PM9102AP

SINGLE PHASE POWER/ENERGY METERING MODULE PULSE OUTPUT

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

DESCRIPTION

The SAMES single phase power/energy metering module, the PM9102AP, provides two pulse rate output options, the frequency of which are proportional to the active power consumption.

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

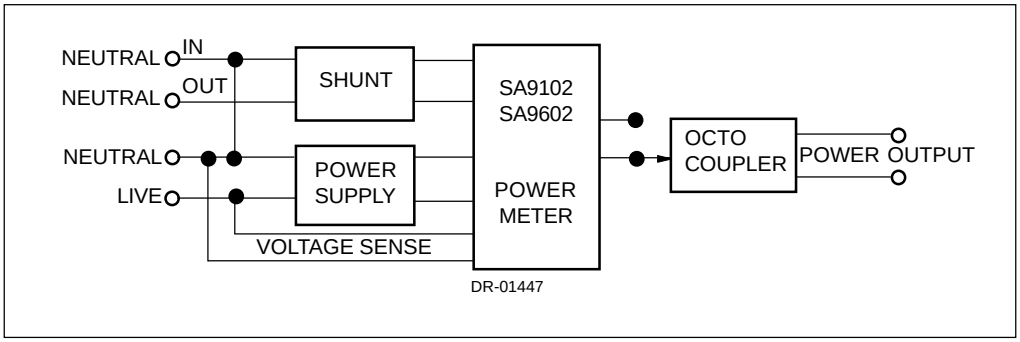
The method of calculation takes the power factor into account.

The output of this innovative universal power/energy metering circuit is ideally suited for energy calculations in applications using a µ-controller or mechanical counter.

The application utilises the SAMES SA9102CP, SA9102FP, SA9102HP, SA9602EP (DIP-20), SA9602HP (DIP-20) or SA9602MP 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 (Note2)	T_O	-10	+70	°C
Max Current through Sensor	I_{MAX}		800 (Note 3)	A
	I_{MAX}		2000 (Note 4)	A

Note 1: Voltages are specified with reference to Live.
Note 2: The SA9102 and SA9602 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 PM9102APE only.)

Parameter	Symbol	Min	Typ	Max	Unit	Condition
Supply voltage (Continuous)	V_{AC}	180 90	230 115	265 135	V V	PM9102APE PM9102APA
Frequency output	FOUTX	Refer to applicable IC data sheet				
Power consumption [1]				800	mW	V_{AC} = 230V Supply direct from mains
				200	mW	5VAC supply
Isolation voltage[2]	V_{IS}			2500	V	Continuous
Output transistor collector current	I_O			10	mA	V_{OL} =1V

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
JP1	SA9102/SA9602 output pin selector (Jumper)
SK1	Power measurement output

FUNCTIONAL DESCRIPTION

1. Power Calculation

In the Application Circuit (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 saturates at input currents greater than18µA_{RMS}. The mains voltage (230V + 15% -20%) is used to supply the circuitry with power and for the power calculation, together with the current information from the current sensor (shunt resistor).

The SA9102CP, SA9602EP (DIP-20), SA9602HP (DIP-20) and SA9602MP integrated circuits may be adjusted to accommodate any voltage or current values. The method of calculating external component values is described in paragraph 5 (Circuit Description).

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

The calculated power is integrated over time and converted into a corresponding frequency. The frequency is transmitted as a pulse rate through an opto-coupler.

2. Electrostatic Discharge (ESD) Protection

The device's inputs/outputs are protected against ESD according to 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, if a supply is taken directly from the mains.

4. Isolation

The pulse output is isolated from the module, which is at mains potential, via an opto-coupler. (In the event of the use of a current transformer for current sensing, an opto-coupler would not be required.)

5. Circuit Description

The Application Circuit (Figure 2) details the components required for the 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 for 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 SA9102 / SA9602 at maximum line current.

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

$R_1 = R_2 = (I_L/16\mu A_{RMS}) * RSH/2$

Where I_L = Line current

RSH = Shunt resistor/termination 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 and P_7 defines all on-chip bias and reference currents. With $R_7 + P_7 = 24k\Omega$, optimum conditions are set. $R_7 + P_7$ may be varied by ±10% for calibration purposes. Any change to $R_7 + P_7$ will affect the output quadratically.

