Dot Matrix LED Driver with Key Scanning

General Description

ET1638 is a high reliability matrix LED driver IC with 10 segments output (SEG), 8 commons output (GRID), display memory, control circuit, key scan circuit , using 3-line serial interface communication.

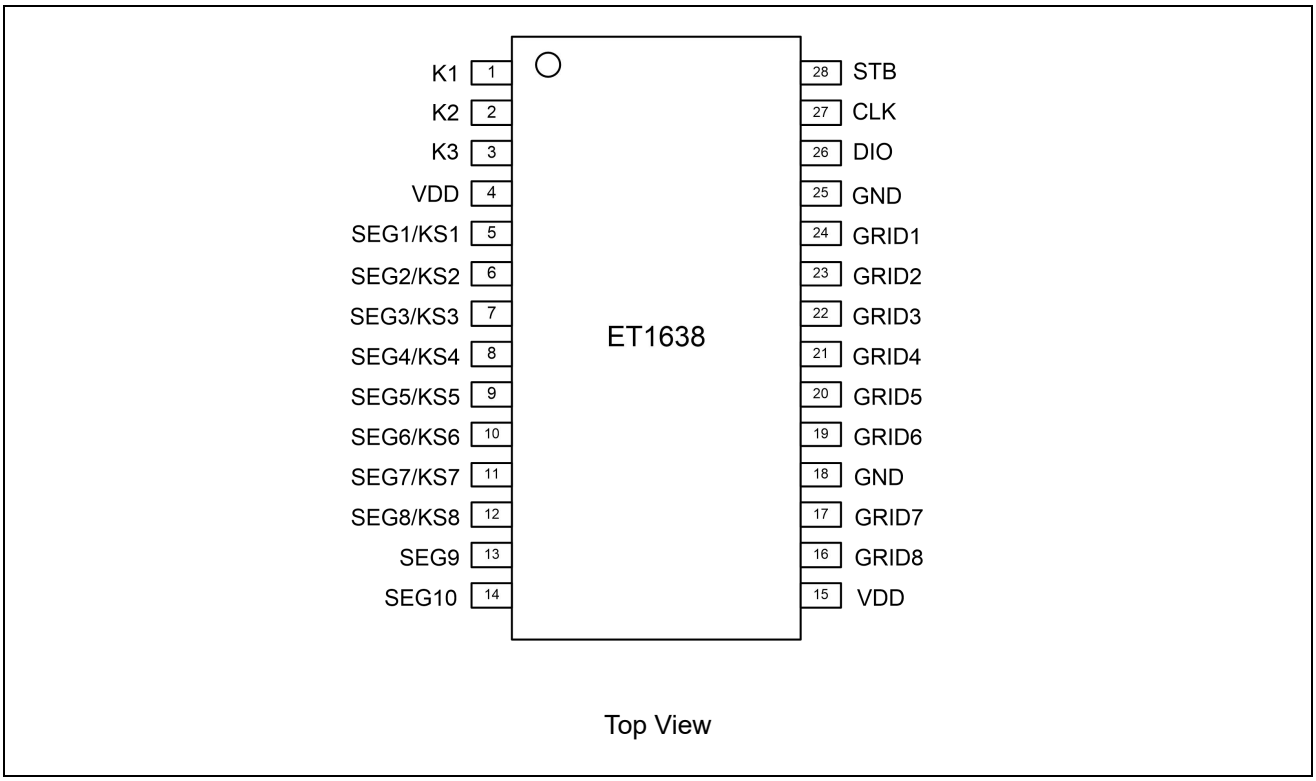
It is suitable for small LED display driver.Package is SOP28.

Features

- Display Mode: 10Segs × 8Grids
- Keyboard Scanning: 8 × 3Matrix
- Gray adjustment: 8 duty Cycles
- 3 wire Serial Interface
- Built in RC Oscillation
- Built in Power on Reset
- Part Number and package

