

Revie Flex 700 – Installation App Note

*Application Note**v1.0*

OVERVIEW

At only 96 millimeters long, the Revie 700 is the ideal antenna for small form-factor IoT devices. It covers the most common cellular bands from 698 MHz to 6000 MHz to support the major carrier networks.

This application note displays performance data for the Revie Flex 700 antenna when integrated into different device configurations. When placed in dense environments with nearby metallic and non-metallic objects, antenna performance can be degraded or worse yet, detuned out of the desired frequency band. This application note provides a series of comparative data to enhance and speed the wireless design engineer's efforts to integrate the Revie Flex 700 into their end devices.

This application note provides the following:

- Best-practice guidelines for installation into customer end devices. Consideration is given to the impact of nearby objects.
 - Metallic objects (PCB ground plane) in the same plane
 - Metallic objects (PCB ground plane) in a perpendicular plane
 - Metallic objects (PCB ground plane) parallel above the antenna plane
- Antenna RF comparisons of efficiency and gain over frequency
- Packaging and ordering details

Configuration

PART NUMBER	EXPOSED CABLE LENGTH	CONNECTOR
EFF6989A3S-19MHF1	190.0 mm +/- 3 mm (7.48 +/- 0.12 in.)	MHF1/U.FL or equivalent

INSTALLATION GUIDELINE SUMMARY

Important: Broad-banded antennas in small-factors such as these are susceptible to many influences. These include the following:

- Material type and thickness onto which the antenna is placed.
- The proximity of nearby items. Both plastic and, to a much greater extent, metal objects greatly affect antenna performance. These objects can include device housings, PCB ground planes, batteries, metal device structures, connector bodies, and large magnetic components.

6 GHz band: The Revie Flex 700 antenna is 100% tested in production over the frequency range of 698 – 6000 MHz. However, with the recent approval of the UNII -5,-6,-7, and -8 bands from 5925 to 7125 MHz for unlicensed use, we believe it is important that forward-looking customers can recognize the performance of this antenna over that extended range in the anticipation of possible use-cases in these frequency bands. As a result, the VSWR over the range to 7125 MHz is shown below (although not 100% tested in production). Contact Laird Connectivity regarding your applications that may need this antenna tested over those upper bands.

The radiating cable and its specific length are an integral part of defining an antenna's operating performance. In general, the longer the cable the more performance improvement that can be achieved. However, this is counteracted by additional RF cable losses that occur in small diameter coax cables, especially at the higher frequencies.

SPECIFICATIONS

ELECTRICAL SPECIFICATIONS

Laird Connectivity Part Number	EFF6989A3S-19MHF1											
Operating Frequency (MHz)	698-824	824-894	880-960	1350-1550	1550-1690	1690-1880	1850-1990	1910-2170	2300-2500	2500-2700	3300-4200	4900-6000
Gain (dBi) – Avg	0.5	0.9	2.0	3.7	4.1	3.6	3.5	3.7	3.4	3.0	2.4	4.0
Gain (dBi) – Max	0.9	1.4	2.7	4.0	4.2	4.1	3.7	3.9	3.7	3.5	3.3	4.5
Efficiency (%) – Avg	50	46	46	71	75	81	84	83	75	69	64	68
Efficiency (dB) – Avg	-3.00	-3.40	-3.40	-1.50	-1.30	-0.90	-0.80	-0.80	-1.30	-1.60	-2.00	-1.70
VSWR – Avg	2.1	2.4	2.0	2.3	1.9	1.8	1.7	1.4	1.7	2.1	1.7	1.5
VSWR – Max	<2.5					<2.0				<2.5		<2.2
Nominal Impedance (Ohms)	50											
Polarization	Linear vertical											
Azimuth Beamwidth	360°, Omnidirectional											
Input Power (W) – Max	5											

Note: Measured on a 1.7 mm thick polycarbonate sheet.
A minimum cable length of 190 mm is required to achieve the stated efficiency.

MECHANICAL SPECIFICATIONS

Dimensions – L x W x H – mm (inches)	96.0 x 21.0 x 0.2 (3.78 x 0.83 x 0.008)
Connector	U.FL / MHF1 or equivalent
Cable Type	Coax 1.13 (gray color)
Cable Exposed Length – mm (in.)	190 ± 5 (7.48 ± 0.2)
Flexible Circuit material	Polyimide (black masking)

ENVIRONMENTAL SPECIFICATIONS

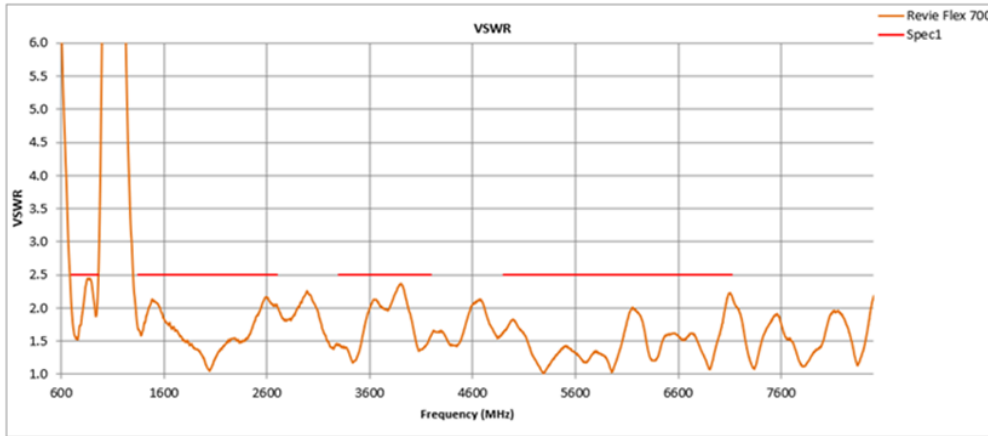
Operating Temperature – °C (°F)	-30 to +70°C (-22 to +158°F)
Storage Temperature – °C (°F)	-40 to +85°C (-40 to +185°F)
Material Substance Compliance	RoHS

