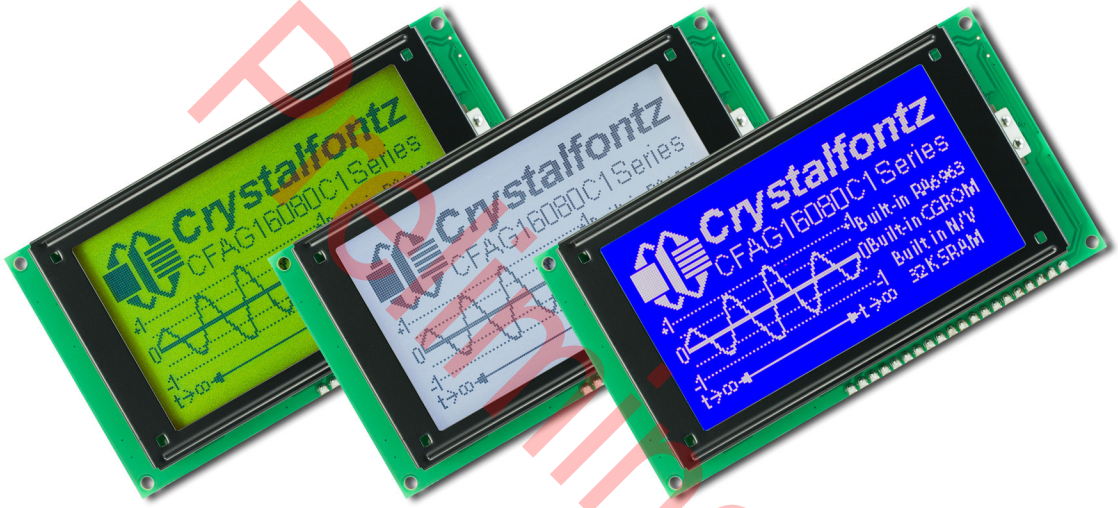
GRAPHIC DISPLAY MODULE DATA SHEET



Preliminary Data Sheet Release Date 2014-07-02
for
CFAG16080C1-xxx-TZ:
CFAG216080C1-TFH-TZ
CFAG216080C1-TMI-TZ
CFAG16080C1-YYH-TZ

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CFAG16080C1-xxx-TZ Data Sheet Revision History

Data Sheet Preliminary Release: 2014-07-02
First Data Sheet for new products.

About Variations

We work continuously to improve our products. Because display technologies are quickly evolving, these products may have component or process changes. Slight variations (for example, contrast, color, or intensity) between lots are normal. If you need the highest consistency, whenever possible, order and arrange delivery for your production runs at one time so your displays will be from the same lot.

The Fine Print

Certain applications using Crystalfontz America, Inc. products may involve potential risks of death, personal injury, or severe property or environmental damage ("Critical Applications"). CRYSTALFONTZ AMERICA, INC. PRODUCTS ARE NOT DESIGNED, INTENDED, AUTHORIZED, OR WARRANTED TO BE SUITABLE FOR USE IN LIFE-SUPPORT APPLICATIONS, DEVICES OR SYSTEMS OR OTHER CRITICAL APPLICATIONS. Inclusion of Crystalfontz America, Inc. products in such applications is understood to be fully at the risk of the customer. In order to minimize risks associated with customer applications, adequate design and operating safeguards should be provided by the customer to minimize inherent or procedural hazard. Please contact us if you have any questions concerning potential risk applications.

Crystalfontz America, Inc. assumes no liability for applications assistance, customer product design, software performance, or infringements of patents or services described herein. Nor does Crystalfontz America, Inc. warrant or represent that any license, either express or implied, is granted under any patent right, copyright, or other intellectual property right of Crystalfontz America, Inc. covering or relating to any combination, machine, or process in which our products or services might be or are used.

All specifications in Data Sheets 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.

Company and product names mentioned in this publication are trademarks or registered trademarks of their respective owners.

About Volatility

This module has volatile memory.

