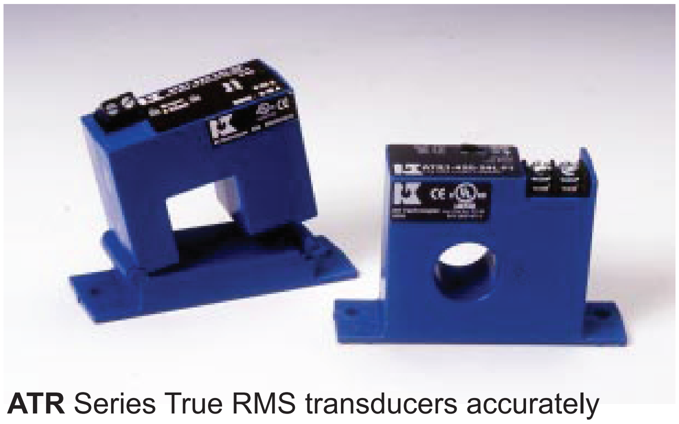
NK Technologies

Measuring VFD Output Current

Variable frequency drives (VFDs) improve control and conserve energy by regulating motor speed. The most common types are PWM (Pulse Width Modulation) and Six Step. Both technologies are based on high speed switching, which distorts the AC sine wave.

The two principal methods used to measure VFD output amperage are Average Responding and True RMS. Understanding them can help you specify the right current sensor for these demanding applications.

Most current transducers are the “average responding” type. They work on the assumption that the measured current is a pure sine wave. Their circuitry rectifies and filters the current waveform to obtain an ‘average’ DC signal. Since the RMS value of a sinusoidal waveform is the peak value divided by $\sqrt{2}$, this ‘average’ signal is scaled and converted to 4-20mA, or 0-5 VDC. This method provides fast response at a moderate cost but, of course, only works on a pure sine waves. (Figure 1)



ATR Series True RMS transducers accurately measure nonlinear (VFD) and linear (sinusodial waveforms.

VFD outputs are *simulated* sine waves with peaks significantly greater than the true current. The relative sizes of these peaks change as the output frequency changes. An average responding transducer that is calibrated for sinusoidal waveforms could accurately measure the VFD output at 20 Hz, but be 20% high at 30Hz, and 10% low at 40Hz.

Measuring Waveforms of Equal Power

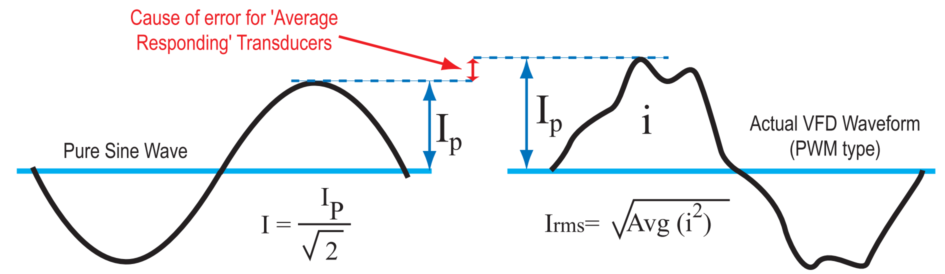


Fig. 1 An Average Responding transducer performs the equivalent of taking the signal peak then dividing the peak averge value by 1.414. This is accurate on pure sinusoidal (linear) loads only.

Fig 2. A True RMS transducer applies 'Root Mean Square' calculation (see formula.) This produces an accurate measurement of all waveforms, including the distorted VFD output shown above.

The best way to accurately measure non-sinusoidal waveforms is to use Root Mean Square (RMS) algorithm. A True RMS measurement is obtained by first squaring the signal, averaging the squared signal and finally taking the square root of that average (Figure 2). The result is the true power (heating value) of the wave. This allows very different waveforms to be compared to each other and to the equivalent DC (heating) value.

How do you know if you have a True RMS Transducer? If the product is described as “True RMS on Sinusoidal waveforms” you have an average responding transducer with a clever but misleading specification. A true RMS Transducer will be described as “True RMS on all waveforms” and “Accurately Measures VFDs or SCRs”.