BAND COMPLIANCE MATRIX

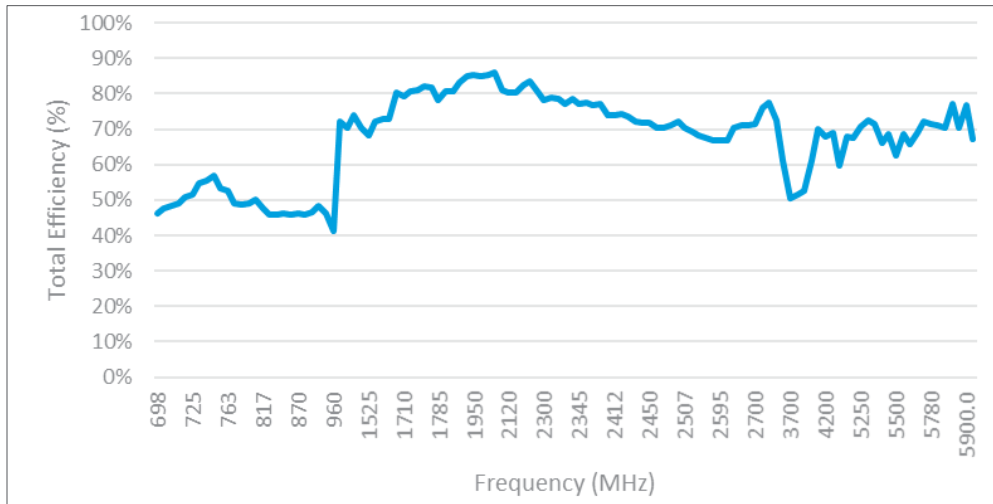
5G NR Operating Band	4G/LTE (E-UTRA) Operating Band	Uplink (UL) operating band			Downlink (DL) operating band			Duplex Mode	EFF6989A3S-19MHF1 (Revie Flex 700) ✓ = Compliant X = Not Compliant	EFF6060A3S-xxMHF1 (Revie Flex 600) ✓ = Compliant X = Not Compliant	EFF6925A3S-150MHF1 (Original Revie Flex) ✓ = Compliant X = Not Compliant
		F _{UL_low}	–	F _{UL_high}	F _{DL_low}	–	F _{DL_high}				
n1	1	1920 MHz	–	1980 MHz	2110 MHz	–	2170 MHz	FDD	✓	✓	✓
n2	2	1850 MHz	–	1910 MHz	1930 MHz	–	1990 MHz	FDD	✓	✓	✓
n3	3	1710 MHz	–	1785 MHz	1805 MHz	–	1880 MHz	FDD	✓	✓	✓
--	4	1710 MHz	–	1755 MHz	2110 MHz	–	2155 MHz	FDD	✓	✓	✓
n5	5	824 MHz	–	849 MHz	869 MHz	–	894 MHz	FDD	✓	✓	X
n7	7	2500 MHz	–	2570 MHz	2620 MHz	–	2690 MHz	FDD	✓	✓	X
n8	8	880 MHz	–	915 MHz	925 MHz	–	960 MHz	FDD	✓	✓	X
--	9	1749.9 MHz	–	1784.9 MHz	1844.9 MHz	–	1879.9 MHz	FDD	✓	✓	✓
--	10	1710 MHz	–	1770 MHz	2110 MHz	–	2170 MHz	FDD	✓	✓	✓
--	11	1427.9 MHz	–	1447.9 MHz	1475.9 MHz	–	1495.9 MHz	FDD	✓	✓	X
--	12	699 MHz	–	716 MHz	729 MHz	–	746 MHz	FDD	✓	✓	✓
n13	13	777 MHz	–	787 MHz	746 MHz	–	756 MHz	FDD	✓	✓	✓
--	14	788 MHz	–	798 MHz	758 MHz	–	768 MHz	FDD	✓	✓	✓
--	17	704 MHz	–	716 MHz	734 MHz	–	746 MHz	FDD	✓	✓	✓
--	18	815 MHz	–	830 MHz	860 MHz	–	875 MHz	FDD	✓	✓	✓
--	19	830 MHz	–	845 MHz	875 MHz	–	890 MHz	FDD	✓	✓	X
n20	20	832 MHz	–	862 MHz	791 MHz	–	821 MHz	FDD	✓	✓	✓
--	21	1447.9 MHz	–	1462.9 MHz	1495.9 MHz	–	1510.9 MHz	FDD	✓	✓	X
--	22	3410 MHz	–	3490 MHz	3510 MHz	–	3590 MHz	FDD	✓	✓	X
--	24	1626.5 MHz	–	1660.5 MHz	1525 MHz	–	1559 MHz	FDD	✓	✓	X
n25	25	1850 MHz	–	1915 MHz	1930 MHz	–	1995 MHz	FDD	✓	✓	✓
n26	26	814 MHz	–	849 MHz	859 MHz	–	894 MHz	FDD	✓	✓	X
--	27	807 MHz	–	824 MHz	852 MHz	–	869 MHz	FDD	✓	✓	✓
n28	28	703 MHz	–	748 MHz	758 MHz	–	803 MHz	FDD	✓	✓	✓
--	29	N/A			717 MHz	–	728 MHz	–	✓	✓	✓
--	32	N/A			1452 MHz	–	1496 MHz	–	✓	✓	X
--	33	1900 MHz	–	1920 MHz	1900 MHz	–	1920 MHz	TDD	✓	✓	✓
n34	34	2010 MHz	–	2025 MHz	2010 MHz	–	2025 MHz	TDD	✓	✓	✓
--	35	1850 MHz	–	1910 MHz	1850 MHz	–	1910 MHz	TDD	✓	✓	✓
--	36	1930 MHz	–	1990 MHz	1930 MHz	–	1990 MHz	TDD	✓	✓	✓
--	37	1910 MHz	–	1930 MHz	1910 MHz	–	1930 MHz	TDD	✓	✓	✓
n38	38	2570 MHz	–	2620 MHz	2570 MHz	–	2620 MHz	TDD	✓	✓	X
n39	39	1880 MHz	–	1920 MHz	1880 MHz	–	1920 MHz	TDD	✓	✓	✓
n40	40	2300 MHz	–	2400 MHz	2300 MHz	–	2400 MHz	TDD	✓	✓	✓
n41	41	2496 MHz	–	2690 MHz	2496 MHz	–	2690 MHz	TDD	✓	✓	X
--	42	3400 MHz	–	3600 MHz	3400 MHz	–	3600 MHz	TDD	✓	✓	X
--	43	3600 MHz	–	3800 MHz	3600 MHz	–	3800 MHz	TDD	✓	✓	X
--	44	703 MHz	–	803 MHz	703 MHz	–	803 MHz	TDD	✓	✓	✓
--	45	1447 MHz	–	1467 MHz	1447 MHz	–	1467 MHz	TDD	✓	✓	X
--	46	5150 MHz	–	5925 MHz	5150 MHz	–	5925 MHz	TDD	✓	✓	X
--	47	5855 MHz	–	5925 MHz	5855 MHz	–	5925 MHz	TDD	✓	✓	X
--	48	3550 MHz	–	3700 MHz	3550 MHz	–	3700 MHz	TDD	✓	✓	X
--	49	3550 MHz	–	3700 MHz	3550 MHz	–	3700 MHz	TDD	✓	✓	X
n50	50	1432 MHz	–	1517 MHz	1432 MHz	–	1517 MHz	TDD	✓	✓	X
n51	51	1427 MHz	–	1432 MHz	1427 MHz	–	1432 MHz	TDD	✓	✓	X
--	52	3300 MHz	–	3400 MHz	3300 MHz	–	3400 MHz	TDD	✓	✓	X
--	53	2483.5 MHz	–	2495 MHz	2483.5 MHz	–	2495 MHz	TDD	✓	✓	✓
--	65	1920 MHz	–	2010 MHz	2110 MHz	–	2200 MHz	FDD	✓	✓	✓
n66	66	1710 MHz	–	1780 MHz	2110 MHz	–	2200 MHz	FDD	✓	✓	✓
--	67	N/A			738 MHz	–	758 MHz	FDD	✓	✓	✓
--	68	698 MHz	–	728 MHz	753 MHz	–	783 MHz	FDD	✓	✓	✓
--	69	N/A			2570 MHz	–	2620 MHz	FDD	✓	✓	X
n70	70	1695 MHz	–	1710 MHz	1995 MHz	–	2020 MHz	FDD	✓	✓	✓
n71	71	663 MHz	–	698 MHz	617 MHz	–	652 MHz	FDD	X	✓	X
--	72	451 MHz	–	456 MHz	461 MHz	–	466 MHz	FDD	X	X	X
--	73	450 MHz	–	455 MHz	460 MHz	–	465 MHz	FDD	X	X	X
n74	74	1427 MHz	–	1470 MHz	1475 MHz	–	1518 MHz	FDD	✓	✓	X
n75	75	N/A			1432 MHz	–	1517 MHz	FDD	✓	✓	X
n76	76	N/A			1427 MHz	–	1432 MHz	FDD	✓	✓	X
n77	...	3300 MHz	–	4200 MHz	3300 MHz	–	4200 MHz	TDD	✓	✓	X
n78	...	3300 MHz	–	3800 MHz	3300 MHz	–	3800 MHz	TDD	✓	✓	X

