

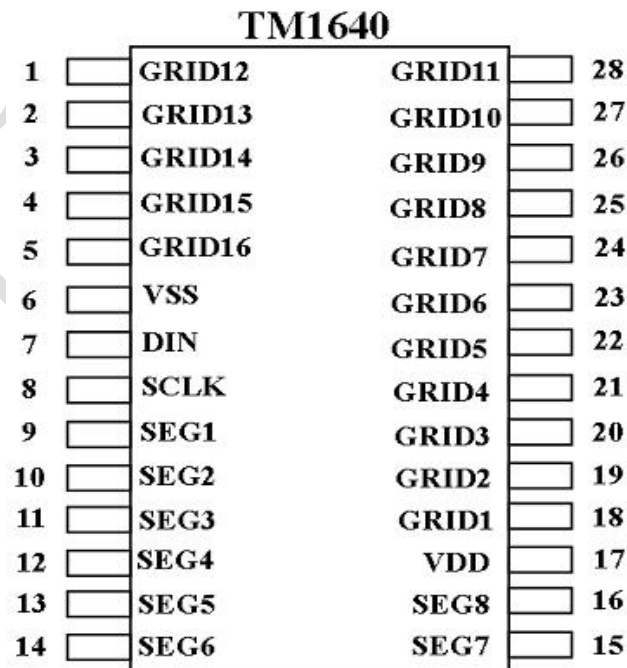
I. Overview

TM1640 is a LED (Light Emitting Diode Display) drive control circuit integrating MCU digital interface, digital latch, LED high voltage drive circuit, etc. The product has excellent performance and reliable quality, and is mainly applied in display drive for electronic scales and other small home appliances. In addition, it adopts the SOP28 packaging mode.

II. Features

- Power CMOS technique
- Display mode (8 sections × 16 bits) supports common cathode digital tube output
- Brightness adjusting circuit (duty cycle adjustable among 8 levels)
- Dual-line serial interface (CLK, DIN)
- Mode of oscillation: built-in RC oscillation (**450KHz+5%**)
- Built-in power-on reset circuit
- Built-in auto blanking circuit
- Mode of packaging: SOP28

III. Definitions of the pins



IV. Functions of the pins

| Sign | Name | No. | Description |
|-------------------------------|--------------------|--------------|--|
| DIN | Data input | 7 | Serial data input; input data changed at low level and transferred at high level of SCLK |
| SCLK | Clock input | 8 | Input data at rising edge |
| SG1-SG8 | Output (section) | 9-16 | Section output, P tube open drain output |
| GRID1-GRID11 GRID12-GRID16 | Output (bit) | 18-28 1-5 | Bit output, N tube open drain output |
| VDD | Logic power supply | 17 | 5V±10% |
| VSS | Logic grounding | 6 | Connect to system grounding |

V. Electrical parameters

Limit parameters (Ta = 25°C, Vss = 0 V)

| Parameters | Sign | Scope | Unit |
|-------------------------------|------|-------------------|------|
| Logic power voltage | VDD | -0.5 to +7.0 | V |
| Logic input voltage | VI1 | -0.5 to VDD + 0.5 | V |
| LED SEG drive output current | IO1 | -200 | mA |
| LED GRID drive output current | IO2 | +20 | mA |
| Power consumption | PD | 400 | mW |
| Work temperature | Topt | -40 to +85 | °C |
| Storage temperature | Tstg | -65 to +150 | °C |

Normal work condition (Ta = -40 to +85°C, Vss = 0 V)

| Parameters | Sign | Min. | Typical | Max. | Unit | Test condition |
|--------------------------|------|---------|---------|---------|------|----------------|
| Logic power voltage | VDD | | 5 | | V | - |
| High level input voltage | VIH | 0.7 VDD | - | VDD | V | - |
| Low level input voltage | VIL | 0 | - | 0.3 VDD | V | - |

