

Type2AE

RF trace and trace antenna design guidelines for FCC

Rev.1.0



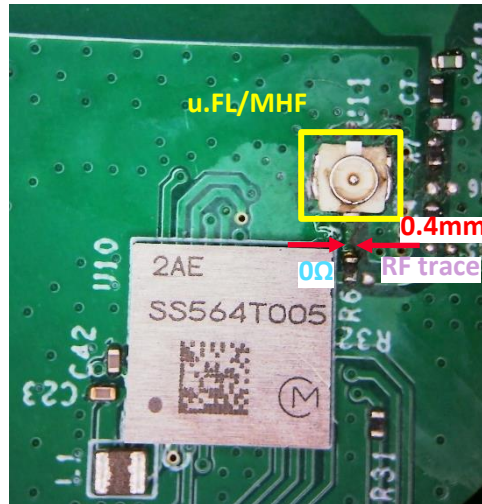
Two types of antenna are certified associating with the module.

- PCB antenna
- Dipole antenna

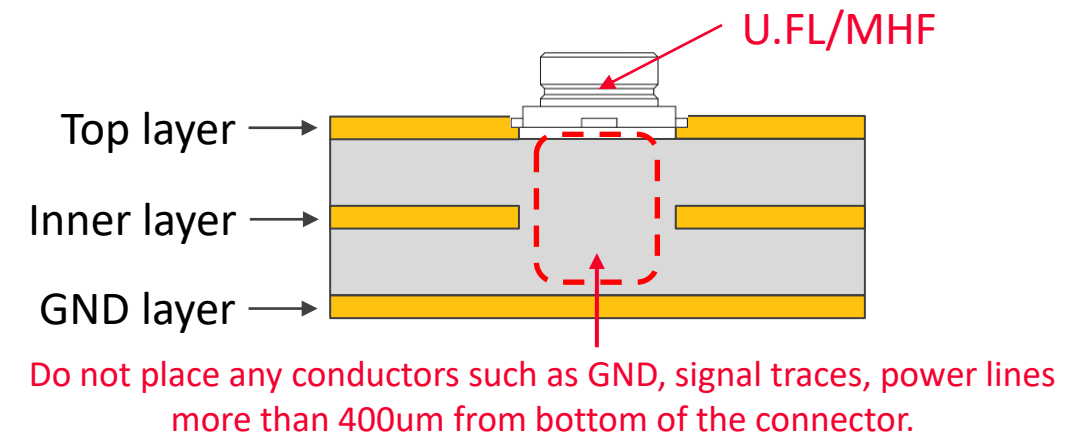
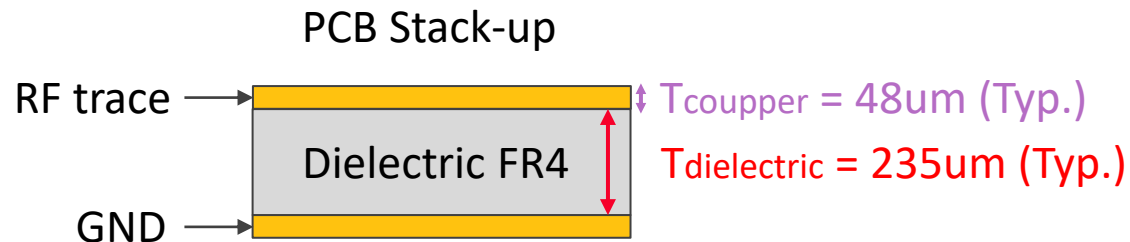
Their peak gains in dual bands are summarized as below.

Antenna Type	Peak gain at 2.4GHz	Peak gain at 5GHz
PCB antenna	3.0dBi	3.3dBi
Dipole antenna	3.4dBi	4.75dBi

Layout guide of RF trace for the u.FL antenna connector



- Must copy the RF traces of the DXF file on the board completely. Allowance to inaccuracy of trace width is Typ. +/-0.025mm (1mil). Typical width should be read from the DXF file.
- Stack height between the standard GND layer and the RF trace layer must be 235um (Typ.)
Allowance to inaccuracy of stack height is +/-0.025mm (1mil).
- Passive components must be placed on the same location as the DXF file shows and also same values must be used as the left figure.
- Keep out more than 400um under the U.FL/MHF connectors.
Ask to connector vendor in detail.

