Guide to Custom LCD Design

■ Ordering Procedure

ORDERING PROCEDURE		
CUSTOMER	KEC	SCHEDULE

Beginning of order process — Confirmation of details

Custom design sheet

design pattern

Mask film

prototype design

specification for sample product
design estimate
tooling charge

5~10days (1W)

Approval of specifications

Detail design (CAD)

Sample production

20~25days (3W)

Approval of sample

Final specification confirmation
Discussion for start of production

Purchase order
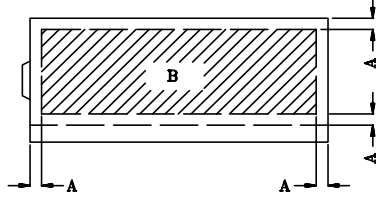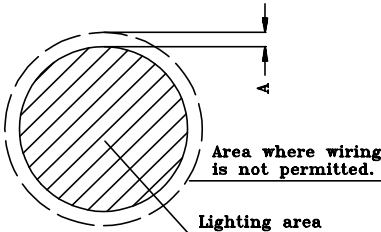
Start of production

Shipment

Guide to Custom LCD Design
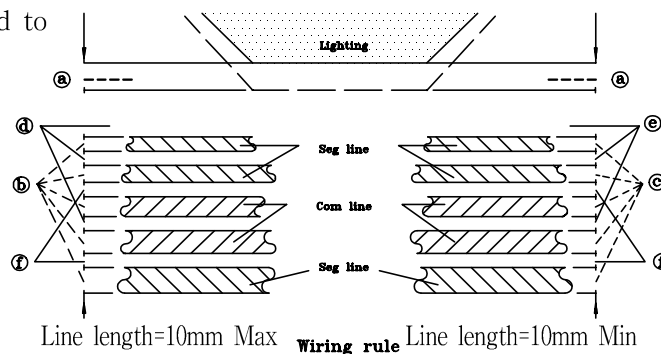
■ Display patterns

Comprehensive services, from design to final production, allows freedom of design to make full use of each characteristic. Refer to the following standards when creating a preliminary design.

1. Design Standards

	Item	Point	Standard	
			Details	Standard Values
①	Effective line area (excluding Seg terminal)	Protects against broken edges of glass	"B″ Shows area for pattern or wiring.	A≧0.4mm
②	Perimeter area where wiring is not permitted.	Protects against broken characters, abnormal lighting, etc.	Limitation on lines does not include lines running to lighting area.	ⓐ A≧0.08mm (full perimeter)
③	Wiring width and interval	Wiring should be carefully considered when designing the lighting area.	See table below	

Length	10mm max.	10mm min.	Space between other substrates (Space between Seg. and Com.)
Line	ⓑ 0.08mm min.	ⓒ 0.1mm min.	ⓕ 0.1mm min.
Space	ⓓ 0.08mm min.	ⓔ 0.1mm min.	

・As a standard, maximum values should be regarded as a length of 20mm, and stacking up to 10 lines.
・Display quality may be adversely affected by uneven line resistance or lighting load(difference between lighting areas for each line), even when the above standards are applied.
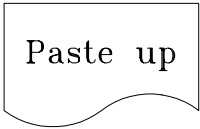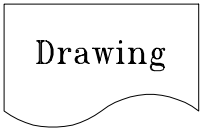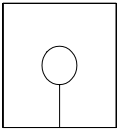
●Application Example
The letters A through H correspond to the standards listed above.

Line length=10mm Max **Wiring rule** Line length=10mm Min

Guide to Custom LCD Design

2. Presentation of design data

There are a number of different formats that can be used for the presentation of design data.
The precision and time required for final design is affected by the procedure used.

|	Format	Characteristics	Remarks
Ⓐ	Paste up	Enlargement and reduction of photographic film allows precise reproduction of any design. Suitable for irregular designs. The greater the enlargement, the better the precision.	・Please submit the original paste up. ・Please select from among 3, 5, 10 and 20 times. ・As a rule, determine the enlargement according to a maximum paste up size of 600mm.
Ⓑ	Drawing	Precise drawing can be produced with input to CAD. All data must be converted into numeric values. Generally suitable for array type patterns.	Consists of : ┌ General layout drawing └ Detailed drawings
Ⓒ	FD	Allows precise reproduction of design simulation. The most precise of the methods described here, and reduces the number of days requried until production of a prototype.	The method requires specific data formats. Acceptable Formats are: 1.Auto-CAD data 2.IGES format 3.DXF format 　others

Data also can be acceptable in combinations of the four formats (Ⓐ through Ⓒ)described above.

