

ET1616 - Matrix LED Controller and Driver

General Description

ET1616 is an LED Controller driver with 7 segment output lines, 4 grid output lines, one display memory, control circuit are all incorporated into a single chip to build a highly reliable peripheral device for a single chip microcomputer. Serial data is fed to ET1616 via a three-line serial interface, ET1616 pin assignments and application circuit are optimized for easy PCB Layout and cost saving advantages.

Features

- CMOS Technology
- Low Power Consumption
- Max 28 LED Display Matrix (7Segs × 4Grids)
- 8-step Dimming Circuitry
- 3-Serial Interface for Clock, Data Input/Output, Strobe Pins
- Built in RC oscillation

Device Information

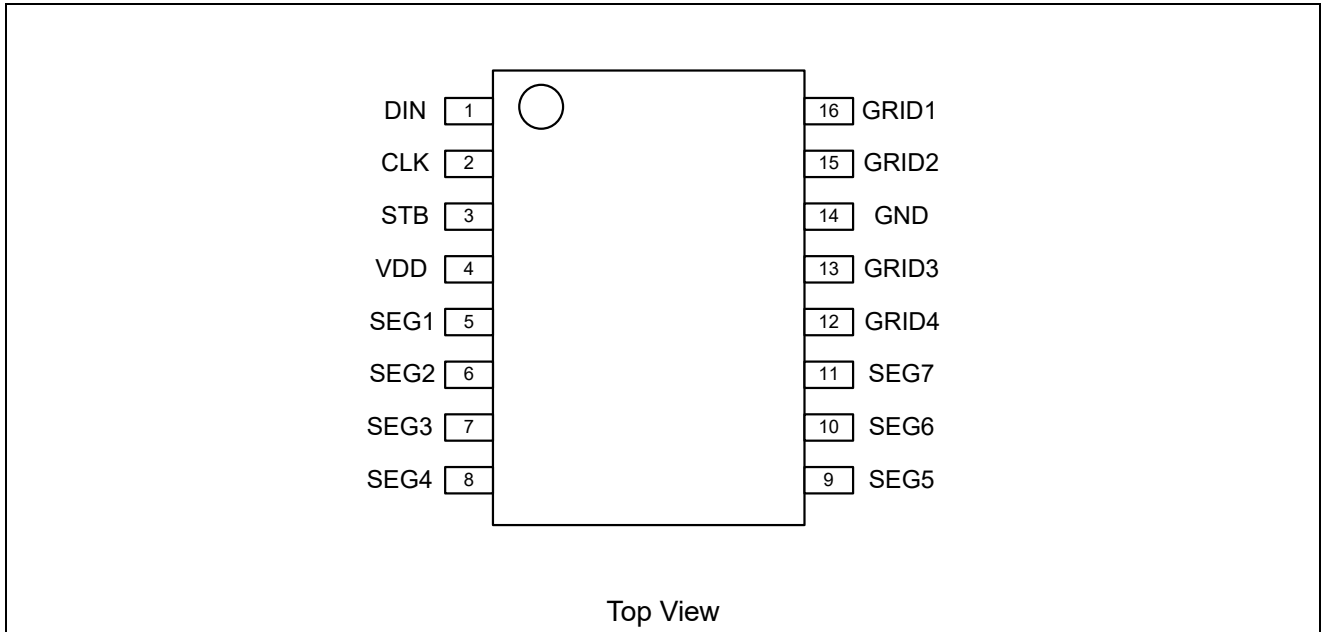
Part No.	Package
ET1616M	SOP16
ET1616P	DIP16

