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DL8838   LED Driver IC

DESCRIPTION

DL8838 is and LED Controller driven on a 1/4 to 1/7 duty factor. Fourteen to eleven segment output lines, 4 to 7 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 DL8838 via a three-line serial interface. Housed in a 28-pin SO Package, DL8838's pin assignments and application circuit are optimised for easy PCB Layout and cost saving advantages.
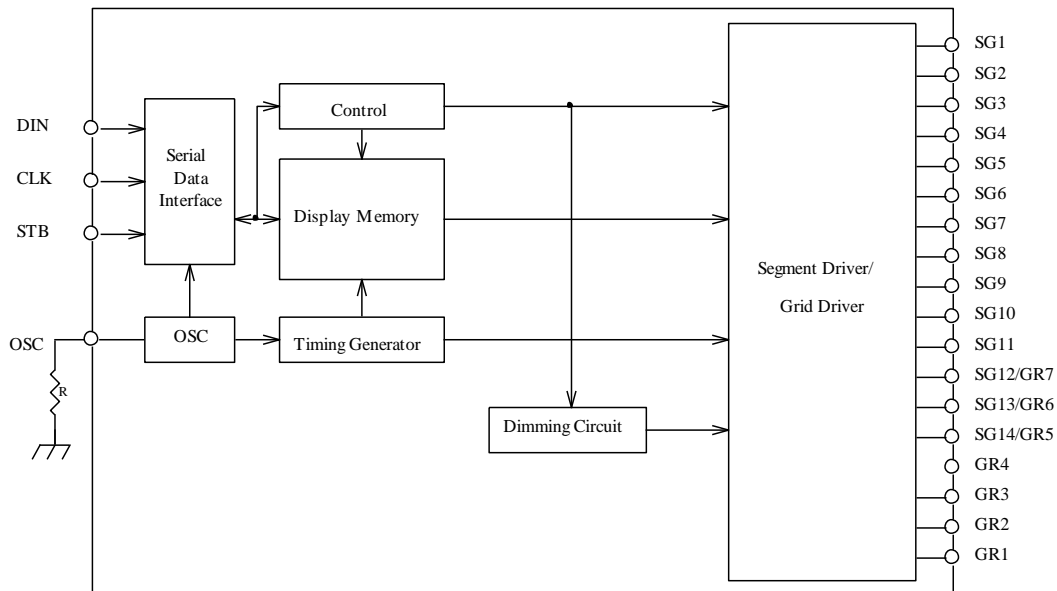
FEATURES

- CMOS technology
- Low power consumption
- 8-step dimming circuitry
- Serial interface for clock, data input, strobe pins
- Available in 28-pin, SO package

APPLICATION

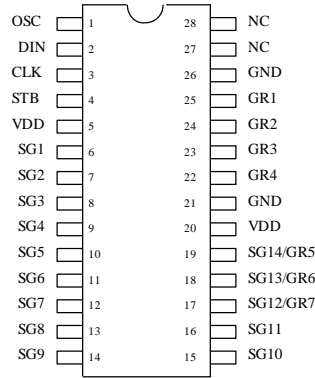- Microcomputer peripheral device

BLOCK DIAGRAM
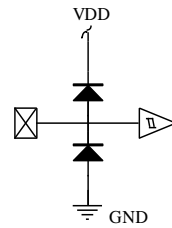
DL8838   LED Driver IC

PIN CONFIGURATION

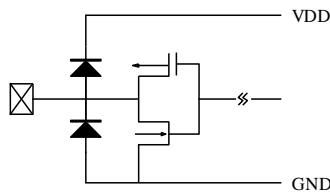|			
OSC	1	28	NC
DIN	2	27	NC
CLK	3	26	GND
STB	4	25	GR1
VDD	5	24	GR2
SG1	6	23	GR3
SG2	7	22	GR4
SG3	8	21	GND
SG4	9	20	VDD
SG5	10	19	SG14/GR5
SG6	11	18	SG13/GR6
SG7	12	17	SG12/GR7
SG8	13	16	SG11
SG9	14	15	SG10

INPUT/OUTPUT CONFIGURATIONS

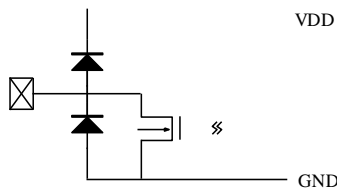The schematic diagrams of the input and output circuits of the logic section are shown below.
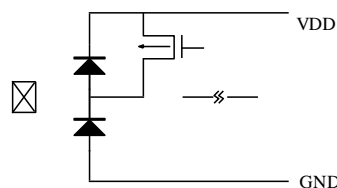
Input Pins: CLK, STB&DIN

