MCP3905A/06A Evaluation Board User's Guide

Note the following details of the code protection feature on Microchip devices:

• Microchip products meet the specification contained in their particular Microchip Data Sheet.

• Microchip believes that its family of products is one of the most secure families of its kind on the market today, when used in the intended manner and under normal conditions.

• There are dishonest and possibly illegal methods used to breach the code protection feature. All of these methods, to our knowledge, require using the Microchip products in a manner outside the operating specifications contained in Microchip's Data Sheets. Most likely, the person doing so is engaged in theft of intellectual property.

• Microchip is willing to work with the customer who is concerned about the integrity of their code.

• Neither Microchip nor any other semiconductor manufacturer can guarantee the security of their code. Code protection does not mean that we are guaranteeing the product as "unbreakable."

Code protection is constantly evolving. We at Microchip are committed to continuously improving the code protection features of our products. Attempts to break Microchip's code protection feature may be a violation of the Digital Millennium Copyright Act. If such acts allow unauthorized access to your software or other copyrighted work, you may have a right to sue for relief under that Act.

Trademarks

QUALITY MANAGEMENT SYSTEM
CERTIFIED BY DNV
ISO/TS 16949:2002

MCP3905A/06A EVALUATION BOARD USER'S GUIDE

Table of Contents

MCP3905A/06A EVALUATION BOARD USER'S GUIDE

Preface

NOTICE TO CUSTOMERS

All documentation becomes dated, and this manual is no exception. Microchip tools and documentation are constantly evolving to meet customer needs, so some actual dialogs and/or tool descriptions may differ from those in this document. Please refer to our web site (www.microchip.com) to obtain the latest documentation available.

Documents are identified with a "DS" number. This number is located on the bottom of each page, in front of the page number. The numbering convention for the DS number is "DSXXXXXA", where "XXXXX" is the document number and "A" is the revision level of the document.

For the most up-to-date information on development tools, see the MPLAB® IDE on-line help. Select the Help menu, and then Topics to open a list of available on-line help files.

INTRODUCTION

This chapter contains general information that will be useful to know before using the MCP3905A/06A Evaluation Board. Items discussed in this chapter include:

- Document Layout
- Conventions Used in this Guide
- Recommended Reading
- The Microchip Web Site
- Customer Support
- Document Revision History

DOCUMENT LAYOUT

This document describes how to use the MCP3905A/06A Evaluation Board as a development tool to emulate and debug firmware on a target board. The manual layout is as follows:

- **Chapter 1. "Product Overview"** – Important information about the MCP3905A/06A Evaluation Board.
- **Chapter 2. "Installation and Operation"** – Includes a detailed description of each block and instructions on how to get started with this board.
- **Appendix A. "Schematics and Layouts"** – Shows the schematic and board layout diagrams for the MCP3905A/06A Evaluation Board.
- **Appendix B. "Bill Of Materials (BOM)"** – Lists the parts used to build the MCP3905A/06A Evaluation Board.

MCP3905A/06A Evaluation Board User's Guide

CONVENTIONS USED IN THIS GUIDE

This manual uses the following documentation conventions:

DOCUMENTATION CONVENTIONS

Description	Represents	Examples
Arial font:		
Italic characters	Referenced books	*MPLAB® IDE User's Guide*
	Emphasized text	...is the *only* compiler...
Initial caps	A window	the Output window
	A dialog	the Settings dialog
	A menu selection	select Enable Programmer
Quotes	A field name in a window or dialog	"Save project before build"
Underlined, italic text with right angle bracket	A menu path	*File>Save*
Bold characters	A dialog button	Click **OK**
	A tab	Click the **Power** tab
N'Rnnnn	A number in verilog format, where N is the total number of digits, R is the radix and n is a digit.	4'b0010, 2'hF1
Text in angle brackets < >	A key on the keyboard	Press <Enter>, <F1>
Courier New font:		
Plain Courier New	Sample source code	`#define START`
	Filenames	`autoexec.bat`
	File paths	`c:\mcc18\h`
	Keywords	`_asm, _endasm, static`
	Command-line options	`-Opa+, -Opa-`
	Bit values	`0, 1`
	Constants	`0xFF, 'A'`
Italic Courier New	A variable argument	`file`.o, where `file` can be any valid filename
Square brackets [ ]	Optional arguments	`mcc18 [options] file [options]`
Curly brackets and pipe character: { | }	Choice of mutually exclusive arguments; an OR selection	`errorlevel {0|1}`
Ellipses...	Replaces repeated text	`var_name [, var_name...]`
	Represents code supplied by user	`void main (void) { ... }`

RECOMMENDED READING

This user's guide describes how to use MCP3905A/06A Evaluation Board. Other useful documents are listed below. The following Microchip documents are available and recommended as supplemental reference resources.

MCP3905A Data Sheet, *"Energy Metering IC with Active Real Power Pulse Output"* **(DS21948)**

This data sheet provides detailed information regarding the MCP3905 device.

AN994 *"IEC Compliant Active Energy Meter Design Using The MCP3905A/06A"* **(DS00994)**

This application note documents the design decisions associated with this reference design.

MCP3905A/06A Energy Meter Reference Design (DS51565)

This reference design is a stand-alone, low-cost energy meter. It can act as either a stand-alone energy meter, or as the analog front-end design for LCD microcontroller-based meters. This reference design is compliant with EMC requirements per energy metering standards IEC62053 and legacy IEC61036, IEC1046 and IEC687.

THE MICROCHIP WEB SITE

Microchip provides online support via our web site at www.microchip.com. This web site is used as a means to make files and information easily available to customers. Accessible by using your favorite Internet browser, the web site contains the following information:

• **Product Support** – Data sheets and errata, application notes and sample programs, design resources, user's guides and hardware support documents, latest software releases and archived software
• **General Technical Support** – Frequently Asked Questions (FAQs), technical support requests, online discussion groups, Microchip consultant program member listing
• **Business of Microchip** – Product selector and ordering guides, latest Microchip press releases, listing of seminars and events, listings of Microchip sales offices, distributors and factory representatives

CUSTOMER SUPPORT

Users of Microchip products can receive assistance through several channels:

• Distributor or Representative
• Local Sales Office
• Field Application Engineer (FAE)
• Technical Support

Customers should contact their distributor, representative or field application engineer (FAE) for support. Local sales offices are also available to help customers. A listing of sales offices and locations is included in the back of this document.

Technical support is available through the web site at: http://support.microchip.com.

MCP3905A/06A Evaluation Board User's Guide

DOCUMENT REVISION HISTORY

Revision B (August 2009)

• Update from MCP3905/06 to MCP3905A/06A devices.

Revision A (August 2005)

• Initial Release of this Document.

Chapter 1. Product Overview

1.1 INTRODUCTION

This chapter provides an overview of the MCP3905A/06A Evaluation Board and covers the following topics:

- What is the MCP3905A/06A Evaluation Board?
- What the MCP3905A/06A Evaluation Board kit includes

1.2 WHAT IS THE MCP3905A/06A EVALUATION BOARD?

The MCP3905A/06A Evaluation Board is designed to test a variety of meter designs using the MCP3905A/06A energy metering Integrated Circuit (IC). Stand-alone MCP3905A energy meter designs, as well as those using a PICmicro® Microcontroller Unit (MCU), are easily designed using this evaluation board as the prototype Analog Front-End (AFE).

