1. General Descriptions

HT1628 is an LED Controller driven on a 1/7to 1/8 duty factor. Eleven segment output lines, six grid output lines, 1 segment/grid output lines, one display memory, control circuit , key scan 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 HT1628 via a four-line serial interface.Housed in a 28-pin SOP Package, HT1628 pin assignments and application circuit are optimized for easy PCB Layout and cost saving advantages.

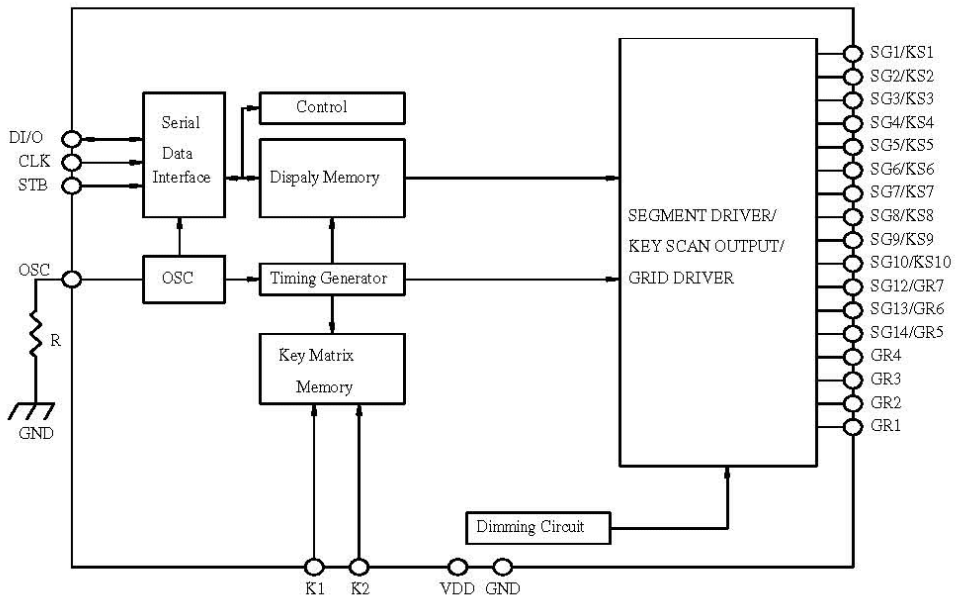
2. Features

- CMOS Technology
- Low Power Consumption
- Multiple Display Modes
- Key Scanning
- 8-Step Dimming Circuitry
- Serial Interface for Clock, Data Input, Data Output, Strobe Pins
- Available in 28-Pin, SOP Package

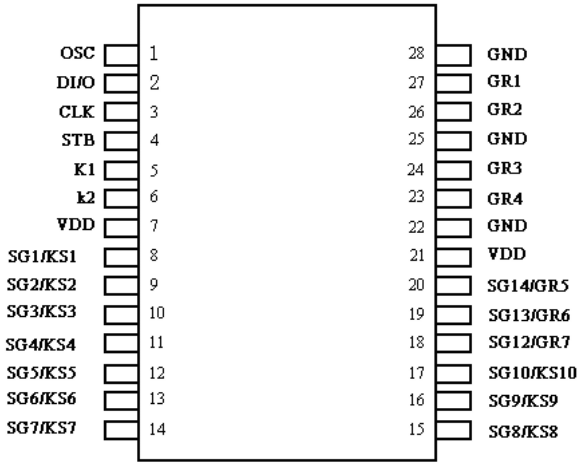
Application Features:

- Micro-computer Peripheral Device
- VCR set
- Combi set

3. Function Block Diagram



4. Pin Configuration



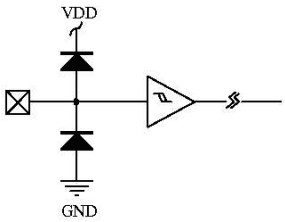
5. Pin Descriptions

NO.	Name	I/O	Description
1	OSC	I	Oscillator Input Pin A resistor is connected to this pin to determine the oscillation frequency
2	DI/O	I/O	Data Output Pin (N-Channel, Open-Drain) or Data Input pin This pin Outputs/Input serial data at the falling(rising) edge of the shift clock.
3	CLK	I	Clock Input Pin This pin reads serial data at the rising edge and outputs data at the falling edge.
4	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.
5,6	K1 to K2	I	Key Data Input Pins. The data sent to these pins are latched at the end of the display cycle. (Internal Pull-Low Resistor)
22,25,28	GND	-	Ground Pin
8~17	SG1/KS1 to SG10/KS10	O	Segment Output Pins (p-channel, open drain) Also acts as the Key Source
18~20	SG12/GR7 toSG14/GR5	O	Segment/Grid Output Pins
7,21	VDD	-	Power Supply
23,24,26,27	GR4 to GR1	O	Grid Output Pins

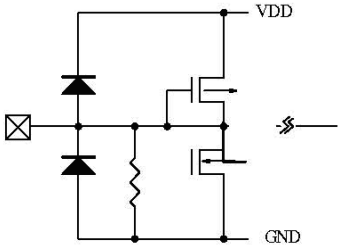
6. Input/output Configurations

The schematic diagrams of the input and output circuits of the logic section are shown below.

