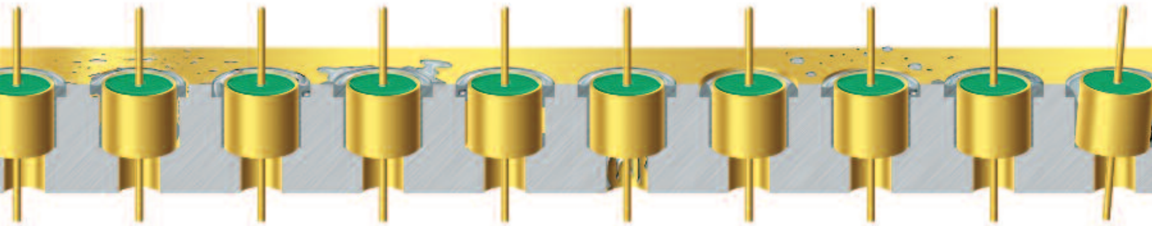
THUNDERLINE-Z

Top Ten Soldering Pitfalls

and how to avoid them



A guide to creating high performance RF packages

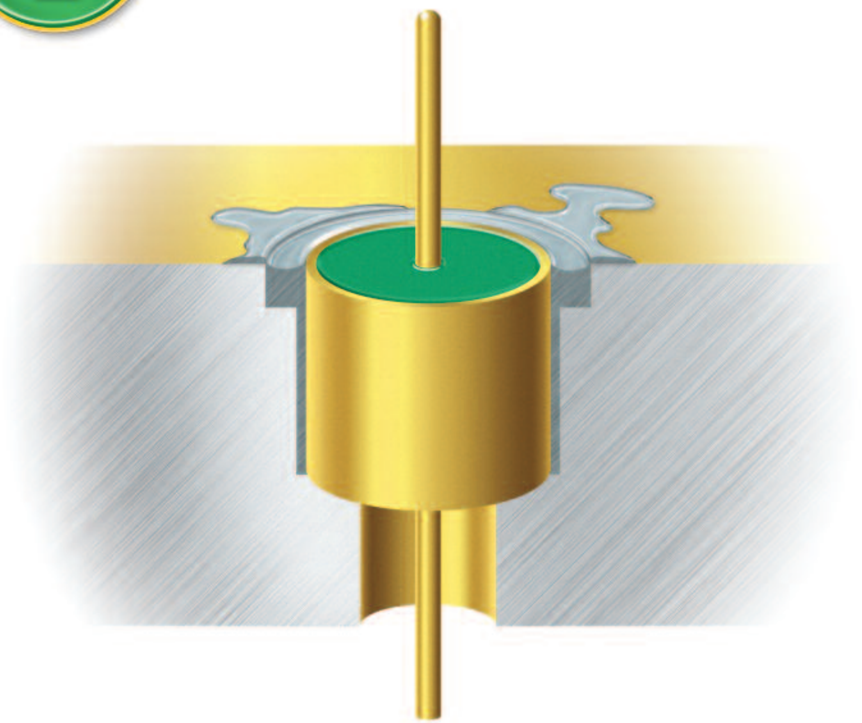
EMERSON

The quality of the package is only as good as the performance of the feedthru.

The performance of the feedthru is only as good as the integrity of the solder joint.

Soldering feedthrus can be tricky business, and a faulty solder joint can make or break the performance of a package. Thunderline-Z's extensive package design and manufacturing experience has helped us to understand many of the soldering problems you may be facing. We have assembled this guide to help you avoid the most common feedthru installation pitfalls and to recognize them should they occur.

