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This development/evaluation tool complies with EU RoHS2 Directive 2011/65/EU.
This development/evaluation tool, when incorporating wireless and radio-telecom functionality, is in compliance with the essential requirement and other relevant provisions of the R&TTE Directive 1999/5/EC and the FCC rules as stated in the declaration of conformity provided in the module datasheet and the module product page available at www.microchip.com.
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Signed for and on behalf of Microchip Technology Inc. at Chandler, Arizona, USA.

Rodger Richey
Director of Development Tools

Date

4/4/17
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Safety Notice

The following safety notices and operating instructions should be adhered to in order to avoid a safety hazard. If in any doubt, consult your supplier.

**WARNING** – The Wireless Power Development Board generates AC voltages in excess of 144 Vpk-pk on the resonator circuit, which consists of the primary winding coil (L1) and resonator capacitors (C10, C18 and C24).

**General Notices:**

- The Wireless Power Development Board is intended for evaluation and development purposes, and should only be operated in a normal laboratory environment, as defined by IEC 61010-1:2001.
- Clean with a dry cloth only.
- Operate flat on a bench away from any surface items that might come in contact with the board. Do not move during operation and avoid direct contact with the bottom layer of the board.
- The Wireless Power Development Board should not be connected or operated if there is any apparent damage to the unit.
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 “DSxxxxxxxxA”, where “xxxxxxxx” is the document number and “A” is the revision level of the document.

For the most up-to-date information on development tools, see the MPLAB® IDE on-line help. Select the Help menu, and then Topics to open a list of available on-line help files.

INTRODUCTION

This preface contains general information that will be useful to know before using the Wireless Power Development Board. Topics discussed in this preface include:

• Document Layout
• Conventions Used in this Guide
• Recommended Reading
• The Microchip Web Site
• Development Systems Customer Change Notification Service
• Customer Support
• Document Revision History

DOCUMENT LAYOUT

This user’s guide provides an overview of the Wireless Power Development Board. The document is organized as follows:

• Chapter 1. “Introduction” – This chapter introduces the Wireless Power Development Board and provides a brief overview of its features.
• Chapter 2. “Hardware” – This chapter describes the board layout and the main components of the Wireless Power Development Board.
• Chapter 3. “Demonstration Program Operation” – This chapter describes the demonstration software that is preloaded on the device that accompanies the Wireless Power Development Board.
• Appendix A. “Board Layout and Schematics” – This appendix provides diagrams of the hardware layout, as well as schematic diagrams for the Wireless Power Development Board.
CONVENTIONS USED IN THIS GUIDE

This manual uses the following documentation conventions:

<table>
<thead>
<tr>
<th>DOCUMENTATION CONVENTIONS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Description</td>
</tr>
<tr>
<td>-----------------------------</td>
</tr>
<tr>
<td>Arial font:</td>
</tr>
<tr>
<td>Italic characters</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>Initial caps</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>Quotes</td>
</tr>
<tr>
<td>Underlined, italic text with right angle bracket</td>
</tr>
<tr>
<td>Bold characters</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>N'Rnnnn</td>
</tr>
<tr>
<td>Text in angle brackets &lt; &gt;</td>
</tr>
<tr>
<td>Courier New font:</td>
</tr>
<tr>
<td>Plain Courier New</td>
</tr>
<tr>
<td>Filenames</td>
</tr>
<tr>
<td>File paths</td>
</tr>
<tr>
<td>Keywords</td>
</tr>
<tr>
<td>Command-line options</td>
</tr>
<tr>
<td>Bit values</td>
</tr>
<tr>
<td>Constants</td>
</tr>
<tr>
<td>Italic Courier New</td>
</tr>
<tr>
<td>Square brackets [ ]</td>
</tr>
<tr>
<td>Curly braces and pipe character: { }</td>
</tr>
<tr>
<td>Ellipses...</td>
</tr>
<tr>
<td>Represents code supplied by user</td>
</tr>
</tbody>
</table>

DS50002623A-page 10  Advance Information  © 2017 Microchip Technology Inc.
RECOMMENDED READING

This user’s guide describes how to use the Wireless Power Development Board. The device-specific data sheets contain current information on programming the specific microcontroller or Digital Signal Controller (DSC) devices. The following Microchip documents are available and recommended as supplemental reference resources:

**MPLAB® C Compiler for PIC24 MCUs and dsPIC® DSCs User’s Guide (DS51284)**

This comprehensive guide describes the usage, operation and features of Microchip’s MPLAB C compiler (formerly MPLAB C30) for use with 16-bit devices.

