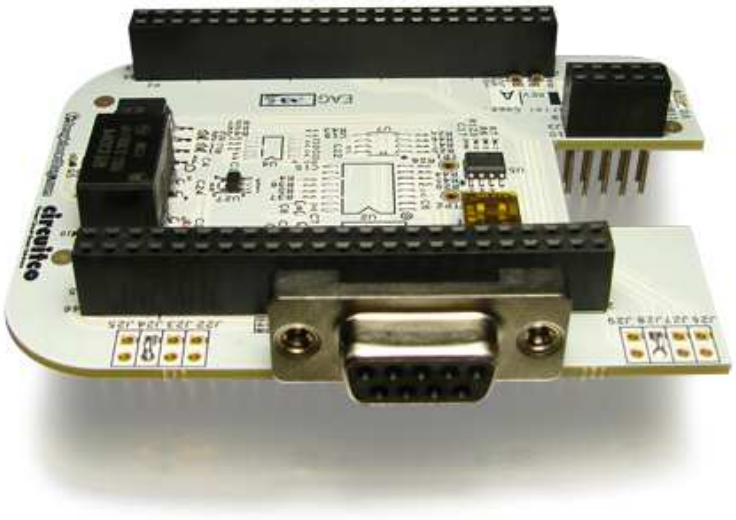
BeagleBone CANBus Cape



System Reference Manual

Revision A2
January 5th, 2013

THIS DOCUMENT

For any questions, concerns, or issues submit them to support@beagleboardtoys.com

BEAGLEBONE CANBUS CAPE DESIGN

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Before returning the board, please visit Beagleboardtoys.com/support

To return a defective board, please request an RMA at
http://www.beagleboardtoys.com/support/rma

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NOTES

1.0 Introduction

This document is the System Reference Manual for the BeagleBone CANBus Cape, an add-on board for the BeagleBone.

This document is intended as a guide to assist anyone purchasing or who are considering purchasing the board to understand the overall design and usage of the BeagleBone CANBus Cape from the system level perspective.

The design is subject to change without notice as we will work to keep improving the design as the product matures.

The key sections in this document are:

Section 2.0 – Change History
Provides tracking for the changes made to the System Reference Manual.

Section 3.0 – Overview
This is a high level overview of the BeagleBone CANBus Cape.

Section 4.0 – Features and Specification
Provided here are the features and electrical specifications of the board.

Section 5.0 – System Architecture and Design
This section provides information on the overall architecture and design of the BeagleBone CANBus Cape. This is a very detailed section that goes into the design of each circuit on the board.

Section 6.0 – Mechanical
Information is provided here on the dimensions of the BeagleBone CANBus Cape.

Section 7.0 – Design Materials
This section provides information on where to get the design files.

2.0 Change History

2.1 Change History

Table 1 tracks the changes made for each revision of this document.

Table 1. Change History

Rev	Changes	Date	By
A1	Initial release.	09/28/2012	BBT
A2	Add section 2.2	01/05/2013	BBT

2.2 A2 vs. A1

U27 and C24 are removed and bypass resistor R52 is added in revision A2 to fix the communication issue on revision A1.

3.0 BeagleBone CANBus Cape Overview

3.1 Descriptions

The BeagleBone CANBus Cape makes use of DCAN1 interface of the AM335x processor to provide a Controller Area Network (CAN) interface that meets the specifications of ISO11898. The CAN Bus interface can be accessed via a standard D-Sub 9 female serial connector. This connector is located to the side so it doesn't interfere with any capes stacked above it. The BeagleBone CANBus Cape also supports SocketCAN.

Figure 1 below is a picture of the board.

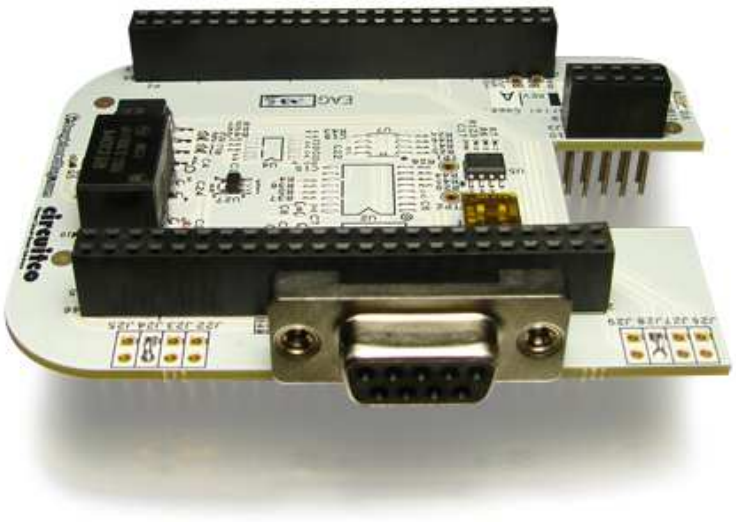

Figure 1. The BeagleBone CANBus Cape

3.2 In The Box

The final packaged BeagleBone CANBus Cape product will contain the following items:

- 1 BeagleBone CANBus Cape

3.3 Repairs

If you feel the board is in need of repair, follow the RMA Request process found at http://www.beagleboardtoys.com/support/rma

Do not send the board in for repair until an RMA authorization has been provided.

Do not return the board to the distributor unless you want to get a refund. You must get authorization from the distributor before returning the board.

4.0 Features and Specifications

This section covers the specifications of the BeagleBone CANBus Cape and provides a high level description of the major components and interfaces that make up the board.

Table 2 provides a list of the BeagleBone CANBus Cape's features.

Table 2. BeagleBone CANBus Cape Features

Compatible Serial Port	UART1
Power	3.3 V via expansion header
Indicator	Power LED
Connector	Two 46-position connectors
	One 10-position connector
	One D-Sub9 serial connector

4.1 Key Component Locations

Figure 2 shows the location of the key components on the board.

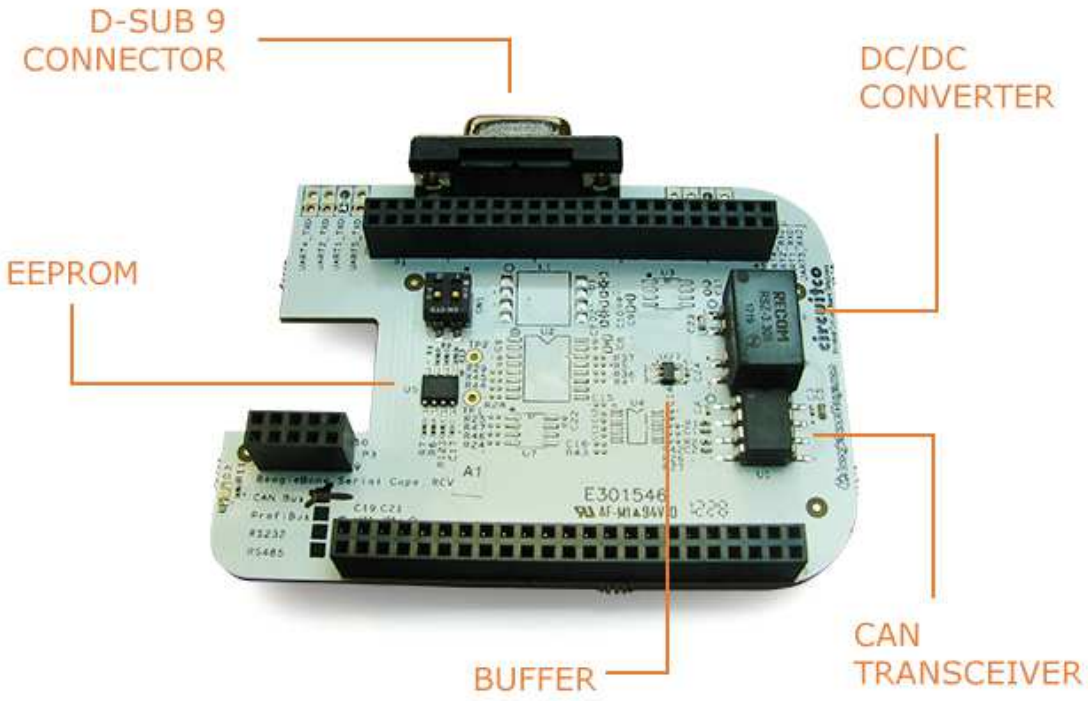

Figure 2. Key Components

4.2 CAN Bus Interface

The BeagleBone CANBus Cape uses an RSZ-3.305HP to provide isolated power sources for the CAN transceiver ISO1050. ISO1050 is a galvanically isolated CAN transceiver that isolates grounds and prevents noise currents from entering local ground. The bus side of the transceiver is connected to a D-Sub 9 connector and provides an option to install a terminal resistor. The controller side of the transceiver is connected to DCAN1 port of AM335x on BeagleBone.

