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eSIP Package Information

eSIP® Package Enables Simpler, Lower Profile Power Supplies

Power Integrations' new eSIP package has the same low thermal impedance as the traditional TO-220, yet it's only half the height. This is ideal for slimmer electronic products such as LCD monitors, flat screen TVs, and set-top boxes.

eSIP benefits:

- Reduced height of package allows lower profile designs
- Similar junction-to-case thermal impedance (θ_{JC}) as standard TO-220 package
- Heat slug connected to Source to reduce EMI noise
- Simple clip-mounted heatsink reduces manufacturing cost and improves repeatability

Mounting Options

- Adhesive Mounting Tape
- Plastic Strap
- Stainless Steel Strap
- Stainless Steel U-Clip
- Manufacturer Information

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For specific information on package dimensions, please see Power Integrations' Package Information Document.

Package Comparison

Package	Mounting Method	Minimum Mounted Height	Heatsink Potential
eSIP (L)	Adhesive	2.1 mm	Source
eSIP (E)	Adhesive U-Clip Plastic Mini Strap Plastic Strap Metal Strap	10.5 mm 15.5 mm 20 mm 24 mm 20 mm	Source
TO-220 (PI)	Screw	21 mm	Source
TO-220 (Standard)	Screw	21 mm	Drain

Figure 1 (right) illustrates the height difference between some of the packages shown in the above table. The L version of the eSIP, mounted with the adhesive mounting compound, has the lowest mounting height of 2.1 mm. The E version of the eSIP, mounted with the same compound, also has a very low profile (10.5 mm) when compared to the TO-220.

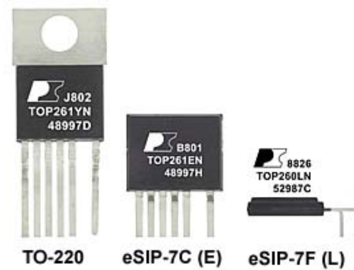


Figure 1: eSIP E and L packages with TO-220

The Power Integrations TO-220 and eSIP packages feature an exposed lead frame. This lead frame is connected to the SOURCE terminal of the MOSFET power device. When mounted, it is also connected to the heatsink. This ensures that the heatsink is connected to the DC(-) rail, which is also the electrically quiet node, and therefore does not lead to an increase in radiated EMI.

For more details on the eSIP package, please see Power Integrations' Package Information Document.

The following information on commonly available mounting methods and suppliers will help designers when using the eSIP package.

Multiple Mounting Options

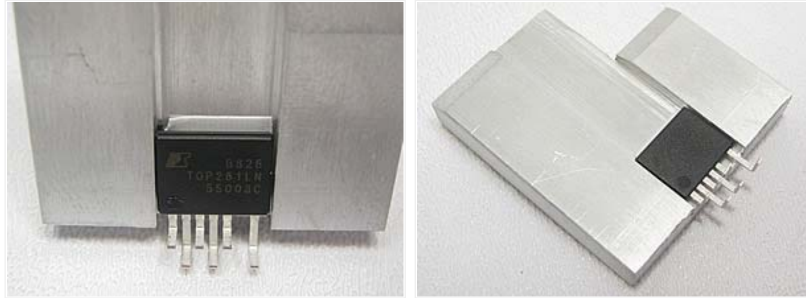
There are multiple low-cost mounting options for the eSIP package.

- Adhesive Mounting Tape
- eSIP plastic strap with screw
- eSIP plastic mini strap with screw
- eSIP stainless steel strap with screw
- Standard stainless steel U-shaped spring clip (U-Clip)
- Adhesive mounting compound

Adhesive Mounting Tape

Adhesive mounting tape replaces both the mounting hardware and thermal grease normally required when mounting a power

semiconductor design to a heatsink. The tape itself is coated with a pressure sensitive adhesive that sticks the power device to the heatsink without the need for additional mounting hardware. Thermal impedance is dependant on the applied pressure used when mounting. Overall thermal impedance is similar to thermally conductive glue or thermal grease. This mounting method is especially useful for the eSIP (L) package, where a low profile is a requirement.



Figures 2 & 3: eSIP (L) Mounted to Heatsink Using Adhesive Tape (Visible Along Top Edge of Package)

Mounting Guidelines for eSIP with adhesive tape

The thermal impedance of the adhesive tape when assembled is a function of the pressure applied during the attachment process.

When mounting the eSIP, a pressure of 100 PSI (~0.69 N/mm2) is recommended; for the eSIP package, this equates to approximately 55 N applied across the front surface of the package.

It is important that this force is applied evenly across the whole surface of the package to ensure a consistent bond and thermal impedance.

For specific details on the use of adhesive tape please refer to the manufacturer's information.