Source: Band configurations per 3GPP; TS 36.101 (2020-04-08)

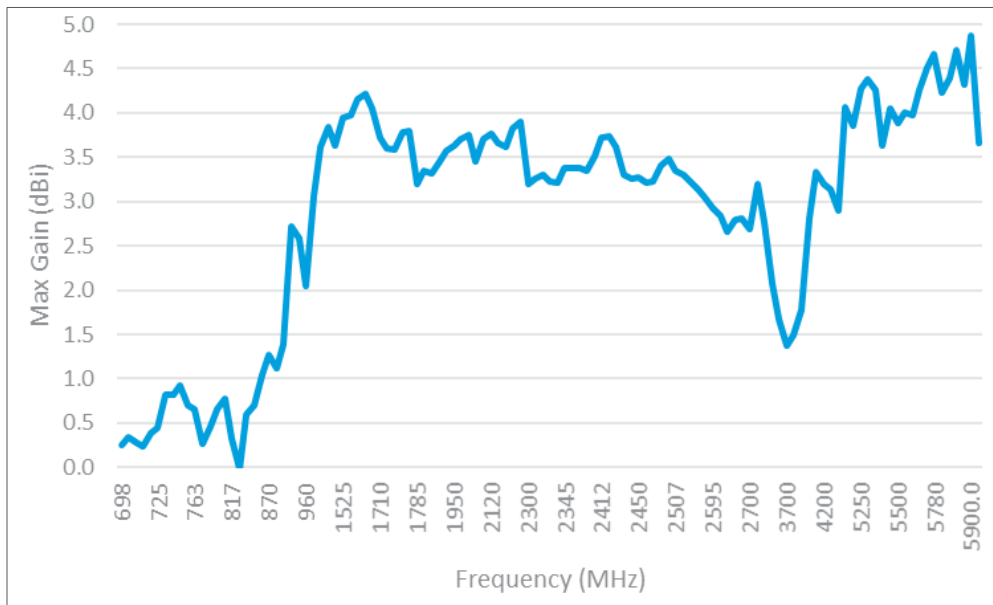
VSWR



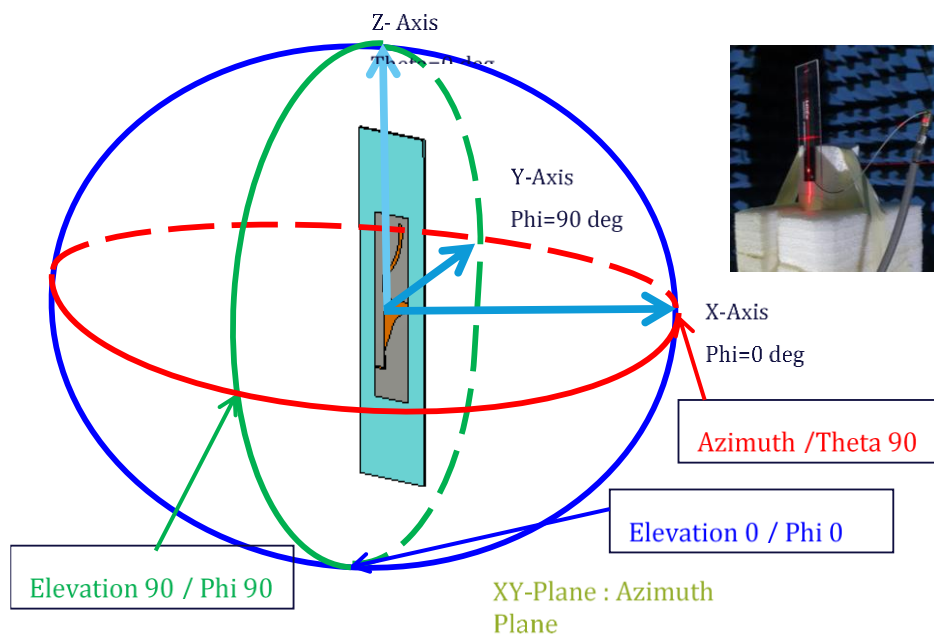
TOTAL EFFICIENCY (%)



