

# LD1960A

9 SEGMENT X 7 GRID LED Driver with Key scan

Ver. 4.0 / Feb. 2012

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LDT Inc. does NOT assume any responsibility use of circuits described.

## LD1960A Revision History

Version	Contents	Date
1.0	- First Version	2011. 06. 20
2.0	- Key Scan Read Sequence change 4Byte Repeat → 8Byte Repeat	2011 . 08. 08
3.0	- . K1 Pin Key Scan function disable & Pin description changed - . Add to DIP Type Package (P23)	2011. 11. 03
4.0	- . VIH & VIL range Change (P7) VIH : 0.5VDD, VIL : 0.2VDD → VIH : 0.6VDD, VIL : 0.4VDD	2012. 02. 02

## DESCRIPTION

The LD1960A is specifically designed for LED and LED DISPLAY drivers. The LD1960A has 9 to 6 segment output lines, 7 to 4 grid output lines, one display memory, control circuit, 3 line serial data interface, and 6 x 2 matrix key scan. Those functions are all incorporated into a single chip to build a highly reliable peripheral device for a single chip microcomputer.

It is very convenient to control for numeric display. LD1960A's pin assignments and application Circuit are optimized for easy PCB layout and cost saving advantages.

## FEATURES

- CMOS technology
- Segment output line selection by command : 6 ~ 9
- Grid output line selection by command : 7 ~ 4
- Operation voltage : 5V
- Low power consumption
- 8-step dimming control by command
- Serial interface for clock, data input/output, strobe pins
- 20-pin TSSOP package, 20-pin DIP package

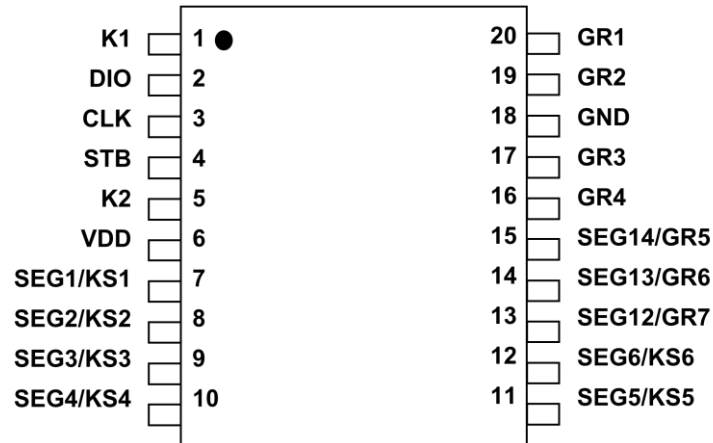
## APPLICATION

- Segment LED display : VCR, DVD, MWO

## ORDERING INFORMATION

Device name	Segment	Grid	Key Scanning	PKG Type
LD1960A-TSS	6~9 Segment	7~4Grid	6X1 matrix	20TSSOP
LD1960A-DIP	6~9 Segment	7~4Grid	6X1 matrix	20 DIP

