



PRODUCT SPECIFICATION FOR LCD MODULE

MODULE NO. : ET-G12864-1
REVERSION : V1
TYPE : COG

Customer Approval:

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PREPARED BY		DATE	
CHECKED BY		DATE	
APPROVED BY		DATE	



1. General Specifications

Item	Standard Value	Unit
Number of dots	128(W) x 64(H)	dots
Display Pattern	<input checked="" type="checkbox"/> Dot-Graphic <input type="checkbox"/> Character <input type="checkbox"/> Digits <input type="checkbox"/> with ICON <input type="checkbox"/> _____	
Module Dimension	51.5(W) x45.5(H) x2.1(T)	mm
Viewing Area	48.5(W) x34.7(H)	mm
Active Area	40.67(W) x 24.16(H)	mm
DOT Size	0.288(W) x 0.348 (H)	mm
DOT Pitch	0.318(W) x 0.378(H)	mm
LCD Type	<input type="checkbox"/> TN, Positive <input type="checkbox"/> TN, Negative <input type="checkbox"/> HTN, Positive <input type="checkbox"/> HTN, Negative <input type="checkbox"/> STN, Yellow-Green <input type="checkbox"/> STN, Gray <input type="checkbox"/> STN, Blue <input type="checkbox"/> FSTN, Positive <input type="checkbox"/> FSTN, Negative <input type="checkbox"/> Color STN <input type="checkbox"/> FM LCD	
Polarizer Type	<input type="checkbox"/> Transmissive <input type="checkbox"/> Reflective <input type="checkbox"/> Transflective <input type="checkbox"/> Anti-Glare	
View Direction	<input type="checkbox"/> 6H <input type="checkbox"/> 12H <input type="checkbox"/> _____	
Operation Voltage	<input checked="" type="checkbox"/> 3.0 (3.3) <input type="checkbox"/> 5.0 <input type="checkbox"/> _____	V
DC-DC Converter	<input checked="" type="checkbox"/> Build-in <input type="checkbox"/> External	
LCD Controller & Driver	S6B0724A01(COG)	
LCD Driving Method	1/65duty, 1/9bias	
Interface Type	<input type="checkbox"/> 6800 <input type="checkbox"/> 8080 <input type="checkbox"/> I2C <input type="checkbox"/> Serial <input type="checkbox"/> SPI	
Backlight Type	<input type="checkbox"/> LED <input type="checkbox"/> CCFL <input type="checkbox"/> EL <input checked="" type="checkbox"/> no Backlight <input type="checkbox"/> _____	
Backlight Color	<input type="checkbox"/> Yellow-Green <input type="checkbox"/> White <input type="checkbox"/> Amber <input type="checkbox"/> Blue <input type="checkbox"/> Red <input type="checkbox"/> _	
EL/CCFL Driver type	<input type="checkbox"/> Build-in <input type="checkbox"/> External	
Operation Temperature(oC)	-20~70 (TOPL ~ TOPH)	deg..
Storage Temperature (oC)	-30~80 (TSTL ~ TSTH)	deg..

Note: Label "■" means the option selected.



4. Pin Description

Pin No.	Symbol	Level	Description
1	INTRS	H/L	H :using built in resistors , L :not using in resistors.
2	C68	H/L	H:6800-series MPU interface ,L:8080-series MPU interface
3	VR		Vo voltage adjustment pin which is valid only .when on – chip resistors are not used (INTRS)
4	V0	I/O	LCD driver supply voltages
5	V4	I/O	
6	V3	I/O	
7	V2	I/O	
8	V1	I/O	
9	C2+		Capacitor 2 positive connection pin for voltage converter
10	C2-		Capacitor 2 negative connection pin for voltage converter
11	C1+		Capacitor 1 positive connection pin for voltage converter
12	C1-		Capacitor 1 negative connection pin for voltage converter
13	C3+		Capacitor 3 positive connection pin for voltage converter
14	VOUT	----	Voltage converter output
15	VSS		Ground
16	VDD		Supply voltage for logic Ground
17~24	DB7~DB0	H/L	Data bus.
25	E	H, H, L	Chip enable signal
26	R/W	H/L	H: Read mode, L: Write mode
27	RS	H/L	H: DB<0:7> Display RAM Data, L: DB<0:7> Instruction Data
28	/RESETB	L	Reset input pin .when RESETB is low ,initialization is executed.
29	/CSB	H/L	Chip select input
30	NC	---	

5. Absolute Maximum Ratings

Parameter	Symbol	Rating	Unit
Supply voltage range	VDD	- 0.3 to +7.0	V
	VLCD	- 0.3 to +17.0	V
Input voltage range	VIN	- 0.3 to VDD + 0.3	V
Operating temperature range	TOPR	- 40 to +85	°X
Storage temperature range	TSTR	- 55 to +125	°X

NOTES:

- VDD and VLCD are based on VSS = 0V.
- Voltages $V0 \geq V1 \geq V2 \geq V3 \geq V4 \geq VSS$ must always be satisfied.(VLCD = V0 – VSS)
- If supply voltage exceeds its absolute maximum range, this LSI may be damaged permanently.It is desirable to use this LSI under electrical characteristic conditions during general operation.Otherwise, this LSI may malfunction or reduced LSI reliability may result.



