# DISPLAY Elektronik GmbH

CONTROL BUTTON

# DE CB-480480A VMH-PW-N

**Product Specification**                                        **Ver.: 8**

**05.09.2023**

**Revision History**

| Revision | Date | Originator | Detail | Remarks |
|:---:|:---:|:---:|:---|:---:|
| 0 | 08.04.2022 | ZFY | Initial Release | |
| 1 | 29.04.2022 | LQ | Modify Outline Drawing(B) | P5 |
| 2 | 23.08.2022 | LQ | Modify Basic Parameters | P4 |
| | | | Modify Outline Drawing(C) | P5 |
| | | | Modify Pins and Module Parameter | P6 |
| | | | Modify Optical Characteristic | P7 |
| | | | Add OPERATING GUIDE | P12-19 |
| 3 | 17.12.2022 | LQ | Modify Outline Drawing(D) | P5 |
| | | | Modify Luminance | P6&P7 |
| 4 | 08.01.2023 | LQ | Modify Basic Parameters | P4 |
| | | | Modify Reliability | P11 |
| 5 | 28.04.2023 | LQ | Modify Outline Drawing(D) | P5 |
| 6 | 23.05.2023 | ZYJ | Modify Basic Parameters | P4 |
| | | | Modify Outline Drawing(D) | P5 |
| | | | Modify Module Size | P6 |
| | | | Modify Positioning Points and Positions | P10 |
| | | | Modify Movement Amount of Pressing the Rotating Button | P11 |
| 7 | 26.05.2023 | LQ | Modify Outline Drawing(F) | P5 |
| 8 | 05.09.2023 | LL | Modify Outline Drawing | P5 |
| | | | | |

## Table of Contents

## 1.    General Description

De CB-480480A VMH-PW-N series module is a module that perfectly combines the display screen, encoder, push button and status LED into a rotating button display. The unique innovative structure and exquisite manufacturing process of the module make it have excellent reliability and excellent control experience. It is applicable to the demand of rotating button control in many industrial applications of electronic products

## 2.    Basic Parameters

1.    2.1 inch circular display 480*480 TFT/UART Interface
2.    Annular status LED indicator
3.    EC4301-AX-11.2/6.2-20P20 encoder
4.    Integral push button
5.    FPC standard 0.5mm-6P interface
6.    Three point standard screw installation

## 3.    Mechanical Characteristics

### 3.1.        Appearance picture



### 3.2.        Basic Structure
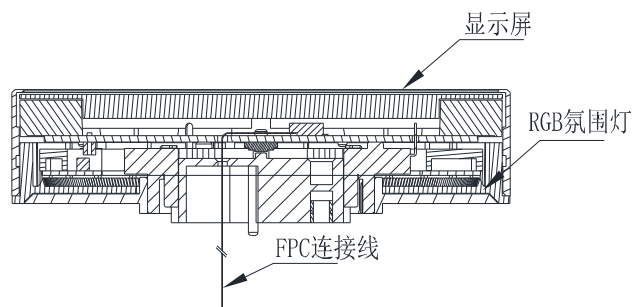
## 3.3.          Outline Drawing



| NO. | PIN NAME |
|-----|----------|
| 1 | 5V |
| 2 | GND |
| 3 | THS |
| 4 | TCK |
| 5 | TX |
| 6 | RX |
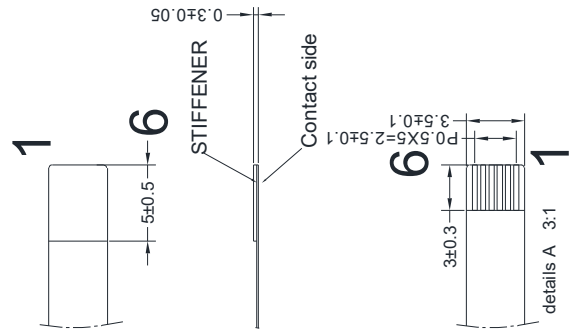
### 4.   Interface Pins Definition

