MCP9700 Thermistor Demo Board User's Guide

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MCP9700 THERMISTOR DEMO BOARD USER'S GUIDE

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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 MCP9700 Thermistor 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 MCP9700 Thermistor Demo Board as a development tool. The manual layout is as follows:

- **Chapter 1. "Product Overview"** – Important information about the MCP9700 Thermistor Demo Board.
- **Chapter 2. "Installation and Operation"** – This chapter includes a detailed description of each function of the demo board and instructions for how to begin using the board.
- **Appendix A. "Schematic and Layouts"** – Shows the schematic and layout diagrams for the MCP9700 Thermistor Demo Board.
- **Appendix B. "Bill Of Materials (BOM)"** – Lists the parts used to build the MCP9700 Thermistor 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) { ... }`

RECOMMENDED READING

This user's guide describes how to use the MCP9700 Thermistor Demo Board. The following Microchip documents are available on our web site (www.microchip.com) and recommended as supplemental reference resources.

AN897, *"Thermistor Temperature Sensing with MCP6SX2 PGAs"*, DS00897

Explains the functionality and design of this board's circuit. Contains measurement results.

MCP9700 Data Sheet, *"Low-Power Linear Active Thermistor™"*, DS21942

This data sheet provides detailed information regarding the MCP9700 product family.

MCP6S21/2/6/8 Data Sheet, *"Single-Ended, Rail-to-Rail I/O, Low Gain PGA"*, DS21117

Gives detailed information on the MCP6S21/2/3/6/8 Programmable Gain Amplifiers (PGA).

MCP6S91/2/3 Data Sheet, *"Single-Ended, Rail-to-Rail I/O, Low Gain PGA", DS21908*

Gives detailed information on the MCP6S91/2/3 PGAs.

PIC18F2455/2550/4455/4550 Data Sheet, *"28/40/44-Pin, High-Performance, Enhanced Flash, USB Microcontrollers with nanoWatt Technology"*, DS39632

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

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- **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
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- Field Application Engineer (FAE)
- Technical Support
- Development Systems Information Line

Customers should contact their distributor, representative or field application engineer 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

DOCUMENT REVISION HISTORY

Revision A (August 2008)

- Initial Release of this Document

Chapter 1. Product Overview

1.1 INTRODUCTION

The following name and assembly number are found on the MCP9700 Thermistor Demo Board's Printed Circuit Board (PCB):

- 102-00156

This PCB goes by the following title:

- MCP9700 Thermistor Demo Board

This board is supported by AN897, *"Thermistor Temperature-Sensing with MCP6SX2 PGAs"*, (DS00897). It uses a BC Components® 2322 640 55103 NTC thermistor to detect temperature. The circuit also includes a voltage divider and a MCP6S22 Programmable Gain Amplifier (PGA) and the MCP9700 Linear Active Thermistor.

- Kit Contents
- MCP9700 Thermistor Demo Board
- Associated Tools
- Initial Set-up

1.2 WHAT IS THE MCP9700 THERMISTOR DEMO BOARD?

The MCP9700 Thermistor Demo Board contains the analog circuitry to measure temperature. It uses BC Components' 2322 640 55103 NTC thermistor to convert temperature to resistance. The thermistor is placed in a voltage divider which converts resistance to voltage. This voltage is filtered and placed at the MCP6S22 Programmable Gain Amplifier's (PGA) CH0 input. The PGA gains and buffers the thermistor.

In addition, the board includes the MCP9700 Linear Active Thermistor. The MCP9700 outputs voltage proportional to temperature. A PIC18F2550 is used to both measure the voltage output of the MCP9700 and the MCP6S22 using an integrated 10-bit Analog to Digital Converter and communicate to a PC via USB interface.

Temperature can be datalogged using Microchip Thermal Management Software Graphical User Interface (GUI).

1.3 WHAT THE MCP9700 THERMISTOR DEMO BOARD KIT INCLUDES

- MCP9700 Thermistor Demo Board – An assembled and tested PCB (102-00156)
- Microchip Thermal Management Graphical User Interface
- Analog and Interface Products Demonstration Boards CD-ROM (DS21912)
  - MCP9700 Thermistor Demo Board User's Guide, (DS51753)

NOTES:

Chapter 2. Installation and Operation

2.1 INTRODUCTION

The MCP9700 Thermistor Demo Board makes it easy to explore the operation of two thermistor applications using the MCP6S22 PGA and the MCP9700 Linear Active Thermistor. Items discussed in this chapter include:

- Configuring the MCP9700 Thermistor Demo Board
- Using the MCP9700 Thermistor Demo Board
- Using the Microchip Thermal Management GUI

2.2 GETTING STARTED

This section describes how to power up and interface with the MCP9700 Thermistor Demo Board, Figure 2-1.

