

BM78xBT Wireless Data Communication Protocol

Advertising Packet (Total bytes default at 20 bytes, and may vary & are subject to “Device Name” length)

Description	Index	Value	Remark
Advertising Data1: <<Flags>>			
Length	[0]	0x02	Don't care
<<Flags>>	[1]	0x01	Don't care
General discoverable mode	[2]	0x06	Don't care
Advertising Data2:<<Device Name>>			
Length of	[3] ¹⁾	0x08	Remote Changeable
<<Device Name>>	[4]	0x09	Don't care
'B' (ASCII code)	[5]	0x42	Remote Changeable
'M' (ASCII code)	[6]	0x4D	Remote Changeable
'7' (ASCII code)	[7]	0x37	Remote Changeable
'8' (ASCII code)	[8]	0x38	Remote Changeable
'x' (ASCII code)	[9]	0x78	Remote Changeable
'B' (ASCII code)	[10]	0x42	Remote Changeable
'T' (ASCII code)	[11]	0x54	Remote Changeable
Advertising Data3:<<Manufacturer Specific Data>>			
Length	[12]	0x07	Fixed
<<Manufacturer Specific Data>>	[13]	0xFF	Don't care
Manufacturer Specific Data-1	[14]	0X31	Fixed
Manufacturer Specific Data-2	[15]	0X01	Fixed
'B'	[16]	0x42	Fixed
'M'	[17]	0x4D	Fixed
Model Series ID	[18]	0x0B	Fixed
Status	[19]	0x00	Fixed

¹⁾Valid value: 0x02 ~ 0x0D. Minimum Device Name length is 1 ASCII code. Maximum Device Name length is 12 ASCII codes

Command/Response Packet (32 bytes)

Description	Index	Value	Remark
HeadByte0	[0]	0xFF	HEAD
HeadByte1	[1]	0x01	SOH
Packet Length	[2]	0x20	
Packet Type	[3]		0x01: Command; 0x02: Response
Protocol Version	[4]	0x01	
MAC address0	[5]		BLE Device Address ¹⁾
MAC address1	[6]		
MAC address2	[7]		
MAC address3	[8]		
MAC address4	[9]		
MAC address5	[10]		
Command0	[11]		See Command Table
Command1	[12]		
Password Identification	[13]	0x01	
Arg0	[14]		Command/Response Arguments
Arg1	[15]		
Arg2	[16]		
Arg3	[17]		
Arg4	[18]		
Arg5	[19]		
Arg6	[20]		
Arg7	[21]		
Arg8	[22]		
Arg9	[23]		
Arg10	[24]		
Arg11	[25]		
Arg12	[26]		
Arg13	[27]		
Checksum0	[28]		CRC calculation ²⁾ of Index [2]~[27] bytes: To use the CRC-16 reverse algorithm based on the polynomial $x^{16}+x^{15}+x^2+1$ (0x8005)
Checksum1	[29]		
EndByte0	[30]	0xFF	HEAD
EndByte1	[31]	0x03	ETX

¹⁾BLE Device address can be got from any Response Packet.

²⁾CRC calculation:

```

unsigned int crc_chk(unsigned char* data, unsigned char length)
{
    int j;
    unsigned int reg_crc=0xFFFF;

```

```

while(length-->0)
{
    reg_crc ^= *data++;
    for(j=0;j<8;j++)
    {
        if(reg_crc & 0x01) // LSB(b0)=1
            reg_crc=(reg_crc>>1) ^ 0xA001;// 0x8005 reverse
        else
            reg_crc=reg_crc >>1;
    }
}
return reg_crc;
}

```

Command Table

[Command1:Command0]		Response Packet (32 bytes)	
		If succeed, responded "Command + ArgN"	If fail, responded "Command + ArgN"
0x0004	Get BLE firmware version	0x0004 + ArgN0004	0x8001 + ArgN0004F
0x0010	RTC time calibration	0x0010 + ArgN0010	0x8001 + ArgN0010F
0x0040	Set BLE to OTA standby mode	0x0040 + ArgN0040	0x8001 + ArgN0040F
0x0116	Get Model Series ID	0x0116 + ArgN0116	0x8001 + ArgN0116F
0x0140	Set Connection Password	0x0140 + ArgN0140	0x8001 + ArgN0140F
0x0141	Get Connection Password	0x0141 + ArgN0141	0x8001 + ArgN0141F
0x0142	Set Device Name	0x0142 + ArgN0142	0x8001 + ArgN0142F
0x0143	Get Device Name	0x0143 + ArgN0143	0x8001 + ArgN0143F
0x0151	Verify Connection Password ¹⁾	0x0151 + ArgN0151	0x8001 + ArgN0151F