6. DC Characteristics

(VSS = 0V, VDD = 2.4 to 3.6V, Ta = -40 to 85°C)

Voltage converter input voltage	VCI	× 2		2.4	-	3.6	V	VCI
		× 3		2.4	-	3.6		
		× 4		2.4	-	3.6		
		× 5		2.4	-	3.2		
Voltage converter output voltage	VOUT	×2 / ×3 / ×4 / ×5		95	99	-	%	VOUT
Voltage regulator operating voltage	VOUT			6.0	-	16.0	V	VOUT
Voltage follower operating voltage	V0			4.5	-	15.0	V	V0 *9
Reference voltage	VREF	Ta = 25°C	- 0.05%/°C	2.04	2.1	2.16	V	*10

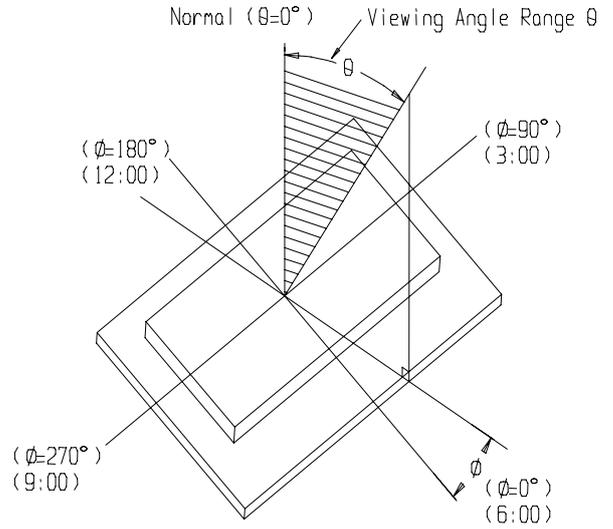
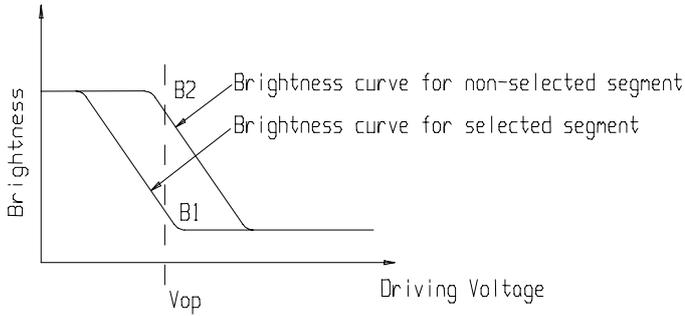
6. Electro-optical Characteristics (VDD=5.0V, Ta = 25 °C)

Item	Symbol	Condition	Min	Type	Max	Unit	Remarks	Note
Contrast ratio	Cr	---	2	3	---	---	---	1
Viewing angle range	θ	Cr ≥ 2	35	---	---	deg	∅ = 90°	2
			35	---	---	deg	∅ = 270°	2
			50	---	---	deg	∅ = 0°	2

			33	---	---	deg	$\varnothing = 180^\circ$	2
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Figure 6. Definition of contrast ratio 'Cr'. & viewing angle range 'θ'.

$$Cr = \frac{\text{Brightness of non-selected segment}(B2)}{\text{Brightness of selected segment}(B1)}$$



Note1: Definition of contrast ratio Cr .

Note2: Definition of viewing angle range 'θ'.

5. Instruction Table



Instruction	RS	RW	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0	Description
Display ON / OFF	0	0	1	0	1	0	1	1	1	DON	Turn on/off LCD panel When DON = 0: display OFF When DON = 1: display ON
Initial display line	0	0	0	1	ST5	ST4	ST3	ST2	ST1	ST0	Specify DDRAM line for COM0
Set page address	0	0	1	0	1	1	P3	P2	P1	P0	Set page address
Set column address MSB	0	0	0	0	0	1	Y7	Y6	Y5	Y4	Set column address MSB
Set column address LSB	0	0	0	0	0	0	Y3	Y2	Y1	Y0	Set column address LSB
Read status	0	1	BUSY	ADC	ON/OFF	RESETB	0	0	0	0	Read the internal status
Write display data	1	0	Write data								Write data into DDRAM
Read display data	1	1	Read data								Read data from DDRAM
ADC select	0	0	1	0	1	0	0	0	0	ADC	Select SEG output direction When ADC = 0: normal direction (SEG0@SEG131) When ADC = 1: reverse direction (SEG131@SEG0)
Reverse display ON / OFF	0	0	1	0	1	0	0	1	1	REV	Select normal / reverse display When REV = 0: normal display When REV = 1: reverse display
Entire display ON / OFF	0	0	1	0	1	0	0	1	0	EON	Select normal/entire display ON When EON = 0: normal display. When EON = 1: entire display ON
LCD bias select	0	0	1	0	1	0	0	0	1	BIAS	Select LCD bias
Set modify-read	0	0	1	1	1	0	0	0	0	0	Set modify-read mode
Reset modify-read	0	0	1	1	1	0	1	1	1	0	release modify-read mode
Reset	0	0	1	1	1	0	0	0	1	0	Initialize the internal functions
SHL select	0	0	1	1	0	0	SHL	x	x	x	Select COM output direction When SHL = 0: normal direction (COM0@COM63) When SHL = 1: reverse direction (COM63@COM0)
Power control	0	0	0	0	1	0	1	VC	VR	VF	Control power circuit operation
Regulator resistor select	0	0	0	0	1	0	0	R2	R1	R0	Select internal resistance ratio of the regulator resistor
Set reference voltage mode	0	0	1	0	0	0	0	0	0	1	Set reference voltage mode
Set reference voltage register	0	0	x	x	SV5	SV4	SV3	SV2	SV1	SV0	Set reference voltage register
Set static indicator mode	0	0	1	0	1	0	1	1	0	SM	Set static indicator mode
Set static indicator register	0	0	x	x	x	x	x	x	S1	S0	Set static indicator register
Power save	-	-	-	-	-	-	-	-	-	-	Compound Instruction of display OFF and entire display ON
NOP	0	0	1	1	1	0	0	0	1	1	Non-Operation command
Test Instruction_1	0	0	1	1	1	1	x	x	x	x	Don't use this instruction
Test Instruction_2	0	0	1	0	0	1	x	x	x	x	Don't use this instruction

