

Ver 1.2

TFT LCD Specification

Model NO.: TD028STEB1



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Table of Contents

NO.	Item	Page
	Cover Sheet	1
	Table of Contents	2
	Record of Reversion	3
1	Features	4
2	General Specification	4
3	Input / Output Terminals	5
4	Absolute Maximum Ratings	8
5	Electrical Characteristics	9
6	Block Diagram	11
7	Timing Chart	14
8	Power On/Off Sequence	19
9	Optical Characteristics	21
10	Reliability	25
11	Handling Cautions	26
12	Mechanical Drawing	29
13	Packing Drawing	30

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TD028STEB1

Record of Reversion

Rev	Issued Date	Description
1.0	May, 17, 2005	New
		Update 7.1 Display timing
11	Mar 08 2006	Update 7.3 Setup / Hold Timing chart
1.1	Mai, 00, 2000	Update 5 ELECTRICAL CHARACTERISTICS
		Update 8 Power On/Off Sequence
10	Mar 31 2006	Update 7.3, Note for 2 source IC timing,
1.2	Mai, 51, 2000	Update 12 Panel drawing with 2 source T/P

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1. FEATURES

The 2.8 inch (real 2.83 inch) LCD module is the Transflective active matrix color TFT LCD module. LTPS (Low Temperature Poly Silicon) TFT technology is used and COG design are built on the panel. Highly integrated LCD module includes touch panel, backlight and TFT LCD panel with minimal external circuits and components required.

2. GENERAL SPECIFICATION

lt	em	Description	Unit
Display Size (Diagon	al)	2.8 inch (real 2.83 inch)	-
Display Type		Transflective	-
Active Area (HxV)		43.2 X 57.6	mm
Number of Dots (HxV	/)	240 x RGB x 320	dot
Dot Pitch (HxV)		0.06 X 0.180	mm
Color Arrangement		RGB Stripe	-
Color Numbers		262,144 (18 bits)	-
Outline Dimension (H	lxVxT)	52.9X 71.7 X 4.2 (FPC excluded)	mm
Weight		35 (Max)	g
	LCD Panel +	23 (Тур)	
Power consumption	System		mW
	Backlight	288 (Typ, I _F = 20mA)	

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3. INPUT/OUTPUT TERMINALS

3.1 TFT LCD module

Recommend connector: FH23-61S-0.3SHW, HIROSE

Pin	Symbol	I/O	Description	Remark
1	DE	IN	Data Enable Signal	
2	MCLK	IN	LCM Pixel Clock	
3	RESET	IN	IC Reset Signal	
4	TSP1	OUT	TSP Interface Signal Y2	
5	DVSS	IN	Digital Ground	
6	VCOM_I	INI		
7	VCOM_I			
8	AVSS	IN	Analog Ground	
9	VVEE	INI	Cata Off Valtage Co. 4 EV Typ EV	
10	VVEE		Gate On Voltage, -0.0~-4.5V, Typ5V	
11	VGH	INI		
12	VGH		Gate On voltage, 9.5V ~ 10.5V, Typ. 10V	
13	DVSS	IN	Digital Ground	
14	TSP2	OUT	TSP Interface Signal X2	
15	VCOM_H	OUT	Positive Power Output for VCOM	
16	VCOM_O		VCOM Output	
17	VCOM_O	001		
18	VCOM_L	OUT	Negative Power Output for VCOM	
19	AVSS	IN	Analog Ground	
20	DVDD	INI		
21	DVDD			
22	AVDD	INI	Analog Supply Dower 4 91/ 5 61/ Typ 5 01/	
23	AVDD			
24	TSP3	OUT	TSP Interface Signal Y1	
25	DVSS	IN	Digital Ground	
26	IV6P	OUT	Negative Voltage Output Pad	
27	TSP4	OUT	TSP Interface Signal X1	
28	DVDD	IN	Digital Supply Power, 2.5~3.3V, Typ. 2.8V	
29	PD17	IN	R5 (Red MSB)	
30	PD16]	R4	
31	PD15	1	R3	
32	PD14	1	R2	