Output Pins: SG14/GR5 TO SG12/GR7

Output Pins: GR1 to GR4

Output Pins: SG1 to SG11

PIN DESCRIPTION

Pin Name	I/O	Description	Pin No.
OSC	I	Oscillator Input Pin A resistor is connected to this pin to determine the oscillation frequency	1
DIN	I	Data Input Pin This pin inputs serial data at the rising edge of the shift clock (starting from the lower bit)	2
CLK	I	Clock Input Pin The pin reads serial data at the rising edge.	3
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.	4
VDD	-	Power Supply	5,20
SG1 to SG11	O	Segment Output Pins(p-channel, open drain)	6~16
SG12/GR7 to SG14/GR5	O	Segment Output Pin/Grid Output Pin (CMOS Output)	17~19
GND	-	Ground Pin	21,26
GR4 to GR1	O	Grid Output Pins (n-channel, open drain)	22~25
NC	-	No Connection	27,28

FUNCTIONAL DESCRIPTION

Commands

A command is the first byte (b0 to b7) inputted to DL8838 via the DIN Pin after STB Pin has changed from "HIGH" to "LOW" State. If for some reason the STB Pin is set to "HIGH" while data or commands are being transmitted, the serial communication is initialised, and the data/commands being transmitted are considered invalid.

COMMAND 1:DISPLAYMODE SETTING COMMANDS

DL8838 provides 4 display mode settings as shown in the diagram below: As stated earlier a command is the first one byte (b0 to b7)transmitted to DL8838 via the DIN Pin when STB is "LOW". However, for these commands, Bit No.3 to Bit No.6 (b2 to b5) are ignored, Bit No.7&Bit No.8 (b6 to b7)are given a value of "0".

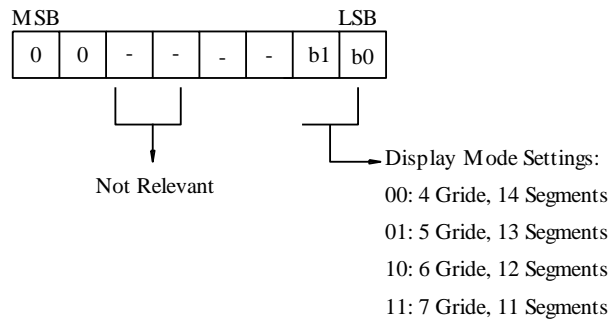The Display Mode Setting Commands determine the number of segments and grids to be used (1/4 to 1/7 duty, 14 to 11 segments). When these commands are executed, the display is forcibly turned off. A display command "ON" must be executed in order to resume display. If the same mode setting is selected, no command execution is take place, therefore, nothing happens.

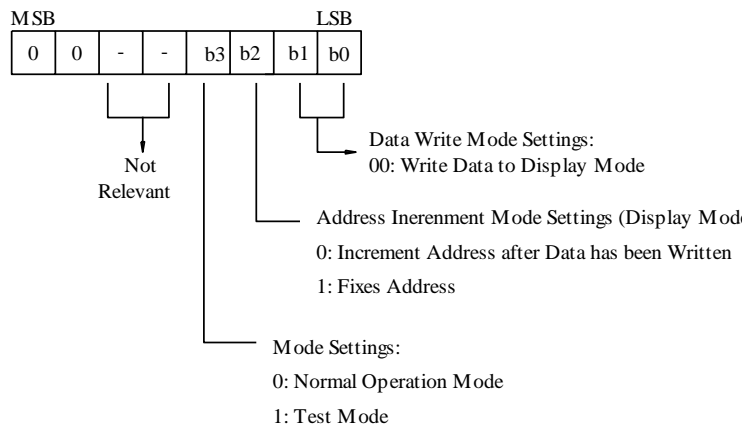When Power is turned "ON", the 7-Grid, 11-Segment Mode is selected.

Not Relevant

Display Mode Settings:
00: 4 Gride, 14 Segments
01: 5 Gride, 13 Segments
10: 6 Gride, 12 Segments
11: 7 Gride, 11 Segments

COMMAND 2: DATA SETTING COMMANDS

The Data Setting Commands executes the Data Write Mode for DL8838. 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, but 4 to bit 1 (b3 to b0) are given the value of "0".

