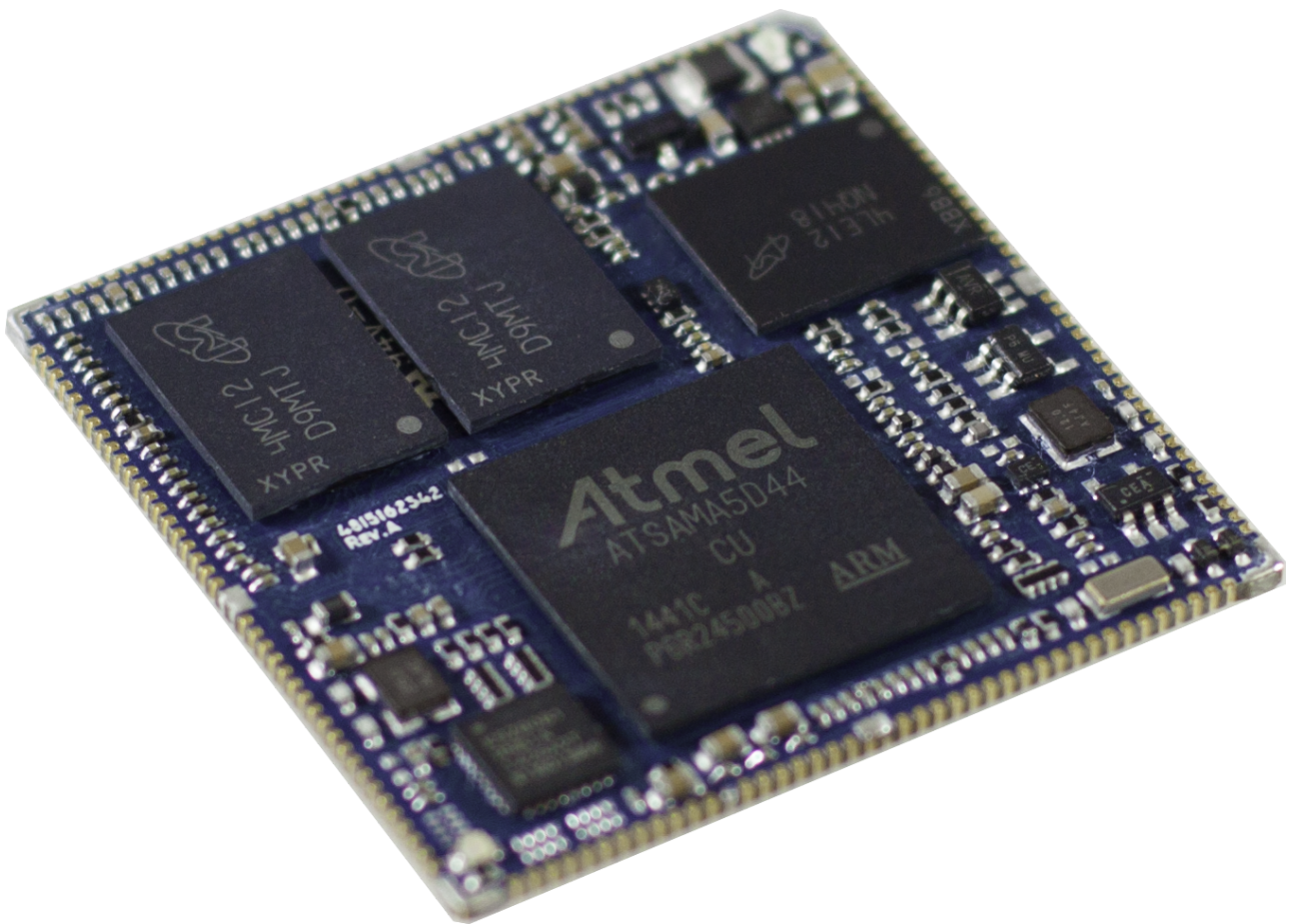




DevelBoard Blue

Hardware Reference Manual



Revision 1.5

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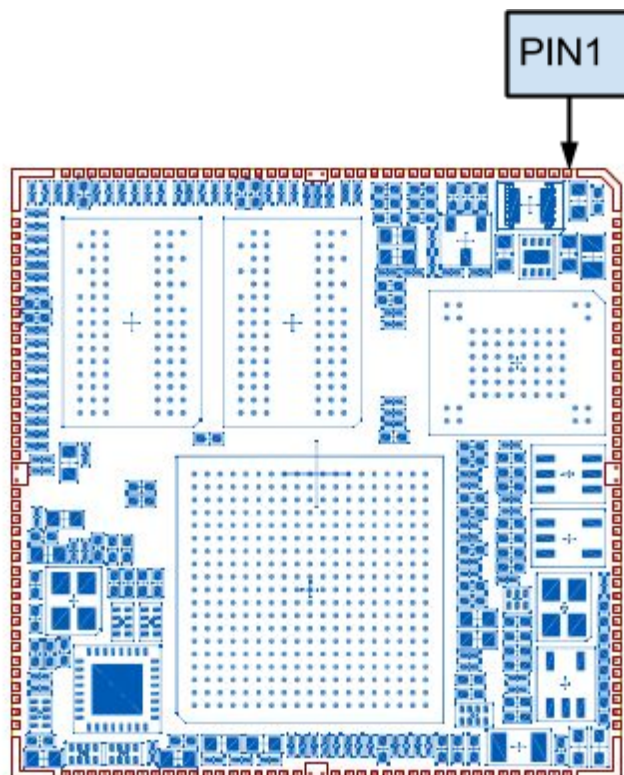
Board Features

	Feature
Processor	Atmel ATSAMAD44 ARM® Cortex®-A5 core
Clock Speed	600 MHz
Memory	128 to 512 MiB DDR2 RAM, 128 to 512MiB NAND Flash
Peripherals	• HW decoder for MPEG-4, H.264, H.263, VP8 e JPEG • LCD/TFT display controller • ISI Camera Interface • 3 USB High speed host ports • 1 USB High speed device port • 2 ethernet 10/100 MAC ports • 2 SD/MMC interfaces • 3 SPI ports • 5 USART, 2 UART, 1 debug serial port • 2 SSC • 4 I²C • 3 32bit timers • 1 4 channels PWM • 1 5 channel ADC, 10 bit resolution • Crypto engine for AES/DES/RSA/ECC/SHA/TRNG • Support for resistive touchscreen • up to 152 GPIO shared with other peripherals
Power supply	Single 3.3V, 0.7W(typical)
Temperature Range	-40°C to +85°C
Size	38x38x2.7 mm
Weight	6g

