# LinkIt 2523 HDK User's Manual



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# 1. Introduction

MediaTek LinkIt™ 2523 hardware development kit (HDK) is a fully functional development platform for RTOS for IoT and Wearable applications powered by MediaTek 2523G, an ARM Cortex-M4 core-based microcontroller unit (MCU). The HDK has rich connectivity features and interfaces such as SPI, I2S, PCM, UART, ADC, PWM, JTAG and clock out generators.

The LinkIt 2523 HDK enables application development, prototyping and evaluation using sensors, Bluetooth, Bluetooth low energy, GNSS, audio (speech, headset and speaker), MIPI, serial, camera serial interface, keypad, battery management, micro SD and eMMC portable storage support, USB (2.0). The LinkIt 2523 HDK also has built-in antenna that is able to receive Bluetooth (2.1 to 4.0), and GNSS (GPS, GLONASS and BeiDou) signals. In addition, the USB to serial wire debug (SWD) converter and JTAG feature provides convenient development and debugging process.

The MT2523 HDK supports OpenSDA to provide more streamlined development for debugging and flashing the binary code.

This user manual covers MT2523G and MT2523D integrated chipsets. The functions and pin assignments from both chipsets are identical, except the MT2523D doesn't support GNSS communication.

The user manual guides you through the following.

Describing the hardware features of the LinkIt 2523 HDK.
Configuring the LinkIt 2523 HDK with specific pin and jumper assignments.
Providing the hardware schematics for more detailed configuration and reference design.
Listing bill of materials (BOM) for the LinkIt 2523 HDK.

# 2. Get Started with the HDK

This section provides details on how to configure the HDK and install the required peripheral drivers for the full operation of the development platform. The details of this section are used in the LinkIt 2523 Getting Started Guide.

## 2.1. Configuring the LinkIt 2523 HDK

Before commencing the application development, you need to configure the HDK.

The front of the LinkIt 2523 HDK is shown in Figure 1.

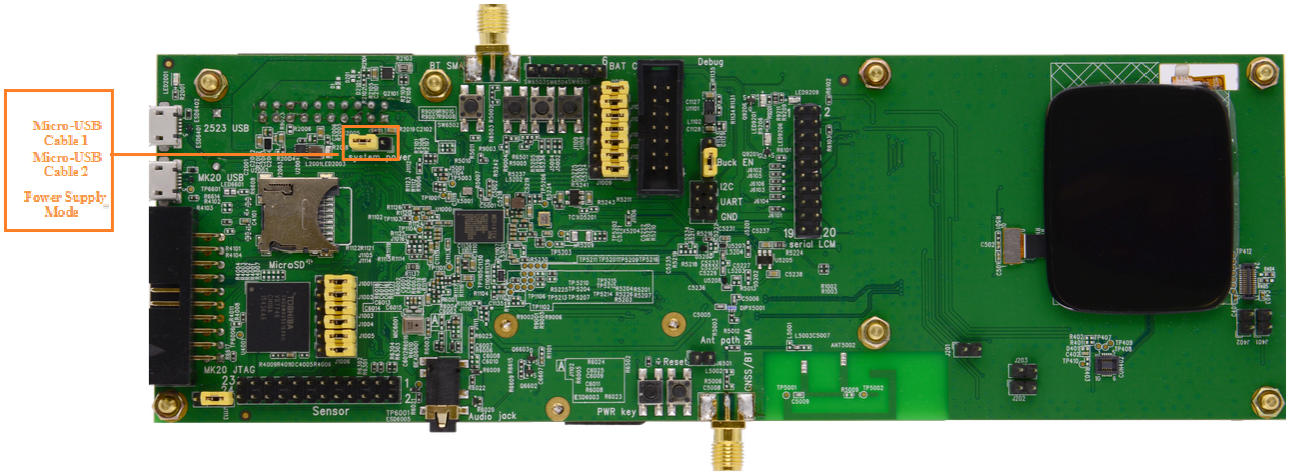



***Figure 1. LinkIt 2523 HDK's front view***

The Micro-USB Cable 1 can be used for powering up the board and downloading the binary using the LinkIt 2523 Flash Tool.
The Micro-USB Cable 2 can be used for debugging with GDB and downloading the binary using Keil IDE.

## 2.2. Installing the LinkIt 2523 HDK drivers

This section describes how to install LinkIt 2523 HDK drivers used on PCs running Microsoft Windows. To install the driver for getting the log:

1) Connect the UART 0 on LinkIt 2523 HDK to the computer using a USB to UART cable, such as PL2303 USB to TTL cable.
2) Download and install the USB to UART cable driver, such as PL2303 USB to TTL cable driver from here.
3) Connect the MT2523 HDK to the computer using the micro-USB cable 1,
4) Open Windows Control Panel, click **System** and:

5 ) On Windows 7 and 8, click **Device Manager**. On Windows XP, click the **Hardware** tab and then **Device Manager**. In **Device Manager**, navigate to **Ports (COM & LPT)** (see Figure 2). A new COM device should appear under **Ports (COM & LPT)** in **Device Manager**, as shown in Figure 2. Note the `COMx` port number of the **Prolific USB-to-Serial Comm Port**, this information is needed to complete configuration of the SDK. Use that port to send log from your LinkIt 2523 HDK.

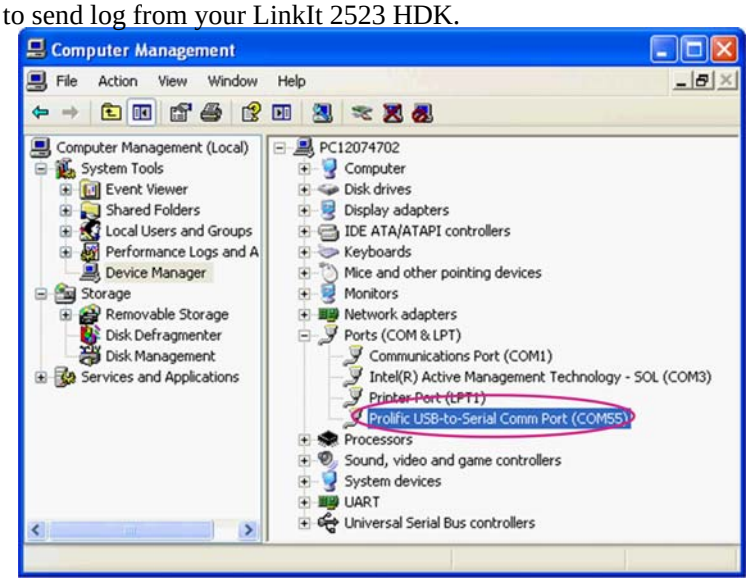



***Figure 2. Device COM port for logging on your PC***

To install the driver for debugging:

1) Download and install the Windows serial port driver from here.

2) Connect the LinkIt 2523 HDK to the computer using the micro-USB cable 1 and the micro-USB cable 2,

3) Open Windows Control Panel, click **System** and:

On Windows 7 and 8, click **Device Manager**.

On Windows XP, click the **Hardware** tab and then **Device Manager**.

4) In **Device Manager**, navigate to **Ports (COM & LPT)** (see Figure 3)

5) A new COM device should appear under **Ports (COM & LPT)** in **Device Manager**, as shown in Figure Note the `COMx` port number of the **mbed Serial Port**, this information is needed to complete configuration of the SDK. Use that port to send and receive data to and from your LinkIt 2523 HDK.

