

Microchip MCP3909 和 PIC18F85J90 单相电表参考设计电路

Microchip 公司的 MCP3909 是支持 IEC 62053 国际电表标准的电表 IC,具有 16 位双 ADC 输出数据格式,20 位乘法器输出数据格式,两通路的 SINAD 为 81dB,1000:1 动态范围的有用功率测量误差 0.1%,片内基准电压超低漂移 15 ppm/°C.本文介绍 MCP3909 主要特性,功能方框图以及采用 MCP3909 和 PIC18F85J90 的单相电表参考设计电路图.

MCP3909 and PIC18F85J90 Single Phase Energy Meter Reference Design

Energy Metering IC with SPI Interface and Active Power Pulse Output

The MCP3909 device is an energy-metering IC designed to support the IEC 62053 international metering standard specification. It supplies a frequency output proportional to the average active real power, with simultaneous serial access to ADC channels and multiplier output data. This output waveform data is available at up to 14 kHz with 16-bit ADC output and 20-bit multiplier output words. The 16-bit, delta-sigma ADCs allow for a wide range of IB and I_{MAX} currents and/or small shunt (<200 μOhms) meter designs. A no-load threshold block prevents any current creep measurements for the active power pulse outputs. The integrated on-chip voltage reference has an ultra-low temperature drift of 15 ppm per degree C.

This accurate energy metering IC with high field reliability is available in the industry standard 24-lead SSOP pinout.

MCP390 主要特性:

- Supports IEC 62053 International Energy Metering Specification and legacy IEC 1036/61036/687 Specifications
- Digital waveform data access through SPI interface
- 16-bit Dual ADC output data words
- 20-bit Multiplier output data word
- Dual functionality pins support serial interface access and simultaneous Active Power Pulse Output
- Two 16-bit second order delta-sigma Analog-to-Digital Converters (ADCs) with multi-bit DAC
- 81 dB SINAD (typ.) both channels

- 0.1% typical active energy measurement error over 1000:1 dynamic range
- PGA for small signal inputs supports low value shunt current sensor
- Ultra-low drift on-chip reference: 15 ppm/°C (typical)
- Direct drive for electromagnetic mechanical counter and two-phase stepper motors
- Low IDD of 4 mA (maximum)
- Tamper output pin for negative power indication
- Industrial Temperature Range: -40°C to +85°C