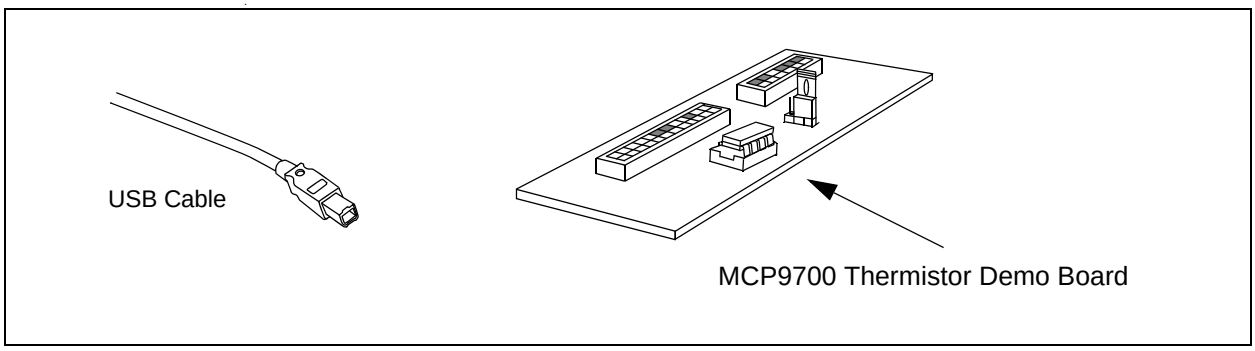


FIGURE 2-1: *MCP9700 Thermistor Demo Board Block Diagram.*

2.2.1 Hardware Setup

1. The MCP9700 Thermistor Demo Board has a mini-USB connector for a PC interface. Connect the USB cable from the MCP9700 Thermistor Demo Board to a PC. The MCP9700 Thermistor Demo Board is fully powered and temperature can be measured.
2. Start the Thermal Management Software GUI for data logging or to evaluate the MCP9700 Thermistor Demo Board features.

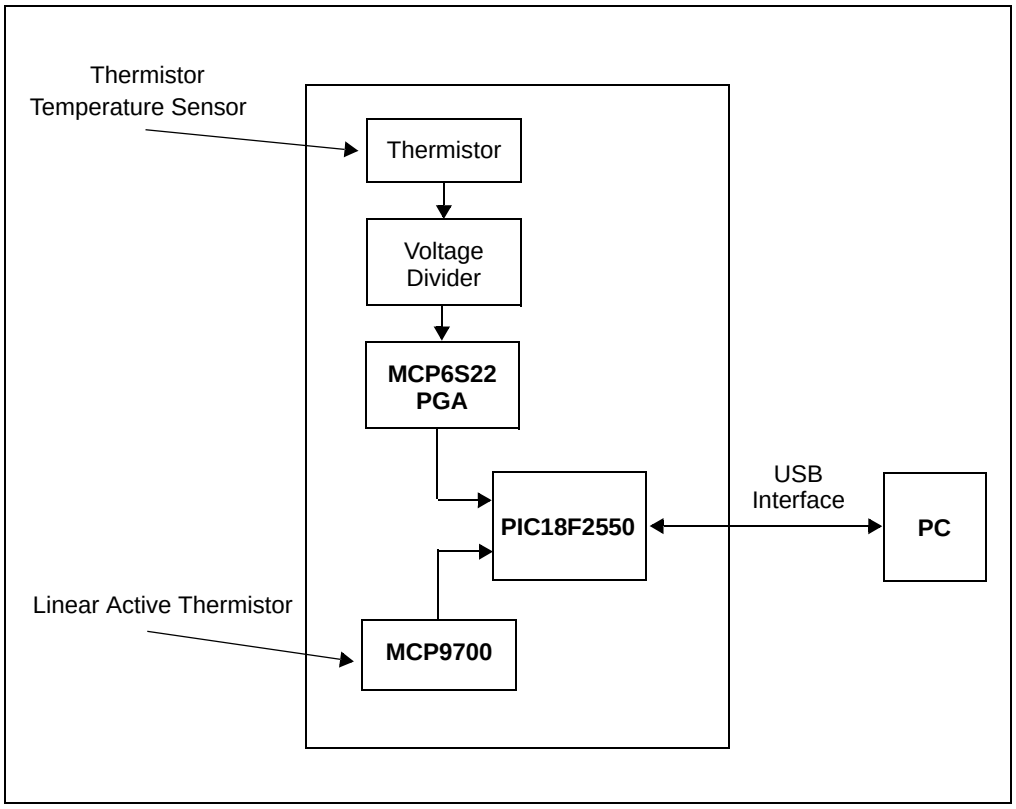


FIGURE 2-2: *MCP9700 Thermistor Demo Board Circuit Block Diagram.*

The MCP9700 Thermistor Demo Board includes a Thermistor and Microchip's MCP9700 Linear Active Thermistor temperature sensors. The thermistor is biased using a resistive stack which can be adjusted using the user settable dip switches. The voltage across the thermistor is proportional to change in temperature. The thermistor output is gained and buffered using Microchip's MCP6S22 Programmable Gain Amplifier (PGA). The output of the PGA is directly connected to an Analog to Digital Converter. The MCP9700 output voltage is also directly connected to an ADC. The data from the ADC is sent to the PC using the USB interface.

The user can compare and evaluate both the standard thermistor solution and Microchip's Linear Active Thermistor solution using this MCP9700 Thermistor Demo Board.

2.3 CONFIGURING BOARD

2.3.1 Configuring Jumper JMP1 (select Thermistor or Rvar)

Figure 2-3 shows how jumper JMP1 configures the circuit. When the shorting bar is on the right side of jumper JMP1, the thermistor R_{TH} is connected to the circuit. When it is on the left side of jumper JMP1, the thermistor emulator Rvar is connected to the circuit.

Refer to Figure A.3 for the complete schematic.

