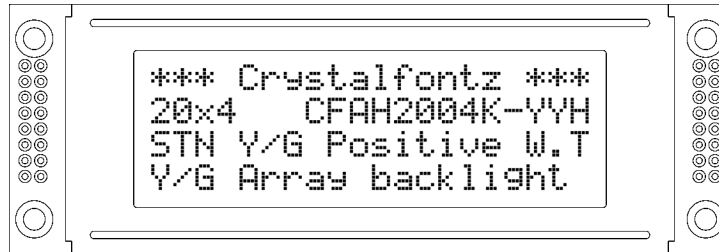


# Crystalfontz America, Incorporated

## CHARACTER LCD MODULE SPECIFICATIONS



Crystalfontz Model Number	<b>CFAH2004K-YYH-JP#</b>
Hardware Version	<b>v0.0 December 2005</b>
Data Sheet Version	<b>v0.0a January 2006</b>
Product Pages	<a href="http://www.crystalfontz.com/products/2004K">www.crystalfontz.com/products/2004K</a>

Customer Name	
Customer Part Number	

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## REVISION HISTORY

HARDWARE	
2005/12/01	Current hardware version: <b>v0.0</b> New module.

DATA SHEET	
2005/12/01	Data Sheet version: v0.0 New Data Sheet.
2006/01/01	Current Data Sheet version: <b>v0.0a</b> Changes since last released version (v0.0): Added " <a href="#">Luminous Intensity</a> " specification (Pg. 12). Minor formatting and rewording changes to improve readability.

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## FEATURES

- ❑ 20x4 LCD has a large display area in a compact 116 mm x 40 mm package (4.57" x 1.57"). CFAH2004K-YYH-JP# is only 2 millimeters higher than our 20x2 LCD [CFAH2002A](#).
- ❑ 8-bit or 4-bit parallel interface.
- ❑ Industry standard HD47780 compatible controller.
- ❑ RoHS compliant (indicated by “#” at the end of the part number).
- ❑ Yellow-green array LED backlit with STN yellow-green, positive transfective mode LCD (displays dark characters on yellow-green background).
- ❑ Wide temperature operation: -20 °C to +70°C.
- ❑ Sunlight readable.

## MODULE CLASSIFICATION INFORMATION

C
F
A
H
2
0
0
4
K
-
Y
Y
H
-
J
P
#

❶
❷
❸
❹
❺
❻
❼
❽
❾
❿

❶	Brand	Crystalfontz America, Inc.
❷	Display Type	H – Character
❸	Number of Characters (horizontally)	20
❹	Number of Lines (vertically)	04
❺	Model Identifier	K
❻	Backlight Type & Color	Y – LED, yellow-green
❼	Fluid Type, Image (positive or negative), & LCD Glass Color	Y – STN, positive, yellow-green
❽	Polarizer Film Type, Temperature Range (normal or wide), & View Angle (o'clock)	H – Transflective, WT, 6:00
❾	CGROM Font	JP – Japanese and English
❿	RoHS Status	# – RoHS Compliant

## ORDERING INFORMATION

PART NUMBER	FLUID	LCD GLASS COLOR	IMAGE	POLARIZER FILM	BACKLIGHTS
CFAH2004K-YYH-JP#	STN	yellow-green	positive	transflective	yellow-green array LEDs

Also see [Backlight Characteristics \(By Module Part Number\) \(Pg. 12\)](#).

# SYSTEM BLOCK DIAGRAM

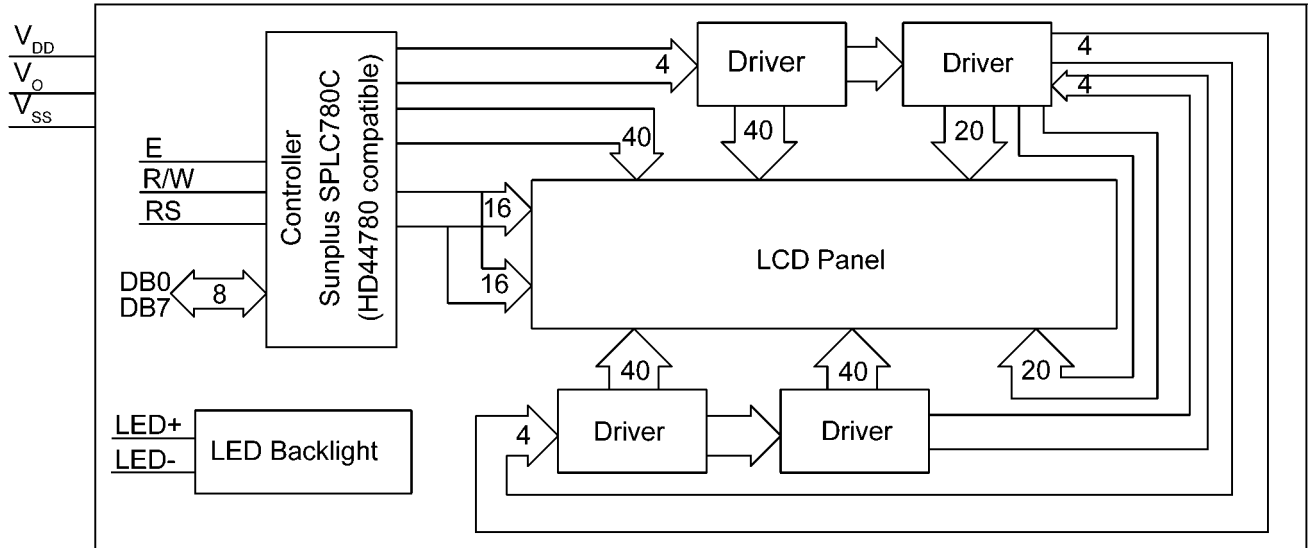


Figure 1. System Block Diagram

## PHYSICAL CHARACTERISTICS

---

ITEM	SIZE (mm)
Module Dimensions	116 (W) x 40 (H) x 15.0 (D)
Viewing Area	76 (W) x 25.2 (H)
Active Area	70.4 (W) x 20.8 (H)
Character Size	2.95 (W) x 4.75 (H)
Character Pitch	3.55 (W) x 5.35 (H)
Dot Size	.55 (W) x .55 (H)
Dot Pitch	.60 (W) x .60 (H)
Depth	15.0
Weight	68 grams (typical)

