

POWERTIP TECH. CORP.

DISPLAY DEVICES FOR BETTER ELECTRONIC DESIGN

Specification For Approval



Customer ELATEC

Model Type LCD Module

Sample Code PG12864LRS-JNN-B-SA

Mass Production Code : _____

Edit A

| Customer Sign | Sales Sign | Approved By | Prepared By |
|---------------|------------|--|--|
| | |  |  5/31/00 |

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DISPLAY DEVICES FOR BETTER ELECTRONIC DESIGN

1. SPECIFICATIONS

1.1 Features

- Full dot-matrix structure with 128 dots *64 dots
- 1/64 Duty, 1/9 bias
- STN LCD, positive
- Transflective LCD, gray
- 6 o'clock viewing angle
- 8 bits parallel data input
- LED Backlight

1.2 Mechanical Specifications

- Outline dimension : 75.0mm(L)*52.7mm(W)*8.4mm (H)
- Viewing area : 60.0mm *32.6mm
- Active area : 55.01mm *27.49mm
- Dot size 0.39mm * 0.39mm
- Dot pitch : 0.43mm * 0.43mm

1.3 Absolute Maximum Ratings

| Item | Symbol | Conditions | Min. | Max. | Unit |
|--------------------------|---------|------------|------|---------|------|
| Power supply Voltage | VCC | - | 0 | 6.7 | V |
| LCD drive Supply voltage | VCC-VLC | - | 0 | 8.15 | V |
| Input voltage | VIN | - | 0 | VCC+0.3 | V |
| Operating temperature | TOPR | - | 0 | +50 | °C |
| Storage temperature | TSTG | - | -20 | +70 | °C |
| Humidity*1 | HD | - | - | 90 | %RH |

1.4 DC Electrical Characteristics

| Item | Symbol | Condition | Min. | Typ. | Max. | Unit |
|----------------------|--------|-----------|--------|------|--------|------|
| Logic Supply voltage | VCC | - | 4.5 | 5 | 5.5 | V |
| “H” input voltage | VIH | - | 0.7VCC | - | VCC | V |
| “L” input voltage | VIL | - | 0 | - | 0.3VCC | V |
| Supply current | IDD | VCC=5V | - | 1.32 | 0.33 | mA |
| LCD driving voltage | VOP | VCC-VLC | 8.14 | - | 9.20 | V |



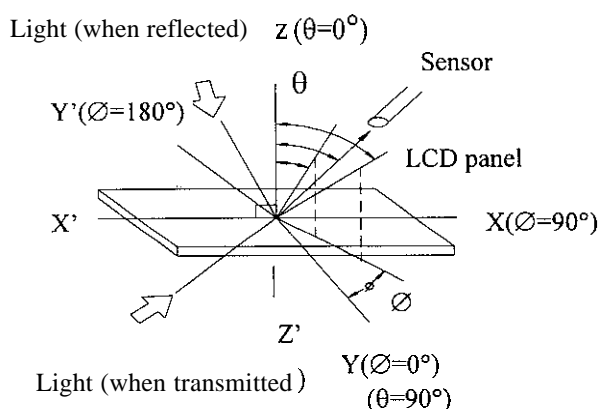
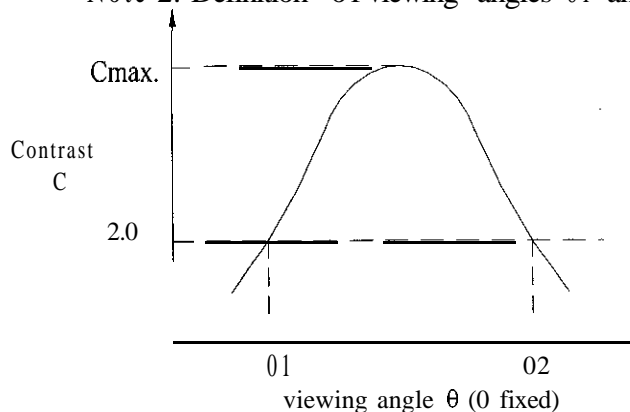
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1.5 Optical Characteristics

