

LED Driver (8 x 6)

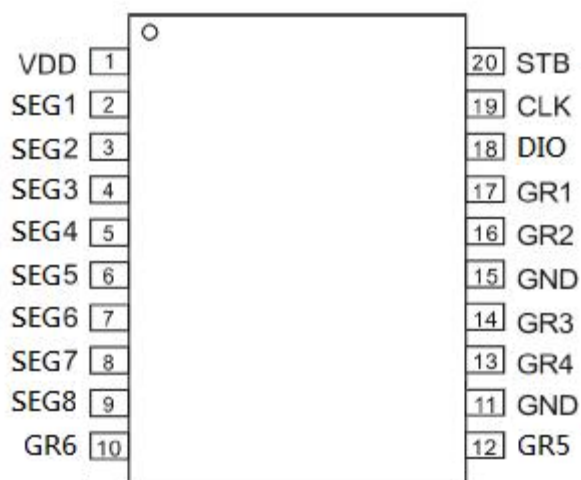
. General Description :

TT1620 is a LED Controller driver. Eight segment output lines, Six grid output lines, display memory, pulse width control circuit, 3 wire interface circuit are all incorporated into a single chip to build a highly reliable peripheral device for a single chip microcomputer.

Features :

- ◇ Display Mode : 8 segment X 6 Grid
- ◇ 8 step Dimming adjustment
- ◇ Build-in RC oscillator
- ◇ Serial interface for clock, data Input/ output, strobe pins
- ◇ CMOS technology
- ◇ Low power consumption
- ◇ SOP20 package (TT1620)

.Pin Assignment :



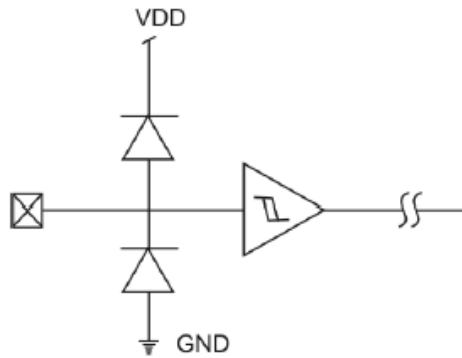
TT1620

Pin Description :

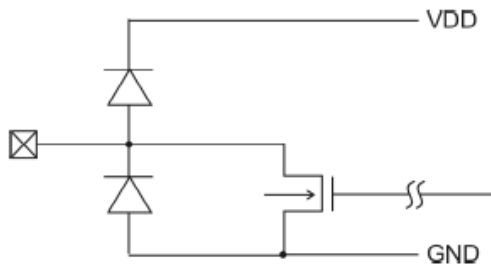
Pin Name	I/O	Pin Description
DIO	I/O	Data Input Pin : This pin inputs serial data at the rising edge of the shift clock (starting from the lower bit) Data Output Pin (N-Channel, Open-Drain)
CLK	I	Clock Input Pin This pin reads serial data at the rising edge and outputs data at the falling edge.
STB	I	Serial Interface Strobe Pin The data input after the STB has fallen is processed as a command. When this pin is HIGH", CLK is ignored.
VDD	P	Power Supply
SEG1 ~SEG8	O	Segment Output Pins (p-channel, open drain)
GND	P	Ground Pin
GR1 ~ GR6	O	Grid Output Pins

Equivalent Circuits for Inputs and Outputs :

