SHIRATECH

CB-20

Development and carrier board for AT-501

Product Brief

Revision 1.2

Contents

1 Scope

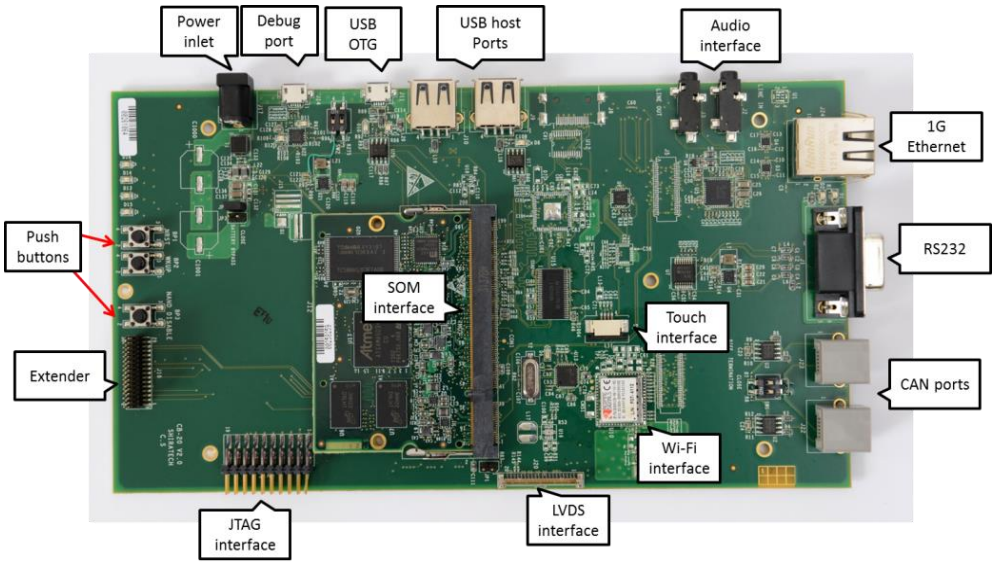
The following document provides a description of the CB-20 carrier board when used with the AT-501 system on module. Note that some of the components mentioned in the document are optional and will not be available in all products.

2 Overview

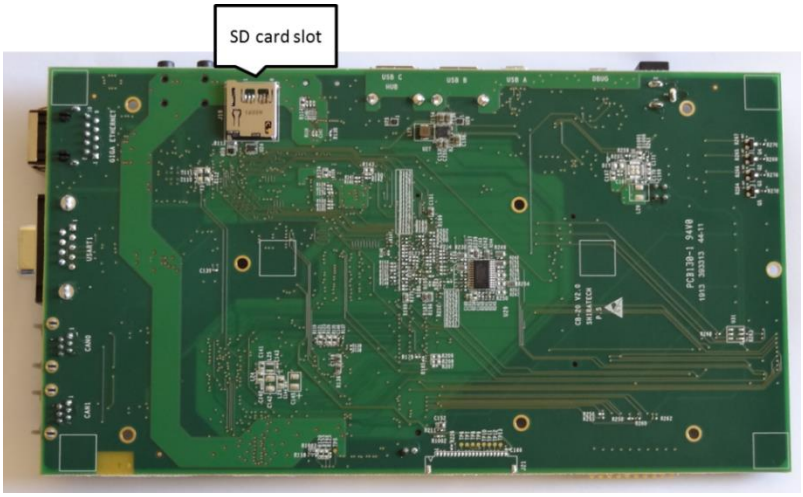
The CB-20 is a fully featured development and carrier board for ShiraTech's AT-501 system on modules (SoM) based on Atmel's SAMA5D3x, Cortex-A5 processor. The board can be used by software teams as a development platform with all relevant peripherals for simulating the target product functionalities. It can also be used as a reference design for hardware teams or as a ready for use control and display unit to be integrated in commercial products.

The CB-20 is equipped The AT-501 using the SAMA5D34 processor, for other option check with sales@shiratech.com