1/64 duty, 1/9 bias, $V_{opr}=8.15V$, $T_a=25^{\circ}C$

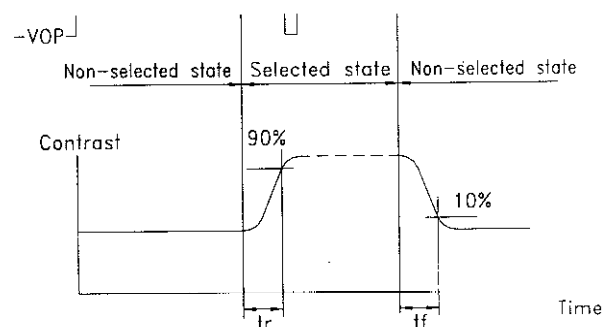
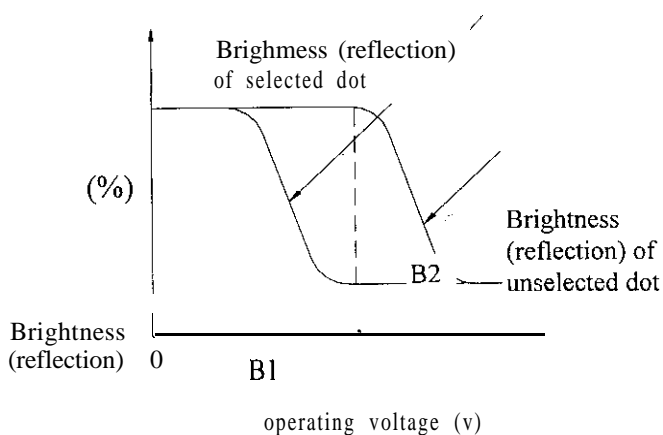
| Item | Symbol | Conditions | Min. | Typ. | Max | Reference |
|---------------------|----------|--|--------------|-------|-------|-------------|
| Viewing angle | θ | $C \geq 2.0, \phi = 0^{\circ}C$ | 30° | - | - | Notes 1 & 2 |
| Contrast | C | $\theta = 5^{\circ}, \phi = 0^{\circ}$ | 2 | 3 | - | Note 3 |
| Response time(rise) | t_r | $\theta = 5^{\circ}, \phi = 0^{\circ}$ | - | 130ms | 200ms | Note 4 |
| Response time(fall) | t_f | $\theta = 5^{\circ}, \phi = 0^{\circ}$ | - | 300ms | 500ms | Note 4 |

Note 1: Definition of angles θ and ϕ Note 2: Definition of viewing angles θ_1 and θ_2 

Note : Optimum viewing angle with the naked eye and viewing angle θ at C_{max} . Above are not always the same.

Note 3: Definition of contrast C

$$C = \frac{\text{Brighness (reflection) of unselected dot (B2)}}{\text{Brighness (reflection) of selected dot (B1)}}$$



Note: Measured with a transmissive LCD panel which is displayed 1 cm'

V_{opr} : Operating voltage
 t_r : Response time (rise)

f_{FRM} : Frame frequency
 t_f : Response time (fall)



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1.6 Backlight Characteristic

The LCD Module is backlight using a LED panel

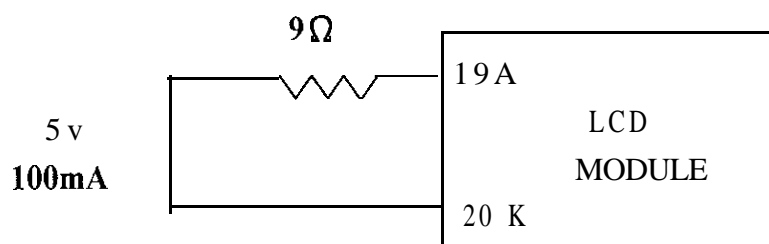
- .Maximum Ratings

| Item | Symbol | Conditions | Min. | Max. | Unit |
|-----------------------|--------|------------|------|------|------|
| Forward current | IF | TA=25°C | - | 25 | mA |
| Reverse voltage | VR | TA=25°C | - | 8 | V |
| Power dissipation | PO | TA=25°C | - | 1.5 | W |
| Operating Temperature | TOPR | - | -20 | 70 | °C |
| Storage temperature | TSTG | - | -40 | 80 | °C |

- .Electrical Ratings

| Item | Symbol | Condition | Min. | Typ. | Max. | Unit |
|--------------------|--------------|-----------|------|------|------|-------------------|
| Forward voltage | VF | IF=100mA | - | 4.1 | 4.4 | V |
| Reverse current | IR | VR=8V | - | - | 0.2 | mA |
| Luminous intensity | IV | IF=100mA | - | 20 | - | cd/m ² |
| Wavelength | HUE | IF=100mA | 571 | - | 576 | nm |
| Color | Yellow Green | | | | | |

