



# MT7682 HDK V10 User's Guide

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## Document Revision History

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Revision	Date	Description
1.0	5 May 2017	Initial release

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## 1. Introduction

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MediaTek LinkIt™ for real-time operating system (RTOS) is a low-cost and easy to use Internet of Things (IoT) development platform to design, prototype, evaluate and implement IoT projects. The platform supports MT7682 hardware development kit (HDK) by SAC. This user manual provides required knowledge on features of the HDK, including the pins, communication interfaces, core microcontroller unit (MCU) description, the networking capabilities and how to use them through the host driver.

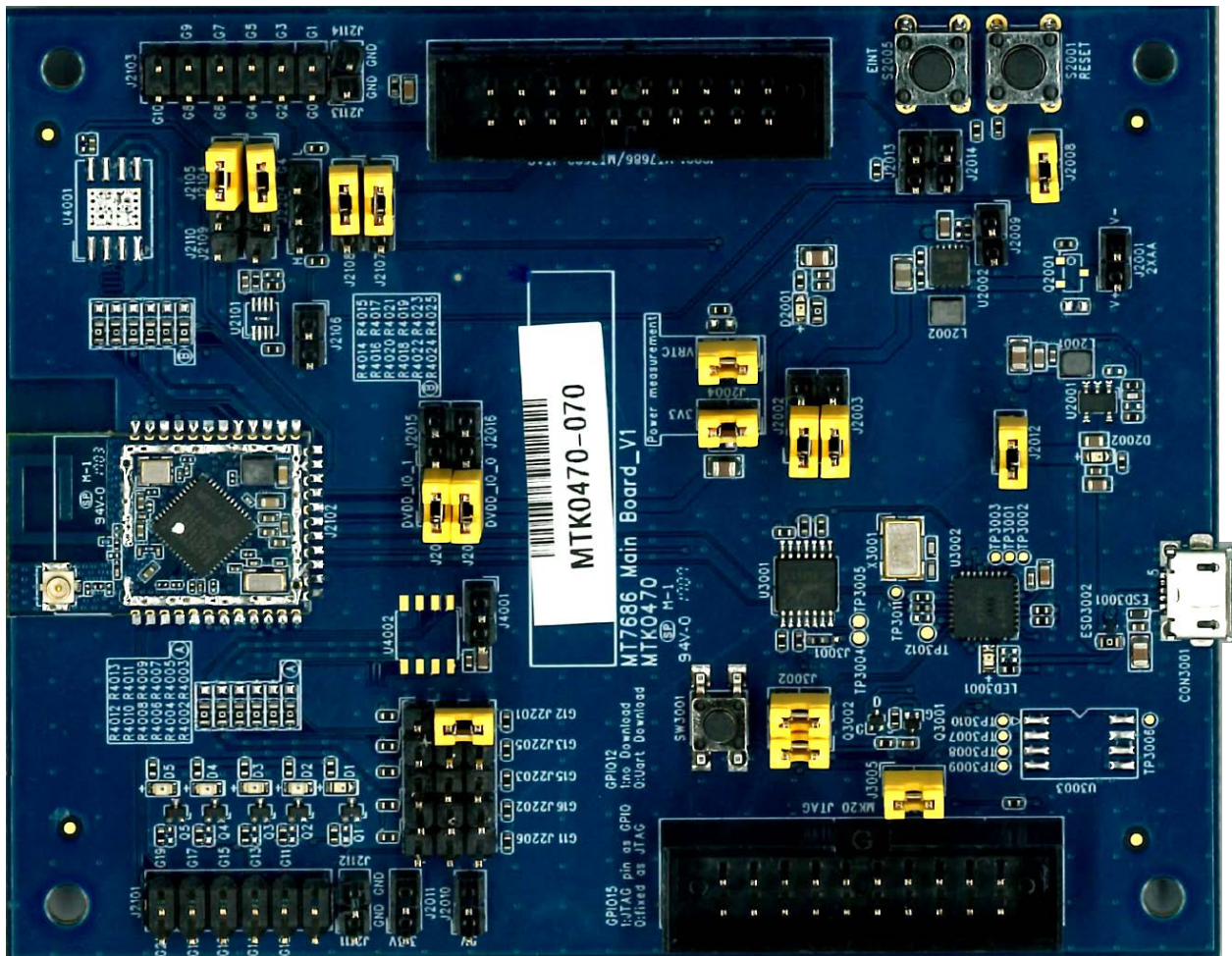
The HDK includes MediaTek MT7682 chipset which is based on ARM Cortex-M4 with floating point unit in QFN48 package. It enables rich connectivity features, communication with cloud services and real-time control. The MT7682 HDK supports ARM [mbed](#) IoT Device Platform for more convenient debugging and binary code download operations.

The following features are available:

- Mass storage device (MSD) programmer.
  - The MT7682 HDK has three binary files for bootloader, Wi-Fi connectivity and FreeRTOS. The MSD programmer enables to update the FreeRTOS binary file only.
- Coresight Debug Access Port ([CMSIS-DAP](#)) debug interface.
  - A firmware debug interface similar to [ST-link](#) or [J-link](#). It enables debugging a target project or downloading a binary to the flash storage of the device.
- Virtual Serial Port.
  - Supports UART functionality, such as transferring log information from the HDK.

These features are used to download and debug a project on MT7682 HDK.

The front view of the HDK is shown in Figure 1.



