MANUCA User Manual

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Introduction

Product Features

The MANUCA DK include the following features:

- MCU: STM32F767ZI, based on ARM Cortex M7 CPU architecture with running speed up to 216 MHz.
- Memories:
  - 2MB Flash memory.
  - 512KB SRAM.
  - Backup PSRAM.
- USB Connectivity:
  - Speed: support both Full-speed (12Mbit/s) and low-speed (1.5Mbit/s) operation.
  - Modes: Master/host mode, slave/device mode, on-the-go (OTG) mode.
  - Connector: USB micro-AB type receptacle.
- Ethernet Connectivity:
  - Speed: 10Mb/s (10Base-T) and 100Mb/s (100Base-TX).
  - Support auto speed negotiation and auto-MDIX.
  - Connector: RJ45.
- MicroSD Card:
  - Capacity: SDSC (2GB) and SDHC (32GB).
  - Bus: SPI bus, and SD bus (subject to hardware configuration and software support).
- Sensors:
  - On-board 3-axis accelerometer.
  - On-board *PCB temperature* sensor.
  - On-board *Enclosure/casing temperature* sensor.
- LED Indicators:
  - Power supply converter output status.
  - USB power status.
  - 3 user/software Programmable status.
- Push Buttons:
  - Hardware Reset Button.
  - Software (user defined) Button.
  - WiFi/Wireless Module Reset Button.
- Debug Interface:
  - JTAG and Serial Wire Debug (SWD) interface support. Accessible through a standard 10-pin 1.27mm pitch ARM-Cortex debug connector.
  - Serial (UART) interface support through a 6-pin 2.56mm pitch connector.

- Digi XBee® Compatible Interface:
    - Support on-board direct plug-in for Digi XBee® compatible modules.
    - Supported Serial communication interface with the Host: SPI, UART.
- External Peripherals Interface:
    - 3 x I2C bus interface connectors.
    - 3 x SPI bus interface connectors.
    - 2 x UART/RS485 interface connectors.
    - Tamper Switch interface connector.
- Expansion connectors:
    - Provides connectivity from MANUCA DK to an expansion board.
    - Provides power source (3.3V, 5V), SPI bus interface, and digital I/O signals .
- Power Management:
    - Support multiple source(s) of input power:
        - DC adapter (9V - 12V DC), as the main power source.
        - Lithium-Ion or Lithium-Polymer Battery, as backup for the main power source.
        - 5V power from TTL-to-USB serial converter, as the main power source. Note: for development used only (Not suitable for deployment).
        - Lithium polymer Battery, as backup power for the RTC, backup PSRAM, and backup registers.
    - On-board Power Path Management system:
        - Enabled auto selection of input power source(s).
        - Perform auto switch-over of power source when one of the input power source(s) failed or no longer available.
    - On-board Battery Management system:
        - Battery Charger for Main Power Backup battery.
        - Battery Charger for RTC Backup battery.
- Low Power Operation:
    - Support Sleep, Stop and Standby modes of operation.
- Recommended Operating Temperature: 0°C - +70°C.
- Storage Temperature: -40°C - +85°C.
- Options for DIN Rail mount and Box mount.
- Board dimension: 100mm X 105mm.
- Regulatory Compliance: Designed with the intention to comply with FCC Part 15 Class B device and EU EN 55022 class B emission requirements.

Quick Start

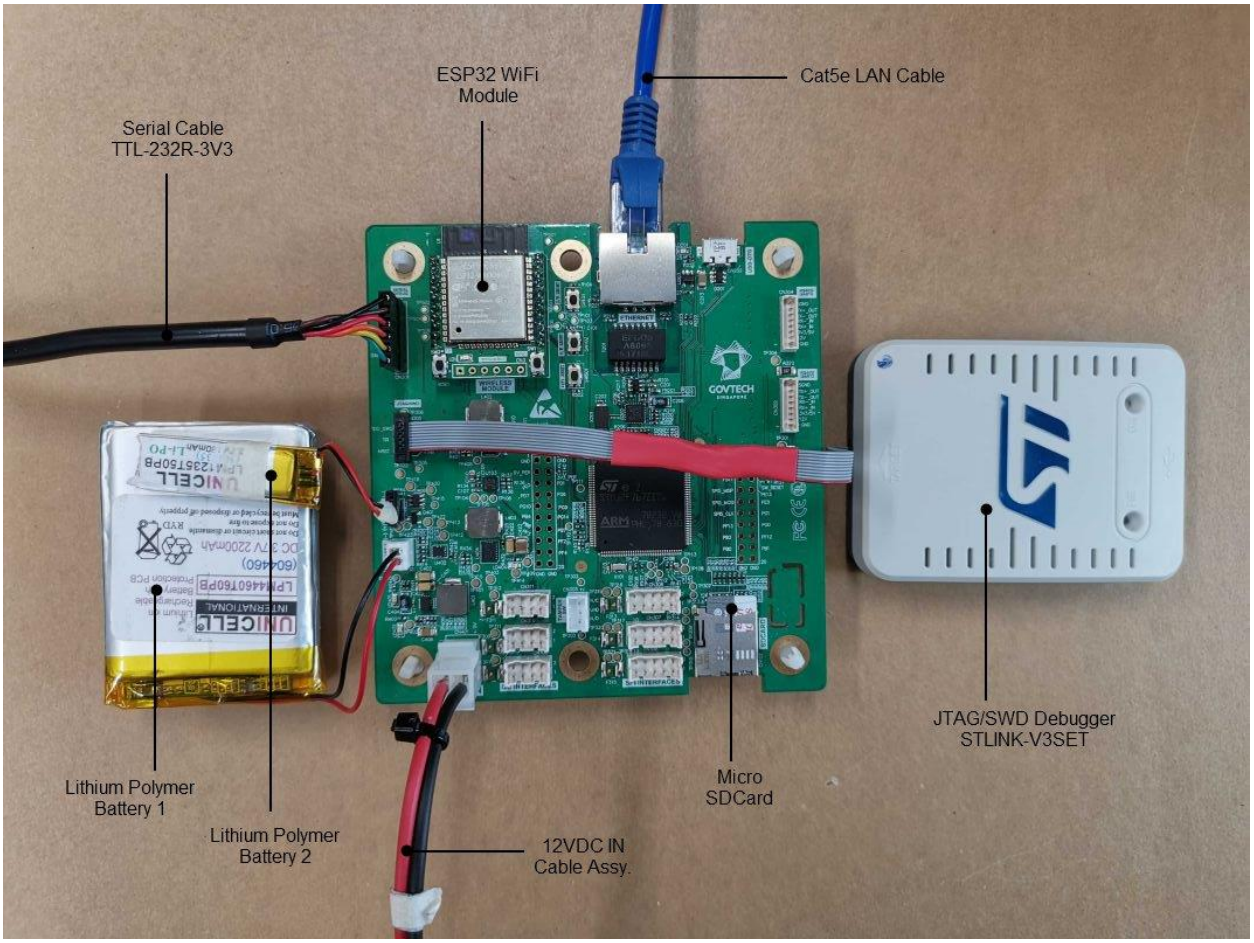
Following is a complete general hardware setup to get started with the MANUCA DK:

1. ***WiFi connection***: plug in the ESP32 WiFi Module onto the slot (board label: 'WIRELESS MODULE').
2. ***Ethernet connection***: plug in an Ethernet cable (CAT5e/CAT6) to connector CN201, and connect it to an external Router or Ethernet Switch.
3. ***Program/flash/debug the board***: Connect the JTAG/SWD connector (CN305) to a JTAG/SWD Debugger (eg. STLINK-V3SET).
4. ***Store data/image to microSDCard***: Insert a microSDCard into the microSDCard slot CN102.
5. ***Serial debug***: Connect a *TTL-to-USB* serial converter (eg. TTL-232R-3V3) to connector CN301.
6. ***Preserve RTC function and MCU internal backup registers content during power off***: Connect a small rechargeable single-cell Lithium polymer (3.7V, 80mAH ~ 200mAH) to connector CN403.
7. ***USB functions***: connect a USB micro-AB cable to connector CN202. The USB supports two types of functions: *USB Targeted Host* and *USB Peripheral*. Choose the correct USB cable type accordingly.
8. ***Connect Input Power Supplies to the MANUCA DK***. Three ways to provide power source to MANUCA DK:
    1. Connect 12V DC power to the 12V DC IN connector CN401.
    2. Connect a rechargeable single-cell Lithium Ion or Lithium polymer Battery (3.7V, 1000mAH ~ 5000mAH) to connector CN402 (Board Label: BATT1).
    3. Connect a *TTL-to-USB* serial converter (eg. TTL-232R-3V3) to connector CN301.

       Note: The TTL-232R-3V3 can only provide up to 200mA current. Make sure not to exceed the specified current limit.

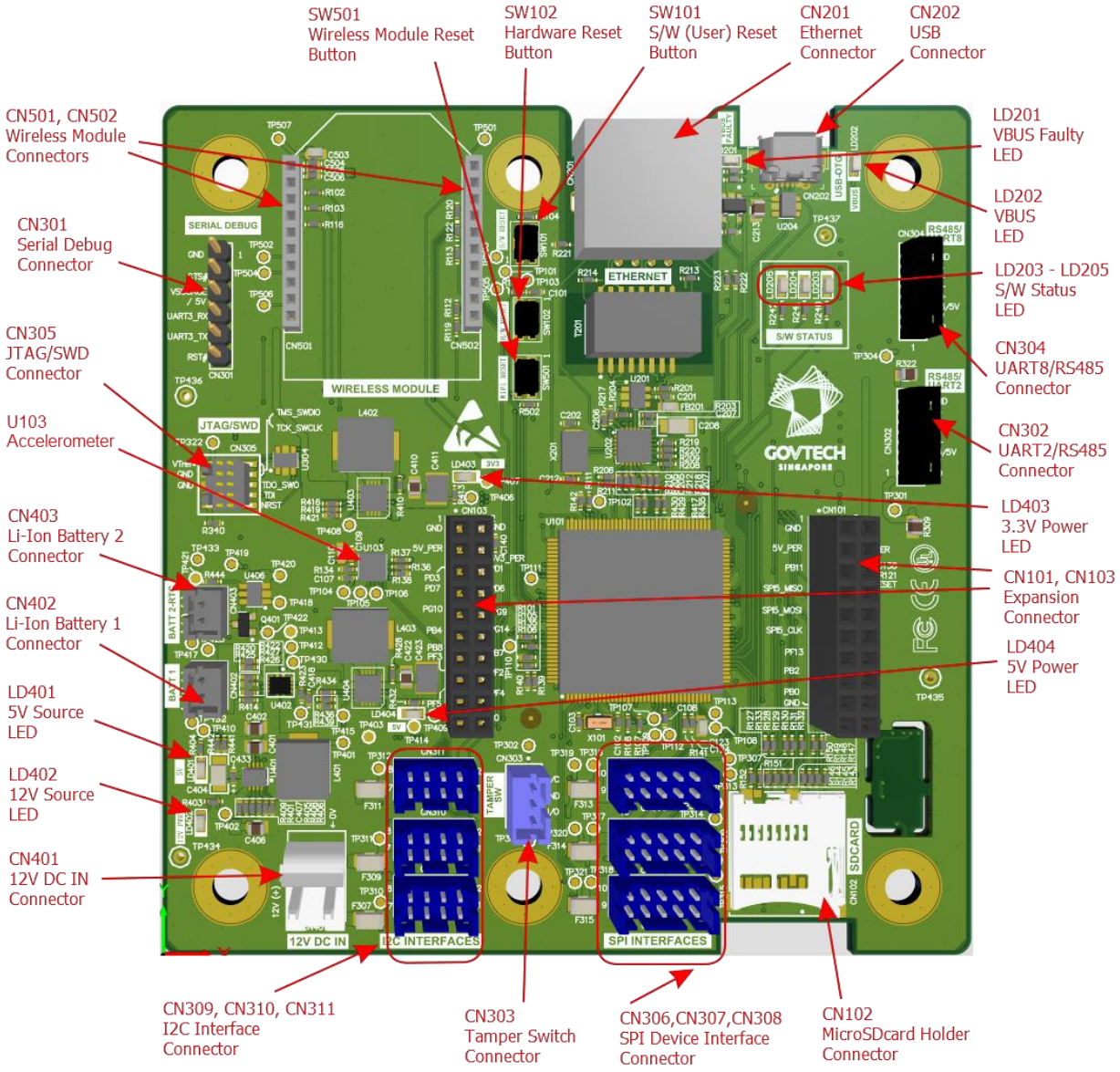
9. Turn on the power supply to the MANUCA DK.
10. ***Flash/Program*** the MANUCA DK with the image and start the development.

Below is an example of the typical MANUCA DK Development setup:

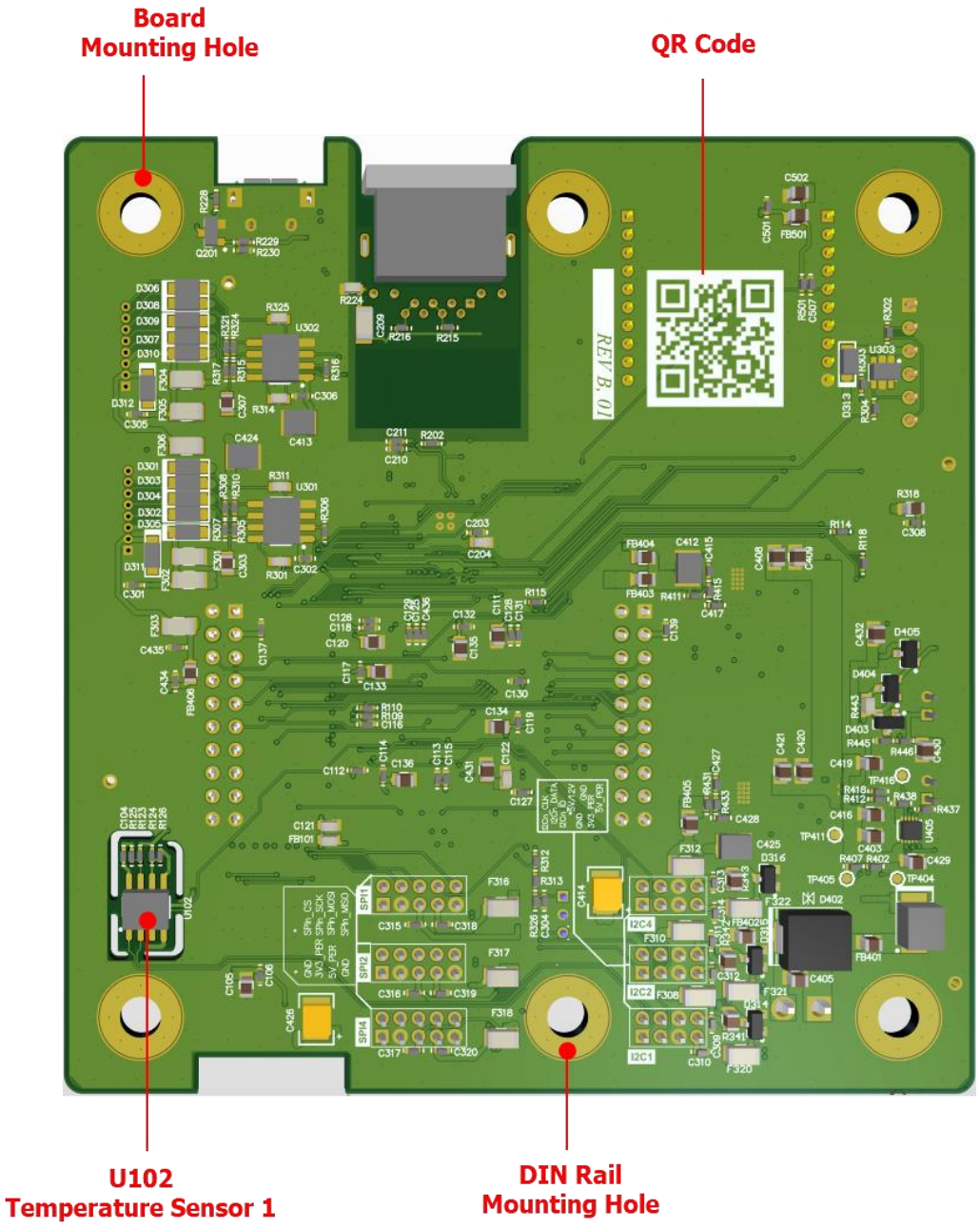


MANUCA DK Layout

Top Layout



Bottom Layout



Manuca DK Features

MANUCA DK Power Management System

The MANUCA DK can be powered by one of the following input sources:

- From a 12V, 1A DC power supply. This is the main source for the MANUCA DK.
- From a TTL-to-USB converter/cable, providing 5V, 200mA current. Note that this source of power is convenient for development use, but not suitable for deployment use.
- From a Main Backup Battery supply (BATT1), which serves as backup power for the main DC power supply - in case the mains supply is interrupted or temporarily cut off.

If more than one input power supply sources are available to the MANUCA DK, the MANUCA DK's power path management circuitry will automatically detect, select and transition between these available input sources seamlessly.

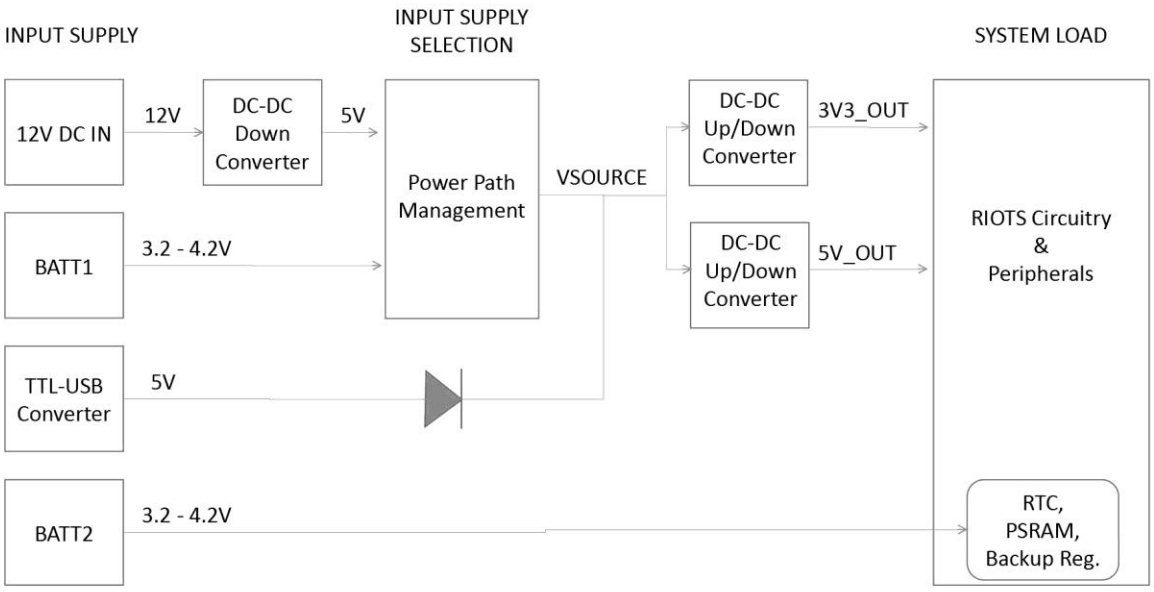
When one of the available power source fails, the power path management circuitry will automatically switch-over to an alternative backup power source and thus provide an un-interrupted power to the board.

Built-in priority voltage supervisor is used for selecting the input source:
When all input power supply sources are available, priority is given to 12VDC IN source, followed by BATT1 (Li-Ion battery) supply source. The output from this power path management will then be ORed with the TTL-to-USB serial converter supply source. Whichever voltage that is the highest will be selected to supply power to the MANUCA DK.

The following signal is used for monitoring the power source that is used for supplying the power to the MANUCA DK:

Signal Name	Pin Name	Pin Type	Usage
PWR_SEL	PD13	Input GPIO	Power source indicator (U402, TPS2121): '0'= power source is supplied by the Backup Battery 1, '1'= Power source is supplied by 12V DC IN

Below is the simplified power distribution block diagram for the MANUCA DK:



Battery Management

The MANUCA DK comes with built-in charging circuitry. It supports both the Lithium Ion and Lithium polymer type of single-cell, rechargeable battery.

The Main Backup Battery (BATT1) is used as backup power for the 12VDC IN. During power outage, the Main Backup Battery will replace the 12VDC IN power to supply power to MANUCA DK so that there is no disruption to the operation of the MANUCA DK. When the 12VDC IN power is restored, MANUCA DK will automatically switch-over to use the 12VDC IN power, and automatically re-charge the Main Backup Battery until it's fully charged.

The RTC Backup Battery (BATT2-RTC) is used as backup power source for the on-board RTC, PSRAM and Backup Registers. When both Main power sources (12VDC IN and BATT1) are no longer available, the RTC Backup Battery will be providing the power to the above mentioned sub-system. This will ensure that during power outage, the RTC time-of-day clock and calender will continue running, PSRAM content and Backup Registers content remain intact until the main power source is restored.

