

NHD-C160100CZ-RN-FBW

COG (Chip-On-Glass) Liquid Crystal Display Module

NHD- Newhaven Display
C160100- 160 x 100 Pixels
CZ- Model
R- Reflective
N- No Backlight
F- FSTN Positive
B- 6:00 Optimal View
W- Wide Temperature
RoHS Compliant

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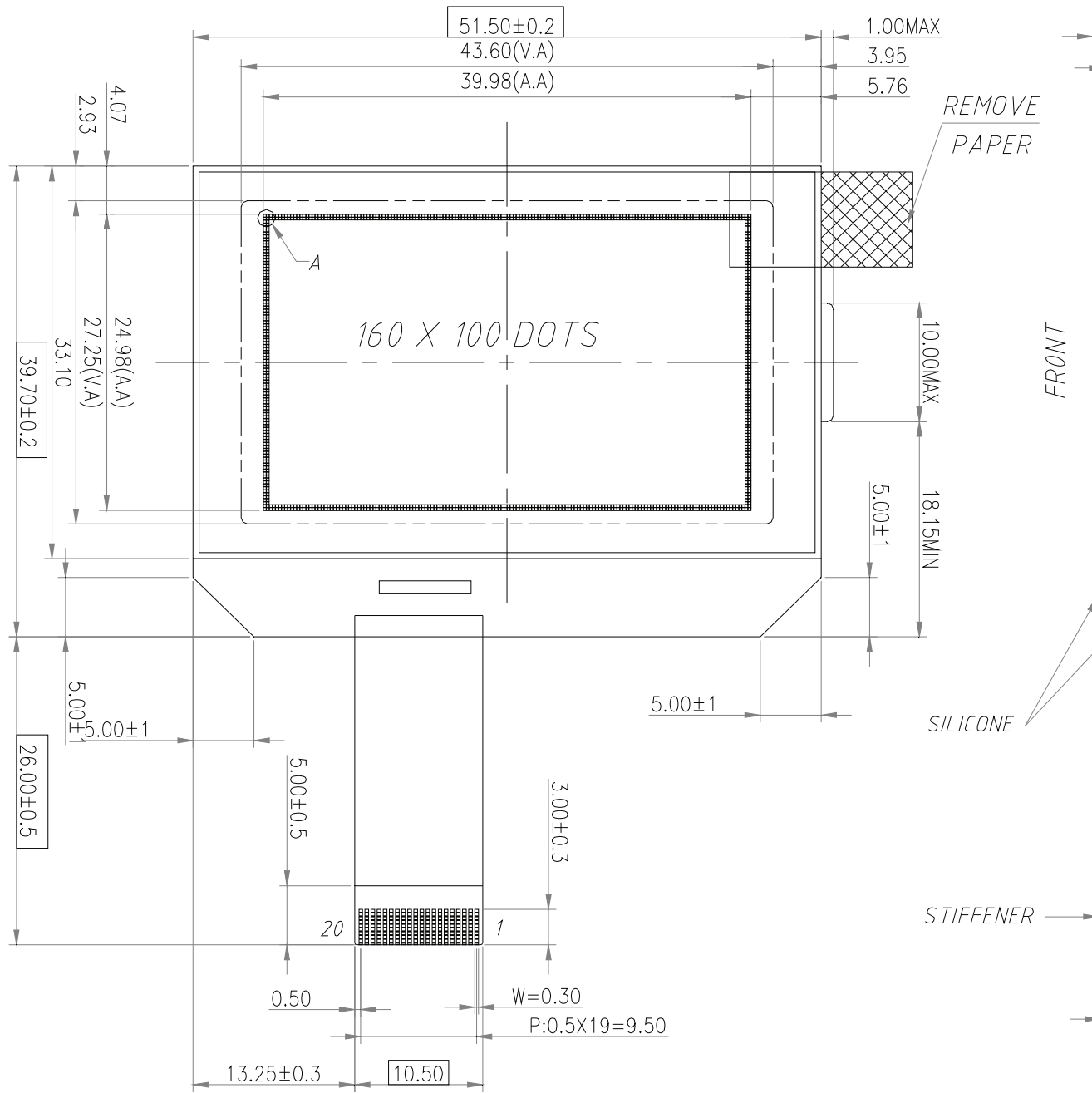
Document Revision History

