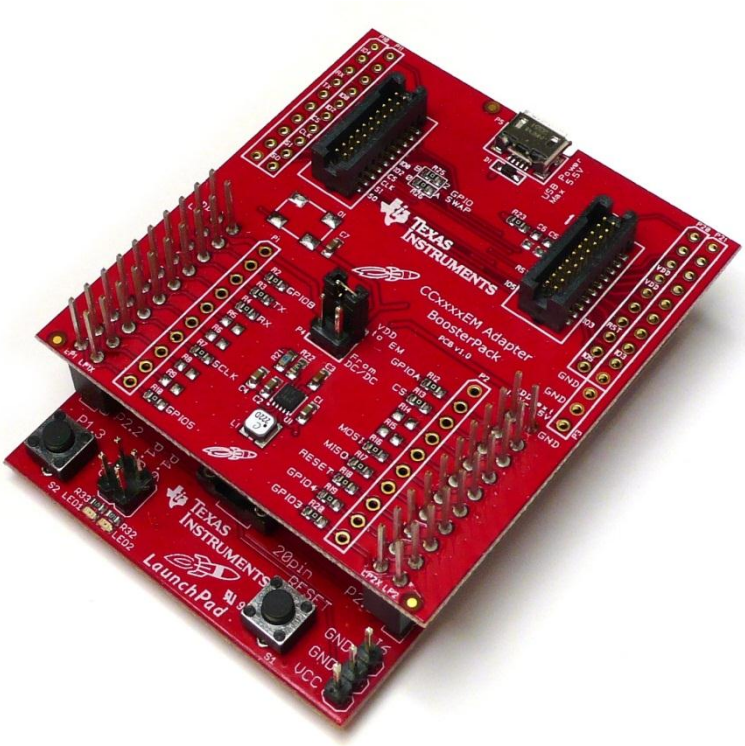
EM Adapter BoosterPack
User's Guide



Literature number SWRU338
revision A

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1 Introduction

Thank you for purchasing the EM Adapter BoosterPack.

The adapter board is a simple sandwich board that makes it easy to connect one of the many available RF Evaluation Modules (EM), like the CC1101EM, CC1120EM, CC2500EM, and CC2520EM to a TI MCU LaunchPad development board. The adapter board provides access to all of the pins on the EM connector and is designed to make it easy to re-configure the connections between the EM and LaunchPad (LP) to fit any combination of evaluation modules and LaunchPads.

The adapter board is equipped with a USB connector to make it possible to power the assembly (LaunchPad + adapter + EM, or just the adapter + EM) if the power supply on the LaunchPad is insufficient.

If you like to build your own BoosterPack, please refer to the "Build Your Own BoosterPack" wiki [2].

2 About this Manual

This manual describes the EM Adapter BoosterPack hardware.

3 Acronyms and Definitions

BP	BoosterPack
CS	Chip Select
EM	Evaluation Module
LP	LaunchPad
MCU	Micro Controller Unit
MISO	Master Out Slave In
MOSI	Master In Slave Out
RF	Radio Frequency
SCLK	Serial Clock
SoC	System on Chip
SPI	Serial Peripheral Interface
TI	Texas Instruments
USB	Universal Serial bus

