

LCD MODULE SPECIFICATION

MODEL NO.

BG12864C series

FOR MESSRS:

ON DATE OF:

APPROVED BY:

C O N T E N T S

1. Numbering System
2. General Specification
3. Absolute Maximum Ratings
4. Electrical Characteristics
5. Optical Characteristics
6. Interface Pin Function
7. Timing characteristics
8. Power supply for LCD Module and LCD operating voltage adjustment
9. Backlight information
10. Display control instruction
11. Quality Assurance
12. Reliability

1. Numbering System

| | | | | | | | | | |
|-----------------|-----------------|--------------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-------------------|
| <u>B</u> | <u>C</u> | <u>2004</u> | <u>A</u> | <u>G</u> | <u>P</u> | <u>L</u> | <u>E</u> | <u>B</u> | <u>xxx</u> |
| 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |

| | | | |
|----------|---|--|--|
| 0 | Brand | | Bolymin |
| 1 | Module Type | | C= character type G= graphic type P= TAB/TCP type O= COG type F= COF type |
| 2 | Format | | 2002=20 characters, 4 lines 12232= 122 x 32 dots |
| 3 | Version No. | | A type |
| 4 | LCD Color | | G=STN/gray Y=STN/yellow-green C=color STN B=STN/blue F=FSTN T=TN |
| 5 | LCD Type | | R=positive/reflective P=positive/transflective M=positive/transmissive N=negative/transmissive |
| 6 | Backlight type/color | | L=LED array/ yellow-green H=LED edge/white R=LED array/red G=LED edge/yellow-green D=LED edge/blue E=EL/white B=EL/blue C=CCFL/white |
| 7 | CGRAM Font (applied only on character type) | | J=English/Japanese Font E=English/European Font C=English/Cyrillic Font H=English/Hebrew Font |
| 8 | View Angle/ Operating Temperature | | B=Bottom/Normal Temperature H=Bottom/Wide Temperature U=Bottom/Ultra wide Temperature T=Top/Normal Temperature W=Top/Wide Temperature C=9H/Normal Temperature |
| 9 | Special Code | | 3=3 volt logic power supply n=negative voltage for LCD c=cable/connector xxx=to be assigned on data sheet t=temperature compensation for LCD p=touch panel |

2. General Specification

(1) Mechanical Dimension

| Item | Standard Value | Unit |
|--------------------------|---|------|
| Number of dots | 128×64 | dots |
| Module dimension (L*W*H) | 80.0*70.0*13.6(Max)-LED array/edge B/L 80.0*70.0*9.7(Max)- E/L or No B/L | mm |
| View area | 72(W)×40(H) | mm |
| Active area | 66.52(W)×33.24(H) | mm |
| Dot size | 0.48(W)×0.48(H) | mm |
| Dot pitch | 0.52(W)×0.52(H) | mm |

(2) Controller IC: KS107 / KS108

(3) Temperature Range

| | Normal | Wide |
|-----------|-----------|-----------|
| Operating | 0 ~ +50 | -20 ~ +70 |
| Storage | -10 ~ +60 | -30 ~ +80 |

3. Absolute Maximum Ratings

| Item | Symbol | Min | Typ | Max | Unit |
|--------------------------|-----------------------------------|-----|-----|-----------------|------|
| Operating Temperature | T _{OP} | -20 | - | +70 | |
| Storage Temperature | T _{ST} | -30 | - | +80 | |
| Input Voltage | V _I | 0 | - | V _{CC} | V |
| Supply Voltage For Logic | V _{CC} | 0 | - | 67 | V |
| Supply Voltage For LCD | V _{CC} -V _{LCD} | 0 | - | 16.7 | V |
| Supply Voltage For LCD | V _{OUT} | - | - | -5 | V |

4. Electrical Characteristics

| Item | Symbol | Condition | Min. | Typ. | Max. | Unit |
|--------------------------|-----------------|-----------|-------------|------|-------------|------|
| Supply Voltage For Logic | $V_{DD}-V_{SS}$ | - | 4.5 | 5.0 | 5.5 | V |
| Supply Voltage For LCD | $V_{DD}-V_0$ | Ta=-20 | - | 9.3 | - | V |
| | | Ta=25 | - | 9.0 | - | V |
| | | Ta=+70 | - | 8.7 | - | V |
| Input High Vol | V_{IH} | - | $0.7V_{DD}$ | - | V_{DD} | V |
| Input Low Vol | V_{IL} | - | 0 | - | $0.3V_{DD}$ | V |
| Output High Vol | V_{OH} | - | 2.4 | - | - | V |
| Output Low Vol. | V_{OL} | - | - | - | 0.4 | V |
| Supply Current | I_{DD} | - | - | 13.0 | - | mA |

5. Optical Characteristics

a. STN

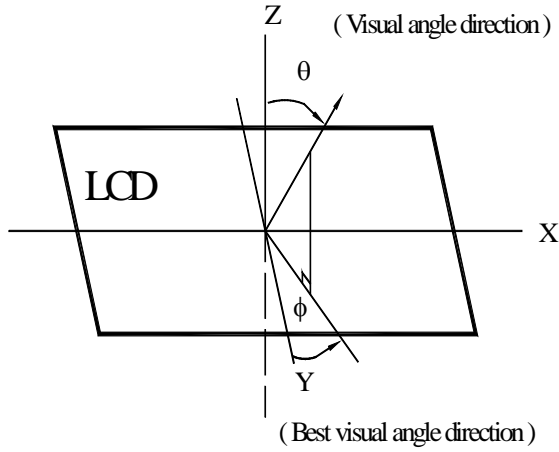
| Item | Symbol | Condition | Min. | Typ. | Max. | Unit |
|---------------------|--------|-----------|------|------|------|------|
| View Angle | (V) | CR 2 | 10 | | 45 | deg |
| | (H) | CR 2 | -30 | | 30 | deg |
| Contrast Ratio | CR | - | | 3 | | - |
| Response Time 25 | T rise | - | | 100 | 150 | ms |
| | T fall | - | | 150 | 200 | ms |

