

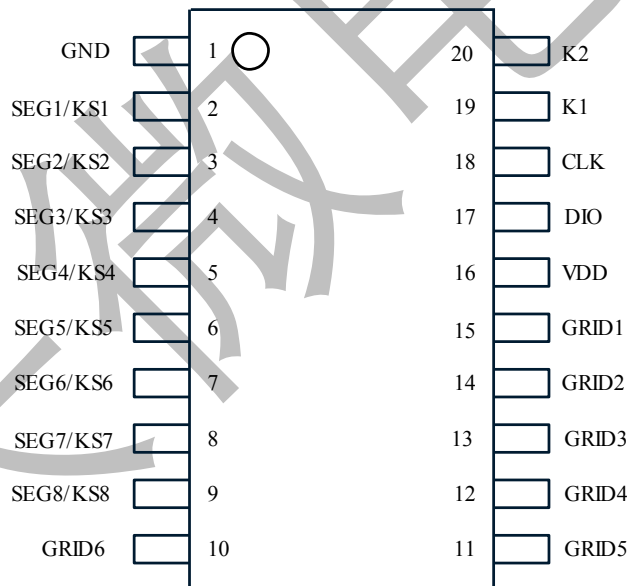
Features description

TM1637 is a kind of LED (light-emitting diode display) drive control special circuit with keyboard scan interface and it's internally integrated with MCU digital interface, data latch, LED high pressure drive and keyboard scan. This product is in DIP20/SOP20 package type with excellent performance and high quality, which is mainly applicable to the display drive of induction cooker, micro-wave oven and small household electrical appliance.

Function features

- Applied power CMOS technique
- The display mode (8 segments*6 bit) supports output by common anode LED.
- Keyboard scan (8×2bit), with enhanced identification circuit with anti-interference keys
- Luminance adjustment circuit (adjustable 8 duty ratio)
- Two-wire serial interface (CLK, DIO)
- Oscillating type: Built-in RC oscillator
- Built-in power-on reset circuit
- Built-in automatic blanking circuit
- Package type: DIP20/SOP20

Pin information



Pin functions

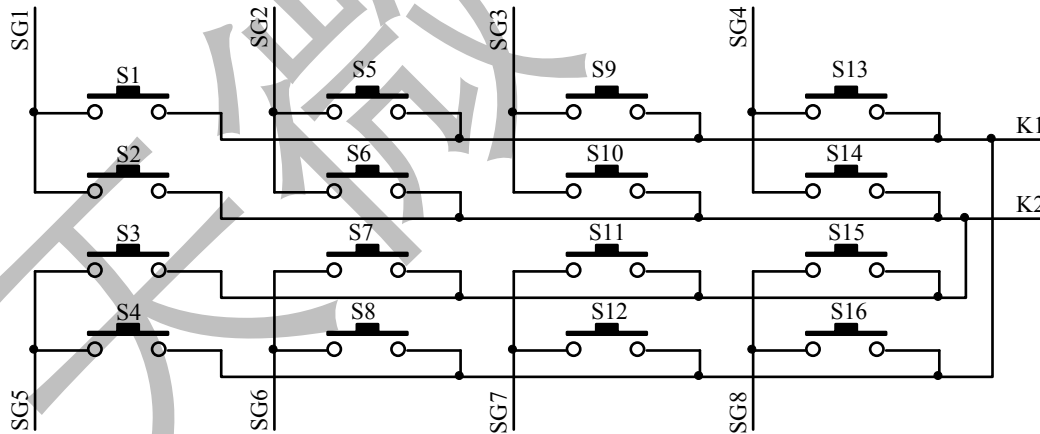
| Symbols | Pin name | Pin No. | Description |
|-------------|-----------------------------|---------|--|
| DIO | Data input/output | 17 | It is used for serial data input and output. The input data has a low level fluctuation while high level transfer at SCLK. Once one bit is transferred, one ACK is generated at falling edge of the 8 th clock inside the chip. |
| CLK | Clock input | 18 | It is used for data input and output at rising edge. |
| K1~K2 | Data input by keyboard scan | 19-20 | Inputting the pin data here and it will be latched when the display cycle is over. |
| SG1~SG8 | Output (segment) | 2-9 | Segment Output (also keyboard scan) and N-channel open drain output |
| GRID6~GRID1 | Output (bit) | 10-15 | Bit output and P-channel open drain output |
| VDD | Logic Supply | 16 | Anode power connection |
| GND | logic ground | 1 | Grounding connection |



Electrostatic discharge led by much static at dry weather or environment could damage the integrated circuit. TITAN MICRO ELECTRONICS suggests you to take every measure to protect integrated circuit. ESD damage or decreased performance by inappropriate operation or welding could lead to chip failure.