1.3 WHAT THE MCP3905A/06A EVALUATION BOARD KIT INCLUDES

This MCP3905A/06A Evaluation Board Kit includes:

- The MCP3905A/06A Evaluation Board (with MCP3905A installed)(102-00057)
- Important Information Sheet

NOTES:

MCP3905A/06A EVALUATION BOARD USER'S GUIDE

Chapter 2. Installation and Operation

2.1 INTRODUCTION

The MCP3905A/06A Evaluation Board provides easy evaluation of the MCP3905A energy-metering IC to metering customers. High-voltage AC input line and load connections, including the necessary space for current shunt or Current Transformer (CT) evaluation, are all included. Jumpers with shunts and a reset switch are connected to the MCP3905A/06A device to further facilitate device evaluation and meter design. Multiple input channel configuration circuits are included for both differential and single-ended signals. LEDs for evaluating the MCP3905A/06A output visually are on-board. A standard 14-pin PICtail™ daughter board header is included for a connection to a variety of Microchip PICmicro® microcontroller demonstration (demo) boards, allowing for PIC16, PIC18 and dsPIC® DSC development system meter designs. This connection can also be isolated using an on-board, optical-isolation IC.
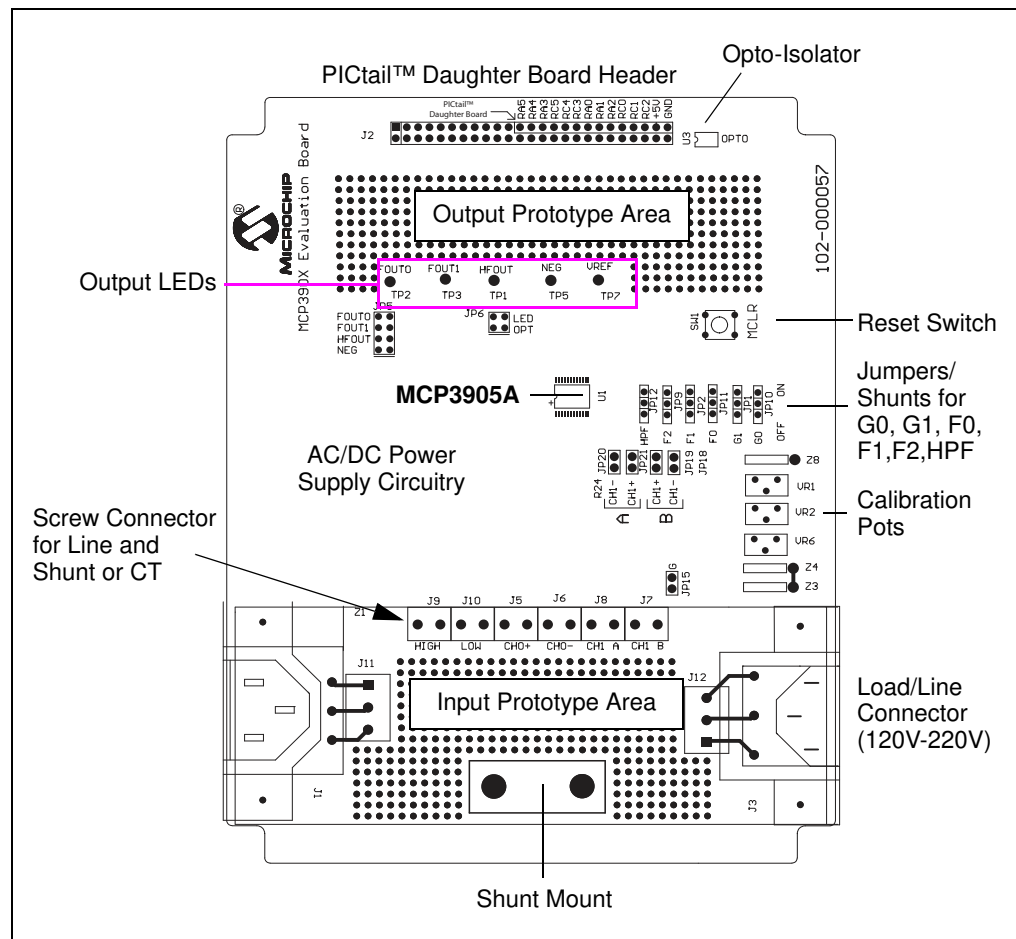

FIGURE 2-1:   *MCP3905A/06A Evaluation Board.*

MCP3905A/06A Evaluation Board User's Guide

2.2 FEATURES

The MCP3905A/06A Evaluation Board has the following features:

- Large space for easy connection to AC line and loads provide area for experiments using different current-sensing elements
- Easy connection to both PICDEM™ demonstration boards for a variety of PICmicro® MCU-based meter designs
- Jumpers and shunts for simple device configuration
- On-board, low-cost AC-to-DC power supply circuitry to demonstrate the low-cost MCP3905 AFE design used in the MCP3905A/06A Energy Meter Reference Design (DS51565)
- EMC immunity and Printed Circuit Board (PCB) design as used in the MCP3905A/06A Energy Meter Reference Design (DS51565)
- Designed to fit inside recommended plastic enclosure for safe, high-voltage demonstrations and experiments (enclosure is optional and is not included)

2.3 GETTING STARTED

The following example is given to describe how to use this evaluation board using a current-sensing shunt, 220 VAC line voltage and a 10A load. All connections described in this section are dependent on the choice of current-sensing element. A 250 $\mu\Omega$ shunt is selected as the current-sensing element.

2.3.1 Step 1: Install Current-Sensing Element and Make Appropriate Input Connections

Use the input prototype area to connect the line/load and current-sensing elements to the appropriate screw-type connector. An example of connecting the shunt is shown in Figure 2-2. Please note that the phase-side of the line should be used as the GND reference to the MCP3905A/06A Evaluation Board when using the AC/DC power supply circuit in shunt examples like the one in Figure 2-2.
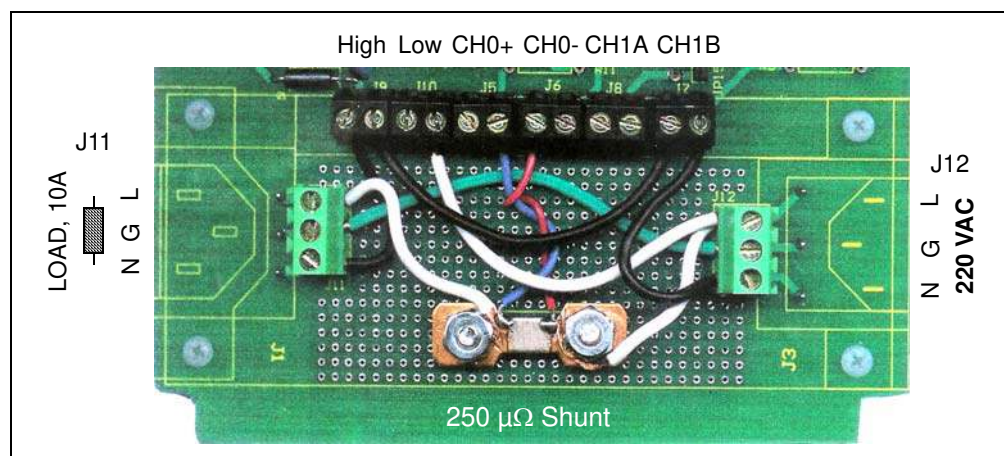
FIGURE 2-2: *Example Input Prototype Area Connections Using Shunt. The system is biased to the line-side of the two-wire power supply.*