b. FSTN

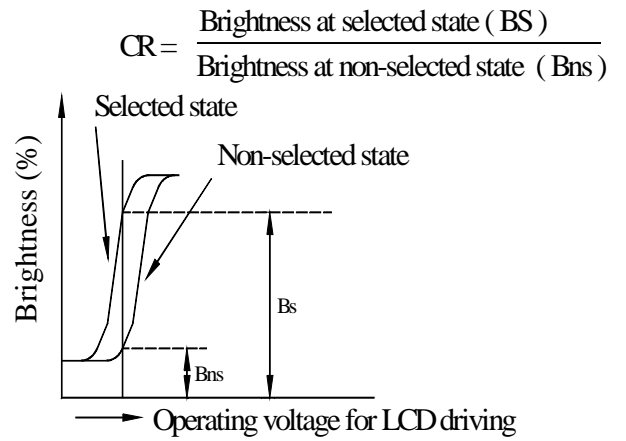
| Item | Symbol | Condition | Min. | Typ. | Max. | Unit |
|---------------------|--------|-----------|------|------|------|------|
| View Angle | (V) | CR 3 | 10 | | 60 | deg |
| | (H) | CR 3 | -45 | | 45 | deg |
| Contrast Ratio | CR | - | | 5 | | - |
| Response Time 25 | T rise | - | | 100 | 150 | ms |
| | T fall | - | | 150 | 200 | ms |