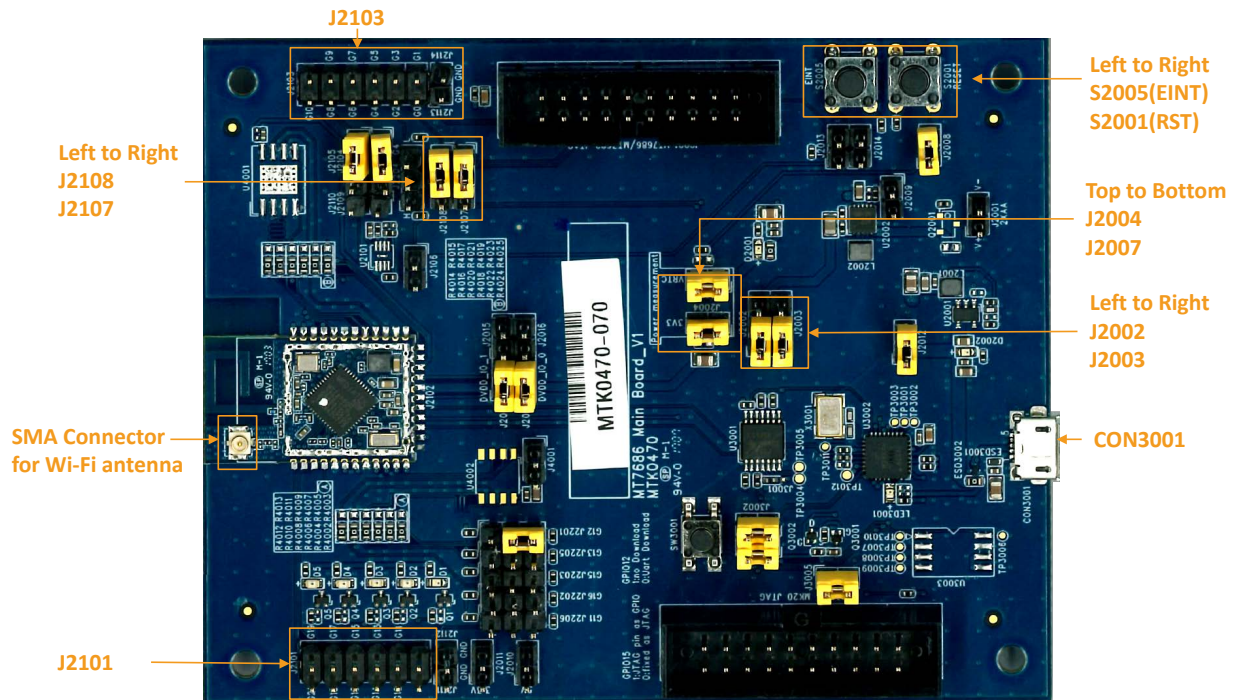
**Figure 1. Front view of MT7682 HDK**

## 2. Get started with the HDK

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

### 2.1. Configuring the MT7682 HDK

MT7682 HDK includes a main board and a MT7682 stamp module. The MT7682 stamp module is mounted on the main board. The top view of the main board is shown in Figure 2.



**Figure 2. Jumpers and connectors on the MT7682 HDK**

The description of pins (Figure 2) and their functionality is provided below.

- 1) **CON3001** is a USB connector to debug through UART, transmit and receive a signal and supply power from the PC. The USB connectivity with the PC is supported by the on-board [MK20DX128VFM5](#).
  - a) Set the jumpers **J2002**, **J2003**, **J2004** and **J2007** on, if the board is powered by a USB connector.
- 2) **S2005** enables the external interrupt (configured at **GPIO0**), see section 4.4, “Buttons”, for more details.
- 3) Press **S2001** to reset the system.
- 4) **Wi-Fi Antenna** is a PCB antenna. MT7682 stamp module is by default connected to the PCB antenna to transmit and receive RF signals.

The default configuration of the MT7682 HDK supports the following functionality:

- 1) Power supply. Attach a micro-USB connector to the **CON3001**.
- 2) Supports RTC interrupt.
- 3) Clock source — 32.768kHz source crystal clock for the RTC mode or external clock operating on 32.768 kHz.



- 4) XTAL at 40MHz.
- 5) Supports RTC mode.

The hardware settings of the stamp module are shown below:

- 1) XTAL at 40MHz.
- 2) Clock source — 32.768kHz source crystal clock for the RTC mode or external clock operating at 32.768kHz.
- 3) Supports RTC mode.

## 2.2. Installing the MT7682 HDK drivers on Microsoft Windows

To configure the MT7682 HDK:

- 1) Connect the HDK to the computer using a micro-USB cable.
- 2) Download and install mbed Windows serial port driver from [here](#). Open Windows **Control Panel** then click **System** and:
  - On Windows 7 and 8, click **Device Manager**.
  - On Windows XP, click the **Hardware** tab and then **Device Manager**.
- 3) In **Device Manager**, navigate to **Ports (COM & LPT)** (see Figure 3).
- 4) A new **COM** device should appear under **Ports (COM & LPT)** in **Device Manager**, as shown in Figure 3. Note the **COMx** port number of the serial communication port, this information is needed to send command and receive logs from the COM port. Virtual COM port is connected to the board through the **UART1** of the chipset, see section 4.5, “Extension connectors”. The **mbed Serial Port (UART1)** is applied to flash the board and log the outputs.



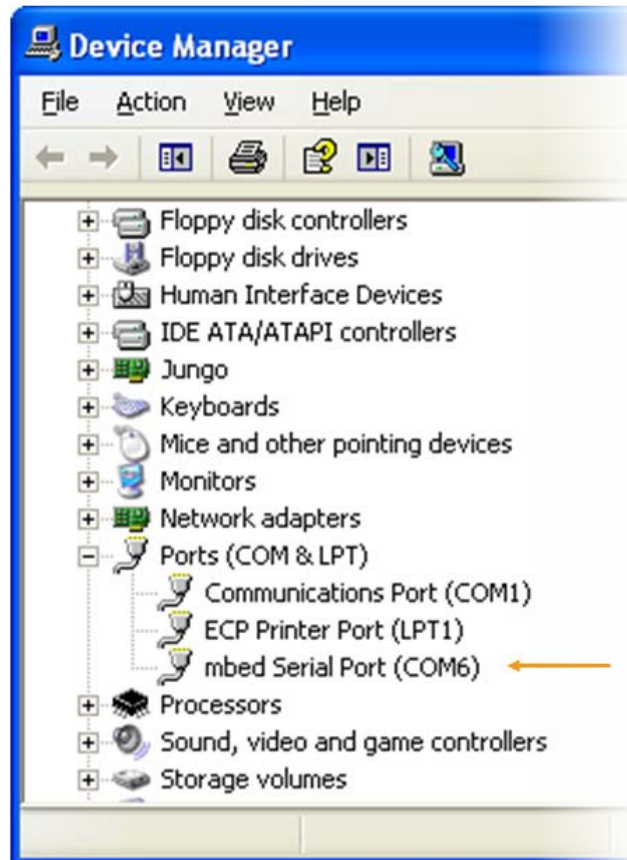


Figure 3. COM port associated with the MT7682 HDK

## 2.3. Configuring the HDK flash mode

The MT7682 HDK is embedded with 2MB flash memory. The boot options are either from the Flash memory or from the UART port.

To update the firmware on the MT7682 HDK:

- 1) Set the jumpers **J2002**, **J2003**, **J2004** and **J2007** on.
  - In this mode, if the power is on, the board will load ROM code and start the **ATE Daemon** or **Firmware Upgrade Daemon** according to the MT7682 Flash Tool's behavior on the PC. A message "ccc" is sent to the **UART0** port of the chipset and the code is uploaded to the embedded flash memory through **UART0**.
- 2) Connect the board to the computer using a micro-USB cable.

The development board should now be connected to the PC, as shown in Figure 2.

To run the project on the MT7682 HDK:

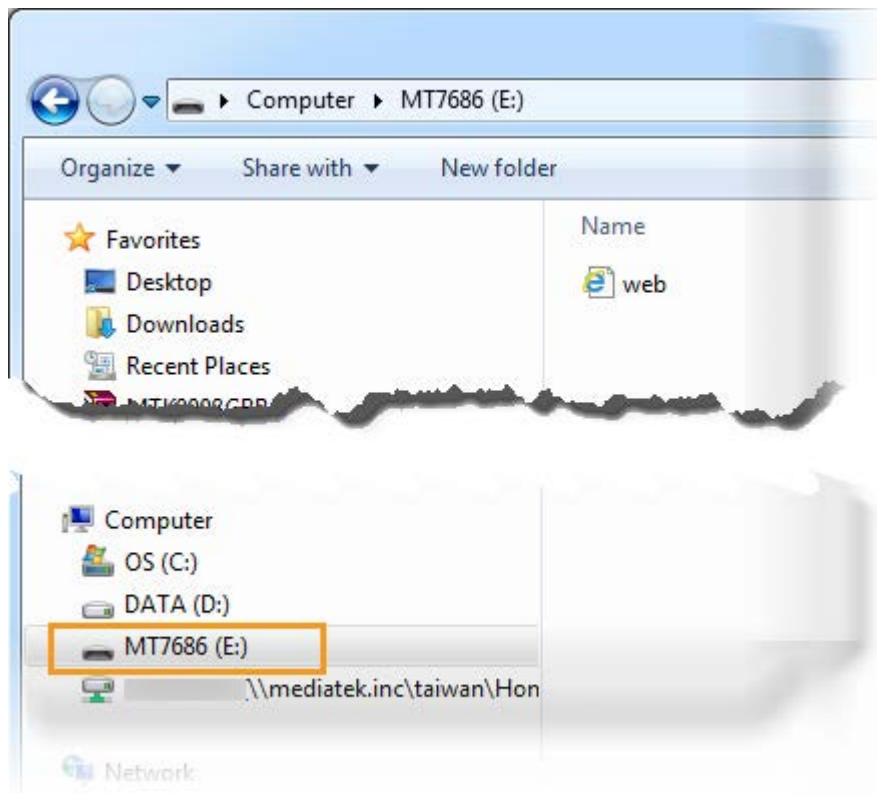
- 1) Set the jumpers **J2002**, **J2003**, **J2004** and **J2007** on.
  - In this mode, if the power is on, the board will load firmware from the Flash and reboot.
- 2) Connect the board to a computer using a micro-USB cable.

The development board should now be connected to the PC, as shown in Figure 2.

## 2.4. Downloading the image using the MT7682 HDK as a removable storage

To update the FreeRTOS binary only (example project binary: `mt7682_iot_sdk.bin`), use the HDK as a mass storage device according to the following steps:

- 1) Power up the board with a micro-USB cable.
- 2) Navigate to **Computer** on your PC to check if a new mass storage named **MT7682** is available under **Removable Disk**, as shown in Figure 4.
- 3) Open the **MT7682** removable storage, then drag and drop the binary `mt7682_iot_sdk.bin` to complete downloading the image.



**Figure 4. New removable storage detected**

### 3. Hardware Features

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This section provides the main supported features of the MT7682 HDK. The detailed description of the features is provided in the upcoming sections.

- IEEE 802.11bgn Wireless Connectivity Single Chip with QFN40 package.
- The IOs on MT7682 are 3.3V compatible.
- Support for [FreeRTOS](#).
- Flexible on-board power supply
  - [USB](#) with power ( $V_{BUS}$ , 5V).
  - External  $V_{IN}$  (1.8~3.2V).
- Ten LEDs
  - Power LEDs (**D2001, D2002**) and user LEDs (**D1, D2, D3, D4, D5**).
- Three push buttons
  - System Reset.
  - Real Time Clock (RTC) Interrupt.
  - External Interrupt.
- XTAL (Crystal Oscillator)
  - 40MHz source clock support with low power consumption in idle mode.
  - 32.768kHz clock for the RTC mode or external 32.768kHz mode.
- USB re-enumeration capability: two different interfaces supported on the same USB.
  - [CMSIS-DAP](#) USB.
  - Virtual COM port UART through USB on PC.
- On-board chip antenna with [U.FL](#) for conducted testing.
- Micro USB connector for power and debug connections.
- Headers for current measurement.

## 4. Hardware Feature Configuration

### 4.1. Microcontroller

MT7682 features an ARM Cortex-M4 with floating point processor, which is the most energy efficient ARM processor available.

MT7682 provides low power consumption embedded architecture and it's optimized for various types of applications in home automation, smart grid, handheld devices, personal medical devices and industrial control that have lower data rates, and transmit or receive data on an infrequent basis.

### 4.2. Power supply

MT7682 HDK supports two types of power supply.

- 1) Power up with a micro-USB connector.

An on-board switching regulator provides voltage of 3.3V for the MT7682 HDK based on MT7682F, if the power is supplied from an on-board micro-USB connector **CON3001** (Figure 2). This supply can be isolated from the switching regulator using the jumpers. Note, that the jumpers **J2002**, **J2003**, **J2004** and **J2007** are required to be set on. More details on the jumpers can be found in Table 1.

**Table 1. Jumper settings for system power input through USB connection**

Jumper	Usage	Comments
<b>J2002(1-2)</b>	3.3V power supply	Use micro-USB connector supporting 3.3V power source.
<b>J2004</b>	Current measurement	Measures the current flow in MT7682F.
<b>J2003(1-2)</b>	RTC3V3 power supply	Use micro-USB connector supporting RTC 3V3 power.
<b>J2007</b>	Current measurement in RTC mode	Measures the current flow in RTC mode for MT7682.

- 2) Power up using an AA or AAA battery.

- Connect an external AA battery to battery pin header (**J2001**) to supply power to the system, as shown in Figure 5. When using an AA battery, plug the USB to micro-USB connector **CON5** (Figure 2). Note, that the jumpers **J2003**, **J2004**, and **J2007** are required to be set on. More details on the jumpers can be found in Table 2.

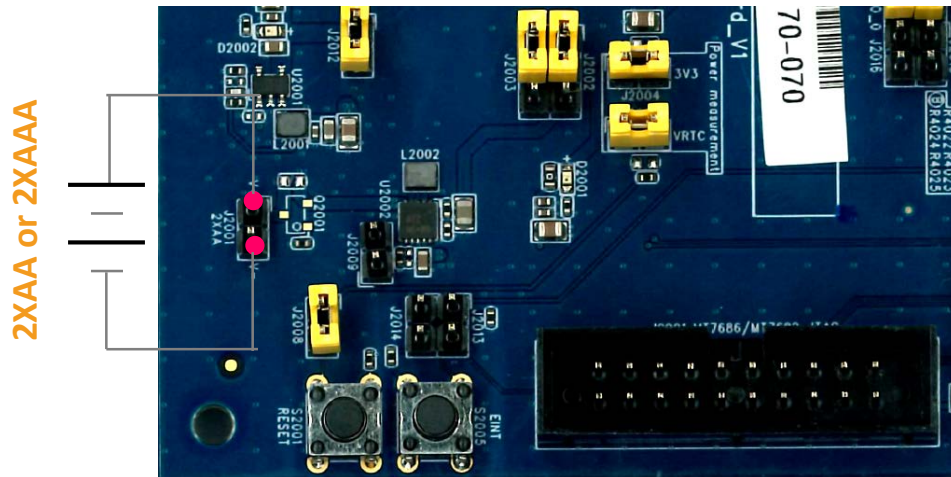


Figure 5. Power up the HDK using an AA or AAA Battery (J2001)

Table 2. System power input from AA or AAA battery jumpers

Jumper	Usage	Comments
J2002(2-3)	3.3V power supply	Use AA or AAA battery source supporting 3.3V power.
J2004	Current measurement	Measures the current flow in MT7682.
J2003(2-3)	RTC 3V3 power supply	Use AA or AAA battery source supporting RTC 3V3 power.
J2007	Current measurement in RTC mode	Measures the current flow in RTC mode for MT7682.

### 4.3. LEDs

The MT7682 HDK has onboard LEDs associated with different functionalities of the board (Figure 6).

