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Vinka Microelectronics

VK1629 Datasheet

16×8 LED DRIVER

Rev.1.3

1 General Description

VK1629 is a dedicated chip for digital tube or dot matrix LED driver control with a keyboard scanning interface. It integrates a 4-wire serial interface, data latch, LED driver, keyboard scanning and other circuits internally. The SEG pin is connected to the anode of the LED, and the GRID pin is connected to the cathode of the LED. It can support a dot matrix LED display panel with 16SEGx8GRID, and the maximum support is an 8x4 key matrix. High-end display screen drivers suitable for products such as refrigerators, air conditioners, and home theaters. It adopts the LQFP44 packaging form.

2 Key Features

- Operating voltage：3.0-5.5V
- Built-in RC oscillator
- 16 SEG pins, 8 GRID pins
- The SEG pin can only be connected to the anode of the LED, and the GRID pin can only be connected to the cathode of the LED
- Maximum support for 8×4 matrix keys
  (key/display multiplexing requires hardware circuit coordination)
- 4-wire serial interface
- The overall brightness is adjustable at 8 levels
- The built-in display RAM is 16×8 bits
- Built-in power-on reset circuit
- Available Packages:
  LQFP44(10.0mm×10.0mm PP=0.8mm)

3 Application Field

- Small household appliances
- Induction cooker/microwave oven
- Pressure gauge

4 Product Selection

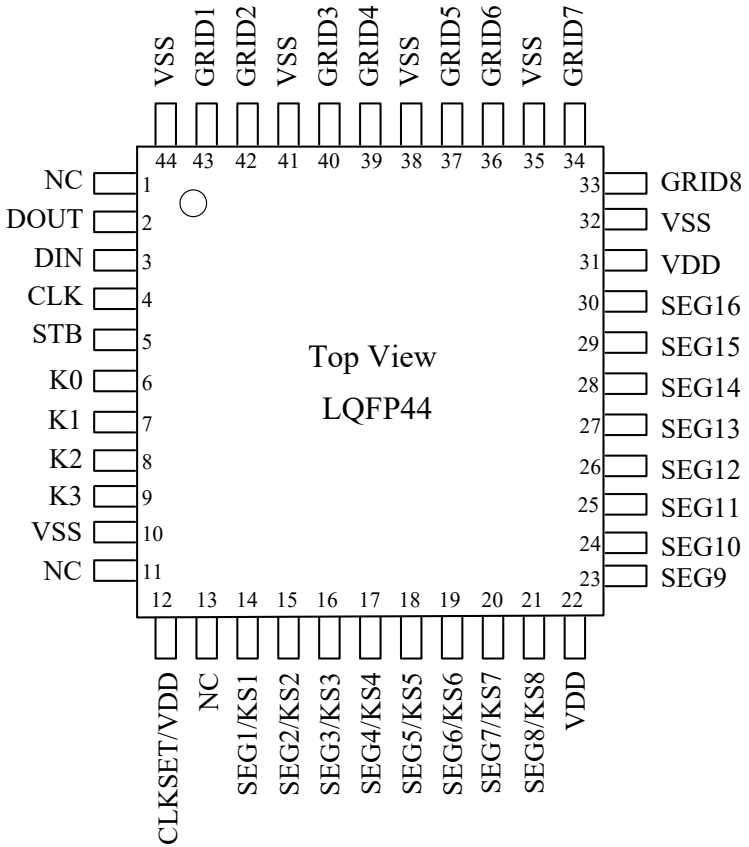
Part No.	Common Cathode Drive	Common Anode Drive	Key press	Packaging
VK1S38A	8 / 8	8 / 8	8×3	SSOP24
VK1638	10 / 8	8 / 10	8×3	SOP28
VK1629A	16 / 8	8 / 16	---	SOP32
VK1629B	14 / 8	8 / 14	8×2	SOP32
VK1629C	15 / 8	8 / 15	8×1	SOP32
VK1629D	12 / 8	8 / 12	8×4	SOP32
VK1629	16 / 8	8 / 16	8×4	LQFP44
VK6932	8 / 16	16 / 8	---	SOP32

Note: For both common cathode and common anode digital tubes, SEG is connected to the anode and GRID to the cathode.

5 Ordering Information

Part No.	Packaging	Tube Qty	Tray(reel) Qty	Box Qty	Total Qty	Notes
VK1S38A	SSOP24	60/tube		6000/box	20800 PCS	
VK1638	SOP28	26/tube		2080/box	16000 PCS	
VK1629A	SOP32	20/tube		1600/box	16000 PCS	
VK1629B	SOP32	20/tube		1600/box	16000 PCS	
VK1629C	SOP32	20/tube		1600/box	16000 PCS	
VK1629D	SOP32	20/tube		1600/box	16000 PCS	
VK1629	LQFP44		160/tray	1600/box	16000 PCS	
VK6932	SOP32	20/tube		1600/box	16000 PCS	