4 Hardware Description

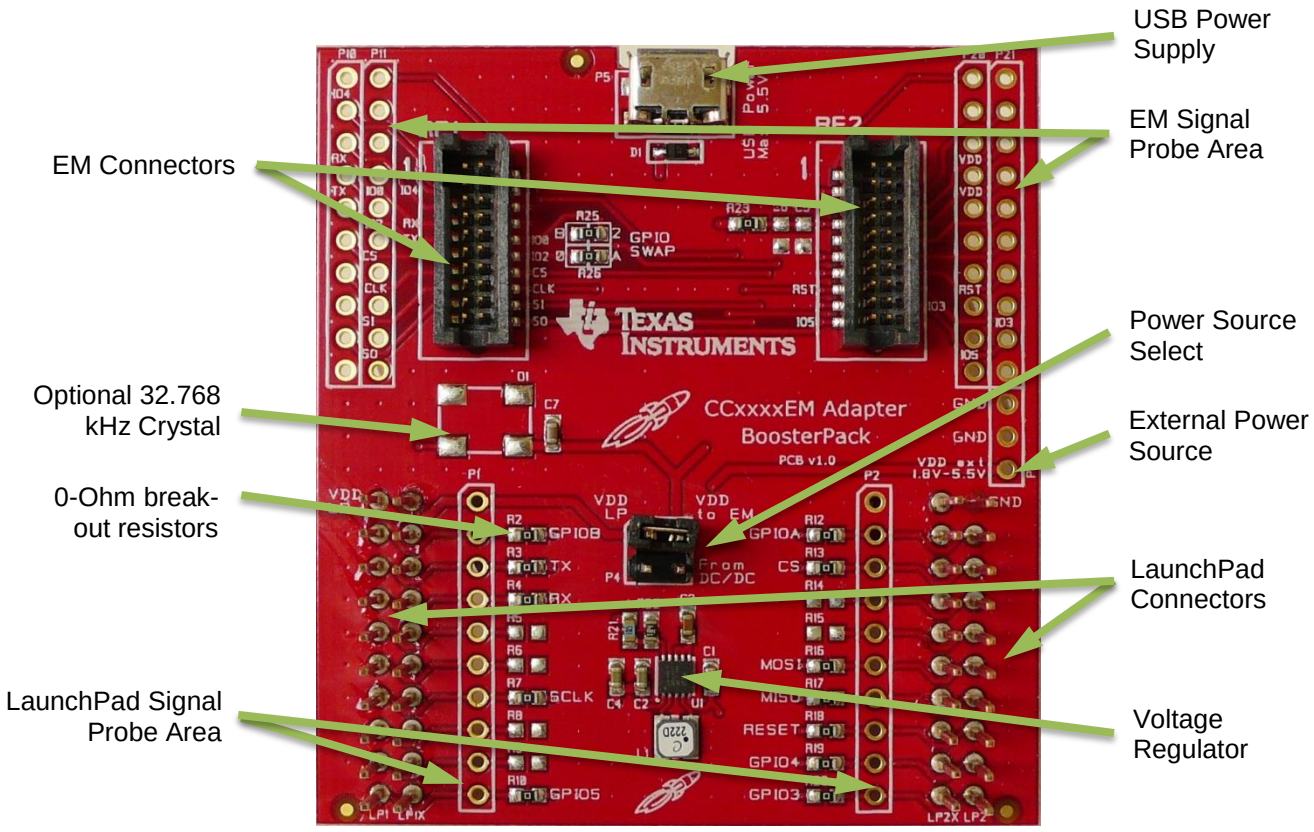


Figure 1 - EM Adapter BoosterPack Details

4.1 EM Connectors

The part number of the EM connectors on the adapter board is TFM-110-02-L-D-A from Samtec [7]. They mate with e.g. SFM-110-02-L-D-A, also from Samtec.

4.2 LaunchPad Connectors

The LaunchPad connectors on the adapter board are SSQ-110-23-L-D from Samtec.

Dual-row headers/sockets are used to allow full pass-through of all signals from an XL type LaunchPad, e.g. the Tiva TM4C LaunchPad [4], to an appropriate BoosterPack [6] stacked on top of the EM Adapter BoosterPack.

At the time of writing this document, the EM Adapter BoosterPack is compatible with the following LaunchPads:

- MSP430 ValueLine LaunchPad [3]
- Tiva TM4C LaunchPad [4]
- C2000 Piccolo LaunchPad [5]

4.3 LaunchPad to EM Interconnection

4.3.1 Interconnect Concept

Figure 2 below shows the basic concept of how the signals from the LaunchPad connectors are connected to signals on the EM connectors. All of the pins on the connectors are available on probe headers or pin holes on the board.