Not Relevant

Data Write Mode Settings:
00: Write Data to Display Mode

Address Inerenment Mode Settings (Display Mode
0: Increment Address after Data has been Written
1: Fixes Address

Mode Settings:
0: Normal Operation Mode
1: Test Mode

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 "00H".

Please refer to the diagram below.

Address: 00H to 0DH

Not Relevant
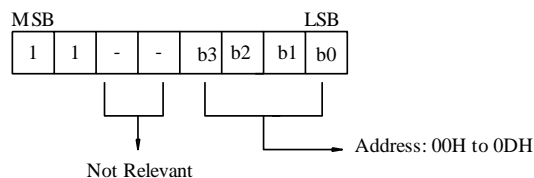
Display Mode and RAM Address

Data transmitted from an external device to DL8838 via the serial interface are stored in the Display RAM and are assigned addresses. The RAM Addresses of DL8838 are given below in 8 bits unit.

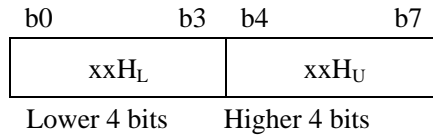| SG1 SG4	SG5 SG8	SG9 SG12	SG13 SG14	
00_{HL}	00_{HU}	01_{HL}	01_{HU}	**DIG1**
02_{HL}	02_{HU}	03_{HL}	03_{HU}	**DIG2**

04_{HL}	04_{HU}	05_{HL}	05_{HU}	**DIG3**
06_{HL}	06_{HU}	07_{HL}	07_{HU}	**DIG4**
08_{HL}	08_{HU}	09_{HL}	09_{HU}	**DIG5**
$0A_{HL}$	$0A_{HU}$	$0B_{HL}$	$0B_{HU}$	**DIG6**
$0C_{HL}$	$0C_{HU}$	$0D_{HL}$	$0D_{HU}$	**DIG7**

b0　　　　　　b3	b4　　　　　　b7
xxH_L	xxH_U
Lower 4 bits	Higher 4 bits

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

MSB							LSB
1	0	-	-	b3	b2	b1	b0

Not Relevant

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

Display Settings:

0: Display OFF

1: Display ON
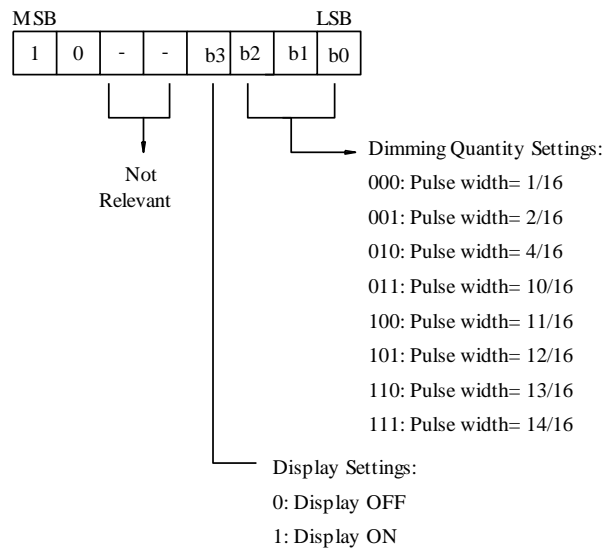
DISPLAY TIMING WAVEFORM

Tdisplay-500us

| SG Output | DIG1 | DIG2 | DIG3 | DIG4 | ----------- | DIGn | DIG1 |

G1

G2

G3

G4

Gn
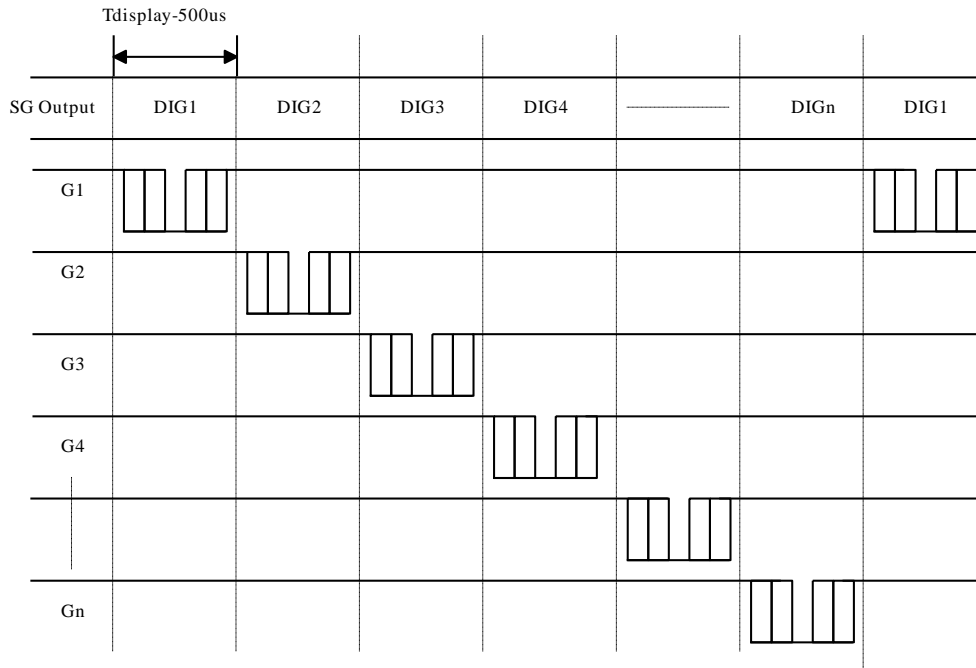
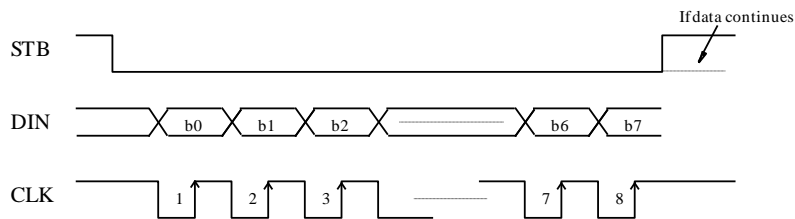## SERIAL COMMUNICATION FORMAT

The following diagram shows the DL8838 serial communication format

RECEPTION (Data/ Command Write)

If data continues

STB

DIN   b0   b1   b2   -------------   b6   b7

CLK   1   2   3   -------   7   8

SWITCHING CHARACTERISTIC WAVEFORM

DL8838 Switching Characteristics Waveform is given below

DL8838   **LED Driver IC**
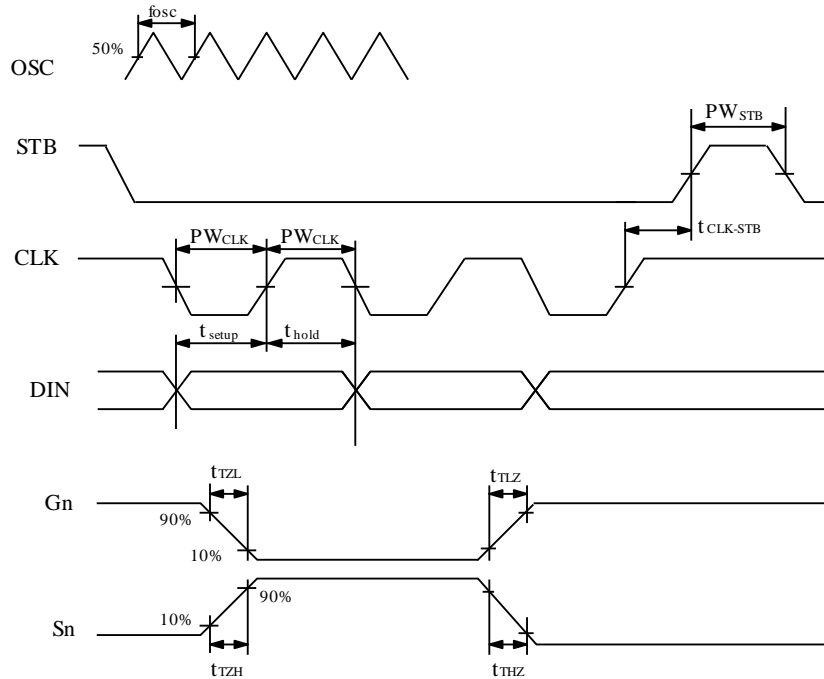
where: PW_{CLK} (Clock Pulse Width) $\geqslant$ 400nS PW_{STB} (Strobe Pulse Width) $\geqslant 1\mu$ s

t_{setup} (Data Setup Time) $\geqslant$100nS t_{hold} (Data Hold Time) $\geqslant$100nS

