



Unlocking Smart Building KNX IoT Connectivity

## KNX IoT Development Board Datasheet

Rev. 1.0, May. 2023

### General description

Cascoda's KNX IoT development board provides everything you need to develop your KNX IoT application with Cascoda's Thread Certified Chili2 module.

It features Cascoda's SMARTRange™ technology to provide long-range Thread connectivity for whole-house coverage. It provides easy integration with Cascoda's dashboard and our KNX Hub for connectivity to a wider KNX system or for backhaul connectivity.

### Features

- Certified Thread-based radio supporting mesh networking, long range and low power consumption
- Arm® Cortex®-M23 Architecture
- Highly secure PSA Certified™ security for IoT applications
- 512 KB dual-bank application ROM (APROM)
- 96 KB on-chip SRAM
- 8MBit (1M x 8) FLASH for over the air (OTA) upgrade
- Analog Interfaces (ADC, DAC, Comparator)
- Easy integration with Cascoda's KNX Hub for IPv4/IPv6 backhaul connectivity
- Ultra-low-power battery operation & battery charging
- Four programmable buttons & LEDs
- E-Paper display integration
- A library of sensor & actuator plug-in boards, ready to develop your solution
- Automatic code generation for your chosen target combination of sensors/actuators/switches/leds

### Communications interfaces

- USB (HID)
- UART (to 6 Mb/s)
- I2C
- SPI

### Fixed supply options

- USB 5V Supply from the USB
- External 5V Supply (+5V)
- External 3.3V UART Supply
- External Supply 3.3V to 35V

### Battery supply options

- CR123A 3V non-rechargeable Lithium Battery
- 16340 (RCR123A) 3.6/3.7V rechargeable Lithium-Ion Battery (BATT)

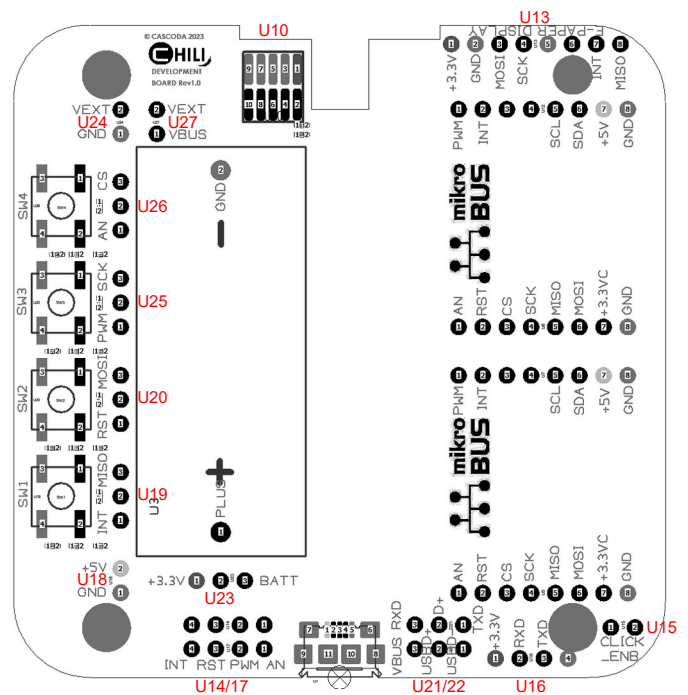
### Board configuration options

- Thirteen programmable GPIO pins for configuration options
- Four programmable switches
- Four programmable LEDs
- E-Paper display option supporting multiple driver chips
- Integrated chip antenna and an external antenna option
- Battery charging and monitoring

