Product Specification

GM 8.0” WVGA

Product code: [DJ080EA-01G]

Customer Ref.:	23498633	RFQ Ref.:	1000723099
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Approved by:		
General Motors Name: Date: Signature:		**Innolux** Name: : Jos de Bakker Date: : 2015-01-06 Signature: :

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1 REVISIONS

Number	Module	Item	Date
A		Draft Specification	JUNE 5th 2014
A1		3.1/4/8.1.3/9.3.2/11/16	Jan 6th 2015

2 FEATURES

The active matrix color TFT LCD module has an 8.0 inch diagonal active area containing 800xRGB x 480 pixels and has an 8-bits (x3) colors capability. The TFT is in aSi (Amorphous Silicon) technology. Display drivers are placed on the panel. The module further includes LED backlight and electronics and LED driver on a PCBA.

Typical Applications are automotive driver information, infotainment, navigation, and telematics systems.

The product is designed for the requirement of the green product, and the specification complies with INX's "Green Product Chemical Substance Specification Standard Hand Book".

3 REFERENCE DOCUMENTS

- GIS-398 Directed Buy Display Requirements Specification [Revision 1.2 / June 29, 2011] *
- Component Technical Specification (CTS) Directed Buy Color TFT Displays [Revision 0.6draft / June 28, 2011] *
- SPI doc. No: 20110323001AA
- Application notes:
  - INX Application Note - Mounting INX TFT Module
  - Thread forming screws - Mounting INX TFT Module
  - A brief note on thermal management for LCD module
  - ….

- Note: In the event there is a conflict between the GM document (GIS) and this INX Specification, the GM document (GIS) will take precedence, except for the below listed approved deviations, for which this INX Specification will take precedence.

3.1 Approved deviations:

Original:			Approved Deviation:
GM Spec.	Section		CMI Spec. Section: / Or CMI Deviation Commment:
CTS	2.4	→	Section 5.2 Module Drawing Section 5.3 Exploded Drawing
CTS	2.5.2	→	Section 6.1 I/O Pinning
CTS	2.8	→	Section 5.4 Main ID Label Drawing
GIS-398	-050	→	Deviatoin Comment: Some test set-ups need to be redefined to equivalent lab testing since CMI can not test on vehicle assembled level. Some tests are intended for system supplier rather than for the display supplier.
GIS-398	-070	→	Deviatoin Comment: 4.2" Size: Thickness 12 [mm] okay when excluding 'mounting features' 8.0" Size: Height 120.7 [mm] (iso 120.0 [mm]) 8.0" Size: Thickness 12 [mm] (iso 13.5 [mm]), excl. 'mounting features' 4.2" Contrast Ratio: 1:1000 MIN / 1:1800 TYP (iso 1:1100 MIN / 1:2000 TYP) 4.2" Reflectivity: SCI 5.5% / SCE 1.9% TYP (iso 7%) 8.0" Reflectivity: SCI 2.6% / SCE 0.6% TYP (iso 1%) [due to change from AGAR to AGLR]
GIS-398	-080	→	Section 11. Optical Characteristics (Luminance & Contrast)
GIS-398	-090	→	Section 11. Optical Characteristics (Dimming Ratio)
GIS-398	-100	→	"environmental temperature" is assumed to be 'panel surface' for the Display
GIS-398	-110	→	Section \11. Optical Characteristics (Response Time)
GIS-398	-130	→	Section 11. Optical Characteristics (Luminance Homogeneity)
GIS-398	-140	→	Section 15.1.15 Functional Optical check
GIS-398	-150	→	Deviatoin Comment: CR>10:1 is difficult at 45klx, due to display is transmissive, not transflective. CR depends very much on front surface reflection and brightness out of the display and viewing angle. Must be verified on the samples inside the application
GIS-398	-160	→	Section 11. Optical Characteristics (Surface Reflectance)
GIS-398	-180	→	Section 11. Optical Characteristics (Colour-point)
GIS-398	-200	→	Deviatoin Comment: CMI will use H3 "According to JIS K5600"
GIS-398	-210	→	Deviatoin Comment: "Not Applicable" as Tier1 will add the Application Protection Film
GIS-398	-230	→	Section 11. Optical Characteristics (Polariser absorbtion angle)
GIS-398	-250	→	Deviatoin Comment: From -20degC to 75degC with reduced brightness and contrast and response time according to the panel temperature (typical TFT behavior)
GIS-398	-270	→	Section 15. Quality Requirements

4 GENERAL SPECIFICATIONS

Key Parameters	Description	Unit
Display size (diagonal)	8.0	inch
Aspect ratio	15:9	-
Number of dots (H x V)	800 x RGB x 480	dot
Color arrangement	RGB Stripe	-
LCD type	Transmissive, aSi	-
Image mode	Normally Black	-
Brightness	min. 450 / typ. 650	Cd/m²
Operating Temperature	-40 to +85	°C
Functional Temperature	-40 to +90	°C
Storage Temperature	-40 to +95	°C
Electronics and interface		
Interface method	Parallel RGB (HSY+VSY + DE mode)	-
Color depth	RGB 8bits=16M	-
Mechanical dimensions		
Module outline dimension (H x V x T)	191.8 x 120.7 x 12.0 (excluding mounting features)	mm
Active area (H x V)	174.0 x 104.4	mm
Dot pitch (H x V)	0.2175 x 0.2175	mm
Subpixel pitch (H x V)	0.0725 x 0.2175	mm
Weight	370 +/- 10	g
Basic display features		
Surface treatment	AG380LR	-
Visibility with polarized sunglasses	Visible	-
Power consumption(typ.)	5.5	W

4.1 Basic features

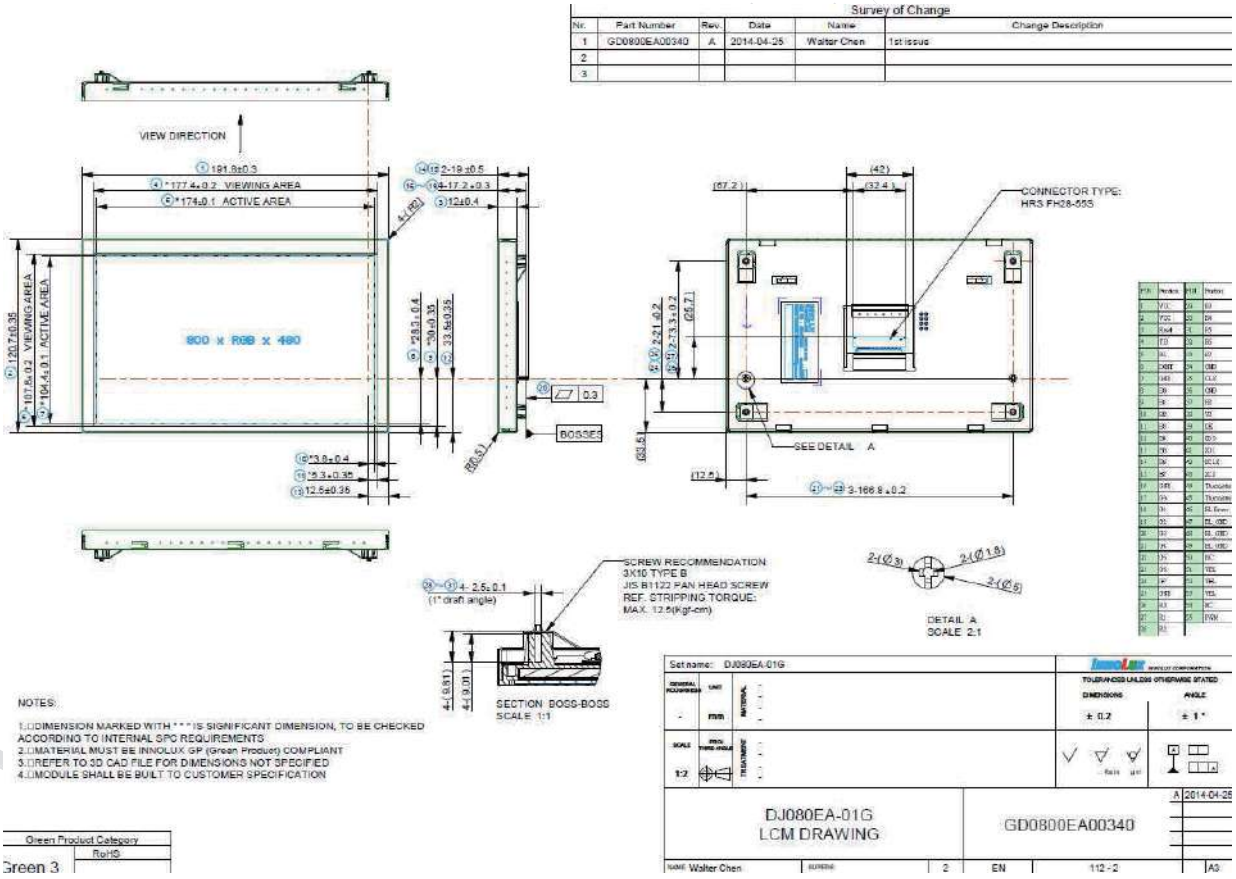
- 3x8bits (or 3x6 option) RGB with DE, Hsync, Vsync and clock input
- COG including timing controller
- Internal NTC Temperature sensor
- Left / right and top / bottom scanning
- Integrated LED backlight driving with high dimming ratio

