Low Power Atomiser Module

# BM52D5121-1

Revision: V1.00 Date: September 27, 2023

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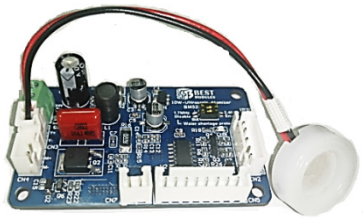
## Features



- Operating voltage: 18V~26.5V
- Operating current: 420mA for 10W atomisation
- Transmission mode: bidirectional UART communication – baud rate: 9600
- Functions and effects: water shortage protection, over current protection, timing operation, adjustable atomisation power, three RGB modes
- Atomisation rate: 70ml/h – for reference, affected by structures
- Atomisation plate frequency: 1.7MHz/2.4MHz
- Fan power control: full power, half power, off
- Size: 65.3mm×39.2mm×14mm

## General Description

The BM52D5121-1 is a low power atomiser module with 32-level adjustable atomisation power ranging from 5W to 10W. The module includes a wide range of functions such as water shortage protection, timing, fan power selection, RGB operating mode selection and atomisation plate frequency selection. It provides a 4-pin bidirectional UART interface and can be used with BMduino development boards, external host devices and other tools. These features make the module suitable for use in applications such as fragrance diffusers, humidifiers and medical atomisers.

## Applications

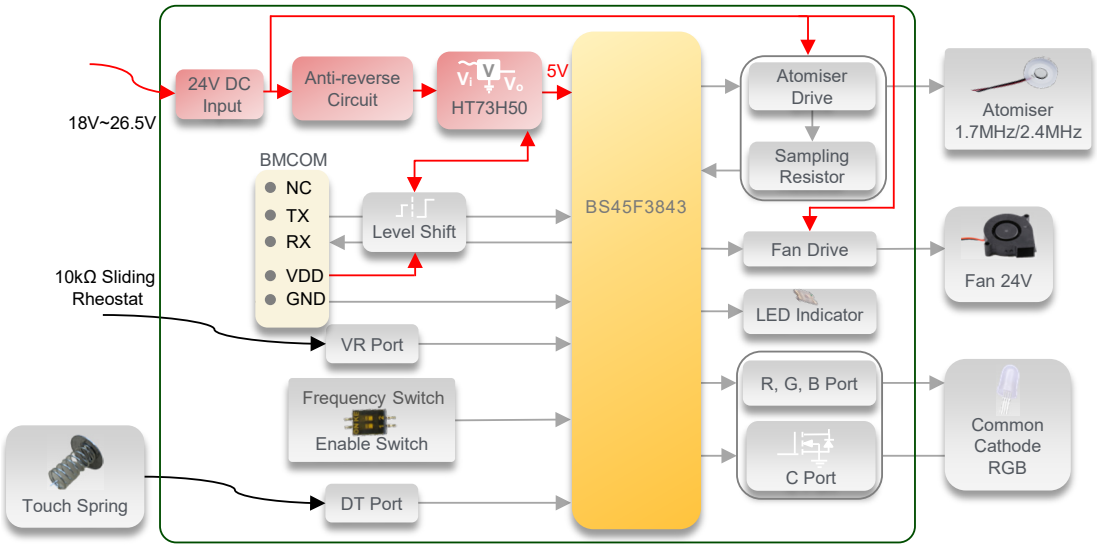
- Fragrance diffusers
- Humidifiers
- Medical atomisers

## Selection Table

| Part No. | Output Frequency | Rated Power | Interface |
|---|---|---|---|
| BM52D5021-1 | 108kHz | 2.0W | UART |
| BM52D5121-1 | 1.7MHz, 2.4MHz | 5W~10W | UART |

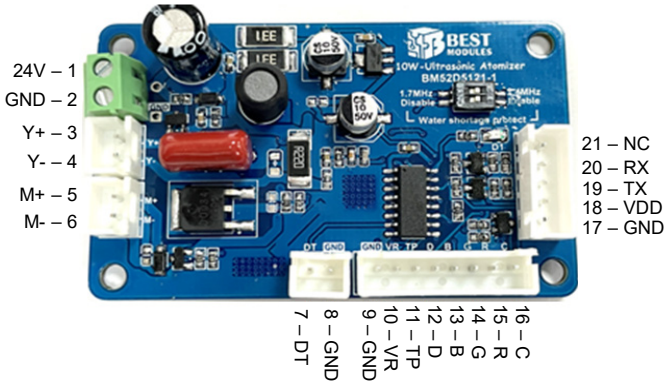
* Products are available from Best Modules