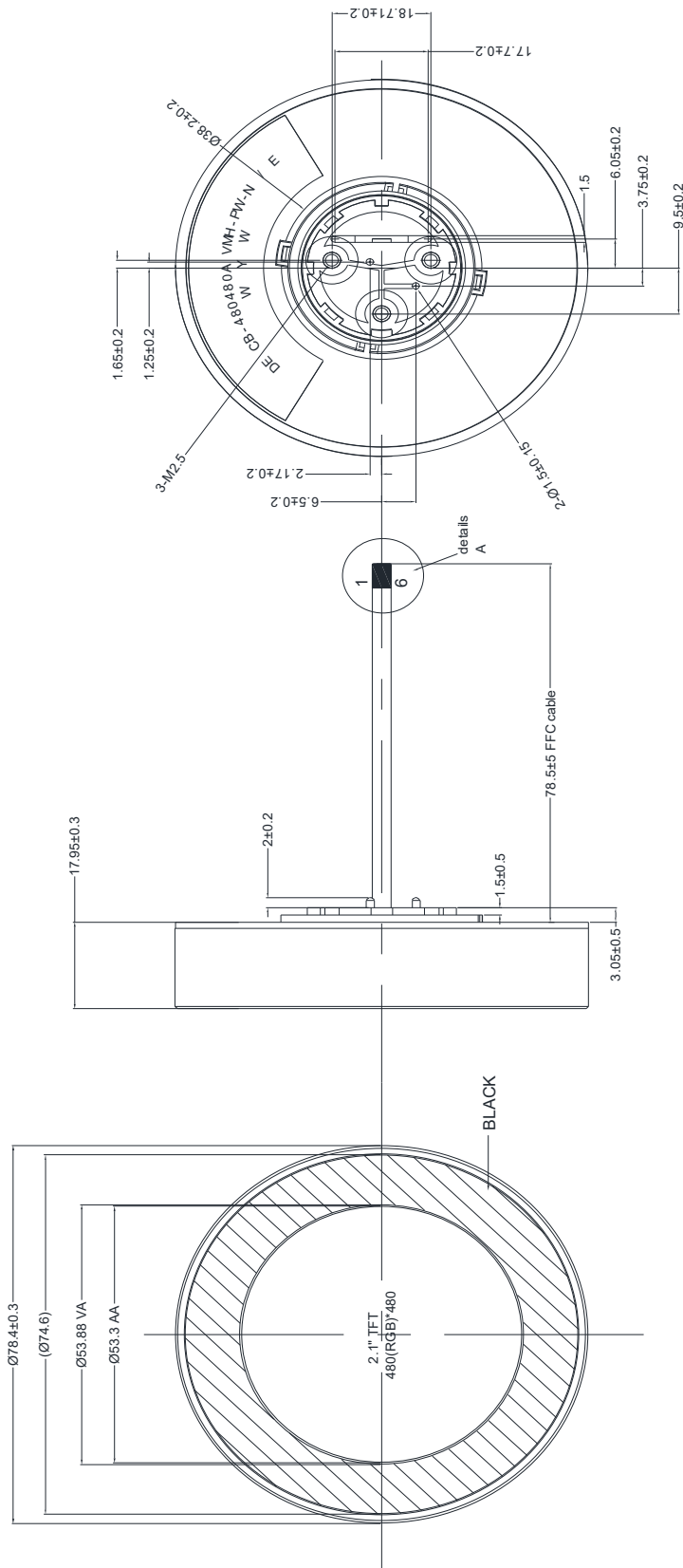| PIN | Symbol | Definition | Remarks |
|---|---|---|---|
| 1 | 5V | Power supply | |
| 2 | GND | Power Ground | |
| 3 | THS | Software Burning pin | 3.3V |
| 4 | TCK | Software Burning pin | 3.3V |
| 5 | TX | Data Output | 3.3V |
| 6 | RX | Data Input | 3.3V |

### 5.   Module Parameter

| Features | Details | Remark |
|---|---|---|
| Module Size | Φ78.40 x 17.95 mm | - |
| Viewing Area | Φ53.88 mm | - |
| Active Area | Φ53.30 mm | - |
| Display Size | 2.1" | - |
| View Direction | ALL | - |
| Display mode | Transmissive / Normal black | - |
| Color | 262k | - |
| Resolution | 480 x 480 | - |
| Luminance | 300cd/m$^2$ | - |
| Operating Temperature | -20°C～70°C /96H | - |
| Storage Temperature | -30°C～80°C /96H | - |
| Operating Voltage | 4.5V～7V,   typ : 5V | - |
| Current Consumption | 150mA～350mA , typ:280mA | - |
| Weight | (TBD) | - |

### 6.   Optical Characteristics

Ta=25ºC

| Parameter | Symbol | Condition | Min. | Typ. | Max. | Unit | Remark |
|---|---|---|---|---|---|---|---|
| Contrast Ratio | C/R | θ = 0° | 800 | 1000 | - | - | Note(4) |
| NTSC Ratio | S | θ =0° | 64 | 69 | - | % | Note(7) |
| Luminance | L | θ =0° | 240 | 300 | - | cd/m2 | Note(5) |
| Luminance uniformity | UW | θ =0° | 70 | 80 | - | % | Note(3) |
| Response Time | TR+ TF | 25 °C | - | 30 | 35 | ms | Note(2) |
| Color Coordination | RX | θ = 0° (Center) Normal viewing angle B/L On | -0.05 | 0.628 | +0.05 | NTSC (x,y) | Note(6) |
| | RY | | | 0.350 | | | |
| | GX | | | 0.297 | | | |
| | GY | | | 0.661 | | | |
| | BX | | | 0.142 | | | |
| | BY | | | 0.077 | | | |
| | WX | | | 0.277 | | | |
| | WY | | | 0.341 | | | |
| Viewing Angle | θ L | C/R>10 | 80 | 85 | - | Degree | Note(1) |
| | θ R | | 80 | 85 | - | | |
| | θ U | | 80 | 85 | - | | |
| | θ D | | 80 | 85 | - | | |

Test Conditions:

1. VDD=3.3V, IF=20mA (Backlight current), the ambient temperature is+25℃.

2. The test systems refer to Note 8.


**Note1:** Definition of Viewing Angle: The viewing angle range that the CR>10
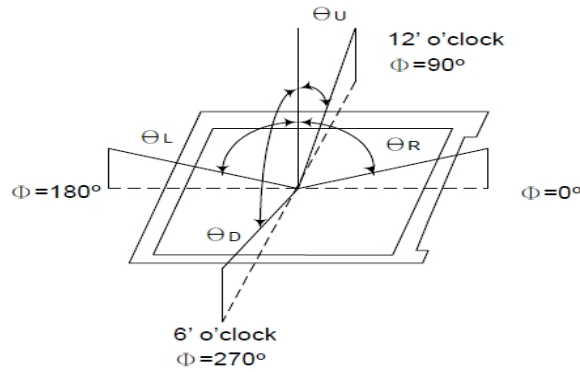
**Note2:** Definition of Response time: Sum of TR and TF
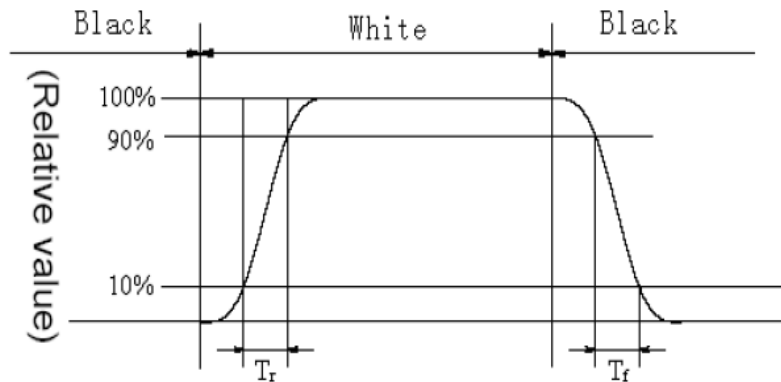


**Note 3:** Definition of Luminance Uniformity: Active area is divided into 9 measuring areas, every measuring point is placed at the center of each measuring area.

Luminance Uniformity = ——————————————— ×100%
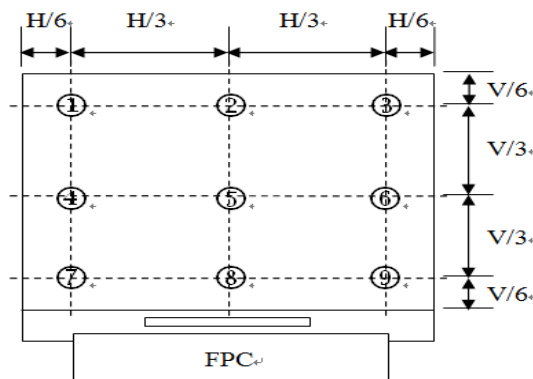


**Note4:** Definition of Contrast Ratio (CR): measured at the center point of panel

**Note 5:**
$$Contrast\ ratio\ (CR) = \frac{Luminance\ measured\ when\ LCD\ on\ the\ "White"\ state}{Luminance\ measured\ when\ LCD\ on\ the\ "Black"\ state}$$
Definition of Luminance: Center Luminance of white is defined as luminance values of 1point average across the LCD surface.

**Note 6:** Definition of Color Chromaticity (CIE 1931)
Color coordinates of white & red, green, blue measured at center point of LCD.

**Note 7:** Definition of NTSC ratio:

$$\text{NTSC ratio} = \frac{\text{Area of RGB triangle}}{\text{Area of NTSC triangle}}$$



1931 CIE Chromaticity Diagram
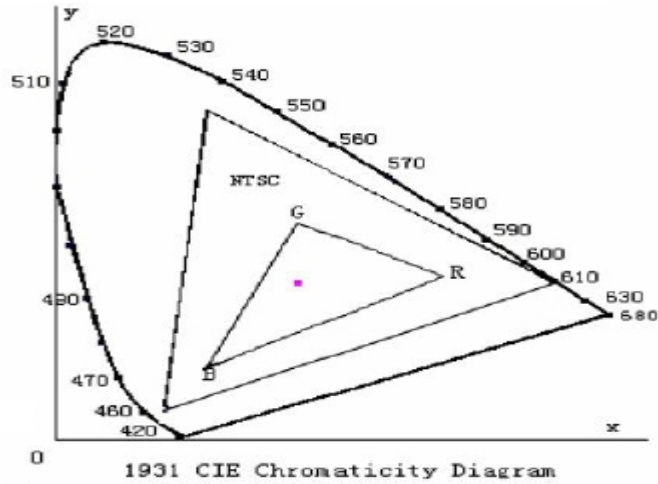
**Note 8:** Definition of optical measurement system.

