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Specification	
Part Number:	
Version:	
Date:	
Revision	

1 Features

The LCM is a color active matrix thin film transistor (TFT) liquid crystal display (LCD) that uses amorphous silicon TFT as a switching device. This TFT LCD panel has a 3.5 inch diagonally measured active display area with HVGA resolution (320 horizontal by 480 vertical pixels array).

(1) Construction: 3.5” TFT-LCD, White LED driver , Backlight and PCB.
(2) Main LCD :
    1. 3.5” TFT-LCD Panel
    2. Supported HVGA Resolution
    3. Compatible with ROHS Standard
    4. LCD Driver:ILI9488
(3) Interface: LVDS Interface

2 Mechanical specifications

Item	Specification
LCD size	3.5 inch(Diagonal)
Resolution	320 (RGB) X 480
Driver IC	ILI9488
Display mode	Normally White
Display Type	Transmissive
Dot pitch	0.153 (W) X 0.153(H) mm
Active area	48.96(W) X 73.44(H)
Module size	58.0X 87.0 X 5.12
Color Filter Structure	Stripe RGB
Interface	LVDS
View Direction	12 o’clock
Response Time	(30)(Typ.)ms
Contrast Ratio	(500)(Typ.)
NTSC	(60)(Typ.)%

3 Absolute max. ratings and environment

3-1 Absolute max. ratings

Ta=25°C GND=0V

Item	Symbol	Min.	Max.	Unit	Remarks
Power voltage	VDD – GND	-0.3	+4.6	V	
Power voltage	VLED –GND	-0.3	+6.5	V	
Input voltage	VIN	-0.5	VDD+0.3	V	

3-2 Environment

Item	Specifications	Remarks
Storage temperature	Max. +80 °C Min. -30 °C	Note 1: Non-condensing
Operating temperature	Max. +70 °C Min. -20 °C	Note 1: Non-condensing

Note 1：

Ta≦+40 °C・・・・Max.85%RH

Ta＞+40 °C・・・・The max. humidity should not exceed the humidity with 40 °C 85%RH.

4 Electrical specifications

4-1 Electrical characteristics of LCM

(Ta=25 °C)

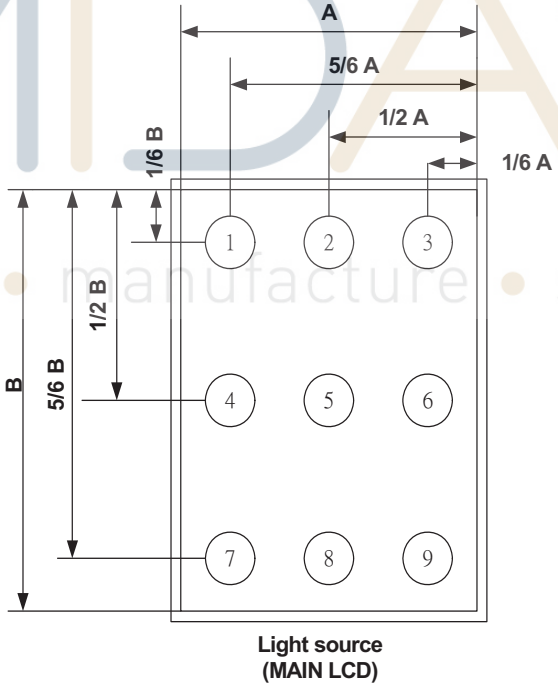
Item	Symbol	Conditions	MIN.	TYP.	MAX.	Unit
Input power voltage	V_{DD}	GND=0	2.5	2.8	3.3	V
LED driver input voltage	V_{LED}	GND=0	2.5	3.3	5.5	V
High-level input voltage	V_{IHC}	GND=0	$0.8V_{DD}$		V_{DD}	V
Low-level input voltage	V_{ILC}	GND=0	0		$0.2V_{DD}$	V
Consumption current of VDD	I_{DD}	LED OFF	-	T.B.D	-	mA
Consumption current of VLED	I_{LED}	V_{LED}=3.3V	-	140	-	mA

※ 1. 1/480 duty.

4-2 LED back light specification

Item	Symbol	Conditions	MIN.	TYP.	MAX.	Unit
Forward voltage	V_f	I_f =15mA	21	22.4	24.5	V
Reverse voltage	V_r		-	-	30	V
Forward current	I_f	7-chip Serial	10	15	20	mA
Power Consumption	P_{BL}	I_f =15mA	-	336	-	mW
Uniformity (with L/G)	-	I_f=15mA	75%*1	-	-	
Bare LED Luminous intensity	I_f	I_f =15mA	3750	-	-	cd/m^2
Color coordinate (Center point)	X	I_f =15mA	0.275	-	0.345	
	Y		0.275	-	0.345	
Luminous color	White					
Chip connection	7 chip Serial connection					

Bare LED measure position:



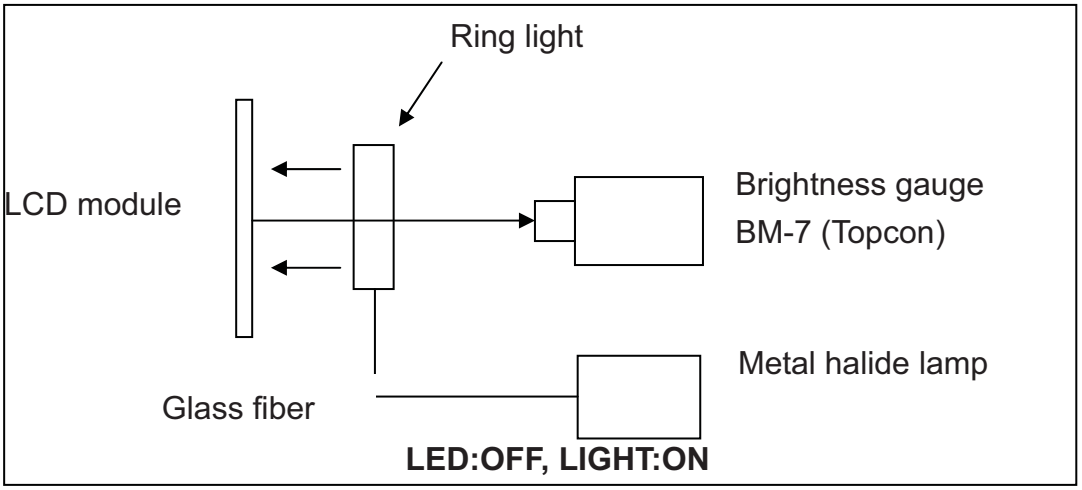
*1 Uniformity (LT): $\frac{Min(P1 \sim P9)}{Max(P1 \sim P9)} \times 100 \geq 80\%$

