

Kinkan is small but very versatile wireless LAN CPU module based on Realtek RTL8197FS SoC

Kinkan is packed with an extensive set of interfaces and robust 1GHz CPU based on MIPS 24Kc core. Module dimensions 19.5 mm x 26.7 mm. Back side of the module is component free and module is implemented in LGA (land grid array) form for compact surface mount designs. Built in 128MB RAM and 32MB FLASH lets comfortably run embedded Linux applications under OpenWRT.

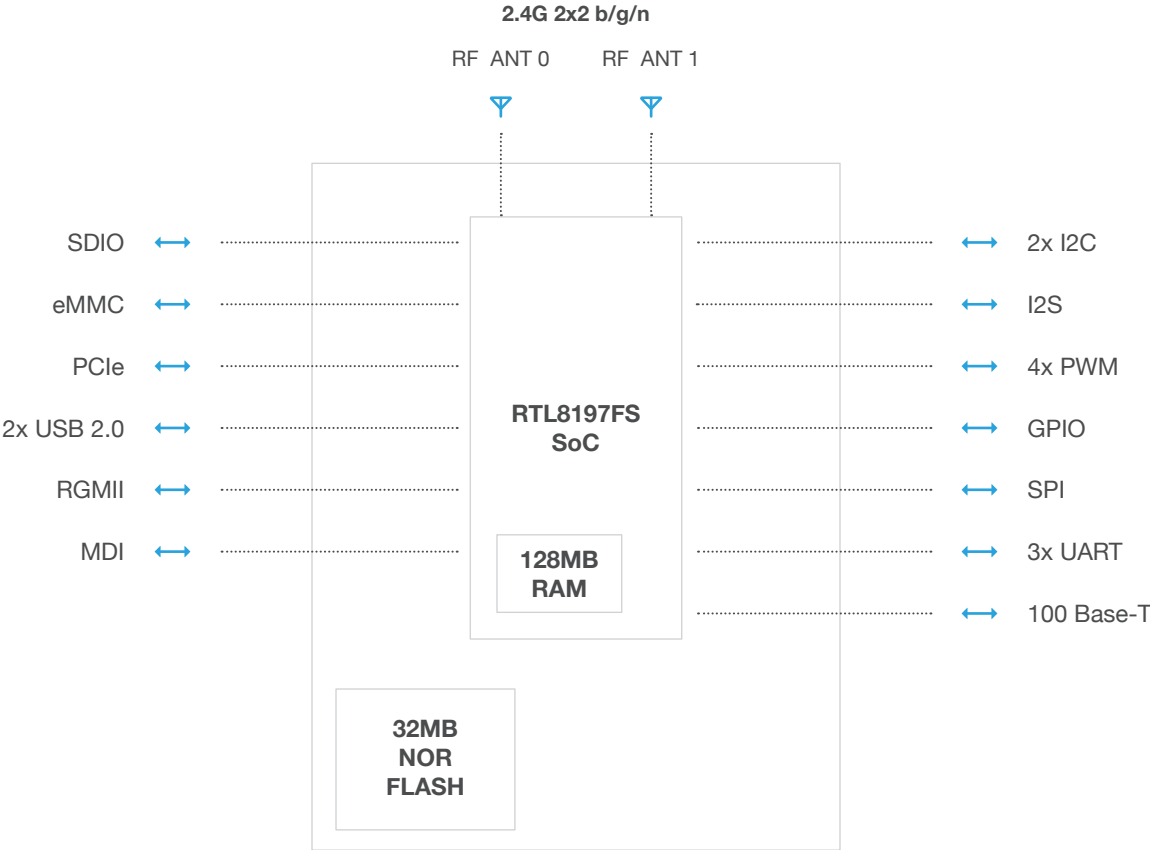
Kinkan supports GPIO, I2C, SPI, UART, I2S, PCM/SLIC, 2 x USB2.0 host, PCIe, MDIO, PWM, RGMII, 100BaseT PHY, SDXC SD Card, eMMC module, SPI and parallel NAND and can boot from SD card, eMMC module built in NOR, external SPI and parallel NAND FLASH.

High performance is not affecting low power consumption with the load on LAN and WLAN interfaces it consumes up to 4W of power.

