

Overview

To ensure business continuity and enable high-volume supply-chain capability for all tin-lead (Sn/Pb) plating type products, Xilinx is qualifying Pre-Plated Lead-Frame (PPF) without solder plating process for QFP packages.

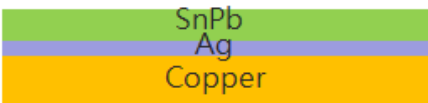

This additional lead-frame type will adhere to the same performance, quality and reliability specifications that apply to all product families, proven through extensive qualification and testing. As a result, there is no change in form, fit, function, or reliability with this lead-frame addition.

FAQs

Q1: What is the PPF lead-frame?

There are certain types of lead-frame widely used in the industry that have multiple layers of material plated onto the lead-frame such as pre-plated lead-frames (PPF). A three-layer lead-frame plating scheme comprising of nickel (Ni), palladium (Pd) and gold (Au) has been widely adopted in the market for over ten years as a green solution for semiconductor packaging (refer to [Table 1](#)). These three-layers are pre-plated onto the lead-frame at the lead-frame supplier before package assembly.

Table 1: The IC terminal plating for Ag and PPF Lead-Frame (L/F).

Item	Ag L/F	PPF
IC terminal plating		

Q2: Why is Xilinx making this change?

Xilinx assembly supplier will stop Sn/Pb solder plating process in Q1 CY2020. Therefore, Xilinx has changed the lead-frame from Ag L/F plating to PPF. This change ensures business continuity and enables high-volume supply-chain capabilities while the PPF can meet the restriction of hazardous substances in electrical and electronic equipment (RoHS) directive specification.

Q3: When will this change take effect?

This change will take effect in Q1 CY2020.

Q4: Which products are affected?

This change affects all speeds and temperature grades such as commercial / industrial “XC” and defense “XQ” of the device packages as defined in the tables below (Table 2, Table 3 and Table 4). Any associated specification control document (SCD) versions of the standard part numbers are also affected.

Table 2: Spartan-II and Spartan-3 FPGA QFP Device-Packages Affected

Device	Package-Pin	Device	Package-Pin	Device	Package-Pin
XC2S100	PQ208	XC3S100E	TQ144	XC3S400	PQ208
	TQ144		VQ100		TQ144
XC2S15	TQ144	XC3S200	PQ208	XC3S50	PQ208
	VQ100		TQ144		TQ144
XC2S150	PQ208		VQ100		VQ100
XC2S200	PQ208	XC3S200A	VQ100	XC3S500E	PQ208
XC2S30	TQ144	XC3S250E	VQ100	XC3S50A	TQ144
	VQ100		PQ208		VQ100
XC2S50	PQ208		TQ144	XC3S50AN	TQ144
	TQ144				

Table 3: CoolRunner-II CPLD QFP Device-Packages Affected

Device	Package-Pin	Device	Package-Pin	Device	Package-Pin
XC2C128	TQ144	XC95144XL	TQ100	XCR3032XL	VQ44
	VQ100		TQ144	XCR3064XL	VQ100
XC2C256	PQ208	XC95288XL	PQ208	XCR3128XL	VQ44
	TQ144		TQ144		TQ144
	VQ100	XC9536XL	VQ44	VQ100	
XC2C32A	VQ44		XCR3256XL	PQ208	
XC2C384	PQ208	XC9572XL	TQ100	XCR3384XL	TQ144
	TQ144		VQ44		PQ208
XC2C512	PQ208		VQ64	TQ144	
XC2C64A	VQ100		XCR3512XL	PQ208	
	VQ44				

Table 4: QPro PROM QFP Device-Package Affected

Device	Package-Pin
XQ17V16	VQ44

Q5: What is the different between the Ag plating and PPF L/F?

There is no difference between the Ag planting and PPF L/F in the SMT process (comparison result found in [Table 5](#)) The reflow profile can be found in [Table 6](#). Typically the Ag planting takes place at the assembly supplier while the PPF takes place at the lead-frame supplier.

For the component appearance, there are no differences for both L/Fs, except the PPF lead will appear brighter than the original lead since the PPF appear the metal sleek directly. (Refer to [Table 7](#) and [Table 8](#)).

Table 5: SMT comparison for Ag planting and PPF L/F.