Application

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

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Pin Assignments

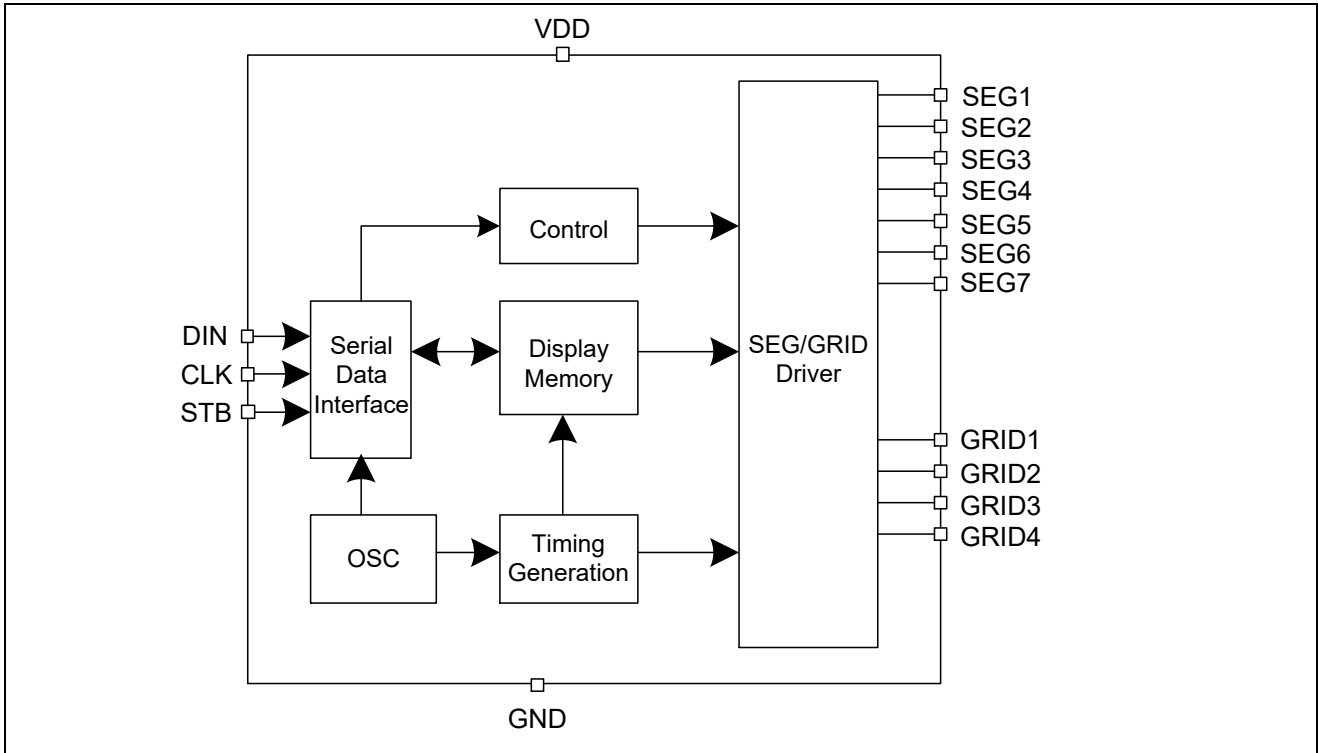


Pin. Function

Pin No.	Pin Name	I/O	Description
1	DIN	I	Data Input Pin
2	CLK	I	Clock Input Pin
3	STB	I	Serial Interface Strobe Pin
4	VDD	—	Power Supply
5~11	SEG1 ~ SEG7	O	Segment output, connected to LED anode.
14	GND	—	GND Pin
12, 13, 15, 16	GRID4 ~ GRID1	O	Grid output, connected to LED cathode.

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Block Diagram



Functions Description

Command

After the STB port status changes from high to low, input command bytes through the DIN port. If the STB port is set to high for some reason while the data or command is being transmitted, the serial communication is initialized and the data/command being entered is considered invalid.

Command 1: display mode setting command

The display mode setting command determines the number of segments (4 grids, 7 segments) used. A display command must be executed to continue the display. If the same mode is selected, the command is not executed.

MSB						LSB		Function	Description
B7	B6	B5	B4	B3	B2	B1	B1		
0	0	NC, Set to 0 please				0	0	Display segment and grid setting	7 Segs×4 Grids

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Command2: Data Command Setting

Data setup commands perform write display data .When the power supply is powered on, bits 4 to 1 (B3 to B0) should be set to 0.

MSB

LSB

B7	B6	B5	B4	B3	B2	B1	B0	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	Write Data	Display data input mode

Command3: Display Address Setting

The address setting command is used to set the display memory address.If the address ranges from 00H,02H,04H,06H , the address is valid.If the address is 07H or higher, the data is invalid unless the correct address is set again.When the power supply is powered on, the address is 00H.

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	1	0	Display address 02H
1	1			0	1	0	0	Display address 04H
1	1			0	1	1	0	Display address 06H

Address assignment:

SEG1.....SEG4	SEG5.....SEG7	
00HL	00HU	GRID1
02HL	02HU	GRID2
04HL	04HU	GRID3
06HL	06HU	GRID4

Definition of H_U and H_L in RAM address:

B0	B1	B2	B3	B4	B5	B6	B7
xxHL				xxHU			
Low 4bits				High 4bits			

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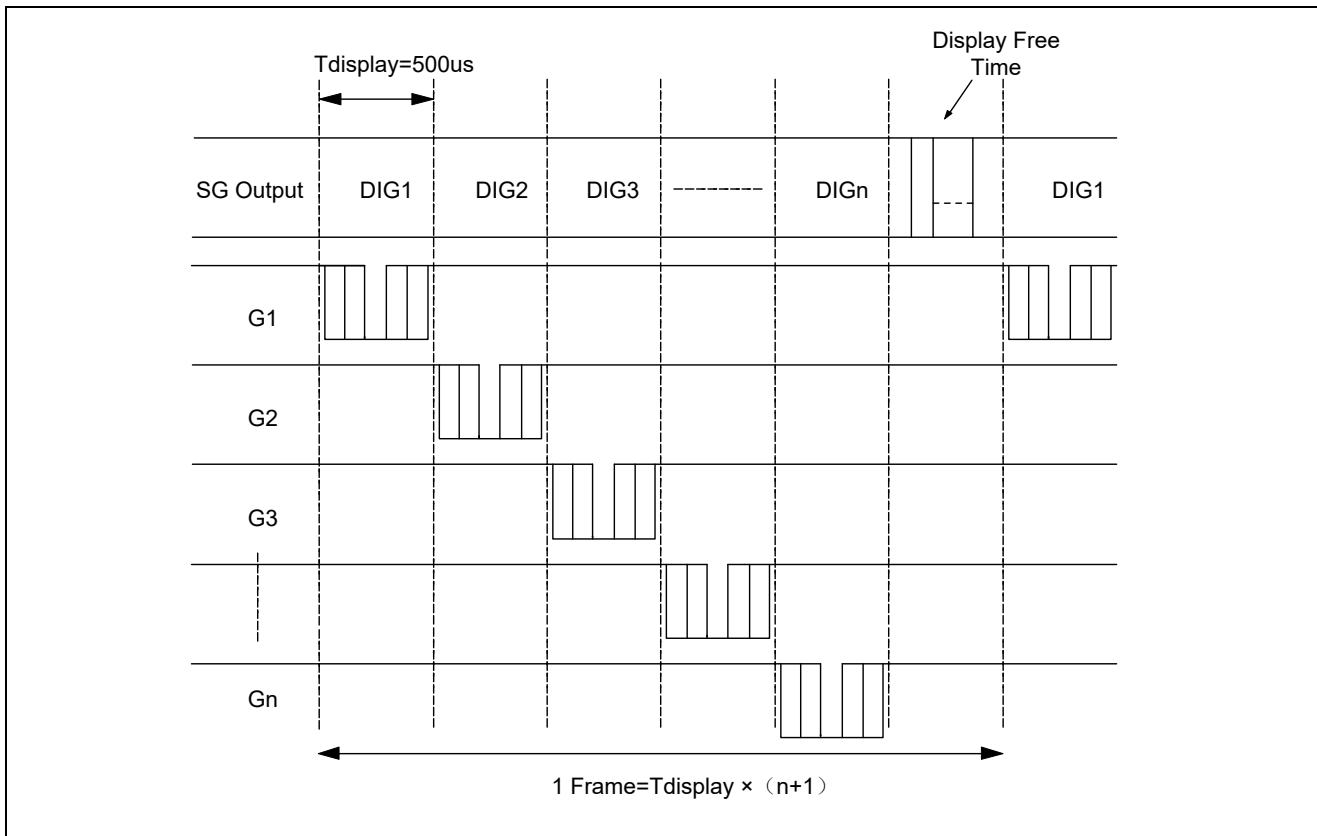
Command4: Display Control Setting