1 Solder Overflow

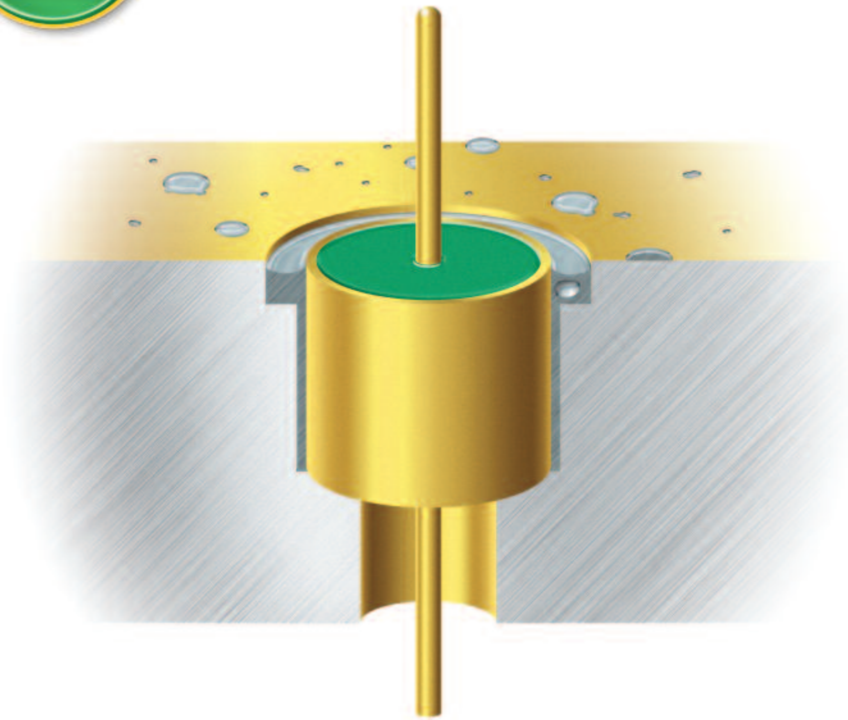


Problem: Solder overflow is the appearance of uneven solder flowing out of and around the solder joint area. In addition to being a visual reason for part rejection, overflowing solder is cause for concern.

Causes: A number of uncontrolled processes can cause solder overflow including temperature, solder volume and package hole geometry. Excessive temperature and uneven heat distribution are the most common causes. Another, less common but more concerning cause, is a mismatch between solder volume and the hole geometry in the soldered package.

Solutions: The solutions to solder overflow are to control temperature and engineer hole geometry for the solder used. The best way to control temperature is with a soldering furnace with tightly monitored temperature profiles and atmosphere management. To select the optimum solder, the design of the housing is the first consideration. The hole geometry must be matched to the type of feedthru or connector being used and to the characteristics and volume of the solder selected. Further control is gained by utilizing tight tolerance solder preforms to supply the proper volume of solder to the joint.

2 Solder Splash

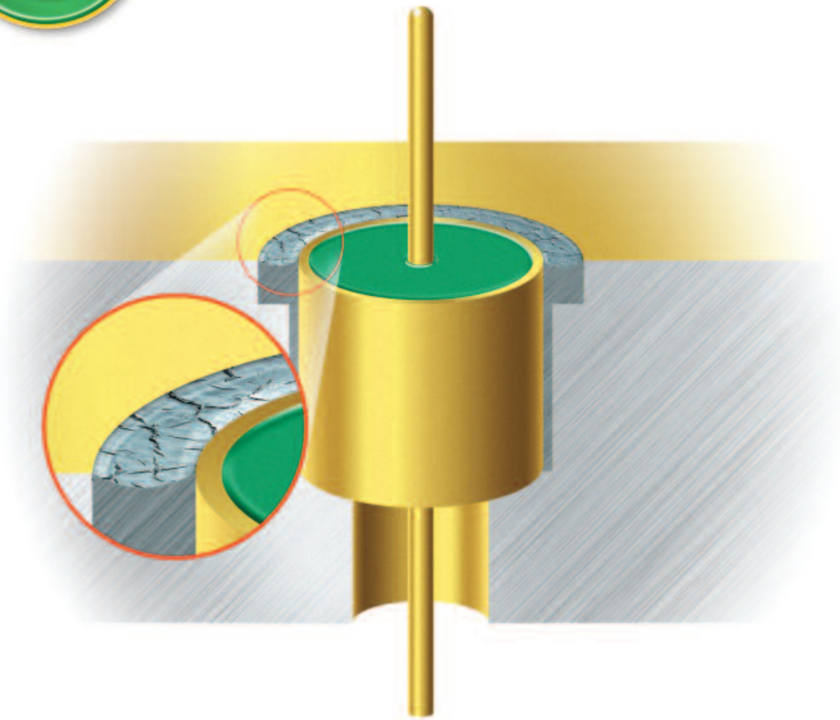


Problem: Solder splash is recognized by small bursts of solder extending away from the solder joint.

Causes: There are several potential causes for solder splash: uneven temperature gradients within the receptor housing during solder flow; improper flux and/or solder selection; incompatible housing or feedthru plating; or an incorrect flow temperature for the solder. Poor preparation of the housing before solder application can also lead to solder splash.

Solutions: To prevent solder splash it is important to allow enough time for heat to be introduced to the package housing. This is accomplished best by thermalcouple monitoring and accurately controlling the dwell time within the furnace prior to increasing temperature for solder flow. It is also important to thoroughly clean the housing to remove residual dirt and oils. This ensures an uninterrupted flow of solder to the solder joint. Gaining an understanding of solder types and fluxes is also important.