| Revision | Date | Description | Changed by |
|----------|------------|---|------------|
| 0 | 6/17/2007 | Initial Release | - |
| 1 | 9/11/2009 | User guide reformat | BE |
| 2 | 10/14/2009 | Updated Electrical Characteristic | MC |
| 3 | 12/08/2009 | Updated Block Diagram, Pins 4 and 5, and Timing Characteristics | MC |
| 4 | 9/2/15 | Mechanical drawing updated | AK |
| 5 | 9/18/2015 | Mechanical drawing updated | SB |
| 6 | 8/9/16 | LCD Glass supplier changed | AK |
| 7 | 6/11/19 | Pull Tab added to Drawing & Supply Current Updated | SB |

Functions and Features

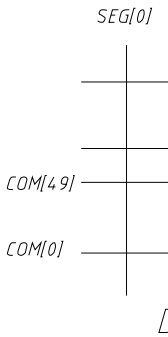
- 160 x 100 pixels
- Built-in ST7528 controller
- Parallel 8080 interface
- +3.0V power supply
- 1/100 duty cycle; 1/11 bias
- RoHS Compliant

A
B
C
D
E
F



Notes:

- 1. Display Type: FSTN / Positive / Reflective
- 2. VLCD: 11.5V ± 0.3V
- 3. Driver IC: ST7528
- 4. Operating Temp: -20°C to +70°C
- 5. Storage Temp: -30°C to +80°C
- 6. Optimal View: 6:00

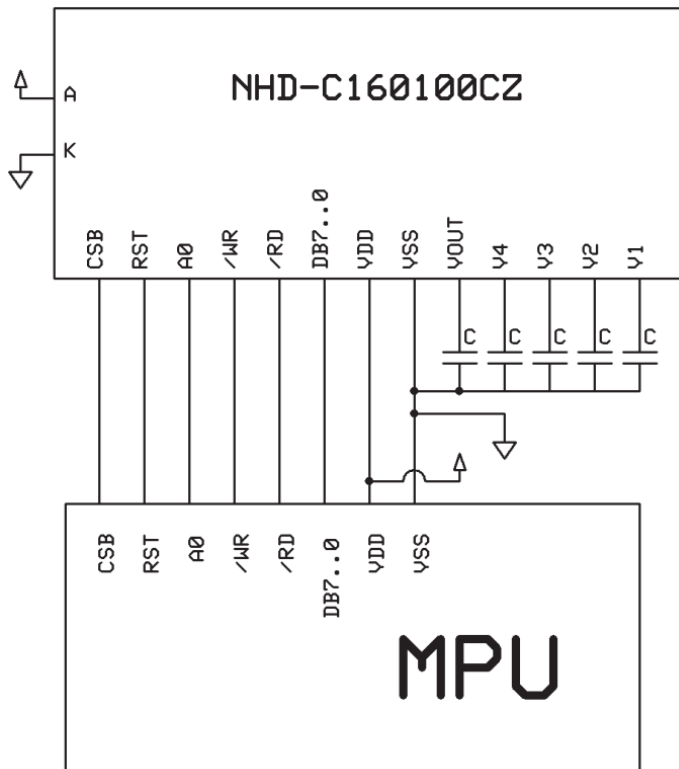


1 2 3 4

Pin Description and Wiring Diagram

| Pin No. | Symbol | External Connection | Function Description |
|---------|------------------|---------------------|--|
| 1 | CSB | MPU | Active LOW Chip Select signal |
| 2 | RST | MPU | Active LOW Reset signal |
| 3 | A0 | MPU | Register Select signal. A0=1: Data, A0=0: Command |
| 4 | /WR | MPU | Active LOW Write signal |
| 5 | /RD | MPU | Active LOW Read signal |
| 6-13 | DB0-DB7 | MPU | Bi-directional 8-bit data bus. |
| 14 | V _{DD} | Power Supply | Supply voltage for LCD and logic (+3.0V) |
| 15 | V _{SS} | Power Supply | Ground |
| 16 | V _{OUT} | Power Supply | Connect to 1uF cap to V _{SS} or V _{DD} |
| 17 | V ₄ | Power Supply | 1.0uF-2.2uF cap to V _{SS} |
| 18 | V ₃ | Power Supply | 1.0uF-2.2uF cap to V _{SS} |
| 19 | V ₂ | Power Supply | 1.0uF-2.2uF cap to V _{SS} |
| 20 | V ₁ | Power Supply | 1.0uF-2.2uF cap to V _{SS} |

