ZEONIF™ XL-Series

Advanced materials for High-Speed Circuit and Radio Frequency (RF) module Applications

Zeon Corporation Yuya Suzuki

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  - Concept of XL
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  - High Reliability
  - Processability
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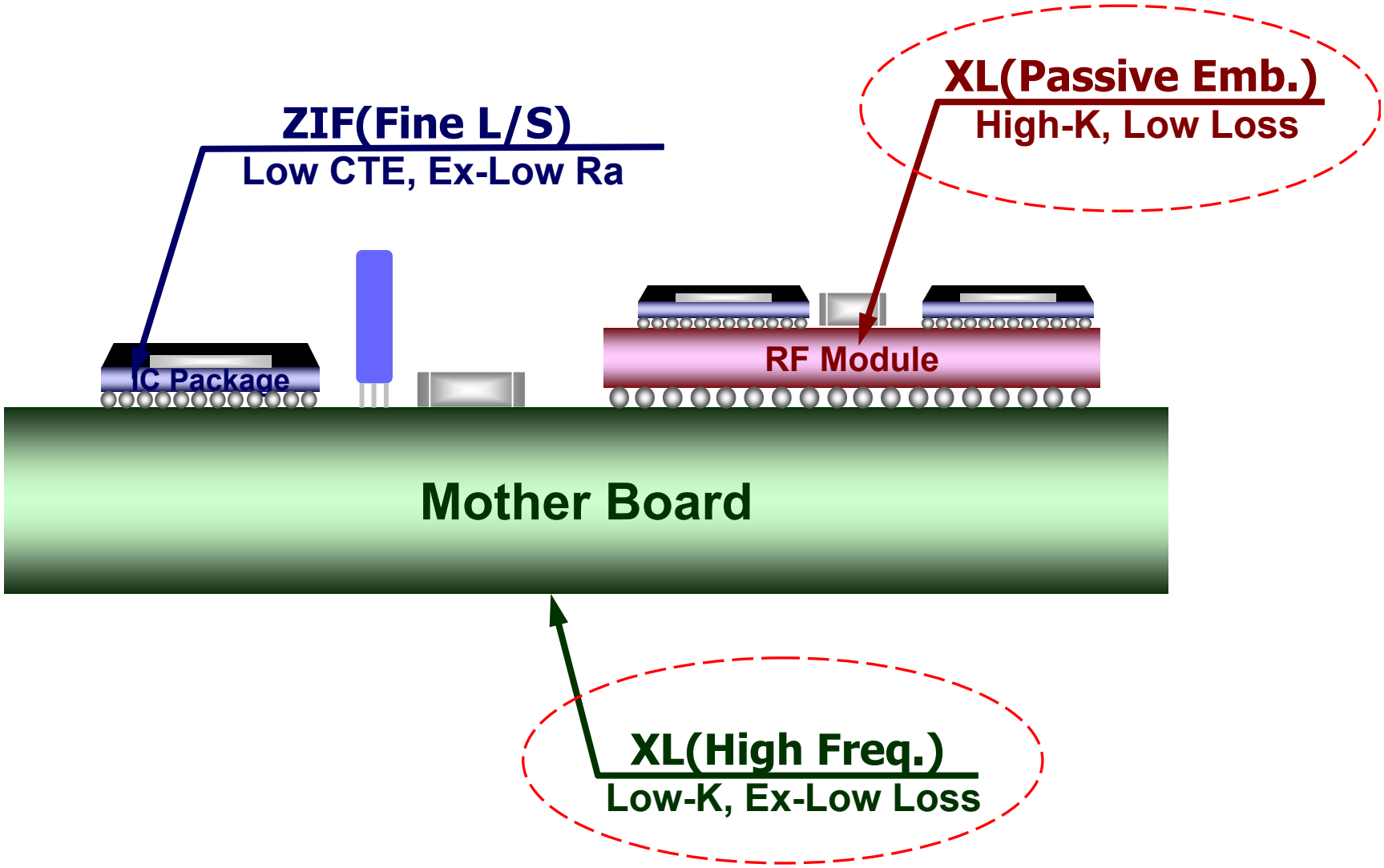
  - Miniaturized RF module using XL-high Dk