The Main Battery Backup charger (U405) uses TI's BQ24040DSQ charger IC.

User can monitor the charger status by monitoring the following signals:

Signal Name	Pin Name	Pin Type	Usage
–	–	–	–
CHG_BAT1_PFAIL	PG4	Input GPIO	Monitor the input voltage to the charger: '0' = Input voltage is normal, '1' = Input voltage falls below the threshold (< 3.45V).
~CHG_BAT1_ON	PG5	Input GPIO	Monitor the charging status: '0' = battery is being charged, '1' = not charging or charging is completed

For RTC Backup battery charger (U406), the charger IC used is LTC1734LES6-4.2 and is configured to provide 75mA charging current.
The battery voltage can be monitored by reading the following signal:

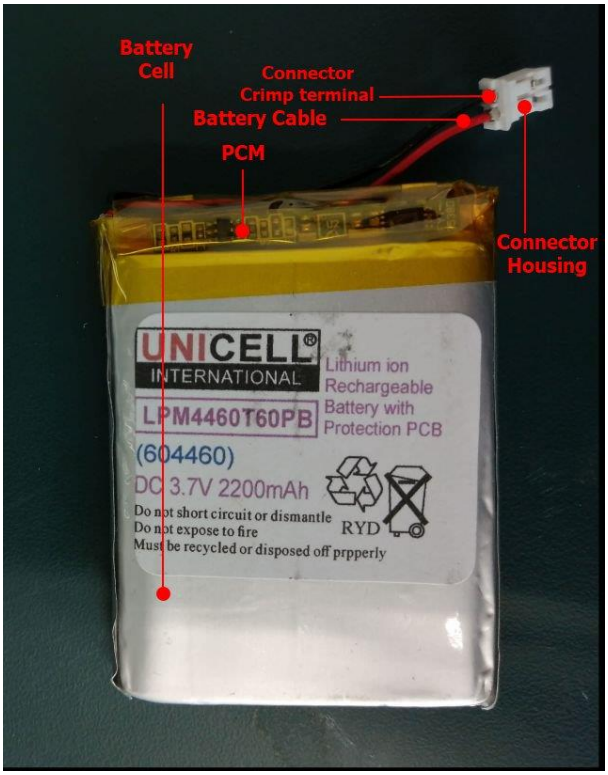
Signal Name	**Pin Name**	**Pin Type**	**Usage**
ADC_IN1	PG2	Analog	Measure the RTC Backup Battery voltage

Please take into account the voltage divider ratio (0.763) when calculating the battery voltage.

The Battery Connectors on the MANUCA DK (CN402, CN403) uses *B2B-PH-K-S* from JST.
The Battery pack connector should use the correct mating part that matches it:

- Housing: component part number is PHR-2. PHR-2 Housing
- Crimp terminal: component part number is SPH-002T-P0.5S. SPH-002T-P0.5S Crimp Terminal

Make sure to use the correct type of battery connector and ensure that the battery wire *polarity* is correct when connecting to the Battery Connector on the MANUCA DK.
Picture below shows the battery pack with the battery wire, the connector (housing, crimp terminal) and the wire connection polarity:



Safety Precaution: Follow the battery pack wire polarity connection as shown above. **Do not** reverse the polarity connection to the connector.

Main Backup Battery (BATT1)

The Main Backup Battery Charger is capable of charging any type of single-cell Lithium Ion or Lithium Polymer battery with 1A charging current and a fixed 10 hour safety timer for charge time-out.
For optimum use, the recommended specs for the Main backup battery is as follow:

- Single cell (1S), rechargeable Lithium Polymer or Lithium Ion.
- Nominal Capacity: between 1000mAH ~ 5000mAH. Larger capacity implies longer operating hours.
- Nominal voltage: 3.7V ~ 3.8V.
- Operating voltage range: 3.2V ~ 4.2V.
- Discharge current: minimum 1A. Recommended to use 2A or above if heavy load is expected (eg. when connected the board with many external sensors/devices that consume large amount of current).
- Include Protection Circuit Module (PCM).

Example:
Li-Polymer 785060

RTC Backup Battery (BATT2-RTC)

The charging current for the RTC Backup Battery is fixed at around 75mA. As such, when selecting the RTC backup battery, one must take into account the amount of time required to fully charge the battery.
The recommended rechargeable battery pack for the RTC backup battery is as follow:

- Single cell (1S) Lithium Polymer or Lithium Ion.
- Nominal Capacity: between 70mAH ~ 200mAH. Use larger capacity to support longer power shutdown period.
- Nominal voltage: 3.7V ~ 3.8V.
- Operating voltage range: 3.2V ~ 4.2V.
- Discharge current: minimum 10mA.
- Include Protection Circuit Module (PCM).

Example:
Li-Polymer 401230

USB

The USB connector on MANUCA DK uses a USB micro-AB type receptacle connector, CN102. It is based on USB 2.0 standard, support both low-speed (1.5MBps) and full-speed (12MBps) data rate. It can be programmed to work as USB-OTG, USB Host, or USB Peripheral.

USB OTG

AS USB OTG, the MANUCA DK performing both master and slave roles.
As of this writing, the USB OTG mode is not yet supported.

USB Host

The MANUCA DK will act as a Host, and provide 5V power supply through the VBUS line to the USB connector. The 5V power can be turned on/off and can supply up to 500mA of current. Program the USB function to act as USB Host, and connect an external USB device to the USB port to activate the USB host function.
To enable or disable the 5V VBUS supply to the USB connector, the software need to program and monitor the following pins:

Signal Name	Pin Name	Pin Type	Usage
USB_PowerOn	PG6	Output GPIO	'0'= Disable 5V VBUS, '1'= Enable 5V VBUS
USB_OverCurrent	PG7	Input GPIO	USB OTG 5V VBUS power condition: '0'= VBUS is faulty, either due to current exceed 0.6A, voltage fall below 2.5V, or overheated, '1'= no fault

When the VBUS power is turned on, the LED LD202 will light up. If the VBUS is faulty, LED LD201 will light up.

USB Peripheral

Program the USB function to act as USB peripheral, and Connect it to a host (eg. Computer).

Ethernet

The MANUCA DK supports 10M/100M Ethernet communication via a Ethernet PHY LAN8742A-CZ (U202) and RJ45 connector (CN201).
The Ethernet PHY is connected to the MCU's built-in MAC controller via the RMII interface. The Ethernet also support both full-duplex and half-duplex operation, auto-negotiation, as well as auto-polarity detection and correction (auto-MDIX), thus eliminating the hassle of having to switch between using straight-through LAN cable and crossover LAN cable.
For detailed signals connection/mapping between the Ethernet PHY and the MCU, refer to APPENDIX A for the details.

MicroSDCard

The MicroSDCard support the industry standard SD/SDIO MMC card host interface.
It supports SD/SDHC card with storage capacity up to 32GB. SDXC and SDUC cards are not supported currently.
The MANUCA DK uses generic SPI bus mode as the default communication mode between the uSDCard and the MCU. SD bus mode is also possible, but that required the change of hardware setting and software support.

