APPLICATION NOTE

Hand Soldering Guidelines for VPT DC-DC Converters and Accessory Products

DC-DC CONVERTERS AND ACCESSORIES

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Introduction

VPT, Inc., a HEICO company, is dedicated to the highest level of quality. With expert, experienced personnel, state-of-the-art technology, and strict quality procedures, VPT produces reliable power supply products for the demanding environments of avionics, military, and space environments.

VPT's hybrid thick-film DC-DC converters and accessory products are hermetically sealed to keep moisture and/or contaminants from entering the package cavity. Products of this type use a projection weld or seam weld process to create the hermetic seal between the lid and the package body. Depending on lead (pin) diameter/length and package configuration, products of this type will use either a matched or compression glass or brazed ceramic disc to create a hermetic seal between the lead and package body. This glass or ceramic seal also serves the dual purpose of electrically isolating the lead from the package body.

VPT Series metal-packaged, hi-rel COTS DC-DC converters and accessory products are internally conformal coated and housed in a six-sided non-hermetic rugged metal enclosure to reduce moisture and contamination from entering the package cavity. Products of this type use a non-electrically conductive isolator to create a seal between the lead and package body. This isolator also serves the dual purpose of electrically isolating the lead from the package body.

These products should not be exposed to aqueous cleaning systems to avoid moisture ingress into the package that could potentially cause catastrophic failure.

VXR and VPT Series fully-encapsulated hi-rel COTS DC-DC converters and accessory products utilize VPT's patented V-Shield® technique. This technique uses a hard epoxy fill that is more compatible with aqueous cleaning systems.

VSC Series space COTS DC-DC converters and accessory products are fully encapsulated with dual-sided heatsinking and low outgassing. Radiation performance is guaranteed using radiation lot acceptance tested (RLAT) components. Guaranteed to 30 MeV/mg/cm^2 for SEE and 30krad(Si) for TID. The VSC Series is designed for smaller satellites in low Earth orbit (LEO) and NASA Class D missions.

This document details the proper processes for hand soldering products into systems and applications while ensuring product safety and maintaining functional integrity. VPT welcomes inquiries into any areas not specifically covered in this document. Please contact your sales representative or the VPT sales department for more information.

Solder Dipping and Wave Soldering

If the application requires the pins to be de-golded or needs better wettability to attach to the PCB assembly, VPT products can be solder dipped or wave soldered. This can be seen below in Figure 1. The gold thickness of VPT product pins is provided in Appendix B but is usually 50 to 100 microns. The pins should first be dipped in flux and then can be dipped in a solder pot at a temperature that should not exceed the lead solder temperature listed on the unit's datasheet. The standard value for this is 270°C for 10 seconds, but you should check the datasheet for your specific unit to make sure. Any soldering method that does not exceed this limit is an acceptable way to tin the pins. If icicles or excess solder remains, re-dip the pins in flux and then solder for an additional three seconds.

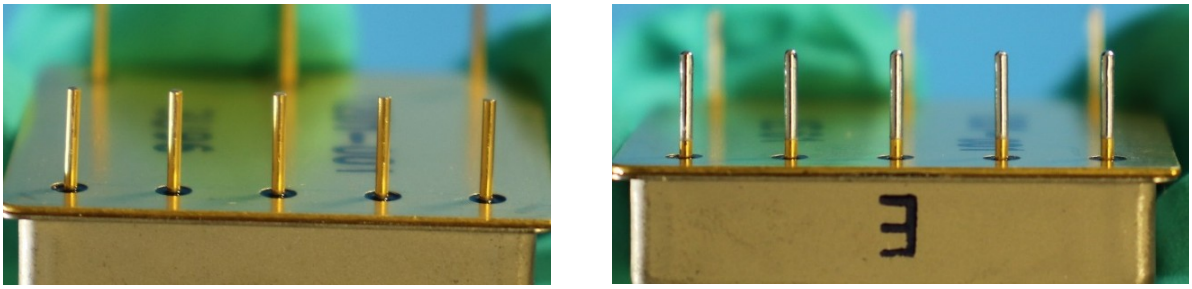

Figure 1: Standard pins (left) and solder-dipped pins (right).

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Hand Soldering

VPT products can be mounted and connected in systems in many different configurations with various processes. The most popular and well-controlled soldering method for PCB attachment is wave soldering. In many systems, however, this is not a viable option because of limiting configurations, resources, or hard wiring. This usually leaves hand soldering using a soldering iron, hot air system, or other method as the best option. Using a wave soldering or selective soldering machine process that simulates the preheating and hand soldering process described below is also a viable option.

