製 品 標 準

(LTF460HE02-A01)

LCD 總括
HD LCD 事業部
開發 2 Group

항번	개정전(From)	개정후(To)
1	All 최초 제정	
REV01	7page ACC 관리 기준 미기재	관리 기준 기재

1. 목적

제품 정보를 정의하고 개발제품 Target을 설정하며, 이를 부서간에 공유하기 위함.

2. 적용범위

TFT LCD LTF460HE02-A01

3. 일반개요

3.1 개요

LTF460HE02-A01는 비정질 실리콘(Amorphous Silicon) 박막 트랜지스터(TFT; Thin Film Transistor)를 스위칭 소자로 사용한 컬러 능동 행렬(Color active matrix) 방식의 TFT 액정 표시소자(LCD;Liquid Crystal Display) Module이다. Module은 Panel, 구동 회로부와 Backlight부로 구성되며, Interface 방법은 Digital 영상정보를 직렬로 고속 전송하는 방식의 일종인 LVDS방식을 채용하였다. 본 제품은 1,920 * 1,080(16:9) 화소를 포함하고, 1.07 Billion의 색상을 지원한다. 그리고 독자 기술인 PVA Mode 기술을 적용하여 시야각은 상하좌우 89° 이상을 제공하는 광시야각 제품이며, 고속 응답 속도를 지원하는 120Hz 지원 제품이다.

3.2 특징

① High Contrast Ratio & High Color Saturation
② 고속 응답 특성(120Hz 지원)
③ Wide UXGA (1,920 x 1,080 화소)급 Full HD 지원 (16:9)
④ S-PVA(Super Patterned Vertical Align) Mode 광시야각(±178°)
⑤ 22 CCFL B/L Unit 설계 적용
⑥ Sync Format : DE(Data Enable) Only Mode 지원, H/V-sync Mode 지원 불가
⑦ LVDS 인터페이스 (2pixel/clock)

3.3 응용분야

① Public Display
② Home-alone Multimedia TFT-LCD TV
③ High Definition TV Ready (HD TV Ready)
④ AV 제품의 화상 표시 단말기

3.4 일반사양

항 목	사 양	단 위	비 고
유효표시면적	1018.08(H) x 572.67(V)	mm	
구동소자	a-Si TFT Active matrix		
표현가능색 수	1.07 Billion (10bit True)	color	
화소수	1,920 × 1,080	pixel	16 : 9
화소배열	RGB Vertical Stripe		
화소크기	0.17675(H) × 0.53025(W)	mm	
표시모드	Normally Black		
표면처리	Haze 14% , AG(3H)		Anti_Glare

4. 기구사양

Item		Min.	Typ.	Max.	Note
Module size	Horizontal(H)	1082	1083	1084	mm
	Vertical(V)	626	627	628	mm
	Depth(D)	50.6	51.6	52.6	mm
Weight			**15.0**	**15.5**	**Kg**

5. 절대 최대 정격

5.1 환경 사양 절대 정격

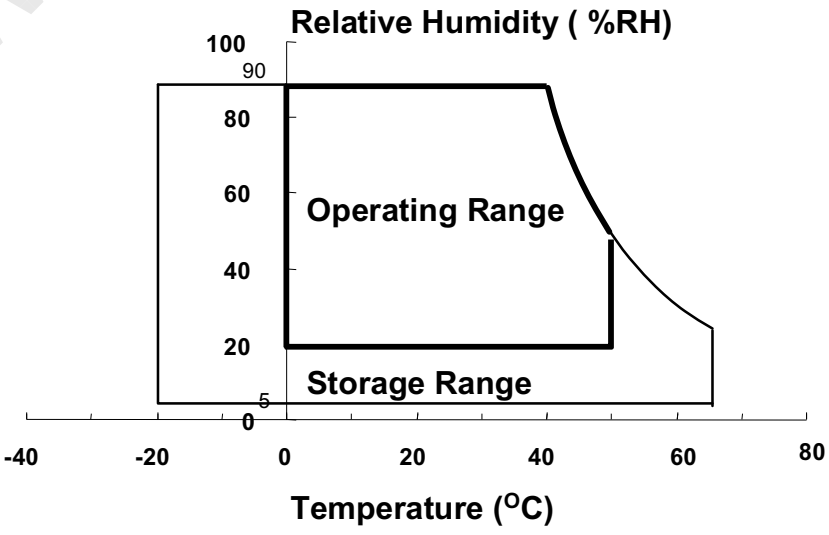
Item	Symbol		Min.	Max.	Unit	Note
Storage temperature	T_{STG}		-20	65	℃	(1)
Operating temperature (Ambient temperature)	T_{OPR}		0	50	℃	(1)
Shock (non - operating)	Snop	x, y 축	-	40	G	(2),(4)
		z 축	-	30		
Vibration (Non - operating)	Vnop		-	1.5	G	(3),(4)

NOTE (1) 온도와 상대습도 관계는 아래 그림에 따른다.
(최대습구 온도는 39℃임 <40℃에서 93.8%RH에 해당>)

NOTE (2) 11ms, sine wave, 1 time for ±X, ±Y, ±Z axis

NOTE (3) 10-300 Hz, Sweep rate 10min, 30min for X,Y,Z axis

NOTE (4) 진동 및 충격 Test시 모듈을 고정하는 치구는 모듈이 치구에 의해 트위스트 되거나 Bent되지 않도록 충분히 견고해야 한다.



5.2 전기적 사양 절대 정격

5.2.1 TFT LCD MODULE 절대 정격

(V_{SS} = 0 V)

ITEM	SYMBOL	MIN.	MAX.	UNIT	NOTE
Power Supply Voltage/ Display	V_{DD}	V_{SS}-0.5	V_{DD}+10%	V	(1)

NOTE(1) Within Ta (25± 2 ° C) .

5.2.2 BACK-LIGHT UNIT 절대정격

(Ta:25±2℃)

Item	Symbol	Min.	Max.	Unit.	Note
Lamp Current	I_L	4.0	8.0	mArms	(1),(2),(3)
Lamp Frequency	F_L	40	60	kHz	(1)

NOTE(1) Max 값 이상으로 인가 될 경우 제품이 영구손상을 입을 수 있음.
기능 동작은 Normal Operating Condition에 기술된 조건내에 한정되어야 함.
NOTE(2) Single Lamp 기준
NOTE(3) Lamp Current 값은 Cold 전극부에서 전류계로 측정된 값임.

6. 광학 특성

6.1 측정 환경

-. 환경 조건

온도 : 25℃±2℃ / 습도 : 25%~85% RH / 압력 : 86kPa~106kPa / 암실 : 1Lux이하 / 무풍(직접적인 바람 제거) / 무진동

-. Warm-Up Time : ① 최소 30분 이상

② 주기적(약 15초 간격)으로 center 휘도를 측정하여 10분전 휘도와 현재 휘도 차이의 비가 0.5%이하가 되는 최초 시점

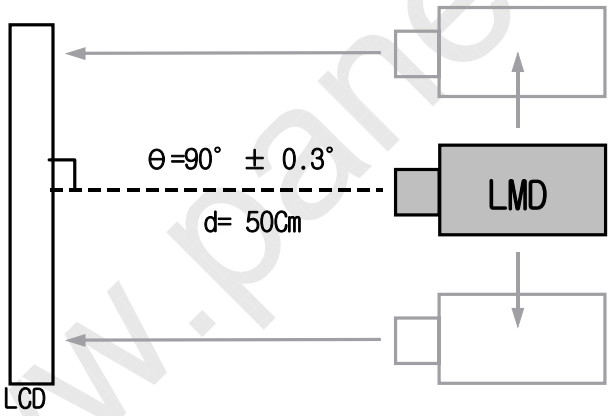
$$T_{warm\text{-}up} = (|\ Lum_{t\text{-}10} - Lum_{now}\ |\ /\ Lum_{now}\ ) \times 100 < 0.5 \text{ 가 되는 시간}$$

where , $Lum_{t\text{-}10}$는 10분전 휘도 , Lum_{now}는 현재 휘도

6.2 측정 장비(LMD : Light Measurement Device)

-. 종류 : BM-5A(TOPCON社), BM-7(TOPCON社), SR-3(TOPCON社), RD-80S(TOPCON社), PR-650(Photo Reserch社), EZ-Contrast(Eldim社)

-. 측정 거리 및 방향 :



LMD	Field
BM-5A / SR-3	2°
BM-7 / RD-80S	2°/ 1°
PR-650	1°

6.3 구동 조건

-. TFT LCD Module:V_{DD} = 12.0 V, f_V=60㎐, fDCLK = 148.5㎒, I_L = **6.0mA(rms)** , Column반전 구동

