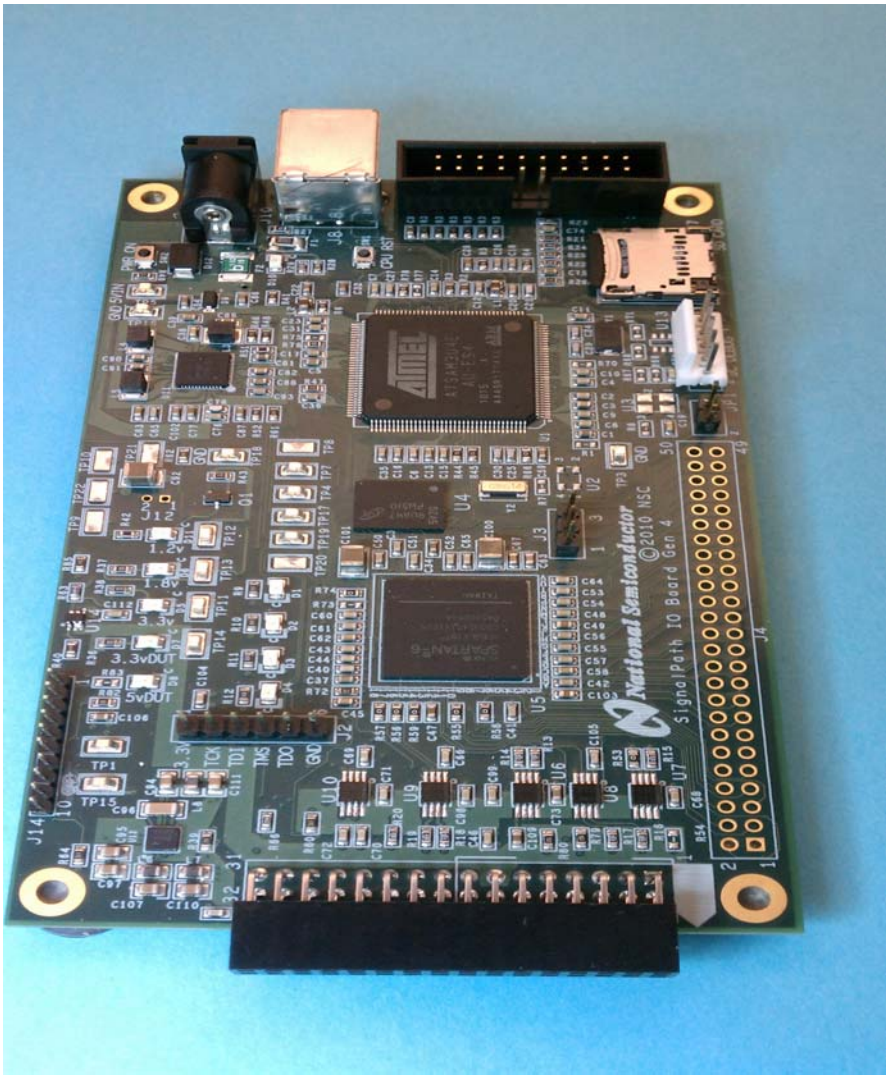
National Semiconductor

SPIO-4

Precision Signal-Path Controller Board



Users' Guide

December 2010

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1.0 SPIO-4 System Overview

The SPIO-4 is one of several National Semiconductor digital controller/capture boards that are used by multiple evaluation systems. The objective of these software/hardware evaluation systems is to allow our customers to easily and accurately evaluate National's signal-path devices in a lab setting. At the time of SPIO-4's release, two different evaluation system software (GUIs) make use of this board: the WaveVision-5 and the Sensor AFE. The board ships with the current version of the WaveVision-5 software.

In addition to the controller/capture board (i.e., the SPIO-4) and the evaluation GUI software (e.g., WaveVision-5 or Sensor AFE), the third essential element of an evaluation system is the device or signal-path evaluation board that plugs into the controller board. This eval board is generically referred to as the "DUT board". Each DUT board comes with its own Users' Guide which documents its specific features. Each DUT board also comes with some software that the user must install before using it. In the case of the WaveVision-5 GUI, this software is essentially a device-specific module that adds support for the future device eval boards. In the case of Sensor AFE device family, the eval board comes with a complete, custom Sensor AFE that is specifically paired with that device.

The WaveVision-5 and Sensor AFE GUI software have their own Users' Guide documents that describe how to interact with the GUI.

This User's Guide describes only the SPIO-4 board. The user is expected to refer to this guide only if necessary. The DUT Users' Guide and the GUI Users' Guide are the primary documents that describe how to work with a National signal-path evaluation board.

The latest version of this document may be obtained from National Semiconductor's web site at www.national.com.

1.1 SPIO-4 System Features

- Captures or sources multiple signal-path data streams and transfers them to/from the PC based application software through a USB 2.0 connection (USB1.1 compatible).
- Supports jumper-less, plug-and-play configuration. The GUI automatically discovers the attached DUT board and loads the appropriate software module for it.
- Supports a wide variety of signal-path evaluation board through a standardized connector (GPSI-16/GPSI-32).
- Capable of storing up to 8MBytes of signal-path data.
- DUT interface can be SPI, I2C or parallel.
- Powered either by PC via USB or external supply.

1.2 Packing List

The SPIO-4 kit (National order number SPIO-4/NOPB) consists of the following components:

- SPIO-4 Board
- USB cable
- User's Guide (This Document)
- WaveVision-5 GUI software

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1.3 Board Layout Overview

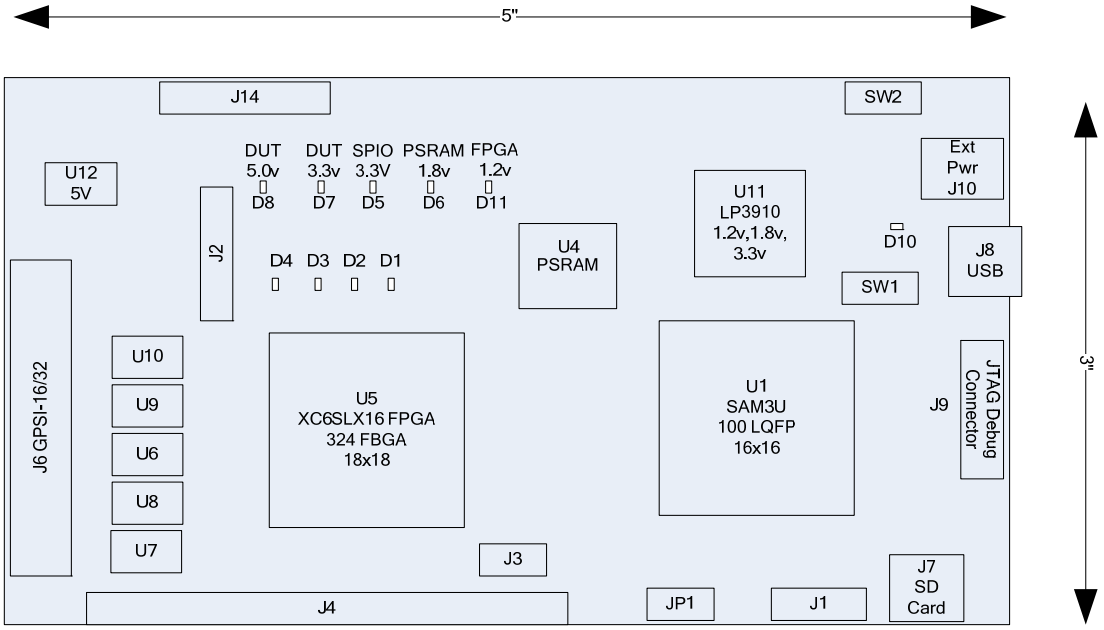
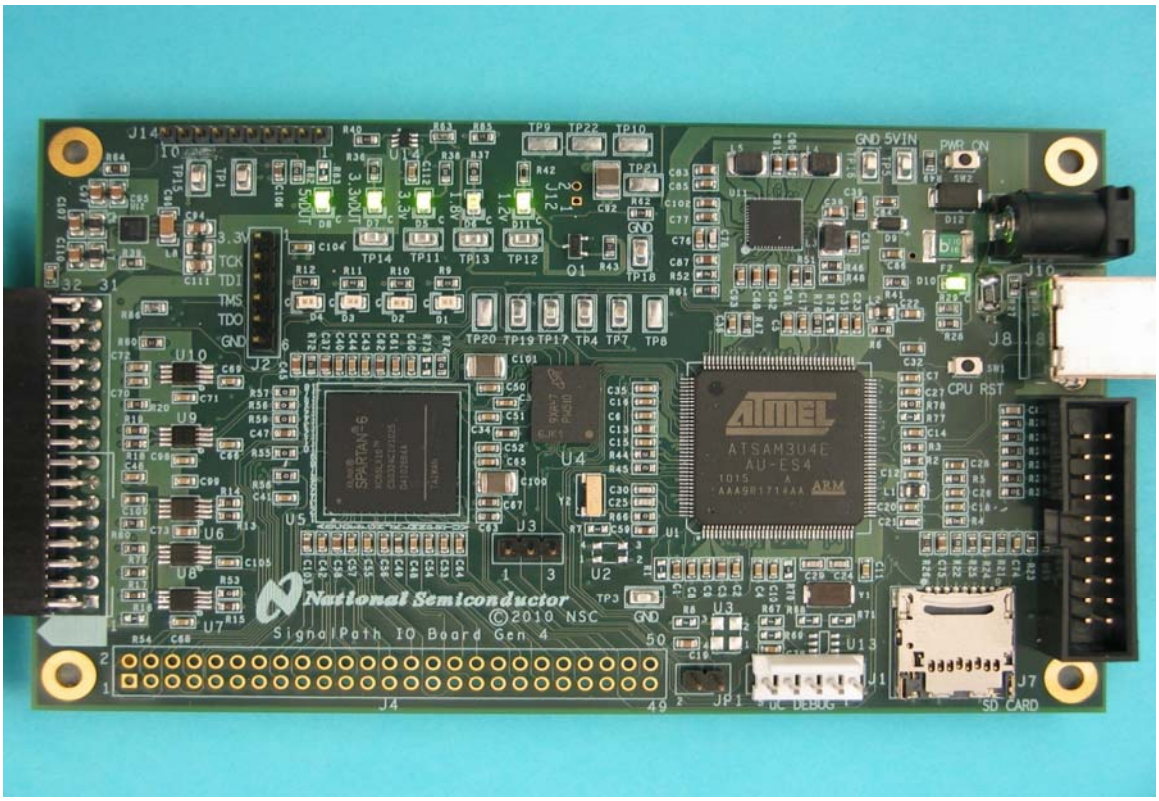


Figure 1 - SPIO-4 Board Layout – Component Side



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1.4 Component Description

The following table describes both the on-board connectors and the main components used in the SPIO-4 System shown in Figure 1.

