
EMBER[®] EM35XX BREAKOUT BOARD TECHNICAL SPECIFICATION

Silicon Labs' Ember EM35xx Breakout Board contains the hardware peripherals for the development and deployment of a low-data-rate, low-power ZigBee application on the EM300 series System-on-Chips (SoCs). The SoC is part of the four-layer (FR4-based) module that connects to the EM35xx Breakout Board through the board-to-board connectors. The EM35xx Breakout Board hardware stimuli include a temperature sensor, two buttons, a piezo buzzer, two LEDs, and a 2" x 2" through-hole prototyping area. In addition, the EM35xx Breakout Board contains a USB transceiver with USB connector, a RS-232 transceiver with DB-9 connector, Data Emulation Interface (DEI), Packet Trace Port programming interface, and regulated power planes. Revision B0 and later of the EM35xx Breakout Board include an optional interface to 2 MB external DataFlash in support of the ZigBee OTA Profile for over-the-air (OTA) application bootloader purposes. Revision C0 and later of the EM35xx Breakout Board includes a dedicated USB connector for EM358x USB, Embedded Trace Module (ETM) interface for EM358x via third-party debuggers, and an optional interface to 8 MB external DataFlash in support of OTA application bootloader purposes via either EM35xx SC1 or SC2. Details contained within this document refer to revision C0 and later unless otherwise noted.

You can obtain the EM35xx Breakout Board voltage supply from one of five sources: Ember Debug Adapter (ISA3) (through the Packet Trace Port), external VDC supply, two USB ports (EM358x and SC1 UART), or AAA battery pack. The various voltage supplies offer a degree of flexibility when testing different network topologies.

This document provides the technical specification for the EM35xx Breakout Board. It describes the board-level interfaces as well as the key performance parameters. In addition, it provides the necessary information for developers to validate their application designs using the EM35xx Breakout Board.

New in This Revision

Updated based on revision C2 updates in support of EM358x.

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1 Breakout Board Features

The EM35xx Breakout Board offers:

- Configurable hardware support for application development
 - Temperature sensor (connects to EM35xx GPIO)
 - Two buttons (connect to EM35xx GPIO)
 - Piezo buzzer (connect to EM35xx GPIO)
 - Two LEDs (connect to EM35xx GPIO)
- RS-232 transceiver with DB-9 connector for serial communication (with hardware (HW) handshake support)
- USB transceiver with USB connector (Type B)
- USB connector for EM358x USB interface (Type B) (Revision C only)
- 2 MB external DataFlash for ZigBee OTA Profile support via EM35xx SC2 (Revision B only)
- 8 MB external DataFlash for ZigBee OTA Profile support via EM35xx SC1 or SC2 (Revision C only)
- Control Interface for the EM35xx Radio Communications Module (RCM)
 - RCM RESET button
 - Voltage Supply connection (VBRD)
- 2" x 2", 0.1" pitch prototyping area
- 26-pin, 0.1" pitch, dual-row logic-analyzer shrouded connector
- 10-pin, 0.05" pitch, dual-row Packet Trace Port connector
- 20-pin, 0.05" pitch, dual-row ARM-compatible Embedded Trace Module (ETM) connector (interfaces with third-party debuggers) (Revision C only)
- 12-pin, 0.1" pitch, dual-row, data emulation interface (DEI) with configuration header
- 14-pin, 0.05" pitch, single-row along with a 19-pin 0.05" pitch, single-row, board-to-board connector for the module
- Selection pins for DC power source selection (either external DC power supply, USB, Debug Adapter (ISA3), or AAA battery pack). LEDs indicate which power supply has been selected.
- 2-pin module VDC pin for connection of an ammeter for module current measurements
- 2-pin jumpers for each of the HW application peripherals, buzzer, buttons, piezo, temperature sensor, and LEDs
- 3-pin selection jumpers for connection to the EM35xx UART (SC1). The selection jumpers route signals (RXD, TXD, nRTS, and nCTS) to either an USB transceiver, RS-232 transceiver, or allow access to the TTL levels.

Table 1 lists the DC electrical characteristics of the EM35xx Breakout Board.

Table 1. DC electrical characteristics

Parameter	Min.	Typ.	Max.	Unit
VDD supply				
External DC Supply (J1 / J32)	4		20 ¹	V
USB Host	4.5	5		V
Debug Adapter (ISA3)	3.1	3.3V	3.5	V
Battery	2.1		3.6	
External DC supply (J3.2)	3.1	3.3	3.5	V
Current draw (peripherals)				
Piezo buzzer			10	mA
Buttons (enabled)			6	mA
Temperature sensor (enabled)			5	mA
Current draw (miscellaneous)				
RS-232 transceiver			4	mA
USB transceiver (for SC1 UART)			15	mA
LDO distribution			10	mA
Operating temperature	0		+ 55	C

¹ Maximum external DC supply voltage is 15 V for revisions B1 and earlier of the EM35xx Breakout Board. See document TS12, *Errata EM35xx Breakout Board Technical Specification*, for more information.

2 Components

Figure 1 illustrates the components on layer 1 (top side).

