

PRELIMINARY PRODUCT INFORMATION

(All information in this technical data sheet is subject to change without notice.)

Updated: Feb 14, 2017

0.5" 1280x720 (HD720) LCoS Display

KLS-050-HD720

LCoS (liquid Crystal on Silicon) Field Sequential Color DISPLAY Module

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Revision History

Rev	ECN No.	Description of changes	Date	Prepared
P0		Initial release	02/14/17	John Kim

1. General Description

KLS-050-HD702 is LCoS (liquid crystal on silicon) reflective display module with integrated RGB LED driver. It has 0.5" active area with 1280x720 (HD720) resolution with over 82% reflection ratio. Gray scale on the pixel is determined with an 8-bit gray scale signal for each dot.

The application for this product include HMD (head mount display), HUD (head up display), projectors and more.

General Specification

ITEM	SPECIFICATION
Active area	11.008(H) x 6.192(V) mm
Number of pixels	1280(H) x 720(V)
Pixel pitch	0.0086(H) x 0.0086(V) mm
Module outline dimension	25.00(H) x 11.00(V) x 4.05(H) mm
Color depth	8-bit gray scale
Display mode	Reflective (mirror)
Reflection Ratio	Minimum 82% (at $\lambda = 550\text{nm}$)

2. Absolute Maximum Rating

2.1 Environmental Maximum Rating

Parameter	Symbol	Values		Units	Notes
		Min.	Max.		
Operating Temperature	T _{OP}	-10	+70	°C	1
Storage Temperature	T _{ST}	-40	+85	°C	1

Note: 1. Humidity \leq 90% RH. No condensation.

2.2 Electrical Maximum Rating

Symbol	Description	Ratings		Unit
		Min.	Max.	
V _{DDH}	Driver Power Supply Voltage	-0.3	+15	VDC
V _{DDL}	Logic Power Supply Voltage	-0.3	+3.6	VDC
T _{Operating}	Operating Temperature	-10	+70	°C
T _{Storage}	Storage Temperature	-40	+85	°C

Stresses above what is listed under "Absolute Maximum Rating" may cause permanent damage to the device. These are stress ratings only. Functional operation of this device at these or any other conditions above what is indicated in the operational sections of this specification is not implied and exposure to absolute maximum rating conditions for extended periods may affect device reliability.

3. Electrical Characteristics

Symbol	Description	Min.	Typ.	Max.	Unit	Condition
V _{DDH}	Driver Power Supply Voltage	10.0	12.0	13.5	VDC	R xVCM =1.2 V
V _{DDL}	Logic Power Supply Voltage	1.7	1.8	2.0	VDC	
V _{DDLED}	LED Power Supply Voltage	2.0	5.0	6.0	VDC	
V _{DDLVDS}	LVDS Input Voltage	1.125	1.25	1.375	VDC	
I _{LVDS}	LVDS Input Current	-10		10	μA	Min. in V=GND Max. in V=V _{DDL}
Power	Display module Driver Current		10	20	mA	V _{DDH}
	Display module Logic Current		20	50	mA	V _{DDL}
	LED Power Current		20	100	mA	V _{LED}
	Power Consumption (Display Module)		156	370	mW	
	Power Consumption (FSC LED)		100	600	mW	

4. Power On/Off Sequence

4.1 Power ON sequence

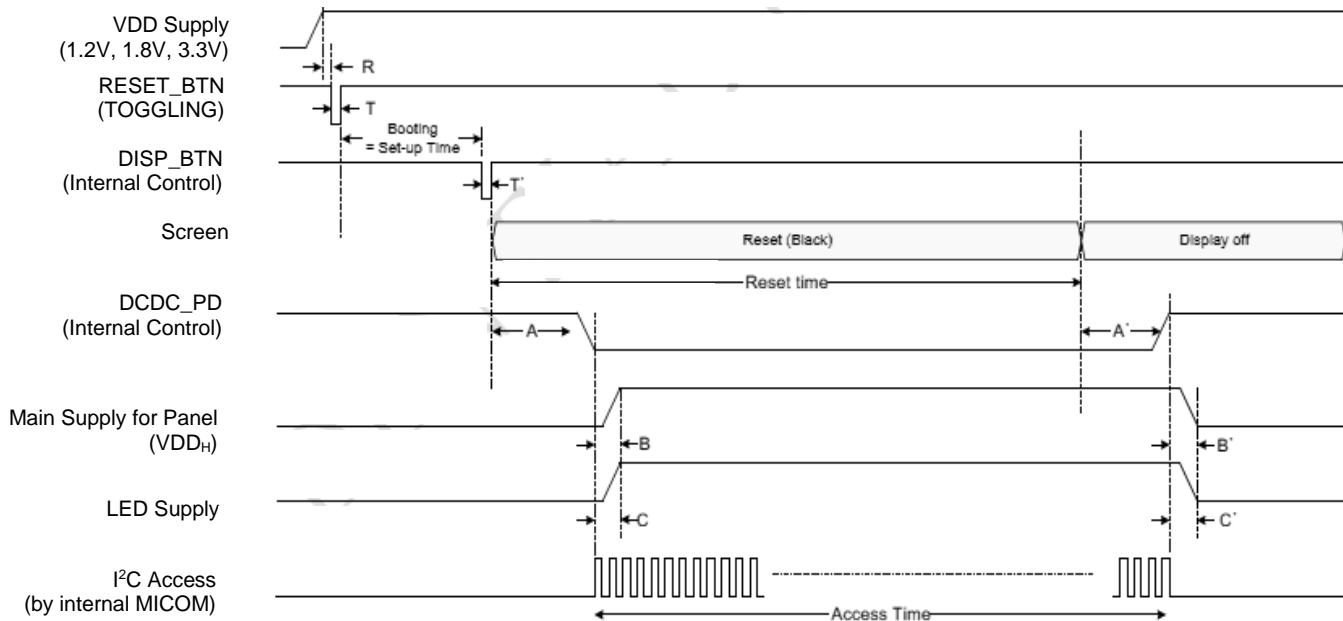
Parameter	Symbol	Min	Unit
Power-Up Setup Margin 1.2V, 1.8V, 3.3V		Don't care	
RESETB	R	1	ms
RESETB(Toggling) ¹	T	1	ms
Internal Booting Timing	Booting	500	ms
DISP_BTN(Internal Toggling) ²	T'	1	ms
Reset time(Internal Control)	Reset Time	1000	ms
DCDC_PD (Internal Control)	A	50	ms
Main Supply for Panel (VDDH)	B	10	ms
LED Supply	C	10	ms
DCDC_PD Disable (After Reset, internal Control)	A'	50	ms
Main Supply (VDDH)	B'	10	ms
LED Supply	C'	10	ms
I ² C Access(Internal access by MICOM) ³	Access Time	1000	ms

Notes:

¹ RESETB Toggling

² Internal MICOM used only.

