

MSP432™ Hardware Tools

User's Guide



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Read This First

About This Manual

This manual describes the hardware tools that support the Texas Instruments 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). 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](#).

Hardware

This chapter contains information relating to the hardware tools and includes schematics, PCB pictorials, and bills of materials. All other tools 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.

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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.

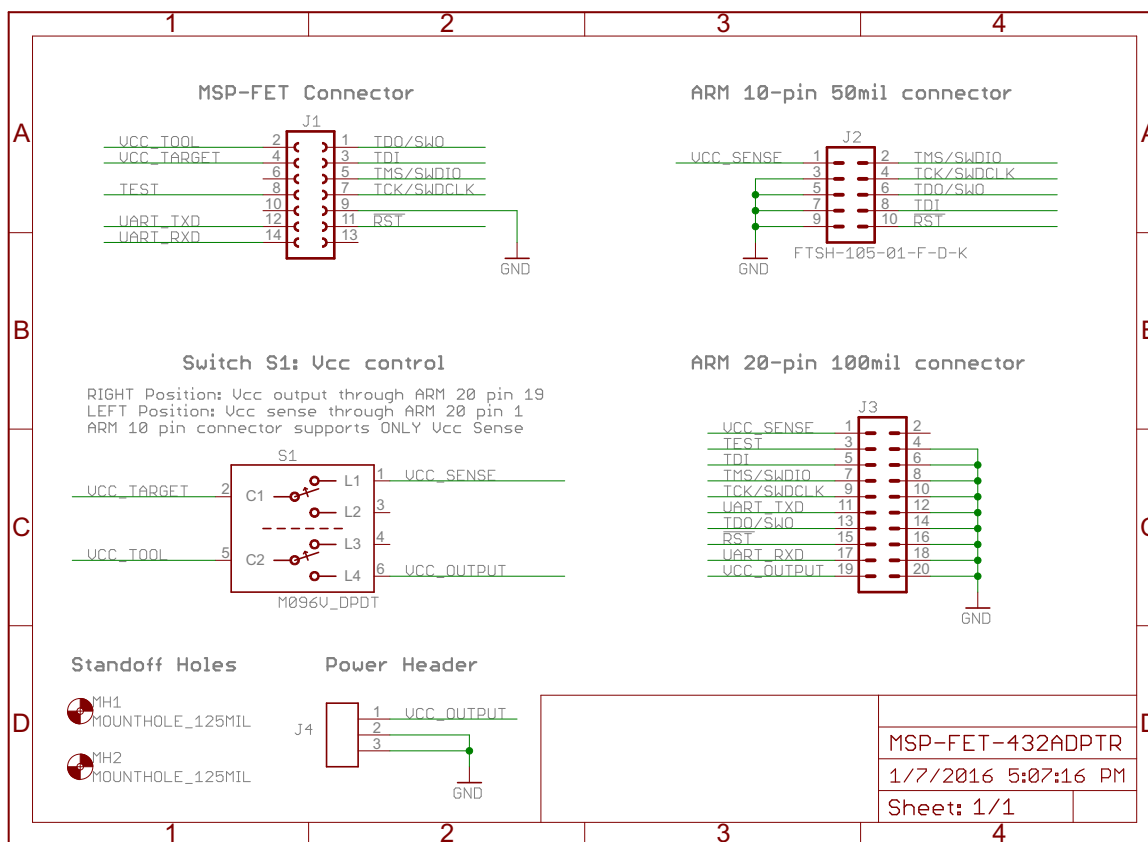
The [Cortex-M debug standard](#) works a bit differently. In this standard, the V_{CC} Sense is always active, no matter where the external voltage is coming from. Some debug probes, such as the IAR I-Jet and Segger J-Link have a voltage output, all while still sensing the V_{CC} Sense.

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	<ul style="list-style-type: none"> • External power is sensed through ARM pin 1 • External power needs to be connected to debug target 	<ul style="list-style-type: none"> • 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	<ul style="list-style-type: none"> • External power is sensed through ARM pin 1 • External power needs to be connected to debug target 	<ul style="list-style-type: none"> • 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.