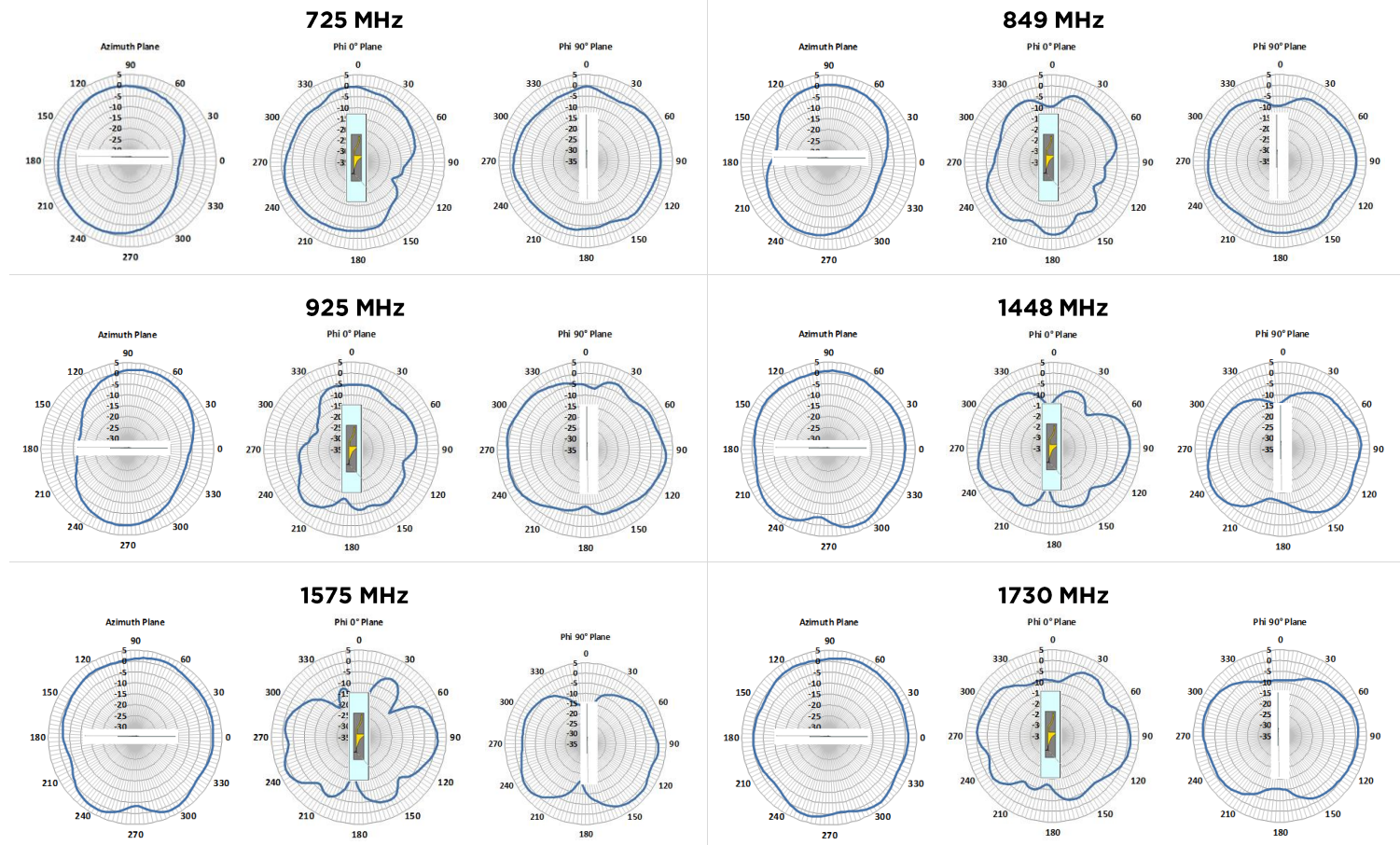
MAX GAIN (dBi)



COORDINATE MEASURING SYSTEM

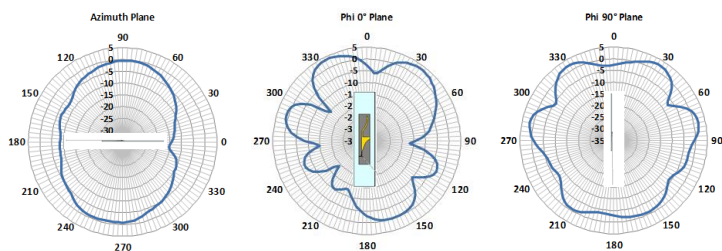


RADIATION PATTERNS

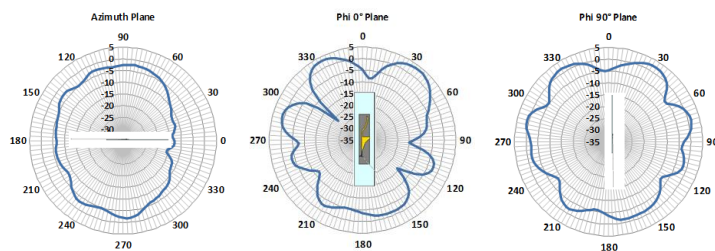


RADIATION PATTERNS

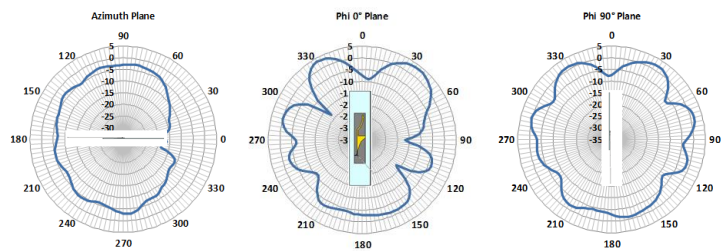
5150 MHz



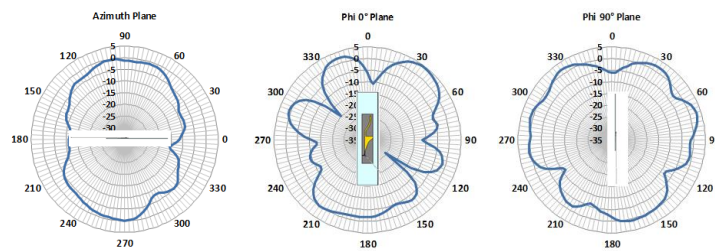
5450 MHz



5500 MHz



2500 MHz



INSTALLATION GUIDELINE SUMMARY

The following examples show measured antenna performance for a variety of design-in scenarios. The goal is to give an indication of the performance a design engineer can expect to achieve when utilizing the Revie Flex 700 antenna in their application when given similar spacings from nearby metallic objects. For these measurements, we used the EFF6989A3S-19MHF1 antenna. We placed it on a 180 x 40 x 1.7 mm polycarbonate material to represent integration in the final device.

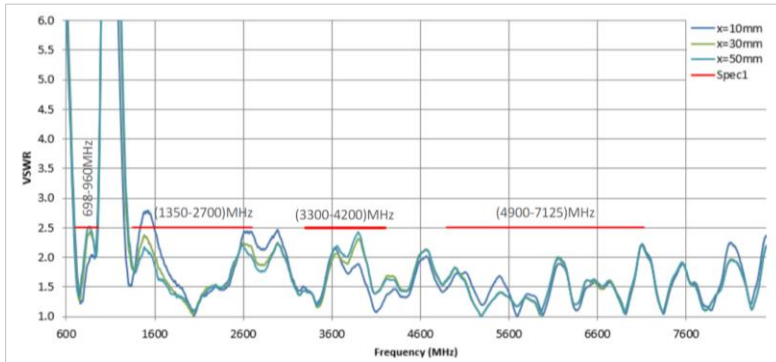
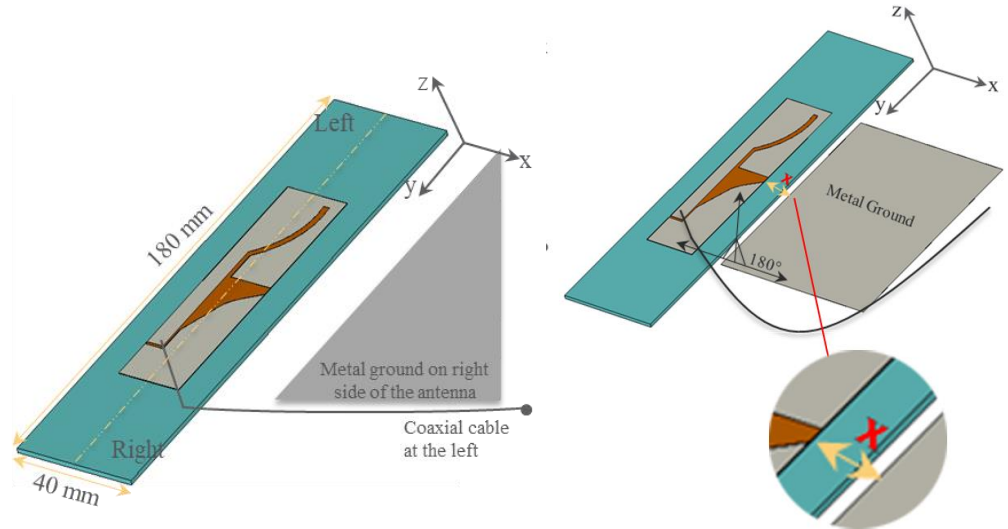
The following diagram shows the terminology and coordinates used for the various test conditions.

