

Features

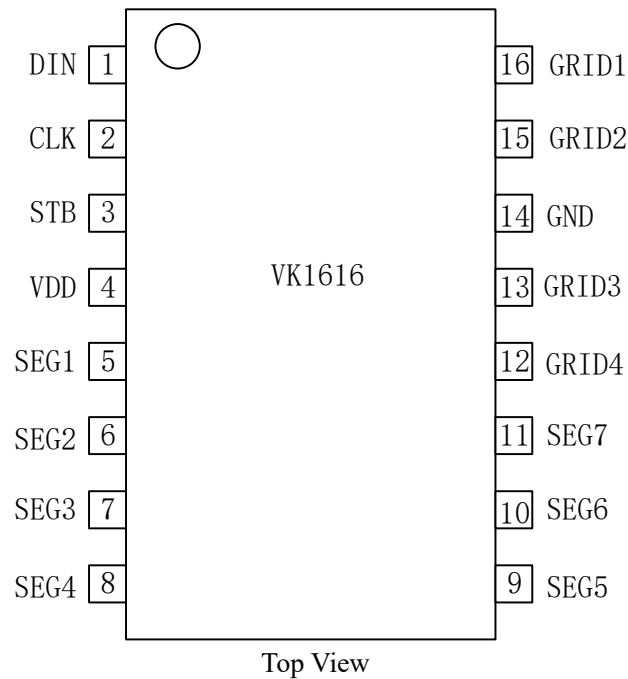
- Operating voltage 3.0-5.5V
- Built-in RC oscillator
- 7 SEG pins, 4 GRID pins.
- SEG pins connect to LED Anode , GRID pins connect to LED Cathode
- 3-wire serial interface
- 8-level brightness control
- Built-in 7X4 bit display RAM
- Power-On Reset(POR)
- Strong anti-interference ability
- Package:
SOP16(150mil)(9.90mm × 3.90mm PP=1.27mm)
DIP16 (250mil) (19.4mm x 6.4mm PP=2.54mm)

1 General Description

VK1616 is a RAM Mapping LED display driver . The Display segment numbers in the device is 7SEGx4GRID. It suitable for multiple LED applications including LED modules and display subsystems. The device communicates with host microcontrollers via a 3 line Serial Interface. SEG pins connect to LED Anode , GRID pins connect to LED Cathode. SOP16/DIP16 package.

