Rocktech Displays Limited

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LCD Module Specification

Module P/N: RK020HH131

Version: 1.0

Description : 2.0 inch TFT 240*320 Pixels with
              LED backlight, All viewing angle
              350 nits brightness

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Revision History

Date	Rev.	Page	Description
2019-07-25	**1.0**	**All**	**First issue**

CONTENTS

1. General Features

Item	Spec	Remark
Display Mode	Normally Black transmissive	
Viewing Direction	FREE	IPS
Input Signals	CPU 8bit	
Outside Dimensions	36.20 (W) x51.60(H) x2.38(D)	
Active Area	30.60 mm(W)×40.80 mm(H)	
Number of Pixels	240(RGB)×320	
Dot Pitch	0.1275mm(W)×0.1275mm(H)	
Pixel Arrangement	RGB Vertical stripes	
Drive IC	ST7789V	

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	-	4.6	V	
Power for Circuit Logic	Vt	-0.3	-	VDD+0.3	V	
Storage Humidity	H_{ST}	10	-		%RH	
Storage Temperature	T_{ST}	-30	-	80	℃	At 25±5℃
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		VDD	2.5	2.8	3.3	V	
Power For Circuit Logic		IOVCC	1.65	1.8	3.3	V	
Logic Input Voltage	Low Voltage	V_{IL}	-0.3	-	0.2VDD	V	
	High Voltage	V_{IH}	0.8VDD	-	VDD	V	
Logic Output Voltage	Low Voltage	V_{OL}	0	-	0.2VDD	V	
	High Voltage	V_{OH}	0.8VDD	-	-	V	

3.2 Driving Backlight

Item	Sym.	Min	Typ.	Max	Unit	Note
Backlight driving voltage	V_F	-	6.4	-	V	
Backlight driving current	I_F	30	40	50	mA	
Backlight Power Consumption	W_{BL}	-	256	-	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	640	800	-		FIG.1
2)Module Luminance	L	300	350	-	cd/m^2	FIG.1
3)Response time	Tr+Tf	-	30	-	ms	FIG.2
4)Viewing Angle	θ_T	-	80	-	Degree	FIG.3
	θ_B	-	80	-		
	θ_L	-	80	-		
	θ_R	-	80	-		
5)Chromaticity	Wx	0.256	0.296	0.336		
	Wy	0.285	0.325	0.365		
	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
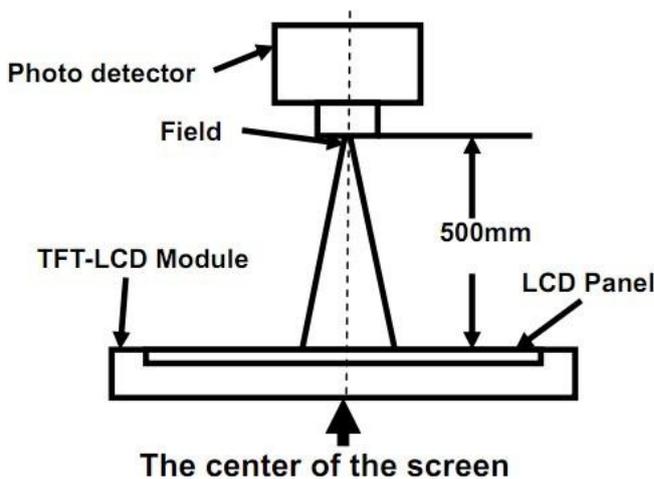
Item	Photo detector	Field
Contrast Ratio		
Luminance	SR-3A	1°
Chromaticity		
Lum Uniformity		
Response Time	BM-7A	2°