SMT Process & MC capability suggest				
	Item	Suggest	Ag L/F	PPF L/F
Solder paste	1	Solder paste alloy type	SAC305;63Sn/37Pb	
	1	Stencil type (laser, etch, electroform..)	Laser+ electro-polish	
Printer/Stencil	2	Stencil opening	There are generally two types of calculations formulas, but needs to filling the outer end portion with solder on the outer leader (completely wet) to comply with the IPC-A-610E. Area Ratio: Area of Aperture open/ Aperture Wall Area=LW/2T(L+W) Area Ratio > 0.66 Aspect Ratio: Aperture With/ Stencil Thickness= W/T Aspect Ratio > 1.5	
	3	Printing pressure / speed	Depend on PCB	
	4	Cleaning stencil time auto / manual	Auto clean	
	5	Solder paste thickness	SPI check thickness (-0.01/+0.07mm)	
	6	Stencil opening size, pad / form	AOI check coverage	
	7	Machine capability	<+/-25um	
	Mounter	1	Vision alignment method, check lead / body form ...	Aligment lead pin
2		Mount force	0 distance from PCB	
3		Mount speed, slowly / fast	Slowly	
4		Machine capability	<+/-30um	
Reflow	1	Reflow profile condition, preheat time / peak temperature..	Depend on PCB & Component	
	2	Profile condition	<=Δ5°C	
	3	Nitrogen addition, Oxygen content? Ppm	500ppm~1500ppm	
	4	Machine capability	Accuracy 5°C, Heat Zone min 7 zone	

Table 6: SMT reflow suggestion profile.

Sn63/Pb37	Statistic Name	Set
Max Rising Slope	Tsmax	< 3°C
Max Falling Slope	Ramp-down	< 3°C
Preheat/Soak Time/ (120~160°C)	ts	60~120 sec
Melting/Liquidous Time/ (TL:Over 183°C)	tL	30~90 sec
Peak Temperature	Tp	220±10°C
Sn96.5/Ag3.0/Cu0.5	Statistic Name	Set
Max Rising Slope	Tsmax	< 3°C
Max Falling Slope	Ramp-down	< 3°C
Preheat/Soak Time (150~180°C)	ts	60~120 sec
Melting/Liquidous Time (TL:Over 217°C)	tL	60~90 sec
Peak Temperature	Tp	235~245°C

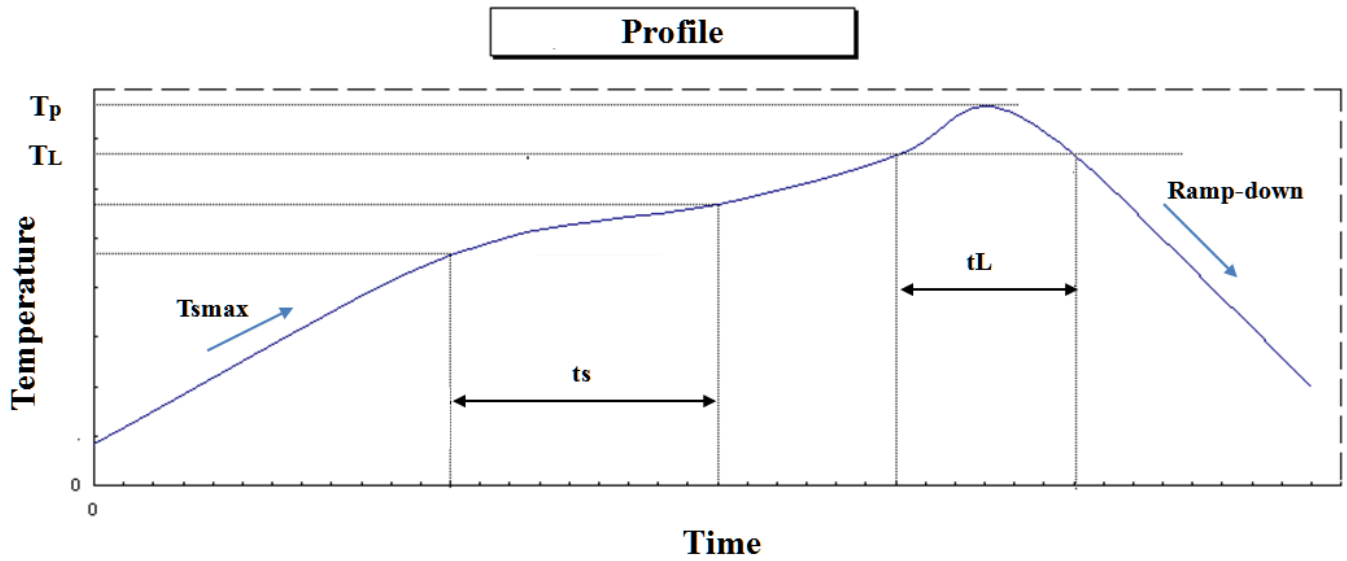
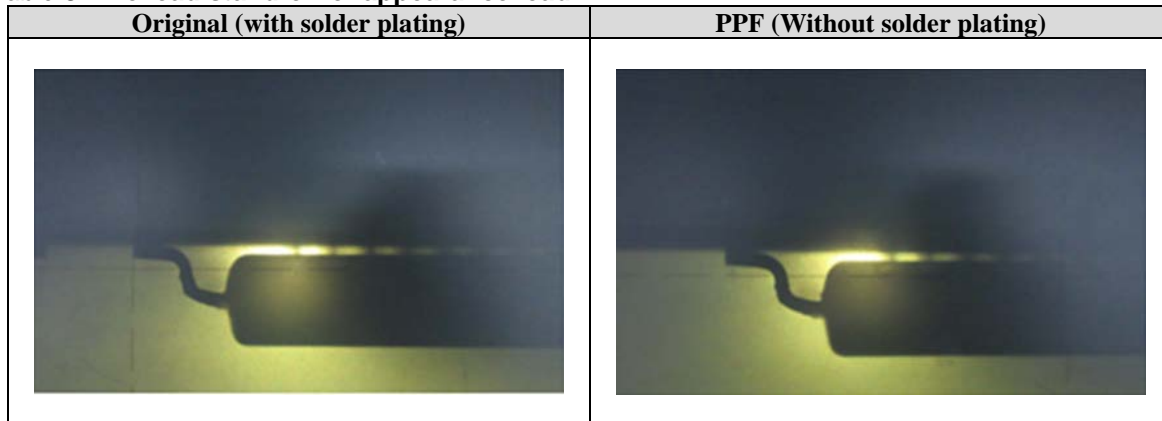


