MSP432™ SimpleLink™ Microcontrollers Hardware Tools

User's Guide

TEXAS INSTRUMENTS

Contents

List of Figures

List of Tables

Read This First

About This Manual

This manual describes the hardware tools that support the Texas Instruments SimpleLink™ MSP432™ device family of ARM® Cortex®-M based microcontrollers.

How to Use This Manual

This manual describes the setup and operation of the hardware tools. It does not fully describe the MSP432 microcontrollers or the development software systems. For details of these items, see the appropriate TI documents listed in Important MSP432 Documents on the Web.

Important MSP432 Documents on the Web

The primary sources of MSP432 information are the device-specific data sheets and user's guides. The MSP432 web site contains the most recent versions of these documents.

Documents that describe the Code Composer Studio™ tools (Code Composer Studio IDE, assembler, C compiler, linker, and librarian) are available on the Code Composer Studio page. A Wiki page (FAQ) that is specific to the Code Composer Studio tools is available at processors.wiki.ti.com/index.php/Category:CCS. The TI E2E™ Community support forums provide additional help.

Documentation for third-party tools, such as the IAR Embedded Workbench® for ARM IDE or the Segger J-Link debug probe, can be found on the respective third-party website.

If You Need Assistance

Support for the MSP432 devices and the hardware development tools is provided by the Texas Instruments Product Information Center (PIC). Contact information for the PIC can be found on the TI web site. The TI E2E™ Community support forums for the MSP432 provide open interaction with peer engineers, TI engineers, and other experts. Additional device-specific information can be found on the MSP432 web site.

Trademarks

SimpleLink™ MSP432, SimpleLink, Code Composer Studio, TI E2E are trademarks of Texas Instruments.
ARM, Cortex are registered trademarks of ARM Limited.
IAR Embedded Workbench is a registered trademark of IAR Systems.

Hardware

This chapter contains information relating to the hardware tools and includes schematics, PCB pictorials, and bills of materials. Other tools such as EVMs and LaunchPad development kits are described in separate product-specific user's guides. Information about the TI XDS100 and XDS200 debug probes is not included in this document and can be found at www.ti.com/tool/xds100 and www.ti.com/tool/xds200, respectively.

1.1 MSP-FET-432ADPTR

1.1.1 Introduction

The MSP-FET-432ADPTR is an adapter to convert the 14-pin JTAG connector to either standard ARM 10-pin or ARM 20-pin connectors. This allows for use of the MSP-FET debug probe with MSP432 Cortex-M devices.

1.1.2 Key Features

• Use MSP-FET to debug MSP432 Cortex-M Devices
• 10-pin ARM support
• 20-pin ARM support

1.1.3 Kit Contents

• 1x MSP-FET-432ADPTR 14-pin JTAG to ARM adapter

1.1.4 Configuration and Usage

The MSP-FET-432ADPTR allows the use of the MSP-FET debug probe with the MSP432 Cortex-M family of devices. Operation is straight-forward, with only one selection for how the power is sourced. This selection is required because of the difference in the power source and sense behavior of the MSP-FET and the ARM debug standard.

The MSP-FET debug probe has two power states:

1. V_{CC} Output
   • MSP-FET outputs a voltage to the target.
   • Output voltage is configurable in the IDE.
   • In V_{CC} output state, the MSP-FET voltage sense functionality is not enabled.
2. V_{CC} Sense
   • MSP-FET senses an existing external voltage (not from the MSP-FET itself).
   • The JTAG signals are level shifted accordingly to match this voltage.
   • In V_{CC} Sense state, the MSP-FET output voltage is not provided.

The Cortex-M debug standard works a bit differently. In this standard, the V_{CC} Sense is always active, no matter where the external voltage is coming from. Some debug probes, such as the IAR I-jet and Segger J-Link have a voltage output, all while still sensing the V_{CC} Sense.

Table 1-1. Matrix of S1 Switch Orientation Compared to ARM Connector Option

	V_{CC} Sense (S1 Left)	V_{CC} Output (S1 Right)
ARM 20-pin connector	• External power is sensed through ARM pin 1 • External power needs to be connected to debug target	• Power is provided by the MSP-FET through ARM pin 19. • Alternatively, power can be wired to the target using connector J4. • This output matches other ARM debug probes like IAR i-Jet and SEGGER J-Link • Note that the IAR i-Jet outputs 3.3 V, and SEGGER J-Link outputs 5 V on this pin. Ensure the target accounts for the specific voltage output by MSP-FET.
ARM 10-pin connector	• External power is sensed through ARM pin 1 • External power needs to be connected to debug target	• There is no pin to connect the power output on the 10 pin connector • Power output is provided on connector J4. This can be wired to the target board.

1.1.5 Hardware Design

Figure 1-1 shows the schematic of the MSP-FET-432ADPTR.
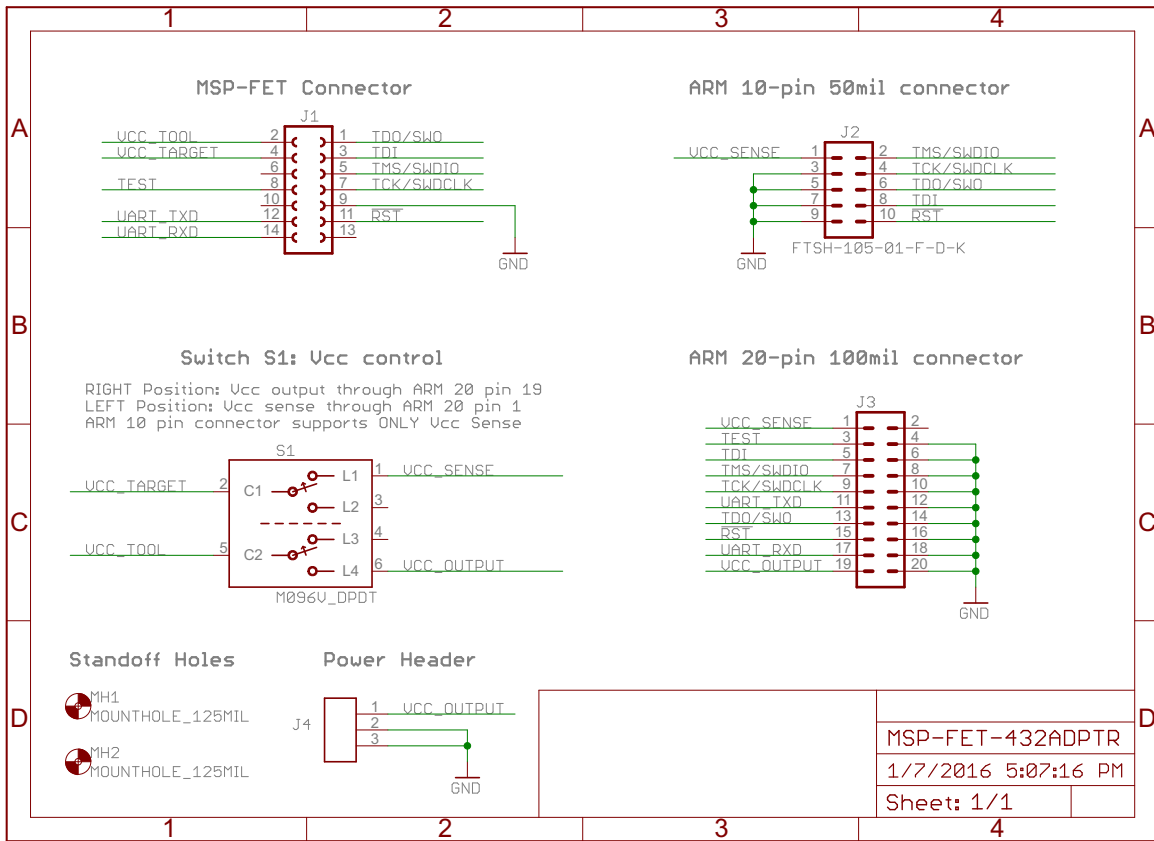
Copyright © 2016, Texas Instruments Incorporated

Figure 1-1. MSP-FET-432ADPTR Schematic

Table 1-2 lists the bill of materials for the MSP-FET-432ADPTR.

