



**MCP1631HV**  
**Digitally Controlled**  
**Programmable Current Source**  
**Reference Design**

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# MCP1631HV DIGITALLY CONTROLLED PROGRAMMABLE CURRENT SOURCE REFERENCE DESIGN

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**NOTES:**



# MCP1631HV DIGITALLY CONTROLLED PROGRAMMABLE CURRENT SOURCE REFERENCE DESIGN

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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 web site ([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 “DSXXXXA”, where “XXXX” 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 MCP1631HV Digitally Controlled Programmable Current Source Reference Design. 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 MCP1631HV Digitally Controlled Programmable Current Source Reference Design as a LED driver or a battery charger. The manual layout is as follows:

- **Chapter 1. “Product Overview”** – Important information about the MCP1631HV Digitally Controlled Programmable Current Source Reference Design.
- **Chapter 2. “Installation and Operation”** – Includes instructions on how to get started with this user’s guide and a description of the user’s guide.
- **Appendix A. “Schematic and Layouts”** – Shows the schematic and layout diagrams for the MCP1631HV Digitally Controlled Programmable Current Source Reference Design.
- **Appendix B. “Bill Of Materials (BOM)”** – Lists the parts used to build the MCP1631HV Digitally Controlled Programmable Current Source Reference Design.
- **Appendix C. “Demo Board Firmware”** – Provides general information about the application firmware flowcharts and where the source code can be found.

## 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<sup>®</sup> 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><i>File&gt;Save</i></u>
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's guide describes how to use the MCP1631HV Digitally Controlled Programmable Current Source Reference Design. Other useful documents are listed below. The following Microchip documents are available and recommended as supplemental reference resources.

**MCP1631 Data Sheet, "High-Speed, Microcontroller-Adaptable, Pulse Width Modulator", DS22063A**

This data sheet provides detailed information regarding the MCP1631/MCP1631V, MCP1631HV and MCP1631VHV product families.

**PIC16F616/HV616 Data Sheet, "14-Pin Flash-Based, 8-Bit CMOS Microcontrollers", DS41288A**

This data sheet provides detailed information regarding the PIC16F616 product family.

**AN1137 Application Note, "Using the MCP1631 Family to Develop Low-Cost Battery Chargers", DS01137A.**

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- Field Application Engineer (FAE)
- Technical Support

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

## **DOCUMENT REVISION HISTORY**

### **Revision A (May 2009)**

- Initial Release of this Document.



## Chapter 1. Product Overview

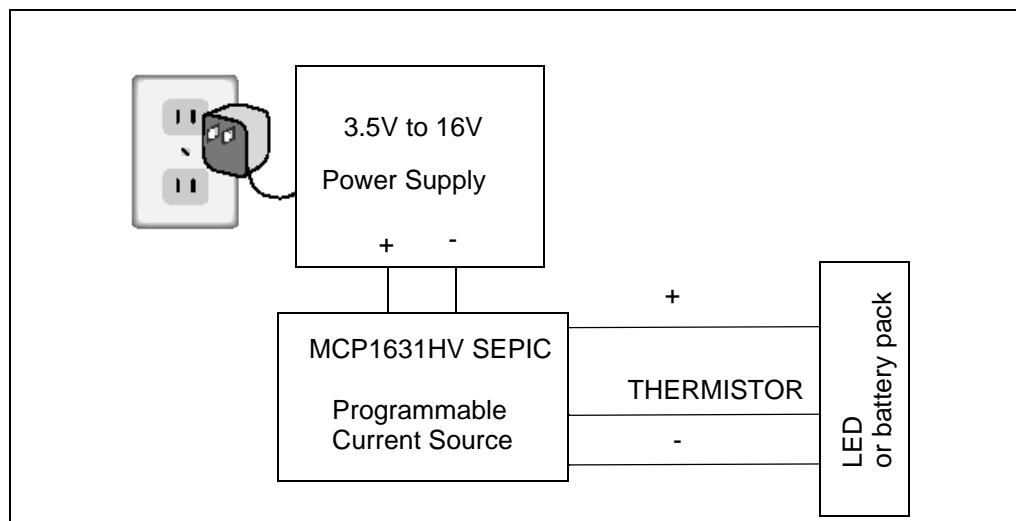
### 1.1 INTRODUCTION

The MCP1631HV Digitally Controlled Programmable Current Source Reference Design is used to drive and dim one or more power LEDs in a series or parallel topology (depending on the LED's capability). The reference design may also be used to charge one to four cell NiMH/NiCd or one to two cell Li-Ion battery packs. The board uses the MCP1631HV high-speed analog PWM controller and PIC16F616 microcontroller to generate the proper dimming ratio for LEDs or charge algorithm for NiMH, NiCd and Li-Ion batteries.

The MCP1631HV Digitally Controlled Programmable Current Source Reference Design is used to evaluate Microchip's MCP1631HV in a SEPIC power converter application. The MCP1631HV Digitally Controlled Programmable Current Source Reference Design is user programmable. Multiple user functions may be selected by re-compiling the source code. The board can drive LEDs or charge NiMH, NiCd or Li-Ion batteries with a maximum current of 1A. In Charger Mode, the MCP1631HV Digitally Controlled Programmable Current Source Reference Design provides a constant current charge (Ni-based chemistry) and constant current/constant voltage (Li-Ion based chemistry) with preconditioning, cell temperature monitoring (for Ni-based) and battery pack fault monitoring. In LED Driver mode, the MCP1631HV Digitally Controlled Programmable Current Source Reference Design provides a constant user defined current and a 10:1 dimming ratio. The dimming ratio and maximum current can be selected before compiling the source code. The board has LED indicators to provide multiple fault indication.

This chapter covers the following topics:

- What is the MCP1631HV Digitally Controlled Programmable Current Source Reference Design Reference Design?
- What the MCP1631HV Digitally Controlled Programmable Current Source Reference Design Reference Design Kit includes.



**FIGURE 1-1:** Block Diagram.

## 1.2 WHAT IS THE MCP1631HV DIGITALLY CONTROLLED PROGRAMMABLE CURRENT SOURCE REFERENCE DESIGN?

This board utilizes Microchip's MCP1631HV-3.3 (high-speed PIC® MCU PWM TSSOP-20, 3.3V supply version).

The MCP1631HV Digitally Controlled Programmable Current Source Reference Design is a complete stand-alone constant current LED power supply with a dimming ratio of 10:1. The board is capable of delivering a maximum of 1 Amp @ 8.5W output power. Efficiency is typically 85% at the maximum power.

**TABLE 1-1: DEFAULT OUTPUT CAPABILITY IN DRIVING LED MODE**

Maximum output current <sup>1</sup>	Dimming ratio	Maximum Output power <sup>1</sup>	Overvoltage protection	Thermal shutdown <sup>2</sup>
700 mA	10:1	8.5W	9V	40°C

**Note 1:** Maximum output current can be modified in the source code. Absolute max is 1A @8.5W.

**2:** For an easy start with the MCP1631HV Digitally Controlled Programmable Current Source Reference Design Board, this option is not enabled in the compiled .hex file which is available on the Microchip website.

The board may also be re-programmed to charge Li-Ion, NiMH, and NiCd battery packs. The MCP1631HV Digitally Controlled Programmable Current Source Reference Design is capable of charging one to four NiMH/NiCd batteries connected in series or one to two Li-Ion batteries in series. See Table 1-2 for detailed charger capabilities.

**TABLE 1-2: MULTI-CHEMISTRY CHARGER CAPABILITY**

Battery Chemistry	1 Cell	2 Cells	3 Cells	4 Cells
Li-Ion	1A	500 mA	NA	NA
NiMH or NiCd	700 mA	700 mA	700 mA	700 mA

**Note:** The SEPIC converter is capable of buck-boost operation. The duty cycle may be changed in the source code to allow boost operation. Set the "00234R1.h" header file pre-processor duty cycle definition to:

```
#define OSCILLATOR_DUTY_CYCLE 25
for 25% duty cycle and to allow boost operation.
```

The input voltage range for the reference board is 3.5V to 16V.