3 Solder Crystallization

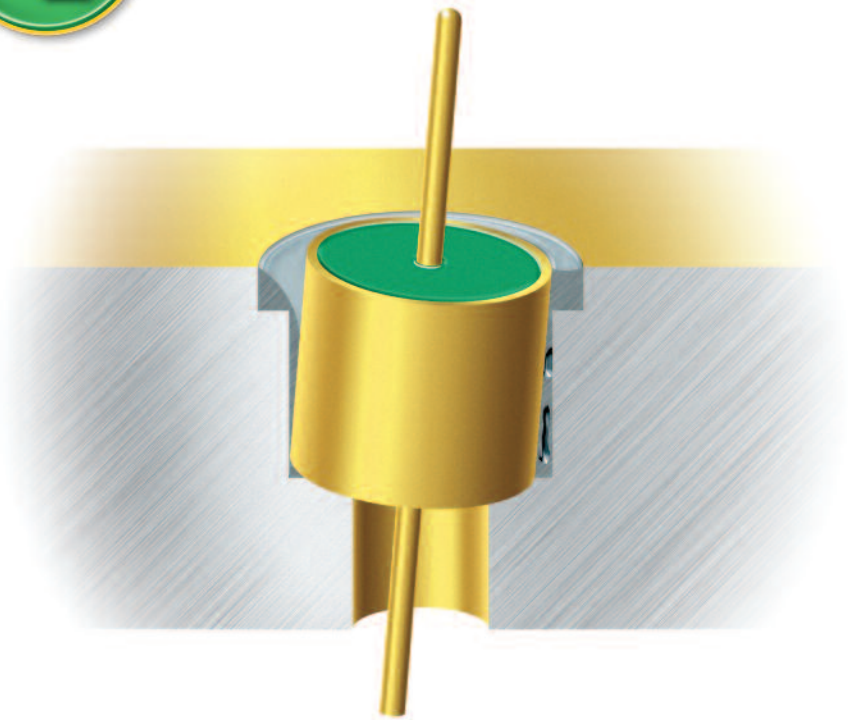


Problem: Solder crystallization is characterized by a cracked and uneven appearance of the solder joint. Although not necessarily an immediate cause for visual rejection, crystallization in the joint may indicate a poor solder joint that will fail over time and should be corrected.

Causes: Solder crystallization commonly occurs as a result of improper flux selection or not thoroughly cleaning the housing with the right cleaning materials. Crystallization can also occur as a result of temperature gradients during the soldering process. In an oven soldering process the wrong mix of forming gases can also result in crystallization.

Solutions: The selection of a flux that matches the soldering process conditions, such as temperature and cleaning, is important to avoiding crystallization. The use of a soldering oven also adds considerable control to the soldering process. Tailoring the temperature profile and ambient gas flows to the selected solder and plating materials is key in creating a quality solder joint. By uniformly increasing temperature and matching the forming gases in the furnace to the selected solder and housing plating material, you will gain control over the key parameters in avoiding crystallization.

4 Crooked Feedthrus

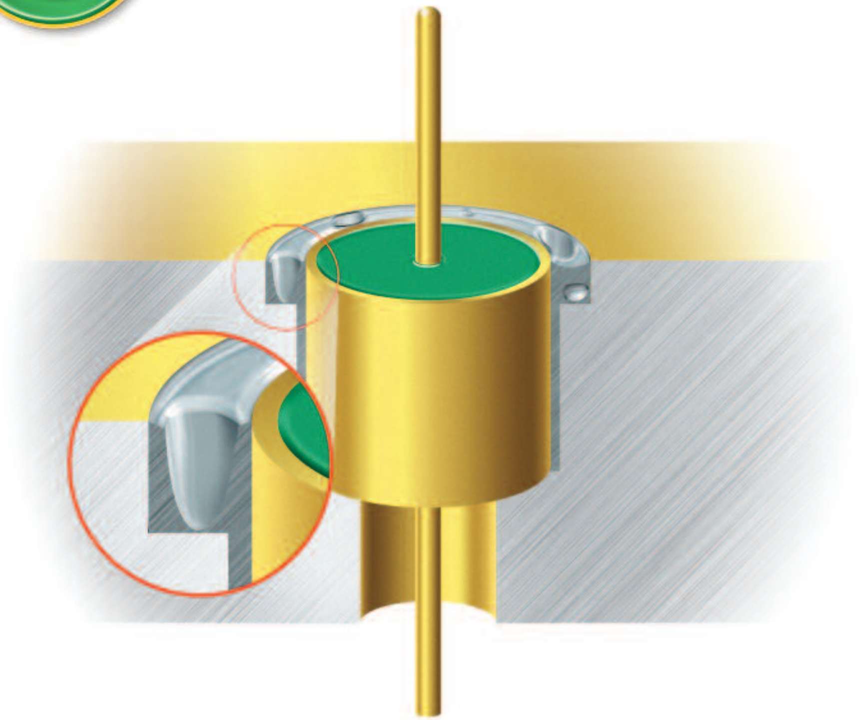


Problem: When the body of a feedthru is not flush with the housing this is a visual clue that the body shell is not parallel with the walls of the hole. A crooked feedthru is also an indication of an uneven soldered joint and therefore a weak point and reason for failure upon inspection.

Causes: There can be a number of reasons for poor mechanical alignment between the feedthru and housing hole, including: a poorly machined hole; a poorly designed or built fixture; a worn fixture; or the wrong hole geometry.

Solutions: A statistical inspection of housings prior to soldering can ensure the base structure is proper. Having a fixture engineered for a specific housing layout and tolerances is key. Designing the hole cavity to work with the fixture and the soldering preform is another important design consideration.