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

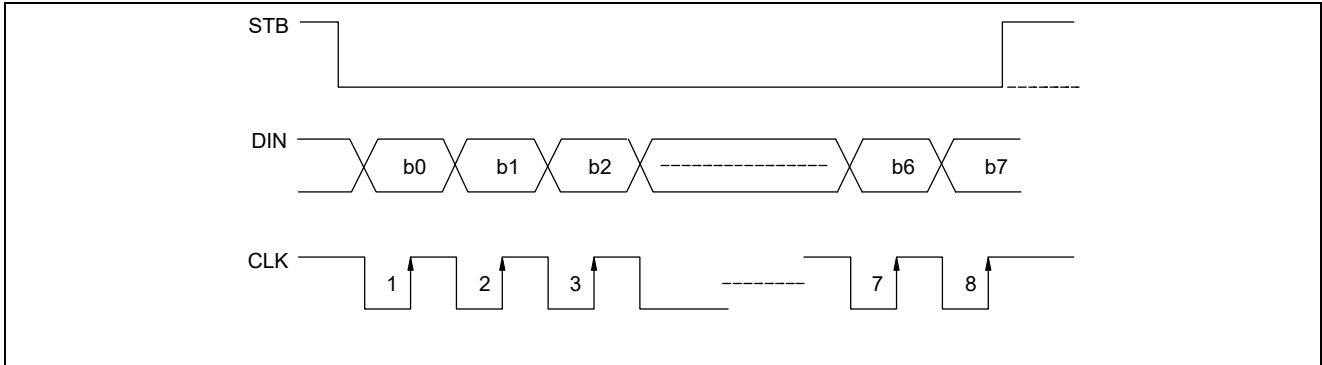
Display Sequence Timing



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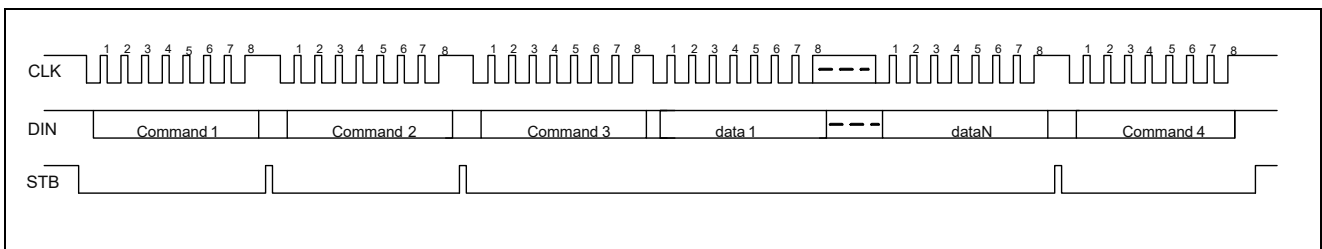
Serial Communication Format

The following figure shows the serial communication format of ET1616. It is recommended to connect a pull-up resistor (1K ~ 10K) to the DIN port.



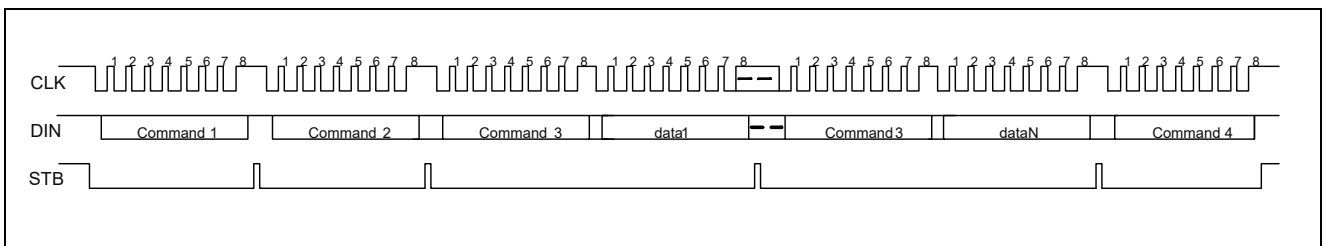
Communication application time series

Continuous display data writing (Automatic address increase)



- Command1: Display mode setting
- Command2: Data command setting
- Command3: Address command setting
- Data1~n: Display data (MAX 4 bytes)
- Command4: Display control command