Part Number	Package	Packing	MSL
ET1638	SOP28(7.5mm × 18mm)	Tube	3

Pin Configuration

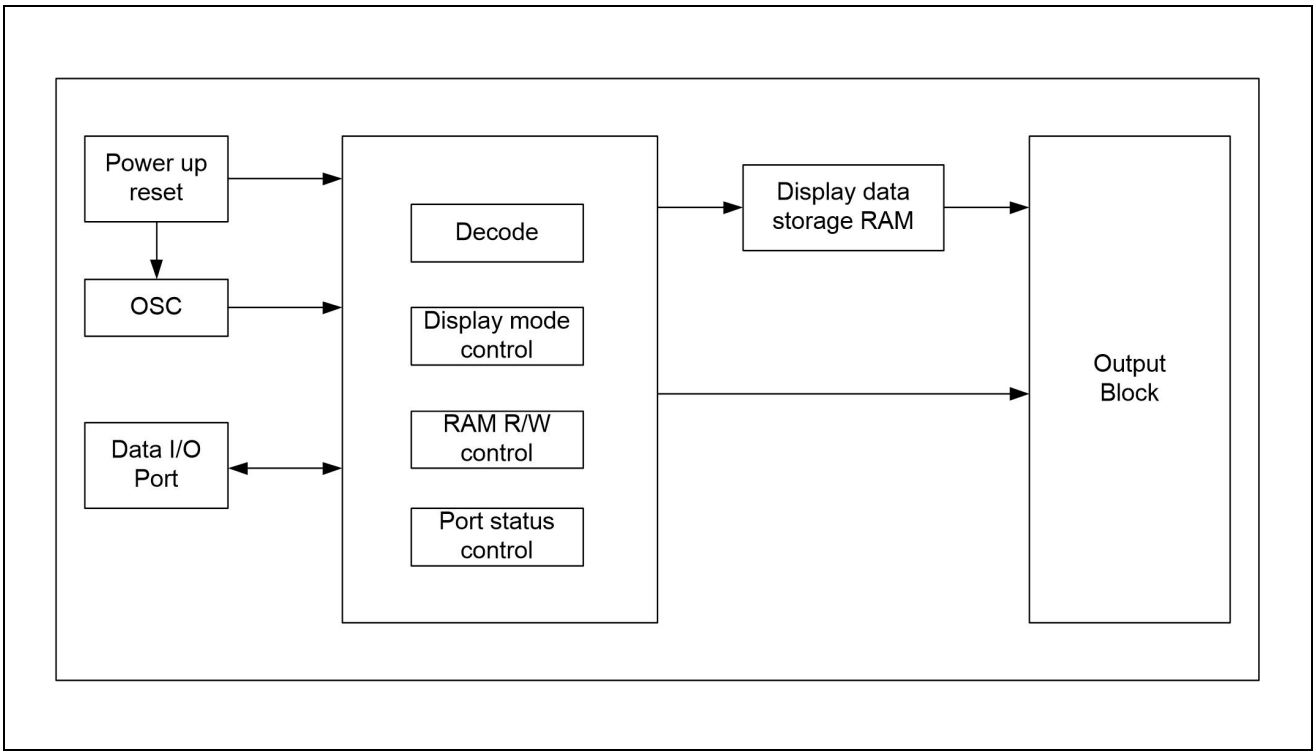


Top View

Pin Function

Pin No.	Symbol	I/O	Description
1~3	K1~K3	I	Input data port for key matrix.
4,15	VDD	-	Power supply.
5~12	SEG1/KS1~ SEG8/KS8	O	Segment output port, connect LED positive, also used as input for key scanning.
13~14	SEG9~SEG10	O	Segment output port, connected to LED positive.
16,17,19~24	GRID8~GRID1	O	Grid output port, connected to LED negative
18,25	GND	-	GND
26	DIO	I/O	Serial data input / output port.
27	CLK	I	Serial clock input port.
28	STB	I	Serial data strobe port.

Function Block Diagram



Functions Description

Command

When the STB port status changes from high to low, the bytes of the command (B7-B0) is input from the DIO port. If STB port is set to high for some reason during data or command transmission, serial communication is initialized and the data/command being input is considered invalid.

Command1：Display Mode Setting

ET1638's display mode format is following:

MSB LSB

B7	B6	B5	B4	B3	B2	B1	B0	Function	Description
1	0	NC, fill in 0			0	0	0	Display duty cycle setting	Duty cycle is 1/16
1	0				0	0	1		Duty cycle is 2/16
1	0				0	1	0		Duty cycle is 4/16
1	0				0	1	1		Duty cycle is 10/16
1	0				1	0	0		Duty cycle is 11/16
1	0				1	0	1		Duty cycle is 12/16
1	0				1	1	0		Duty cycle is 13/16
1	0				1	1	1		Duty cycle is 14/16
1	0			0				Display ON/OFF setting	Display OFF
1	0			1					Display ON

Command2：Data Command Setting

ET1638's data command format is following:

MSB LSB

B7	B6	B5	B4	B3	B2	B1	B0	Function	Description
0	1	NC, fill in 0				0	0	Data write mode	Display data input mode
0	1				0			Address increase mode	Automatic address increase
0	1				1				Fixed address
0	1			0				Test mode setting	Normal mode
0	1			1					Test mode

Command3：Display Address Setting

ET1638's display address format is following:

MSB LSB

B7	B6	B5	B4	B3	B2	B1	B0	Description
1	1	NC, fill in 0		0	0	0	0	Display address 00H
1	1			0	0	0	1	Display address 01H
1	1			0	0	1	0	Display address 02H
1	1			0	0	1	1	Display address 03H
1	1			0	1	0	0	Display address 04H
1	1			0	1	0	1	Display address 05H
1	1			0	1	1	0	Display address 06H
1	1			0	1	1	1	Display address 07H
1	1			1	0	0	0	Display address 08H
1	1			1	0	0	1	Display address 09H

Note： Default data is 00H,If the set address exceeds 09H, it is considered invalid until a valid address is entered.