³ Do not access from external MCU during this time.

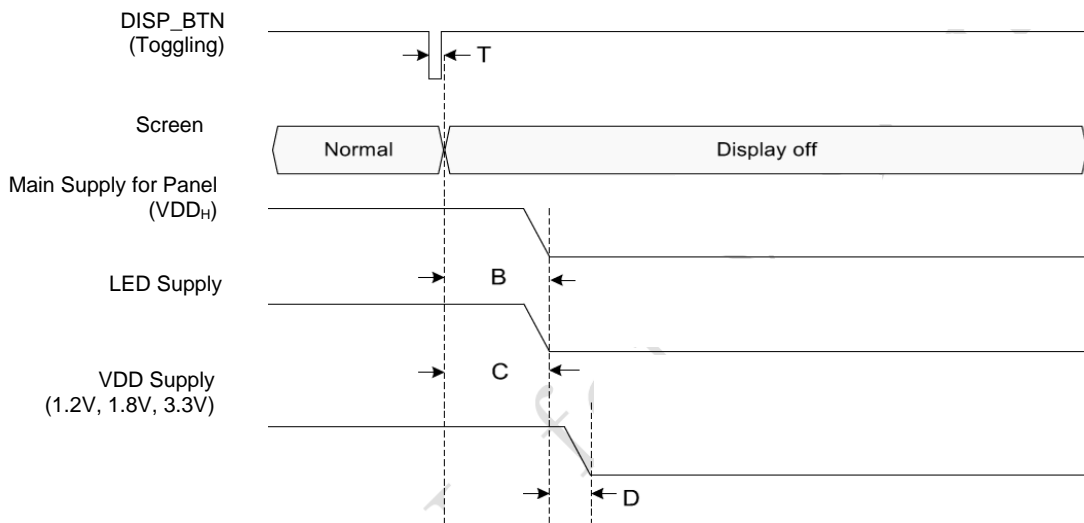


4.2 Power Off sequence

Parameter	Symbol	Min	Unit
DISP_BTN(Toggling) ¹	T	1	ms
DCDC_PD(Internal Control)	A	50	ms
Main Supply for Panel (VDDH)	B	10	ms
LED Supply	C	10	ms
VDD Supply(1.2V, 1.8V, 3.3V)	D	10	ms

Notes:

¹To Power Off reset. DISP_BTN Toggling.

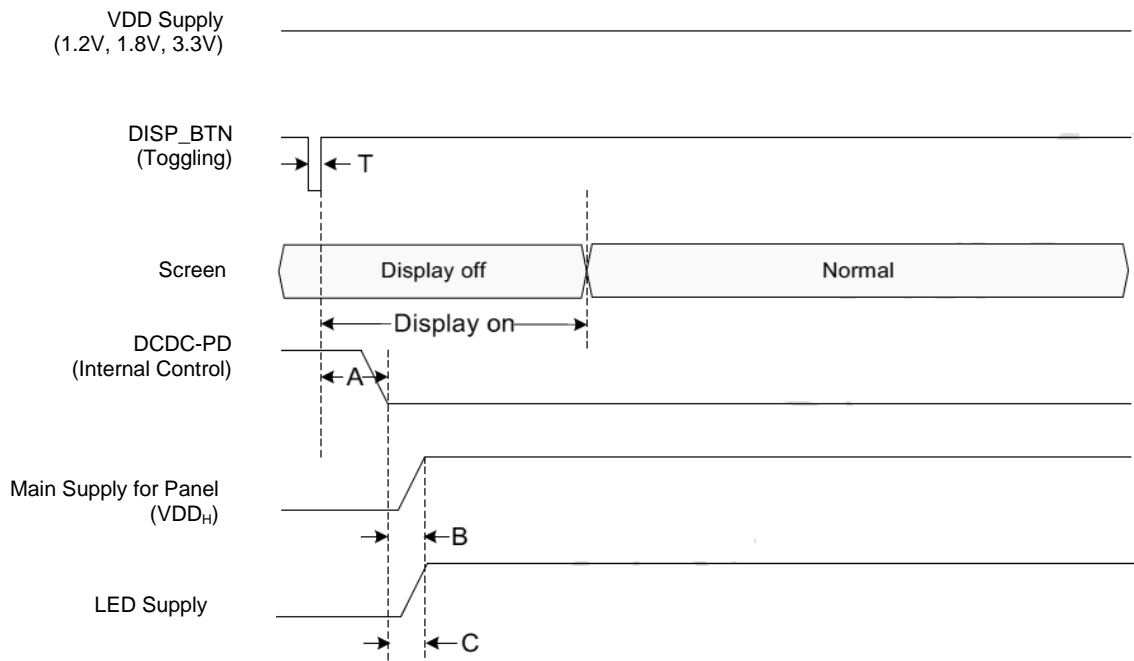


4.3 Display ON sequence

Parameter	Symbol	Min	Unit
DISP_BTN (Toggling) ¹	T	1	ms
Display on	Display on	150	ms
DCDC_PD(Internal Control)	A	50	ms
Main Supply for Panel (VDDH)	B	10	ms
LED Voltage Supply	C	10	ms

Notes:

¹Display on signal (DISP_BTN Toggling)

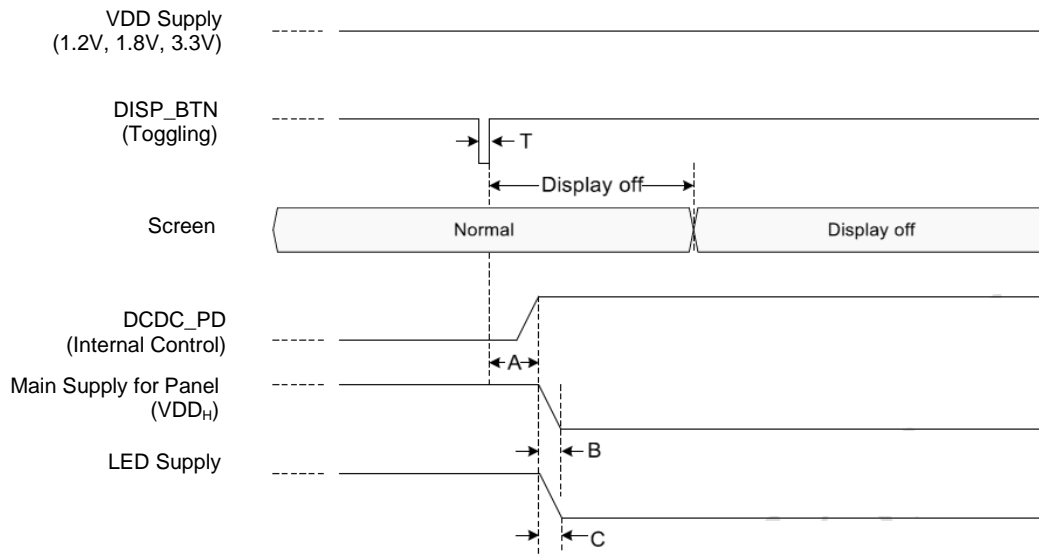


4.4 Display OFF sequence

Parameter	Symbol	Min	Unit
DISP_BTN (Toggling) ¹	T	1	ms
Display off	Display off	150	ms
DCDC_PD (Internal Control)	A	50	ms
Main Supply for Panel (VDDH)	B	10	ms
LED Supply	C	10	ms