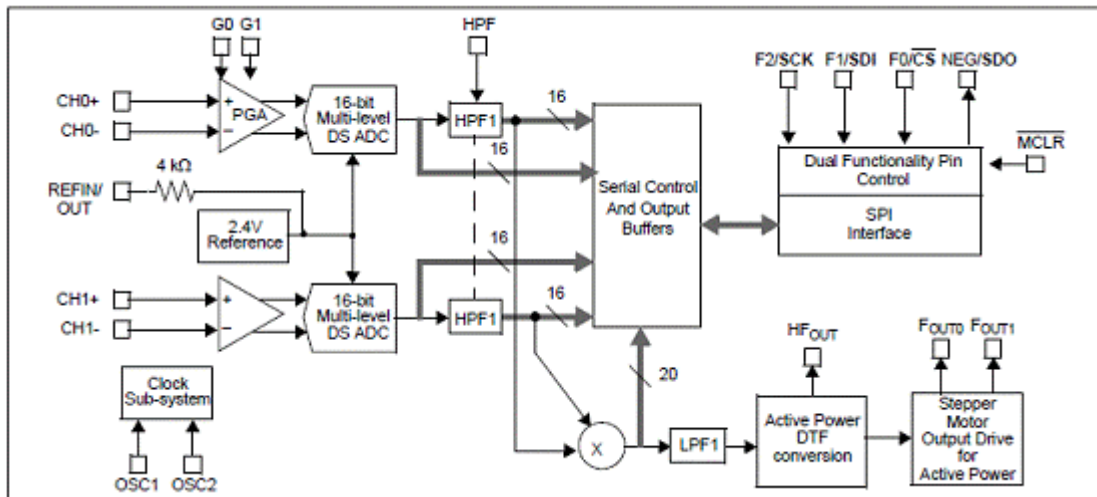


图 1.MCP390 功能方框图

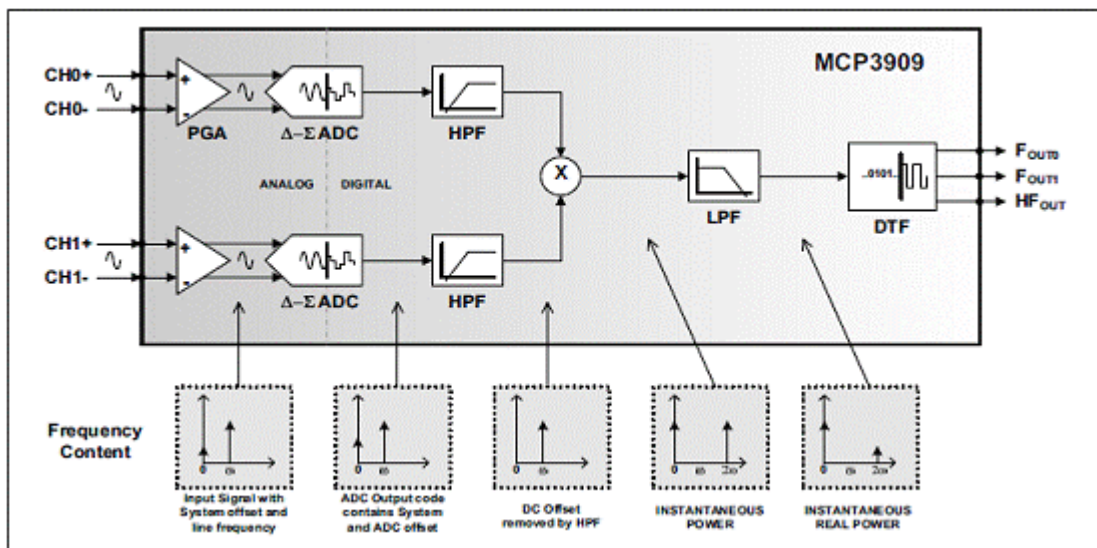


图 2.MCP3909 带频率图的有用功率信号流程图

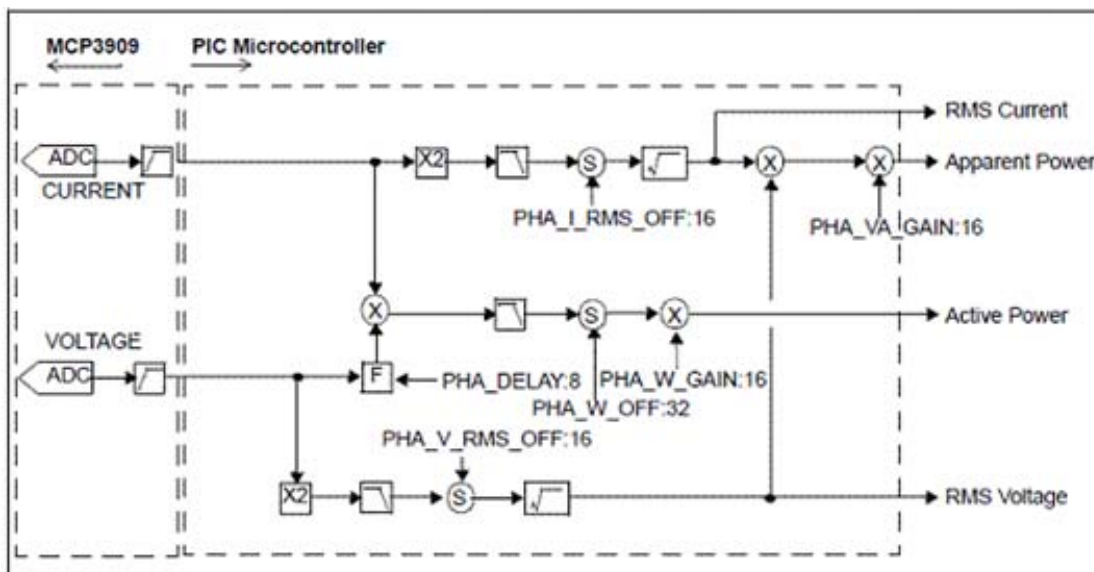


图 3.采用 PIC MCU 从波形取样计算功率图

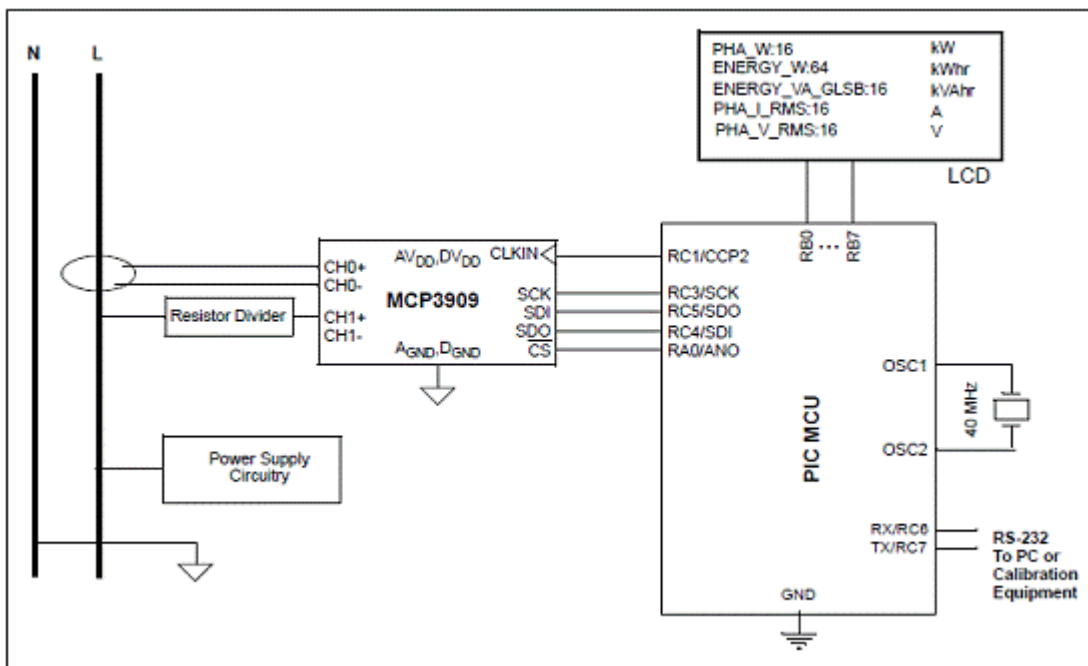


图 4.采用 MCU 的电表简图

采用 MCP3909 和 PIC18F85J90 的单相电表参考设计

MCP3909 and PIC18F85J90 Single Phase Energy Meter Reference Design

The MCP3909/PIC18F85J90 Single Phase Energy Meter Reference Design is a fully functional single phase meter. The design is intended to be low cost and is transformerless. The design uses a half-wave rectified power supply circuit and a shunt current sensing element. A single MCP3909

acts as the analog front end measurement circuitry. The PIC18F85J90 directly drives the LCD glass and displays active energy consumption.

The meter design contains serially accessible registers and is intended to be flexible and upgraded to a variety of PIC® micro-based energy meter designs using the firmware presented herein. The “Single Phase Energy Meter Software” offers a functional and simple means to monitor and control the PIC18F85J90 and can be used to create custom calibration setups. In some situations, only a single point calibration may be required. The energy meter software offers an automated step by step calibration process that can be used to quickly calibrate energy meters.