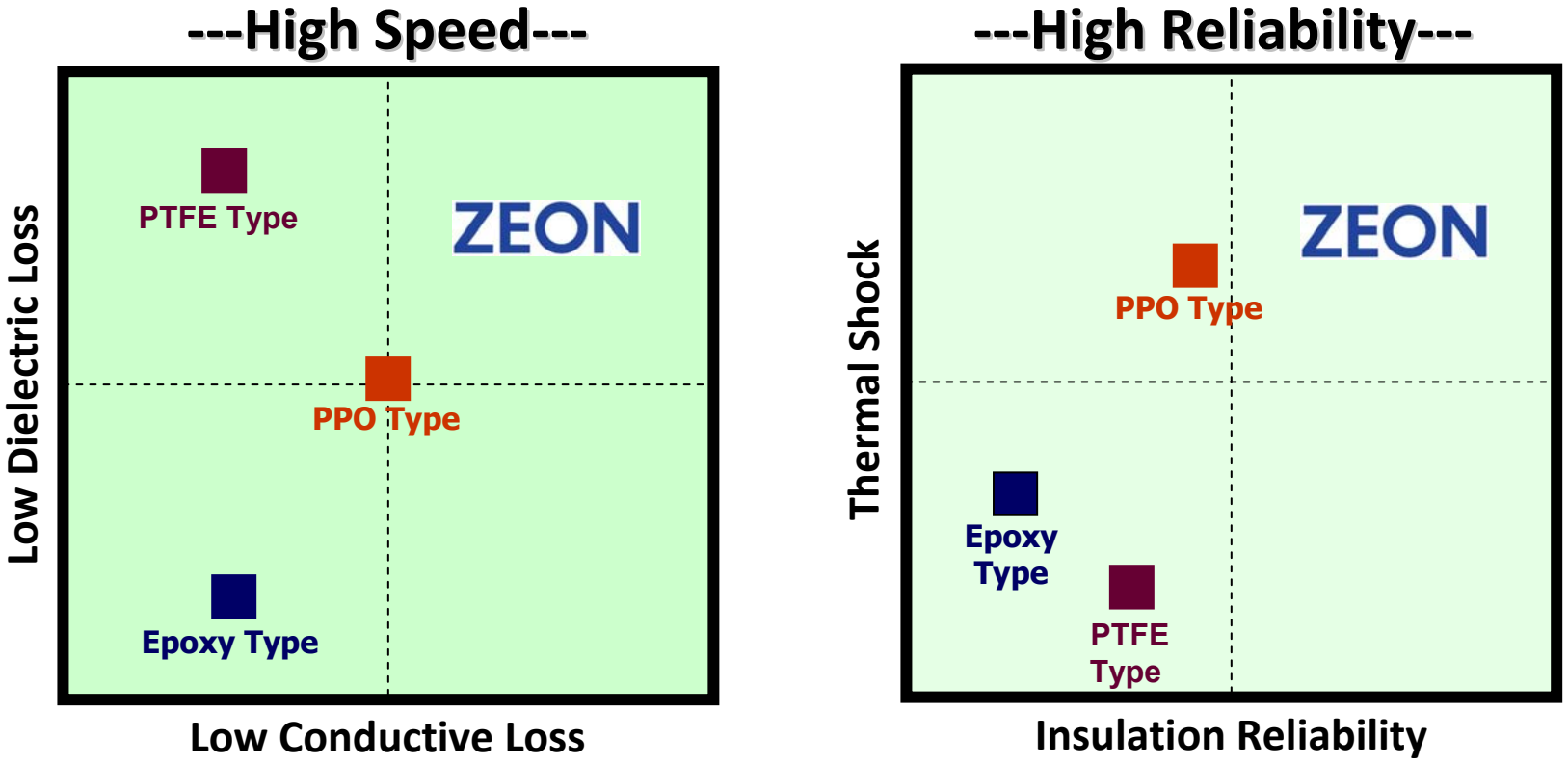
ZEONIF™ XL

Zeonif product portfolio Overview



Design Concept of XL-Series

XL-Series contributes to achieve the High Speed/Freq. and high reliability substrate.

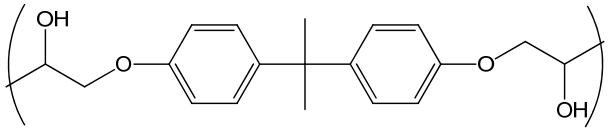
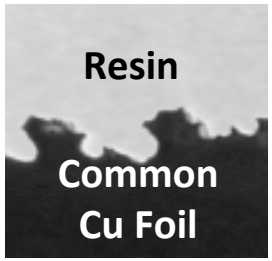
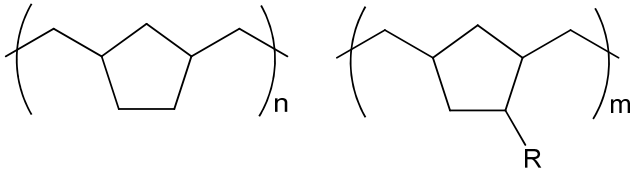


General Properties of XL

Content	Unit	Zeon			Others		
		XL (halogen)	XL-HF	XL-200	Epoxy	PTFE	PPE
		Low Dk halogen	*Low Dk halogen-free*	*High Dk halogen-free*			
Dk(1GHz)	-	3.5	4.5	6.7	4.4	3.0	3.8
Df(1GHz)	-	0.001	0.001	0.003	0.018	0.0013	0.002
Tg(DMA 1Hz)	C	180	180	175	155	20	190
CTE_z(<Tg)	ppm/C	50	45	40	65	-	45
CTEx-y(<Tg)		12	12	12	16		
Cu Foil Roughness	μm	 <150nm	 <150nm	 <150nm	 >>1μm	 >>1μm	 >1μm
Peel Strength (thickness35μm)	kN/m	1.1	0.8	0.7	1.4		0.8
Water abs.(23C*200HR)	%	0.06	0.08	0.08	0.2	-	0.15
Glass Cloth	-	E Glass	E Glass	E Glass	E Glass	E Glass	E Glass
Young's modulus	GPa	12	15	15	21		

Low loss and low moisture absorption material compatible to general packaging process

How to get low loss?