2 Pinouts and pin description

2.1 VK1616 SOP16/DIP16 Pin Assignment

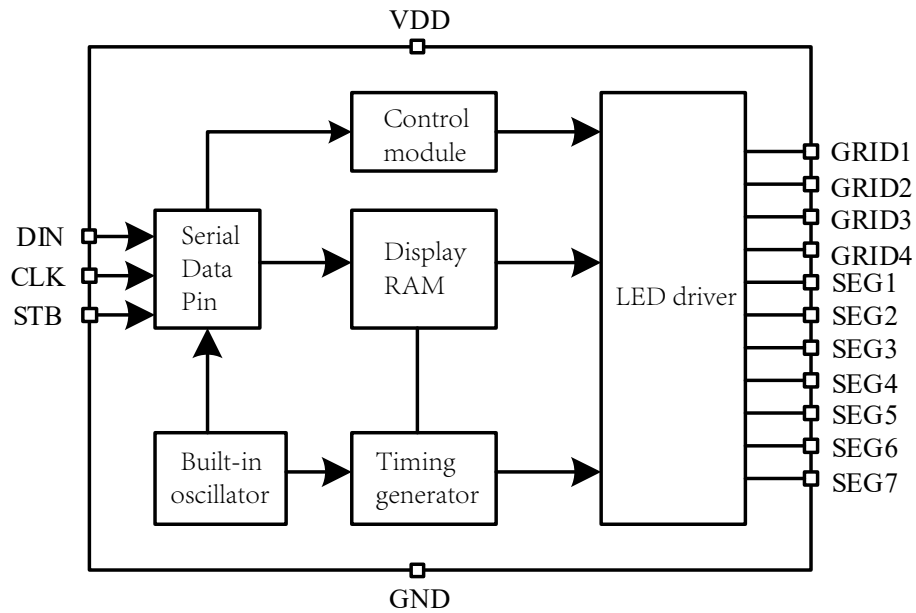


2.2 VK1616 SOP16/DIP16 Pin Description

No.	Name	I/O	Function
1	DIN	I	Data input pin, Serial data is input on the rising edge of the clock.
2	CLK	I	CLK signal input pin, Read the serial data to the display RAM on the rising edge, and output the data on the falling edge.
3	STB	I	Chip selection signal input pin, 1-disable, 0-enable.
4	VDD	VDD	Positive power supply
5~11	SEG1-SEG7	O	LED SEG outputs (P-MOS open drain)
12,13, 15,16	GRID4- GRID1	O	LED GRID outputs (N-MOS open drain)
14	GND	GND	Negative power supply

3 Functional Description


3.1 Block diagram



3.2 Display RAM

The static display memory (RAM) is organized into 7×4 bits and stores the displayed data. The contents of the RAM are directly mapped to the contents of the LCD driver. Display address is 0xC0-0xC6. If you want to lighted on or off an LED, only set or clear the corresponding display RAM bit to 1 or 0, For example, if LED1 driven by SEG1 pin and GRID1 pin is on or off, only set bit0 to 1 or 0 of the corresponding display RAM (0xC0). The ram bit corresponding to the unused SEG pin is cleared to 0.

The following is a mapping from the RAM to the LED pattern:

SEG	×	×	×	×	×	×	×	×	×	Address	×	SEG7	SEG6	SEG5	SEG4	SEG3	SEG2	SEG1	Address	SEG	GRID	
GRID1										0xC1									0xC0	GRID1	GRID1	
GRID2										0xC3										0xC2	GRID2	GRID2
GRID3										0xC5										0xC4	GRID3	GRID3
GRID4										0xC7										0xC6	GRID4	GRID4
	D7	D6	D5	D4	D3	D2	D1	D0			D7	D6	D5	D4	D3	D2	D1	D0				

Note:

At the initial system power on, the value stored in the chip display RAM may be random. It is recommended to clear the display RAM after power on, write 0x00 to the all display RAM (0xC0-0xC6).

SEG pins connect to LED Anode, GRID pins connect to LED Cathode, Reverse connection is not allowed.

3.3 Serial communication command

3.3.1 Serial Interface

3 lines are required to interface with the VK1616

STB is the chip select pin. it is used to enable / disable communication with the controller, high level disable(prohibits and initializes internal timing), low level enables. The first byte input by the DIN pin after the falling edge of the STB is used as the command. If the STB is set to high level during instruction or data transmission, the serial communication is initialized and the command or data being transmitted is invalid.

CLK is the clock signal pin.It reads the data on the rising edge and outputs the data on the falling edge.

DIN is the data input pin , Input serial data on the rising edge of the clock, starting from the low bit.

3.3.2 Command Format

Command is used to set the Display Mode or write the Display Data or read Key data. After the falling edge of STB, the first byte input by DIO is used as the command byte, After decoding, Bit7 and bit6 of the byte are the command bits, as shown in the following table:

bit7	bit6	Command Function
0	0	Display Mode Set Command
0	1	Data Read/Write Set Command
1	0	Display Control Command
1	1	Address Set Command

3.3.3 Command Description

3.3.3.1 Display Mode Set Command

Set the number of SEGs and GRIDs. Although VK1616 has no segment multiplexed pins, it needs a write mode command when writing codes. When the command is executed, Forced display off. If the same mode setting is selected, the command will not be executed.

When powered on, the default display mode is 7 SEGs and 4 GRIDs.

bit7	bit6	bit5	bit4	bit3	bit2	bit1	bit0	Display Mode
0	0	-----				1	1	7SEG 4GRID

3.4.3.2 Data Read/Write Set Command

This command is used to write Display data and related commands. Bit1 and bit0 bits are not allowed to be set to 01 or 11.

when powered on, bit3-bit0 data is 0.

bit7	bit6	bit5	bit4	bit3	bit2	bit1	bit0	Function	Note
0	1	---				0	0	Write data set	Write data to the RAM
0	1				0			Address mode set	address increase
0	1				1				address fixed
0	1			0				Work mode set	normal mode
0	1			1					test mode

3.3.3.3 Address Set Command

Set the address of the Display RAM (0xC0 - 0xC6) , When powered on, the address is set to C0H.