7. System Control Commands

7.1 Display ON/OFF

Alternatively turns the display on and off.

E		R/W									
A0	/RD	/WR	D7	D6	D5	D4	D3	D2	D1	D0	Setting
0	1	0	1	0	1	0	1	1	1	1	Display ON
										0	Display OFF

When the display OFF command is executed when in the display all points ON mode, power save mode is entered. See the section on the power saver for details.

7.2. Display Start Line Set

Specifies line address (refer to Figure 6) to determine the initial display line, or COM0. The RAM display data becomes the top line of LCD screen. The higher number of lines in ascending order, corresponding to the duty cycle follows it. When this command changes the line address, smooth scrolling or a page change takes place.



E R/W											
A0	/RD	/WR	D7	D6	D5	D4	D3	D2	D1	D0	Line address
0	1	0	0	1	0	0	0	0	0	0	0
					0	0	0	0	0	1	1
					0	0	0	0	1	0	2
								↓			↓
					1	1	1	1	1	0	62
					1	1	1	1	1	1	63

7. 3. Page Address Set

Specifies page address to load display RAM data to page address register. Any RAM data bit can be accessed when its page address and column address are specified. The display remains unchanged even when the page address is changed. Page address 8 is the display RAM area dedicated to the indicator, and only D0 is valid for data change.

E R/W											
A0	/RD	/WR	D7	D6	D5	D4	D3	D2	D1	D0	Page address
0	1	0	1	0	1	1	0	0	0	0	0
							0	0	0	1	1
							0	0	1	0	2
								↓			↓
							0	1	1	1	7
							1	0	0	0	8

7. 4. Column Address Set

Specifies column address of display RAM. Divide the column address into 4 higher bits and 4 lower bits. Set each of them succession. When the microprocessor repeats to access the display RAM, the column address counter is incremental by during each access until address 132 is accessed. The page address is not changed during this time.

	E R/W																			Column address	
	A0	/RD	/WR	D7	D6	D5	D4	D3	D2	D1	D0	A7	A6	A5	A4	A3	A2	A1	A0		
High bits →	0	1	0	0	0	0	1	A7	A6	A5	A4	0	0	0	0	0	0	0	0	0	0
Low bits →							0	A3	A2	A1	A0	0	0	0	0	0	0	0	1	0	1
												0	0	0	0	↓	0	0	1	0	2
												1	0	0	0	0	0	1	0		↓
												1	0	0	0	0	0	1	1		130
																					131

7. 5. Read Status

This command is used to control the output status of signal SYNC, PM, CL and FR.

E R/W										
A0	/RD	/WR	D7	D6	D5	D4	D3	D2	D1	D0
0	0	1	BUSY	ADC	ON/OFF	RESET	0	0	0	0

BUSY: When high, the NT7534 is busy due to internal operation or reset. Any command is rejected until BUSY goes low. The busy check is not required if enough time is provided for each cycle.

ADC: Indicates the relationship between RAM column address and segment drivers. When low, the display is reversed and column address "131-n" corresponds to segment driver n. when high, the display is normal and column address corresponds to segment driver n.

ON/OFF: Indicates whether the display is on or off. When low, the display turns on. When high,



the display turns off. This is the opposite of Display ON/OFF command.

RESET: Indicates the initialization is in progress by /RES signal or by reset command. When low, the display is on. When high, the chip is being reset.

7.6. Write Display Data

Write 8-bit data in display RAM. As the column address automatically increments by 1 after each write, the microprocessor can continue to write data of multiple words.

E R/W										
A0	/RD	/WR	D7	D6	D5	D4	D3	D2	D1	D0
1	1	0	Write data							

7.7. Read Display Data

Reads 8-bit data from display RAM area specified by column address and page address. As the column address automatically increments by 1 after each write, the microprocessor can continue to read data of multiple words. A single dummy read is required immediately after column address setup. Refer to the display RAM section of FUNCTIONAL DESCRIPTION for details. Note that no display data can be read via the serial interface.

E R/W										
A0	/RD	/WR	D7	D6	D5	D4	D3	D2	D1	D0
1	0	1	Read data							

7.8. ADC Select

Changes the relationship between RAM column address and segment driver. The order of segment driver output pads could be reversed by software. This allows flexible IC layout during LCD module assembly. For details, refer to the column address section of Figure 4. When display data is written or read, the column address is incremented by 1 as shown in Figure 4.