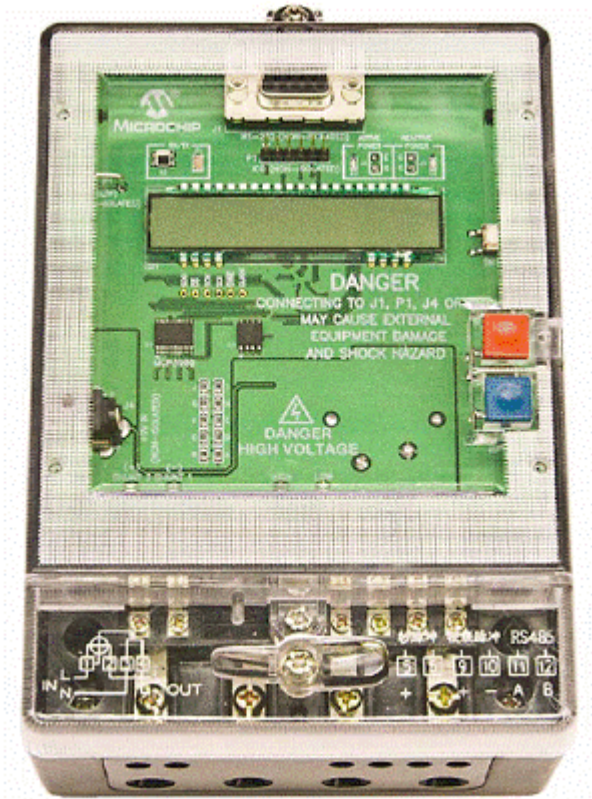


图 5.单相电表外形图

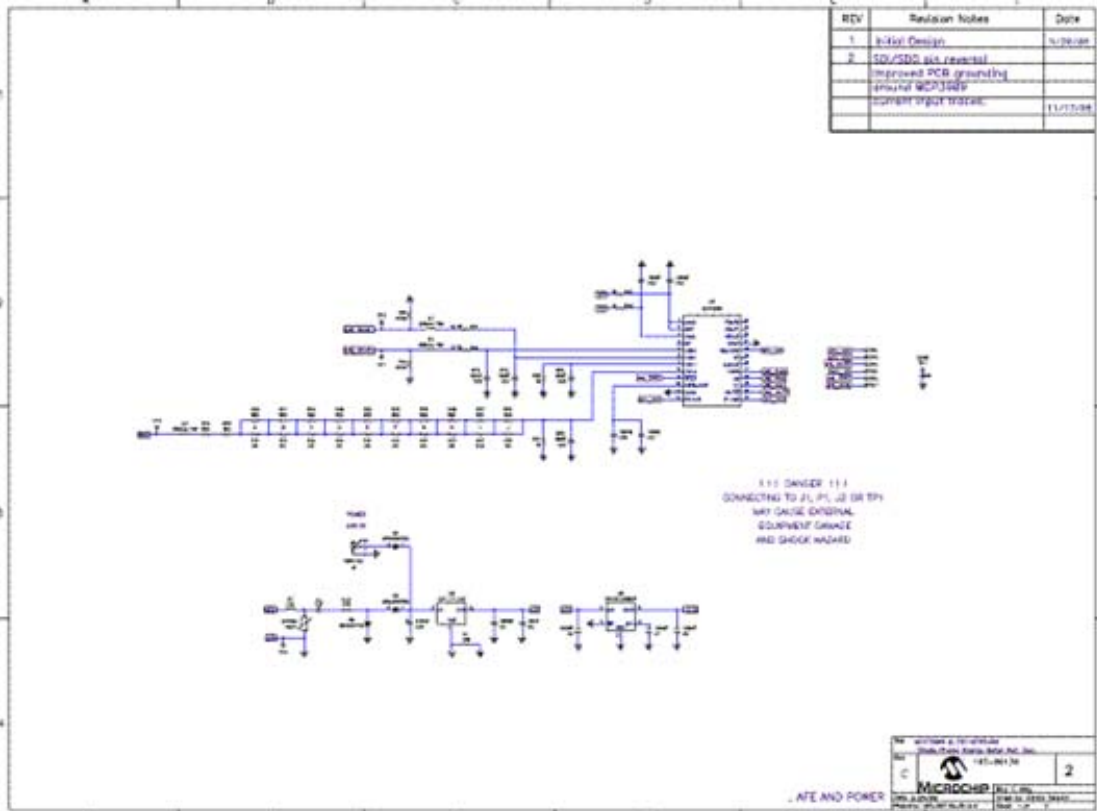


图 6.单相电表参考设计电路图(1)

