MCP1012
1W Demonstration Board
User's Guide

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MCP1012 1W DEMONSTRATION 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 website (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 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 MCP1012 1W Demonstration Board. Items discussed in this chapter include:

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

DOCUMENT LAYOUT

This document describes how to use the MCP1012 1W Demonstration Board as a development tool. The manual layout is as follows:

- **Chapter 1. "Product Overview"** – Important information about the MCP1012 1W Demonstration Board.
- **Chapter 2. "Installation and Operation"** – Includes instructions on how to get started with the MCP1012 1W Demonstration Board and a description of each function.
- **Chapter 3. "Setup One"** – Description of the functioning of the MCP1012 in Start-Up mode when it is supplied by the secondary side of the transformer and no load is applied at the output (neither of the R20, R21, R22, or R23 resistors is connected) (setup 1A) as well as a description of the functioning of the MCP1012 in Start-Up mode when it is supplied by the secondary side of the transformer and a load is applied at the output (the resistor R21 - 68Ω is connected through SW1.2) (setup 1B).
- **Chapter 4. "Setup Two"** – Description of the functioning of the MCP1012 in Start-Up mode when it is supplied by an external power supply (15V) at V_{DD} pin

and a load is applied at the output (the resistor R20 - 51Ω is connected through SW1.1).

- **Chapter 5. "Setup Three"** – Description of the Sleep/Wake-Up functions of the MCP1012 in Start-Up mode when it is supplied by an external power supply (15V) at V_{DD} pin and a load is applied at the output (the resistor R20 - 51Ω is connected through SW1.1).
- **Chapter 6. "Setup Four"** – A description of the functioning of the MCP1012 in Normal Run mode when an external command is applied at PULSE pin and the C/S pin voltage does not reach the COMP1 Reference (252 mV) (setup 4A) as well as a description of the functioning of the MCP1012 in Normal Run mode when an external command is applied at PULSE pin and the C/S pin voltage reaches the COMP1 Reference (252 mV) (setup 4B).
- **Chapter 7. "Setup Five"** – Description of the functioning of the MCP1012 in Start-Up mode when a short circuit is created on the secondary side of the transformer.
- **Appendix A. "Schematic and Layouts"** – Shows the schematic and layouts for the MCP1012 1W Demonstration Board.
- **Appendix B. "Bill of Materials (BOM)"** – Lists the parts used to build the MCP1012 1W Demonstration 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 MCP1012 1W Demonstration Board. Another useful document is listed below. The following Microchip document is available and recommended as a supplemental reference resource:

- **MCP1012 Data Sheet - "*Primary Side Start-Up IC for Isolated Converters*" (DS20006277**)

THE MICROCHIP WEBSITE

Microchip provides online support via our website at 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's guides and hardware support documents, latest software releases and archived software
- **General Technical Support** – Frequently Asked Questions (FAQs), technical support requests, online discussion groups, Microchip consultant program member listing
- **Business of Microchip** – Product selector and ordering guides, latest Microchip press releases, listing of seminars and events, listings of Microchip sales offices, distributors and factory representatives

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- 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.

DOCUMENT REVISION HISTORY

Revision A (February 2020)

- Initial release of this document.

Chapter 1. Product Overview

1.1 INTRODUCTION

This chapter provides an overview of the MCP1012 1W Demonstration Board and covers the following topics:

- MCP1012 Short Overview(1)
- MCP1012 1W Demonstration Board Description
- Contents of the MCP1012 1W Demonstration Board Kit

1.2 MCP1012 SHORT OVERVIEW(1)

1.2.1 Features

- High Voltage Start-Up (rated 500V/700V)
- Internal Open-Loop, Peak Current Mode, Current Regulator for Start-Up
- Current Regulator Constant 21.0 µs OFF Time
- Programmable Low Frequency Oscillator (LFO) Period
- Cycle-by-Cycle Current Limiting
- Protection against Continuous Conduction Mode (CCM) of Operation
- Able to Accept External PWM Commands from a Secondary-Side Controller via Isolator (Optocoupler or Pulse Transformer)
- Undervoltage Lockout (UVLO) and Overvoltage Lockout (OVLO) Protections
- Sleep and Wake-Up Commands
- Robust Gate Driver, able to drive 2.2 nF Load at 65 kHz
- Overtemperature Protection (Thermal Shutdown)
- Package: 7-Lead SOIC
- Environmentally Friendly, EU RoHS Compliant, Pb-Free

1.2.2 Description

The MCP1012 is used as a primary-side start-up IC for starting an off-line Switch Mode Power Converter, exemplified in this user's guide and the data sheet by a Flyback converter.

The primary functions of the MCP1012 are:

- Starting-Up the Flyback Converter using an Internal Open-Loop, Peak Current Mode, Current Regulator
- Accepting PWM commands via optocoupler or pulse transformer from a Secondary-Side Controller
- Providing undervoltage (UVLO) and overvoltage (OVLO) protection
- Peak cycle-by-cycle current limiting when either under control of its internal current regulator or under control of the Secondary-Side Controller
- Overtemperature protection

Note 1: More detailed information regarding the capabilities of the MCP1012 is available in the data sheet.

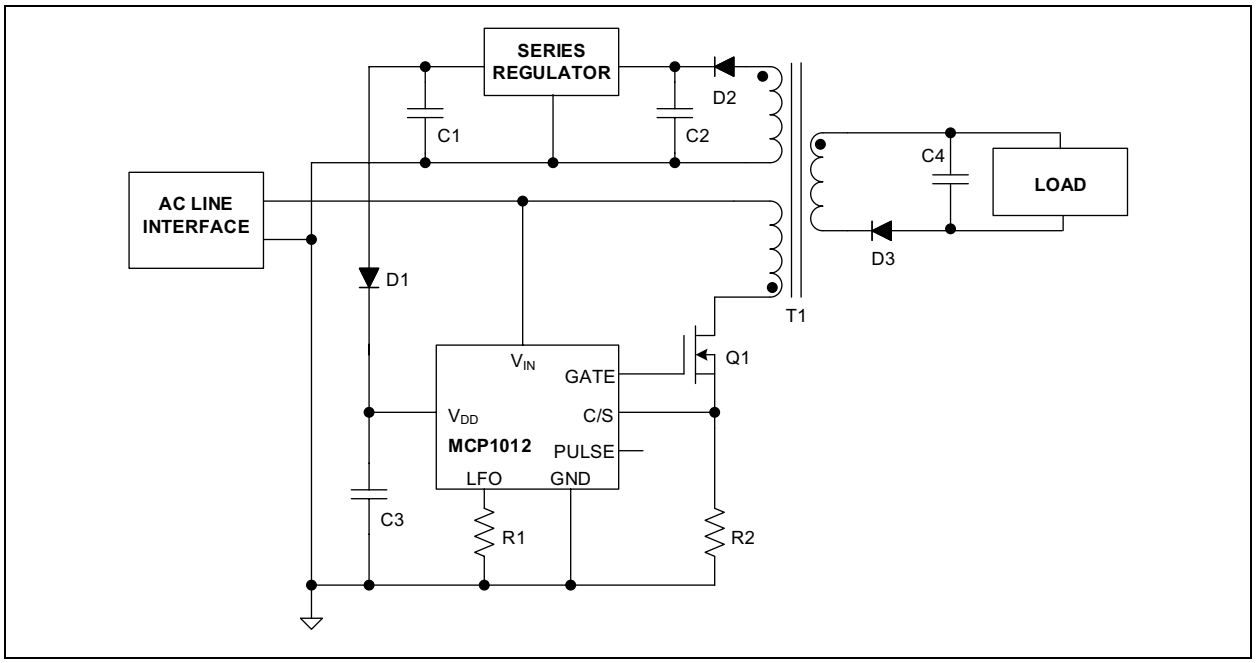


FIGURE 1-1: *MCP1012 Typical Application — in an Open Loop Flyback Topology.*

1.3 MCP1012 1W DEMONSTRATION BOARD DESCRIPTION

The MCP1012 1W Demonstration Board is used to evaluate and demonstrate Microchip Technology's MCP1012 product. This board demonstrates the capabilities of the MCP1012 in a Flyback converter application supplied from an external voltage source (120V–500V), with regulated output.

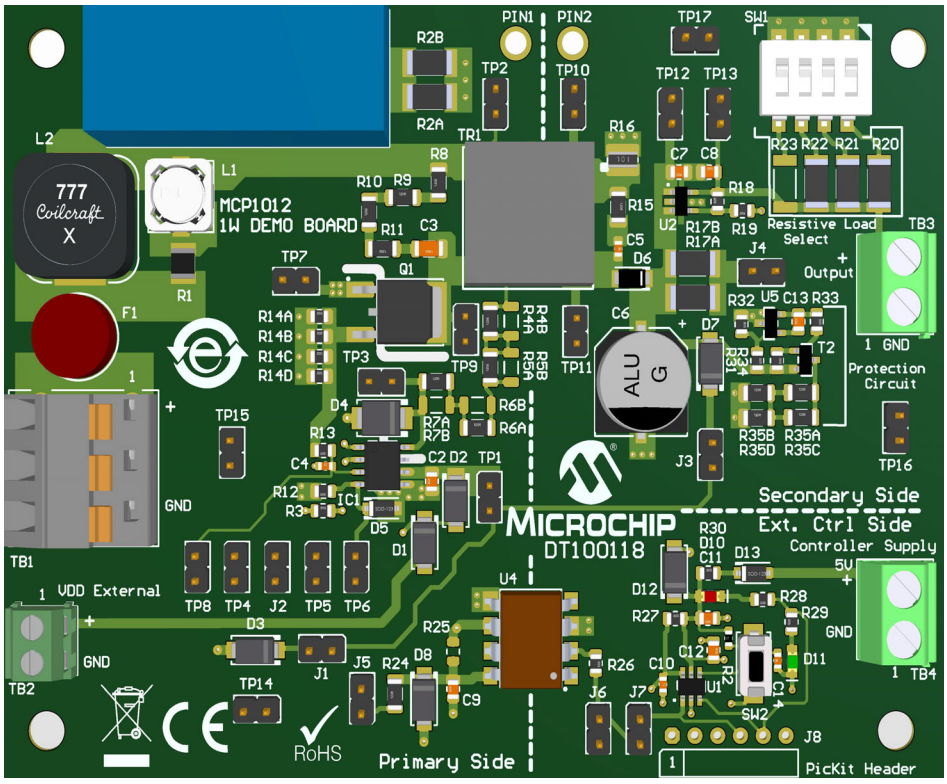


FIGURE 1-2: *MCP1012 1W Demonstration Board Top View.*

1.4 CONTENTS OF THE MCP1012 1W DEMONSTRATION BOARD KIT

The MCP1012 1W Demonstration Board kit includes:

- MCP1012 1W Demonstration Board (DT100118)
- Isolated Jumper JP1 (Mechanical hardware jumper 6.35 mm 1x2 D3087-98)
- Important Information Sheet

NOTES:

Chapter 2. Installation and Operation

2.1 GETTING STARTED

In order to use and evaluate the capabilities of the MCP1012, several hardware tools are required and several guidelines will be followed.