**MPLAB® X IDE User’s Guide (DS50002027)**

This document describes how to set up the MPLAB X IDE software and use it to create projects and program devices.

**dsPIC33 ‘GS’ Data Sheets**

Refer to these documents for detailed information on the dsPIC33 ‘GS’ SMPS Digital Signal Controllers (DSCs). Reference information found in these data sheets include:

- Device memory maps
- Device pinout and packaging details
- Device electrical specifications
- List of peripherals included on the devices

**dsPIC33/PIC24 Family Reference Manual Sections**

Family Reference Manual (FRM) sections are available, which explain the operation of the dsPIC® DSC and PIC24 MCU family architecture and peripheral modules. The specifics of each device family are discussed in the individual family’s device data sheet.

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- **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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The Development Systems product group categories are:

- **Compilers** – The latest information on Microchip C compilers and other language tools. These include the MPLAB® C compiler; MPASM™ and MPLAB 16-bit assemblers; MPLINK™ and MPLAB 16-bit object linkers; and MPLIB™ and MPLAB 16-bit object librarians.

- **Emulators** – The latest information on the Microchip MPLAB REAL ICE™ in-circuit emulator.

- **In-Circuit Debuggers** – The latest information on the Microchip in-circuit debugger, MPLAB ICD 3.

- **MPLAB X IDE** – The latest information on Microchip MPLAB X IDE, the Windows® Integrated Development Environment for development systems tools. This list is focused on the MPLAB X IDE, MPLAB SIM simulator, MPLAB X IDE Project Manager, and general editing and debugging features.

- **Programmers** – The latest information on Microchip programmers. These include the MPLAB PM3 device programmer and the PICkit™ 3 development programmers.

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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 web site at: http://support.microchip.com

DOCUMENT REVISION HISTORY

**Revision A (May 2017)**

This is the initial released version of this document.
Chapter 1. Introduction

This chapter introduces the Wireless Power Development Board and provides an overview of its features. The topics covered include:

- Wireless Power Development Board Functionality and Features
- Electrical Specifications

FIGURE 1-1: WIRELESS POWER DEVELOPMENT BOARD

1.1 OVERVIEW

The Microchip Wireless Power Development Board supports the Qi 1.2.2 standard. The board is a single coil transmitter that operates with a +12V input. The Wireless Power Development Board includes digital demodulation, Foreign Object Detection (FOD), LED status indicators and LED power level indicators. The Qi 1.2.2 standard is implemented with a Microchip dsPIC® DSC. These devices include a powerful CPU core, multiple PWM generators and advanced analog modules, allowing you to customize wireless power transfer applications and designs.
1.2 WIRELESS POWER DEVELOPMENT BOARD FUNCTIONALITY AND FEATURES

The Microchip Wireless Power Development Board is based on the Qi specified single coil, MP-A2 design topology. Figure 1-2 illustrates the high-level block diagram of the Wireless Power Development Board. A capacitance of 247 nF (±5%) and an inductance of 10 µF (±10%) comprises the resonant circuit. These two components determine the analog ping frequency for mobile device/wireless power receiver detection. This board includes MOSFET drivers, MOSFETs, a current sense amplifier, power transfer/power LED indicators and an envelope detector for demodulation.

FIGURE 1-2: WIRELESS POWER DEVELOPMENT BOARD BLOCK DIAGRAM

Note 1: J3 includes Vdd, GND, PGED2, PGEC2 and MCLR.
Note 2: K1 and K2 are circuit gains.
The software state machine for the power transmitter includes seven distinct phases for communication and power transfer. When receiving messages from a mobile device, the power transmitter demodulates the Amplitude Shift Keyed (ASK) encoded messages. When communicating with a wireless power receiver (mobile device), the power transmitter uses Frequency Shift Keying (FSK) for message encoding. FSK communication from the power transmitter applies to v1.2.2 medium power receivers. The medium power transmitter is both Qi v1.1 (Low Power – 5W) and Qi v1.2.2 (Medium Power – 15W) specification compatible.

