POTENTIAL FAILURE MODE AND EFFECTS ANALYSIS

LEAD FREE ASSEMBLY PROCESS FMEA

ALL ITEMS MAY NOT APPLY TO A PARTICULAR PART CONFIGURATION

Item No: Lead Free Solder Process	Process Responsibility: TURI Lead Free FMEA Group		FMEA No: FMEA0100	Page: 1/5
Core Team: TURI Lead Free Group	Issue Date: September 13, 2006	Revision: 9/13/06	Customer: Lead Free Process	

FMEA No / Process										Follow Up						
No	Failure Mode	Cl	Effect	Sev	Cause	Occ	Process Controls	Det	RPN	Planned Actions	Date	CAR	Sev	Occ	Det	RPN
Screen Printing																
002	Insufficient Pad Coverage per IPC-610 Rev D		Poor print (Insufficient height, Volume)	8	Incorrect aperture size on stencil/Stencil thickness/Equipment parameter print set up	6	AOI/Monitoring paste shelf life/Monitor Solder paste exposure time/Maintenance of the equipment/LSM paste measurements height, volume, Visual Inspection	5	240	Process Owner Specific			8	3	3	72
034	insufficient solder		Poor Print	8	improper precondition of paste/Paste sticking to stencil/Poor Print Parameters;	6	AOI/Monitoring paste shelf life/Monitor Solder paste exposure time/Maintenance of the equipment/LSM paste measurements: height, volume/visual inspection	5	240	Process owner specific			8	3	3	72
035	improper solder print dispensing		Poor print	7	paste problems: clogged tube/old paste/	5	AOI/Monitoring paste shelf life/Monitor Solder paste exposure time/Maintenance of the equipment/LSM paste measurements height, volume, visual Inspection	5	175	Process owner specific			7	3	2	42
Pick & Place																
004	components fail AOI system with lead free soldering. Balls not seen.		Component rejection (false rejection)	3	vision system not optimized for lead free	7	Optimize Machine for lead free soldering.	2	42	Process owner specific			3	1	2	6
Reflow																
023	Ceramic ball grid array solder joint failure/cracking		test failure/latent failures	8	CTE mismatch/Poor CBGA Design/	8	Review CBGA design/Reliability Qualification	9	576	Process Owner Specific			8	4	9	288
028	excess Intermetallic growth		weak solder joint/environmental failure	10	HASL/ Sn Plating with SnCu Ni barrier prevents excess IMC or electroimmersion sn, improper reflow profile	8	Material selection , nickel barrier between tin and copper, witness part analysis, proper reflow profile	10	800	Process Owner Specific			10	2	10	200

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006	solder voiding		CCA fails inspection/part does not work at customer site	8	incorrect profile and belt speed, trapped flux, especially in BGA bumps that melt during reflow, proper PCB surface.	8	Thermocouple boards and take profile Cpk measurements, proper flux and paste selection.	8	512	Process owner specific			8	3	8	192
032	via hole cracking		parts fail test or field failure	10	Excessive z-axis expansion, improper material due to excessive heat (30 deg C higher profile temperature) , Cu plating too thin.	8	Material selection profile, profile and process control, inspection training, IST testing	8	640	Process Owner Specific			10	3	5	150
029	z axis delamination		board fails test or in the field	10	Excessive z direction CTE incompatible, with Pb-Free reflow or wave process, rework process	8	material selections, profile and process control, witness piece inspection, IST testing	8	640	Process Owner Specific			10	3	5	150
016	lead frame damage		product fails test	8	CTE mismatch.	2	alloy 42 (preferred) versus copper	8	128	Process Owner Specific			8	2	8	128
015	Degradation of die attach conductive epoxy		Part fails ICT/Functional test or fails out in the field.	10	Improper Material selection and or processing.	8	RoHs compatible material selection, proper process and controls/witness first piece/acoustic	5	400	Process Owner Specific			10	3	3	90
046	Improper wetting criteria per IPC 610 Rev D		CCA fails test	10	reflow TAL, ramp rate or TMAX incorrect, wrong flux	8	Profile CCA and measure Cpk process capability, improve flux, proper inspection training	4	320	Process Owner Specific			10	2	4	80
018	popcorning		Part does not work during test	10	Improper storage moisture criteria, MSL level incorrect	8	Test per J-STD-020, proper controls	7	560	Process Owner Specific			10	2	4	80
025	solderability issue		poor wetting	8	board finish subject to oxidation and aging, insufficient solder, poor flux, aged parts	8	Proper stencil and/or profile, development and control of improved flux selection, part age control,	5	320	Process Owner Specific			8	3	3	72
013	Board Delamination		CCA fails /latent defect	8	Wrong laminate material used/excess reflow heat/Moisture in CCA/Improper board storage	7	Check board material properties (Td and Tg)/Proper Storage/Proper profile/Reflow Process Control/Inspection/ICT	10	560	Process owner specific.			8	2	4	64
033	foil attachment could peel much faster		Parts fail test	10	High Temperatures, poor material selection, improper board lamination.	7	proper material selection and lamination, witness first piece.	5	350	Process Owner Specific			10	2	3	60
021	ceramic capacitors, resistors cracking/open		test failure;	10	CTE mismatch issue	4	Reflow profile; flexi cap; modifying component location; fixture device; thicken PCB; power cycling	5	200	Process Owner Specific			10	2	3	60