¹⁾Default Connection Password: 0000

Command: 0x0004 - Get BLE firmware version

Command Packet Arguments - Arg[0]~[13]: 0x00

ArgN0004 Response Packet Arguments - Arg[2:0]: BLE Firmware version ID; Arg[3]~[13]: 0x00

Example:

If Arg[2:0] = [0x00, 0x01, 0x11], BLE Firmware version is 0.1.17

If Arg[2:0] = [0x01, 0x02, 0x14], BLE Firmware version is 1.2.20

ArgN0004F Response Packet Arguments - Arg[1:0]: 0x0004; Arg[3:2]: Error Code; Arg[4]~[13]: 0x00

Command: 0x0010 - RTC time calibration

Command Packet Arguments –

Arg[0]= Second (0 ~ 59)

Arg[1]= Minute (0 ~ 59)
Arg[2]= Hour (0 ~ 23)
Arg[3]= Date (1 ~ 31)
Arg[4]= Day (1 ~ 7)
Arg[5]= Month (1 ~ 12)
Arg[6]= Year (0 ~ 99 for 2000 ~ 2099)
Arg[7]~[13]: 0x00

ArgN0010 Response Packet Arguments -

Arg[0]= Second (0 ~ 59)
Arg[1]= Minute (0 ~ 59)
Arg[2]= Hour (0 ~ 23)
Arg[3]= Date (1 ~ 31)
Arg[4]= Day (1 ~ 7)
Arg[5]= Month (1 ~ 12)
Arg[6]= Year (0 ~ 99 for 2000 ~ 2099)
Arg[7]~[13]: 0x00

ArgN0010F Response Packet Arguments – Arg[1:0]: 0x0010; Arg[3:2]: Error Code; Arg[4]~[13]: 0x00

Command: 0x0040 - Set BLE to OTA standby mode (refer to “BM78xBT OTA Programming file” for OTA update)

Command Packet Arguments – Arg[0]: 0x01; Arg[1]~[13]: 0x00

ArgN0040 Response Packet Arguments - Arg[0]: 0x00 or 0x01; Arg[1]~[13]: 0x00

ArgN0040F Response Packet Arguments - Arg[1:0]: 0x0040; Arg[3:2]: Error Code; Arg[4]~[13]: 0x00

Command: 0x0116 - Get Model Series ID

Command Packet Arguments - Arg[0]~[13]: 0x00

ArgN0116 Response Packet Arguments - Arg[0]=0x0B (ID for BM78x Model series); Arg[1]~[13]: 0x00

ArgN0116F Response Packet Arguments - Arg[1:0]: 0x0116; Arg[3:2]: Error Code; Arg[4]~[13]: 0x00

Command: 0x0140 - Set Connection Password

Command Packet Arguments - Arg[0]~[3]: New Connection Password; Arg[4]~[13]: 0x00

ArgN0140 Response Packet Arguments - Arg[0]~[3]: New Connection Password; Arg[4]~[13]: 0x00

ArgN0140F Response Packet Arguments - Arg[1:0]: 0x0140; Arg[3:2]: Error Code; Arg[4]~[13]: 0x00

Command: 0x0141 - Get Connection Password

Command Packet Arguments - Arg[0]~[13]: 0x00

ArgN0141 Response Packet Arguments - Arg[0]~[3]: Connection Password; Arg[4]~[13]: 0x00

ArgN0141F Response Packet Arguments - Arg[1:0]: 0x0141; Arg[3:2]: Error Code; Arg[4]~[13]: 0x00

Command: 0x0142 - Set Device Name

Command Packet Arguments - Arg[0]~[11]: New Device Name; Arg[12]~[13]: 0x00

ArgN0142 Response Packet Arguments - Arg[0]~[11]: New Device Name; Arg[12]~[13]: 0x00

