ET6224R - Dot Matrix LED Driver

General Description

ET6224R is a matrix LED driver IC, it has 10~13 segment outputs and 7~4 grid outputs and 1 display storage unit and some control circuit. It inherits MCU digital interface, data latch and LED driver module. It is suitable for small LED display driver.

Features

- Power supply voltage from 3V to 5.5V
- Display Mode: 10 Segs × 7 Grids ~13 Segs × 4 Grids ,Max support 70 LED
- Gray adjustment: 8 duty cycle
- Keyboard scanning: 2 × 10
- Built in RC oscillation
- Built in power on reset
- Three wire serial interface
- Package: SOP24 (ET6224R), TSSOP24 (ET6224RV), SSOP24 (ET6224RS)

Device Information

Part No.	Package	Size
ET6224R	SOP24	15.38mm × 10.2mm
ET6224RV	TSSOP24	7.8mm × 6.4mm
ET6224RS	SSOP24	8.65mm × 6mm

Application

- Household appliances, Toy display
- Smart portable devices, Smart audio

Pin Assignments

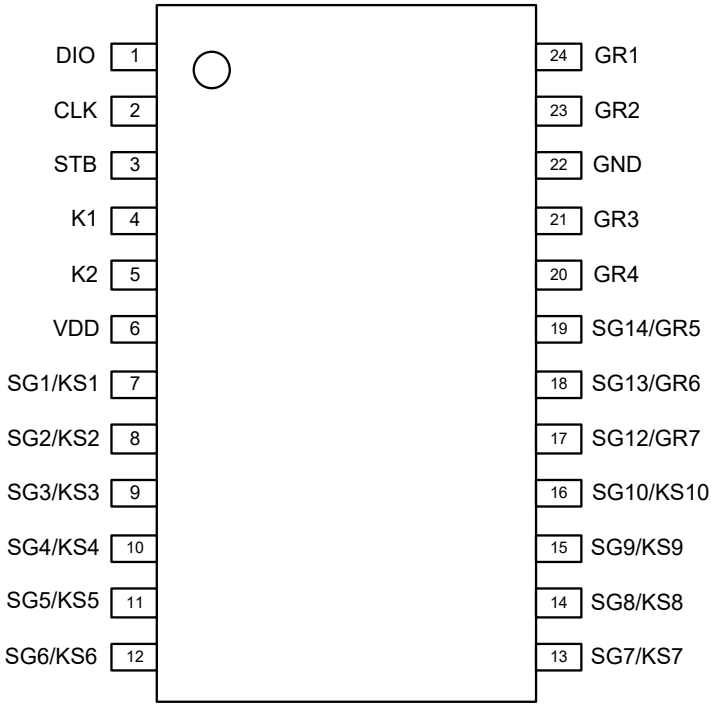


Figure 1. Pin Assignments (Top View)

Pin. Function

Pin No.	Symbol	I/O	Description
1	DIO	I/O	Serial data input/output port.
2	CLK	I	Serial clock input port.
3	STB	I	Serial data strobe port.
4,5	K1,K2	I	Key data input port. (Build in pull down resistance)
6	VDD	—	Power supply
7～16	SG1/KS1～SG10/KS10	O	Segment output port, (Connected LED positive pole)/Key scan output
17~19	SG12/GR7～SG14/GR5	O	Segment/Grid output port, select segment or grid output through registers.
22	GND	—	Ground
20,21,23,24	GR4～GR1	O	Grid output port, Connected LED negative pole

