PM9103AP

SINGLE PHASE POWER/ENERGY METERING MODULE SERIAL INTERFACE

FEATURES

- Performs both power and energy measurement
- Meets the accuracy requirements for Class 1 AC Watt hour meters
- Protected against ESD
- Total power consumption rating below 500mW (excluding current sensing)
- Uses a shunt resistor for current sensing
- Operates over a wide temperature range
- Serial interface having a RS232 Protocol

DESCRIPTION

The SAMES single phase power/energy metering module, the PM9103AP, provides energy data via a RS232 compatible serial interface.

Energy consumption is determined by the power measurement being integrated over time.

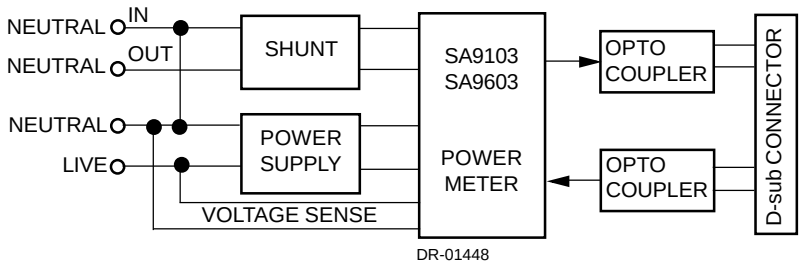
The method of calculation takes the power factor into account.

The output of this innovative universal power/energy meter is ideally suited for energy calculations in applications using a µ-controller.

The application utilises the SAMES SA9103CP, SA9103EP or SA9603CP power metering integrated circuits for power measurement.

As a safety measure, this application shows the current sensor connected to the neutral line. In practice, the live line may be used for current sensing, provided that the supply connections (MAINS) are reversed on the module.

BLOCK DIAGRAM



ABSOLUTE MAXIMUM RATINGS*

Parameter	Symbol	Min	Max	Unit
Supply Voltage (Note 1)	V_{AC}		540	V
Current Sense Input (Note 1)	V_{IV}	-2.5	+2.5	V
Storage Temperature	T_{STG}	-25	+125	°C
Operating Temperature	T_{O}	-10	+70 (Note 2)	°C
Max Current	I_{MAX}		800 (Note 3)	A
through Sensor	I_{MAX}		2000 (Note 4)	A

Note 1: Voltages are specified with reference to Live.

Note 2: The SA9103 and SA9603C integrated circuits are specified to operate over the temperature range -10°C to +70°C. The module functionality will however depend upon the external components used.

Note 3: t = 500ms

Note 4: t = 1ms

*Stresses above those listed under “Absolute Maximum Ratings” may cause permanent damage to the device. This is a stress rating only. Functional operation of the device at these or any other conditions above those indicated in the operational sections of this specification, is not implied. Exposure to Absolute Maximum Ratings for extended periods may affect device reliability.

ELECTRICAL CHARACTERISTICS

(Over the temperature range -10°C to +70°C, unless otherwise specified. Power consumption figures are applicable to the PM9103APE only.)

Parameter	Symbol	Min	Typ	Max	Unit	Condition
Supply Voltage (Continuous)	V_{AC}	180 90	230 115	265 135	V V	PM9103APE PM9103APA
Power Measurement range	P_{RNG}	-18400		18400	W	Specified accuracy
Power Consumption[1]				800	mW	V_{AC} = 230V Supply direct from mains
Isolation Voltage[2]	V_{IS}			2500	V	Continuous
Opto-coupler Output Current	I_O			10	mA	V_{OL} = 1V
Opto-coupler Input Current	I_I			10	mA	

Note 1: Power consumption specifications exclude power consumed by the current sensor.

Note 2: Isolation voltage may be specified, depending on customer requirements.

CONNECTION DESCRIPTION

Designation	Description
MAINS	Voltage supply connection to Neutral line
	Voltage supply connection to Live line
NEUTRAL IN	Connection to positive side of current sensor
NEUTRAL OUT	Connection to negative side of current sensor
SK1 D-sub connector 9-Pin	Serial Input Serial Output

FUNCTIONAL DESCRIPTION

1. Power Calculation

In the Application Circuit (see Figure 2), the output current from the current sensor will be between 0 and 16µA (0 to 80A through a shunt resistor of 625µΩ). The current input stage of the module, saturates at input currents greater than 18µA$_{RMS}$. The mains voltage (Voltage + 15% - 20%) is used to supply the circuitry with power and to perform the power calculation, together with the current information from the current sensor (shunt resistor).

