

# 78xBT Family 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] <sup>1)</sup> | 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             |

<sup>1)</sup>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 <sup>1)</sup>                                                                                                                  |
| MAC address1            | [6]   |       |                                                                                                                                                   |
| MAC address2            | [7]   |       |                                                                                                                                                   |
| MAC address3            | [8]   |       |                                                                                                                                                   |
| MAC address4            | [9]   |       |                                                                                                                                                   |
| MAC address5            | [10]  |       |                                                                                                                                                   |
| Command0                | [11]  |       | See <b>Command Table</b>                                                                                                                          |
| 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 <sup>2)</sup> 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                                                                                                                                               |

<sup>1)</sup>BLE Device address can be got from any Response Packet.

<sup>2)</sup>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<br>"Command + ArgN" | If fail, responded<br>"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 <sup>1)</sup> | 0x0151 + ArgN0151                         | 0x8001 + ArgN0151F                     |

<sup>1)</sup>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 “78xBT Family 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 78x Family 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 <sup>1)</sup>

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

<sup>1)</sup>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 78xBT Family

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

## 78xBT Family 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 78xBT (Single Display Device)                                                                                                            |
| Checksum0             | [20]  |       | CRC calculation <sup>1)</sup> 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                                                                                                                                               |

<sup>1)</sup>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 78xBT                                                                                                                                |
| Logging Data set ID2  | [5]   | 0x00  |                                                                                                                                                   |
| Logging Data set ID3  | [6]   | 0x00  |                                                                                                                                                   |
| Device Reading PK ID  | [7]   | 0x01  | 0x01 only for 78xBT (Single Display Device)                                                                                                       |
| Device RTC Time       | [8]   |       | See <b>Device RTC Time [8] ~ [13] Format</b>                                                                                                      |
|                       | [9]   |       |                                                                                                                                                   |
|                       | [10]  |       |                                                                                                                                                   |
|                       | [11]  |       |                                                                                                                                                   |
|                       | [12]  |       |                                                                                                                                                   |
|                       | [13]  |       |                                                                                                                                                   |
| Device Status Flag0   | [14]  |       | See <b>[Status Flag0 ~ Flag2]</b>                                                                                                                 |
| Device Status Flag1   | [15]  |       |                                                                                                                                                   |
| Device Status Flag2   | [16]  |       |                                                                                                                                                   |
| Device Type           | [17]  | 0x01  | 0: Sensor; 1: Meter                                                                                                                               |
| Main-Function ID      | [18]  |       | See <b>Function ID</b> Table                                                                                                                      |
| Reserved              | [19]  | 0x00  |                                                                                                                                                   |
| Sub-Function ID       | [20]  |       | See <b>Function ID</b> Table                                                                                                                      |
| Device Reading0       | [21]  |       | Device Reading [2] ~ [0]: Signed bytes<br>e.g.: 0x008000 = 32768<br>0xFF8000 = -32768                                                             |
| Device Reading1       | [22]  |       |                                                                                                                                                   |
| Device Reading2       | [23]  |       |                                                                                                                                                   |
| Reading Decimal Point | [24]  |       | See <b>Decimal Point [24]</b>                                                                                                                     |
| Metrics Prefix        | [25]  |       | -9="n"; -6="μ"; -3="m"; 0=" "; 3="k", 6="M", 9="G"                                                                                                |
| Function Unit         | [26]  |       | See <b>Function Unit [26]</b>                                                                                                                     |
| Display Digit Number  | [27]  |       | 3:XXX; 4:"XXXX"; 5:"XXXXX"; 6:"XXXXXX"                                                                                                            |
| Checksum0             | [28]  |       | CRC calculation <sup>1)</sup> 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                                                                                                                                               |

<sup>1)</sup>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 <sup>1)</sup>          | RECORD                       | MAX <sup>2)</sup>               | MIN <sup>2)</sup>               | AVG <sup>3)</sup>               | 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  |            |

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

<sup>2)</sup>Accompany with RECORD or CREST mode

<sup>3)</sup>Accompany with RECORD mode

### Status Flag0

|    | Bit7                        | Bit6                      | Bit5                               | Bit4                               | Bit3                            | Bit2                                    | Bit1       | Bit0 |
|----|-----------------------------|---------------------------|------------------------------------|------------------------------------|---------------------------------|-----------------------------------------|------------|------|
|    | CREST                       | RELative                  | HOLD                               | AUTO-Ranging                       | AUTO-HOLD                       | ASCII reading <sup>4)</sup>             | 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 |            |      |

<sup>4)</sup>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             | $\mu$ A           | 0x00            | AC $\mu$ A              |  |
|                  |                   | 0x01            | DC $\mu$ A              |  |
|                  |                   | 0x02            | DC+AC $\mu$ A           |  |
|                  |                   | 0x03            | Hz of $\mu$ 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:

