



**16032 Arminta Street Van Nuys, CA 91406**

**Phone: (818) 988-7696**

**Fax: (818) 988-7841**

**<http://www.electronic-source.com>**

## **DESIGNING FOR MANUFACTURABILITY**

Proven guidelines for improving quality by making products easier to build and test

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## 1. SMT General Requirements

The section contains a general set of specifications and data requirements to facilitate the off-line programming of Surface Mount (SMT) assemblies being built by Electronic Source Company. The specifications are not intended to be an exact requirement for data format, but merely a proven set of guidelines. The recommendations are designed to allow the pre-processing of CAD & ASCII data into an SMT program in machine-readable format.

By following these guidelines, ESC can provide you with manufacturing services in the most efficient manner possible. A high-level of efficiency will allow ESC to maintain low costs for our customers. This document also defines the communication channels for each step in the manufacturing process.

### A. Documentation

1. A hard copy of the BOM (Bill Of Materials), Assembly Drawing and any ECOs (Engineering Change Orders) are all required from the customer.
2. An ESC Order Form must accompany each kit.

### B. Electronic Files

1. Electronic Copy of the BOM

ASCII or comma-delimited file formats such as Excel, Access, ODBC are acceptable. At a minimum, this file should contain the following fields:

- a. Component Part Number
- b. Component Description
- c. Component Package (1206, QFP160, etc.)
- d. Reference Designators (i.e. R5, U2). These designators must match the reference designators used on the Silkscreen layer.

2. Assembly Drawing

A copy of the assembly drawing showing component footprints and orientations should be provided. This is especially true if package data for components is not noted in the BOM. This can be provided in Autocad .DWG format or hard copy if preferred.

### 3. Gerber Files

A Gerber Paste Mask File is required to generate a stencil. In order to avoid editing charges from ESC's stencil supplier, the Gerber must include the Paste Mask File with Fiducials. If the PCB is supplied in panel format, the Gerber Paste Mask file must be panelized, again with Fiducials. (The PCB fabricator usually supplies the panelized Gerber).

Customers may supply existing stencils. However, if manufacturing issues arise because of the condition of the stencil, ESC may request to order a new stencil.

### 4. SMT Programming

SMT Programming requires centroid or placement data. This data provides five critical pieces of information for each part location:

- A. X Coordinate
- B. Y Coordinate
- C. Reference Designator (i.e. R5)
- D. Part Number
- E. Part Rotation (i.e. 0, 90, 180 degrees)

This information is requested in an Excel spreadsheet or a space or tab limited ASCII format. Without complete information, additional programming charges are required to generate SMT placement programs. Costs will increase and delivery times will be impacted.

Gerber and Placement data should be emailed to: [data@electronic-source.com](mailto:data@electronic-source.com)

### C. Other Requirements

- Land Patterns must adhere to IPC-782 (Surface Mount Design and Land Pattern Standard)
- Panels must be routed to maintain enough structural integrity to remain firm on a conveyor.
- A fully loaded assembly (Sample or Golden Board) is requested in order to generate an accurate Reflow Profile.

### Production and Quality Correspondence

Please submit Production and Quality correspondence to:  
[production@electronic-source.com](mailto:production@electronic-source.com).

We appreciate the opportunity to become one of your valued suppliers and look forward to conducting future business.

## 2. Kitting and Consignment Guidelines

Kitting is extremely critical to the success of a manufacturing run. It is ESC's belief that quality begins with a well-organized and complete kit. Delivery turnaround begins upon receipt of a complete kit.

### A. Attrition

Passive Components: Should be supplied on tape and reel. Five percent overage or 20 pieces, whichever is greater is required.

ICs: Ideally, ESC would like at least one or two additional units. Low attrition rates are an ESC goal, however there are times when we may require additional overage.

All parts must be marked with the customer's part number.

### B. Shortages

ESC strives to audit kits within 24 hours of receipt. In order to minimize costs arising from additional handling, ESC customers should supply complete kits. (ESC will accept kitting material in no more than two increments. First the initial kit to get started and any last items needed to complete that kit). Efficiency is affected when kits are submitted "piece meal", which in turn negatively impacts cost and delivery.