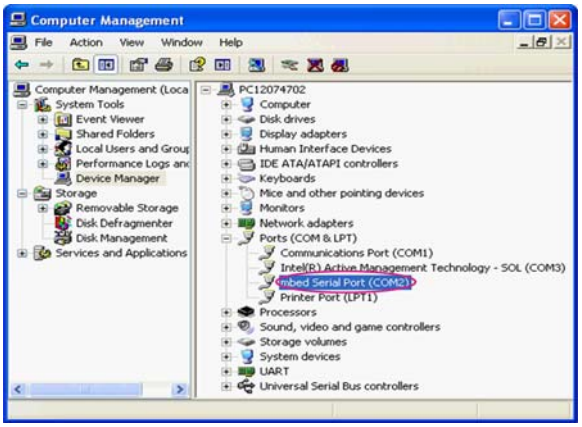



***Figure 3. Device COM port for debugging on your PC***

## 2.3 Downloading the project image using the LinkIt 2523 HDK as a removable storage

To update the FreeRTOS image only (SDK project image: `iot_sdk_demo.bin`) use the LinkIt 2523 development board as a removable disk drive according to the following steps:

1) Connect the LinkIt 2523 development board to your PC with a micro-USB cable.

2) Navigate to **Computer** on your PC to check if a new mass storage named **MT2523** is available under **Removable Disk**, as shown in Figure 4.

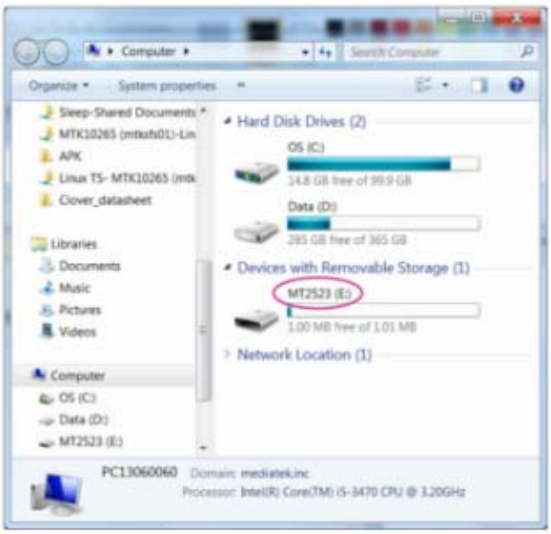



***Figure 4. LinkIt 2523 module connected as removable disk storage***

3) Open the **MT2523** removable storage, then drag and drop the image `iot_sdk_demo.bin` to the removable storage to complete downloading the flash.

# 3. Hardware Description

LinkIt 2523 HDK provides connections between the system on chip (SOC) and the peripherals, such as micro SD card, eMMC, MIPI LCM, serial LCM, touch panel, serial camera, sensor daughterboard, GNSS, Bluetooth, audio speech and high speed USB 2.0.

The top and bottom layout views (Figure 5 and Figure 6, respectively) show the positions of the peripherals on the HDK. Some of the peripherals are mutually exclusive. The eMMC and the micro SD, for example, cannot be used at the same time, as the corresponding pins can only be assigned to one function at a time.

The LinkIt 2523 HDK provides the following features for application development.

- ARM Cortex-M4 core-based LinkIt 2523G microcontroller.
  - Internal 160kB SRAM and 4MB PSRAM.
  - Internal 4MB serial flash.
- Rich interfaces.
  - Two I2Cs.
  - Four master SPIs and a slave SPI.
  - One master I2S and one slave I2S.
  - One PCM interface supports master.
  - Four UARTs.
  - Five 12-bit ADCs.
  - Five PWMs by alternative voltage level.
  - Two SDMMCs.
  - JTAG debugging support.
  - Five sets of clock outputs.
- Peripherals.
  - One serial camera interface supporting up to 3-bit mode image capture.
  - Two display modes by serial interface and MIPI which resolution is up to 320*320.
  - Keypad supported to simulate buttons like volume up/down, backward, enter.
  - Onboard speaker, onboard analog microphone and audio jack appliance.
- User-friendly customization.
  - Supports Bluetooth (2.4GHz) and GNSS onboard antenna connectivity and also an SMA connector for dedicated antenna connectivity.
  - Supports 2-wire SWD interface for debugging purposes.
  - Headers for convenient and accurate current measurement.