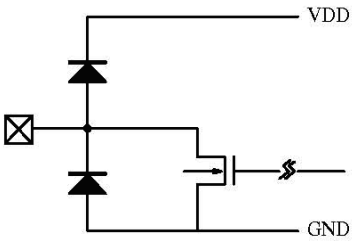
6.1 Input Pins: CLK, STB & DIN



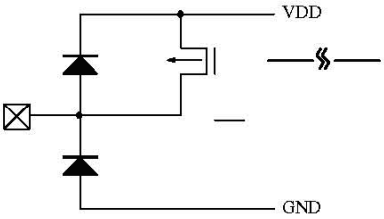
6.2 Input Pins: K1 to K2



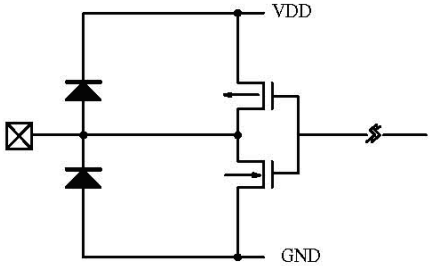
6.3 Output Pins: DOUT, GR1 to GR4



6.4 Output Pins: SG1 to SG10



6.5 Output Pins: GR5, GR6 and SG12/GR7



7. Function Descriptions

7.1 Command

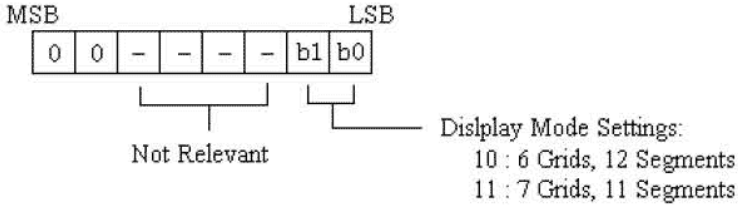
A command is the first byte (b0 to b7) inputted to A1628 via the DIN Pin after STB pin has changed from HIGH to LOW Stage. If for some reason the STB Pin is set to HIGH while data or commands are being transmitted, the serial communications is initialized, and the data/commands being transmitted are considered invalid.

7.1.1 Command 1: Display Mode Setting Commands

HT1628 provides 2 display mode settings as shown in the diagram below: As stated earlier a command is the first one byte (b0 to b7)transmitted to HT1628 via the DIN 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 value of 0.

The Display Mode Setting Commands determine the number of segments and grids to be used (12 to 11 segments, 6 to 7 grids). A display command 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.

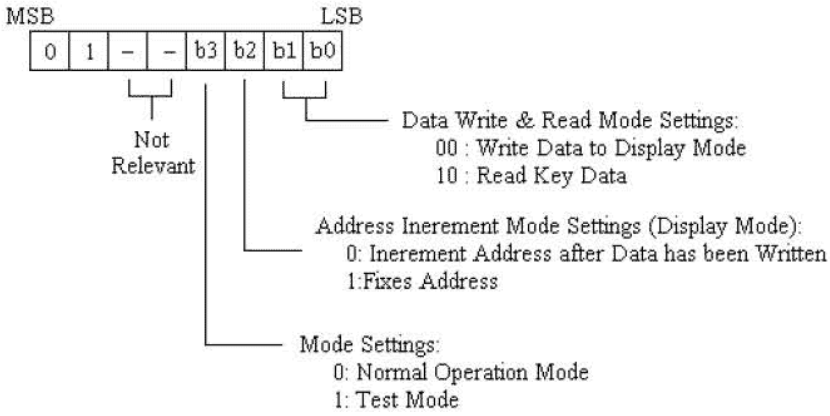
When Power is turned ON, the 7-grid, 11-segment modes is selected.



