RE46C190
Demo Board
User's Guide

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Preface

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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 RE46C190 Demo 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 RE46C190 Demo Board as a development tool to emulate and debug firmware on a target board. The manual layout is as follows:

- **Chapter 1. "Product Overview"** – This chapter introduces the main characteristics of the RE46C190 Demo Board.
- **Chapter 2. "Installation and Operation"** – Includes a detailed description of the board and instructions on how to get started.
- **Appendix A. "Schematic and Layouts"** – Shows the schematic and layout diagrams.
- **Appendix B. "Bill of Materials (BOM)"** – Lists the parts used to build the RE46C190 Demo Board.

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) { ... }`

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RECOMMENDED READING

This user's guide describes how to use the RE46C190 Demo Board. Other useful documents are listed below. The following Microchip documents are available and recommended as supplemental reference resources.

- **RE46C190 Data Sheet - *"CMOS Low Voltage Photoelectric Smoke Detector ASIC with Interconnect and Timer Mode"*, DS22271.**

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

DOCUMENT REVISION HISTORY

Revision A (April 2011)

- Initial Release of this Document.

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Chapter 1. Product Overview

1.1 INTRODUCTION

The RE46C190 is a low voltage, programmable photo smoke detector with interconnect, local alarm indication, programmable setup, programmable calibration, programmable feature selection, boost regulator and horn driver. This device has a minimal external component count.

This chapter provides an overview of the RE46C190 Demo Board and covers the following topics:

- What is the RE46C190 Demo Board?
- What the RE46C190 Demo Board Kit Contains

1.2 WHAT IS THE RE46C190 DEMO BOARD?

The RE46C190 Demo Board is a complete stand-alone smoke detector application with a smoke chamber emulator. The demo board allows the evaluation of all the functions that the RE46C190 device has. Key test points of the device are available at the bottom edge of the demo board.

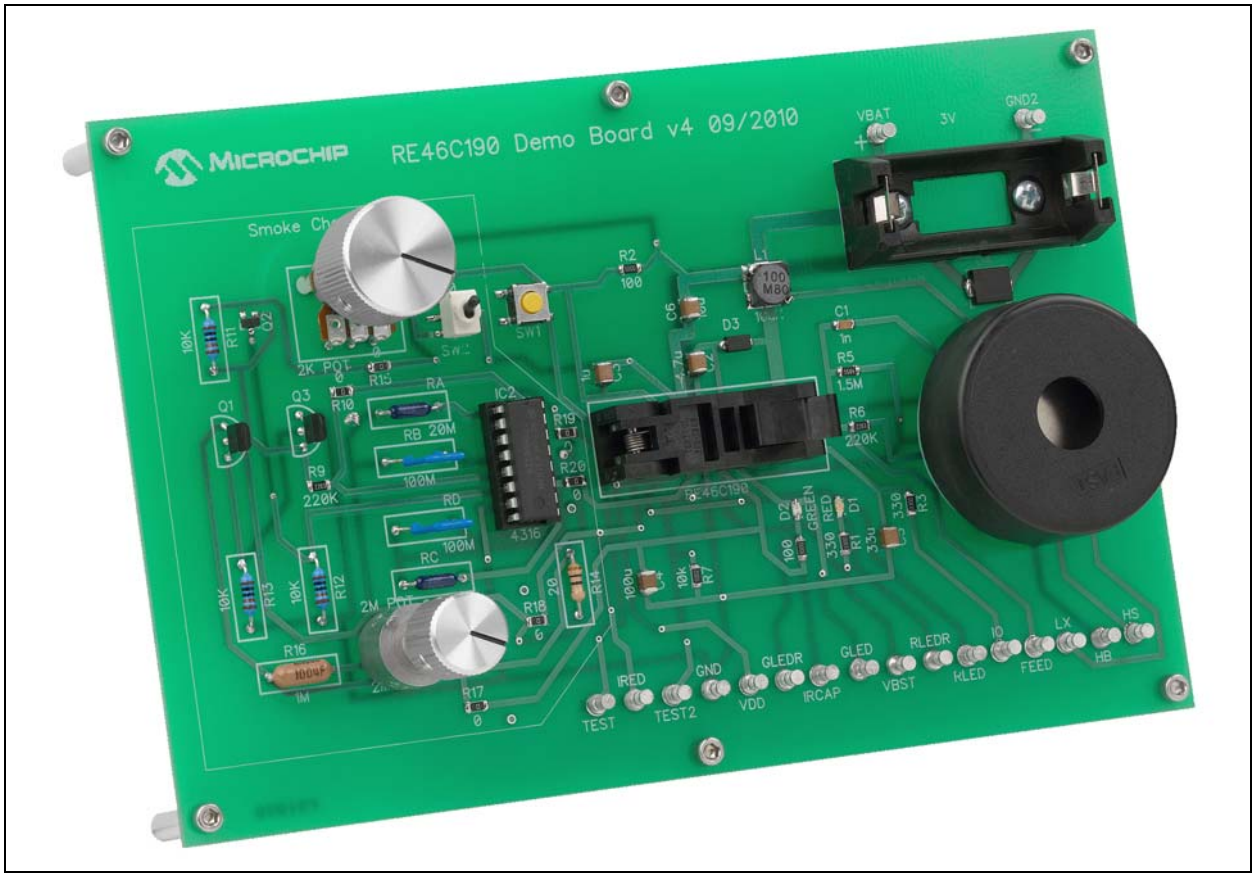

FIGURE 1-1: RE46C190 Demo Board.