### C. Problems to Avoid

1. Strips (if strips are unavoidable, there should be a minimum of 6 inches of leader tape).
2. Parts should be supplied on their original reel for part verification purposes.
3. Axial and radial parts should be supplied on tape.
4. SMT and PTH parts should be segregated.
5. SMT ICs are preferably supplied on tape or in JEDEC trays. Tubes require vibratory magazines for pick up. This process can be inaccurate which in turn causes higher attrition rates as well as other SMT placement problems.

### **\*\* WARNING \*\***

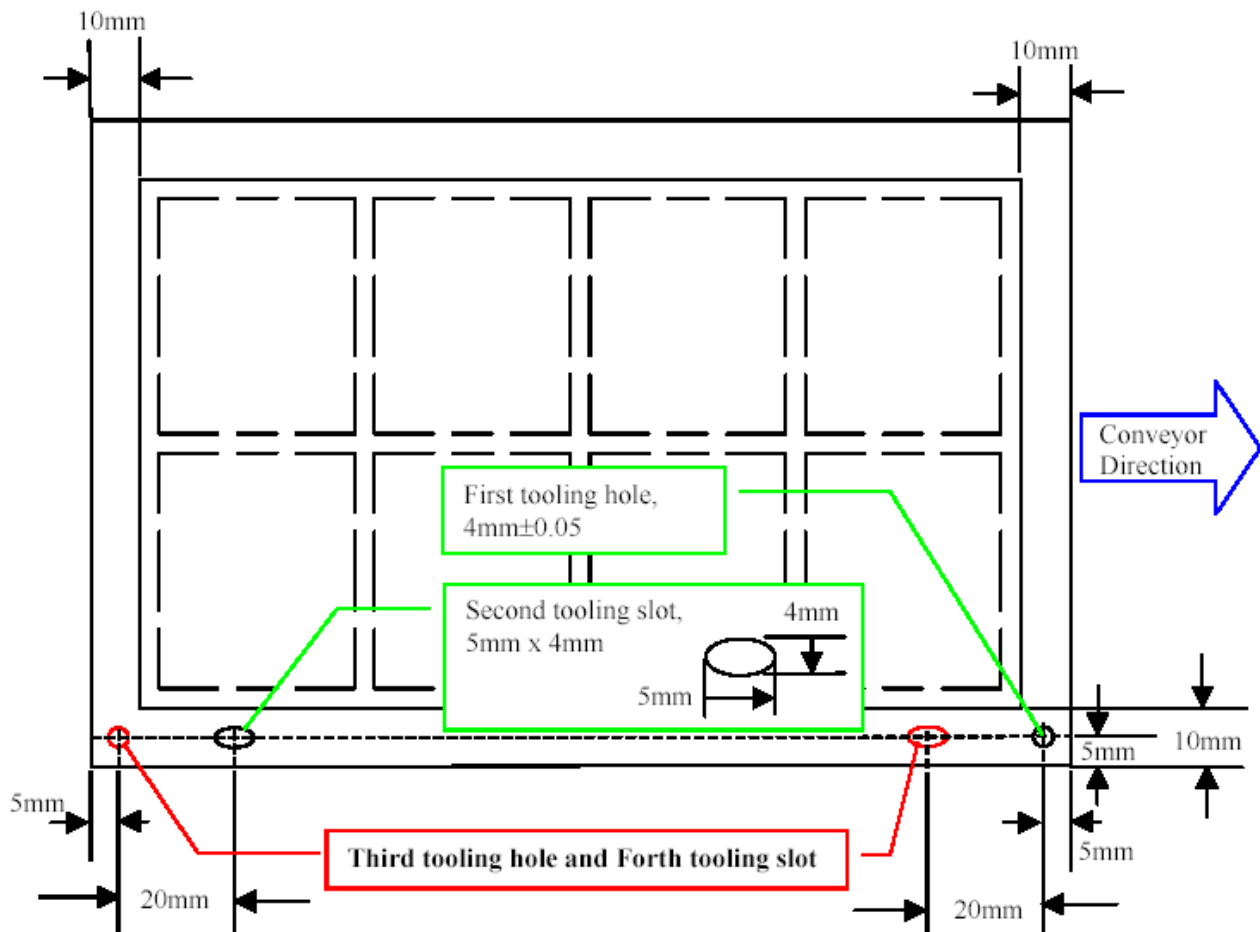
Parts should never arrive loose or in a bag. When kits arrive in this condition, assembly costs are impacted which will be reflected in the pricing.

### **Kitting Correspondence**

Please submit Kitting correspondence to: [kitting@electronic-source.com](mailto:kitting@electronic-source.com).

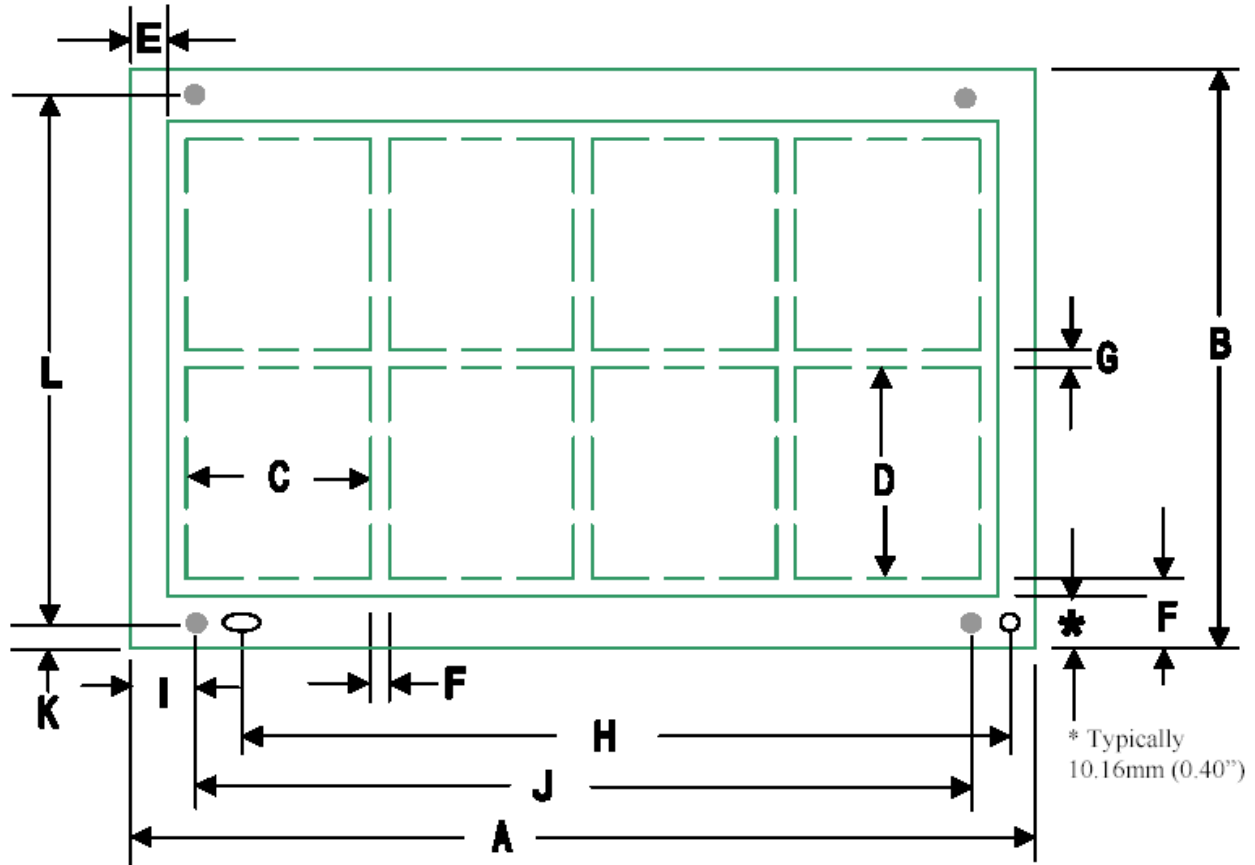
### 3. Tooling Hole Requirements

- ESC only requires one tooling hole; 4mm (0.158") un-plated hole as per drawing
- Located 5mm from bottom/right corner on border as per the drawing below
- Commonly placed on the bottom rail, which should be the longer side of the panel
- 10mm borders provide added structural integrity
- Contrary to the diagram, the 2<sup>nd</sup>, 3<sup>rd</sup> and 4<sup>th</sup> tooling holes are not required