4.3 Power Indicator

The BeagleBone CANBus Cape features an LED (D3) to indicate that power is applied to the cape. This LED is green when lit.

4.4 Mechanical Specifications

Size:	4.00” x 2.50”
Layers:	4
PCB thickness:	.062”
RoHS Compliant:	Yes

4.5 Electrical Specifications

Table 3 is the electrical specification of the external interfaces to the BeagleBone CANBus panel.

Table 3. BeagleBone CANBus Electrical Specifications

Specification	Min	Typ	Max	Unit
Power				
Input Voltage DC		3.3		V
Environmental				
Temperature range	0		+85	C

5.0 System Architecture and Design

This section provides a high level description of the design of the BeagleBone CANBus Cape and its overall architecture.

5.1 System Block Diagram

Figure 3 is the high level block diagram of the BeagleBone CANBus Cape.

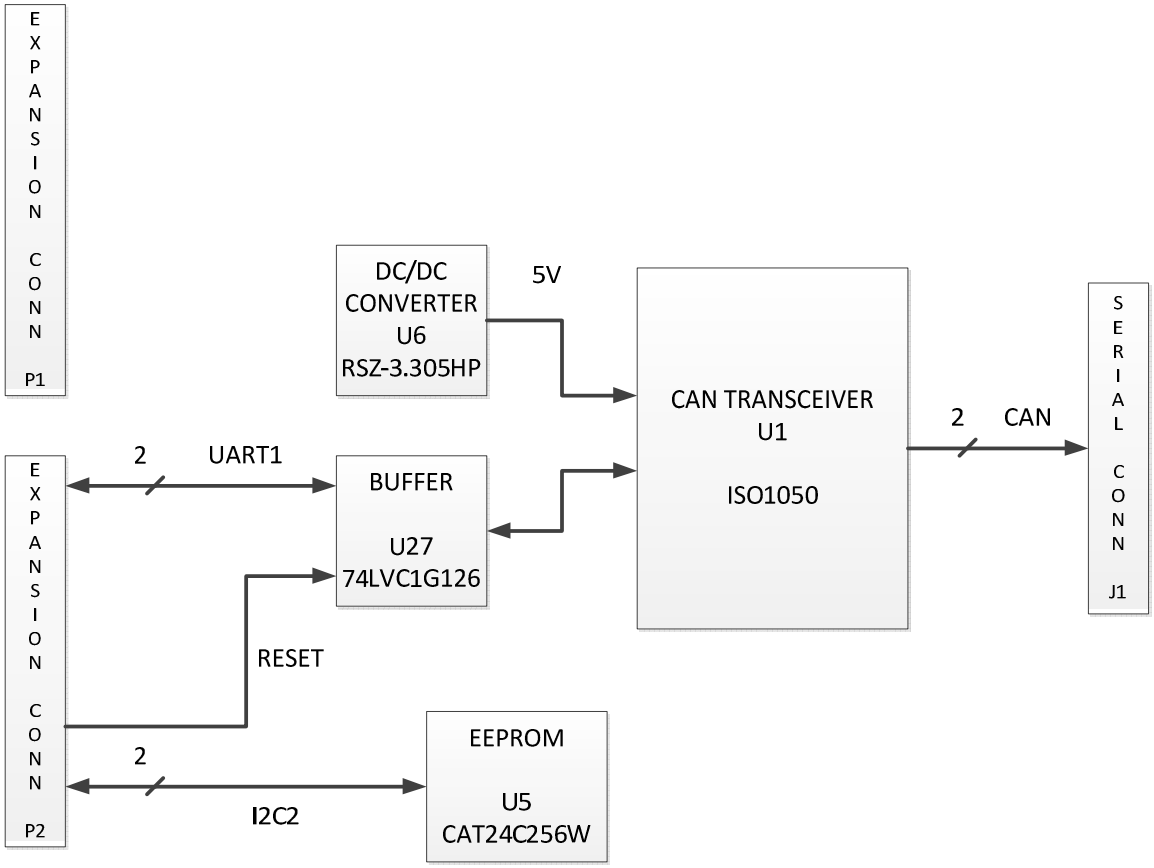

Figure 3. BeagleBone CANBus Cape High Level Block Diagram

5.2 CAN Transceiver

ISO1050 is a galvanically isolated CAN transceiver. The input and output buffers are isolated by a silicon oxide insulation barrier that provides galvanic isolation of up to 2500 V_{RMS}. The device is powered by 3.3V supply that comes from the expansion connectors. It also has an isolated secondary power source of 5V. The bus side is connected to bus signals; therefore, 5V is required to provide a high signal-to-noise ratio. The controller

side is connected to UART port of AM335X; these signals are required to be at 3.3V voltage level.

