



## GRAPHIC OLED MODULE DATA SHEET



Datasheet Release 2016-03-16  
for  
[CFAL12864QX-G](#) and [CFAL12864QX-Y](#)

### **Crystalfontz America, Incorporated**

12412 East Saltese Avenue  
Spokane Valley, WA 99216-0357

Phone: 888-206-9720

Fax: 509-892-1203

Email: [support@crystalfontz.com](mailto:support@crystalfontz.com)

URL: [www.crystalfontz.com](http://www.crystalfontz.com)



### Datasheet Revision History

Datasheet Release: 2016-03-16  
Removed information on LEDs. OLEDs do not have LEDs.

Preliminary Data Sheet Release: 2014-09-08  
Data Sheet revised to reflect that CFAL12864QX-G and CFAL12864QX-Y are now available on the CrystalFontz website. Display module specifications have not changed.

- Photos added to title page.
- Expanded Module Reliability information.

Data Sheet Preliminary Release: 2014-03-24  
Preliminary Data Sheet for the CFAL12864QX-G and CFAL12864QX-Y display modules. Possible special customer request. These modules are not available on the CrystalFontz website.

### Hardware Updates

To see updates, look for the Product Notices tab on the product's web page. If there is no Product Notices tab, the product does not have any updates.

### About Variations

Slight variations (for example, contrast, color, or intensity) between lots are normal.



### The Fine Print

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### About Volatility

The CrystalFontz CFAL12864QX-G and CFAL12864QX-Y modules have volatile memory.



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## PHYSICAL CHARACTERISTICS

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### CFAL12864QX-G

| Item             | Dimension          | Unit |
|------------------|--------------------|------|
| Dot Matrix       | 128 x 64           | —    |
| Module dimension | 73.0 × 41.86 × 3.0 | mm   |
| Active Area      | 61.41 × 30.69      | mm   |
| Pixel Size       | 0.45 × 0.45        | mm   |
| Pixel Pitch      | 0.48 × 0.48        | mm   |
| Display Mode     | Passive Matrix     |      |
| Display Color    | Monochrome (Green) |      |
| Drive Duty       | 1/64 Duty          |      |
| IC               | SSD1325            |      |

### CFAL12864QX-Y

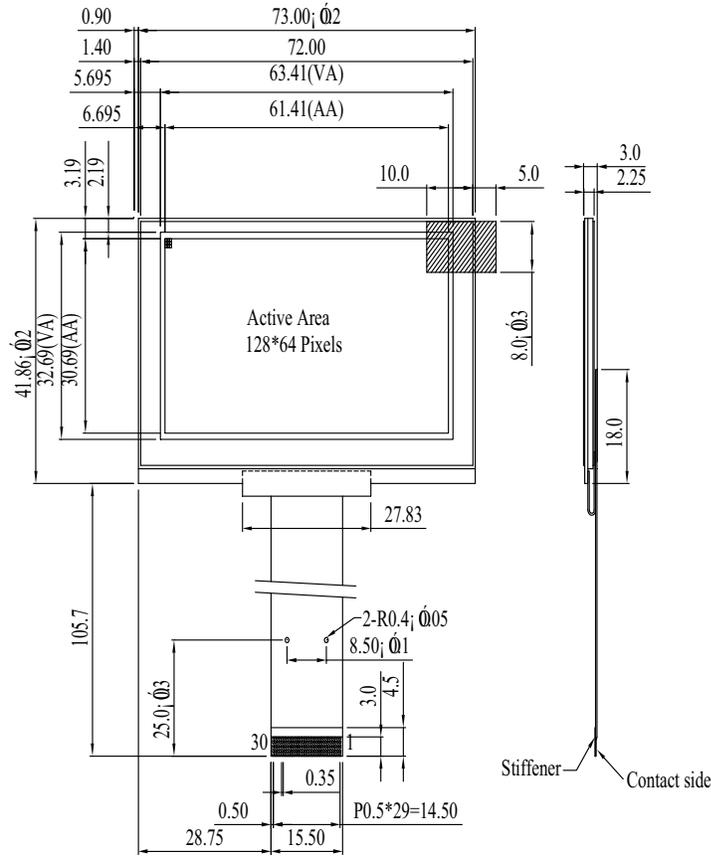
CFAL12864QX-Y has the same physical characteristics as CFAL12864QX-G shown above, except display color is yellow monochrome.

