

**VGA Cholesteric Display Modules and Controller Assemblies****Display Module with Integrated Controller****Product Description**

**640 x 480 (VGA) Display Modules** are for general purpose graphic and character display applications. All Kent Displays Cholesteric Liquid Crystal Display (ChLCD) products take advantage of the technology's unique "No Power" attribute without compromising superior optical performance even in direct sunlight.

**The 640 x 480 Controller** is available in two configurations – RS232 and Local Serial (TTL).

Display modules with the integrated controller require a communication cable, CD-ROM, and DC power supply for operation.

**Demonstration Kit**

**The 640 x 480 Demonstration Kit** contains everything you need to quickly evaluate the features and capabilities of the 640 x 480 system.

Each demonstration kit contains a 640 x 480 display module with RS232 controller (part #'s 015346-5V-H-xxx and 10120-14), attached AA cell holder and batteries, communication cable, (part # 010123), and CD-ROM with user interface software & related documents (part # 03930).

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**Product Features**

**Display Module:**

- 640 Columns x 480 Rows
- 85 DPI (dots per inch)
- Approximate Overall Size: 9.74x6.85x0.3 Inches
- Available in Four Colors
- 5V Logic Interface
- Low Profile Modular Design
- Superior Brightness
- Excellent Optical Quality
- Viewing Cone Comparable to Paper
- Full or Partial Screen Update Capability
- Indefinite Image Memory ("No Power")

**Controller:**

- Font Generator & Graphic Image Capability
- Communication Options
  - RS-232 Interface
  - Local Serial Interface
- Automatic Sleep Mode
- LED Indicators to Support Operation & Control
- Input Voltage: 3.5 - 9 VDC
- Built-In Test Mode

**Typical Applications**

- General Purpose Indoor or Outdoor Signage
- Machine Interface Displays
- Battery Powered, Portable Displays
- Instrumentation Displays
- Point of Sale Displays
- e-Book Reader Display

**Ordering Information:**

Display Module*	
Part #	Description
01534602166	Module, 640x480 Yellow/Black
01534602167	Module, 640x480 White/Blue
01534602168	Module, 640x480 Yellow-Grn/Blk
01534602169	Module, 640x480 Green/Black

Controller* – RS232 & Local Serial	
Part #	Description
01012014	Controller, RS232, 19.2K
01012016	Controller, TTL, 19.2K

Demonstration Kit	
Part #	Description
090022166	Demo Kit, 640x480 Yellow/Black
090022167	Demo Kit, 640x480 White/Blue
090022168	Demo Kit, 640x480 Yellow-Grn/Blk
090022169	Demo Kit, 640x480 Green/Black

Related Items	
Part #	Description
01012301	Communication Cable
03930	Software CD

\*All 640 x 480 display modules (0153465VHxxx) require a controller, serial communication cable and DC power supply for operation.

Contact Kent Displays at [sales@kentdisplays.com](mailto:sales@kentdisplays.com) for complete sign assemblies, custom configurations, pricing, and additional information.

**Display Modules and Controllers**

<b>General Specifications</b>	
<b>Parameter</b>	<b>Description</b>
Display Type	Cholesteric Reflective LCD
Format	640 columns x 480 rows
Resolution	84.7 dots per inch, or 0.30 mm between pixel center-lines
Image Area	7.6 in x 5.7 in (191.97 mm x 143.97 mm) [239.96 mm or 9.4 in diagonal]
Display Module Weight	10.5 oz (297.5 grams)
Operating Temperature Range	0°C to +60°C (custom operating temperatures available)
Storage Temperature Range	-40°C to +100°C
Full Image Update Rate	2.8 sec (@ 23°C, refer to graph on page 6 for more details)
Maximum Number of Display Modules per Controller	1
Sleep Mode Activated After	20 sec

<b>640x480 Display Module Power Requirements<sup>1</sup></b>			
<b>Parameter</b>	<b>Minimum</b>	<b>Typical</b>	<b>Maximum</b>
Power Source Voltage Range ( $V_{DD}$ ) – (RS-232 & Local Serial variations)	3.5 VDC	6.0 VDC	9.0 VDC
High Level Logic Input Voltage ( $V_{IH}$ )	4.75 VDC	-	-
Low Level Logic Input Voltage ( $V_{IL}$ )	-	-	0.8 VDC
Average Operating Power (while driving image)	-	285 mW	-