5 Solder Blow Holes

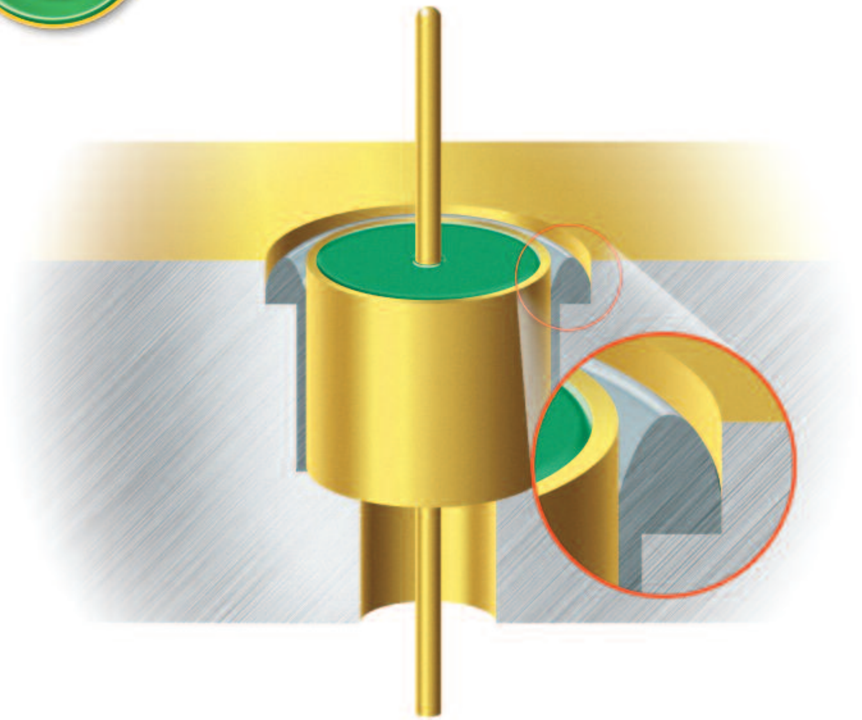


Problem: Voids in a solder joint will visually appear as pin holes or have a crater like or "blow hole" appearance where the bottom of the void is not visible. Both of these appearances are reasons for rejection and concern for the integrity of a solder joint.

Causes: The cause for solder voids can be singular or a combination of many factors. The primary reasons for solder voids include: improper volume of solder; an uneven temperature profile; poorly designed hole geometry; improper alignment of the feedthru leading to uneven solder paths; or selecting the wrong flux.

Solutions: Precision cavity and solder preform are essential to ensuring an optimum fill of the solder area. To eliminate voids caused by uneven solder flow it is important to maintain feedthru alignment using a fixture during assembly and oven transport. Establishing and controlling a soldering temperature profile is also key to managing the flux evaporation rate to eliminate voids during soldering.

6 Poor Fillet/Wetting Angle

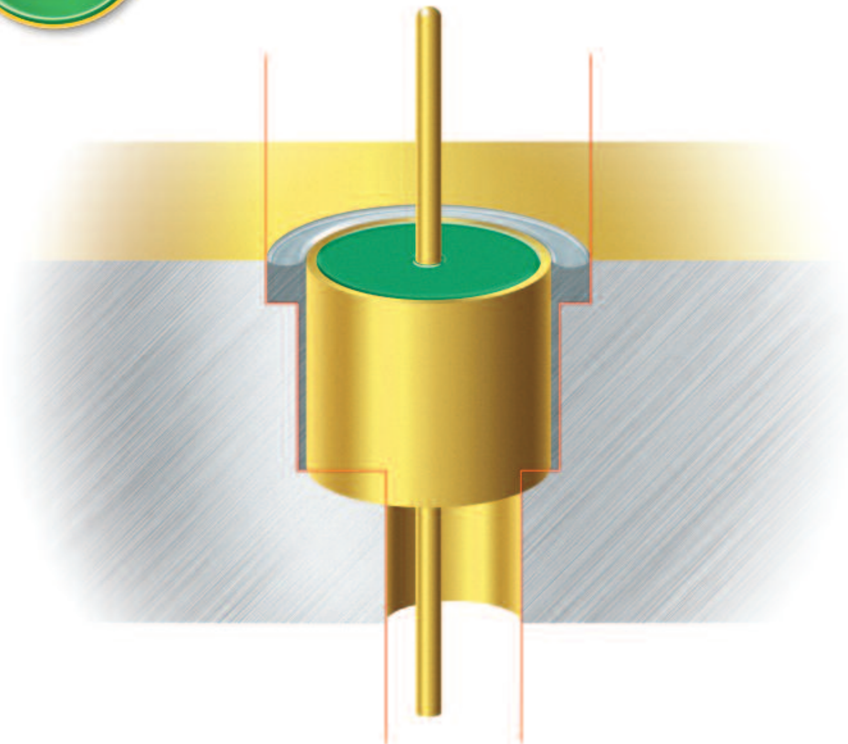


Problem: A poor wetting angle, or lack of wetting, is an indication that there is improper solder flow and thus poor bonding. A good solder joint will have an angular fillet at the base of the joint, a strong wetting angle is an indication that the solder joint has a strong bond.