The medium power wireless transmitter development board uses PI closed-loop frequency control for power transfer. The dsPIC DSC device provides the necessary memory and peripherals for current/voltage measurements, PWM generation, analog signal comparison, input capture and general purpose I/Os, eliminating the need to perform these functions with external circuitry.

The dsPIC ‘GS’ devices are specifically designed to provide design flexibility at low-cost. dsPIC ‘GS’ devices for wireless power applications offer the benefit of additional on-chip resources for added design functionality based on system needs and limited only by designer creativity.

The dsPIC ‘GS’ family of devices provides the following features:

• Integrated program and data memory on a single chip
• Ultra-fast interrupt response time with interrupt priority logic
• High-speed ADC with multiple Sample-and-Hold (S&H) circuits
• High-resolution PWM generators, specially designed to support different power topologies
• High-speed analog comparators for control loop implementation and system protection
• On-chip system communications (I2C/SPI/UART)
• On-chip Fast RC (FRC) oscillator for lower system cost
• Alternate Working register sets for context switching for improved control loop execution

1.2.1 System Resources Utilized

The following information summarizes the memory resources used with Level 1 optimization:

• Under 20% of RAM memory
• Under 45% of Flash memory

The following list summarizes the analog channels used:

• AN0 – Demodulation Signal
• AN1 – Transmitter Coil Current
• AN2 – Vin Feedback
• AN6 – Temperature Sensor

The following list summarizes the peripherals used:

• IC1 – Input capture (in conjunction with AN0)
• Timer1 – 1 ms system synchronization clock
• ADCMP0 – Digital comparator for +12V DC input over/undervoltage protection
• I2C1 – Used for communication with the I/O expander for power transfer LED control
• PWM1H/2H – Full-bridge inverter drive signals
• GPIO – For Status LED control
1.2.2 Power Stage

The power transmitter consists of a full-bridge power inverter. If the mobile device placed on the transmitter is a low-power receiver, the inverter will operate in Half-Bridge mode. If the mobile device placed on the transmitter is a medium power receiver, the inverter will operate in Full-Bridge mode. The inverter may revert back to Half-Bridge mode from Full-Bridge mode if the medium power receiver renegotiates for low-power transfer for increased efficiency at loads less than 5W.

INVERTER MODES:
• Half-Bridge: Load Requirements ≤ 5W
• Full-Bridge: Load Requirements ≤ 15W

1.2.3 Transmitter and Receiver User Interface Status Indicator LEDs

The power transmitter status user interface LED bank consists of D10, D11 and D12. These LEDs provide the status of the power transmitter while engaged to the power receiver. The LEDs are illuminated based on the base station status, as highlighted in Table 1-1:

1.2.4 Transmitter Power Transfer Level Indicator LEDs

The power transfer indicator LEDs are illuminated proportionately to the power being delivered to the receiver. This LED bank includes D13-D20. The illumination of the LEDs is normalized to the power rating of the receiver placed on the power transmitter.

1.2.5 Foreign Object Detection (FOD)

When a foreign object (electrical conductor) is placed on or near the alternating magnetic field of the Qi transmitter, there will be an induced electrical current in the foreign object. This leads to power losses and a degradation of the overall system efficiency. Foreign Object Detection (FOD) is a feature that is implemented to rectify this issue.

Microchip’s transmitter board implements Foreign Object Detection based on the power loss method. In this method, the power difference between the transmitted power and received power is constantly monitored and compared to a threshold. The threshold is a function of the power rating of the receiver placed on the transmitter. If the power loss exceeds the specification threshold, the transmitter magnetic field is disabled and a red LED blinks on and off continuously to indicate the presence of a foreign object, prompting the user to remove the receiver from the transmitter and to remove the foreign object that is nearby.