Notes:

¹ Display Off signal. (DISP_BTN Toggling)

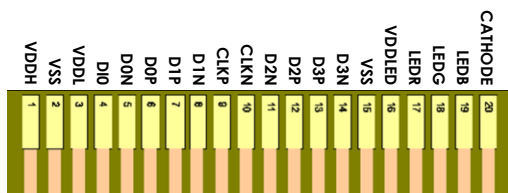


5. Interface Connection

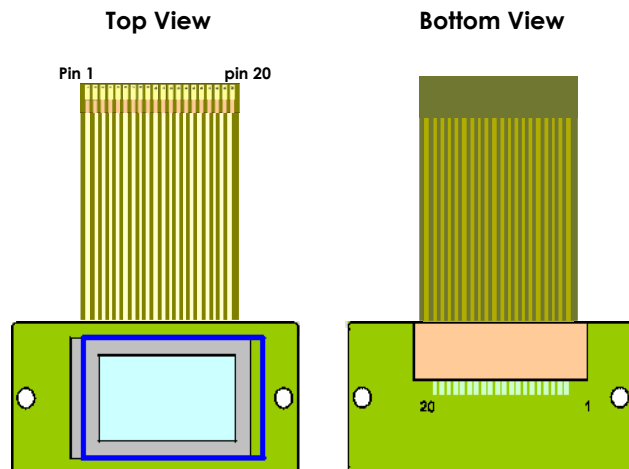
LCoS Display Driving Section (Pin assignment)

Connector Used: Hirose TF31-20S-0.5SH or equivalent

Pin	Name	I/O	Description
1	V _{DDH}	I	12.0V analog power supply
2	V _{SS}	I	Ground common for analog & digital
3	V _{DDL}	I	1.8V digital power supply
4	D _{I0}	I	Command and packet strobe
5	D _{0N}	I	LVDS Differential Data Input - (ch0)
6	D _{0P}	I	LVDS Differential Data Input + (ch0)
7	D _{1P}	I	LVDS Differential Data Input + (ch1)
8	D _{1N}	I	LVDS Differential Data Input - (ch1)
9	CLK _P	I	LVDS Differential Clock Input +
10	CLK _N	I	LVDS Differential Clock Input -
11	D _{2N}	I	LVDS Differential Data Input - (ch2)
12	D _{2P}	I	LVDS Differential Data Input + (ch2)
13	D _{3P}	I	LVDS Differential Data Input + (ch3)
14	D _{3N}	I	LVDS Differential Data Input - (ch3)
15	V _{SS}	I	Ground common for analog & digital
16	V _{DDLED}	I	5.0V LED power supply
17	LED _R	O	Anode. LED Red
18	LED _G	O	Anode. LED Green
19	LED _B	O	Anode. LED Blue
20	Cathode	I	LED common cathode

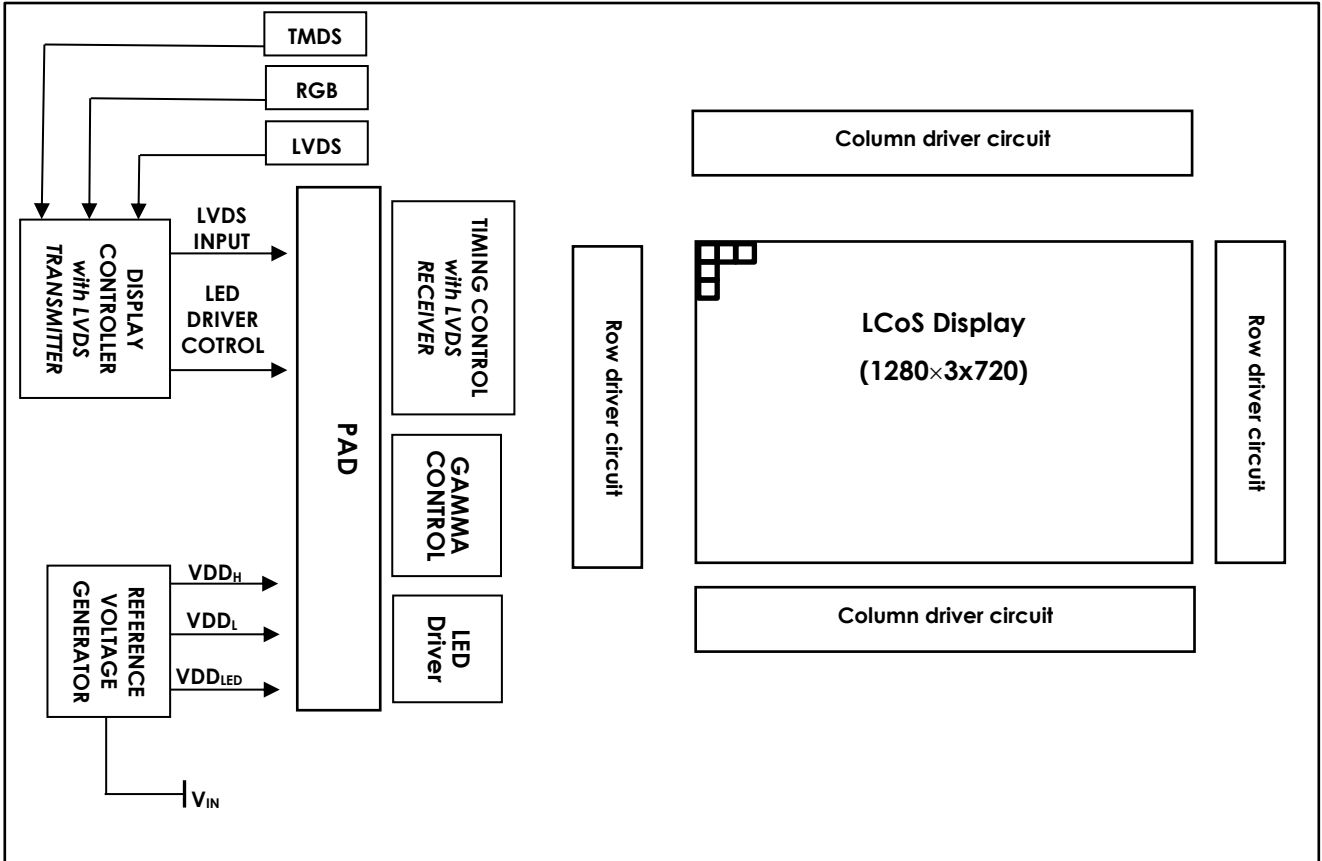


FPC Pin configuration



6. LCoS Display driving

6.1 Interface Block Diagram



6.2 LVDS interface command packet

Address Select Pin (AS)	MSB							Bit Name		LSB
	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0	Bit 0	
D0P/N	0	0	0	0	0	0	0	0	0	
D1P/N	POL		0	0	FS		0	0	0	
D2P/N	OE		0	0	LS		0	0	0	
D3P/N	0	0	0	0	0	0	0	0	0	

