



**Atlantis  
USB4916  
Application Example**

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## Preface

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## INTRODUCTION

This chapter contains general information that will be useful to know before using Atlantis. Items discussed in this chapter include:

- [Document Layout](#)
- [Conventions Used in this Guide](#)
- [The Microchip Web Site](#)
- [Development Systems Customer Change Notification Service](#)
- [Customer Support](#)
- [Document Revision History](#)

## DOCUMENT LAYOUT

This document describes how to use the Atlantis as a tool for development of Android Auto, Apple CarPlay, and FlexConnect applications.

- **Chapter 1. “Overview”** – Shows a brief description of Atlantis.
- **Chapter 2. “System Requirements”** – Describes the list of requirements used for the development of Atlantis.
- **Chapter 3. “Schematics Design”** – Description of the Atlantis schematics.
- **Chapter 4. “PCB Layout”** – Describes the PCB layout process and layout requirements for Atlantis.
- **Chapter 5. “Software”** – Describes software and firmware required for operation of Atlantis.
- **Chapter 6. “Hardware Testing”** – Describes the basic flow for testing Atlantis.
- **Appendix A. “Atlantis Top View”** – This appendix shows a top view of Atlantis.
- **Appendix B. “Atlantis Evaluation Board Schematics”** – This appendix shows the Atlantis schematics.
- **Appendix C. “Atlantis BOM”** – This appendix includes the Atlantis Bill of Materi-

als (BOM).

- **Appendix D. “Atlantis Silk Screens”** – This appendix includes the Atlantis silk screens.

## CONVENTIONS USED IN THIS GUIDE

This manual uses the following documentation conventions:

### DOCUMENTATION CONVENTIONS

| Description                                      | Represents                                                                                          | Examples                                                    |
|--------------------------------------------------|-----------------------------------------------------------------------------------------------------|-------------------------------------------------------------|
| <b>Arial font:</b>                               |                                                                                                     |                                                             |
| Italic characters                                | Referenced books                                                                                    | <i>MPLAB® IDE User's Guide</i>                              |
|                                                  | Emphasized text                                                                                     | ...is the <i>only</i> compiler...                           |
| Initial caps                                     | A window                                                                                            | the Output window                                           |
|                                                  | A dialog                                                                                            | the Settings dialog                                         |
|                                                  | A menu selection                                                                                    | select Enable Programmer                                    |
| Quotes                                           | A field name in a window or dialog                                                                  | "Save project before build"                                 |
| Underlined, italic text with right angle bracket | A menu path                                                                                         | <u><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)<br>{ ...<br>}                              |

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- **MPLAB IDE** – The latest information on Microchip MPLAB IDE, the Windows Integrated Development Environment for development systems tools. This list is focused on the MPLAB IDE, MPLAB IDE Project Manager, MPLAB Editor and MPLAB SIM simulator, as well as general editing and debugging features.
- **Programmers** – The latest information on Microchip programmers. These include production programmers such as MPLAB REAL ICE in-circuit emulator, MPLAB ICD 3 in-circuit debugger and MPLAB PM3 device programmers. Also included are nonproduction development programmers such as PICSTART Plus and PIC-kit 2 and 3.

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### DOCUMENT REVISION HISTORY

#### Revision A (May 2017)

- Initial Release of this Document.

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## Chapter 1. Overview

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### 1.1 INTRODUCTION

Atlantis is an application example based on Microchip's USB4916 USB 2.0 Hi-Speed Multi-Host Reflector Hub. It is intended for automotive infotainment applications using software platforms such as Apple CarPlay and Android Auto.

Atlantis provides the following features:

- USB4916 Automotive grade USB 2.0 Hi-Speed hub
  - Two USB 2.0 High Speed downstream ports using USB-C receptacles with CarPlay/Android Auto and 3A battery charging.
  - Two USB 2.0 High Speed downstream ports using USB-A receptacles with CarPlay/Android Auto and 2A battery charging.
  - USB to SMBus bridge
  - USB to I<sup>2</sup>S bridge
  - USB to GPIO bridge
- Accessory Connector provides flexibility for adding additional features
- LED indicators for 5V, 3.3V (green)
- LED indicators for port power (green)
- LED indicator for board reset (red)
- LED indicators for SPI Flash Activity (blue)

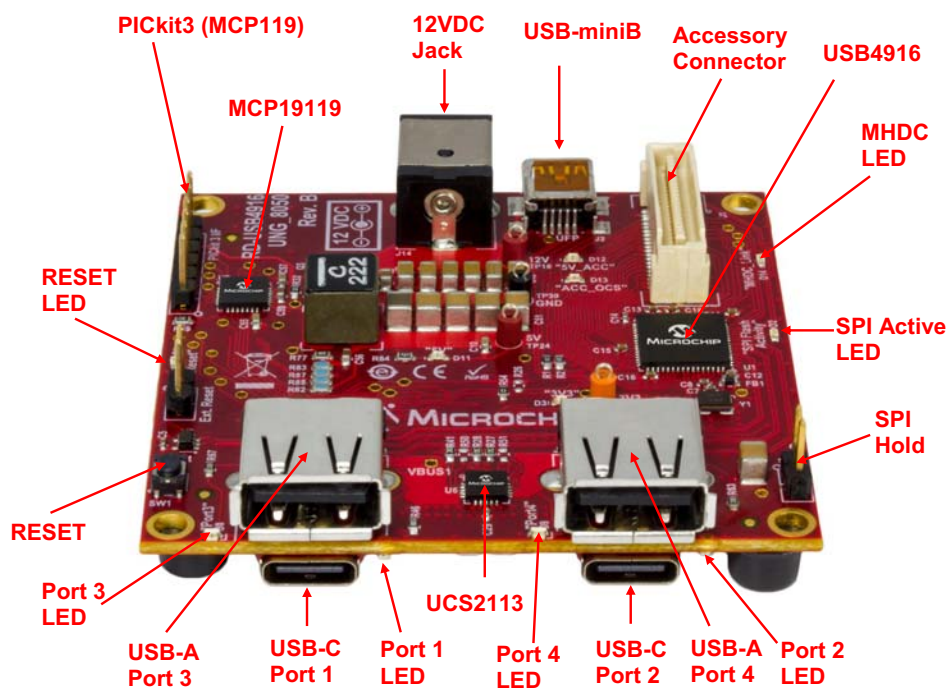
### 1.2 REFERENCES

Concepts and materials available in the following documents may be helpful when reading this document. Visit [www.microchip.com](http://www.microchip.com) for the latest documentation.

- *Microchip Internal Document, USB4904 Automotive Hub*, Rev C, November 2016
- *Microchip Internal Document, USB4916/USB4914 Product Brief*, DS00002154B, November 2016
- *Microchip, UCS2113 Data Sheet*, DS20005680A, December 2015
- *Microchip, MCP19119 Data Sheet*, DS20005350A, October 2014

### 1.3 TERMS AND ABBREVIATIONS

SMBus - Serial Management Bus  
SPI - Serial Protocol Interface  
I<sup>2</sup>S - Inter Integrated Circuit Sound Bus  
BC - Battery Charging  
PPC - Port Power Controller  
DRP - Dual-Role Port



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## Chapter 2. System Requirements

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A typical design project starts with an initial list of project requirements, which is refined as more detail is provided during the review process.

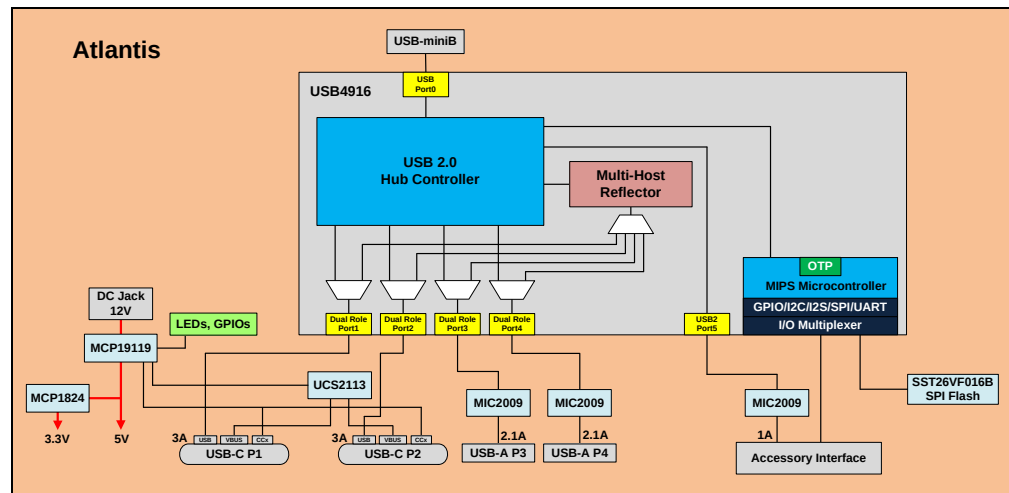
This section outlines the System Design Requirements of Atlantis.

- Atlantis is intended as an application example for the USB4916 USB 2.0 Hi-Speed Multi-Host Automotive Hub Controller with CarPlay and Android Auto support.
- Atlantis will include a USB 2.0 high speed upstream port for connection to an automotive head unit and will use a USB 2.0 mini-B receptacle as is commonly used in automotive head units.
- Atlantis will provide four downstream dual-role ports (DRP): two with USB-C receptacles and two with USB-A receptacles.
- The four USB downstream DRP ports must provide battery charging capability.
- The USB-C ports will provide basic operation at 5V, 3A. Additional features such as power delivery and alternate modes are not required.
- The USB downstream DRP connectors should be on the front.
- LED port power indicators for the USB downstream DRP ports must be next to the corresponding USB connector.
- Atlantis should operate from a 12VDC power supply.
- Atlantis should provide an expansion interface that includes a USB downstream port and all the GPIO (PFX) signals available in the USB4916.
- The 12VDC power connector and the USB upstream port should be on the rear of the board.
- The board footprint should be compact enough to fit in a small enclosure (3" x 3" or less) that could be used in an automotive console.

## 2.1 SYSTEM BLOCK DIAGRAM

Figure 2-1 shows the Atlantis block diagram.

**FIGURE 2-1: ATLANTIS BLOCK DIAGRAM**



The Atlantis block diagram was generated from the requirements list plus additional inputs and refinements during block diagram reviews.

### 2.1.1 Atlantis

At the center of the Atlantis diagram is the USB4916 USB 2.0 High Speed Hub. The USB downstream ports 1 and 2 are each connected to USB-C connectors, and USB downstream ports 3 and 4 are connected to USB-A connectors.

The UCS2113 is a USB dual port power controller used to enable port power and handle overcurrent events for USB ports 1 and 2. It provides up to 3A of battery charging current on each port.

The MIC2039 is a single port power controller, two MIC2039 devices are used to enable port power and handle overcurrent events for USB ports 3 and 4.

The MCP19119 Digitally-Enhanced Power Analog Controller is used to implement the switching 12VDC to 5VDC supply at up to 12A. The MCP19119 includes an MCU with ADC channels and GPIOs and is also used for sampling of the USB-C CCx signals and VBUS power and to control the PWRENx signals to the UCS2113 Port Power Controller.

A 40 pin accessory interface connector provides access to all the programmable function (PFx) pins of the USB4916 and also includes the USB downstream port 5 signals.

## Chapter 3. Schematics Design

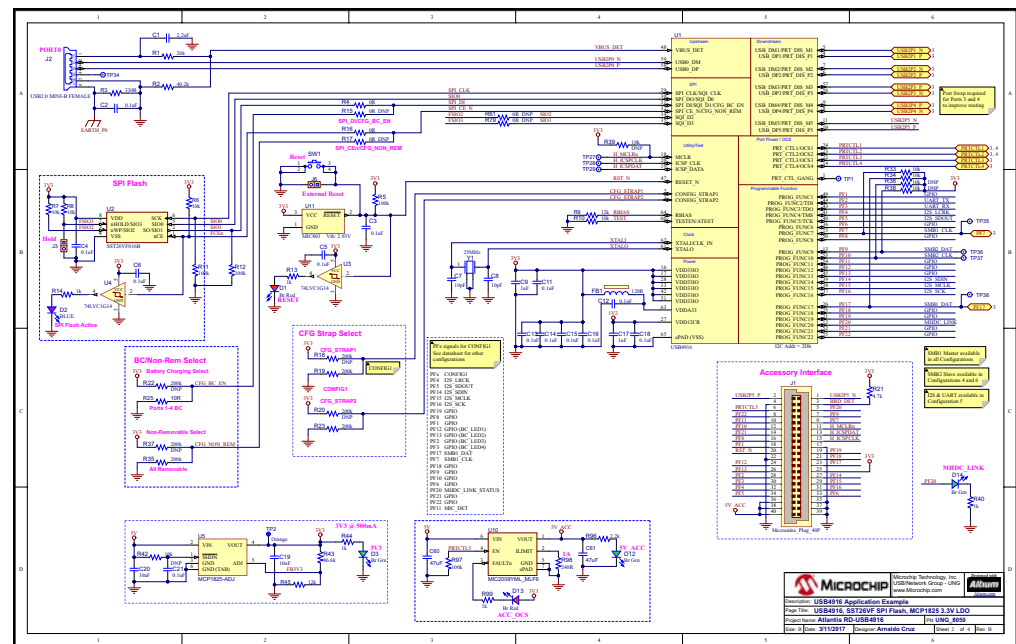
### 3.1 ATLANTIS SCHEMATICS

#### 3.1.1 USB4916 USB 2.0 Hi-Speed Automotive Hub

The USB4916 automotive hub includes the following features:

- USB 2.0 high speed hub with 4 USB downstream Dual-Role Ports (DRPs) with capability to support Apple CarPlay/Android Auto operation
- One additional standard USB downstream port
- USB Bridging to SMBus (I<sup>2</sup>C), I<sup>2</sup>S, UART, SPI, and GPIOs

**FIGURE 3-1: ATLANTIS SCHEMATICS PAGE 2 - USB4916**



The schematics page above shows the USB4916 hub U1 which provides 4 USB DRPs with Multi-Host Reflector connectivity which allows Apple CarPlay operation. The MCP1825 voltage regulator U5 provides 3.3V for local circuitry and includes green LED indicator D3. The reset circuit includes reset pushbutton SW1, the MIC803 reset supervisor U11 to insure that reset is not released until voltage is above 2.9V, and red LED indicator D1. SPI flash U2 is available for optional custom firmware and for test/debug, with blue LED indicator D2 to turning on when the SPI flash is accessed. If the SPI flash is not used two of the SPI signals (SPI\_DI, SPI\_CE\_N) can be used instead as configuration straps for USB downstream port battery charging (Table 3-1) and non-removable port configuration (Table 3-2). Note that battery charging, non-removable ports, and other features can be configured via internal one time programmable (OTP) memory in the USB4916.

