

Lampex LCD/LCM

Liquid crystals are a phase of matter whose order is intermediate between that of a liquid and that of a crystal. The molecules are typically rod-shaped organic moieties about 25 Angstroms in length and their ordering is a function of temperature. The nematic phase, for example, is characterized by the orientation order of the constituent molecules. The molecular orientation (and hence the material's optical properties) can be controlled with applied electric fields. Nematics are (still) the most commonly used phase in liquid crystal displays (LCDs).

The most common application of Liquid Crystal Technology is in Liquid Crystal Displays (LCDs). With the advantages of thin construction, ultra low power consumption, and with the improving viewing angle and resolutions, LCD technology has become indispensable in today's applications.

From the ubiquitous wristwatch, pocket calculator to an advanced VGA computer screen, this type of display has evolved into an important and versatile interface.

And with the continuously improving backlighting technology, these LCD technologies are widely used for nighttime viewing applications as well.

LAMPEX Offers LCDs & LCMs in various Types as below:

TN Display: TN Fluid is the least expensive type. The viewing angle is about 40-45, and must be designated "top" or "bottom" view preference. Bottom view is used when the user will be below the plane perpendicular to the display, such as on a desk calculator. Top view is used when the display is mounted on a vertical surface below eye level. TN (Twisted Nematic) LCD display forms the majority and also the most fundamental display mode for liquid crystal. The Liquid crystal forms a 90-degree twist cell. TN has the advantage of very low tooling cost and unit cost. It is economic and has reasonable viewing cone. It is widely in used for low multiplex application (up to 1/16 MUX with 1/4 acceptable to most people). The display has good neutral background color with black on segment color.

HTN Display: With 110 degree twist cell, the HTN (Hyper Twisted Nematic or High Performance Twisted Nematic depending) display exhibit a slightly yellowish/gray or greenish/gray background with very dark black segments which is acceptable to most customers. However, what it gains in its increase viewing cone as well as its tolerance to work with medium multiplex level (up to 1/32 MUX), it sacrifices in response time, thus would not be suitable for very low temperature applications. **STN Display:** STN has high contrast and wide viewing angle fluids. With 240-degree twist cell, the STN (super twisted nematic) exhibits very steep electro-optic response and is suitable for high multiplex application (above 1/16 multiplex level) up to 1/240 Multiplex level (up to QVGA).

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FSTN Display: FSTN (Film Compensated Super Twisted Nematic) as its name suggested uses an additional optical film to compensate for the color effect found in super twisted nematic displays. With finally a neutral background and virtually a black / dark gray "ON" segment color, the display gives a comfortable paper feel viewing. Due to much higher yield related cost, the display is generally reserve for high value applications such as mobile phone application and mono-color PDA application.

AlphaNumeric LCD's are used for displaying user defined text and numeric information from the program. The displayed information can be different error messages, process parameters like temperature, pressure, motor speeds etc, production data like number of units produced, quality status of the material processed etc, various machine faults and much more.

The range starts from 8 Characters x 1 Line till 40 Characters x 2 Lines. With Wide choice of PCB Sizes, Character Heights form mini to Super Jumbo all in various grades such as TN, HTN, STN-Gray, STN-Yellow Green, and FSTN types.

You have wide choice of Standard Backlight Options of EL, LED Backlight. Options are available for selection of Operating Temperature such as commercial, industrial, wide & super wide temp ranges. Some of them can be made to specs meeting to -55° C in the negative side and +105°C operating conditions.

All AN-LCM's are built in the standard popular Hitachi's HD44780 or its equivalent controller. Standard Controller is built-in with English & Japanese Fonts. Other fonts such as European, Cyrillic, Russian, or Greek options available and are to be made to order. And semi or fully customized modules will take care of any gaps in the standard availability of modules.