CONTENTS

MECHANICAL SPECIFICATIONS

PHYSICAL CHARACTERISTICS

CFAG16080C1-TFH-TZ

Item	Dimension	Unit
Number of dots	160 x 80	—
Module dimension	100.0 x 54.0 x 14.6 (MAX)	mm
View area	72.0 x 40.0	mm
Active area	67.17 x 33.57	mm
Dot size	0.39 x 0.39	mm
Dot pitch	0.42 x 0.42	mm
LCD type	FSTN Positive Transflective (In LCD production, It will occur slightly color difference. We can only guarantee the same color in the same batch.)	
Duty	1/80	
View direction	6 o'clock	
Backlight Type	LED, White	
IC	RA6963	

CFAG16080C1-TMI-TZ

LCD type	STN Negative, Blue Transmisstive (In LCD production, It will occur slightly color difference. We can only guarantee the same color in the same batch.)

The other Physical Characteristic specifications are the same as CFAG16080C1-TFH-TZ.

CFAG16080C1-YYH-TZ

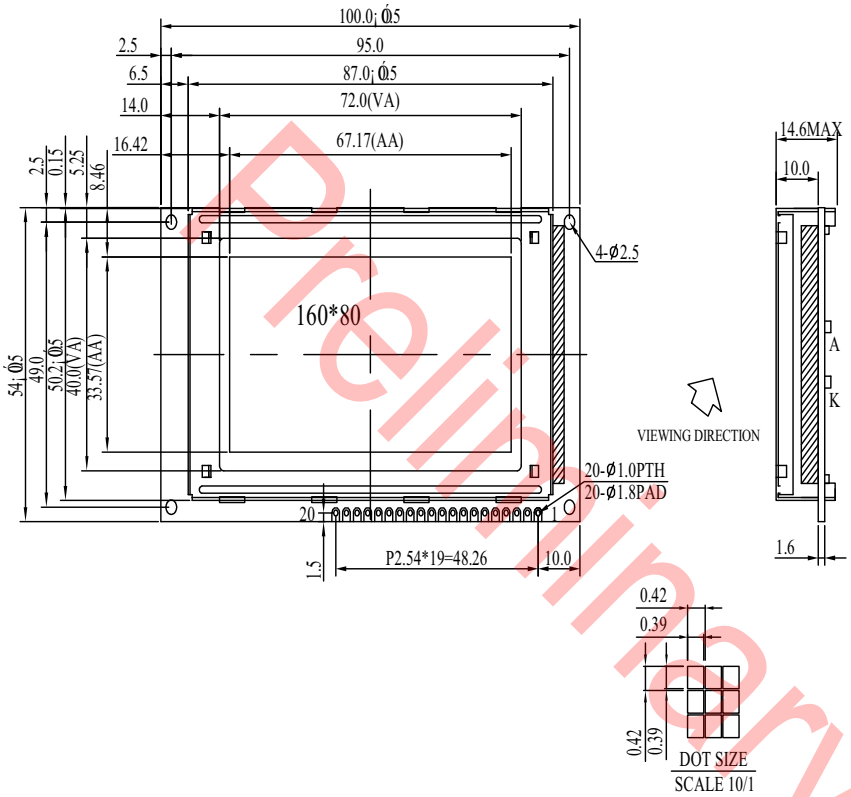
LCD type	STN Positive, Yellow Green Transflective (In LCD production, It will occur slightly color difference. We can only guarantee the same color in the same batch.)

The other Physical Characteristic specifications are the same as CFAG16080C1-TFH-TZ.

ADDITIONAL FEATURES

- These display modules have a RAiO RA6963 Dot Matrix LCD Controller LSI with Neotec NT7086 LCD segment drivers. For interface information and other details, see controller datasheets on our website.
- RoHS compliant. Factory is ISO certified.