**TABLE 3-1: ATLANTIS USB BATTERY CHARGING PORTS CONFIGURATION**

| BC        | Name    | Description                   |
|-----------|---------|-------------------------------|
| No BC     | 200k PD | No battery charging           |
| Port 1    | 200K PU | Battery charging on port 1    |
| Ports 1-2 | 10k PD  | Battery charging on ports 1-2 |
| Ports 1-3 | 10K PU  | Battery charging on ports 1-3 |
| Ports 1-4 | 10 PD   | Battery charging on ports 1-4 |

**TABLE 3-2: ATLANTIS USB NON-REMOVABLE PORTS CONFIGURATION**

| Non_Rem   | Name    | Description             |
|-----------|---------|-------------------------|
| All Rem   | 200k PD | All ports removable     |
| Port 1    | 200K PU | Port 1 non-removable    |
| Ports 1-2 | 10k PD  | Ports 1-2 non-removable |
| Ports 1-3 | 10K PU  | Ports 1-3 non-removable |
| Ports 1-4 | 10 PD   | Ports 1-4 non-removable |

Green LED indicator D14 turns on when the USB4916 internal Multi-Host reflector is active with a USB upstream connection and a USB DRP port that has been switched to be an upstream port. This will occur during an active CarPlay session.

The Atlantis Accessory Interface connector J1 is a 40 pin connector included for system expansion. It includes all the Programmable Function (PFx) pins and the USB downstream port 5 signals from the USB4916. It also has 5V power protected by USB Port Power Controller U10 set at 1A and enabled by a board detect signal generated when a board is plugged into J1. Green LED indicator D12 turns on when the 5V\_ACC is enabled. See [Table 3-3](#) for J1 pin-out.

**TABLE 3-3: ATLANTIS ACCESSORY MODULE INTERFACE SIGNALS**

| Pin | Name      | Description                                                       |
|-----|-----------|-------------------------------------------------------------------|
| 1   | USBP5_N   | USB4916 U1 downstream port 5 USB negative data signal             |
| 2   | USBP5_P   | USB4916 U1 downstream port 5 USB positive data signal             |
| 3   | BRD_DET   | Board detect signal is used to generate PRTCTL5                   |
| 4   | GND       | Reference ground                                                  |
| 5   | PF20      | USB4916 Multi-host link status                                    |
| 6   | PRTCTL5   | Port Control 5 signal is active when Accessory board is connected |
| 7   | PF9       | USB4916 multi-purpose programmable function pin                   |
| 8   | PF22      | USB4916 multi-purpose programmable function pin                   |
| 9   | PF7       | USB4916 SMB1_CLK                                                  |
| 10  | PF11      | USB4916 multi-purpose programmable function pin                   |
| 11  | H_MCLR_N  | USB4916 In-Circuit Serial Programmer Reset                        |
| 12  | PF10      | USB4916 multi-purpose programmable function pin                   |
| 13  | H_ICSPDAT | USB4916 In-Circuit Serial Programmer Data                         |
| 14  | PF21      | USB4916 multi-purpose programmable function pin                   |
| 15  | H_ICSPCLK | USB4916 In-Circuit Serial Programmer Clock                        |
| 16  | PF8       | USB4916 multi-purpose programmable function pin                   |
| 17  | GND       | Reference ground                                                  |

**TABLE 3-3: ATLANTIS ACCESSORY MODULE INTERFACE SIGNALS (CONTINUED)**

| Pin | Name   | Description                                     |
|-----|--------|-------------------------------------------------|
| 18  | PF1    | USB4916 multi-purpose programmable function pin |
| 19  | PF19   | USB4916 multi-purpose programmable function pin |
| 20  | RST_N  | Reset signal from Atlantis                      |
| 21  | PF18   | USB4916 multi-purpose programmable function pin |
| 22  | GND    | Reference ground                                |
| 23  | PF17   | USB4916 SMB1_CLK                                |
| 24  | PF12   | USB4916 multi-purpose programmable function pin |
| 25  | 3V3    | 3.3V at 50 mA for Accessory board               |
| 26  | PF13   | USB4916 multi-purpose programmable function pin |
| 27  | PF14   | USB4916 multi-purpose programmable function pin |
| 28  | PF2    | USB4916 multi-purpose programmable function pin |
| 29  | PF15   | USB4916 multi-purpose programmable function pin |
| 30  | PF3    | USB4916 multi-purpose programmable function pin |
| 31  | PF16   | USB4916 multi-purpose programmable function pin |
| 32  | PF4    | USB4916 multi-purpose programmable function pin |
| 33  | PF6    | USB4916 multi-purpose programmable function pin |
| 34  | PF5    | USB4916 multi-purpose programmable function pin |
| 35  | GND    | Reference ground                                |
| 36  | 5V_ACC | 5V at 1A for Accessory board                    |
| 37  | GND    | Reference ground                                |
| 38  | 5V_ACC | 5V at 1A for Accessory board                    |
| 39  | GND    | Reference ground                                |
| 40  | 5V_ACC | 5V at 1A for Accessory board                    |

The USB4916 configuration strap pins CONFIG\_STRAP1 and CONFIG\_STRAP2 provide various configuration options that sets the functionality of the PFx pins. There are 6 configurations defined that are set with different resistor values. CONFIG\_STRAP2 requires a 200k PD; all other values are undefined. CONFIG\_STRAP1 requires a resistor as shown in [Table 3-4](#). Atlantis is set for CONFIG1.

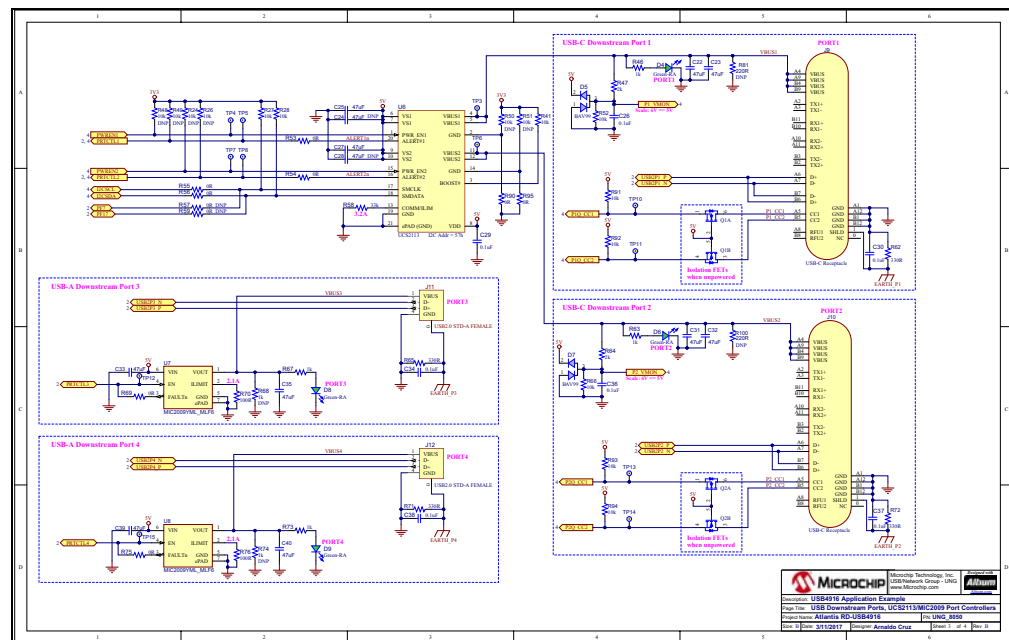
**TABLE 3-4: USB4916 CONFIGURATIONS**

| PFx  | CONFIG1   | CONFIG2 | CONFIG3        | CONFIG4   | CONFIG5    | CONFIG6   |
|------|-----------|---------|----------------|-----------|------------|-----------|
|      | 200k PD   | 200k PU | 10k PD         | 10k PU    | 10R PD     | 10R PU    |
| PF4  | I2S_LRCK  | GPIO    | GPIO           | I2S_LRCK  | I2S_LRCK   | I2S_LRCK  |
| PF5  | I2S_SDOUT | GPIO    | GPIO (BC_LED1) | I2S_SDOUT | I2S_SDOUT  | I2S_SDOUT |
| PF14 | I2S_SDIN  | GPIO    | GPIO (BC_LED2) | I2S_SDIN  | I2S_SDIN   | I2S_SDIN  |
| PF15 | I2S_MCLK  | GPIO    | GPIO (BC_LED3) | I2S_MCLK  | I2S_MCLK   | I2S_MCLK  |
| PF16 | I2S_SCK   | GPIO    | GPIO (BC_LED4) | I2S_SCK   | I2S_SCK    | I2S_SCK   |
| PF19 | GPIO      | GPIO    | UART_nDC D     | GPIO      | UART_nDC D | GPIO      |
| PF8  | GPIO      | GPIO    | UART_nDSR      | GPIO      | UART_nDSR  | GPIO      |

**TABLE 3-4: USB4916 CONFIGURATIONS (CONTINUED)**

| PFx  | CONFIG1          | CONFIG2          | CONFIG3          | CONFIG4          | CONFIG5          | CONFIG6          |
|------|------------------|------------------|------------------|------------------|------------------|------------------|
|      | 200k PD          | 200k PU          | 10k PD           | 10k PU           | 10R PD           | 10R PU           |
| PF1  | GPIO             | GPIO             | UART_nDTR        | GPIO             | UART_nDTR        | GPIO             |
| PF12 | GPIO (BC_LED1)   | GPIO (BC_LED1)   | UART_nCTS        | GPIO (BC_LED1)   | UART_nCTS        | GPIO (BC_LED1)   |
| PF13 | GPIO (BC_LED2)   | GPIO (BC_LED2)   | UART_nRTS        | GPIO (BC_LED2)   | UART_nRTS        | GPIO (BC_LED2)   |
| PF2  | GPIO (BC_LED3)   | GPIO (BC_LED3)   | UART_TX          | GPIO (BC_LED3)   | UART_TX          | GPIO (BC_LED3)   |
| PF3  | GPIO (BC_LED4)   | GPIO (BC_LED4)   | UART_RX          | GPIO (BC_LED4)   | UART_RX          | GPIO (BC_LED4)   |
| PF17 | SMB1_DAT         | SMB1_DAT         | SMB1_DAT         | SMB1_DAT         | SMB1_DAT         | SMB1_DAT         |
| PF7  | SMB1_CLK         | SMB1_CLK         | SMB1_CLK         | SMB1_CLK         | SMB1_CLK         | SMB1_CLK         |
| PF18 | GPIO             | GPIO             | CONNECT_IND1     | PRI_SUSPEND      | GPIO             | GPIO             |
| PF9  | GPIO             | GPIO             | CONNECT_IND2     | SMB2_DAT         | GPIO             | SMB2_DAT         |
| PF10 | GPIO             | GPIO             | CONNECT_IND3     | SMB2_CLK         | GPIO             | SMB2_CLK         |
| PF6  | GPIO             | GPIO             | CONNECT_IND4     | GPIO             | GPIO             | GPIO             |
| PF20 | MHDC_LINK_STATUS | MHDC_LINK_STATUS | MHDC_LINK_STATUS | MHDC_LINK_STATUS | MHDC_LINK_STATUS | MHDC_LINK_STATUS |
| PF21 | GPIO             | GPIO             | GPIO             | GPIO             | GPIO             | GPIO             |
| PF22 | GPIO             | GPIO             | GPIO             | GPIO             | GPIO             | GPIO             |
| PF11 | MIC_DET          | GPIO             | GPIO             | GPIO             | GPIO             | GPIO             |

**FIGURE 3-2: ATLANTIS PAGE 3: USB DOWNSTREAM PORTS**



Downstream ports 3 and 4 are USB 2.0 Type-A ports with 2A battery charging capability using MIC2009YML Port Power Controllers U7 and U8. Green LED indicators D8 and D9 turn on when power is available at Port3 and Port 4 respectively.

[illegible]

### 3.1.1.1 LEDS

**TABLE 3-5: ATLANTIS LEDS**

| LED | Name             | Description                                                                                                                                   |
|-----|------------------|-----------------------------------------------------------------------------------------------------------------------------------------------|
| D1  | RESET            | Red LED indicates the RST_N (reset) signal is asserted, this could be due to pushbutton SW1 being pressed or due to an external reset signal. |
| D2  | SPI Flash Active | Blue LED indicates when the USB4916 is accessing the SPI flash U3.                                                                            |
| D3  | 3V3              | Green LED D3 indicates when 3.3V power is available from LDO regulator U.                                                                     |
| D4  | PORT1            | Green LED indicates when 5V_ACC VBUS power is available at the Accessory Interface connector J1.                                              |

**TABLE 3-5: ATLANTIS LEDS (CONTINUED)**

| LED | Name      | Description                                                                                                                             |
|-----|-----------|-----------------------------------------------------------------------------------------------------------------------------------------|
| D6  | PORT2     | Green LED indicates when 5V_ACC VBUS power is available at the Accessory Interface connector J1.                                        |
| D8  | PORT3     | Green LED indicates when 5V_ACC VBUS power is available at the Accessory Interface connector J1.                                        |
| D9  | PORT4     | Green LED indicates when 5V_ACC VBUS power is available at the Accessory Interface connector J1.                                        |
| D11 | 5V        | Green LED indicates when 5V power is available from the switching regulator supply on page 4.                                           |
| D12 | 5V_ACC    | Green LED indicates when 5V_ACC VBUS power is available at the Accessory Interface connector J1.                                        |
| D13 | ACC_OCS   | Red LED indicates when there is an overcurrent condition on the 5V_ACC rail detected by Port Power Controller U10.                      |
| D14 | MHDC_LINK | Green LED indicates that both USB hosts of the multi-host reflector have enumerated. This will happen during an active CarPlay session. |

## 3.1.1.2 HEADERS

Atlantis Headers are shown in [Table 3-6](#).

