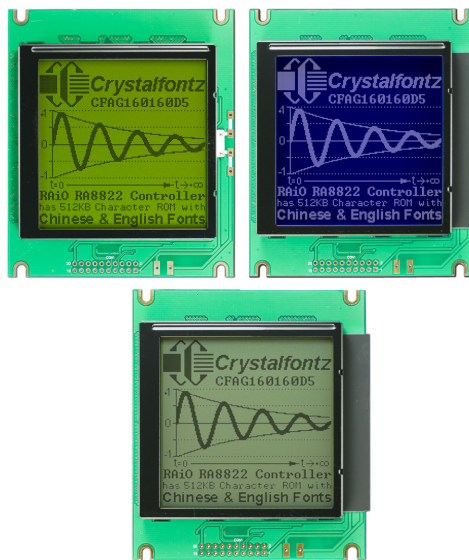




## DISPLAY MODULE DATASHEET



Datasheet Release 2016-02-29  
for  
[CFAG160160D5 Series](#)

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## GENERAL INFORMATION

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### Datasheet Revision History

Datasheet Release: 2016-02-29  
First datasheet for the new CFAG160160D5 series: CFAG160160D5-TFH-VGB, CFAG160160D5-TMI-VGB, and CFAG160160D5-YYH-VGB.

### Product Change Notifications

To check for Product Change Notifications for the CFAG160160D5 series, see the Product Notices tab on its web page:  
<https://www.crystalfontz.com/product/CFAG160160D5#pcn>

Product pages without a Product Notices tab do not have Product Change Notifications.

### About Variations

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

### About Volatility

This display module has volatile memory.



### The Fine Print

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All specifications in Datasheets and on our website are, to the best of our knowledge, accurate but not guaranteed. Corrections to specifications are made as any inaccuracies are discovered.

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
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## DISPLAY MODULE DESCRIPTION

### VARIANTS IN THE CFAG160160D5 SERIES

The three variants in the CFAG160160D5 Series are:

COLOR	PART NUMBER	DESCRIPTION	LEDS	Sunlight Readable
	CFAG160160D5-TFH-VGB	Dark on light gray background.	White	Yes
	CFAG160160D5-TMI-VGB	White on blue background.	White	No
	CFAG160160D5-YYH-VGB	Dark on yellow-green background.	Yellow-Green	Yes

### GENERAL SPECIFICATIONS

#### CFAG160160D5-TFH-VGB

Item	Dimension	Unit
Number of dots	160 x 160	—
Module dimension	86.5 x 100.0 x 14.5	mm
View area	62.0 x 62.0	mm
Active area	60.78 x 60.78	mm
Dot size	0.36 x 0.36	mm
Dot pitch	0.38 x 0.38	mm
LCD type	FSTN Positive Transflective	
Duty	1/160	
View direction	6 o'clock	
Backlight Type	LED, White	
IC	RA8822	



### CFAG160160D5-TMI-VGB

Item	Dimension	Unit
Number of dots	160 x 160	—
Module dimension	86.5 x 100.0 x 14.5	mm
View area	62.0 x 62.0	mm
Active area	60.78 x 60.78	mm
Dot size	0.36 x 0.36	mm
Dot pitch	0.38 x 0.38	mm
LCD type	STN Negative, Blue Transmissive	
Duty	1/160	
View direction	6 o'clock	
Backlight Type	LED, White	
IC	RA8822	

### CFAG160160D5-YYH-VGB

Item	Dimension	Unit
Number of dots	160 x 160	—
Module dimension	85.0 x 100.0 x 14.5	mm
View area	62.0 x 62.0	mm
Active area	60.78 x 60.78	mm
Dot size	0.36 x 0.36	mm
Dot pitch	0.38 x 0.38	mm
LCD type	STN Positive Transflective Yellow-Green	
Duty	1/160	
View direction	6 o'clock	
Backlight Type	LED, YellowGreen	
IC	RA8822	