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■ Panel dimensions and configuration

The following tables show the standard dimensions and shapes available.
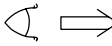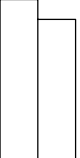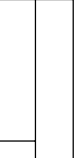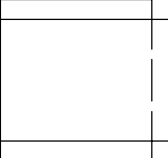
For special applications, custom sizes and designs are also available.
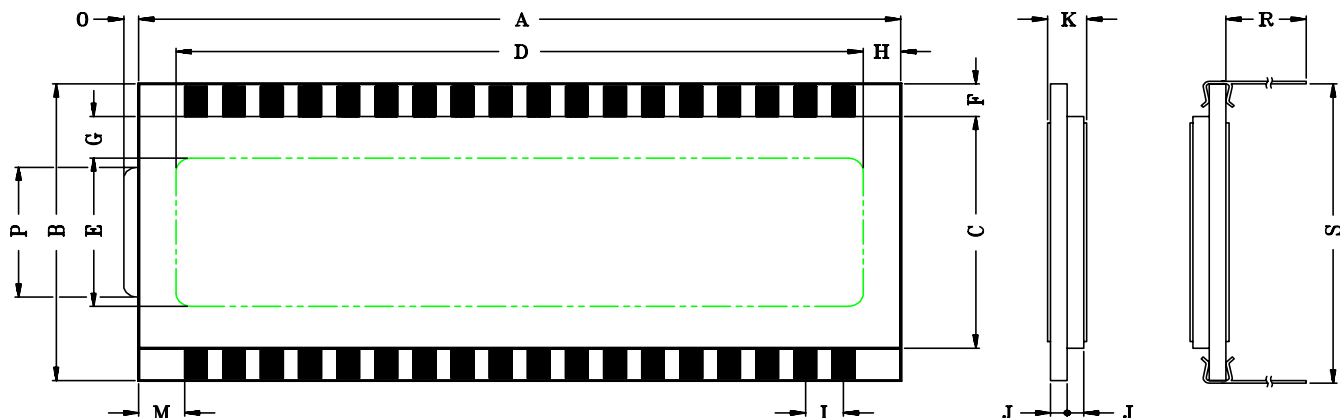
ITEM	STANDARD VALUE			TOLERANCE
	MIN	TYP	MAX	
GLASS DIMENSIONS: WIDTH (A)				
FOR PIN TYPE	30	–	150	
FOR NO PIN TYPE	20	–	180	±0.3
HEIGHT (B)				
FOR PIN TYPE	15	–	60	
FOR NO PIN TYPE	10	–	90	
GLASS THICKNESS (J)	–	0.5	–	
	–	0.7	–	±0.1
	–	1.1	–	
POLARIZER THICKNESS FRONT	0.15	–	0.3	
BACK	0.15	–	0.3	±0.05
TOTAL DISPLAY THICKNESS (K)	–	–	1.65	
	–	–	2.05	
	–	–	2.85	
SEAL WIDTH (G, H)	1.2	1.5	–	
CONTACT LEDGE WIDTH				
FOR PIN CONNECTORS	2.4	2.5	–	
FOR ELASTOMER VERSION	1.5	2.0	–	
FOR HEAT SEAL CONNECTORS	1.5	2.0	–	
PITCH OF TERMINAL ELECTRODES (I)		1.8		
		2.0		
		2.54		
GLASS EDGE TO FIRST TERMINAL ELECTRODE (M)				
FOR PIN TYPE	3.0	–	–	
FOR NO PIN TYPE	2.0	–	–	
PIN LENGTH (R)	–	–	29	±1.0

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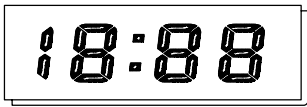
■ Configuration (terminals)

