ROBOTIC
PRINTED CIRCUIT BOARD
ASSEMBLY LINE

MET 415
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1. BARE PCBs
2. SOLDER PASTE
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BLANK PCB LOADING STATION
Bare printed circuit boards arrive at the factory pre-loaded in cartridges. Fanuc robot lifts the board cartridge and places it onto a Kiva driven floor truck. The destination of the floor truck is the assembly line. The Kiva robot is programmed to this location.
Another view: Bare printed circuit boards arrive at the factory pre-loaded in cartridges. Fanuc robot lifts the board cartridge and places it onto a Kiva driven floor truck.
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KIVA DRIVEN FLOOR TRUCK
The floor truck is a cart consisting of a Kiva style robot and an automated board loader. View on left is Kiva robot, cart and board loader. The board loader can both load and unload bare PCBs or fully assembled PCBs in and out of the cartridge.

View on right is fully loaded truck ready for travel to the PCB assembly line.
Another view: Left: cart without the Kiva robot. The Kiva robot engages underneath the cart forming a truck. Right: Empty PCB holding cartridge.
Another view: Cart assembled with loader and PCB cartridge. Waiting for Kiva pickup and delivery to destination.
Kiva style robot. Will travel programmed floor route. Robot performs mule tasks moving PCB trucks to and from the assembly line. The Kiva needs to dock and recharge when its battery begins to run low.
Battery powered PCB loader, an elevator for the Insertion and removal of PCBs to and from the PCB cartridge.
Automated plates extend and retract moving PCBs in and out when required.
Another view:
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When the Kiva Truck docks with the Assembly Line, a PCB loading / unloading program is activated. The PCB loader has extracted a bare board from its rack and has placed it onto moving conveyor belt. A technician monitors the activity.
The bare PCB moves along the conveyer belt it is approaching a sensor driven board loading fixture (one at each workcell). The front two sensors (spring switches) detect when the board is on top, this makes the front locking gate recess, allowing for continued PCB movement onto the holding fixture. On the sides of the fixture are moving rollers to guide the board along the fixture and stop when the board is in the desired position.
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The bare PCB moves along the conveyor belt as it approaches a sensor-driven board loading fixture (one at each workcell). The front two sensors (spring switches) detect when the board is on top, causing the front locking gate to recess, allowing for continued PCB movement onto the holding fixture. On the sides of the fixture are moving rollers to guide the board along the fixture and stop when the board is in the desired position.
Once the PCB has covered the leading front switches and the trailing two switches, it is in the desired position. The rear gate raises locking the board in position, and the rollers temporarily turn off. At this time the solder paste program begins. When the board is fully pasted, a fixture release program will commence.
The solder paste dispenser is a robot that travels along a programmed XYZ axis. Its function is to apply .002-.003” thick solder paste in each position an IC device lead will sit. Unlike a traditional wave solder, this machine only applies solder to the top-side of the PCB. When the board is fully pasted, the dispenser head will retract and a fixture release program will begin.
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Solder paste has been fully applied to the PCB, the fixture release program immediately begins. First the leading gate depresses, the rollers begin spinning and the PCB starts its journey down the conveyor to its next destination: IC Chip Assembly. When the PCB clears the trailing sensors, the rear gate will once again rise and lock into position awaiting the next PCB.
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PICK AND PLACE STATION
3. IC ASSEMBLY
Solder paste has been fully applied to the PCB, the fixture release program immediately begins. First the leading gate depresses, the rollers begin spinning and the PCB starts its journey down the conveyer to its next destination: IC Chip Assembly. When the PCB clears the trailing sensors, the rear gate will once again rise and lock into position awaiting the next PCB.
The solder-paste prepared PCB moves along the conveyor belt, it is approaching another sensor-driven board loading fixture. Again, the front two sensors (spring switches) detect when the board is on top, this makes the front locking gate recess, allowing for continued PCB movement onto the holding fixture. On the sides of the fixture are moving rollers to guide the board along the fixture and stop when the board is in the desired position.