The demo board is designed for battery operation using a CR123A battery, or can be operated using a power supply.

The RE46C190 application circuit is on the right side of the board by the battery holder and piezo horn, while the smoke chamber emulator is on the left side. The emulator can be disconnected from the application circuit and a photo smoke chamber or its components can be connected to the demo board.

1.3 WHAT THE RE46C190 DEMO BOARD KIT CONTAINS

The RE46C190 Demo Board kit includes:

- RE46C190 Demo Board (102-00344)
- Pre-programmed RE46C190 parts
- Knob and standoffs for final board assembly
- Important Information Sheet

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Chapter 2. Installation and Operation

2.1 INTRODUCTION

The RE46C190 Demo Board allows full evaluation of the RE46C190 functionality, including programmability. The demo board consists of two parts:

- RE46C190 application circuit (see Figure 2-1)
- A smoke-chamber emulation circuit (see Figure 2.2).

The smoke-chamber emulation circuit can be disconnected from the RE46C190 application circuit so the actual photo smoke chamber components can be evaluated in the RE46C190 application circuit. The board can be operated from a CR123A battery, or be powered from a 3V power supply.

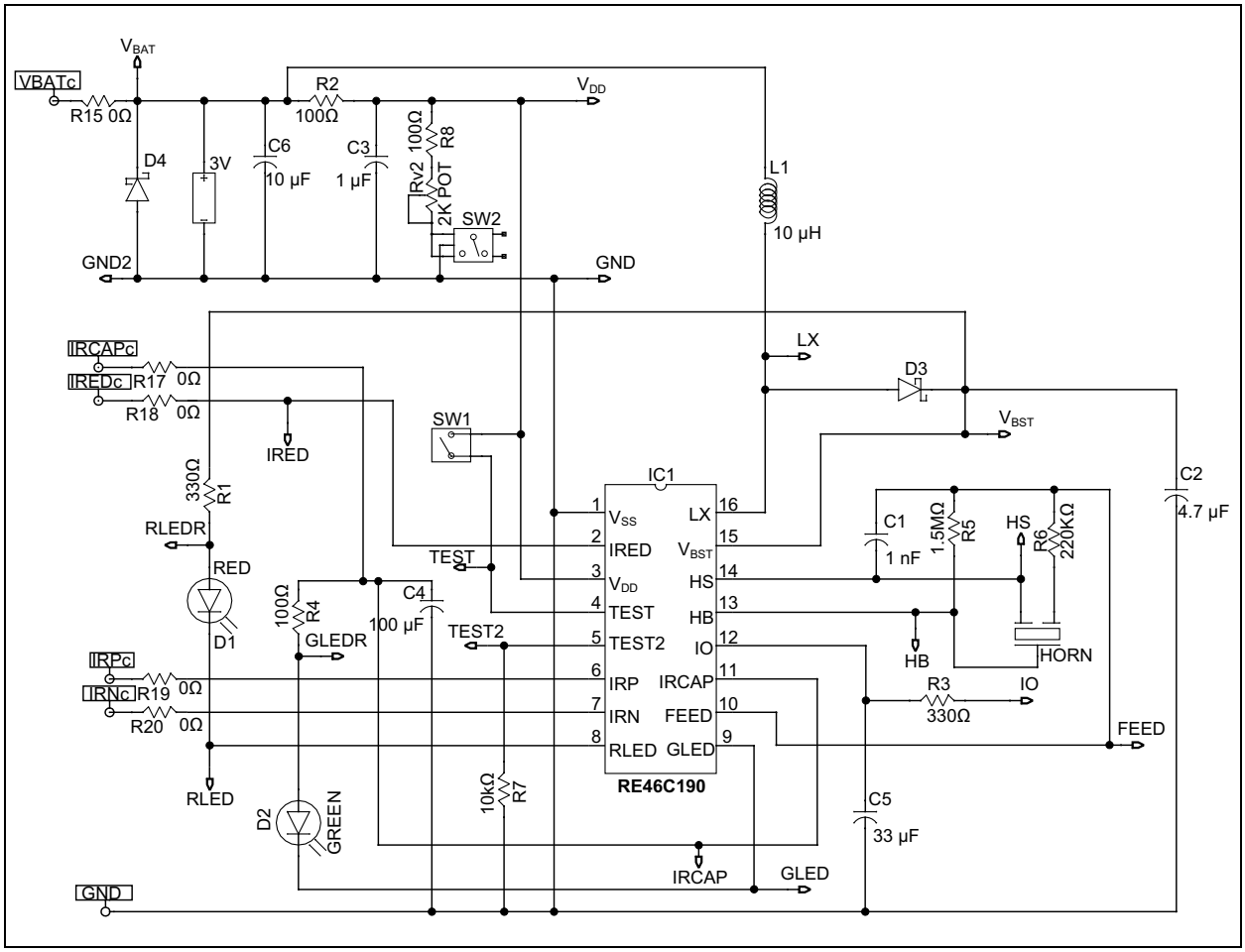

FIGURE 2-1: *RE46C190 Application Circuit.*

2.2 SETUP

Before powering the RE46C190 Demo Board, complete the following steps:

1. Place the potentiometer knob on the 2M POT.
2. Attach the six standoffs with screws are provided to act as legs for the demo board.
3. Start with the switch in OFF state, toggled toward the label R8, and ensure that Rv2 is turned fully clockwise, to its highest resistance value. The switch (SW2) and the potentiometer (Rv2) allow the apparent battery voltage (V_{DD}) to be lowered so the low battery operation of the application can be evaluated.
4. Ensure that the 2M POT, used to set the current in the smoke chamber emulator, is turned fully counterclockwise to set a minimum photodiode current.
5. Ensure there is a preprogrammed RE46C190 in the ZIF socket. The socket's pin 1 designator is located near capacitor C2.
6. Insert a CR123A battery in the battery holder, or connect a 3V power supply to the terminals next to the battery holder (VBAT and GND2).