- 1) **D2002** indicates the power rail 5V is on.
- 2) **D2001** indicates the power rail 3.3V is on.

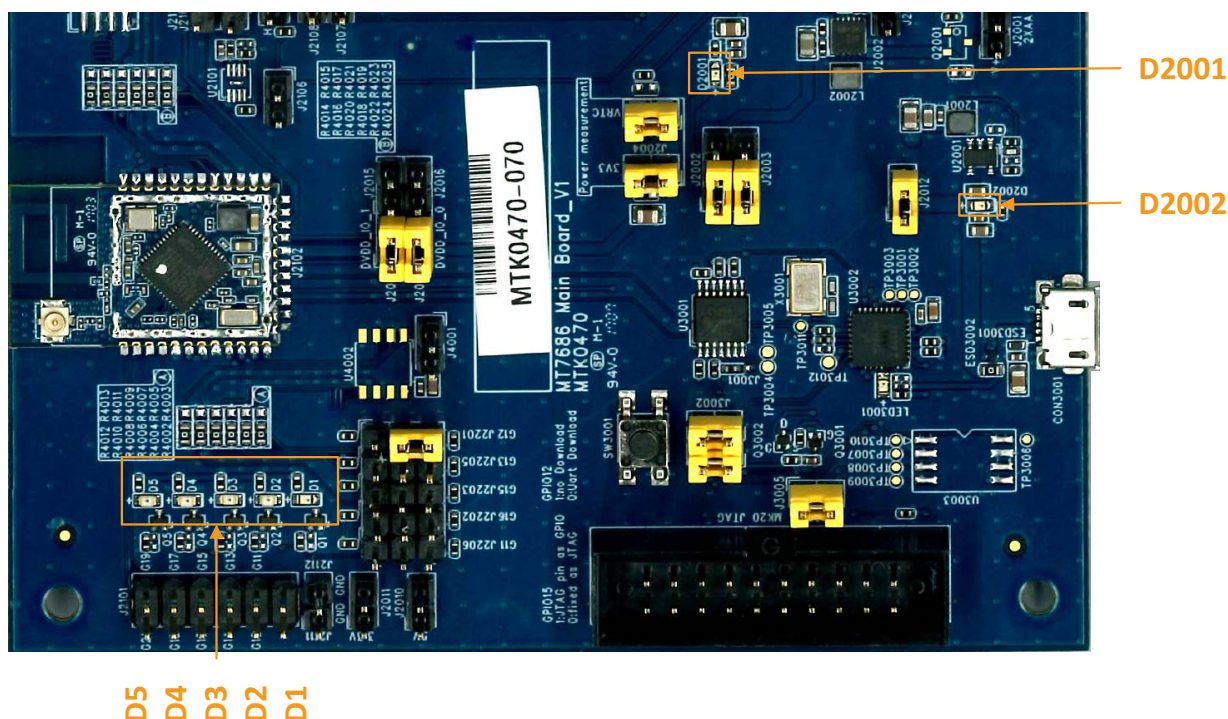


Figure 6. On-board LEDs

3) **D1, D2, D3, D4, and D5** are LEDs assigned for user interaction. All LEDs are high active (Figure 6). GPIO pins to activate the LEDs are shown in Table 3.

Table 3. GPIO pins to activate the LEDs

LED	GPIO
D1	GPIO11
D2	GPIO12
D3	GPIO13
D4	GPIO14
D5	GPIO15

## 4.4. Buttons

The MT7682 HDK is equipped with buttons with the following functionality. The push buttons are shown in Figure 2.

- 1) System reset button (**S2001**) resets the MT7682 HDK.
- 2) External interrupt button (**S2005**). Users can configure GPIO0 as an external interrupt pin. Press the button to wake up the system from the sleep mode.

## 4.5. Extension connectors

The MT7682 HDK provides similar pin-out extension connectors (**J2101** and **J2103**) for various sensor and device connectivity, as shown in Figure 2 and described in Table 4.

The board has 14 GPIOs multiplexed with other interfaces. Depending on the use case, user can configure each I/O functionality.

**Table 4. GPIO pin multi-function definition and pin-out extension connectors**

Connector Pin Number	Signal Name	Connector Pin Number	Signal Name
<b>J2101.1</b>	GPIO20	<b>J2103.1</b>	GPIO0
<b>J2101.2</b>	GPIO19	<b>J2103.2</b>	GPIO1
<b>J2101.3</b>	GPIO18	<b>J2103.3</b>	GPIO2
<b>J2101.4</b>	GPIO17	<b>J2103.4</b>	GPIO3
<b>J2101.5</b>	GPIO16	<b>J2103.5</b>	GPIO4
<b>J2101.6</b>	GPIO15	<b>J2103.6</b>	GPIO5
<b>J2101.7</b>	GPIO14	<b>J2103.7</b>	GPIO6
<b>J2101.8</b>	GPIO13	<b>J2103.8</b>	GPIO7
<b>J2101.9</b>	GPIO12	<b>J2103.9</b>	GPIO8
<b>J2101.10</b>	GPIO11	<b>J2103.10</b>	GPIO9
		<b>J2103.11</b>	GPIO10

Pin alias	Name	Direction	Description
<b>GPIO0</b>	GPIO[0]	I/O	General purpose input, output
	UART1_RTS	O	UART1 RTS
	PWM[0]	I/O	Pulse-width-modulated output
	EINT[0]	I	External interrupt
	I2C1_CLK	I/O	I2C1 CLK
	I2S_RX	I	I2S slave RX
<b>GPIO1</b>	GPIO[1]	I/O	General purpose input, output
	UART1_CTS	O	UART1 CTS
	PWM[1]	O	Pulse-width-modulated output
	EINT[1]	I	External interrupt
	I2C1_CLK	I/O	I2C1 CLK
	I2S_TX	O	I2S slave TX
<b>GPIO2</b>	GPIO[2]	I/O	General purpose input, output
	UART1_RX	I	UART1_RX
	PWM[0]	O	Pulse-width-modulated output
	EINT[2]	I	External interrupt
	I2S_WS	O	I2S slave TX
<b>GPIO3</b>	GPIO[3]	I/O	General purpose input, output