6 Package Pinout Information(SOP32)



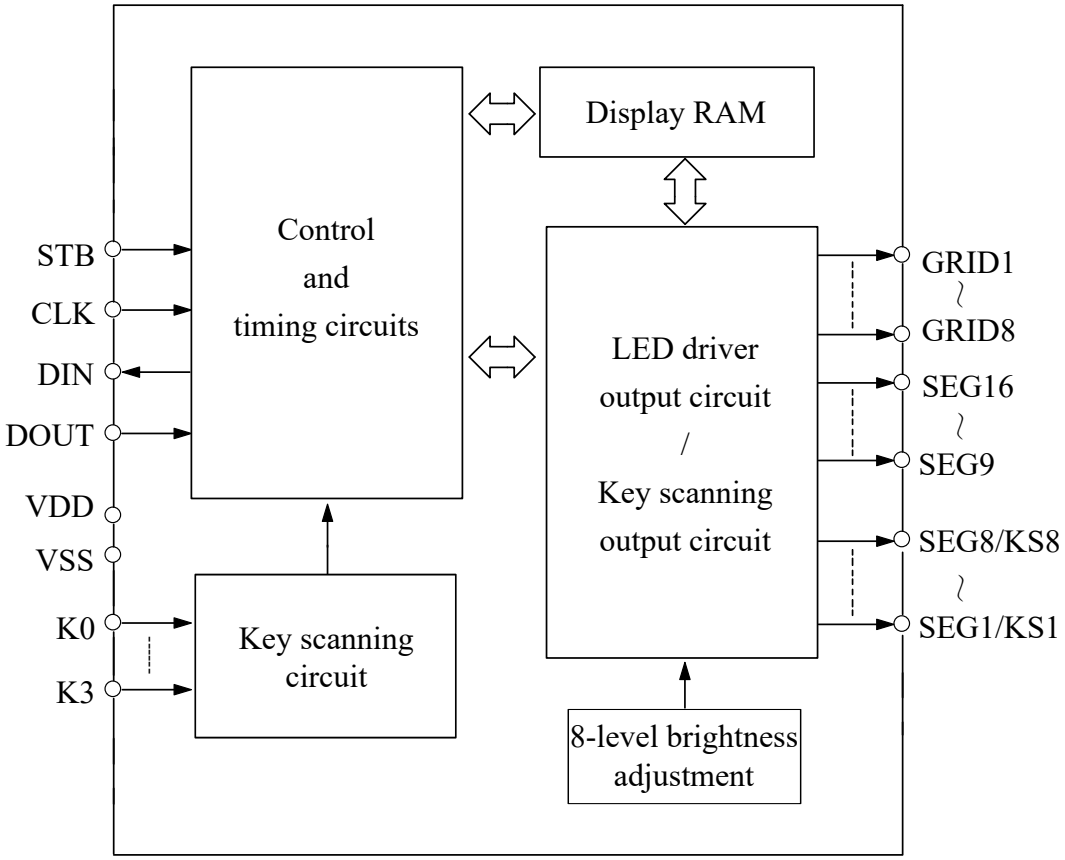
For more information: Page 19

6.1 VK1629/LQFP44 Pin Description

No.	Name	I/O	Function
1,11,13	NC	---	NC
2	DOUT	O	Open-drain output requires an external pull-up resistor. Read the serial data at the rising edge of the clock, starting from the lower bit. It can be short-circuited with DIN for DIO use.
3	DIN	I	Write serial data at the rising edge of the clock, starting from the lower bit. It can be short-circuited with DOUT for DIO use
4	CLK	I	The clock signal writes data to the DIN pin at the rising edge to the display RAM, and reads data from the DOUT pin at the rising edge.
5	STB	I	Chip selection signal, high level disabled, low level enabled.
6-9	K0-K3	I	Key scanning input, the key signal is latched after the display cycle ends
10,32,35 38,41,44	VSS	VSS	Negative power supply
14-21	SEG1/KS1 SEG8/KS8	O	LED SEG output (P-channel); Key scan output
22,31	VDD	VDD	Positive power supply
23-30	SEG9-SEG16	O	LED SEG output (P-channel)
33,34 36,37 39,40 42,43	GRID8-GRID1	O	LED GRID output (N-channel open-drain output)

7 Functional Description

7.1 Block Diagram



7.2 Display RAM- Storage Structure

The static display memory (RAM) has a structure of 16×8 bits and stores the displayed data. The content of RAM is directly mapped to the display content of the LED driver, with display addresses ranging from 0xC0 to 0xCF, and there are a total of 16 display units. If you want to turn on or off a certain LED, simply set the corresponding display RAM position 1 or clear 0. For example, to control the on/off of LED1 driven by pins SEG1 and GRID1, simply set the Bit0 position of the corresponding display RAM (address 0xC0) to 1 or clear 0. Clear the RAM bits corresponding to the unused SEG pins in the application to 0.

The process of mapping the contents in RAM to leds is shown in the following table:

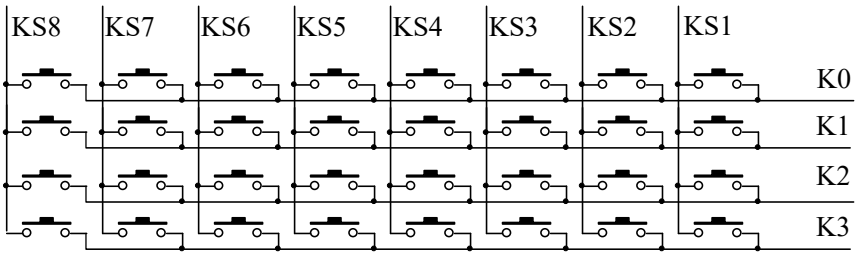
SEG / GRID	SEG16	SEG15	SEG14	SEG13	SEG12	SEG11	SEG10	SEG9	Addr	SEG8	SEG7	SEG6	SEG5	SEG4	SEG3	SEG2	SEG1	Addr	SEG / GRID
GRID1									0xC1									0xC0	GRID1
GRID2									0xC3									0xC2	GRID2
GRID3									0xC5									0xC4	GRID3
GRID4									0xC7									0xC6	GRID4
GRID5									0xC9									0xC8	GRID5
GRID6									0xCB									0xCA	GRID6
GRID7									0xCD									0xCC	GRID7
GRID8									0xCF									0xCE	GRID8
	D7	D6	D5	D4	D3	D2	D1	D0		D7	D6	D5	D4	D3	D2	D1	D0		

Note:

1. The value stored inside the chip display RAM at the moment of power-on may be random. It is recommended that the customer perform a power-on reset of the display RAM, that is, write all the data 0x00 to the 16-byte display RAM(address 0xC0-0xCF) after power-on.
2. The SEG pin can only be connected to the anode of the LED, and the GRID pin can only be connected to the cathode of the LED. They must not be reversed.