2.1.1 Required Hardware Tools

- MCP1012 1W Demonstration Board (DT100118)
- 120–500 VDC, min. 0.5A DC HV power supply
- 15.0 VDC, min. 0.5A DC power supply
- 5.0 VDC, min. 100 mA DC power supply (only for Sleep/Wake-Up functions testing)
- DC Voltmeter
- Jumpers (2.54 mm)
- Oscilloscope (optional)
- Signal Generator (optional)

2.1.2 Recommendations before Starting the Setup Process

• Place the MCP1012 1W Demonstration Board on a non-conductive surface when connected to the DC power supplies.

• Do not come into contact with the demonstration board while it is connected to the DC HV power supply.

• Disconnect the demonstration board from the DC power supplies before performing any work on the MCP1012 1W Demonstration Board.

• Connect instruments that have earth-referenced inputs (such as most oscilloscopes) only if the galvanic separation is present against the AC mains, or use a 1:1 transformer for supplying the demonstration board.

Failure to adhere to these guidelines may result in damage to the demo unit, the tests instruments, and/or can put in danger the person conducting the tests.

2.2 SETUP PROCEDURE

The functionality of the MCP1012 1W Demonstration Board can be evaluated through seven different setups, which are described in the following chapters.

NOTES:

Chapter 3. Setup One

3.1 SETUP 1A

INTRODUCTION

This setup will show the functioning of the MCP1012 in Start-Up mode when it is supplied by the secondary side of the transformer and no load is applied at the output (neither of the R20, R21, R22, or R23 resistors is connected).

STEPS

1. Connect/disconnect the jumpers and the switch SW1 according to Table 3-1.

TABLE 3-1: STATE OF THE JUMPERS AND SWITCH - SETUP 1A

J1	J2	J3	J4	J5	J6	J7	JP1	SW1.1	SW1.2	SW1.3	SW1.4
ON	OFF	ON*	OFF	OFF	OFF	OFF	ON[1]	OFF	OFF	OFF	OFF

Note 1: JP1 and J3 connections eliminate the galvanic isolation between the Primary Side and the Secondary Side of the transformer. Specific safety procedures must be taken into account. The MCP1012 is supplied from the secondary side of the transformer. On the board JP1 is connected to PIN1 and PIN2.

2. Connect the voltmeter at the TB3 connector with the positive test probe at the upper terminal.
3. If available, connect two oscilloscope probes at TP1 (V_{DD} Input) and TP6 (GATE output). Connect the ground probes on the primary side, at the TP14 or TP15 Test Points.
4. Connect the DC HV power supply in the range of 120–500 VDC at TB1:

   - the positive terminal must be connected at the uppermost terminal of the TB1 PCB connector

   - the negative terminal must be connected to the bottommost terminal of the TB1 PCB connector (the middle terminal of the TB1 PCB connector is not connected)
5. Read the voltmeter and check if the output voltage of the board is in the range of 4.5V to 5.5V.
6. Check on the oscilloscope screen the V_{DD} voltage and the GATE signal as they are presented in Figure 3-1.

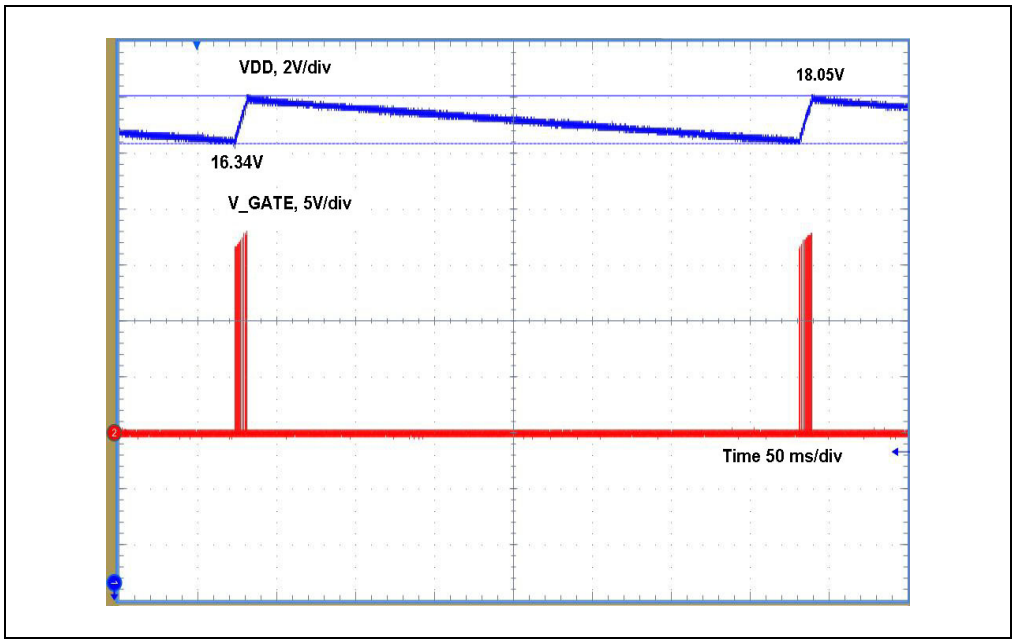


FIGURE 3-1: *MCP1012 V_GATE and V_{DD} Hysteretic Voltage Supply at No Load.*

Note that the MCP1012 is hysteretic supplied, between the $OVLO_{ON}$ and $OVLO_{OFF}$ thresholds.

7. Disconnect the DC HV power supply.

3.2 SETUP 1B

INTRODUCTION

This setup will show the functioning of the MCP1012 in Start-Up mode when it is supplied by the secondary side of the transformer and a load is applied at the output (the resistor R21 - 68Ω is connected through SW1.2)

STEPS

1. Connect/disconnect the jumpers and the switch SW1 according to Table 3-2.

TABLE 3-2: THE STATE OF THE JUMPERS AND SWITCH - SETUP 1B

J1	J2	J3	J4	J5	J6	J7	JP1	SW1.1	SW1.2	SW1.3	SW1.4
ON	OFF	ON[1]	OFF	OFF	OFF	OFF	ON[1]	OFF	ON[2]	OFF	OFF

Note 1: JP1 and J3 connections eliminate the galvanic isolation between the Primary Side and the Secondary Side of the transformer. Specific safety procedures must be taken into account. The MCP1012 is supplied from the secondary side of the transformer. On the board JP1 is connected to PIN1 and PIN2.

2: SW1.2 is the second switch on the right side of the board.

2. Connect the voltmeter at the TB3 connector with the positive test probe at the upper terminal.
3. If available, connect two oscilloscope probes at TP1 (V_{DD} Input) and TP6 (GATE output). Connect the ground probes on the primary side, at the TP14 or TP15 Test Points.

4. Connect the DC HV power supply in the range of 120–500 VDC at TB1:

   - the positive terminal must be connected at the uppermost terminal of the TB1 PCB connector

   - the negative terminal must be connected to the bottommost terminal of the TB1 PCB connector (the middle terminal of the TB1 PCB connector is not connected)

5. Read the voltmeter and check if the output voltage of the board is in the range of 4.5V to 5.5V.
6. Check on the oscilloscope screen the V_{DD} voltage and the GATE signal as they are presented in Figure 3-2.

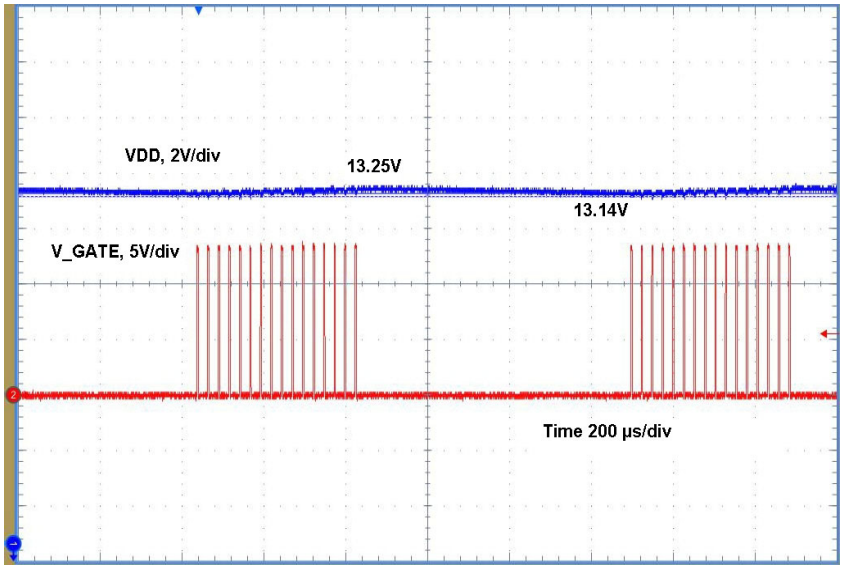


FIGURE 3-2: *MCP1012 V_GATE and V_{DD} when a Load Is Connected.*

7. Disconnect the DC HV power supply.

NOTES:

Chapter 4. Setup Two

4.1 SETUP 2

INTRODUCTION

This setup will show the functioning of the MCP1012 in Start-Up mode when it is supplied by an external power supply (15V) at V_{DD} pin and a load is applied at the output (the resistor R20 - 51Ω is connected through SW1.1).