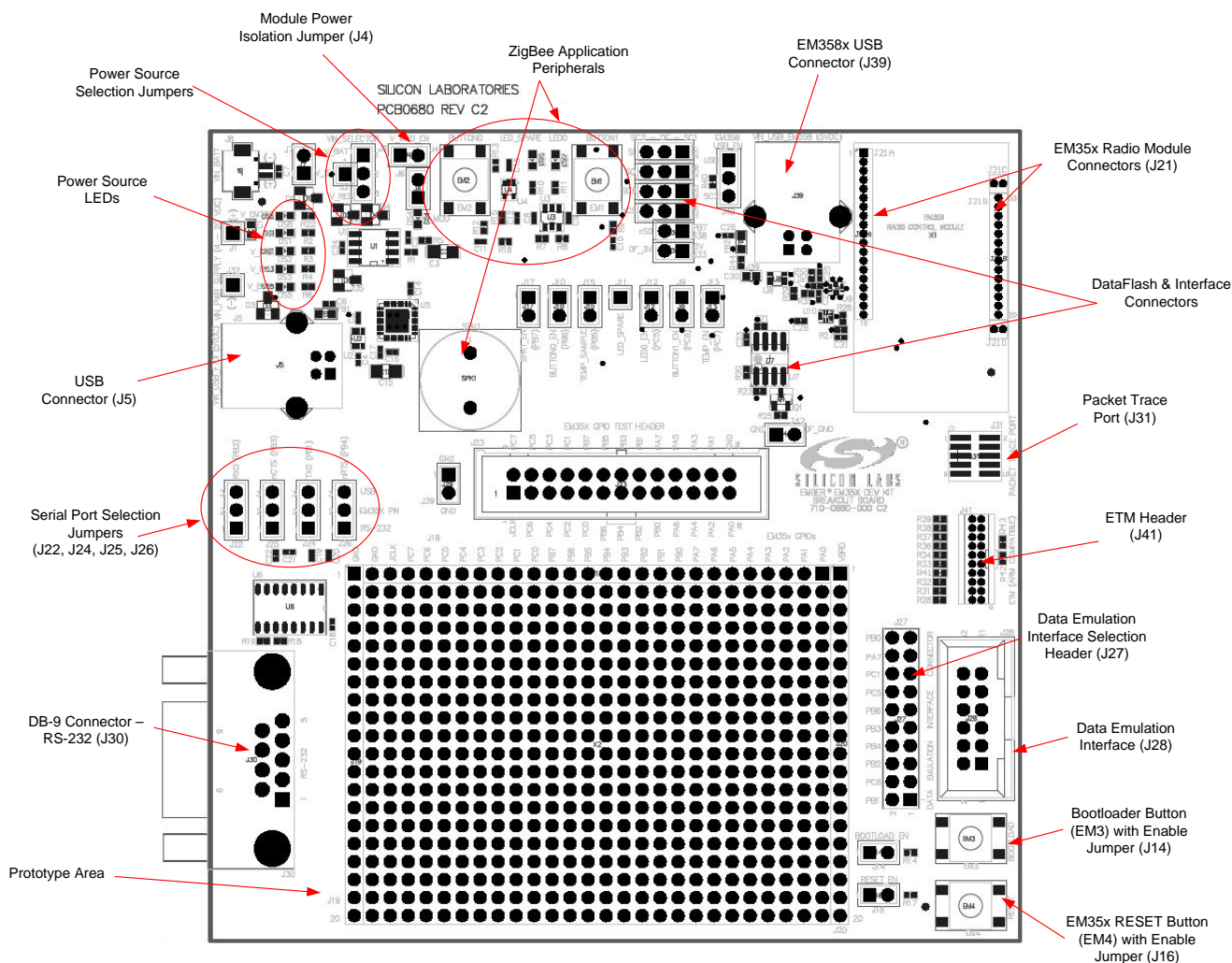


Figure 1. Assembly Print for Layer 1

2.1 Power Supply and Distribution

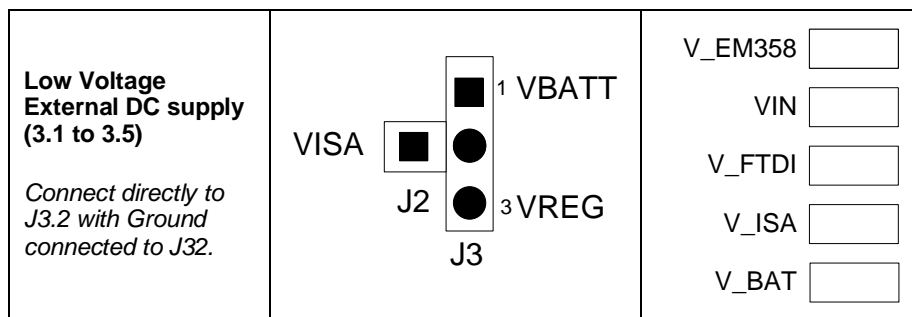
The EM35xx Breakout Board can be powered from one of six sources:

- 4V to 20V External DC Power supply (Positive connected J1 and Ground connected to J32)
- Battery pack connector (J8)
- USB Host (J5, via Wall wart or PC connection)
- EM358x USB Host (J39, via Wall wart or PC connection) (Revision C only)
- Debug Adapter (ISA3) (through Packet Trace Port, J31)
- 2.1 to 3.6V External DC Power supply (Positive connected to J3.2 and Ground connected to J32)

The EM35xx Breakout Board contains power source selection jumpers (J2 and J3) which allows only one DC source to power the board. This eliminates the possibility of overcurrent resulting from power supply contention. Table 2 illustrates the connection scheme and LED indication for each power source.

Table 2: Power Supply Connections

Power Source	Selection Scheme (J2 and J3)	LED Indicator
<p>High Voltage External supply (4 V to 20 V)</p> <p><i>Connect VDD to J1 and GND to J32.</i></p>	<p>VISA</p> <p>J2</p> <p>J3</p> <p>1 VBATT</p> <p>3 VREG</p>	<p>V_EM358 <input type="checkbox"/></p> <p>VIN <input checked="" type="checkbox"/></p> <p>V_FTDI <input type="checkbox"/></p> <p>V_ISA <input type="checkbox"/></p> <p>V_BAT <input type="checkbox"/></p>
<p>USB Host</p> <p><i>Connect USB cable to J5.</i></p>	<p>VISA</p> <p>J2</p> <p>J3</p> <p>1 VBATT</p> <p>3 VREG</p>	<p>V_EM358 <input type="checkbox"/></p> <p>VIN <input type="checkbox"/></p> <p>V_FTDI <input checked="" type="checkbox"/></p> <p>V_ISA <input type="checkbox"/></p> <p>V_BAT <input type="checkbox"/></p>
<p>EM358x USB Host</p> <p><i>Connect USB cable to J39.</i></p>	<p>VISA</p> <p>J2</p> <p>J3</p> <p>1 VBATT</p> <p>3 VREG</p>	<p>V_EM358 <input checked="" type="checkbox"/></p> <p>VIN <input type="checkbox"/></p> <p>V_FTDI <input type="checkbox"/></p> <p>V_ISA <input type="checkbox"/></p> <p>V_BAT <input type="checkbox"/></p>
<p>Debug Adapter (ISA3)</p> <p><i>Connect ISA3 to J31.</i></p>	<p>VISA</p> <p>J2</p> <p>J3</p> <p>1 VBATT</p> <p>3 VREG</p>	<p>V_EM358 <input type="checkbox"/></p> <p>VIN <input type="checkbox"/></p> <p>V_FTDI <input type="checkbox"/></p> <p>V_ISA <input checked="" type="checkbox"/></p> <p>V_BAT <input type="checkbox"/></p>
<p>Battery pack</p> <p><i>Connect AAA battery pack (supplied by Silicon Labs).</i></p>	<p>VISA</p> <p>J2</p> <p>J3</p> <p>1 VBATT</p> <p>3 VREG</p>	<p>V_EM358 <input type="checkbox"/></p> <p>VIN <input type="checkbox"/></p> <p>V_FTDI <input type="checkbox"/></p> <p>V_ISA <input type="checkbox"/></p> <p>V_BAT <input checked="" type="checkbox"/></p>



2.1.1 External DC Power Supply (J1 and J32 or J3.2 and J32)

The EM35xx Breakout Board allows two easy to use connections to an external power supply.

- The first connection (Low Voltage) allows for a 3.1 to 3.5 V DC external supply to be connected to J3.2 (positive) and J32 (Ground). The power supply should be able to source up to 250 mA at the set voltage. When using a power supply in this mode, there should be no jumpers on J2 or J3 as shown in Table 2.
- The second connection (High Voltage) allows for a 4 V to 20 V DC external supply to be connected to J1 (positive) and J32 (Ground). The power supply should be able to source up to 300 mA at the set voltage. When using a power supply in this mode, there should be a jumper connecting J3.3 and J3.2 as shown in Table 2.

2.1.2 Battery Connector (J8)

The 2-pin, keyed battery connector (Hirose, P/N: DF13-2P-1.25H(50)) allows for connection to a DC power supply or battery pack. The EM35xx Breakout Board is shipped with a 2-AAA battery pack with appropriate mating connector for easy attachment. Batteries are sold separately. When using a battery pack, a jumper must be connected between J3.1 and J3.2 as shown in Table 2.

2.1.3 Packet Trace Port (J8)

The EM35xx Breakout Board can also be powered from a Debug Adapter (ISA3). To enable this power supply, simply connect the Debug Adapter (ISA3) to the Packet Trace Port (J8) and connect the power selection jumper between J2 and J3.2 as shown in Table 2. In addition, the Debug Adapter (ISA3) selection toggle switch must be put in the INT position. The Debug Adapter (ISA3) provides a target voltage of 3.3 V and sources as much as 250 mA. See document TS7, *Ember Debug Adapter (ISA3) Technical Specification*, for more details on the Debug Adapter (ISA3).

Note: If the Debug Adapter (ISA3) is connected directly to the Packet Trace Port on the Module, the jumper at J4 must be connected as well as the jumper across J2 and J3.2.

2.1.4 USB Host (J5)

The EM35xx Breakout Board can also be powered by a USB Host (PC or Silicon Labs-supplied USB power supply). To operate in this mode, a USB Host must be connected to J5 and the power selection jumper must be connected between J3.2 and J3.3 as shown in Table 2.

2.1.5 EM358x USB Host (J39)

The EM35xx Breakout Board can also be powered by an EM358x USB Host (PC or Silicon Labs-supplied USB power supply). To operate in this mode, the EM358x USB Host must be connected to J39 and the power selection jumper must be connected between J3.2 and J3.3 as shown in Table 2.

2.2 Deep Sleep Testing of the Ember Module

To allow for accurate deep sleep current measurements, the EM35xx Breakout Board isolates the module VDD power supply from the regulated power domain on the EM35xx Breakout Board. The only connection point between the module power supply and the EM35xx Breakout Board supply is through the VMOD_EN header (J4).

By isolating the module power supply in this manner, an ammeter can be placed across J4 to monitor the current sourced to the module. To perform accurate deep sleep measurements, configure the EM35xx Breakout Board as follows:

- Confirm J40 is configured for SC2 and not USB.
- Remove J4 and place ammeter across this jumper.
- Remove J6 so the V_MOD LED DS4 is not driven. If supplying voltage by J8 battery connector, also remove J7 so the V_BATT LED DS5 is not driven.
- Remove J33-J38 jumpers to isolate DataFlash IC from circuit.
- Issue "shutdown" in nodetest.
- Once command is issued and node is asleep, remove J22 and J24-J26 (UART jumpers).
- Make sure the Packet Trace Port cable, DEI cable, and RS-232 cable are all detached from the EM35xx Breakout Board.

