



TO

DATE : Apr. 6. 2011

SAMSUNG TFT-LCD**MODEL NO : LTN156AT22-001**

NOTE : Extension code [001]
→ LTN156AT22-**001**
Surface type [**Anti-Glare**]

The information described in this SPEC is approved and can not be changed without prior notice.

APPROVED BY : **S. K. Lee**

PREPARED BY : LCD Application Engineering, Sales & Marketing Team

SAMSUNG ELECTRONICS CO., LTD.**Samsung Secret**

CONTENTS

Revision History	----- (3)
General Description	----- (5)
1. Absolute Maximum Ratings	----- (6)
1.1 Absolute Ratings of environment	
1.2 Electrical Absolute Ratings	
2. Optical Characteristics	----- (8)
3. Electrical Characteristics	----- (11)
3.1 TFT LCD Module	
3.2 Backlight Unit	
3.3 LED Driver	
4. Block Diagram	----- (14)
4.1 TFT LCD Module	
5. Input Terminal Pin Assignment	----- (15)
5.1 Input Signal & Power	
5.2 LVDS Interface	
5.3 LVDS characteristics	
5.4 Input Signals, Basic Display Colors and Gray Scale of Each Color.	
5.5 Pixel format	
6. Interface Timing	----- (21)
6.1 Timing Parameters	
6.2 Timing Diagrams of interface Signal	
6.3 Power ON/OFF Sequence	
7. Outline Dimension	----- (23)
8. Packing	----- (26)
9. Markings & Others	----- (28)
10. General Precautions	----- (30)
11. EDID	----- (32)

REVISION HISTORY

Approval

Date	Revision No.	Page	Summary
Oct. 12. 2010	P00	All	LTN156AT22-001 model spec was issued first.
Oct. 29. 2010	P01	p. 8 p. 9 p. 11 p. 13 p. 15	R,G,B color chromaticity was updated. Figure of note 4 was changed from 5points to 1point. Current of power supply was updated. LED driver characteristic was updated as RT8510 LED driver. Pin 5 (WPN) was updated with on, off levels.
Nov. 12. 2010	P02	p. 15 p. 24	Pin5 (WPN) was updated as NC. Thickness on the outline dimension was corrected from 5.65mm max to 5.5mm max.
Dec. 14. 2010	P03	p. 11, 12 p. 14 p. 24 p. 26 p. 27	Max pattern was updated as 1 dot inversion. No.8 LED was updated as clean. Bigger 8-M2 direction Weight was changed from 490g max to 450g max. Packing was updated as paper box. Pallet was updated as paper box.
Jan. 17. 2011	P04	p. 28	To classify use, Characteristic changing on Model Label (From C to D / The Mean of 'D' is DID用)
Feb. 15. 2011	P05	p. 10 p. 11 p. 12 p. 14 p. 25 p. 26	LED current was changed from 26.5mA to 25.5mA. Note4 was updated. Max pattern was changed from black to 1 dot inversion . LED connection and placement was updated as 36ea LEDs. The name of Interface connector was updated. EPS was removed.
Mar. 24. 2011	P06	p. 8 p. 11 p. 14	Typ. uniformity was updated. Max. 450mA is fixed with the margin from the maximum current in the SEC's test by even. The numbering of LED placement was updated.
Mar. 25. 2011	A00	All p. 25	Approval specification of LTN156AT22-001 was issued. PCB cover was updated on the outline drawing.
Mar. 28. 2011	A01	p.1 p. 6	The information described in this SPEC is approved and can not be changed without prior notice. Operating temp. was updated from 0 to 40 degrees. Altitude (operation) was changed from 10,000feet to 15,000feet.

Samsung Secret

REVISION HISTORY

Approval

Date	Revision No.	Page	Summary
Mar. 28. 2011	A01	p. 1, 4, 23, 24	Model name of outline dimension was updated as LTN156AT22-001.
Mar. 30. 2011	A02	ALL	Revision code of Doc.No was updated as -001.
Apr. 6. 2011	A03	p. 6	Typ. of weight was changed from 430g to 405g.

Samsung Secret

Doc.No.

LTN156AT22-001

Rev.No

04-A03-S-110406

Page

4 / 34

GENERAL DESCRIPTION

DESCRIPTION

LTN156AT22-001 is a color active matrix TFT (Thin Film Transistor) liquid crystal display (LCD) that uses amorphous silicon TFT as switching devices. This model is composed of a TFT LCD panel, a driver circuit and a backlight system. The resolution of a 15.6" contains 1366 x 768 pixels and can display up to 262,144 colors. 6 O'clock direction is the Optimum viewing angle.

FEATURES

- Thin and light weight
- High contrast ratio, high aperture structure
- 1366 x 768 pixels resolution (16:9)
- Fast Response Time
- Low power consumption
- LED BLU Structure
- DE (Data enable) only mode
- 3.3V LVDS Interface
- On board EDID chip
- Pb-free product
- RoHS comply product
- Flicker should be optimized with 2 by 1 half gray green pattern before shipping MP.

APPLICATIONS

- Notebook PC
- If the usage of this product is not for PC application, but for others, please contact SEC

GENERAL INFORMATION

Item	Specification	Unit	Note
Display area	344.232 (H) x 193.536 (V) (15.6" diagonal)	mm	
Driver element	a-Si TFT active matrix		
Display colors	262,144		
Number of pixel	1366 x 768	pixel	16 : 9
Pixel arrangement	RGB vertical stripe		
Pixel pitch	0.252 (H) x 0.252 (V) (TYP.)	mm	
Display Mode	Normally white		
Surface treatment	Haze 25, Hardness 3H (Reflection ratio 3~4%)		Anti-Glare

Samsung Secret

Mechanical Information

Item		Min.	Typ.	Max.	Unit	Note
Module size	Horizontal (H)	358.8	359.3	359.8	mm	
	Vertical (V)	209.0	209.5	210	mm	
	Depth (D)	-	-	5.5	mm	(1)
Weight		-	405	450	g	

Note (1) Measurement condition of outline dimension

. Equipment : Vernier Calipers

. Push Force : 500g · f (minimum)

1. ABSOLUTE MAXIMUM RATINGS

1.1 ENVIRONMENTAL ABSOLUTE RATINGS

Item	Symbol	Min.	Max.	Unit	Note
Storage temperate	T_{STG}	-20	60	°C	(1)
Operating temperate (Temperature of glass surface)	T_{OPR}	0	40	°C	(1)
Shock (non-operating)	Snop	-	210	G	(2),(5)
			50		(3),(5)
Vibration (non-operating)	Vnop	-	2.41	G	(4),(5)
Altitude (operation)	-	-	15,000	feet	
Altitude (storage)	-	-	40,000	feet	

Note (1) Temperature and relative humidity range are shown in the figure below.

95 % RH Max. ($40\text{ }^{\circ}\text{C} \geq T_a$)

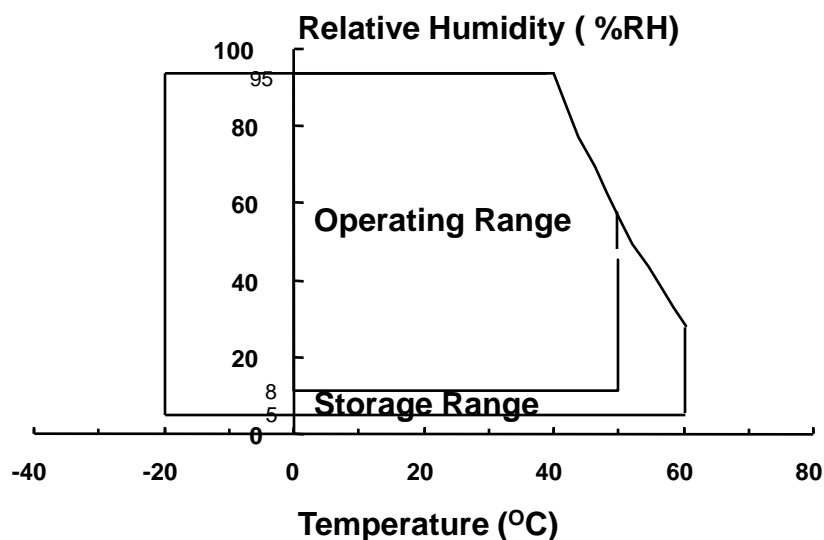
Maximum wet - bulb temperature at $39\text{ }^{\circ}\text{C}$ or less. ($T_a > 40\text{ }^{\circ}\text{C}$) No condensation.

(2) 2ms, half sine wave, one time for $\pm X, \pm Y, \pm Z$.

(3) 11ms, Trapezoidal wave, one time for $\pm X, \pm Y, \pm Z$.

(4) 5~500 Hz, Random vibration, 30 min for X,Y,Z.

(5) At testing Vibration and Shock, the fixture in holding the Module to be tested have to be hard and rigid enough so that the Module would not be twisted or bent by the fixture.



Samsung Secret

1.2 ELECTRICAL ABSOLUTE RATINGS

(1) TFT LCD MODULE

 $V_{DD} = 3.3V, V_{SS} = GND = 0V$

Item	Symbol	Min.	Max.	Unit	Note
Power Supply Voltage	V_{DD}	$V_{DD} - 0.3$	$V_{DD} + 0.3$	V	(1)
Logic Input Voltage	V_{DD}	$V_{DD} - 0.3$	$V_{DD} + 0.3$	V	(1)

Note (1) Within T_a (25 ± 2 °C)

2. OPTICAL CHARACTERISTICS

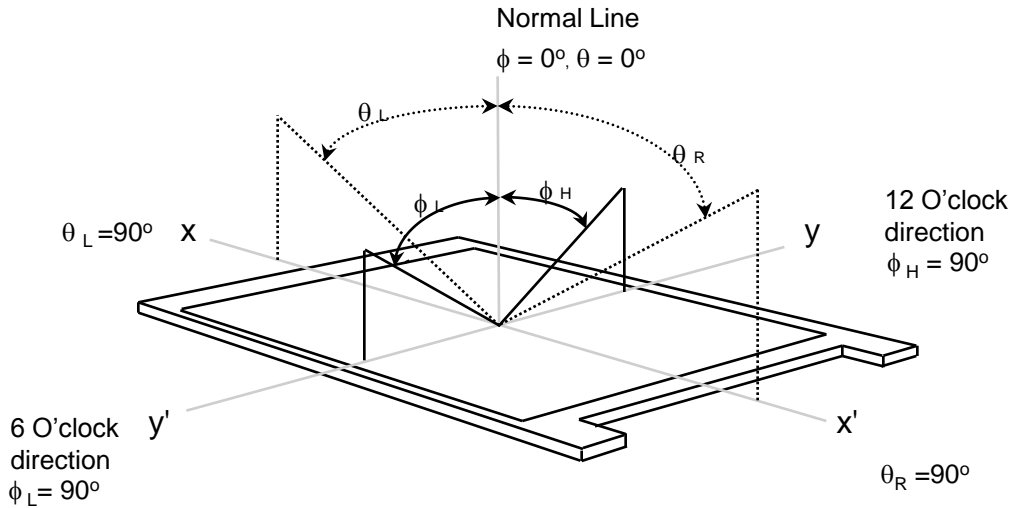
The following items are measured under stable conditions. The optical characteristics should be measured in a dark room or equivalent state with the methods shown in Note (5).
Measuring equipment : TOPCON SR-3