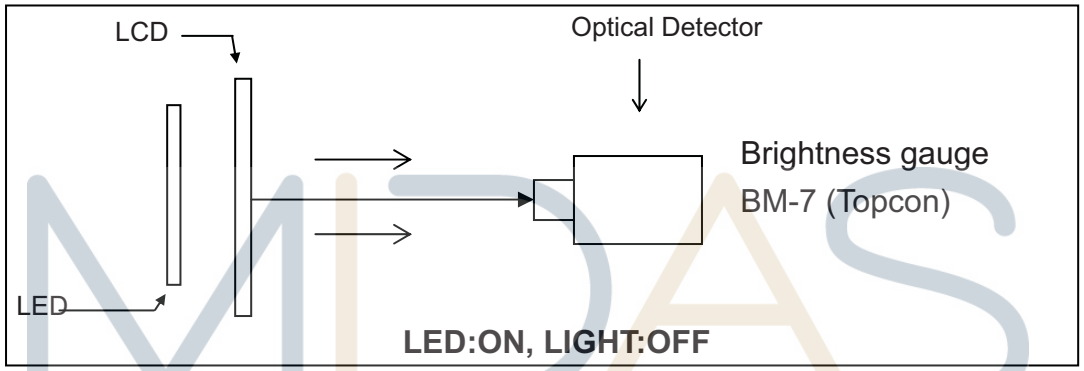
5 Optical characteristics

The optical characteristics are measured under stable conditions as following notes.

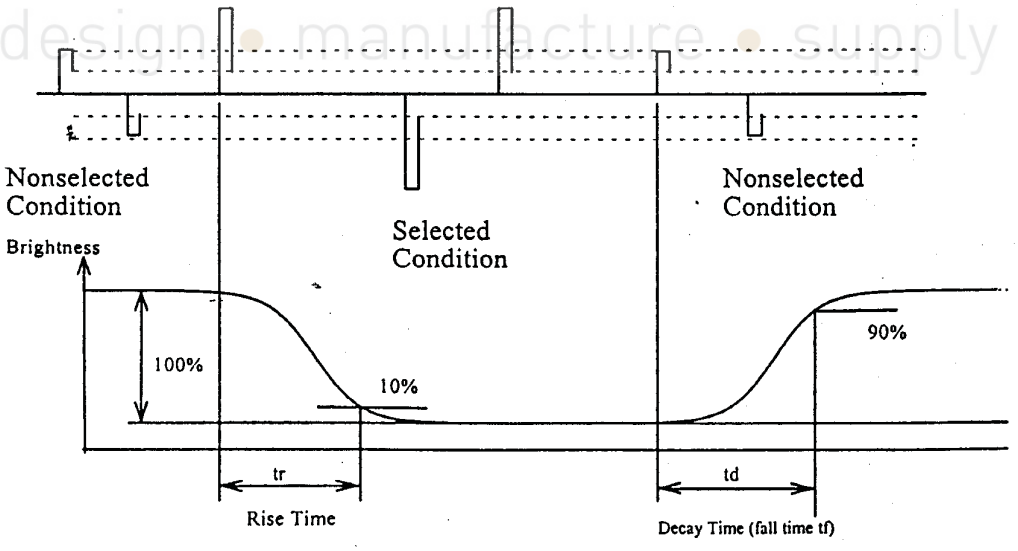
Item	Conditions		Min.	Typ.	Max.	Unit	Conditions
Viewing Angle (CR>10/5)	Horizontal	θx+	-	(70)	-	deg.	(1),(2)
		θx-	-	(70)	-		
	Vertical	θy+	-	(70)	-		
		θy-	-	(60)	-		
Contrast ratio	Center		-	(500)	-	-	(1)
Response Time	Rising + Falling		-	(30)	-	Ms	(1),(3)
CF Color Chromaticity (CIE1931)	Red x		0.562	0.612	0.662		
	Red y		0.268	0.318	0.368		
	Green x		0.090	0.14	0.190		
	Green y		0.109	0.159	0.209		
	Blue x		0.086	0.136	0.186		
	Blue y		0.092	0.142	0.192		
	White x		0.249	0.299	0.349		
	White y		0.284	0.334	0.384		
NTSC	CIE1931		-	(60)	-	%	(1)
Transmittance	-		(5.1)	(5.5)	-	%	(1),(4)
Brightness	Temp 25 °C		360	450			