An input terminal block is provided to apply the input voltage to the board. An output header with 5 pins is also provided as a means to connect the load LEDs or battery pack and an external 10 kΩ thermistor. When used, thermistors should either be mounted on the LED heatsink next to the LED case or internal to the NiMH/NiCd battery pack.

A programming header compatible with the PICkit™2 and ICD 2 programmers is on board for updating the firmware contained in the PIC16F616. Firmware updates are required to switch between LED, NiMH/NiCd, and Li-Ion modes of operation.

## 1.3 WHAT THE MCP1631HV DIGITALLY CONTROLLED PROGRAMMABLE CURRENT SOURCE KIT INCLUDES

The MCP1631HV Digitally Controlled Programmable Current Source kit includes:

- The MCP1631HV Digitally Controlled Programmable Current Source Reference Design,102-00234
- Important Information "Read First"



# MCP1631HV DIGITALLY CONTROLLED PROGRAMMABLE CURRENT SOURCE REFERENCE DESIGN

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## Chapter 2. Installation and Operation

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### 2.1 INTRODUCTION

The MCP1631HV Digitally Controlled Programmable Current Source Reference Design demonstrates Microchip's MCP1631HV high-speed Pulse Width Modulator (PWM) used in LED lighting and multi-chemistry battery charger applications. When used in conjunction with a microcontroller, the MCP1631HV will control the power system duty cycle to provide output voltage or current regulation. A PIC16F616 microcontroller is used to provide the MCP1631HV switching frequency oscillator and reference voltage. The MCP1631HV generates a duty cycle and provides fast overcurrent protection based upon the feedback and current sense inputs. MCP1631HV external signals include the input oscillator, the reference voltage, the feedback voltage and the current sense. The MCP1631HV generates a square-wave output signal to drive the powertrain switch. The power train used for the MCP1631HV Digitally Controlled Programmable Current Source Reference Design is a Single-Ended Primary Inductive Converter (SEPIC). The PIC16F616 microcontroller is programmable, allowing the user to modify or develop their own firmware routines to further evaluate the MCP1631HV Digitally Controlled Programmable Current Source Reference Design in this application.

### 2.2 FEATURES

The MCP1631HV Digitally Controlled Programmable Current Source Reference Design has the following features:

- Input Operating Voltage Range: +3.5V to +16V
- Firmware default output current of 700 mA with dimming ratio 10:1 (70 mA/step)
- Maximum output current of 1000 mA
- Maximum output power of 8.5W
- Drive one or more LEDs
- Firmware for charging Li-Ion, NiMH, and NiCd batteries
- ON/OFF/Dimming switch
- Status and fault indication
- Hardware and software overvoltage protection (OVP) set to 9.0V. The software value can be modified in the source code to be less than 9.0V

## 2.3 GETTING STARTED

The MCP1631HV Digitally Programmable Current Source Reference Design is fully assembled and tested for driving and dimming power LEDs. At the output, one or more LEDs can be connected in parallel or series topology. With the default firmware, the board can drive a 700 mA load with 9V overvoltage protection. This board requires an external voltage source within a range of +3.5V to +16V input. User supplied LED's are also required to evaluate the reference board. A user supplied thermistor mounted on the LED package is needed to use the thermal shutdown feature in firmware.

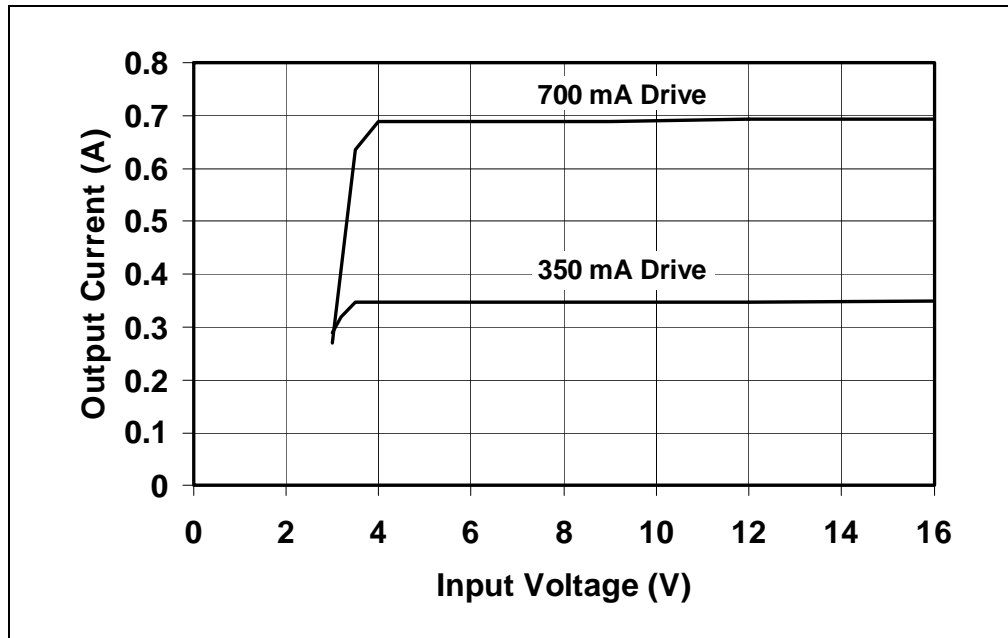


FIGURE 2-1: LED Driver Output Current vs. Input Voltage.

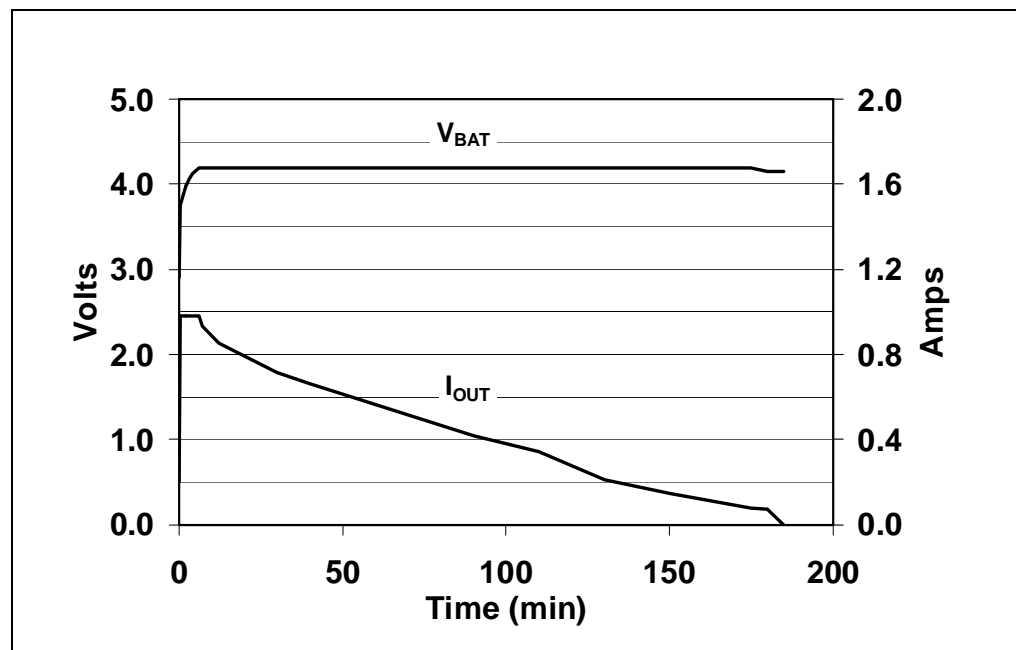
# Installation and Operation

The MCP1631HV Digitally Programmable Current Source Reference Design firmware may be re-programmed with the charger profile for Li-Ion or NiMH/NiCd battery packs. Firmware profile pre-processor definitions are :

- #define LION\_SUPPORT DISABLED
- #define NIMH\_SUPPORT DISABLED
- #define LED\_DRIVER\_SUPPORT ENABLED

Setting one of the profiles to ENABLED and the other two to DISABLED will select the ENABLED profile at compile time. The re-compiled code will then perform the functions required for the selected profile.