Recommended LCD connector: 0.5mm pitch pins. Molex p/n: 52746-2070



Electrical Characteristics

| Item | Symbol | Condition | Min. | Typ. | Max. | Unit |
|-----------------------------|------------------|---|---------------------|------|---------------------|------|
| Operating Temperature Range | T _{OP} | Absolute Max | -20 | - | +70 | °C |
| Storage Temperature Range | T _{ST} | Absolute Max | -30 | - | +80 | °C |
| Supply Voltage | V _{DD} | - | 2.7 | 3.0 | 3.3 | V |
| Supply Current | I _{DD} | T _{OP} =25°C, V _{DD} =3.0V | 0.38 | 0.75 | 1.13 | mA |
| Supply for LCD (contrast) | V _{LCD} | | 11.2 | 11.5 | 11.8 | V |
| "H" Level input | V _{IH} | - | 0.7*V _{DD} | - | V _{DD} | V |
| "L" Level input | V _{IL} | - | V _{SS} | - | 0.3*V _{DD} | V |
| "H" Level output | V _{OH} | - | 0.7*V _{DD} | - | V _{DD} | V |
| "L" Level output | V _{OL} | - | V _{SS} | - | 0.3*V _{DD} | V |

Optical Characteristics

| Item | Symbol | Condition | Min. | Typ. | Max. | Unit |
|------------------------|--------|------------------------|------|------|------|------|
| Optimal Viewing Angles | Top | CR≥2 | - | 20 | - | ° |
| | Bottom | | - | 40 | - | ° |
| | Left | | - | 45 | - | ° |
| | Right | | - | 45 | - | ° |
| Contrast Ratio | CR | - | 2 | 4 | - | - |
| Response Time | Rise | T _{OP} = 25°C | - | 70 | 104 | ms |
| | Fall | | - | 140 | 215 | ms |

Controller Information

Built-in ST7528 controller.

Please download specification at http://www.newhavendisplay.com/app_notes/ST7528.pdf