Impact on Antenna VSWR of Parallel Metal Objects (Ground Plane) to the Right Side of the Antenna with Variation in X-Axis

General Test Conditions:

- Metal ground plane besides flex PCB right
- Coaxial cable bend right
- Flex PCB is at same plane as metal ground plane

The following are test configurations with/without metal ground plane when coax cable bend to right/left.



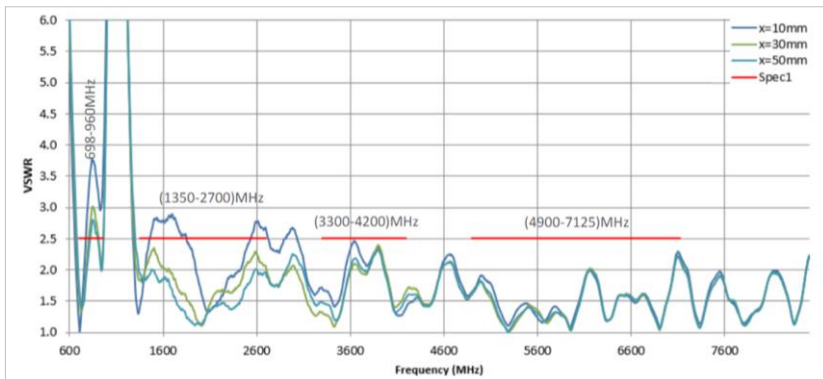
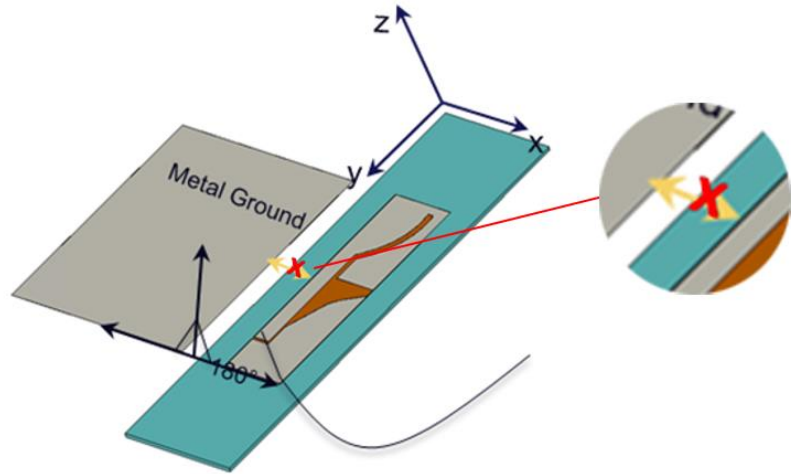
Proximity of Parallel Ground on Right Side

VSWR (Max)	X = 10 mm	X = 30 mm	X = 50 mm
698– 806 MHz	2.389	2.255	2.117
806–894 MHz	2.049	2.427	2.523
880–960 MHz	3.114	2.779	2.673
1350–1580 MHz	2.795	2.375	2.168
1550–1610 MHz	2.744	2.219	2.131
1690–1880 MHz	1.988	1.720	1.624
1850–1990 MHz	1.546	1.366	1.354
1910–2180 MHz	1.481	1.487	1.425
2300–2700 MHz	2.444	2.243	2.213
3300–4200 MHz	2.160	2.317	2.424
4900–5925 MHz	2.026	2.142	2.129
6000–7125 MHz	2.232	2.220	2.208

Impact on Antenna VSWR of Parallel Metal Objects (Ground Plane) to the Left Side of the Antenna with Variation in X-Axis

General Test Conditions:

- Metal ground plane besides flex PCB right
- Coaxial cable bend right
- Flex PCB is at same plane as metal ground plane



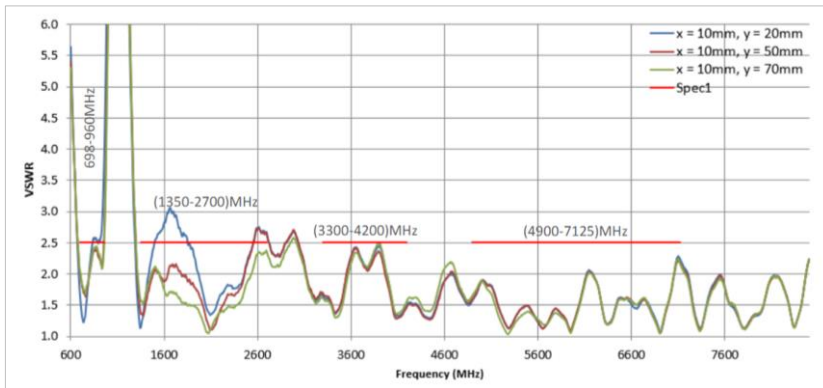
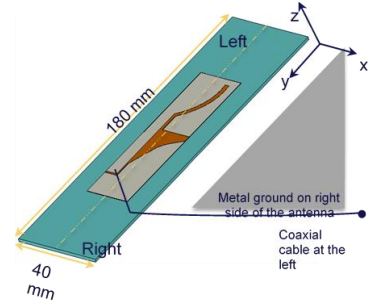
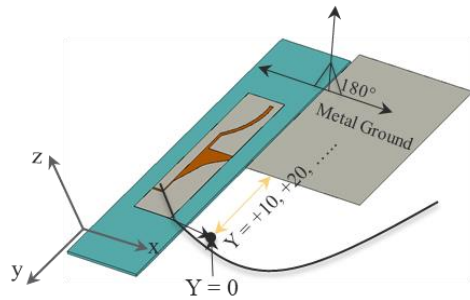
Proximity of Parallel Ground on Left Side

VSWR (Max)	X = 10 mm	X = 30 mm	X = 50 mm
698– 806 MHz	3.338	2.574	2.346
806–894 MHz	3.768	3.016	2.800
880–960 MHz	3.675	2.831	2.599
1350–1580 MHz	2.828	2.356	2.005
1550–1610 MHz	2.791	2.159	2.001
1690–1880 MHz	2.889	1.952	1.710
1850–1990 MHz	2.487	1.543	1.242
1910–2180 MHz	2.317	1.674	1.438
2300–2700 MHz	2.774	2.296	2.019
3300–4200 MHz	2.457	2.402	2.325
4900–5925 MHz	2.245	2.129	2.142
6000–7125 MHz	2.288	2.225	2.225

Impact on Antenna VSWR of Parallel Metal Objects (Ground Plane) to the Right Side of the Antenna – X-axis constant; variations in Y-axis

General Test Conditions:

- Metal ground plane placed beside flex PCB on right side
- Coaxial cable bend right
- Flex PCB is at same plane as metal ground plane



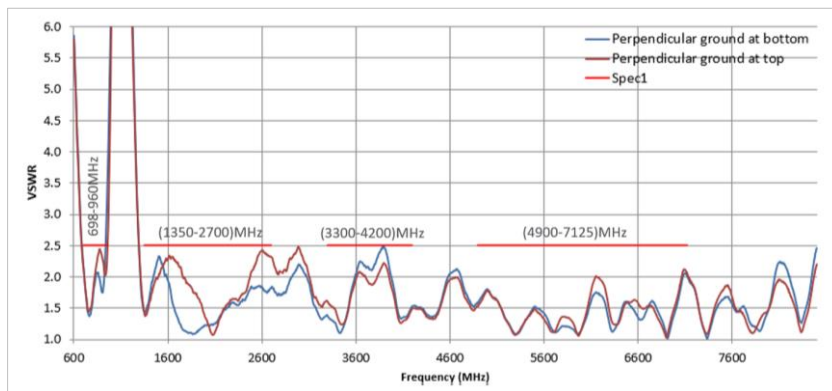
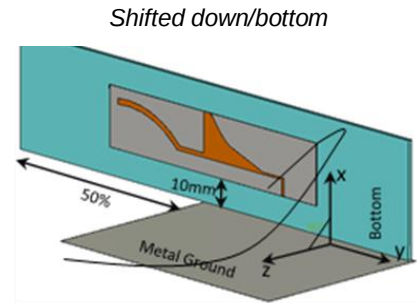
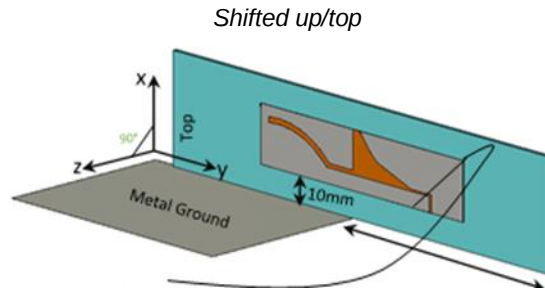
*Proximity of Parallel Ground on Right Side
with Different Variation along y-axis*

VSWR (Max)	X = 10 mm Y = 20 mm	X = 30 mm Y = 50 mm	X = 50 mm Y = 70 mm
698– 806 MHz	2.197	2.069	2.096
806–894 MHz	2.582	2.390	2.442
880–960 MHz	4.096	2.816	2.624
1350–1580 MHz	2.729	2.070	2.123
1550–1610 MHz	2.836	1.995	2.123
1690–1880 MHz	3.000	2.150	1.712
1850–1990 MHz	2.513	1.910	1.513
1910–2180 MHz	2.377	1.845	1.499
2300–2700 MHz	2.748	2.735	2.373
3300–4200 MHz	2.448	2.414	2.496
4900–5925 MHz	2.002	2.035	2.193
6000–7125 MHz	2.283	2.210	2.233

Impact on Antenna VSWR of Perpendicular Metal Object (Ground Plane) – With 10 mm Spacing and Shifted Up (Top) and Down (Bottom)

General Test Conditions:

- Metal ground plane is placed perpendicular to flex PCB bottom/top
- 50% of flex PCB Top/Bottom is out of the ground plane



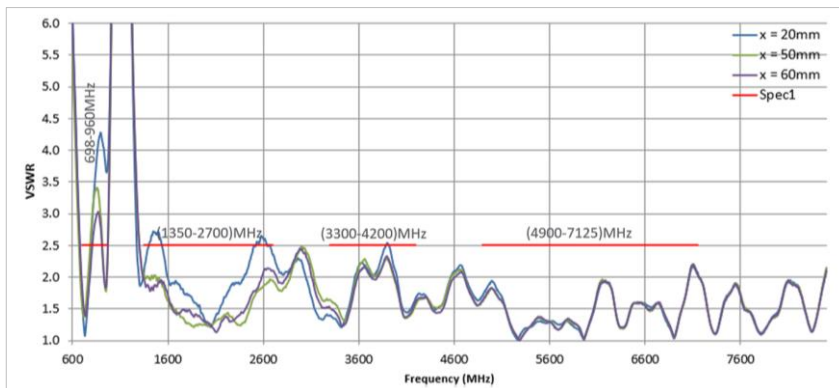
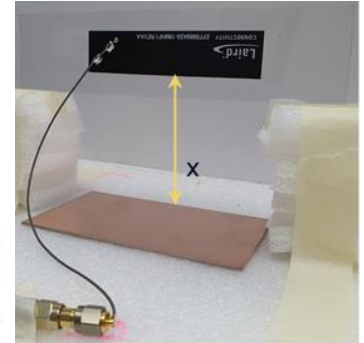
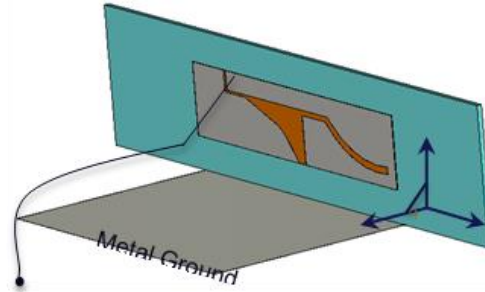
Proximity of Antenna with Perpendicular Ground

VSWR (Max)	Bottom	Top
698– 806 MHz	2.222	2.258
806–894 MHz	2.075	2.435
880–960 MHz	3.726	2.563
1350–1580 MHz	2.334	2.288
1550–1610 MHz	2.166	2.335
1690–1880 MHz	1.413	2.232
1850–1990 MHz	1.230	1.824
1910–2180 MHz	1.432	1.699
2300–2700 MHz	1.858	2.425
3300–4200 MHz	2.484	2.212
4900–5925 MHz	2.126	1.991
6000-7125 MHz	2.061	2.117

Impact on Antenna VSWR at various Distances from Perpendicular Metal Object (Ground Plane)

General Test Conditions:

- Metal ground plane is placed at left side of flex PCB
- Flex PCB is perpendicular/90 degree to metal ground plane