Causes: A prime cause for a poor fillet or poor wetting angle is the result of insufficient heat energy from either poor temperature control or component duration in a heating zone. Parts that are not properly prepared to remove contamination can reject solder, this rejection will also lead to a poor wetting angle. The breakdown of flux at the soldering temperature can also be a possible cause to investigate poor wetting.

Solutions: Engineering an oven temperature profile for the housing to be soldered will ensure the right distribution of heat energy for good solder flow. Regular oven calibration for temperature will ensure the repeatability of a temperature profile. Cleaning of metal surfaces is essential to ensure the removal of oils and oxide contaminants prior to soldering. Selecting the proper flux for the temperature ranges to be worked is also critical in forming a strong solder bond.

7 Misaligned Holes

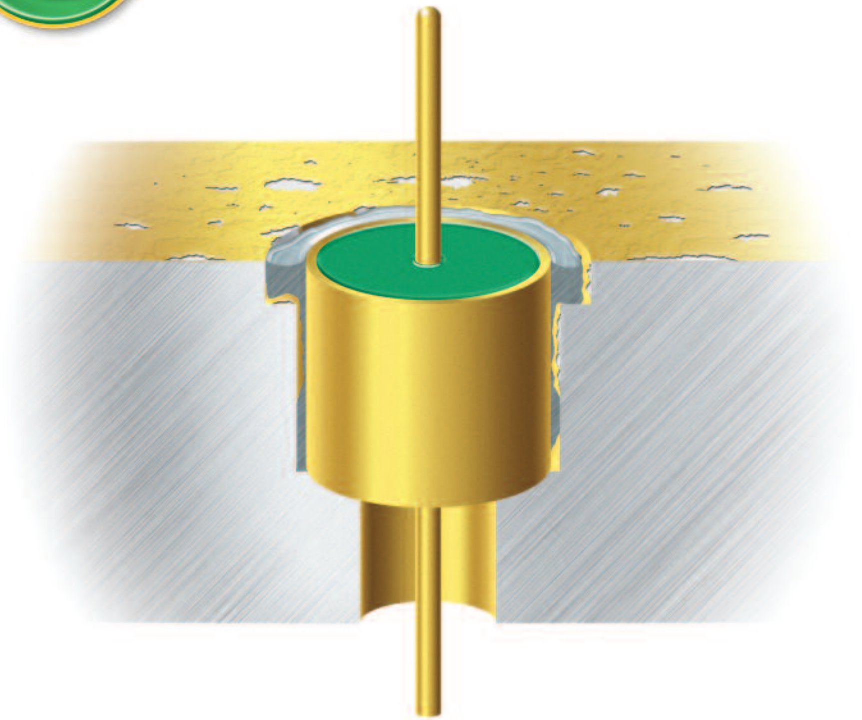


Problem: To the installer or inspector a misaligned holed may not be readily apparent. A properly machined hole however, is crucial in providing a repeatable and sustainable solder joint. Improper width or depth can lead to feedthru damage and alter electrical performance. If the cavity for the solder joint is too small the solder may not flow evenly to reach and completely wet the surface of the two metal surfaces to be joined. If the cavity is too big or too wide there is a greater chance for the component being sealed to move or for solder to find it's way out of the solder cavity.

Causes: Poor mechanical design and machining.

Solutions: The key is to pay as much attention to the design and tolerances of the holes for each type of component as is spent on the overall package design. This will prevent individual components from becoming the weak link in the final package. This requires an understanding of the relationship of hole and component geometries and knowledge of soldering processes for varied applications.