7.1.2 Command 2: Data Setting Commands

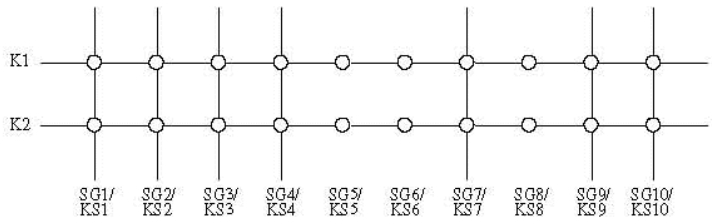
The Data Setting Commands executes the Data Write or Data Read Modes for HT1628. The data Setting Command, the bits 5 and 6 (b4,b5) are ignored, bit 7 (b6) is given the value of 1 while bit 8 (b7) is given the value of 0. Please refer to the diagram below.

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

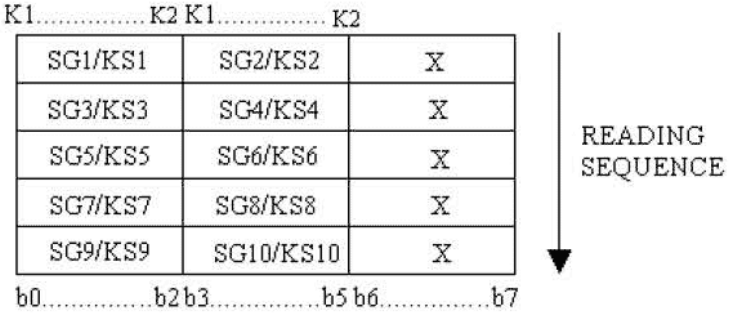


7.1.3. HT1628 Keymatrix & Keyinput Data Storage Ram

HT1628 Key Matrix consists of 10 x 3 array as shown below:



Each data entered by each key is stored as follows and read by a READ Command, starting from the last significant bit. When the most significant bit of the data (b0) has been read, the least significant bit of the next data (b7) is read.

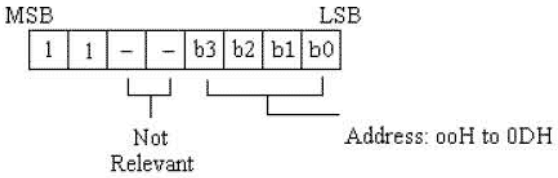


Note: b6 and b7 do not care

7.1.4 Command 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 00H to 0DH. If the address is set to 0EH or higher, the data is ignored until a valid address is set. When power is turned ON, the address is set at at 00H.

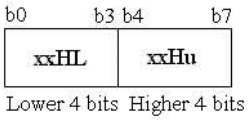
Please refer to the diagram below.



7.1.5 Displaymode And Ramaddress

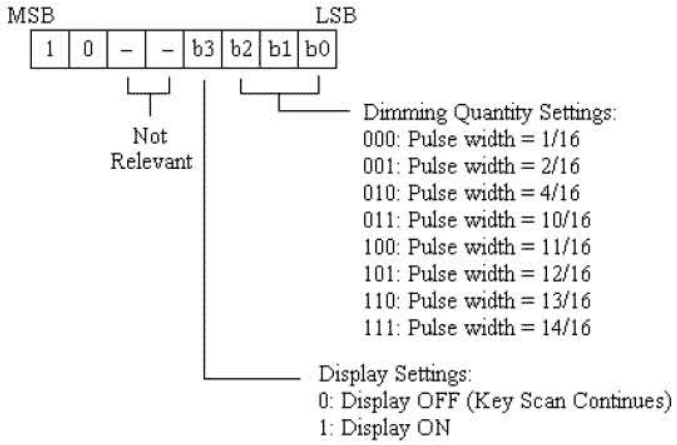
Data transmitted from an external device to HT1628 via the serial interface are stored in the Display RAM and are assigned addresses. The RAM addresses of HT1628 are given below in 8 bits unit.

SG1	SG4 SG5	SG8 SG9 SG12	
00HL	00Hu	01HL	DIG1
02HL	02Hu	03HL	DIG2
04HL	04Hu	05HL	DIG3
06HL	06Hu	07HL	DIG4
08HL	08Hu	09HL	DIG5
0AHL	0AHu	0BHL	DIG6
0CHL	0CHu	0DHL	DIG7