NOTE 1: Optical characteristic measurement system

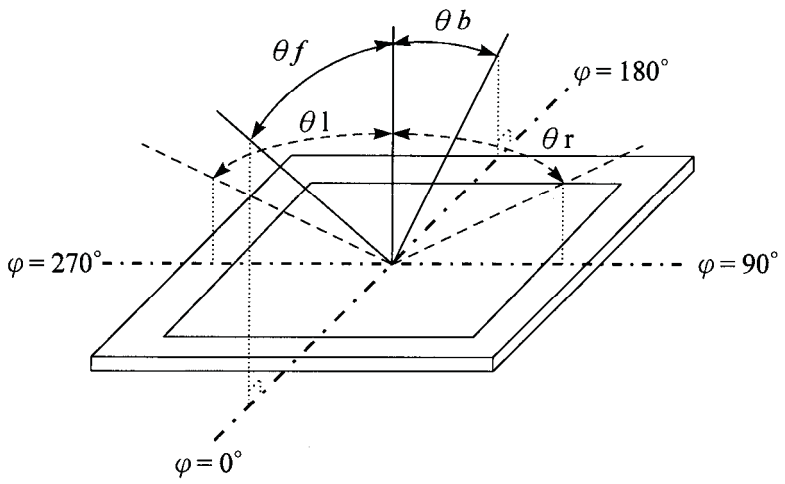




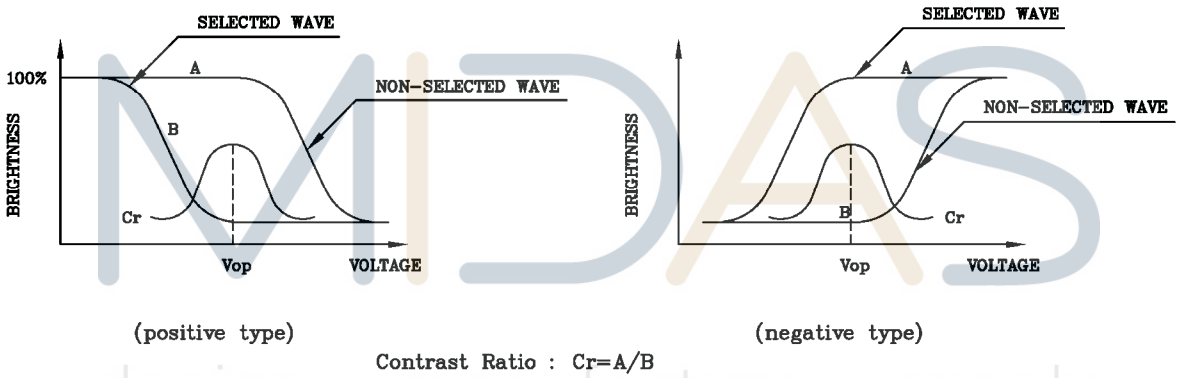
NOTE 2: Response tome definition



NOTE 3: φ、θ definition

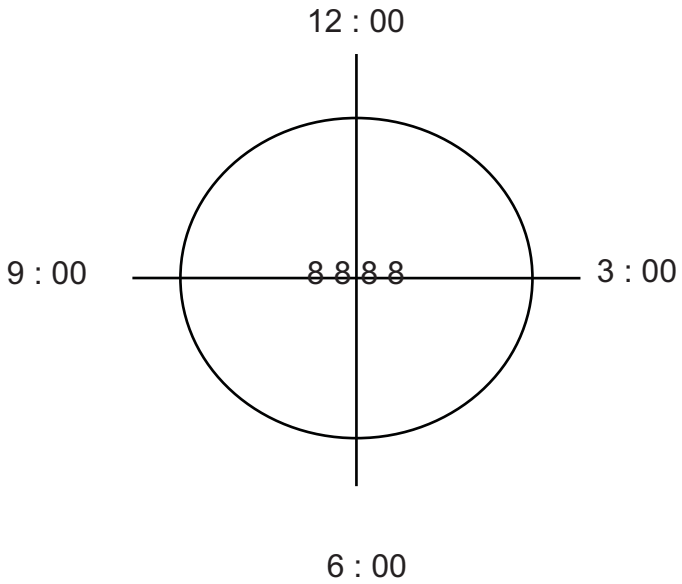


NOTE 4: Contrast definition



Contrast Ratio : Cr=A/B

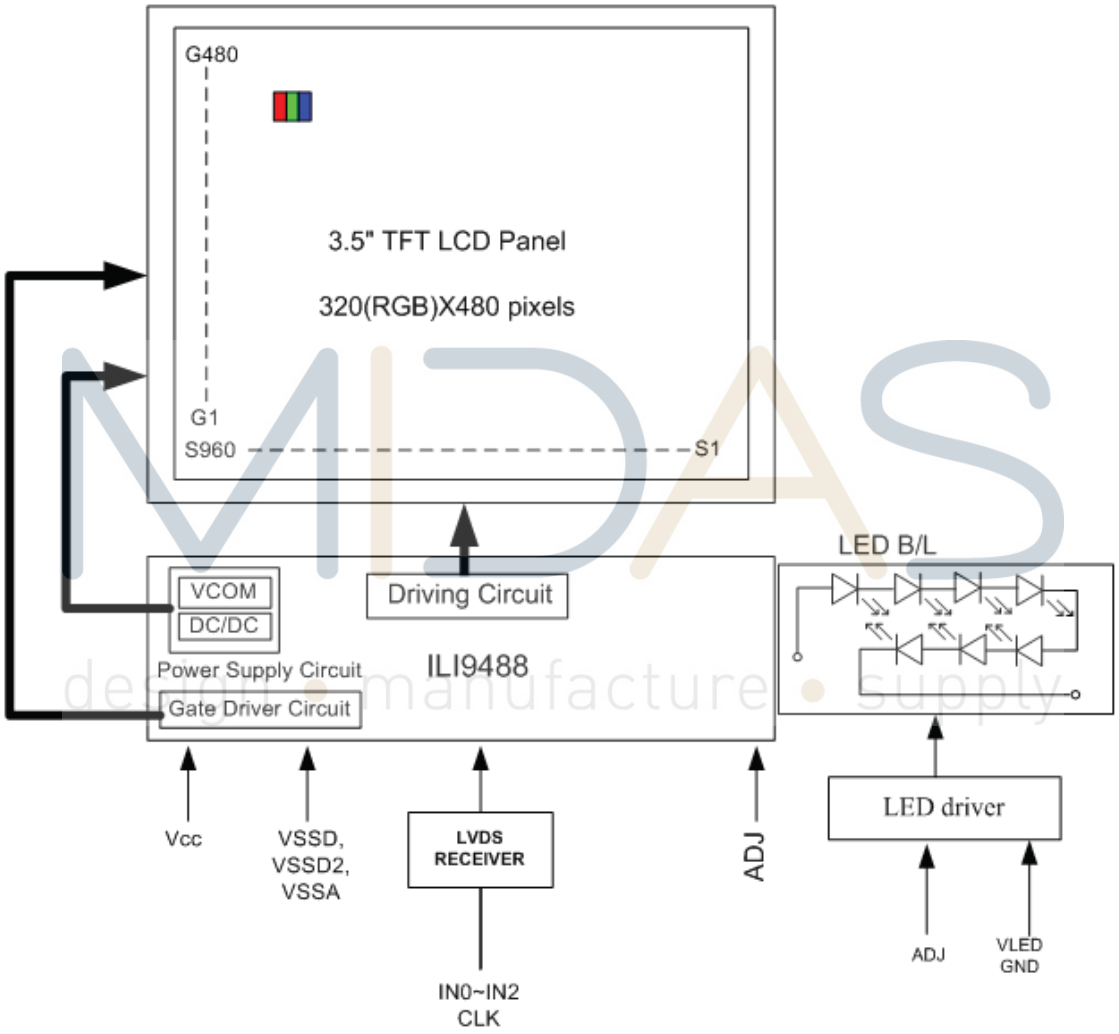
NOTE 5: Visual angle direction priority



6 Block Diagram

Block diagram (Main LCD)

Display format	:	Transmissive ,Normally White
Display composition	:	320 x RGB x 480 dots
LCD Driver	:	ILI9488
Back light	:	White LED x 7



7 Electrical Specifications

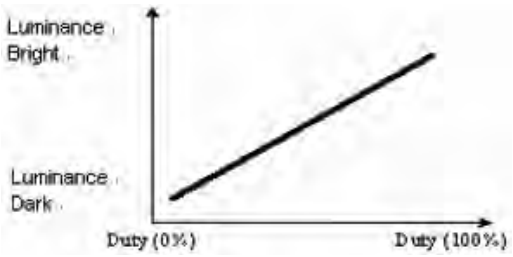
7.1 TFT LCD Panel FPC Descriptions

Pin No	Symbol	Function
1	VDD	POWER SUPPLY
2	VDD	POWER SUPPLY
3	GND	Power Ground
4	GND	Power Ground
5	IN0-	Transmission Data of Pixels
6	IN0+	Transmission Data of Pixels
7	GND	Power Ground
8	IN1-	Transmission Data of Pixels 1
9	IN1+	Transmission Data of Pixels 1
10	GND	Power Ground
11	IN2-	Transmission Data of Pixels 2
12	IN2+	Transmission Data of Pixels 2
13	GND	Power Ground
14	CLK-	Sampling Clock
15	CLK+	Sampling Clock
16	GND	Power Ground
17	ADJ	Adjust for LED brightness
18	VLED	Power supply for LED
19	GND	Power Ground
20	GND	Power Ground

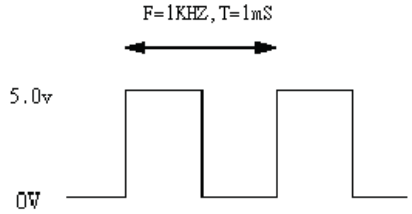
Note1: The module is with a MCU 48R05/06. The MCU will send the initial code to LCD Driver IC when power ON.