2.3.2   Step 2: Select Channel 0 Input Method

Resistor sockets R_{11} and R_{12} should be left open when using a shunt. JP3, JP13 and JP14 should also be open. This configuration puts the shunt across the channel inputs differentially with the users option of a RC filter.
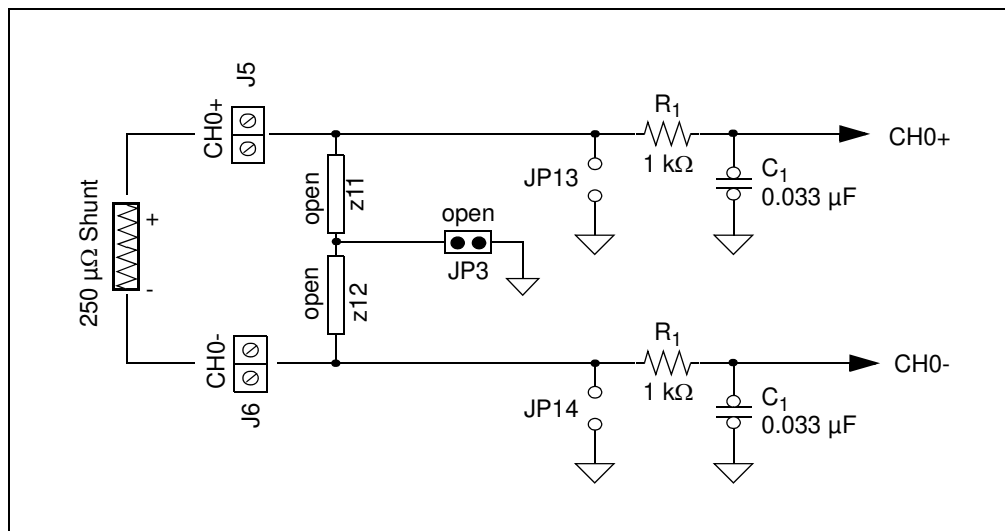
FIGURE 2-3:   *Channel 0 Jumpers for 250 $\mu\Omega$ Shunt Selection.*

2.3.3   Step 3: Select Channel 1 Input Method

Using JP18, JP19, JP20 and JP21, select if Channel 1 will be single-ended or differential, and which input will be tied to the voltage divider and potentiometer. In Figure 2-4, the voltage divider and potentiometer are connected to the positive input, while the negative input is connected to A_{GND} through the RC.
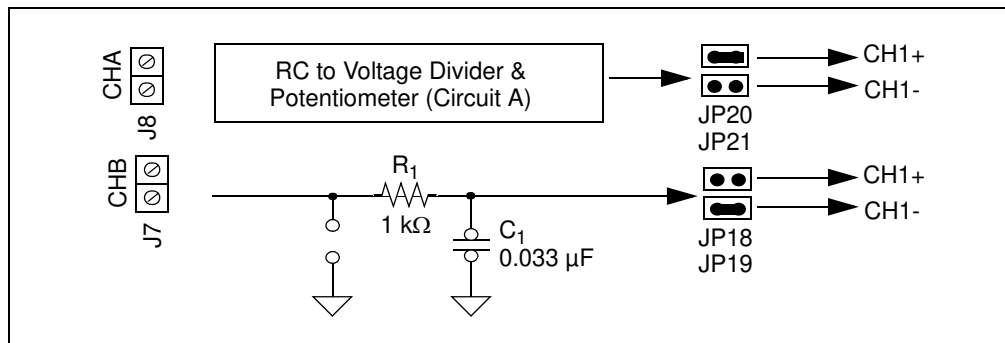
FIGURE 2-4:   *Channel 1 Input Method Example.*

2.3.4   Step 4: Select desired output evaluation method

Jumpers JP5 and JP6 select the output evaluation method. In this example, we are selecting HF_{OUT} connected to the LED for blink.
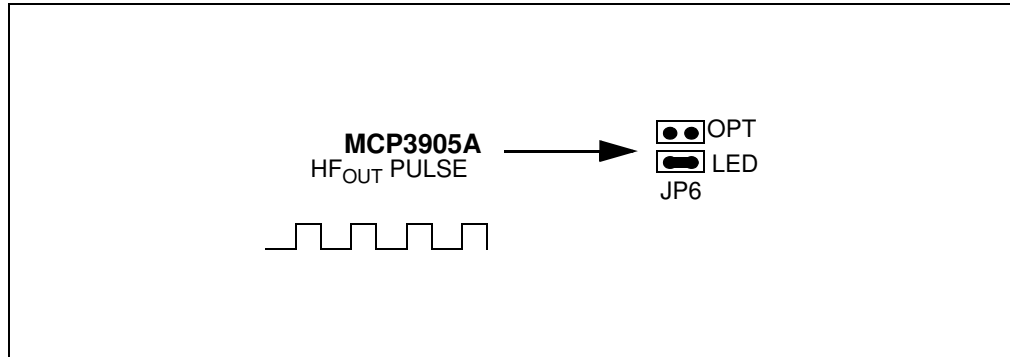
FIGURE 2-5:   *Connecting the MCP3905A High-Frequency Output to the LED.*

2.3.5   Step 5: Select +5V Source

With the connections for J9 and J11 made in Figure 2-2, the 220V AC/DC power supply circuit can be used as the +5V supply. Here we put JP4 in the "INT" position for internal connection.

2.3.6   Step 6: Connect Line and Load and Observe MCP3905A Output

Once all jumper positions have been selected, connecting 220V with the correct L,G,N connections and an appropriate load (10A in this example) will power both the MCP3905A/06A Evaluation Board and create the MCP3905A output (LED, BLINKING) in Figure 2-5.

2.4   MCP3905A/06A EVALUATION BOARD OVERVIEW

The functional blocks of the MCP3905A/06A Evaluation Board will be described in this section. For more detailed information regarding design decisions and approaches to IEC1036 compliance, refer to AN994, "IEC Compliant Active Energy Meter Design Using The MCP3905A/06A" (DS00994). For a detailed circuit schematic, refer to **Appendix A. "Schematics and Layouts"** and **Appendix B. "Bill Of Materials (BOM)"** for a list of the parts used to build the MCP3905A/06A Evaluation Board.

2.5 FUNCTIONAL BLOCK DESCRIPTIONS

2.5.1 Input Prototype Area

All line/load, shunt and CT connections are to be made next to the screw-type connectors J5-J12. This area includes two mounting holes for a standard shunt connector. All high-voltage connections go onto this prototype area.

2.5.2 High-Voltage Input Connections (J5-12)

These screw-type connections are for shunts, CTs, line and load. The shunt resistance should be placed in parallel with J5 and J6. A variety of experiments using shunts and CTs can be performed here in conjunction with the input prototype area.

J9 and J10 feed the AC/DC power supply circuitry. J10 is the reference connection to the entire board. Shunt-type meters should be connected to the line-side. One example is given in the figure below.

