Rocktech Displays Limited

LCD Module Specification

Module P/N: RK035FQ08

Version: 1.0

Description : 3.5 inch TFT 320*240 Pixels with
LED backlight, 400 nits brightness

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Revision History

Date	Rev.	Page	Description
2020-09-24	1.0	All	First issue

CONTENTS

1. General Features

Item	Spec	Remark
Display Mode	Normally White transmissive	
Viewing Direction	12 O'CLOCK	
Interface	MCU/SPI/RGB	
Outside Dimensions	76.84 (W) x63.84(H) x3.27(D)	
Active Area	70.08mm(W)×52.56mm(H)	
Number of Pixels	320(RGB)×240	
Dot Pitch	0.219mm(W)×0.219mm(H)	
Pixel Arrangement	RGB Vertical stripes	
Drive IC	SSD2119	

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	VCC	-0.3	-	4.0	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		VCC	1.4	3.3	3.6	V	
Logic Input Voltage	Low Voltage	V_{IL}	0	-	0.2VCC	V	
	High Voltage	V_{IH}	0.8VCC	-	VCC	V	
Logic Output Voltage	Low Voltage	V_{OL}	0	-	0.1VCC	V	
	High Voltage	V_{OH}	0.9VCC	-	VCC	V	

3.2 Driving Backlight

Item	Sym.	Min	Typ.	Max	Unit	Note
Backlight driving voltage	V_F	-	19.2	-	V	
Backlight driving current	I_F	15	20	25	mA	
Backlight Power Consumption	W_{BL}	-	384	-	mW	
Lift Time	-	-	50000	-		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	-	700	-		FIG.1
2)Module Luminance	L	350	400	-	cd/m^2	FIG.1
3)Response time	Tr+Tf	-	20	-	ms	FIG.2
4)Viewing Angle	θ_T	50	60	-	Degree	FIG.3
	θ_B	60	70	-		
	θ_L	60	70	-		
	θ_R	60	70	-		
5)Chromaticity	Wx	0.258	0.298	0.338		
	Wy	0.291	0.331	0.371		
	Rx	-	-	-		
	Ry	-	-	-		
	Gx	-	-	-		
	Gy	-	-	-		
	Bx	-	-	-		
	By	-	-	-		

◆ Measurement System

Notes:

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

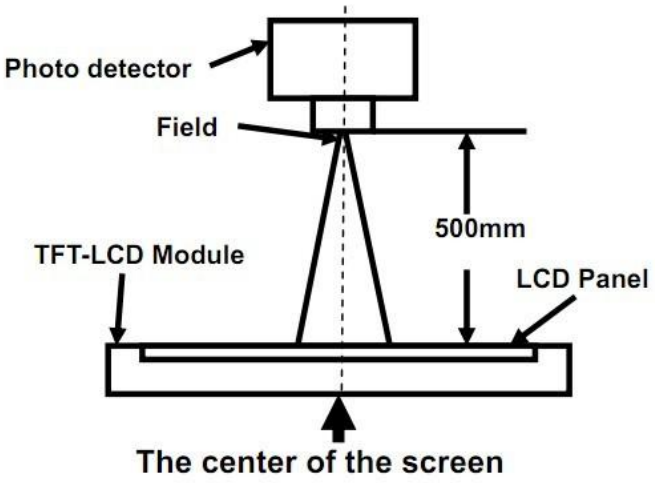
$$\text{Contrast Ratio} = \frac{\text{Surface Luminance with all white pixels}}{\text{Surface Luminance with all black pixels}}$$

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.