### Programming and debug option

- USB or UART programming
- JTAG / SWD ICE programming with debug

### Top view



### Housing option

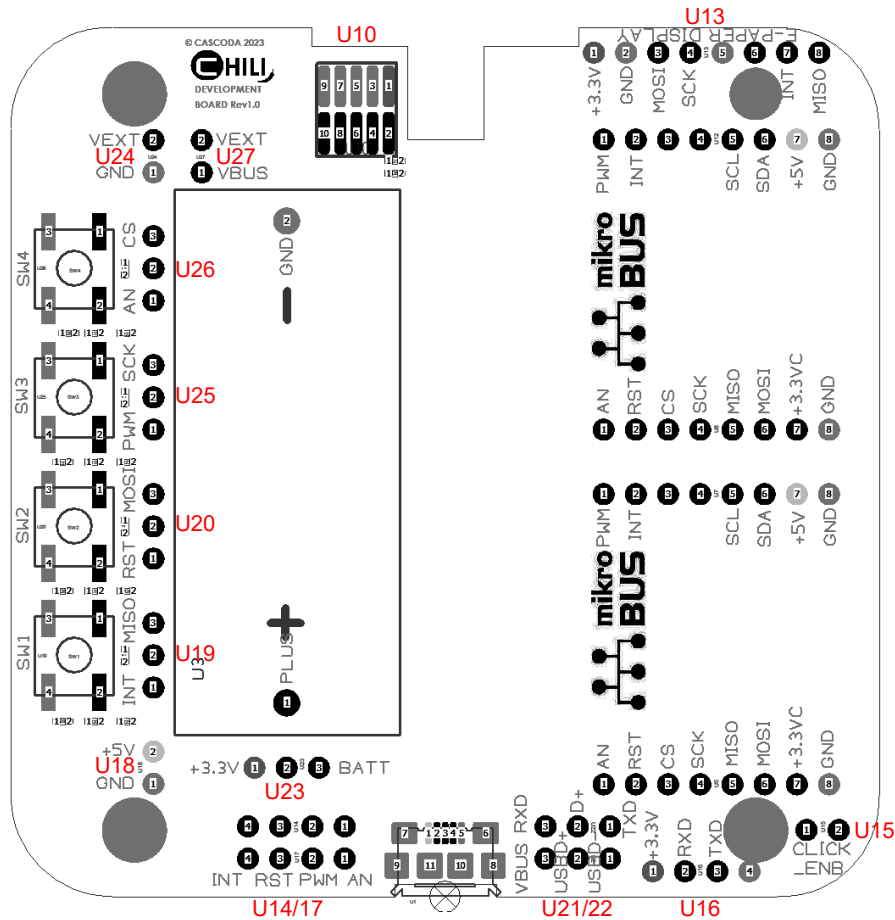
- Compatible with CamdenBoss CBRS02V series wall housing

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## 1 Development Board Top View

The following figure shows the top view of the Development Board including all headers for configuration.



**Figure 1.1: Development Board Top View**

The board headers have the following functions:

U10	10-Pin 0.05" JTAG/SWD ICE Connector for Programming and Debug
U13	8-Pin Header for connecting E-Paper Display
U14/17	Two 4-Pin Headers for configuring Battery Charging and Monitoring Functionality
U15	2-Pin Header for enabling Software Control of the Power Supply for the MikroBUS™ Interfaces
U16	4-Pin Header for UART Interface
U18	2-Pin Header for external 5V Supply (+5V)
U19, U20, U25, U26	3-Pin Headers for configuring the 4 Switch/LED Pairs SW1 to SW4
U21/22	3-Pin Header for USB Interface
U23	3-Pin Header for Power Supply from Battery (+3.3V, BATT)
U24	2-Pin Header for external Supply (3.3V to 35V, VEXT)
U27	2-Pin Header for Power Supply Configuration

## 2 Power Supply Configurations

The following power supply options are available:

- USB 5V Supply from the USB Connector  $V_{BUS}$  (+5V)
- External 5V Supply from Header U18 (+5V)
- External 3.3V Supply from UART Interface Header U16 (+3.3V)
- External Supply 3.3V to 35V from Header U24 (VEXT)
- CR123A 3V non-rechargeable Lithium Battery (3.3V)
- 16340 (RCR123A) 3.6/3.7V rechargeable Lithium-Ion Battery (BATT)

### 2.1.1 USB 5V Supply from the USB Connector

When connecting the board to a computer/laptop via USB, the +5V  $V_{BUS}$  should be used to supply the board. Populate header U27 with jumper to route the USB +5V to the power supply circuitry. If USB communications is used, also populate header U21/22.

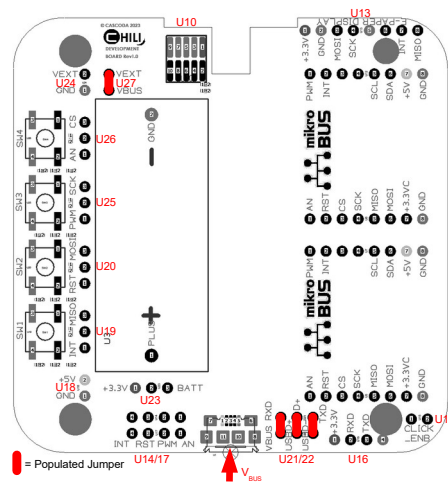


Figure 2.1: USB +5V Power Supply

### 2.1.2 External 5V Supply

An external +5V power supply can be attached using header U18. Populate U27 with jumper to route the external +5V to the power supply circuitry.

