# LAUNCHXL-F28069M Overview

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## Trademarks



# 1 Introduction

The C2000™ Piccolo™ LaunchPad™, LAUNCHXL-F28069M, is a complete low-cost development board for the Texas Instruments Piccolo F2806x devices and InstaSPIN technology. The LAUNCHXL-F28069M kit features all the hardware and software necessary to develop applications based on the F2806x microprocessor. The LaunchPad is based on the superset F28069M device, and easily allows users to migrate to lower cost F2806x devices once the design needs are known. It offers an on-board JTAG emulation tool allowing direct interface to a PC for easy programming, debugging, and evaluation. In addition to JTAG emulation, the USB interface provides a universal asynchronous receiver/transmitter (UART) serial connection from the F2806x device to the host PC.

Users can download an unrestricted version of Code Composer Studio™ IDE to write, download, and debug applications on the LAUNCHXL-F28069M board. The debugger is unobtrusive, allowing the user to run an application at full speed with hardware breakpoints and single stepping available while consuming no extra hardware resources.

As shown in Figure 1, the LAUNCHXL-F28069M C2000 LaunchPad features include:

- USB debugging and programming interface via a high-speed galvanically isolated XDS100v2 debug probe featuring a USB/UART connection
- Superset F28069M device that allows applications to easily migrate to lower cost devices
- Two user LEDs
- Device reset pushbutton
- Easily accessible device pins for debugging purposes or as sockets for adding customized extension boards
- InstaSPIN library in ROM, allowing implementation of InstaSPIN-MOTION and InstaSPIN-FOC solutions
- Dual 5 V quadrature encoder interfaces
- CAN Interface with integrated transceiver
- Boot selection switches

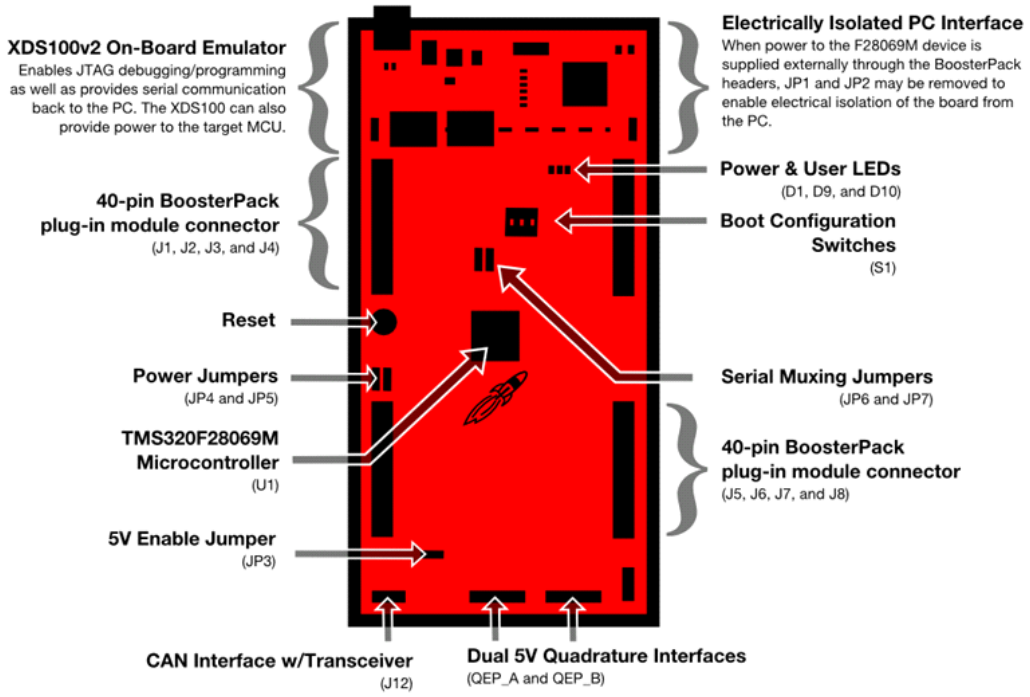


**Figure 1. LAUNCHXL-F28069M Board Overview**

## 2 Kit Contents

The LAUNCHXL-F28069M LaunchPad experimenter kit includes the following items:

- C2000 LaunchPad Board (LAUNCHXL-F28069M)
- Mini USB-B Cable, 0.5m
- Quick Start Guide

### *2.1 Revisions*

The first and only production released of the LAUNCHXL-F28069M in 2014 was revision 1.2.

**All Revisions:**

- Resistor R7 in the oscillator circuit is incorrectly placed or should not be installed. This resistor may impact startup time or robustness of the clocking circuit over the full operating range of the MCU or different physical layouts of this circuit. The probability is low that this resistor will have any impact on the functionality of this EVM as is not intended to be operated outside of Standard Temperature and Pressure in a lab or prototype environment. Do not use this circuit as reference. For more information on the Follow the requirements for the oscillator schematic, see the device-specific data sheet.

## 3 Installation

The F28069M LaunchPad is supported in both Code Composer Studio and Energia. Depending on your tools preference you may wish to install one or the other or both.

### *3.1 Energia*

Go to Energia.nu and and click on the Guide tab. Click on the link for your operating system and follow the directions to install Energia.

## 3.2 Code Composer Studio

### 3.2.1 Download the Required Software

Code Composer Studio IDE (www.ti.com/ccs) is available for free without any restriction when used with the XDS100v2 debug probe on the C2000 LaunchPad. Drivers, examples, and other support software needed to get started are distributed through C2000Ware (www.ti.com/tool/c2000ware) and controlSUITE (www.ti.com/tool/controlsuite). C2000Ware is the recommended download for new installations.

For InstaSPIN motor control projects, install and run the latest version of MotorWare.exe (www.ti.com/motorware). In the window that opens, under Resources, follow the Kit Readme and GUI Quick Start Guide for the LAUNCHXL-F28069M.

### 3.2.2 Install the Software

Once downloaded, install Code Composer Studio and C2000Ware or controlSUITE.

### 3.2.3 Install the Hardware

After Code Composer Studio is installed, plug the supplied USB cable into the C2000 LaunchPad board and into an available USB port on your computer.

Windows® will automatically detect the hardware and ask you to install software drivers. Let Windows run a search for the drivers and automatically install them. After Windows successfully installs the drivers for the integrated XDS100v2 debug probe, your LaunchPad is now ready for use.

**NOTE:** If the USB Serial COM Port is not identified by the computer, reprogram the XDS100v2 EEPROM using these instructions.

# 4 Getting Started With the LAUNCHXL-F28069M

## 4.1 Getting Started

The first time the LAUNCHXL-F28069M is used, a demo application automatically starts when the board is powered from a USB host. If your board does not start the demo application, try placing S1 in the following positions and resetting the board: UP - UP - DOWN. To start the demo, connect the LAUNCHXL-F28069M with the included mini-USB cable to a free USB port. The demo application starts with the LEDs flashing to show the device is active.

## 4.2 Demo Application, Internal Temperature Measurement

The LAUNCHXL-F28069M includes a pre-programmed TMS320F28069M device. When the LaunchPad is connected via USB, the demo starts with an LED flash sequence. After a few seconds the device switches into a temperature measurement mode.

A reference temperature is taken at the beginning of this mode and the LEDs of the LaunchPad are used to display any difference between the current temperature and the reference temperature. If the device gets warmer than the reference temperature the red LED is lit with an intensity proportional to the temperature difference. However, if the device cools down compared to the reference temperature, a blue LED is lit in the same fashion.

In addition to the LED display, temperature information is also displayed on your PC through the USB/UART connection. To view the UART information on your PC, first figure out the COM port associated with the LaunchPad. To do this in Windows, right click on *My Computer* and click on *Properties*. In the dialog box that appears, click on the Hardware tab and open *Device Manager*. Look for an entry under Ports (COM & LPT) titled "XDS100 Class USB Serial Port (COMX)", where X is a number.

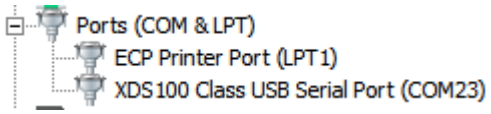


**Figure 2. USB Serial Port**

**NOTE:** If the USB Serial COM Port is not identified by the computer, reprogram the XDS100v2 EEPROM using these instructions.

Remember this number for when you open a serial terminal. The demo applications UART data was written and debugged using PuTTY, and for the best user experience we recommend you use PuTTY to view the UART data. PuTTY can be downloaded from the following URL:

http://www.chiark.greenend.org.uk/~sgtatham/putty/download.html

Open your serial terminal program and open the COM port you found previously in device manager with the following settings: 115200 Baud, 8 data bits, no parity, 1 stop bit. After opening the serial port in your serial terminal, reset the Launchpad with the reset push button and observe the serial terminal for a surprise.

### 4.3 Program and Debug the Temperature Measurement Demo Application

The project and associated source code for the C2000 Piccolo LaunchPad demo is included in the controlSUITE software package and should automatically be found by the TI Resource Explorer in Code Composer Studio v6. In the resource explorer, open the controlSUITE folder and then the Development Tools entry and look for the C2000 LaunchPad line item. Expand this item and LAUNCHXL-F28069M, then select the LaunchPad Demo Application. Follow the steps in the main pane of the resource explorer to import, build, debug, and run this application.