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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

1.2.4.1 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. Also make sure that the following jumpers have been set as shown here before connecting the debug probe and power supply (see [Figure 1-2](#)):

- JP8: Open
- JP12: Open
- J1: Close 2-3
- JP1: Closed
- JP2: Closed
- J16: Closed
- J2: Connect external VCC to pin 1, and external GND to pins 2 or 3

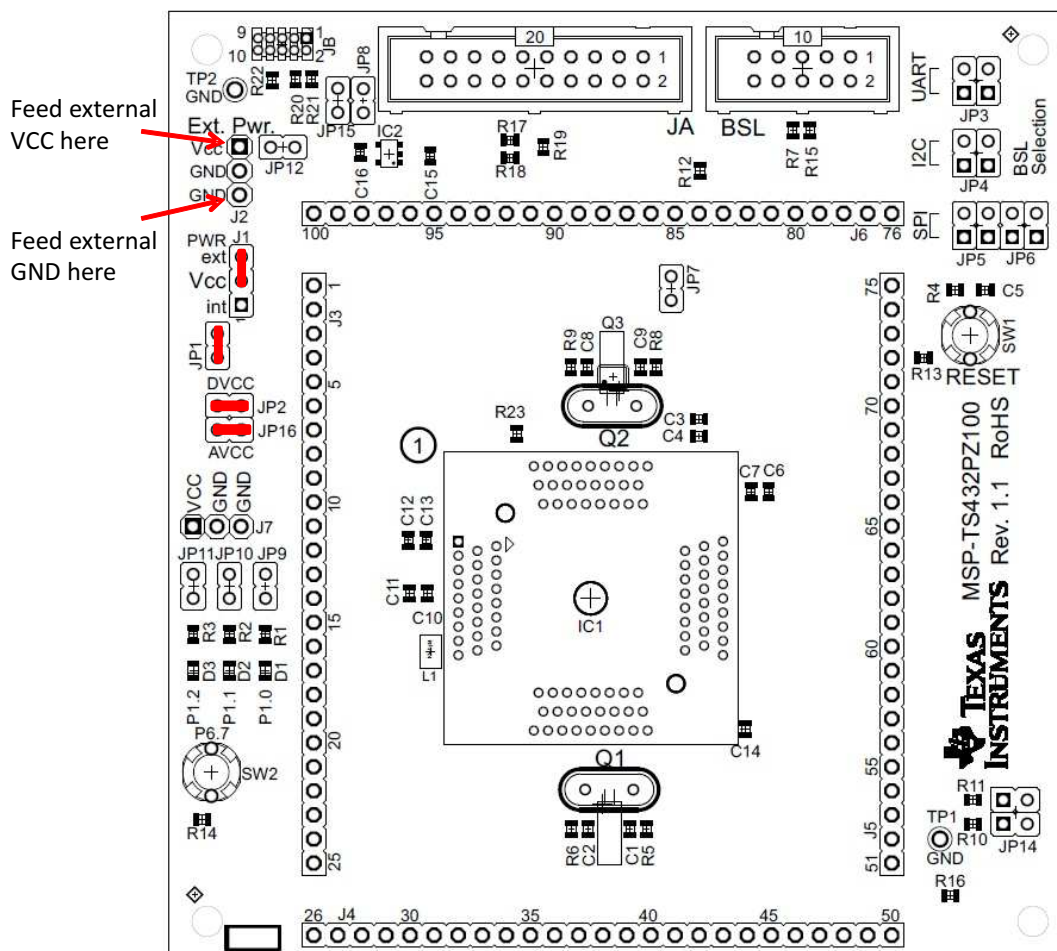


Figure 1-2. Board Configuration For External Target Power Supply

1.2.4.2 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, make sure the following jumpers are set as shown here before connecting the debug probe (see [Figure 1-3](#)):

- JP8: Closed
- JP12: Closed
- J1: Close 1-2
- JP1: Closed
- JP2: Closed
- JP16: Closed

If the debug probe supplies a logic level voltage through pin 19, the LDO can be entirely bypassed using JP15. Always follow the voltage limits defined in the device data sheet.

