

# GAINSTRONG

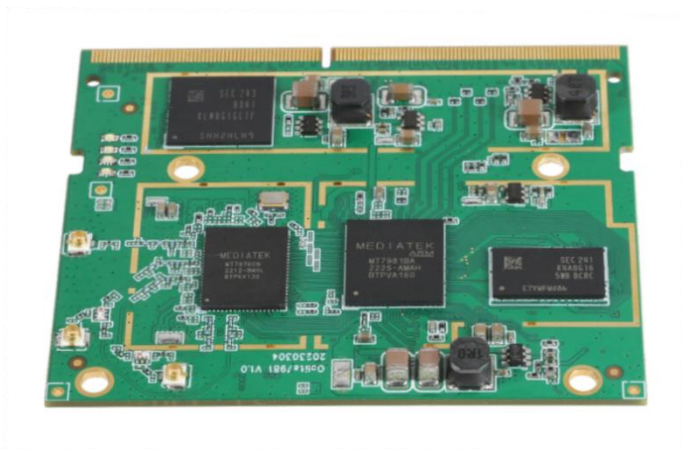
## Oolite-MT7981B V1\_SPEC\_EN

### *Golden Finger Module*

*Version 1.0.4*

Author: WSY

*April 23, 2023*



| Revision | Date       | Contents of Revision Change  | Remark |
|----------|------------|--|--------|
| 1.0.0    | 2023-04-23 | First release  | WSY    |
| 1.0.1    | 2023-05-18 | Modify the configuration table   | WSY    |
| 1.0.2    | 2023-08-02 | Update the configuration table<br>Update the pin definitions for PIN 16<br>9 and PIN 170 of the cheat code | WSY    |
| 1.0.3    | 2023-09-13 | Update 58, 59PIN definitions   | WSY    |
| 1.0.4    | 2024-02-26 | Modify the configuration table   | WSY    |

| Development Board Functional choose table                              |   |                      |   |                            |                      |                      |                      |
|--|---|----------------------|---|----------------------------|----------------------|----------------------|----------------------|
| POE  | BLE5.0                                  | Zigbee3.0            | Halow WiFi  | RS485(RS232)               | RTC                  | TF Card              | NVMe SSD             |
| Without<br>(default)   | Without<br>(default)                    | Without<br>(default) | 700MHz  | Support RS485<br>(default) | Without<br>(default) | Support<br>(default) | Without<br>(default) |
|  |   |                      | 868MHZ  |                            |                      |                      |                      |
|  |   |                      | 900MHZ  |                            |                      |                      |                      |
|  |   |                      | Without<br>(default)  |                            |                      |                      |                      |
| Module Optional Configuration table                                    |   |                      |   |                            |                      |                      |                      |
| RAM(DDR4)  | SPI Nor Flash<br>(default no nor flash) |                      | SPI NAND Flash or EMMC<br>(EMMC and Nand Flash can only choose one) |                            |                      |                      |                      |
| 512MB  | 16MB                                    |                      | Nand Flash :128MB(default)  |                            |                      |                      |                      |
| 1GB(default)   | 32MB                                    |                      | Nand Flash:256MB  |                            |                      |                      |                      |
|  | 64MB                                    |                      | EMMC:4GB  |                            |                      |                      |                      |
|  |   |                      | EMMC:8GB  |                            |                      |                      |                      |
| Flash common configuration choose                                      |   |                      |   |                            |                      |                      |                      |
| 1. Nand Flash:Starting system from Nand Flash (default 128MB )         |   |                      |   |                            |                      |                      |                      |
| 2. eMMC:Starting system from eMMC                                      |   |                      |   |                            |                      |                      |                      |
| 3. Nor Flash:Starting system from Nor Flash                            |   |                      |   |                            |                      |                      |                      |
| 4. Nor Flash+eMMC： Starting system from Nor Flash,eMMC as data storage |   |                      |   |                            |                      |                      |                      |
| Optional Accessory Table   |   |                      |   |                            |                      |                      |                      |
| Package  | 12/2A(US adapter)                       |                      | 3*dual band 5dBi Antenna  |                            |                      | Carton+Pearl Cotton  |                      |
|  | 12/2A(EU adapter)                       |                      |   |                            |                      |                      |                      |
|  | 12/2A(CN adapter)                       |                      |   |                            |                      |                      |                      |

# 1 INTRODUCTION

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The Oolite-MT7981B V1 module use the MT7981B main chipset, and MT7976C WiFi6 chip are connected externally,Support 2.4GHz&5.8GHz Dual - Frequency work

MT7981B is a highly integrated wireless network router system-on-chip used for high wireless performance, home entertainment, and home automation and so on.

MT7981B is fabricated with advanced silicon process and integrates a Dual-core ARM® Cortex-A53 MPCore™ operating up to 1.3GHz and more DRAM bandwidth. This SoC also includes a variety of peripherals, including SGMII, and USB3.0 (Host) ports. To support popular network applications, MT7981B also implements two 2.5Gbps HSGMII Ethernet interface. MT7981B combines with a RF chip, they can provide dual-band concurrent chipset solution for WIFI6E AX3000 wireless router platform.