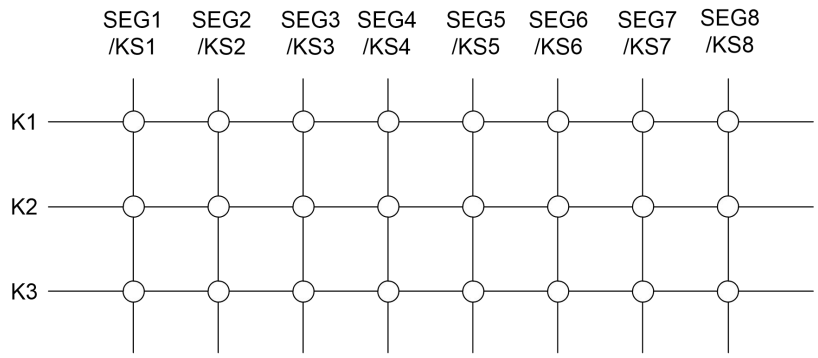
Address assignment：

SEG1~SEG4	SEG5~SEG8	SEG9~SEG10	*	GRID
00HL	00HU	01HL		**GRID1**
02HL	02HU	03HL		**GRID2**
04HL	04HU	05HL		**GRID3**
06HL	06HU	07HL		**GRID4**
08HL	08HU	09HL		**GRID5**
0AHL	0AHU	0BHL		**GRID6**
0CHL	0CHU	0DHL		**GRID7**
0EHL	0EHU	0FHL		**GRID8**

Note： HL=B0、B1、B2、B3 , HU=B4、B5、B6、B7.

Key scan matrix and storage RAM

The key scan matrix of ET1638 is composed of an 8×3 array as shown below:



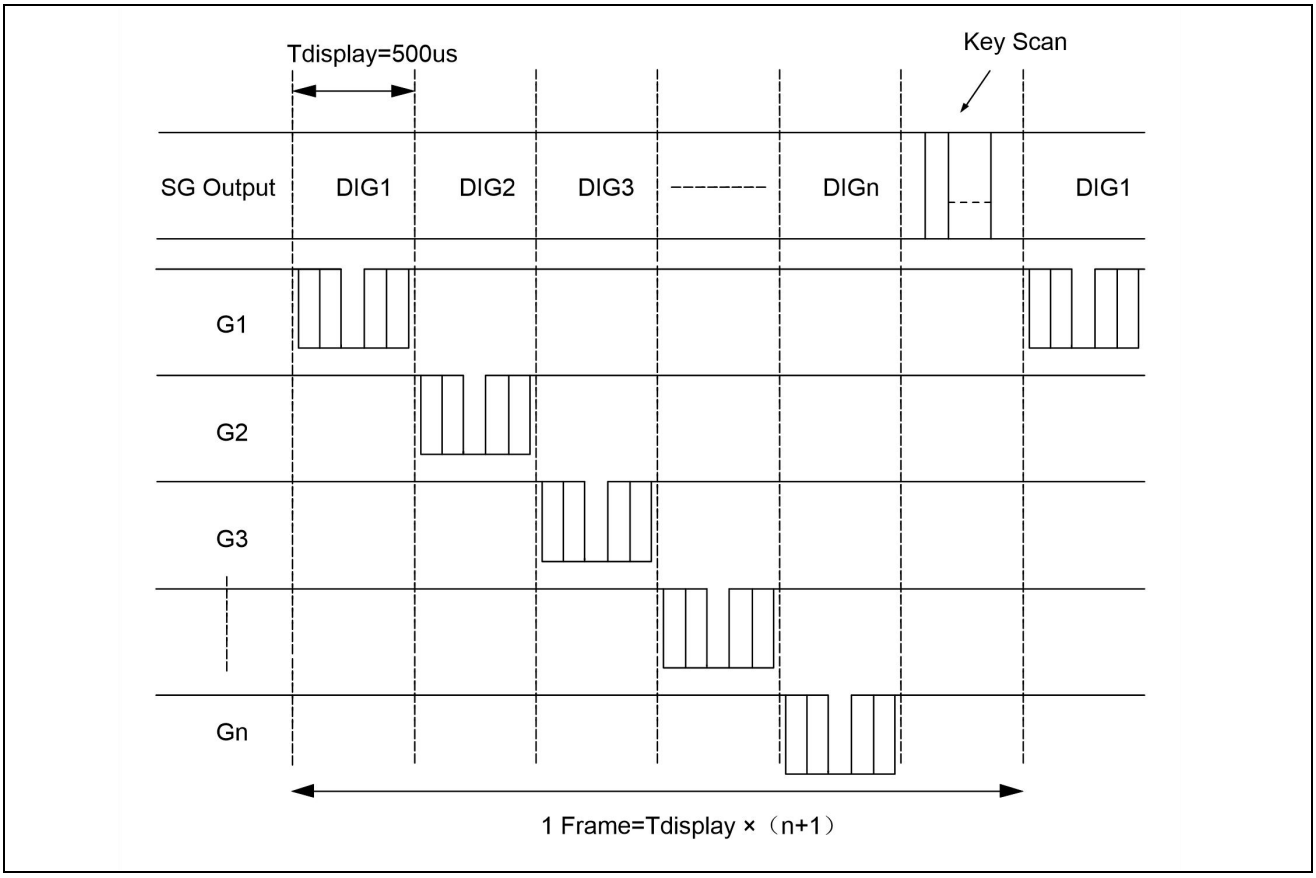
The key scan input data is stored as follows, and is read from the lowest bit (B0) using the READ command. The corresponding key scan data is shown in the table below:

B0	B1	B2	B3	B4	B5	B6	B7	BYTE	
K3	K2	K1	*	K3	K2	K1	*		
SG1/KS1				SG2/KS2				BYTE1	Read Order ↓
SG3/KS3				SG4/KS4				BYTE2	
SG5/KS5				SG6/KS6				BYTE3	
SG7/KS7				SG8/KS8				BYTE4	

Note: ET1638 supports composite keys, but the same K * can only have one SEG/KS key pressed.