Table 1-2. MSP-FET-432ADPTR Bill of Materials

Qty	Reference	Manufacturer	Description	Part Number	Alternate Part Number	PCB Decal, Package	Supplier	Digi-Key Number
1	J1	Standard	Conn Header 14POS 0.100" TH, RA, Gold, Digikey S9203-ND			2 x 7 0.100"	Digikey	S9203-ND
1	J2	Samtec	CONN HEADER 10POS DUAL VERT, Digikey FTSH-105-01-F-D-K-ND	FTSH-105-01-F-D-K		2 x 5 0.050"	Digikey	FTSH-105-01-F-D-K-ND
1	J3	Standard	CONN HEADER LOW-PRO 20POS GOLD, Digikey HRP20H-ND			2 x 10 0.100"	Digikey	HRP20H-ND
1	J4	Standard	CONN HEADER .100 SINGL STR 3POS, Digikey S1012E-03-ND			1 x 3 0.100"	Digikey	S1012E-03-ND
1	S1	Standard	SW SLIDE DPDT 2POS, Digikey 401-2001-ND		M096V		Digikey	401-2001-ND
1	MH1	Standard	Standoff Nylon 4-40 8mm/ 0.375"				CM	
1	MH2	Standard	Standoff Nylon 4-40 8mm/ 0.375"				CM	

1.2 MSP-TS432PZ100

1.2.1 Introduction

> **NOTE:** This kit does not include MSP432 microcontroller samples. To sample the compatible
> devices, visit the product page or select the related MCU after adding the tool to the TI Store
> cart: MSP432P401R.

The MSP-TS432PZ100 is a stand-alone ZIF socket target board used to program and debug the MSP432
MCU in-system through the JTAG interface or the Serial Wire Debug (SWD 2-wire JTAG) protocol. Two
standard ARM Cortex-M debug connectors provide connectivity to a large number of debug probes from
Texas Instruments and third parties.

All device pins are readily accessible through dedicated headers, which makes the board the ideal center
of a prototype setup.

1.2.2 Key Features

• ZIF socket for 100-pin QFP (PZ) packages
• Access to all 100 device pins
• LEDs and buttons
• 2 x Cortex-M JTAG connectors supporting all 10- or 20-pin compatible debug probes

1.2.3 Kit Contents

• One READ ME FIRST document
• One MSP-TS432PZ100 target socket board
• One TI Terms and Conditions for Evaluation Modules
• One 32.768-kHz crystal from Micro Crystal
• Four SAM1029-25-ND 25-pin 100-mil through-hole male headers
• Four SAM1213-25-ND 25-pin 100-mil through-hole female headers

1.2.4 Configuration and Usage

Table 1-3 lists the devices that are compatible with the MSP-TS432PZ100 target socket board.

Table 1-3. Device Compatibility

Board	Socket Type	Supported Devices
MSP-TS432PZ100	100-pin QFP (PZ100)	MSP432P401RIPZ MSP432P401MIPZ MSP432P4111TPZ MSP432P4111IPZ MSP432P411YTPZ MSP432P411YIPZ MSP432P411VTPZ MSP432P411VIPZ

1.2.4.1 MSP-TS432PZ100 Rev 1.1

1.2.4.1.1 Board Configuration For External Target Power Supply

If the application needs to operate in stand-alone mode (for example, to measure current consumption without debug overhead) or when using ARM Cortex-M debug probes that do not provide power for the target device (for example, TI XDS100, XDS200, Keil ULINK2, or Keil ULINK Pro), power must be supplied externally to the target socket board.

Always follow the voltage limits defined in the device data sheet. Set the jumpers according to Table 1-4 before connecting the debug probe and power supply (see Figure 1-2).

Table 1-4. Jumper Settings for External Target Power Supply

| Jumper	State	Description
J1	Close 2-3	Connect EXTERNAL VCC to board VCC
J2		Connect external VCC to J2-1, and external GND to J2-2 or J2-3, per the labelling on the PCB silkscreen.
JP1	Closed	Current-measurement header (closed unless measuring I_{CC})
JP2	Closed	Current-measurement header (closed unless measuring I_{DVCC})
JP16	Closed	Current-measurement header (closed unless measuring I_{AVCC})
JP8	Open	Disconnect Pin 19 from LDO input
JP12	Open	Disconnect LDO output from internal VCC (INTVCC)
JP15	Open	Do not short LDO input to output
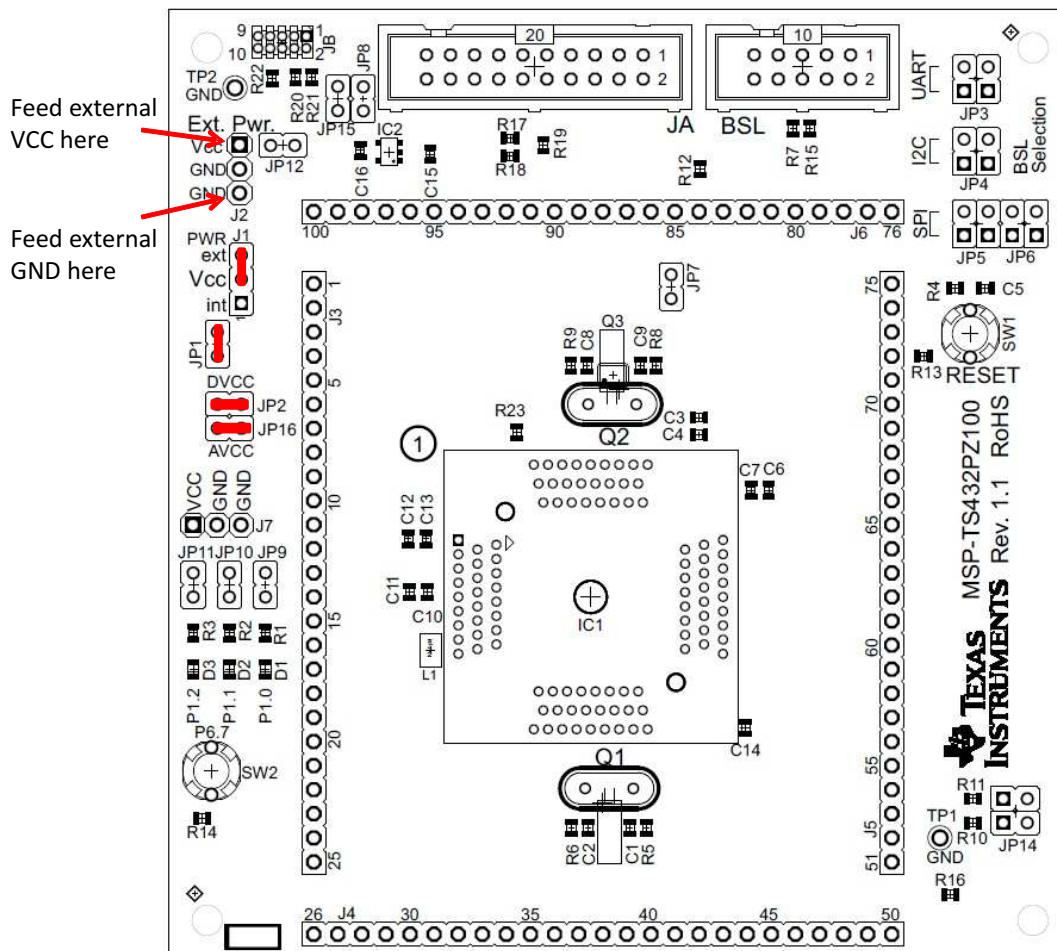
Figure 1-2. Board Configuration For External Target Power Supply

1.2.4.1.2 Board Configuration When Using ARM Cortex-M Debug Probes With Target Power Supply Capability

Some third-party ARM Cortex-M debuggers (for example, Segger J-Link and IAR i-Jet) can optionally supply a 5-V voltage to the target system through pin 19 of the debug connector. The LDO IC2 uses this voltage to generate the 3.3-V target supply voltage. To use the LDO, set the jumpers according to Table 1-5 before connecting the debug probe (see Figure 1-3).

Table 1-5. Jumper Settings to Use Onboard LDO

Jumper	State	Description
J1	Close 1-2	Connect Internal VCC (INTVCC) to board VCC
JP1	Closed	Current-measurement header (closed unless measuring I_{CC})
JP2	Closed	Current-measurement header (closed unless measuring I_{DVCC})
JP16	Closed	Current-measurement header (closed unless measuring I_{AVCC})

If the debug probe does not supply a logic level through pin 19 on the 20-pin connector, follow the jumper setting in Table 1-5.

Table 1-6. Jumpers for Debug Probe Does Not Supply Logic Level on Pin 19

Jumper	State	Description
JP8	Closed	Connect pin 19 to LDO input
JP12	Closed	Connect LDO output to the internal VCC (INTVCC)
JP15	Open	Do not short LDO input to output

If the debug probe does supply a logic level through pin 19 on the 20-pin connector, follow the jumper settings in Table 1-7.