5 MECHNICAL DESCRIPTION

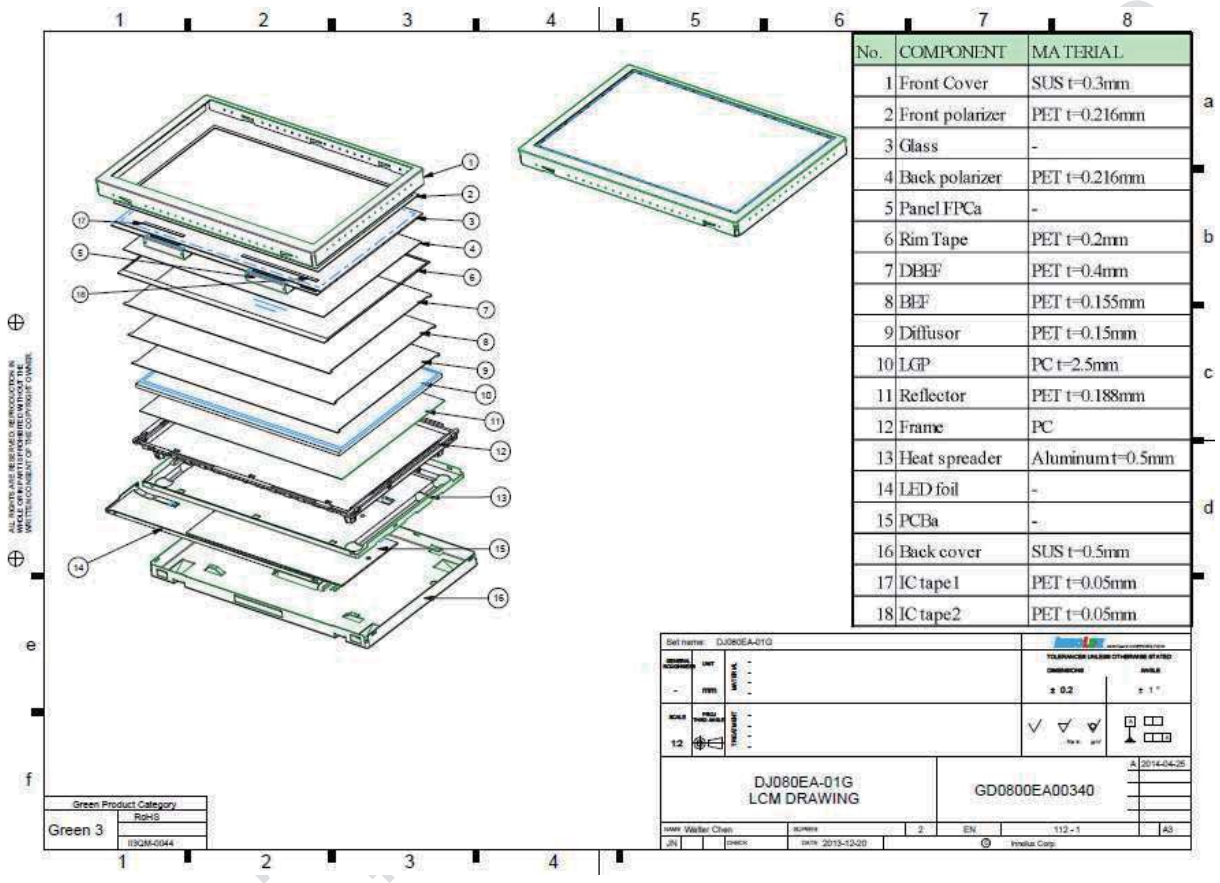
5.1 Module key components

- TFT panel
- PCBA including LED driving circuit
- LED backlight, including light guide and optical foils
- Metal frame(s)

5.2 Module drawing

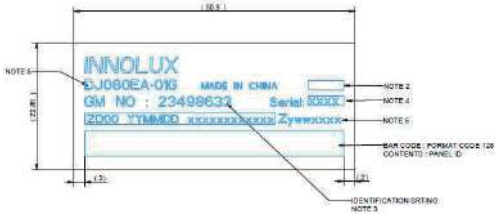


5.3 Exploded drawing



No.	COMPONENT	MATERIAL
1	Front Cover	SUS t=0.3mm
2	Front polarizer	PET t=0.216mm
3	Glass	-
4	Back polarizer	PET t=0.216mm
5	Panel FPCa	-
6	Rim Tape	PET t=0.2mm
7	DBEF	PET t=0.4mm
8	BEF	PET t=0.155mm
9	Diffusor	PET t=0.15mm
10	LGP	PC t=2.5mm
11	Reflector	PET t=0.188mm
12	Frame	PC
13	Heat spreader	Aluminum t=0.5mm
14	LED foil	-
15	PCBa	-
16	Back cover	SUS t=0.5mm
17	IC tape1	PET t=0.05mm
18	IC tape2	PET t=0.05mm

5.4 Main ID label drawing



NOTES:
1) RELEASE LINER SHOULD BE STICKED ON THE BOTTOM SIDE OF LABEL
2) "PCP PHASE"-"SAMPLE VERSION"(eg. DV2)
WHERE DV AND PV ARE STAND FOR PCP PHASE
WHERE x IS THE SAMPLE VERSION FROM 1 TO 9 ACCORDING TO THE SAMPLES STATUS
3) DETAIL OF IDENTIFICATION STRING :
ZD00, yymmdd, xxxxxx
ZD00: ZD is MFG SITE CODE,
00 IS NO. OF SIGNIFICANT PRODUCT CHANGE
(STARTING FROM 00, THEN 01, 02, ...)
yy : YEAR OF PRODUCTION e.g.00 (2000)
mm : MONTH OF PRODUCTION e.g. 05 (May)
dd : DAY OF PRODUCTION e.g. 02
XXXXXXXXXX : PANEL ID (12 DIGITS)
4) SERIAL NUMBER, e.g. 0001, 0002, 0003...
5) CUSTOMER PART NO. xxxxxxx
6) MODULE LOT NUMBER
Z : MFG SITE CODE
y : YEAR OF LOT CARD PRINTING
ww : WEEK OF LOT CARD PRINTING
xxxx : LOT NUMBER
7) DETAIL PRINTING CONTENT FOLLOW 180 SHEET

6 INPUT / OUTPUT PINNING AND CONNECTOR DESCRIBTION

6.1 I/O Pinning

Recommend Connector type:

Input connector 55 Pole | **FH28-55S-0.5SH(05)**

PIN No.	Symbol	I/O	Function
1	VCC	Power	External main and I/O power supply ; Power3V3
2	VCC	Power	External main and I/O power supply : Power3V3
3	RESET	Input	Reset panel Driver IC and LED Driver IC RESET = 0:reset RESET = 1:normal operation
4	TB	Input	Vertical shift direction (gate output) selection. TB = 0: Bottom->Top TB = 1: Top ->Bottom (default: Customer to Pull high, internal IC Pull high*)
5	RL	Input	Horizontal shift direction (source output) selection. RL = 1: Left -> Right(default: Customer to Pull high, internal IC Pull high*) RL = 0: Right -> Left
6	DINT	Input	Input data format selection. DINT = 0:6-bits mode DINT = 1:8-bits mode(default: Customer to Pull high, internal IC Pull high*)
7	GND	Power	Ground
8	B0	Input	Blue Data (for 6bits mode, customer pull low, IC internally are pulled high*)
9	B1	Input	Blue Data (for 6bits mode, customer pull low, IC internally are pulled low*)
10	B2	Input	Blue Data (6bits B0 / 8bits B2)
11	B3	Input	Blue Data (6bits B1 / 8bits B3)
12	B4	Input	Blue Data (6bits B2 / 8bits B4)
13	B5	Input	Blue Data (6bits B3 / 8bits B5)
14	B6	Input	Blue Data (6bits B4 / 8bit B6)
15	B7	Input	Blue Data (6bit B5 / 8bit B7)
16	GND	Power	Ground
17	G0	Input	Green Data (for 6bits mode, customer pull low, IC internally are pulled high*)
18	G1	Input	Green Data(for 6bits mode, customer pull low, IC internally are pulled low*)
19	G2	Input	Green Data (6bit G0 / 8bit G2)
20	G3	Input	Green Data (6bit G1 / 8bit G3)
21	G4	Input	Green Data (6bits G2 / 8bits G4)

22	G5	Input	Green Data (6bits G3 / 8bits G5)
23	G6	Input	Green Data (6bits G4 / 8bits G6)
24	G7	Input	Green Data (6bits G5 / 8bits G7)
25	GND	Power	Ground
26	R0	Input	Red Data(for 6bits mode, customer pull low, IC internally are pulled high*)
27	R1	Input	Red Data(for 6bits mode, customer pull low, IC internally are pulled low*)
28	R2	Input	Red Data (6bits R0 / 8bits R2)
29	R3	Input	Red Data (6bits R1 / 8bits R3)
30	R4	Input	Red Data (6bits R2 / 8bits R4)
31	R5	Input	Red Data (6bits R3 / 8bits R5)
32	R6	Input	Red Data (6bits R4 / 8bits R6)
33	R7	Input	Red Data (6bits R5 / 8bits R7)
34	GND	Power	Ground
35	CLK	Input	Pixel clock
36	GND	Power	Ground
37	HS	Input	Horizontal sync
38	VS	Input	Vertical sync
39	DE	Input	Data Enable
40	SDO	Output	SPI interface
41	SDI	Input	SPI interface, if no use, pin should pull low
42	SCLK	Input	SPI interface, if no use, pin should pull low
43	SCS	Input	SPI interface, if no use, pin should pull high
44	Thermistor	Output	NTC connection thermistor 1 : at module PCBa
45	Thermistor	Output	NTC connection thermistor 2 : at module backlight LED FPCa.
46	BL Error	Not Used	Pull high / No function
47	BLGND	Power	Backlight's Ground
48	BLGND	Power	Backlight's Ground
49	BLGND	Power	Backlight's Ground
50	NC		
51	VBL	Power	Backlight voltage
52	VBL	Power	Backlight voltage
53	VBL	Power	Backlight voltage
54	NC		
55	PWM	Input	Digital PWM Dimming Input

* Note: Source driver internal pull high / pull low data

Parameter	Symbol	Min.	Typ.	Max.	Unit	Conditions
Pull low/ high resistor	R_I	125	250	375	kΩ	For I/O circuit

7 ABSOLUTE MAXIMUM RATINGS

There is a difference between the maximum value of a parameter's specification and its absolute maximum value. The maximum value indicates that the performance will be reduced when you go beyond this value, but this is reversible. Where the absolute maximum value as indicated in this section is a value beyond which permanent damage to the product or its function may be expected.