8 Key Scanning

8.1 Key Data Reading



The key scanning is automatically completed by the hardware. Users only need to read the key values in sequence. It takes two display cycles to complete one key scan, with each display cycle approximately taking 4ms. Within 8ms, two different keys were pressed successively, and the key values read twice were those of the first pressed key.

After the host sends the command to read the key, it starts to read the 4-byte key data in sequence. The read key data is output from the lower bit. When a certain key is pressed, the bit position within the corresponding key data byte is 1.

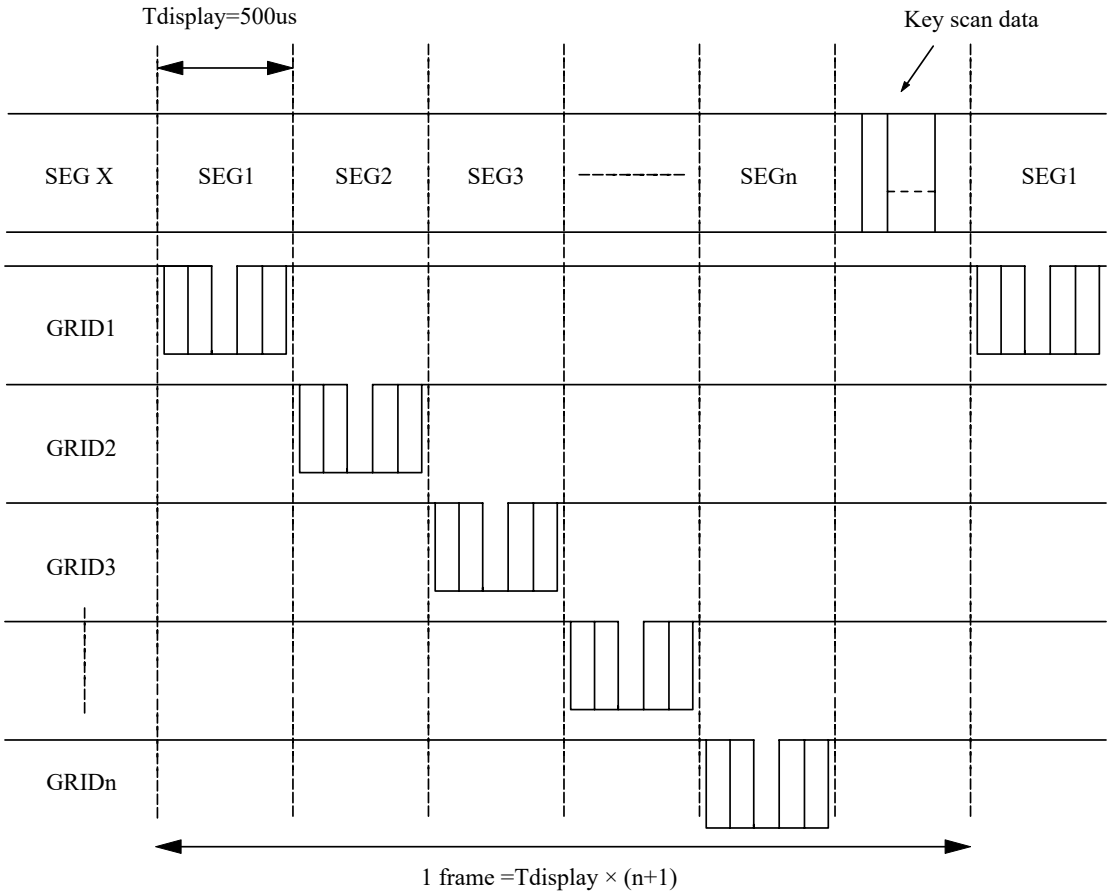
The keys and their corresponding key data are as shown in the following figure:

Key data	K0	K1	K2	K3	K0	K1	K2	K3
Byte 1	KS2				KS1			
Byte 2	KS4				KS3			
Byte 3	KS6				KS5			
Byte 4	KS8				KS7			
	D7	D6	D5	D4	D3	D2	D1	D0

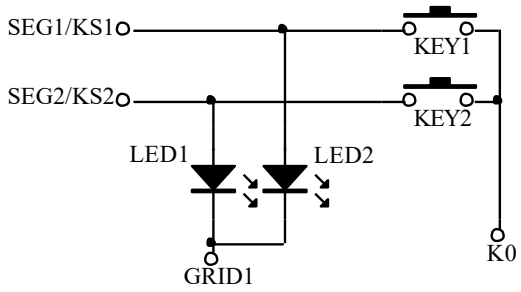
Note:
Reading key data must be done in sequence. Cross-byte reading is not allowed, and the reading should not exceed 4 bytes.
A combination key can only be the same KS; different K pins can be used as combination keys. The same K and different KS pins cannot be used as combination keys.