NOTE :

1. ADJ adjust brightness to control Pin , Pulse duty the bigger the brighter.



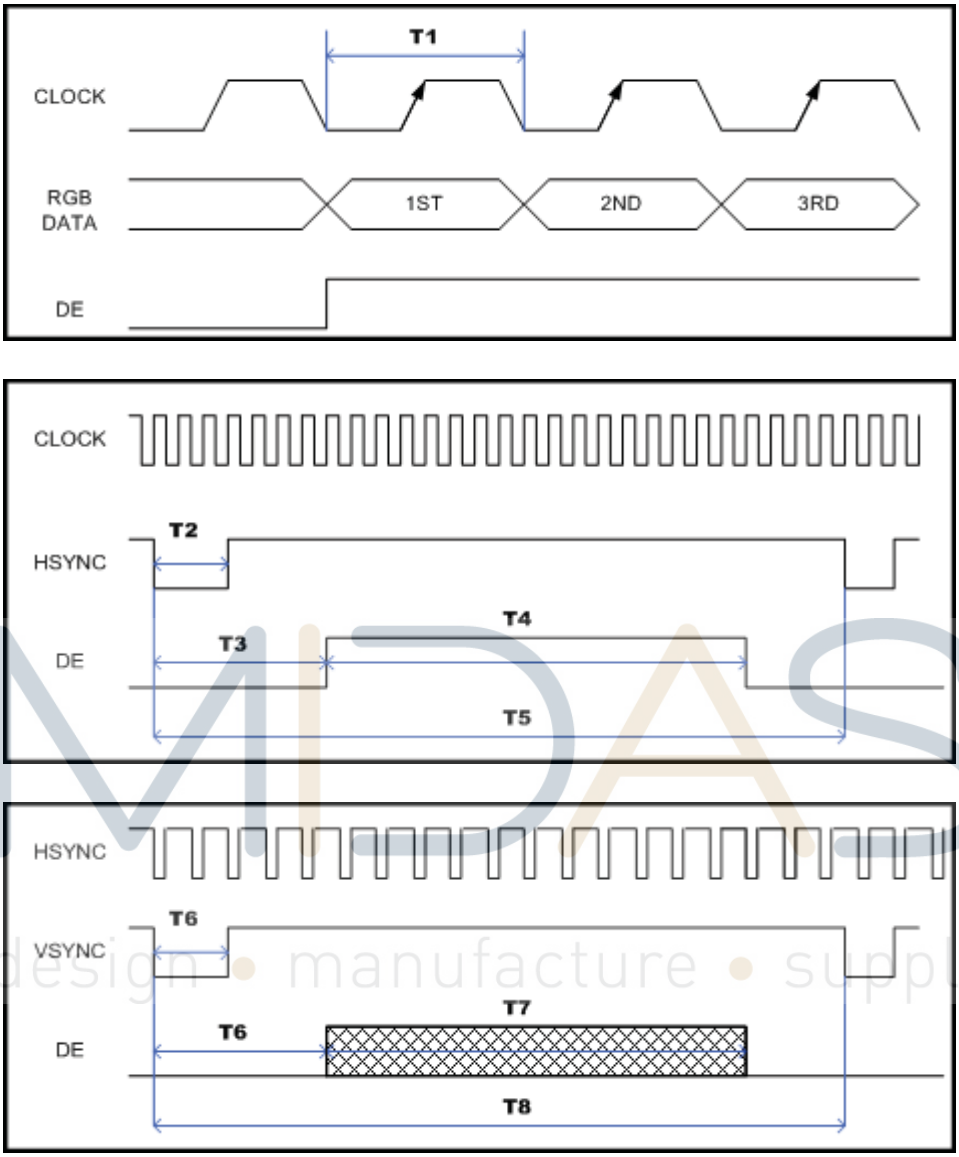
2. ADJ signal = 0 ~ 5.0V , operation frequency : 100Hz~200KHz



3. GND Pin must ground contact , can not be floating.

8. Electrical Characteristics

8.1 Progressive Scan Timing condition for Generic TFT LCD controller.



ITEM	SYMBOL	MIN	TYP	MAX	UNIT
Clock Frequency	1/T1	--	20	--	MHz
HSYNC Plus Wide	T2	3	15	--	clocks
HSYNC to DE	T3	6	15	--	Clocks
Horizontal Display Period	T4	--	320	--	Clocks
Horizontal total Period	T5	--	450	--	Clocks
VSYNC Plus Wide	T2	--	2	--	Lines
VSYNC to DE	T6	--	2		Lines
Vertical Display Period	T7	--	480	--	Lines
Vertical total Period	T8	--	485	--	Lines

8.2.1RGB Interface Timing

The timing chart of 16/18 bit DPI interface mode is illustrated in Figure 19.