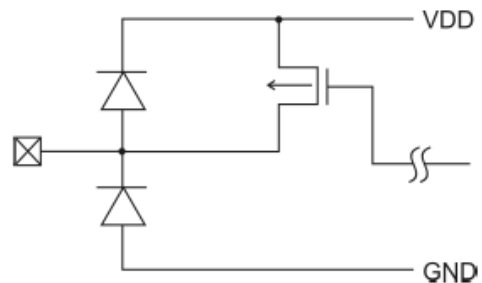
INPUT PINS: CLK, STB



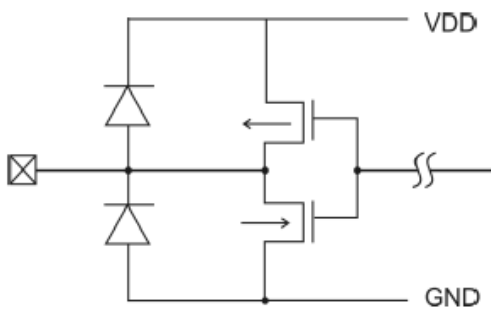
OUTPUT PINS: GR1 TO GR4



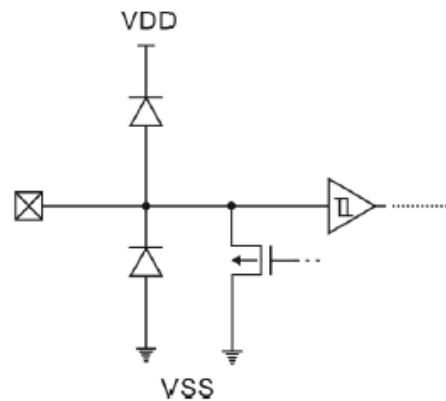
OUTPUT PINS: SEG1 ~ SEG8



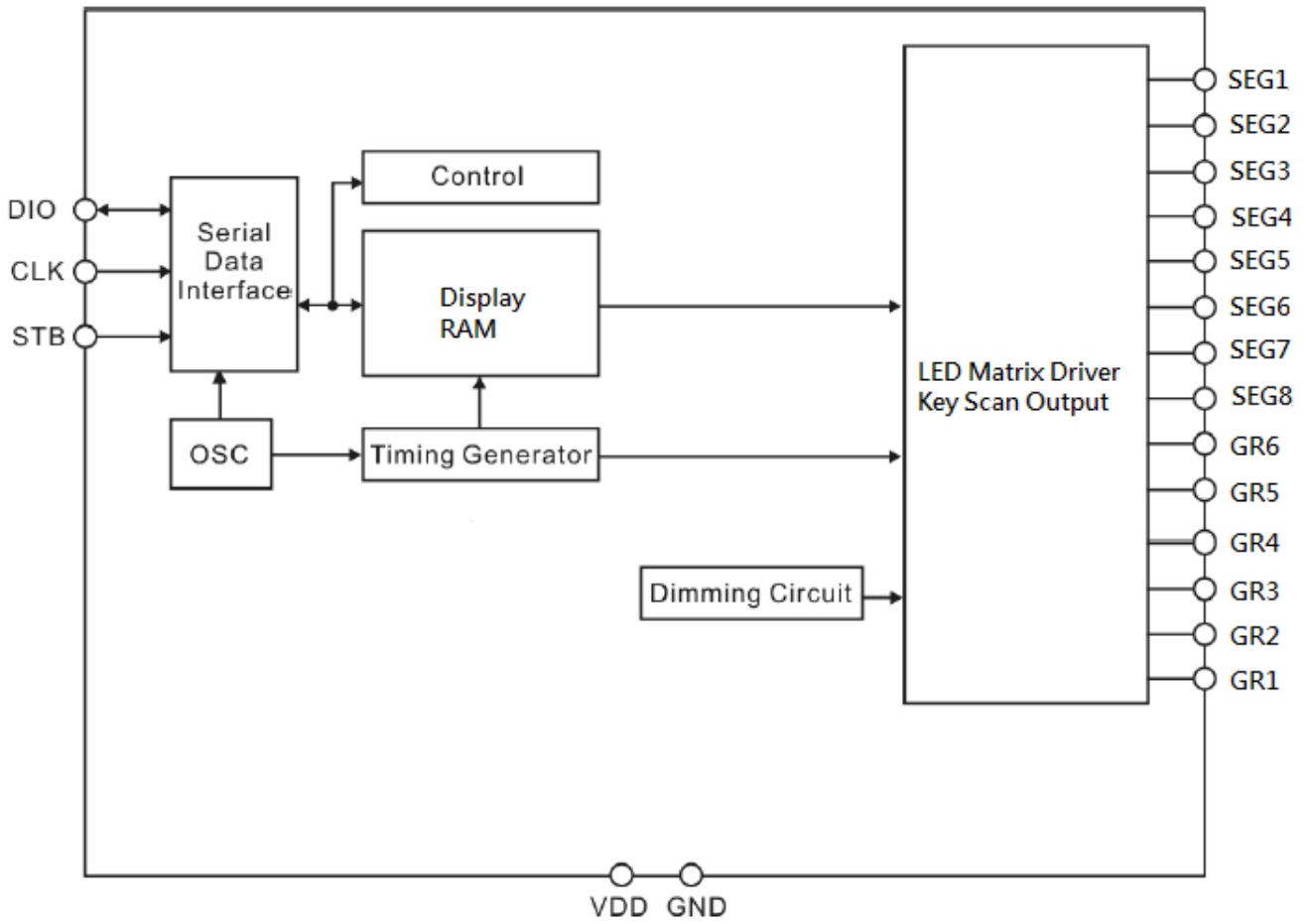
OUTPUT PINS: GR5, GR6



INPUT PIN & OUTPUT PIN: DIO



. Block Diagram :



FUNCTION DESCRIPTION

COMMANDS

A command is the first byte (b0 to b7) inputted to TT1620 via the DIO Pin after STB Pin has changed from HIGH to LOW State. If for some reason the STB Pin is setting to HIGH while data or commands are being transmitted, the serial communication is initialized, and the data/commands being transmitted are considered invalid.

