# Constant Current Matrix LED Driving Circuit

## General Description

ET6280 is an array type constant current LED driver circuit, which has 32 steps constant current global adjustment function, and supports up to 8×8 matrix output. Each point has 256 steps PWM current adjustment function.

ET6280 internal integration of MCU digital interface, data latch, RAM, PWM constant current drive module. It is mainly used in the display driver of household appliances, with the advantages of rich display effect and simple operation.

## Features

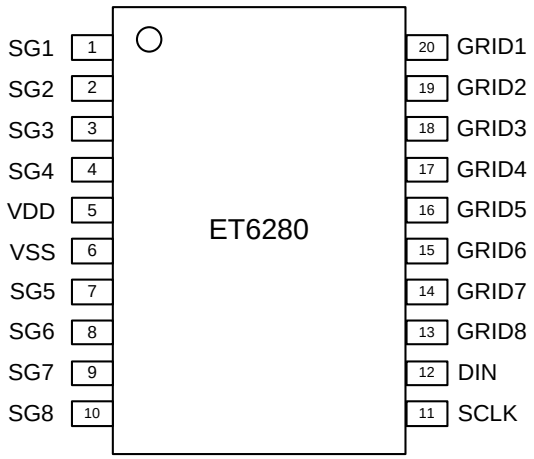
- 8 constant current driver channels, max output current 32mA.
- Support 1～8 scan application, the maximum application matrix is 8×8
- Each point supports 256 steps brightness adjustment
- Two wire serial interface(SCLK，DIN)
- Built in RC oscillation
- Built in power on reset circuit
- Built in automatic blanking circuit
- Part Number and Package

| Part No. | Package |
|---|---|
| ET6280 | SOP20 |
| ET6280V | TSSOP20 |

## Application

- LED Matrix driver
- Digital tube driver

## Pin Assignments




Top View (SOP20/TSSOP20)

## Pin Function

| Pin No. | | Name | Function |
|---|---|---|---|
| SOP20 | TSSOP20 | | |
| 1~4,7~10 | 1~4,7~10 | SG1~SG8 | Segment output, connected to LED anode. |
| 5 | 5 | VDD | Power supply . |
| 6 | 6 | VSS | GND |
| 11 | 11 | SCLK | Clock input, enter data on the rising edge. |
| 12 | 12 | DIN | Serial data input, the input data changes at the low level of SCLK and is transmitted at the high level of SCLK. |
| 13~20 | 13~20 | GRID8~GRID1 | Grid output, connected to LED cathode. |

## Absolute Maximum Ratings (Unless otherwise noted ,$T_A$=25°C)

| Symbol | Characteristic | Rating | Unit |
|---|---|---|---|
| $V_{DD}$ | Supply voltage | -0.5~7.0 | V |
| $V_I$ | Input Voltage | -0.5~$V_{DD}$+0.5 | V |
| $I_{O1}$ | LED SEG drive output current | -35 | mA |
| $I_{O2}$ | LED GRID drive output current | 400 | mA |
| $P_{D1}$ | Power Dissipation (SOP20) | 450 | mW |
| $P_{D2}$ | Power Dissipation (TSSOP20) | 450 | mW |
| $T_J$ | Junction Temperature | -40～150 | °C |
| $T_A$ | Operating Temperature | -40～85 | °C |
| $T_{STG}$ | Storing Temperature | -65～150 | °C |
| $V_{ESD}$ | HBM (All Pins) | ±4.0 | KV |
| | CDM (All Pins) | ±1.0 | KV |