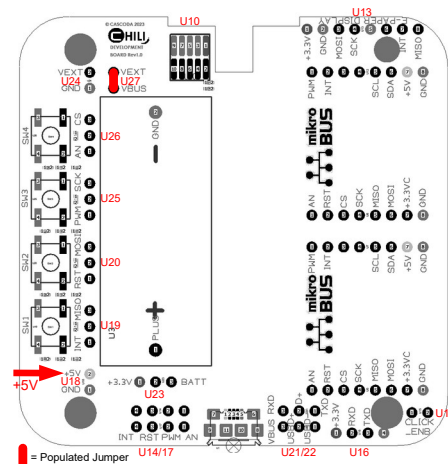


Figure 2.2: External +5V Power Supply

### 2.1.3 External 3.3V Supply from UART Interface

The board can be supplied by an external +3.3V power supply from the UART interface. In this case do not populate header U27.

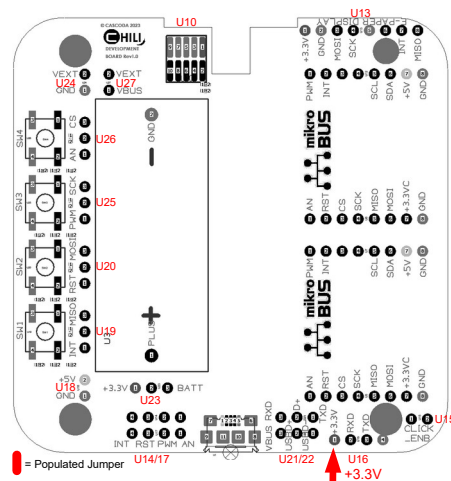


Figure 2.3: External +3.3V Power Supply from UART Interface

### 2.1.4 External Supply from 3.3V to 35V

An external 3.3V to 35V power supply (VEXT) can be attached using header U24 to cater for higher voltage applications such as lighting.

**Caution:** Do not populate header U27 (connect VEXT to VBUS) when using VEXT, as this can result in damage to the circuitry!! Only use header U24 to supply voltages above +5V to the board.

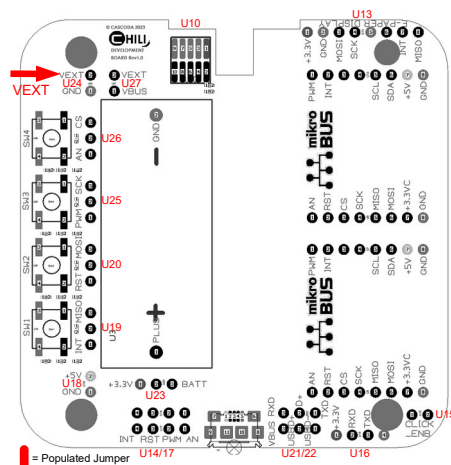


Figure 2.4: External +3.3V to +35V Power Supply

### 2.1.5 CR123A 3V Non-Rechargeable Lithium Battery (3.3V)

When using a non-rechargeable CR123A battery connect 3-pin header U23 to +3.3V. Do not populate header U27.

**Caution:** Do not connect U23 to the BATT side of the header or populate header U27, as trying to recharge a non-rechargeable CR123A battery may cause fire!!

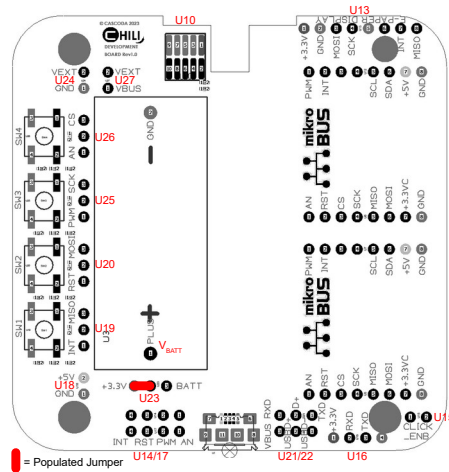


Figure 2.5: Non-rechargeable CR123A 3V Lithium Battery

### 2.1.6 16340 (RCR123A) 3.6/3.7V Rechargeable Lithium-Ion Battery (BATT)

When using a rechargeable 16340 (RCR123A) type battery connect 3-pin header U23 to BATT. Populate header U27. The battery will be charged via the +5V supply either by connecting the USB connector or connecting an external +5V supply using header U18.