Block Diagram

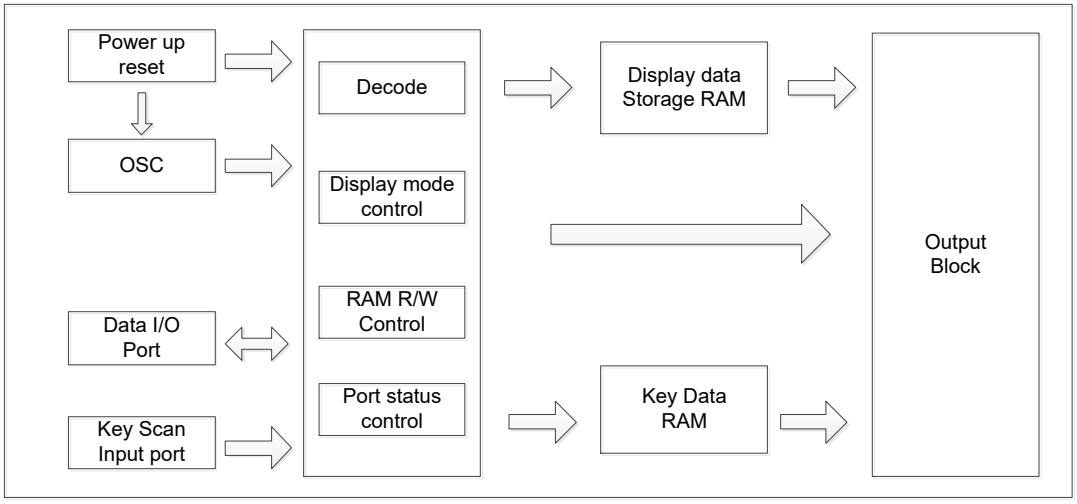


Figure 2. Block Diagram

Functions Description

Command

When the STB port status changes from high to low, the bytes of the command (b7-b0) is input from the DIN 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.

Serial Communication Format

The following figure shows the serial communication format of ET6224R. It is recommended to connect a pull-up resistor (1K ~ 10K) to the DIO port.

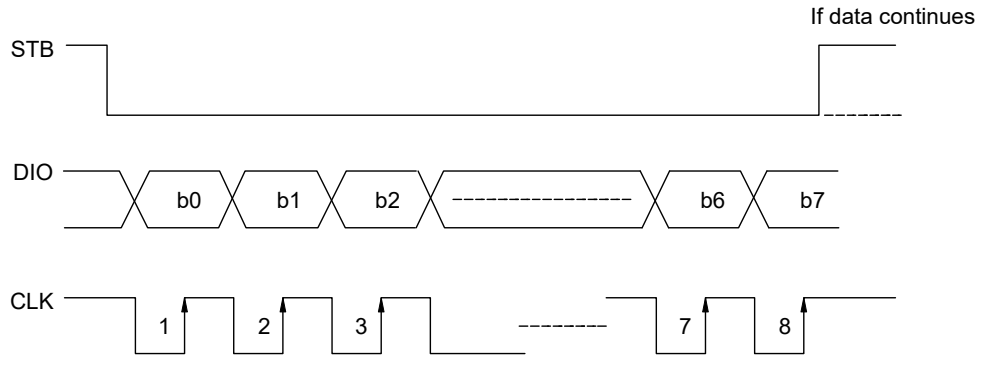


Figure 3. Serial Communication Format

Data transmission（Data read）

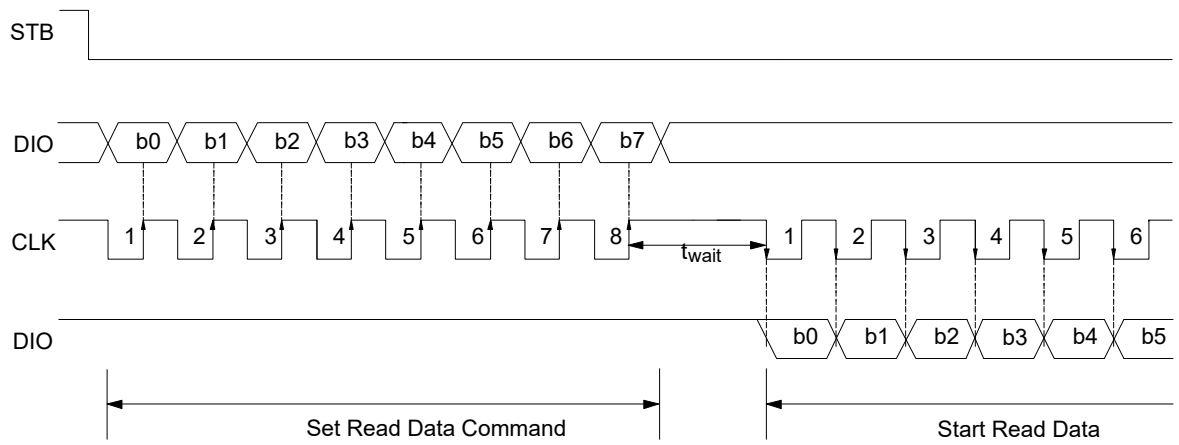


Figure 4. Data transmission（Data read）

Note: T_{wait}（waiting 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}).

