Transparent Transmission BLE Transceiver Module

Base on TI's CC2340

SPECIFICATION

Model No.: DL-CC2340-B

Version: V1.0

DL-CC2340-B

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Before using this module, please pay attention to the following important matters:

This module is an electrostatic sensitive product. Please operate it on an anti-static workbench during installation and testing.

This DL-CC2340-B BLE Module uses a PCB-on-board antenna by default, which is intended to be embedded in your product or application, and does equip with a metal shield itself for a better anti-interference ability.

Metal objects and wires should be kept away from the PCB antenna as far as possible. If the product uses a metal shell, be sure to leave enough space for the antenna (cannot be covered by metal). Otherwise, the RF signal will be seriously attenuated, which will affect the effective distance.

Disclaimer:

This specification is just for your information, all the charts and pictures used in this specification are for reference only. The actual test shall prevail for details. We do not assume any responsibility for personal injury or property loss caused by user's improper operation.

This specification is subject to change due to the continuous improvement and upgrading of the product version, and the latest version specification shall prevail. DREAMLNK reserves the right of final interpretation and modification of all contents in this specification.

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Revision History

Date	Version	Formulation / Revision of Contents	Approved by
2023-7-01	V1.0	DL-CC2340-B Standard Version BLE Module	Fagan Xu

NOTE: Page numbers for previous revisions may differ from page numbers in the current version.

Content

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1.Module Overview

1.1 Brief Introduction

DL-CC2340-B is a low-power BLE Module designed base on TI's SimpleLink™ wireless series CC2340R5 Bluetooth® Low Energy Chip. The module has a built-in PCB antenna, a compact size (20PIN, 18*12mm), and a total of 15 I/Os. It is equipped with a full-featured firmware (can be called via AT command), which supports Peripheral & Central integration. Under AT configuration, it can perform operations such as scanning, broadcasting, automatic connection, and service discovery. During connection, changes to PHY, MTU, and connection parameters can be made to better control throughput and low power consumption. Transparent transmission can be achieved through the BLE GATT transport layer for Server and Client, while automatic connection and pre-configuration of connection parameters can be also performed. Your external MCU only needs to achieve transparent transmission of Bluetooth configuration and transparent transmission mode through UART interface, making BLE development easier to get started.

The TI CC2340R chip uses a 48-MHz Cortex-M0+ kernel, with a running power consumption of only 53μA/MHz, and integrates up to 512KB of flash memory, 36KB of SRAM. It can achieve a low power consumption and superior functional performance. Moreover, this Bluetooth Low Energy module has a built-in 48MHz external high-speed and 32.768Khz external low-speed clock with an accuracy of 10ppm, making BLE connections more stable.

In terms of RF performance, this DL-CC2340-B Bluetooth module integrates RF balun internally, with simplified RF design, and reduced power consumption. With an optimized harmonic and RF matching, it only consumes 5.1mA, with an RX current of 5.3mA, and a TX power of 0dBm. The typical sensitivity can reach as high as -96.5 dBm @ 1 Mbps, and they can also achieve an output power up to +8 dBm. Its outstanding energy consumption indicators makes it suitable for low-power application scenarios such as battery buttons. In order to meet the limit standards for RF power in various countries, the power of this CC2340 Bluetooth module can be also adjusted (ranging from -21 dBm to+8 dBm).

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1.2 Features

Hardware Features:

- Chip Model: TI CC2340R5
- Operating Frequency Band: BLE 2.4GHz;
- Physical Layer: LE 1M PHY, LE 2M PHY, LE Coded PHY
- Working Voltage: 1.7-3.8V;
- Maximum Output Transmission Power: +7dBm;
- Receiving Current: 5.3mA;
- Sleep Current:<0.8μA (RTC);
- Sensitivity:

  Bluetooth ® Low Energy 125 kbps: -102dBm

  Bluetooth ® Low Energy 1 Mbps: -96dBm
- Working Temperature: -40 ℃ ~ +85 ℃
- Storage Temperature: -40 ℃ ~ +85 ℃
- High stability

Software Features:

- Easily configure and save via AT command, for a simple development and debugging;
- Transparent Transmission mode for data transmission and data flow control;
- Can wake up MCU in sleep, and send data after a specified delay time;
- Supports any serial port baud rate of 1920-51000bps;
- Support Peripheral & Central integration:

  Act as both Central and Peripheral, broadcasting and scanning simultaneously

  Supports data transparent transmission between slave servers and mobile APPs

  Supports transparent transmission as a host client with other CC2340 or other devices
- Scanning:

  Scanning specified parameters, can achieve low-power scanning

  Scanning can display the Bluetooth name of the device

  Can automatically connect devices based on Bluetooth Address settings, and start automatic connection after scanning
- Broadcasting:

  Supports Bluetooth and Factory name change

  Support parameter changes, such as broadcast interval
- Data Transparent Transmission:

  As a Peripheral that supports GATT servers, it creates transparent features, and other Bluetooth devices can scan and write notification feature values after connection