### ADDITIONAL FEATURES

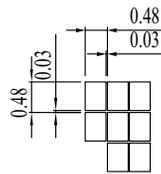
- These modules have a [Solomon Systech SSD1325](#) 128 x 80, 16-level grayscale dot matrix OLED/PLED segment/common driver with controller.
- Interface choices are 8-bit parallel (8080 or 6800) or SPI.
- RoHS compliant.
- CrystalFontz America Incorporated is ISO 9001:2008 certified.



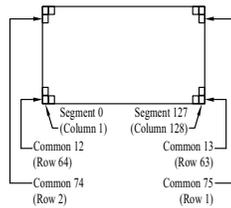
# MODULE OUTLINE DRAWING



| PIN NO. | SYMBOL  |
|---------|---------|
| 1       | NC(GND) |
| 2       | VCC     |
| 3       | VCOMH   |
| 4       | IREF    |
| 5       | D7      |
| 6       | D6      |
| 7       | D5      |
| 8       | D4      |
| 9       | D3      |
| 10      | D2      |
| 11      | D1      |
| 12      | D0      |
| 13      | E/RD#   |
| 14      | R/W#    |
| 15      | D/C#    |
| 16      | RES#    |
| 17      | CS#     |
| 18      | NC      |
| 19      | BS2     |
| 20      | BS1     |
| 21      | VDD     |
| 22      | NC      |
| 23      | NC      |
| 24      | NC      |
| 25      | NC      |
| 26      | NC      |
| 27      | NC      |
| 28      | NC      |
| 29      | VSS     |
| 30      | VSL     |



Detail DOTS  
Scale 10/1

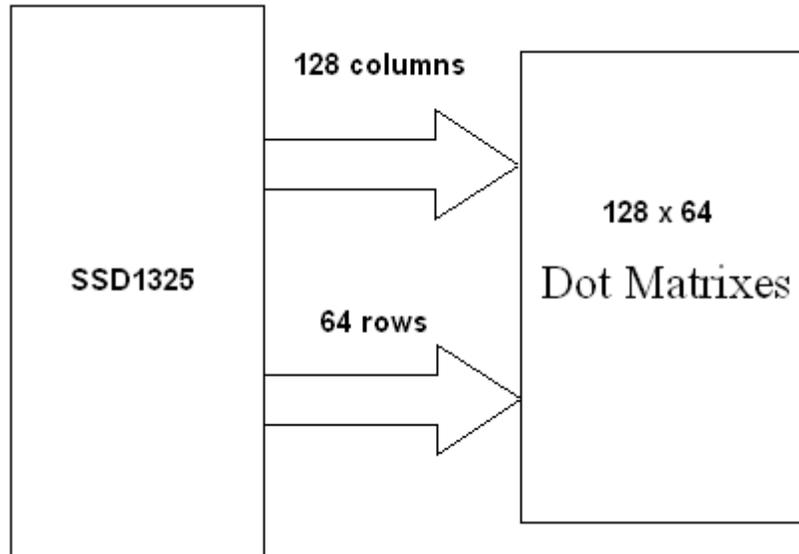


The non-specified tolerance of dimension is  $\pm 0.3\text{mm}$ .



## SYSTEM BLOCK DIAGRAM

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## DETAILS OF INTERFACE PIN FUNCTIONS