Component	1.4.1.1 Description
J1	Serial Debug connector
J2	Header to provide access to the FPGA's JTAG interface for debug
J3	Jumper to select J4 IO voltage (3.3V or programmable)
J4 (DBG)	Debug/Development Connector(See section 2.6).
J6 (GPSI-32)	GPSI-16/32 Connector to DUT.
J7 (micro_SD)	This holds the microSD card for storage or development purposes
J8 (USB)	USB cable Connection.
J9 (JTAG)	Atmel Processor JTAG Debug Header.
J10 (POWER)	+5-6V Power Supply Connection –Optional (See Section **Error! Reference source not found.**).
J14 (USNAP)	Additional header providing power and serial interface to processor
JP1	Jumpers for test purposes only.
U1	Atmel SAM3U Processor
U4	8Mx16 PSRAM
U5	Xilinx Spartan LX16 FPGA
D1-D4	FPGA Status LEDs (See section 2.4)
D6	1.8V PSRAM Core voltage Surface mount power LED.
D7	3.3V DUT supply voltage Surface mount power LED.
D8	5.0V DUT supply voltage Surface mount power LED.
D10	USB input power LED.
D11	1.2V FPGA Core voltage Surface mount power LED.
SW1	Reset switch
SW2	Power On pushbutton

Table 1 - Main component reference designators

1.5 SPIO-4 Board Test Points

The following table describes the main Test Points available.

Test point	Description
TP1, TP3, TP16, TP18(GND)	Ground test points.
TP11	3.3V Digital IO Voltage for SPIO Board
TP12	1.2V for FPGA core voltage
TP13	1.8V for PSRAM core voltage
TP14	3.3V for DUT Digital Supply
TP15	5.0V for DUT Analog Supply

Table 2 - Test Points

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2 System Functionality

2.1 System Block Diagram

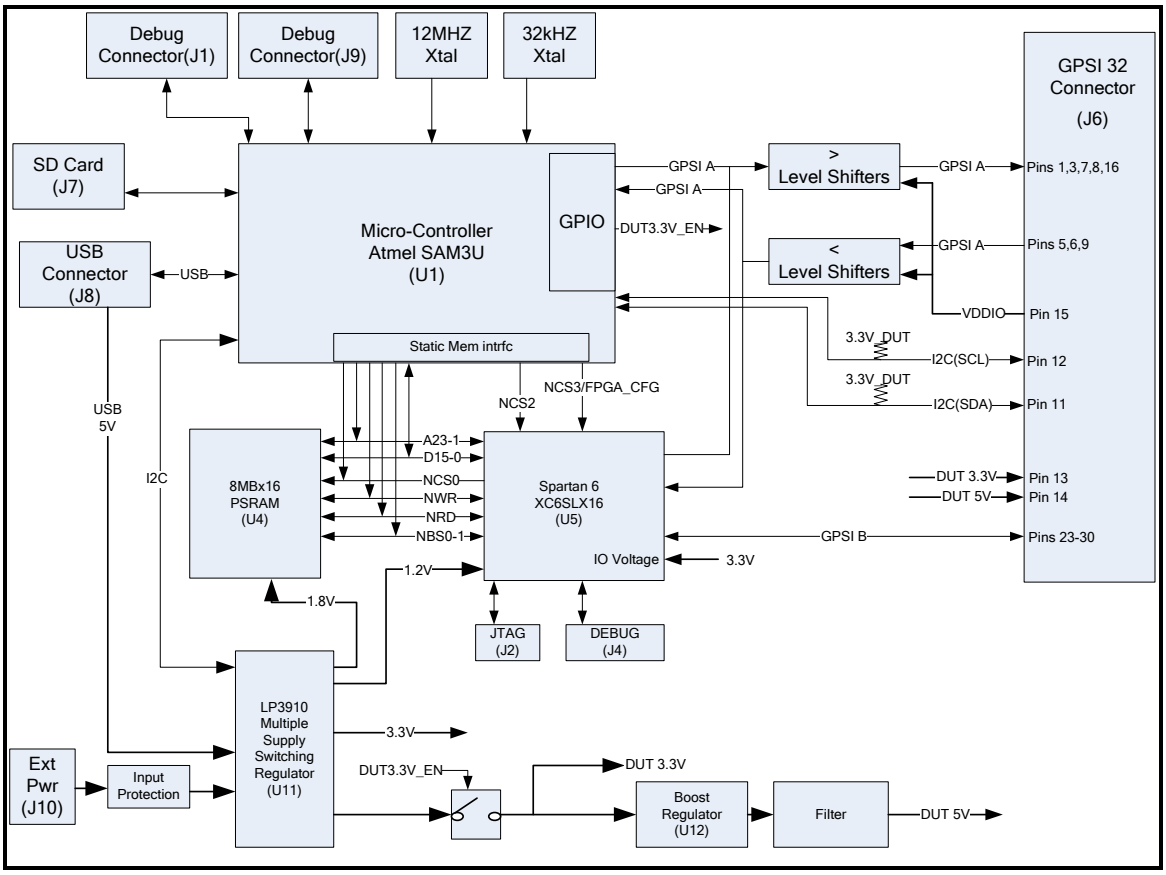

Figure 2 - SPIO-4 System Block Diagram

2.2 General System Overview

The SPIO-4 board is controlled via the Atmel SAM3U micro-controller that is based on an ARM M3, 32-bit embedded core. It provides the interface to the computer via a USB interface. The DUT board interfaces to the SPIO-4 via J6, the GPSI-16/32 connector. The GPSI-16/32 interface provides control, data and power to the DUT board. The interfaces on the GPSI-32 can be I2C, SPI with multiple-device capability, and parallel interface. The dedicated I2C interface on the GPSI-16/32 is primarily for control and DUT identification, while the dedicated SPI interface may be used for control or for data transfer. The I2C interface is derived from the peripheral of the microcontroller. As there can be a wide variety of SPI requirements for DUTs, the SPI interface can be provided via a processor peripheral and over the dedicated SPI lines as shown in this document, or the on-board Xilinx Spartan XC6SLX16 FPGA may be used. In fact, the FPGA may be used to implement DUT interfaces other than SPI – such as high-speed I2C for data purposes and parallel data-plus-clock interfaces. A large external SRAM 8Mx16 is connected to both the processor and the FPGA which is used to provide additional device data storage in case the microcontroller's or FPGA's on-board memory is insufficient.

Power is provided to the system via the USB cable, or external power jack. A switching regulator is used to produce the 3.3 volt supply required by the microcontroller and GPSI-32 devices. A boost regulator creates the regulated 5 volt supply required by the devices interfaced to the GPSI-32 connector.

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2.3 Automatic Device Detection & Configuration

The SPIO-4 system supports automatic hardware detection and configuration of the device under test. The GUI software actually carries out the device detection and configuration task. The FPGA is re-configured on the fly by the host PC when the SPIO-4 Board is powered on, or whenever ADC evaluation boards are exchanged and SPIO-4 power is cycled.

Each DUT board has either an FPGA configuration file, or a microcontroller firmware module, unique to it. The GUI software, in conjunction with the USB micro-controller, determines which DUT board has been plugged in. It then loads a configuration file tailored for that DUT board into the FPGA and/or the microcontroller.

Normally, the configuration process is totally transparent to the user, and requires no intervention. However, some devices may allow this process to be overridden. Refer to the evaluation board manual for more information.

Important Note: Many of our device evaluation boards ***do*** require jumper configurations to select channels, voltages, or other options. Please consult the manual that came with the evaluation board for specific information.

Important Note: Please be aware that DUT boards are NOT hot swappable. Please power down both the SPIO-4 board and the DUT board prior to swapping DUT board.

2.4 LED Indicators

There are several LED indicators on the SPIO4 board. the ones described bleow are driven directly by separate power rails on the SPIO4 board but as those rails can only be controlled by the processor they not only indicate a particular rails is on, they also show a state of the SPIO4 firmware as discussed below.