Display Timing

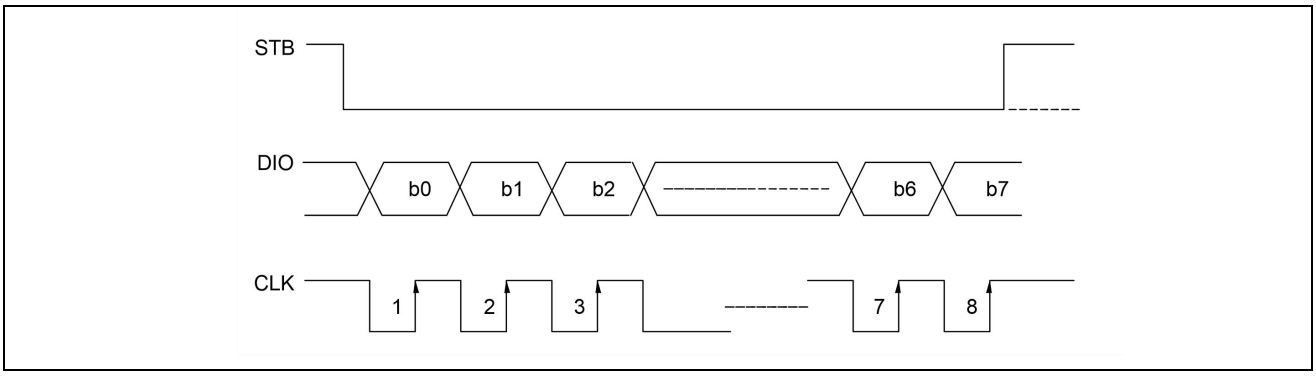
Display timing figure is following：



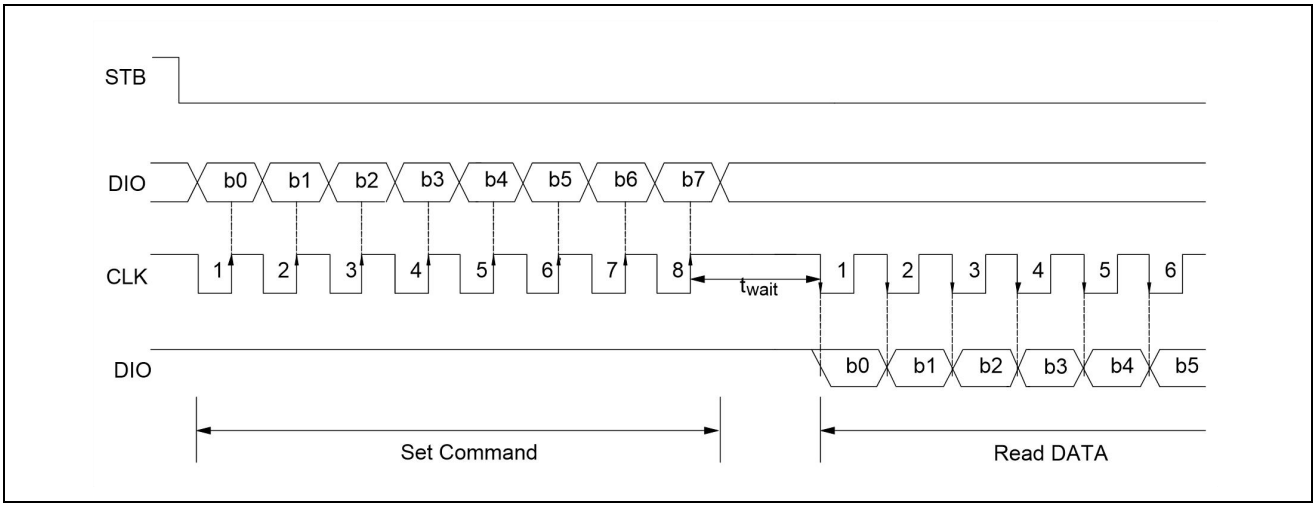
Serial Communication Format

The following figure shows the serial communication format of ET1638. It is recommended to connect a pull-up resistor (1K ~ 10K) to the DIO port.

