



**MICROCHIP**

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**MCP9604**  
**Thermocouple IC**  
**Evaluation Board**  
**User Guide**

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# MCP9604 THERMOCOUPLE IC EVALUATION BOARD USER GUIDE

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## Preface

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### 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 website ([www.microchip.com](http://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 “DSXXXXXXXXA”, where “XXXXXXXX” 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 online help. Select the Help menu, and then Topics to open a list of available online help files.

## INTRODUCTION

This chapter contains general information that will be useful to know before using the MCP9604 Thermocouple IC Evaluation Board. Items discussed in this chapter include:

- Document Layout
- Conventions Used in This Guide
- Recommended Reading
- The Microchip Website
- Customer Support
- Revision History

## DOCUMENT LAYOUT

This document describes how to use the MCP9604 Thermocouple IC Evaluation Board as a development tool. The document is organized as follows:

- **Chapter 1. “Product Overview”** – This chapter includes important information about the MCP9604 Thermocouple IC Evaluation Board.
- **Chapter 2. “Installation and Operation”** – This chapter includes a detailed description of each function of the evaluation board and instructions on how to begin using the board.
- **Appendix A. “Schematic and Layouts”** – Shows the schematic and layout diagrams for MCP9604 Thermocouple IC Evaluation Board.
- **Appendix B. “Bill of Materials (BOM)”** – Lists the parts used to build the MCP9604 Thermocouple IC Evaluation Board.

# MCP9604 Thermocouple IC Evaluation Board User Guide

## CONVENTIONS USED IN THIS GUIDE

This manual uses the following documentation conventions:

### DOCUMENTATION CONVENTIONS

Description	Represents	Examples
<b>Arial font:</b>		
Italic characters	Referenced books	<i>MPLAB® IDE User's Guide</i>
	Emphasized text	...is the <i>only</i> 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	<u>File</u> > <i>Save</i>
Bold characters	A dialog button	Click <b>OK</b>
	A tab	Click the <b>Power</b> 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>
<b>Courier New font:</b>		
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	<i>file.o</i> , where <i>file</i> can be any valid filename
Square brackets [ ]	Optional arguments	mcc18 [options] <i>file</i> [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 guide describes how to use the MCP9604 Thermocouple IC Evaluation Board. Other useful documents are listed below. The following Microchip documents are available and recommended as supplemental reference resources:

- **MCP960X/L0X/RL0X Data Sheet – “Thermocouple EMF to Temperature Converter,  $\pm 1.5^{\circ}\text{C}$  Maximum Accuracy” (20005426)**

This data sheet provides detailed information regarding the MCP9604 device:

- **PIC18F2455/2550/4455/4550 Data Sheet – “28/40/44-Pin, High-Performance, Enhanced Flash, USB Microcontrollers with nanoWatt Technology” (39632)**

This data sheet provides detailed information regarding the PIC18F2455/2550/4455/4550 devices.

## THE MICROCHIP WEBSITE

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

- **Product Support** – Data sheets and errata, application notes and sample programs, design resources, user 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 website at:

<http://www.microchip.com/support>.

## REVISION HISTORY

**Revision A (September 2025)**

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## Chapter 1. Product Overview

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### 1.1 INTRODUCTION

This chapter provides an overview of the MCP9604 Thermocouple IC Evaluation Board and covers the following topics:

- What is the MCP9604 Device?
- What is the MCP9604 Thermocouple IC Evaluation Board?
- What the MCP9604 Thermocouple IC Evaluation Board Kit Contains

### 1.2 WHAT IS THE MCP9604 DEVICE?

The MCP9604 is a Thermocouple Electromotive Force (EMF) to temperature converter. This device converts thermocouple EMF to degree Celsius with integrated Cold-Junction compensation. MCP9604 corrects the thermocouple nonlinear error characteristics of eight thermocouple types and outputs  $\pm 1.5^{\circ}\text{C}$  accurate temperature data for the selected thermocouple. The correction coefficients are derived from the National Institute of Standards and Technology (NIST) ITS-90 Thermocouple Database.

### 1.3 WHAT IS THE MCP9604 THERMOCOUPLE IC EVALUATION BOARD?

The MCP9604 Thermocouple IC Evaluation Board is used to evaluate four MCP9604 Thermocouples EMF voltage to degree Celsius converter. Users can easily evaluate all device features using a Type K thermocouple (not Included). The device also supports Types J, T, N, E, B, S and R thermocouples. Each of these types can be evaluated by replacing the Type K thermocouple connector with the corresponding connectors.

In addition, the MCP9604 Thermocouple IC Evaluation Board connects to a PC via a USB interface. Temperature can be data-logged using the Microchip Thermal Management Software Graphical User Interface (GUI).

### 1.4 WHAT THE MCP9604 THERMOCOUPLE IC EVALUATION BOARD KIT CONTAINS

The MCP9604 Thermocouple IC Evaluation Board package includes:

- MCP9604 Thermocouple IC Evaluation Board (EV19L27A)
- USB-C Cable
- Important Information Sheet

**Note:** Type K thermocouple is not included (recommended part number: 5SRTC-TT-K-24-36 sub-miniature connector).

## Chapter 2. Installation and Operation

### 2.1 INTRODUCTION

The MCP9604 Thermocouple IC Evaluation Board enables users to easily evaluate all user-programmable features such as thermocouple selection, temperature alert limit settings, temperature resolutions and Power mode.

Items discussed in this chapter include:

- [Required Tool](#)
- [Getting Started](#)
- [Microchip Thermal Management Software GUI](#)
- [Configuring the MCP9604](#)
- [Data Acquisition](#)

### 2.2 REQUIRED TOOL

The evaluation board software requires Windows® 7 or later, with a USB connection.

### 2.3 GETTING STARTED

This section describes how to power up and interface with the MCP9604 Thermocouple IC Evaluation Board.

#### 2.3.1 Hardware Setup

1. The MCP9604 Thermocouple IC Evaluation Board has a mini USB connector. The USB connection is needed for power and data acquisition.