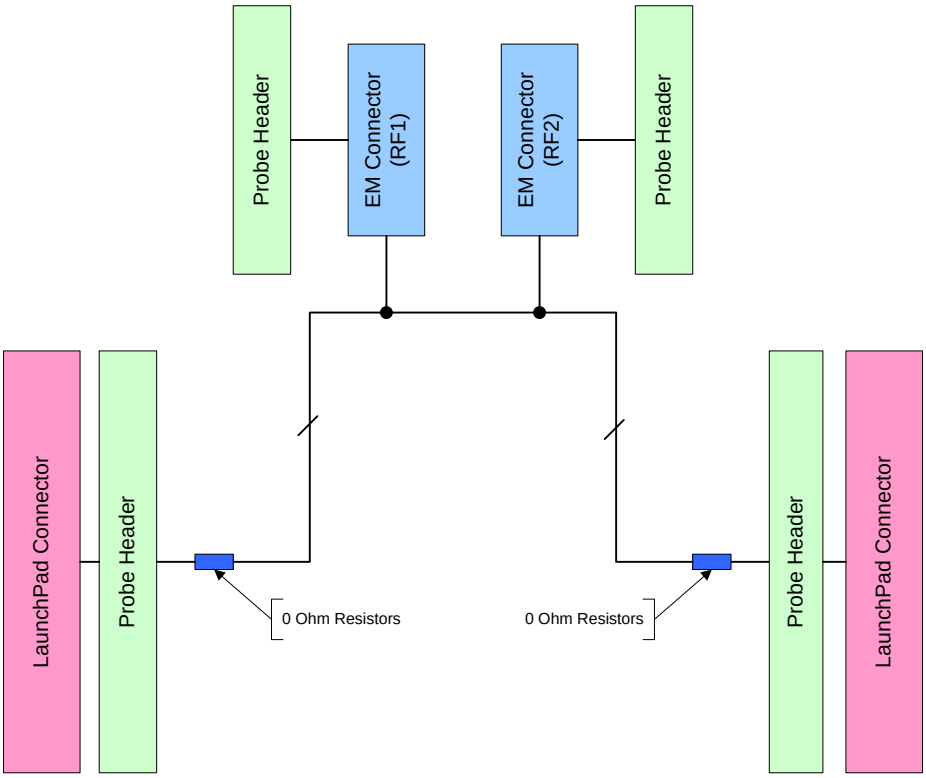


Figure 2 - Interconnect Concept

All signals between the LP and EM connectors are interconnected with a 0-Ohm resistor. By removing the resistor, the signal path is broken and it is easy to wire strap between the various probe pins to adjust the interconnection to fit any EM and LP pin-out. Figure 3 illustrates the concept.

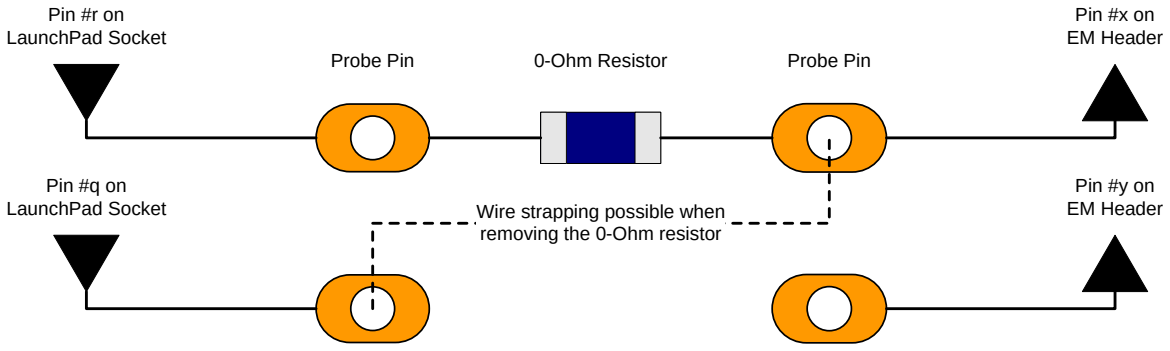


Figure 3 - Re-wiring Concept

4.3.2 Detailed Pin-out

The tables below show the pin-out from the EM connectors and LP connectors and how these signals are connected together.