Table 1-7. Jumpers for Debug Probe Does Supply Logic Level on Pin 19

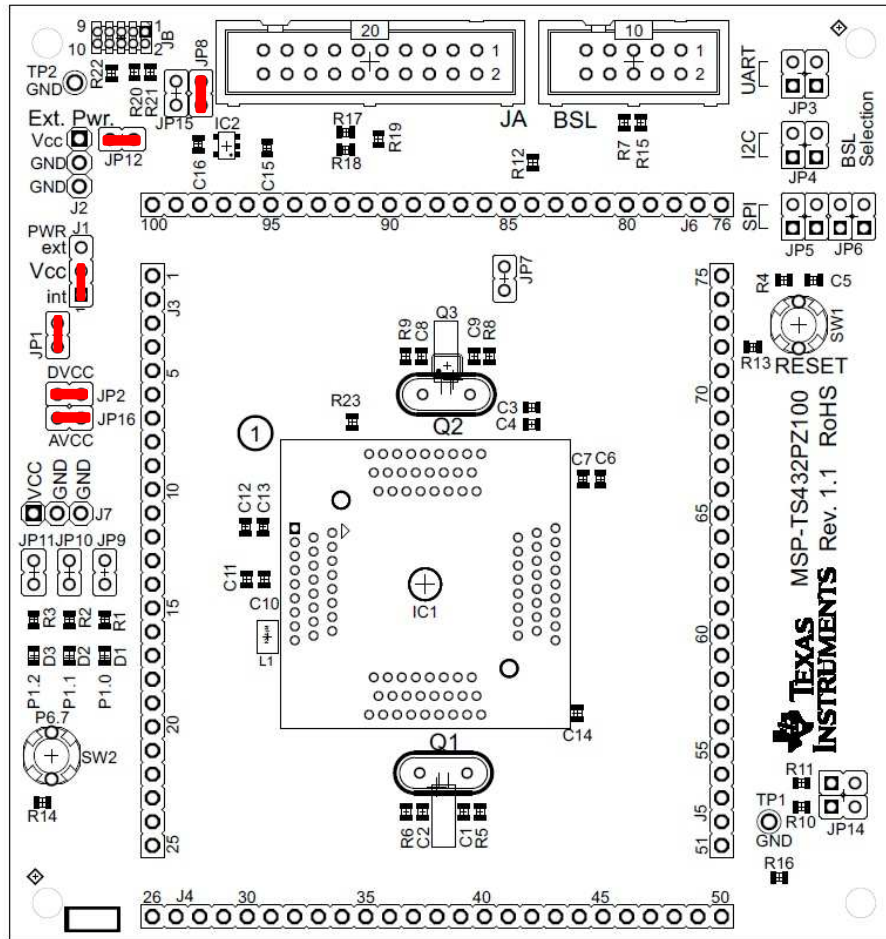| Jumper	State	Description
JP8	Open	Disconnect pin 19 from LDO input
JP12	Open	Disconnect LDO output from internal VCC (INTVCC)
JP15	Closed	Bypasses the LDO by connecting pin 19 directly to onboard VCC (INTVCC)

Figure 1-3. Board Configuration For Debugger-Supplied Target Power

1.2.4.2 MSP-TS432PZ100 Rev 1.3 and Newer

1.2.4.2.1 Board Configuration For External Target Power Supply

If the applications needs to operate in stand-alone mode (for example, to measure current consumption without debug overhead) or when using ARM Cortex-M debug probes that do not provide power for the target device (for example, TI XDS100, XDS200, Keil ULINK2, or Keil ULINK Pro), power must be supplied externally to the target socket board.

Always follow the voltage limits defined in the device data sheet. Set the jumpers according to Table 1-8 before connecting the debug probe and power supply (see Figure 1-4).

Table 1-8. Jumper Settings

| Jumper	State	Description
J2		Connect external VCC to J2-1, and external GND to J2-2 or J2-3, per the labelling on the PCB silkscreen. NOTE: Some V1.3 boards have incorrect silkscreen labeling. Make sure to follow the figures shown in this user's guide.
JP1	Closed	Current-measurement header (closed unless measuring I_{CC})
JP2	Closed	Current-measurement header (closed unless measuring I_{DVCC})
JP3	Closed	Current-measurement header (closed unless measuring I_{AVCC})
JP6	Open	Disconnects input of LDO to allow VCC to be driven externally
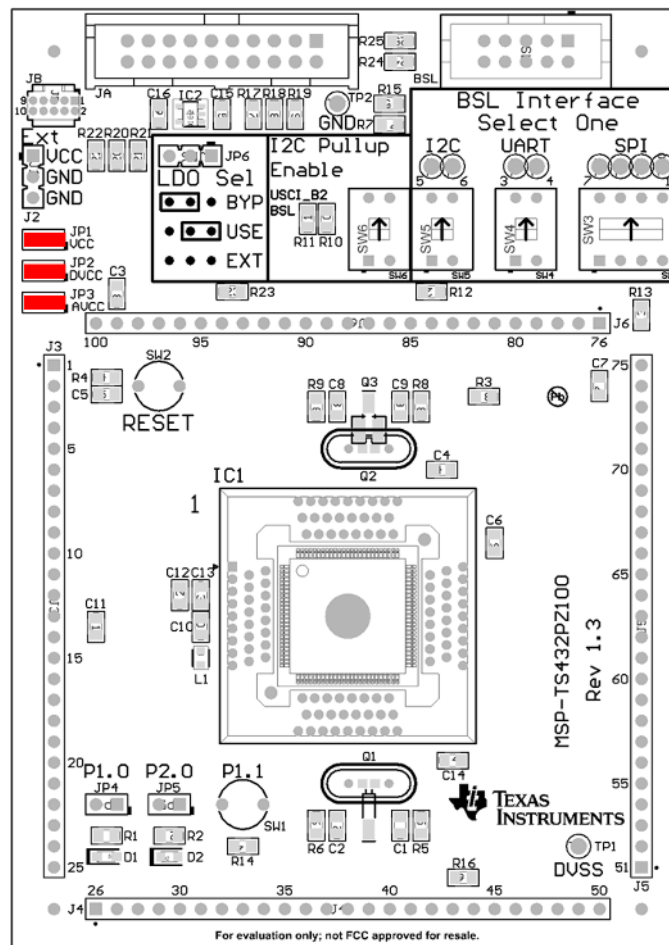
Figure 1-4. Board Configuration When Using Cortex-M Debug Probes With Target Power Supply Capability

Some third-party ARM Cortex-M debuggers (for example, Segger J-Link and IAR i-Jet) can optionally supply a 5-V voltage to the target system through pin 19 of the debug connector. The LDO IC2 uses this voltage to generate the 3.3-V target supply voltage. To use the LDO, set the jumpers according to Table 1-9 before connecting the debug probe (see Figure 1-5 or Figure 1-6):

Table 1-9. Jumper Settings to Use LDO

Jumper	State	Description
JP1	Closed	Current-measurement header (closed unless measuring I_{CC})
JP2	Closed	Current-measurement header (closed unless measuring I_{DVCC})
JP3	Closed	Current-measurement header (closed unless measuring I_{AVCC})

If the debug probe does not supply a logic level through pin 19 on the 20-pin connector, also close pins 1-2 on JP6 (see Figure 1-5):

Table 1-10. Jumper Settings for Debug Probe Does Not Supply Logic Level on Pin 19

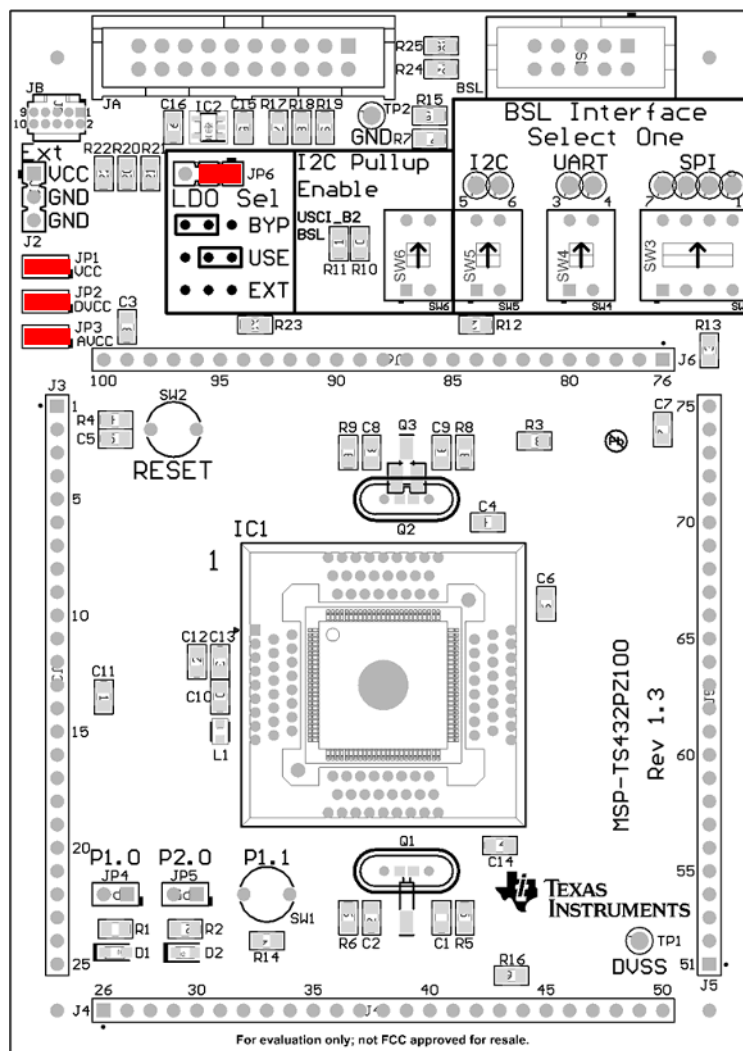| Jumper	State	Description
JP6	Close 1-2	Connect board VCC to LDO output