Led D#	Description
D10	Indicates power (USB or External) is present to SPIO board
D5	3.3V Digital IO Voltage for SPIO Board is up (required for all operations)
D6	1.2V for FPGA core voltage – Indicates processor has completed low level hardware initialization and is ready to program the FPGA
D11	1.8V for PSRAM core voltage - Indicates processor has completed low level hardware initialization and is able to use the PSRAM
D7 & D8	3.3V & 5V DUT Supplies – Indicates the processor has detected a DUT board inserted and has powered it

Table 3 - LED Behavior

2.5 DUT Interface (GPSI-16/32)

The SPIO-4 Data Capture Board is connected to the DUT through the GPSI-16/32 (J6) connector. As described previously, the GPSI-32 interface provides control, data and power to the DUT board. See Table 1 below for signal specifics. The GPSI-16/32 interface also supports a subset within it called GPSI-16 which consists of the lower order pins 1-16. A given DUT board may use a 16-pin, GPSI-16 port only, or may use the whole 32-pin port. GPSI-16 has level shifters allowing some of the DUT interface voltages to go from 1.65V to 5.5V LVTTL levels under the direct control of the DUT board circuitry. To achieve that voltage range the voltage level shifters are NOT bidirectional. A DUT board requiring bi-directional signals must use the upper-order portion of the GPSI-32. Note, however, that upper order portion of GPSI-32 requires adherence to 3.3V LVTTL voltage levels as it does not have level shifters.

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Below are two photos demonstrating the proper mating of a GPSI16 and a GPSI32 DUT board to the SPIO4.

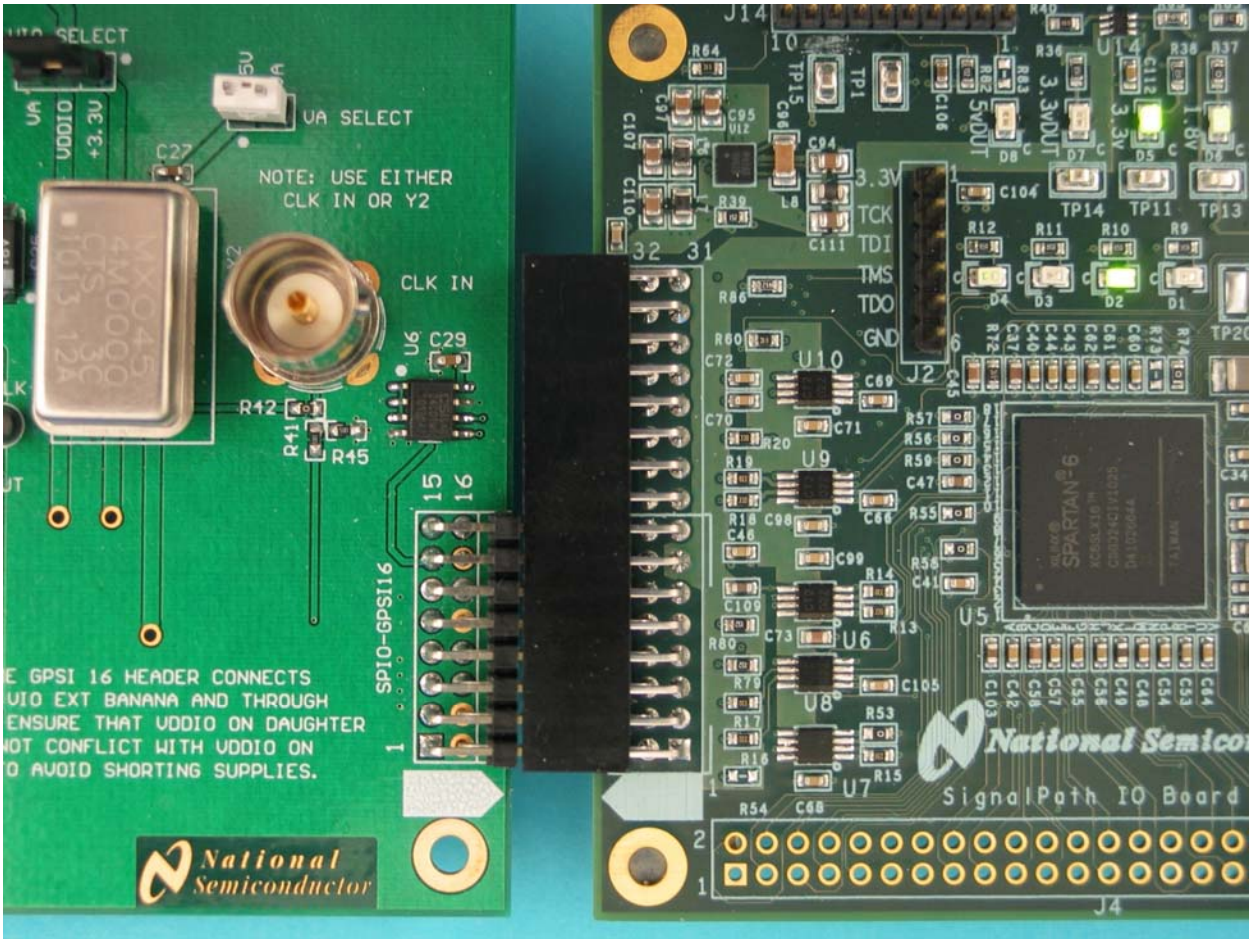

Figure 3 - GPSI 16 DUT to SPIO4 Mating

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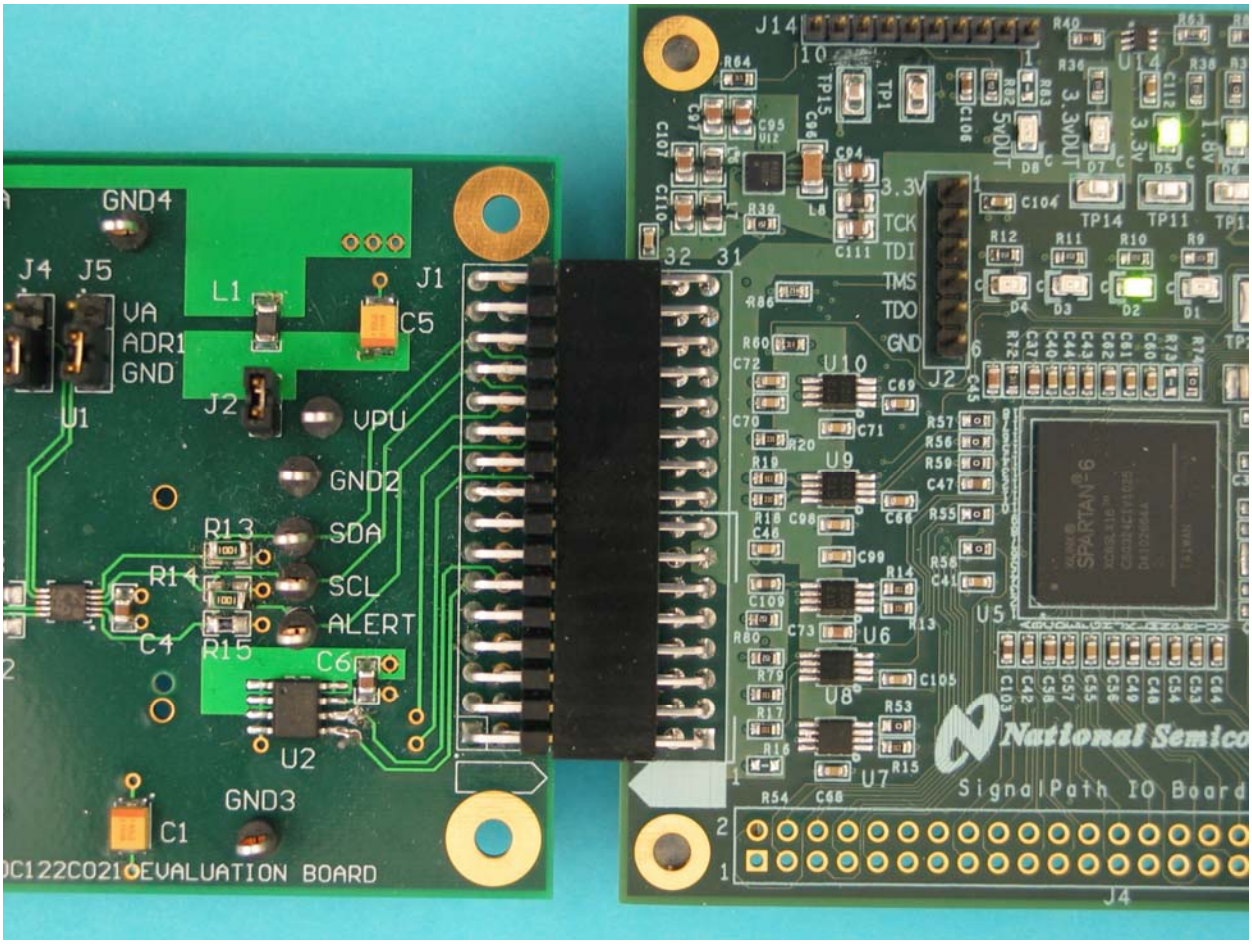

Figure 4 - GPSI 32 DUT to SPIO4 Mating

2.5.1 Level Shifters

The board incorporates level shifters to allow flexible output voltages on the uni-directional SPI signals of GPSI-16 port, as shown in the board block diagram. VDDIO – a supply voltage from the GPSI-16/32 connector coming from the DUT board – provides the voltage to the output side of the level translators. If the DUT has no special requirements for voltage and simply needs basic 3.3V signal levels, the 3.3V output from the GPSI connector could be connected to VDDIO on the DUT board. The level shifters are uni-directional. If VDDIO is not provided, the level shifters enter a shutdown state with all input pins tri-stated. The state passed along to the processor in this case would be logic low.