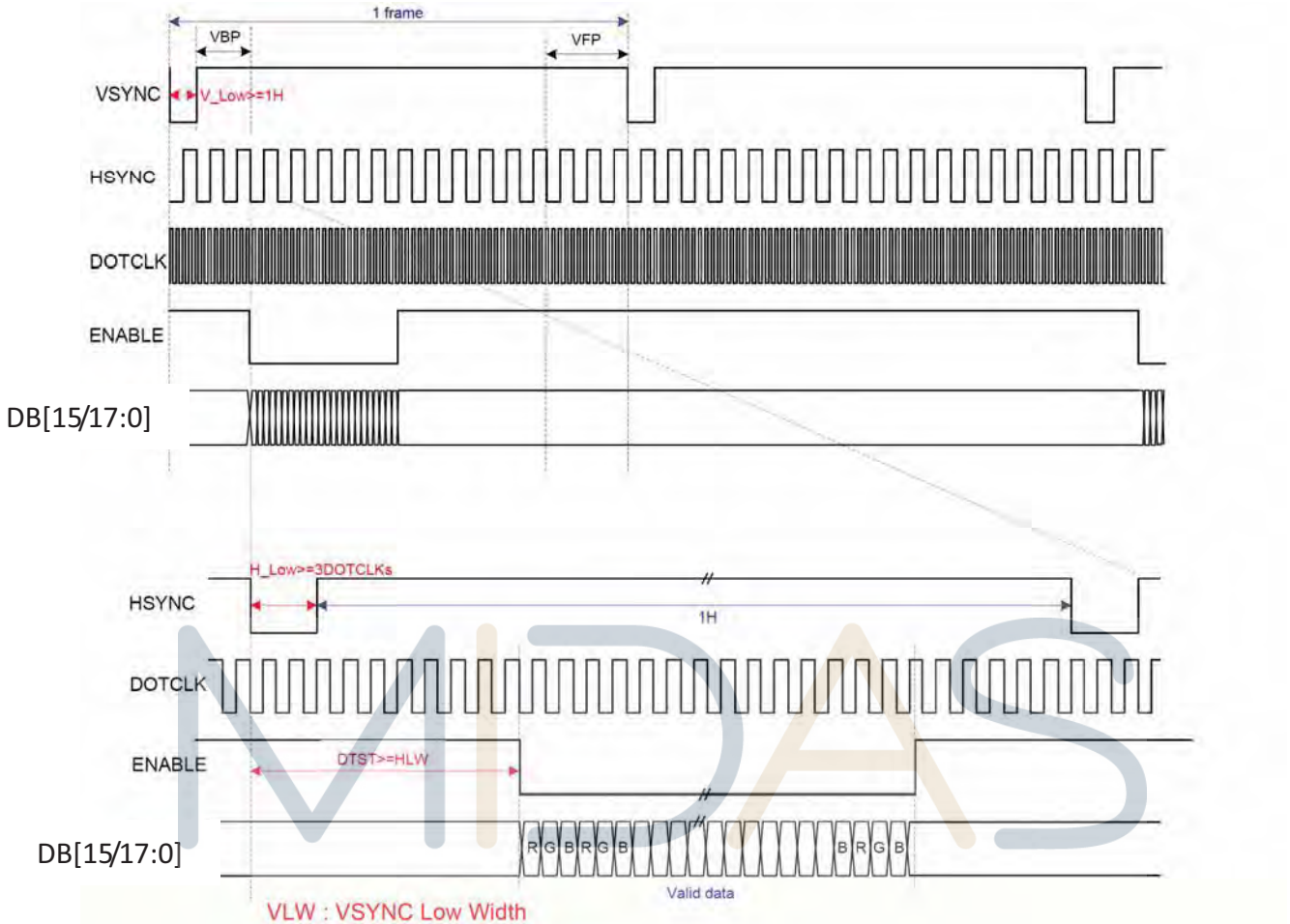
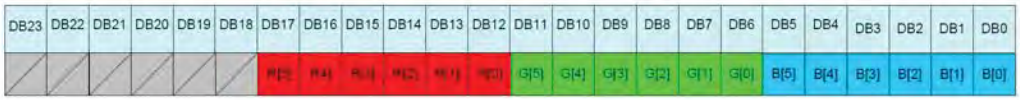
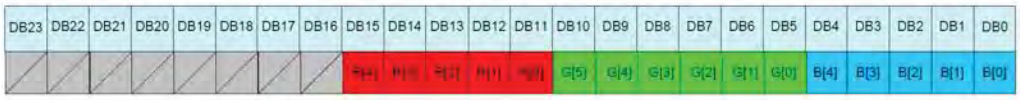


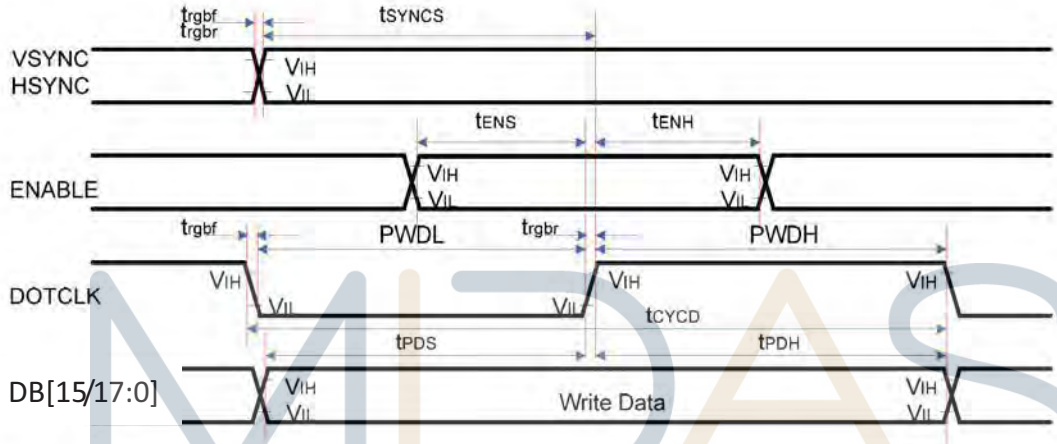
Figure 19: DPI Interface Timing Diagram

18-bit DPI interface connection (DB [17:0] is used): set pixel format DPI [2:0] = 3'h6



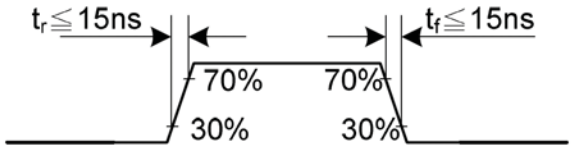
16-bit DPI interface connection (DB [15:0] is used): set pixel format DPI [2:0] = 3'h5





Signal	Symbol	Parameter	min	max	Unit	Description
VSYNC/ HSYNC	t_{SYNCS}	VSYNC/HSYNC setup time	15	-	ns	**16/18** bit bus RGB interface mode
	t_{SYNCH}	VSYNC/HSYNC hold time	15	-	ns	
ENABLE	t_{ENS}	ENABLE setup time	15	-	ns	
	t_{ENH}	ENABLE hold time	15	-	ns	
DB[15/17:0]	t_{POS}	Data setup time	15	-	ns	
	t_{PDH}	Data hold time	15	-	ns	
DOTCLK	PWDH	DOTCLK high-level period	20	-	ns	
	PWDL	DOTCLK low-level period	20	-	ns	
	t_{CYCD}	DOTCLK cycle time	50	-	ns	
	t_{rgbr}, t_{rgbf}	DOTCLK,HSYNC,VSYNC rise/fall time	-	15	ns	

Note: Ta = -30 to 70 ℃, IOVCC = 1.65V to 3.3V, VCI = 2.5V to 3.3V, AGND = DGND = 0V



8.2.2 LVDS Signal

switching characteristics over recommended operating conditions (unless otherwise noted)

PARAMETER		TEST CONDITIONS	MIN	TYP†	MAX	UNIT
t_{su}	Setup time, D0–D20 to CLKOUT↓	C_L = 8 pF, See Figure 5	5			ns
t_h	Data hold time, CLKOUT↓ to D0–D20		5			ns
$t_{(RSKM)}$	Receiver input skew margin§ (see Figure 7)	t_c = 15.38 ns (±0.2%), |Input clock jitter| < 50 ps¶,	550	700		ps
t_d	Delay time, CLKIN↑ to CLKOUT↓ (see Figure 7)	V_{CC} = 3.3 V, t_c = 15.38 ns (±0.2%), T_A = 25°C	3	5	7	ns
t_{en}	Enable time, $\overline{SHTDN}$ to phase lock	See Figure 7		1		ms
t_{dis}	Disable time, $\overline{SHTDN}$ to off state	See Figure 8		400		ns
t_t	Transition time, output (10% to 90% t_r or t_f) (data only)	C_L = 8 pF		3		ns
t_t	Transition time, output (10% to 90% t_r or t_f) (clock only)	C_L = 8 pF		1.5		ns
t_w	Pulse duration, output clock			0.50 t_c		ns

† All typical values are at V_{CC} = 3.3 V, T_A = 25°C.