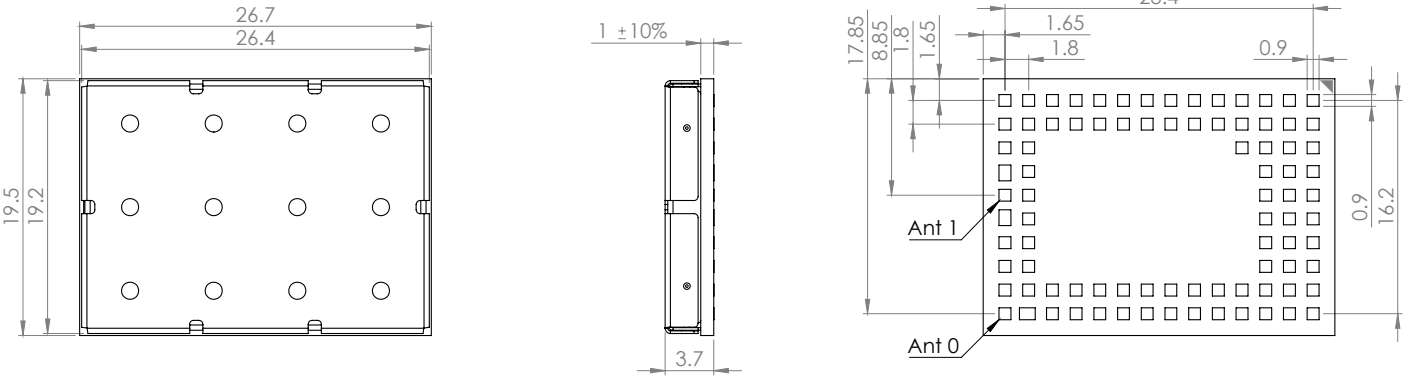
Quick specs

- 802.11 b/g/n 2.4 GHz, 2x2 MIMO, 300 Mbps data rate
- 32 MB FLASH, 128 MB RAM
- Linux friendly , OpenWRT flash image and source code are available for download on www.8devices.com/wiki_kinkan
- CPU – RTL8197FS (1 GHz CPU based on MIPS 24Kc core)
- 22 dBm per chain output power radio
- Small form factor - 19.5 by 26.7 mm
- Surface mountable (LGA form), single side design
- Available interfaces - GPIO, I2C, SPI, UART, I2S, PCM/SLIC, 2 x USB2.0 host, PCIe, MDIO, PWM, RGMII, 100BaseT PHY, SDXC SD Card, eMMC module, SPI and parallel NAND flash

Block diagram



Module dimensions



Radio characteristics

| Receive sensitivity (dBm) | 802.11N (20 MHz) | 7.2 Mbps | 14.4 Mbps | 21.7 Mbps | 28.9 Mbps | 43.3 Mbps | 57.8 Mbps | 65 Mbps | 72.2 Mbps |
|---------------------------|------------------|----------|-----------|-----------|-----------|-----------|-----------|----------|-----------|
| | | | -91 | -89 | -86 | -84 | -80 | -76 | -74 |
| 802.11N (40 MHz) | 15 Mbps | 30 Mbps | 45 Mbps | 60 Mbps | 90 Mbps | 120 Mbps | 135 Mbps | 150 Mbps | |
| | | -89 | -86 | -84 | -80 | -77 | -73 | -72 | -70 |

| Output power (dBm) | 802.11N (20 MHz) | 7.2 Mbps | 14.4 Mbps | 21.7 Mbps | 28.9 Mbps | 43.3 Mbps | 57.8 Mbps | 65 Mbps | 72.2 Mbps |
|--------------------|------------------|----------|-----------|-----------|-----------|-----------|-----------|----------|-----------|
| | | | 23 | 23 | 23 | 22 | 21 | 20 | 19 |
| 802.11N (40 MHz) | 15 Mbps | 30 Mbps | 45 Mbps | 60 Mbps | 90 Mbps | 120 Mbps | 135 Mbps | 150 Mbps | |
| | | 23 | 23 | 23 | 22 | 21 | 20 | 19 | 17 |