Mechanical Characteristics

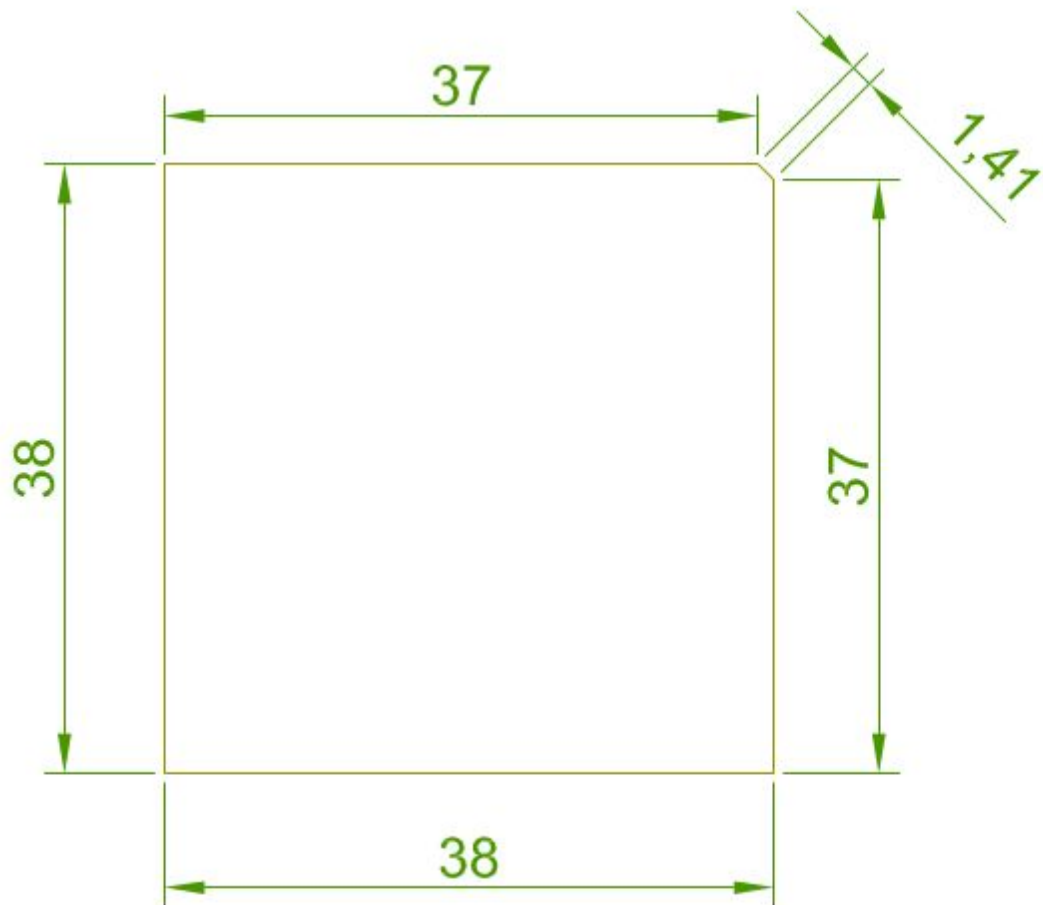
Component Side view

Pin #1 is indicated by a notch which is in the top right corner in the image.



Module Outline

NOTE: dimensions are in millimeters.

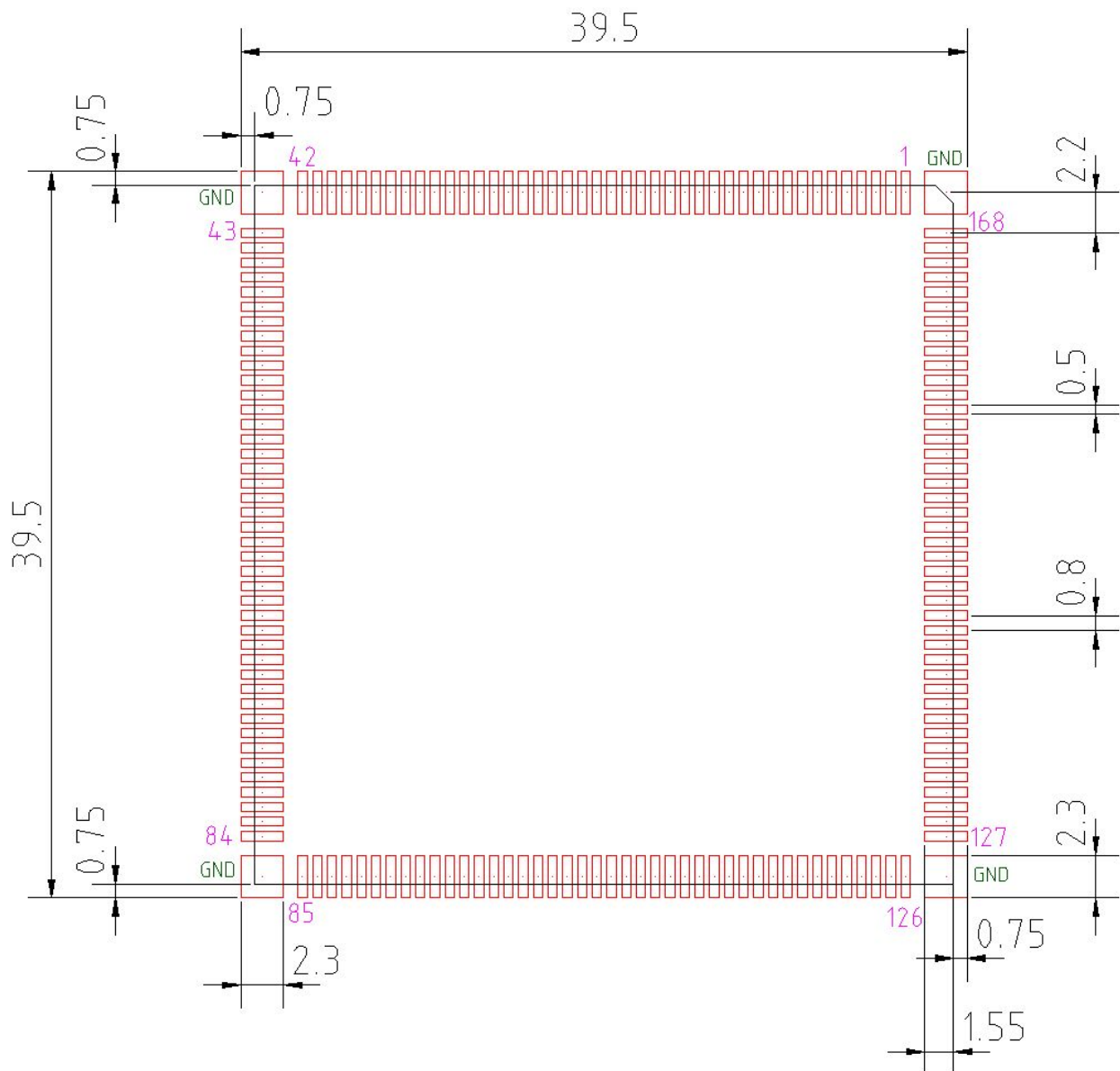


Module height is **2.7** millimeters.

Recommendations for carrier board design

The board has 168 pins placed all around the module. There are therefore 42 pins for each side. Pad dimensions are 0.4x1.5 mm with a pitch of 0.8mm. There are also 4 GND connections at the module corners which are not included in pin count.

We recommend to use the following landing pattern for soldering the module on the carrier board PCB.



Top view, unit:mm

We suggest to surround each pad with a 0.05mm solder mask.

We also supply the schematic symbol and PCB footprint for various CADs. Please check on our site.

We suggest to avoid running noisy traces (e.g. high speed digital, RF, high current traces, etc...) underneath the module on a layer where the module is mounted. Signal traces can be run on a third layer under the solid ground layer and beneath the module mounting.

PCB planarity

We recommend to try to achieve the best planarity in PCB manufacturing and finishing process to improve the mechanical strength of solder joints.