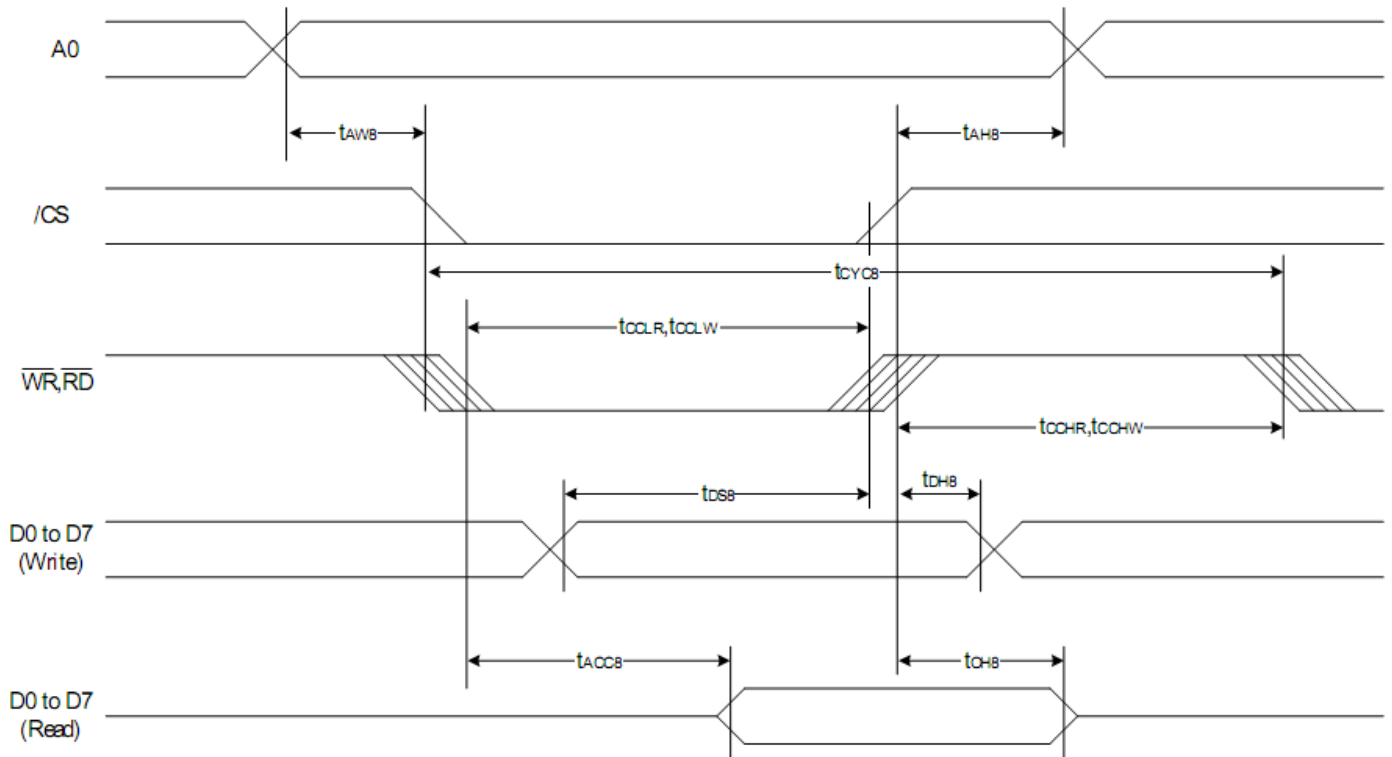
Table of Commands

| Instruction | A0 | RW | DB7 | DB6 | DB5 | DB4 | DB3 | DB2 | DB1 | DB0 | Description |
|-----------------------------------|----|----|------------|-----|-----|-----|-----|-----|-----|-----------------------|---|
| EXT=0 or 1 | | | | | | | | | | | |
| Mode Set | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 0 | 0 | 0 | 2-byte instruction to set Mode and FR(Frame frequency control) BE(Booster efficiency control) |
| | 0 | 0 | FR3 | FR2 | FR1 | FR0 | 0 | BE | x' | EXT | |
| EXT=0 | | | | | | | | | | | |
| Read display data | 1 | 1 | Read data | | | | | | | Read data into DDRAM | |
| Write display data | 1 | 0 | Write data | | | | | | | Write data into DDRAM | |
| Read status | 0 | 1 | BUSY | ON | RES | MF2 | MF1 | MF0 | DS1 | DS0 | Read the internal status |
| ICON control register ON/OFF | 0 | 0 | 1 | 0 | 1 | 0 | 0 | 0 | 1 | ICON | ICON=0: ICON disable(default) ICON=1: ICON enable & set the page address to 16 |
| Set page address | 0 | 0 | 1 | 0 | 1 | 1 | P3 | P2 | P1 | P0 | Set page address |
| Set column address MSB | 0 | 0 | 0 | 0 | 0 | 1 | Y9 | Y8 | Y7 | Y6 | Set column address MSB |
| Set column address LSB | 0 | 0 | 0 | 0 | 0 | 0 | Y5 | Y4 | Y3 | Y2 | Set column address LSB |
| Set modify-read | 0 | 0 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | Set modify-read mode |
| Reset modify-read | 0 | 0 | 1 | 1 | 1 | 0 | 1 | 1 | 1 | 0 | release modify-read mode |
| Display ON/OFF | 0 | 0 | 1 | 0 | 1 | 0 | 1 | 1 | 1 | D | D=0: Display OFF D=1: Display ON |
| Set initial display line register | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | x' | x' | 2-byte instruction to specify the initial display line to realize vertical scrolling |
| | 0 | 0 | x' | S6 | S5 | S4 | S3 | S2 | S1 | S0 | |
| Set initial COM0 register | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 1 | x' | x' | 2-byte instruction to specify the initial COM0 to realize window scrolling |
| | 0 | 0 | x' | C6 | C5 | C4 | C3 | C2 | C1 | C0 | |
| Set partial display duty ration | 0 | 0 | 0 | 1 | 0 | 0 | 1 | 0 | x' | x' | 2-byte instruction to set partial display duty ratio |
| | 0 | 0 | D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 | |
| Set N-line inversion | 0 | 0 | 0 | 1 | 0 | 0 | 1 | 1 | x' | x' | 2-byte instruction to set N-line inversion register |
| | 0 | 0 | x' | x' | x' | N4 | N3 | N2 | N1 | N0 | |
| Release N-line inversion | 0 | 0 | 1 | 1 | 1 | 0 | 0 | 1 | 0 | 0 | Release N-line inversion mode |
| Reverse display ON/OFF | 0 | 0 | 1 | 0 | 1 | 0 | 0 | 1 | 1 | REV | REV=0: normal display REV=1: reverse display |
| Entire display ON/OFF | 0 | 0 | 1 | 0 | 1 | 0 | 0 | 1 | 0 | EON | EON=0: normal display EON=1: entire display ON |