$t_{CLK\text{-}STB}$ (Clock-Strobe Time) $\geqslant 1\mu$ s t_{THZ}(Fall Time)$\leqslant 10\mu$ s

t_{TZH}(Rise Time) $\leqslant 1\mu$ s   fosc= Oscillation Frequency

$t_{TZL} < 1\mu$ s $t_{TLZ} < 10\mu$ s

APPLICATIONS

Display memory is updated by incrementing addresses. Please refer to the following diagram.
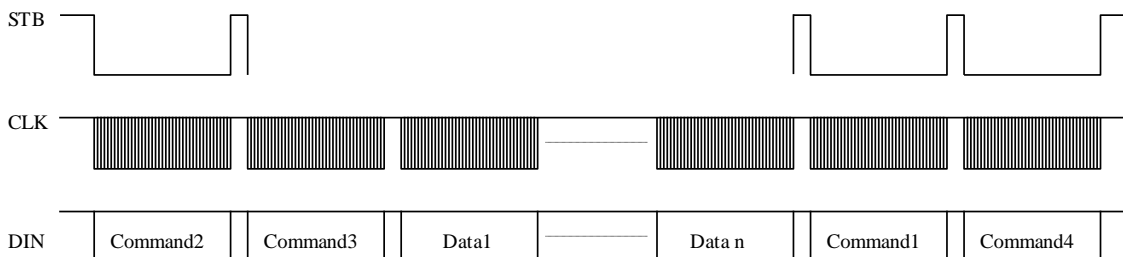
where: Command 1: Display Mode Setting Command

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.

STB

CLK

DIN | Command2 | Command3 | Data | Command 3 | Data |

where:

where: Command 2 — Data Setting Command

Command 3 — Address Setting Command

Data — Display Data

DL8838   **LED Driver IC**

RECOMMENDED SOFTWARE PROGRAMMING FLOWCHART

```
                    ┌──────────────┐
                    │    START     │
                    └──────┬───────┘
                           ▼
                    ┌──────────────┐
                    │  Relay 200ms │
                    └──────┬───────┘
                           ▼
                    ┌──────────────┐
                    │     SET      │────────────┐
                    │  COMMAND2    │            │
                    │ (Write Data) │            │
                    └──────┬───────┘            │
                           ▼                    │
                    ┌──────────────┐            │
                    │     SET      │            │
                    │  COMMAND3    │            │   INITIAL
                    │Clear Display │            │   SETTING
                    │     RAM      │            │
                    │ (See Note 5) │            │
                    └──────┬───────┘            │
                           ▼                    │
                    ┌──────────────┐            │
                    │     SET      │            │
                    │  COMMAND1    │            │
                    └──────┬───────┘            │
                           ▼                    │
                    ┌──────────────┐            │
                    │     SET      │────────────┘
                    │  COMMAND4    │
                    │(88H~8FH:     │
                    │ Display ON)  │
                    └──────┬───────┘
                           ▼
                    ┌──────────────┐◄───────────┐
                    │    MAIN      │            │
                    │  PROGRAM     │            │
                    └──────┬───────┘            │
                           ▼                    │
                    ┌──────────────┐            │
                    │     SET      │            │
                    │  COMMAND2    │            │
                    │ (READ KEY &  │            │
                    │  WRITEDATA   │            │
                    │  INCLUDED)   │            │
                    └──────┬───────┘            │   MAIN
                           ▼                    │   LOOP
                    ┌──────────────┐            │
                    │     SET      │            │
                    │  COMMAND3    │            │
                    └──────┬───────┘            │
                           ▼                    │
                    ┌──────────────┐            │
                    │     SET      │            │
                    │  COMMAND1    │            │
                    └──────┬───────┘            │
                           ▼                    │
                    ┌──────────────┐            │
                    │     SET      │────────────┘
                    │  COMMAND4    │
                    └──────┬───────┘
                           ▼
                    ┌──────────────┐
                    │     GND      │
                    └──────────────┘
```
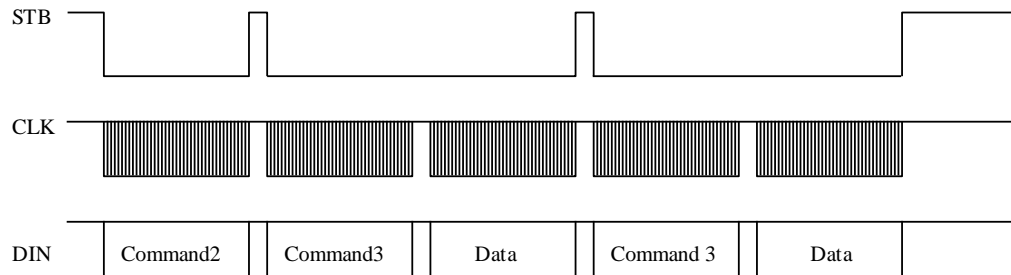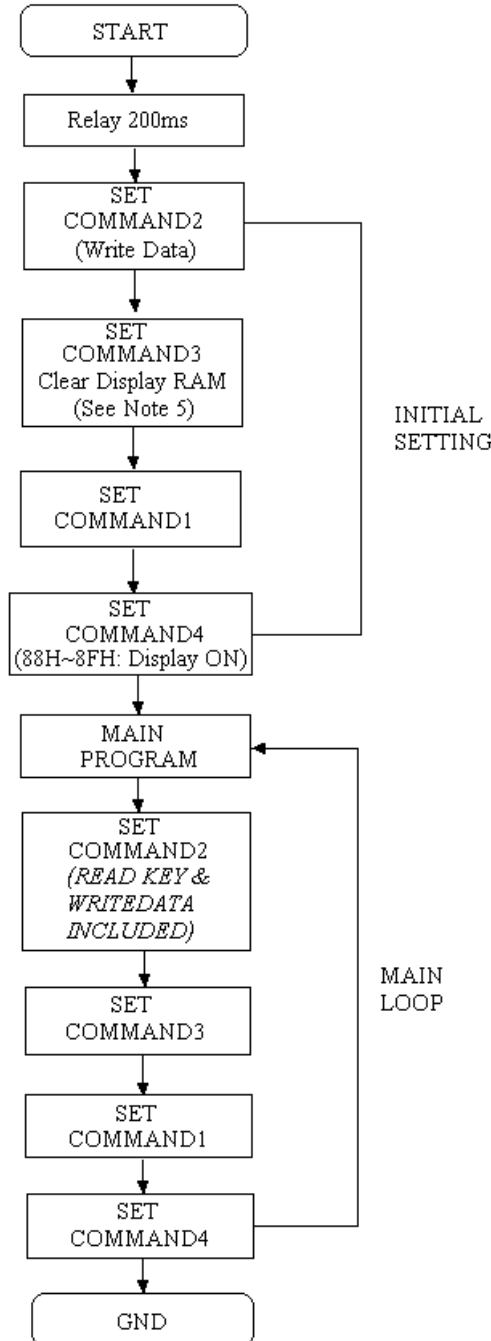
Note: 1. Command 1: Display Mode Commands

2. Command 2: Data Setting Commands

3. Command 3: Address Setting Commands
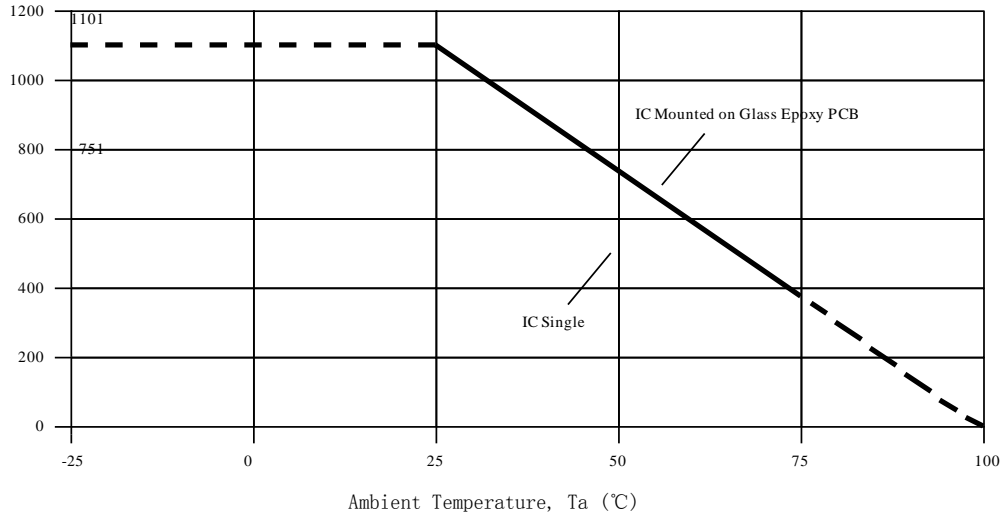
4. Command 4: Display Control Commands

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.