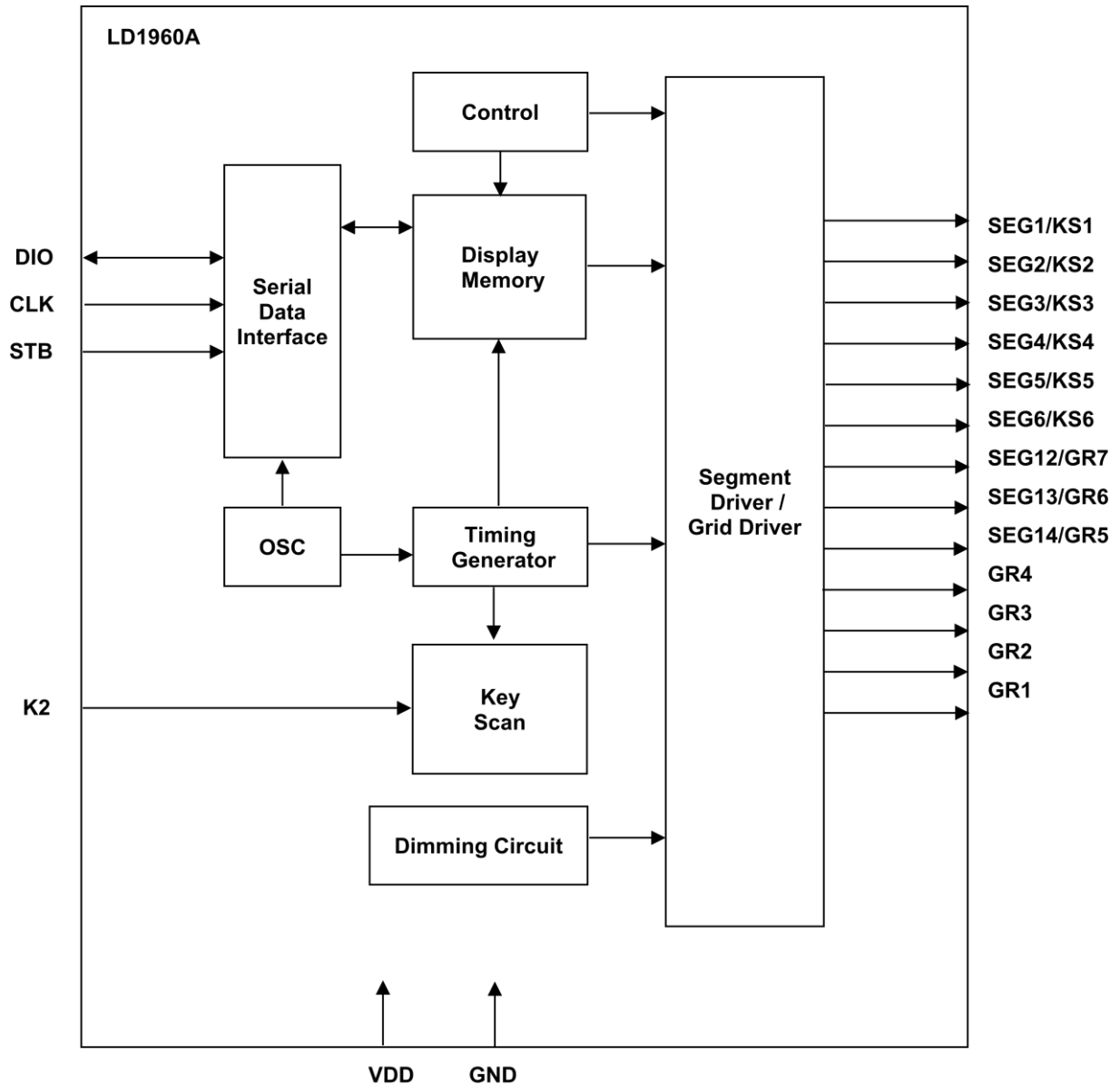
## PIN CONFIGURATION

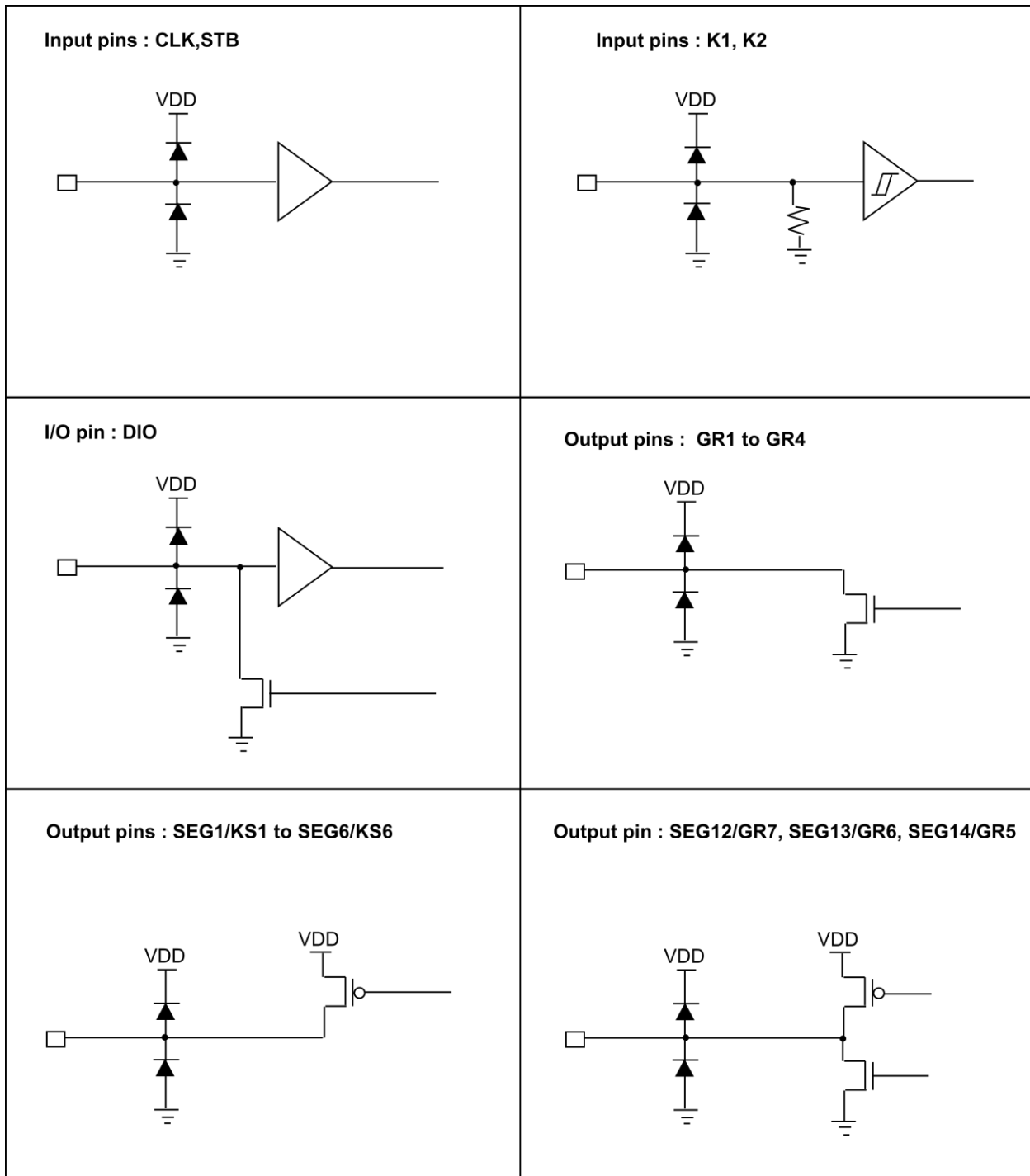


## PIN DESCRIPTION

PIN NAME	I/O	DESCRIPTION	PIN No.
K1	I	User don't use. It is only test mode pin This pin has pull down resistor(4.2K) internally.	1
DIO	I/O	Serial Data Input and N-channel open drain Output Pin This pin inputs serial data at CLK rising edge. This pin outputs at CLK falling edge.	2
CLK	I	Serial clock input pin Input data is triggered at rising edge. Output data is triggered at falling edge.	3
STB	I	When this pin is HIGH, CLK signal is ignored. The data input after the STB has fallen is processed as a command.	4
K2	I	Key scan input pin. This pin is operated with SEG1/KS1 to SEG6/KS6 pins. This pin has Pull down resistor internally.	5
VDD	-	Power Supply	6
SEG1/KS1 to SEG6/KS6	O	Segment output pins. ( P-channel open drain) Also key scan source pins.	7,8,9,10 11,12
SEG12/GR7	O	Segment / Grid output pin	13
SEG13/GR6	O	Segment / Grid output pin	14
SEG14/GR5	O	Segment / Grid output pin	15
GR4,GR3,GR2,GR1	O	Grid output pin	16,17,19,20
GND	-	Ground Pin	18

## BLOCK DIAGRAM



**INPUT/OUTPUT PINS SCHEMATIC DIAGRAM**


## ABSOLUTE MAXIMUM RATINGS

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

PARAMETER	SYMBOL	RATING	UNIT
Supply Voltage	VDD	-0.5 to +7.0	V
Logic Input Voltage	VI	-0.5 to VDD+0.5	V
Driver Output Current/Pin	IOLGR	+250	mA
	IOHSEG	-50	mA
Maximum Driver Output Current/Total	ITOTAL	400	mA

## RECOMMENDED OPERATING RANGE

(Unless otherwise stated, Ta= -40 to +85°C, GND=0V)

PARAMETER	SYMBOL	MIN.	TYP.	MAX.	UNIT
Logic Supply Voltage	VDD	2.7	5	5.5	V
Dynamic Current (see Note)	IDDdyn	.	.	5	mA
High-Level Input Voltage	VIH	0.6VDD	.	VDD	V
Low-Level Input Voltage	VIL	0	.	0.4VDD	V

**Note : Test Condition : Set Display Control Commands = 80H (Display Turn OFF State)**

## ELECTRICAL CHARACTERISTICS

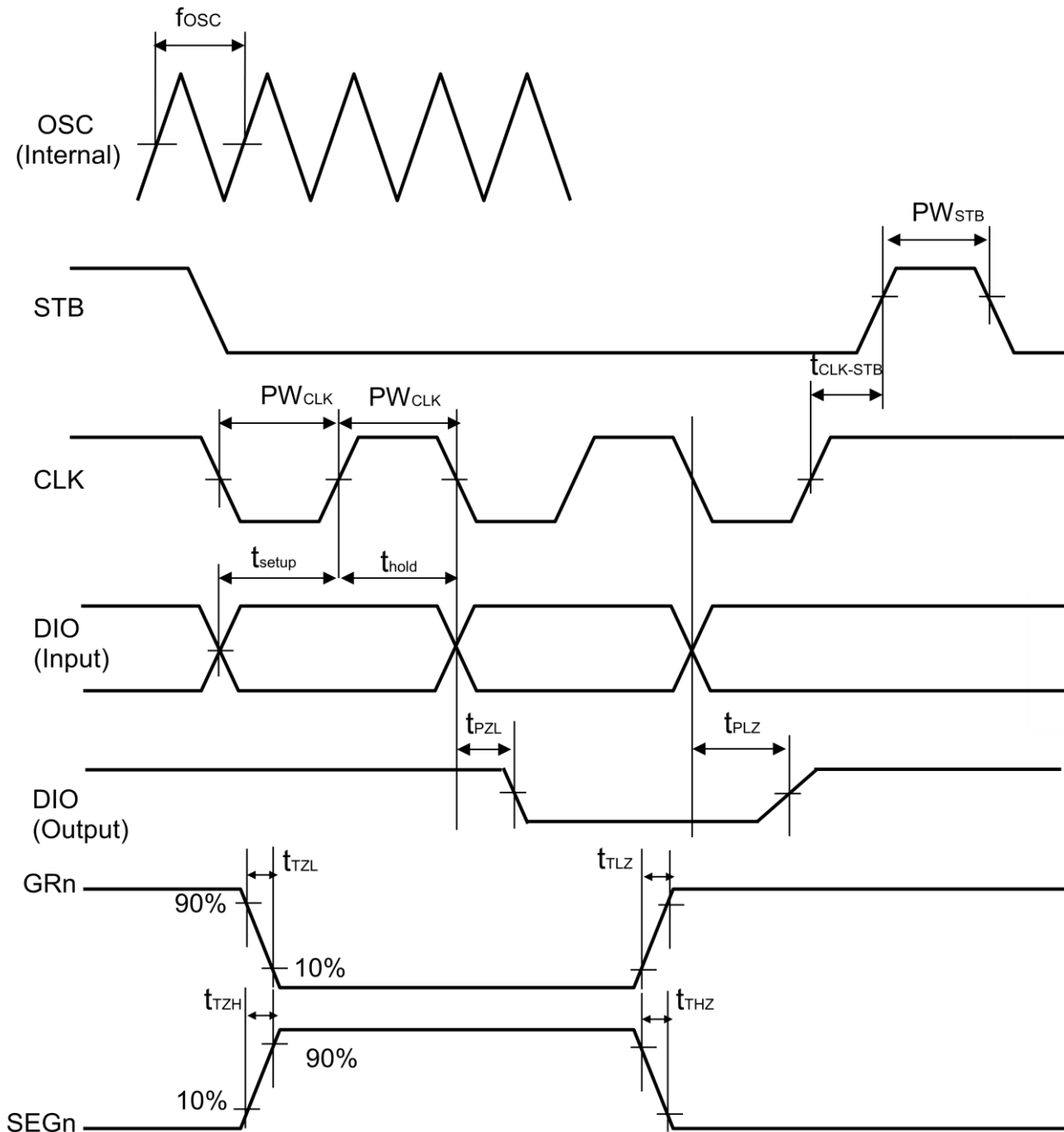
(Unless otherwise stated, VDD=5V, GND=0V, Ta=25°C)