## TEMPERATURE RANGE

---

CRITERIA	SPECIFICATION
Operating Temperature Range	-20°C minimum to +70°C maximum
Storage Temperature Range	-30°C minimum to +80°C maximum

## OPTICAL CHARACTERISTICS

---

Viewing Direction	6 o'clock
-------------------	-----------

ITEM	SYMBOL	CONDITION	MINIMUM	TYPICAL	MAXIMUM
View Angle	(V) $\theta$	CR>2	-20°		35°
Contrast Ratio	(H) $\rho$	CR>2	-30°		30°
LCD Response Time	T rise			250 ms	
	T fall			250 ms	

## CONDITIONS FOR DEFINITIONS IN FIGURES 2 AND 3

- Operating Voltage:  $V_{OP}$
- Viewing Angle ( $\theta, \varphi$ ):  $0^\circ, 0^\circ$
- Frame Frequency: 64 Hz
- Driving Waveform: 1/N Duty, 1/a Bias

## DEFINITION OF OPERATION VOLTAGE ( $V_{OP}$ )

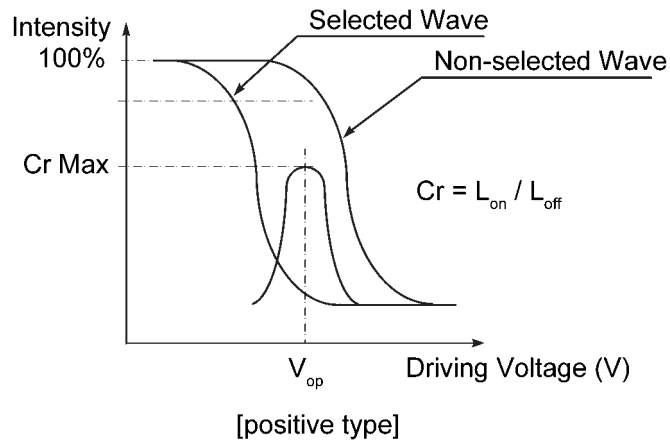


Figure 2. Definition of Operation Voltage ( $V_{OP}$ )

## DEFINITION OF RESPONSE TIME ( $T_R, T_F$ )

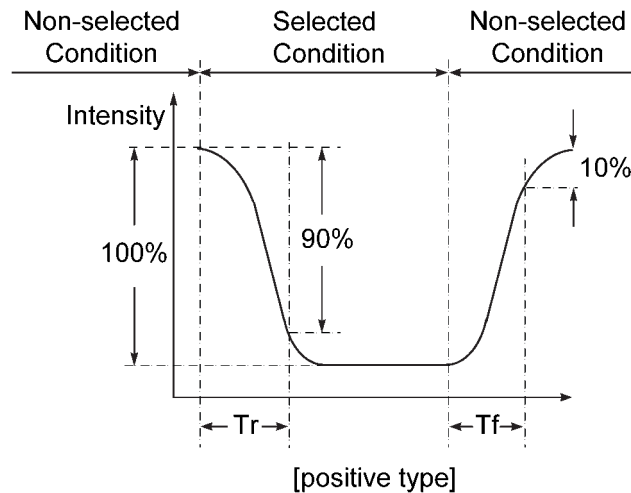


Figure 3. Definition of Response Time ( $T_r, T_f$ )

## DEFINITION OF VIEWING ANGLE (CR>2)

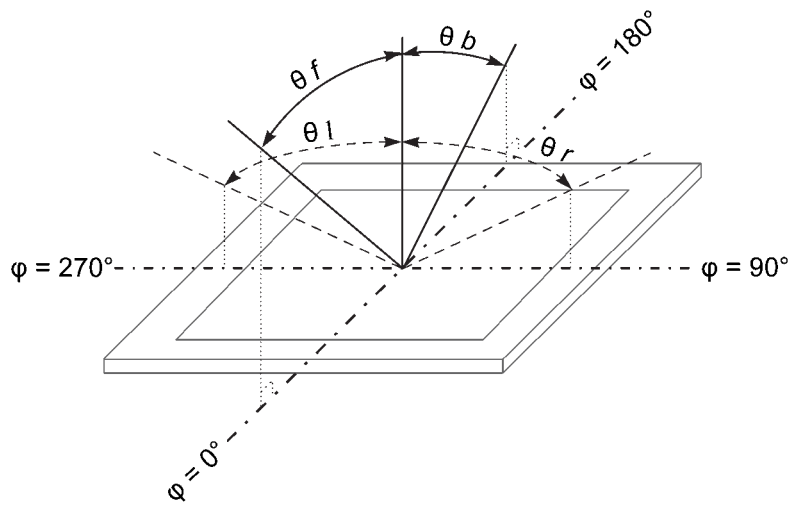


Figure 4. Definition of Viewing Angle



## ELECTRICAL SPECIFICATIONS

DRIVING METHOD	SPECIFICATION
Duty	1/16
Bias	1/5

CHARACTERISTIC	SYMBOL	ABSOLUTE MAXIMUM RATINGS
Operating Voltage	$V_{DD}$	-0.3v to +7.0v
Driver Supply Voltage	$V_{LCD}$	$V_{LCD} = V_{DD} - 12v$ to $V_{LCD} = V_{DD} + 0.3v$ or $V_O = -7v$ to $V_O = +5.3v$ (for $V_{DD} = +5v$ )
Input Voltage Range	$V_{IN}$	-0.3v to $V_{DD} + 0.3v$