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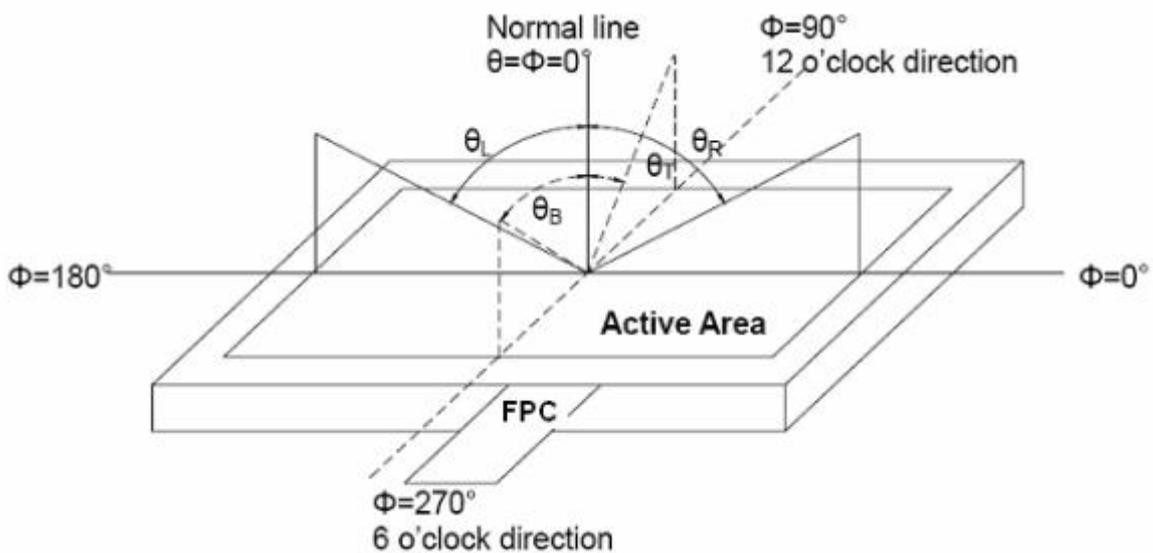
Response Time = Rising Time(Tr) + Falling Time(Tf)

