Solderball Pin^{TM} Interconnects

"A Coplanar SMT Interconnect Solution" **Application Notes**

1.0 The Challenges of Interconnecting Parallel Stacked PCBs

Autosplice Solderball Pin^{TM} technology allows high-speed automated placement of discrete solderball SMT interconnects that automatically compensate for coplanarity variances of .012” to .015" (.304mm to .381mm) during assembly of parallel PCBs.

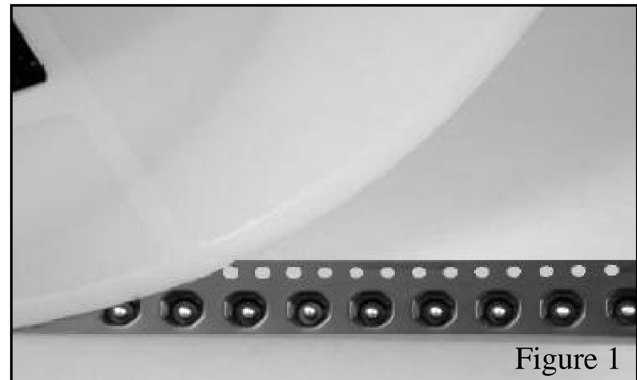


Figure 1

The need for robust interconnects between parallel stacked PCBs has become a key issue for manufacturers of power modules, wireless handsets, mobile handheld devices, and other motherboard/daughterboard assemblies. Managing coplanarity variances between the PCBs during final assembly is critical to ensure that all contact points form robust solderjoint connections.

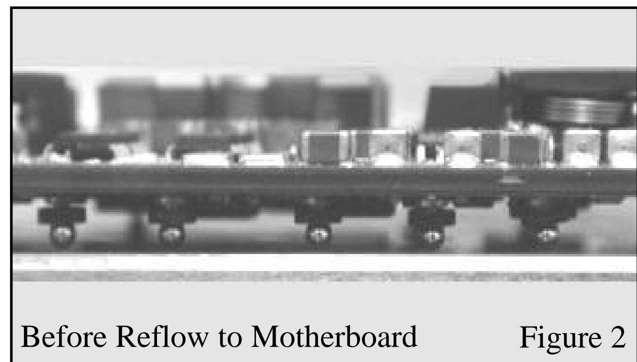
Designers of parallel stacked PCB modules must be able to flexibly specify the pattern and positioning of individual interconnects, while maintaining optimal coplanarity, robust solderjoints and a high degree of automated efficiency.

2.0 Combining Automated Placement of Discrete Interconnects with the Inherent Advantages of Solderballs Pins

The Solderball Pin addresses all of these issues by combining automation-ready discrete interconnects with proven solderball technology that compensates for variances in coplanarity. Solderball Pins functionally replace conventional through-hole pins by providing a SMT solution that is both robust and efficient to implement.

Solderball Pins are packaged in tape & reel format (See Figure 1) and can be placed on the PCB module at high speed using standard in-line "chipshooter" placement equipment.

With solderballs on the other end of the pins, the daughterboard module can then be placed on the motherboard PCB (see figure 2) and efficiently soldered in place, using standard solderpaste methods and reflow processes. During reflow, the molten solderballs enable the daughter module's weight to settle into the motherboard, thus automatically compensating for coplanarity variances as high as .015" (.381mm) while promoting optimal solder wicking as the solderjoint is formed.


Before Reflow to Motherboard Figure 2

3.0 Assembly Process Steps for Using Solderball Pins

The following sections provide a brief overview of the processing steps involved with the use of Solderball Pins.

3.1 Same Module Designs Can Be Used with Either SMT or Through Hole

Solderball Pin technology enables the same basic module designs that are used with through-hole interconnects to be smoothly transitioned to SMT processes.