The RE46C190 Demo Board allows two adjustments when evaluating the RE46C190 device. The first adjustment uses the 2M POT to increase the current to the photodiode inputs IRN and IRP to simulate a smoke condition, by turning the potentiometer knob in a clockwise direction.

WARNING

The smoke emulator circuit is sensitive to the battery voltage or power supply voltage. To ensure consistent results from the smoke emulator, be sure the VBAT voltage is the same as used in the previous tests.

When switch SW2 is toggled toward the center of the board, Rv2 is able to reduce the apparent battery voltage (V_{DD}) supplied to the IC, when turned counterclockwise.

If a power supply is being used in place of a battery, be sure the current limit is set for a value greater than 2A. When the boost regulator is operating, it can draw peak currents greater than 1.0A. A low current limit may cause the power supply voltage to drop, and may reset the IC. This can appear as a non-specified operation.

Due to the sampling rate of the IC, the potentiometer adjustments do not have an immediate effect. Refer to the RE46C190 Data Sheet for specific information on timing.

2.3 GETTING STARTED

To emulate the basic smoke detect operation, slowly turn the 2M POT clockwise, until RLED flashes and the piezo horn sounds. This is the Alarm mode. A piece of tape over the hole in the piezo horn case reduces the volume of the horn during testing. Turn the 2M POT counterclockwise until the Alarm mode ends. This is the Hysteresis mode of operation. The GLED flashes to indicate a local alarm, i.e. this particular device has been in an alarm condition. Press SW1, the Push-to-Test button. The piezo horn will chirp as an audible indication that the Local Alarm Memory is set. When the button is released, the Local Alarm Memory is reset to Normal operation. Refer to the RE46C190 Data Sheet for specific details on device operation in Normal mode.

Repeat the test above, but leave the IC in Alarm mode, and press SW1 to enter the Hush mode. Continue by turning the 2M POT clockwise to re-enter the Alarm mode. Refer to the RE46C190 Data Sheet for Push-to-Test and Reduced Sensitivity operation.

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Another basic test is the low battery test. Connect a digital multimeter to the test pins V_{DD} and GND, to monitor the V_{DD}. Toggle the switch SW2 toward the center of the demo board and observe the change in V_{DD}. Turn Rv2 counterclockwise to lower the V_{DD} voltage to less than 2.4V, where the low battery threshold should be set. The piezo horn chirps once every 43 seconds. The low battery Silence mode can be entered by pressing SW1. Refer to the RE46C190 Data Sheet for details on the Supervisory mode.

The chamber test can be evaluated by first toggling the switch SW2 toward the label R8 and then turning the 2M POT fully counterclockwise. This places the demo board in a Non-Alarm state. Short the test point IRED to the test point IRCAP. This disables the smoke chamber emulator and causes the IC to fail the chamber test. Three chirps are heard after the test fails. Refer to the RE46C190 Data Sheet for details on this Supervisory mode.

Table 2-1 lists the program settings for the RE46C190 samples included with the demo board. Due to limitations of the smoke emulator, the IRED current, the photo amplifier gain and the integration time should not be changed.

TABLE 2-1: PRE-PROGRAMMED RE46C190 SAMPLE

Parameter	Setting
Long Term Drift Limit	0
Chamber Test Limit	2
Hush Limit	20
Hysteresis Limit	15
Normal Smoke Limit	20
Photo Amplifier Gain Factor	1
Integration Time	100 µs
Low Battery Trip Limit	2.4V
Long Term Drift Enable	Disable
Low Battery Hush Enable	Enable
IRED Current	150 mA
Hush Option	Never Cancel
End Of Life Enable	Disabled
Tone Select	Temporal

Table 2-2 is a list of the test points easily available on the bottom of the demo board. Refer to **A.2 “Board Schematic - RE46C190 Application Circuit and Smoke Chamber Regulator”** for details of the connection of the test point. When using the test points, use an oscilloscope to observe RE46C190’s operation.