PARAMETER	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
High-Level Output Current	IOHSG1	$V_o = V_{DD} - 2V$ SEG1 to SEG6,SEG14/GR5 SEG13/GR6,SEG12/GR7	-20	-25	-40	mA
	IOHSG2	$V_o = V_{DD} - 3V$ SEG1 to SEG6,SEG14/GR5 SEG13/GR6,SEG12/GR7	-25	-30	-50	mA
Low-Level Output Current	IOLGR	$V_o = 0.3V$ GR1 TO GR4,SEG14/GR5 SEG13/GR6,SEG12/GR7	100	140	-	mA
Low-Level Output Current	IOLDOUT	$V_o = 0.4V$ DIO	4	-	-	mA
Segment High-Level Output Current Tolerance	ITOLSG	$V_o = V_{DD} - 3V$ SEG1 to SEG6,SEG14/GR5 SEG13/GR6,SEG12/GR7	-	-	±5	%
High-Level Input Voltage	VIH	-	0.6VDD	-	VDD	V
Low-Level Input Voltage	VIL	-	0	-	0.4VDD	V
Oscillation Frequency	fOSC	-	350	500	650	kHz
K1 to K2 Pull Down Resistor	KSR	VDD=5V	40	-	100	kΩ

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## SWITCHING CHARACTERISTIC WAVEFORM

LD1960A switching characteristics waveform is given below.



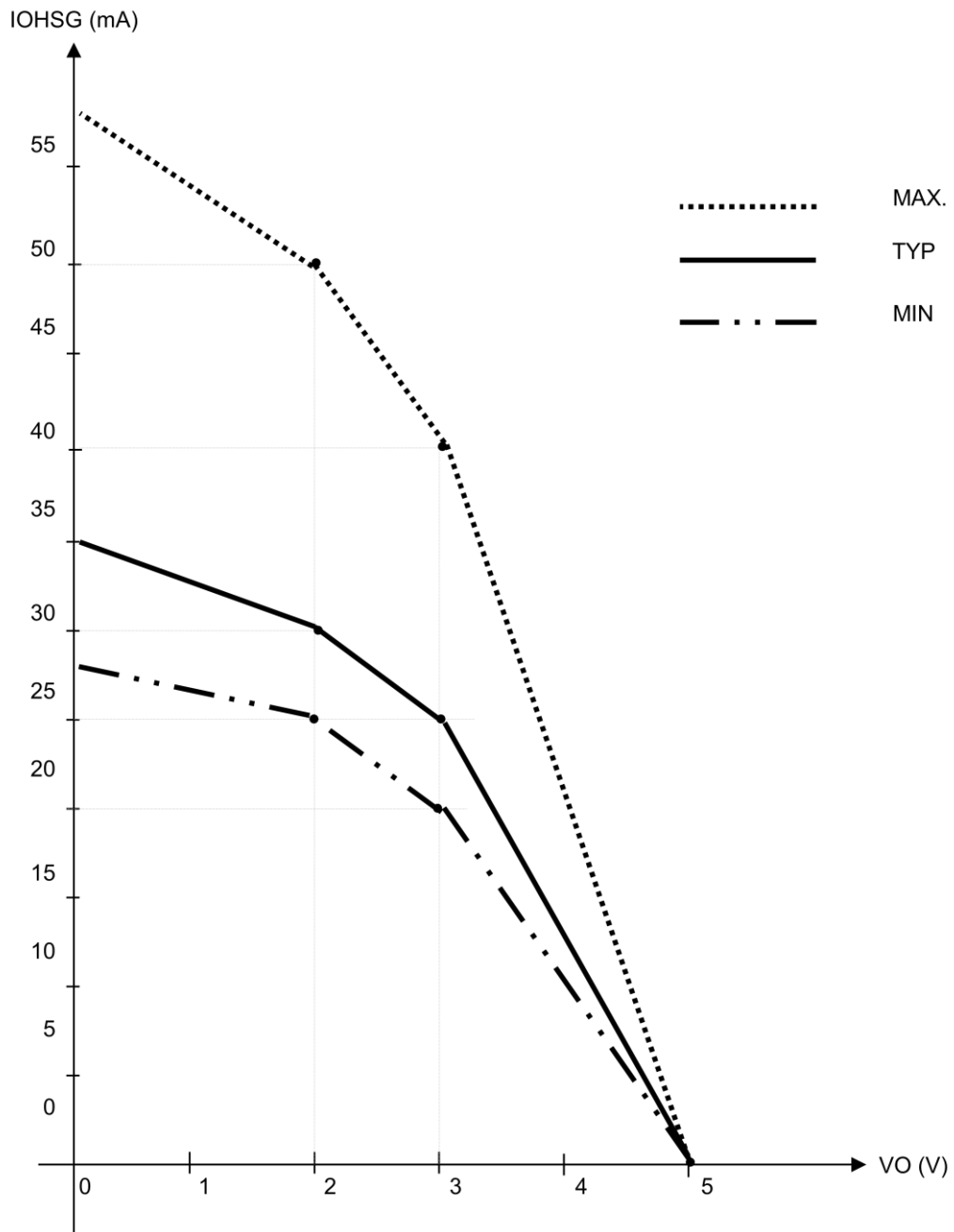
$PW_{CLK}$  (Clock Pulse Width)  $\geq 400ns$   
 $t_{setup}$  (Data Setup Time)  $\geq 100ns$   
 $t_{CLK-STB}$  (Clock - Strobe Time)  $\geq 1\mu s$   
 $t_{TZH}$  (Rise Time)  $\leq 1\mu s$   
 $t_{TZL} < 1\mu s$

$PW_{STB}$  (Strobe Pulse Width)  $\geq 1\mu s$   
 $t_{hold}$  (Data Hold Time)  $\geq 100ns$   
 $t_{THZ}$  (Fall Time)  $\leq 10\mu s$   
 $t_{TLZ} < 10\mu s$   
 $t_{PZL}$  (Propagation Delay Time)  $\leq 100ns$   
 $t_{PLZ}$  (Propagation Delay Time)  $\leq 300ns$



## SEG PIN Resistance

LD1960A SEG pins resistor characteristics is given below.



## FUNCTIONAL DESCRIPTION

### COMMANDS

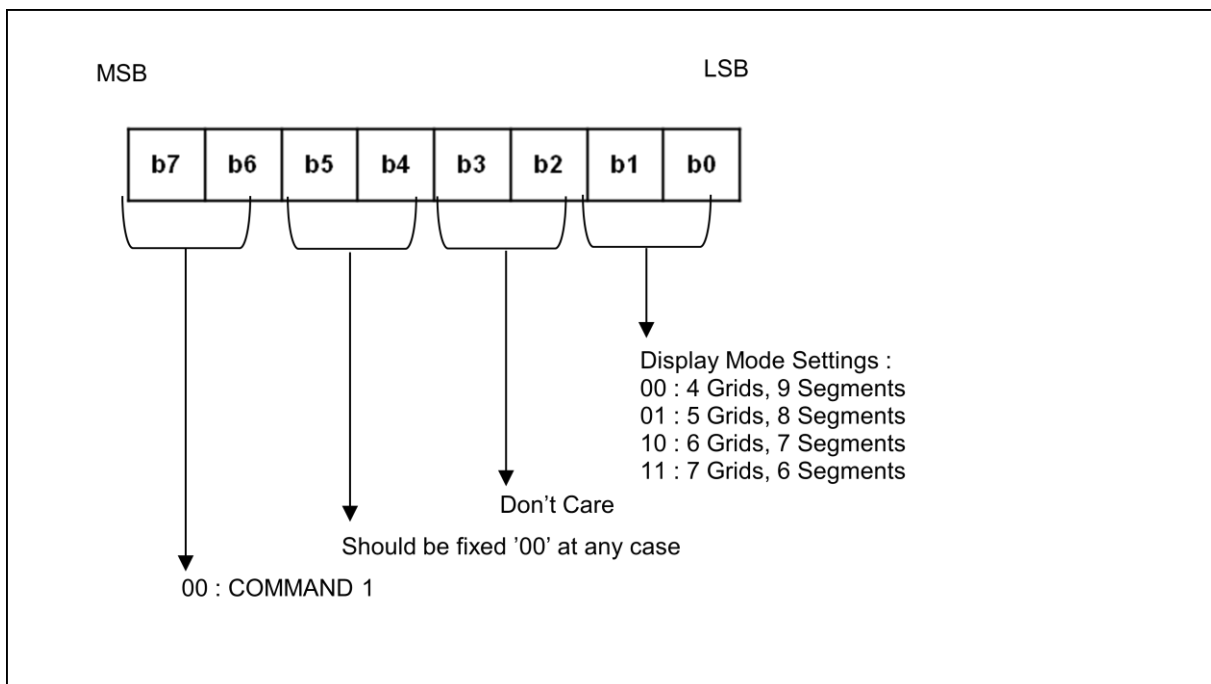
The LD1960A has 4 kind of commands. The first command is display setting command, the second command is data setting command, the third command is address setting command and the fourth command is display control command.