The optical characteristics should be measured in dark room. After 5 minutes operation, the optical properties are measured at the center point of the LCD screen.(Response time is measured by Photo detector TOPCON BM-7, Field of view: 1°/Height: 500mm.)
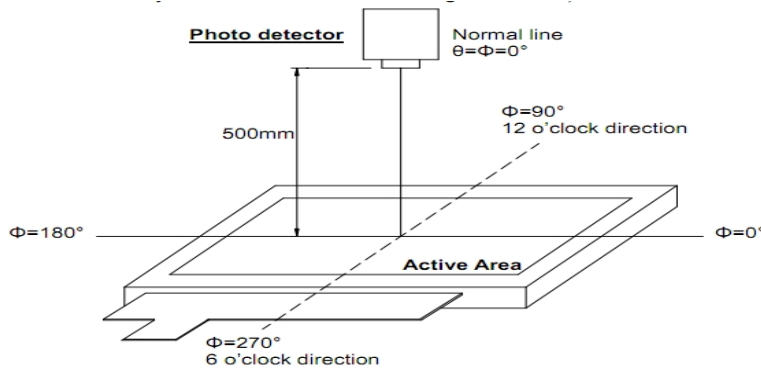
## 7. Reliability

| Item | Test Condition | SPECIFICATIONS |
|---|---|---|
| Insulation Impedance | Apply a voltage of 250V DC between the metal outer rotating button and the base for 1 minute. | The resistance between the metal outer rotating button and the base is more than 100M Ω. |
| Rated Voltage | Apply a voltage of 300V AC between the metal outer rotating button and the base for 1 minute. | No insulation damage |
| Full Rotation Angle | | 360° (No stop point) |
| Rotation Torque | | 15±7mN.m (150±70gf.cm) |
| Positioning Points and Positions | | 20 positioning points (interval angle 18°±2 °) |
| Axial Compression Strength | At the shaft end, apply a static load force of 5Kgf along the axial direction and press down for 10 seconds (the screw is fixed on the face shell). | The shaft is not damaged and press is normal; The electrical performance is normal |
| Axial Drawing Strength | At the shaft end, apply a static load force of 5Kgf along the axial direction and pull up for 10 seconds (the screw is fixed on the face shell). | The shaft is not damaged and press is normal; The electrical performance is normal |
| Rotational Life | Under no-load condition, the shaft rotates 30000 at the speed of 600 ~ 1000 cycles / hour (1 cycle refers to 360° clockwise and 360° counterclockwise) | Torque: - 50% ~ + 10% of the initial value Rotating button display LCD can be powered on and adjusted normally. |
| High Humidity Experiment | 60 ± 3°C,   90 ~ 95%RH, 96 ± 4Hrs Before function test and visual inspection, the product must have enough recovery time, at least 1.5 hours in normal temperature and humidity. | The surface of the outer rotating button is free of cracking and bubbling, and the display screen is free of OCA falling off. Rotating button display LCD can be powered on and adjusted normally. |
| High Temperature Experiment | 70 ± 3°C, 96 ± 4Hrs Before function test and visual inspection, the product must have enough recovery time, at least 1.5 hours in normal temperature and humidity. | The surface of the outer rotating button is free of cracking and bubbling, and the display screen is free of OCA falling off. Rotating button display LCD can be powered on and adjusted normally. |

| Thermal Cycling Test | 阶段<br>step | 温度<br>Temperature | 放置时间<br>Durationure | The surface of the outer rotating button is free of cracking and bubbling, and the display screen is free of OCA falling off. Rotating button display LCD can be powered on and adjusted normally. |
|---|---|---|---|---|
| | 1 | −20℃ | 0.5 hour | |
| | 2 | 常温<br>standard atmospheric conditions | 0.5 hour | |
| | 3 | 70℃ | 0.5 hour | |
| | 4 | 常温<br>standard atmospheric conditions | 0.5 hour | |
| | 试验周期: 5周<br>test cycle: 5 cycles | | | |
| | Before function test and visual inspection, the product must have enough recovery time, at least 1.5 hours in normal temperature and humidity. | | | |
| Force of Pressing the Rotating Button | Apply an axial force to the face cover plate until it does not move, and take the large value in the force application process. | | | 250±30gf |
| Movement Amount of Pressing the Rotating Button | Fix the product on the face cover plate, apply a static load force of twice the driving force directly above the cover plate, and measure the moving distance when the rotating button is pressed to immobility. | | | 0.5±0.2 mm |
| Press Life of the Rotating Button | After the product is fixed, apply a pressing pressure of 250±30gf axially, press it to the end and release it to let it return freely. Press 100000 times. The pressing speed is 1500-1800 times per hour. | | | The pressing force is - 50% ~ + 10% of the initial value. Rotating button display LCD can be powered on and adjusted normally. The plastic part is free of damage, deformation and rotation is normal. |

## 8. Product Packaging Information

Storage environment and conditions:

1. It shall be stored in a well ventilated environment with temperature of - 15°C ~ + 25°C, relative humidity of 40% - 65% and no harmful gas around.