As a Center that supports GATT clients, it discovers transparent transmission features and notifies the client and server that the data is valid. When the client and server data are valid, it wakes up the main control device through AUX and transmits the data to the device
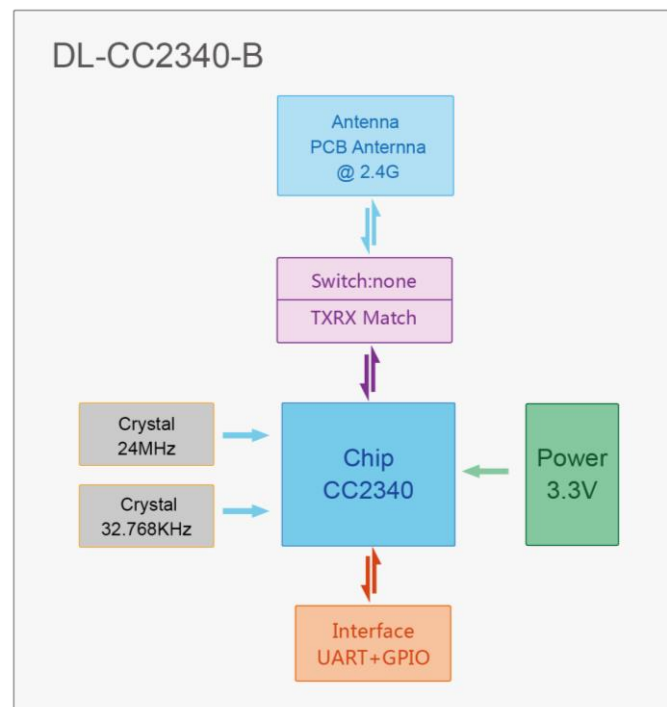
● BLE broadcasting, scanning, and changing of connection parameters greatly increase battery standby time;

● Initiate BLE PHY settings (LE 1M/LE 2M/LE Coded)

● Supports low power consumption for broadcasting, scanning, and connection, with excellent performance indicators

● Support RSSI acquisition (to be updated);

● Support customization

Customized peripheral functions such as ADC acquisition, PWM, GPIO (currently with BLE switch control)

Supports mobile phones to use APP software to control the 4-channel LED lights of CC2340, and provides APP source code
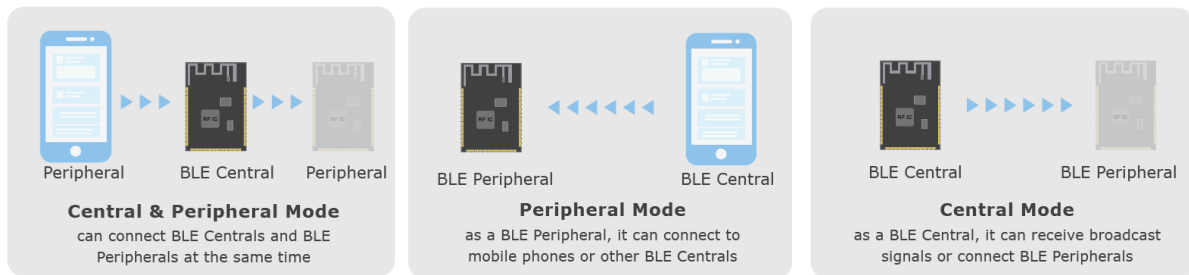
Customized BLE functions: such as more connections, special UUID read and write, connection logic, etc.

1.3 Circuit Schematic Diagram

1.4 Typical Application

Multiple roles and connections

Central & Peripheral Mode	Peripheral Mode	Central Mode
Peripheral — BLE Central — Peripheral	BLE Peripheral — BLE Central	BLE Central — BLE Peripheral
can connect BLE Centrals and BLE Peripherals at the same time	as a BLE Peripheral, it can connect to mobile phones or other BLE Centrals	as a BLE Central, it can receive broadcast signals or connect BLE Peripherals

AT firmware can serve as a client and server on the GATT layer, for data transparent transmission
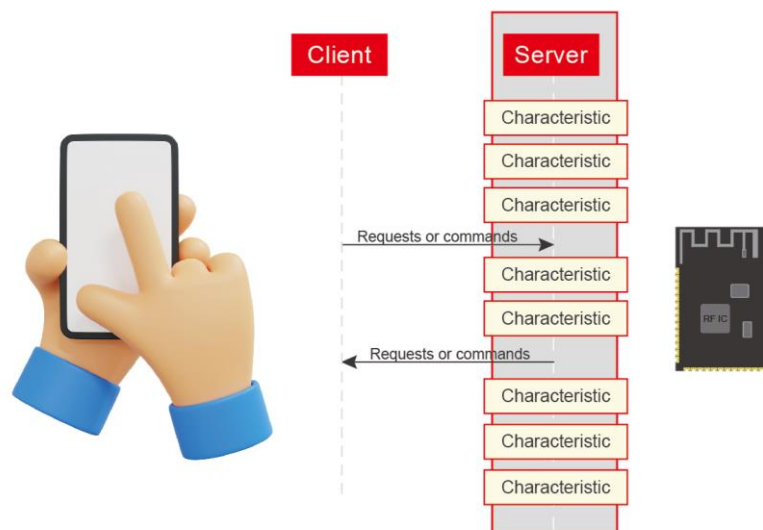
2. Technical Parameters

AT Firmware Hardware Parameters

Parameter	Min.	Typical	Max.	Unit	Remark
Operating Conditions					
Working Voltage (VDD)	1.75	3.3	3.8	V	Unable to output Max. power when the power supply voltage is below 2.4V
Communication Level	-0.2	3.3	VDD+0.2	V	Exceeding this range may damage the RF chip
Working Temperature	-40	25	85	℃	The larger the temperature difference, the greater the required bandwidth

Current Consumption					
RX Current (Radio+MCU)	6	7	9	mA	
TX Current (Radio+MCU)		6 7 12		mA	@ -8dbm @ 0dbm @ +7dbm
Minimum Sleep Current	0.4	0.8	3	uA	@ Register Save, Complete Sleep
RF Parameters					
Recommended Frequency (Ensure best performance)	2400		2483	MHz	2.4G ISM Frequency Band
Transmission Power Range	-20	0	7	dBm	
Sensitivity		-102 -96 -92		dBm	@ 125 kbps (LE Coded) @ 1 Mbps (LE 1M) @ 2 Mbps (LE 2M)