## Block Diagram




## Pin Assignment

Low power atomiser module pins:




## Pin Description

| Pin | Function | Description |
|---|---|---|
| 1 | 24V | Positive power supply input pin |
| 2 | GND | Negative power supply input pin |
| 3 | Y+ | Atomisation plate positive pin |
| 4 | Y- | Atomisation plate negative pin |
| 5 | M+ | Fan positive pin |
| 6 | M- | Fan negative pin |
| 7 | DT | Water detection pin |
| 8 | GND | Connected to ground for Shielding wire |
| 9 | GND | Connected to ground |
| 10 | VR | Atomisation power (atomisation rate) adjustment pin in Stand-alone mode, an external 10kΩ variable resistor is connected for adjustment |

| Pin | Function | Description |
|---|---|---|
| 11 | TP | Water detection disable and water level calibration connection pin |
| 12 | D | LED external connection pin |
| 13 | B | Blue LED drive output – PWM output |
| 14 | G | Green LED drive output – PWM output |
| 15 | R | Red LED drive output – PWM output |
| 16 | C | RGB Common pin |
| 17 | GND | Connected to ground |
| 18 | VDD | Communication logic reference voltage |
| 19 | TX | UART data transmit pin |
| 20 | RX | UART data receive pin |
| 21 | NC | No connection |

# Technical Specifications

## Recommended Operating Conditions

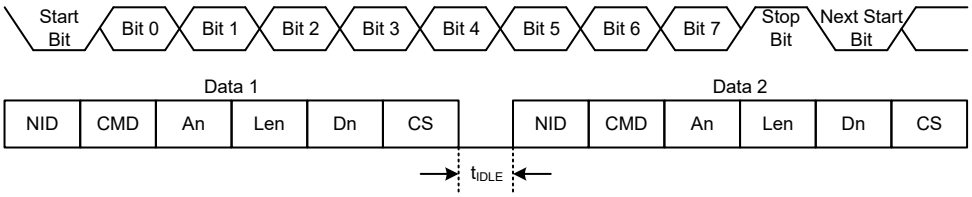
Ta=25°C

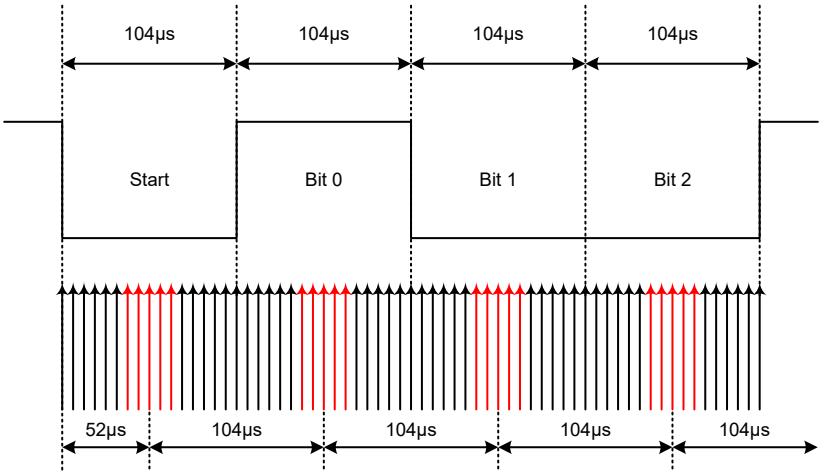
| Symbol | Parameter | Conditions | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|
| $V_{IN}$ | Input Voltage | 1.7MHz/2.4MHz atomisation plate | 18 | 24 | 26.5 | V |
| $I_{DD}$ | Operating Current | 24V @ 10W | — | 420 | — | mA |
| | | 24V @ 5W | — | 210 | — | mA |
| $V_{DD}$ | MCU Operating Voltage | — | — | 5 | 5.5 | V |
| $I_{STB}$ | Standby Current | 24V | — | — | 200 | μA |