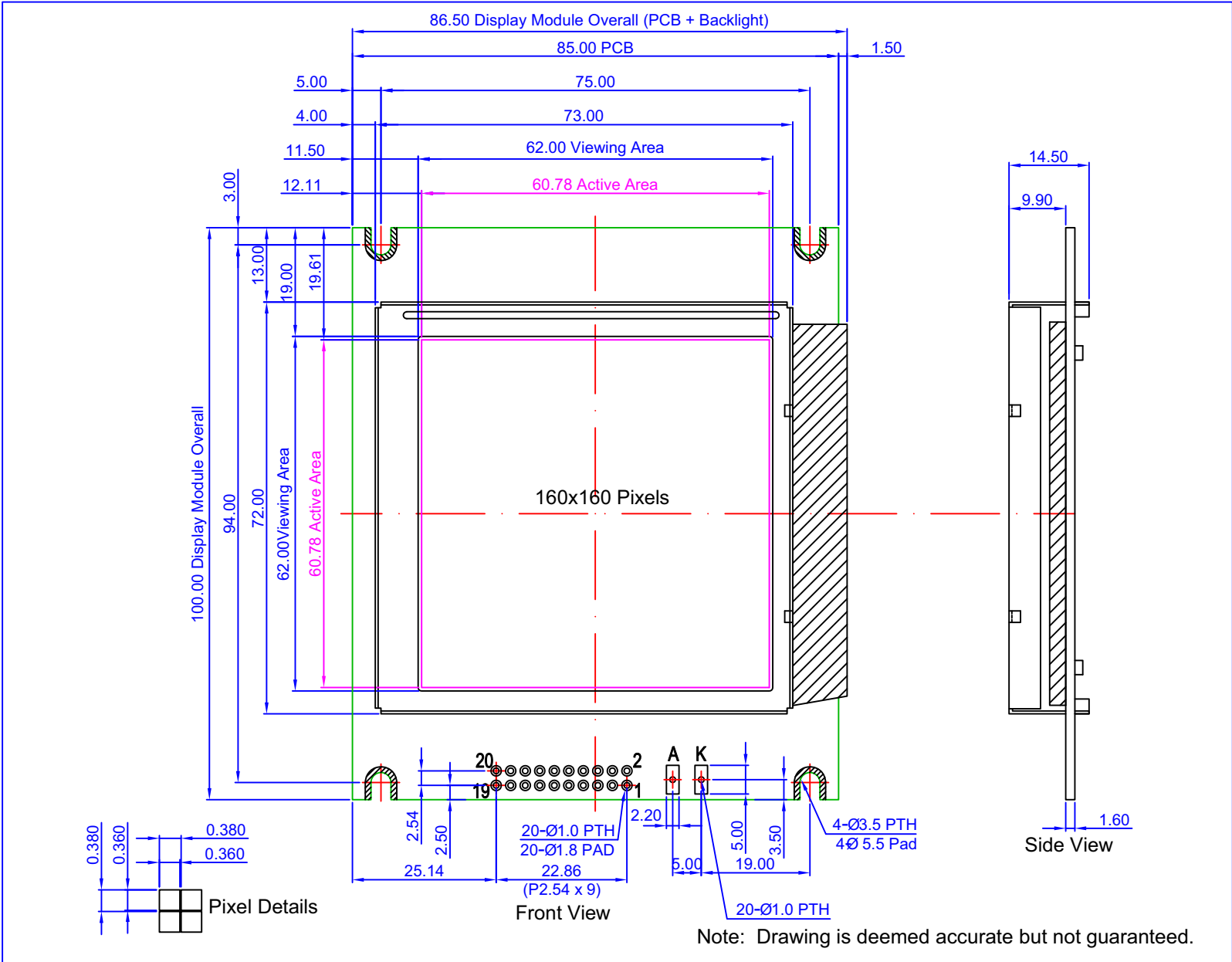


## **ADDITIONAL FEATURES**

- Interface choices are 4-bit and 8-bit parallel.
- This series supports English and Chinese (BIG5 and GB) characters.
- This series has a built-in negative voltage generator, eliminating the need to set up a second, negative power from the host.
- For additional communication information, see the [RAiO RA8803/8822](#) LCD controller specifications on our website.
- These displays are RoHS compliant.
- CrystalFontz America Incorporated is ISO 9001:2008 certified.



# DISPLAY MODULE OUTLINE DRAWINGS



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

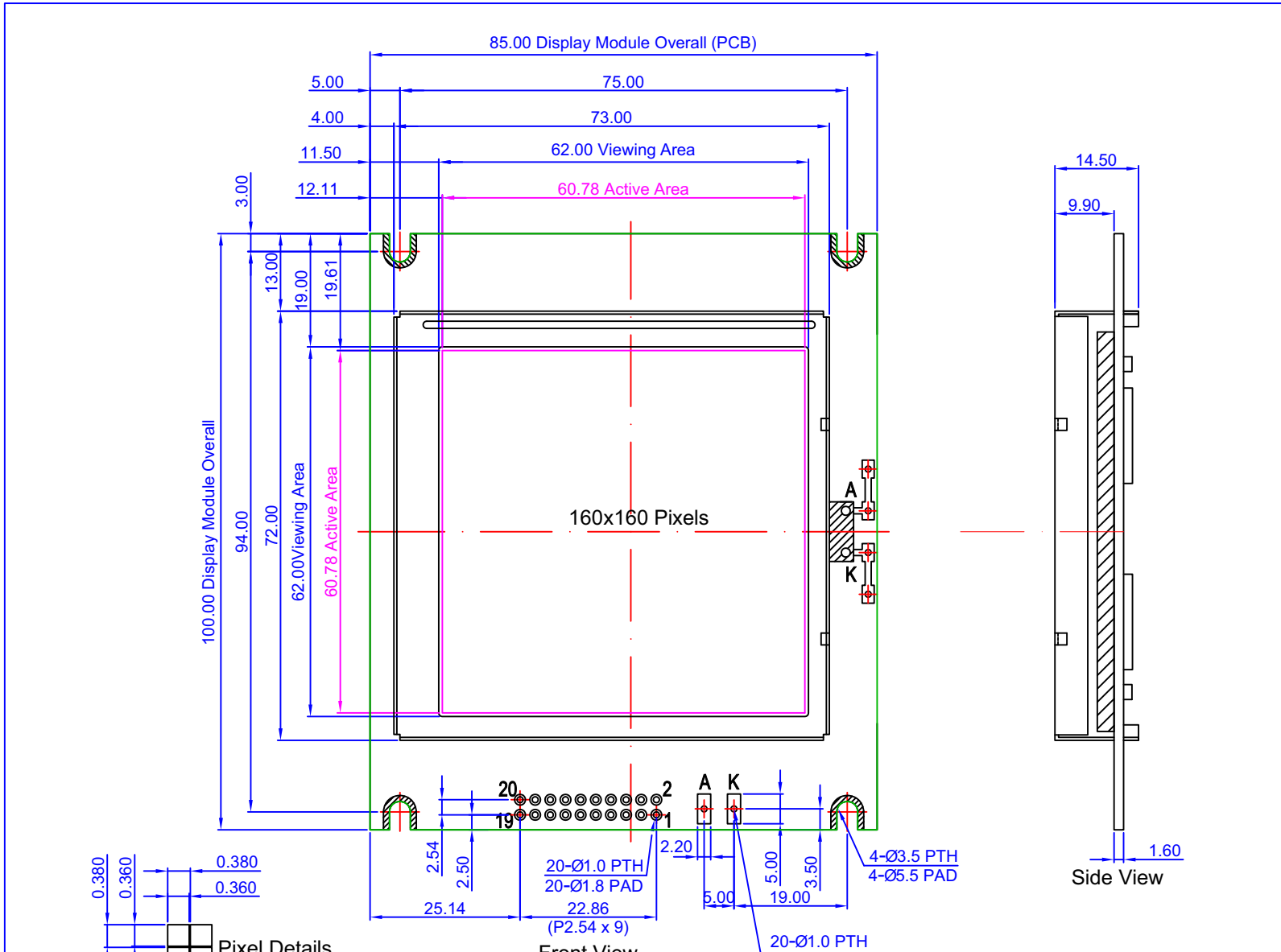
Part No.(s):  
CFAG160160D5-TFH  
CFAG160160D5-TMI