## Electrical Characteristics (Unless otherwise noted，$V_{DD}$=5V ,$T_A$=25°C)

| Symbol | Characteristic | Condition | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|
| DC Characteristics | | | | | | |
| $V_{DD}$ | Supply voltage | | 4.5 | 5 | 5.5 | V |
| $V_{IH}$ | Logic high level | SCLK，DIN | 0.7*$V_{DD}$ | | $V_{DD}$ | V |
| $V_{IL}$ | Logic low level | SCLK，DIN | 0 | | 0.3*$V_{DD}$ | V |
| $I_I$ | Input current | SCLK，DIN：$V_I$=$V_{DD}$ | - | - | ±1 | μA |
| $I_{OH}$ | LED SEG drive output current | SG1~SG8,$V_O$=$V_{DD}$-1V | -29 | -32 | -35 | mA |
| $I_{OL}$ | LED GRID drive output current | GRID1~GRID8,$V_O$=0.3V | 250 | | - | mA |
| $I_{DD\_DYN}$ | Dynamic current Dissipation | No load, Display off | - | - | 5 | mA |
| Switch Characteristics | | | | | | |
| Fosc | Oscillation frequency | | | 1 | | MHz |
| $T_{TZH1}$ | GRID1~GRID8 rising time | $C_L$=300pF,$R_L$=1K | | | 2 | μs |
| $T_{TZH2}$ | SEG1~SEG8 rising time | | | | 0.5 | μs |
| $T_{THZ}$ | Dropping time | $C_L$=300pF, SEGn, GRIDn | | | 120 | μs |
| $C_I$ | Input capacitance | | | | 15 | pF |
| Timing Characteristics | | | | | | |
| $PW_{CLK}$ | Clock pulse width | | 400 | - | - | ns |
| $t_{SETUP}$ | Data setup time | | 100 | - | - | ns |
| $t_{HOLD}$ | Data hold time | | 100 | - | - | ns |

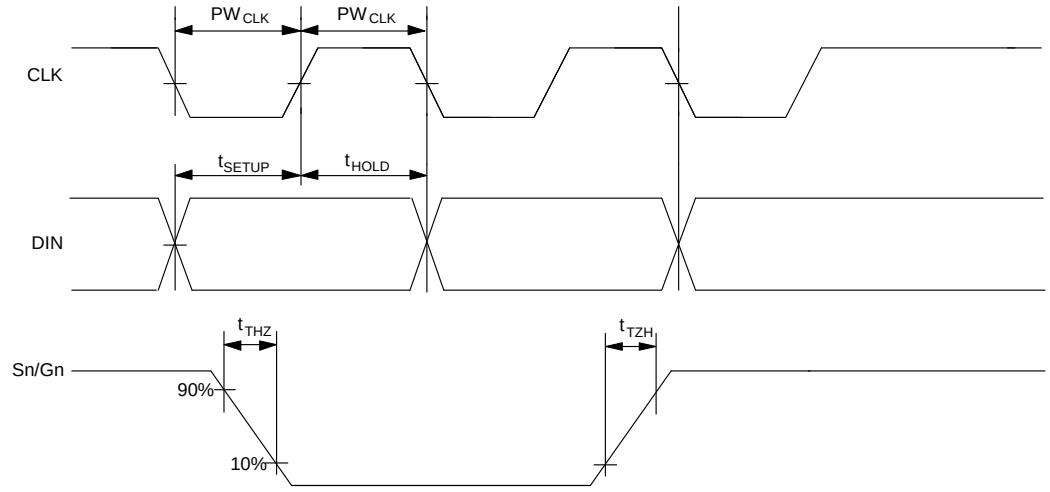



Figure1. Timing Diagram

## Functions Description

### 1. Serial Port Interface

The data of MCU communicates with ET6280 through two-wire bus interface. While input data, when SCLK is high level, the signal on DIN must remain unchanged; only when the clock signal on SCLK is low level, the signal on DIN can be changed. The input of data is always high in the front and low in the back. The start condition of data input is that din changes from high to low when SCLK is high, and the end condition is that din changes from low to high when SCLK is high.

