

Industrial LCD Display Modules

YANO Takakazu, MIWA Tomoo

Abstract

Since industrial display modules have very diverse applications, which include instrument measuring, ATM terminals, POS terminals, copiers, ticket venders, auto vending machines, machine tool monitors and broadcasting monitors etc., they should be designed assuming use in all the conceivable environments. This paper is intended to introduce examples of use and application of LCD modules applying the SFT technology that is the core technology of NEC LCD Technologies as well as the NLT technology and the adaptive design technology. In closing, this paper also proposes a display solution using an LED backlight as an example of adaptive technology.

Keywords

liquid crystal, LCD, SFT technology, NLT technology, LED

1. Introduction

At present, LCD modules are disseminated so widely that the word reminds us immediately of their applications, such as the PC, cellular phone and TV. In addition to such consumer-oriented applications, LCD applications have recently been expanding by developing new products and new markets that are making use of the slim size and light weight that are advantages of the LCD as well as by replacing the CRT.

2. Performances of Industrial Display Modules

Industrial displays have very diverse applications, which include; measuring instrument, ATM terminals, POS terminals, copiers, ticket venders, auto vending machines, machine tool monitors and broadcasting monitors (**Fig. 1**).

The product performances required in the industrial display market are different from the consumer market in which uniform products are mass-produced in short cycles.

Since industrial display sets are used in various operating environments according to a wide range of purposes, they must offer high reliability, high picture quality and high usability. For example, the machine tool must feature vibration resistance because it is subjected to vibrations permanently and an outdoor auto vending machine needs a wide operating temperature range because its temperature rises under direct sunlight and decreases in a cold environment.

As the required characteristics as seen above vary for each

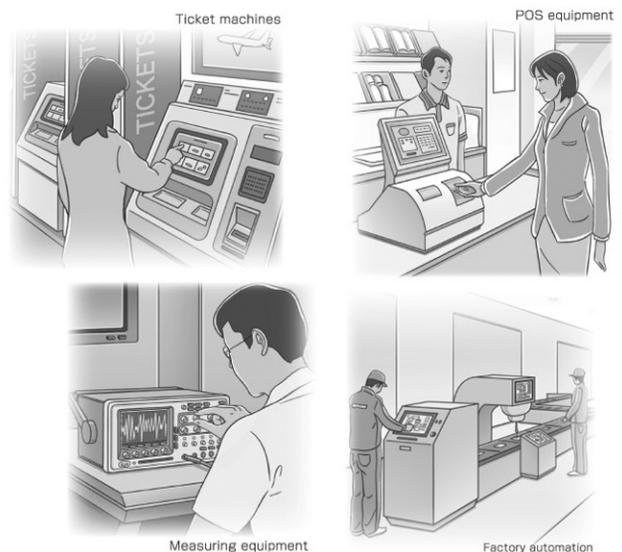


Fig. 1 Examples of applications in industrial equipment.

piece of equipment, the display modules for industrial applications should be designed in consideration of these variations.

In addition, since industrial products are used for a very long period sometimes for more than 10 years, a stable supply for a long period is required for these products.

The reason that the industrial display modules of NEC LCD Technologies are used worldwide is that we achieve and offer the required performances by making full use of the SFT (Super Fine TFT), NLT (Natural Light TFT), VIT (Value Integrated TFT) and other technologies based on the adaptive design

Industrial LCD Display Modules

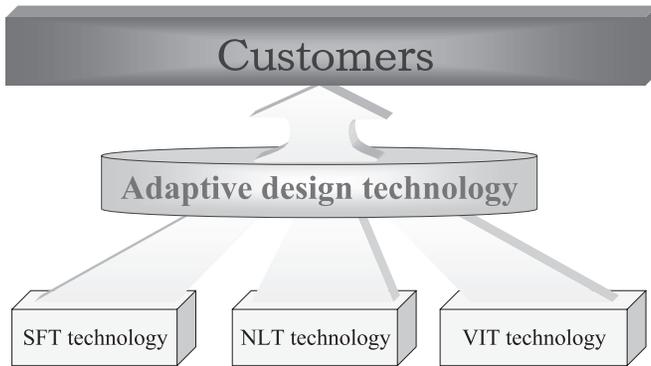


Fig. 2 Achievement of required performances based on various technologies.

technology, which is one of our core technologies. The modules are thus made to be compatible with various applications and operating environments (Fig. 2).