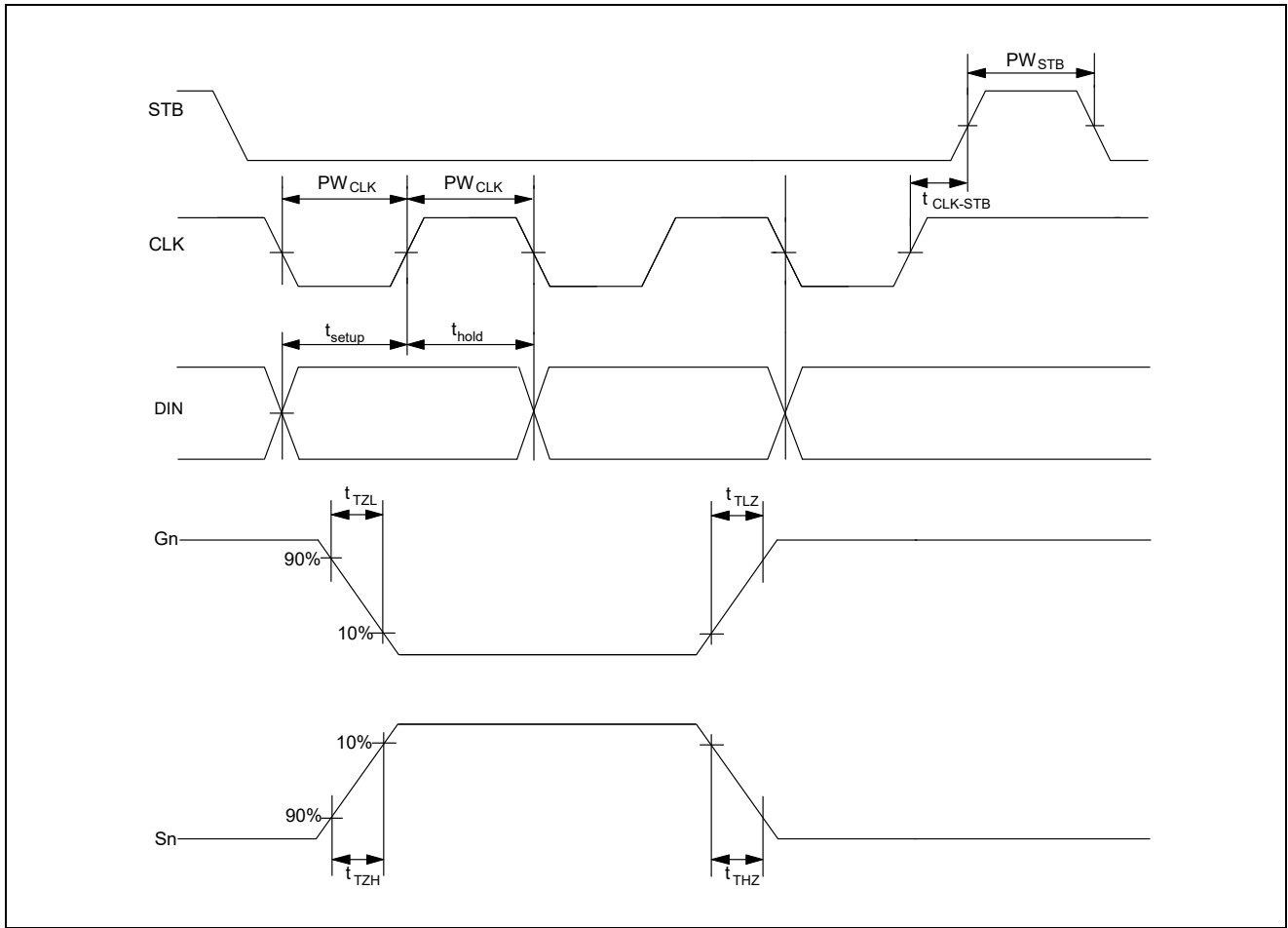
Single display data writing (fixed address mode)



- Command1: Display mode setting
- Command2: Data command setting
- Command3: Address command setting
- Data1: Display data
- Command4: Address command setting
- DataN: Display data
- Command5: Display control command

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Conversion Characteristic Waveform