Item	Symbol	Min	Typ	Max	Unit	Remark
Input supply voltage	VCC	-0.3		3.6	V	
Backlight supply voltage	VBL	-0.3	12	25	V	
Logic input voltage	Vin	-0.3		3.6	V	
Logic output voltage	Vout	-0.3		3.6	V	
Relative humidity	RH	-	-	90	%	@ 60 ℃, Note 1
Operation temperature	OTR	-40		85	℃	Note 2
Functional temperature	FTR	-40		90	℃	Note 2
Storage temperature	STR	-40		95	℃	

Note 1: No condensation allowed under any condition

Note 2: Panel surface temperature should not exceed 90°C. For temperature ranges +85°C to +90°C, any picture quality, electrical characteristic, optical characteristic, etc, are not guaranteed, however, the display module will operate and will be readable/legible. The display module should not be operated continuously under the extreme temperatures for more than 24 hours

8 ELECTRICAL CHARACTERISTICS

8.1 Electrical description and block diagram

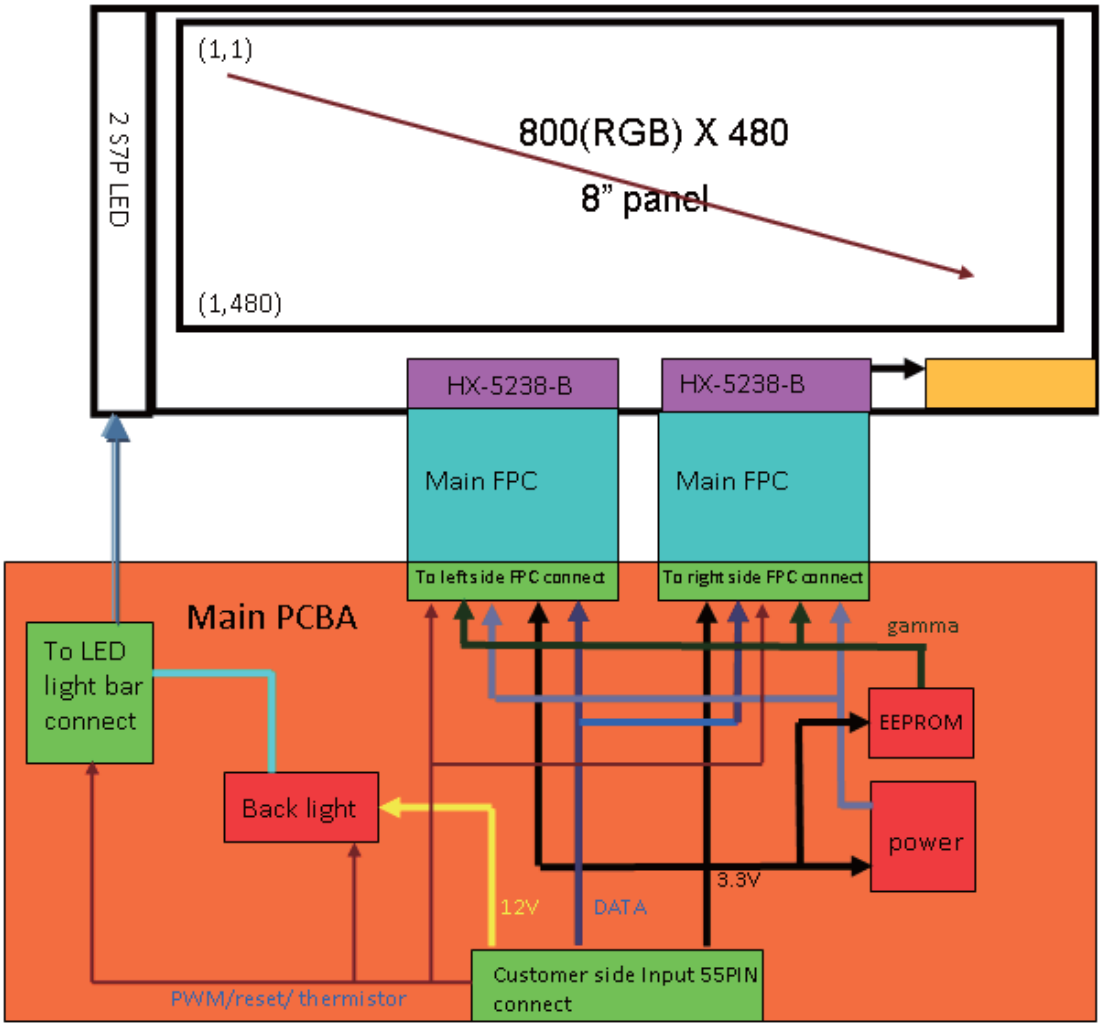
8.1.1 Description display electronics

The display module comes with a 8 bits (6-bits) RGB digital interface. The display’s data and synchronization signals (DE, CLK,HS, VS,…) , which generates all necessary control signals for the source and gate drivers. DC-DC converter on the module produces the voltages required for driving of panel. Please refer to the block diagram in section 8.1.3.

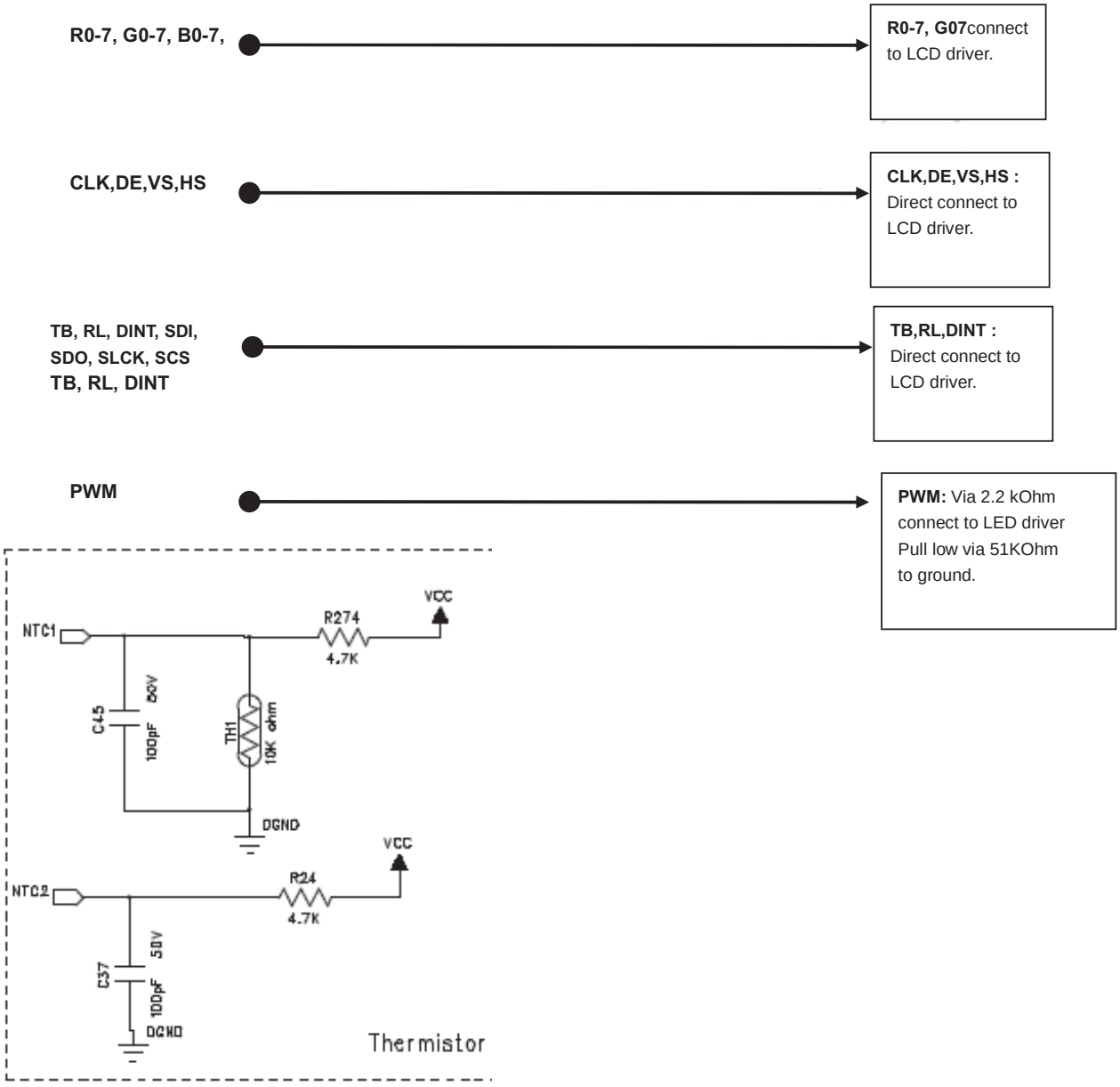
8.1.2 Description backlight electronics

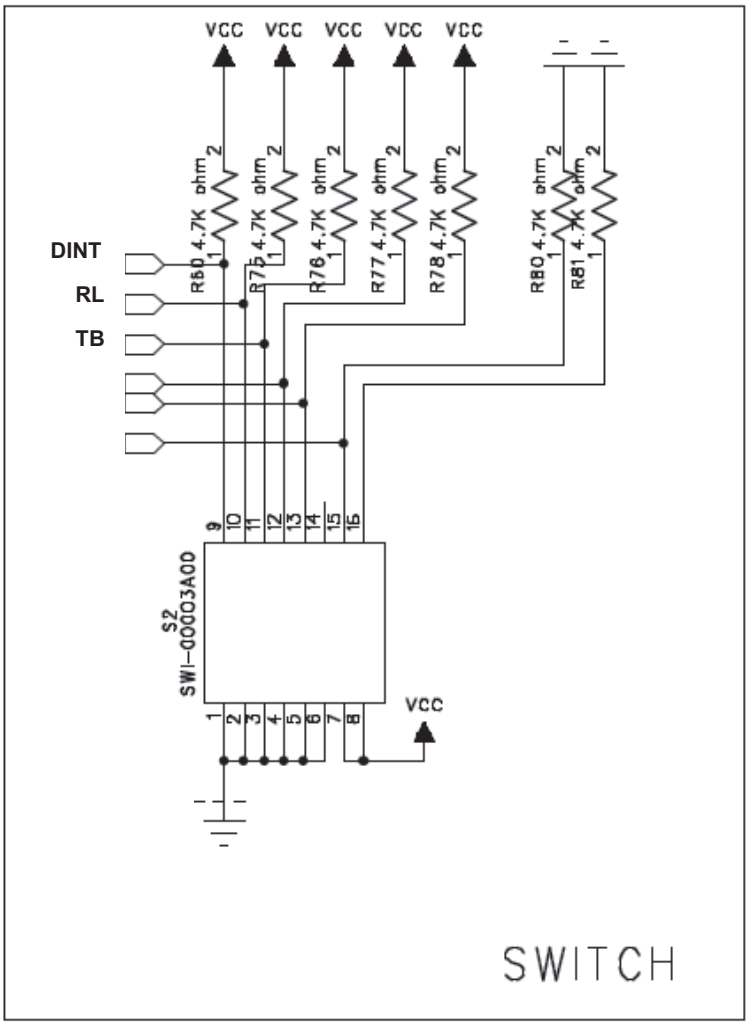
LED driver electronic includes LED driver, dimming control and LED driver is a boost converter used to step-Up the input voltage of +12V for driving the LED backlight. PWM dimming control pin is provided to control the brightness of LED backlight.