This connection scheme offers the highest degree of power supply flexibility. Wake the EM35xx from deep sleep by pressing either Button 0 or Button 1.

Note: The use of virtual UART port 4900 is not recommended when interfacing to nodetest for deep sleep testing, because this does not allow for proper configuration of the EM35xx for deep sleep measurements. Therefore, use either pass-through UART port 4901, USB, or RS-232 to interface to the nodetest application.

2.3 ZigBee Application Peripherals

As previously mentioned, the EM35xx Breakout Board offers six peripherals to assist in ZigBee application development including:

- Temperature sensor
- Two (2) "normally open" buttons
- 4 kHz piezo buzzer
- Two (2) LEDs
- External DataFlash

Each peripheral connects to an EM35xx GPIO through a two-pin peripheral header. Because each peripheral header on the EM35xx Breakout Board ships with a jumper in place, the peripherals default to "HW Enabled." If application development does not require the peripheral, simply remove the jumper.

Note: Each peripheral consumes power. Be sure to factor this into the current consumption equations when testing the module in deep sleep mode or if using the battery pack to power the EM35xx Breakout Board.

2.3.1 Temperature Sensor (U4)

The temperature sensor is an off-the-shelf component from National Semiconductor (MFG P/N: LM20BIM7). The temperature sensor requires an enable signal to be asserted (active high) prior to generating an analog voltage proportional to the ambient temperature of the EM35xx Breakout Board. Therefore, two EM35xx GPIO signals, PC7 and PB5, are routed to pin 2 of peripheral headers J13 and J15, respectively.

- PC7 enables the temperature sensor when asserted (active high), when a jumper is installed at J13.

- PB5 contains the analog temperature information from the sensor, when it is enabled and a jumper is installed at J15.

Due to the EM35xx ADC voltage reference at 1.2 V, the temperature sensor output is scaled to between 0 and 1.2 V through a resistive voltage divider. If you want to connect a temperature sensor from a different manufacturer, scale the output in a similar manner.

The EM35xx Breakout Board is shipped with a jumper installed at J13 and J15. If the jumpers are removed, a different compatible device can be attached to pin 2 of both J13 and J15.

For more information on the temperature sensor, refer to its data sheet (<http://www.ti.com/product/LM20>).

2.3.2 Buttons (EM1, EM2)

Two programmable, normally-open buttons are provided for software debugging and application development. When either button is pressed, the connected net is driven low. A single-pole RC filter minimizes the effects of switching noise.

These buttons map to the backchannel button commands as follows:

- EM2: controlled by the `button 0` command
- EM1: controlled by the `button 1` command

For information about the `button` command, see document UG1110, *EM35xx Development Kit User Guide*.

Two EM35xx GPIO signals, PB6 and PC6, are routed from the EM35xx Module to pin 2 of peripheral headers J9 and J10, respectively. In the default configuration of the EM35xx Breakout Board, jumpers are positioned across J9 and J10 to enable buttons EM1 and EM2, respectively. If the jumpers are removed, different compatible devices can be attached to pin 2 of breakout headers J9 and J10 instead of the buttons.

2.3.3 Buzzer (SPK1)

A programmable buzzer is provided for software debugging and application development. An EM35xx GPIO signal, PB7, is routed to pin 2 of peripheral header J17. In the default configuration of the EM35xx Breakout Board, a jumper is positioned across J17 to enable use of the buzzer. The buzzer installed on the EM35xx Breakout Board is from CUI (MFG P/N: CEP-1160). For more information on the buzzer, refer to its data sheet (<http://www.cui.com/Product/Resource/PDFRedirect/110/CEP-1160.pdf>).

2.3.4 LEDs (DS6 and DS7)

The EM35xx Breakout Board contains two LEDs for software debugging and application development. Each LED is buffered (non-inverting) to allow for connection to any EM35xx GPIO. One EM35xx GPIO, PC5, is routed to pin 2 of header J12. To turn on DS7 (RED) from the EM35xx RCM, install a jumper at J12, configure PC5 as an output and drive it low. To turn on DS6 (GREEN), make a physical connection between an unused EM35xx GPIO and J11 (single pin header). Once this is done, then that GPIO must be configured as an output and driven low to illuminate DS6.

2.3.5 External DataFlash (U7)

The external DataFlash is an off-the-shelf component. Revision B boards have 2 MB components from Adesto (MFG P/N: AT45DB021D-SSH-B), while revision C boards have 8 MB components from WinBond (MFG P/N: W25Q80BVSNIG). The DataFlash is used in cases where ZigBee OTA Profile application bootloader is required. Note that the DataFlash is included on EM35xx Breakout Board revision B0 and later. The DataFlash is connected to the EM35xx RCM through jumpers J33-J38. The EM35xx Breakout Board is shipped with jumpers installed for interfacing with EM35xx SC1. If all six jumpers are installed properly at J33-J38, the external DataFlash connects to the EM35xx SC1 or SC2 for application bootloading. Figure 2 illustrates the jumper configuration for the DataFlash

interface. Connect J34-J37 on the left-hand side for interfacing to EM35xx SC2 and on the right-hand side for EM35xx SC1.

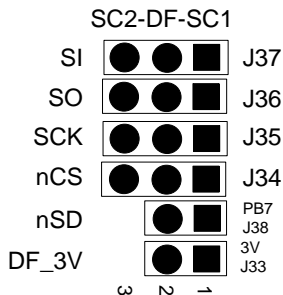


Figure 2. Jumper for DataFlash Connections

For more information on the DataFlash, refer to its data sheet (<http://www.adestotech.com/sites/default/files/datasheets/doc3638.pdf> for the Revision B Adesto part, and <http://www.winbond.com/NR/ronlyres/4D2BF674-7427-4FC8-AEF0-1A534DF74F16/0/W25Q80BV.pdf> for the Revision C WinBond part).

2.4 Serial Communication for EM35xx SC1 UART

To enhance the software development experience, access to the EM35xx SC1 UART is available directly from the EM35xx Breakout Board or by telnetting into port 4901 of an ISA3 connected to an Ethernet network. On the EM35xx Breakout Board, it is available as RS-232, USB and TTL-compliant signal levels.

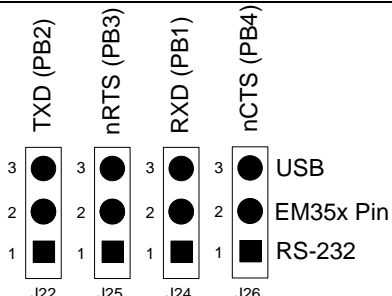
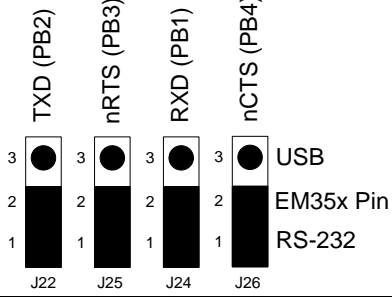
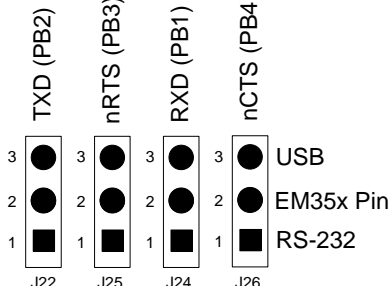
To minimize current consumption and allow for the different configuration options, the EM35xx Breakout Board individually routes the EM35xx SC1 UART signals TXD (EM35xx PB2), RXD (EM35xx PB1), nRTS (EM35xx PB3), and nCTS (EM35xx PB4) to pin 2 of headers J22, J24, J25 and J26 respectively. TTL-level access to these UART signals is available at pin 2 of these headers. To route the UART signals to the USB transceiver, connect the jumpers between pins 3 and 2 to each of the headers. Placing the jumpers across pins 1 and 2 route the UART signals to the RS-232 transceiver. To access the EM35xx UART SC1 with an ISA3, remove the jumpers on J22, J24, J25 and J26 and place them on the DEI jumper connector (J27) as summarized below and shown in Figure 3.

- TXD: J27.1 to J27.2
- RXD: J27.5 to J27.6
- nRTS: J27.7 to J27.8
- nCTS: J27.9 to J27.10

Each jumper configuration is shown in Table 3.