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33	PD13		R1	
34	PD12	IN	R0 (Red LSB)	
35	PD11		G5 (Green MSB)	
36	PD10		G4	
37	PD9	INI	G3	
38	PD8		G2	
39	PD7		G1	
40	PD6		G0 (Green LSB)	
41	PD5		B5 (Blue MSB)	
42	PD4		B4	
43	PD3	IN	B3	
44	PD2		B2	
45	PD1		B1	
46	PD0	IN	B0 (Blue LSB)	
47	ISC	OUT	Capacitor Connection Pad	
48	DVSS (SCL)	IN	Digital Ground (Serial interface clock input)	
49	DVSS (SDA)	IN/OUT	Digital Ground (Serial interface data input/output)	
50	DVSS (CS)	IN	Digital Ground (Serial interface chip select input)	
51	DVSS	IN	Digital Ground	
52	HSYNC	IN	Horizontal SYNC Input	
53	DVSS	INI	Digital Ground (Digplay mode coloct)	
54	DVSS (CM)	IIN	Digital Ground (Display mode select)	
55	VS	OUT	Positive Power Output for Source Driver	
56	VSYNC	IN	Vertical SYNC Input	
57	MAIN_LED+	INI	LED Bower (Anode)	
58	MAIN_LED+			
59	MAIN_LED-		LED Rower (Cathoda)	
60	MAIN_LED-	001		
61	DVSS	IN	Digital Ground	

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3.2 Touch panel Pin

Touch Panel	Module	Symbol	Description	Remark
Pin	Pin			
1	27	X1	Touch Panel Right Side	
2	24	Y1	Touch Panel Lower Side	
3	14	X2	Touch Panel Left Side	
4	4	Y2	Touch Panel Upper Side	

Pin Assignment for Touch panel



Touch Panel Pin Name						
Pin No	Note					
1	X1	Glass				
2	Y1	Film				
3	X2	Glass				
4	Y2	Film				

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4.ABSOLUTE MAXIMUM RATINGS

					GND=0V
Item	Symbol	MIN	MAX	Unit	Remark
Lagia Supply Valtaga	DVDD	-0.3	3.6	V	
Logic Supply Voltage	AVDD	-0.3	6.0	V	
Power Supply for H/V Driver	VGH	-0.3	19	V	
	VVEE	-0.3	19	V	
Touch Panel Operation Voltage	V_{Touch}	-	5	V	
Backlight LED forward Voltage	V _F	-	14.4	V	
Backlight LED reverse Voltage	V _R	-	20	V	
Backlight LED forward current (Ta=25℃)	I _F	-	25	mA	Note
Operating Temperature	Topr	-20	+60	°C	
Storage Temperature	Tstg	-30	+70	°C	

Note: Relation between maximum LED forward current and ambient temperature is showed as bellow.





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Ta=25℃

5.ELECTRICAL CHARACTERISTICS

5.1 Driving TFT LCD Panel

<u> </u>							-
Item		Symbol	MIN	TYP	MAX	Unit	Remark
Logio Supply Voltor		DVDD	2.5	2.8	3.3	V	
Logic Supply Voltag	je	AVDD	4.8	5.0	5.6	V	
Bower Supply for H		VGH	9.5	10	10.5	V	
Power Supply for H/V Driver		VVEE	-6.0	-5.0	-4.5	V	
	High	VIH	0.8DVDD	-	DVDD		R[5:0], G[5:0],
Data Input Voltage	0					V	B[5:0] CLK
	Low	VIL	GND	-	0.2DVDD	-	DE
DVDD Supply Current		I _{DVDD}		0.74	1.9	mA	Note 1
AVDD Supply Current		I _{AVDD}		1.85	4.0	mA	Note 2
VGH Supply Current		I _{VGH}		0.07	0.3	mA	
VVEE Supply Curre	ent	I_{VVEE}		0.05	0.5	mA	

Note 1: The typical supply current specification is measured at the line inversion test pattern (black and white interlacing horizontal lines as the diagram shown below)



Note 2: Gamma correction voltage is set to achieve the optimun at AVDD=5.0V. Use the voltage at level as close to 5.0V as possible.

5.2 DC/DC Spec

Ta=25℃

ltem	Input voltage		Input Current	Input ripple (Max)	Remark	
	MIN	TYP	MAX			
DVDD	2.5	2.8	3.3	0.74		
AVDD	4.8	5.0	5.6	1.85	50mV	Note
VGH	9.5	10.0	10.5	0.07	150mV	
VVEE	-6.0	-5.0	-4.5	0.05	200mV	

Note: AVDD is analog voltage supply therefore use as less ripple as possible.