8.1.3 Block diagram



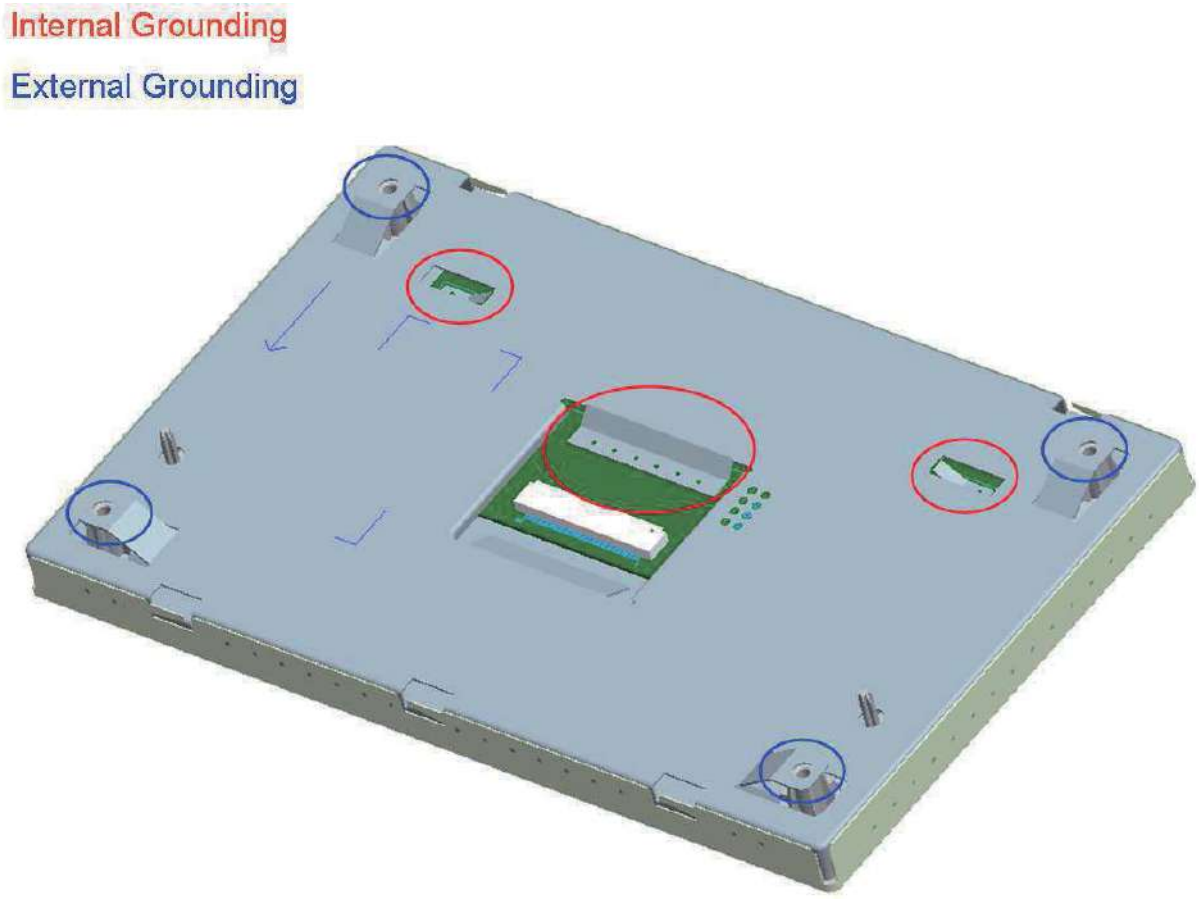
8.1.4 Electrical Block diagram





** Application circuit example of DINT、RL、TB **

8.1.5 Grounding Block diagram



8.2 Recommended operating conditions

8.2.1 Recommended voltage supply range

Typical Voltage rating

Parameter	Symbol	Min.	Typ.	Max	Unit
Input supply voltage	VCC	3	3.3	3.6	Volt
Allowed ripple voltage		-100		100	mV
Input supply current *1	I_{VCC}	100	120	150	mA
Inrush current supply voltage *2	I_{VCC}	-	-	8	A
Parasitic Current (VCC) *5	I_{VCC}	-	-	5	mA
Backlight supply voltage	VBL	8	12	18	Volt
Backlight supply current *3	I_{VBL}	300	400	500	mA
Inrush current backlight *4	I_{VBL}	-	-	28	A
Parasitic Current (VBL) *5	I_{VBL}	-	-	50	uA
Logic low level input voltage	VIL	0	-	0.3VCC	Volt
Logic high level input voltage	VIH	0.7VCC	-	VCC	Volt
Logic Low level output voltage	VOL	GND	-	GND+0.4	Volt
Logic high level output voltage	VOH	VCC-0.4	-	-	Volt

*1: Based on PV sample with white pattern and VCC is 3.3V.

*2: Based on PV sample measured with current probe after VCC below 0.3V. The duration of peak current is below 40 micron sec.

*3: Based on PV sample with white pattern and VBL is 12V.

*4: Based on PV sample measured with current probe after VBL below 0.3V. The duration of peak current is below 40 micron sec.

*5: Based on PV sample measured I_{VCC} (VCC=3.3V) and I_{VBL} (VBL=12V) when RESET pin is pulled low.

8.2.2 Capacitive input characteristics on power supply pins

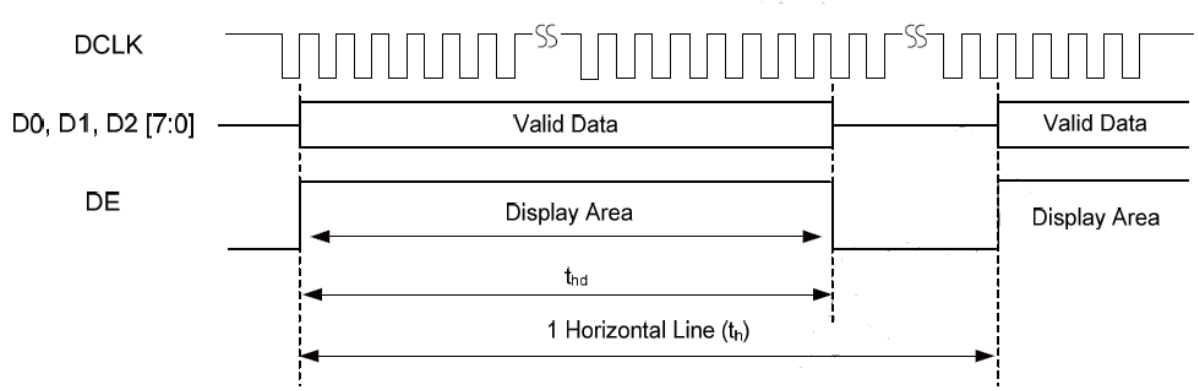
VBL 12V Input capacitance is 24.2uF ±10 %

VCC 3V3 Input capacitance is 49.6uF ±10 %

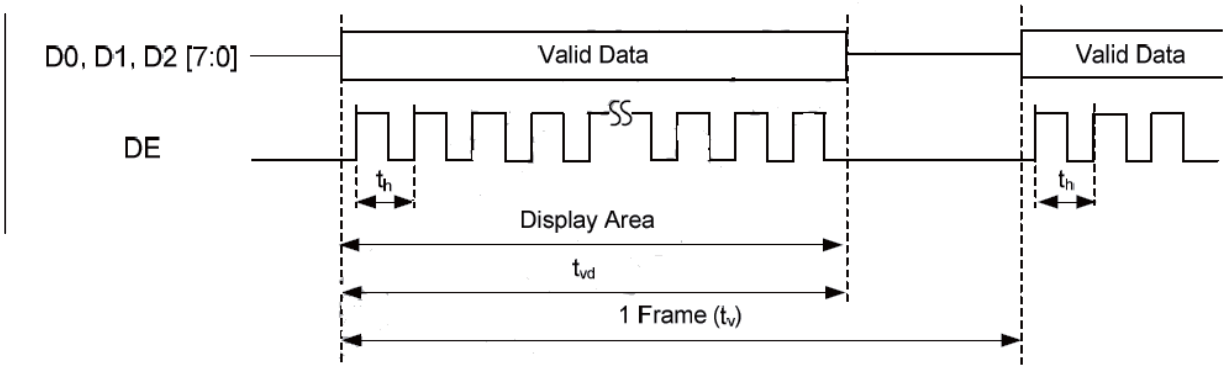
8.2.3 Input characteristics for TTL mode signals

Only DE mode

- Horizontal



- Vertical



8.3 Backlight control

8.3.1 PWM Dimming input.

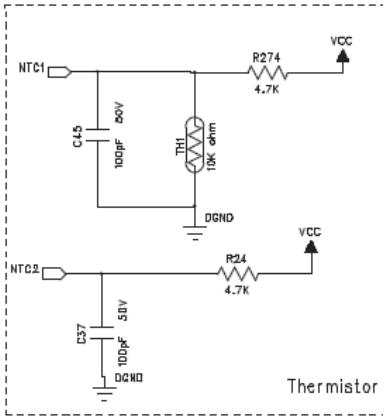
The brightness can be controlled using an external PWM input. The device accepts PWM frequency up to 20 kHz and a minimum pulse width down to 1 µsec. A 5000:1 dimming ratio is achieved at a frequency of 200 Hz. A logic high signal enables all two current sources and a logic low disables them.

8.3.2 PWM Dimming Function of LED Driver

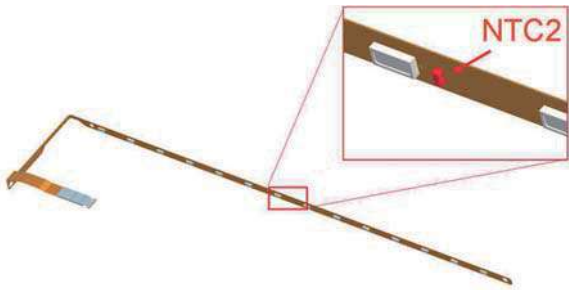
Item	Symbol	Min	Typ	Max	Unit
PWM Freq	PWM Frequency	200			Hz
PWM Voltage Level	PWM H	3.0		5.5	V
	PWM L	0	-	0.8	V

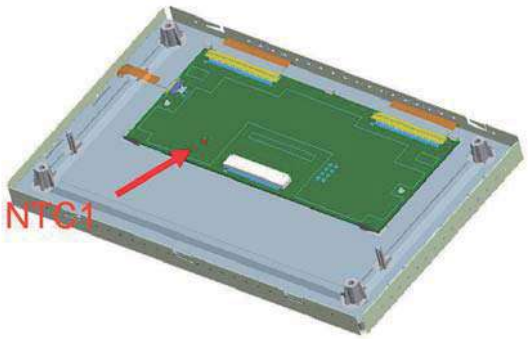
8.4 Backlight NTC resistor

Type: NCP15XH103F03RC / Murata (Refer to data sheet.)
The nominal value of the NTC is around 10kohm at 25 degrees.
Refer to data sheet.