Table 3: Serial Communication Selection Jumpers

UART Path	Selection Scheme (J22, J25, J24 and J26)
EM35xx SC1 to USB	<p style="text-align: center;"> TXD (PB2) nRTS (PB3) RXD (PB1) nCTS (PB4) </p> <p style="text-align: center;"> 3 3 3 3 USB 2 2 2 2 EM35x Pin 1 1 1 1 RS-232 </p> <p style="text-align: center;">J22 J25 J24 J26</p>

<p>EM35xx SC1 to TTL</p>	
<p>EM35xx SC1 to RS-232</p>	
<p>EM35xx SC1 over Debug Adapter (ISA3)</p> <p><i>Connect DEI cable to J28.</i></p>	

Note To connect to the EM35xx UART over a Debug Adapter (ISA3), the Debug Adapter (ISA3) must be connected to an Ethernet connection. It can be accessed by selecting “Serial 1” within the Console view of the Ember Desktop or by telnetting to Port 4901.

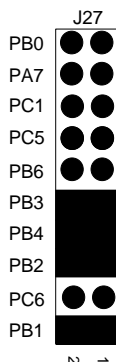


Figure 3. Jumper Settings Required for EM35xx SC1 UART Access by Debug Adapter

2.5 Data Emulation Interface (J28)

The 12-pin, dual-row, data emulation interface contains 10 EM35xx GPIO signals, as well as voltage (VBRD) and ground (GND) connections. When connected to the Debug Adapter (ISA3), the connector provides additional debug features to software developers.

One feature involves the port 4901 UART connection via Debug Adapter (ISA3). To enable the UART connection to the EM35xx UART signals, install four jumpers on J27 as shown in Figure 3.

Another feature involves manipulation of BUTTON0 and BUTTON1 GPIO signals. To enable GPIO manipulation of BUTTON0 and BUTTON1, install jumpers on J27 at PB6 and PC6, respectively.

2.6 EM358x USB Interface (J39)

Access to the EM358x USB com port is available directly from the EM35xx Breakout Board via the USB connector J39. To access EM358x USB, J40 must be installed with the shorting jumper configured as USB rather than SC2, and the firmware application must be built for using USB (nodetest-usb, for example). With J40 configured as SC2, SC2 pins are available for general I/O or external DataFlash uses. With J40 configured as USB, SC2 pins are dedicated to USB and not available for other uses. See Table 4 for these corresponding jumper configurations.

Table 4: USB Enable Selection Jumper

Mode Selection	Jumper Configuration
EM358x SC2 for USB	<p>EM358X USB_EN</p> <p>USB J40 SC2</p>
EM358x SC2 for general I/O or DataFlash uses	<p>EM358X USB_EN</p> <p>USB J40 SC2</p>

For additional information on EM358x USB, refer to AN740, *Using the Ember® EM358x USB*.

2.7 EM35xx Module Interface Connector (J21)

Two single-row, 0.05" pitch, connectors make up the EM35xx module interface to the EM35xx Breakout Board. In addition, two single-row, guide connectors assist with connecting the EM35xx module to the EM35xx Breakout Board. The board-to-board connector scheme allows access to all EM35xx GPIO as well as nRESET and the JCLK signals. The connector is illustrated in Figure 4, while the dimensions are listed in Figure 5.

Table 5. Pinout and Signal Names of the Interface Connector

Pin #	Signal name	Direction ²	Connector	Description
1	GND	Power	J21A	Ground Connection
2	PC5	I/O	J21A	EM35xx GPIO
3	PC6	I/O	J21A	EM35xx GPIO
4	PC7	I/O	J21A	EM35xx GPIO
5	PA7	I/O	J21A	EM35xx GPIO
6	PB3	I/O	J21A	EM35xx GPIO
7	nRESET	I/O	J21A	Active low chip reset (internal pull-up on EM35xx)
8	PB4	I/O	J21A	EM35xx GPIO
9	PA0	I/O	J21A	EM35xx GPIO
10	PA1	I/O	J21A	EM35xx GPIO
11	PA2	I/O	J21A	EM35xx GPIO
12	PA3	I/O	J21A	EM35xx GPIO
13	GND	Power	J21A	Ground connection
14	PA4	I/O	J21A	EM35xx GPIO
15	PA5	I/O	J21A	EM35xx GPIO
16	PA6	I/O	J21A	EM35xx GPIO
17	PB1	I/O	J21A	EM35xx GPIO
18	PB2	I/O	J21A	EM35xx GPIO
19	GND	Power	J21A	Ground connection
20	GND	Power	J21B	Ground connection
21	JCLK	Input	J21B	JTAG interface, serial clock
22	PC2	I/O	J21B	EM35xx GPIO
23	PC3	I/O	J21B	EM35xx GPIO
24	PC4	I/O	J21B	EM35xx GPIO
25	PB0	I/O	J21B	EM35xx GPIO
26	PC1	I/O	J21B	EM35xx GPIO
27	PC0	I/O	J21B	EM35xx GPIO
28	PB7	I/O	J21B	EM35xx GPIO
29	PB6	I/O	J21B	EM35xx GPIO
30	PB5	I/O	J21B	EM35xx GPIO
31	GND	Power	J21B	Ground connection
32	VDD	Power	J21B	2.1 to 3.6V Module Power Domain
33	GND	Power	J21B	Ground connection
34	NC	N/A	J21C	Not connected; guide pin
35	NC	N/A	J21C	Not connected; guide pin
36	NC	N/A	J21D	Not connected; guide pin
37	NC	N/A	J21D	Not connected; guide pin

² with respect to the RCM

2.8 Prototyping Area

The 2.8" x 2" (0.1" pitch) prototyping area on the EM35xx Breakout Board offers software developers an extra degree of flexibility. As shown in Figure 4, it allows access to VBRD, GND, and each of the 24 EM35xx GPIOs. Therefore, you can solder any sensor or input device to the prototyping area and connect it to the EM35xx GPIO for development and debugging.

As shown in Figure 6, the leftmost column is connected to GND and the rightmost column to VBRD. The top row is connected to the EM35xx GPIOs. Included in the top row are additional GND and JCLK connections. The remainder of the array is available for application development.

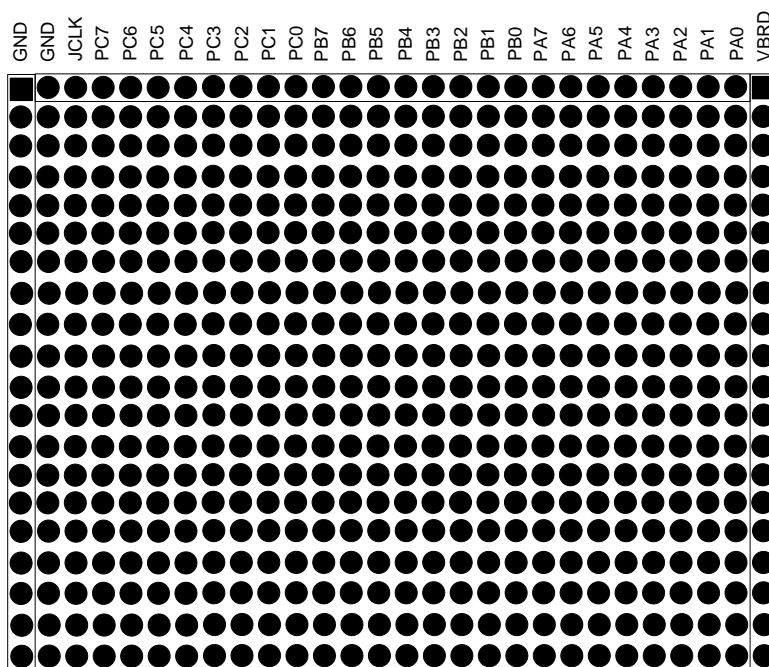


Figure 6. EM35xx Breakout Board Prototyping Area

3 EM35xx Breakout Board Schematic

The EM35xx Breakout Board schematic is included at the end of this document.

CONTACT INFORMATION

Silicon Laboratories Inc.