- .Light LED Backlight



2. MODULE STRUCTURE

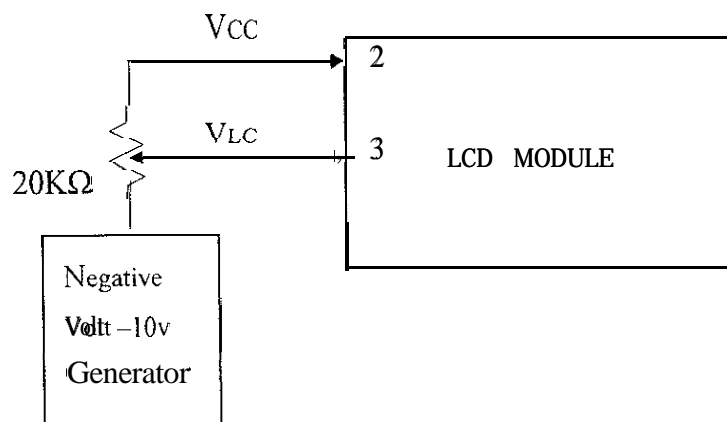
2.1 Counter Drawing

*See Appendix

2.2 Interface Pin Description

| Pin No. | Symbol | Function |
|---------|-------------------|---|
| 1 | V _{DD} | Power supply for logic (+5V) |
| 2 | V _{SS} | Signal ground (GND) |
| 3 | V _{LC} | Operating voltage for LCD (variable) |
| 4 - 7 | DB0~ DB3 | Four low order bi-directional three-state data bus lines. Use for data transfer between the MPU and the LCD module. These four are not used during 4-bit operation. |
| 8 - 11 | DB4~ DB7 | For high order bi-directional three-state data bus lines. Used for data transfer between the MPU and the LCD module. DB7 can be used as a busy flag. |
| 12 | /CS1 | Chip enable for D2 (segment 1 to segment 64) |
| 13 | /CS2 | Chip enable for D3 (segment 65 to segment 128) |
| 14 | RST | Reset signal |
| 15 | R/ \overline{W} | R/W signal input is used to select the read/write mode High =Read mode, Low =Write mode |
| 16 | D/ \overline{I} | Register selection input High =Data register Low =Instruction register (for write) Busy flag address counter (for read) |
| 17 | E | Start enable signal to read or write the data |
| 18 | V _{SS} | Ground |
| 19 | A | LED Backlight(+) |
| 20 | K | LED Backlight(-) |