Table 7: The appearance for original and PPF lead.



Table 8: The lead stand-off of appearance lead.



Q6: How to check if solder fillet is good?

Based from IPC-A-610 “Acceptability of Electronic Assemblies” spec 8.2.5 Flat Ribbon, L and Gull Wing Leads definition, we can observe solder fillet performance. (Refer to [Table 9](#) and [Table 10](#)).

Table 9: Dimensional Criteria - Flat Ribbon, L and Gull Wing Leads

Feature	Dim.	Class 1	Class 2	Class 3
Maximum Side Overhang	A	50% (W) or 0.5 mm [0.02 in], whichever is less; Note 1		25% (W) or 0.5 mm [0.02 in], whichever is less; Note 1
Maximum Toe Overhang	B	Note 1		
Minimum End Joint Width	C	50% (W)		75% (W)
Minimum Side Joint Length	D	(1W) or 0.5 mm [0.02 in], whichever is less	3 (W) or 75% (L), whichever is longer	
			100% (L)	
Maximum Heel Fillet Height	E	Note 4		
Minimum Heel Fillet Height	F	Note 3	(G) + 50% (T) Note 5	(G) + (T) Note 5
Solder Thickness	G	Note 3		
Formed Foot Length	L	Note 2		
Lead Thickness	T	Note 2		
Lead Width	W	Note 2		

Note 1. Does not violate minimum electrical clearance.

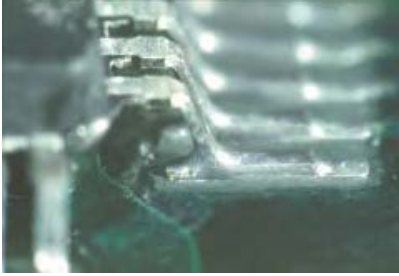
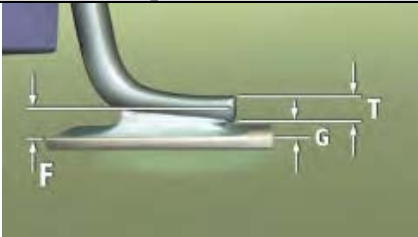
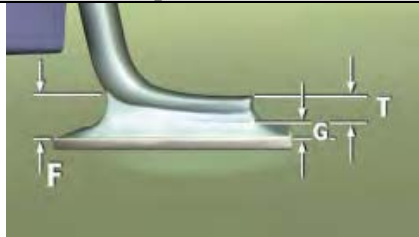
Note 2. Unspecified dimension, or variable in size as determined by design.

