

TOPFOUND TECHNOLOGY LIMITED

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Product Specification

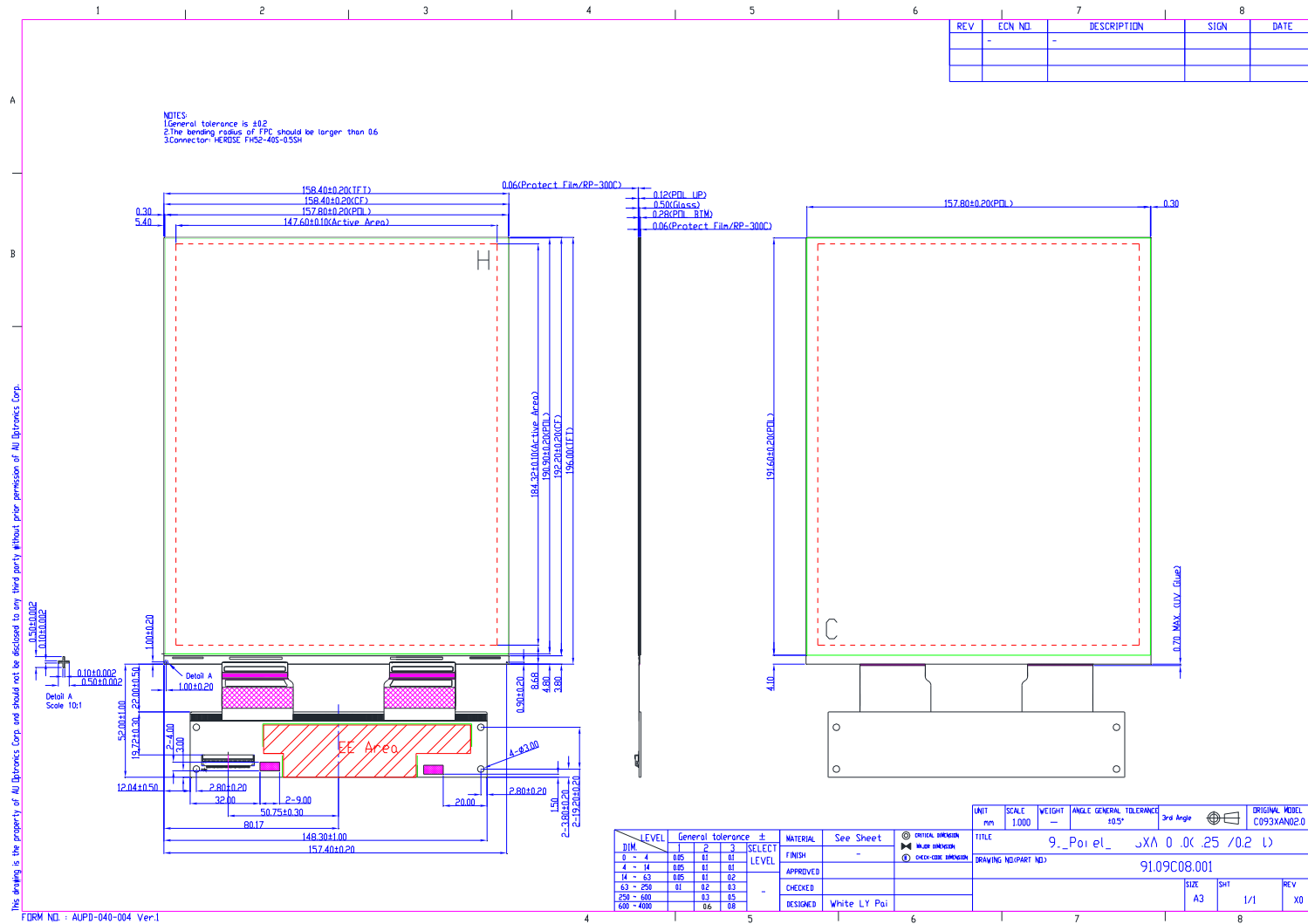
9.6" COLOR TFT-LCD (FOG)

MODEL NAME: TF096SS04

A. Physical Specifications

NO.	Item	Unit	Specification	Remark
1	Display Resolution	dot	820 RGB(H) x 1024(V)	
2	Active Area	mm	147.6(H) x 184.32(V)	
3	Screen Size	inch	9.6(Diagonal)	
4	Dot Pitch	mm	0.06 x 0.18	
5	Color Configuration	—	R. G. B. Stripe	
6	Color Depth	—	16.7 M colors	
7	Overall Dimension	mm	158.4 x 196 x 0.9 mm	
8	Weight	g	62	
9	Display Mode	—	Normally Black	
10	Surface Treatment	—	HC	
11	Polarizer orientation of transmitting light	°	90	Note 2

B. Outline Dimension (Tentative)



C. Electrical Specifications

1. TFT LCD Panel Pin Assignment

Connector: Hirose FH52-40S-0.5SH (Default),
TBC if any cost impact to using Kyocera

