Interfacing the Planar Systems EL640.480-AF1, AG1 and AM1 Displays

EL640.480
Application Note 116-01

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Introduction

Planar's new series of low cost ICEBrite ™ VGA format 6.4", 8.1" and 10.4" diagonal displays have been designed to integrate efficiently into many applications. This application note was designed to help customers quickly choose the best connectors, cables, system power supplies and display controllers for their application. In addition, the last section is devoted to electrical interfacing and troubleshooting.

The Connector and Cable Assembly

The first step in interfacing to any display is finding the right cables and connectors to electrically join the systems. The ICEBrite family of displays uses a single 20 pin, 2 mm connector (Samtec STMM-110-01-T-D or equivalent) for all power and video signals.

Female connectors and cables may be purchased from any number of connector manufacturers. In addition, there are many companies that specialize in manufacturing custom cable assemblies that can help with this task.

The following list outlines some of the manufacturers and part numbers for female 2 mm connectors.

Suitable female connectors

Manufacturer	Part Number	Description
Samtec	TCSD-10-D-5-01-F-N-5"	20 position 2 mm cable
Molex	87259-2011	20 pin female polarized receptacle

As with any cable assembly, the total interface cable length should be kept to a minimum to minimize reflections and EMI. Planar recommends that the cable be kept under 0.7 meter. Although all ICEBrite EL displays incorporate good EMI design guidelines, the EMI signature is often most affected by system level design. Careful choice of cabling and cable length, or EMI suppression filters in the cable, help reduce the system EMI. Cable terminations for impedance matching should also be considered to reduce EMI, noise and display flicker.

When creating a cable for your specific system, the exact pin to pin connections can get confusing due to the inconsistencies in the display business. The following notes should help sort out which signals on the video controller should connect to which signals on the ICEBrite displays.

- CP1, or data input latch, is often referred to as LP, HS, HSYNC or LOAD.
- CP2, or data input clock, is often referred to as CP, XSCL, CLOCK, DCLK, CK, NCLK, or CLK.S, or scan start up signal, is often referred to as VS, VSYNC, FLM, DIN, YD, FP or FRAME.
- VDDH, VEE or VLCD, usually referred to as the power supply for LCD, is not required for the ICEBrite EL displays. This voltage is usually -15 to - 28 V and provides the bias voltage necessary to drive the liquid crystal. The ICEBrite displays require only +12 V and +5 V to operate so an external negative supply is unnecessary.
- DISP, DISPOFF, ENAB or ENABLE is used in LCDs to enable or disable the display. The ICEBrite displays will be turned off by halting the control signals, and thus this pin is not needed.
- FR or DF is used to provide the AC signal required by many LCDs. ICEBrite EL does note require this signal.
- Vadj is used on some liquid crystal displays to set the operating point, or contrast. ICEBrite EL does not require this signal since the contrast is not a function of input voltage, viewing angle, or temperature.

Power Supplies

One of the next items that need to be addressed when integrating the ICEBrite displays in a new system is the power supply requirements. All ICEBrite displays have an integrated DC-DC converter to create the necessary voltages that drive the EL display. Therefore, the only power signals required are +12 V DC for the DC-DC converter, and +5 V DC for the digital logic. Things like current (or power) capability, overcurrent protection, filtering and power supply sequencing should be considered when selecting these two supplies for an ICEBrite system.

In EL displays, the total power draw is very dependent on the pattern (text, graphics, etc.) on the display. Typical power is lowest with all pixels off, slightly higher with all pixels on, and a maximum when displaying a 2x2 checkerboard pattern. Of course the important thing for display integrators is how much power the display will draw with their patterns of text or graphics. To help system designers estimate the impact on the power budget, Planar specifies a “typical” power consumption which consists of filling the entire screen with Es and measuring the power. As an example, the 10.4" display is specified at 24W maximum and 10W typical at 120 Hz.

Another factor affecting total power draw is the scan rate at which the display is refreshed. The ICEBrite displays are specified to run between 60 and 120 Hz. After a certain overhead, power consumption will roughly double when doubling the scan rate. So, for the 10.4" ICEBrite display, maximum power is 24W at 120 Hz. If we assume overhead is about 4W and subtract this out, the power consumption is 20W at 120 Hz which would scale down to 10W at 60 Hz. After adding the overhead back in, the total power estimate is 10W + 4W = 14W at 60 Hz. In this way, a system designer has flexibility to balance total brightness, which increases linearly with scan rate as well, and total power.