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No	Failure Mode	Cl	Effect	Sev	Cause	Occ	Process Controls	Det	RPN	Planned Actions	Date	CAR	Sev	Occ	Det	RPN
026	poor solderability		solder joints not acceptable	10	2nd side reflow of board finish ages/ removes organics/degrades it/Ag oxidizes/	8	Audit proper handling instructions, proper storage and solderability finish selection and application	5	400	Process Owner Specific			10	2	3	60
027	Conductive Anodic Filament		part fails during ICT/functional test and in the field	10	improper material (bd material Td to low) / improper storage/ improper board material material/variability in raw material.	1	proper board processing/proper reflow/proper storage/proper raw material handling/process control monitoring (stress coupon testing/sample lot qual tests)	8	80	Process owner specific			10	2	3	60
040	tombstoning		solder touch up/excess rework	6	longer wetting time, poor reflow profiles, poor part storage	6	profile control, inspection if aged,AOI, Inspection training	5	180	Process Owner Specific			6	3	3	54
019	Degradation of Package/plastic melts		Parts fail during test	10	Improper material selection and/or processing.	8	RoHS compatible material selection, proper process and controls	5	400	Process Owner Specific			10	1	5	50
042	poor solder joint grain structure		Weak solder joint	10	reflow profile cooling too slow	6	thermocouple board and measure profile Cpk, witness piece analysis	10	600	Process Owner Specific			10	1	5	50
041	cracked solder joint		open	10	thermal shock/reflow profile cooling to fast	6	Adhere to design rules, proper reflow, correct material selection, inspection training, x-ray	5	300	Process Owner Specific			10	2	2	40
005	solder balls		Shorts	10	solder paste profile has a excessive ramp rate, aperture size, solder paste properties properties not proper, use of no clean, poor stencil apertures	8	Use a cleanable flux and clean, proper reflow profile and pad design, stencil aperture modifications, proper inspection training, AOI Inspection	5	400	Process owner specific			10	2	2	40
020	reduced BGA solder wetting/voiding		opens	10	TAL not long enough, poor reflow profile development, poor paste flux selection	8	reflow profile development proper paste and flux selection, x-ray	9	720	Process Owner Specific			10	2	2	40
030	Solder mask failures such as blistering, delamination of solder mask, delamination from main laminate itself.		CCA fails inspection	4	Poor mask selection for lead free, poor mask processing, improper profile,	7	proper mask selection and laminator controls, proper profile, inspection	8	224	Process Owner Specific			4	3	3	36
007	cold solder joints		parts fail inspection/parts fail during test/latent defect	8	solder profile incorrect/flux inadequate.	7	Right solder paste/ proper flux/train inspectors/ proper profiling/lead finish condition/solderability test/wetting balance (J-STD-002)	5	280	Process owner specific			8	2	2	32

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037	parts fail IPC-610 wetting criteria/dewetting/non wetting		CCA fails inspection	8	Incorrect stencil aperture Size and design/board surface finish chosen, poor flux chemistry, poor material handling storage, aged parts	8	Stencil and /or profile development and control, improved flux selection, part age control	4	256	Process Owner Specific			8	2	2	32
043	pinholes		rework	4	flux trapped in solder and then is released leaving pin holes	7	proper paste selection and reflow profile control	5	140	Process Owner Specific			4	2	4	32
022	laminate module thermal degradation		parts experience failure during test	8	Wrong laminate substrate used, poor storage conditions, excessive heat during reflow, wrong module component chosen	8	Proper Tg and Td material, proper storage and reflow processing, inspection training, witness piece analysis, select proper module component	8	512	Process Owner Specific			8	2	2	32
039	Board Warpage		weak/poor solder joints/board does not fit in unit/open circuit	7	Wrong laminate material used/poor board design/Improper reflow profile	8	Fixturing/Redesign/Test/Improper profiling/Reflow process control	1	56	Process Owner Specific			7	2	1	14
Clean																
011	Pb Free flux residue difficult to clean.		ICT Test failures, field failures	10	reflow bakes flux residue	8	flux and solder profile analysis, materials selection, cleaning process improvements.	5	400	Process Owner Specific			10	3	5	150
Selective Soldering																
044	fillet lifting		open	9	solder shrinks more	5	proper profiles and solder selection, inspector training and certification	5	225	Process Owner Specific			9	3	3	81
045	tearing		part fails inspection, test failure, multiple retests	6	Shrinkage issue with wavesolder/solective soldering	5	proper profiles and controls	5	150	Process Owner Specific			6	2	2	24
ICT																
047	Flux residue difficult to pin probe.		fails test, multiple retests	4	improper flux chemistry or reflow profile	9	proper reflow profile, proper flux and paste selection	1	36	Process Owner Specific			4	3	1	12
Rework																
053	cracked end caps on discrete components		latent defect/intermittent or full open circuit.	8	Excessive thermal gradient due to lead free rework.	6	nitrogen/hot air convection rework machine/uniform heating/hot plate/operator training/military grade discrete	8	384	Process Owner Specific			8	2	8	128
052	Lifted pads		Inspection defect/Open Circuit/Field Failure	8	Excessive heat applied for lead free rework.	8	Nitrogen or hot air rework machine/operator training/hot plate/	5	320	Process Owner Specific			8	1	5	40

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Field Failures																
048	Open Circuit		Product does not work	10	Over time the SnAgCu diffuses into the Sn causing SnCu3 Intermetallic layer. Also occurs with high current applied causing electromigration.	8	Prevent if appropriate by adding zinc to solder.	10	800	Process Owner Specific			10	4	10	400
017	short in the field		product fails in the field.	10	tin Whiskering, poor material selection.	9	proper component solderability finishes/Add a nickel barrier	10	900	Process Owner Specific- Tin Whisker Mitigation Plan required with high rel electronics.			10	3	10	300