400 West Cesar Chavez
Austin, TX 78701
Tel: 1+(512) 416-8500
Fax: 1+(512) 416-9669
Toll Free: 1+(877) 444-3032

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EM35x Development Kit Breakout Board

Sheet 1 - Cover Sheet


Sheet 2 - Power Management, Manufacturing

Sheet 3 - Applications Circuits, Breadboard

Sheet 4 - EM35x RCM Connectors, User Interfaces, DataFlash

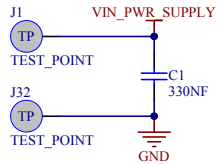
Sheet 5 - EM358x-Specific USB and ETM Circuitry

Sheet 6 - Notes

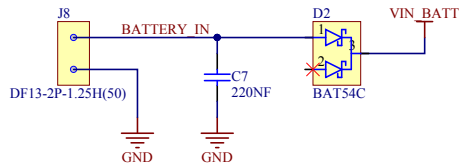
 SILICON LABS 25 Thomson Place, 2nd Floor Boston, MA 02210, USA www.silabs.com 617-951-0200	WES Apps, Boston	
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	Title: EM35x Development Kit Breakout Board	
	Part Number: 130-0680-000	Rev: C2
	Sheet Name: 0680_1_Cover.SchDoc	Date: 5/21/2013 Time: 8:19:47 AM Sheet: 1 of 6 Size: B

POWER SUPPLY, DC, 4V to 20V

* Place J1 close to J32



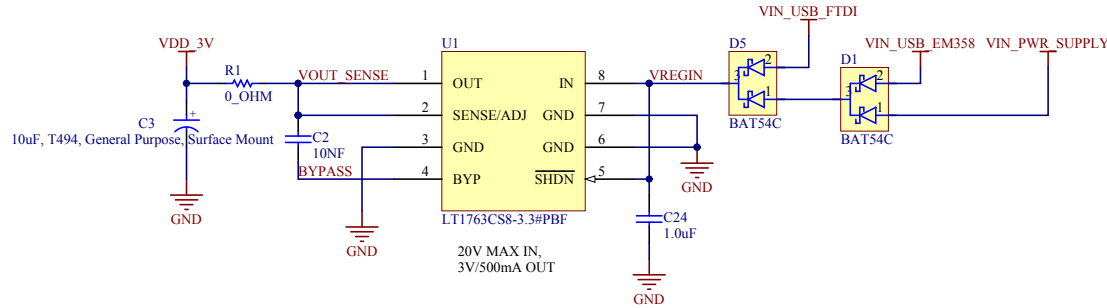
BATTERY CONNECTOR (2 AAA), 1.5V to 3.1V



FTDI USB / EM358X USB / VIN_PWR_JACK DOWN CONVERSION

U1 Regulator Power Priority:

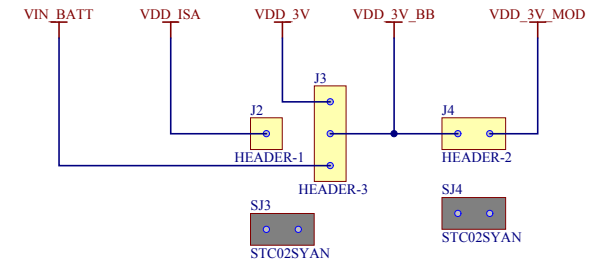
- VIN_USB_FTDI has priority over VIN_USB_EM358
- VIN_PWR_SUPPLY has priority over both VIN_USB_FTDI and VIN_USB_EM358
- If VIN_USB_EM358 is the only power source, the EM358 is self-powered
- Power selection jumper J2/J3 still determines source of power for VDD_3V_BB and VDD_3V_MOD



BREAKOUT BOARD AND MODULE POWER SELECTOR

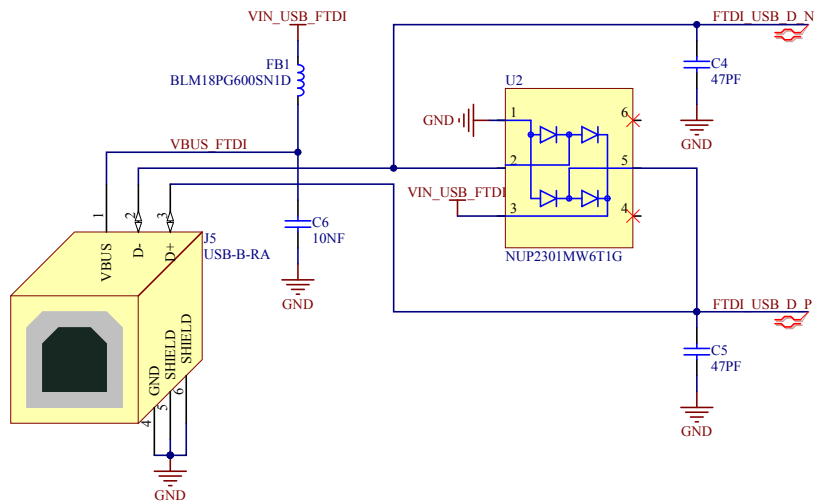
Headers J2 and J3 allow the user to select the power source. There are five (5) possible power sources for the Breakout Board:

1. External 3V Supply (connect directly to J3.2)
2. External Regulated Supply from 4V to 20V (connect shorting jumper between J3.2 and J3.3)
3. Ember battery pack with 2 AAA (connect shorting jumper between J3.1 and J3.2)
4. USB Bus Powered (connect shorting jumper between J3.2 and J3.3)
5. InSight Adapter (connect shorting jumper between J2 and J3.2)



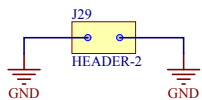
The shorting jumper at J4 can be replaced with a current meter to measure module current draw

USB FTDI UART CONNECTION (TYPE B) 5V



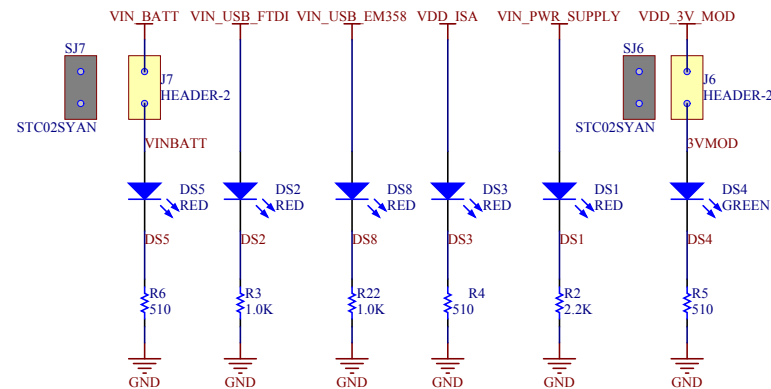
TEST EQUIPMENT GND CONNECTION

* Place J29 close to J23



POWER INDICATOR LEDS

* Remove J6 when performing a Deep Sleep Test



PCB INFORMATION

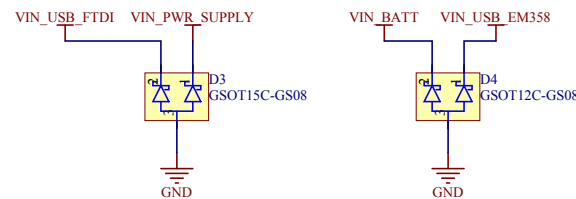
Top Side Board Logo
PCB1
710-0680-000

SN Bar Code Label
SN1
130-0680-000

FIDUCIALS

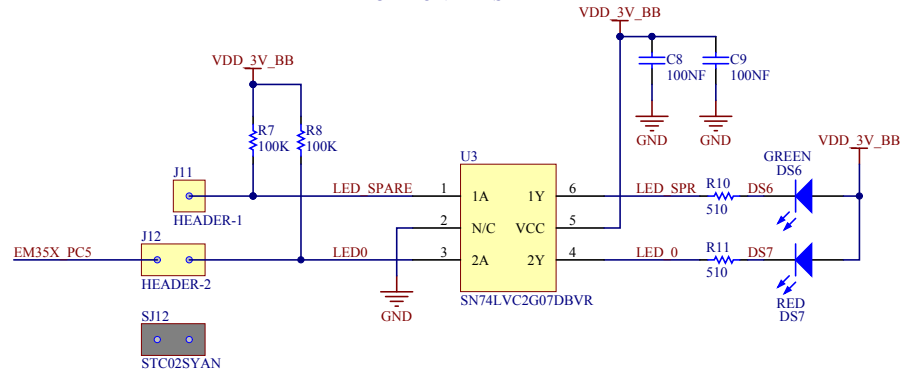


ESD SUPPRESSION (POWER SUPPLY)