E R/W											
A0	/RD	/WR	D7	D6	D5	D4	D3	D2	D1	D0	Setting
0	1	0	1	0	1	0	0	0	0	0	Normal
										1	Reverse

7.9. Normal/ Reverse Display

Reverses the Display ON/OFF status without rewriting the contents of the display data RAM.

E R/W											
A0	/RD	/WR	D7	D6	D5	D4	D3	D2	D1	D0	Setting
0	1	0	1	0	1	0	0	1	1	0	RAM Data "H"
											LCD ON voltage (normal)
										1	RAM Data "L"
											LCD ON voltage (reverse)

7.10. Entire Display ON

Forcibly turns the entire display on regardless of the contents of the display data RAM. At this time, the contents of the display data RAM are held. This command has priority over the Normal/Reverse Display command. When D is low, the normal display status is provided.



E R/W											
A0	/RD	/WR	D7	D6	D5	D4	D3	D2	D1	D0	Setting
0	1	0	1	0	1	0	0	1	0	0	Normal display mode Display all points ON
										1	

When D0 is high, the entire display ON status is provided. If the Entire Display ON command is executed in the display OFF status, the LCD panel enters Power save mode. Refer to the Power Save section for details.

7. 11. LCD Bias Set

This command selects the voltage bias ratio required for the liquid crystal display.

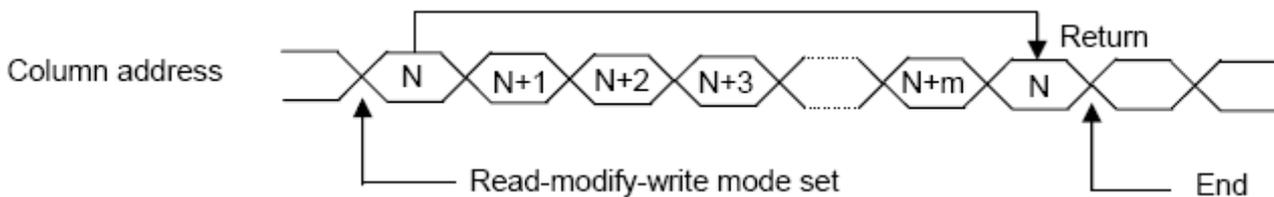
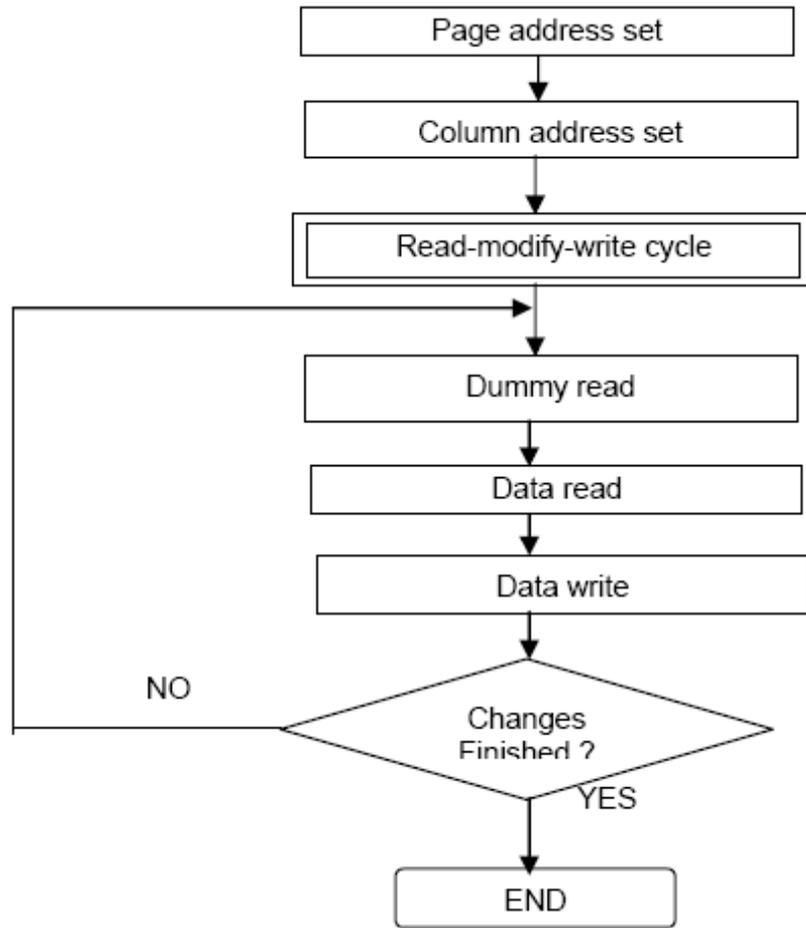
E R/W											Select Status				
A0	/RD	/WR	D7	D6	D5	D4	D3	D2	D1	D0	1/65duty	1/49duty	1/33duty	1/55duty	1/53duty
0	1	0	1	0	1	0	0	0	1	0	1/9 bias	1/8 bias	1/6 bias	1/8 bias	1/8 bias
										1	1/7 bias	1/6 bias	1/5 bias	1/6 bias	1/6 bias

7. 12. Read-Modify-Write

A pair of Read-Modify-Write and End commands must always be used. Once Read-Modify-Write is issued, column address is not incremental by Read Display Data command but incremental by Write Display Data command only. It continues until End command is issued. When the End is issued, column address returns to the address when Read-Modify-Write is issued. This can reduce the microprocessor load when data of a specific display area is repeatedly changed during cursor blinking or other events.