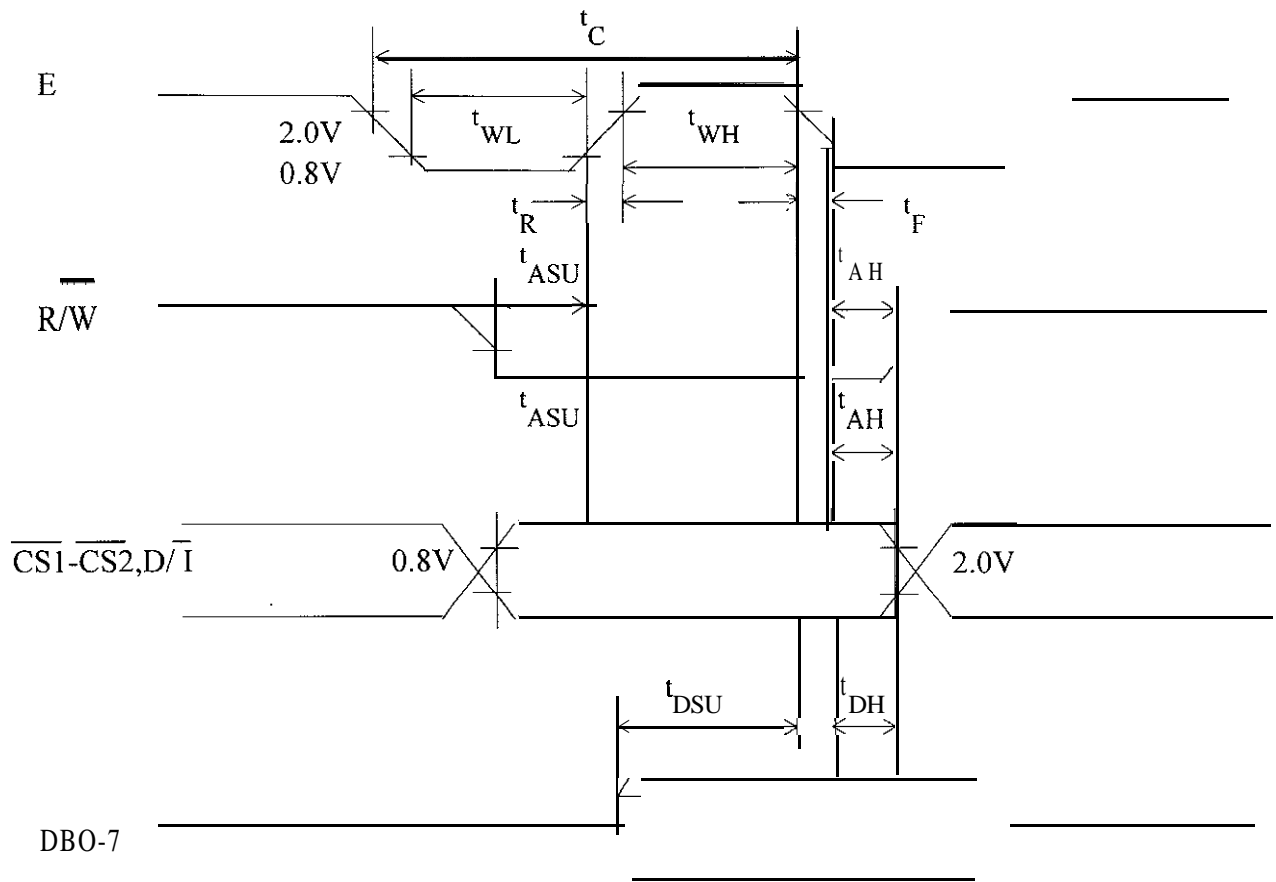
Contrast Adjust



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2.3 Timing Characteristics

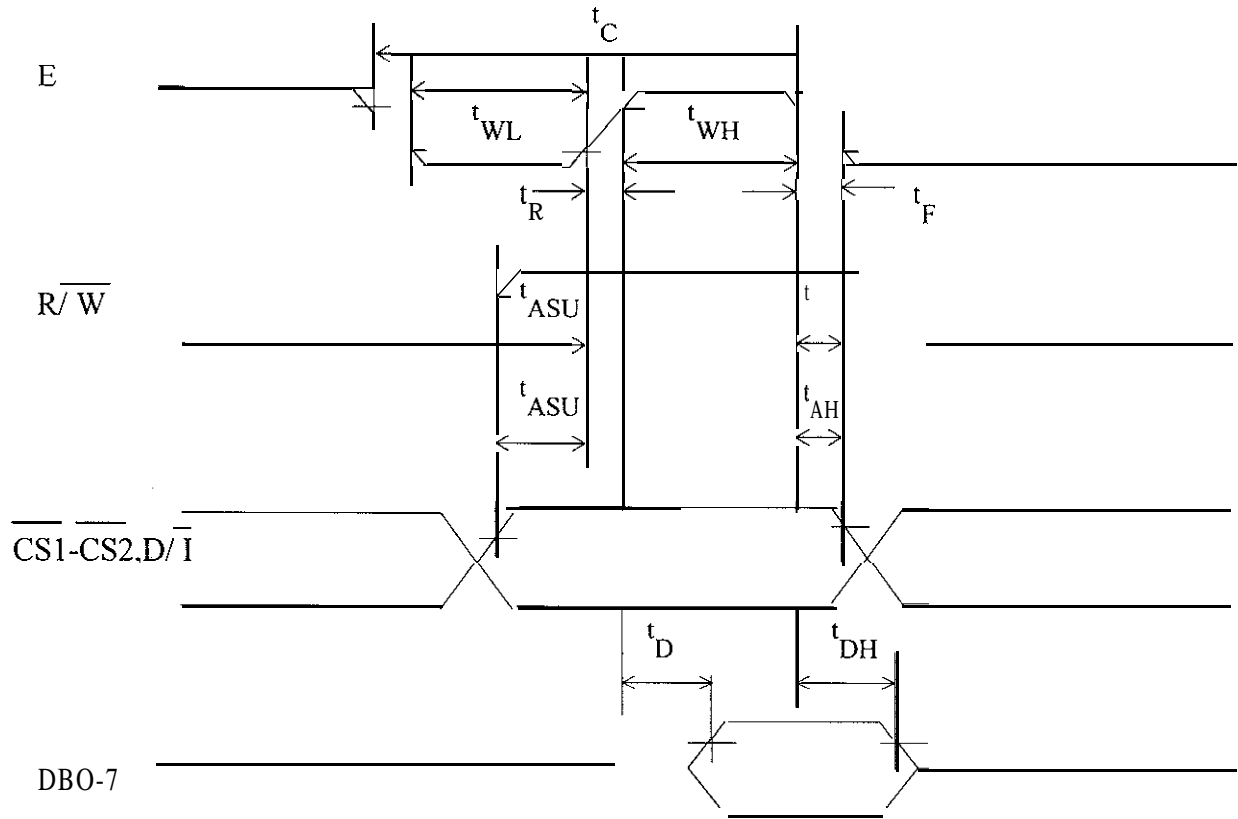


MPU Write timing



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MPU Read timing

| Characteristic | Symbol | Min. | Typ | Max | Unit |
|------------------------|-----------|------|-----|-----|------|
| E Cycle | t_C | 1000 | - | - | ns |
| E High Level Width | t_{WH} | 450 | - | - | ns |
| E Low Level Width | t_{WL} | 450 | - | - | ns |
| E Rise Time | t_R | - | - | 25 | ns |
| E Fall Time | t_F | - | - | 25 | ns |
| Address Set-Up time | t_{ASU} | 140 | - | - | ns |
| Address Hold Time | t_{AH} | 10 | - | - | ns |
| Data Set-Up Time | t_{SU} | 200 | - | - | ns |
| Data Delay Time | t_D | - | - | 320 | ns |
| Data Hold Time (Write) | t_{DHW} | 10 | - | - | ns |
| Data Hold Time (Read) | t_{DHR} | 20 | - | - | ns |