The CANBus Cape provides an option to install a terminal resistor for CAN bus signals. The CAN High and CAN Low signals are connected to pin 7 and pin 2 of D-Sub connector J1. The ground signal for CAN is isolated and connected to pin 3 of J1. **Figure 4** shows the transceiver circuit on the CANBus Cape.

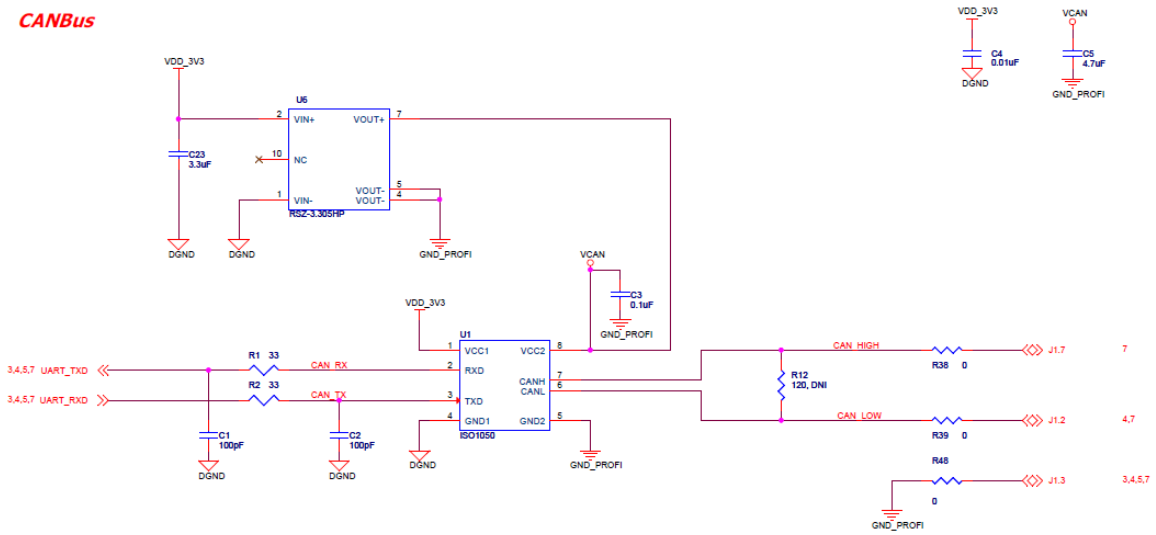

Figure 4. CAN Transceiver Circuit

5.3 Isolated Power and Ground

The CANBus Cape uses an isolated DC-DC converter RSZ-3.305HP to convert 3.3V to 5.0V for the CAN transceiver. RSZ-3.305HP features a transformer driver, an isolation transformer, a rectifier network as well as a linear regulator. The supply and ground leads on the input and output sides are isolated. This isolation prevents noise currents from entering local ground and damage sensitive circuitry.

5.4 Controller Signals

The controller side of the ISO1050 is connected to UART1 port of AM335X, which can also be pin-muxed as DCAN1. A noise filter is applied between the transceiver and the controller.

As of this revision, the BeagleBone CANBus Cape uses the same printed circuit board (PCB) as other serial capes; therefore, the controller signals RX and TX are connected to a UART selection circuit where user can select which UART port is used. However, since only UART1 port supports DCAN1, the jumpers of other UART ports are removed on the CANBus Cape and the RXD and TXD jumpers of UART1 are hard-wired. **Figure 5** shows the UART selection circuit on the CANBus Cape.