8.2 Key Scan Timing

The key scanning and display sequence diagram is as follows:

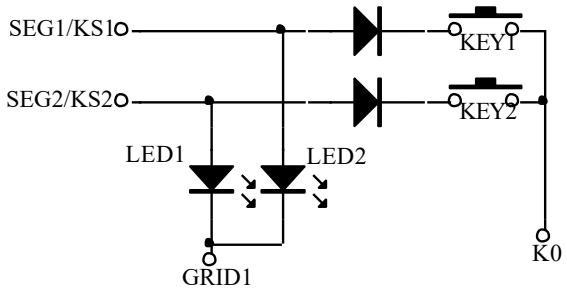


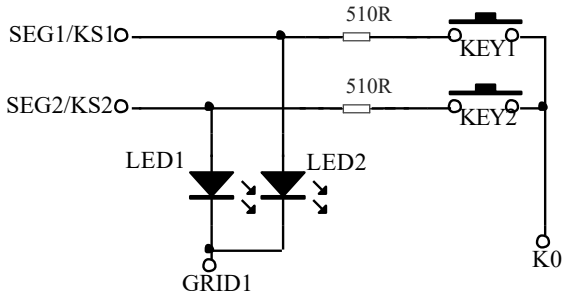
8.3 Key/Display Reuse



As shown in the above figure, for LED1 to be on and LED2 to be off, SEG1 needs to be in the "0" state and SEG2 in the "1" state. If KEY1 and KEY2 are pressed simultaneously, it is equivalent to SEG1 and SEG2 being short-circuited. At this time, both LED1 and LED2 will be on. This can be solved by connecting a diode in series or a resistor.

As shown in the following figure:





Note: The resistance value of the resistor should be selected at 510 ohms. If it is too high, it may cause the key to fail; if it is too low, it may not solve the problem of display interference.

9 Serial Communication Commands

9.1 Communication Interface

The VK1629 has four communication pins.

The STB pin signal is used to enable/disable communication with the main controller. A high STB level disables and initializes the internal timing, while a low STB level enables the first byte input from the DIO pin after the falling edge of the STB as an instruction. If the STB is set to a high level during instruction or data transmission, Then the serial communication is initialized, and the instructions or data being transmitted are invalid.

The CLK pin is the clock input pin. Data is written to the DIN pin at the rising edge to the display RAM, and data is read from the DOUT pin at the rising edge.

The DIN pin is a serial data input pin. Writing data or commands must be done through the DIN pin, starting from the lower bit.

The DOUT pin is a serial data output pin. Data must be read through the DOUT pin, starting from the lower bit

9.2 Command Format

Commands are used to set the display mode, write display data and read key values.

The first byte input by DIO after the falling edge of STB is taken as the command. After decoding, the highest two bits, 7 and 6, are selected to distinguish different commands, as shown in the following table:

bit7	bit6	Function
0	1	Data read and write setting command
1	0	Display control command
1	1	Address setting command

10 Command Description

10.1 Display Mode Setting Command

This command is used for LED display data writing and key reading as well as related commands. bit1 and bit0 bits are not allowed to be set to 01 or 11.
When powered on, the bit3-bit0 data is 0.

bit7	bit6	bit5	bit4	bit3	bit2	bit1	bit0	Function	Note
0	1	---				0	0	Data read and write mode Settings	Write data to display register
0	1					1	0		Read the key data
0	1				0			Address increase mode Settings	Automatic address increment
0	1				1				Fixed address
0	1			0				Working mode Settings	Normal mode
0	1			1					Test mode

10.2 Address Setting Command

Set the address of the displayed RAM (0×C0-0×CD). When powered on, the address is set to 0×C0 by default.

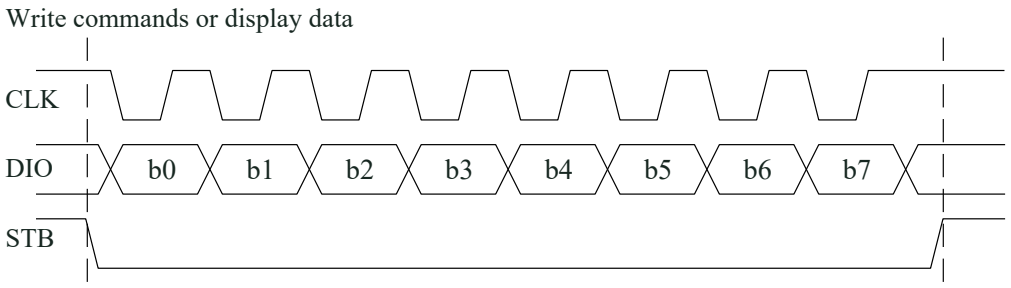
bit7	bit6	bit5	bit4	bit3	bit2	bit1	bit0	Display RAM address
1	1	---		0	0	0	0	0xC0
1	1			0	0	0	1	0xC1
1	1			0	0	1	0	0xC2
1	1			0	0	1	1	0xC3
1	1			0	1	0	0	0xC4
1	1			0	1	0	1	0xC5
1	1			0	1	1	0	0xC6
1	1			0	1	1	1	0xC7
1	1			1	0	0	0	0xC8
1	1			1	0	0	1	0xC9
1	1			1	0	1	0	0xCA
1	1			1	0	1	1	0xCB
1	1			1	1	0	0	0xCC
1	1			1	1	0	1	0xCD
1	1			1	1	1	0	0xCE
1	1			1	1	1	1	0xCF