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TD028STEB1

Ta=25℃

5.3 Driving backlight	Ta=25℃					
Item	Symbol	MIN	TYP	MAX	Unit	Remark
Forward Current	I _F	-	20	25	mA	LED/Part
LED Life Time	-	-	10000		Hr	I _F : 20mA
Forward Current Voltage	V _F	-	14.4	16	V	I _F : 20mA ,LED/Part

Note: Backlight driving circuit is recommend as the fix current circuit.

5.4 Driving touch panel (Analog resistance type)

Item Symbol MIN TYP MAX Unit Remark Resistor between terminals (XR-XL) Rx 1300 Ω 200 -Ry Ω Resistor between terminals (YU-YL) 200 -1300 **Operation Voltage** -5 V DC V_{Touch} --1.5 +1.5Line Linearity (X direction) -% -Note -1.5 +1.5% Line Linearity (Y direction) --Chattering 10 -ms -JIS K 5600 Surface Hardness Н _ 3 --Minimum tension for detecting -80 -g ΜΩ Ri 20 At DC 25V Insulation Resistance --

Note. The minimum test force is 80 g.

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6. BLOCK DIAGRAM



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Application Circuit Diagram



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Vcom Waveform



Image sticking circuit:

DC/DC disable model (DC_ENB=High)



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7. TIMING CHART

7.1 Display timing

Display	Baramatar	Symbol	Conditions	Ratings			Linit
Mode	Farameter	Symbol	Conditions	MIN	TYP	MAX	Unit
	Vertical cycle	VP	-	323	326	340	Line
	Vertical data start	VDS	VS+VBP	_	4	—	Line
	Vertical front porch	VFP	-	_	2	—	Line
	Vertical back portch	VBP	-		2	—	Line
	Vertical active area	VDISP	-	—	320	_	Line
	Horizontal cycle	HP	-	260	280	300	dot
Normal	Horizontal front porch	HFP	-	—	10	—	dot
	Horizontal Sync Pulse width	HS	-	—	10	_	dot
	Horizontal Back porch	HBP		—	20	_	dot
	Horizontal Data start	HDS	HS+HBP	—	30	—	dot
	Horizontal active area	HDISP	-	_	240	_	dot
	Clock froquency	fclk		5.02	6.39	6.85	MHz
		tclk	-	199	156	146	nS

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7.2 Input timing chart









*1 The frequency of CLK should keep in the range as input timing chart determined whether in display or blanking region to ensure IC operating normally.

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7.3 Setup / Hold Timing chart





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If the VS falling edge and HS rising edge are in the same time, the timing is in the margin and not surely which is the first valid data line.



If VS falling edge is delay some time after HS rising edge, this timing will cause the first valid data line delay one HS time.

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Paramatar	Symbol	Conditiona		Llpit			
Farameter	Symbol	Conditions	MIN	TYP	MAX	Unit	
Vertical Sync. Setup time	tvsys		20	-	-	ns	
Vertical Sync. Hold time	tvsyh		20	-	-	ns	
Horizontal Sync. Setup time	thsys		20	-	-	ns	
Horizontal Sync. Hold time	thsyh		20	-	-	ns	
Phase difference of Sync.	thu	240x320	-(tHSW-1)	-	1Hcycle-1	clk	
Signal Falling edge (Note1)	LLIN						
Clock "L" Period	tckl		75	-	-	ns	
Clock "H" Period	tckh		75	-	-	ns	
Data setup time	tds		20	-		ns	
Data Hold time	tdh		20	-	-	ns	
DE timing (1)	tdes		-5			ns	
DE timing (2)	tdeh		30	_	_	ns	

Note: Thy range if it can't meet our spec, just give up first Hsync. It can't impact any side effect.

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8. Power On/Off Sequence

8.1 Power On Sequence (with Internal DC/DC disable mode)



(Note1) RGB interface input – VSYNC/HSYNC/DCK/R5-0/G5-0/B5-0/DE

(Note2) Level shifter output – CKH1/CKH2/CKH3/STV1/STV2/CKV1/CKV2/ENBV/CSV)

(Note3) Marked time is typical value (Typical values depend on the frequency of VSYNC)

(Note4) VVEE, AVDD and VGH should be open before external power on

(Note5) Maximum rising time of DVDD is 2ms

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8.2 Power Off Sequence (with Internal DC/DC disable mode)