6.4 광학 특성

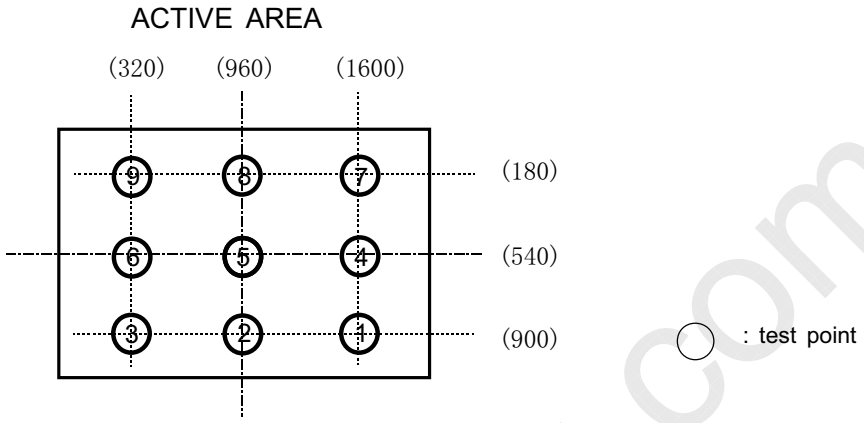
Item		Symbol	Condition	Min.	Typ.	Max.	Unit	Note
Contrast Ratio (Center of screen)		C/R	Normal f = 0 q = 0 Viewing Angle	2,000	3,000	-		(2) SR-3
Response Time	Rising	Tr		-	10	13	msec	(5) BM-7 RD-80S
	Falling	Tf		-	6	10		
	GtoG (Avg)			-	6	9		
Luminance of White (Center of screen)		YL		400	520	-	cd/m^2	(3) SR-3
Color Chromaticity (CIE 1931)	Red	Rx		TYP. -0.03	0.640	TYP. +0.03		(4) PR650, SR-3 Center Point
		Ry			0.335			
	Green	Gx			0.283			
		Gy			0.605			
	Blue	Bx			0.145			
		By			0.059			
	White	Wx			0.280			
		Wy			0.290			
Color Reproducibility				70	72		%	SR-3
Color Temperature		CCT		8,000	10,000		K	SR-3
Viewing Angle	Hor.	q L	C/R > 10 :1	75	89	-	Degrees	(6) EZ-Contrast
		q R		75	89	-		
	Ver.	f H		75	89	-		
		f L		75	89	-		
Brightness Uniformity (9 points)		Buni		-	-	25	%	(4) SR-3
Flicker				-	-	20		(8) BM-7 RD-80S
Crosstalk			13Gray 이하 (64G 기준)	-	-	10	%	(7) BM-5A
			14Gray 이상 (64G기준)	-	-	5	%	
Gamma Value				1.9	2.2	2.5		
MPRT		MPRT	-	8	11	ms	VG- 848	당사 MPRT 측정 방법 기준

※ White 25Gray (256Gray 기준) Wx, Wy 색좌표 관리 기준 (계측기 Minolta CA-210, 모듈 1Hr Aging 기준)

1. White 25Gray Pattern 기준 Wy 색좌표 0.305 이하로 관리
2. Wy 색좌표가 Wx 색좌표보다 높을 것

NOTE (1)

측정위치 : 판넬상 측정위치는 9개 점으로 한다.



NOTE (2) 대비비(C/R : Contrast ratio)

: 측정위치 중앙(Point ⑤)에서 White 상태(G_{MAX})와 Black 상태(G_{MIN})의 비로 정의.

$$C/R = \frac{\text{판넬상에서 WHITE 상태 휘도}}{\text{판넬상에서 BLACK 상태 휘도}}$$

NOTE (3) White 휘도의 정의 (Y_L) :

측정위치 중앙(Point ⑤)의 white 휘도(Y_L) 를 측정한 값.

NOTE (4) Brightness Uniformity(Buni) :

측정 화면 : Fully White

측정화면상의 9개의 휘도를 측정, 아래와 같이 정의한다.

$$\frac{B_{max} - B_{min}}{B_{max}} \times 100$$

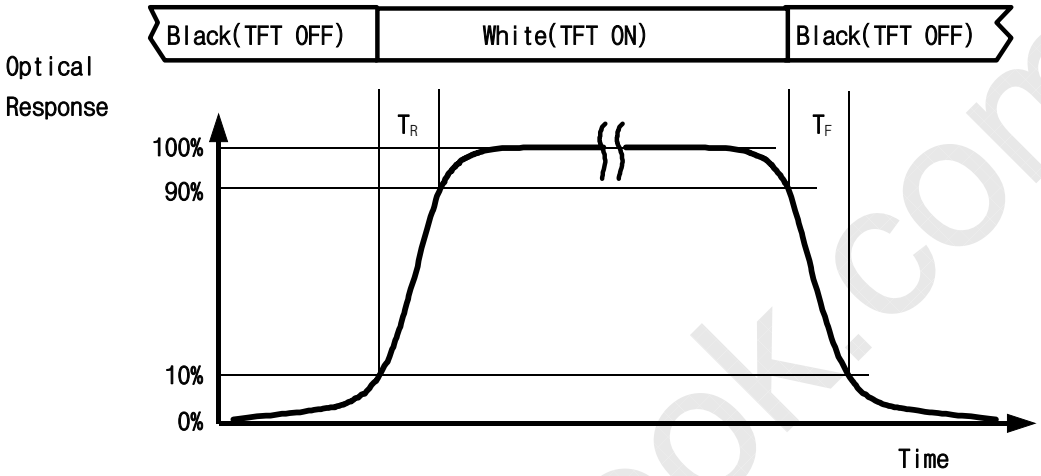
where, Bmax = Maximum brightness

Bmin = Minimum brightness

NOTE (5)

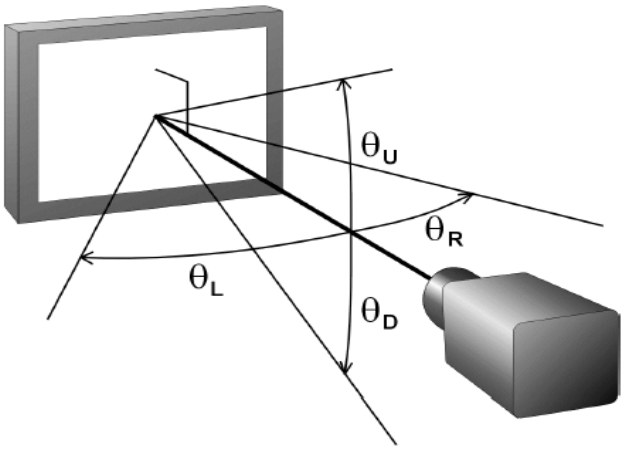
응답시간(Response time)의 정의

: 화면이 어두어 질 때와 밝아질 때에 투과율이 10%와 90%사이로 변화하는 시간의 합.



NOTE (6)

시야각(Viewing angle)의 정의 : C/R이 10이상되는 시각의 범위



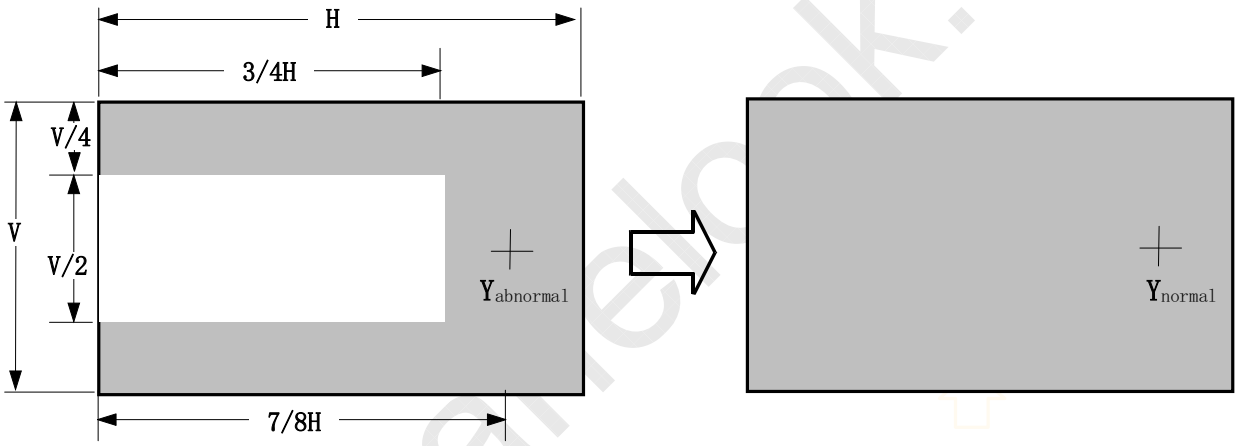
NOTE (7) 상호 혼선(Crosstalk;Cross modulation)의 정의(D_{SHA}): 화소간의 신호간섭에 의하여 대비비가 저하되는 현상.