ArgN0142F Response Packet Arguments - Arg[1:0]: 0x0142; Arg[3:2]: Error Code; Arg[4]~[13]: 0x00

Command: 0x0143 - Get Device Name

Command Packet Arguments - Arg[0]~[13]: 0x00

ArgN0143 Response Packet Arguments - Arg[0]~[11]: Device Name; Arg[12]~[13]: 0x00

ArgN0143F Response Packet Arguments - Arg[1:0]: 0x0143; Arg[3:2]: Error Code; Arg[4]~[13]: 0x00

Command: 0x0151 - Verify Connection Password ¹⁾

Command Packet Arguments - Arg[0]~[3]: Connection Password; Arg[4]~[13]: 0x00

ArgN0151 Response Packet Arguments - Arg[0]~[3]: Connection Password; Arg[4]~[13]: 0x00

ArgN0151F Response Packet Arguments - Arg[1:0]: 0x0151; Arg[3:2]: Error Code; Arg[4]~[13]: 0x00

¹⁾Press-and-hold the **Hz** button and then turn Rotary Switch from **OFF** to **Capacitance** function position within 0.6 second can restore original factory settings for wireless communication

Connection Password (Default: **0000**) & Device Name. Meter will display "Org" shortly to confirm.

Error code:

- 0 : Checksum error
- 1 : Invalid channel ID
- 2 : Out of setting range
- 3 : invalid password
- 4 : invalid password
- 5 : invalid arguments
- 6 : Insufficient permissions

APP UUID for BM78xBT

Unknown Service

UUID : 0003CDD0-0000-1000-8000-00805f9b0131

Primary Service

Unknown Characteristic

UUID : 0003CDD5-0000-1000-8000-00805f9b0131

Properties : NOTIFY

Descriptor :

Client Characteristic Configuration

UUID : 0x2902

Length : 185 Bytes

Unknown Characteristic (Command Packet)

UUID : 0003CDD4-0000-1000-8000-00805f9b0131

Properties : READ/WRITE

Length : 32 Bytes

Caution: Attribute MTU size must be set to 185 bytes

BM78xBT Reading Output format (Total 152 bytes):

Device Information Packet (24 bytes; see details below) + Device Reading Packet (32 bytes; see details below) + Device Reading Packet (0x00 for all 32 bytes) + Device Reading Packet (0x00 for all 32 bytes) + Device Reading Packet (0x00 for all 32 bytes)

Device Information Packet (24 bytes)

Description	Index	Value	Remark
HeadByte0	[0]	0xFF	HEAD
HeadByte1	[1]	0x01	SOH
Packet Length	[2]	0x18	
Packet Type	[3]	0x04	0x04: Device Information; 0x05: Device Reading
Protocol Version	[4]	0x01	
Device Category ID	[5]	0x02	0x02: Multimeter; 0x03: Clamp-on meter
MAC address0	[6]		Bluetooth Device Address
MAC address1	[7]		
MAC address2	[8]		
MAC address3	[9]		
MAC address4	[10]		
MAC address5	[11]		
Device Battery Status	[12]	0x00	If 0x02, Device is at Low Battery status
Power Source Flag	[13]	0x00	
Reserve1	[14]	0x00	
Reserve2	[15]	0x00	
Reading Packet No.1	[16]	0x04	The number of "Device Reading Packet" will be transmitted out after "Device Information Packet"
Reading Packet No.2	[17]	0x00	
Reading Packet No.3	[18]	0x00	
Device Reading PK No.	[19]	0x01	0x01 for BM78xBT (Single Display Device)
Checksum0	[20]		CRC calculation ¹⁾ of Index [2]~[19] bytes: To use the CRC-16 reverse algorithm based on the polynomial $x^{16}+x^{15}+x^2+1$ (0x8005)
Checksum1	[21]		
EndByte0	[22]	0xFF	HEAD
EndByte1	[23]	0x03	ETX

¹⁾CRC calculation:

```

unsigned int crc_chk(unsigned char* data, unsigned char length)
{
    int j;
    unsigned int reg_crc=0xFFFF;
    while(length--)
    {
        reg_crc ^= *data++;
        for(j=0;j<8;j++)
        {