<b>Controller Power Requirements<sup>1</sup></b>			
<b>Parameter</b>	<b>Minimum</b>	<b>Typical</b>	<b>Maximum</b>
Power Source Voltage ( $V_{DD}$ )	3.6 VDC	6.0 VDC	9.0 VDC
Average "Wake-up" mode power consumption when updating a display module	-	129 mW	-
Average "Idle" mode power consumption	-	114 mW	-
"Sleep Mode" power consumption display module & controller	-	< 6 $\mu$ W	-

<b>Controller Communication Interface Information</b>	
<b>Parameter</b>	<b>Description</b>
Serial communication format	RS-232: Asynchronous, full duplex, 8 data bits, 1 stop bit, no parity.
Baud rate	19.2 Kbps
Protocol format	Kent Displays character/graphics serial protocol. (Refer to Data Sheet 25016 for details).
Mating communication plug	2mm pitched 3-conductor plug, Hirose P/N DF3-3S-2C w/ DFS-2428SC crimped contacts, or equivalent, (RS232) 2mm pitched 4-conductor plug, Hirose P/N DF3-4S-2C w/ DFS-2428SC crimped contacts, or equivalent, (TTL)

\*Specifications are subject to change without prior notice.

<sup>1</sup> Values given assume 25 °C Temp.

**Controller:**

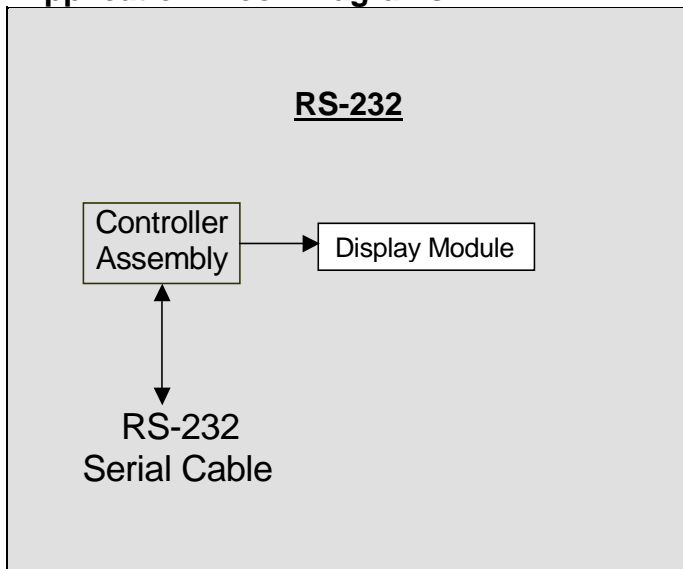
<b>Power Supply Header: J6</b>		
Pin #	Symbol	Description
1	+ Power (V <sub>DD</sub> )	Positive power termination.
2	- Power (GND-Return)	Negative power termination.

<b>Communication Header Interface: J4 (RS232)</b>		
Pin #	Symbol	Description
1	RX_DATA	Module receive- data input termination (RS-232).
2	Ground	Ground termination point (RS-232 use only).
3	TX_DATA	Module transmit- data output termination (RS-232).

<b>Communication Header Interface: J2 (Local Serial)</b>		
Pin #	Symbol	Description
1	RX_DATA	Module receive- data input termination. Module Wake Input, (Based on "Parked High" condition). Wakes with Low Input, or when input is <~0.7 VDC).
2	Ground	Ground termination point (RS-232 use only).
3	TX_DATA	Module transmit- data output termination (0-5 Volt Logic Input).
4	+5 VDC	Power Source Input, (for Level Shifters circuit). Not Available in Sleep Mode.