Transfer (data write operation)



Transfer (data read operation)

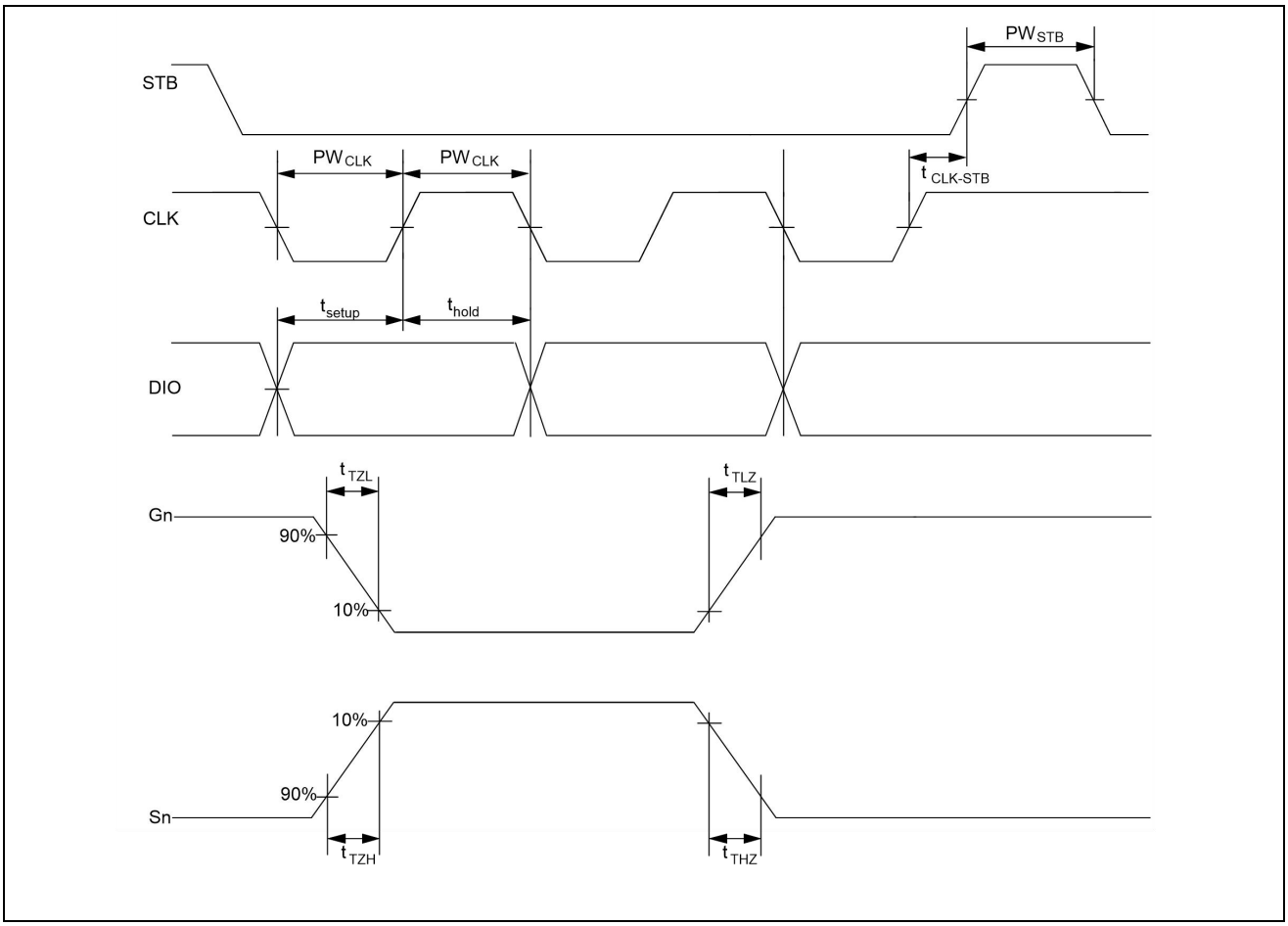


t_{wait}（Wait time）≥1μs

It should be noted that when reading data, the rising edge is the eighth clock of the instruction to the falling edge of the first clock of the subsequent data reading must be longer than or equal to 1us waiting time(t_{wait}).

Conversion Characteristic Waveform

ET1638's conversion characteristic waveform is following:



PW_{CLK}（clock pulse width）≥400ns

PW_{STB}（STB filter width）≥1μs

t_{setup}（data setup time）≥100ns

t_{hold}（data hold time）≥100ns

$t_{CLK-STB}$（clock filter time）≥1μs

t_{THZ}（dropping time）≤10μs

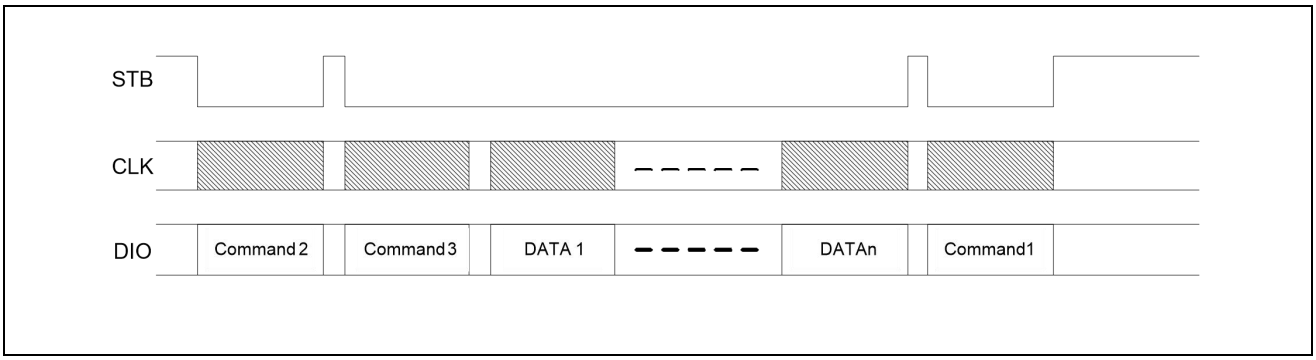
t_{TZH}（rising time）≤1μs

t_{TZL}<1μs

t_{TLZ}<10μs

Application

1. Continuous display data writing (Automatic address increase)



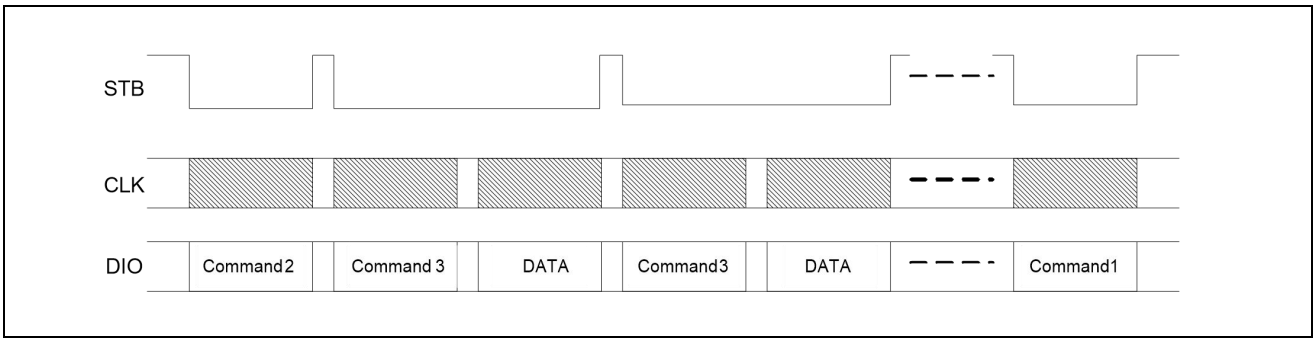
Command2：Data command setting

Command3：Address command setting

DATA1～n：Display data（Max 14bytes）

Command1：Display mode setting

2. Single display data writing(fixed address mode)



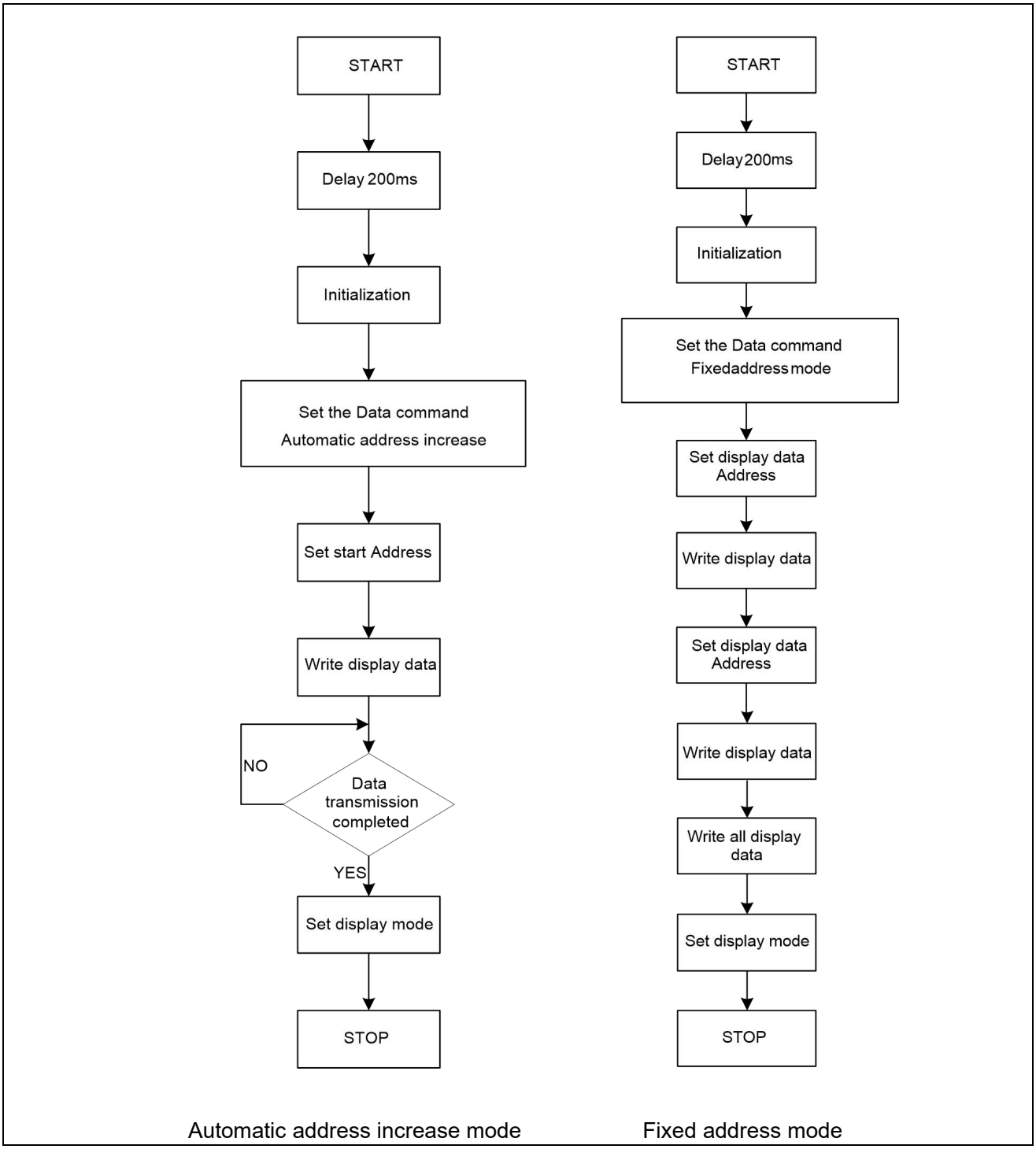
Command2：Data command setting

Command3：Address command setting

DATA：Display data

Command1：Display mode setting

Software Flow Diagram



When the IC is powered on for the first time, the contents of the display RAM are not defined, so be sure to clear the contents of the display RAM in the initialization setting.

Absolute Maximum Ratings

Characteristic	Symbol	Rating	Unit
Supply Voltage	V_{DD}	-0.5～+7	V
Logic Input Voltage	V_I	-0.5～V_{DD}+0.5	V
Driver Output Current	I_{OLGR}	+200	mA
	I_{OHSG}	-50	mA
Max Output Driver current	I_{TOTAL}	400	mA
Junction Temperature	T_J	-40～+150	°C
Storage Temperature	T_{STG}	-65～+150	°C

Recommended Operating Conditions

Characteristic	Symbol	Min	Typ	Max	Unit
Supply Voltage	V_{DD}	3.0	5.0	5.5	V
Dynamic current (*)	I_{DD_DYN}			5	mA
High Level Input Voltage	V_{IH}	0.6V_{DD}		V_{DD}	V
Low Level Input Voltage	V_{IL}	0		0.3V_{DD}	V
Operating Temperature	T_A	-40		85	°C

Note*：Set display mode command = 80H (display off & no load)