	UART1_TX	O	UART1_TX
	PWM[1]	O	Pulse-width-modulated output
	EINT[3]	I	External interrupt
	I2S_CK	O	I2S slave TX
<b>GPIO4</b>	GPIO[4]	I/O	General purpose input, output
	SPI_A_SIO2_M	I/O	SPI_ A master SIO2
	PWM[1]	O	Pulse-width-modulated output
	EINT[4]	I	External interrupt
	SPI_A_SIO2_S	I/O	SP_ A I slave SIO2
	I2S_MCK	O	I2S master MCK
<b>GPIO11</b>	GPIO[11]	I/O	General purpose input, output
	MC0_CK_M	O	SDIO master CK
	PWM[3]	O	Pulse-width-modulated output
	EINT[11]	I	External interrupt
	MC0_CK_S	O	SDIO slave CK
	CLK02	O	Clock output source_2
	I2S_RX	I	I2S RX
<b>GPIO12</b>	GPIO[12]	I/O	General purpose input, output
	SPI_B_SIO3_M	I/O	SPI_ B master SIO3
	UART0_RTS	I	UART0 RTS
	EINT[12]	I	External interrupt
	SPI_A_SIO3_S	I/O	SPI_ B slave SIO3
	UART2_TX	O	UART2 TX
	I2S_TX	O	I2S TX
	MC0_CMD_M	O	SDIO master CMD
	MC0_CMD_S	O	SDIO slave CMD
<b>GPIO13</b>	GPIO[13]	I/O	General purpose input, output
	SPI_B_SIO2_M	I/O	SPI_ B master SIO2
	UART0_RTS	I	UART0 RTS
	EINT[13]	I	External interrupt
	SPI_A_SIO2_S	I/O	SPI_ B slave SIO2
	UART2_RTS	I	UART2 RTS
	I2S_WS	O	I2S WS
	MC0_DA0_M	I/O	SDIO master DA0
	MC0_DA0_S	I/O	SDIO slave DA0
	CLK04	O	Clock output source_4
<b>GPIO14</b>	GPIO[14]	I/O	General purpose input, output
	SPI_B_SIO1_M	I/O	SPI_ B master SIO1
	UART0_RTS	I	UART0 RTS
	EINT[14]	I	External interrupt

	SPI_A_SIO1_S	I/O	SPI_B slave SIO1
	UART2_RTS	I	UART2 RTS
	TDM_RX	I	TDM RX
	MC0_DA1_M	I/O	SDIO master DA1
	MC0_DA1_S	I/O	SDIO slave DA1
	CLK04	O	Clock output source_4
	PWM[4]	O	Pulse-width-modulated output
<b>GPIO15</b>	GPIO[15]	I/O	General purpose input, output
	SPI_B_SIO0_M	I/O	SPI_B master SIO0
	UART0_RTS	I	UART0 RTS
	EINT[15]	I	External interrupt
	SPI_A_SIO0_S	I/O	SPI_B slave SIO0
	UART2_RTS	I	UART2 RTS
	TDM_TX	I	TDM TX
	MC0_DA2_M	I/O	SDIO master DA2
	MC0_DA2_S	I/O	SDIO slave DA2
	I2C1_SCL	O	I2C1 SCL
	PWM[3]	O	Pulse-width-modulated output
<b>GPIO16</b>	GPIO[16]	I/O	General purpose input, output
	SPI_B_SCK_M	O	SPI_B master SCK
	UART0_RTS	I	UART0 RTS
	EINT[16]	I	External interrupt
	SPI_A_SCK_S	I/O	SPI_B slave SCK
	UART2_RTS	I	UART2 RTS
	TDM_WS	I	TDM WS
	MC0_DA3_M	I/O	SDIO master DA3
	MC0_DA3_S	I/O	SDIO slave DA3
	I2C1_SDA	I/O	I2C1 SDA
	UART3_TX_N9	I	N9_UART3 TX
<b>GPIO17</b>	GPIO[17]	I/O	General purpose input, output
	SPI_B_CS_M	O	SPI_B master CS
	EINT[16]	I	External interrupt
	SPI_B_CS_S	I/O	SPI_B slave CS
	UART2_RTS	I	UART2 RTS
	TDM_CK	I	TDM CK
	PWM[5]	O	Pulse-width-modulated output
	CLK03	O	Clock output source_3
	ADC_IN0	I	Auxiliary ADC input
<b>GPIO21</b>	GPIO[21]	I/O	General purpose input, output
	EINT[19]	I	External interrupt

GPIO22	UART0_RX	I	UART0 RX
	ADC_IN3	I	Auxiliary ADC input
	I2C1_SCL	O	I2C1 SCL
	PWM[5]	O	Pulse-width-modulated output
	GPIO[22]	I/O	General purpose input, output
	EINT[20]	I	External interrupt
	UART0_TX	O	UART0 TX

Note, to use the GPIO8 and GPIO9 pins as I2C0, add pull-up resistors on the HDK or on the I2C0 daughterboard.

To add pull-up resistors on the HDK, refer to the resistor locations in Figure 7. The location of R2101 is for adding the pull-up resistor for I2C0\_SDA (GPIO9). The location of R2102 is for adding the pull-up resistor for I2C0\_CLK (GPIO8).

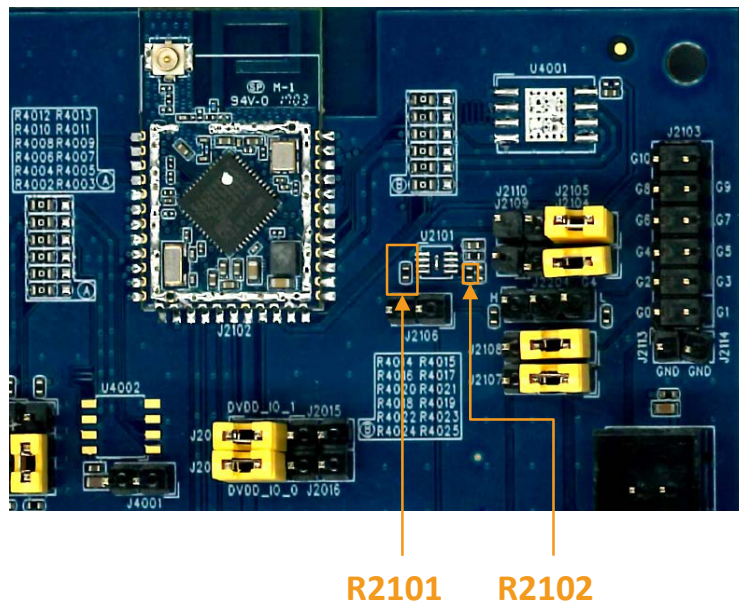


Figure 7. Locations of I2C pull-up resistors

## 4.6. RTC

The MT7682 HDK features an RTC module. The clock source operates at 32.768kHz crystal oscillator or an external clock source. The RTC has built-in accurate timer to wake up the system when the user-defined timer expires. The RTC uses a different power source from the Power Management Unit (PMU). In hibernate or sleep mode, the PMU is turned off while the RTC module remains powered on. The RTC module only consumes 3μA in hibernate mode. The RTC has a dedicated PMU control pin PMU\_EN\_RTC (pin 14) used to turn the power on when the RTC timer expires and turn the power off when it intends to enter the hibernate mode.

## 4.7. RF connections

By default, the board ships with RF signals routed to the on-board circuit antenna. An on-board U.FL, a conductive test component, (I-PEX) connector enables to test the signals using a compatible cable. If a user wants to perform the testing, the user needs to solder the capacitor from the location **C17** to **C18**.