MODULE OUTLINE DRAWING



PIN NO.	SYMBOL
1	Vee
2	VSS
3	VDD
4	VO
5	/WR
6	/RD
7	/CE
8	C/D
9	/RST
10	DB0
11	DB1
12	DB2
13	DB3
14	DB4
15	DB5
16	DB6
17	DB7
18	FS
19	A
20	K

ELECTRICAL SPECIFICATIONS

ABSOLUTE MAXIMUM RATINGS

Item	Symbol	Min	Typ	Max	Unit
Operating Temperature	T_{OP}	-20	—	+70	℃
Storage Temperature	T_{ST}	-30	—	+80	℃
Input Voltage	V_{IN}	-0.3	—	V_{DD}+0.3	V
Supply Voltage For Logic	V_{DD}-V_{SS}	-0.3	—	+7.0	V

RECOMMENDED DC CHARACTERISTICS

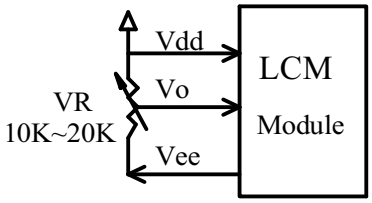
Item	Symbol	Condition	Min	Typ	Max	Unit
Supply Voltage For Logic	V_{DD}-V_{SS}	—	3.0	—	5.5	V
Supply Voltage For LCD	V_{DD}-V_0	Ta=-20℃	—	—	—	V
*Note		Ta=25℃	11.0	11.5	12.0	V
		Ta=70℃	—	—	—	V
Input High Volt.	V_{IH}	—	0.8V_{DD}	—	V_{DD}	V
Input Low Volt.	V_{IL}	—	0	—	0.2 V_{DD}	V
Output High Volt.	V_{OH}	—	V_{DD}-0.3	—	V_{DD}	V
Output Low Volt.	V_{OL}	—	0	—	0.3	V
Supply Current	I_{DD}	—	13.8	14.2	16.0	mA

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

DETAILS OF INTERFACE PIN FUNCTIONS

Pin No.	Symbol	Level	Description
1	Vee	—	Negative Voltage Output
2	VSS	0V	Ground
3	VDD	—	Power supply for logic
4	V0	—	Power supply for LCD driver
5	/WR	H / L	Data write. Write data into RA6963 when /WR = L
6	/RD	H / L	Data read. Read data from RA6963 when RD = L
7	/CE	H / L	Chip enable the controller RA6963
8	/CD	H / L	Command/data read/write
9	/RST	L	Reset the LCM
10	DB0	H / L	Data bus line
11	DB1	H / L	Data bus line
12	DB2	H / L	Data bus line
13	DB3	H / L	Data bus line
14	DB4	H / L	Data bus line
15	DB5	H / L	Data bus line
16	DB6	H / L	Data bus line
17	DB7	H / L	Data bus line
18	FS	H / L	Pins for selection of font ;
19	A	—	Power supply for B/L +
20	K	—	Power supply for B/L -

TYPICAL VO CONNECTIONS FOR DISPLAY CONTRAST



ESD (ELECTRO-STATIC DISCHARGE)

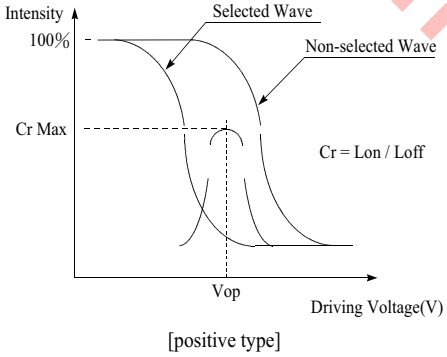
The circuitry is industry standard CMOS logic and is susceptible to ESD damage. Please use industry standard antistatic precautions as you would for any other static sensitive devices such as expansion cards, motherboards, or integrated circuits. Ground your body, work surfaces, and equipment.

