

## VGA Cholesteric Display & Controller Modules for Graphic, Text and Terminal Applications

### Typical Applications

- Battery Powered, Portable Displays
- General Purpose Indoor or Outdoor Signage
- Point of Sale Displays
- Instrumentation Displays
- eBook
- VT100 Compatible Terminal Display

### Product Description

The Kent Displays, Inc. 640x480x9.4 VGA (640x480) cholesteric displays are modular units designed for general-purpose graphic and character display applications. A controller module version is also available for "Dumb Terminal" applications. Intended uses include eBook, instrumentation, point of sale, terminal and other general-purpose indoor/outdoor display applications.

As with all Kent Display cholesteric (ChLCD) products, the VGA module contains the same optical and power saving advantages over traditional LCD products. After an image is generated on the module, it will remain indefinitely after power is removed, until a new image is created.



640x480x9.4 VGA Display Module

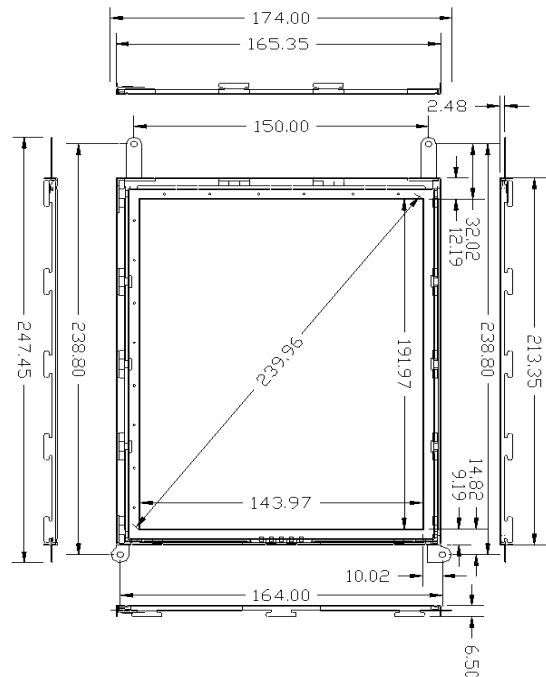
### Display Only Features:

- 640 x 480 pixels, 85 dpi, 240 mm (9.45") diagonal image area.
- Battery powered capability (3.5-9 VDC).
- Operates using 5V logic (3V as non-standard).
- Graphic or character generation capability.
- Full or Partial Screen Update Capability
- **Dynamic Update Capability, including:**  
*Wipe, Scroll, Rotate, Open, Close, Flashing, Swell and Fade.*
- Indefinite image memory capability.
- 360 degree unlimited viewing angle.
- Superior brightness & optical characteristics

### Display w/Optional Controller Features:

- Up to 31 controllers can be controlled from a host computer (Unique Address capability).
- Battery powered capability (3-9 VDC Input).
- Automatic Wake/Idle & Sleep mode capability.
- Local diagnostics and control.
- \*Stores up to 27 unique messages per display.
- 640, 2048, 3840 or 6360 Characters/Display w/ Text Generator.
- 4 unique fonts, and font controls w/ Text Generator.
- Automatic message generation capability.
- RS-232, RS-485, TTL and/or RF "wireless" interface.
- VGASoft, Windows-Based Software supplied with product, provides the following features:  
*Text and Graphical Editor.*  
*Message/ Image Storage & Retrieval.*
- VT100 Compatible Terminal Emulation (w/10120-26)

\* Based on controller module, storing full screen, larger font text messages



VGA Display Mechanical Drawing (in mm)

### Product Ordering Information:

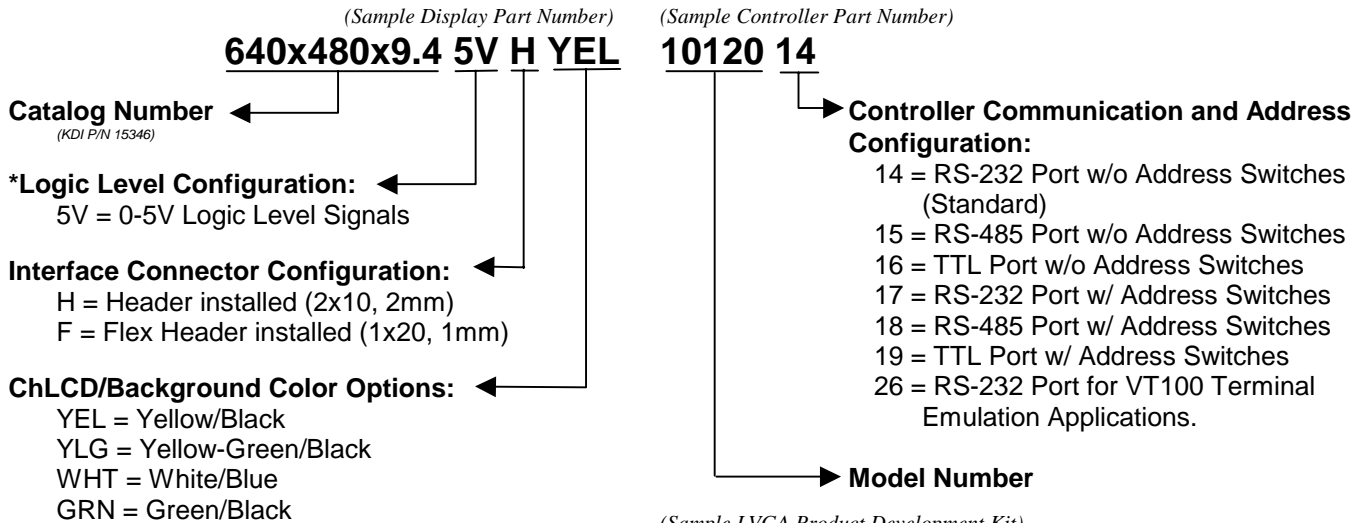
See detailed Ordering Information & list on next sheet.