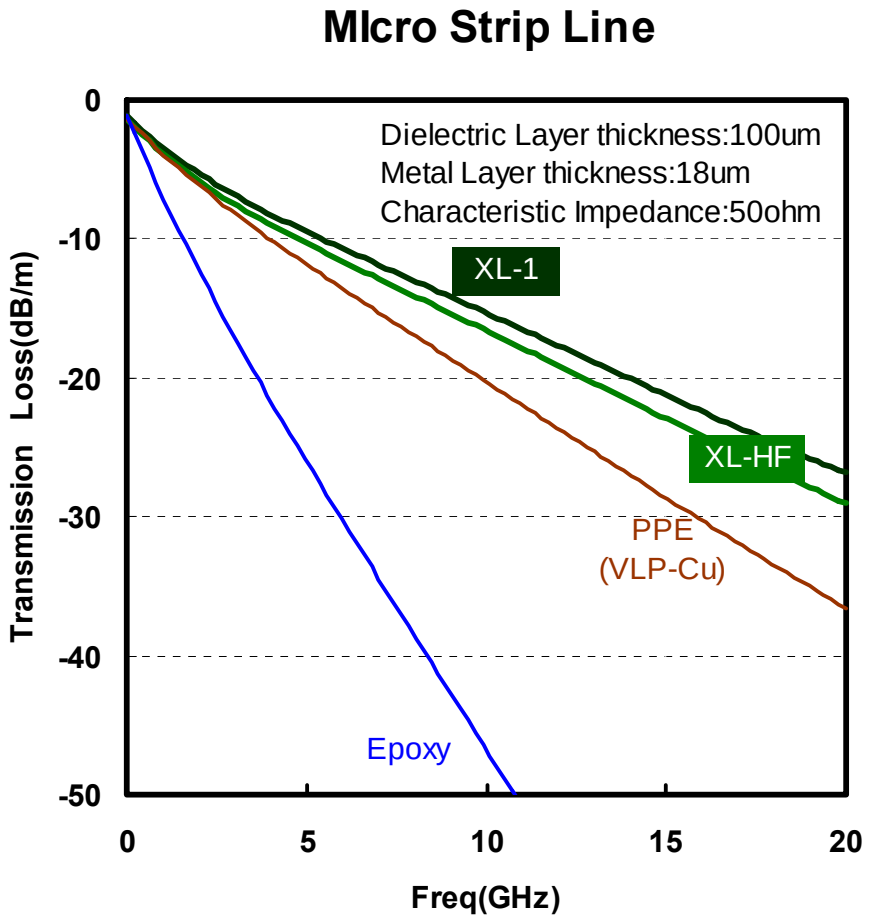
	■Dielectric Loss■ (Ld)	■Conductive Loss■ (Lc)
Conventional		
XL-Series		

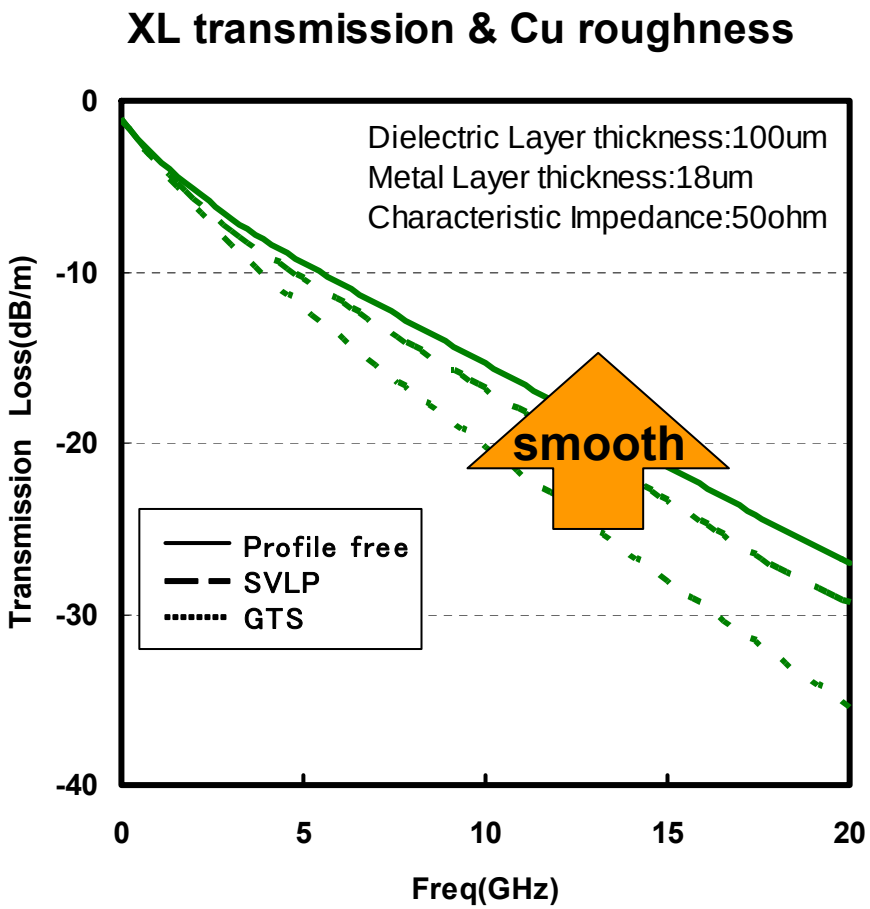
Low Dk/Df
Low water abs.