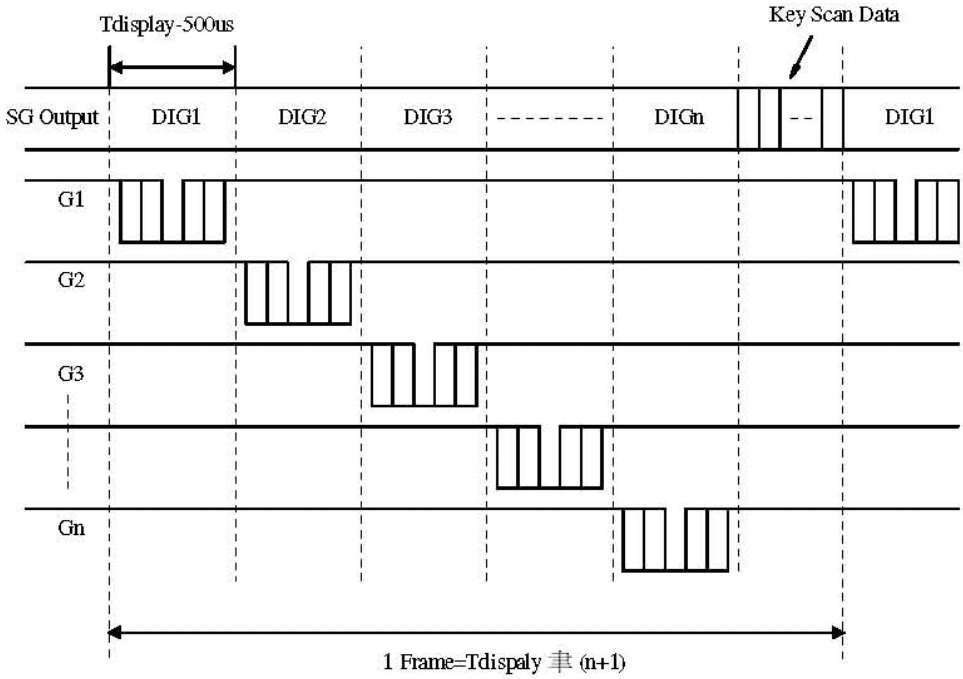
7.1.6 Command 4: Display Control Commands

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).



7.2 Scanning And Display Timing

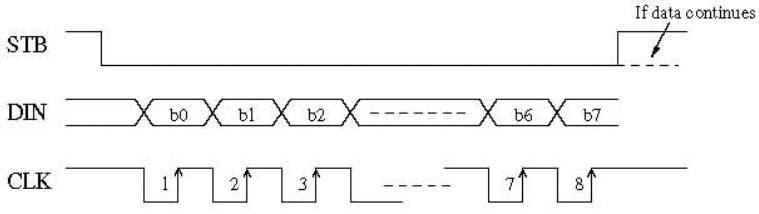
The key Scanning and Display Timing diagram is given below. One cycle of key scanning consists of 2 frames. The data of the are 10 x 3 matrix is stored in the RAM.



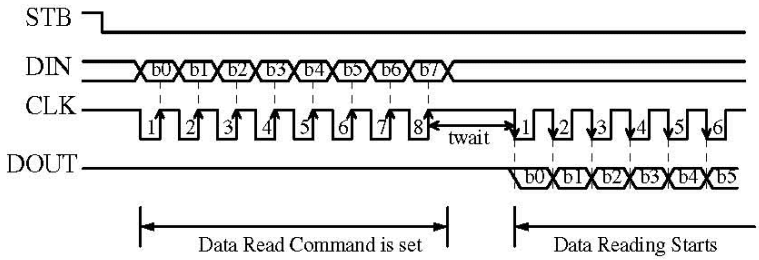
7.3 Serial Communication Format

The following diagram shows the HT1628 serial communication format. The DOUT Pin is an N-channel, open drain output pin; therefore, it is highly recommended that an external pull-up resistor (1 K Ohms to 10 K Ohms) must be connected to DOUT.