| No.  | Symbol  | I/O | Function  |
|------|---------|-----|---|
| 1    | NC(GND) |     | Reserved Pin (Supporting Pin)<br>The supporting pin can reduce the influences from stresses on the function pins. This pin must be connected to external ground.  |
| 2    | VCC     | P   | Power Supply for OLED Panel<br>This is the most positive voltage supply pin of the chip. It must be supplied externally.  |
| 3    | VCOMH   | P   | Voltage Output High Level for COM Signal<br>This pin is the input pin for the voltage output high level for COM signals. It can be supplied externally or internally. When VCOMH is generated internally, a capacitor should be connected between this pin and VSS.   |
| 4    | IREF    | I   | Current Reference for Brightness Adjustment<br>This pin is segment current reference pin. A resistor should be connected between this pin and VSS. Set the current at 10 $\mu$ A.   |
| 5~12 | D7~D0   | I/O | Host Data Input/Output Bus<br>These pins are 8-bit bi-directional data bus to be connected to the microprocessor's data bus. When serial mode is selected, D1 will be the serial data input SDIN and D0 will be the serial clock input SCLK   |
| 13   | E/RD#   | I   | Read/Write Enable or Read<br>This pin is MCU interface input. When interfacing to a 68XX-series microprocessor, this pin will be used as the Enable (E) signal. Read/write operation is initiated when this pin is pulled high and the CS# is pulled low. When connecting to an 80XX-microprocessor, this pin receives the Read (RD#) signal. Data read operation is initiated when this pin is pulled low and CS# is pulled low. |
| 14   | R/W#    | I   | Read/Write Select or Write<br>This pin is MCU interface input. When interfacing to a 68XX-series microprocessor, this pin will be used as Read/Write (R/W#) selection input. Pull this pin to "High" for read mode and pull it to "Low" for write mode.<br>When 80XX interface mode is selected, this pin will be the Write (WR#) input. Data write operation is initiated when this pin is pulled low and the CS# is pulled low. |
| 15   | D/C#    | I   | Data/Command Control<br>This pin is Data/Command control pin. When the pin is pulled high, the input at D7~D0 is treated as display data.<br>When the pin is pulled low, the input at D7~D0 will be transferred to the command register. For detail relationship to MCU interface signals, please refer to  |



## DETAILS OF INTERFACE PIN FUNCTIONS, CONT'D

|     |               |   | the<br>Timing Characteristics Diagrams.<br>When the pin is pulled high and serial interface mode is selected, the data at SDIN is treated as data. When it is pulled low, the data at SDIN will be transferred to the command register.                            |        |               |               |        |     |   |   |   |     |   |   |   |
|-----|---------------|---|--|--------|---------------|---------------|--------|-----|---|---|---|-----|---|---|---|
| 16  | RES#          | I | Power Reset for Controller and Driver<br>This pin is reset signal input. When the pin is low, initialization of the chip is executed.  |        |               |               |        |     |   |   |   |     |   |   |   |
| 17  | CS#           | I | Chip Select<br>This pin is the chip select input. The chip is enabled for MCU communication only when CS# is pulled low.   |        |               |               |        |     |   |   |   |     |   |   |   |
| 18  | NC            |   | Reserved Pin<br>The N.C. pins between function pins are reserved for compatible and flexible design.   |        |               |               |        |     |   |   |   |     |   |   |   |
| 19  | BS2           | I | Communicating Protocol Select<br>These pins are MCU interface selection input. See the following table:  |        |               |               |        |     |   |   |   |     |   |   |   |
| 20  | BS1           |   | <table border="1"> <thead> <tr> <th></th> <th>68XX-parallel</th> <th>80XX-parallel</th> <th>Serial</th> </tr> </thead> <tbody> <tr> <td>BS1</td> <td>0</td> <td>1</td> <td>0</td> </tr> <tr> <td>BS2</td> <td>1</td> <td>1</td> <td>0</td> </tr> </tbody> </table> |        | 68XX-parallel | 80XX-parallel | Serial | BS1 | 0 | 1 | 0 | BS2 | 1 | 1 | 0 |
|     | 68XX-parallel |   | 80XX-parallel  | Serial |               |               |        |     |   |   |   |     |   |   |   |
| BS1 | 0             | 1 | 0  |        |               |               |        |     |   |   |   |     |   |   |   |
| BS2 | 1             | 1 | 0  |        |               |               |        |     |   |   |   |     |   |   |   |
| 21  | Vdd           | P | Power Supply for Logic Circuit<br>This is a voltage supply pin. It must be connected to external source.   |        |               |               |        |     |   |   |   |     |   |   |   |
| 22  | NC            |   | Reserved Pin<br>The N.C. pins between function pins are reserved for compatible and flexible design.   |        |               |               |        |     |   |   |   |     |   |   |   |
| 23  | NC            |   |  |        |               |               |        |     |   |   |   |     |   |   |   |
| 24  | NC            |   |  |        |               |               |        |     |   |   |   |     |   |   |   |
| 25  | NC            |   |  |        |               |               |        |     |   |   |   |     |   |   |   |
| 26  | NC            |   |  |        |               |               |        |     |   |   |   |     |   |   |   |
| 27  | NC            |   |  |        |               |               |        |     |   |   |   |     |   |   |   |
| 28  | NC            |   |  |        |               |               |        |     |   |   |   |     |   |   |   |
| 29  | Vss           | P | Ground of OLED System<br>This is a ground pin. It also acts as a reference for the logic pins, the OLED driving voltages, and the analog circuits. It must be connected to external ground.  |        |               |               |        |     |   |   |   |     |   |   |   |
| 30  | VSL           | 0 | Voltage Output Low Level for SEG Signal<br>This pin is the output pin for the voltage output low level for SEG signals. A capacitor should be connected between this pin and VSS.  |        |               |               |        |     |   |   |   |     |   |   |   |