2. During storage and transportation, the stacking height of products shall not exceed 5 boxes.

| Items | Normal Parameters | Limit Parameters | Material Valid Status | Remarks |
|---|---|---|---|---|
| Temperature | 25°C | 85°C | Normal | |
| Humidity | 65% | 95% | Normal | |

## 9.   Operation Process

### 9.1.  Operation Flow Chart
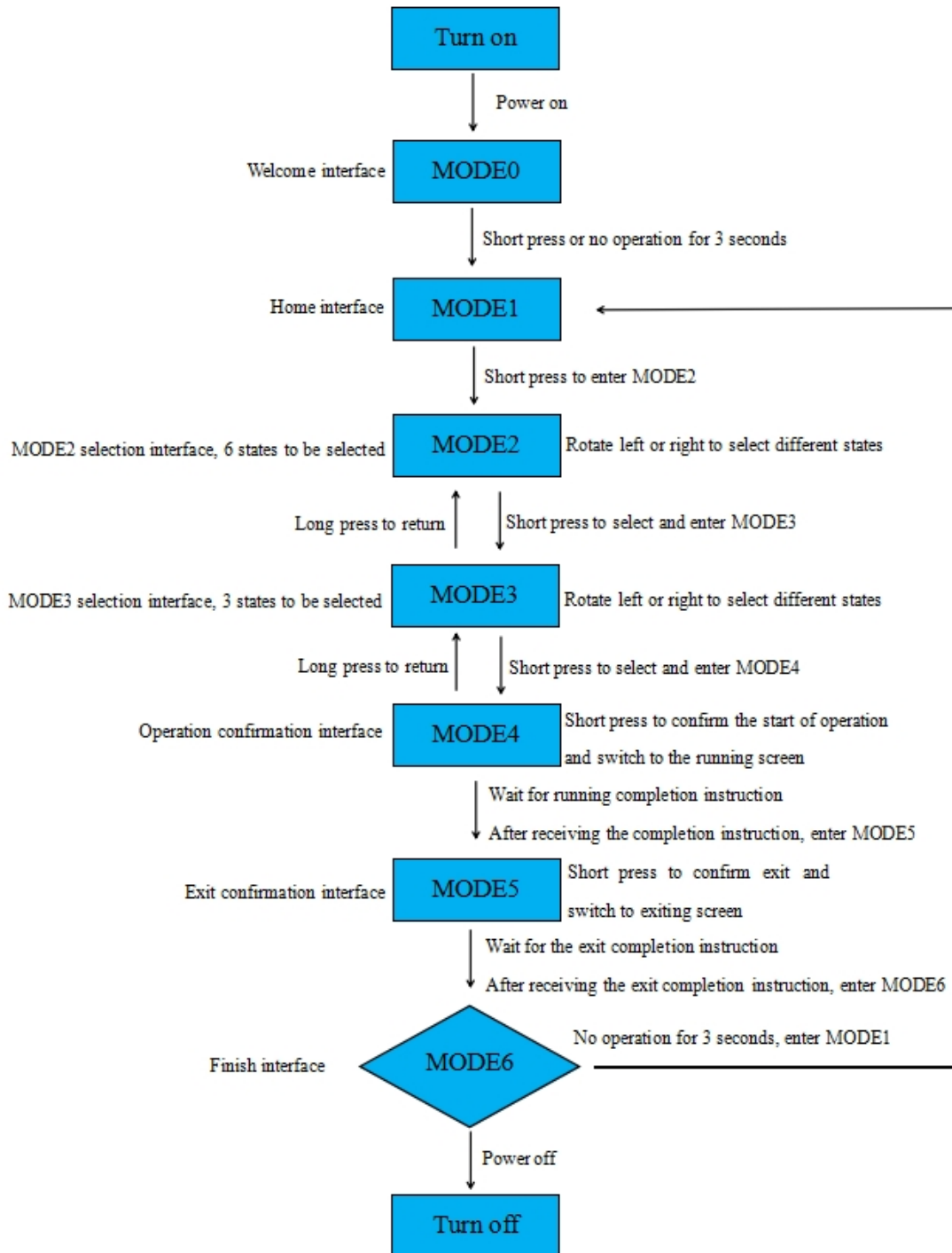
**9.2. Detailed Description of Operation**

### 9.2.1. Power on:

Turn on the module power supply switch and the module will be powered o;

### 9.2.2. MODE0:

Welcome interface, short press or no operation for 3 seconds to enter MODE1

### 9.2.3. MODE1:

Standby interface, short press to enter MODE2 for selection;

### 9.2.4. MODE2:

In MODE2 selection interface, rotate left or right to switch different states of MODE2. Short press to confirm the MODE2 state and enter MODE3. Long press to return to MODE1. There are six states for MODE2 to choose from;

### 9.2.5. MODE3:

In MODE3 selection interface, rotate left or right to switch different states of MODE3. Short press to confirm the MODE3 state and enter MODE4. Long press to return to MODE2. There are three states for MODE3 to choose from;

### 9.2.6. MODE4:

Operation Confirmation interface, short press to confirm the start of the operation, the display switches to the operating interface, long press to return to MODE3 selection interface, and enter MODE5 after receiving the operation completion instruction;

### 9.2.7. MODE5:

Pour out confirmation interface, short press to confirm the start of pour out, the display switches to the pouring out interface, and enter MODE6 after receiving the pour out completion instruction;

### 9.2.8. MODE6:

Finish interface, no operation for 3 seconds to enter MODE1;

### 9.2.9. Power off:

Turn off the power supply and the module will be powered off;

## 10. Annular LED Status Indicator

When the button is triggered, the color is switched randomly. When it is running or exiting, it is the breathing light effect.