A voltage greater than 11.5V on V_{DD} pin disables the internal HV regulator.

STEPS

1. Connect/disconnect the jumpers and the switch SW1 according to Table 4-1.

TABLE 4-1: THE STATE OF THE JUMPERS AND SWITCH - SETUP 2

J1	J2	J3	J4	J5	J6	J7	JP1	SW1.1	SW1.2	SW1.3	SW1.4
ON	OFF	OFF	OFF	OFF	OFF	OFF	OFF	ON[1]	OFF	OFF	OFF

Note 1: SW1.1 is the first switch on the right side of the board.

2. Connect the voltmeter at the TB3 connector with the positive test probe at the upper terminal.
3. If available, connect two oscilloscope probes at TP6 (GATE output) and TP8 (C/S input). Connect the ground probes on the primary side, at the TP14 or TP15 Test Points.
4. Connect the DC power supply 15V at the TB2 connector:

   - the positive terminal must be connected at the upper terminal of the TB2 PCB connector

   - the negative terminal must be connected to the bottom terminal of the TB2 PCB connector
5. Connect the DC HV power supply in the range of 120–500 VDC at the TB1 connector:

   - the positive terminal must be connected at the uppermost terminal of the TB1 PCB connector

   - the negative terminal must be connected to the bottommost terminal of the TB1 PCB connector (the middle terminal of the TB1 PCB connector is not connected)
6. Read the voltmeter and check if the output voltage of the board is in the range of 4.5V to 5.5V.

7. Check on the oscilloscope screen the V_GATE voltage and the C/S signal, as they are presented in Figure 4-1.

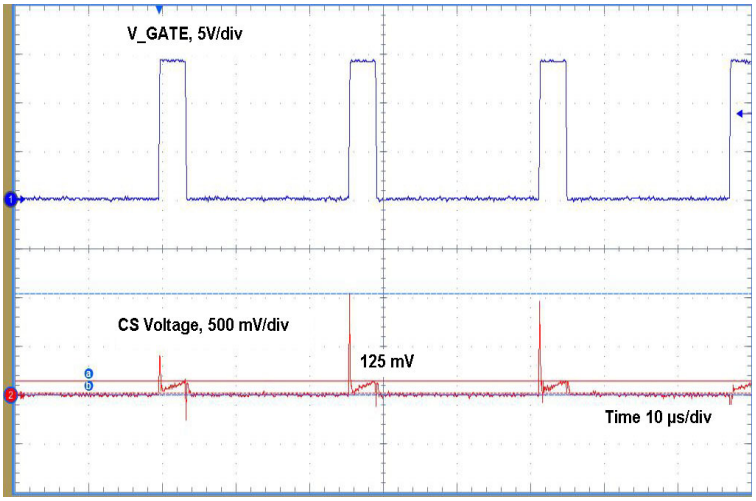


FIGURE 4-1: *MCP1012 V_GATE and C/S Voltage.*

During the Leading Edge Blanking (LEB) period the spikes on C/S pin are ignored. After LEB, once the C/S voltage reaches the threshold of 125 mV, the GATE signal is inhibited.

8. Check on the oscilloscope screen the V_GATE voltage, as it is presented in Figure 4-2. Set the oscilloscope accordingly.

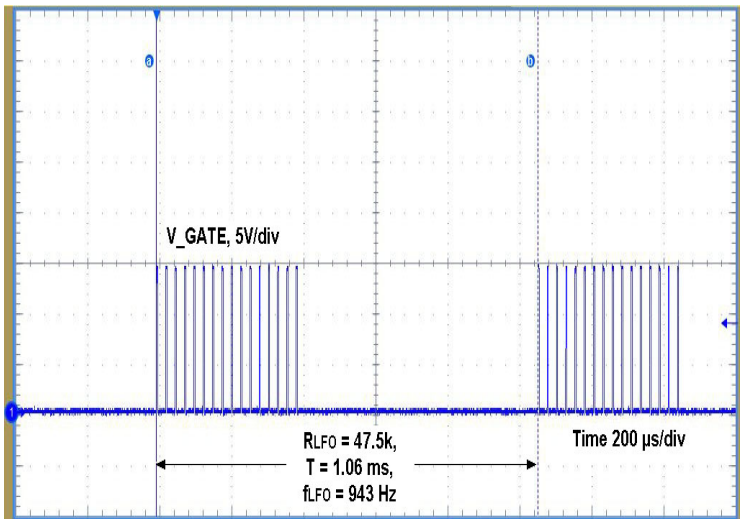


FIGURE 4-2: *MCP1012 V_GATE Voltage.*

The value of the resistor connected to LFO pin is 47.5 kΩ. This value conducts to an LFO period of 1.06 ms or a frequency of 943 Hz. On each LFO period, a number of 16 pulses can be seen.

9. Check on the oscilloscope screen the V_GATE voltage, as it is presented in the Figure 4-3. Set the oscilloscope accordingly.

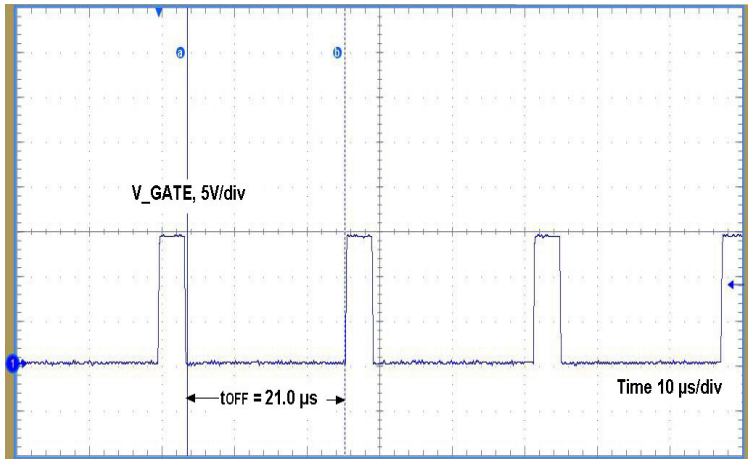


FIGURE 4-3: *MCP1012 V_GATE Voltage, t_{OFF} Interval.*

After V_GATE signal is inhibited, t_{OFF} has a constant interval of 21.0 µs.

10. Disconnect the DC power supplies.

NOTES:

Chapter 5. Setup Three

5.1 SETUP 3

INTRODUCTION

This setup will show the Sleep/Wake-Up functions of the MCP1012 in Start-Up mode when it is supplied by an external power supply (15V) at V_{DD} pin and a load is applied at the output (the resistor R20 - 51Ω is connected through SW1.1).

The Sleep/Wake-Up functions are active in both Start-Up and Normal Run mode.

STEPS

1. Connect/disconnect the jumpers and the switch SW1 according to Table 5-1.

TABLE 5-1: THE STATE OF THE JUMPERS AND SWITCH - SETUP 3

J1	J2	J3	J4	J5	J6	J7	JP1	SW1.1	SW1.2	SW1.3	SW1.4
ON	OFF	OFF	OFF	ON	OFF	ON	OFF	ON[1]	OFF	OFF	OFF

Note 1: SW1.1 is the first switch on the right side of the board.

2. Connect the voltmeter at the TB3 connector with the positive test probe at the upper terminal.
3. If available, connect two oscilloscope probes at TP6 (GATE output) and TP4 (PULSE input). Connect the ground probes on the primary side, at the TP14 or TP15 Test Points.
4. Connect the DC power supply 15V at the TB2 connector:

   - the positive terminal must be connected at the upper terminal of the TB2 PCB connector

   - the negative terminal must be connected to the bottom terminal of the TB2 PCB connector
5. Connect the DC power supply 5.0V at the TB4 connector:

   - the positive terminal must be connected at the upper terminal of the TB4 PCB connector

   - the negative terminal must be connected to the bottom terminal of the TB4 PCB connector
6. Connect a DC HV power supply in the range of 120–500 VDC at the TB1 connector:

   - the positive terminal must be connected at the uppermost terminal of the TB1 PCB connector

   - the negative terminal must be connected to the bottommost terminal of the TB1 PCB connector (the middle terminal of the TB1 PCB connector is not connected)
7. Read the voltmeter and check if the output voltage of the board is in the range of 4.5V to 5.5V.

8. Push the push button SW2 and check on the oscilloscope screen the V_GATE voltage and the PULSE signal, as they are presented in Figure 5-1 and Figure 5-2.

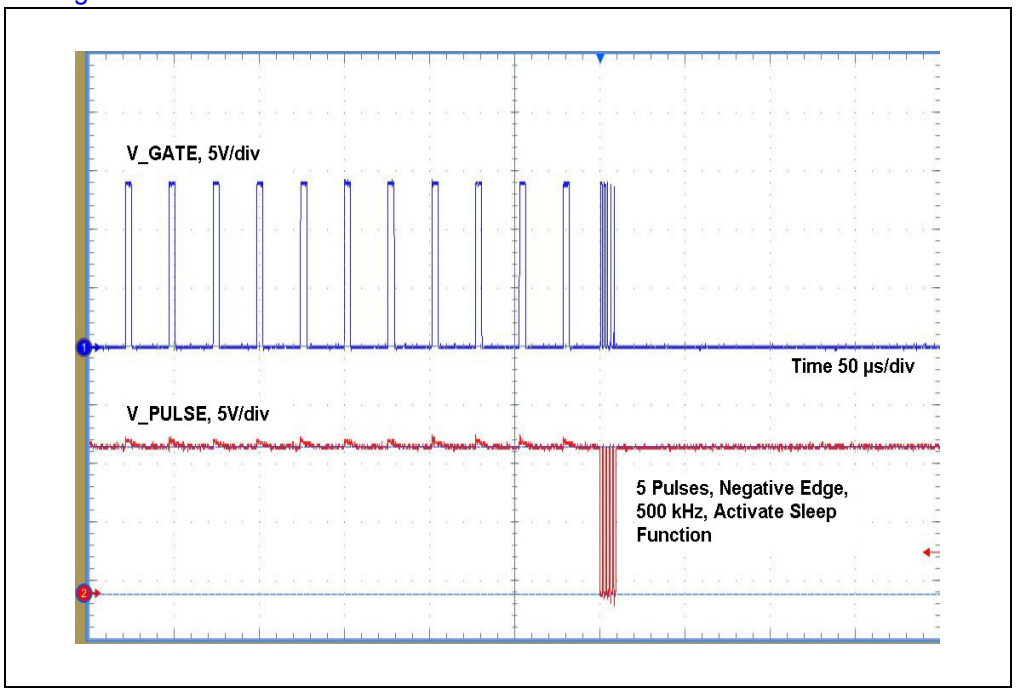


FIGURE 5-1: *MCP1012 Sleep Command.*

Five pulses applied on PULSE pin negative edge at 500 kHz activate the Sleep function of the MCP1012.