The power is not distributed evenly between the +5 V supply and the +12 V supply. Since the +5 V supply is used in the digital logic only, the total power consumption of this supply is specified as a maximum of 500mW. The remainder of the power is on the +12 V line for the DC-DC converter. Care should be taken to insure the current carrying capability of the +12 V supply and PCB traces/connector/cable is adequate for the expected current draw of the ICEBrite display. Typical and maximum current draw can be found in the ICEBrite specification.

Once the system can supply the current required, the next step is to insure that the system cannot supply too much current if there is a malfunction. Typical concerns can be anything from a screwdriver dropped on the display, thus shorting out components, to a massive voltage spike that destroys the DC-DC converter. Planar suggests some type of overcurrent limit protection on at least the +12 V input, and preferably both, either by fuse or current limiting circuit. If by fuse, a general guideline is to rate the fuse at 1.8 to 2x the display maximum current rating with a medium to fast acting fuse.

Another item that should be addressed is the possible current spikes in the +12 V supply causing conducted EMI concerns. The DC-DC converter on the ICEBrite displays typically incorporate some type of switching regulator that runs about 100 kHz which can add current spikes to the system +12 V rail. Often, a ferrite bead, or choke can be added in series with the +12 V supply to minimize this affect. This can also help power supply regulation which is important to insure the proper operation of the display.

Like LCDs, proper power supply sequencing is important to insure the display is not damaged. However, the EL power supply sequencing requirements are much simpler to implement. In general, the only requirement is that the +5 V supply must be present whenever the +12 V supply is applied. In practice, ICEBrite EL displays have been designed to allow simultaneous application of both +12 V and +5 V as long as +5 V is present by the time the +12 V line reaches +12 V.

Display Controllers

Many different chipsets are available for interfacing to flat panel displays like the Chips and Technologies 65XXX series, the SMOS 1351F and the Cirrus Logic 754X or 6245 series. If your application does not require chip level integration, there are many vendors that can supply board level solutions for serial control, PC104, ISA and many other interfaces. Because there are so many different architectures, processors, and application requirements, it is impossible to outline all of the options for controlling the ICEBrite series of the displays. Below we have tried so summarize some of the options that have been used in the past with EL displays.

Chips and Technologies can supply a number of ICs that will interface to the ICEBrite family of displays like the 65530,65535, 65540 and 65545. In addition, these ICs have grayscale algorithms that can be used to implement three to four levels of gray on a monochrome display. Refer to the ICEBrite grayscale interfacing application note for more details on implementing grayscale. Contact Chips and Technologies for information on pricing, availability and component recommendations.

The SMOS 1351F is a low cost, controller solution that is easily integrated in a system and interfaces to many popular embedded processors. This chip makes the display look like a memory location or simple I/O device so there are no provisions for VGA command set compatibility. This solution can provide a much lower level, simple, interface to the display assembly. Contact SMOS Systems for information on pricing, availability and component recommendations.

Cirrus Logic provides a number of flat panel controller ICs. These ICs are very similar to the Chips and Technologies Solutions, but with a slightly different configuration. Our customers have successfully integrated our displays with a CL-GD6435. Cirrus is currently suggesting either the 754X series or the 6245 series for new designs. Contact Cirrus Logic for information on pricing, availability and component recommendations.

There are many more third party vendors that can help in interfacing to the ICEBrite displays. The following is a partial list of third party vendors that supply board level products for interfacing to EL displays. See page 11 for contact information in order to verify that these solutions will work in your specific application. (Planar provides this information as a reference only, and does not imply any recommendation or endorsement of the products.)

- **Teknor Microsystems, Inc.** provides SBC computers and PC compatible boards based on the Chips and Technologies ICs.
- **Alpha Point Ltd.** provides products that convert single scan panel drive to dual scan panel drive. This product can convert normal feature connector data to dual scan data that can drive the ICEBrite displays.
- **Allus Technology Corporation** designs and manufactures SBC computers with integrated flat panel support and PC compatible flat panel display controllers. Using their personality modules, the controller board adapts to any particular display that is attached.
- **Octagon Systems** offers VGA interface cards that are based on the Chips and Technologies ICs.
- **Ampro Computers, Inc.** provides PC104 compatible embedded controller solutions. Their product offering includes a VGA compatible interface board that is based on the Chips and Technologies ICs.