Read the key scan data

Key scan matrix of 8×2bit is shown as the following:



When a key is pressed, the key scan data is as follows: (Where low level is forward and high level is backward, 1110_1111 stands for 0xF7).

| | SG1 | SG2 | SG3 | SG4 | SG5 | SG6 | SG7 | SG8 |
|----|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|
| K1 | 1110_1111 | 0110_1111 | 1010_1111 | 0010_1111 | 1100_1111 | 0100_1111 | 1000_1111 | 0000_1111 |
| K2 | 1111_0111 | 0111_0111 | 1011_0111 | 0011_0111 | 1101_0111 | 0101_0111 | 1001_0111 | 0001_0111 |

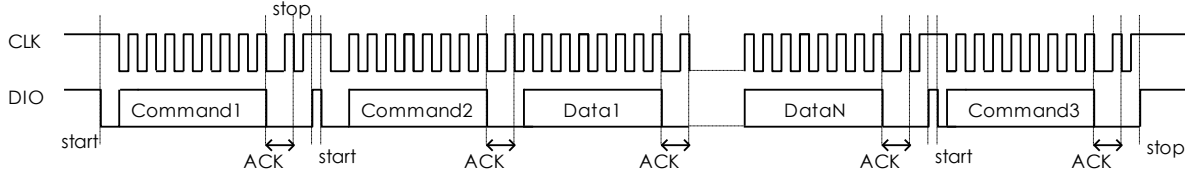
Note: Where there is no key pressed down, the key read data should be 1111_1111 with forward low level and backward high level. Since strong interference exists in the use of kitchen appliances, such as induction cooker, negative edge trigger mode was applied in TM1637 to avoid mistake trigger, which is also the called “key jumping”. TM 1637 doesn’t support combined key pressing.

Display register address

Stored data in the register is transferred to the TM1637 from outside elements by serial interface, with 6 bytes units of address from C0H to C5H in correspondence with the LED lights connected with SEG pin and GRID pin on the chip. LED data is displayed from low level to high level in respect of display address, and should be operated from low level to high level in respect of data bytes.

| SEG8 | SEG7 | SEG6 | SEG5 | SEG4 | SEG3 | SEG2 | SEG1 | |
|----------------------|------|------|------|----------------------|------|------|------|-------|
| xxHU(high four bits) | | | | xxHL (low four bits) | | | | |
| B7 | B6 | B5 | B4 | B3 | B2 | B1 | B0 | |
| C0HU | | | | C0HL | | | | GRID1 |
| C1HU | | | | C1HL | | | | GRID2 |
| C2HU | | | | C2HL | | | | GRID3 |
| C3HU | | | | C3HL | | | | GRID4 |
| C4HU | | | | C4HL | | | | GRID5 |
| C5HU | | | | C5HL | | | | GRID6 |

2、Write SRAM data in address auto increment 1 mode.



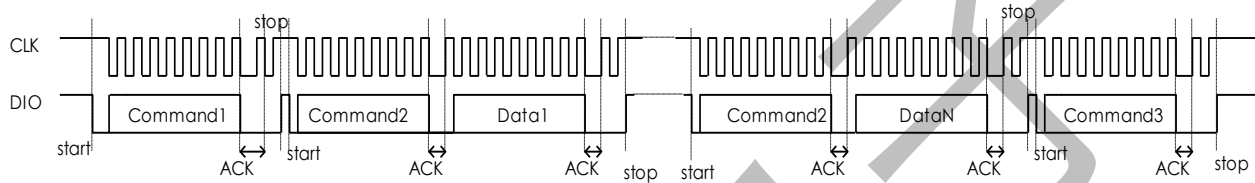
Command1: Set data

Command2: Set address

Data1~N: Transfer display data

Command3: Control display

3、Write SRAM data in a fixed address mode



Command1: Set data

Command2: Set data

Data1~N: Transfer display data

Command3: Control display

Data command

Command is used to set the display mode and the LED driver status.