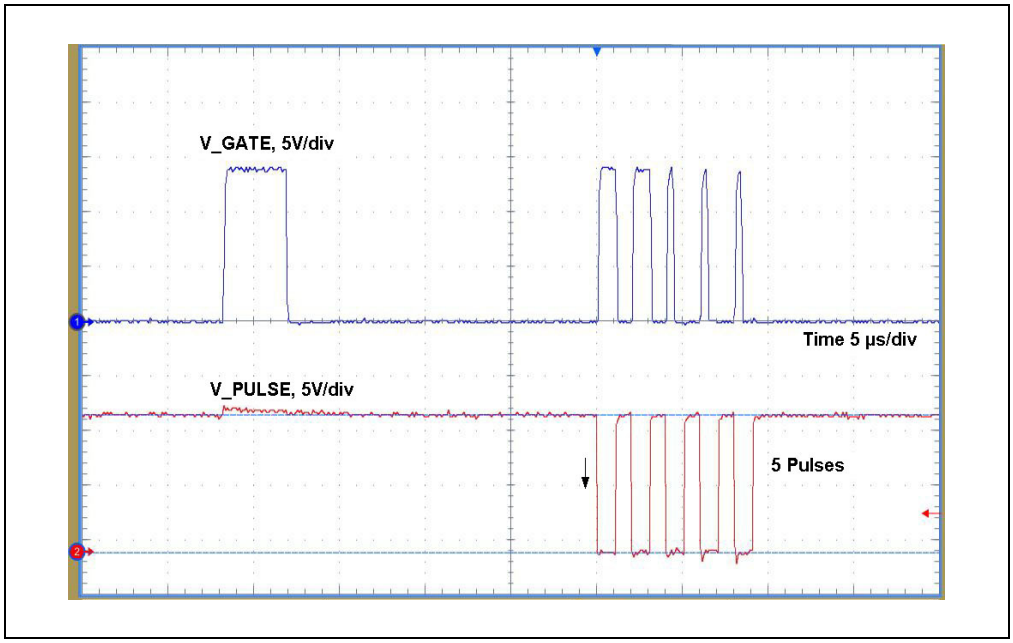


FIGURE 5-2: *MCP1012 Sleep Command (Figure 5-1 Detail).*

9. Read the voltmeter and check if the output voltage is 0V.

10. Push the push button SW2 again and check on the oscilloscope screen if the V_GATE voltage and the PULSE signal are as they are presented in Figure 5-3 and Figure 5-4.

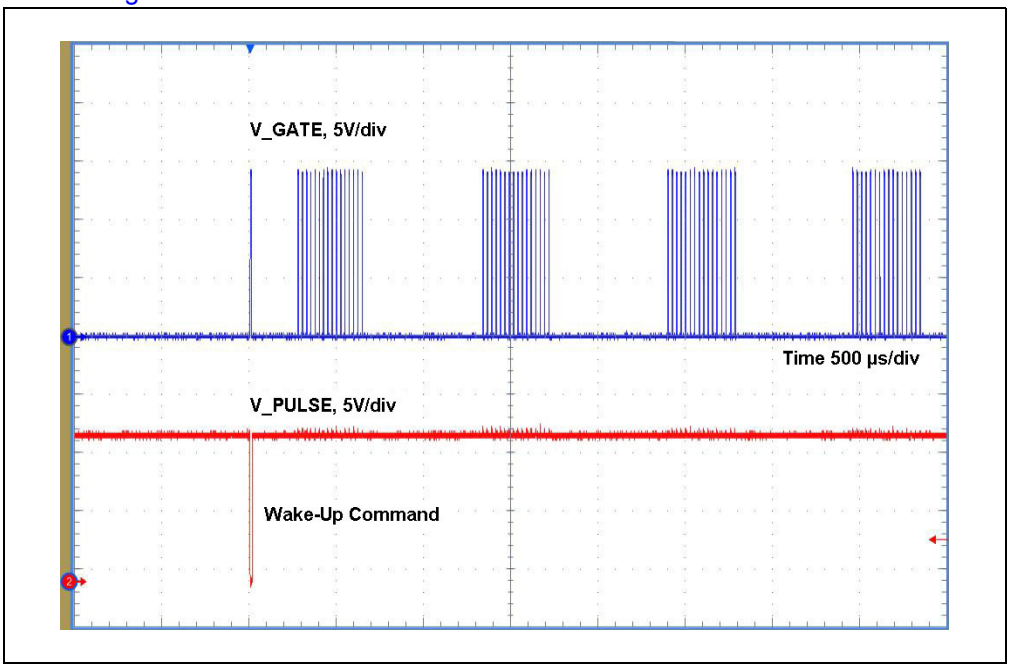


FIGURE 5-3: *MCP1012 Wake-Up Command.*

The Wake-Up command consists of a single valid PWM Pulse.

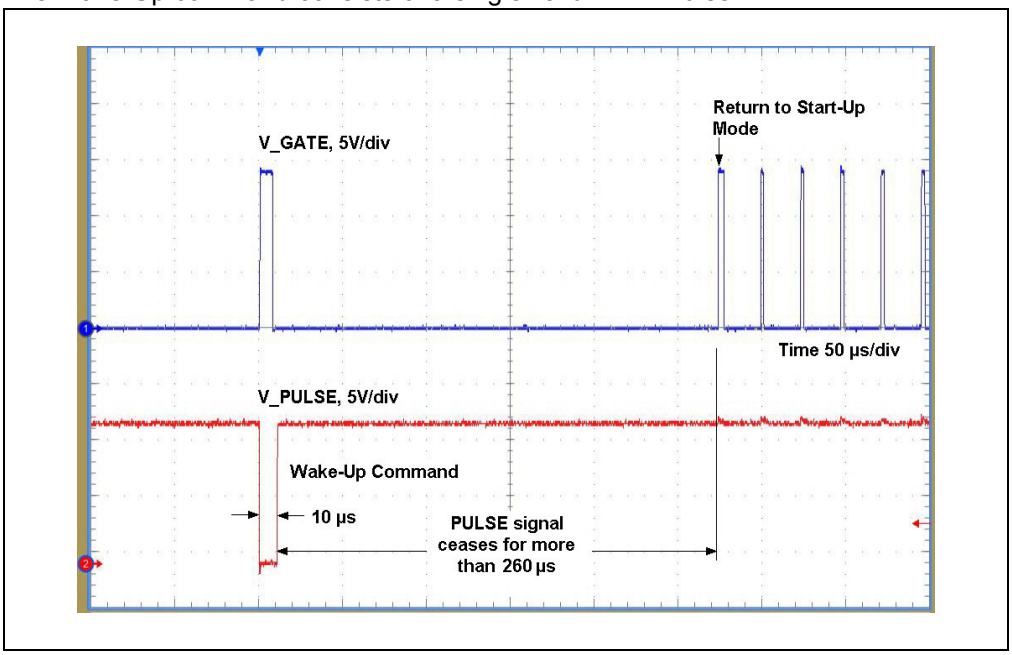


FIGURE 5-4: *MCP1012 Wake-Up Command (Figure 5-3 Detail).*

If the external PWM signal ceases for a period greater than 260 µs typical, then the gate driver will be driven by the internal current regulator (return to Start-Up mode).

11. Read the voltmeter and check if the output voltage of the board is in the range of 4.5V to 5.5V.
12. Disconnect the DC power supplies.

NOTES:

Chapter 6. Setup Four

6.1 SETUP 4A

INTRODUCTION

This setup will show the functioning of the MCP1012 in Normal Run mode when an external command is applied at PULSE pin and the C/S pin voltage does not reach the COMP1 Reference (252 mV).

When a valid PWM signal in the 20-65 kHz frequency range is detected on the PULSE pin and the internal HV regulator is turned off by applying a voltage greater than 11.5V typical on the V_{DD} pin, the MCP1012's gate driver is driven by the signal at the PULSE pin and not by the internal signal. The COMP1 Reference threshold during external command switches from 125 mV to 252 mV typical.