## 5 Hardware Configuration

The F28069M LaunchPad gives users several options as to how to configure the board.

### 5.1 Power Domain

The F28069M LaunchPad has several different power domains to enable JTAG isolation. Jumpers JP1, JP2, JP3, JP4, and JP5 configure where power is passed.

| Jumper | Power Domain |
|---|---|
| JP1 | Enable 3.3 V from USB (disables isolation) |
| JP2 | Enable GND from USB (disables isolation) |
| JP3 | Enable 5 V switcher (powered off 3.3 V supply of target device) |
| JP4 | Connects target MCU 3.3 V to second set of BoosterPack headers |
| JP5 | Connects target MCU 5 V to second set of BoosterPack headers |

## 5.2 Serial Connectivity

The LAUNCHXL-F28069M has a USB to UART adapter built in. This makes it easy to print debug information back to the host PC even in isolated environments. The F28069M device on this LaunchPad contains two SCI (UART) peripherals, while the LaunchPad has three places these peripherals need to be routed. Because of this, a serial connectivity mux has been added to the board to make configuration of the SCI routing easy. Routing is configured via two jumpers (JP6 and JP7). Configure the jumpers as shown in Table 1 for the serial connectivity you desire.

**Table 1. Serial Connectivity**

| MUX_SEL (JP7) | CH_SEL(JP 6) | Function |
|---|---|---|
| ON | ON | USB/UART Disabled; J1.3 and J1.4 – GPIO28 and GPIO29; J7.3 and J7.4 – GPIO15 and GPIO58 |
| ON | OFF | USB/UART – GPIO28 and GPIO29, J1.3 and J1.4 – Hi-Z; J7.3 and J7.4 – GPIO15 and GPIO58 |
| OFF | ON | USB/UART – GPIO15 and GPIO58; FAULT/OCTW – GPIO28 and GPIO29; J7.3 and J7.4 – Hi-Z |
| OFF | OFF | USB/UART – GPIO15 and GPIO58; FAULT/OCTW – GPIO28 and GPIO29; J7.3 and J7.4 – Hi-Z |

**NOTE:** If the USB Serial COM Port is not identified by the computer, reprogram the XDS100v2 EEPROM using these instructions.

## 5.3 Boot Mode Selection

The LaunchPad's F28069M device includes a boot ROM that performs some basic start-up checks and allows for the device to boot in many different ways. Most users will either want to perform an emulation boot or a boot to flash (if they are running the application standalone). S1 has been provided to allow users to easily configure the pins that the boot ROM checks to make this decision.

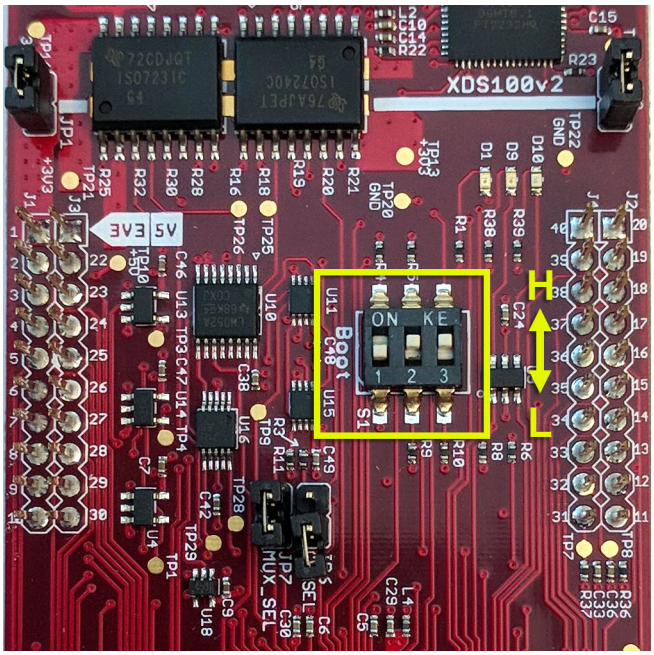


**Figure 3. Boot Switch Orientation**

The boot modes shown in Table 2 can be selected using S1:

**Table 2. S1 Boot Mode Settings**

| Boot Mode | S1-Switch 1 (GPIO34)<br>H = Pulled to 1<br>L = Pulled to 0 | S1-Switch 2 (GPIO37 / TDO)<br>H = Pulled to 1<br>L = Pulled to 0 | S1-Switch 3 (TRSTn)<br>H = XDS100v2 (1)<br>L = Tied to 0 |
|---|---|---|---|
| Emulation Boot (2) | L | H | H |
| Parallel IO | L | L | L |
| SCI | H | L | L |
| Wait | L | H | L |
| GetMode | H | H | L |

(1) TRSTn is controlled by the XDS100v2 when Switch 3 is set to the H position. While connected to the device, TRSTn is driven to 1 by the XDS100v2. While disconnected from the device, TRSTn is pulled to 0.

(2) When the board is first powered on through the XDS100v2 USB port, the device will boot before the user can connect to the device. Therefore, Switch 1 and Switch 2 should be configured to the Wait boot mode to hold the CPU in a safe state until the user can connect to the device.

**NOTE:** The USB debugger cannot connect to the device when S1-Switch 3 is placed in the L position because TSRTn is disconnected from the XDS100v2.

More information about boot mode selection can be found in the *Boot ROM* section of the *TMS320x2806x Piccolo technical reference guide*.

## 5.4 Connecting a Crystal

Although the Piccolo device present on the LAUNCHXL-F28069M has an internal oscillator — and for most applications this is sufficient — the LaunchPad offers a footprint for through-hole HC-49 crystals for users who require a more precise clock. If you wish to use an external crystal, solder the crystal to the Q1 footprint and appropriate load capacitors to the C3 and C4 footprints. You also need to configure the device to use the external oscillator in software.

## 5.5 Connecting a BoosterPack

The F28069M LaunchPad is the perfect experimenter board to start hardware development with the F2806x devices. All of the connectors are aligned in a 0.1-in (2.54-mm) grid to allow easy and inexpensive development of add on boards called BoosterPacks. These satellite boards can access all of the GPIO and analog signals. The the pin out of the connectors can be found in Section 5.

## 5.6 Device Migration Path

Applications developed on the LAUNCHXL-F28069M can easily be migrated to any of these lower cost devices in the F2806x family:

| Part Number | Description |
|---|---|
| TMS320F28069 | 32-Bit Real Time Microcontroller, 90 MHz, 256KB Flash, 100KB RAM |
| TMS320F28069F | 32-Bit Real Time Microcontroller, 90 MHz, 256KB Flash, 96KB RAM |
| TMS320F28069M | 32-Bit Real Time Microcontroller, 90 MHz, 256KB Flash, 96KB RAM |
| TMS320F28068 | 32-Bit Real Time Microcontroller, 90 MHz, 256KB Flash, 100KB RAM |
| TMS320F28068F | 32-Bit Real Time Microcontroller, 90 MHz, 256KB Flash, 96KB RAM |
| TMS320F28068M | 32-Bit Real Time Microcontroller, 90 MHz, 256KB Flash, 96KB RAM |
| TMS320F28067 | 32-Bit Real Time Microcontroller, 90 MHz, 256KB Flash, 100KB RAM |
| TMS320F28066 | 32-Bit Real Time Microcontroller, 90 MHz, 256KB Flash, 68KB RAM |
| TMS320F28065 | 32-Bit Real Time Microcontroller, 90 MHz, 128KB Flash, 100KB RAM |
| TMS320F28064 | 32-Bit Real Time Microcontroller, 90 MHz, 128KB Flash, 100KB RAM |
| TMS320F28063 | 32-Bit Real Time Microcontroller, 90 MHz, 128KB Flash, 100KB RAM |
| TMS320F28062 | 32-Bit Real Time Microcontroller, 90 MHz, 128KB Flash, 52KB RAM |
| TMS320F28062F | 32-Bit Real Time Microcontroller, 90 MHz, 128KB Flash, 52KB RAM |

# 6 LAUNCHXL-F28069M Hardware

## 6.1 Device Pin Out

The F28069M LaunchPad is not 100% compatible with the BoosterPack Standard pin out. to verify compatibility between a BoosterPack and this LaunchPad, consult both the tables below as well as the pin out requirements of the BoosterPack. TI provides a tool that can help ease this process. Use the Ti BoosterPack Checker tool. Some existing BoosterPacks can be used, or one can be created.

Table 3 through Table 6 lists the pin out and pin mux options for the C2000 LaunchPad.

The F28069M LaunchPad is not 100% compatible with the BoosterPack Standard pin out. to verify compatibility between a BoosterPack and this LaunchPad, consult both the tables below as well as the pin out requirements of the BoosterPack. TI provides a tool that can help ease this process. Use the TI BoosterPack Checker tool. Some existing BoosterPacks can be used, or one can be created.