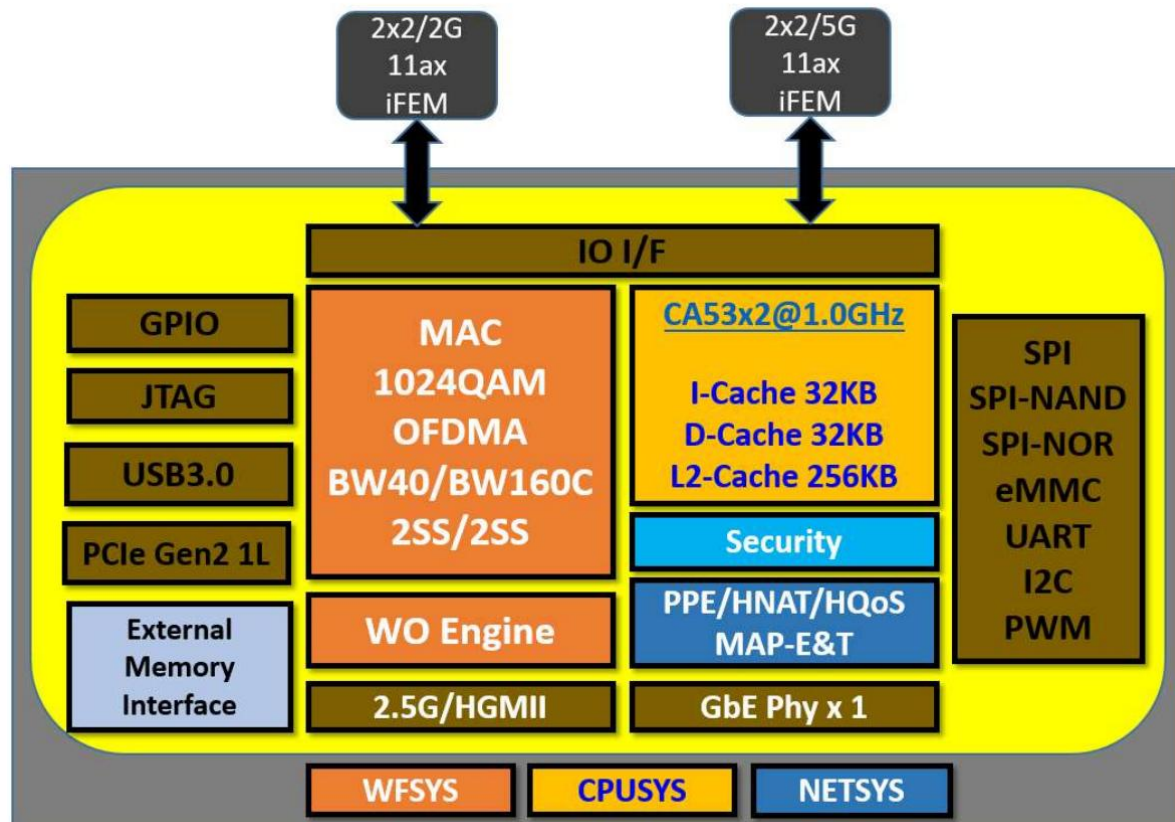
Besides the connectivity features, the hardware-based NAT engine with QoS embedded in MT7981B transporting the audio/video streams in higher priority than other non-timely services also enriches the home entertainment application. The SFQ separating P2P sessions from audio/video ones so that MT7981B guarantees the streaming service.

With the advanced technology and abundant features, MT7981B is well positioned to be the core of next generation Smart WiFi AP router, and home gateway systems.

## Features

- MT7981B Embedded dual-core ARM® Cortex-A53
- RAM: default 512MByte (1GB optional)
- SPI NAND Flash: default 128MByte (256MByte optional)
- Support EMMC(4GB/8GB) optional **Nand Flash and eMMC can only choose one**
- Support Nor Flash (16MByte/32MByte/64MByte )optional
- 2x2 (2ss) 11ax 2.4GHz + 3x3 (2ss) 11ax 5GHz  
( Total 3\*IPEX , Two dual -frequency antennas, one 2.4GHz antennas)  
Integrated PA, LNA and TR-SW 20/40/80/160MHz bandwidth  
Support up to 1024QAM
- 1-port 10/100/1000Mbps ethernet( Integrate 1G PHY)
- 1-port 10/100/1000/2.5Gbps HSGMII
- 1 x USB 3.0 (or 1x PCIe )
- GPIOs
- Support JTAG interface
- OpenWrt / Linux 5.4 SDK
- Power supply voltage: 12V/1.5A or 5V/3A
- Size: 69.9mm x 58mm x 4.8mm