Supporting Documents – Adhesive Tape

Bond-Ply Datasheet

Plastic eSIP Straps

The plastic eSIP straps are low cost mounting option for the eSIP package. These are held in place with a screw and work by applying pressure to the front of the package. In some applications, the temperature of the heatsink may get as high as 125 °C; the softening temperature of the strap should be >150 °C. Detailed information about the plastic eSIP straps can be found in the Supporting Documents area of this section.

Figure 4: Plastic eSIP Strap

Figure 5: Plastic eSIP Strap Mounting eSIP to a Standard TO-220 Heatsink

Figure 6: Plastic eSIP Mini Strap

Figure 7: eSIP mounted to heatsink with Mini Strap

Figure 8: eSIP mounted to heatsink with Mini Strap (showing package details)

Figure 9: Plastic eSIP EZ Strap

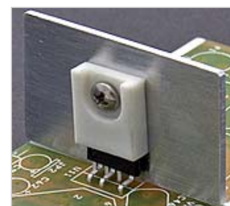


Figure 10: eSIP Mounted to Heatsink with EZ Strap

Mounting Guidelines for eSIP plastic straps (screw mount)

Hole Size: Designed for standard TO-220 heatsinks (3.2 mm typical)
Screw Size: 3 mm (M3) pan head screw
Maximum Torque: The screw torque recommendation is 1.8 to 2.3 lbf • in or 0.20 to 0.26 Nm maximum.

To avoid the need for a washer between the screw head and the surface of the strap the screw head should be flat. Excessive unevenness, the use of a smaller screw, or larger heat sink hole can cause the strap to crack. As with the TO-220 package, the use of lock nuts, spring washer, and thread lock is permissible.

Self-tapping screws are not recommended due to the variability in the force they apply to the strap and therefore the eSIP package. Rivets should not be used under any circumstances.

As for all semiconductors the heatsink mounting surface must be flat and without burrs to prevent damage to the IC. Finally, the IC should be mounted to the heat sink before soldering the assembly to the PCB. Soldering the IC and heat sink to the PCB and then mounting the strap will put unacceptable mechanical stress on the IC package.

The use of thermal grease or a thermally conductive pad is recommended to reduce the thermal impedance between the rear of the package and the heatsink.

Supporting Documents – Plastic eSIP Strap	
Strap Drawing	

Supporting Documents – Plastic eSIP Mini Strap	
Mini Strap Drawing	
Material Safety Data Sheet (MSDS)	
Material Specifications - English	
Material Specifications - Chinese	
RoHS Test Report	

Supporting Documents – EZ Strap	
EZ Strap Drawing	

Stainless Steel eSIP Strap

The stainless steel eSIP strap provides a metal option to the plastic eSIP strap. This strip is held in place with a screw and works by applying pressure to the front of the package. Detailed information about the stainless steel eSIP strap can be found in the supporting documents table of this section.

Figure 11: Metal eSIP strap mounting eSIP to a heatsink

Mounting Guidelines for eSIP stainless steel strap with screw

Hole Size: Designed for standard TO220 heatsinks (3.2 mm typical)
Screw Size: 3 mm (M3) pan head screw
Maximum Torque: The screw torque recommendation 0.26 Nm (2.3 lbf · in).

Due to the robustness of the metal material the torque used to fix the metal strap to the heatsink is less critical than for plastic types (no risk of cracking). Providing the mounting point is firmly attached to the heatsink then the force applied to the eSIP package is a function of the strap design and material used.

Self-tapping screws may be used but threaded screws are recommended due to their repeatability and robustness against shock. Rivets should not be used due to the shock that the eSIP part experiences during the riveting process. As with the TiO-220 package, the use of lock nuts, spring washer, and thread lock is permissible.

As for all semiconductors the heatsink mounting surface must be flat and without burrs to prevent damage to the IC. Finally, the IC should be mounted to the heat sink before soldering the assembly to the PCB. Soldering the IC and heat sink to the PCB and then mounting the strap will put unacceptable mechanical stress on the IC package.

The use of thermal grease or a thermally conductive pad is recommended to reduce the thermal impedance between the rear of the package and the heatsink.

Supporting Documents – Stainless Steel eSip Clip	
Steel Strap Drawing	
RoHS Inspection Certificate	
RoHS Test Report	

Stainless Steel U-Clip

Another option of mounting the eSIP is to use a U-Clip. The U-Clip fits over the side of the heatsink and the front of the package and holds the package firmly to the heatsink (see Figure 6). A variety of U-Clips are commonly available. Some of these options from Aavid Thermalloy are shown below in Fig. 13.