6.3 LVDS interface option packet

Address Select Pin (AS)	MSB				Bit Name			LSB	
	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0	Bit 0
D0P/N	DCON<4:0>				0	0	0	0	0
D1P/N	LED<2:0>		0	WE<1:0>		0	0	0	0
D2P/N	WDATA<5:0>						0	0	0
D3P/N	ADDR<6:1>						0	ADDR<0>	

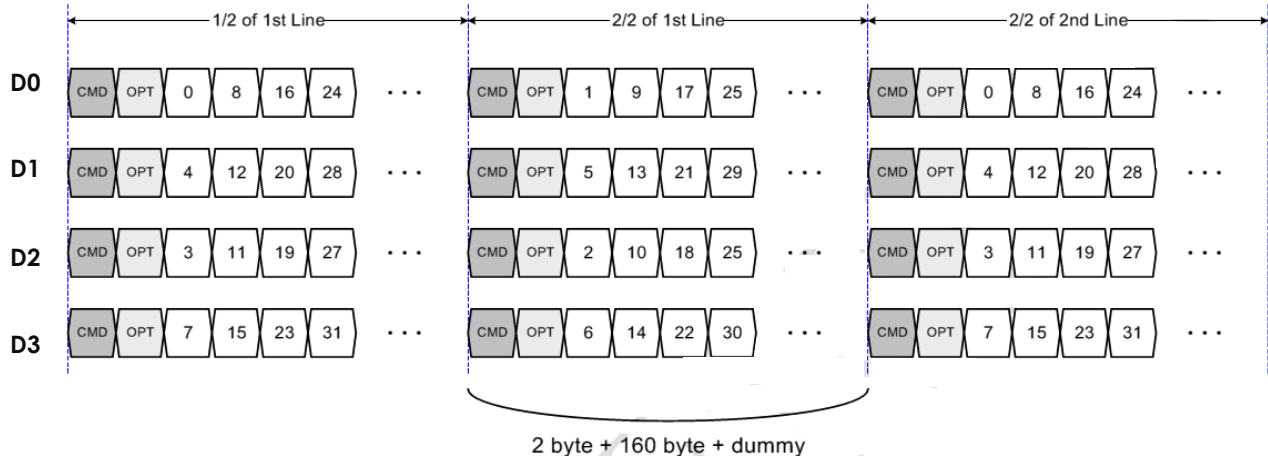
6.4 LVDS interface command packet description

Name	Bit(s)	Description
FS	<1:0>	Frame Start
LS	<1:0>	Line Start
POL	<1:0>	Inverse Pixel Driving Voltage
OE	<1:0>	Not Used

6.5 LVDS interface option packet description

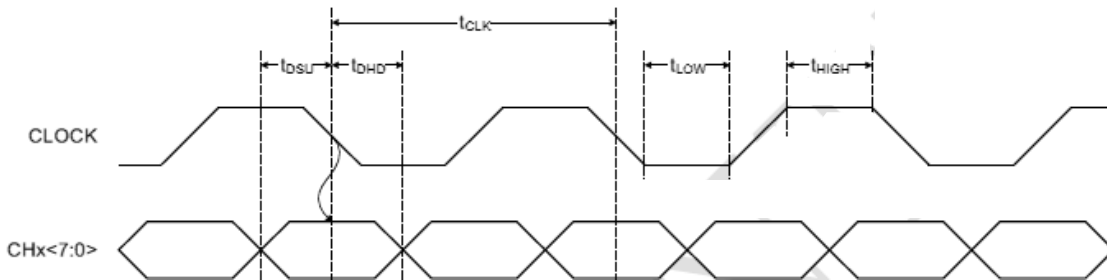
Name	Bit(s)	Description
DCON	<4:0>	Dimming Control. (Control signal of LED driver)
WE	<1:0>	Register Write Enable
LED	<2:0>	<0>Red, <1>Green, <2>Blue LED ON / OFF
WDATA	<5:0>	Register Write Data
ADDR	<6:0>	Register Read Data

6.5 DATA packet format



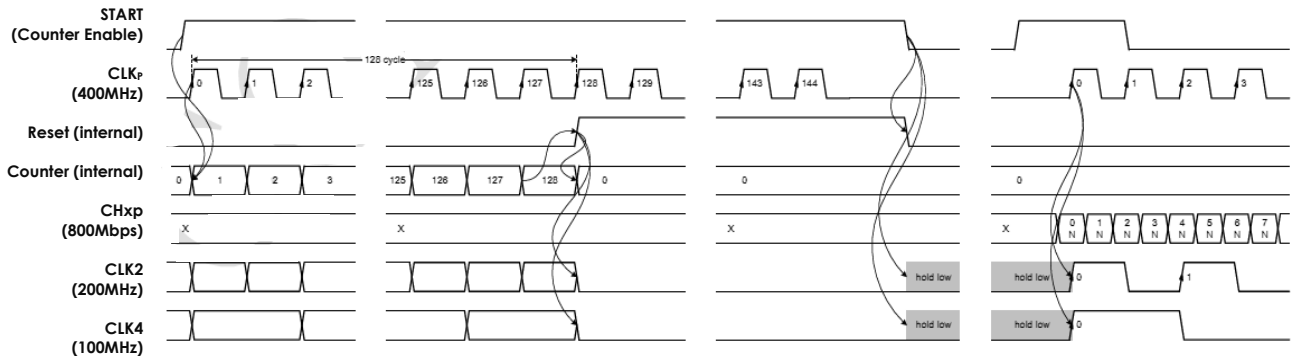
6.6 Serial DATA Input Timing

Parameter	Symbol	Standard Mode		Fast Mode		Unit
		Min	Max	Min	Max	
LVDS Tx Clock Period	t _{CLK}				400	MHz
High Period of the LVDS Tx Clock	t _{HIGH}	1.0		0.7		ns
Low Period of the LVDS Tx Clock	t _{LOW}	1.0		0.7		ns
Data Setup Time	t _{DSU}	1.0		0.3		ns
Data Hold Time	t _{DHD}	0.4	3.45	0.3	0.9	ns