Scale:  
Not to scale  
Units:  
Millimeters

Drawing Number:  
CFAG160160D5  
Date:  
2016-02-02

Hardware Rev.:  
Sheet:  
1 of 2



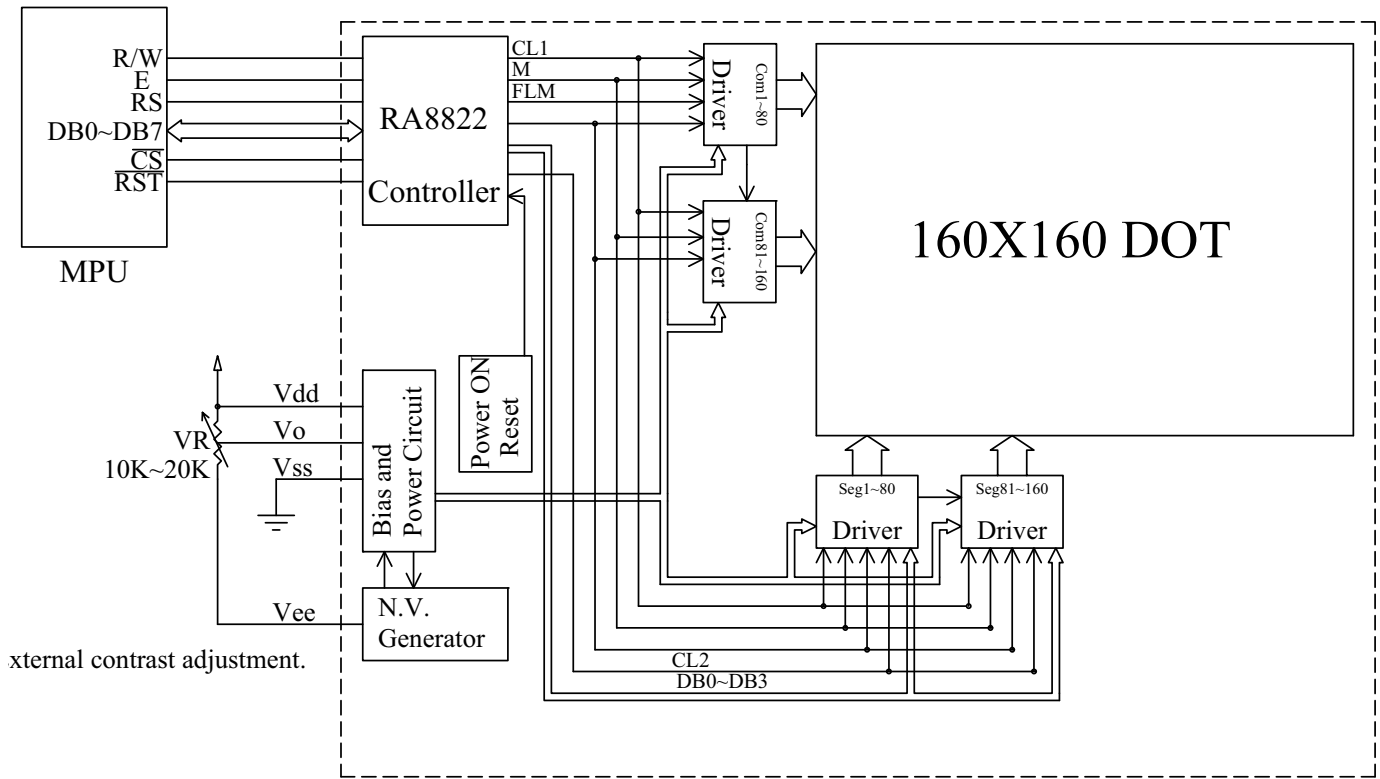


Note: Drawing is deemed accurate but not guaranteed.





## SYSTEM BLOCK DIAGRAM



\*:6800 family or 8080 interface selectable.



## ELECTRICAL CHARACTERISTICS

---

### ABSOLUTE MAXIMUM RATINGS

The display modules use LED backlights. LED backlights are easy to use, but they are also easily damaged.

Item	Symbol	Min	Typ	Max	Unit
Operating Temperature	$T_{OP}$	-20	—	+70	°C
Storage Temperature	$T_{ST}$	-30	—	+80	°C
Input Voltage	$V_{IN}$	-0.3	—	$V_{DD}+0.3$	V
Supply Voltage For Logic	$V_{DD}-V_{SS}$	-0.3	—	+6.5	V

#### CAUTION

Ensure that you have proper current and voltage control for your backlight before connecting the backlight circuit.