# LinkIt 2523 HDK User's Guide

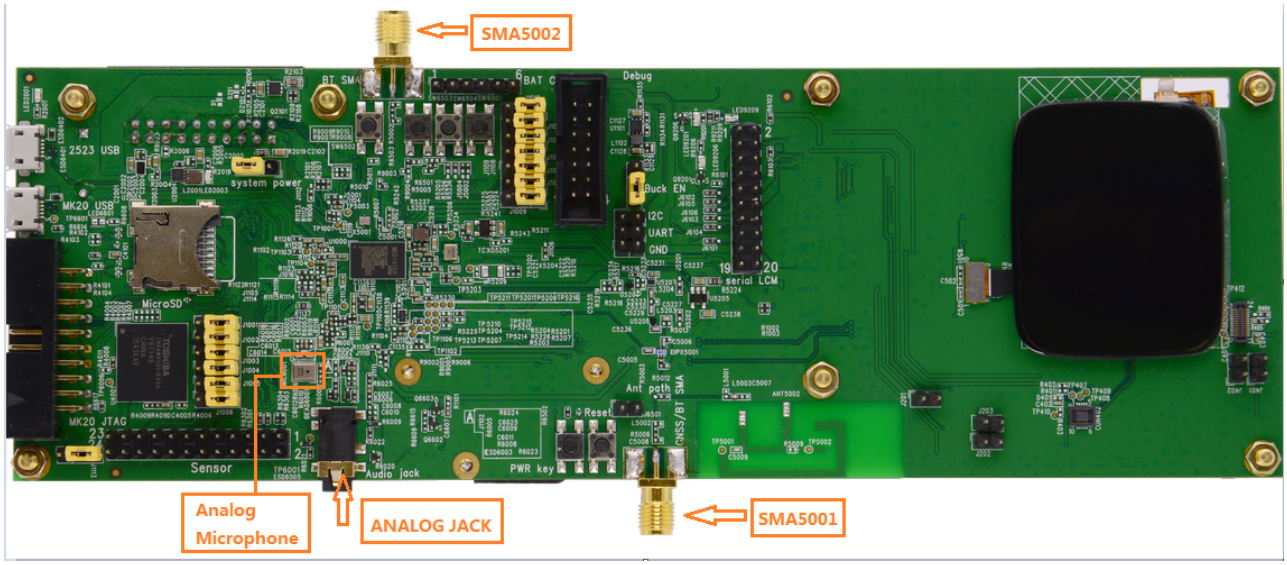



*Figure 5. LinkIt 2523 HDK's top view*

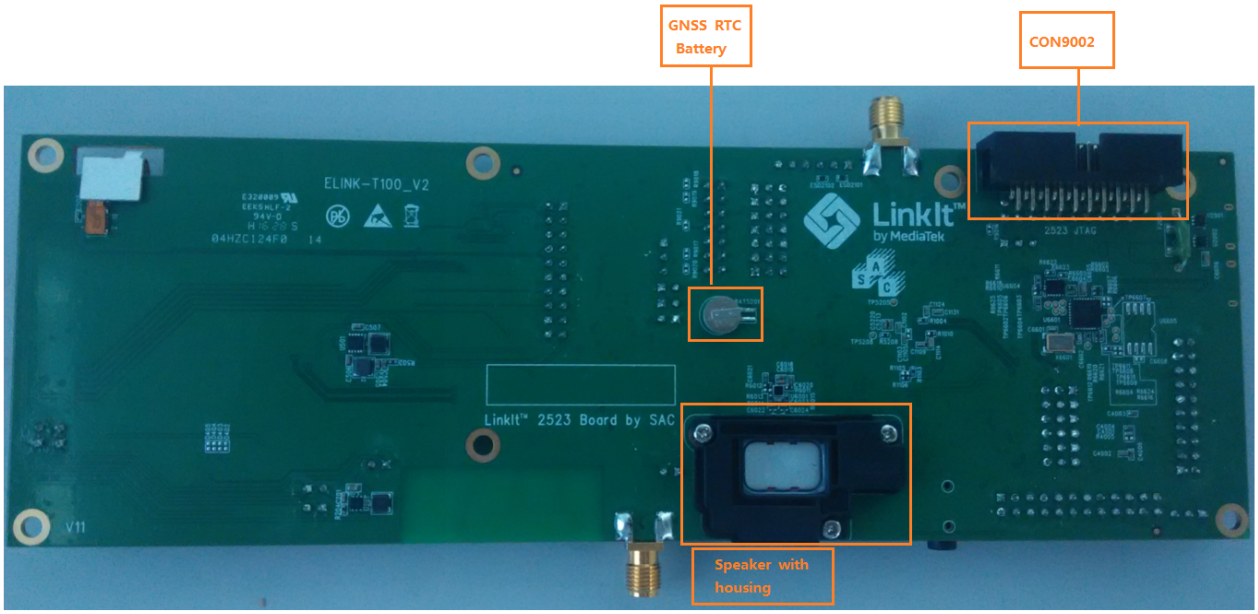



*Figure 6. LinkIt 2523 HDK's bottom view*

# 4. Hardware Feature Configuration

## 4.1. Microcontroller unit

The LinkIt 2523 HDK is powered by MediaTek 2523 SOC, designed for IoT applications and equipped with flexible pin assignments for custom applications.

MT2523 SOC is an ARM Cortex-M4 core-based architecture, with built-in Bluetooth and Bluetooth low energy connectivity support, GNSS, audio interface, internal PSRAM and flash storage. The LinkIt 2523 HDK provides peripheral support for the I2C, SPI, UART, ADC, PWM, clock generator, audio and SDMMC interfaces.

LinkIt 2523 featured applications include but are not limited to industrial applications and automation, medical signal processing applications such as sports physiological signal recording, long term medical data recording, home automation applications, tracking and safety applications using GNSS.

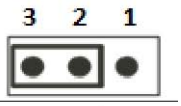
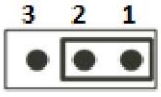
## 4.2. Power

This section describes the power source options for the LinkIt 2523 HDK. The HDK can operate powered by USB or a battery. To charge the battery the USB cable has to be connected. The board can enter the sleep mode using the PSRAM memory. The sleep mode can be enabled or disabled by the software. The LinkIt 2523 HDK also enables GPIO voltage setting configuration based on the supported components. It also can supply power to the storage, such as micro SD or eMMC. The HDK supports an active GNSS antenna that requires a power input, see section 4.2.4, "Powering on an active GPS antenna".

### 4.2.1. Powering up with the USB

Connect a micro USB cable directly to CON6401 or CON6601 to supply power to the HDK. Switch the jumper J2001 to pin 1 and pin 2, to charge the battery using a USB connector. To boot up the system without a battery, see the jumper setting in Table 1. The jumper J2001 location is shown in Figure 7.

***Table 1. Power input jumpers***

| | |
|---|---|
| **Power path switch** | Jumper J2001 is assigned for the power rail. The main power traces through jumper J2001 to the system.<br>Connect the jumper J2001 pins to set the power source from CON6401 or CON6601, as shown below.<br>  <br>Connect the jumper J2001 pins to set the power source from battery connector CON2101, as shown below.<br>  |

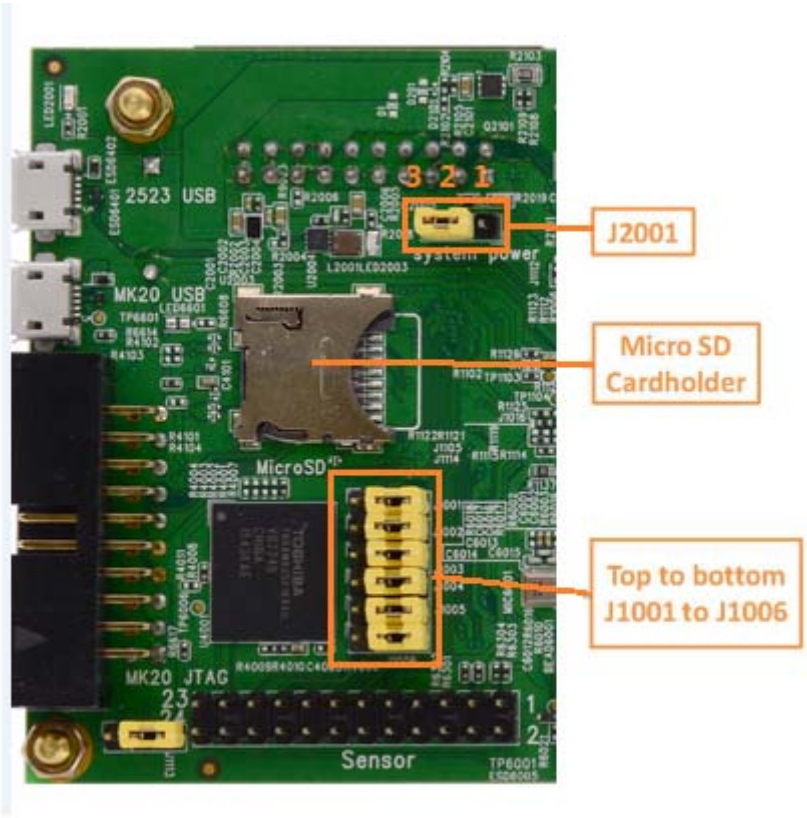
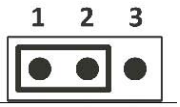
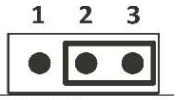



*Figure 7. The positions of J1111, J2001, J1001 to J1006, R1113, R4009, R4010 and Micro SD cardholder on the board*

### 4.2.2. Power source for digital I/O

LinkIt 2523 HDK supplies power to devices with different voltage support. GPIO voltage level customization is shown in Table 2. Jumper and resistor positions are specified in Figure 8.

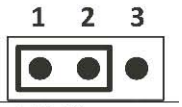
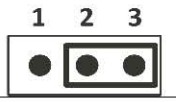
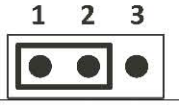
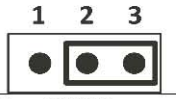
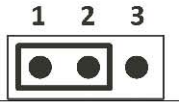
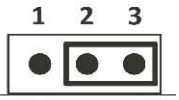
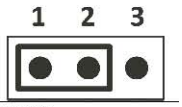
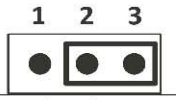
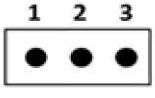
***Table 2. GPIO voltage level customization with jumper and pin (illustrated) settings***

| | |
|---|---|
| **Power rail DVDD_VIO_A voltage** | Connect the jumper J1106 pins to set the power rail DVDD_VIO_A to VIO28, as shown below.<br>  |
| | Connect the jumper J1106 pins to set the power rail DVDD_VIO_A to VIO18, as shown below.<br>  |
| **Power rail** | Connect the jumper J1108 pins to set the power rail DVDD_VIO_C to VIO28, as shown below. |

Connect the jumper J1106 pins to set the power rail DVDD_VIO_Ato VIO28, as shown below.