EM Connector 1 (RF1)			
Signal name	**Pin**	**Pin**	**Signal name**
GND	1	2	-
GPIO4	3	4	-
OSC32k	5	6	-
RX	7	8	-
TX	9	10	GPIO0 (A)
-	11	12	GPIO2 (B)
-	13	14	SPI CS
-	15	16	SPI SCLK
-	17	18	SPI MOSI
GND	19	20	SPI MISO

EM Connector 2 (RF2)			
Signal name	**Pin**	**Pin**	**Signal name**
-	1	2	GND
-	3	4	-
-	5	6	-
VDD	7	8	-
VDD	9	10	-
-	11	12	-
-	13	14	-
RESET	15	16	-
-	17	18	GPIO3
GPIO5	19	20	GND

LaunchPad (LP1)	Adapter Board	
	Signal name	**EM Header**
LP1.1	VDD	VDD
LP1.2	GPIOB (2)	RF1.12
LP1.3	GPIO (TX)	RF1.09
LP1.4	GPIO (RX)	RF1.07
LP1.5	-	-
LP1.6	-	-
LP1.7	SPI SCLK	RF1.16
LP1.8	-	-
LP1.9	-	-
LP1.10	GPIO5	RF2.19

LaunchPad (LP2)	Adapter Board	
	Signal name	**EM Header**
LP2.1	GND	GND
LP2.2	GPIOA (0)	RF1.10
LP2.3	SPI CS	RF1.14
LP2.4	-	-
LP2.5	-	-
LP2.6	SPI MOSI	RF1.18
LP2.7	SPI MISO	RF1.20
LP2.8	RESET	RF2.15
LP2.9	GPIO4	RF1.03
LP2.10	GPIO3	RF2.18

4.4 Powering the Adapter Board

Use the power select jumper, P4, to switch between power sources for the evaluation module. Figure 4 shows an overview of how the various power sources are connected to the power jumper.

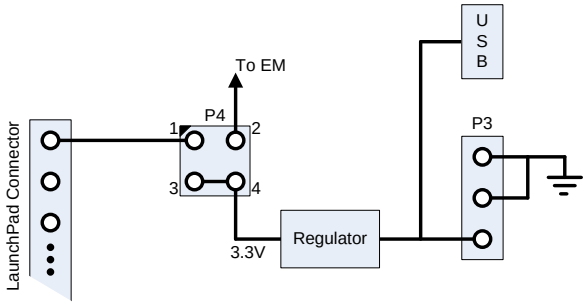
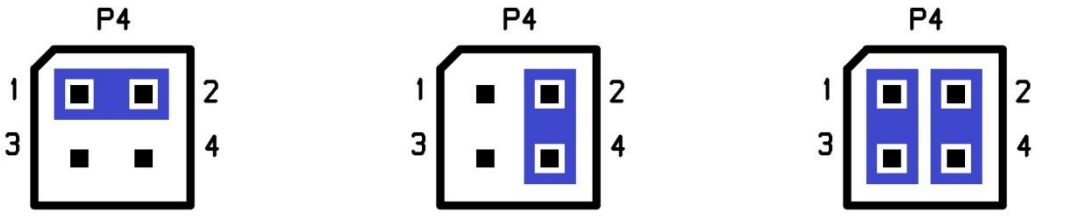


Figure 4 - Power Select Jumper Detailed Overview

The default option is to power the adopter board, and thus the evaluation module (EM), directly from the LaunchPad (LP). In this case, the jumper should short-circuit pin 1 and 2. See Figure 5 below (the default option on the left).



Default:
Power EM from LP

Alternative 1:
Power EM from USB

Alternative 2:
Power LP and EM from USB

Figure 5 - Power Select Jumper

The board is equipped with a USB connector and a voltage regulator to make it possible to supply power from USB. Any USB power source can be used, with a maximum voltage of 5.5V. This voltage source can be used if the LaunchPad is unable to supply sufficient current (for example for the CC3000 WiFi evaluation modules). Note that the USB connector can ONLY be used as a power source. The USB data lines are not connected.

To power the assembly from USB, the jumper on header P4 must be rotated 90 degrees so that pin 2 is connected to pin 4. See Figure 5, alternative 1. The on-board buck/boost regulator will set the voltage to 3.3V.