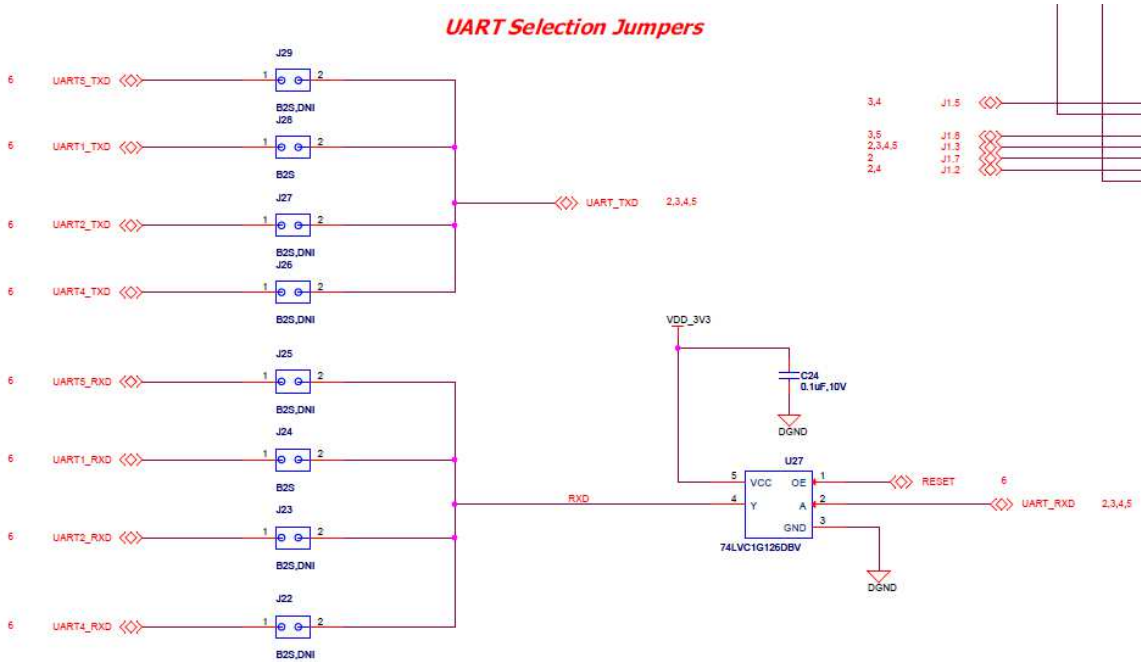

Figure 5. UART Selection Circuit

5.5 EEPROM

The BeagleBone CANBus Cape has an EEPROM containing information that will allow the SW to identify the board and to configure the expansion headers pins as needed. EEPROMs are required for all Capes sold in order for them to operate correctly when plugged in the BeagleBone.

The EEPROM used on this cape is the same one as is used on the BeagleBone, a CAT24C256. The CAT24C256 is a 256 kb Serial CMOS EEPROM, internally organized as 32,768 words of 8 bits each. It features a 64-byte page write buffer and supports the Standard (100 kHz), Fast (400 kHz) and Fast-Plus (1 MHz) I2C protocol. **Figure 6** is the design of the EEPROM circuit.