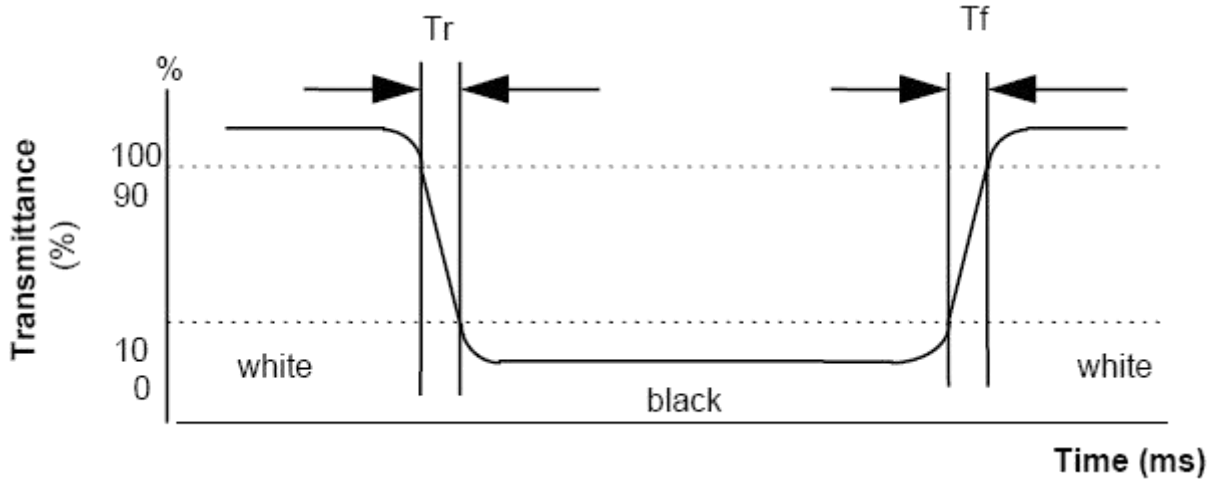
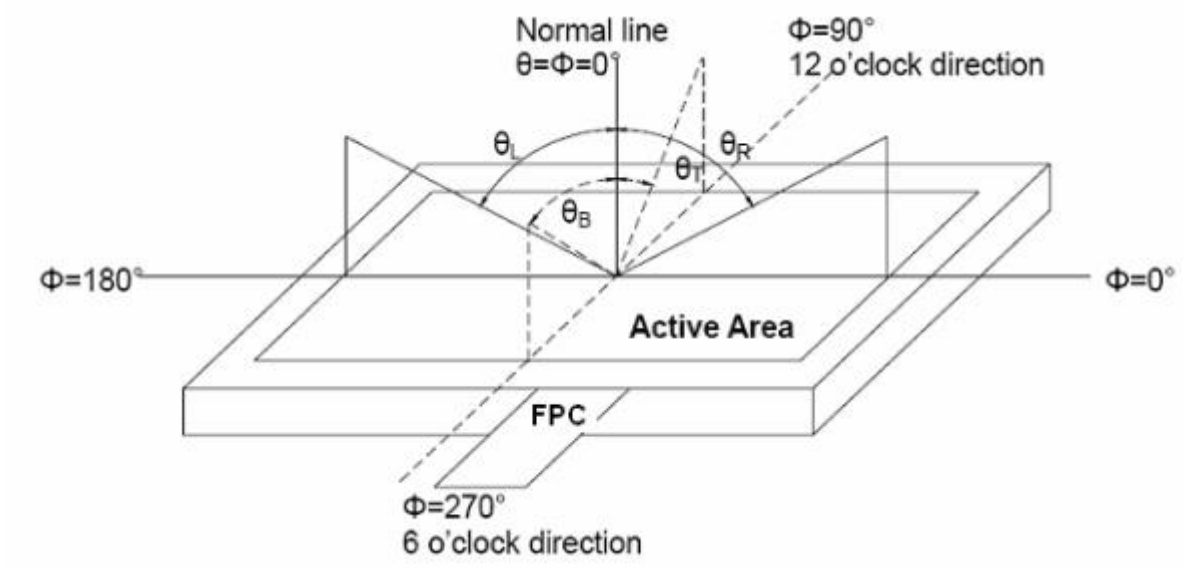
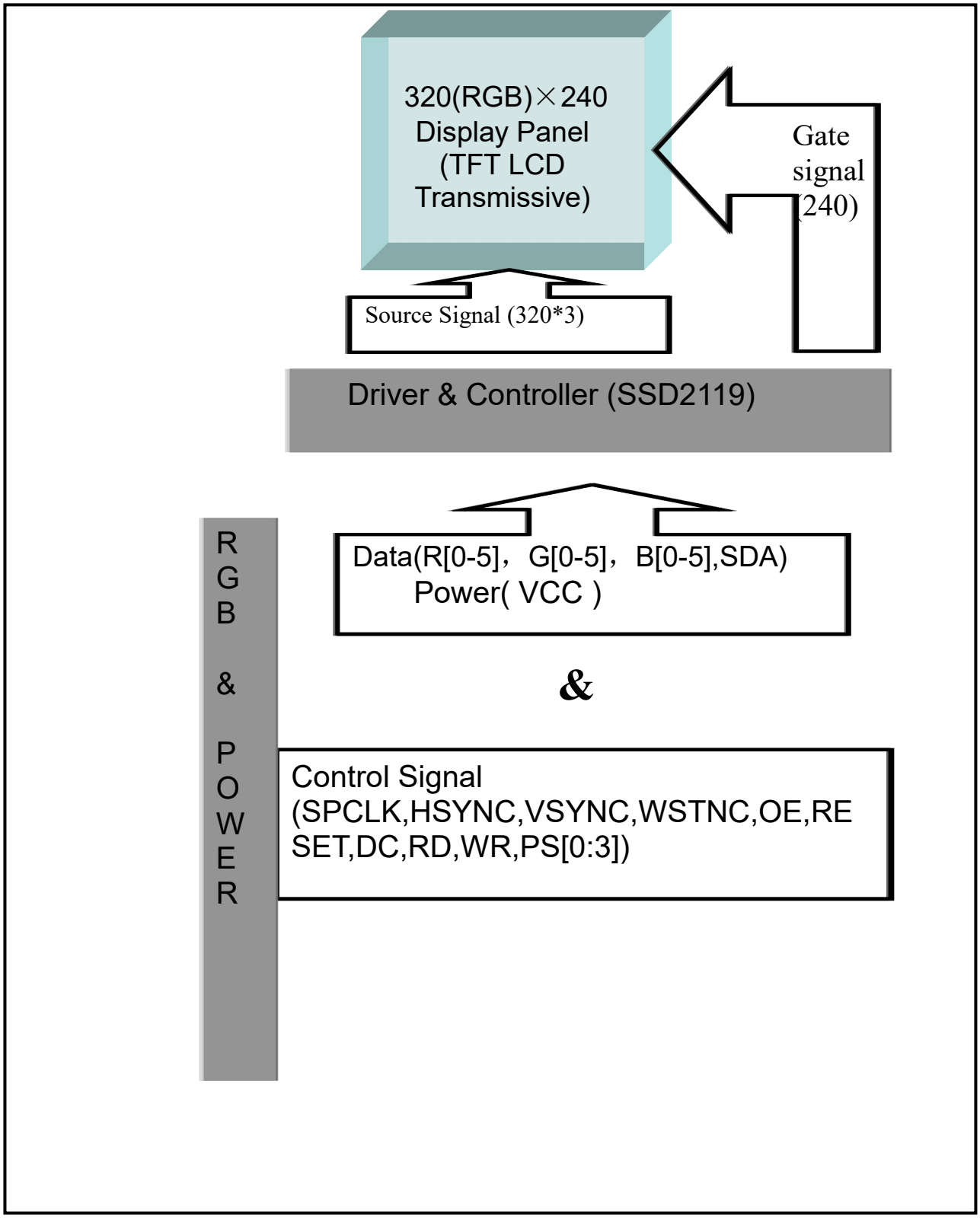