We suggest to use horizontal finishing processes (e.g. Chemical Gold) and to contact your PCB manufacturer in order to achieve the best compromise between planarity and other characteristics (e.g. needed padstack, impedance, etc...).

Ordering Information

Please use the following codes:

Product	RAM size	Flash size	Code	Operating temperature
DevelBoard Blue SOM	128MiB	128MiB	DBB128R128F	-40°C to +85°C
DevelBoard Blue SOM	256MiB	512MiB	DBB256R512F	-40°C to +85°C

Module Pinout

PIN	Primary	Alternate	PIO Peripheral A	PIO Peripheral B	PIO Peripheral C	CPU PAD	Note
1	PC30	AD3	-	-	PWMH0	T12	-
2	PC3	-	SPIO_NPCS0	PWML3	ISI_D11	T9	-
3	PC20	-	ISI_D1	TF1	-	V11	-
4	PD22	-	-	-	-	U11	-
5	PD25	-	-	-	-	R11	-
6	PC31	AD4	-	-	PWMH1	T13	-
7	PC19	-	ISI_D0	TK1	-	U14	-
8	PC21	-	ISI_D2	TD1	-	U15	-
9	PC24	-	ISI_D5	RK1	PCK1	T16	-
10	PC23	-	ISI_D4	RD1	-	U16	-
11	PC26	-	ISI_D7	TWCK3	UTXD1	R16	-
12	PE3	-	-	MCIO_DB2	-	P16	-
13	PE20	-	-	TCLK5	MC11_DA0	M14	-
14	PE16	-	-	RXD3	TIOB0	M15	-
15	PE26	-	-	RXD4	-	L15	-
16	PC29	AD2	-	SPIO_NPCS3	PWMFIO	R13	-
17	PE27	-	-	TXD4	-	M16	-
18	PE19	-	-	TIOB5	MC11_CDA	N16	-
19	PE4	-	-	MCIO_DB3	-	U18	-
20	PE5	-	-	CTS3	-	R17	-
21	GND	-	-	-	-	-	-
22	GND	-	-	-	-	-	-
23	PE1	-	-	MCIO_DB0	-	U17	-
24	PE8	-	-	TCLK3	PWML3	T19	-
25	PC25	-	ISI_D6	TWD3	URXD1	V17	-
26	PE2	-	-	MCIO_DB1	-	T17	-
27	PE12	-	-	TIOA1	PWMH2	P17	-
28	PE0	-	-	MCIO_CDB	CTS4	W19	-
29	PE14	-	-	TCLK1	PWMH3	N17	-
30	PE6	-	-	TIOA3	-	V19	-

31	PE7	-	-	TIOB3	PWMF1	U19	-
32	PE9	-	-	TIOA2	-	T18	-
33	PE24	-	-	RTS3	-	L19	-
34	PE13	-	-	TIOB1	PWML2	P18	-
35	PE18	-	-	TIOA5	MCI1_CK	P19	-
36	PE11	-	-	TCLK2	-	R18	-
37	PE25	-	-	SCK4	IRQ	M17	-
38	PE17	-	-	TXD3	TCLK0	N19	-
39	PE15	-	-	SCK3	TIOA0	N18	-
40	PE22	-	-	TIOB4	MCI1_DA2	M19	-
41	PE21	-	-	TIOA4	MCI1_DA1	M18	-
42	PE28	-	-	RTS4	-	L17	-
43	PE23	-	-	TCLK4	MCI_DA3	L18	-
44	PA27	-	LCDHSYNC	PWML0	SPI1_NPCS2	H4	-
45	PA24	-	LCDPWM	PCK0	-	H5	-
46	PA29	-	LCDDEN	PWML1	-	J5	-
47	PA12	-	LCDDAT12	G1_RX0	-	G5	-
48	PA16	-	LCDDAT16	-	NTRST	H6	-
49	PA10	-	LCDDAT10	G1_RXDV	-	F5	-
50	PA7	-	LCDDAT7	-	-	E5	-
51	PA1	-	LCDDAT1	-	-	F6	-
52	PA14	-	LCDDAT14	G1_TX0	-	E4	-
53	PA2	-	LCDDAT2	G1_TXCK	-	E6	-
54	PA11	-	LCDDAT11	G1_RXER	-	D5	-
55	PA4	-	LCDDAT4	G1_TXEN	-	D6	-
56	PA26	-	LCDVSYNC	PWMH0	SP1_NPCS1	E3	-
57	PA3	-	LCDDAT3	G1_RXCK	-	C6	-
58	PA13	-	LCDDAT13	G1_RX1	-	C5	-
59	PA5	-	LCDDAT5	G1_TXER	-	B6	-
60	PA15	-	LCDDAT15	G1_TX1	-	B5	-
61	PA0	-	LCDDAT0	-	TMS	A7	-
62	PA6	-	LCDDAT6	G1_CRS	-	A6	-
63	GND	-	-	-	-	-	-
64	GND	-	-	-	-	-	-
65	PA8	-	LCDDAT8	-	TCK	A5	-
66	PA21	-	LCDDAT21	G1_TX3	-	B4	-

67	PA23	-	LCDDAT23	G1_MDIO	-	A4	-
68	PA19	-	LCDDAT19	G1_RX3	-	C4	-
69	PA20	-	LCDDAT20	G1_TX2	-	A3	-
70	PA22	-	LCDDAT22	G1_MDC	-	B3	-
71	PA17	-	LCDDAT17	-	-	D4	-
72	PA9	-	LCDDAT9	G1_COL	-	F4	-
73	PA25	-	LCDDISP	TD0	-	F3	-
74	PA28	-	LCDPCK	PWMH1	SP1_NPCS3	G3	-
75	PA18	-	LCDDAT18	G1_RX2	-	G4	-
76	ETH_LEDSPEED	-	-	-	-	-	-
77	ETH_LEDACLINK	-	-	-	-	-	-
78	ETH_RXN	-	-	-	-	-	-
79	ETH_RXP	-	-	-	-	-	-
80	ETH_TXN	-	-	-	-	-	-
81	ETH_TXP	-	-	-	-	-	-
82	NC	-	-	-	-	-	-
83	NC	-	-	-	-	-	-
84	NC	-	-	-	-	-	-
85	NC	-	-	-	-	-	-
86	NC	-	-	-	-	-	-
87	NC	-	-	-	-	-	-
88	NC	-	-	-	-	-	-
89	NC	-	-	-	-	-	-
90	NC	-	-	-	-	-	-
91	NC	-	-	-	-	-	-
92	NC	-	-	-	-	-	-
93	PB1	-	G0_RXCK	SCK2	ISI_PCK	A2	-
94	PB3	-	G0_TXER	CTS2	ISI_VSYNC	C2	-
95	PB19	-	SPI1_MOSI	-	-	C1	-
96	PB20	-	SPI1_SPCK	-	-	D1	-
97	PB14	-	G0_TX2	SPI2_NPCS1	PWMH0	A1	-
98	PB24	-	DRXD	-	TDI	E1	-
99	PB15	-	G0_TX3	SPI2_NPCS2	PWML0	E2	-
100	PB10	-	G0_RX2	PCK2	PWML1	F1	-
101	PB22	-	SPI1_NPCS1	-	-	G1	-
102	PB5	-	G0_COL	TXD2	PCK2	H2	-