These are stress ratings only. Functional operation of the display module at these or any other conditions beyond those listed under Recommended DC Characteristics below is not implied. Stresses beyond those listed above can cause permanent damage.

Prolonged exposure at temperatures outside of the operating range may cause permanent damage to the display module.



## RECOMMENDED DC CHARACTERISTICS

Item	Symbol	Condition	Min	Typ	Max	Unit
Supply Voltage For Logic	$V_{DD}-V_{SS}$	—	4.75	5.0	5.25	V
Supply Voltage For LCM	$V_{DD}-V_0$	Ta=-20°C	—	—	21.0	V
*Note		Ta=25°C	17.5	18.0	18.5	V
		Ta=70°C	15.4	—	—	V
Input High Volt.	$V_{IH}$	—	$0.8 V_{DD}$	—	$V_{DD}$	V
Input Low Volt.	$V_{IL}$	—	$V_{SS}$	—	$0.2 V_{DD}$	V
Output High Volt.	$V_{OH}$	—	$0.8 V_{DD}$	—	$V_{DD}$	V
Output Low Volt.	$V_{OL}$	—	$V_{SS}$	—	$0.2 V_{DD}$	V
Supply Current	$I_{DD}$	$V_{DD}=5.0V$	—	116.0	—	mA

\*Note: Please design the VOP adjustment circuit on customer's main board

## ESD (ELECTRO-STATIC DISCHARGE)

The circuitry is industry standard CMOS logic and is susceptible to ESD damage. Please use industry standard anti-static 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.

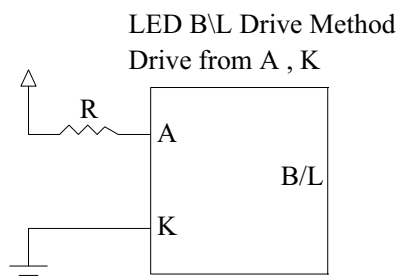
## LED BACKLIGHT CHARACTERISTICS

The CFAG160160D5-TFH-VGB and CFAG160160D5-TMI-VGB have white LED backlights. The CFAG160160D5-YYH-VGB has a yellow-green LED backlight.

### NOTE

For the CFAG160160D5-TFH-VGB and CFAG160160D5-TMI-VGB displays, we recommend that the white LED backlights be dimmed or turned off during periods of inactivity to conserve their lifetime.

Backlight Circuit:





**CFAG160160D5-TFH-VGB And CFAG160160D5-TMI-VGB**

PARAMETER	SYMBOL	MIN	TYP	MAX	UNIT	TEST CONDITION
Supply Current	I <sub>LED</sub>	—	96	120	mA	V=3.5V
Supply Voltage	V	3.4	3.5	3.6	V	—
Reverse Voltage	V <sub>R</sub>	—	—	5	V	—
Color	White					

**Note: The LED of B/L is drive by current only, drive voltage is for reference only. drive voltage can make driving current under safety area (current between minimum and maximum).**

**CFAG160160D5-YYH-VGB**

PARAMETER	SYMBOL	MIN	TYP	MAX	UNIT	TEST CONDITION
Supply Current	I <sub>LED</sub>	810	900	1080	mA	V=4.2V
Supply Voltage	V	4.0	4.2	4.4	V	—
Reverse Voltage	V <sub>R</sub>	—	—	5	V	—
Color	YellowGreen					

**Note: The LED of B/L is drive by current only, drive voltage is for reference only. drive voltage can make driving current under safety area (current between minimum and maximum).**



## OPTICAL CHARACTERISTICS

### OPTICAL CHARACTERISTICS

Changes in voltage can result in changes in contrast.

#### CFAG160160D5-TFH-VGB

Item	Symbol	Condition	Min	Typ	Max	Unit
View Angle	$\theta$	$CR \geq 2$	0	—	30	$\psi = 180^\circ$
	$\theta$	$CR \geq 2$	0	—	60	$\psi = 0^\circ$
	$\theta$	$CR \geq 2$	0	—	45	$\psi = 90^\circ$
	$\theta$	$CR \geq 2$	0	—	45	$\psi = 270^\circ$
Contrast Ratio	CR	—	—	5	—	—
Response Time	T rise	—	—	200	300	ms
	T fall	—	—	250	350	ms

#### CFAG160160D5-TMI-VGB And CFAG160160D5-YYH-VGB

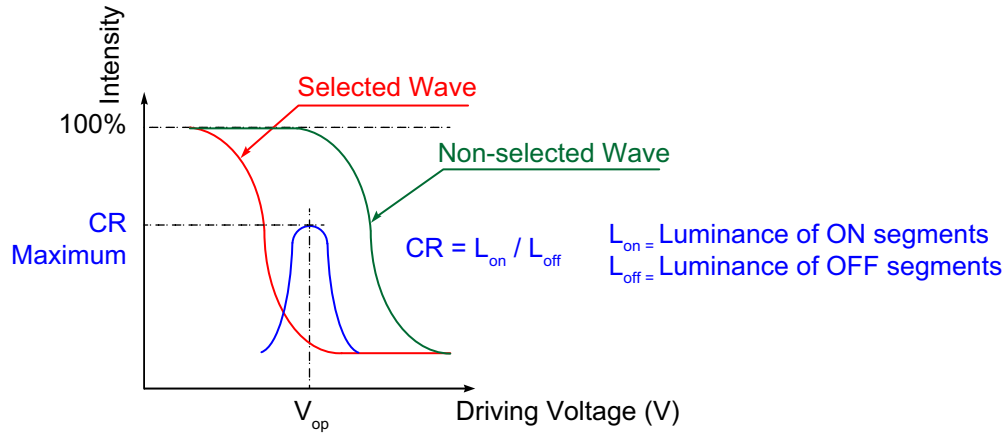
Item	Symbol	Condition	Min	Typ	Max	Unit
View Angle	$\theta$	$CR \geq 2$	0	—	20	$\psi = 180^\circ$
	$\theta$	$CR \geq 2$	0	—	40	$\psi = 0^\circ$
	$\theta$	$CR \geq 2$	0	—	30	$\psi = 90^\circ$
	$\theta$	$CR \geq 2$	0	—	30	$\psi = 270^\circ$
Contrast Ratio	CR	—	—	3	—	—
Response Time	T rise	—	—	150	200	ms
	T fall	—	—	150	200	ms