The SA9103CP, SA9103EP and SA9603C integrated circuits may be adjusted to accommodate any voltage or current values. The method for calculating external component values is described in paragraph 6 (Circuit Description).

SAMES offers two evaluation module options, namely 230V/80A and 115V/80A.

The calculated power is integrated into a 22 bit integrator, which is accessable via a serial interface having a RS232 protocol. The power calculation takes the power factor into account.

2. Electrostatic Discharge (ESD) Protection

The device's inputs/outputs are protected against ESD according to the Mil-Std 883C, method 3015. The modules resistance to transients will be dependant upon the protection components used.

3. Power Consumption

The overall power consumption rating for this power metering application (Figure 2), is under 500mW, excluding the current sensor, when the supply is taken directly from the mains.

4. Isolation

The serial interface is isolated from the module which is at mains potential, via two opto-couplers. (In the event of the use of a current transformer for current sensing, the opto-couplers would not be required.)

5. Serial Interface

Reading and resetting of the on-chip integrators may be performed using a Personel Computer (PC). A standard serial cable should be used to connect SK1 to the PC. The computers port settings are as follows:

19 200 Baud
1 Start bit
1 Stop bit
No parity bits

The Serial Interface allows for the following operations:

Read Integrator: The device transmits the current integrator status to the controller, after the current measurement cycle has been completed (8 mains periods maximum).

Reset Integrator: The integrator is reset without transmitting the integrator status.

Read/Reset Integrator: The device transmits the integrator status and resets the integrator after the current measurement cycle has been completed.

In a typical application, the system controller monitors the status of the on-chip integrator using the "Read" command.

If after a "Read" command, the integrator value is sufficiently high, a "Read/Reset" command from the controller causes the integrated circuit to complete the existing measurement cycle, transmit the 16 most significant bits of the 22 bit integrator via the Serial Output, to the controller and restart the integrator.

The most significant bit of the 16 bits, indicates the direction of energy consumption measured (0 = Positive, 1 = Negative).

Refer to the SA9103C, SA9103E or SA9603C datasheets for the serial interface command protocols.

6. Circuit Description

The Application Circuit (figure 2) shows the components required for the serial interface power metering module, using a shunt resistor for current sensing.

In this application the device requires +2.5V, 0V, -2.5V DC supply.

The most important external components are:

C_1 and C_2 are the outer loop capacitors of the two integrated oversampling A/D converters. The value of these capacitors is 560pF. The actual values determine signal to noise and stability performance. The tolerance should be within ±10%.

C_3 and C_4 are the inner loop capacitors of the A/D converters. The optimum value is 3.3nF. The actual values are uncritical. Values smaller than 0.5nF and larger than 5nF should be avoided.

R_2, R_1 and RSH are the resistors defining the current level into the current sense input. The values should be selected for an input current of $16\mu A_{RMS}$ into the SA9103 / SA9603C at maximum line current.

Values for RSH of less than 200µΩ should be avoided.

$R_1 = R_2 = I_L/16\mu A_{RMS} * R_{SH}/2$.

Where I_L = Line current

RSH = Shunt resistor/terminating resistor

R_3, R_6 and R_4 set the current for the voltage sense input. The values should be selected so that the input current into the voltage sense input (virtual ground) is set to $14\mu A_{RMS}$.