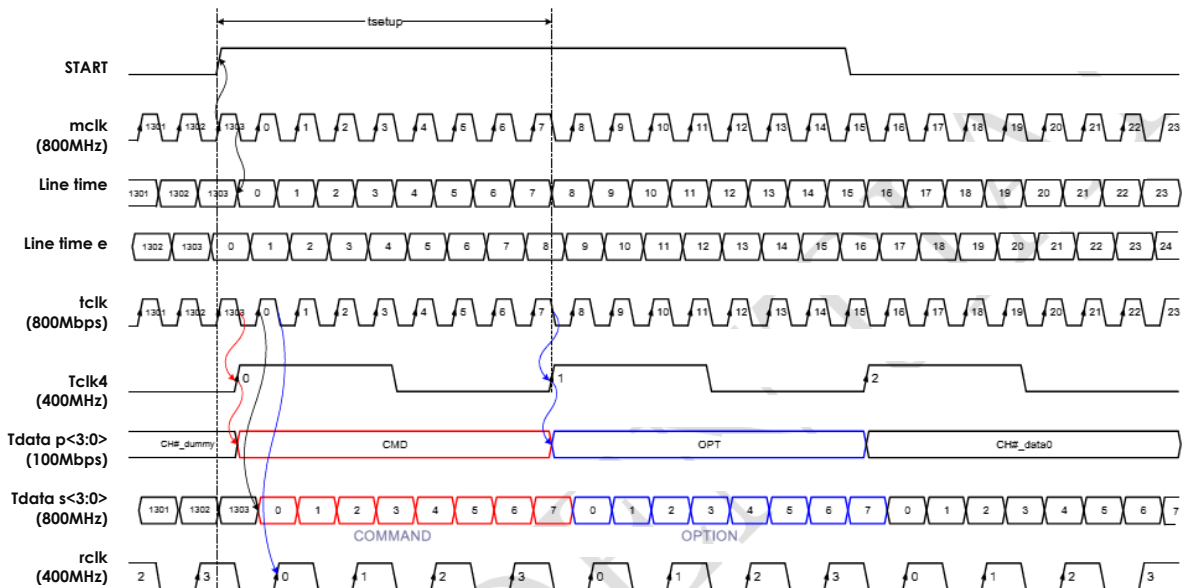
6.7 Reset Timing Diagram

- Power ON reset
- Long START reset
- Enable Reset: START high over 128 cycle duration
- Need several clock toggling to reset safely
- Disable reset: START falling
- C_CLOCK synchronized at 1st CLK risign dege
- Data bit 0 is also defined.

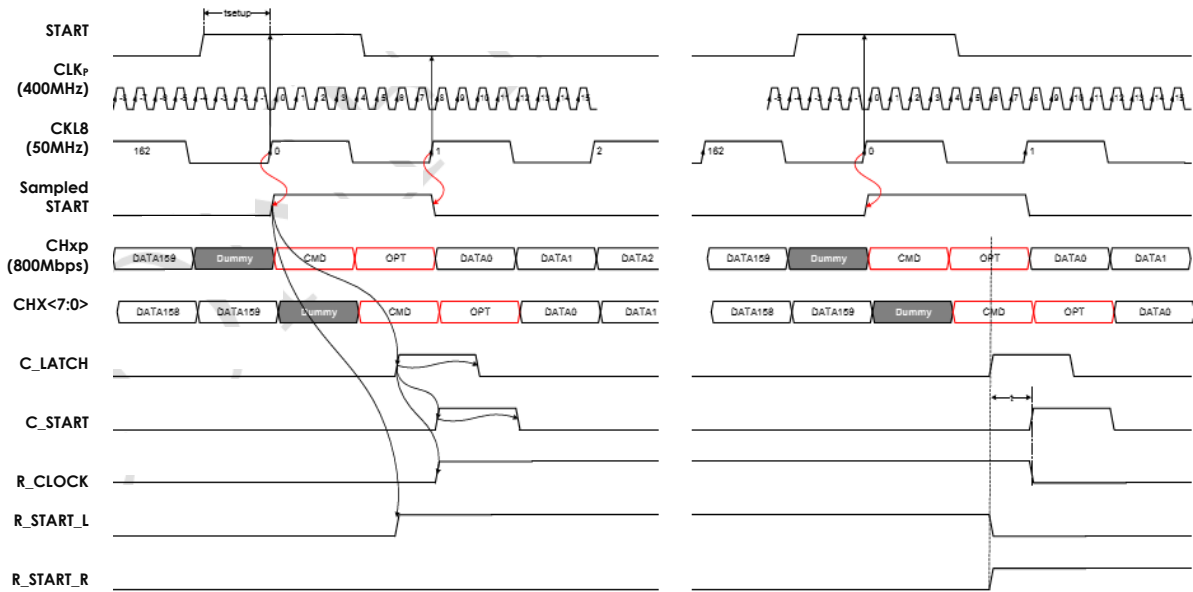


6.8 Command and Option Packet Timing

- START rise before line cycle 0
- Output serial data @ rising edge of tclk
- Double rate of rclk Clock
- Change parallel data @ falling edge of tclk (half cycle earlier)