Continuous display data writing(Automatic address increase)

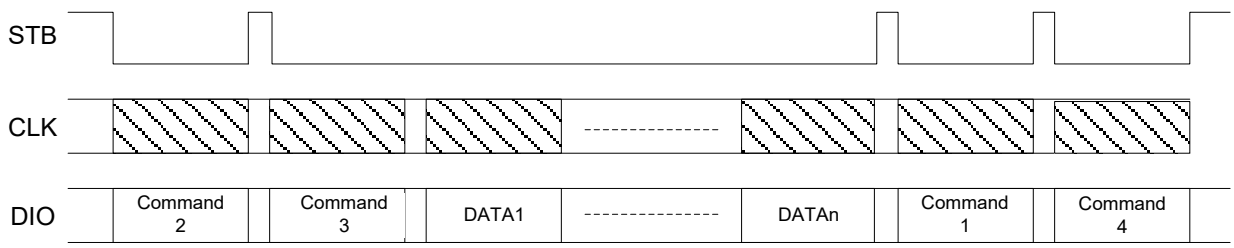


Figure 5. Continuous display data writing(Automatic address increase)

- Command1：Display mode setting
- Command2：Data command setting
- Command3：Address command setting
- DATA1～n： Display data (MAX 14bytes)
- Command4：Display control command

Single display data writing(fixed address mode)

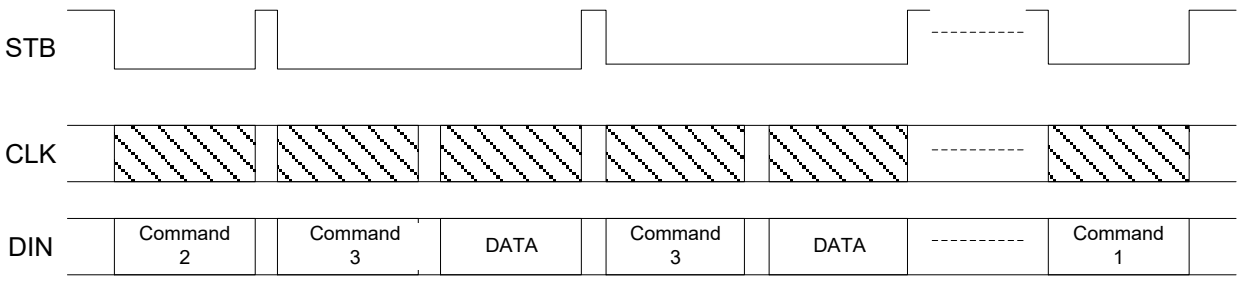


Figure 6. Single display data writing(fixed address mode)

- Command1：Display mode setting
- Command2：Data command setting
- Command3：Address command setting
- DATA：Display data

Command1：Display Mode Setting

Display mode setting command determines the segments and grids used(4~7 grids, 13~10 segments). A display mode setting command must be executed to continue the display. If the same mode setting is selected, the command is not executed.

B7	B6	B5	B4	B3	B2	B1	B1	Function	Description
0	0	NC, Set to 0 please				0	0	Display segment and grid setting	13Segs×4Grids
						0	1		12 Segs×5 Grids
						1	0		11 Segs×6 Grids
						1	1		10 Segs×7 Grids（default）

Command2：Data Command Setting

B7	B6	B5	B4	B3	B2	B1	B1	Function	Description
0	1	NC, Set to 0 please		0				Mode setting	Normal mode
				1					Test mode
					0			Address mode	Automatic address increase
					1				Fixed address
						0	0	Data write/read	Display data input mode
						1	0		Read Key Data

Key scan matrix and key scan input data storage RAM

The key scan matrix of ET6224R is composed of 2×10 array：

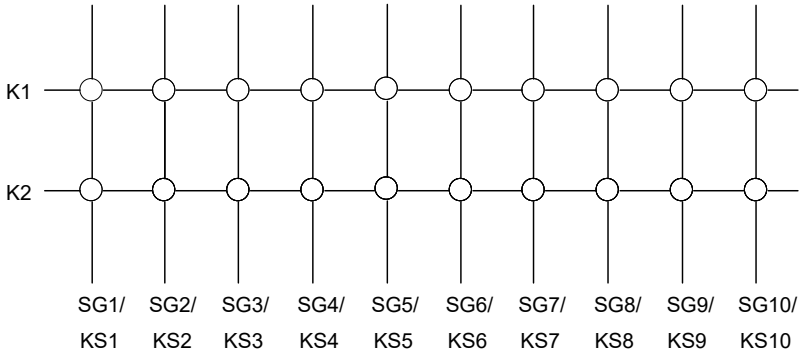


Figure 7. key scan matrix

The data of each key input is stored as follows, which is read from the lowest bit(B0→B7) by read command. When the highest bit(B7) of the data is read out, the lowest bit(B0) of the next data is read out. When the the key between K* and KS* pins is pushed, the corresponding bits of byte is “1”.