Very often it is required to display the data in different graphical formats in addition to text and numeric formats. These Graphic LCD's fill in that critical void in the availability of displays. The data and various process parameters can be graphically represented in various forms like bar charts, line charts, x-y charts, and circle diagrams etc., which not only enhance the presentation but also make them easy to understand. Lampex Offers from wide choice of Graphics LCMs from 32x32 Pixels to 320x240 Pixels in the MONO STN types and In Color STN from 1.8" , 3.5" , & 5.7" up to 320xRGBx240 Pixels.

We have specialized in the following areas color displays:

- Hand Held Low power
- Semi and Full Custom Design
- Industrial Grade specification
- Sunlight Readable Technology

Typical applications include Telecom, Instrumentation, ATM's, Information KIOKS, Medical Instruments, Mobil Phones, and many more.

LCD FAQ

Q. How do I know what type of LCD to use for our product?

A. That will really depends on a number of factors including multiplex driving scheme, temperature, voltage/power, artwork design, contrast requirements and cost budget.

TN	<ul style="list-style-type: none"> • Economic to build, low tooling cost • Excellent choice for icons/segment drive. • True black and white operation • Fast response time when properly design • Good for Low MUX: direct drive to 1/16 (really max out at 1/4) Well established technology, little surprise and has very high yield • Good for negative mode display 	<ul style="list-style-type: none"> • Not good for high multiplex application, i.e. 1/16 can be the limit • Limited viewing cone (the higher the multiplex scheme, the narrower the cone)
HTN	<ul style="list-style-type: none"> • Much better contrast and also wide viewing cone • Good for medium multiplex application (<1/64 Mux scheme) • Very cheap to build and also with good tooling cost • Material cost is close to that of TN display 	<ul style="list-style-type: none"> • Tinted green or yellowish background give old feel • Sluggish response • The multiplex level range is very narrow for most application (<1/64 Mux scheme)
STN	<ul style="list-style-type: none"> • Extremely wide viewing cone, in most cases, for less than 1/64th multiplex scheme, a viewing cone independent display is possible to build. • Good for high multiplex level (excellent for as high as 1/240 multiplex scheme meaning that it is possible to build QVGA display • Also well established this day • Possible to get black and white display through use of compensation film • For most people, the light yellow/green background color is pleasant. 	<ul style="list-style-type: none"> • Expensive to build • Specification by non-professional is difficult • Almost necessary to use standard driver for driving display, meaning that the design (i.e. multiplex scheme) would need to match closely to one of standard multiplex scheme available on the market. • Optimization of electronic circuitry is as important as that of LCD, in some cases, it is difficult for engineer with little LCD background to fully comprehend what is needed for good looking display • Slower response due to very high frequency • Color shift with temperature (e.g. Auto application) limits its application (depends on materials and configuration) • Darker background as compare with TN displays

Q. What is lifetime of LCD and backlight?

A. Very long, in most cases, providing the operating condition is stable, the LCD may operate for years. Just for reference, below is typical lifetime for displays:

	LCD	LED	EL	CCFL
Current consumptions	N/A	High (7.5mA per die)	Low (0.12 mA/cm ²)	Low
Service Life	>80,000 hrs	Long >30,000 hrs	Short (typical 5,000 hrs)	Long (typical 30,000 hrs)
Driving Characteristics	AC	DC	AC	AC
Brightness	N/A	Low to medium	Low to medium	High

Q. What is thickness of LCD and glasses?

A. Thickness of LCD depends on stacking height. Typical standard structure of LCD consists of:

Layer	Description
1	Top Polarizer with thickness of approximately 0.08mm~0.15mm
2	Top Glass with thickness between 0.5mm and 1.1mm typical
3	Liquid crystal cell with thickness negligible (4 to 9 micron)
4	Bottom Glass with thickness between 0.5mm and 1.1 mm typical
5	Bottom polarizer with or without reflector

Q. What is a TFT-LCD?

A. TFT-LCD, which stands for thin-film-transistor liquid crystal display, consists of glass substrates on the bottom, a color filter substrate on the top and liquid crystal in between. The special properties of the liquid crystal are manipulated to create images. These technology intensive products represent the next generation in displays. They are flat and thin, easy to carry around and consume less power. Refer to the Technology section for details.