- Rising Time(Tr) : Full White 90% → Full White 10% Transmittance.
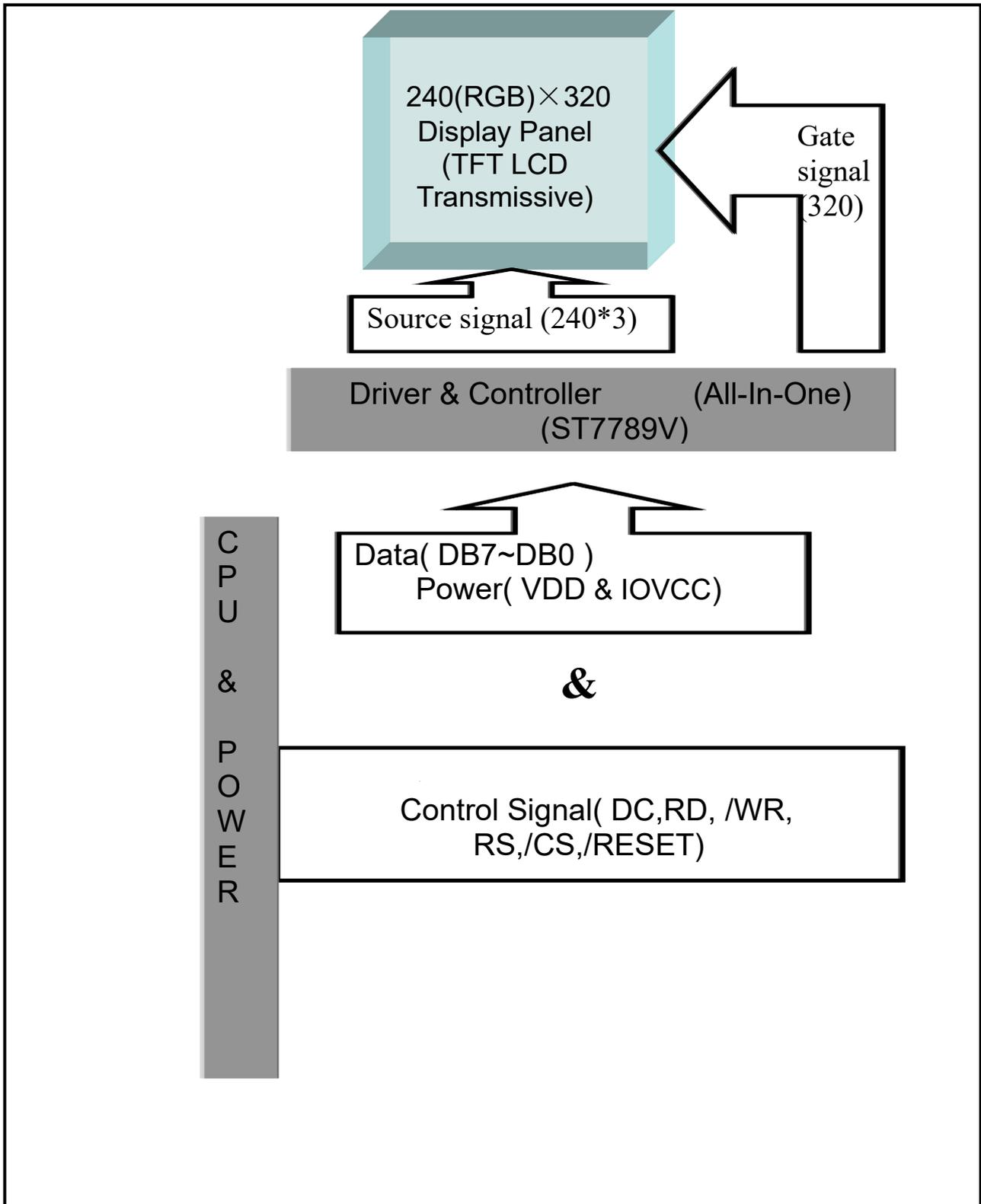- Falling Time(Tf) : Full White 10% → Full White 90% Transmittance.
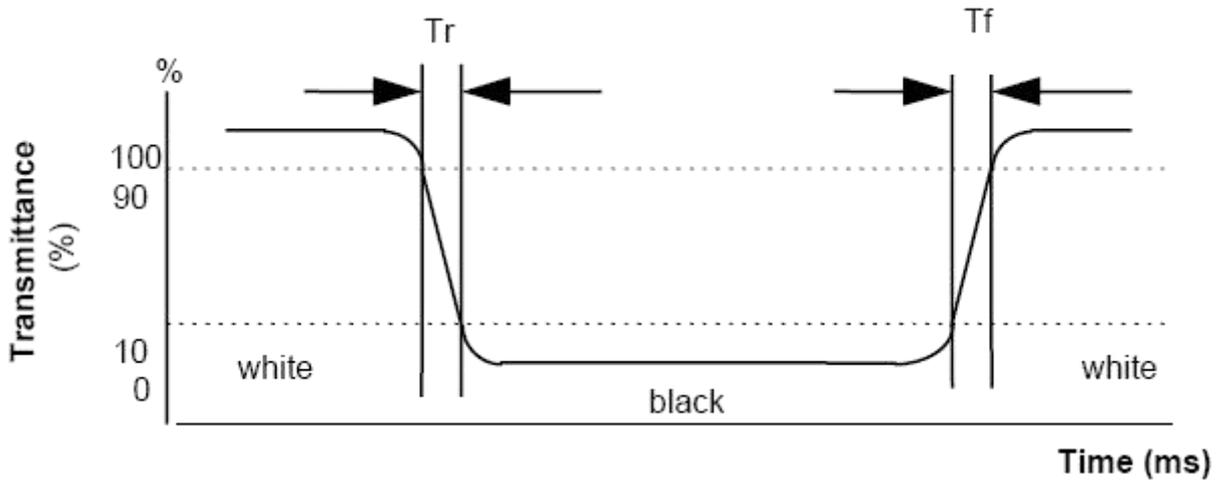
FIG. 3 The definition of Viewing Angle

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

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5.Block Diagram

240(RGB)×320
Display Panel
(TFT LCD
Transmissive)

Gate
signal
(320)

Source signal (240*3)

Driver & Controller   (All-In-One)
(ST7789V)

C
P
U

&

P
O
W
E
R

Data(DB7~DB0)
Power(VDD & IOVCC)

&

Control Signal(DC,RD, /WR,
RS,/CS,/RESET)

6.Pin Description

Item	Terminal	Functions
1	LED1K	B/L Power input PIN negative
2	LED2K	B/L Power input PIN negative
3	IOVCC	Power input 1.8V-3.3V
4	GND	Ground
5	/WR	Write Data PIN
6	DB0	DATA BUS
7	GND	Ground
8	DB2	DATA BUS
9	DB4	DATA BUS
10	DB6	DATA BUS
11	/CS	Chip Select Input PIN
12	/RESET	RESET PIN
13	TE	Tearing effect output pin to synchronies MCU to frame writing
14	DB7	DATA BUS
15	DB5	DATA BUS
16	GND	Ground
17	DB3	DATA BUS
18	DB1	DATA BUS
19	DC	Data&Comand Select PIN
20	RD	Read Data PIN
21	GND	Ground
22	VDD	Power input 2.8V-3.3V
23	LED2A	B/L Power input PIN anode
24	LED1A	B/L Power input PIN anode