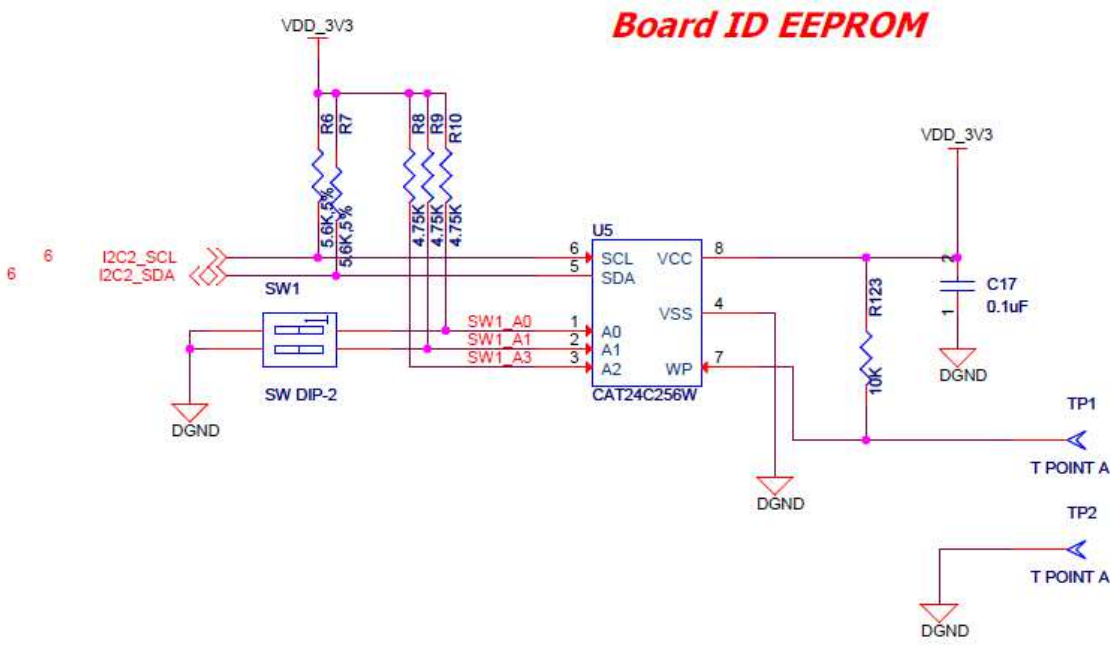

Figure 6. BeagleBone CANBus Cape EEPROM

5.5.1 EEPROM Address

In order for each Cape to have a unique address, a board ID scheme is used that sets the address to be different depending on the order in which it is stacked onto the main board. A two position dipswitch or jumpers is used to set the address pins of the EEPROM. It is the responsibility of user to set the proper address for each board. Address line A2 is always tied high. This sets the allowable address range for the expansion cards to 0x54 to 0x57.All other I2C addresses can be used by the user in the design of their Capes. But, these addresses must not be used other than for the board EEPROM information.

5.5.2 I2C Bus

The EEPROMs on each expansion board is connected to I2C2. For this reason I2C2 must always be left connected and should not be changed by SW to remove it from the expansion header pin mux. The I2C signals require pull-up resistors. Each board must have a 5.6K resistor on these signals. With four resistors this will be an affective resistance of 1.4K if all Capes were installed.

6.0 Mechanical Information

This section provides information on the mechanical aspect of the BeagleBone CANBus Cape. **Figure 7** is the dimensions of the BeagleBone CANBus Cape.

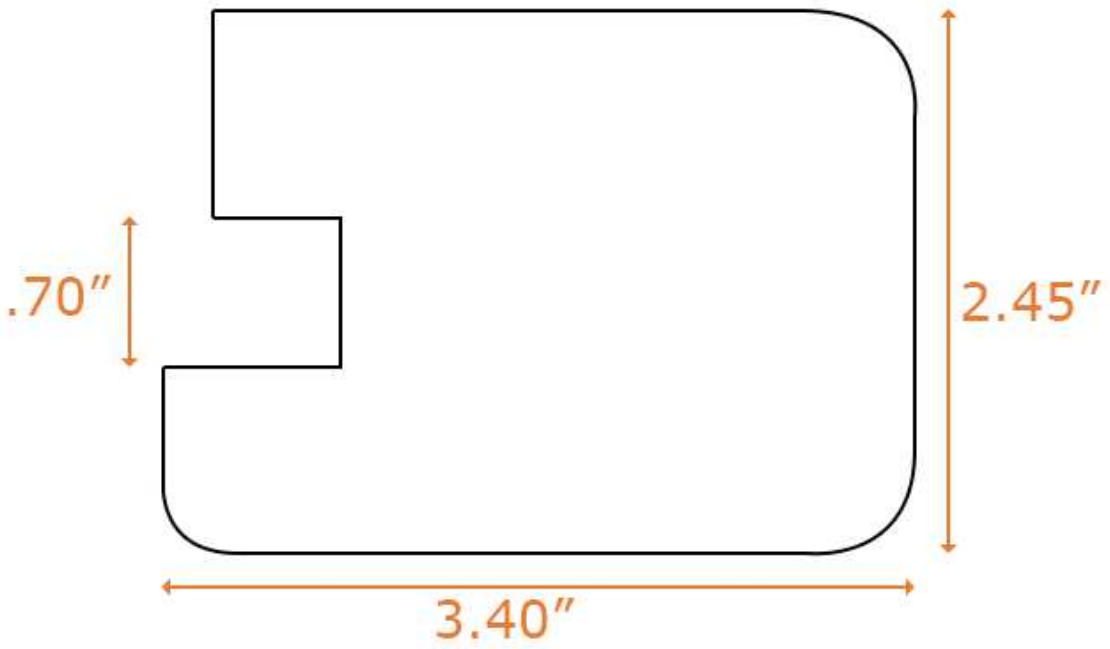

Figure 7. BeagleBone CANBus Cape Dimensions Drawing

7.0 Design Materials

Design information can be found at BeagleBoardToys wiki:
http://beagleboardtoys.com/wiki/index.php?title=BeagleBone_CANBus

Provided there is:

- Schematic in PDF
- Schematic in OrCAD
- Manufacturing files
  - PCB Gerber
  - PCB Layout (Allegro)
- Bill of Materials
- System Reference Manual (This document)

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