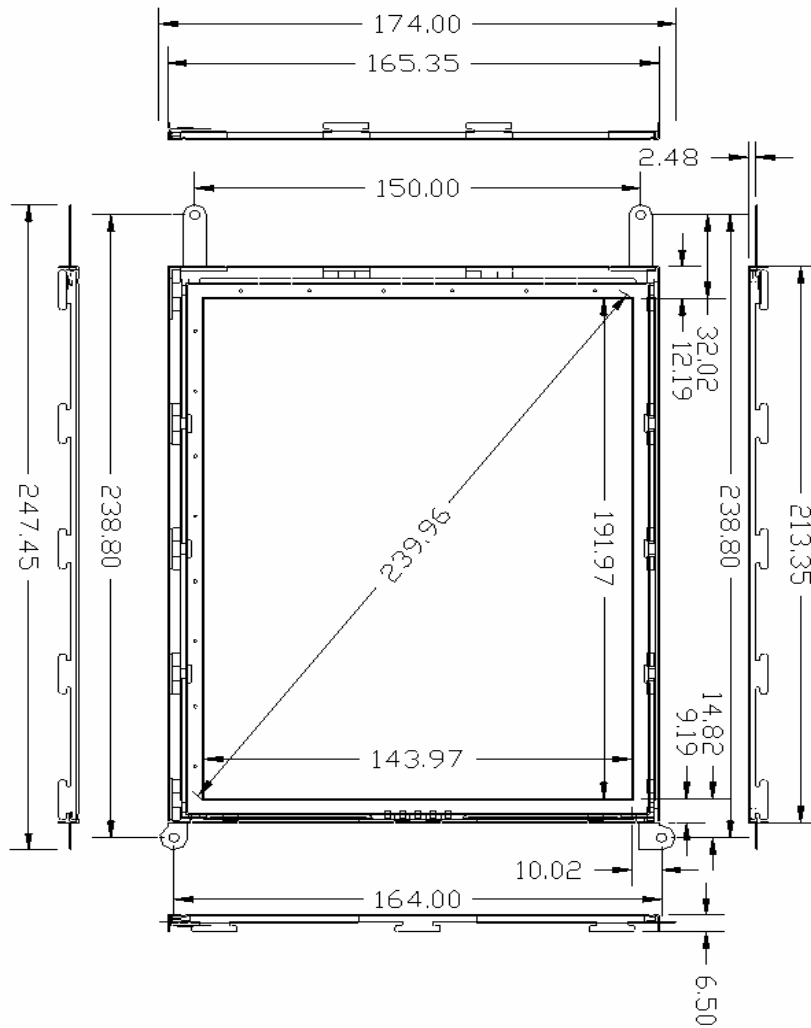
<b>Local on Board Control Descriptions</b>	
Symbol	Description
"RESET"	Controller reset button.
"TEST"	Controller diagnostic button input for onboard control.
"WAKE-UP"	Module local wakeup button input.
D3, "LED"	LED diagnostic output controlled for onboard feedback.

**Application Block Diagrams**

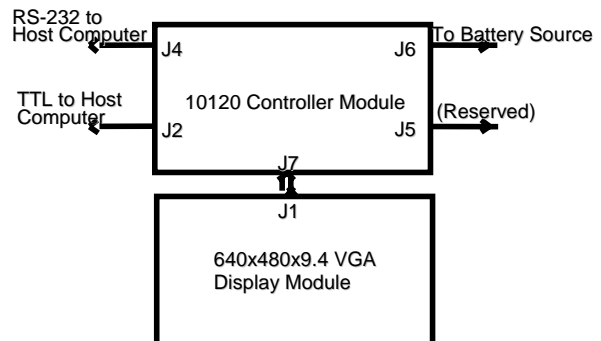
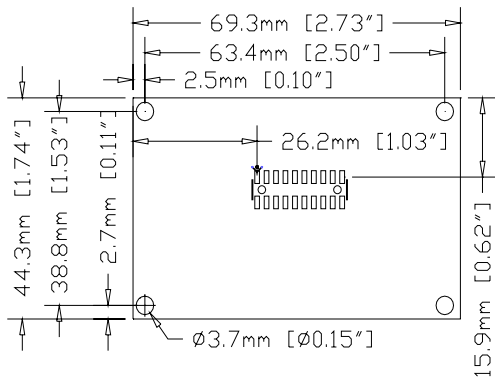