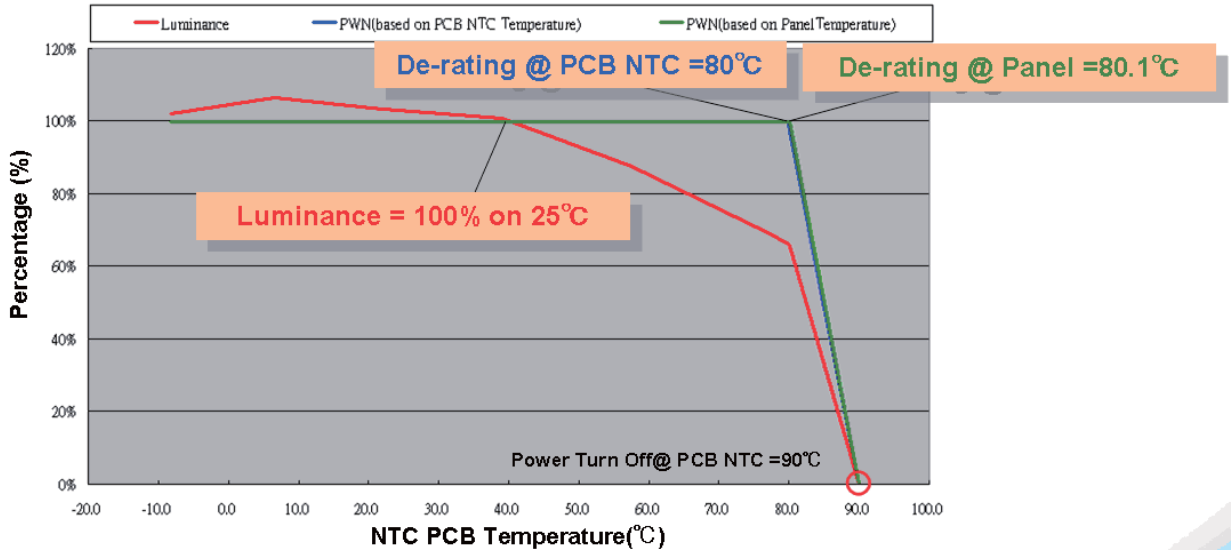


Note: NTC1 and NTC2 with same design

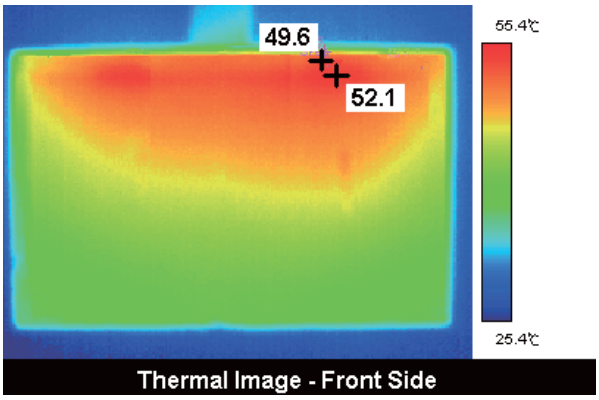


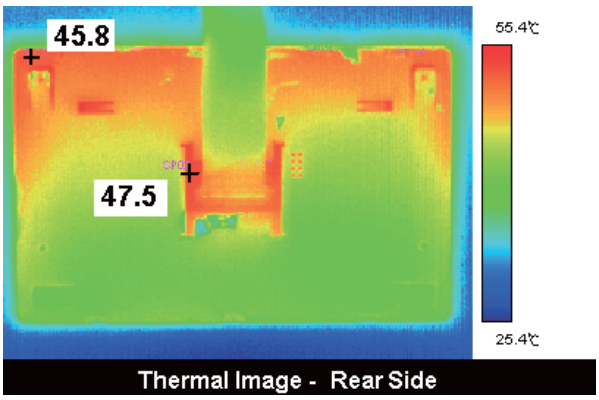


8.5 Recommend de-rating curve



8.6 Thermal Image @25℃

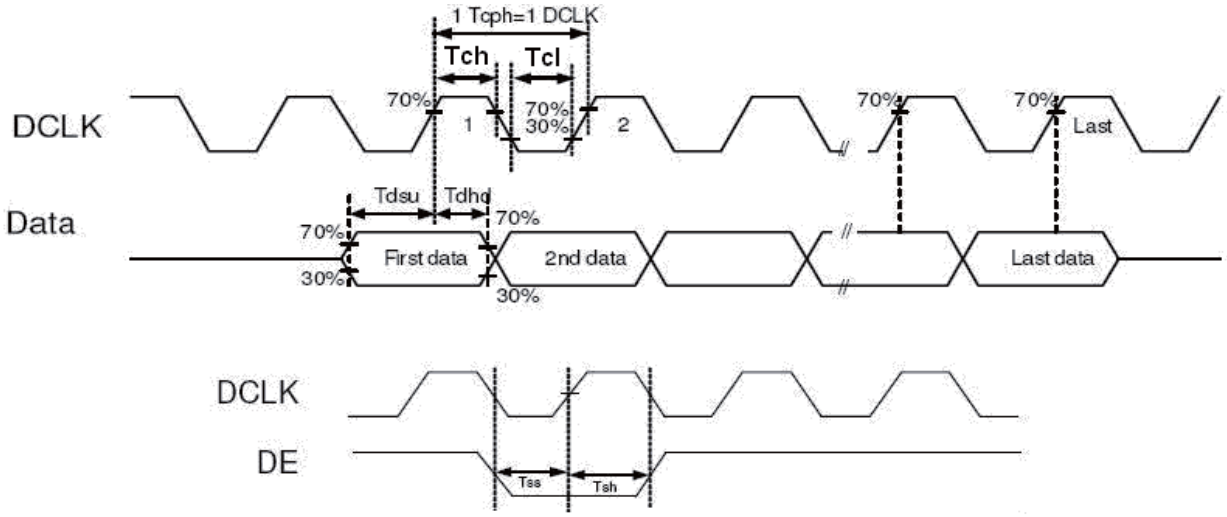




<Since different material has different emissivity, different spectrum is used for different material>

9 TIMING

9.1 Video timing



Item	Symbol	Spec.			Unit
		Min.	Typ.	Max.	
DCLK period	T_{cph}	12	-	-	ns
DCLK high duty ratio	T_{ch}	20%*Tcph		80%*Tcph	ns
DCLK low duty ratio	T_{cl}	20%*Tcph		80%*Tcph	ns
Data setup time	T_{dsu}	5	-	-	ns
Data hold time	T_{dhd}	5	-	-	ns
DE setup time	T_{ss}	5	-	-	ns
DE hold time	T_{sh}	5	-	-	ns

Table: Input data parameters

9.2 Input timing

Himax5238B

Parameter	Symbol	800xRGBx480			Unit
		Min.	Typ.	Max.	
DCLK Frequency	FDCLK	-	26.36	-	MHZ
Horizontal valid data	thd		800		DCLK
1 Horizontal Line	th	820	832	1483	DCLK
Vertical valid data	tvd		480		H
1 Vertical field	tv	490	528	576	H
Frame rate	FR	50	60	65	HZ

Optional input timing

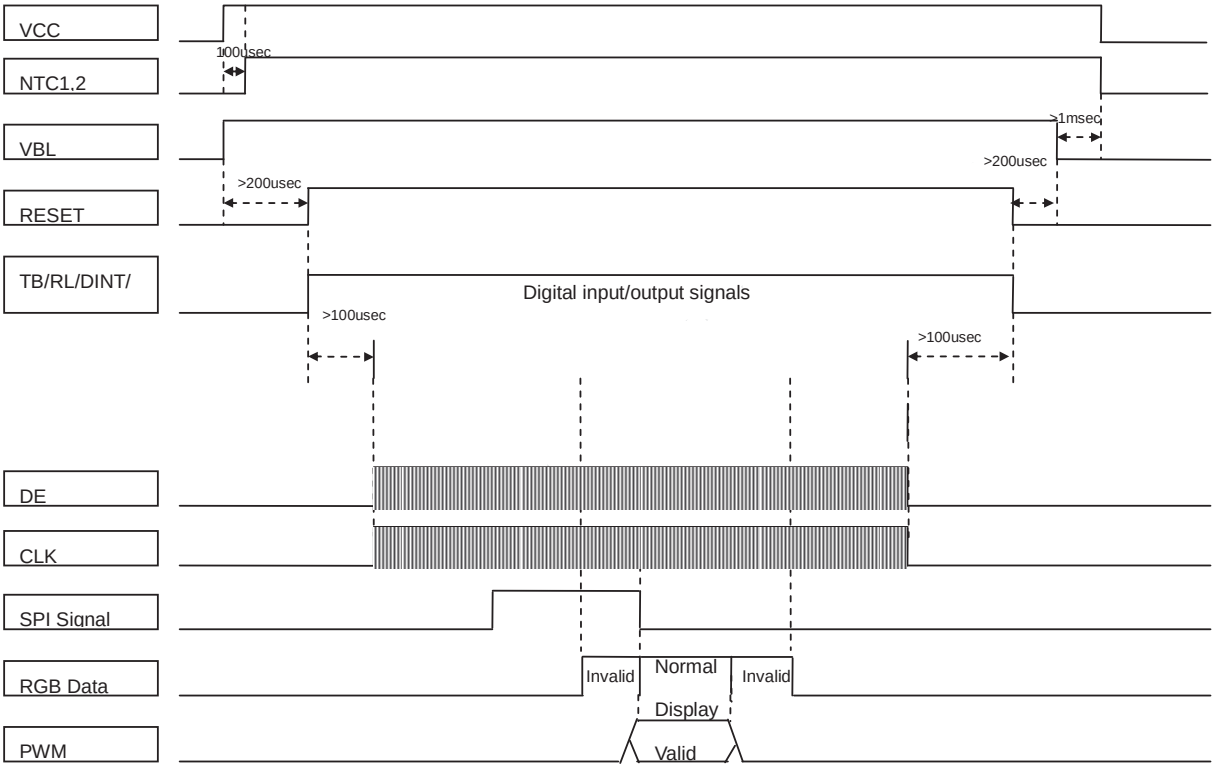
GIS-317

Parameter	Symbol	800xRGBx480 (RS[3:0]=0x6h)			Unit
		Min.	Typ.	Max.	
DCLK Frequency	F_{DCLK}	26.62	33.26	34.60	MHz
Horizontal valid data	t_{hd}		800		
Hsync Pulse Width	t_{hpw}	5	-	t_h - 5	DCLK
Hsync back porch	t_{hbp}	20	-	222	DCLK
Hsync front porch	t_{hfp}	2	-	-	DCLK
1 Horizontal Line	t_h	1024	1056	1088	DCLK
Vertical valid data	t_{vd}		480		H
Vsync Pulse Width	t_{vpw}	2	-	t_v - 2	H
Vsync back porch	t_{vbp}		35 (only)		H
Vsync front porch	t_{vfp}	2	-	-	H
1 Vertical field	t_v	520	525	530	H
Frame rate	FR	50	60	60	Hz
Note (customer's spec.)			GIS-317 (V1.6_24sep2010)		