Connect the jumper J1106 pins to set the power rail DVDD_VIO_Ato VIO18, as shown below.

Connect the jumper J1108 pins to set the power rail DVDD_VIO_Cto VIO28, as shown below.

| | |
|---|---|
| **DVDD_VIO_C voltage** |  |
| | Connect the jumper J1108 pins to set the power rail DVDD_VIO_C to VIO18, as shown below. |
| |  |
| **Power rail DVDD_GPO voltage** | Connect the jumper J1109 pins to set the power rail DVDD_GPO to VIO28, as shown below. |
| |  |
| | Connect the jumper J1109 pins to set the power rail DVDD_GPO to VIO18, as shown below. |
| |  |
| **Power rail DVDD18_VIO18 voltage selection** | Connect the jumper J1110 pins to set the power rail DVDD18_VIO18 to VIO28, as shown below. |
| |  |
| | Connect the jumper J1110 pins to set the power rail DVDD18_VIO18 to VIO18, as shown below. |
| |  |
| **Power rail DVDD_VMC voltage** | Connect the jumper J1111 pins to set the power rail DVDD_VMC to VIO18, as shown below. |
| |  |
| | Connect the jumper J1111 pins to set the power rail DVDD_VMC to VIO28, as shown below. |
| |  |
| | Remove the jumper J1111 to select the power rail DVDD_VMC connected with VMC while the resistor R1113 is mounted. Mount the resistors R1113 and R4101, to use micro SD storage. |
| |  |

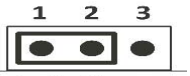
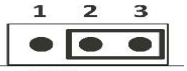
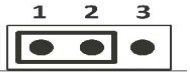
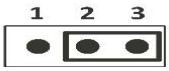
### 4.2.3. Powering on the eMMC or micro SD

The LinkIt 2523 HDK supports eMMC and micro SD card for storage. The HDK operates with either eMMC or micro SD card enabled but not both at the same time.

### 4.2.4. Powering on an active GPS antenna

The active GPS antenna on LinkIt 2523 HDK can be either software controlled or hardware activated. Table 3 provides details on how to determine if the antenna is activated by direct power supply or by software control. Adjust the jumpers J5201 and J5202 to change the settings. The jumper locations are shown in Figure 8.

***Table 3. Enabling the active GPS antenna on MT2523G with jumper pin settings (illustrated)***

| | |
|---|---|
| **Low noise amplifier activation control (Should be synchronized with J5202)** | Connect the jumper J5201 pins to enable the active GPS antenna using the power rail, as shown below.<br>  <br>Connect the jumper J5201 pins to enable the active GPS antenna controlled by software settings, as shown below.<br>  |
| **Active antenna power supply (Should be synchronized with J5201)** | Connect the jumper J5202 pins to supply power and enable the active GPS antenna using the power rail, as shown below.<br>  <br>Connect the jumper J5202 pins to supply power and enable the active GPS antenna controlled by software settings, as shown below.<br>  |

Connect the jumper J5201 pins to enable the active GPS antenna using the power rail, as shown below.

### 4.2.5. The LCM backlight power source ISINK

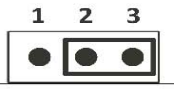
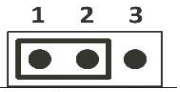
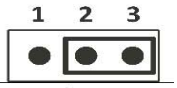
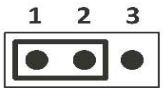
For display function, there is one LED driving current sink for LCM backlight function which the pin name is ISINK. Users are able to adjust the current by setting. Please be aware about the LCM current and voltage needed to meet the LCM requirement; also including the maximum current and voltage loading limitation of ISINK pin.

When the current sink is activated, LED9209 will be powered on to indicate users backlight enable. Please refer to Table 7 for more details and to Figure 9 for the LED locations on the HDK.

### 4.2.6. PSRAM power source

The PSRAM power source can be set to either always power on or could be controlled by user setting. Table 4 provides the jumper settings for each of the methods. Both of J1105 and J1113 could be adjusted for PSRAM power source.

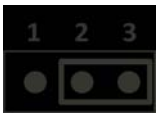
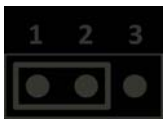
***Table 4. PSRAM power source selection jumpers***

| | |
|---|---|
| **PSRAM power supply J1105 (Should be synchronized with J1113)** | Connect the jumper J1105 pins to set the power source from VSWXM, as shown below.<br>  <br>Connect the jumper J1105 pins to set the power source from VIO18, as shown below.<br>  |
| **PSRAM power supply J1113 (Should be synchronized with J1105)** | Connect the jumper J1113 pins to set the power source from VIO18, as shown below.<br>  <br>Connect the jumper J1113 pins to set the power source from VSWXM, as shown below.<br>  |

### 4.2.7. Serial flash I/O power source

Table 5 provides two different settings for powering up the serial flash.

***Table 5. Serial flash I/O power source selection jumper***

| | |
|---|---|
| **Serial flash I/O power supply J1112** |  <br>Connect the jumper J1112 pins to set the power source from VIO18, as shown below.<br>  <br>Connect the jumper J1105 pins to set the power source from VSF, as shown below. |

### 4.2.8. Analog I/O power selection

Table 6 provides two different settings for powering up the analog I/O.

***Table 6. Analog I/O power source selection jumper***

| | |
|---|---|
| **Analog I/O power supply J1114** |  <br>Connect the jumper J1114 pins to set the power source from VA28, as shown below.<br>Connect the jumper J1114 pins to set the power source from VIO28, as shown below. |

***Table 8. The LED indicators***

| | |
|---|---|
| **USB power source indicator** | LED2001 indicates if power is supplied to both LinkIt 2523 and CMSIS-DAP using USB connectors. |
| | LED2003 indicates if the power source is from USB cable and the buck is enabled. |
| **Buck power indicator** | |
| **CMSIS-DAP power indicator** | LED6601 indicates if the power of the CMSIS-DAP is on. This LED is not mounted on the HDK v2.0. It can be soldered, if necessary. |
| **eMMC/micro SD power indicator** | LED9201 indicates if the micro SD or eMMC power rail is enabled. |

LED6601 indicates if the power of the CMSIS-DAP is on. This LED is not mounted on the HDK v2.0. It can be soldered, if necessary.