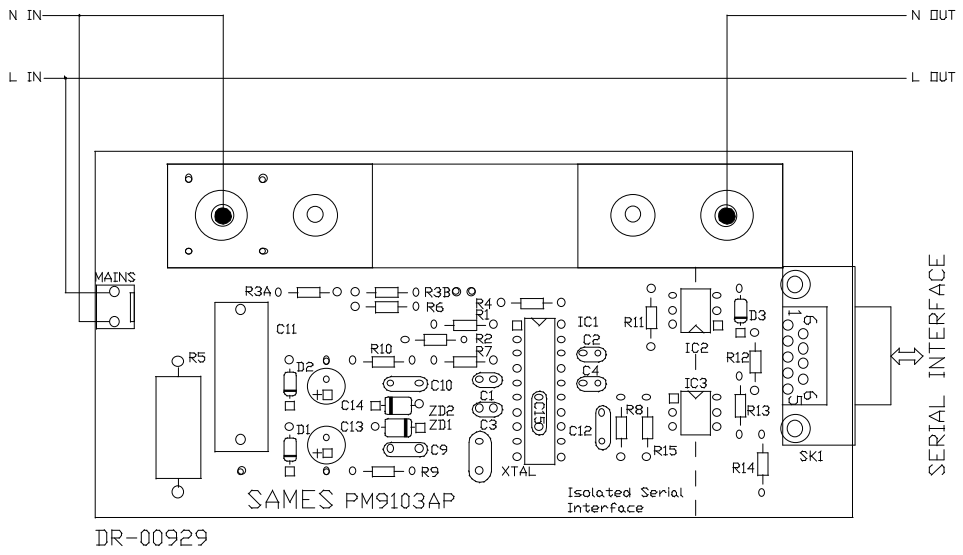
R_7 defines all on-chip bias and reference currents. With R_7 = 24kΩ, optimum conditions are set.

XTAL is a colour burst TV crystal (f = 3.5795MHz) for the oscillator. The oscillator frequency is divided down to 1.7897MHz on-chip and supplies the A/D converters and the digital circuitry.

7. Demonstration Software

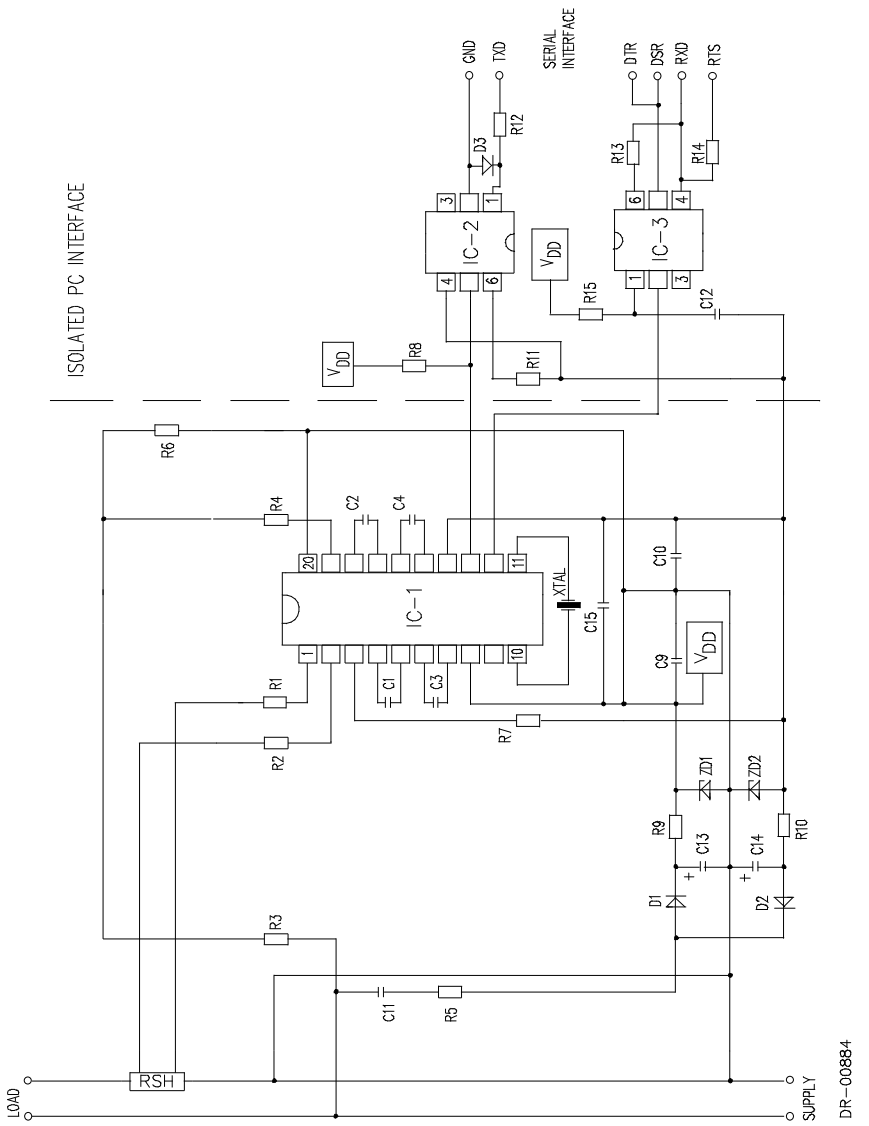
Software which runs under Windows 3.1 is provided with each evaluation module. See README.TXT on the diskette supplied for the installation instructions.