## DEFINITION OF OPERATION VOLTAGE

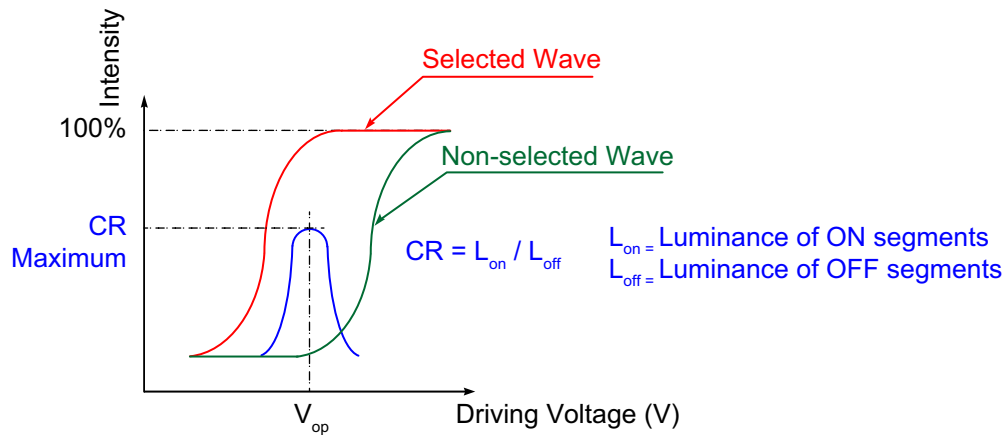
### CFAG160160D5-TFH-VGB And CFAG160160D5-YYH-VGB

Positive operation voltage:



### CFAG160160D5-TMI-VGB

Negative operation voltage:

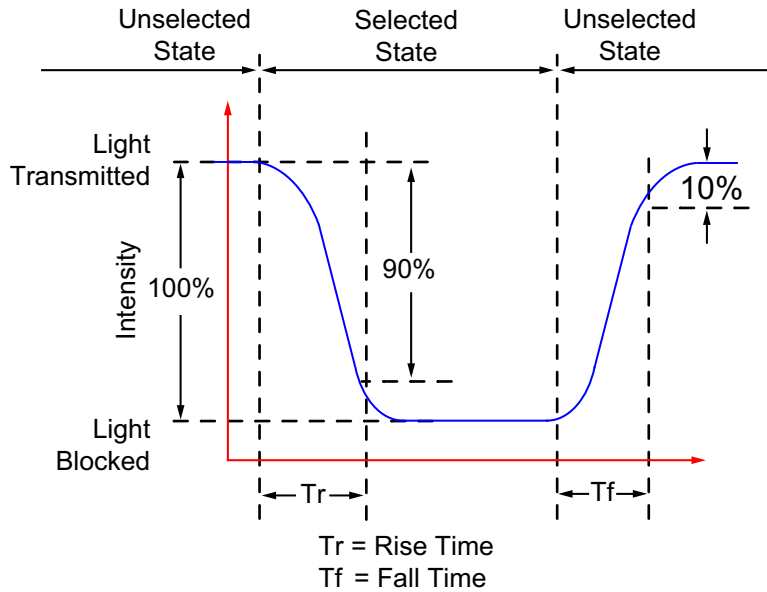




## DEFINITION OF RESPONSE TIME (TR OR TF)

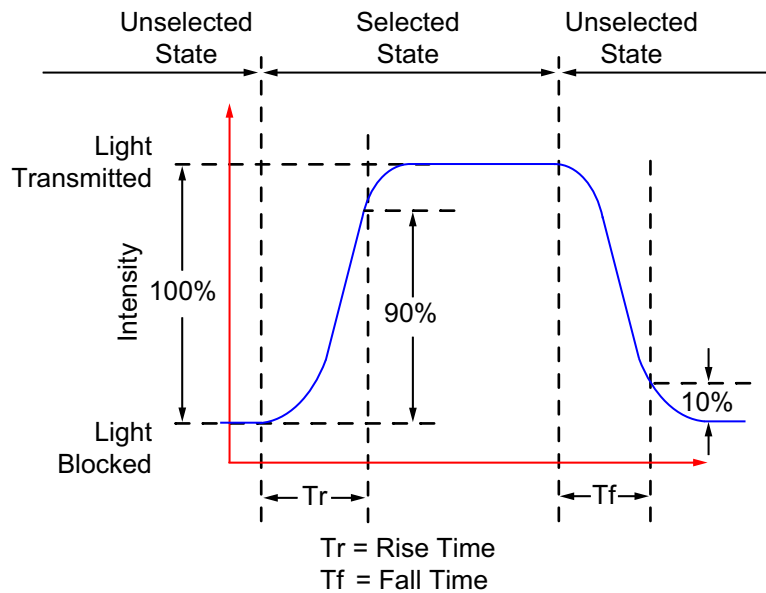
### CFAG160160D5-TFH-VGB And CFAG160160D5-YYH-VGB