	Double terminal	Lower terminal	Upper terminal	Reverse double terminal	Reverse lower terminal	Reverse upper terminal
Standard applications	Rubber connector			With pin		
		Heat seal			Heat seal	

Triple terminal
TOP VIEW
Rubber connector, Heat seal
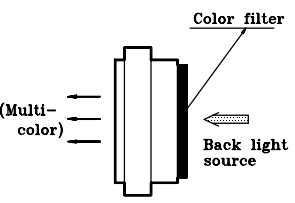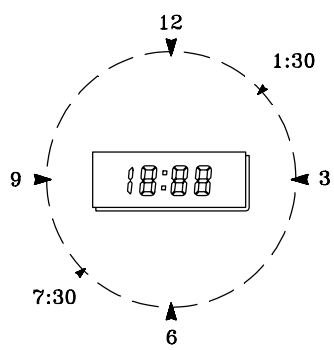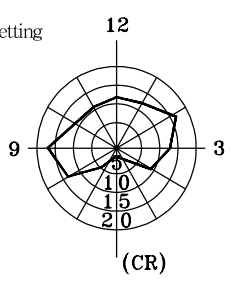
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■ Display conditions and viewing angle

Such factors as display conditions and field of view angle are effected by operating conditions, and so the proper mode must be selected.

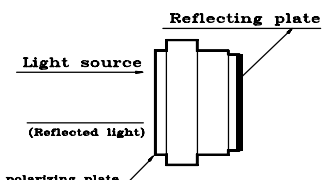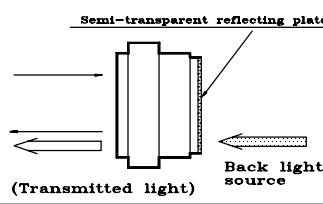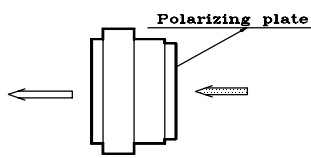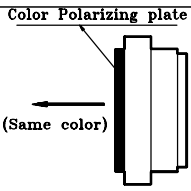| Display mode			Applications	Characteristics
	Positive display		General	Basic low-power LCD. Display is illuminated by ambient light, making it difficult to read in dark environments.
	Negative display		Back light display Multi-color display	A backlight make characters stand out clearer. Multi-color display produced using color filters.
	Reflective type		General	Generally used in bright environments.
	Semi-transparent, reflective type		External light and back light display	Can be used as reflective type when ambient light is bright, and as transparent type when ambient light is dim.
	Transparent type		Back light display	Used with backlight for dark environments.

This thickness of the polarizing plate, semi-transparent reflecting plate, and reflecting plate may be restricted in order to allow optimum LCD characteristics.

Standard specifications
Polarizing plate thickness ···························· 0.15mm
Semi-transparent reflecting plate thickness ······ 0.25mm
Reflecting plate thickness ···························· 0.25mm

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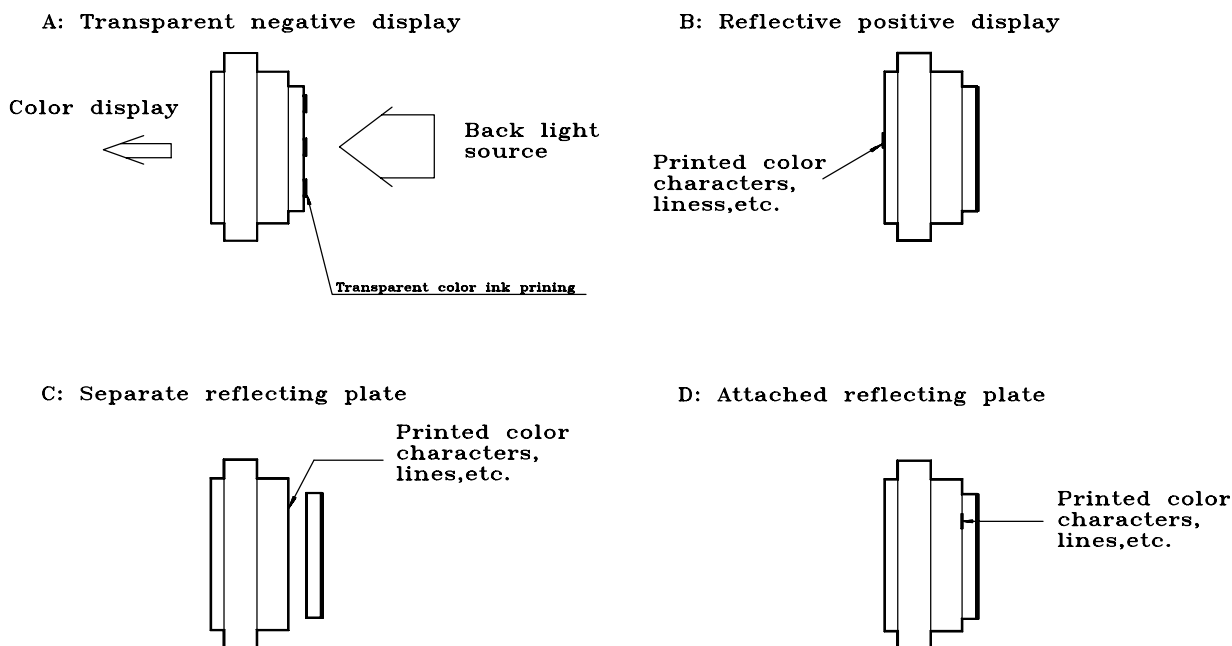| Display Mode		Applications	Characteristics
TN	(background color/ light color) Gray/Black	Viewing angle and direction somewhat limited.	
HTN	Gray/Black	Up to 1/48 duty drive possible. Wide visual field.	
STN	Green/Blue Gray/Purple White/Blue White/Black	Up to 1/200 duty drive possible. High quality image.	
Color polarizing plate	Color Polarizing plate (Same color)	For color coordination with product design.	Colored polarizing plate, color displayed characters.
Color filter	Color filter (Multi-color) Back light source	Color display stands out for alarms, etc.	Used in combination with negative display for partial coloring.
	12 1:30 9 3 7:30 6 18:88	For timepiece displays that require high-contrast at various angles and directions. Viewing angle can be adjusted during installation of product.	Example contrast characteristic diagram for following conditions: 3V, 1/3D, 1/3B $\theta = 60°$ viewing angle setting 12:00 12 9 3 5 10 15 20 (CR)

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■ Options

The options noted in this section are available to make the LCD easier to use.

1. Color ink printing

Color ink printing on a transparent negative display helps to make certain characters or figures stand out. Color ink printing can also be used to differentiate functions on computer display applications.

・ Example applications

A: Transparent negative display

Color display

Back light source

Transparent color ink prining

B: Reflective positive display

Printed color characters, liness,etc.

C: Separate reflecting plate

Printed color characters, lines,etc.

D: Attached reflecting plate

Printed color characters, lines,etc.

	Polarizing plate type			Printed surface		*Printing method
Example	Transparent type	Reflective type	Separate reflecting plate	On glass	On polarizing plate	Screen printing
A	○				○	○
B		○			○	○
C		○	○	○		○
D		○		○		

*1. Printing is affected by minimum line width, printing size and other factors. Consult with your KEC representative for details.