103	PB23	-	SPI1_NPCS2	-	-	H1	-
104	PB25	-	DTXD	-	TDO	J1	-
105	GND	-	-	-	-	-	-
106	GND	-	-	-	-	-	-
107	PB4	-	G0_CRS	RXD2	ISI_HSYNC	J3	-
108	PB11	-	G0_RX3	RTS2	PWMH1	K4	-
109	PB28	-	SPI2_NPCS3	TD0	PWMH1	K1	-
110	PB18	-	SPI1_MISO	-	-	K2	-
111	PB21	-	SPI1_NPCS0	-	-	L3	-
112	PB31	-	-	TF0	-	L1	Generic LED
113	PB27	-	SPI1_NPCS3	TK0	PWML0	L2	-
114	PD8	-	PCK0	-	-	M1	-
115	PD9	-	FIQ	-	-	M2	-
116	PE31	-	ADTRG	-	-	L4	-
117	PD12	-	RXD0	-	-	N1	-
118	PD10	-	CTS0	-	-	N2	-
119	PD11	-	RTS0	SPI2_MISO	-	N3	-
120	PD13	-	TXD0	SPI2_MOSI	-	P3	-
121	PD29	-	SCK1	-	-	P1	-
122	PD28	-	SCK0	-	-	R1	-
123	PE29	-	DIBP	URXD0	TWD1	V1	-
124	SHDN	-	-	-	-	T2	-
125	PE30	-	DIBN	UTXD0	TWCK1	U2	-
126	VBATT	-	-	-	-	-	-
127	PD16	-	RXD1	-	-	R2	-
128	PD17	-	TXD1	SPI2_NPCS0	-	R3	-
129	PB30	-	TWCK2	RF0	-	M4	-
130	PD14	-	CTS1	-	-	P2	-
131	JTAGSEL	-	-	-	-	V2	-
132	WKUP	-	-	-	-	V3	-
133	PD26	-	-	-	-	U13	-
134	PC28	AD1	-	SPI0_NPCS2	PWML1	T11	-
135	PIOBU0	-	-	-	-	U3	-
136	PC27	AD0	-	SPI0_NPCS1	PWML0	U12	-
137	PB29	-	TWD2	RD0	PWML1	M3	-
138	PC4	-	SPI0_NPCS1	MCIO_CK	PCK1	W5	-

139	PA31	-	TWCK0	-	-	J4	Int. E ² PROM
140	PA30	-	TWD0	-	-	D3	Int. E ² PROM
141	HHSDMA	DHSDM	-	-	-	V14	-
142	HHSDPA	DHSDP	-	-	-	W14	-
143	HHSDMB	-	-	-	-	V15	-
144	HHSDPB	-	-	-	-	W15	-
145	HHSDPC	-	-	-	-	W16	-
146	HHSDMC	-	-	-	-	V16	-
147	GND	-	-	-	-	-	-
148	GND	-	-	-	-	-	-
149	#RESET	-	-	-	-	-	-
150	ADCREF_EXT	-	-	-	-	-	not connected
151	PC2	-	SPI0_SPCK	PWMH3	ISI_D10	V5	-
152	BOOT_RECOVERY	-	-	-	-	-	-
153	PC0	-	SPI0_MISO	PWMH2	ISI_D8	-	-
154	PIOBU1	-	-	-	-	T3	-
155	PD15	-	RTS1	SPI2_SPCK	-	N4	-
156	PD31	-	SPI0_NPCS2	PCK1	-	P5	-
157	PB26	-	PCK0	RK0	PWMH0	M5	-
158	PD20	-	-	-	-	T10	-
159	PC1	-	SPI0_MOSI	PWML2	ISI_D9	P8	-
160	PD27	-	-	-	-	T14	-
161	PC22	-	ISI_D3	RF1	-	T15	-
162	3V3	-	-	-	-	-	-
163	3V3	-	-	-	-	-	-
164	PE10	-	-	TIOB2	-	N14	-
165	PD21	-	-	-	-	P10	-
166	PD23	-	-	-	-	R10	-
167	PD24	-	-	-	-	U10	-
168	PD19	-	-	-	-	P11	-

Power Supply

The module needs only a single 3.3V power supply to operate properly.

Please connect all 3V3 and GND pins (included the four GND connections at the corners) to the power supply to avoid signal integrity problems. The power supply circuit should be designed in order to supply at least **500mA**.

GPIO levels

All DevelBoard GPIOs have 3.3V logic levels.

Symbol	Value	Unit
$V_{IL}MAX$	0.8	V
$V_{IH}MIN$	2.0	V
$V_{OL}MAX (@I_OMAX)$	0.4	V
$V_{OH}MIN (@I_OMAX)$	VDD - 0.4	V

Please note that all pins are **NOT** 5V-tolerant.

Special Pins

SHDN

This pin is connected to the SHDN pin of the CPU. It is used to shut down an external power supply.

This pin is always high and goes low when the CPU performs a software shutdown. It is connected to the VDDDBU domain voltage.

For more information, please refer to the ATSAMA5D44 datasheet:

<http://www.atmel.com/devices/ATSAMA5D44.aspx>

VBATT

This voltage is be used to supply the VDDDBU domain voltage peripherals of the CPU (e.g. the real time clock).

You can connect the VBATT pin to a battery or backup capacitor with a voltage in range 2.6-3.3V. You can leave it unconnected if the VDDDBU peripherals are not used. VDDDBU is internally generated with a LDO connected with a diode to 3.3V if VBATT is not present.

WKUP

This pin is connected to the WKUP pin of the CPU. It is used to wake up the CPU is in shutdown mode. For more information, please refer to the ATSAMA5D44 datasheet:

<http://www.atmel.com/devices/ATSAMA5D44.aspx>

#RESET

General reset of the board, active low. Keep this pin low ($\#RESET < 1V$) for at least 1ns to reset the board. This pin has an internal pullup of 100K to 3.3V power supply. Can be left unconnected if reset control is not needed.

ADCREF_EXT

Not connected in current DevelBoard Blue version. Currently ADCVREF of the CPU is connected to the 3.3V power supply. For normal operation leave this pin unconnected.