The assembly process for a double-sided through-hole module (See Figure 3) typically requires the following steps:

- Paste - Place SMT Devices - Reflow
- Pin Insertion
- Flip
- Paste - Place SMT Devices - Reflow

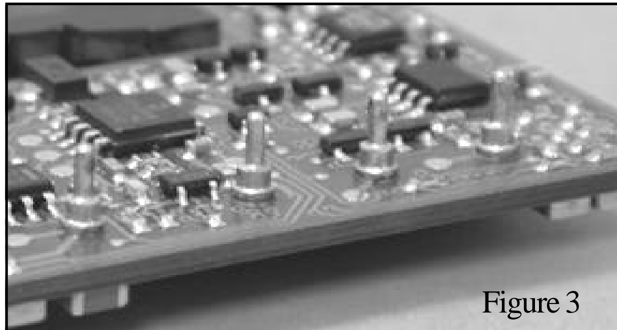


Figure 3

Using Solderball Pin technology completely eliminates the pin insertion step, along with the need for specialized pin insertion equipment. The assembly process for a double-sided SMT now would require the following steps:

- Paste - Place (SMT devices and Solderball Pins) - Reflow
- Flip
- Paste - Place SMT Devices - Reflow

The result is a complete SMT module (See Figure 4) with Solderball Pin SMT interconnects, based on the existing through-hole design. At the end of this step, the PCB module is ready for final assembly or, if it is being sold as a commercial component, it is ready for packaging and shipment to end customers for final assembly into their products.

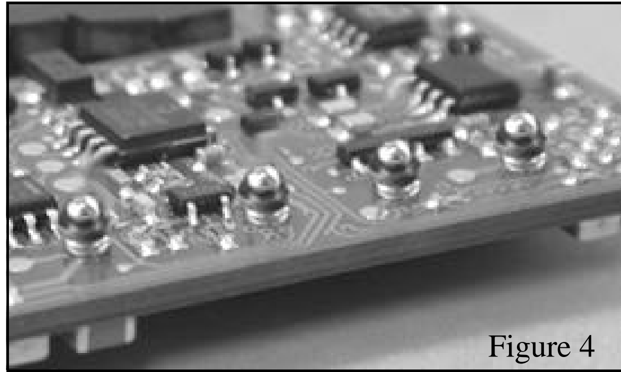


Figure 4

3.2 Assembly of the Daughter Module to the Second PCB or Motherboard

The Solderball Pin design allows the completed PCB module to be efficiently placed into paste on the second parallel stacked PCB (or motherboard assembly) and processed along with all other SMT components, using standard reflow operations.

The completed PCB module can be placed directly into solderpaste on the motherboard with existing SMT pick and place systems and standard process technologies (See Figure 5).

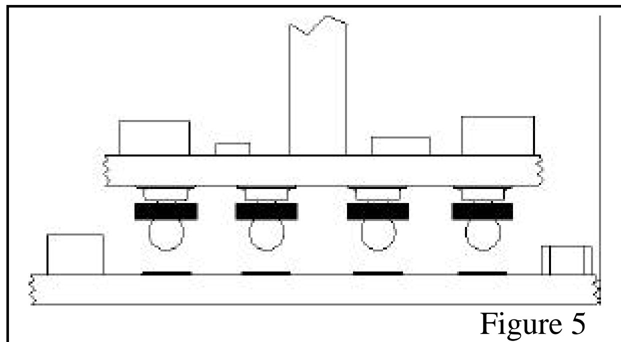


Figure 5

Because the Solderball Pin is designed to opti mize efficient solder wicking and robust solderjoint formation, daughter modules can be placed directly into standard amounts of solderpaste on the motherboard, without necessitating any specialized secondary processes.

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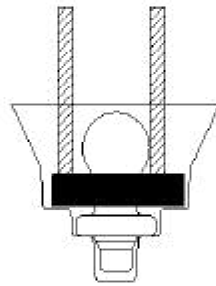
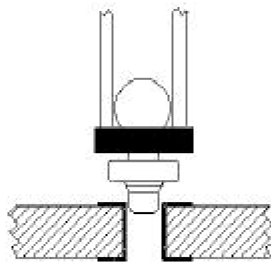
Solderball Pin Module Assembly Process