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GPSI Connector (J6) Pin Description			
Pin #	**Signal Name/Function**	**Voltage Level**	**Direction (From SPIO-4)**
Pins 1-16 form the GPSI-16 subset:			
1	SCS0_A~ *SerialBus A – Chip Select for device 0.*	1.65 to 5.5V	*OUTPUT*
2	GND		
3	SCK_A *Serial Bus A – Serial Clock from the master to the device.*	1.65 to 5.5V	*OUTPUT*
4	DUT_Present~ *The DUT board shall ground this pin. The SPIO-4 senses this pin to determine the DUT board's presence.*	N/A	*INPUT*
5	SMISO_A *Serial Bus A – Data from the slave (device) to the master. The device may implement this as a tri-state signal that can be driven by multiple devices on Serial Bus A in a bussed fashion. The pull-up resistor, if required, is on the **DUT** board.*	1.65 to 5.5V	*INPUT*
6	Dev_INT~/SDRDY_A~ *In certain applications, if required, this pin serves as the DRDY~ signal from the DUT to the SPIO-4. In other cases, this pin may be a general interrupt pin from the device to the SPIO-4.* *On the SPIO-4 board this signal connects to an interrupt pin on the microcontroller.*	1.65 to 5.5V	*INPUT*
7	SMOSI_A *Serial Bus A – Data from the master to the slave (device).*	1.65 to 5.5V	*OUTPUT*
8	SCS1_A~ *SerialBus A – Chip Select for device 1.*	1.65 to 5.5V	*OUTPUT*
9	Ref_CLK *Reference clock from the DUT board to the SPIO-4 board.If not used, the DUT board should ground this pin.*	1.65 to 5.5V	*INPUT*
10	GND		
11	SDA *Data line of the I2C bus.* *Pulled-up to +3.3V_DUT on the SPIO-4 board through a 1.5k resistor.*	3.3V	Birdirectional
12	SCL *Clock line of the I2C bus.* *Pulled-up to +3.3V_DUT on the SPIO-4 board through a 1.5k resistor.*	3.3V	Birdirectional
13	+3.3V_DUT *Switched by the SPIO-4 conditional on the DUT_Present~ having been seen. The ID EEPROM and the entire I2C bus on the DUT board must be unconditionally powered by this supply. Max. peak current: 50mA (subject to total power budget limit of **200mW** over both supplies). Maximum capacitor loading for this node is not to exceed 50uF.*	3.3V	*OUTPUT*
14	+5V_DUT *This supply is sourced by the SPIO-4 and is intended to power the core functionality of the DUT board – if desired. Nominal current: 35mA. Max. peak current: 50mA (subject to total power budget limit of **200mW** over both supplies). If power from the SPIO-4 is not required,*	5.0V	*OUTPUT*

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	the DUT board must leave this pin open. Maximum capacitor loading for this node is not to exceed 50uF.		
15	**VDDIO** *Interface Supply always provided by the DUT board. Both the DUT board and the SPIO-4 board power their I/O drivers with this supply (except the I2C bus – which is always +3.3V). Only the SPI_A related signals on the GPSI-16 subset are affected by this I/O supply. Voltage Range: 1.6V to 5.5V. Capable of supplying 100mA.*	1.65 to 5.5V	***INPUT***
16	**SCS2_A~** *SerialBus A – Chip Select for device 2.*	1.65 to 5.5V	***OUTPUT***
17	**DUT_PWR_Enable** *For those DUT boards that support intelligent power-up control, this signal from the SPIO-4 enables the DUT power regulators.*	3.3V	***OUTPUT***
18	*Available for implementation specific use. Refer to the DUT board manual. If unused, leave it open. (Possible use: DUT_RESET~)*	3.3V	
19	*Available for implementation specific use. Refer to the DUT board manual. If unused, leave it open.*	3.3V	
20	*Available for implementation specific use. Refer to the DUT board manual. If unused, leave it open.*	3.3V	
21	*Available for implementation specific use. Refer to the DUT board manual. If unused, leave it open.*	3.3V	
22	*Available for implementation specific use. Refer to the DUT board manual. If unused, leave it open.*	3.3V	
23	*Available for implementation specific use. Refer to the DUT board manual. If unused, leave it open.* If a second SPI bus is implemented, then use this pin as shown: **SCS0_B~** *SerialBus B – Chip Select for device 0.*	3.3V	
24	*Available for implementation specific use. Refer to the DUT board manual. If unused, leave it open.* If a second SPI bus is implemented, then use this pin as shown: **SDRDY_B~** *In certain SPI applications, if required, this pin serves as the DRDY~ signal from the DUT to the SPIO-4.*	3.3V	
25	*Available for implementation specific use. Refer to the DUT board manual. If unused, leave it open.* If a second SPI bus is implemented, then use this pin as shown: **SCK_B** *Serial Bus B – Serial Clock from the master to the device.*	3.3V	
26	*Available for implementation specific use. Refer to the DUT board manual. If unused, leave it open.* If a second SPI bus is implemented, then use this pin as shown: **SCS1_B~** *SerialBus B – Chip Select for device 1.*	3.3V	
27	*Available for implementation specific use. Refer to the DUT board manual. If unused, leave it open.* If a second SPI bus is implemented, then use this pin as shown: **SMISO_B**	3.3V	

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	*Serial Bus B – Data from the slave (device) to the master. The device may implement this as a tri-state signal that can be driven by multiple devices on Serial Bus B in a bussed fashion. The pull-up resistor, if required, is on the **DUT** board.*		
28	*Available for implementation specific use. Refer to the DUT board manual. If unused, leave it open.* If a second SPI bus is implemented, then use this pin as shown: SCS2_B~ *SerialBus B – Chip Select for device 2.*	3.3V	
29	*Available for implementation specific use. Refer to the DUT board manual. If unused, leave it open.* If a second SPI bus is implemented, then use this pin as shown: SMOSI_B *Serial Bus B – Data from the master to the slave (device).*	3.3V	
30	*Available for implementation specific use. Refer to the DUT board manual. If unused, leave it open.* If a second SPI bus is implemented, then use this pin as shown: SCS3_B~ *SerialBus B – Chip Select for device 3.*	3.3V	
31	*Reserved for future use. The DUT board shall leave this pin open.*	3.3V	
32	GND		

Table 4 GPSI-32 Signals

2.6 Auxiliary Interface

The SPIO-4 Board can be connected to auxiliary test equipment through debug connector J4 located on the board.

2.7 Computer Interface

The SPIO-4 Board communicates with a PC via standard USB 2.0 at high-speed (up to a 480 Mbits/sec signaling rate). It is fully backward compatible with USB 1.1 devices and cables.

2.8 Memory

The SPIO-4 Board comes with 8M x 16bits of PSRAM for data storage. It is a single Micron MT45W8MW16BGX PSRAM configured for asynchronous accesses. In asynchronous configuration the fastest access speed is 70ns latency or approximately 14.2 MHz per 16 bit transfer. Both the processor and the FPGA have read/write access to the PSRAM. The processor's Static Memory Interface mastership is controlled by firmware with in the processor as there is no hardware mechanism to share the bus.

2.9 Power Requirements

The SPIO-4 Data Capture Board can be solely powered via the USB interface power but can also be powered by external power supply. The SPIO-4 Data Capture Board consumes up to 500 mA of current depending on the DUT load. ADC evaluation boards differ widely in their power consumption – please consult the manual that came with your evaluation board, and verify if an external supply is required for your DUT board. External power can be supplied via J10 and must be greater than 4.5V and less than 6.0V DC with a current rating of at least 1A.