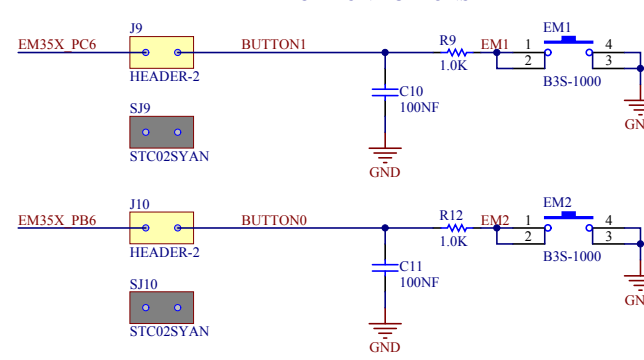


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Part Number: 130-0680-000	Rev: C2
Sheet Name: 0680_2_Power_Mfg_SchDoe	
Date: 5/21/2013	Time: 8:19:47 AM
Sheet: 2 of 6	Size: B

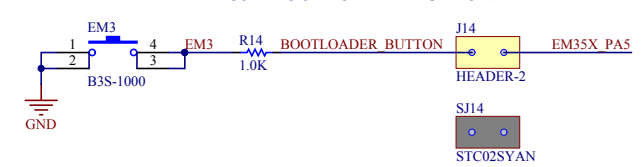
APPLICATION LEDS



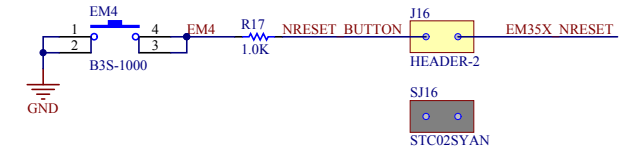
APPLICATION BUTTONS



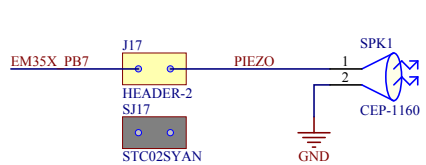
EM35X BOOTLOADER BUTTON



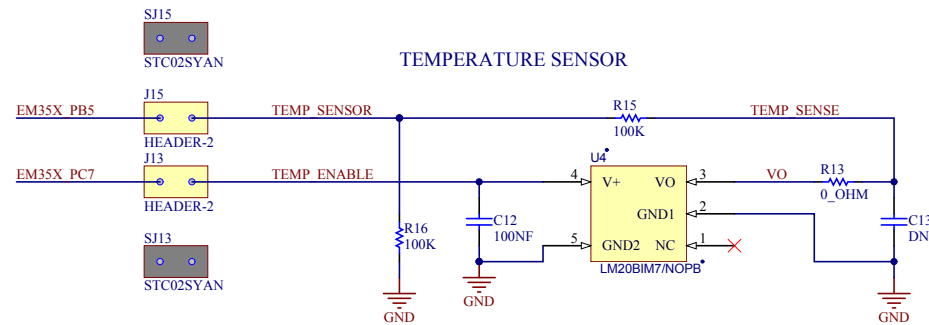
EM35X RESET BUTTON (ACTIVE LOW)



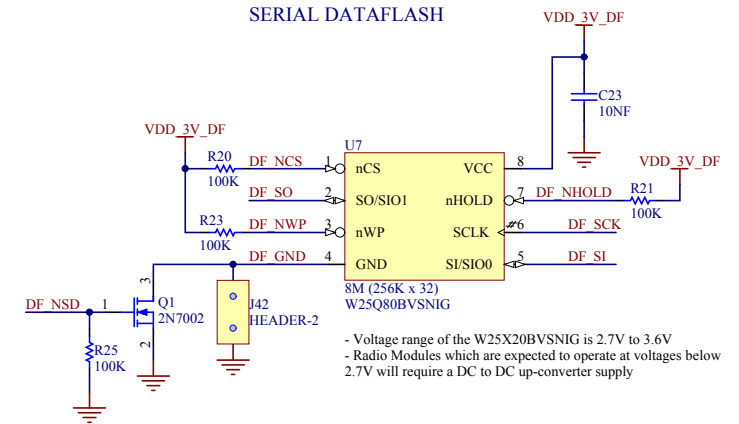
PIEZO SPEAKER



TEMPERATURE SENSOR

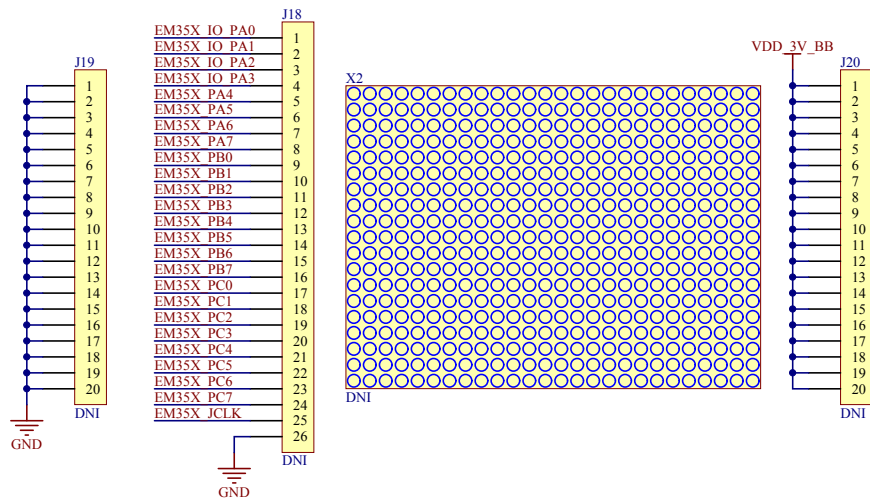


SERIAL DATAFLASH



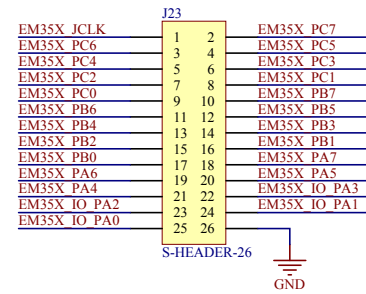
PERIPHERAL SCRATCH PAD (0.1" PITCH)

* Note: J18 EM35X_PA0 through EM35X_PA3 are switched IO not available when EM358 USB is enabled via J40

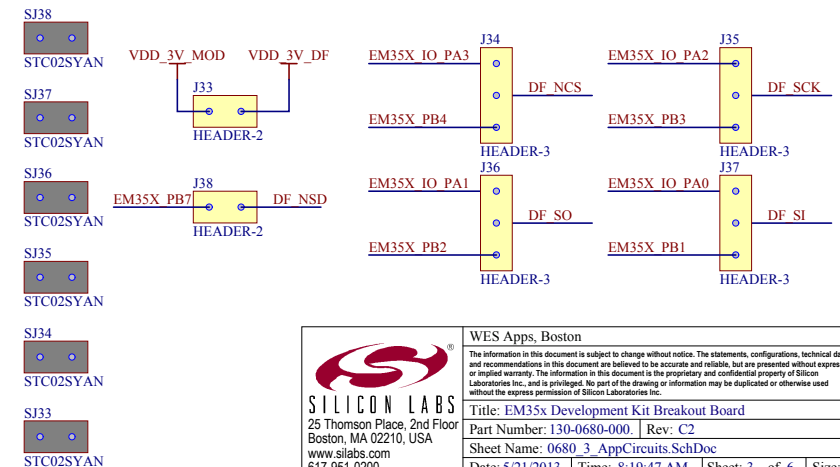


26-PIN DUAL ROW TEST CONNECTOR

* Note: J23 EM35X_PA0 through EM35X_PA3 are switched IO not available when EM358 USB is enabled via J40