$$Crosstalk\ \ Modulation\ \ Ratio(D_{SHA}) = \frac{|Y_{normal} - Y_{abnormal}|}{Y_{normal}} \times 100(\%)$$

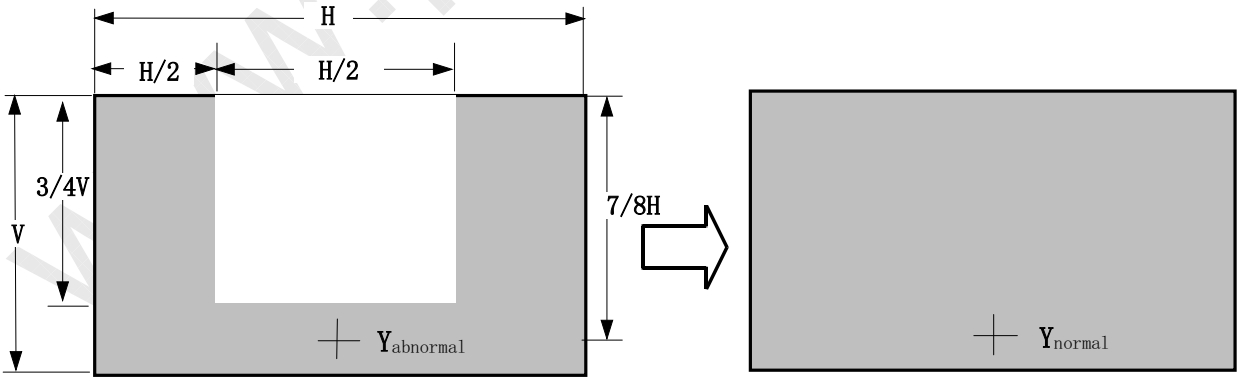
* White Box 이외의 back ground pattern은 Gray1~ Gray64 까지 4Gray 간격으로 측정
* Horizontal Crosstalk 과 Vertical Crosstalk을 모두 측정
* 측정 결과중 가장 큰값을 Crosstalk라고 정의

참고 : Normally White mode시 Box는 Black(Gmin) /Normally Black mode시 Box는 white(Gmax)

* Crosstalk 측정 Pattern 및 Point



Horizontal Crosstalk



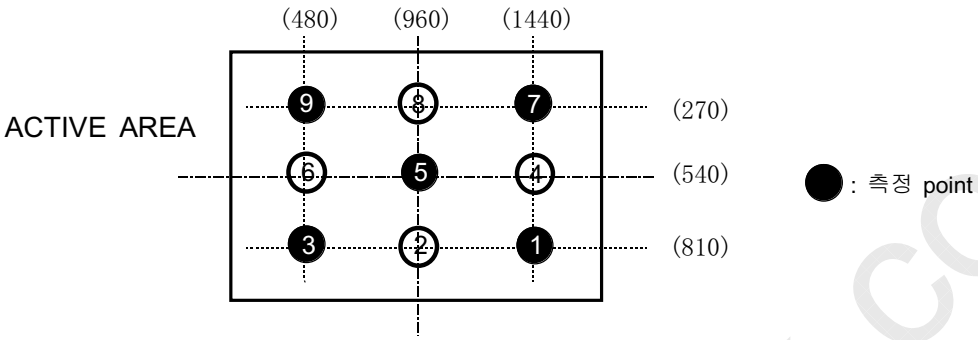
Vertical Crosstalk

Note (8) (측정장비=BM-7, 측정거리=50cm)

화면의 번쩍 거림(Flicker)의 정의 : LCD Panel의 화면이 깜박거리는 현상.

ⓐ 계산식은 Flicker 측정표준에 준함.

ⓑ 측정위치



ⓒ 플리커 측정 패턴 (구동 방식은 1 by 1 Dot 반전구동임)

1 by 1 DOT 반전 Pattern (Total Gray 64 중 Gray #22 , #32 , #45)

7. 전기적 특성

7.1 TFT LCD 모듈

Item		Symbol	Min.	Typ.	Max.	Unit	Note
Voltage of Power Supply		Module V_{DD}	10.8	12.0	13.2	V	(1)
Current of Power Supply	(a) Black	I_{DD}	-	1500	1650	mA	(2),(3) (Without Inverter) Column Driving
	(b) White		-	1750	1900	mA	
	(c) Checker			2560	2800	mA	
	(d) H_Stripe		-	2700	3000	mA	
Vsync Frequency		f_V	-	59.94	-	Hz	
Hsync Frequency		f_H	-	67.5	-	kHz	
Main Frequency		f_{DCLK}	-	148.352	-	MHz	
Rush Current		I_{RUSH}	-	5	6	A	(4)

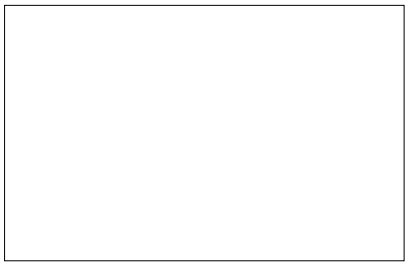
NOTE (1) 디스프레이 데이터 및 타이밍 신호용 콘넥터는 연결되어 있을 것(V_{SS} = 0V)
전압치는 입력 Connector에서의 측정치임.

(2) f_V = 59.94Hz, f_{DCLK} = 148.352MHz, V_{DD} = 12V, DC current

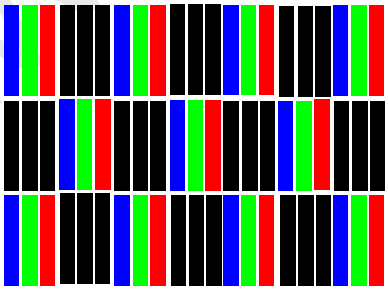
(3) 소비전력 체크 패턴

(a) Black 패턴

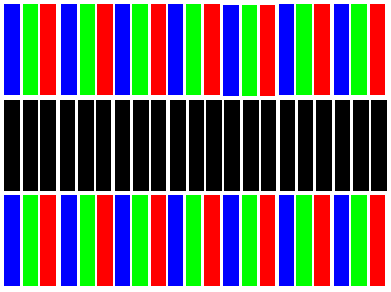
(b) White 패턴



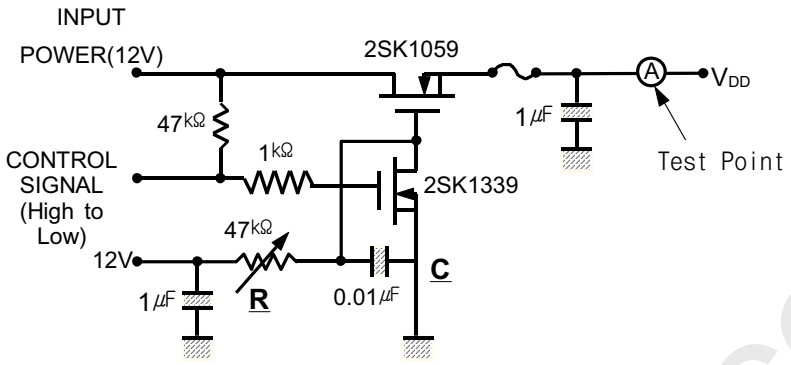
(c) Checker 패턴



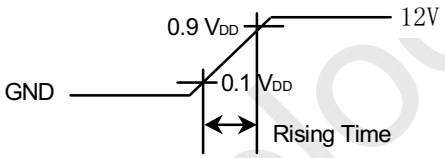
(d) H-Stripe 패턴



(4) 측정조건 (12V구동, rising time =470㎲)



Note : Control Signal : High(+12V) >Low(Ground)
All Signal lines to panel except for power 5V : Ground
The rising time of supplied voltage is controlled to 470us by R and C value.