7.3.1 Reception (Data/Command Write)



7.3.2 Transmission (Data Read)

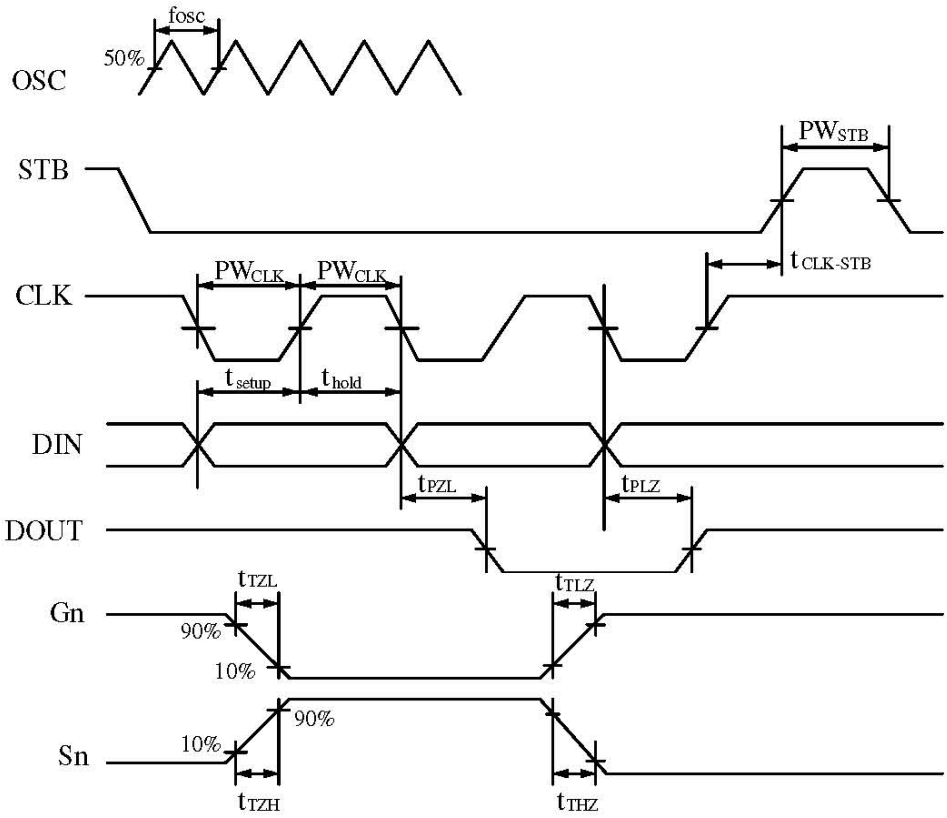


where: t_{wait} (waiting time) $\geqslant$ 1 μ s

It must be noted that when the data is read, the waiting time (t_{wait}) between the rising 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 1μs.

7.4 Switching Characteristic Waveform

A1628 Switching Characteristics Waveform is given below.



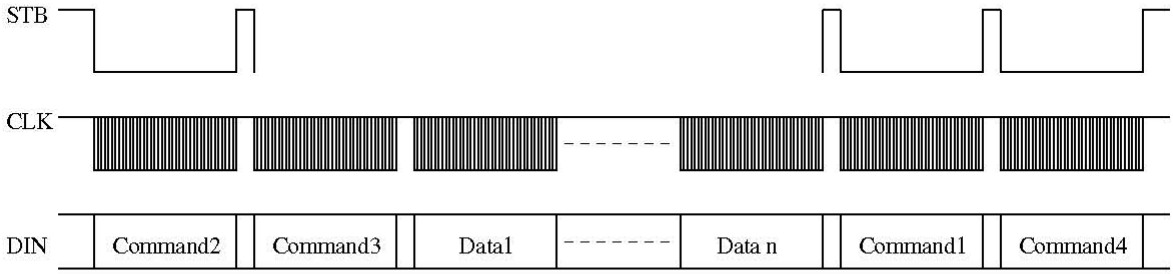
where: PW_{CLK} (Clock Pulse Width) ≥ 400nS
PW_{STB} (Strobe Pulse Width) ≥1μs
t_{setup} (Data Setup Time) ≥100nS
t_{hold} (Data Hold Time) ≥100nS
t_{CLK}-STB (Clock-Strobe Time) ≥1μs
t_{THZ}(Fall Time)≤10μs
t_{TZH}(Rise Time) ≤1μs
t_{PZL}(Propagation Delay Time) ≤100nS
f_{osc}=Oscillation Frequency
t_{PLZ}(Propagation Delay Time) ≤300uS
t_{TZL}< 1μs
t_{TLZ}<10μs

Note: Test condition under
t_{THZ} (Pull low risistor=100k ohms, Loading capacitor =300pf)

t_{TLZ} (Pull high risistor =100k ohms, Loading capacitor=300pf)