LED9201 indicates if the micro SD or eMMC power rail is enabled.

| | |
|---|---|
| **Core power indicator** | LED9206 indicates if the main power rail for LinkIt 2523 core operates successfully. |
| **Display current sink indicator** | The only amber indicator LED9209 indicates if the backlight of the display panel is on. |

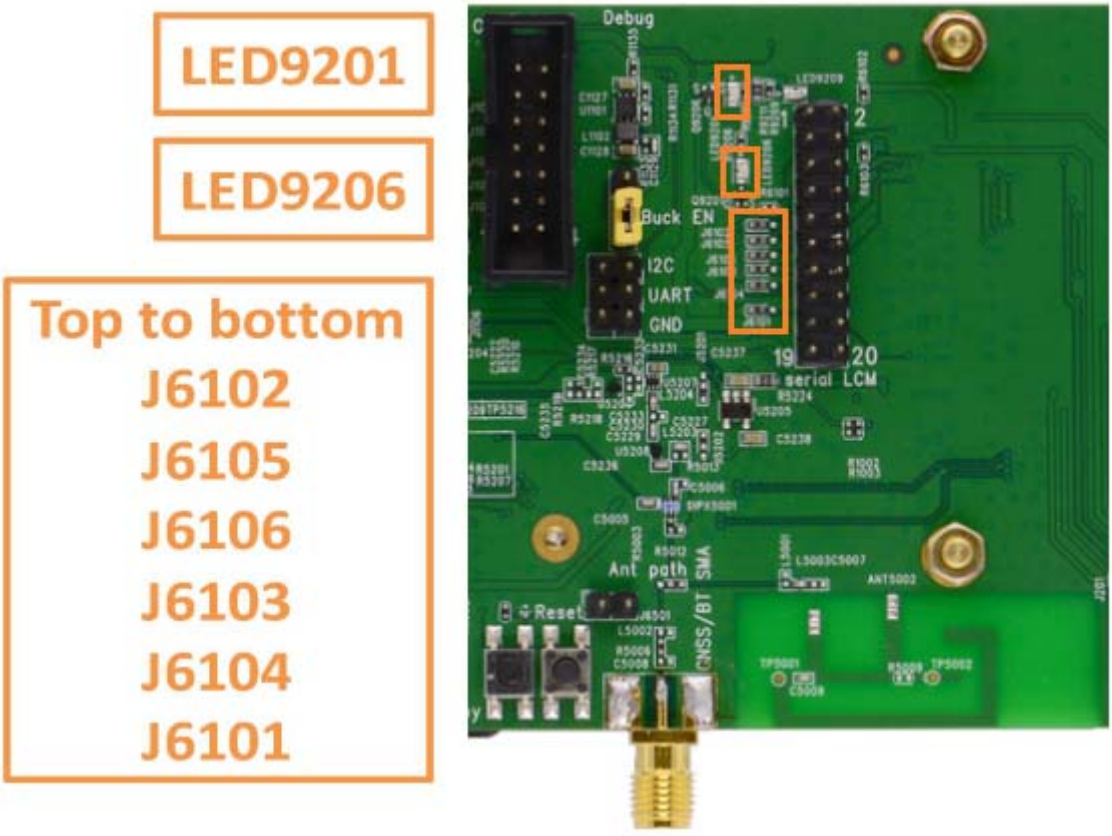



***Figure 9. The positions of LED indicators and debugging footprint***

## 4.5. Buttons

The LinkIt 2523 HDK has four buttons that could support keypad functionality. To improve the LinkIt 2523 pin usage, the buttons could be designed with double key feature, as shown in Table 9.

The JTAG debug feature is assigned to the same set of pins as the buttons on the HDK. The pins are SW6502, SW6503, SW6504 and SW6505 and they will be disabled when JTAG feature is enabled using resistors R9001 and R9007. Buttons are active if the resistors R9001 and R9007 are mounted to GND and GPIO18, GPIO20 and GPIO22 are set to keypad when the LinkIt 2523 HDK is powered on. The locations are shown in Figure 10.

***Table 9. Buttons and corresponding keypad functionality***

## 4.6. GPIO

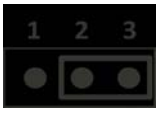
LinkIt 2523 GPIOs provide the following internal states: digital high and digital low, input and output. The pins can be configured using Easy PinMux Tool located under /doc folder. To learn more about the software registers and GPIO functionality, please refer to the LinkIt 2523 API reference manual.

MT2523 digital die eFuse, MT2523 real time clock (RTC) source selection and pins assigned for user applications are GPIO features that could be customized for user defined applications.

### 4.6.1. MT2523 digital die eFuse

The MT2523 digital die eFuse function can be enabled to protect the binary image stored on the HDK, as shown in Table 10.

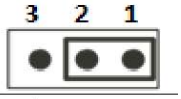
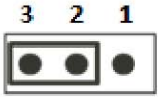
***Table 10. LinkIt 2523 board's eFuse jumper pin settings (illustrated)***

| | |
|---|---|
| Enable/Disable eFuse | Connect the jumper J1102 (see Figure 8) to GND to disable the eFuse setting on the HDK, as shown below.   Connect the jumper J1102 to power rail VIO28 to enable the eFuse setting on the HDK, as shown below.   |

### 4.6.2. LinkIt 2523 board's real time clock source

MT2523 real time clock (RTC) source can be provided either using the internal or external clock. Connect the jumper J1103 to pin 1 and pin 2 to provide 32.786kHz internal clock signal for power saving operations. Connect jumper J1103 to pin 2 and pin 3 to select the clock source generated by external XTAL oscillator. Jumper J1104 should be synchronized with the jumper J1103. Switch J1104 to connect pin 1 and pin 2 for power saving; if 32.768kHz XTAL is mounted. Connect jumper J1104 to pin 2 and pin 3 for XTAL cost reduction. Table 11 provides details on how configure the RTC jumper settings for the HDK. The pin, jumper and resistor locations can be found in Figure 10.

***Table 11. LinkIt 2523 board's RTC jumper pin settings***

| | |
|---|---|
| **32.768kHz XTAL enable/disable** | Connect jumpers J1103 and J1104 pins to enable 32.768kHz XTAL, as shown below.   |
| | Connect jumpers J1103 and J1104 pins to disable 32.768kHz XTAL, as shown below.   |

Connect jumpers J1103 and J1104 pins to enable 32.768kHz XTAL, as shown below.

### 4.6.3. Pins reserved for user applications

Users are able to use camera daughterboard pin headers and sensor daughterboard pin headers for their applications. In addition LinkIt 2523 HDK provides two sets of two-pin headers, the jumpers J1013 and J1014 for I2C, UART, EINT and GPIO. Please look up pin assignment tables to realize multi-mode selections, see sections 4.16.1, "UART connector" and 4.16.2, "I2C connector".

## 4.7. LCM

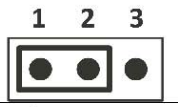
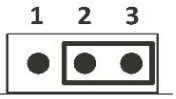
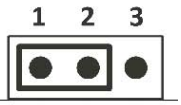
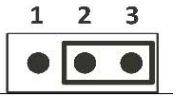
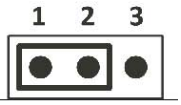
The LinkIt 2523 HDK supports two types of display topology: MIPI DSI and serial interface with a maximum resolution of display of up to 320*320. The connectors CON6101 and CON6102 on the HDK are reserved for LCM. CON6101 supports both MIPI DSI and serial interface. CON6102 supports the serial display interface only.

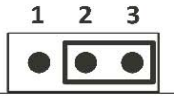
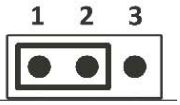
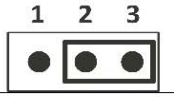
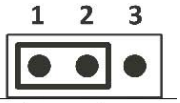
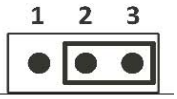
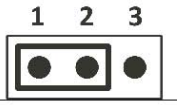
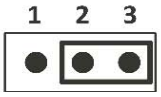
The HDK supports only one display at a time. The jumper selection for J6101 to J6106 for MIPI or serial interface display connected to CON6101 can remain the same, or you can modify the jumper traces for serial display.

The connectors CON6101 or CON6102 support touch panel connected to the I2C interface. Please look up Table 12 pin definition for more details on the connector.

Jumpers J6101 to J6106 are designed for high speed connector and serial pin header switching. Table 10 presents jumper settings for different use case scenarios.