FIG. 3 The definition of Viewing Angle

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

<table>
<tr><th>Pin No.</th><th>Symbol</th><th>Description</th></tr>
<tr><td>1-2</td><td>LED_K</td><td rowspan="2">Power supply for LED backlight</td></tr>
<tr><td>3-4</td><td>LED_A</td></tr>
<tr><td>5</td><td>GND</td><td>Power supply (system ground)</td></tr>
<tr><td>6</td><td>XR</td><td rowspan="4">Terminal of touch panel.</td></tr>
<tr><td>7</td><td>YD</td></tr>
<tr><td>8</td><td>XL</td></tr>
<tr><td>9</td><td>YU</td></tr>
<tr><td>10</td><td>GND</td><td>Power supply (system ground)</td></tr>
<tr><td>11-13</td><td>NC</td><td>No connection</td></tr>
<tr><td>14</td><td>RESET</td><td>System reset pin</td></tr>
<tr><td>15</td><td>CS</td><td>Chip select pin</td></tr>
<tr><td>16</td><td>SPCLK</td><td>Clock pin of serial interface</td></tr>
<tr><td>17</td><td>SDA-SDI</td><td>Data pin of serial interface</td></tr>
<tr><td>18-19</td><td>NC</td><td>No connection</td></tr>
<tr><td>20-25</td><td>B[0-5]</td><td>Blue data 6-bit/18bit bi-directional (D0-D5)</td></tr>
<tr><td>26-27</td><td>NC</td><td>No connection</td></tr>
<tr><td>28-33</td><td>G[0-5]</td><td>Green data 6-bit/18bit bi-directional (D6-D11)</td></tr>
<tr><td>34-35</td><td>NC</td><td>No connection</td></tr>
<tr><td>36-41</td><td>R[0-5]</td><td>Red data 6-bit/18bit bi-directional (D12-D17)</td></tr>
<tr><td>42</td><td>HSYNC</td><td>Line synchronization signal input</td></tr>
<tr><td>43</td><td>VSYNC</td><td>Frame /Ram synchronization signal input</td></tr>
<tr><td>44</td><td>DCLK</td><td>Dot clock signal</td></tr>
<tr><td>45-46</td><td>AVDD</td><td>Supply voltage for lcd driving</td></tr>
<tr><td>47-48</td><td>VCC</td><td>Supply voltage for logic</td></tr>
<tr><td>49</td><td>DC</td><td>Parallel Interface</td></tr>
<tr><td>50</td><td>RD</td><td>I80 system: Serves as a read signal and reads data at the low level.</td></tr>
<tr><td>51</td><td>WR</td><td>I80 system: Serves as a write signal and writes data at the rising edge.</td></tr>
<tr><td>52-55</td><td>PS[0:3]</td><td>Interface selection pin
<table>
<tr><th>PS3</th><th>PS2</th><th>PS1</th><th>PS0</th><th>Interface mode</th></tr>
<tr><td>0</td><td>0</td><td>1</td><td>0</td><td>16-bit 8080 parallel interface, D[17:10]&D[8:1]</td></tr>
<tr><td>0</td><td>0</td><td>1</td><td>1</td><td>8-bit 8080 parallel interface, D[8:1]</td></tr>
<tr><td>0</td><td>1</td><td>0</td><td>0</td><td>9-bit RGB(262 colour) + 3-wire SPI, D[8:0]</td></tr>
<tr><td>0</td><td>1</td><td>0</td><td>1</td><td>16-bit RGB(262K colour) + 3-wire SPI, D[17:10]&D[8:1]</td></tr>
<tr><td>0</td><td>1</td><td>1</td><td>0</td><td>18-bit RGB(262K colour) + 3-wire SPI, D[17:0]</td></tr>
<tr><td>0</td><td>1</td><td>1</td><td>1</td><td>6-bit RGB(262K colour) + 3-wire SPI, D[8:3]</td></tr>
<tr><td>1</td><td>0</td><td>1</td><td>0</td><td>18-bit 8080 parallel interface, D[17:0]</td></tr>
<tr><td>1</td><td>0</td><td>1</td><td>1</td><td>9-bit 8080 parallel interface, D[8:0]</td></tr>
<tr><td>1</td><td>1</td><td>1</td><td>0</td><td>3-wire SPI</td></tr>
</table></td></tr>
<tr><td>56</td><td>WSYNC</td><td>Ram Write Synchronization output</td></tr>
<tr><td>57</td><td>NC</td><td>No connection</td></tr>
<tr><td>58</td><td>OE</td><td>Display enable pin from controller</td></tr>
<tr><td>59-60</td><td>GND</td><td>Power supply (system ground)</td></tr>
</table>

Table 1.

PS3	PS2	PS1	PS0	Interface Mode	Data bus input
0	0	0	0	16-bit 6800 parallel interface	D[17:10], D[8:1]
0	0	0	1	8-bit 6800 parallel interface	D[17:10]
0	0	1	0	16-bit 8080 parallel interface	D[17:10], D[8:1]
0	0	1	1	8-bit 8080 parallel interface	D[17:10]
0	1	0	0	9-bit generic D[9:16] (262k colour) + 3-wire SPI If 65K color, D12 shorts to D17 internally	
0	1	0	1	16-bit generic (262k colour) + 3-wire SPI	
0	1	1	0	18-bit generic (262k colour) + 3-wire SPI	
0	1	1	1	6-bit generic D[8:3] (262k colour) + 3-wire SPI	
1	0	0	0	18-bits 6800 parallel interface	D[17:0]
1	0	0	1	9-bits 6800 parallel interface	D[17:9]
1	0	1	0	18-bit 8080 parallel interface	D[17:0]
1	0	1	1	9-bit 8080 parallel interface	D[17:9]
1	1	1	0	3-wire SPI	
1	1	1	1	4-wire SPI	

7.Timing Characteristics

7.1 Command

1. LCD_Initial_SSD2119:(for 16bit 8080 interface)

COMMAND	CODE	DESCRIPTION
R28H	0006	Enable R25, R29 register
R00H	0001	OSCEN=1
R10H	0000	Sleep=0
R07H	0033	Display control. CM=0
R11H	6870	65K color, X, Y auto increase ,updated in horizontal direction
R02H	0600	line inversion
R03H	4A38	VGH/VGL= 5/-3
R01H	32EF	Gate lines =240
R0FH	0000	Start scan line = 0
R25	A000	Frame frequency
R0BH	5308	Frequency
R0CH	0003	VCIX2
R0DH	0009	VLCD63
R0EH	2700	VCOML
R1EH	0068	VCOMH
R44H	EF00	HAS and HEA station
R45H	0000	Vertical address start station
R46H	013F	Vertical address end station
R30H	0000	Gamma B control 1
R31H	0101	Gamma B control 2
R32H	0100	Gamma B control 3
R33H	0305	Gamma B control 4
R34H	0707	Gamma B control 5
R35H	0305	Gamma B control 6
R36H	0707	Gamma B control 7
R37H	0201	Gamma B control 8
R3AH	1200	Gamma B control 9
R3BH	0900	Gamma B control 10
R22H	--	Write data to RAM