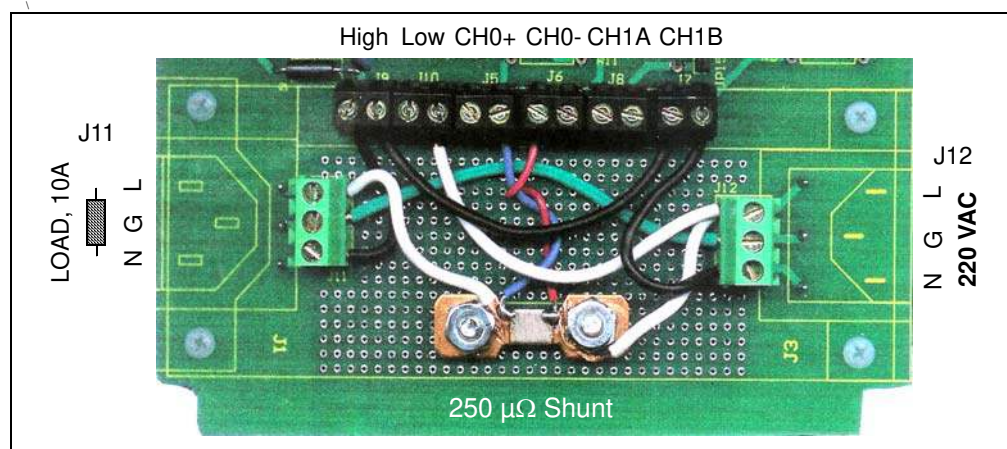*FIGURE 2-6:*   *Example Wiring Using Two-Wire System with Shunt.*

2.5.3 Jumpers and Shunts for MCP3905 Gain and Frequency Constant F_C Selection (JP1, 2, 9-12)

Jumpers and shunts for both logic-high and logic-low are included for all gain and frequency constant selections, with filter options Off and On columns being clearly labelled.
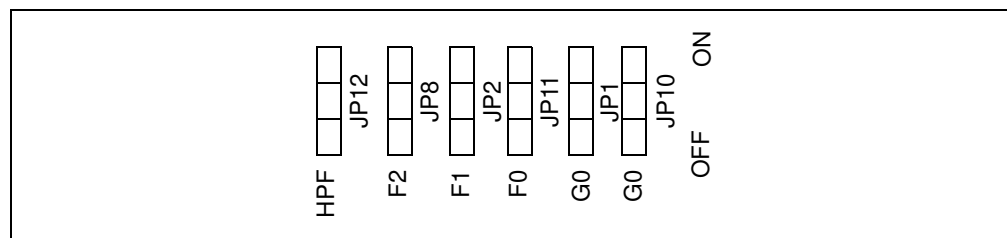
FIGURE 2-7:   *MCP3905A Jumper Selections.*

MCP3905A/06A Evaluation Board User's Guide

2.5.4 Jumpers and Shunts for MCP3905A Channel 0 Input Configurations (JP5, JP6, ZN-N)

Channel 0 is a differential input to the MCP3905A device and is intended for the current-sensing channel of the energy meter. Channel 0 on this evaluation board contains resistor sockets for CT burden resistors, as well as a RC filter on each input, with the option of shorting either input to ground. Two examples of jumper configuration are given in Figure 2-8 and Figure 2-9.

FIGURE 2-8: *Channel 0 Jumpers for 250 $\mu\Omega$ Shunt Selection.*
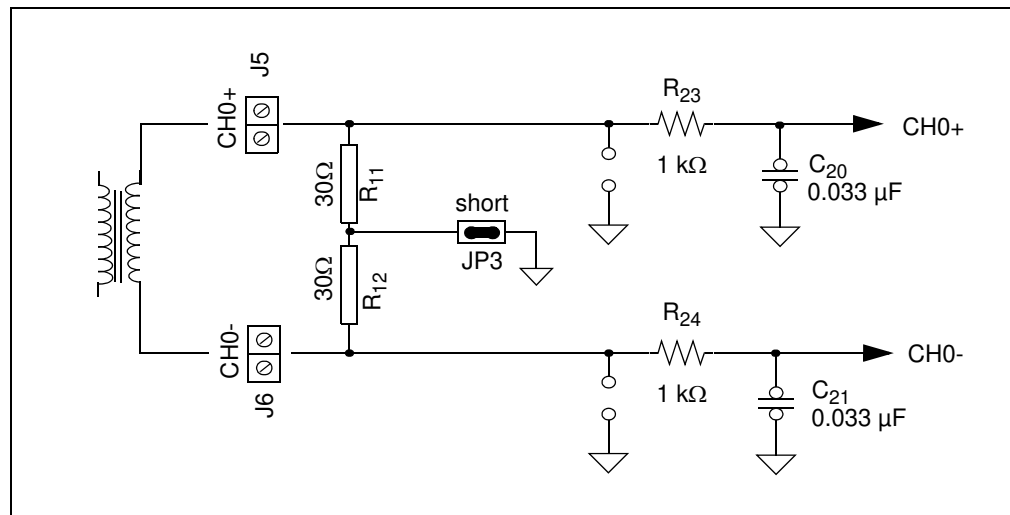
FIGURE 2-9: *Example of Channel 0 Jumpers with 60Ω Burden Resistor for Connection to Current Transformer.*

2.5.5   Channel 1 RC Circuit with A_{GND} Option – Circuit A

Channel 1 is a differential input with two possible circuit selections for each single-ended input (circuit A and circuit B). Using the MCP3905A/06A Evaluation Board, either of the inputs can be connected to the RC or to A_{GND}, allowing single-ended or differential experiments. JPX should be shorted to ground for all single-ended input configurations.
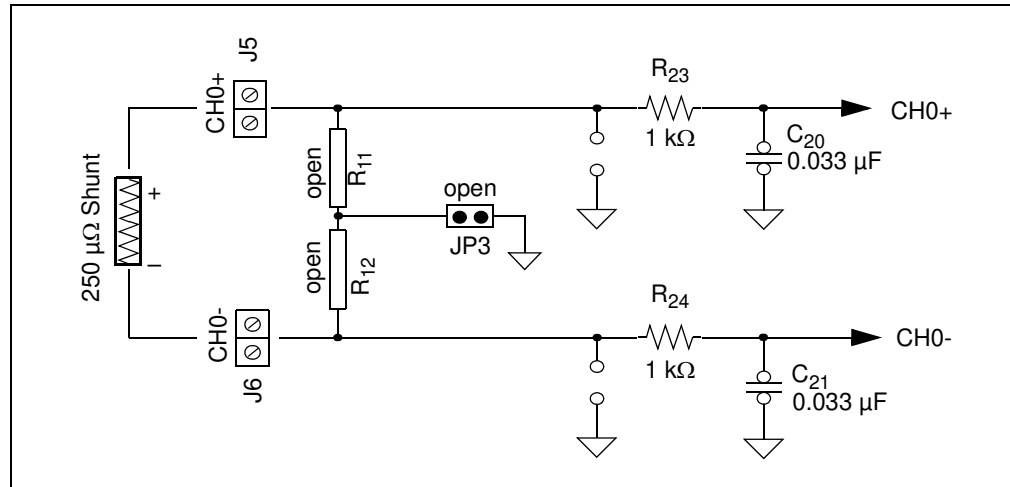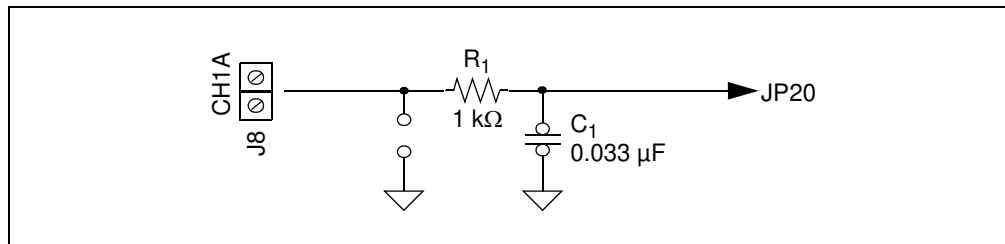