B0	B1	B2	B3	B4	B5	B6	B7	BYTE
K1	K2	X	K1	K2	X	X	X	
SG1/KS1			SG2/KS2			0	0	BYTE1
SG3/KS3			SG4/KS4			0	0	BYTE2
SG5/KS5			SG6/KS6			0	0	BYTE3
SG7/KS7			SG8/KS8			0	0	BYTE4
SG9/KS9			SG10/KS10			0	0	BYTE5

READING SEQUENCE

Note：B2、B5～B7 undefined.

Command3：Display Address Setting

ET6224R’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
1	1			1	0	1	0	Display address 0AH
1	1			1	0	1	1	Display address 0BH

1	1		1	1	0	0	Display address 0CH
1	1		1	1	0	1	Display address 0DH

Note： Default data is 00H

Address assignment：

SEG1~SEG4	SEG5~SEG8	SEG9~SEG12	SEG13~SEG14	GRID
00HL	00HU	01HL	01HU	GRID1
02HL	02HU	03HL	03HU	GRID2
04HL	04HU	05HL	05HU	GRID3
06HL	06HU	07HL	07HU	GRID4
08HL	08HU	09HL	09HU	GRID5
0AHL	0AHU	0BHL	0BHU	GRID6
0CHL	0CHU	0DHL	0DHU	GRID7

b0…….b3	b4……b7
xxH_L	xxH_U
Low 4bits	High 4bits

Note： Default data is 00H

Command4：Display Control Setting

ET6224R’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

Software flow chart

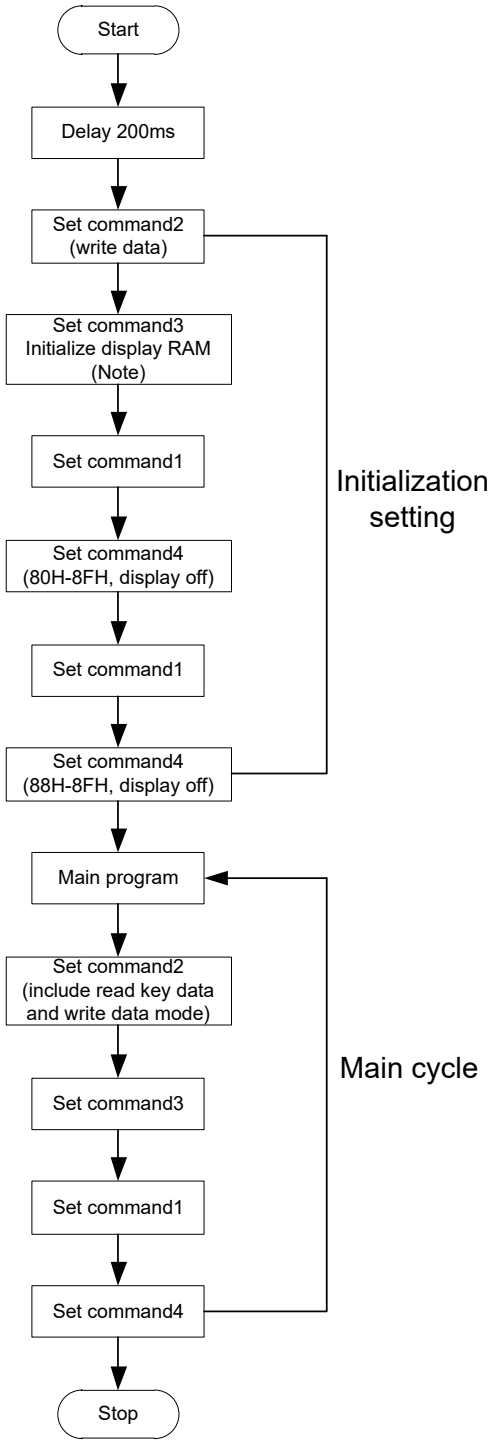


Figure 8. Instruction operation flow chart

Notes：

- Command1：Display mode setting
- Command2：Data command setting
- Command3：Address command setting
- Command4：Display control command

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

(Unless otherwise noted ,T_A=25°C)