OPTICAL SPECIFICATIONS

CFAG16080C1-TFH-TZ

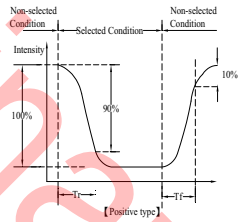
Item	Symbol	Condition	Min	Typ	Max	Unit
View Angle	θ	CR≧2	0	—	30	ψ= 180°
	θ	CR≧2	0	—	60	ψ= 0°
	θ	CR≧2	0	—	45	ψ= 90°
	θ	CR≧2	0	—	45	ψ= 270°
Contrast Ratio	CR	—	—	5	—	—
Response Time	T rise	—	—	150	200	ms
	T fall	—	—	150	200	ms

Definition of Operation Voltage (Vop)



[positive type]

Definition of Response Time (Tr , Tf)

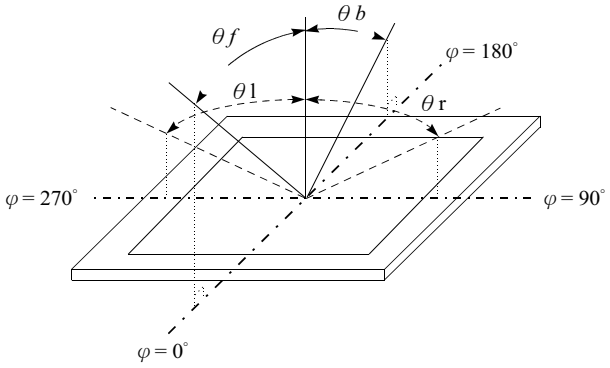


Conditions :

Operating Voltage : Vop Viewing Angle(θ，φ) : 0°， 0°

Frame Frequency : 64 HZ Driving Waveform : 1/N duty , 1/a bias

Definition of viewing angle(CR≧2)



CFAG16080C1-TMI-TZ AND CFAG16080C1-YYH-TZ

Item	Symbol	Condition	Min	Typ	Max	Unit
View Angle	θ	CR≧2	0	—	20	ψ= 180°
	θ	CR≧2	0	—	40	ψ= 0°
	θ	CR≧2	0	—	30	ψ= 90°
	θ	CR≧2	0	—	30	ψ= 270°
Contrast Ratio	CR	—	—	3	—	—
Response Time	T rise	—	—	150	200	ms
	T fall	—	—	150	200	ms

LED BACKLIGHT CHARACTERISTICS

CFAG16080C1-TFH-TZ AND CFAG16080C1-TMI-TZ

PARAMETER	SYMBOL	MIN	TYP	MAX	UNIT	TEST CONDITION
Supply Current	ILED	—	64	80	mA	V=3.5V
Supply Voltage	V	3.4	3.5	3.6	V	—
Reverse Voltage	VR	—	—	5	V	—

CFAG16080C1-YYH-TZ

PARAMETER	SYMBOL	MIN	TYP	MAX	UNIT	TEST CONDITION
Supply Current	ILED	297	330	396	mA	V=4.1V
Supply Voltage	V	3.9	4.1	4.3	V	—
Reverse Voltage	VR	—	—	8	V	—

MODULE RELIABILITY AND LONGEVITY

MODULE RELIABILITY

Values listed below are approximate and represent typical lifetime.

CFAG16080C1-TFH-TZ AND CFAG16080C1-TMI-TZ	SPECIFICATION	
LCD portion, excluding white LEDs	50,000 to 100,000 hours	
Backlights with White LEDs	***Power-On Hours***	***% of Initial Brightness (New Module)***
	<10,000 hours	>70%
	<50,000 hours	>50%
Notes *Under operating and storage temperature specification limitations, humidity noncondensing) RH up to 65%, and no exposure to direct sunlight.* *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.*		

CFAG16080C1-YYH-TZ	SPECIFICATION
Including yellow-green LED backlight	Brightness will be >50% of a new module's initial brightness for at least 50,000 hours of operation when supply to each LED is below 330 mA.
Notes *Under operating and storage temperature specification limitations, humidity noncondensing) RH up to 65%, and no exposure to direct sunlight.*	

MODULE LONGEVITY (EOL/REPLACEMENT POLICY)

Crystalfontz is committed to making all of our modules available for as long as possible. For each module we introduce, we intend to offer it indefinitely. We do not preplan a module's obsolescence. The majority of modules we have introduced are still available.

