Bourns® Thick Film on Steel (TFOS) Technology

WHITE PAPER

Introduction

Bourns has a well-established history of adapting its advanced thick film printing technology to its component products. The Company continues to develop and process thick film inks that are used in cutting-edge products. For example, thick film printing technology is integral to the manufacturing of Bourns® Trimpot® trimming potentiometers. These products have a trusted reputation for providing exceptional reliability and performance. Now, Bourns is applying the versatility of thick film printing and extending its use on stainless steel substrates which allow higher power for more demanding application requirements.

This white paper outlines the benefits designers can realize in utilizing a TFOS Component in their application.

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Precision Monitoring and Measuring Solution

The Bourns® Model TFOS30-1-150T exemplifies the capabilities of this technology's high power and energy performance.

Bourns engineered its TFOS or Thick Film on Stainless Steel technology to be used on products for demanding applications such as pre-charge or discharge applications in battery energy storage systems, industrial power supplies, inverters, motor drives, heaters, and any application where higher power is needed. These low-profile components offer high pulse withstanding capabilities that can easily be attached to heat sinks.

Designed to handle high operating temperatures and high-power ratings, the Model TFOS30-1-150T component can be used to monitor and or measure voltage, ohmic value, or temperature. Its flat design makes it ideal for space-constrained applications and efficient energy management during variable frequency operations.

TFOS Construction Advantages

- The base is a stainless steel substrate. The surface of the steel is cleaned thoroughly to remove any contaminants, ensuring adhesion of subsequent layers.
- A high-integrity dielectric layer is applied to the cleaned steel substrate. This layer acts as an insulator, preventing electrical conduction through the steel.
- Once the dielectric layer is in place, thick film conductor and resistor patterns are applied using a screen-printing process.
- After each pass of the printed substrate, it is fired in a high-temperature furnace. This step is critical as it solidifies the thick film materials, ensuring they adhere to the dielectric layer and form robust conductive and resistive paths.
- After all the layers have been through firing, a protective overglaze layer is then applied over the conductor and resistor patterns. This overglaze provides mechanical protection, environmental resistance, and electrical insulation to the underlying layers.

Most significant is that the TFOS component can be customized to your exact requirement:

- Alternative shapes and dimensions available up to 406 mm x 406 mm
- Integration of temperature measurement elements
- Alternative ohmic values
- Alternative connections
  - Pad termination
  - Termination cables or flying leads
  - Push-on connectors

Bourns thick film steel offers excellent thermal transfer, enabling high power densities for both surge handling and continuous operation. With effective heat sinking, power capacity can be significantly enhanced. The resistor features customizable lead wires and push-on connectors. This technology delivers outstanding performance compared to other resistor types, demonstrating resilience to extreme temperature cycles without performance degradation, capable of meeting AEC-Q200.

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Application Example

TFOS technology can be used to monitor, protect, and manage energy transfer from a fuel cell stack to a vehicle. The stainless steel substrate in TFOS technology features a robust thick film dielectric protected by a high-temperature overglaze. It offers high thermal efficiency, fast heat dissipation, and strong mechanical durability that can withstand extremely high element temperatures up to 350 °C. Bourns has conducted extensive laboratory testing of its TFOS design to ensure its reliability and performance. For the fuel cell stack, the TFOS functions ensure seamless and safe energy transfer, preventing potential overloads or overheating by efficiently managing the power.

Additional Typical Applications

- **AC-DC, DC-DC power converters**
- **Battery energy storage systems**
- **Industrial power supplies**
- **Motor drives**
- **Dynamic braking systems**
- **Heaters**
- **Elevators**
- **Consumer products**
- **Solar inverters**

Electrical Data

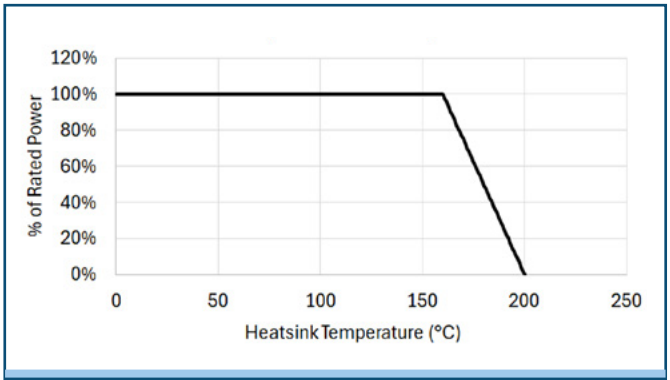

Figure 1. | Temperature Derating

- **Resistance range = 150 ohms**
- **Resistance tolerance = ±10 % std**
- **Pulse power rating = 3 kW**
- **Power rating on heatsink* = 260 W**
- **Power rating on fan-cooled heatsink** = 900 W**
- **Dielectric withstand = 2500 VDC**
- **TCR = <+600 ppm/°C**

Application Notes:

** A heatsink with thermal resistance ≤0.59°C/W is required to operate this power rating. Full coverage, void-free thermal grease must be applied when using the heatsink.*

*** Mounted on a heatsink with a thermal resistance ≤0.59 °C/W with 72.1 CFM air flow.*

- *Solder reflow can be used to process the termination pad.*

Physical Data

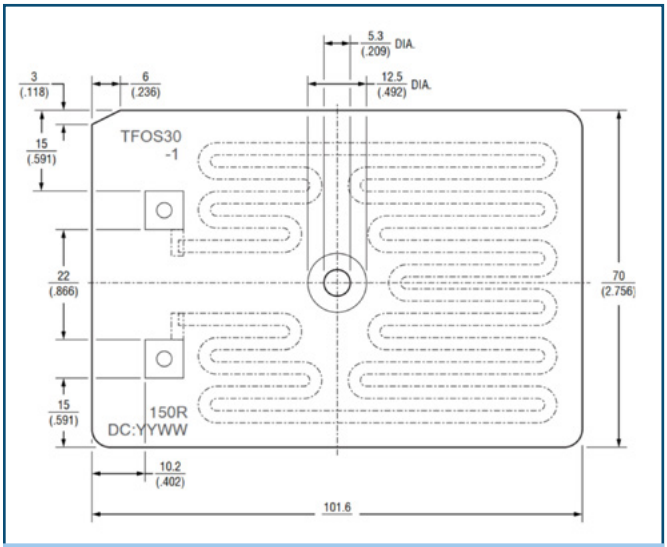

Figure 2. | Product Dimensions (all dimensions in mm/in)

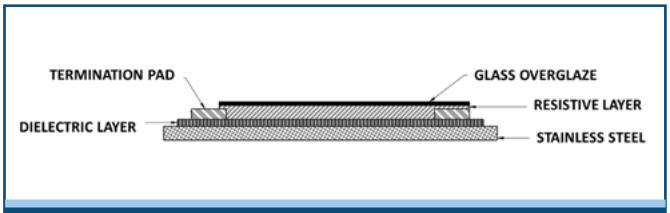

Figure 3. | Product Construction

Conclusion

Bourns® TFOS, Thick Film on Stainless Steel technology offers significant advantages in your application by providing exceptional thermal transfer characteristics, power ratings, and many customization options. Bourns TFOS is a reliable solution for applications requiring superior performance characteristics.