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 Kent, OH 44240, USA  
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# 640x480x9.4

## VGA Cholesteric Display & Controller Modules for Graphic, Text and Terminal Applications

### 640x480 Product Ordering Information:



(Sample LVGA Product Development Kit)

**90022-WHT**

(RF Slave Module Part Number)

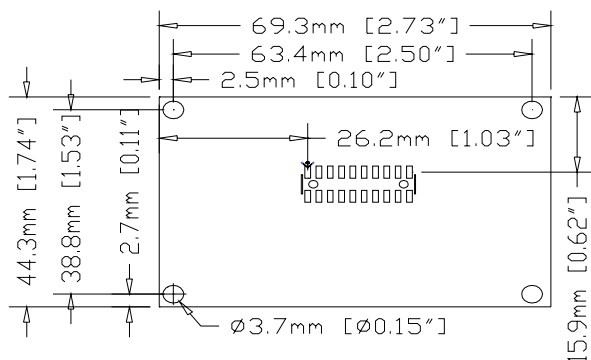
**10158**

(RF Host Box Part Number)

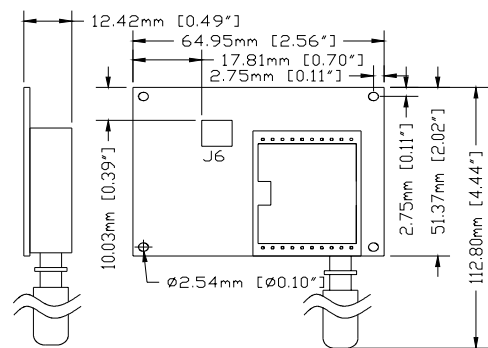
**10146**

\* - A non-standard "3V-F" configuration is available per request.

Typical VGA Module and Related Product Ordering Examples:	
640x480x9.4-5V-F-YLG	VGA Yellow-Green/Black Display Module, 5V interface, 1 mm pitched flex header installed (contacts away from display).
640x480x9.4-5V-H-GRN	VGA Green/Black Display Module, 5V interface, 2x10, 2 mm pitched header installed (standard).
10120-14	Standard 640x480 Controller Module, with RS-232 port, without address switches.
90022-YEL	640x480 Product Development Kit with Yellow/Black Display (1 "5V-H" display, standard controller, software, COMM & power cables, documentation and technical support are provided).



**10120 Controller Mechanical Drawing**



**10158 RF Slave Mechanical Drawing**

# 640x480x9.4

## VGA Cholesteric Display & Controller Modules for Graphic, Text and Terminal Applications

### General Specifications – 640x480x9.4 Display Modules

Parameter	Value/Description	Units
Display Panel Resolution and Format	Cholesteric reflective LCD (ChLCD) material with contrasting color background, 640 columns by 480 rows.	
Pixel Pitch	.30 (84.67 DPI)	mm
Pixel Size	0.27 x 0.27 mm	mm
ChLCD Image Area Dimensions	191.97 x 143.97 (239.96 mm, 9.45" diagonal)	mm
Display Viewing Area Dimensions	192.97 x 144.97	mm
Bezel Outside Dimensions	213.35 x 165.35	mm
Display Module Weight	297.5 (0.656lb)	g
*Operating Temperature Range	0 to 70	°C
**Image Clearing Temperature All Display Configurations	~90-95	°C
Storage Temperature Range	-40 to +100**	°C
Illumination Source	None (reflective technology).	
Full Image Update Rate: Typical all module types	Less than 2.8 (in 1x mode, @ 23.5 °C. ½ the duration if 2x mode, ... 1/8 the duration in 8x mode. Refer to graph on subsequent sheet)	Sec.
UV Protection Recommendations	98% blocking of 380 nm and lower spectral components is recommended	
Recommended Transparent Plastic Display Cover	Acrylite OP-3-P-99, matte finish, with UV blocker, or equivalent	
Recommended Mating Connector Socket	"-F" configurations: 1.0 mm pitched 20 conductor flex, Parlex p/n 1.00mm-20-87-B-OS or equiv., matching header, Molex P/N 71220-2000 or equiv. "-H" configurations: 2.0 mm pitched, 2x10 socketed header, Samtec P/N TLE-110-01-GT-DV, or equivalent ribbon cable plug, Samtec P/N TCSD-10-01-N	

\*. Displays and controllers have been tested to operate between -20-70 °C, however electronics can only be guaranteed between 0 and 70 °C. Image quality may degrade at temperatures above 70 °C.

\*\* Display will not retain image if the display temperature is greater than specified clearing temperature.

### Electrical Characteristics – 640x480x9.4 Display Modules

Parameter	Min.	Typ.	Max.	Units	Condition
Power Source Voltage (V <sub>CC</sub> )	4.75	5.0	5.25	V DC	T <sub>A</sub> = 25 °C
Power Source Voltage (V <sub>DD</sub> )	3.5		9.0	V DC	T <sub>A</sub> = 25 °C
High Level Logic Input Voltage (V <sub>IH</sub> )	4.75			V DC	
Low Level Input Voltage (V <sub>IL</sub> )			0.8	V DC	
*Average Operating Power, Enabled Active (P <sub>EA</sub> )		285	1055	mW	EN_PWR = High, checkerboard image driven on display
**Average Operating Power, Enabled Inactive (P <sub>EI</sub> )		175		mW	EN_PWR = High, All inputs at steady state
***Average Operating Power, Not Enabled (P <sub>NE</sub> )		0.015		mW	EN_PWR = Low
Power w/ Display Disconnected & Maintaining Image			0	mW	V <sub>CC</sub> & V <sub>DD</sub> removed from display.

\* Indicates power draw from V<sub>DD</sub> while the display is updating (EN\_PWR & ENABLE active). . Max power output is during brief bulk erase (~100ms @ 25 C°)

\*\* Indicates power draw from V<sub>DD</sub> while the display is not updating & EN\_PWR is active & ENABLE inactive.

\*\*\* Indicates power draw from V<sub>DD</sub> while the display is not updating & EN\_PWR inactive.