**Table 3. F28069M LaunchPad Pin Out and Pin Mux Options - J1, J3**

| Mux Value | | | | J1 Pin | J3 Pin | Mux Value | | | |
|---|---|---|---|---|---|---|---|---|---|
| 3 | 2 | 1 | 0 | | | 0 | 1 | 2 | 3 |
| | | | +3.3V | 1 | 21 | +5V | | | |
| | | | ADCINA6 | 2 | 22 | GND | | | |
| | | | J1.3 | 3 | 23 | ADCINA7 | | | |
| | | | J1.4 | 4 | 24 | ADCINB1 | | | |
| SPISIMOB | SCITXDA | $\overline{TZ1}$ | GPIO12 | 5 | 25 | ADCINA2 | | | |
| | | | ADCINB6 | 6 | 26 | ADCINB2 | | | |
| XCLKOUT | SCITXDB | SPICLKA | GPIO18 | 7 | 27 | ADCINA0 | | | |
| SCITXDB | MCLKXA | EQEP1S | GPIO22 | 8 | 28 | ADCINB0 | | | |
| ADCSOCBO | EPWMSYNCO | SCLA | GPIO33 | 9 | 29 | ADCINA1 | | | |
| ADCSOCAO | EWPMSYNCI | SDAA | GPIO32 | 10 | 30 | NC | | | |

**Table 4. F28069M LaunchPad Pin Out and Pin Mux Options - J4, J2**

| Mux Value | | | | J4 Pin | J2 Pin | Mux Value | | | |
|---|---|---|---|---|---|---|---|---|---|
| 3 | 2 | 1 | 0 | | | 0 | 1 | 2 | 3 |
| Rsvd | Rsvd | EPWM1A | GPIO0 | 40 | 20 | GND | | | |
| COMP1OUT | Rsvd | EPWM1B | GPIO1 | 39 | 19 | GPIO19 | $\overline{SPISTEA}$ | SCIRXDB | ECAP1 |
| Rsvd | Rsvd | EPWM2A | GPIO2 | 38 | 18 | GPIO44 | MFSRA | SCIRXDB | EPWM7B |
| COMP2OUT | SPISOMIA | EPWM2B | GPIO3 | 37 | 17 | NC | | | |
| Rsvd | Rsvd | EPWM3A | GPIO4 | 36 | 16 | RESET# | | | |
| ECAP1 | SPISIMOA | EPWM3B | GPIO5 | 35 | 15 | GPIO16 | SPISIMOA | Rsvd | $\overline{TZ2}$ |
| SPISOMIB | Rsvd | $\overline{TZ2}$ | GPIO13 | 34 | 14 | GPIO17 | SPISOMIA | Rsvd | $\overline{TZ3}$ |

**Table 4. F28069M LaunchPad Pin Out and Pin Mux Options - J4, J2 (continued)**

| Mux Value | | | | J4 Pin | J2 Pin | Mux Value | | | |
|---|---|---|---|---|---|---|---|---|---|
| 3 | 2 | 1 | 0 | | | 0 | 1 | 2 | 3 |
| | | | NC | 33 | 13 | GPIO50 | EQEP1A | MDXA | TZ1 |
| | | | DAC1 | 32 | 12 | GPIO51 | EQEP1B | MDRA | TZ2 |
| | | | DAC2 | 31 | 11 | GPIO55 | SPISOMIA | EQEP2B | HRCAP2 |

**Table 5. F28069M LaunchPad Pin Out and Pin Mux Options - J5, J7**

| Mux Value | | | | J5 Pin | J7 Pin | Mux Value | | | |
|---|---|---|---|---|---|---|---|---|---|
| 3 | 2 | 1 | 0 | | | 0 | 1 | 2 | 3 |
| | | | +3.3 V | 41 | 61 | +5 V | | | |
| | | | NC | 42 | 62 | GND | | | |
| | | | J7.3 | 43 | 63 | ADCINB7 | | | |
| | | | J7.4 | 44 | 64 | ADCINB4 | | | |
| COMP1OUT | MDXA | EQEP1A | GPIO20 | 45 | 65 | ADCINA5 | | | |
| | | | NC | 46 | 66 | ADCINB5 | | | |
| SPICLKB | SCITXDB | TZ3 | GPIO14 | 47 | 67 | ADCINA3 | | | |
| COMP2OUT | MDRA | EQEP1B | GPIO21 | 48 | 68 | ADCINB3 | | | |
| SCIRXDB | MFSXA | EQEP1I | GPIO23 | 49 | 69 | ADCINA4 | | | |
| HRCAP1 | EQEP2A | SPISIMOA | GPIO54 | 50 | 70 | NC | | | |

**Table 6. F28069M LaunchPad Pin Out and Pin Mux Options - J8, J6**

| Mux Value | | | | J8 Pin | J6 Pin | Mux Value | | | |
|---|---|---|---|---|---|---|---|---|---|
| 3 | 2 | 1 | 0 | | | 0 | 1 | 2 | 3 |
| EPWMSYNCO | EPWMSYNCI | EPWM4A | GPIO6 | 80 | 60 | GND | | | |
| ECAP2 | SCIRXDA | EPWM4B | GPIO7 | 79 | 59 | GPIO27 | HRCAP2 | EQEP2S | SPISTEB |
| ADCSOCAO | Rsvd | EPWM5A | GPIO8 | 78 | 58 | GPIO26 | ECAP3 | EQEP2I | SPICLKB |
| ECAP3 | SCITXDB | EPWM5B | GPIO9 | 77 | 57 | NC | | | |
| ADCSOCBO | Rsvd | EPWM6A | GPIO10 | 76 | 56 | RESET# | | | |
| ECAP1 | SCIRXDB | EPWM6B | GPIO11 | 75 | 55 | GPIO24 | ECAP1 | EQEP2A | SPISIMOB |
| | | | NC | 74 | 54 | GPIO25 | ECAP2 | EQEP2B | SPISOMIB |
| | | | NC | 73 | 53 | GPIO52 | EQEP1S | MCLKXA | TZ3 |
| | | | DAC3 | 72 | 52 | GPIO53 | EQEP1I | MFSXA | Rsvd |
| | | | DAC4 | 71 | 51 | GPIO56 | SPICLKA | EQEP2I | HRCAP3 |

## 6.2 Schematics

Figure 4 shows the F28069M LaunchPad schematic.