2. LCD_Initial_SSD2119:(for 18bit+3wire SPI and 4wire SPI)

COMMAND	CODE	DESCRIPTION
R28H	0006	Enable R25, R29 register
R00H	0001	OSCEN=1
R10H	0000	Sleep=0
R07H	0033	Display control. CM=0
R11H	4E70	DFM[1:0] : 262k Color Mode DenMode = 1 : RGB interface ignore HSYNC, VSYNC pin and HBP, VBP WMode = 1 : Write RAM from Generic RGB data (POR, if PS:00xx)
R02H	0600	line inversion
R03H	6A38	VGH/VGL= 5/-3
R01H	32EF	
R0CH	0005	VCIX2
R0DH	000D	VLCD63
R0EH	2D00	VCOML
R1EH	00BE	VCOMH
R15	0058	
R30H	0000	Gamma B control 1
R31H	0101	Gamma B control 2
R32H	0100	Gamma B control 3
R33H	0305	Gamma B control 4
R34H	0707	Gamma B control 5
R35H	0305	Gamma B control 6
R36H	0707	Gamma B control 7
R37H	0201	Gamma B control 8
R3AH	1200	Gamma B control 9
R3BH	0900	Gamma B control 10
R22H	--	Write data to RAM

7.2 AC Electrical Characteristics

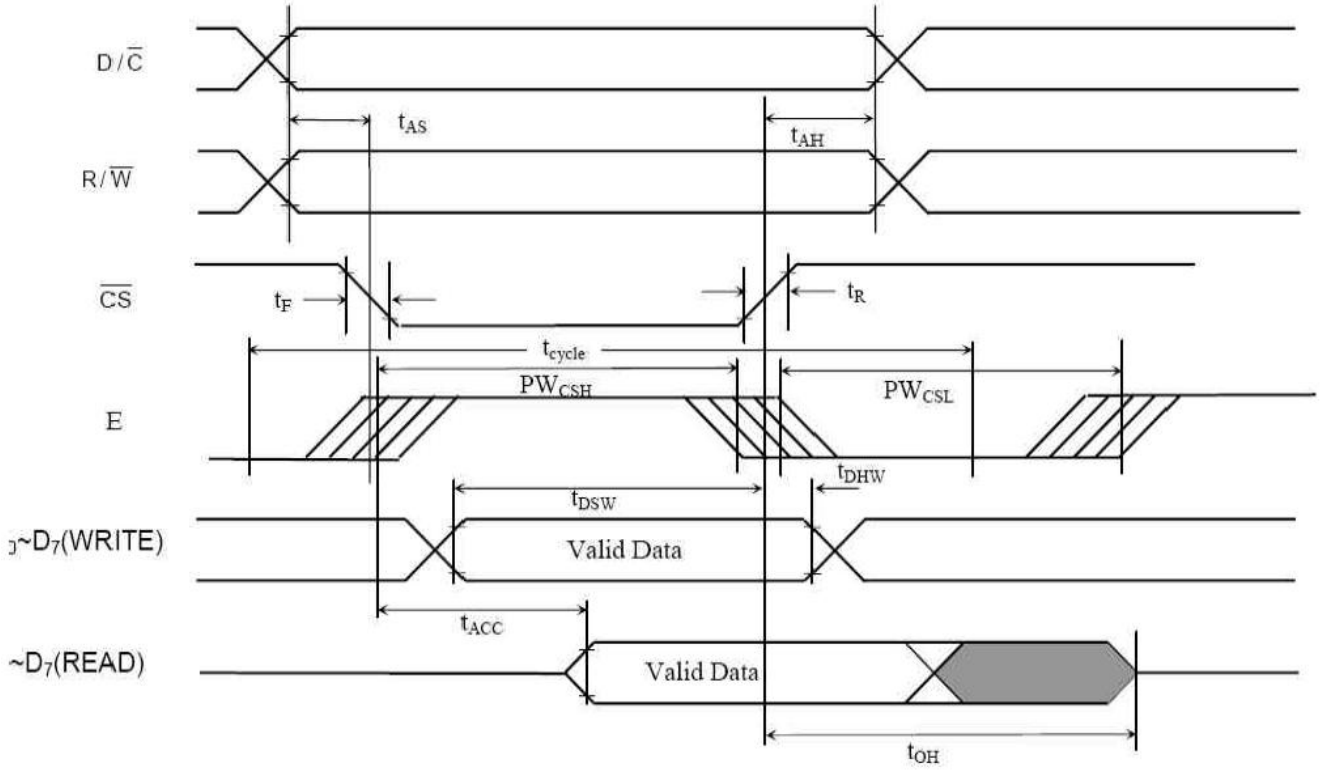
1.Parallel 6800 Timing Characteristics

(T_A = -40 to 85°C, V_{DDIO} = 1.4V to 3.6V)

Symbol	Parameter	Min	Typ	Max	Unit
t_{cycle}	Clock Cycle Time (write cycle)	75	-	-	ns
t_{cycle}	Clock Cycle Time (read cycle)	1000	-	-	ns
t_{AS}	Address Setup Time (R/$\overline{W}$)	0	-	-	ns
t_{AH}	Address Hold Time (R/$\overline{W}$)	0	-	-	ns
t_{DSW}	Data Setup Time (D0~D7, WRITE)	5	-	-	ns
t_{DHW}	Data Hold Time (D0~D7, WRITE))	5	-	-	ns
t_{ACC}	Data Access Time (D0~D7, READ)	250	-	-	ns
t_{OH}	Output Hold time (D0~D7, READ)	100	-	-	ns
PW_{CSL}	Pulse width /CS low (write cycle)	40	-	-	ns
PW_{CSH}	Pulse width /CS high (write cycle)	25	-	-	ns
PW_{CSL}	Pulse width /CS low (read cycle)	500	-	-	ns
PW_{CSH}	Pulse width /CS high (read cycle)	500	-	-	ns
t_R	Rise time (/CS)	-	-	4	ns
t_F	Fall time (/CS)	-	-	4	ns

Note: CS can be pulled low during the write cycle, only /RW is needed to be toggled