## OPTICAL CHARACTERISTICS

### CFAL12864QX-G

| Item                                    | Symbol       | Condition | Min    | Typ  | Max  | Unit              |
|---|--------------|-----------|--------|------|------|-------------------|
| View Angle                              | (V) $\theta$ |           | 160    |      |      | deg               |
|   | (H) $\phi$   |           | 160    |      |      | deg               |
| Contrast Ratio                          | CR           | Dark      | 2000:1 |      | —    | —                 |
| Response Time                           | T rise       | —         |        | 10   |      | $\mu$ s           |
|   | T fall       | —         |        | 10   |      | $\mu$ s           |
| Display with 50% check Board Brightness |              |           | 60     | 80   |      | cd/m <sup>2</sup> |
| CIEx(Green)                             |              | (CIE1931) | 0.24   | 0.28 | 0.32 |                   |
| CIEy(Green)                             |              | (CIE1931) | 0.59   | 0.63 | 0.67 |                   |

### CFAL12864QX-Y

| Item                                    | Symbol       | Condition | Min    | Typ  | Max  | Unit              |
|---|--------------|-----------|--------|------|------|-------------------|
| View Angle                              | (V) $\theta$ |           | 160    |      |      | deg               |
|   | (H) $\phi$   |           | 160    |      |      | deg               |
| Contrast Ratio                          | CR           | Dark      | 2000:1 |      | —    | —                 |
| Response Time                           | T rise       | —         |        | 10   |      | $\mu$ s           |
|   | T fall       | —         |        | 10   |      | $\mu$ s           |
| Display with 50% check Board Brightness |              |           | 60     | 80   |      | cd/m <sup>2</sup> |
| CIEx(Yellow)                            |              | (CIE1931) | 0.45   | 0.47 | 0.49 |                   |
| CIEy(Yellow)                            |              | (CIE1931) | 0.48   | 0.50 | 0.52 |                   |



## ABSOLUTE MAXIMUM CHARACTERISTICS

| Parameter                  | Symbol | Min  | Max | Unit | Notes |
|----------------------------|--------|------|-----|------|-------|
| Supply Voltage for Logic   | VDD    | -0.3 | 4   | V    | 1, 2  |
| Supply Voltage for Display | VCC    | 0    | 15  | V    | 1, 2  |
| Operating Temperature      | TOP    | -40  | +80 | °C   | -     |
| Storage Temperature        | TSTG   | -40  | +80 | °C   | -     |

Note 1: All the above voltages are on the basis of "VSS = 0V".

Note 2: When this module is used beyond the above absolute maximum ratings, permanent breakage of the module may occur. Also, for normal operations, it is desirable to use this module under the conditions according to Section 6 "Electrical Characteristics". If this module is used beyond these conditions, malfunctioning of the module can occur and the reliability of the module may deteriorate