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3 SPIO-4 Bill of Materials

Item	Description	Qty.	Reference	Mfg. Name	Mfg. No.
1	CAP CER 10000PF 25V Y5V 0603	1	C1	MURATA ELECTRONICS (VA)	GRM188F51E103ZA01D
2	CAP CER .47UF 10V X7R 0603	1	C103	TAIYO YUDEN (VA)	LMK107B7474KA-T
3	CAP .10UF 16V CERAMIC X7R 0603	58	C2,C4,C6,C7,C8,C9,C10,C11,C12,C14,C15,C16,C17,C18,C20,C23,C26,C27,C31,C33,C35,C36,C40,C41,C42,C43,C44,C46,C48,C50,C51,C52,C53,C54,C55,C56,C57,C60,C61,C64,C65,C66,C68,C69,C70,C71,C72,C74,C76,C79,C85,C93,C98,C99,C104,C105,C108,C112	YAGEO (VA)	CC0603KRX7R7BB104
4	CAP CERAMIC 10PF 50V NP0 0603	2	C21,C78	KEMET (VA)	C0603C100J5GACTU
5	CAP CER 15PF 50V C0G 5% 0603	4	C24,C25,C29,C30	TDK CORPORATION (VA)	C1608C0G1H150J
6	CAP CER 4.7UF 10V Y5V 0603	5	C28,C32,C77,C84,C86	MURATA ELECTRONICS (VA)	GRM188F51A475ZE20D
7	CAP CER 10UF 6.3V Y5V 0603	22	C3,C5,C13,C19,C22,C37,C38,C39,C45,C58,C62,C73,C75,C80,C82,C83,C87,C88,C89,C90,C91,C102	TDK CORPORATION (VA)	C1608Y5V0J106Z
8	CAP CER 1.0UF 10V X7R 0603	9	C34,C47,C49,C59,C63,C67,C81,C106,C109	TAIYO YUDEN (VA)	LMK107B7105KA-T
9	CAP CER 100UF 10V X5R 1210	3	C92,C100,C101	TAIYO YUDEN (VA)	LMK325BJ107MM-T
10	CAP CER 10UF 10V X5R 0805	6	C94,C95,C97,C107,C110,C111	JOHANSON DIELECTRICS INC (VA)	100R15X106KV4E
11	CAP CER 1.0UF 16V X7R 20% 1206	1	C96	TDK CORPORATION (VA)	C3216X7R1C105M/0.85
12	LED TOPLED 570NM GREEN CLR SMD	10	D1,D2,D3,D4,D5,D6,D7,D8,D10,D11	OSRAM OPTO SEMICONDUCTORS INC(VA)	LG M67K-G1J2-24-0-2-R18-Z
13	DIODE ZENER 6.2V 3W DO214AA	1	D12	MICRO COMMERCIAL CO (VA)	3SMBJ5920B-TP
14	DIODE SCHOTTKY 1A 20V SOD-123	1	D9	MICRO COMMERCIAL CO (VA)	MBRX120LF-TP
15	RES 0.0 OHM 1/2W 1210 SMD	1	F1	VISHAY/DALE (VA)	CRCW12100000Z0EA
16	PTC RESETTABLE 1.10A 16V 1812	1	F2	BOURNS INC (VA)	MF-MSMF110/16-2
17	CONN HEADER VERT 5POS .100 TIN	1	J1	TYCO ELECTRONICS AMP	640454-5
18	CON PWR JCK 2.0 X 6.5MM W/O SW	1	J10	CUI INC	PJ-037A
19	CONN HEADER 10POS 2MM VERT T/H	1	J14	3M	951110-8622-AR
20	CONN HEADER VERT SGL 6POS GOLD	1	J2	3M	961106-6404-AR
21	BERGSTIK II .100" SR STRAIGHT	1	J3	FCI	68000-203HLF
22	CONN FEMALE 32POS DL .1" R/A TIN	1	J6	SULLINS CONNECTOR SOLUTIONS	PPTC162LJBN-RC
23	CONN MICRO SD R/A HING TYPE SMD	1	J7	HIROSE ELECTRIC CO LTD (VA)	DM3C-SF
24	CONN RCPT USB TYPE B R/A PCB	1	J8	FCI	61729-0010BLF
25	CONN HEADER 2.54MM 20POS GOLD	1	J9	SULLINS CONNECTOR SOLUTIONS	SBH11-PBPC-D10-ST-BK
26	BERGSTIK II .100" SR STRAIGHT	1	JP1	FCI	68001-202HLF
27	INDUCTOR 10UH 100MA 0805	2	L1,L2	MURATA ELECTRONICS (VA)	LQM21FN100M70L
28	INDUCTOR 2.2UH 1.20A 20% 1210	3	L3,L4,L5	TDK CORPORATION (VA)	NLCV32T-2R2M-PFR
29	FERRITE CHIP 2700 OHM 200MA 0805	3	L6,L7,L8	MURATA ELECTRONICS (VA)	BLM21BD272SN1L
30	TRANSISTOR NPN GP 40V SOT23	1	Q1	MICRO COMMERCIAL CO (VA)	MMBT3904-TP
31	RES 33.0 OHM 1/10W 1% 0603 SMD	8	R13,R14,R15,R16,R17,R18,R19,R20	YAGEO (VA)	RC0603FR-0733RL
32	RES 39 OHM 1/10W 5% 0603 SMD	2	R2,R3	PANASONIC - ECG (VA)	ERJ-3GEYJ390V
33	RES 10K OHM 1/10W 1% 0603 SMD	17	R21,R26,R30,R31,R32,R33,R34,R43,R46,R47,R48,R49,R60,R61,R64,R72,R85	STACKPOLE ELECTRONICS INC (VA)	RMCF0603FT10K0
34	RES 46.4K OHM 1/10W 1% 0603 SMD	5	R22,R23,R24,R25,R28	STACKPOLE ELECTRONICS INC (VA)	RMCF0603FT46K4
35	RES 68K OHM 1/10W 5% 0603 SMD	1	R29	PANASONIC - ECG (VA)	ERJ-3GEYJ683V
36	RES 1.5K OHM 1/10W 5% 0603 SMD	7	R39,R41,R44,R45,R79,R80,R82	STACKPOLE ELECTRONICS INC (VA)	RMCF0603JT1K50
37	RES 6.8K OHM 1/10W 1% 0603 SMD	1	R4	STACKPOLE ELECTRONICS INC (VA)	RMCF0603FT6K80
38	RES 100K OHM 1/10W 1% 0603 SMD	2	R40,R62	STACKPOLE ELECTRONICS INC (VA)	RMCF0603FT100K
39	RES 649 OHM 1/10W 1% 0603 SMD	1	R42	PANASONIC - ECG (VA)	ERJ-3EKF6490V
40	RES 0.0 OHM 1/10W 0603 SMD	15	R5,R6,R27,R35,R37,R53,R55,R56,R57,R58,R59,R66,R74,R76,R78	STACKPOLE ELECTRONICS INC (VA)	RMCF0603ZT0R00
41	RES 4.64K OHM 1/10W 1% 0603 SMD	1	R51	PANASONIC - ECG (VA)	ERJ-3EKF4641V
42	RES 121K OHM 1/10W 1% 0603 SMD	1	R52	STACKPOLE ELECTRONICS INC (VA)	RMCF0603FT121K
43	RES 680K OHM 1/10W 5% 0603 SMD	1	R63	PANASONIC - ECG (VA)	ERJ-3GEYJ684V
44	RES 9.1K OHM 1/10W 5% 0603 SMD	1	R86	PANASONIC - ECG (VA)	ERJ-3GEYJ912V
45	RES 750 OHM 1/10W 1% 0603 SMD	6	R9,R10,R11,R12,R36,R38	STACKPOLE ELECTRONICS INC (VA)	RMCF0603FT750R
46	SWITCH TACT SPST W/O GND SMD	2	SW1,SW2	OMRON ELECTRONICS INC-ECB DIV (VA)	B3U-1000P
47	PC TEST POINT MINIATURE SMT	14	TP1,TP3,TP4,TP5,TP7,TP11,TP12,TP13,TP14,TP15,TP16,TP17,TP18,TP19	KEYSTONE ELECTRONICS (VA)	5015
48	ATSAM3U4EA-AU-ND	1	U1		ATSAM3U4EA-AU-ND
49	LP3910SQ-AA	1	U11		LP3910SQ-AA
50	LM2750LD-5.0CT-ND	1	U12		LM2750LD-5.0CT-ND
51	IC LOAD SWITCH INTEGRATED SC70-6	1	U14	FAIRCHILD SEMICONDUCTOR (VA)	FDG6342L
52	IC PSRAM 128MBIT 70NS 54VFBGA	1	U4	MICRON TECHNOLOGY INC (VA)	MT45W8MW16BGX-701 IT TR
53	XC6SLX16-2CSG324C	1	U5		XC6SLX16-2CSG324C
54	IC BUS TRANSCVR 2BIT N-INV SM8	5	U6,U7,U8,U9,U10	TEXAS INSTRUMENTS (VA)	SN74LVC2T45DCTR
55	CRYSTAL 12.00 MHZ 8PF SMD	1	Y1	NDK (VA)	NX5032GA 12MHZ AT-W
56	CRYSTAL 32.768KHZ 12.5PF SMD	1	Y2	ABRACON CORPORATION (VA)	ABS10-32.768KHZ-T
57	PCB Fab	1	Fab	National Semiconductor	551600474-001

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4 SPIO-4 Schematics

Following pages show the schematics of the board. These are provided for general information purposes only. National reserves the right to make modifications to the board design at any time.

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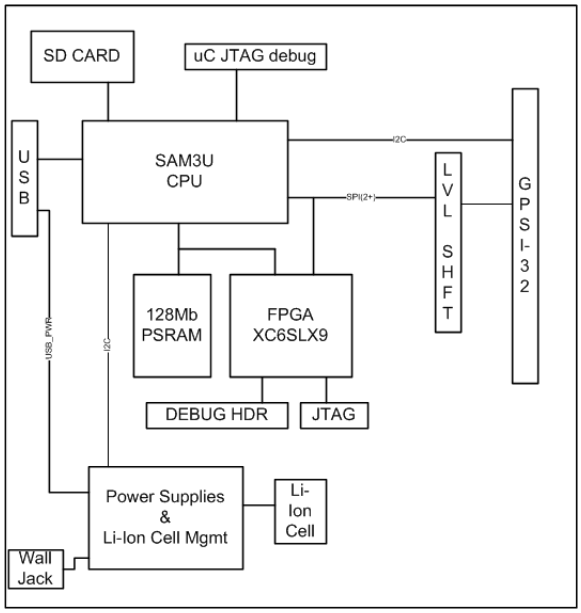
SPIO45 Interface Board Block Diag