The first byte input from DIO at CLK falling edge acts as a command. The highest B7 and B6 bytes after decoding are used to distinguish different commands.

| B7 | B6 | Command |
|----|----|-------------------------------------|
| 0 | 1 | Data command setting |
| 1 | 0 | Display and control command setting |
| 1 | 1 | Address command setting |

When STOP command is sent during command or data transfer, serial communication is initialized and command or data transferring becomes invalid (Command or data transferred before remain effective.).

1、Data command setting

This command is to set data write and data read. 01 and 11 are not permitted to set for B1 and B0 bits.

| MSB | | | | LSB | | | | Function | Description |
|-----|----|---|----|-----|----|----|----|----------------------------------|--------------------------------|
| B7 | B6 | B5 | B4 | B3 | B2 | B1 | B0 | | |
| 0 | 1 | Zero should be inserted for irrelevant items. | | | | 0 | 0 | Data write and read mode setting | Write data to display register |
| 0 | 1 | | | | | 1 | 0 | | Read key scan data |
| 0 | 1 | | | | 0 | | | Address adding mode setting | Automatic address adding |
| 0 | 1 | | | | 1 | | | | Fix address |
| 0 | 1 | | | 0 | | | | Test mode setting (for internal) | Normal mode |
| 0 | 1 | | | 1 | | | | | Test mode |

2、 Address command setting

| MSB | | | | LSB | | | | Display address |
|-----|----|---|----|-----|----|----|----|-----------------|
| B7 | B6 | B5 | B4 | B3 | B2 | B1 | B0 | |
| 1 | 1 | Zero should be inserted for irrelevant items. | | 0 | 0 | 0 | 0 | C0H |
| 1 | 1 | | | 0 | 0 | 0 | 1 | C1H |
| 1 | 1 | | | 0 | 0 | 1 | 0 | C2H |
| 1 | 1 | | | 0 | 0 | 1 | 1 | C3H |
| 1 | 1 | | | 0 | 1 | 0 | 0 | C4H |
| 1 | 1 | | | 0 | 1 | 0 | 1 | C5H |