**Mechanical Dimensions:**

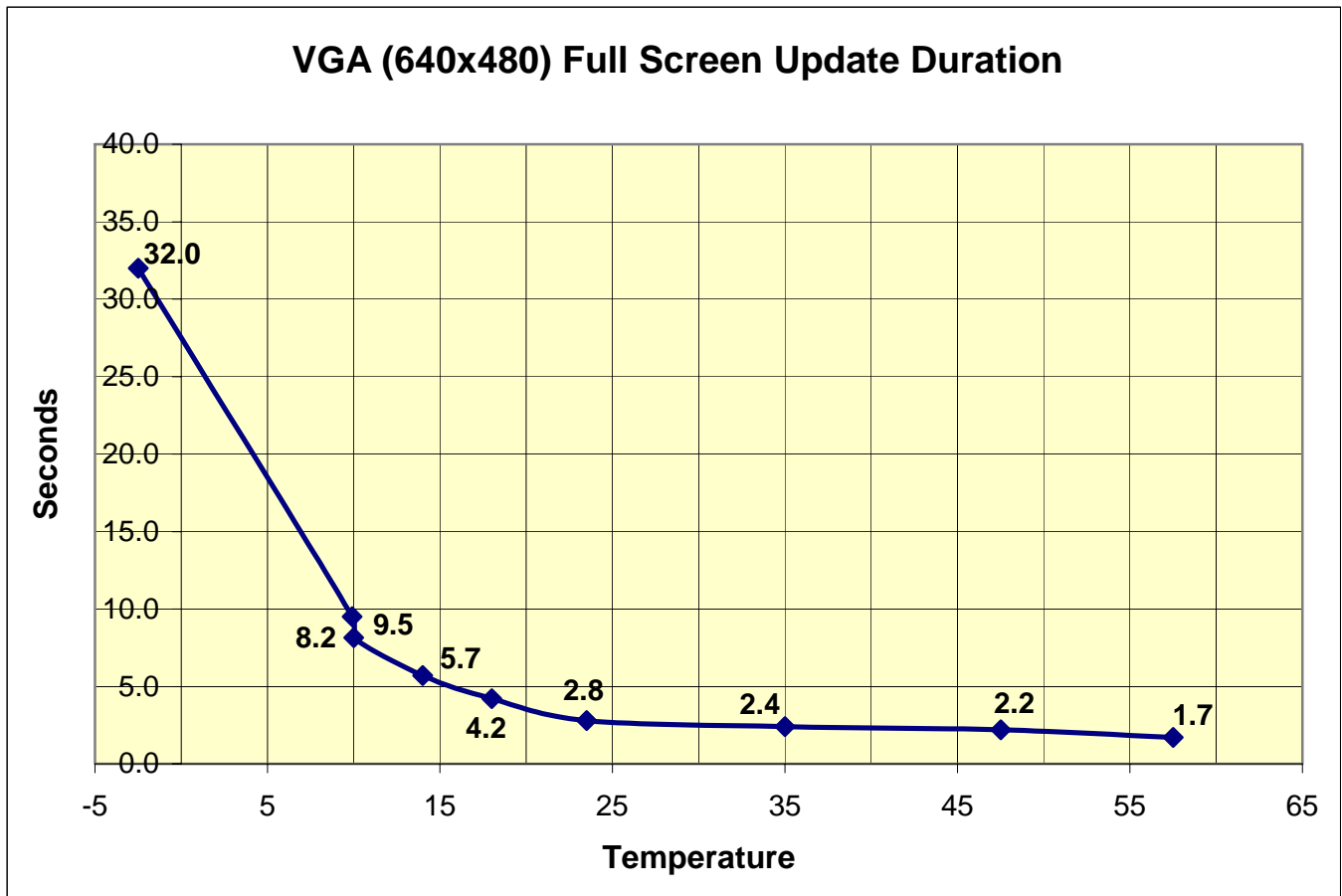
**640x480 Display Module**



**10120 Display Controller**



**Image Update Information**



The chart above illustrates measured full screen update durations with respect to temperature for 640 x 480 display module. The update duration is approximately 2.8 seconds at room temperature.

**FRONT COVER MATERIAL SELECTION:**

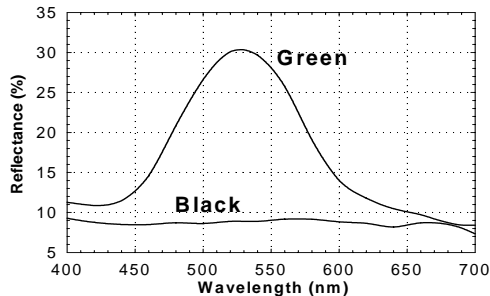
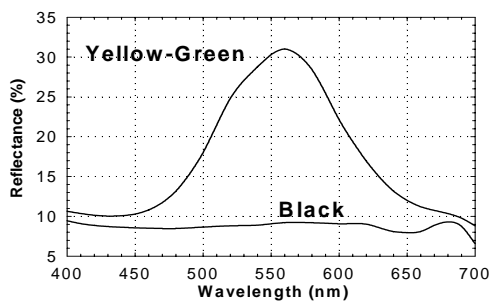
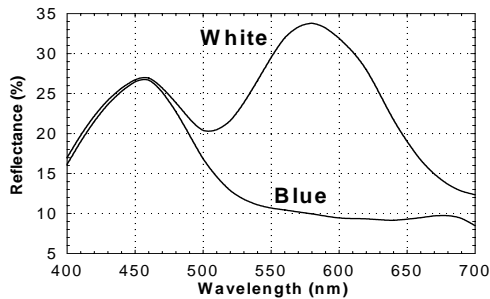
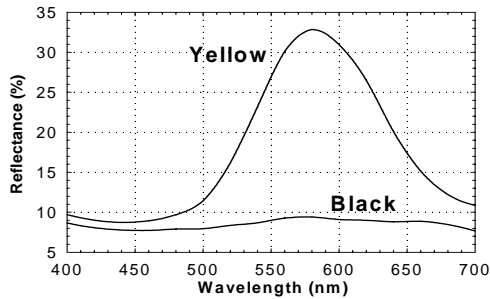
The following front cover requirements are necessary to insure image quality during the life of the 640x480 display module:

1. Cholesteric Liquid Crystal materials require protection from UV light. A UV blocking material with a minimum 98% cutoff at 380nm and lower spectral components is required.
2. The finished product design should incorporate a transparent cover such as acrylic, polycarbonate, etc., to protect the viewing area of the display. Place the protective cover as close to the display module as possible. The protective cover should be of sufficient thickness to resist flexing, or if flexed should not touch the surface of the display. Acrylite® OP-3 P-99 matte finish and Acrylite® OP-3 material without matte finish are examples of a recommended protective cover material.

Adding an anti-glare and/or anti-reflective surface film or finish to the viewing side of the protective cover may improve the optical performance in certain display applications and lighting conditions.

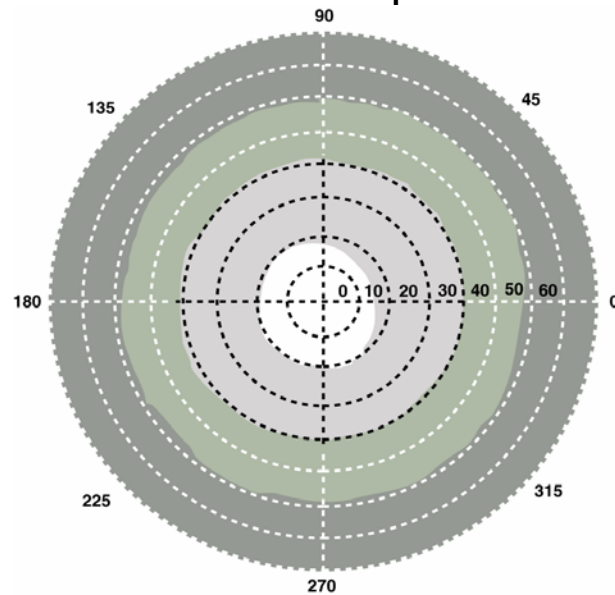
### Optical Characteristics for Standard Color Configurations

The graphs to the left outline the spectral reflectance characteristics for a given display pixel when switched to either of the two possible stable states: reflective planar or transparent focal conic. The top line in each chart outlines the reflective characteristic of the planar state. The bottom line outlines the reflective characteristic of the transparent focal conic state. Graphs for the 4 standard color combinations are illustrated.



*The above reflectance curves are from a single pixel. Actual reflectance will vary depending on display resolution, aperture ratio, and other factors.*

### Contrast Ratio Polar Representation



As illustrated in the polar graph above, all Kent Displays' ChLCD products have a 360-degree viewing cone. When measured normal to the plane of the display, the monochromatic contrast ratio is as high as 25:1 with a peak reflectivity approaching 35% of the incident light. The contrast ratio reduces as the viewing angle approaches the plane of the display but is still excellent at 11:1. Since no polarizers are used, display contrast reduces uniformly in all azimuthal directions when the viewing angle is increased.

Products and technologies of Kent Displays, Inc. are protected by the US Patents: 5,493,430, 5,570,216, 5,636,044, 5,644,330, 5,251,048, 5,384,067, 5,437,811, 5,453,863, 5,668,614, 5,691,796, 5,695,682, 5,748,277, 5,766,694, 5,847,798 and numerous other patent applications by Kent Display Systems, Inc., Kent Displays, Inc. and Kent State University pending in the U.S. and in foreign patent filings include: PCT, Canada, China, Europe, Israel, Japan, Korea, and Taiwan among others.