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}	+250	mA
	I_{OHSG}	-50	mA
Max Output Driver current	I_{TOTAL}	250	mA
Operating Junction Temperature	T_J	-40～+150	°C
Storage Temperature	T_{STG}	-65～+150	°C

Recommended Operating Conditions

(Unless otherwise noted ,T_A = 25°C)

Characteristic	Symbol	Min	Typ	Max	Unit
Supply Voltage	V_{DD}	3.0	5.0	5.5	V
High Level Input Voltage	V_{IH}	0.8V_{DD}	—	V_{DD}	V
Low Level Input Voltage	V_{IL}	0	—	0.25V_{DD}	V
Operating Temperature	T_A	-40		85	°C

Electrical Characteristics

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

Characteristic	Symbol	Test Condition	Min	Typ	Max	Unit
High Level Output Current	I_{OHSG1}	SGn port，V_O=V_{DD}-2V	-40	-50	-60	mA
	I_{OHSG2}	SGn port，V_O=V_{DD}-3V	-50	-60	-70	mA
Low Level Output Current	I_{OLGR}	GRn port，V_O= 0.3V	80	100		mA
Low Level Output Current(DIO PIN)	I_{OLDOUT}	V_O=0.4V	4			mA
High Level Input Voltage	V_{IH}		0.8V_{DD}		5	V
Low Level Input Voltage	V_{IL}		0		0.25V_{DD}	V
Dynamic current	I_{DD_DYN}*		—		1	mA

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

Transformation Characteristic Time Sequence

Symbol	Descripiton	Range	Units
PW_{CLK}	CLK pulse width	≥400	ns
PW_{STB}	STB pulse width	≥1	us
t_{setup}	Data setup time	≥100	ns
t_{hold}	Date hold time	≥100	ns
$t_{CLK-STB}$	CLK-STB time	≥1	us
t_{THZ}	Falling time	≤10	us
t_{TZH}	Rising time	≤1	us
t_{PZL}	Transmission delay time	≤100	ns
t_{PLZ}	Transmission delay time	≤300	ns
t_{TZL}		<1	us
t_{TLZ}		<10	us