(VCC1=2.7~3.6V, VCC2=VCC1, VSS1=VSS2=VSSA=0V, T_{OP} =95℃~-40℃)

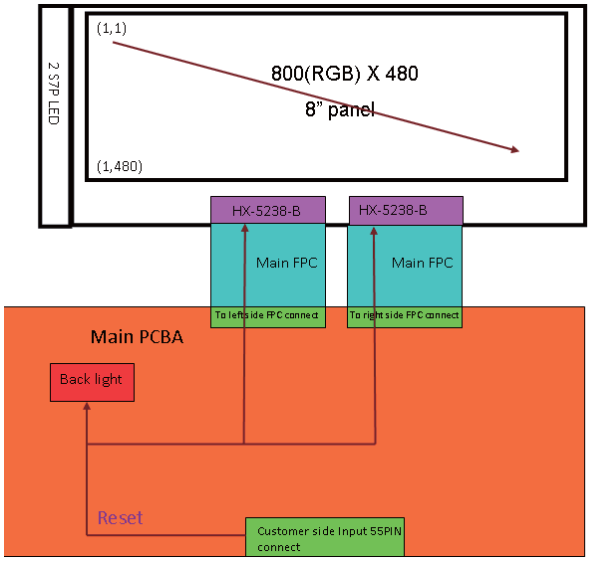
9.3 Power ON / OFF sequence

9.3.1 Power ON / OFF



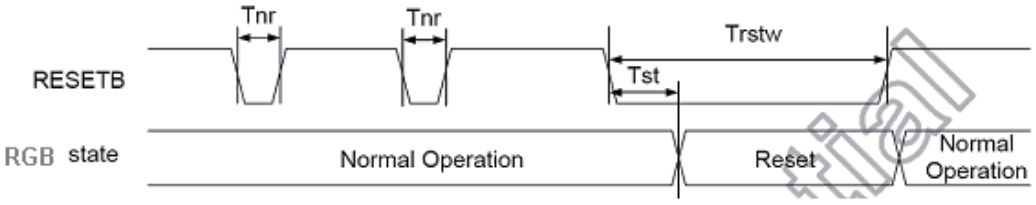
Note : NTC1/2 is Output Signal.

9.3.2 Reset timing



Function	Description	Reset		Remark
		High	Low	
TFT Panel Reset & Standby*	Panel normal operation when Reset High Panel turn off (black) when Reset Low	Normal	Reset & Standby*	
LED Driver Enable	Backlight normal operation when Reset High Backlight turn off when Reset Low	Enable	Disable	

Note: There could be some flicker depending on reset release compared to CLK, DE, VS, HS,…., etc timing if normal power on/off is not followed (See 9.3.1)



Typical reset timing

Parameter	Symbol	Min	Typ.	Max	Unit
RESET low pulse width	T rstw	10	-	-	usec.
Negative noise pulse width	T nr		-	4	usec.
Reset start time	T st	4	-		usec.

10. COLOR COMBINATION TABLE

Colors & Gray Scale		Grey Scale	Input data signal																							
			R0	R1	R2	R3	R4	R5	R6	R7	G0	G1	G2	G3	G4	G5	G6	G7	B0	B1	B2	B3	B4	B5	B6	B7
COLOURS	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
	Blue	-	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1
	Green	-	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0
	Cyan	-	0	0	0	0	0	0	0	0	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	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	0	0	0	0	0	0	0	0	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	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
RED	Black	GS0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	⇑	GS1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	darker	GS2	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	⇑	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓
	⇓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓
	brighter	GS253	1	0	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	⇓	GS254	0	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Red	GS255	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GREEN	Black	GS0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	⇑	GS1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	darker	GS2	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	⇑	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓
	⇓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓
	brighter	GS253	0	0	0	0	0	0	0	0	1	0	1	1	1	1	1	1	0	0	0	0	0	0	0	0
	⇓	GS254	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0
	Green	GS255	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0
BLUE	Black	GS0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	⇑	GS1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
	darker	GS2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
	⇑	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓
	⇓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓
	brighter	GS253	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	1	1	1	1	1
	⇓	GS254	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1
	Blue	GS255	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1

11. OPTICAL CHARACTERISTICS

Conditions unless specified otherwise:

- T_{AMB} = 25°C ± 3°C
- Supply voltage module = 12V (Backlight voltage)
- Elapsed time from switch ON module (including backlight) is greater than 30 minutes
- RGB test patterns only
- Brightness = 100% unless specified.
- Measurements are conducted perpendicular

Item		Symbol	Condition	Min.	Typ.	Max.	Unit	Remark
Luminance	650 version	L	α = 0° ß = 0°	450	650	-	cd/m²	
			α = +30° ß = 0°	315	455	-		
			α = -30° ß = 0°	315	455	-		
			α = 0° ß = +30°	315	455	-		
			α = 0° ß = -30°	315	455	-		
			α = +45° ß = 0°	225	325	-		
			α = -45° ß = 0°	225	325	-		
Luminance homogeneity (Note 1)		Lhom	100% x L_{min}/L_{max}	85		-	%	
Dimming ratio (Note 2)		Dim	-		1:5000	-	-	
Surface reflectance (anti-glare)		Rfsurf (SCI)	-	-	2.6	-	%	
		Rfsurf (SCE)	-	-	0.6	-	%	
Contrast ratio (Note 3)		CR	+25°C	1:1100	1:2000	-	-	
			α = +30° ß = 0°	1:275	-	-		
			α = -30° ß = 0°	1:275	-	-		
			α = 0° ß = +30°	1:275	-	-		
			α = 0° ß = -30°	1:275	-	-		
			α = +45° ß = 0°	1:165	-	-		

Item		Symbol	Condition	Min.	Typ.	Max.	Unit	Remark
			α = -45° ß = 0°	1:165	-	-		
			α = +80° ß = 0°	> 1:10	-	-		
			α = -80° ß = 0°	> 1:10	-	-		
			α = 0° ß = +80°	> 1:10	-	-		
			α = 0° ß = -80°	> 1:10	-	-		
Colour-point	white	x_W	-	0.250	0.290	0.330	-	Note 4
		y_W	-	0.280	0.320	0.360		
	red	x_R	-	0.585	0.615	0.645		
		y_R	-	0.318	0.348	0.378		
	green	x_G	-	0.29	0.320	0.35		
		y_G	-	0.585	0.615	0.645		
	blue	x_B	-	0.12	0.150	0.18		
		y_B	-	0.065	0.095	0.125		
NTSC ratio		NTSC	-		65		-	-
Response time	Black to white	Tr	At 25°C	-	16	-	ms	Note 5
	White to black	Tf		-	6	-		
	Black to white	Tr	At –20°C	-	210	-		
	White to black	Tf		-	105	-		
	Black to white	Tr	At –30°C	-	550	-		
	White to black	Tf			280	-		
Polariser absorption angle		P	-	-	0	-	(deg)	

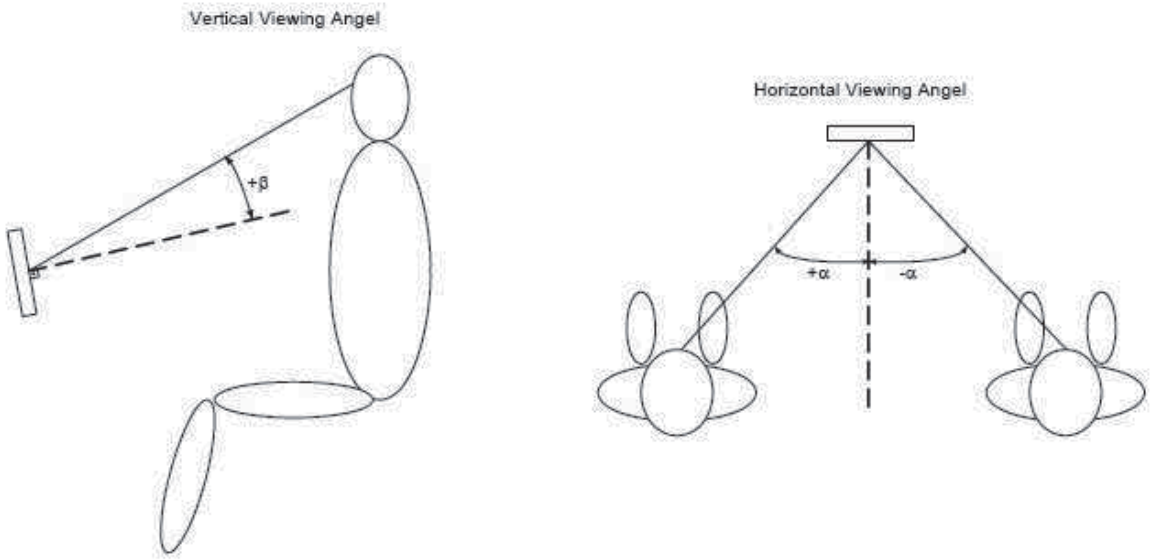
Note 1: Definition of homogeneity according to the VESA standard (version 2.0, dated 1st June 2001 – page 118, section 306-1). Luminance is measured at the 9 specified points on the screen in full-white display pattern.

Note 2: Dimming Ratio measurement:
Maximum brightness (LED maximum PWM driving) has to be measured first, then minimum brightness. Waiting time for dimming ratio measurement is 30 minutes for maximum brightness and then another 30 minutes for minimum brightness.

Note 3: Contrast Ratio measurement:

The contrast ratio (CR) is the ratio between the transmission (τ) in a full white area (all RGB signal bits =1) and the transmission (τ_d) in a dark area (all RGB signal bits =0):

$CR = \tau / \tau_d$



Note 4: Color-point:

Mentioned color points are target values. Actual color points depend on color filter availability and will be updated / confirmed after sample measurement.

Note 5: Switching time:

Switching times at higher than ambient temperatures (> 25° C) are equal or better (faster) than the specified values for 25° C in above table due to the physics of Liquid Crystal material. Due to this they are normally not specified nor measured.