The instruction data transmission process is shown in the figure below：

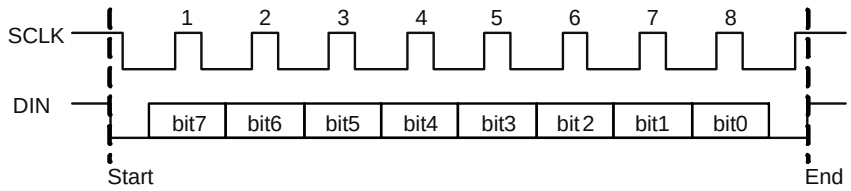



Figure 2. Instruction data transmission format

Write SRAM data address continuous write mode (First address must be 0X00)：

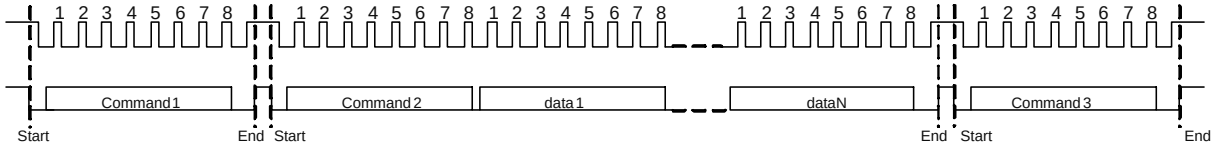



Figure 3. Automatic address continuous write data format

Command1： Set data

Command2：Set address

Data1~N：Transmit display data

Command3：Control display

Write SRAM data to fixed address mode：

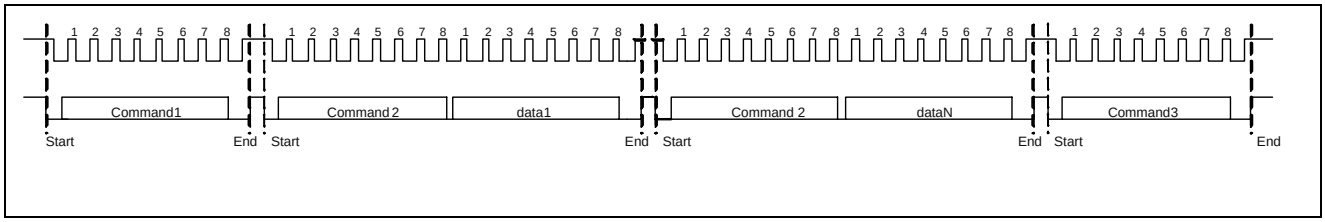



Figure 4. Write SRAM data to fixed address format

Command1：Set data

Command2：Set address

Data1~N：Transmit display data

Command3：Control display

***Note***：Before using fixed address write mode, SRAM needs to be initialized with continuous write mode.

### 2. Data Instruction

The command is used to set the display mode and the status of the LED driver. After the instruction start is valid, the first byte entered by DIN is regarded as an instruction. After decoding, the highest B7 and B6 bits are selected to distinguish different instructions.

| B7 | B6 | Instruction |
|---|---|---|
| 0 | 0 | Initialization Setting |
| 0 | 1 | Data Instruction |
| 1 | 0 | Display Control Instruction setting |
| 1 | 1 | Address Instruction setting |

Table 1. Instruction setting classification

If end is valid during instruction or data transmission, serial communication is initialized and the instruction or data being transmitted is invalid (the instruction or data previously transmitted remains valid).

### 2.1 Data Command Set

Before writing display data, send data instruction. The data instruction sets the number of scan lines, which determines the range of SRAM address, the number of write data, and the final display cycle.

Address mode：Automatic address mode means that the address is automatically accumulated from 00h when writing data. The maximum address value depends on the number of scanning lines. The fixed address mode is to use the address in the address setting command to write data.

| B7 | B6 | B5 | B4 | B3 | B2 | B1 | B0 | Description |
|---|---|---|---|---|---|---|---|---|
| 0 | 1 | 0 | 0 | 0 | | 0 | | 1scan line |
| | | 0 | 0 | 1 | | | | 2 scan line |
| | | 0 | 1 | 0 | | | | 3 scan line |
| | | 0 | 1 | 1 | | | | 4 scan line |
| | | 1 | 0 | 0 | | | | 5 scan line |
| | | 1 | 0 | 1 | | | | 6 scan line |
| | | 1 | 1 | 0 | | | | 7 scan line |
| | | 1 | 1 | 1 | | | | 8 scan line |
| | | | | | 0 | | | Automatic address mode |
| | | | | | 1 | | | Fixed address mode |
| | | | | | | | 0 | Force update mode |
| | | | | | | | 1 | Automatic update mode |

Table 2. Data Instruction setting

***Note***: Data automatic update mode is recommended

### 2.2 Address Instruction Setting

| B7 | B6 | B5 | B4 | B3 | B2 | B1 | B0 | Display Address |
|---|---|---|---|---|---|---|---|---|
| 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 00H |
| 1 | 1 | 0 | 0 | 0 | 0 | 0 | 1 | 01H |
| 1 | 1 | ~ | ~ | ~ | ~ | ~ | ~ | ~ |
| 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 3EH |
| 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 3FH |