Power consumption

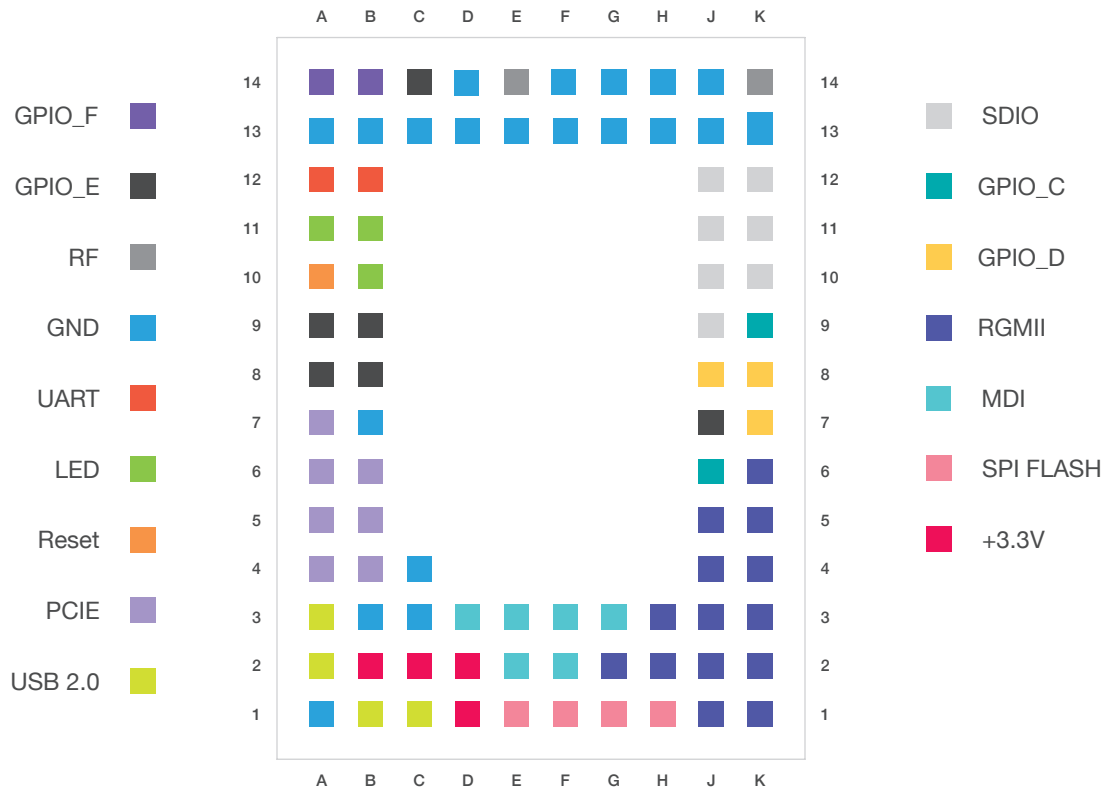
| Scenario | Voltage, V | Current, A | Power, W |
|------------------------|------------|------------|----------|
| Idle without beacons | 3.3 | 0.262 | 0.86 |
| Idle with beacons | 3.3 | 0.363 | 1.2 |
| RF transmit at 50 Mbps | 3.3 | 0.748 | 2.47 |

Operating conditions

The module can operate in a wide temperature range and different conditions depending on the enclosure. The following guidelines guarantee that it will work correctly.

| Parameter | Units | Min | Max |
|-------------------------------------|-------|-----|-----|
| Working environment | °C | 0 | 55 |
| Storage environment | °C | -40 | 70 |
| Operating humidity (non condensing) | %RH | 5% | 90% |