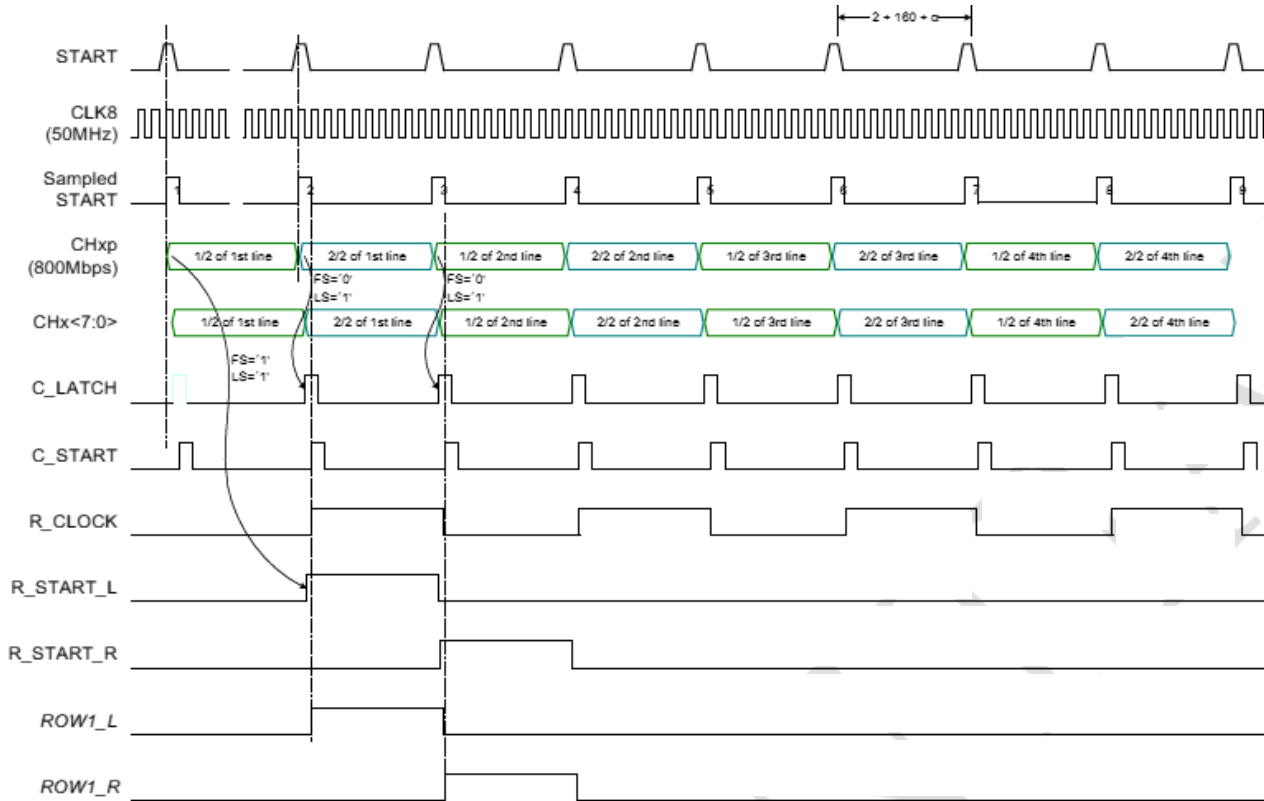


Command and Option Packet Timing 1

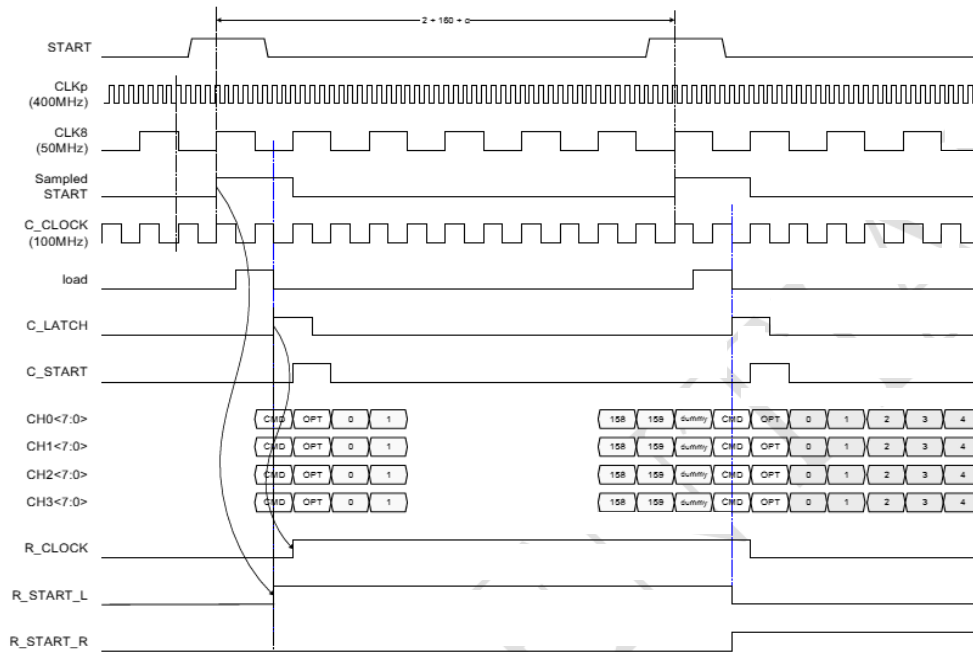


Command and Option Packet Timing 2

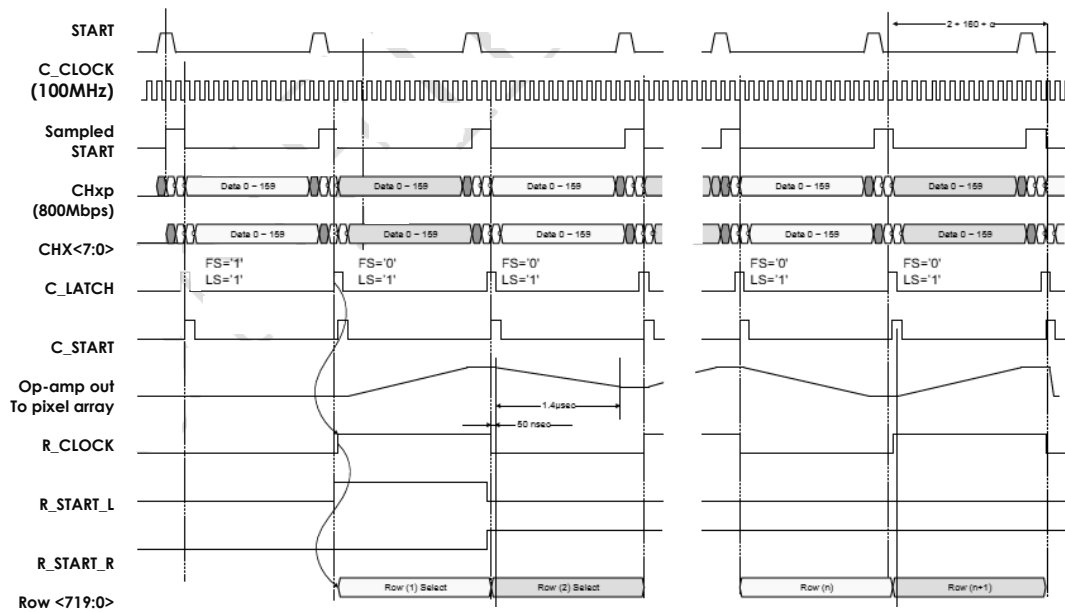
6.9 Row line select signal timing



6.10 Column signal timing

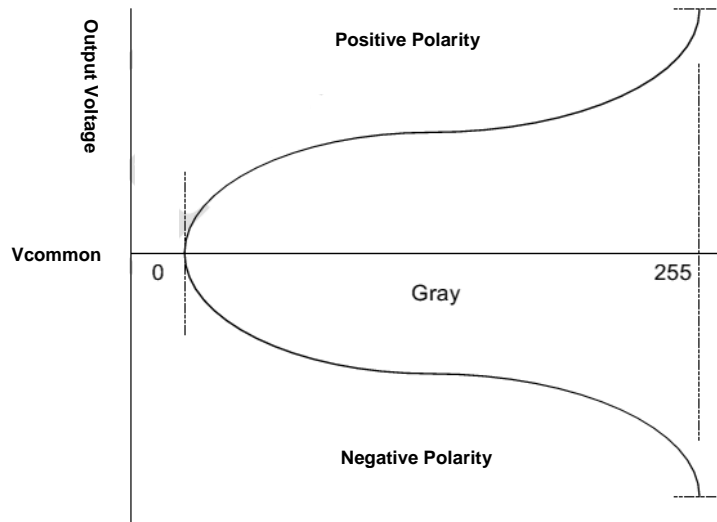
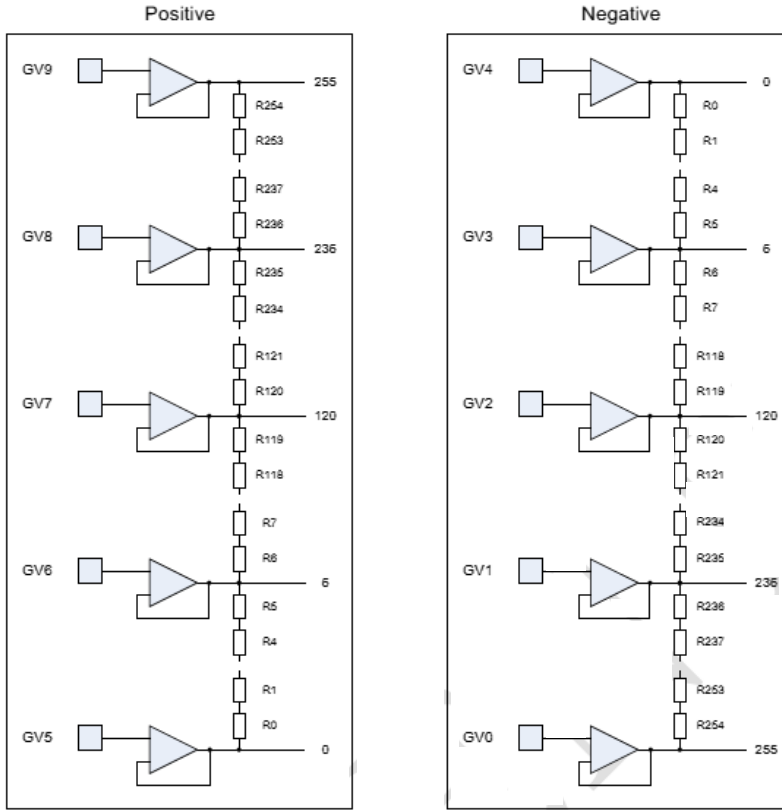


Colume Signal Timing 1