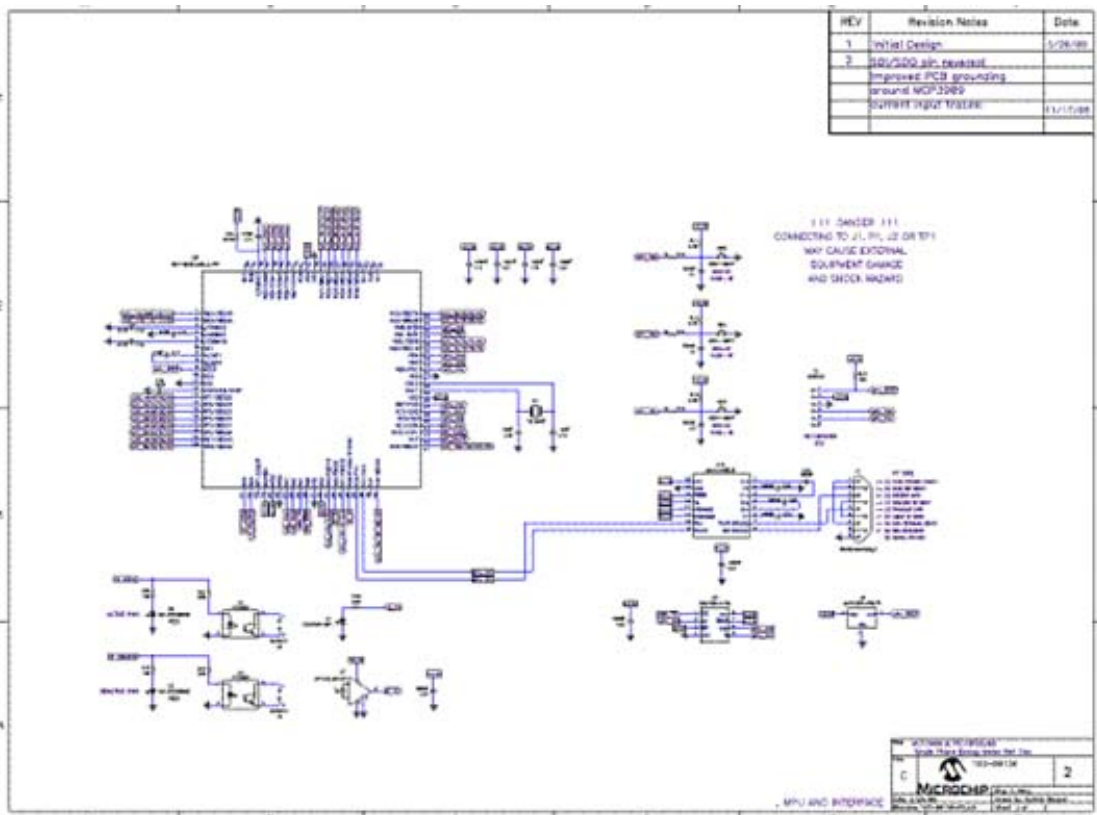


图 7.单相电表参考设计电路图(2)