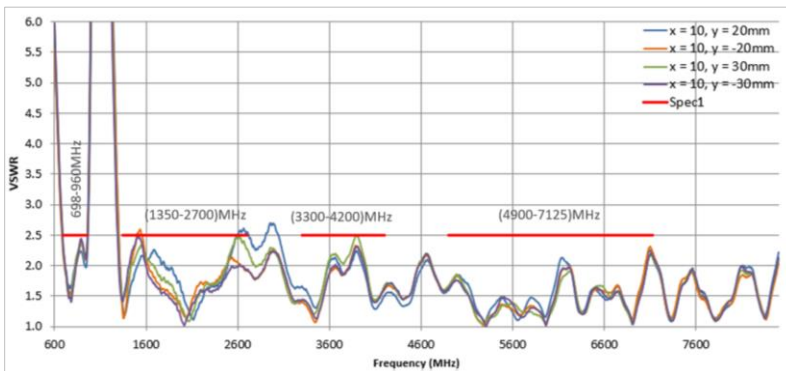
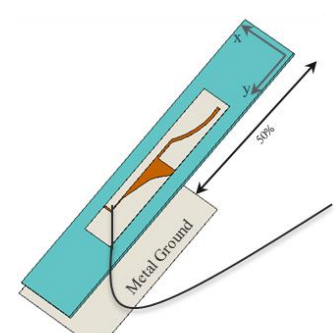
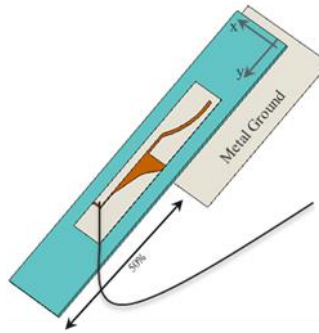
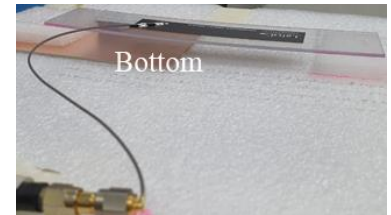
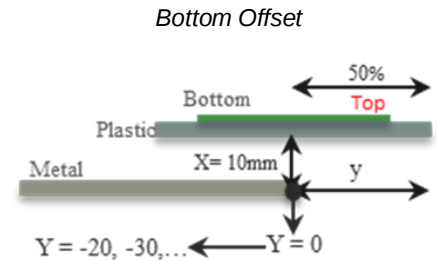
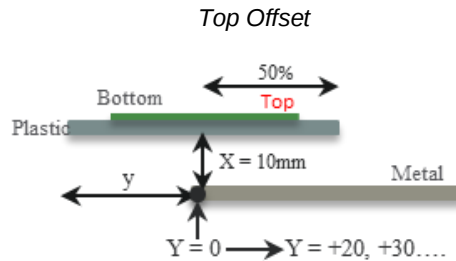
VSWR (Max)	X = 20 mm	X = 50 mm	X = 60 mm
698–806 MHz	2.916	3.024	2.513
806–894 MHz	4.268	3.413	3.033
880–960 MHz	4.268	3.259	2.990
1350–1580 MHz	2.718	2.054	1.982
1550–1610 MHz	2.417	1.855	1.960
1690–1880 MHz	1.926	1.484	1.497
1850–1990 MHz	1.678	1.271	1.422
1910–2180 MHz	1.634	1.403	1.406
2300–2700 MHz	2.644	1.968	2.144
3300–4200 MHz	2.533	2.294	2.331
4900–5925 MHz	2.185	2.124	2.086
6000–7125 MHz	2.163	2.213	2.199

Proximity of Antenna with Underneath Perpendicular Ground Plane

Impact on Antenna VSWR When Antenna is Placed Above and Offset from Metal Object (Ground Plane) with Variation Along Y-Axis

General Test Conditions:

- Metal ground plane is placed at the Bottom of flex PCB
- Coaxial cable bend right
- 50% of flex PCB Top/Bottom is out of the ground plane.
- Values of y are not overlapped with antenna



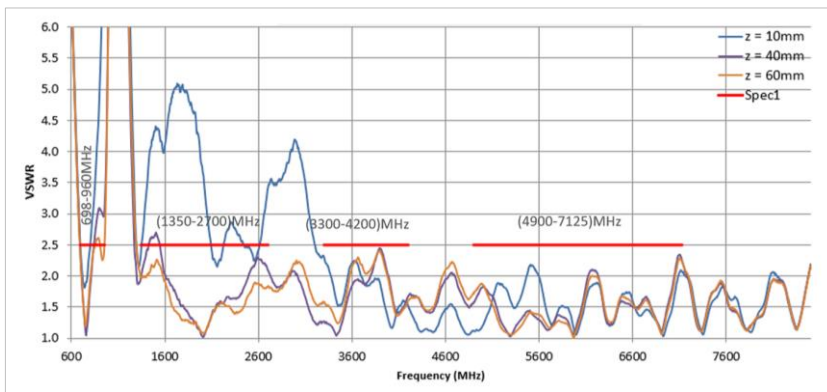
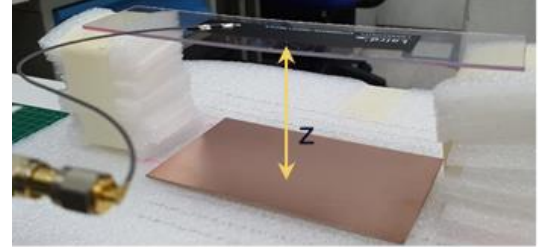
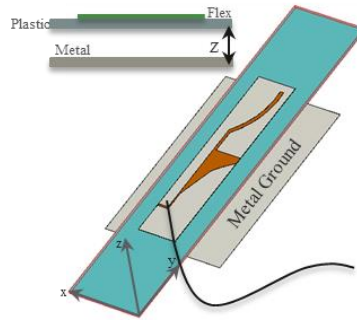
Proximity of Antenna with Parallel Ground Along Y-Axis

VSWR (Max)	X = 10 mm Y = 20 mm	X = 10 mm Y = -20 mm	X = 10 mm Y = 30 mm	X = 10 mm Y = -30 mm
698–806 MHz	2.209	2.184	2.318	2.313
806–894 MHz	2.241	2.401	2.349	2.442
880–960 MHz	2.276	2.498	2.481	2.530
1350–1580 MHz	2.168	2.600	2.333	2.493
1550–1610 MHz	2.168	2.516	2.333	2.389
1690–1880 MHz	2.256	1.814	1.982	1.699
1850–1990 MHz	1.969	1.549	1.700	1.479
1910–2180 MHz	1.845	1.714	1.558	1.560
2300–2700 MHz	2.609	2.135	2.459	2.008
3300–4200 MHz	2.240	2.329	2.485	2.313
4900–5925 MHz	2.098	2.170	2.190	2.196
6000–7125 MHz	2.248	2.312	2.161	2.191

Impact on Antenna VSWR When Antenna is Placed Parallel and Over the Metal Object (Ground Plane)

General Test Conditions:

- Metal ground plane is placed underneath at flex PCB



Proximity of Antenna with Underneath Perpendicular Ground Plane

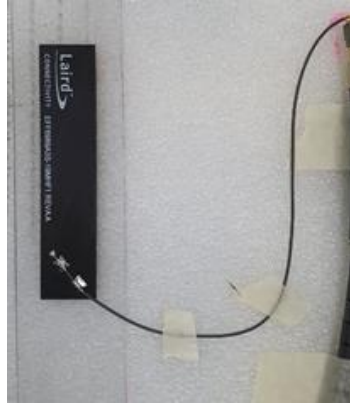
VSWR (Max)	Z = 10 mm	Z = 40 mm	Z = 60 mm
698–806 MHz	2.597	2.412	2.386
806–894 MHz	4.713	3.085	2.615
880–960 MHz	8.947	3.267	2.736
1350–1580 MHz	4.398	2.704	2.263
1550–1610 MHz	4.221	2.487	2.263
1690–1880 MHz	5.088	1.812	1.498
1850–1990 MHz	4.870	1.408	1.289
1910–2180 MHz	4.629	1.587	1.548
2300–2700 MHz	3.429	2.297	1.900
3300–4200 MHz	2.322	2.447	2.412
4900–5925 MHz	2.170	2.056	2.231
6000–7125 MHz	2.089	2.348	2.287

