

	Process Description	Industry Standard	Saturn Electronics PCB	PCB Supplier 2	Top Score
1.	Copper Laminate (base material)	Standard sheet sizes that are sheared to size in-house.	Standard panel sizes with saw-cut edges. This significantly reduces contamination in subsequent processes (e.g., imaging, testing, etc.)		
2.	Drilling	Drilling machine that requires tools to be changed manually. Maximum panel sizes are typically 18" x 24".	Saturn's lowest-end drilling machines are Excellon Mark VI CNC drillers with Tool Management System (TMS). TMS allows an operator to load all tools at once into a cartridge, with the machine doing the rest of the work.  Saturn also has two Excellon Century 2001 drilling machines. These machines are equipped with larger tables sizes that enable us to drill panels up to 20" x 28". This will reduce handling per piece in subsequent processes.  Also, these machines are equipped with automatic measurement systems that measure drill bit length, diameter, spindle runout, and broken drill bit detection. Essentially, these capabilities remove the human element from these drilling issues, thereby minimizing the chance of operator error.		
3.	Image Room	Enclosed room.	Saturn has a Class 10,000 Clean Room.  The environment in this room minimizes foreign material from creating common shorts in the imaging process. Also, strict temperature and humidity controls prevent distortion in the customer artwork.		
4.	Imaging / Exposure	Customer artwork is aligned manually by eyeballing the registration of the film to the drilled panel.	Saturn is in the process of retro-fitting its exposures with MultiLine drawers. MultiLine tooling removes the human factor involved in lining up the bottom film to the top film. This should result in significantly reduced off-registration issues once they are fully implemented.		
5.	Plating Through Holes (PTH)	Manual dip tanks.	Saturn employs two automatic electro-plating lines and, as such, PTH is a two-step process.  First, the boards are passed through a Shadow line that places a fine layer of conductive material on the inside wall of each hole, which allows copper plating to occur. Saturn adjusts the conveyor rate based on an internal guideline to account for variations in hole sizes. This ensures that all holes are adequately plated.  Saturn has built a custom automatic plating line that has been designed and constructed primarily in-house. The intent was to minimize plating variation,		

			<p>which is the main goal of production plating. This was accomplished by including the following:</p> <p>It houses racks that only allow panels to be plated one-high.</p> <p>Anode-to-anode distance is 28 inches (maximum allowable distance for plating).</p> <p>Water-submerged positive cathode contact.</p> <p>Chemical-submerged anode bars for positive contact.</p> <p>Eductor system. This utilizes a high-volume chemical flow parallel to the panels instead of air to accomplish chemical agitation.</p> <p>Mechanical agitation to allow chemical to flow through holes.</p> <p>Dual-sided rectification to equalize copper plating from one side of the rack to the other.</p> <p>State-of-the-art rectifiers (two per rack) with 0.5% maximum ripple effect.</p> <p>Panels are now being plated at 17 amps per square feet (ASF), versus an industry standard of 30 ASF. This will result in more uniform plating, albeit lowered production.</p> <p>High ductile plating process that meets Delphi C7000 specs for 1,000 hour cycle tests.</p>		
6.	Strip-Etch-Strip	Conveyorized line that is capable of producing 7 mil line/spacing.	Saturn has combined all three steps into one conveyorized line. Saturn is capable of producing 5 mil line/spacing in production quantities.		
7.	Cleaning prior to LPI	Manual dip tanks or small conveyorized chemical cleaning line.	Instead of using a chemical cleaning process that may increase ionic contamination and compromise the surface finish, Saturn utilizes a Pumice Scrubber to clean boards prior to LPI. This process uses a volcanic ash mixture and soft nylon brushes to remove copper oxidation.		
8.	Liquid Photo-Imageable Soldermask	Manual tables or AutoRoll machines.	Saturn has purchased 6 DP-model LPI applicators to be used in lieu of AutoRoll soldermask applicators. This will result in less soldermask within holes and eliminates dimple marks on the board surface.		
9.	LPI Image	Customer artwork is aligned manually by eyeballing the registration of the film to the drilled panel.	Saturn is in the process of retro-fitting its exposures with MultiLine drawers. MultiLine tooling removes the human factor involved in lining up the bottom film to the top film. This should result in significantly reduced off-registration issues once they are fully implemented.		