**Caution:** Do not connect U23 to the +3.3V side of the header, as fully charged batteries may exceed the voltage limit of 3.3V components.

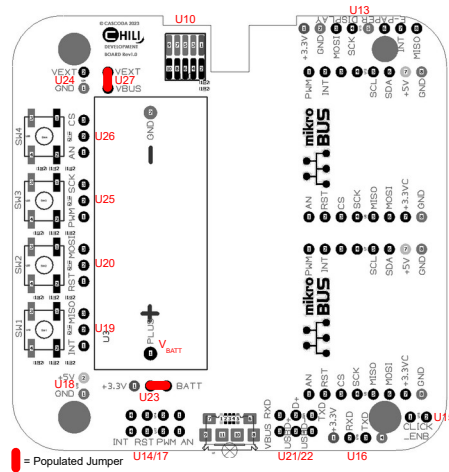


Figure 2.6: Rechargeable 16340 3.6/3.7V Lithium-Ion Battery

## 3 Communications Interface Configuration

The development board can be configured for using either USB or UART as bi-directional communications interface for messaging and CLI applications. Both interfaces are supported and selectable by the Cascoda SDK.

### 3.1.1 USB Interface for Communications

In order to use the USB communications interface (HID mode), header U21/22 has to be populated with 3 jumpers for D+, D- and V<sub>BUS</sub>. If V<sub>BUS</sub> is used as board power supply, also populate header U27.

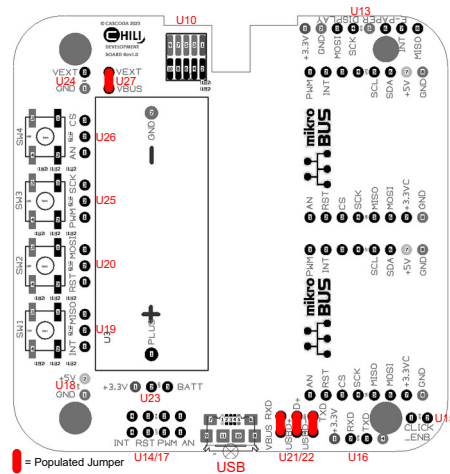


Figure 3.1: USB Communication Interface

In addition to providing a communications interface, the USB interface can also be used for re-programming the development board firmware on the Chili2S module using the Cascoda *chilictl* command line application. For further information see the documentation of the Cascoda SDK on GitHub.

Note that when developing low-power applications and the board regularly enters sleep mode, the USB interface is not appropriate, as the USB host will terminate the connection every time the device enters sleep mode.

### CMake Configuration for SDK Build

When configuring the Development Board for USB Communications, the following variables have to be set in the SDK configuration:

- `CASCODA_BM_INTERFACE:` `USB`

The `CASCODA_BM_USB_HID_*` variables should be left to default.

### 3.1.2 UART Interface for Communications

When using the UART communications interface, header U21/22 should not be populated. If the +3.3V power supply of the interface is used as development board power supply, header U27 should as well not be populated.

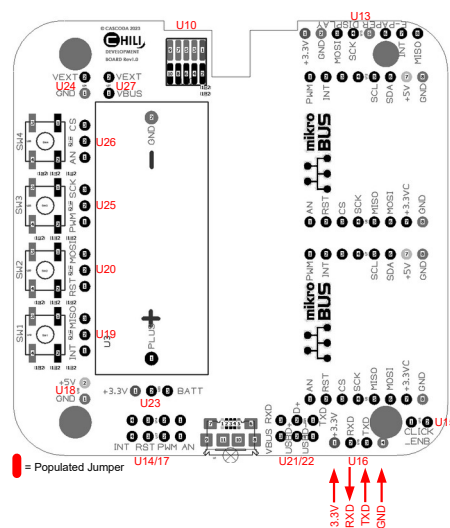


Figure 3.2: UART Communication Interface

When using the UART interface for providing a communications interface for messaging and CLI applications, it is recommended to connect the board to a computer/laptop using a 3.3V USB to Serial Adapter cable, such as the FTDI UMFT230XB-WE breakout board. The cables / breakout boards often provide a CTS# input which should be hardwired to GND, as otherwise communications from the host to the development board will not be enabled.