LCD SUPPLY VOLTAGE		MINIMUM	TYPICAL	MAXIMUM
Supply voltage for driving LCD ( $V_{DD} - V_O$ )	$T_A = 0^\circ C$			+4.8v
	$T_A = +25^\circ C$		+4.5v	
	$T_A = +50^\circ C$	+4.2v		

CURRENT CONSUMPTION		MINIMUM	TYPICAL	MAXIMUM
Supply current ( $I_{DD}$ ) $V_{DD} = +5v$			+1.2 mA	

## DC CHARACTERISTICS

CHARACTERISTICS	SYMBOL	MINIMUM	TYPICAL	MAXIMUM	TEST CONDITION
Input High Voltage	$V_{IH1}$	+2.2v		$V_{DD}$	Pins: E, RS, R/W, DB0 - DB7
Input Low Voltage	$V_{IL1}$	-0.3v		-0.6v	
Input High Current	$I_{IH}$	-2.0 $\mu$ A		+2.0 $\mu$ A	Pins: RS, R/W, DB0 - DB7 $V_{DD} = +5.0$ v
Input Low Current	$I_{IL}$	-20 $\mu$ A	-50 $\mu$ A	-100 $\mu$ A	
Output High Voltage	$V_{OH1}$	+2.4v		$V_{DD}$	$I_{OH} = -0.1$ mA Pins: DB0 - DB7
Output Low Voltage	$V_{OL1}$			+0.4v	$I_{OL} = 0.1$ mA Pins: DB0 - DB7

## ESD (ELECTRO-STATIC DISCHARGE)

The circuitry is industry standard CMOS logic and susceptible to ESD damage. Please use industry standard anti-static precautions as you would for any other PCB such as expansion cards or motherboards. For more information, read [CARE AND HANDLING PRECAUTIONS \(Pg. 18\)](#).

## TYPICAL $V_O$ CONNECTIONS

Adjust  $V_O$  to +1v ( $V_{LCD} = +4$ v) as an initial setting. When the module is operational, readjust  $V_O$  for optimal display appearance.

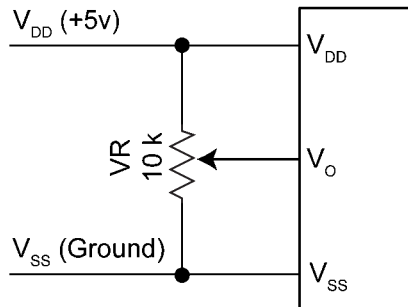


Figure 5.  $V_O$  Connections for Normal Temperature Operation

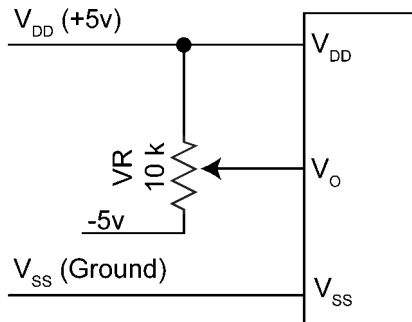


Figure 6.  $V_O$  Connections for Wide Temperature Operation

## BACKLIGHTS

The CFAH2004K-YYH-JP# uses LED backlights. LED backlights are easy to use properly but they are also easily damaged by abuse.

**NOTE**

Do not connect +5v to the backlight terminals. This will ruin the backlight.

LEDs are “current” devices. The important thing to an LED is the current flowing through it, not the voltage across it. Ideally, a current source would be used to drive the LEDs. In practice, a simple current limiting resistor will work well in most applications and is much less complex than a current source.

You need to know what the forward voltage of the LEDs will be so you can calculate a current limiting resistor ( $R_{LIMIT}$ ). The forward voltage will vary slightly from display to display.

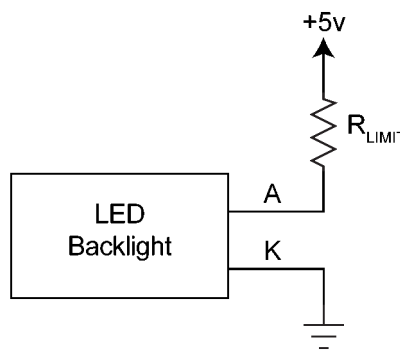


Figure 7. Typical LED Backlight Connections

The general equation to calculate  $R_{LIMIT}$  is:

$$R_{LIMIT} \text{ (minimum)} = \frac{V_{DD} \text{ (supply voltage)} - V_{LED} \text{ (LED forward voltage)}}{I_{LED} \text{ (maximum LED current)}}$$

The specific  $R_{LIMIT}$  calculation for the CFAH2004K-YYH-JP# at  $V_{DD} = +5v$  is:

$$R_{LIMIT} = \frac{5v - 4.2v}{0.180 \text{ A (maximum)}} = 5\Omega \text{ (minimum)}$$

The backlight may be dimmed by PWM (Pulse Width Modulation). The typical range for the PWM frequency is from 100 to 300 Hz.