Table 3. Display Address Instruction Setting

***Note***: When power on, the address is set to 00H by default.

The corresponding relationship among display data, chip pins and display addresses is shown in the table below：

| SEG8 Bit7~Bit0 | SEG7 Bit7~Bit0 | SEG6 Bit7~Bit0 | SEG5 Bit7~Bit0 | SEG4 Bit7~Bit0 | SEG3 Bit7~Bit0 | SEG2 Bit7~Bit0 | SEG1 Bit7~Bit0 | |
|---|---|---|---|---|---|---|---|---|
| 07H | 06H | 05H | 04H | 03H | 02H | 01H | 00H | **GRID1** |
| 0FH | 0EH | 0DH | 0CH | 0BH | 0AH | 09H | 08H | **GRID2** |
| 17H | 16H | 15H | 14H | 13H | 12H | 11H | 10H | **GRID3** |
| 1FH | 1EH | 1DH | 1CH | 1BH | 1AH | 19H | 18H | **GRID4** |
| 27H | 26H | 25H | 24H | 23H | 22H | 21H | 20H | **GRID5** |
| 2FH | 2EH | 2DH | 2CH | 2BH | 2AH | 29H | 28H | **GRID6** |
| 37H | 36H | 35H | 34H | 33H | 32H | 31H | 30H | **GRID7** |
| 3FH | 3EH | 3DH | 3CH | 3BH | 3AH | 39H | 38H | **GRID8** |

Table 4. Display the corresponding relationship among data, address and chip pin

### 2.3 Display Control Instruction

| B7 | B6 | B5 | B4 | B3 | B2 | B1 | B0 | Description |
|---|---|---|---|---|---|---|---|---|
| 1 | 0 | 0 | 0 | 0 | 0 | | | Display Off |
| | | | | 1 | | | | Display on |
| | | | | | | 0 | 0 | Line feed time: 4 PWM clock cycles |
| | | | | | | 0 | 1 | Line feed time: 8 PWM clock cycles |
| | | | | | | 1 | 0 | Line feed time: 12 PWM clock cycles |
| | | | | | | 1 | 1 | Line feed time: 16 PWM clock cycles |

Table 5. Display Control Instruction

***Note***: Display cycle: Number of scanning lines × (line feed time + 256 steps PWM cycle)

### 2.4 Initialization Setting

After the system is powered on, the initialization setting command is sent first. The initialization setting command can be used to adjust the SEG current (high level output current).

| B7 | B6 | B5 | B4 | B3 | B2 | B1 | B0 | SEG current gain factor(G) |
|---|---|---|---|---|---|---|---|---|
| 0 | 0 | 0 | 1 | 0 | 0 | 1 | 0 | 0 |
| 0 | 0 | | 1 | 1 | 1 | 1 | 1 | 1 |
| 0 | 0 | | ~ | ~ | ~ | ~ | ~ | ~ |
| 0 | 0 | | | | | | | 30 |
| 0 | 0 | | | | | | | 31 |