**TABLE 3-6: ATLANTIS HEADERS**

| LED | Name           | Description                                                                                                                                                                                                                                             |
|-----|----------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| J3  | HOLD           | The HOLD header J3 is used to force the SPI flash into a hold state when a jumper is inserted, preventing data transfers. This is used when it is desired to force the USB4916 to run code from internal ROM when firmware is present in the SPI flash. |
| J6  | External Reset | The External Reset header J6 is intended for connecting a remote reset switch.                                                                                                                                                                          |
| J15 | PICKit 3 I/F   | The PICKit 3 header J15 is used for programming the MCP19119.                                                                                                                                                                                           |

## Chapter 4. PCB Layout

### 4.1 ATLANTIS LAYOUT

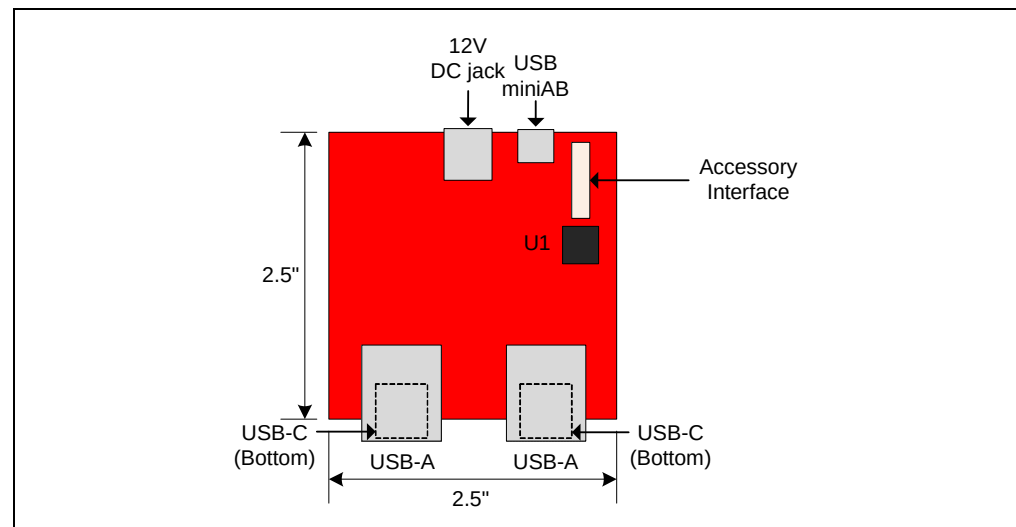
Input to the PCB layout process includes component signal connectivity (netlist), mechanical requirements, and electrical constraints. As part of the electrical constraints, signals that need special attention include high frequency signals, high power rails, and analog signals.

#### 4.1.1 Component Placement

The PCB layout process starts with component placement and initially connector placement.

For the Atlantis board as per the requirements the USB downstream ports need to go on the front and the USB upstream port connector needs to go on the back along with the 12V DC jack connector. Assuming a 2" x 2" board, given the number and size of all the components, a rough placement is shown in [Figure 4-1](#).

**FIGURE 4-1: ATLANTIS PRELIMINARY PLACEMENT**



The rest of the components are then placed paying attention to high frequency signals that may require proximity between certain components, component clearance, or visibility (for example LEDs).

Also it is required to review layout recommendation on component data sheets for any special requirements on component placement and routing.

Nets that need special attention in the Atlantis main layout include:

- USB high speed differential signals - 480 MHz
- SPI flash clocks - 60 MHz
- Crystal oscillator clock - 25 MHz
- 5V - up to 12A
- VBUS1 - up to 3A
- VBUS2 - up to 3A

- VBUS3 - up to 2.1A
- VBUS4 - up to 2.1A
- 5V\_ACC - up to 1A

Signals that need special attention in the Atlantis 12VDC to 5VDC converter layout include:

- Nets connected to Q3, Q4, and L1
- VSEN\_P, VSEN\_N
- ISEN\_P, ISEN\_N

### 4.1.2 Signal Routing

Once all the components are placed and all the footprints are done the design is ready for signal routing. At this point the number of routing layers and layer stackup needs to be selected. For lower noise, it is better to use separate power and ground planes. As such, four layers are used, as listed in [Table 4-1](#):

**TABLE 4-1: ATLANTIS STACKUP**

| Layer | Type   | Description                                 |
|-------|--------|---------------------------------------------|
| 1     | Signal | Signal layer ( <a href="#">Figure 4-2</a> ) |
| 2     | GND    | Ground layer ( <a href="#">Figure 4-3</a> ) |
| 3     | Power  | Power layer ( <a href="#">Figure 4-4</a> )  |
| 4     | Signal | Signal layer ( <a href="#">Figure 4-5</a> ) |

The layer information and other physical requirements such as trace width and spacing, via sizes, and component spacing is added as design rules/constraints into the PCB layout tool used.