5.1 Definitions

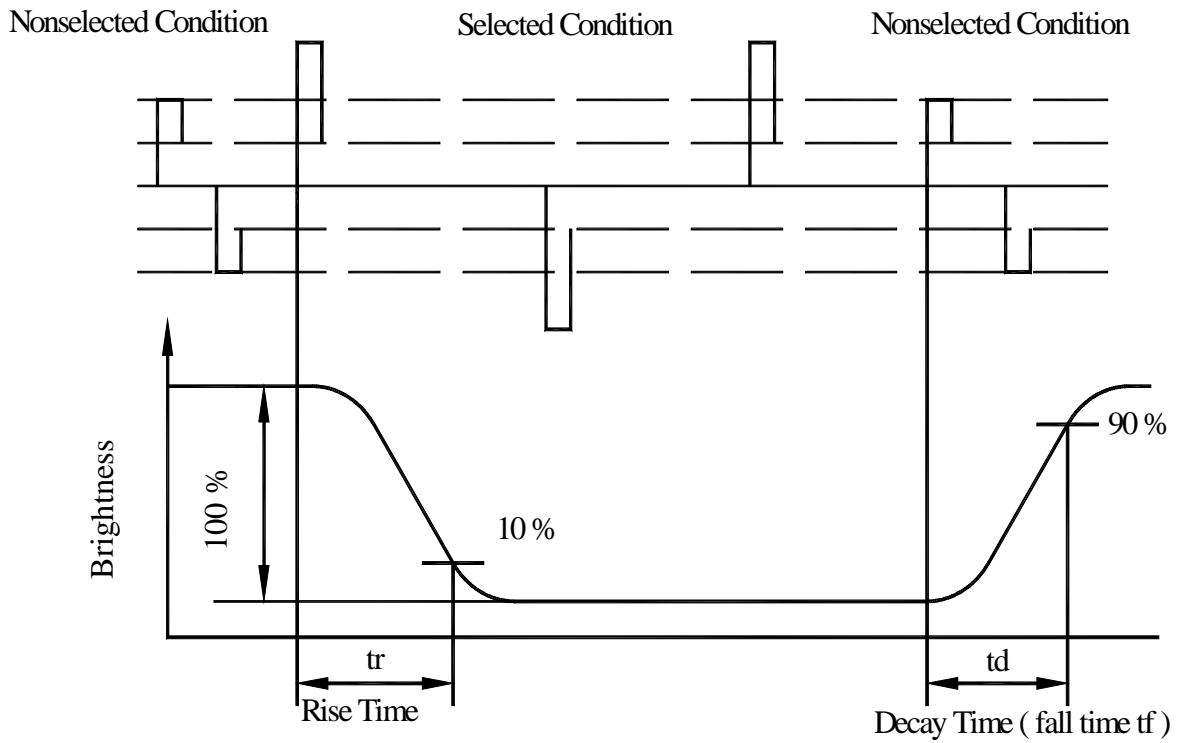
View Angles



Contrast Ratio



Response time



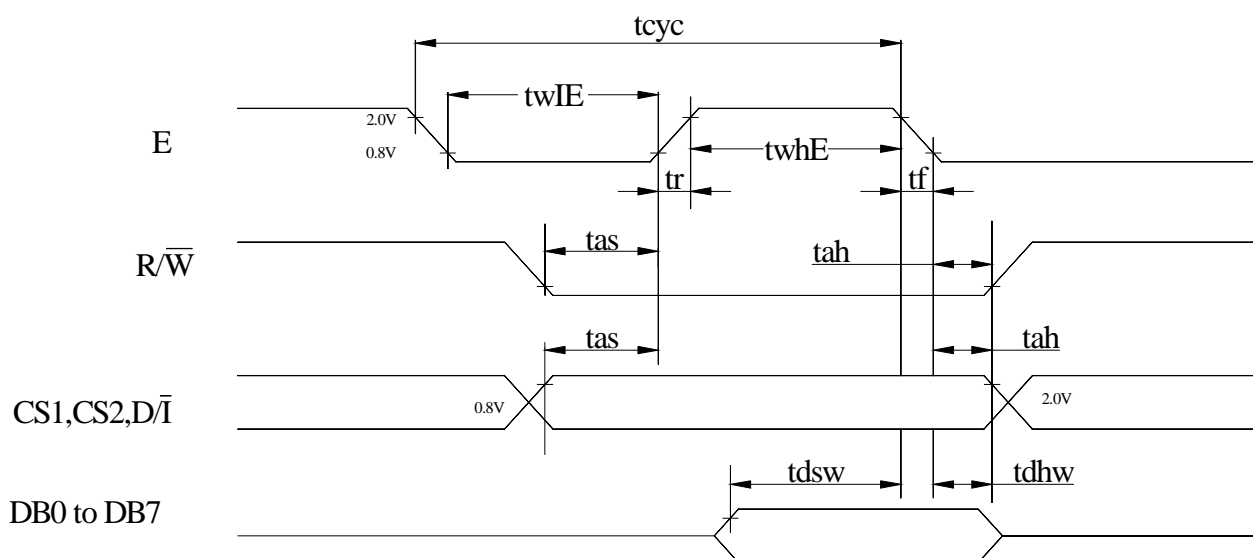
6. Interface Pin Function

| Pin No. | Symbol | Level | Description |
|---------|-----------------|------------|--|
| 1 | V _{ss} | 0V | Ground |
| 2 | V _{dd} | 5.0V | Supply voltage for logic |
| 3 | V _O | (Variable) | Operating voltage for LCD |
| 4 | D/I | H/L | H: Data , L: Instruction |
| 5 | R/W | H/L | H: Read(MPU Module) , L :Write(MPU Module) |
| 6 | E | H | Enable signal |
| 7 | DB0 | H/L | Data bus line |
| 8 | DB1 | H/L | Data bus line |
| 9 | DB2 | H/L | Data bus line |
| 10 | DB3 | H/L | Data bus line |
| 11 | DB4 | H/L | Data bus line |
| 12 | DB5 | H/L | Data bus line |
| 13 | DB6 | H/L | Data bus line |
| 14 | DB7 | H/L | Data bus line |
| 15 | CS1 | L | Chip Select for IC1 |
| 16 | CS2 | L | Chip Select for IC2 |
| 17 | /RST | L | Reset signal |
| 18 | V _{ee} | | Negative Voltage output |
| 19 | A | - | Power supply for B/L (+) |
| 20 | K | - | Power supply for B/L (GND) |

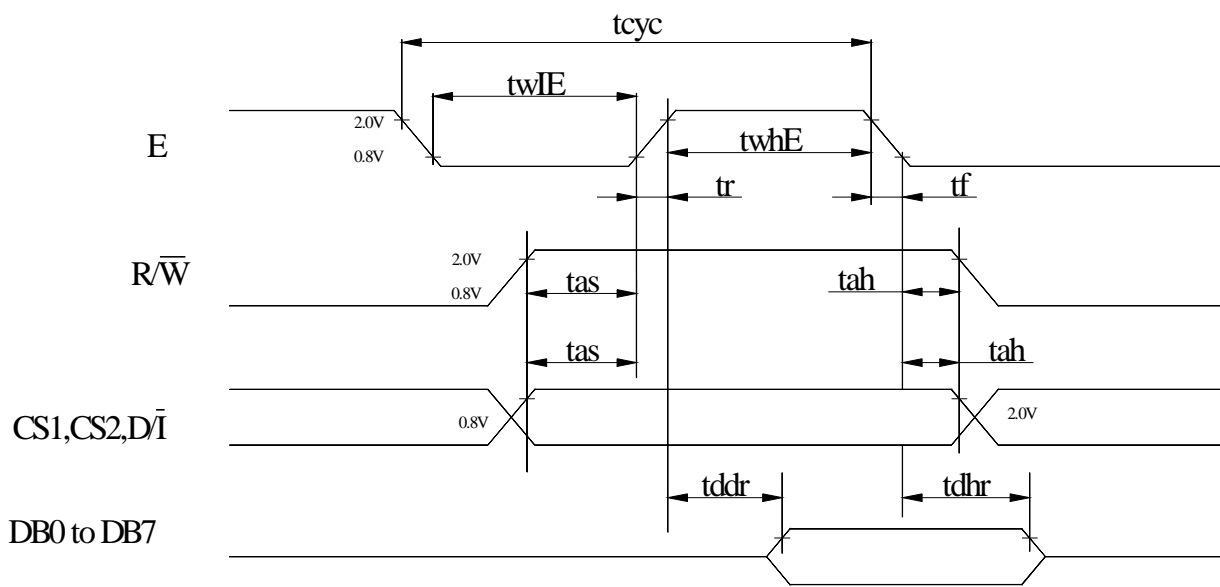
7. Timing Characteristics

MPU Interface

| Characteristic | Symbol | Min | Typ | Max | Unit |
|------------------------|--------|------|-----|-----|------|
| E cycle | tcyc | 1000 | - | - | ns |
| E high level width | twhE | 450 | - | - | ns |
| E low level width | twlE | 450 | - | - | ns |
| E rise time | tr | - | - | 25 | ns |
| E fall time | tf | - | - | 25 | ns |
| Address set-up time | tas | 140 | - | - | ns |
| Address hold time | tah | 10 | - | - | ns |
| Data set-up time | tdsw | 200 | - | - | ns |
| Data delay time | tddr | - | - | 320 | ns |
| Data hold time (write) | tdhw | 10 | - | - | ns |
| Data hold time (read) | tdhr | 20 | - | - | ns |