Cross linking
Adhesion

COP (Cyclo-olefin Polymer) → Low Ld
Profile free Cu foil → Low Lc

Transmission loss in micro strip line



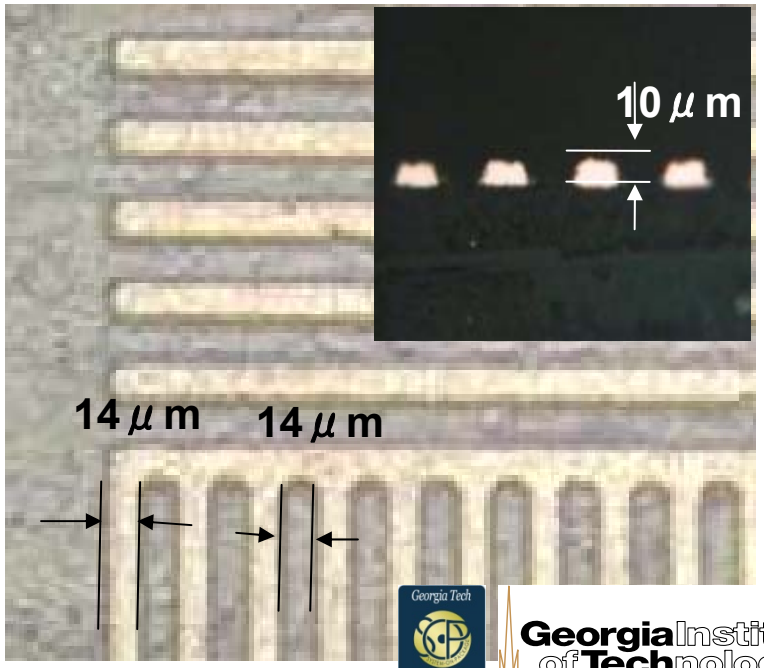


Extremely low transmission Loss due to low Ld & Lc

Fine line/space

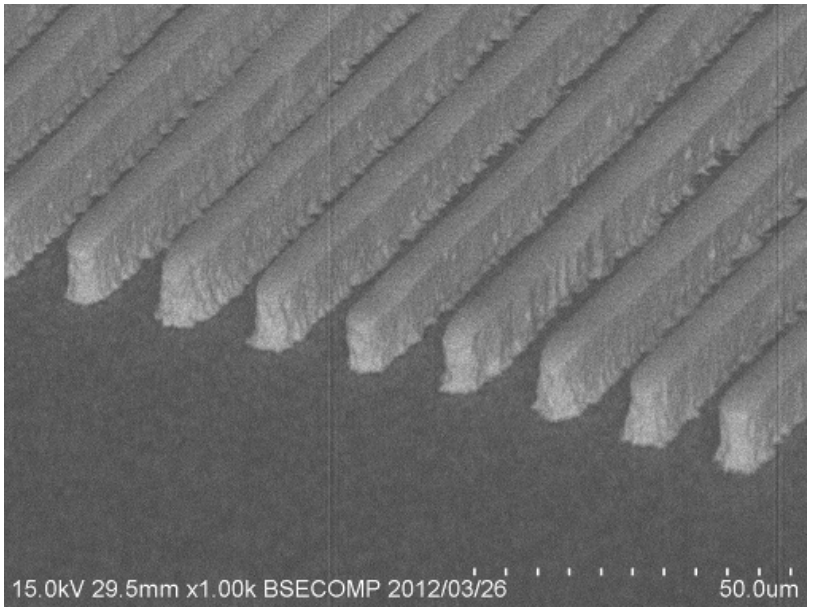
Subtractive process

L/S = 14/14



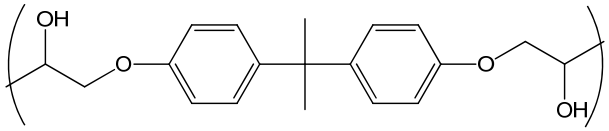
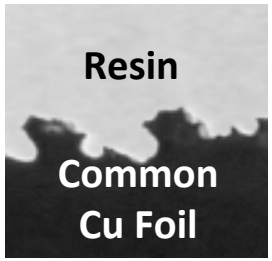
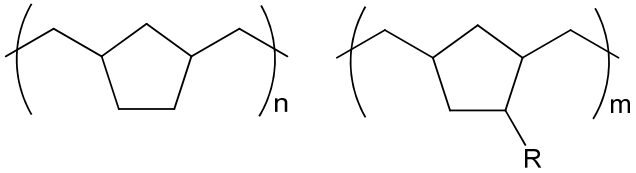
MSAP

L/S = 8/8



Very fine line/space feasible because of profile-free surface

Low moisture absorption

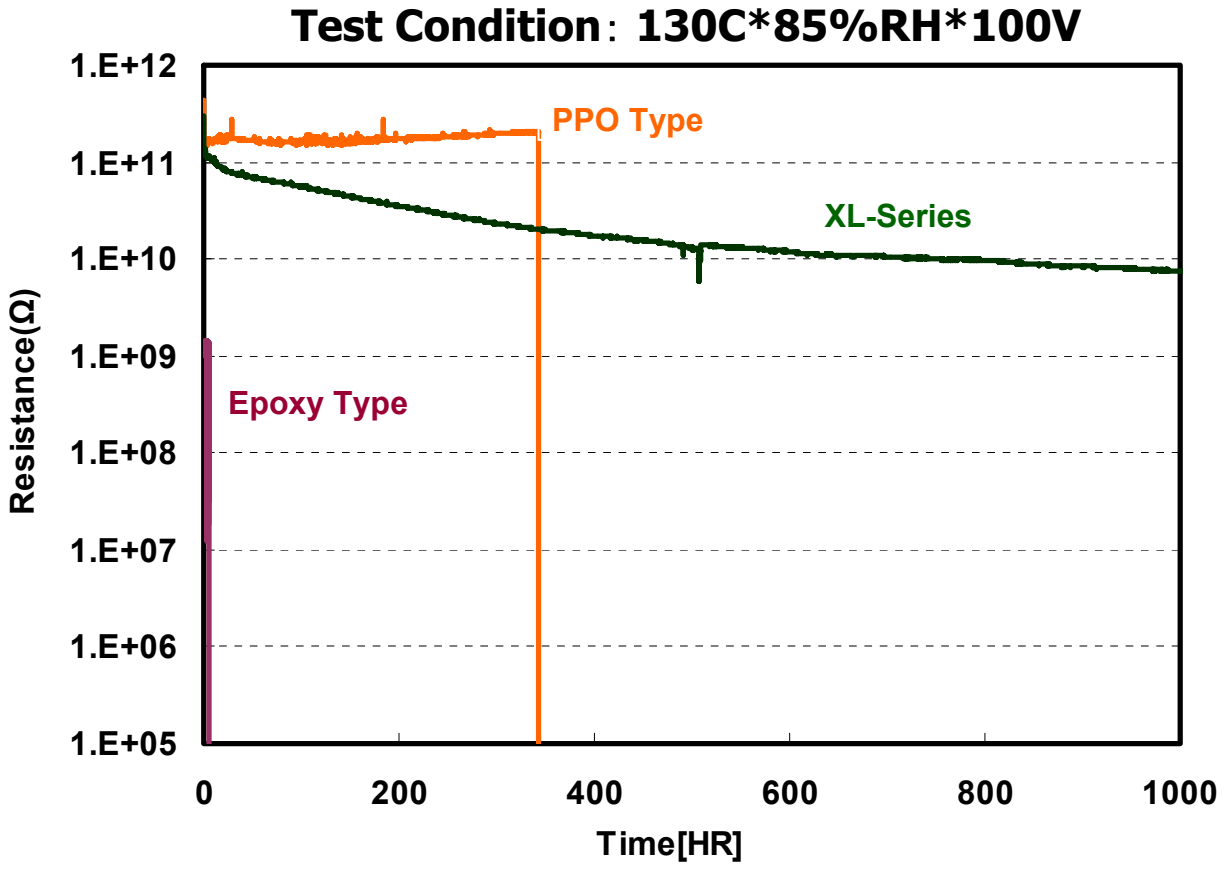
	■Dielectric Loss■ (Ld)	■Conductive Loss■ (Lc)
Conventional		
XL-Series		