## RECOMMENDED DC CHARACTERISTICS

| Item                              | Symbol | Condition | Min                 | Typ | Max                 | Unit |
|-----------------------------------|--------|-----------|---------------------|-----|---------------------|------|
| Supply Voltage for Logic          | VDD    | —         | 2.8                 | 3.0 | 3.3                 | V    |
| Supply Voltage for Display        | VCC    | —         | 10                  | 12  | 15                  | V    |
| High Level Input                  | VIH    | —         | $0.8 \times V_{DD}$ | —   | $V_{DD}$            | V    |
| Low Level Input                   | VIL    | —         | 0                   | —   | $0.2 \times V_{DD}$ | V    |
| High Level Output                 | VOH    | —         | $0.9 \times V_{DD}$ | —   | $V_{DD}$            | V    |
| Low Level Output                  | VOL    | —         | 0                   | —   | $0.1 \times V_{DD}$ | V    |
| 50% Check Board operating Current |        | VCC =12 V | 26                  | 28  | 32                  | mA   |

## ESD (ELECTRO-STATIC DISCHARGE)

The circuitry is industry standard CMOS logic and is susceptible to ESD damage. Please use industry standard antistatic precautions as you would for any other static sensitive devices such as expansion cards, motherboards, or integrated circuits. Ground your body, work surfaces, and equipment.



# PRODUCT RELIABILITY AND LONGEVITY

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## MODULE RELIABILITY

| PART NUMBER  | SPECIFICATION   |
|--|---|
| CFAL12864QX-G and<br>CFAL12864QX-Y   | Brightness will be >50% of a new module's initial brightness for at least 50,000 hours of operation when supply to OLED is below 28 mA. |
| <i>Under operating and storage temperature specification limitations, humidity non-condensing) RH up to 65%, and no exposure to direct sunlight. Value listed above is approximate and represent typical lifetime.</i> |   |

## MODULE LONGEVITY (EOL / REPLACEMENT POLICY)

CrystalFontz is committed to making all of our OLED modules available for as long as possible. Occasionally, a supplier discontinues a component, or a process used to make the module becomes obsolete, or the process moves to a more modern manufacturing line. In order to continue making the module, we will do our best to find an acceptable replacement part or process which will make the “replacement” fit, form, and function compatible with its predecessor.

We recognize that discontinuing a module may cause problems for some customers. However, rapidly changing technologies, component availability, or low customer order levels may force us to discontinue (“End of Life”, EOL) a module. For example, we must occasionally discontinue a module when a supplier discontinues a component or a manufacturing process becomes obsolete. When we discontinue a module, we will do our best to find an acceptable replacement module with the same fit, form, and function.

In most situations, you will not notice a difference when comparing a “fit, form, and function” replacement module to the discontinued module it replaces. However, sometimes a change in component or process for the replacement module results in a slight variation, perhaps an improvement, over the previous design.

Although the replacement module is still within the stated Datasheet specifications and tolerances of the discontinued module, changes may require modification to your circuit and/or firmware. Possible changes include:

- *Controller.* A new controller may require minor changes in your code.
- *Component tolerances.* Module components have manufacturing tolerances. In extreme cases, the tolerance stack can change the visual or operating characteristics.

Please understand that we avoid changing a module whenever possible; we only discontinue a module if we have no other option. We publish Part Change Notices (PCN) as soon as possible.

## CARE AND HANDLING PRECAUTIONS

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For optimum operation of the module and to prolong its life, please follow the precautions below. Excessive voltage will shorten the life of the module. You must drive the display within the specified voltage limit. See *Absolute Maximum Ratings* in [ABSOLUTE MAXIMUM CHARACTERISTICS \(Pg. 11\)](#).



## HANDLING CAUTION FOR MODULES SHIPPED IN TRAYS

If you receive modules packed in trays, handle trays carefully by supporting the entire tray. Trays were made to immobilize the modules inside their packing carton. Trays are not designed to be rigid. Do not carry trays by their edges; trays and modules may be damaged.

## ESD (ELECTRO-STATIC DISCHARGE)

The circuitry is industry standard CMOS logic and susceptible to ESD damage. Please use industry standard antistatic precautions as you would for any other static sensitive devices such as expansion cards, motherboards, or integrated circuits. Ground your body, work surfaces, and equipment.

