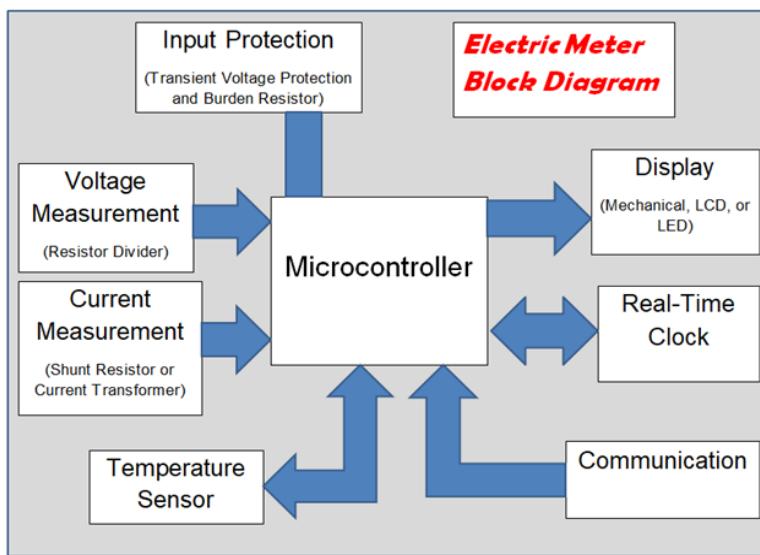


# Resistors in Metering Applications

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This application highlight will discuss resistor applications in electricity meters. The rapid expansion of the smart grid has brought along with it an increase in the functionality of meters, and an increase in resistor content. In addition to the hundreds of general purpose resistors that are used in meters, there are also some application specific resistor requirements. This application feature will discuss those non-commodity resistors in more detail.



## Input Protection

The meter requires protection from external overloads including protection from lightning strikes. Typically this is accomplished with a combination of a metal oxide varistor (MOV) for voltage protection and fusible wirewound burden resistor for current limiting. The MOV can be surface mount or thru hole. It can be a wide range of sizes depending on the level of protection required and the burden resistor used with it. Typical RMS voltages for MOV's are 150 V, 250 V, 300 V, 385 V and 575 V. The burden resistor is typically a fusible wirewound. The fusible wirewound resistor size and power rating will vary with the level of protection required and the size of the MOV. Smaller MOV's typically require larger, more robust resistors. Typical fusible wirewounds with power ratings of 3 to 7 watts and resistance values ranging from 36 ohms to 150 ohms are regularly used. Stackpole's WWF can be customized for the pulse handling and fusing performance required for a wide variety of meter requirements.

## Voltage Measurement

The metrology section of the meter measures the amount of power being used. In this application, a resistor network is used as a voltage divider. This network of resistors is typically made up of melf resistors with accuracy better than 1% and TCR better than 100 ppm. In addition, these melf resistors must demonstrate adequate stability in surviving surges as well as stability under a wide range of environmental and electrical stresses. Metal film melfs have a great combination of low thermal resistance, good pulse handling, low noise, and exceptional electrical and environmental stability.



Stackpole's MLFA Series of  
MELF Resistors



## Resistors in Metering Applications

Typical designs will use series and parallel combinations of 4 to 8 melf resistors usually in resistance values above 100 K ohms. Stackpole's MLFA offers the exceptional electrical and environmental performance needed for accurate voltage measurement.

Another solution uses high voltage resistors in the place of melf resistors. Parallel combinations of several high voltage resistors are used in conjunction with standard film resistors to provide the voltage division with the proper accuracy. Stackpole's RVC and HVC series are popular choices for this design.

### Current Measurement

Current measurement is also a portion of the metrology section. The current measurement in conjunction with the voltage measurement provides the information for power usage along with power factor and reactive power. The measurement is typically done with a shunt resistor or current transformer. When using a shunt resistor, it is normally an all metal design with resistance values below 5 milliohm, and TCR as low as possible. Power ratings for the shunt resistor range from 1 to 5 watts. Stackpole's HCS series is a great option for these shunt resistor designs.



Stackpole's HCS Series of High Current Shunt Resistors

### LED Display

Many of today's meter designs have LED displays and digital registry. For those meters, there are several non-commodity resistors that are needed. Input protection is typically provided by a fusible wirewound in the 2W to 5W power range and in resistance values around 10 ohms. Stackpole's WWF and SP3A are ideal choices for this requirement. The LED driver buck converter typically uses current sense resistors in relatively higher resistance values (1ohm to 5ohm). Stackpole's RMCF series and CSR / CSRN series are suitable choices for this application.

For higher current and higher efficiency designs these resistors may require metal element resistors such as the CSRF, CSNL, CSS / CSSH, or the HCS series. The DC to DC converter providing power to the LED string typically requires current limiting during power up and power down. Stackpole's RPC is an ideal solution here and provides outstanding reliable performance in a relatively inexpensive SMD package.

