Rocktech Displays Limited

LCD Module Specification

Module P/N: RK060BFHD032

Version: 1.0

Description : 5.99 inch TFT 1080*2160 Pixels with LED backlight,All viewing angle, 400 nits brightness

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Revision History

Date	Rev.	Page	Description
2021-11-23	1.0	All	First issue

CONTENTS

1. General Features

Item	Spec	Remark
Display Mode	Normally Black transmissive	
Viewing Angle	FREE	IPS
Input Signals	MIPI	
Outside Dimensions	70.24 (W) x142.28(H) x1.59(D)	
Active Area	68.04mm(W)×136.08mm(H)	
Number of Pixels	1080(RGB)×2160	
Dot Pitch	0.063 mm(W) ×0.063mm(H)	
Pixel Arrangement	RGB Vertical stripes	
Drive IC	HX8399C	

2. Absolute Maximum Ratings

The following are maximum values which, if exceeded may cause operation or damage to the unit.

ITEM	Sym.	Min.	Typ.	Max.	Unit	Remark
Power for Circuit Driving	VDD	-0.3	-	3.3	V	
Backlight Forward Current	I_{LED}	-	-	25	mA	For each LED
Storage Temperature	T_{ST}	-30	-	80	℃	
Operating Ambient Humidity	H_{OP}	10	-		%RH	
Operating Ambient temperature	T_{OP}	-20	-	70	℃	

3. Electrical Specification

3.1 Driving TFT LCD Panel

Item		Sym.	Min	Typ.	Max	Unit	Note
Power for Circuit Driving		IOVCC	1.65	1.8	3.3	V	
		AVDD	4.5	5.5	6	V	
		AVEE	-6	-5.5	-4.5	V	
Logic Input Voltage	Low Voltage	V_{IL}	0	-	0.3IOVCC	V	
	High Voltage	V_{IH}	0.7IOVCC	-	IOVCC	V	
Logic Output Voltage	Low Voltage	V_{OL}	0	-	0.2IOVCC	V	
	High Voltage	V_{OH}	0.8IOVCC	-	IOVCC	V	

3.2 Driving Backlight

Item	Sym.	Min	Typ.	Max	Unit	Note
Backlight driving voltage	V_F	-	24.0	-	V	
Backlight driving current	I_F	30	40	50	mA	
Backlight Power Consumption	W_{BL}	-	960	-	mW	
Life Time	-	-	50,000	-		Note 3

Note 1: (Unless specified, the ambient temperature Ta=25℃)
Note 2: The recommended operating conditions refer to a range in which operation of this product is guaranteed. Should this range is exceeded, the operation cannot be guaranteed even if the values may be without the absolute maximum ratings.
Note 3: If LED is driven by high current, high ambient temperature & humidity condition. The life time of LED will be reduced. Operating life means brightness goes down to 50% initial brightness. Typical operating life time is estimated data.

4.Optical Specifications

Optical characteristics are determined after the unit has been 'ON' and stable for approximately 30 minutes in a dark environment at 25 ℃. The values specified are at an approximate distance 500mm from the LCD surface at a viewing angle of Φ and θ equal to 0°.

Item	Sym.	Values			Unit	Note
		Min.	Typ.	Max.		
1)Contrast Ratio	C/R	1000	1200	-		FIG.1
2)Module Luminance	L	350	400	-	cd/m^2	FIG.1
3)Response time	Tr+Tf	-	25	-	ms	FIG.2
4)Viewing Angle	θ_T	-	80	-	Degree	FIG.3
	θ_B	-	80	-		
	θ_L	-	80	-		
	θ_R	-	80	-		
5)Chromaticity	Wx	0.243	0.283	0.323		
	Wy	0.267	0.307	0.347		
	Rx	-	-	-		
	Ry	-	-	-		
	Gx	-	-	-		
	Gy	-	-	-		
	Bx	-	-	-		
	By	-	-	-		

◆ Measurement System

Notes:

1. Contrast Ratio(CR) is defined mathematically as :

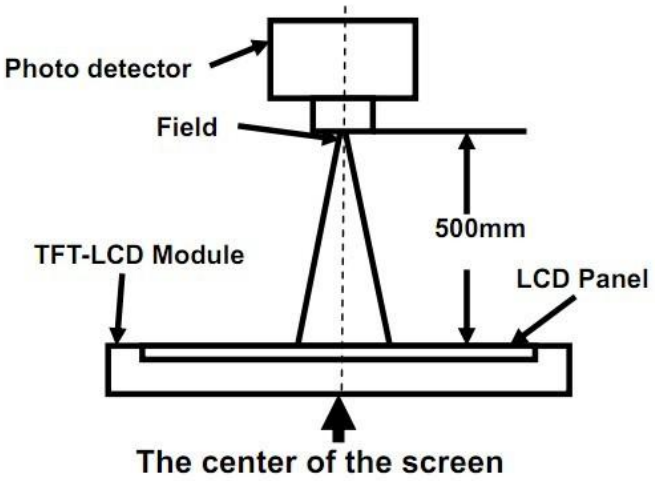
$$\text{Contrast Ratio} = \frac{\text{Surface Luminance with all white pixels}}{\text{Surface Luminance with all black pixels}}$$

2. Surface luminance is the center point across the LCD surface 500mm from the surface with all pixels displaying white. For more information see FIG 1.