FIGURE 2-10:   *Channel 1 RC Circuit A.*

2.5.6   Channel 1 Voltage Divider Circuit and Calibration Potentiometer – Circuit B

Circuit B includes 4 resistor sockets and a mechanical potentiometer. This allows for experiments calibrating the output of the MCP3905A by changing Channel 1's input signal amplitude.
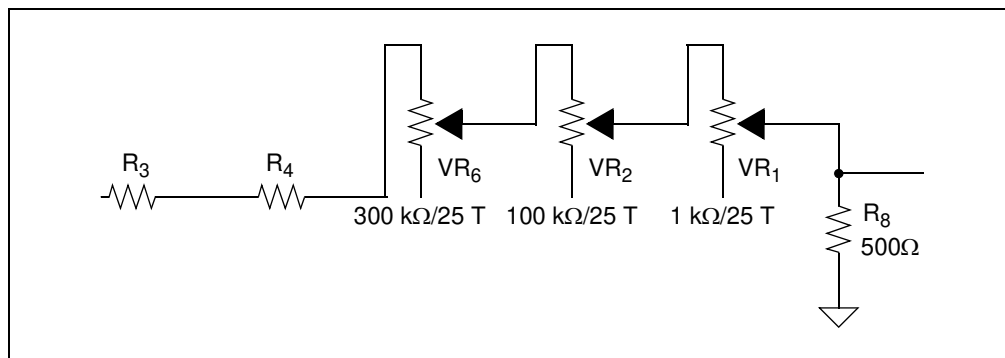
FIGURE 2-11:   *Voltage Divider on Channel 1 Including Potentiometers VR_1, VR_2 and VR_6 for Calibration Experiments, Labeled Circuit B on the PCB Silk-Screen.*

2.5.7   MCP3905A

Center-of-board, 24-lead surface-mount package. Refer to the MCP3905A Data Sheet, *"Energy Metering IC with Active Real Power Pulse Output"* (DS21948) for a detailed description.

2.5.8 DC Power Supply

A low-cost DC power supply circuit is included on the MCP3905A/06A Evaluation Board. This is the same DC power supply circuit used in the MCP3905A/06A Energy Meter Reference Design. The DC power supply is created from a half-wave zener diode-limited AC signal feeding a 7805 +5V regulator.

C_{17} and C_{16} divide the AC signal coming directly from the line, with their values depending on the AC source expected. The board comes populated with a series capacitor of 0.47 µF, designed to divide down an AC line voltage of 220 V_{RMS}. If the DC power supply is to be used with a 120 V_{RMS} AC source capacitor, C_{16} should change to 1 µF. Refer to **Appendix B. "Bill Of Materials (BOM)"** for detailed part information.

For more detail on this circuit design, as well as for 120V circuit specifications, refer to AN994 "IEC Compliant Active Energy Meter Design Using The MCP3905A/06A" (DS00994).

2.5.9 Output Prototype Area

A second prototype area is included for experiments using the MCP3905A output. All MCP3905A outputs (F_{OUT0}, F_{OUT1}, HF_{OUT}, REVP) are brought out to the prototype area.

2.5.10 Connecting the MCP3905A/06A Evaluation Board to a PICDEM™ Demonstration Board

A standard 14-pin PICtail™ daughter board connector is included on this board, as shown in Figure 2-12. Any number of MCP3905A with PICmicro MCU meter designs can be developed. An optical isolator is included with the MCP3905A/06A Energy Meter Reference Design as an additional level of protection for direct-connect meters using a shunt. It is connected to the selected output of the MCP3905A via JP5. A pull-up resistor is required on the output of the optical isolator to allow the selected logic signal to appear on the PICmicro MCU-based demo board, which is isolated entirely from the MCP3905A/06A Evaluation Board. The output of the optical isolator is connected to RC0 on this connector, as shown in Figure 2-12. RC0 was chosen to be the default output due to the timer1 clock input on many PICmicro® MCUs.
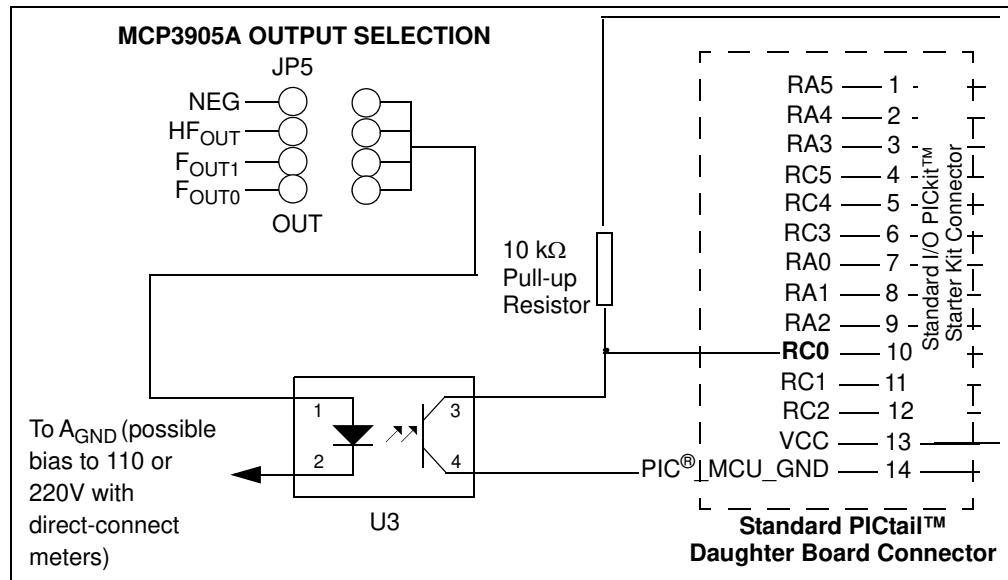
FIGURE 2-12: Optical isolation of the MCP3905A outputs to the PICkit™ header. The output is connected to RC0 using a 10 kΩ pull-up resistor to the PICtail™ daughter board header +5V and the PICmicro® MCU header, GND.

Appendix A. Schematics and Layouts

A.1   INTRODUCTION

This appendix contains the following schematics and layouts for the MCP3905A/06A Evaluation Board User's Guide:

• Board Schematic
• Board – Top Layer and Silk-Screen
• Board – Bottom Layer

A.2   SCHEMATICS AND PCB LAYOUT

The layer order is shown in Figure A-1.