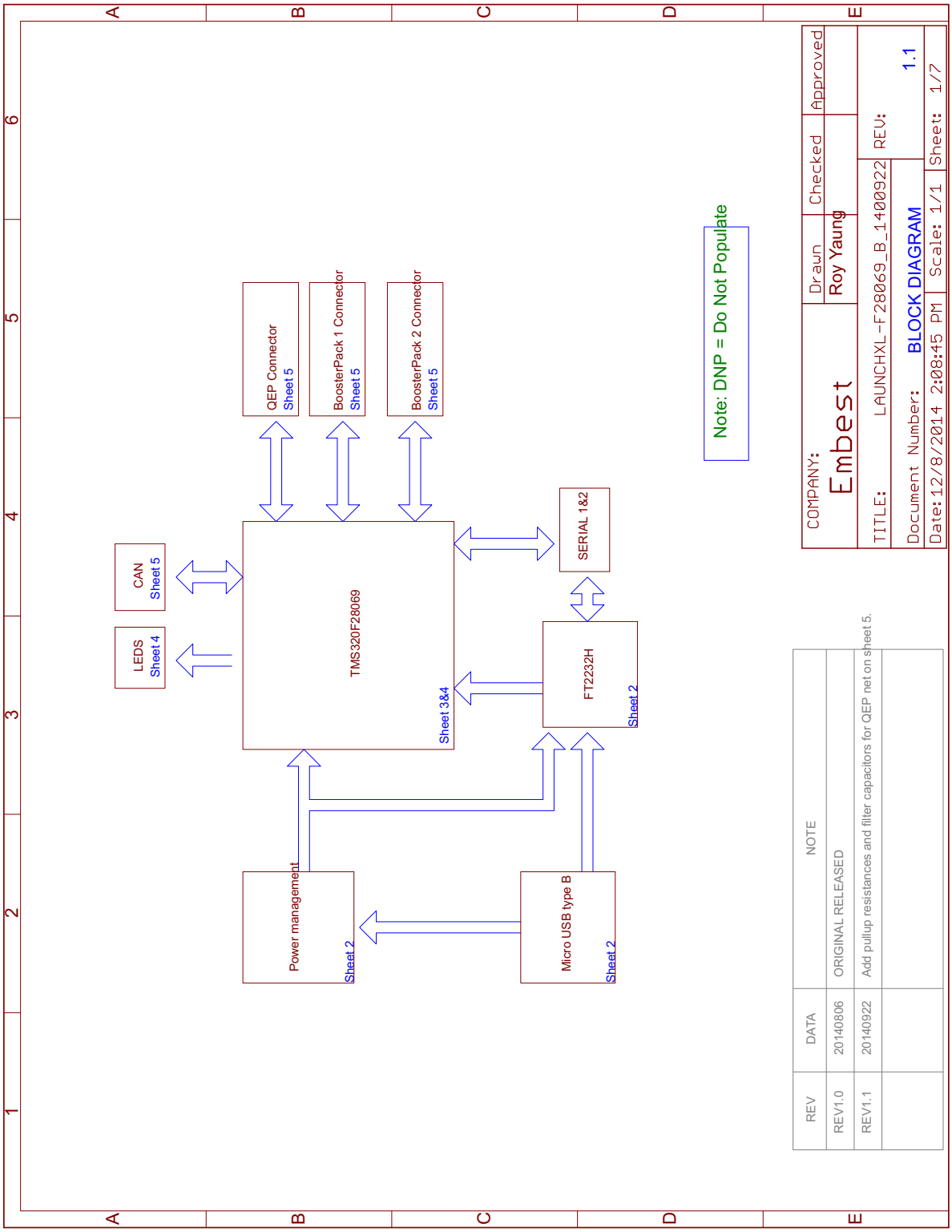


**Figure 4. LAUNCHXL-F28069_B_1400922 Block Diagram Schematic**

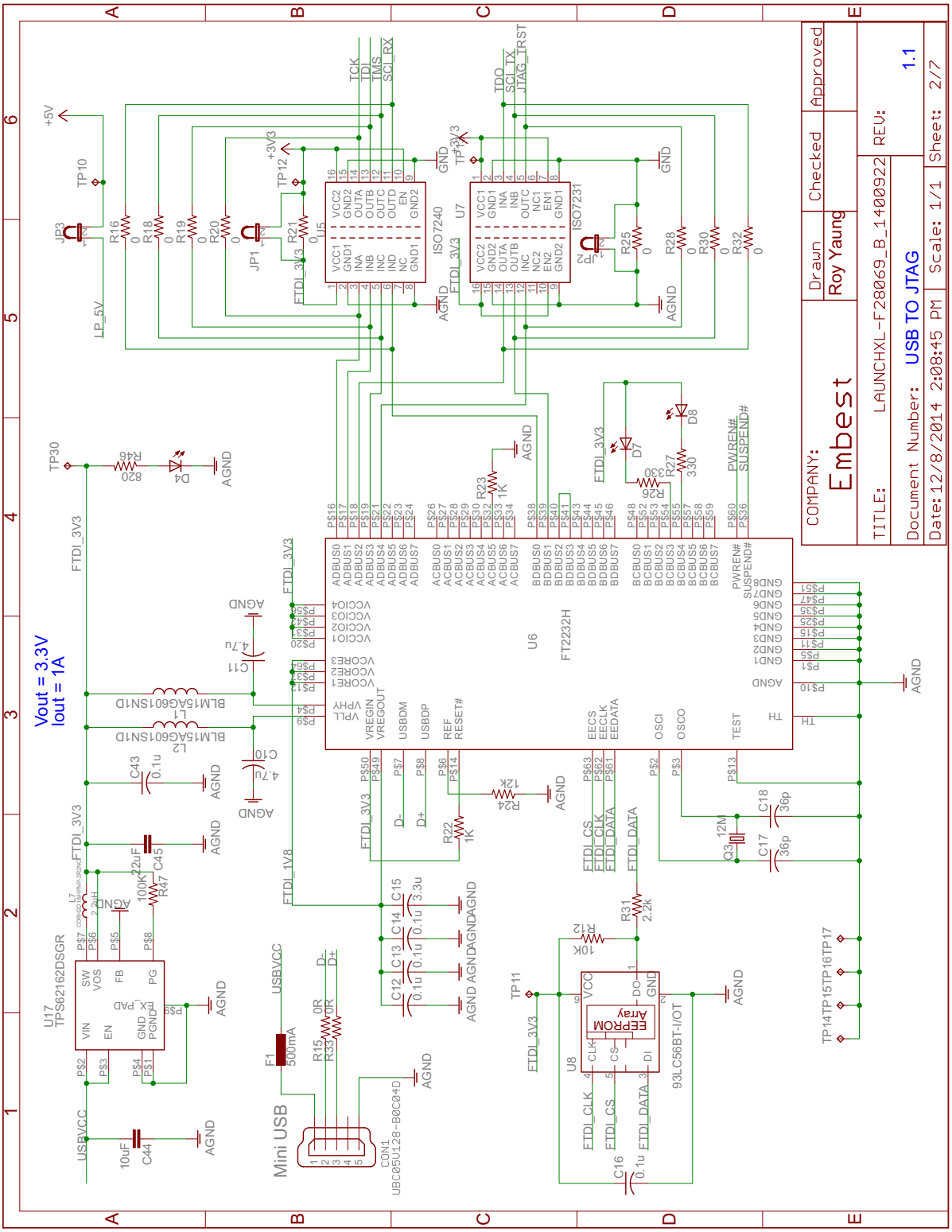


**Figure 5. LAUNCHXL-F28069_B_1400922 USB to JTAG Schematic**

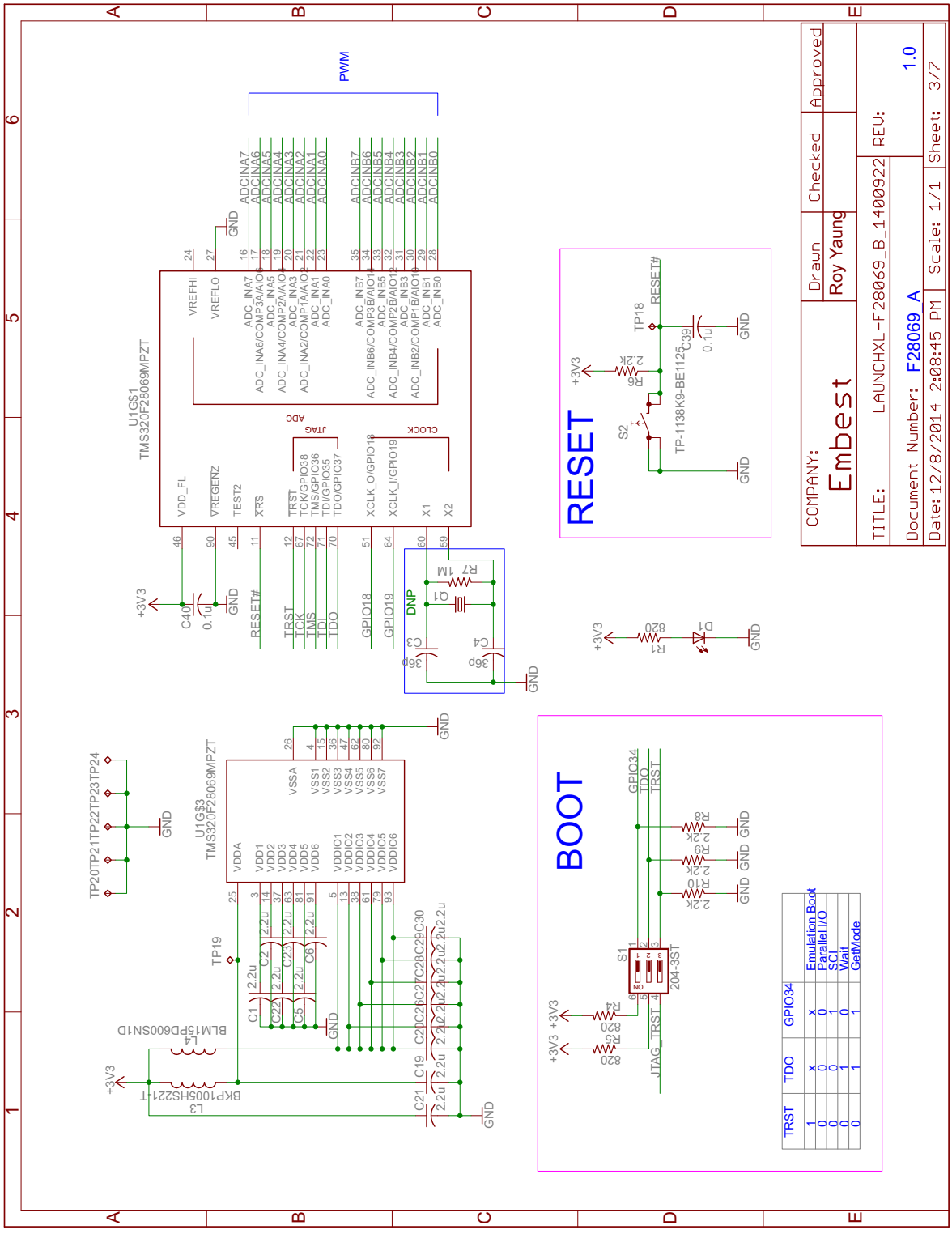


**Figure 6. LAUNCHXL-F28069_B_1400922 F28069_A Schematic**

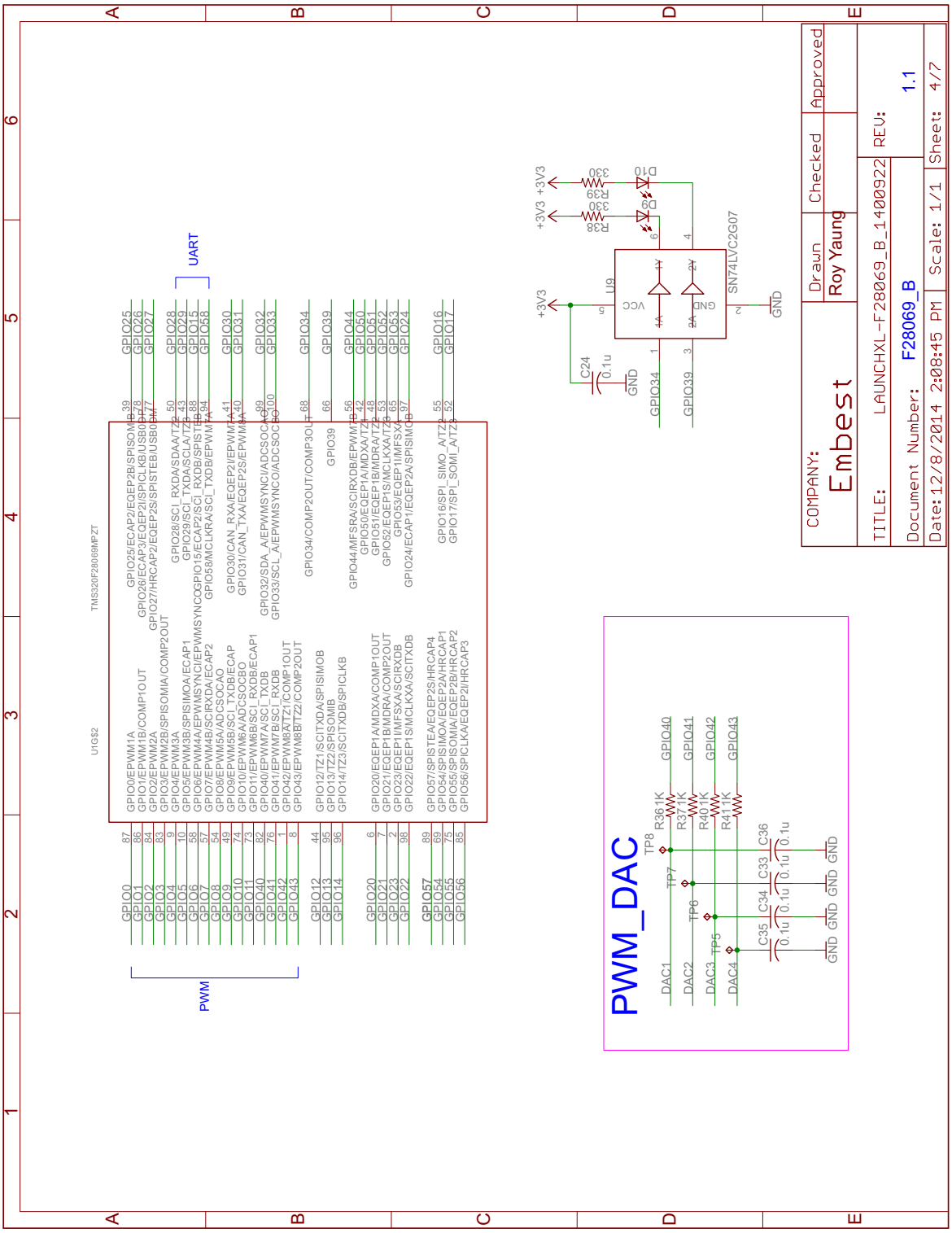


**Figure 7. LAUNCHXL-F28069_B_1400922 F28069_B Schematic**

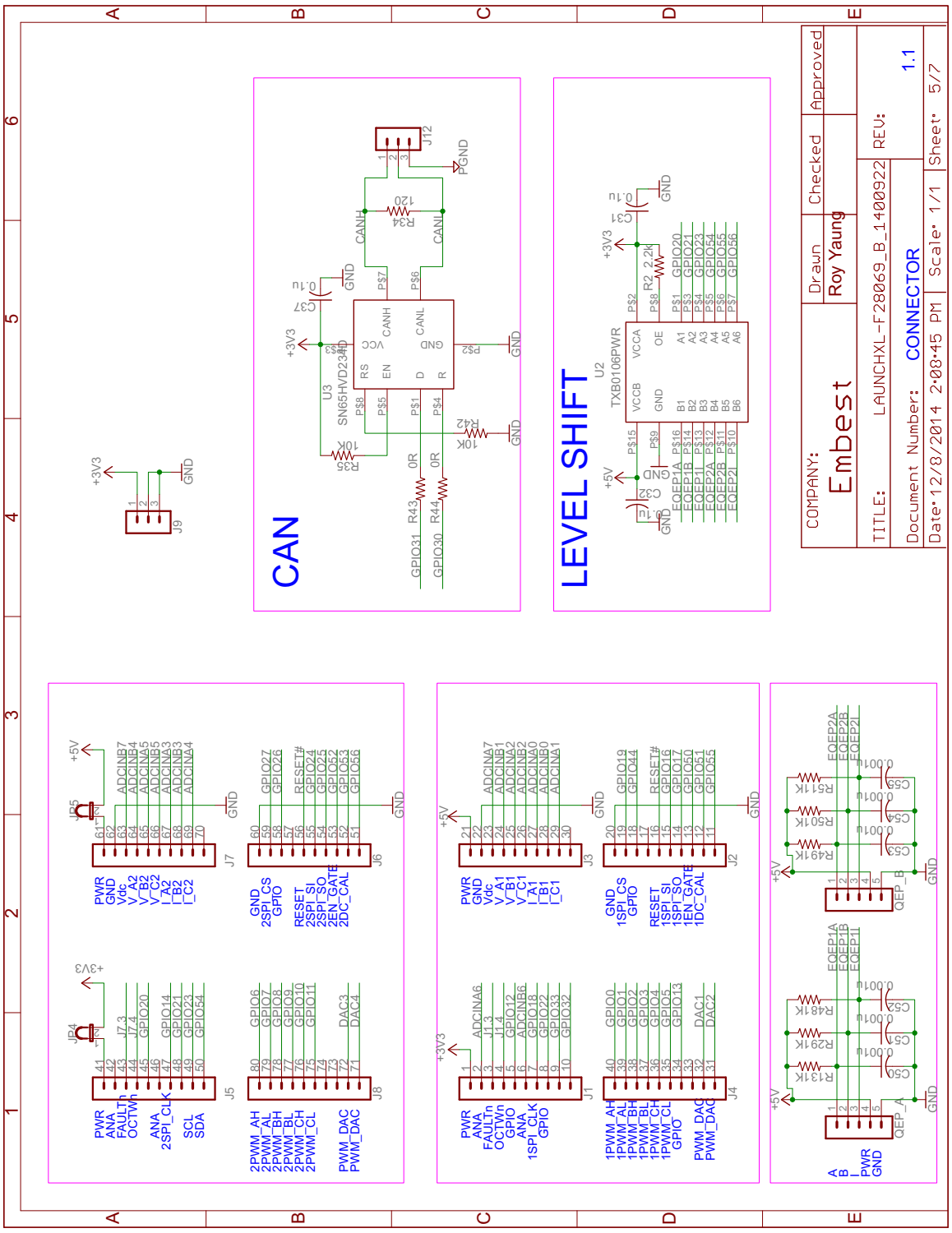