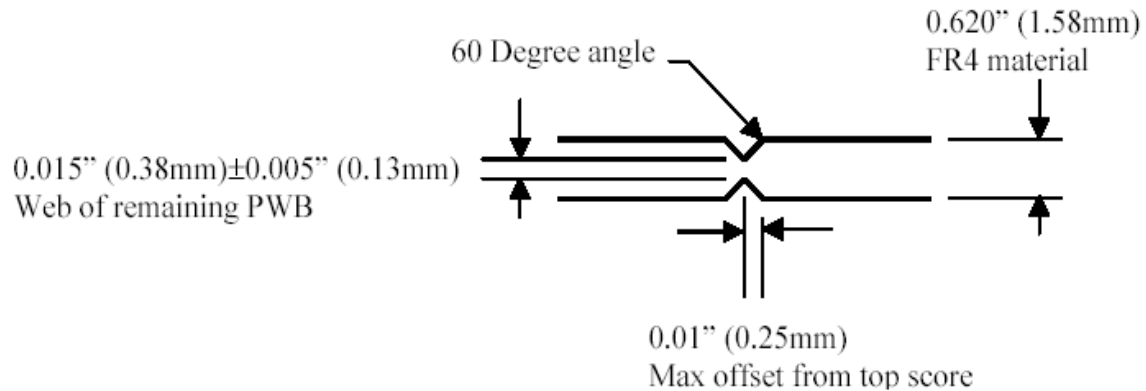


#### 4. Panelization Dimension Requirements

The primary dimension of concern is Figure F (i.e. the rail clearance). As stated on the previous page, we're typically looking for a minimum of 10mm clearance from the edge of the panel to any SMT placement on the assembly. All other dimensions on this diagram can be extracted from the XY CAD data that you provide.



## Vscore Breakout Detail

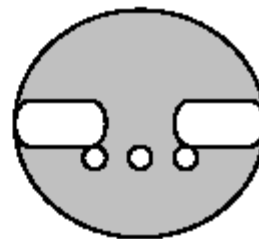


### **Notes:**

- (1) For de-panelization purposes, ensure components are at least 3/16" (4.76mm) away from scored edges
- (2) Common scoring: 1/3-1/3-1/3 approach, 0.021" web on scoring for 1/16" PCB
- (3) Use deeper scoring as shown above if PCB is small (dense panel)

## Internal Breakout Detail

Typically 3 un-plated 0.046" (1.17mm) holes evenly spaced with left and right holes breaking through routing

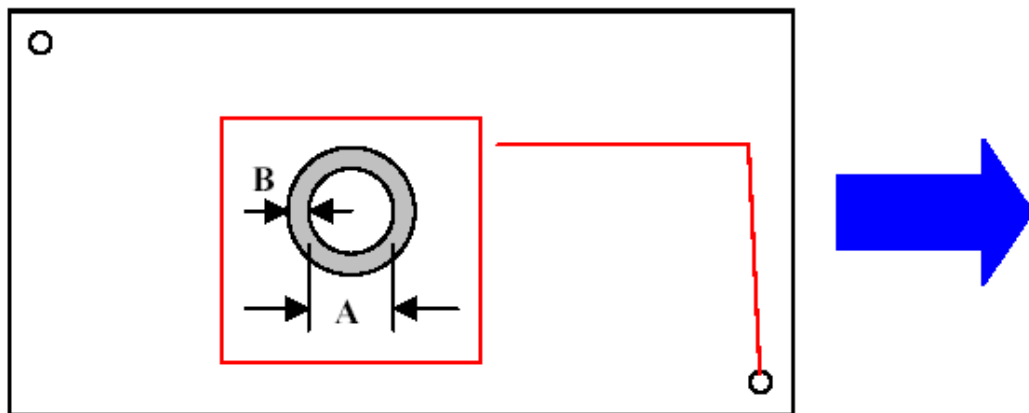


## 5. Fiducial Mark Requirements

Fiducial marks provide common measurable points for all steps in the assembly process. This allows all automated assembly equipment to accurately locate the circuit pattern. Fiducial Marks are generally categorized in two types:

### Global Fiducial

- Two marks located diagonally across the board preferably on top left and bottom right corner
- The marks are formed of tin lead plating in the center circular pad
- Do not apply solder resist within outer circle as shown below
- Do not mount components or place traces within 1.5mm from the center of the mark



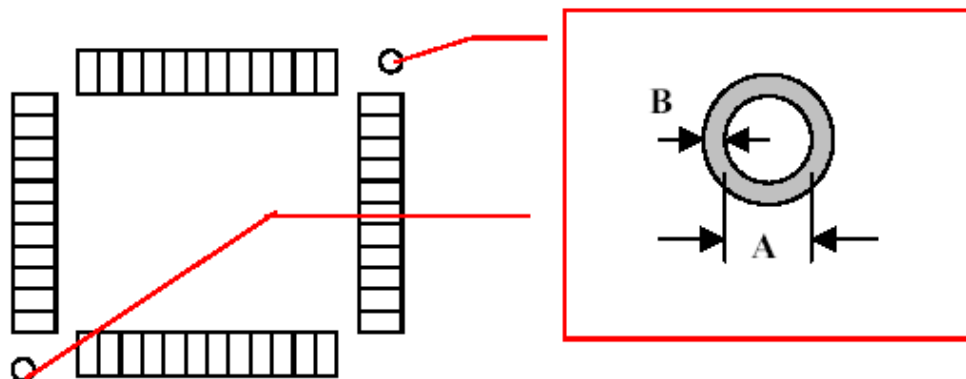
Dimensions:

A= 1.02mm (0.040") +/- 5%

B= 0.51mm (0.020") +/- 15%

### Local Fiducial (QFP package component mark)

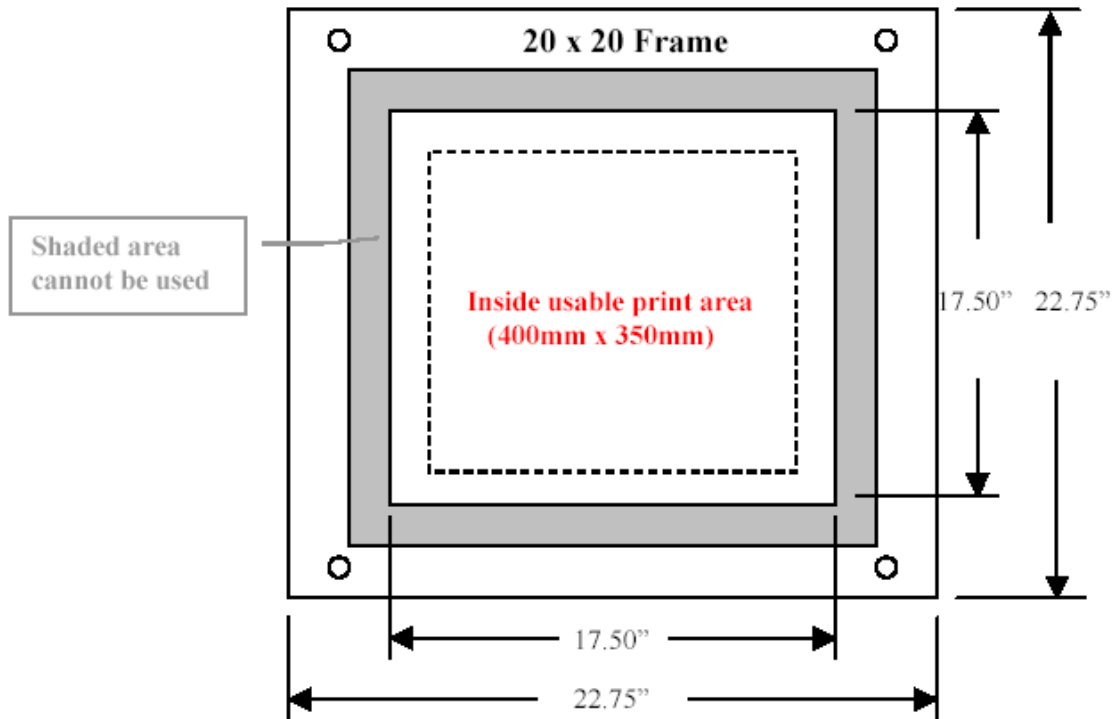
- Two marks diagonally
- Two component marks for each QFP