FIGURE A-1:   *Layer Order.*

A.3   BOARD SCHEMATIC

A.4   BOARD LAYOUT – TOP LAYER AND SILK-SCREEN

A.5 BOARD LAYOUT – BOTTOM LAYER

104-00057R2
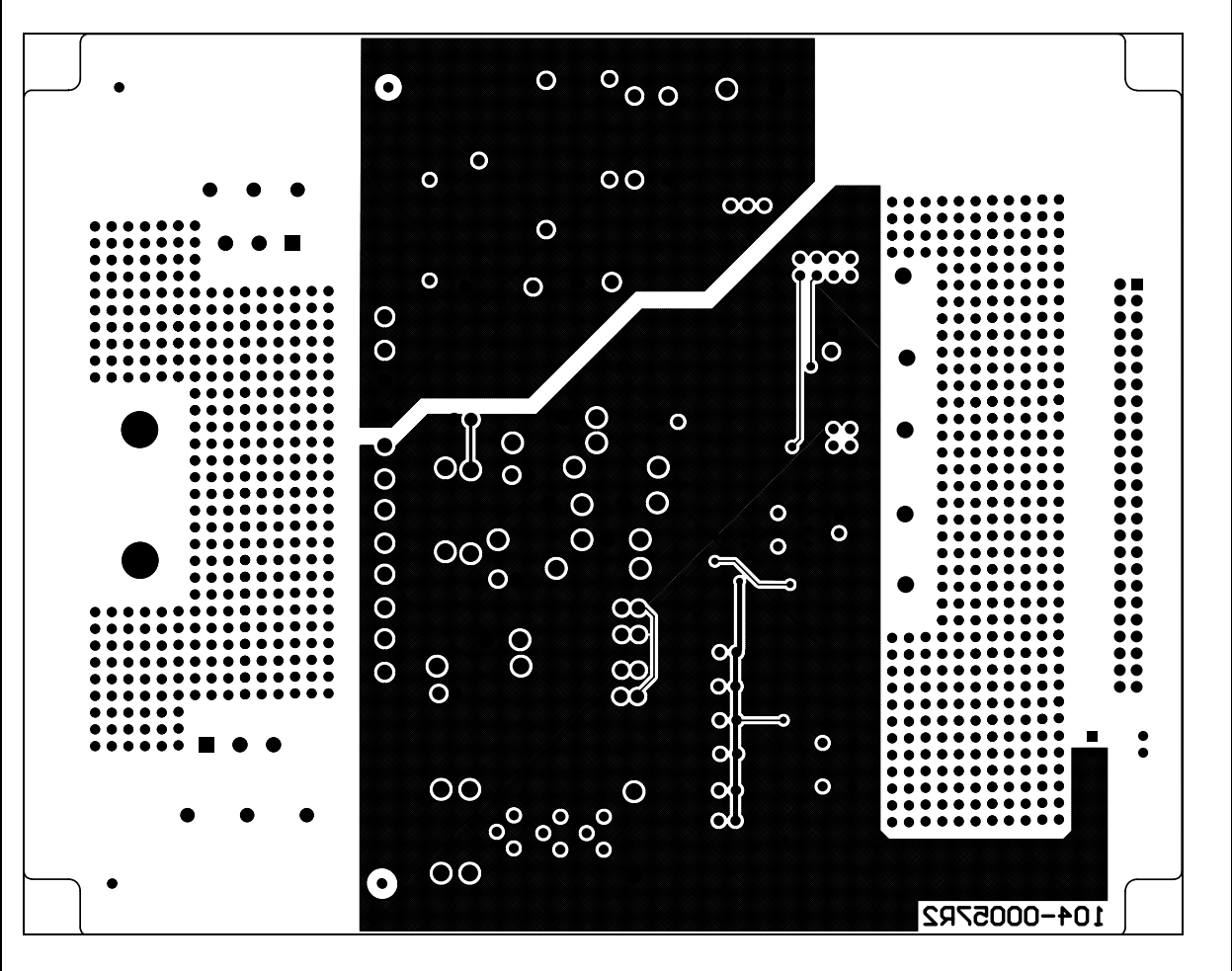
Appendix B. Bill Of Materials (BOM)

TABLE B-1: BILL OF MATERIALS (BOM)