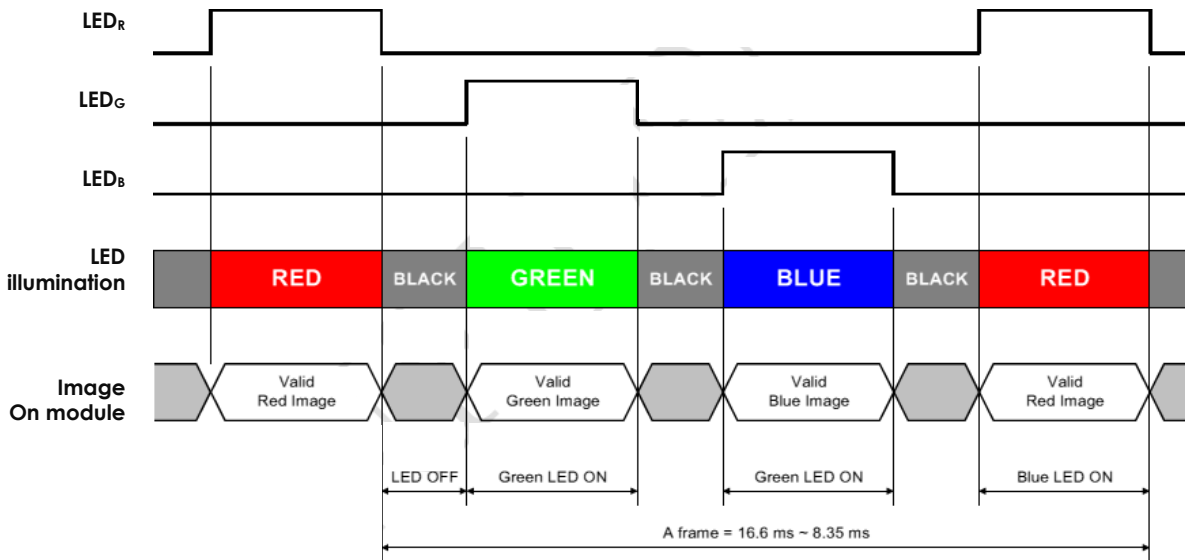
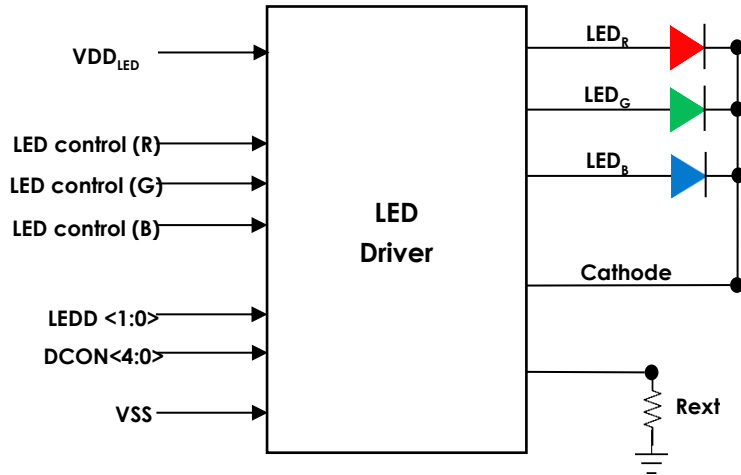


Column Signal Timing 2

6.11 Gamma R-String & TAB voltages



6.12 LED Driving



7. Optical Specifications

Optical characteristics are determined after the unit has been 'ON' and stable in a dark environment at 25°C. The values specified are at an approximate distance 50cm from the reflected image surface at the center.