7.Timing Characteristics (Details refer to ST7789V)
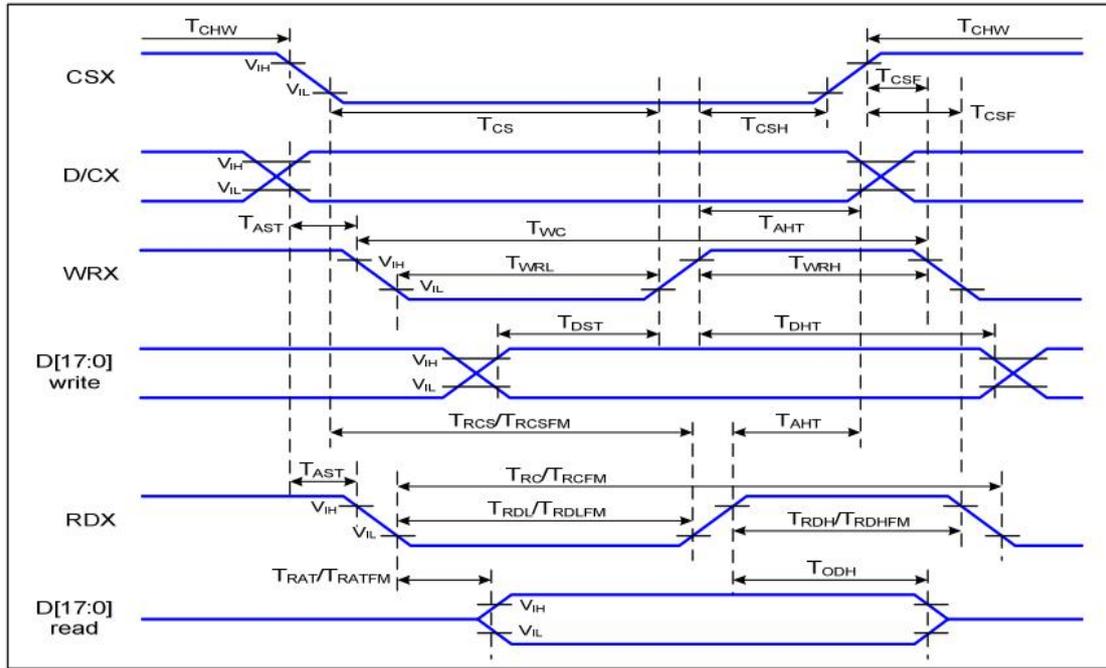
7.1. Parallel Interface   Characteristics

Figure 1 Parallel Interface Timing Characteristics (8080-Series MCU Interface)

*VDDI=1.65 to 3.3V, VDD=2.4 to 3.3V, AGND=DGND=0V, Ta=25℃*

Signal	Symbol	Parameter	Min	Max	Unit	Description
D/CX	T_{AST}	Address setup time	0		ns	-
	T_{AHT}	Address hold time (Write/Read)	10		ns	
CSX	T_{CHW}	Chip select "H" pulse width	0		ns	-
	T_{CS}	Chip select setup time (Write)	15		ns	
	T_{RCS}	Chip select setup time (Read ID)	45		ns	
	T_{RCSFM}	Chip select setup time (Read FM)	355		ns	
	T_{CSF}	Chip select wait time (Write/Read)	10		ns	
	T_{CSH}	Chip select hold time	10		ns	
WRX	T_{WC}	Write cycle	66		ns	
	T_{WRH}	Control pulse "H" duration	15		ns	
	T_{WRL}	Control pulse "L" duration	15		ns	
RDX (ID)	T_{RC}	Read cycle (ID)	160		ns	When read ID data
	T_{RDH}	Control pulse "H" duration (ID)	90		ns	
	T_{RDL}	Control pulse "L" duration (ID)	45		ns	
RDX (FM)	T_{RCFM}	Read cycle (FM)	450		ns	When read from frame memory
	T_{RDHFM}	Control pulse "H" duration (FM)	90		ns	
	T_{RDLFM}	Control pulse "L" duration (FM)	355		ns	
D[17:0]	T_{DST}	Data setup time	10		ns	For CL=30pF