7.1.2 Operation temperature range at specific component

Part	Spec	Ambient Operating Temperature	Junction Operating Temperature
Timing Controller	K120FM*1	0℃ ~ 70℃	-20℃ ~ 125℃
FRC	FRC 9wxyM	0℃ ~ 70℃	Max 125℃

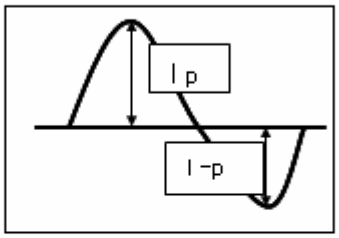
7.2 BALANCE BOARD

7.2.1 Recommended Input Electrical characteristic

ITEM	SYMBOL	MIN	TYP	MAX	Note	UNIT	Remark
Total input current	IT	263	(270)	297	(1)	mArms	At Dimming 100% 약 6.0mA @ 1 lamp당 IT = IHV1 + IHV2 | IHV1 | = | IHV2 |
Operating voltage	HV1, HV2	660	(730)	800		Vrms	
Inverter Frequency	fop	46	48	50		kHz	Switching Frequency
Dimming Frequency	fpwm	140	150	160		Hz	-
Dim duty ratio	Dpwm	20	-	100	(2)	%	Normal Bright Control Range ※ Refer to Note(2) for Striking Mode Operation
Striking voltage	HVstrike	2240	-	(3000)	(2) (3)	Vrms	Max Value: 발란스 보드의 Corona 방전 개시 전압 Min Value: Based on Lamp SPEC
Striking Time	Tstrike	1.0	-	2.0		Sec	Based on Lamp SPEC
Shutdown time	Tshutdown	1.0	1.5	2.0		Sec	-

Note (1) Asymmetric ratio must less than 10 % ($| I_p - I_{-p} | / (I_{rms} < 0.1$)

Crest factor must be from 90 % to 110 % ($0.9 < I_p$ or $I_{-p} / (I_{rms} \times \sqrt{2}) < 1.1$)



* Unbalance rate :
$| I_p - I_{-p} | / I_{rms} * 100$

* Distortion rate :
I_p (or I_{-p}) / I_{rms}

(2) Striking Voltage(HV_{STRIKE}) based on CCFL spec. at 0℃ ambient temperature.

Striking Mode Operation Requirement

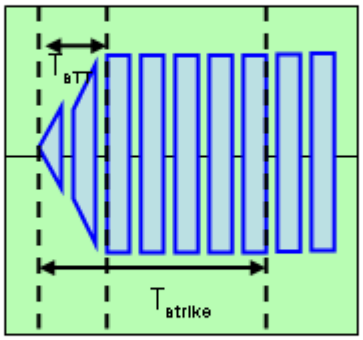
- Soft Start Time(Tsst) = 10msec ± 20%
- PWM Dimming < 90%
- No current flows in PWM Dimming Off Period

Normal PWM Dimming Operation

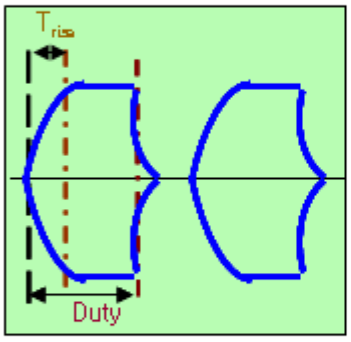
- PWM Dimming Rising/Falling Time Trise < 200usec

Trise can be tuned for minimizing Acoustic Noise Emission

IP and Balance Board should be tuned without oscillation waveform



Lamp Current (Striking Mode)]



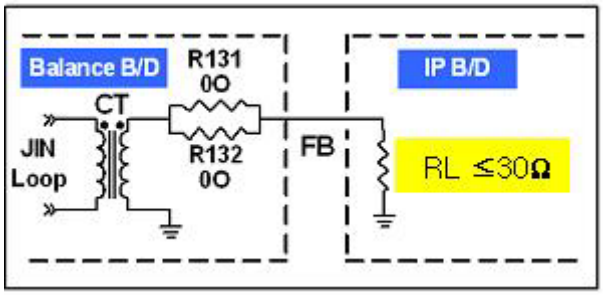
Lamp Current (PWM Dimming Mode)]

(3) Striking Mode from IP must be maintained until all of lamps turn on (within Lamp Strike Time)

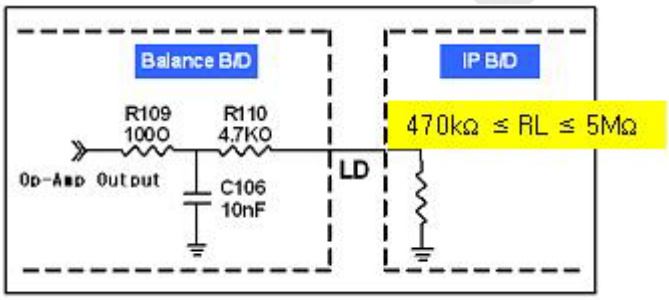
6.4.3 Feedback I/O specification

ITEM		SYMBOL	MIN	TYP	MAX	UNIT	Note	Remark
Supply Voltage		Vcc	10.8	12	13.2	Vdc		
Input Current		Ic	(20)	-	(100)	mA		
Protect	High Voltage	VLD	Vcc-0.5		Vcc	V	(2)	Normal : High Abnormal : Low
	Low Voltage		-	-	1			

Note(1) Balance Board Feedback output stage



Note(2) Balance Board LD output stage



7.2.3 입/출력 pin 사양

INTERFACE

1 CN103 CONNECTOR : KN30-7P-1.25H (Hirose)

Pin NO	SYMBOL	REMARK
1	VCC(+12V)	Power Supply for Protection Circuit
2,3	FB	Lamp Current Detected Voltage
4.5	GND	Signal Ground
6,7	LD	CCFL Connector Open & Non-lighting signal

2 CN102(left),CN101(right) CONNECTOR: SM02-BADAS-3-TB(JST)

PIN NO.	SYMBOL	REMARK
1	HV1	High Voltage Input A
2	HV1	

3 CN101(left),CN102(right) CONNECTOR : 130001WR-02E(YENHO)

PIN NO.	SYMBOL	REMARK
1	HV2	High Voltage Input B
2	HV2	

7.3 Back-Light Unit

Back Light는 직하형으로 22개의 CCFL이 포함되어 있으며 Lamp의 특성은 다음과 같다.

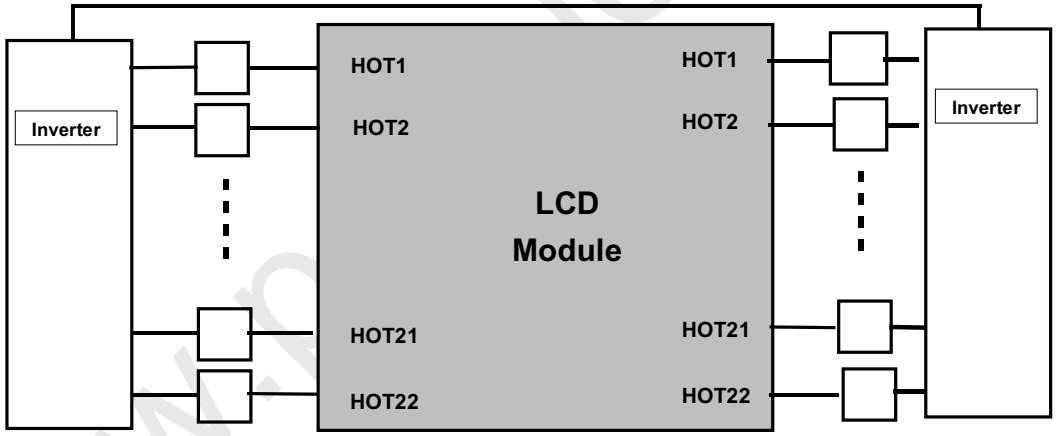
Ta=25 ± 2° C

Item	Symbol	Min.	Typ.	Max.	Unit	Note
Lamp Current	I_L	4.0	6.0	8.0	mArms	(1)
Lamp Voltage	V_L	1560	1500	1430	Vrms	(1)
Lamp Frequency	f_L	40	-	60	kHz	
Operating Life Time	Hr	50000		-	Hour	(2)
Start up Voltage	Vs	-	-	0℃, (2350) 25℃,(1950)	Vrms	(3)

NOTE(1) Lamp의 동작 보증 범위로 램프 전류는 고주파수용 전류계로 아래 그림처럼 측정함.

Lamp Voltage Min: Lamp Current --- mArms 기준.

Lamp Voltage Max: Lamp Current --- mArms 기준.