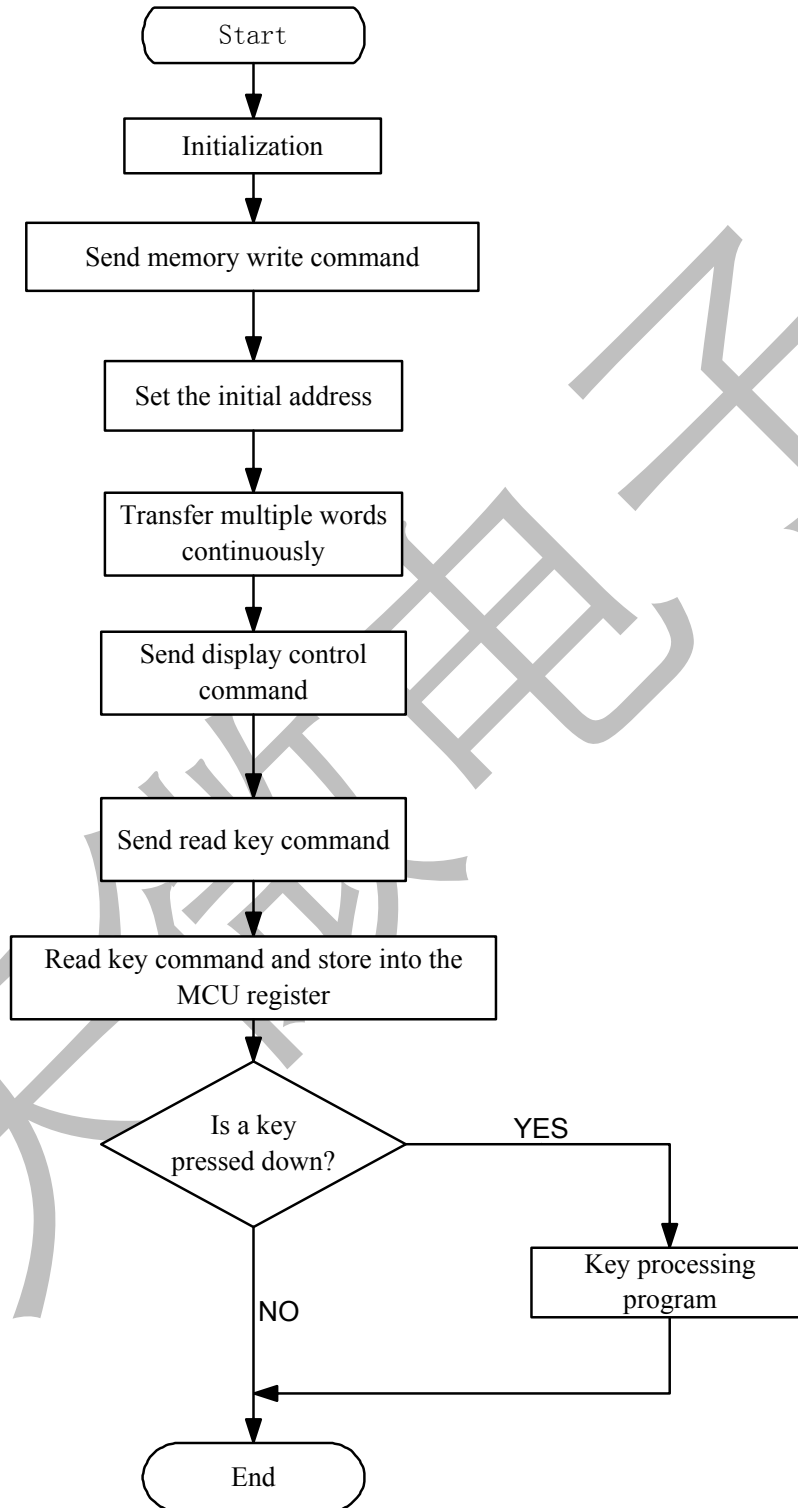
The command is used to set the display register address. If the address is set as C6H or a higher one, the data will be ignored until effective address is set. Once electrified, the default address is C0H.