Module pinout



Multi-function pins, total 47

| Module pin | SoC pin | GPIO | I/O | WiFi PCM | RGMII | P-Nand | I2S | SPI-N or SD-eMMC PWM EVENT | EJTAG SPI-Nand | LED SPI | UART | I2CReset |
|------------|---------|-----------|-----|----------|---------|---------|-------------------------------------|----------------------------|----------------|-----------------------|--------|--------------------------|
| D3 | 29 | GPIO_A[0] | O | | | | | MF_CK | SPI_NAND_CK | SPI0_CLK | | I2C0_SCL |
| E3 | 102 | GPIO_A[1] | B | | | | | MF_D0 | SPI_NAND_D0 | SPI0_TXD | | I2C0_SDA |
| G3 | 96 | GPIO_A[2] | B | | | | | MF_D1 | SPI_NAND_D1 | SPI0_RXD SPI0_TRXD | | I2C1_SCL I2C1_SCL_SLV |
| E2 | 39 | GPIO_A[3] | B | | | | | MF_RSTN | SPI_NAND_D2 | SPI0_CS0N | | I2C1_SDA I2C1_SDA_SLV |
| F2 | 41 | GPIO_A[4] | O | | | | | MF_CS0N | SPI_NAND_CS0N | | | I2C1_SCL |
| F3 | 30 | GPIO_A[5] | B | | | | I2S_SD3_O | MF_CS1N | SPI_NAND_D3 | | | I2C1_SDA |
| J1 | 66 | GPIO_A[6] | O | | P0_TXD3 | NF_ALE | I2S_MCLK | PWM0 | | SPI0_CLK | | |
| K3 | 128 | GPIO_A[7] | O | | P0_TXD2 | NF_CLE | I2S_SCLK | PWM1 | | SPI0_CS0N | | |
| G2 | 70 | GPIO_B[0] | O | | P0_TXD1 | NF_RD# | I2S_WS I2S_SD2_O | PWM2 | | SPI0_TXD | | I2C1_SCL |
| J3 | 3 | GPIO_B[1] | B | | P0_RXC | NF_CE0# | I2S_SD1_O I2S_SD1_I I2S_SD3_O | PWM3 | JTAG TCK | SPI0_RXD SPI0_TRXD | | I2C1_SDA |
| K6 | 76 | GPIO_B[2] | B | PCM_CLK | P0_RXD3 | NF_D0 | I2S_MCLK | EVENT0 | JTAG_TRSTN | SPI0_TXD_SLV | U2_RTS | |
| J5 | 5 | GPIO_B[3] | B | PCM_FS | P0_RXD2 | NF_D1 | I2S_SCLK | EVENT1 | JTAG_TMS | SPI0_RXD_SLV | U2_TX | |
| K5 | 75 | GPIO_B[4] | B | PCM_TXD | P0_RXD1 | NF_D2 | I2S_WS | EVENT2 | JTAG_TDI | SPI0_CLK_SLV | U2_RX | |
| J4 | 4 | GPIO_B[5] | B | PCM_RXD | P0_RXD0 | NF_D3 | I2S_SD1_O | EVENT3 | | SPI0_CS0N_SLV | U2_CTS | |