* Ta = 25 ± 2 °C, V_{DD}=3.3V, f_v= 60Hz, f_{DCLK} = 72.33 MHz, PWM duty = 100%

Item	Symbol	Condition	Min.	Typ.	Max	Unit	Note	
Contrast Ratio	CR	1 center point	300	500	-	-	(1), (2), (5)	
Response Time at Ta (Rising + Falling)	T _{RT}		-	16 (6.75 + 9.25)	25	msec	(1), (3)	
Average Luminance of White	Y _{L,AVE}	1 center point	190	220	-	cd/m ²	PWM duty = 100% (1), (4)	
Color Chromaticity (CIE)	Red	R _X	Normal Viewing Angle φ = 0 θ = 0	0.585	0.615	0.645	-	
		R _Y		0.325	0.355	0.385		
	Green	G _X		0.305	0.335	0.365		
		G _Y		0.580	0.610	0.640		
	Blue	B _X		0.120	0.150	0.180		
		B _Y		0.070	0.100	0.130		
	White	W _X		0.283	0.313	0.343		
		W _Y		0.299	0.329	0.359		
Viewing Angle	Hor.	θ _L	CR ≥ 10	40	45	-	Degrees	(1), (5) SR-3
		θ _R		40	45	-		
	Ver.	φ _H		10	15	-		
		φ _L		30	35	-		
Color Gamut			-	60	-	%		
13 Points White Variation	δ _L		-	1.6	1.7	-	(6)	

Samsung Secret

Note 1) Definition of Viewing Angle : Viewing angle range($10 \leq C/R$)

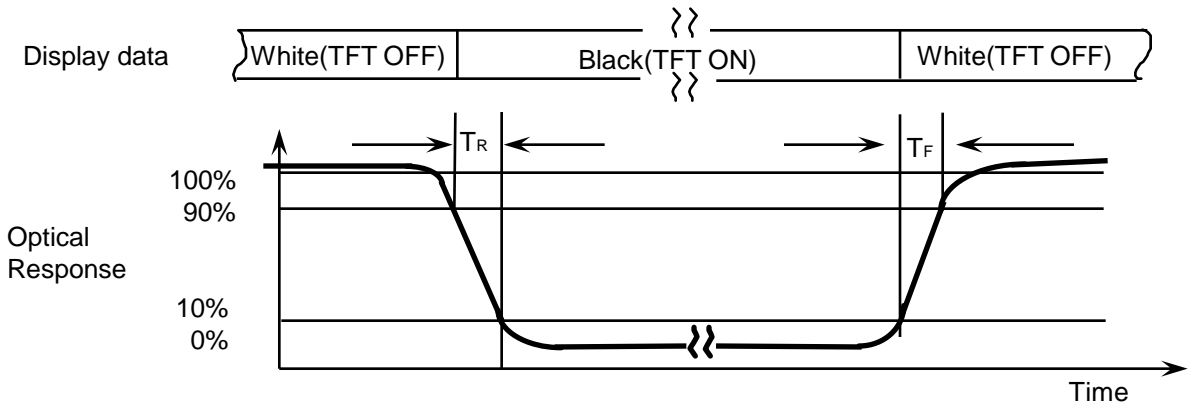


Note 2) Definition of Contrast Ratio (CR) : Ratio of gray max (Gmax) ,gray min (Gmin) at 5 points(4, 5, 7, 9, 10)

$$CR = \frac{CR(4) + CR(5) + CR(7) + CR(9) + CR(10)}{5}$$

Points : (4) , (5) , (7) , (9) , (10) at the figure of Note (6).

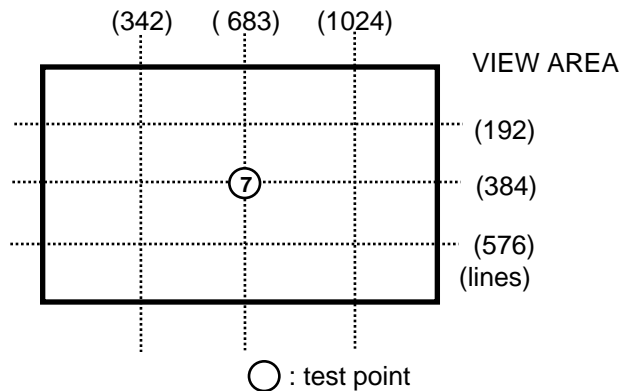
Note 3) Definition of Response time :



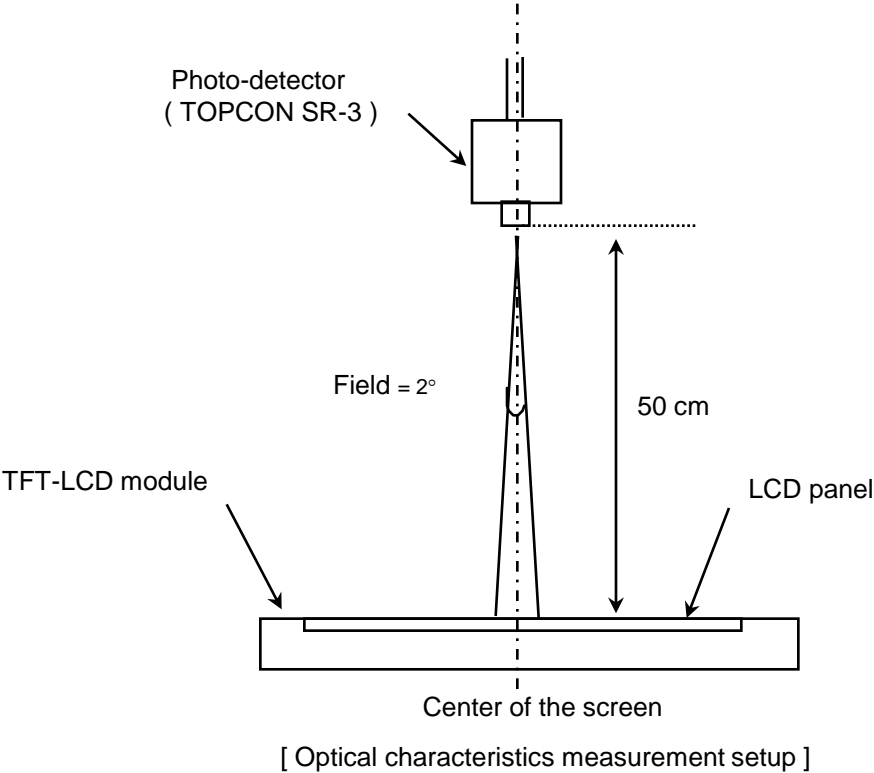
Note 4) Definition of Average Luminance of White : measure the luminance of white at 1 point.

. Center 1point of White ($Y_{L,AVE}$)

$$Y_{,CENTER} = Y_{L7}$$

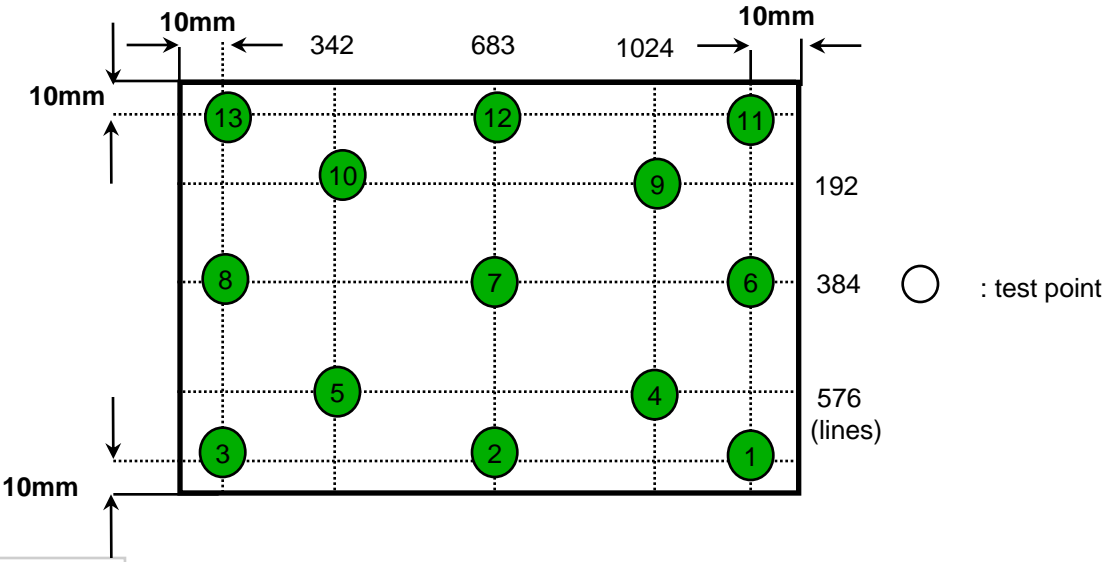


Note 5) After stabilizing and leaVBLg the panel alone at a given temperature for 30 min , the measurement should be executed. Measurement should be executed in a stable, windless, and dark room. 30 min after lighting the backlight. This should be measured in the center of screen.
 LED current : 25.5 mA
 Environment condition : Ta = 25 ± 2 °C



Note 6) Definition of 13 points white variation (δL), [① ~ ⑬]

$$\delta L = \frac{\text{Maximum luminance of 13 points}}{\text{Minimum luminance of 13 points}}$$



Samsung Secret

3. ELECTRICAL CHARACTERISTICS

Approval

3.1 TFT LCD MODULE

Ta= 25 ± 2°C

Item	Symbol	Min.	Typ.	Max.	Unit	Note	
Voltage of Power Supply	V _{DD}	3.0	3.3	3.6	V		
Differential Input Voltage for LVDS Receiver Threshold	High	V _{IH}	-	-	+100	mV	V _{CM} = +1.2V (+/- 10%)
	Low	V _{IL}	-100	-	-	mV	
Vsync Frequency	f _v	-	60	-	Hz		
Hsync Frequency	f _H	-	47.4	-	KHz		
Main Frequency	f _{DCLK}	67.5	72.33	80	MHz		
EDID Input Voltage	V _{EDID}	2.5	3.3	5.0	V		
EDID Input Current	I _{EDID}	-	0.8	1.0	mA		
Skew	ps	-500	-	+500	ps	f _{DCLK} = 72.33MHz	
Rush Current	I _{RUSH}	-	-	1.5	A	(4)	
Current of Power Supply	White	I _{DD}	-	200	-	mA	(2),(3)*a
	Mosaic		-	220	-	mA	(2),(3)*b
	V. Stripe		-	350	-	mA	(2),(3)*c
	Black		-	200	-	mA	(2),(3)*d
	1 dot		-	400	450	mA	(2),(3),(4)*e

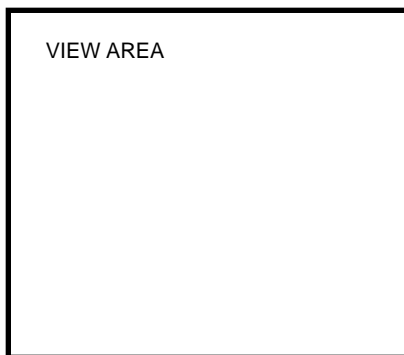
Note (1) Display data pins and timing signal pins should be connected.(GND = 0V)

(2) f_v = 60Hz, f_{DCLK} = 72.33 MHz, V_{DD} = 3.3V , DC Current.

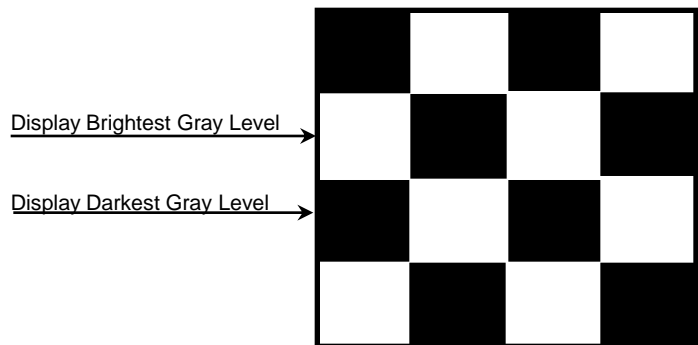
(3) Power dissipation pattern

(4) Max. 450mA is fixed with the margin from the maximum current in the SEC's test by even.