Electrical characteristics (Ta = -40 to +85°C, VDD = 4.5 to 5.5 V, Vss = 0 V)

| Parameters | Sign | Min. | Typical | Max. | Unit | Test condition |
|-------------------------------------|--------|---------|---------|---------|------|--------------------------------|
| High level output current | Ioh1 | -20 | -25 | -40 | mA | GRID1~GRID16, Vo = vdd-2V |
| | Ioh2 | -20 | -30 | -50 | mA | GRID1~GRID16, Vo = vdd-3V |
| Low level output current | IOL1 | 80 | 140 | - | mA | SEG1~SEG8 Vo=0.3V |
| Low level output current | Idout | 4 | - | - | mA | VO = 0.4V, dout |
| High level output current allowance | Itolsg | - | - | 5 | % | VO = VDD - 3V, GRID1~GRID16 |
| Input value | 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 consumption | IDDdyn | - | - | 5 | mA | No load and display off |

Switching characteristics (Ta = -40 to +85°C, VDD = 4.5 to 5.5 V)

| Parameters | Sign | Min. | Typical | Max. | Unit | Test condition | |
|-------------------------|--------|------|---------|------|------|----------------------------------|-----------------|
| Oscillation frequency | fosc | - | 450 | - | KHz | | |
| Transmission time delay | tPLZ | - | - | 300 | ns | CLK → DIO | |
| Transmission time | tPZL | - | - | 100 | ns | CLK → DIO CL = 15pF, RL = 10K | |
| Rising time | TTZH 1 | - | - | 2 | μs | CL = | GRID1 to GRID16 |
| Rising time | TTZH 2 | - | - | 0.5 | μs | CL = | SEG1 to SEG8 |
| Dropping time | TTHZ | - | - | 120 | μs | CL = 300pF, Segn, Gridn | |
| Max. clock frequency | Fmax | 1 | - | - | MHz | Duty ratio 50% | |
| Input capacitance | CI | - | - | 15 | pF | - | |

Time sequence characteristics (Ta = -40 to +85°C, VDD = 4.5 to 5.5 V)

| Parameters | Sign | Min. | Typical | Max. | Unit | Test condition |
|--------------------|--------|------|---------|------|------|----------------|
| Clock pulse width | PWCLK | 400 | - | - | ns | - |
| Strobe pulse width | PWSTB | 1 | - | - | μs | - |
| Data setup time | tSETUP | 100 | - | - | ns | - |
| Data hold time | tHOLD | 100 | - | - | ns | - |
| Waiting time | tWAIT | 1 | - | - | μs | CLK↑→CLK↓ |

VI. Description the interfaces

Data in microprocessor communicate with TM1640 through the bus interface. During data input, if CLK is at high level, the signal on DIN shall remain unchanged; it can only be changed if the clock signal on CLK is at low level. Low level of data inputs are always transmitted before high level. The starting condition of data input is: when CLK is high, the

DIN becomes low from high; the ending condition is: when CLK is high, the DIN becomes high from low.

Transmission process of command data is shown in the following figure:

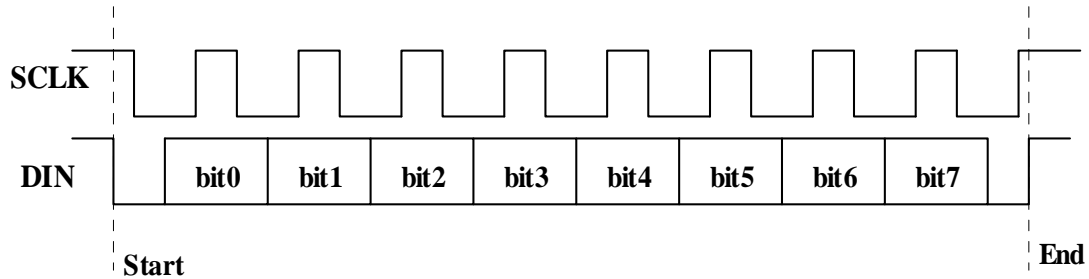


Figure 2: Command data transmission format

Writing SRAM data address auto + 1 mode:

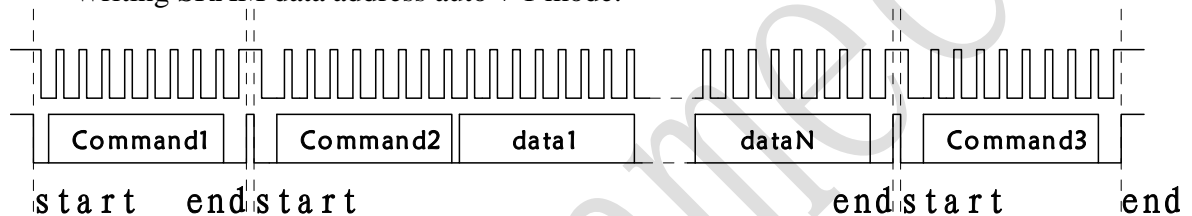


Figure 3: Format of auto address writing data

Command1: set data
Command2: set address
Data1-N: transmit display data
Command3: control display

Writing SRAM data fixed address mode:

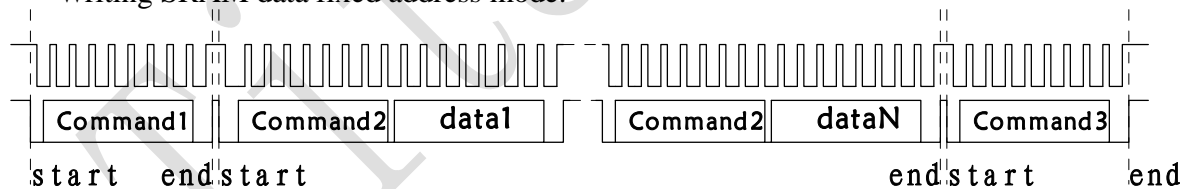


Figure 4: Format of fixed address writing data

Command1: set data
Command2: set address
Data1-N: transmit display data
Command3: control display

VII. Data command

Commands are used to set display mode and status of LED driver.

When START command becomes valid, the first byte input by DIN is taken as the first command. Through decoding, the highest B7 and B6 bits are adopted to distinguish different commands.

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

Table 7: Command setting classification

If END becomes valid during transmission of command or data, the serial communication will be initialized and the commands or data under transmission will become invalid (those completed transmission will remain valid).

Data command setting:

| B7 | B6 | B5 | B4 | B3 | B2 | B1 | B0 | Description |
|----|----|------------------------------------|----|----|----|------------------------------------|----|-----------------------------|
| 0 | 1 | Fill in 0 for items not applicable | | | 0 | Fill in 0 for items not applicable | | Address auto + 1 |
| 0 | 1 | | | | 1 | | | Fixed address |
| 0 | 1 | | | 0 | | | | Normal mode |
| 0 | 1 | | | 1 | | | | Testing mode (internal use) |

Address command setting:

| B7 | B6 | B5 | B4 | B3 | B2 | B1 | B0 | Display address |
|----|----|------------------------------------|----|----|----|----|----|-----------------|
| 1 | 1 | Fill in 0 for items not applicable | | 0 | 0 | 0 | 0 | 00H |
| 1 | 1 | | | 0 | 0 | 0 | 1 | 01H |
| 1 | 1 | | | 0 | 0 | 1 | 0 | 02H |
| 1 | 1 | | | 0 | 0 | 1 | 1 | 03H |
| 1 | 1 | | | 0 | 1 | 0 | 0 | 04H |
| 1 | 1 | | | 0 | 1 | 0 | 1 | 05H |
| 1 | 1 | | | 0 | 1 | 1 | 0 | 06H |
| 1 | 1 | | | 0 | 1 | 1 | 1 | 07H |
| 1 | 1 | | | 1 | 0 | 0 | 0 | 08H |
| 1 | 1 | | | 1 | 0 | 0 | 1 | 09H |
| 1 | 1 | | | 1 | 0 | 1 | 0 | 0AH |
| 1 | 1 | | | 1 | 0 | 1 | 1 | 0BH |
| 1 | 1 | | | 1 | 1 | 0 | 0 | 0CH |
| 1 | 1 | | | 1 | 1 | 0 | 1 | 0DH |
| 1 | 1 | | | 1 | 1 | 1 | 0 | 0EH |
| 1 | 1 | | | 1 | 1 | 1 | 1 | 0FH |

Table 8: Display address command setting

When power-on, the default address is set as 00H.