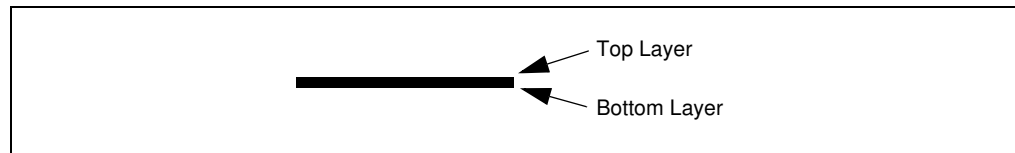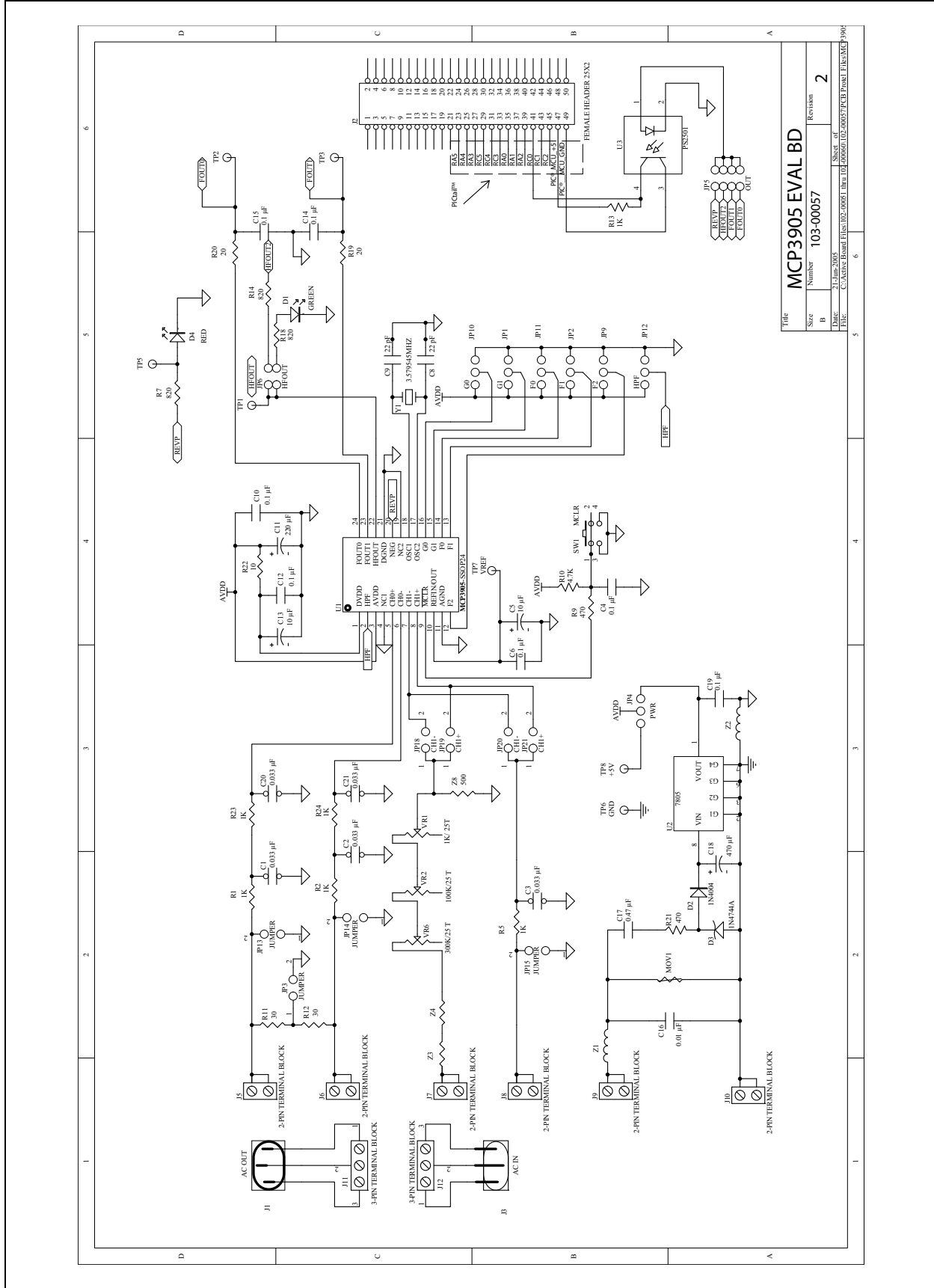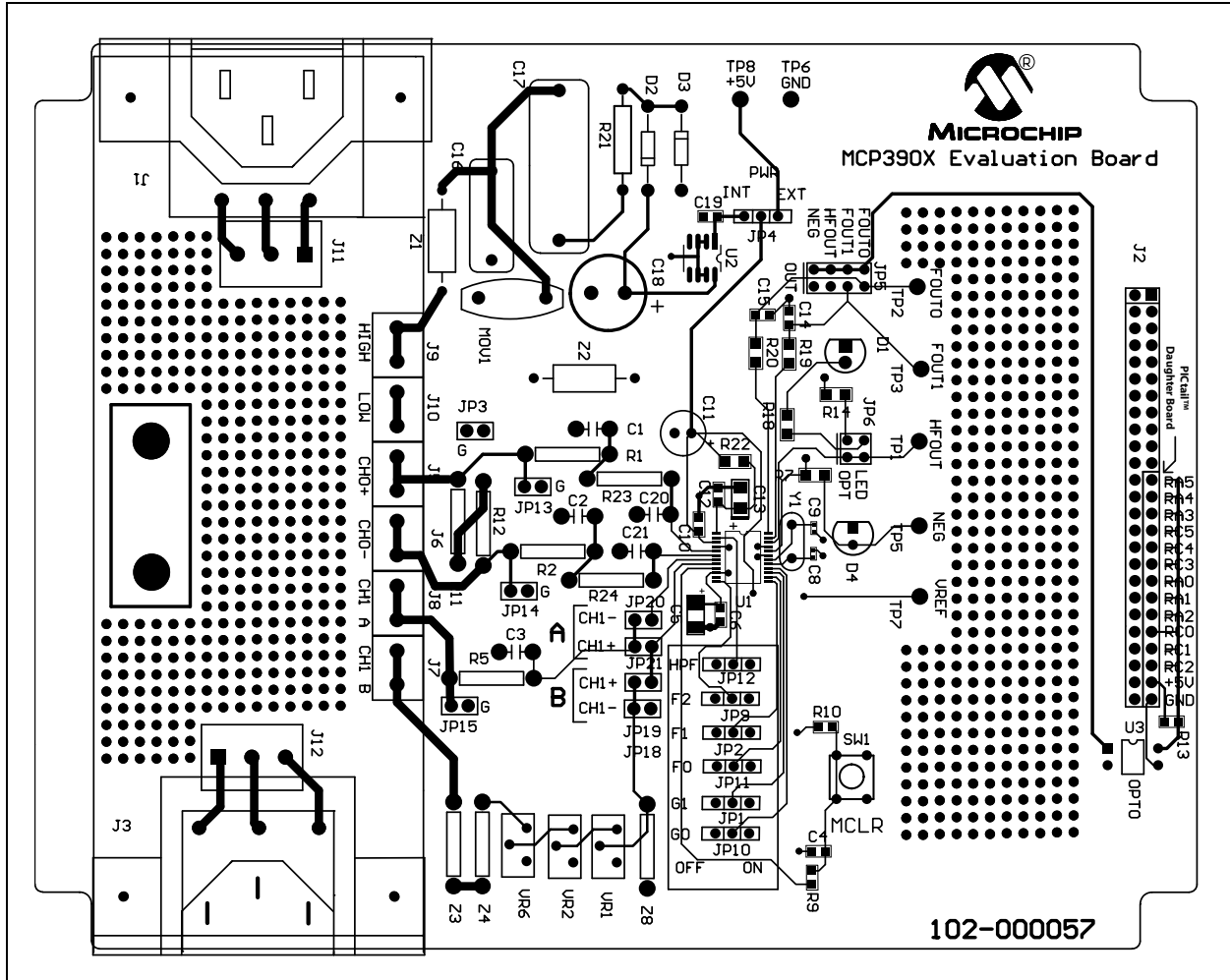| Qty	Reference	Description	Manufacturer	Part Number
5	C1, C2, C3, C20, C21	033 µF 100V 10% MONOLIT CERM CAP	EPCOS	B37987M1333K000
7	C4, C6, C10, C12, C14, C15, C19	CAP .1 µF 16V CERAMIC X7R 0805	Panasonic® - ECG	ECJ-2VB1C104K
2	C5, C13	CAPACITOR TANT 10 µF 6.3V 20% SMD	Nichon	F930J106MAA
2	C8, C9	CAP 22 PF 50V CERAMIC 0402 SMD	Panasonic - ECG	ECJ-0EC1H220J
1	C11	CAP 220 µF 10V ELECT FC RADIAL	Panasonic - ECG	EEU-FC1A221S
1	C16	01 µF INTERFERFENCE METAL CAP	Panasonic - ECG	ECQ-U2A103MN
1	C17	.47 µF/630VDC METAL POLY CAP	Panasonic - ECG	ECQ-E6474KF
1	C18	CAP 470 µF 35V ELECT FC RADIAL	Panasonic - ECG	EEU-FC1V471
30	C1, C2, C3, C20, C21, R1, R2, R5, R11, R12, R23, R24, Z3, Z4, Z8	PIN RECPT .015/.025 DIA 0252 SER Note* - 2 Pins per Location	Mill-Max® Manufacturing Corp.	0252-0-15-15-30-27-10-0
1	D1	LED GREEN CLEAR 5MM ROUND	Panasonic - SSG	LN31GCPH
1	D2	RECTIFIER GPP 400V 1A DO-41	Diodes Inc	1N4004-T
1	D3	DIODE ZENER 15V 1W 5% DO-41	Diodes Inc	1N4744A-T
1	D4	LED RED CLEAR 5MM ROUND	Panasonic - SSG	LN21RCPH
1	J1	AC OUTPUT CONN Top or Bottom placement	SCHURTER	4300.0251
1	J2	"DO NOT INSTALL"	—	—
1	J3	AC INPUT CONN Top or Bottom placement	SCHURTER	GSP1.8101.1
6	J5, J6, J7, J8, J9, J10	TERMINAL BLOCK 5MM VERT 2POS PCB	Jameco Valuepro	TERM BLK-R
4	J1 & J3	SCREW MACH PHIL 4-40X3/8 NYLON	Building Fasteners	NY PMS 440 0038 PH
4	J1 & J3	NUT HEX 4-40 NYLON	Building Fasteners	NY HN 440
7	JP1, JP2, JP4, JP9, JP10, JP11, JP12	HEADER, .1"ST MALE, 1RW, 3PIN, (10) .025"PST, .23"GOLDTAIL	Jameco Valuepro	7000-1X3SG-R
8	JP3, JP15, JP13, JP14, JP18, JP20, JP21, JP19	"HEADER, .1""ST MALE, 1RW, 2PIN, (10) .025""PST, .21""GOLDTAIL	Jameco Valuepro	7000-1X2SG-R
1	JP5	HEADER,.1"ST MALE,2RW,8PIN, .025"PST,.23"GOLDTAIL (10)	Jameco Valuepro	0-2X4SG-R

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.