Table 1

AT Firmware Power Consumption Indicators

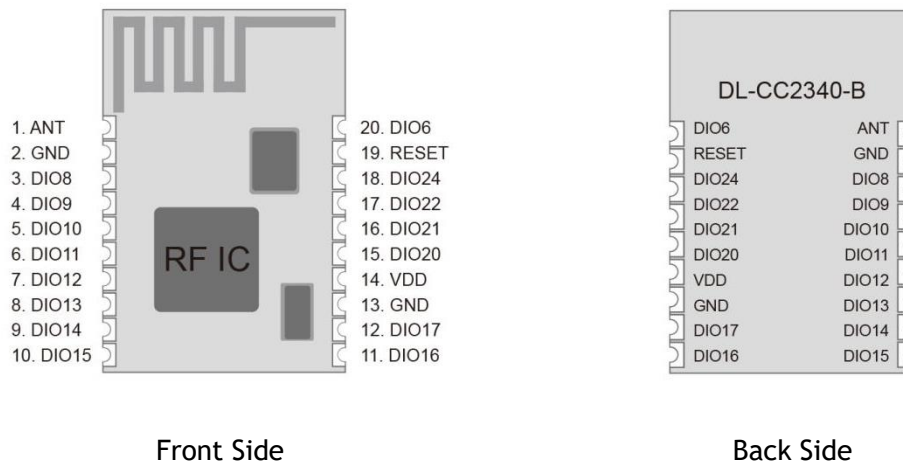| Broadcasting: (0dbm 1Mbps)	
Power Consumption	Remark
100ms	125uA
200ms	70uA
500ms	25uA
1000ms	15uA
2000ms	9uA
Initiate Connection: (0dbm 2Mbps)	
100ms	277uA ConnInterval = 16, connLatency = 0, connTimeout = 200
200ms	60uA (connect) ConnInterval = 80, connLatency = 0, connTimeout = 500
500ms	17uA ConnInterval = 400, connLatency = 0, connTimeout = 1000
Scanning: (0dbm 1Mbps)	
6s (last 500ms)	230uA
6s (last 200ms)	90uA

Table 2

AT Firmware Software Parameters

Parameter	Value	Remark
Max. Rate	GATT Server 30Kb/s GATT Client: 26Kb/s	Restricted by BLE protocol stack connection parameters and serial port baud rate Test conditions: Wireless Rate: PHY_ 2Mbps Connection Interval 7.5ms Serial Baud Rate:>115200bps
Buffer Area	TX: 200Byte RX: 200Byte	@ Exceeding this range will result in packet loss
Non-Empty Buffer Delay	400-600uS	Please wait beyond this time first, to judge whether the transmission is complete through AUX
AT response time	600us-900us	The time from "the completion of command" to "the module's response to the command" Test command: AT Baud rate: 115200
Reset Duration	<100ms	The time from "executing reset" to "initialization completion"
AT -> Transparent Transmission	<2ms	Switching between "AT command" and "transparent transmission"
Sleep -> Transparent Transmission	<8ms	Please wait for AUX to Low, before switching from "sleep mode" to "work mode"
Max. number of connections	As a Center, one Peripheral can be connected; As a Peripheral, three Centers can be connected; If act as both Peripheral & Central, one Central / Peripheral can be connected	

Table 3

3. Pin Diagram (AT Firmware Defaulted Definition)

Front Side   Back Side

Pin Diagram of DL-CC2340-B

Pin Functions:

Pin Name	I/O Type	Pin Description
VCC	PWR	To maximize the chip function, ≥2.5V stable voltage is recommended
GND	PWR	Ground
ANT	Analog I/O	This BLE module is equipped with a built-in PCB antenna, and it is not necessary to use this pin normally. It is necessary to ensure that there are no leads, otherwise it will affect its performance. RF signal input/output port, π-matching circuit must be reserved; Adopt 50Ω impedance matching for RF routing, route the ground and add via holes around it
DIO21(AUX)	Digital Output	**Indicate the working status of the module:** **Used to wake up MCU in sleep mode:** L: Idle H: The module receives the data and outputs the data through the serial port after the set delay **When Transmitting Data to the Module:** L: The buffer is empty (Transmitting completed) H: Buffer is not empty
DIO22(UART-RX)	Digital Input	TTL serial port input, connected to external TXD output pin

DIO20(UART-TX)	Digital Output	TTL serial port output, connected to external RXD input pin
DIO24(MODE)	Digital Input	Control Module Sleep, defaulted high level 0: Sleep (or wake-on-radio) 1: Wake up High level can be directly connected, if no need to consider low power consumption
RESET	Digital Input	Hardware reset, active low
Other I/O Ports	Digital Output / Input	Common I/O ports, no function at present, can be customized to realize the following functions: 1. Peripheral functions, such as ADCPWM 2. RF status indication 3. Connection status indication 4. Switching Value (key value fast emission, **Latching / Inching Mode** etc.) If not used, it must be N/C (No Connection)

Note: DIO24(MODE) are defaulted N/C (No Connection), but it needs to be connected to a certain level; otherwise, AT may not reply, or electric leakage will occur when it enters sleep mode.
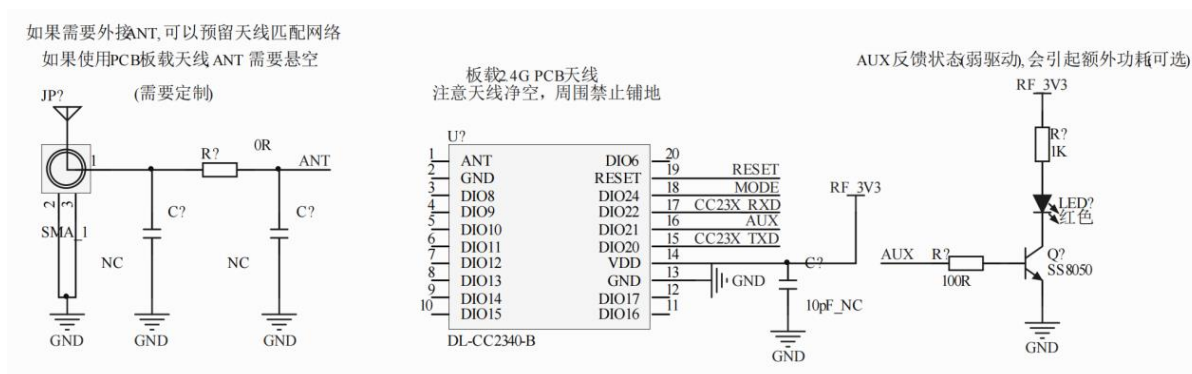
Table 4: Pin Functions of DL-CC2340-B