2.1 Top view



2.2 Bottom view



3 Detailed description

3.1 Block diagram

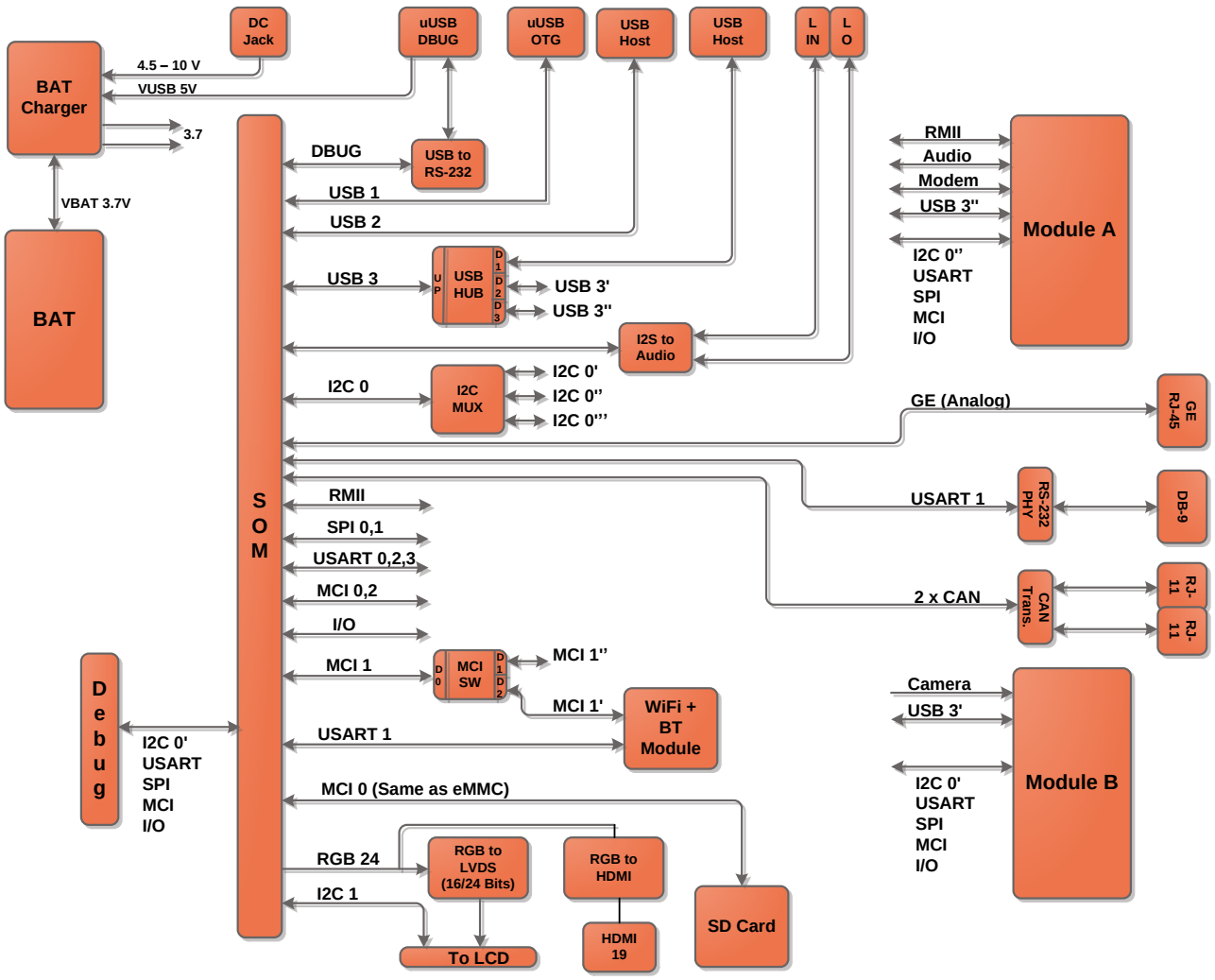


Figure 1 - CB-20 Block diagram

3.2 CB20 interfaces

The CB-20 offers a large variety of interfaces for supporting a large variety of applications. The following table provides the available interfaces and their mapping to the various interfaces and the internal ports of the processor.

Interface	Connector name	Processor interface	Remarks
Debug port	J-14	PB-30,PB31	Micro USB Type A/B. An internal RS232 to USB converter by an FTD chip.
USB OTG	J-11	HHSDMA, HHSDPA	USB 2.0 Type-A Host/Device
USB host port 1	J-10	HHSDMB, HHSDPB	USB 2.0 Type-A Host
USB host port 2	J-9	HHSDMC, HHSDPC	USB 2.0 Type-A Host Interface from USB HUB
Audio interface 1	J-3	Audio Interface	Stereo Out
Audio interface 2	J-2	Audio Interface	Stereo Line in
Giga Ethernet port	J-24	GMAC 0	RJ-45
RS232 port	J-1	USART 1	DB-9
CAN interface 0	J-23	CAN0	RJ-11
CAN interface 1	J-22	CAN1	RJ-11
JTAG interface	J-16		20 pins 2.54 Header
Extender	J-18	SPI-1, USART-3, I2C from Extender, 10 GPI	30 pins 1.25 Header
Power inlet	J-17		Power Jack, 5-9 Volt

Table 1 – External interfaces

The following paragraphs provides detailed description on each of the available interfaces.

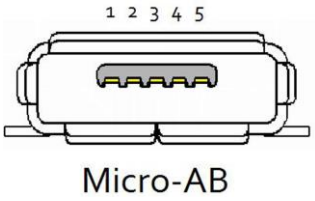
3.2.1 Debug port – J14

The debug port is used for debug and UART connectivity to the product. In order to simplify the use and to avoid external converting cable, the CB-20 has a build in RS232 to USB converter - FT230 from FTDI connected to a Micro USB connector (AB type). It is connected to the processor debug port (PB30, PB31). The USB to RS-232 convertor is fed by the 3.3V power (The USB 5V power is not in use). It is a USB device and its parameters can be configured via the USB interface (See FT-230X data-sheet for more details). The device is preconfigured to the following mode:

- **Rate** - 115,200 Bps, **data** – 8 bits, **party** – none, **stop** – 1bit and **flow control** – none.

The port has two LEDs D11 (TX) and D12 (RX) that indicate traffic streaming through the device.

If the external device is disconnected from the USB port the CB-20 will sense it automatically and the FTDI chip will change into suspended mode and the processor will be notified (VBUS signal) about the event in order to stop the communication.