| Module pin | SoC pin | GPIO | I/O | WiFi PCM | RGMI | P-Nand | I2S | SPI-N or SD-eMMC PWM EVENT | EJTAG SPI-Nand | LED SPI | UART | I2CReset |
|------------|---------|-----------|-----|----------|----------|---------|-----------|----------------------------|----------------|--|------------------|-----------------------------|
| H2 | 71 | GPIO_B[6] | O | | P0_TXD0 | NF_WP# | | PWM0 | JTAG_TDO | SPI1_CLK | U1_RTS | I2C1_SCL |
| J2 | 73 | GPIO_B[7] | B | | P0_TXC | | I2S_SD1_I | PWM1 | | SPI1_CS0N | U1_RX | I2C0_SDA I2C0_SCL SLV |
| K1 | 2 | GPIO_C[0] | O | | P0_TXCTL | NF_WE# | | PWM2 | | SPI1_TXD | U1_TX | I2C0_SCL |
| K4 | 74 | GPIO_C[1] | B | | P0_RXCTL | NF_R/B# | | PWM3 | | SPI1_RXD SPI1_TRXD | U1_CTS | I2C0_SDA I2C0_SDA SLV |
| H3 | 77 | GPIO_C[2] | B | | P0_MDC | | | | | SPI0_CLK SPI1_CLK | U1_RTS | I2C0_SCL I2C1_SCL |
| K2 | 48 | GPIO_C[3] | B | | P0_MDIO | | | | | SPI1_CS0N SPII_CS0N | U1_TX | I2C0_SDA I2C1_SDA |
| K9 | 127 | GPIO_C[4] | O | | | | | EMMC_RSTN | | SPI0_CSIN | | |
| J6 | 67 | GPIO_C[5] | B | | | | I2S_WS | SD_WP EVENT0 | | SPI0_TXD SPI1_TXD | U1_RX | |
| J9 | 69 | GPIO_C[6] | B | | | | I2S_SCLK | SD_CD EVENT1 | | SPI0_RXD SPI0_TRXD SPI1_RXD SPI1_TRXD | U1_CTS | |
| K11 | 10 | GPIO_C[7] | B | | | | I2S_MCLK | EMMC_CLK EVENT2 | | SPI0_CLK SPII_CLK | | |
| J11 | 11 | GPIO_D[0] | B | | | | I2S_SD1_O | EMMC_CMD EVENT3 | | SPI0_CS0N SPI1_CS0N | | |
| J10 | 8 | GPIO_D[1] | B | | | NF_D4 | I2S_WS | EMMC_DAT0 | | | U1_RX U2_RX | |
| K10 | 78 | GPIO_D[2] | B | | | NF_D5 | I2S_SCLK | EMMC_DAT1 | | | U1_CTS U2_CTS | |
| J12 | 83 | GPIO_D[3] | B | | | NF_D6 | I2S_MCLK | EMMC_DAT2 | | | U1_RTS U2_RTS | |
| K12 | 12 | GPIO_D[4] | B | | | NF_D7 | I2S_SD1_O | EMMC_DAT3 | | | U1_TX U2_TX | |
| J8 | 82 | GPIO_D[5] | B | PCM_CLK | | | | EMMC_DAT4 PWM0 | | SPI1_CLK | | |
| K8 | 81 | GPIO_D[6] | B | PCM_FS | | | | EMMC_DAT5 PWM1 | | SPI1_CS0N | | |
| K7 | 9 | GPIO_D[7] | B | PCM_TXD | | | | EMMC_DAT6 PWM2 | | SPI1_CS0N | | |
| J7 | 79 | GPIO_E[0] | B | PCM_RXD | | | | EMMC_DAT7 PWM3 | | SPI1_RXD SPI1_TRXD | | |
| B8 | 47 | GPIO_E[1] | B | WBB0 | | | | | | | | |
| C14 | 92 | GPIO_E[2] | B | WBB1 | | | | | | | | |
| B9 | 46 | GPIO_E[3] | B | WBB2 | | | | | | | | |
| A9 | 110 | GPIO_E[4] | B | WBB3 | | | | | | | | |
| A8 | 108 | GPIO_E[5] | O | WBB4 | | | | | | | | |
| A14 | 93 | GPIO_F[0] | O | WBB7 | | | | | | | | |
| B14 | 27 | GPIO_F[1] | O | WBB8 | | | | | | | | |
| B10 | 43 | GPIO_G[6] | B | | | | | PWM0 | | LED_PORT0 | | |
| B11 | 28 | GPIO_H[0] | B | | | | | PWM2 | | LED_PORT2 | | |
| A10 | 106 | GPIO_H[1] | B | | | | | PWM3 | | LED_PORT3 | | RESETN |
| A11 | 42 | GPIO_H[2] | B | | | | | | | LED_PORT4 | | |
| A12 | 38 | GPIO_H[3] | B | | | | | | | | U0_RX | |
| B12 | 101 | GPIO_H[4] | O | | | | | | | | U0_TX | |
| B6 | 44 | GPIO_H[5] | O | | | | | | | | | PCIE_RSTN |

I/O descriptions:

B bidirectional

O output

100 Base-T MDI pins

| Module pin | Function |
|------------|------------|
| G1 | MDI_TXO4_P |
| H1 | MDI_TXO4_N |
| E1 | MDI_RXI4_N |
| F1 | MDI_RXI4_P |

USB pins

| Module pin | Function |
|------------|----------|
| B1 | USB1_N |
| C1 | USB1_P |
| A3 | USB0_N |
| A2 | USB0_P |

RF pins

| Module pin | Function |
|------------|----------|
| K14 | 2G_ANT0 |
| E14 | 2G_ANT1 |

PCIe pins

| Module pin | Function |
|------------|------------|
| A6 | PCIE_CLK_N |
| A7 | PCIE_CLK_P |
| B5 | PCIE_RX_N |
| A5 | PCIE_RX_P |
| A4 | PCIE_TX_N |
| B4 | PCIE_TX_P |

+3.3V DC power pins

| Module pin |
|----------------|
| B2, C2, D1, D2 |

Ground pins

| Module pin |
|--|
| A1, A13, B3, B7, B13, C3, C4, C13, D13, E13, F13, F14, G13, G14, H13, H14, J13, J14, K13 |