## 2 MAIN CHIP BLOCK DIAGRAM



### 3 MAIN CHIP FEATURES

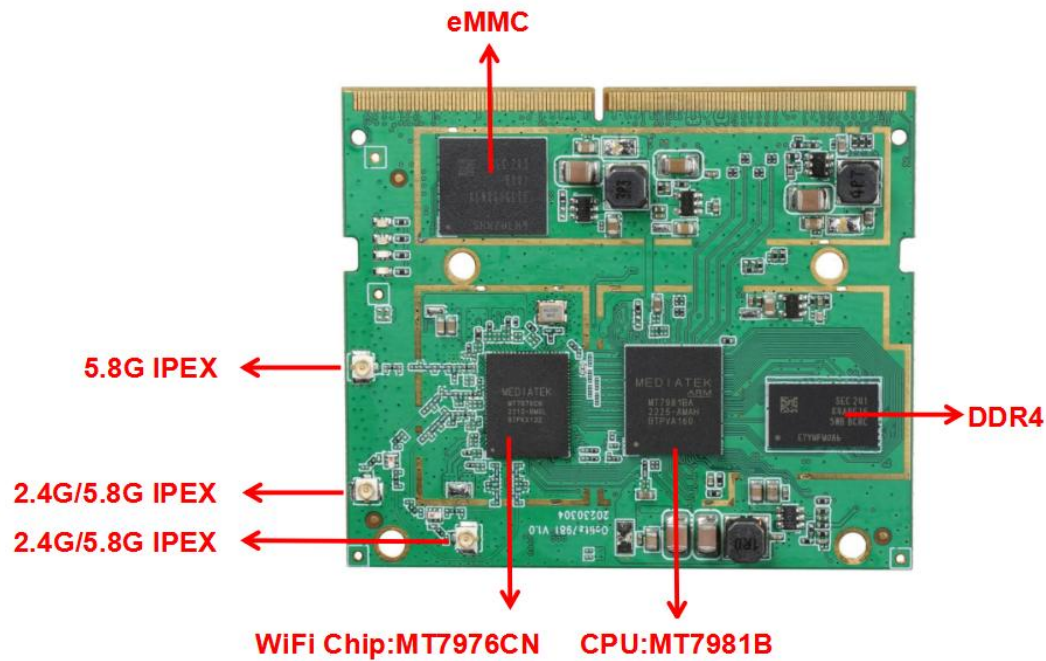
The following table covers the main features offered by the MT7981B. Overall, the MT7981B supports the requirements of a high-level AP/router, and a number of interfaces together with a large RAM capacity.

| Feature            | Description  |
|--------------------|--|
| CPU                | ARM CA53 (1.3GHz, Dual-core)   |
| I-Cache, D-Cache   | 32kB, 32kB per core  |
| L2 Cache           | 256KB  |
| Security           | Support 2* 256-bit Multi-key on OTP efuse<br>Support 64 versions OTP efuse for Anti-roll back  |
| DRAM data          | 16bit (external memory interface)  |
| External DDR3/DDR4 | 2133 Mbps (2GB support)  |
| WIFI               | 2x2 (2ss) 11ax 2.4GHz + 3x3 (2ss) 11ax 5GHz<br>Integrated PA, LNA and TR-SW 20/40/80/160MHz bandwidth<br>Support up to 1024QAM<br>Support external LNA and PA support (option) |
| Ethernet           | HSGMII x 2; Integrate 1G PHY for extender  |
| HNAT/HQoS          | HQoS 64 queues, SFQ 1K queues<br>HNAT (IPv4, IPv6 routing, DS-Lite, 6RD)   |
| USB                | USB3.0 x 1   |
| PCIe               | PCIe Gen2 1-Lane x 1   |
| SPIM NAND Flash    | Use on-die ECC   |
| SPI Flash (NOR)    | Max 52MHz<br>data bit width x1/x2/x4<br>Support 4-byte address mode compatible with 3-byte address mode  |
| eMMC               | eMMC v4.5 @50MHz 3.3V  |
| I2C                | I2C x 1<br>100kHz, Support 7/10-bit addressing   |
| SPI                | SPI x 1<br>Support DMA and FIFO mode   |
| UART               | UART-Lite(2-pins) x 1<br>UART(4-pins) x 2  |
| Package            | 13.0 mm x 11.7 mm, TFBGA   |

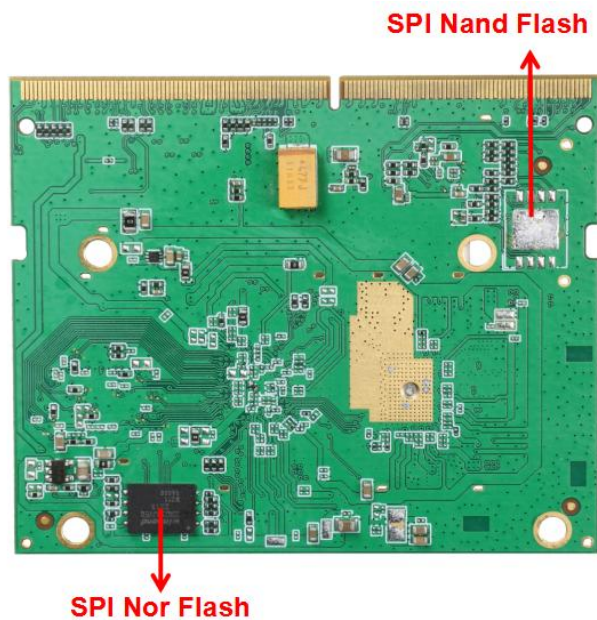


## 4 PICTURES

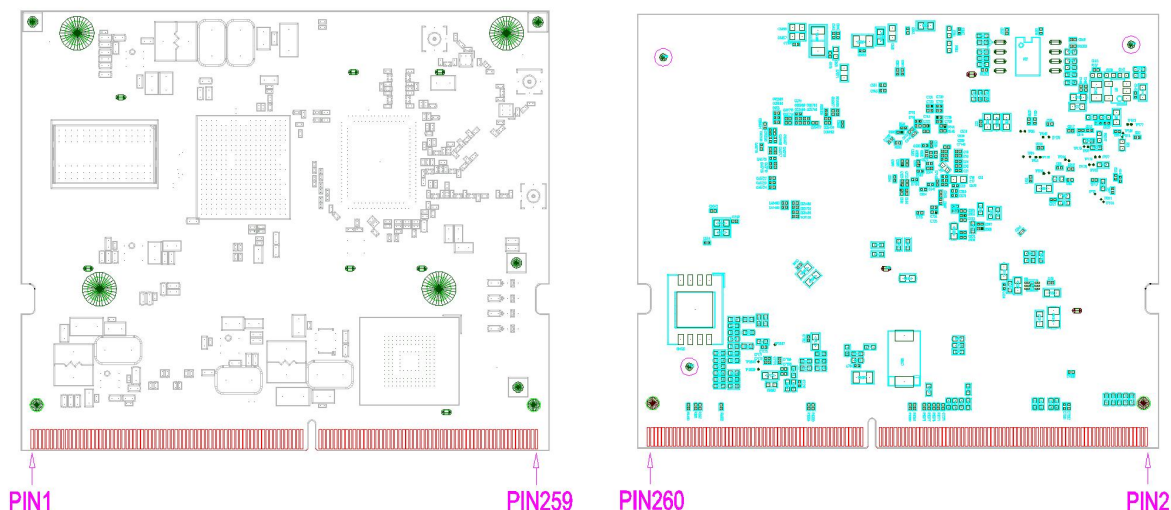
TOP:



Bottom:



## 5 PINS DESCRIPTION



| Front(TOP) |   | Back(BOTTOM) |  |
|------------|---|--------------|--|
| PINs       | Pin definition  | PINs         | Pin definition   |
| 1          | GND   | 2            | GND  |
| 3          | GPIO6/<br>JTAG_JTMS/WM_JTAG_JTMS/<br>UART2_CTS/PTA_EXT_WLAN_ACT | 4            | GPIO5/<br>JTAG_JTDI/WM_JTAG_JTDI/<br>UART2_TXD/PTA_EXT_PRI               |
| 5          | GND   | 6            | GND  |
| 7          | GPIO4/<br>JTAG_JTDO/WM_JTAG_JTDO/<br>UART2_RXD/PTA_EXT_ACT      | 8            | GPIO8/<br>JTAG_JTRST_N/WM_JTAG_JTRST_N/<br>GBE_LED0/<br>NET_WO0_UART_TXD |
| 9          | GND   | 10           | GND  |
| 11         | GPIO7/<br>JTAG_JTCLK/<br>WM_JTAG_JTCLK/<br>UART2_RTS/PWM2       | 12           | unused (kept floating)   |
| 13         | System power-on reset signal<br>(keep floating)                 | 14           | GND  |
| 15         | GND   | 16           | GPIO12/<br>WO0_JTAG_JTCLK/<br>PCM_FS                                     |
| 17         | GPIO11/<br>WO0_JTAG_JTMS/<br>PCM_CLK                            | 18           | GND  |
| 19         | GND   | 20           | GPIO9/<br>WO0_JTAG_JTDO/WM_AICE_TCKC<br>/PCM_DTX                         |
| 21         | GPIO9<br>/WO0_JTAG_JTDO/WM_AICE_TCKC/PC<br>M_DTX                | 22           | GND  |
| 23         | GND   | 24           | SPI2_MISO/<br>UART1_CTS/GPIO28   |



|    |   |    |   |
|----|---|----|---|
| 25 | Repeat SPI NOR flash(use with caution)<br>GPIO28/SPI2_MISO/UART1_CTS/WA_AI<br>CE_TCKC       | 26 | GND   |
| 27 | GND   | 28 | Repeat SPI NOR flash(use with caution)<br>SPI2_WP/GPIO31/WF5G_LED/WA_UART_TX<br>D/I2C_SDA |
| 29 | Repeat SPI NOR flash(use with caution)<br>GPIO30/SPI2_HOLD/WF2G_LED/WM_U<br>ART_TXD/I2C_SCL | 30 | GND   |
| 31 | GND   | 32 | GPIO13/WO0_JTAG_JTRST_N/PWM0/GBE_L<br>ED1/PCM_MCK   |
| 33 | unused (kept floating)  | 34 | unused (kept floating)  |
| 35 | GND   | 36 | GND   |
| 37 | Repeat SPI NOR flash(use with caution)<br>GPIO29/SPI2_CS/UART1_RTS/<br>WA_AICE_TMSC         | 38 | Repeat SPI NOR flash(use with caution)<br>GPIO26/SPI2_CLK/UART1_RXD                       |
| 39 | GND   | 40 | GND   |
| 41 | USB3.0/PCIE/SGMII1 data pin TX +  | 42 | USB3.0/PCIE/SGMII1 data pin TX -  |
| 43 | GND   | 44 | GND   |
| 45 | USB3.0/PCIE/SGMII1 data pin RX +  | 46 | USB3.0/PCIE/SGMII1 data pin RX -  |
| 47 | GND   | 48 | GND   |
| 49 | PCIE_CKP  | 50 | PCIE_CKN  |
| 51 | GND   | 52 | GND   |
| 53 | unused (kept floating)  | 54 | unused (kept floating)  |
| 55 | unused (kept floating)  | 56 | GND   |
| 57 | GND   | 58 | USB HS/FS/LS data pin Data USB_DM   |
| 59 | USB HS/FS/LS data pin Data USB_DP   | 60 | GND   |
| 61 | GND   | 62 | GBE_TXVP_A_P0   |
| 63 | GBE_TXVN_A_P0   | 64 | GND   |
| 65 | GND   | 66 | GBE_TXVP_B_P0   |
| 67 | GBE_TXVN_B_P0   | 68 | GND   |
| 69 | GND   | 70 | GBE_TXVP_C_P0   |
| 71 | GBE_TXVN_C_P0   | 72 | GND   |
| 73 | GND   | 74 | unused (kept floating)  |
| 75 | unused (kept floating)  | 76 | unused (kept floating)  |
| 77 | GND   | 78 | GND   |
| 79 | GBE_TXVP_D_P0   | 80 | GBE_TXVN_D_P0   |
| 81 | GND   | 82 | GND   |
| 83 | GBE_Reset(External PHY use)<br>GPIO39   | 84 | GBE_INT(External PHY use)<br>GPIO38   |
| 85 | GND   | 86 | GND   |
| 87 | 5V ≥ 3A or 12V ≥ 1.5A   | 88 | 5V ≥ 3A or 12V ≥ 1.5A   |
| 89 | GND   | 90 | GND   |
| 91 | 5V ≥ 3A or 12V ≥ 1.5A   | 92 | 5V ≥ 3A or 12V ≥ 1.5A   |