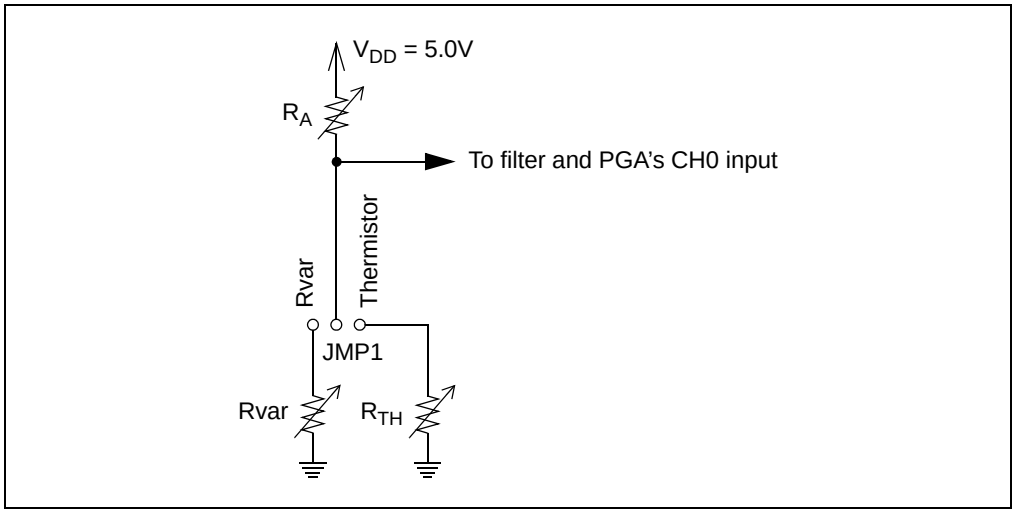


FIGURE 2-3: *Simplified Jumper Circuit.*

2.3.2 Configuring DIP Switch SW1 (R_A)

DIP switch SW_1 and resistors R_1 – R_7 in Figure 2-4 emulate the voltage divider resistor (R_A in Figure 2-3). R_1 is placed in series with the others to prevent shorting the supplies together. These resistors produce a binary sequence of values between 0.5 kΩ and 32.0 kΩ.

Refer to Figure A.3 for the complete schematic.

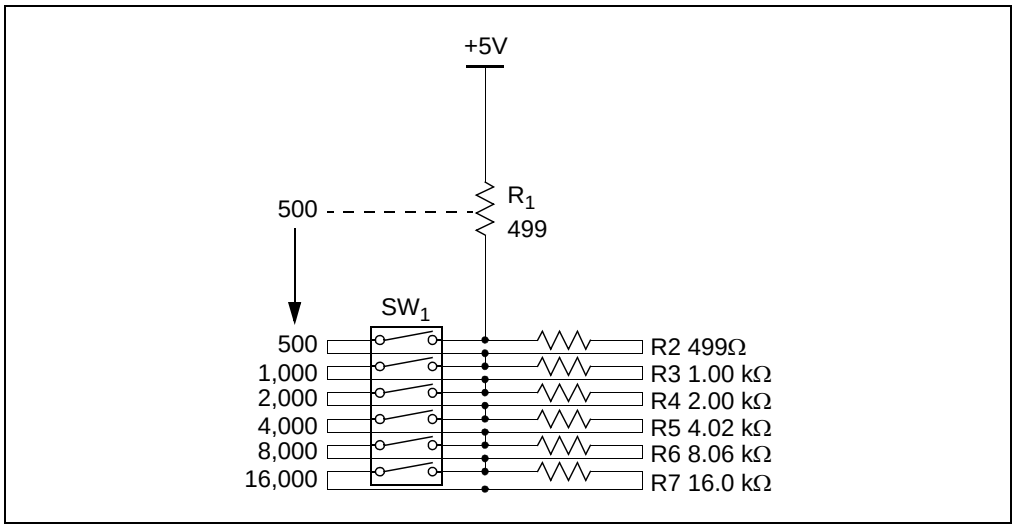


FIGURE 2-4: *R_A Emulator.*

Each resistor with its switch (in SW1) pointing to the right, away from the silk screen resistor values, is not added into the total for R_A (it shorts that resistor).

Each resistor with its switch (in SW1) pointing to the left, towards the silk screen resistor values, is added into the total for R_A.

As an example, if the top four switches are to the right, and the bottom two are to the left, then R_A is calculated as 500 + 0 + 0 + 0 + 0 + 8,000 + 16,000 = 24,500Ω.

2.3.3 Using the Thermistor (R_{TH})

In **Appendix A. "Schematic and Layouts"**, R_{21} is the thermistor (R_{TH} in Figure 2-3). The resistance changes depending on temperature; see AN897, *"Thermistor Temperature Sensing with MCP6SX2 PGAs"* (DS00897).

2.3.4 Configuring DIP Switch SW2 (R_{TH} Emulator, Rvar)

DIP switch SW2 and resistors R_8 – R_{19} in Figure 2-5 comprise the thermistor emulator (Rvar in Figure 2-3). Rvar produces a binary sequence of resistances between 0Ω and 409.5 kΩ.

Refer to Figure A.3 for the complete schematic.

