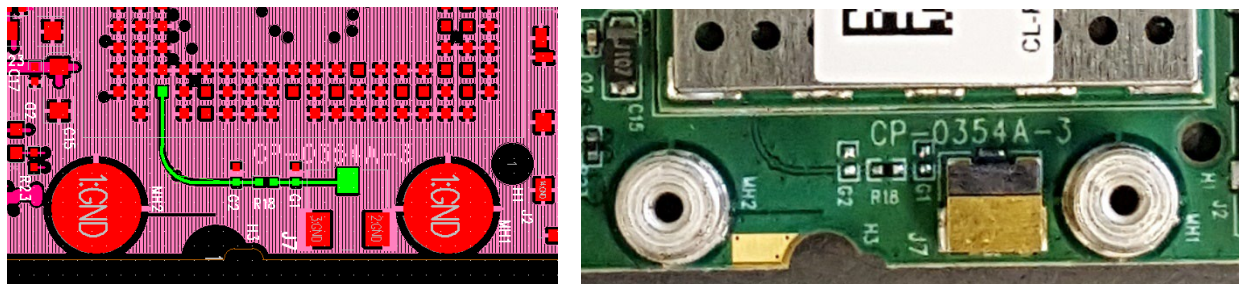


Figure 7 FCC and ISED approved trace design layout and picture for external antennas with female MMCX connector.

Table 7 Antenna micro-strip trace parts for external antennas MMCX female

Part Number	Designator	Description	Manufacturer
N/A	G1, G2	Not installed	N/A
RK73Z1ETTP	R18	RESISTOR 0.0 OHMS 1/16W 5% 1005/0402 SMT	KOA Speer Electronics
6-1460820-2	J7	MMCX CONNECTOR RIGHT ANGLE JACK (female), Tin pl. SMT	TE Connectivity

Layout and parts for external antennas with MMCX (from C2PC of March 2020)

As preliminary information for Figure 8, the traces width of all sections is 0.2mm and the length of each section, starting from the LGA pad to J1 connector are: LGA pad to G2: 5.65mm; G2 to J1: 7.35mm. However, refer to associated Gerber files for more accurate details on dimensions and refer to Trilliant Networks Inc for more details on the Gerber files. Table 8 shows the parts used in the reference trace design.

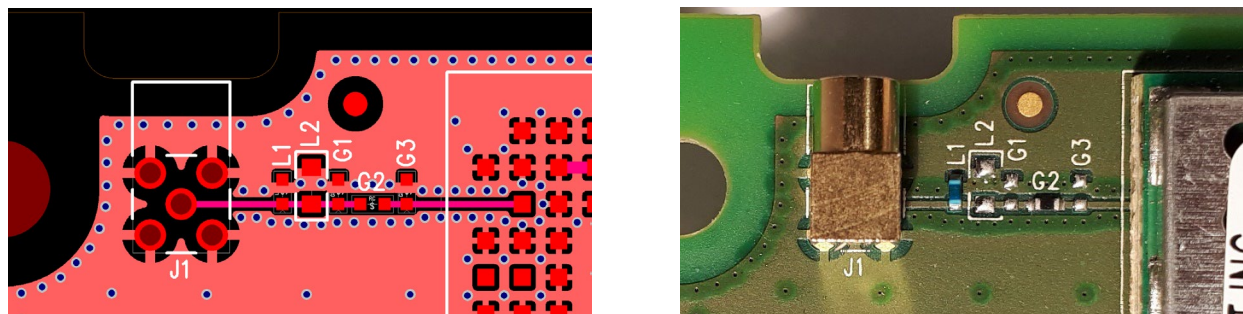


Figure 8 FCC and ISED approved trace design layout and picture for external antennas with MMCX connector

Table 8 Antenna micro-strip trace parts for external antennas MMCX

Part Number	Designator	Description	Manufacturer
N/A	L2, G1, G3	Not installed	N/A
RMC16S-000T	G2	RESISTOR 0.0 OHMS 1/16W 5% 1005/0402 SMT	Megastar Electronics
LQW15AN75NG00D	L1	INDUCTOR 75nH 2% 135mA 2.1Ohm, Self-resonance 2.4GHz, 0402 SMT	MURATA
CONMMCX002	J1	MMCX CONNECTOR RIGHT ANGLE JACK RECEPTACLE TH, Brass Gold pl.	Linx Technologies

Design validation & production procedures

To verify compliance of the reference trace, a coupon must be requested with every manufacturing panel form and for which the characteristics are described in the Gerber files. Part of these characteristic are shown in Figure 9. Then a network analyzer is used to measure the impedance of this coupon in order to validate the antenna trace.

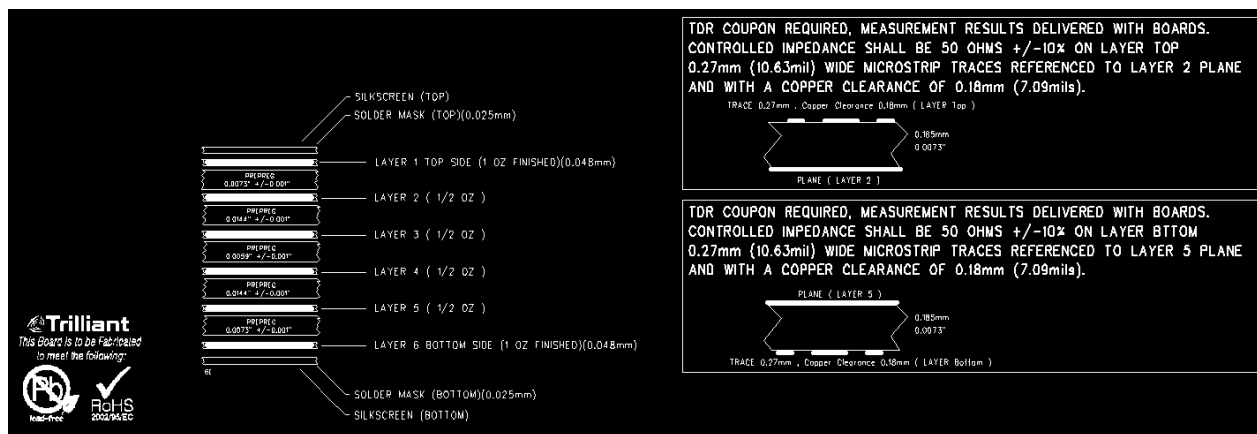


Figure 9 Coupon requirements to validate trace impedance

Other considerations

The only antennas, also describe is section **Error! Reference source not found.**, that can be used with the module using the reference trace design are the:

- Trilliant, CP-0299A, 4.8 dBi
- Linx, ANT-2.4-uSP, 3.8 dBi
- TopPoint Technology, DD100006143, 3.5 dBi
- Larsen Antenna, RO2406NM, 6 dBi
- Mobile Mark, IMAG5-2400-3K-BLK-120, 5 dBi
- L-Com, HG2403RD-RTF, 3 dBi
- Mobile Mark, CVS-2400, 2.5 dBi
- Molex 1461530100, 3 dBi

The use of any other antenna or any changes to the reference trace design are subject to additional testing and authorization through a Class II permissive change.