Pin status on boot

| Kinkan pin | SoC pin | GPIO | HW default direction | Supported directions | Strap pin | During boot state (before software control) |
|------------|---------|----------|----------------------|----------------------|-----------|---|
| D3 | 29 | GPIOA[0] | Input | Output | Y | Internal pull-down only in strap period |
| E3 | 102 | GPIOA[1] | Input | Bidirectional | | Internal pull-up |
| G3 | 39 | GPIOA[2] | Input | Bidirectional | | Internal pull-up |
| E2 | 39 | GPIOA[3] | Input | Bidirectional | | Internal pull-up |
| F2 | 41 | GPIOA[4] | Input | Output | Y | Internal pull-down only in strap period |
| F3 | 30 | GPIOA[5] | Input | Bidirectional | | Internal pull-up |
| J1 | 66 | GPIOA[6] | Output | Output | Y | Internal pull-down only in strap period |
| K3 | 128 | GPIOA[7] | Output | Output | Y | Internal pull-up only in strap period |
| G2 | 70 | GPIOB[0] | Output | Output | Y | Internal pull-down only in strap period |
| J3 | 3 | GPIOB[1] | Input | Bidirectional | | Internal pull-up |
| K6 | 76 | GPIOB[2] | Input | Bidirectional | | Internal pull-up |
| J5 | 5 | GPIOB[3] | Input | Bidirectional | | Internal pull-up |
| K5 | 75 | GPIOB[4] | Input | Bidirectional | | Internal pull-up |
| J4 | 4 | GPIOB[5] | Input | Bidirectional | | Internal pull-up |
| H2 | 71 | GPIOB[6] | Output | Output | Y | Internal pull-down only in strap period |
| J2 | 73 | GPIOH[7] | Bidirectional | Bidirectional | | Internal pull-up |
| K1 | 2 | GPIOC[0] | Output | Output | Y | Internal pull-down only in strap period |
| K4 | 74 | GPIOC[1] | Input | Bidirectional | | Internal pull-up |
| H3 | 77 | GPIOC[2] | Input | Bidirectional | | Internal pull-up |
| K2 | 48 | GPIOC[3] | Bidirectional | Bidirectional | | Internal pull-up |
| K9 | 127 | GPIOC[4] | Output | Output | Y | Internal pull-up only in strap period |
| J6 | 67 | GPIOC[5] | Input | Bidirectional | | Internal pull-up |
| J9 | 69 | GPIOC[6] | Input | Bidirectional | | Internal pull-up |
| K11 | 10 | GPIOC[7] | Output | Bidirectional | | Internal pull-up |
| J11 | 11 | GPIOD[0] | Bidirectional | Bidirectional | | Internal pull-up |
| J10 | 8 | GPIOD[1] | Bidirectional | Bidirectional | | Internal pull-up |
| K10 | 78 | GPIOD[2] | Bidirectional | Bidirectional | | Internal pull-up |
| J12 | 83 | GPIOD[3] | Bidirectional | Bidirectional | | Internal pull-up |
| K12 | 12 | GPIOD[4] | Bidirectional | Bidirectional | | Internal pull-up |
| J8 | 82 | GPIOD[5] | Bidirectional | Bidirectional | | Internal pull-up |
| K8 | 81 | GPIOD[6] | Bidirectional | Bidirectional | | Internal pull-up |
| K7 | 9 | GPIOD[7] | Bidirectional | Bidirectional | | Internal pull-up |
| J7 | 79 | GPIOE[0] | Bidirectional | Bidirectional | | Internal pull-up |
| B8 | 47 | GPIOE[1] | Output | Bidirectional | | Internal pull-down |
| C14 | 92 | GPIOE[2] | Bidirectional | Bidirectional | | Internal pull-down |
| B9 | 46 | GPIOE[3] | Bidirectional | Bidirectional | | Internal pull-down |
| A9 | 110 | GPIOE[4] | Bidirectional | Bidirectional | | Internal pull-down |
| A8 | 108 | GPIOE[5] | Output | Output | Y | Internal pull-down |
| A14 | 93 | GPIOF[0] | Output | Output | Y | Internal pull-down |
| B14 | 27 | GPIOF[1] | Output | Output | Y | Internal pull-down |
| B10 | 43 | GPIOG[6] | Output | Bidirectional | | Internal pull-down |
| B11 | 28 | GPIOH[0] | Output | Bidirectional | | Internal pull-down |
| A10 | 106 | GPIOH[1] | Output | Bidirectional | | Internal pull-down |
| A11 | 42 | GPIOH[2] | Output | Bidirectional | | Internal pull-down |
| A12 | 38 | GPIOH[3] | Input | Bidirectional | | Internal pull-up |
| B12 | 101 | GPIOH[4] | Output | Output | Y | Internal pull-up only in strap period |
| B6 | 44 | GPIOH[5] | Output | Output | Y | Internal pull-down only in strap period |