*a) White Pattern

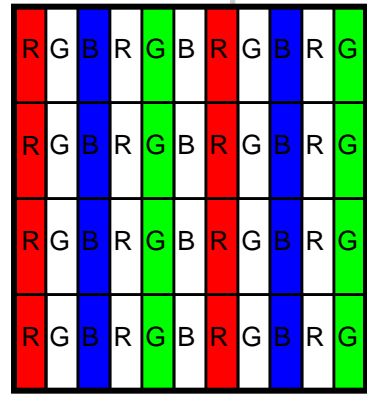
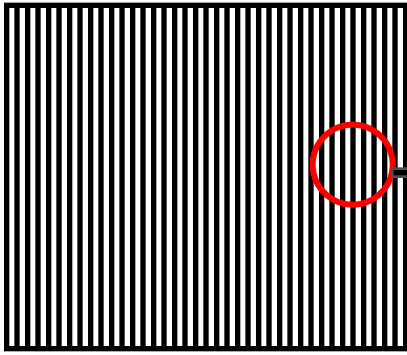


*b) Mosaic Pattern



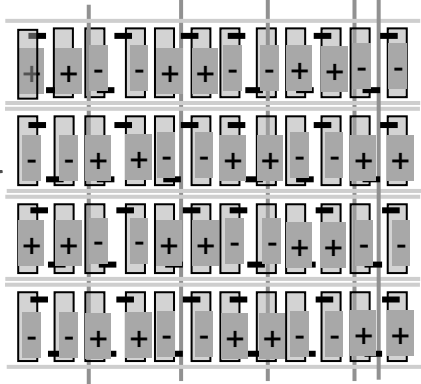
Samsung Secret

*c) 1dot Vertical stripe pattern

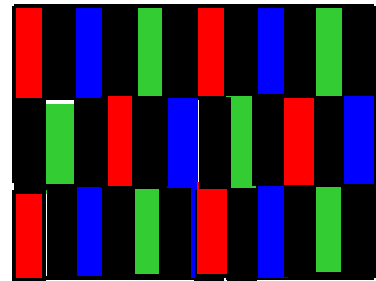
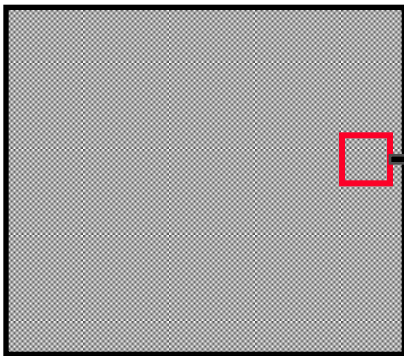


royal

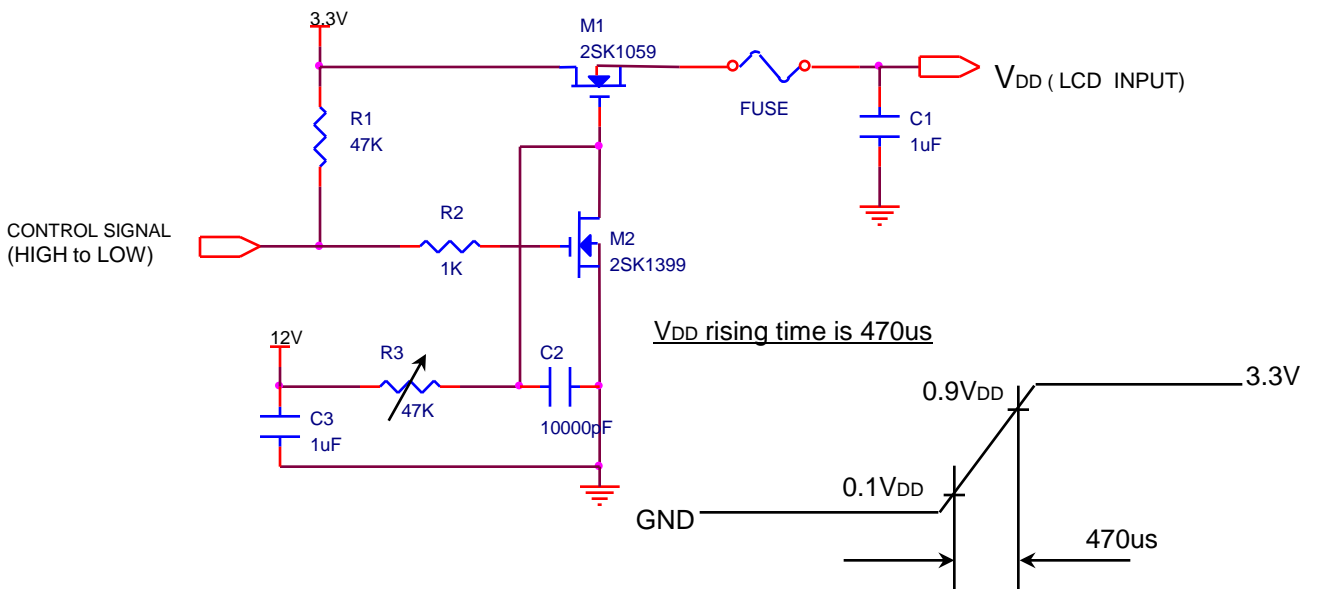
*d) Black



*e) Max pattern : 1dot inversion



4) Rush current measurement condition



Samsung Secret

3.2 BACK-LIGHT UNIT

Ta= 25 ± 2 °C

Item	Symbol	Min.	Typ.	Max.	Unit	Note
Operating Life Time	Hr	10,000	-	-	Hr	(1)

Note (1) Life time (Hr) of LEDs can be defined as the time in which it continues to operate under the condition Ta= 25 ± 2 °C and PWM duty = 100% until one of the following event occurs.

- When the brightness becomes 50% or lower than the original.

3.3 LED Driver

- LED Driver Manufacturer : Richtek (RT8510)

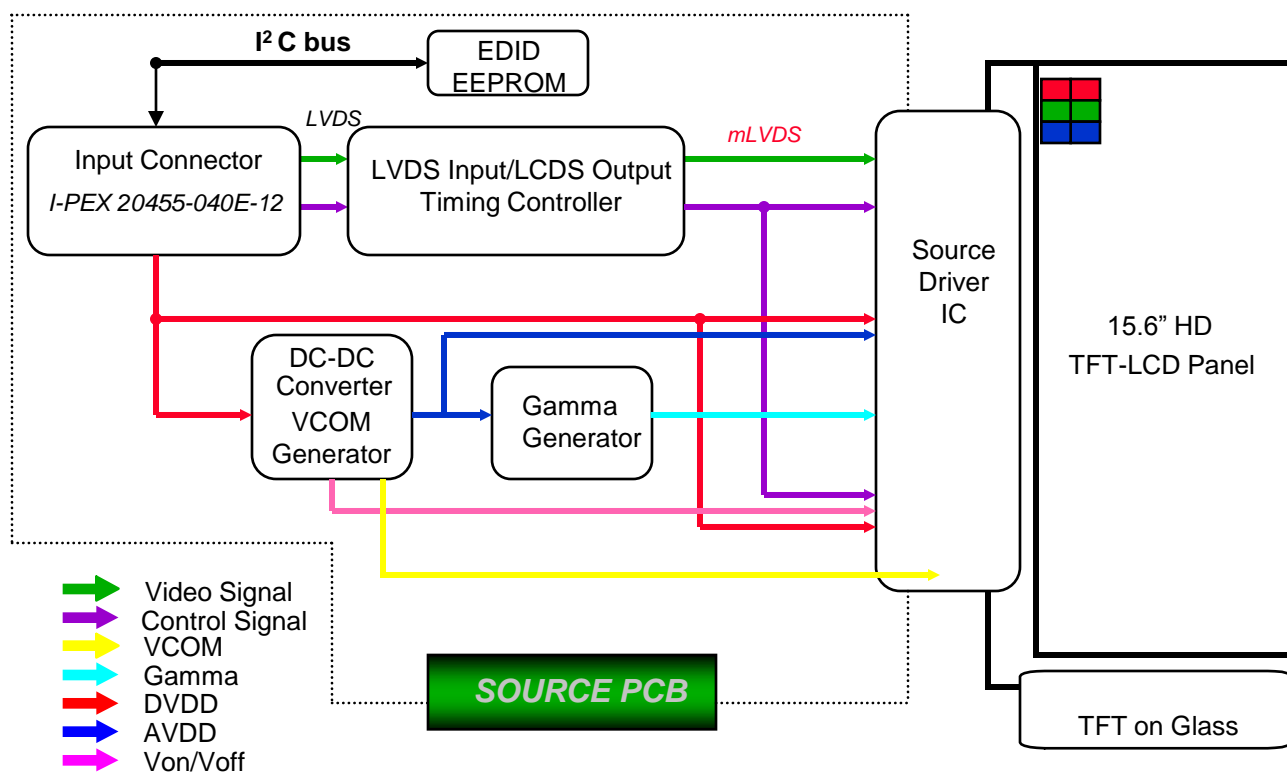
Ta= 25 ± 2 °C

Item	Symbol	Min.	Typ.	Max.	Unit	Note
Input Voltage	V _{BL}	7	12	21	V	
V _{LED on level voltage}	V _{LED_on}	7	-	21	V	
V _{LED off level voltage}	V _{LED_off}	0	-	2	V	
Input Current	I	-	320	340	mA	
Input Power	P _{in}	-	3.84	4.08	W	P _{in} = V _{BL} x I
PWM duty ratio	-	6	-	100	%	(1)
PWM Frequency	F _{PWM}	0.1	-	30	KHz	(1)
PWM Impedance	Z _{PWM}	2.4	-	-	Mohm	
PWM high level vol.	V _{PWM_H}	2.0	-	5.0	V	
PWM low level vol.	V _{PWM_L}	0	-	0.5	V	
LED_EN Impedance	Z _{PWM}	50	-	-	Mohm	
LED_EN high vol.	V _{LED_EN_H}	2.0	-	5.0	V	
LED_EN low vol.	V _{LED_EN_L}	0	-	0.8	V	
LED rush current	I _{LED RUSH}	-	-	1.5	A	

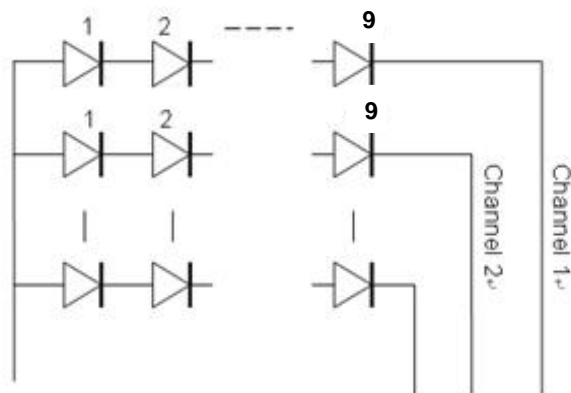
Note -(1) PWM can be guaranteed under the same condition as operation temperature T_{OPR} 0 ~ 50 °C.