## 11. Communication Protocol

UART serial port of TTL level is used for communication, asynchronous serial full duplex mode is adopted, baud rate is 115200bps, 8 data bits, no check bit, 1 stop bit;

### 11.1. Communication Protocol Format

| SEQ | Data Content | Bytes | Value | Content Description |
|-----|--------------|-------|-------|---------------------|
| D1 | Start code | 1 Byte | 0xA5 | Fixed to 0xA5 |
| D2 | Start code | 1 Byte | 0x5A | Fixed to 0x5A |
| D3 | Length | 1 Byte | 0x0A | Data length, including start code and check code |
| D4 | Function word | 1 Byte | 0xA1 | Command function |
| D5 | Mode | 1 Byte | [0-6] | Corresponding to seven different modes |
| D6 | Reserve | 1 Byte | | Reserved value |
| D7 | CRC1 | 1 Byte | | CRC16 check value |
| D8 | CRC2 | 1 Byte | | CRC16 check value |
| D9 | End code | 1 Byte | 0XFC | Fixed to 0XFC |
| D10 | End code | 1 Byte | 0XCF | Fixed to 0XCF |

### 11.2. Communication Instruction Description

11.2.1. Mode Switching Instruction

After the module is switched from MODE0-MODE6, it will continuously issue the instruction once per second. After receiving the return instruction and checking that it is consistent, it will stop issuing;

The module issues instructions:

| D1 | D2 | D3 | D4 | D5 | D6 | D7 | D8 | D9 | D10 |
|----|----|----|----|----|----|----|----|----|-----|
| 0XA5 | 0X5A | 0X0A | 0XA1 | MODE | Reserve | CRC1 | CRC2 | 0XFC | 0XCF |

MODE:0-6, representing the current mode of the module;

Return instruction:

| D1 | D2 | D3 | D4 | D5 | D6 | D7 | D8 | D9 | D10 |
|----|----|----|----|----|----|----|----|----|-----|
| 0XA5 | 0X5A | 0X0A | 0XB1 | MODE | Reserve | CRC1 | CRC2 | 0XFC | 0XCF |

MODE:0-6, which represents the mode received by the lower level. When it is consistent with the current mode of the module, it is judged that the lower level has correctly received the mode switching instruction, and the module will stop issuing the mode switching instruction;

11.2.2. MODE2 Selection Instruction

When the module selects MODE2 state (switches and enters Mode3), in addition to sending the switching mode instruction, it will also send the MODE2 selection instruction. Like the switching mode instruction, it will be sent continuously once a second before the return instruction is received and the inspection is consistent;

The module issues instructions:

| D1 | D2 | D3 | D4 | D5 | D6 | D7 | D8 | D9 | D10 |
|----|----|----|----|----|----|----|----|----|-----|
| 0XA5 | 0X5A | 0X0A | 0XA2 | MODE2 | Reserve | CRC1 | CRC2 | 0XFC | 0XCF |

MODE2:0-5, which represents the selection of six states of MODE2.

Return instruction:

| D1 | D2 | D3 | D4 | D5 | D6 | D7 | D8 | D9 | D10 |
|----|----|----|----|----|----|----|----|----|-----|
| 0XA5 | 0X5A | 0X0A | 0XB2 | MODE2 | Reserve | CRC1 | CRC2 | 0XFC | 0XCF |

MODE2:0-5, which represents the MODE2 states received by the lower level. When it is consistent with the MODE2 status of the module, it is judged that the lower level has received the correct MODE2 state value. At this time, the module will stop issuing the MODE2 selection instruction.

### 11.2.3. MODE3 Selection Instruction

When the module selects MODE3 state (switches and enters MODE4), in addition to sending the switching mode instruction, it will also send the MODE3 selection instruction. Like the switching mode instruction, it will be sent continuously once per second before the return instruction is received and the inspection is consistent;

The module issues instructions:

| D1 | D2 | D3 | D4 | D5 | D6 | D7 | D8 | D9 | D10 |
|----|----|----|----|----|----|----|----|----|-----|
| 0XA5 | 0X5A | 0X0A | 0XA3 | MODE3 | Reserve | CRC1 | CRC2 | 0XFC | 0XCF |

MODE3:1-3, which represents the selection of three states of MODE3.

Return instruction:

| D1 | D2 | D3 | D4 | D5 | D6 | D7 | D8 | D9 | D10 |
|----|----|----|----|----|----|----|----|----|-----|
| 0XA5 | 0X5A | 0X0A | 0XB3 | MODE3 | Reserve | CRC1 | CRC2 | 0XFC | 0XCF |

Represents the MODE3 states received by the lower level. When it is consistent with the MODE3 state of the module, it is judged that the lower level has received the correct MODE3 state value. At this time, the module will stop issuing the MODE3 selection instruction.