Low Dk/Df
Low water abs.

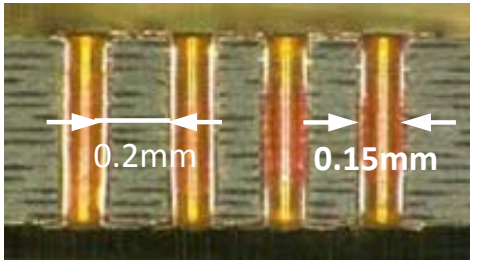
Cross linking
Adhesion

No polar group in main chain
→ extremely low moisture uptake

Insulation Resistance Test



<Test Piece Info.>

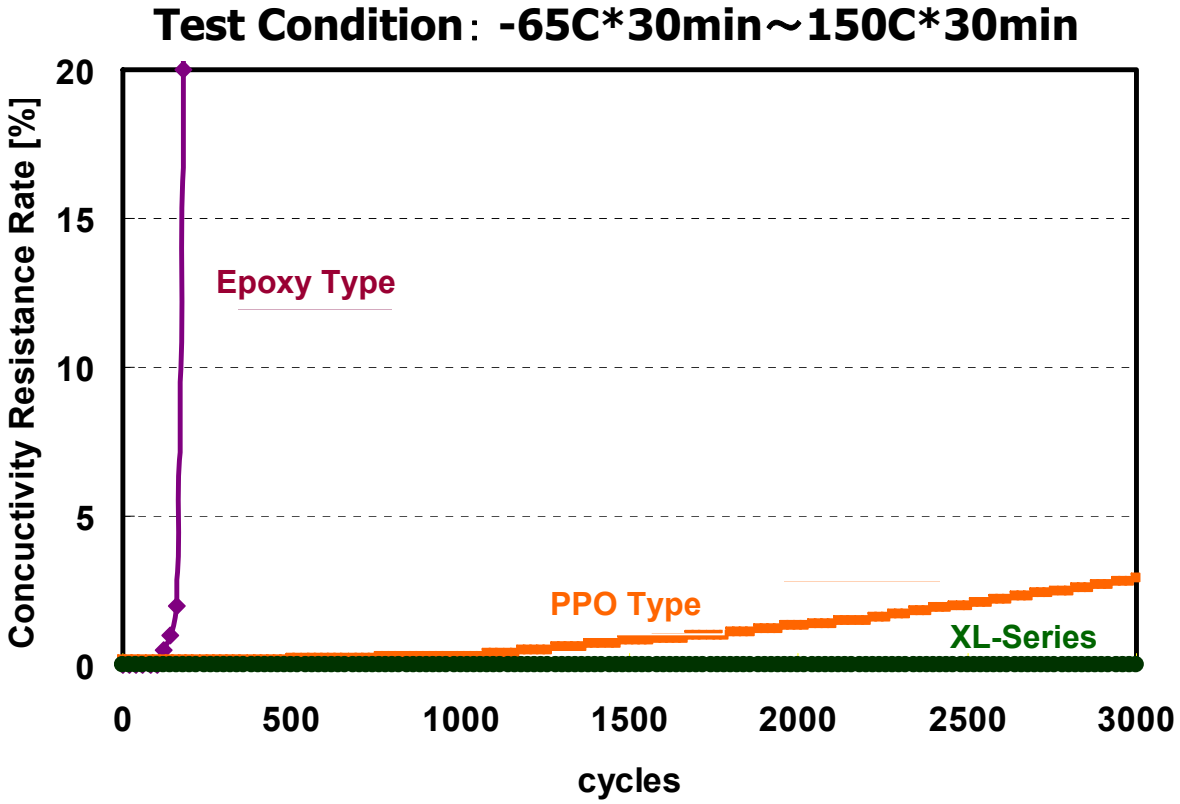


<Test Sample>
-Thickness ; 0.8mmt
-Hole number ; 20holes
-Land diameter ; 0.4mm

***Pre-Condition:**
MSL 2A / 260 C(JESD22-A113)

High resistance up to 1000HR.

Thermal Shock Reliability



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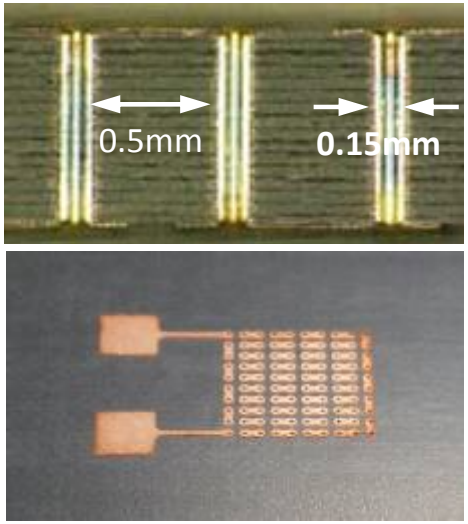


<Test Sample>
-Thickness ; 0.8mmt
-Hole number ; 100holes
-Land diameter ; 0.45mm

*Pre-Condition
MSL 2A / 260 C(JESD22-A113)

High resistance even under sever condition

Processability of XL

【Press & Drilling】

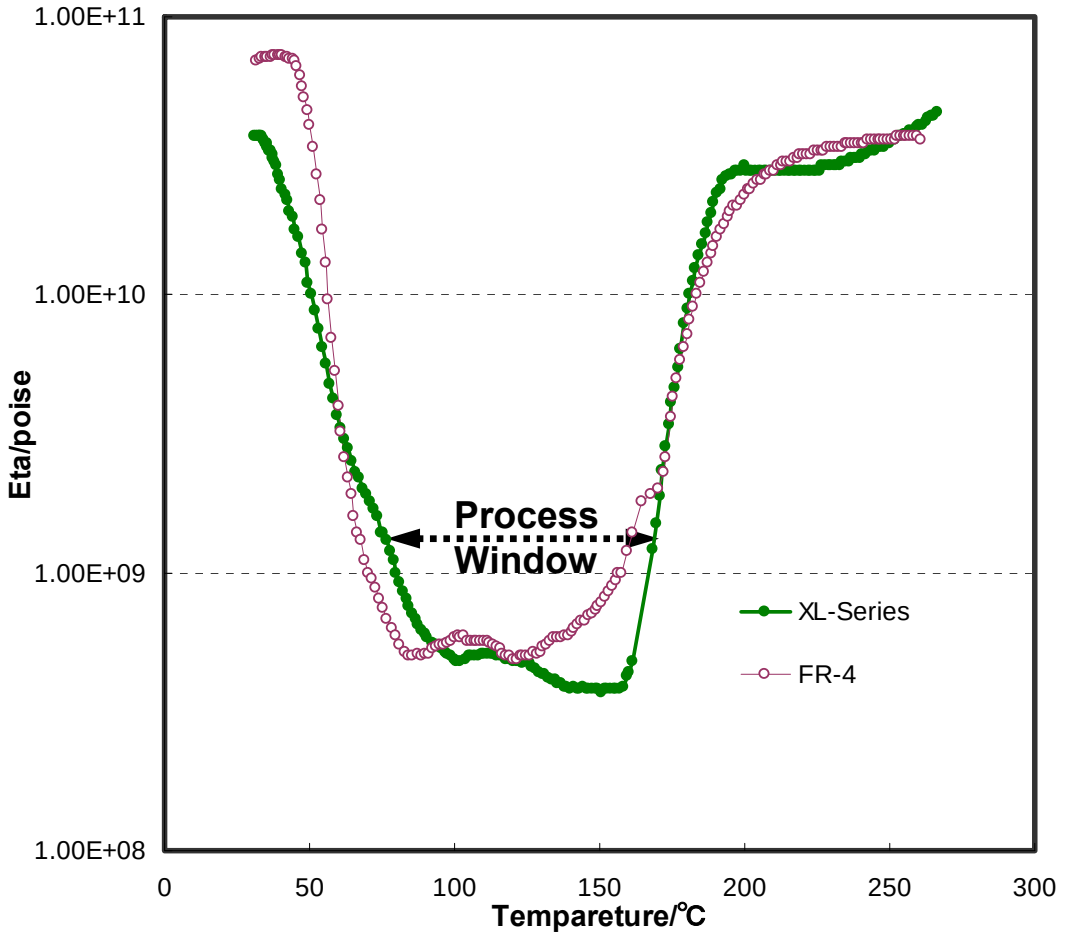
Process	Condition	FR-4	XL-Series
Lamination	Temp.	160C	190C
	Pressure	2.5MPa(363psi)	3MPa(435psi)
	Time	50min	30min
Drilling (0.3mmϕ)	Chip Load	20um/rev	20um/rev
	Speed	120～160krpm	120～160krpm

【 Desmear】

Process	Comp.	FR-4	XL-Series
Swell	**Securigant P/ NaOH aq.**	60C*5min	60C*5min
Rinse	**Deionized water**	R.T*20s(3)	R.T*20s(3)
Micro etch	**Compact CP/ NaOH aq.**	80C*10min	80C*10min
Rinse	**Deionized water**	R.T*60C(3)	R.T*60C(3)
Reduction	**Securigant P500 98%H2SO4 aq.**	40C*5min	40C*5min
Rinse	**Deionized water**	R.T*20s(3)	R.T*20s(3)
Dry	**Air**	150C*30min	150C*30min