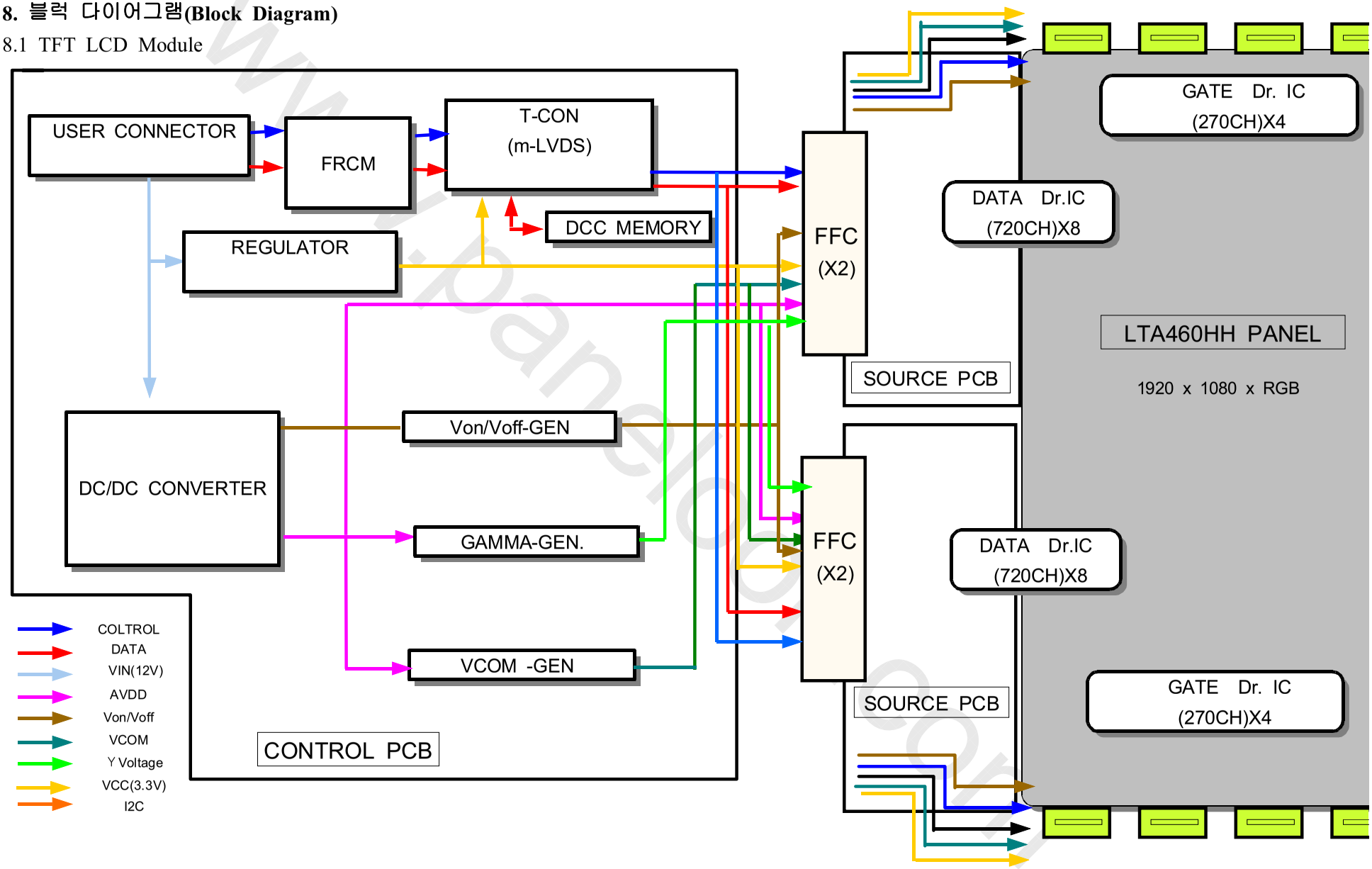
(2) 램프수명은 램프 전류 보증범위에서 연속 구동시 표준상태에서 휘도가 원래 밝기의 50%이하 밝기로 될때까지의 시간으로 정의함.(Ta=25℃)

- 상기 수명은 Lamp 단품 수명임

(3) 명기된 값 이상의 전압이 Lamp를 start시키기 위하여 Lamp에 1초 이상 인가되어야 함. 그렇지 않을 경우 Lamp가 점등되지 않을 수 있음.

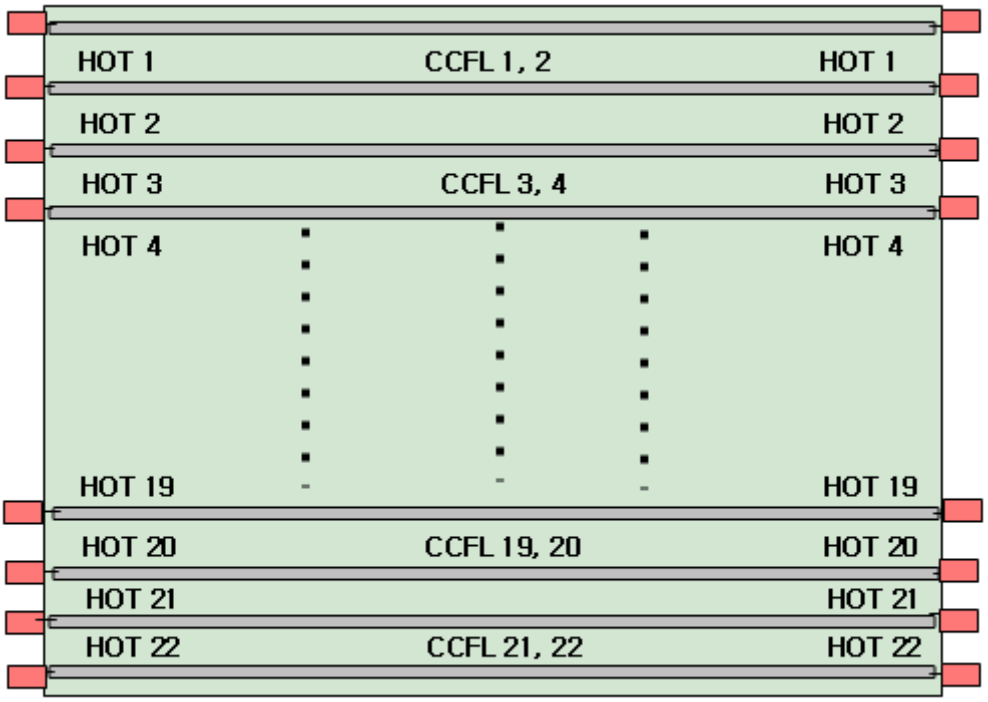
8. 블럭 다이어그램(Block Diagram)

8.1 TFT LCD Module



8.2 Back Light Unit

HOT 사양 : HIGH VOLTAGE



9. 입력단 신호 순서(Input Terminal Pin Assignment)

9.1 TFT LCD 모듈(Interface signal & power) connector : FI-RE51S-HF (JAE)

Pin	Description		Pin	Description	
1	Vdd (12V)		26	Even LVDS Signal	RE[0]P
2	Vdd (12V)		27		RE[1]N
3	Vdd (12V)		28		RE[1]P
4	Vdd (12V)		29		RE[2]N
5	Vdd (12V)		30		RE[2]P
6	GND		31		GND
7	GND		32		RECLK-
8	GND		33		RECLK+
9	GND		34		GND
10	Odd LVDS Signal	RO[0]N	35		RE[3]N
11		RO[0]P	36		RE[3]P
12		RO[1]N	37		RE[4]N
13		RO[1]P	38		RE[4]P
14		RO[2]N	39	GND	
15		RO[2]P	40	No connection	NOTE1
16		GND	41	No connection	
17		ROCLK-	42	No connection	
18		ROCLK+	43	No connection	
19		GND	44	No connection	
20		RO[3]N	45	LVDS_SEL	NOTE2
21		RO[3]P	46	No connection	NOTE1
22		RO[4]N	47	No connection	
23		RO[4]P	48	No connection	
24	GND		49	No connection	
25	Even LVDS	RE[0]N	50	No connection	
			51	No connection	

(NOTE1) NOT CONNECTED : THIS PINS ARE ONLY USED FOR SEC INTERNAL OPERATIONS.
(NOTE2) LVDS SELECTION OPTION : HIGH(3.3V) → Normal , LOW(GND) & Default → Jeida

9.2 Inverter Input

■ PIN ASSIGNMENT

1. CN128, CN228 CONNECTOR : SM02-BDAE-10 (JST)

PIN NO.	SYMBOL	REMARK
1	HOT	+ High Voltage
2	HOT	- High Voltage

2. CN125 CONNECTOR :KN30-07P-1.25H(001)(Hirose)

PIN NO.	SYMBOL	REMARK
1	VCC	VCC
2	F/B	Feedback
3	GND	GND
4,5,6,7	LD_IP	Lamp detection