BOOT_RECOVERY

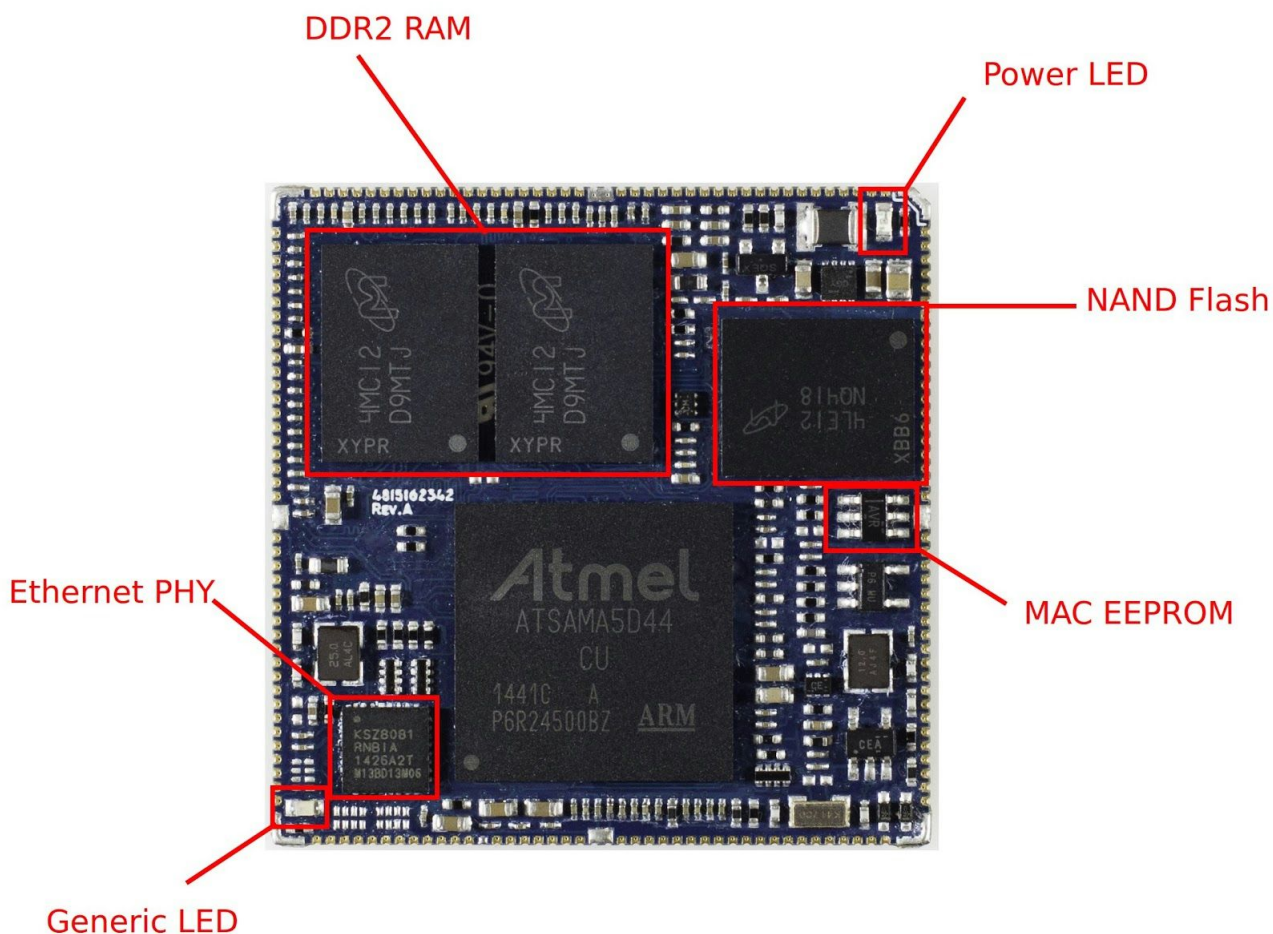
For normal operation, this pin can be driven low or left unconnected. If driven high, this pin disables the CE input of the onboard flash memory. This is useful to prevent the CPU from booting from the onboard flash if something goes wrong during development or if you want the CPU to boot from other devices.

GPIO Driven during Boot Program Execution

The Atmel bootloader present on the CPU of the DevelBoard uses several GPIOs in peripheral mode to communicate with external memory devices. Care must be taken when these GPIOs are used by the application. The connected devices could be unintentionally driven at boot time, and thus electrical conflicts between output pins used by the bootloader and the connected devices could occur. To assure the correct functionality, it is recommended to plug in critical devices to other pins, not used by bootloader. The following contains a list of pins that are driven during the boot program execution. These pins are driven during the boot sequence for a period of less than 1 second if no correct boot program is found. Before performing the jump to the application in the internal SRAM, all the GPIOs and peripherals used in the boot program are set to their reset state.

PIN	Name	Peripheral	Bootloader type
35	MCI1_CK - PE18	MCI1A	SD Card / eMMC
18	MCI1_CDA - PE19	MCI1A	
13	MCI1_D0 - PE20	MCI1A	
41	MCI1_D1 - PE21	MCI1A	
40	MCI1_D2 - PE22	MCI1A	
43	MCI1_D3 - PE23	MCI1A	
159	MOSI - PC1	SPI0	SPI Flash
153	MISO - PC0	SPI0	
151	SPCK - PC2	SPI0	
2	NPCS0 - PC3	SPI0	
138	NPCS1 - PC4	SPI0	
14	RXD3 - PE16	DBGU	SAM-BA Monitor
38	TXD3 - PE17	DBGU	

Onboard Peripherals



LEDs

DevelBoard Blue has two onboard LEDs: Power LED and Generic LED. The Power LED is connected to the 3.3V power supply and turns on as soon as the power is applied.

The Generic LED is connected to **PB31** and can be controlled by the CPU:

PIN	Name
112	PB31/Generic LED

MAC EEPROM

DevelBoard Blue has an onboard MAC EEPROM which is used to store the MAC address of the onboard ethernet interface and other service information. The EEPROM is connected to the I²C bus TWI0 of the CPU:

PIN	Name
139	TWCK0
140	TWD0

The EEPROM is accessed at boot time to read the MAC address and therefore these pins cannot be used as generic GPIOs. They can be used as a normal I²C bus by the user. The connected EEPROM has 2 I²C addresses: 0x58 for MAC and 0x50 for the EEPROM, please ensure other devices connected on the bus have different addresses to avoid conflicts.

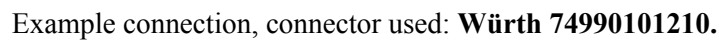
Ethernet (GMAC0 - eth0)

The DevelBoard Blue has an on-board ethernet PHY connected to GMAC0. You can directly connect the board to an ethernet transformer/connector.

List of signals:

PIN	Name
76	ETH_LEDSPEED
77	ETH_LEDACTLINK
78	ETH_RXN
79	ETH_RXP
80	ETH_TXN
81	ETH_TXP

ETH_TXP, ETH_TXN and ETH_RXP, ETH_RXN are two differential pairs. They should be routed together with **100** Ohm differential trace impedance.