Note that the labelling for TXD and RXD is as seen from the host, so TXD is an input to the development board, and RXD is output.

In addition to providing a communications interface, the UART interface can also be used for re-programming the development board firmware on the Chili2S module using the Cascoda *chilictl* command line application. For further information see the documentation of the Cascoda SDK on GitHub.

### CMake Configuration for SDK Build

When configuring the Development Board for UART Communications, the following variables have to be set in the SDK configuration:

- `CASCODA_BM_INTERFACE:` `UART`
- `CASCODA_CHILI2_UART_CHANNEL` `4`
- `CASCODA_CHILI2_UART_BAUDRATE` `115200`

A baud rate of 115200 b/s should be used when connecting the board to a computer/laptop with a USB to Serial Adapter. When connecting the board directly to a host as a co-processor, higher baud rates (max. 6 Mb/s) can be used, depending on the specific host processor.

## 4 Board Configuration

### 4.1 Multi-Function Pin (MFP) Mapping

The following table provides an overview of the possible multifunction pin connections of the board which are supported by the Cascoda SDK drivers.

Chili2S Module Pin	M2351 GPIO Port	Option 1 MikroBUS™, Communications	Option 2 Switches/LEDs, Communications	Option 3 E-Paper Display	Option 4 Battery Charging and Monitoring
2	PF.0	MikroBUS™ I2C SCL			
4	PF.1	MikroBUS™ I2C SDA			
5	PB.12	MikroBUS™ INT	Switch/LED SW1 Position 1	RST	USB_PRESENT
6	PB.13	MikroBUS™ RST	Switch/LED SW2 Position 1		VOLTS_TEST
11	PA.13	USB D-	UART RXD		
12	PA.14	USB D+	MikroBUS™ VDD33 Enable		
17	PA.12	USB VBUS	UART TXD		
31	PB.5	MikroBUS™ SPI MISO	Switch/LED SW1 Position 2	BUSY	
32	PB.4	MikroBUS™ SPI MOSI	Switch/LED SW2 Position 2	DIN	
33	PB.3	MikroBUS™ SPI SCK	Switch/LED SW3 Position 2	CLK	
34	PB.2	MikroBUS™ SPI CS	Switch/LED SW4 Position 2	DC	
35	PB.1	MikroBUS™ PWM	Switch/LED SW3 Position 1		VOLTS
36	PB.0	MikroBUS™ AN	Switch/LED SW4 Position 1		CHARGE_STAT

**Table 4.1: Multi-Function Pin Configurations**

There are five primary functional groups:

- Communications Interfaces (USB, UART)
- Switches / LEDs



- MikroBUS™ Interface for MikroE CLICK Boards™
- E-Paper Display
- Battery Charging and Monitoring

For each Chili2S module pin / M2351 GPIO port used as Multi-Function Pin (MFP) there are several options to connect depending on the desired functionality. The jumper settings on the board have to be set to corresponding to the software drivers implemented in the Cascoda SDK. If a pin in the table above is used for a specific function, it cannot be used for other functions (the entries in the same row of the table are mutually exclusive). For example, if pin 35 is used for a CLICK Board using the PWM signal, it cannot be used as Switch/LED3 Position 1 or the Battery Charging and Monitoring VOLTS signal. For further information on the functionality see the following sections of this document.

## 4.2 Switches / LEDs

The development board supports four Switch/LED pairs, SW1-SW4. Depending on the software driver configuration each pair can act either as a Switch or a LED. Each of the four Switch/LED pairs can be configured to be connected to two different pins via a 3-way jumper, Position 1 or Position 2.

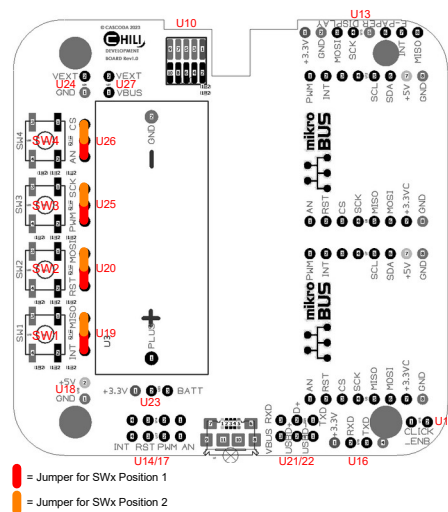


Figure 4.1: Switch / LED Configuration

If a Switch/LED pair is not used as a Switch or LED, the jumper on the corresponding header should not be populated.