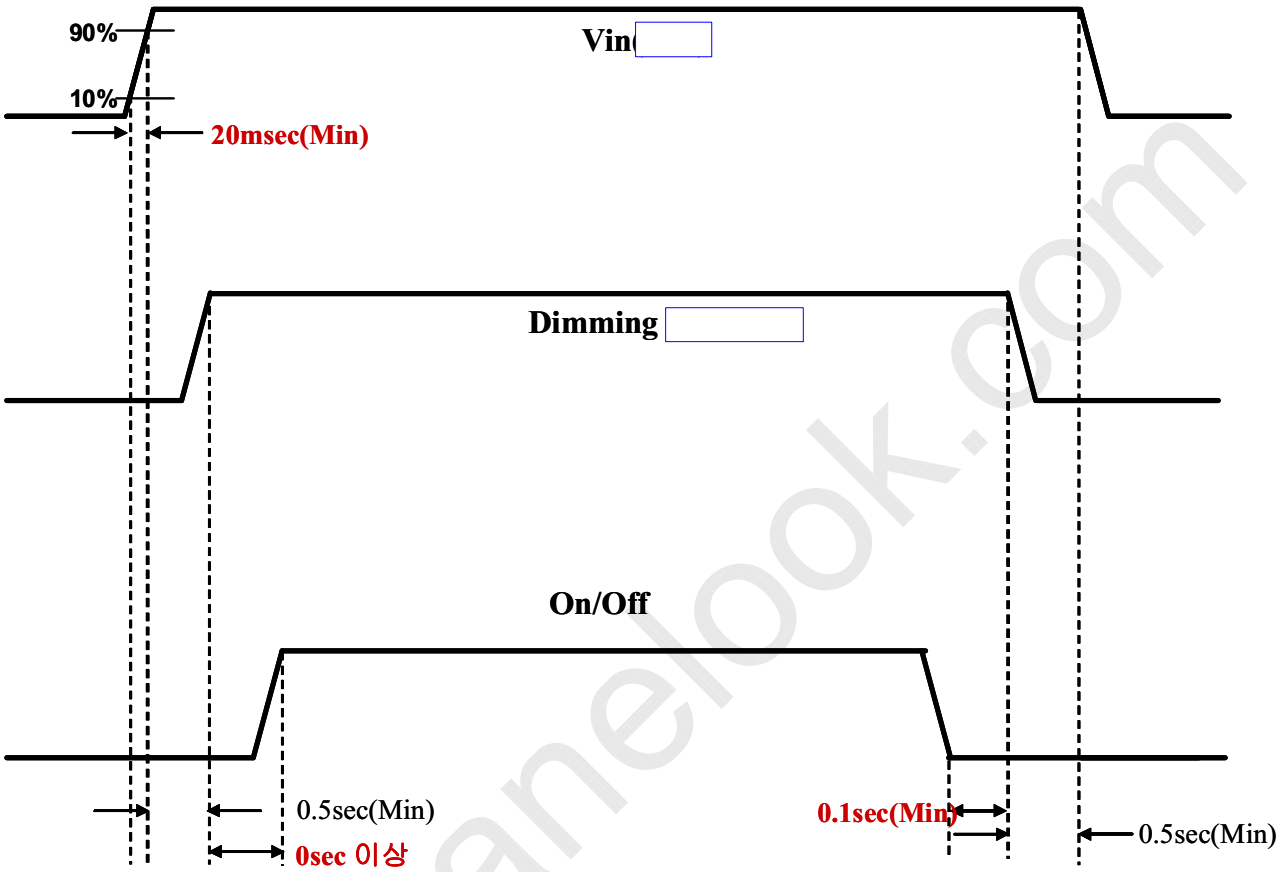
3. CN126 CONNECTOR : KN30-10P-1.25H (Hirose)

PIN NO.	SYMBOL	REMARK
1, 2	LOOP2	Current loop for balance
3, 4	LOOP1	Current loop for balance
5	PROT	Open Protection
6	PROT1	Short Protection
7	VCC	VCC
8	N.C	N.C
9, 10	GND	GND

4. CN225 CONNECTOR : KN30-10P-1.25H (Hirose)

PIN NO.	SYMBOL	REMARK
1, 2	GND	GND
3	N.C	N.C
4	VCC	VCC
5	PROT1	Short Protection
6	PROT	Open Protection
7, 8	LOOP1	Current loop for balance
9, 10	LOOP2	Current loop for balance

9.2.2 Inverter Board input Power Sequence



9.3 입력신호와 표시색상과의 관계

COLOR	DISPLAY	DATA SIGNAL																														GRAY SCALE LEVEL
		RED										GREEN										BLUE										
		R0	R1	R2	R3	R4	R5	R6	R7	R8	R9	G0	G1	G2	G3	G4	G5	G6	G7	G8	G9	B0	B1	B2	B3	B4	B5	B6	B7	B8	B9	
BASIC COLOR	BLACK	0	0	0	0	0	0	0	0	0	0	0	0	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	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	-
	GREEN	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	-
	CYAN	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	-
	RED	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-
	MAGENTA	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	-
	YELLOW	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0	0	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	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	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	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	0	0	0	0	0	0	0	0	0	0	0	0	0	R2
		:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	R3~
		:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	R1020
	↓ LIGHT	1	0	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	R1021
		0	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	R1022
	RED	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	R1023
GRAY SCALE OF GREEN	BLACK	0	0	0	0	0	0	0	0	0	0	0	0	0	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	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	G1
		0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	G2
		:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	G3~
		:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	G1020
	↓ LIGHT	0	0	0	0	0	0	0	0	0	0	1	0	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	G1021
		0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	G1022
	GREEN	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	G1023
GRAY SCALE OF BLUE	BLACK	0	0	0	0	0	0	0	0	0	0	0	0	0	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	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	B1
		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	B2
		:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	B3~
		:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	B1020
	↓ LIGHT	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	1	1	1	1	1	1	1	B1021
		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	B1022
	BLUE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	B1023

NOTE

(1) Gray 정의 :

Rn : 빨강색 Gray, Gn : 녹색 Gray, Bn : 파란색 Gray (n=Gray level)

(2) 입력신호 : 0=Low level voltage, 1=High level voltage

10. 인터페이스 타이밍

10.1 Time parameter(DE only Mode)

- FRC 통합

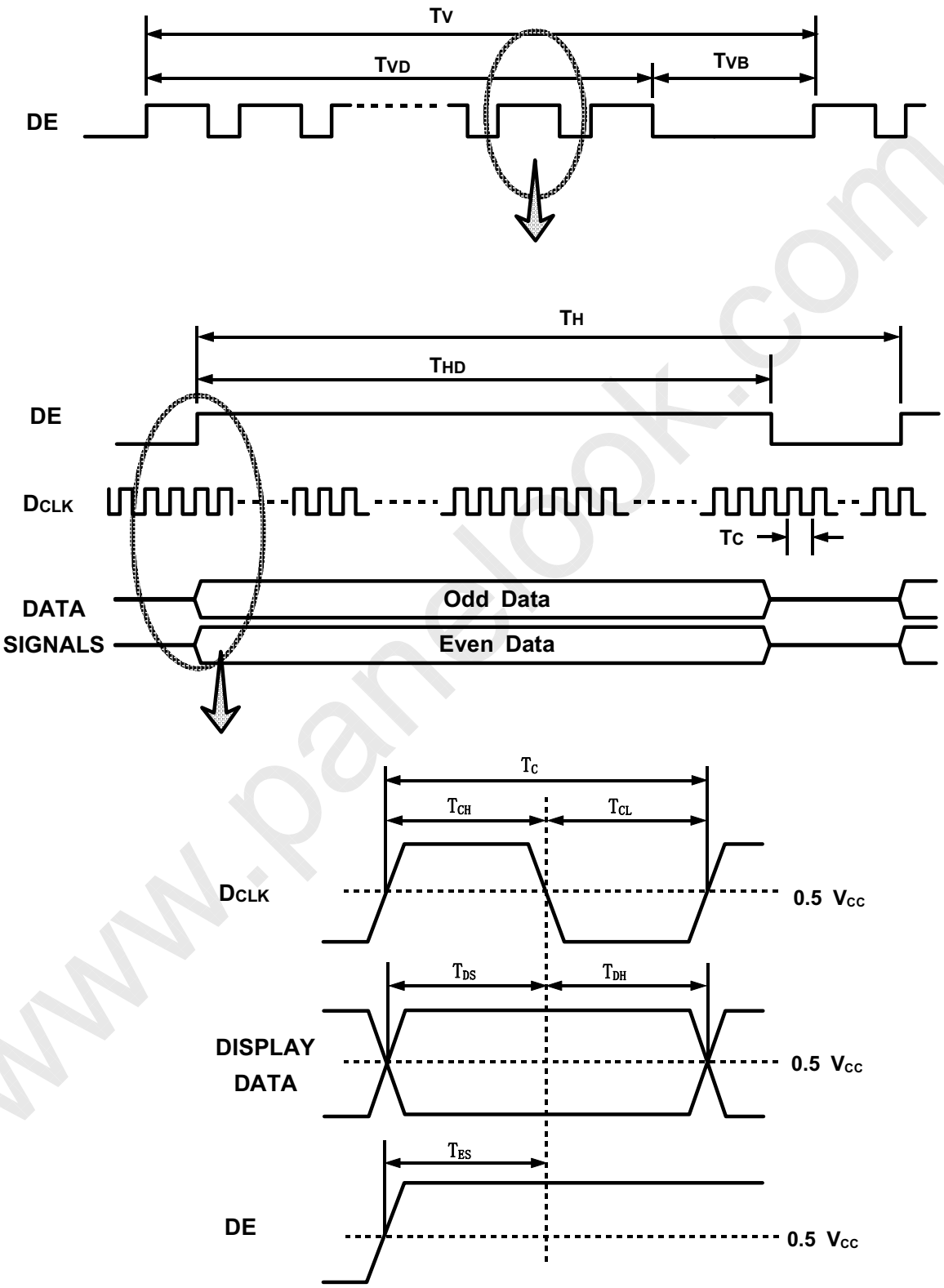
SIGNAL	ITEM	SYMBOL	MIN.	TYP.	MAX.	UNIT	NOTE
Clock	Frequency	1/Tc	-	148.352	-	MHz	2 Pixels/clk
	Hgh Time	Tch	4	-	-	nsec	
	Low Time	Tcl	4	-	-	nsec	
Data	Setup Time	Tds	4	-	-	nsec	
	Hold Time	Tdh	4	-	-	nsec	
Data Enable	Setup Time	Tes	4	-	-	nsec	
Frame Frequency	Cycle	Tv	-	16.7	-	msec	
Vertical Active Disply Term	Display Period	Tvd	-	1080	-	lines	
	Vertical Total	Tvb	-	1125	-	lines	
Horizontal Active Display Term	Display Period	Thd	-	1920	-	clocks	
	Horizontal Total	Th	-	2200	-	clocks	