Conversion Characteristic Waveform

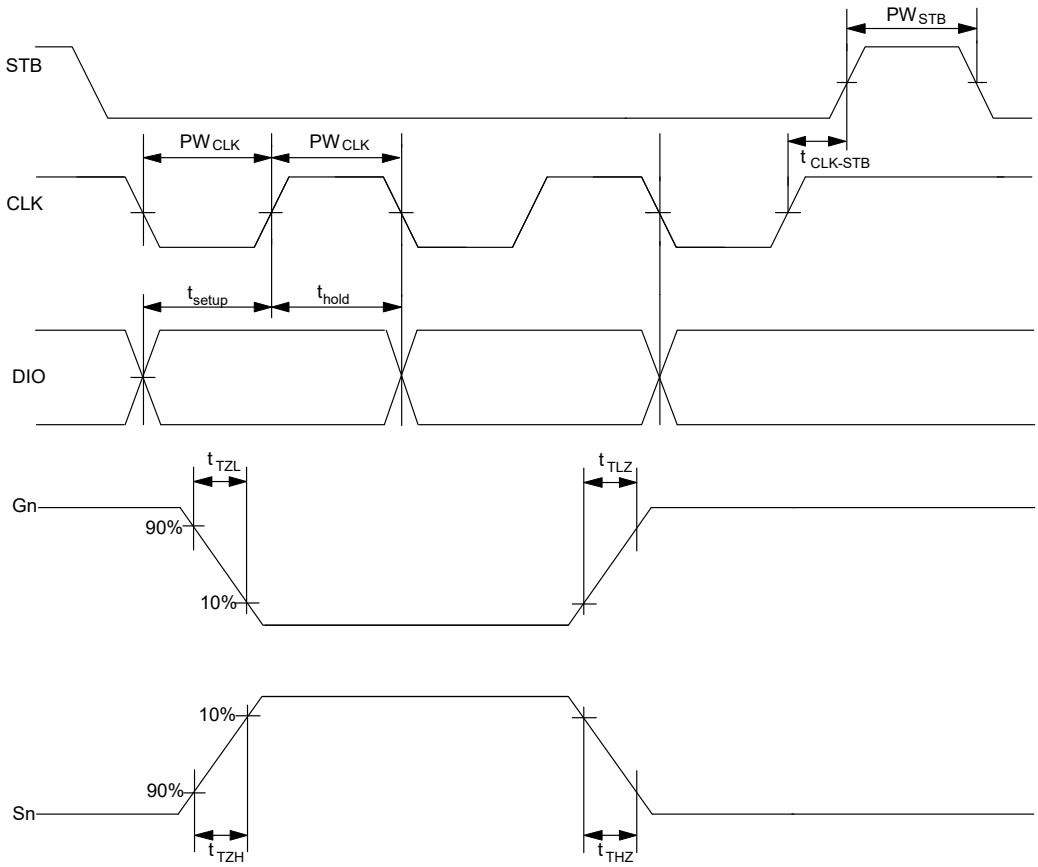


Figure 9. Conversion Characteristic Waveform

Application circuit

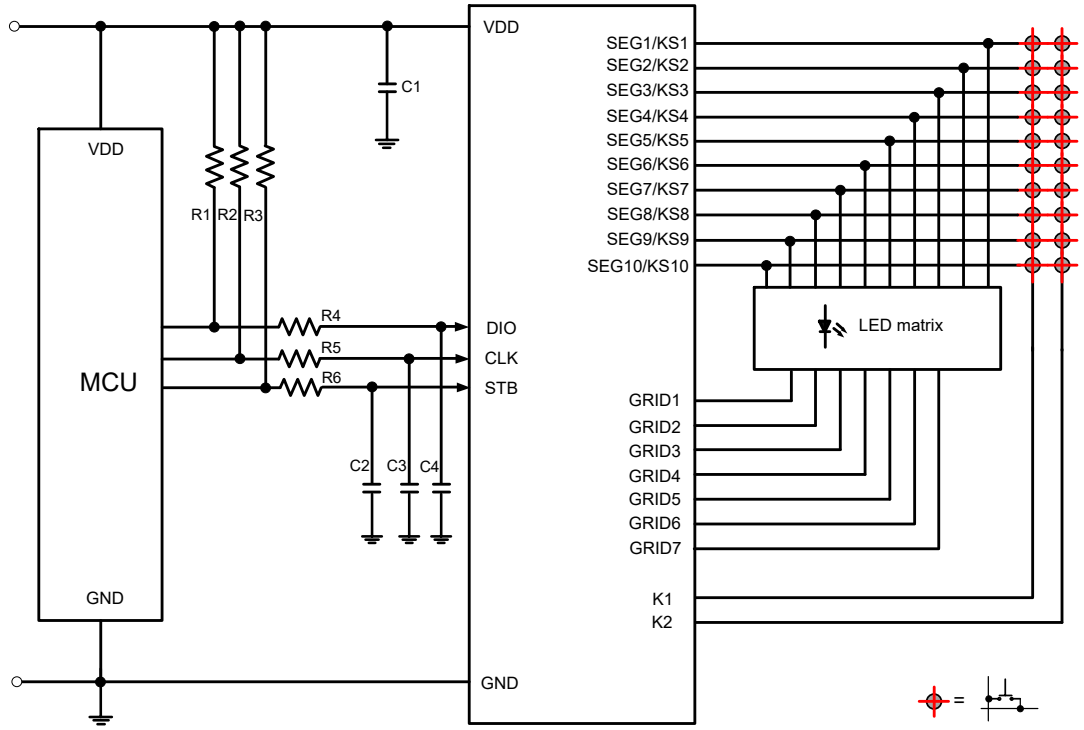


Figure 11. application circuit

Notes：

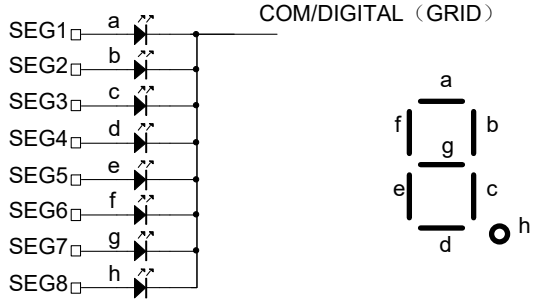
1. This application circuit is only for reference.