1



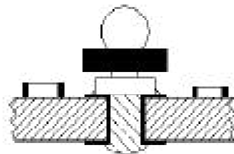
Pick Solderball Pin From Tape

2



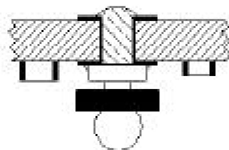
Place Into PCB

3



Reflow with Other SMT Coponents

4

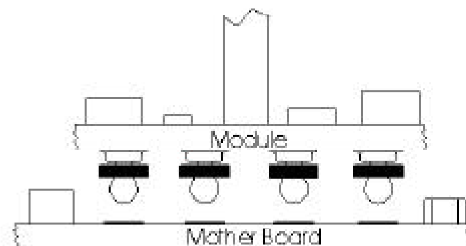


Flip Module and Process Second Side

5

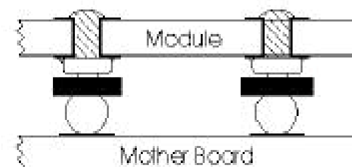
Package Module in Standard Tray or
Tape and Reel to Ship to End User

6



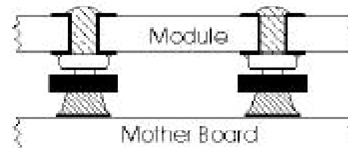
Pick Module for Placement
to Mother Board

7



Place into Standard
Amounts of Solder Paste

8



Reflow

3.3 Coplanarity-Compensation During Final Assembly Reflow Solder Process

Solderball Pins are designed to provide automatic coplanarity compensation, while maintaining compatibility with most standard SMT processes. During reflow, each Solderball Pin provides adjustment flexibility that is equal to the distance by which the diameter of the solderball extends beyond the end of the pin inside the ball. (See Figure 6) The internal pin provides a rigid and high-conductivity foundation and the reflow of the solderball allows a physical adjustment up to .015" (.381mm) as each solderjoint is formed.

When the solderballs "go liquidus" during reflow the molten solder wicks and adheres to both the copper pin and the landing pad, forming a robust solderjoint. Because the weight of the daughter module is greater than the buoyancy of the molten solder, the unit is able to settle to the standoff height “D” on to the motherboard during reflow, thus compensating for variances in coplanarity between the PCBs.

This ability to automatically adjust for coplanarity variances during reflow means that the manufacturer gains a significant amount of "latitude in the process window" because all of the contacts do not have to be perfectly seated during the initial placement. For example, a typical module might have between 6 and 12 discrete interconnect points, of which several points could be slightly up off of the pads and would still be brought into compliance as the module sinks towards the motherboard during reflow.

Each Solderball Pin is designed with an integrated black insulator collar (See Figure 7) that prevents solder from flowing all the way up the shaft of the pin during reflow, thus assuring that the flow instead forms a consistent solderjoint with the target pad on the underlying PCB. This also promotes efficient use of the available solder, thus allowing for optimal results with standard solderpaste levels.

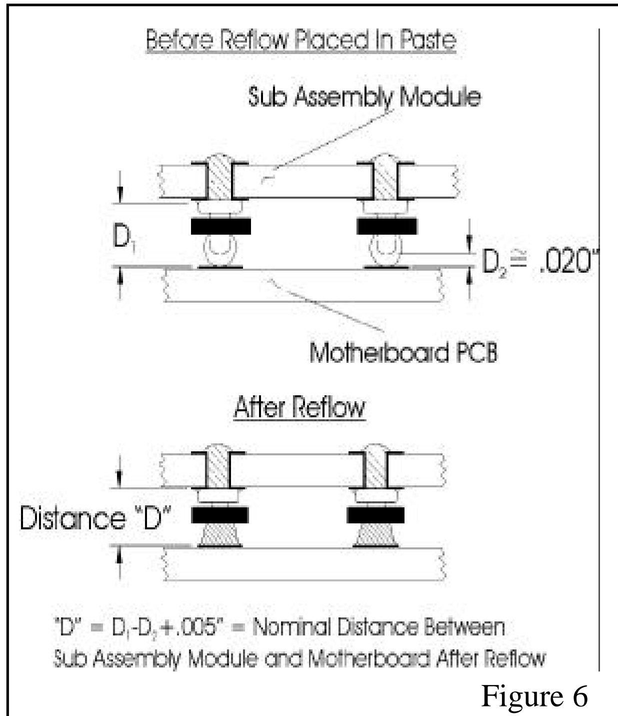


Figure 6

When compared to other alternatives for creating module-level SMT connections, such as floating contacts, post-forming of flex pins, or complex cladding methods, Solderball Pins provide an