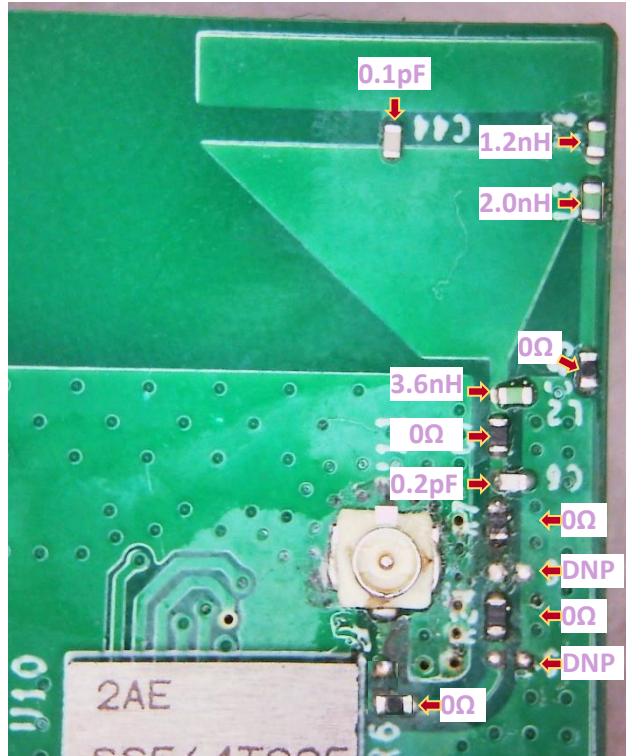


Layout guide of RF trace for the trace antenna

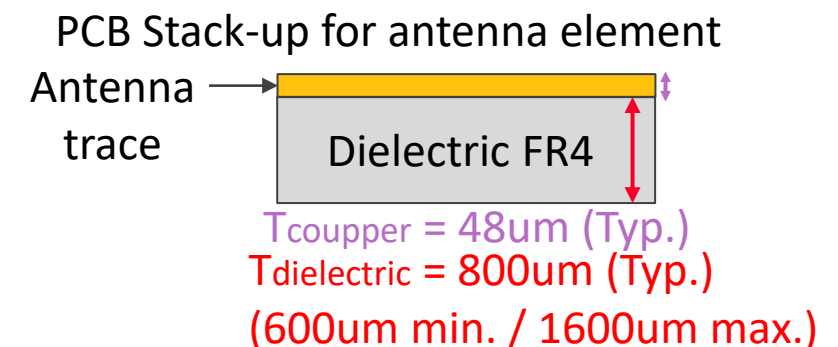
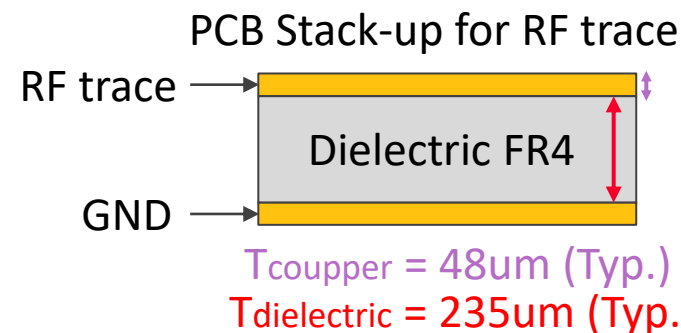
<Measurement condition>

Condition	Memo	Tuning 1	Tuning 2	Tuning 3	Tuning 4	Matching circuit							
						Shunt 1	Series 1	Shunt 2	Series 2	Shunt 3	Series 3	Shunt 4	
Condition 1	Optimized matching	1.2nH	0.1pF	2.0nH	0ohm	3.6nH	0ohm	0.2pF	0ohm	None	0ohm	None	

Size:1005 GRM15 / LQG15HS / Register Size:1005 GJM15



- Must copy the antenna design of the DXF file on the board completely
- Must copy the RF traces of the DXF file on the board completely.
Allowance to inaccuracy of trace width is Typ. +/-0.025mm (1mil).
Typical width should be read from the DXF file.
- Recommended total thickness of PCB (Dielectric) is 0.8mm.
(Must be $0.6\text{mm} \leq \text{PCB Thickness} \leq 1.6\text{mm}$)
- Stack height between the standard GND layer and the RF trace layer must be 235um (Typ.)
Allowance to inaccuracy of stack height is +/-0.025mm (1mil).
- Passive components must be placed on the same location as the DXF file shows and also same values must be used as the left figure.