TABLE 2-2: RE46C190 DEMO BOARD TEST POINTS

Test Point	Description
V_{BAT}	The battery voltage or power supply voltage
GND2	Second connection to V_{SS}
TEST	Connection to Pin 4 of the RE46C190 device and the push-to-test button
IRED	Connection to the smoke chamber emulator and to Pin 2 of the RE46C190 device
TEST2	Connection to Pin 5 of the RE46C190 device
GND	Connection to V_{SS}
V_{DD}	Connection to Pin 3 of the RE46C190 device
GLEDR	Connection to the green LED resistor and the green LED anode
IRCAP	Connection to the smoke chamber emulator and to Pin 11 of the RE46C190 device
GLED	Connection to the cathode of the green LED and to Pin 9 of the RE46C190 device
V_{BST}	Connection to Pin 15 of the RE46C190 device
RLEDR	Connection to the red LED resistor and the red LED anode
RLED	Connection to the red LED cathode and to Pin 8 of the RE46C190 device
IO	Connection to Pin 12 of the RE46C190 device
FEED	Connection to Pin 10 of the RE46C190 device
LX	Connection to Pin 16 of the RE46C190 device
HB	Connection to Pin 13 of the RE46C190 device
HS	Connection to Pin 14 of the RE46C190 device

2.4 MODIFYING THE DEMO BOARD

The RE46C190 Demo Board can be modified to include a smoke chamber, or smoke chamber components. Jumpers R19 and R20 can be removed to allow a photodiode to be connected to the IRP and IRN pins of the IC, respectively. R17 and R18 can be removed to allow an infrared LED to be connected to the IRCAP and IRED pins, respectively.

The removal of jumper R15 will disconnect the smoke chamber emulator from the VBAT line. This allows the measurement of the smoke detector application average input current. It is important that the toggle switch SW2 be placed in the OFF position for this measurement.

WARNING

The input current measurement requires an ammeter setting that can handle the large current draw of the boost regulator, while resolving microamperes of current. The effective series resistance of the ammeter can affect the operation of the boost regulator.
An alternative method for this measurement is to place a 100 µF capacitor between the terminal VBAT and GND2, and connect one end of a 100Ω resistor to VBAT. Connect the ammeter to the other end of the resistor and then to the positive terminal of the power supply, or battery. Connect the negative terminal of the battery or power supply to the terminal GND2. This simple RC filter will smooth out the current peaks. The capacitor should have a low ESR to minimize the voltage ripple at the VBAT terminal.

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Appendix A. Schematic and Layouts

A.1 INTRODUCTION

This appendix contains the following schematics and layouts for the RE46C190 Demo Board.

- **A.2 "Board Schematic - RE46C190 Application Circuit and Smoke Chamber Regulator"**
- **A.3 "Smoke Chamber Emulation Circuit"**
- **A.4 "Board - Top Silk and Pads"**
- **A.5 "Board - Top Trace and Pads"**
- **A.6 "Board - Bottom Trace and Pads"**

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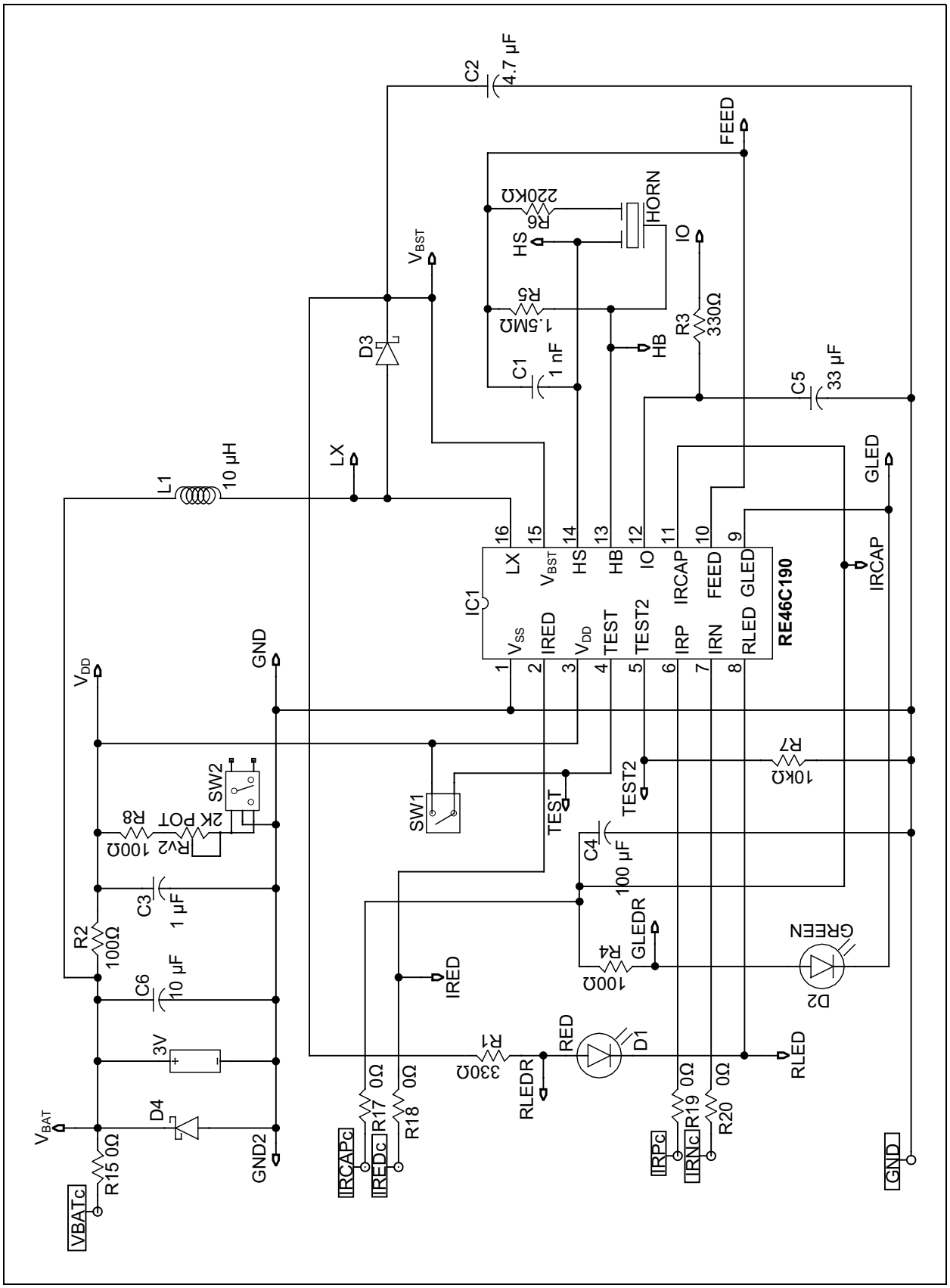
A.2 BOARD SCHEMATIC - RE46C190 APPLICATION CIRCUIT AND SMOKE CHAMBER REGULATOR