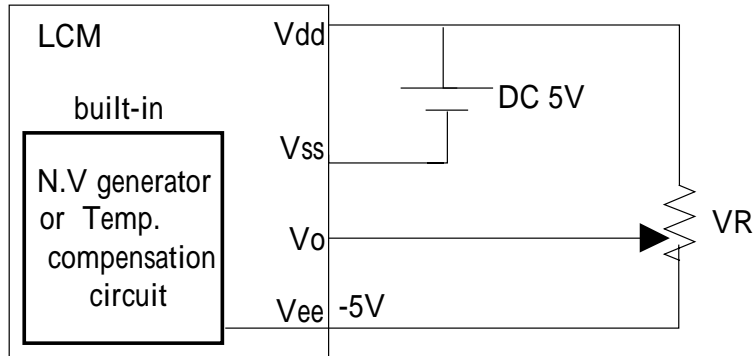
MPU Write Timing



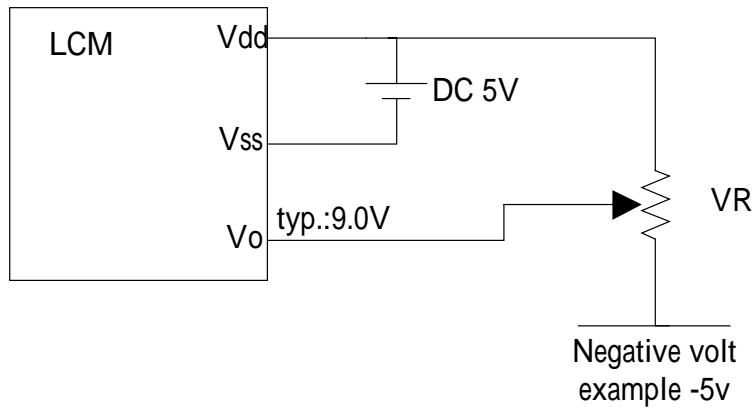
MPU Read Timing

8. Power Supply for LCD Module and LCD Operating Voltage a Adjustment

* LCM operating on " DC 5V " input with built-in negative voltage



* (Option) LCM operating on " DC 5V " input with external negative voltage



9. Backlight Information

9.1 Specification

(1) LED array / yellow-green

| Parameter | Symbol | Min | Typ | Max | Unit | Test Condition |
|--------------------|------------------|-----|--------|-----|-------------------|-------------------------|
| Supply Current | I _{LED} | | 330 | 660 | mA | V=4.2V |
| Supply Voltage | V | - | 4.2 | 4.6 | V | |
| Reverse Voltage | V _R | - | - | 8 | V | |
| Luminous Intensity | I _V | | 186.6 | - | cd/m ² | I _{LED} =330mA |
| Wave Length | p | | 570 | | nm | I _{LED} =330mA |
| Life Time | | - | 100000 | - | Hr. | V 4.2V |
| Color | Yellow Green | | | | | |

(2) LED edge / yellow-green

| Parameter | Symbol | Min | Typ | Max | Unit | Test Condition |
|--------------------|------------------|-----|--------|-----|-------------------|-------------------------|
| Supply Current | I _{LED} | | 120 | 160 | mA | V=4.2V |
| Supply Voltage | V | - | 4.2 | 4.6 | V | |
| Reverse Voltage | V _R | - | - | 8 | V | |
| Luminous Intensity | I _V | | - | - | cd/m ² | I _{LED} =120mA |
| Wave Length | p | | 570 | | nm | I _{LED} =120mA |
| Life Time | | - | 100000 | - | Hr. | V 4.2V |
| Color | Yellow Green | | | | | |

(3) LED edge/white

| Parameter | Symbol | Min | Typ | Max | Unit | Test Condition |
|--------------------|------------------|-----|-------|-----|-------------------|-------------------------|
| Supply Current | I _{LED} | | 100 | 125 | mA | V=3.5V |
| Supply Voltage | V | | 3.5 | 3.6 | V | - |
| Reverse Voltage | V _R | - | - | 10 | V | - |
| Luminous Intensity | I _V | - | 25 | - | cd/m ² | I _{LED} =100mA |
| Wave Length | p | - | - | - | nm | I _{LED} =100mA |
| Life Time | | - | 70000 | - | Hr. | V 3.5V |
| Color | White | | | | | |

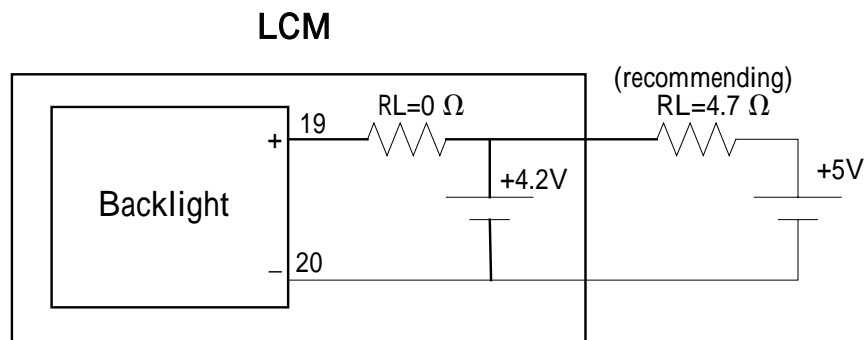
(4) EL white

| Parameter | Symbol | Min | Typ | Max | Unit | Test Condition |
|-------------------|--------|-------|--------|------|-------------------|--------------------|
| Drive Voltage | Vmax | 65 | | 110 | Vrms | 25°C |
| Drive Wave | Fmax | 400 | | 1000 | Hz | 25°C |
| Brightness | | 3.5 | - | - | cd/m ² | 65V/400Hz |
| Power Consumption | | - | 80 | - | mW | 65V/400Hz |
| Chromatism | X | - | 0.3173 | - | - | 65V/400Hz |
| | Y | - | 0.3995 | - | - | 65V/400Hz |
| Life time | | 5000 | | | hour | 65V/400Hz |
| Color | | White | | | - | Light on 65V/400Hz |

