

# Camptech II Circuits - Manufacturing Process Control Plan

Process / Operation Description	Machine Device Sig. Tool	Characteristics			Methods				Reaction Plan & Corrective Action	
		No.	Product	Process	Product/Process Specification Tolerance	Evaluation/ Measurement Tech.	Sampling			Control Method
							Sample Size	Frequency		
Material receiving			Material ordered	- Visual inspection - Verify against purchase order	Packaging condition, total quantity, documentation, follow Receiving Process No missing / shortage / extra quantity / damages allowed.	Visual inspection	5%	All orders	Sign packing slip. Receiving log.	Inform supplier, determine if product can be used or needs to be returned to supplier. QOP-83-01 Control of Nonconforming Product. Quarantine the part if necessary.
Incoming Inspection		1	Copper clad laminate	Visual inspection	- Purchase Order - Surface integrity - Thickness - Copper weight - Panel size	- Micrometer - Electrometer - Tape measure	1 sample	Each batch	Sign packing slip. Receiving log.	Inform supplier, determine if product can be used or needs to be returned to supplier. QOP-83-01 Control of Nonconforming Product. Quarantine the part if necessary.
		2	Prepeg	Visual inspection	- Purchase Order - Surface integrity - Expiry date - Product label information	Visual inspection	1 sample	Each batch	Sign packing slip. Receiving log.	Inform supplier, determine if product can be used or needs to be returned to supplier. QOP-83-01 Control of Nonconforming Product. Quarantine the part if necessary.
		3	Dry film	Visual inspection	- Purchase order - Expiry date - Product labels	Visual inspection	1 sample	Every box	Sign packing slip. Receiving log.	Inform supplier, determine if product can be used or needs to be returned to supplier. QOP-83-01 Control of Nonconforming Product. Quarantine the part if necessary.
		4	Chemicals, solder bars	Visual inspection	- Purchase Order - Expiry date - Product labels	Visual inspection		Every container	Sign packing slip. Receiving log.	Inform supplier, determine if product can be used or needs to be returned to supplier. QOP-83-01 Control of Nonconforming Product. Quarantine the part if necessary.
		5	Solder mask and silk screen inks	Visual inspection	- Purchase Order - Expiry date - Appearance	Visual inspection	1 sample	Every pack	Sign packing slip. Receiving log.	Inform supplier, determine if product can be used or needs to be returned to supplier. QOP-83-01 Control of Nonconforming Product. Quarantine the part if necessary.
Order Processing		1	Order entry	- Order review - Order entry - Customer file verification	- Order review - Customer file verification	- Check revision of supplied files - Confirmation with customer		Every order	Order processing process	Inform customer
Engineering/Planning Artwork		1	Customer supplied information	- Review of customer files, artwork, drawings, special instructions	- Production file versions	- Check revision of supplied files - Confirmation with customer		Every order	Production work order	Inform sales dept.
			CAM report generation	Pentalogix software				Every order		
			Gerber file panelization	- Engineering - Customer file approval	Customer requirements			Every order		Redo. Receive updated files
			Artwork generation: - silkscreen - solder mask - copper layer	Engineering	Customer requirements			Every order		Redo. Receive updated files
			Drill data sheet	Engineering				Every order		Redo. Receive updated files
			Program generation	Engineering		Drill template		Every order		Redo. Receive updated files
Material Preparation & Release		1	Copper clad laminate thickness	Measurement	Production work order	Micrometer	100%		Production work order	Recheck & reject
			Copper thickness	Measurement	Production work order	Electrometer			Production work order	Recheck & reject
			Shearing/pre-cut	Work instruction	Production work order	Material type, thickness, panel size			Production work order	Recheck & reject