Pin	Signal	Description
1	VBUS	5V input, can be used as power source
2	DM	Data
3	DP	Data
4	ID	Not Connected
5	GND	Digital ground
	Case	Analog Ground

3.2.1.1 Charging through the Debug port (ordering option)

In case the CB-20 is equipped a battery control device (Battery ordering option) then the Debug port can be used for charging the unit. When the debug port is connected to an external charger it will detect if it is a computer or a charger and will set the PSEL signal accordingly. The PSEL signal controls the current which can be drown from an external source.

Note: In case the CB-20 is connected to a USB port of a computer the current drown is limited to 500mA and in case of an external charger the current can be up to 1.5A.

When connected to a computer the charge current might not be enough to compensate the CB-20 power usage.

3.2.2 Ethernet interface

The CB-20 is equipped with a 1Gbe Ethernet interface. The following figure shows the Ethernet design on the CB-20.

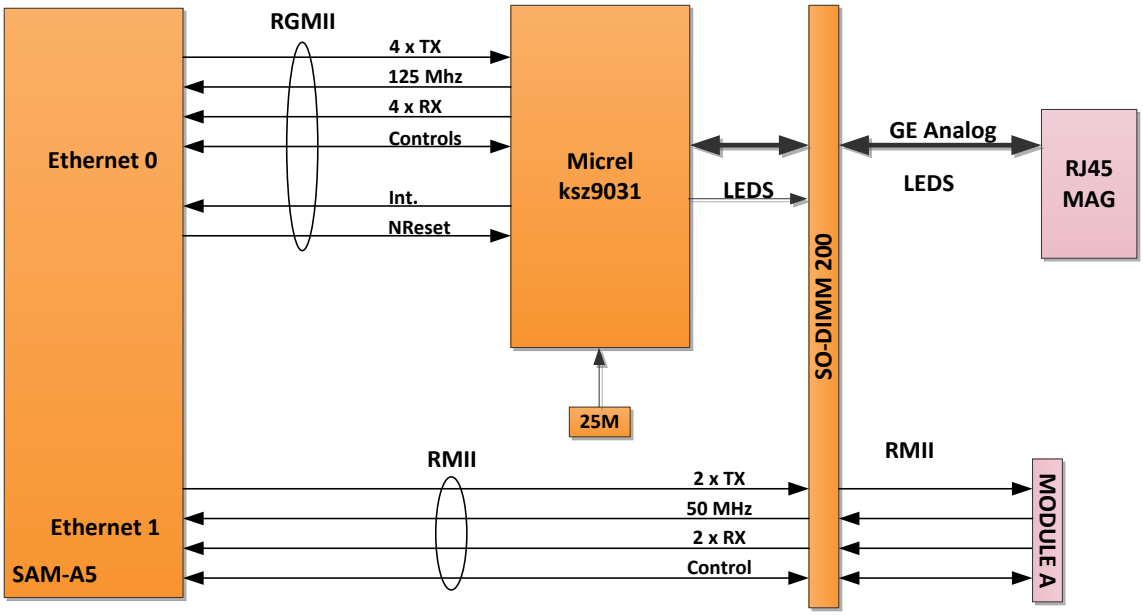
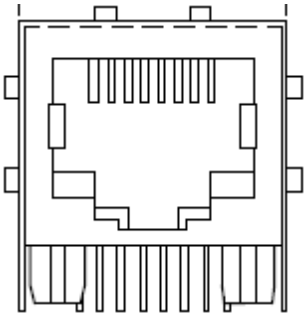


Figure 2 - Giga Ethernet and Fast Ethernet Connections

3.2.2.1 1Gbe Ethernet port – J24

The GE interface uses an RJ-45 connector with build in magnetics. Two LEDs are used for the Ethernet port D1 – activity and D2 – Link status.

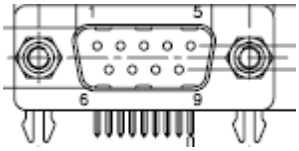


Pin	Signal	Description
1	TX1+	Transmit+ (support 100M)
2	TX1-	Transmit- (Support 100M)
3	RX1+	Receive + (Support 100M)
4	TX2+	Transmit+
5	TX2-	Transmit-
6	RX1-	Receive + (Support 100M)
7	RX2+	Receive
8	RX2-	Receive
	Case	Analog Ground

Note: One of the options to expand the number of Ethernet ports is by using an Ethernet switch. The GE port can be connected to an external 10/100 or 10/100/1000 Ethernet switch. For more details contact support@shiratech.com .

3.2.3 USART port – J1

The CB-20 provides an RS-232 USART interface. It is connected to a DB-9 female connector using an RS-232 transceiver (MAX3232E by Maxim). The supported signals are TX, RX, CTS and RTS. The UART signals are connected to the SAMA5Dx USART1 signals.



Pin	Signal	Description
1	NC	
2	TX	Transmit (Output)
3	RX	Receive (Input)
4	NC	
5	GND	Digital GND (Ferrit)
6	NC	
7	CTS	Clear To Send (Input)
8	RTS	Request To Send (Output)
9	NC	
	Case	Analog Ground

3.2.4 USB interfaces

The CB-20 offers 3 USB ports. One USB OTG port and two USB host ports. The following figure shows the USB design of the CB-20.