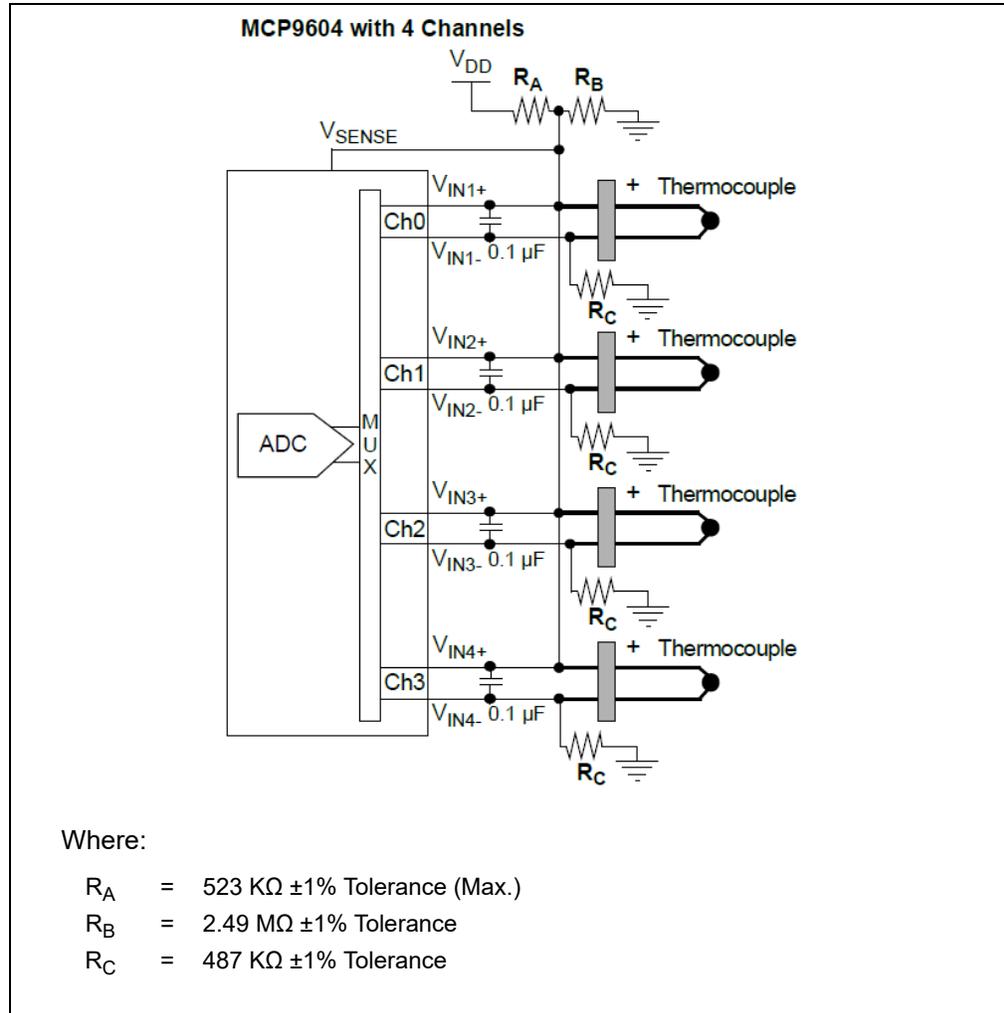


**FIGURE 2-1:** MCP9604 Thermocouple IC Evaluation Board.

# MCP9604 Thermocouple IC Evaluation Board User Guide

## 2.3.2 Hardware Operation

The MCP9604 Thermocouple IC Evaluation Board is fully powered from a PC USB 5V source. Once power is applied and the USB is successfully enumerated, the PIC<sup>®</sup> microcontroller is ready to receive commands from GUI MCP9604 settings or transfer temperature data.



**FIGURE 2-2:** Functional Block Diagram.

The block diagram (Figure 2-2) shows that the thermocouple connector is directly connected to the MCP9604. The four Alert outputs are connected to test points for external connections. Additionally, these outputs are also connected to the microcontroller I/O pins so that the Alert Output statuses can be detected in software.

**Note:** The MCP9604 Open/Short Circuit detection feature detects when a Thermocouple is disconnected or shorted to  $V_{DD}$  or GND and assert the OC and SC Alert outputs. If any one of the thermocouples is disconnected then the temperature registers will not update, and the Open Circuit Alert pin asserts. Therefore, all four thermocouples must be properly connected for the temperature register to update with a valid temperature data.

## 2.4 MICROCHIP THERMAL MANAGEMENT SOFTWARE GUI

The Microchip Thermal Management Graphical User Interface allows users to evaluate the MCP9604 for temperature-sensing applications. This software tool can be downloaded and installed from the evaluation board product page. The software requires the 'Microsoft.NET Framework' package. If this framework package is not installed on the computer, then the software will automatically download and install it. After the installation is successfully completed, the hardware is required to start the graphical user interface.

Once the hardware is connected, the software recognizes the device ID and displays the corresponding GUI for the evaluation board. Disconnecting the USB will close the GUI. This tool enables the user to evaluate the sensor features and perform temperature data logging.

Figure 2-3 shows the data acquisition interface with a plot of the thermocouple Hot-Junction and Cold-Junction temperature data. The Y1 axis is the Hot-Junction temperature and the Y2 axis is the Cold-Junction temperature. This data can also be exported by right-clicking the plot and following the export options.

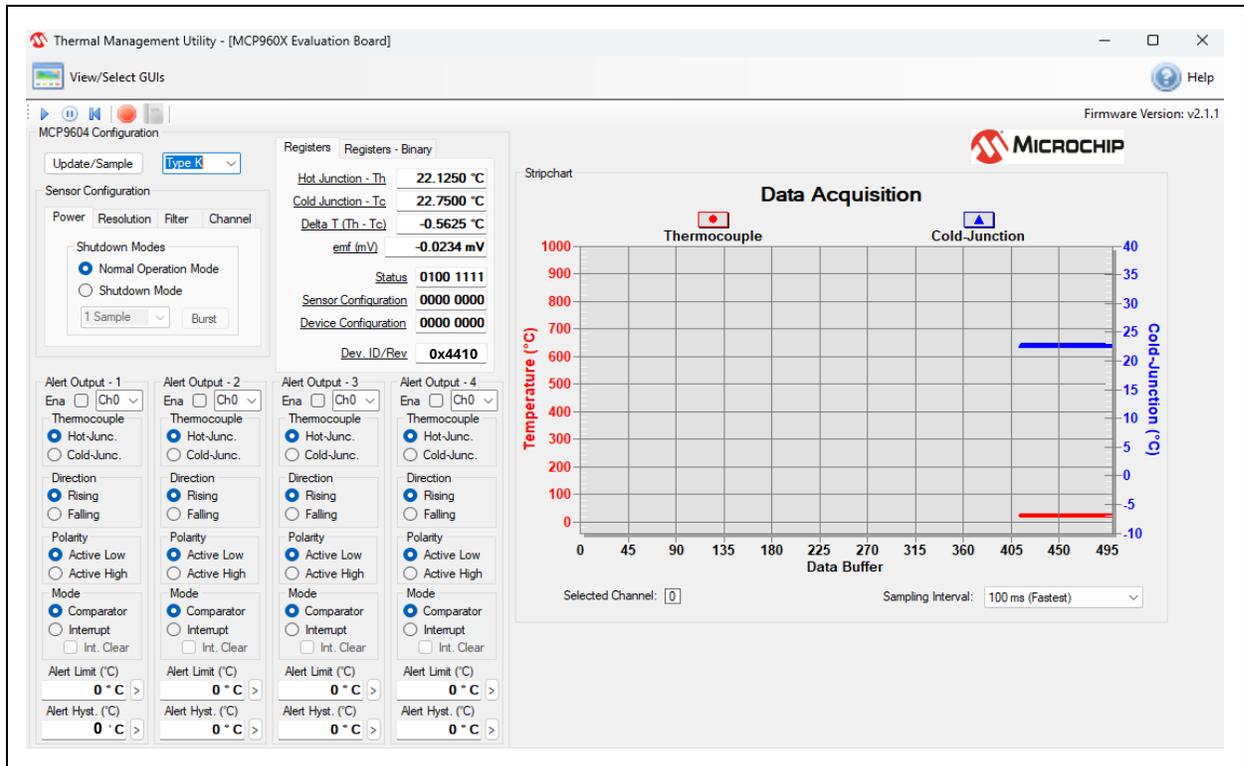
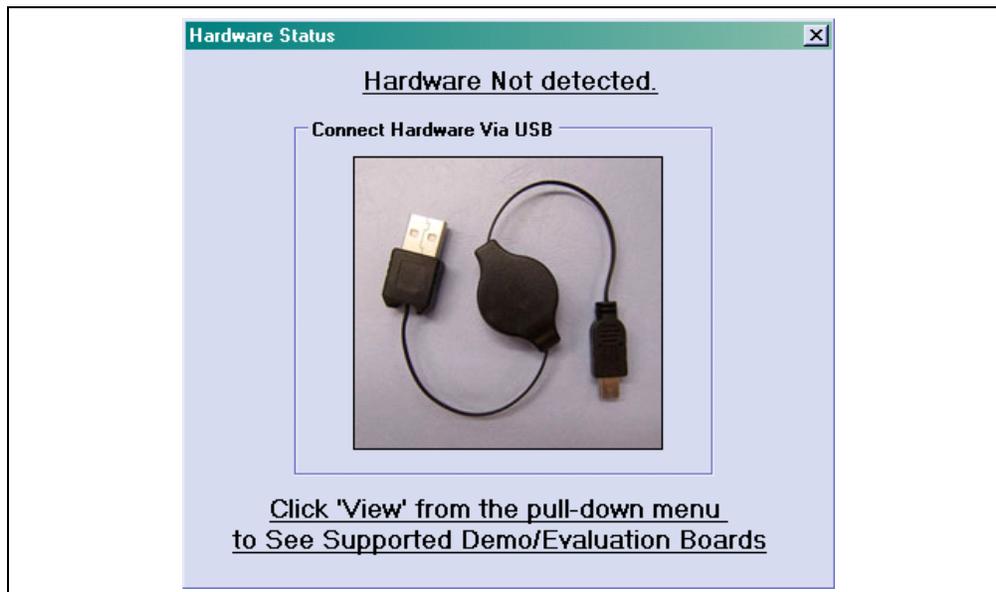


FIGURE 2-3: Data Acquisition Interface.