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2.4 Display command

| Instructions | R/W | Code | | | | | | | | Functions | 1 |
|----------------------|-----|------------|-----|---------------------------|-------|-----|------------|-----|-----|---|---|
| | | DB7 | DB6 | DB5 | DB4 | DB3 | DB2 | DB1 | DB0 | | |
| Display on/off | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1/0 | Controls display on/off. RAM data and internal status are not affected. (0:OFF,1:ON) | |
| Display start line | 0 | 1 | 1 | Display start line (0-63) | | | | | | Specifies the RAM line displayed at the top of the screen. | |
| Set Page (x address) | 0 | 1 | 0 | 1 | 1 | 1 | Page (0-7) | | | Sets the page (X address) of RAM at the page (X address) register. | |
| Set Y address | 0 | 0 | 1 | Y address (0-63) | | | | | | Sets the Y address in the Y address counter. | |
| Status read | 1 | Busy | 0 | ON/OFF | Reset | 0 | 0 | | | Reads the status. Reset 1: Reset 0: Normal ON/OFF 1: Display off 0: Display on Busy 1: Internal operation 0: Ready | |
| Write display data | 0 | Write data | | | | | | | | Writes data DBO (LSB) to DB7 (MSB) on the data bus into display RAM. | Has access to the address of the display RAM specified in advance. After the access, Y address is increased by 1. |
| Read display data | 1 | Read data | | | | | | | | Reads data DBO (LSB) to DB7 (MSB) from the display RAM to the data bus. | |

Detailed Explanation

Display On/Off

| | | | | | | | | | | |
|------|-----|-----|-----|-------|-----|-----|---|---|---|---|
| | R/W | D/I | DB7 | | DB0 | | | | | |
| Code | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | D |
| | MSB | | | | | LSB | | | | |

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.



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Display Start Line

| | R/W | D/I | DB7 | | | | | | DB0 |
|------|-----|-----|-----|-------|-------|-------|-------|-------|-----|
| Code | 0 | 0 | 1 | 1 | A | A | A | A | A |
| | MSB | | | | LSB | | | | |

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 1 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. 1132, 1/24 etc.), the data of total line number of LCD screen, from the line specified by display start line instruction, is displayed. See figure 1.

Set page (X address)

| | R/W | D/I | DB7.. | ... | ... | ... | ... | ..DB0 |
|------|-----|-----|-------|-----|-----|-----|-----|-------|
| Code | 0 | 0 | 1 | 0 | 1 | 1 | 1 | A |
| | MSB | | | | LSB | | | |

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 2.

Set Y Address

| | R/W | D/I | DB7. | ... | ... | ... | ... | DB0 |
|------|-----|-----|------|-----|-----|-----|-----|-----|
| Code | 0 | 0 | 0 | 1 | A | A | A | A |
| | MSB | | | | LSB | | | |

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 | | | | | | DB0 |
|------|-----|-----|------|-------|--------|-------|-------|-------|-----|
| Code | 1 | 0 | Busy | 0 | ON/OFF | Reset | 0 | 0 | 0 |
| | MSB | | | | LSB | | | | |

- Busy

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



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- ON/OFF

Shows the liquid crystal display conditions: 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 is being initialized. In this condition, no instructions except status read can be accepted.

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

Write Display Data

| | | | | | |
|------|-----|-----|--------|---------------|-----|
| | R/W | D/I | DB7... | | DB0 |
| Code | 0 | 1 | D | D D D D D D D | D |
| | | | | MSB | LSB |

Write S-bit data DDDDDDDD (binary) into the display data RAM. Then Y address is increased by 1 automatically.

Read Display Data

| | | | | | |
|------|-----|-----|-------|---------------|-----|
| | R/W | D/I | DB7.. | | DB0 |
| Code | 1 | 1 | D | D D D D D D D | D |
| | | | | MSB | LSB |

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

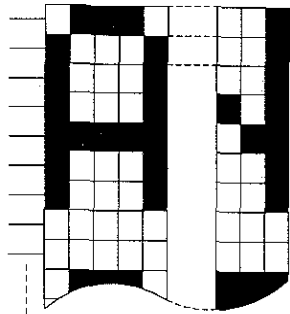
One dummy read is necessary right after the address setting. For details, refer to the explanation of output register in “Function of Each Block”.



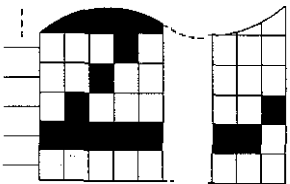
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COM1
COM2
COM3
COM4
COM5
COM6
COM7
COM8
COM9