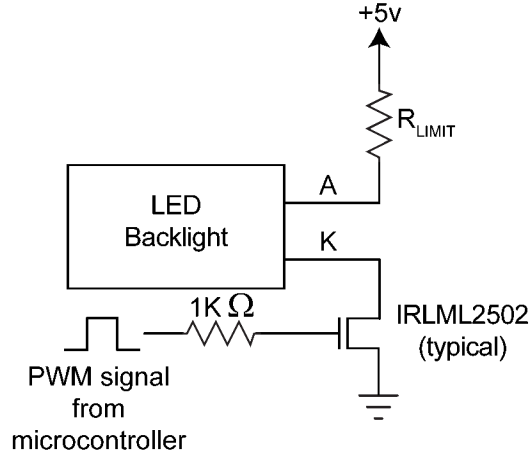


Figure 8. Typical LED Backlight Connections for PWM Dimming

## BACKLIGHT CHARACTERISTICS (BY MODULE PART NUMBER)

<b>CFAH2004K-YYH-JP#</b>			
<i>Dark characters on yellow-green background</i>			
<b>PARAMETER</b>	<b>MINIMUM</b>	<b>TYPICAL</b>	<b>MAXIMUM</b>
Current ( $I_{LED}$ )		180 mA	
Forward Voltage ( $V_{LED}$ )	+4.0v	+4.2v	+4.4v
Reverse Voltage			+5v
Luminous Intensity (IV) $I_{LED} = 190 \text{ mA}$		34 $\text{cd/m}^2$	
Wavelength ( $\lambda_p$ ) $I_{LED} = 190 \text{ mA}$		568 nm	

## RELIABILITY

---

ITEM	SPECIFICATION
LCD portion (excluding Backlight)	50,000 to 100,000 hours (typical)
Yellow-green LED Backlights	50,000 to 100,000 hours (typical)

## INTERFACE PIN FUNCTIONS

PIN	SIGNAL	LEVEL	DIRECTION	DESCRIPTION
1	V <sub>SS</sub>	+0v	–	Ground
2	V <sub>DD</sub>	+5.0v	–	Supply voltage for logic
3	V <sub>O</sub>	variable	–	Supply voltage for driving LCD $V_O = +1v$ typical at $V_{DD} = +5v$ which gives a $V_{LCD} = (V_{DD} - V_O) = +4v$
4	RS	H/L	I	Register selection input H: data register (for read and write) L: instruction code (for write)
5	R/W	H/L	I	Read/write selection input H: read (MPU←module) L: write (MPU→module)
6	E	H,H→L	I	Read/write enable signal H: write data is latched on the falling edge H→L: read data is enabled by a high level
7	DB0	H/L	I/O	Data bit 0
8	DB1	H/L	I/O	Data bit 1
9	DB2	H/L	I/O	Data bit 2
10	DB3	H/L	I/O	Data bit 3
11	DB4	H/L	I/O	Data bit 4
12	DB5	H/L	I/O	Data bit 5
13	DB6	H/L	I/O	Data bit 6
14	DB7	H/L	I/O	Data bit 7
15	LED+ (A)	–	–	Supply voltage for LED “A” or “anode” or “+” of LED backlight
16	LED- (K)	–	–	Supply voltage for LED “K” or “cathode” or “-” of LED backlight

## SPLC780C CONTROLLER INTERFACE INFORMATION

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The CFAH2004K-YYH-JP# uses a Sunplus SPLC780C controller. The CFAH2004K-YYH-JP# is compatible with the industry standard Hitachi HD44780 controller. Software written for modules that use the HD44780 should work without modification for the CFAH2004K-YYH-JP#.

For your reference, we included the SPLC780C controller data sheet as an appendix to this CFAH2004K-YYH-JP# data sheet. Links to some of the most useful sections of the SPLC780C data sheet are:

- Instruction description (see [5. Functional Description in Appendix B, page 6](#)).
- Instruction table (see [5.3 Instruction Table in Appendix B, page 8](#).)
- Initializing the module (see [5.7 Reset Function in Appendix B, page 11](#)).
- Timing Characteristics (see [6. Electrical Specifications in Appendix B, page 21](#)).

## DISPLAY POSITION DDRAM ADDRESS

---

The following table shows the relationship between the controller's addresses and the corresponding character location on the CFAH2004K-YYH-JP#.

ROW	COLUMN																			
	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
0	0x00	0x01	0x02	0x03	0x04	0x05	0x06	0x07	0x08	0x09	0xA	0xB	0xC	0xD	0xE	0xF	0x10	0x11	0x12	0x13
1	0x40	0x41	0x42	0x43	0x44	0x45	0x46	0x47	0x48	0x49	0x4A	0x4B	0x4C	0x4D	0x4E	0x4F	0x50	0x51	0x52	0x53
2	0x14	0x15	0x16	0x17	0x18	0x19	0x1A	0x1B	0x1C	0x1D	0x1E	0x1F	0x20	0x21	0x22	0x23	0x24	0x25	0x26	0x27
3	0x54	0x55	0x56	0x57	0x58	0x58	0x5A	0x5B	0x5C	0x5D	0x5E	0x5F	0x60	0x61	0x62	0x63	0x64	0x65	0x66	0x67