Figure 2-2 shows the charge profiles for a single-cell 1000 mAh Li-Ion battery pack. Figure 2-3 shows the charge profile for a three-cell 600 mAh NiMH battery pack with Temperature Shutdown disabled. Disabling the Temperature Shutdown is only done one time in the lab to profile the battery pack and chemistry. The Temperature Shutdown should always be enabled in production firmware to prevent the battery pack from overheating during a charge cycle.



**FIGURE 2-2:** Li-Ion Charge Profile for 1000 mAh Cell.

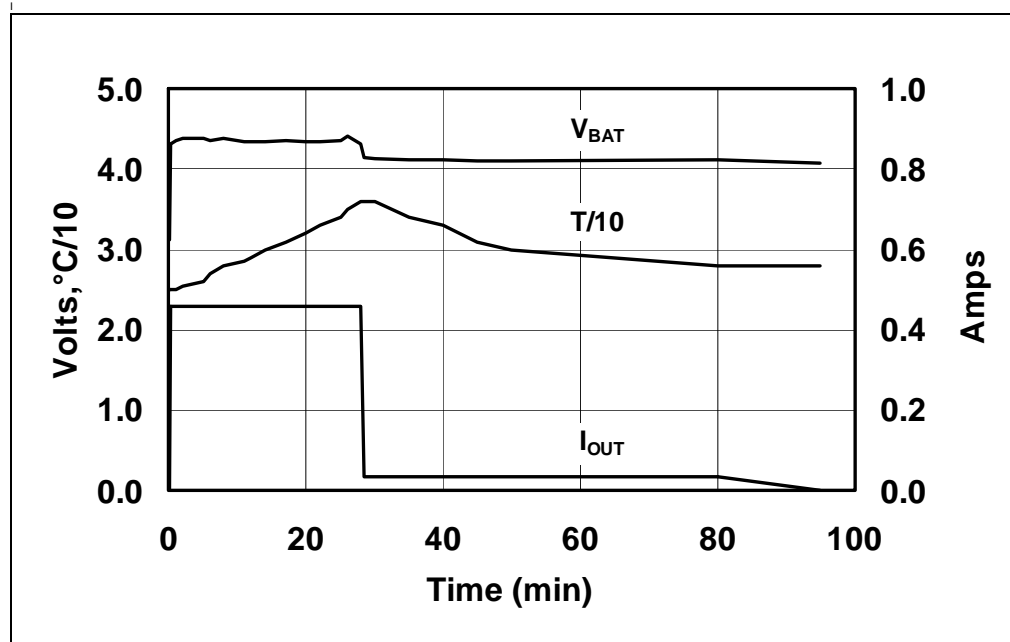
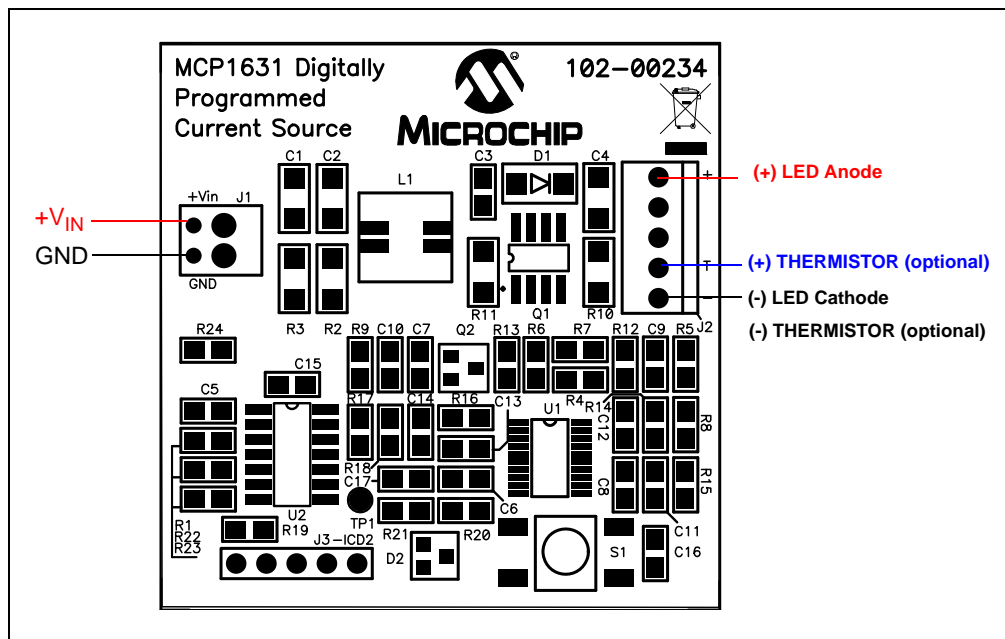


FIGURE 2-3: NiMH Three-Cell (3.6V/600 mAh) Charged at Maximum 0.75C.

## 2.3.1 Power Input and Output Connection

### 2.3.1.1 POWERING THE MCP1631HV DIGITALLY PROGRAMMABLE CURRENT SOURCE REFERENCE DESIGN

1. Prepare the power supply to be connected to the input terminal block, J1. The input voltage source should be limited to the 0V to +16V range. For nominal operations, the recommended input voltage should be between +3.5 and +16 volts with a 12W input supply.
2. Connect the positive side of the input source (+) to pin +V<sub>IN</sub> of J1. Connect the negative or return side (-) of the input source to pin GND of J1. Refer to Figure 2-4.



**FIGURE 2-4:** Power Supply and Load Connections Diagram.

### 2.3.1.2 APPLYING A LOAD TO THE MCP1631HV DIGITALLY CONTROLLED PROGRAMMABLE CURRENT SOURCE REFERENCE DESIGN

1. To apply an LED load to the MCP1631HV Digitally Controlled Programmable Current Source Reference Design, the anode of the LED should be connected to pin 1 (+) of J2. The cathode of the LED should be connected to pin 5 (-) of J2. The default drive current for LEDs is set to 700 mA in the supplied firmware. The LED load which is connected to the reference board must be capable of handling 700 mA. If the LED load is not capable of handling 700 mA, then the firmware must be re-compiled with the LED drive current set to the current capability of the LED load being used. The minimum programmed current that the board will generate is 10% of the programmed drive current. For the reference board firmware which is set to 700 mA of drive current, the minimum would be 70 mA.
2. Optionally, a thermistor referenced to the (-) pin of J2 may be utilized for thermal shutdown.  
The recommended thermistor is EPCOS Inc. P/N: B57500M0103A005.

**Note:** The Thermal Shutdown is not enabled by default in the firmware. It can be enabled by re-compiling the source code with this feature enabled. The thermistor must be used if the board is programmed with NiMH/NiCd charger firmware.

### 2.3.1.3 USING THE REFERENCE BOARD

The push button is used to switch the output ON or OFF (Standby). The first pressing of the power button will turn on the board and drive the output at 10% of programmed current (70 mA for the default firmware). The GREEN LED will flash with a 1 second period, indicating that it is in normal operating mode.

The board is capable of a 10:1 dimming ratio. Each additional pressing of the power button will increment the output drive current by 10% of the programmed drive current up to the actual programmed drive current value.

To switch the output OFF, press and hold the push button for about 2 seconds until the LED turns RED.

### 2.3.1.4 STATUS AND FAULT INDICATION

The MCP1631HV Digitally Programmable Current Source Reference Design has a dual color (red/green) LED to indicate the status and faults. Table 2-1 shows the status of the LEDs during various states of operating modes.

If a *no load*, *overvoltage*, or *overtemperature* fault condition occurs during operation, the fault condition will be indicated by a flashing RED LED.

The RED LED will flash at a 1 Hz rate if an overtemperature condition has been detected. An overtemperature condition will result in Thermal Shutdown.

The RED LED will flash at a 2 Hz rate if an overvoltage or missing load condition has been detected. An overvoltage or missing load condition will result in an Overvoltage Shutdown.

A fault condition must exist for 5 consecutive firmware sampling periods to be validated as a hard fault.

**TABLE 2-1: STATUS OUTPUT**

STATE / FAULT	LED Status
Standby / Charge Complete State	GREEN ON
ON (Dimming or Charging) State	GREEN Flashing
Switching to Standby State	RED ON after button press delay
Over Temperature Fault	RED Flashing (1 Hertz)
Over Voltage Fault	RED Flashing (2 Hertz)
Charge Timeout Fault	RED Flashing (2 Hertz)
Calibration Complete State	YELLOW (both LEDs ON)



## 2.3.1.5 MCP1631 PROGRAMMABLE CURRENT SOURCE AS BATTERY CHARGER

The MCP1631HV Digitally Controlled Programmable Current Source Reference Design reference board is provided with the LED driver firmware programmed into the U2 microcontroller.

The reference board package also has compiled firmware \*.hex files included for Li-Ion and NiMH/NiCd battery packs. There are two versions of charger firmware. One is for Li-Ion cells (00234R1-LiIon\_Charger.hex) and the other is for NiCd/NIMH cells (00234R1-NiMH\_NiCd\_Charger.hex).

### 2.3.1.5.1 How to Connect and Charge a Battery with the MCP1631HV Digitally Controlled Programmable Current Source Reference Design

To charge a battery pack with the MCP1631HV Digitally Controlled Programmable Current Source Reference Design, the positive connector of the battery should be connected to J2-1 (+). The negative terminal of the battery should be connected to J2-5 (-).

A thermistor referenced to J2-5 (-) should be used for thermal shutdown if the battery chemistry is NiMH/NiCd. To evaluate a NiMH/NiCd battery charger pack that does not have an internal thermistor, it is recommended to attach an EPCOS Inc.

P/N: B57500M0103A005 thermistor onto one of the cells of the battery pack. This thermistor should be connected to J2-4 (+) and J2-5 (-).

**Note:** The maximum charge current for the Li-Ion chemistry is programmed and limited at 1A for a single cell (4.2V) or 500 mA for two cells in series topology. The pre-programmed maximum charge current for NiMH/NiCd chemistry is 700 mA.

For evaluation, all charge parameters can be modified in source code. See the header file 00234R1.h for the pre-processor definitions.

### 2.3.1.5.2 Charge Profiles

The pre-programmed parameters for the battery charge profiles are:

- **Li-Ion**
  - Qualification: Precharge at 200 mA for  $V_{CELL} < 3.0V$
  - Constant Current: 1A for 1 Cell, 0.5A for 2 Cells
  - Constant Voltage: 4.20V (this value should be calibrated for better accuracy, see **Section 2.3.1.5.4 “Calibrating the Output Voltage for the Li-Ion Chemistry Profile”**)
  - Charge Termination: 70 mA for 1 Cell and 2 Cells
  - Overvoltage Detection: Once detected, attempts to restart the charge cycle 5 times. If overvoltage is still present, the charge cycle is aborted and the RED LED is flashed.
- **NiMH/NiCd**
  - Qualification: Precharge at 140 mA for  $V_{CELL} < 0.9V$
  - Constant Current: 700 mA for 1 Cell to 4 Cell
  - Terminate Fast Charge for -dV/dT or +dT/dt
  - Top off Charge Current: 35 mA  
Top off Charge Time: 1 hour
  - Overvoltage Detection: Once detected, attempts to restart the charge cycle 5 times. If overvoltage is still present, the charge cycle is aborted and the RED LED is flashed.

### 2.3.1.5.3 How the MCP1631HV Digitally Controlled Programmable Current Source Reference Design Operates in Charger Mode

Follow the instructions in **Section 2.3.1.5.1 “How to Connect and Charge a Battery with the MCP1631HV Digitally Controlled Programmable Current Source Reference Design”** to connect a battery pack at the board. In the Standby (OFF) state, the GREEN LED will be lit. Push the S1 button to start the charge profile and turn on the output. The GREEN LED will flash.

If any fault conditions are detected during charging, the RED LED will flash and the output will automatically turn off. See Table 2-1 to identify the nature of the fault. When a charge cycle successfully completes, the GREEN LED will be turned ON and the output will be turned off. The system will stay in a Standby (OFF) state until the next button push.

At any moment, the charging can be stopped by pressing and holding the push button until the RED LED turns on.

The default calibration value for the Li-Ion pack is 4.2V. For better accuracy, the output voltage should be calibrated before starting a charge cycle. See **Section 2.3.1.5.4 “Calibrating the Output Voltage for the Li-Ion Chemistry Profile”** for instructions.

### 2.3.1.5.4 Calibrating the Output Voltage for the Li-Ion Chemistry Profile

Prior to the first Li-Ion charging cycle, it is recommended to calibrate the charger termination voltage for better accuracy. Connect a 12V power supply to the J1 connector. Select another power supply for the calibration voltage and set it to the desired termination voltage between 3.9V and 4.20V. Connect the calibration power supply to the J2 connector. Connect the positive lead to J2-1 and the negative lead to J2-5.

1. Press S1 to turn on the board.
2. Wait for the GREEN LED to light. If it does not light, check for faults.
3. When the GREEN LED is lit, press and hold down S1 for 2 seconds until the YELLOW LED (both green and red LEDs) is lit. The YELLOW status indicator signals the calibration is complete.
4. The calibration power supply can now be removed from the J2 output connector.

## 2.3.1.6 VIEW THE STATE OF MCP1631HV DIGITALLY CONTROLLED PROGRAMMABLE CURRENT SOURCE REFERENCE DESIGN

The MCP1631HV Digitally Controlled Programmable Current Source Reference Design is able to show, using an oscilloscope, the system state. To use this feature, connect the scope probe to test point TP1. Testpoint TP1 is output pin U2-8 of the PIC16F616 microcontroller. There are nine status waveforms listed below. A pulse stream of one to nine 10  $\mu$ s pulses are generated at TP1 test point every one second interval. The pulse stream indicates the current state of the system software. Note that the first two states may complete immediately and thus may be difficult to capture on a non-storage scope.

- 1 pulse - output power is switched ON
- 2 pulses - qualification charging
- 3 pulses - charging - NiMH / NiCd constant current mode
- 4 pulses - charging - NiMH / NiCd top off current mode
- 5 pulses - charging - Li-Ion constant current mode
- 6 pulses - charging - Li-Ion constant voltage mode
- 7 pulses - dimming - LED constant current mode
- 8 pulses - fault - overvoltage protection state
- 9 pulses - output power switched OFF (Standby)

## 2.3.1.7 PROGRAMMING THE PIC16F616 MICROCONTROLLER

To evaluate the board, the firmware package provides 3 hex files for the LED driver, Li-Ion Battery Charger, and NiMH/NiCd Battery Charger. The board is factory programmed with the LED driver firmware for 700 mA maximum current and 10:1 dimming (~70 mA/step). All parameters may be changed in firmware to the desired value according to the output capability. The source code is commented extensively and helps the user to define the board.

The header file, `00234R1.h`, contains the pre-processor definitions which define the system. The user may modify the definitions to change specific system parameters to meet design goals.

mikroElektronika's mikroC compiler was used to compile the source code and create the hex files for downloading to the reference board. The mikroC compiler is available at <http://www.mikroe.com>. The compiler is not included with the reference board kit.

Header J3 is provided for in-system circuit programming. A PICkit<sup>TM</sup>2 programmer may be connected to J3 to program the reference board.

1. Connect the PICkit<sup>TM</sup>2 programmer to J3.
2. Start the PICkit<sup>TM</sup>2 software.
3. Set Device to PIC16F616.
4. *Erase* the device.
5. Select "File" then "Import Hex" from the menu. Browse to the desired `*.hex` firmware file to download.
6. *Write* the file.
7. The status window should indicate success or failure of the download.

NOTES:



# MCP1631HV DIGITALLY CONTROLLED PROGRAMMABLE CURRENT SOURCE REFERENCE DESIGN

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## Appendix A. Schematic and Layouts

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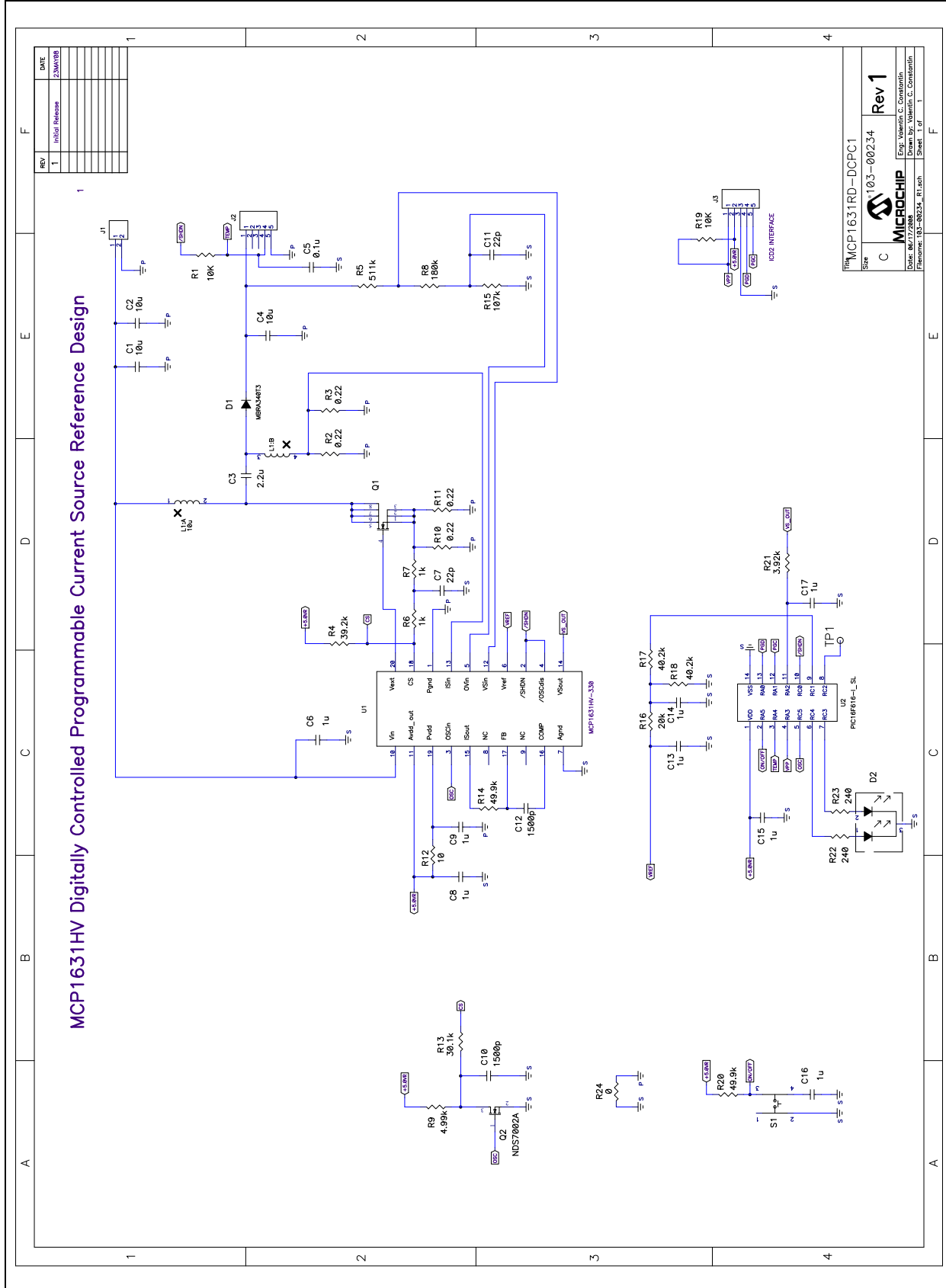
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### A.1 INTRODUCTION

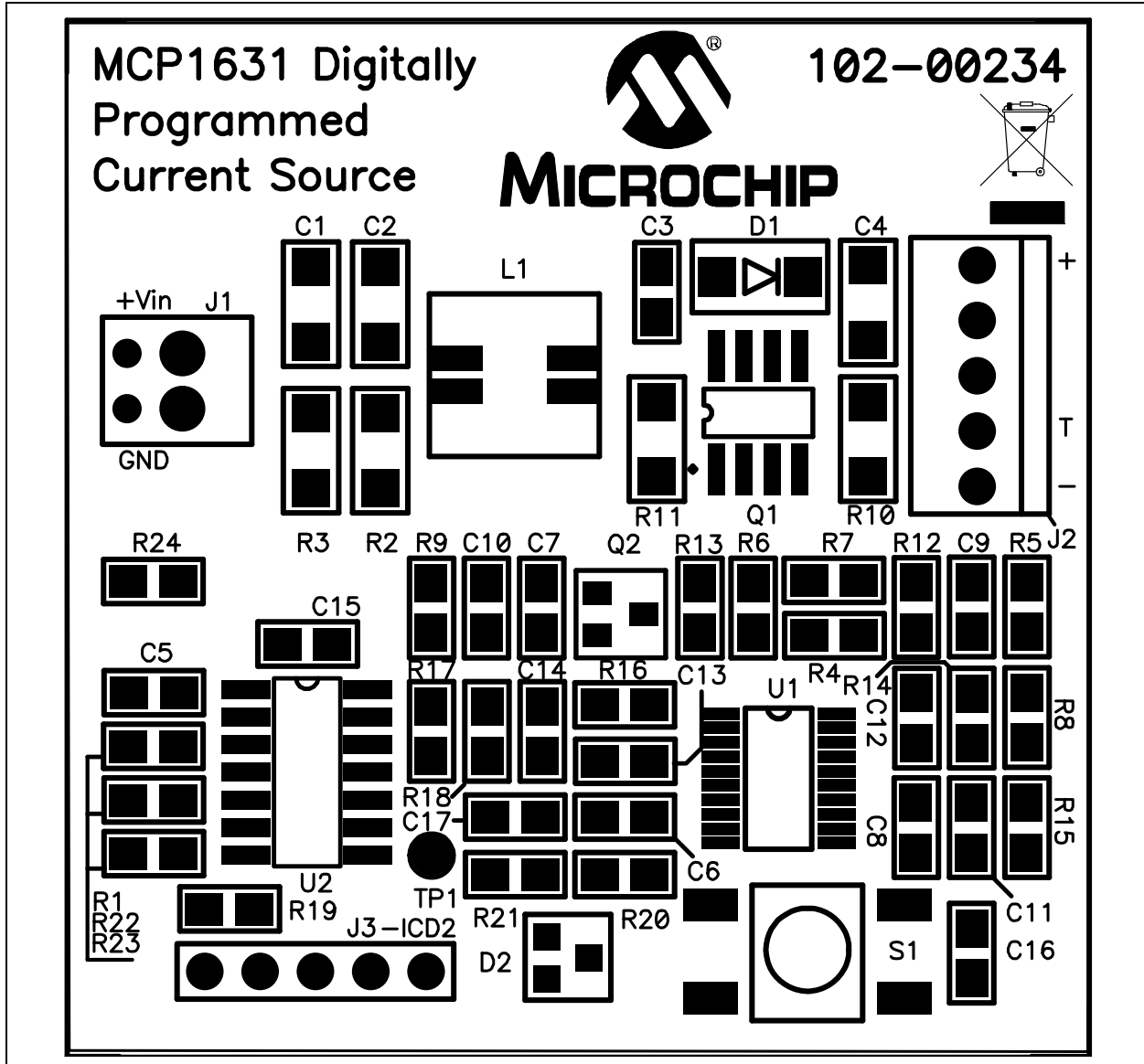
This appendix contains the following schematics and layouts for the MCP1631HV Digitally Controlled Programmable Current Source Reference Design:

- Board Schematic
- Board – Top Solder Pads and Silk-Screen Layers
- Board – Top Copper Layer
- Board – Bottom Copper Layer

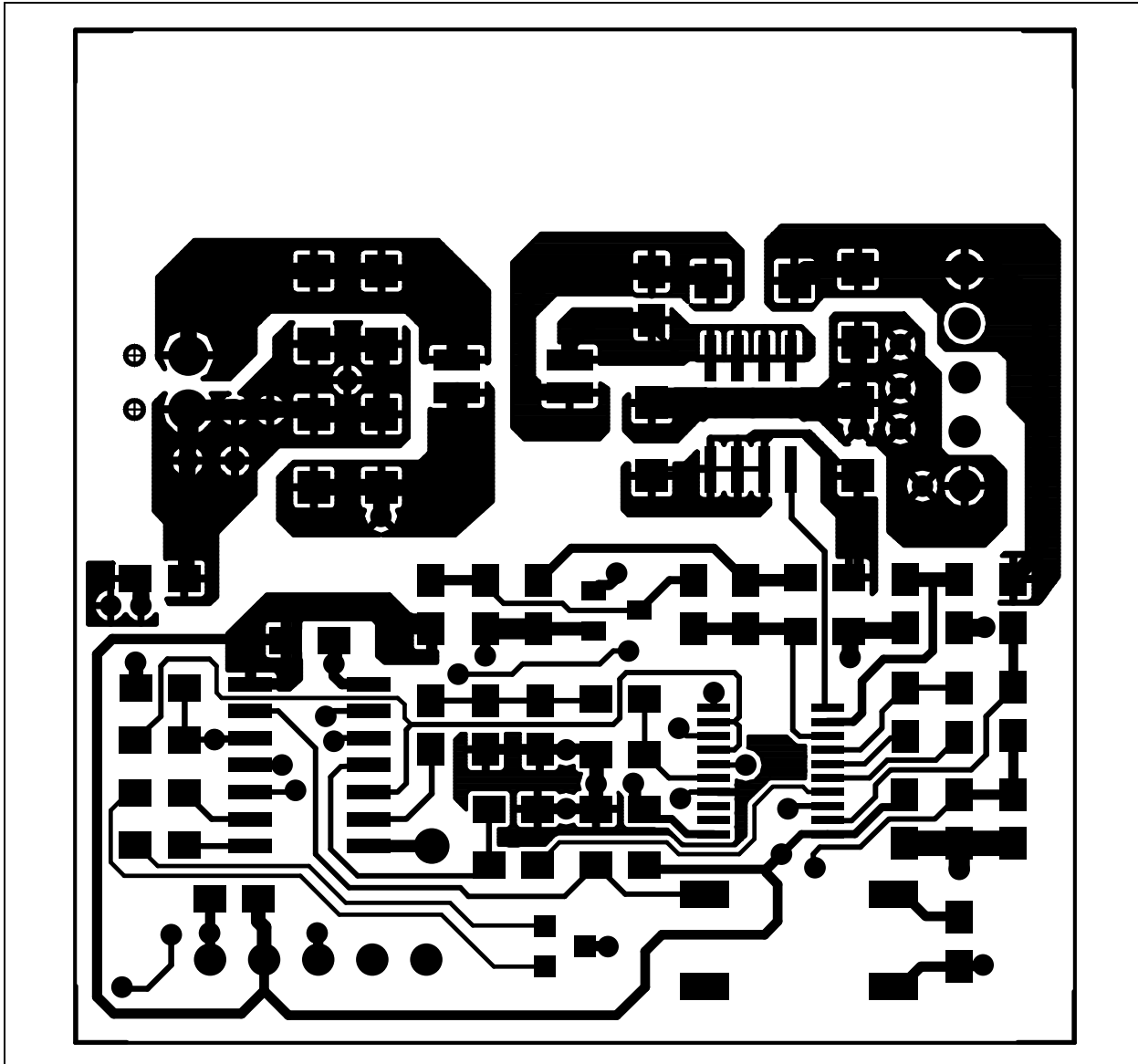
A.2 BOARD – SCHEMATIC



## A.3 BOARD – TOP SOLDER PADS AND SILK-SCREEN LAYERS

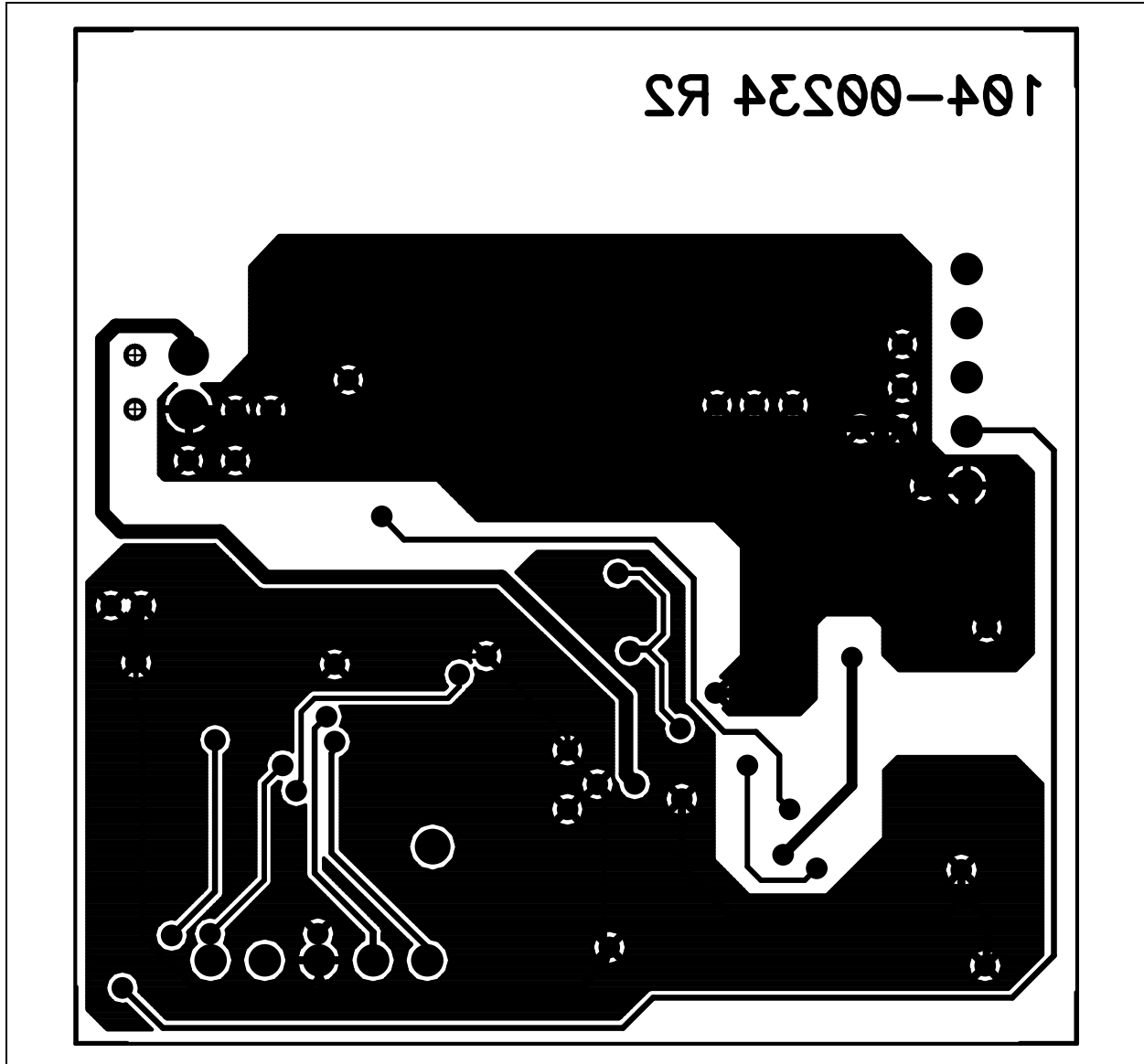


A.4 BOARD – TOP COPPER LAYER





## A.5 BOARD – BOTTOM COPPER LAYER



**NOTES:**



# MCP1631HV DIGITALLY CONTROLLED PROGRAMMABLE CURRENT SOURCE REFERENCE DESIGN

## Appendix B. Bill Of Materials (BOM)

**TABLE B-1: BILL OF MATERIALS**

Qty	Reference	Description	Manufacturer	Part Number
3	C1, C2, C4	CAP CERAMIC 10UF 25V X5R 1206	Panasonic® - ECG	ECJ-3YB1E106M
1	C10, C12	CAP 1500PF 50V CERM CHIP 0805	Panasonic - ECG	ECJ-2VB1H152K
1	C3	CAP CER 2.2UF 25V X7R 0805	Murata Electronics® North America	GRM21BR71E225KA73L
1	C5	CAP .1UF 16V CERAMIC X7R 0805	Panasonic - ECG	ECJ-2VB1C104K
8	C6, C8, C9, C13, C14, C15, C16, C17	CAP CER 1.0UF 25V X7R 0805	Taiyo Yuden	TMK212BJ105KG-TR
2	C7, C11	CAP 22PF 50V CERM CHIP 0805 SMD	Panasonic - ECG	ECJ-2VC1H220J
1	D1	DIODE SCHOTTKY 30V 3A SMA	ON Semiconductor	MBRA340T3G
2	D2	LED Dual RED/GREEN Clear SOT-23	Lumex® Opto/Components Inc.	SSL-LX15IGC-RP-TR
1	J2	CONN HEADER 5POS .100 VERT TIN FRICTION LOCK	Molex® Electronics	22-23-2051
1	J3	CONN HEADER 5POS .100 VERT TIN	Molex Electronics	22-03-2051
1	L1	SMD-Shielded Power Transformers (SEPIC) WE-DD	Würth Elektronik	744877100
1	PCB	RoHS Compliant Bare PCB, Digitally Controlled Programmable Current Source Reference Design	Microchip Technology Inc.	104-00234