## UART Interface

Ta=25°C

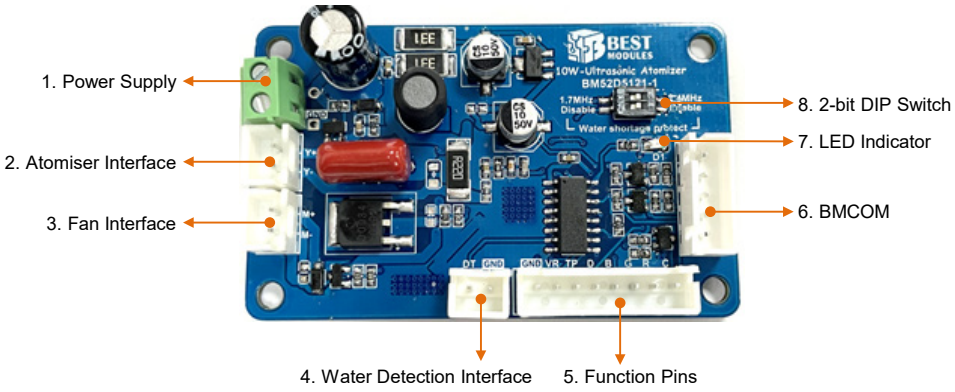
| Symbol | Parameter | Conditions | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|
| BDR | UART Baud Rate | — | — | 9600 | — | bps |
| $t_{IDLE}$ | Interval of each UART Data Transmission | — | 10 | — | — | ms |
| $t_{FQR}$ | Frequency Tracking Time | — | — | — | 3.2 | s |



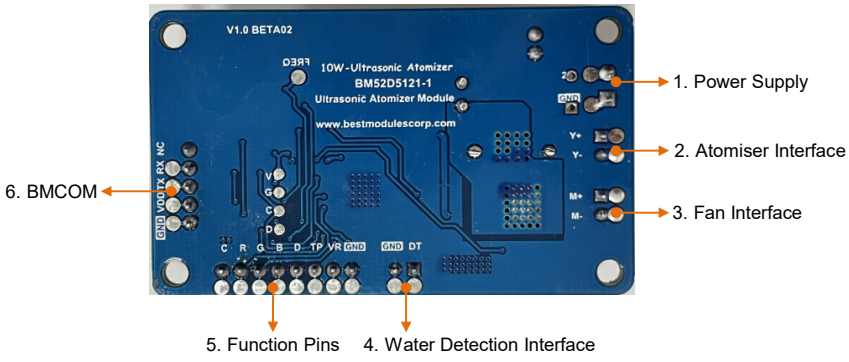



Note: After power-on, when the power setting command is sent the first time and the module starts atomisation, it takes a time of up to 3.2s for frequency tracking. During this time, other commands cannot be responded.

## Hardware Description




**PCBA Front View**




**PCBA Back View**

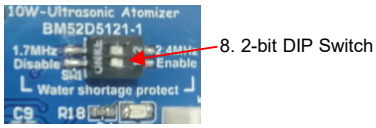
## Power Supply


- Power Supply – use 24V adapter, the specification of ≥0.6A is recommended

## LED Indicator

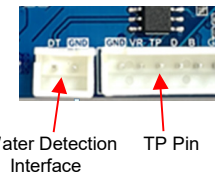

- LED indicator – used to indicate the atomiser current operating status
  - LED always on: This indicates that the water level detection is enabled, all functions are normal and there is water for atomisation
  - LED on for 5s and off for 1s: This indicates that the water level detection is disabled and there is water for atomisation
  - LED on for 1s and off for 1s: This indicates that the water level detection is enabled and it is in a water shortage status
  - LED on for 200ms and off for 200ms: This indicates that situations such as frequency tracking failure, over current and water level calibration failure occur
  - LED on for 200ms and off for 1s: This indicates that the module is calibrating the water level

## 2-bit DIP Switch




- 2-bit DIP switch – It includes the atomisation plate frequency selection and water detection disable/enable selection functions
  - 1.7MHz and 2.4MHz options are used for the atomisation plate frequency selection
  - Disable and Enable options are used for the water detection disable/enable selection