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

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

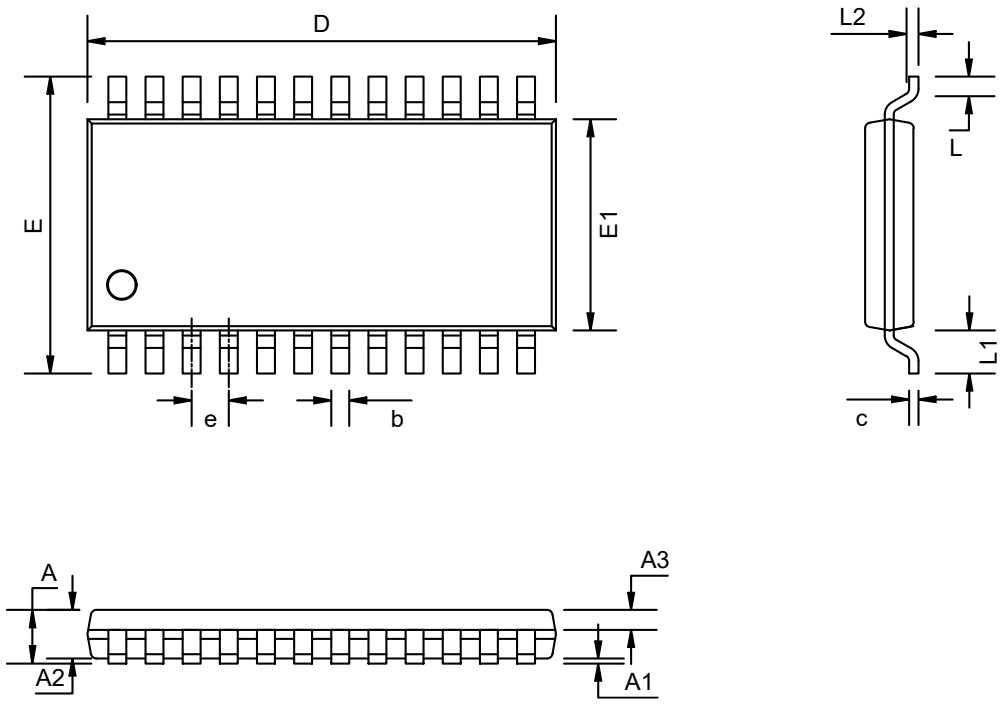
4. The series resistance of the communication port and the capacitor for GND should be placed as close as possible to ET6224R, and the resistance value and capacitance value should be adjusted according to the actual anti-interference requirements and verification results.

Common cathode LED connection



Package

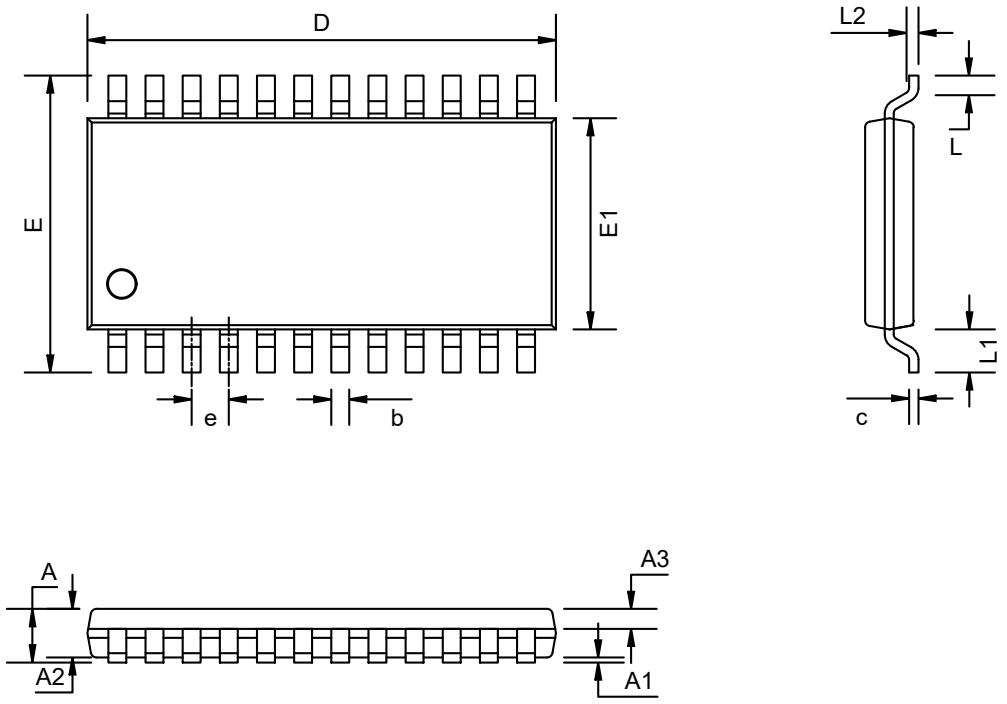
SOP24



COMMON DIMENSIONS
(UNITS OF MEASURE=MILLIMETER)