3. Response time is the time required for the display to transition from white to black (Rising Time, Tr) and from black to white (Falling Time, Tf). For additional information see FIG 2.

4. Viewing angle is the angle at which the contrast ratio is greater than 10. The angles are determined for the horizontal or x axis and the vertical or y axis with respect to the z axis which is normal to the LCD surface. For more information see FIG 3.

FIG. 1 Optical Characteristic Measurement Equipment and Method



Item	Photo detector	Field
Contrast Ratio	SR-3A	1°
Luminance		
Chromaticity		
Lum Uniformity		
Response Time	BM-7A	2°

FIG. 2 The definition of Response Time

The response time is defined as the following figure and shall be measured by switching the input signal for “black” and “white”.

Response Time = Rising Time(Tr) + Falling Time(Tf)

- Rising Time(Tr) : Full White 90% → Full White 10% Transmittance.
- Falling Time(Tf) : Full White 10% → Full White 90% Transmittance.

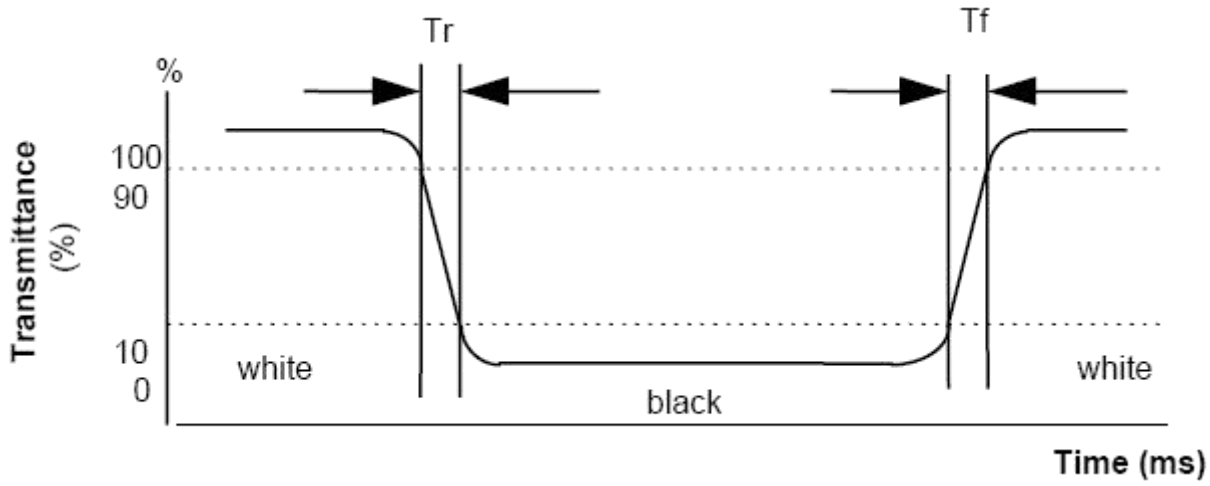
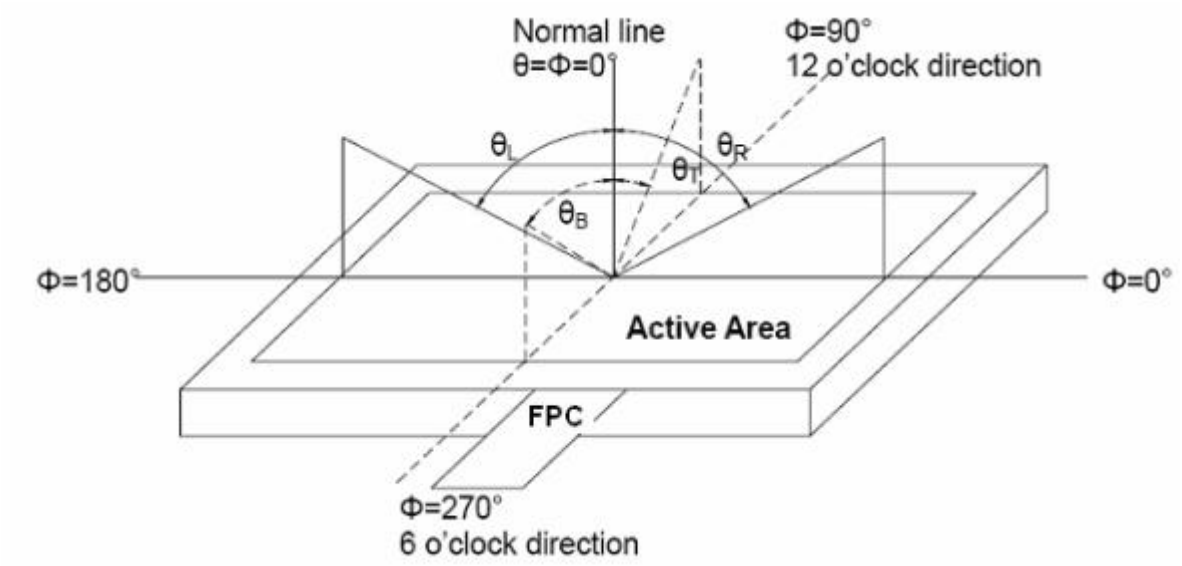
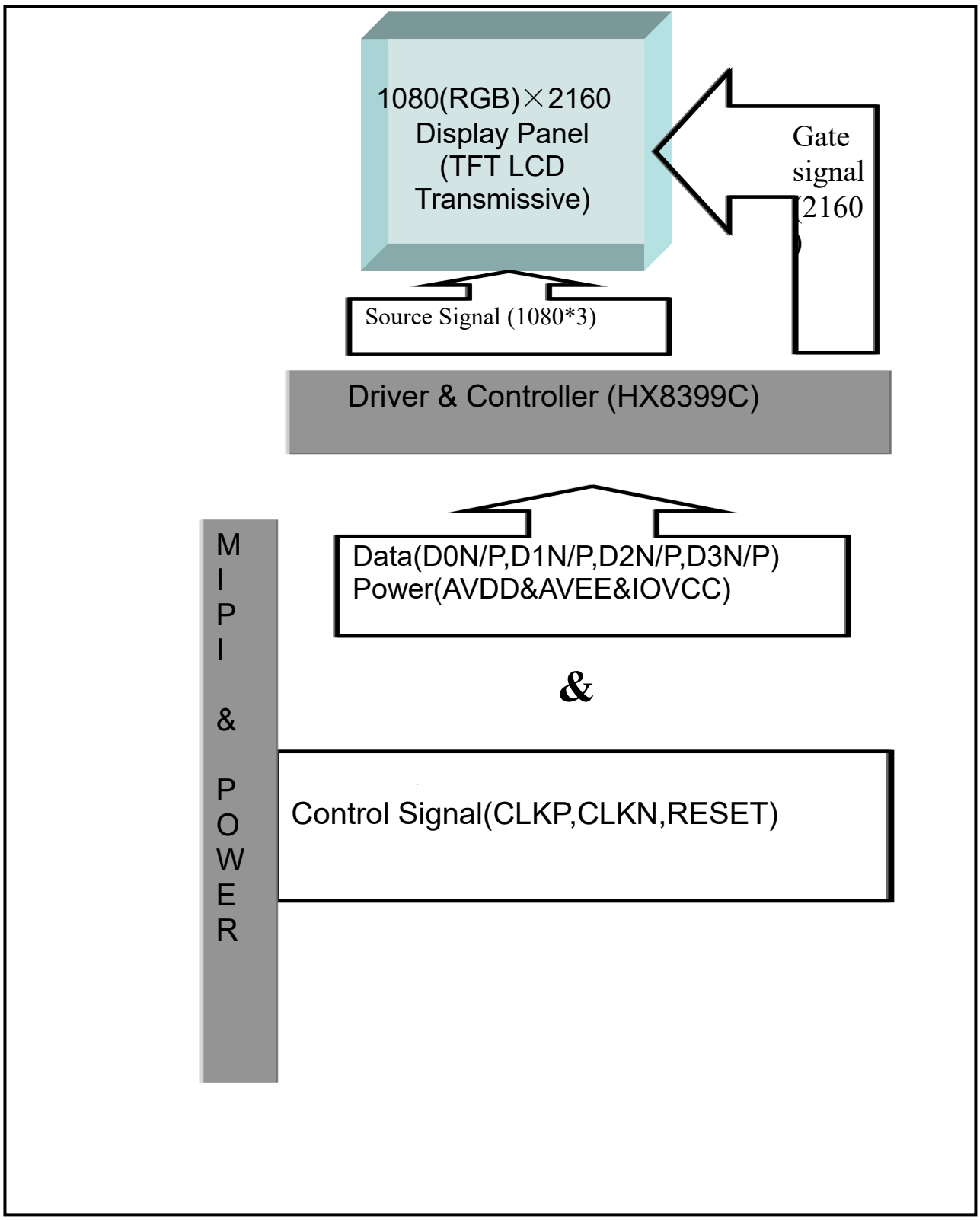


FIG. 3 The definition of Viewing Angle

Use Fig. 1(Test Procedure) under Measurement System to measure the contrast from the measuring direction specified by the conditions as the following figure.