***Table 12. LinkIt 2523 HDK display peripheral jumper pin settings (illustrated)***

| | |
|---|---|
| **LCM display reset** | Set the jumper J6101 to connect the LCM reset signal to high speed connector, as shown below.<br>  |
| | Set the jumper J6101 to connect the LCM reset signal to serial pin header, as shown below.<br>  |
| **LCM display chip select** | Set the jumper J6102 to connect the LCM SCE signal to high speed connector, as shown below.<br>  |
| | Set the jumper J6102 to connect the LCM SCE signal to serial pin header, as shown below.<br>  |
| **LCM display clock** | Set the jumper J6103 to connect the LCM SCK signal to high speed connector, as shown below.<br>  |
| | Set the jumper J6103 to connect the LCM SCK signal to serial pin header, as shown below. |

| | |
|---|---|
| |  |
| **LCM display tearing** | Set the jumper J6104 to connect the LCM PTE signal to high speed connector, as shown below.<br>  |
| | Set the jumper J6104 to connect the LCM PTE signal to serial pin header, as shown below.<br>  |
| **LCM display data** | Set the jumper J6105to connect the LCM SDA signal to high speed connector, as shown below.<br>  |
| | Set the jumper J6105 to connect the LCM SDA signal to serial pin header, as shown below.<br>  |
| **LCM display address** | Set the jumper J6106 to connect the LCM SA0 signal to high speed connector, as shown below.<br>  |
| | Set the jumper J6106 to connect the LCM SA0 signal to serial pin header, as shown below.<br>  |

## 4.8. Audio

The LinkIt 2523 HDK is equipped with a loud speaker to enable audio playback. To apply this feature on the HDK assign the GPIO45 as an output to enable the amplifier. LinkIt 2523 HDK also supports full duplex to develop audio receive and speak at the same time for real-time development. It's using the I2S interface with master and slave with a sampling rate of 48Hz and bit width of up to 16bits for stereo.

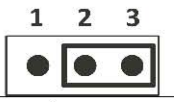
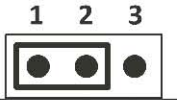
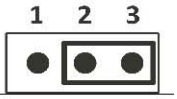
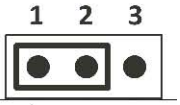
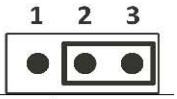
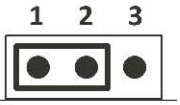
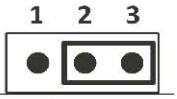
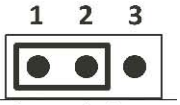
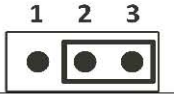
## 4.9. Speech

There is one analog microphone on the LinkIt 2523 HDK for audio recording. The audio jack also supports the OMTP standard for recording. The locations of the microphone and audio jack are shown in Figure 5.

## 4.10. MSDC

The LinkIt 2523 HDK supports any micro SD card of FAT32 format to read and write data. Micro SD card plug-in is detected at GPIO10 with various voltage levels.
The HDK also supports eMMC. eMMC feature is shared with micro SD card by comprehensive pin jumper switching, please refer to Table 13 for more details.

*Table 13. Jumper settings (illustrated) for storage options*

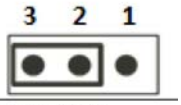
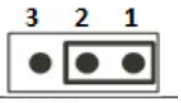
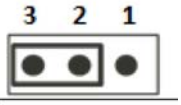
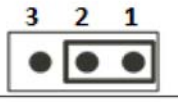
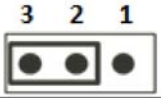
| | |
|---|---|
| **Storage data line 0** | Connect the jumper J1001 to set the storage data line 0 to eMMC, as shown below.<br>  |
| | Connect the jumper J1001 to set the storage data line 0 to micro SD, as shown below.<br>  |
| **Storage data line 1** | Connect the jumper J1002 to set the storage data line 1 to eMMC, as shown below.<br>  |
| | Connect the jumper J1002 to set the storage data line 1 to micro SD, as shown below.<br>  |
| **Storage data line 2** | Connect the jumper J1003 to set the storage data line 2 to eMMC, as shown below.<br>  |
| | Connect the jumper J1003 to set the storage data line 2 to micro SD, as shown below.<br>  |
| **Storage data line 3** | Connect the jumper J1004 to set the storage data line 3 to eMMC, as shown below.<br>  |
| | Connect the jumper J1004 to set the storage data line 3 to micro SD, as shown below.<br>  |
| **Storage clock line** | Connect the jumper J1005 to set the storage clock line to eMMC, as shown below.<br>  |
| | Connect the jumper J1005 to set the storage clock line to micro SD, as shown below. |

| | |
|---|---|
| **Storage command line** | Connect the jumper J1006 to set the storage command line to eMMC, as shown below. Connect the jumper J1006 to set the storage command line to micro SD, as shown below. |

## 4.11. Camera

Connect the camera daughterboard (see Figure 10) to the camera connector to enable the camera. The sensor daughterboard features are shared with camera using a jumper switch (see Table 14). The LinkIt 2523 HDK supports serial interface cameras.

***Table 14. Jumper pin settings (illustrated) for camera and sensor daughter boards***

| | |
|---|---|
| **Camera power down / sensor board chip select** | Set the jumper J1007 to connect the sensor daughterboard using SPI chip select, as shown below.<br>  |
| | Set the jumper J1007 to connect camera daughterboard using camera power down, as shown below.<br>  |
| **Camera reset / sensor board power down** | Set the jumper J1008 to connect the sensor daughterboard using the GPIO, as shown below.<br>  |
| | Set the jumper J1008 to connect the camera daughterboard using the camera reset, as shown below.<br>  |
| **Camera data line 1 / sensor board data output** | Set the jumper J1009 to connect the sensor daughterboard using the SPI data output, as shown below.<br>  |
| | Set the jumper J1009 to connect the camera daughterboard using data line 1, as shown below. |

| | |
|---|---|
| **Camera data line 0 / sensor board clock** | Set the jumper J1010 to connect the sensor daughterboard using the SPI clock, as shown below. |
| | Set the jumper J1010 to connect the camera daughterboard using data line 0, as shown below. |
| **Camera pixel clock input / sensor board data input** | Set the jumper J1011 to connect the sensor daughterboard using the SPI data input, as shown below. |
| | Set the jumper J1011 to the camera daughterboard using pixel clock input, as shown below. |
| **Camera pixel clock output / sensor board reset** | Set the jumper J1012 to connect the sensor daughterboard connection using the GPIO, as shown below. |
| | Set the jumper J1012 to connect the camera daughterboard using the camera pixel clock output or data line 0, as shown below. |
| **Camera pixel clock output / camera data line 2** | Set the jumper J1015 to connect the camera daughterboard using the camera pixel clock output, as shown below. |
| | Set the jumper J1015 to connect the camera daughterboard using the camera data line 2, as shown below. |

## 4.12. USB

LinkIt 2523 HDK has two USB connectors, CON6401 see section 4.16.11, “USB2.0 high speed connector CON6401” and CON6601 see section 4.16.12, “CMSIS-DAP USB 1.1 full speed connector CON6601”, as shown in Figure 18. The CON6401 is used to flash the LinkIt 2523 HDK with the LinkIt 2523 Flash Tool.

The CON6601 is for CMSIS-DAP USB communication, mass storage and a serial port. The CMSIS-DAP is the debugging user interface for embedded devices. The mass storage is for flashing the LinkIt 2523 using the SWD interface. The user can drag and drop the LinkIt 2523 binary file and the FreeRTOS binary file to the mass storage device to flash LinkIt 2523 image directly. The serial port also supports UART2 connectivity on the LinkIt 2523 HDK.