3、 Display control

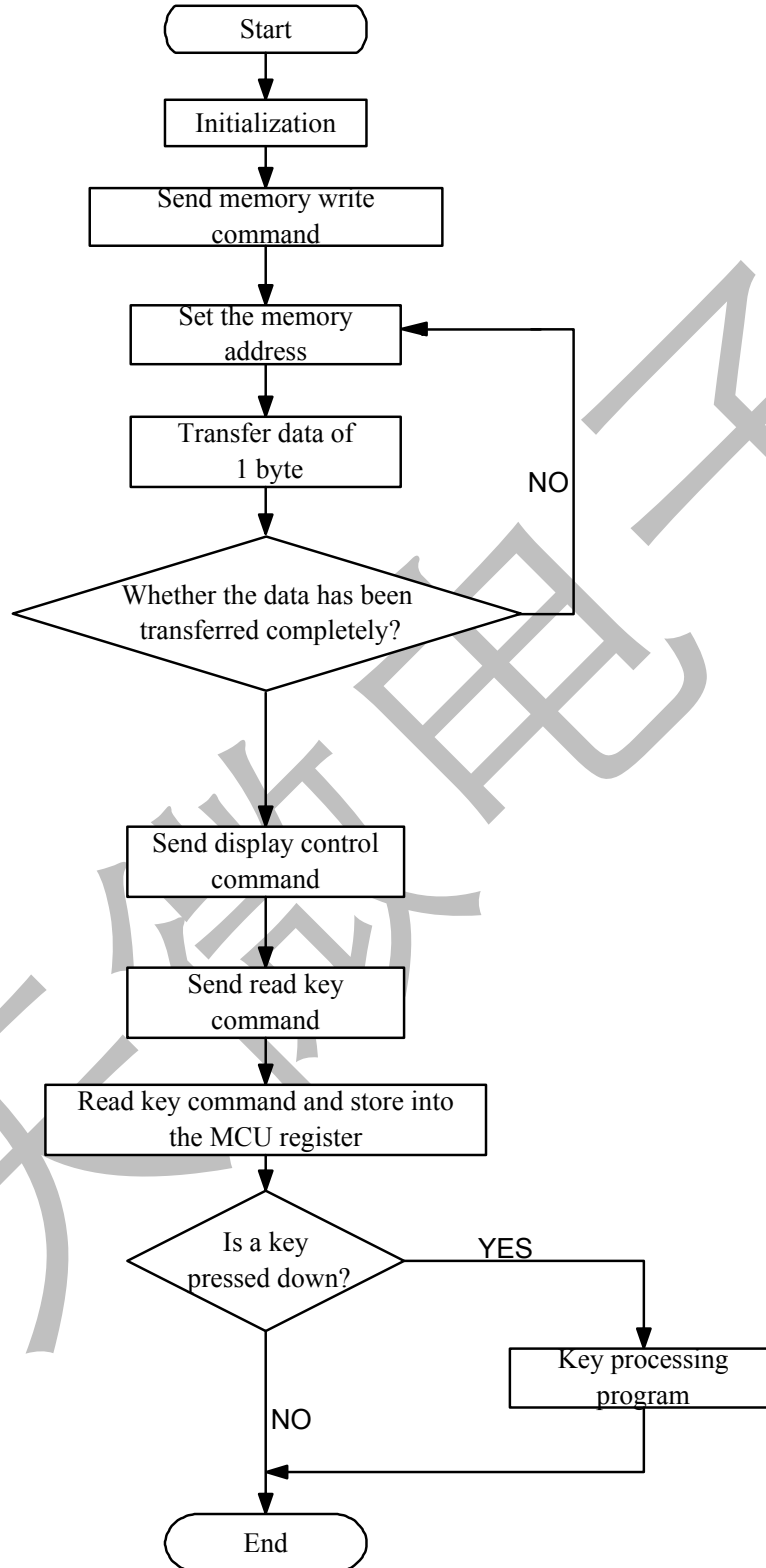
| MSB | | | | LSB | | | | Function | Description |
|-----|----|---|----|-----|----|----|----|------------------------------|--------------------------------------|
| B7 | B6 | B5 | B4 | B3 | B2 | B1 | B0 | | |
| 1 | 0 | Zero should be inserted for irrelevant items. | | | 0 | 0 | 0 | Setting of extinction number | 1/16 Pulse width is set as 1/16. |
| 1 | 0 | | | | 0 | 0 | 1 | | 2/16 Pulse width is set as 2/16 |
| 1 | 0 | | | | 0 | 1 | 0 | | 4/16 Pulse width is set as 4/16 |
| 1 | 0 | | | | 0 | 1 | 1 | | 10/16 Pulse width is set as 10/16 |
| 1 | 0 | | | | 1 | 0 | 0 | | 11/16 Pulse width is set as 11/16 |
| 1 | 0 | | | | 1 | 0 | 1 | | 12/16 Pulse width is set as 12/16 |
| 1 | 0 | | | | 1 | 1 | 0 | | 13/16 Pulse width is set as 13/16 |
| 1 | 0 | | | | 1 | 1 | 1 | | 14/16 Pulse width is set as 14/16 |
| 1 | 0 | | | 0 | | | | Display switch setting | Display OFF |
| 1 | 0 | | | 1 | | | | | Display ON |

Program flow chart

1、Flow chart of program using address auto increment 1 mode



2、Flow chart of program design using fixed address



Electrical parameter
1、 Limit parameter (Ta = 25℃, Vss = 0 V)

| Parameters | Symbol | Range | Unit |
|-----------------------------------|--------|------------------|------|
| Logic power supply voltage | VDD | -0.5 ~ +7.0 | V |
| Logic input voltage | VI1 | -0.5 ~ VDD + 0.5 | V |
| LED and SEG drive sink current | IO1 | 50 | mA |
| LED and GRID drive source current | IO2 | 200 | mA |
| Power loss | PD | 400 | mW |
| Work temperature | Topt | -40 ~ +85 | ℃ |
| Storage temperature | Tstg | -65 ~ +150 | ℃ |