E R/W										
A0	/RD	/WR	D7	D6	D5	D4	D3	D2	D1	D0
0	1	0	1	1	1	0	0	0	0	0

* Even in read/modify/write mode, other commands aside from display data read/write commands can also be used.



7. 13. End

Cancels Read-Modify-Write mode and returns column address to the original address (when Read-Modify-Write is issued)

E R/W										
A0	/RD	/WR	D7	D6	D5	D4	D3	D2	D1	D0
0	1	0	1	1	1	0	1	1	1	0

7. 14. Reset

This command resets the Display Start Line register, Column Address counter, Page Address register, and Common output mode register, the V0 voltage regulator internal resistor ratio register, the Electronic Volume register, the static indicator mode register, the read-modify-write mode register, and the test mode. The Reset command does not affect on the contents of display RAM. Refer to the Reset circuit section of Function Description.



E R/W										
A0	/RD	/WR	D7	D6	D5	D4	D3	D2	D1	D0
0	1	0	1	1	1	0	0	0	1	0

The Reset command cannot initialize LCD power supply. Only the Reset signal to the /RES pad can initialize the supplies.

7. 15. Output Status Select Register

When D3 is high or low, the scan direction of the COM output pad is selectable. Refer to Output Status Selector Circuit in Function Description for details.

E R/W			Selected Mode													
A0	/RD	/WR	D7	D6	D5	D4	D3	D2	D1	D0		1/65duty	1/49duty	1/33duty	1/55duty	1/53duty
0	1	0	1	1	0	0	0	*	*	*	Normal	COM0→COM63	COM0→COM47	COM0→COM31	COM0→COM53	COM0→COM51
								1			Reverse	COM63→COM0	COM47→COM0	COM31→COM0	COM53→COM0	COM51→COM0

*: Invalid bit

D3 = 0: Normal (COM0 → COM63/47/31)

D3 = 1: Reverse (COM63/47/31 → COM0)

7.16. Power Control Set

Select one of eight power circuit functions using 3-bit register. An external power supply and part of on-chip power circuit can be used simultaneously. Refer to Power Supply Circuit section of FUNCTIONAL DESCRIPTION for details.

E R/W			Selected Mode								
A0	/RD	/WR	D7	D6	D5	D4	D3	D2	D1	D0	
0	1	0	0	0	1	0	1	0	1	0	Booster circuit: OFF
											Booster circuit: ON
											Voltage regulator circuit: OFF
											Voltage regulator circuit: ON
0	1	0	0	1	0	0	0	0	0	0	Voltage follower circuit: OFF
											Voltage follower circuit: ON

7. 17. V0 Voltage Regulator Internal Resistor Ratio Set

This command sets the V0 voltage regulator internal resistor ratio. For details, see explanation under "The Power Supply Circuits".

A0	E	R/W	D7	D6	D5	D4	D3	D2	D1	D0	Hex	Rb/Ra Ratio
0	1	0	0	0	1	0	0	0	0	0	20h	Small
								0	0	1	21h	
								0	1	0	22h	
								:	:	:	:	
								1	1	0	26h	
								1	1	1	27h	Large

7. 18. The Electronic Volume (Double Byte Command)

This command makes it possible to adjust the brightness of the liquid crystal display by controlling the liquid crystal drive voltage V_0 through the output from the voltage regulator circuits of the internal liquid crystal power supply. It is a two-byte command used as a pair with the electronic volume mode set command and the electronic volume register set command, and both commands must be issued one after the other.

E		R/W										
A0	/RD	/WR	D7	D6	D5	D4	D3	D2	D1	D0	V_5	
0	1	0	*	*	0	0	0	0	0	1	Small	
			*	*	0	0	0	0	1	0	↓	
			*	*	0	0	0	0	1	1		
			*	*	1	1	1	1	1	0		
			*	*	1	1	1	1	1	1	Large	

7. 19. Static Indicator (Double Byte Command)

This command controls the static drive system indicator display. The static indicator display is controlled by this command only, and is independent of other display control commands. This is used when one of the static indicator liquid crystal drive electrodes is connected to the FR terminal, and the other is connected to the FRS terminal. A different pattern is recommended for the static indicator electrodes than for the dynamic drive electrodes. If the pattern is too close, it can result in deterioration of the liquid crystal and of the electrodes.

The static indicator ON command is a double bytes command paired with the static indicator register set command, and thus command must be executed one after the other. (The static indicator OFF command is a single byte command)