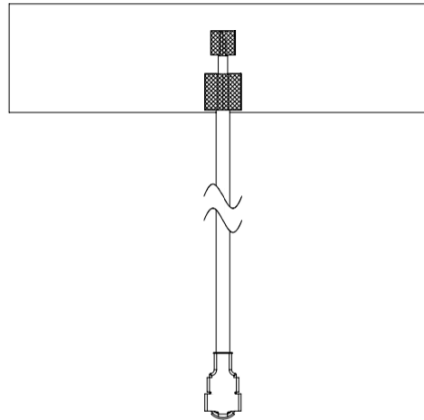


Planning certified external antenna

- Type2AE module is going to be certified with below antennas.

Maker	P/N	Form factor	Type	2.4Ghz Gain (dBi)	5Ghz Gain (dBi)
Molex	146187	u.FL/flexible	dipole	3.4	4.75

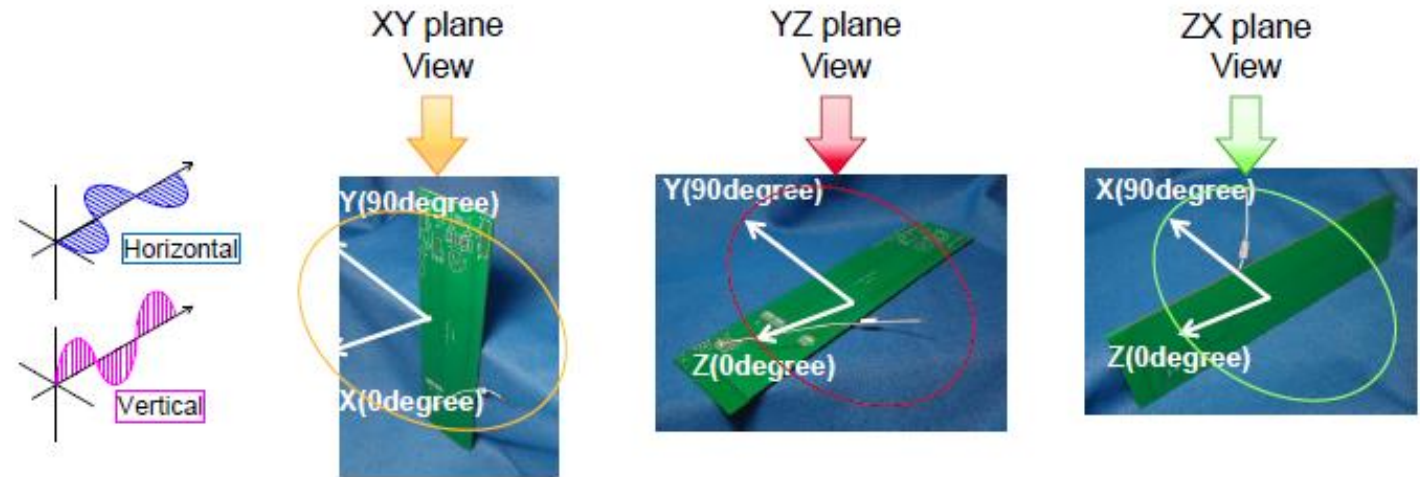
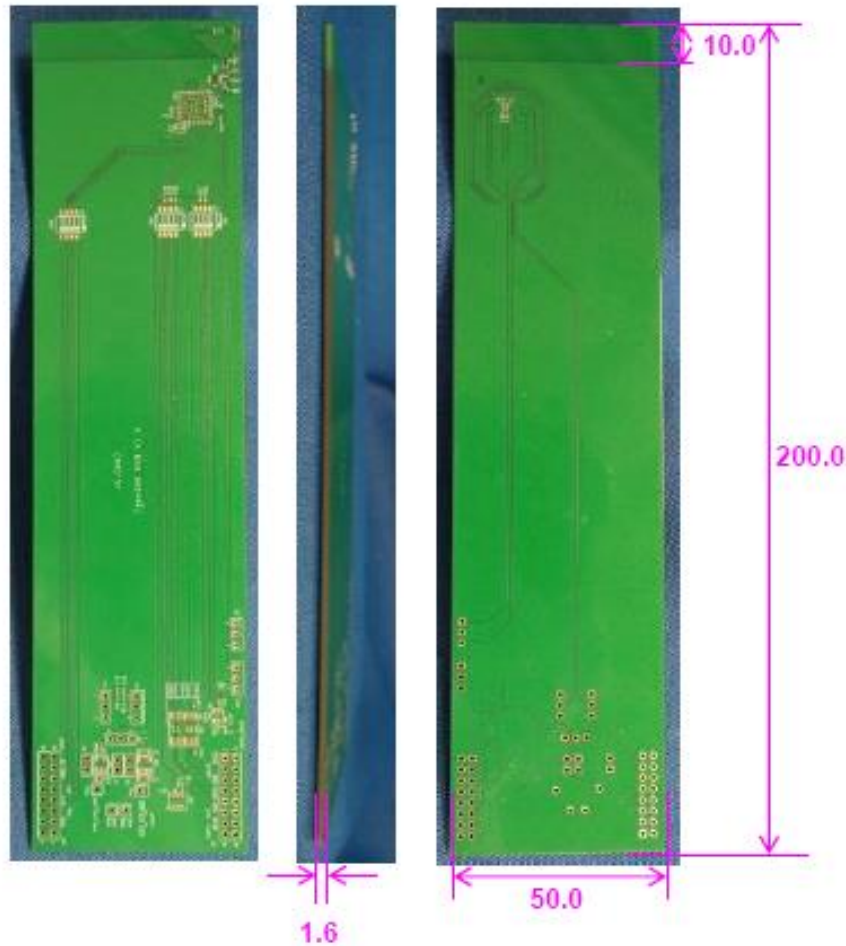
- The user can use any other antennas that is attached to the U.FL/MHF connectors with following conditions.
 - Form factor : PCB/Film type antenna (Similar “T-Shape” appearance is acceptable)