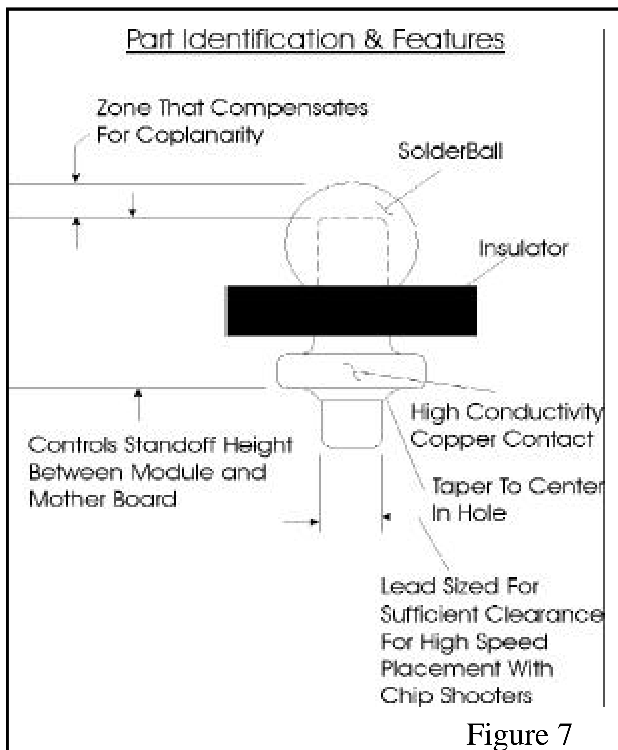


Figure 7

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inherently simple approach that leverages existing automation techniques as well as flexibility and autocompensation advantages of solderball technology.

4.0 Solderball Pins are Designed for Efficient High-speed Pick and Place

Solderball Pins are packaged in EIA standard tape & reel format and are designed for placement on high-speed "chipshooter" equipment, without any requirement for specialized feeders or placement platforms.

The insulator collar on each pin acts a mating point for the placement machine's vacuum pick-up head to assure consistent alignment during placement of the pins on to the first PCB. Instead of having the vacuum head attempt to pick-up the rounded surface of the solderball and run the risk of canting the alignment, the system is designed for the nozzle to slip completely over the solderball and acquire the uniformly flat surface of the collar. (See Figure 8)

4.1 Vision System Settings

Based on the lighting type utilized (Back-lit or Front-lit) the vision system should be set up to look at different areas of the Solderball Pin. (See Figure 8)

4.1.1 Back-Lit

When using a back-lit system the vision system will be looking for the black insulator. It then becomes important that insulator hides the nozzle so that the vision system doesn't mistake the nozzle for the component. Therefore the relationship of the ID of the nozzle to the solderball and the OD of the nozzle to the insulator is important. (See Figure 8) The nozzle selected should have an inside diameter (ID) that is between .177mm to .254mm larger than the solderball on the pin. It is recommended that the nozzle's OD be a maximum of