FIGURE 4-2: ATLANTIS TOP LAYER

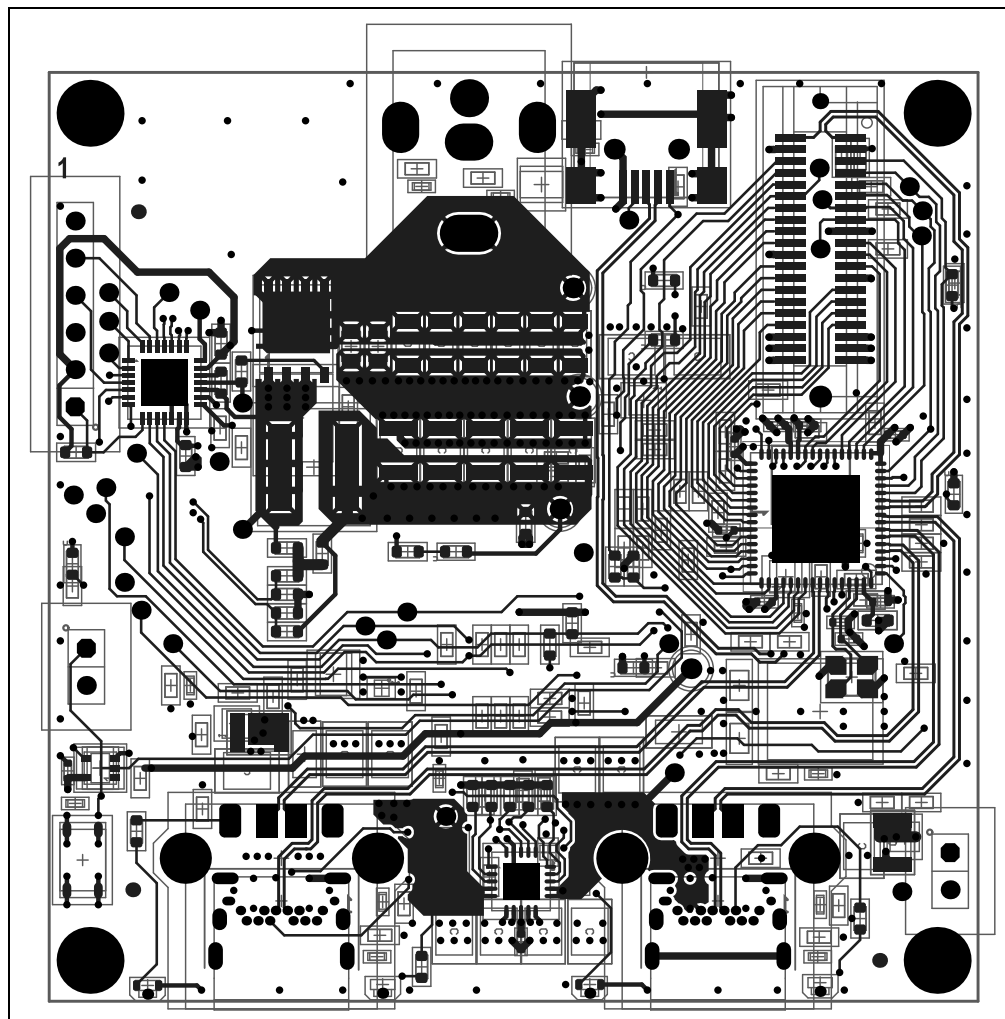


FIGURE 4-3: ATLANTIS GROUND LAYER

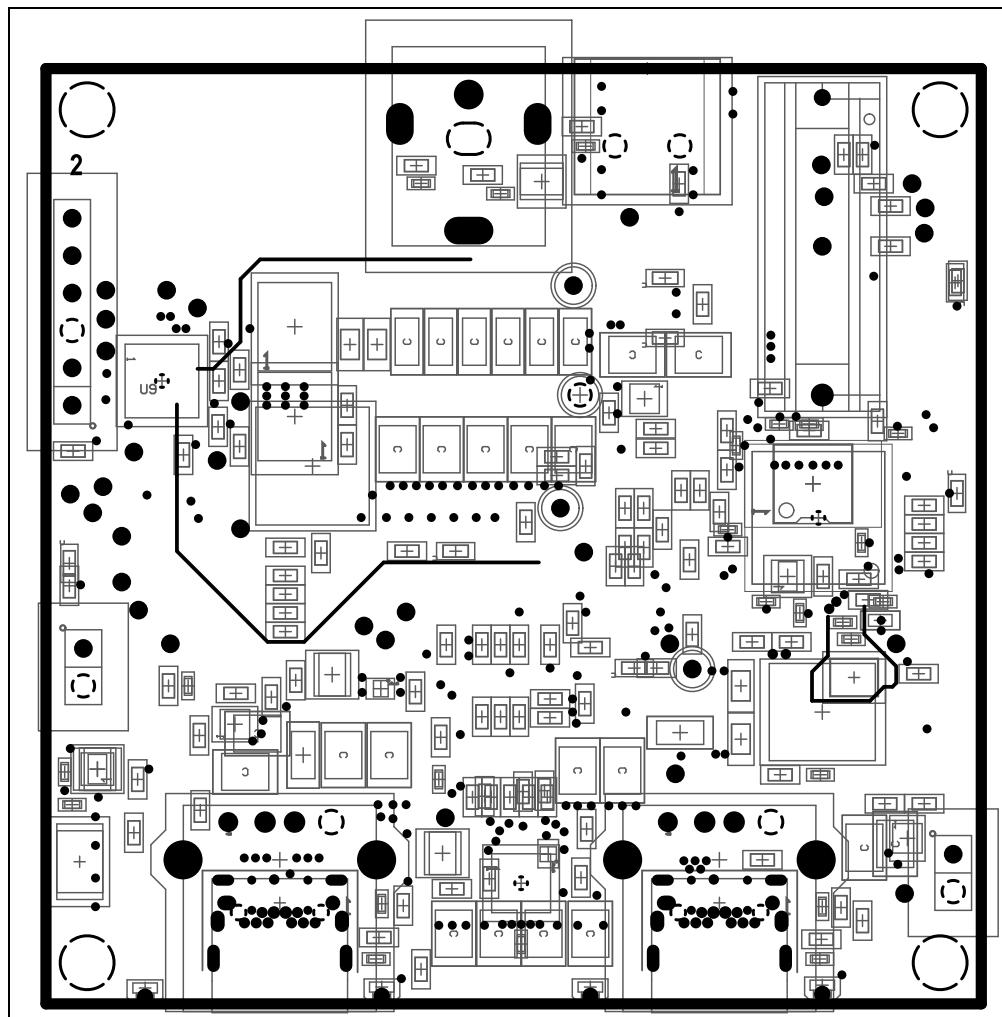


FIGURE 4-4: ATLANTIS POWER LAYER

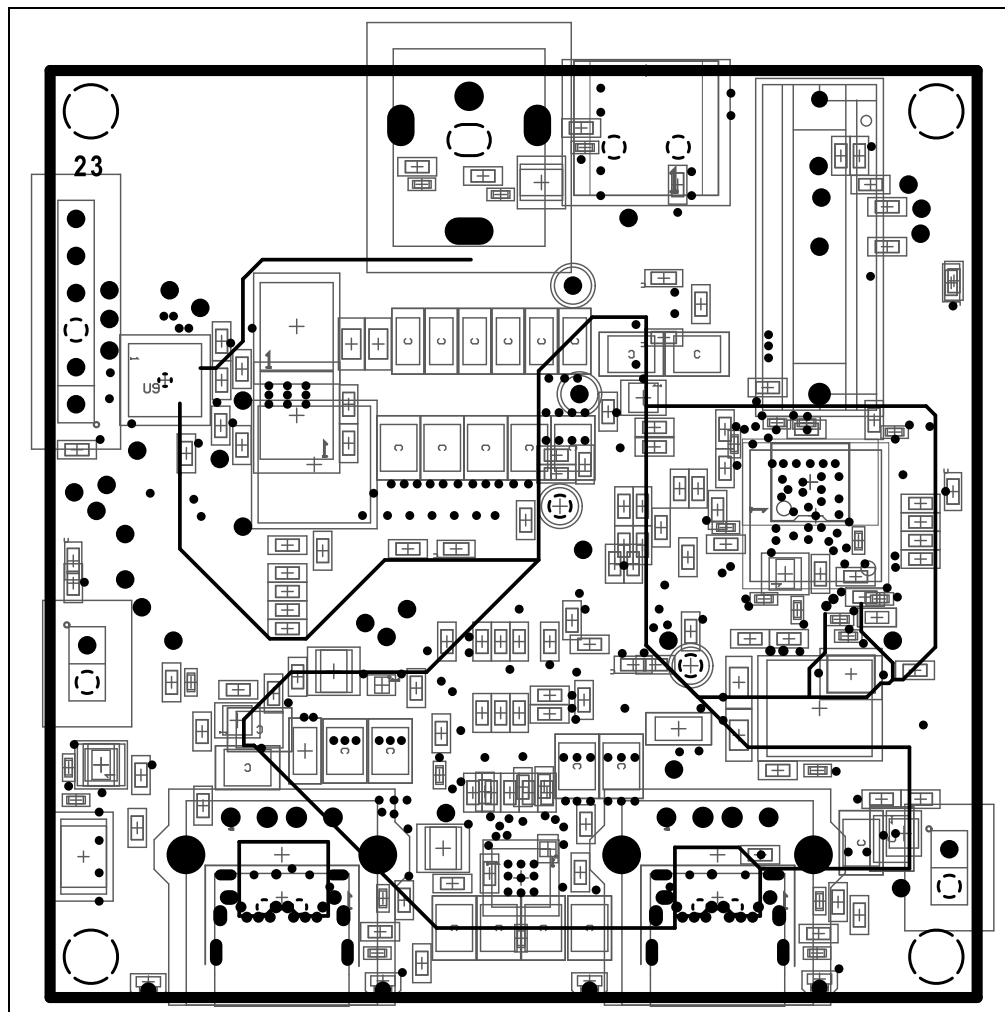
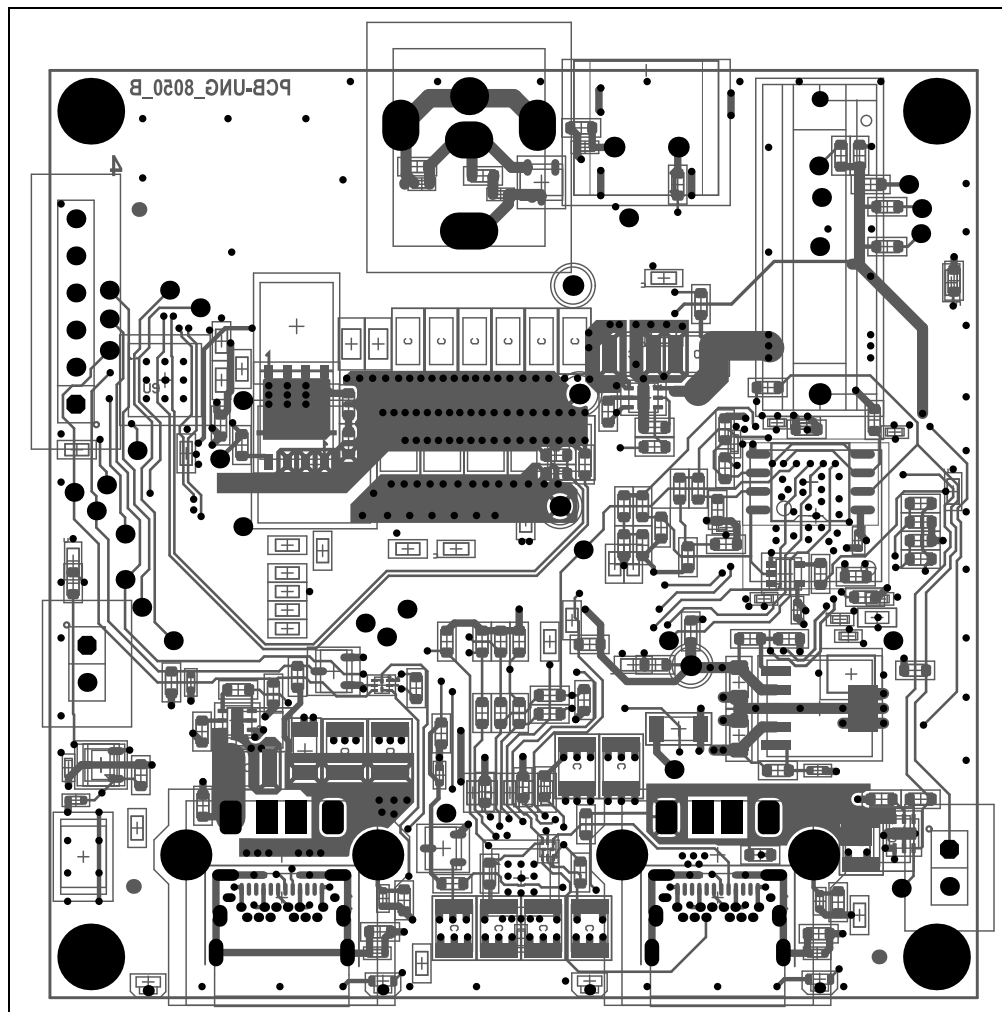


FIGURE 4-5: ATLANTIS BOTTOM LAYER



---

## Chapter 5. Software

---

### 5.1 ATLANTIS SOFTWARE REQUIRED

#### 5.1.1 Firmware

The USB4916 internal ROM firmware is highly functional and no external SPI flash firmware is required for CarPlay/Android Auto operation. At this time, it is recommended to add an SPI footprint during prototype development just in case an issue is encountered.

#### 5.1.2 OTP Programming

OTP programming is required for the USB4916 as follows:

- DP/DM signal swap for USB ports 3 and 4. The DP/DM signals were swapped in the PCB layout to improve routing and avoid vias on the DP/DM traces.
- USB Universal Battery charging enabled on all 4 downstream ports.
- Program Product String: **Atlantis**

#### 5.1.3 System Application

This is software running on the Automotive Head Unit.

The USB host software communicates with the Hub Feature Controller and detects the Product string: **Atlantis**

##### Initialization:

There is no special code required for initialization

**CarPlay Mode:** When iPhone is detected

- Check USB topology to determine which USB downstream DRP port to swap
- Send CarPlay command to selected DRP port/iPhone
- Send SetRole Switch Setup Packet command to Hub for the selected DRP

#### 5.1.4 Example Linux Code to Initiate a CarPlay Session

```
*  
  
* ENDPOINT_REFLECTOR_COMMAND.c - Sample application for issuing the  
* ENDPOINT REFLECTOR COMMAND in order to  
*                                     initiate an automotive CarPlay Mode Session  
*  
* Copyright (C) 2013-2016 Microchip Technology Germany II GmbH & Co. KG  
*  
* Andrew Rogers <andrew.rogers@microchip.com>  
* Christian Gromm <christian.gromm@microchip.com>  
*
```

```
* This program is distributed in the hope that it will be useful,  
* but WITHOUT ANY WARRANTY; without even the implied warranty of  
* MERCHANTABILITY or FITNESS FOR A PARTICULAR PURPOSE. See the  
* GNU General Public License for more details.  
*  
* This file is licensed under GPLv2.  
*  
*/  
  
#include <stdio.h>  
#include <stdlib.h>  
#include <string.h>  
#include <pthread.h>  
#include <libusb.h>  
#include <semaphore.h>  
#include <errno.h>  
  
/* the buffer sizes can exceed the USB MTU */  
#define MAX_CTL_XFER64  
#define MAX_BULK_XFER512  
  
/* replace this with your ID pair  
* VENDOR_ID is always 0x0424 for Microchip/SMSC Hubs  
* PRODUCT_ID is 0x4940 for the USB4715/USB49xx Family internal Hub Feature  
Controller Device  
* Note: Endpoint Reflector Command is not issued to Hub.  
*/  
  
#define VENDOR_ID0x0424  
#define PRODUCT_ID0x4940  
#define VENDOR_ID_IPHONE 0x05AC  
#define PRODUCT_ID_IPHONE 0x12A8  
  
/**  
* struct my_usb_device - struct that ties USB related stuff  
* @dev: pointer libusb devic  
* @dev_handle: device handle for USB devices  
* @ctx: context of the current session  
* @device_desc: structure that holds the device descriptor fields  
* @inbuf: buffer for USB IN communication  
* @outbut: buffer for USB OUT communication  
*/
```

---

```

struct libusb_session {
    libusb_device **dev;
    libusb_device_handle *dev_handle;
    libusb_context *ctx;
    struct libusb_device_descriptor device_desc;
    unsigned char inbuf[MAX_CTL_XFER];
    unsigned char outbuf[MAX_BULK_XFER];
    uint16_t wValue;
    int port_num;
};

static struct libusb_session session;

int main(int argc, char **argv)
{
    int r,i,z;
    char yesno[] = "";
    int timeout_time;
    char port_select[] = "";
    ssize_t cnt;
    int port;
    int err = 0;
    //uint16_t wValue;

    printf("This demo will show off the Endpoint Reflector command.\n");

    printf("Setup the Endpoint Reflector Command....\n");
    printf("If smartphone does not enumerate NCM device within 'X' time, the hub
will revert to default.\n");
    TIMEOUT:
    printf("0-No
Timeout\n1-10ms\n2-100ms\n3-500ms\n4-1s\n5-5s\n6-10s\n7-20s\n");
    scanf("%i", &timeout_time);
    switch(timeout_time){
        case 0:
            printf("No timeout selected\n");
            printf("Which port will the command be sent to?\n");
            scanf("%s", port_select);
            if (strcmp(port_select, "1") == 0)
            {
                printf("Port 1 selected\n");
                session.port_num = 1;
            }
        }
    }

```

---

```
        session.wValue = 0x0011;
    }
    else if(strcmp(port_select, "2") == 0)
    {
        printf("Port 2 selected\n");
        session.port_num = 2;
        session.wValue = 0x0012;
    }
    else if(strcmp(port_select, "3") == 0)
    {
        printf("Port 3 selected\n");
        session.port_num = 3;
        session.wValue = 0x0013;
    }
    else if(strcmp(port_select, "4") == 0)
    {
        printf("Port 4 selected\n");
        session.port_num = 4;
        session.wValue = 0x0014;
    }
    else
    {
        printf("Invalid Port Selected\n");
        while(getchar()!='\n');
        goto TIMEOUT;
    }
    break;
```

case 1:

```
    printf("Timeout of 10ms selected\n");
    printf("Which port will the command be sent to?\n");
    scanf("%s", port_select);
    if (strcmp(port_select, "1") == 0)
    {
        printf("Port 1 selected\n");
        session.port_num = 1;
        session.wValue = 0x0111;
    }
    else if(strcmp(port_select, "2") == 0)
    {
        printf("Port 2 selected\n");
        session.port_num = 2;
        session.wValue = 0x0112;
```

---

```

    }
    else if(strcmp(port_select, "3") == 0)
    {
        printf("Port 3 selected\n");
        session.port_num = 3;
        session.wValue = 0x0113;
    }
    else if(strcmp(port_select, "4") == 0)
    {
        printf("Port 4 selected\n");
        session.port_num = 4;
        session.wValue = 0x0114;
    }
    else
    {
        printf("Invalid Port Selected\n");
        while(getchar() != '\n');
        goto TIMEOUT;
    }
    break;

```

case 2:

```

printf("Timeout of 100ms selected\n");
printf("Which port will the command be sent to?\n");
scanf("%s", port_select);
if (strcmp(port_select, "1") == 0)
{
    printf("Port 1 selected\n");
    session.port_num = 1;
    session.wValue = 0x0211;
}
else if(strcmp(port_select, "2") == 0)
{
    printf("Port 2 selected\n");
    session.port_num = 2;
    session.wValue = 0x0212;
}
else if(strcmp(port_select, "3") == 0)
{
    printf("Port 3 selected\n");
    session.port_num = 3;
    session.wValue = 0x0213;
}

```

```
        else if(strcmp(port_select, "4") == 0)
        {
            printf("Port 4 selected\n");
            session.port_num = 4;
            session.wValue = 0x0214;
        }
        else
        {
            printf("Invalid Port Selected\n");
            while(getchar()!='\n');
            goto TIMEOUT;
        }
        break;

case 3:
    printf("Timeout of 500ms selected\n");
    printf("Which port will the command be sent to?\n");
    scanf("%s", port_select);
    if (strcmp(port_select
```

---

---

**NOTES:**



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## Chapter 6. Hardware Testing

---

### 6.1 ATLANTIS HARDWARE TESTING

Once boards are received from assembly they should be visually inspected for any assembly problems. A voltmeter can be used to verify that no shorts are present on the power rails.

A check against the BOM (Bill of Materials) is recommended to insure that the correct components are assembled on the board. During this process orientation of ICs should be verified.

#### 6.1.1 Powering Up and Programming the MCP19119

Using a 12VDC bench supply with current limit capability connect the 12V and ground to DC jack J14. Set the supply for 12V with a current limit of 0.2A and power up the supply. Since the MCP19119 is un-programmed at this time the board 5V and 3.3V rails are not powered. The MCP19119 has an internal LDO which provide 5V (5%), with a voltmeter verify that this voltage is available at pin 1 of J15. Once this is verified, connect a PICkit-3 to J15 and program the MCP19119.

#### 6.1.2 5V and 3V3 Voltages

After programming the MCP19119 verify with a voltmeter that 5.25V is available at TP24 and green LED D11 is on.

- 5.25V at TP25 and green LED D11 is on
- 3.3V at TP2 and green LED D3 is on

#### 6.1.3 MCP19119 Switching Regulator

A more detailed test of the MCP19119 switching regulator circuit includes verifying the output voltage ripple, and operation under various load conditions, including the maximum rated load current using an electronic load.

#### 6.1.4 Functional Test

With Atlantis powered on connect a USB mini-B cable to the USB upstream connector J2 and the other end of the cable to a USB-A port on a PC. The PC should enumerate the USB4916 as a generic USB Hub.

The USB-A ports 3 and 4 are standard ports and should be enabled after the USB4916 enumeration. The green LED D8 should be turned on for USB port 3, the green LED D9 should be turned on for USB port 4.

Connect a USB flash drive to USB ports 3 and 4 and verify that they show up as storage devices on the PC. You should verify operation by transferring files to each drive. An overcurrent condition should be generated on each downstream port by shorting VBUS to ground to verify overcurrent handling by the port controller. For shorting VBUS a small clip can be connected to the VBUS pin of the USB-A connector, a USB pass-through dongle could also be used.