(Note1) RGB interface input - VSYNC/HSYNC/DCK/R5-0/G5-0/B5-0/DE

(Note2) Level shifter output – CKH1/CKH2/CKH3/STV1/STV2/CKV1/CKV2/ENBV/CSV)

(Note3) VVEE, AVDD and VGH should be open after external power off

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9. Optical Characteristics

- 9.1 Optical Specification
 - (1) Back light Off w / Touch panel

								Ta=25 ℃
Item	Sym	loc	Condition	MIN	TYP	MAX	Unit	Remarks
Viewing Angles	Θ11(R) Θ12(L)		CR ≥ 2	35	45	-	Degree	Note 9-1
				25	35	-		
	Θ21(U)			35	45	-		
	Θ22(D)			35	45	-		
Chromaticity	White	х	∩_ ∩°	0.275	0.310	0.345	-	Note 9-3
	vviite	У	0=0	0.290	0.330	0.370		
Contrast Ratio	CR		⊖=0°	5:1	10:1	-	-	Note 9-2
Reflectivity	R		⊖=0°	5	10	-	%	Note 9-4

(2) Back Light On w / Touch panel

Ta=25°℃

Item	Symbol		Condition	MIN	TYP	MAX	Unit	Remarks
	Θ11(R)		CR ≥ 10	40	45	-	Degree	Note 9-1
Viewing Angles	Θ12(L)			35	40	-		
	Θ21(U)			55	60	-		
	Θ22(D)			30	35	-		
Response Time	Tr+Tf		⊖=0°	-	35	50	ms	Note 9-5
Contrast Ratio	CR		⊖=0°	90:1	150:1	-	-	Note 9-6
Luminance	L		⊖=0°	125	150	-	cd/m ²	Note 9-7
			I _F =20mA					
NTSC	-		-	40	45	-	%	Note 9-7
Uniformity	-		-	75	80	-	%	Note 9-8
Chromaticity	Red	х	⊖=0°	0.533	0.568	0.603		Note 9-9
		у		0.305	0.345	0.385		
	Green	х		0.265	0.300	0.335		
		у		0.529	0.569	0.609		
	Blue -	х		0.111	0.146	0.181		
		у		0.093	0.133	0.173		
	White	х		0.260	0.295	0.330		
		у		0.283	0.323	0.363		

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9.2 Basic measure condition

- (1) Driving voltage
 - VDD= 12.0V, VEE=-6.5V
- (2) Ambient temperature: Ta= 25° C
- (3) Testing point: measure in the display center point and the test angle $\Theta = 0^{\circ}$
- (4) Testing FacilityEnvironmental illumination: ≤ 1 Lux

a. System A



b. System B



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Note 9-2: Contrast ratio in back light off (Measure System A)

Contrast Ration is measured in optimum common electrode voltage.

CR = Luminance with white image Luminance with black image

Note 9-3: White chromaticity as back light off: (Measure System A)

Note 9-4: Reflectivity (R) (Measure System A)

In the measuring system A, calculate the reflectance by the following formula.

 $Reflectivity(R) = \frac{Output from the white display panel}{Output from the reflectance standard} X Reflectance factor of reflectance standard X Reflectance factor of reflectance standard Stand$

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Contrast Ration is measured in optimum common electrode voltage.

Note 9-7: Luminance: (Measure System B) Test Point: Display Center

Note 9-8: Uniformity (Measure System B)

The luminance of 9 points as the black dot in the figure shown below are measured and the uniformity is defined as the formula:



Note 9-9: White chromaticity as back light on (Measure System B)

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10. Reliability

No	Test Item	Condition			
1	High Temperature Operation	Ta=+60℃, 240hrs			
2	High Temperature & High Humidity Operation	Ta=+40℃, 95% RH, 240hrs			
3	Low Temperature Operation	Ta= -20°C , 240hrs			
4	High Temperature Storage (non-operation)	Ta=+70℃, 240hrs			
5	Low Temperature Storage (non-operation)	Ta= -30℃, 240hrs			
6	Thermal Shack (non energian)	-30°C $\leftarrow \rightarrow$ 70°C, 50 cycles			
	mermai Snock (non-operation)	30 min 30 min			
	Posistance to Static Electricity Discharge	C=200pF, R=0 Ω;			
7		Discharge: ±150V			
		3 times / Terminal			
8 Surfa	Surface Discharge (nep operation) (I CD	C=150pF, R=330 Ω;			
	Surface)	Discharge: Air: ±15kV; Contact: ±8kV			
	surace)	5 times / Point; 5 Points / Panel			
	Vibration (non-operation)	Frequency: 10~55Hz; Amplitude: 1.5mm			
9		Sweep Time: 11min			
		Test Time: 2 hrs for each direction of X, Y, Z			
10	Shock (non-operation)	Acceleration: 100G; Period: 6ms			
		Directions: ±X, ±Y, ±Z; Cycles: Three times			
		Hit 1,000,000 times with a silicon rubber of R8			
11 F	Pin Activation Test (Touch Panel)	HS 60.			
		Hitting Force: 250g			
		Hitting Speed: 3 time/sec			
12	Writing Friction Resistance Test (Touch	Pen: 0.8R Polyacetal stylus			
		Load: 250g			
	Panel)	Speed: 3 Strokes/sec			
		Stroke: 35mm			
		100000 times			