# MCP9604 Thermocouple IC Evaluation Board User Guide

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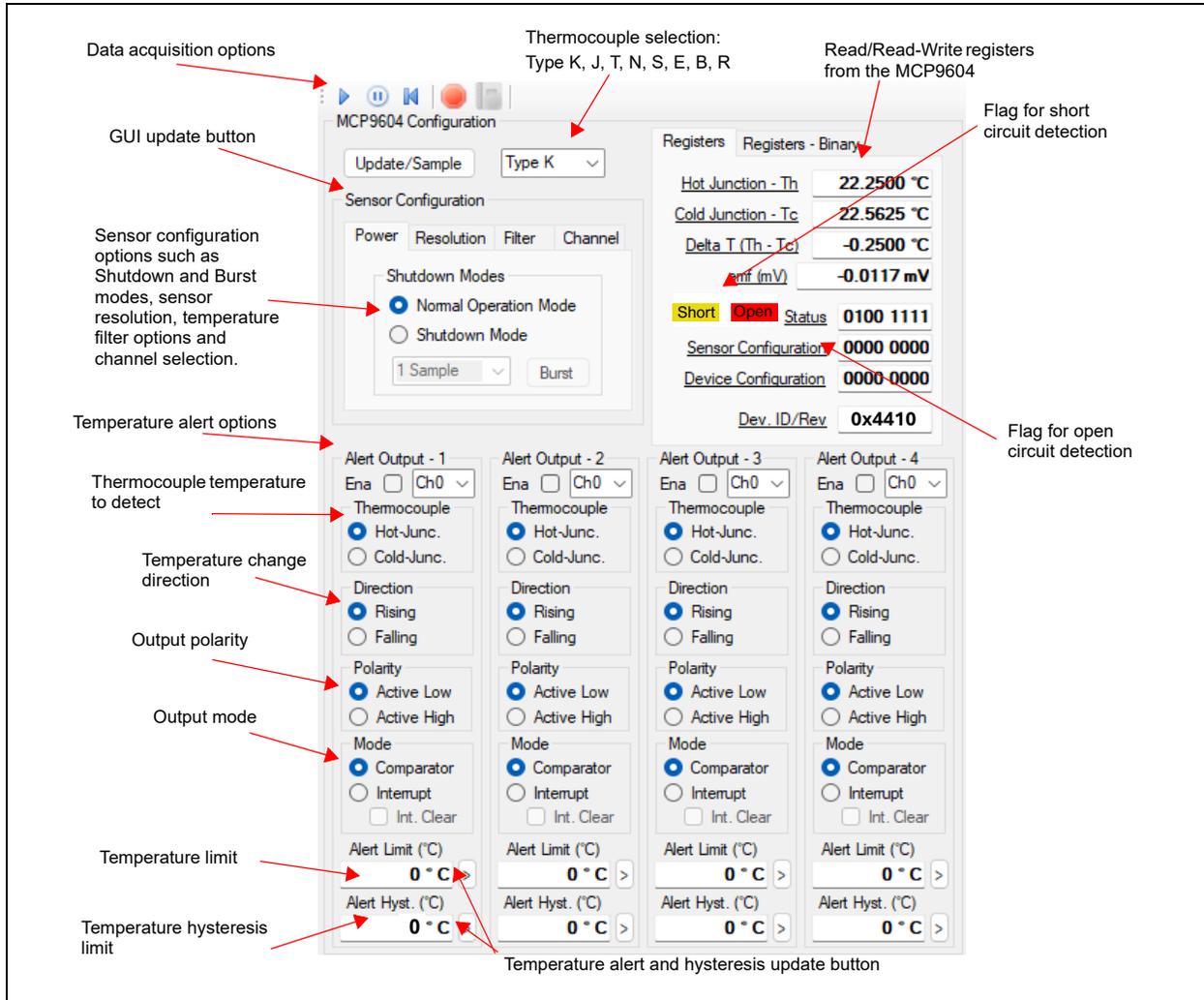
Use the Thermal Management Software Graphical User Interface (GUI) for temperature data logging or to evaluate the sensor board features. If the hardware is properly connected, the software will recognize the hardware, otherwise, the software will show the 'Hardware Not Detected' message box, as indicated in [Figure 2-4](#).



**FIGURE 2-4:** Hardware Not Detected Message Box.

## 2.5 CONFIGURING THE MCP9604

[Figure 2-5](#) shows the user interface for various sensor options. Once these options are selected, the software programs the device and refreshes the GUI from the device. Therefore the GUI displays the updated device settings.



**FIGURE 2-5:** Sensor Configuration Options.

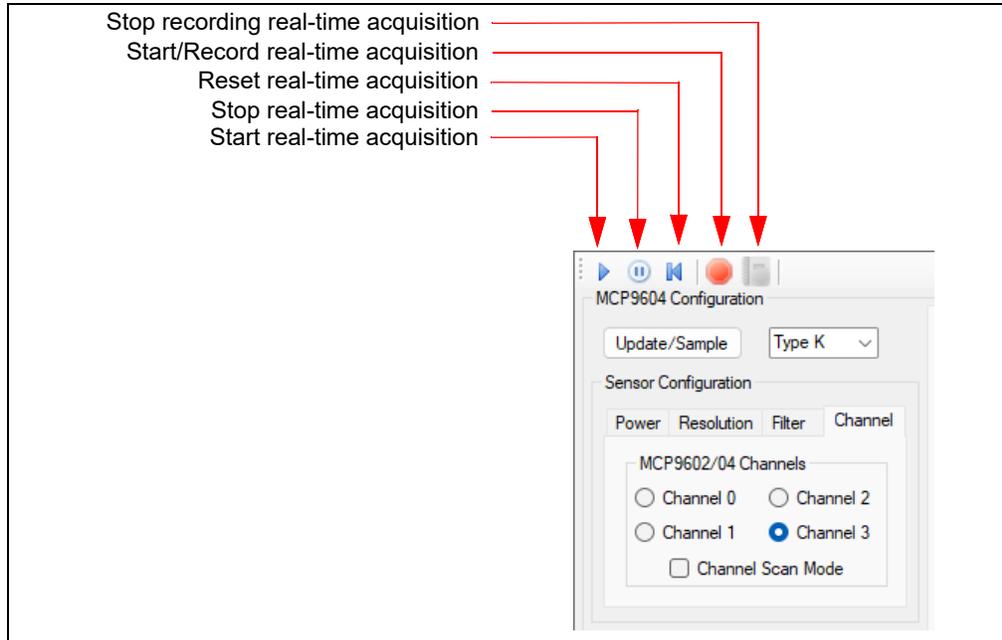
## 2.5.1 How to Check for Open Circuit and Short Circuit Conditions

The GUI shows the open circuit and short circuit flags using a yellow and red colored texts as shown in Figure 2-5. These features can be validated by simply disconnecting the thermocouple header from the board for open circuit detection, or by shorting the thermocouple wire to the system ground or power source ( $V_{SS}$  or  $V_{DD}$  test points on the evaluation board).

## 2.6 DATA ACQUISITION

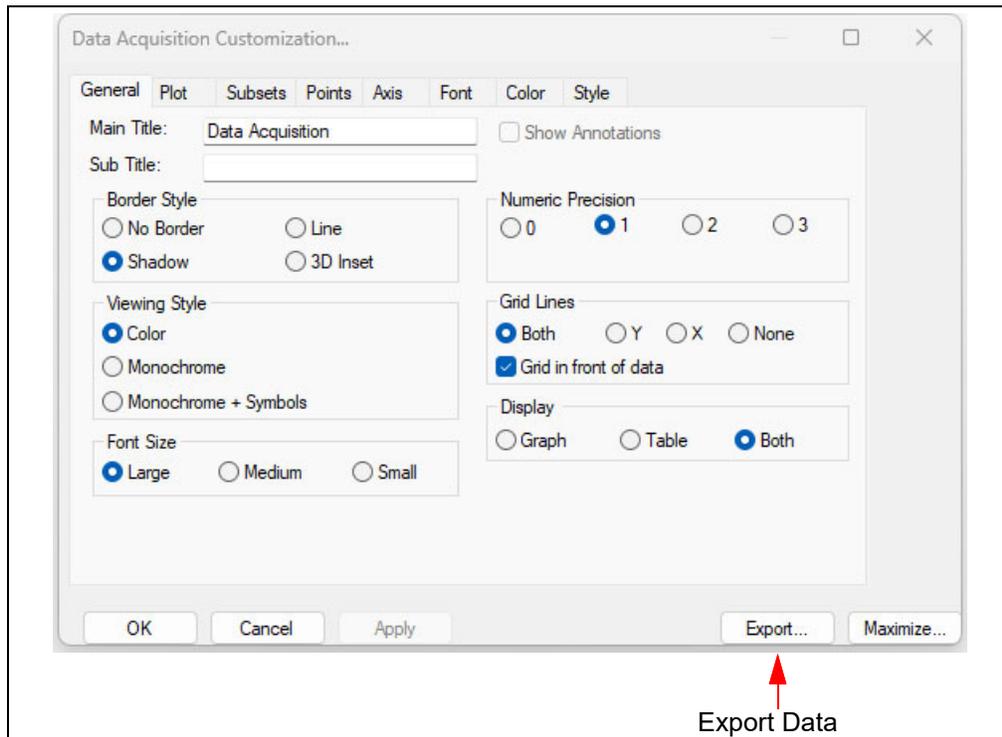
The black “Play”, “Stop”, and “Reset” icons (Figure 2-6) can be used to perform continuous data acquisitions. The red “Record” icon enables the user to data log to an external file. The logging interval can be adjusted using the Interval scroll bar from 100 ms to 30s, as shown in Figure 2-3.