|     |   |     |  |
|-----|---|-----|--|
| 93  | GND   | 94  | GND  |
| 95  | unused (kept floating)  | 96  | unused (kept floating)   |
| 97  | unused (kept floating)  | 98  | GND  |
| 99  | GND   | 100 | 5V $\geq$ 3A or 12V $\geq$ 1.5A  |
| 101 | 5V $\geq$ 3A or 12V $\geq$ 1.5A   | 102 | GND  |
| 103 | GND   | 104 | 5V $\geq$ 3A or 12V $\geq$ 1.5A  |
| 105 | 5V $\geq$ 3A or 12V $\geq$ 1.5A   | 106 | GND  |
| 107 | GND   | 108 | unused (kept floating)   |
| 109 | GBE_EXT_MDC(External PHY use)/<br>SMI_MDC(Serial management clock)/<br>GPIO36/I2C_SCL | 110 | GBE_EXT_MDIO(External PHY use)/<br>SMI_MDIO(Serial management data)/<br>GPIO37/I2C_SDA |
| 111 | unused (kept floating)  | 112 | unused (kept floating)   |
| 113 | Repeat 109 PIN (kept floating)  | 114 | Repeat 110 PIN (kept floating)   |
| 115 | MT7981B Boot mode Jumper(external<br>prohibition using keep float)                    | 116 | unused (kept floating)   |
| 117 | unused (kept floating)  | 118 | unused (kept floating)   |
| 119 | UART0_RXD(Debug UART)   | 120 | UART0_TXD(Debug UART)  |
| 121 | GPIO3/PCIE_PERESET_N  | 122 | SYS_WATCHDOG/GPIO2   |
| 123 | unused (kept floating)  | 124 | unused (kept floating)   |
| 125 | unused (kept floating)  | 126 | GPIO34/WF2G_LED/PCIE_CLK_REQ   |
| 127 | GPIO35/WF5G_LED/PCIE_WAKE_N   | 128 | unused (kept floating)   |
| 129 | unused (kept floating)  | 130 | unused (kept floating)   |
| 131 | unused (kept floating)  | 132 | unused (kept floating)   |
| 133 | unused (kept floating)  | 134 | unused (kept floating)   |
| 135 | unused (kept floating)  | 136 | unused (kept floating)   |
| 137 | unused (kept floating)  | 138 | unused (kept floating)   |
| 139 | unused (kept floating)  | 140 | unused (kept floating)   |
| 141 | unused (kept floating)  | 142 | unused (kept floating)   |
| 143 | unused (kept floating)  | 144 | unused (kept floating)   |
| 145 | unused (kept floating)  | 146 | unused (kept floating)   |
| 147 | unused (kept floating)  | 148 | unused (kept floating)   |
| 149 | unused (kept floating)  | 150 | unused (kept floating)   |
| 151 | unused (kept floating)  | 152 | unused (kept floating)   |
| 153 | unused (kept floating)  | 154 | unused (kept floating)   |
| 155 | unused (kept floating)  | 156 | unused (kept floating)   |
| 157 | unused (kept floating)  | 158 | unused (kept floating)   |
| 159 | unused (kept floating)  | 160 | unused (kept floating)   |
| 161 | unused (kept floating)  | 162 | unused (kept floating)   |
| 163 | unused (kept floating)  | 164 | unused (kept floating)   |
| 165 | unused (kept floating)  | 166 | unused (kept floating)   |
| 167 | GND   | 168 | GND  |