B7	B6	B5	B4	B3	B2	B1	B0	RAM Address
1	1	----		0	0	0	0	00H
1	1			0	0	1	0	02H
1	1			0	1	0	0	04H
1	1			0	1	1	0	06H

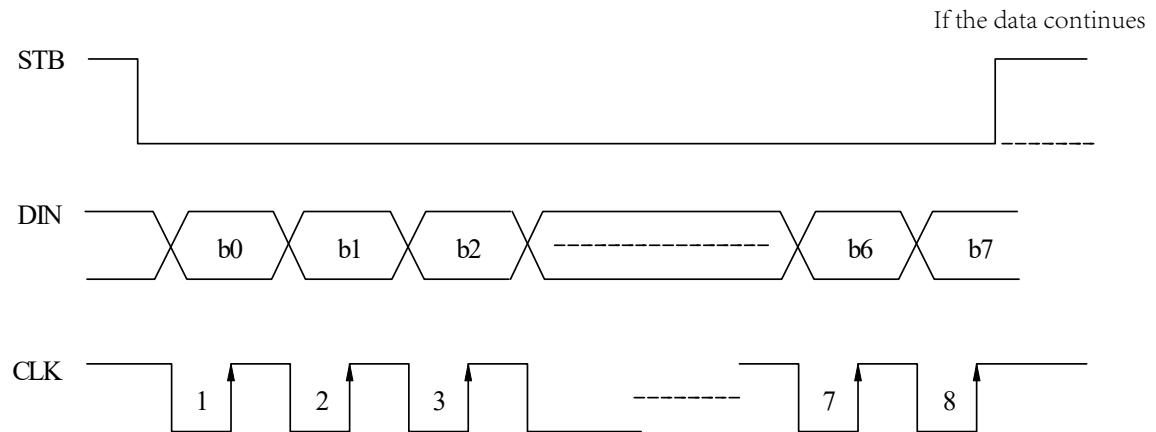
3.4.3.4 Display Control Command

Set the Display ON or OFF and select the Display brightness (level 8).

bit7	bit6	bit5	bit4	bit3	bit2	bit1	bit0	Function	Note	
1	0	----			0	0	0	Set GRID Pulse Width	1/16 duty	
1	0				0	0	1		2/16 duty	
1	0					0	1		0	4/16 duty
1	0					0	1		1	10/16 duty
1	0					1	0		0	11/16 duty
1	0					1	0		1	12/16 duty
1	0					1	1		0	13/16 duty
1	0					1	1		1	14/16 duty
1	0			0				Display on/off	Display off	
1	0			1					Display on	

3.4.4 Command Timing Diagrams

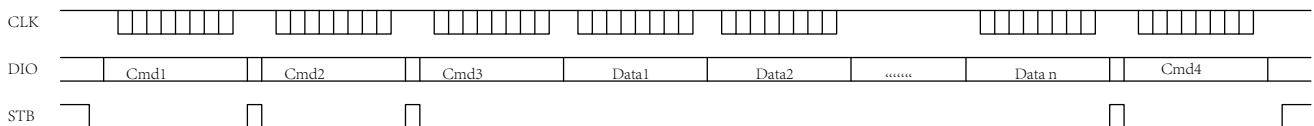
Write data timing diagram



4 Command application

4.1 Send Display data(Address auto Increment)

Using the address auto-increase mode, First set the starting address of the data to be transmitted (Display RAM address). After the start address command byte is sent, The only addresses used are 0xC0, 0xC2, 0xC4, 0xC6, and STB is set high after the data is transferred.