1	Q1	MOSFET N-CH 30V 5.9A 8-SOIC	Vishay® / Siliconix	SI4346DY-T1-E3
1	Q2	MOSFET N-CH 60V 280MA SOT-23	Fairchild Semiconductor®	NDS7002A
2	R1, R19	RES 10.0K OHM 1/8W 1% 0805 SMD	Panasonic - ECG	ERJ-6ENF1002V
1	R12	RES 10.0 OHM 1/8W 1% 0805 SMD	Panasonic - ECG	ERJ-6ENF10R0V
2	R14, R20	RES 49.9K OHM 1/8W 1% 0805 SMD	Panasonic - ECG	ERJ-6ENF4992V
1	R15	RES 107K OHM 1/8W 1% 0805 SMD	Panasonic - ECG	ERJ-6ENF1073V
1	R16	RES 20.0K OHM 1/8W 1% 0805 SMD	Panasonic - ECG	ERJ-6ENF2002V
2	R17, R18	RES 40.2K OHM 1/8W 1% 0805 SMD	Panasonic - ECG	ERJ-6ENF4022V

**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.

## MCP1631HV Digitally Controlled Programmable Current Source Reference Design

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

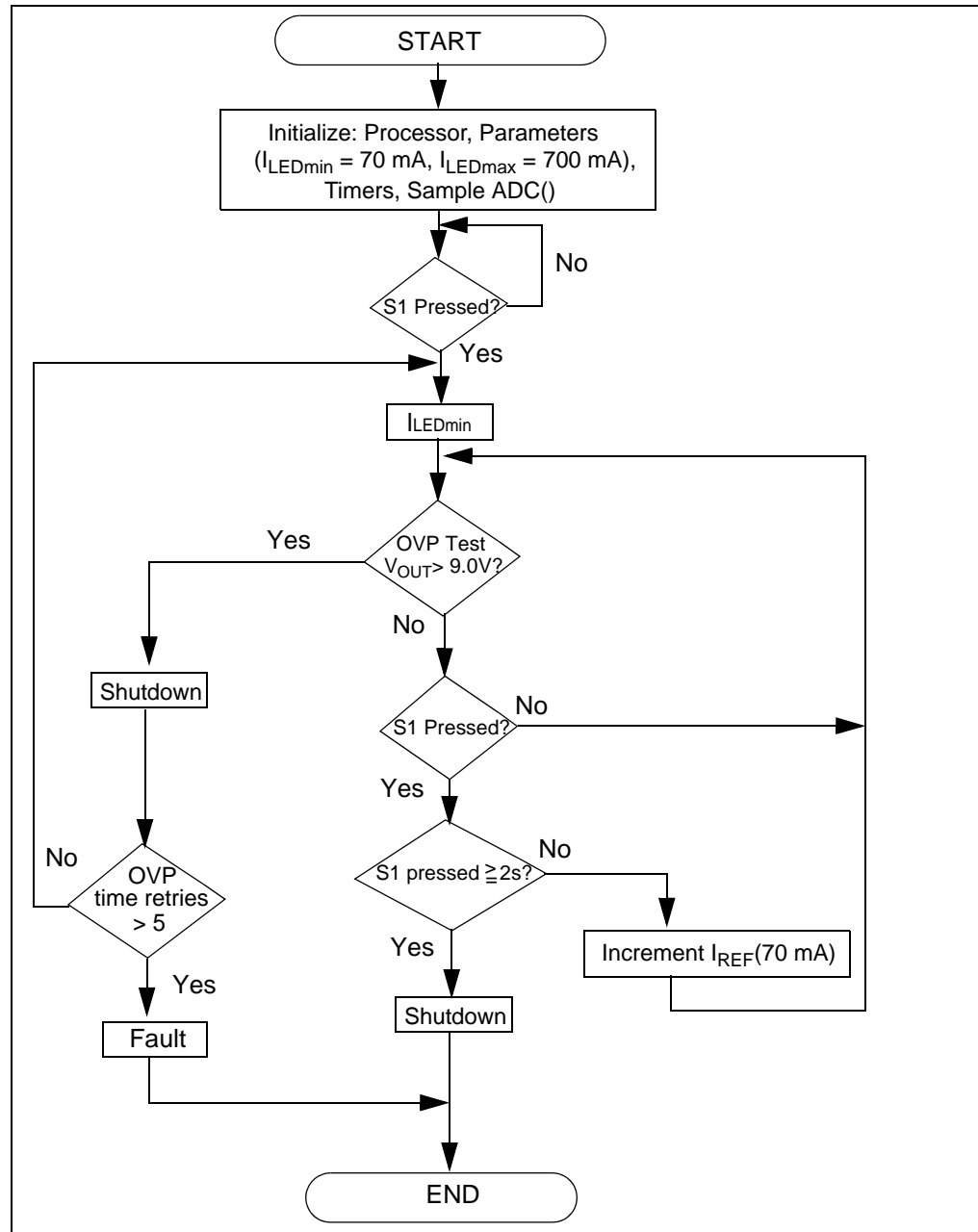
Qty	Reference	Description	Manufacturer	Part Number
1	R21	RES 3.92K OHM 1/8W 1% 0805 SMD	Panasonic - ECG	ERJ-6ENF3921V
1	R24	RES 0.0 OHM 1/8W 5% 0805 SMD	Panasonic - ECG	ERJ-6GEY0R00V
1	R4	RES 39.2K OHM 1/8W 1% 0805 SMD	Panasonic - ECG	ERJ-6ENF3922V
2	R6, R7	RES 1.00K OHM 1/8W 1% 0805 SMD	Panasonic - ECG	ERJ-6ENF1001V
1	U1	MCP1631HV 3.3V 20 Pin TSSOP High Speed PWM	Microchip Technology Inc.	MCP1631HV-330E/ST
1	U2	IC PIC MCU 14-Pin Flash-Based, 8-Bit CMOS MCU	Microchip Technology Inc.	PIC16F616-I/SL