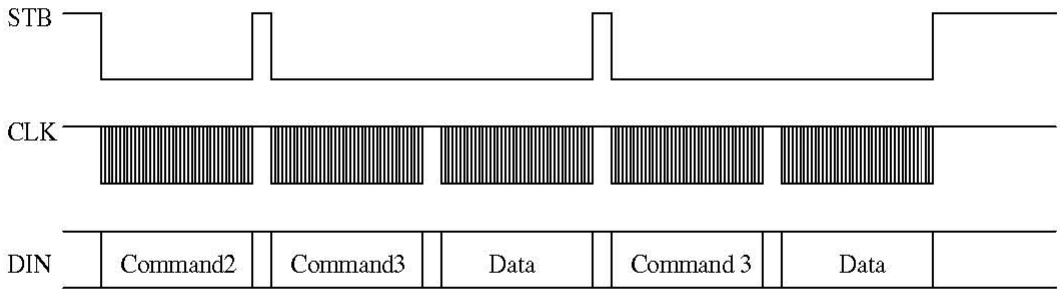
7.5 Applications

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



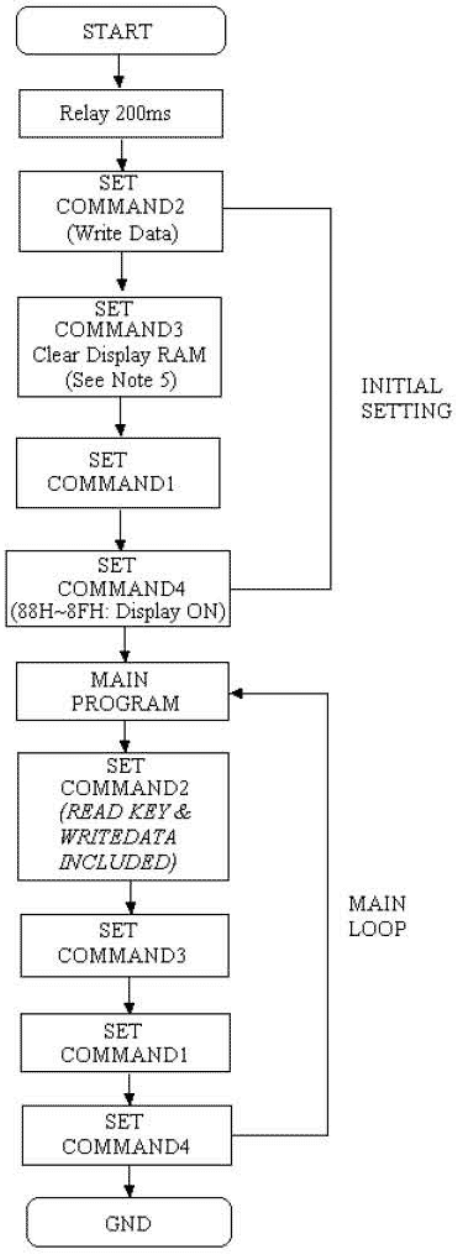
where: Command 1: Display Mode Setting Command
Command 2: Data Setting Command
Command 3: Address Setting Command
Data 1 to n : Transfer Display Data (14 Bytes max.)
Command 4: Display Control Command

The following diagram shows the waveforms when updating specific addresses.



where: Command 2 — Data Setting Command
Command 3 — Address Setting Command
Data — Display Data

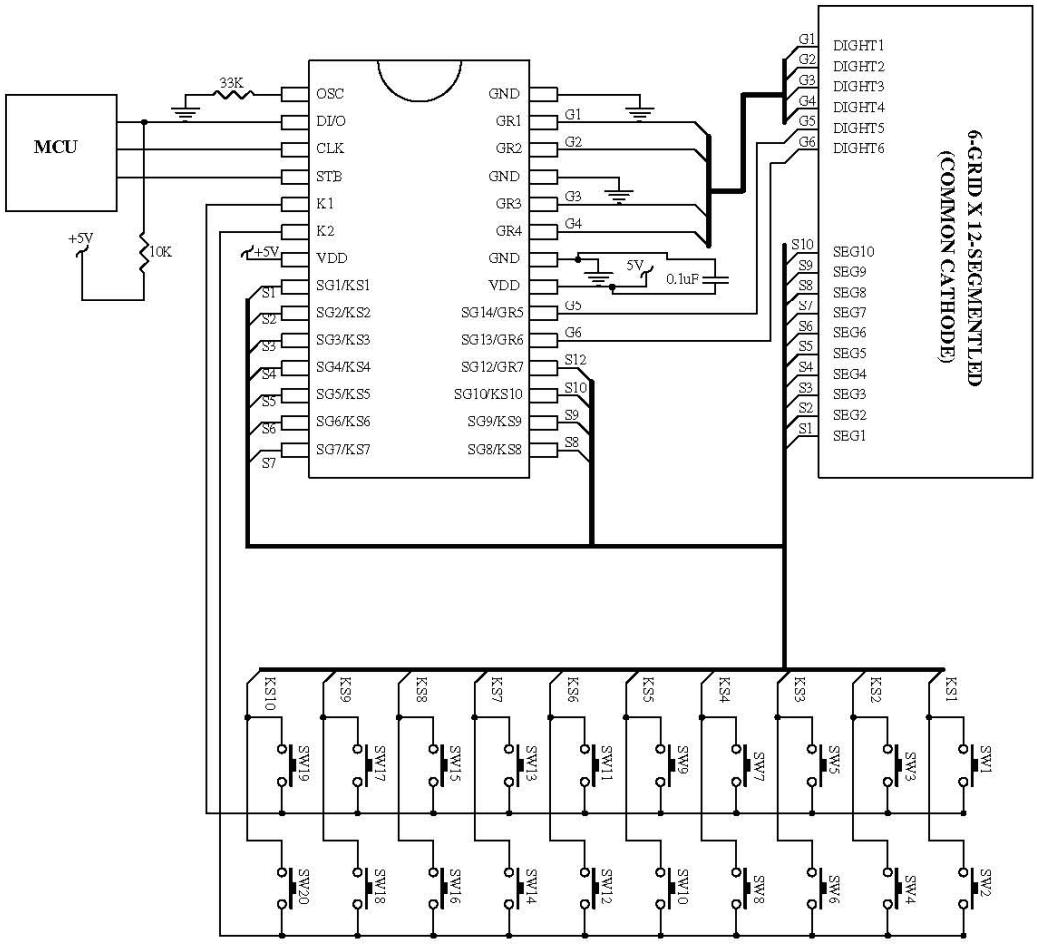
8. Recommended Software Programming Flowchart