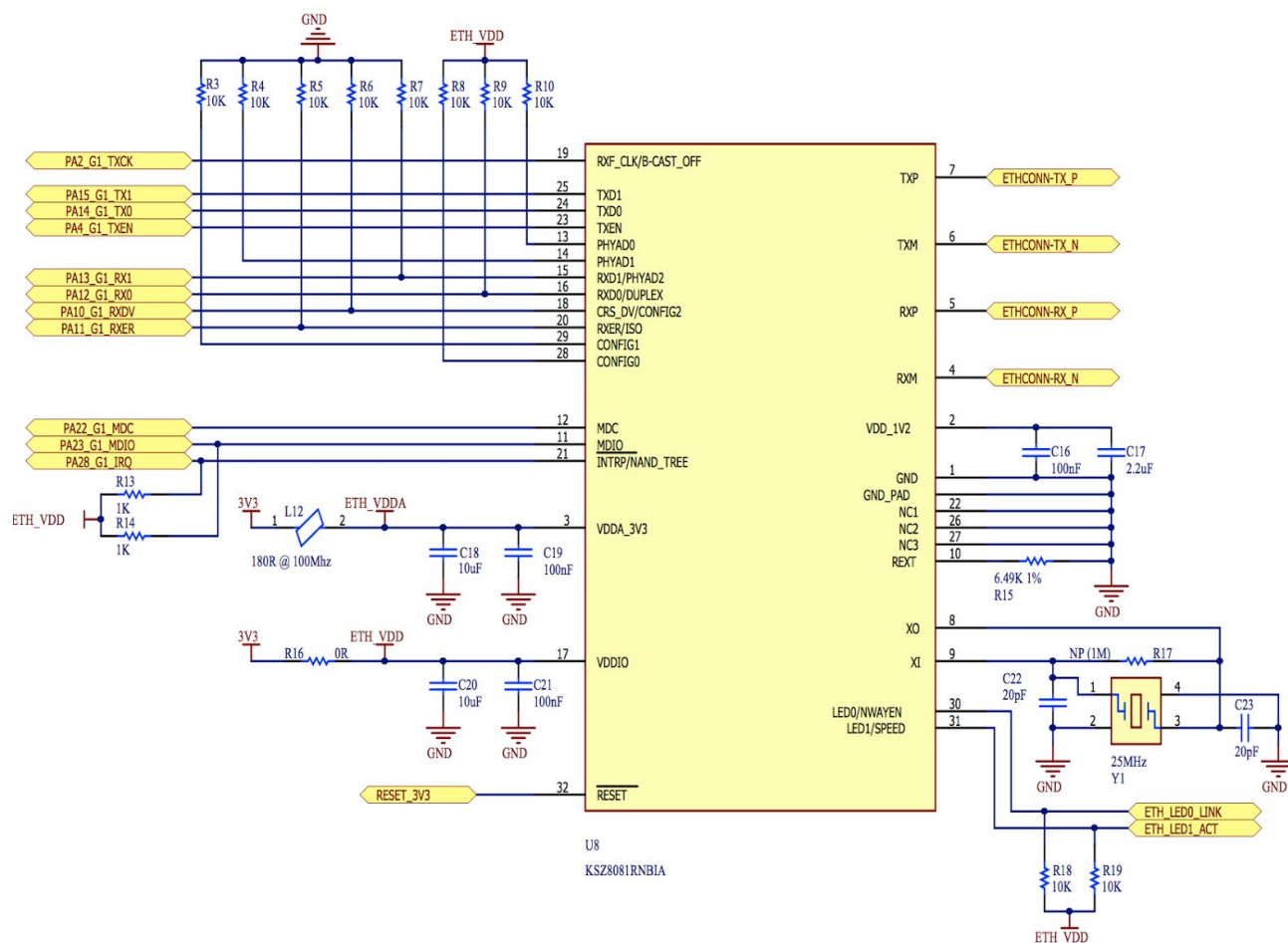
Ethernet connection (GMAC1 - eth1)

The second ethernet port (GMAC1) needs a external PHY connected to the RMII interface of the microprocessor.

List of signals:

PIN	Name
47	G1_RX0
49	G1_RXDV
52	G1_TX0
53	G1_TXCK
54	G1_RXER
55	G1_TXEN
58	G1_RX1
60	G1_TX1
67	G1_MDIO
70	G1_MDC
74	PA28 (optional)

NOTE: pin 74 (PA28) is optional and can be connected to any free GPIO port of the board. It is only used if your PHY interface supports/needs to send IRQ requests.



Example GMAC1 connection using the **Micrel KSZ8081RNBIA** 10/100 ethernet physical layer transceiver:

USB connection

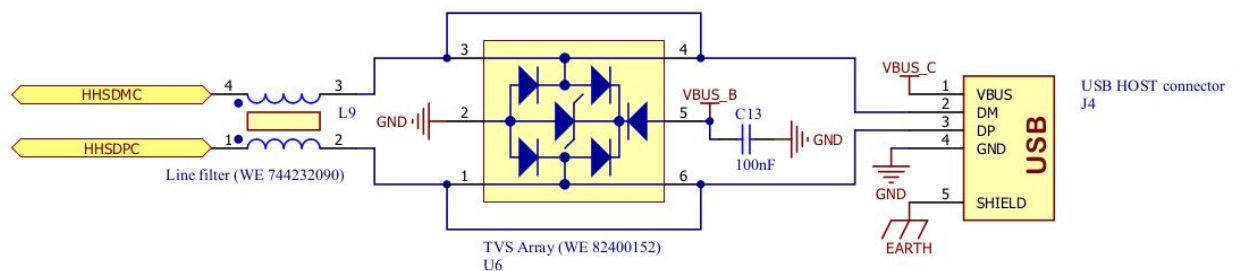
The board has 2 high-speed USB host ports and 1 high-speed USB OTG port.

List of signal:

PIN	Name	Notes
141	HHSDMA/DHSDM	USB OTG port A, D- signal
142	HHSDPA/DHSDP	USB OTG port A, D+ signal
143	HHSDMB	USB host port B, D- signal
144	HHSDPB	USB host port B, D+ signal
145	HHSDPC	USB host port C, D+ signal
146	HHSDMC	USB host port C, D- signal

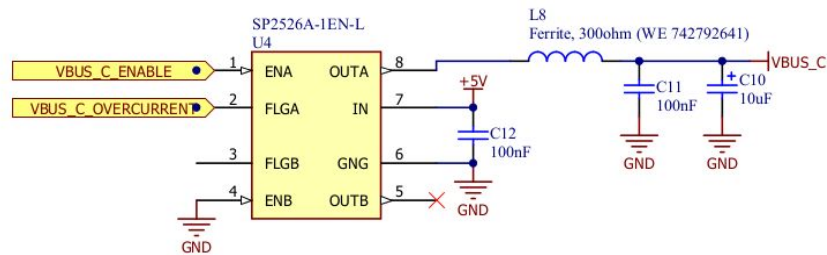
USB signals are a differential pair. They should be routed together with **90 Ohm** differential trace impedance.

It is also recommended to use a common mode filter and ESD protection on USB data signals:



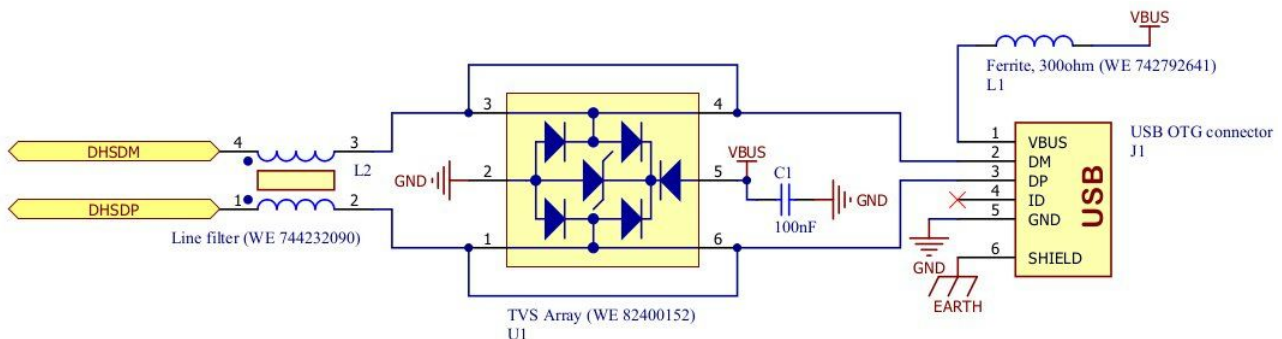
Example connection of USB host port C, line filter used **Würth 744232090**, TVS array **Würth 82400152**.