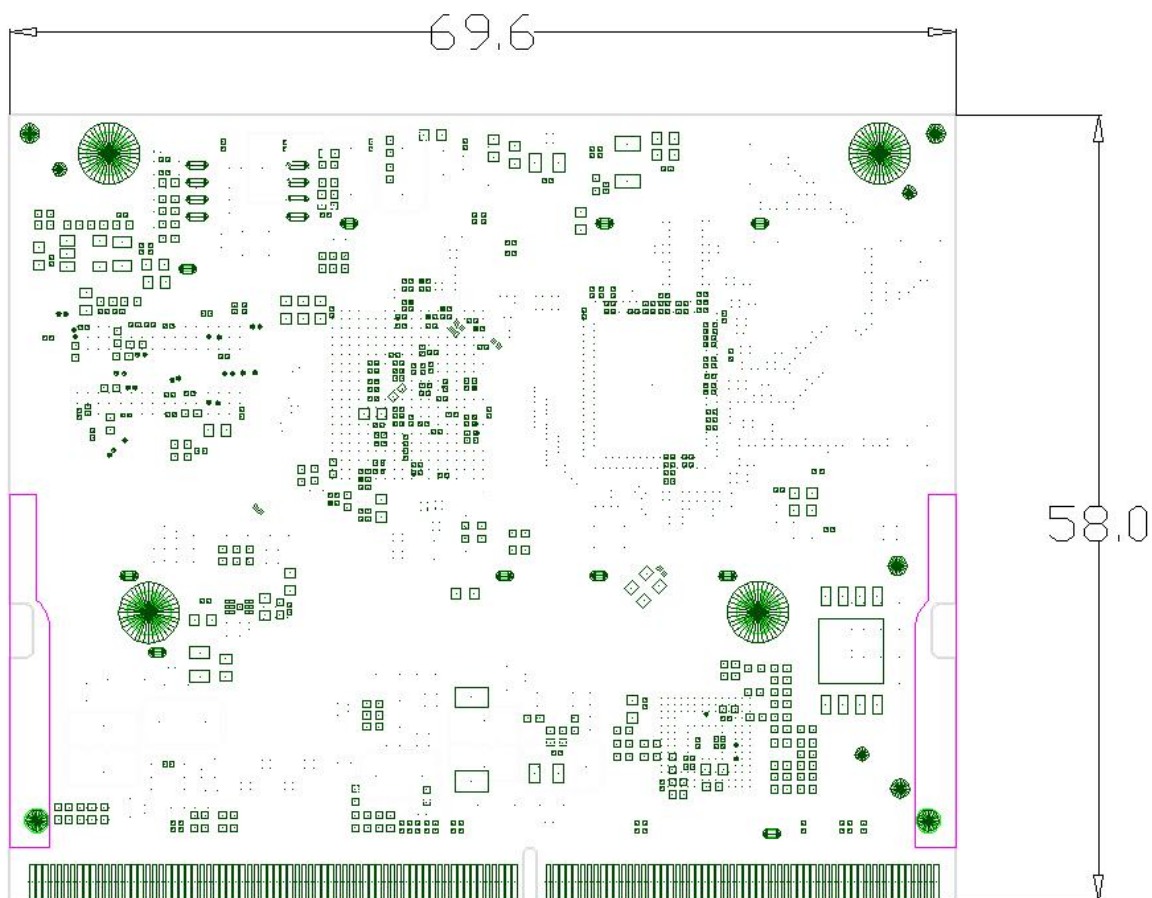
|     |   |     |  |
|-----|---|-----|--|
| 169 | SGMII 0 data pin TX -   | 170 | SGMII 0 data pin TX +                        |
| 171 | GND   | 172 | GND  |
| 173 | SGMII 0 data pin RX +   | 174 | SGMII 0 data pin RX -                        |
| 175 | GND   | 176 | GND  |
| 177 | unused (kept floating)  | 178 | unused (kept floating)                       |
| 179 | unused (kept floating)  | 180 | GND  |
| 181 | GND   | 182 | unused (kept floating)                       |
| 183 | unused (kept floating)  | 184 | GND  |
| 185 | GND   | 186 | unused (kept floating)                       |
| 187 | unused (kept floating)  | 188 | GND  |
| 189 | GND   | 190 | unused (kept floating)                       |
| 191 | unused (kept floating)  | 192 | GND  |
| 193 | GND   | 194 | unused (kept floating)                       |
| 195 | unused (kept floating)  | 196 | GND  |
| 197 | GND   | 198 | unused (kept floating)                       |
| 199 | unused (kept floating)  | 200 | unused (kept floating)                       |
| 201 | GND   | 202 | GND  |
| 203 | unused (kept floating)  | 204 | unused (kept floating)                       |
| 205 | GND   | 206 | GND  |
| 207 | unused (kept floating)  | 208 | unused (kept floating)                       |
| 209 | GND   | 210 | GND  |
| 211 | unused (kept floating)  | 212 | unused (kept floating)                       |
| 213 | GND   | 214 | GND  |
| 215 | unused (kept floating)  | 216 | unused (kept floating)                       |
| 217 | GND   | 218 | GND  |
| 219 | unused (kept floating)  | 220 | unused (kept floating)                       |
| 221 | Repeat PIN 115/ MT7981B Boot mode Jumper(external prohibition using keep float) | 222 | GND  |
| 223 | GND   | 224 | unused (kept floating)                       |
| 225 | unused (kept floating)  | 226 | GND  |
| 227 | GND   | 228 | Aux ADC input 1                              |
| 229 | Aux ADC input 0   | 230 | GND  |
| 231 | GND   | 232 | Aux ADC input 2                              |
| 233 | GPIO_RESET/GPIO1/WA_AICE_TMISC/<br>WM_AICE_TMISC                                | 234 | GND  |
| 235 | GND   | 236 | GPIO_WPS/GPIO0/WA_AICE_TCKC/<br>WM_AICE_TCKC |
| 237 | MT7981B Boot mode Jumper(external prohibition using keep float)                 | 238 | GND  |