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**FIGURE 2-6:** Real-Time Acquisition.

The data acquisition display chart (Figure 2-3) can be customized. The customizing options (Figure 2-7) can be selected by either double-clicking or right-clicking the chart (Figure 2-3). The displayed data can also be exported.



**FIGURE 2-7:** Chart Setup Options.

## 2.6.1 How to Measure, Plot and Save Multiple Thermocouples Sets of Data

Connect the MCP9604 Thermocouple IC Evaluation Board to the computer using a USB-C cable. Once the hardware is connected, the GUI for the evaluation board will be displayed on the screen.

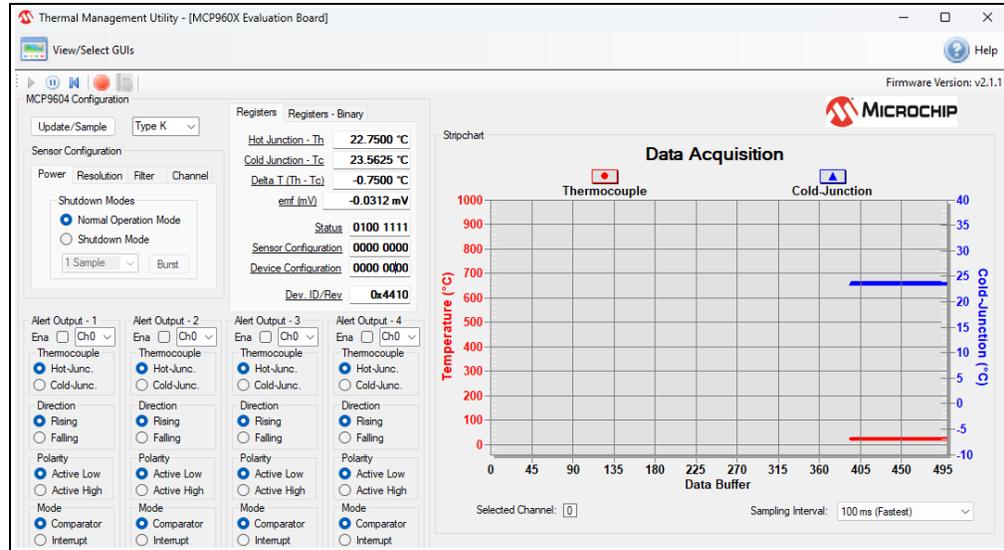
This tool enables the user to perform temperature data logging right away by following a few simple steps.

1. Begin by setting up how to save the collected data.

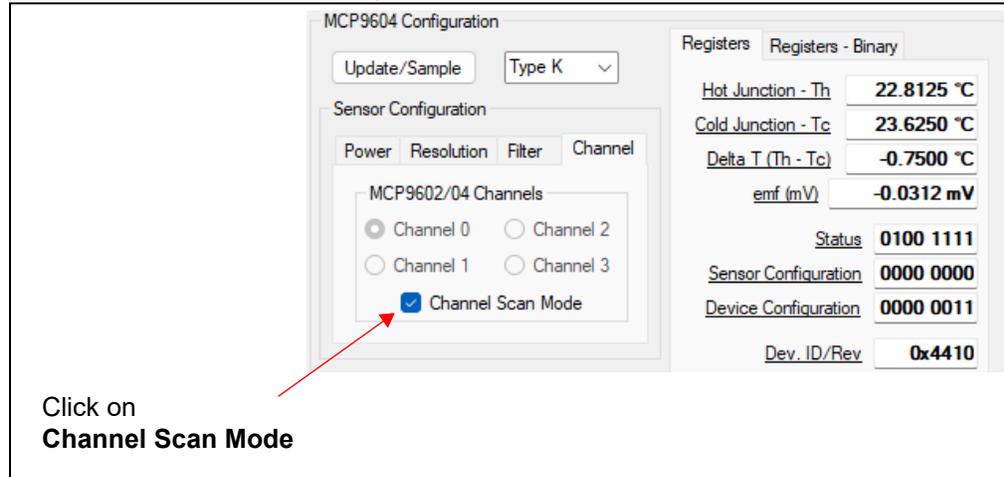
The screenshot displays the Thermal Management Utility GUI for the MCP9604 Evaluation Board. The interface includes a control bar with a red arrow pointing to the 'Start/Record' button, labeled 'Start/Record real-time acquisition'. Below this, the 'MCP9604 Configuration' section shows 'Update/Sample' and 'Type K' settings. The 'Sensor Configuration' panel is set to 'Normal Operation Mode' with '1 Sample' and 'Burst' options. The 'Registers - Binary' section displays real-time data: Hot Junction - Th (23.8125 °C), Cold Junction - Tc (26.2500 °C), Delta T (Th - Tc) (-2.4375 °C), emf (mV) (-0.1055 mV), Status (0100 1111), Sensor Configuration (0000 0000), Device Configuration (0000 0000), and Dev. ID/Rev (0x4410). A file save dialog is open at the bottom, with a red arrow pointing to the 'File name' field, labeled 'Name and save the file'. The dialog shows the current directory as 'Windows (C:)' and the file type as 'Data File (\*.txt)'.

# MCP9604 Thermocouple IC Evaluation Board User Guide

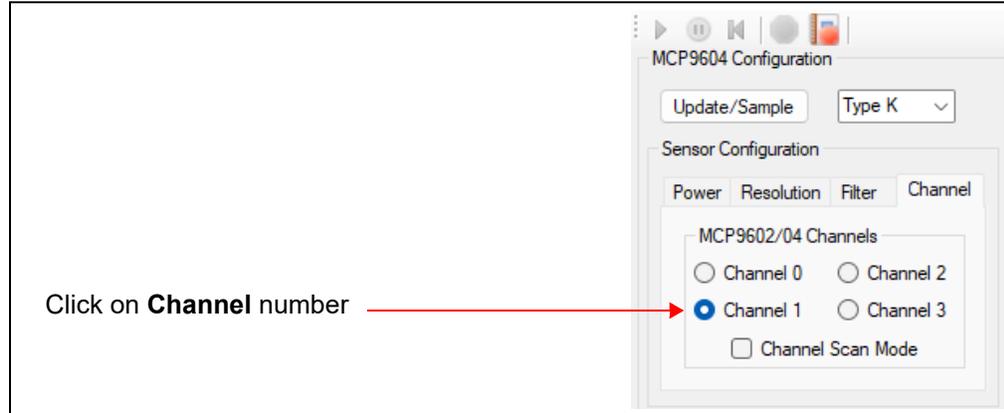
2. The data collection will begin automatically.