Impact on Antenna VSWR when Cable is Routed with Tight vs Loose Radius

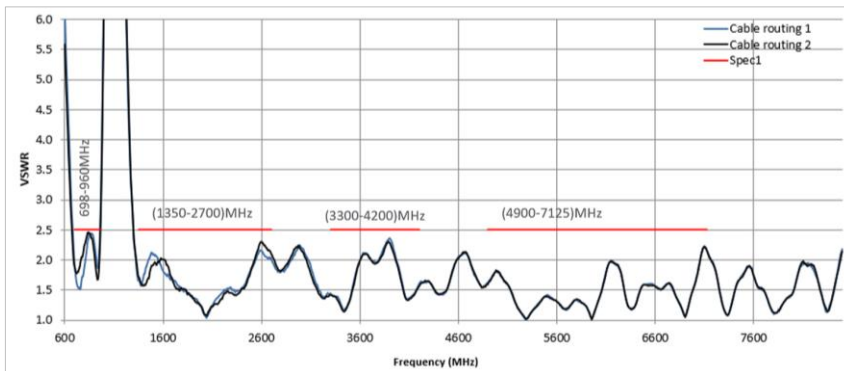
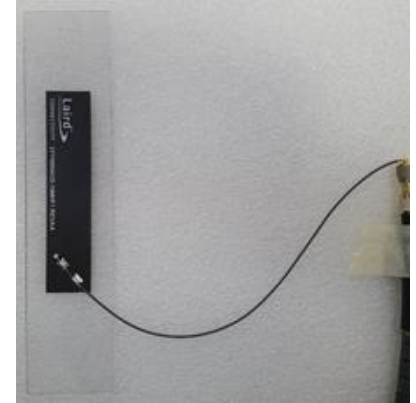
General Test Conditions:

- Flex is placed on a plastic PC
- Cable routed to the right side

Tight Bend Radius (1)



Loose Bend Radius (2)



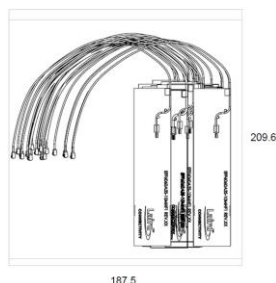
VSWR (Max)	Cable Routing 1	Cable Routing 2
698–806 MHz	1.974	2.077
806–894 MHz	2.444	2.444
880–960 MHz	2.498	2.495
1350–1580 MHz	2.123	2.123
1550–1610 MHz	2.015	2.015
1690–1880 MHz	1.705	1.705
1850–1990 MHz	1.451	1.451
1910–2180 MHz	1.424	1.434
2300–2700 MHz	2.165	2.165
3300–4200 MHz	2.361	2.361
4900–5925 MHz	2.117	2.117
6000–7125 MHz	2.220	2.220

Antenna in Free Space and with Different Cable Routing

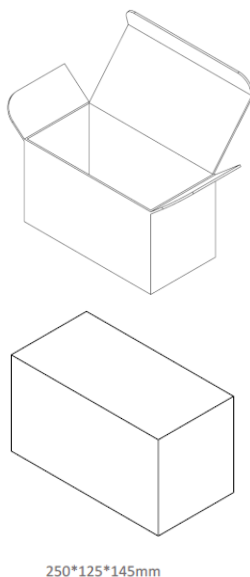
PACKAGING INFORMATION

	BAG	CARTON		MASTER PACK		AIR PALLET	OCEAN PALLET
Number of Antennas	20 antennas	10 bags	200 antennas	8 cartons	1600 antennas	14400	38400
Dimensions – mm (in.)	209.6 x 187.5 (8.25 x 7.38)	250 x 125 x 145 (9.84 x 4.92 x 5.71)		526 x 305 x 266 (20.71 x 12.01 x 10.47)		1200 x 800 x 1024 (47.24 x 31.5 x 40.31)	1200 x 800 x 1325 (47.24 x 31.5 x 52.17)
Weight – kg (lb.)	0.057 (0.13)	0.57 (1.26)		4.56 (10.05)			

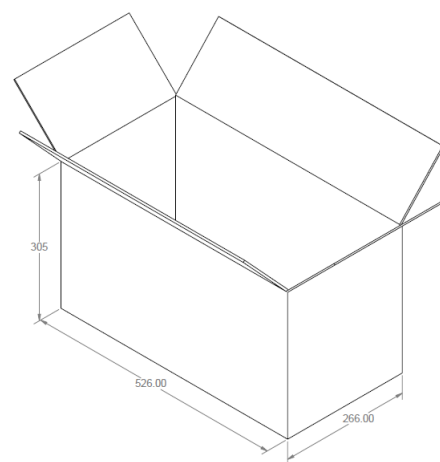
Bag



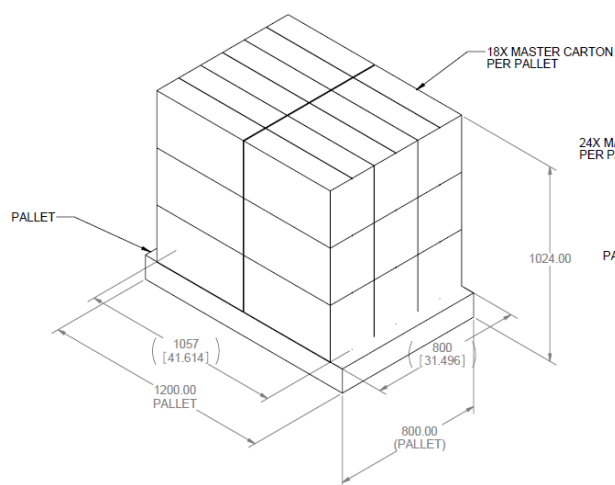
Carton



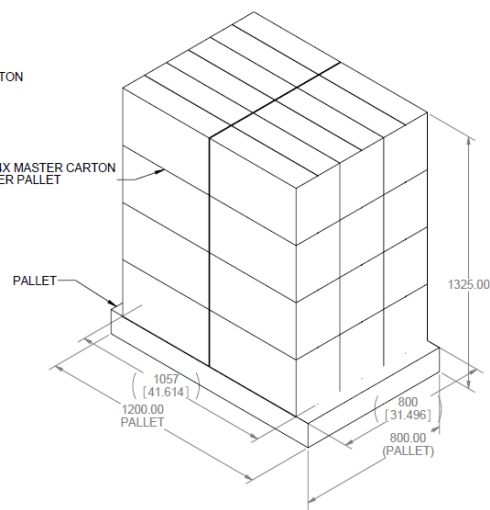
Master Pack



Air Pallet



Ocean Pallet



REVISION HISTORY

Version	Date	Notes	Approver
1.0	16 Sept 2020	Initial Release	Paul Fadlovich

sales@lairdconnect.com
support@lairdconnect.com
www.lairdconnect.com



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