The relationships between display data, chip pins and display addresses are shown in the following table:

| SEG8 | SEG7 | SEG6 | SEG5 | SEG4 | SEG3 | SEG2 | SEG1 |
|----------------------------|------|------|------|------|------|------|--------|
| B7 | B6 | B5 | B4 | B3 | B2 | B1 | B0 |
| Display memory address 00H | | | | | | | GRID1 |
| Display memory address 01H | | | | | | | GRID2 |
| Display memory address 02H | | | | | | | GRID3 |
| Display memory address 03H | | | | | | | GRID4 |
| Display memory address 04H | | | | | | | GRID5 |
| Display memory address 05H | | | | | | | GRID6 |
| Display memory address 06H | | | | | | | GRID7 |
| Display memory address 07H | | | | | | | GRID8 |
| Display memory address 08H | | | | | | | GRID9 |
| Display memory address 09H | | | | | | | GRID10 |
| Display memory address 0AH | | | | | | | GRID11 |
| Display memory address 0BH | | | | | | | GRID12 |
| Display memory address 0CH | | | | | | | GRID13 |
| Display memory address 0DH | | | | | | | GRID14 |
| Display memory address 0EH | | | | | | | GRID15 |
| Display memory address 0FH | | | | | | | GRID16 |

Table 9: Relationship between display data, addresses and chip pins

Display control:

| MSB | | | | LSB | | | | Function | Description |
|-----|----|------------------------------------|----|-----|----|----|----|--|--------------------------|
| B7 | B6 | B5 | B4 | B3 | B2 | B1 | B0 | | |
| 1 | 0 | Fill in 0 for items not applicable | | 1 | 0 | 0 | 0 | Extinction Number setting (brightness setting) | Set pulse width to 1/16 |
| 1 | 0 | | | 1 | 0 | 0 | 1 | | Set pulse width to 2/16 |
| 1 | 0 | | | 1 | 0 | 1 | 0 | | Set pulse width to 4/16 |
| 1 | 0 | | | 1 | 0 | 1 | 1 | | Set pulse width to 10/16 |
| 1 | 0 | | | 1 | 1 | 0 | 0 | | Set pulse width to 11/16 |
| 1 | 0 | | | 1 | 1 | 0 | 1 | | Set pulse width to 12/16 |
| 1 | 0 | | | 1 | 1 | 1 | 0 | | Set pulse width to 13/16 |
| 1 | 0 | | | 1 | 1 | 1 | 1 | | Set pulse width to 14/16 |
| 1 | 0 | | | 0 | X | X | X | Display switch setting | Display off |
| 1 | 0 | | | 1 | X | X | X | | Display on |