Note 3. Wetting is evident.

Note 4. See 8.2.5.5 Flat Ribbon, L, and Gull Wing Leads, Maximum Heel Fillet Height (E).

Note 5. In the case of a toe-down lead configuration, the minimum heel fillet height (F) extends at least to the mid-point of the outside lead bend.

Table 10: Target - Class 1,2,3

Acceptable - Class 1	Acceptable - Class 2	Acceptable - Class 3
 <p>A wetted fillet is evident.</p>	 <p>Minimum heel fillet height (F) is equal to solder thickness (G) plus 50% lead thickness (T) at connection side.</p>	 <p>Minimum heel fillet height (F) is equal to solder thickness (G) plus lead thickness (T) at connection side.</p>

Q7: What is the ability for the solder joint and the fatigue test?

For the solder-ability, PPF lead-frame also can meet solder coverage >95% for lead-free (245°C ±5°C, 5 sec) and eutectic (215°C ±5°C, 5 sec) type as the SPEC : J-STD-002 defined. (Refer to [Table 11](#)).

For the fatigue test, PPF can meet criteria (mass weight: 1.05 oz and >3 cycles without any lead broken or crack) as the SPEC : JESD-B105 defined. (Refer to [Table 12](#).)

For the Sn whisker, the PPF L/F does not have this phenomenon as the SPEC: JP002 defined which is different on Ag L/F. (Refer to [Table 13](#)).

Table 11: Solder-ability:

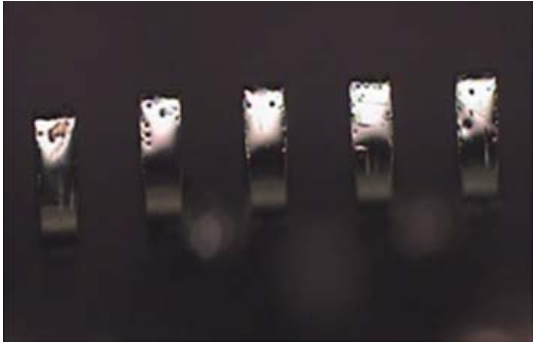
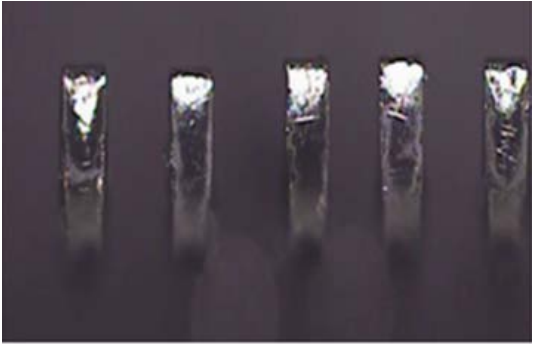
Item	PPF L/F	
	Eutectic (Sn63/Pb37)	Lead free (Sn96.5/Ag3.0/Cu0.5)
Soldering type		
Criteria	>95%	>95%
Result	PASS	PASS
Attached		

Table 12: Fatigue test:

Test item	Data	Cycle
Lead fatigue test (Mass weight:1.5oz)	Avg	0/10

Table 13: Sn whisker:

<p>JEDEC/IPC Joint Publication No. 002 Page 8</p> <p>5 Finish and substrate considerations and mitigation methods (cont'd)</p> <p>Other material sets and combinations can be considered if good technical arguments can be made regarding their effectiveness in the reduction of tin whiskers, and are backed up with tin whisker test data. The whisker test procedures used by the product supplier should also be specified.</p> <p>The industry continues to work on a test method designed to quickly indicate a deposit's susceptibility to whisker growth. Any mitigation practice should be used with the understanding that the responsibilities to verify the impact of potential whisker growth on a system's long term reliability is the end users, see JESD201.</p> <p>5.1 Non-tin plating</p> <p>Non-tin plating, such as Nickel/Palladium/Gold, Nickel/Gold or Nickel/Palladium, do not have Sn whisker problems and should be considered for lead-frame applications. This plating has more than a ten year history of field use, 1992-to present [29]. Non-tin plating, however, does have other potential issues, including adhesion to mold compounds that need to be evaluated prior to product conversion.</p>
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Revision History

The following table shows the revision history for this document:

Date	Version	Description of Revisions
10/29/2018	1.0	Initial release.

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