2、 Normal working range (Ta = -40~+85℃, Vss = 0 V)

| Parameters | Symbol | Minimum | Typical | Maximum | Unit | Test condition |
|----------------------------|--------|---------|---------|---------|------|----------------|
| Logic power supply voltage | VDD | | 5 | | V | - |
| High-level input voltage | VIH | 0.7 VDD | - | VDD | V | - |
| Low-level input voltage | VIL | 0 | - | 0.3 VDD | V | - |

3、 Electrical character (Ta = -40 - +85℃, VDD = 4.5 - 5.5 V, Vss = 0 V)

| Parameters | Symbol | Minimum | Typical | Maximum | Unit | Test condition |
|-------------------------------------|--------|---------|---------|---------|------|-------------------------------|
| GRID drive source current | Ioh1 | 80 | 120 | 180 | mA | GRID1~GRID6, Vo = vdd-2V |
| | Ioh2 | 80 | 140 | 200 | mA | GRID1~GRID6, Vo = vdd-3V |
| SEG drive sink current | IOL1 | 20 | 30 | 50 | mA | SEG1~SEG8 Vo=0.3V |
| DOUT pin output low current | Idout | 4 | - | - | mA | Vo = 0.4V, dout |
| High-level output current tolerance | Itolsg | - | - | 5 | % | Vo = VDD - 3V, GRID1~GRID6 |
| Output pull down resistor | RL | | 10 | | KΩ | K1~K2 |

| | | | | | | |
|--------------------------|--------|---------|------|---------|----|-------------------------|
| Input current | II | - | - | ±1 | μA | VI = VDD / VSS |
| High-level input voltage | VIH | 0.7 VDD | - | | V | CLK, DIN |
| Low-level input voltage | VIL | - | - | 0.3 VDD | V | CLK, DIN |
| Lagging voltage | VH | - | 0.35 | - | V | CLK, DIN |
| dynamic current loss | IDDdyn | - | - | 5 | mA | Non-loaded, display OFF |

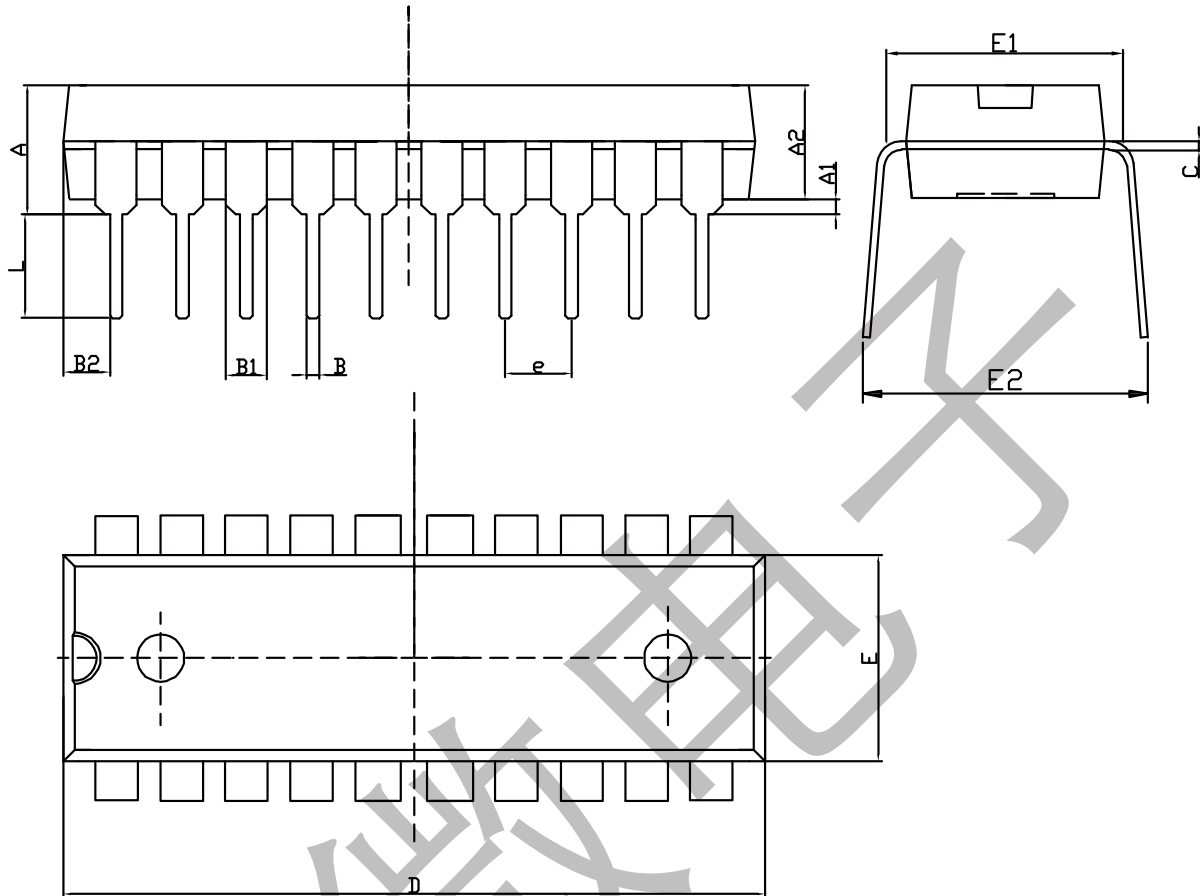
4、Switching character (Ta = -40 - +85℃, VDD = 4.5 - 5.5 V, Vss = 0 V)