## DESIGN AND MOUNTING

- The exposed surface of the “glass” is actually a polarizer laminated on top of the glass. To protect the soft plastic polarizer from damage, the module ships with a protective film over the polarizer. Please peel off the protective film slowly. Peeling off the protective film abruptly may generate static electricity.
- The polarizer is made out of soft plastic and is easily scratched or damaged. When handling the module, avoid touching the polarizer. Finger oils are difficult to remove.
- To protect the soft plastic polarizer from damage, place a transparent plate (for example, acrylic, polycarbonate, or glass) in front of the module, leaving a small gap between the plate and the display surface. We use HP-92 Lexan, which is readily available and works well.
- Do not disassemble or modify the module.
- The display can be mounted vertically onto a front panel using a variety of methods. If the enclosure is plastic, it can be molded to have the display snap into place. A metal enclosure can use a milled faceplate with mounting tabs to secure the module. Adhesives can be used, as long as they are not similar to “super-glue” because these emit vapors that can damage the display over time.
- Use care to keep the exposed terminals clean. Contamination, including fingerprints, may make soldering difficult and the reliability of the soldered connection poor.
- Do not reverse polarity to the power supply connections. Reversing polarity will immediately ruin the module.
- Sharp bends can damage the panel. Do not crease the cables. Do not bend the cables tightly against the edge of the module. Do not repeatedly bend the cable beyond its elastic region. Limit bend radius to at least R5.00 mm.

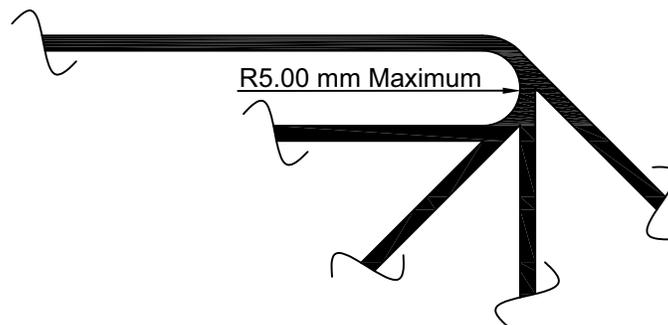


Figure 1. Limit Bend Radius Of FPC And FFC Cables

- Do not repeatedly bend the FFC/FPC beyond its elastic region.

## AVOID SHOCK, IMPACT, TORQUE, OR TENSION

- Do not expose the module to strong mechanical shock, impact, torque, or tension.
- Do not drop, toss, bend, or twist the module.



- Do not place weight or pressure on the module.

## CAUTION

All electronics may contain harmful substances. Avoid contamination by using care to avoid damage during handling. If any residues, gases, powders, liquids, or broken fragments come in contact with your skin, eyes, mouth, or lungs, immediately contact your local poison control or emergency medical center.

## HOW TO CLEAN

1. Turn display off.
2. Use the removable protective film to remove smudges (for example, fingerprints) and any foreign matter. If you no longer have the protective film, use standard transparent office tape (for example, Scotch® brand “Crystal Clear Tape”).
3. If the polarizer is dusty, you may carefully blow it off with clean, dry, oil-free compressed air.
4. If you must clean with a liquid, never use glass cleaners, as they may contain ammonia or alcohol that will damage the polarizer over time. Never apply liquids directly on the polarizer. Long contact with moisture may permanently spot or stain the polarizer. Use filtered water to slightly moisten a clean lint-free microfiber cloth designed for cleaning optics. (For example, use a cloth sold for cleaning plastic eyeglasses.)
5. The plastic is easily scratched or damaged. Use a light touch as you clean the polarizer. Wipe gently.
6. Use a dry microfiber cloth to remove any trace of moisture before turning on the display module.
7. Gently wash the microfiber cloths in warm, soapy water and air dry before reuse.

## OPERATION

- We do not recommend connecting this module to a PC's parallel port as an “end product.” This module is not “user friendly” and connecting it to a PC's parallel port is often difficult, frustrating, and can result in a “dead” display due to mishandling. For more information, see our forum thread at <http://www.crystalfontz.com/forum/showthread.php?s=&threadid=3257>.
- Your circuit should be designed to protect the module from ESD and power supply transients.
- Observe the operating temperature limitations: a minimum of  $-40^{\circ}\text{C}$  to a maximum of  $+80^{\circ}\text{C}$  non-condensing with minimal fluctuation. Operation outside of these limits may shorten life and/or harm display. Changes in temperature can result in changes in contrast.
  - At lower temperatures of this range, response time is delayed.
  - At higher temperatures of this range, display becomes dark. (You may need to adjust the contrast.)
- Operate away from dust, moisture, and direct sunlight.