The USB-C ports are enabled only when a device is connected, with nothing connected there is no VBUS voltage on the USB-C connectors. Connect a USB-C flash drive or use a USB-C plug to USB-A receptacle adapter to connect a flash drive to each port.

Port 1 green LED D4 and Port 2 green LED D6 should turn on. Verify each flash drive shows up as a storage devices on the PC. You should verify operation by transferring files to each drive. An overcurrent condition should be generated on each downstream port by shorting VBUS to ground to verify overcurrent handling by the port controller. For shorting VBUS TP3 can be used for Port 1 and TP6 for Port 2.

### 6.1.5 USB Battery Charging

USB battery charging can be enabled by use of the USB4916 battery charging strap pin or by OTP. The Atlantis boards use OTP for enabling battery charging on all downstream ports. When using the battery charging strap pin, the SPI flash is not available since this pin is shared with SPI\_DI. In most applications the SPI flash is not used so the pins are available. To use the battery charging strap, remove R4 and solder it at location R15. This will enable battery charging for all 4 downstream ports.

The USB4916 OTP can be programmed with the Protouch tool.

### 6.1.6 Reset Circuit

To test the reset circuit press the reset pushbutton SW1 and verify that red LED D1 turns on while SW1 is pressed.

With the board powered off verify that red LED D1 turns on for a few seconds when the board is powered on.

Using a scope verify that from a powered off condition the reset signal is not released before the 3V3 power rails is at 2.93V.

### 6.1.7 USB Signal Quality Tests

As a USB Hub Atlantis should pass all the required USB-IF compliance tests. Signal quality tests were run on the upstream and the four DRP downstream ports as shown in the next figures.

**FIGURE 6-1: ATLANTIS UPSTREAM PORT**

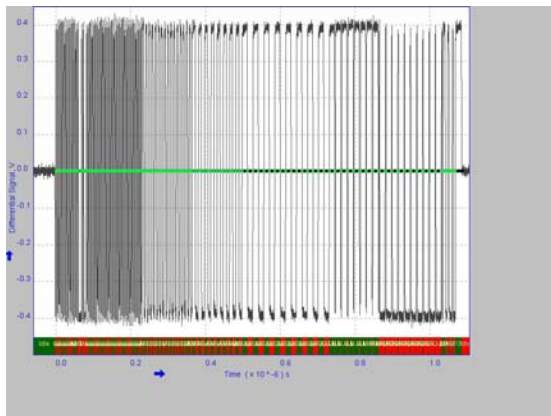
## Signal Quality Test Results in Tek format

**Device ID:** hs\_001

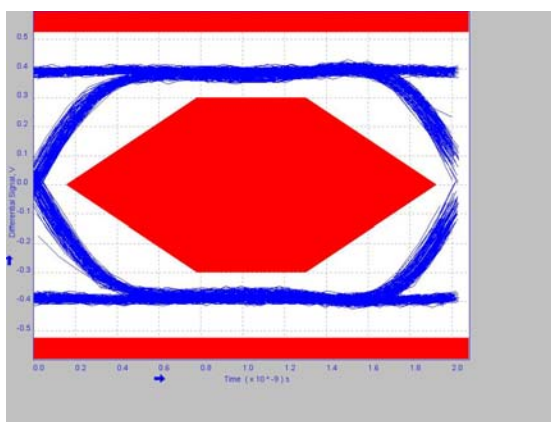
**Device Description:** High Speed, Near End Device, Up Stream Testing, Tier 1, UNG\_8050 Rev A S/N 15.

**Date:** Fri Dec 16 13:58:42 EST 2016

**Overall Result:** Pass\*



Waveform Plot



Eye Diagram

Results based on USB-IF / Waiver Limits :

| Measurement Name   | Minimum       | Maximum       | Mean          | pk-pk         | Standard Deviation | RMS           | Population | Status |
|--------------------|---------------|---------------|---------------|---------------|--------------------|---------------|------------|--------|
| Monotonic Property | -             | -             | -             | -             | -                  | -             | 0          | Pass   |
| Eye Diagram Test   | -             | -             | -             | -             | -                  | -             | -          | Pass   |
| Signal Rate        | 472.9375Mbps  | 488.7586Mbps  | 480.0407Mbps  | 0.0000bps     | 2.892382Mbps       | 480.2230Mbps  | 512        | Pass   |
| EOP Width          | -             | -             | 16.58821ns    | -             | -                  | -             | 1          | Pass   |
| EOP Width (Bits)   | -             | -             | 7.963018      | -             | -                  | -             | 1          | Pass   |
| Falling Edge Rate  | 1.094454kV/us | 1.271756kV/us | 1.192326kV/us | 177.3013 V/us | 34.33026 V/us      | 1.192815kV/us | 107        | Pass   |
| Rising Edge Rate   | 1.129236kV/us | 1.298501kV/us | 1.217308kV/us | 169.2642 V/us | 35.81777 V/us      | 1.217830kV/us | 108        | Pass   |

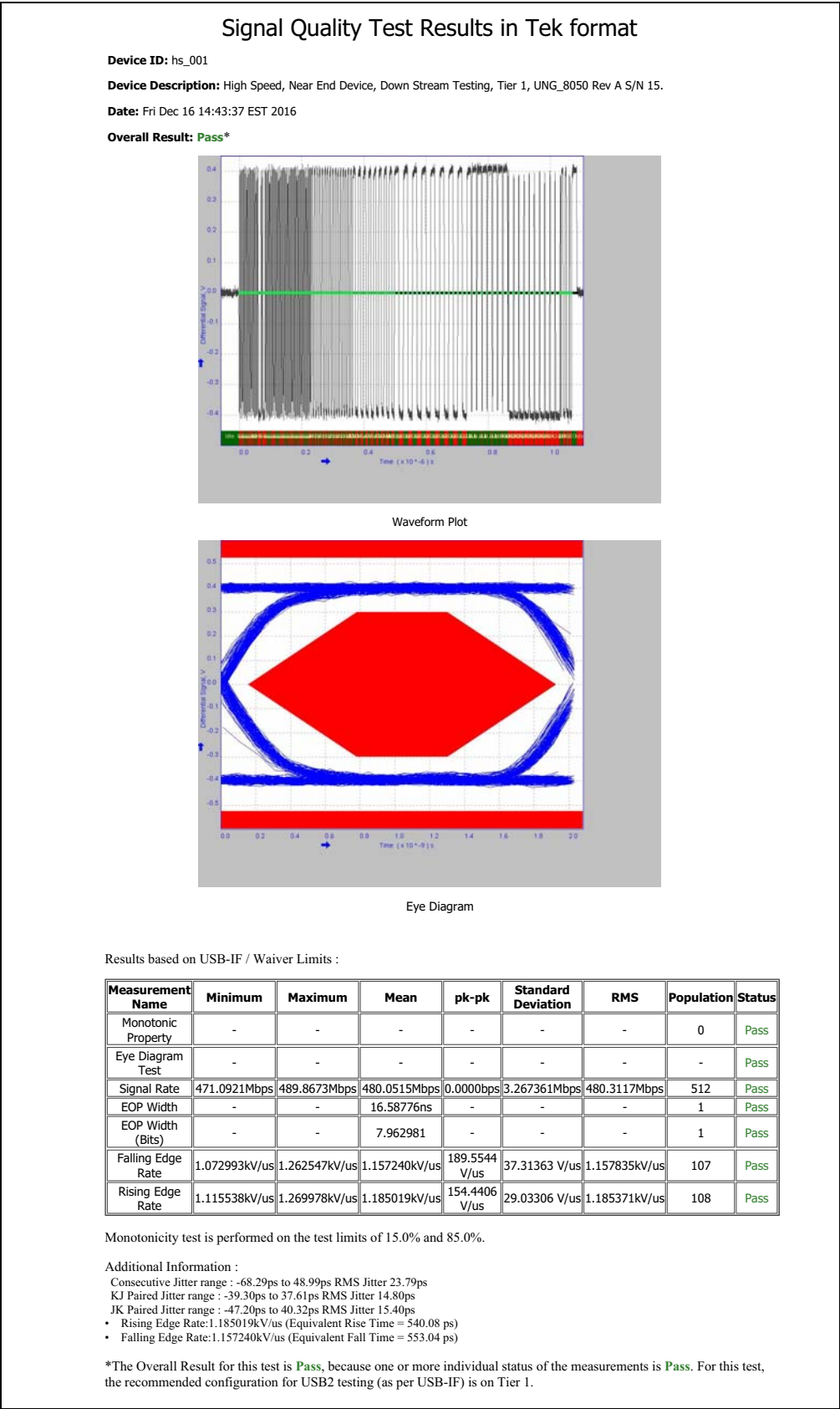
Monotonicity test is performed on the test limits of 15.0% and 85.0%.

Additional Information :

- Consecutive Jitter range : -77.94ps to 54.97ps RMS Jitter 27.69ps
- KJ Paired Jitter range : -34.58ps to 38.04ps RMS Jitter 15.62ps
- JK Paired Jitter range : -42.15ps to 31.69ps RMS Jitter 15.72ps
- Rising Edge Rate:1.217308kV/us (Equivalent Rise Time = 525.75 ps)
- Falling Edge Rate:1.192326kV/us (Equivalent Fall Time = 536.77 ps)

\*The Overall Result for this test is **Pass**, because one or more individual status of the measurements is **Pass**. For this test, the recommended configuration for USB2 testing (as per USB-IF) is on Tier 1.

FIGURE 6-2: ATLANTIS DOWNSTREAM PORT 1



**FIGURE 6-3: ATLANTIS DOWNSTREAM PORT 2**

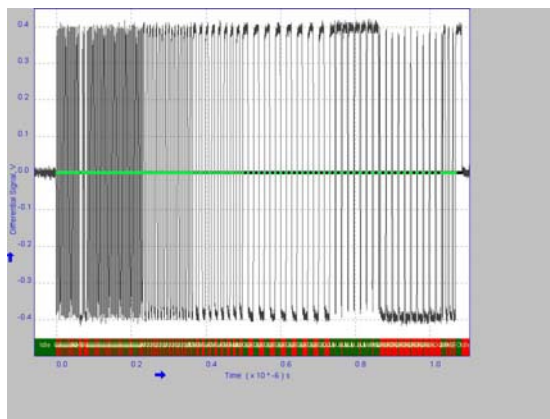
## Signal Quality Test Results in Tek format

**Device ID:** hs\_001

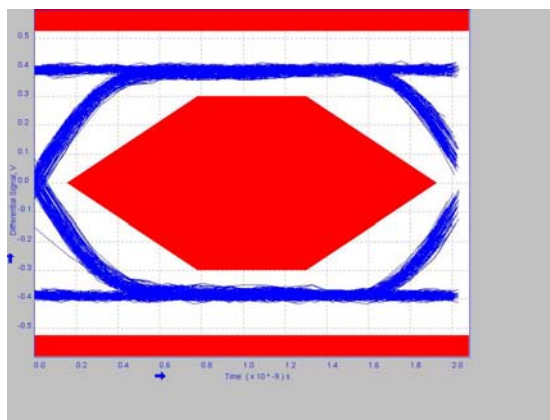
**Device Description:** High Speed, Near End Device, Down Stream Testing, Tier 1, UNG\_8050 Rev A S/N 15.

**Date:** Fri Dec 16 14:45:15 EST 2016

**Overall Result:** Pass\*



Waveform Plot



Eye Diagram

Results based on USB-IF / Waiver Limits :

| Measurement Name   | Minimum       | Maximum       | Mean          | pk-pk         | Standard Deviation | RMS           | Population | Status |
|--------------------|---------------|---------------|---------------|---------------|--------------------|---------------|------------|--------|
| Monotonic Property | -             | -             | -             | -             | -                  | -             | 0          | Pass   |
| Eye Diagram Test   | -             | -             | -             | -             | -                  | -             | -          | Pass   |
| Signal Rate        | 472.5738Mbps  | 489.7505Mbps  | 480.0509Mbps  | 0.0000bps     | 2.973829Mbps       | 480.1986Mbps  | 512        | Pass   |
| EOP Width          | -             | -             | 16.54835ns    | -             | -                  | -             | 1          | Pass   |
| EOP Width (Bits)   | -             | -             | 7.944050      | -             | -                  | -             | 1          | Pass   |
| Falling Edge Rate  | 1.070891kV/us | 1.212183kV/us | 1.144017kV/us | 141.2921 V/us | 32.02680 V/us      | 1.144461kV/us | 107        | Pass   |
| Rising Edge Rate   | 1.062968kV/us | 1.248856kV/us | 1.161424kV/us | 185.8887 V/us | 30.84290 V/us      | 1.161830kV/us | 108        | Pass   |