Below is the pins connection between the MicroSDcard holder (CN102)and the MCU:

Signal Name	MCU Pin Name	uSDCard Pin Name/no.	SPI mode Function
SDMMC1_D1	PC9	DAT3/CS (pin2)	SPI3_CS
SDMMC1_D2	PC10	CLK (pin5)	SPI3_SCLK
SDMMC1_D3	PC11	DAT0 (pin7)	SPI3_MISO
SDMMC1_CK	PC12	CMD (pin3)	SPI3_MOSI
SDMMC1_CD	PD0	-	Card presence detect: '0'= card is inserted/present, '1'= no card detected

Accelerometer Sensor

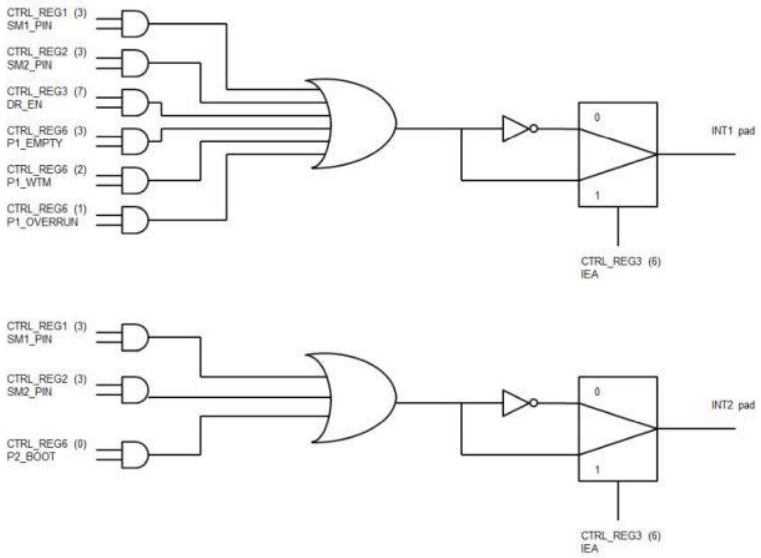
A 3-axis linear accelerometer (U103) is built-in to the MANUCA DK for motion related applications. The chipset used is LIS3DSH from STMicroelectronics.

The accelerometer interface to the MCU is based on I2C bus. It can support both standard mode (100KBits/s) and full speed (400KBits/s) operation.
The MCU can communicate with the accelerometer via I2C1 bus at I2C address 0x36.
Two Interrupt signals from the accelerometer (INT1, INT2) are used for alerting the MCU when the pre-programmed user-defined event occured. In this way, the accelerometer can continuously working while the MCU is in sleep mode.

Below is the list of Interrupt lines and its associated functions:

Signal Name	Pin Name	Function
~INT1-DRDY_ACCEL	PD11	Interrupt INT1 for Data-ready signal (DRDY) or State Machine status from Accelerometer: '0'= new set of measured data is available, '1'= no new data (default)
~INT2_ACCEL	PD12	Interrupt INT2 from accelerometer: '0'= interrupt INT2 event occurs (as per programmed), '1'= no new event (default)

Block Diagram below shows the accelerometer registers that can be programmed to generate the interrupt events (INT1, INT2):



For more detailed explanation, refer to Application Note AN3393.

Temperature Sensor

There are two temperature sensors available on MANUCA DK:

- Temperature sensor 1 (U102)
- Temperature sensor 2 (U103)

The temperature sensor 1 uses TI's TMP75AID. It is used for sensing the local ambient temperature, such as the temperature inside the MANUCA DK's casing/enclosure.
It can be accessed via I2C1 bus at address 0x93. It also provides an interrupt line that can be programmed to alert the MCU, such as overtemperature. Refer to Appendix A table, pin 79 description for the usage.
The temperature sensor 2 make use of the temperature sensor embedded inside the accelerometer sensor.
Since it is placed near the high power dissipating area (ie. DC-DC converters), it can be used for estimating the MANUCA DK's hotspot temperature. Refer to the *Accelerometer Sensor* section for more details.

LED Indicators

Below is the list of LED indicators on the MANUCA DK:

LED	Function / Indicator
LD201	Illuminate when USB VBUS is faulty (USB operates in Host mode)
LD202	Illuminate when USB VBUS power is turned on (USB operates in Host mode)
LD203,LD204,LD205	For application use. Programmable by user
LD401	Illuminates when 5V_SOURCE power is turned on
LD402	Illuminates when 12V DC IN power is turned on.
LD403	Illuminates when 3V3_OUT power is turned on.
LD404	Illuminates when 5V_OUT power is turned on.

Push Buttons

There are three push buttons on the board, each used for different purpose:

Push Button	Function / Indicator
SW101	SW RESET: Software/user defined button.
SW102	HW RESET: MANUCA DK hardware system reset button. Used for reseting or to re-initialize the hardware circuitry without power cycle the board
SW501	WiFi RESET: for reseting the plug-in Wireless Module

Serial Debug Interface

The serial debug is available on UART3 port of the MCU. It can be used by the software for capturing and debugging data streams through a remote serial terminal.
The debug connector (CN301) uses a 2.54mm pitch 6-pin header.
The UART3 signals are based on 3.3V CMOS/TTL logic level.

Below is the list of the signals available on the Serial debug connector:

Connector pin no.	Signal Name	MCU pin Name	Function
1	GND	-	Ground connection
2	N.C	-	-
3	VCC (+5V)	-	5V DC power to MANUCA DK
4	UART3_RX	PD9	UART3 Receive Signal from Serial Debug
5	UART3_TX	PD8	UART3 Transmit Signal to Serial Debug
6	N.C	-	-

To connect the serial debug to a debug host (eg. Computer/notebook), it is recommended to use a TTL-to-USB serial converter/cable.
Here are the list:

- FTDI: TTL-232R-3V3
- Adafruit: FTDI Serial TTL-232 USB Cable

  Take note of the connector orientation when plugging in the serial converter to MANUCA DK.
  The black color wire on the serial converter denotes GND (pin no. 1) and should be aligned and mated with pin 1 of connector CN301.

JTAG/SWD Interface

The JTAG/SWD interface (CN305) support both JTAG and SWD (Serial Wire Debug) protocols. It is used for programming and debugging the MCU.
The interface connector follows the standard 10-pin ARM Cortex connector and its pinout assignment.

The connector used is FTSH-105-01-F-DV-K, and the pinout assignment is as follow:

Pin no.	Description	Pin no.	Description
1	VCC	2	TMS/SWDIO
3	GND	4	TCK/SWDCLK
5	GND	6	TDO/SWO
7	-	8	TDI/NC
9	GND Detect	10	nRESET

Here is the list of the JTAG/SWD debugger/programmer for MANUCA DK:

- STLINK-V3SET modular in-circuit debugger and programmer

Expansion Connectors

The expansion Connectors consist of two connectors: CN101, CN103. It provides a way for extending the functionality of the MANUCA DK by connecting it to an extension board (daughter board).
These are double row, 2.54mm pitch, 20 contacts female with 8.5mm height connectors from Harwin M20-7831042.

