

**Possible Influences and Benefits**  
**on SEMI FPD Standards**  
**in view of**  
**Industry Standard Panels 13.3”, 14.1”, and 15.0”**  
**Specification**  
(version 1.0)

Edited by  
Curt Ward  
ABRE  
11/99

## Table of Contents

<b>Introduction.....</b>	<b>3</b>
Background.....	3
Purpose of Paper .....	3
<b>Summary Overview of ISP (version 1.0).....</b>	<b>3</b>
Standard Objectives .....	3
Summary of Electrical Interface Requirements .....	4
Display Data Channel .....	4
Logic Power and Data/Control Interface .....	4
Summary of Mechanical Interface Requirements.....	4
XGA Active Area Pixel Layout.....	4
13.3" Standard Panel Critical Dimensions.....	4
14.1" Standard Panel Critical Dimensions.....	4
15.0" Standard Panel Critical Dimensions.....	4
Obtaining Specification and Additional Information .....	4
<b>Possible Benefits and Influences of Implementation .....</b>	<b>5</b>
<b>Possible Influences or Areas of Focus for SEMI FPD Standards .....</b>	<b>9</b>
Materials and Components .....	9
Equipment & Physical Interface/Material Handling.....	9
Environmental Health & Safety (EHS) & Information and Controls.....	10
Locating SEMI FPD Standards.....	10

*Prepared under SEMI Contract # 27563-000*

*Opinions expressed here are those of the writer and not those of SEMI.*

## **Introduction**

### ***Background***

The major notebook OEMs came together in May 1999 to form a Standard Panel Work Group (SPWG). The companies were comprised of by procurement and engineering executives at Compaq, Dell, Hewlett-Packard, IBM and Toshiba Corp. These companies account for more than 50% share of the notebook PC market. In addition, DisplaySearch participated by coordinating and facilitating the working meetings. This group worked with their display manufactures to publish in October 1999 an agreed upon Industry Standard Panel (ISP) specification for 13.3", 14.1" and 15.0" notebook displays. This standard established a set of interface and dimensional standards for the above displays, which make up about 80% of today's LCD market place. The standard accommodates all current commercial notebook display technologies. It is currently available via the Display Search web site [www.displaysearch.com](http://www.displaysearch.com) as noted below.

That isn't to say that there were not standards to begin with. Until the advent of this standard, the notebook and display industry had many standards, each customized by the OEM or the supplier or both. Technology or form factors or both drove them, but not by the industry as a whole. As a result the display manufactures had to retool for each new display along with the end users. This lead to protracted lead times, schedule slips, lots of documentation and logistic issues along with product obsolescence problems. It also meant missed or limited market opportunities for display makers, due to the customized specifications of a display. The equipment suppliers who had to create almost custom tooling for each panel maker had to endure the ripple effect from this. The driving force behind this, as is with all standardization efforts, was to provide a mutual set of specifications that allows both the notebook OEM and the display manufacture. This in turn would benefit all by reducing the over all time and costs of selling, engineering, manufacturing and delivering a high quality display, and or product, to their customers.

### ***Purpose of Paper***

As this is an industry wide standard, there was discussion among SEMI FPD members as to what areas of FPD manufacturing might be affected by the implementation of ISP spec. It would also prove useful if this paper could provide:

- some general background information on the standard,
- how will the OEM and FPD supplier community implement the standard,
- what are some of the possible cost/benefits of the newly created standard,
- and with this in mind, then what might be some possible next steps or areas for focus for the SEMI FPD members.

## **Summary Overview of ISP (version 1.0)**

### ***Standard Objectives***

For the three display sizes in the XGA resolution (1024x768) LCD panels:

1. Define standards for selected electrical and mechanical interface requirements

2. In addition, through the support for Microsoft PC99 and future PCxxxx requirements, and the DDC and EEDID interface, it will allow transparent usage with minimum changes to the system BIOS or Drivers. The purpose being to specify panel timing so that no BIOS or driver changes are required to use a new display.

### ***Summary of Electrical Interface Requirements***

#### **Display Data Channel**

- 3DDC2B Physical Layer Electrical
- EDID Logical Layer

#### **Logic Power and Data/Control Interface**

- Interface Connector
- Interface Signal Definition
- Power Sequencing
- Interface Cable Pin Assignment (Table 1)
- Logic Power & LVDS Signals Sequencing Diagram
- LVDS Data and Control Signal Interface
- LVDS Termination Impedance
- Backlight Electrical Interface (w/ Table 2)

### ***Summary of Mechanical Interface Requirements***

There are four figures in this section. They established the dimensions and tolerances for each of the three displays in the standard. In figures 3-5 the outside dimensions of for each display is specified as fixed in  $X \pm 0.5$  mm but there is a + 0.0 mm & a - 2.5 mm in the Y. This allows accommodation for different driver and interconnect technologies, but still holds a standard dimension that does not require retooling. Other items covered in the drawing are the Active Area, Connector Keep-out Area, Interface Connector for XGA and below, Bezel Opening, and Backlight connector.