## CHARACTER GENERATOR ROM (CGROM)

To find the code for a given character, add the two numbers that are shown in bold for its row and column. For example, the lowercase "h" is in the column labeled "96<sub>10</sub>" and in the row labeled "8<sub>10</sub>". So you would add 96 + 8 to get 104. When you send a byte with the value of 104 to the display, then a lowercase "h" will be shown. Additional character sets are available. Minimum order may be required. (See [APPENDIX B: SUNPLUS SPLC780C CONTROLLER DATA SHEET \(Pg. 26\).](#))

upper 4 bits lower 4 bits	0 <sub>10</sub> 0000 <sub>2</sub>	16 <sub>10</sub> 0001 <sub>2</sub>	32 <sub>10</sub> 0010 <sub>2</sub>	48 <sub>10</sub> 0011 <sub>2</sub>	64 <sub>10</sub> 0100 <sub>2</sub>	80 <sub>10</sub> 0101 <sub>2</sub>	96 <sub>10</sub> 0110 <sub>2</sub>	112 <sub>10</sub> 0111 <sub>2</sub>	128 <sub>10</sub> 1000 <sub>2</sub>	144 <sub>10</sub> 1001 <sub>2</sub>	160 <sub>10</sub> 1010 <sub>2</sub>	176 <sub>10</sub> 1011 <sub>2</sub>	192 <sub>10</sub> 1100 <sub>2</sub>	208 <sub>10</sub> 1101 <sub>2</sub>	224 <sub>10</sub> 1110 <sub>2</sub>	240 <sub>10</sub> 1111 <sub>2</sub>
0 <sub>10</sub> 0000 <sub>2</sub>	CGRAM [0]			0	1	2	3	4				一	二	三	四	五
1 <sub>10</sub> 0001 <sub>2</sub>	CGRAM [1]		!	1	2	3	4	5				。	ア	イ	ウ	エ
2 <sub>10</sub> 0010 <sub>2</sub>	CGRAM [2]		"	2	3	4	5	6				「	」	×	◎	◎
3 <sub>10</sub> 0011 <sub>2</sub>	CGRAM [3]		#	3	4	5	6	7				」	ウ	テ	モ	モ
4 <sub>10</sub> 0100 <sub>2</sub>	CGRAM [4]		\$	4	5	6	7	8				、	エ	ト	カ	ワ
5 <sub>10</sub> 0101 <sub>2</sub>	CGRAM [5]		%	5	6	7	8	9				・	オ	カ	キ	ク
6 <sub>10</sub> 0110 <sub>2</sub>	CGRAM [6]		&	6	7	8	9	0				ヲ	カ	ニ	ヨ	ド
7 <sub>10</sub> 0111 <sub>2</sub>	CGRAM [7]		'	7	8	9	0	1				ヲ	キ	ク	ケ	コ
8 <sub>10</sub> 1000 <sub>2</sub>			(	8	9	0	1	2				、	ウ	キ	ウ	ク
9 <sub>10</sub> 1001 <sub>2</sub>			)	9	0	1	2	3				、	ウ	ク	ル	リ
10 <sub>10</sub> 1010 <sub>2</sub>			*	*	J	Z	j	z				エ	コ	ノ	ク	キ
11 <sub>10</sub> 1011 <sub>2</sub>			+	+	K	K	K	K				オ	カ	ヒ	ヒ	フ
12 <sub>10</sub> 1100 <sub>2</sub>			,	<	L	羊	羊	羊				カ	シ	フ	フ	キ
13 <sub>10</sub> 1101 <sub>2</sub>			-	=	円	円	円	円				ユ	ズ	ズ	ヒ	キ
14 <sub>10</sub> 1110 <sub>2</sub>			.	>	N	^	n	^				ヨ	セ	ホ	^	フ
15 <sub>10</sub> 1111 <sub>2</sub>			/	?	0	0	0	0				ウ	ウ	ウ	ウ	ウ

Figure 9. Character Generator ROM (CGROM)



