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Using PTC Thermistors with Yaskawa AC Drives

Application Note

Motor Temperature Protection Function using Drive Analog Input and Positive Temperature Coefficient (PTC) Thermistors.

DOCUMENT NO. AN.AFD.28

1 Using PTC Thermistors with Yaskawa AC Drives

Yaskawa series drives E7, P7, F7, A1000, and Z1000 include an analog input function to provide motor over-temperature protection for motors that include Positive Temperature Coefficient (PTC) thermistors. A common thermistor configuration is a three PTC thermistors connected in series and installed one thermistor per phase in the motor. this configuration is designed in accordance with European Standard DIN-44082. Thermistor characteristics are shown in ***Figure 1***. Note that resistance values shown are for a single thermistor. Typical applications employ three thermistors connected electrically in series, thus multiplying the thermistor resistance times three.

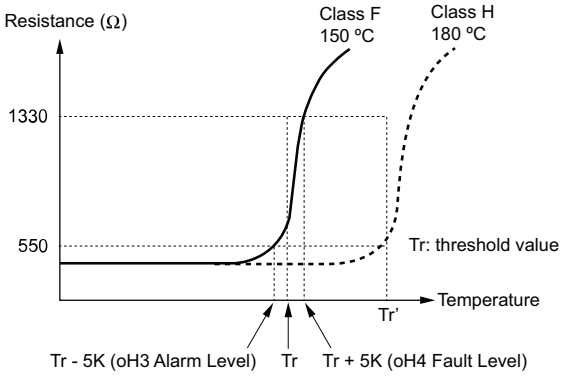

Figure 1 PTC Thermistor Temperature-Resistance Value Characteristics

Standard DIN-44092 requires the overheat trip point to be less than 2.5 Vdc. Yaskawa's built-in trip point is 2.34 Vdc, and the internal resistance at the drive's analog input to common is 20,000 ohms. This is important because the formula published in most Yaskawa drive instruction manuals does not consider the drives internal resistance and may cause the drive to trip on motor over heat unexpectedly. The branch resistance value of 18,000 ohms shown in the manuals is only valid for three thermistors in series made to conform to DIN-44092 and a 15 Vdc drive power supply. See ***Figure 2***.

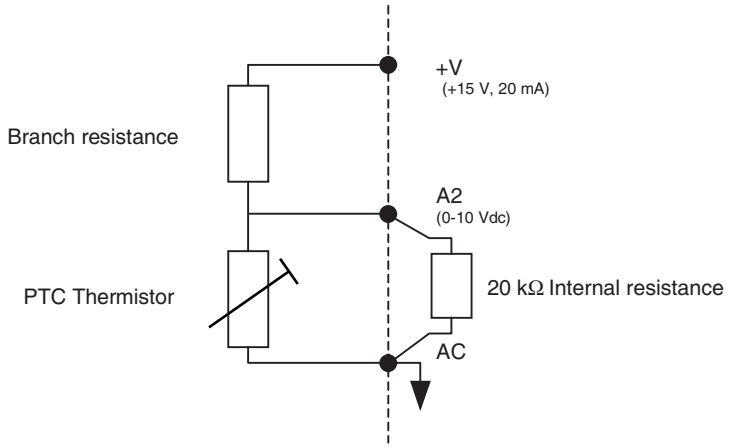

Figure 2 Thermistor to Drive Connection Diagram

It is important to note that the A1000 and Z1000 series drives have a 10.5 Vdc power supply. The branch resistance value will be 12,000 ohms in the case of a three DIN-44092 compliant thermistors configuration. Additionally, the A1000 series drive has a branch resistor embedded in the drive terminal PC board for this application. See ***Figure 3***.

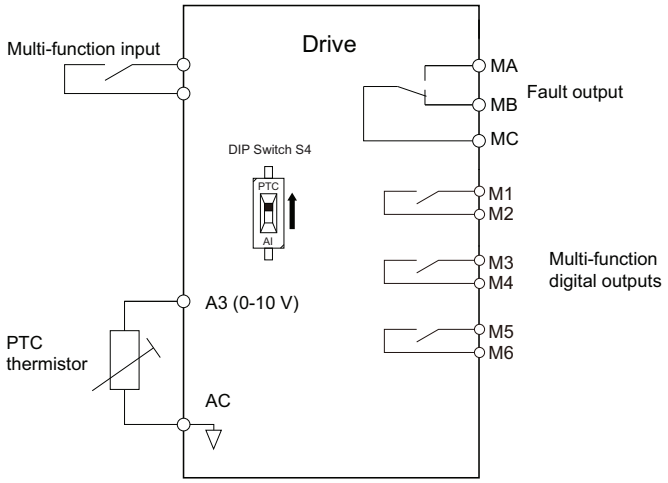

Figure 3 A1000 Connection of a Motor PTC

The calculation described here can be used for most other PTC type thermistors. The thermistor characteristics, quantity, and connection must be provided by the customer. The drive analog input voltage (10.5 Vdc for "1000" series drives, 15 Vdc for "7" series drives), trip voltage (2.34 Vdc), and internal resistance (20,000 ohms) are known. See ***Figure 4***.

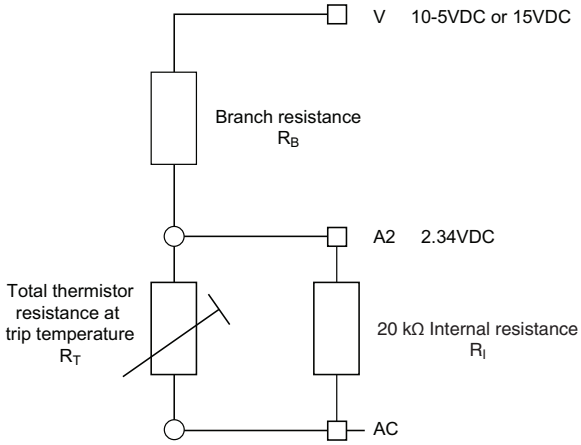

Figure 4 Motor PTC Drive Circuit

Use Ohm's Law and input the drive's internal resistance and trip voltage. The required branch resistance for any type and number of PTC thermistors can be calculated using this formula:

$$R_B = \frac{(V - 2.34)}{\left(\left(\frac{2.34}{R_T}\right) + 0.000117\right)}$$

Where: R_B = Branch resistance
V = Drive analog input supply voltage (15 Vdc for "7" series drives, 10.5 Vdc for "1000" series drives)
R_T = Total thermistor resistance at trip temperature

The A1000 series models for 930 amp and 1200 amp ratings also have the capability of accepting Negative Temperature Coefficient (NTC) thermistors. See the A1000 Technical Manual for details.

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