#### COMMAND 1 : DISPLAY MODE SETTING COMMAND

The Display mode setting command has 2bit (b1,b0) for display mode setting and 2bit (b7,b6) for commands. The 2bits(b5 ~ b4) should be fixed '00' at any case. The 2bits (b3 ~ b2) are don't care bit. The command bits (b7,b6) are "0","0" for COMMAND1.

The display mode setting command determines the number of segments and grids. This command should be executed for display off. And the default of b1,b0 are "1","1" for power on. This status is selected 7 grids, 6 segments . If b1,b0 are "1","0" then 6 grids 7 segments.

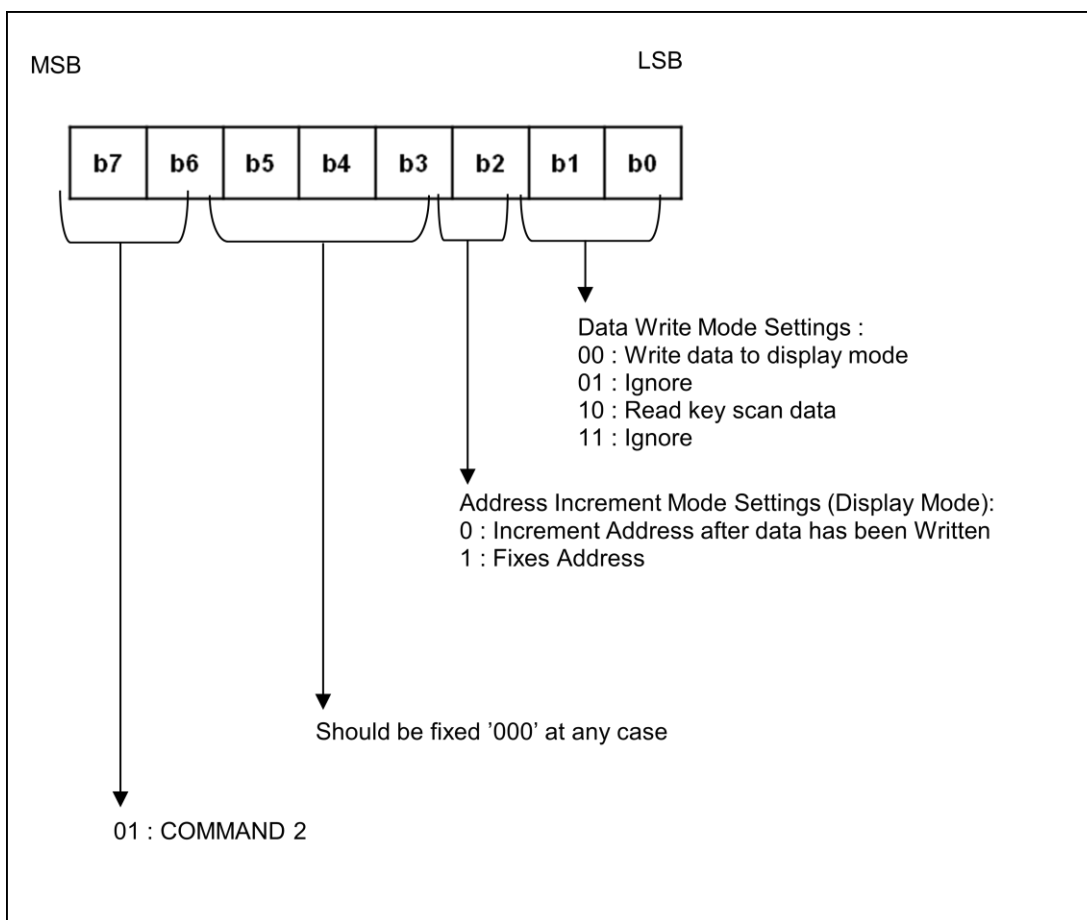
If b1,b0 are "0","1" then 5 grids 8 segments. If b1,b0 are "0","0" then 4 grids 9 segments.



## COMMAND 2 : DATA SETTING COMMAND

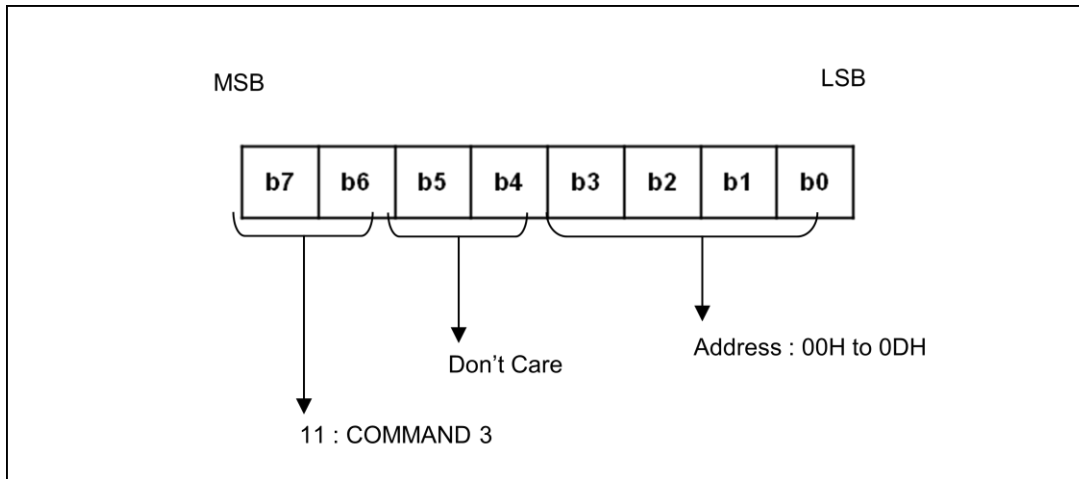
The data setting command consists of data write mode setting, address increment mode setting and mode setting . And the default of b3 to b0 are all "0" for power on.

The Data write mode settings have 2bit (b1,b0) for writing data to display mode and read key scan data. And address increment mode setting has 1bit (b2) for selecting address Increment or fixed. And 3bits(b5 ~ b3) should be fixed '000' at any case. The command bits (b7,b6) are "0","1" for COMMAND2.



### COMMAND 3 : ADDRESS SETTING COMMAND

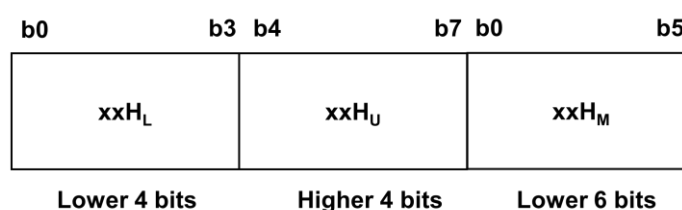
The display memory is addressed by Address Setting Command. The valid address range is "00H" to 0DH". If the address is set to 0EH to 0FH, the data is ignored until a valid address is set. When power is turned ON, the address is set at "00H".