Symbol	Min	Nom	Max
A	2.35	2.60	2.80
A1	0.05	0.15	0.30
A2	2.25	2.45	2.65
A3	1.05	1.15	1.25
b	0.36	--	0.49
c	0.21	--	0.34
D	15.24	15.34	15.44
E	9.80	10.20	10.60
E1	7.40	7.50	7.60
e	1.27BSC		
L	0.40	0.60	0.80
L1	1.35REF		
L2	0.25BSC		

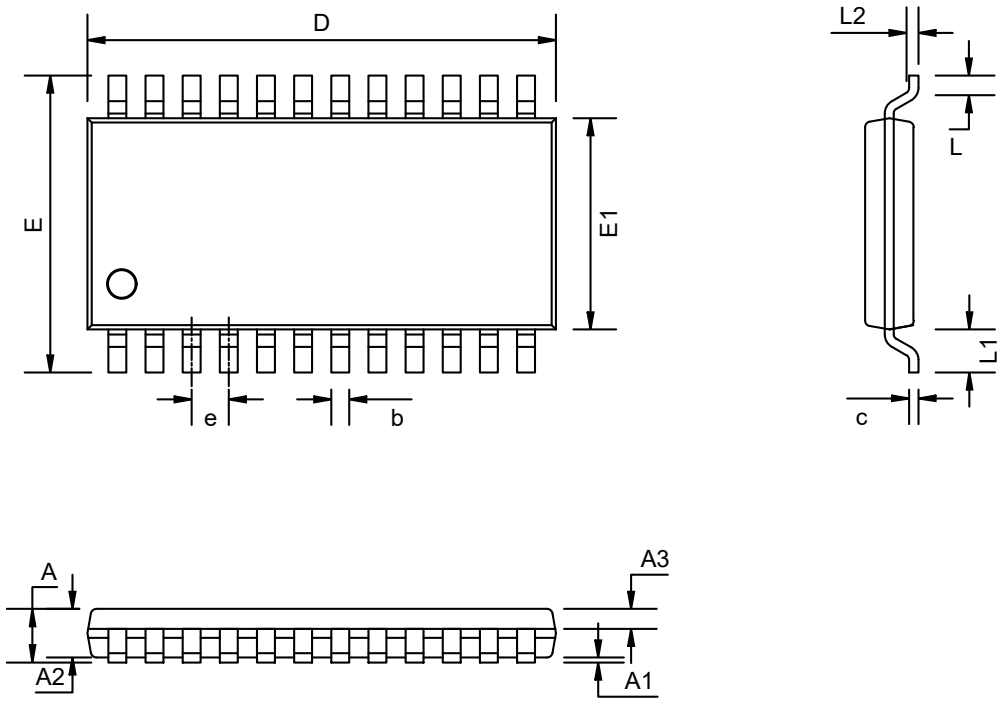
TSSOP24



COMMON DIMENSIONS
(UNITS OF MEASURE=MILLIMETER)

Symbol	Min	Nom	Max
A	-	-	1.20
A1	0.05	-	0.15
A2	0.80	0.90	1.00
A3	0.34	0.39	0.44
b	0.20	-	0.29
c	0.10	-	0.19
D	7.70	7.80	7.90
E	6.20	6.40	6.60
E1	4.30	4.40	4.50
e	0.65BSC		
L	0.45	0.60	0.75
L1	1.00BSC		
L2	0.25BSC		

SSOP24



COMMON DIMENSIONS
(UNITS OF MEASURE=MILLIMETER)

Symbol	Min	Nom	Max
A	-	-	1.75
A1	0.10	-	0.25
A2	1.30	1.40	1.50
A3	0.34	0.39	0.44
b	0.23	0.28	0.33
c	0.10	-	0.19
D	8.45	8.65	8.85
E	5.80	6.00	6.20
E1	3.70	3.90	4.10
e	0.635BSC		
L	0.50	0.65	0.80
L1	1.05BSC		
L2	0.25BSC		

Revision History and Checking Table

Version	Date	Revision Item	Modifier	Function & Spec Checking	Package & Tape Checking
1.0	2020-02-24	Add historical version information	Shilj	Shilj	Liujy
1.1	2020-04-01	Updated formatting	shibo	shibo	Liujy
1.2	2023-03-21	Updated formatting	shibo	shibo	Liujy