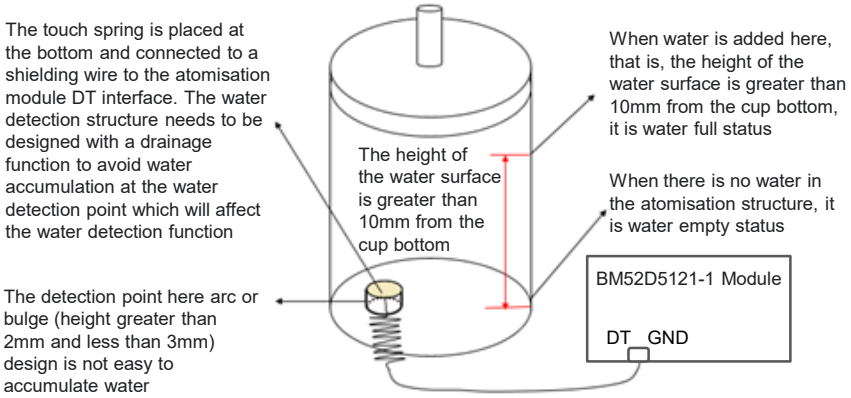
## TP Pin and Water Calibration




- The water calibration steps are as follows:
  - Step 1. Enable the water detection function. The module is connected to the peripheral device, the water detection pin, DT, is connected to the water detection structure and the TP pin is connected to a key to ground.
  - Step 2. Keep water empty, press the key or send the water empty calibration command, the status LED will be turned on for 0.1s and off for 1s in cycles which indicates that the water empty calibration is completed.

- Step 3. Fill the container with water (water level ≥10mm is recommended), and then press the key again or send the water full calibration command.
- Step 4. Observe the status LED indicator. If the LED is always on, this indicaes that the water calibration is successful. If the status LED indicator blinks at 2.5Hz, this indicates that the calibration fails, requiring to power on again to execute the calibration.

• In the communication mode, both using the TP key and sending the calibration instructions are available.

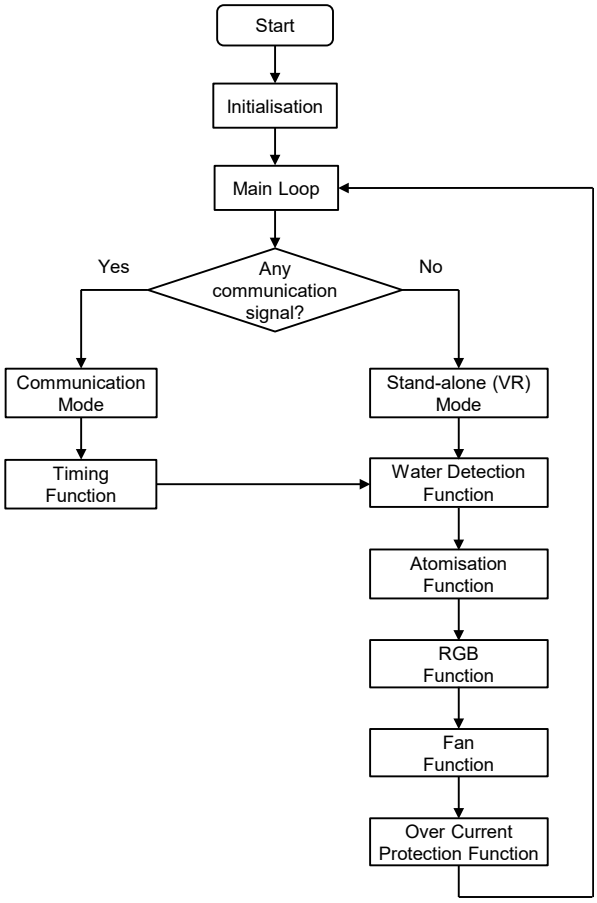



## Functional Description

The module can drive the 1.7MHz/2.4MHz atomisation plate. The atomisation function can be turned on using a potentiometer. The atomisation power and atomisation time can be controlled using the UART serial interface. These features assist users to develop their products quickly.

### Functional Processes

After the system is powered on and the initialisation is completed, if the VR is connected to a 10kΩ sliding rheostat before power-on, the operating mode is recognised as stand-alone mode. Otherwise, it is recognised as communication mode.