#### Display Mode and RAM Address

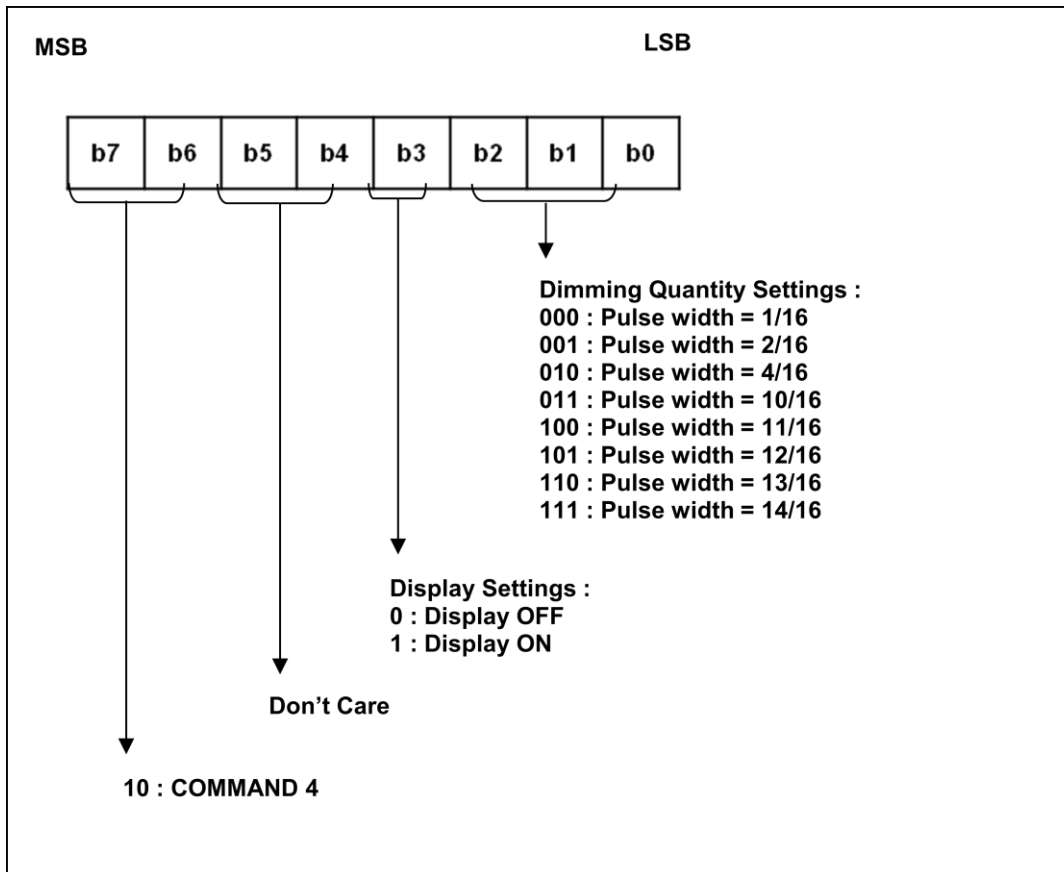
Data transmitted from an external device to LD1960A via the serial interface are stored in the Display RAM and are assigned addresses. The RAM Addresses of LD1960A are given below in 8 bit unit.

SEG1	SEG4	SEG5	SEG8	SEG9	SEG14	
00H <sub>L</sub>	00H <sub>U</sub>				01H <sub>M</sub>	GR1
02H <sub>L</sub>	02H <sub>U</sub>				03H <sub>M</sub>	GR2
04H <sub>L</sub>	04H <sub>U</sub>				05H <sub>M</sub>	GR3
06H <sub>L</sub>	06H <sub>U</sub>				07H <sub>M</sub>	GR4
08H <sub>L</sub>	08H <sub>U</sub>				09H <sub>M</sub>	GR5
0AH <sub>L</sub>	0AH <sub>U</sub>				0BH <sub>M</sub>	GR6
0CH <sub>L</sub>	0CH <sub>U</sub>				0DH <sub>M</sub>	GR7

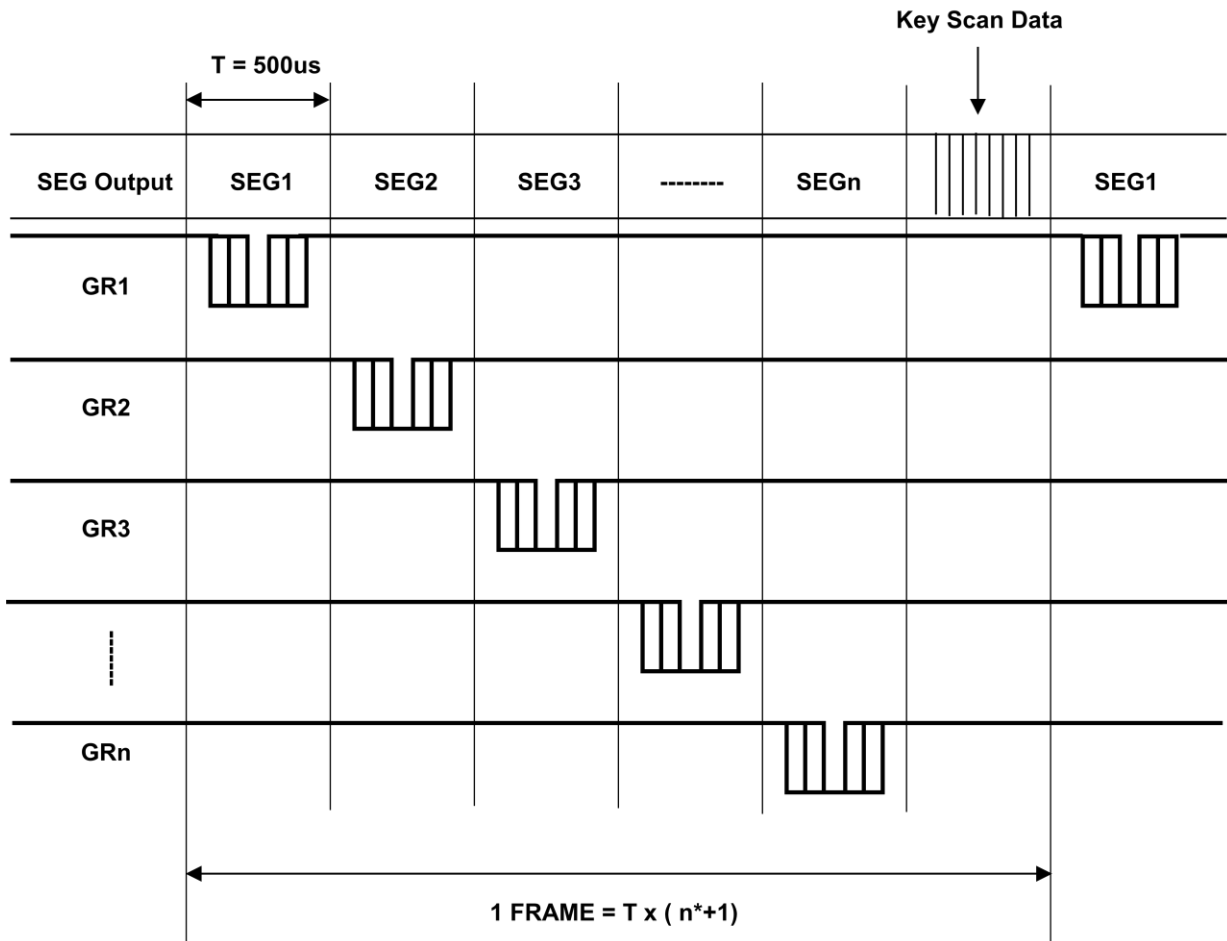


**COMMAND 4 : DISPLAY CONTROL COMMANDS**

The Display Control Commands are used to turn ON or OFF a display. It is 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 display is turned OFF.