8 Poor/Improper Plating

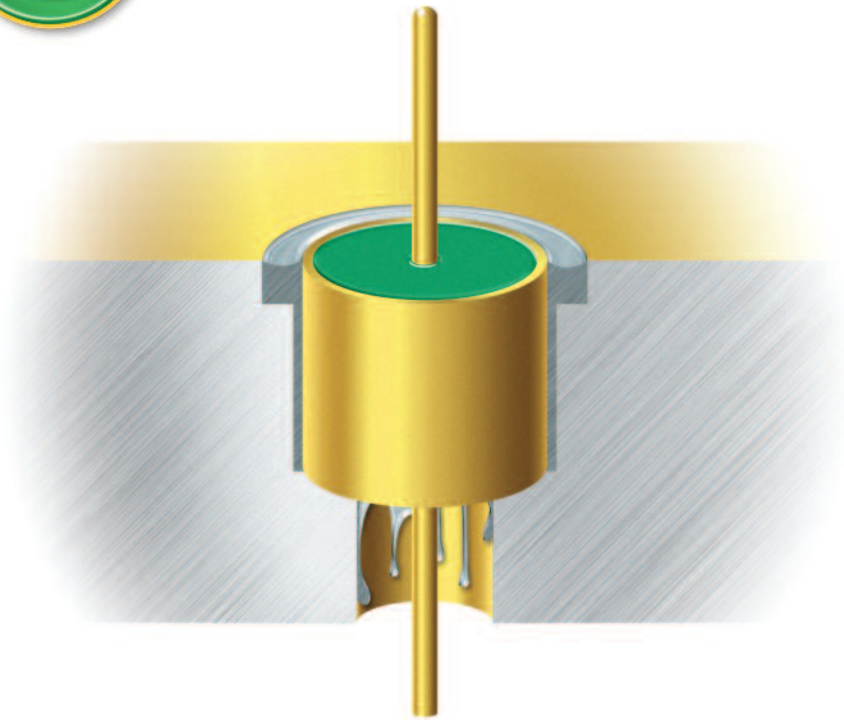


Problem: Blisters, voids or flaking of the plating in the solder joint area can lead to poor solder adhesion and therefore a weak joint that may later result in a hermetic or electrical failure. While the plating finish may be correct for the base metal, the plating selection also needs to match requirements for adherence to the filler metal used in the solder joint.

Causes: Poor plating adhesion is often the result of impurities left on the metal surface prior to plating or storage, or can be the result of selecting the wrong plating for the desired application. In making plating choices the base housing material and the solder filler metal need to be taken into consideration.

Solutions: To select the right plating for a specific application involves consideration of the housings base metal, the soldering process and the environmental conditions that the final package will incur. Proper cleaning of the base metal is also essential to provide a strong plated surface. Machining fluids and cleaners not properly selected and managed will cause a plating adhesion problem.

9 Airline Obstruction

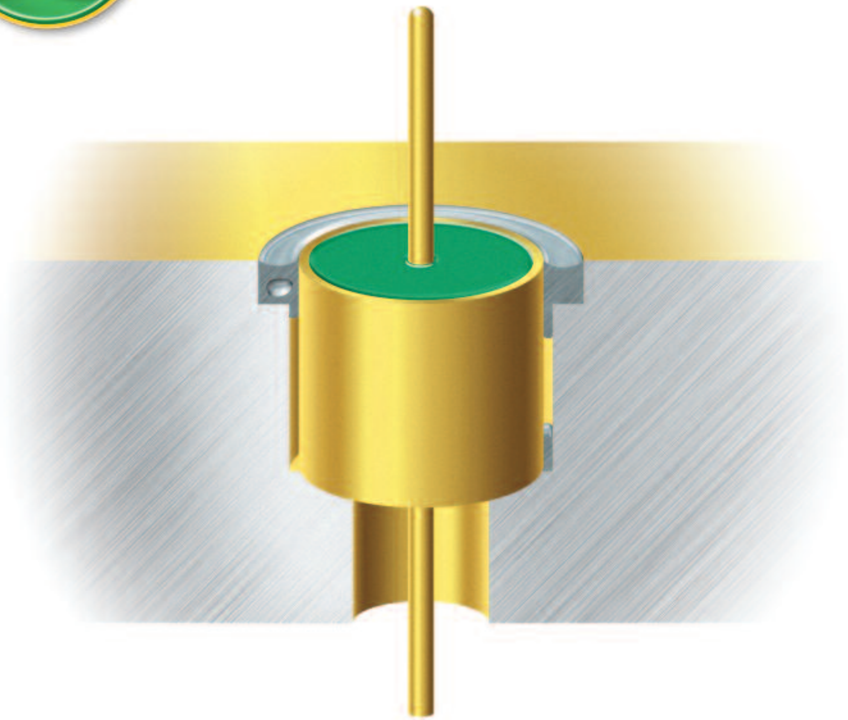


Problem: Airline obstructions caused by uncontrolled solder flow creates an improper ratio of pin diameter to aperture diameter which determine the ohmic impedance value.

Causes: Alteration in the airline geometry is generally the result of solder flowing into an area that it does not belong. This creep of solder can be the result of having an excess solder volume, poor heat control during the flow of solder or poor fixturing for the solder operation.

Solutions: Using the correct volume of solder for the feedthru and hole design provides a basis to control the flow of solder outside of the joint area. Holding the system securely in place with proper fixturing and maintaining this fixturing builds upon this base. The optimal system for heat control is using an oven to form the solder joint. Realizing the heat profile of the oven is most important. Proper maintenance, multiple oven zones, and repeatability in temperature and oven atmosphere, are essential to completely control the solder joint formation.

10 Hidden Solder Voids



Problem: The most difficult, and perhaps the most dangerous pitfall of all, is when voids are out of sight. Hidden voids can be a cause for mechanical failure or hermeticity loss over time. Electrical performance may also be in jeopardy.

Causes: Any one or several of the previously discussed causes may have occurred.

Solutions: Because voids below the surface are not visible, your first line of defense is proper electrical testing and an understanding of the potential causes of poor performance. Reviewing all of the previously discussed solutions and systematically addressing each one, is the only way to prevent hidden voids from reoccurring.