TABLE B-1:   BILL OF MATERIALS (BOM) (CONTINUED)

Qty	Reference	Description	Manufacturer	Part Number
1	JP6	HEADER, ST MALE, 2RW, 4PIN, .1""CTR, .025 PST,	Jameco Valuepro	2X2SG-R
2	J11, J12	TERMINAL BLOCK 5MM VERT 3POS PCB	Jameco Valuepro	DT128V3P-R
15	JP1, JP2, JP3, JP4, JP5, JP6, JP9, JP10, JP11, JP12, JP13, JP14, JP15, JP19, JP20	.100" Shorting Block with Handle	Jameco Valuepro	2012JH-R
1	MOV1	Suppressors;Clamping Voltage Max.:710V; Peak Surge	EPCOS	SIOV-S20K275
1	PCB	RoHS Compliant Bare PCB, MCP3905A/06A Evaluation Board	Microchip Technology Inc.	104-00057
5	R1, R2, R5 R23, R24	RES 1.00K OHM 1/4W 1% METAL FILM	Yageo® America	MFR-25FBF-1K00
3	R7, R14, R18	RES 820 OHM 1/4W 5% 1206 SMD	Yageo America	RC1206JR-07820RL
1	R9	RES 475 OHM 1/10W 1% 0805 SMD	Panasonic - ECG	ERJ-6ENF4750V
1	R10	RES 4.75K OHM 1/10W 1% 0805 SMD	Panasonic - ECG	ERJ-6ENF4751V
2	R11, R12	RES 30.1 OHM 1/4W 1% METAL FILM	Yageo America	MFR-25FBF-30R1
1	R13	RES 10.0K OHM 1/10W 1% 0805 SMD	Panasonic - ECG	ERJ-6ENF1002V
2	R19, R20	RES 20.0 OHM 1/8W 1% 1206 SMD	Panasonic - ECG	ERJ-8ENF20R0V
1	R21	RES 470 OHM 1W 5% METAL OXIDE	Yageo America	RSF100JB-470K
1	R22	RES 10 OHM 1/8W 1% 1206 SMD	Panasonic - ECG	ERJ-8ENF10R0V
1	SW1	SWITCH TACT 6MM MOM 100GF	Omron Electronics Inc.	B3F-1000
7	TP1, TP2, TP3, TP5, TP6, TP7, TP8	"DO NOT POPULATE"	Keystone Electronics®	5012
1	U1	MCP3905A PWR Meter Chip	Microchip Technology Inc.	**MCP3905A-I/SS**
1	U2	IC VOLT REG 5V 100MA 8-SOIC	Fairchild Semiconductor®	KA78L05AD
1	U3	1 CHANNEL OPTO COUPLER TRANS DIP	NEC	PS2501-1-A
1	VR1	POT 1.0K OHM 3/8" SQ CERM SL MT	Bourns Inc.	3296Y-1-102LF
1	VR2	POT 100K OHM 3/8" SQ CERM SL MT	Bourns Inc.	3296Y-1-104LF
1	VR6	POT 500K OHM 3/8" SQ CERM SL MT	Bourns Inc.	3296Y-1-504LF
1	Y1	CRYSTAL 3.579545MHZ 17PF HC49/US	ECS Inc.	ECS-35-17-4X
2	Z1, Z2	BEAD CORE SINGLE 3.5X9MM AXIAL	Panasonic - ECG	EXC-ELSA39
2	Z3, Z4	RES332KOHM1/4W1%METALFILM Socket	Yageo America	MFR-25FBF-332K
1	Z8	RES 499 OHM 1/4W 1% METAL FILM	Yageo America	MFR-25FBF-499R
5	EA corner of PCB and on in the middle	BUMPON TALL TAPER SQ .50X.23 BK	3M/ESM	SJ-5518 (BLACK)

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.

NOTES:

WORLDWIDE SALES AND SERVICE

AMERICAS

Corporate Office
2355 West Chandler Blvd.
Chandler, AZ 85224-6199
Tel: 480-792-7200
Fax: 480-792-7277
Technical Support:
http://support.microchip.com
Web Address:
www.microchip.com

Atlanta
Duluth, GA
Tel: 678-957-9614
Fax: 678-957-1455

Boston
Westborough, MA
Tel: 774-760-0087
Fax: 774-760-0088

Chicago
Itasca, IL
Tel: 630-285-0071
Fax: 630-285-0075

Cleveland
Independence, OH
Tel: 216-447-0464
Fax: 216-447-0643

Dallas
Addison, TX
Tel: 972-818-7423
Fax: 972-818-2924

Detroit
Farmington Hills, MI
Tel: 248-538-2250
Fax: 248-538-2260

Kokomo
Kokomo, IN
Tel: 765-864-8360
Fax: 765-864-8387

Los Angeles
Mission Viejo, CA
Tel: 949-462-9523
Fax: 949-462-9608

Santa Clara
Santa Clara, CA
Tel: 408-961-6444
Fax: 408-961-6445

Toronto
Mississauga, Ontario,
Canada
Tel: 905-673-0699
Fax: 905-673-6509

ASIA/PACIFIC

Asia Pacific Office
Suites 3707-14, 37th Floor
Tower 6, The Gateway
Harbour City, Kowloon
Hong Kong
Tel: 852-2401-1200
Fax: 852-2401-3431

Australia - Sydney
Tel: 61-2-9868-6733
Fax: 61-2-9868-6755

China - Beijing
Tel: 86-10-8528-2100
Fax: 86-10-8528-2104

China - Chengdu
Tel: 86-28-8665-5511
Fax: 86-28-8665-7889

China - Hong Kong SAR
Tel: 852-2401-1200
Fax: 852-2401-3431

China - Nanjing
Tel: 86-25-8473-2460
Fax: 86-25-8473-2470

China - Qingdao
Tel: 86-532-8502-7355
Fax: 86-532-8502-7205

China - Shanghai
Tel: 86-21-5407-5533
Fax: 86-21-5407-5066

China - Shenyang
Tel: 86-24-2334-2829
Fax: 86-24-2334-2393

China - Shenzhen
Tel: 86-755-8203-2660
Fax: 86-755-8203-1760

China - Wuhan
Tel: 86-27-5980-5300
Fax: 86-27-5980-5118

China - Xiamen
Tel: 86-592-2388138
Fax: 86-592-2388130

China - Xian
Tel: 86-29-8833-7252
Fax: 86-29-8833-7256

China - Zhuhai
Tel: 86-756-3210040
Fax: 86-756-3210049

ASIA/PACIFIC

India - Bangalore
Tel: 91-80-3090-4444
Fax: 91-80-3090-4080

India - New Delhi
Tel: 91-11-4160-8631
Fax: 91-11-4160-8632

India - Pune
Tel: 91-20-2566-1512
Fax: 91-20-2566-1513

Japan - Yokohama
Tel: 81-45-471- 6166
Fax: 81-45-471-6122

Korea - Daegu
Tel: 82-53-744-4301
Fax: 82-53-744-4302

Korea - Seoul
Tel: 82-2-554-7200
Fax: 82-2-558-5932 or
82-2-558-5934

Malaysia - Kuala Lumpur
Tel: 60-3-6201-9857
Fax: 60-3-6201-9859

Malaysia - Penang
Tel: 60-4-227-8870
Fax: 60-4-227-4068

Philippines - Manila
Tel: 63-2-634-9065
Fax: 63-2-634-9069

Singapore
Tel: 65-6334-8870
Fax: 65-6334-8850

Taiwan - Hsin Chu
Tel: 886-3-6578-300
Fax: 886-3-6578-370

Taiwan - Kaohsiung
Tel: 886-7-536-4818
Fax: 886-7-536-4803

Taiwan - Taipei
Tel: 886-2-2500-6610
Fax: 886-2-2508-0102

Thailand - Bangkok
Tel: 66-2-694-1351
Fax: 66-2-694-1350

EUROPE

Austria - Wels
Tel: 43-7242-2244-39
Fax: 43-7242-2244-393

Denmark - Copenhagen
Tel: 45-4450-2828
Fax: 45-4485-2829

France - Paris
Tel: 33-1-69-53-63-20
Fax: 33-1-69-30-90-79

Germany - Munich
Tel: 49-89-627-144-0
Fax: 49-89-627-144-44

Italy - Milan
Tel: 39-0331-742611
Fax: 39-0331-466781

Netherlands - Drunen
Tel: 31-416-690399
Fax: 31-416-690340

Spain - Madrid
Tel: 34-91-708-08-90
Fax: 34-91-708-08-91

UK - Wokingham
Tel: 44-118-921-5869
Fax: 44-118-921-5820

03/26/09