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.

Figure 1: Connection Diagram

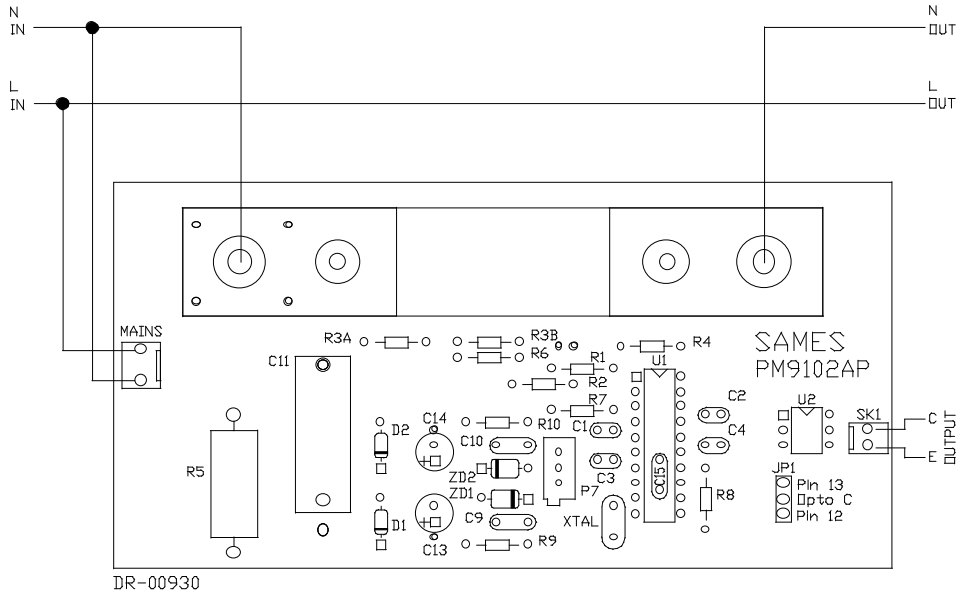
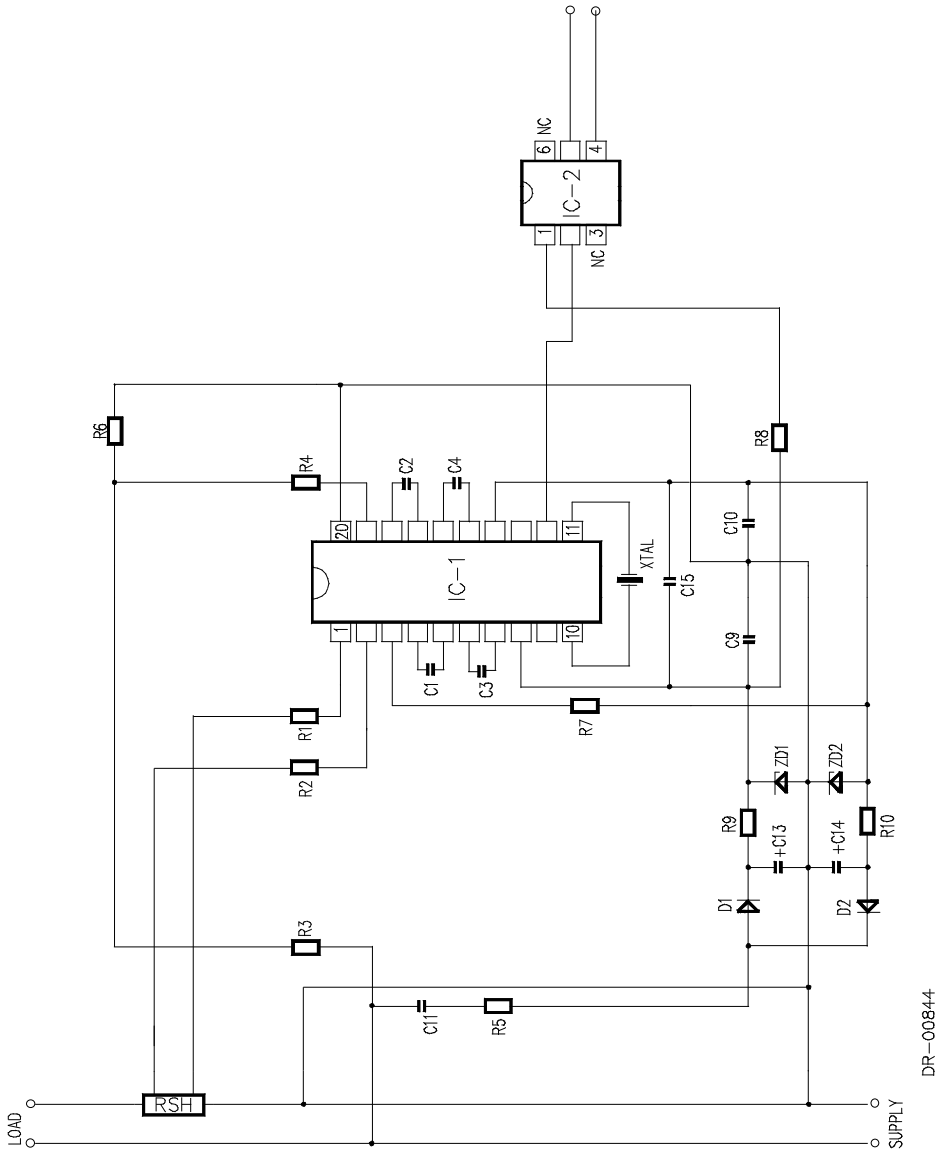