Start your installation with a high quality feedthru from Thunderline-Z

Thunderline 50s™

Thunderline 50s are the world's largest variety of RF feedthrus in the industry, with pin diameters from 0.005 to 0.040 and frequency ranges from 3 to 125 GHz. High quality levels are achieved through tight control of tolerances and the manufacturing process to yield a zero meniscus. This zero meniscus allows for higher frequency response while maintaining a metal-to-metal contact with the housing to achieve optimal power transfer.

Thunderline Cap Feeds™

Thunderline Cap Feeds offer a DC feedthru filtered to the customer's specification. The robust construction allows the customer the freedom of the broadest solder schedule available. Cap Feeds are available in diameters from 0.098 upward. A complete range of capacitance values at varying tolerances is available as single feedthrus or in multi-header designs.

Thunderline DC Feeds™

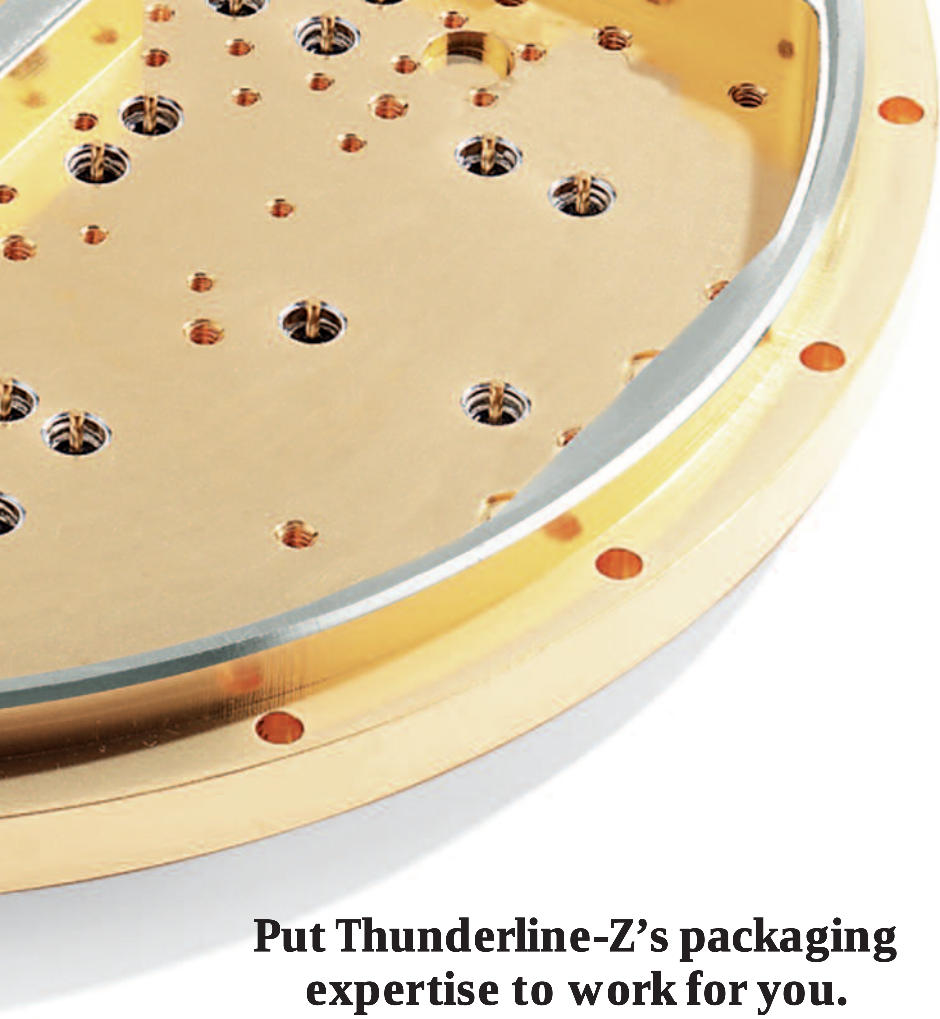
Thunderline DC Feeds are manufactured using precision components and controlled furnace technologies. Feedthrus are available in all quantities from research and development to high volume commercial applications. These rugged DC feedthrus come in an infinite mix of pin and body diameters and lengths. They are designed to satisfy the desires of quality minded engineers while meeting the competitive pricing demands needed in today's marketplace.

Thunderline Bell Pins™

The Thunderline Bell Pin is a revolutionary design that has been developed to work with lightweight aluminum or brass housings. They easily attach to the bottom of packages to create true hermetic surface-mountable parts. They are an ideal solution to costly, bulky Kovar packaging problems. By employing Bell Pins in your next design you'll be able to decrease costs while maintaining package integrity.

Thunderline Pro-Fit™

If one of our standard feedthrus doesn't fit your application, allow us to put our expertise to work in designing and manufacturing an exact solution. Thunderline Pro-fit feedthrus can be manufactured to any diameter or pin length with your choice of terminations. By allowing us to design the perfect solution you can have the engineering freedom to design the package you need.