### 11.2.4. Start Instruction

When the module is in the MODE4 state and short press the button to enter the operation confirmation state, issue the start instruction. Like the mode switching instruction, it is continuously sent once per second before receiving the return instruction (no consistent inspection is required);

The module issues instructions:

| D1 | D2 | D3 | D4 | D5 | D6 | D7 | D8 | D9 | D10 |
|----|----|----|----|----|----|----|----|----|-----|
| 0XA5 | 0X5A | 0X0A | 0XA4 | 0X01 | Reserve | CRC1 | CRC2 | 0XFC | 0XCF |

Return instruction:

| D1 | D2 | D3 | D4 | D5 | D6 | D7 | D8 | D9 | D10 |
|----|----|----|----|----|----|----|----|----|-----|
| 0XA5 | 0X5A | 0X0A | 0XB4 | ST | Reserve | CRC1 | CRC2 | 0XFC | 0XCF |

ST=1, indicates start; ST=2, indicates finish; When receiving ST=2, the module will switch from MODE4 to MODE5;

### 11.2.5. Exit Instruction

When the module is in the MODE5 state and short press the button to enter the exit confirmation state, issue the exit instruction. Like the mode switching instruction, it is continuously sent once per second before receiving the return instruction (no consistent inspection is required);

The module issues instructions:

| D1 | D2 | D3 | D4 | D5 | D6 | D7 | D8 | D9 | D10 |
|----|----|----|----|----|----|----|----|----|-----|
| 0XA5 | 0X5A | 0X0A | 0XA5 | 0X01 | Reserve | CRC1 | CRC2 | 0XFC | 0XCF |

Return instruction:

| D1 | D2 | D3 | D4 | D5 | D6 | D7 | D8 | D9 | D10 |
|----|----|----|----|----|----|----|----|----|-----|
| 0XA5 | 0X5A | 0X0A | 0XB5 | ST | Reserve | CRC1 | CRC2 | 0XFC | 0XCF |

ST=1, indicates exit; ST=2, indicates exit complete;   When receiving ST=2,the module will switch from MODE6 to MODE6.

## 11.3. Check Bit Description

Please refer to the following code to calculate the check bit:

```c
#define MODBUSLIB_ZERO                          (0)
#define MODBUSLIB_M_DATALENTH_MAX               (0x7D)
#define MODBUSLIB_LOSTCOMM_THRESHOLD            (5)
/* CRC Related */
#define MODBUSLIB_FIXED_POLY_VALUE              (0Xa001)
#define MODBUSLIB_BYTE_LENGTH                   (7)
#define MODBUSLIB_CRC_INITIAL_VALUE             (0Xffff)    /* 0Xffff */
U16 Modbus_OneByteCrc(U16 u16Crc, U8 u8_Data)
{
    U16 u8_BitCounter = MODBUSLIB_ZERO;
    u16Crc = (u16Crc ^ u8_Data);
    for (u8_BitCounter = MODBUSLIB_ZERO; u8_BitCounter <= MODBUSLIB_BYTE_LENGTH; u8_BitCounter++)
    {
        if (0x01 == (u16Crc & 0x01))/*if LSB is one*/
        {
            u16Crc >>= 1;/*if LSB is not one then rotate data right only once*/
            u16Crc = u16Crc ^ MODBUSLIB_FIXED_POLY_VALUE;/*again XOR with fixed polynomial value*/
        }
        else
        {
            u16Crc >>= 1;/*if LSB is not one then rotate data right only once*/
        }
    }/*end of for(ucByte = MODBUSLIB_ZERO; ucByte <= BYTE_LENGTH; ucByte++)*/

    return (u16Crc);
}
U16 Modbus_Calculate16CRC(U8 *pu8_Data, U8 u8_Length, U16 u16CRCInitialValue)
{
    U8   u8_Loop = MODBUSLIB_ZERO;
    U16 u16CRC_Value = MODBUSLIB_ZERO;

    u16CRC_Value = u16CRCInitialValue;     /* Initial CRC value */
    for (u8_Loop = MODBUSLIB_ZERO; u8_Loop < u8_Length; u8_Loop++)
    {
        u16CRC_Value = Modbus_OneByteCrc(u16CRC_Value, *pu8_Data++);
    }
    return (u16CRC_Value);
}
```

## 12.  Secondary Development Description

This module has the function of secondary development. Users can replace the interface of the module through the following methods.

### 12.1.  Preparation of Software Tools and Picture Materials

Download tools: USB to serial port tool;

Software Tools:

1: Batch program-------BmpToBinForENC21.exe

2: Picture download software-------PicDownload_V2.01.exe

Picture Materials:

The user replaces the pictures with corresponding serial numbers as required, and the pictures are in BMP format, and all pictures need to be placed in BMP_FIL folder, the corresponding table of picture naming is as follows:

| Picture Naming | Corresponding Interface |
|---|---|
| 000.BMP | Welcome interface |
| 001.BMP | Standby interface |
| 101.BMP | Work-pattern 1 interface |
| 102.BMP | Work-pattern 2 interface |
| 103.BMP | Work-pattern 3 interface |
| 104.BMP | Work-pattern 4 interface |
| 105.BMP | Work-pattern 5 interface |
| 106.BMP | Work-pattern 6 interface |
| 201.BMP | Setting the working status 1 interface |
| 202.BMP | Setting the working status 2 interface |
| 203.BMP | Setting the working status 4 interface |
| 301.BMP | Working running status 1 interface |
| 302.BMP | Working running status 2 interface |
| 303.BMP | Working running status 3 interface |
| 304.BMP | Working running status 4 interface |
| 401.BMP | Finish interface |
| 501~505.BMP | Picture of the demo run countdown |
| 601~605.BMP | Demo cup countdown picture |