STEPS

1. Connect/disconnect the jumpers and the switch SW1 according to Table 6-1.

TABLE 6-1: THE STATE OF THE JUMPERS AND SWITCH - SETUP 4A

J1	J2	J3	J4	J5	J6	J7	JP1	SW1.1	SW1.2	SW1.3	SW1.4
ON	OFF	OFF	OFF	ON	OFF	OFF	OFF	OFF	OFF	OFF	OFF

2. Connect at the jumper J4 an external load consisting of a 10Ω, min. 3W resistor.
3. Connect at the jumper J6 the output of the signal generator with the next setup: square waveform, minimum voltage 0V, maximum voltage +5.0V, frequency 20 kHz, duty cycle 75%.
4. Connect three oscilloscope probes at TP4 (PULSE input), TP6 (GATE output), and TP8 (C/S input). Connect the ground probes on the primary side, at the TP14 or TP15 Test Points.
5. Connect a DC power supply 15V at the TB2 connector:

   - the positive terminal must be connected at the upper terminal of the TB2 PCB connector

   - the negative terminal must be connected to the bottom terminal of the TB2 PCB connector
6. Connect a 120 VDC DC HV power supply at TB1:

   - the positive terminal must be connected at the uppermost terminal of the TB1 PCB connector

   - the negative terminal must be connected to the bottommost terminal of the TB1 PCB connector (the middle terminal of the TB1 PCB connector is not connected)
7. Activate the output of the signal generator

8. Check on the oscilloscope screen the signals V_PULSE, V_GATE and V_C/S as they are presented in Figure 6-1

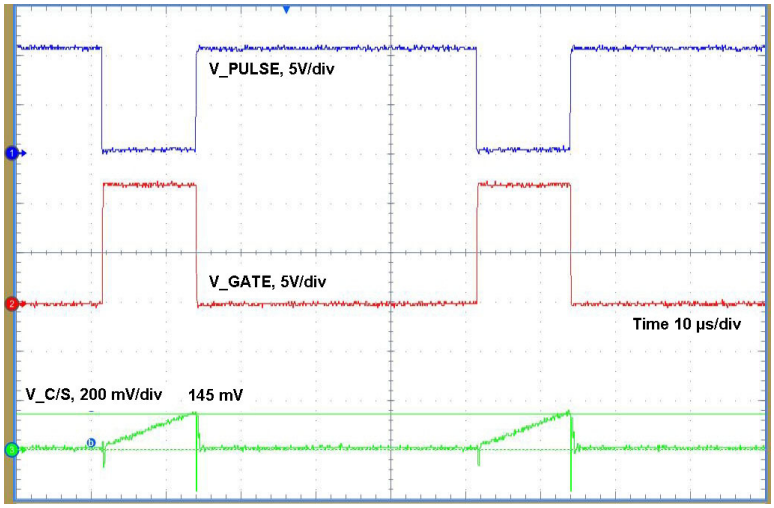


FIGURE 6-1: *V_PULSE, V_GATE and V_CS when COMP1 Reference Is Not Reached.*

When a valid PWM signal in the 20–65 kHz frequency range is applied the MCP1012's gate driver is driven by the signal at the PULSE pin and not by the internal signal. The COMP1 Reference threshold during external command switches from 125 mV to 252 mV typical.

9. Disconnect the DC power supplies.
10. Disconnect the load at J4.

6.2 SETUP 4B

INTRODUCTION

This setup will show the functioning of the MCP1012 in Normal Run mode when an external command is applied at PULSE pin and the C/S pin voltage reaches the COMP1 Reference (252 mV).

STEPS

1. Connect/disconnect the jumpers and the switch SW1 according to Table 6-2.

TABLE 6-2: THE STATE OF THE JUMPERS AND SWITCH - SETUP 4B

J1	J2	J3	J4	J5	J6	J7	JP1	SW1.1	SW1.2	SW1.3	SW1.4
ON	OFF	OFF	OFF	ON	OFF	OFF	OFF	OFF	OFF	OFF	OFF

2. Connect at the jumper J4 an external load consisting of a 10Ω, min 3W resistor.
3. Connect at the jumper J6 the output of the signal generator with the next setup: square waveform, minimum voltage 0V, maximum voltage +5.0V, frequency 20 kHz, duty cycle 30%.
4. Connect three oscilloscope probes at TP4 (PULSE input), TP6 (GATE output), and TP8 (C/S input). Connect the ground probes on the primary side, at the TP14 or TP15 Test Points.
5. Connect a DC power supply 15V at the TB2 connector:

- the positive terminal must be connected at the upper terminal of the TB2 PCB connector

- the negative terminal must be connected to the bottom terminal of the TB2 PCB connector

6. Connect a 120 VDC DC HV power supply at TB1:

   - the positive terminal must be connected at the uppermost terminal of the TB1 PCB connector

   - the negative terminal must be connected to the bottommost terminal of the TB1 PCB connector (the middle terminal of the TB1 PCB connector is not connected)

7. Activate the output of the signal generator.
8. Check on the oscilloscope screen the signals V_PULSE, V_GATE, and V_C/S as they are presented in Figure 6-2.

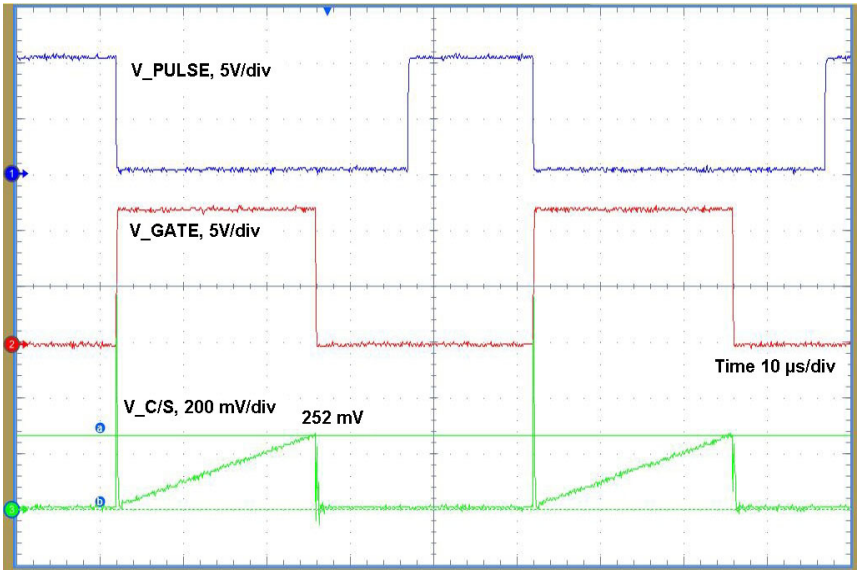


FIGURE 6-2: *V_PULSE, V_GATE, and V_CS when the COMP1 Reference Is Reached.*

When the voltage on the C/S pin reaches the COMP1 reference (typ. 252 mV), the Gate command is turned off even if the PULSE logic state is Low.

9. Disconnect the DC power supplies.

NOTES:

Chapter 7. Setup Five

7.1 SETUP 5

INTRODUCTION

This setup will show the functioning of the MCP1012 in Start-Up mode when a short circuit is created on the secondary side of the transformer.

STEPS

1. Connect/disconnect the jumpers and the switch SW1 according to Table 7-1.

TABLE 7-1: THE STATE OF THE JUMPERS AND SWITCH - SETUP 5

J1	J2	J3	J4	J5	J6	J7	JP1	SW1.1	SW1.2	SW1.3	SW1.4
ON	OFF	OFF	ON	OFF	OFF	OFF	ON[1]	ON[2]	OFF	OFF	OFF

Note 1: JP1 connection eliminates the galvanic isolation between the Primary Side and the Secondary Side of the transformer. Specific safety procedures must be taken into account.

2: SW1.1 is the first switch on the right side of the board.

2. Connect a voltmeter at the TB3 connector with the positive test probe at the upper terminal.
3. If available, connect two oscilloscope probes at TP6 (GATE output) and TP12. Connect the ground probes on the primary side, at the TP14 or TP15 Test Points.
4. Connect a DC power supply 15V at the TB2 connector:

   - the positive terminal must be connected at the upper terminal of the TB2 PCB connector

   - the negative terminal must be connected to the bottom terminal of the TB2 PCB connector
5. Connect a DC HV power supply in the range of 120–500 VDC at the TB1 connector:

   - the positive terminal must be connected at the uppermost terminal of the TB1 PCB connector

   - the negative terminal must be connected to the bottommost terminal of the TB1 PCB connector (the middle terminal of the TB1 PCB connector is not connected)
6. Read the voltmeter and check if the output voltage of the board is 0V.

7. Check on the oscilloscope screen the V_GATE voltage during the short circuit condition as it is presented in Figure 7-1.

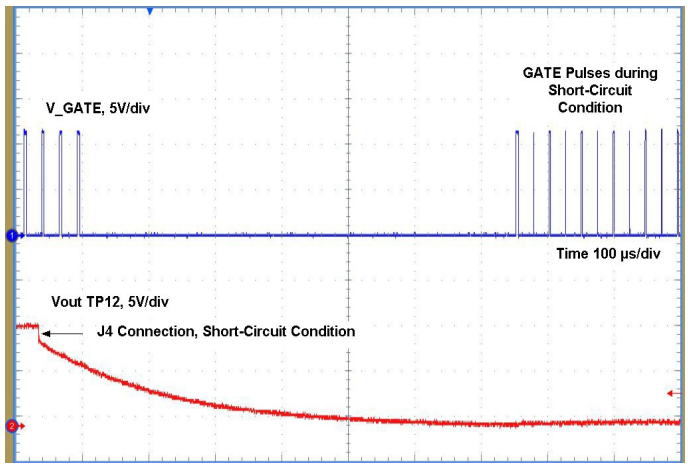


FIGURE 7-1: *MCP1012 V_GATE Voltage during a Short Circuit Condition.*

8. Disconnect the DC power supplies.
9. Disconnect the jumper J4.
10. Reconnect the DC power supplies.

Check the functionality of the MCP1012 by running the setups described in this user's guide.