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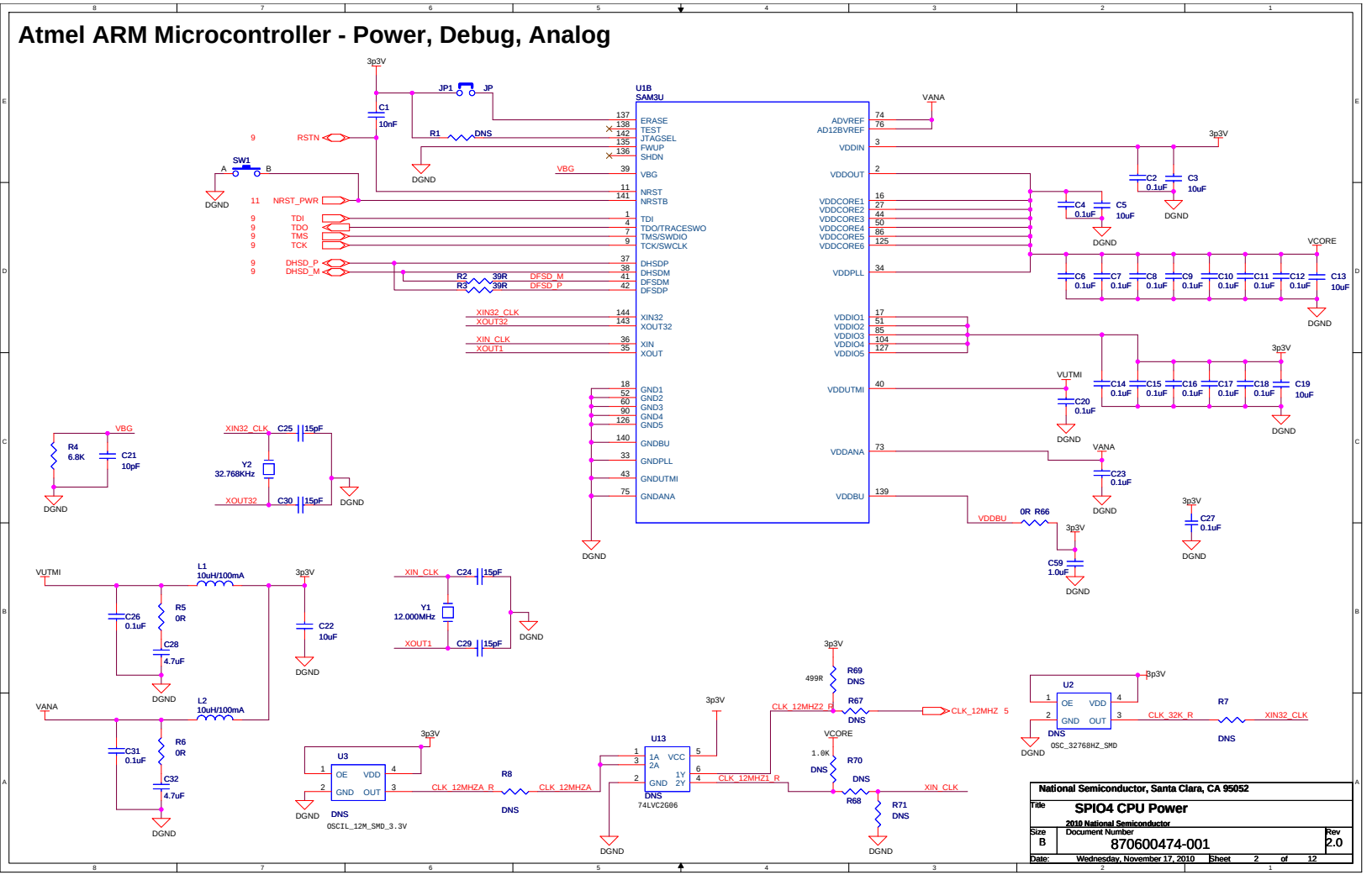
Atmel ARM Microcontroller - Power, Debug, Analog



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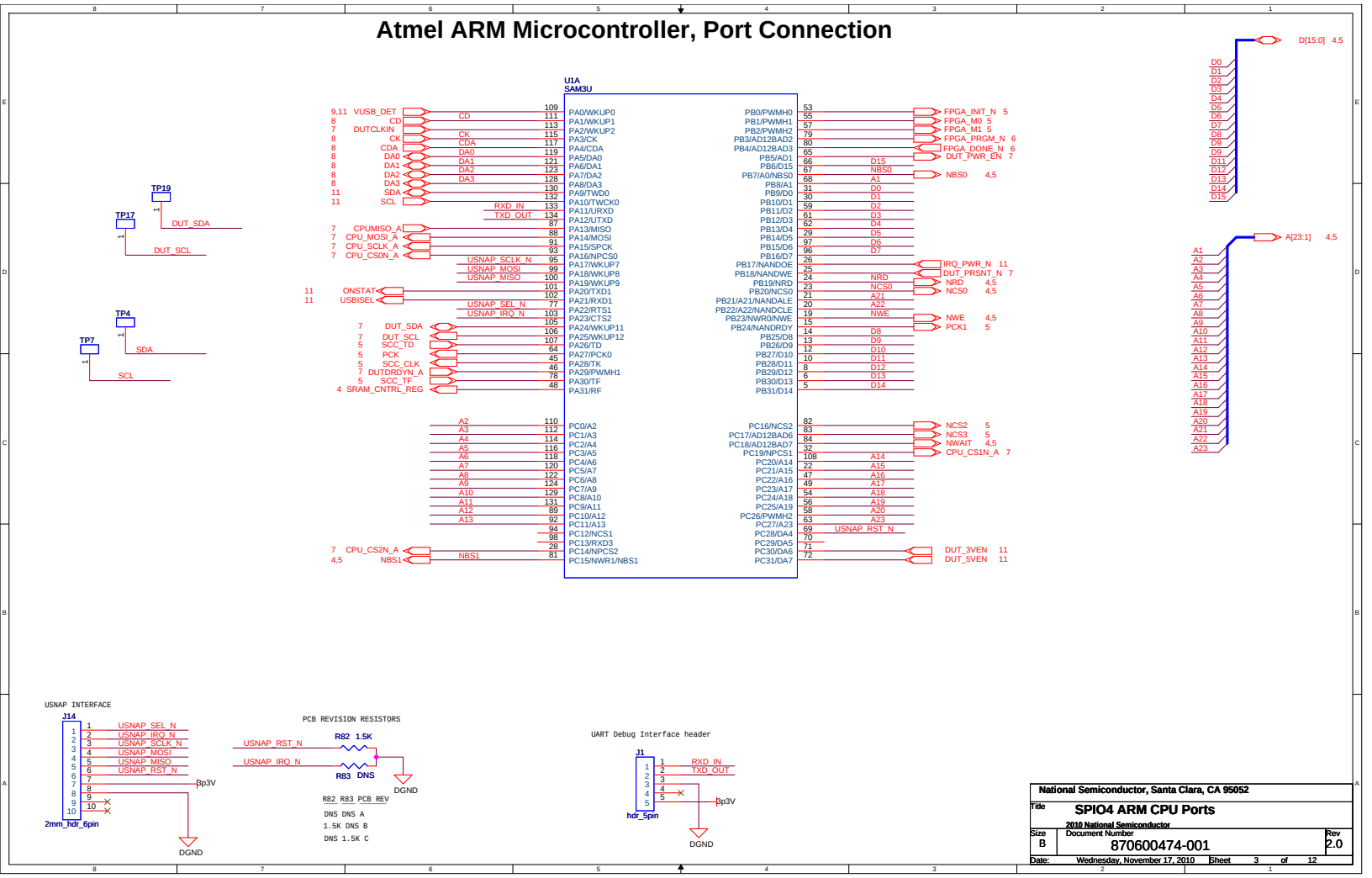
Atmel ARM Microcontroller, Port Connection



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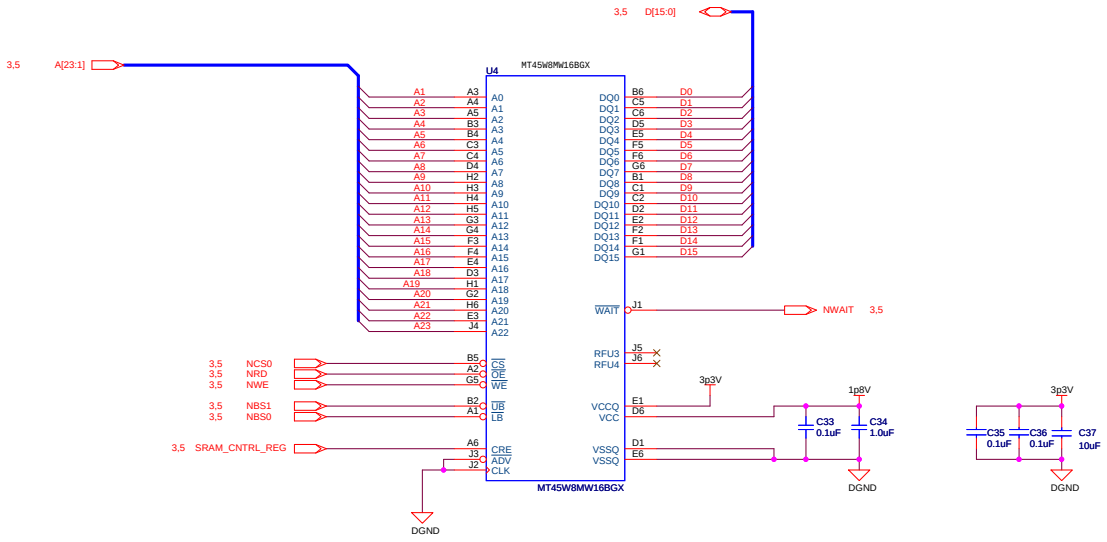