**Figure 8. LAUNCHXL-F28069_B_1400922 Connector Schematic**

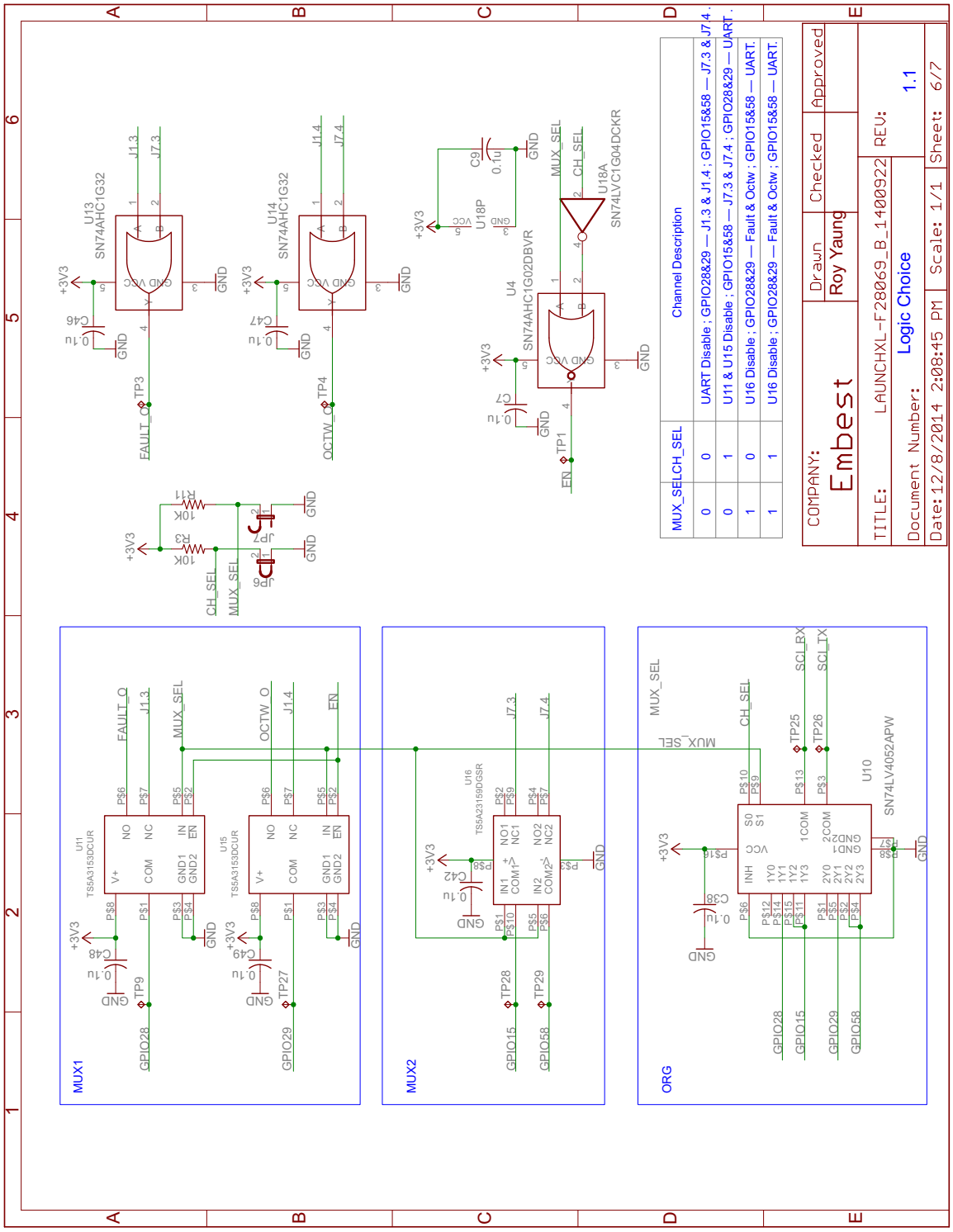


**Figure 9. LAUNCHXL-F28069_B_1400922 Logic Choice Schematic**

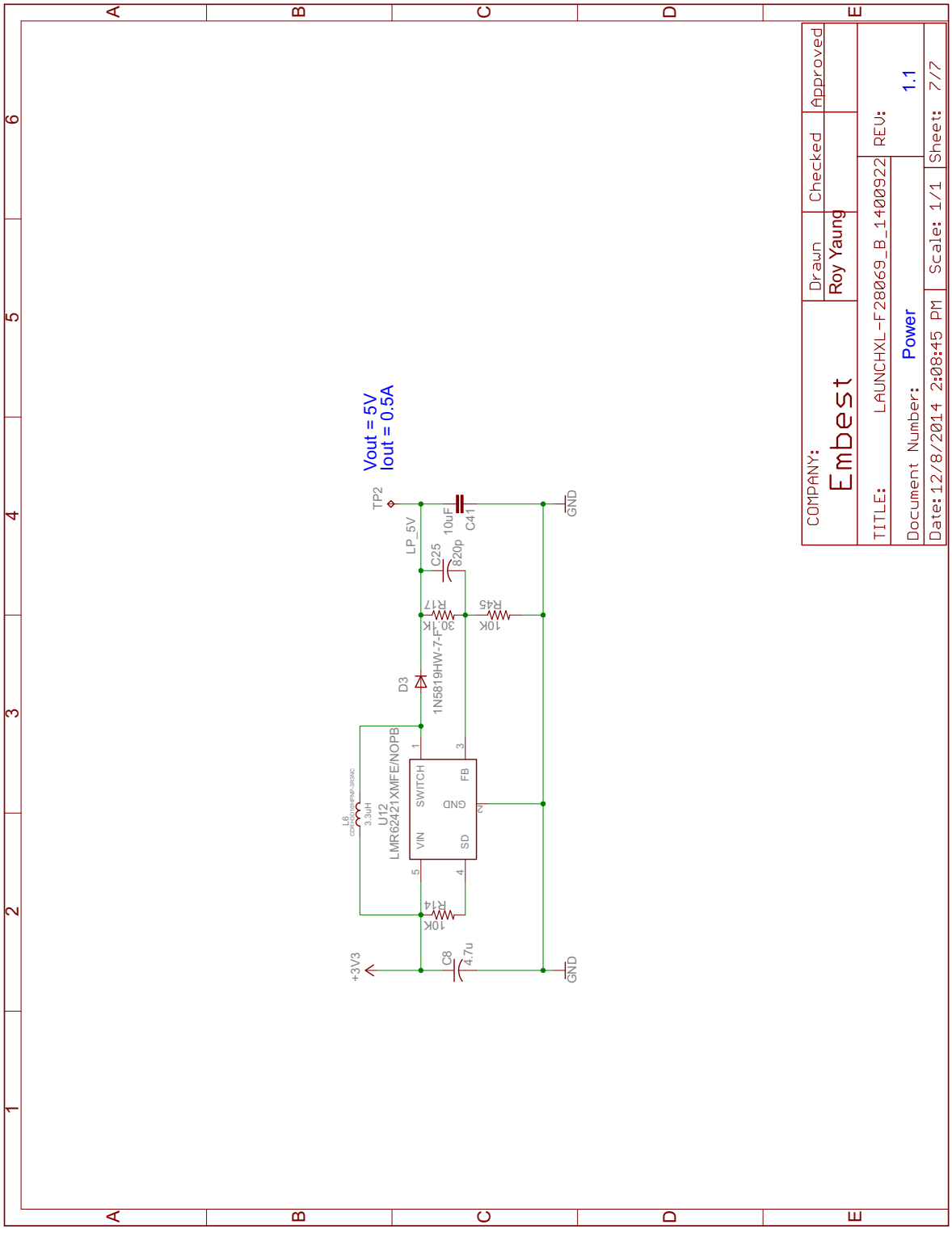


**Figure 10. LAUNCHXL-F28069_B_1400922 Power Schematic**

## 6.3 PCB Layout

Figure 11 through Figure 16 shows the LAUNCHXL-F28069M PCB layout.

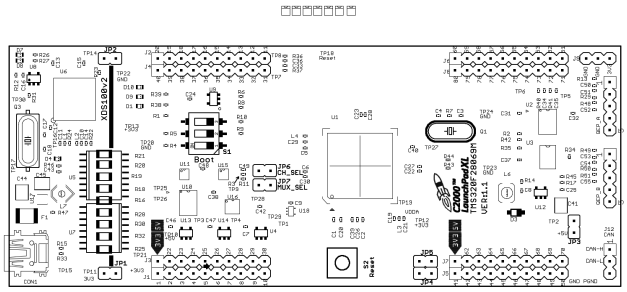