Cmd1: Display Mode Set Cmd -Set the number of SEG and GRID displayed by the LED(Can be set at initialization)

Cmd2: Data Read/Write Set Cmd -Set address auto-increase mode (0x (0x40)

Cmd3: Address Set Cmd -Set the start address of the display RAM (0xC0-0xC6)

Data1-Datan: Send display data to the start address set by Cmd3 and the subsequent address

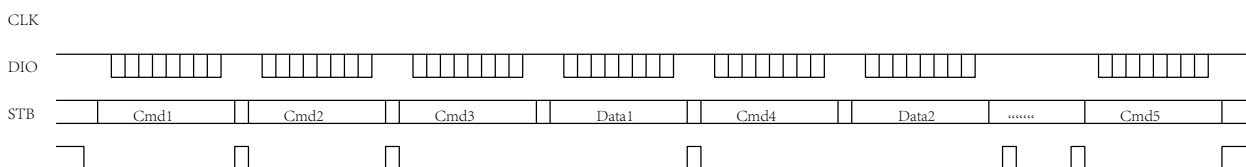
Cmd4: Display Control Cmd -Display ON and select the Display brightness

Note: As the RAM address is automatically incremented when writing data, 0 is sent between discontinuous addresses to fill in. For example: Send data data0-data3.

data0->0xC0 0->0xC1 data1->0xC2 0->0xC3 data2->0xC4 0->0xC5 data3->0xC6

4.2 Send Display data(Fixed Address)

Using the fixed address mode, first set the address of the data to be transmitted (Display RAM address), After sending the address, directly transmit 1 byte of display data; Then transfer the address of the next display data, and directly transfer 1 byte of display data Until the last byte of display data is transmitted, Up to 4 bytes.



Cmd1: Display Mode Set Cmd -Set the number of SEG and GRID displayed by the LED(Can be set at initialization)

Cmd2: Data Read/Write Set Cmd -Set fixed address mode (0x44)

Cmd3: Address Set Cmd -Set Display RAM address (0xC0,0xC2,0xC4,0xC6)

Data1: Send the Display data to the display RAM address set by Cmd3

Cmd4: Address Set Cmd -Set Display RAM address (0xC0,0xC2,0xC4,0xC6)

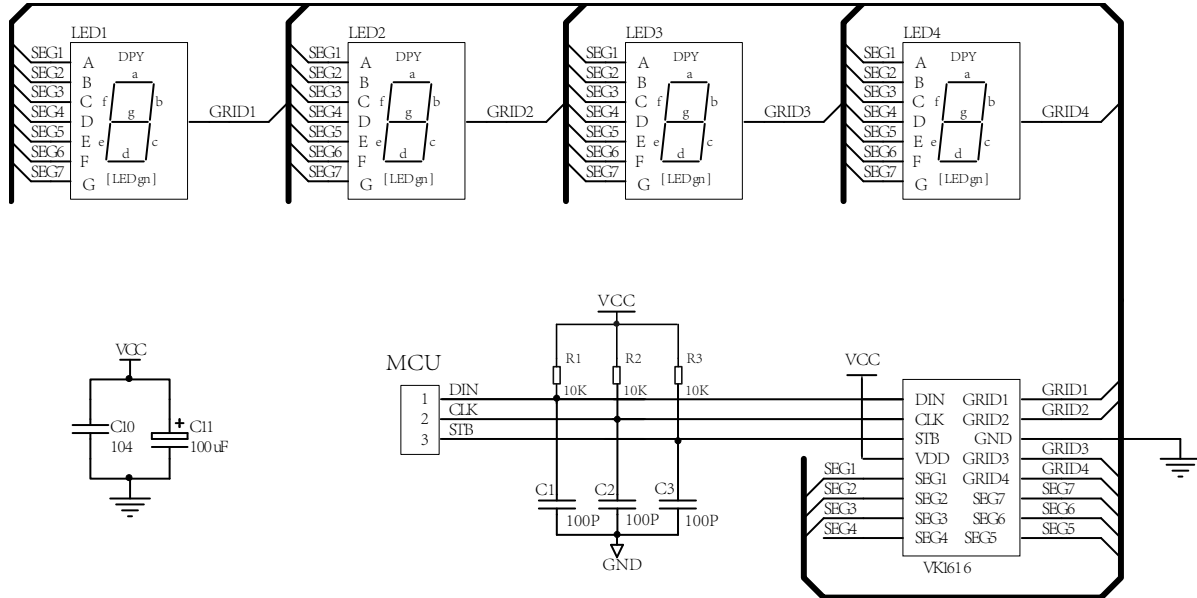
Data2: Send the Display data to the display RAM address set by Cmd4