Figure 1-5. Board Configuration for Debug Probe Does Not Supply Logic Level on Pin 19

If the debug probe does supply a logic level through pin 19 on the 20-pin connector, also close pins 2-3 on JP6 (see Figure 1-6):

Table 1-11. Jumper Settings for Debug Probe Does Supply Logic Level on Pin 19

Jumper	State	Description
JP6	Close 2-3	Connect board VCC to pin 19, bypassing LDO
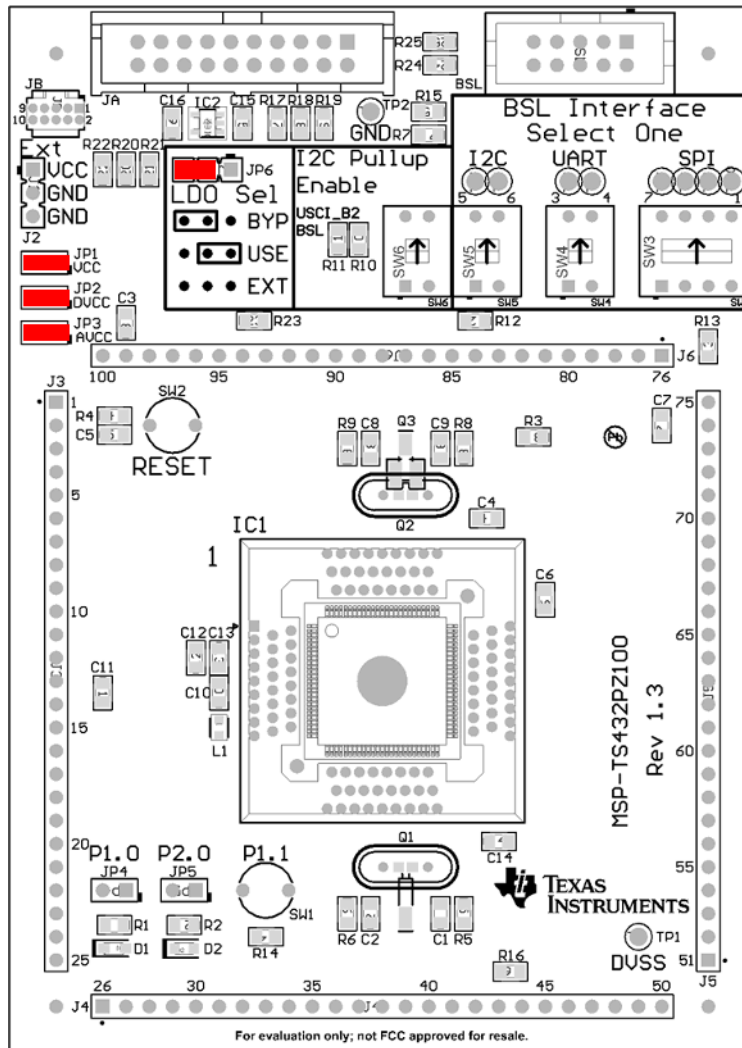
Figure 1-6. Board Configuration for Debug Probe Does Supply Logic Level on Pin 19

1.2.5 Hardware Design

1.2.5.1 MSP-TS432PZ100 Rev 1.1

Figure 1-7 shows the MSP-TS432PZ100 Rev 1.1 schematic.

Figure 1-7. MSP-TS432PZ100 Rev 1.1 Target Socket Board, Schematic

Copyright © 2016, Texas Instruments Incorporated

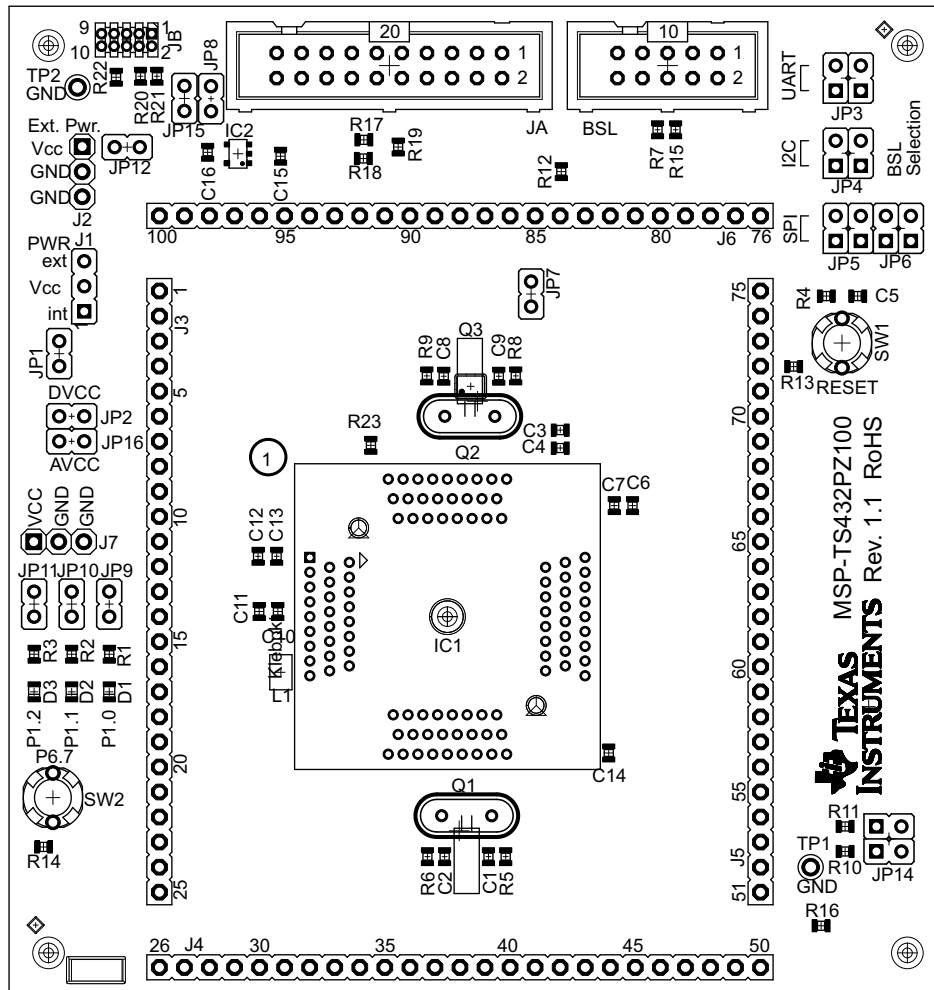Figure 1-8 shows the MSP-TS432PZ100 Rev 1.1 assembly drawing.

Figure 1-8. MSP-TS432PZ100 Rev 1.1 Target Socket Board, PCB

Table 1-12 lists the key components of the MSP-TS432PZ100 Rev 1.1 board.

Table 1-12. MSP-TS432PZ100 Rev 1.1 Important Board Components

Reference	Description	Comment
IC1	Socket for PZ100 package	
J1	Selector between internal and external power supply.	J1-J2 = Internal J2-J3 = External
J2	Header to feed external voltage to device. If used, connect a 2-wire cable to J1-1, J1-2 (Vcc,Gnd).	
J7	VCC header. Can be used to observe device VCC when supplied by the debug probe or to feed in external power.	
JA	20-pin Cortex-M debug connector	
JB	10-pin Cortex-M debug connector	
JP1	Header to measure current flowing into AVCC and DVCC power domains.	Jumper = Normal operation Open = Measure current from pin 2 to 1
JP2	Header to disconnect DVCC from VCC supply. Connect an ammeter to measure current flowing into the digital domain.	Jumper = Normal operation Open = Measure current from pin 2 to 1

Table 1-12. MSP-TS432PZ100 Rev 1.1 Important Board Components (continued)

Reference	Description	Comment
JP8	Header to disconnect 3.3-V LDO voltage input from pin 19 of header JA. Pin 19 of header JA is used by some third party ARM Cortex-M debuggers (for example, Segger J-Link and IAR i-Jet) to supply a 5-V voltage to the target system.	
JP12	Header to disconnect 3.3-V LDO voltage output from INTVCC. Remove this header if your debugger does not supply power to avoid current draw by the unpowered LDO.	
JP15	Header to bypass 3V3 LDO in case a debug probe supplies a logic level voltage through pin 19 of header JA.	
JP16	Header to disconnect AVCC from VCC supply. Connect an ammeter to measure current flowing into the analog domain.	Jumper = Normal operation Open = Measure current from pin 2 to 1

1.2.5.1.1 Bill Of Materials

Table 1-13 lists the bill of materials for the MSP-TS432PZ100 Rev 1.1.