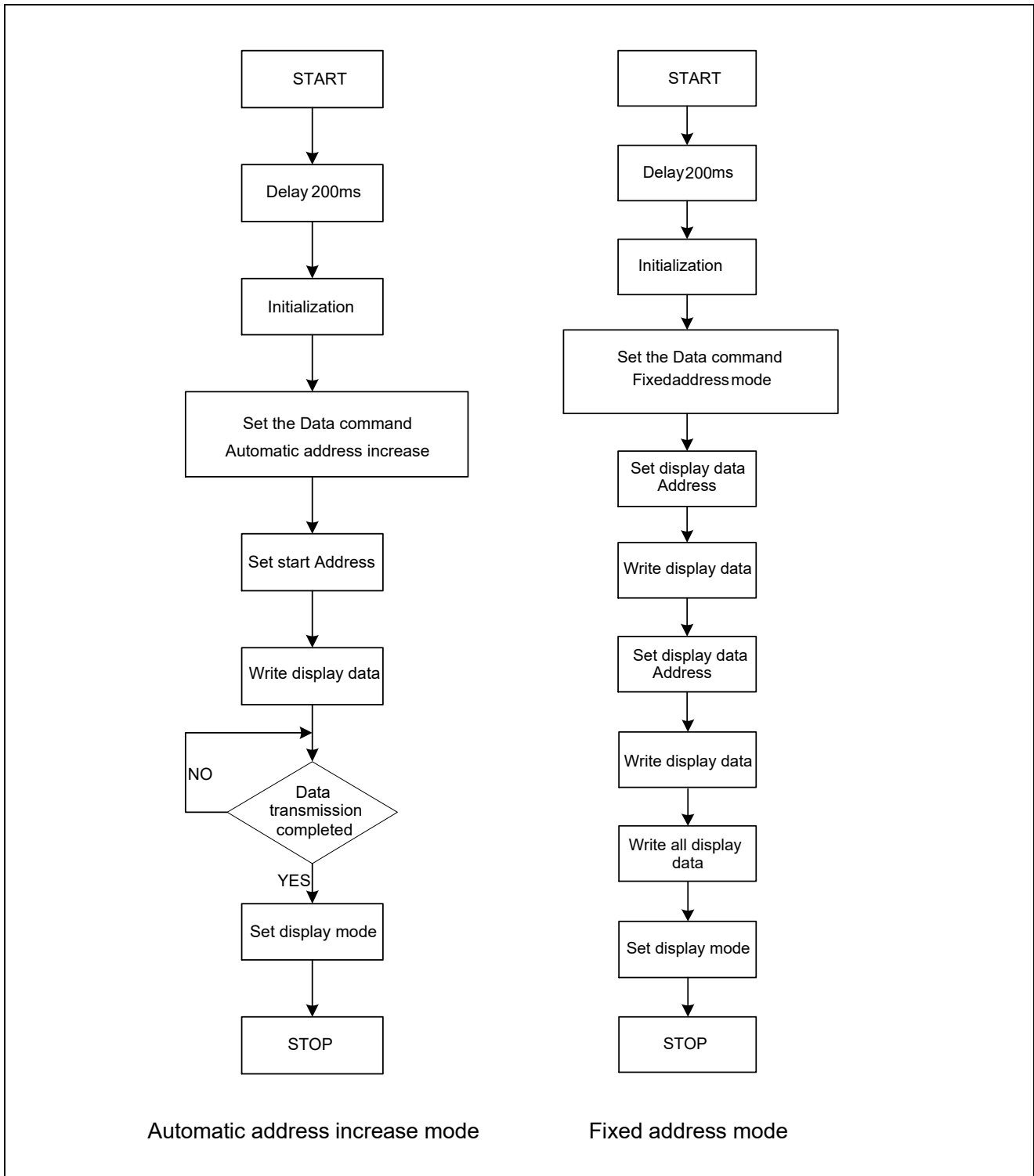


Transformation Characteristic

Symbol	Descripton	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_{TTL}		< 1	us
t_{TLZ}		< 10	us

Note: The test conditions : t_{THZ} (pull-down resistance = 10k Ω , loading capacitance = 300pF), t_{TLZ} (pull-up resistance = 10k Ω , loading capacitance = 300pF)

Software flow chart



Note: 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.

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Absolute Maximum Ratings

(Unless otherwise noted , $T_A=25^{\circ}\text{C}$)

Characteristic	Symbol	Rating	Unit
Supply Voltage	V_{DD}	-0.5~+7.0	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
Junction Temperature	T_J	-40~+150	$^{\circ}\text{C}$
Storage Temperature	T_{STG}	-55~+150	$^{\circ}\text{C}$

Recommended Operating Conditions

(Unless otherwise noted , $T_A=25^{\circ}\text{C}$)

Characteristic	Symbol	Min	Typ	Max	Unit
Supply Voltage	V_{DD}	3.0	5.0	5.5	V
Dynamic current	$I_{DD_DYN}^*$	—	—	1	mA
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	$^{\circ}\text{C}$

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

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Electrical Characteristics

(Unless otherwise noted, $V_{DD}=5V$, $T_A=25^{\circ}C$)

Characteristic	Symbol	Test Condition	Min	Typ	Max	Unit
High Level Output Current	I_{OHSG1}	$V_O=V_{DD}-2V$, SEG1~SEG7	-40	-50	-60	mA
	I_{OHSG2}	$V_O=V_{DD}-3V$, SEG1~SEG7	-50	-60	-70	mA
Low Level Output Current	I_{OLGR}	$V_O=0.3V$, GRID1~GRID4	85	100	—	mA
Percentage of high level output current at segment	I_{TOLSG}	$V_O=V_{DD}-3V$, SEG1~SEG7	—	—	+5	%
High Level Input Voltage	V_{IH}	—	$0.6V_{DD}$	—	V_{DD}	V
Low Level Input Voltage	V_{IL}	—	0	—	$0.3V_{DD}$	V
Oscillation Frequency	F_{OSC}		350	500	650	kHz