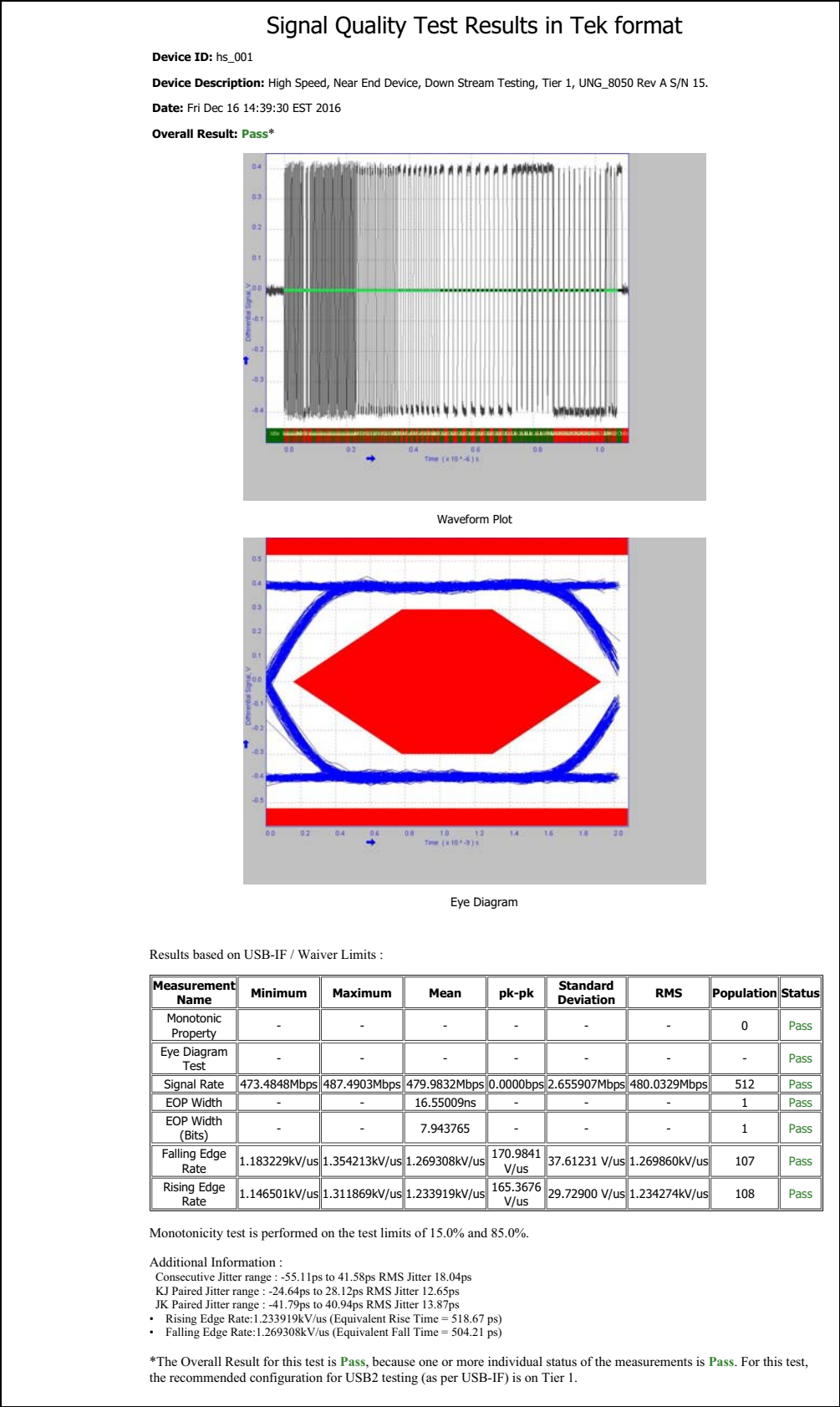
Monotonicity test is performed on the test limits of 15.0% and 85.0%.

Additional Information :

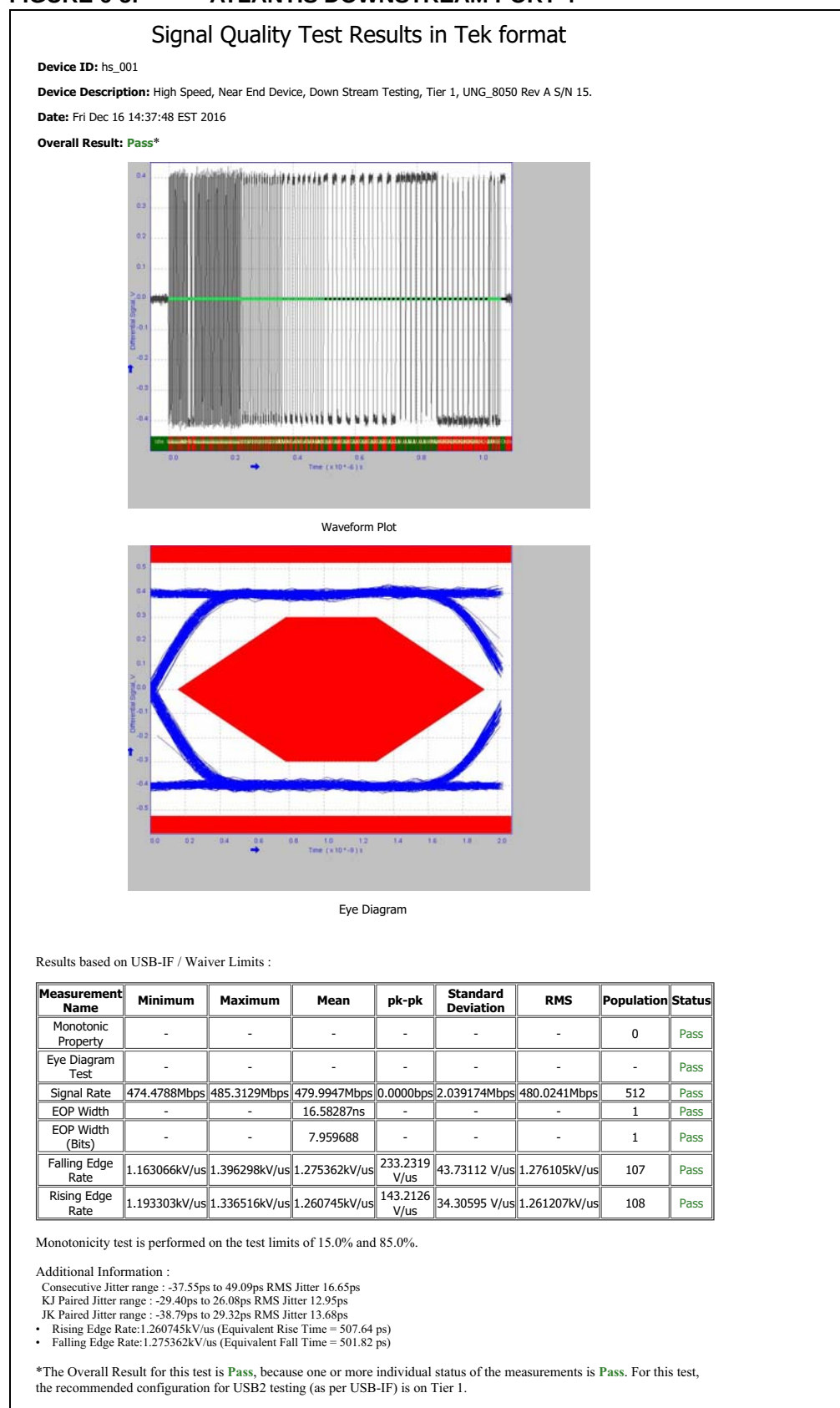
- Consecutive Jitter range : -49.63ps to 61.99ps RMS Jitter 24.35ps
- KJ Paired Jitter range : -31.52ps to 40.69ps RMS Jitter 15.20ps
- JK Paired Jitter range : -37.62ps to 29.85ps RMS Jitter 12.95ps
- Rising Edge Rate:1.161424kV/us (Equivalent Rise Time = 551.05 ps)
- Falling Edge Rate:1.144017kV/us (Equivalent Fall Time = 559.43 ps)

\*The Overall Result for this test is **Pass**, because one or more individual status of the measurements is **Pass**. For this test, the recommended configuration for USB2 testing (as per USB-IF) is on Tier 1.

FIGURE 6-4: ATLANTIS DOWNSTREAM PORT 3



**FIGURE 6-5: ATLANTIS DOWNSTREAM PORT 4**

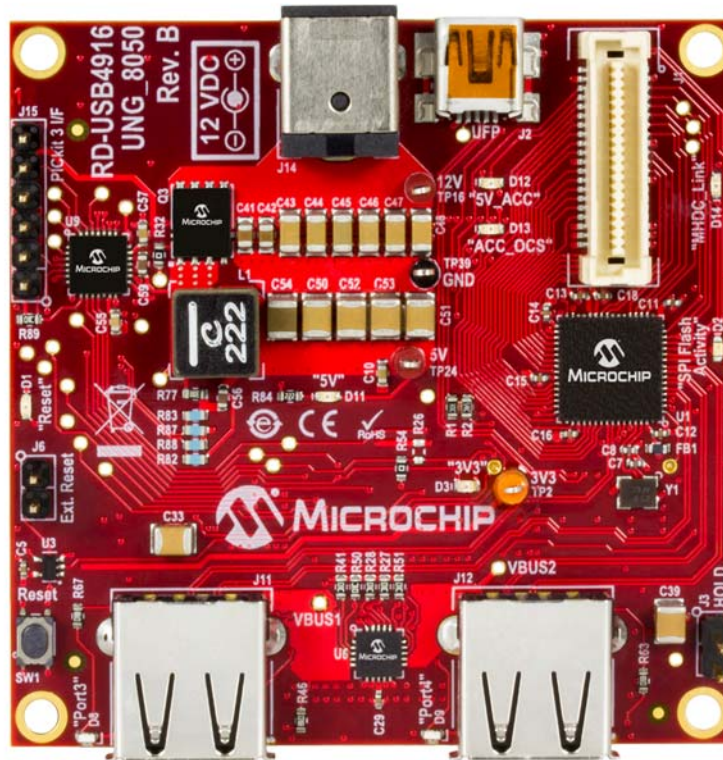


NOTES:

## Appendix A. Atlantis Top View

### A.1 ATLANTIS TOP VIEW

FIGURE A-1: ATLANTIS TOP VIEW



NOTES:

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## **Appendix B. Atlantis Evaluation Board Schematics**

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### **B.1 INTRODUCTION**

This appendix shows the Atlantis Evaluation Board Schematics.

| Table of Contents |                                                        |
|-------------------|--------------------------------------------------------|
| Sheet             | Description                                            |
| 1                 | Table of Contents, Revision History, Block Diagram     |
| 2                 | USB4916, SST26VF SPI Flash, MCP1825 3.3V LDO           |
| 3                 | USB Downstream Ports, UCS2113/MIC2009 Port Controllers |
| 4                 | MCP19119 12V to 5V Switching Regulator                 |

| Notes |                                                                  |
|-------|------------------------------------------------------------------|
| 1     | All resistors are 1% unless specified otherwise                  |
| 2     | Shunt jumper default selections are marked with an asterisk [*]. |

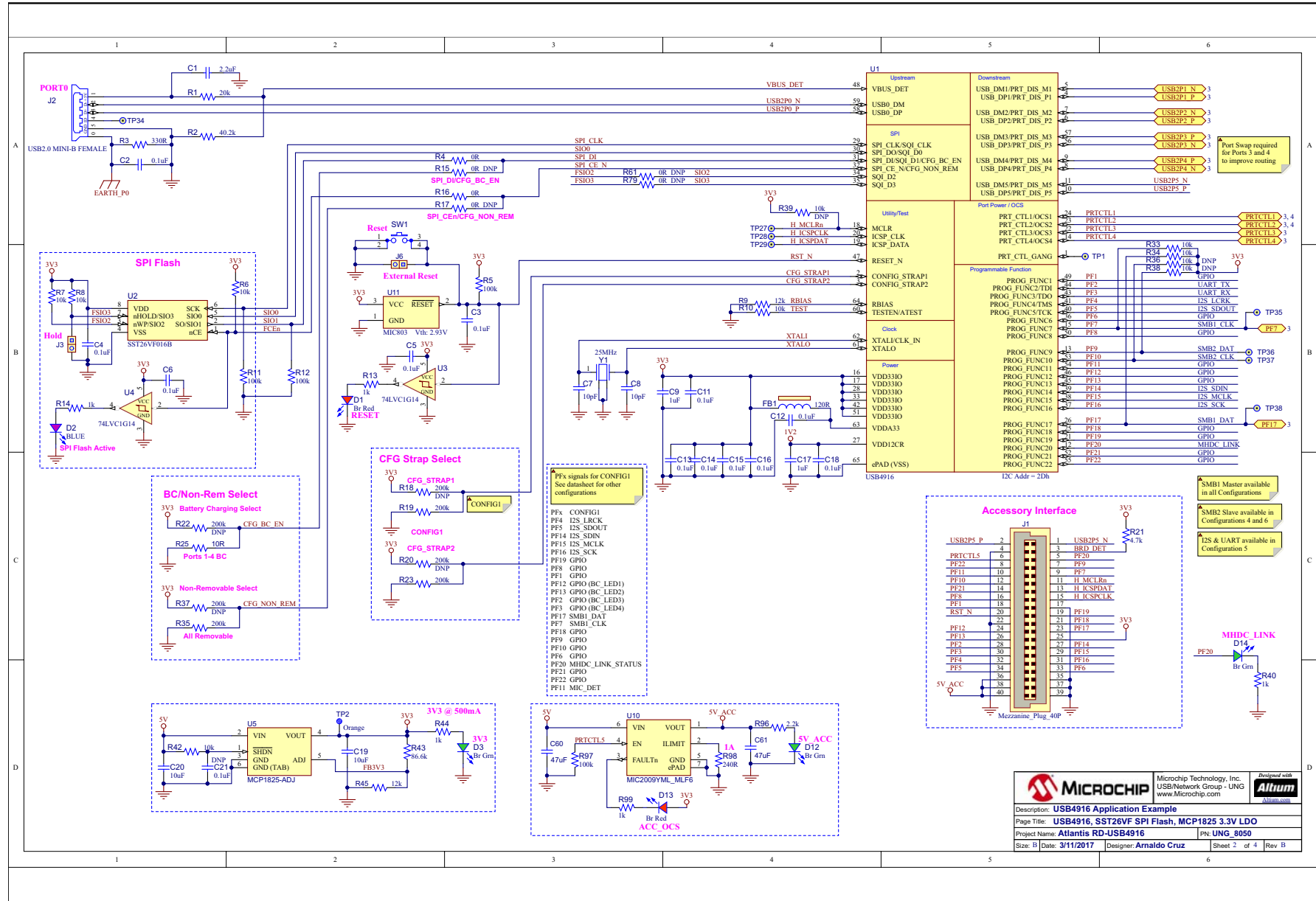
| Revision History |            |                                                                                                                                                                    |         |
|------------------|------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------|
| Revision         | Date       | Revision Summary                                                                                                                                                   | Author  |
| B                | 12-07-2016 | From Rev A: replaced J14 for DC Jack, switched U9-5(PRTCTL1) with U9-21(P2_VMON). Added 0R resistors R61, R79 to allow disconnect of SIO2, SIO3 from SPI flash U2. | A. Cruz |
| B1               | 3-10-2017  | U6 replaced with UCS2113, added Pfx table and updated schematic Page Titles.                                                                                       | A. Cruz |
|                  |            |                                                                                                                                                                    |         |
|                  |            |                                                                                                                                                                    |         |
|                  |            |                                                                                                                                                                    |         |
|                  |            |                                                                                                                                                                    |         |
|                  |            |                                                                                                                                                                    |         |
|                  |            |                                                                                                                                                                    |         |