In order to supply the USB host port, it is also recommended to use a USB power distribution switch:



In the example above, the **Exar SP2526A** dual channel USB power distribution switch is used to power USB C port. VBUS_C_ENABLE and VBUS_C_OVERCURRENT can be connected to any available GPIO in order to enable the USB power and sense overcurrent events.

Example USB OTG port A:



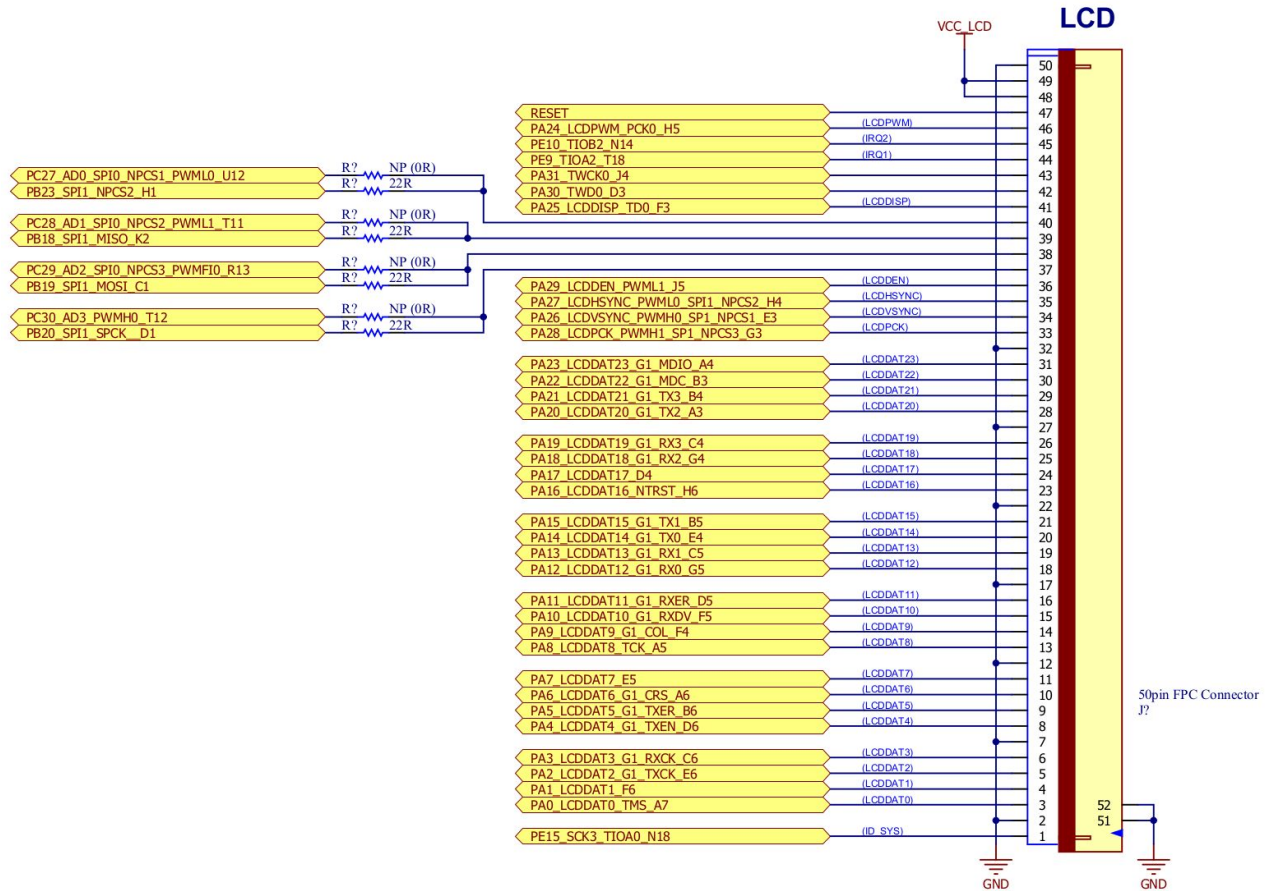
J1 is a miniAB connector has an additional fifth pin: ID. ID can be connected to any available GPIO pin and can be used to detect USB role if needed.

LCD interface

LCD signals:

PIN	Name
44	LCDHSYNC
45	LCDPWM
46	LCDDEN
47	LCDDAT12
48	LCDDAT16
49	LCDDAT10
50	LCDDAT7
51	LCDDAT1
52	LCDDAT14
53	LCDDAT2
54	LCDDAT11
55	LCDDAT4
56	LCDVSYNC
57	LCDDAT3
58	LCDDAT13
59	LCDDAT5
60	LCDDAT15
61	LCDDAT0
62	LCDDAT6
65	LCDDAT8
66	LCDDAT21
67	LCDDAT23
68	LCDDAT19
69	LCDDAT20
70	LCDDAT22
71	LCDDAT17
72	LCDDAT9
73	LCDDISP
74	LCDPCK
75	LCDDAT18

Example LCD connection:



SD card connections

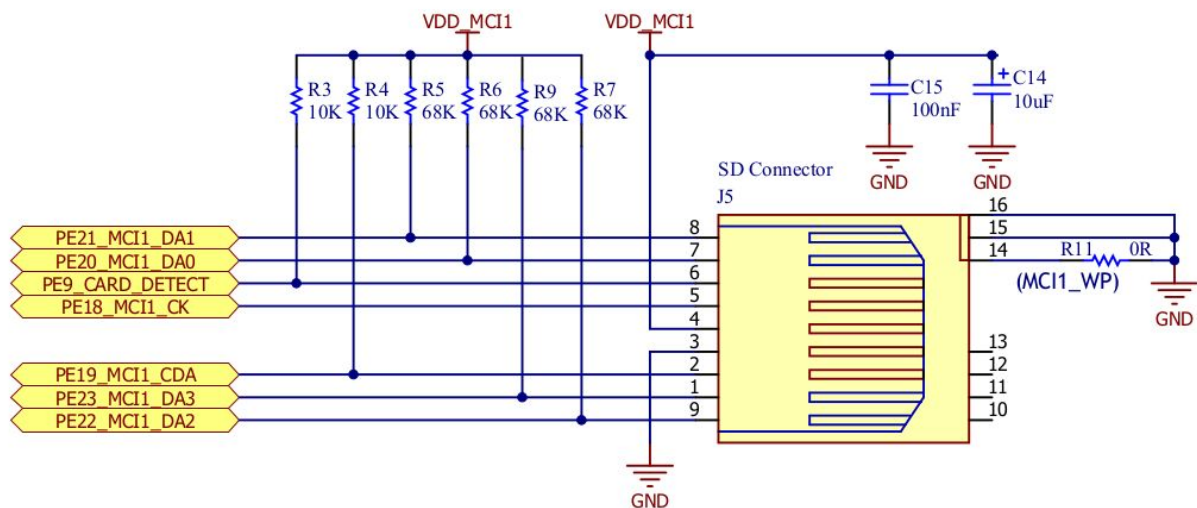
The board has 2 SDIO interfaces, MCI0 and MCI1 which can be connected to SD cards.