Note: All measurements taken with DMM at 5V V<sub>CC</sub>, 3.5V V<sub>DD</sub>

# 640x480x9.4

## VGA Cholesteric Display & Controller Modules for Graphic, Text and Terminal Applications

### Interface Connections – 640x480x9.4-5V-H, Configuration Display Module (J1)

Pin #	Symbol	I/O	Description
15	HV_CTL	I	Optional (recommended) Function Pin that can be used to control the High Voltage Converter Amplitude (Connect to V <sub>SS</sub> if not used).
7	LATCH	I	“Latch” column image data to ChLCD material and reset the column data pointer (triggered at trailing edge).
13	C_CLK	I	Clock Column data present on the 8-bit data bus (trailing edge triggered).
9	PHASE	I	Phase. Dictates polarity and frequency of applied ChLCD waveform.
11	R_CLK	I	Clock Row data present on the row data input, D0 (trailing edge triggered).
5	ENABLE	I	When disabled (low), all driver outputs at a ground potential.
3	EN_PWR	I	Enable Power. Turn on module DC-DC converter & enable data input.
20	TEMP_CTL	O	Analog ChLCD material temperature output (not required for operation).
4	D0, Row Data	I	Data element 0 of column data bus, Row Data input.
6	D1	I	Data element 1 of column data bus.
8	D2	I	Data element 2 of column data bus.
10	D3	I	Data element 3 of column data bus.
12	D4	I	Data element 4 of column data bus.
14	D5	I	Data element 5 of column data bus.
16	D6	I	Data element 6 of column data bus.
18	D7	I	Data element 7 of column data bus.
2	V <sub>SS</sub> (power GND)	Pwr	Power return termination point
1	V <sub>DD</sub>	Pwr	Positive DC, power supply voltage (3.5 to 9 VDC, Battery or system power source)
19	V <sub>CC</sub>	Pwr	Positive 5-Volt DC, Logic Power termination point
17	No Connect	--	Spare interface termination

Notes:

1. All inputs are 0-5 Volt logic inputs, with exception of EN\_PWR.

### Interface Connections – 640x480x9.4-5V-F, Configuration Display Module (J3)

Pin #	Symbol	I/O	Description
1	HV_CTL	I	Optional (recommended) Function Pin that can be used to control the High Voltage Converter Amplitude (Connect to V <sub>SS</sub> if not used).
2	LATCH	I	“Latch” column image data to ChLCD material and reset the column data pointer (triggered at trailing edge).
3	C_CLK	I	Clock Column data present on the 8-bit data bus (trailing edge triggered).
4	PHASE	I	Phase. Dictates polarity and frequency of applied ChLCD waveform.
5	R_CLK	I	Clock Row data present on the row data input, D0 (trailing edge triggered).
6	ENABLE	I	When disabled (low), all driver outputs at a ground potential.
7	EN_PWR	I	Enable Power. Turn on module DC-DC converter & enable data input.
8	TEMP_CTL	O	Analog ChLCD material temperature output (not required for operation).
9	D0, Row Data	I	Data element 0 of column data bus, Row Data input.
10	D1	I	Data element 1 of column data bus.
11	D2	I	Data element 2 of column data bus.
12	D3	I	Data element 3 of column data bus.
13	D4	I	Data element 4 of column data bus.
14	D5	I	Data element 5 of column data bus.
15	D6	I	Data element 6 of column data bus.
16	D7	I	Data element 7 of column data bus.
17	V <sub>SS</sub> (power GND)	Pwr	Power return termination point
18	V <sub>SS</sub> (power GND)	Pwr	Power return termination point
19	V <sub>DD</sub>	Pwr	Positive DC, power supply voltage (3.5 to 9 VDC, Battery or system power source)
20	V <sub>CC</sub>	Pwr	Positive 5-Volt DC, Logic Power termination point

Notes:

1. All inputs are 0-5 Volt logic inputs, with exception of EN\_PWR.

## Detailed Product Description

The Kent Displays 640x480 Display modules are modular units designed for general-purpose text and graphic display applications. Intended uses include instrumentation devices, portable battery powered displays, point of sale and other general-purpose indoor/outdoor sign applications.

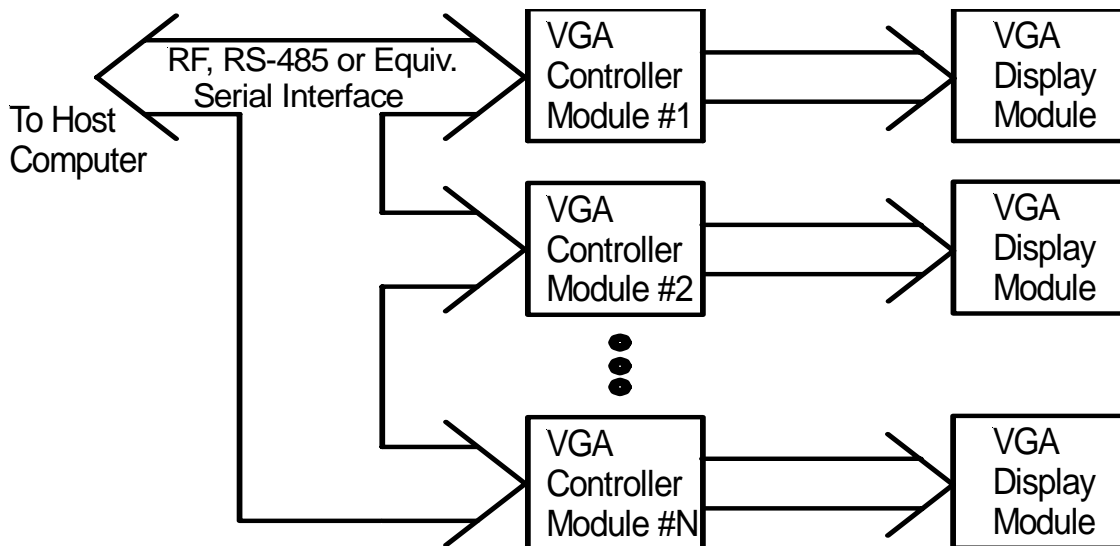
## VGA Cholesteric Display & Controller Modules for Graphic, Text and Terminal Applications

Use of the 640x480 display module without the separate 10120 controller is for customers who intend to drive the display with their own custom controller or CPU board. The pin out description for the parallel interface provided is described in the Interface Connection table above.