No.	Pin Name	I/O	Description	Remarks
1	GND	G	Ground.	
2	GND	G	Ground.	
3	NC	-		
4	VGL	PI	Negative power supply voltage for TFT.	
5	VGL	PI	Negative power supply voltage for TFT.	
6	NC	-		
7	VGH	PI	Positive power supply voltage for TFT.	
8	VGH	PI	Positive power supply voltage for TFT.	
9	NC	-		
10	AVDD	PI	Analog power supply voltage.	
11	AVDD	PI	Analog power supply voltage.	
12	SDO	O	Serial communication data input/output pin.	For AUO internal use
13	VDD	PI	Digital power supply voltage.	
14	VDD	PI	Digital power supply voltage.	
15	NC/VPP	-	For AUO internal use, please float this pin.	
16	GND	G	Ground.	
17	GND	G	Ground.	
18	NIND0	I	Negative LVDS differential input.	
19	PIND0	I	Positive LVDS differential input.	
20	GND	G	Ground.	
21	NIND1	I	Negative LVDS differential input.	
22	PIND1	I	Positive LVDS differential input.	
23	GND	G	Ground.	
24	NIND2	I	Negative LVDS differential input.	
25	PIND2	I	Positive LVDS differential input.	
26	GND	G	Ground.	
27	CLKN	I	Negative LVDS differential clock input.	
28	CLKP	I	Positive LVDS differential clock input.	
29	GND	G	Ground.	
30	NIND3	I	Negative LVDS differential input.	
31	PIND3	I	Positive LVDS differential input.	
32	GND	G	Ground.	
33	GRB	I	Global reset pin.	

34	STB	I	Standby mode control. When LCD enter STBYB mode, source output and Vcom turn to 0V.(Black Pattern) STBYB = "H", normal operation. STBYB = "L", standby mode.	
35	AB_IND	O	TFT LCD feedback signal for status monitoring. AB_IND = "H": IC is at normal operation. AB_IND = "L": IC is at abnormal status.	Note1
36	MUTE	I	MUTE mode control. When LCD enter MUTE mode, source output turn to black pattern. MUTE = "H": normal operation. MUTE = "L": output black pattern.	
37	CSB	I	Serial communication chip selection.	For AUO internal use
38	SCL	I	Serial communication clock input.	For AUO internal use
39	SDA	I/O	Serial communication data input/output pin.	For AUO internal use
40	GND	G	Ground.	

2. Input Timing Diagram

Fig 1 Input Timing Diagram

DE mode

Parameter		Symbol	Min.	Typ.	Max.	Unit.	Remark
CLK Frequency		F_{CLK}	54.3	54.7	69.9	MHz	60Hz
HSYNC	Period	T_H	880	884	1010	CLK	
	Horizontal display area	T_{HD}	820			CLK	
	Horizontal blanking	$T_{HBP} + T_{HFP}$	60	64	190	CLK	
VSYNC	Period	T_V	1030	1032	1153	HS	
	Vertical display area	T_{VD}	1024			HS	
	Vertical blanking	$T_{VBP} + T_{VFP}$	6	8	129	HS	

3. Absolute Maximum Ratings

Items	Symbol	Values		Unit	Condition
		Min	Max		
Power Voltage	VDD	-0.3	5	V	GND = 0 V
	AVDD	-0.3	15	V	GND = 0 V
	VGH	-0.3	VGL+40	V	GND = 0V
	VGL	-20	0.3	V	GND = 0V
	VGH-VGL	-0.3	40	V	GND = 0V
Operation Temperature	Topa	-30	85	°C	Ambient
Storage Temperature	Tstg	-40	95	°C	Ambient

Note 1: Functional operation should be restricted under normal ambient temperature.

Note 2: Short time operation between -40 °C ~ -30 °C doesn't provide full performance but a correct image on the LCD. The LCD is guaranteed no permanent damage during this short time but not suggested to operate under this condition.

4. DC Electrical Characteristics

The following items are measured under stable condition and suggested application circuit.

a. Power Specification

Parameter	Symbol	Min	Typ	Max	Unit	Notes
Power Supply	VDD	3	3.3	3.6	V	
	IVDD	-	23	30	mA	
	AVDD	13	13.5	14	V	
	IAVDD	-	19	115	mA	
	VGH	19	20	21	V	
	IVGH	-	0.48	0.58	mA	
	VGL	-12	-11	-10	V	
	IVGL	-	0.48	0.58	mA	

b. Signal DC Electrical Characteristics

Parameter	Symbol	Min	Typ	Max	Unit	Notes
Input high level voltage	V_{IH}	$0.7 \cdot V_{DD}$	-	VDD	V	Note 1
Input low level voltage	V_{IL}	GND	-	$0.3 \cdot V_{DD}$	V	Note 1
Output high level voltage	V_{OH}	$V_{DD} - 0.4$	-	VDD	V	Output high level voltage
Output low level voltage	V_{OL}	GND	-	0.4	V	Output low level voltage
Single-end input high threshold voltage	R_{XVTH}	-	-	0.085	V	Note 2
Single-end input low threshold voltage	R_{XVTL}	-0.085	-	-	V	Note 2
Differential Input Common Mode Voltage	R_{XVCM}	1.0	1.2	1.4	V	Note 2
Differential input voltage	$ V_{ID} $	0.17	-	0.6	V	Note 2