§ The parameter $t_{(RSKM)}$ is the timing margin available to allocate to the transmitter and interconnection skews and clock jitter. The value of this parameter at clock periods other than 15.38 ns can be calculated from t_{RSKM} = tc/14 – 550 ps.

¶ |Input clock jitter| is the magnitude of the change in input clock period.

PARAMETER MEASUREMENT INFORMATION

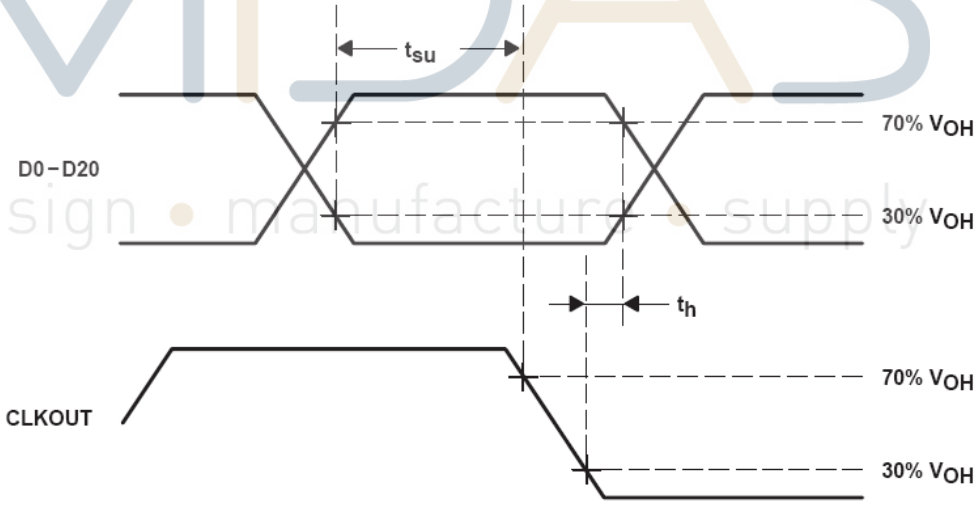


Figure 5. Setup and Hold Time Waveforms

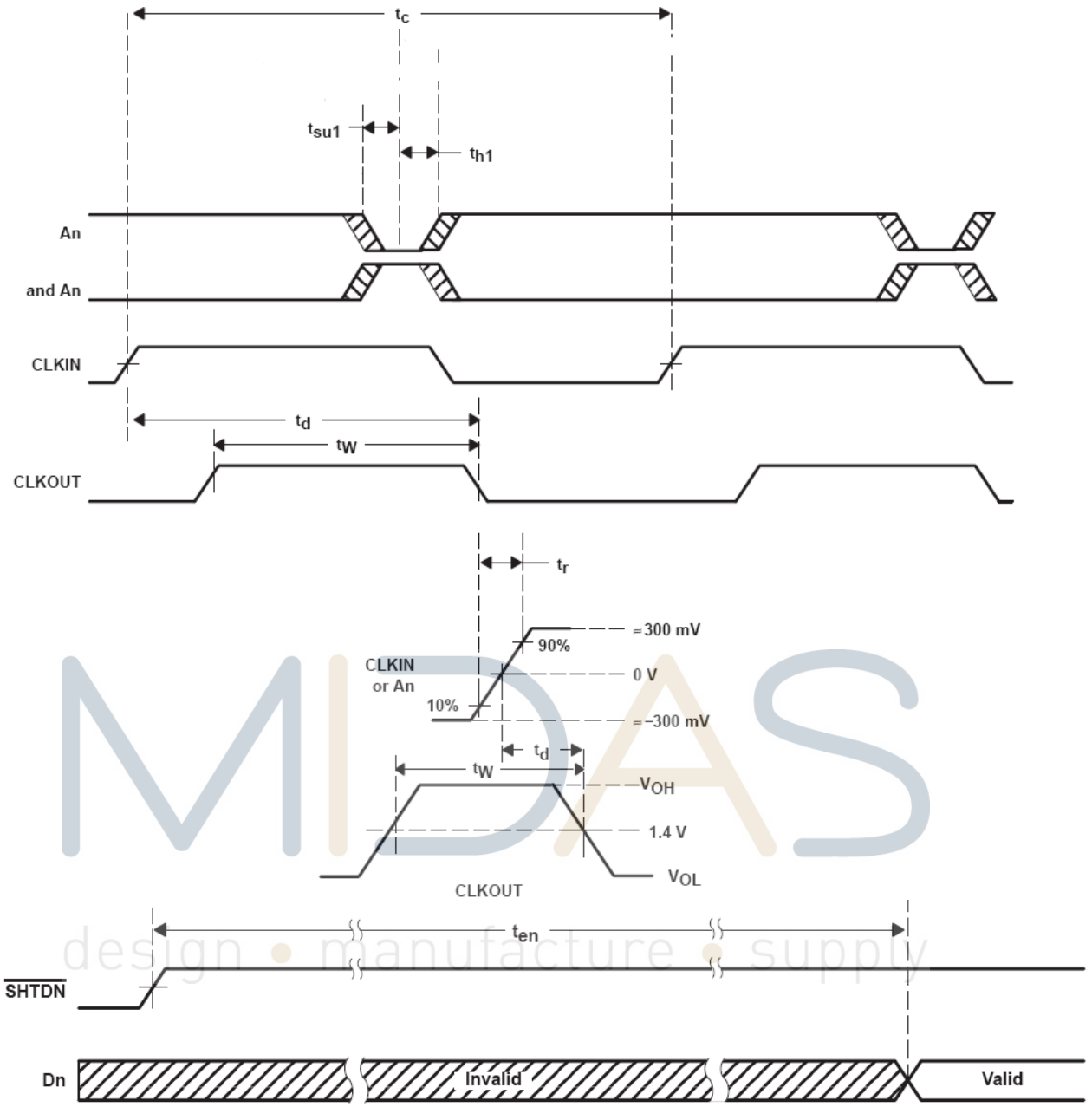


Figure 7. Enable Time Waveforms

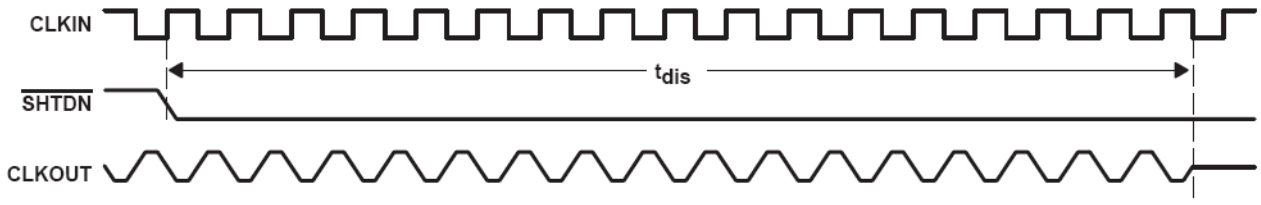
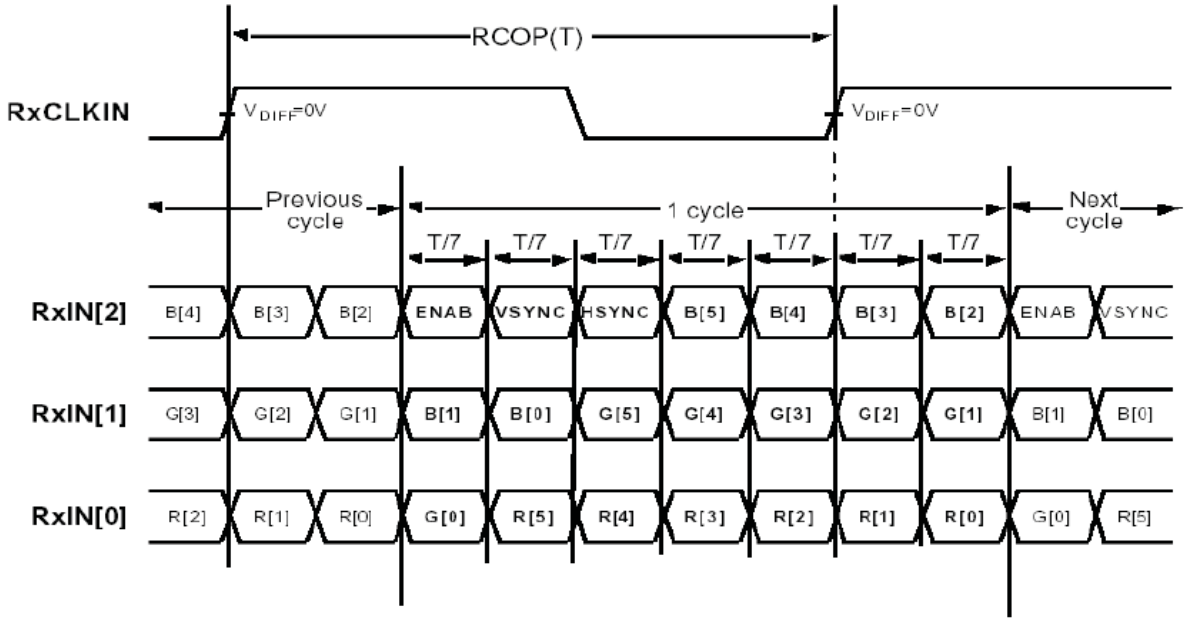


Figure 8. Disable Time Waveforms

8.2.3 The Input Data Format



Note : R/G/B[5]s are MSBs and R/G/B[0]s are LSBs

Signal Name	Description	Remark
R7 R6 R5 R4 R3 R2 R1 R0	Red Data 7 Red Data 6 Red Data 5 Red Data 4 Red Data 3 Red Data 2 Red Data 1 Red Data 0	Red-pixel Data For 8Bits LVDS input MSB: R7 ; LSB: R0 For 6Bits LVDS input MSB: R5 ; LSB: R0
G7 G6 G5 G4 G3 G2 G1 G0	Green Data 7 Green Data 6 Green Data 5 Green Data 4 Green Data 3 Green Data 2 Green Data 1 Green Data 0	Green-pixel Data For 8Bits LVDS input MSB: G7 ; LSB: G0 For 6Bits LVDS input MSB: G5 ; LSB: G0
B7 B6 B5 B4 B3 B2 B1 B0	Blue Data 7 Blue Data 6 Blue Data 5 Blue Data 4 Blue Data 3 Blue Data 2 Blue Data 1 Blue Data 0	Blue-pixel Data For 8Bits LVDS input MSB: B7 ; LSB: B0 For 6Bits LVDS input MSB: B5 ; LSB: B0
RxCLKIN	LVDS Data Clock	
DE	Data Enable Signal	When the signal is high, the pixel data shall be valid to be displayed.

9. RELIABILITY

Test Item	Test Conditions	Note
High Temperature Operation	70±3°C , t=240 hrs	
Low Temperature Operation	-20±3°C , t=240 hrs	