Q. What is the future outlook for TFT-LCDs?

A. TFT-LCDs solve the problems of portability, bulkiness and electro-magnetic emissions that CRT displays present. The current brightness and response time problems with TFT-LCDs are being addressed with technology advancements. The main applications for TFT-LCD was notebook PCs and desktop monitors, where they replace CRT's thick tubes. Importantly, industrial applications and value-added niche markets such as medical equipment and instrument panels are growing fast. In the future, TFT-LCDs will be found in most every facet of life.

Q. What are the common types of LCDs used in the market?

A. There are two types of LCDs commonly used in the market. One is TN (twisted nematic); this type of LCD has a narrow viewing angle. The other is STN (super-twisted Nematic); this has a wider viewing angle.

Q. How many types of display methods are available?

A. Basically there are three types of display methods:

- Segment type (7 segments, 14 segments, 16 segments)
- Dot Matrix type.
- Graphical type.

Q. What types of connectors are used in LCDs?

A. The connectors used for LCDs are electrometric (rubber connector), pin and flexible cable.

Q. How many types of viewing modes are used in LCD glass?

A. There are three types:

- Reflective,
- Trans-missive, and
- Trans-reflective.

"Trans-missive" and "Trans-reflective" are used with an LED, EL, or CCFL backlight.

Q. Is temperature a matter of concern in LCDs?

Yes, since the LCDs are widely used, some of the applications will be in extreme weather conditions where a wide temperature range is required. Normally the wide temperature range for a TN type LCD is -30 ~ 75C (operation Temp.) and -30 ~ 70C (storage temp.)

Q. What are the types of driving modes used in LCDs?

A. There are two types of driving modes. One is "Static" and the other is "Multiplexed". "Static" is a method of activating an LCD where each segment has an independent connection, whereas the "Multiplexed" method is a method where the LCD is driven by different channels. This method requires additional information such as "Duty" and "Bias". For example, 1/2 duty, 1/4 Bias defines an 8 x 1 LCD display.

Q. How do we define the viewing direction?

A. We use four different viewing directions for LCDs: 3 o'clock, 6 o'clock, 9 o'clock and 12 o'clock viewing means you look at the LCD from its left side, 6 o'clock means you

look at the LCD from the bottom...and so on. 6'clock is the most common viewing direction. Examples of 6 o'clock viewing are calculators and notebooks.

Q. [How do I know what type of LCD to use for our product?](#)

A. That will really depend on a number of factors including multiplex driving scheme, temperature, voltage/power, artwork design, contrast requirements and cost budget. We supply TN, HTN, STN, and also special product such as cholesteric bi-stable displays and single polarizer high contrast reflective TN/HTN display.

Q. [How does LCD get driven?](#)

A. LCD is driven by AC (alternating current), it is best to use standard LCD driver IC to generate as this will simplify your development time. Alternatively, for simple TN segment drive, most MCU may emulate the AC current but would need a lot of background know how. For example, simple TN segment drive would require as low as 40Hz to as high as 120 Hz. Depending on the operating environment such as temperature and would affect the contrast of the display. Some experiment may be needed to find the optimum operating condition.

Q. [What is ESD and does that affect LCDs?](#)

A. ESD stands for electro-static discharge, it is arc or discharge of electrons between two surfaces when potential difference is great enough for discharge to take place. Because LCD is made mainly by non-conductive material such as glass and plastic, ESD can happen in LCD. In most cases, this can be easily overcome by design of peripheral connection and mounting.

Q. [What is ITO?](#)

A. ITO stands for Indium Tin Oxide, more precisely, it is a mixture of indium oxide and tin oxide. Two important characteristics about these materials are:

Optically transparent with refractive index of between 1.4 and 1.8 which is close to that of soda lime glass (commonly used as the supporting substrate of LCD). It is a conductive inorganic material. The conductivity of this layer depends on the thickness.