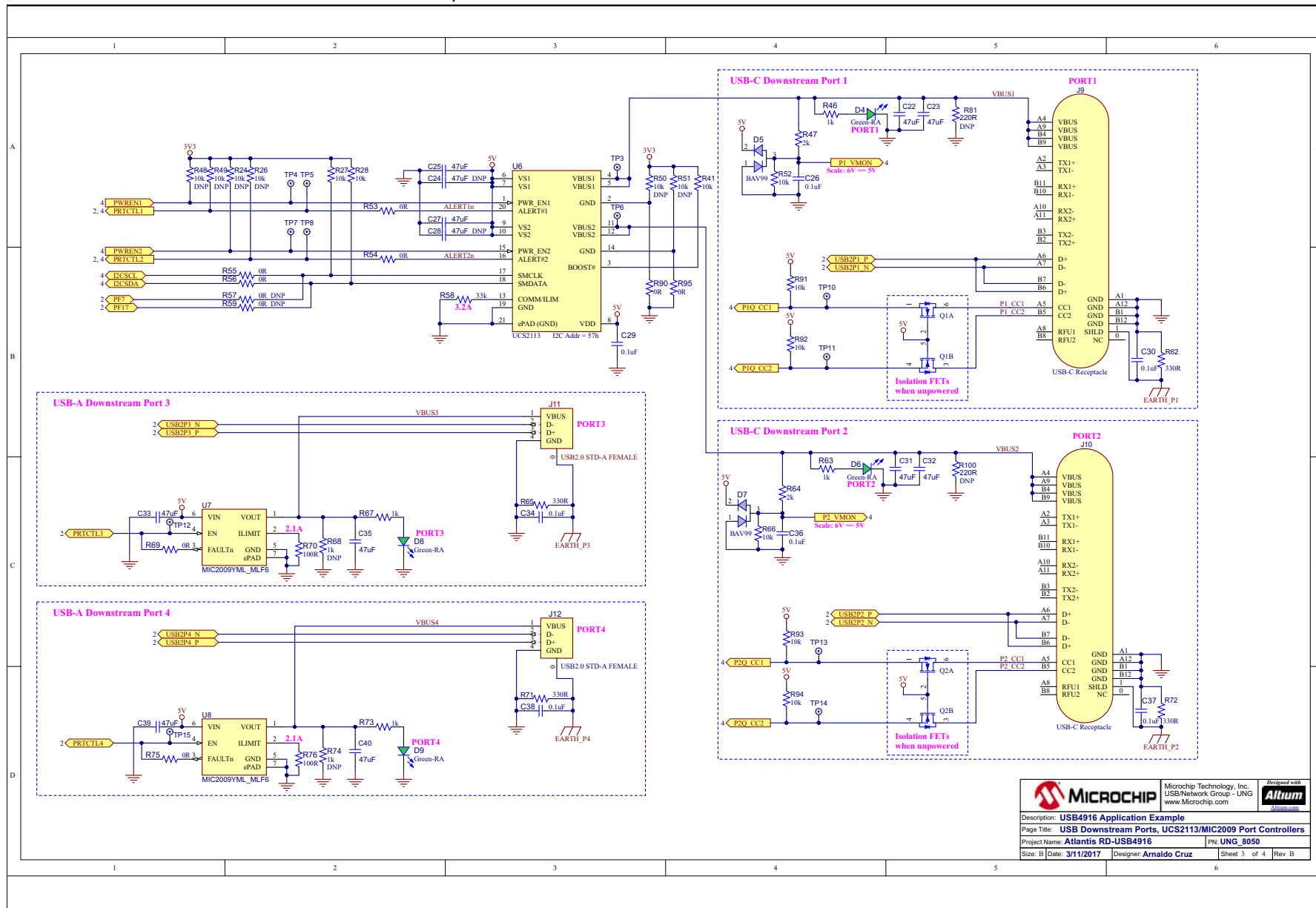
**Atlantis**

MICROCHIP  
 Description: **USB4916 Application Example**  
 Page Title: **Table of Contents, Revision History, Block Diagram**  
 Project Name: **Atlantis RD-USB4916**      PN: **UNG\_8050**  
 Size: B | Date: **3/11/2017**    Designer: **Arnaldo Cruz**    Sheet 1 of 4    Rev B

FIGURE B-2: USB4916, SST26VF SPI FLASH, MCP1825 3.3V LDO

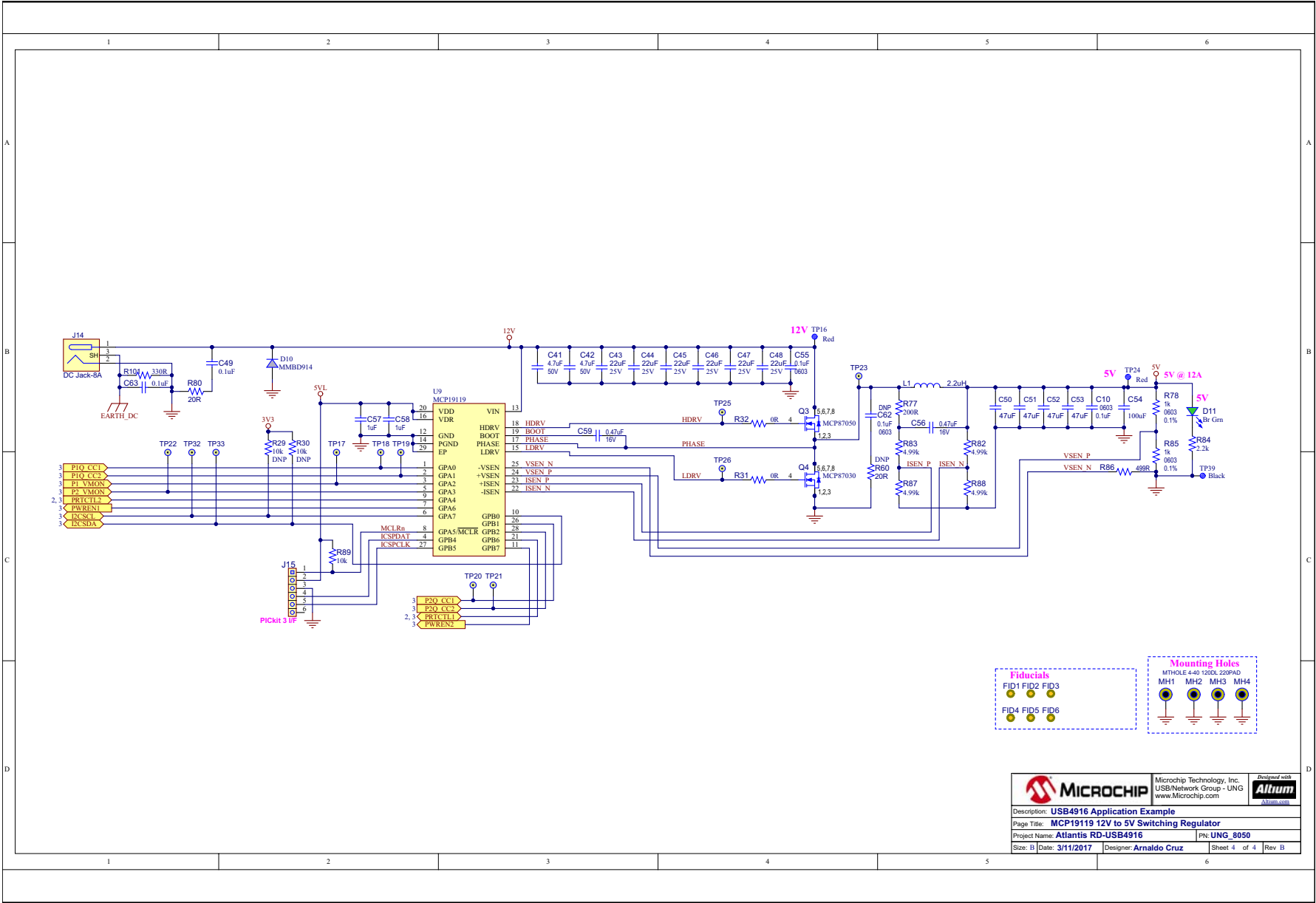


**FIGURE B-3: USB DOWNSTREAM PORTS, UCS2112/MIC2039 PORT CONTROLLERS**



|  |                                                                                                                                                                                                                                                                                         |               |
|--|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------|
|  | Microchip Technology, Inc.                                                                                                                                                                                                                                                              | Designed with |
|  | USB/Network Group - UNG                                                                                                                                                                                                                                                                 |               |
|  | www.Microchip.com                                                                                                                                                                                                                                                                       |               |
|  | Description: <b>USB4916 Application Example</b><br>Page Title: <b>USB Downstream Ports, UCS2113/MIC2009 Port Controllers</b><br>Project Name: <b>Atlantis RD-USB4916</b> P/N: <b>UNG_8050</b><br>Size: B   Date: <b>3/11/2017</b> Designer: <b>Arnaldo Cruz</b> Sheet 3 of 4      Rev B |               |

FIGURE B-4: MCP19119 12V TO 5V SWITCHING REGULATOR



NOTES:

## Appendix C. Atlantis BOM

### C.1 INTRODUCTION

This appendix shows the Atlantis Evaluation Bill of Materials (BOM):

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

| Item | Quantity | Designator                                                                                         | Description                                                                    | Manufacturer                   | Manufacturer Part Number |
|------|----------|----------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------|--------------------------------|--------------------------|
| 1    | 1        | C1                                                                                                 | CAP CER 2.2uF 10V 10% X7R SMD 0603                                             | Murata                         | GRM188R71A225KE15D       |
| 2    | 21       | C2, C3, C4, C5, C6, C11, C12, C13, C14, C15, C16, C18, C26, C29, C30, C34, C36, C37, C38, C49, C63 | CAP CER 0.1uF 16V 10% X7R SMD 0402                                             | Murata                         | GRM155R71C104KA88D       |
| 3    | 2        | C7, C8                                                                                             | CAP CER 10pF 50V 5% NP0 SMD 0402                                               | Murata                         | GRM1555C1H100JZ01D       |
| 4    | 2        | C9, C17                                                                                            | CAP CER 1uF 6.3V 10% X5R SMD 0603                                              | Panasonic                      | ECJ-1VB0J105K            |
| 5    | 2        | C10, C55                                                                                           | CAP CER 0.1uF 50V 10% X7R SMD 0603                                             | Murata                         | GRM188R71H104KA93D       |
| 6    | 2        | C19, C20                                                                                           | CAP CER 10uF 16V 10% X5R SMD 0805                                              | Murata                         | GRM21BR61C106KE15L       |
| 7    | 1-DNP    | C21                                                                                                | CAP CER 0.1uF 16V 10% X7R SMD 0402                                             | Murata                         | GRM155R71C104KA88D       |
| 8    | 16       | C22, C23, C25, C27, C31, C32, C33, C35, C39, C40, C50, C51, C52, C53, C60, C61                     | Capacitor, 47uF, 16V, 10%, X5R, 1210                                           | Murata                         | GRM32ER61C476KE15K       |
| 9    | 2-DNP    | C24, C28                                                                                           | Capacitor, 47uF, 16V, 10%, X5R, 1210                                           | Murata                         | GRM32ER61C476KE15K       |
| 10   | 2        | C41, C42                                                                                           | CAP CER 4.7uF 50V 10% X5R SMD 0805                                             | TDK Corporation                | C2012X5R1H475K125AB      |
| 11   | 6        | C43, C44, C45, C46, C47, C48                                                                       | CAP CER 22uF 25V 10% X5R SMD 1206                                              | Murata Electronics             | GRM31CR61E226KE15L       |
| 12   | 1        | C54                                                                                                | CAP CER 100uF 10V 20% X5R SMD 1210                                             | Taiyo Yuden                    | LMK325BJ107MM-T          |
| 13   | 2        | C56, C59                                                                                           | CAP CER 0.47uF 16V 10% X7R SMD 0603                                            | Murata                         | GRM188R71C474KA88D       |
| 14   | 2        | C57, C58                                                                                           | CAP CER 1uF 10V 10% X7R SMD 0603                                               | Taiyo Yuden                    | LMK107B7105KA-T          |
| 15   | 1-DNP    | C62                                                                                                | CAP CER 0.1uF 50V 10% X7R SMD 0603                                             | Murata                         | GRM188R71H104KA93D       |
| 16   | 2        | D1, D13                                                                                            | LED, Bright Red, 0603                                                          | Lite-On                        | LTST-C191KRKT            |
| 17   | 1        | D2                                                                                                 | DIO LED BLUE 2.8V 20mA 15mcd Clear SMD 0603                                    | Lite-On                        | LTST-C193TBKT-5A         |
| 18   | 4        | D3, D11, D12, D14                                                                                  | LED, Bright Green, 0603                                                        | Lite-On                        | LTST-C191KGKT            |
| 19   | 4        | D4, D6, D8, D9                                                                                     | LED, Green, 0603, RA                                                           | Lite-On                        | LTST-S270KGKT            |
| 20   | 2        | D5, D7                                                                                             | DIO RECTARR BAV99 1.25V 200mA 70V SOT-23-3                                     | Fairchild                      | BAV99                    |
| 21   | 1        | D10                                                                                                | DIODE SWITCHING 75V 0.2A SOT-23                                                | Diodes Inc.                    | MMBD914-7-F              |
| 22   | 1        | FB1                                                                                                | FERRITE 600mA 120R SMD 0603                                                    | TDK Corporation                | MMZ1608B121CTAH0         |
| 23   | 1        | J1                                                                                                 | Connector, mezzanine, plug 2x20 positions, 0.8mm pitch, 11.7mm stacking height | TE Connectivity                | 5179031-1                |
| 24   | 1        | J2                                                                                                 | CON USB2.0 MINI-B FEMALE SMD R/A                                               | Molex Inc                      | 548190572                |
| 25   | 1        | J3, J6                                                                                             | CONN HEADER 2POS .100" SGL GOLD                                                | Samtec                         | TSW-102-07-G-S           |
| 26   | 2        | J9, J10                                                                                            | USB TYPE-C Conn Receptacle Top mount TH/SMT                                    | Advanced Connector INC, (ACon) | NBR25-AK5322             |
| 27   | 2        | J11, J12                                                                                           | CON USB2.0 STD-A FEMALE TH R/A                                                 | TE Connectivity AMP Connectors | 292303-1                 |
| 28   | 1        | J14                                                                                                | CONN PWR JACK 2.5X6.5MM, 8A                                                    | CUI Inc                        | PJ-063BH                 |
| 29   | 1        | J15                                                                                                | CON HDR-2.54 MALE 1x6 GOLD 5.84MH TH VERT                                      | Samtec                         | TSW-106-07-G-S           |
| 30   | 1        | L1                                                                                                 | Power Inductor 2.2 uH 20% 17.8A, 6.3mOhms, shielded                            | Coilcraft                      | XAL7070-222MEC           |