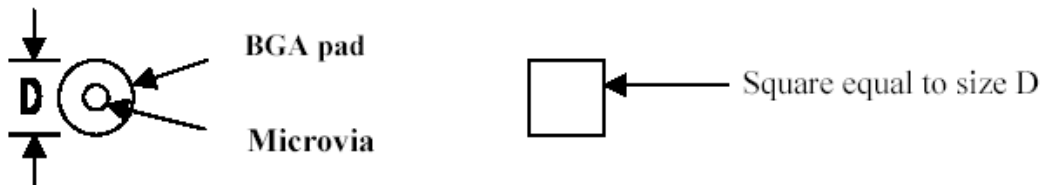
# Machine Capabilities

## Stencil

<b>Board Handling</b>	<b>DEK 265GS (Fully-Automatic w/Vision)</b>
Minimum Size	40 x 50mm
Maximum Size	510 x 508mm (20" x 20")
PCB thickness	0.2 – 6mm
Warpage	Up to 8mm
Underside Component Clearance	Programmable 3mm – 42mm



**Note:** Recommended paste layer outline for BGA pads containing microvias (see drawing below)



**Pick and Place machines**

Machine	Smallest Component	Largest Component	Finest Pitch	Largest Board	Total Capacity
FUJI IP-2*	1608	38 mm sq. QFP	12 mil	14" x 18"	5K CPH
FUJI CP-IV**	0402	20 mm sq. QFP	15 mil	14" x 18"	25K CPH
FUJI CP-IV-2**	0402	20 mm sq. QFP	15 mil	14" x 18"	25K CPH
MYDATA MY9 w/HYDRA	0201	2.2" sq. QFP	10 mil	15" x 20"	10-21K CPH
MYDATA TP11 w/HYDRA	0402	2.2" sq. QFP	15 mil	15" x 20"	6-16K CPH
				<b>TOTAL</b>	<b>71-92K CPH</b>

Notes: \* FUJI IP-2 can place components up to 54 mm sq. QFP with optional camera upgrade  
 \*\* FUJI CP-IV can place components up to 32 mm sq. QFP with optional camera upgrade



**VJ Technologies VJ 1000 X-Ray Machine**

120kV high-resolution, high-power, real time x-ray machine, 4" Lens, 5-Axis Manipulator, 360-degree rotation and 90-degree tilt, up to 5000X magnification, analytical software to detect voids.



### **ERSASCOPE Visual Inspection System**

Provides cross-sectional, non-destructive visual image of hidden solder joints for all types of BGA, MicroBGA, and Flip-Chip components, in addition to many other applications, e.g. interior fillets of PQFP and PLCC components, where a microscope or X-ray fails.

Provides images from practically any angle with an enormous 350x magnification range.



### **AirVAC DRS24C BGA Rework Station**

Packages: BGA, CCGA, CBGA, uBGA and CSP packaging

Range of parts: Minimum – 5 mm sq. components with 8 mil pitch.  
Maximum – BGA parts with exterior dimensions of 54mm sq.

**Notes:** Adapters are available for processing 2mm square parts with 4 mil pitch  
System field of view is 50mm square



### **CR Technology RTI-6520 Automated Optical Inspection**

The RTI-6520 provides full character recognition allowing component value verification. Inspects for missing, misaligned, wrong, and reversed components. Provides SPC reporting via internal network.



### **Heller 1500SX Pure Convection Surface Mount Reflow System**

The Heller 1500SX can handle board sizes up to 22", closed loop P.D. controller, three thermocouples for profile generation, and ten independently controlled heating zones.



### **Electrovert EconoPak Plus Dual Wave Solder Machine**

Computer controlled, 16" V-Groove type finger conveyor, Foam Fluxer, Dual Wave, 2 lower preheats with upper stainless tunnel, Lambda Omega with Chipwave.