5.Block Diagram



6.Pin Description

Item	Terminal	Functions
1	LCD_ID	Connect 1k resistor to GND
2	CTP_RST	TP PIN
3	CTP_INT	
4	CTP_SCL	
5	CTP_SDA	
6	CTP_VDD	
7	GND	Ground
8	TE	Tearing effect output pin to synchronize MCU to frame writing, activated by S/W command
9	RST	LCD Reset pin
10	K2	B/L Power input PIN negative
11	K1	B/L Power input PIN negative
12	A	B/L Power input PIN anode
13	VIO18	Interface power supply: 1.8V
14	AVEE	Power supply -5.5V
15	AVDD	Power supply +5.5V
16-25	NC	NC
26	GND	Ground
27	D0N	Differential data pairs for MIPI interface(-).
28	D0P	Differential data pairs for MIPI interface(+).
29	GND	Ground
30	D1N	Differential data pairs for MIPI interface(-).
31	D1P	Differential data pairs for MIPI interface(+).
32	GND	Ground
33	CLKN	Differential clock or strobe pair for MIPI interfaces(-).
34	CLKP	Differential clock or strobe pair for MIPI interfaces(+).
35	GND	Ground
36	D2N	Differential data pairs for MIPI interface(-).
37	D2P	Differential data pairs for MIPI interface(+).
38	GND	Ground
39	D3N	Differential data pairs for MIPI interface(-).
40	D3P	Differential data pairs for MIPI interface(+).

7.Timing Characteristics

7.1 Low Power Mode Characteristics

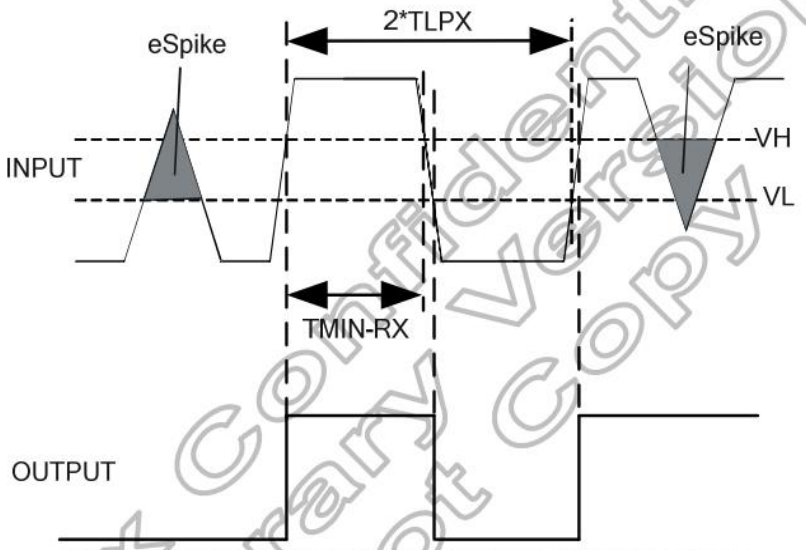


Figure 8.6: Input glitch rejections of low-power receivers

Parameter	Symbol	Spec.			Unit
		Min.	Typ.	Max.	
Logic 0 input threshold	V_{IL}	-	-	550	mV
Logic 1 input threshold	V_{IH}	880	-	-	mV

Table 8.9: LP receiver DC specifications

Parameter	Symbol	Spec.			Unit
		Min.	Typ.	Max.	
Input pulse rejection[(1),(2) (3)]	e_{SPIKE}	-	-	300	V.ps
Minimum pulse width response[(4)]	T_{MIN}	20	-	-	ns
Peak-to-peak interference voltage	V_{INT}	-	-	200	mV
Interference frequency	f_{INT}	450	-	-	MHz

Note: (1) Time voltage integration of a spike above VIL when being in LP-0 state or below VIH when being in LP-1 state
(2) An impulse less than this will not change the receiver state.
(3) In addition to the required glitch rejection, implementers shall ensure rejection of known RF-interferers.
(4) An input pulse greater than this shall toggle the output.

Table 8.10: LP receiver AC specifications

7.2 Vertical & Horizontal Timings

Parameter	Symbol	Condition	Spec.			Unit
			Min.	Typ.	Max.	
Vertical cycle	VP	-	534+8xNL	-	-	Line
Vertical low pulse width	VS	-	2	-	Note(1)	Line
Vertical front porch	VFP	-	2	-	-	Line
Vertical back porch	VBP	-	2	-	Note(1)	Line
Vertical data start point	-	VS+VBP	4	-	Note(1)	Line
Vertical blanking period	VBL	VS+VBP+VFP	6	-	-	Line
Vertical active area	-	VDISP	-	528+8xNL	-	Line
Vertical Refresh rate	VRR	-	-	60	-	Hz

Note: (1) The VS and VBP pulse width are related to GSP and GCK timing. The GSP and GCK must be set at corresponding position for LCD normal display.