....up to 4 bytes of data to be send

Cmd5: Display Control Cmd -Display ON and select the Display brightness

5 Application Circuits

8-SEG LED Display shared Cathode



6 Electrical characteristics

6.1 Absolute Maximum Ratings

Item	Symbol	Ratings	Unit
Power voltage	VDD	-0.3~7.0	V
Input Voltage	VIN	$V_{SS}-0.5 \sim V_{DD}+0.5$	V
Power Dissipation	PD	400	mW
Drive Output Current	I_{OLGRID}	+250	mA
	I_{OHSEG}	-50	mA
Storage Temperature	TSTG	-50~+125	°C
Operating Temperature	TOTG	-40~+85	°C

6.2 DC Characteristics

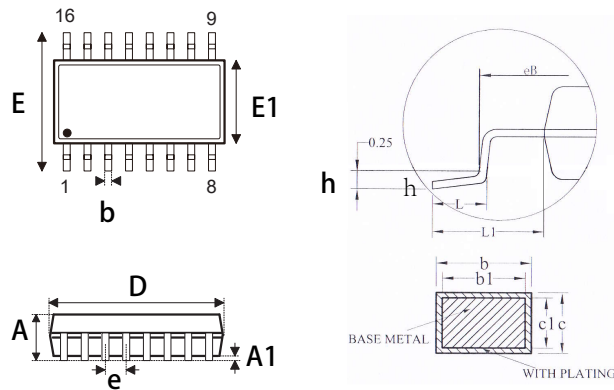
Item	Symbol	Min.	Typ.	Max.	Unit	Test Conditions	
						VDD	Conditions
Operating Voltage	VDD	3.0	—	5.5	V	—	—
Quiescent Current	I_{DD}	—	0.5	1.0	mA	5V	No load/LED OFF
High Level output Current	I_{OHSEG1}	-20	-25	-40	mA	5V	VO=VDD-2V SEG1- SEG7
	I_{OHSEG2}	-25	-30	-50			VO=VDD-3V SEG1- SEG7
Low Level input Current	I_{OLGRID}	100	140	—	mA	5V	VO=0.3V GRID1- GRID4
High level output current tolerance	I_{TOLSEG}	—	—	5	%	VDD	VO=VDD-3V(VDD=5V) VO=VDD-2V(VDD=3V) SEG1 to SEG7
Input Low Voltage	V_{IL}	0	—	0.3	VDD	VDD	STB, CLK, DIO
Input High Voltage	V_{IH}	0.7	—	1.0		VDD	
pull-down resistor	R_L	—	—	—	kΩ	5V	—

6.3 AC Characteristics

Item	Symbol	Min.	Typ.	Max.	Unit	Test Conditions
Transmission delay time	t_{PLZ}	-	-	300	nS	CLK → DOUT
	t_{PZL}	-	-	100	nS	CL = 15pF, RL = 10K Ω
Rise Time	$t_{ZH 1}$	-	-	2	μS	CL=300pF SEG1-SEG7
	$t_{TZH 2}$	-	-	0.5	μS	CL=300pF GRID1-GRID4
Fall Time	t_{THZ}	-	-	1.5	μS	CL = 300pF SEGn,GRIDn
Max. input Freq	F _{MAX}	-	-	1	MHz	50% duty
Input Capacitance	C _I	-	-	15	pF	-