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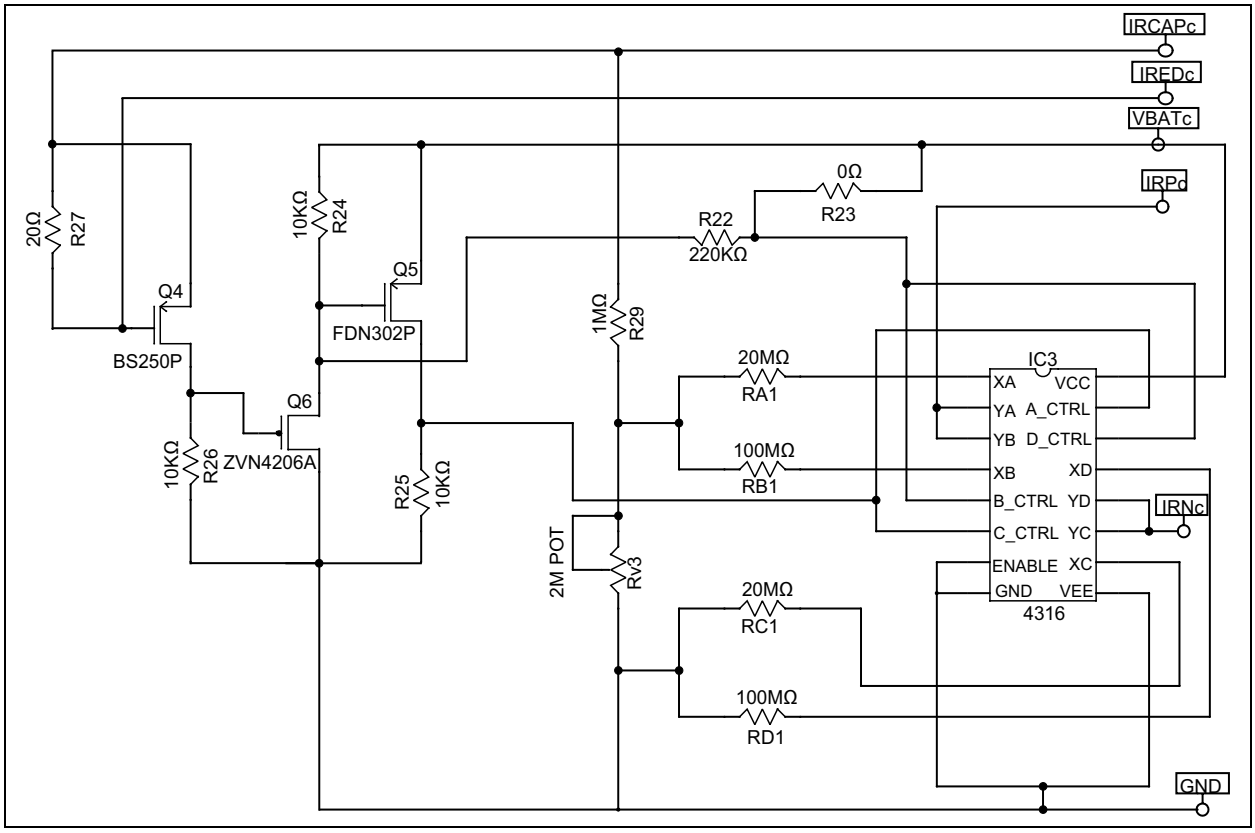