Parameter	Symbol	Condition	Spec.			Unit
			Min.	Typ.	Max.	
HS cycle	HP	-	H_RES+15	-	-	DCK
HS low pulse width	HS	-	5	-	-	DCK
Horizontal back porch	HBP	-	5	-	-	DCK
Horizontal front porch	HFP	-	5	-	-	DCK
Horizontal data start point	-	HS+HBP	10	-	-	DCK
Horizontal blanking period	HBLK	HS+HBP+HFP	15	-	-	DCK
Horizontal active area	HDISP	-	-	H_RES	-	DCK

7.3 Reset Timing

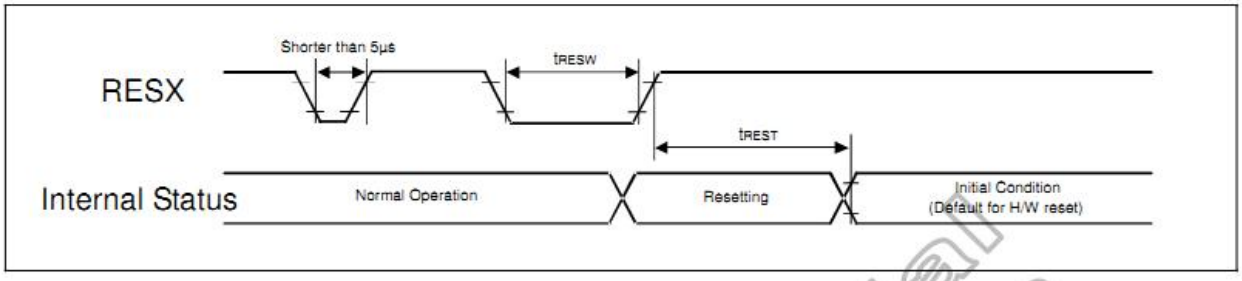


Figure 8.12: Reset input timing

Symbol	Parameter	Related pins	Spec.			Unit	Note
			Min.	Typ.	Max.		
t_{RESW}	Reset low pulse width(1)	RESX	10	-	-	µs	-
t_{REST}	Reset complete time(2)	-	-	-	50	ms	-

Note: (1) Spike due to an electrostatic discharge on RESX line does not cause irregular system reset according to the table below.

RESX Pulse	Action
Shorter than 5µs	Reset Rejected
Longer than 10µs	Reset
Between 5µs and10µs	Reset Start

(2) During Reset Complete Time, OTP will be latched to internal register during this period. This loading is done every time when there is H/W reset complete time **(tREST)** within 5ms after a rising edge of RESX.

(3) Spike Rejection also applies during a valid reset pulse as shown below:

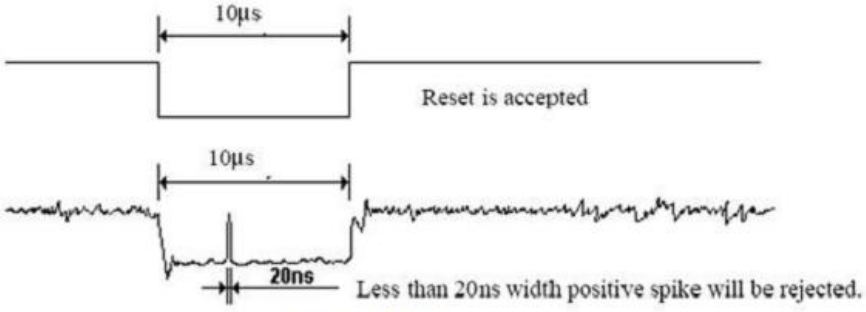
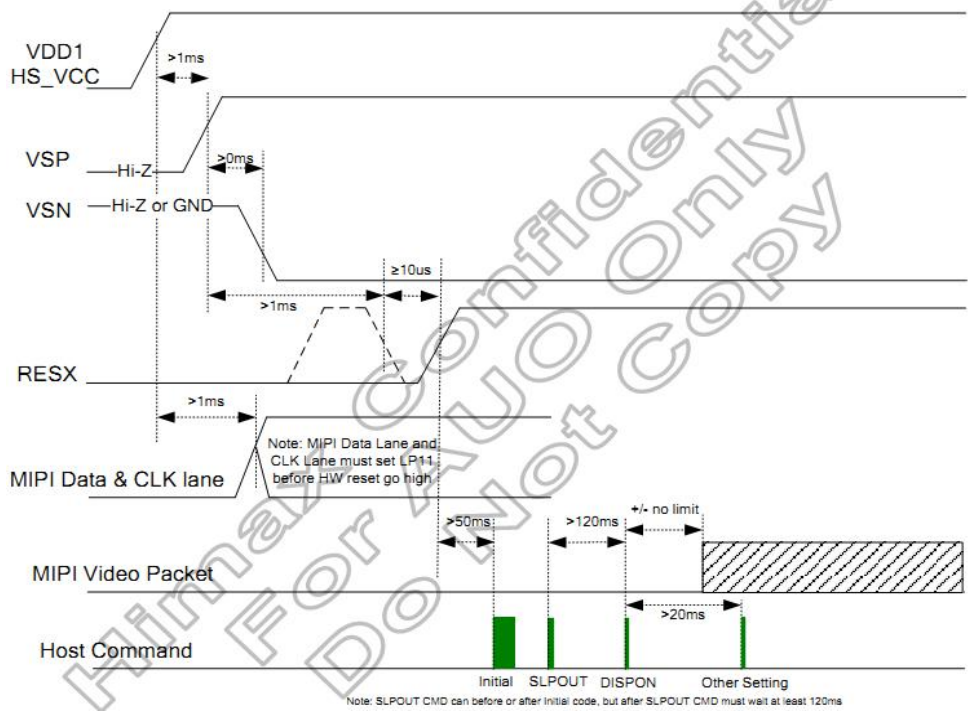