B7	B6	COMMANDS
0	0	DISPLAY MODE SETTING COMMANDS
0	1	DATA SETTING COMMANDS
1	0	DISPLAY CONTROL COMMANDS
1	1	ADDRESS SETTING COMMANDS

1: DISPLAY MODE SETTING COMMAND

TT1620 provides a display mode setting as shown in the diagram below: As stated earlier a command is the first one byte (b0 to b7) transmitted to TT1628/TT1668 via the DIO Pin when STB is LOW. However, for these commands, the bit 3 to bit 6 (b2 to b5) are ignored, bit 7 & bit 8 (b6 to b7) are given a value of 0.

A display commands ON must be executed in order to resume display. If the same mode setting is selected, no command execution is take place, therefore, nothing happens.

When Power is turned ON, the 7-grid, 10-segment modes is selected.

MSB							LSB		
B7	B6	B5	B4	B3	B2	B1	B0	DISPLAY MODE	
0	0	--	--	--	--	1	0	6 digits, 8 segments	

2: DATA SETTING COMMANDS

The Data Setting Commands executes the Data Write or Data Read Modes for TT1620. The data Setting Command, the bits 5 and 6 (b4, b5) are ignored, bit 7 (b6) is given the value of 1 while bit 8 (b7) is given the value of 0.

Please refer to the diagram below.

When power is turned ON, bit 4 to bit 1 (b3 to b0) are given the value of 0.

MSB				LSB			
B7	B6	B5	B4	B3	B2	B1	B0
0	1	-	-	B3	B2	B1	B0

B1:B0 : Data write & read mode settings:

0 0 : Write data to display mode

1 0 : Read key data

B2 : Data write & read mode settings:

0 : Increment address after data has been written

1 : Fixed address

B3 : Mode settings:

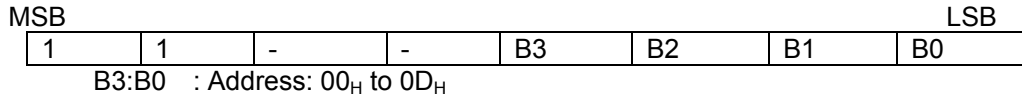
0 : Normal operation mode

1 : Test mode

3: ADDRESS SETTING COMMANDS

Address Setting Commands are used to set the address of the display memory. The address is considered valid if it has a value of 00_H to 0D_H. If the address is set to 0E_H or higher, the data is ignored until a valid address is set. When power is turned ON, the address is set at 00_H.

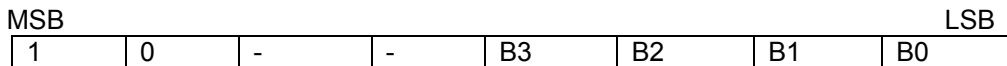
Please refer to the diagram below.



SEG1	SEG2	SEG3	SEG4	SEG5	SEG6	SEG7	SEG8		
B0	B1	B2	B3	B4	B5	B6	B7	00 _H	GR1
B0	B1	B2	B3	B4	B5	B6	B7	02 _H	GR2
B0	B1	B2	B3	B4	B5	B6	B7	04 _H	GR3
B0	B1	B2	B3	B4	B5	B6	B7	06 _H	GR4
B0	B1	B2	B3	B4	B5	B6	B7	08 _H	GR5
B0	B1	B2	B3	B4	B5	B6	B7	0A _H	GR6
B0	B1	B2	B3	B4	B5	B6	B7	0C _H	No Used

4: DISPLAY CONTROL COMMANDS

The Display Control Commands are used to turn ON or OFF a display. It also used to set the pulse width. Please refer to the diagram below. When the power is turned ON, a 1/16 pulse width is selected and the displayed is turned OFF (the key scanning is started).