Kent Displays cholesteric liquid crystal displays (ChLCD) are an advanced reflective display technology, which contains a BI-stable non-volatile memory feature. After an image is written to the ChLCD, the image will remain indefinitely until a new image is generated. The image will remain on the module display after power is removed. It does not require "power consuming" update signals to retain the image as with traditional LCD technologies. Furthermore, since the technology is completely reflective, no "power robbing" backlight is required to generate a high quality image. The memory and reflective features enable the display to be very energy efficient, enabling long life battery operation.

Since a ChLCD does not reflect polarized light, it exhibits a much wider viewing angle over traditional LCD technologies. Extremely high contrast characteristics are exhibited consistently at viewing angles near the edge of the display in all directions. The display also exhibits excellent sunlight readability characteristics. The more light put onto the display face, the brighter the image will appear.

The VGA 640x480x9.4 display and 10120 Controller modules configured as indicated in Application Block Diagram will contain the following features:



Notes:  $N \leq 31$

### VGA Display w/Controller Module to Host Computer Application Block Diagram (Non-Terminal Applications)

- A full duplex asynchronous **RS-232, TTL**, half-duplex **RS-485**, or half-duplex **RF wireless serial interface** can be used to communicate between the host computer and the controller modules. The standard module protocol will support full duplex, half-duplex or simplex operations. Each module is assigned a unique address for multi-drop applications by selecting the module switch setting. 31 unique address selections are possible. Controller modules without the address switches are configured to address #1. Un-addressed modules will ignore the host commands. Broadcast messages are also supported (broadcast messages are assigned address number 0). The module communicates at a standard data rate of 19.2k baud. Other data rates, such as 38.4k, 9600 or other baud rates can be configured per request.
- **Character and graphical interface capability.** Full or partial panel graphic or text images can be generated on a given display panel. The standard Kent Displays serial protocol supports all full or partial display graphical and text generation operational modes described. The host computer can change a display image by outputting an ASCII character sequence, or graphic pixel data to the corresponding controller module. The protocol is designed to minimize the communication packet lengths, enable error checking, support multiple address locations, and provide wake-up commands to support a typical "hard wired" configuration (RS-232, RS-485 or TTL formats) or an unlicensed wireless RF communication link. Refer to Kent Displays document 25016 for a detailed communication protocol description (25016 protocol description does not apply to display & controller modules configured for "Terminal Application" using 10120-26 controller).
- The VGA modules have the capability to output text and graphic images in **Dynamic Update mode**. This mode of operation provides the user with the following update features:
  - a. Scroll On, Scroll OFF
  - b. Wipe ON, Wipe OFF
  - c. Open ON, Open OFF
  - d. Close ON, Close OFF

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- e. Rotate ON
- f. Flashing, Fade and Swell

Updating display sections in this mode provides an **animation sequence**, allowing the user to **view multiple frames of data in a moving sequence**. Kent Displays patented “**Cumulative Drive™**” techniques enables this feature. The most common application for this type of update method is to display numbers entered on a keypad in a scrolling fashion, frame by frame as the numbers are entered. Different “ON” and “OFF” presentation methods are also possible using the controller protocol and VGA Interface software provided with the products. The user simply has to enter the text, or create a graphic image (Using the Graphic editor activated by the VGASoft) to output in the static frame, and the VGA controller will create the frame sequences automatically for the user! The user can also make the image section larger (for instance, a 10 row font can be output using 20, 30, ... 80 rows of the display) by selecting the corresponding height adjustment feature on the user interface software. Parameters on flashing images, such as the Invert and non-invert image duration's and the number flashes for the respective display image can also be dictated by the user. The VGA Interface software provides a nice windows-based human interface to control these features.

- o When using the **VGA controller text generator**, the user can **select between a 30 row fonts, a 15-row font, a 10-row font and a 5x7 character font**. Using the 30-row font, up to 40 characters/line and 16 lines of text can be generated on the display. Using the 15-row font, up to 64 characters/line and 32 text lines can be output on a display. Using the 10 row font, up to 80 characters /line and 48 lines of text can be output on the displays. The 5x7 font can be used to output 106 characters/line and 60 lines of text. Using partial screen text images can also alter a text line within a full screen image. Text based objects can be “Stretched” vertically to 2x, 3x, ... 8x their size to increase the update speed by 2x, 3x,.. 8x the normal duration. However, the number of text lines per screen is ½ with the 2x feature, 1/3 with the 3x feature, ... 1/8 with the 8x feature. The user can also use the windows-based text generator on the graphic editor activated by the VGASoft to create text based graphical images for output on the display panels. All the described features are available and demonstrated with the VGASoft software, provided with the product.
- o The Kent Displays automatic “**Wake/Idle/Sleep mode**” is a standard feature, which **supports extended life battery operation**. If no messages or data is received from the host computer after a pre-determined duration, or no local diagnostic/control activity is sensed by the controller logic, the module will reduce power consumption by activating an “Idle” mode operation automatically. If the VGA controller senses no further activity, it will remove the load from the 3.5-9 volt power source. In “**Sleep mode**”, the display module will contain the image generated, and power consumption will be less than 6 microwatts (power required to maintain the sleep control circuitry, RS-232 & RS-485 versions). The module will “wake-up” and resume normal operation after it receives the host wake-up signal.
- o Automatic temperature compensation circuitry to **extend the module operating temperature range to -20 and 80 C<sup>0</sup>** (standard module electronics can only be guaranteed from 0 to 70 C<sup>0</sup>)
- o Diagnostic switches and an LED indication to support **local operation and control**.