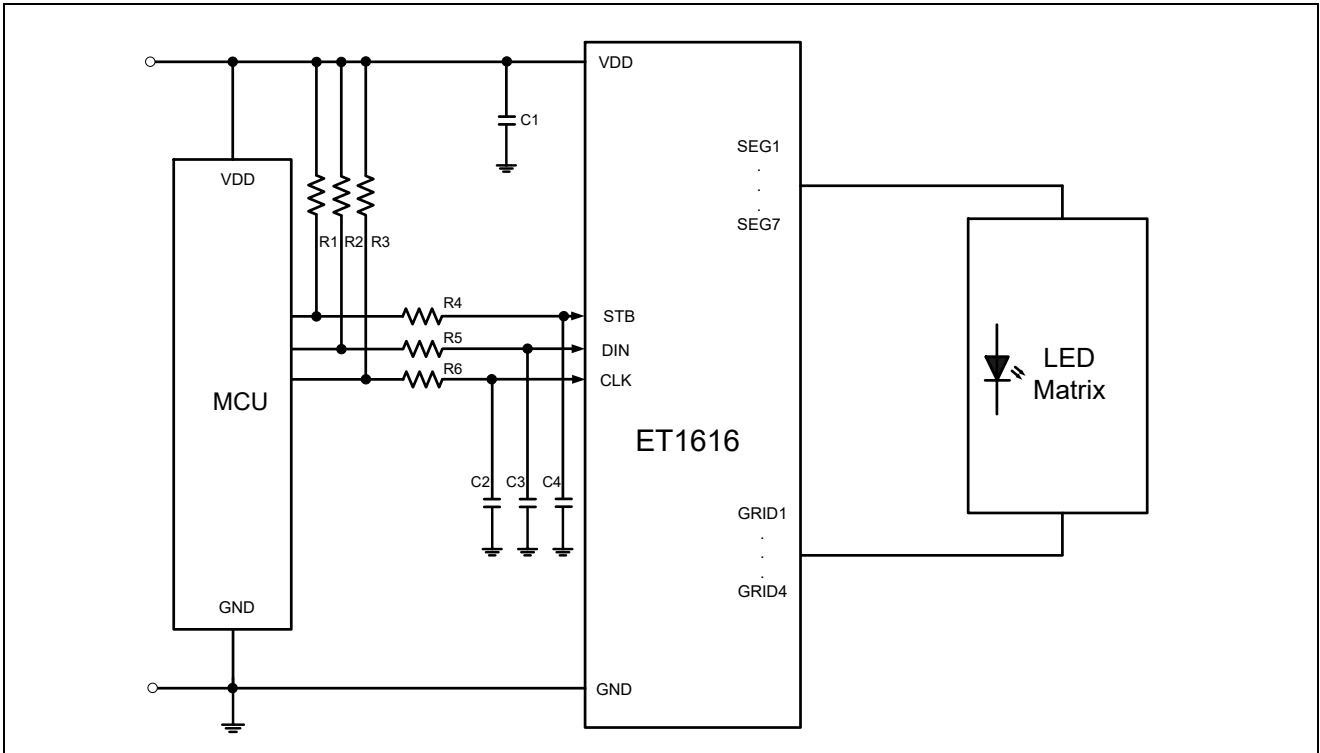
Electrical Characteristics

(Unless otherwise noted, $V_{DD}=3.0V$, $T_A=25^{\circ}C$)

Characteristic	Symbol	Test Condition	Min	Typ	Max	Unit
High Level Output Current	I_{OHSG1}	$V_O = V_{DD} - 2V$, SEG1~SEG7	-15	-20	-35	mA
Low Level Output Current	I_{OLGR}	$V_O=0.3V$, GRID1~GRID4	65	80	—	mA
High Level Input Voltage	V_{IH}	—	$0.8V_{DD}$	—	3.3	V
Low Level Input Voltage	V_{IL}	—	0	—	$0.25V_{DD}$	V
Oscillation Frequency	F_{OSC}		300	420	580	kHz

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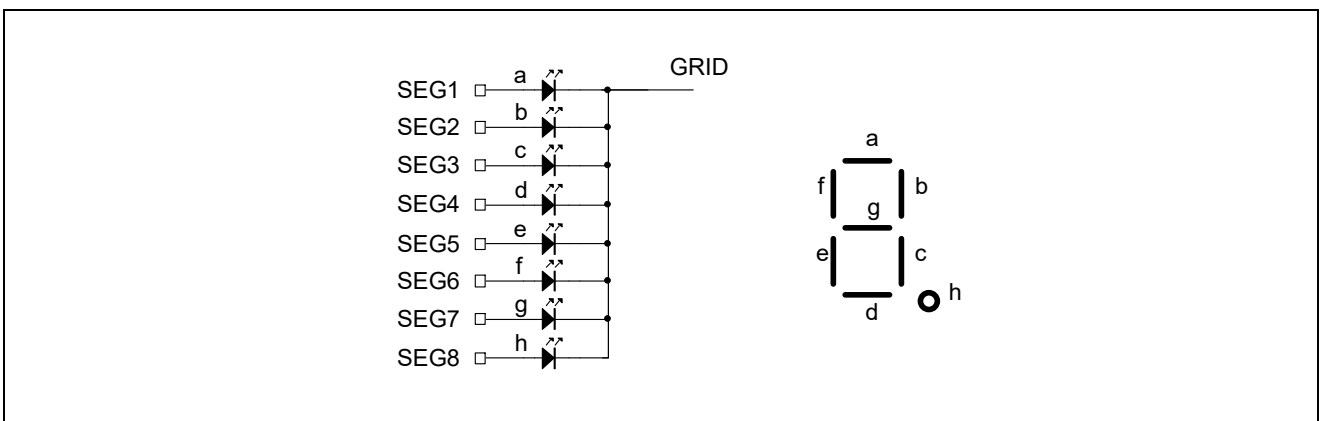
Application circuit