SERIAL DATAFLASH SC1/SC2 SELECTION



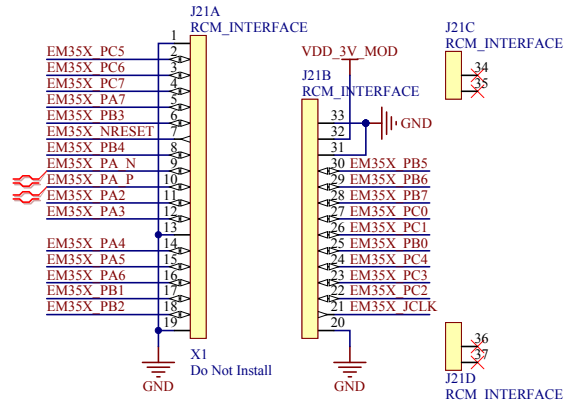
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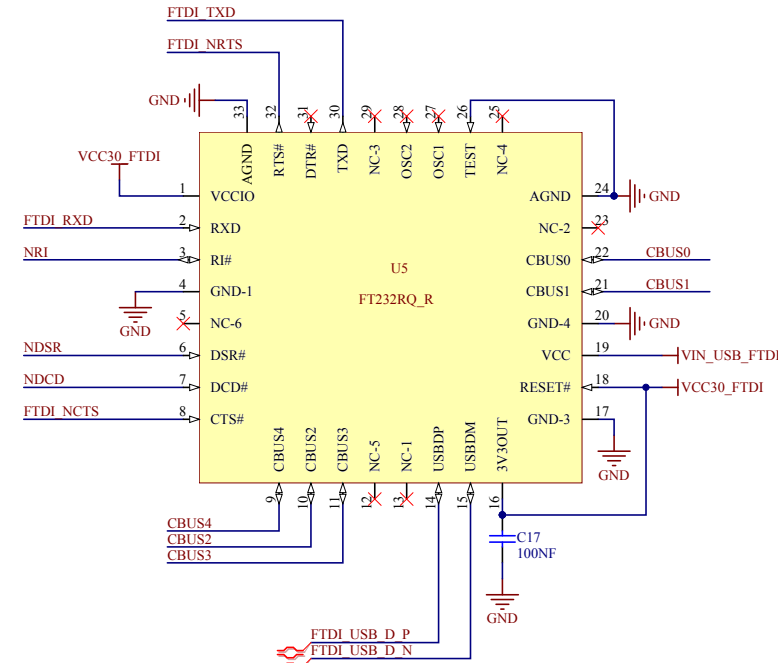
Title: EM35x Development Kit Breakout Board
Part Number: 130-0680-000 | Rev: C2
Sheet Name: 0680_3_AppCircuits.SchDoc
Date: 5/21/2013 | Time: 8:19:47 AM | Sheet: 3 of 6 | Size: B

EM35X RCM INTERFACE HEADERS

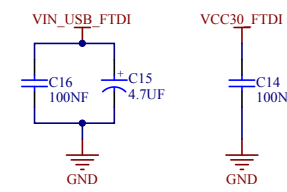


* EM35X_PA_N is PA0 (USB_DM), EM35X_PA_P is PA1 (USB_DP)

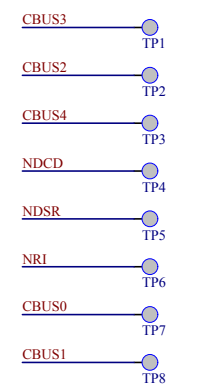
USB / UART IC - EM35X SC1 UART INTERFACE



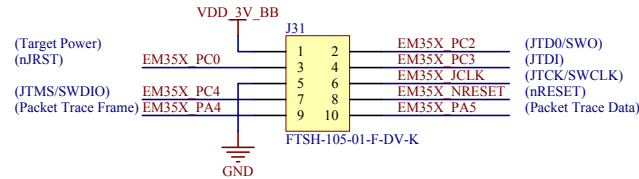
USB IC DECOUPLING



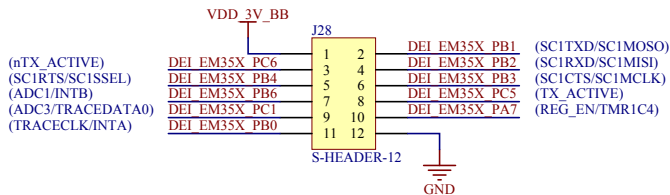
FTDI GPIO TEST POINTS



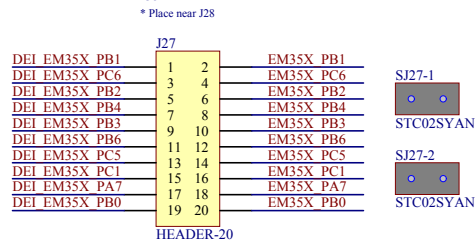
INSIGHT PORT (ISP)



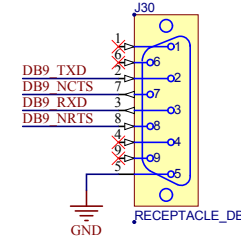
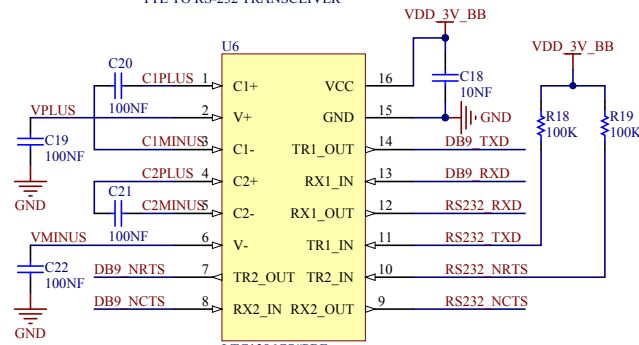
EM35X DEI CONNECTOR



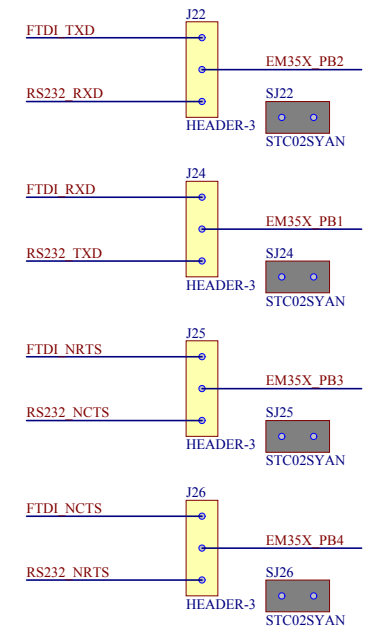
EM35X DEI HEADER



TTL TO RS-232 TRANSCEIVER



USB/RS-232 SELECTOR



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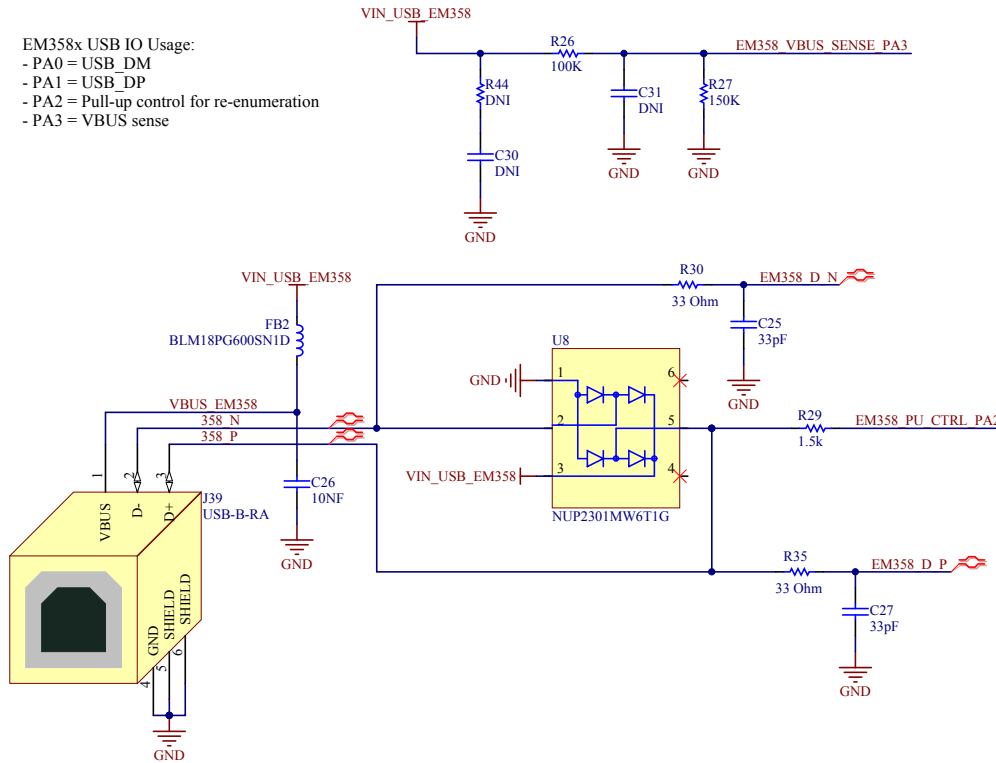
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 Sheet Name: 0680_4 User Interfaces.SchDoc
 Date: 5/21/2013 | Time: 8:19:47 AM | Sheet: 4 of 6 | Size: B