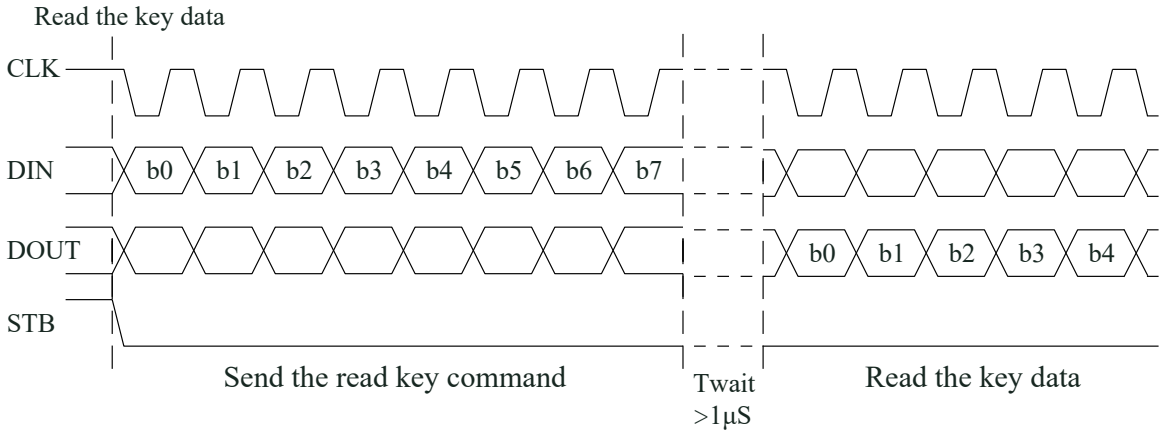
10.3 Display Control Command

Set the display switch and select the display brightness (8 levels).

bit7	bit6	bit5	bit4	bit3	bit2	bit1	bit0	Function	Note
1	0	---			0	0	0	Set the pulse width	Set the pulse width to 1/16
1	0				0	0	1		Set the pulse width to 2/16
1	0				0	1	0		Set the pulse width to 4/16
1	0				0	1	1		Set the pulse width to 10/16
1	0				1	0	0		Set the pulse width to 11/16
1	0				1	0	1		Set the pulse width to 12/16
1	0				1	1	0		Set the pulse width to 13/16
1	0				1	1	1		Set the pulse width to 14/16
1	0			0				Display switch	Show off
1	0			1					Display on

10.4 Command Timing

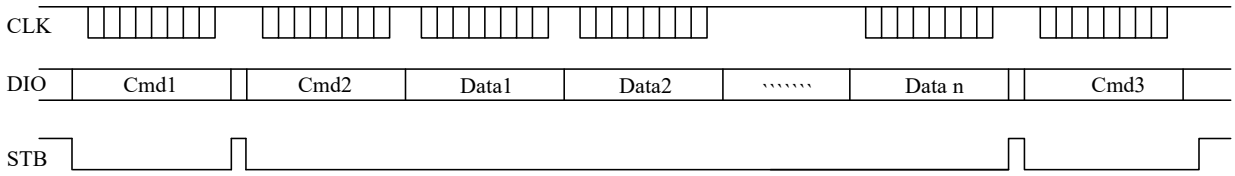




11 Command Application

11.1 Send Display Data (address automatically adds 1)

To transfer display data using the address auto-increment mode, first set the starting address of the data to be transferred (corresponding to the display RAM address). After the starting address command word is sent, the STB does not need to be set high and can directly transmit the display data, with a maximum of 16 sections. After the data is transmitted, the STB is set high, and the display data is output starting from the lower bit.



Cmd1: Data Read and Write Setting Command - Set Address to Increase automatically (0×40)

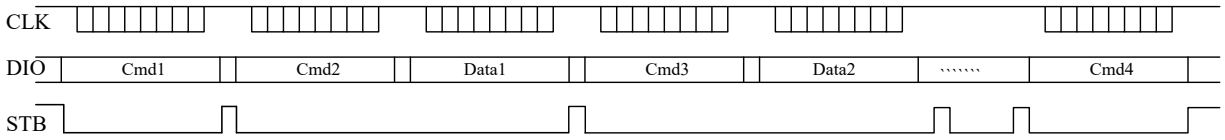
Cmd2: Address Setting Command - Set the display RAM starting address (0×C0-0×CF)

Data1-Datan: Send the display data to the starting address set by Cmd2 and the subsequent display RAM (up to 16 bytes)

Cmd3: Display Control Command - Display on and set the display brightness level

11.2 Send Display Data (fixed address)

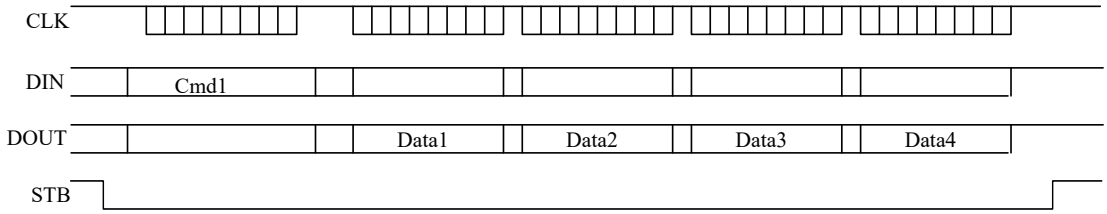
To transfer display data using the fixed address mode, first set the address of the data to be transferred (corresponding to the display RAM address). After the address is sent, the STB does not need to be set high and can directly transfer 1 byte of display data. After the data is transferred, the STB is set high. Send the address of the next display data. The STB does not need to be set high and can directly send 1 byte of display data. After the data is transmitted, the STB is set high. ... Until the last byte of the display data is transmitted, up to a maximum of 16 bytes, the display data is output starting from the lower bit.