**BM52D5121-1 Function Flowchart**

## Stand-alone Mode

- Connect an external 10kΩ variable resistor for adjustment, ranging from 5W to 10W.
- In the stand-alone mode, the atomisation power is controlled by the sliding rheostat. When the resistance is greater than or equal to 1.8kΩ, the atomisation will be turned on. Adjust the sliding rheostat to increase the resistance, and the atomisation power will be increased from 5W to 10W, with a total of 32 levels.
- In the stand-alone mode, the RGB mode is preset to streaming light mode. The streaming light starts with Red LED being the brightest and Green LED and Blue LED being the darkest. The streaming light change effect is that Green LED fading in → Red LED fading out → Blue LED fading in → Green LED fading out → Red LED fading in → Blue LED fading out → Green LED fading in and so on. A complete streaming cycle time is 600ms~66000ms, which is adjustable. In the stand-alone mode, the preset status after power-on is the streaming light with the streaming cycle time fixed at 12s.

| Resistance | Atomisation power |
|---|---|
| ≤1.6kΩ | Atomisation off |
| 1.8kΩ | 5.2W |
| 2.7kΩ | 6.3W |
| 3.9kΩ | 7.7W |

| Resistance | Atomisation power |
|---|---|
| 5.1kΩ | 9W |
| ≥6.6kΩ | 10W |

**Atomisation Power corresponding to External VR Resistance**

Note: 1. The external resistance must not be greater than 10kΩ. Otherwise, it may be determined as UART communication mode during power-on detection.

2. In the stand-alone mode, when the module receives UART data transmission, it will switch to UART communication mode (irreversible), and the VR will lose the adjustment function.

## UART Mode

- Communication mode: After power-on, the module will enter sleep. It needs to be woken up using the RX pin by sending module commands except the sleep and module status read instructions.
- If the module is in frequency tracking, the communication can only be carried out after the frequency tracking is completed. In the water-existing situation, the frequency tracking will start after the atomisation power setting command is sent for the first time or the frequency tracking command is sent.
- UART communication baud rate: 9600
- Data bit: 8 bits, stop bit: 1 bit, parity bit: no
- Communication frame format:
  - Host sending

| Frame Head (Head) | Module Type (MOD) | Data Length (LEN) | Command (CMD) | Data (D0~D3) | Checksum |
|---|---|---|---|---|---|
| 1-byte | 2-byte | 1-byte | 1-byte | 0~4-byte | 1-byte |

  - Module return

| Frame Head (Head) | Module Type (MOD) | Data Length (LEN) | Status | Data (D0~D3) | Checksum |
|---|---|---|---|---|---|
| 1-byte | 2-byte | 1-byte | 1-byte | 0~4-byte | 1-byte |

Description: The Frame Head is fixed at 0x55

The Module Type is fixed at 0x31, 0x02

The LEN value is the length of command code (or status code) + data (Dn)

The checksum starts from the frame header, takes the lowest 8 bits of the sum of all data bytes and complements it.

Status type:

0x00: Successful reception

0x40: checksum error

- Write data instruction set

| No. | CMD | Function | Host Sent Data (D0~Dn) | Example |
|---|---|---|---|---|
| 1 | 0x02 | Module calibration | 1-byte data:<br>0x01: Water empty calibration<br>0x02: Water full calibration | Host: 55 31 02 02 02 01 72<br>D0=0x01, indicating a water empty calibration<br>Module: 55 31 02 01 00 76, indicating a successful reception |
| 2 | 0x03 | Set the module atomisation power | 1-byte data: 0x00~0x20<br>0x00: Atomisation off<br>0x01~0x20: 32-level atomisation, ranging from 5W to 10W. The step size of each level is (5/32)W | Host: 55 31 02 02 03 01 71<br>D0=0x01, indicating a 5W atomisation<br>Module: 55 31 02 01 00 76, indicating a successful reception |
| 3 | 0x04 | Set the fan power level | 1-byte data: bit1~bit0: 00~11<br>00: Full power<br>01: Half power<br>10, 11: Fan off | Host: 55 31 02 02 04 01 70<br>D0=0x01, indicating fan half power<br>Module: 55 31 02 01 00 76, indicating a successful reception |
| 4 | 0x05 | Set the module to re-track | None | Host: 55 31 02 01 05 71<br>Module: 55 31 02 01 00 76 |
| 5 | 0x06 | Set the RGB lighting effect | 4-byte data:<br>D0:<br>bit5~bit4: Breathing cycle time<br>00: 4.7s<br>01: 6.4s<br>10: 8.3s<br>11: 9.3s<br>bit1~bit0:<br>00: Light off<br>01: Streaming light<br>10: Breathing light<br>11: Normal light – a certain color LED is always on<br>Breathing light and normal light mode:<br>D1, D2, D3: D1 indicates red LED, D2 indicates green LED, D3 indicates blue LED, 0x00~0x80, corresponding to the brightness from low to high<br>Streaming light mode:<br>D1, D2, D3: D1 is the streaming light change speed high byte, D2 is the streaming light change speed low byte, and the range is 10~1100 in decimal, corresponding to a streaming cycle time of 600ms~66000ms, with the step size of 60ms. The recommended value for D1 and D2 ranges from 0x0064 to 0x012c<br>D3 has no effect | Host: 55 31 02 05 06 12 80 40 00 9a<br>D0=0x12, indicating that the RGB mode is a breathing effect<br>D1=0x80, indicating that the red light brightness is 0x80<br>D2=0x40, indicating that the greeb light brightness is 0x40<br>D3=0x00, indicating that the blue light brightness is 0x00 and the lighting effect is orange<br>Module: 55 31 02 01 00 76, indicating a successful reception |
| 6 | 0x07 | Set the module timing | 2-byte data:<br>D0 is the time high byte, D1 is the time low byte. When the value is 0, the timing is turned off. When the value is 1~64800, it corresponds to 1s~18h, with the step size of 1s | Host: 55 31 02 03 07 0e 10 4f, data= 0x0e10 (3600), indicating a 1h timing<br>Module: 55 31 02 01 00 76, indicating a successful reception |
| 7 | 0x08 | Set the module sleep | None | Host: 55 31 02 01 08 6e<br>Module: 55 31 02 01 00 76, indicating a successful reception |
| 8 | 0x0b | Set the module reset | None | Host: 55 31 02 01 0b 6b<br>Module: 55 31 02 01 00 76, indicating a successful reception |