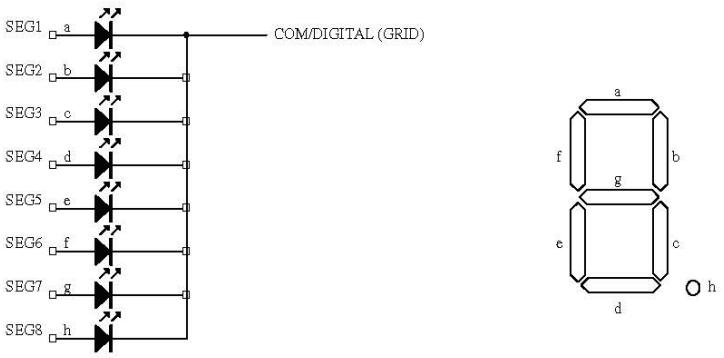
Note: 1. Command 1: Display Mode Commands
2. Command 2: Data Setting Commands
3. Command 3: Address Setting Commands
4. Command 4: Display Control Commands
5. When IC power is applied for the first time, the contents of the Display RAM is not defined; thus, it

is strongly suggested that the contents of the Display RAM must be cleared during the initial setting.

9. Application Circuit



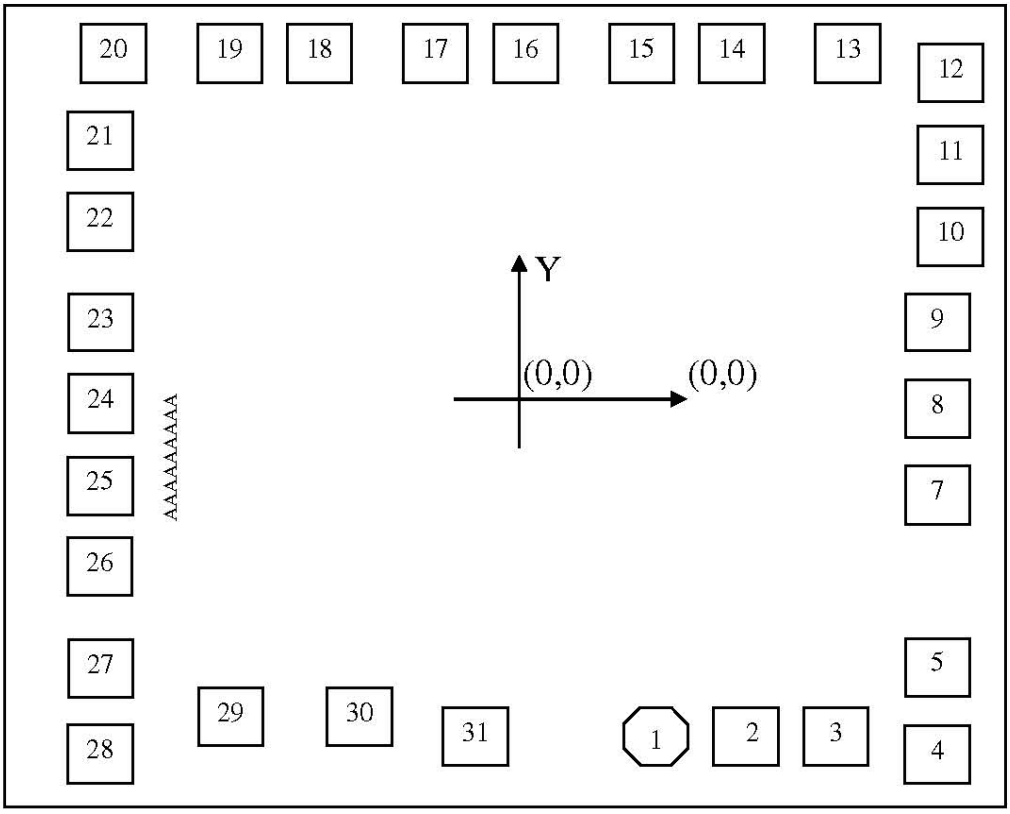
Common Cathode Type LED Panel：



10. PAD Location

NO.	PADNAME	X	Y
1	OSC	205	-446
2	DOUT	332	-446
3	DIN	449	-446
4	CLK	566	-468
5	STB	566	-350
6	K1	566	-233
7	K2	566	-115
8	K3	566	2
9	VDD	566	120
10	SG1/KS1	593	237
11	SG2/KS2	593	347
12	SG3/KS3	593	457
13	SG4/KS4	451	468
14	SG5/KS5	291	468
15	SG6/KS6	181	468
16	SG7/KS7	20	468

NO.	PADNAME	X	Y
17	SG8/KS8	-90	468
18	SG9/KS9	-250	468
19	SG10/KS10	-360	468
20	SG11	-526	468
21	SG12/GR7	-531	367
22	GR6	-531	235
23	GR5	-531	104
24	VDD	-531	-6
25	GND	-531	-116
26	GR4	-531	-226
27	GR3	-531	-358
28	GND	-531	-468
29	GR2	-380	-420
30	GR1	-204	-420
31	GND	-55	-446



Chip Size: (1520,1280) μ m

Note: The substrate must be connected to GND

11. Absolute Maximum Ratings

(Unless otherwise stated, Ta=25℃, GND=0V)

Parameter	Symbol	Limits	Unit
Supply Voltage	V_{DD}	-0.5 to +7	V
Logic Input Voltage	V_I	-0.5 to V_{DD} +0.5	V
Driver Output Current	I_{OLGR}	+250	mA
	I_{OHSG}	-50	mA
Maximum Driver Output Current/Total	I_{TOTAL}	400	mA

12. Recommended Operating Range