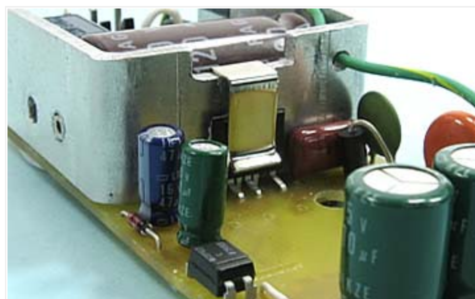


Figure 12: TopSwitch-HX mounted by the stainless steel U-Clip

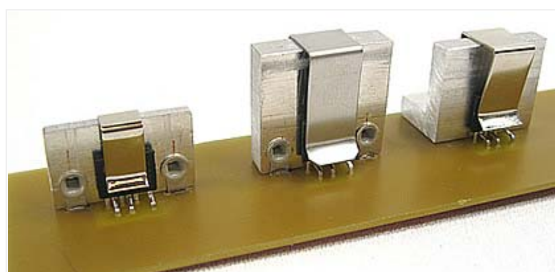


Figure 13: U-Clips mounting eSIP devices to various heatsinks

The U-Clip is a common mounting option in many of today's high volume designs. Below are two photographs showing the U-Clip being used in high-volume inkjet printer power supplies. Figure 14 shows the U-Clip securing a bridge rectifier to a heatsink. Figure 15 shows a TO-220 held in place by the U-Clip.

Figure 14: U-Clip securing an input bridge rectifier

Figure 15: U-Clip securing a standard TO-220 power MOSFET

Mounting Guidelines for eSIP stainless steel U-clip

It recommended that the eSIP is attached to the heatsink using the U-clip to form a sub-assembly.

This sub-assembly is then assembled into the printed circuit board before soldering. This is to ensure that co-planarity is maintained between the eSIP and heatsink surface.

Soldering the eSIP first then attaching the heatsink is not recommended as typically the eSIP will not make good contact with the heatsink thereby increasing thermal impedance.

In a production environment a jig may be used to ensure alignment of the eSIP part and heatsink while the clip is inserted.

Vibration Resistance

To demonstrate the ability of the U-Clip to stay securely in place during vibration and mechanical shock, an test board (shown above in Figure 13), using the CLP212SG, CLP212G and CL212TG clips from Aavid Thermalloy, was submitted for testing to the ensure that they were able to meet the IEC-60068 standard. All three of the U-Clips studied passed the shock and vibration test. The full test report can be downloaded here.

Adhesive Tape Manufacturer Information

Manufacturer	Contact Information	Type	Part Number
The Berquist Company	http://www.bergquistcompany.com	Adhesive Tape	Bond-Ply 100

eSIP Strap Manufacturer Information

Manufacturer	Contact Information	Type	Part Number	Recommended Heatsink Height (without notching)
Kang Yang Hardware Enterprises Co., Ltd	Nancy Lin +886-2-2647-6930 nancy@kangyang.com.tw	Mini	PH-3	20 mm
		Metal Plastic	TRK-24 TC-24NNHA	20 mm
	Thermshield, LLC PO Box 1641			

Thermshield	Laconia, NH 03247 +1 603 524-3714 +1 603 524-6602 (FAX) sales@thermshield.com http://www.thermshield.com	Plastic	TS-11042-CY	24 mm

U-Clip Manufacturer Information

Manufacturer	Contact Information	Type	Part Number	Recommended Heatsink Height (without notching)	Recommended Heatsink Wall Thickness
Aavid Thermalloy	www.aavidthermalloy.com	U-Clip	CLP212SG	15.5 mm	2.25 mm
			CLP212G	24 mm	6.2 mm
			CLP212TG	20 mm	4.8 mm

ORDER eSIP CLIP SAMPLES NOW

Use of Interface Materials

Thermal Compounds (Grease)

Thermal compounds formulated to provide grease-like consistency ensure excellent thermal contact between the eSIP device and the heatsink. This is important to consider in higher power/dissipation designs.

When thermal compounds are used, care should be taken to apply only a thin film. Applying too much can have the counter productive effect of increasing thermal resistance. Excess thermal compound will typically appear at the edges of the mating surfaces of the clip and the heatsink. Excess thermal compound on the edge of the eSIP on the edge with the pins can also increase the risk of bridging between pins causing leakage currents to flow thereby affecting performance.

Silicone Rubber Insulating Pads:

Use of silicone rubber insulators generally results in a thermal resistance higher than that achieved with use of thermal grease. Silicone rubber insulators are often used for applications where the insulator provides electrical isolation between the power device being cooled and the heatsink. This is done while maintaining a low thermal resistance between the power device. Unless the power supply design uses one common heatsink, or electrical isolation is a need in order to meet safety and regulatory requirements, silicone rubber insulators are not necessary to be used with the eSIP package.

If a silicone rubber insulator is used, care must be taken to ensure that the smallest possible thickness that still meets the safety agency requirements should be used.

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