Positive response time:



### CFAG160160D5-TMI-VGB

Negative response time:



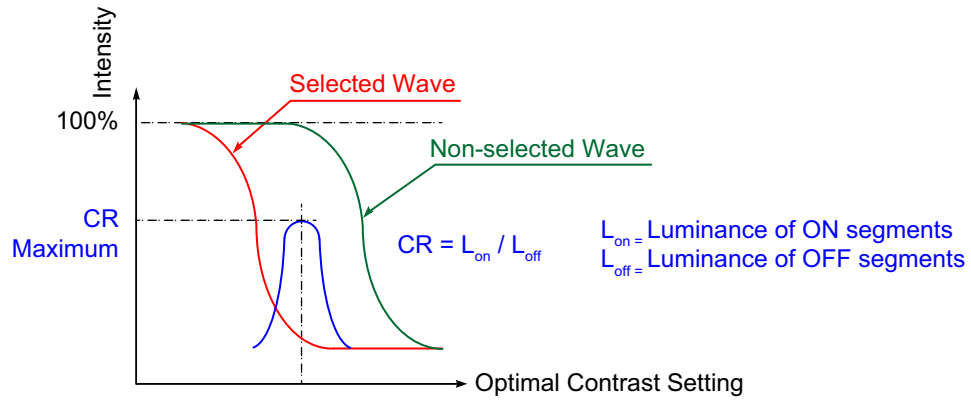




## DEFINITION OF OPTIMAL CONTRAST SETTING

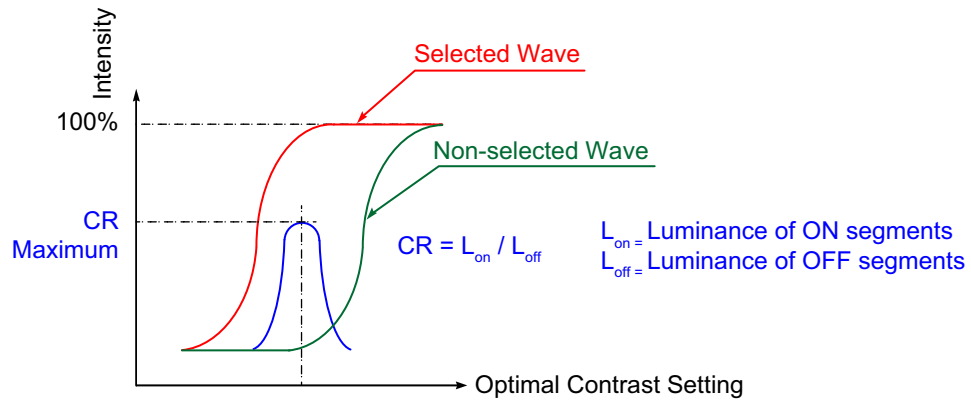
### CFAG160160D5-TFH-VGB And CFAG160160D5-YYH-VGB

Positive optimal contrast setting:



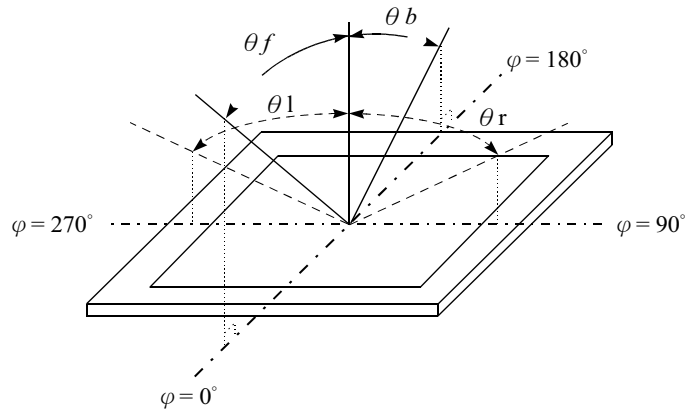
### CFAG160160D5-TMI-VGB

Negative optimal contrast setting:



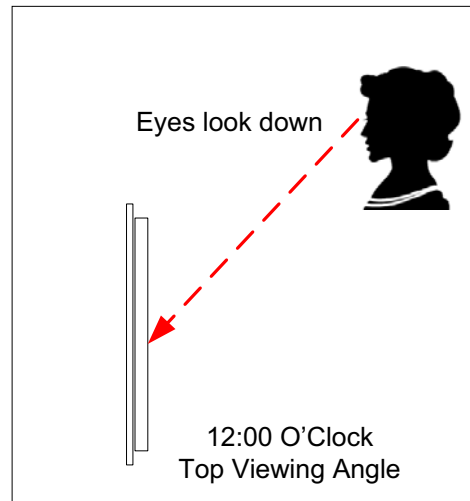
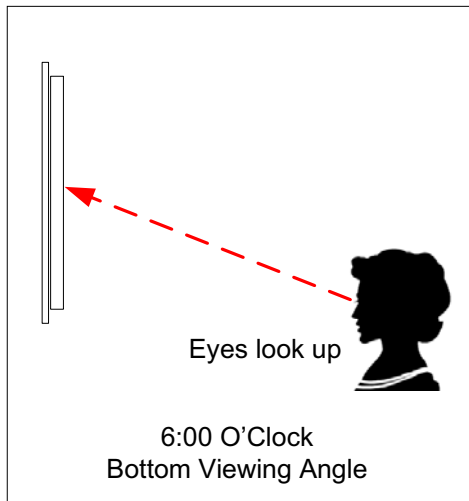