#### **XGA Active Area Pixel Layout**

#### **13.3" Standard Panel Critical Dimensions**

#### **14.1" Standard Panel Critical Dimensions**

#### **15.0" Standard Panel Critical Dimensions**

### ***Obtaining Specification and Additional Information***

A copy of the standard can be seen and or downloaded at the following web URL:

[www.displaysearch.com](http://www.displaysearch.com)

Click on the SPWG icon and it will take you to the ISP home page. In addition to the SPWG members, the standard has been endorsed by leading notebook PC OEMs and FPD manufacturers including Acer Inc., Acer Display Technology Inc., Chi Mei Optoelectronics, Chunghwa Picture Tubes, Compal Electronics Inc., First International Computer Inc., HannStar Display Corp., Hitachi Ltd., Hyundai Electronics Industries Co. Ltd., Intel Corp., Inventec Corp, LG.Philips LCD Co. Ltd., Quanta Computer Inc., Quanta Display Inc., Samsung Electronics Co., Ltd., Sharp Corp., Toshiba America Electronic Components Inc. and Unipac Optoelectronics Corp. Additional companies are also expected to provide their support. Quotes from executives at endorsing companies can be found on the DisplaySearch SPWG web site.

## **Possible Benefits and Influences of Implementation**

The potential benefit and influence across the industry, when this standard is fully implemented could be significant. Some of the companies that participated in the development of this standard were contacted to try and gain an understanding of how this standard is viewed, in light of the following questions. The answers try to reflect the consensus view of the industry as of the date November 1999.

### **1. What are the projected benefits and costs of implementing the mechanical standard?**

- Your customers, your company, your suppliers

*The approach was to take different suppliers panels and design rules and establish a set of industry design margins. In almost in every case, the final set of dimensions is larger than what most suppliers need, but this will allow for some new or different approaches. It now accommodates all suppliers but it does not accommodate all the technologies (e.g. tab vs polysilicon drivers). The standard helps to accommodate different interconnect technologies. It also makes the Notebook about 1/3% of 1% larger but this was acceptable to all to be able to achieve an industry standard that did not leave any current supplier out. Suppliers might be able to use this room to help improve brightness uniformity for the standard panel size, which is now a little bigger than necessary. Luminance uniformity is one of the worst issues and it is hoped that this standard might help provide for some additional physical room that could be used for improving this performance issue.*

*It is difficult to project how much of cost savings there might be. However, it could be conservatively estimated that there might be as little as \$10 to as much as \$20 of material cost reductions for the LCD manufacturers. There might be more if they can begin to standardize some components across the industry. The OEMs will be able to save a substantial sum of money in terms of tooling, assembly costs, EMI design/testing, etc. When this is project out over many programs, one OEM projected possible savings of as much as \$2 million in development/NRE costs. Additionally, they could greatly simplify their service operations and service inventory stack-ups. As an example one supplier stated that they had at one time forty different panels that they were purchasing, and only a few that were interchangeable. So a drastic reduction in the panel part numbers will make significant reductions in tooling redesign, changes and inventory as a result of the ISP. Next new product design and packaging projects would reduce both costs and times to market.*

*One of the biggest advantages, is that it would open additional markets for the suppliers which in turn would allow the OEMs to add more capacity quickly to meet customer demand.*

**2. What are your expectations for when and how this standard will be implemented?**

- Will there be different plans for the mechanical Vs the electronic portions?
- From your company’s point of view and from your suppliers point of view
- Will there be a grace period, if so how long (minimum and maximum)?

*Currently there are about 15 major suppliers with the following part numbers:*

<b>Display Size</b>	<b>Qty of Part #s</b>
12.1	115
13.3	75
14.1	60
<b>Total</b>	<b>250</b>

\*\* Source: DisplaySearch, Ross Young

*There are another 5 or more suppliers that will come into the market soon which would mean even more part numbers. It is hoped that once fully implemented there might be only 3 part numbers as a function of size but that additional part numbers would differentiate displays by features or performance.*

*It has been conservatively estimated that there might be be \$10-15 of material cost reductions for the LCD manufacturers and maybe more if they can begin to standardize some components across the industry as a whole. OEMs will be able to save a substantial sum of money in terms on tooling, assembly costs, EMI design/testing, etc. When viewed over many different product efforts within a single company, OEMs could save millions of dollars in development/NRE costs. There are additional benefits in simplification and reduction of the documentation, operations engineering and inventory.*

*A major advantage is that an OEM can much more quickly add capacity through second or third qualified sources, thereby being able to meet increasing customer demand. From the Panel Suppliers point of view, additional markets are now available to them, where they were once frozen out due to design compatibility issues. In short, a Panel Supplier for these three displays would now have total market access, with little barrier to entry.*

**3. What are your expectations for when and how this standard will be implemented?**

- Will there be different plans for the mechanical Vs the electronic portions?