3. Adaptive Design Technology

The needs for industrial display modules for various applications are very wide as seen above. To meet these needs, we use the adaptive design technology based on expertise accumulated through long years of experience in providing industrial display modules.

For applications in severe mechanical environments that are accompanied with vibrations and impacts, we propose LCD modules designed with vibration and impact resistance by a meticulous selection of internal components and clearances. Also, for applications in severe operating temperatures, we apply adaptive design over a wide range of temperatures by selection of internal parts, clearances and derating.

To ensure stable supply for a long period, we design every display component to be compatible for electrical interfacing, external dimensions and installation position with previously produced items, even when production of an item has been discontinued or if a new item is developed aiming at improving performance or quality. In addition, we have also optimized the design of the color filter and backlight system by improving their gradation reproduction performance and reducing their sizes.

4. SFT Technology

The SFT technology serves to maintain high picture quality



Fig. 3 Example of use in broadcasting station monitors.

because the gradation and chromaticity do not vary with regard to viewing angles and their response to medium gradations is rapid. Up to the present, the technology has been subjected to multiple improvements to meet various needs. Eventually, success has been achieved in assuring compatibility between the high transmittance and wide color gamut that were formerly in a tradeoff relationship, by successfully applying improvements to both of them.

Since compact to medium-sized monitors for professional use, particularly for broadcasting systems must offer a quick response rate and wide color gamut to display moving images, SFT technology is being used extensively in this field (Fig. 3).

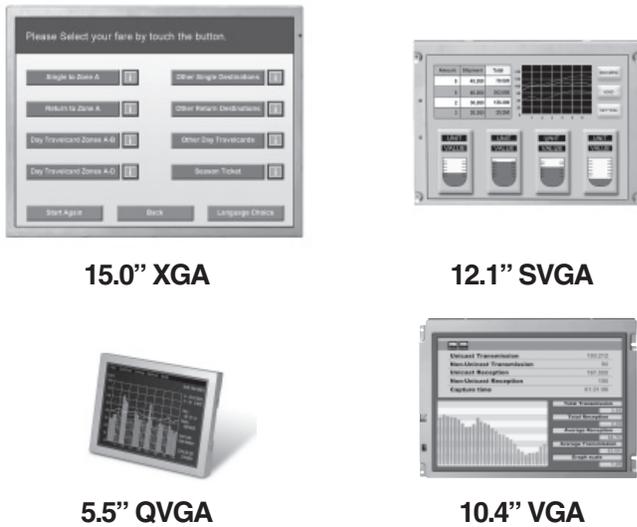
Moreover, by using the wide viewing angle that is one of the main features of this technology, we are able to provide display modules that can support various viewing positions by considering barrier-free applications. Headrest monitors for aircraft, ATM terminals and information terminals are a case in point.

5. NLT Technology

Recently, LCD modules are often used outdoors as well as indoors. However, as the visibility of ordinary LCD modules deteriorates when they are used outdoors, the LCD modules for use in outdoor light environments usually use reflective liquid crystals. However, the reflective LCD panel has a complicated internal structure and low color reproducibility and is thus not suitable for use at night or in dark locations.

In order to overcome these issues, we adopt two kinds of NLT technologies, which are;

- 1) ST-NLT (Super-Transmissive NLT) technology, and;
- 2) SR-NLT (Super-Reflective NLT) technology.



15.0" XGA

12.1" SVGA

5.5" QVGA

10.4" VGA

Fig. 4 ST-NLT-based products.