4. BLOCK DIAGRAM

4.1 TFT LCD Module

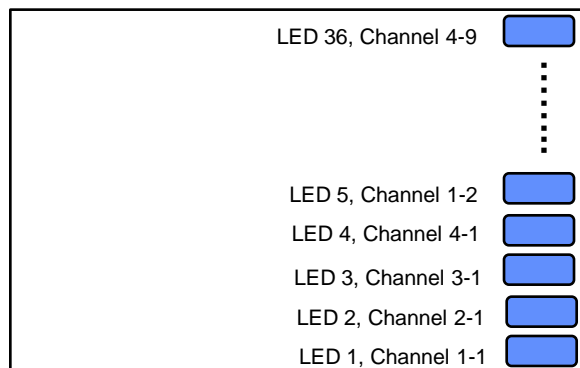


4.2 LED connection and placement



9 LEDs x 4 channels = Total 36 LEDs

LED Wiring



LED Placement

Samsung Secret

5. INPUT TERMINAL PIN ASSIGNMENT

Approval

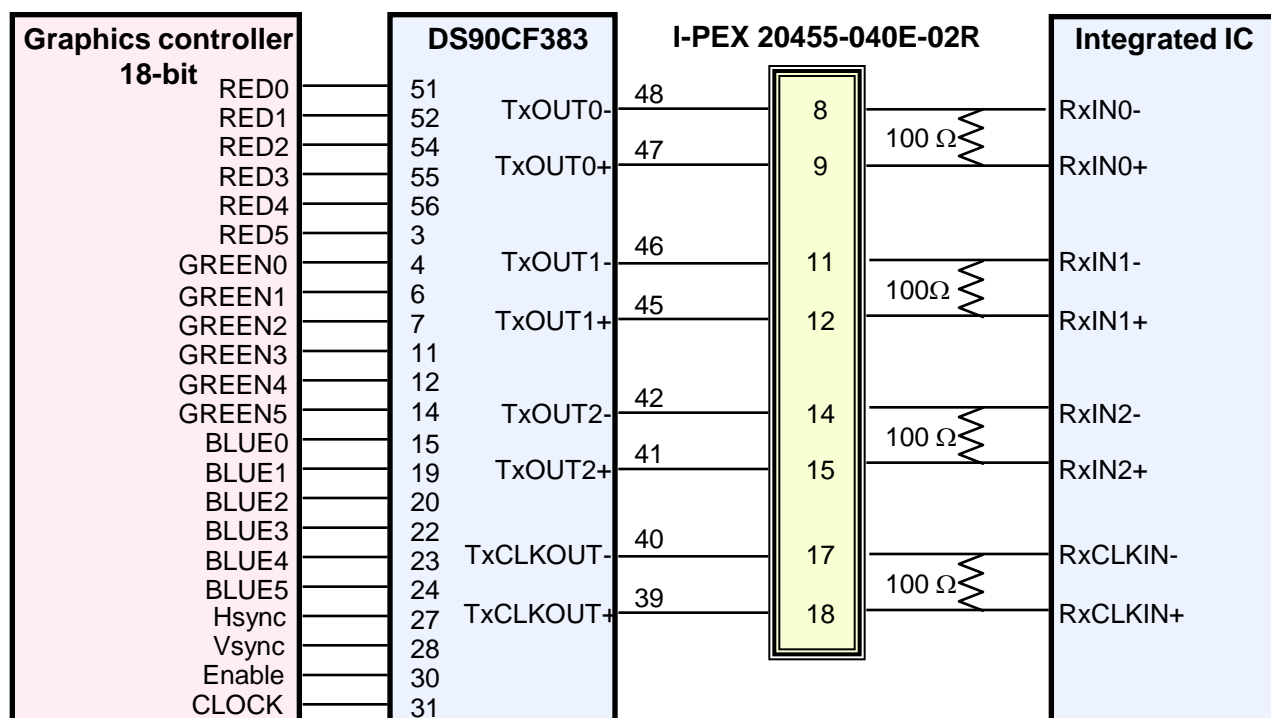
5.1. Input Signal & Power LVDS, Connector : I-PEX 20455-040E-02R
Mating Connector: I-PEX 20454-040T-01 or 02

Pin	Symbol	Function
1	NC	No Connection (Reserved for supplier)
2	VCC	Power Supply, 3.3V (typical)
3	VCC	Power Supply, 3.3V (typical)
4	VCC_EDID	DDC 3.3V power, Current 0.8mA (typical)
5	NC	No Connection (Reserved for supplier)
6	CLK_EDID	DDC Clock
7	DATA_EDID	DDC Data
8	RXin0-	- LVDS differential data (R0-R5, G0)
9	RXin0+	+ LVDS differential data (R0-R5, G0)
10	GND	Ground
11	RXin1-	- LVDS differential data (G1-G5, B0-B1)
12	RXn1+	+ LVDS differential data (G1-G5, B0-B1)
13	GND	Ground
14	RXin2-	- LVDS differential data (B2-B5,HS,VS, DE)
15	RXn2+	+ LVDS differential data (B2-B5,HS,VS, DE)
16	GND	Ground
17	CIKIN-	- LVDS differential clock input
18	CIKIN+	+ LVDS differential clock input
19	GND	Ground
20~21	NC	No Connection
22	GND	Ground
23~24	NC	No Connection
25	GND	Ground
26~27	NC	No Connection
28	GND	Ground
29~30	NC	No Connection
31~33	GND	LED Ground
34	NC	No Connection
35	PWM	PWM for luminance control
36	LED_EN	BL On/Off (On: 2.0~5.0V, Off: 0~0.8V)
37	NC	No Connection
38~40	VBL(7~21)	*LED Power Supply 7V-21V

Samsung Secret

5.2 LVDS Interface : Transmitter DS90CF363 or Compatible

Pin No.	Name	RGB Signal	Pin No.	Name	RGB Signal
51	TxIN0	R0	14	TxIN14	G5
52	TxIN1	R1	15	TxIN15	B0
54	TxIN2	R2	19	TxIN18	B1
55	TxIN3	R3	20	TxIN19	B2
56	TxIN4	R4	22	TxIN20	B3
3	TxIN6	R5	23	TxIN21	B4
4	TxIN7	G0	24	TxIN22	B5
6	TxIN8	G1	27	TxIN24	Hsync
7	TxIN9	G2	28	TxIN25	Vsync
11	TxIN12	G3	30	TxIN26	DE
12	TxIN13	G4	31	TxCLKIN	Clock

LVDS INTERFACE

Note : The LCD Module uses a 100ohm resistor between positive and negative lines of each receiver input.

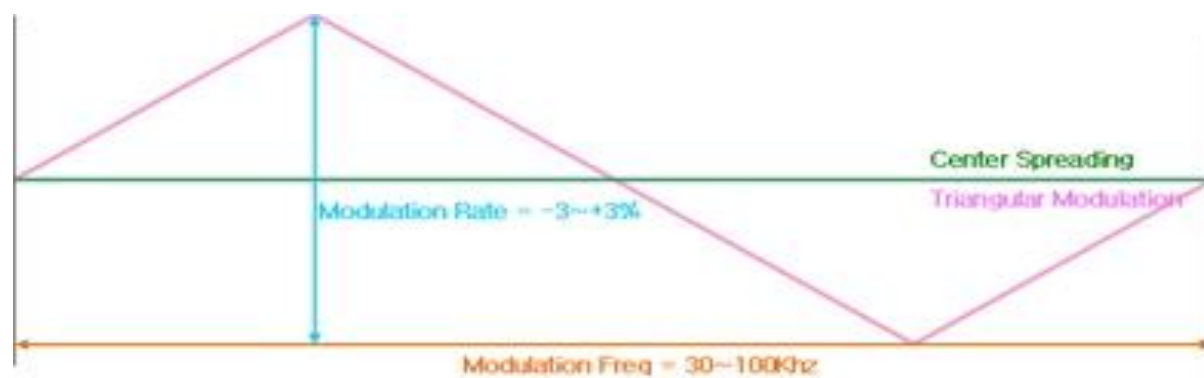
Samsung Secret

5.3 LVDS characteristics

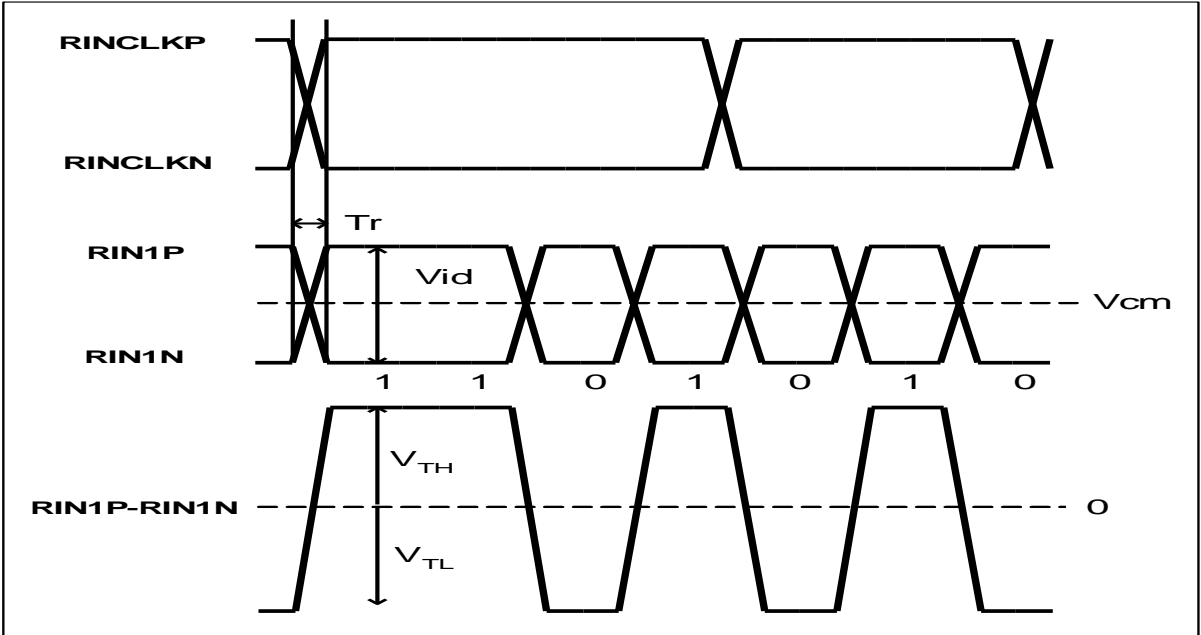
LVDS DC Specifications						
Characteristics	Symbol	Conditions	Min	Typ	Max	Unit
Differential input high threshold voltage	VTH	V _{cm} = 1.2V	100			mV
Differential input low threshold voltage	VTL		100			mV
Differential input voltage	Vid		100		600	mV
Common mode voltage	V _{cm}	Vid = 100mV, AVDD33I = 3.3V	0.4	1.2	2.9	V

LVDS AC Specifications						
Characteristics	Symbol	Min	Typ	Max	Unit	Remarks
ROUTCLK frequency	fRCP	30	72.33	105	MHz	-
TTL data set-up to ROUTCLK	tRS	0.3/fRCP			ns	
TTL data hold from ROUTCLK	tRH	0.3/fRCP			ns	
Skew (Strobe) right margin	TRSRM			500	ps	
Skew (Strobe) left margin	TRSLM			500	ps	
LVDS clock to clock skew margin (Even to odd)	Tskew_eo	-1/7		+1/7	T _{clk}	-
Unit delay width in skew control block	Δ		100		ps	@NN,55°C,2.5/1.2V