### Table 1-1: LED Conditions

<table>
<thead>
<tr>
<th>Status</th>
<th>Green LED</th>
<th>Yellow LED</th>
<th>Red LED</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mobile Device is Detected</td>
<td>ON</td>
<td>OFF</td>
<td>OFF</td>
</tr>
<tr>
<td>Charging or in Power Transfer Phase</td>
<td>BLINKING</td>
<td>OFF</td>
<td>OFF</td>
</tr>
<tr>
<td>Charge is Complete</td>
<td>ON</td>
<td>BLINKING</td>
<td>OFF</td>
</tr>
<tr>
<td>System Error</td>
<td>OFF</td>
<td>OFF</td>
<td>ON</td>
</tr>
<tr>
<td>Reduced Power Delivery</td>
<td>OFF</td>
<td>ON</td>
<td>OFF</td>
</tr>
<tr>
<td>Foreign Object is Detected</td>
<td>OFF</td>
<td>OFF</td>
<td>BLINKING</td>
</tr>
</tbody>
</table>
1.2.6 System Efficiency

The transmitter-receiver system efficiency is defined as the receiver load power divided by the transmitter inverter input power. The four main factors that influence the system efficiency are:

1. Transmitter inverter efficiency.
2. Receiver efficiency.
3. Receiver coil distance.
4. Receiver coil placement.

The first two factors are usually independent of each other and are attributed to circuit design and component selection. The third factor is defined by the Qi specification. The MP-A2 transmitter design requires a distance of 3 (+0.5/-0.25) mm from the surface of the transmitter coil to the interface surface. The acrylic cover fulfills this requirement. For best test results, it is recommended that the distance requirements for the test receiver, used alongside the wireless power transfer development board, be also followed (see Qi specification for test receiver-specific distance requirements). The fourth factor is heavily influenced by the displacement between the receiver and transmitter coils. The displacement can be with respect to the x-y coordinates relative to the surface of the transmitter coil and by the angular pitch. Tests have shown that displacement affects both efficiency and FOD. Therefore, from a user’s point of view, it is paramount that both the receiver coil and the transmitter coil be centrally aligned.

![Coil Alignment Diagram]

**Ideal Alignment:**
- Displacement: $$\Delta x = \Delta y = 0$$
- Pitch: $$\theta = 0^\circ$$
As shown in Figure 1-4, system efficiency per the Qi specification is calculated by dividing the receiver load power \( P_{OUT} \) by the transmitter inverter input power \( P_{IN} \). The lines above and below the coils imply proper alignment.

Figure 1-5 shows typical measured system efficiencies when testing two low-power receivers, LP Rx1 and LP Rx2, and one medium power receiver, MP Rx.
1.2.7 Wireless Power Development Board Power

- J1: +12V Input Power Connector
- MIC39100 1A, 3.3V Low Quiescent Current LDO Regulator

1.2.8 Powering Up the Wireless Power Development Board

1. Ensure that there are no metallic materials on or near the coil of the transmitter.
2. Verify that the +12V power source is turned off.
3. Connect both GND and +12V from the power source to J1.
4. Turn on the power source, or if using a +12V adapter, plug it into the wall outlet.
5. Centrally align and place a low-power (Qi v1.1) or medium power (Qi v1.2.2) receiver coil onto the transmitter coil.
6. If the mobile device is successfully detected by the transmitter board, the green LED (D10) should become illuminated.
7. If the transmitter successfully enters the power transfer phase, the green LED (D10) should begin blinking on and off.
8. If there is a load on the receiver, the LED bank, which consists of D13-D20, should be illuminated proportionately to the load applied.
9. Monitor the status LEDs, D10-D12, for any changes in the status of the system.

1.3 ELECTRICAL SPECIFICATIONS

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Minimum</th>
<th>Typical</th>
<th>Maximum</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Voltage</td>
<td>11</td>
<td>12</td>
<td>13</td>
<td>V</td>
</tr>
<tr>
<td>Current</td>
<td>—</td>
<td>—</td>
<td>2.4</td>
<td>A</td>
</tr>
<tr>
<td>Analog Ping Frequency</td>
<td>—</td>
<td>101</td>
<td>—</td>
<td>kHz</td>
</tr>
<tr>
<td>Digital Ping Frequency</td>
<td>—</td>
<td>140</td>
<td>—</td>
<td>kHz</td>
</tr>
<tr>
<td>Power Transfer Frequency</td>
<td>110</td>
<td>—</td>
<td>145</td>
<td>kHz</td>
</tr>
</tbody>
</table>

1.3.1 Standby Power

The typical standby power when no mobile device is placed on the base station is 720 mW.
Chapter 2. Hardware

This chapter describes the hardware components of the Wireless Power Development Board. Topics covered include:

- Board Assembly
- Signal Configuration
- Application Components
- Board Connectors

2.1 BOARD ASSEMBLY

The board assembly is shown in Figure 2-1. Table 2-1 provides a description of the components.