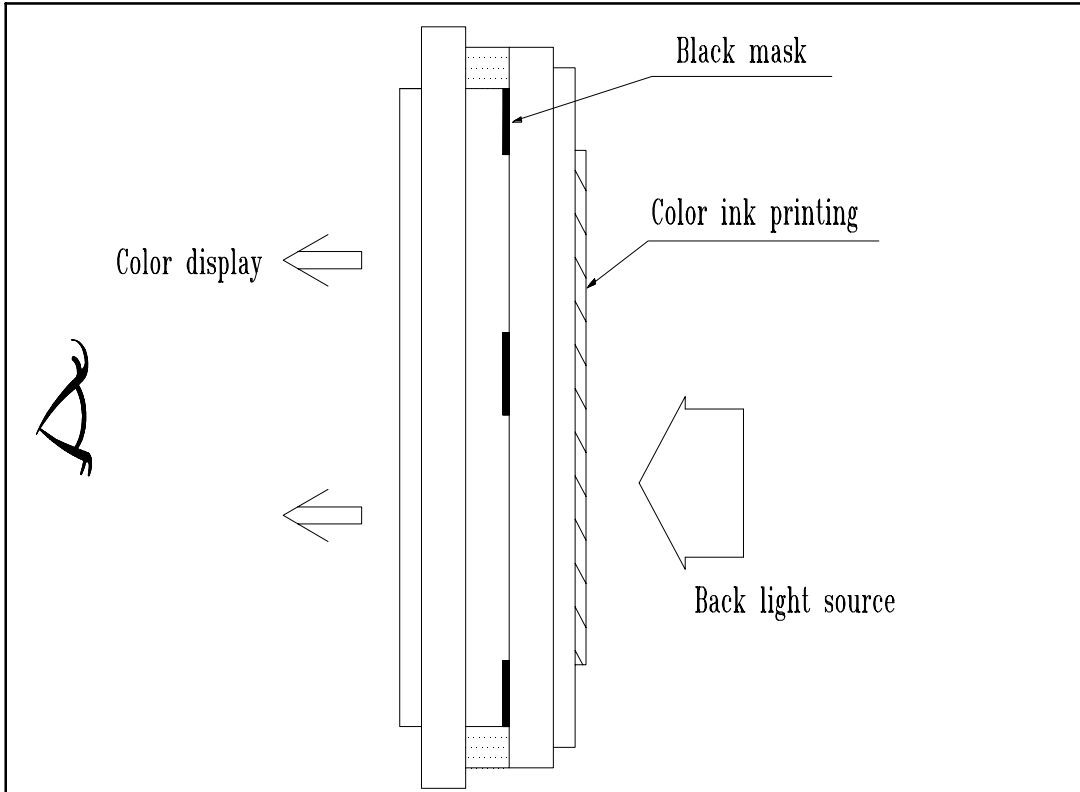2. Please present color samples when ordering.

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2. Black masking

A process called masking is used to create high-contrast displays by covering inside of the LCD glass in the areas that are not to be displayed. When used in combination with the color ink printing process, a wide variety of colors can be produced.

・Configuration
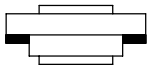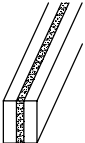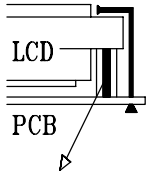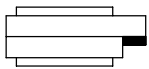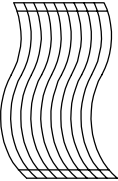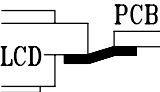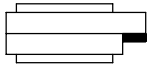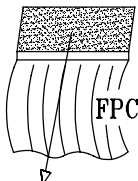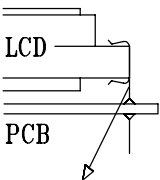
Example application	Method	Characteristics
Use a negative display when : ・When good contrast is not possible because the backlight is too bright. ・When color separation lines can be seen. ・When overall panel brightness differs according to viewing angle.	Black mask type	Drive conditions do not affect design.

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3. Connection and mounting method

Connections of the LCD and drive circuit should be made in accordance with the application and the required level of product quality. Use the following guide when determining a mounting method.

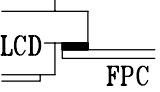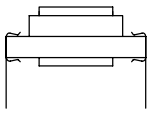| Connection method	LCD configuration	Mounting methods		Number of terminals and terminal pitch	Merits	Demerits
		Connector type	Mounting example			
Ⓐ Rubber connector		Rubber connector	Rubber connector, 80% compression.	Multi-terminal, 0.4mm minimum.	Cheap, easy connection, terminal pitch can be made as small as desired.	Uniform pressure required.
Ⓑ Heat seal		Heat seal	Heat seal, applied using thermocompression bonder.	Multi-terminal, 0.4mm minimum.	High level of freedom in mounting layout.	Special thermocompression bonder required.
Ⓒ Anistropic connector		Anistropic connector	Anistropic connector, applied using thermocompression bonder.	Multi-terminal, 0.4mm minimum.	High level of freedom in mounting layout.	Special thermocompression bonder required.
Ⓓ Pin connector	See section titled Options for details.		Pin connector, soldered.	Few-terminal, 2.54 mm, 2.0 mm, 1.8 mm	Can be soldered Highly reliable High level of freedom in mounting on back of LCD	Terminal pitch limitations.

