Shunt Application Notes

A Shunt is a resistor designed to be connected in parallel with a measuring device. The shunt is used for current measurement beyond the measuring devices range.

Ohmite shunts are designed for use with 75 millivolt measuring instruments. The accuracy of Ohmite shunts is ±1/2% of the rated value. A shunt is a resistor, and will generate heat as current is passed thru it. The resistance material used in shunts is affected by this heat. The resistance of the shunt needs to be constant under different temperature conditions. The maximum operating temperature should be 80°C and the usual range is 40°– 60°C.

For continuous operation, it is recommended that shunts are not run at more than two-thirds (2/3) the rated current under normal conditions of use as per IEEE standards.

The Surface temperature of the resistance blades should never exceed 145 °C as this will permanently damage the shunt.

Mounting

The shunt should be mounted with the resistance plates of the shunt mounted in a vertical position to promote free convectional flow of air. Forced air cooling should be provided if shunt will be in an enclosed location.

Consideration for Lead Length

Some applications may require the use of long wire leads for measurement. The long lead length creates an additional voltage drop. This drop should be considered in the application and when ordering instruments for measurement.

Ratings

Ohmite Shunts are rated based on the below criteria:

- **Reference Temperature:** 25°C (±2°C)
- **Position:** Resistance plates mounted vertically, this allows free air circulation.
- **Connections:** Properly bolted using all terminals slots and bolt holes.

A shunt is used as part of a bus-bar assembly; it relies on the mounting structure to conduct away a major portion of the heat generated. The shunt should be properly mounted to a bus capable of absorbing this generated heat.

Shunt Calculations and Selection

Shunt ratings are established by finding the power required to achieve a specified resistive element temperature rise in free air at certain predetermined conditions. When operating conditions are significantly different from the rating conditions, the shunt should be de-rated accordingly to keep the element temperature within reasonable limits in order to prevent premature failure or causing permanent change in resistance.

Overload Calculation

A shunt does not need to be rated as Ohms law would indicate in an overload application. If a shunt is repeatedly energized for a period less than 5 minutes, an overload rating may be calculated per the below formulas:

D= ratio of ON time to the total period in seconds.
$F_{tr} = \sqrt{D}$
$P_{puls} = P_{max} / F_{tr}$
$P_{max} = P_{rated} \times 0.66$
P_{max} = maximum continuous power
P_{rated} = catalog rated power
P_{puls} = maximum pulsating power

Example: A 500 Amp 75mV shunt is energized for 10 seconds of each minute.
D = 10 / 60 = 0.166 and $F_{tr} = \sqrt{0.166} = 0.408$
P_{rated} = 500 x 0.075 = 37.5 watts
$P_{max} = P_{rated}$ x 0.66 = 37.5 x 0.66 = 24.75 watts
$P_{puls} = P_{max}$ / Factor = 24.75 / 0.408 = 60.66 watts

Utilizing Ohms law in conjunction with the calculations above, this shunt can be loaded up to 635 Amps.

Temperature Consideration

When elevated ambient temperatures are present the Shunt needs to be de-rated. A temperature of 125°C is the maximum temperature limit for the resistive plates. The de-rating can be found per the below formulas:

R_{se} = °C above ambient temperature
Temp = Elevated operating temperature of shunt in °C
P_{rated}= rated power according to ohms law x 0.66
$P_{max} = P_{rated}$ x 0.66
$P_{out} = P_{max}$ x (1-T/A)

Example: what is the maximum load of a 200 Amp 75 mV shunt if operated in a 100°C ambient temperature? Ambient temperature is 25°C.

R_{se} = 75
Temp = 100
P_{rated}= (200 x 0.075) = 15 watts
P_{max} = (15 x 0.66) = 9.9 watts
P_{out} = 9.9 x (1-75/100) = 9.9 x (0.25) = 2.475 watts

Utilizing Ohms law in conjunction with the calculations above, this shunt can be loaded up to 81 amps and not exceed the max operating temp of 125°C.