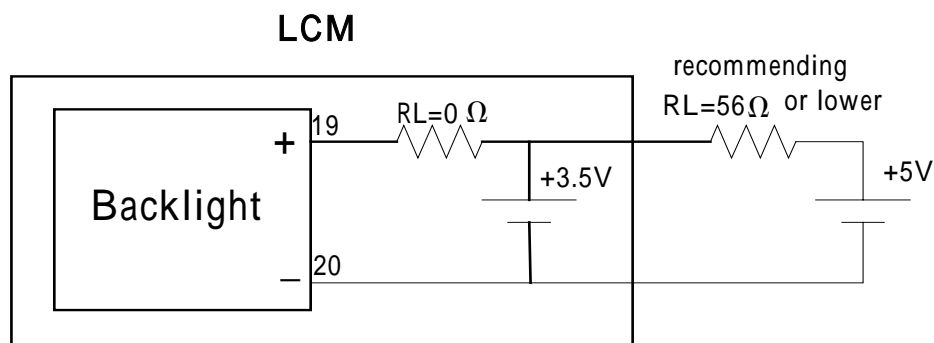
9.2 Backlight driving methods

a. LED B/L drive from pin19 (LED+) pin20 (LED-)

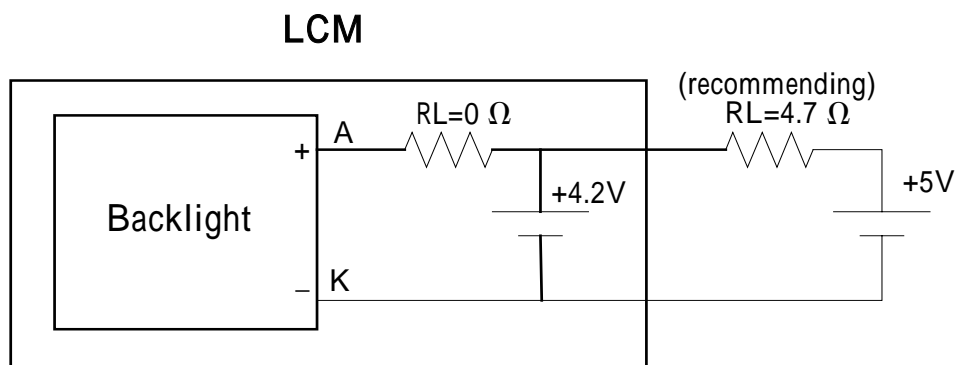
a.1 array / edge (yellow-green)



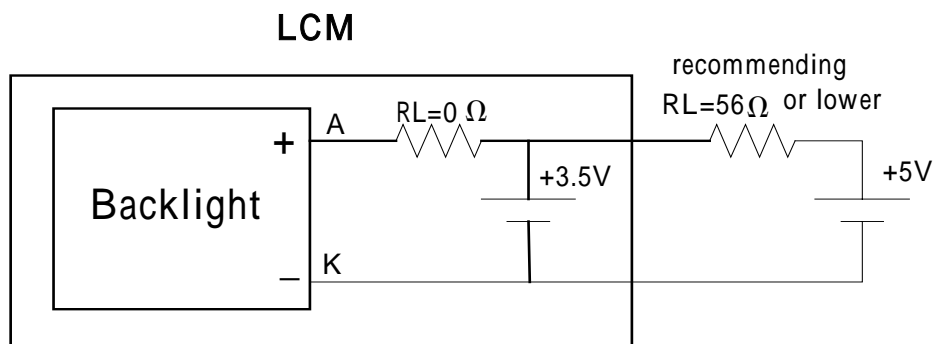
a.2 edge / white



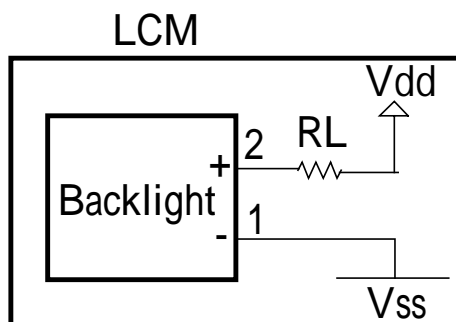
- b. LED B/L drive from A.K directly
 - b.1 array / edge (yellow-green)



- b.2 edge / white

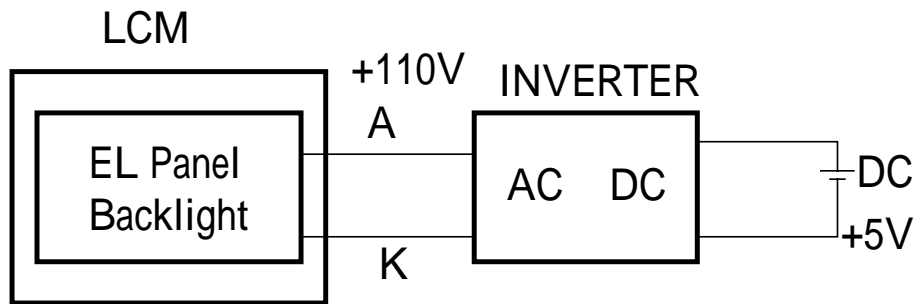


- c. * (Option) LED B/L drive from pin1 (Vss) pin2 (Vdd)



- (1) Jump 1,2 Short
- (2) Current Resistor required on RL
- (3) Jump 19,20 open
- (4) To be sure of enough current supply for both VDD + LED B/L

d. E/L B/L driven from A.K cable directly



10. Display Control Instruction

The display control instructions control the internal state of the KS0108B. Instruction is received from MPU to KS0108B for the display control. The following table shows various instructions.