Table 10: Display mode control command

VIII. *Display cycle*

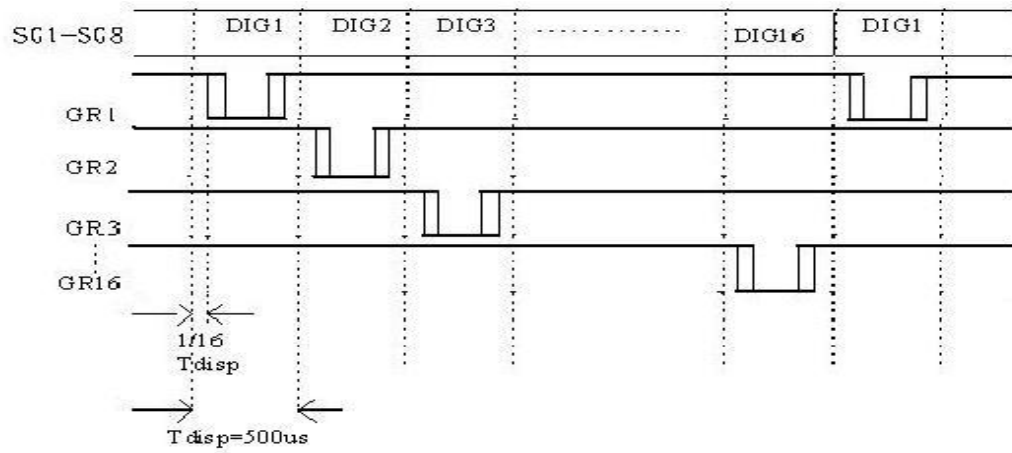
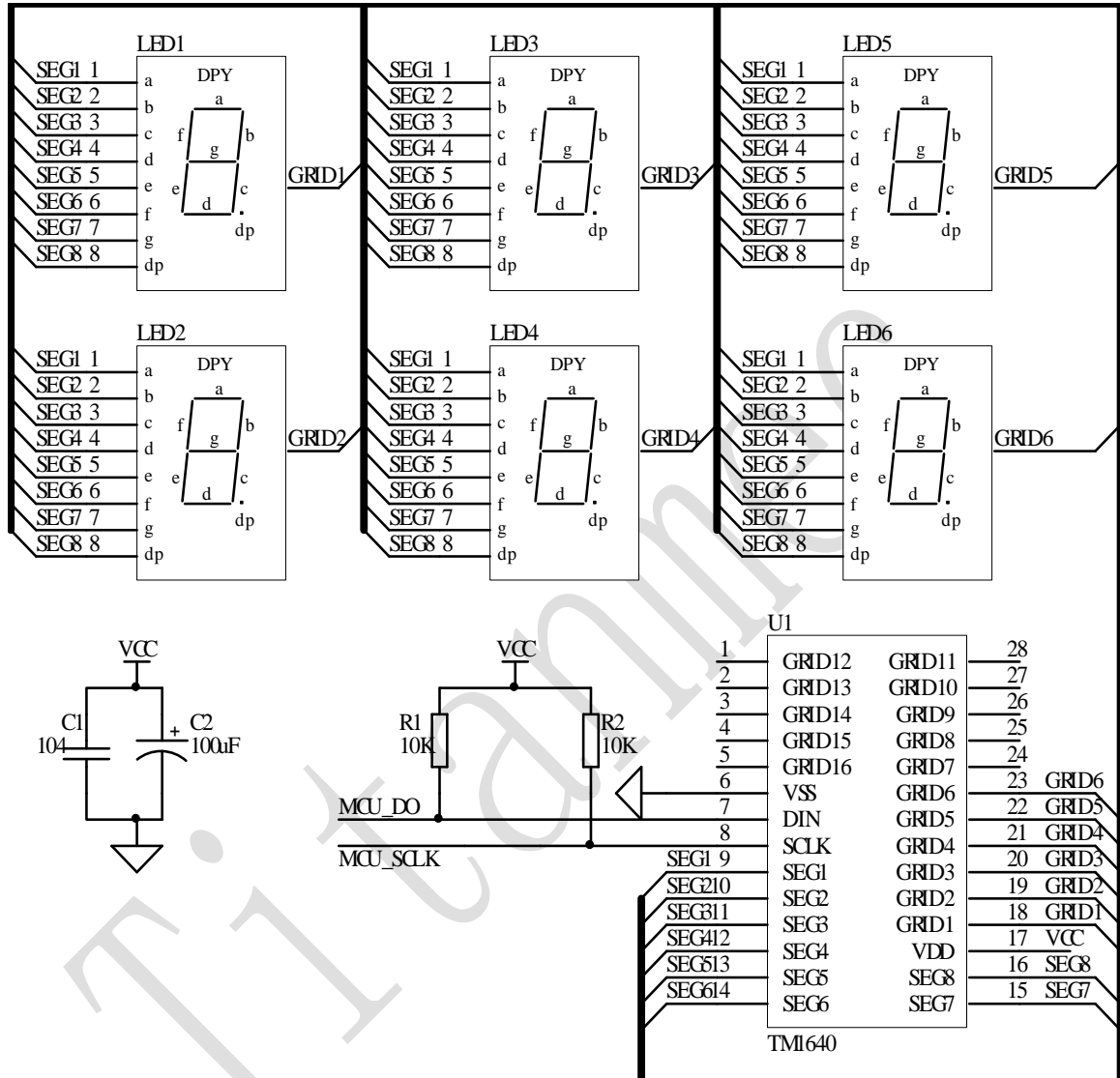