Figure 11. Top Silk

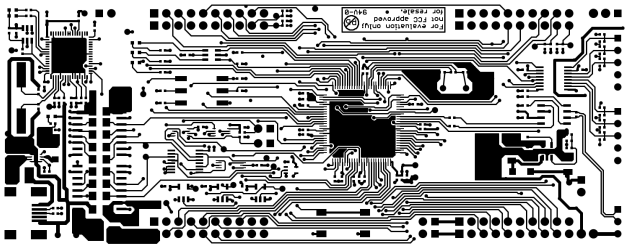

Figure 12. Top Copper

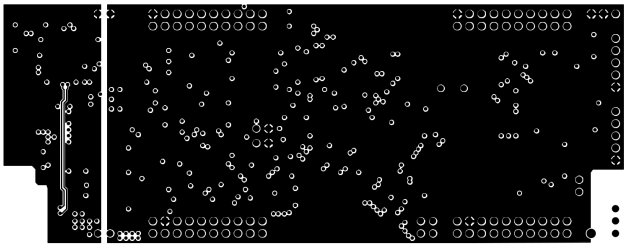

Figure 13. Inner Copper 1

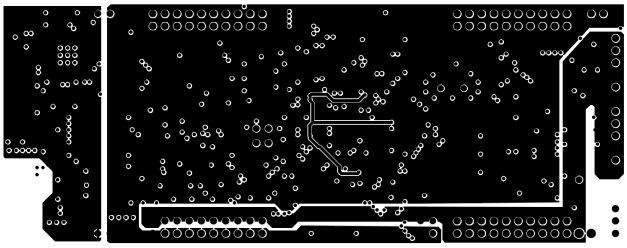

Figure 14. Inner Copper 2

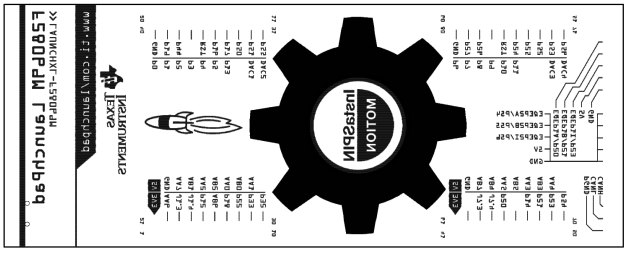

Figure 15. Bottom Silk

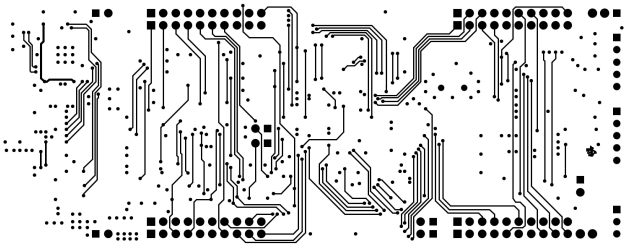

Figure 16. Bottom Copper

## 6.4 Bill of Materials (BOM)

Table 7 lists the LAUNCHXL-F28069M bill of materials.