Notes:

1. This application circuit is only for reference.
2. C1=1uF and should be placed as close as possible to the VDD.
3. The series resistance of the communication port and the capacitor for GND should be placed as close as possible to ET1616, and the resistance value and capacitance value should be adjusted according to the actual anti-interference requirements and verification results.

Common cathode LED connection

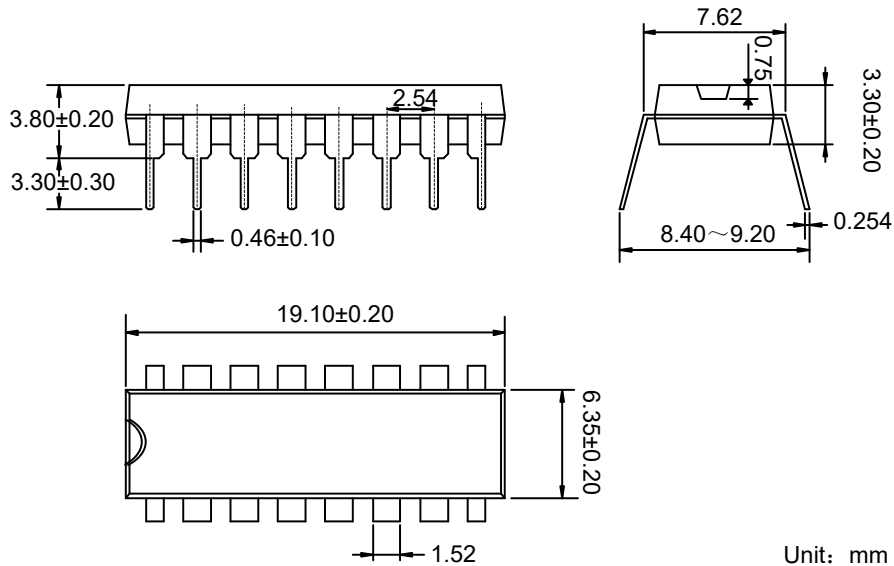


Note: This application circuit is only for reference.

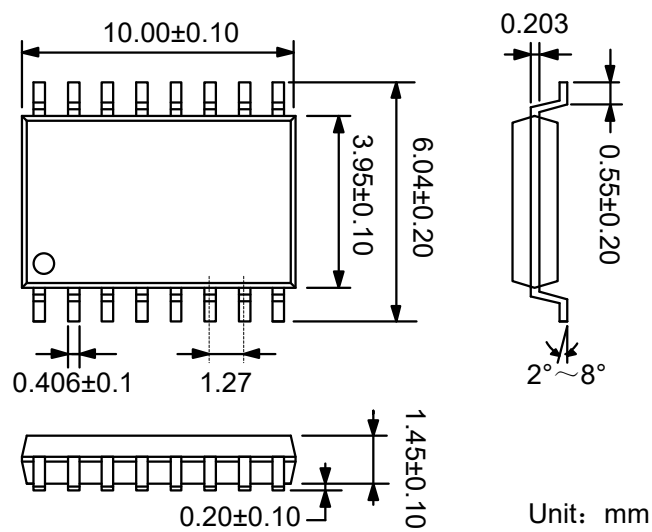
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Package

DIP16



SOP16



Revision History and Checking Table

Version	Date	Revision Item	Modifier	Function & Spec Checking	Package & Tape Checking
1.0	2018-01-19	Original Version	Shi Liang Jun	Shi Liang Jun	Zhu Jun Li
1.1	2020-04-07	Update form	Shi Bo	Shi Liang Jun	Shi Bo
1.2	2023-1-20	Update form	Shi bo	Shi Bo	Shi Bo