→ 본 제품은 DE only mode로 동작하며, H-sync와 V-sync신호의 입력여부는 정상적인 동작에 영향을 주지 않음.

- FRC CHIP 제외한 K120FM 기준 (DE only mode)

SIGNAL	ITEM	SYMBOL	MIN.	TYP.	MAX.	UNIT	NOTE
Clock	Frequency	1/Tc	240	297	310	MHz	-
Hsync		Fh	100	135	140	KHz	-
Vsync		Fv	90	120	125	Hz	-
Vertical Active Disply Term	Display Period	Tvd	-	1080	-	lines	-
	Vertical Total	Tv	**1090**	1125	**1380**	lines	-
Horizontal Active Display Term	Display Period	Thd	-	1920	-	clocks	-
	Horizontal Total	Th	**2090**	2200	**2350**	clocks	-

10.2 인터페이스 신호의 타이밍 다이어그램(DE Only Mode)

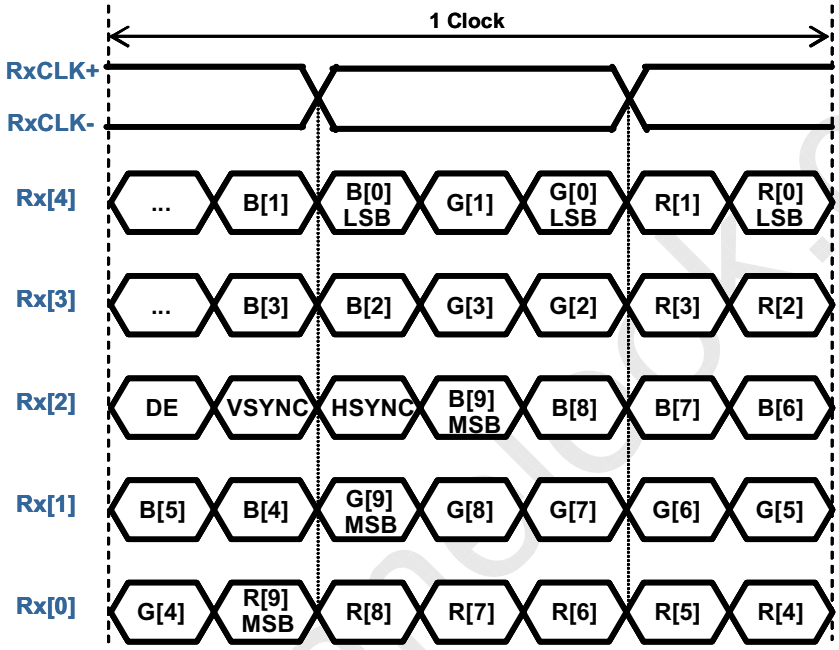


10.3 LVDS Interface

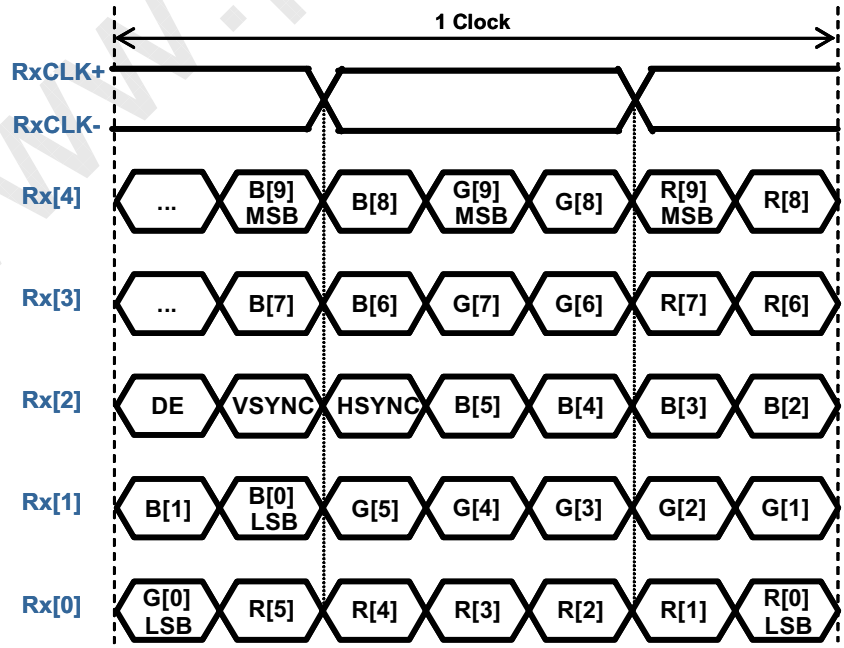
- LVDS Receiver : Tcon(merged)내장형
- JEIDA & Normal Data Format

LVDS OPTION(입력 45pin) : IF THIS PIN : HIGH (3.3 V) → NORMAL NS LVDS FORMAT OTHERWISE : OPEN or LOW (GND) → JEIDA LVDS FORMAT

JEIDA FORMAT (Each Channel)