FIGURE 2-1: WIRELESS POWER DEVELOPMENT BOARD ASSEMBLY
TABLE 2-1: WIRELESS POWER DEVELOPMENT BOARD

<table>
<thead>
<tr>
<th>Feature #</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Digital Signal Controller – dsPIC33EP32GS202</td>
</tr>
<tr>
<td>2</td>
<td>+3.3V LDO Circuit</td>
</tr>
<tr>
<td>3</td>
<td>Input Programming Connector</td>
</tr>
<tr>
<td>4</td>
<td>8-LED Power Transfer Level Indicator Circuit</td>
</tr>
<tr>
<td>5</td>
<td>FET Drivers</td>
</tr>
<tr>
<td>6</td>
<td>+12V Input Connector</td>
</tr>
<tr>
<td>7</td>
<td>Demodulation Circuit</td>
</tr>
<tr>
<td>8</td>
<td>Dual FET ICs</td>
</tr>
<tr>
<td>9</td>
<td>Resonance Capacitors</td>
</tr>
<tr>
<td>10</td>
<td>Temperature Sensor Circuit</td>
</tr>
<tr>
<td>11</td>
<td>Current Sensing Circuit</td>
</tr>
<tr>
<td>12</td>
<td>Transmitter Coil</td>
</tr>
</tbody>
</table>

2.2 SIGNAL CONFIGURATION

Table 2-2 provides a list of test points provided on the Wireless Power Development Board, along with a brief functional description.

TABLE 2-2: Wireless Power Development Board Test Points

<table>
<thead>
<tr>
<th>Test Point</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>+12V_IN</td>
</tr>
<tr>
<td>2</td>
<td>3.3V</td>
</tr>
<tr>
<td>3</td>
<td>GND</td>
</tr>
<tr>
<td>4-6</td>
<td>RESONATOR</td>
</tr>
<tr>
<td>7</td>
<td>DEMOD</td>
</tr>
<tr>
<td>8</td>
<td>CURRENT SENSE</td>
</tr>
<tr>
<td>9</td>
<td>CS_LEFT</td>
</tr>
<tr>
<td>10</td>
<td>AVDD</td>
</tr>
<tr>
<td>11</td>
<td>PWM1H</td>
</tr>
<tr>
<td>12</td>
<td>PWM2H</td>
</tr>
<tr>
<td>13</td>
<td>AGND</td>
</tr>
<tr>
<td>14</td>
<td>CS_RIGHT</td>
</tr>
<tr>
<td>15</td>
<td>I/O – Used for General Development</td>
</tr>
<tr>
<td>16</td>
<td>I/O – Used for Verifying Demodulation Signal</td>
</tr>
<tr>
<td>17</td>
<td>12V</td>
</tr>
</tbody>
</table>
2.3 APPLICATION COMPONENTS

Table 2-3 describes the application components that are available on the Wireless Power Development Board.

<table>
<thead>
<tr>
<th>Label</th>
<th>Component</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>U1</td>
<td>AD8418</td>
<td>Current sense amplifier.</td>
</tr>
<tr>
<td>U2</td>
<td>MIC3900</td>
<td>+3.3V LDO voltage regulator for all +3.3V devices.</td>
</tr>
<tr>
<td>U3</td>
<td>MCP9700</td>
<td>Measures temperature near the coil.</td>
</tr>
<tr>
<td>U4</td>
<td>NCP3420DR2G</td>
<td>Half-bridge FET drivers.</td>
</tr>
<tr>
<td>U5</td>
<td>dsPIC33EP32GS202</td>
<td>Provides the processing power for the demonstration applications.</td>
</tr>
<tr>
<td>U6</td>
<td>NCP3420DR2G</td>
<td>Half-bridge FET drivers.</td>
</tr>
<tr>
<td>U7</td>
<td>MCP23008</td>
<td>I/O expander via I²C communication to drive the LED power indicator.</td>
</tr>
<tr>
<td>Q1</td>
<td>DMG4800LSD</td>
<td>Half-bridge FETs – dual FET package.</td>
</tr>
<tr>
<td>Q2</td>
<td>DMG4800LSD</td>
<td>Half-bridge FETs – dual FET package.</td>
</tr>
<tr>
<td>L1</td>
<td>760308103102</td>
<td>Transmitter coil.</td>
</tr>
</tbody>
</table>

2.4 BOARD CONNECTORS

Table 2-4 describes the hardware connections available on the Wireless Power Development Board.