Table 1-13. MSP-TS432PZ100 Rev 1.1 Bill Of Materials

Pos.	Ref Des. No.	No. Per Board	Description	Digi-Key Part No.	Comment
1	PCB	1	95.0 x 100.0 mm	"MSP-TS432PZ100" Rev. 1.1	2 layers, green solder mask
2	C1, C2	2	12pF, CSMD0805	1276-1120-1-ND	DNP
3	C8, C9	2	22pF, CSMD0805	490-3608-1-ND	
4	C3	1	10uF/10V, CSMD0805	490-1709-2-ND	
5	C4, C6, C10, C13, C14	5	100nF, CSMD0805	490-1666-1-ND	
6	C5	1	1.1nF, CSMD0805	490-1623-2-ND	
7	C7, C11, C15, C16	4	1uF/10V, CSMD0805	490-1702-2-ND	
8	C12	1	4u7, CSMD0805	445-1370-1-ND	
9	D1	1	green LED, HSMG-C170, DIODE0805	516-1434-1-ND	
10	D2	1	yellow LED, DIODE0805		DNP
11	D3	1	red LED, DIODE0805		DNP
12	R1	1	330R, 0805	541-330ATR-ND	
13	R2, R3,	2	330R, 0805	541-330ATR-ND	DNP
14	R5, R6, R7, R8, R9	5	0R, 0805	541-0.0ATR-ND	DNP
15	L1	1	4.7uH, 0806	490-4044-1-ND	Murata
16	R12, R13, R15	3	0R, 0805	541-0.0ATR-ND	
17	R4	1	47k, 0805	541-47KATR-ND	
18	R10, R11	2	4k7, 0805	541-4.7KATR-ND	
19	R14	1	47k, 0805	541-47KATR-ND	DNP
20	R16	1	91kOhm, 0.1%, 25ppm/°C , 0805	P91KDACT-ND	
21	R17, R18, R19, R20, R21, R22, R23	7	27R, 0805	541-27ATR-ND	
22	JP1, JP2, JP9, JP7, JP16	4	2-pin header, male, TH	SAM1035-02-ND	Place jumper on header
23	JP8, JP12, JP15	3	2-pin header, male, TH	SAM1035-02-ND	Not jumpered
24	JP10, JP11	2	2-pin header, male, TH	SAM1035-02-ND	DNP, keep pads free of solder
25	J1	1	3-pin header, male, TH	SAM1035-03-ND	Place jumpers on pins 1-2

Table 1-13. MSP-TS432PZ100 Rev 1.1 Bill Of Materials (continued)

Pos.	Ref Des. No.	No. Per Board	Description	Digi-Key Part No.	Comment
26	JP3, JP4, JP5, JP6, JP14	5	2x2-pin header, male, TH	SAM1034-02-ND	
27	J2, J7	2	3-pin header, male, TH	SAM1035-03-ND	
28	J3, J4, J5, J6	4	25-pin header, TH	SAM1029-25-ND	DNP: Headers are enclosed in kit. Keep vias free of solder.
29	J3, J4, J5, J6	4	25-pin receptacle, TH	SAM1213-25-ND	DNP: Receptacles are enclosed in kit. Keep vias free of solder.
30	JA	1	20-pin connector, male, TH	HRP20H-ND	
31	JB	1	10-pin connector	FTSH-105-01-F-D-K	Samtec: FTSH-105-01-F-D-K
32	BSL	1	10-pin connector, male, TH	HRP10H-ND	
33	IC1	1	Socket: IC357-1004-053N, LQFP100		Manuf. Yamaichi
34	IC1	2	MSP432P401RIPZ		Not enclosed in kit
35	Q1	1	MS3V-TR1 (32,768kHz/ 20ppm/12,5pF)	depends on application	DNP, Micro Crystal, enclosed in kit, keep vias free of solder
36	Q2	1	DNP, Crystal	depends on application	DNP, keep vias free of solder
37	Q3	1	KX-7T 48MHz 12pF 30/30/50ppm		Geyer Electronic - 12.88710
38	SW2	1	EVQ-11L05R	P8079STB-ND	
39	SW1	1	EVQ-11L05R	P8079STB-ND	
40	IC2	1	TLV70033DDC, TSOT23-5	296-25276-2-ND	

1.2.5.2 MSP-TS432PZ100 Rev 1.3

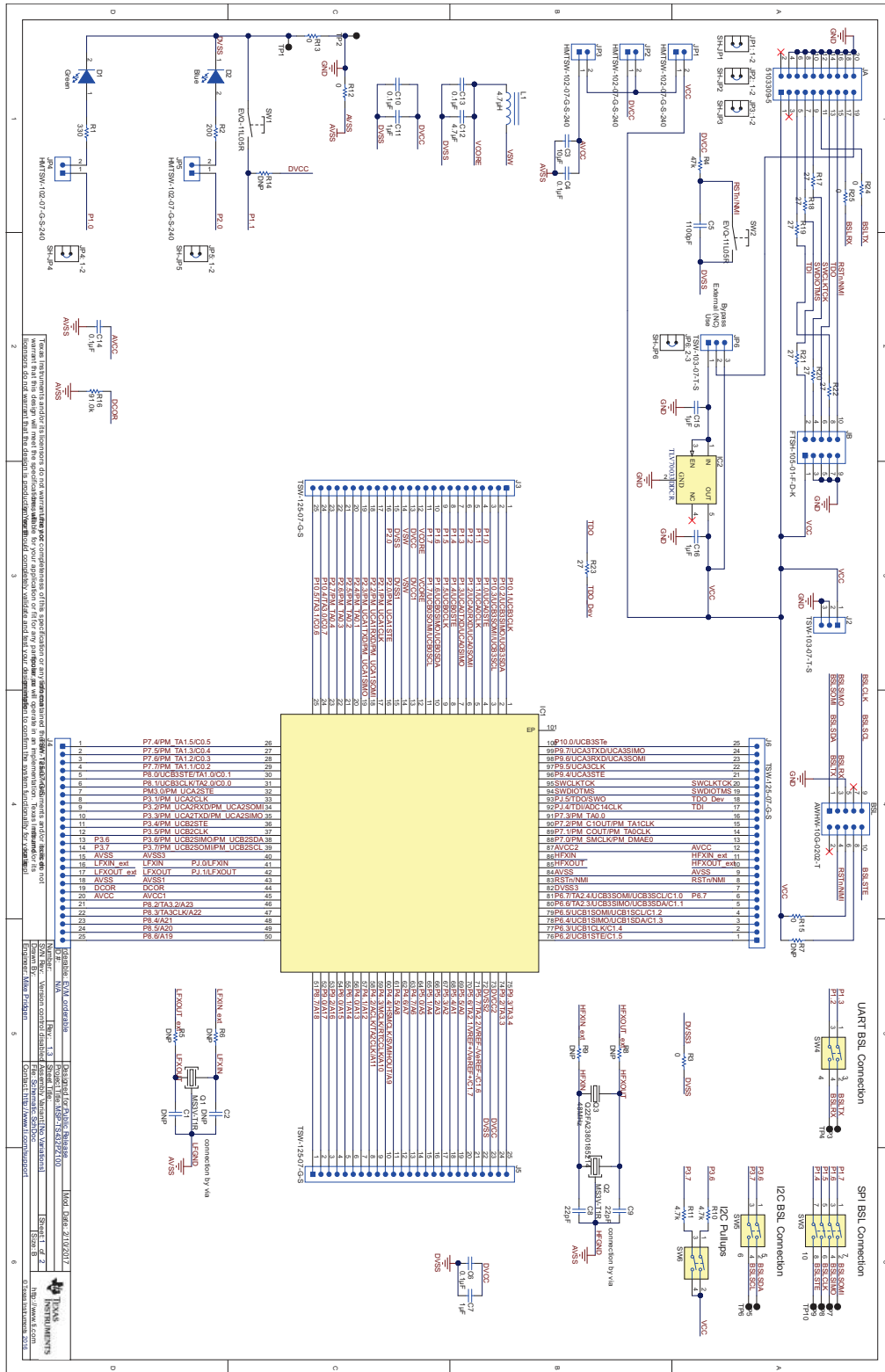Figure 1-9 shows the MSP-TS432PZ100 schematic.