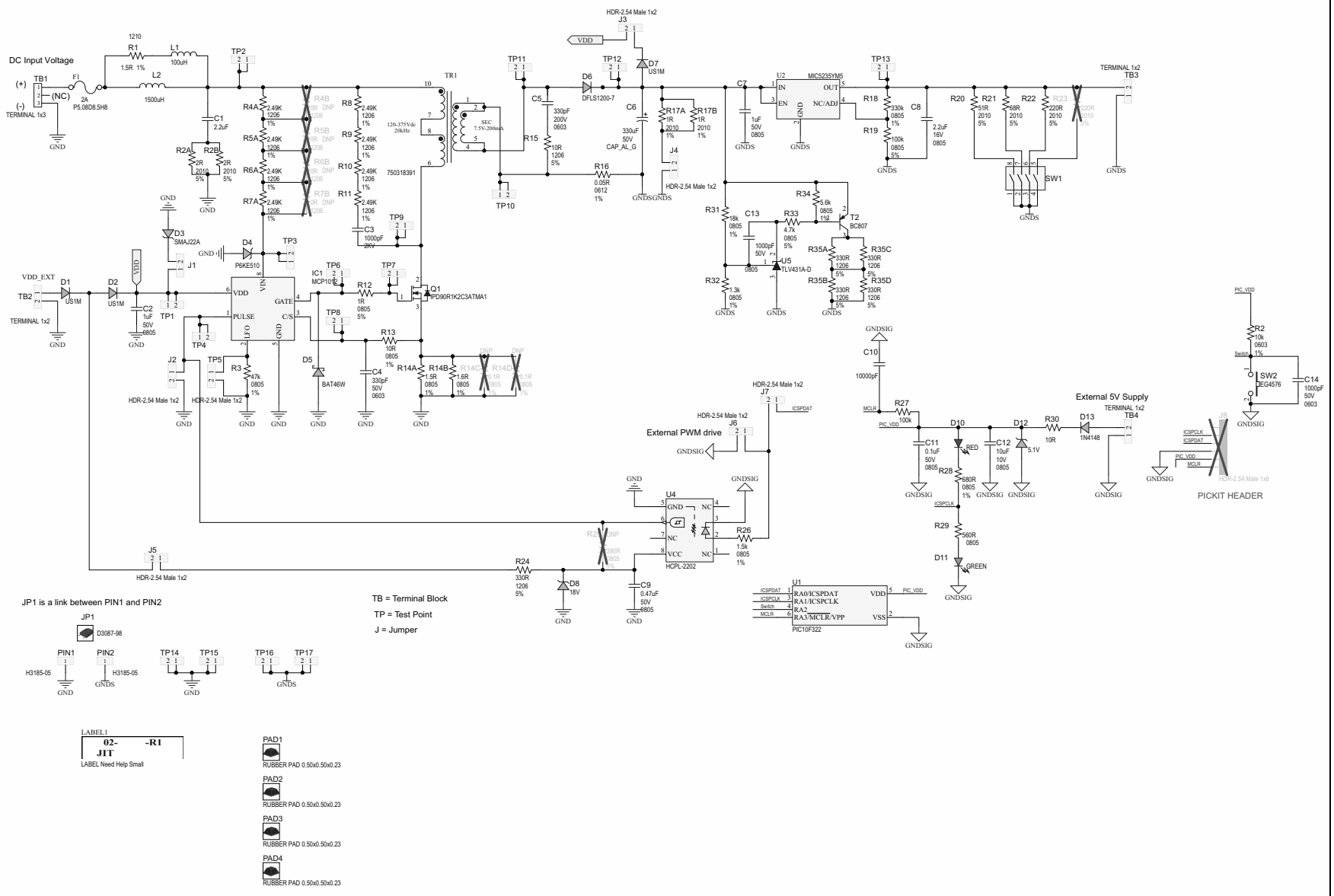
Appendix A. Schematic and Layouts

A.1 INTRODUCTION

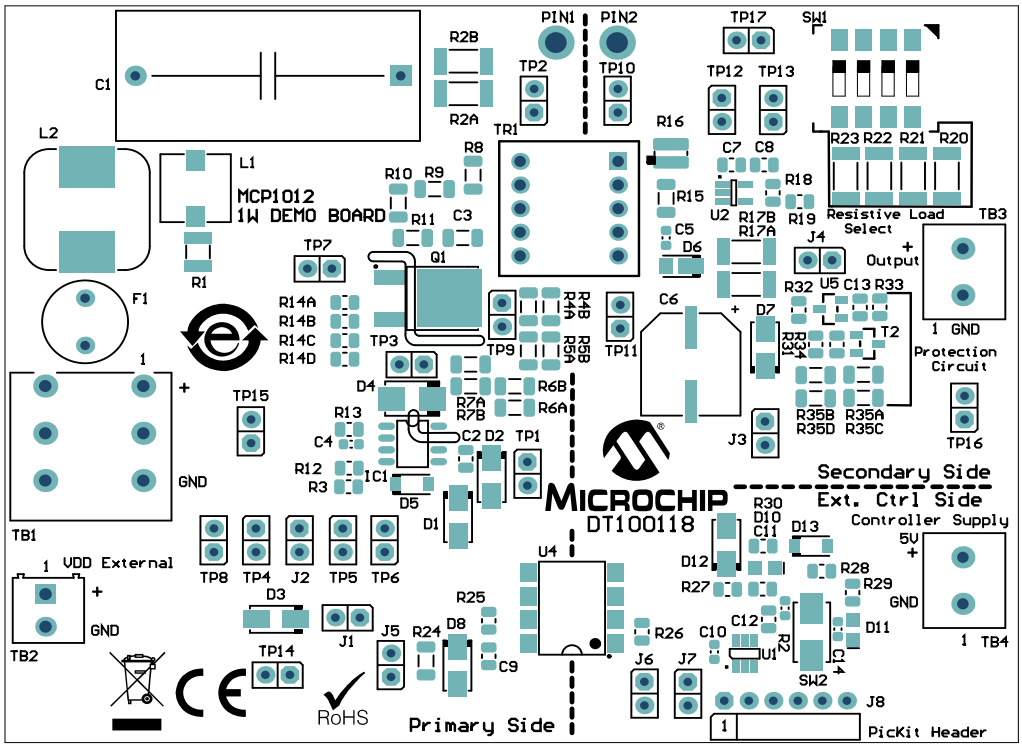
This appendix contains the following schematic and layouts for the MCP1012 1W Demonstration Board:

- Board – Schematic
- Board – Top Silk
- Board – Top Copper and Silk
- Board – Top Copper
- Board – Bottom Copper
- Board – Bottom Copper and Silk
- Board – Bottom Silk