DL8838   LED Driver IC

SOP28 300MIL THERMAL PERFORMANCE IN STILL AIR AT $_{TJ}$=100℃

ABSOLUTE MAXIMUM RATINGS

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

Parameter	Symbol	Ratings	Unit
Supply Voltage	V_{DD}	-0.5 to +7.0	Volts
Logic Input Voltage	V_I	-0.5 to V_{DD} +0.5	Volts
Driver Output Current	I_{OLGR}	+250	mA
	I_{OHSG}	-50	mA
Maximum Driver Output Current/Total	I_{TOTAL}	400	mA

RECOMMENDED OPERATING RANGE

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

Parameter	Symbol	Min.	Typ.	Max.	Unit
Logic Supply Voltage	V_{DD}	4.5	5	5.5	V
Dynamic Current (see Note)	I_{DDdyn}	-	-	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)*

ELECTRICAL CHARACTERISTICS

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

| Parameter	Symbol	Test Condition	Min.	Typ.	Max.	Unit
High-Level Output Current	$I_{OHSG(1)}$	Vo=V_{DD}-1V SG1 to SG11, SG12/GR7 to SG14/GR5	10	-14	-30	mA
	$I_{OHSG(2)}$	Vo=V_{DD}-2V SG1 to SG11, SG12/GR7 to SG14/GR5	-20	-25	-50	mA
Segment High-Level Output Current Tolerance	I_{TOLSG}	Vo=V_{DD}-1V SG1 to SG11, SG12/GR7 to SG14/GR5	-	-	±5	%
Low-Level Output Current	I_{OLGR}	Vo=0.3V GR1 to GR4, SG12/GR7 to SV14/GR5	100	140	–	mA
High-Level Input Voltage	V_{IH}	-	0.8 V_{DD}	-	-	V
Low-Level Input Voltage	V_{IL}	-	-	-	0.3V_{DD}	V
Oscillation Frequency	fosc	R=51 KOhms	350	500	650	KHz

APPLICATION CIRCUIT
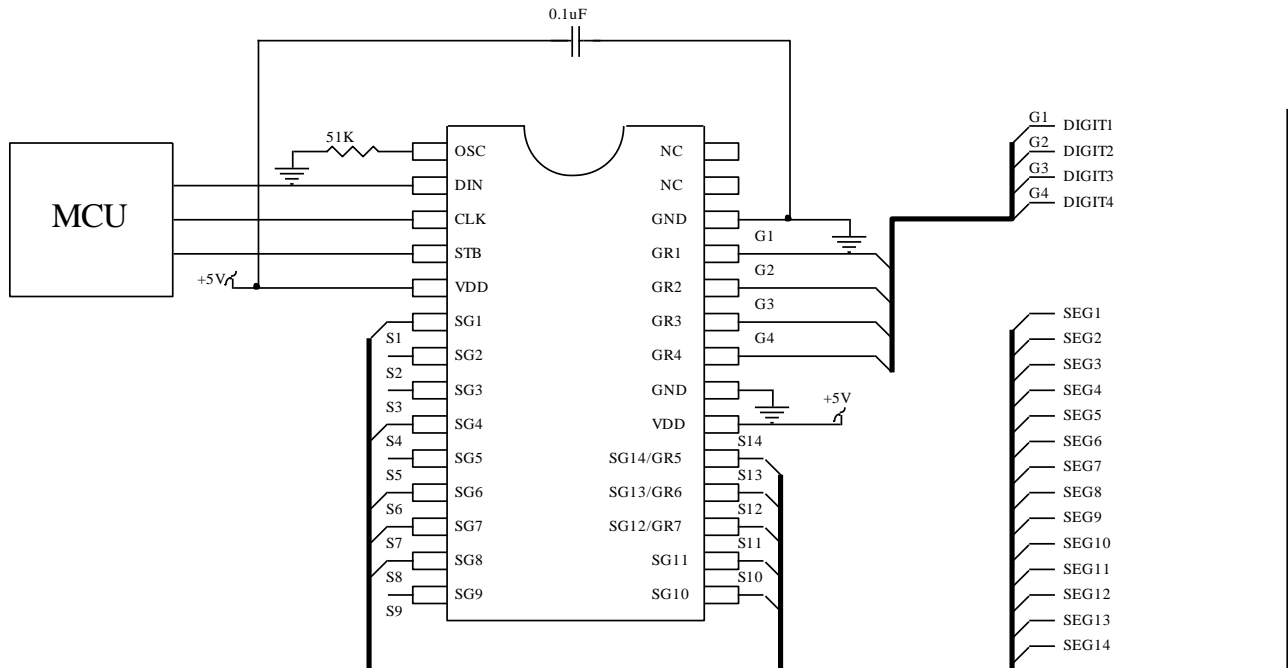
Note: 1. The capacitor (0.1uF)connected between be GND and VDD Pins must be located as near as possible to the DL8838 chip.