3. To record four different temperatures at the same time.

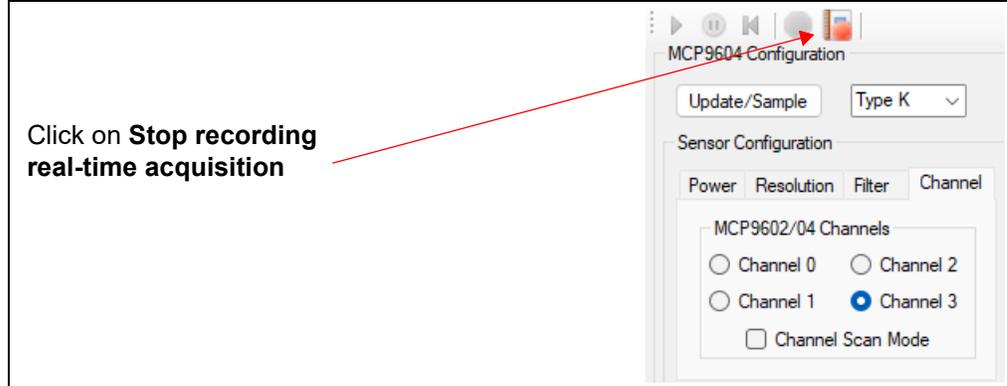


4. To record temperature for a specific channel.



# Installation and Operation

5. To stop recording.



Click on **Stop recording real-time acquisition**

6. Record data acquisition results.

Date,	Time,	Sampling-Interval			
19-Jun,	01:57PM,	100ms			
Number,	Temp H-Junction,	Temp C-Junction,	Unit,	Channel	
1,	24.7500,	25.3125,	°C ,	0	
2,	24.7500,	25.3125,	°C ,	0	
3,	24.7500,	25.3125,	°C ,	0	
4,	24.7500,	25.3750,	°C ,	0	
5,	24.8125,	25.3750,	°C ,	0	
6,	24.8125,	25.3750,	°C ,	0	
7,	24.8125,	25.3750,	°C ,	0	
8,	24.7500,	25.3125,	°C ,	0	
9,	24.8125,	25.3750,	°C ,	0	
10,	24.8125,	25.3750,	°C ,	0	
11,	24.8125,	25.3750,	°C ,	0	
12,	24.8125,	25.3750,	°C ,	0	
385,	25.4375,	25.3750,	°C ,	0	
386,	24.6875,	25.3125,	°C ,	1	
387,	25.5000,	25.3750,	°C ,	2	
388,	24.7500,	25.3125,	°C ,	3	
389,	25.4375,	25.3750,	°C ,	0	
390,	24.7500,	25.3750,	°C ,	1	
391,	25.5000,	25.3750,	°C ,	2	
392,	24.7500,	25.3125,	°C ,	3	
393,	25.4375,	25.3750,	°C ,	0	
394,	24.6875,	25.3125,	°C ,	1	
395,	25.5000,	25.3750,	°C ,	2	
396,	24.7500,	25.3750,	°C ,	3	
493,	25.5000,	25.3750,	°C ,	1	
494,	25.5000,	25.3750,	°C ,	1	
495,	25.5000,	25.3750,	°C ,	1	
496,	25.4375,	25.3125,	°C ,	1	
497,	25.4375,	25.3125,	°C ,	1	
498,	25.4375,	25.3750,	°C ,	1	
499,	25.4375,	25.3750,	°C ,	1	
602,	24.9375,	25.3750,	°C ,	2	
603,	24.8750,	25.3125,	°C ,	2	
604,	24.8750,	25.3125,	°C ,	2	
605,	24.8750,	25.3125,	°C ,	2	
606,	24.9375,	25.3750,	°C ,	2	
607,	24.9375,	25.3750,	°C ,	2	
608,	24.9375,	25.3750,	°C ,	2	

Channel 0 collected temperature data

Scan Mode collected temperature data (4 different channels)

Channel 1 collected temperature data

Channel 2 collected temperature data

# MCP9604 Thermocouple IC Evaluation Board User Guide

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670,	25.5625,	25.3750,	°C ,	3
671,	25.5000,	25.3125,	°C ,	3
672,	25.5625,	25.3750,	°C ,	3
673,	25.5625,	25.3750,	°C ,	3
674,	25.5625,	25.3750,	°C ,	3
675,	25.5625,	25.3750,	°C ,	3
676,	25.5000,	25.3125,	°C ,	3

**Channel 3** collected temperature data



# MCP9604 THERMOCOUPLE IC EVALUATION BOARD USER GUIDE

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## Appendix A. Schematic and Layouts

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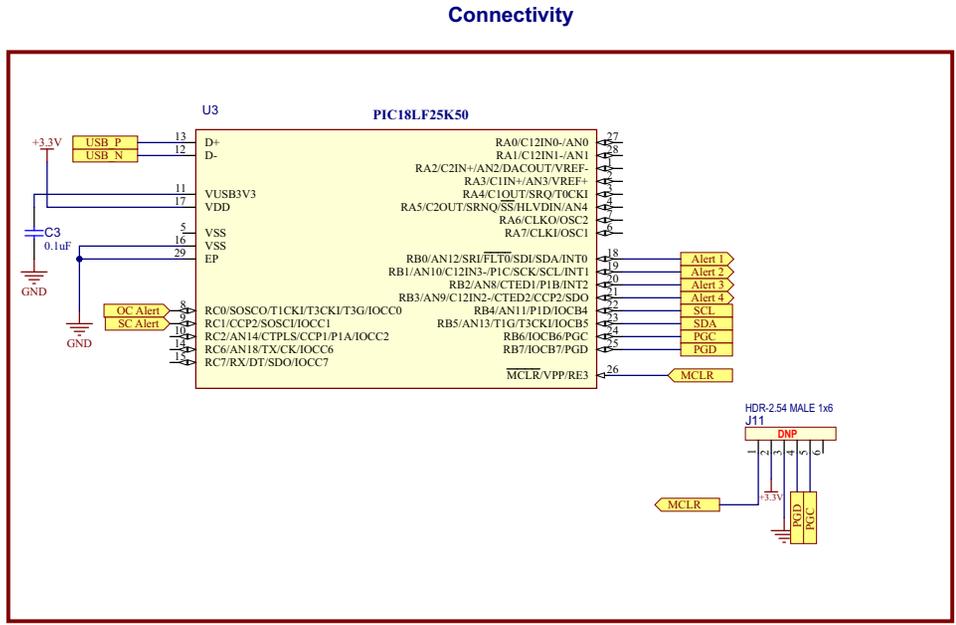
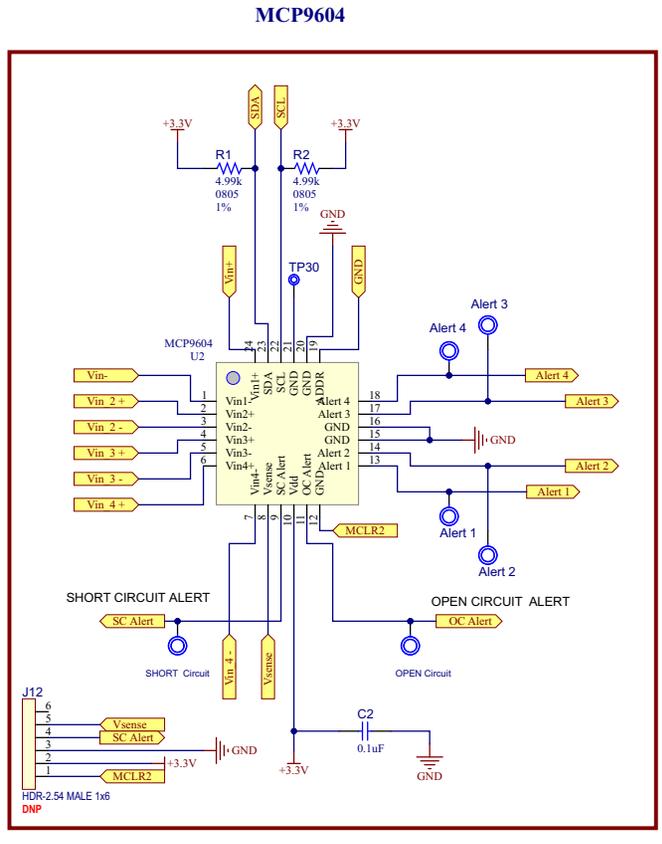
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### A.1 INTRODUCTION

This appendix contains the following schematics and layouts for the MCP9604 Thermocouple IC Evaluation Board:

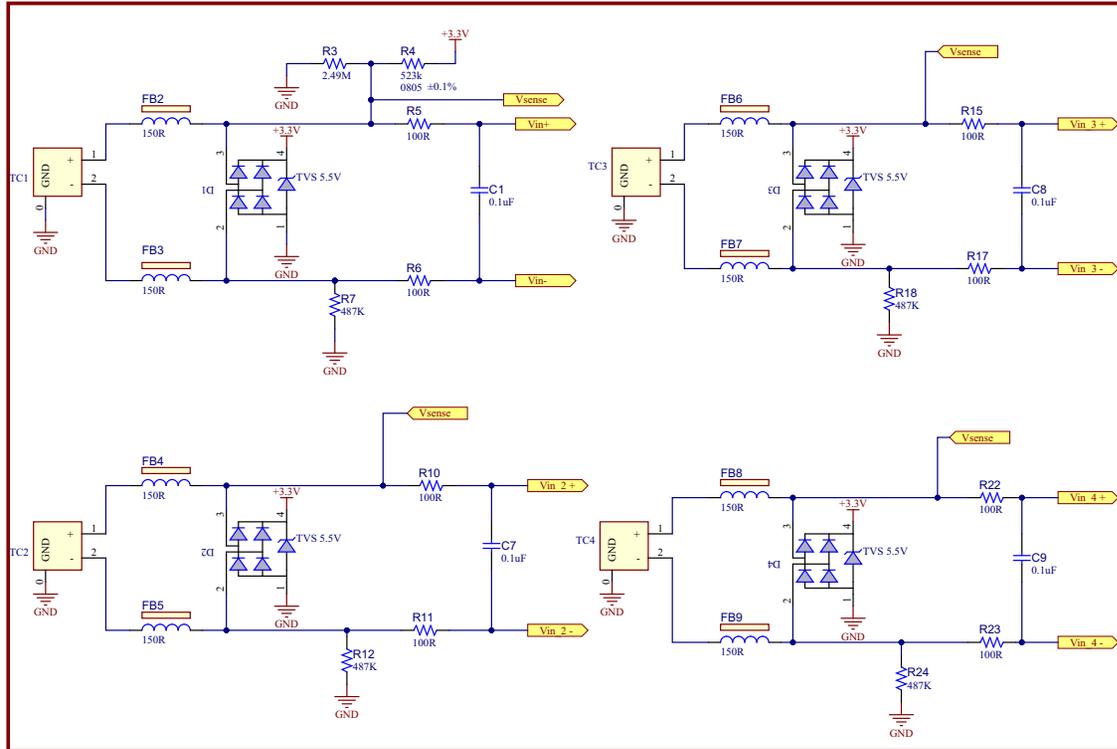
- [Schematic 1](#)
- [Schematic 2](#)
- [Board – Top Silk](#)
- [Board – Top Copper and Silk](#)
- [Board – Top Copper](#)
- [Board – Bottom Copper](#)
- [Board – Bottom Copper and Silk](#)
- [Board – Bottom Silk](#)

A.2 SCHEMATIC 1

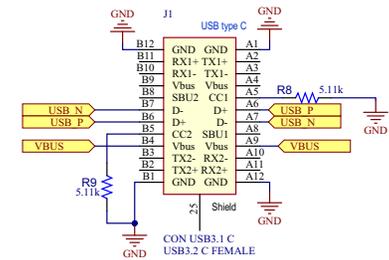
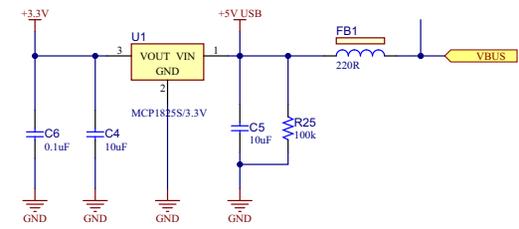