## DISPLAY TIMING WAVEFORM

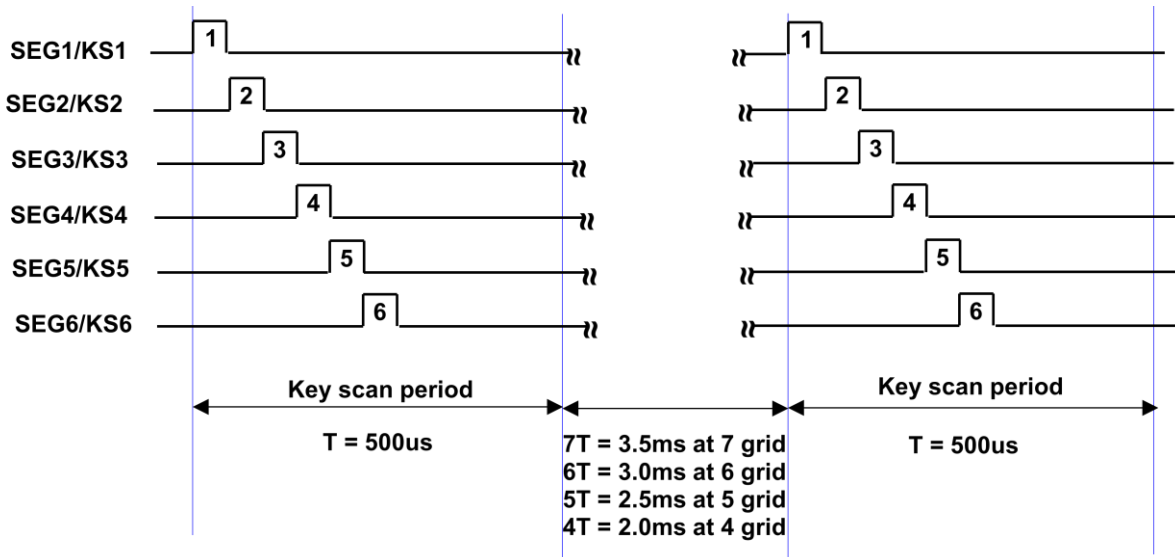


\*) n is the number of Grid

## KEY SCAN

### 1) Key Scan Timing

The key scan period is 500us at oscillator=500Khz.



### 2) Key scan operation

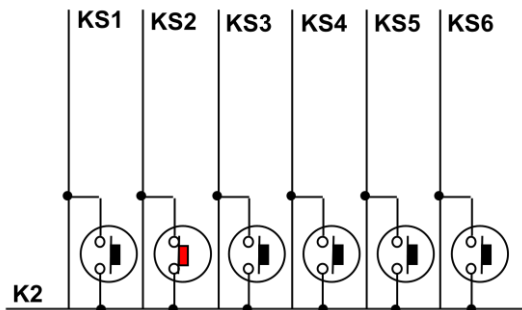
The key scan is operated always.

Multiple key presses are recognized by determining whether multiple key data bits are set.

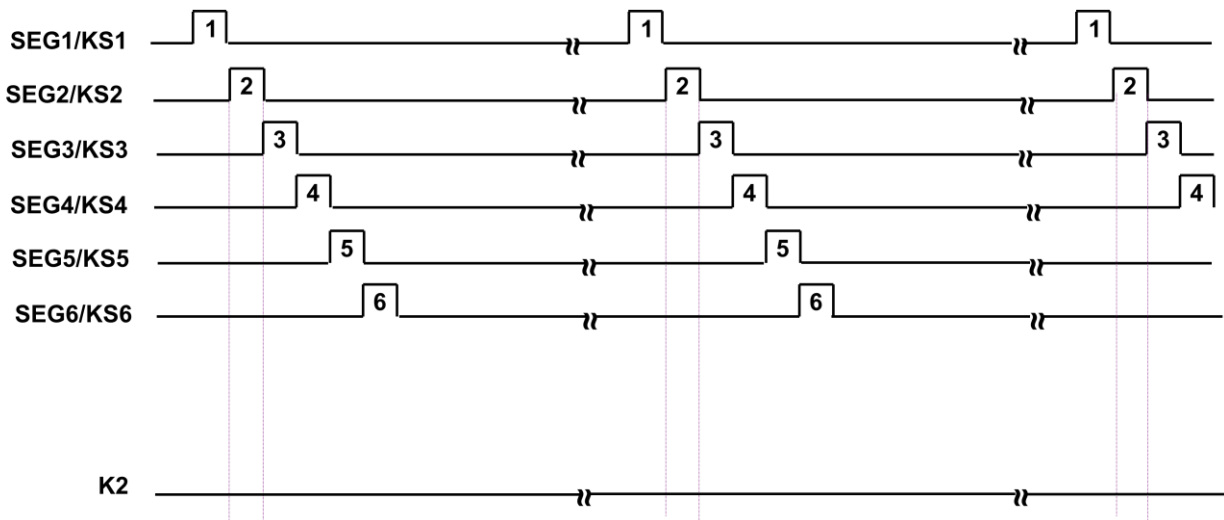
### 3) Key scan data read sequence

K1	K2	K1	K2					
X	SEG1/KS1	X	X	SEG2/KS2	X	0	1	1'st byte read
X	SEG3/KS3	X	X	SEG4/KS4	X	0	1	2'nd byte read
X	SEG5/KS5	X	X	SEG6/KS6	X	0	1	3'rd byte read
X	X	X	X	X	X	0	1	4'th byte read
X	X	X	X	X	X	0	1	5'th byte read
X	X	X	X	X	X	0	1	6'th byte read
X	X	X	X	X	X	0	1	7'th byte read
X	X	X	X	X	X	0	1	8'th byte read
b0	b1	b2	b3	b4	b5	b6	b7	

Key press = "1", Key no press = "0" read.

**4) Key Scan Example**


If SW switch is pressed, the K2 of key input pin is high by KS2 at key scan timing.  
So the K2 pin input is high.

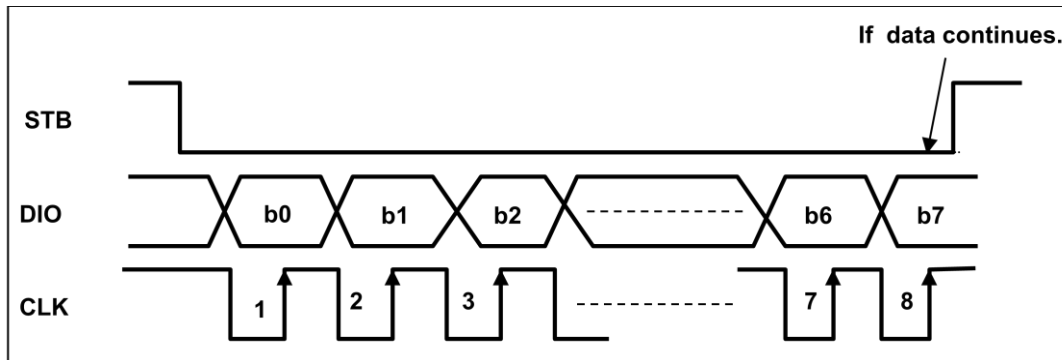




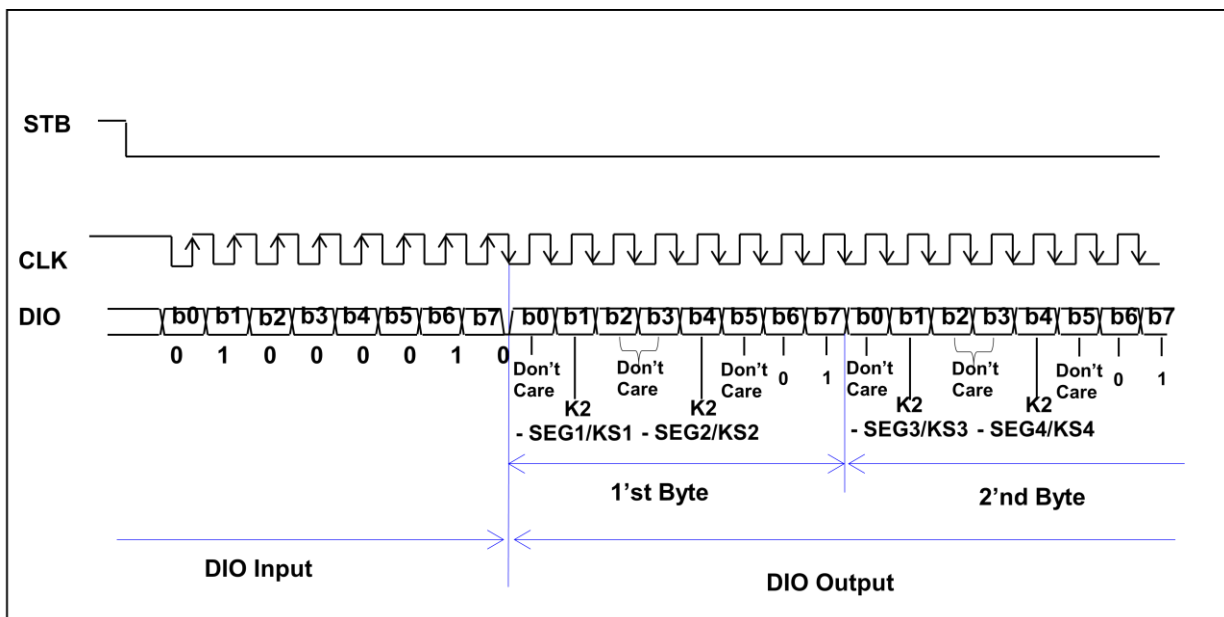
## SERIAL COMMUNICATION FORMAT

The following diagram shows the LD1960A serial communication format.