As an alternative to USB, you can connect an external power source to the board using the pin holes for connector P3 (on the right hand side of the board). The voltage source shall be in the range from 1.8V to 5.5V. The power select jumper on P4 should in this case be in the same position as when a USB cable is connected.

Avoid connecting both a USB cable and an external power source to the adapter board at the same time.

By connecting an additional jumper on P4, short-circuiting pin 1-3, you can use the USB supply to both power the EM and the LaunchPad, as shown in Figure 5, alternative 2. In this case, remove any other power source from the LaunchPad.

You can also bypass the on-board regulator altogether by connecting an external power source directly to pin 2 on P4. In this case, the voltage supplied by the power source shall be within the maximum and minimum operating voltage limits of the evaluation module connected to the adapter board. **To avoid signal level conflicts, make sure the voltage supplied to the EM is similar to the voltage on the LP.**

4.5 Measuring the Current Consumption

By connecting an ammeter between the power source pin (pin 1 or 3) on the power select header P4 and the power sink pin (pin 2 on the same header), you can easily measure the current consumed by the connected EM board.

4.6 GPIO Swap Resistors

In order to support existing software for the various EM boards available, the Adapter Board allows simple swapping on the signals from EM connector 1 to pins on the LaunchPad connector.

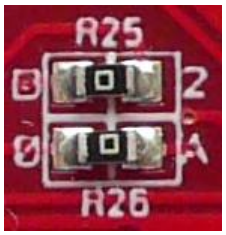
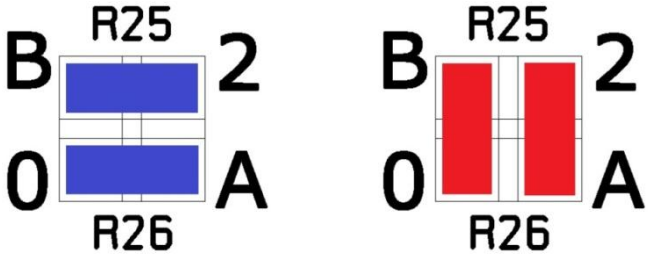


Figure 6 - GPIO Swap Resistors

In the default position, the signal GPIO0 (RF2.10) goes to GPIOA (LP1.2) and GPIO2 (RF2.12) goes to GPIOB (LP2.2). As shown in Figure 7, by rotating the two 0603 0-Ohm resistors R25 and R26, you swap these interconnections, such that GPIO0 is connected to LP2.2 (GPIOB) and GPIO2 is connected to LP1.2 (GPIOA).



Default **Alternate**

Figure 7 - GPIO Swap Resistor Positions

4.7 Optional 32k Oscillator

To support some of the Bluetooth CC256x evaluation modules that require an external clock signal on EM connector pin RF1.5, it is possible to mount a 32.768 kHz crystal oscillator on the adapter board.