# 640x480x9.4

## VGA Cholesteric Display & Controller Modules for Graphic, Text and Terminal Applications

### General Specifications – 10120 Controller with 640x480x9.4 Display Modules

Parameter	Value/Description	Units
30 Row Character Pixel Configuration/ Characters per Display/ Lines per Display.	16 pixels wide by 30 pixels high/ 640 Characters per Display / 16 Text Lines (1x configuration. ½ the # of Text lines if 2x configuration, ... 1/8 <sup>th</sup> text lines if 8x)	--
15 Row Character Pixel Configuration/ Characters per display/ Lines per Display	10 pixel wide by 15 pixels high/ 2048 Characters per Display/ 32 Text Lines (1x mode)	--
10 Row Character Pixel Configuration/ Characters per display/ Lines per Display	8 pixel wide by 10 pixels high/ 3840 Characters/ 48 Text Lines (1x mode)	--
5x7 Character Pixel Configuration/ Characters per display/ Lines per Display	6 pixel wide by 8 pixels high/ 6360 Characters/ 60 Text Lines (1x mode)	--
Text Generator Character Set Capability	30 Row: Modified Letter Gothic Bold 22 point. 15 Row: Modified Fixed Distance 11 point. 10 Row: Modified Fixed Distance 9 point (default). 5x7: Typical 5x7 characters.	--
Character Set Controls	<u>Underline.</u>	--
# Display Modules/ Controller	1 (more displays can be "Daisy Chained" from controller header, however additional displays will contain the same image information as display position #1).	--
Message Storage Capability	58,400 Bytes, equating to 27 Full Screen large font Text, 9 Full screen small font text, 1 Full Screen Graphic (VGA Mode), 6 Full screen graphic (1/4 VGA Mode), 474 Partial Screen Text (Dyn. Update, Flashing or Normal), 6 Partial Screen Graphic, or 45 Partial Screen Dynamic Update Graphic Messages per display.	--
<u>Operating Temperature Range</u> All controller configurations:	*-20 to 80	C°
<u>Storage Temperature Range</u>	-40 to +100 C°.	C°.
<u>Possible Controller Address Selections</u>	31 (standard, more are available per request)	
Standard Total Wakeup Duration without communication or local activity	20 (Typical)	Sec.
Standard Active Wakeup Duration Before implementing Idle Mode	10 (Typical)	Sec.

\* Indicates display electronics can only be guaranteed between 0 and 70° ambient. Update rates will be slower at lower temperature extremes. Image quality may degrade at operating temperatures above 70 C°.

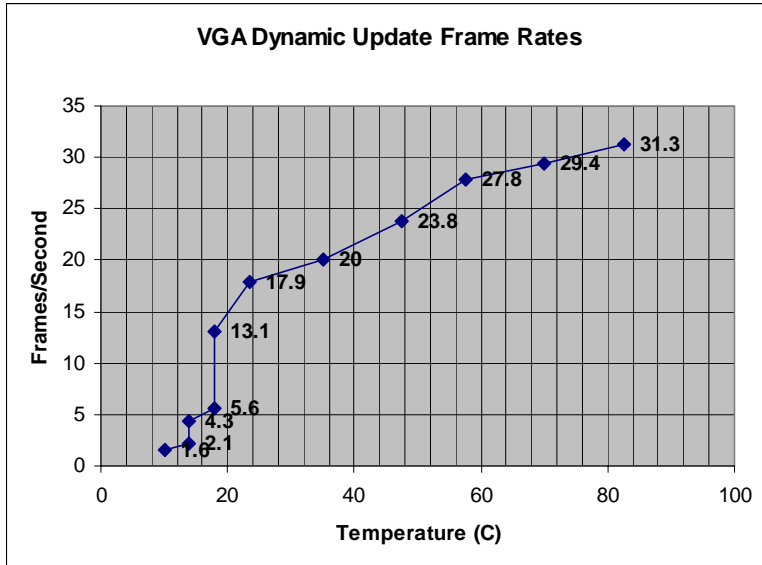
Power Requirements (10120 Controller Module)		
Power Source (V <sub>DD</sub> )	***1.1 – 10 (T = 25 C°)	VDC
**Average "Wake-up" Active Mode Power Consumption (10120-14)	129 (typical, w/ V <sub>Battery</sub> = 6.0 volts, T = 25 C°), 123 (typical, w/ V <sub>Battery</sub> = 3.0 volts, T = 25 C°)	mW
**Average "Wake-up" Idle Mode Power Consumption (10120-14)	114 (typical, w/ V <sub>Battery</sub> = 6.0 volts, T = 25 C°), 105 (typical, w/ V <sub>Battery</sub> = 3.0 volts, T = 25 C°)	mW
**Average "Sleep Mode" Power Consumption.	Less than 6 microWatts (w/ V <sub>Battery</sub> = 3.0 - 6.0 volts, T = 25 C°, RS-232, RS-485), Less than 72 microWatts (w/ V <sub>Battery</sub> = 3.0 - 6.0 volts, T = 25 C°, TTL Port Versions)	uW
Recommended Power Interface (J6)	Standard 2.54 mm pitched via's in PCB.	

\* Indicates display electronics can only be guaranteed between 0 and 70° ambient. Update rates will be slower at lower temperature extremes. Image quality may degrade at operating temperatures above 70 C°.

\*\* Values indicate average power measurements taken when not generating images (using a DVM). Power values provided for display should be added to "Active Mode" power value above, when considering total power values when image generation occurs.

\*\*\* Indicates power source must be able to supply sufficient current when battery approaches lower specified voltage limit.

### General Specifications – 10120 Controller with 640x480x9.4 Display Modules (Con't) Dynamic Update Information (“Cumulative Drive™”)



Frame rates illustrated reflect measurements taken of the dynamic update of a 10 row (or 20, 30, .. 80 row if “2x, 3x,..-8x” feature implemented) 640x480x9.4 display section during the presentation “ON” of a particular image. A slightly faster frame rate will occur when measuring the presentation “OFF” of an image. As indicated, a typical frames rate of nearly 18 frames/second can be expected at room temperatures (23.5 C<sup>o</sup>).

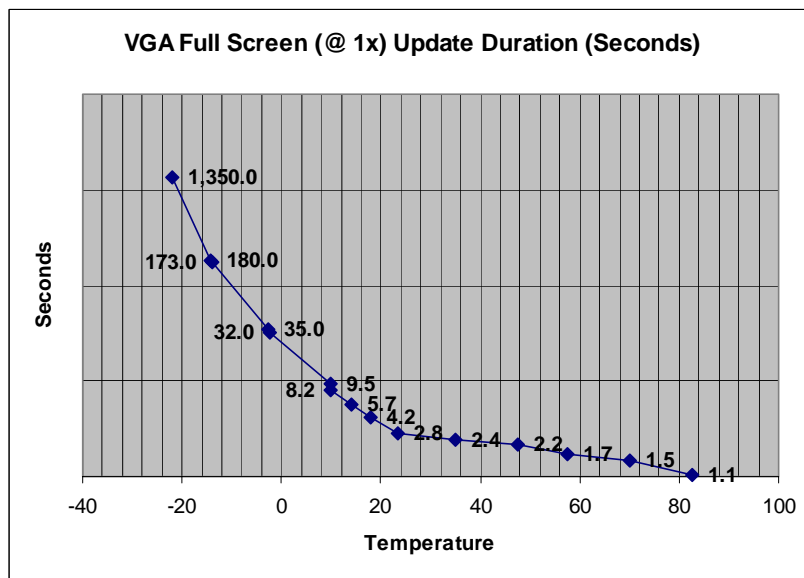
The chart to the left illustrates the maximum frame rates possible with the 10120 controllers and VGA-display combination. The following additional features are provided and can be programmed for each dynamic update message loaded into the controller RAM:

1. **Scroll, Wipe, Open, Close and Rotate** presentation methods.
2. Different ON and OFF presentation methods are available for each message (i.e. Rotate ON, Pause, then Scroll OFF).
3. Pause Duration's to allow the requested static frame to remain on the display between ON & OFF presentation methods are programmable from 0.1 to 25.5 seconds, in 0.1-second increments.
4. “2x – 8x” feature – Graphic or text data can be doubled, tripled, ... or eight times in size vertically to create a larger image update area.
5. Image invert or non-invert characteristics.

The controller module is also capable of generating **flashing** text messages, allowing the user to dictate the invert pause duration, non-invert duration (each can be set up to 25.5 seconds, in 0.1 second increments), and the number of flashing cycles to implement.

Static frames of data can also be output in a “Swell” and “Fade” modes, which enhance image appearances or aesthetics during the update process.

### Full Screen Update Rate Information



The graph above reflects full screen update duration (when configured to the slowest 1x mode, where all 480 rows contain unique data) measurements taken on 640x480x9.4 displays at the temperatures indicated. As indicated, a typical update duration of 2.8 Seconds can be expected at room temperatures (23.5 C<sup>o</sup>).

The chart to the left illustrates measured full screen (all 480 rows) update durations when configured to the slowest 1x mode, with respect to temperature for a 640x480x9.4 display and 10120 controller module. As indicated on the chart, a typical update duration of 2.8 Seconds can be expected at typical room temperatures (23.5 C). When configured to 2x mode, ½ the durations indicated can be expected. When configured to 3x mode, 1/3 the durations indicated can be expected. .... When configured to 8x mode, 1/8<sup>th</sup> the durations indicated can be expected.

If faster full screen update rates are necessary, the 640x480x9.4 display module can be configured to drive in “Dynamic Drive™” mode as a custom module. In this configuration, 1x update durations of 4 to 5 times faster than the durations indicated to the left can be expected.

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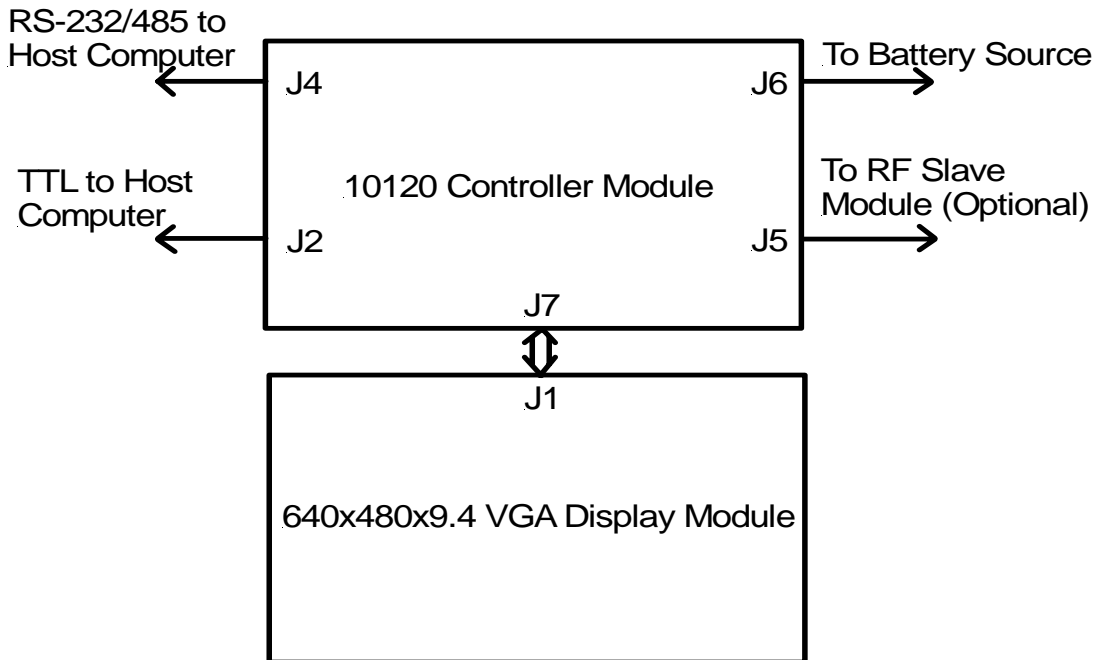
10120 Controller Module Communication Interfaces/Information	
Serial Communication Format	RS-232 (10120-14, 10120-17 & 10120-26 Modules): Asynchronous, full duplex, 8 bits/byte, 1 Stop, no parity. RS-485 (10120-15 & 10120-18 Modules): half duplex, Everything else same. TTL (10120-16 & 10120-19 Modules): Asynchronous, full duplex, 8 bits/byte, 1 Stop, no parity.
Standard Baud Rate:	19.2k Baud (other rates, such as 38.4k, 9600, 4800, 2400 & 1200 are available per request).
Standard Protocol Format	Standard Kent Displays Character/Graphic Serial Protocol (refer to Kent Displays document 25016 for details).
Recommended Matting Communication Plug	Standard 2mm pitched 3-socketed plug; Hirose P/N DF3-3S-2C w/ DFS-2428SC crimped contacts, or equivalent (RS-232 & RS-485 Configurations) Standard 2mm pitched 4-socketed plug; Hirose P/N DF3-4S-2C w/ DFS-2428SC crimped contacts, or equivalent (TTL Configurations)

### Module Interconnect Descriptions

The following interconnect rules apply when installing only the 640x480x9.4, VGA display module into the finished product:

1. Mount the display module into the finished product using the four mounting holes on the module printed circuit board and bezel frame.
2. In order to preserve the quality and life of the display, the finished product design should incorporate a transparent protective cover to protect the viewing area of the display. Use a material that can block UV light, has anti-glare properties and provides protection from user applied pressure points.
3. Mount the cover as close as possible to the face of the display. Use Acrylite OP-3-P-99, matte finish, with UV blocker, or equivalent material.
4. Connect J1 ("H" configuration) or J3 ("F" configuration) of the display module to the user's CPU based electronic assembly.