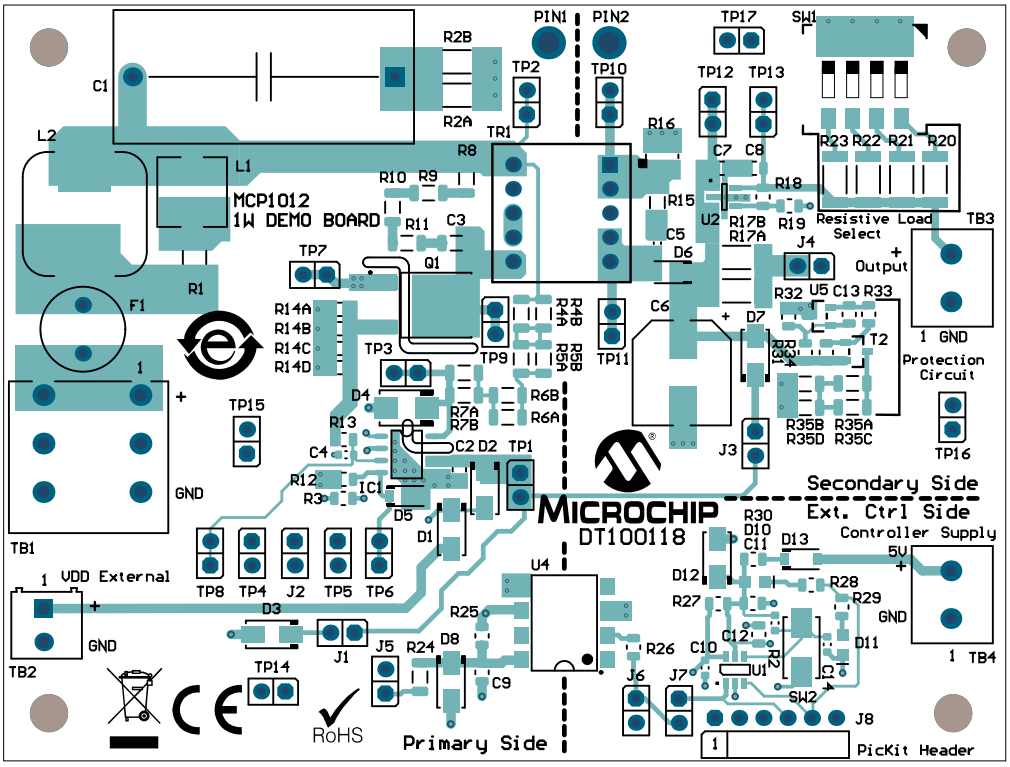
A.2 BOARD – SCHEMATIC



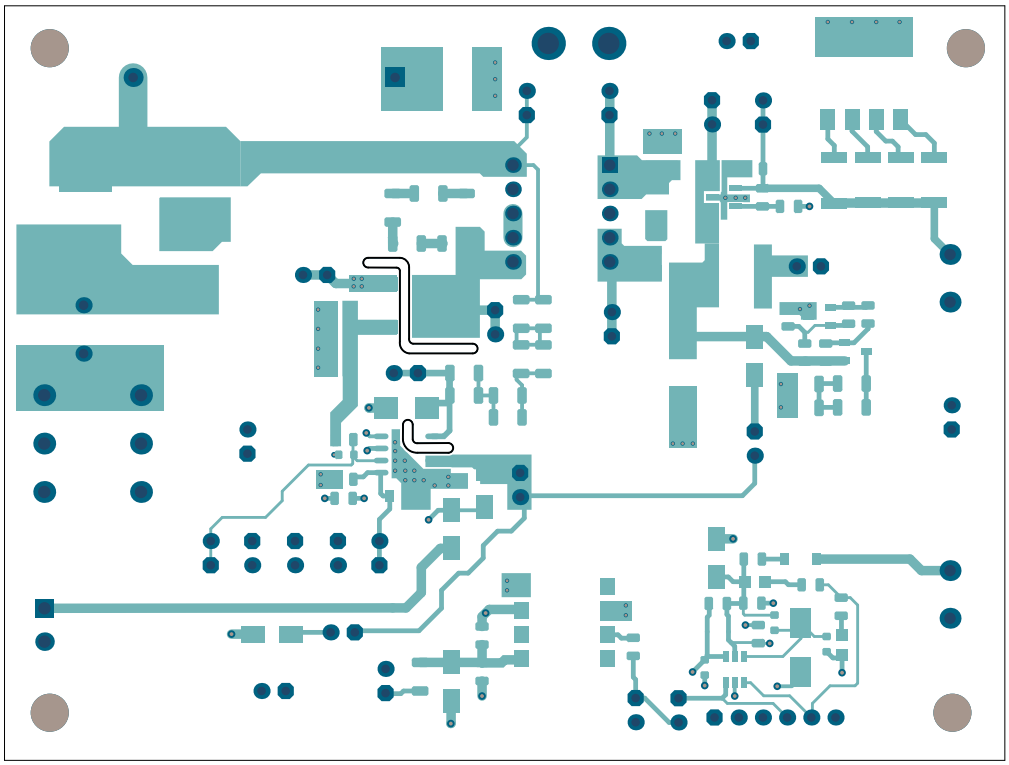
A.3 BOARD – TOP SILK



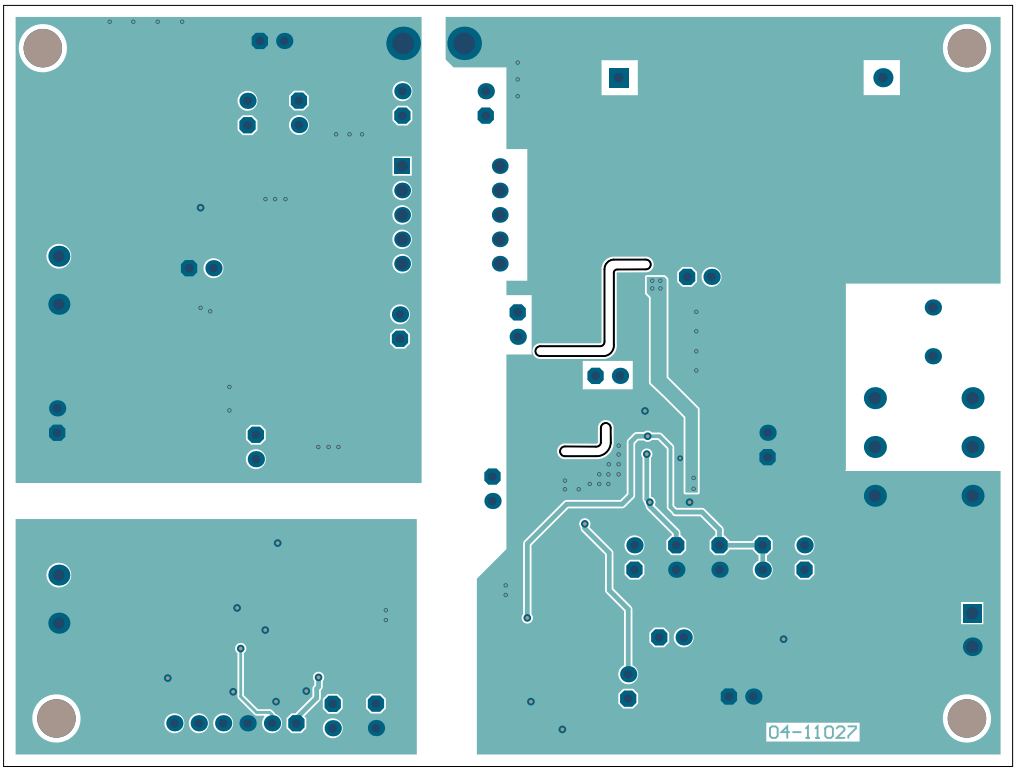
A.4 BOARD – TOP COPPER AND SILK



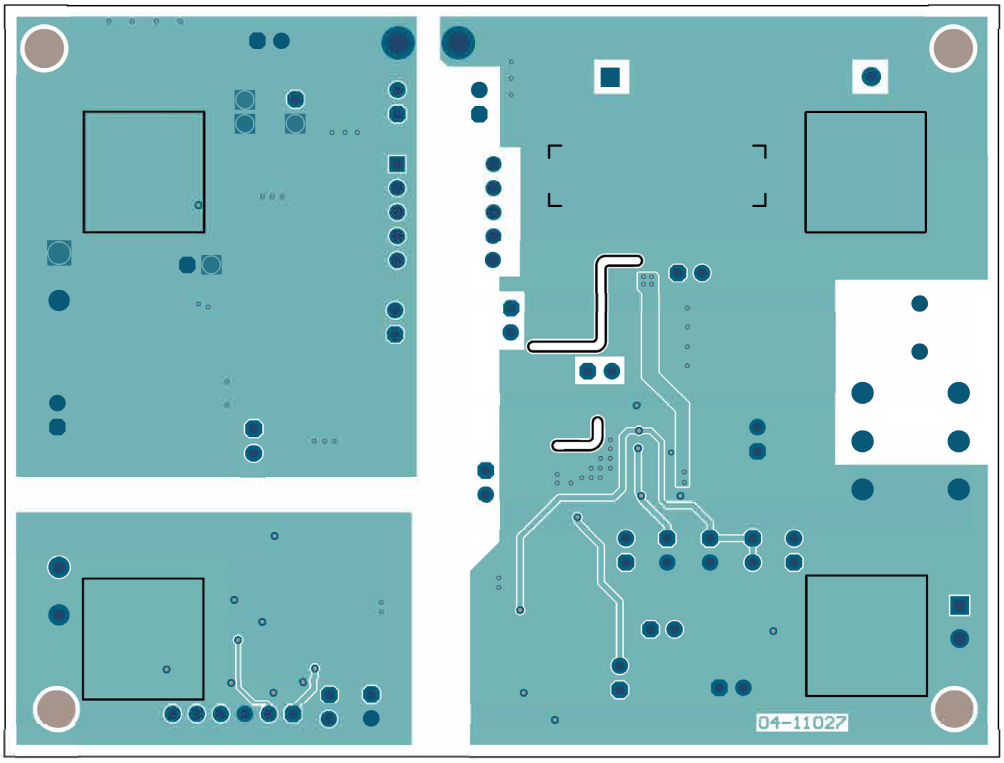
A.5 BOARD – TOP COPPER



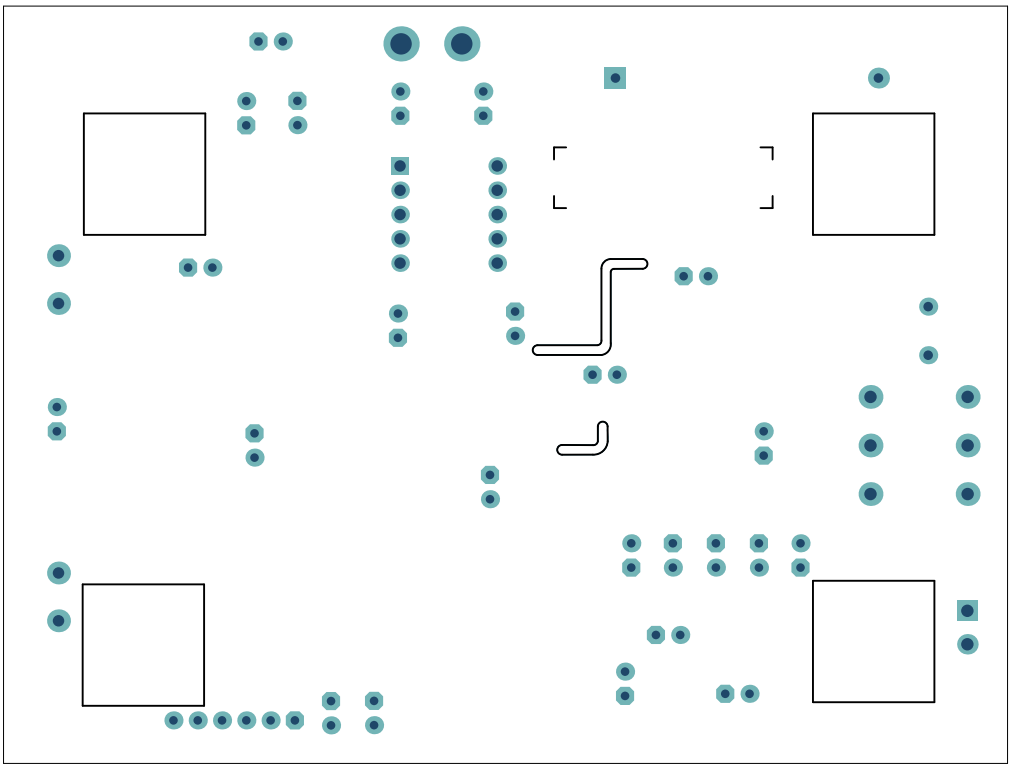
A.6 BOARD – BOTTOM COPPER



A.7 BOARD – BOTTOM COPPER AND SILK



A.8 BOARD – BOTTOM SILK



NOTES:

Appendix B. Bill of Materials (BOM)

TABLE B-1: BILL OF MATERIALS (BOM)

Qty.	Reference	Description	Manufacturer	Part Number
1	C1	Capacitor, film, 2.2 µF 305 VAC 20% radial P27.5L31.5W14H24.5	EPCOS AG	B32924C3225M
2	C2, C7	Capacitor, ceramic, µF 50V 10% X7R, surface mount, 0805	Murata Electronics North America, Inc.	GRM21BR71H105KA12L
1	C3	Capacitor, ceramic, 1000 pF 2KV 10% X7R surface mount, 1206	Johanson Dielectrics Inc.	202R18W102KV4E
1	C4	Capacitor, ceramic, 330 pF 50V 5% C0G surface mount, 0603	KEMET	C0603C331J5GACTU
1	C5	Capacitor, ceramic, 330 pF 200V 10% X7R surface mount, 0603	KEMET	C0603C331K2RAC7867
1	C6	Capacitor, Alu., 330 µF 50V 20% surface mount, G	Panasonic Electronic Components	EEE-FT1H331AP
1	C8	Capacitor, ceramic, 2.2 µF 16V 10% X7R surface mount, 0805	Murata Electronics North America, Inc	GRM21BR71C225KA12L
1	C9	Capacitor, ceramic, 0.47 µF 50V 10% X7R surface mount, 0805	Murata Electronics North America, Inc	GRM21BR71H474KA88L
1	C10	Capacitor, ceramic, 10000 pF 25V 10% X7R surface mount, 0603	Panasonic®- ECG	ECJ-1VB1E103K
1	C11	Capacitor, ceramic, 0.1 µF 50V 10% X7R, surface mount, 0805	Cal-Chip Electronics Inc.	GMC21X7R104K50NTLF
1	C12	Capacitor, ceramic, 10 µF 10V 10% X5R, surface mount, 0805	Taiyo Yuden Co., Ltd.	LMK212BJ106KG-T
1	C13	Capacitor, ceramic, 1000 pF 50V 10% X7R, surface mount, 0805	Murata Electronics North America	GRM216R71H102KA01D
1	C14	Capacitor, ceramic, 1000 pF 50V 20% X7R, surface mount, 0603	TDK Corporation	C1608X7R2A102K080AA
3	D1, D2, D7	Diode, rectifier, US1M 1.7V 1A 1000V DO-214AC_SMA	Vishay Dale	US1M-E3/61T
1	D3	Diode, TVS, SMAJ22A 22V 400W SMD DO-214AC_SMA	Bourns®, Inc.	SMAJ22A
1	D4	Diode, TVS, P6KE510 434V 600W DO-214AA_SMB	Micro Commercial Components Corp. (MCC)	SMBJP6KE510A-TP
1	D5	Diode, Schottky, BAT46W-TP 450 mV 10 mA 100V, surface mount, SOD-123	Micro Commercial Components Corp. (MCC)	BAT46W-TP