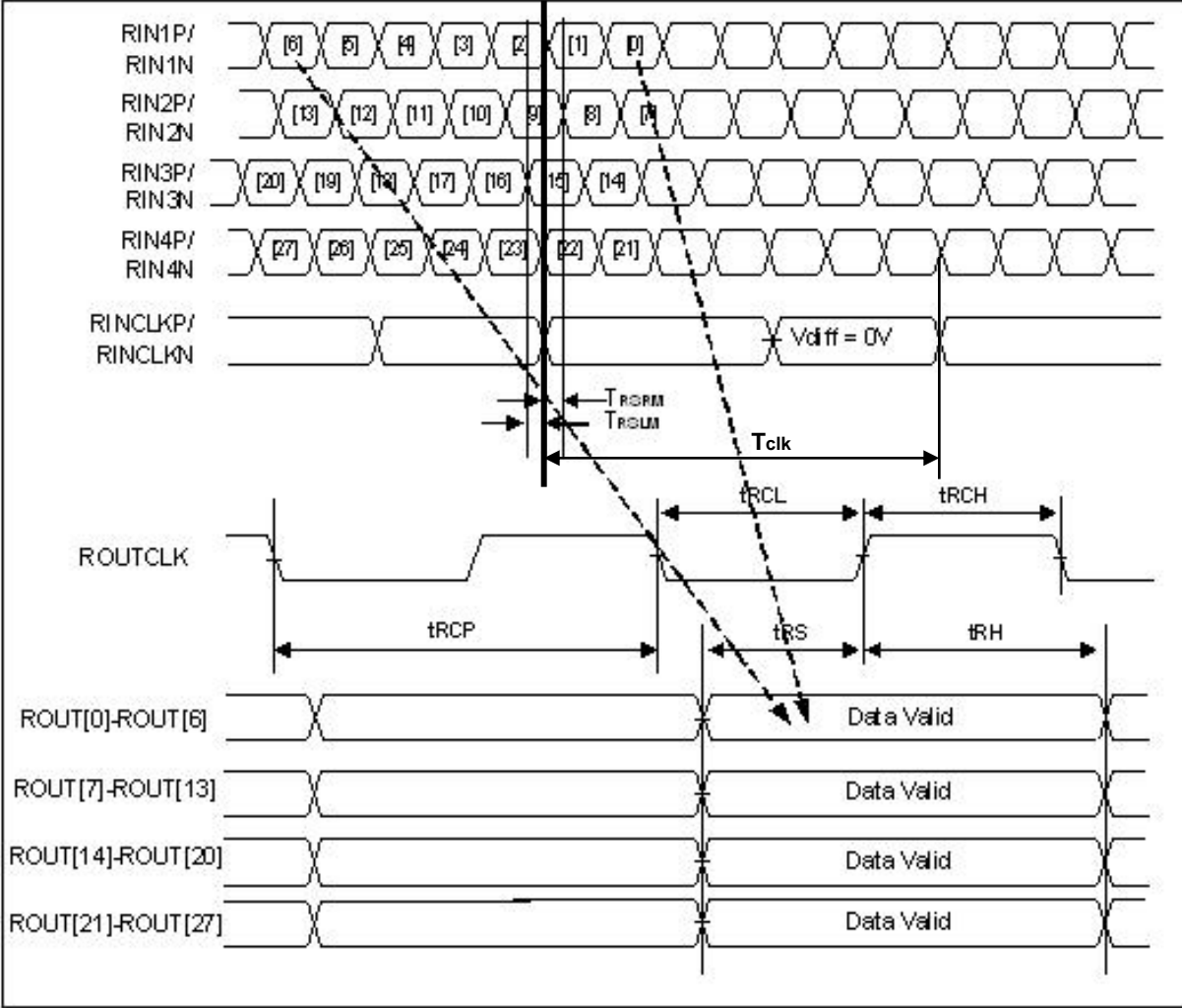
Characteristics	Symbol	Min	Typ	Max	Unit	Remarks
Modulation Rate	F _{mr}	-3		3	%	@ MAINCLK = 72.33MHz
Modulation Frequency	F _{mf}	30		300	Khz	



Samsung Secret



< Definition of LVDS DC characteristics >



< Definition of LVDS AC characteristics >

Samsung Secret

5.4 Input Signals, Basic Display Colors and Gray Scale of Each Color

Color	Display	Data Signal																	Gray Scale Level	
		Red					Green					Blue								
		R0	R1	R2	R3	R4	R5	G0	G1	G2	G3	G4	G5	B0	B1	B2	B3	45		B5
Basic Colors	Black	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-
	Blue	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	-
	Green	0	0	0	0	0	0	1	1	1	1	1	1	0	0	0	0	0	0	-
	Cyan	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	-
	Red	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	-
	Magenta	1	1	1	1	1	1	0	0	0	0	0	0	1	1	1	1	1	1	-
	Yellow	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0	-
	White	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	-
Gray Scale Of Red	Black	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	R0	
	Dark	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	R1	
	↑	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	R2	
	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	R3~R60	
	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:		
	↓	1	0	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	R61	
	Light	0	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	R62	
	Red	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	R63	
Gray Scale Of Green	Black	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	G0	
	Dark	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	G1	
	↑	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	G2	
	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	G3~G60	
	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:		
	↓	0	0	0	0	0	0	1	0	1	1	1	1	0	0	0	0	0	G61	
	Light	0	0	0	0	0	0	0	1	1	1	1	1	0	0	0	0	0	G62	
	Green	0	0	0	0	0	0	1	1	1	1	1	1	0	0	0	0	0	G63	
Gray Scale Of Blue	Black	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	B0	
	Dark	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	B1	
	↑	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	B2	
	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	B3~B60	
	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:		
	↓	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	1	1	B61	
	Light	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	B62	
	Blue	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	B63	

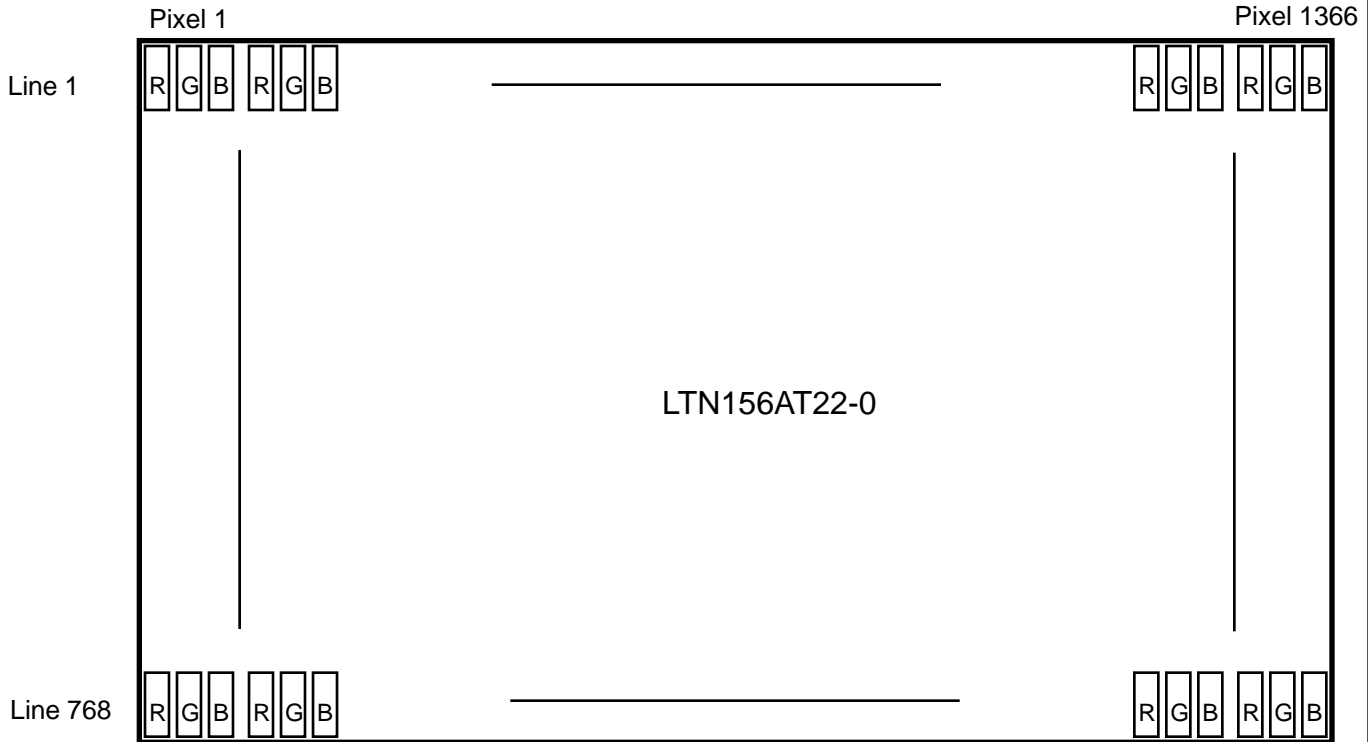
Note 1) Definition of gray :

Rn: Red gray, Gn: Green gray, Bn: Blue gray (n=gray level)

Note 2) Input signal: 0 =Low level voltage, 1=High level voltage

Samsung Secret

5.5 Pixel Format in the display



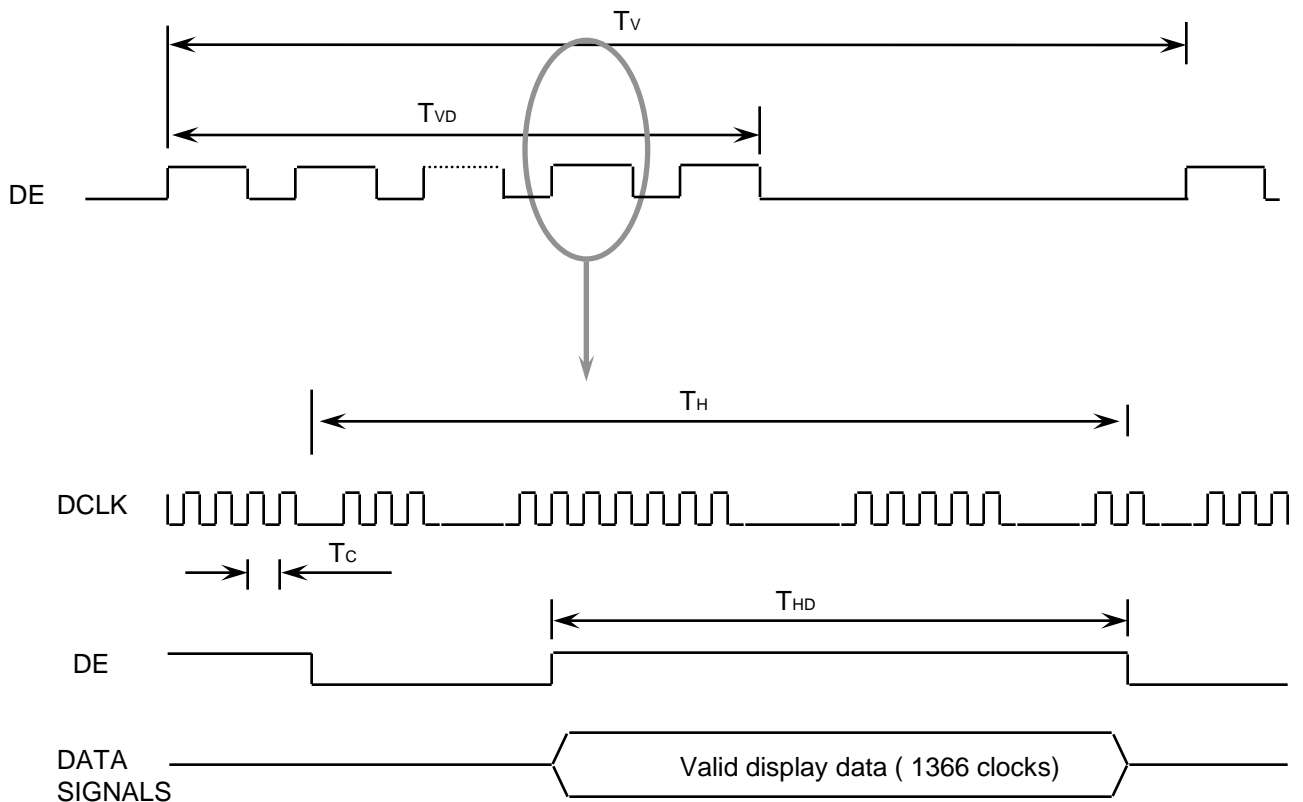
Samsung Secret

6. INTERFACE TIMING

6.1 Timing Parameters

Signal	Item	Symbol	Min.	Typ.	Max.	Unit	Note
Frame Frequency	Cycle	TV	780	790	807	Lines	-
Vertical Active Display Term	Display Period	TVD	-	768	-	Lines	-
One Line Scanning Time	Cycle	TH	1430	1526	1620	Clocks	-
Horizontal Active Display Term	Display Period	THD	-	1366	-	Clocks	-