Parallel 6800-series Interface Timing Characteristics



2.Parallel 8080 Timing Characteristics

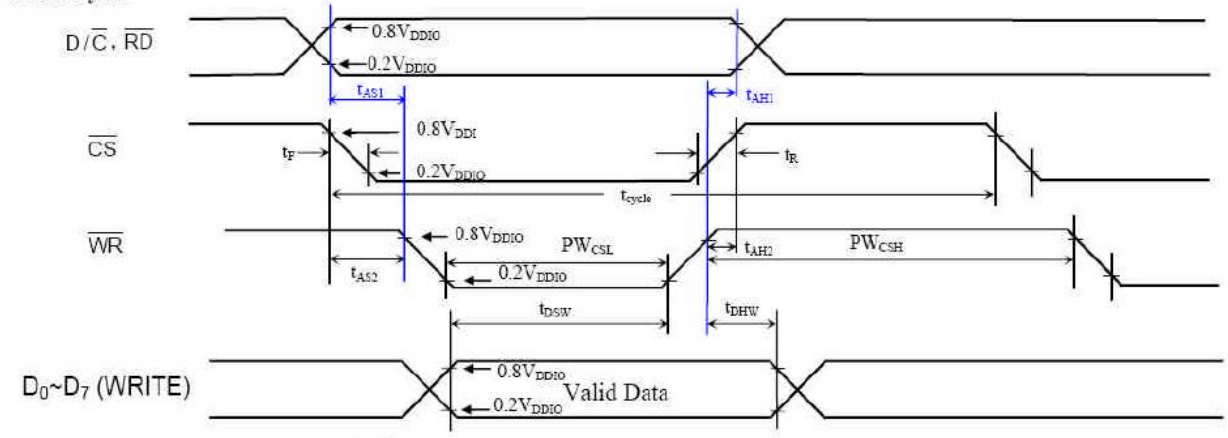
(T_A = -40 to 85°C, V_{DDIO} = 1.4V to 3.6V)

Symbol	Parameter	Min	Typ	Max	Unit
t_{cycle}	Clock Cycle Time (write cycle)	75	-	-	ns
t_{cycle}	Clock Cycle Time (read cycle)	1000	-	-	ns
t_{AS1}	Address Setup Time between (R/$\overline{W}$) and D/$\overline{C}$	0	-	-	ns
t_{AH1}	Address Hold Time between (R/$\overline{W}$) and D/$\overline{C}$	0	-	-	ns
t_{AS2}	Address Setup Time between (R/$\overline{W}$) and $\overline{CS}$	0	-	-	ns
t_{AH2}	Address Hold Time between (R/$\overline{W}$) and $\overline{CS}$	0	-	-	ns
t_{DSW}	Data Setup Time (D0~D7, WRITE)	5	-	-	ns
t_{DHW}	Data Hold Time (D0~D7, WRITE))	5	-	-	ns
t_{ACC}	Data Access Time (D0~D7, READ)	250	-	-	ns
t_{OH}	Output Hold time (D0~D7, READ)	100	-	-	ns
PW_{CSL}	Pulse width /CS low (write cycle)	40	-	-	ns
PW_{CSH}	Pulse width /CS high (write cycle)	25	-	-	ns
PW_{CSL}	Pulse width /CS low (read cycle)	500	-	-	ns
PW_{CSH}	Pulse width /CS high (read cycle)	500	-	-	ns
t_R	Rise time (/CS)	-	-	4	ns
t_F	Fall time (/CS)	-	-	4	ns

Note: CS can be pulled low during the write cycle, only /RW is needed to be toggled

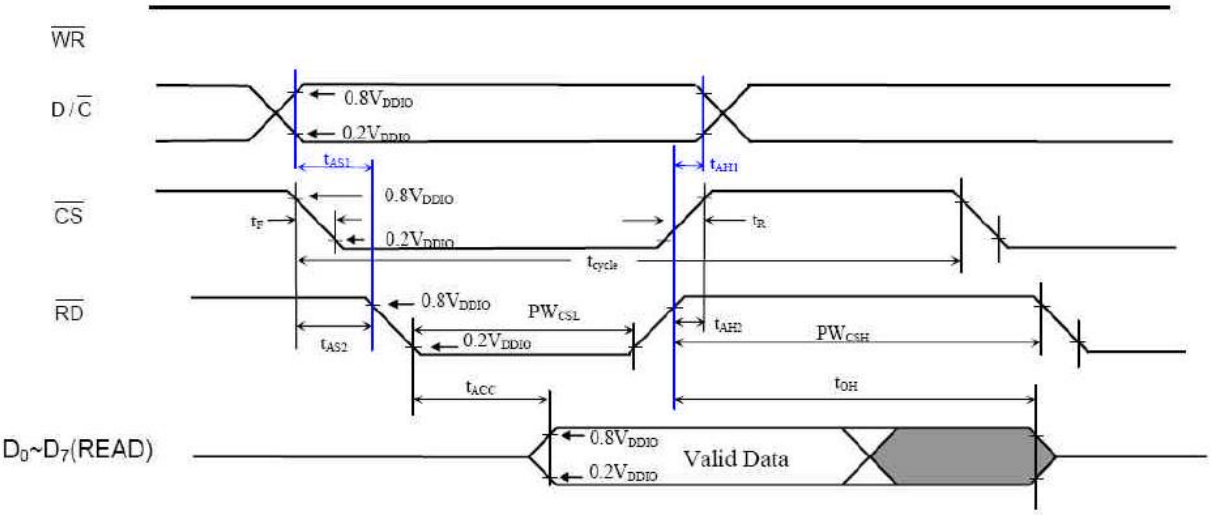
Parallel 8080-series Interface Timing Characteristics

Write Cycle



Remark: It's highly recommended that $\overline{RD}$ remains high for the whole write cycle