| Parameters | Symbol | Minimum | Typical | Maximum | Unit | Test condition | |
|-------------------------|--------|---------|---------|---------|------|--------------------------|---------------|
| oscillation frequency | fosc | - | 450 | - | KHz | | |
| Transmission delay time | tPLZ | - | - | 300 | ns | CLK → DIO | |
| | tPZL | - | - | 100 | ns | CL = 15pF, RL = 10K Ω | |
| Rise time | TTZH 1 | - | - | 2 | μs | CL = 300p F | GRID1 ~ GRID6 |
| | TTZH 2 | - | - | 0.5 | μs | | SEG1 ~ SEG8 |
| Fall time | TTHZ | - | - | 120 | μs | CL = 300pF, Segn, Gridn | |
| Maximum clock frequency | Fmax | - | - | 500 | KHz | 占空比50% 50% duty ratio | |
| Input capacitance | CI | - | - | 15 | pF | - | |

5、Timing character (Ta = -40 - +85℃, VDD = 4.5 - 5.5 V, Vss = 0 V)

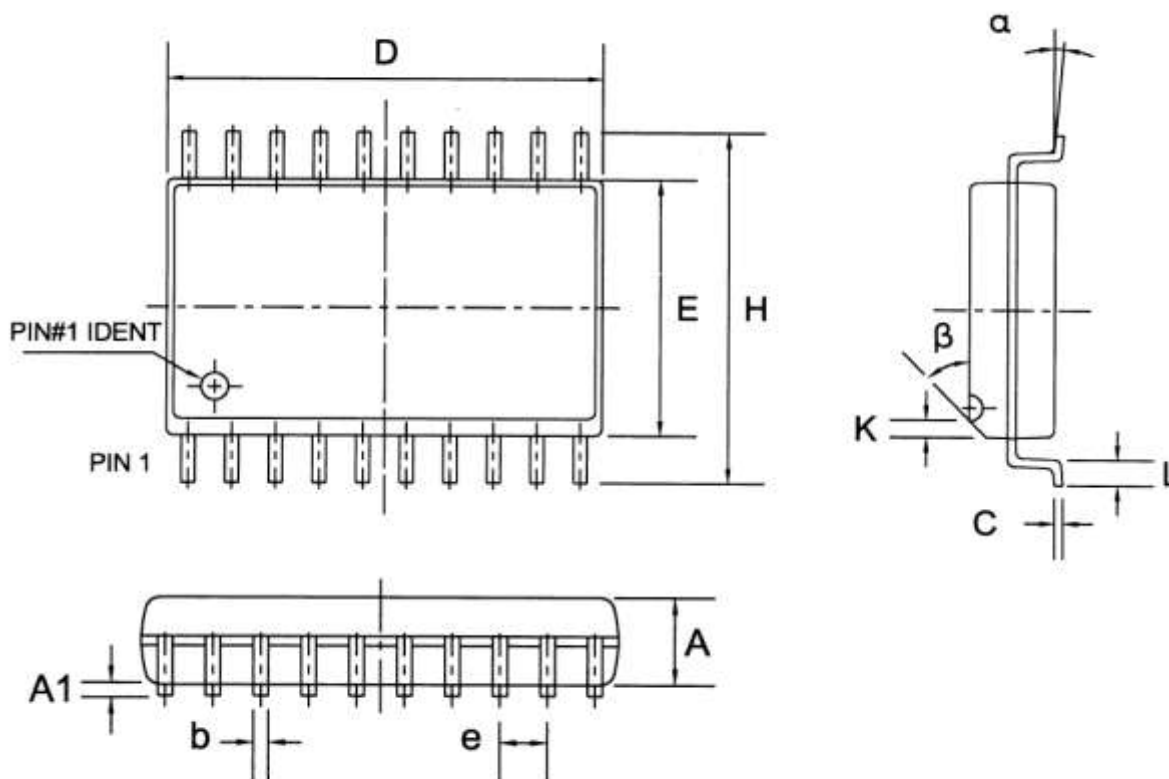
| Parameters | Symbol | Minimum | Typical | Maximum | Unit | Test condition |
|-------------------|--------|---------|---------|---------|------|----------------|
| Clock pulse width | PWCLK | 400 | - | - | ns | - |
| Data setup time | tSETUP | 100 | - | - | ns | - |
| Data hold time | tHOLD | 100 | - | - | ns | - |
| Waiting time | tWAIT | 1 | - | - | μs | CLK↑→CLK↓ |

**IC Package diagram
DIP20**



| Symbol | Unit: mm | | |