Reception (Data/Command Write)

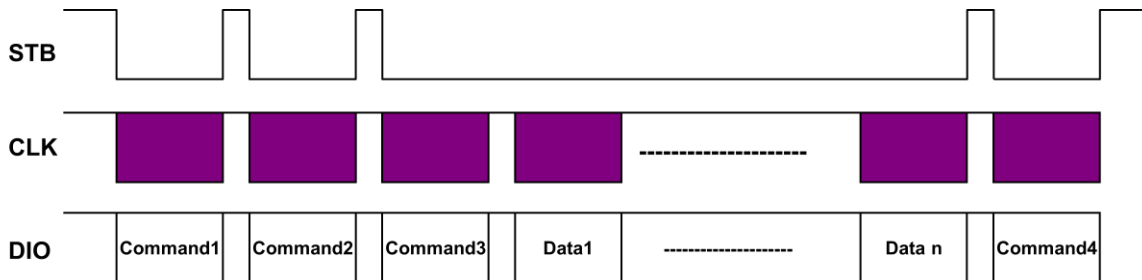


Transmission (Data Read)



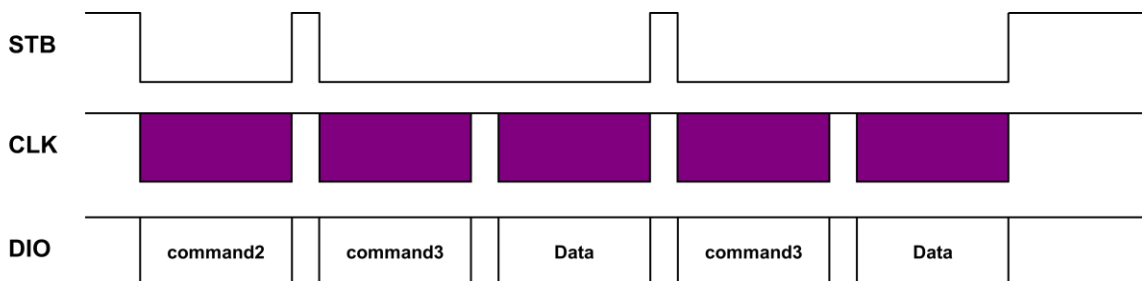
## SERIAL COMMUNICATION EXAMPLES

Serial communication timing diagram for initialization setting.

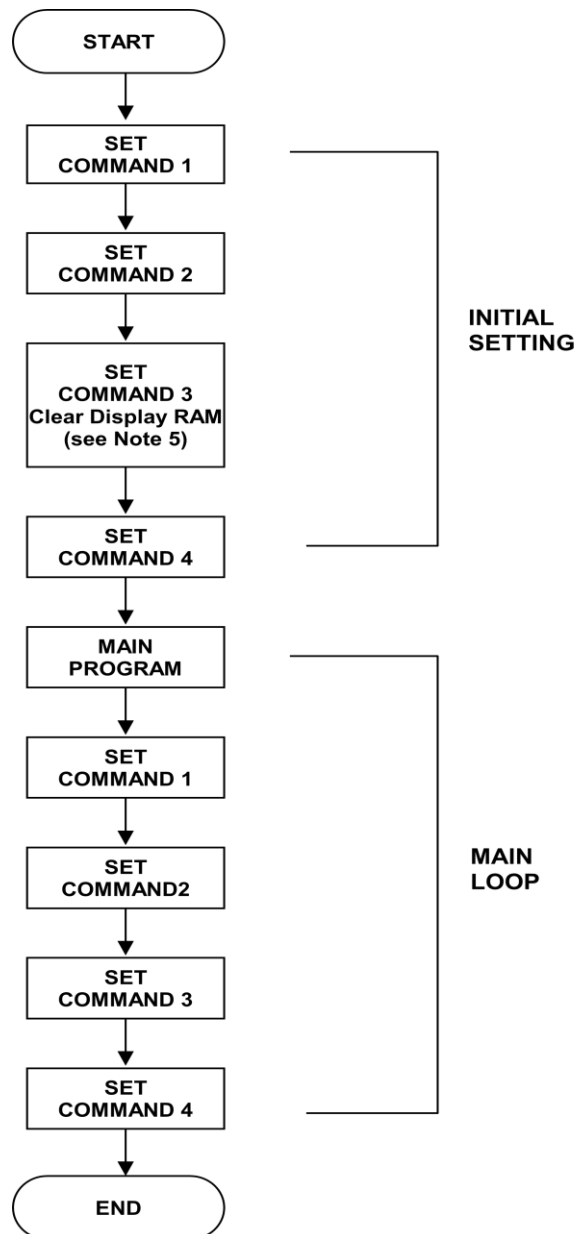


Where : Command 1 : Display Mode Setting  
 Command 2 : Data Setting Command  
 Command 3 : Address Setting Command  
 Data 1 to n : Transfer Display Data (14 Bytes max.)  
 Command 4 : Display Control Command

Memory updating timing diagram.



Where : Command 2 : Data Setting Command  
 Command 3 : Address Setting Command  
 Data : Display Data