Read Cycle

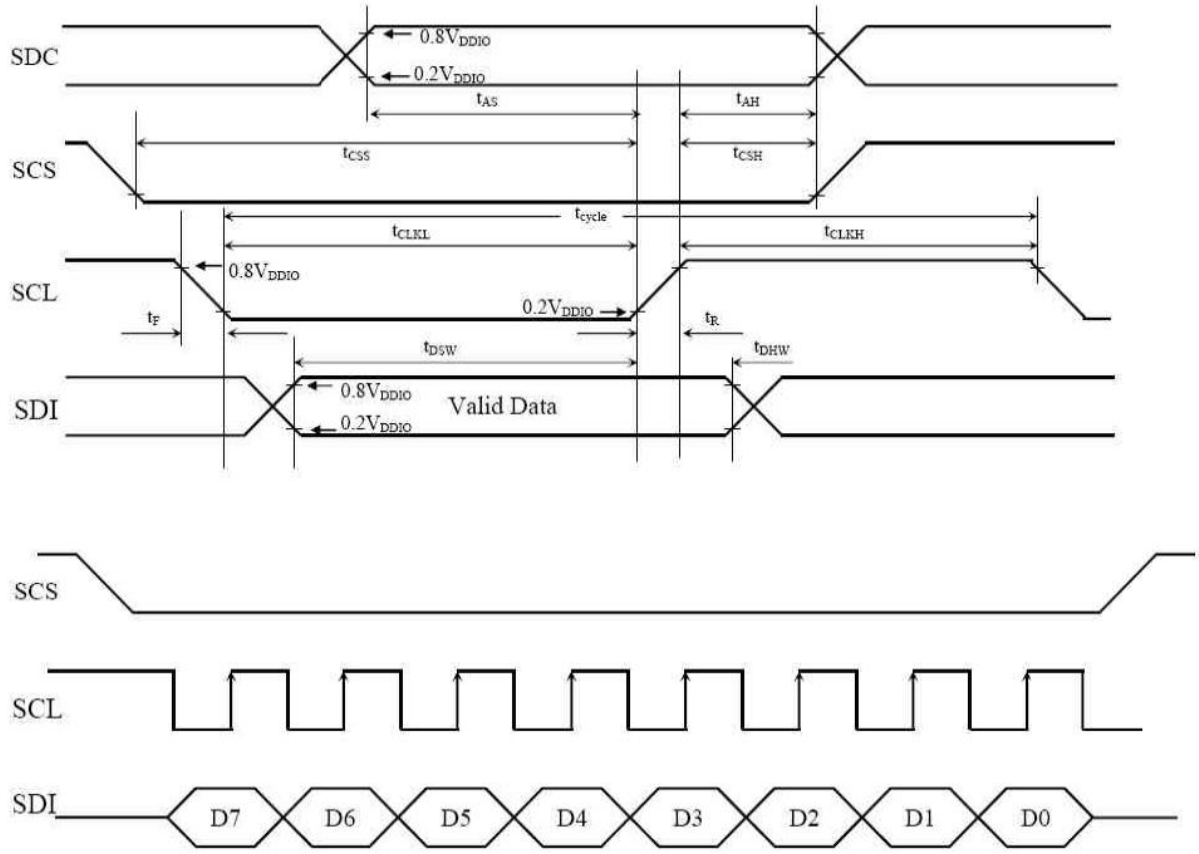


3. Serial Timing Characteristics

(T_A = -40 to 85°C, V_{DDIO} = 1.4V to 3.6V)

Symbol	Parameter	Min	Typ	Max	Unit
t_{cycle}	Clock Cycle Time	77	-	-	ns
f_{CLK}	Serial Clock Cycle Time SPI Clock tolerance = +/- 2 ppm	-	-	15	MHz
t_{AS}	Register select Setup Time	4	-	-	ns
t_{AH}	Register select Hold Time	5	-	-	ns
t_{CSS}	Chip Select Setup Time	2	-	-	ns
t_{CSH}	Chip Select Hold Time	10	-	-	ns
t_{DSW}	Write Data Setup Time	5	-	-	ns
t_{OHW}	Write Data Hold Time	10	-	-	ns
t_{CLKL}	Clock Low Time	38	-	-	ns
t_{CLKH}	Clock High Time	38	-	-	ns
t_R	Rise time	-	-	4	ns
t_F	Fall time	-	-	4	ns

4 wire Serial Timing Characteristics



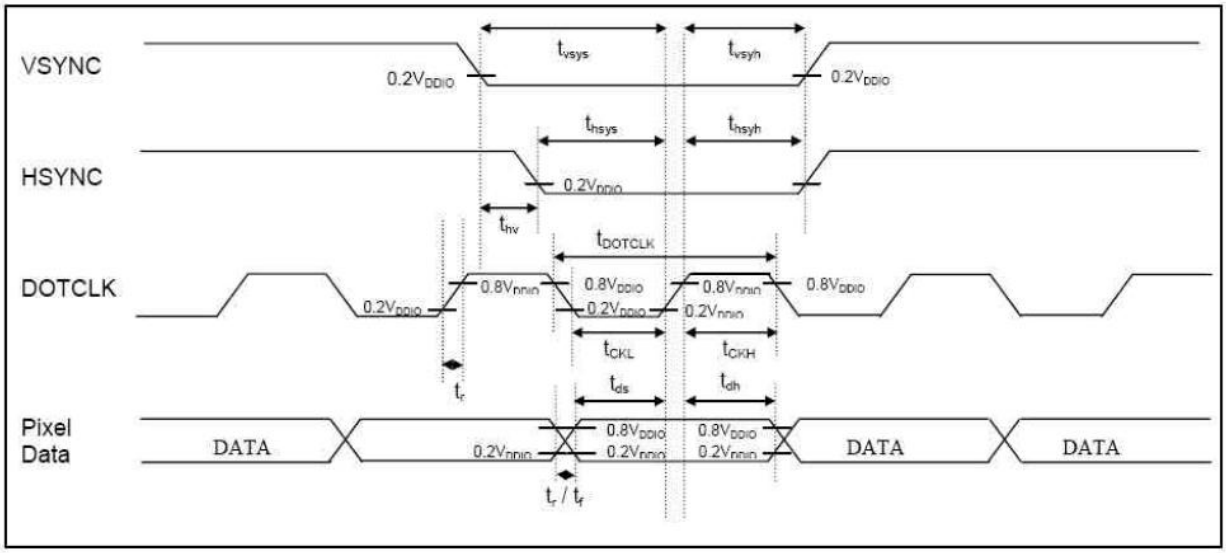
4. RGB Timing Characteristics

(T_A = -40 to 85°C, V_{DDIO} = 1.4V to 3.6V)