The expansion connectors provides the power supply (3.3V, 5V), SPI bus and general purpose input output (GPIO) signals from the MCU that can be programmed and reconfigured to perform specific task.

Connector CN101 pinout Assignment:

Connector Pin no.	Signal Name	MCU pin Name	Function
1	GND	-	Common Ground
2	GND	-	Common Ground
3	5V_PER	-	5V DC supply for external devices. Current is limited to 1 Amp
4	3V3_PER	-	3.3V DC supply for external devices. Current is limited to 1 Amp
5	PB11	PB11	General purpose I/O (GPIO) signal
6	SW_RESET	PG8	Connected to Software/user-defined push button SW101
7	SPI5_MISO	PF8	SPI-5 Master-in Slave-out signal to MCU
8	PE13	PE13	General purpose I/O (GPIO) signal
9	SPI5_MOSI	PF9	SPI-5 Master-out Slave-in signal from MCU
10	PE8	PE8	General purpose I/O (GPIO) signal
11	SPI5_CLK	PF7	SPI-5 Clock signal from MCU
12	PG1	PG1	General purpose I/O (GPIO) signal
13	PF13	PF13	General purpose I/O (GPIO) signal
14	PG0	PG0	General purpose I/O (GPIO) signal

15	PB2	PB2	General purpose I/O (GPIO) signal
16	PF12	PF12	General purpose I/O (GPIO) signal
17	PB0	PB0	General purpose I/O (GPIO) signal
18	PB1	PB1	General purpose I/O (GPIO) signal
19	GND	-	Common Ground
20	GND	-	Common Ground

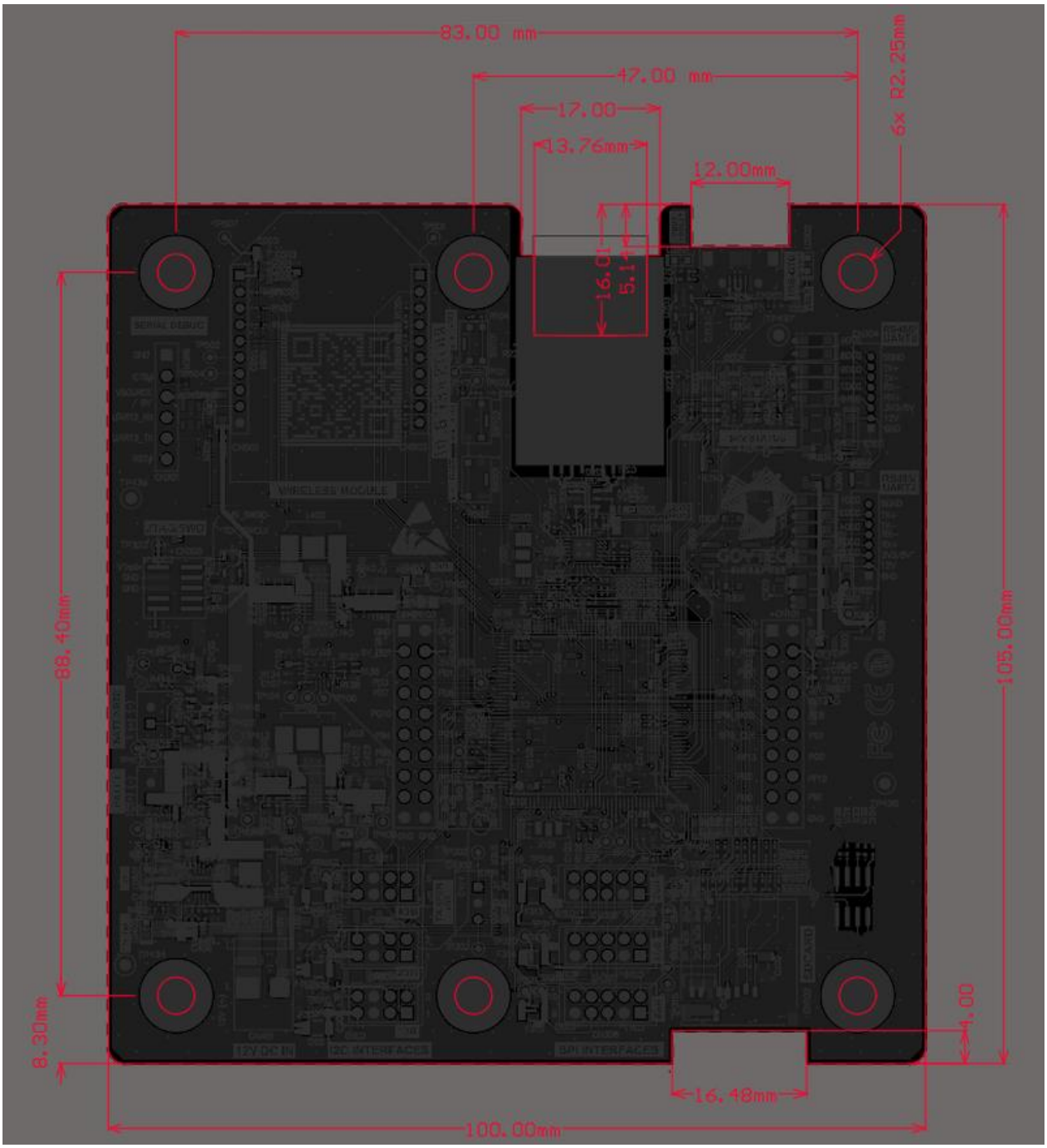
Connector CN103 pinout Assignment:

Connector Pin no.	Signal Name	MCU pin Name	Function
1	GND	-	Common Ground
2	GND	-	Common Ground
3	5V_PER	-	5V DC supply for external devices. Current is limited to 1 Amp
4	3V3_PER	-	3.3V DC supply for external devices. Current is limited to 1 Amp
5	PD3	PD3	General purpose I/O (GPIO) signal
6	PD1	PD1	General purpose I/O (GPIO) signal
7	PD7	PD7	General purpose I/O (GPIO) signal
8	PD6	PD6	General purpose I/O (GPIO) signal
9	PG10	PG10	General purpose I/O (GPIO) signal
10	PG9	PG9	General purpose I/O (GPIO) signal
11	PB4	PB4	General purpose I/O (GPIO) signal
12	PG14	PG14	General purpose I/O (GPIO) signal
13	PB8	PB8	General purpose I/O (GPIO) signal
14	PB7	PB7	General purpose I/O (GPIO) signal
15	PF3	PF3	General purpose I/O (GPIO) signal

16	PF2	PF2	General purpose I/O (GPIO) signal
17	PF5	PF5	General purpose I/O (GPIO) signal
18	PF4	PF4	General purpose I/O (GPIO) signal
19	GND	-	Common Ground
20	GND	-	Common Ground

For more details, please refer to Appendix A.

PCB Mechanical Outline



Precautions

- To avoid fire hazard and other safety concerns, use only Lithium polymer battery pack that has built-in protection circuit module (PCM).
- The MANUCA DK is not a complete product. As such, it is unlikely to meet all the applicable regulatory and safety compliance standards which normally associated with similar products.