Figure 1-9. MSP-TS432PZ100 Rev 1.3 Target Socket Board, Schematic

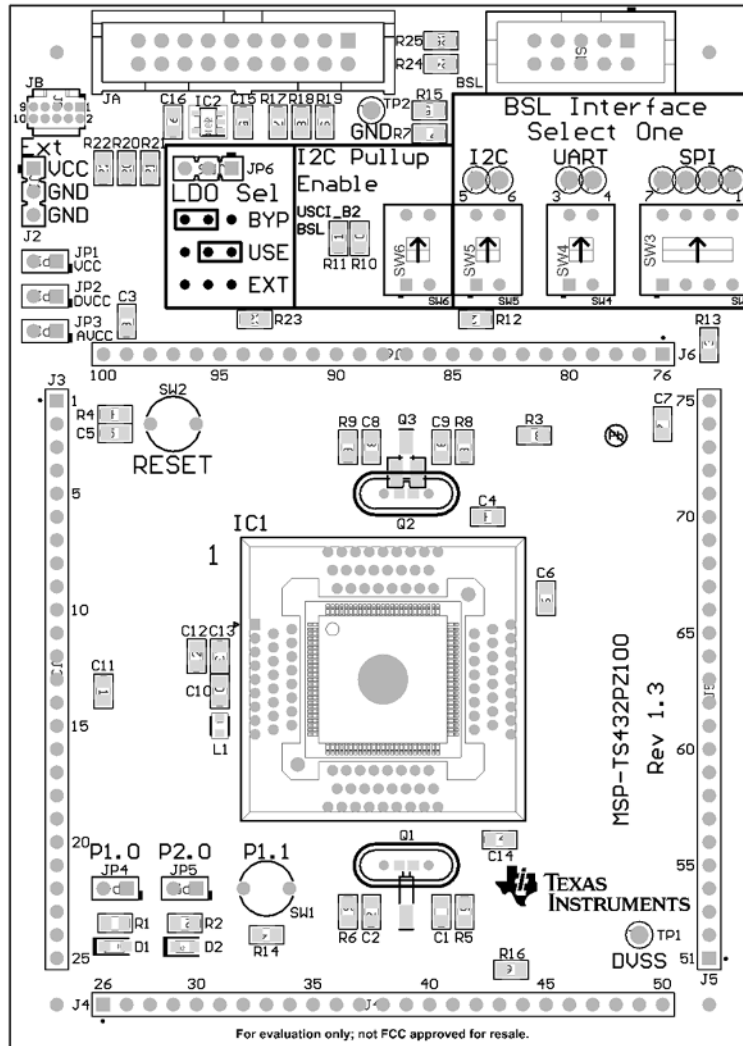Figure 1-10 shows the MSP-TS432PZ100 assembly drawing.

Figure 1-10. MSP-TS432PZ100 Rev 1.3 Target Socket Board, PCB

Table 1-14 lists the key components of the MSP-TS432PZ100 Rev 1.3 board.

Table 1-14. MSP-TS432PZ100 Rev 1.3 Important Board Components

Reference	Description	Comment
IC1	Socket for PZ100 package	
J2	Header to feed external voltage to device. If used, connect a 2-wire cable to J1-1, J1-2 (VCC, GND).	
JA	20-pin Cortex-M debug connector	
JB	10-pin Cortex-M debug connector	
JP1	Header to measure current flowing into AVCC and DVCC power domains.	Jumper = normal operation Open = measure current from pin 2 to 1
JP2	Header to disconnect DVCC from VCC supply. Connect an ammeter to measure current flowing into the digital domain.	Jumper = normal operation Open = measure current from pin 2 to 1
JP3	Header to disconnect AVCC from VCC supply. Connect an ammeter to measure current flowing into the analog domain.	Jumper = normal operation Open = measure current from pin 2 to 1
JP6	Header to select how VCC is supplied to the target.	No Jumper = externally sourced VCC Jumper pins 1-2 = VCC sourced from JTAG directly Jumper pins 2-3 = VCC sourced from LDO output
SW3	Switch to connect SPI BSL connections between target device and BSL header	Switch ON to enable, SW4 and SW5 should be OFF
SW4	Switch to connect UART BSL connections between target device and BSL header	Switch ON to enable, SW3 and SW5 should be OFF
SW5	Switch to connect I^2C BSL connections between target device and BSL header	Switch ON to enable, SW3 and SW4 should be OFF
SW6	Switch to connect 4.7kOhm pullup resistors to target device pins 38 and 39, which are also the I^2C BSL connections	Switch ON to connect pullup resistors Switch OFF to disconnect pullup resistors

1.2.5.2.1 Bill Of Materials

Table 1-15 lists the bill of materials for the MSP-TS432PZ100 Rev 1.3.

Table 1-15. MSP-TS432PZ100 Rev 1.3 Bill Of Materials

Item	Designator	Quantity	Description	Supplier Part Number	Note
1	!PCB1	1	PCB, 3.20" x 4.50"		2 layers, green solder mask
2	BSL	1	Header (shrouded), 100mil, 5x2, Gold, TH	A33159-ND	
3	C1, C2	0	CAP, CERM, 12 pF, 50 V, +/- 5%, C0G/NP0, 0805	311-1100-1-ND	DNP
4	C3	1	CAP, CERM, 10 µF, 10 V, +/- 10%, X5R, 0805	490-1709-1-ND	
5	C4, C6, C10, C13, C14	5	CAP, CERM, 0.1 µF, 50 V, +/- 10%, X7R, 0805	490-1666-1-ND	
6	C5	1	CAP, CERM, 1100 pF, 50 V, +/- 5%, C0G/NP0, 0805	490-1623-1-ND	
7	C7, C11, C15, C16	4	CAP, CERM, 1 µF, 10 V, +/- 10%, X5R, 0805	490-1702-1-ND	
8	C8, C9	2	CAP, CERM, 22 pF, 50 V, +/- 5%, C0G/NP0, 0805	490-3608-1-ND	
9	C12	1	CAP, CERM, 4.7 µF, 10 V, +80/-20%, Y5V, 0805	311-1371-2-ND	
10	D1	1	LED, Green, SMD	754-1939-1-ND	
11	D2	1	LED, Blue, SMD	732-4982-1-ND	
12	H1, H2, H3, H4	4	125mil Mounting Hole		
13	IC1	1	MSP432P401RIPZ Socket	945-IC357-1004-053N	
14	IC2	1	Single Output LDO, 200 mA, Fixed 3.3 V Output, 2 to 5.5 V Input, with Low IQ, 5-pin SOT (DDC), -40 to 125 degC, Green (RoHS & no Sb/Br)	296-27937-2-ND	
15	J2, JP6	2	Header, 2.54 mm, 3x1, Tin, TH	SAM1035-03-ND	
16	J3, J4, J5, J6	4	Header, 100mil, 25x1, Gold, TH	SAM1029-25-ND	
17	JA	1	Header (shrouded), 100mil, 10x2, Gold, TH	A33166-ND	
18	JB	1	Header, 1.27 mm, 5x2, Gold, TH	FTSH-105-01-F-D-K-ND	
19	JP1, JP2, JP3, JP4, JP5	5	Header, 100mil, 2x1, Gold, TH	HMTSW-102-07-G-S-240-ND	
20	L1	1	Inductor, Wirewound, Ferrite, 4.7 µH, 0.3 A, 0.8 ohm, SMD	490-4044-1-ND	
21	Q1, Q2	0	32.768KHz +/-20ppm 12.5pF	94M8466	DNP
22	Q3	1	SMD Crystal	FA-238 48.0000MB-W0-ND	
23	R1	1	RES, 330, 5%, 0.125 W, 0805	541-330ACT-ND	
24	R2	1	RES, 200, 5%, 0.125 W, 0805	541-200ACT-ND	
25	R3, R12, R13, R15, R24, R25	6	RES, 0, 5%, 0.125 W, 0805	541-0.0ACT-ND	
26	R4	1	RES, 47 k, 5%, 0.125 W, 0805	541-47KACT-ND	
27	R5, R6, R7, R8, R9	0	RES, 0, 5%, 0.125 W, 0805	541-0.0ACT-ND	DNP
28	R10, R11	2	RES, 4.7 k, 5%, 0.125 W, 0805	541-4.7KACT-ND	
29	R14	0	RES, 47 k, 5%, 0.125 W, 0805	541-47KACT-ND	DNP
30	R16	1	RES, 91.0 k, 0.1%, 0.125 W, AEC-Q200 Grade 0, 0805	P91KDACT-ND	

Table 1-15. MSP-TS432PZ100 Rev 1.3 Bill Of Materials (continued)

Item	Designator	Quantity	Description	Supplier Part Number	Note
31	R17, R18, R19, R20, R21, R22, R23	7	RES, 27, 5%, 0.125 W, 0805	541-27ACT-ND	
32	SH-JP1, SH-JP2, SH-JP3, SH-JP4, SH-JP5, SH-JP6	6	Shunt, 100mil, Gold plated, Black	3M9580-ND	JP1: 1-2, JP2: 1-2, JP3:1-2, JP4: 1-2, JP5: 1-2, JP6: 2-3
33	SW1, SW2	2	Switch Tactile SPST-NO 0.02A 15V	P8079STB-ND	
34	SW3	1	Quad Pole Single Throw TH DIP Switch	GH7198-ND	
35	SW4, SW5, SW6	3	Double Pole Single Throw TH DIP Switch	GH7727-ND	
36	TP1, TP2, TP3, TP4, TP5, TP6, TP7, TP8, TP9, TP10	0	Test Point, Miniature, Black, TH	36-5001-ND	DNP

1.2.5.3 MSP-TS432PZ100 Revision History

Revision	Date	Comments
Rev 1.1	March 2015	First released revision
Rev 1.3	September 2016	Changed LDO configuration jumpers. Replaced BSL selection jumpers with switches.