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

Qty.	Reference	Description	Manufacturer	Part Number
1	D6	Diode, Schottky, DFLS1200-7 850 mV 1A 200V POW-ERDI-123	Diodes Incorporated®	DFLS1200-7
1	D8	Diode, zener, SMAZ18-13-F 18V 1W DO-214AC_SMA	Diodes Incorporated	SMAZ18-13-F
1	D10	Diode, LED, red 2.2V 20 mA 40 mcd, clear, surface mount, 0805	Dialight Corporation	598-8110-107F
1	D11	Diode, LED, green, 3.1V 20 mA 400 mcd, clear, surface mount, 0805	QT-Brightek Corporation (QTB)	QBLP631-IG
1	D12	Diode, zener SMAZ5V1-13-F 5.1V 1W DO-214AC_SMA	Diodes Incorporated	SMAZ5V1-13-F
1	D13	Diode, rectifier, 1N4148 1.25V 150 mA 100V SOD-123	Micro Commercial Components Corp. (MCC)	1N4148W-TP
1	F1	Resistor, fuse, 2A 300 VAC, Slow, radial, TH P5.08D8.5H8	Littelfuse®	38312000000
1	IC1	IC MCP1012 SOIC-8	Microchip Technology Inc.	**MCP1012-V/EKA**
24	J1, J2, J3, J4, J5, J6, J7, TP1, TP2, TP3, TP4, TP5, TP6, TP7, TP8, TP9, TP10, TP11, TP12, TP13, TP14, TP15, TP16, TP17	Connector, header-2.54 male 1x2 Gold 5.84 MH TH, vertical	Amphenol Commercial	77311-118-02LF
1	JP1	Mechanical, hardware, jumper, 6.35 mm 1x2 D3087-98	Harwin Plc.	D3087-98
1	L1	Inductor, 100 µH 0.79A 20%, surface mount, L7.3W7.3H4.5	Wurth Electronik	744777920
1	LABEL1	Label, assembly with rev. level (small modules) per MTS-0002	—	—
1	L2	Inductor 1500 µH 810 mA 10%, surface mount, L12.3W12.3H10	Coilcraft	MSS1210-155KEB
4	PAD1, PAD2, PAD3, PAD4	Mechanical, hardware, rubber pad, SQ, taper 0.50x0.50x0.23 black	3M	SJ-5518
1	PCB1	MCP1012 Demonstration Board - printed circuit board	Microchip Technology Inc.	**04-11027-R1**
2	PIN1, PIN2	Connector, receptacle, 1pin AU H3185-05 THT	Harwin Plc.	H3185-05
1	Q1	Transistor FET N-Channel IPD90R1K2C3ATMA1 900V 5.1A 1.2R 83W TO-252-3	Infineon Technologies AG	IPD90R1K2C3ATMA1
1	R1	Resistor, TKF 1.5R 1% 1/3W, surface mount, 1210	Stackpole Electronics, Inc.	RMCF1210FT1R50
1	R2	Resistor, TF 10k 1% 1/16W surface mount, 0603	TE Connectivity	CPF0603F10KC1
2	R2A, R2B	Resistor, TKF 2R 5% 3/4W, surface mount, 2010	Panasonic - ECG	ERJ-12ZYJ2R0U

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

Qty.	Reference	Description	Manufacturer	Part Number
1	R3	Resistor, TKF 47k 1% 1/8W, surface mount, 0805	Stackpole Electronics, Inc.	RMCF0805FT47K0
8	R4A, R5A, R6A, R7A, R8, R9, R10, R11	Resistor, TKF 2.29k 1% 1/4W, surface mount, 1206	Yageo Corporation	RC1206FR-072K49L
1	R12	Resistor, TKF 1R 5% 1/8W, surface mount, 0805	Panasonic	ERJ-6RQJ1R0V
2	R13, R30	Resistor, TKF 10R 1% 1/8W, surface mount, 0805	ROHM Semiconductor	MCR10EZHF10R0
1	R14A	Resistor, TKF 1.5R 1% 1/8W, surface mount, 0805	TT Electronics	ASC0805-1R5FT5
1	R14B	Resistor, TKF 1.6R 1% 1/8W, surface mount, 0805 AEC-Q200	Panasonic	ERJ-6RQF1R6V
1	R15	Resistor, TKF 10R 5% 1/4W, surface mount, 1206	Yageo Corporation	AC1206JR-0710RL
1	R16	Resistor, TF 0.05R 1% 1W, surface mount, 0612	Susumu Co., Ltd	PRL1632-R050-F-T1
2	R17A, R17B	Resistor, TKF 1R 1% 3/4W, surface mount, 2010	Vishay Dale	CRCW20101R00FKEF
1	R18	Resistor, TKF 330k 1% 1/8W, surface mount, 0805 AEC-Q200	Panasonic	ERJ-6ENF3303V
2	R19, R27	Resistor, TKF 100k 5% 1/8W, surface mount, 0805	Panasonic	ERJ-6GEYJ104V
1	R20	Resistor, TKF 51R 5% 3/4W, surface mount, 2010	Panasonic	ERJ-12ZYJ510U
1	R21	Resistor, TKF 68R 5% 3/4W, surface mount, 2010	Panasonic	ERJ-12ZYJ680U
1	R22	Resistor, TKF 220R 5% 3/4W, surface mount, 2010	Panasonic	ERJ-12ZYJ221U
5	R24, R35A, R35B, R35C, R35D	Resistor, TKF 330R 5% 1/4W, surface mount, 1206	Panasonic	ERJ-8GEYJ331V
1	R26	Resistor, TKF 1.5k 1% 1/8W, surface mount, 0805	Panasonic	ERJ-6ENF1501V
1	R28	Resistor, TKF 680R 1% 1/8W, surface mount, 0805	Stackpole Electronics, Inc	RMCF-1/10-680-1%
1	R29	Resistor, TKF 560R 1% 1/8W, surface mount, 0805	Stackpole Electronics, Inc	RMCF0805FT560R
1	R31	Resistor, TKF 18k 1% 1/8W, surface mount, 0805	Stackpole Electronics, Inc	RMCF-1/10-18K-1%
1	R32	Resistor, TKF 1.3k 1% 1/8W, surface mount, 0805	Yageo Corporation	RC0805FR-071K3L
1	R33	Resistor, TKF 4.7k 5% 1/8W surface mount, 0805	Panasonic	ERJ-6GEYJ472V
1	R34	Resistor, TKF 5.6k 1% 1/8W, surface mount, 0805	Vishay Dale	CRCW08055K60FKEA
1	SW1	Switch, DIP 4 SPST 24V 100 mA 1-1825059-3, surface mount	TE Connectivity	1-1825059-3

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

Qty.	Reference	Description	Manufacturer	Part Number
1	SW2	Switch, tact. SPST 12V 50mA TL3302AF180QJ, surface mount	E-Switch®, Inc.	TL3302AF180QJ
1	T2	Transistor, BJT, PNP BC807-16L -45V -500 mA 225 mW SOT-23-3	ON Semiconductor®	BC807-16LT1G
1	TB1	Connector, terminal 5.08 mm 1x3 female 16-22AWG 10A TH R/A	Wurth Electronik	691415520003
1	TB2	Connector, terminal 3.5 mm 1x2 Female 24-16AWG 10A TH R/A	Wurth Electronik	691214110002
1	TB3, TB4	Connector, terminal 5 mm 1x2 female 12-26AWG 18A TH R/A	Phoenix Contact	1935161
1	TR1	Transistor, power 12:1 7.5V 200R14C, R14D mA7.6 mH TH	Wurth Electronik	750318391
1	U1	Microchip MCU 8-Bit 16 MHz 918B 64B PIC10F322-I/OT SOT-23-6	Microchip Technology Inc.	**PIC10F322-I/OT**
1	U2	Microchip Analog LDO ADJ MIC5235YM5-TR SOT-23-5	Microchip Technology Inc.	**MIC5235YM5-TR**
1	U4	IC Optoisolator 3.75 kV 5 Mb HCPL-2202-300E DIP-8 GW	Broadcom®	HCPL-2202-300E
1	U5	IC Power TLV431BSN1T1G Shunt Voltage Reference SOT23-3	ON Semiconductor	TLV431BSN1T1G

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 (BOM – DO NOT POPULATE)

Qty.	Reference	Description	Manufacturer	Part Number
0	J8	Connector, Header-2.54 male 1x6 gold 5.84 MH TH R/A **DO NOT POPULATE**	Amphenol Commercial	68016-106HLF
0	R4B, R5B, R6B, R7B	Resistor, TKF 0R surface mount 1206 **DO NOT POPULATE**	Yageo Corporation	RC1206JR-070RL
2	R14C, R14D	Resistor, TKF 0.1R 1% 1/8W, surface mount 0805 **DO NOT POPULATE**	Panasonic - ECG	ERJ-L06KF10CV
0	R23	Resistor, TKF 220R 5% 3/4W, surface mount, 2010 **DO NOT POPULATE**	Panasonic - ECG	ERJ-12ZYJ221U
0	R25	Resistor, TKF 390R 5% 1/8W, surface mount, 0805 **DO NOT POPULATE**	Panasonic - ECG	ERJ-6GEYJ391V

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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