At no time during soldering operations should any VPT product or pin be exposed to temperatures more than the respective lead solder temperature listed on the unit's datasheet. Additionally, at no time during soldering operations should any VPT product or pin be exposed to these high temperatures for more than 10 seconds. This can compromise the solder inside of the unit, causing internal solder joints, inducing electrical and mechanical failures, latent defects, and attachment failures. VPT performs 100% external visual inspection and electrical verification testing after hand soldering operations to verify that the leads and internal components have not been damaged as part of the process. VPT recommends that all products are inspected to ensure the soldering process has passed industry standards and no damage occurred when performing any hand soldering process.

VPT recommends following these steps when hand soldering products into PCBs and systems:

Note: For mounting side leaded packages with lead extenders, please refer to the Soldering Lead Extenders section below first.

1. Careful Insertion. Insert the unit into the PCB. Be sure to place the product straight into the mounting holes to prevent bent leads or seal damage.

2. Thermal Conductivity (Heat Sink). VPT products require a path to dissipate heat. Good contact with the base plate is required. VPT has custom-cut thermal gap pads that can be used to ensure good thermal conductivity. The TP Series of accessory thermal pads provide an effective method of ensuring a low thermal resistance path, good thermal performance, and excellent isolation between the DC-DC converter and the mounting plane. To learn more about thermal mounting pads or to order today, please visit www.vptpower.com/vpt-products/thermal-mounting-pads/.

   Thermal compounds can be used as well. The hi-rel COTS products that utilize the VPT V-Shield® (VXR and VPT – W packages) can have the heat dissipated from the top or

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bottom.

3. Pre-heating PCB Assembly. If the PCB is too thick, has solder pads that are too large, or simply needs more heat for soldering, the PCB assembly may need to be pre-heated before soldering to ensure that the soldering iron can achieve solder melt temperature quickly enough.

   Furthermore, it is best to get the full PCB assembly (including VPT products) heated to minimize the temperature delta. Assemblies can be heated in an oven or by using a hot plate until they reach a steady state. The temperature of the oven/hot plate is limited by either the storage temperature of the VPT products or the temperature limitation of the rest of the PCB assembly. The storage temperatures for VPT products are as follows:

   1. Hybrids: 150°C
   2. Fully Encapsulated V-Shield® COTS: 125°C
   3. Metal Packaged COTS: 125°C

4. Pre-heating Solder Pad. Heat the area around the lead to be soldered (PCB pad, plane, relief, etc.) with a high-quality, heat-controlled soldering iron. Ensure that no contact is made with the lead itself. Wire solder (electronic grade with a non-corrosive - RMA, no- clean, etc. - flux core) should be held to the area (not the tip of the soldering iron) until it starts to melt and can be moved over the pad with the soldering iron. It is helpful to pre-tin the solder pads before the product is installed to help with solder transfer.

5. Applying Solder to The Leads. As soon as the solder starts to melt, move the soldering iron into contact with the lead (while maintaining contact with the solder pad), add enough solder to complete the joint, and remove.

6. Wire Wrapped Leads/Through Hole Devices (Optional). In applications where the assembly would experience high vibrations wire wrapped leads could be used. Wire-wrapped leads are a good way to decrease the stress on the glass seals of the VPT products and provide mechanical relief to the leads. Please see the figures below on how to wire wrap.

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Care should be taken not to bend or put pressure on the pins. This could bend or crack the glass seal on hermetic packages, which could compromise the device, allowing moisture ingress that can induce a latent failure.

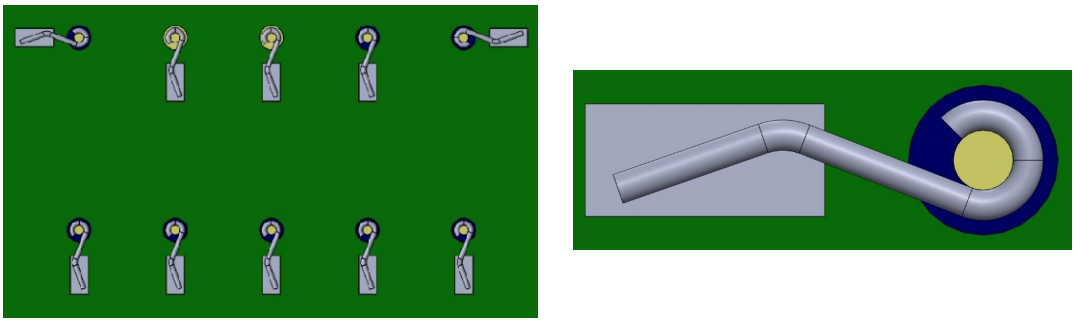

Figure 2: Wire-wrapped pin leads.

7. Side Leaded Packages (Optional). The VPT products with side leads can be attached using the same technique. The stranded wire should be pre-tinned and formed in a J-hook bend, as shown below in Figure 3.