*Some panel suppliers are already working on standard designs. OEMs are expecting to see some standard products showing up on most supplier roadmaps in Q1 and Q2 of 2000, with several showing up in Dec’99. Most OEMs are in discussions with their suppliers, working towards the adoption of this standard. One OEM stated that one of his suppliers is taking pride in trying to be the first to provide panels in volume to meet the standard. It is generally expected that standard panels will be available in volume Q3 2000 and beyond. Transition issues will be dealt with across the year and by 2001 most displays should be compliant.*

*There is no formal time line requirements given to the panel suppliers, nor any obligation amongst the SPWG (standard panel working group), that platform designs MUST support the standard. In fact, there maybe justifiable design reasons to utilize some non-standard*

*solutions. It is hoped that in 2001 there will be full compliance with the standard. The expectation being that about 80% or more of the market would shift to standard panels.*

**4. When fully implemented, is it possible that this standard would lead to lower production costs for current products and faster and lower development costs for new displays that are compliant with this standard?**

- If so, why? If not why not?

*It might be possible to reduce as much as 3 months of design cycle time, with the adoption of the standard panels. In addition, development costs could possibly be reduced by a significant amount of due to second source qualification, reduction in design time, money and tooling along with a possible increased capture of revenues due to not missing market opportunities.*

**5. What do the display makers think about this standard? (answered from OEMs)**

- What do they like most and why?
- What do they like least and why?

*Suppliers have the opportunity to bring new technologies, (in a standard package), to market much more quickly and simply. They have the ability to shift supply from customer to customer much more easily. They have the opportunity to standardize components to a much higher degree, (making it easier to secure supply and to drive down material costs. It could help them reduce the number/versions of the same panel, e.g. one supplier had 13 different versions associated with each of one OEM's different design requirements. It will make it easier to get designed into an OEM that they currently do not have business with. What it will not do is allow them to differentiate their products based on form factor. A possible downside from the supplier's perspective might be the advent of a more competitive environment due to easier 2<sup>nd</sup>/3<sup>rd</sup> source capabilities. From the OEM's perspective this would allow them to meet upside demand quicker and may have an effect of expanding the overall market size through slightly lower prices and more availability.*

**6. If display maker resources are limited where would you like to see them prioritize their efforts and why?**

*OEMs believe that standardization will allow the display manufacturers to more wisely utilize their limited engineering resources by focussing on real differentiating performance parameters. Today, panel manufacture and OEM must spend significant resources on mechanical support issues alone. If we were to choose which performance parameter is most important to us, it would probably be a toss-up between higher resolutions, and improved reliability. But these performance care-about's change over time and from platform to platform, depending on the target end-user customer. However, if there were a need to focus a scarce set of resources, it would be most beneficial to focus on mechanical portion of the standard. This could help the supplier and the OEM as well, in that it could reduce part numbers/engineering time for the different panels sizes. Some of the Asian suppliers are very happy about this are working on this now. Others are working towards this but not as aggressively.*

**7. Are there similar plans to develop both mechanical and electronic interface standards for displays beyond 15"?**

- If so in what time frame? If not why not?

*The three display sizes were picked because they constitute about 80% of the current notebook display volume. The next displays might be for monitor applications, where VESA is discussing it but no effort is yet underway. Dell desires to expand the scope of the standardization effort to larger size panels, to the monitor market, and to other factors, (including timing, integrated inverters, and other non-TFT technologies). Nothing formal has been discussed between the SPWG members, however, in this regard. In the notebook area the 10.4" and 12.1" might be looked at and discussed.*

*It should be noted that the SPWG is planning to "move" management of the Standard from the SPWG to a more formal organization, such as VESA.*

## **Possible Influences or Areas of Focus for SEMI FPD Standards**

The SEMI FPD standards efforts are focused across five major areas, **Physical Interface & Material Handling, Equipment, Materials & Components, Environmental Health & Safety** and **Information and Controls**. Each area will be covered to address the issue of influence and or focus for current and or future SEMI FPD Standard efforts.

### ***Materials and Components***

At the outset the mechanical portion of the ISP specification, which establishes outside dimensions for each type of display, may have the most possible influence on SEMI FPD standard activity. The area that appears most obvious would be in providing a great amount of assistance in the on going struggle of establishing industry standards for **substrate outside dimensions**. The single biggest contributing factor to why that has not happened to date lies in the customized set of displays standards that have been created by the suppliers and OEM's. The ripple effect of this is that many panel manufactures have different substrate sizes, leading to tooling differences between panel manufactures. This means that virtually every equipment order is to some degree a custom tool order. This would not be bad if the equipment supplier could charge full margin for this difference. However, the panel manufactures put constant pressure on the equipment suppliers to reduce costs, footprints while improving output and yields.

It should be mentioned, that even with the these dimensional standards, there are other driving issues inside of a display manufacturing process that seeks real estate on the glass substrate, (e.g. scribe streets, interconnect lines, test sites to name just a few). This does not make the problem of substrate standardization insurmountable but it does make it a little more complex. In addition, continuing display size changes may make standardization of a substrate size difficult, but not impossible if the industry as a whole could see the time and financial benefits that all would gain if the glass substrate size was standardized.

In the area of components, there might be a number of possible opportunities. Given that the advent of the ISP this might allow the industry to turn some of these components into commodities with commodity price reductions. One example might be the backlight electrical connector. In addition, all the tooling associated with cell /module assemblies as well as assembly of the display to the computer might also be a candidate for standardization and therefore cost reduction through standardization.

### ***Equipment & Physical Interface/Material Handling***

Current specifications, due to the lack of a standard substrate size, spell out the +/- tolerances in X and Y, when referencing the substrate itself. This has allowed the material handling world to deal only somewhat effectively in starting to establish physical interface standards. If the materials group could achieve consensus on a substrate dimensional standard there would be a trickle over effect into these two groups to deal with their area of interest.

Other than in the area of masks, FPD has done much in the way of Equipment standards. Clearly, if substrate standard dimensions existed there would be many areas that could be

worked on. These standards normally deal with issues related to mechanical, electrical, and spatial aspects of semiconductor process equipment (stand-alone or clustered) and subsystems (i.e., mass flow controllers, wafer carriers, mini-environments) interfaces. It also includes standards for material movement, equipment reliability and maintainability, tool accommodation (i.e., tool-to-facilities), and contamination contributed by the equipment. Clearly, there are areas that could be worked on even without a standard for substrate outside dimension. But there is a nagging question that if many of the pieces of equipment must be built to accommodate the different substrate sizes, is there still value in working on standards in the other areas. It should be noted that standards already exists in the integrated circuit side of SEMI which at first glance would appear to have direct applicability to FPD equipment and are substrate neutral. A few examples might be:

- SEMI E7-91 (Re-approved 06/99) Specification for Electrical Interfaces for the U.S. Only
- SEMI E10-0699E Standard for Definition and Measurement of Equipment Reliability, Availability, and Maintainability (RAM)
- SEMI E12-96 Standard for Standard Pressure, Temperature, Density, and Flow Units Used in Mass Flow Meters and Mass Flow Controllers
- SEMI E14-93 Measurement of Particle Contamination Contributed to the Product from the Process or Support Tool
- SEMI E29-93 (Re-approved 02/99) Standard Terminology for the Calibration of Mass Flow Controllers and Mass Flow Meters
- SEMI E31 and E7 Electrical Interfaces (Japan and USA respectively)
- SEMI E43-95 Recommended Practice for Measuring Static Charge on Objects and Surfaces

Without a great deal of work, these standards might be easily adopted for FPD benefit and use.

### ***Environmental Health & Safety (EHS) & Information and Controls***

In both of these areas, the issues that are faces are substrate neutral and therefore would not be influences on way or another by a substrate dimension standard. It should be noted, however, that in the area of EHS, there currently are efforts going on in Japan and the USA to understand the current S2 document and its applicability for FPD. Korea at the end of 1999, driven by Samsung, has just recently announced the requirement of S Mark for all FPD and IC tools to be sold in Korea. S Mark addresses the safety requirements for tools and is based on the current SEMI S2, S8 and CE Mark standards. A Korean government office is being set up to help with the implementation and compliance of this.

It could be speculated that there might be an indirect influence of a substrate dimension standard, in that if equipment and material handling systems were now being built to standard dimensions, there would be quite useful to have a good set of standards in this area as well.

### ***Locating SEMI FPD Standards***

A list of currently published SEMI FPD standards maybe viewed at the following web URL: <http://dom.semi.org/PUBS/SEMIPUBS.NSF/ad174874d48acf20882565f6000c5038?OpenView>

Under the heading of Published Standards, click on Standards Publications and this will bring up a listing of all the currently published standards. For any additional information please contact the FPD Standards Engineer: Bettina Weiss at 650-940-6998.