| Instruction | D/I | R/W | DB7 | DB6 | DB5 | DB4 | DB3 | DB2 | DB1 | DB0 | Function | |
|----------------------|-----|-----|------------------|-----|--------------------------|-----------------------|-----|-------------|-----|-----|---|--|
| Display ON/OFF | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 0/1 | Controls the display on or off. Internal status and display RAM data are not affected. 0:OFF, 1:ON | |
| Set Address | 0 | 0 | 0 | 1 | Y address (0~63) | | | | | 0 | Sets the Y address in the Y address counter. | |
| Set Page (X address) | 0 | 0 | 1 | 0 | 1 | 1 | 1 | Page (0 ~7) | | | Sets the X address at the X address register. | |
| Display Start Line | 0 | 0 | 1 | 1 | Display start line(0~63) | | | | | 0 | Indicates the display data RAM displayed at the top of the screen. | |
| Status Read | 0 | 1 | B U S Y | 0 | ON/ OFF | R E S E T | 0 | 0 | 0 | 0 | Read status. BUSY 0:Ready 1:In operation ON/OFF 0:Display ON 1:Display OFF RESET 0:Normal 1:Reset | |
| Write Display Data | 1 | 0 | Display Data | | | | | | | | 0 | Writes data (DB0:7) into display data RAM. After writing instruction, Y address is increased by 1 automatically. |
| Read Display Data | 1 | 1 | Display Data | | | | | | | | 0 | Reads data (DB0:7) from display data RAM to the data bus. |

10.1 Detailed Explanation

Display On/Off

| R/W | D/I | DB7 | DB6 | DB5 | DB4 | DB3 | DB2 | DB1 | DB0 |
|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | D |

The display data appears when D is 1 and disappears when D is 0. Though the data is not on the screen with D = 0, it remains in the display data RAM. Therefore, you can make it appear by changing D = 0 into D = 1.

Display Start Line

| R/W | D/I | DB7 | DB6 | DB5 | DB4 | DB3 | DB2 | DB1 | DB0 |
|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| 0 | 0 | 1 | 1 | A | A | A | A | A | A |

Z address AAAAAA (binary) of the display data RAM is set in the display start line register and displayed at the top of the screen. Figure 2. shows examples of display (1/64 duty cycle) when the start line = 0-3. When the display duty cycle is 1/64 or more (ex. 1/32, 1/24 etc.), the data of total line number of LCD screen, from the line specified by display start line instruction, is displayed.

Set Page (X Address)

| R/W | D/I | DB7 | DB6 | DB5 | DB4 | DB3 | DB2 | DB1 | DB0 |
|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| 0 | 0 | 1 | 0 | 1 | 1 | 1 | A | A | A |

X address AAA (binary) of the display data RAM is set in the X address register. After that, writing or reading to or from MPU is executed in this specified page until the next page is set. See Figure 1.

Set Y Address

| R/W | D/I | DB7 | DB6 | DB5 | DB4 | DB3 | DB2 | DB1 | DB0 |
|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| 0 | 0 | 0 | 1 | A | A | A | A | A | A |

Y address AAAAAA (binary) of the display data RAM is set in the Y address counter. After that, Y address counter is increased by 1 every time the data is written or read to or from MPU.

Status Read

| R/W | D/I | DB7 | DB6 | DB5 | DB4 | DB3 | DB2 | DB1 | DB0 |
|-----|-----|------|-----|--------|-------|-----|-----|-----|-----|
| 0 | 0 | Busy | 0 | On/Off | RESET | 0 | 0 | 0 | 0 |

•Busy

When busy is 1, the LSI is executing internal operations. No instruction are accepted while busy is 1, so you should make sure that busy is 0 before writing the next instruction.

•ON/OFF

Shows the liquid crystal display condition: on condition or off condition.

When on/off is 1, the display is in off condition.

When on/off is 0, the display is in on condition.

•RESET

RESET = 1 shows that the system system is being initialized. In this condition, no instructions except status read can be accepted.

RESET = 0 shows that initializing has system is in the usual operation condition.

Write Display Data

| R/W | D/I | DB7 | DB6 | DB5 | DB4 | DB3 | DB2 | DB1 | DB0 |
|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| 0 | 0 | D | D | D | D | D | D | D | D |

Writes 8-bit data DDDDDDDD (binary) into the display data RAM. The Y address is increased by 1 automatically.

Read Display Data

| R/W | D/I | DB7 | DB6 | DB5 | DB4 | DB3 | DB2 | DB1 | DB0 |
|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| 0 | 0 | D | D | D | D | 1 | D | D | D |

Reads out 8-bit data DDDDDDDD (binary) from the display data RAM. Then Y address is increased by 1 automatically.

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One dummy read is necessary right after the address setting. For details, refer to the explanation of output register in “Function of Each Block”.