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11. Handling Cautions

11.1 ESD (Electrical Static Discharge) strategy

ESD will cause serious damage of the panel, ESD strategy is very important in handling. Following items are the recommended ESD strategy

- (1) In handling LCD panel, please wear gloves with non-charged material. Using the conduction ring connects wrist to the earth and the conducting shoes to the earth necessary is.
- (2) The machine and working table for the panel should have ESD protection strategy.
- (3) In handling the panel, ionized airflow decreases the charge in the environment is necessary.
- (4) In the process of assemble the module, shield case should connect to the ground.

11.2 Environment

- (1) Working environment of the panel should be in the clean room.
- (2) Because touch panel has protective film on the surface, please remove the protection film slowly with ionized air to prevent the electrostatic discharge.

11.3 Touch panel

- (1) The front touch panel is vulnerable to heavy weight, so any input must be done by special stylus or by a finger. Do not put any heavy stuff on it.
- (2) When any dust or stain is observed on a film surface, clean it using a glass lens cleaner for something similar.

11.4 Others

- (1) Turn off the power supply before connecting and disconnecting signal input cable.
- (2) Because the connection area of FPC and panel is not so strong, do not handle panel only by FPC or bend FPC.
- (3) Water drop on the surface or condensation as panel power on will corrode panel electrode.
- (4) As the packing bag open, watch out the environment of the panel storage. High temperature and high humidity environment is prohibited.
- (5) In the case the TFT LCD module is broken, please watch out whether liquid crystal leaks out or not. If your hand touches liquid crystal, wash your hands cleanly with water and soap as soon as possible

11.5 Design notes on touch panel

- (1) Explanation of each boundary of touch panel
 - A.Boundary of Double-sided adhesive
 - a. Electrically detectable within this zone.
 - When holding the touch panel by housing, it needs to be held at outside of this zone.
 - b. Film is supported by double-sided adhesive tape.
 - B.Viewing area
 - a. Cosmetic inspection to be done for this area.

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This area is set as inside of boundary of double-sided adhesive with tolerance.

- C.Boundary of transparent insulation
 - a. Purpose is to "Help" to secure insulation.
 - b. Electrical insulation on this area is not guaranteed.
 - c. We do recommend not to hold this area by something like housing or gasket.
- $\operatorname{D}\mathsf{.}\mathsf{Active}$ area
 - a. This area is where the performance is guaranteed.

This area set as 2.3mm inside from the boundary area of double-sided adhesive tape since its neighboring area is less durable to writing friction.



¹ There is some possibility to damage ITO



No Damage to ITO



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- (2) Housing and touch panel
 - a. Please have clearance between the side of touch panel and any conductive material such as metal frame (Drawing.1). Transparent electrode exists on glass of touch panel from end to end.
 - b. It is recommended to fix a touch panel on the LCD module chassis rather than the touch panel housing. Clinging at conductive material and side of touch panel might cause the malfunction.



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12. Mechanical Drawing

12.1 with source 1 T/P



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12.2 with source 2 T/P



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13. Packing Drawing



TD028STEB1 Module Delivery Packing Instruction:

(1) Module packed into tray cavity with panel face down.

- (2) Tray stacking with 15 layers and with 1 empty tray above the stacking tray unit. Then put 2pcs desiccant above the empty tray.
- (3) Stacking tray unit put into the LDPE bag and fix by adhesive tape.
- (4) Put 1pcs cardboard inside the carton bottom, and pack the finished package into the carton. Then put 1pcs cardboard above the packing finished good.
- (5) Carton sealing with adhesive tape.

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