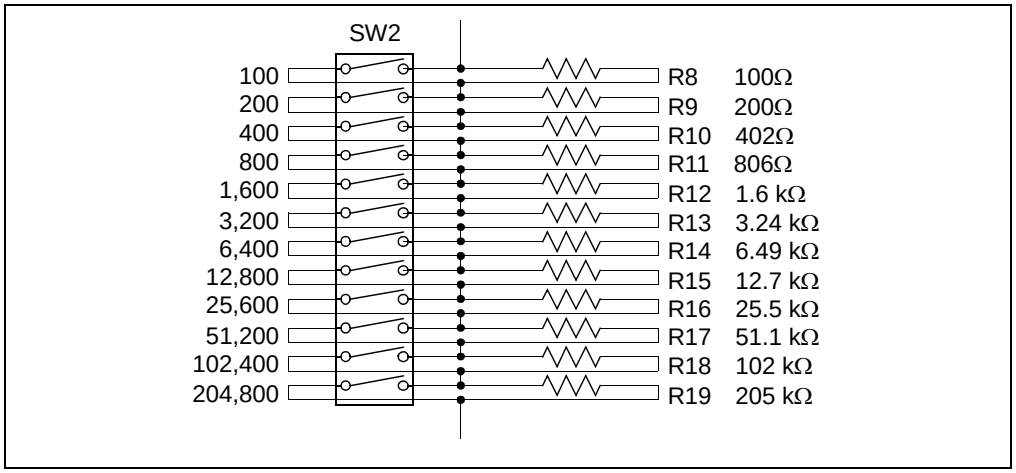


FIGURE 2-5: *R_{TH} Emulator (Rvar).*

Each resistor with its switch (in SW2) pointing to the right, away from the silk screen resistor values, is not added into the total for R_A (it shorts that resistor).

Each resistor with its switch (in SW) pointing to the left, towards the silk screen resistor values, is added into the total for R_A.

As an example, if the top ten switches are to the right, and the bottom two are to the left, then Rvar is calculated as 0 + 0 + ... + 0 + 102,400 + 204,800 = 307,200Ω.

AN897, *"Thermistor Temperature Sensing with MCP6SX2 PGAs"* (DS00897) contains information on converting this resistance to the equivalent, nominal thermistor temperature, and vice versa.

2.3.5 Using the MCP9700

The MCP9700 Linear Active Thermistor is a temperature sensor which outputs voltage directly proportional to change in temperature. This sensor provides a 10 mV per degree Celsius temperature coefficient and it measures temperature from -40°C to +125°C, see datasheet (DS21942) for details.

2.3.6 Microchip Thermal Management GUI

The Microchip Thermal Management Graphical User Interface is an easy to use software tool which allows users to evaluate the MCP9700 Thermistor Demo Board and sensor features, as displayed in Figure 2-6.

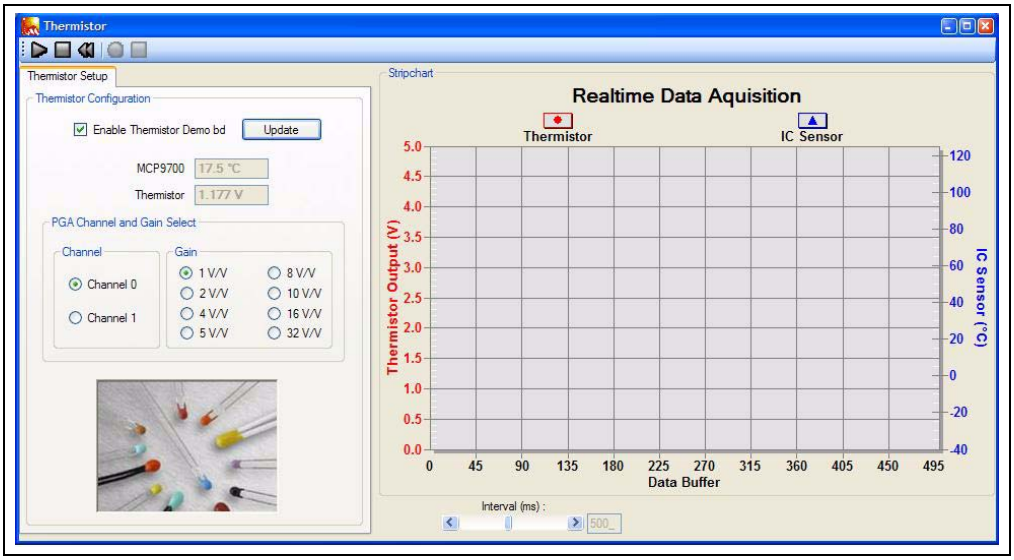


FIGURE 2-6: *Microchip Thermal Management GUI.*

Once the hardware is connected, the software recognizes the device ID and displays the corresponding GUI for the MCP9700 Thermistor Demo Board. This tool enables the user to evaluate the demo board features and perform temperature datalog. The black “Play”, “Stop’, and “Reset” icons can be used to perform continuous datalog. And the red “Record” icon enables the user to datalog to an external file. The logging interval can be adjusted using the Interval Scroll bar from 100 ms to 1000 ms.

The Real-time Data Acquisition charting tool can be customized by double clicking the chart, as shown in Figure 2-7. Additional options are available by right clicking the chart. The users can also zoom into a specific plot range by clicking and dragging the section.

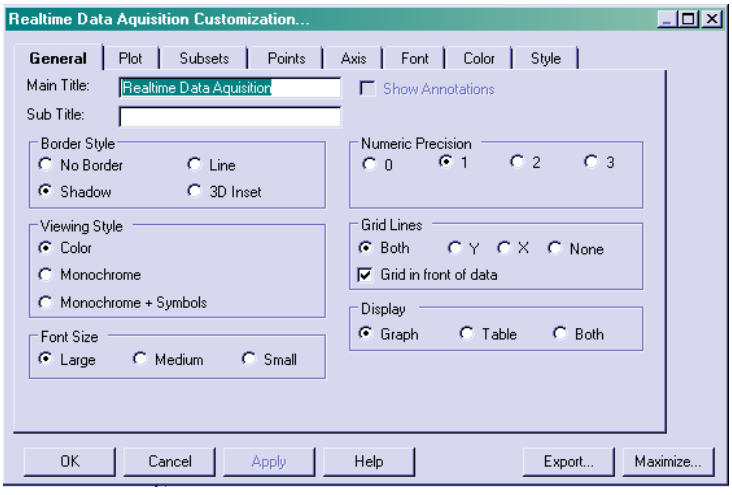


FIGURE 2-7: *Chart Setup Options.*

NOTES:

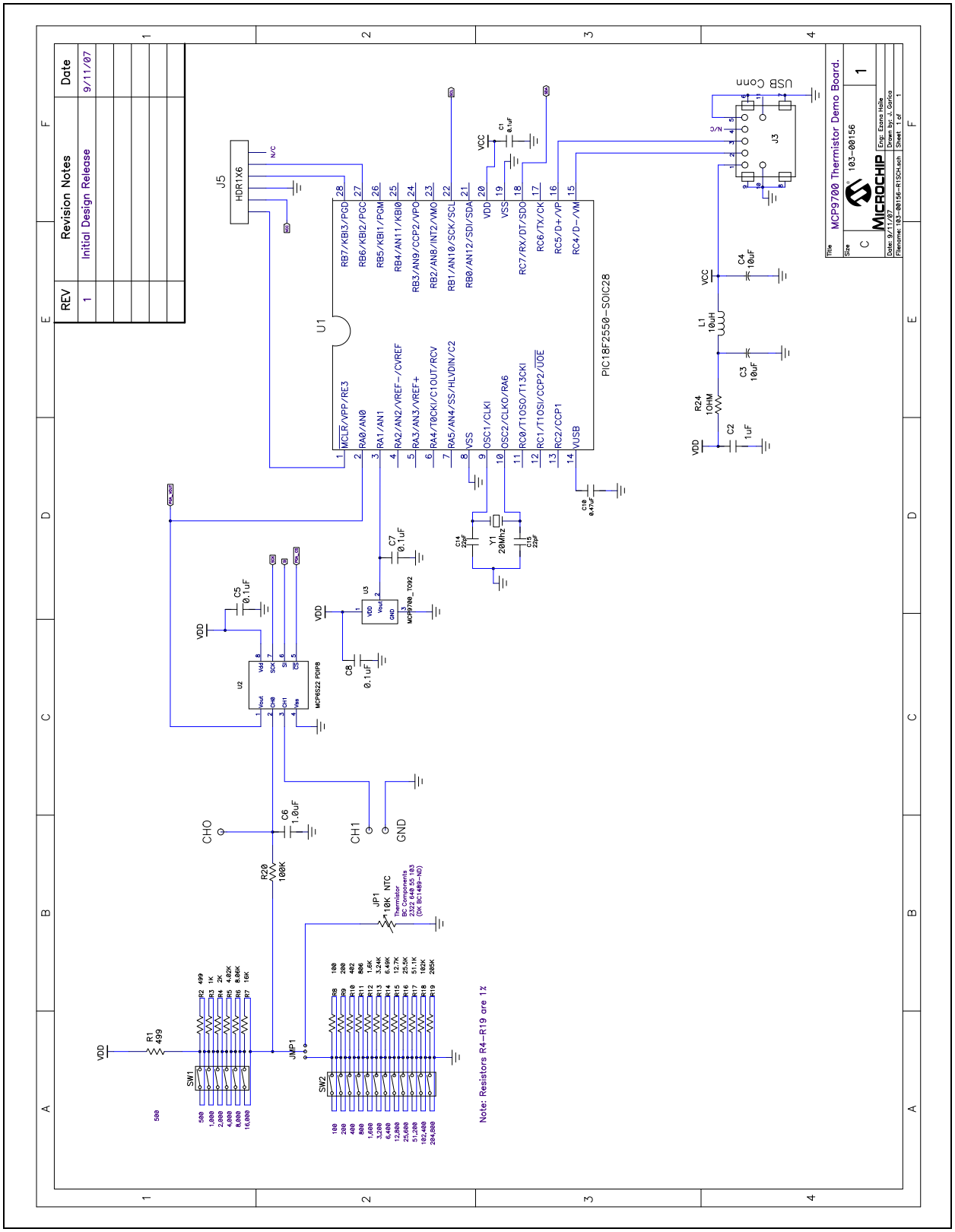
Appendix A. Schematic and Layouts

A.1 INTRODUCTION

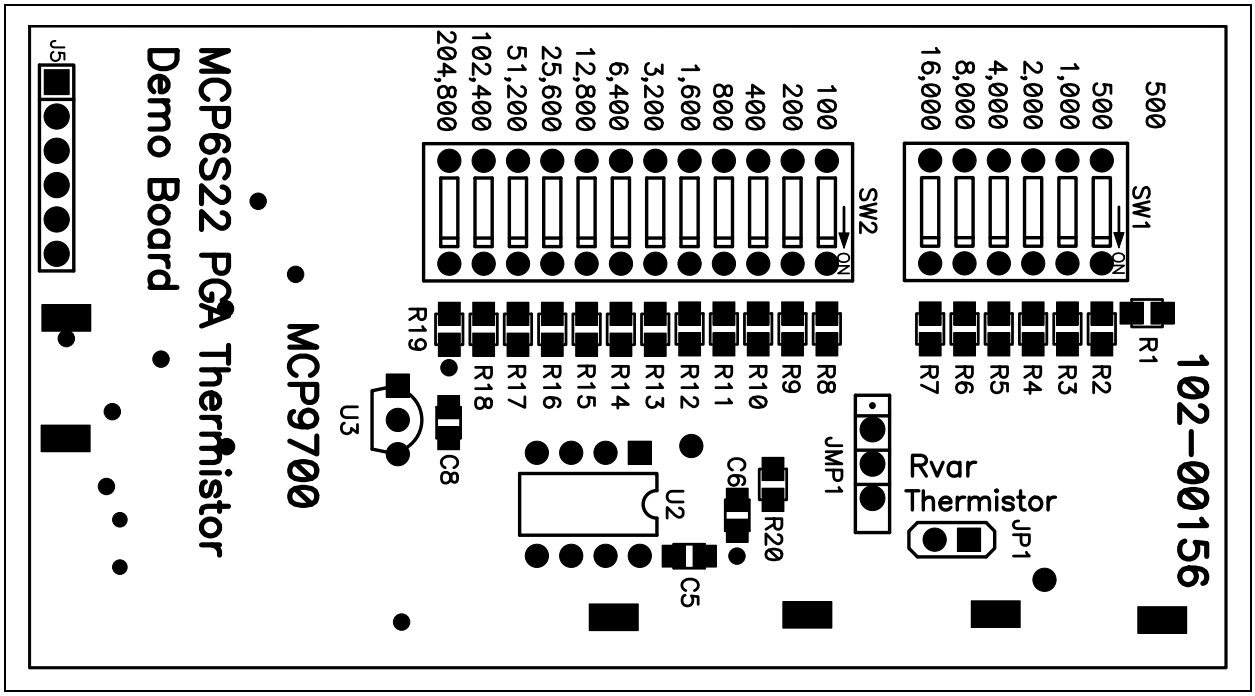
This appendix contains the following schematics and layouts for the MCP9700 Thermistor Demo Board:

- Board Schematic
- Board - Top Layer
- Board - Silk-screen Layer
- Board - Bottom Layer