2. DL8838 power supply is separate form the application system power supply.
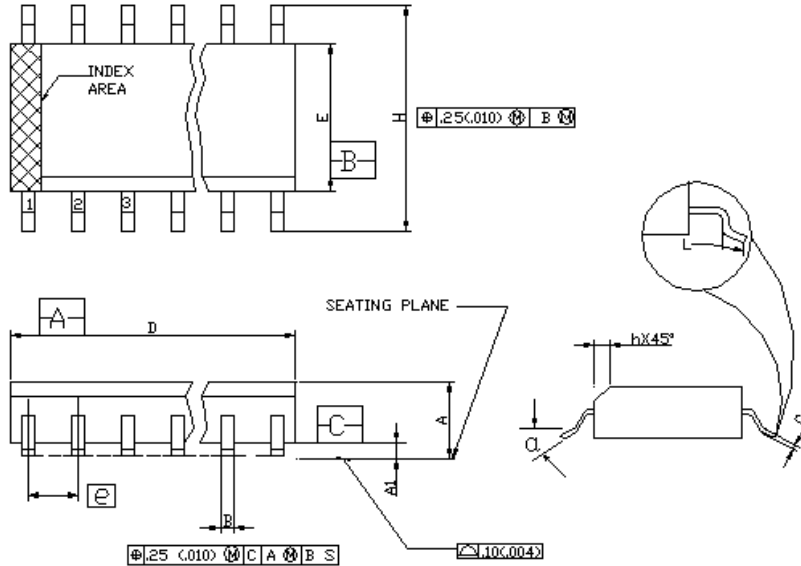
DL8838   LED Driver IC

COMMON CATHODE TYPE LED PANEL:
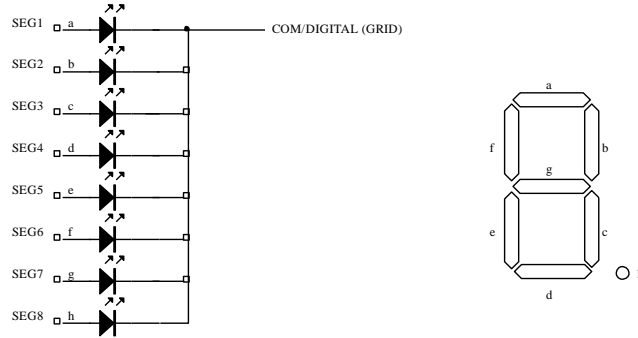
PACKAGE INFORMATION

28 Pins, SOP Package (300mil)

Symbol	Dimensions in Millimeter		
	Min	Nom.	Max
A	2.35		2.65
A1	0.10		0.30
B	0.33		0.51
C	0.23		0.32
D	17.70		18.10
E	7.40		7.60
e		1.27 bsc	
H	10.00		10.65
h	0.25		0.75
L	0.40		1.27
α	0°		8°

Notes:

1. Dimensioning and tolerancing per ANSI Y14.5-1982.

2. Dimension D does not include mold flash, protrusions or gate burrs. Mold flash, protrusions and gate burrs shall not exceed 0.15mm (0.006 in) per side.

3. Dimension E does not include interlead flash or protrusions. Interlead flash and protrusion shall not exceed 0.15mm (0.010 in) per side.

4. The chamfer on the body is optional. If it is not present, a visual index feature must be located within the crosshatched area.

5. "L" is the length of terminal for soldering to a substrate.

6. "N" is the number of terminal positions (N=28).

7. The lead width B as measured 0.36mm (0.014in) or greater above the seating plane, shall not exceed a maximum value of 0.61 mm (0.024 in).

8. Controlling dimension: MILLIMETER

9. Refer to JEDEC MS-013 Variation AE.

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