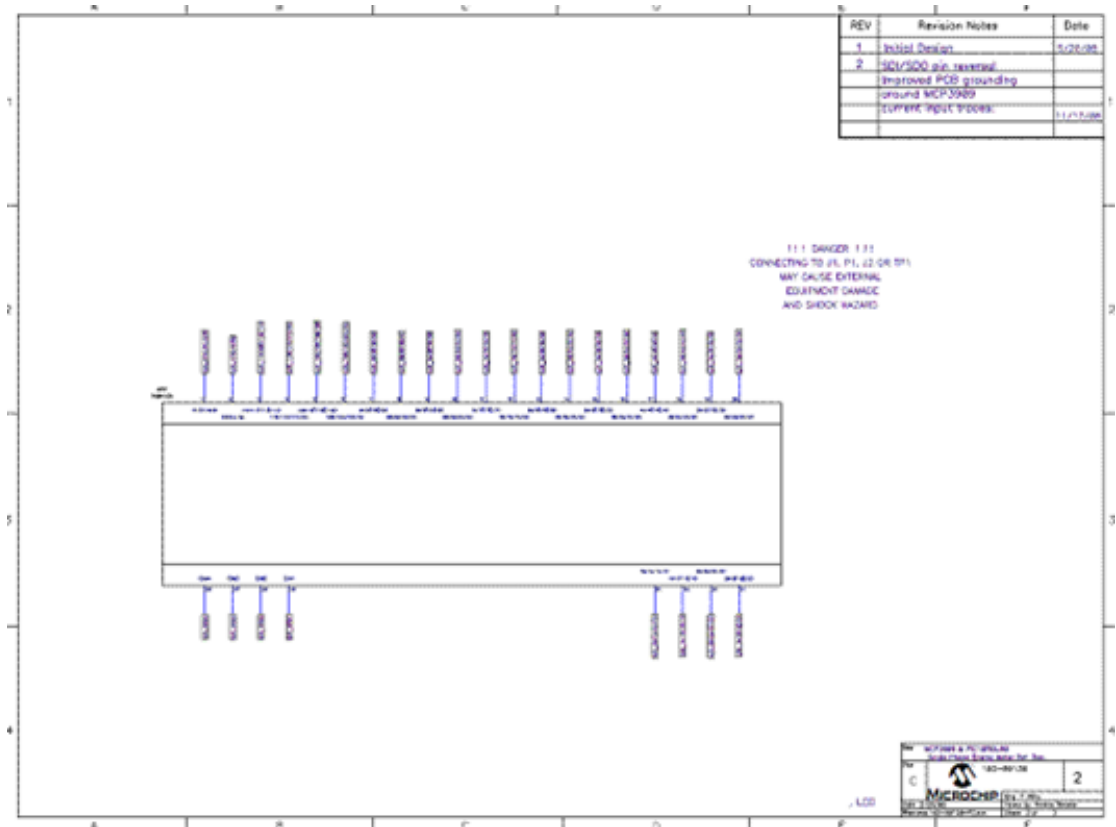


图 8.单相电表参考设计电路图(3)

单相电表参考设计材料清单(BOM):

Qty	Reference	Description	Manufacturer	Part Number
22	C1, C2, C3, C5, C6, C7, C9, C12, C18, C21, C22, C23, C24, C25, C27, C29, C30, C32, C33, C34, C36, C37	CAP CER .1UF 25V 10% X7R 0603	Murata Electronics®	GRM188R71E104KA01D
1	C4	CAP 1.0UF 630V METAL POLYPRO	EPCOS	B32614A6105J008
2	C8, C19	CAP CER 10UF 6.3V X5R 0603	Murata Electronics	GRM188R60J106ME47D
1	C10	CAP 470UF 25V ELECT FC SMD	Panasonic® - ECG	EEE-FC1E471P
5	C11, C13, C14, C16, C17	CAP CER 47000PF 25V 10% X7R 0603	Murata Electronics	GRM188R71E473KA01D
2	C15, C20	CAP CER 18PF 50V 5% C0G 0603	Murata Electronics	GRM1885C1H180JA01D
4	C26, C28, C31, C35	CAP CER 6800PF 50V 5% C0G 1206	Murata Electronics	GRM3195C1H682JA01D
1	D1	IRED 940NM TOP MNT SMD	Sharp® Microelectronics	GL100MN0MP
2	D2, D3	LED 1.6X0.8MM 625NM RED CLR SMD	Kingbright Corporation	APT1608EC
1	D4	DIODE ZENER 600W 15V 40A SMA	ON Semiconductor®	BZG03C15G
2	D5, D6	DIODE STD REC 1A 600V SMA	ON Semiconductor	MRA4005T3G
2	L1, L2	Chip Ferrite Beads / EMI Filters 150ohms 100MHz .3A Monolithic 1806 SMD	Steward	LI1806C151R-10
3	L3, L4, L5	Chip Ferrite Beads / EMI Filters 150ohms 100MHz .8A Monolithic 0805 SMD	Steward	LI0805H151R-10
1	LCD	LCD Glass size 65.00 x 18.00	Xiamen Ocular Optics Co., Ltd.	DP076P
1	J1	CONN DSUB RCPT 9POS STR PCB SLD	FCI	D09S24A4GV00LF
1	J2	CONN POWERJACK MINI R/A T/H	Switchcraft®	RAPC722X
2	J3, J4	DO NOT INSTALL	—	—
1	MOV1	VARISTOR 275V RMS 20MM RADIAL	EPCOS	S20K275E2
1	P1	6 X 1 Header 2.54mm on center 6 mm/2.5mm	Samtec	TSW-106-07-G-S
1	PCB	RoHS Compliant Bare PCB, MCP3909/PIC18F85J90 Single Phase Energy Meter Reference Design	Microchip Technology Inc.	104-000130
10	R1-R10	RES 0.0 OHM 1/8W 5% 0805 SMD	Rohm Co., Ltd	MCR10EZJH000
3	R11, R12, R13	RES 4.70K OHM 1/10W 1% 0603 SMD	Rohm Co., Ltd	MCR03EZPFX4701
3	R14, R15, R16	RES 1.00K OHM 1/10W 1% 0603 SMD	Rohm Co., Ltd	MCR03EZPFX1001
3	R17, R21, R36	RES 698 OHM 1/10W 1% 0603 SMD	Rohm Co., Ltd	MCR03EZPFX6980
1	R18	RES 470 OHM 1W 5% 2512 SMD	Panasonic - ECG	ERJ-1TYJ471U
2	R19, R20	RES 100 OHM 1/10W 1% 0603 SMD	Rohm Co., Ltd	MCR03EZPFX1000
1	R22	DO NOT INSTALL	—	—
1	R23	RES 10.0K OHM 1/10W 1% 0603 SMD	Rohm Co., Ltd	MCR03EZPFX1002