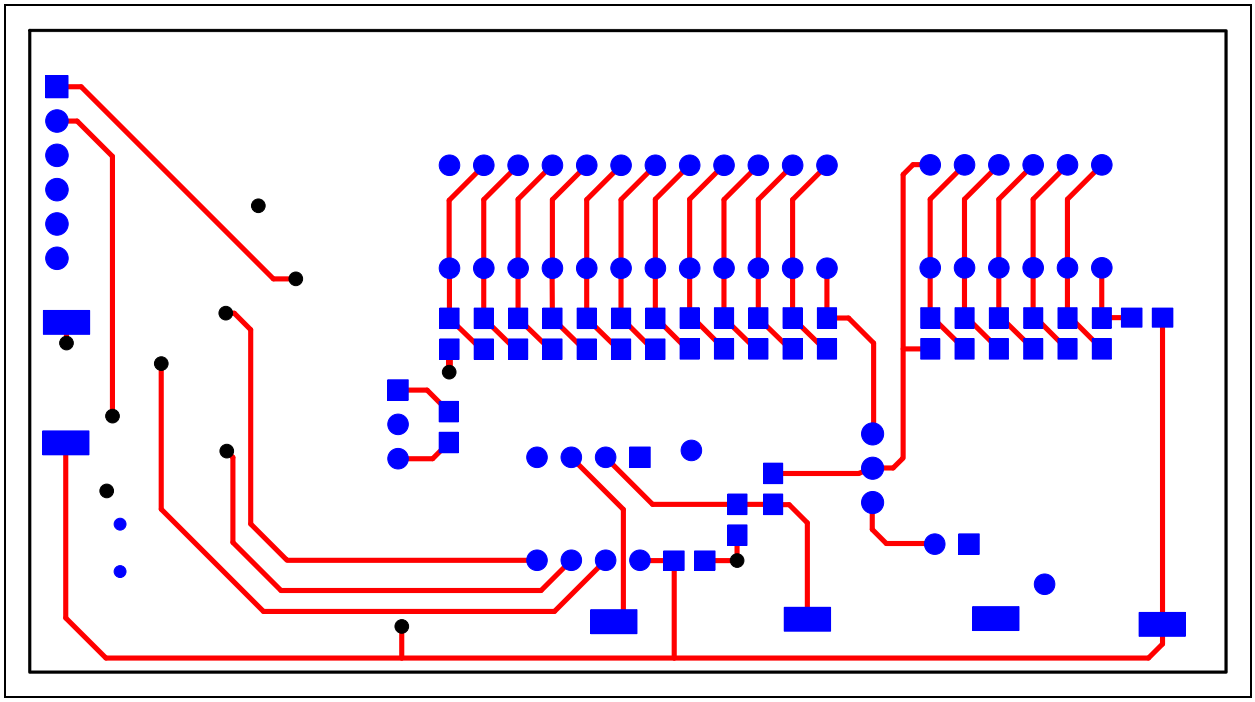
A.2 BOARD SCHEMATIC - PAGE 1



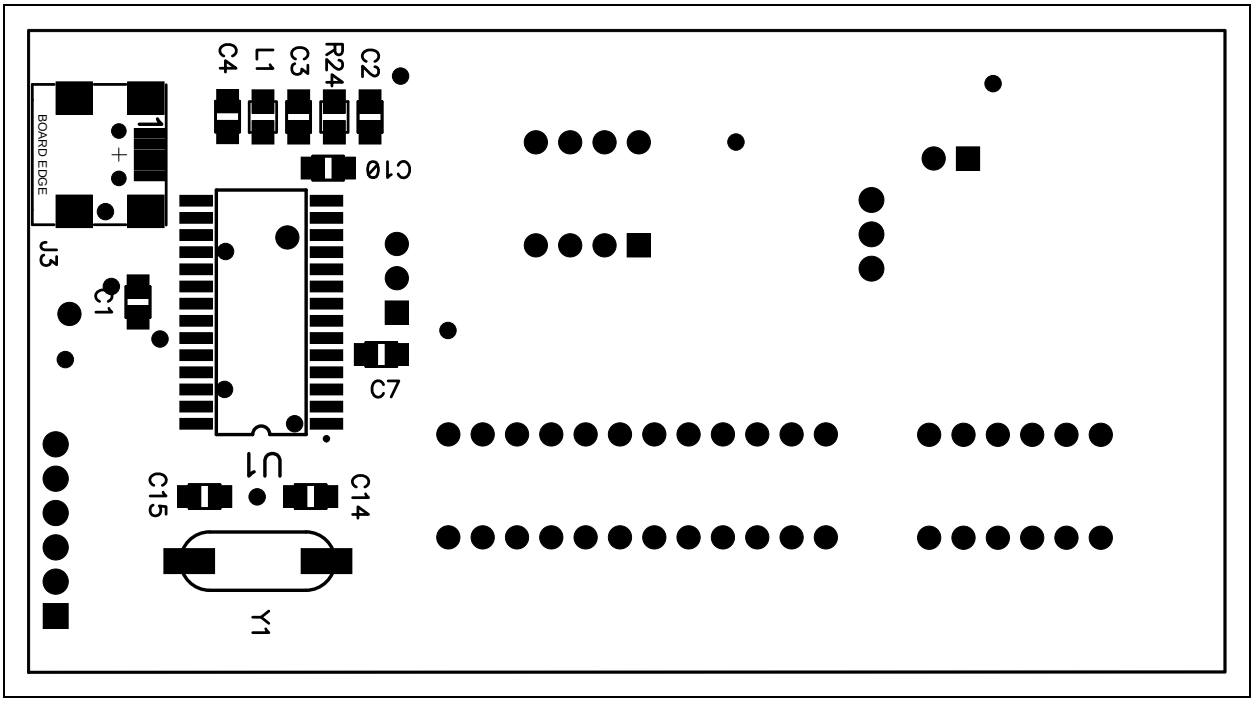
A.3 BOARD - TOP SILK-SCREEN LAYER