4.Module Dimension
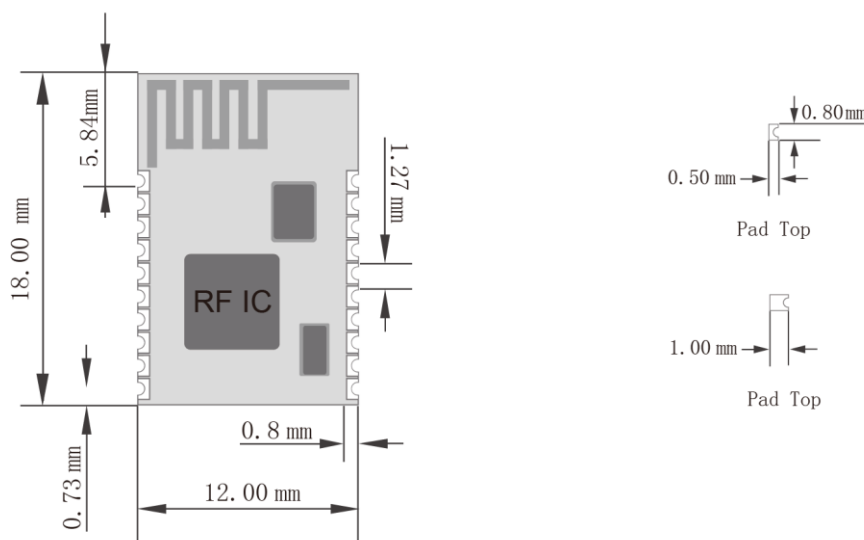
DL-CC2340-B Module Dimension

5.Application Connection Diagram

Remark:

1. If an external antenna (customized hardware) is required, please reserveπ-type matching circuit on your PCBA; If PCB on-board antenna will be used, please make ANT Pin N/C (No Connection);

2. If PCB-on-board antenna been used, sufficient clearance needs to be left above the antenna (the antenna area needs to be clear on both sides), and make sure no copper laying under the antenna;

3. AUX feedback weak driving may cause additional power consumption;

6.Circuit Design

6.1 Power Supply Design

● Please pay attention to the power supply voltage of the device, exceeding the recommended voltage range may cause function abnormally and permanently damage;

● Try to use a DC stabilized power supply, and the power ripple coefficient should be as small as possible; the power load when transmitting the maximum power needs to be also considered;

● The module needs to be grounded reliably, and a good grounding can achieve better performance output and reduce the impact of RF on other sensitive devices.

6.2 RF Routing Design

● The module should be far away from RF interference sources, such as high-frequency circuit transformer, and it is forbidden to route the wires directly under the module, otherwise it may affect the receiving sensitivity;

● When using the on-board antenna, the antenna part needs to be clear on both sides. It is strictly prohibited to lay the ground around the antenna (within 5mm), and it is best to extend the antenna out of the board frame.

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7.Command Format & Error Code

7.1 AT Command Format

The module uses AT commands and supports the following three types of AT commands, but pay attention to below tips:

1) AT command must be ended with "\r\n", but not separate "\r" or "\n";

2) "<...>" specifies a command or parameter. Actually, this "square bracket <...>" is not required in transmission;

3) The parameter separator is separated by "," and which cannot contain spaces.

Type	Command Format	Command Response
Execute Command	AT+<cmd> <p1>,<p2>,... (<cmd> and <p1> should be separated by a space)	OK\r\n ERROR: <erron>\r\n
Set Command	AT+<cmd>=<p1>,<p2>,...	OK\r\n ERROR: <erron>\r\n
Query Command	AT+<cmd>?	+<cmd>:<p1>,<p2> OK\r\n (Parameter and "OK" should be separated by a space) ERROR:<erron>\r\n

Table 5: Command Format

7.2 Error Code

If the command is executed incorrectly, the following error code will be returned:

Error Code	Description
0	Command successfully executed
1	Command not found
2	Wrong type of command
3	Wrong parameters for command
4	Internal error
5	Internal error
others	Internal error

Table 6: Error Code

7.3 Notice

If the command is successfully sent, the module will return an OK message; If some commands fail to execute, the module will return message parsed in "+xxx: xxx=xxx,..." format.