| Instruction | A0 | RW | DB7 | DB6 | DB5 | DB4 | DB3 | DB2 | DB1 | DB0 | Description |
|---|----|----|-----|-----|-----|-----|-----|-----|------|------|---|
| Ext=0 | | | | | | | | | | | |
| Power control | 0 | 0 | 0 | 0 | 1 | 0 | 1 | VC | VR | VF | Control power circuit operation |
| Select DC-DC step-up | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 1 | DC1 | DC0 | Select the step-up of internal voltage converter |
| Select regulator register | 0 | 0 | 0 | 0 | 1 | 0 | 0 | R2 | R1 | R0 | Select the internal resistance ratio of the regulator resistor |
| Select electronic volumn register | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 2-byte instruction to specify the reference voltage |
| | 0 | 0 | x' | x' | EV5 | EV4 | EV3 | EV2 | EV1 | EV0 | |
| Select LCD bias | 0 | 0 | 0 | 1 | 0 | 1 | 0 | B2 | B1 | B0 | Select LCD bias |
| Set Bias Power Save Mode | 0 | 0 | 1 | 1 | 1 | 1 | 0 | 0 | 1 | 1 | Bias Power save Save the Bias current consumption |
| | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| Release Bias Power Save Mode | 0 | 0 | 1 | 1 | 1 | 1 | 0 | 0 | 1 | 1 | Bias Power save release set the Bias power to normal |
| | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | |
| SHL select | 0 | 0 | 1 | 1 | 0 | 0 | SHL | x' | x' | x' | COM bi-directional selection SHL=0: normal direction SHL=1: reverse direction |
| ADC select | 0 | 0 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | ADC | SEG bi-direction selection ADC=0: normal direction ADC=1: reverse direction |
| Oscillator on start | 0 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 1 | Start the built-in oscillator |
| Set power save mode | 0 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 0 | P | P=0: normal mode P=1: sleep mode |
| Release power save mode | 0 | 0 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 1 | release power save mode |
| Reset | 0 | 0 | 1 | 1 | 1 | 0 | 0 | 0 | 1 | 0 | initial the internal function |
| Set data direction & display data length(DDL) | x' | x' | 1 | 1 | 1 | 0 | 1 | 0 | 0 | 0 | 2-byte instruction to specify the number of data bytes. (SPI mode) |
| | x' | x' | D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 | |
| Select FRC and PWM mode | 0 | 0 | 1 | 0 | 0 | 1 | 0 | FRC | PWM1 | PWM0 | FRC(1:3FRC, 0:4FRC) PWM1 PWM0 0 0 45PWM 0 1 45 PWM 1 0 60PWM 1 1 --- |
| NOP | 0 | 0 | 1 | 1 | 1 | 0 | 0 | 0 | 1 | 1 | <u>No operation</u> |
| Test Instruction | 0 | 0 | 1 | 1 | 1 | 1 | x' | x' | x' | x' | <u>Don't use this instruction</u> |