The maximum charging current is 1.5A at 5V DC for the LinkIt 2523 HDK's internal charger. The USB power source is passing through the connector CON6401 on the HDK.

## 4.13. GNSS (LinkIt 2523G only)

The LinkIt 2523G HDK is equipped with GNSS chip with a built-in multiband onboard antenna with an operating range of 1.5GHz-2.4GHz. Switch the jumper J5003 to receive Bluetooth, Bluetooth Low Energy and GNSS signal by an onboard antenna or SMA connector.

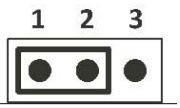
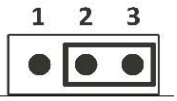
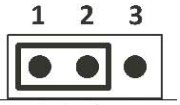
LinkIt 2523G HDK supports GPS, GLONASS, BeiDou, Galileo, QZSS and SBAS standard, with optimized power consumption and extended battery life. Onboard antenna and SMA connector path switch are described in see section 4.14, "Bluetooth and Bluetooth Low Energy".

## 4.14. Bluetooth and Bluetooth Low Energy

The LinkIt 2523 HDK supports Bluetooth 4.2 for Bluetooth core specification updates for an improved speed and reliable data transfer. The transfer speed is up to 2.5 times faster and the protocol stack size is smaller. Bluetooth 4.2 also consumes less power. It is backward compatible with Bluetooth 4.0 and 4.1, and it also adopts Bluetooth core versions starting from 1.1 with Bluetooth BR/EDR.

There are three options to power up the HDK with Bluetooth, Bluetooth Low Energy and external buck power supply. The data transfer is through the onboard antenna or an external antenna with an SMA connector. Car-kit connector CON5001 is used to measure the received Bluetooth and GPS signal strength by an external cable connected to the HDK. If the car-kit is connected, it will use the Bluetooth signal from the external cable not the signal provided by an onboard antenna. The SMA connector SMA5002 could be connected with external antenna cable for Bluetooth and Bluetooth Low Energy signal strength validation. Some of the jumpers are designed to switch between the RF signal and Bluetooth mode. Details on switching modes are presented in Table 15.

***Table 15. Jumper pin settings (illustrated) for Bluetooth***

| | |
|---|---|
| **Bluetooth external buck activated** | Connect the jumper J1101 pins to set the external buck U1101 enabled by ROM, as shown below.<br>  |
| | Connect the jumper J1101 pins to set the external buck U1101 enabled by power rail VIO28, as shown below.<br>  |
| **Bluetooth external clock source** | Connect the jumper J5001 pins to set the Bluetooth clock to the clock signal generated by 26MHz XTAL oscillator, as shown below.<br>  |
| | Connect the jumper J5001 pins to set the Bluetooth clock to an external clock |

| | |
|---|---|
| **Bluetooth power input** | source, as shown below. Connect the jumper J5002 pins to set the Bluetooth main power source to VBT, as shown below.<br><br>Connect the jumper J5002 pins to set the Bluetooth main power source to VIO18, as shown below.<br><br>Mount the R5005 and disconnect the jumper J5002 to set the Bluetooth main power source to VIO28. |
| **Bluetooth antenna path** | Connect the jumper J5003 pins to select the antenna signal uplink and downlink paths on an onboard antenna, as shown below.<br><br>Connect the jumper J5003 pins to select the antenna signal uplink and downlink path using SMA connector, as shown below. |
| **Bluetooth I/O power input** | Connect the jumper J5004 pins to set the Bluetooth I/O power source to VBT, as shown below. Connect the jumper J5004 pins to set the Bluetooth I/O power source to VIO18, as shown below.<br>Connect the jumper J5005 pins to set the Bluetooth I/O power source to AVDD_BTRF_ext, as shown below. Connect the jumper J5005 pins to set the Bluetooth I/O power source to VIO28, as shown below. |

## 4.15. Connectors

The LinkIt 2523 HDK supports connectors to capture a signal, plug-in an external component, update an image and more. This section provides details and pin definitions for the connectors.

### 4.16.1. UART connector

The jumper J1013 is reserved for user applications that can be configured for different modes, such as UART, GPIO and EINT. The jumper location is shown in Figure 11.

### 4.16.2. I2C connector

The jumper J1014 (see Figure 11) is reserved for user applications that can be configured for different modes, such as GPIO and I2C. The jumper location is shown in Figure 11.

#### 4.16.3. Battery connector CON2102

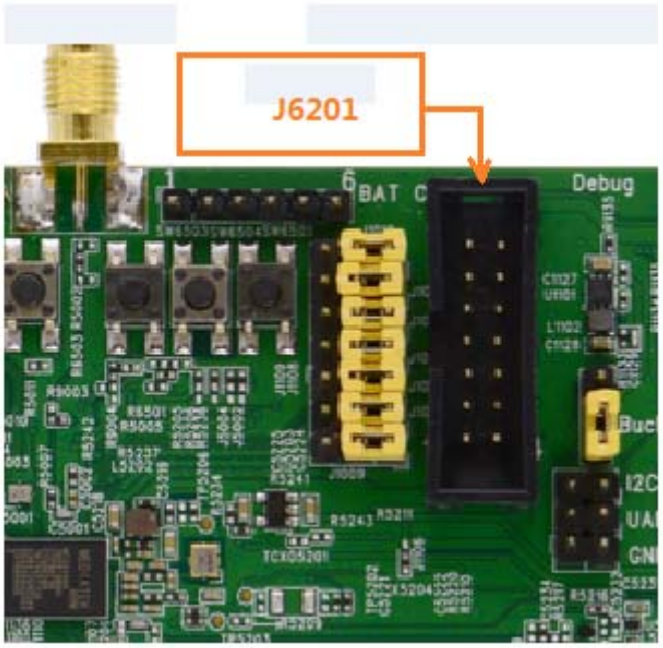
The user can connect a battery to the connector CON2102 with the pin configuration as shown in Table 17.

***Table 17. Battery connector CON2101 (see Figure 11)***

| Pin number | Description | Pin number | Description |
|---|---|---|---|
| 1 | VBAT | 2 | VBAT |
| 3 | NTC | 4 | GND |
| 5 | GND | 6 | NC |

### 4.16.4. Camera daughterboard connector CON6201

Connector CON6201 (see Figure 14 and Figure 15) is able to connect camera daughterboard to capture images. The direction of camera module is to the left, also means camera module on daughterboard should be toward USB connectors. Users are able to customize the applications by pin assignment Table 22 if no camera daughterboard is at hand.