**RECOMMENDED SOFTWARE PROGRAMMING FLOW CHART**


Note : 1. Command 1 : Display Mode Setting

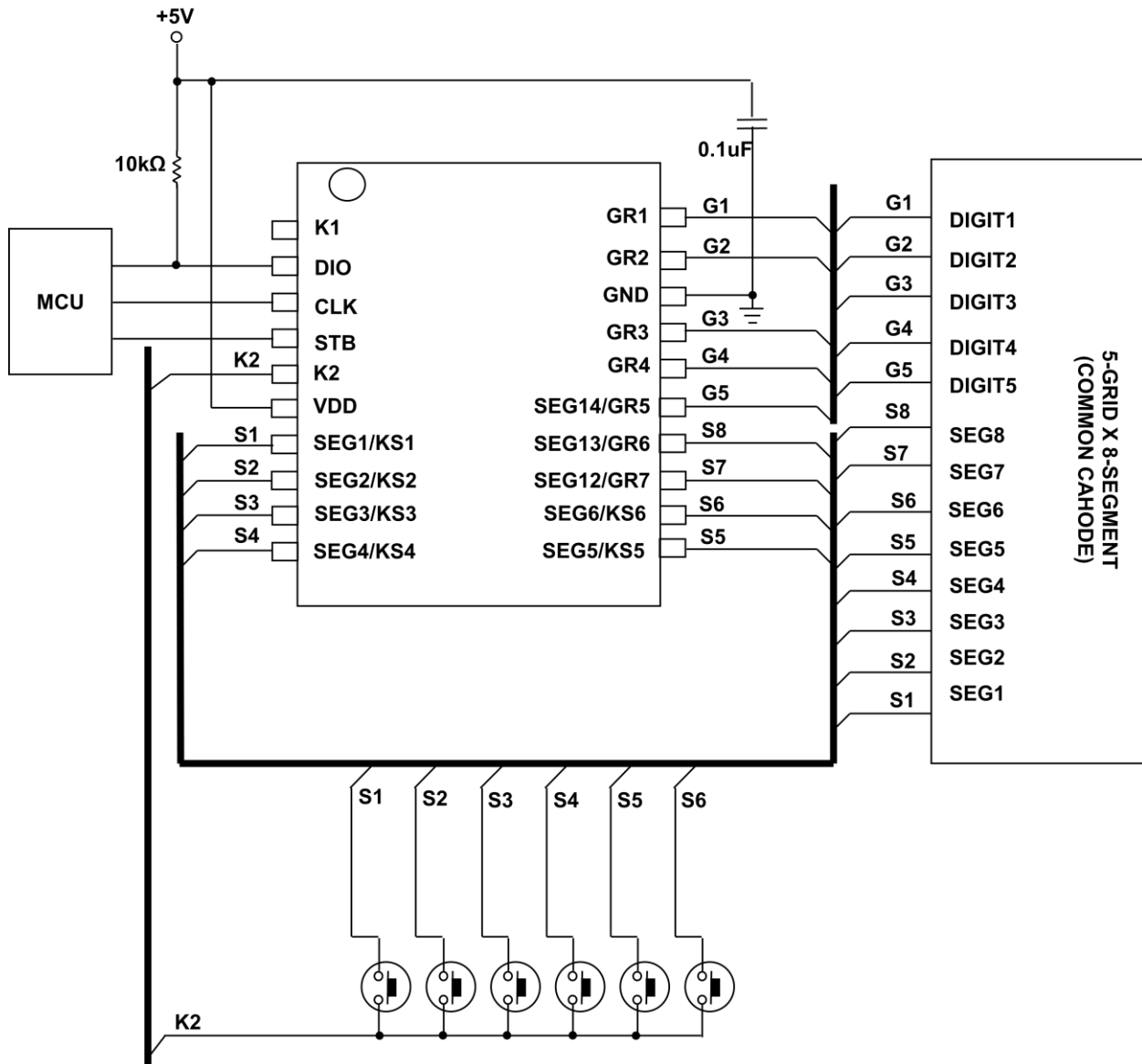
2. Command 2 : Data Setting Commands

3. Command 3 : Address Setting Commands

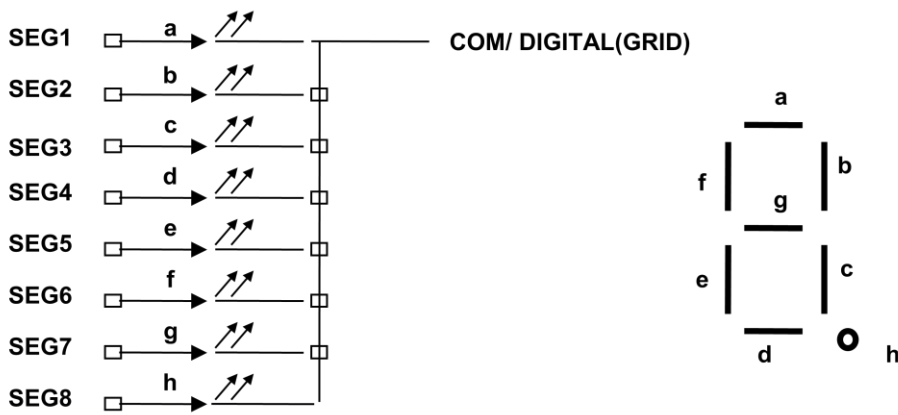
4. Command 4 : Display Control Commands

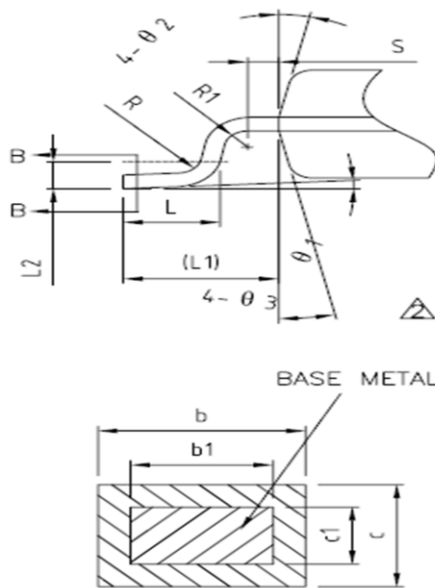
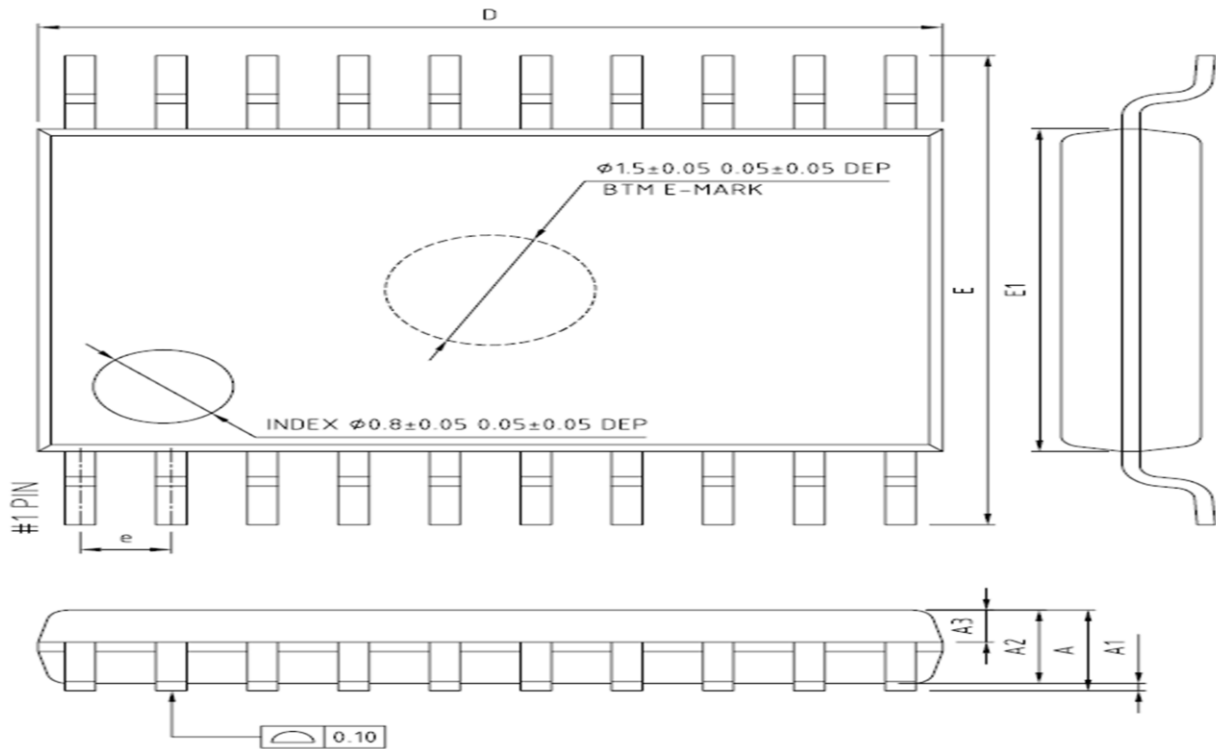
5. When IC power is applied for the first time, the contents of the Display RAM are not defined : thus, it is strongly suggested that the contents of the Display RAM must be cleared during the initial setting.

## TYPICAL APPLICATION CIRCUIT



## LED PANEL FOR CATHODE TYPE



**PACKAGE INFORMATION**
**TSSOP 20**
**Unit : mm**

**COMMON DIMENSIONS**  
(UNITS OF MEASURE=MILLIMETER)

SYMBOL	MIN	NOM	MAX
A	—	—	1.20
A1	0.05	—	0.15
A2	0.90	1.00	1.05
A3	0.34	0.44	0.54
b	0.20	—	0.28
b1	0.20	0.22	0.24
c	0.10	—	0.19
c1	0.10	0.13	0.15
D	6.40	6.50	6.60
E	6.20	6.40	6.60
E1	4.30	4.40	4.50
e	0.65BSC		
L	0.45	0.60	0.75
L1	1.00REF		
L2	0.25BSC		
R	0.09	—	—
R1	0.09	—	—
S	0.20	—	—
$\theta 1$	0°	—	8°
$\theta 2$	10°	12°	14°
$\theta 3$	10°	12°	14°

SECTION B-B