The following additional interconnect rules apply when installing the 640x480x9.4, VGA display and 10120 controller module into the finished product, as indicated in following figure:



**Typical Controller to Display Interconnect Diagram**

- a. Apply the same steps for the display module as indicated in step 1 through 4 above.
- b. As indicated in Typical Controller to Display Module Interconnect Diagram above, attach J7 of the controller module to J1 of the display by either a direct "Header to Header" connect (be sure to align pin 1 of J7 to pin 1 of J1), or by installing a ribbon cable assembly (consisting of two 2x10, 2 mm pitched plugs and 1 mm pitch ribbon cable) between the 2 specified header locations. If

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installing a direct "Header to Header" configuration, the short component side of the controller should be facing the back of the display, with the portion of the controller containing the diagnostic switches and LED extended from the left side of the display.

- c. Connect the battery or power source terminals of the finished product to J6 of the controller module. Any standard 0.1" type header, connector or open wires can be used as a power interface. Verify the DC power source applied does not exceed 10.0 volts DC. Verify the positive terminal of the source is connected to J6 pin 1 (Marked with Pad/via)
- d. Connect to the host computer either using the J4 header location (RS-232 or RS-485), or to J2 (if a TTL, or 0-5 VDC serial interface is required). Use the plugs and terminations specified in the 10120 Controller Module Communication Interfaces/Information table of this document (above).
- e. If using the wireless RF communication option, mount the 10158 RF slave module into the finished product in a position to enable the module antenna to be exposed to a maximum of the product exterior. Connect the RF slave module to the J5 header on the controller using the ribbon cable provided with the RF module.
- f. If necessary, mechanically mount the controller module to the finished product accordingly using the 4 mounting holes provided, or using some other equivalent method.

### VGA Controller Power and Communication Interface Details

The following tables outline all the power and communication terminations for the VGA, 10120 controller modules:

#### Power Interface Connection: J6 – 10120 Controller Modules

Pin #	Symbol	Description
1 (Marked with Pad/via)	+ Power	Positive Power Termination
2 (Marked with O Pad/via)	- Power (Return)	Negative Power Termination.

#### RS-232/485 Communication Interface: J4 – 10120 Controller Modules

Pin #	Symbol	Description
1	RX_DATA	Module receive data input termination (RS-232). Positive data communication termination point (RS-485). Module "Wake" input (Based on parked low condition).
2	Ground	Ground termination point.
3	TX_DATA	Module transmit data output termination (RS-232). Negative data communication termination point (RS-485).

#### TTL Communication Interface: J2 – 10120 Controller Modules (Rev. G Controller, or Later only)

Pin #	Symbol	Description
1	RX_DATA	Module receive data input termination (w/ respect to controller module). Module Wake Input (Based on Parked High condition. Wakes w/ Low input, or when Input is below ~ 0.7 VDC). 0-5 Volt Logic Input.
2	Ground	Ground termination point.
3	TX_DATA	Controller module transmit data output termination. 0-5 Volt Logic Input.
4	+5 VDC	Power Source input to be used for Finished Product Level Shifters circuitry. Source not provided when Controller is in sleep mode.

#### Local Control/Diagnostic Descriptions – 10120 Modules

Symbol	Description
"RESET" (SW2)	Controller Reset momentary switch.
"TEST" (SW3)	Controller Diagnostic momentary switch (For local control).
D3	LED Diagnostic Output (For local control feedback).
"WAKE" (SW4)	Module Local "Wakeup" momentary switch.
Address, Bit 1 (R2)	Module Address Bit1 (= 1) Shorting Pads (10120-7,-8,-12), or SW1 Bit1 position (10120-9,-10,-13)
Address, Bit 2 (SW1, pins 2-11)	Module Address Bit2 (= 2) Shorting Pads (10120-7,-8,-12), or SW1 Bit2 position (10120-9,-10,-13)
Address, Bit 3 (SW1, pins 3-10)	Module Address Bit3 (= 4) Shorting Pads (10120-7,-8,-12), or SW1 Bit3 position (10120-9,-10,-13)
Address, Bit 4 (SW1, pins 4-9)	Module Address Bit4 (= 8) Shorting Pads (10120-7,-8,-12), or SW1 Bit4 position (10120-9,-10,-13)
Address, Bit 5 (SW1, pins 5-8)	Module Address Bit5 (= 16) Shorting Pads (10120-7,-8,-12), or SW1 Bit5 position (10120-9,-10,-13)

Note: a 10120-14, 10120-15, 10120-16 & 10120-26 modules are always set as address #1. The address cannot be changed without jumper wires. Address setting for 10120-26 module not pertinent or necessary for terminal application.

# 640x480x9.4

## VGA Cholesteric Display & Controller Modules for Graphic, Text and Terminal Applications

### Terminal Application for 640x480x9.4 Product:

As indicated previously, the 640x480x9.4 VGA display and controller module can be used to emulate a standard VT100 type, ASCII compatible terminal. The user will need to purchase the 10120-26 controller module with the product.