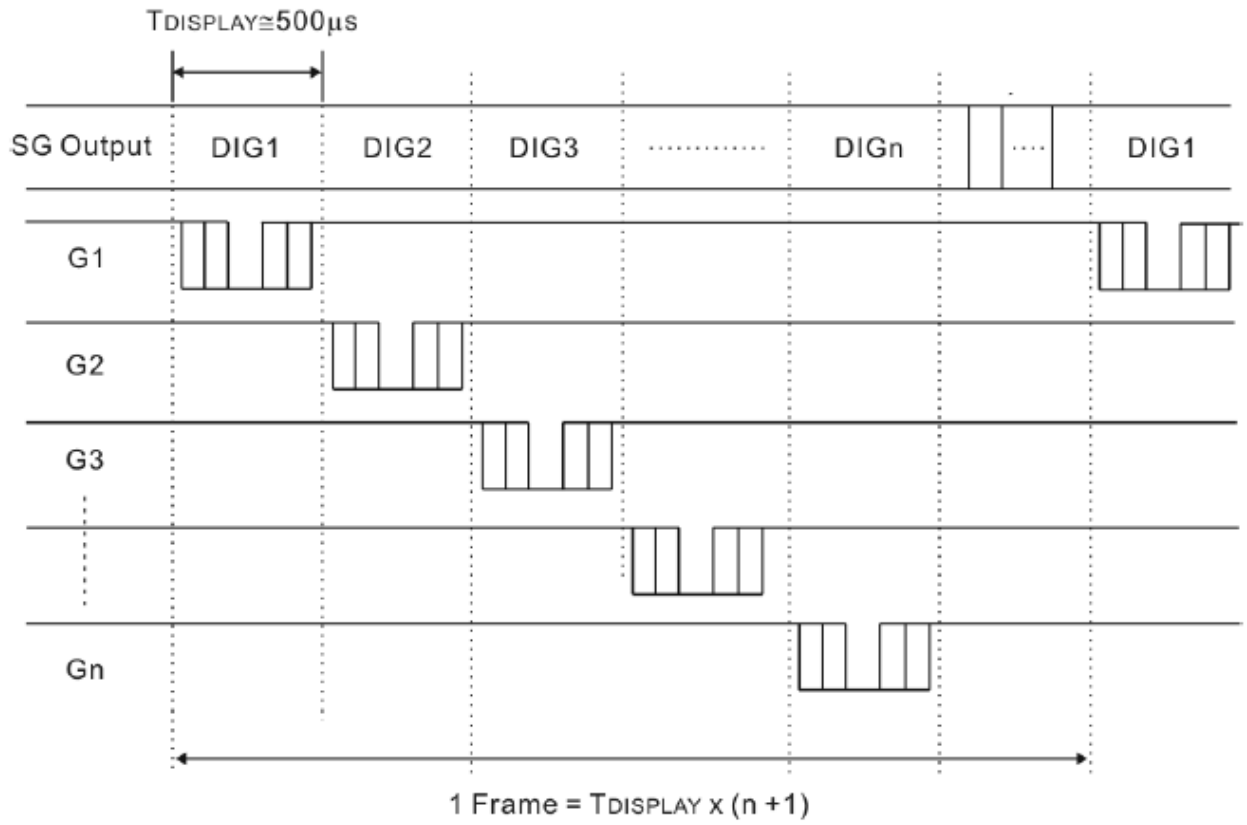
B2~B0 : Dimming quantity settings:

- 000: Pulse width=1/16
- 001: Pulse width=2/16
- 010: Pulse width=4/16
- 011: Pulse width=10/16
- 100: Pulse width=11/16
- 101: Pulse width=12/16
- 110: Pulse width=13/16
- 111: Pulse width=14/16

B3: Display settings:

- 0: Display off
- 1: Display on

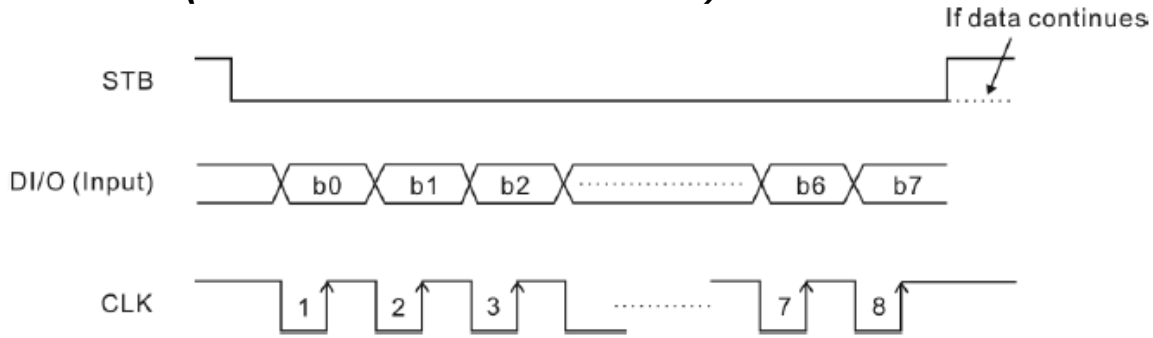
DISPLAY TIMING



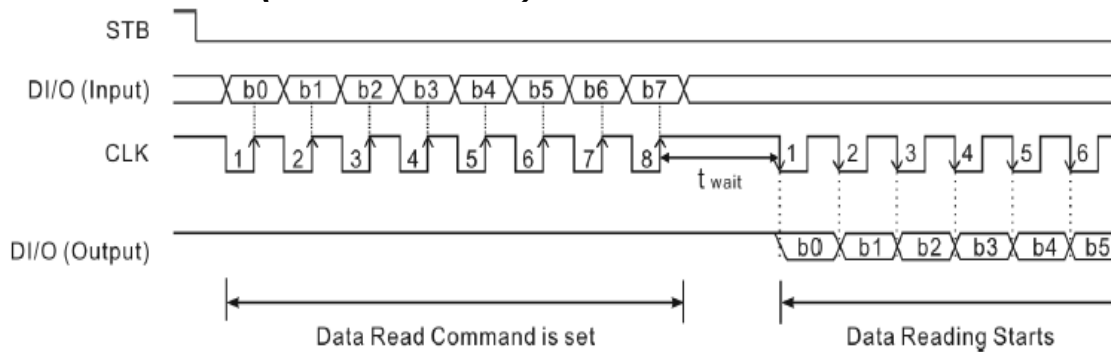
SERIAL COMMUNICATION FORMAT

The following diagram shows the TT1620 serial communication format. The DIO Pin is an N-channel, open-drain output pin; therefore, it is highly recommended that an external pull-up resistor (1KΩ to 10KΩ) must be connected to DIO.

RECEPTION (DATA/COMMAND WRITE)



TRANSMISSION (DATA READ)

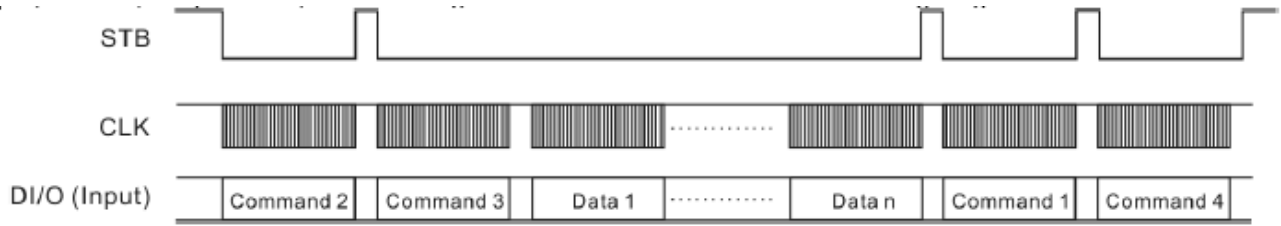


Where: t_{wait} (waiting time) $\geq 1\mu s$

It must be noted that when the data is read, the waiting time (t_{wait}) between the rises of the eighth clock that has set the command and the falling of the first clock that has read the data is greater or equal to $1\mu s$.

APPLICATIONS

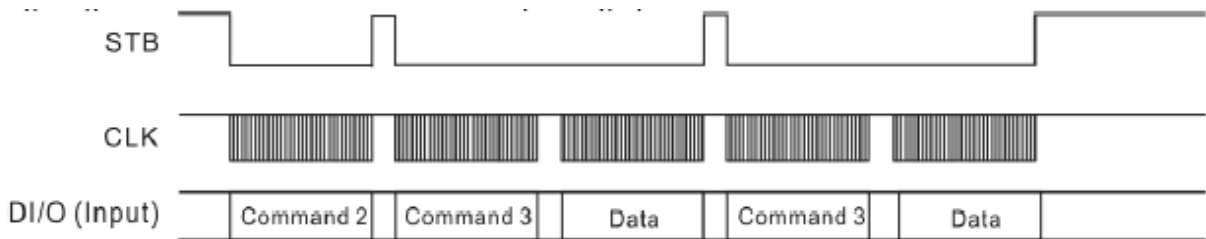
Display memory is updated by incrementing addresses. Please refer to the following diagram.