1.3 MSP-FET

See the *MSP Debuggers User's Guide*.

Revision History

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

STANDARD TERMS FOR EVALUATION MODULES

1. *Delivery:* TI delivers TI evaluation boards, kits, or modules, including any accompanying demonstration software, components, and/or documentation which may be provided together or separately (collectively, an "EVM" or "EVMs") to the User ("User") in accordance with the terms set forth herein. User's acceptance of the EVM is expressly subject to the following terms.

    1.1 EVMs are intended solely for product or software developers for use in a research and development setting to facilitate feasibility evaluation, experimentation, or scientific analysis of TI semiconductors products. EVMs have no direct function and are not finished products. EVMs shall not be directly or indirectly assembled as a part or subassembly in any finished product. For clarification, any software or software tools provided with the EVM ("Software") shall not be subject to the terms and conditions set forth herein but rather shall be subject to the applicable terms that accompany such Software

    1.2 EVMs are not intended for consumer or household use. EVMs may not be sold, sublicensed, leased, rented, loaned, assigned, or otherwise distributed for commercial purposes by Users, in whole or in part, or used in any finished product or production system.

2. *Limited Warranty and Related Remedies/Disclaimers*:

    2.1 These terms do not apply to Software. The warranty, if any, for Software is covered in the applicable Software License Agreement.

    2.2 TI warrants that the TI EVM will conform to TI's published specifications for ninety (90) days after the date TI delivers such EVM to User. Notwithstanding the foregoing, TI shall not be liable for a nonconforming EVM if (a) the nonconformity was caused by neglect, misuse or mistreatment by an entity other than TI, including improper installation or testing, or for any EVMs that have been altered or modified in any way by an entity other than TI, (b) the nonconformity resulted from User's design, specifications or instructions for such EVMs or improper system design, or (c) User has not paid on time. Testing and other quality control techniques are used to the extent TI deems necessary. TI does not test all parameters of each EVM. User's claims against TI under this Section 2 are void if User fails to notify TI of any apparent defects in the EVMs within ten (10) business days after delivery, or of any hidden defects with ten (10) business days after the defect has been detected.

    2.3 TI's sole liability shall be at its option to repair or replace EVMs that fail to conform to the warranty set forth above, or credit User's account for such EVM. TI's liability under this warranty shall be limited to EVMs that are returned during the warranty period to the address designated by TI and that are determined by TI not to conform to such warranty. If TI elects to repair or replace such EVM, TI shall have a reasonable time to repair such EVM or provide replacements. Repaired EVMs shall be warranted for the remainder of the original warranty period. Replaced EVMs shall be warranted for a new full ninety (90) day warranty period.

3. *Regulatory Notices:*

    3.1 *United States*

        3.1.1 *Notice applicable to EVMs not FCC-Approved:*

        FCC NOTICE: This kit is designed to allow product developers to evaluate electronic components, circuitry, or software associated with the kit to determine whether to incorporate such items in a finished product and software developers to write software applications for use with the end product. This kit is not a finished product and when assembled may not be resold or otherwise marketed unless all required FCC equipment authorizations are first obtained. Operation is subject to the condition that this product not cause harmful interference to licensed radio stations and that this product accept harmful interference. Unless the assembled kit is designed to operate under part 15, part 18 or part 95 of this chapter, the operator of the kit must operate under the authority of an FCC license holder or must secure an experimental authorization under part 5 of this chapter.

        3.1.2 *For EVMs annotated as FCC – FEDERAL COMMUNICATIONS COMMISSION Part 15 Compliant:*

        CAUTION

        This device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

        Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

        FCC Interference Statement for Class A EVM devices

        NOTE: This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

FCC Interference Statement for Class B EVM devices

NOTE: This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- *Reorient or relocate the receiving antenna.*
- *Increase the separation between the equipment and receiver.*
- *Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.*
- *Consult the dealer or an experienced radio/TV technician for help.*

3.2 *Canada*

3.2.1 *For EVMs issued with an Industry Canada Certificate of Conformance to RSS-210 or RSS-247*

Concerning EVMs Including Radio Transmitters:

This device complies with Industry Canada license-exempt RSSs. Operation is subject to the following two conditions:

(1) this device may not cause interference, and (2) this device must accept any interference, including interference that may cause undesired operation of the device.

Concernant les EVMs avec appareils radio:

Le présent appareil est conforme aux CNR d'Industrie Canada applicables aux appareils radio exempts de licence. L'exploitation est autorisée aux deux conditions suivantes: (1) l'appareil ne doit pas produire de brouillage, et (2) l'utilisateur de l'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement.

Concerning EVMs Including Detachable Antennas:

Under Industry Canada regulations, this radio transmitter may only operate using an antenna of a type and maximum (or lesser) gain approved for the transmitter by Industry Canada. To reduce potential radio interference to other users, the antenna type and its gain should be so chosen that the equivalent isotropically radiated power (e.i.r.p.) is not more than that necessary for successful communication. This radio transmitter has been approved by Industry Canada to operate with the antenna types listed in the user guide with the maximum permissible gain and required antenna impedance for each antenna type indicated. Antenna types not included in this list, having a gain greater than the maximum gain indicated for that type, are strictly prohibited for use with this device.

Concernant les EVMs avec antennes détachables

Conformément à la réglementation d'Industrie Canada, le présent émetteur radio peut fonctionner avec une antenne d'un type et d'un gain maximal (ou inférieur) approuvé pour l'émetteur par Industrie Canada. Dans le but de réduire les risques de brouillage radioélectrique à l'intention des autres utilisateurs, il faut choisir le type d'antenne et son gain de sorte que la puissance isotrope rayonnée équivalente (p.i.r.e.) ne dépasse pas l'intensité nécessaire à l'établissement d'une communication satisfaisante. Le présent émetteur radio a été approuvé par Industrie Canada pour fonctionner avec les types d'antenne énumérés dans le manuel d'usage et ayant un gain admissible maximal et l'impédance requise pour chaque type d'antenne. Les types d'antenne non inclus dans cette liste, ou dont le gain est supérieur au gain maximal indiqué, sont strictement interdits pour l'exploitation de l'émetteur

3.3 *Japan*

3.3.1 *Notice for EVMs delivered in Japan:* Please see http://www.tij.co.jp/lsds/ti_ja/general/eStore/notice_01.page 日本国内に輸入される評価用キット、ボードについては、次のところをご覧ください。
http://www.tij.co.jp/lsds/ti_ja/general/eStore/notice_01.page

3.3.2 *Notice for Users of EVMs Considered "Radio Frequency Products" in Japan:* EVMs entering Japan may not be certified by TI as conforming to Technical Regulations of Radio Law of Japan.

If User uses EVMs in Japan, not certified to Technical Regulations of Radio Law of Japan, User is required to follow the instructions set forth by Radio Law of Japan, which includes, but is not limited to, the instructions below with respect to EVMs (which for the avoidance of doubt are stated strictly for convenience and should be verified by User):

1. Use EVMs in a shielded room or any other test facility as defined in the notification #173 issued by Ministry of Internal Affairs and Communications on March 28, 2006, based on Sub-section 1.1 of Article 6 of the Ministry's Rule for Enforcement of Radio Law of Japan,

2. Use EVMs only after User obtains the license of Test Radio Station as provided in Radio Law of Japan with respect to EVMs, or

3. Use of EVMs only after User obtains the Technical Regulations Conformity Certification as provided in Radio Law of Japan with respect to EVMs. Also, do not transfer EVMs, unless User gives the same notice above to the transferee. Please note that if User does not follow the instructions above, User will be subject to penalties of Radio Law of Japan.

【無線電波を送信する製品の開発キットをお使いになる際の注意事項】 開発キットの中には技術基準適合証明を受けていないものがあります。 技術適合証明を受けていないもののご使用に際しては、電波法遵守のため、以下のいずれかの措置を取っていただく必要がありますのでご注意ください。

1. 電波法施行規則第6条第1項第1号に基づく平成18年3月28日総務省告示第173号で定められた電波暗室等の試験設備でご使用いただく。
2. 実験局の免許を取得後ご使用いただく。
3. 技術基準適合証明を取得後ご使用いただく。

なお、本製品は、上記の「ご使用にあたっての注意」を譲渡先、移転先に通知しない限り、譲渡、移転できないものとします。
　　　　上記を遵守頂けない場合は、電波法の罰則が適用される可能性があることをご留意ください。 日本テキサス・インスツルメンツ株式会社
東京都新宿区西新宿６丁目２４番１号
西新宿三井ビル

3.3.3 *Notice for EVMs for Power Line Communication:* Please see http://www.tij.co.jp/lsds/ti_ja/general/eStore/notice_02.page

電力線搬送波通信についての開発キットをお使いになる際の注意事項については、次のところをご覧ください。http://www.tij.co.jp/lsds/ti_ja/general/eStore/notice_02.page

3.4 *European Union*

3.4.1 *For EVMs subject to EU Directive 2014/30/EU (Electromagnetic Compatibility Directive)*:

This is a class A product intended for use in environments other than domestic environments that are connected to a low-voltage power-supply network that supplies buildings used for domestic purposes. In a domestic environment this product may cause radio interference in which case the user may be required to take adequate measures.