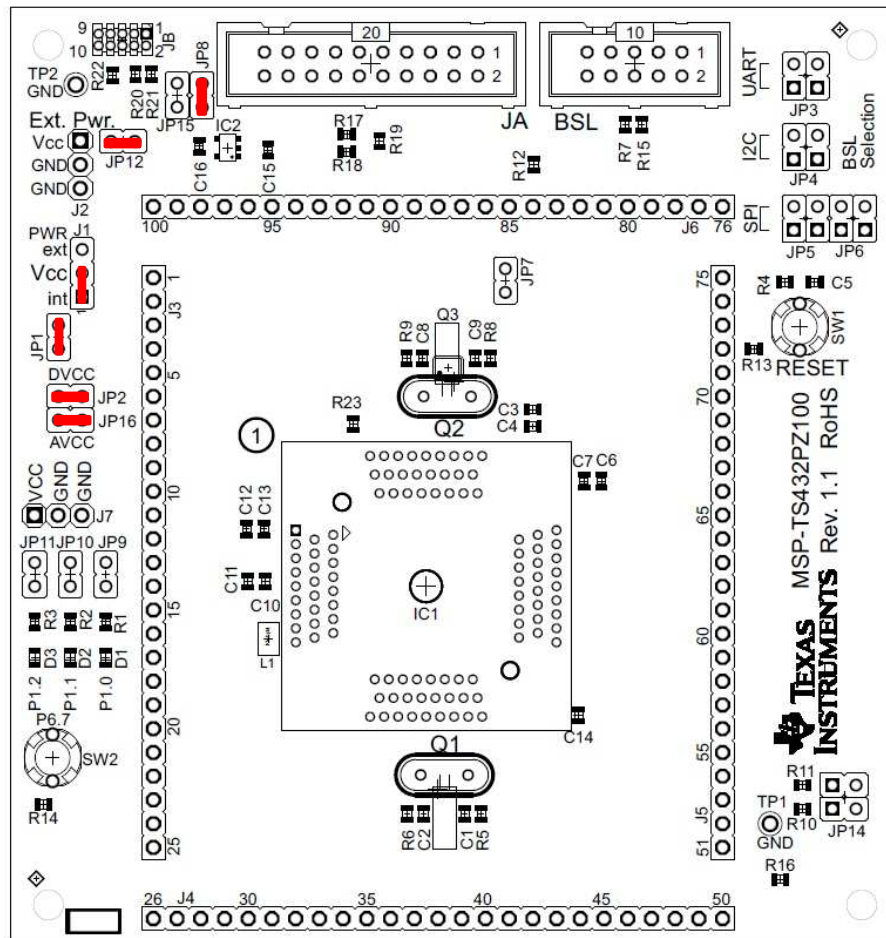