	T$_{DHT}$	Data hold time	10		ns	
	T$_{RAT}$	Read access time (ID)		40	ns	
	T$_{RATFM}$	Read access time (FM)		340	ns	
	T$_{ODH}$	Output disable time	20	80	ns	

Table 4 8080 Parallel Interface Characteristics
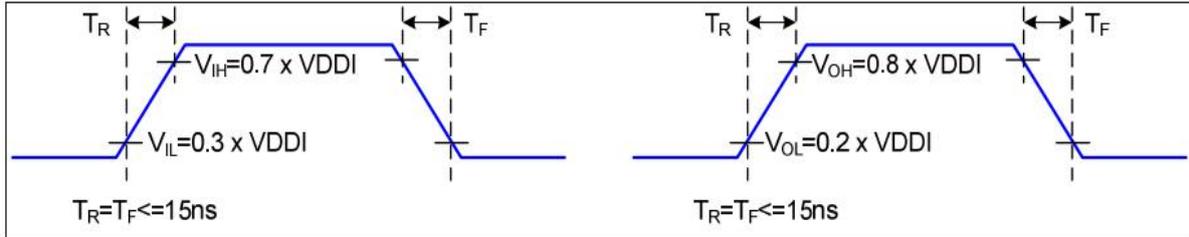
Figure 2 Rising and Falling Timing for I/O Signal
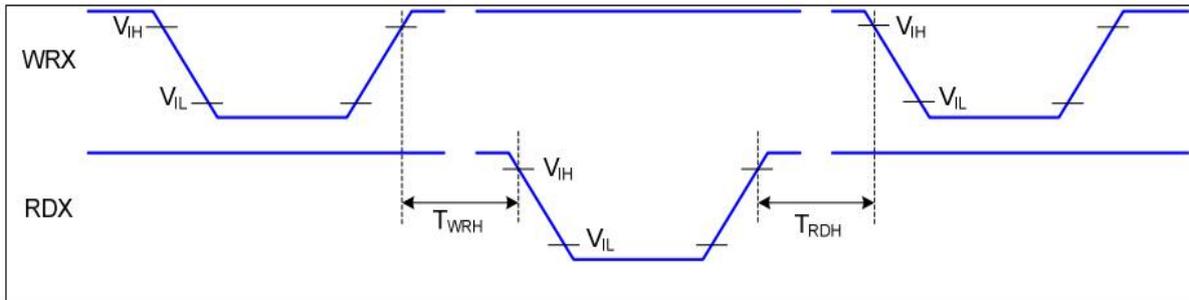
Figure 3 Write-to-Read and Read-to-Write Timing

Note: The rising time and falling time (Tr, Tf) of input signal and fall time are specified at 15 ns or less. Logic high and low levels are specified as 30% and 70% of VDDI for Input signals.
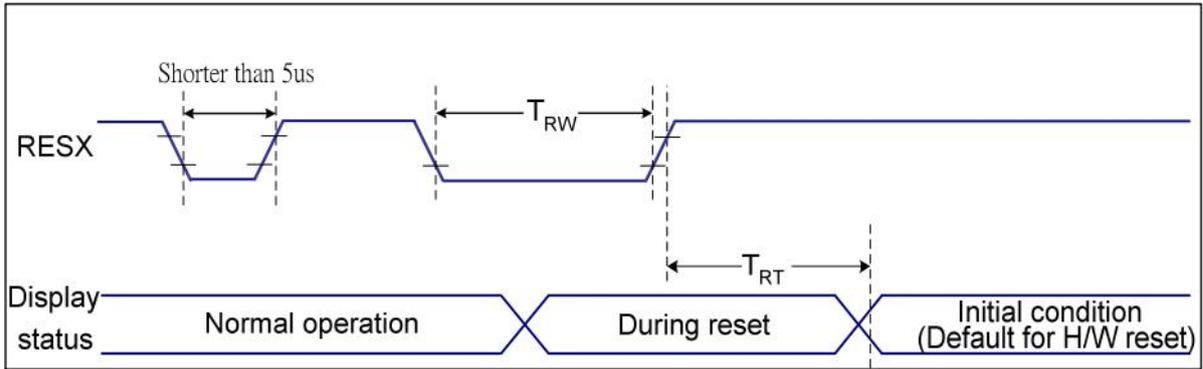
7.2 Reset Operation

Figure 7 Reset Timing

VDDI=1.65 to 3.3V, VDD=2.4 to 3.3V, AGND=DGND=0V, Ta=25℃

| Related Pins	Symbol	Parameter	MIN	MAX	Unit
RESX	TRW	Reset pulse duration	10	-	us
	TRT	Reset cancel	-	5 (Note 1, 5)	ms
				120 (Note 1, 6, 7)	ms

Table 9 Reset Timing

Notes:

1. The reset cancel includes also required time for loading ID bytes, VCOM setting and other settings from NVM (or similar device) to registers. This loading is done every time when there is HW reset cancel time (tRT) within 5 ms after a rising edge of RESX.