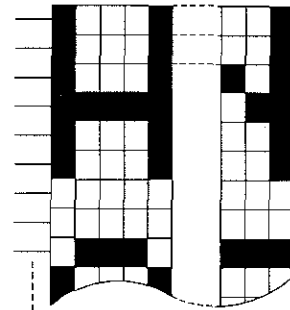


COM60
COM61
COM62
COM63
COM64

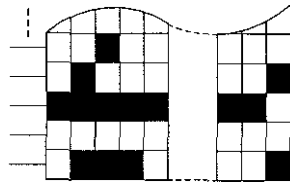


Start line = 0

COM1
COM2
COM3
COM4
COM5
COM6
COM7
COM8
COM9

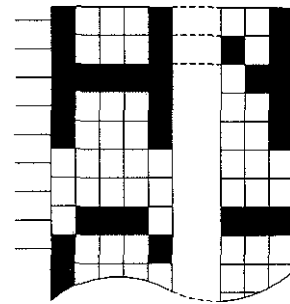


COM60
COM61
COM62
COM63
COM64



Start line = 1

COM1
COM2
COM3
COM4
COM5
COM6
COM7
COM8
COM9



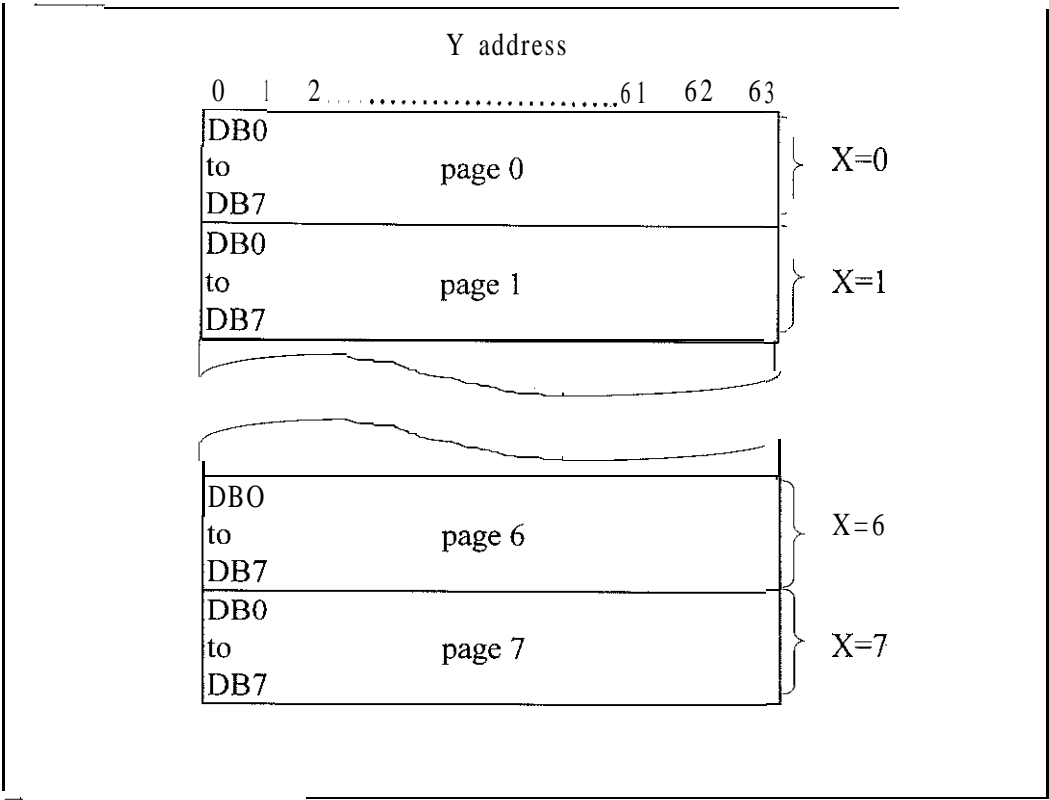
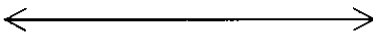


Figure 2 Address Configuration of Display Data RAM



-3. RELIABILITY

3.1 Content of Reliability Test

| Environmental Test | | | |
|--------------------|--------------------------------------|---|--------------------------|
| NO | Test Item | Content of Test | Test Condition |
| 1 | High temperature storage | Endurance test applying the high storage temperature for a long time. | 70°C 100 hrs |
| 2 | Low temperature storage | Endurance test applying the high storage temperature for a long time. | -30°C 100 hrs |
| 3 | High temperature operation | Endurance test applying the electric stress (Voltage & Current) and the thermal stress to the element for a long time. | 70°C 100 hrs |
| 4 | Low temperature operation | Endurance test applying the electric stress under low temperature for a long time. | -20°C 100 hrs |
| 5 | High temperature /Humidity Storage | Endurance test applying the high humidity storage for a long time. | 70°C,90%RH 50 hrs |
| 6 | High temperature /Humidity Operation | Endurance test applying the electric stress (Voltage & Current) and temperature / humidity stress to the element for a long time. | 70°C,90%RH 50 hrs |
| 7 | Temperature Cycle | Endurance test applying the low and high temperature cycle. $-25^{\circ}\text{C} \rightarrow 25^{\circ}\text{C} \rightarrow 75^{\circ}\text{C}$ $30\text{min} \leftarrow 5\text{min} \leftarrow 30\text{min}$  1 cycle | -25°C / 75°C 10 cycle |