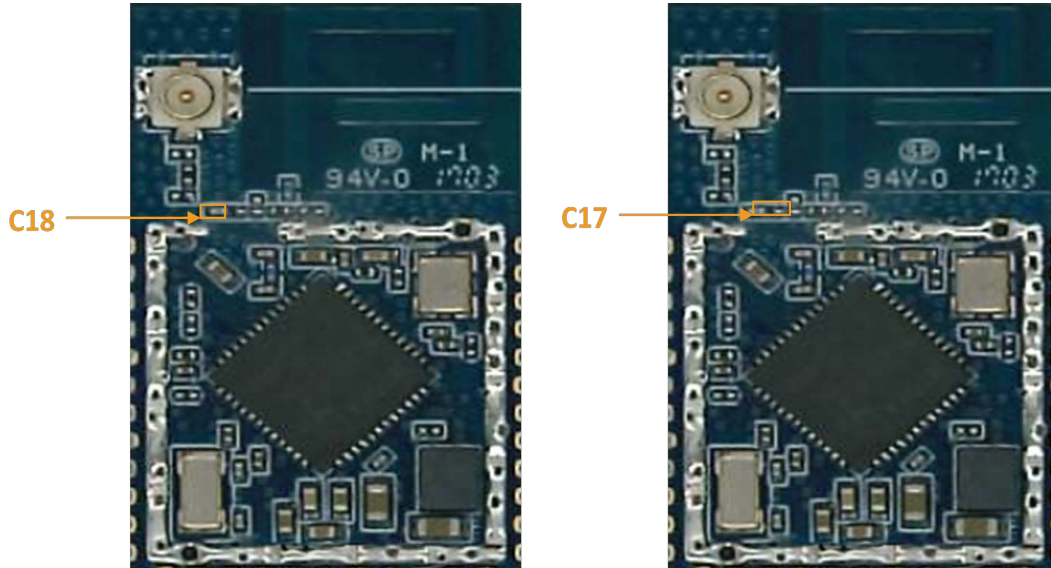


Figure 8. Location of the components C17 and C18

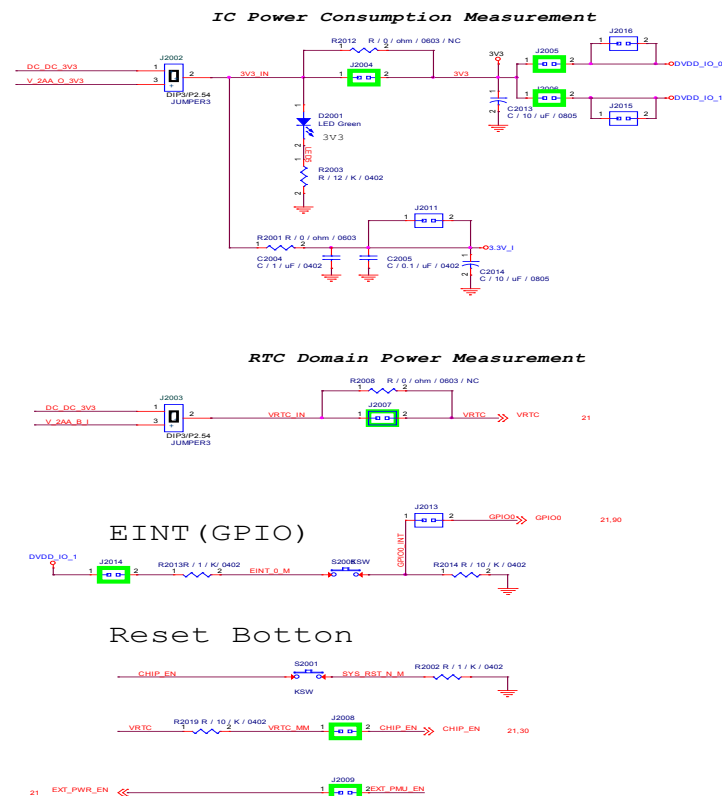
## 4.8. CMSIS-DAP Firmware update procedure

The latest firmware from OpenSDA platform can be downloaded from the mbed official website. To update the binary firmware of CMSIS-DAP, press and hold the **S2001**, then plug-in the USB cable to **CON3001**, release the button **S2001** once the mass storage is shown, and then drag and drop in the binary code. After the mass storage disappears, keep the power connected for 10 seconds, and then reboot the system again to finish the firmware update.

Before you start to update CMSIS-DAP firmware via CON3001, please remember to confirm the Jumpers J2107 and J2108 are put on 2 and 3 pin.

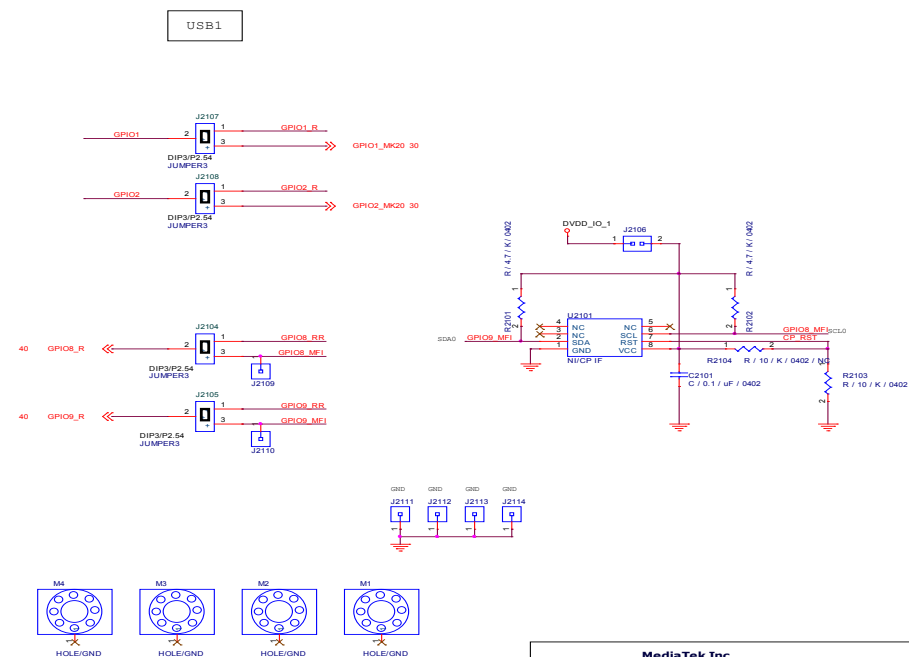
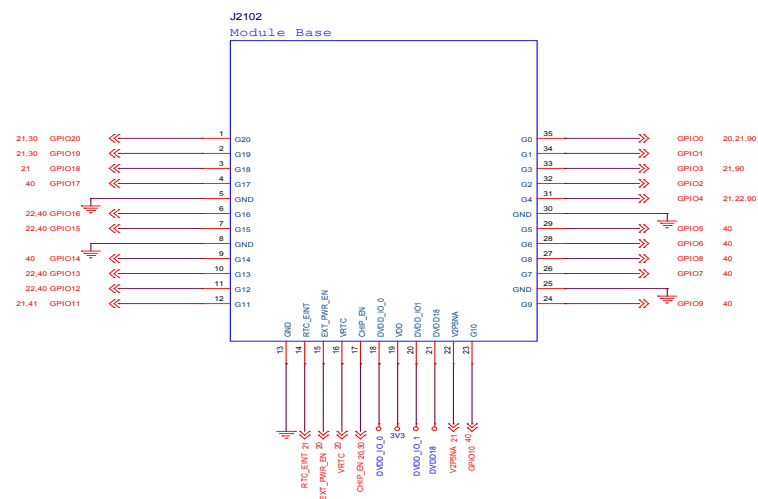