## 4.3 MikroBUS™ Interfaces for MikroE CLICK Boards™

There are two separate MikroBUS™ sockets on the development board connected in parallel. The sockets are used to attach CLICK Board sensors and actuators to the development boards. The following interfaces are supported for the MikroBUS™:

### I2C

As the pins used for driving the I2C signals (pins 2 and 4) are not used for any other functionality apart from programming, two separate CLICK boards with I2C interfaces can always be attached to the development board as long as they are configured with different I2C slave addresses.

Note that the I2C signal pins are also used for programming the device when attaching a programming / debug device to the board using header U10 (see 5). In this case, if a I2C CLICK Board is attached to the development board, removing the programming cable and power-cycling the board is sometimes required after programming to free up the I2C bus.

Virtually all CLICK Boards already contain the required I2C pull-up resistors (typically 4.7 kΩ). Footprints (R0402) for additional pull-ups exist on the development board (R21, R26), but are not populated by default.

### SPI

As the two MikroBUS™ sockets are connected in parallel, only one SPI CLICK Board can be attached to the development board. This however can be usually combined with other CLICK Boards using I2C or GPIO interfaces.

### GPIO

Sensors and actuators with a GPIO interface can generally be used on the development board.

It is recommended to check the specific CLICK Board datasheets to determine which MikroBUS™ signals are used when connecting sensors or actuators to the development board.

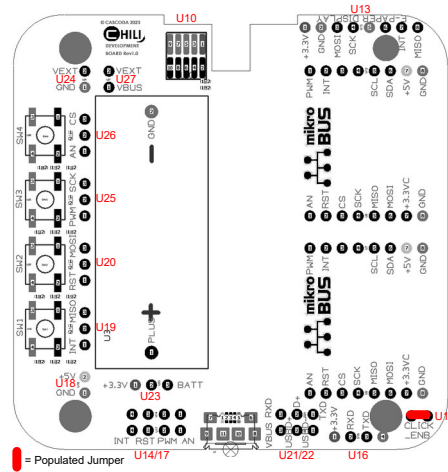
### UART

The UART signals (TX, RX) are not connected for the MikroBUS™ sockets on the development board. Therefore CLICK boards with UART interface can not be used.

## MikroBUS™ Interface Power Control

The +3.3V power supply to the MikroBUS™ sockets can be software controlled and switched off by a crowbar for isolating CLICK™ Boards during sleep. This can be useful as, although many sensor devices used on CLICK Boards have programmable low-power modes, LEDs, voltage converters and level shifters on the sensor boards still consume a considerable amount of power. However, this has to be examined individually for each sensor as long initialisation and calibration times on power-up can be an issue.

When using the software power supply control for the MikroBUS™, header U15 should be populated with a jumper, see the figure below. It should **not** be populated if the power supply control is not used, as this can unintentionally switch off the power supply to the interface.

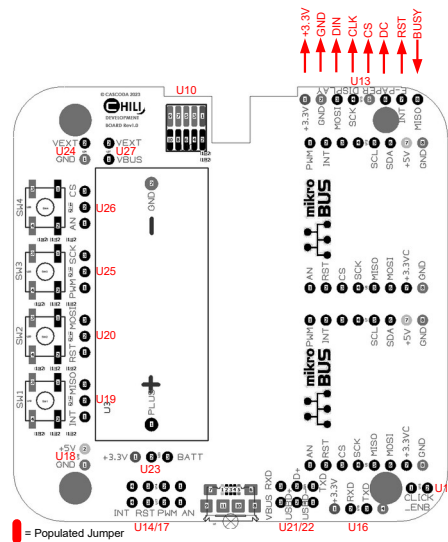


**Figure 4.2: Enabling MikroBUS™ Interface Power Control**

Note that the MikroBUS™ Interface Power Control cannot be used if the USB communications interface is used. In this case header U15 should not be populated.

## 4.4 E-Paper Display

A E-Paper display interface is included on the development board using header U13, see figure below.