High Temperature Storage	80±3°C , t=240 hrs	1,2
Low Temperature Storage	-30±3°C , t=240 hrs	1,2
Humidity Test	40°C , Humidity 90%, 72 hrs	1,2
Thermal Shock Test	-30°C ~ 25°C ~ 80°C 30 min. 5 min. 30 min. (1 cycle) Total 5 cycle	1,2
Vibration Test (Packing)	Sweep frequency：10~55~10 Hz/1min Amplitude : 0.75mm Test direction : X.Y.Z/3 axis Duration : 30min/each axis	2

Note 1: Condensation of water is not permitted on the module.

Note 2: The module should be inspected after 1 hour storage in normal conditions (15-35°C, 45-65%RH).

Definitions of life end point:

- Current drain should be smaller than the specific value.
- Function of the module should be maintained.
- Appearance and display quality should not have degraded noticeably.
- Contrast ratio should be greater than 50% of the initial value.

10 USE PRECAUTIONS

10-1 Handling precautions

1) The polarizing plate may break easily so be careful when handling it. Do not touch, press or rub it with a hard-material tool like tweezers.
2) Do not touch the polarizing plate surface with bare hands so as not to make it dirty. If the surface or other related part of the polarizing plate is dirty, soak a soft cotton cloth or chamois leather in benzine and wipe off with it. Do not use chemical liquids such as acetone, toluene and isopropyl alcohol. Failure to do so may bring chemical reaction phenomena and deteriorations.
3) Remove any spit or water immediately. If it is left for hours, the suffered part may deform or decolorize.
4) If the LCD element breaks and any LC stuff leaks, do not suck or lick it. Also if LC stuff is stuck on your skin or clothing, wash thoroughly with soap and water immediately.

