SALEM™-3T

SOLID STATE ALL ELECTRONIC THREE-PHASE TRI-VECTOR ENERGY METER

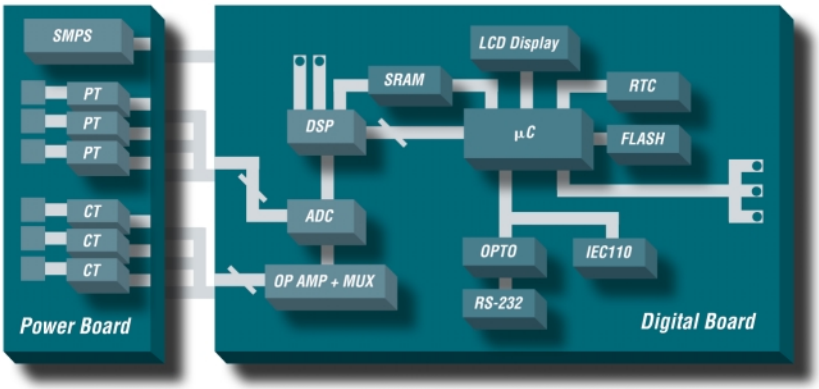
OVERVIEW

Analog Devices' SALEM-3T powerful Digital Signal Processor and Microcontroller-based **S**olid State **A**ll **El**ectronic **E**nergy **M**eter reference design satisfies virtually all three-phase power and energy measurement requirements. The design is offered as a complete fully-engineered solution that can be customized. OEMs have the option of using the chipset only, consisting of the Digital Signal Processor + Analog-to-Digital Converter + metering software, to design their own meter using any microcontroller.

The combination of a DSP and a microcontroller provides computational power and extensive data management features on a single platform. The SALEM-3T energy meter is powered by an on-board switched-mode power supply, which could be used in either the 3-phase/3-wire or 3-phase/4-wire mode, and is operational over a wide supply voltage range.

HIGHLIGHTS

- A Three-Phase, Tri-Vector Energy Meter Design with Class 0.5 Accuracy
- Uses a DSP + Microcontroller
- Accuracy Maintained for Nonsinusoidal or Dynamic or Unbalanced Loads
- Data Displayed on a 16 × 2 LCD Display
- Remote Meter Calibration Facilitated with Windows-Based Software
- Y2K-Compliant
- Software Included to Provide Phase Compensation for Current Transformers
- Harmonic Analysis
  – Includes All Odd Harmonics up to 11th Order



Block Diagram of SALEM-3T

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Various computations are performed by the digital signal processor to provide the following parameters:

Table I: Basic Parameters

Parameter	For Each Phase	Total
RMS Value of Voltage	•	
RMS Value of Current	•	
Apparent Power	•	•
Active Power	•	•
Capacitive Reactive Power	•	•
Inductive Reactive Power	•	•
Power Factor	•	•
Frequency		•
Apparent Energy	•	•
Active Energy (Import)	•	•
Active Energy (Export)	•	•
Inductive Reactive Energy	•	•
Capacitive Reactive Energy	•	•

A resistor divider network scales down the three-phase voltage measured by the meter. The line currents are sensed with current sensors. An 8-channel multiplexed sampling 12-bit Analog-to-Digital Converter digitizes the signal conditioned voltage and current signals, and sends the serial output data to the DSP. If the phase compensation for the external current transformers is enabled, the processor compensates the current channel with respect to the voltage channel. The DSP stores the acquired current and voltage signals in its internal Data Memory for computation of various parameters. The computed data is temporarily stored in an external SRAM for the microcontroller to acquire, process and store in the FLASH Memory.

The microcontroller manages all of the peripherals including the real-time clock (RTC), FLASH Memory, Serial Port, LCD Display, and it also boots the DSP. The RTC is Y2K-compliant and provides a century bit to the microcontroller. In addition to peripheral management, the microcontroller performs complete data management.