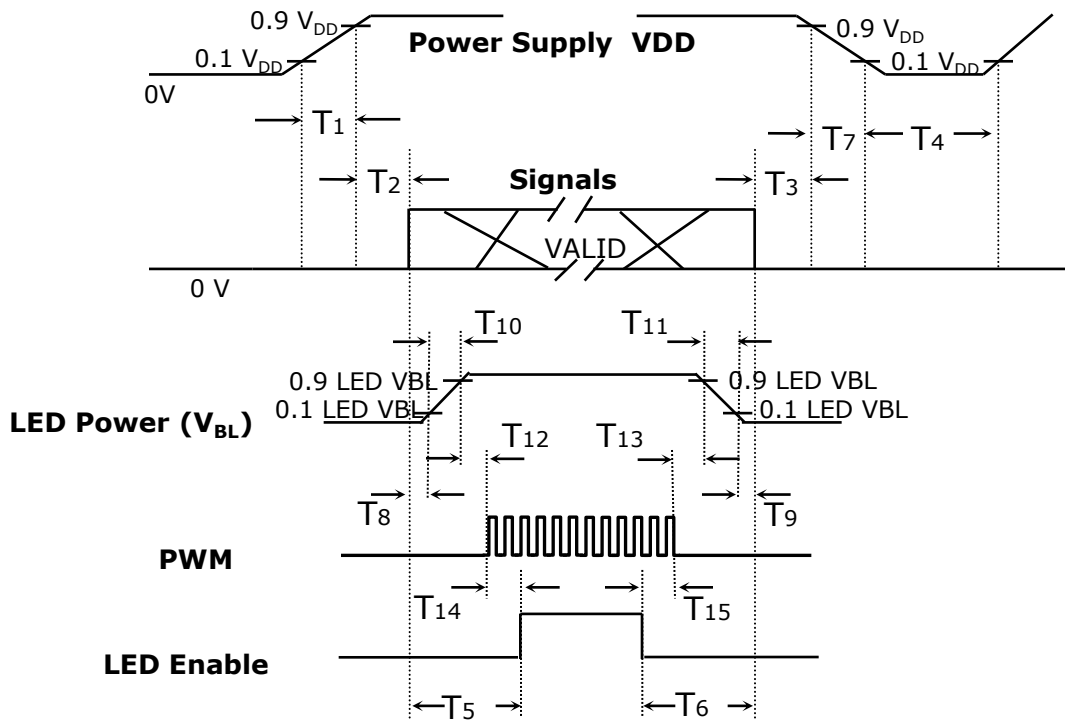
6.2 Timing diagrams of interface signal



Samsung Secret

: To prevent a latch-up or DC operation of the LCD module, the power on/off sequence should be as the diagram below.

Power ON/OFF Sequence



Timing (ms)	Remarks
$0 < T_1 \leq 10$	V _{DD} rising time from 10% to 90%
$0 < T_2 \leq 50$	Delay from V _{DD} to valid data at power ON
$0 < T_3 \leq 50$	Delay from valid data OFF to V _{DD} OFF at power Off
$400 \leq T_4$	V _{DD} OFF time for Windows restart
$200 \leq T_5$	Delay from valid data to LED enable at power ON
$200 \leq T_6$	Delay from valid data off to LED disable at power Off
$0 < T_7 \leq 10$	V _{DD} falling time from 90% to 10%
$0 < T_{10} < 10$	LED VBL rising time from 10% to 90%
$0 < T_{11} < 10$	LED VBL falling time from 90% to 10%
$10 < T_{12}$	Delay from LED driver VBL rising time 90% to PWM ON
$10 < T_{13}$	Delay from PWM Off to LED driver VBL falling time 10%
$0 < T_{14}$	Delay from PWM ON to LED Enable ON
$0 < T_{15}$	Delay from B/L Enable Off to PWM Off

Timing Parameters and definition

Note (1) Regarding the timing of T₈ and T₉, the following one are recommended
 $10 < T_8$: Delay from valid data on to LED driver VBL rising time 10%
 $10 < T_9$: Delay from LED driver VBL falling time 10% to valid data Off

Samsung Secret

7. MECHANICAL OUTLINE DIMENSION

Approval

[Refer to the next page]

Samsung Secret

Doc.No.

LTN156AT22-001

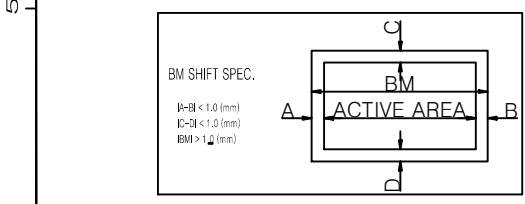
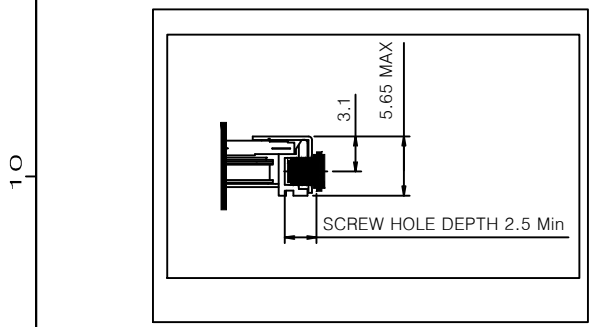
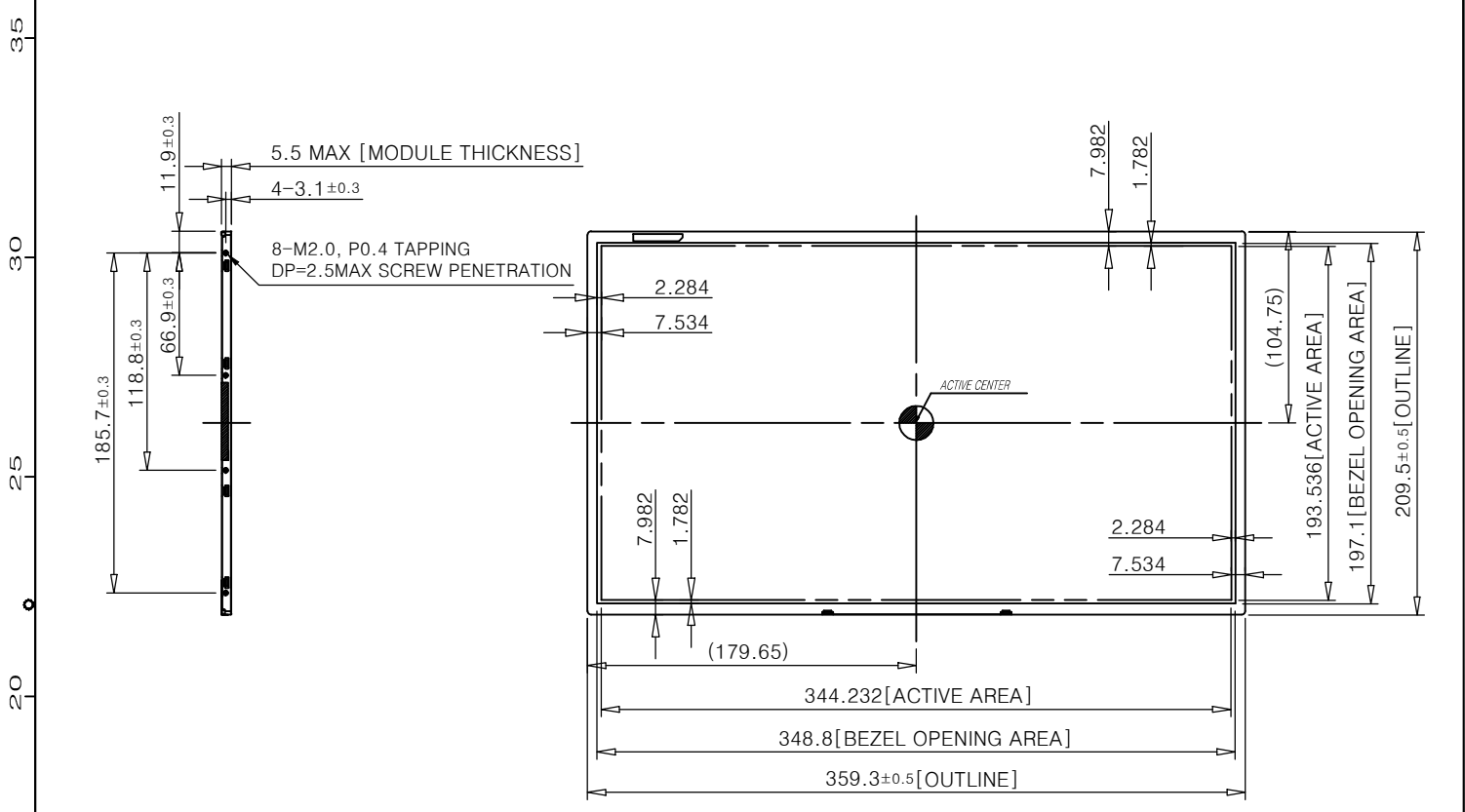
Rev.No