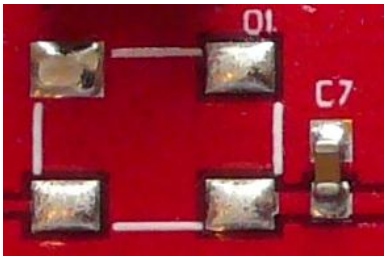
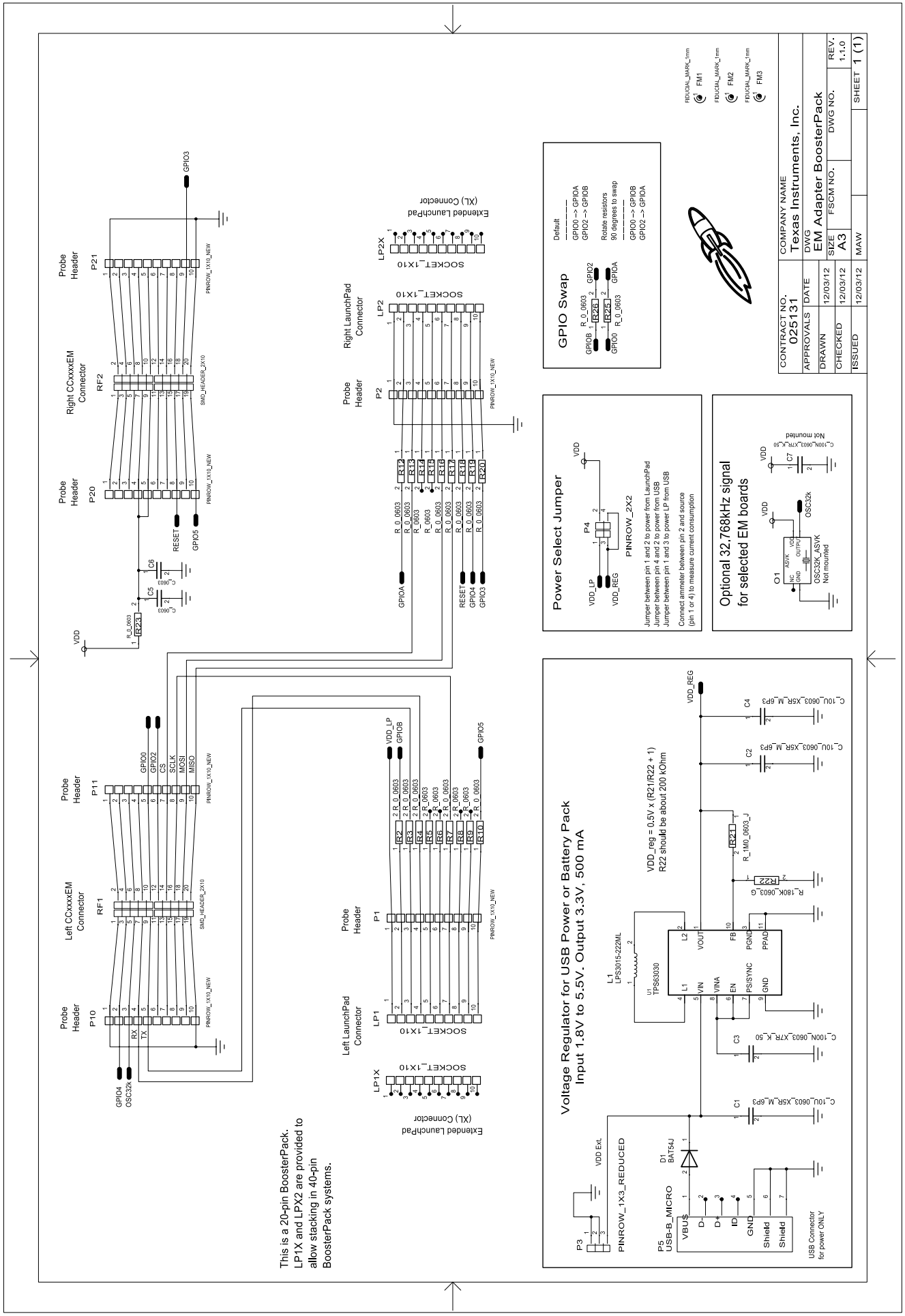


Figure 8 - Oscillator Solder Pads

The board is designed to fit a 5x7 mm oscillator from Abracon [8]. This part is easily available from suppliers like Digi-Key and Future Electronics.

5 Schematics



6 References

[1] EM Adpater BoostePack product web site
http://www.ti.com/tool/boost-ccemadapter

[2] Build Your Own BoosterPack
http://processors.wiki.ti.com/index.php/BYOB

[3] MSP430 ValueLine LaunchPad
http://www.ti.com/tool/msp-exp430g2

[4] Tiva TM4C LaunchPad
http://www.ti.com/tool/ek-tm4c123gxl

[5] C2000 Piccolo LaunchPad
http://ti.com/tool/launchxl-f28027

[6] Overview of BoosterPacks
http://processors.wiki.ti.com/index.php/BoosterPacks

[7] Samtec
http://www.samtec.com

[8] Abracon ASVK 32.768 kHz Oscillator
http://www.abracon.com/Oscillators/ASVK.pdf

7 Document History

Revision	Date	Description/Changes
-	2013-03-12	First revision.
A	2013-04-15	New pictures

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