12. COMMUNICATION INTERFACE SPECIFICATION

12.1 SPI interface spec. (Preliminary concept).

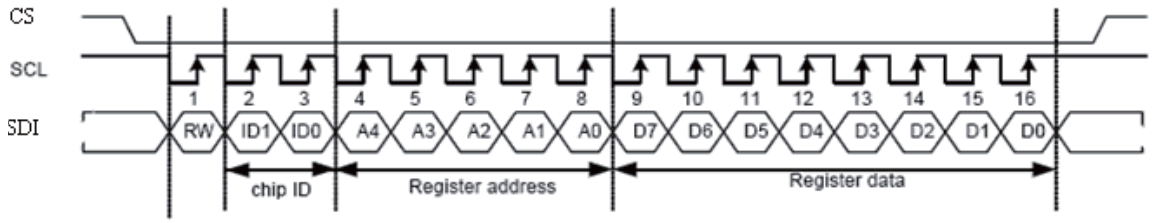
Use of the SPI commands to alter the FoS (Front of Screen) performance should be agreed with General Motors' Display Engineering.

12.2 Physical: Single address.

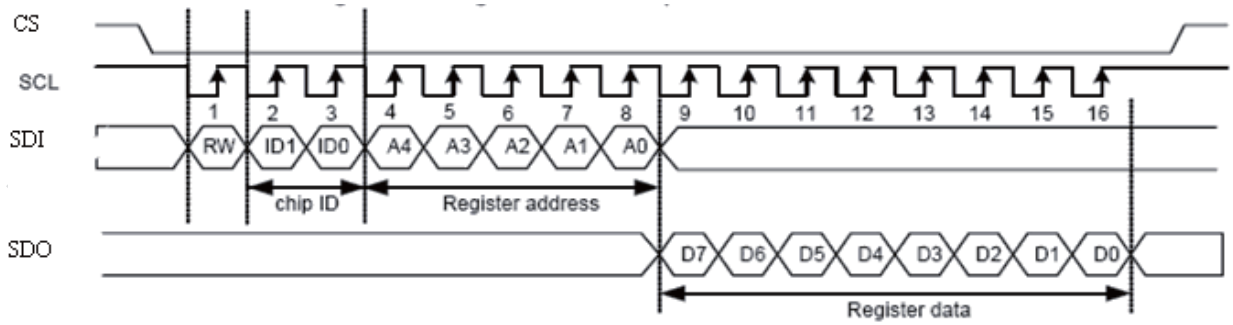
SPI Signal Timing Chart

READ:

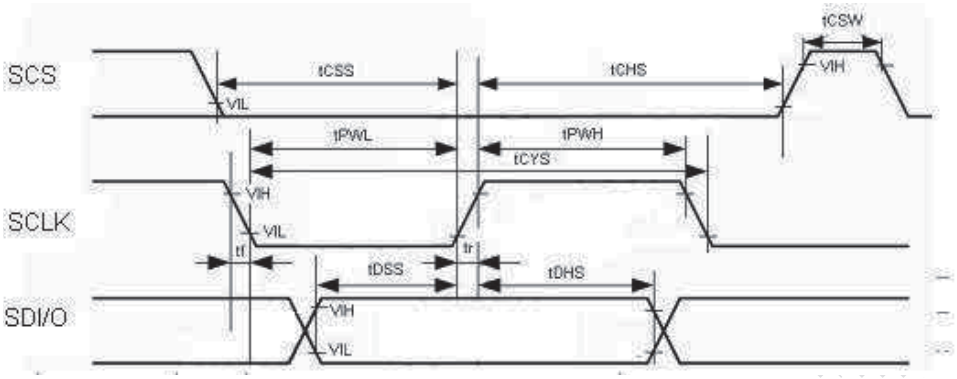
The read/write control bit RW would be equal to "L", chip ID bits ID[1:0], serial address bits A[4:0] and serial data bits D[7:0] are read at the rising edge of the serial clock SCL, via the serial input pin SDI when writing.
The serial interface signal timing chart and specification are shown as below.



Write:

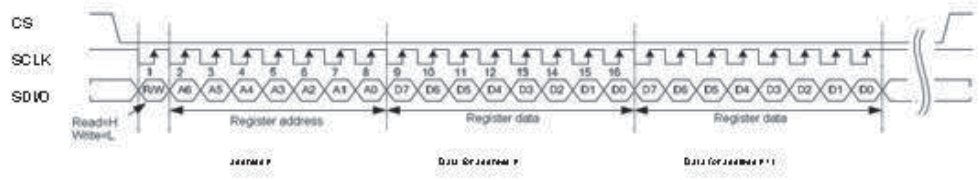


12.3 Detailed Timing



Remarks: SPI registers will be reset to the default values when "Reset" is active (low)

12.4 Burst mode



12.5 SPI registers

SPI register details are published in a separate document (Doc #: 20110323001AA), which can be obtained on request through GM.

13. LUMINANCE OVER LIFE TIME

Condition	MTBF	Unit	Remark
Ambient temperature 25°C in continuous operation at typical luminance	15k	hour	Note 1

Note 1: Luminance over life time is defined as the time during which the luminance of the module will retain 70% of the original value at ambient temperature of 25°C.

14. ENVIRONEMTAL / RELIABILITY TESTS

RELIABILITY

No	Test Item	Condition	Reference
1	High Temperature Operation (1)*	Ta=+85℃, 240hrs	IEC60068-2-2-Bb
2	High Temperature Storage (non-operation)	Ta=+95℃, 504hrs	IEC60068-2-2-Bb
3	Low Temperature Operation	Ta=-40℃, 240hrs	IEC60068-2-1-Ab
4	Low Temperature Storage (Non-operation)	Ta=-40℃, 504hrs	IEC60068-2-2-Ab
5	High Temperature & High Humidity Operation	Ta=+60℃, 90% RH, 504hrs	IEC60068-2-78 Cab
6	Thermal Shock (non-operation)	-40℃, 30 min⟷85℃, 30 min; 168 cycles	IEC60068-2-14-Na
7	UV exposure resistance	765 W/m^2 / 168 hrs; Power off.	IEC60068-2-5-Sa
8	Surface Discharge (non-operation)	C=150pF, R=330Ω; Air Discharge: ±15KV Contact Discharge: ±8KV	IEC61000-4-2
9	Vibration (non-operation)	(Non-operation) 3 directions: X, Y, Z axes; Sweeps: 10 (1 oct/min); Frequency: 10 →150 →10 Hz; 10-58 Hz: constant amplitude 0.75mm peak; 58-150 Hz: constant acceleration 10g peak	IEC60068-2-27-Ea IEC60068-2-6Fc
10	Shock (non-operation)	3 directions: X, Y, Z axes Repeats: 6Peak acc.: 100G Pulse duration: 6ms	IEC60068-2-27-Ea

(1)* 85 degrees for HOT testing is referring to the TFT surface temperature, not ambient temperature

(2) Ta: Ambient Temperature

14.1 EMC level requirements:

CISPR25 Level 5 is target to be reached

14.2 ESD

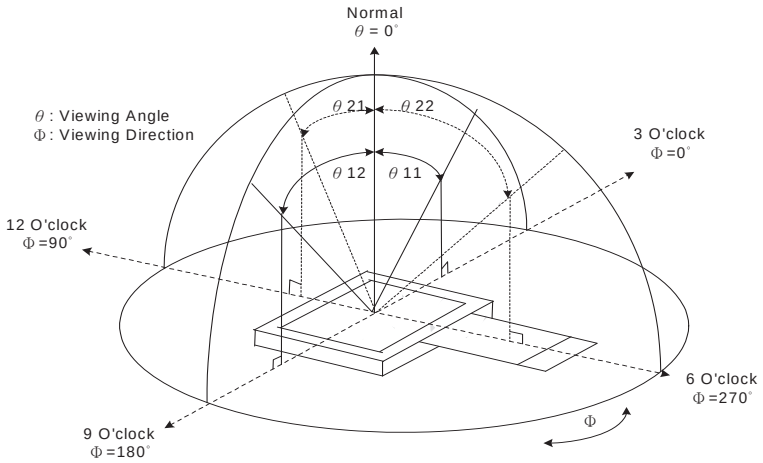
TEST	CONDITIONS	METHOD	REMARK
Human Body mode	10 KV (330Ω,150pF)	IEC 61000-4-2	Not operated

15. QUALITY REQUIREMENTS

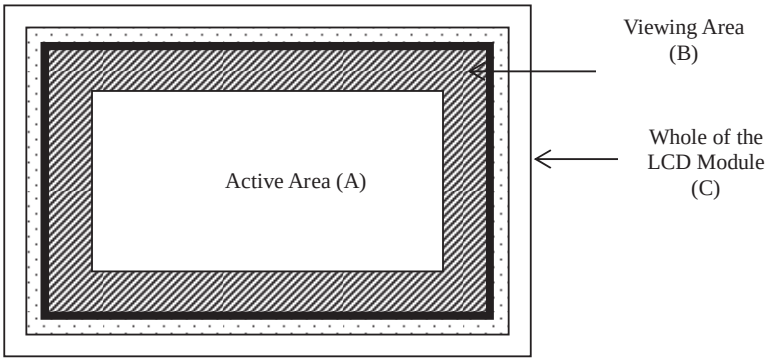
15.1. Shipping Cosmetic Specification

15.1.1. Inspection Conditions

Viewing time: ≤ 10 seconds
Viewing distance: 35cm
Ambient illumination: Standard 150~600Lux(light-on), 700~1500 Lux (light- off)
Ambient temperature: 20…25ºC
Light source condition: Based on the specification
Inspection view angle: U/D/L/R: 10°(θ21/θ22/θ11/θ12)



15.1.2. Inspection Zone



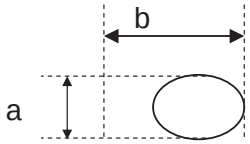
A zone: The inside of the Active Area (as defined on the Product Drawing)
B zone: The inside of the Viewing Area (as defined on the Product Drawing) except the A Zone
C zone: Whole of the LCD Module except the zone A and B. (Including FPC& Metal Frame)

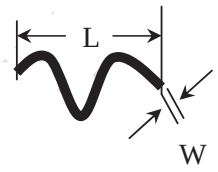
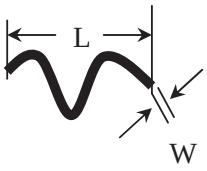
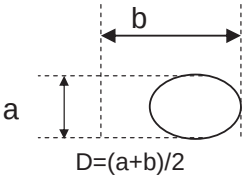
15.1.3. Functional Defects

Incomplete segment zones	not allowed
Segment shorts (dark or bright segments/dots)	not allowed
Wrong position of the good viewing area	not allowed
Irregular contrast	not allowed

15.1.4 Cosmetic Inspection

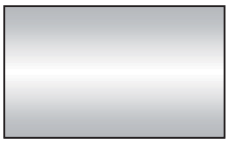
For all below Inspection Items the 1st criteria is visibility through a 5%ND Filter:
Not Visible: Ignore
Visible: Apply below table