Notify Message	Notification Example
Scan	+SCANST:STA=Start... +SCANEVEN:STA=FAILED,Reason=%u +SCANEVEN:STA=WND_ENDED,AdvNum=%u +SCANRET:xxxxxxxxxxxxxx
Connect	Successfully Connected +CONNOK:Handle=%u,Addr=%s,Role=%u,Num=%d Disconnected +DISCONN:Handle=%u,Reason=%u,Num=%d
BLE Parameters Update	Connection Parameter Update +LINKPARM:Handle=%02u,Interval=%u,Latency=%u,Timerout=%u PHY Update +PHYEVEN:Handle=%d PHY=%s MTU Update +MTUEVEN:Handle=%u,Size=%u
RSSI	+RSSI_EVEN:%d
Query Connection Information	+BLINFO=Handle=%u,Addr=%s,Role=%u,PHY=%d,Interval=%d,Latency=%d,Timerout=%d,Mtu=%d
Automatic Connection	Device not Found +ACONNENEN:STA=Candidate Not Found Device Found +ACONNEVEN:STA=Find OK,peerAddr=%s Insufficient Stack +ACONNEVEN:STA=Heap ERR Connected +ACONNEVEN:STA=Host Have been connected
Service Discovery	+DSCSVCENEN:xxxxxxxxxxxxxx

8.AT Command

Basic commands

Test Module Response

AT
Description Check if it is in AT mode AT OK If it is not at AT Mode, or if there is no carriage return (for line change), there will be no reply

Query Version Number

AT+VER
Description Query Version Number AT+VER? +VER:AT_CC2340_V1.0_230610 OK Note: Different batches may have different version numbers

Save the Modified Parameters

AT+SAVE
Description Any modified parameters are not saved directly, unless this command is been called (to save the modified parameters) AT+SAVE OK

Restart the Module

AT+RESET
Description Restart the Module AT+RESET It will receive a power on notification +PWRUP

Restore Factory Defaults

AT+DEFAULT
Description AT+DEFAULT OK This AT command requires a reboot to fully take effect

Set/Query Serial Port Parameters

AT+UART	
Description	Query Serial Port Parameters: AT+UART? Set Serial Port Parameters: AT+UART=<baudrate>,<databits>,<stopbits>, <parity> baudrate: Baud Rate 1920~5120000 is supported, while 115200 is strongly recommend, but not lower rate parity: Check Bit UART_PAR_NONE = 0, ART_PAR_EVEN = 1, UART_PAR_ODD = 2, UART_PAR_ZERO = 3, ART_PAR_ONE = 4 databits: Data bits UART_LEN_5 = 0, UART_LEN_6 = 1, UART_LEN_7 = 2, UART_LEN_8 = 3 stopbits: Stop bits UART_STOP_ONE = 0, UART_STOP_TWO = 1
Example	Query Serial Port Parameters: AT+UART? +UART:115200,3,0,0 OK Set as Default: AT+UART=115200,3,0,0 OK Only change the baud rate AT+UART=115200,-,-,- OK
Execution	After the module changes the baud rate, it sends "OK" with the updated baud rate Can be saved

Serial Port Packaging Timeout

AT+NDTS	
Description	The packaging time refers to the continuous serial port data sent by the MCU in transparent transmission mode. The module will detect no new data within the specified (X)mS and package the data for transmission. This setting should be based on the "baud rate", and it is best to reserve a transmission interval of 3 bytes

	Query AT+NDTS? Factory default Set AT+NDTS=<waitTime> WaitTime: Range 0-100, 0 is to disable packaging function Unit: mS
Execution	Can be saved

AUX to Data Transmission Delay (used to wake up MCU)

AT+AUXT	

Description	When data is received, AUX is relative to the serial port TX's "Pre-set high level" and "low level in delay". If the MCU is in sleeping, a reasonable value needs to be set to wait for the MCU to wake up before sending data.
	
	Query AUX output time
	Factory default: +AUXT: 0,0 OK
	
	  AuxPreTime:
	  AuxDelayTime:
	
	Range 0-100
	Unit: mS

Execution	Can be saved

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Transparent Transmission Settings

Enter Transparent Transmission

AT+ENTM	
Description	Enter Transparent Transmission AT+ENTM Query Transparent Transmission Settings AT+ENTM？ Set Transparent Transmission AT+ENTM=\<gattRole>,\<connhandle> gattRole: GATT role 0: As a GATT Server transparent (Peripheral) 1: As GATT Client Transparent (Central) Connhandle: Connection Handle For GATT clients only, '-' can be used to automatically judge the connected device, so that even after disconnecting and reconnecting, transparent transmission can continue. If succeed, it will return "OK" It may report an error, and the reason for the error can be ignored 1: As a client, service discovery failed+CLIENT: STA=Discover SVC ERR
Description	For Peripheral devices, as a Gatt Server, you can first call this AT command to enter transparent transmission: AT+ENTM=0- For Central devices, entering transparent as a Gatt client requires specifying a transparent object handle. A '-' will automatically check which device it is connected to as a client, usually only one device For example: AT+ENTM=1,- After setting, it can enter transparent transmission AT+ENTM OK
Execution	Can be saved, default to transparent mode upon startup; factory set to GATT Server transparent mode, can be changed via 'Set Transparent Mode'

Exit Transparent Transmission

+++	
Description	Exit Transparent Transmission Sending +++ in transparent mode, you will receive a notice when exiting transparent mode +ATMODE OK

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Bluetooth Universal AT Commands

Set Bluetooth Address

AT+BADDR	
Description	Query fixed Bluetooth address: AT+BFADDR? Set fixed Bluetooth address: AT+BFADDR=<bleAddr> bleAddr: Bluetooth address, 6 bytes in total, which is 12 characters

Bluetooth PHY

AT+PHY	
Description	For Central/Peripheral connections, it will actively initiate a PHY change request, but will only be changed once Query default PHY settings: AT+PHY? Initiate a request to change the PHY and set it as the default PHY setting: AT+PHY=<connHandle>,<phy> Phy: PHY_1MBPS=0 PHY_ 2MBPS=1 PHY_1MBPS_2MBPS=2 PHY_CODED=3 PHY_1MBPS_ 2MBPS_CODED=3
Return Value	The command returns OK. Notification will be sent after the changes are completed