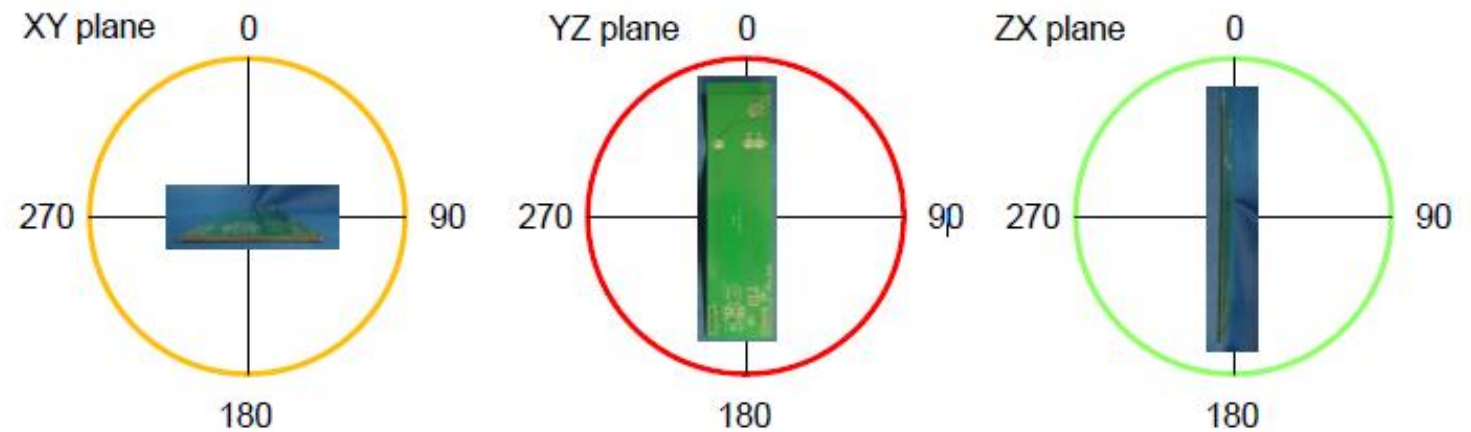
- Antenna type : Dipole antenna
- Antenna gain :
 - 2.4GHz 0dBi $\leq$ 2.4GHz Gain $\leq$ 3.4dBi (Planning)
 - 5GHz 0dBi $\leq$ 5GHz Gain $\leq$ 4.75dBi (Planning)