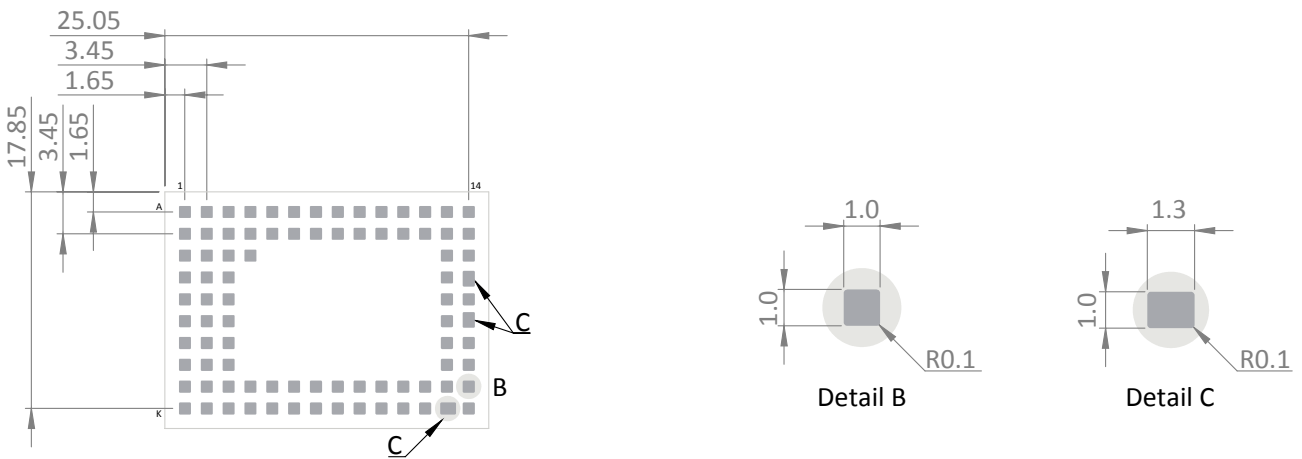
Power supply

It is recommended to use pin B2, C2, D1 and D2 to give power supply to the module.

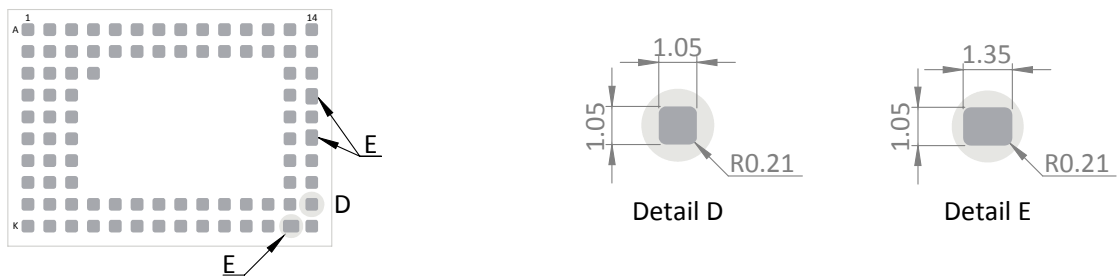
Power ratings (needs update)

| Parameter | Units | Min | Nominal | Max |
|----------------------------|-------|------|---------|------|
| 3.3V power supply (+/-10%) | V | 2.97 | 3.3 | 3.63 |