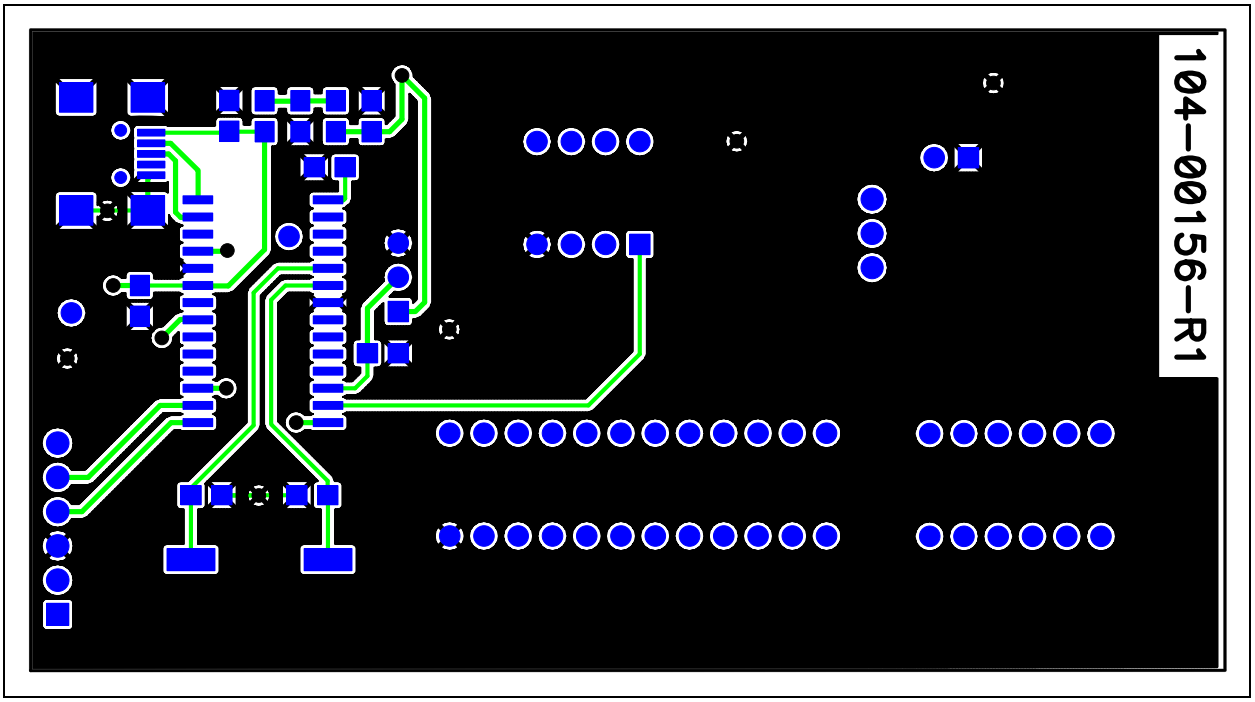
A.4 BOARD - TOP LAYER



A.5 BOARD - BOTTOM SILK



A.6 BOARD - BOTTOM LAYER



Appendix B. Bill Of Materials (BOM)