# MODULE OUTLINE DRAWING

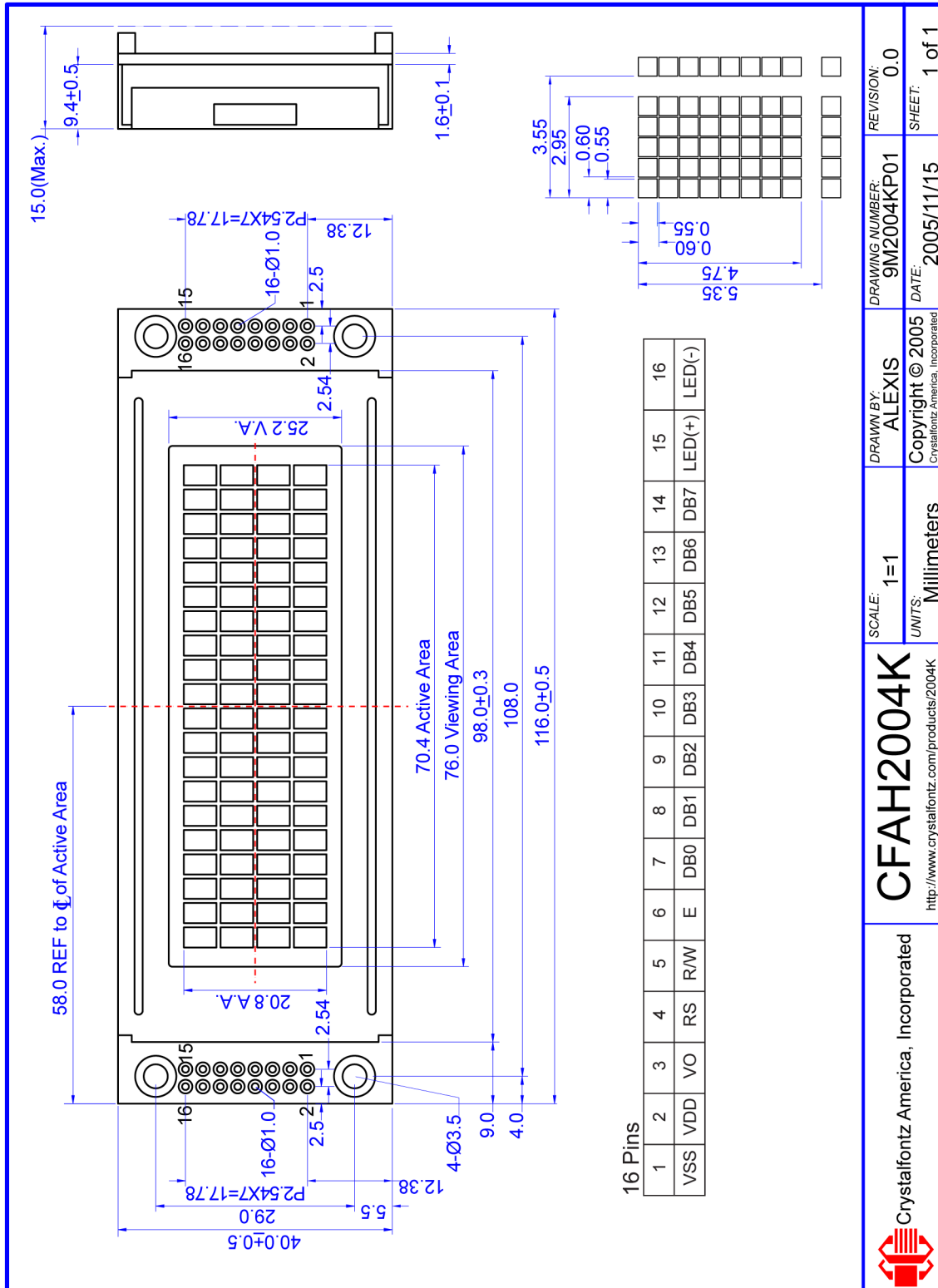


Figure 10. CFAH2004K Module Outline Drawing

## CARE AND HANDLING PRECAUTIONS

---

For optimum operation of the CFAH2004K-YYH-JP# and to prolong its life, please follow the precautions described below.

### ELECTROSTATIC DISCHARGE (ESD)

Please use industry standard antistatic precautions as you would for any other PCB such as expansion cards or motherboards. Ground your body, work surfaces, and equipment.

### DESIGN AND MOUNTING

- To protect the polarizer from damage, the CFAH2004K-YYH-JP# ships with a protective film over the LCD glass. Please peel off the protective film slowly. Peeling off the protective film abruptly may generate static electricity.
- Place a transparent plate (for example, acrylic, polycarbonate, or glass) in front of the CFAH2004K-YYH-JP#, 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 CFAH2004K-YYH-JP#.
- Do not modify the tab of the metal holder or make connections to it.
- Solder only to the I/O terminals. Use care when removing solder—it is possible to damage the PCB.
- Do not reverse polarity to the power supply connections. Reversing polarity will immediately ruin the module.

### AVOID SHOCK, IMPACT, TORQUE, AND TENSION

- Do not expose the CFAH2004K-YYH-JP# to strong mechanical shock, impact, torque, and tension.
- Do not drop, toss, bend, or twist the CFAH2004K-YYH-JP#.
- Do not place weight or pressure on the CFAH2004K-YYH-JP#.

### IF LCD PANEL BREAKS

- If the LCD panel breaks, be careful to not get the liquid crystal fluid in your mouth or eyes.
- If the liquid crystal fluid touches your skin, clothes, or work surface, wash it off immediately using soap and plenty of water.
- Do not eat the LCD panel.

### CLEANING

- To clean the front of the LCD, a standard household glass cleaner works well. Gently wipe with a nonabrasive soft cloth.
- The exposed surface of the LCD “glass” is actually the front polarizer laminated to the glass. The polarizer is made out of a fairly soft plastic and is easily scratched or damaged. The polarizer will eventually become hazy if you do not take great care when cleaning it. Long contact with moisture (from condensation or cleaning) may permanently spot or stain the polarizer.

## OPERATION

- Your circuit should be designed to protect the CFAH2004K-YYH-JP# from ESD and power supply transients.
- Observe the operating temperature limitations: a minimum of -20°C to +70°C maximum with minimal fluctuations. Operation outside of these limits may shorten the life and/or harm the display.
  - 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

- Store in an ESD-approved container away from dust, moisture, and direct sunlight.
- Observe the storage temperature limitations: a minimum of -30°C minimum to +80°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 CFAH2004K-YYH-JP#s while they are in storage.