PCB footprint

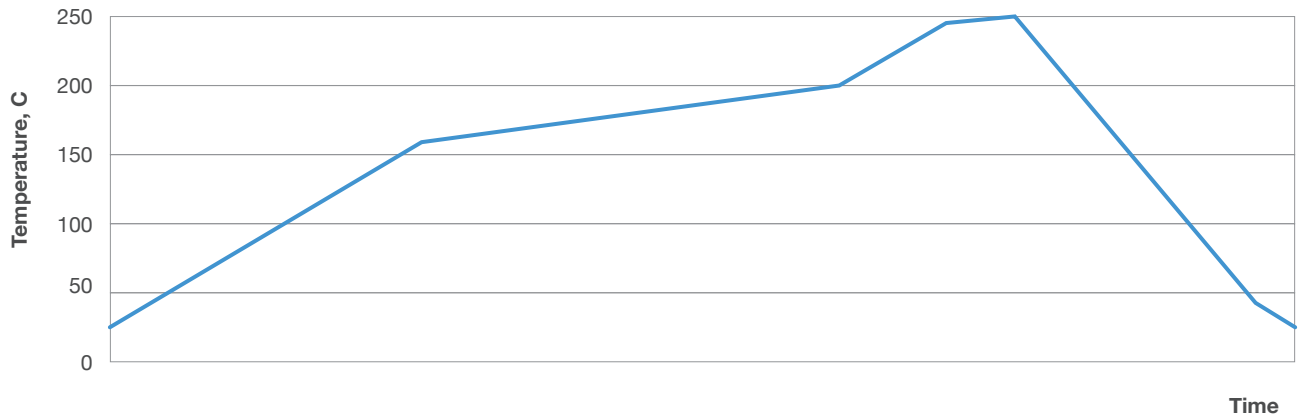


Soldering paste footprint



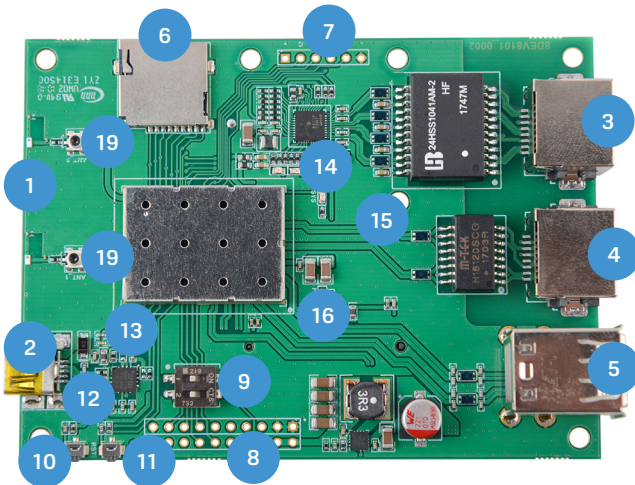
Reflow profile

| | |
|---|----------------|
| Ramp up rate | 3°C/second max |
| Maximum time maintained above 217°C | 120 seconds |
| Peak temperature | 250°C |
| Maximum time within 5°C of peak temperature | 20 seconds |
| Ramp down rate | 6°C/second max |

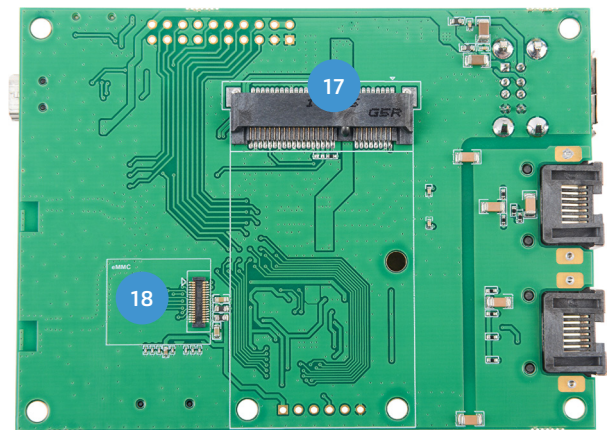


Development kit

Top view



Bottom view



- | | |
|---|--|
| <ol style="list-style-type: none"> 1. Ceramic 2.4 GHz omni-directional antennas 2. Mini USB Type B (console + power 5V) 3. 1000 Base-T LAN port 4. 100 Base-T LAN port 5. 2 x USB Type A (host interface) 6. Micro SD card slot 7. SPI/ GPIO pins 8. GPIO pins 9. Boot source selector switch (internal module flash, SD/emmc) | <ol style="list-style-type: none"> 10. Button (reset to defaults) 11. Button (hardware reset) 12. UART RX/TX activity LEDs 13. Kinkan-DVK power LED 14. LAN activity LEDs 15. Programmable system LED 16. PCIe card activity LED 17. PCIe slot 18. eMMC module connector 19. Murata MM-8430 type connectors for RF testing |
|---|--|