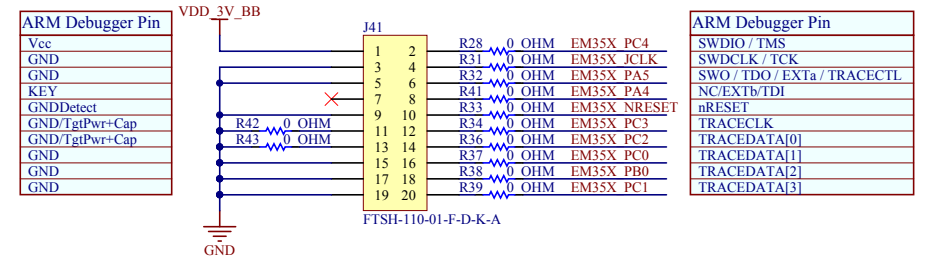
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EM358x USB INTERFACE (TYPE B) 5V

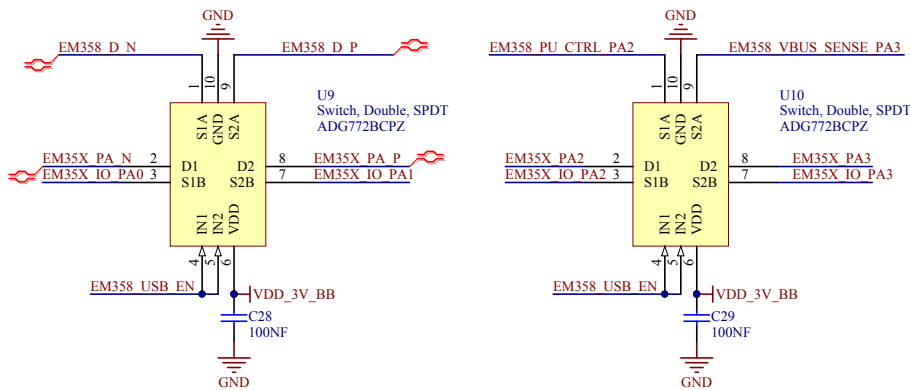
- EM358x USB IO Usage:
- PA0 = USB_DM
 - PA1 = USB_DP
 - PA2 = Pull-up control for re-enumeration
 - PA3 = VBUS sense



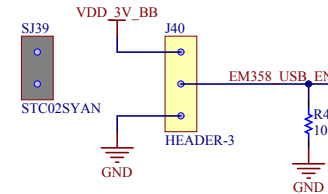
EM358x ETM HEADER (DEBUG ARM COMPATIBLE)



EM358x IO SWITCHING FOR USB VERSUS IO/DATAFLASH



EM358x USB ENABLE JUMPER



EM358_USB_EN States:
 VDD_3V_BB (pin 1) = EM358x USB enabled, SC2 not available
 GND (pin 2) = EM358x USB disabled, SC2 available for Serial DataFlash or other uses

SCHEMATIC NOTES:

-- Version A0 --

*Released: December 8, 2009

*Initial version released, Version A0 (initial draft)

-- Version B0 --

*Released: January 13, 2010

*Changes from A0 include:

1. Added U7, DataFlash
2. Added C23, 10nF
3. Added R20, 0 Ohm
4. Added R21, 0 Ohm
5. Added J33, 10 pin shorting plug header
6. Added SJ19 - SJ23, Shorting Plugs

-- Version B2 --

*Released: August 19, 2011

*Changes from B0 schematic and B1 BOM include:

1. Added C24 1uF cap to U1 regulator, incorporating ECO C00273 into design
2. Changed D3 from GSOT12C to GSOT15C
3. Updated shorting jumper notes
4. Updated C3 to a lower ESR cap for better regulator stability

-- Version C0 --

*Released: September 20, 2012

*Changes from B2 schematic and B3 BOM include:

1. Recreated schematic in Altium Designer.
2. Removed MH1-4, since rubber bump-ons used instead of stand-offs.
3. Added dedicated USB connector for EM358 USB.
4. Added support for external DataFlash on SC1 as well as SC2.
5. Added USB switches for PA0-3 switching between USB mode and IO/DF mode.
6. Replaced Atmel AT45 DataFlash with 8MBit WinBond DataFlash W25Q80BVSNIQ.
7. Added DataFlash Shutdown control circuit, controlled by EM35X_PB7.
8. Added VIN_USB_EM358 power path through regulator and power LED.
9. Various net name changes to distinguish between FTDI USB and EM358 USB.
10. Added ARM Compatible ETM header.

-- Version C1 --

*Released: September 29, 2012

*Changes from C0 include:

1. Fixed error with R29 PA2 pull-up control.
2. Added decoupling caps to U9 and U10.
3. Updated J41 to correct part (610-0097-000).

-- Version C2 --

*Released: May 21, 2013

*Changes from C1 include:

1. Corrected VBUS Sense Divider for PA3, as it was backwards. Also increased values from 10K and 15K to 100K and 150K to reduce standby current.
2. Replaced R24 with 2-pin jumper J42.
3. Changed termination resistors R30 and R35 values from 26.1 ohms to 33 ohms, as well as changed shunt caps C25 and C27 from DNI to 33pF.
4. Added filter components R44, C30, and C31 for VBUS overshoot protection on PA3 (DNI at this time).
5. Changed J41 from SMT to TH component, since TH is a standard part.

PCB LAYOUT NOTES:

-- Version A0 --

*Released: December 8, 2009

*Initial version released, Version A0 (initial draft)

-- Version B0 --

*Released: January 13, 2010

*Changes from A0 include:

1. Added U7, DataFlash, plus routes
2. Added C23, 10nF, plus routes
3. Added R20, 0 Ohm, plus routes
4. Added R21, 0 Ohm, plus routes
5. Added J33, 10 pin shorting plug header, plus routes
6. Changed silkscreen text at J22 to display "RXD (PB2)"
7. Changed silkscreen text at J24 to display "TXD (PB1)"
8. Changed silkscreen text at J25 to display "nCTS (PB3)"
9. Changed silkscreen text at J26 to display "nRTS (PB4)"
10. Reduced size of Ember logo, Moved it and rotated it 90 degrees

-- Version B2 --

*Released: August 19, 2011

*Changes from B0 layout and B1 BOM include:

1. Added bump-on outlines for bottom-side assembly
2. Added C24 1uF cap to U1 regulator
3. Updated drill sizes for some through-hole decals
4. Updated DB-9 connector footprint from vertical to right-angle
5. Fixed board outline dimensioning error

-- Version B3 --

*Released: August 27, 2012

*Changes from B2 layout and B2 BOM include:

1. Replaced Ember logo with Silicon Labs logo

-- Version C0 --

*Released: September 20, 2012

*Changes from B3 layout and B3 BOM include:

1. Imported layout from PADS into Altium Designer.
2. Removed MH1-4, since rubber bump-ons used instead of stand-offs.
3. Added dedicated USB connector for EM358 USB.
4. Added support for external DataFlash on SC1 as well as SC2.
5. Added USB switches for PA0-3 switching between USB mode and IO/DF mode.
6. Replaced Atmel DataFlash with WinBond DataFlash W25Q80BVSNIQ.
7. Added DataFlash Shutdown control circuit.
8. Added BAT54C for EM358 USB power.
9. Added VIN_USB_EM358 power LED.
10. Added ARM Compatible ETM header.

-- Version C1 --

*Released: September 29, 2012

*Changes from C0 include:


1. Fixed error with R29 PA2 pull-up control.
2. Added decoupling caps to U9 and U10.
3. Added SST outline to U1.
4. Fixed SSB polarity issue with J5.
5. Moved peripheral headers away from DataFlash headers.
6. Moved buttons and LEDs closer together to make more room for DataFlash and USB_EN headers.

-- Version C2 --

*Released: May 21, 2013

*Changes from C1 include:

1. J41 changed from SMT to TH.
2. R24 replaced with 2-pin jumper J42.
3. Added overshoot filter components R44, C30, and C31.
4. Mask vias on top side, leaving bottom-side vias unmasked for ICT.

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	Part Number: 130-0680-000		Rev: C2	
	Sheet Name: 0680_6_Notes_SchDoc		Date: 5/21/2013 Time: 8:19:47 AM Sheet: 6 of 6 Size: B	