2. 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 5us	Reset Rejected
Longer than 9us	Reset
Between 5us and 9us	Reset starts

3. During the Resetting period, the display will be blanked (The display is entering blanking sequence, which maximum time is 120 ms, when Reset Starts in Sleep Out –mode. The display remains the blank state in Sleep In –mode.) and then return to Default condition for Hardware Reset.

4. Spike Rejection also applies during a valid reset pulse as shown below:

10μs

Reset is accepted

10μs

20ns Less than 20ns width positive spike will be rejected.
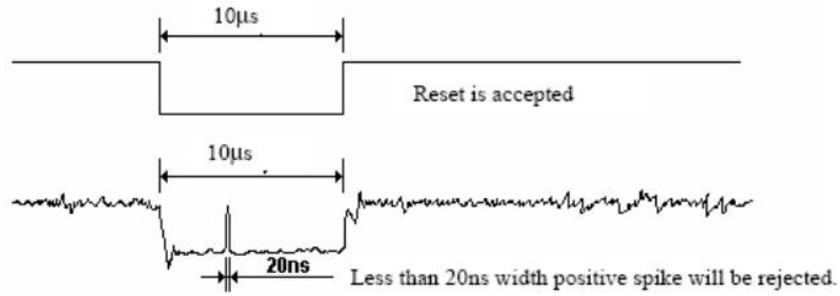
5. When Reset applied during Sleep In Mode.

6. When Reset applied during Sleep Out Mode.

7. It is necessary to wait 5msec after releasing RESX before sending commands. Also Sleep Out command cannot be sent for 120msec.

Reset Timing Characteristics (IOVCC = 1.65 ~ 3.6 V)

Item	Symbol	Unit	Min.	Typ.	Max.
Reset low-level width	$t_{RES\ L}$	ms	1	-	-
Reset rise time	t_{rRES}	μs	-	-	10
Reset high-level width	$t_{RES\ H}$	ms	50	-	-

t_{RES_L} t_{rRES}

nRESET V_{IL} V_{IH} t_{RES_H}

8.Outline Dimension

Specification:
1. Viewing angle: FREE
2. Display mode: Normally Black
3. Operating temp: -20°C~+70°C
4. Storage temp: -30°C~+80°C
5. LCD Driver IC: ST7789V
6. Backlight: 4 chip White LED
7. General Tolerance: ±0.2
8. ROHS Request

51.60±0.1
42.40
40.80(A.A)
2.00
2.80
8.00
36.20±0.1
30.60(A.A)
240(RGB)X320 DOTS
FREE
2.0"
23.20
2.80
REMOVE TAPE

正反面EMI

3,7
2,1
0,35
0,4
0,23
5,37
5

0.3(PI补强)
Stiffener
CONNECTOR TYPE:
DF40C-24DP-0.4V

不含导电布
2.38Max

51.60±0.2
9.80±0.3
8.00
8.30
16.47±0.3

A1
A2
OK1
OK2
K1
K2

PIN DESCRIPTION	
1	LED1K
2	LED2K
3	IOVCC
4	GND
5	/WR
6	DB0
7	GND
8	DB2
9	DB4
10	DB6
11	/CS
12	/RESET
13	TE
14	DB7
15	DB5
16	GND
17	DB3
18	DB1
19	DC
20	RD
21	GND
22	VDD
23	LED2A
24	LED1A

DRG DATE		19.07.24
CHECK	LIGANG	
CHECK		
APPROVE		
TITLE:	LCM OUTLINE	
MODEL:	RK020HH131	
DWG No.		
PAGE	1 OF 1	
REV	REV.	
UNIT	mm	
SIZE	A4	

REV, DRG DATE   DESCRIPTION   DRAWN BY
1.0   20190724   线框开窗变更   LIGANG

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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.