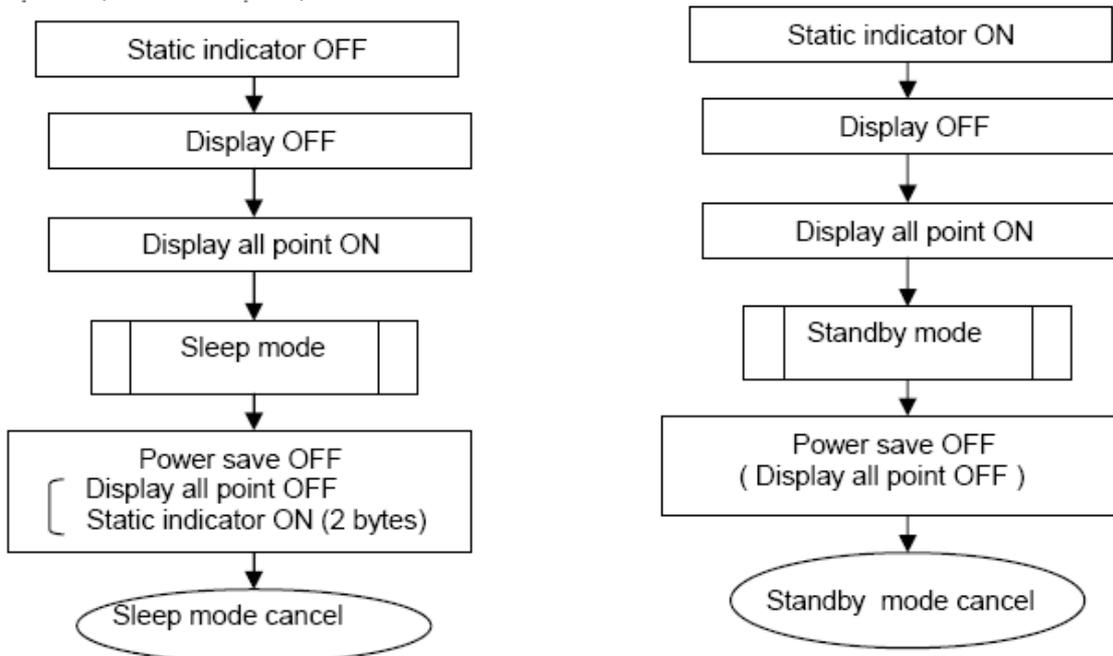
7.20. Power Save (Compound Command)

When the display all points ON is performed while the display is in the OFF mode, the power saver mode is entered, thus greatly reducing power consumption.

The power saver mode has two different modes: the sleep mode and the standby mode. When the static indicator is OFF, it is the sleep mode that is entered. When the static indicator is ON, it is the standby mode that is entered.

In the sleep mode and in the standby mode, the display data is saved as is the operating mode that was in effect before the power saver mode was initiated, and the MPU is still able to access the display data RAM.

Refer to figure 28 for power save off sequence.





Sleep Mode

This mode stops every operation of the LCD display system, and can reduce current consumption nearly to a static current value if no access is made from the microprocessor. The internal status in the sleep mode is as follows:

- (1) Stops the oscillator circuit and LCD power supply circuit.
- (2) Stops the LCD driver and outputs the VSS level as the segment/common driver output.
- (3) Holds the display data and operation mode provided before the start of the sleep mode.
- (4) The MPU can access the built-in display data RAM.

Standby Mode

Stops the operation of the duty LCD displays system and turns on only the static drive system to reduce current consumption to the minimum level required for static drive. The ON operation of the static drive system indicates that the NT7534 is in standby mode. The internal status in the standby mode is as follows:

- (1) Stops the LCD power supply circuit.
- (2) Stops the LCD drive and outputs the VSS level as the segment / common driver output. However, the static drive system still operates.
- (3) Holds the display data and operation mode provided before the start of the standby mode.
- (4) The MPU can access the built-in display data RAM.

When the Reset command is issued in the standby mode, the sleep mode is set.

- When the LCD drive voltage level is given by an external resistive driver, the current of this resistor must be cut so that it may be fixed to floating or VSS level, prior to or concurrently with causing the NT7534 to go to the sleep mode or standby mode.
- When an external power supply is used, likewise, the function of this external power supply must be stopped so that it may be fixed to floating or VSS level, prior to or concurrently with causing the NT7534 to go to the sleep mode or standby mode.

7.21. NOP

Non-Operation Command.

E R/W										
A0	/RD	/WR	D7	D6	D5	D4	D3	D2	D1	D0
0	1	0	1	1	1	0	0	0	1	1

7.22. Test Command

This is the dedicated IC chip test command. It must not be used for normal operation. If the Test command is issued inadvertently, set the /RES input to low or issue the Reset command to release the test mode.

A0	E R/W									Hex
	/RD /WR	D7	D6	D5	D4	D3	D2	D1	D0	
0	1 0	1	1	1	1	0	1	0	0	F0h to FFh

*: Invalid bit

Cautions: The NT7534 maintains an operation status specified by each command. However, the internal operation status may be changed by a high level of ambient noise. Users must consider how to suppress noise on the package and system or to prevent ambient noise insertion. To prevent a spike in noise, built-in software for periodical status refreshment is recommended. The test command can be inserted in an unexpected place. Therefore it is recommended to enter the test mode reset command F0h during the refresh sequence.