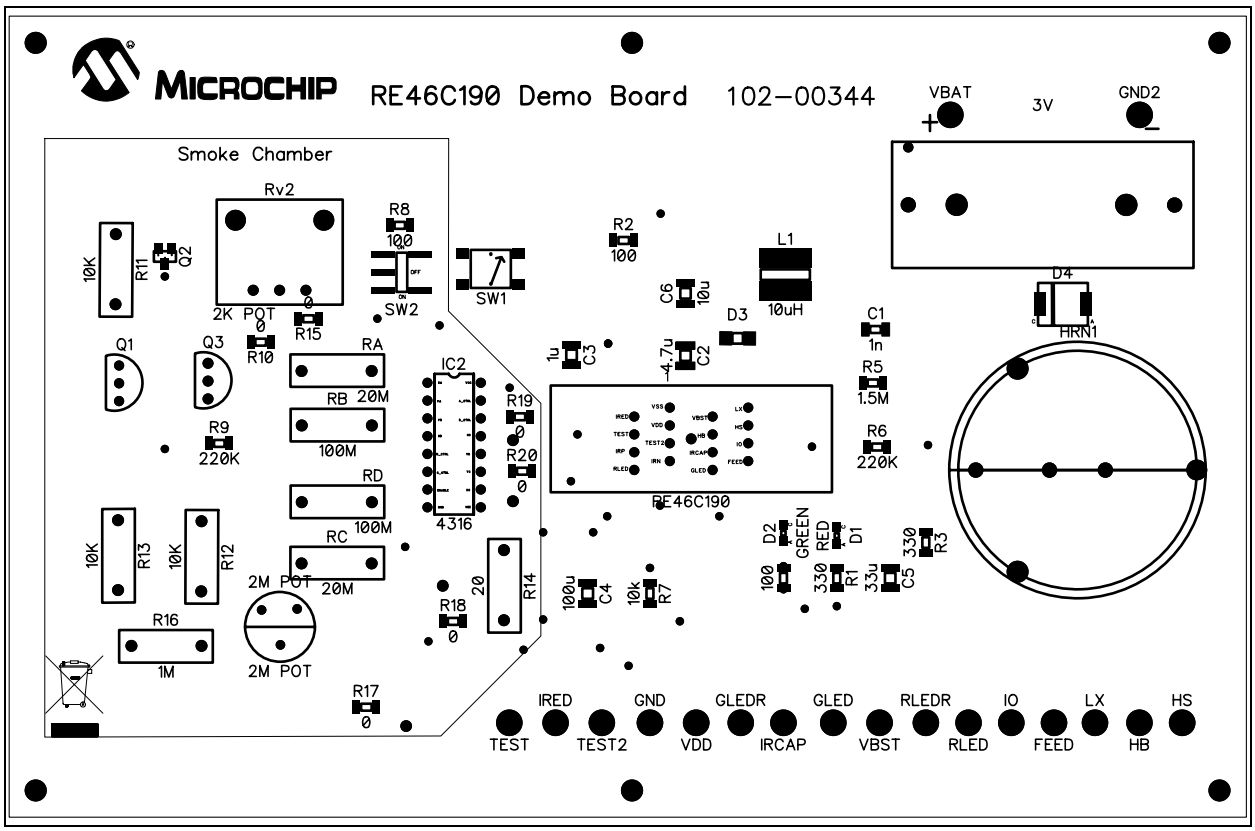
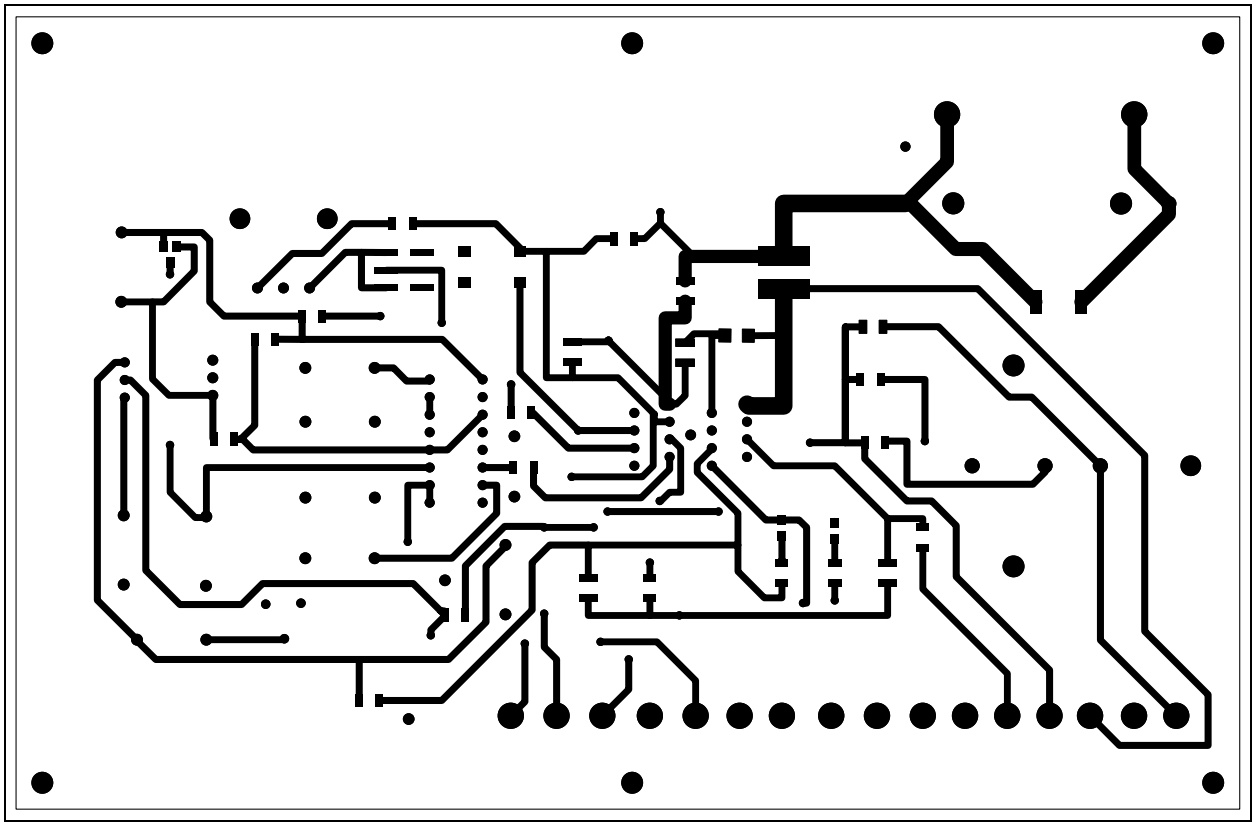
A.3 SMOKE CHAMBER EMULATION CIRCUIT