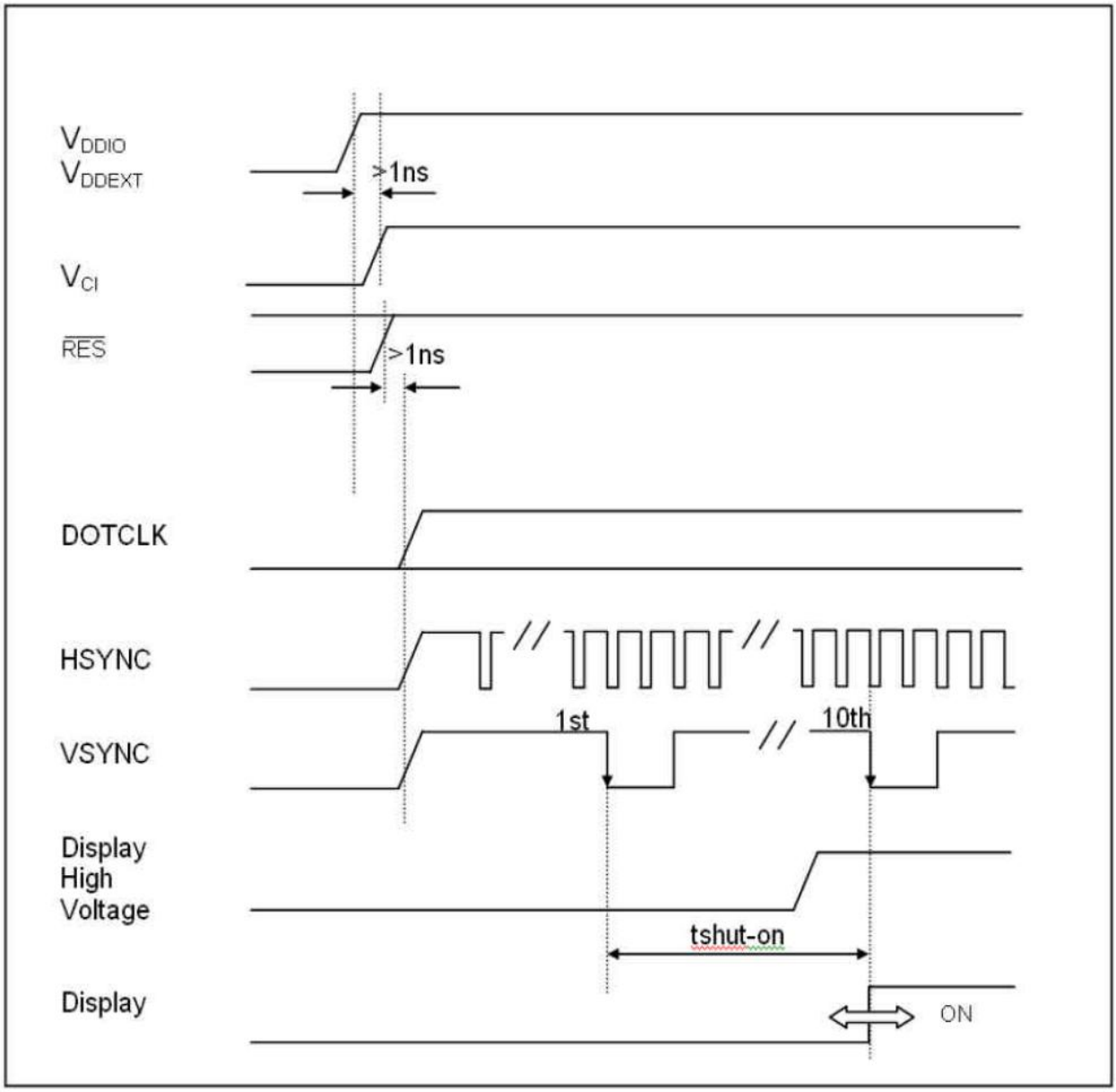
Symbol	Parameter	Min	Typ	Max	Unit
f_{DOTCLK}	DOTCLK Frequency (70Hz frame rate)	1	5.5	8.2	MHz
t_{DOTCLK}	DOTCLK Period	122	182	1000	us
t_{VSYS}	Vertical Sync Setup Time	20	-	-	ns
t_{VSYH}	Vertical Sync Hold Time	20	-	-	ns
t_{HSYS}	Horizontal Sync Setup Time	20	-	-	ns
t_{HSYH}	Horizontal Sync Hold Time	20	-	-	ns
t_{HV}	Phase difference of Sync Signal Falling Edge	0	-	320	t_{DOTCLK}
t_{CLK}	DOTCLK Low Period	61	-	-	ns
t_{CKH}	DOTCLK High Period	61	-	-	ns
t_{DS}	Data Setup Time	25	-	-	ns
t_{DH}	Data hold Time	25	-	-	ns
t_{RES}	Reset pulse width	8			ns

Note: External clock source must be provided to DOTCLK pin of SSD2119. The driver will not operate in absence of the clocking signal.