Certified trace antenna - measurement conditions

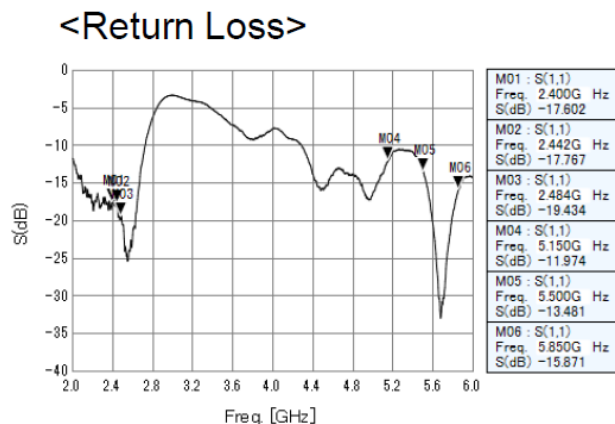
Board appearance



2D Directional indication



Certified trace antenna - performance



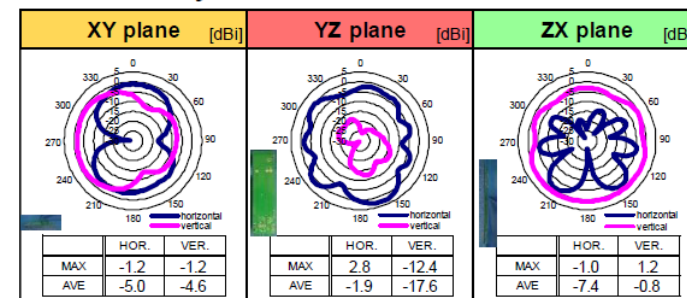
<Efficiency>

*Red color shows peak gain
[dBi] [dB]

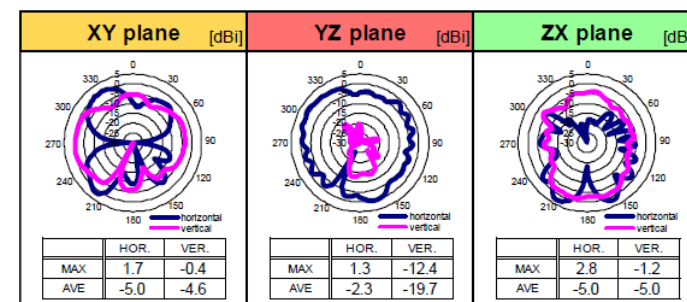
LINEAR POLAMIZATION		XY-plane		YZ-plane		ZX-plane		Total Efficiency
		hor.	ver.	hor.	ver.	hor.	ver.	
2400 MHz	MAX.	-1.1	-1.0	3.0	-13.4	-1.1	0.9	-0.9
	AVE.	-4.8	-4.5	-2.0	-18.7	-7.5	-1.0	
2442 MHz	MAX.	-1.2	-1.2	2.8	-12.4	-1.0	1.2	-0.9
	AVE.	-5.0	-4.6	-1.9	-17.6	-7.4	-0.8	
2484 MHz	MAX.	-1.5	-0.5	3.0	-11.8	-0.5	1.7	-0.8
	AVE.	-5.2	-4.1	-1.7	-16.8	-7.3	-0.6	

LINEAR POLAMIZATION		XY-plane		YZ-plane		ZX-plane		Total Efficiency
		hor.	ver.	hor.	ver.	hor.	ver.	
5150 MHz	MAX.	1.8	-0.8	1.9	-12.2	2.7	-0.7	-1.4
	AVE.	-4.4	-4.7	-2.1	-19.6	-4.6	-4.4	
5500 MHz	MAX.	1.7	-0.4	1.3	-12.4	2.8	-1.2	-1.6
	AVE.	-5.0	-4.6	-2.3	-19.7	-5.0	-5.0	
5850 MHz	MAX.	2.1	-1.4	0.9	-12.7	3.3	-3.0	-1.6
	AVE.	-4.7	-5.6	-2.5	-19.8	-4.4	-6.0	

<Directivity>



@2442MHz



@5500MHz

<Measurement result>

Total efficiency

Condition	Frequency [MHz]						Average 2GHz band [dB]		Average 5GHz band [%]	
	2400	2442	2484	5150	5500	5850	Average 2GHz band	Average 5GHz band	Average 2GHz band	Average 5GHz band
Condition 1	-0.9	-0.9	-0.8	-1.4	-1.6	-1.6	-0.9	-1.5	82.1	70.3

Peak gain

Condition	Frequency [MHz]						Max. [dBi]	
	2400	2442	2484	5150	5500	5850	2GHz band	5GHz band
Condition 1	3.0	2.8	3.0	2.7	2.8	3.3	3.0	3.3

Dipole antenna

- The dipole antenna is a model from Molex with a U.FL connector

Maker	P/N	Form factor	Type	2.4GHz Gain (dBi)	5GHz Gain (dBi)
Molex	146187	U.FL/flexible	dipole	3.4	4.75