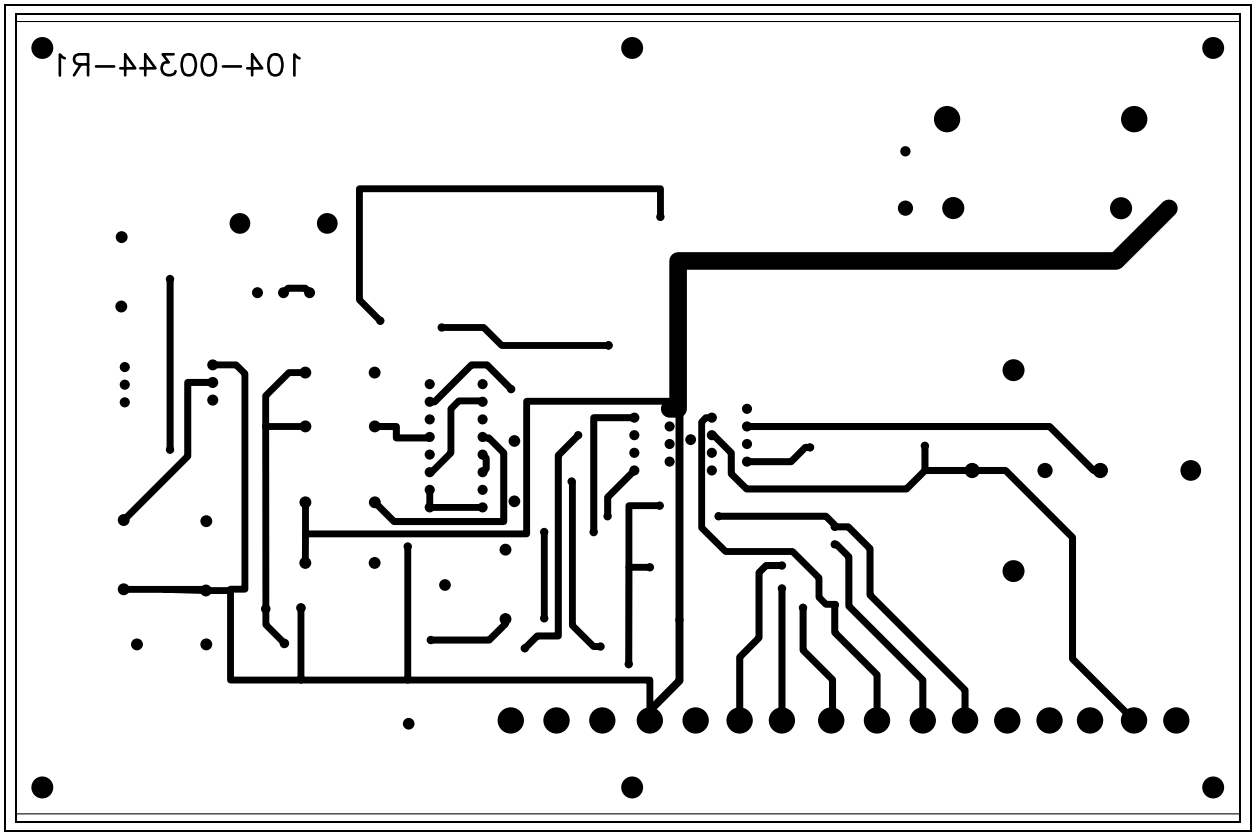
A.4 BOARD - TOP SILK AND PADS



A.5 BOARD - TOP TRACE AND PADS



A.6 BOARD - BOTTOM TRACE AND PADS



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Appendix B. Bill of Materials (BOM)

TABLE B-1: BILL OF MATERIALS (BOM)