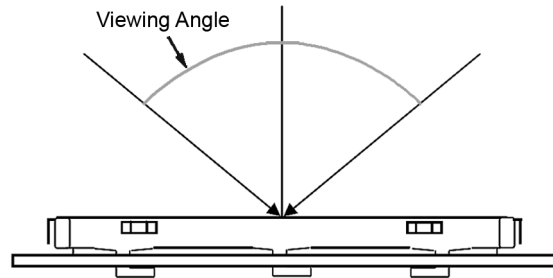


# APPENDIX A: QUALITY ASSURANCE STANDARDS

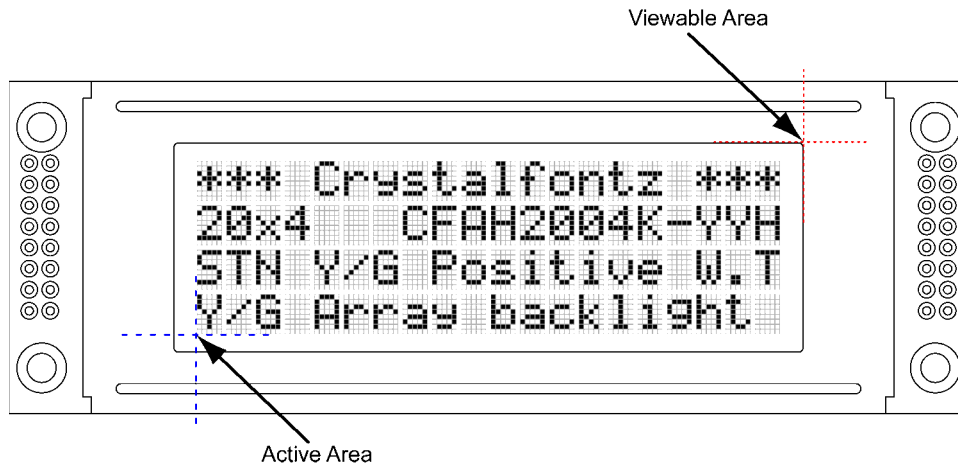
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## INSPECTION CONDITIONS

- Environment
  - Temperature:  $25\pm 5^{\circ}\text{C}$
  - Humidity: 30~85% RH
- 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:  $30\pm 5$  cm (about 12 inches)
  - Viewable angle: inspect at  $45^{\circ}$  angle of vertical line right and left, top and bottom



## DEFINITION OF ACTIVE AREA AND VIEWABLE AREA





## ACCEPTANCE SAMPLING


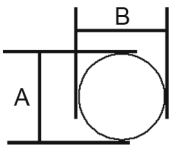
DEFECT TYPE	AQL*
Major	≤.65%
Minor	<1.0%
* Acceptable Quality Level: maximum allowable error rate or variation from standard	

## DEFECTS CLASSIFICATION

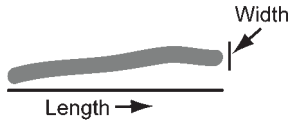
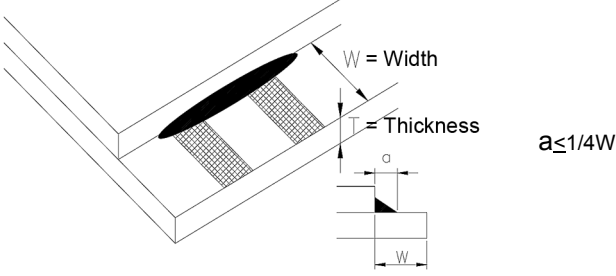
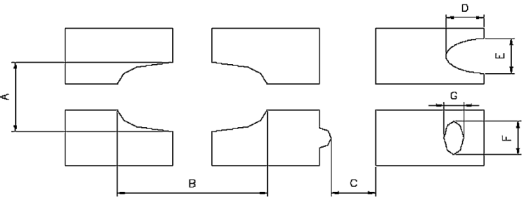
Defects are defined as:

- 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	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. (See <a href="#">Inspection Conditions (Pg. 20)</a> ).		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	



#	DEFECT TYPE	CRITERIA			MAJOR / MINOR
6	Dark lines or scratches in display area  	<i>Defect Width (mm)</i>	<i>Defect Length (mm)</i>	<i>Acceptable Qty</i>	Minor
		$\leq 0.03$	$\leq 3.0$	3	
		0.03 to 0.05	$\leq 2.0$	2	
		0.05 to 0.08	$\leq 2.0$	1	
		0.08 to 0.10	$\leq 3.0$	0	
		$\geq 0.10$	$> 3.0$	0	
7	Bubbles between polarizer film and glass	<i>Defect Size (mm)</i>	<i>Acceptable Qty</i>	Minor	
		$\leq 0.20$	Ignore		
		0.20 to 0.40	3		
		0.40 to 0.60	2		
		$\geq 0.60$	0		
8	Glass rest defect				Minor
9	Display pattern defect				Minor
		<i>Dot Size (mm)</i>	<i>Acceptable Qty</i>		
		$((A+B)/2) \leq 0.2$	$\leq 3$ total defects $\leq 2$ pinholes per digit		
		$C > 0$			
		$((D+E)/2) \leq 0.25$			
		$((F+G)/2) \leq 0.25$			