Qty	Reference	Description	Manufacturer	Part Number
2	R24, R25	1206 Precision Thin Film Chip Resistors 1/4watt 332Kohms .1% 25ppm	Vishay® Interotechnology Inc.	TNPW1206332KBETY
2	R37, R38	RES 1.00K OHM 1/8W 1% 0805 SMD	Rohm Co., Ltd	MCR10EZHF1001
2	R40, R43	RES 10.0 OHM 1/10W 1% 0603 SMD	Rohm Co., Ltd	MCR03EZPFX10R0
2	R41, R42	RES 1.0K OHM .1% 1/4W 0805 SMD	Susumu Co Ltd	RGH2012-2E-P-102-B
3	SW1, SW2, SW3	SWITCH TACT 6MM 230GF H=4.3MM	Omron Electronics	B3S-1002P
1	TP1	Wire Test Point 0.3" Length	Component Corporation®	PJ-202-30
1	U1	Sensors 3V 38 kHz Surface Mount	Sharp Microelectronics	GP1US301XP
1	U2	Energy Metering IC with SPI Interface and Active Power Pulse	Microchip Technology Inc.	MCP3909T-I/SS
1	U3	SPI Serial EEPROM Family	Microchip Technology Inc.	25LC256-I/SN
2	U4, U7	PHOTOCOUPLER DARL OUT 4-SMD	Sharp Microelectronics	PC365NJ0000F
1	U5	n IC 3.3V 100MA LDO REG SOT-23-5	Texas Instruments Inc.	TPS79133DBVR
1	U6	IC REG LDO 800MA 5.0V SOT-223	National Semiconductor	LM1117MP-5.0/NOPB
1	U8	PIC18F Microcontroller with 32K bytes of Flash, 2048 bytes of RAM	Microchip Technology inc.	PIC18F85J90-I/PT
1	U9	MCP130 is a voltage supervisory device	Microchip Technology Inc.	MCP130T-270I/TT
1	U10	±15kV ESD-Protected, RS-232 Transceivers	Maxim	MAX3323EEUE+
1	X1	CRYSTAL 10.0000MHZ 10PF SMD	Abracon™ Corporation	ABM3B-10.000MHZ-10-1-U-T

Note 1: The components listed in this Bill of Materials are representative of the PCB assembly. The released BOM used in manufacturing uses all RoHS-compliant components.