## Camptech II Circuits - Manufacturing Process Control Plan

Process / Operation Description	Machine Device Sig. Tool	Characteristics			Methods				Reaction Plan & Corrective Action	
		No.	Product	Process	Product/Process Specification Tolerance	Evaluation/ Measurement Tech.	Sampling			Control Method
							Sample Size	Frequency		
Drilling	Excellon EX300	1	Machine set-up	Prepare drills	- Drilling data sheet - Check for: 1) Misregistration 2) Extra, missing or miss located holes 3) Measure drills 4) Incomplete drilled holes	- Drilling data sheet - Pin gauge	First off	Each batch	First off on Product work order	Machine adjustment
				Program selection						Correct program selection
Desmear & Etchback	Tanks, heaters, timer, racks and agitation motor, rectifier	1		Work instructions	Check that holes are black	Visual inspection	2-3 boards	Each batch	Visual inspection	Repeat process
Deburring	Chemcut Deburring Machine	1	Deburred panels	Deburring process Worki instruction - WI-09	Check for burrs and plugs	Visual inspection	100%	100%	Visual inspection	Plugged holes are cleaned with drills.
Direct Metallization (DMS-E)	Tanks, heaters, timers, racks, agitation motor and rails, mixer, filter pump, oven	1		Work instruction	Check for voids, residue	- Visual inspection - Copper flashed	2-3 boards	Each batch	Sign off on Production work order	Rejected board are run through this process again.
				Oven dry						
				Copper flash						
				Pumice scrubbing						
Dry film	ISC 650 Laminator Dupont LC-2400 Laminator	1	Laminated sheets	Laminating Work Instruction	Bubbling, film lifting	Visual inspection	100%	100%	- Temperature: 110 °C - Speed: 1.2-1.35 m/min - Pressure: 40-60 PSI	Panels are stripped of film, cleaned and re-laminated.
Exposing		1	Exposed copper	Clean artwork, examine for nicks, cuts, opens, shorts, excessive touch-up, misregistration, breakout	- Completeness of film package - Film alignment - Revision of films	Visual inspection	100%	100%	QC First off on Product work order	Repeat process
Black Oxide	Various tanks, heaters, racks and HP 24 dryer	1		Work instructions	Check for evenness of oxide	Visual inspection	100%	100%	Sign off on Production work order	Repeat process
Punch Location Holes	Multiline Technology Punch Press	1		Punch tooling holes Work Instruction	Check location and quantity	Visual inspection	Every panel	Every panel	Visual inspection	
Developing	IS Procex Aqueous Developer			Work instructions	Check for: 1) missing traces or pads 2) reduced spacing, trace widths 3) shorts, nick, cuts, pinholes 4) registration 5) dry film residue	Visual inspection	Every panel	Every panel	Visual inspection	Repeat process - pass through developer at a faster speed.
Pumice Scrubbing	Pumex SHD-2000	1	Scrubbed panels	Pumice scrubbing	Surface must be clean and free of oxidation	Visual inspection	100%	100%	Visual inspection	Re-clean
Direct Metallization (DMS-E)	Tanks, heaters, timers, racks, agitation motor and rails, mixer, filter pump, oven	1		Work instructions - Oven dry - Copper flash	Check for voids, residue	Visual inspection	100%	100%	Sign off on Production work order	Rejected board are run through this process again.
				Pumice scrubbing						