10-2 Installing precautions

1) The PCB has many ICs that may be damaged easily by static electricity. To prevent breaking by static electricity from the human body and clothing, earth the human body properly using the high resistance and discharge static electricity during the operation. In this case, however, the resistance value should be approx. 1MΩ and the resistance should be placed near the human body rather than the ground surface. When the indoor space is dry, static electricity may occur easily so be careful. We recommend the indoor space should be kept with humidity of 60% or more. When a soldering iron or other similar tool is used for assembly, be sure to earth it.
2) When installing the module and ICs, do not bend or twist them. Failure to do so may crack LC element and cause circuit failure.
3) To protect LC element, especially polarizing plate, use a transparent protective plate (e.g., acrylic plate, glass etc) for the product case.
4) Do not use an adhesive like a both-side adhesive tape to make LCD surface (polarizing plate) and product case stick together. Failure to do so may cause the polarizing plate to peel off.

10-3 Storage precautions

1) Avoid a high temperature and humidity area. Keep the temperature between 0°C and 35°C and also the humidity under 60%.
2) Choose the dark spaces where the product is not exposed to direct sunlight or fluorescent light.
3) Store the products as they are put in the boxes provided from us or in the same conditions as we recommend.

10-4 Operating precautions

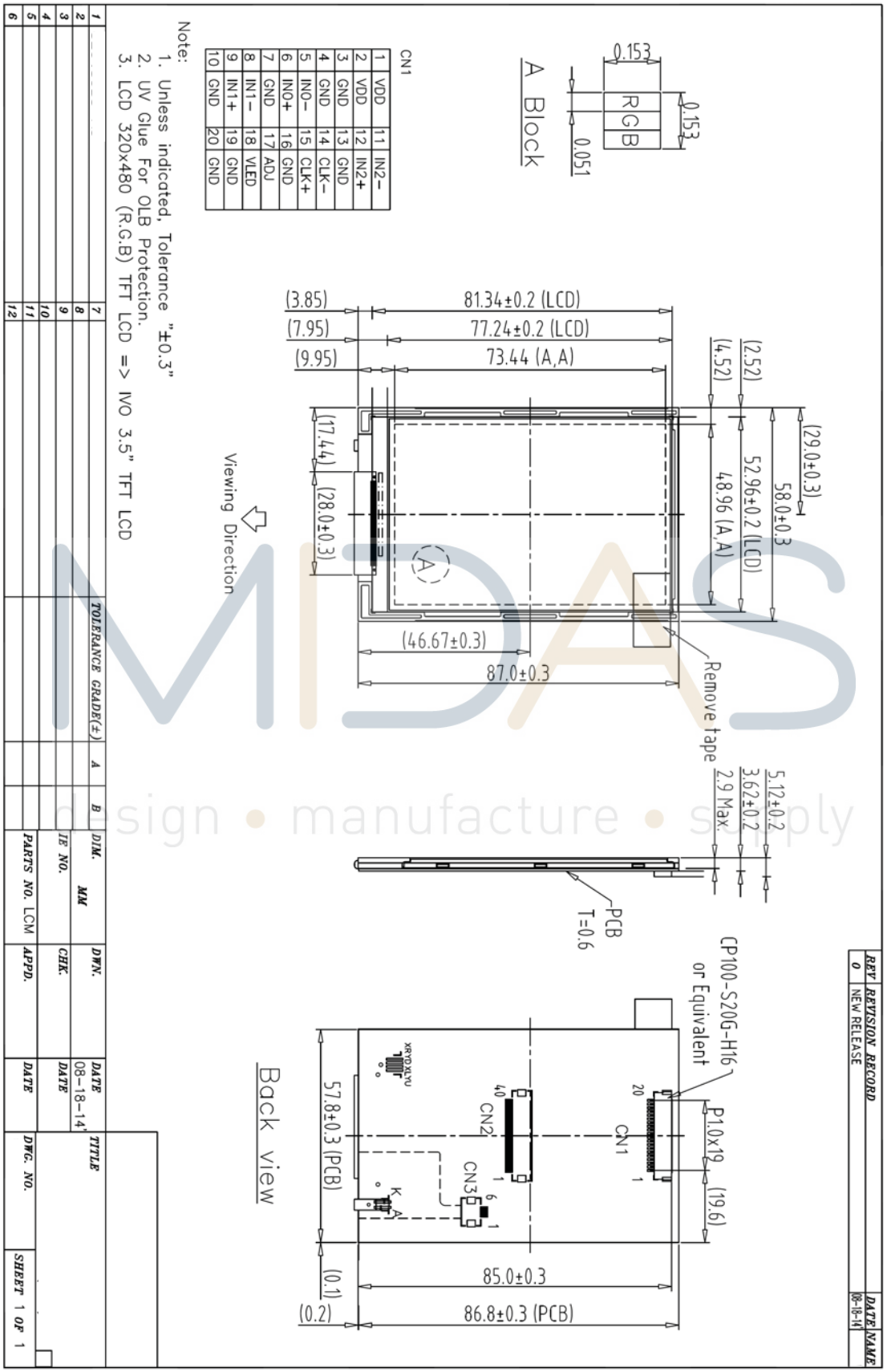
1) Do not boost the applied drive voltage abnormally. Failure to do so may break ICs. When applying power voltage, check the electrical features beforehand and be careful. Always turn off the power to the LC module controller before removing or inserting the LC module input connector. If the input connector is removed or inserted while the power is turned on, the LC module internal circuit may break.
2) The display response may be late if the operating temperature is under the normal standard, and the display may be out of order if it is above the normal standard. But this is not a failure; this will be restored if it is within the normal standard.
3) The LCD contrast varies depending on the visual angle, ambient temperature, power voltage etc. Obtain the optimum contrast by adjusting the LC dive voltage.
4) When carrying out the test, do not take the module out of the low-temperature space suddenly. Failure to do so will cause the module condensing, leading to malfunctions.
5) Make certain that each signal noise level is within the standard (L level: 0.2Vdd or less and H level: 0.8Vdd or more) even if the module has functioned properly. If it is beyond the standard, the module may often malfunction. In addition, always connect the module when making noise level measurements.
6) The CMOS ICs are incorporated in the module and the pull-up and pull-down function is not adopted for the input so avoid putting the input signal open while the power is ON.
7) The characteristic of the semiconductor element changes when it is exposed to light emissions, therefore ICs on the LCD may malfunction if they receive light emissions. To prevent these malfunctions, design and assemble ICs so that they are shielded from light emissions.

8) Crosstalk occurs because of characteristics of the LCD. In general, crosstalk occurs when the regularized display is maintained. Also, crosstalk is affected by the LC drive voltage. Design the contents of the display, considering crosstalk.

10-5 Other

1) Do not disassemble or take the LC module into pieces. The LC modules once disassembled or taken into pieces are not the guarantee articles.
2) The residual image may exist if the same display pattern is shown for hours. This residual image, however, disappears when another display pattern is shown or the drive is interrupted and left for a while. But this is not a problem on reliability.
3) Midas will provide one year warrantee for all products and three months warrantee for all repairing products.

11. MECHANIC DRAWING



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