The ST-NLT technology features a unique optical design that implements an “improved backlight usage efficiency” and “reduced surface reflection of extraneous light.” As a result, it allows a transmissive LCD to offer a high display quality with high contrast even under a strong extraneous light environment such as during daytime outdoors.

This technology is used most often in LCD panels that would be used in environments exposed to extraneous light, such as for ATM terminals, measuring instruments, auto vending machines and ticket vending machines.

As a result of the lineup expansion to meet customer needs, our ST-NLT technology-based products currently cover six sizes from 5.5” to 15.0” and four resolution values from QVGA to XGA. With a total of 10 models combining size and resolution for industrial applications, we offer a full lineup to meet a wider variety of customer needs than ever (Fig. 4).

On the other hand, the SR-NLT technology is often used in compact terminals for outdoor use. This technology offers two modes including the “transmission mode” that uses the backlight as the light source and the “reflection mode” that use the ambient light as the light source. These modes can be switched over by switching the backlight on-off.

6. Introduction of New Industrial Products

In general, the LCD panel is combined with a light source unit called backlight, and most backlights use a cold cathode fluorescent lamp (CCFL) as the light source. However, the

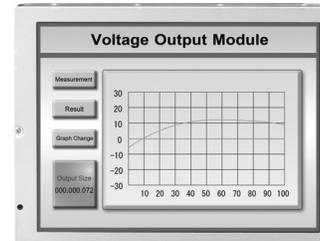


Fig. 5 6.5" LCD module “NL10276BC13-01C”.

white LED is recently attracting attention in the industrial market as a new light source based on the considerations;

- 1) reduction of environmental load;
- 2) reduction of power consumption;
- 3) reduction of thickness (weight), and;
- 4) improvement of impact resistance.

The new 6.5” LCD module uses a white LED backlight to reduce the power consumption, thickness and weight as well as to improve the vibration and impact resistance, and achieves high visibility under a strong extraneous light environment with the ST-NLT technology. It meets the diversified requirements for the display device for use in professional mobile information terminals (Fig. 5).

Recently, the needs for compact, rigid professional mobile information terminals are rapidly expanding mainly in North America for use in; the equipment maintenance operations of power supply, gas supply, city water supply, communications and railroads, measurement operations for land surveys, for construction and civil engineering sites and for order handling, inventory and delivery destination management operations in the transportation industry.

The use of a white LED array with high light emitting efficiency in the backlight system and the elimination of the inverter that has been indispensable with the traditional CCFL (Cold Cathode Fluorescent Lamp) backlight system have reduced the power consumption by about 40% (compared to our previous product).

This trend has contributed to saving the battery power of the system in which the LCD module is installed.

In addition, a thickness reduction of about 15% and a weight reduction of about 17% compared to the CCFL system (our previous product) also helps contribute to reductions in size and weight.

Compared to the CCFL system that uses glass tubes, the plant-installation type device has a lower risk of damage by impact vibration and offers higher reliability and durability when used in a portable product.

The non-necessity of an inverter can reduce high-frequency

noise and harmonic currents. Thus, troubles to nearby equipment such as noise interference and mis-operation can be reduced. Furthermore, the wider range of brightness adjustment compared to the CCFL also makes it possible to set the optimum brightness according to extraneous light and remaining battery capacity situations.

From the viewpoint of the environmental efforts that we have been tackling in achieving compliance with the RoHS Directive, the LED system is a 100% mercury-free system thanks to the elimination of CCFL tubes.

7. Conclusion

We intend to continue to develop industrial LCD modules with white LED backlight systems and to pioneer new application fields by expanding operating environments of LCD modules. Our product development, production methods and other measures will be conducted with the aim of further enhancing the satisfaction of our customers at every opportunity.

Authors' Profiles

YANO Takakazu
Technical Manager,
Module Design Department,
Technology Division,
NEC LCD Technologies, Ltd.

MIWA Tomoo
Assistant Manager,
Module Design Department,
Technology Division,
NEC LCD Technologies, Ltd.