Table 8.16: Reset timing

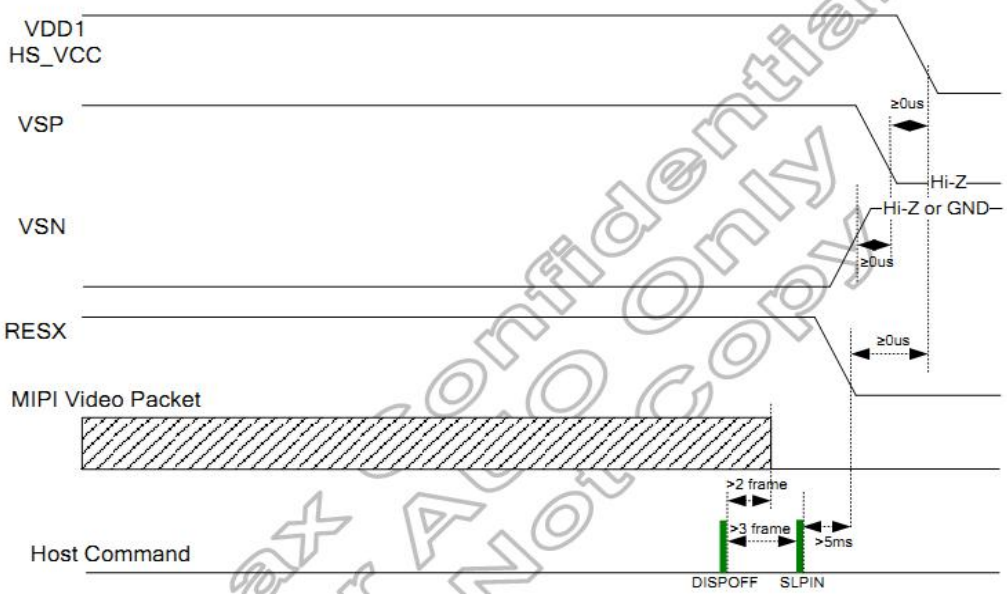
7.4 Power On Sequence

1.External Power On. Wait until power stable.
2.Keep HS_CLKP/HS_CLKN, HS_D0P/HS_D0N, HS_D1P/HS_D1N
HS_D2P/HS_D2N, HS_D3P/HS_D3N in STOP state(LP-11).
3.Hardware reset (>10us)
4.Wait 50ms for OTP reload
5.Send initial code