(Unless otherwise stated, Ta=-20 to +70℃, GND=0V)

Parameter	Symbol	Test Conditions	Min.	Typ.	Max.	Unit
Logic Supply Voltage	V_{DD}		4.5	5	5.5	V
Dynamic Current (see Note)	I_{DDdyn}		-	-	2.5	mA
High-Level Input Voltage	V_{IH}		0.8V_{DD}	-	V_{DD}	V
Low-Level Input Voltage	V_{IL}		0	-	0.3V_{DD}	V

Note: Test Condition: Set Display Control Commands = 80H (Display Turn OFF State & under no load)

13. Electrical Characteristics

(Unless otherwise stated, V_{DD}=5V, GND=0V, Ta=25℃)

Parameter	Symbol	Test Condition	Min.	Typ.	Max.	Unit
High-Level Output Current	IOHSG1	Vo=VDD-2V SG1 to SG10, SG12/GR7	-20	-25	-40	mA
	IOHSG2	Vo=VDD-3V SG1 to SG12, SG12/GR7	-25	-30	-50	mA
Low-Level Output Current	IOLGR	Vo=0.3V GR1 to GR6, SG12/GR7	50	65	-	mA
Low-Level Output Current	IOLDOUT	Vo=0.4V	10	-	-	mA
Segment High-Level Output Current Tolerance	ITOLSG	Vo=VDD-3V SG1 to SG10, SG12/GR7	-	-	±5	mA
High-Level Input Voltage	VIH	-	0.8 V_{DD}	-	5	V
Low-Level Input Voltage	VIL	-	0	-	0.3V_{DD}	V
Oscillation Frequency	fosc	R=36 KΩ	350	500	650	KHz
K1 to K2 Pull Down Resistor	RKN	K1 to K2 VDD=5V	40	-	100	KΩ

14. Editions

Editions	Expression	Date
V1.0	New Editions	2007-01-03

15. Notices

1. The information contained herein could be changed without notice owing to product and /or technical improvements. Please make sure before using the product that the information you are referring to is up-to-date.
2. No responsibility is assumed by us for any consequence resulting from any wrong or improper operation, etc.of the product.