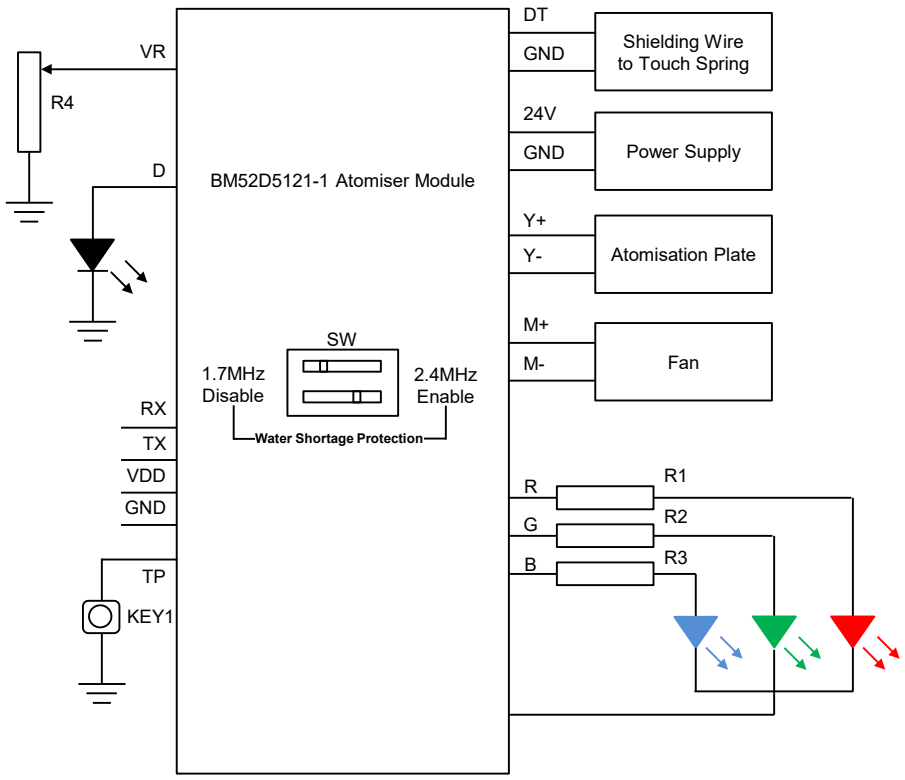
- Read data instruction set

| No. | CMD | Function | Module Return Data (D0~Dn) | Example |
|---|---|---|---|---|
| 1 | 0x81 | Obtain the water sensing value | 1-byte data: 0x00~0x80<br>When the water sensing value is greater than a certain calibration value, it indicates the water existing status. When the water sensing value is less than the calibration value, it indicates the waterless status. When the water detection is disabled, the water detection value is always 0 | Host: 55 31 02 01 81 f5<br>Module: 55 31 02 02 00 15 60<br>D0=0x15, indicating that the water sensing value is 0x15 |
| 2 | 0x82 | Obtain the calibration value data | 1-byte data: 0x00~0x80<br>When the water level value is less than this value, it indicates that the status is waterless and the atomisation stops | Host: 55 31 02 01 82 f4<br>Module: 55 31 02 02 00 15 60<br>D0=0x15, indicating that the water calibration value is 0x15 |
| 3 | 0x83 | Obtain the atomisation power | 1-byte data: 0x00~0x20<br>0x00: Atomisation off<br>0x01~0x20: 32-level atomisation, ranging from 5W to 10W. The step size of each level is (5/32)W | Host: 55 31 02 01 83 f3<br>Module: 55 31 02 02 00 20 55<br>D0=0x20, indicating that the atomisation power is 10W |
| 4 | 0x84 | Obtain the fan power level | 1-byte data:<br>bit1~bit0: 00~11<br>00: Full power<br>01: Half power<br>10, 11: Fan off | Host: 55 31 02 01 84 f2<br>Module: 55 31 02 02 00 00 75<br>D0=0x00, indicating fan full power |
| 5 | 0x86 | Obtain the RGB data | 4-byte data:<br>D0:<br>bit5~bit4: Breathing cycle time<br>00: 4.7s<br>01: 6.4s<br>10: 8.3s<br>11: 9.3s<br>bit1~bit0:<br>00: Light off<br>01: Streaming light<br>10: Breathing light<br>11: Normal light – a certain color LED is always on<br>Breathing light and normal light mode:<br>D1, D2, D3: D1 indicates red LED, D2 indicates green LED, D3 indicates blue LED, 0x00~0x80, corresponding to the brightness from low to high<br>Streaming light mode:<br>D1, D2, D3: D1 is the streaming light change speed high byte, D2 is the streaming light change speed low byte, and the range is 10~1100 in decimal, corresponding to a streaming cycle time of 600ms~66000ms, with the step size of 60ms. The recommended value for D1 and D2 ranges from 0x0064 to 0x012c<br>D3 has no effect | Host: 55 31 02 01 86 f0<br>Module: 55 31 02 05 00 01 00 c8 00 a9<br>D0=0x01, indicating streaming light<br>D1, D2=0x00c8 (200), indicating a streaming cycle time of 12s (200×60ms) |