Q. [What ITO resistance is available?](#)

A. For ITO, the term of resistance is based on ohms per square. Commonly, ITO resistance is 200, 120, 100, 80 and 25 depending on the requirement. The choice could be based on artwork design (such as trace width and area), current requirements, etc.

Q. [What interconnection technology is available to connect LCD to peripherals?](#)

A. Commonly available through us are

1. Pin connection (with pitch commonly at 2.54mm, 1.8mm standard)
2. Heat seal connection
3. FPC (flexible PC)
4. Zebra or sometimes known as elastomer inter-connector

Q. What test is done to LCD?

A. Standard tests and control includes

1. 100% Electrical test (that test for operating voltage, logic of display)
2. Dimensional and cosmetic inspection including viewing angle
3. Sample inspection using thermal, thermal cycle, and humidity

Q. What is viewing angle?

A. LCD utilize physical phenomena of liquid crystal know as birefringence (which describe its properties of having two different refractive index depending on orientation) to create the light blocking and passing effect. Because of this, normally, the best viewing cone is best at a certain direction which is know as viewing angle. It is commonly specify by: 12:00, 6:00, 3:00 and 9:00 except in special situation such as automotive which may require nonstandard direction.

Q. How does CCFL and EL gets driven?

A. Inverter is used to generate the AC current needs for both device. However, due to the high voltage requirements by CCFL, a transformer is often need to increase the supply voltage.

Q. Does UV light affect LCDs?

A. The answer really depends on material selection and configuration. Because liquid crystal is a primarily organic compound, most liquid crystal material is susceptible to UV disintegration. There are some liquid crystals, which are specially design for outdoors application that is more UV resistance. When use with UV blocking polarizer, the LCD can be resistance to ultra violet damage.

Q. What other factors may affect life of LCD?

A. Two factors:

1. Moisture - extreme moisture exposure will cause sodium migration in the glass which will contaminate the liquid crystal, often result in increase of current and effect extrusion of ITO patterns.
2. Heat - as the polarizer is made of plastic (often Mylar based material), heat will de-stress the polarizer, which will eliminate the polarizing effect. Special iodine type polarizer may be necessary to use at cost of lower polarizing efficiency (thus darker and diminishing contrast). This is trade off one must take when specify the product. The cut off is normally at around +85 degree centigrade.

Q. What is alignment layer and what is TOP coating?

A. As previously explained, liquid crystal has two distinctive refractive index known as birefringence, in classical view and text book, liquid crystal used in common display application are in what we call nematic phase which is more like a glass rod which will

turn when influence by electromagnetic force. Alignment layer is used to anchor the liquid crystal molecule at the glass surface forming the boundary condition for the display to work.

Coating is simply a material put under the alignment material, which act as a barrier layer. The main purpose is to reduce chance of ionic contamination, which will deteriorate the display performance and shorten its lifetime. Very often, silicon dioxide is used for this purpose.

Q. Why does LCD turns dark when left under the sun? Is there any problem with the display?

A. For most cases, TN, HTN and STN utilize the phase known as nematic for display purpose. Within this phase, the liquid crystal has a "rod shape" exists within the solution which has fast response and has excellent electro-optic properties. This phase, however, only exists within a limited temperature range. The higher end of this temperature range is known as clearing point, above which, the liquid crystal lost its birefringence properties and cannot bend the light path anymore. Thus the polarizer will then be the only factor which affect incoming and out coming light. When the LCD is cooled down to below its clearing point, the display should be working again. The temperature for the clearing point varies greatly from material to material and you should contact our engineers regarding what you have. Normally a safe margin should be used to avoid clearing point when designing the display.

Lampex has kept a team of trained, experienced and caring engineers on standby to service and provide answers to any problems that you may come across whilst using any or our products and services. These technical experts will guide you through any task associated with the hardware, software, connections, firmware, routines, application, procedure and indeed every facet of our products and services. This level of care comes, in the case of the QFP range of modules, in addition to the standard warranty of one year from date of our supply against manufacturing defects that may be encountered by you.

Our dedicated readiness is to assist you for all your needs.

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