04-A03-S-110406

Page

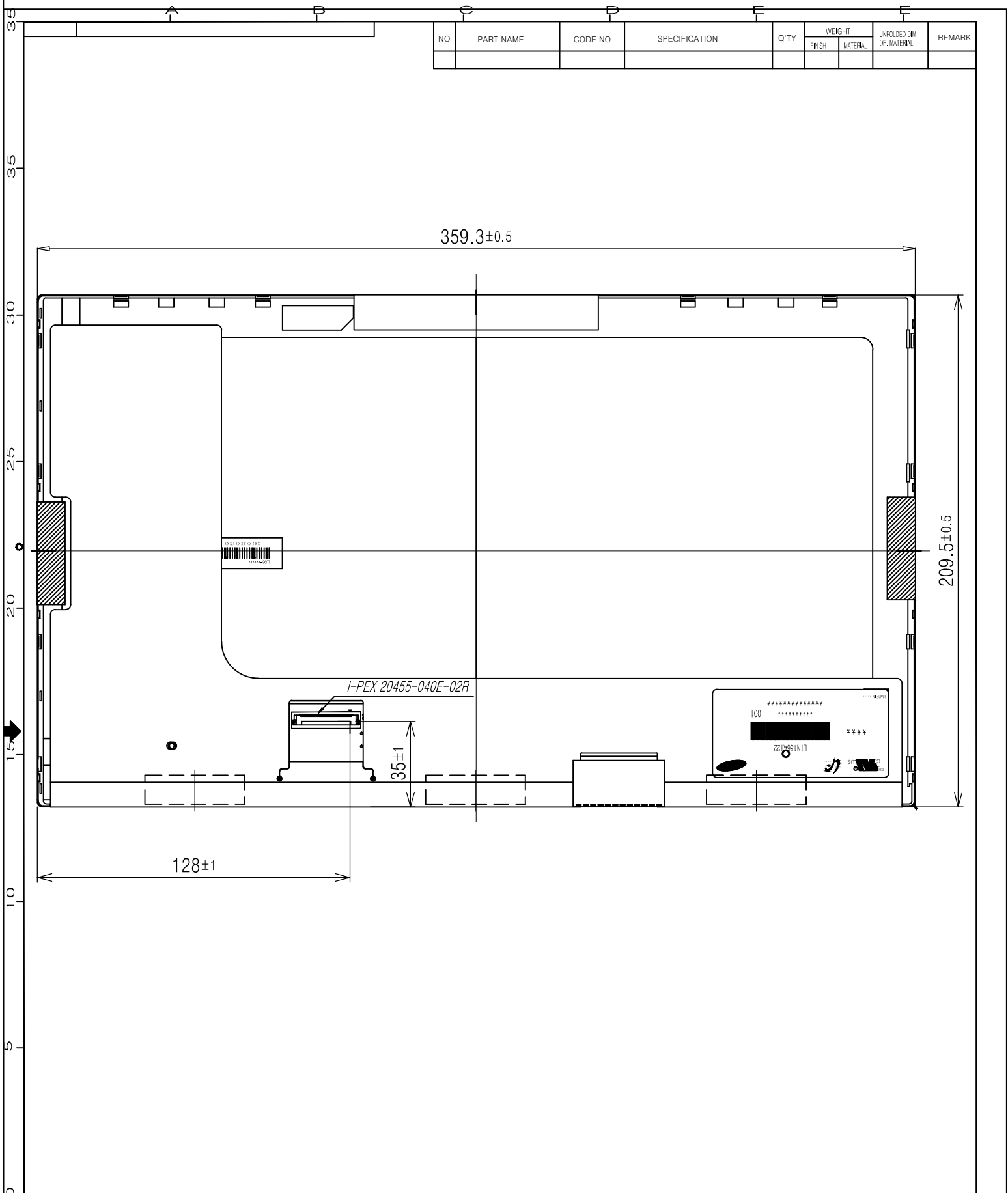
23 / 34

NO	PART NAME	CODE NO	SPECIFICATION	Q'TY	WEIGHT		UNFOLDED DIM. OF MATERIAL	REMARK
					FINISH	MATERIAL		



- * NOTE**
- SIGNAL INTERFACE CONNECTOR TO BE SPECIFIED AS BELOW.
 - MAKER : I-PEX (Not accept compatible connector basically)
 - INPUT CONNECTOR : I-PEX 20455-040E-02R
 - LED CONNECTOR FOR BACKLIGHT TO BE SPECIFIED AS BELOW.
 - MAKER : UJU Electronics
 - PART NO : 51441-1041
 - MAXIMUM SCREW TORQUE : MAX 2.5 Kgf-cm
 - WEIGHT : 450 g MAX
 - In order to avoid IC damage, it is not allow that overlapping of cables or antennas, camera , WLAN , WWAN over these COF locations.
 - Chassis Gap : Max 0.7mm

NO. 000-000000	REV	DATE	DESCRIPTION OF REVISION			REASON	CHG'D BY		
	UNIT	mm	DRAWN BY	DES'D BY	CHK'D BY	APP'D BY	MODEL NAME	LTN156AT22-001	
	SCALE	0.3		H.H.KIM	M.K.HYUN		PART/SHEET NAME	OUTLINE DIMENSION	SHEET 1 / 1
	TOLERANCE	±0.5		2010.10.29	2010.10.29		SPEC. NO.		VER. 000
	SAMSUNG ELECTRONICS							CODE NO.	



NO	PART NAME	CODE NO	SPECIFICATION	Q'TY	WEIGHT		UNFOLDED DIM. OF MATERIAL	REMARK
					FINISH	MATERIAL		

359.3±0.5

209.5±0.5

I-PEX 20455-040E-02R

35±1

128±1

REVISION

REV	DATE	DESCRIPTION OF REVISION	REASON			CHG'D BY			
			DRA'N BY	DES'D BY	CHK'D BY	APP'D BY	MODEL NAME	LTN156AT22-001	
				H.H.KIM	M.K.HYUN		PART/SHEET NAME	OUTLINE DIMENSION	SHEET 1 / 1
			TOLERANCE	2011.03.25	2011.03.25		CODE NO.		VER.
SAMSUNG ELECTRONICS									

8. PACKING

Approval

1. CARTON(Internal Package)

(1) Packing Form

Corrugated Cardboard box form as shock absorber

(2) Packing Method

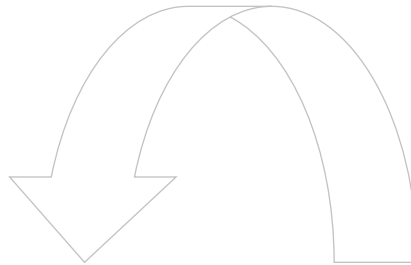
All 22pcs panels have each "Static electric protective sack" (22pcs)

(Two panels are in 1 partition.)

PANEL



BAG-SHIELDING



PACKING CASE



CUSHION PAD

Note 1) Total Weight : Approximately 12.0 kg

2) Acceptance number of piling : 22 sets

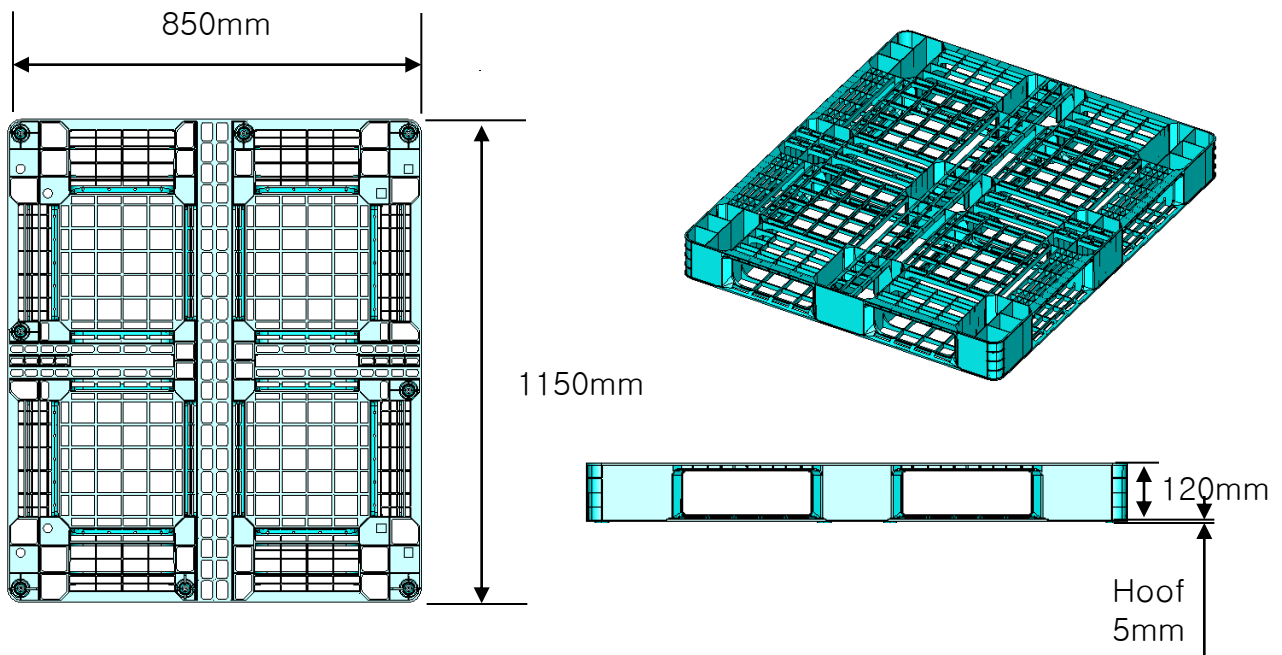
3) Carton size : 283(W) x 263(D) x 401 (H)

Samsung Secret

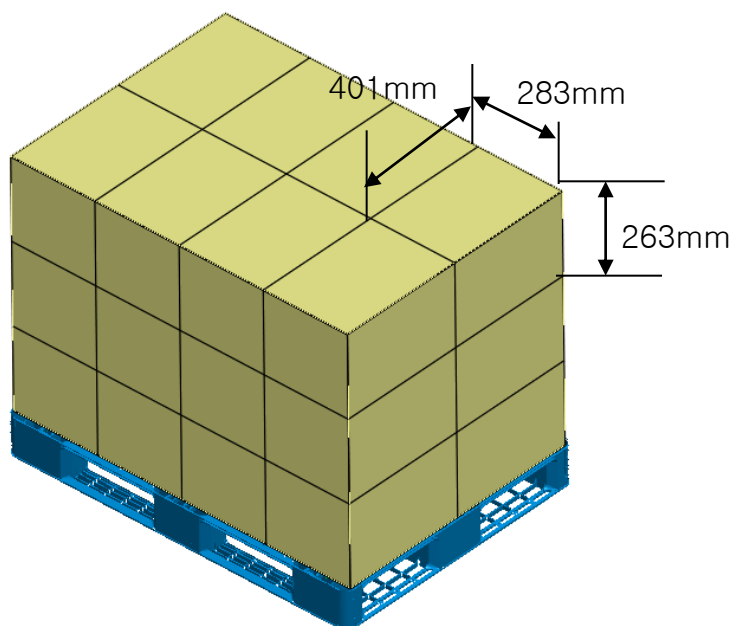
(3)Packing Material

No	Part name	Quantity
1	Static electric protective sack	20
2	Packing case (Inner box) included shock absorber	1 set
3	Pictorial marking	2 pcs
4	Carton	1 set

(4)Pallet Form



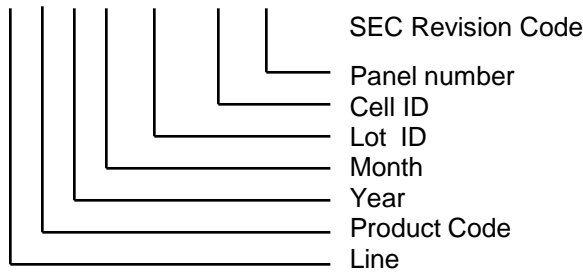
Note 1) Total : 24 boxes



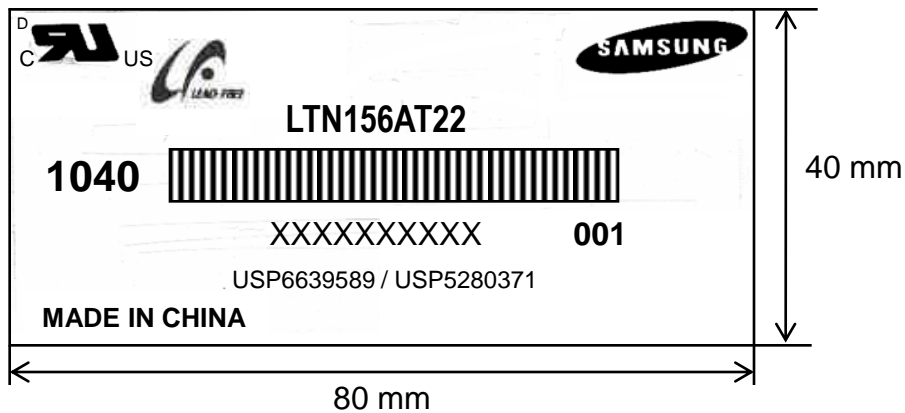
9. MARKINGS & OTHERS

A nameplate bearing followed by is affixed to a shipped product at the specified location on each product.