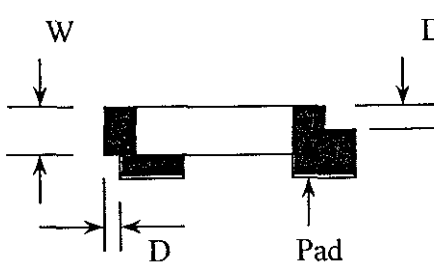
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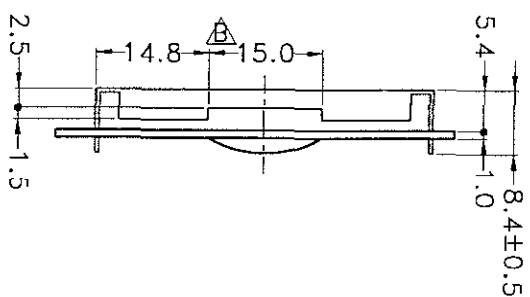
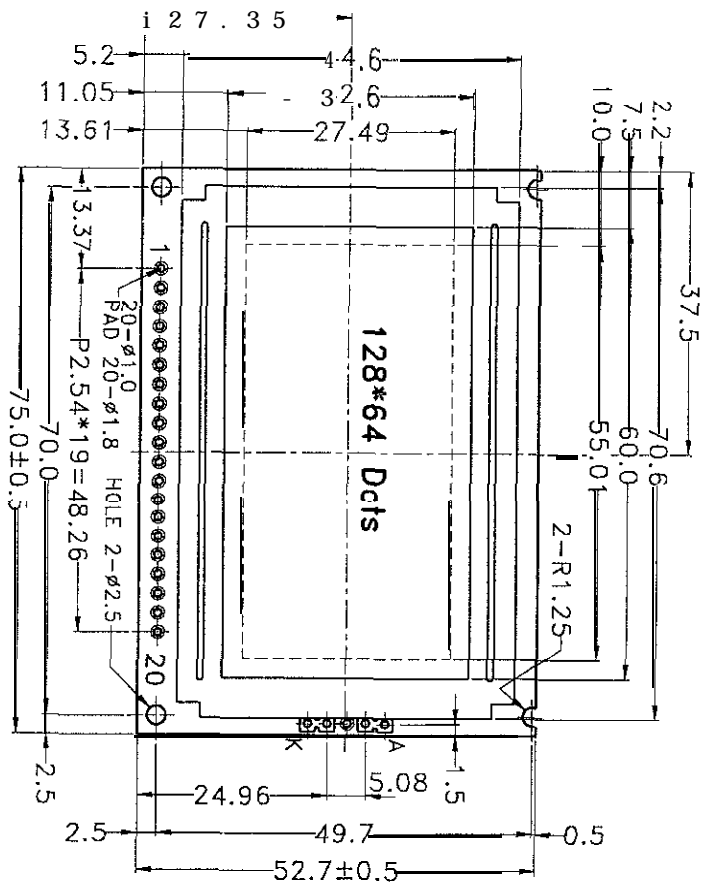
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5.Out Going Inspection Specification

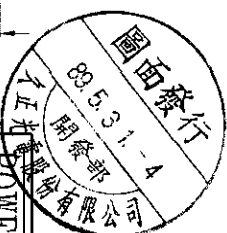
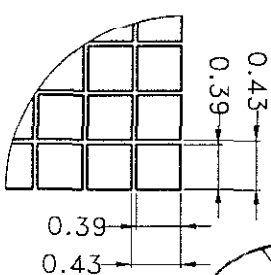
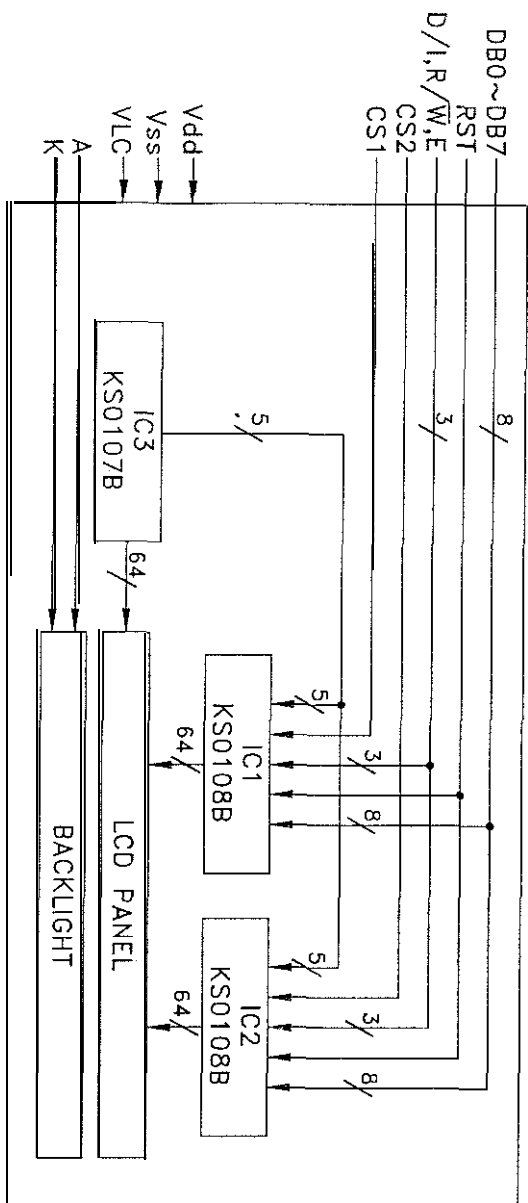
1. Inspection Standard : MIL-STD-105E Table Normal Inspection Single Sampling Level II °
2. Defect Level : Major Defect AQL 0.65; Minor Defect AQL 1 .0 °
3. Equipment : Gauge . MIL-STD . Powertip Tester 、 Sample °
4. Specification :