### 12.2.  Image Processing

1.   Prepare BMP_ File folder and place BMP_FILE folder and batch program BmpToBinForENC21.exe in the same folder, and an empty folder named BMP_DATA needs to be created in this folder, and then execute the batch program BmpToBinForENC21.exe ;



BMP_DATA    BMP_FILE    BmpToBin ForENC21. exe    DATA.BIN    PicDownlo ad_V2.01.e xe
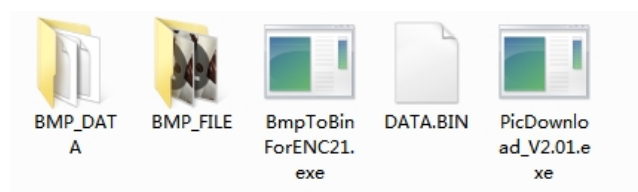
2.    After execution, in BMP_ DATA folder, two files will be generated in it. BMPDATA.BIN is a data file in which all picture data are placed in turn, TABLE.BIN is a table file, which is also equivalent to an index file;



BMPDATA.BIN        TABLE.BIN
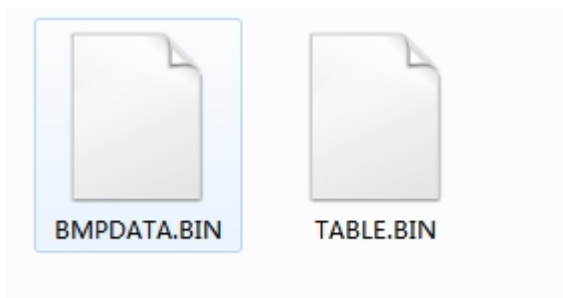
### 12.3. Data Download

1.    After generating BMPDATA.BIN file and TABLE.BIN file, connect the module to the computer through the serial port. The connection characteristics can be tested by sending instructions with the serial port assistant to ensure that the connection is normal, and then download the data with the picture download software;



BMP_DAT        BMP_FILE        BmpToBin        DATA.BIN        PicDownlo
A                                ForENC21.                        ad_V2.01.e
                                    exe                                xe
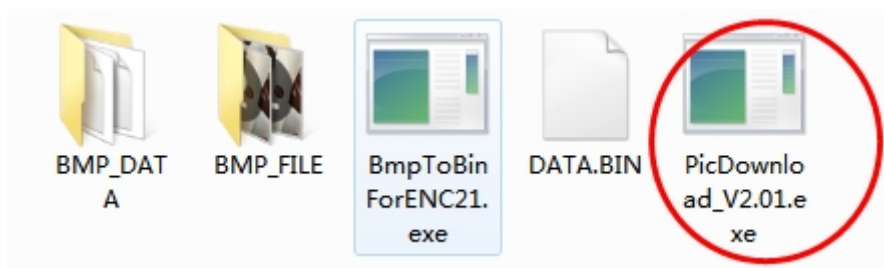
2.    Plug in the USB-to-serial port tool and adjust the COM port to COM1，PicDownload_V2.01.exe，After the download, the window will automatically close and complete the replacement of picture data at this time;



请输入串口号:1_
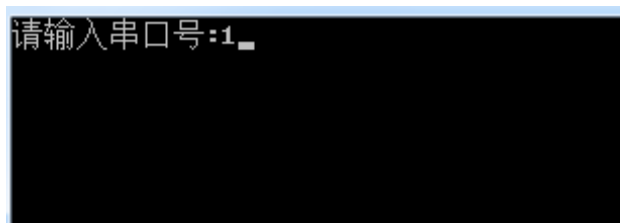
**Appendix 1 application case: coffee machine controller process**

```
                    ┌──────────────┐
                    │   Power on    │
                    └──────┬───────┘
                           ↓
                    ┌──────────────────┐
                    │ Welcome interface │
                    └──────┬───────────┘
                           ↓
                    ┌──────────────────┐ ←──────────┐
                    │ Standby interface │            │
                    └──────┬───────────┘            │
                           ↓                         │
                    ┌──────────────────┐            │
                    │  Coffee selection │            │
                    └──────┬───────────┘            │
                           ↓                         │
                    ┌────────────────────┐          │
                    │ Cup number selection│          │
                    └──────┬─────────────┘          │
                           ↓                         │
                    ┌────────────────────────┐      │
                    │ Operation confirmation  │      │
                    └──────┬─────────────────┘      │
                           ↓ Operating              │
                    ┌────────────────────────┐      │
                    │  Operation completion   │      │
                    └──────┬─────────────────┘      │
                           ↓                         │
                    ┌────────────────────────┐      │
                    │  Pour out confirmation  │      │
                    └──────┬─────────────────┘      │
                           ↓ Pouring                │
                    ┌────────────────────────┐      │
                    │   Pour out completion   │      │
                    └──────┬─────────────────┘      │
                           ↓                         │
                         ◇ Finish ◇ ────────────────┘
                           ↓
                    ┌──────────────┐
                    │   Power off   │
                    └──────────────┘
```