



# APPLICATION NOTE

CRA2512

Industrial Controls

Use of the Low Ohmic Resistor CRA2512 in Inverter Drives



## For Use in:

- Paper machines
- Presses
- Cooling tower fans
- Water pumps
- Crane hoists

The 3 phase inverters are used in variable speed control applications. They can be found in a wide spectrum of automated controls including paper machines, presses, fans in cooling towers, pumps for water supplies, or axial, transversal and hoisting movements in cranes and many more.

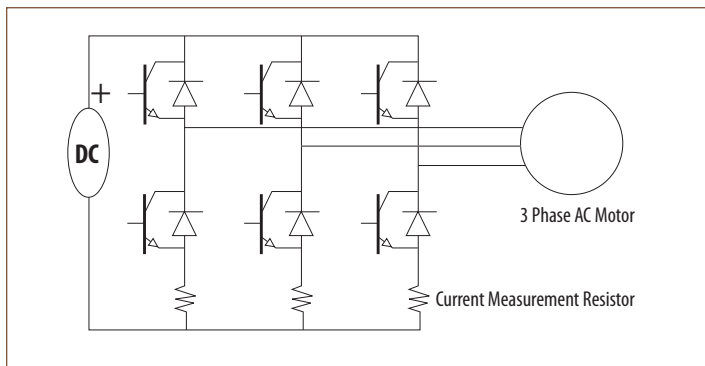


Figure 1. Typical schematic of a 3 phase inverter driving a motor with low ohmic resistors used for control.

Inverters provide accurate and efficient control of standard motors creating cost-effective solutions. AC motors are less expensive than DC motors which would otherwise be used.

Low ohmic resistors are an economical way to monitor and regulate the current used in the 3 phases by connecting them between a transistor on each leg and ground. An A/D converter and microcontroller calculate the current and establish what actions are

needed by the PWM controller. The accuracy of the control relies upon the current measurement of resistors remaining within the budgeted tolerance.

$R_1$  is the Resistance measured at Temperature  $T_1$ . Data sheets specify the TCR under conditions where the part is not placed under power. The T's resistance of the device is measured at ambient temperature (+25 °C) and then again at the temperature extreme (-55 °C or +125 °C). However the surface temperature of the chip will increase when placed under power and this in turn will affect the resistance. Furthermore, the actual ambient temperature can be quite high under normal operating conditions. This is because the circuit board will be confined in an enclosure with other heat-generating components with little or no air movement.

The Temperature Coefficient (TCR) of a resistor is used with the following formula:

$$TC = \frac{TR_1(T_2 - T_1)}{TR_2 - TR_1 \times 10^6}$$

TC = Temperature coefficient in PPM/ °C  
 $TR_1$  = TR at ambient temperature  $T_1$   
 $TR_2$  = TR at ambient temperature  $T_2$   
 $10^6$  = Conversion factor to PPM



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The CRA2512 series is rated to 3 watts of continuous applied power. It consists of a copper nickel alloy plate with solderable terminals and has the dimensions of a standard 2512 size resistor. Its high power density allows for some PCB space reduction. The TCR is specified as  $\pm 75$  PPM/ $^{\circ}\text{C}$  with the resistance being measured typically between an ambient temperature of  $25^{\circ}\text{C}$  and either  $+125^{\circ}\text{C}$  or  $-55^{\circ}\text{C}$ .

As a rule, power components such as shunt resistors are run at 30 - 50 % of their rating in real applications. This allows for operating at higher ambient temperatures and should result in a longer mean time to failure (MTTF). Commercial inverter drives are very compact and the temperature within their enclosure can often exceed  $80^{\circ}\text{C}$  when running at full load. It is therefore more useful to understand how the resistor will perform under power at higher ambient temperatures. Shown below are resistance readings from a unit powered at 1 watt at three different ambient temperatures. The matrix also shows the temperature on the surface of the units.

Power = 1 W	T = 25 °C	T = 85 °C	T = 125 °C
Resistance	10 mW	10.045 mW	10.075 mW
Surface Temperature	48 °C	101 °C	138 °C

*The results show a remarkably low drift even under load conditions and at high operating temperatures typically found in real life applications.*

For more information on the CRA2512 and other resistive products from Bourns, please visit

**[www.bourns.com](http://www.bourns.com)**

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