Figure 1: Connection Diagram



APPLICATION CIRCUIT

Figure 2: Application using a Shunt Resistor for Current Sensing, having a PC (Personal Computer) Interface.



Note: The Serial Interface having a RS232 protocol, has been designed to operate directly with a PC (Personal Computer).

Parts List For Application Circuit: Figure 2

Item	Symbol	Description	Detail
1	IC-1	SA9103CP/SA9103EP/SA9603C	DIP-20
2	IC-2	Opto Coupler 4N35	DIP-6
3	IC-3	Opto Coupler 4N35	DIP-6
4	D1	Diode, Silicon, 1N4148	
5	D2	Diode, Silicon, 1N4148	
6	D3	Diode, Silicon, 1N4148	
7	ZD1	Diode, Zener, 2.4V, 200mW	
8	ZD2	Diode, Zener, 2.4V, 200mW	
9	XTAL	Crystal, 3.5795MHz	Colour burst TV
10	R1	Resistor, 1.6kΩ, 1%, metal	Note 1
11	R2	Resistor, 1.6kΩ, 1%, metal	Note 1
12	R3A	Resistor, 1%, metal	Note 2
13	R3B	Resistor, 1%, metal	Note 2
14	R4	Resistor, 1M, ¼W	
15	R5	Resistor, 470Ω, 2W, 5%, carbon	
16	R6	Resistor, 24k, ¼W, metal	
17	R7	Resistor, 24k, ¼W, metal	
18	R8	Resistor, 680Ω, ¼W, 5%	
19	R9	Resistor, 680Ω, ¼W, 5%	
20	R10	Resistor, 680Ω, ¼W, 5%	
21	R12	Resistor, 120Ω, ¼W, 5%	
22	R13	Resistor, 120k, ¼W, 5%	
23	R14	Resistor, 3.9k, ¼W, 5%	
24	R15	Resistor, 120Ω, ¼W, 5%	
25	C1	Capacitor, 560pF	
26	C2	Capacitor, 560pF	
27	C3	Capacitor, 3.3nF	
28	C4	Capacitor, 3.3nF	
29	C9	Capacitor, 100nF	
30	C10	Capacitor, 100nF	
31	C11	Capacitor, polyester	Note 2
32	C12	Capacitor, 100nF	
33	C13	Capacitor, 100µF, 16V	
34	C14	Capacitor, 100µF, 16V	
35	C15	Capacitor, 820nF, 16V	
36	RSH	Shunt Resistor, 80A, 50mV (625µΩ)	Note 1

Note 1: Resistor (R1 and R2) values are dependant upon the selected value of RSH. See paragraph 6 (Circuit Description) when selecting the value for RSH.

Note 2: See the table below, detailing the component values for the selected voltage standard.

Item	Symbol	Description		Detail
		PM9103APA 115V	PM9103APE 230V	
12	R3A	120kΩ	200kΩ	
13	R3B	82kΩ	180kΩ	
31	C11	1µF	0.47µF	

ORDERING INFORMATION

Part Number	Description
PM9103APA	115V, 80A Module
PM9103APE	230V, 80A Module

Any Sales or technical questions may be posted to our e-mail address below:
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For the latest updates on datasheets, please visit out web site:
http://www.sames.co.za

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