FR-4 process compatible

Lamination property



Good resin flowability almost same as FR-4

Summary of XL

1. Extremely low dissipation factor(Df)

-minimizes dielectric loss(Q_L) of a circuit

-achieves high frequency transmission

2. Profile free conductive layer

-zeronizes conductive loss(Q_C) delivered from Ra/Rz

-realizes fine line spacing with subtractive process

3. Low moisture absorption

-reduces resistance change under humidity test

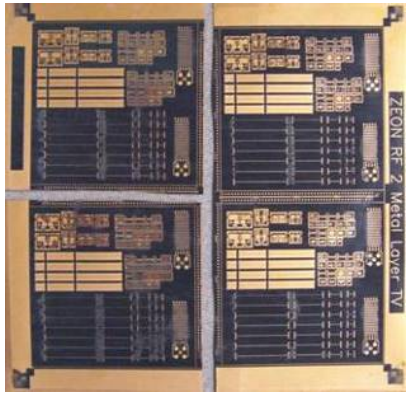
4. Good processability

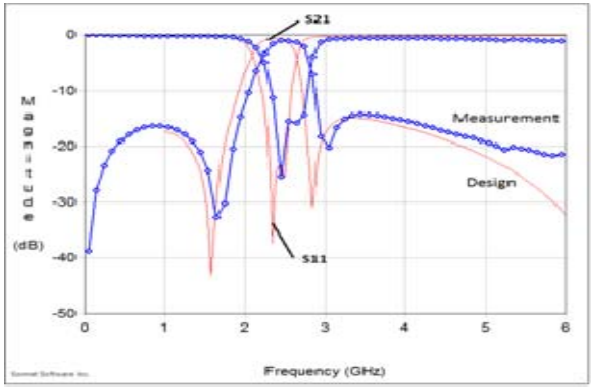
-provides multilayer PCB with conventinal process

Joint work at GT-PRC

RF module with XL-200 (high Dk)

Miniaturization of embedded filter

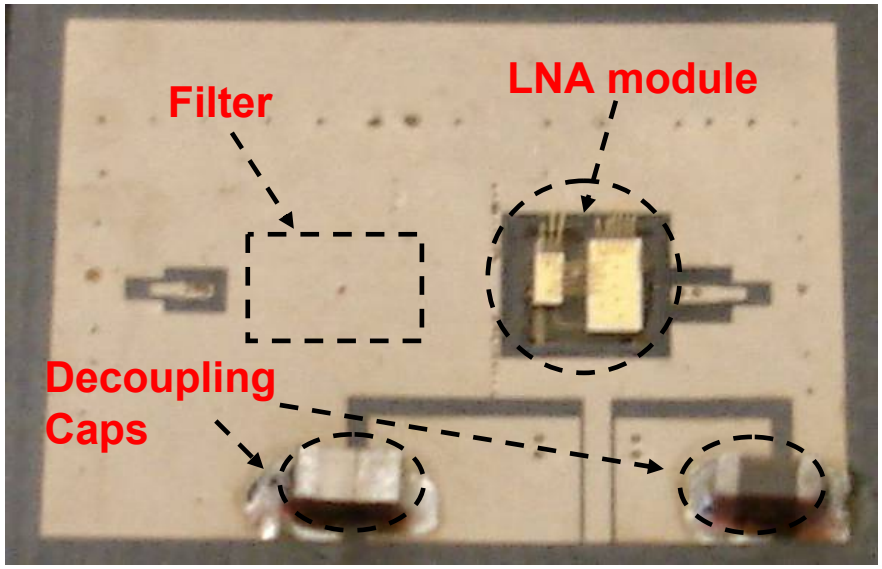




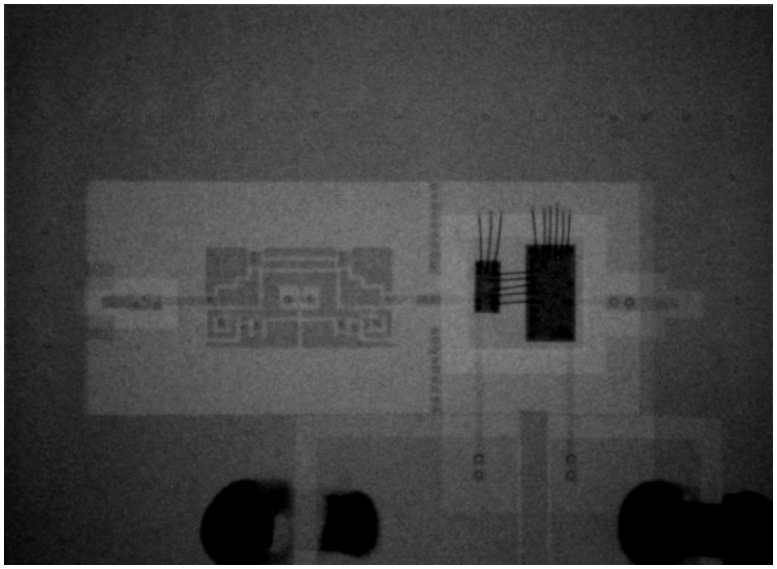
Material	Volume (mm^3)	Insertion Loss (dB)	Number of Layers	Dk	Df
FR-4	1.32 (2.2x3x0.2)	2.1	4	3	0.004
LTCC	2.72 (2.2x1.4x0.9)	1.7	4	7.8	0.001
LCP	12	1.6	4	2.9	0.002
BT	2.38 (2x1.7x0.7)	2.2	8	-	0.02
XL-200	**0.85** (3.5x4.6x0.05)	1.08	**2**	6.5	0.003