| Instruction | A0 | RW | DB7 | DB6 | DB5 | DB4 | DB3 | DB2 | DB1 | DB0 | Description |
|--|----|----|-------------------|-----|------|------|------|------|------|------|---|
| EXT=1 | | | | | | | | | | | |
| Set white mode and 1 st frame, set pulse width | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | Set white mode and 1st frame |
| | 0 | 0 | X' | X' | GA05 | GA04 | GA03 | GA02 | GA01 | GA00 | |
| Set white mode and 2 nd frame, set pulse width | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | Set white mode and 2nd frame |
| | 0 | 0 | X' | X' | GA05 | GA04 | GA03 | GA02 | GA01 | GA00 | |
| Set white mode and 3 rd frame, set pulse width | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | Set white mode and 3rd frame |
| | 0 | 0 | X' | X' | GA05 | GA04 | GA03 | GA02 | GA01 | GA00 | |
| Set white mode and 4 th frame, set pulse width | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | Set white mode and 4th frame |
| | 0 | 0 | X' | X' | GA05 | GA04 | GA03 | GA02 | GA01 | GA00 | |
| Set gray level 1 mode | 0 | 0 | 84H~87H (4 bytes) | | | | | | | | Set gray level1 |
| Set gray level 2 mode | 0 | 0 | 88H~8BH (4 bytes) | | | | | | | | Set gray level2 |
| Set gray level 3 mode | 0 | 0 | 8CH~8FH (4bytes) | | | | | | | | Set gray level3 |
| Set gray level 4 mode | 0 | 0 | 90H~93H (4bytes) | | | | | | | | Set gray level4 |
| Set gray level 5 mode | 0 | 0 | 94H~97H (4bytes) | | | | | | | | Set gray level5 |
| Set gray level 6 mode | 0 | 0 | 98H~9BH (4 bytes) | | | | | | | | Set gray level6 |
| Set gray level 7 mode | 0 | 0 | 9CH~9FH (4 bytes) | | | | | | | | Set gray level7 |
| Set gray level 8 mode | 0 | 0 | A0H~A3H (4 bytes) | | | | | | | | Set gray level8 |
| Set gray level 9 mode | 0 | 0 | A4H~A7H (4 bytes) | | | | | | | | Set gray level9 |
| Set gray level 10 mode | 0 | 0 | A8H~ABH (4 bytes) | | | | | | | | Set gray level10 |
| Set gray level 11mode | 0 | 0 | ACH~AFH (4 bytes) | | | | | | | | Set gray level11 |
| Set gray level 12 mode | 0 | 0 | B0H~B3H (4 bytes) | | | | | | | | Set gray level12 |
| Set gray level 13 mode | 0 | 0 | B4H~B7H (4 bytes) | | | | | | | | Set gray level13 |
| Set gray level 14 mode | 0 | 0 | B8H~BBH (4 bytes) | | | | | | | | Set gray level14 |
| Set Dark mode and 1st frame, set pulse width | 0 | 0 | 1 | 0 | 1 | 1 | 1 | 1 | 0 | 0 | Set Dark mode and 1st frame, set pulse width |
| | 0 | 0 | X' | X' | GAF5 | GAF4 | GAF3 | GAF2 | GAF1 | GAF0 | |
| Set Dark mode and 2nd frame, set pulse width | 0 | 0 | 1 | 0 | 1 | 1 | 1 | 1 | 0 | 1 | Set Dark mode and 2nd frame, set pulse width |
| | 0 | 0 | X' | X' | GAF5 | GAF4 | GAF3 | GAF2 | GAF1 | GAF0 | |
| Set Dark mode and 3rd frame, set pulse width | 0 | 0 | 1 | 0 | 1 | 1 | 1 | 1 | 1 | 0 | Set Dark mode and 3rd frame, set pulse width |
| | 0 | 0 | X' | X' | GAF5 | GAF4 | GAF3 | GAF2 | GAF1 | GAF0 | |
| Set Dark mode and 4th frame, set pulse width | 0 | 0 | 1 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | Set Dark mode and 4th frame, set pulse width |
| | 0 | 0 | X' | X' | GAF5 | GAF4 | GAF3 | GAF2 | GAF1 | GAF0 | |