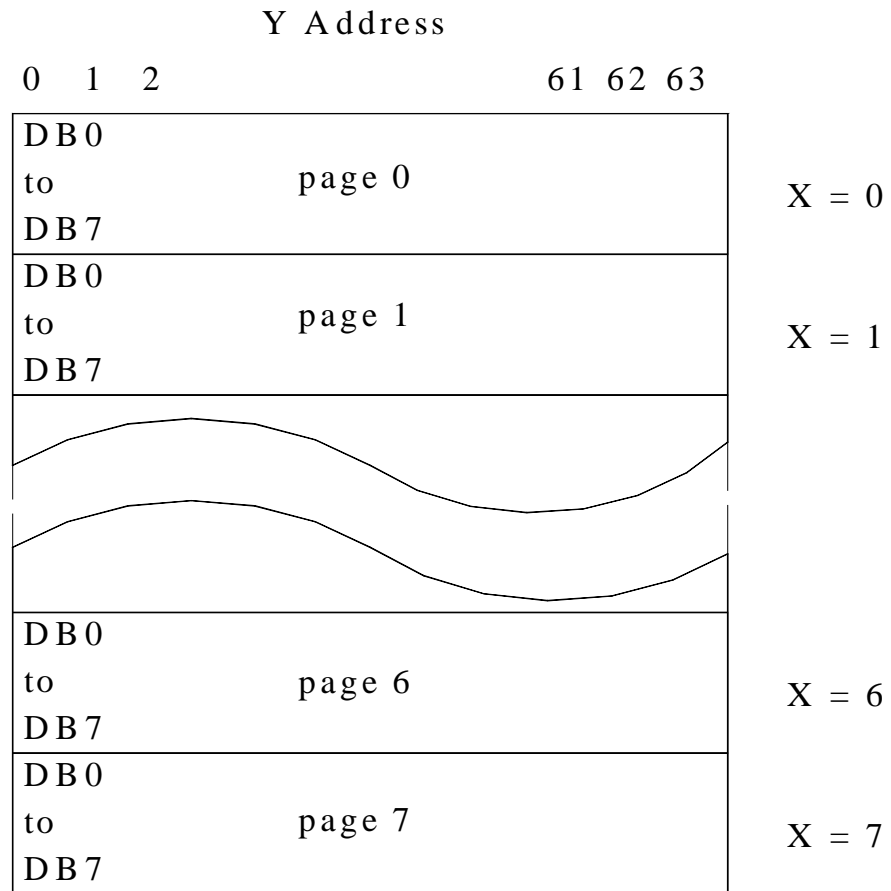
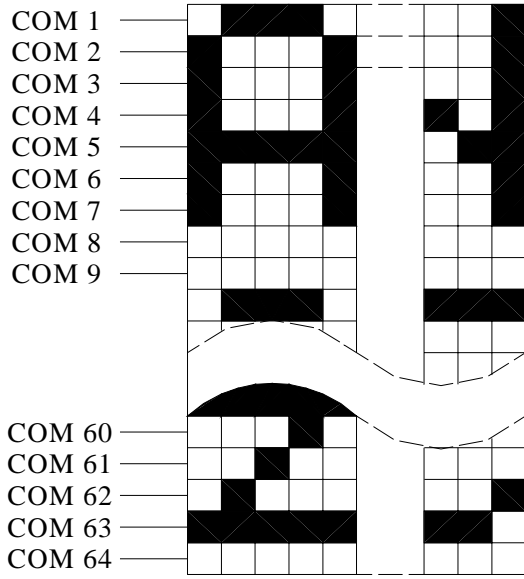
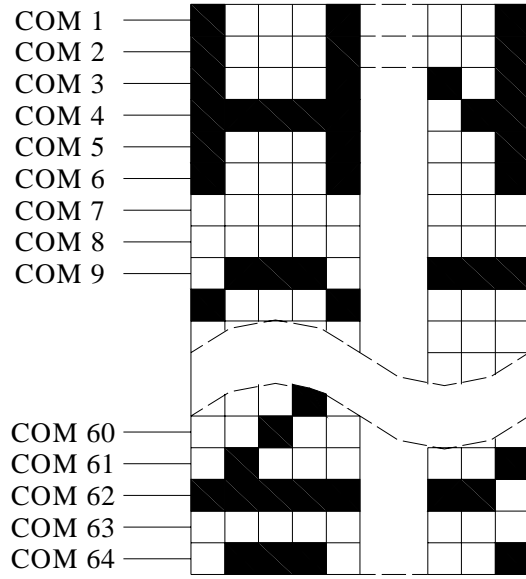


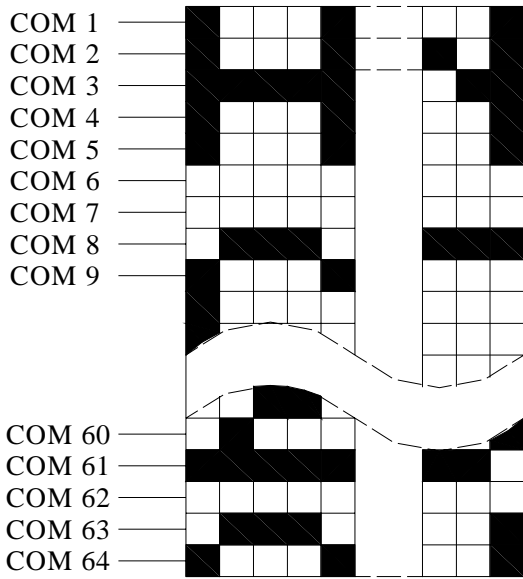
Figure 1.



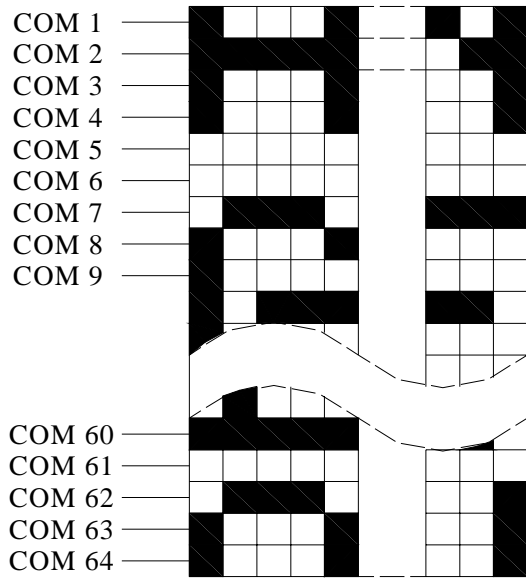
Start line = 0



Start line = 1



Start line = 3



Start line = 4

Figure 2.