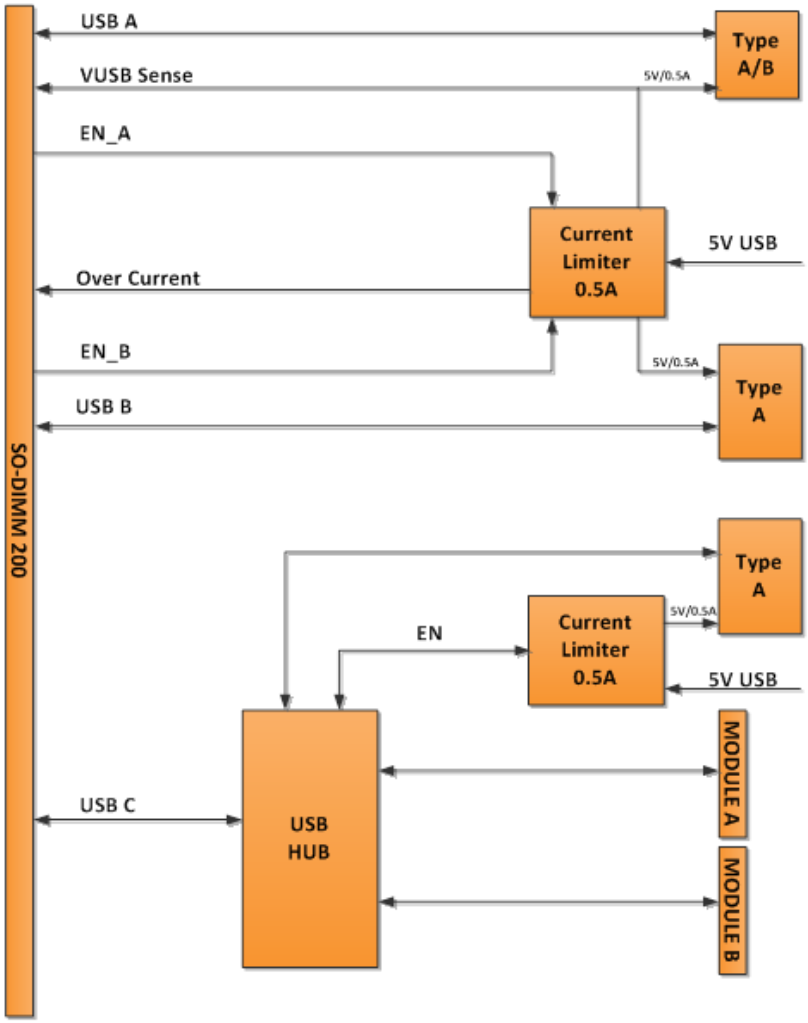


Figure 3 - USB Interfaces

3.2.4.1 USB OTG – J11

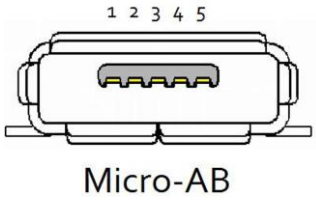
The USB OTG is a USB port connected to the USB Port A of the processor using a Micro-USB Type-AB connector.

It supports USB 2.0 and can be programmed as Host or Device. It can also be programmed as an OTG interface. By monitoring the VUSB (PD-29) signal it can determine if it is connected to a Host or a device.

The USB OTG interface has the following LED:

- D10 - USB OTG Power ON – power out is enabled in case of a host, or in case of power inlet when in device mode

Note: This port should be used for SAM-BA connectivity.



Pin	Signal	Description
1	VBUS	VBUS sense (PD29)
2	DM	Data
3	DP	Data
4	ID	ID signal connected to a 10K pull-up.
5	GND	Digital ground
	Case	Analog Ground

3.2.4.2 USB Host Interface – J9, J10

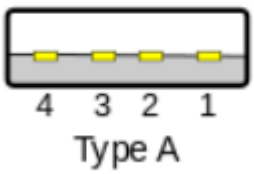
The USB ports have their own DC to DC converter. Ports A and B power drivers are enabled by the processor using dedicated I/O ports while the USB HUB controls the power of port C.

J10 – Host USB port is connected to the USB port B of the processor supporting a USB 2.0 host interface. It is connected to a USB Type-A connector. USB port B provides a 5 volt power source with driving current of up to 0.5 Ampere for driving the power of an external USB device.

The interface has the following LED:

- D9 - USB Host (J10) Power out Enable

The power outlet is controlled via a dedicated I/O pin **PD26** of the processor.



Pin	Signal	Description
1	VBUS	5V out
2	DM	Data
3	DP	Data
4	GND	Digital ground
	Case	Analog Ground

J9 – Host USB port is connected to the USB port C of the processor via an internal USB hub. The USB HUB is placed between the external USB connector J9 and the internal port C of the processor. The HUB used is self-configured device of USB2513QFN36 by SMSC.

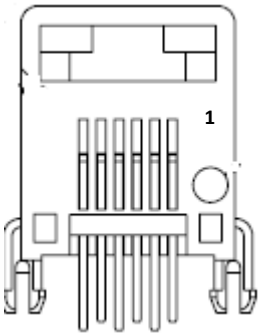
The USB Host interface has the following LEDs:

- D8 - USB Host (J9) Power out Enable
- D6 – USB hub is active.