#	DEFECT TYPE	CRITERIA	MAJOR / MINOR												
10	Chip in corner		Minor												
		<table border="1"> <thead> <tr> <th><i>a</i></th> <th><i>b</i></th> <th><i>c</i></th> <th>Acceptable Qty</th> </tr> </thead> <tbody> <tr> <td>&lt;4 mm</td> <td><math>\leq W</math></td> <td><math>c \leq T</math></td> <td>3</td> </tr> </tbody> </table>		<i>a</i>	<i>b</i>	<i>c</i>	Acceptable Qty	<4 mm	$\leq W$	$c \leq T$	3				
		<i>a</i>		<i>b</i>	<i>c</i>	Acceptable Qty									
<4 mm	$\leq W$	$c \leq T$	3												
11	Chip on "non-contact" edge of LCD		Minor												
		<table border="1"> <thead> <tr> <th><i>a</i></th> <th><i>b</i></th> <th><i>c</i></th> <th>Acceptable Qty</th> </tr> </thead> <tbody> <tr> <td><math>\leq 3</math> mm</td> <td><math>\leq 1</math> mm</td> <td><math>\leq T</math></td> <td>Ignore</td> </tr> <tr> <td><math>\leq 4</math> mm</td> <td><math>\leq 1.5</math> mm</td> <td><math>\leq T</math></td> <td>3</td> </tr> </tbody> </table>		<i>a</i>	<i>b</i>	<i>c</i>	Acceptable Qty	$\leq 3$ mm	$\leq 1$ mm	$\leq T$	Ignore	$\leq 4$ mm	$\leq 1.5$ mm	$\leq T$	3
		<i>a</i>		<i>b</i>	<i>c</i>	Acceptable Qty									
		$\leq 3$ mm		$\leq 1$ mm	$\leq T$	Ignore									
$\leq 4$ mm	$\leq 1.5$ mm	$\leq T$	3												
12	Chip on "contact" edge of LCD, on the active side		Minor												
		<table border="1"> <thead> <tr> <th><i>a</i></th> <th><i>b</i></th> <th><i>c</i></th> <th>Acceptable Qty</th> </tr> </thead> <tbody> <tr> <td><math>\leq 2</math> mm</td> <td><math>\leq W/4</math></td> <td><math>\leq T</math></td> <td>Ignore</td> </tr> <tr> <td><math>\leq 3</math> mm</td> <td><math>\leq W/4</math></td> <td><math>\leq T</math></td> <td>3</td> </tr> </tbody> </table>		<i>a</i>	<i>b</i>	<i>c</i>	Acceptable Qty	$\leq 2$ mm	$\leq W/4$	$\leq T$	Ignore	$\leq 3$ mm	$\leq W/4$	$\leq T$	3
		<i>a</i>		<i>b</i>	<i>c</i>	Acceptable Qty									
		$\leq 2$ mm		$\leq W/4$	$\leq T$	Ignore									
$\leq 3$ mm	$\leq W/4$	$\leq T$	3												



#	DEFECT TYPE	CRITERIA	MAJOR / MINOR												
13	Chip on "contact" edge of LCD, on the inactive side		Minor												
		<table border="1"> <thead> <tr> <th>a</th> <th>b</th> <th>c</th> <th>Acceptable Qty</th> </tr> </thead> <tbody> <tr> <td>≤3 mm</td> <td>≤1 mm</td> <td>≤T</td> <td>Ignore</td> </tr> <tr> <td>≤4 mm</td> <td>≤1.5 mm</td> <td>≤T</td> <td>3</td> </tr> </tbody> </table>		a	b	c	Acceptable Qty	≤3 mm	≤1 mm	≤T	Ignore	≤4 mm	≤1.5 mm	≤T	3
		a		b	c	Acceptable Qty									
		≤3 mm		≤1 mm	≤T	Ignore									
≤4 mm	≤1.5 mm	≤T	3												
<table border="1"> <thead> <tr> <th>a</th> <th>b</th> <th>c</th> <th>Acceptable Qty</th> </tr> </thead> <tbody> <tr> <td>&lt;3 mm</td> <td>≤1.5 mm</td> <td>≤1/2 T</td> <td>3</td> </tr> </tbody> </table>	a	b	c	Acceptable Qty	<3 mm	≤1.5 mm	≤1/2 T	3							
a	b	c	Acceptable Qty												
<3 mm	≤1.5 mm	≤1/2 T	3												
Unacceptable if c>50% of glass thickness or if the seal area is damaged.															
14	Chip in seal area		Minor												
		<table border="1"> <thead> <tr> <th>a</th> <th>b</th> <th>c</th> <th>Acceptable Qty</th> </tr> </thead> <tbody> <tr> <td>&lt;3 mm</td> <td>≤1.5 mm</td> <td>≤1/2 T</td> <td>3</td> </tr> </tbody> </table>		a	b	c	Acceptable Qty	<3 mm	≤1.5 mm	≤1/2 T	3				
		a		b	c	Acceptable Qty									
<3 mm	≤1.5 mm	≤1/2 T	3												
Unacceptable if c>50% of glass thickness or if the seal area is damaged.															
15	Backlight defects	<ol style="list-style-type: none"> <li>1. Light fails or flickers. (Major)</li> <li>2. Color and luminance do not correspond to specifications. (Major)</li> <li>3. Exceeds standards for display's blemishes or foreign matter (<a href="#">see test 5, Pg. 21</a>), and dark lines or scratches (<a href="#">see test 6, Pg. 22</a>). (Minor)</li> </ol>	See list												
16	COB defects	<ol style="list-style-type: none"> <li>1. Pinholes &gt;0.2 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												
17	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. (Minor)</li> <li>4. Solder (if any) on bezel, LED pad, zebra pad, or screw hole pad is not smooth. (Minor)</li> </ol> <p>*Minor if display functions correctly. Major if the display fails.</p>	See list												





#	DEFECT TYPE	CRITERIA	MAJOR / MINOR
18	Soldering defects	1. Unmelted solder paste. 2. Cold solder joints, missing solder connections, or oxidation.* 3. Solder bridges causing short circuits.* 4. Residue or solder balls. 5. Solder flux is black or brown. *Minor if display functions correctly. Major if the display fails.	Minor

## **APPENDIX B: SUNPLUS SPLC780C CONTROLLER DATA SHEET**

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The complete *Sunplus SPLC780C 16COM/40SEG Controller/Driver Data Sheet* (47 pages) follows.