## DEFINITION VIEWING ANGLES (CR<sub>≥2</sub>)



## DEFINITION OF 6 O'CLOCK AND 12:00 O'CLOCK VIEWING ANGLES

This CFAG160160D5 Series has a 6:00 o'clock viewing angle





## DETAILS OF INTERFACE PIN FUNCTIONS

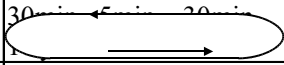
Pin No.	Symbol	Level	Description
1	FGND	—	Frame Ground
2	V <sub>SS</sub>	—	Power supply (GND)
3	V <sub>DD</sub>	—	Power supply (+5V)
4	Vo	—	Contrast Adjustment
5	R/W	H / L	Write/Read-Write When MPU I/F is 8080 series, this pin (WR#) is used as data write, active low. When MPU I/F is 6800 series, this pin(R/W#) is used as data read/write control. Active high for read and active low for write.
6	E	H / L	Enable/Read Enable When MPU I/F is 8080 series, this pin (RD#) is used as data read, active low. When MPU I/F is 6800 series, this pin (EN) is used as Enable, active high.
7	/CS	L	Chip select
8	RS	H / L	Register/Memory Select The MPU will access Register when RS is Low and access Data Memory when RS is High. Usually connect to MPU address bus A0.
9	BUSY	—	Busy Signal This is a busy output to indicate the RA8822 is in busy state. It could be setup active high or low. If setup active high, the RA 8822 can't be access when BUSY pin is high. It's should be connected to MPU I/O input. The MPU have to poll this pin before accessing RA8822
10	/RST	L	Reset signal
11	DB0	H / L	Data Bus These are data bus for data transfer between MPU and 8822. The high nibble DB[7..4] should be connect High when 4-bit data bus mode is used.
12	DB1	H / L	
13	DB2	H / L	
14	DB3	H / L	
15	DB4	H / L	
16	DB5	H / L	
17	DB6	H / L	
18	DB7	H / L	
19	NC	—	No connection
20	V <sub>ee</sub>	—	Negative voltage output



# PRODUCT RELIABILITY AND LONGEVITY

## DISPLAY MODULE RELIABILITY TEST RESULTS

Content of Reliability Test (Wide temperature, -20°C~70°C)

Environmental Test			
Test Item	Content of Test	Test Condition	Note
High Temperature storage	Endurance test applying the high storage temperature for a long time.	80°C 200hrs	2
Low Temperature storage	Endurance test applying the low storage temperature for a long time.	-30°C 200hrs	1,2
High Temperature Operation	Endurance test applying the electric stress (Voltage & Current) and the thermal stress to the element for a long time.	70°C 200hrs	—
Low Temperature Operation	Endurance test applying the electric stress under low temperature for a long time.	-20°C 200hrs	1
High Temperature/Humidity storage	The module should be allowed to stand at 60°C,90%RH max For 96hrs under no-load condition excluding the polarizer, Then taking it out and drying it at normal temperature.	60°C,90%RH 96hrs	1,2
Thermal shock resistance	The sample should be allowed stand the following 10 cycles of operation -20°C 25°C 70°C 	-20°C/70°C 10 cycles	—
Vibration test	Endurance test applying the vibration during transportation and using.	Total fixed amplitude : 1.5mm Vibration Frequency : 10~55Hz One cycle 60 seconds to 3 directions of X,Y,Z for Each 15 minutes	3
Static electricity test	Endurance test applying the electric stress to the terminal.	VS=800V,RS=1.5kΩ CS=100pF 1 time	—

**Note1: No dew condensation to be observed.**

**Note2: The function test shall be conducted after 4 hours storage at the normal Temperature and humidity after remove from the test chamber.**

**Note3: The packing have to including into the vibration testing.**



## DISPLAY MODULE RELIABILITY

Note on display modules with white LEDs: We list the lifetime of white LEDs at 50,000 hours to emphasize that white LEDs do not have the extremely long lifetime typical of red, yellow-green, or blue LEDs. The white LEDs dim over time, especially if driven with high currents. The dimming may not be noticeable when a single display is installed. However, if a new display is installed next to a display that has been on continuously for a very long time, you will see the difference. To preserve the lifetime of white LEDs, we recommend that white LED backlights are dimmed or turned off when not needed. Also, please do not use more current than you need to achieve your brightness requirements.

CFAG160160D5 Series	SPECIFICATION	
All LCDs in series, <i>excluding</i> backlight	50,000 to 100,000 hours (typical)	
CFAG160160D5-YYH-VGB including yellow-green LED backlight (ILED $\leq$ 900 mA)	50,000 to 100,000 hours (typical)	
CFAG160160D5-TFH-VGB and CFAG160160D5-TMI-VGB, including white LED Backlight (ILED $\leq$ 96 mA)* *We recommend that the backlight of the white LED backlit modules be dimmed or turned off during periods of inactivity to conserve the white LED backlight lifetime.	Power-On Hours	% of Initial Brightness (New Module)
	<10,000	>90%
	<50,000	>50%
Under operating and storage temperature specification limitations, humidity (non-condensing) RH up to 65%, and no exposure to direct sunlight.		

## DISPLAY MODULE LONGEVITY (EOL / REPLACEMENT POLICY)

CrystalFontz is committed to making all of our display 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 display 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 display 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 display 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:

- *LCD fluid, polarizers, or the LCD manufacturing process.* These items may change the appearance of the display, requiring an adjustment to  $V_O$ .
- *Backlight LEDs.* Brightness may be affected (perhaps the new LEDs have better efficiency) or the current they draw may change (new LEDs may have a different VF).
- *Controller.* A new controller may require minor changes in your code.
- *Component tolerances.* Display 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 display 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

---

For optimum operation of the display module and to prolong its life, please follow the precautions below.