The following specifications apply to the 640x480x9.4 display and 10120-26 controller module:

#### General Specifications – 10120-26 “Terminal” Controller with 640x480x9.4 Display Modules

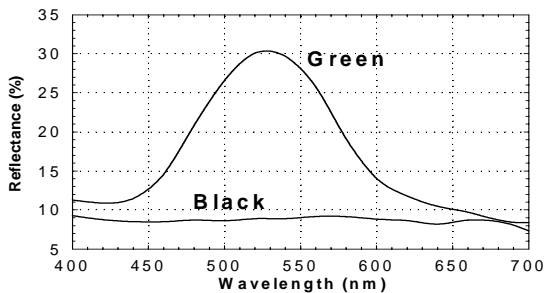
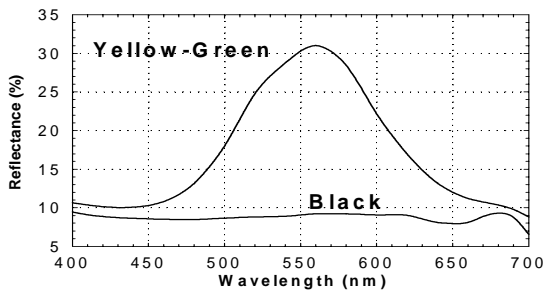
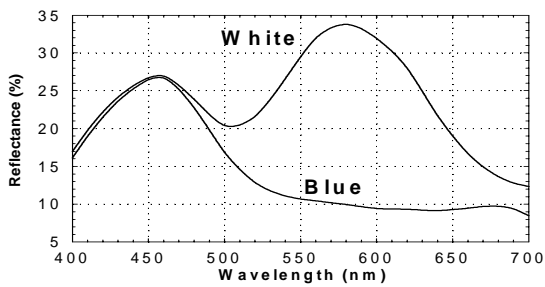
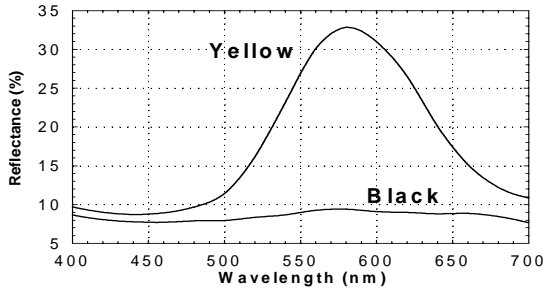
Parameter	Value/Description
Characters Displayed per Text line	80 Standard (Terminal can be supplied as a custom unit w/ smaller 5x7 font capable 106 characters/Line)
Characters Stored per Text line	132 Displayable ASCII characters Standard.
Standard Font	Modified Fixed Distance 9 stretched to 2x mode (Each character occupies 8x20 pixel space)
Standard Text Characteristics	Bright characters on dark background (standard).
Maximum Displayable Text Lines / Display	23 (Standard)
Text Line Storage Capacity in RAM	410 (Standard minimum)
Cursor Characteristics	Blinking Line (4 Display rows high), positioned below present character to be entered.
Cursor Blink Rate	1 second ON, 1 second OFF continuously (standard default).
Wake/Idle/Sleep mode Characteristics	Disabled (standard). Controller will “Wake” after reception of data on serial port, and remain in active mode indefinitely until power is removed.
Auto-Wrap Feature	Enabled (standard). Cursor will automatically move to next line position, left margin after 81 characters are entered for a given line (cursor is still in same text line when Auto-Wrap condition occurs).

The 10120-26 controller and 640x480x9.4 display module will generate all standard visible ASCII characters (from space ((32 decimal)) to “~” ((126 decimal)) on the display module immediately after reception of the data from the input source (keyboard input or equivalent). The following non-visible characters are also supported by the controller, which represents a “sub-set” of the standard VT100 command and control sequences:

Miscellaneous Control Functions		
Character Mnemonic	Hex Code	Actions or functions implemented
CR	0D	Moves cursor to left margin, and down 1 line. Indicates end of storage for corresponding text line.
BS	08	Moves cursor to left 1 position (unless cursor at left margin), and deletes any character previously entered.
CAN	18	If received during an escape or control sequence, the corresponding command is cancelled
Cursor, or “Arrow” Control Functions		
Character Mnemonics	Hex Codes	Actions or functions implemented
ESC [ A	1B 5B 41	Cursor will move UP one text line position.
ESC [ B	1B 5B 42	Cursor will move DOWN one text line position.
ESC [ C	1B 5B 43	Cursor will move to the RIGHT one character position in selected line.
ESC [ D	1B 5B 44	Cursor will move to the LEFT one character position in selected line.
Erase Control Functions		
Character Mnemonics	Hex Codes	Actions or functions implemented
ESC [ 2 J	1B 5B 32 4A	Erases entire screen. Cursor will move to top-left margin position.

\* Additional command and control sequences can be added per request.

### Optical Characteristics for Typical Standard Color Configurations:

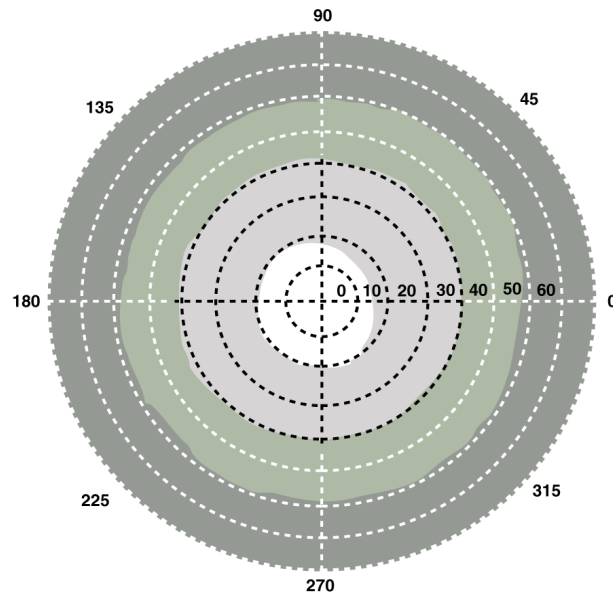


The above reflectance curves reflect measurements taken from a single pixel. Actual reflectance will depend on display resolution, aperture ratio and other factors.

#### Typical ChLCD Spectral Reflectance Characteristics

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.

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



**Contrast Ratio Polar Representation**

As illustrated in the polar graph above, all Kent Displays ChLCD products have a 360-degree viewing cone. **Contrast** at near normal viewing angles is as high as 25:1 and reflectivity up to 35% of incident light. Contrast reduces with increased viewing angle, but is still excellent at 11:1 when viewed at the edge of the display. Since no polarizers are used, display contrast reduces uniformly in all directions when the viewing angle is increased.