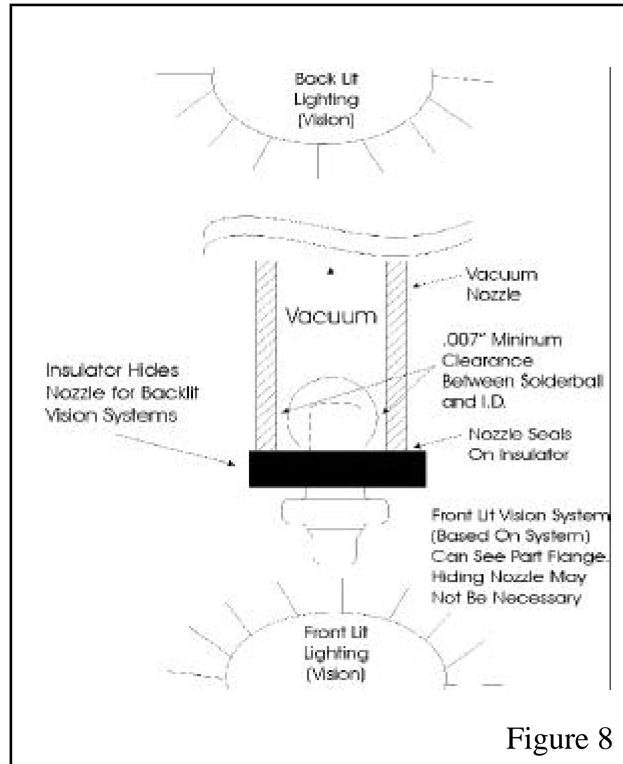


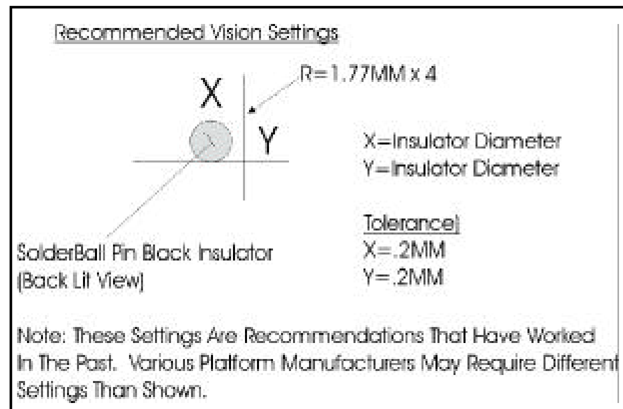
Figure 8

.254mm smaller than the insulator's diameter.

4.1.2 Front Lit Vision System

A front-lit system the vision system should be able to differentiate between the silver color flange on the pin and the black insulator. This will allow the vision system to use the flange of the pin for part alignment. In this case the relationship between the nozzle the solderball and the insulator becomes less important. (See Figure 8)

4.1.3 Other Vision System Recommendations



4.2 Picking the Solderball

Because the nozzle pick plane is the insulator, the pick up depth for the nozzle from the top surface of the pocket tape should be approximately .020” (.7mm) (See figure 9).

4.3 Placing the Solderball

Since the leg of the Solderball Pin is tapered from the flange, the machine should be set up during the placement cycle for an over travel of approximately .012” (.3mm) from the surface of the PCB. This will guarantee that the part is seated properly and that the flange is in contact with the paste. The component library should indicate the component thickness as the dimension between the flange and the insulator. Note that the measurement for over travel is from the Solderball Pin's flange to the surface of the PCB. (See Figure 9 for details).

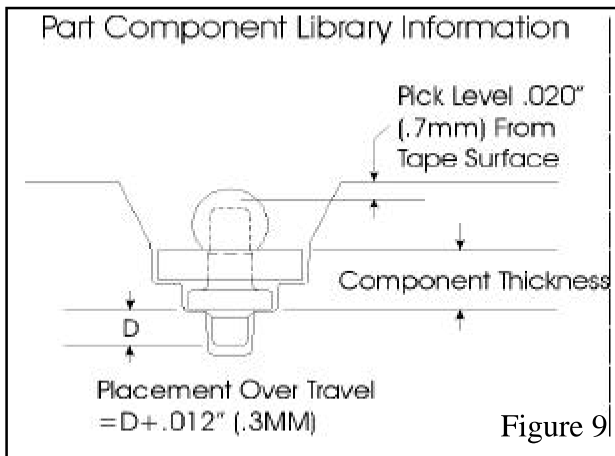


Figure 9

5.0 Solderball Pin Specifications, Configurations, Options

Initially, Solderball Pins are available in the following configurations:

- Available solderball diameters of .062" (1.57) (standard) with options for .055" (1.4) or .031" (.787) (low profile).
- Pin diameters of .040" (1.0) or .062" (1.57)
- Solderballs initially consist of 63/37 Eutectic Solder - with future options for lead-free tin/silver/copper balls
- All configurations packaged in EIA standard tape & reel
- Future designs also could combine the Solderball Pin with Autosplice's TreadHead SMT technology to provide a pure SMT-to-SMT interconnect solution.

Solderball Pin's use of high conductivity copper for the pin enables the interconnect to conduct from 30 to 40 Amps in order to meet requirements across a full range of today's power device applications.

Solderball Pins are available to fit in the two most prevalent PCB hole diameters that are currently used in the power industry - .040" (1mm) and .062" (1.5mm) pin terminals. This gives manufacturers optimal flexibility for using the same core production processes to create either conventional modules with through-hole pins or surface mount modules using Solderball Pins.

The standard solderball diameter of .062" (1.57) is designed to accommodate the majority of applications, however production options for solderball diameters of .055" (1.4) or .031" (.787) also allow for low-profile applications and smaller placement centers, in which the amount of solder under the device must be limited.

