

# Designing a Magnetically Immune Polyphase Smart Meter, Part 3: Comparing Isolated Shunt Sensing Architectures



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In part 1 of this three-part series, I discussed the isolated shunt sensing building blocks, and in part 2, I presented an overview of two different shunt sensing architectures. In this installment, I will compare the two architectures.

Figure 1 summarizes the differences between the isolated modulator and metrology analog front end (AFE) shunt sensing architectures.

	Isolated modulator	Metrology AFE
<b>Metrology engine</b>	Host MCU	Metrology AFE
<b>Separation of metrology and host functionalities</b>	Host or additional metrology MCU calculates metrology parameters	Relatively <u>more separation</u> (AFE calculates most metrology parameters)
<b>ADC sample data</b>	Raw ADC values available	Raw ADC values not available
<b>Phase-to-phase calculations</b>	Simplest; uses ADC sample data	Most complex; uses a zero crossing signal
<b>Voltage isolation</b>	No	Yes
<b>Number of slave devices</b>	0 (MSP430F67xx) to 1 (AMC1210)	3
<b>Data rate/emissions</b>	Relatively high	Relatively low
<b>Extra ADC needed?</b>	Yes, internal >10-bit ADC of MCU	No
<b>Size</b>	Relatively large	Relatively compact
<b>V circuit-&gt;I circuit crosstalk</b>	Relatively small	Relatively large
<b>Example devices</b>	AMC1210/MSP430F67641A, AMC1304/05/06, AMC1106	MSP430I20xx + ISO77xx

Figure 1. Comparing the Isolated Modulator and Metrology AFE Shunt Sensing Architectures

## Metrology Calculations

In the isolated modulator architecture, the host/metrology microcontroller (MCU), not the isolated shunt sensing device, performs all metrology calculations. In the isolated metrology AFE architecture, the isolated shunt sensing device does the majority of calculations. This means that the isolated metrology AFE architecture offloads the work that the host MCU would otherwise do, which provides better separation between metrology and the host.

One disadvantage of this, however, is that since there isn't one device with access to all of the raw analog-to-digital converter (ADC) data of the different phases, phase-to-phase calculations (such as determining the



However, one advantage of having the voltage sensed separately from the current is that there is less crosstalk from the voltage front-end circuitry to the current front-end circuitry. This voltage-to-current crosstalk is a factor in the energy percentage error seen at lower currents for the different architectures.

To summarize, the isolated modulator is good in systems that calculate advanced metrology parameters like harmonics and phase-to-phase measurements. The isolated metrology AFE architecture is good for low-emission, compact systems that require good separation of the metrology and host functions and only need basic metrology parameters calculated.

#### **Additional Resources**

- [View all TI smart e-meter reference designs.](#)
- Watch the [Polyphase Current Measurement with Isolated Shunt Sensors](#) training series.

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