Cmd1: Data Read and Write Settings Command - Set Fixed Address Mode (0×44)
Cmd2: Address Setting Command - Set display RAM Address (0×C0-0×CF)
Data1: Send display data to the display RAM address set by Cmd2
Cmd3: Address Setting Command - Set display RAM Address (0×C0-0×CF)
Data2: Send display data to the display RAM address.... set by Cmd3 A maximum of 16 bytes of data can be transmitted
Cmd4: Display Control Command - Display on and set Display Brightness Level (0×88|0×85)

11.3 Read The Key Data

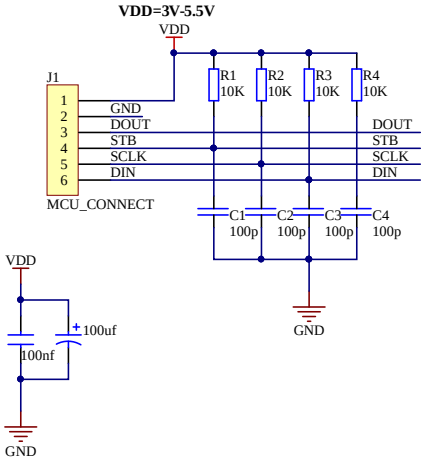
The data read and write setting command is set to read key data, and then starts to read 4 bytes of key data in sequence. The read key data is output starting from the lower bit.

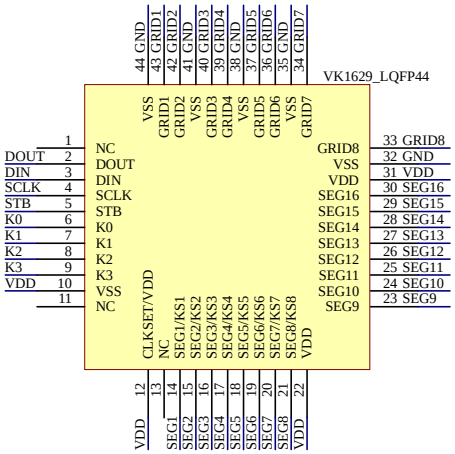


Cmd1: Display Mode Setting Command - Set to read key data (0×42)
Data1-Data4: Read 4 bytes of key data in sequence, and output the key data starting from the lower bit.

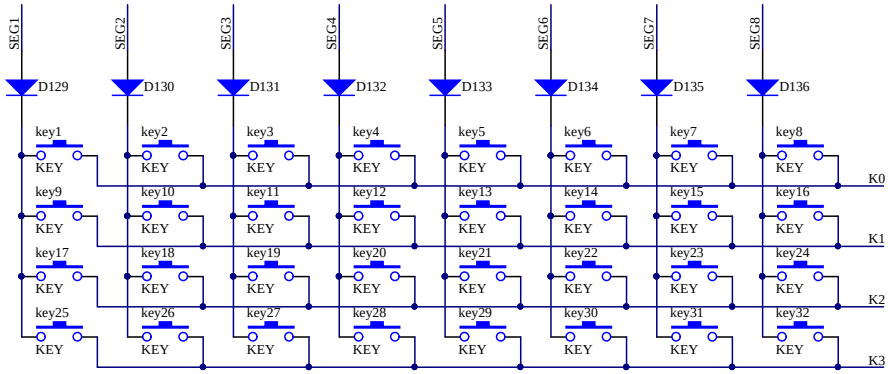
12 Application Circuits

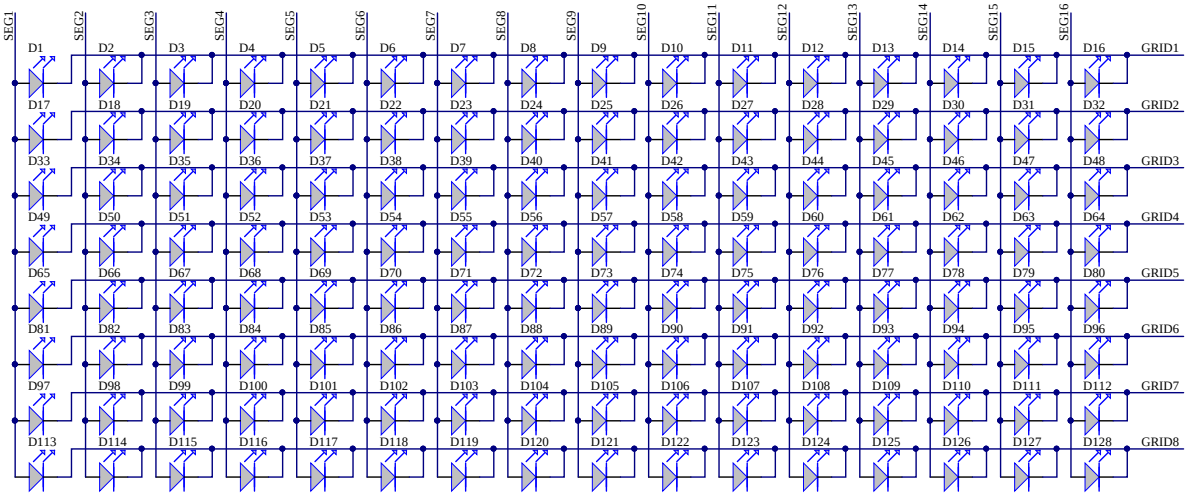
When the power supply for the single-chip microcomputer (3.3V) and the driver chip (5V) is inconsistent, it is recommended to add a level conversion circuit to the communication pin. When the interference around the level conversion circuit is relatively large, a 10R to 10k resistor and a PF-class small capacitor to ground can be connected in series on the communication pin





The filter capacitor between VDD and GND should be placed as close to the chip as possible on the PCB board to enhance the filtering effect.