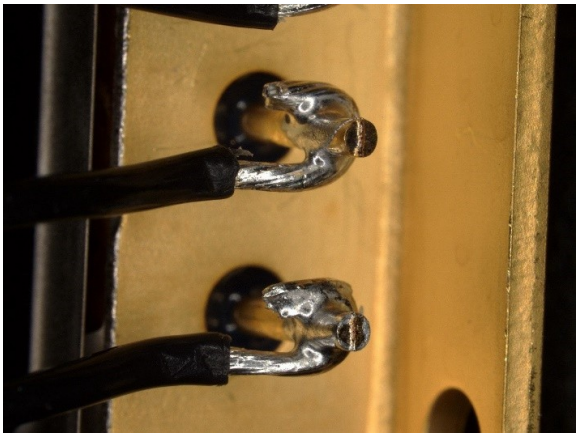

Figure 3: Side leaded J -hook pin connections.

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8. Test for Success. After soldering is completed, VPT recommends a visual inspection to verify solder joint acceptability and attachment to the PCB. When inspecting the seals in hybrids, look for chip-outs that cover greater than 50% of the insulator distance between the lead and package. Also, be aware of chip-outs that expose more than 0.010 inches (2.54mm) of base metal on the lead or penetrate the insulator below the meniscus plane. The remaining flux from the soldering operation should be cleaned to ensure all flux residue is removed. VPT's hybrid and fully encapsulated V-Shield® COTS products are resistant to water and cleaning solvents. For metal-packaged COTS, wipe the VPT unit using isopropyl alcohol (IPA).

VPT has an application video explaining topics covered in this application note. To find the Mounting and Thermal Considerations overview video, please visit our website and navigate to the "Videos" link under the "Resources" tab in the top navigation.

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Soldering Lead Extenders

1. Carefully insert the lead extenders (VPT Part Number: A9001-002 or A9001-003) onto the pins on one side of the header, either pointing up or down depending on the requirement. Press the lead extenders onto the pins until it stops. VPT uses fixtures to ensure that the lead extenders are inserted with the right spacing. See the figures below.

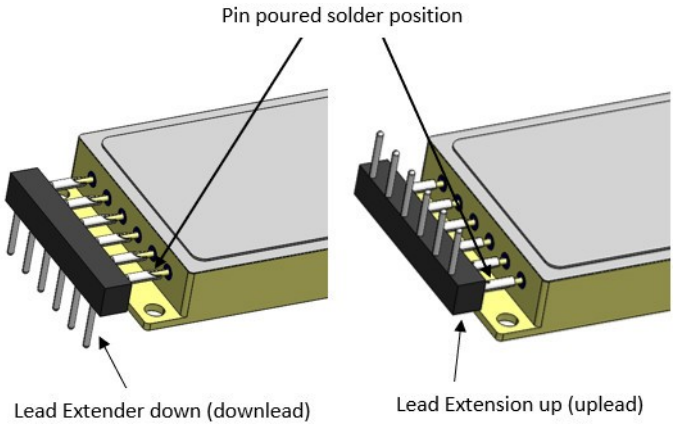

Figure 4: Soldered up lead (UL) and down lead (DL) extensions.

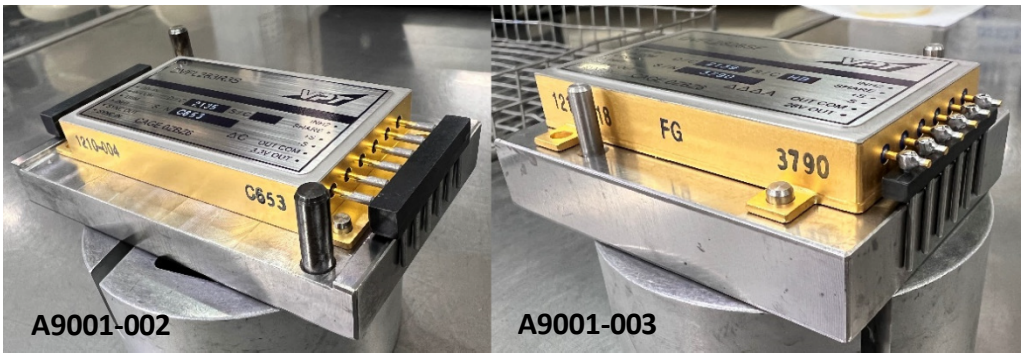

Figure 5: A comparison of traditional down leads (left) to the extended down lead option (right).