Small and high performance filter due to low loss and high Dk

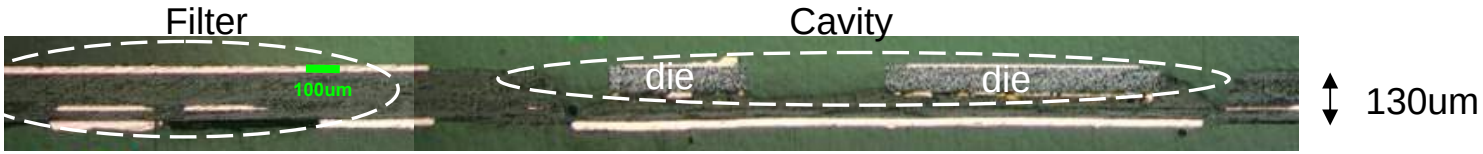
Receiver Module Fabrication



Top view of assembled module



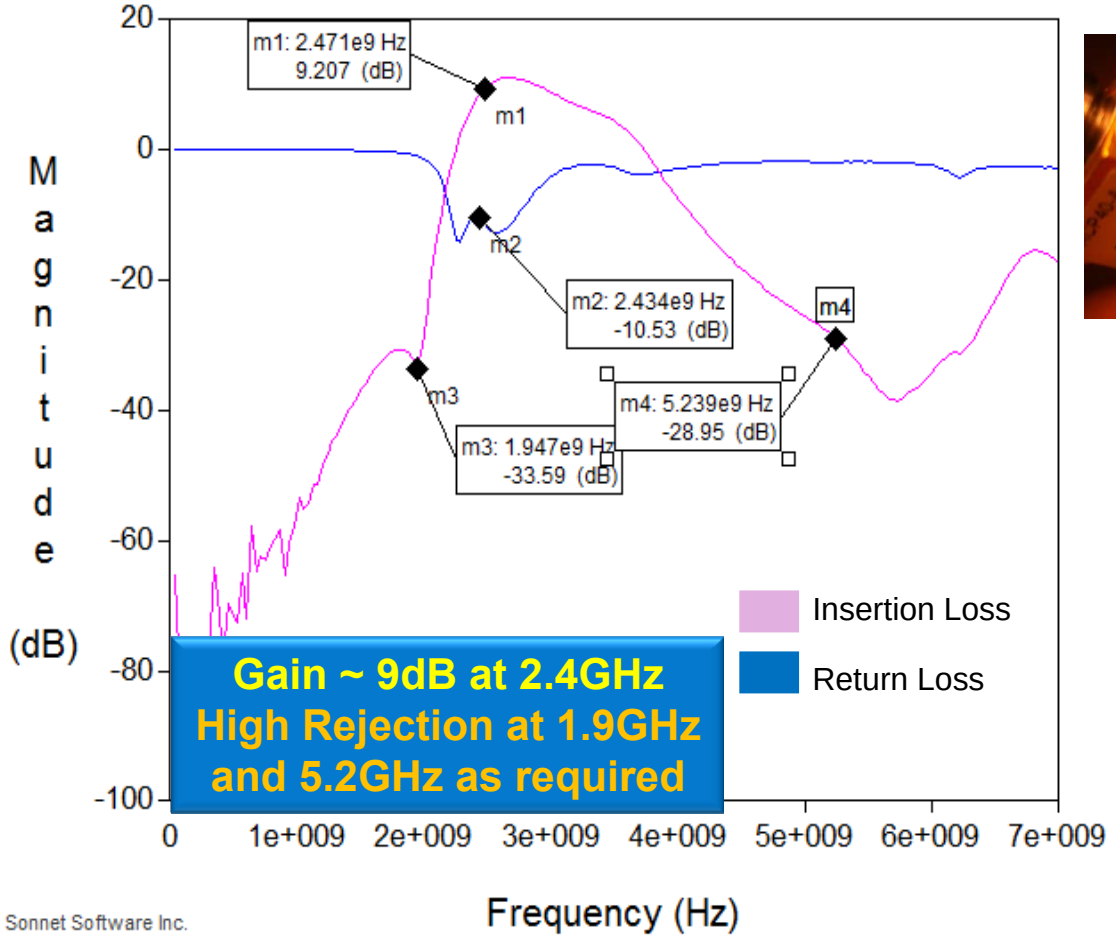
X-ray image of module

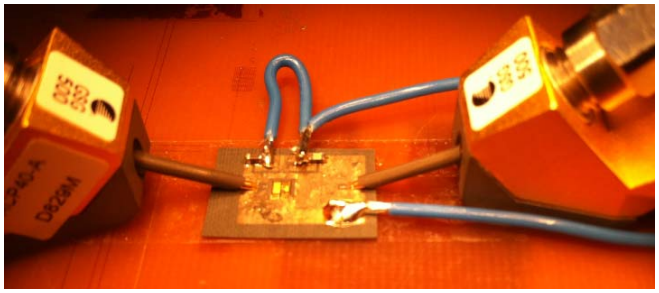


Cross-section of module

World's thinnest 130um receiver module

Receiver Module Response





- SOLT Calibration
- GSG 500um RF probes
- Supply: 3.3V, 14mA
- Vector Network Analyzer

Demonstration of 130um thin RF module with specification satisfied

Summary

Super-thin WLAN RF Receiver with embedded passives and chip-last embedded GaAs Actives has been demonstrated with XL-200 (high Dk)

- Reduced form factor
  - 130um World's thinnest 3D organic module
  - 5-10X volume reduction
- High RF performance
  - Gain: 9.2 dB
  - Out-of-band rejection: 34 dB
- Embedded passive substrate testability for selective site die embedding

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