11. Quality Assurance

Screen Cosmetic Criteria

| No. | Defect | Judgement Criterion | Partition | | | | | | | | | | | | | | | | | | | | |
|-----------|-------------------------------|---|-----------|-------------------------------|-------|-----------|-----------|---|-----------|---|-------|---|-----------|-------------------------------|-------|-----------|-----------|---|-----------|---|-------|---|-------|
| 1 | Spots | <p>A) Clear</p> <table border="1"> <thead> <tr> <th>Size:d mm</th> <th>Acceptable Qty in active area</th> </tr> </thead> <tbody> <tr> <td>d 0.1</td> <td>Disregard</td> </tr> <tr> <td>0.1<d 0.2</td> <td>6</td> </tr> <tr> <td>0.2<d 0.3</td> <td>2</td> </tr> <tr> <td>0.3<d</td> <td>0</td> </tr> </tbody> </table> <p>Note:Including pin holes and defective dots which must be within one pixel size.</p> <p>B) Unclear</p> <table border="1"> <thead> <tr> <th>Size:d mm</th> <th>Acceptable Qty in active area</th> </tr> </thead> <tbody> <tr> <td>d 0.2</td> <td>Disregard</td> </tr> <tr> <td>0.2<d 0.5</td> <td>6</td> </tr> <tr> <td>0.5<d 0.7</td> <td>2</td> </tr> <tr> <td>0.7<d</td> <td>0</td> </tr> </tbody> </table> | Size:d mm | Acceptable Qty in active area | d 0.1 | Disregard | 0.1<d 0.2 | 6 | 0.2<d 0.3 | 2 | 0.3<d | 0 | Size:d mm | Acceptable Qty in active area | d 0.2 | Disregard | 0.2<d 0.5 | 6 | 0.5<d 0.7 | 2 | 0.7<d | 0 | Minor |
| Size:d mm | Acceptable Qty in active area | | | | | | | | | | | | | | | | | | | | | | |
| d 0.1 | Disregard | | | | | | | | | | | | | | | | | | | | | | |
| 0.1<d 0.2 | 6 | | | | | | | | | | | | | | | | | | | | | | |
| 0.2<d 0.3 | 2 | | | | | | | | | | | | | | | | | | | | | | |
| 0.3<d | 0 | | | | | | | | | | | | | | | | | | | | | | |
| Size:d mm | Acceptable Qty in active area | | | | | | | | | | | | | | | | | | | | | | |
| d 0.2 | Disregard | | | | | | | | | | | | | | | | | | | | | | |
| 0.2<d 0.5 | 6 | | | | | | | | | | | | | | | | | | | | | | |
| 0.5<d 0.7 | 2 | | | | | | | | | | | | | | | | | | | | | | |
| 0.7<d | 0 | | | | | | | | | | | | | | | | | | | | | | |
| 2 | Bubbles in Polarizer | <table border="1"> <thead> <tr> <th>Size:d mm</th> <th>Acceptable Qty in active area</th> </tr> </thead> <tbody> <tr> <td>d 0.3</td> <td>Disregard</td> </tr> <tr> <td>0.3<d 1.0</td> <td>3</td> </tr> <tr> <td>1.0<d 1.5</td> <td>1</td> </tr> <tr> <td>1.5<d</td> <td>0</td> </tr> </tbody> </table> | Size:d mm | Acceptable Qty in active area | d 0.3 | Disregard | 0.3<d 1.0 | 3 | 1.0<d 1.5 | 1 | 1.5<d | 0 | Minor | | | | | | | | | | |
| Size:d mm | Acceptable Qty in active area | | | | | | | | | | | | | | | | | | | | | | |
| d 0.3 | Disregard | | | | | | | | | | | | | | | | | | | | | | |
| 0.3<d 1.0 | 3 | | | | | | | | | | | | | | | | | | | | | | |
| 1.0<d 1.5 | 1 | | | | | | | | | | | | | | | | | | | | | | |
| 1.5<d | 0 | | | | | | | | | | | | | | | | | | | | | | |
| 3 | Scratch | In accordance with spots cosmetic criteria. When the light reflects on the panel surface, the scratches are not to be remarkable. | Minor | | | | | | | | | | | | | | | | | | | | |
| 4 | Allowable Density | Above defects should be separated more than 30mm each other. | Minor | | | | | | | | | | | | | | | | | | | | |
| 5 | Coloration | Not to be noticeable coloration in the viewing area of the LCD panels. Back-light type should be judged with back-light on state only. | Minor | | | | | | | | | | | | | | | | | | | | |

12. Reliability

Content of Reliability Test

| Environmental Test | | | | |
|--------------------|---|--|---|---------------------|
| No. | Test Item | Content of Test | Test Condition | Applicable Standard |
| 1 | High Temperature storage | Endurance test applying the high storage temperature for a long time. | 80 200hrs | — |
| 2 | Low Temperature storage | Endurance test applying the high storage temperature for a long time. | -30 200hrs | — |
| 3 | High Temperature Operation | Endurance test applying the electric stress (Voltage & Current) and the thermal stress to the element for a long time. | 70 200hrs | — |
| 4 | Low Temperature Operation | Endurance test applying the electric stress under low temperature for a long time. | -20 200hrs | — |
| 5 | High Temperature/ Humidity Storage | Endurance test applying the high temperature and high humidity storage for a long time. | 60 ,90%RH 96hrs | — |
| 6 | High Temperature/ Humidity Operation | Endurance test applying the electric stress (Voltage & Current) and temperature / humidity stress to the element for a long time. | 40 ,90%RH 96hrs | — |
| 7 | Temperature Cycle | <p>Endurance test applying the low and high temperature cycle.</p> <p style="text-align: center;"> -30 25 80 </p> <p style="text-align: center;"> </p> <p style="text-align: center;">1 cycle</p> | -30 /80 10 cycles | — |
| Mechanical Test | | | | |
| 8 | Vibration test | Endurance test applying the vibration during transportation and using. | 10~22Hz 1.5mmp-p 22~500Hz 1.5G Total 0.5hrs | — |
| 9 | Shock test | Constructional and mechanical endurance test applying the shock during transportation. | 50G Half sign wave 11 msdc 3 times of each direction | — |
| 10 | Atmospheric pressure test | Endurance test applying the atmospheric pressure during transportation by air. | 115mbar 40hrs | — |
| Others | | | | |
| 11 | Static electricity test | Endurance test applying the electric stress to the terminal. | VS=800V,RS=1.5k CS=100pF 1 time | — |

***Supply voltage for logic system=5V. Supply vo