## A.3 SCHEMATIC 2

### Thermocouples



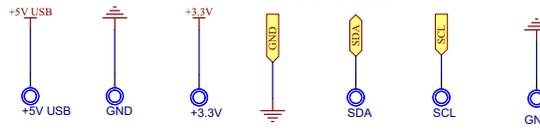
### Power



### Mechanicals

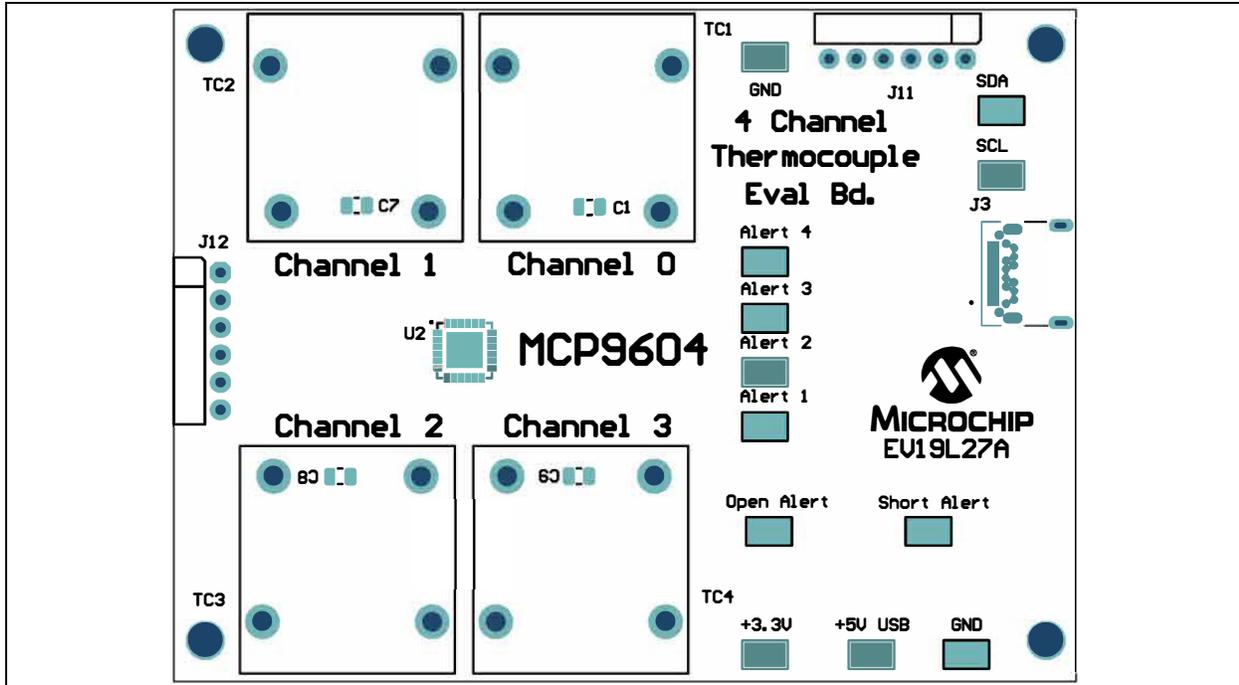


### Test Points

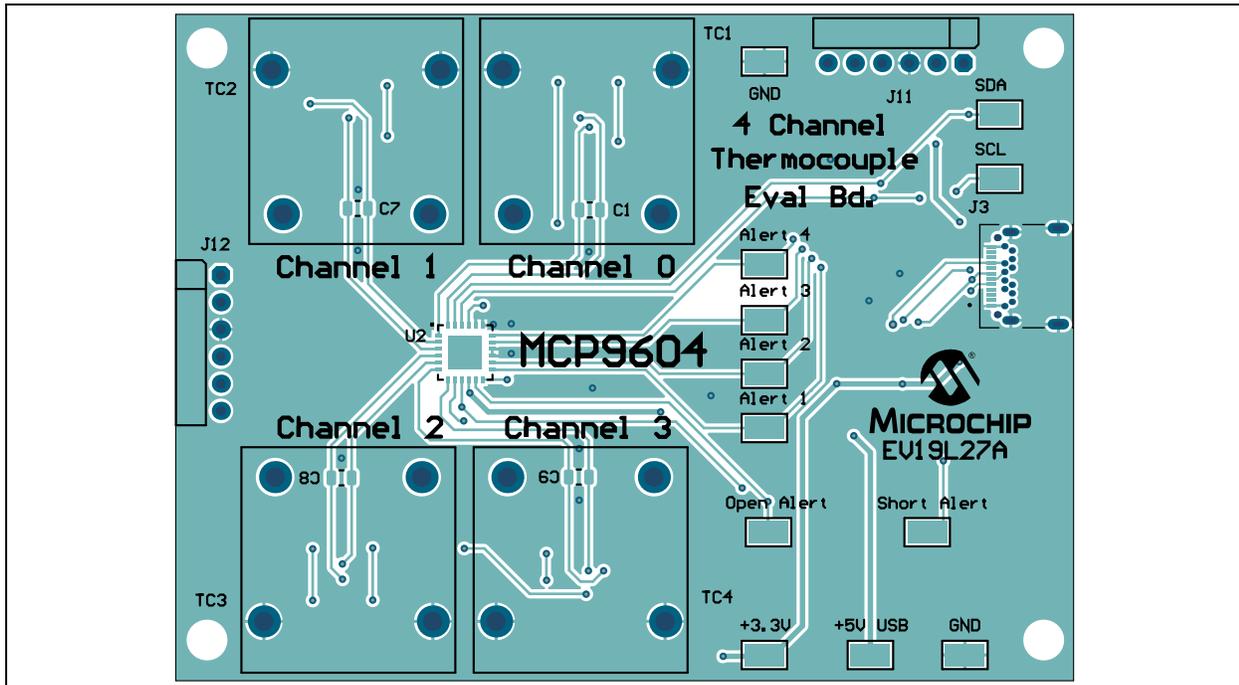


# MCP9604 Thermocouple IC Evaluation Board User Guide

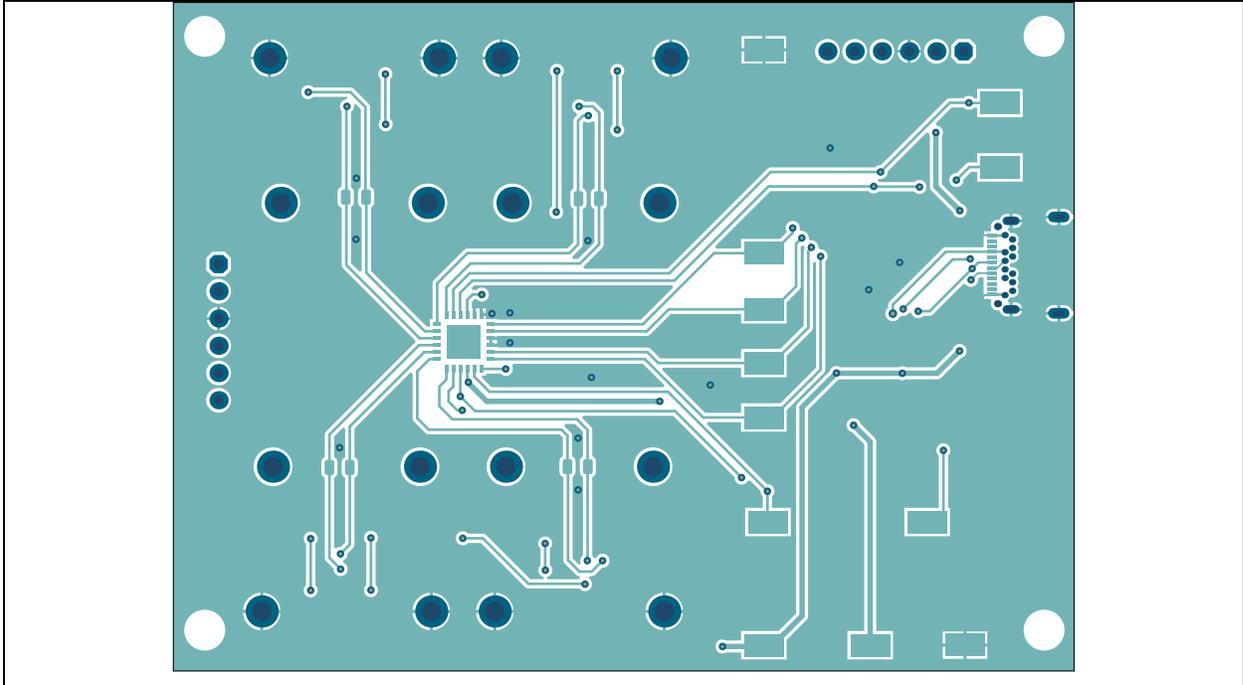
## A.4 BOARD – TOP SILK



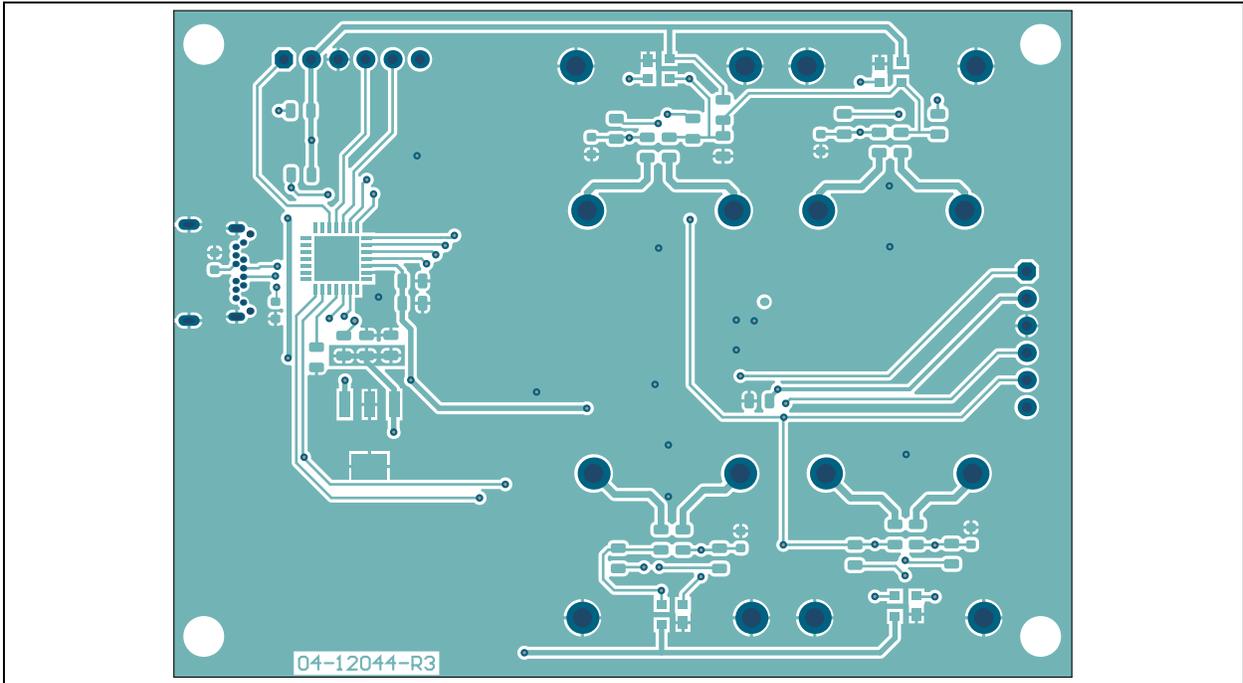
## A.5 BOARD – TOP COPPER AND SILK



## A.6 BOARD – TOP COPPER

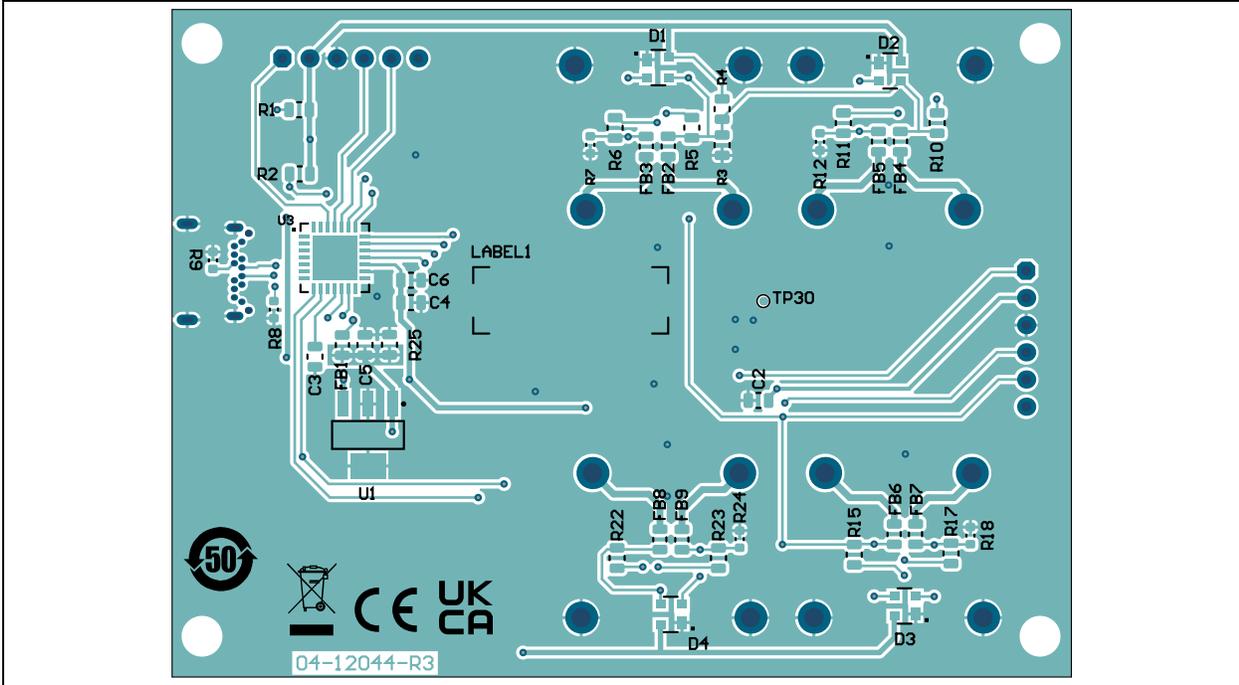


## A.7 BOARD – BOTTOM COPPER

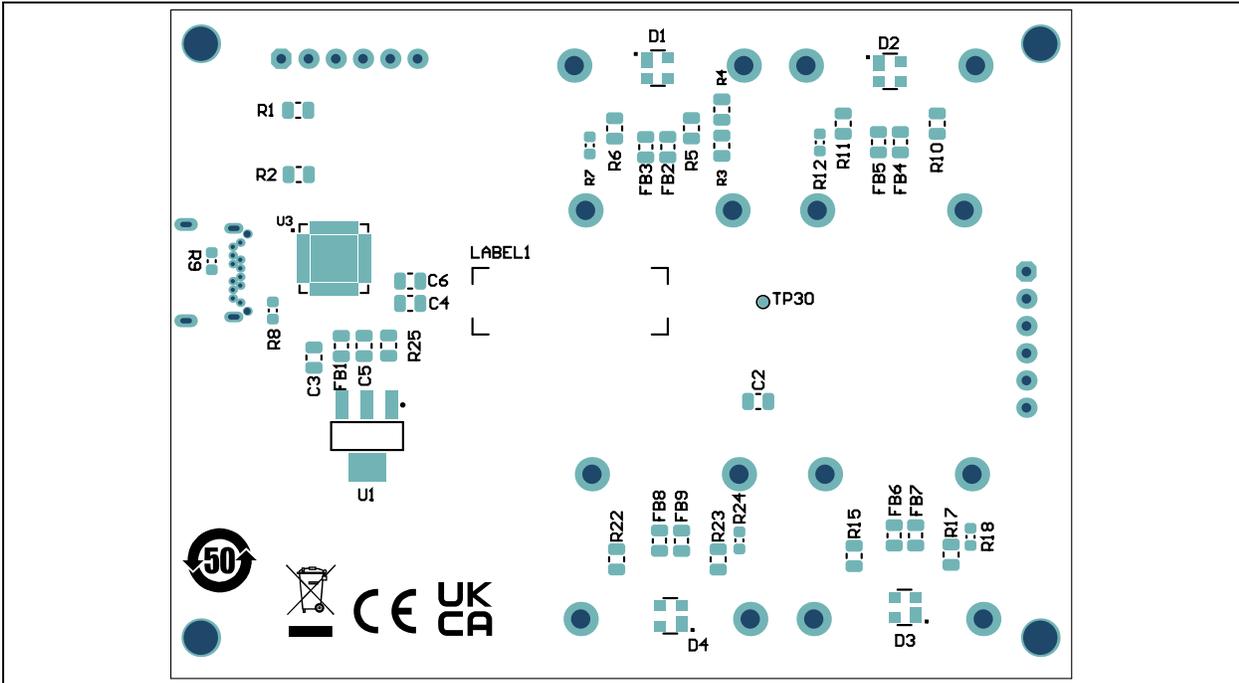


# MCP9604 Thermocouple IC Evaluation Board User Guide

## A.8 BOARD – BOTTOM COPPER AND SILK



## A.9 BOARD – BOTTOM SILK



**Appendix B. Bill of Materials (BOM)**

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

Qty.	Reference	Description	Manufacturer	Part Number
12	+3.3V, +5V USB, Alert 1, Alert 2, Alert 3, Alert 4, GND, SCL, SDA, TP1, TP2	Connector, TP Loop, silver, 0.38, SMD	Keystone <sup>®</sup> Electronics Corp.	5018
7	C1, C2, C3, C6, C7, C8, C9	Capacitor, ceramic, 0.1uF, 50V, 10%, X7R, surface mount, 0805	KEMET	C0805C104K5RACTU
2	C4, C5	Capacitor, ceramic, 10uF, 6.3V, 20%, X5R, surface mount, 0805	Murata Electronics <sup>®</sup>	GRM21BR60J106ME19L
1	CBL1	Mechanical hardware, cable, USB 3.1, Male A-type, C male, 1 meter	Assmann Electronics Inc.	A-USB31C-31A-100
4	D1, D2, D3, D4	TVS, diode, 5.5V, SOT143B	Nexperia USA Inc.	PRTR5V0U2X,215
1	FB1	Ferrite, 2A, 220R, surface mount, 0805	Murata Electronics	BLM21PG221SN1D
8	FB2, FB3, FB4, FB5, FB6, FB7, FB8, FB9	Ferrite, 150R@100MHz, 800mA, surface mount, 0805	Laird Technologies <sup>®</sup>	LI0805H151R-10