MTU Length

AT+MTU	
Description	For initiating an MTU change request after a Central/Peripheral connection, it is best to set the MTU to the longest length packet sent +3 Query MTU length AT+MTU? Factory default AT+MTU=65 Set MTU AT+MTU=<connHandle>,<mtuLen> connHandle: The handle of the connection, used to initiate MTU changes mtuLen: Range: 23-65
Execution	The command returns OK. Notification will be sent after the changes are completed (if the settings are the same, no notification will be given) This function will affect transmission efficiency (rate), and will to some extent affect power consumption

Connection Parameters

AT+LPRM
Description
Query the current default connection parameters: AT+LPRM? Factory default: +LPRM: 0,6,6,0200,0 OK (the first 0 is connHandle and can be ignored) Initiate a connection parameter update request and use it as the default connection parameter AT+CONNP=<connHandle>,<intervalMin>,<intervalMax>,<connLatency>,<connTimeout> connHandle: Set the handle of an object. If present, parameter changes will be initiated intervalMin: Min. Connection Interval, range: 6-3200, units: 1.25ms (7.5 ms to 4000 ms) intervalMax: Max. Connection Interval, range: 6-3200, units: 1.25ms (7.5 ms to 4000 ms) connLatency: The latency period, if the peripheral has no data to send, it can skip connection events and remain in sleep mode, thereby saving power consumption, range: 0 to 499 connTimeout: Connection timeout; range: 10 to 3200; units: 10m (100 ms to 32000 ms)
Execution
1.5 seconds after each connection event, a request to change the connection parameters will be initiated proactively. This can be changed by setting a default connection request. Except for low-power situations, it is not recommended to have a large interval, and it is recommended to be less than 100ms, otherwise it will cause communication delay. At the same time, setting other BLE parameters will also be very slow The command returns OK. If the connection handle exists and the other device supports changing connection parameters, a notification will be received: +CONNP=<connInterval>,<connLatency>,<connTimeout> If there is no notification, the possible reasons are as follows: 1. The connection handle does not exist 2. The other party's device does not support changes 3. Parameters do not meet the specifications

Bluetooth Power

AT+RFPWR
Description
Query fixed Bluetooth power AT+RFPWR? Set fixed Bluetooth power AT+RFPWR=<pwr> PWR: Power Range: -20-8 Unit: dbm

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Bluetooth RSSI

AT+RSSI
Description	Query RSSI AT+RSSI?

Disconnect

AT+DISC	
Description	Disconnect through handle AT+DISC=<connHandle> Disconnect all connections AT+DISC
Return Value	The command returns OK. Notification will be sent after disconnect are completed

Connection Information

AT+BLINFO	
Description	Query the Bluetooth connection status of the unit 　AT+BLINFO?
Return Value	The command returns OK. Notification information: +BLINFONum:ConnNum=2 +BLINFO:Handle=0,Addr=0x30AF7E295665,Role=8,PHY=0,Interval=16,Latency=0,Timerout=1000,Mtu=65 +BLINFO:Handle=1,Addr=0x7EA21B0AA7D9,Role=4,PHY=0,Interval=24,Latency=0,Timerout=500,Mtu=65 Each ending in \r\n, with a maximum length of 150

Peripheral Relative Commands

Bluetooth Name

AT+ADVNAME	
Description	Query the Broadcast name and Manufacturer name: AT+ADVNAME? Default name:　+ADVNAME: SPT34-2F553C43, Dreamlink OK Among them: SPT34- is fixed, 2F553C43 is the last 4 bytes of MAC address Set the Broadcast name and Manufacturer name: AT+ADVNAME=<Complete Local>,<Manufacturer> Complete Local: Broadcast name, range:<=14 characters Manufacturer: Manufacturer name, range:<=12 characters Default Configuration Effective immediately
Execution	The command returns OK Effective immediately Can be saved

Broadcast Parameters

AT+ADVP	
Description	Read AT+ADVP? Set Broadcast Parameters AT+ADVP=<primIntMin>,<primIntMax>,<primChanMap>,<priPhy>,<advCanConn> PrimIntMin: Minimum broadcast interval unit 0.625ms Range of 20 ms to 10485.759375 s PrimIntMax: Maximum broadcast interval unit 0.625ms Range of 20 ms to 10485.759375 s PrimChanMap: Priority Channel 　1:GAP_ADV_CHAN_37　　2:GAP_ADV_CHAN_38　　3:GAP_ADV_CHAN_37_38 　4:GAP_ADV_CHAN_39　　5:GAP_ADV_CHAN_37_39　6:GAP_ADV_CHAN_38_39 　7:GAP_ADV_CHAN_ALL PriPhy: Priority PYH: 　1:　　PHY_1Mbps 　3:　　PHY_CODED_S8 　134:　PHY_CODED_S2 AdvCanConn: Can it be connected
Execution	Effective immediately, can be saved

Broadcast Status

AT+ADVP	
Description	Start or stop broadcasting AT+ADVSTA=<Status> Status: 1: Start broadcasting, 0: Stop broadcasting
Execution	Effective immediately, can be saved Start-up reading and perform broadcasting based on the status

Server Transparent Service UUID and Characteristic UUID

AT+SVCUUID	
Description	Set server transparent service UUID and read/write UUID characteristics AT+SVCUUID =<svcUuid>,<writeUuid>,<readUuid> svcUuid: UUID of transparent transmission service writeUuid: Characteristic UUID of Client end write readUuid: Characteristic UUID of Client end read Factory default: AT+SVCUUID=FFB0,FFB1,FFB2 This will generate a service with UUID FFB0, which has two features FFB1 and FFB2, used for transparent transmission of write and read Of course, the AT firmware also includes a button control feature FFB3