■ Drive Characteristics(TN-LCD)

The drive conditions are intrinsically related to display characteristics. The product's power supply specifications(including temperature dependency) especially affect the display quality within the operating temperature range. please specify the voltage variation range in the "CUSTOM LCD DESIGN SHEET".

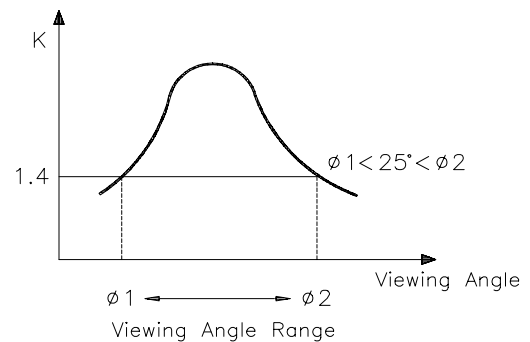| ITEM			TN NORMAL						TN EXTENDED					
			STATIC	1/2	1/3	1/4	1/8	1/16	STATIC	1/2	1/3	1/4	1/8	1/16
OPERATING TEMPERATURE(Top)			0℃~+60℃						−30℃~+80℃					
STORAGE TEMPERATURE(Tstg)			−10℃~+70℃						−40℃~+85℃					
OPERATING VOLTAGE(Vop)			MIN: 3.0Vop MAX: 5.0Vop						MIN: 3.0Vop MAX: 5.0Vop					MIN: 5.0Vop MAX: 7.0Vop
RESPONSE TIME (msec)	RISE TIME	0℃	160	200	450	500	550	600	100	140	300	350	350	350
		25℃	100	100	200	200	250	250	70	60	140	160	160	160
	DECAY TIME	0℃	300	350	480	500	500	500	200	240	320	350	350	350
		25℃	150	150	200	200	220	230	100	90	150	160	160	160
VIEWING ANGLE	θ		−20~45	5~45	10~40		10~30		−20~45	5~45	10~40		10~30	
	φ		−40 ~ 40		−30 ~ 30				−40 ~ 40		−30 ~ 30			
CONTRAST RATIO (K)			12	8	6	6	5	4	12	8	6	6	5	4
CAPACITANCE PER SEGMENT (Cs)			1500PF/Cm^2						1500PF/Cm^2					
DISSIPATION CURRENT			3.0μA/Cm^2						3.0μA/Cm^2					
DC RESISTANCE (Rs)			100MΩ/mm^2						100MΩ/mm^2					

(a) Definition of viewing angle θ and φ

(b) Definition of viewing angle $\varphi1$ and $\varphi2$
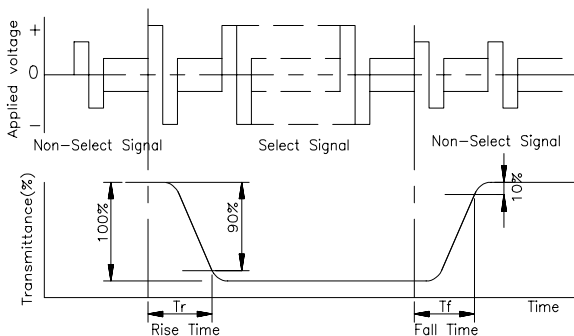
(c) Definition of optical response time

(d) Definition of contrast ratio k

■ Drive Characteristics(HTN-LCD)

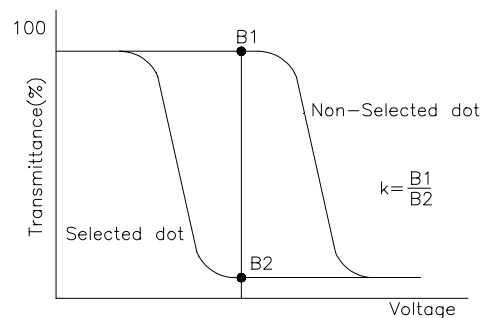Characteristics according to HTN-LCD are nearly the same to TN-LCD. But HTN-LCD possess wider view angle characteristic to compare TN-LCD.