| 6 | 0x87 | Obtain the remaining timing time | 2-byte data:<br>D0 is the time high byte, D1 is the time low byte. When the value is 0, the timing is turned off. When the value is 1~64800, it corresponds to 1s~18h, with the step size of 1s | Host: 55 31 02 01 87 ef<br>Module: 55 31 02 03 00 1c 20 38<br>Data=0x1c20 (7200), indicating that the remaining timing time is 2h |
| 7 | 0x89 | Obtain the F/W version data | 2-byte data:<br>D0 is verision high byte, D1 is verision low byte | Host: 55 31 02 01 89 ed<br>Module: 55 31 02 03 00 01 00 73<br>D0=0x01, D1=0x00, indicating that the version is V1.00 |

| No. | CMD | Function | Module Return Data (D0~Dn) | Example |
|---|---|---|---|---|
| 8 | 0x8a | Obtain the module status data | 1-byte data:<br>bit0: Water detection status bit<br>0: No water has been detected<br>1: Water has been detected<br>bit1: Water calibration status bit<br>0: Calibration succeeded, or the calibration function has not been executed after power-on<br>1: Calibration failed<br>bit2: Over current status bit<br>0: Normal atomisation or indicating that the atomisation function has not been executed after power-on<br>1: Atomisation with over current occurrence<br>bit3: Frequency tracking status bit<br>0: Frequency tracking succeeded or indicating that the frequency tracking function has not been executed after power-on<br>1: Frequency tracking failed<br>bit4: Sleep status bit<br>0: The module is running<br>1: The module enters sleep status | Host: 55 31 02 01 8a ec<br>Module: 55 31 02 02 00 01 74<br>D0=0x01, indicating that the module status is as follows:<br>The module is running and water has been detected; the calibration is successful or indicating that the calibration function has not been executed after power-on; the atomisation operates normally or indicating that the atomisation function has not been executed after power-on; the frequency tracking is successful or indicating that the frequency tracking function has not been executed after power-on |