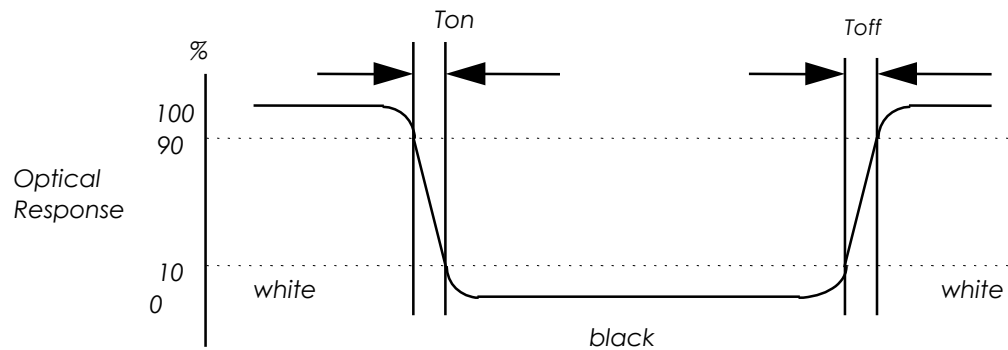
Parameter	Symbol	Cond.	Min	Typ	Max	Unit	Notes
Contrast Ratio (with FSC LED Backlight)	CR		-	500	-		1
Reflection Ratio ($\lambda=550\text{nm}$)	R		-	83	-	%	
Response Time	Tr	Ta=25°C	-	0.7	-	ms	2
Response Time	Td	Ta=25°C	-	0.8	-	ms	2

Notes

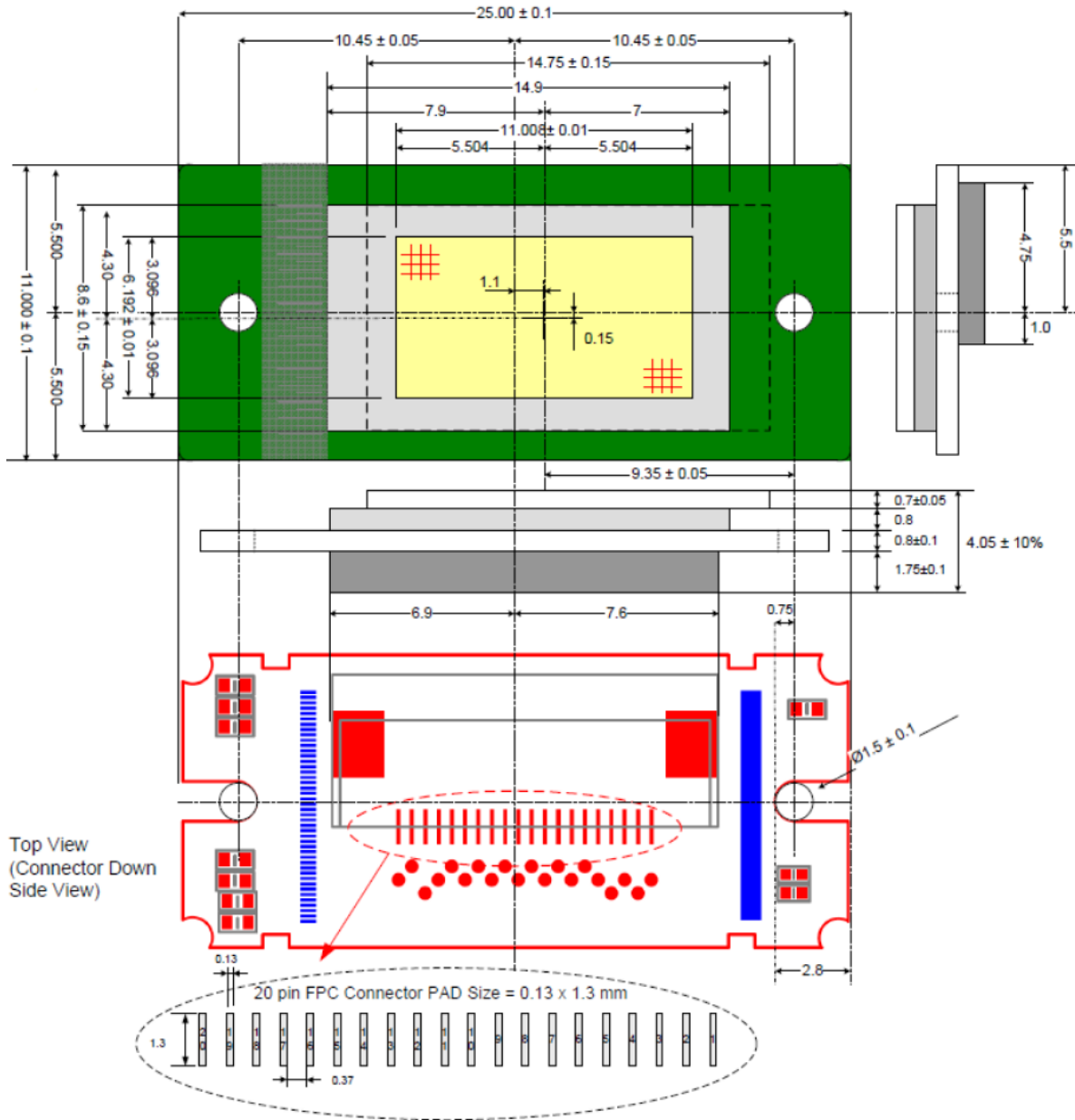
- Contrast Ratio (CR) is defined mathematically as:

$$\text{Contrast Ratio} = \frac{\text{Luminance with all white pixels}}{\text{Luminance with all black pixels}}$$

- Response time is the time required for the display to transition from white to black (Rise Time, Tr) and from black to white (Decay Time, Td). The response time is defined as the following figure and shall be measured by switching the input signal for "black" and "white".



8. Mechanical Dimensions



9. Reliability

Environment test conditions

No.	Test Item	Conditions
1	High temperature storage test	TBD°C x TBD h
2	Low temperature storage test	TBD°C x TBD h
3	High temperature & high humidity operation test	TBD°C x TBD%RH x TBD h
4	High temperature operation test	TBD°C x TBD h
5	Low temperature operation test	TBD°C x TBD h
6	Thermal Shock	TBD

Result Evaluation Criteria: There should be no change which might affect the practical display function when the display quality test is conducted under normal operating condition.

10. Packing Form

- a) Package quantity in one box: TBD
- b) Box Size: TBD

11. ELECTROSTATIC DISCHARGE CONTROL

Since the LCoS display is composed of electronic circuits, it is at risk to electrostatic discharge. Make certain that the operator(s) is connected to ground through ESD wristband or other ESD protection equipment. The operator should do not touch I/F pin directly.

12. STORAGE

When storing LCoS display for a long time, the following precautions should be followed.

1. Store them in a dark place. Do not expose the module to sunlight or fluorescent light. Keep the temperature between 5°C and 35°C at normal humidity.
2. It is recommended that they be stored in the container in which they were shipped.



ESD (electrostatic discharge) sensitive device.
 Charged devices and circuit boards can discharge without detection and damage may occur on devices subject to high energy ESD. Proper ESD precaution should be taken to avoid performance degradation or loss of functionality.