5. AC Electrical Characteristics**a. Input AC characteristics**

Parameter	Symbol	Min	Typ.	Max	Unit	Remark
VDD power on slew time	T_{POR}	-	-	15	ms	From 0V to 90% VDD
GRB active pulse width	T_{GRB}	1	-	20	ms	VDD=3.3V
GRB slew time	T_{GRBR}	1	-	15	ms	From 0V to 90% VDD
STB resetttle time	T_{STB}	160	-	500	ms	
VDD resetttle time	T_{RES}	1	-	-	s	

b. Differential signal AC characteristics

Parameter	Symbol	Min	Max	Unit	Remark
CLK Frequency	R_{XFLK}	54.3	69.9	MHZ	Refer to input timing table.
CLK Period	T_{LVCLK}	14.3	18.42	ns	
1 data bit time	UI	1/7	1/7	T_{LVCLK}	Without SSC.
Input data skew margin	T_{RSKM}	0.25	0.25	UI	$ V_{ID} = 170\text{mV}$, $R_{XVCM} = 1.2\text{V}$ w/o SSC.
Input data position 1	T_{POS1}	-0.25	0.25	UI	
Input data position 0	T_{POS0}	0.75	1.75	UI	

Fig 2 LVDS AC characteristics diagram**c. SSC tolerance of LVDS receiver**

Parameter	Symbol	Min	Typ	Max	Unit	Remark
Modulation Frequency	SSC_{MF}	23		93	KHZ	
Modulation Rate	SSC_{MR}	-	-	$\pm 3\%$	ns	

6. Power on/off sequence (Tentative)

The LCD adopts high voltage driver IC, so it could be permanently damaged under a wrong power on/off sequence. The suggested LCD power sequence is below:

a. Power on sequence:

VDD → MUTE & GRB → STB → LVDS → VGL or AVDD → VGH → LED

Fig 3 Power on sequence

Power on timing:

Parameter	Value			Unit	Remark
	Min	Typ.	Max		
T1	-	-	15	ms	VDD rising time
T2	1	-	-	ms	Time interval between VDD and MUTE+GRB
T3	1	-	-	ms	Time interval between GRB and STB
T4	1	-	-	ms	Time interval between STB and LVDS
T5	0	-	80	ms	Time interval between LVDS and AVDD
T6	0	-	80	ms	Time interval between LVDS and VGL
T7	0	-	-	ms	Time interval between VGL and VGH
T8	100	-	-	ms	Time interval between VGH and LED

b. Power Off sequence:

LED → STB → LVDS → AVDD → VDD & MUTE & GRB → VGL & VGH

Fig 4 Power off sequence

Note1: VGH must be maintained at more than 70% when VDD falling to 1.5V.

Note2: VGL must be maintained at less than -5V when VDD falling to 1.5V.

Note3: LED 10% of T1 means LED off.

Note4: Either turning off all power/signals as above sequence or turning off all power/signals simultaneously will not damage source IC & gate IC.

Note5: Operating in abnormal power on/off sequence will lead to flicker or image sticking problem.

Power off timing:

Parameter	Value			Units	Remark
	Min	Typ	Max		
T1	90	100	-	ms	Time interval between LED and STB
T2	70	-	90	ms	Time interval between STB and LVDS
T3	0	-	50	ms	Time interval between LVDS off and AVDD
T4	0	-	7	ms	Time interval between AVDD and MUTE&GRB
T5	0		13	ms	Time interval between MUTE&GRB and VDD
T6	0		200	ms	Time interval between VDD and VGH

D. Optical specifications

(Note 1, 2)

Item	Symbol	Condition	Min	Typ	Max	Unit	Remark
Response Time	Tr+Tf	$\theta = 0^\circ$, Ta=25°C	-	-	20	ms	Note 3, 4
		$\theta = 0^\circ$, Ta=-20°C	-	-	150		
Contrast ratio	CR	Ta=25°C perpendicular	800	1000	-		Note 5
Transmittance	Tr%	Ta=25°C perpendicular	3.99	4.57	-	%	Note 6
Gamma	γ	Ta=25°C perpendicular	2.0	2.2	2.4		Note 7
Cell Transmittance Uniformity	%	Ta=25°C perpendicular	90	95			Note 8
Contrast ratio Over viewing angle	CR	H \pm 40°, V \pm 15°	500	-	-		Note 9, 10,11,12, 13

E. Reliability Test Items

No.	Test items	Conditions		Remark
1	High temperature storage	Ta= 95 °C	240 Hrs	Note1, 4
2	Low temperature storage	Ta= -40 °C	240 Hrs	
3	High temperature operation	Ta= 85 °C	240 Hrs	
4	Low temperature operation	Ta= -40 °C	240 Hrs	Note1, 3, 4
5	High temperature and high humidity	Ta= 60 °C, RH90%	240 Hrs	Operation Note 4
6	Heat shock	-40 °C ~ 85 °C / 240 cycles, 1 Hrs/cycle		Non-operation Note 4