The USB hub controls the power outlet of the USB interface. The USB HUB is controlled via I2C I/O expended (see section 3.3.1.2).

3.2.5 CAN interface – J22, J23

The CB-20 is equipped with 2 CAN ports. The CAN ports are equipped with RJ-11 connectors (6P6C) with the following pin out:



Pin	Signal	Description
1	3.3V	Output power
2	NC	
3	GND	Digital Ground
4	CANL	Data
5	CANH	Data
6	GND	Digital Ground

Note: A 4 wire cable can be used as well.

3.2.6 7" TFT LCD

The CB-20 is optionally equipped with a 7" TFT LCD with resistive touch support. The LCD supports maximum resolution of 800 x 480 with color depth of 16 bits per pixel.

The LCD has an LVDS interface which is connected to the SAMA5D34 16 bits RGB interface via a converter SN75LVDS83B by TI. The touch support is done via a dedicated connector which connects between the processor's Resistive Touchscreen Controller and the 4-Wire resistive touch screen.

The LCD is connected to the through J20 (the connector used is DF19G-20P-1V from Hirose). The connector includes the following interfaces:

- Y0-Y2 differential data.
- CLKOUT differential clock.
- LCD_DISP enable the LCD.
- LCD_PWM set the display intensity

The LCD is powered by a 5V power source.

Note – Due to errata of the SAMA5D3 the LCD_PWM is not operational and set to fixed level. It is recommended to use a dedicated PWM output.

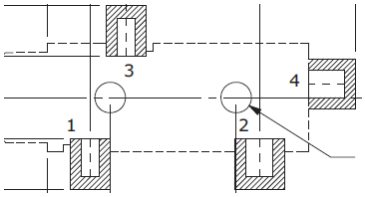
Pin	Signal	Description
1	LCD_PWM	LCD Brightness
2	SEL68	6bits or 8 bits color per pixel *
3	LCD_DISP	Enable the LCD *
4	NC	
5	5V_LCD	5V for LCD powering
6	5V_LCD	5V for LCD powering
7	5V_LCD	5V for LCD powering
8	GND	Digital Ground
9	CLKOUTP	Differential clock
10	CLKOUTN	Differential clock
11	Y2P	Differentials Pair2
12	Y2M	Differentials Pair2
13	Y1P	Differentials Pair1
14	Y1M	Differentials Pair1
15	Y0P	Differentials Pair0
16	Y0M	Differentials Pair0
17	Y3P	Differentials Pair3 (Optional)
18	Y3M	Differentials Pair3 (Optional
19	GND	Digital Ground
20	GND	Digital Ground

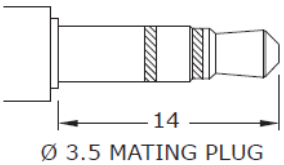
The CB-20 supports a 4-Wire resistive touch screen. It is connected to the LCD with a dedicated flat cable through a 1m"m FPC connector - J7.

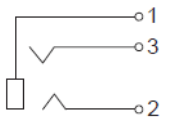
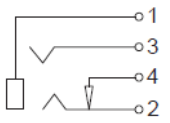
Pin	Signal	Description
1	YU	Y Up (AD3)
2	XR	X right (AD1)
3	YD	Y Down (AD2)
4	XL	X left (AD0)

3.2.7 Audio J2, J3

The CB-20 includes TI's TLV320AIC3106 codec for digital sound input and output, the codec is connected to the SSC0 port of the processor. The Audio interface includes audio jacks for microphone input (line in - J2) and headphone output (line out - J3). The CB-20 uses SJ-3524 3.5mm connectors.





Model No.	SJ-3523-SMT	SJ-3524-SMT
Schematic		
PIN		
1	sleeve	sleeve
2	tip	tip
3	ring	ring
4	NP	tip switch

3.2.8 JTAG/ICE interface

The JTAG connector is a 20 pins 2.54mm right angle header. It supports the J-link debugger cable for ICE connectivity. For more details about the ICE from Segger see the following link:
http://www.segger.com/debug-probes.html

Signal	Pin		Pin	Signal
3.3V	1		2	3.3V
NTRST	3		4	GND
TDI	5		6	GND
TMS	7		8	GND
TCK	9		10	GND
RTCK	11		12	GND
TDO	13		14	GND
NRST	15		16	GND
NC	17		18	GND
NC	**19**		**20**	**GND**

JP1 select the JTAG mode:

- When open, operation mode/emulator.
- When closed – JTAG testing

3.2.9 Micro SD slot – J19 (bottom side)

The CB-20 supports a 4-bits Micro SD card. It is connected to the SAMA5Dx MCI0 through the edge connector. The Micro-SD powered by a 3.3V power supply.

The CB-20 uses Foxconn's micro-SD connector (WQ2182C-DES1-7F), recommended for projects targeted for large quantities.