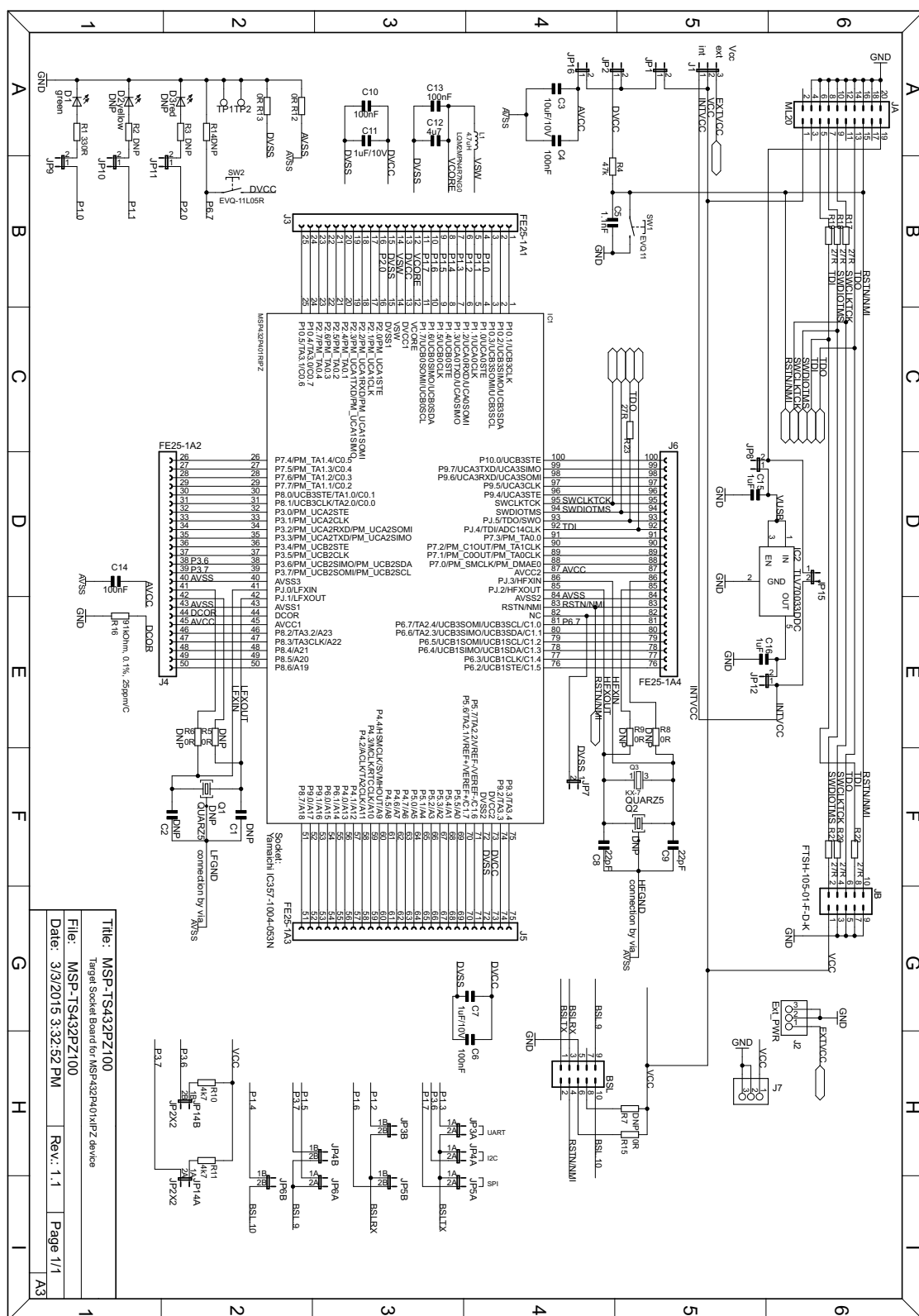