Qty	Reference	Description	Manufacturer	Part Number
3	BH1	CR123A Battery Holder for PCB mount - RoHS Compliant (BCR123A)	http://www.batteryspace.com	BCR123A
1	C1	Multilayer Ceramic Capacitor (MLCC) - 1206 100 volts 1000pF 10% X7R	Kemet® Electronics Corp.	C1206Y102K1RACTU
1	C2	Multilayer Ceramic Capacitor (MLCC) - SMD/SMT 1210 4.7uF 25volts X7R 20%	TDK® Corporation	C3225X7R1E475M
1	C3	Multilayer Ceramic Capacitor (MLCC) - 1210 100 volts 1uF 20% X7R	TDK Corporation	C3225X7R2A105M
1	C4	Multilayer Ceramic Capacitor (MLCC) - SMD/SMT 1210 100uF 6.3 volts X5R 20%	TDK Corporation	C3225X5R0J107M
1	C5	Multilayer Ceramic Capacitor (MLCC) - SMD/SMT 1210 33uF 6.3volts X5R 20%	TDK Corporation	C3225X5R0J336M
1	C6	Multilayer Ceramic Capacitor (MLCC) - SMD/SMT 1210 10uF 25volts X5R 10%	TDK Corporation	C3225X5R1E106K
1	D1	SMD Red 2.0V LEDs	Lumex® Inc.	SML-LXF0805SIC-TR
1	D2	SMD Green, 565nm 2.2V, 10mcd	Lumex Inc.	SML-LX0805GC-TR
1	D3	SCHOTTKY RECTIFIER, 1.5A, 25V, DO-214AC	Vishay® Intertechnology, Inc.	BYS10-25-E3/TR
1	D4	FAST SWITCH DIODE, 3A 600V DO-214AB	Vishay Intertechnology, Inc.	RS3J-E3/57T
1	HRN1	PCB mounting, Piezo Horn Sealed-type	MynTahl Corp.	EFM-290ED
1	IC1	SOIC SOCKET, 16POS, SMD Connector Type:SOIC Socket	3M	216-7383-55-1902
1	IC1	Microchip will Consign	Microchip Technology Inc.	**RE46C190S16F**
1	IC2	CONN IC SOCKET 16POS DIP TIN	Tyco® Electronics	2-641610-1
1	IC2 Socket	IC MUX/DEMUX QUAD 1X1 16DIP	ON Semiconductor®	MC74HC4316ANG
1	L1	Power Inductors 10uH 1.7A	Sumida Corporation	CDRH6D28NP-100NC
1	Q1	MOSFET P-CH 45V 230MA TO92-3	Diodes® Incorporated/Zetex	BS250P
1	Q2	MOSFET P-CH 20V 2.4A SSOT3	Fairchild Semiconductor®	FDN302P
1	Q3	MOSFET N-CH 60V 600MA TO92-3	Diodes Incorporated/Zetex	ZVN4206AV
1	PCB	RoHS Compliant Bare PCB, RE46C190 Demo Board	—	104-00344
6	R10, R15, R17, R18, R19, R20	Resistor 1206-SMD 0 ohm Jumper	Bourns® Inc.	CR1206-J/-000ELF
2	R1, R3	Resistors1206-SMD 1/4 watt 330 ohms 1%	Vishay Intertechnology, Inc./Dale	CRCW1206330RFKTA

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
3	R2, R4, R8	Resistor 1206-SMD 1/4 watt 100 ohms 1%	Vishay Intertechnology, Inc./Dale	CRCW1206100RFKEA
1	R5	Resistors1206-SMD 1/4 watt 1.5 Meg ohms 1%	Vishay Intertechnology, Inc./Dale	CRCW12061M50FKEA
2	R6, R9	Resistors1206-SMD 1/4 watt 220K ohms 1%	Vishay Intertechnology, Inc./Dale	CRCW1206220KFKEA
1	R7	Resistors 1206-SMD 1/4 watt 10K ohms 1%	Vishay Intertechnology, Inc./Dale	CRCW120610K0FKEA
6	R10, R15, R17, R18, R19, R20	Resistor 1206-SMD 0 ohm Jumper	Bourns Inc.	CR1206-J/-000ELF
3	R11, R12, R13	10KΩ Resistor	Vishay Intertechnology, Inc.	CCF0710K0GKE36
1	R14	RESISTOR, METAL FILM, 20OHM, 250mW, 1%	Multicomp	MCMF0W4FF200JA50
1	R16	RESISTOR, METAL FILM, 1MOHM, 500mW, 2%	Vishay Intertechnology, Inc.	CCF071M00GKE36
2	RA, RC	RESISTOR 20M OHM. 5W CARB COM	Ohmite® Mfg., Co.	OF206JE
2	RB, RD	RESISTOR, HV, 100MOHM, 800mW, 1%	Tyco Electronics	HBA100MFZRE
1	Rv1	POT 2.5MEG OHM CARBON 1/2W	Precision Electronic Components Ltd.	SPRU2551S28
1	Rv2	Potentiometer 2K LINEAR 12MM	Bourns Inc.	PDB12-H4251-202BF
1	SW1	SWITCH TACT 6MM 230GF H=4.3MM	OMRON Corporation	B3S-1002P
1	SW2	Toggle Switches SPDT ON-NONE-ON SMT	C&K Components	GT11MSCBE
18	Test Points	Circuit Board Hardware - PCB TERMINAL PIN TURRET	Harwin Plc.	H2121-01

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-2: BILL OF MATERIALS - HARDWARE PARTS

Qty	Reference	Description	Manufacturer	Part Number
2	Bat Holder Hex Nuts	NUT HEX 4-40 NYLON	B&F™ Fastener Supply	NY HN 440
2	Bat Holder Screws	SCREW MACH PHIL 4-40X3/8 NYLON	B&F Fastener Supply	NY PMS 440 0038 PH
1	POT Dials	SWITCH KNOB STRAIGHT .74" NATRL	Tyco Electronics	KLN700A1/4
1	POT Dials	SWITCH KNOB STRAIGHT .50" NATRL	Tyco Electronics	KLN500A1/8
6	Standoffs	SCREW MACH PHIL 4-40X1/4 NYLON	B&F Fastener Supply	NY PMS 440 0025 PH
6	Standoffs	STANDOFF HEX .500"L 4-40THR NYL	Keystone Electronics®	1902C

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.

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