Where:

- Command 1: Display mode setting command
- Command 2: Data setting command
- Command 3: Address setting command
- Data 1 to n: Transfer display data (14 bytes max.)
- Command 4: Display control command

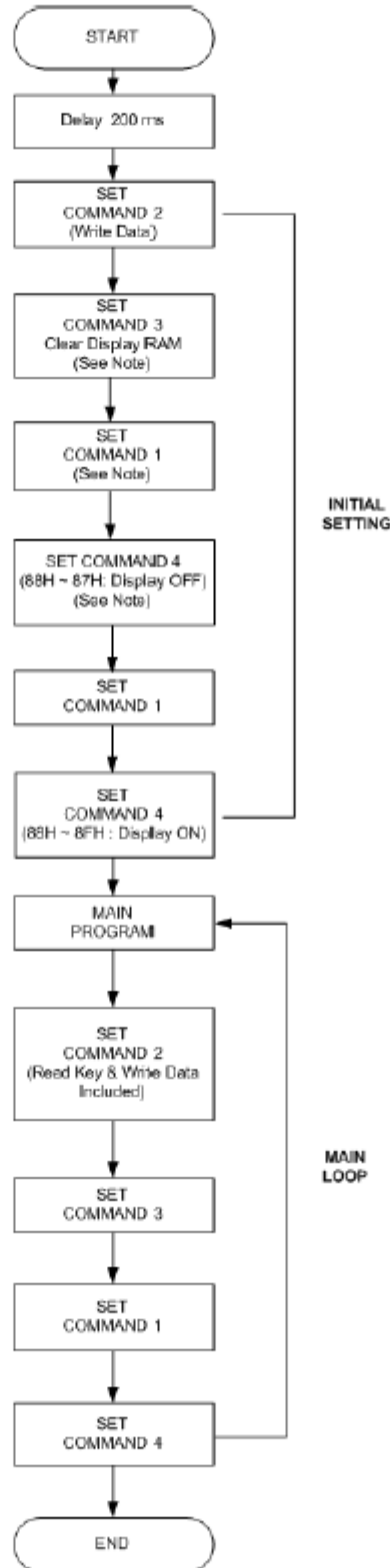
The following diagram shows the waveforms when updating specific addresses.



Where:

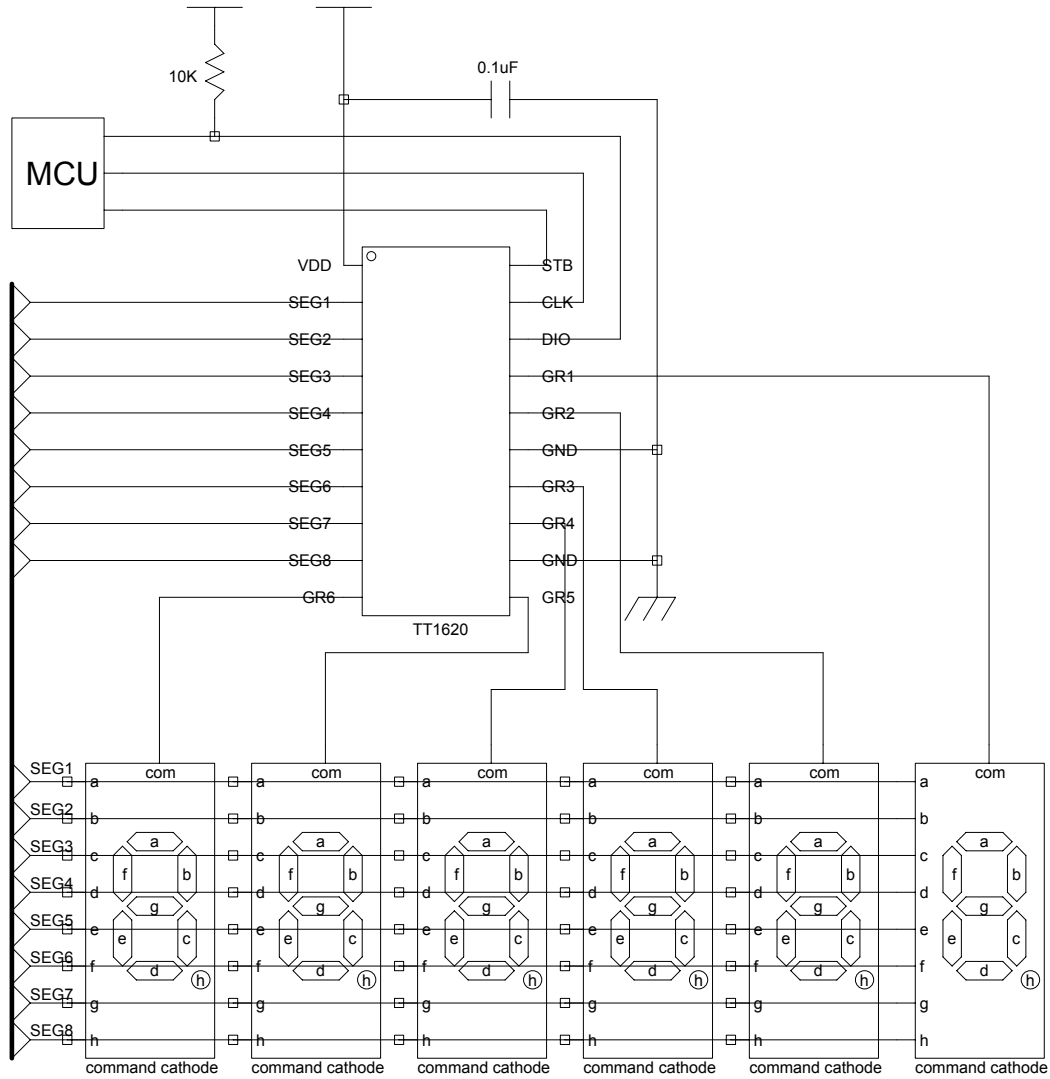
- Command 2: Data setting command
- Command 3: Address setting command
- Data: Data display data