Connect the SEG pin to the anode of the LED and the GRID pin to the cathode of the LED

13 Electrical Characteristics

13.1 Absolute Maximum Ratings

Parameter	Symbol	Ratings	Unit
Supply voltage	VDD	-0.5～7.0	V
Input Voltage	VIN	VSS-0.5～VDD+0.5	V
Storage Temperature	T_{STG}	-50～+125	℃
Operating Temperature	T_{OTG}	-40～+80	℃

13.2 DC Electrical Characteristics

Parameter	Symbol	Min.	Typ.	Max.	Unit	Test Conditions	
						VDD	Conditions
Operating voltage	VDD	3.0	—	5.5	V	—	—
Static current	IDD	—	0.5	1.0	mA	5V	No load /LED off
High-level output current	I_{OHSEG1}	-20	-25	-40	mA	5V	VO=VDD-2V SEG1- SEG15
	I_{OHSEG2}	-25	-30	-50			VO=VDD-3V SEG1- SEG15
Low-level input current	I_{OLGRID}	80	120	—	mA	5V	VO=0.3V GRID1- GRID8
High-level output current tolerance	I_{TOLSEG}	—	—	5	%	VDD	VO=VDD-3V(VDD=5V) VO=VDD-2V(VDD=3V) SEG1-SEG15
Low-level Input	V_{IL}	0	—	0.3	VDD	VDD	STB,CLK,DIN,DOUT
High-level Input	V_{IH}	0.7	—	1.0		VDD	
Pull-down resistor	R_L	—	10	—	kΩ	5V	K0~K3

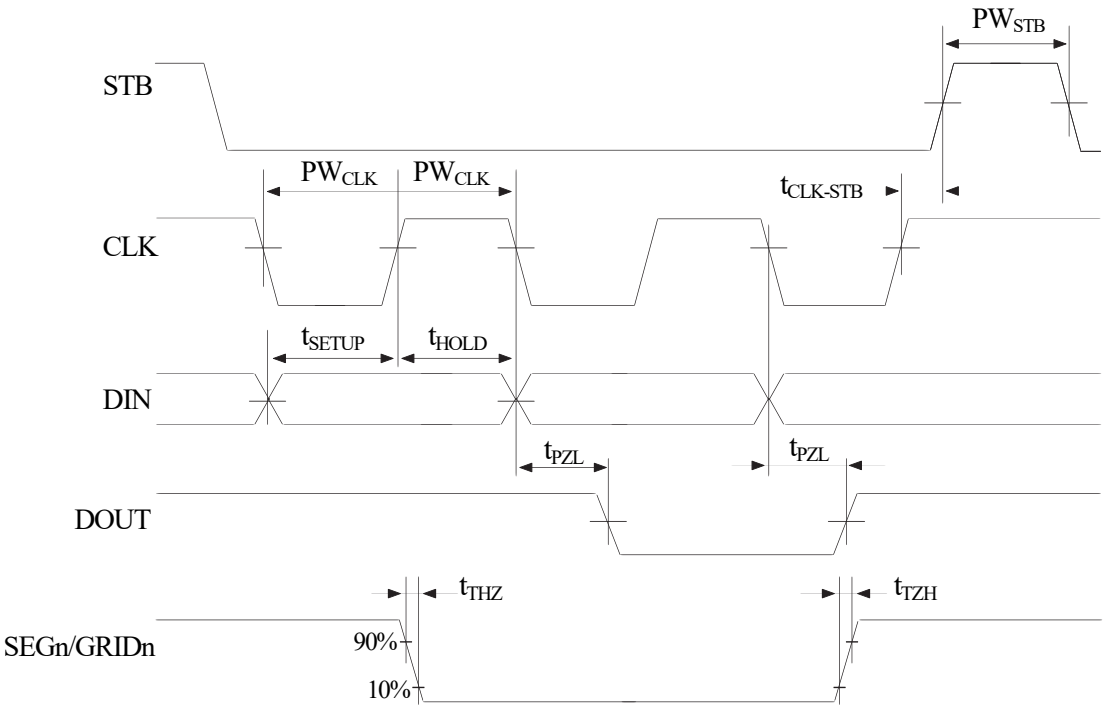
13.3 AC Electrical Characteristics

Switch parameter

Parameter	Symbol	Min.	Typ.	Max.	Unit	Test Conditions
Oscillation frequency	F_{OSC}	—	500	—	KHz	
Transmission delay time	t_{PLZ}	—	—	300	nS	CLK→DOUT CL=15pF,RL=10KΩ
	P_{ZL}	—	—	100	nS	
Rising time	t_{ZH1}	—	—	2	μS	CL=300pF SEG1-SEG16 GRID1-GRID8
	t_{TZH2}	—	—	0.5	μS	CL=300pF GRID1-GRID8
Decrease time	t_{THZ}	—	—	120	μS	CL = 300pF SEGn,GRIDn
Maximum input clock frequency	F_{MAX}	—	—	1	MHz	Duty cycle: 50%
Input capacitance	C_I	—	—	15	pF	—