Timing Characteristics



(VDD = 3.3V , Ta =25°C)

| Item | Signal | Symbol | Condition | Rating | | Units |
|------------------------------|----------|--------|-------------|--------|------|-------|
| | | | | Min. | Max. | |
| Address hold time | A0 | tAH8 | | 0 | — | ns |
| Address setup time | | tAW8 | | 0 | — | |
| System cycle time | | tCYC8 | | 240 | — | |
| Enable L pulse width (WRITE) | WR | tCCLW | | 80 | — | |
| Enable H pulse width (WRITE) | | tCCHW | | 80 | — | |
| Enable L pulse width (READ) | RD | tCCLR | | 140 | — | |
| Enable H pulse width (READ) | | tCCHR | | 80 | — | |
| WRITE Data setup time | D0 to D7 | tDS8 | | 40 | — | |
| WRITE Data hold time | | tDH8 | | 10 | — | |
| READ access time | | tACC8 | CL = 100 pF | — | 70 | |
| READ Output disable time | | tOH8 | CL = 100 pF | 5 | 50 | |

Example Initialization Program

```
//-----  
void write_command(unsigned char datum)  
{  
    A0=0; /*Instruction register*/  
    E=1; /*Read inactive*/  
    P1 = datum; /*put data on port 1*/  
    CS1=0; /*Chip select active*/  
    RW=0; /*Write active*/  
    RW=1; /*Write inactive; latch in data*/  
    CS1=1; /*Chip select inactive*/  
}  
  
//-----  
void write_data(unsigned char datum)  
{  
    A0=1; /*DDRAM data register*/  
    E=1;  
    P1=datum;  
    CS1=0;  
    RW=0;  
    RW=1;  
    CS1=1;  
}  
  
//-----  
void lcd_init(void){  
    write_command(0xA2); //ICON OFF;  
    write_command(0xAE); //Display OFF  
  
    write_command(0x48); //Set Duty ratio  
    write_command(0x80); //No operation  
    write_command(0xa1); //Set scan direction //changed from 0 to 1  
    write_command(0xc8); //SHL select  
    write_command(0x40); //Set START LINE  
    write_command(0x00);  
    write_command(0xab); //OSC on  
  
    write_command(0x64); //3x  
    delay(2000);  
    write_command(0x65); //4x  
    delay(2000);  
    write_command(0x66); //5x  
    delay(2000);  
    write_command(0x67); //6x  
    delay(2000);  
  
    write_command(Ra_Rb); //RESISTER SET  
    write_command(0x81); //Set electronic volume register  
    write_command(vopcode); //n=0~3f  
  
    write_command(0x57); //1/12bias  
    write_command(0x92); //FRC and pwm  
  
    write_command(0x2C);  
    delay(20000); //200ms
```

```
write_command(0x2E);
delay(20000);//200ms
write_command(0x2F);
delay(20000);//200ms
```

```
write_command(0x92); //frc and pwm
write_command(0x38); //external mode
write_command(0x75);
//start settings for 16-level grayscale
write_command(0x97); //3frc,45pwm
```

```
write_command(0x80);
write_command(0x00);
write_command(0x81);
write_command(0x00);
write_command(0x82);
write_command(0x00);
write_command(0x83);
write_command(0x00);
```

```
write_command(0x84);
write_command(0x06);
write_command(0x85);
write_command(0x06);
write_command(0x86);
write_command(0x06);
write_command(0x87);
write_command(0x06);
```

```
write_command(0x88);
write_command(0x0b);
write_command(0x89);
write_command(0x0b);
write_command(0x8a);
write_command(0x0b);
write_command(0x8b);
write_command(0x0b);
```

```
write_command(0x8c);
write_command(0x10);
write_command(0x8d);
write_command(0x10);
write_command(0x8e);
write_command(0x10);
write_command(0x8f);
write_command(0x10);
```

```
write_command(0x90);
write_command(0x15);
write_command(0x91);
write_command(0x15);
write_command(0x92);
write_command(0x15);
write_command(0x93);
write_command(0x15);
```

```
write_command(0x94);
write_command(0x1a);
write_command(0x95);
write_command(0x1a);
write_command(0x96);
write_command(0x1a);
```

```
write_command(0x97);  
write_command(0x1a);
```

```
write_command(0x98);  
write_command(0x1e);  
write_command(0x99);  
write_command(0x1e);  
write_command(0x9a);  
write_command(0x1e);  
write_command(0x9b);  
write_command(0x1e);
```

```
write_command(0x9c);  
write_command(0x23);  
write_command(0x9d);  
write_command(0x23);  
write_command(0x9e);  
write_command(0x23);  
write_command(0x9f);  
write_command(0x23);
```

```
write_command(0xa0);  
write_command(0x27);  
write_command(0xa1);  
write_command(0x27);  
write_command(0xa2);  
write_command(0x27);  
write_command(0xa3);  
write_command(0x27);
```

```
write_command(0xa4);  
write_command(0x2b);  
write_command(0xa5);  
write_command(0x2b);  
write_command(0xa6);  
write_command(0x2b);  
write_command(0xa7);  
write_command(0x2b);
```

```
write_command(0xa8);  
write_command(0x2f);  
write_command(0xa9);  
write_command(0x2f);  
write_command(0xaa);  
write_command(0x2f);  
write_command(0xab);  
write_command(0x2f);
```

```
write_command(0xac);  
write_command(0x32);  
write_command(0xad);  
write_command(0x32);  
write_command(0xae);  
write_command(0x32);  
write_command(0xaf);  
write_command(0x32);
```

```
write_command(0xb0);  
write_command(0x35);  
write_command(0xb1);  
write_command(0x35);  
write_command(0xb2);  
write_command(0x35);
```

```
write_command(0xb3);
write_command(0x35);

write_command(0xb4);
write_command(0x38);
write_command(0xb5);
write_command(0x38);
write_command(0xb6);
write_command(0x38);
write_command(0xb7);
write_command(0x38);

write_command(0xb8);
write_command(0x3a);
write_command(0xb9);
write_command(0x3a);
write_command(0xba);
write_command(0x3a);
write_command(0xbb);
write_command(0x3a);

write_command(0xbc);
write_command(0x3c);
write_command(0xbd);
write_command(0x3c);
write_command(0xbe);
write_command(0x3c);
write_command(0xbf);
write_command(0x3c);
    //end settings for 16-level grayscale
write_command(0x38);
write_command(0x74);
write_command(0xaf); //Display ON
}

//-----
```