|--------|------------|---------------|---------------|
| | Minimum | Typical value | Maximum value |
| A | 3.71 | 4.00 | 4.31 |
| A1 | 0.50 | 0.60 | 0.80 |
| A2 | 3.20 | 3.40 | 3.60 |
| B | 0.33 | 0.45 | 0.53 |
| B1 | 1.525(TYP) | | |
| C | 0.20 | 0.28 | 0.36 |
| D | 25.70 | 26.00 | 26.54 |
| E | 6.20 | 6.40 | 6.75 |
| E1 | 7.32 | 7.78 | 8.25 |
| e | 2.54(TYP) | | |
| L | 3.00 | 3.30 | 3.60 |
| E2 | 8.20 | 8.70 | 9.10 |
| B2 | 0.87 | 1.02 | 1.17 |

SOP20



| Symbol | Dimensions In Millimeters | | | Dimensions In Inches | | |
|----------|---------------------------|-------|-------|----------------------|-------|-------|
| | Min | Nom | Max | Min | Nom | Max |
| A | 2.15 | 2.35 | 2.55 | 0.085 | 0.093 | 0.100 |
| A1 | 0.05 | 0.15 | 0.25 | 0.002 | 0.006 | 0.010 |
| b | — | 0.40 | — | — | 0.016 | — |
| C | — | 0.25 | — | — | 0.010 | — |
| D | 12.40 | 12.70 | 13.00 | 0.488 | 0.500 | 0.512 |
| E | 7.40 | 7.65 | 7.90 | 0.291 | 0.301 | 0.311 |
| e | — | 1.27 | — | — | 0.050 | — |
| H | 10.15 | 10.45 | 10.75 | 0.400 | 0.411 | 0.423 |
| K | — | 0.50 | — | — | 0.020 | — |
| L | 0.60 | 0.80 | 1.00 | 0.024 | 0.031 | 0.039 |
| α | 0° | — | 8° | 0° | — | 8° |
| β | — | 45° | — | — | 45° | — |

All specs and applications shown above subject to change without prior notice.