## STORAGE AND RECYCLING

- Store in an ESD-approved container away from dust, moisture, and direct sunlight, fluorescent lamps, or any ultraviolet ray with humidity less than 90% non-condensing.
- Observe the storage temperature limitations: from  $-40^{\circ}\text{C}$  minimum to  $+80^{\circ}\text{C}$  maximum with minimal fluctuations. Rapid temperature changes can cause moisture to form, resulting in permanent damage.
- Do not allow weight to be placed on the modules while they are in storage.
- Please recycle your outdated modules at an approved facility.



## APPENDIX A: QUALITY ASSURANCE STANDARDS

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### INSPECTION CONDITIONS

- Environment
  - Temperature: 25±5°C
  - Humidity: 30~85% RH (non-condensing)
- For visual inspection of active display area
  - Source lighting: two 20-Watt or one 40-Watt fluorescent light
  - Display adjusted for best contrast
  - Viewing distance: 30±5 cm (about 12 inches)
  - Viewing angle: inspect at 45° angle of vertical line right and left, top and bottom

### COLOR DEFINITIONS

We try to describe the appearance of our display modules as accurately as possible. For the photos, we adjust the backlight (if any) and contrast for optimal appearance. Actual display appearance may vary due to (1) different operating conditions, (2) small variations of component tolerances, (3) inaccuracies of our camera, (4) color interpretation of the photos on your monitor, and/or (5) personal differences in the perception of color.

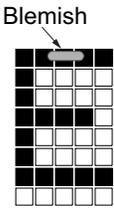
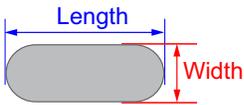
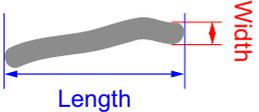
### DEFECTS CLASSIFICATION

Defects are defined as:

- Major Defect: results in failure or substantially reduces usability of unit for its intended purpose
- Minor Defect: deviates from standards but is not likely to reduce usability for its intended purpose



## ACCEPTANCE STANDARDS

| # | DEFECT TYPE   | ACCEPTANCE STANDARDS CRITERIA   |                                       |                       | MAJOR / MINOR         |       |
|---|---|---|---------------------------------------|-----------------------|-----------------------|-------|
| 1 | Electrical defects                                      | 1. No display, display malfunctions, or shorted segments.<br>2. Current consumption exceeds specifications.                 |                                       |                       | Major                 |       |
| 2 | Viewing area defect                                     | Viewing area does not meet specifications.  |                                       |                       | Major                 |       |
| 3 | Contrast adjustment defect                              | Contrast adjustment fails or malfunctions.  |                                       |                       | Major                 |       |
| 4 | Blemishes or foreign matter on display segments         |    | <i>Defect Size</i>                    | <i>Acceptable Qty</i> | Minor                 |       |
|   |   |   | ≤0.30 mm                              | 3                     |                       |       |
|   |   |   | ≤2 defects within 10 mm of each other |                       |                       |       |
| 5 | Blemishes or foreign matter outside of display segments | Defect Size = (Width + Length)/2<br><br> | <i>Defect Size</i>                    | <i>Acceptable Qty</i> | Minor                 |       |
|   |   |   | ≤0.15 mm                              | Ignore                |                       |       |
|   |   |   | 0.15 to 0.20 mm                       | 3                     |                       |       |
|   |   |   | 0.20 to 0.25 mm                       | 2                     |                       |       |
|   |   |   | > 0.30 mm                             | 1                     |                       |       |
| 6 | Dark lines or scratches in display area                 |    | <i>Defect Width</i>                   | <i>Defect Length</i>  | <i>Acceptable Qty</i> | Minor |
|   |   |   | ≤0.03 mm                              | ≤3.0 mm               | 3                     |       |
|   |   |   | 0.03 to 0.05                          | ≤2.0 mm               | 2                     |       |
|   |   |   | 0.05 to 0.08                          | ≤2.0 mm               | 1                     |       |
|   |   |   | 0.08 to 0.10                          | ≤3.0 mm               | 0                     |       |
|   |   |   | ≥0.10                                 | >3.0 mm               | 0                     |       |
| 7 | Bubbles between polarizer film and glass                |   | <i>Defect Size</i>                    | <i>Acceptable Qty</i> | Minor                 |       |
|   |   |   | ≤0.20 mm                              | Ignore                |                       |       |
|   |   |   | 0.20 to 0.40 mm                       | 3                     |                       |       |
|   |   |   | 0.40 to 0.60 mm                       | 2                     |                       |       |
|   |   |   | ≥0.60 mm                              | 0                     |                       |       |