# Atlantis USB4916 Application Example

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

| Item | Quantity | Designator                                                                       | Description                                                  | Manufacturer                    | Manufacturer Part Number |
|------|----------|----------------------------------------------------------------------------------|--------------------------------------------------------------|---------------------------------|--------------------------|
| 31   | 2        | Q1, Q2                                                                           | MOSFET TRENCH 2N-CH 20V 600MA SOT-1216                       | NXP Semiconductors              | PMDXB600UNE              |
| 32   | 1        | Q3                                                                               | MCHP ANALOG MOSFET N-CH 25V 100A 0.006R MCP87050-U/MF PDFN-8 | Microchip                       | MCP87050T-U/MF           |
| 33   | 1        | Q4                                                                               | MCHP ANALOG MOSFET N-CH 25V 100A 0.006R MCP87030-U/MF PDFN-8 | Microchip                       | MCP87030T-U/MF           |
| 34   | 1        | R1                                                                               | RES TKF 20k 1% 1/10W SMD 0603                                | Panasonic                       | ERJ-3EKF2002V            |
| 35   | 1        | R2                                                                               | RES TKF 40.2k 1% 1/10W SMD 0603                              | Yageo                           | RC0603FR-0740K2L         |
| 36   | 5        | R3, R62, R65, R71, R72                                                           | RES TKF 330R 1% 1/10W SMD 0603                               | Panasonic                       | ERJ-3EKF3300V            |
| 37   | 12       | R4, R16, R31, R32, R53, R54, R55, R56, R69, R75, R90, R95                        | RES TKF 0R 1/10W SMD 0603                                    | Panasonic                       | ERJ-3GSY0R00V            |
| 38   | 4        | R5, R11, R12, R97                                                                | RES TF 100k 1% 1/8W SMD 0603                                 | Vishay                          | MCT06030C1003FP500       |
| 39   | 17       | R6, R7, R8, R10, R27, R28, R33, R34, R41, R42, R52, R66, R89, R91, R92, R93, R94 | RES TKF 10k 1% 1/10W SMD 0603                                | Vishay                          | CRCW060310K0FKEA         |
| 40   | 2        | R9, R45                                                                          | RES TKF 12k 1% 1/10W SMD 0603                                | Yageo                           | RC0603FR-0712KL          |
| 41   | 9        | R13, R14, R40, R44, R46, R63, R67, R73, R99                                      | RES TKF 1k 1% 1/10W SMD 0603                                 | Panasonic                       | ERJ-3EKF1001V            |
| 42   | 4-DNP    | R15, R17, R57, R59                                                               | RES TKF 0R 1/10W SMD 0603                                    | Panasonic                       | ERJ-3GEY0R00V            |
| 43   | 4-DNP    | R18, R20, R22, R37                                                               | RES TKF 200k 1% 1/10W SMD 0603                               | Vishay                          | CRCW0603200KFKEA         |
| 44   | 3        | R19, R23, R35                                                                    | RES TKF 200k 1% 1/10W SMD 0603                               | Vishay                          | CRCW0603200KFKEA         |
| 45   | 1        | R21                                                                              | RES TKF 4.7k 1% 1/10W SMD 0603                               | Panasonic                       | ERJ-3EKF4701V            |
| 46   | 11-DNP   | R24, R26, R29, R30, R36, R38, R39, R48, R49, R50, R51                            | RES TKF 10k 1% 1/10W SMD 0603                                | Vishay                          | CRCW060310K0FKEA         |
| 47   | 1        | R25                                                                              | RES TKF 10R 1% 1/10W SMD 0603                                | Panasonic                       | ERJ-3EKF10R0V            |
| 48   | 1        | R43                                                                              | RES TKF 86.6k 1% 1/10W SMD 0603                              | Panasonic Electronic Components | ERJ-3EKF8662V            |
| 49   | 2        | R47, R64                                                                         | RES TKF 2k 1% 1/10W SMD 0603                                 | Panasonic                       | ERJ-3EKF2001V            |
| 50   | 1        | R58                                                                              | RES TKF 33k 1% 1/10W SMD 0603                                | Panasonic                       | ERJ-3EKF3302V            |
| 51   | 1-DNP    | R60                                                                              | RES TKF 20R 1% 1/10W SMD 0603                                | Panasonic                       | ERJ-3EKF20R0V            |
| 52   | 2-DNP    | R61, R79                                                                         | RES TKF 0R 1/10W SMD 0603                                    | NIC Components                  | NRC06Z0TRF               |
| 53   | 2-DNP    | R68, R74                                                                         | RES TKF 1k 1% 1/10W SMD 0603                                 | Panasonic                       | ERJ-3EKF1001V            |
| 54   | 2        | R70, R76                                                                         | RES TKF 100R 1% 1/10W SMD 0603                               | Panasonic                       | ERJ-3EKF1000V            |
| 55   | 1        | R77                                                                              | RES TKF 200R 1% 1/10W SMD 0603                               | Panasonic                       | ERJ-3EKF2000V            |
| 56   | 2        | R78, R85                                                                         | RES TF 1k 0.1% 1/10W SMD 0603                                | Panasonic - ECG                 | ERA-3AEB102V             |
| 57   | 1        | R80                                                                              | RES TKF 20R 1% 1/10W SMD 0603                                | Panasonic                       | ERJ-3EKF20R0V            |
| 58   | 2-DNP    | R81, R100                                                                        | RES 220R 1% 1/4W 1206                                        | Panasonic                       | ERJ-8ENF2200V            |
| 59   | 4        | R82, R83, R87, R88                                                               | RES TKF 4.99k 1% 1/10W SMD 0603                              | Panasonic                       | ERJ-3EKF4991V            |
| 60   | 2        | R84, R96                                                                         | RES TKF 2.2k 1% 1/10W SMD 0603                               | Panasonic                       | ERJ-3EKF2201V            |
| 61   | 1        | R86                                                                              | RES TKF 499R 1% 1/10W SMD 0603                               | Panasonic                       | ERJ-3EKF4990V            |
| 62   | 1        | R98                                                                              | RES TKF 240R 1% 1/10W SMD 0603                               | Yageo                           | 9C06031A2400FKHFT        |
| 63   | 1        | R101                                                                             | RES TKF 330R 1% 1/10W SMD 0603                               | Panasonic                       | ERJ-3EKF3300V            |
| 64   | 1        | SW1                                                                              | SWITCH TACTILE SPST-NO 0.05A 16V                             | C&K Components                  | CKN10502CT-ND            |
| 65   | 1        | TP2                                                                              | TEST POINT PC MINI .040"D ORANGE                             | Keystone Electronics            | 5003                     |
| 66   | 2        | TP16, TP24                                                                       | TEST POINT PC MINI .040"D RED                                | Keystone Electronics            | 5000                     |
| 67   | 1        | TP39                                                                             | TEST POINT PC MINI .040"D BLACK                              | Keystone Electronics            | 5001                     |
| 68   | 1        | U1                                                                               | IC, USB4916, Automotive USB 2.0 Hub, QFN64                   | Microchip Technology            | USB4916-I/9JX            |
| 69   | 1        | U2                                                                               | Flash Serial, SPI, 2.7-3.6V, x1/x2/x4, SOIC8                 | Microchip Technology            | SST26VF016B-104I/SM      |
| 70   | 2        | U3, U4                                                                           | IC BUFF 74LVC1G14SE-7 SNGL SOT-353                           | Diodes Incorporated             | 74LVC1G14SE-7            |
| 71   | 1        | U5                                                                               | IC, LDO ADJ, 2.3 to 6Vin, 0.8V to 5V out, 0.5A               | Microchip Technology            | MCP1825T-ADJE/DC         |

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

| Item | Quantity | Designator  | Description                                            | Manufacturer         | Manufacturer Part Number |
|------|----------|-------------|--------------------------------------------------------|----------------------|--------------------------|
| 72   | 1        | U6          | USB Dual Port Power Switch and Current Monitor         | Microchip Technology | UCS2113-1-V/G4           |
| 73   | 3        | U7, U8, U10 | IC DISTRIBUTION SW ADJ MLF-6                           | Micrel               | MIC2009YML               |
| 74   | 1        | U9          | MCHP ANALOG PWM CONTROLLER 1.6MHz MCP19119-E/MQ QFN-28 | Microchip            | MCP19119-E/MQ            |
| 75   | 1        | U11         | IC, Reset Supervisor, 2.93V, SOT23-3                   | Microchip Technology | MIC803-29D4VM3           |
| 76   | 1        | Y1          | Crystal 25MHz 10pF SMD 4Pin DFN LCC                    | Abracon              | ABM8G-25.000MHZ-B4Y-T    |

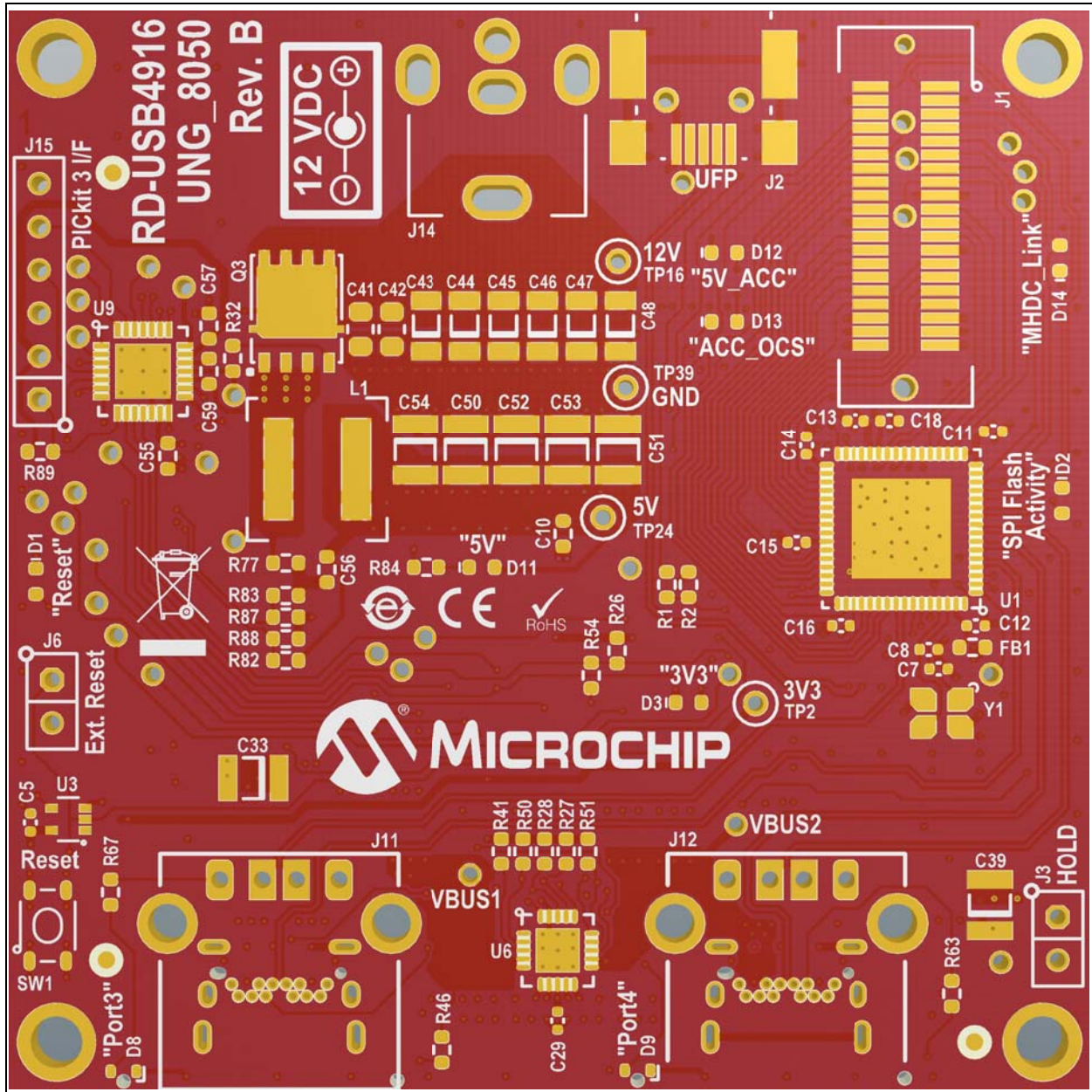
NOTES:

## Appendix D. Atlantis Silk Screens

### D.1 INTRODUCTION

This appendix shows the Atlantis top and bottom silk screen images.

**FIGURE D-1: ATLANTIS TOP SILK SCREEN**



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**NOTES:**



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