Table 6. Initialization setting instruction

***Note***: After the system is powered on, the initialization setting command is sent first.

$I_{SEG} = 0.77*(9+G)$

### 3. Display Cycle

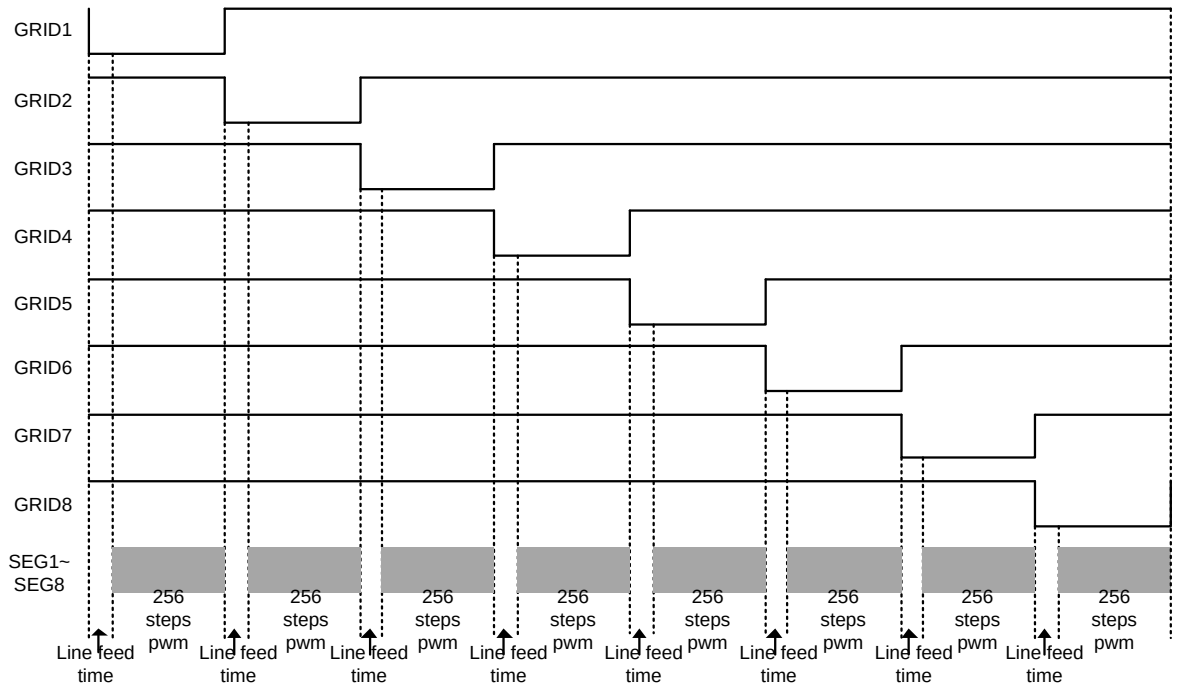
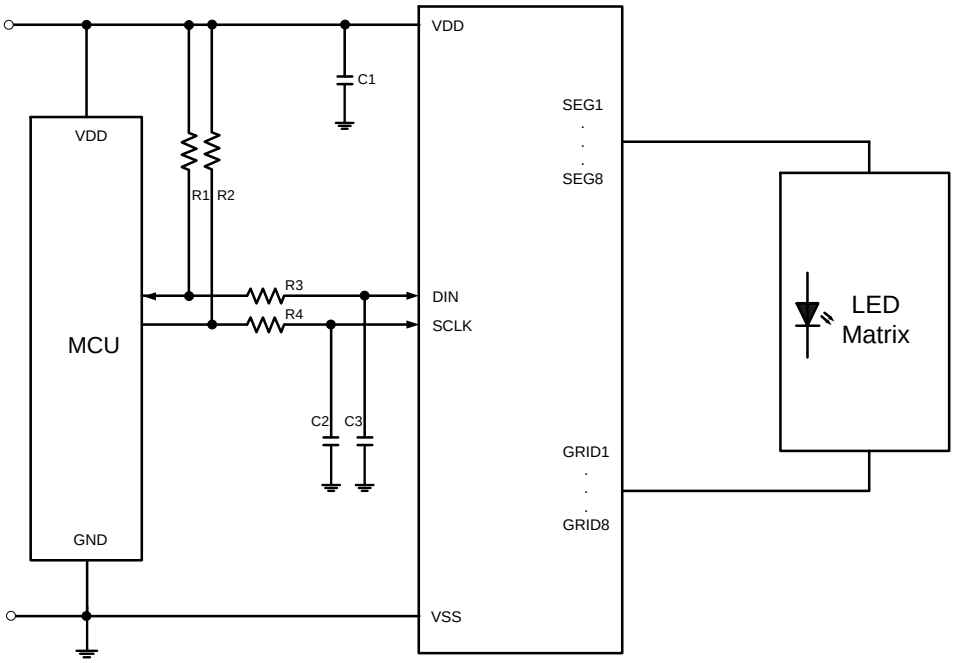



Figure 5. Display Cycle: Scan Line×(Line feed time+256 steps PWM time)