<table>
<thead>
<tr>
<th>Label</th>
<th>Component</th>
<th>Hardware Element Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>J1</td>
<td>2-TERM CONN</td>
<td>+12V Input Power</td>
</tr>
<tr>
<td>J3</td>
<td>RJ25</td>
<td>dsPIC33EP32GS202 Programming Connector</td>
</tr>
</tbody>
</table>
Chapter 3. Demonstration Program Operation

The ‘GS’ series dsPIC® DSC on the Wireless Power Development Board is preprogrammed with Qi v1.2.2 SW to support both low-power and medium power charging applications.

This section covers the following topics:

- Program Demonstration
- Program Top Level Description
- Wireless Transmitter Board Waveforms

3.1 PROGRAM DEMONSTRATION

FIGURE 3-1: Qi v1.2.2 STATE MACHINE
3.2 PROGRAM TOP LEVEL DESCRIPTION

The program begins in the selection phase, and continuously pings and stays in the selection phase until a receiver is detected. Once a valid receiver is detected, it moves to the ping phase, where the digital ping is applied. Once applied, it is Amplitude Shift Keyed (ASK) by the receiver to send messages to the transmitter. The state machine then moves to the configuration phase, where receiver information is collected by the transmitter, including the receiver power rating. If it is determined that the mobile device is a low-power receiver, it continues directly to the power transfer phase. If it is determined that it is a medium power receiver, it moves on to the negotiation phase, where the precise power rating of the mobile device is determined. After doing so, it moves on to the calibration phase, where the transmitted power is calibrated. Once the transmitted power is calibrated, it moves on to the power transfer phase for power transfer. If, at any point, the receiver needs to negotiate another power rating, it moves to the renegotiation phase. Once completed, it returns to the power transfer phase. If a Fault is encountered during any time, the state machine will return to the selection phase. For further details, please consult the Qi specification.

3.3 WIRELESS TRANSMITTER BOARD WAVEFORMS

3.3.1 Qi Analog Ping

FIGURE 3-2: ANALOG PING GRAPH

Channel 3 Probe Menu: 10.0 : 1

Δx = 502.000000000ms

Y(3) = 0.0V

ΔY = 0.0V
The analog ping is used for receiver detection. It provides an analog ping at the resonant frequency of ~100 kHz (~1/(2 * π * sqrt(LC))) every 500 ms. Each ping has a duration of approximately 70 µs, as shown in the figure.
3.3.2 Demodulation

The waveforms in the above oscilloscope plot show the different stages in the demodulation signal. The digital ping is measured at the juncture where the L and C meet (TP6) in the resonance circuit. The digital ping is then passed through the demodulation circuit to extract the demodulated signal. This signal is passed to Analog Channel 0 (AN0), where it is then processed by the software to recreate the message that was sent by the receiver. The transmitter response is dependent on the message(s) received.
3.3.3 Load Step

FIGURE 3-5: LOAD STEP GRAPH

The above figure shows a typical digital ping waveform when a load step from 10% to 100% is applied. Note the increase of the digital ping amplitude. This is to compensate for the additional power requirement from the transmitter.
Appendix A. Board Layout and Schematics

FIGURE A-1: WIRELESS POWER DEVELOPMENT BOARD LAYOUT (TOP)
FIGURE A-2: WIRELESS POWER DEVELOPMENT BOARD LAYOUT (BOTTOM)
<table>
<thead>
<tr>
<th><strong>AMERICAS</strong></th>
<th><strong>ASIA/PACIFIC</strong></th>
<th><strong>ASIA/PACIFIC</strong></th>
<th><strong>EUROPE</strong></th>
</tr>
</thead>
</table>