```

```
        if(reg_crc & 0x01) // LSB(b0)=1
            reg_crc=(reg_crc>>1) ^ 0xA001;// 0x8005 reverse
        else
            reg_crc=reg_crc >>1;
    }
}
return reg_crc;
}
```

Device Reading Packet (32 bytes)

Description	Index	Value	Remark
HeadByte0	[0]	0xFF	HEAD
HeadByte1	[1]	0x02	SOH
Packet Length	[2]	0x20	
Packet Type	[3]	0x05	0x04: Device Information; 0x05: Device Reading
Logging Data set ID1	[4]	0x01	0x000001 for BM78xBT
Logging Data set ID2	[5]	0x00	
Logging Data set ID3	[6]	0x00	
Device Reading PK ID	[7]	0x01	0x01 only for BM78xBT (Single Display Device)
Device RTC Time	[8]		See Device RTC Time [8] ~ [13] Format
	[9]		
	[10]		
	[11]		
	[12]		
	[13]		
Device Status Flag0	[14]		See [Status Flag0 ~ Flag2]
Device Status Flag1	[15]		
Device Status Flag2	[16]		
Device Type	[17]	0x01	0: Sensor; 1: Meter
Main-Function ID	[18]		See Function ID Table
Reserved	[19]	0x00	
Sub-Function ID	[20]		See Function ID Table
Device Reading0	[21]		Device Reading [2] ~ [0]: Signed bytes e.g.: 0x008000 = 32768 0xFF8000 = -32768
Device Reading1	[22]		
Device Reading2	[23]		
Reading Decimal Point	[24]		See Decimal Point [24]
Metrics Prefix	[25]		-9="n"; -6="μ"; -3="m"; 0=" "; 3="k", 6="M", 9="G"
Function Unit	[26]		See Function Unit [26]
Display Digit Number	[27]		3:XXX; 4:"XXXX"; 5:"XXXXX"; 6:"XXXXXX"
Checksum0	[28]		CRC calculation ¹⁾ of Index [2]~[27] bytes: To use the CRC-16 reverse algorithm based on the polynomial $x^{16}+x^{15}+x^2+1$ (0x8005)
Checksum1	[29]		
EndByte0	[30]	0xFF	HEAD
EndByte1	[31]	0x03	ETX

¹⁾CRC calculation:

```

unsigned int crc_chk(unsigned char* data, unsigned char length)
{
    int j;
    unsigned int reg_crc=0xFFFF;
    while(length--)
    {

```

```

reg_crc ^= *data++;
for(j=0;j<8;j++)
{
    if(reg_crc & 0x01) // LSB(b0)=1
        reg_crc=(reg_crc>>1) ^ 0xA001;// 0x8005 reverse
    else
        reg_crc=reg_crc >>1;
}
}
return reg_crc;
}

```

Device RTC Time [8] ~ [13] Format:

The bits of Byte [13]								The bits of Byte [12]							
7	6	5	4	3	2	1	0	7	6	5	4	3	2	1	0
YEAR (2000+1~127)								Month (1~12)				Date (1~31)			

The bits of Byte [11]								The bits of Byte [10]								The bits of Byte [9]								The bits of Byte [8]							
7	6	5	4	3	2	1	0	7	6	5	4	3	2	1	0	7	6	5	4	3	2	1	0	7	6	5	4	3	2	1	0
0	0	0	0	0	Hour (1~23)			Minute (0~59)						Second (0~59)						Mini-Second (0~999)											

[Status Flag0 ~ Flag2]

Status Flag2

	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
	x	x	x	x	x	X	x	x
=0	Don't care							
=1								

Status Flag1

	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
	x	Sign	OL ¹⁾	RECORD	MAX ²⁾	MIN ²⁾	AVG ³⁾	x
=0	Don't care	Display reading is Positive	Display reading is not OL	Record mode is not activated	LCD "MAX" annunciator turns off	LCD "MIN" annunciator turns off	LCD "AVG" annunciator turns off	Don't care
=1		Display reading is Negative	Display reading is OL	Record mode is activated	LCD "MAX" annunciator turns on	LCD "MIN" annunciator turns on	LCD "AVG" annunciator turns on	

¹⁾When Bit5=1, it means Display shows OL. Device Reading [2] ~ [0] can be ignored.