1	J1	Connector, USB, 3.2 TID, Type-C, female, hybrid, R/A	Amphenol Corporation	10137062-00021LF
1	LABEL1	Label, PCBA, 18x6mm, Datamatrix Assy#, Rev, serial, date	ACT Logimark AS	505462
4	PAD1, PAD2, PAD3, PAD4	Mechanical hardware, rubber pad, cylindrical, D7.9, H5.3, black	3M <sup>™</sup>	SJ61A11
1	PCB1	MCP9604 Thermocouple IC Evaluation Board – Printed Circuit Board	—	04-12044-R4
2	R1, R2	Resistor, TF, 4.99k, 1%, 1/8W, surface mount, 0805, AEC-Q200	Panasonic <sup>®</sup> – ECG	ERJ-6ENF4991V
1	R3	Resistor, 2.49M OHM 1% 1/8W 0805	YAGEO Corporation	RC0805FR-072M49L
1	R4	Resistor, 523K OHM 1% 1/10W 0805 AEC-Q200	Panasonic – ECG	P523KDACT-ND
8	R5, R6, R10, R11, R15, R17, R22, R23	Resistor, TKF 100R 1% 1/8W SMD 0805	Vishay <sup>®</sup> Dale	CRCW0805100RFKEAC
4	R7, R12, R18, R24	Resistor, SMD 487K OHM 1% 1/10W 0603 Automotive AEC-Q200	Panasonic – ECG	ERJ-3EKF4873V
2	R8, R9	Resistor, TKF 5.11k 1% 1/10W SMD 0603	YAGEO Corporation	RC0603FR-075K11L

**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.

# Bill of Materials (BOM)

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

Qty.	Reference	Description	Manufacturer	Part Number
1	R25	Resistor, TKF, 100k, 5%, 1/8W, surface mount, 0805	Panasonic – ECG	ERJ-6GEYJ104V
4	TC1, TC2, TC3, TC4	Sensor, accessory, thermocouple, mini connector, Type K, TH, R/A	SparkFun Electronics®	PRT-13612
1	U1	Microchip, Analog, LDO, 3.3V, MCP1825ST-3302E/DB, SOT-223-3	Microchip Technology Inc.	<b>MCP1825ST-3302E/DB</b>
1	U2	MCP9604-E/3YW VFLGA-24	Microchip Technology Inc.	<b>MCP9604-E/3YW</b>
1	U3	Microchip, MCU, 8-BIT, 48MHz 32kB 2kB PIC18LF25K50-I/ML QFN-28	Microchip Technology Inc.	<b>PIC18LF25K50-I/ML</b>

**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.