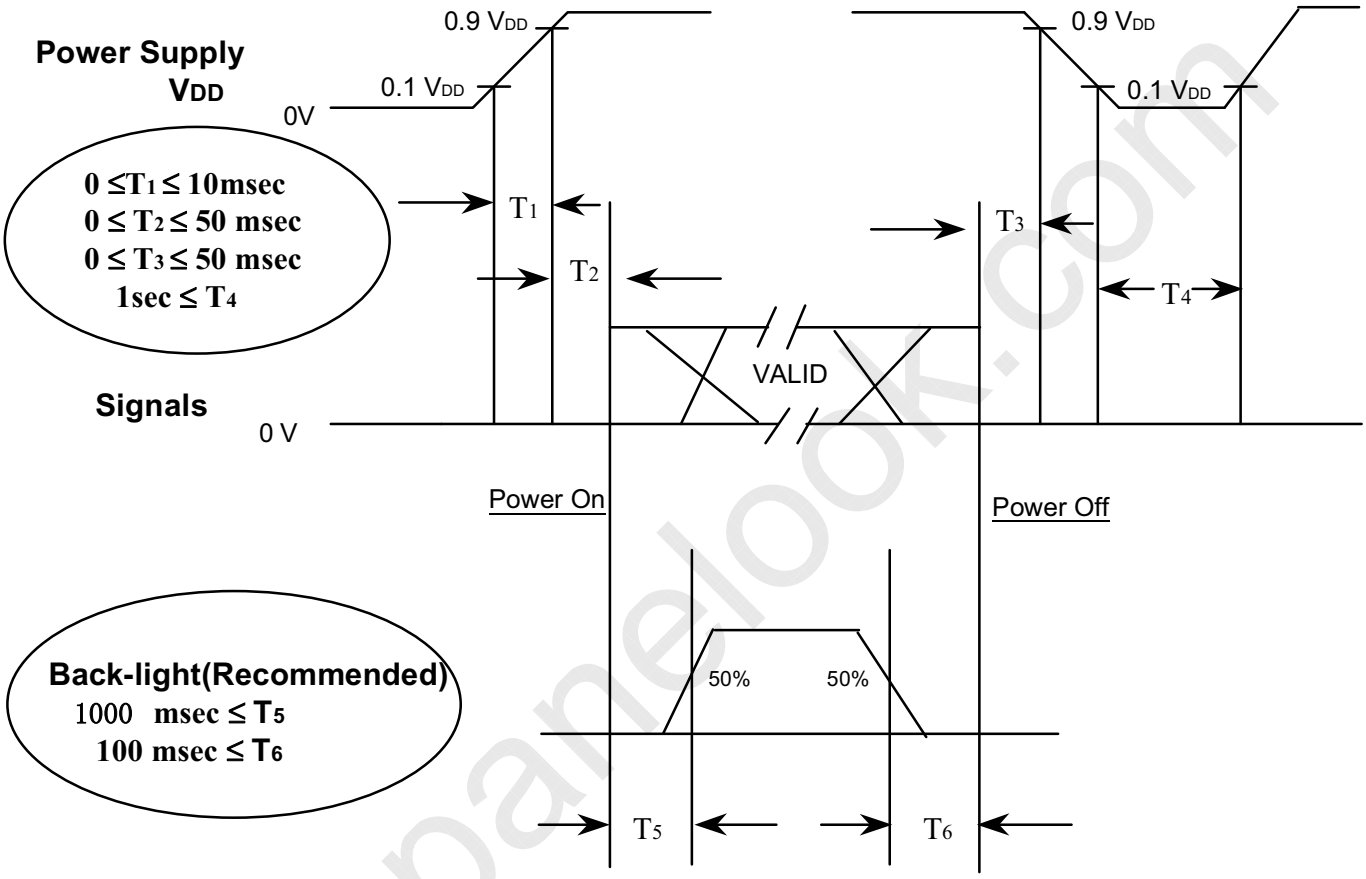
NORMAL FORMAT (Each Channel)



10.4 전원 온/오프 순서(Power ON/OFF Sequence)

10.4.1 TFT-LCD Module

: Latch-up이나 LCD 모듈의 DC operation을 막기 위해 전원 온/오프 순서는 아래와 같아야 함.



NOTE

(1) 모듈에 신호를 인가하는 외부장치의 전원은 V_{DD}와 같아야 한다.

(2) LCD 동작 범위내에서 램프의 전압을 인가 할 것. LCD가 동작되기 전에 램프를 켜거나 램프를 끄기전에 LCD를 끌 때, 화면에 NOISE가 발생할 수 있음.

(3) V_{DD}가 인가된 후 인터페이스 신호가 들어가지 않는 상태(Interface Signal High Impedence)로 장시간 두지 말 것.

(4) Power Off후 재 Power On하기 전에 제품이 완전히 방전후 측정.

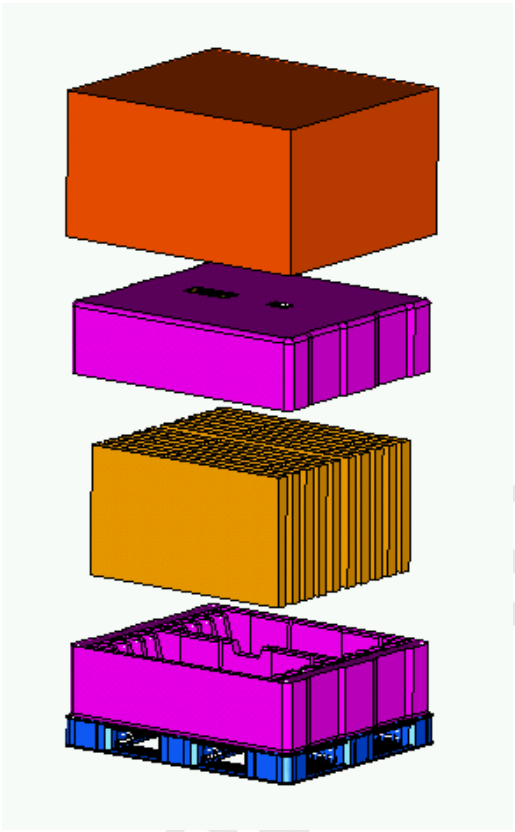
12. PACKING

12.1. CARTON(Internal Package)

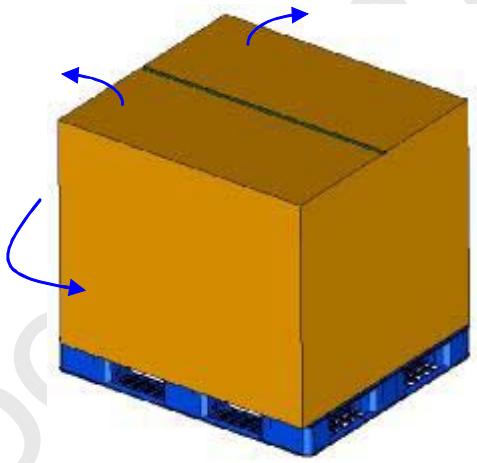
(1) Packing Form

Corrugated fiberboard box and corrugated cardboard as shock absorber

(2) Packing Method



→ Direction : be able to open it



12.2. Packing Specification

Item	Specification	Remark
LCD Packing	10ea / (Packing-Pallet Box)	1. 150 Kg / LCD (10ea) 2. 10 Kg / Cushion-pallet (2ea) 3. 8 Kg / Packing-Pallet Box (1ea) >. Cushion-pallet Material : EPS >. Packing-Pallet Box Material : DW4
Pallet	1Box / Pallet	1. Pallet weight = 8.8kg
Packing Direction	Vertical	
Total Pallet Size	H x V x height	1270mm(H) x 1150mm(V) x 844mm(height)
Total Pallet Weight	**177kg**	Pallet(8.8kg) + Module(15*10=155Kg) + Cushion(up+botton=10kg) + Pallet-BOX(8kg)

13. MARKING & OTHERS

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

(1) Parts number : LTF460HE02-A01
(2) Revision : One letter
(3) Control : One letter
(4) Lot number : 7 J 5 G 010 14 D
① ② ③ ④ ⑤ ⑥ ⑦

① 7 : Line
② J : Device
③ 5 : Year
④ G : Month
⑤ 010 : LOT NO
⑥ 14 : GLASS NO
⑦ D : CELL NO

(5) Nameplate Indication

(6) Bar code marking for Customer

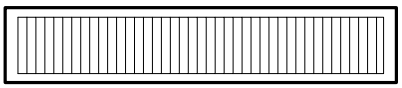
The bar code marking is attached to module backside.

1) MODEL NAME : LTF460HE02-A01
2) SAMSUNG
3) MADE IN KOREA
4) PRODUCTION NUMBER
5) USER MODEL NAME

Bar code shows a) user model name, b) production number

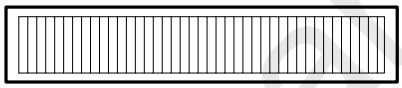
a) User model name

LTF460HE02-A01

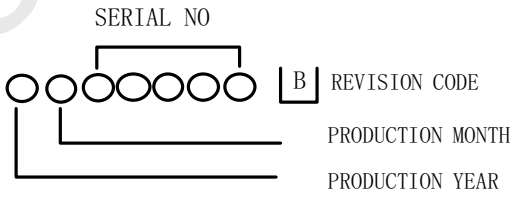


b) Production Number

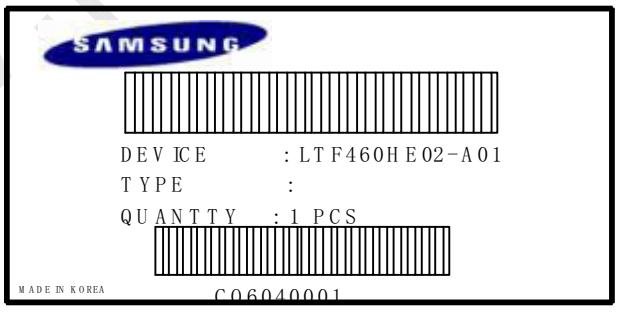
SAMSUNG
MADE IN KOREA



6430008B



(7) Packing box attach



14. General Precautions

14.1 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 CMOS Gate Array IC.

(i) Use finger-stalls 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 module.

(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.

14.2 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 35C 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.

14.3 Operation

(a) Do not connect,disconnect the module in the "Power On" condition.

(b) Power supply should always be turned on/off by the 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).

14.4 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, and 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.