### Main board schematic-1



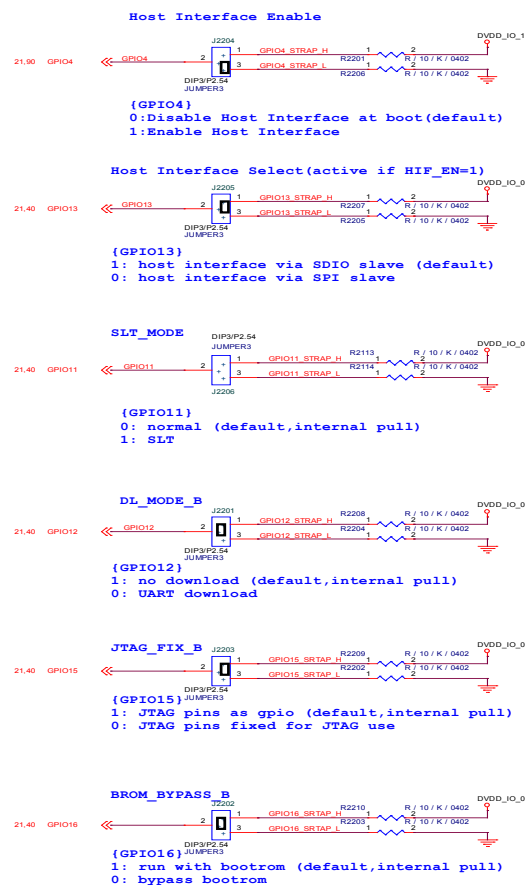
The diagram shows the pin connections for the MT7686 and MT7682 modules. A central box labeled "MT7686\_MT7682 Module" is connected to two sets of pins. The left set of pins (pins 1-12) is connected to the MT7686 module, and the right set of pins (pins 1-12) is connected to the MT7682 module. The connections are as follows:

Pin	MT7686	MT7682
1	GPIO20	GPIO1_R
2	GPIO19	GPIO0
3	GPIO18	GPIO2_R
4	GPIO17_R	GPIO4
5	GPIO16_R	GPIO2_R
6	GPIO15_R	GPIO4
7	GPIO14_R	GPIO2_R
8	GPIO13_R	GPIO4
9	GPIO12_R	GPIO2_R
10	GPIO11	GPIO4
11	RTC_INT	GPIO2_R
12	GPIO10_R	GPIO4



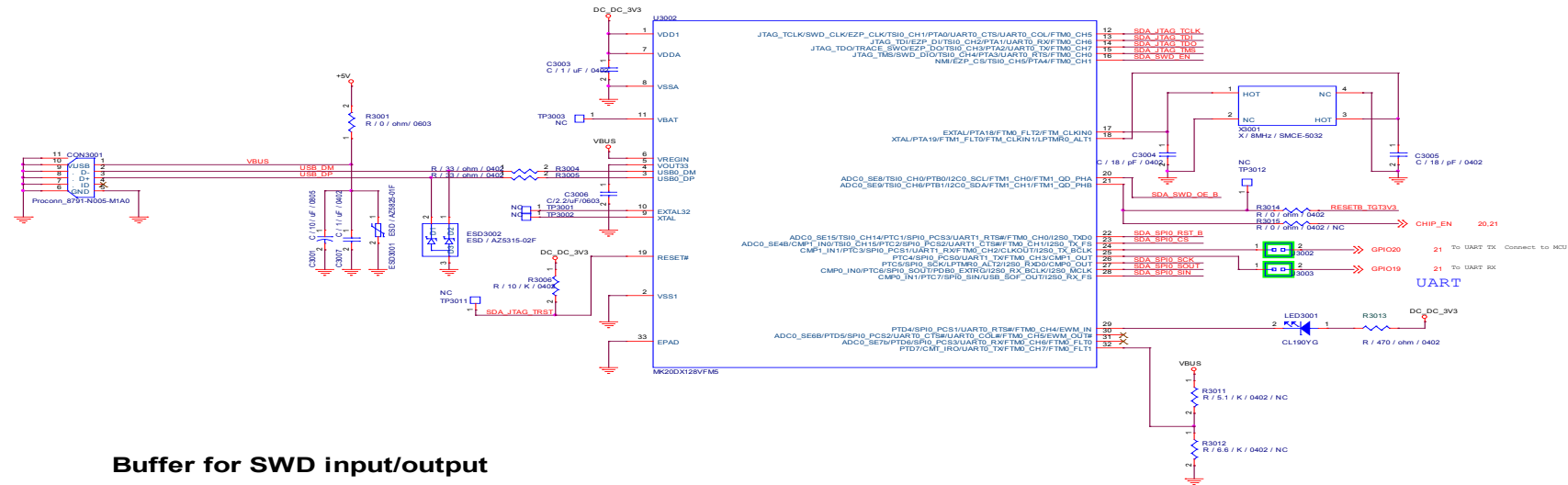
COMPRESSED IMAGE	MediaTek Inc.	
	Title	MT76x7 Main Board
	Size	Document Number
	C	2_Test Interface