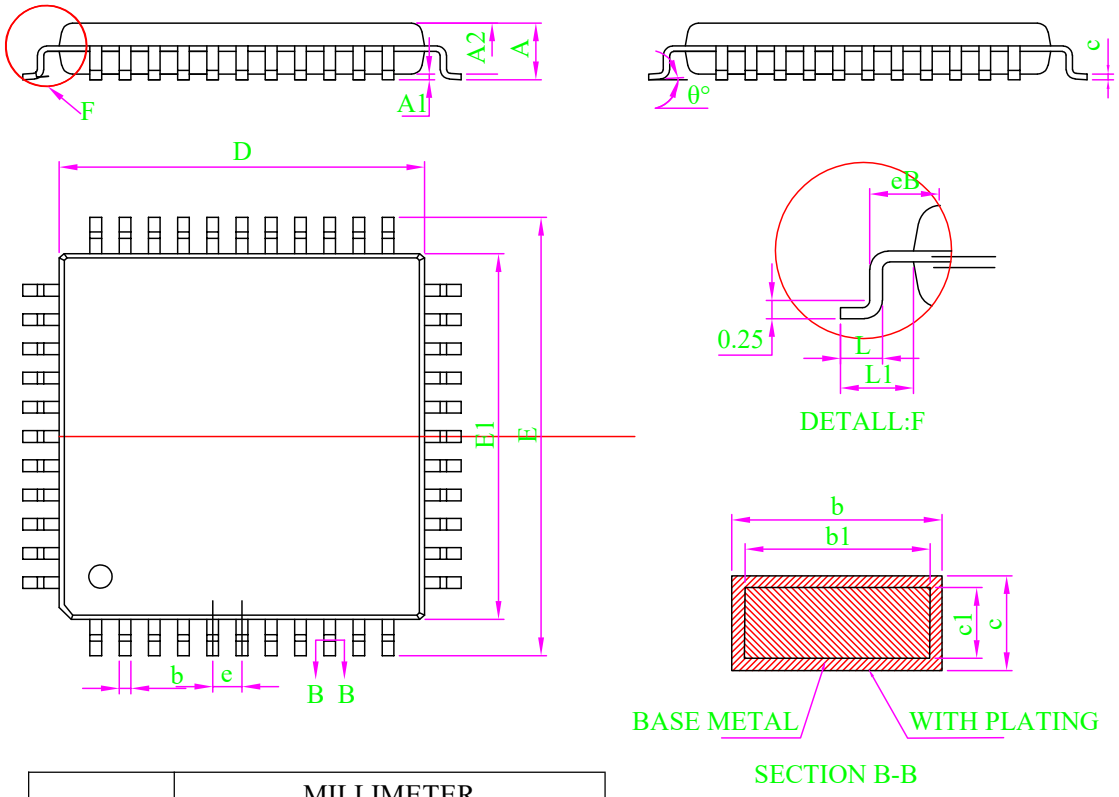
Timing parameter

Parameter	Symbol	Min.	Typ.	Max.	Unit	Test Conditions
Clock pulse width	P_{WCLK}	400	—	—	nS	—
Select pulse width	P_{WSTB}	1	—	—	μS	—
Data establishment time	t_{SETUP}	100	—	—	nS	—
Data retention time	t_{HOLD}	100	—	—	nS	—
CLK→STB time	$t_{CLK-STB}$	1	—	—	μS	CLK↑→STB↑
Waiting time	T_{wait}	1	—	—	μS	CLK↑→CLK↓


PWSTB
STB
PWCLK
PWCLK
tCLK-STB
CLK
tSETUP
tHOLD
DIN
tPZL
tPZL
DOUT
tTHZ
tTZH
SEGn/GRIDn
90%
10%

14 Package Information

14.1 LQFP44(10.0mm × 10.0mm PP=0.8mm)



SYMBOL	MILLIMETER		
	MIN	NOM	MAX
A	-	-	1.70
A1	0.10	0.15	0.20
A2	1.30	1.40	1.50
b	0.28	-	0.36
b1	0.27	0.30	0.33
c	0.13	-	0.17
c1	0.12	0.13	0.14
D	9.90	10.00	10.10
E	11.80	12.00	12.20
eB	11.05	-	11.30
E1	9.90	10.00	10.10
e	0.80 BSC		
L	0.42	0.57	0.72
L1	0.95	1.00	1.15
θ	0	-	8°

Note:

1. All dimension are in mm.
2. Dim D&El does not include plastic flash; Flash: Plastic residual around body edge after de junk/singulation.
3. Dim b does not include dambar protrusion/intrusion.
4. Plating thickness 0.007mm-0.015mm

15 Disclaimer

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Application —— All product application descriptions provided herein are intended for illustrative purposes only.
The Company makes no representations or warranties, express or implied, regarding the suitability of any specific application without further testing or modification.

The customer is solely responsible for determining whether the Company's products are appropriate for their intended applications or end customers.

The customer shall ensure proper design practices, implementation safeguards, and operational validation to minimize risks associated with product use.

The Company shall not be held liable for any defects, losses, costs, or damages arising from weaknesses or failures in the customer's own products or applications, or from the integration or use of third-party products.

Furthermore, the customer shall conduct all necessary testing and validation for any third-party deployment of the Company's products to avoid potential misuse or associated damages. The Company assumes no liability in this regard.

Commercial terms of sale —— Unless otherwise agreed in writing, sales of this product are subject to the Company's standard terms and conditions of sale. The Company expressly rejects the applicability of the customer's general terms and conditions.

Export control—— This product may be subject to applicable export control regulations. The customer is solely responsible for compliance with such regulations, including obtaining any necessary export licenses.

16 Revision History

No.	Version	Date	Modify the content	Check
1	1.0	2018-08-10	Initial release	YES
2	1.1	2018-10-11	Add reference circuit	YES
3	1.2	2019-03-21	Alignment correction	YES
4	1.3	2025-10-11	Change Description	YES

[1] Please refer to the latest version of this document before starting or finalizing any design.

[2] Since the release of this document, the status or availability of this product may have changed. For the most up-to-date information, please visit: https://www.szvinka.com/