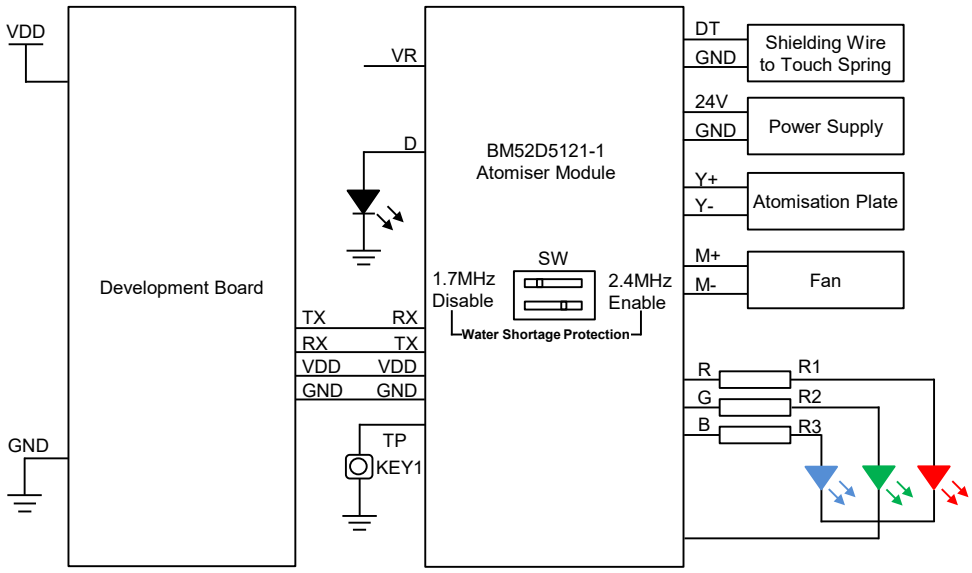
## Application Circuits

### Stand-alone Mode




**Stand-alone Mode Connection Diagram**

## UART Mode




**Communication Mode Connection Diagram**

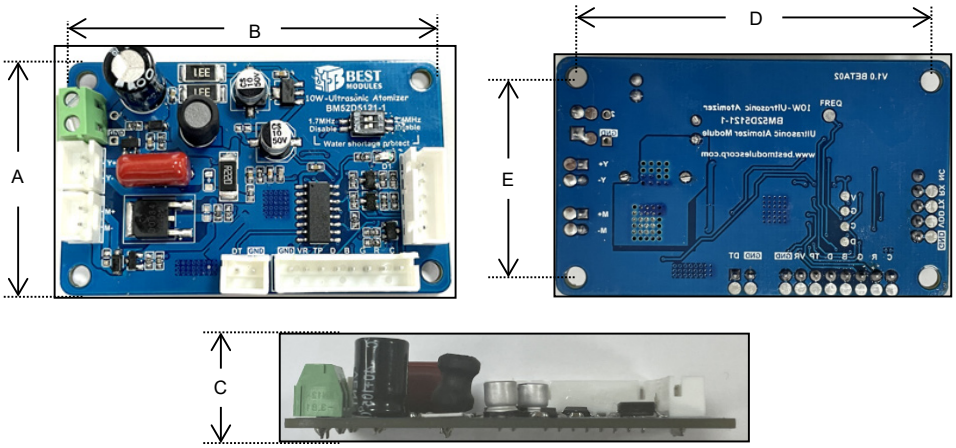
Note: The TP pin is required to be connected as shown in the figure for water calibration, which is not necessary in other situations. The DT water level detection pin can be unconnected when the water detection is disabled. The water detection calibration is only required after each new installation of the structure.

In the communication operating mode, the VR pin does not need to be connected. In the stand-alone operating mode the VR is required to be connected before power-on.

If the pin is not used to connect to an external LED indicator, the D pin does not need to be connected. If the RGB LED is not used, the R, G and B pins can be unconnected.

R1, R2, R3=330Ω, R4=10kΩ sliding rheostat

## Dimensions




| Symbol | Unit | |
|---|---|---|
| | mm | inch |
| A | 39.2 | 1.543 |
| B | 65.3 | 2.571 |
| C | 14.0 | 0.551 |
| D | 58.5 | 2.303 |
| E | 32.4 | 1.285 |
| F | 3.50 | 0.138 |
| G | 2.54 | 0.100 |
| H | 2.54 | 0.100 |
| I | 2.54 | 0.100 |
| D1 | 3.30 | 0.130 |
| D2 | 1.20 | 0.047 |
| D3 | 1.20 | 0.047 |