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. 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 Data Sheet specifications and tolerances of the discontinued module, changes may require modification to your circuit and/or firmware. Possible changes include:

- *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.* 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 will post Part Change Notices on the product's web page as soon as possible. If interested, you can subscribe to future part change notifications.

CARE AND HANDLING PRECAUTIONS

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 (Pg. 7).

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 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.

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 GE HP-92 Lexan, which is readily available and works well.
- Do not disassemble or modify the module.
- Do not reverse polarity to the power supply connections. Reversing polarity will immediately ruin the 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 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.

IF PANEL BREAKS

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.
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. 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.
- Observe the storage temperature limitations. 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 Crystalfontz modules at an approved facility.

APPENDIX A: QUALITY ASSURANCE STANDARDS

INSPECTION CONDITIONS

- Environment
  - Temperature: 25±5°C
  - Humidity: 30~85% RH (noncondensing)
- 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.

ACCEPTANCE SAMPLING

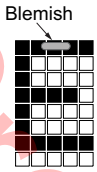
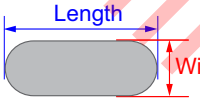
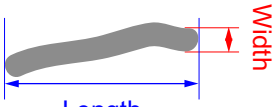
DEFECT TYPE	AQL*
Major	≤.65%
Minor	<1.0%
* Acceptable Quality Level: maximum allowable error rate or variation from standard	

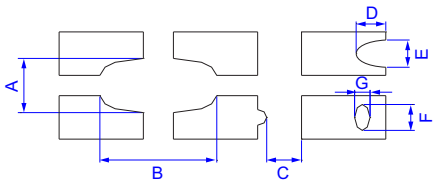
DEFECTS CLASSIFICATION

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		*Defect Size (mm)*	*Acceptable Qty*	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 	*Defect Size (mm)*	*Acceptable Qty*	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 	*Defect Width (mm)*	*Defect Length (mm)*	*Acceptable Qty*	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		*Defect Size (mm)*	*Acceptable Qty*	Minor
			≤0.20	Ignore	
			0.20 to 0.40	3	
			0.40 to 0.60	2	
			≥0.60	0	

<table>
<tr><th>#</th><th>DEFECT TYPE</th><th>ACCEPTANCE STANDARDS CRITERIA (Continued)</th><th>MAJOR / MINOR</th></tr>
<tr><td>8</td><td>Display pattern defect</td><td> 

<table>
<tr><th>Dot Size (mm)</th><th>Acceptable Qty</th></tr>
<tr><td>((A+B)/2)≤0.2</td><td rowspan="4">≤3 total defects

≤2 pinholes per digit</td></tr>
<tr><td>C>0</td></tr>
<tr><td>((D+E)/2)≤0.25</td></tr>
<tr><td>((F+G)/2)≤0.25</td></tr>
</table></td><td>Minor</td></tr>
<tr><td>9</td><td>Backlight defects</td><td>1. Light fails or flickers.*
2. Color and luminance do not correspond to specifications.*
3. Exceeds standards for display’s blemishes or foreign matter (see test 5, Pg. 16), and dark lines or scratches (see test 6, Pg. 16).
*Minor if display functions correctly. Major if the display fails.</td><td>Minor</td></tr>
<tr><td>10</td><td>COB defects</td><td>1. Pinholes >0.2 mm.
2. Seal surface has pinholes through to the IC.
3. More than 3 locations of sealant beyond 2 mm of the sealed areas.</td><td>Minor</td></tr>
<tr><td>11</td><td>PCB defects</td><td>1. Oxidation or contamination on connectors.*
2. Wrong parts, missing parts, or parts not in specification.*
3. Jumpers set incorrectly.
4. Solder (if any) on bezel, LED pad, zebra pad, or screw hole pad is not smooth.
*Minor if display functions correctly. Major if the display fails.</td><td>Minor</td></tr>
<tr><td>12</td><td>Soldering defects</td><td>1. Unmelted solder paste.
2. Cold solder joints, missing solder connections, or oxidation.*
3. Solder bridges causing short circuits.*
4. Solder balls.
*Minor if display functions correctly. Major if the display fails.</td><td>Minor</td></tr>
</table>