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10.	LPI Developing	Standard conveyor that is separated from baking and cleaning lines.	<p>Saturn has conveyORIZED the developing, final baking, and cleaning processes into a single production line. This should improve quality through reduced handling and utilizing higher-end machinery.</p> <p>Our developing line is constructed of a single-chamber, stainless steel developing line.</p>		
11.	Final Baking	Manual conventional ovens (usually Grieve model).	Saturn has installed a Bassi Tunnel oven to perform final baking. Since heat is uniformly applied to the boards and the machine controls the cycle time, quality is improved dramatically.		
12.	Cleaning	Manual dip tanks.	Saturn has a Chemcut XL547 conveyORIZED cleaning line. XL547 model is the latest Chemcut equipment line.		
13.	Hot Air Solder Leveling (HASL)	Vertical HASL.	Saturn has both vertical and horizontal HASL processes. The horizontal HASL allows Saturn to offer fine pitch SMT, even tin-lead thickness, and a flatter finish.		
14.	HASL Post-cleaner	LPI Cleaning line is also used as a post-cleaner.	<p>Saturn has custom fabricated a high-pressure, high-temperature post-cleaner for use after the HASL process.</p> <p>This is a stainless steel post-cleaner unit that runs at 150°F, sprays regular and D.I. water at 1 to 1.5 gallons per minute at 50 psi using 7.5 HP pumps (1/2 gallon per minute, 20-30 p.s.i., 1.5 HP is the best available on the market). Furthermore, the cleaner uses 8-1" wide toothbrush-type agitating brushes versus an industry best of 4-0.5" brushes. This custom process has been proven to remove ionic contamination from the surface of PCBs to well below industry standards.</p>		
15.	Inspection	Visual inspection by personnel using a light table.	Saturn augments its visual inspection process by utilizing visual inspection equipment. This equipment (hole checker) checks for holes that have been plugged by the HASL and LPI processes, incorrectly plated or non-plated holes, and drilled with incorrect drill bit sizes.		
16.	Electrical Testing	Either clam shell tester or single flying probe.	<p>Saturn offers a variety of testing alternatives.</p> <p>First, Saturn has 3 Mania double-sided testing machines and 3 single-sided testing machines.</p> <p>The fixture cost for these testers is half the cost or</p>		

			less than those used in more traditional clam shell testers. Also, Saturn utilizes two flying probe testers for smaller and prototype orders. This allows the customer to forego the cost of a hard testing fixture and, instead, pay a modest testing fee.		
17.	Cleaning after Routing	Washer using city water.	Saturn has installed a washer in its shipping department that uses de-ionized (D.I.) water to clean the boards. D.I. water results in a cleaner board, but more importantly it further removes ionic contamination that may have occurred after HASL.		
18.	Duplicate Processes	Due to cost constraints, many PCB shops will not have duplicate processes.	All of Saturn's processes incorporate duplicate equipment so that in the case of an equipment failure, Saturn's production capabilities will not be compromised.  Furthermore, Saturn has controlling interests in four other PCB facilities so that in the event of a catastrophic event, the supply chain will not be compromised.		
19.	Minimum Hole Size	.015"	.008"		
20.	Minimum Line/Spacing	.007" / .007"	.005" / .005"		
21.	Surface Finishes	HASL	HASL, OSP, Immersion Silver		
22.	Quality Certification	No Certification is viewed as standard	ISO 9000, QS9000, High Reliability Certified		
23.	Financial Liabilities	No standards available	\$0 Bank Debt, \$0 Accounts Payable, \$0 Lease Obligations		



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