| N O | Item | Specification | Judge | Level |
|-----|---|---|-------|-------|
| 1 | Part Number | Inconsistent with the P/N on the flow chart of production | N.G. | Major |
| 2 | Quantity | Inconsistent Q'TY with the flow chart of production | N.G. | Major |
| 3 | Electronic characteristics | Display short | N.G. | Major |
| | | Missing line | N.G. | Major |
| | | Dot missing $A > 1/2$ Dot size | N.G. | Major |
| | $A = (L + W) \div 2$ | No function | N.G. | Major |
| | | Out put data error | N.G. | Major |
| 4 | Appearance | Material difference with flow chart | N.G. | Major |
| | | LCD Assembled in opposite direction | N.G. | Major |
| | $A = (L + W) \div 2$ | Bezel assembled in opposite direction | N.G. | Major |
| | | Shadow within LCD $V/A + 1.0$ mm | N.G. | Major |
| | Dirty particle (Include scratch 、 bubble) | Dirty particle $A > 0.4$ mm | N.G. | Minor |
| | | Dirty particle length > 3.0 mm And $0.01\text{mm} < \text{Width} \leq 0.05\text{mm}$ (Width $> 0.05\text{mm}$ Measure by area) | N.G. | Minor |
| | | Without protective film | N.G. | Minor |
| | | Conductive rubber over bezel | N.G. | Minor |
| 5 | PCB Appearance | Burned PCB | N.G. | Major |
| | | Green paint stripped & visible circuit $A > 1.0\text{mm}$ (Finish coat not counted in) | N.G. | Minor |
| | $A = (L + W) \div 2$ | A particle across the circuit | N.G. | Minor |
| | | Circuit split $> 1/2$ Circuit width | N.G. | Minor |
| | | Any circuit risen | N.G. | Minor |
| | | $0.2\text{mm} < \text{Tin ball area } A \leq 0.4\text{mm}$ And Q'TY > 4 Pieces | N.G. | Minor |
| | | Tin ball area $A > 0.4\text{mm}$ | N.G. | Minor |

| NO | Item | Specification | Judge | Level |
|----|--|--|-------|-------|
| 6 | Molding appearance $A = (L + W) \div 2$ | Too soft : Shape by touch changed | N.G. | Major |
| | | Insufficient epoxy : IC circuit or IC pad visible | N.G. | Minor |
| | | Excessive epoxy : Diameter > 20mm Or High > 2.5mm | N.G. | Minor |
| | | Pin hole through and A > 0.2mm | N.G. | Minor |
| 7 | Bezel appearance $A = (L + W) \div 2$ | Angle between frame and TAB > 45° +16 | N.G. | Minor |
| | | Electroplate strip A > 1.0mm (Top view only) | N.G. | Minor |
| | | Rust (Top view only) | N.G. | Minor |
| | | Crack | N.G. | Minor |
| 8 | Backlight electric characteristics $A = (L + W) \div 2$ | Error backlight color | N.G. | Major |
| | | (No function | N.G. | Major |
| | | Any LED dot no function | N.G. | Major |
| | | PIN soldering without tin A > 1/2 solder pad | N.G. | Minor |
| | | Solder PIN high > 1.5mm | N.G. | Minor |
| 9 | LCD Appearance $A = (L + W) \div 2$ | Polarize rise over V/A | N.G. | Minor |
| 10 | Assembly parts $A = (L + W) \div 2$ | Components mark unclearly | N.G. | Minor |
| | | Components' distance more than 0.7mm from the PCB | N.G. | Minor |
| | | Error position not in center $D > 1/4W$ | N.G. | Minor |
| | |  | | |
| | | Non- solder area > Twice solder area | N.G. | Minor |
| | | Flux area A > 1/4 solder area | N.G. | Minor |
| | | Component broken | N.G. | Minor |



| PIN NO. | SIGNAL |
|---------|--------|
| 1 | Vdd |
| 2 | Vss |
| 3 | VLC |
| 4 | DB0 |
| 5 | DB1 |
| 6 | DB2 |
| 7 | DB3 |
| 8 | DB4 |
| 9 | DB5 |
| 10 | DB6 |
| 11 | DB7 |
| 12 | CS1 |
| 13 | CS2 |
| 14 | RST |
| 15 | R/W |
| 16 | D/I |
| 17 | E |
| 18 | VSS |
| 19 | A |
| 20 | K |



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SCALE: 1/1
MODEL NAME: PG 12864IRS-JNN-B
UNIT: TITLE

mm COUNTER DRAWING

ED1: PAGE: 1/1
DRAWN NO.

APPROVED: PG-97018-006

CHECKER: DRAWN

pg. 2 of 2

The tolerance unless classified $\pm 0.3\text{mm}$

SCALE: 15/1