|      |   |      |   |
|------|---|------|---|
| 239  | GND   | *240 | SPI0_CLK/EMMC_DAT0/SNFI_CLK/GPIO16/U<br>ART1_RXD<br>SPI NAND or EMMC use      |
| 241  | unused (kept floating)  | *242 | SPI0_MOSI/EMMC_DAT1/SNFI_MOSI/UART1<br>_TXD/GPIO17/<br>SPI NAND and EMMC use  |
| 243  | GND   | 244  | GND   |
| *245 | SPI0_WP/EMMC_DAT5/SNFI_WP/WA_U<br>ART_TXD/GPIO21/<br>SPI NAND or EMMC use | *246 | SPI0_MISO/EMMC_DAT2/SNFI_MISO/UART1<br>_CTS/GPIO18/<br>SPI NAND or EMMC use   |
| 247  | GND   | 248  | GND   |
| *249 | SPI0_CS/EMMC_DAT3/SNFI_CS/UART1<br>_RTS/GPIO19/<br>SPI NAND or EMMC use   | *250 | SPI0_HOLD/EMMC_DAT4/SNFI_HOLD/WM_U<br>ART_TXD/GPIO20/<br>SPI NAND or EMMC use |
| 251  | GND   | 252  | GND   |
| *253 | EMMC_CLK/UART2_RTS/PCM_MCK/GP<br>IO25/SPI1_CS/<br>EMMC use                | *254 | EMMC_DAT6/UART2_RXD/PTA_EXT_ACT/GP<br>IO22/SPI1_CLK/<br>EMMC use              |
| 255  | unused (kept floating)  | *256 | EMMC_DAT7/UART2_TXD/PTA_EXT_PRI/GPI<br>O23/SPI1_MOSI/<br>EMMC use             |
| 257  | unused (kept floating)  | 258  | unused (kept floating)  |
| 259  | unused (kept floating)  | *260 | EMMC_CMD/UART2_CTS/PTA_EXT_WLAN_A<br>CT/GPIO24/SPI1_MISO/<br>EMMC use         |

\* Pins are used by module eMMC and Spi nand Flash. When the module does not require eMMC and SPI Nand Flash, it can be used by connecting gold finger through change resistor location

## 6 MECHANICAL

| Dimensions<br>(mm) | Length                   | Width                      | Height                    |
|--------------------|--------------------------|----------------------------|---------------------------|
|                    | 58<br>(Tolerance:±0.2mm) | 69.6<br>(Tolerance:±0.2mm) | 8.0<br>(Tolerance:±0.2mm) |



## 7 SCHEMATIC DESIGN NOTES

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This part contains the schematic and PCB design notes for the customer who use the Core module for their own production. You can see our reference design and the MT7981B Spec. for more detail design information.

### 7.2 USB

Oolite-MT7981B V1 Module support USB3.0 and PCIe Gen2 1-Lane interface, But USB3.0 and PCIe can only choose one of the two. If you want to support two functions at the same time, please refer to our design

### 7.3 POWER

Oolite-MT7981B V1 Module use a wide voltage power supply solution, Input:  $5V \geq 3A$  or  $12V \geq 1.5A$ , The power conversion process has been done inside the module, so there is no need to design a cumbersome power network

Power Ripple:

Small ripple is necessary for better performance, especially for the RF property.

5VDC ripple should be  $\leq 50mV$  at idle state and  $\leq 75mV$  at full load.

12VDC ripple should be  $\leq 60mV$  at idle state and  $\leq 180mV$  at full load.