2. Flux can be used to improve solderability. The up lead (UL) fixture is seen in Figure 6.

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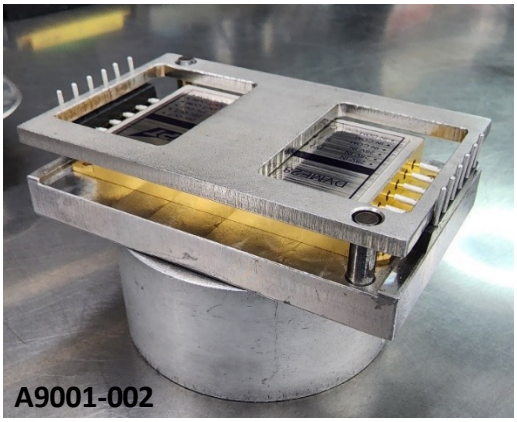

Figure 6: Up Lead Extension Fixture

3. Apply soldering iron to the side of up/down lead near the attach area or pour area (the pour area is specific to A9001-002, as shown in the figure below) to heat the pin and lead extenders.

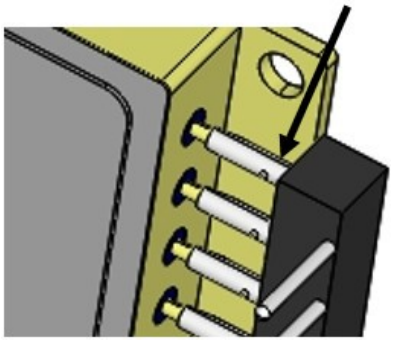

Figure 7: Up Lead and Down Lead solder pour area.

4. Wait for a few seconds (do not exceed three seconds) to allow both pin and lead extenders to get enough heat to melt the solder. For A9001-002, apply solder wire to the poured solder position of the pin and lead extenders to make a good solder connection all the way around the pin. If using A9001-003, ensure a proper solder fillet is seen on both sides, as seen in the image below. Do not apply solder wire to the tip of solder iron because this might cause a cold solder joint that can compromise the electrical connection, potentially causing a failure or the device not to meet the performance required. VPT recommends using isopropyl alcohol for cleaning.

Note: VPT uses a soldering iron temperature of 350˚C for up to 3 seconds for this process. This exceeds the lead solder temperature listed on the datasheet. However, when contact is maintained for less than 3

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seconds, temperatures internal to the unit will not rise to levels that will damage the unit.

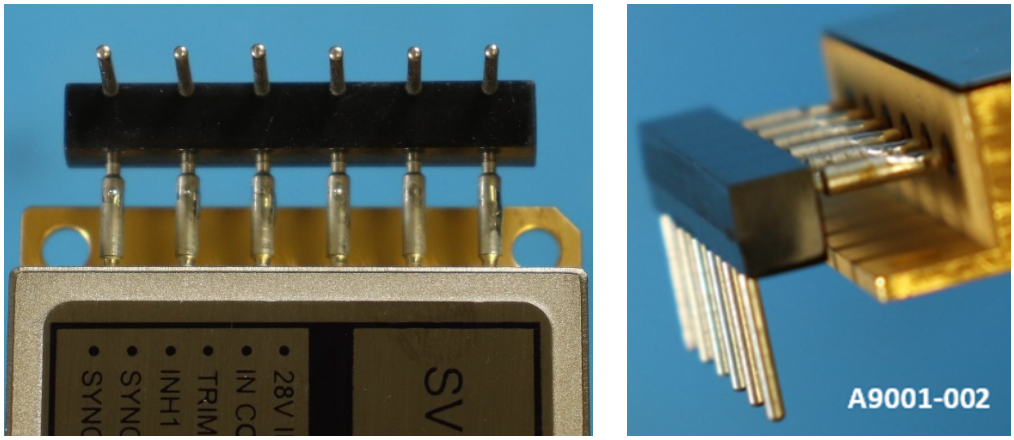

Figure 8: Up Lead and Down Lead extenders after cleaning.

Note: If the device is damaged during this process, it is outside the warranty of the product. Also note that many of VPT's side leaded packages can be purchased with installed lead extenders, contact VPT sales for a quote.

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Contact Information

For further information about any of VPT's products, policies, or programs contained herein, or to request a quotation or place orders please contact your sales representative or the VPT Inc. Sales Department at:

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Appendix A

Please refer to the table below which recommends the minimum hole size and minimum pad diameter size based on the pin size of respective VPT products. These parameters are calculated using IPC-2221 and IPC-2222 Level A (General Design Producibility-Preferred) assuming a hole fabrication tolerance of ±0.003.

Maximum Pin Diameter	Minimum Hole Diameter	Minimum Pad Diameter
0.082"	0.092"	0.118"
0.043"	0.053”	0.079”
0.032"	0.042"	0.068"
0.027"	0.037"	0.063"
0.020"	0.030"	0.056"

Appendix B

Please see the table below for gold-plating and nickel-plating thickness measurements for various VPT packages, respectively. The unit of measurement is in microinches (µin).

Package Type	Gold-Plating Thickness (µin)	Nickel-Plating Thickness (µin)
Hybrid Thick-Film	50-150	200-650
Hi-Rel COTS	60-100	80-140

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