The following parameters can be programmed for storage:

Table II: Maximum Demand and Time of Use

Parameter	Feature
Maximum Demand (MD) – Fixed Interval	MD Integration Time selectable from 5 to 60 minutes, in 5-minute intervals
Maximum Demand – Slipping Interval	Slipping Interval selectable from one to five minutes, in one-minute intervals, with integration time => 5 times the slipping time
Time of Use – Seasons	12 slots to be programmed with starting and ending dates, and to be assigned to any of the five types of seasons including holiday season
Time of Use – Time Slots	12 slots to be programmed with starting and end time, and to be assigned to any of the four types of Tariff Registers

Three-Phase Tri-Vector Energy Meter

In addition to storing various parameters in each Tariff Register, the SALEM-3T energy meter provides the flexibility to store various measured data on a monthly basis. The following parameters are stored in each Tariff Register, and separately on a monthly basis:

Time of Use and Monthly Storage

- Total Imported Active Energy
- Maximum Demand for Imported Active Energy with Date and Time Stamp
- Total Exported Active Energy
- Maximum Demand for the Exported Active Energy with Date and Time Stamp
- Total Capacitive Reactive Energy
- Maximum Demand for Capacitive Reactive Energy with Date and Time Stamp
- Total Inductive Reactive Energy
- Maximum Demand for Inductive Reactive Energy with Date and Time Stamp

The assigned Maximum Demand Limit can be programmed in the meter to provide an optically-isolated pulse to activate an alarm. The Maximum Demand can be automatically reset on a preset date, or by using the on-board button, or on an external terminal using the AD-TRIVEC software. The meter will store the number of times the Maximum Demand has been reset and the date and time stamp for the last reset.

The storage of information relating to a failure of the main power supply, and the information on tampering with the meter are key features built into the SALEM-3T energy meter. When the meter is configured to register power in “Import Mode,” reversal of current is sensed as tampering.

The following data is stored in the meter that can be downloaded using an external terminal:

Failure and Tamper Data

- Date and Time stamp for first and last failure of each phase voltage
- Date and Time stamp for last restoration of each phase voltage
- Total number of failures for each phase voltage
- Date and Time stamp of first occurrence of current reversal (in Import Only mode)
- Number of such occurrences of current reversal

AD-TRIVEC is Windows 95-based menu-driven control and monitoring software, which can be used to calibrate, configure and monitor the SALEM-3T energy meter. The external terminal with this software can monitor the following parameters:

Parameter Monitor

- Basic Parameters: All basic parameters, voltages, currents, powers and energies are displayed simultaneously
- Time-of-Use Data
- Monthly Data
- Failure Data
- Tamper Data

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Calibrating the SALEM-3T energy meter is completely accomplished by software without any adjustment of trim potentiometers. The meter must be connected to a stable voltage and current source. An external terminal running AD-TRIVEC performs a step-by-step operation on the terminal to calibrate the offset, noise and gain parameters of the voltage and current channels of the meter.

To enable software phase-compensation for current transformers (CT) on the meter, based on the physical constants of the CT, computed constants have to be provided. After connecting a white noise source on the voltage and current terminals, the meter can perform phase estimation and fine-tuning of these constants. These constants are then used for the phase compensation during normal operation.

In addition to the calibration, the starting values of the energies can be preset before installation, typically for a replacement of an old meter. The complete data is stored in a Flash memory.

Parameter Configuration

- Enable or disable display of various parameters on the LCD display
- CT and PT Ratios
- User Identification
- User Password
- Season slots and types
- Time-of-use slots and Tariff Registers
- Maximum Demand preset limits
- Maximum Demand type – fixed or slipping method and the respective integration and slipping time

The SALEM-3T energy meter provides the user with flexibility to configure various parameters and update the meter by using the AD-TRIVEC software. This configuration data can be saved on a storage media to update any new meter, without having to go through the step-by-step process of configuring various parameters for each new meter manufactured.

Specifications of Sample Unit

Configuration	3-phase/4-wire
Current	
Nominal	5 Amperes
Maximum	6 Amperes
Frequency	
Reference	50/60 Hz
Range of Operation	40 Hz–150 Hz
Voltage	
Reference	3 x 240 Volts
Range of Operation	168 to –276 Volts (Phase to Neutral)
Power Consumption	<3.5 VA/Phase <1.5 Watt/Phase

Analog Devices, Inc., together with Technology & Research Pvt. Ltd., are developing the most advanced software system solutions today.

All designs using this software must use ADSST-EM-3xxx for ordering the chipset, consisting of a DSP processor and a 12-bit ADC.

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