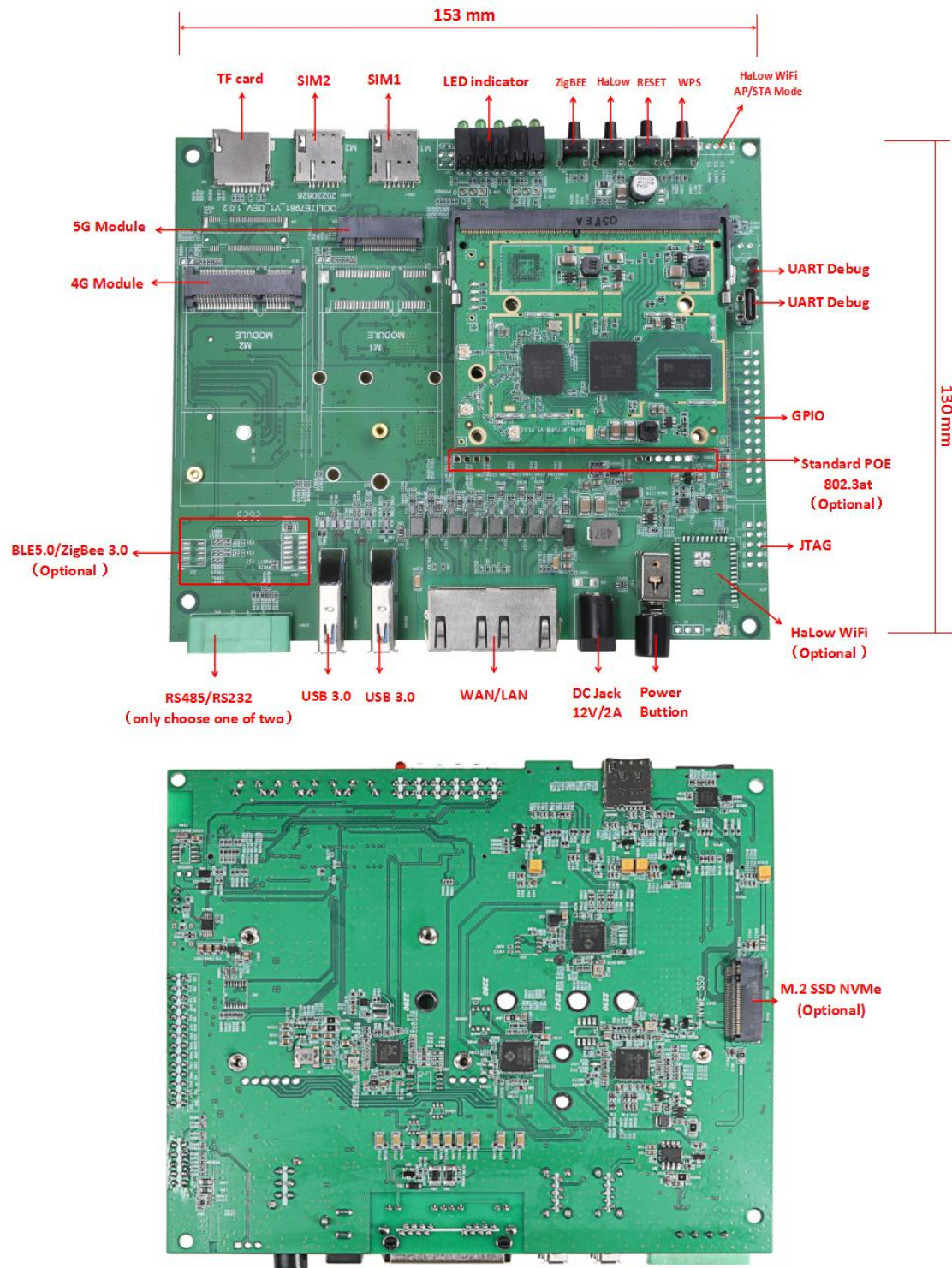


## 8 MODULE OPERATING ENVIRONMENT

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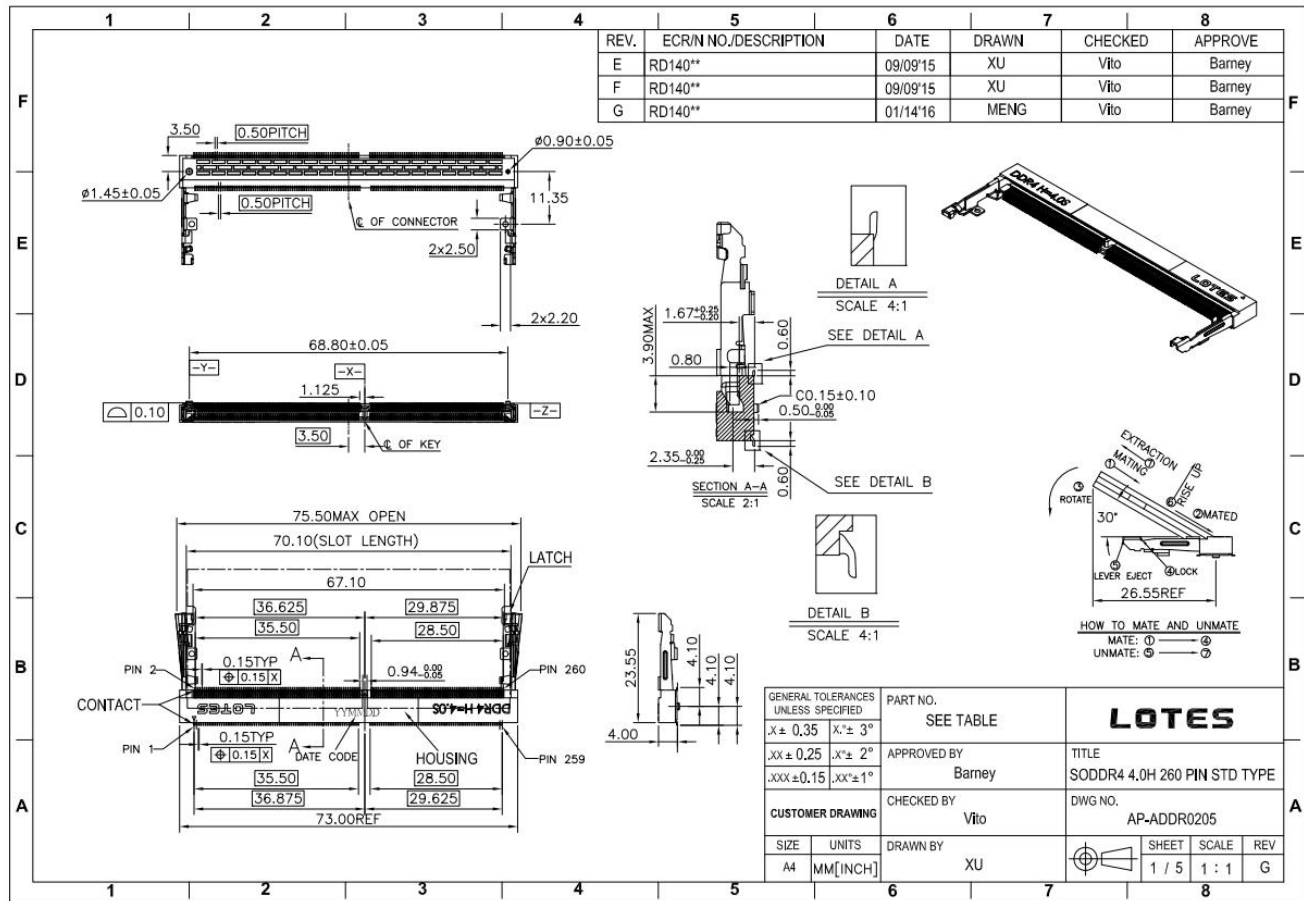
|                       |                        |
|-----------------------|------------------------|
| Operating Temperature | 0°C ~45°C              |
| Storage Temperature   | -40°C ~ 80°C           |
| Operating Humidity    | 10%~90% non-condensing |
| Storage Humidity      | 5%~90% non-condensing  |

## 9 DEVELOPMENT BOARD FUNCTION DESCRIPTION



## 10 FOR COMPONENT SELECTION

### SODDR slot reference specifications



## 11 BASE PLATE OPENING REFERENCE SIZE

Bottom plate reference opening