Put Thunderline-Z's packaging expertise to work for you.

If you're struggling with production constraints, quality issues or a limited time frame in which to complete your packages, turn to Thunderline-Z. In addition to providing the world's most popular feedthrus over the last 3 decades, we have also delivered over 1,000,000 custom hermetic packages.

It all starts with our oven technology. Our state-of-the art process employs multi-atmosphere and multi-zone temperature control. And our experience encompasses the broadest range of soldering technology in the microwave business. You can trust our industry trained engineering team because they know the unique science of designing for hermeticity. We can provide turnkey packages with any combination of feedthrus, press on connectors and multi-pin headers you can imagine.

SolderTight™

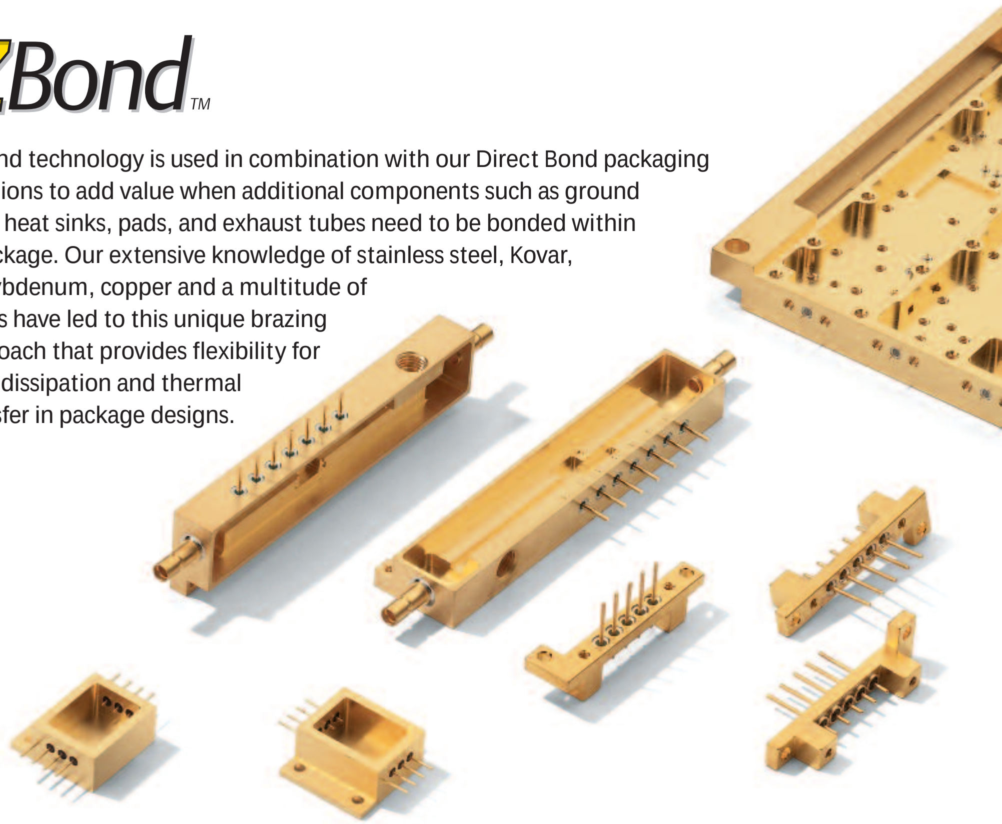
SolderTight technology is a proprietary soldering approach that blends Thunderline-Z's years of metallurgy experience with advanced oven profiling techniques. This technology allows us to create premium packages with any combination of Thunderline Feedthrus and a variety of connector options—including custom connector designs. From basic tin for general applications, to gold/tin solders for applications demanding higher strength and longevity, we have the extensive experience and controlled manufacturing processes to deliver exceptional quality. Customers prefer our packages because they are truly hermetic, easily affordable and delivered to their schedule.

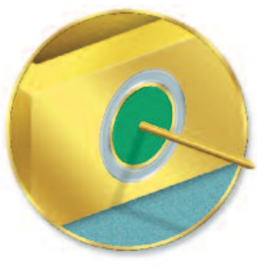
DirectBond™

Direct Bond is Thunderline Z's answer to the need for extremely high performance direct sealed packages where glass is matched and sealed directly to a metal housing. While our experience in soldering has led to premium soldered packages, our additional research and development of tightly monitored temperature control ensures the tightest matched direct seal packages as well. By utilizing these controls we have perfected an approach that guarantees true hermeticity over the widest temperature ranges and helps solve high frequency power loss problems inherent in other manufacturing techniques.

ZBond™

Z Bond technology is used in combination with our Direct Bond packaging solutions to add value when additional components such as ground pins, heat sinks, pads, and exhaust tubes need to be bonded within a package. Our extensive knowledge of stainless steel, Kovar, molybdenum, copper and a multitude of alloys have led to this unique brazing approach that provides flexibility for heat dissipation and thermal transfer in package designs.





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