Pin	Signal	Description
1	MCI0_DA2	Data 0
2	MCI0_DA3	Data 3
3	MCI0_CDA	Command line
4	3.3V	3.3v power
5	MCI0_CK	Clock.
6	GND	Digital ground
7	MCI0_DA0	Data 0
8	MCI0_DA1	Data 1
9	GND	Card inserted polarity (Low)
10	MCI0_CD	Card detect
11	GND	Digital ground
12	GND	Digital ground

Note – The Micro-SD card can be used as a booting memory or as a recovery disk. It has the highest priority on all other nonvolatile memories.

3.2.10 Extender - J18

In order to debug and develop additional interfaces which are not supported by the CB-20, it contains an extender connector (J18) to which the developer can connect external devices. The connector is a standard 30 pin header with 1.27 pitch. Containing the following interfaces:

Signal	Pin		Pin	Signal
3.3V	1		2	3.3V
SPI1_SPCK	3		4	DBEG_I2C_C
SPI1_MOSI	5		6	DEBG_I2C_D
SPI1_MISO	7		8	GND

SPI1_NPCS3	9		10	URT3_TX
GND	11		12	URT3_RTS
GPIO1 (PB10)	13		14	URT3_RX
GPIO2 (PD19)	15		16	URT3_CTS
GPIO3 (PB12)	17		18	GND
GPIO4 (PC29)	19		20	GPIO5 (PE23)
GND	21		22	GPIO6 (PE24)
GPIO7 (PE25)	23		24	GPIO8 (PE29)
GPIO9 (PE26)	25		26	GPIO10 (PE30)
GPIO11 (PE31)	27		28	NC
3.3V	29		30	3.3V

The following table provides a description of the signals available on the Extender:

I2C Interface	
DBEG_I2C_D	Expansion of I2C0, need to be enabled before use (See I2C0)
DBEG_I2C_C	Expansion of I2C0, need to be enabled before use (See I2C0)
SPI1 Master Interface	
SPI1_SPCK	SPI1 clock
SPI1_MOSI	SPI1 MOSI
SPI1_MISO	SPI1 MISO
SPI1_NPCS3	SPI1 Chip Select 3
USART 3	
URT3_TX	USART3 Transmit
URT_RTS	USART3 Request To Send
URT_RX	USART3 Receive
URT_CTS	USART3 Clear To Send
General Purpose I/O	
GPIO1	Input/output, CPU port PB10
GPIO2	Input/output, CPU port PD19
GPIO3	Input/output, CPU port PB12
GPIO4	Input/output, CPU port PC29
GPIO5	Input/output, CPU port PE23
GPIO6	Input/output, CPU port PE24
GPIO7	Input/output, CPU port PE25
GPIO8	Input/output, CPU port PE29
GPIO9	Input/output, CPU port PE26
GPIO10	Input/output, CPU port PE30
GPIO10	Input/output, CPU port PE31

Note: The ports connected directly to the processor can be configured to other options according the pin mux options of the processor.

3.2.11 5V inlet- J17

The CB-20 has a DC input (4.5 – 10 volt) and is equipped with an AC-DC adapter. The design of the CB-20 supports internal battery using an internal battery controller.

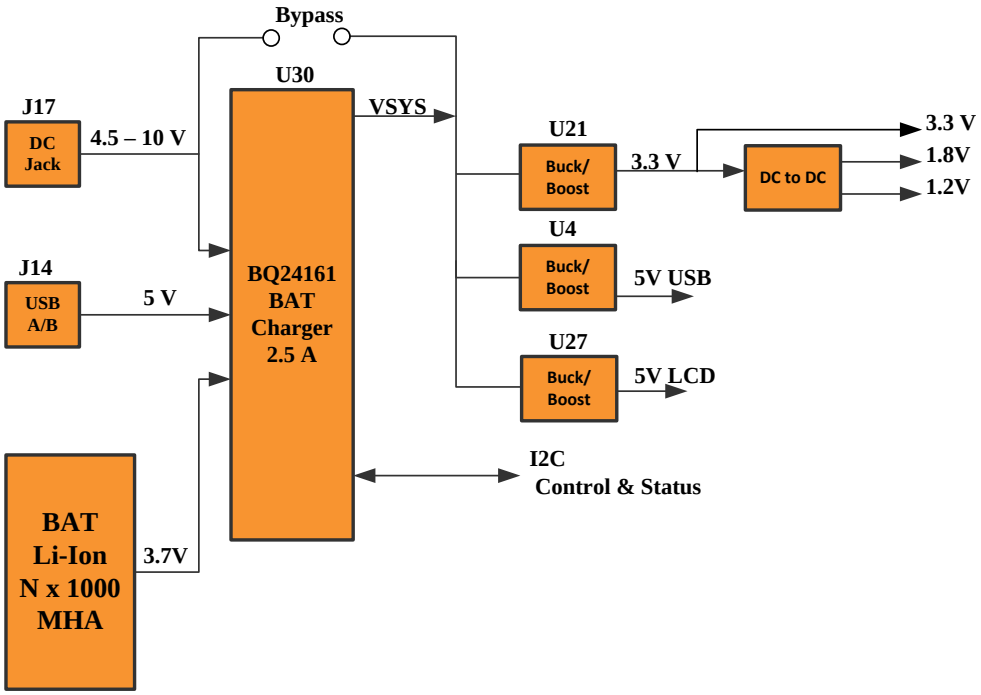


Figure 4– CB-20 Power scheme

The battery control is based on TI BQ24161. The BQ24161 is TI's dual input, single cell switch, battery charger with Power Path Management and I2C control. It has high efficiency DC to DC converter to power the system while simultaneously charging the battery.
The charger system output feeds three Buck/Boost (see note below) DC-to-DC converters:

- 3.3V system power.
- 5V for USB feeding (used by all USB ports).
- 5V for powering the LCD.