The basic Solderball Pin technology also allows for the creation of custom pin diameters and/or pin lengths to meet specific customer requirements. For example, pin lengths can be custom tailored for specific inter-PCB standoff distances to accommodate various component heights on the motherboard. (Use the enclosed Solderball Pin design guide to help Autosplice to define the best part for your application.)

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6.0 Benefits Summary

- Packaged in 16mm EIA standard tape and reel
- Automatically compensates for coplanarity.
- Provide enough solder volume to create a robust SMT interconnect.
- Fits into existing through-holes on module saving real estate
- Allows for seamless conversions from SMT to through-hole designs

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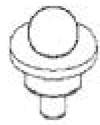
Solderball Pin Design Guide



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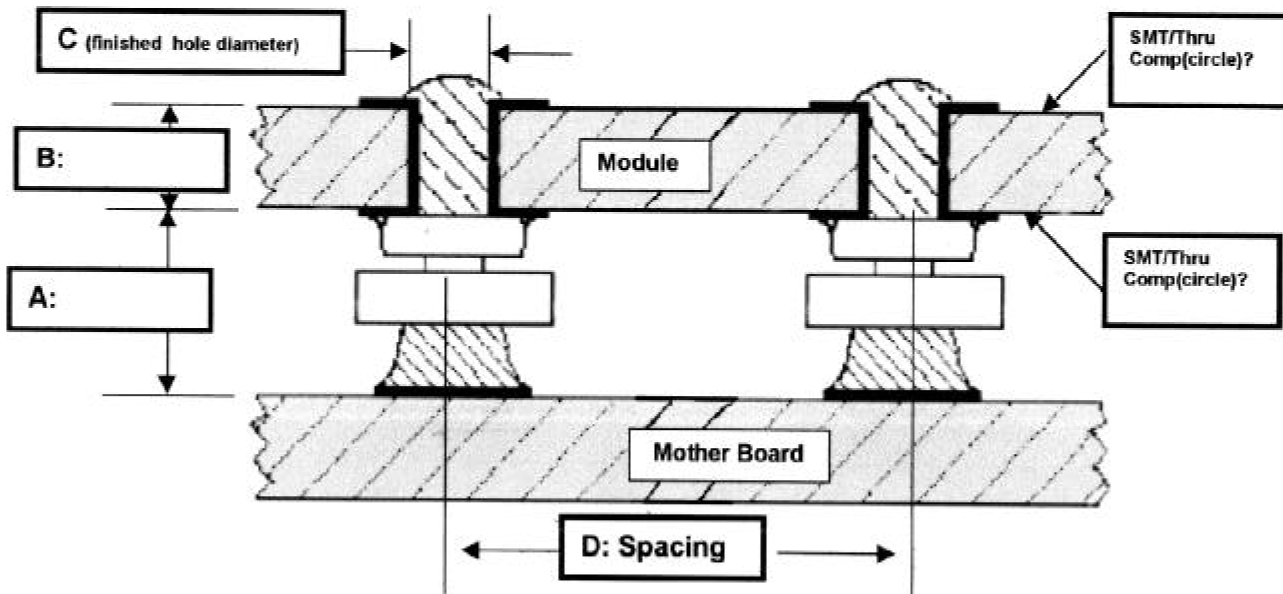
This design guide will assist Autosplice to develop a solderball pin that fits you application requirements. Understanding your application requirements will allow Autosplice to possibly chose an existing solderball pin or use a slight varation from an existing part which will save both time and costs. Provided below is two columns for those applications that might require either two types of solderball pins on one application or if you have various applications with different needs. Please fill as much information as possible and submit to Autosplioce's applications department for assignment and review

Contact Name	
Title	
Company	
Address	

E-mail	
Phone	
Company Web Site	
Application Name	

	Solder Ball Application # 1	Solder Ball Application #2
A: Distance between PCB's after reflow		
B: Minimum thickness of subassembly module		
C: Finished hole size in module (Assume Plated through hole.)		
D: Minimum Center to Center Spacing		
Current Requirement per pin		
Tin/Lead plating or Lead Free ?		
Prototype qty Needs		
Production qty needs		
Other requirements		
Other requirements		
Other requirements		



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