**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.

**Appendix C. Demo Board Firmware**

**C.1 SUMMARY DEVICE FIRMWARE FLOWCHART - LED DRIVER**

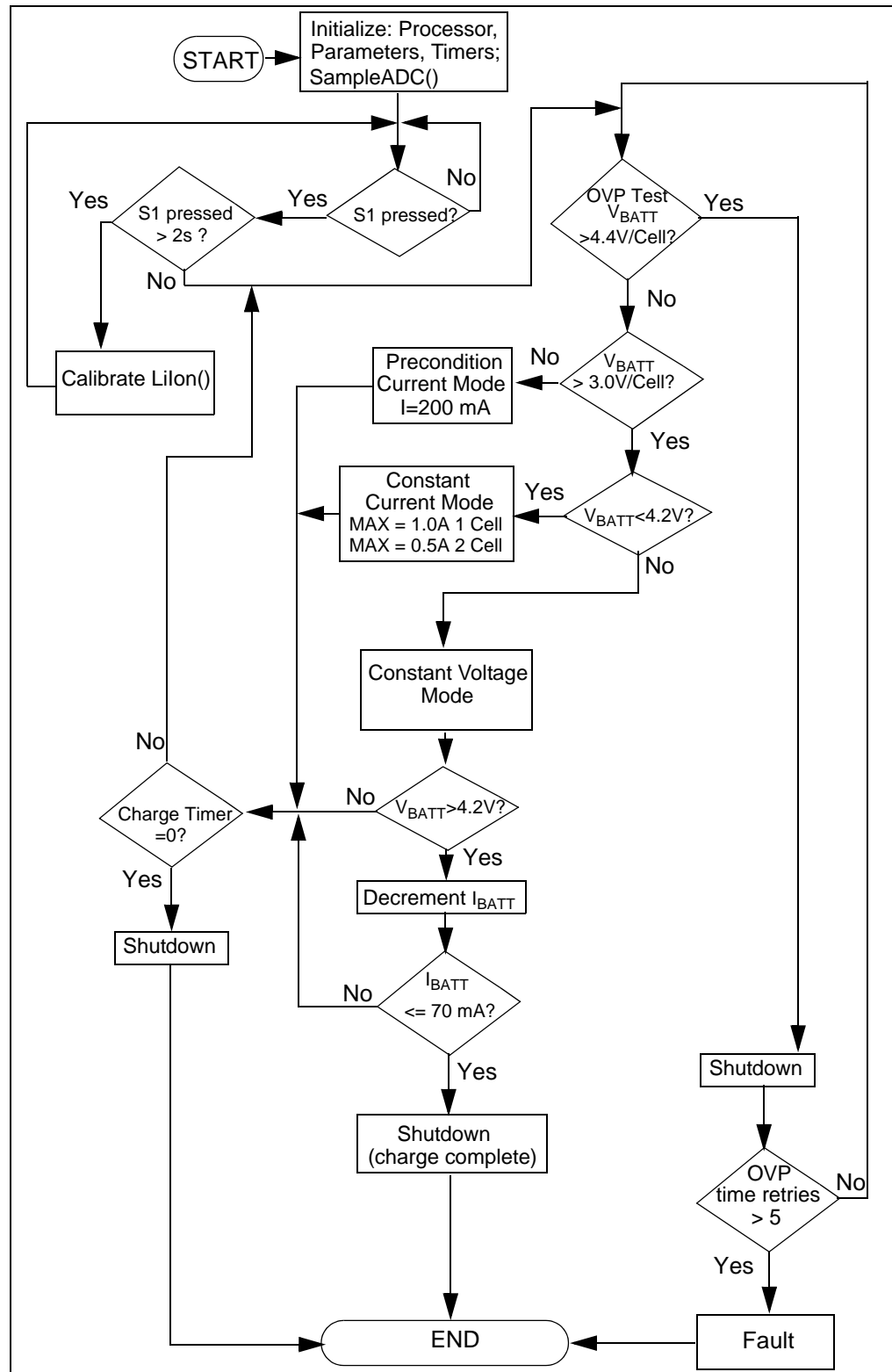
For the latest version of the MCP1631HV Digitally Controlled Programmable Current Source Reference Design LED Driver firmware, visit our web site at [www.microchip.com](http://www.microchip.com).



**FIGURE C-1:** Summary LED Driver Flowchart.

## C.2 SUMMARY DEVICE FIRMWARE FLOWCHART - LI-ION CHARGER

For the latest version of the MCP1631HV Digitally Controlled Programmable Current Source Reference Design Li-Ion Charger firmware, visit our web site at [www.microchip.com](http://www.microchip.com).



**FIGURE C-2:** Summary Li-Ion Charger Profile Flowchart.

## C.3 SUMMARY DEVICE FIRMWARE FLOWCHART - NIMH/NICD CHARGER

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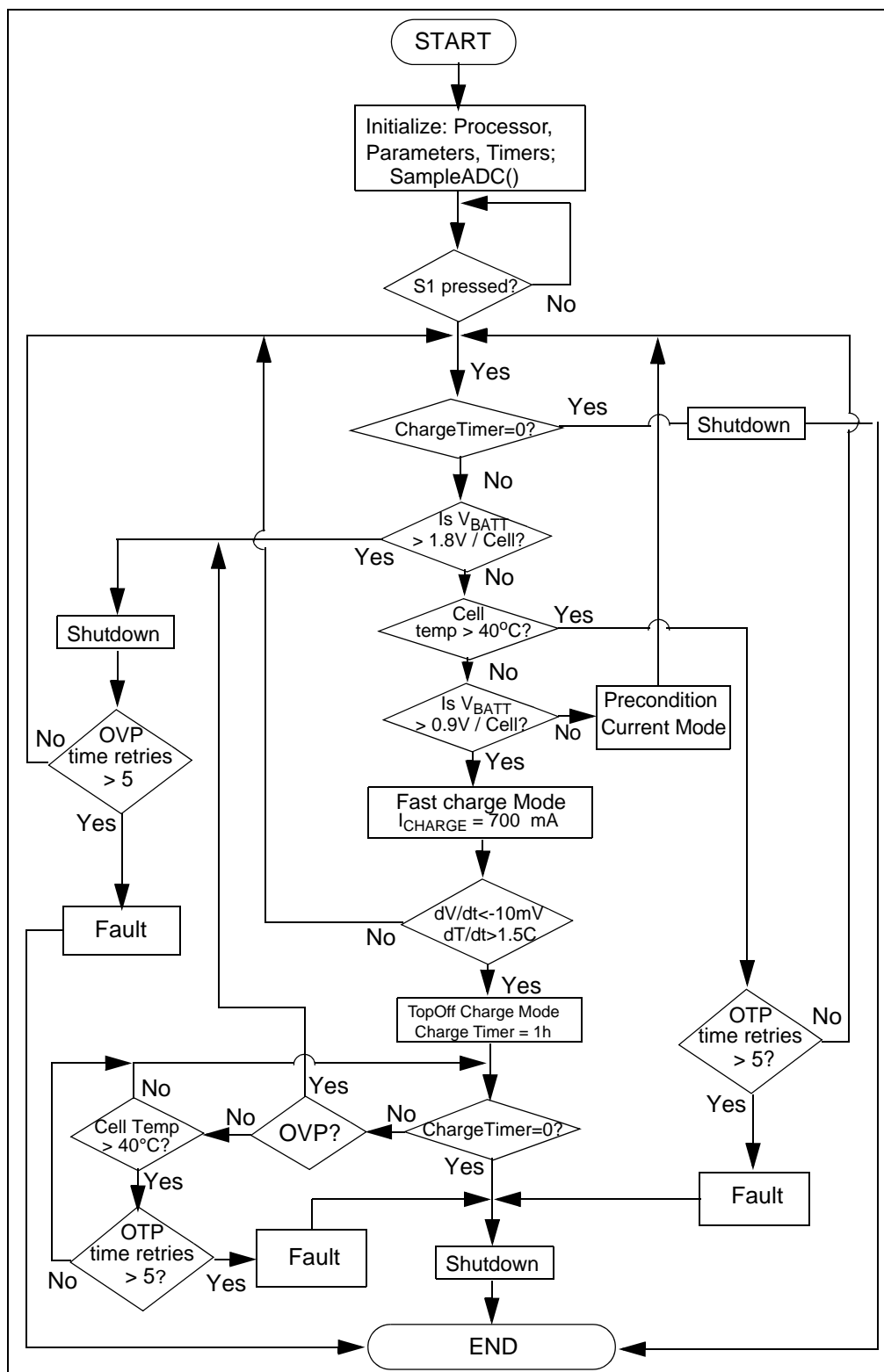


FIGURE C-3: Summary NiMH/NiCd Charger Profile Flowchart.



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