ITEM			HTN NORMAL						HTN EXTENDED					
			STATIC	1/2	1/3	1/4	1/8	1/16	STATIC	1/2	1/3	1/4	1/8	1/16
OPERATING TEMPERATURE(Top)			0℃~+60℃						-30℃~+80℃					
STORAGE TEMPERATURE(Tstg)			-10℃~+70℃						-40℃~+85℃					
OPERATING VOLTAGE(Vop)			MIN: 3.0Vop MAX: 5.0Vop						MIN: 3.0Vop MAX: 5.0Vop					MIN: 5.0Vop MAX: 7.0Vop
RESPONSE TIME (msec)	RISE TIME	0℃	160	200	450	500	550	600	100	140	300	350	350	350
		25℃	100	100	200	200	250	250	70	60	140	160	160	160
	DECAY TIME	0℃	300	350	480	500	500	500	200	240	320	350	350	350
		25℃	150	150	200	200	220	230	100	90	150	160	160	160
VIEWING ANGLE	θ		-20~45	5~45	0~40		0~30		-20~45	5~45	0~40		0~30	
	φ		-40 ~ 40		-30 ~ 30				-40 ~ 40		-30 ~ 30			
CONTRAST RATIO (K)			12	8	6	6	5	4	12	8	6	6	5	4
CAPACITANCE PER SEGMENT (Cs)			1500PF/Cm^2						1500PF/Cm^2					
DISSIPATION CURRENT			3.0μA/Cm^2						3.0μA/Cm^2					
DC RESISTANCE (Rs)			100MΩ/mm^2						100MΩ/mm^2					

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■ Drive Characteristics(STN-LCD)

Characteristics of STN-LCD are excellent viewing angle above TN-LCD.
Below characteristics show it is to measured 1/16duty 1/4bias condition.

Item			STN NORMAL			STN Extended		
			Min.	Typ.	Max.	Min.	Typ.	Max.
OPERATING TEMPERATURE (Top)				0～+50℃			−20～+70℃	
STORAGE TEMPERATURE(Tstg)				−10～+60℃			−30～+80℃	
OPERATING VOLTAGE (Vop)			4.0	4.8	5.6	4.0	4.8	5.6
OPERATING FREQUENCY (fF)			30	60	120	30	60	120
RESPONSE TIME (msec)	RISE TIME	0℃	1200	1600	2000	1200	1500	1800
		25℃	120	150	180	100	120	150
	DECAY TIME	0℃	1600	2000	2400	1600	2000	2400
		25℃	150	180	220	120	150	180
VIEWING ANGLE	θ			−15～30			−15～30	
	ϕ			−30～30			−30～30	
CONTRAST RATIO (K)			2	4	6	3	5	7
DISSIPATION CURRENT (μA/㎠)			2.0	3.0	4.0	2.0	3.0	4.0

Guide to Custom LCD Design

■ Environment and Application

By defining the environmental conditions and the reliability standards for the LCD,
It is possible to develop a design that provides the ultimate in cost performance.

● Reliability Test

TEMPERATURE TESTS	NORMAL GRADE	EXTENDED GRADE
High temperature storage	70℃ 96H (without Polarizer)	85℃ 500H (without Polarizer)
Low temperature storage	-10℃ 240H	-40℃ 500H
High temperature operation	40℃ 96H	80℃ 500H (without Polarizer)
Low temperature operation	0℃ 240H	-30℃ 500H
High temperature, High humidity (storage)	40℃ 90%RH 96H (without Polarizer)	60℃ 90%RH 500H (without Polarizer)
Thermal shock	-25℃ ↔ 25℃ ↔ 70℃ (30min) (5min) (30min) 5 cycle (without Polarizer)	-30℃ ↔ 25℃ ↔ 85℃ (30min) (5min) (30min) 10 cycle (without Polarizer)
Example application	○ Calculators ○ Household appliances ○ Office machines	○ Automotive applications ○ Outdoor displays ○ Other

No considerable changes in external appearance and functions, after testing mentioned above.

＊ Certain modes are unavailable, depending on drive conditions. See ″Drive characteristics″ for details.