Execution	The default generated services are as follows
	
	Unknown Service 透传服务
	UUID: 0xFFB0
	PRIMARY SERVICE
	
	  Unknown Characteristic
	  UUID: 0xFFB1
	  Properties: WRITE Client write
	  Descriptors:
	  Characteristic User Description
	  UUID: 0x2901
	
	  Unknown Characteristic
	  UUID: 0xFFB2
	  Properties: NOTIFY, READ Client read
	  Descriptors:
	  Client Characteristic Configuration
	  UUID: 0x2902
	  Characteristic User Description
	  UUID: 0x2901
	
	The command returns OK, it requires reset to take effect
	Can be saved, initialized when powered on

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Central Relative Commands

Scan Parameters

AT+SCANP	

Description	When scanning, the scanning parameters will be read
	Read scanning parameters
	AT+SCANP?
	Factory default: +SCANP: 0120,110000 OK
	Cycle: 1.28s, Duration: 120ms
	Set scanning parameters
	AT+SCANP=<scanPeriod>,<scanDuration>,<scanfPhy>,<scanInterval>,<scanWindow>
	scanPeriod: if it is 0, it means it will only be executed once; if it is not 0, it will be scanned periodically, with a unit of 1.28 seconds
	scanDuration: the duration must be less than the cycle time (scanPeriod); unit: 10ms
	scanfPhy: Scanned PHY
	   1: PHY_1Mbps
	   4: PHY_CODED
	scanInterval: scan window interval time, requires>scanWindow, unit: 0.625ms
	scanWindow: the duration of the scanning window, with one to more scanning windows per scanning cycle, in units of 0.625ms
	If each cycle is scanned continuously, the scanInterval and scanWindow should be greater than the scanDuration time

Execution	The command returns OK. Can be saved. When starting up, it reads and executes according to the status, whether to broadcast or not

Scan Status

AT+SCANFST	
Description	Turn scanning on or off AT+SCANST=<status> Status: 0: Stop scanning; 1: Start Scan
Execution	The command returns OK. Can be saved. When starting up, it reads and executes according to the status, whether to scan or not. If scanPeriod is not equal to 0, it will continue to scan periodically until the device is successfully connected The scan result will trigger a notification: +SCANEVEN:STA=WND_ENDED,AdvNum=6 +SCANRET:Index=03,Addr=0x0xB096EA36F46D,AddrType=0,Rssi=0,dataLen=28,Name=midea +SCANRET:Index=04,Addr=0x0x30AF7E295665,AddrType=0,Rssi=0,dataLen=14,Name=DREAMLNK_SVC Every time the scanning window is received, it will be sent +SCANRET represents the content of the broadcast, with a maximum of 10 scans per window

Automatic Connection

AT+AUTOCONN	
Description	Query configuration for automatic connection AT+AUTOCONN? Default: +AUTOCONN: 30AF7E295665 OK Set up automatic connection AT+AUTOCONN=<autoBAddr> AutoBAddr: The address for Bluetooth automatic connection, with a total of 6 bytes, which is 12 characters
Execution	The command returns OK. Can be saved. After each scan, the address will be automatically matched and the matching situation will be notified. The successful matching is as follows: 　+AUTOCONN:OK,peerAddr=0x30AF7E295665 If it matches, the connection will be automatically initiated: Connection successful as follows: (Connection successful handle 0, address, number of connections: 1) 　+CONNOK:Handle=0,Addr=0x30AF7E295665,Num=1 After successful connection, transparent service discovery will be automatically performed

Proactively Establish a Connection

AT+CONN	
Description	Proactively Establish a Connection Connect directly through scanned devices or specified BLE addresses AT+CONN=<scanfHandle>, <BAddr>,<AddrType> scanfHandle: Scanned handle, if '-', use BAddr for connection BAddr: Bluetooth 6-byte address, 16 characters AddrType: Default as 0XFF
Execution	Take effect immediately without saving Connect based on the scanned Index, example as below: AT+CONN=0,-,- Connect based on Bluetooth address, example as below: AT+CONN=-,30af7e295665,FF Notification example: +CONNOK:Handle=0,Addr=0x30AF7E295665,Num=1　　(Connection successful handle 0, address, number of connections: 1)

Client Transparent Service Discovery:

AT+CONN	
Description	Execute Service Discovery AT+DSCSVC=<connHandle>,<svcUUUID>,<writeUUID>,<readUUID> connHandle: Connection handle '-' indicates overall configuring svcUUUID: Transparent Service UUID writeUUID: UUID for transparent writie features readUUID: UUID for transparent read features Default factory configuration: AT+DSCSVC=-,FFB0,FFB1,FFB2
Execution	Effective immediately, command returns OK Can be saved It will automatically perform service discovery, every time it connects to the device as a Central Service Discovery Successful Example: AT+DSCSVC=0,FFB0,FFB1,FFB2 If notified as follows +DSCSVCENEN:0xffb0 found 3 Characteristic +DSCSVCENEN:Find writeUUID 0xffb1 0x25 OK +DSCSVCENEN:Find readUUID 0xffb2 0x28 OK +DSCSVCENEN:Find readCCCD and enable notification Then it was found successful, which represent: there are 3 features under the 0xffb0 service, and the specified read and write features have been found and read notifications have been enabled

9.AT Firmware Introduction

Common settings for AT firmware

The AT firmware implements Central-Peripheral integration, which defaults to boot up and enters transparent transmission mode. It will load the previously saved data, and Central will actively complete the connection and try to update the used PHY, MTU size, and connection parameters. The connection parameters will be updated 1.5 seconds after the connection is completed. These BLE protocol stack parameters can be configured through the AT command and are overall effective. If the actual request is successfully changed, it will be sent through the serial port in the form of a notification (under the AT command), The default settings are as follows:

Ser MTU	AT+MTU=0,65
	MTU = 65
Set PHY	AT+PHY=0,1
	PHY = 1Mbps
Set connection parameters LPRM	AT+LPRM=0,6,6,0,200

* Remark: Ignoring handle 0

The influence of MTU, PHY, and connection parameters on power consumption and transmission rate

MTU (Maximum Transmission Unit) refers to the maximum amount of data in the effective number of transmissions of GATT. In BLE, the size of MTU affects the data transfer rate and power consumption. Specifically, the larger the MTU, the more data can be transmitted, thereby increasing the maximum transmission rate, but also increasing power consumption; On the contrary, if the MTU is small, the efficiency of transmitting big data will decrease, but the power consumption will decrease.