The lower power in the CB-20, 1.2V and 1.8V are converted from the 3.3V power.

The battery control and status registers can be access by an I2C interface connected to I2C-0 (See I2C section for more details). The battery charger can be bypass for powering the board directly from the AC/DC adaptor.

Note – Since the battery voltage can drop to 2.5V there is a need to Buck/Boost converters.

3.3 I2C support

3.3.1 Description

The CB-20 supports three I2C interfaces. The CB-20 is equipped with several I2C devices used for configuration and monitoring some of the functions of the CB-20

I2C0

- I2C interface expander.
- I2C I/O expander - I2C0 is expanded to support more I2C slave devices. The following paragraphs describes the I2C expander

I2C1

- Capacitive touch screen (Optional)
- Gyro-Accelerometer (Optional).

I2C2

- Connected to expansion modules (Optional).

3.3.1.1 I2C Interface Expander

The following figure describes the I2C expander.

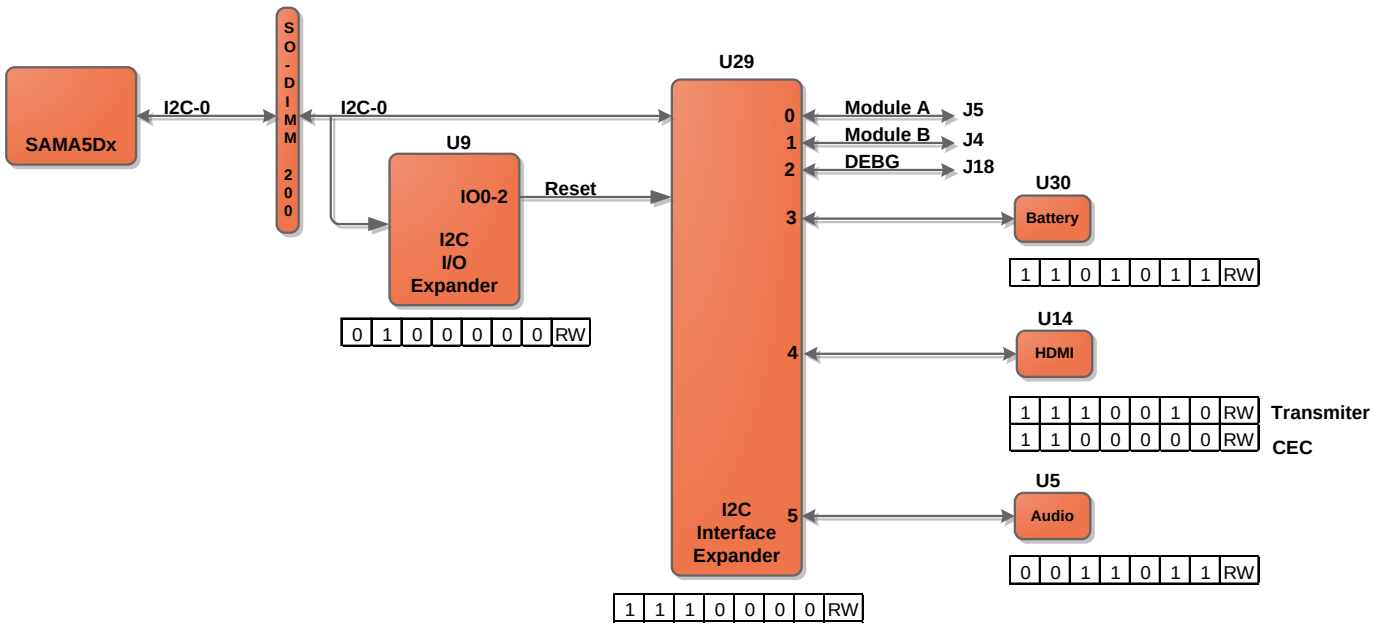


Figure 1 - I2C Interface Expander

The I2C expander is TI's PCA9548 with 8 I2C ports. The three lower bits of its address are programmable (Default address is 0).

The following table describes the interfaces connected to the I2C expander.

Port	Signals	Description
0	MODA_I2C_D MODA_I2C_C	Enables access to I2C devices on expansion module A (J-5).
1	MODA_I2C_D MODA_I2C_C	Enables access to I2C devices on expansion module B (J-4).
2	DEBG_I2C_D DEBG_I2C_C	Enables access to I2C devices connected to the extention connector (J-18).
3	BAT_I2C_D BAT_I2C_C	Enables access to the battery I2C interface (U-30).
4	HDMI_I2C_D HDMI_I2C_C	Enables access to the HDMI I2C interface (U-14).
5	AUD_I2C_D AUD_I2C_C	Enables access to the Audio I2C interface (U-5).
6,7	Not Connected	

Table 2- I2C Expander Ports Allocation

The I2C expander address is

1	1	1	0	0	0	0	RW

0xE1 Read
0xE0 Write

To access an I2C interface, it is first must be enabled at the I2C expander buffer by setting the corresponding bit (See PCA9548 data sheet).
After enabling the port accessing the corresponding I2C slave device is straightforward i.e. using the slave device I2C address.

Note – Enabled ports are not isolated therefore ports of devices with the same I2C address can't be enabled at the same time.

3.3.1.2 I2C I/O Expander

To enable more I/O ports the CB-20 supports TI's TCA6416A 16 bits I/O expander. The following table describes the I/O functionalities.

Port	Signal name	Type	Description
0-0	WL_RST	Out	Resets the Wi-Fi module "0" – Reset "1" - Enable
0-1	GYRO_EN	Out	Enables the Gyroscope module "0" – Disabled "1" - Enabled
0-2	RST_I2C#	Out	Resets the I2C interface expander. "0" – Reset "1" - Enabled
0-3	NC	Out	
0-4	SEL68	Out	Selects the LCD number of bits per color (When supported) "0" – 6 Bits "1" – 8 Bits
0-5	NC	Out	
0-6	USB_HUB_RST	Out	Reset the USB HUB "0" – Reset "1" - Enable
0-7 1-0 1-1 1-2	IO-[4..7]	Out	LED On/Off "0" – LED OFF "1" – LED ON
1-3	WL_WKUP	In	Wake up signal from Wi-Fi "0" – Interrupt "1" – Normal
1-4 1-5 1-6 1-7	INT1_A INT2_A INT1_G INT2_G		Interrupt signals from Gyro and accelerometer "0" – TBD "1" – TBD

Table 3 - I2C I/O expander

The I/O expander address is:

0	1	0	0	0	0	0	RW

0x41 Read
0x40 Write

The I/O expander support an interrupt signal connected to the SAMA5Dx PE-20 I/O pin.

3.3.1.3 I2C Address table

The following table describes the I2C addresses of the slave devices on the CB-20.

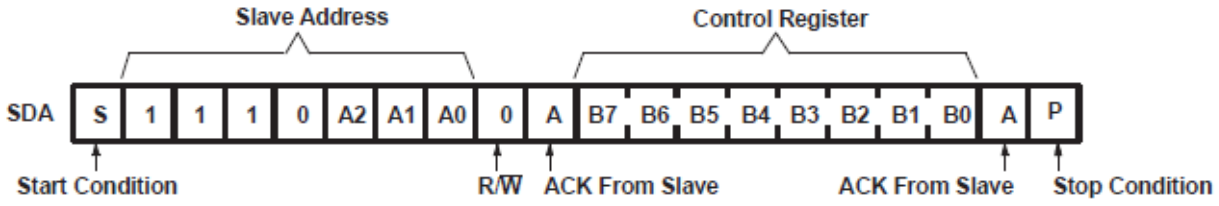
Ref.	Chip	I2C Port	Address A								Port	Address B								Description
U29	PCA9548	0	1	1	1	0	0	0	0	RW										I2C Interface Expander
U9	TCA6416A	0	0	1	0	0	0	0	0	RW										I2C I/O Expander
U14	SIL9022A	0	1	1	1	0	0	0	0	RW	4	0	1	1	1	0	0	1	RW	HDMI Transmitter
												0	1	1	1	1	0	1	RW	HDMI Programming Interface
U5	TLV320AIC3106	0	1	1	1	0	0	0	0	RW	5	0	0	1	1	0	1	1	RW	Audio
U30	BQ24161	0	1	1	1	0	0	0	0	RW	3	1	1	0	1	0	1	1	RW	Battery Charger
J4	Module A	0	1	1	1	0	0	0	0	RW	0									User Configurable
J5	Module B	0	1	1	1	0	0	0	0	RW	1									User Configurable
J18	Debug	0	1	1	1	0	0	0	0	RW	2									User Configurable
J21	LCD	1																		TBD
U8	LSM330DLC	1	1	1	0	1	0	1	A0	RW										Gyro
	LSM330DLC		0	0	1	1	0	0	A0	RW										Accelerometer

Table 4 - I2C Address Mapping

3.3.1.4 Configuring the Audio device with I2C – Example

To configure the audio interface using the I2C interface follow the next step:

Enable the Audio I2C port in the "I2C-0 Interface Expander"



S	1	1	1	0	0	0	0	0	A	B7	B6	1	B4	B3	B2	B1	B0	A	P

0	0	1	1	0	1	1	RW

Configure the Audio device at address using SAMA5Dx's I2C-0 port. (See the Audio chip, TLV320AIC3106 data sheet).

Note – When enabling an I2C port in the "I2C Interface Expander" take care not to change the value of other ports.

3.4 LEDs support

The CB-20 is equipped with 4 general purpose LEDs, these LEDs are controlled via the I2C I/O expender. The LEDs are controlled as follows:

- LED 13 = controlled by I/O 1-0
- LED 14 = controlled by I/O 1-1
- LED 15 = controlled by I/O 0-7
- LED 16 = controlled by I/O 1-2

When the I/O is set to 0 the LED is off.

Note: Writing to the I/O expander will change all the I/O according to the new byte written, care should be taken when changing the LEDs that the other I/O maintain the right value.