Inspection item	Inspection standards	Acceptable Qty	Applied Zone	Inspection Mode	Note
Line defect	Not visible	None	A	Light-On	1
Mura (Uniformity)	Not visible	None	A	Light-On	2
Cross talk	Not visible	None	A	Light-On	---
Bright dot (Sub-pixel)	1dot	0	A	Light-On	3
Dark dot	1dot	3	A	Light-On	4
Dark /Bright spots /foreign matter	Average Diameter (mm) D ≤ 0.15 0.15 < D ≤ 0.4 0.4 < D	Acceptable Qty Ignored 2 0	A	Light-On	 D=(a+b)/2
Jointed dot 1. Bright & Bright 2. Dark & Dark 3. Bright & Dark	 2 jointed dot ≤ 2 jointed dot ≤ 2 jointed dot ≤	 0 0 0	A	Light-On	5
Dot Distance (Between) 1. Bright & Bright 2. Dark & Dark 3. Bright & Dark	 ≤10 mm ≤10 mm ≤10 mm	 0 0 0	A	Light-On	---

Inspection item	Inspection standards	Acceptable Qty	Applied Zone	Inspection Mode	Note
Lints	Width (mm) Length (mm) W ≤ 0.03 0.03 < W ≤ 0.08 & L ≤ 2.0 2.0 < L ≤ 3.0 3.0 < L 0.08 < W	Acceptable Qty Ignored Ignored 2 0 0	A A A A A,B	Light-On Light-Off	
Scratches	Width (mm) Length (mm) W ≤ 0.08 L ≤ 10.0 W ≤ 0.08 L > 10.0 W > 0.08 L ≤ 10.0	Acceptable Qty 3 0 0	A,B	Light-On Light-Off	
Dents, Bubbles	Average Diameter (mm) D ≤ 0.15 0.15 < D ≤ 0.5 D > 0.5	Acceptable Qty Ignored 3 0	A,B	Light-On Light-Off	

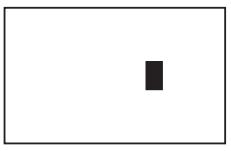
Note 1:
Line Defect

Note2:
Mura

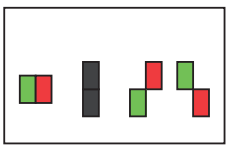


Note2:
Uniformity

Note3:
Bright Dot Defect



Note 4:
Dark Dot Defect



Note 5:
Joined dot defect

15.1.5. Functional Optical check

Inspection item	Inspection standards	Acceptable Qty	Applied Zone	Inspection Mode	Note
Flicker	N/A	≦ -20dB	A	Light-On	Note1
Gamma	Smooth Gray-to-Gray appearance	1.9 – 2.5	A	Light-On	Note 2

Note1:

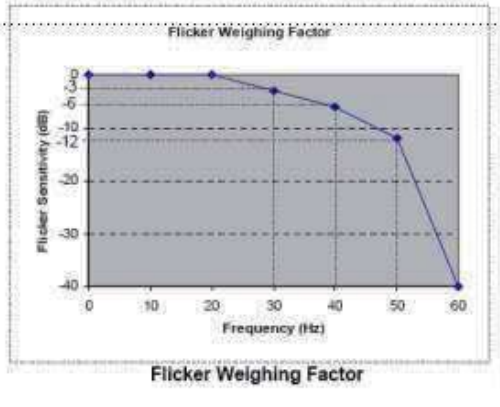
The flicker level is defined using Fast Fourier Transformation (FTT) as follows:

$$Flicker = 20\log_{10}\left(2\frac{f_{FFTC}(n)}{f_{FFTC}(0)}\right) + FS(Hz) \quad (dB)$$

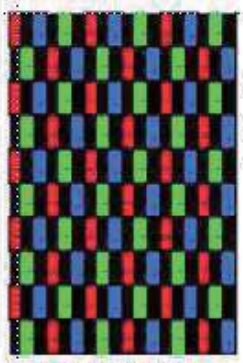
CMI spec. proposal<=-20db

where fFFTC(n) is the nth FFT coefficient, and fFFTC(0) is the 0th FFT coefficient which is DC component. FS(Hz) is the flicker sensitivity as a function of frequency.

The flicker level shall be measured with the test pattern below using photodiode with PMT in a range from 5Hz to 80Hz. The data acquisition window shall be at least 1 second and the sampling rate shall be at least 10,000 Hz. The peak flicker level shall be reported based on the calculation using above formula in which FS(Hz) is determined by the flicker weighing factor in below graphic using linear interpolation between the listed values.



Flicker Weighing Factor



sub-pixel on/off
dark sub-pixel, L0
bright sub-pixel, L186

Flicker Pattern

Note2:

Gamma (γ) are defined by

$$L = aV^{\gamma} + L_b \ldots (1)$$

L, L_b: gray-scale and black luminance; V:gray-signal signal Level

$$\log(1) \longrightarrow \quad \log(L - L_b) = \log a + \gamma \log V \ldots (2)$$

Linear Fitting to obtain

$$\gamma = \{\log(L - L_b) - \log a\} / \log V$$

Gamma curve is measured using 8 equally input levels,Black(0), 32,64,96,128, 160, 192, 224, White(255).

	Minimum	Typical	Maximum
Gamma value	1.9	2.2	2.5

16. PACKING DEFINITION

DJ080PA-01A /DJ080PA-01B /DJ080EA-01G Module delivery packing method -8B02M000GN00N

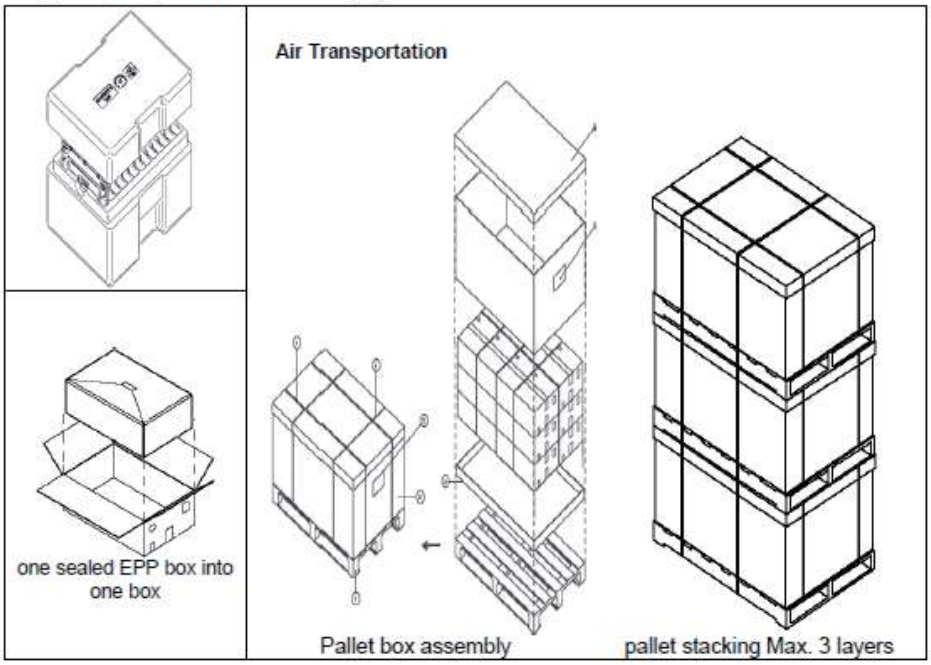
(1) First Level: Inner box level with standard packing method – EPP box in box. INX packing method on this level for this product is 378 x 284 x 210mm.

- Put the sealed module into EPP bottom (8701B00017000) one by one.
- One full EPP bottom contains of *11* pieces modules.
- Put one EPP top (8A04B00027000) onto EPP bottom, seal the EPP box with 2 rolls of tape.
- The seal the EPP box with desiccant bags (8A02B0000B000) will be put into an anti-static bag (8401B0005G000). The ESD bag is sealed with tapes.
- Put one sealed EPP boxed into one box (8201B000K2000).
- The packing quantity per box is *11* pieces. weight (kg) : 5.27 / carton

(2) Second Level: Pallet box level. INX packing method (8B02M000E900N) on this level for this product is 1200 x 800 x 850mm.

- One pallet box is placed on a poly wood pallet wrapped (8A04B00001000) by strips with heat-melt joint.
- One pallet box contains 3 parts-bottom (8201B000K5000), sleeve (8201B000K3000) and cover (8201B000K6000).
- Altogether 24 pieces boxes on one pallet (3 layers and 8 pieces boxes in each layer).
- If not enough full boxes to deliver, fill the pallet box with empty box. Paste "Empty" label for indication.
- The full packing quantity per outer box is 11 x 24 = 264 pieces. weight (kg) : 144.48 / pallet

(3) The pallet packing stack is max. 3 layers.



17. HANDLING AND SAFETY REQUIREMENTS

Warning
The display glass may break when it is dropped or bumped on hard surface. Handle with care. Should the display break, do not touch the liquid crystal material. In case of contamination with liquid crystal material, wash immediately with water and soap.
The display module contains parts that operate at high voltage. Under no circumstances should the front or back cover or the inverter shielding be removed during operation. Do not touch circuit at the backside of the module.

Caution
The display should not be exposed to harmful gasses, such as acid and alkali gasses, which corrode electronic components.
Disassembling the display module can cause permanent damage and invalidates the warrant agreements.
Observe general precautions that are common to handling delicate electronic components. The glass can break and polarizer can easily be damaged. Moreover the display is sensitive to static electricity and other rough environmental conditions.

Caution
Allow enough space at the back of the module for sufficient airflow to disperse heat generated by the backlighting system.
During handling, when the module was dropped to the floor, please do not use the module anymore.

18. DEFINITIONS

Data sheet status	
Objective Specification	This data sheet contains target or goal specifications for product development.
Preliminary Specification	This data sheet contains preliminary data; supplementary data may be published later.
Product Specification	This data sheet contains final product specification.
Limiting values	
Limiting values given are in accordance with the Absolute Maximum Rating System (IEC 134). Stress above one or more of the limiting values may cause permanent damage to the device. These are stress ratings only and operating of the device at these or any other conditions above those given in the Characteristics sections of the specification is not implied. Expose to limiting values for extended periods may affect device reliability.	

19. LIFE SUPPORT APPLICATIONS

These products are not designed for use in life saving appliances, devices or systems where malfunctioning of these products can reasonably be expected to result in personal injury. INX customers using or selling these products for use in such applications do so at their own risk and agree full non liability of INX for any damages resulting from such improper use or sale.