**Table 7. LAUNCHXL-F28069M Bill of Materials**

| S No | Category | MPN | Per | Mfg. | Description | Package | Value | Working Voltage | Reference |
|---|---|---|---|---|---|---|---|---|---|
| 1 | PCB | LAUNCHXL-F28069M PCB | 1 | | 4 layers PCB,Red Soldermask, white Silkscreen, Immersion gold, 51 mm*130.5 mm, LAUNCHXL-F28069M PCB | | | | |
| 2 | MCU | TMS320F28069MPZT | 1 | TI | MCU 32-bit C2000 C28x RISC 128KB Flash 3.3 V 100-Pin LQFP, customer supply | LQFP-100 | | 1.71~1.995 V | U1 |
| 3 | Memory | 93LC56BT-I/OT | 1 | Microchip | IC, EEPROM Serial-Microwire 2K-Bit 128 x 16 2 MHz, 93LC56BT-I/OT,SOT-23-6, SMD | SO-23-6 | 2Kb | 2.5~5.5 V | U8 |
| 4 | DC-DC | LMR62421XMFE/NOPB | 1 | TI | Conv DC-DC Single Step Up 2.7 V to 5.5 V 5-Pin SOT-23 T/R, customer supply | SOT23-5 | | 2.7 V to 5.5 V | U12 |
| 5 | DC-DC | TPS62162DSGR | 1 | TI | Conv DC-DC Single Step Down 3 V to 17 V 8-Pin WSON EP T/R, customer supply | WSON-8 | | 3 V to 17 V | U17 |
| 6 | Logic | SN74AHC1G32DBVR | 2 | TI | IC, Single 2-Input Positive-OR Gate, SN74AHC1G32DBVR, SOT23-5, SMD, customer supply | SOT23-5 | | 2~5.5 V | U13,U14 |
| 7 | Logic | TXB0106PWR | 1 | TI | IC, 6-BIT Bidirectional Voltage-Level Translator with Auto-Direction Sensing and ±15-kV ESD Protection, TXB0106PWR, TSSOP-16, SMD, cusomer supply | TSSOP-16 | | 1.2~5.5 V | U2 |
| 8 | Logic | SN74LV4052APW | 1 | TI | Analog Multiplexer Dual 4:1 16-Pin TSSOP Tube, customer supply | TSSOP-16 | | 2~5.5 V | U10 |
| 9 | Logic | SN74LVC2G07DBVR | 1 | TI | Buffer/Driver 2-CH Non-Inverting Open Drain CMOS 6-Pin SOT-23 T/R, customer supply | SOT23-6 | | 1.65~5.5 V | U9 |
| 10 | Logic | SN74LVC1G04DCKR | 1 | TI | IC, Single Inverter Gate, SN74LVC1G04DCKR, SC70-5, SMD | SC70-5 | | 1.65 V ~ 5.5 V | U18 |
| 11 | Logic | SN74AHC1G02DBVR | 1 | TI | "IC, NOR Gate 1-Element 2-IN CMOS, SN74AHC1G02DBVR,SOT23-5, SMD | SOT23-5 | | 2 V ~ 5.5 V | U4 |
| 12 | Interface | SN65HVD234D | 1 | TI | IC, 3.3 V CAN Transceiver with Sleep Mode, SN65HVD234D,SOIC-8, SMD, customer supply | SO-8 | | 3.3V | U3 |
| 13 | Interface | FT2232HQ-REEL | 1 | FTDI | IC, Dual High Speed USB to Multipurpose UART/FIFO IC,FT2232HQ-REEL, QFN-64, SMD | QFN-64 | | 1.62 V to 1.98 V | U6 |
| 14 | Interface | TS5A3153DCUR | 2 | TI | Analog Switch Single SPDT 8-Pin VSSOP T/R, customer supply | VSSOP-8 | | 1.65~5.5 V | U11, U15 |
| 15 | Interface | TS5A23159DGSR | 1 | TI | Analog Switch Dual SPDT 10-Pin VSSOP T/R, customer supply | VSSOP-10 | | 1.65~5.5 V | U16 |
| 16 | Isolator | ISO7231CDWR | 1 | TI | IC DGTL ISO 3CH CMOS 16SOIC, customer supply | SO-16 | | 3.15~5.5 V | U7 |
| 17 | Isolator | ISO7240CDWR | 1 | TI | IC DGTL ISO 4CH CMOS 16SOIC, customer supply | SO-16 | | 3.15~5.5 V | U5 |
| 18 | Thick film Resistor | RC0402JR-070RL | 4 | YAGEO | RES, 0R, ±5%,1/16W, SMD0402 | 0402 | 0R | 50 V | R15, R33, R43, R44 |
| 19 | Thick film Resistor | RC0402JR-07120RL | 1 | YAGEO | RES, 120R, ±5%, 1/16W, SMD0402 | 0402 | 120R | 50 V | R34 |
| 20 | Thick film Resistor | RC0402JR-07330RL | 4 | YAGEO | RES, 330R, ±5%, 1/16W, SMD0402 | 0402 | 330R | 50 V | R26, R27, R38, R39 |

**Table 7. LAUNCHXL-F28069M Bill of Materials (continued)**

| S No | Category | MPN | Per | Mfg. | Description | Package | Value | Working Voltage | Reference |
|---|---|---|---|---|---|---|---|---|---|
| 21 | Thick film Resistor | RC0402JR-07820RL | 4 | YAGEO | RES, 820R, ±5%, 1/16W, SMD0402 | 0402 | 820R | 50 V | R1, R4, R5, R46 |
| 22 | Thick film Resistor | RC0402JR-071KL | 6 | YAGEO | RES, 1K, ±5%, 1/16W, SMD0402 | 0402 | 1K | 50 V | R22, R23, R36, R37, R40, R41 |
| 23 | Thick film Resistor | RC0402JR-072K2L | 6 | YAGEO | RES, 2K2, ±-5%, 1/16W, SMD0402 | 0402 | 2K2 | 50 V | R2, R6, R8, R9, R10, R31 |
| 24 | Thick film Resistor | RC0402JR-0710KL | 7 | YAGEO | RES, 10K ±5%, 1/16W, SMD0402 | 0402 | 10K | 50 V | R3, R11, R12, R14, R35, R42, R45 |
| 25 | Thick film Resistor | RC0402FR-0712KL | 1 | YAGEO | RES, 12K, ±1%,1/16W, SMD0402 | 0402 | 12K | 50 V | R24 |
| 26 | Thick film Resistor | RC0402FR-0730K1L | 1 | YAGEO | RES, 30K1, ±1%, 1/16W, SMD0402 | 0402 | 30K1 | 50 V | R17 |
| 27 | Thick film Resistor | RC0402JR-07100KL | 1 | YAGEO | RES, 100K, ±5%, 1/16W, SMD0402 | 0402 | 100K | 50 V | R47 |
| 28 | Ceramic Capacitor | GRM1555C1H821JA01D | 1 | Murata | CAP, 820PF, ±5%, C0G, 50 V, SMD0402 | 0402 | 820PF | 50 V | C25 |
| 29 | Ceramic Capacitor | GRM155R71C104KA88D | 23 | Murata | CAP, 100 NF, ±10%, X7R,16 V, SMD0402 | 0402 | 100 NF | 16 V | C7, C9, C12, C13, C14, C16, C24, C31, C32, C33, C34, C35, C36, C37, C38, C39, C40, C42, C43, C46, C47, C48, C49 |
| 30 | Ceramic Capacitor | GRM155R60J225ME15D | 14 | Murata | CAP, 2.2 µF, ±20%, X5R, 6.3 V, SMD0402 | 0402 | 2.2 µF | 6.3 V | C1, C2, C5, C6, C19, C20, C21, C22, C23, C26, C27, C28, C29, C30 |
| 31 | Ceramic Capacitor | GRM32DR71E106KA12L | 2 | Murata | CAP, 10 µF, ±10%, X7R, 25 V, SMD1210 | 1210 | 10 µF | 25 V | C41, C44 |
| 32 | Ceramic Capacitor | CC1210KKX5R7BB226 | 1 | YAGEO | CAP, 22 µF, ±10%, X5R, 16 V, SMD1210 | 1210 | 22 µF | 16 V | C45 |
| 33 | Ceramic Capacitor | GRM155R60J475ME47 | 3 | Murata | CAP, 4.7 µF, ±20%, X5R, 6.3 V, SMD0402 | 0402 | 4.7 µF | 6.3 V | C8, C10, C11 |
| 34 | Ceramic Capacitor | CL05A335MR5NNNC | 1 | Samsung | CAP, 3.3 µF, ±20%, X5R, 4 V, SMD0402 | 0402 | 3.3 uF | 4 V | C15 |
| 35 | Ceramic Capacitor | GRM1555C1H360JA01D | 2 | Murata | CAP, 36 pF, ±5%, C0G, 50 V, SMD0402 | 0402 | 36 pF | 50 V | C17, C18 |
| 36 | Inductor | CDRH2D18/HPNP-2R2NC | 1 | Sumida | Power Inductor, Magnetic shielded, 2.2 µH, 1.6A, 0.06 Ω, 3.0 x 3.0 x 1.8 mm, SMD | 3.0X3.0mm | 2.2 µH | | L7 |
| 37 | Inductor | CDRH3D16/HPNP-3R3NC | 1 | Sumida | Power Inductor, Magnetic shielded, 3.3 µH,1.4A, 0.085 Ω, 3.8 x 3.8 x 1.6 mm, SMD | 3.8X3.8mm | 3.3 µH | | L6 |
| 38 | Ferrite Bead | BLM15AG601SN1D | 2 | Murata | Ferrite Bead, 60 Ω@100 MHz, ±25%, 300 mA,0.6 Ω, SMD0402 | 0402 | 600 Ω | | L1, L2 |
| 39 | Ferrite Bead | BLM15PD600SN1D | 1 | Murata | Ferrite Bead, 60 Ω@100 MHz, ±25%,1700 mA, 0.06 Ω,SMD0402 | 0402 | 60 Ω | | L4 |
| 40 | Ferrite Bead | BLM15AG221SN1D | 1 | Murata | Ferrite Bead, 220 Ω@100 MHz, ±25%, 300 mA, 0.6 Ω, SMD0402 | 0402 | 220 Ω | | L3 |
| 41 | LED | 19-217/R6C-AL1M2VY/3T | 2 | Everlight | LED, Brilliant Red, Water Clear, 20 mA, SMD0603 | 0603 | | 1.7~2.3 V | D8, D9 |