Electrical Characteristics

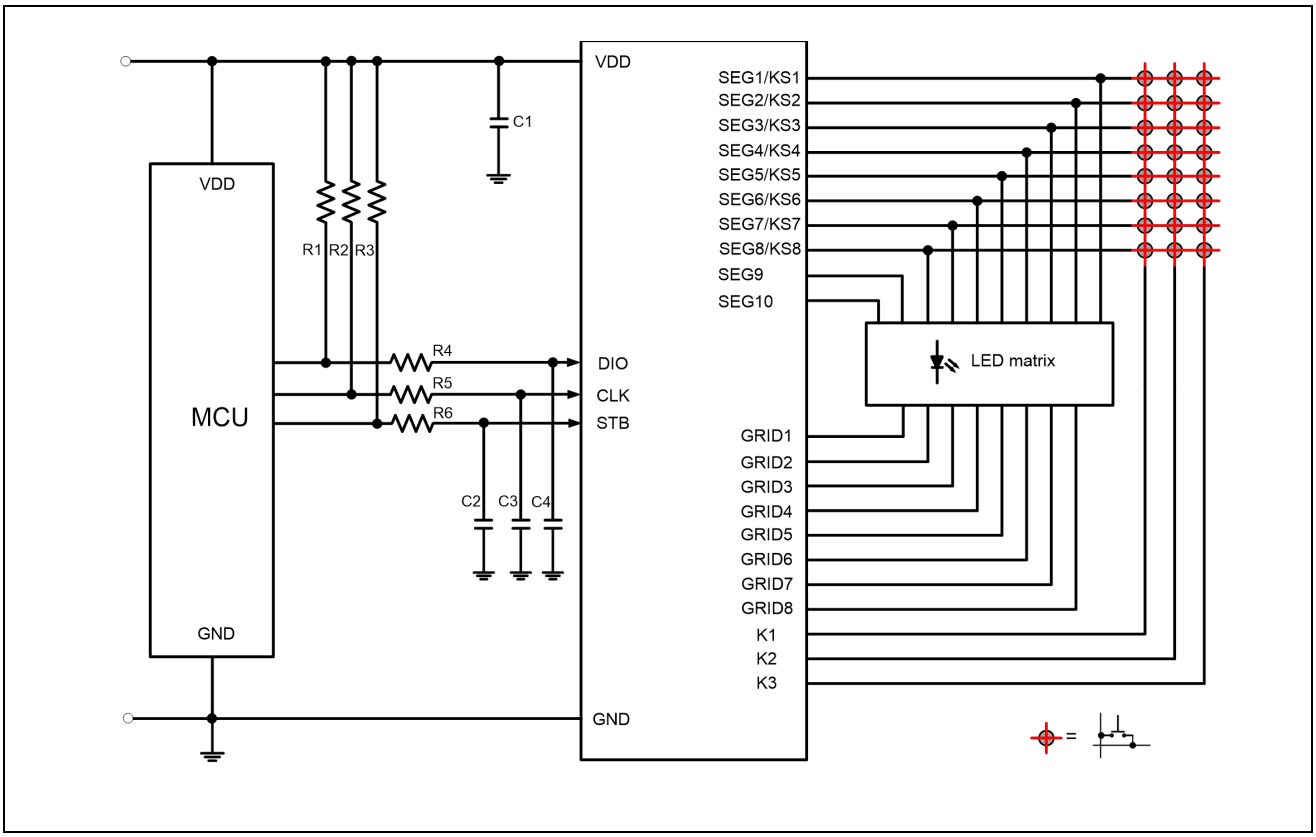
V_{DD} = 5V，GND = 0V，Ta = 25°C

Characteristic	Symbol	Test Condition	Min	Typ	Max	Unit
High Level Output Current	I_{OHSG1}	V_O = V_{DD}-2V，SEGn	-30	-40	-55	mA
	I_{OHSG2}	V_O = V_{DD}-3V，SEGn	-40	-50	-65	mA
Low Level Output Current	I_{OLGR}	V_O = 0.3V，GRIDn	80	110		mA
Low Level Output Current	I_{OLDOUT}	V_O=0.4V ,DIO	4			mA
High Level Input Voltage	V_{IH}	—	0.6V_{DD}		5	V
Low Level Input Voltage	V_{IL}	—	0		0.3V_{DD}	V
Oscillation Frequency	F_{OSC}			300		kHz
K1～K3 Pull Down Resistor	R_{KN}	K1～K3, V_{DD}=5V		10		kΩ

V_{DD} = 3V，GND = 0V，Ta = 25°C

Characteristic	Symbol	Test Condition	Min	Typ	Max	Unit
High Level Output Current	I_{OHSG1}	V_O = V_{DD} -2V，SEGn	-15	-20	-35	mA
Low Level Output Current	I_{OLGR}	V_O = 0.3V，GRIDn	70	90		mA
Low Level Output Current	I_{OLDOUT}	V_O = 0.4V ,DIO	4			mA
High Level Input Voltage	V_{IH}		0.8V_{DD}		3.3	V
Low Level Input Voltage	V_{IL}		0		0.3V_{DD}	V
Oscillation Frequency	F_{OSC}			300		kHz
K1～K3 Pull Down Resistor	R_{KN}	K1～K3，V_{DD} =3V		10		kΩ

Application Example



Notes：

1. This application circuit is only for reference.

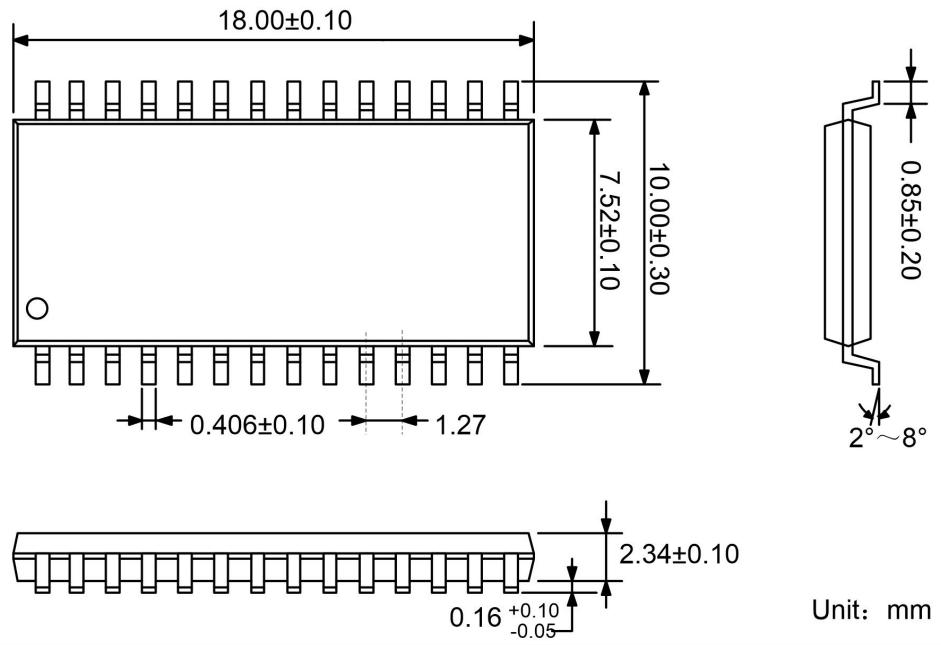
2. C1=1uF and should be placed as close as possible to the VDD.

3. R1~R3 = 4.7kΩ, R4~R6 = 100Ω, C2~C4 = 100pF.

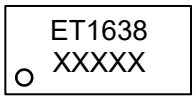
4. The series resistance of the communication port and the capacitor for GND should be placed as close as possible to ET1638, and the resistance value and capacitance value should be adjusted according to the actual anti-interference requirements and verification results.

Package

SOP28



Marking



XXXXX = Tracking Number

Revision History and Checking Table

Version	Date	Revision Item	Modifier	Function & Spec Checking	Package & Tape Checking
1.0	2020-02-24	Original Version	Shi Liang Jun	Shi Liang Jun	Zhu Jun Li
1.1	2024-5-15	Update Typeset	Shi Bo	Shi Liang Jun	Shi Bo
1.2	2026-9-1	Add marking etc	Shi Bo	Li chen xuan	Shi Bo