## Main board schematic-3

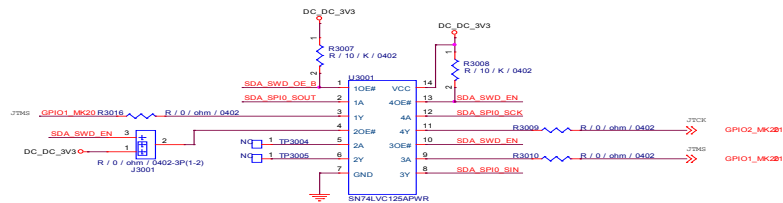




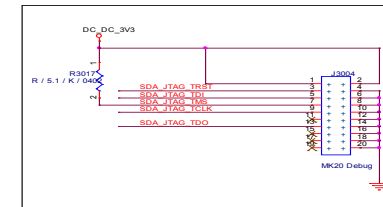
Main board schematic-4



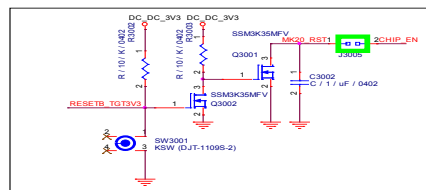
Buffer for SWD input/output



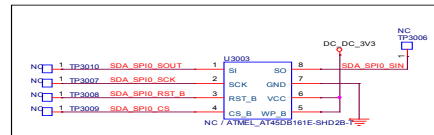
MK20 JTAG connector



For RESETB LVS

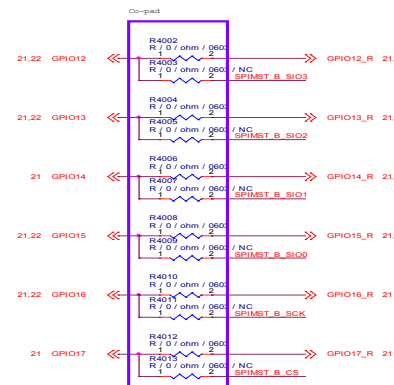
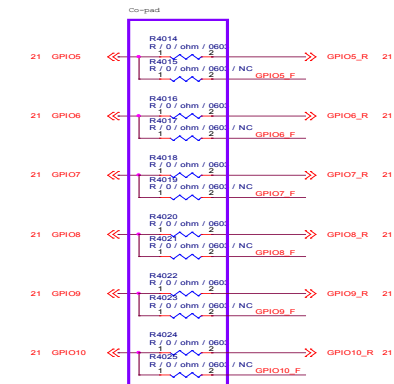
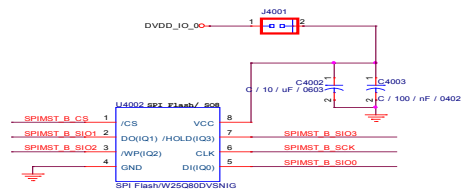
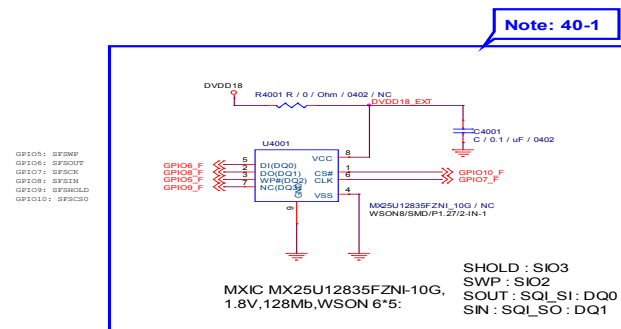


SPI FLASH MEMORY



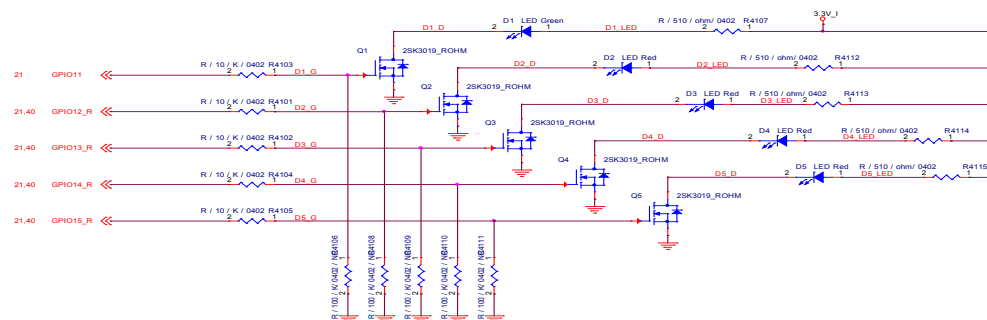
MediaTek Inc.			
Doc	MT7682 Main Board	Rev	3.0
COMPRESSED IMAGE	Document Number	3.0	
Date:	Tuesday, February 07, 2017	Printed	30 of 39

Main board schematic-5



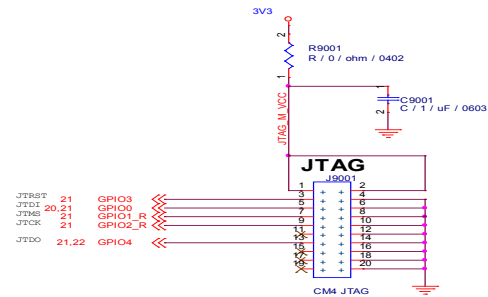
## Main board schematic-6

### USER LED



MediaTek Inc.			
COMPRESSED IMAGE	File	MT7682 Main Board	
	Doc C	Document Number	Rev 3.0
	Date	Tuesday, February 07, 2017	Sheet 41 of 99

Main board schematic-7



MEDIATEK	
Title	90_Debug Interface
Size	MTK Confidential
Date:	Tuesday, February 07, 2017
Sheet	90 of 99

COMPRESSED IMAGE	MediaTek Inc.		
	Title	MT7682 Stamp Module	
	Size: C	Document Number 10_BB_RF	Re

The diagram shows the RF front end of the PCB. It includes an external antenna connected to the circuit through a matching network. The circuit is divided into two main sections: a 2.4 GHz section and a 3.3 GHz section.

**2.4 GHz Section:**

- ANTENNA:** Connected to the circuit through a matching network consisting of capacitors C14, C15, and C16.
- ANTENNA 2.4:** A component labeled "ANTENNA 2.4" is connected to the circuit.
- ANTENNA 2.4:** A component labeled "ANTENNA 2.4" is connected to the circuit.
- ANTENNA 2.4:** A component labeled "ANTENNA 2.4" is connected to the circuit.

**3.3 GHz Section:**

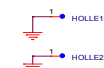
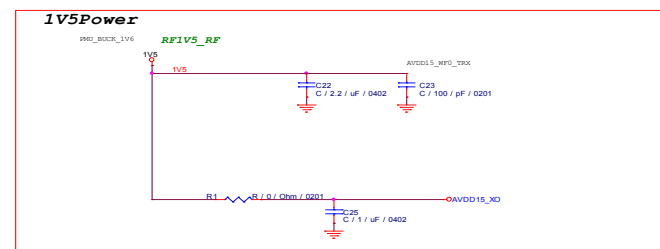
- ANTENNA 3.3:** A component labeled "ANTENNA 3.3" is connected to the circuit.
- ANTENNA 3.3:** A component labeled "ANTENNA 3.3" is connected to the circuit.
- ANTENNA 3.3:** A component labeled "ANTENNA 3.3" is connected to the circuit.

**Power Divider:**

- Power Divider:** A component labeled "Power Divider" is connected to the circuit.
- Power Divider:** A component labeled "Power Divider" is connected to the circuit.
- Power Divider:** A component labeled "Power Divider" is connected to the circuit.

**Other Components:**

- C17:** A capacitor labeled "C17" is connected to the circuit.
- C18:** A capacitor labeled "C18" is connected to the circuit.
- C19:** A capacitor labeled "C19" is connected to the circuit.
- C20:** A capacitor labeled "C20" is connected to the circuit.
- C21:** A capacitor labeled "C21" is connected to the circuit.
- C24:** A capacitor labeled "C24" is connected to the circuit.




MediaTek Inc.			
COMPRESSED IMAGE	Title	MT7682 Stamp Module	
	Size	Document Number	Rev
	C	20_RF Antenna and Connector	

MT7682\_STAMP\_MODULE\_V10 schematic-3


Strap Pin

**XTAL Select**




```
{GPIO17}
0:26MHz (default)
1:40MHz
```

**SLOW\_SRC\_B**



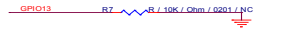
```
{GPIO14}
0:External
1:Internal (from 26/40MHz clock) (default)
```

**Host Interface Enable**



```
{GPIO4}
0:Disable Host Interface at boot(default)
1:Enable Host Interface
```

**Host Interface Select(active if HIF\_EN=1)**

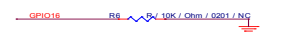


```
{GPIO13}
1: host interface via SDIO slave (default)
0: host interface via SPI slave
```

**JTAG\_FIX\_B**

```
{GPIO15}
1: JTAG pins as gpio (default)
0: JTAG pins fixed for JTAG use
```

**BROM\_BYPASS\_B**



```
{GPIO16}
1: run with bootrom (default)
0: bypass bootrom
```

**SLT\_MODE**

```
{GPIO11}
0: normal (default)
1: SLT
```

**DL\_MODE\_B**

```
{GPIO12}
1: no download (default)
0: UART download
```