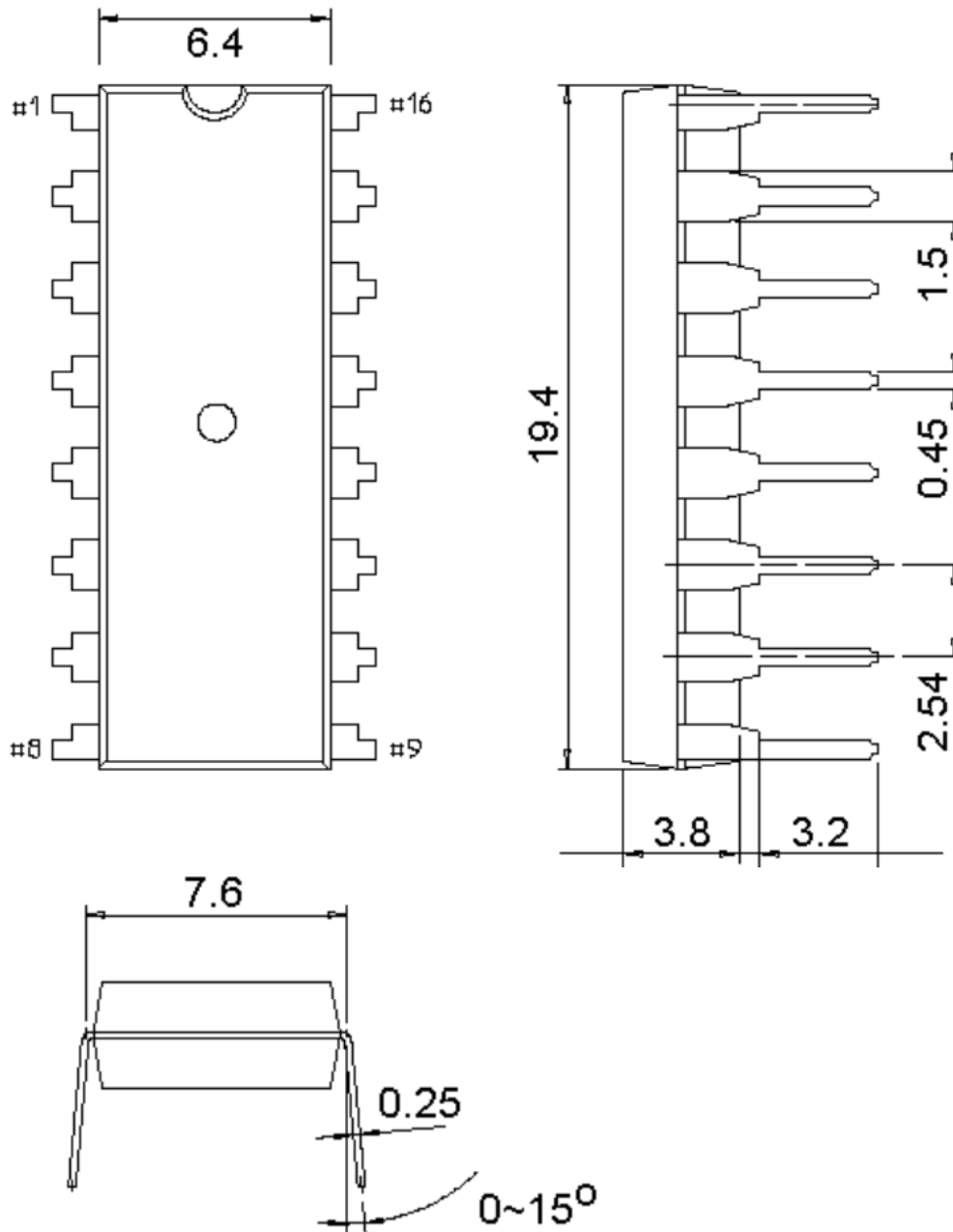
7 Package Information

7.1 SOP16 (150mil) (9.9mmx3.9mm PP=1.27mm)



SYMBOL	MILLIMETER		
	MIN	NOM	MAX
A	---	---	1.55
A1	0.10	---	0.225
b	0.39	---	0.47
b1	0.38	0.41	0.44
c	0.20	---	0.24
c1	0.19	0.20	0.21
D	9.80	9.90	10.00
E	5.80	6.00	6.20
E1	3.80	3.90	4.00
e	1.27BSC		
h	0.25	---	0.50
L	0.50	---	0.80
L1	1.05REF		

7.2 DIP16 (250mil) (19.4mm x 6.4mm PP=2.54mm)



8 Revision history

No.	Version	Date	Modify the content	Check
1	1.0	2018-08-10	Original version	Yes
2	1.1	2019-07-11	Add Ref circuits	Yes
3	1.2	2020-02-11	Update content	Yes

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