To boot DevelerBoard from SD you **must** use MCI1A.

List of signals for MCI1A:

PIN	Name	Notes
13	MCI1_DA0	
18	MCI1_CDA	
35	MCI1_CK	
32	PE9 (optional)	Card detect, any GPIO will do
40	MCI1_DA2	
41	MCI1_DA1	
43	MCI1_DA3	

Example connection:

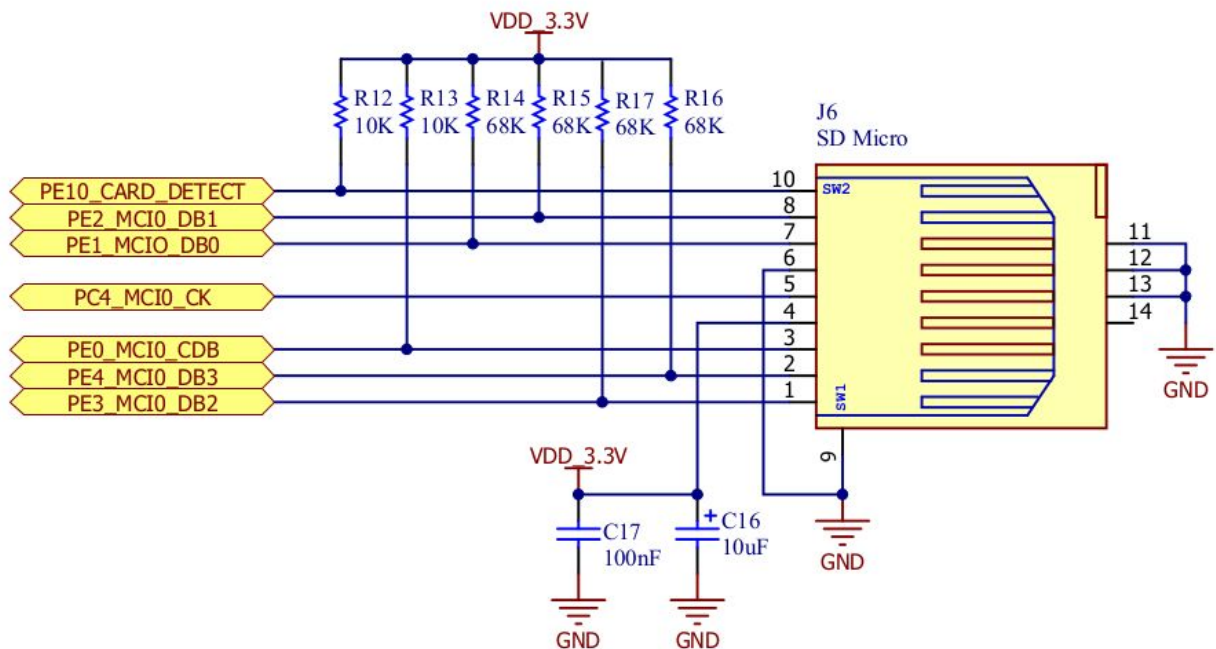


The second SDIO interface is available on MCI0B.

List of signals for MCI0B:

PIN	Name	Notes
12	MCI0_DB2	
19	MCI0_DB3	
23	MCI0_DB0	
26	MCI0_DB1	
28	MCI0_CDB	
138	MCI0_CK	
164	PE10 (optional)	Card detect, any GPIO will do

Example connection:

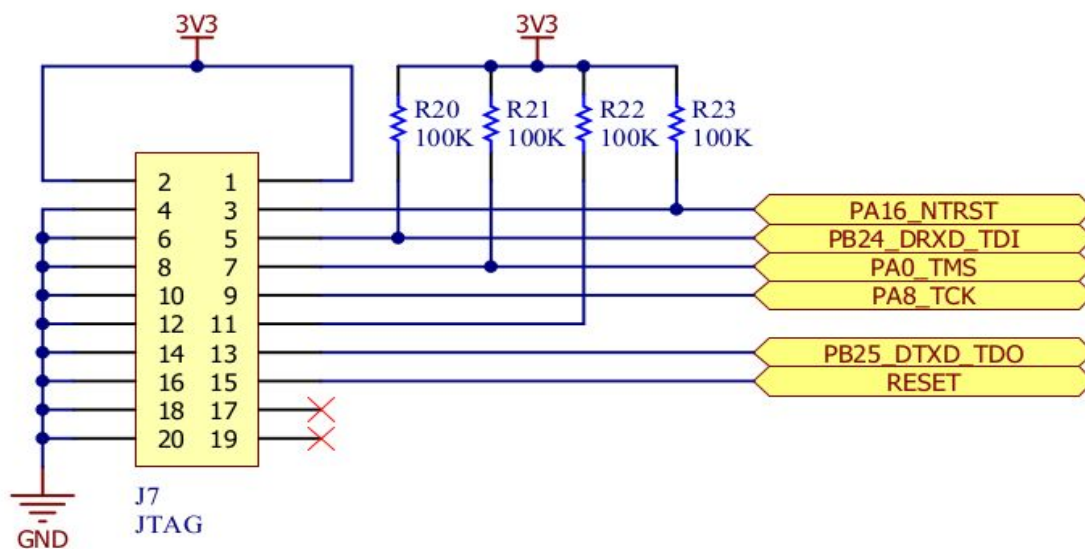


JTAG interface and debug port

JTAG signal list:

PIN	Name
48	NTRST
61	TMS
65	TCK
104	TDO
149	RESET

Example 20 pin JTAG connector:



The board will use UART3 as debug console:

PIN	Name
14	RXD3
38	TXD3

Electrical Characteristics

This module can be damaged by ESD. Develer recommends that all modules be handled with appropriate precautions. Failure to observe proper handling and installation procedures can cause damage. ESD damage can range from subtle performance degradation to complete device failure.

Absolute Maximum Ratings

Value	Minimum	Maximum	Unit
Storage temperature	-55	+150	°C
Voltage on Input Pins with Respect to Ground	-0.3	4.0	V
Maximum operating voltage	-	4.0	V
Total DC Output Current on all I/O lines	-	350	mA

Stresses beyond those listed under “Absolute Maximum Ratings” may cause permanent damage to the module. This is a stress rating only and functional operation of the device at these or other conditions beyond those indicated in the operational sections of this specification is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

Recommended Operating Conditions

Value	Min	Typ.	Max	Unit
Operating temperature	-40	-	+85	°C
Power supply voltage	3.135	3.3	3.465	V

Power Consumption

DevelBoard power consumption measured on a DBB256R512F module @3.3V, 25°C.

TEST	Condition	Typ.	Unit
CPU IDLE	CPU @600MHz, no user task or action, linux shell prompt with no sd, no eth, and no usb device connected.	570	mW
CPU 100%	CPU @600MHz, 100% load with stress-ng-0.03.11 (no sd, no eth, no usb device connected): ./stress-ng --cpu 1 --io 0 --vm 0 -l 100	800	mW
MAX LOAD	CPU @600MHz, 100% load, read/write on USB flash drive	890	mW

DC Characteristics

For DC characteristics and other electrical specifications please refer to the ATSAMA5D44 datasheet:

<http://www.atmel.com/devices/ATSAMA5D44.aspx>