## Camptech II Circuits - Manufacturing Process Control Plan

Process / Operation Description	Machine Device Sig. Tool	Characteristics			Methods				Reaction Plan & Corrective Action	
		No.	Product	Process	Product/Process Specification Tolerance	Evaluation/ Measurement Tech.	Sampling			Control Method
							Sample Size	Frequency		
<b>Copper &amp; tin plating</b>	Tanks, heaters, timers, racks, agitation motor, rails, rectifier and filter	1		Work instructions	Using pin gauges, a minimum of 3 holes checked for hole size before and after plating. Check for plating uniformity. No burnt copper or excessively high spots. No voids in holes.	- Visual inspection - Caviderm	2-3 boards	Each batch	Sign off on Production work order	Repeat process
<b>Strip Resist</b>	Tanks, trays, racks, IS developing machine and glass heater	1		Work instructions	Layers and boards must be free of dry film resist	-Visual inspection	100%	100%	Sign off on Production work order	Repeat process
<b>Etching</b>	Atotech 547XL	1		Work instructions	Check for copper residue	Visual inspection	100%	100%	First off Sign off on Production work order	Repeat process - pass through machine at a faster speed.
<b>Baking</b>	Various ovens	1		Work instruction - WI-20	Temp and time requirements specified in work instructions		100%	100%	Sign off on Production work order	
<b>Stripe Matte Tin</b>	Chemcut Developing System	1		Work instructions	Check board surface for matte-tin residue and cleanliness	Visual inspection	100%	100%	Sign off on Production work order	If board is not free of matte-tin, pass through the machine again at faster speed.
				Pumice scrubbing	Check board cleanliness	Visual inspection	100%	100%		
<b>Solder mask Screening</b>	Pumex SHD-2000, Pako Auto-Printer, ATMA stencil machine.	1		Pumice scrubbing	Check board cleanliness	Visual inspection	2-3 boards	Each batch	First off verification	
		1		Solder mask application. Apply photoimageable mask on board surface. Work instruction - WI-18	Check for: 1) Solder mask in holes 2) Correct registration 3) solder mask color 4) Smooth surface and cleanliness 5) Fingerprints	Visual inspection			First off verification	
	Thermo-Matic 2.0 oven	1		Tack dry Work instruction - WI-18		Visual inspection			First off verification	Strip the solder mask (if applicable) and repeat process
		2		Exposing Work instruction - WI-12		Visual inspection			First off verification	
		3		- Curing - Correct oven temperature and baking time. - Work instruction - WI-20		Visual inspection			First off verification	
<b>Hot Air Solder Leveling</b>		1		Pumice scrubbing	Check board cleanliness	Visual inspection	100%	100%		
	CEL Flux Coater	2		Apply tape. Work instruction - WI-24	Tape must not encroach onto the pads, holes or any other circuit features that requires a solder finish.	Visual inspection	100%	100%	Sign off on Production work order	
		3		Flux coating. Pass through the CEL Flux Coater, one panel at a time Work instruction - WI-24		Visual inspection	100%	100%	First off verification	