BLE Physics (PHY) determines the rate and distance of each transmission.

Connection Parameters (LPRM) Include:

Connection Interval	This is the time interval for communication between master and slave devices. When the Connection Interval is shortened, the communication frequency between the Master and Slave increases, thereby improving data throughput speed and shortening data transmission time. But this can also lead to an increase in power consumption. On the contrary, if the Connection Interval is extended, the communication frequency will decrease, the data throughput speed will also decrease, and the waiting time for data transmission will be longer, but such a setting will reduce power consumption.
Connection Latency	This is a skip connection event that occurs when the device is running a connection event. If the Slave Latency is extended, it is not a must to reply Central data during idle time. When the Slave Latency is reduced or set to 0, it is necessary to reply to Central packets in each connection event, which will lead to an increase in power consumption.
Connection Timed Out	This timeout is the maximum time between two successful connection events. If there is no successful connection event during this period, the device will terminate the connection and return to an unconnected state.

These parameters (factors), such as the maximum number of packets (MTU) per connection interval, the physical layer used (such as LE 1M, LE 2M, or LE encoding), the connection interval, can both affect the data throughput and low power consumption of BLE applications

In the Peripheral host application, the module needs to be initialized as follows:

1. Set broadcast name and factory name (optional)	AT+ADVNAME=DREAMLNK_SVC,Dreamlnk
2. Set Bluetooth address (convenient for the host to automatically connect)	AT+BADDR=4B002F553C3B
3. Set broadcast parameters (it affects broadcast power consumption) and enable	+ADVP:160,160,7,1,1 OK (default 100ms broadcast)
4. Set the transparent transmission service UUID and transparent transmission read/write UUI	AT+SVCUUID=FFB0,FFB1,FFB2 (Default as this, a restart is required, if changes are made)
5.Set transparent transmission mode, save parameters, and enter transparent transmission	AT+ENTM=0,- AT+SAVE AT+ENTM

After the default connection, the broadcast will be turned off. To reconnect, you need to manually turn on the broadcast

In the Central host application, the module needs to be initialized as follows:

1. Set up Automatic Connection Objects: After each scan, the Bluetooth address will be checked. If it is the set Bluetooth address, and the slave's address is 30AF7E295665, the connection will be automatically initiated, it can be set using AT+BADDR=4B002F553C3B.	AT+AUTOCONN=4B002F553C3B
2. Set the write UUID and read UUID under the GATT transparent transmission service UUID This is mainly set up to prepare for transparent transmission. After connecting, it will search for the set read and write UUID. If the search fails, it will not be able to enter transparent transmission	AT+DSCSVC=0,FFB0,FFB1,FFB2
3. Set continuous scanning parameters: This different setting results different connection speeds and power consumption	AT+SCANP:1,120,1,1000,1000 OK

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4. Set to start continuous scanning. Only by setting this can automatic connection work	AT+SCANST=1
5. Set transparent transmission mode, save parameters, and enter transparent transmission	AT+ENTM=1,- AT+SAVE AT+ENTM

* If automatic connection is set, it will be scanned and determined whether the automatic connection is established under AT or transparent transmission. Once the connected device is scanned, it will initiate the connection until it is successful. If the connection is disconnected, it will automatically continue scanning again, and the MCU only uses transparent transmission function.

* Automatic scanning: After scanning the device, scanning will also be automatically turned off, and the host can only connect to one peripheral device

Mode:

	Description	Conditions
Normal Mode (AT command)	Serial port enabled Used for AT Command parameter configuration	MODE=H +++ Exit transparent transmission
Normal Mode (As a transparent GATT client)	Serial port enabled To forward the message received by the serial port to the connected server, a handle needs to be specified. And you can receive messages from the server	MODE=H AT+ENTM=1,-
Normal Mode (As GATT Server transparent)	Serial port enabled To notify the connected client of the message received through the serial port, a handle needs to be specified. And you can receive messages from the client	MODE=H AT+ENTM=0,-
Low Power Consumption	Serial port disabled The BLE protocol stack is working normally, except for handling events on the BLE protocol stack, it is at completely low power consumption for the rest of the time	MODE=L
Completely Low Power Consumption	Serial port disabled No BLE operation specified, power consumption<1uA	MODE=L No broadcast No scanning No connection

The Function of AUX:

Function 1: Check whether transparent transmission is completed
When the MCU passes TX to the RX (UART-RX) of the module, after a period of time, the AUX is high, indicating that the FIFO buffer is not empty and enters the transparent forwarding state. After all transmissions are completed, the AUX is low, indicating that there is no data in the FIFO

Function 2: Serial port data output indicator (used to wake up external sleep MCU)
Under normal circumstances, if a module has data, it will immediately send it through TX. However, in low-power scenarios, the external MCU may be in a sleep state and unable to receive data. It can be achieved by using "AT+AUXT=10,0" to set the AUX high for 10ms, before sending serial data

Handle in AT:
After each connection, a handle will be generated, which remains fixed during the connection period. "AT+BLINFO?" Can query connection information

Save parameters
Parameter changes will be lost during restart, and can be saved to Flash through "AT+SAVE". Restarting will load these parameters

10.Contact us

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