Quality Information

| Test Item | Content of Test | Test Condition | Note |
|---------------------------------------|---|---|------|
| High Temperature storage | Endurance test applying the high storage temperature for a long time. | +80°C , 48hrs | 2 |
| Low Temperature storage | Endurance test applying the low storage temperature for a long time. | -30°C , 48hrs | 1,2 |
| High Temperature Operation | Endurance test applying the electric stress (voltage & current) and the high thermal stress for a long time. | +70°C 48hrs | 2 |
| Low Temperature Operation | Endurance test applying the electric stress (voltage & current) and the low thermal stress for a long time. | -20°C , 48hrs | 1,2 |
| High Temperature / Humidity Operation | Endurance test applying the electric stress (voltage & current) and the high thermal with high humidity stress for a long time. | +40°C , 90% RH , 48hrs | 1,2 |
| Thermal Shock resistance | Endurance test applying the electric stress (voltage & current) during a cycle of low and high thermal stress. | -0°C,30min -> 25°C,5min -> 50°C,30min = 1 cycle 10 cycles | |
| Vibration test | Endurance test applying vibration to simulate transportation and use. | 10-55Hz , 15mm amplitude. 60 sec in each of 3 directions X,Y,Z For 15 minutes | 3 |
| Static electricity test | Endurance test applying electric static discharge. | VS=800V, RS=1.5kΩ, CS=100pF One time | |

Note 1: No condensation to be observed.

Note 2: Conducted after 4 hours of storage at 25°C, 0%RH.

Note 3: Test performed on product itself, not inside a container.

Precautions for using LCDs/LCMs

See Precautions at www.newhavendisplay.com/specs/precautions.pdf

Warranty Information and Terms & Conditions

http://www.newhavendisplay.com/index.php?main_page=terms

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