Electrical Interfacing and Troubleshooting

Due to the many complexities present when bringing up a new system, it is virtually impossible to explain the steps you will need to take to interface and troubleshoot your system. This last section illustrates the basic issues that need to be addressed on the digital timing and electrical interface.

The final step in integrating the ICEBrite family of EL displays is to check the timing relationships from the systems video controller. The ICEBrite interface is modeled after an STN LCD type video interface which is supported by readily available controllers and allows the customer a low cost and flexible way of controlling display brightness, gray-level generation and power consumption. This interface enables high frame rates for increased display luminance, and allows the user the option of utilizing frame averaging grayscale algorithms present in various flat panel VGA controller ICs. See the grayscale application note for information on implementing these algorithms with the Planar displays.

It should be noted that the ICEBrite displays have an onboard selftest function which can be enabled by applying power to the display with the S signal static. The self test mode displays a 1x 2 checkerboard pattern that inverts every few seconds. The display will remain in this mode until two (2) low-to-high transitions of the S signal are detected. The display will then enter and remain in normal (user video driven) operation as long as power is applied. To enter self-test mode again, the display must be reset by cycling +5 V (and +12 V with it) power.

If you are used to working with LCDs, the following inconsistencies should be noted:

- Due to the fast response time of EL displays, some gray level generation techniques that work on LCD may cause flicker on EL. In general, no more than 5 or 6 gray levels can be achieved without considerable flicker.
- Brightness, and power, increase as a function of scan rate with EL displays. In LCD, brightness and power is a function of the backlight settings.

After going through the steps in designing a new system with ICEBrite EL, the next step is to turn on the power. More often than not, simple things like a bad connection, timing discrepancies, etc. cause the display to operate improperly, or not at all. A summary of typical problems and their solutions is shown on the next page.

Symptom	Possible Condition; Solution
Pixel data is jittery or noisy	Display is not being refreshed fast enough; increase scan rate above 60 Hz. Minimum CP1 time is violated; lengthen CP1 time so it is over 34.5 uS. Use of frame rate controlled grayscale that works on LCD, but not on EL; decrease the number of grayshades and/or increase the scan frequencies.
Display is blank	Clock is inverted; invert clock. Data setup and hold is out of specification; bring setup and hold times back to spec. by adding or subtracting delay. Cable may be too long or mis-terminated; shorten cable or change the series resistance to minimize reflections.
	Missing Data, clock, S or CP1 due to possible problems like cable, mis-connections, improperly functioning controller, etc.; insure all data signals are reaching the display. No Data; insure that you are not writing a full off screen to the display. +5 V or +12 V line is mis-connected, missing; insure power is reaching the display. +5 V or +12 V power supply sag; verify the power supplies being used can supply the recommended amount of current for the display. Display did not reset completely; for the display to reset after power is off, the +5 V must drop below a certain threshold. If the video signals are applied while +5 V is off, the +5 V may not drop below this threshold when the +5 V is cycled and the display will be blank. Force video signals to low during power cycle, or force +5 V voltage low.
Display is not readable, but pixels are not noisy or jittery	Improper controller configuration; recheck that the controller is sending the correct 8 bit wide data to the display. The controller should be set up in dual scan mode, 8 pixels per clock. Improper video memory data; the controller may not be writing to the video memory correctly. Work with controller chipset vendor on memory interface.
Flashing	The display flashes every few hours due to the anti-latent image circuitry; this is normal. Every few hours the display reverses the charge across the pixels to minimize latent image. Power supply regulation problems; verify that any spikes on the +12 V and +5 V rails are within the specified regulation requirements.
Display shows checker-board pattern that inverts every few seconds	Display is operating in selftest mode; insure cable is connected correctly, and that the S signal is functioning within specification and reaching the display.

Summary

With an LCD type interface, Planar's ICEBrite displays have been designed to integrate efficiently into many applications. Using readily available controller chips, and standard mounting techniques, these low cost EL displays will find their way into hundreds of new applications. For more assistance with your specific needs contact Planar Applications Engineering at the address on the last page of this document.

Contact Information

Planar provides this information as a reference only, and does not imply any recommendation or endorsement of the products.

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