8. Precautions For Using LCD Modules

Handling Precautions

- (1) The display panel is made of glass. Do not subject it to a mechanical shock by dropping it or impact.
- (2) If the display panel is damaged and the liquid crystal substance leaks out, be sure not to get any in your mouth. If the substance contacts your skin or clothes, wash it off using soap and water.
- (3) Do not apply excessive force to the display surface or the adjoining areas since this may cause the color tone to vary.
- (4) The polarizer covering the display surface of the LCD module is soft and easily scratched. Handle this polarizer carefully.
- (5) If the display surface becomes contaminated, breathe on the surface and gently wipe it with a soft dry cloth. If it is heavily contaminated, moisten cloth with one of the following solvents :
 - Isopropyl alcohol
 - Ethyl alcohol
- (6) Solvents other than those above-mentioned may damage the polarizer. Especially, do not use the following.
 - Water
 - Ketone
 - Aromatic solvents
- (7) Exercise care to minimize corrosion of the electrode. Corrosion of the electrodes is accelerated by water droplets, moisture condensation or a current flow in a high-humidity environment.
- (8) Install the LCD Module by using the mounting holes. When mounting the LCD module make sure it is free of twisting, warping and distortion. In particular, do not forcibly pull or bend the I/O cable or the backlight cable.
- (9) Do not attempt to disassemble or process the LCD module.
- (10) NC terminal should be open. Do not connect anything.
- (11) If the logic circuit power is off, do not apply the input signals.
- (12) To prevent destruction of the elements by static electricity, be careful to maintain an optimum work environment.
 - Be sure to ground the body when handling the LCD modules.
 - Tools required for assembling, such as soldering irons, must be properly grounded.
 - To reduce the amount of static electricity generated, do not conduct assembling and other work under dry conditions.
 - The LCD module is coated with a film to protect the display surface. Exercise care when peeling off this protective film since static electricity may be generated.

Storage Precautions

When storing the LCD modules, avoid exposure to direct sunlight or to the light of fluorescent lamps. Keep the modules in bags (avoid high temperature / high humidity and low temperatures below 0°C). Whenever possible, the LCD modules should be stored in the same conditions in which they were shipped from our company.

Others

Liquid crystals solidify under low temperature (below the storage temperature range) leading to defective orientation or the generation of air bubbles (black or white). Air bubbles may also be generated if the module is subject to a low temperature.

If the LCD modules have been operating for a long time showing the same display patterns, the display patterns may remain on the screen as ghost images and a slight contrast irregularity may also appear. A normal operating status can be regained by suspending use for some time. It should be noted that this phenomenon does not adversely affect performance reliability.

To minimize the performance degradation of the LCD modules resulting from destruction caused by static electricity etc., exercise care to avoid holding the following sections when handling the modules.

- Exposed area of the printed circuit board.
- Terminal electrode sections.

Liquid Crystal Display Modules

LCD is composed of glass and polarizer. Pay attention to the following items when handling.

(1) Please keep the temperature within specified range for use and storage. Polarization degradation, bubble generation or polarizer peel-off may occur with high temperature and high humidity.

(2) Do not touch, push or rub the exposed polarizers with anything harder than an HB pencil lead (glass, tweezers, etc.).

(3) N-hexane is recommended for cleaning the adhesives used to attach front/rear polarizers and reflectors made of organic substances which will be damaged by chemicals such as acetone, toluene, ethanol and isopropylalcohol.

(4) When the display surface becomes dusty, wipe gently with absorbent cotton or other soft material like chamois soaked in petroleum benzine. Do not scrub hard to avoid damaging the display surface.

(5) Wipe off saliva or water drops immediately, contact with water over a long period of time may cause deformation or color fading.

(6) Avoid contacting oil and fats.

(7) Condensation on the surface and contact with terminals due to cold will damage, stain or dirty the polarizers. After products are tested at low temperature they must be warmed up in a container before coming in contact with room temperature air.

(8) Do not put or attach anything on the display area to avoid leaving marks on.

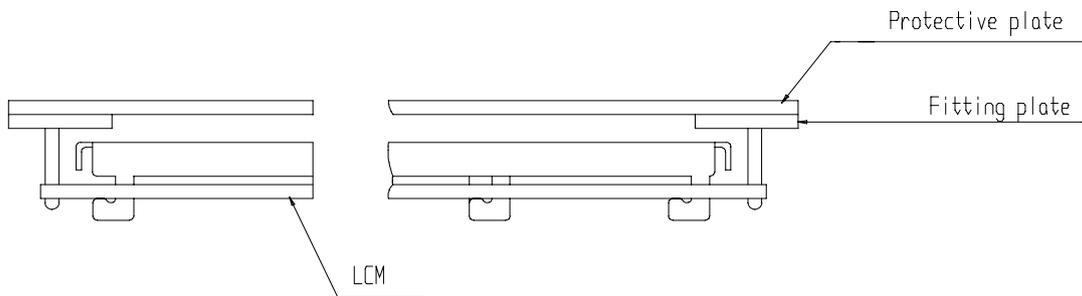
(9) Do not touch the display with bare hands. This will stain the display area and degrade insulation between terminals (some cosmetics are determined to the polarizers).

(10) As glass is fragile. It tends to become or chipped during handling especially on the edges. Please avoid dropping or jarring.

Installing LCD Modules

The hole in the printed circuit board is used to fix LCM as shown in the picture below. Attend to the following items when installing the LCM.

(1) Cover the surface with a transparent protective plate to protect the polarizer and LC cell.



(2) When assembling the LCM into other equipment, the spacer to the bit between the LCM and the fitting plate should have enough height to avoid causing stress to the module surface, refer to the individual specifications for measurements. The measurement tolerance should be ± 0.1 mm.

Precaution for Handling LCD Modules

Since LCM has been assembled and adjusted with a high degree of precision, avoid applying excessive shocks to the module or making any alterations or modifications to it.

(1) Do not alter, modify or change the shape of the tab on the metal frame.

(2) Do not make extra holes on the printed circuit board, modify its shape or change the positions of components to be attached.

(3) Do not damage or modify the pattern writing on the printed circuit board.

(4) Absolutely do not modify the zebra rubber strip (conductive rubber) or heat seal connector.