Appendix A

MANUCA DK MCU Pinout Mapping and functions:

Pin no.	Pin Name	Pin Type	Alternate Functions	Signal Name	Remarks
–	–	–	–	–	–
1	PE2	I/O	SYS_TRACECLK	N.C	-
2	PE3	I/O	SYS_TRACED0	N.C	-
3	PE4	I/O	SPI4_NSS	SPI4_CS	SPI interface to connector CN308
4	PE5	I/O	SPI4_MISO	SPI4_MISO	SPI interface to connector CN308
5	PE6	I/O	SPI4_MOSI	SPI4_MOSI	SPI interface to connector CN308
6	VBAT	Power	-	-	-
7	PC13	I/O	RTC_TAMP1	RTC_TAMP1	Tampered detection signal: '0'= tampered, '1'= normal (default)
8	PC14/OSC32_IN	I/O	RCC_OSC32_IN		
9	PC15/OSC32_OUT	I/O	RCC_OSC32_OUT		
10	PF0	I/O	I2C2_SDA	I2C2_DATA	I2C2 interface to connector CN310
11	PF1	I/O	I2C2_SCL	I2C2_CLK	I2C2 interface to connector CN310
12	PF2	I/O	GPIO_Input	PF2	GPIO signal. Routed to board expansion connector CN103

13	PF3	I/O	GPIO_Input	PF3	GPIO signal. Routed to board expansion connector CN103
14	PF4	I/O	GPIO_Input	PF4	GPIO signal. Routed to board expansion connector CN103
15	PF5	I/O	GPIO_Input	PF5	GPIO signal. Routed to board expansion connector CN103
16	VSS	Power			
17	VDD	Power			
18	PF6	I/O	GPIO_Output	~XBEE_SPI_SSEL	Wireless module SPI Slave select: '0'= Select '1'= Not select (default)
19	PF7	I/O	SPI5_SCK	SPI5_CLK	SPI5 signal. Routed to board expansion connector CN101
20	PF8	I/O	SPI5_MISO	SPI5_MISO	SPI5 signal. Routed to board expansion connector CN101
21	PF9	I/O	SPI5_MOSI	SPI5_MOSI	SPI5 signal. Routed to board expansion connector CN101
22	PF10	I/O	GPIO_Input	~XBEE_SPI_ATTN	Wireless module SPI attention
23	PH0/OSC_IN I/O	RCC_OSC_IN	N.C		
24	PH1/OSC_OUT	I/O	RCC_OSC_OUT	N.C	

25	NRST	Reset		NRST	SensorPOD hardware reset: '0'= Reset asserted, '1'= normal operation (default)
26	PC0	I/O		N.C	
27	PC1	I/O	ETH_MDC		Ethernet PHY signal
28	PC2	I/O	SPI2_MISO	SPI2_MISO	SPI interface to connector CN307
29	PC3	I/O	SPI2_MOSI	SPI2_MOSI	SPI interface to connector CN307
30	VDD	Power			
31	VSSA	Power			
32	VREF+	Power			
33	VDDA	Power			
34	PA0/WKUP	I/O	SYS_WKUP1	N.C	
35	PA1	I/O	ETH_REF_CLK		Ethernet PHY signal
36	PA2	I/O	ETH_MDIO		Ethernet PHY signal
37	PA3	I/O	USART2_RX	USART2_RX USART2/RS485 interface to connector CN302	
38	VSS	Power			
39	VDD	Power			
40	PA4	I/O	SPI1_NSS	SPI1_CS	SPI interface to connector CN306
41	PA5	I/O	SPI1_SCK	SPI1_SCK	SPI interface to connector CN306

42	PA6	I/O	SPI1_MISO	SPI1_MISO	SPI interface to connector CN306
43	PA7	I/O	ETH_CRS_DV		Ethernet PHY signal
44	PC4	I/O	ETH_RXD0		Ethernet PHY signal
45	PC5	I/O	ETH_RXD1		Ethernet PHY signal
46	PB0 *	I/O	GPIO_Output	PB0	GPIO signal. Routed to board expansion connector CN101
47	PB1	I/O	GPIO_Input	PB1	GPIO signal. Routed to board expansion connector CN101
48	PB2	I/O	GPIO_Input	PB2	GPIO signal. Routed to board expansion connector CN101
49	PF11	I/O	GPIO_Output	~XBEE_RESET	Wireless module reset: '0'= reset asserted, '1'= normal operation (default)
50	PF12	I/O	GPIO_Input	PF12	GPIO signal. Routed to board expansion connector CN101
51	VSS	Power			
52	VDD	Power			

53	PF13	I/O	GPIO_Input	PF13	GPIO signal. Routed to board expansion connector CN101.
54	PF14	I/O	I2C4_SCL	I2C4_CLK	I2C2 interface to connector CN311.
55	PF15	I/O	I2C4_SDA	I2C4_DATA	I2C2 interface to connector CN311.
56	PG0	I/O	GPIO_Input	GP0	GPIO signal. Routed to board expansion connector CN101.
57	PG1	I/O	GPIO_Input	GP1	GPIO signal. Routed to board expansion connector CN101.
58	PE7	I/O	GPIO_Input	N.C	-
59	PE8	I/O	GPIO_Input	PE8	GPIO signal. Routed to board expansion connector CN101.
60	PE9	I/O	GPIO_Output	LED_ON_1	Software or user programmable LED
61	VSS	Power			
62	VDD	Power			
63	PE10	I/O	GPIO_Output	LED_ON_2	Software or user programmable LED

64	PE11	I/O	GPIO_Output	LED_ON_3	Software or user programmable LED
65	PE12	I/O	SPI4_SCK	SPI4_SCK	SPI interface to connector CN308
66	PE13	I/O	GPIO_Input	PE13	GPIO signal. Routed to board expansion connector CN101.
67	PE14	I/O	GPIO_Input	N.C	
68	PE15	I/O	GPIO_Input	N.C	
69	PB10	I/O	SPI2_SCK	SPI2_SCK	SPI interface to connector CN307
70	PB11	I/O	GPIO_Input	PB11	GPIO signal. Routed to board expansion connector CN101.
71	VCAP_1	Power			
72	VDD	Power			
73	PB12	I/O	SPI2_NSS	SPI2_CS	SPI interface to connector CN307
74	PB13	I/O	ETH_TXD1	RMII_TXD1	Ethernet PHY signal
75	PB14	I/O	GPIO_Input	N.C	
76	PB15	I/O	GPIO_Input	N.C	
77	PD8	I/O	USART3_TX	UART3_TX	UART3 interface to connector CN301. For MCU serial debugging.