Figure 1-3. Board Configuration For Debugger-Supplied Target Power

1.2.5 Hardware Design

Figure 1-4 shows the MSP-TS432PZ100 schematic.



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Figure 1-4. MSP-TS432PZ100 Target Socket Board, Schematic

Figure 1-5 shows the MSP-TS432PZ100 assembly drawing.

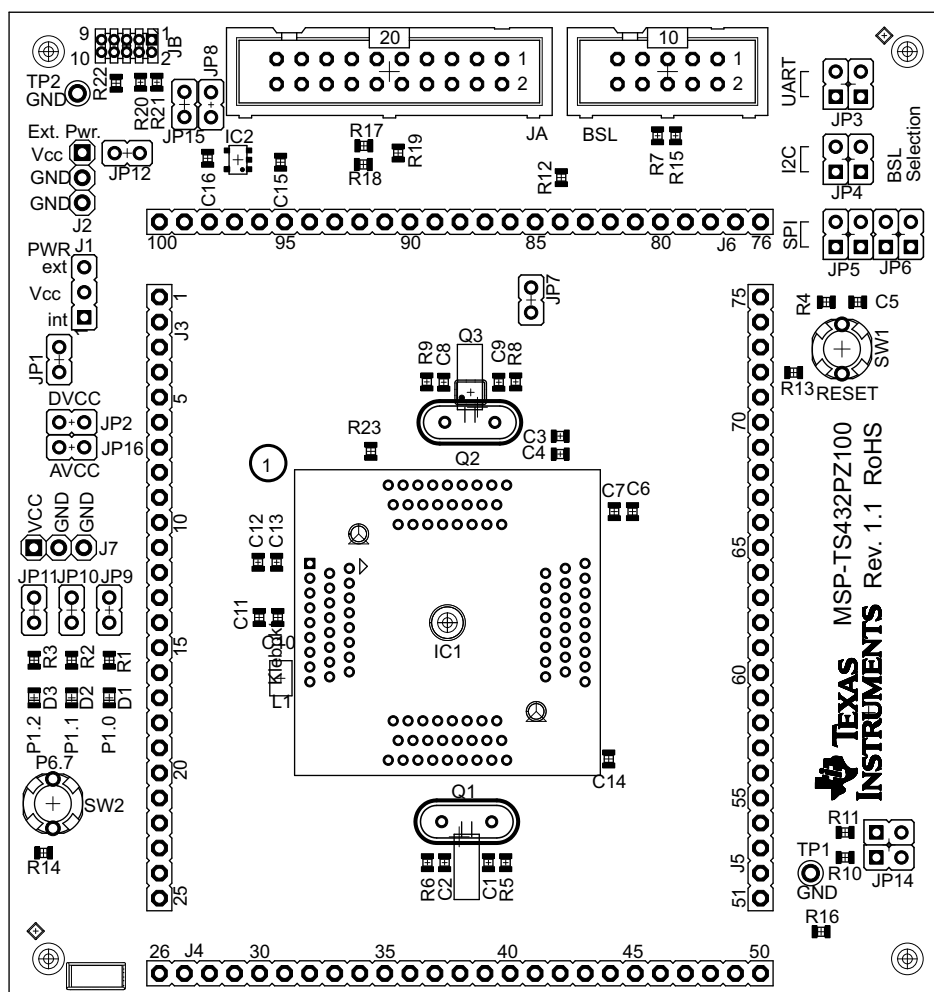


Figure 1-5. MSP-TS432PZ100 Target Socket Board, PCB

Table 1-4 lists the key components of the board.

Table 1-4. Important Board Components

Reference	Description
IC1	Socket for PZ100 package
JA	20-pin Cortex-M debug connector
JB	10-pin Cortex-M debug connector
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.
J1	Selector between internal and external power supply.
JP1	Header to measure current flowing into AVCC and DVCC power domains.
JP2	Header to disconnect DVCC from VCC supply. Connect an ampere meter to measure current flowing into the digital domain.
J2	Header to feed external voltage to device. If used, connect J1-2 and J1-3.
JP15	Header to bypass 3V3 LDO in case a debug probe supplies a logic level voltage through pin 19 of header JA.

Table 1-4. Important Board Components (continued)

Reference	Description
JP16	Header to disconnect AVCC from VCC supply. Connect an ampere meter to measure current flowing into the analog domain.
J7	VCC header. Can be used to observe device VCC when supplied by the debug probe or to feed in external power.

1.2.5.1 Bill Of Materials

Table 1-5 lists the bill of materials for the MSP-TS432PZ100.

Table 1-5. MSP-TS432PZ100 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
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.

Table 1-5. MSP-TS432PZ100 Bill Of Materials (continued)

Pos.	Ref Des. No.	No. Per Board	Description	Digi-Key Part No.	Comment
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 Revision History

Revision	Date	Comments
Rev1.1	March 2015	First released revision

Revision History

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

Changes from March 19, 2015 to May 3, 2016		Page
• Added Section 1.1 , <i>MSP-FET-432ADPTR</i>		6
• Removed former Section 1.1, <i>MSP-TS432PZ100 Rev1.0</i>		8
• Updated structure and headings throughout Section 1.2 , <i>MSP-TS432PZ100</i>		8
• Removed entry for Rev1.0 from Section 1.2.5.2 , <i>MSP-TS432PZ100 Revision History</i>		14

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