- (1) Parts number : LTN156AT22
- (2) Revision code : 3 letters
- (3) Lot number : X X X X XX XX XX 001

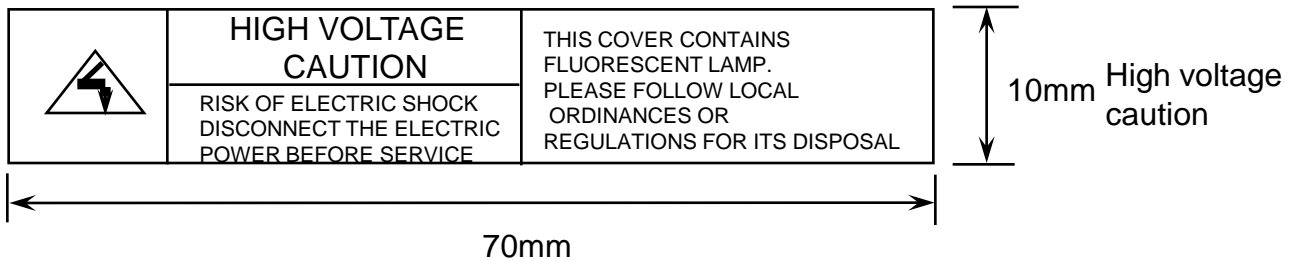


(4) Nameplate Indication



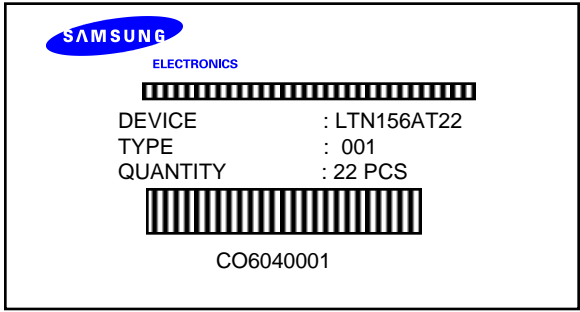
Parts name : LTN156AT22
 Lot number : XXXXXXXXXXXX
 Inspected work week : 1040 (2010 year 40th week)
 Product Revision Code : 001

High voltage caution label



Samsung Secret

(5) Packing small box attach



Samsung Secret

10. GENERAL PRECAUTIONS

Approval

1. Handling

- (a) When the module is assembled, It should be attached to the system firmly using every mounting holes. Be careful not to twist and bend the modules.
- (b) Refrain from strong mechanical shock and / or any force to the module. In addition to damage, this may cause improper operation or damage to the module and CCFT back-light.
- (c) Note that polarizers are very fragile and could be easily damaged. Do not press or scratch the surface harder than a HB pencil lead.
- (d) Wipe off water droplets or oil immediately. If you leave the droplets for a long time, Staining and discoloration may occur.
- (e) If the surface of the polarizer is dirty, clean it using some absorbent cotton or soft cloth.
- (f) The desirable cleaners are water, IPA (Isopropyl Alcohol) or Hexane. Do not use Ketone type materials(ex. Acetone), Ethyl alcohol, Toluene, Ethyl acid or Methyl chloride. It might permanent damage to the polarizer due to chemical reaction.
- (g) If the liquid crystal material leaks from the panel, it should be kept away from the eyes or mouth . In case of contact with hands, legs or clothes, it must be washed away thoroughly with soap.
- (h) Protect the module from static , it may cause damage to the C-MOS Gate Array IC.
- (i) Use fingerstalls with soft gloves in order to keep display clean during the incoming inspection and assembly process.
- (j) Do not disassemble the module.
- (k) Do not pull or fold the lamp wire.
- (l) Do not adjust the variable resistor which is located on the back side.
- (m) Protection film for polarizer on the module shall be slowly peeled off just before use so that the electrostatic charge can be minimized.
- (n) Pins of I/F connector shall not be touched directly with bare hands.

Samsung Secret

2. STORAGE

- (a) Do not leave the module in high temperature, and high humidity for a long time. It is highly recommended to store the module with temperature from 0 to 35 °C and relative humidity of less than 70%.
- (b) Do not store the TFT-LCD module in direct sunlight.
- (c) The module shall be stored in a dark place. It is prohibited to apply sunlight or fluorescent light during the store.

3. OPERATION

- (a) Do not connect, disconnect the module in the “ Power On” condition.
- (b) Power supply should always be turned on/off by following item 6.3 “ Power on/off sequence “.
- (c) Module has high frequency circuits. Sufficient suppression to the electromagnetic interference shall be done by system manufacturers. Grounding and shielding methods may be important to minimize the interference.
- (d) The cable between the back-light connector and its inverter power supply shall be a minimized length and be connected directly . The longer cable between the back-light and the inverter may cause lower luminance of lamp(CCFT) and may require higher startup voltage (Vs).
- (e) The standard limited warranty is only applicable when the module is used for general notebook applications. If used for purposes other than as specified, SEC is not to be held reliable for the defective operations. It is strongly recommended to contact SEC to find out fitness for a particular purpose.
- (f) When you connect a signal cable to LCD, remove an AC adapter by all means. In addition, to connect with keep the correct sequence, not to occur the short by left voltage.

4. OTHERS

- (a) Ultra-violet ray filter is necessary for outdoor operation.
- (b) Avoid condensation of water. It may result in improper operation or disconnection of electrode.
- (c) Do not exceed the absolute maximum rating value. (the supply voltage variation, input voltage variation, variation in part contents and environmental temperature, so on) Otherwise the module may be damaged.
- (d) If the module displays the same pattern continuously for a long period of time, it can be the situation when the image “sticks” to the screen.
- (e) This module has its circuitry PCB's on the rear side and should be handled carefully in order not to be stressed.

Samsung Secret

11. EDID

Approval

Address (HEX)	FUNCTION	Value	BIN	DEC	ASCII or Data	Notes
		HEX				
00	Header	00	00000000	0		EDID Header
01		FF	11111111	255		
02		FF	11111111	255		
03		FF	11111111	255		
04		FF	11111111	255		
05		FF	11111111	255		
06		FF	11111111	255		
07		00	00000000	0		
08	ID Manufacturer Name	4C	01001100	76	S	3 character ID
09		A3	10100011	163	E	"SEC"
0A	ID Product Code	30	00110000	48	[O]	
0B		4E	01001110	78	[N]	
0C	32-bit serial no.	00	00000000	0		
0D		00	00000000	0		
0E		00	00000000	0		
0F		00	00000000	0		
10	Week of manufacture	00	00000000	0		
11	Year of manufacture	13	00010011	19	2009	2009
12	EDID Structure Ver.	01	00000001	1	1	EDID Ver. 1.0
13	EDID revision #	03	00000011	3	3	EDID Rev. 3
14	Video input definition	80	10000000	128		
15	Max H image size	22	00100010	34	34	34 cm(approx)
16	Max V image size	13	00010011	19	19	19 cm(approx)
17	Display Gamma	78	01111000	120	2.2	Gamma 2.2
18	Feature support	0A	00001010	10		
19	Red/green low bits	8D	10001101	141		10000111
1A	Blue/white low bits	A5	10100101	165		11111110
1B	Red x/ high bits	9D	10011101	157	0.615	Red x 0.615= 10011101
1C	Red y	5B	01011011	91	0.355	Red y 0.355= 01011000
1D	Green x	55	01010101	85	0.335	Green x 0.335= 01010101
1E	Green y	9C	10011100	156	0.610	Green y 0.610= 10011100
1F	Blue x	26	00100110	38	0.150	Blue x 0.150= 00100110
20	Blue y	19	00011001	25	0.100	Blue y 0.100= 00011001
21	White x	50	01010000	80	0.313	White x 0.313= 01010000
22	White y	54	01010100	84	0.329	White y 0.329= 01010100
23	Established timing 1	00	00000000	0		
24	Established timing 2	00	00000000	0		
25	Established timing 3	00	00000000	0		
26	Standard timing #1	01	00000001	1		not used
27		01	00000001	1		
28	Standard timing #2	01	00000001	1		not used
29		01	00000001	1		
2A	Standard timing #3	01	00000001	1		not used
2B		01	00000001	1		
2C	Standard timing #4	01	00000001	1		not used
2D		01	00000001	1		
2E	Standard timing #5	01	00000001	1		not used
2F		01	00000001	1		
30	Standard timing #6	01	00000001	1		not used
31		01	00000001	1		
32	Standard timing #7	01	00000001	1		not used
33		01	00000001	1		
34	Standard timing #8	01	00000001	1		not used
35		01	00000001	1		

Samsung Secret

36	Detailed timing/monitor descriptor #1	41	01000001	65	72.33	Main clock= 72.33 MHz
37		1C	00011100	28		
38		56	01010110	86	1366	Hor active=1366 pixels
39		A0	10100000	160	160	Hor blanking=160 pixels
3A		50	01010000	80		4bit : 4bit
3B		00	00000000	0	768	Vertical active=768 lines
3C		16	00010110	22	22	Vertical blanking=22 lines
3D		30	00110000	48		4bit : 4bit
3E		30	00110000	48	48	
3F		20	00100000	32	32	H sync. Width=32 pixels
40		25	00100101	37	2 5	V sync. Offset=2 lines V sync. Width=5 lines
41		00	00000000	0		2bit : 2bit :2bit :2bit
42		58	01011000	88	344	H image size= 344 mm(approx)
43		C1	11000001	193	193	V image size = 193 mm(approx)
44		10	00010000	16		
45		00	00000000	0		No Horizontal Border
46		00	00000000	0		No Vertical Border
47	19	00011001	25			
48	Detailed timing/monitor descriptor #2	00	00000000	0		Manufacturer Specified (Timing)
49		00	00000000	0		
4A		00	00000000	0		
4B		0F	00001111	15		
4C		00	00000000	0		Value=HSPWmin / 2
4D		00	00000000	0		Value=HSPWmax / 2
4E		00	00000000	0		Value=Thbpmmin / 2
4F		00	00000000	0		Value=Thbpmmax / 2
50		00	00000000	0		Value=VSPWmin / 2
51		00	00000000	0		Value=VSPWmax / 2
52		00	00000000	0		Value=TVbpmmin / 2
53		00	00000000	0		Value=TVbpmmax / 2
54		00	00000000	0		Thpmin=value*2 + HA pixelclks
55		1E	00011110	30		Thpmax=value*2 + HA pixelclks
56		B4	10110100	180		Tvpmin=value*2 + VA lines
57		02	00000010	2		Tvpmax=value*2 + VA lines
58		74	01110100	116		Module revision
59	00	00000000	0			
5A	Detailed timing/monitor descriptor #3	00	00000000	0		ASCII Data String Tag
5B		00	00000000	0		
5C		00	00000000	0		
5D		FE	11111110	254		
5E		00	00000000	0		
5F		53	01010011	83	[S]	
60		41	01000001	65	[A]	
61		4D	01001101	77	[M]	
62		53	01010011	83	[S]	
63		55	01010101	85	[U]	
64		4E	01001110	78	[N]	
65		47	01000111	71	[G]	
66		0A	00001010	10	[^]	
67		20	00100000	32	[]	
68		20	00100000	32	[]	
69		20	00100000	32	[]	
6A		20	00100000	32	[]	
6B	20	00100000	32	[]		

Samsung Secret

6C		00	00000000	0		Monitor Name Tag (ASCII)
6D		00	00000000	0		
6E		00	00000000	0		
6F		FE	11111110	254		
70		00	00000000	0		
71	Detailed timing/monitor descriptor #4	31	00110001	49	[1]	
72		35	00110101	53	[5]	
73		36	00110110	54	[6]	
74		41	01000001	65	[A]	
75		54	01010100	84	[T]	
76		32	00110010	50	[2]	
77		32	00110010	50	[2]	
78		2D	00101101	45	[-]	
79		30	00110000	48	[0]	
7A		30	00110000	48	[0]	
7B	31	00110001	49	[1]		
7C	0A	00001010	10	[^]		
7D	20	00100000	32	[]		
7E	Extension Flag	00	00000000	0		
7F	Checksum	05	00000101	5		

Samsung Secret