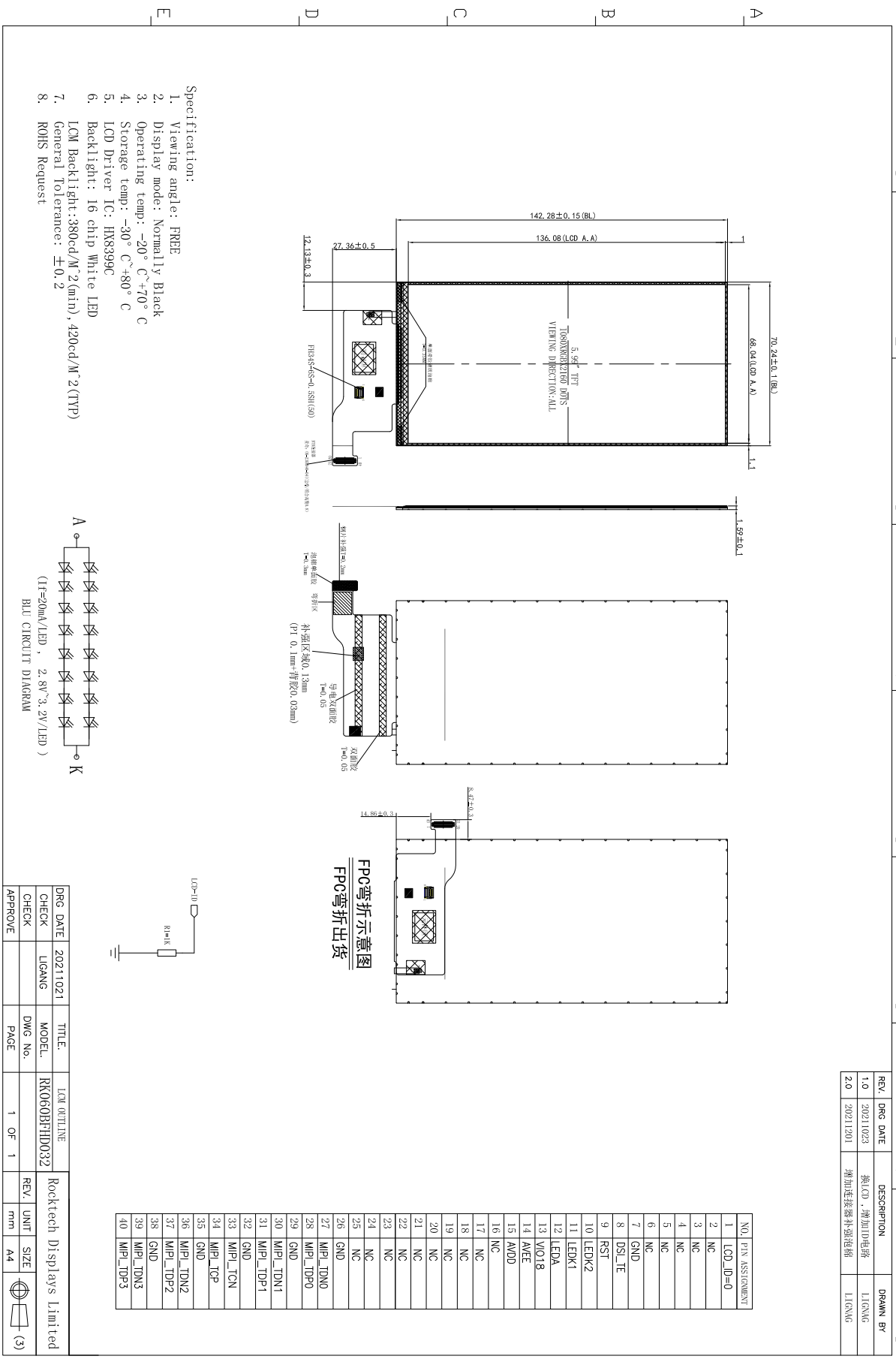


7.5 Power Off Sequence

1. Display Off CMD：
   PacketHeader[05 28 00 xx]
2. Wait 3 frame
3. Sleep In CMD：
   PacketHeader[05 10 00 xx]
4. Delay >5ms(depend on RB2h END_SET_0[2:0] and END_SET_1[1:0] setting)
5. External Power Off



8.Outline Dimension



NO.	PIN ASSIGNMENT
1	LCD_ID=0
2	NC
3	NC
4	NC
5	NC
6	NC
7	GND
8	DSI_TE
9	RST
10	LEDK2
11	LEDK1
12	LEDA
13	VIO18
14	AVEE
15	AVDD
16	NC
17	NC
18	NC
19	NC
20	NC
21	NC
22	NC
23	NC
24	NC
25	NC
26	GND
27	MIPI_TDN0
28	MIPI_TDP0
29	GND
30	MIPI_TDN1
31	MIPI_TDP1
32	GND
33	MIPI_TCN
34	MIPI_TCP
35	GND
36	MIPI_TDN2
37	MIPI_TDP2
38	GND
39	MIPI_TDN3
40	MIPI_TDP3

REV.	DRG DATE	DESCRIPTION	DRAWN BY
1.0	20211023	换LCD，增加ID电路	LIGNAG
2.0	20211201	增加连接器补强泡棉	LIGNAG

DRG DATE	20211021	TITLE.	LCM OUTLINE
CHECK	LIGANG	MODEL.	RK060BFHD032
CHECK		DWG No.	
APPROVE		PAGE	1 OF 1

Rocktech Displays Limited

REV.		
UNIT	mm	
SIZE	A4	(3)