| | Pin number | GPIO # | Power domain | Description | Flexible mode1 | Flexible mode2 | Flexible mode3 | Flexible mode4 | Flexible mode5 | Flexible mode6 | Flexible mode8 | Flexible mode9 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 24 | DVDD_VIO_A | CMRST | GPIO | LSRSTB | CLKO | EINT | GPCOUNTER | JTDI | MC1_DA3 | | |
| 2 | | VBAT | VBAT | | | | | | | | | |
| 3 | 25 | DVDD_VIO_A | CMPDN | GPIO | LSCK1 | DAICLK | MA_SPI2_CS | MA_SPI3_CS | JTMS | MC1_DA2 | SLV_SPI0_CS | |
| 4 | | VCAMA | VCAMA | | | | | | | | | |
| 5 | 29 | DVDD_VIO_A | CMCSK | GPIO | LPTE | CMCSD2 | EINT | | | | | |
| 6 | | | GND | | | | | | | | | |
| 7 | 28 | DVDD_VIO_A | CMMCLK | GPIO | LSA0DA 1 | DAISYNC | MA_SPI2_MISO | MA_SPI3_MISO | JTDO | MC1_DA0 | SLV_SPI0_MISO | |
| 8 | 37 | DVDD_VIO_A | I2C_SDA0 | GPIO | I2C_SDA 1 | | | | | | | |
| 9 | 29 | DVDD_VIO_A | CMCSD2 | GPIO | LPTE | CMCSK | EINT | | | | | |
| 10 | 36 | DVDD_VIO_A | I2C_SCL0 | GPIO | I2C_SCL 1 | | | | | | | |
| 11 | 27 | DVDD_VIO_A | CMCSD1 | GPIO | LSDA1 | DAIPCMOUT | MA_SPI2_MOSI | MA_SPI3_MOSI | JTRSTB | MC1_CK | SLV_SPI0_MOSI | |
| 12 | | | GND | | | | | | | | | |
| 13 | 26 | DVDD_VIO_A | CMCSD0 | GPIO | LSCE_B1 | DAIPCMIN | MA_SPI2_SCK | MA_SPI3_SCK | JTCK | MC1_CM0 | SLV_SPI0_SCK | |
| 14 | | | GND | | | | | | | | | |

### 4.16.10. Sensor daughterboard connector CON6301

Pin header CON6301 is able to connect sensor daughterboard. Users are able to customize the applications by pin

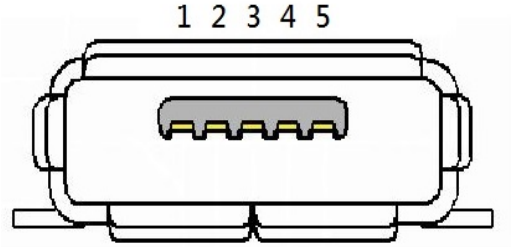
assignment table to fit user scenario if sensor daughterboard unplugged, as described in Table 23.

***Table 23. Sensor daughter board connector CON6301***

| Pin number | GPIO # | Power domain | Description | Flexible mode1 | Flexible mode2 | Flexible mode3 | Flexible mode4 | Flexible mode5 | Flexible mode6 | Flexible mode8 | Flexible mode9 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | | VBAT | VBAT | | | | | | | | |
| 2 | | VA28 | VA28 | | | | | | | | |
| 3 | | VIO28 | VIO28 | | | | | | | | |
| 4 | | VIO18 | VIO18 | | | | | | | | |
| 5 | | | GND | | | | | | | | |
| 6 | | | GND | | | | | | | | |
| 7 | 37 | DVDD_VIO_A | I2C_SDA0 | GPIO | EINT | MC1_DA3 | | | | | |
| 8 | 28 | DVDD_VIO_A | MA_SPI3_MISO | CMMCLK | GPIO | LSA0DA1 | DAISYNC | MA_SPI2_MISO | JTDO | MC1_DA0 | SLV_SPI0_MISO |
| 9 | 36 | DVDD_VIO_A | I2C_SCL0 | GPIO | EINT | MC1_DA2 | | | | | |
| 10 | 27 | DVDD_VIO_A | MA_SPI3_MOSI | CMCSD1 | GPIO | LSDA1 | DAIPCMOUT | MA_SPI2_MOSI | JTRSTB | MC1_CK | SLV_SPI0_MOSI |
| 11 | | | GND | | | | | | | | |
| 12 | 26 | DVDD_VIO_A | MA_SPI3_SCK | CMCSD0 | GPIO | LSCE_B1 | DAIPCMIN | MA_SPI2_SCK | JTCK | MC1_CM0 | SLV_SPI0_SCK |
| 13 | 48 | DVDD_GPO | MA_SPI3_CS1 | GPO | | | | | | | |
| 14 | 25 | DVDD_VIO_A | MA_SPI3_CS0 | CMPDN | GPIO | LSCK1 | DAICLK | MA_SPI2_CS | JTMS | MC1_DA2 | SLV_SPI0_CS |
| 15 | 4 | DVDD_VIO_A | EINT | GPIO | URXD1 | MC1_CK | MA_SPI0_CS | SLA_EDIDO | | | |
| 16 | | | GND | | | | | | | | |
| 17 | 5 | DVDD_VIO_A | EINT | GPIO | UTXD1 | MC1_CM0 | MA_SPI0_SCK | SLA_EDIDI | | | |
| 18 | 7 | DVDD_VIO_A | EINT | GPIO | UTXD2 | MC1_DA1 | MA_SPI0_MISO | SLA_EDICK | | | |
| 19 | 6 | DVDD_VIO_A | EINT | GPIO | URXD2 | MC1_DA0 | MA_SPI0_MOSI | SLA_EDIWS | | | |
| 20 | 29 | DVDD_VIO_A | EINT | CMCSK | GPIO | LPTE | CMCSD2 | MC1_DA1 | BT_RGPIO2 | | |
| 21 | 13 | DVDD_VIO_C | SEN_32K_BB | GPIO | EINT | CLKO | MA_EDIWS | MA_SPI1_MOSI | PWM2 | SLA_EDIWS | |
| 22 | 24 | DVDD_VIO_A | GPIO | EINT | MC1_DA1 | SLA_EDICK | UTXD2 | BT_BUCK_EN_HW | MA_SPI0_MISO | | |
| 23 | | | GND | | | | | | | | |
| 24 | | | GND | | | | | | | | |

### 4.16.3. USB2.0 high speed connector CON6401

Connector CON6401 (see Figure 16 and Figure 18) followed USB 2.0 high speed standard which makes LinkIt 2523 to communicate with other compatible devices. CON6401 could be for charging and system operating power consumption. The 5V power rail is not connected with CON6601. The connector pins are described in Table 24.




| Pin number | Description | Pin number | Description |
|---|---|---|---|
| 1 | VUSB_BB | 2 | D |
| 3 | D+ | 4 | NC |
| 5 | GND | - | - |

### 4.16.4. CMSIS-DAP USB 1.1 full speed connector CON6601

Connector CON6601 (see Figure 17 and Figure 18) is able to update binary code to LinkIt 2523 by CMSIS-DAP without other tools. When a user plugs the USB cable in from computer, the mass storage will pop up after storage driver updated automatically. The storage status is available to drag and drop binary code directly for updating the features that needs updating.

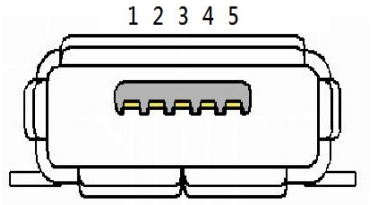



***Table 25. CMSIS-DAP USB FS connector CON6601***

| Pin number | Description | Pin number | Description |
|---|---|---|---|
| 1 | VUSB_DAP | 2 | D |
| 3 | D+ | 4 | NC |
| 5 | GND | - | - |

# Warning

**Note1:** This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:
-Reorient or relocate the receiving antenna.
-Increase the separation between the equipment and receiver.
-Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
-Consult the dealer or an experienced radio technician for help.

**Note2:**The device has been evaluated to meet general RF exposure requirement. The device can be used in portable exposure condition without restriction.

**Note3:**The LINKIT2523HDK module is designed to comply with the FCC statement. FCC ID is 2AINMLINKIT2523HDK. The host system using Nucleus, should have label indicated it contain modular's FCC ID 2AINMLINKIT2523HDK.

This radio module must not installed to co-locate and operating simultaneously with other radios in host system , additional testing and equipment authorization may be required to operating simultaneously with other radio.

This device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

**Any Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.**