RECOMMENDED SOFTWARE FLOWCHART

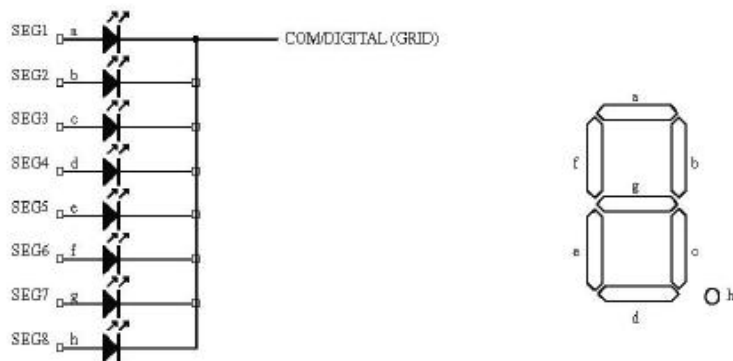


1. Command 1: Display Mode Commands
2. Command 2: Data Setting Commands
3. Command 3: Address Setting Commands
4. Command 4: Display Control Commands
5. When IC power is applied for the first time, the content of the Display RAM is not defined;
Thus, it is strongly suggested that the contents of the Display RAM be cleared during the initial setting.

Application circuit : (Common Cathode Type)



Common Cathode Type LED Panel:



Absolutely Maximum Rating (Unless otherwise stated, $T_a=25^\circ\text{C}$, GND=0V)

Characteristics	Symbol	Rating	Unit
Supply voltage	V_{DD}	-0.5~7.0	V
Input voltage	V_{IN}	-0.5~ $V_{DD}+0.5$	V
LED Seg. Output current	I_{O1}	-50	mA
LED Grid. Output current	I_{O2}	200	mA
Maximum driver output current/total	I_{total}	400	mA
Operating Temperature	T_{opr}	-40~+85	$^\circ\text{C}$
Storage Temperature	T_{stg}	-65~+150	$^\circ\text{C}$