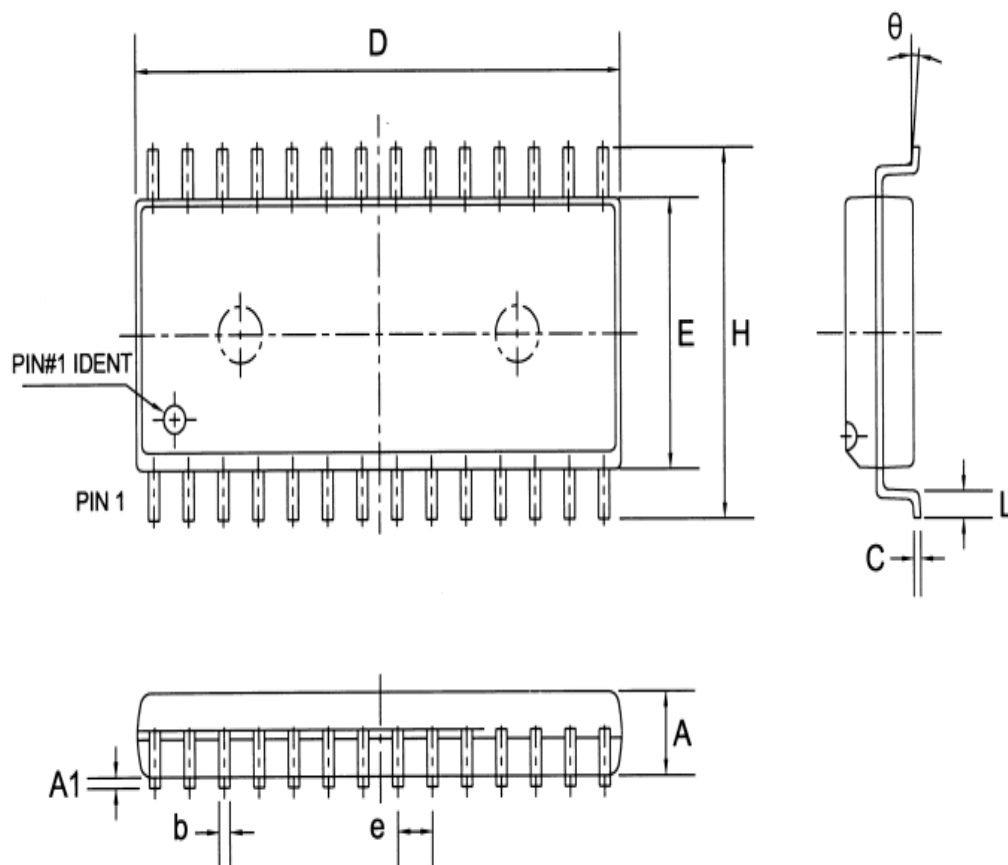
Figure 7: Data display cycle

IX. Hardware connection diagram

Digital tubes shown in the diagram are common cathode digital tubes:



X. IC Packing drawing: (SOP28)



| 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 | 17.40 | 17.70 | 18.00 | 0.685 | 0.697 | 0.709 |
| 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 |
| L | 0.60 | 0.80 | 1.00 | 0.024 | 0.031 | 0.039 |
| θ | 0° | — | 8° | 0° | — | 8° |

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