9.Reliability and Inspection Standard

No.	Test Item		Test Conditions	Remark
1	High Temperature	Storage	80℃, 120Hr	Note
		Operation	70℃, 120Hr	Note
2	Low Temperature	Storage	-30℃, 120Hr	Note
		Operation	-20℃, 120Hr	
3	High Temperature and High Humidity		40℃, 90%RH, 120Hr	Note
4	Thermal Cycling Test(No operation)		-20℃ for 30min, 70℃ for 30 min. 100 cycles. Then test at room temperature after 1 hour	Note
5	Vibration Test(No operation)		Frequency :10~55 HZ; Stroke :1.5 mm;Sweep:10HZ~55HZ~10HZ; 2hours for each direction of X, Y, Z(6 hours for total)	
6	Package Drop Test		Height:60 cm,1 corner, 3 edges, 6 surfaces	
7	Electro Static Discharge		±2KV,Human Body Mode, 100pF/1500Ω	

Note:

1) Sample quantity for each test item is 5~10pcs.
2) Note 4: Before cosmetic and function test, the product must have enough recovery time, at least 2 hours at room temperature.

10.PRECAUTIONS FOR USING LCD MODULES

Handing Precautions

(1) The display panel is made of glass and polarizer. As glass is fragile, it tends to become or chipped during handling especially on the edges. Please avoid dropping or jarring. Do not subject it to a mechanical shock by dropping it or impact.
(2) If the display panel is damaged and the liquid crystal substance leaks out, be sure not to get any in your mouth. If the substance contacts your skin or clothes, wash it off using soap and water.
(3) Do not apply excessive force to the display surface or the adjoining areas since this may cause the color tone to vary. Do not touch the display with bare hands. This will stain the display area and degraded insulation between terminals (some cosmetics are determined to the polarizer).
(4) The polarizer covering the display surface of the LCD module is soft and easily scratched. Handle this polarizer carefully. Do not touch, push or rub the exposed polarizers with anything harder than an HB pencil lead (glass, tweezers, etc.). Do not put or attach anything on the display area to avoid leaving marks on. Condensation on the surface and contact with terminals due to cold will damage, stain or dirty the polarizer. After products are tested at low temperature they must be warmed up in a container before coming is contacting with room temperature air.
(5) If the display surface becomes contaminated, breathe on the surface and gently wipe it with a soft dry cloth. If it is heavily contaminated, moisten cloth with one of the following solvents
- Isopropyl alcohol
- Ethyl alcohol
Do not scrub hard to avoid damaging the display surface.
(6) Solvents other than those above-mentioned may damage the polarizer. Especially, do not use the following.
- Water
- Ketone
- Aromatic solvents
Wipe off saliva or water drops immediately, contact with water over a long period of time may cause deformation or color fading. Avoid contacting oil and fats.
(7) Exercise care to minimize corrosion of the electrode. Corrosion of the electrodes is accelerated by water droplets, moisture condensation or a current flow in a high-humidity environment.
(8) Install the LCD Module by using the mounting holes. When mounting the LCD module make sure it is free of twisting, warping and distortion. In particular, do not forcibly pull or bend the I/O cable or the backlight cable.
(9) Do not attempt to disassemble or process the LCD module.
(10) NC terminal should be open. Do not connect anything.
(11) If the logic circuit power is off, do not apply the input signals.
(12) Since LCM has been assembled and adjusted with a high degree of precision, avoid applying excessive shocks to the module or making any alterations or modifications to it.
- Do not alter, modify or change the shape of the tab on the metal frame.
- Do not make extra holes on the printed circuit board, modify its shape or change the positions of components to be attached.
- Do not damage or modify the pattern writing on the printed circuit board.
- Absolutely do not modify the zebra rubber strip (conductive rubber) or heat seal

connector.
- Except for soldering the interface, do not make any alterations or modifications with a soldering iron.
- Do not drop, bend or twist LCM.

Storage Precautions

When storing the LCD modules, the following precaution is necessary.
(1) Store them in a sealed polyethylene bag. If properly sealed, there is no need for the dessicant.
(2) Store them in a dark place. Do not expose to sunlight or fluorescent light, keep the temperature between 0°C and 35°C.
(3) The polarizer surface should not come in contact with any other objects. (We advise you to store them in the container in which they were shipped).

Others

Liquid crystals solidify under low temperature (below the storage temperature range) leading to defective orientation or the generation of air bubbles (black or white). Air bubbles may also be generated if the module is subject to a low temperature.
If the LCD modules have been operating for a long time showing the same display patterns, the display patterns may remain on the screen as ghost images and a slight contrast irregularity may also appear. A normal operating status can be regained by suspending use for some time. It should be noted that this phenomenon does not adversely affect performance reliability.
To minimize the performance degradation of the LCD modules resulting from destruction caused by static electricity etc., exercise care to avoid holding the following sections when handling the modules.
- Exposed area of the printed circuit board.
-Terminal electrode sections.