**Figure 4.3: E-Paper Display Interface**

The Cascoda SDK includes drivers for the following E-Paper display drivers:

- Good Display IL283820
- Solomon Systech SSD1681

Application examples or the following displays are available:

- Waveshare EPD 2.9", 296 x 128 Pixels (IL283820 driver)
- Waveshare EPD 1.54", 200 x 200 Pixels (SSD1681 driver)

By default the E-Paper header U13 is not populated. When using an E-Paper display, U13 can be populated with a 2.54 mm, 8-way single row, vertical header.

### 4.5 Battery Charging and Monitoring

When powering the development board using a re-chargeable battery (see 2.1.6) the battery will be re-charged as soon as the USB is connected or an external +5V power supply is connected to header U18. Additionally, by populating jumper U14/17 the following signals will be connected to the Chili2S processor:

- USB\_PRESENT USB (or external) +5V is connected
- CHARGE\_STAT Battery Charging Status (Charging/Not Charging)
- VOLTS\_TEST Battery Voltage Measurement: Control
- VOLTS Battery Voltage Measurement: Battery Voltage to ADC for Measurement.

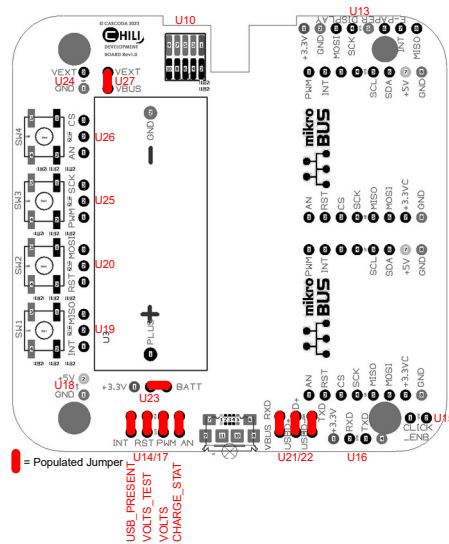


Figure 4.4: Battery Charging and Monitoring

Using the battery charging and monitoring will enable applications to monitor and control the battery charging functionality, for example go into sleep mode when the device is disconnected from the USB, monitor the battery voltage or monitor the charging status. Note that the jumpers above and the corresponding functionality can be used individually, not all of them have to be populated at the same time. Only VOLTS\_TEST and VOLTS require both to be connected at the same time if the battery voltage is to be measured. The Cascoda SDK contains functions to initialise the specific functionality, and read the values and status of the battery interface.

## 5 JTAG/SWD ICE Connector for Programming and Debug

The Development Board is populated with a 10-pin 0.05" connector (U10) to directly connect a programmer or debugging interface, for example a Segger J-Link debug probe or the Nuvoton Nu-Link Pro.

VDD33	1	2	TMS
GND	3	4	TCK
GND	5	6	NC
GND	7	8	NC
GND	9	10	TRSTX

Figure 5.1: 10-Pin Header for JTAG/ICE Programming and Debug

See section 3 Communications Interface Configuration for USB or UART programming.

## 6 Electrical Specifications

This section only specifies parameters specific to the Chili2 Development Board. For more detailed information refer to the Cascoda Chili2S datasheet [1].

### 3.1 Absolute Maximum Ratings

Parameter	Conditions	Min.	Typ	Max	Units
Supply Voltage - USB Supply or +5V	USB Supply or +5V (header U18)	-	-	5.5	V
Supply Voltage - Battery Voltage	Supply on BATT, re-chargeable battery	-	-	4.4	V
Supply Voltage - +3.3V to 35V	Supply on VEXT (header U24), see 1)	-	-	35	V
Supply Voltage - +3.3V	UART or non-rechargeable battery, see 2)	-	-	3.6	V

**Table 6.1: Absolute Maximum Ratings**

1) **Caution: Do not populate header U27 (connect VEXT to VBUS) when using VEXT, as this can result in damage to the circuitry!! Only use header U24 to supply voltages above +5V to the board.**

2) When attaching MikroE CLICK Boards™, please also refer to the corresponding datasheets for the components on the sensor / attenuator boards.

## 7 References

[1] Cascoda Chili2S Module Datasheet, Rev. 0.7, October 2020

## 8 Revision History

Revision	Date	Status	Comments
0.1	1 Mar 2023	Pre-Release	Pre-Release, for Review only.
1.0	26 May 2023	Release	Initial Release for Development Kit.