Figure 2: Application using a Shunt Resistor for Current Sensing.



Parts List for Application Circuit: Figure 2

Item	Symbol	Description	Detail
1	IC-1	SA9102CP/EP/FP/HP / SA9602EP/HP/MP	DIP-20
2	IC-2	Optocoupler, 4N35	DIP-6
3	D1	Diode, Silicon, 1N4148	
4	D2	Diode, Silicon, 1N4148	
5	ZD1	Diode, Zener, 2.4V, 200mW	
6	ZD2	Diode, Zener, 2.4V, 200mW	
7	XTAL	Crystal, 3.5795MHz	Colour burst TV
8	R1	Resistor, 1.6kΩ, 1%, metal	Note 1
9	R2	Resistor, 1.6kΩ, 1%, metal	Note 1
10	R3A	Resistor, 1%, metal	Note 2
11	R3B	Resistor, 1%, metal	Note 2
12	R4	Resistor, 1MΩ, ¼W, 1%, metal	
13	R5	Resistor, 470Ω, 2W, 5%, carbon	
14	R6	Resistor, 24k, ¼W, 1%, metal	
15	R7	Resistor, 22k, ¼W, 1%, metal	
16	P7	Trimpot, 5kΩ	Multi turn
17	R8	Resistor, 680Ω, ¼W, 5%	
18	R9	Resistor, 680Ω, ¼W, 5%	
19	R10	Resistor, 680Ω, ¼W, 5%	
20	C1	Capacitor, 560pF	
21	C2	Capacitor, 560pF	
22	C3	Capacitor, 3.3nF	
23	C4	Capacitor, 3.3nF	
24	C9	Capacitor, 100nF	
25	C10	Capacitor, 100nF	
26	C11	Capacitor, polyester	Note 2
27	C13	Capacitor, 100µF, 16V	
28	C14	Capacitor, 100µF, 16V	
29	C15	Capacitor, 820nF	Note 3
30	JP1	Jumper	
31	RSH	Shunt Resistor, 80A, 50mV (625µΩ)	Note 1

Note 1 : Resistor (R1 and R2) values are dependant upon the selected value of R_{SH}. See paragraph 5 (Circuit Description) when selecting the value for R_{SH}.

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

Note 3 : Capacitor (C15) to be positioned as close as possible to Supply Pins (V_{DD} & V_{SS}) of IC-1.

Item	Symbol	Description		Detail
		PM9102APA 115V	PM9102APE 230V	
10	R3A	120kΩ	200kΩ	
11	R3B	82kΩ	180kΩ	
26	C11	1µF	0.47µF	

ORDERING INFORMATION

Part Number	Description
PM9102APA	115V, 80A Module
PM9102APE	230V, 80A Module

Notes:

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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