| #                        | DEFECT TYPE                     | ACCEPTANCE STANDARDS CRITERIA (Continued)  | MAJOR / MINOR |   |                |                          |   |            |                          |                          |
|--------------------------|---------------------------------|--|---------------|---|----------------|--------------------------|---|------------|--------------------------|--------------------------|
| 8                        | Display pattern defect          |  | Minor         |   |                |                          |   |            |                          |                          |
|                          |                                 | <table border="1"> <thead> <tr> <th>Dot Size</th> <th>Acceptable Qty</th> </tr> </thead> <tbody> <tr> <td><math>((A+B)/2) \leq 0.20</math> mm</td> <td rowspan="5"> <math>\leq 3</math> total defects<br/> <math>\leq 2</math> pinholes per digit                 </td> </tr> <tr> <td><math>C &gt; 0</math> mm</td> </tr> <tr> <td><math>((D+E)/2) \leq 0.25</math> mm</td> </tr> <tr> <td><math>((F+G)/2) \leq 0.25</math> mm</td> </tr> </tbody> </table> |               | Dot Size  | Acceptable Qty | $((A+B)/2) \leq 0.20$ mm | $\leq 3$ total defects<br>$\leq 2$ pinholes per digit | $C > 0$ mm | $((D+E)/2) \leq 0.25$ mm | $((F+G)/2) \leq 0.25$ mm |
|                          |                                 | Dot Size   |               | Acceptable Qty  |                |                          |   |            |                          |                          |
|                          |                                 | $((A+B)/2) \leq 0.20$ mm   |               | $\leq 3$ total defects<br>$\leq 2$ pinholes per digit |                |                          |   |            |                          |                          |
|                          |                                 | $C > 0$ mm   |               |   |                |                          |   |            |                          |                          |
| $((D+E)/2) \leq 0.25$ mm |                                 |  |               |   |                |                          |   |            |                          |                          |
| $((F+G)/2) \leq 0.25$ mm |                                 |  |               |   |                |                          |   |            |                          |                          |
|                          |                                 |  |               |   |                |                          |   |            |                          |                          |
|                          |                                 |  |               |   |                |                          |   |            |                          |                          |
|                          |                                 |  |               |   |                |                          |   |            |                          |                          |
| 9                        | Backlight defects               | <ol style="list-style-type: none"> <li>1. Light fails or flickers.*</li> <li>2. Color and luminance do not correspond to specifications.*</li> <li>3. Exceeds standards for display's blemishes, foreign matter, dark lines or scratches.</li> </ol> <p>*Minor if display functions correctly. Major if the display fails.</p>   | Minor         |   |                |                          |   |            |                          |                          |
| 10                       | PCB defects (if module has PCB) | <ol style="list-style-type: none"> <li>1. Oxidation or contamination on connectors.*</li> <li>2. Wrong parts, missing parts, or parts not in specification.*</li> <li>3. Jumpers set incorrectly.</li> <li>4. Solder (if any) on bezel, LED (if module has LEDs) pad, zebra pad, or screw hole pad is not smooth.</li> </ol> <p>*Minor if display functions correctly. Major if the display fails.</p>   | Minor         |   |                |                          |   |            |                          |                          |
| 11                       | Soldering defects               | <ol style="list-style-type: none"> <li>1. Unmelted solder paste.</li> <li>2. Cold solder joints, missing solder connections, or oxidation.*</li> <li>3. Solder bridges causing short circuits.*</li> <li>4. Solder balls.</li> </ol> <p>*Minor if display functions correctly. Major if the display fails.</p>   | Minor         |   |                |                          |   |            |                          |                          |