Excessive voltage will shorten the life of the display module. You must drive the display module within the specified voltage limit. See [Absolute Maximum Ratings \(Pg. 11\)](#).

### HANDLING CAUTION FOR DISPLAY MODULES SHIPPED IN TRAYS

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

### ESD (ELECTRO-STATIC DISCHARGE)

The circuitry is industry standard CMOS logic and is susceptible to ESD damage. Please use industry standard anti-static 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 controller/driver maintains its internal operating modes until something happens to change it. Excessive external noise can change these internal modes. In your packaging and system design, suppress or prevent the noise from influencing the controller. Also, refresh the operating modes periodically to prevent the effects of unanticipated noise.
- 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 display 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 display 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 display module, leaving a small gap between the plate and the display surface. We use Lexan, which is readily available and works well.
- Do not disassemble or modify the display module.
- Do not reverse polarity to the power supply connections. Reversing polarity will immediately ruin the display module.
- Use care to keep the exposed terminals clean. Contamination, including fingerprints may make soldering difficult, and the reliability of the soldered connection poor.

### AVOID SHOCK, IMPACT, TORQUE, OR TENSION

- Do not expose the display module to strong mechanical shock, impact, torque, or tension.
- Do not drop, toss, bend, or twist the display module.
- Do not place weight or pressure on the display 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 module 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.
7. Gently wash the microfiber cloths in warm, soapy water and air dry before reuse.

## OPERATION

- We do not recommend connecting this display module to a PC's parallel port as an end product. This display 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 module 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 display module from ESD and power supply transients.
- Changes in voltage can result in changes in contrast.
- Observe the operating temperature limitations, non-condensing with minimal fluctuations. Operation outside of these limits may shorten life and/or harm the display module. 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 strong ultraviolet radiation.
- Observe the storage temperature limitations with minimal fluctuations. Rapid temperature changes can cause moisture to form, resulting in permanent damage.
- Do not allow weight to be placed on the display modules while they are in storage.
- Please recycle your outdated CrystalFontz display modules at an approved facility.



## 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 modules as accurately as possible. For the photos, we adjust 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

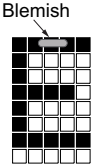
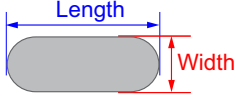
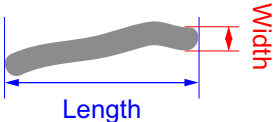
Defects are defined as:

- 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. 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 (mm)</i>	<i>Acceptable Qty</i>	Minor	
			≤0.3	3		
			≤2 defects within 10 mm of each other			
5	Other blemishes or foreign matter outside of display segments	Defect size = (A + B)/2 	<i>Defect Size (mm)</i>	<i>Acceptable Qty</i>	Minor	
			≤0.15	Ignore		
			0.15 to 0.20	3		
			0.20 to 0.25	2		
			0.25 to 0.30	1		
6	Dark lines or scratches in display area		<i>Defect Width (mm)</i>	<i>Defect Length (mm)</i>	<i>Acceptable Qty</i>	Minor
			≤0.03	≤3.0	3	
			0.03 to 0.05	≤2.0	2	
			0.05 to 0.08	≤2.0	1	
			0.08 to 0.10	≤3.0	0	
			≥0.10	>3.0	0	
7	Bubbles between polarizer film and glass		<i>Defect Size (mm)</i>	<i>Acceptable Qty</i>	Minor	
			≤0.20	Ignore		
			0.20 to 0.40	3		
			0.40 to 0.60	2		
			≥0.60	0		



#	DEFECT TYPE	ACCEPTANCE STANDARDS CRITERIA (Continued)	MAJOR / MINOR							
8	Display pattern defect		Minor							
		<table border="1"> <tr> <th>Dot Size (mm)</th> <th>Acceptable Qty</th> </tr> <tr> <td><math>((A+B)/2) \leq 0.2</math></td> <td rowspan="5"> <math>\leq 3</math> total defects  <math>\leq 2</math> pinholes per digit         </td> </tr> <tr> <td><math>C &gt; 0</math></td> </tr> <tr> <td><math>((D+E)/2) \leq 0.25</math></td> </tr> <tr> <td><math>((F+G)/2) \leq 0.25</math></td> </tr> </table>		Dot Size (mm)	Acceptable Qty	$((A+B)/2) \leq 0.2$	$\leq 3$ total defects $\leq 2$ pinholes per digit	$C > 0$	$((D+E)/2) \leq 0.25$	$((F+G)/2) \leq 0.25$
		Dot Size (mm)		Acceptable Qty						
		$((A+B)/2) \leq 0.2$		$\leq 3$ total defects $\leq 2$ pinholes per digit						
		$C > 0$								
$((D+E)/2) \leq 0.25$										
$((F+G)/2) \leq 0.25$										
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 or foreign matter (<a href="#">see test 5, Pg. 25</a>), and dark lines or scratches (<a href="#">see test 6, Pg. 25</a>).</li> </ol> <p><i>*Minor if display functions correctly. Major if the display fails.</i></p>	Minor							
10	COB defects	<ol style="list-style-type: none"> <li>1. Pinholes <math>&gt; 0.2</math> mm.</li> <li>2. Seal surface has pinholes through to the IC.</li> <li>3. More than 3 locations of sealant beyond 2 mm of the sealed areas.</li> </ol>	Minor							
11	PCB defects	<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 pad, zebra pad, or screw hole pad is not smooth.</li> </ol> <p><i>*Minor if display functions correctly. Major if the display fails.</i></p>	Minor							
12	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><i>*Minor if display functions correctly. Major if the display fails.</i></p>	Minor							