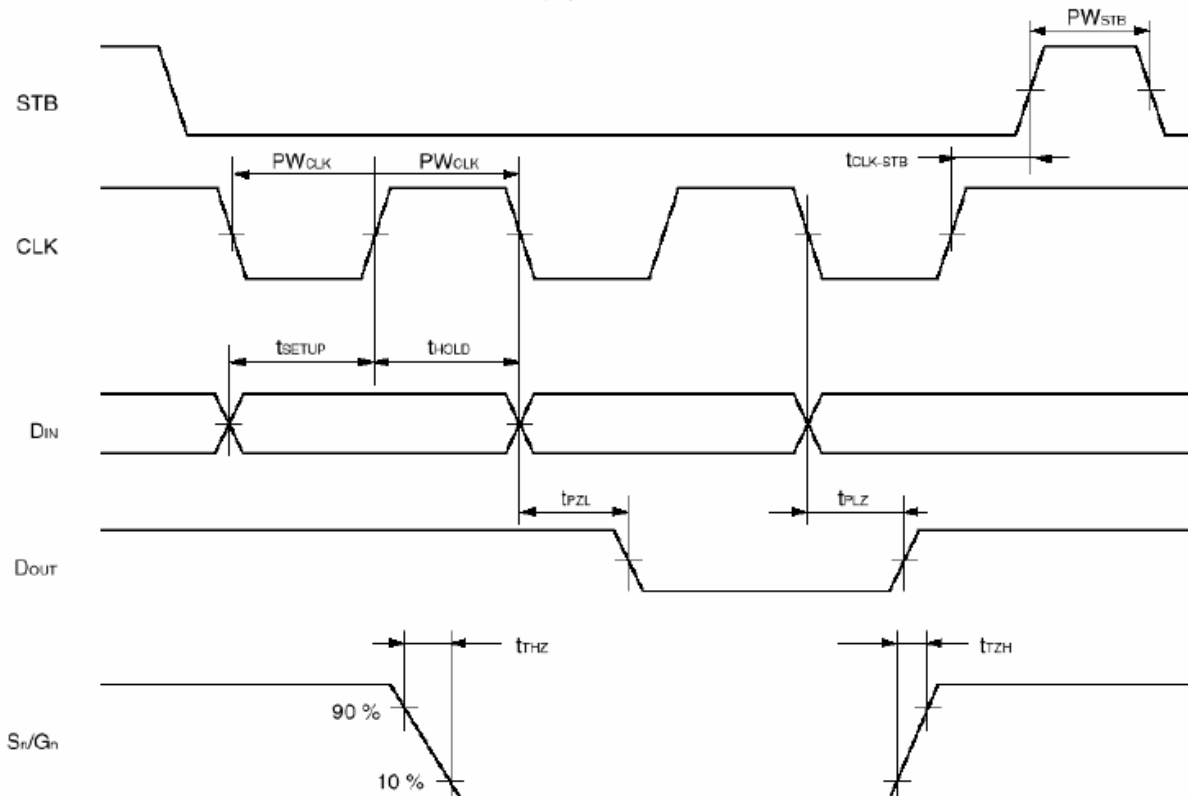
DC Electrical Characteristics (Unless otherwise stated, $V_{DD}=5V$, GND=0V, $T_a=25^\circ\text{C}$)

Characteristics	Symbol	Conditions	Min	Typ	Max	Unit
Supply Voltage	V_{DD}		4.5	5	5.5	V
Operating Current	I_{DD}	LED off, No load		100	200	μA
Input high Voltage	V_{IH}		0.7VDD		VDD	V
Input low Voltage	V_{IL}		0		0.3VDD	V
Output high Current	I_{OHSEG1}	VO=VDD-2V SEG1 to SEG8,	-20	-25	-40	mA
	I_{OHSEG2}	VO=VDD-3V SEG1 to SEG8,	-25	-30	-50	
Output low Current	I_{OLGR}	VO=0.3V GR1 to GR6	100	140		mA
Output low Current	I_{OLIO}	VO=0.4V, DIO	4			mA
Segment out high Current tolerance	I_{TOLSG}	VO=VDD-3V($V_{DD}=5V$) VO=VDD-2V($V_{DD}=3V$) SEG1 to SEG8,			5	%
Input high Voltage	V_{IH}	CLK,DIO,STB	0.7VDD		VDD	V
Input low Voltage	V_{IL}	CLK,DIO,STB	GND		0.3 VDD	V

AC Electrical Characteristics

Characteristics	Symbol	Conditions	Min	Typ	Max	Unit
Oscillation frequency	f_{osc}		350	500	650	KHz
Propagation delay time	t_{PLZ}	CLK → DIO CL=15pF , RL=10KΩ			300	ns
	t_{PZL}				100	
Output rising time	t_{TZH1}	SEG1 ~ SEG8 CL=300pF			2	us
	t_{TZH2}	Grid1 ~ Grid6 CL=300pF			0.5	
Output falling time	T_{THZ}	CL = 300pF , Segn , Gridn			120	us
Clock Frequency	F_{max}	Duty=50%			1	MHz
Input Capacitor	C_I				15	pF
Clock Pulse Width	PW_{CLK}		400			ns
Strobe Pulse Width	PW_{STB}		1			us
Data setup time	t_{SETUP}					ns
Data hold time	t_{HOLD}					ns
CLK → STB	$t_{CLK-STB}$	CLK↑→STB↑	1			us
Wait time	t_{WAIT}	CLK↑→CLK↓	1			us

Timing Diagram



. Package Information