(5) Except for soldering the interface, do not make any alterations or modifications with a soldering iron.

(6) Do not drop, bend or twist LCM.

(7) In order to avoid the cracking of the FPC, you should pay attention to the area of FPC (R50mm) where the FPC was bent. The edge of coverlay; the area of surface of Ni-Au plating, the area of soldering land, the area of through hole.

Electro-Static Discharge Control



Since this module uses a CMOS LSI, the same careful attention should be paid to electrostatic discharge as for an ordinary CMOS IC.

- (1) Make certain that you are grounded when handing LCM.
- (2) Before remove LCM from its packing case or incorporating it into a set, be sure the module and your body have the same electric potential.
- (3) When soldering the terminal of LCM, make certain the AC power source for the soldering iron does not leak.
- (4) When using an electric screwdriver to attach LCM, the screwdriver should be of ground potentiality to minimize as much as possible any transmission of electromagnetic waves produced sparks coming from the commutator of the motor.
- (5) As far as possible make the electric potential of your work clothes and that of the work bench the ground potential.
- (6) To reduce the generation of static electricity be careful that the air in the work is not too dried. A relative humidity of 50%-60% is recommended.

Precaution for soldering to the LCM

- (1) Observe the following when soldering lead wire, connector cable and etc. to the LCM.
 - Soldering iron temperature : $260^{\circ}\text{C} \pm 10^{\circ}\text{C}$.
 - Soldering time : 3-4 sec.
 - Solder : eutectic solder.

If soldering flux is used, be sure to remove any remaining flux after finishing to soldering operation. (This does not apply in the case of a non-halogen type of flux.) It is recommended that you protect the LCD surface with a cover during soldering to prevent any damage due to flux spatters.

(2) When soldering the electroluminescent panel and PC board, the panel and board should not be detached more than three times. This maximum number is determined by the temperature and time conditions mentioned above, though there may be some variance depending on the temperature of the soldering iron.

(3) When remove the electroluminescent panel from the PC board, be sure the solder has completely melted, the soldered pad on the PC board could be damaged.

(4) Soldering iron is not allowed to touch the surface of FPC's cover film directly.

Precautions for Operation

(1) Viewing angle varies with the change of liquid crystal driving voltage (VO). Adjust VO to show the best contrast.

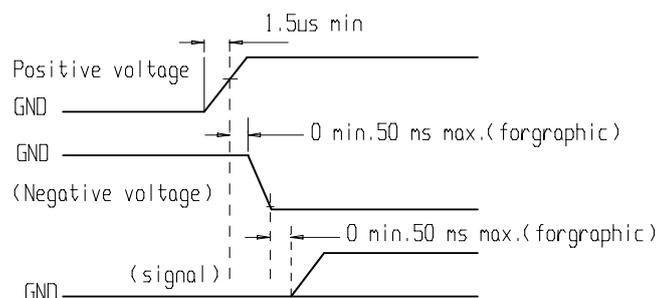
(2) Driving the LCD in the voltage above the limit shortens its life.

(3) Response time is greatly delayed at temperature below the operating temperature range. However, this does not mean the LCD will be out of the order. It will recover when it returns to the specified temperature range.

(4) If the display area is pushed hard during operation, the display will become abnormal. However, it will return to normal if it is turned off and then back on.

(5) Condensation on terminals can cause an electrochemical reaction disrupting the terminal circuit. Therefore, it must be used under the relative condition of 40°C , 50% RH.

(6) When turning the power on, input each signal after the positive/negative voltage becomes stable.



**Storage**

When storing LCDs as spares for some years, the following precaution are necessary.

- (1) Store them in a sealed polyethylene bag. If properly sealed, there is no need for dessicant.
- (2) Store them in a dark place. Do not expose to sunlight or fluorescent light, keep the temperature between 0°C and 35°C.
- (3) The polarizer surface should not come in contact with any other objects. (We advise you to store them in the container in which they were shipped.)
- (4) Environmental conditions :
 - Do not leave them for more than 160hrs. at 70°C.
 - Should not be left for more than 48hrs. at -20°C.

Safety

- (1) It is recommended to crush damaged or unnecessary LCDs into pieces and wash them off with solvents such as acetone and ethanol, which should later be burned.
- (2) If any liquid leaks out of a damaged glass cell and comes in contact with the hands, wash off thoroughly with soap and water.

Limited Warranty

Unless agreed between EAST and customer, EAST will replace or repair any of its LCD modules which are found to be functionally defective when inspected in accordance with EAST LCD acceptance standards (copies available upon request) for a period of one year from date of shipments. Cosmetic/visual defects must be returned to EAST within 90 days of shipment. Confirmation of such date shall be based on freight documents. The warranty liability of EAST limited to repair and/or replacement on the terms set forth above. EAST will not be responsible for any subsequent or consequential events.

Return LCM under warranty

No warranty can be granted if the precautions stated above have been disregarded. The typical examples of violations are :

- Broken LCD glass.
- PCB eyelet's damaged or modified.
- PCB conductors damaged.
- Circuit modified in any way, including addition of components.
- PCB tampered with by grinding, engraving or painting varnish.
- soldering to or modifying the bezel in any manner.

Module repairs will be invoiced to the customer upon mutual agreement. Modules must be returned with sufficient description of the failures or defects. Any connectors or cable installed by the customer must be removed completely without damaging the PCB's eyelet, conductors and terminals.