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Once the PCB has covered the leading front switches and the trailing two switches, it is in the desired position. The rear gate raises locking the board in position, and the rollers temporarily turn off. At this time the IC pick and place assembly program begins. When the board is fully assembled, a fixture release program will commence.
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The pick and place machine is a robot that travels along a programmed XYZ axis. Its function is precision place each integrated circuit device onto its programmed board location. A vacuum nozzle holds the IC device in place. When the board is fully assembled, the pick and place head will retract and a fixture release program will begin.
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The PCB has been fully assembled with ICs, the fixture release program immediately begins. First the leading gate depresses, the rollers begin spinning and the PCB starts its journey down the conveyer to its next destination: Solder Reflow. When the PCB clears the trailing sensors, the rear gate will once again rise and lock into position awaiting the next PCB.
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SOLDER REFLOW STATION
4. REFLOW SOLDERING
The fully assembled PCB travels along the conveyer until it reaches the Heller MKIII Reflow Oven. The PCB will go through multiple zones to first heat to a programmed soldering profile of 260 degrees C for 30 seconds. This is required to melt RoHs Matte-Tin solders.
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The soldered PCB exits the Solder Reflow Oven, it now travels along a conveyer to an Aqueous Cleaning unit to remove solder flux residue and clean the board.
AQUEOUS CLEANING STATION
5. AQUEOUS CLEANING
Aqueous Cleaning unit rinses the PCB with water to remove solder flux residue, cleaning the board.
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Assembled PCB has been cleaned and is ready for Visual Inspection of solder joints. A small Denso robot, fitted with a vision inspection camera is programmed to check each solder joint for uniformity.
VISUAL INSPECTION STATION
6. VISUAL INSPECTION
The assembled PCB is approaching the Vision Inspection holding fixture. When the PCB is in the correct position, the front and rear gates raise and lock. A small Denso robot, fitted with a vision inspection camera is programmed to check each solder joint for uniformity.
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The Denso Robot scans up and down each row of solder joints. Each captured image is compared geometrically against a known good shape. If a cold or uneven solder joint is spotted, then the board is rejected. A signal is sent ahead to the Board Disposition Station to move this board to the Rework Cart. The board is sent ahead for electrical testing.
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The PCB assembly has been visually scanned for soldering defects, now the board fixture gate releases. The board moves ahead for electrical test. Depending on the result of visual inspection, a pass or reject flag has been sent to Board Disposition. For a board to be good, there must be Visual GOOD and Electrical GOOD flags set.
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ELECTRICAL TEST STATION
7. ELECTRICAL TESTING
The assembled PCB is approaching the Electrical Testing holding fixture. When the PCB is in the correct position, the front and rear gates raise and lock. Two small Scara robots, fitted with electronic testing probes check a programmed signal netlist for open and short circuits. If the board passes continuity and anti-continuity testing it will receive a pass flag for electrical test. For a board to be good, both Visual and Electrical flags must be set as GOOD.
The assembled PCB is locked into the Electrical Testing holding fixture. Two small Scara robots, fitted with electronic testing probes, check a programmed signal netlist for open and short circuits. If the board passes continuity and anti-continuity testing, it will receive a pass flag for electrical test. For a board to be good, both Visual and Electrical flags must be set as GOOD.
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The final product has been screen pasted, chip assembled, soldered, cleaned, visually inspected and electrically tested. During visual and electrical testing, status flags were set and sent to the Disposition Station. For a board to be good, both Visual and Electrical flags must be set as GOOD. If one flag has not been set as GOOD, the board is routed for REWORK/REPAIR.
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BOARD DISPOSITION STATION
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THIS BOARD FAILED
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SHIPPING ASSEMBLIES
9. SHIPPING
Good and Bad PCB assemblies arrive at the Shipping Department loaded in cartridges on the back of a Kiva Cart Truck. A Fanuc robot removes the loaded board cartridge off the Kiva Truck and places it onto a palette for shipping. Once the Kiva robot is unloaded, it returns to the PCB Loading Area for reloading. A technician observes and monitors the situation.
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