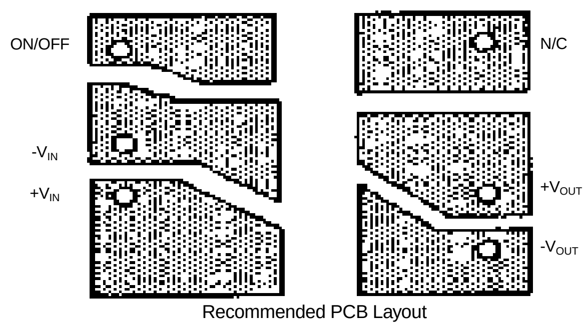
PT3100/4100 Series Thermal Considerations

The PT3100/4100 Series is designed for very low thermal resistance from the internal components to the outer case. The product utilizes all surface-mount components on a ceramic substrate. Ceramic substrates have 70 to 100 times the thermal conductivity of FR-4 material. Two ounce copper traces are used on the ceramic substrate to provide very low electrical resistance and excellent thermal conductivity. Tin plated copper leads are used for input and output power and readily conduct excess heat to the copper pads on the host PC board, effectively using it as a heatsink. Consequently, the thermal performance of the PT3100/4100 Series can be enhanced by maximizing the copper area around the pins of the converter. Figure 23 shows a recommended layout pattern which maximizes this copper area. Two ounce copper is recommended for optimum performance.

Figure 23

COMPONENT SIDE VIEW



The ceramic substrate of the PT3100/4100 Series is also thermally connected to a black anodized aluminum case. By creating very low thermal resistance, heat is readily conducted and evenly distributed to the case. This prevents "hot spots" and allows the internal component temperatures to remain close to the case temperature.

The thermal performance of the PT3100/4100 Series is very dependent on the amount of ambient airflow. Bellcore specifications TR-NWT-000063 defines "free air convection" to be up to 60 linear feet per minute (LFM) of air flow.

The PT3100/4100 Series DC-DC Converters are also protected from thermal overload by an internal over-temperature shutdown circuit. When the junction temperature of the control IC reaches 125°C, the converter will cycle on and off continuously at frequencies as high as 3KHz until the unit is sufficiently cooled.

To calculate the PT3100/4100's maximum case temperature (T_C max) and the maximum ambient operating temperature (T_A max), use the following formulas:

(1) $T_C \text{ max} = T_J \text{ max} - (\theta_{JC} \times P_{DIS})$
(2) $T_A \text{ max} = T_J \text{ max} - (\theta_{JA} \times P_{DIS})$

The junction temperature (T_J) is the internal temperature of the unit when thermal protection circuit is activated, 125°C. The thermal resistance from junction to case, θ_{JC}, is 10°C per watt of power dissipated in the unit. P_{DIS} is the power dissipated in the unit and is calculated as follows:

(3) $P_{DIS} = P_{IN} - P_{OUT}$ or
(4) $P_{DIS} = (1/\text{Efficiency} - 1) \times P_{OUT}$

θ_{JA} is non-linear with respect to power dissipation of the converter as shown in Figure 24 for free air convection. Figure 25 is the maximum ambient temperature verses power dissipation with free air convection.

Figure 24

THERMAL RESISTANCE VS POWER DISSIPATED

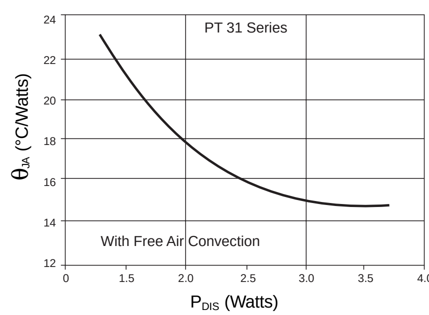
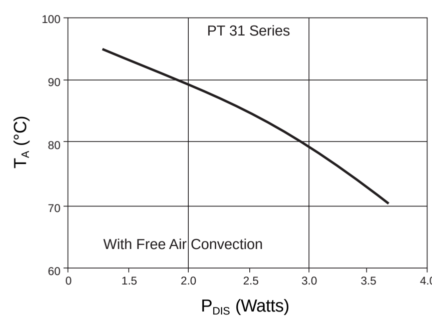


Figure 25

AMBIENT TEMPERATURE VS POWER DISSIPATED



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