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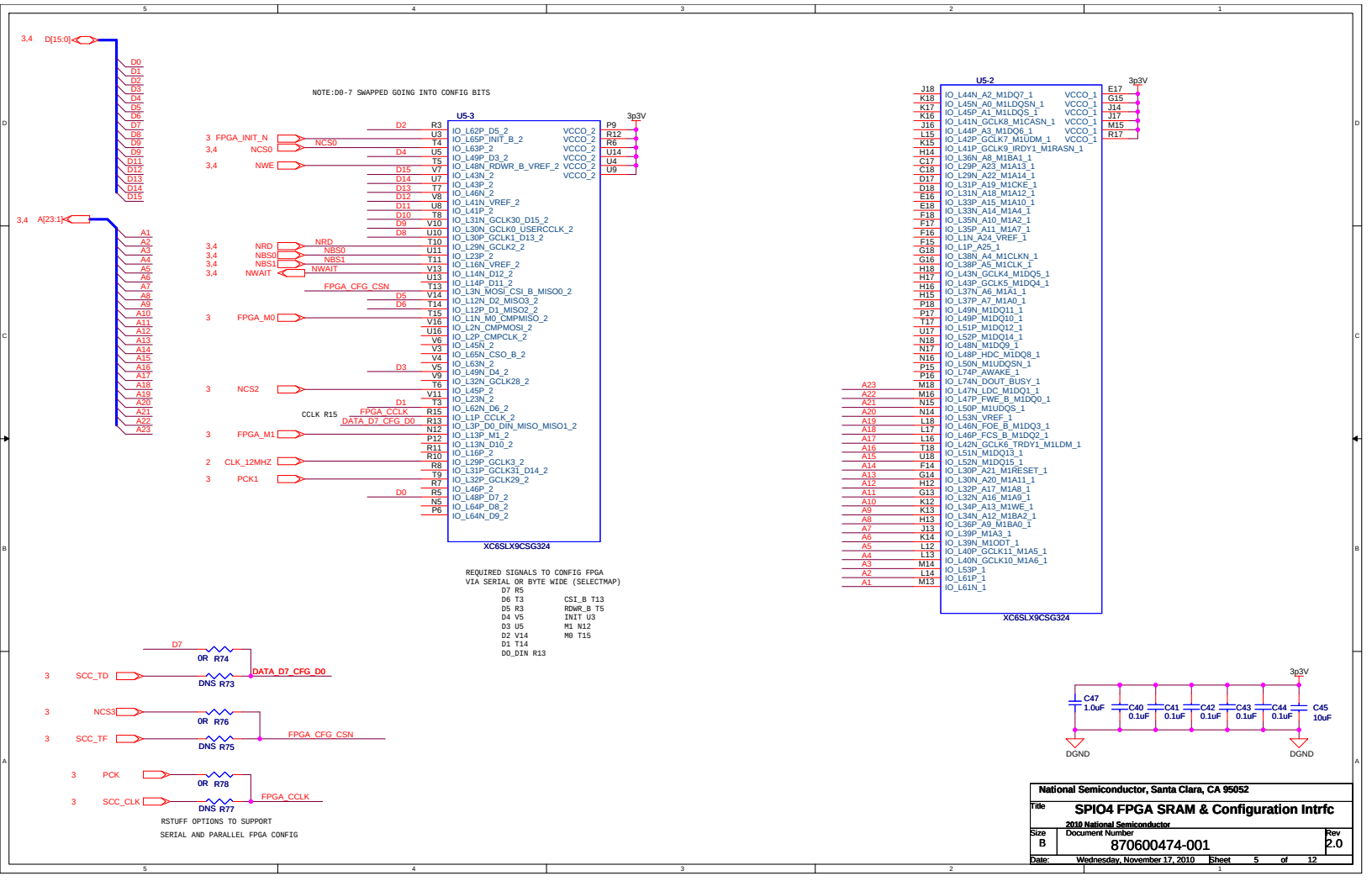

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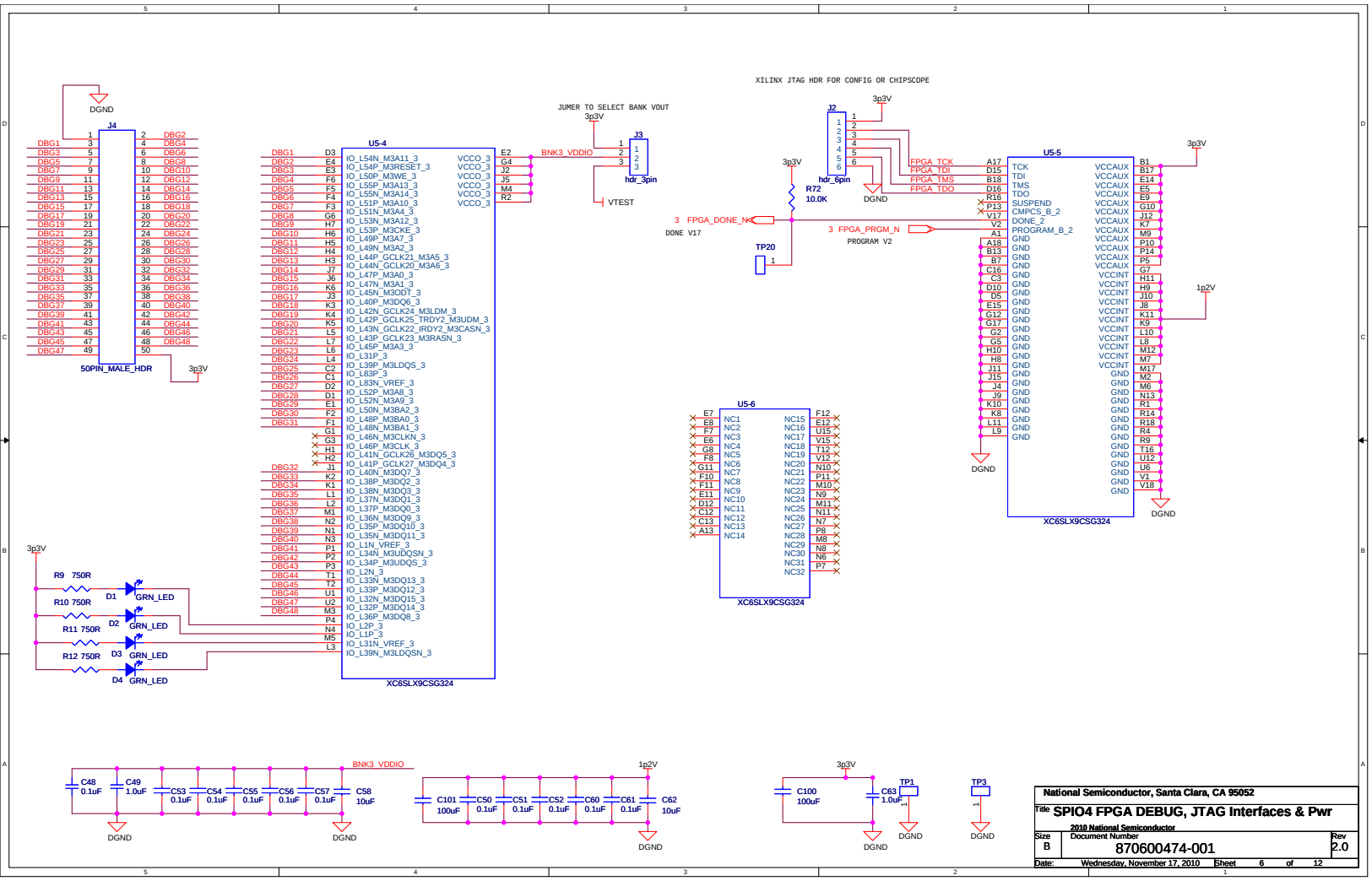

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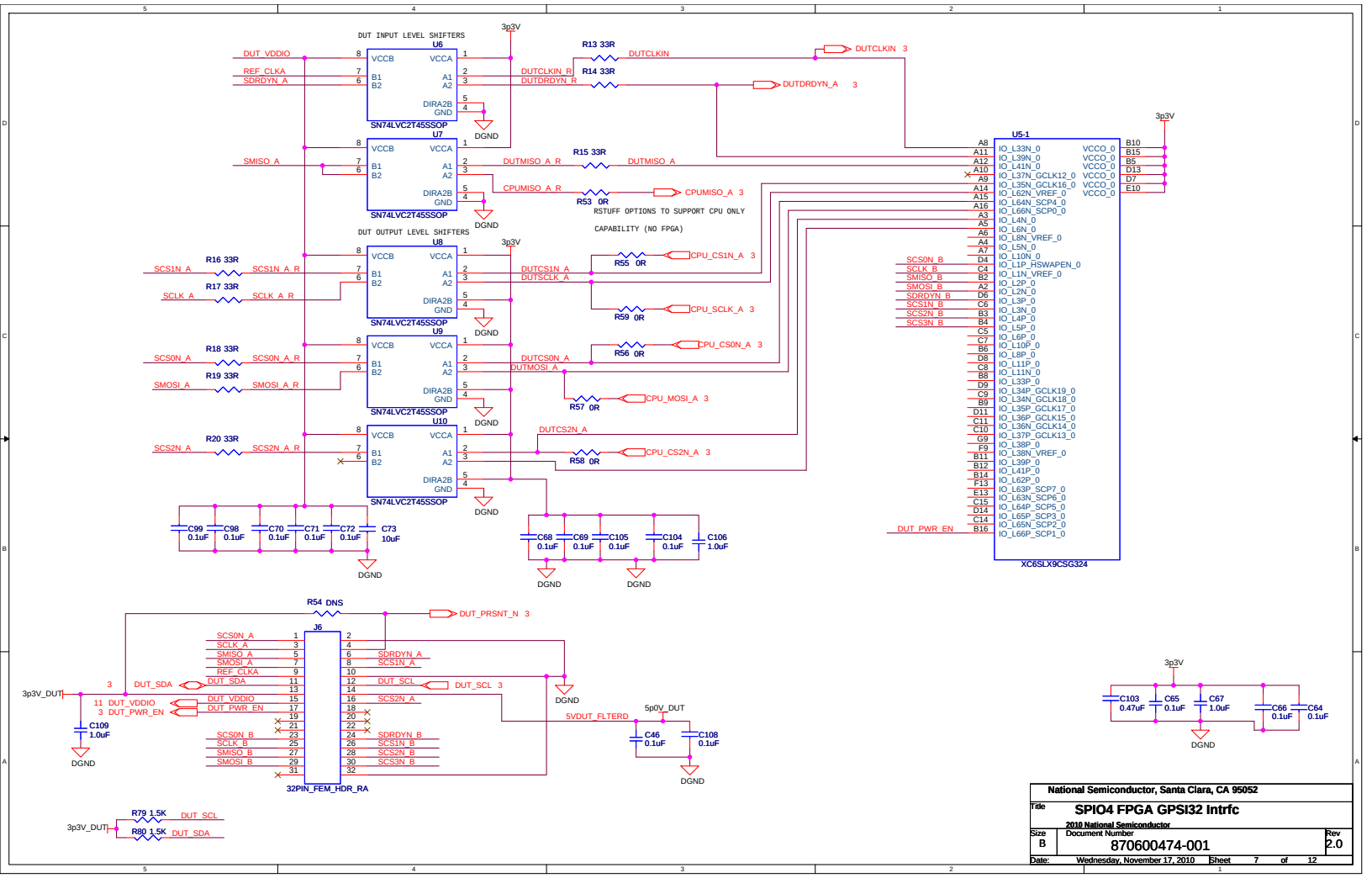