TABLE B-1: BILL OF MATERIALS

Qty	Reference	Description	Manufacturer	Part Number
1	(for JMP1)	Shunt - SOCKET, SHORT BLKS W TAB BLK	AMP®/Tyco Electronics	881545-2
1	(for U1)	CONN IC SOCKET 8POS DIP TIN	AMP/Tyco Electronics	2-641260-1
4	C1,C5,C7,C8	CAP .1UF 25V CERAMIC X7R 0805	Panasonic® - ECG	ECJ-2VB1E104K
1	C10	CAP .47UF 16V CERAMIC X7R 0805	Panasonic - ECG	ECJ-2YB1C474K
2	C14,C15	CAP 22PF 50V CERM CHIP 0805 SMD	Panasonic - ECG	ECJ-2VC1H220J
2	C2,C6	CAP 1.0UF 16V CERAMIC X7R 0805	Kemet® Electronics Corp	C0805C105K4RACTU
2	C3,C4	CAP 10UF 10V CERAMIC F 0805	Panasonic - ECG	ECJ-2FF1A106Z
6	CH0,CH1,GND, VDD	PC TEST POINT COMPACT SMT	Keystone Electronics®	5016
4	EA. Corner	BUMPON TALL TAPER SQ .50X.23 BK (Package comes in 64pcs per unit)	3M	SJ-5518 (BLACK)
1	J3	CONN RECEPT MINI USB2.0 5POS (mini USB)	Hirose Electronic Co Ltd	UX60-MB-5ST
	J5	"DO NOT POPULATE" CONN HEADER VERT 6POS .100 TIN	Tyco® Electronics/Amp	3-644695-6
1	JMP1	CONN HEADER 3POS 0.100 VERT TIN	AMP/Tyco Electronics	3-644456-3
1	JP1	THERMISTOR 10K OHM NTC LEADED	BC Components	2381 640 55103
1	L1	INDUCTOR 10UH 100MA 0805	Murata Electronics® - North America	LQM21FN100M70L
1	PCB	MCP9700 Thermistor Demo Board	Microchip Techgology Inc.	113-00156
2	R1,R2	RES 499 OHM 1/8W 1% 0805 SMD	Panasonic - ECG	ERJ-6ENF4990V
1	R10	RES 402 OHM 1/8W 1% 0805 SMD	Panasonic - ECG	ERJ-6ENF4020V
1	R11	RES 806 OHM 1/8W 1% 0805 SMD	Panasonic - ECG	ERJ-6ENF8060V
1	R12	RES 1.62K OHM 1/8W 1% 0805 SMD	Panasonic - ECG	ERJ-6ENF1621V
1	R13	RES 3.24K OHM 1/8W 1% 0805 SMD	Panasonic - ECG	ERJ-6ENF3241V
1	R14.	RES 6.49K OHM 1/8W 1% 0805 SMD	Panasonic - ECG	ERJ-6ENF6491V
1	R15	RES 12.7K OHM 1/8W 1% 0805 SMD	Panasonic - ECG	ERJ-6ENF1272V
1	R16	RES 25.5K OHM 1/8W 1% 0805 SMD	Panasonic - ECG	ERJ-6ENF2552V
1	R17	RES 51.1K OHM 1/8W 1% 0805 SMD	Panasonic - ECG	ERJ-6ENF5112V
1	R18	RES 102K OHM 1/8W 1% 0805 SMD	Panasonic - ECG	ERJ-6ENF1023V
1	R19	RES 205K OHM 1/8W 1% 0805 SMD	Panasonic - ECG	ERJ-6ENF2053V
1	R20	RES 100K OHM 1/8W 1% 0805 SMD	Panasonic - ECG	ERJ-6ENF1003V
1	R24	RES 10.0 OHM 1/8W 1% 0805 SMD	Panasonic - ECG	ERJ-6ENF10R0V

Note: 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 (CONTINUED)

Qty	Reference	Description	Manufacturer	Part Number
1	R3	RES 1.00K OHM 1/8W 1% 0805 SMD	Panasonic - ECG	ERJ-6ENF1001V
1	R4	RES 2.00K OHM 1/8W 1% 0805 SMD	Panasonic - ECG	ERJ-6ENF2001V
1	R5	RES 4.02K OHM 1/8W 1% 0805 SMD	Panasonic - ECG	ERJ-6ENF4021V
1	R6	RES 8.06K OHM 1/8W 1% 0805 SMD	Panasonic - ECG	ERJ-6ENF8061V
1	R7	RES 16.2K OHM 1/8W 1% 0805 SMD	Panasonic - ECG	ERJ-6ENF1622V
1	R8	RES 100 OHM 1/8W 1% 0805 SMD	Panasonic - ECG	ERJ-6ENF1000V
1	R9	RES 200 OHM 1/8W 1% 0805 SMD	Panasonic - ECG	ERJ-6ENF2000V
1	SW1	SWITCH 6 POS DIP EXTENDED SEALED	Grayhill, Inc	78B06ST
1	SW2	SWITCH 12 POS DIP EXTENDED UNSLD	Grayhill, Inc	78B12ST
1	U1	28/40/44-Pin, High-Performance, Enhanced Flash, USB Microcontrollers with nanoWatt Technology	Microchip Technology Inc.	PIC18F2550-I/SO
1	U2	PGA, Rail-to-Rail I/O, Digital control	Microchip Technology Inc.	MCP6S22-I/P
1	U3	Low-Power Linear Active Thermistor™ Ics	Microchip Technology Inc.	MCP9700-E/TO
1	Y1	CRYSTAL 20.0000 MHZ SERIES SMT	CTS-Frequency Controls	ATS200SM

Note: 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:

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