4 *EVM Use Restrictions and Warnings:*

4.1 EVMS ARE NOT FOR USE IN FUNCTIONAL SAFETY AND/OR SAFETY CRITICAL EVALUATIONS, INCLUDING BUT NOT LIMITED TO EVALUATIONS OF LIFE SUPPORT APPLICATIONS.

4.2 User must read and apply the user guide and other available documentation provided by TI regarding the EVM prior to handling or using the EVM, including without limitation any warning or restriction notices. The notices contain important safety information related to, for example, temperatures and voltages.

4.3 *Safety-Related Warnings and Restrictions:*

4.3.1 User shall operate the EVM within TI's recommended specifications and environmental considerations stated in the user guide, other available documentation provided by TI, and any other applicable requirements and employ reasonable and customary safeguards. Exceeding the specified performance ratings and specifications (including but not limited to input and output voltage, current, power, and environmental ranges) for the EVM may cause personal injury or death, or property damage. If there are questions concerning performance ratings and specifications, User should contact a TI field representative prior to connecting interface electronics including input power and intended loads. Any loads applied outside of the specified output range may also result in unintended and/or inaccurate operation and/or possible permanent damage to the EVM and/or interface electronics. Please consult the EVM user guide prior to connecting any load to the EVM output. If there is uncertainty as to the load specification, please contact a TI field representative. During normal operation, even with the inputs and outputs kept within the specified allowable ranges, some circuit components may have elevated case temperatures. These components include but are not limited to linear regulators, switching transistors, pass transistors, current sense resistors, and heat sinks, which can be identified using the information in the associated documentation. When working with the EVM, please be aware that the EVM may become very warm.

4.3.2 EVMs are intended solely for use by technically qualified, professional electronics experts who are familiar with the dangers and application risks associated with handling electrical mechanical components, systems, and subsystems. User assumes all responsibility and liability for proper and safe handling and use of the EVM by User or its employees, affiliates, contractors or designees. User assumes all responsibility and liability to ensure that any interfaces (electronic and/or mechanical) between the EVM and any human body are designed with suitable isolation and means to safely limit accessible leakage currents to minimize the risk of electrical shock hazard. User assumes all responsibility and liability for any improper or unsafe handling or use of the EVM by User or its employees, affiliates, contractors or designees.

4.4 User assumes all responsibility and liability to determine whether the EVM is subject to any applicable international, federal, state, or local laws and regulations related to User's handling and use of the EVM and, if applicable, User assumes all responsibility and liability for compliance in all respects with such laws and regulations. User assumes all responsibility and liability for proper disposal and recycling of the EVM consistent with all applicable international, federal, state, and local requirements.

5. *Accuracy of Information:* To the extent TI provides information on the availability and function of EVMs, TI attempts to be as accurate as possible. However, TI does not warrant the accuracy of EVM descriptions, EVM availability or other information on its websites as accurate, complete, reliable, current, or error-free.

6. *Disclaimers:*

   6.1 EXCEPT AS SET FORTH ABOVE, EVMS AND ANY MATERIALS PROVIDED WITH THE EVM (INCLUDING, BUT NOT LIMITED TO, REFERENCE DESIGNS AND THE DESIGN OF THE EVM ITSELF) ARE PROVIDED "AS IS" AND "WITH ALL FAULTS." TI DISCLAIMS ALL OTHER WARRANTIES, EXPRESS OR IMPLIED, REGARDING SUCH ITEMS, INCLUDING BUT NOT LIMITED TO ANY EPIDEMIC FAILURE WARRANTY OR IMPLIED WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE OR NON-INFRINGEMENT OF ANY THIRD PARTY PATENTS, COPYRIGHTS, TRADE SECRETS OR OTHER INTELLECTUAL PROPERTY RIGHTS.

   6.2 EXCEPT FOR THE LIMITED RIGHT TO USE THE EVM SET FORTH HEREIN, NOTHING IN THESE TERMS SHALL BE CONSTRUED AS GRANTING OR CONFERRING ANY RIGHTS BY LICENSE, PATENT, OR ANY OTHER INDUSTRIAL OR INTELLECTUAL PROPERTY RIGHT OF TI, ITS SUPPLIERS/LICENSORS OR ANY OTHER THIRD PARTY, TO USE THE EVM IN ANY FINISHED END-USER OR READY-TO-USE FINAL PRODUCT, OR FOR ANY INVENTION, DISCOVERY OR IMPROVEMENT, REGARDLESS OF WHEN MADE, CONCEIVED OR ACQUIRED.

7. *USER'S INDEMNITY OBLIGATIONS AND REPRESENTATIONS.* USER WILL DEFEND, INDEMNIFY AND HOLD TI, ITS LICENSORS AND THEIR REPRESENTATIVES HARMLESS FROM AND AGAINST ANY AND ALL CLAIMS, DAMAGES, LOSSES, EXPENSES, COSTS AND LIABILITIES (COLLECTIVELY, "CLAIMS") ARISING OUT OF OR IN CONNECTION WITH ANY HANDLING OR USE OF THE EVM THAT IS NOT IN ACCORDANCE WITH THESE TERMS. THIS OBLIGATION SHALL APPLY WHETHER CLAIMS ARISE UNDER STATUTE, REGULATION, OR THE LAW OF TORT, CONTRACT OR ANY OTHER LEGAL THEORY, AND EVEN IF THE EVM FAILS TO PERFORM AS DESCRIBED OR EXPECTED.

8. *Limitations on Damages and Liability:*

   8.1 *General Limitations.* IN NO EVENT SHALL TI BE LIABLE FOR ANY SPECIAL, COLLATERAL, INDIRECT, PUNITIVE, INCIDENTAL, CONSEQUENTIAL, OR EXEMPLARY DAMAGES IN CONNECTION WITH OR ARISING OUT OF THESE TERMS OR THE USE OF THE EVMS , REGARDLESS OF WHETHER TI HAS BEEN ADVISED OF THE POSSIBILITY OF SUCH DAMAGES. EXCLUDED DAMAGES INCLUDE, BUT ARE NOT LIMITED TO, COST OF REMOVAL OR REINSTALLATION, ANCILLARY COSTS TO THE PROCUREMENT OF SUBSTITUTE GOODS OR SERVICES, RETESTING, OUTSIDE COMPUTER TIME, LABOR COSTS, LOSS OF GOODWILL, LOSS OF PROFITS, LOSS OF SAVINGS, LOSS OF USE, LOSS OF DATA, OR BUSINESS INTERRUPTION. NO CLAIM, SUIT OR ACTION SHALL BE BROUGHT AGAINST TI MORE THAN TWELVE (12) MONTHS AFTER THE EVENT THAT GAVE RISE TO THE CAUSE OF ACTION HAS OCCURRED.

   8.2 *Specific Limitations.* IN NO EVENT SHALL TI'S AGGREGATE LIABILITY FROM ANY USE OF AN EVM PROVIDED HEREUNDER, INCLUDING FROM ANY WARRANTY, INDEMNITY OR OTHER OBLIGATION ARISING OUT OF OR IN CONNECTION WITH THESE TERMS, , EXCEED THE TOTAL AMOUNT PAID TO TI BY USER FOR THE PARTICULAR EVM(S) AT ISSUE DURING THE PRIOR TWELVE (12) MONTHS WITH RESPECT TO WHICH LOSSES OR DAMAGES ARE CLAIMED. THE EXISTENCE OF MORE THAN ONE CLAIM SHALL NOT ENLARGE OR EXTEND THIS LIMIT.

9. *Return Policy.* Except as otherwise provided, TI does not offer any refunds, returns, or exchanges. Furthermore, no return of EVM(s) will be accepted if the package has been opened and no return of the EVM(s) will be accepted if they are damaged or otherwise not in a resalable condition. If User feels it has been incorrectly charged for the EVM(s) it ordered or that delivery violates the applicable order, User should contact TI. All refunds will be made in full within thirty (30) working days from the return of the components(s), excluding any postage or packaging costs.

10. *Governing Law:* These terms and conditions shall be governed by and interpreted in accordance with the laws of the State of Texas, without reference to conflict-of-laws principles. User agrees that non-exclusive jurisdiction for any dispute arising out of or relating to these terms and conditions lies within courts located in the State of Texas and consents to venue in Dallas County, Texas. Notwithstanding the foregoing, any judgment may be enforced in any United States or foreign court, and TI may seek injunctive relief in any United States or foreign court.