**Table 7. LAUNCHXL-F28069M Bill of Materials (continued)**

| S No | Category | MPN | Per | Mfg. | Description | Package | Value | Working Voltage | Reference |
|---|---|---|---|---|---|---|---|---|---|
| 42 | LED | 19-217/G7C-AN1P2/3T | 2 | Everlight | LED, Super Yellow Green, Water Clear, 20 mA, SMD0603 | 0603 | | 1.75~2.35 V | D1, D4 |
| 43 | LED | 19-217/BHC-AN1P2/3T | 2 | Everlight | LED, Blue, Water Clear, 20 mA, SMD0603 | 0603 | | 1.7~2.2 V | D7, D10 |
| 44 | Diode | 1N5819HW-7-F | 1 | Diodes | Diode,Schottky Diode, 1N5819HW-7-F, 40 V, 1A, SOD-123,SMD | SOD-123 | | 40 V | D3 |
| 45 | Polyswitch | SMD1812P050TF | 1 | PTTC | Polyswitch, SMD1812P050TF, 15 V, Ihold=0.5A, Itrip=1A, 0.5 Ω, SMD1812 | 1812 | | 15 V | F1 |
| 46 | Crystal | 7D12000182BTAF60Q5 | 1 | Interquip | Crystal, 7D12000182BTAF60Q5, 12 MHz, ±20 PPM, 18PF, HC-49S, SMD | HC-49SMD | 12 MHz | | Q3 |
| 47 | Pin Header | P6E02A-602530-B1 | 7 | CHI-BAN | Connector, Pin Header, Straight, Male,1 x 2 Pin, 2.54 MM pitch, 6.06, 3.00, Gold Flash 1µ, black, DIP | DIP | | | JP1,JP2,JP3,JP4,JP5,JP6, JP7 |
| 48 | Pin Header | P6E03A-602530-B1 | 2 | CHI-BAN | Connector, Pin Header, Straight, Male, 1 x 3 Pin, 2.54 MM pitch, 6.06, 3.00, Gold Flash 1µ, black, DIP | DIP | | | J9,J12 |
| 49 | Pin Header | P101-1*05SGF-116A-NX | 2 | Townes | Connector, Pin Header, Straight, Male, 1 x 5 Pin, 2.54 MM pitch, 6.06, 3.00, Gold Flash 1µ, black, DIP | DIP | | | QEP_A, QEP_B |
| 50 | Pin Socket | CRD-081413-A-G | 4 | Major League | Connector, Pin Socket, Straight, Female, 2 x 10 Pin, 2.54 MM pitch, 8.5, 9.92, Gold Flash 1µ, black, DIP | DIP | | | J1,J2,J3,J4,J5, J6,J7,J8 |
| 51 | USB Connector | UBF11-03 | 1 | JXT | Connector, MiniUSB AB port, 5 Position, Right Angle, Gold Flash 1µ, black, SMD | SMD | | | CON1 |
| 52 | Shunt | MJ501-EOGF-B-K | 7 | Townes | Connector, Shunt, 2Pin, 2.54 MM Pitch, 6 MM Height, Gold Flash 1µ, black | | | | U$1, U$2, U$9, U$10, U$11, U$12, U$13, |
| 53 | Tacticle Switch | TP-1138K9-BE1125 | 1 | Toneparts | Switch, Tacticle, 160gf ±50gf, black housing, black plunger, 6*6*4.3 MM, SMD | SMD-4 | | | S2 |
| 54 | DIP Switch | DSIC03LSGET | 1 | KE | Switch, DIP SWITCH, 3 Position, 2.54 MM Pitch, black housing, white plunger, SMD | SMD | | | S1 |
| 55 | Thick Film Resistor | RC0402FR-071KL | 6 | YAGEO | RES, 1K, ±1%, 1/16W, SMD0402 | 0402 | 1K | 50 V | R13,R29,R48-R51 |
| 56 | Ceramic Capacitor | GRM155R71H102KA01D | 6 | Murata | CAP ,1NF, ±10%, X7R, 50 V, SMD0402 | 0402 | 1NF | 50 V | C50-C55 |
| 57 | ESD bag | Anti-static bag 180*130mm , | 1 | | Anti-static bag 180*130 mm | | | | |
| 58 | Label | 700/SCH, Label,11mm*7mm | 1 | | 700/SCH Label,11 mm*7 mm | | | | |

## 7 Frequently Asked Questions (FAQ)

1. Can other programming and debug tools (such as an XDS510 debug probe) be used with the C2000 LaunchPad?

   While a user could potentially connect an external debug probe to the F28069M device present on the LaunchPad, it would require some rework of the board. It is recommended that users who want to use an external debug probe purchase a controlCard and docking station that includes an external JTAG connector.

2. What versions of Code Composer Studio can be used to develop software for the C2000 LaunchPad?

   It is highly recommend that novice users develop applications with Code Composer Studio v6. The drivers, examples, and other associated software are tailored to make the user experience as smooth as possible in Code Composer Studio v6.

3. Why can't I connect to the LaunchPad in Code Composer Studio?

   There are a number of things that could cause this and they all have an easy fix.

   - Is S1 switch 3 in the down position?

     This is the TRST pin that enables and disables JTAG functionality on the chip. This switch must be in the up position for the debug probe to be able to connect.

   - Are both power LEDs lit?

     The board has two power domains because of the isolated JTAG interface. For low-voltage application development, JTAG isolation is not needed and the power domains can be combined to allow for convenience (that is, the board can be powered completely through the USB). Ensure that jumpers are placed on the posts of JP1 and JP2.

   - Are drivers correctly installed for the XDS100v2 present on the LaunchPad?

     Right click on *My Computer* and select properties. Navigate to the *Hardware* tab in the dialog box and open the device manager. Scroll to the bottom of the list and expand the *USB Serial Bus controllers* item. Are there two entries for *TI XDS100 Channel A/B*? If not, try unplugging and replugging in the board. Does Windows give you any messages in the system tray? In Device Manger, do either of the entries have a yellow exclamation mark over their icon? If so, try reinstalling the drivers.

4. Why is the serial connection not working?

   The most common cause of this is the serial muxing being set incorrectly. Ensure that JP7 has a jumper placed on it while JP6 does not have a jumper before proceeding further.

   - Are you using the correct COM port?

     Right click on *My Computer* and select properties. Navigate to the *Hardware* tab in the dialog box and open the device manager. Scroll to *Ports (COM & LPT)* and expand this entry. Is there a USB Serial Port listed? If so, read the COM number to the right of the entry; this is the COM number you should be using.

     If the USB Serial COM Port is not identified by the computer, reprogram the XDS100v2 EEPROM using these instructions.

   - Are you using the correct baud rate?

     Most, if not all, of the examples are configured for a baud rate of 115200 when the CPU is running at 60 MHz. If you have changed the PLL settings or written your own application you may have to recalculate the baud rate for your specific application. For information on how to do this, see the *TMS320x2802x, 2803x Piccolo serial communications interface (SCI) reference guide*.

# 8 References

The following documents describe the C2000 devices. Copies of these documents are available on the Internet at http://www.ti.com/c2000 and www.ti.com/c2000-launchpad, or click on the links below:

- Texas Instruments: *TMS320F2806x Piccolo™ microcontrollers data manual*
- Texas Instruments: *TMS320F2806x Piccolo™ MCUs Silicon errata revisions B, A, 0*
- Texas Instruments: *TMS320x2806x Piccolo technical reference guide*
- Texas Instruments: *TMS320C28x extended instruction sets technical reference manual*
- Texas Instruments: *TMS320C28x instruction set simulator technical overview*
- Texas Instruments: *TMS320C28x optimizing C/C++ compiler user's guide*
- Texas Instruments: *TMS320C28x assembly language tools user's guide*
- Texas Instruments: *TMS320x2802x, 2803x Piccolo serial communications interface (SCI) reference guide*

# Revision History

NOTE: Page numbers for previous revisions may differ from page numbers in the current version.

| Changes from A Revision (August 2018) to B Revision | Page |
|---|---|
| • Global replace of "emulator" with "debug probe" | 1 |
| • Added Section 2.1 to document known issues with Design | 3 |
| • Added link to XDS100 reprogram instructions | 22 |

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