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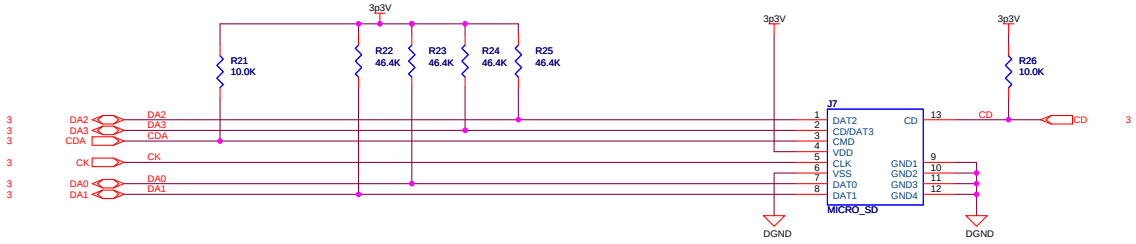
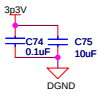
Micro SD Card





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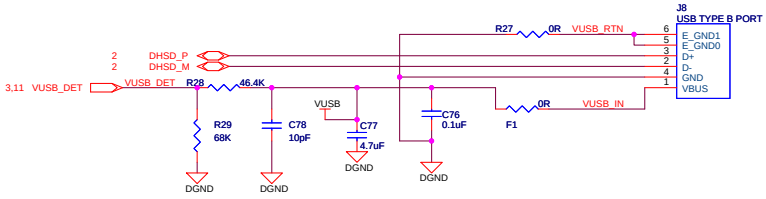
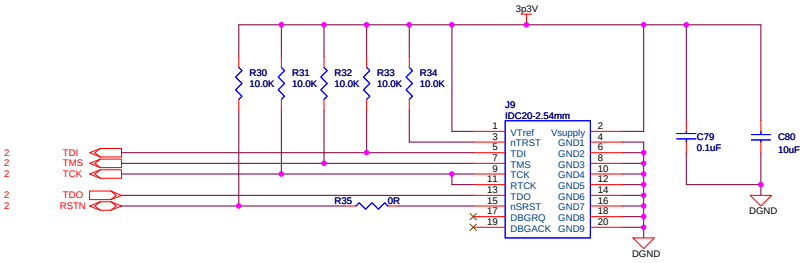
USB, CPU JTAG





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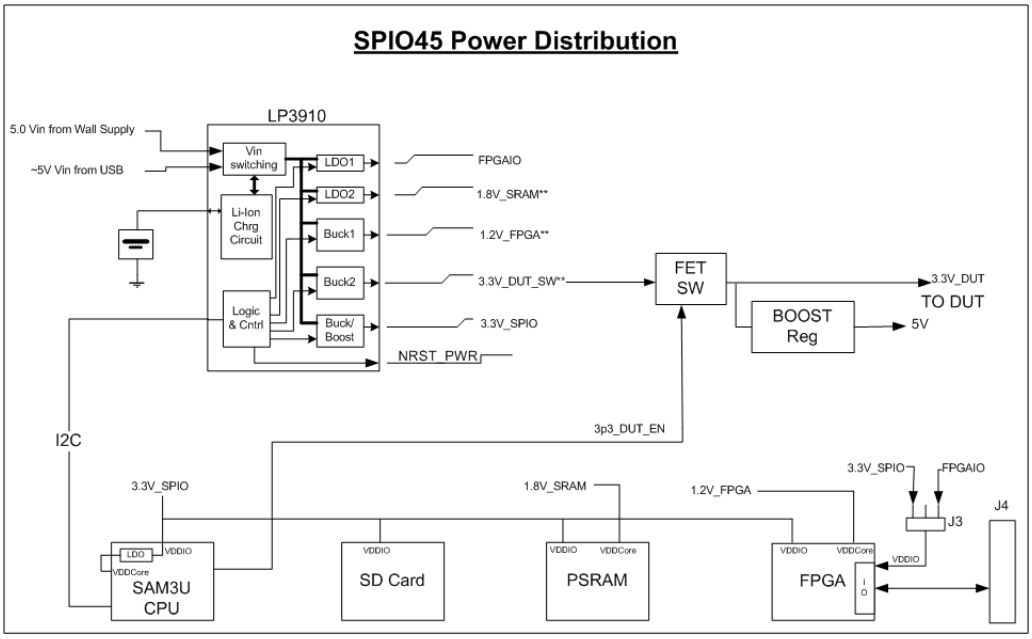

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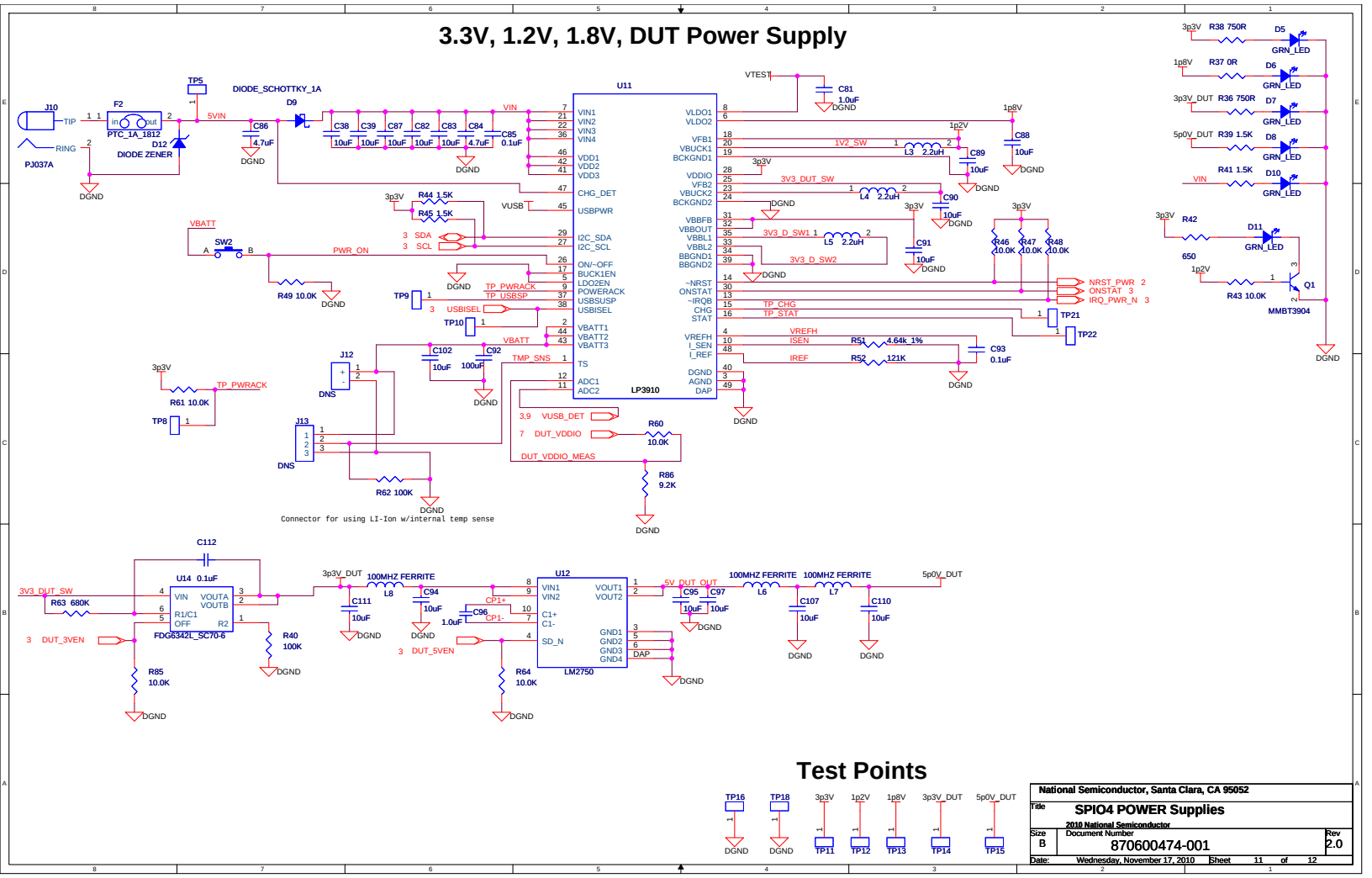
3.3V, 1.2V, 1.8V, DUT Power Supply



Test Points

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