²⁾Accompany with RECORD or CREST mode

³⁾Accompany with RECORD mode

Status Flag0

	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
	CREST	RELative	HOLD	AUTO-Ranging	AUTO-HOLD	ASCII reading ⁴⁾	x	x
=0	CREST mode is not activated	REL mode is not activated	Display reading not in HOLD status	Measurement in Manual-Ranging mode	AUTO-HOLD mode is not activated	When Display is a numerical reading	Don't care	
=1	CREST mode is activated	REL mode is activated	Display reading in HOLD status	Measurement in Auto-Ranging mode	AUTO-HOLD mode is activated	When Display is not a numerical reading		

⁴⁾When ASCII reading bit=1 and:

Device Reading [2]~[0] = 0x000001, Meter is displaying "Auto".

Device Reading [2]~[0] = 0x000002, Meter is displaying "InEr".

Device Reading [2]~[0] = 0x000003, Meter is displaying "- ".

Device Reading [2]~[0] = 0x000004, Meter is displaying "- - ".

Device Reading [2]~[0] = 0x000005, Meter is displaying "- - - ".

Device Reading [2]~[0] = 0x000006, Meter is displaying "- - - - ".

Device Reading [2]~[0] = 0x000007, Meter is displaying "- - - - -".

Device Reading [2]~[0] = 0x00000A, Meter is displaying “EF-H”.
 Device Reading [2]~[0] = 0x00000B, Meter is displaying “EF-L”.

Decimal Point [24]

If Display Digit Number byte [27] = 5 (Display 5 digits)

Decimal Point [24] =	0	1	2	3	4
Display value =	XXXXX	X.XXXX	XX.XXX	XXX.XX	XXXX.X

If Display Digit Number byte [27] = 4 (Display 4 digits)

Decimal Point [24] =	0	1	2	3
Display value =	XXXX	X.XXX	XX.XX	XXX.X

Function Unit [26]

Function Unit		
0x02	V	Volt
0x03	A	Amp
0x04	Ω	Ohm
0x05	S	Siemens (Ū)
0x06	F	Farad
0x08	Hz	Hertz
0x0A	%	Duty
0x14	°C	Celsius
0x15	°F	Fahrenheit
0x4F	%4~20mA	Current loop

Function ID Table

Main Function ID	Function Type	Sub-Function ID	Display Function	
0x02	AutoCheck	0x00	LoZ-ACV	
		0x01	LoZ-DCV	
		0x03	AUTO	
0x03	Volt	0x00	ACV	
		0x01	DCV	
		0x02	DC+ACV	
		0x03	Hz of Line Volt	
0x17	VFD	0x00	Hz of VFD-ACV	
		0x01	VFD-ACV	
0x04	mV	0x00	ACmV	
		0x01	DCmV	
		0x02	DC+ACmV	
0x05	μ A	0x00	AC μ A	
		0x01	DC μ A	
		0x02	DC+AC μ A	
		0x03	Hz of μ A	
0x06	mA	0x00	ACmA	
		0x01	DCmA	
		0x02	DC+ACmA	
		0x03	Hz of mA	
		0x08	%4~20mA	
0x07	A	0x00	ACA	
		0x01	DCA	
		0x02	DC+ACA	
		0x03	Hz of A	
0x0C	Temperature	0x00	T1	
		0x01	T2	
		0x02	T1 - T2	
0x0D	Resistance	0x00	Resistance	
0x0E	Capacitance	0x00	Capacitance	
0x0F	Continuity	0x00	Continuity	
0x10	Diode	0x00	Diode	
0x11	nS Conductance	0x00	nS Conductance	
0x12	Duty Cycle (%)	0x00	Duty Cycle (%)	
0x13	Logic-Hz	0x00	Logic-Hz	
0x22	EF	0x00	EF-Lo	
		0x01	EF-Hi	
0x23	Hz of Line signal	0x00	Hz of Line Volt/Current	

Proposal design flowchart:

