White Paper – TBD

Future Proof Your Display!

Renesas Electronics America Inc.

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Choosing a display for a consumer application such as a smart phone carries little risk for the designer from a lifetime perspective, as the phone often drives sufficient volume to justify dedicated production or even a custom display. A new year heralds a new model with a new display and last year's model is quickly discontinued, leaving the unlucky industrial designer with the challenge of finding a replacement and updating their design in weeks... rather than investing their resources in creating new value. Many industrial applications need to last for many years in production, but can an industrial display last for the production life of the equipment? In many cases this can be 10 or even 20 years! Is it possible for a display to be available for such a long period?

In this paper we examine the key factors that can affect the lifetime of graphic LCD displays, to help you reach the right conclusion and help make decisions fitting to your particular circumstances and needs.

Glossary of Terms

STN – an older monochrome technology, sometimes using a blue/white colour for a more appealing appearance.

TFT displays – widely used for colour graphic panels and offer high contrast, wide viewing angles and rich colour.

Reflective – due to the absence of a backlight they offer low power consumption and lower cost, but provide little ergonomic benefit.

Transmissive displays reflect no ambient light and are dependent on the backlight. With no reflective mirror, the brightness and contrast are excellent, whilst power consumption is high.

Transflective displays combine the best of both reflective and transmissive panels, readable without the backlight, but without the strong images of transmissive displays.

Display Selection Criteria

Some areas require careful design consideration and should allow for a degree of maintenance or rework without major redesign of the equipment or front panel. These include the degradation of the backlight, touchscreen or simply the phase out of the panel itself, so the designer needs to consider the following:

- Mitigation against the risk of panel obsolescence
- Mechanical mounting of the display
- Backlight Technology and its inherent lifetime
- Touchscreen lifetime (if used)
- Operating Temperature Range
- Methods of driving the display

In the following sections we examine the key areas above to determine the criteria for the designer that can enable the design and panel meeting the lifetime requirements.

The Display Itself

Industrial graphic displays can easily operate for more than 10 years (see later). However typical manufacturing lifetimes for the display can be as little as a few years, depending on the manufacturer & intended end use. It should also be remembered that the rules of supply and demand apply not only to the LCD manufacturer, but also the suppliers of all the components that make a display panel. Careful selection is needed.

Monochrome STN displays are still used in many industrial applications and offer low cost, small panel sizes ranging from 1" to around 10", with resolutions up to VGA (640 x 480 pixels). They are available in reflective, transmissive and transflective formats and a wide range of screen shapes.

Colour TFT panels tend to be used in consumer applications and are exposed much more to risk of discontinuation. Sizes range from 3.5" to 19" typically, resolutions up to full HD (1920 x 1080) with standard and wide format options. Popular sizes are the smaller 5" or 6.5" displays which offer a good combination of graphics, brightness and cost, whilst industries such as factory automation favour larger 10.4" to 15.6" TFT displays that can provide higher levels of information and animation.

The useful operating life of an LCD panel is usually determined by the backlight. Most manufacturers nowadays employ long lasting, low power LED backlight technology to give better brightness, readability and longer life. These backlights have operating lives typically around 100,000 hours (backlight operating life is usually characterised to 50% maximum brightness). The backlight is also often replaceable, thus increasing the life of the panel.

Every panel has to be "driven" and there are a number of different possibilities depending on the resolution. Lower resolution panels up to around WQVGA (480 x 272 pixels) can be driven directly from some MCU's without the need for an external controller. Panels that have CMOS or TTL interfaces generally do not require any additional signal drivers, however low voltage interfaces such as LVDS (Low Voltage Differential Signalling) will require specific interface drivers between the MCU and the panel.

Figure 1 shows a typical direct RGB panel interface with interfaces to the LCD panel and frame buffer memory.

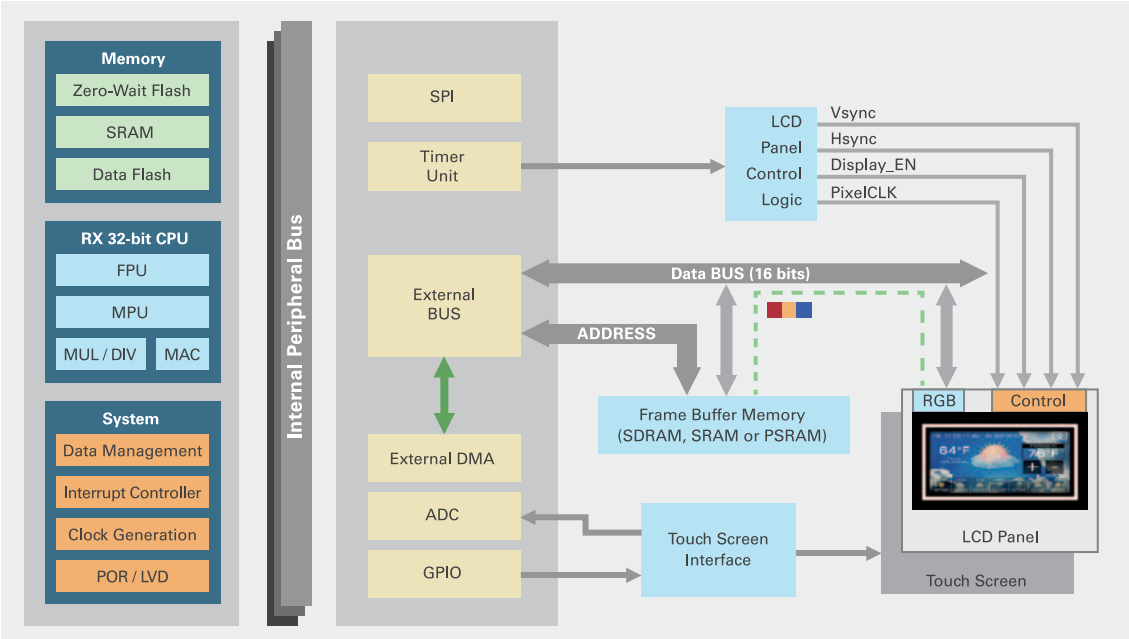

Figure 1: LCD Direct Drive Block Diagram

Examples of direct MCU to LCD interface and a LVDS equivalent are shown in figures 2 and 3.

Larger resolution panels will require either a dedicated graphics controller IC or a graphics control board as the MCU alone cannot provide the high speed signals required. Interfaces to graphics controller IC's typically use the MCU's external peripheral bus with dedicated for driving the LCD panel. Graphic control boards offer a variety of interfaces including USB and Ethernet. It should be remembered that all of these components can be affected by obsolescence, causing a redesign of the system and such should be considered carefully by the designer so that it is as flexible as possible.

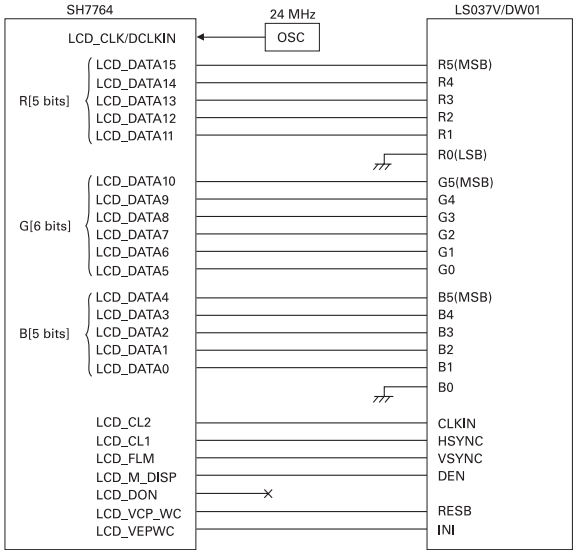

Figure 2: MCU LCD Direct Interface

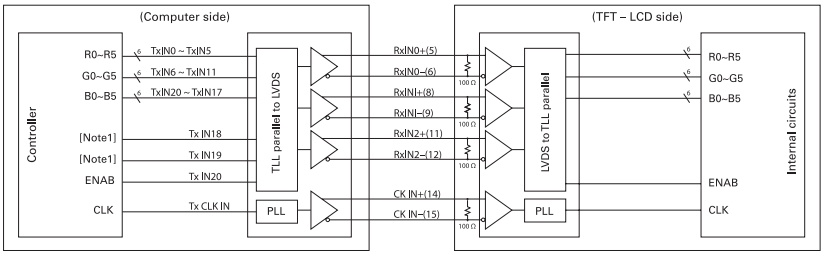

Figure 3: LVDS Interface Example

Backlight Issues

The backlight is fundamental to the longevity of the panel with all having a finite lifetime dependent on their total operating time, which can vary dramatically depending on the application.

Table 1 shows the standard operating lifetimes of current backlight technologies and the equivalent time in years of 100% usage. (Times are measured to 50% brightness).

In practice there will be periods when the equipment may not be operating such as maintenance, holidays and weekends, which is of course dependent on the application and industry. Some industries operate at almost 100% of the time, for example a factory automation plant when the system may only be turned off during the maintenance downtime.

Backlight Style	Operating Life	Lifetime
CCFL	50,000 hours	5¾ years
LED	70,000 hours	5¾ years
LED	100,000 hours	5¾ years

Table 1: Standard Backlight Operating Life

Maintenance downtime however does not have a big impact, adding only around 336 hour's life, assuming a shutdown of once per year for two weeks.

However you can see from table 1 above that by careful selection the operating life of the panel can be achieved without necessarily having to do anything special, but what if the backlight is dimmed or switched off during periods of inactivity, what is the impact on the life of the panel? Let's compare a scenario of operating the backlight for 100%, 50% and 25% of the time.

I think it is clear from figure 4, that dimming or switching off the backlight or even the whole panel can save power but deliver a lifetime that could suit many industrial applications and utilising the latest LED technology, a 20 year life is possible.

Backlight Life (Years)

Operation	CCFL (50K)	LED (70K)	LED (100K)
100%	5.75	8	11.5
50%	8.625	12	17.25
25%	10.0625	14	20.125

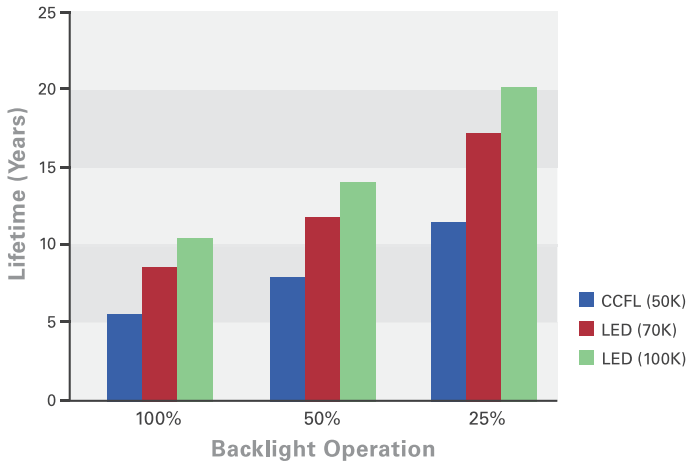

Figure 4: Backlight Operating Life

Applications that say only operate during the working week would require a total 124,000 hour life if operated 100% of the time. When factoring in the effects of dimming, switching off the backlight or powering off the whole panel, achieving the required life is definitely possible especially as both CCFL and LED backlights are usually replaceable providing an additional level of security against failure.

Touchscreen Considerations

It is not the intention here to discuss the respective merits of touch technologies, but to consider touchscreen endurance and its effects on the lifetimes of the panels. The most common types used today in industrial panels are 5-wire resistive and Projected Capacitive Technology (PCT), offering good touch sensitivity, interface options and can be supplied as an add-on unit or factory installed by the manufacturer.

The use of a touchscreen of any type will decrease the luminance of the panel by up to 20% for resistive and 10 to 15% for PCT, which may result in using a higher level on the backlight decreasing its operating life.

Resistive panels tend to be made using a softer surface material resulting in lower impact and scratch resistance and an endurance of around 3 million touches. Linearity and drift can be a problem that could require recalibration and interfaces can be direct analogue or serial (RS232, USB) via an integrated touch controller device.

Projected Capacitance Technology panels are generally made of a harder material offering better impact and scratch resistance and a virtually unlimited touch endurance. Linearity and drift are non-existent requiring no recalibration. Interfaces are generally RS232 or USB supplied by the capacitive touch controller.

Touchscreen endurance is difficult to answer as the question “how many touches are made per day” will vary from application to application. Both Resistive and PCT are designed to last the lifetime of the panel, but PCT looks to offer the best solution as there are no limitations on the lifetimes of the touchscreen.

Fitting a touch screen is not a simple task and should ideally be handled by the manufacturer or specialist to ensure and good alignment and bonding to the display. Replacing a touchscreen is in many cases is difficult or not possible resulting in a replacing the complete panel.

Obviously the use of a touchscreen is an option where in some applications the “control” functions could be implemented on a separate touch or control panel, or are not required at all, so that any longevity concerns of using a touch screen are removed.

Mechanical Mounting

Mounting or changing a display panel can be difficult as manufacturers do not offer compatibility even for panels of the same size. One suggestion could be to mount the panel on a secondary bezel or plate as this can be changed to accommodate the fixing of an alternate display while assembly to the front panel remains the same.

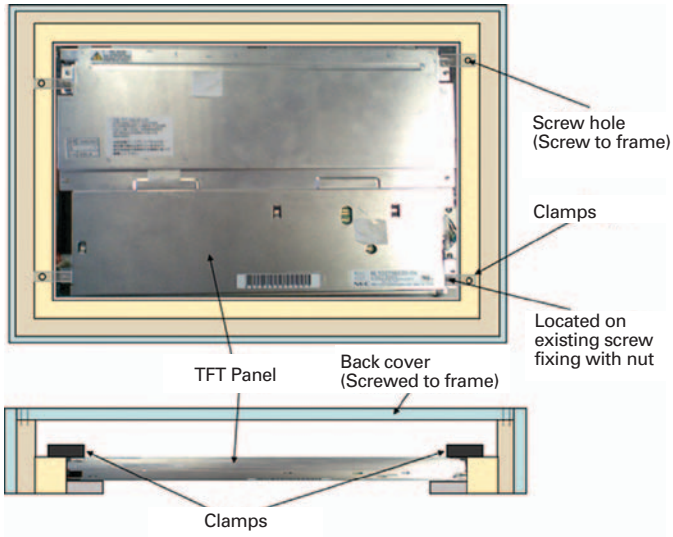

Figure 5: Panel Mounting Example

Figure 5 shows an example of mounting a 10.4" TFT panel in an external plinth. It should be noted that this was designed to be external and hinged at the bottom, but the principle allows the panel to be replaced easily in case of a failure. If longest life is required then this is to be highly recommended as it leaves your design protected from the vagaries of product discontinuation and changes in technology.

Supply and Demand

With panel production lives up to seven years at best, the availability falls short of some equipment life requirements. All major manufacturers will offer an obsolescence policy with notice and last time buys of between one and two years. This allows the user time to purchase a number of panels and time to plan changes to another panel or manufacturer. In some cases this could provide the user with enough product to support up to the equipment end of life depending on the where the equipment is in its life cycle.

The use of technology that is designed for consumer markets while being very attractive and utilising the latest technologies should be avoided for any application requiring a long lifetime. The product life of this type of display can be as little as a year.

Conclusions

The question was can a LCD panel last the lifetime of the equipment?

From the topics discussed above that affect the lifetime of the panel, then the major limitation is the longevity of supply, but by adopting a flexible system design and the choice of the key options such as panel type, backlight technology, touchscreen, flexible mounting, operation and temperature range, plus the use of a reputable supplier offering a good production availability and obsolescence policy and planning for the possibility of replacing the panel.

The answer can certainly be YES!

Written by: David Parsons – Consultant to Renesas Electronics (Europe) GmbH. David can be contacted at DCP Electronics and Software Services.