# Camptech II Circuits - Manufacturing Process Control Plan

Process / Operation Description	Machine Device Sig. Tool	Characteristics			Methods				Reaction Plan & Corrective Action	
		No.	Product	Process	Product/Process Specification Tolerance	Evaluation/ Measurement Tech.	Sampling			Control Method
							Sample Size	Frequency		
	Lantronic HASL machine	4		Solder levelling	Check for: 1) Reduced spacing 2) Solder nodules 3) Plugged or reduced hole size 4) Excessive solder on surface mount pads 5) Incomplete coverage of surface copper 6) Black holes 7) Dewetting 8) Granular solder 9) Delamination, measing or blistering of base material 10) Blistering or discoloration of the solder mask 11) Blow holes (check for low copper) 12) Solder on gold tips	Visual inspection	100%	100%	First off verification	Panels are baked, fluxed and Re-HASLed.
	IS Cleaning Machine	5		Cleaning	Panels should not appear oily	Visual inspection	100%	100%	Sign off on Production work order	
<b>Silk Screen Printing</b>	ATMA stencil machine	1	Silk screen appearance	Work instructions	Check for: 1) misregistration 2) colour of ink 3) idents on circuit pads 4) legible sharp image 5) skips or dry spots 6) correct date code and UL logo	Visual inspection	100%	100%	First off verification	
	Colight UV 24	2	Silk screen appearance	Bake Work instruction - WI-18	No flaking or lifting of idents when tape is applied & then lifted	Tape test, Visual inspection	100%	100%	First off verification	Silk screen is removed by a solvent, panels are cleaned and then re-screened.
<b>Scoring</b>	Accu Score AS-200	1	Set-up	- Load program - Tool pin/hole alignment	Make sure that: - the correct program is loaded - the panel orientation in the machine is correct	Visual inspection	1 panel	Every order	First off verification	
	Caliper	2	Dimensions	Work instruction - WI-36	- Location & depth of scoring - dimensions & shape - no missing or extra scoring lines	Caliper, Visual Inspection	5%	Every order	First off verification	Re-program the machine, check cutter/ bits
<b>Routing</b>	Excellon Mark VI	1	Set-up	- Load program - Tool pin/hole alignment Work instruction - WI-36	- Length and width of board - dimensions of cut-out - all required cut-outs have been made	Caliper, Visual Inspection	1 panel	Every order	First off verification	
	Caliper	2	Dimensions	Work instruction - WI-36	- Length and width of board - dimensions of cut-out - all required cut-outs have been made	Caliper, Visual Inspection	5%	Every order	First off verification	Re-program the machine, check cutter/ bits
<b>Final Cleaning</b>	Complex Wash Conveyorized Chamber	1	Appearance	Wash. Work instruction - WI-28	No soap residue and Routing debris	Visual inspection	100%	100%	Sign off on Production work order	Re-clean. If necessary check machine & cleaning solution
	Grieve Oven	2		Oven dry	200-F min. for 5-10 minutes				Sign off on Production work order	Re-clean. If necessary check machine & cleaning solution
<b>Electrical testing</b>	TTI Bare Board Testers	1		Leakage test voltage	150 - 200 volts	Tester	100%	100%	Sign off on Production work order	Notify supervisor
				Isolation resistance test	5 Mohms	Tester	100%	100%		
				Continuity resistance test	10 ohms	Tester	100%	100%		
		1		Check that board rev. matches, job card and drawing	A match of rev. # across all documents	Visual inspection				Rework or scrap
	Micrometer	2		Measure the PCB over the copper and compare it to the job card and drawing		Micrometer				Identify & locate failure, fix & re-test.

# Camptech II Circuits - Manufacturing Process Control Plan

Process / Operation Description	Machine Device Sig. Tool	Characteristics			Methods				Reaction Plan & Corrective Action						
		No.	Product	Process	Product/Process Specification Tolerance	Evaluation/ Measurement Tech.	Sampling			Control Method					
							Sample Size	Frequency							
Final Inspection		3	Appearance & surface	Check solder mask color & type	Customer order	Visual inspection	100%	100%	Sign off on Production work order						
		4		Check finish of copper under the solder mask	Customer order	Visual inspection									
		5		Check silk screen color, type and both sides of the board, pass tape test	Customer order	Visual inspection									
		6		Check panelization	Matches customer order	Visual inspection									
	Pin gauge	7		Check hole sizes	Are within tolerances	Pin gauge									
		8		Check all required in-process inspection points on production work order	Have been performed & passed	Visual inspection									
	Caliper	9		Check profile, slot and cut-outs	Are within tolerances	Caliper				Repair if possible.					
	Granite table	10		Bow and twist of boards	Are within tolerances	Granite table									
		11		Check for special requirements by customer	Customer order	Visual inspection									
		12		Check angular ring	Sufficient annular ring per IPC standards	Visual inspection									
		13		Check for cosmetic appearance, surface imperfection, markings, solderability	No dirt, foreign matter, fingerprint, burrs, nicks, flux residue, extraneous copper, plating in non-plated through holes, blurred silkscreen, etc. Date code, UL and manufacturer's logo per customer's master drawing or requirements. Boards exhibit good wetting of solder on the surface and in the solder coated holes. No separation or other forms of degradation of the conductive pattern.	Visual inspection									
	Pack & Ship			1	Include following reports: - C of C - Test Report - Final Audit Report - Microsection Report	Count				- Production work order - Ship per customer specifications	Calculation	100%	100%	Sign off on Production work order	Notify supervisor
		Packing				Visual inspection					100%	100%	Notify supervisor		
Labelling		Visual inspection	100%			100%	Notify supervisor								
Box		Visual inspection	100%			100%	Notify supervisor								