## Application circuit




8×8 LED array display application circuit

***Notes***：

***1***. This application circuit is only for reference.

***2***. C1=1uF and should be placed as close as possible to the VCC.

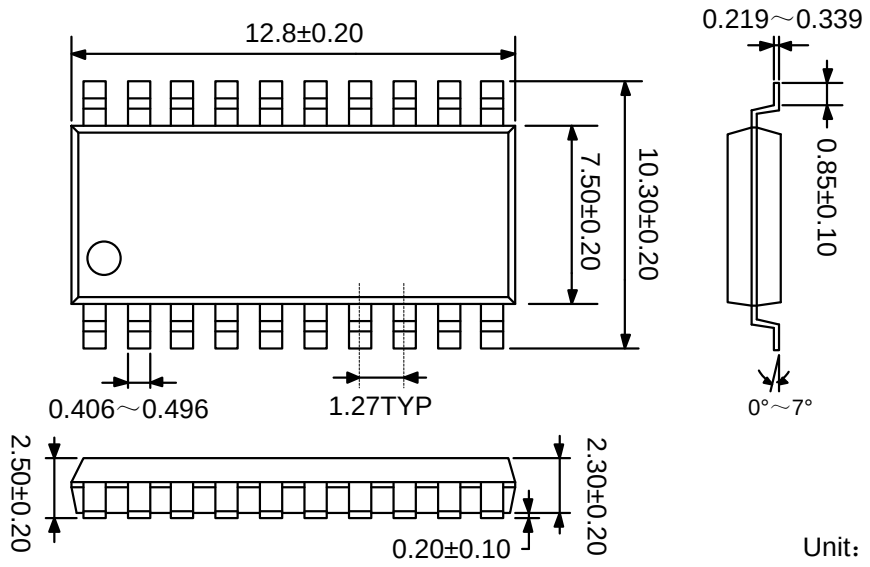
***3***. R1～R2= 4.7kΩ; R3～R4 = 100Ω; C2～C3 = 100pF;

***4***. The series resistance of the communication port and the capacitor for GND should be placed as close as possible to IC, and the resistance value and capacitance value should be adjusted according to the actual anti-interference requirements and verification results

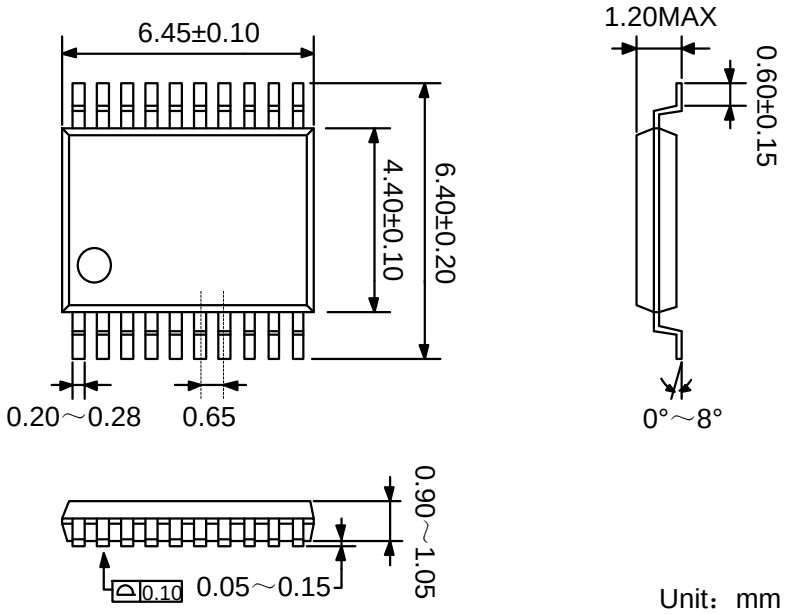
***5.*** DIN and SCLK signals must adopt push-pull output structure.

## Package

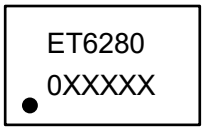
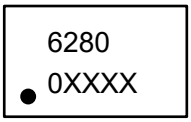
SOP20




TSSOP20



## Marking Information

| ET6280 | ET6280V |
|---|---|
|  |  |
| ET6280 : Part Number<br>0XXXXX : Lot Number | 6280 : Part Number<br>0XXXX : Lot Number |

## Revision History and Checking Table

| Version | Date | Revision Item | Modifier | Function & Spec Checking | Package & Tape Checking |
|---|---|---|---|---|---|
| 1.0 | 2019-12-03 | Initial Version | Liuxm | Liuxm | Zhujl |
| 1.1 | 2021-04-26 | Add Marking Information | Liuxm | Liuxm | Zhujl |
| 1.2 | 2021-11-10 | Update Package size | Liuxm | Liuxm | Zhujl |
| 1.3 | 2022-11-21 | Update Typeset | Shibo | Shibo | Shibo |
| 1.4 | 2023-4-21 | Add TSSOP package | Shibo | Shibo | Shibo |