78	PD9	I/O	USART3_RX	UART3_RX	UART3 interface to connector CN301. For MCU serial debugging.
79	PD10	I/O	GPIO_Input	OVERTEMP_ALERT	Alert signal from Temp sensor (U102, TMP75AID): '0'= normal operation (default), '1'= preset temp threshold trigger
80	PD11	I/O	GPIO_Input	~INT1-DRDY_ACCEL	Interrupt INT1 for Data-ready signal (DRDY) or State Machine status from Accelerometer: '0'= new set of measured data is available, '1'= no new data (default)
81	PD12	I/O	GPIO_Input	~INT2_ACCEL	interrupt 2 signal from accelerometer: '0'= normal operation (default), '1'= interrupt 2 trigger

82	PD13	I/O	GPIO_Input	PWR_SEL	Power source indicator from power MUX (U402, TPS2121): '0'= power source is supplied by the internal Li-Ion Battery 1, '1'= Power source is supplied by external 12VDC power
83	VSS	Power			
84	VDD	Power			
85	PD14	I/O	GPIO_Input	PG_5V	5V DC-DC converter (U404) output power status: '0'= failure, '1'= good (normal)
86	PD15	I/O	GPIO_Input	PG_3V3	3.3V DC-DC converter (U403) output power status: '0'= failure, '1'= good (normal)
87	PG2	I/O	GPIO_Input	ADC_IN1	ADC1 reading for Li-Ion battery 2 voltage.
88	PG3	I/O	GPIO_Input	N.C	

89	PG4	I/O	GPIO_Input	CHG_BAT1_PFAIL	Li-Ion battery 1 charger (U405) input voltage indicator:, '0'= above UVLO (>3.45V, normal), '1'= below UVLO (failure)
90	PG5	I/O	GPIO_Input	~CHG__BAT1_ON	Li-Ion battery 1 charger (U405) charging status: '0'= charging, '1'= no charging or charge complete
91	PG6	I/O	GPIO_Output	USB_PowerOn	USB OTG 5V VBUS power control: '0'= Disable 5V VBUS, '1'= Enable 5V VBUS
92	PG7	I/O	GPIO_Input	USB_OverCurrent	USB OTG 5V VBUS power condition: '0'= VBUS current exceed 0.6A, voltage fall below 2.5V, or overheated (faulty), '1'= no fault (default)
93	PG8	I/O	GPIO_Input	SW_RESET	Trigger signal for Software reset: '0'= normal operation (default), '1'= Initiate software reset process
94	VSS	Power			

95	VDDUSB	Power			
96	PC6	I/O	USART6_TX	USART6_TX	UART6 interface to WiFi Module
97	PC7	I/O	USART6_RX	USART6_RX	UART6 interface to WiFi Module
98	PC8	I/O	SDMMC1_D0	SDMMC1_D0	SDIO (DAT0) interface to SDCard
99	PC9	I/O	SDMMC1_D1	SDMMC1_D1	SDIO/SPI mode (DAT1/CS) interface to SDCard
100	PA8	I/O	GPIO_Input	N.C	
101	PA9	I/O	USB_OTG_FS_VBUS	USB_VBUS	USB VBUS detect
102	PA10	I/O	USB_OTG_FS_ID	USB_ID	USB ID detect
103	PA11	I/O	USB_OTG_FS_DM	USBD_N	USB Data Bus D-
104	PA12	I/O	USB_OTG_FS_DP	USBD_P	USB Data Bus D+
105	PA13	I/O	SYS_JTMS-SWDIO	TMS_SWDIO	JTAG/SWD interface for MCU. Connect to connector CN305.
106	VCAP_2	Power			
107	VSS	Power			
108	VDD	Power			
109	PA14	I/O	SYS_JTCK-SWCLK	TCK_SWCLK	JTAG/SWD interface for MCU. Connect to connector CN305.

110	PA15	I/O	SYS_JTDI	TDI	JTAG interface for MCU. Connect to connector CN305.
111	PC10	I/O	SDMMC1_D2	SDMMC1_D2	SDIO/SPI mode (DAT2/SCLK) interface to SDCard
112	PC11	I/O	SDMMC1_D3	SDMMC1_D3	SDIO/SPI mode (DAT3/MISO) interface to SDCard
113	PC12	I/O	SDMMC1_CK	SDMMC1_CK	SDIO/SPI mode (CLK/MOSI) interface to SDCard
114	PD0	I/O	GPIO_Input	SDMMC1_CD	SDCard presence detection: '0'= card is inserted/present, '1'= no card (default)
115	PD1	I/O	GPIO_Input	PD1	GPIO signal. Routed to board expansion connector CN103.
116	PD2	I/O	SDMMC1_CMD	SDMMC1_CMD	SDIO (CMD) interface to SDCard
117	PD3	I/O	GPIO_Input	PD3	GPIO signal. Routed to board expansion connector CN103
118	PD4	I/O	USART2_DE	N.C	

119	PD5	I/O	USART2_TX	USART2_TX	USART2/RS485 interface to connector CN302
120	VSS	Power			
121	VDD	Power			
122	PD6	I/O	GPIO_Input	PD6	GPIO signal. Routed to board expansion connector CN103
123	PD7	I/O	GPIO_Input	PD7	GPIO signal. Routed to board expansion connector CN103
124	PG9	I/O	GPIO_Input	PG9	GPIO signal. Routed to board expansion connector CN103
125	PG10	I/O	GPIO_Input	PG10	GPIO signal. Routed to board expansion connector CN103
126	PG11	I/O	ETH_TX_EN	RMII_TX_EN	Ethernet PHY Signal interface
127	PG12	I/O	USART6_RTS	~USART6_RTS_out	UART6 RTS signal to Wireless Module Connector CN502
128	PG13	I/O	ETH_TXD0	RMII_TXD0	Ethernet PHY Signal interface
129	PG14	I/O	GPIO_Input	PG14	GPIO signal. Routed to board expansion connector CN103
130	VSS	Power			

131	VDD	Power			
132	PG15	I/O	USART6_CTS	~USART6_CTS_in UART6	CTS signal from Wireless Module Connector CN502
133	PB3	I/O	SYS_JTDO-SWO	TDO_SWO	JTAG/SWD interface for MCU. Connect to connector CN305
134	PB4	I/O	GPIO_Input	PB4	GPIO signal. Routed to board expansion connector CN103
135	PB5	I/O	SPI1_MOSI	SPI1_MOSI	SPI interface to connector CN306
136	PB6	I/O	I2C1_SCL	I2C1_CLK	I2C1 Clock line interface to onboard temperature sensor (U102), Accelerometer (U103), and connector CN309.
137	PB7	I/O	GPIO_Output	PB7	GPIO signal. Routed to board expansion connector CN103
138	BOOT0	Boot	BOOT0	BOOT0	Boot configuration pin for boot area selection: ‘0’ = BOOT_ADD0 (default), ‘1’= BOOT_ADD1

139	PB8	I/O	GPIO_Input	PB8	GPIO signal. Routed to board expansion connector CN103
140	PB9	I/O	I2C1_SDA	I2C1_DATA	I2C1 Data line interface to/from onboard temperature sensor (U102), Accelerometer (U103), and connector CN309.
141	PE0	I/O	UART8_RX	UART8_RX	USART8/RS485 RX line interface from connector CN304
142	PE1	I/O	UART8_TX	UART8_TX	USART8/RS485 TX line interface to connector CN304
143	PDR_ON	Reset			‘0’= Disable internal reset, ‘1’= Enable internal reset (default)
144	VDD	Power			