RGB Timing Characteristics

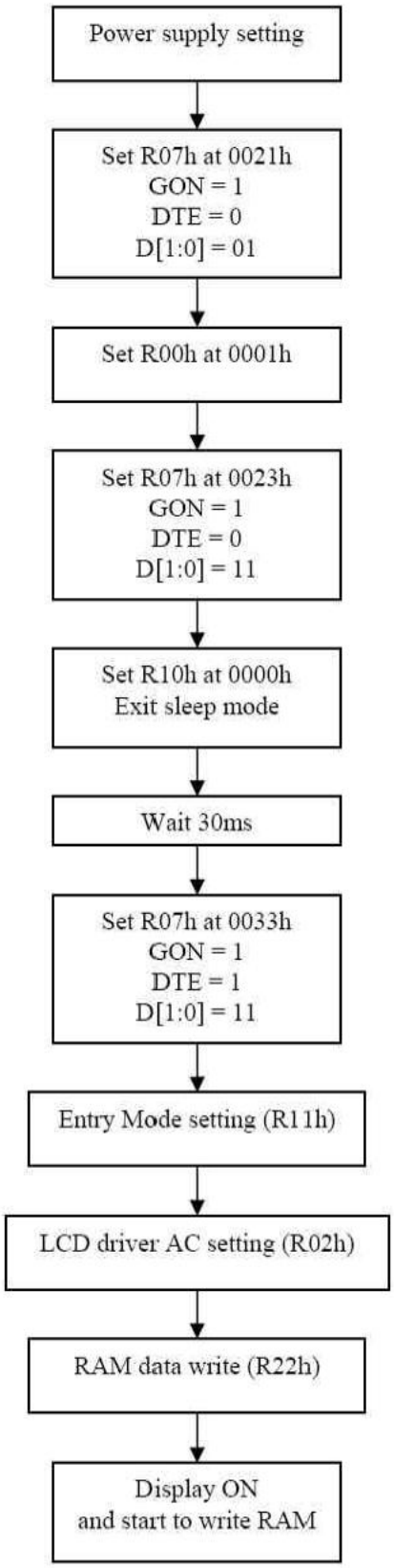


7.3 Power UP Sequence

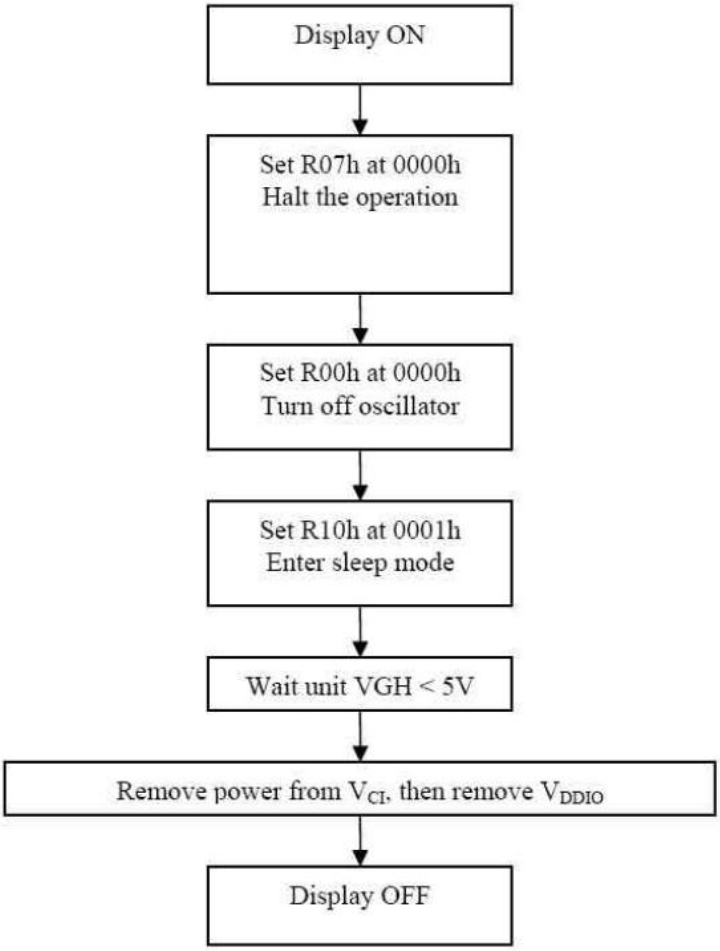


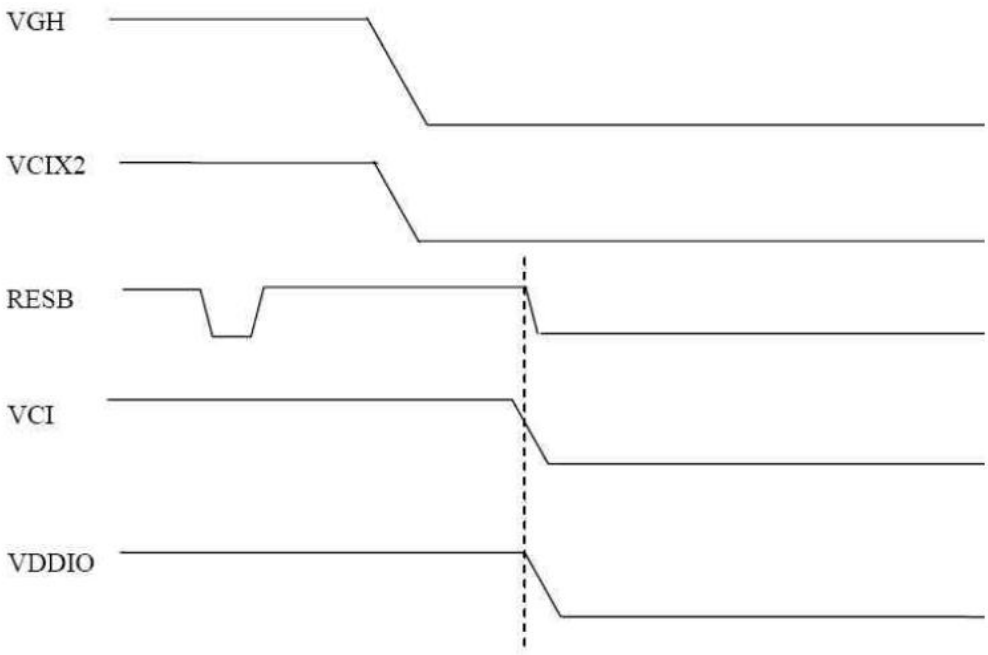
7.4 Display Sequence

1.Display ON Sequence



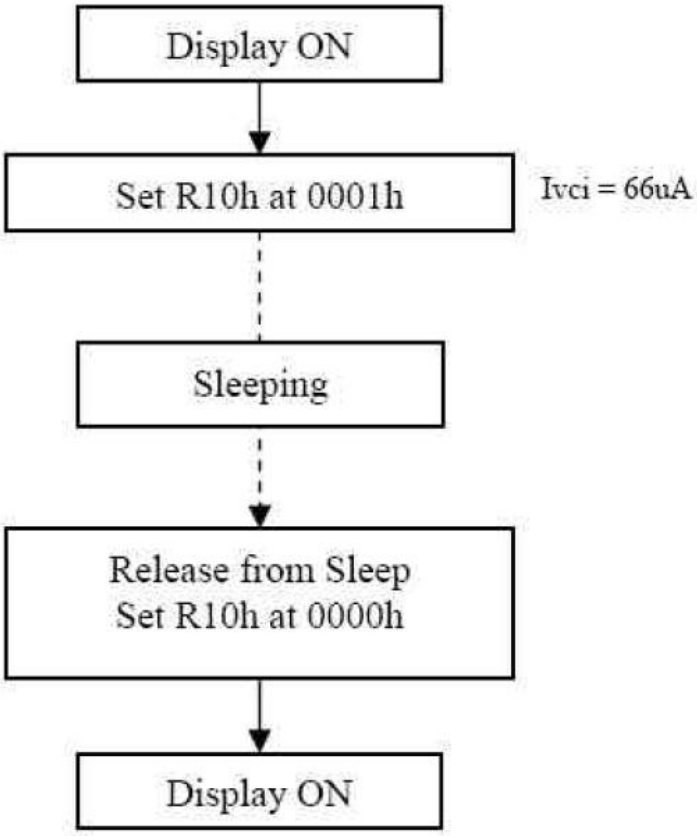
2.Display Off Sequence



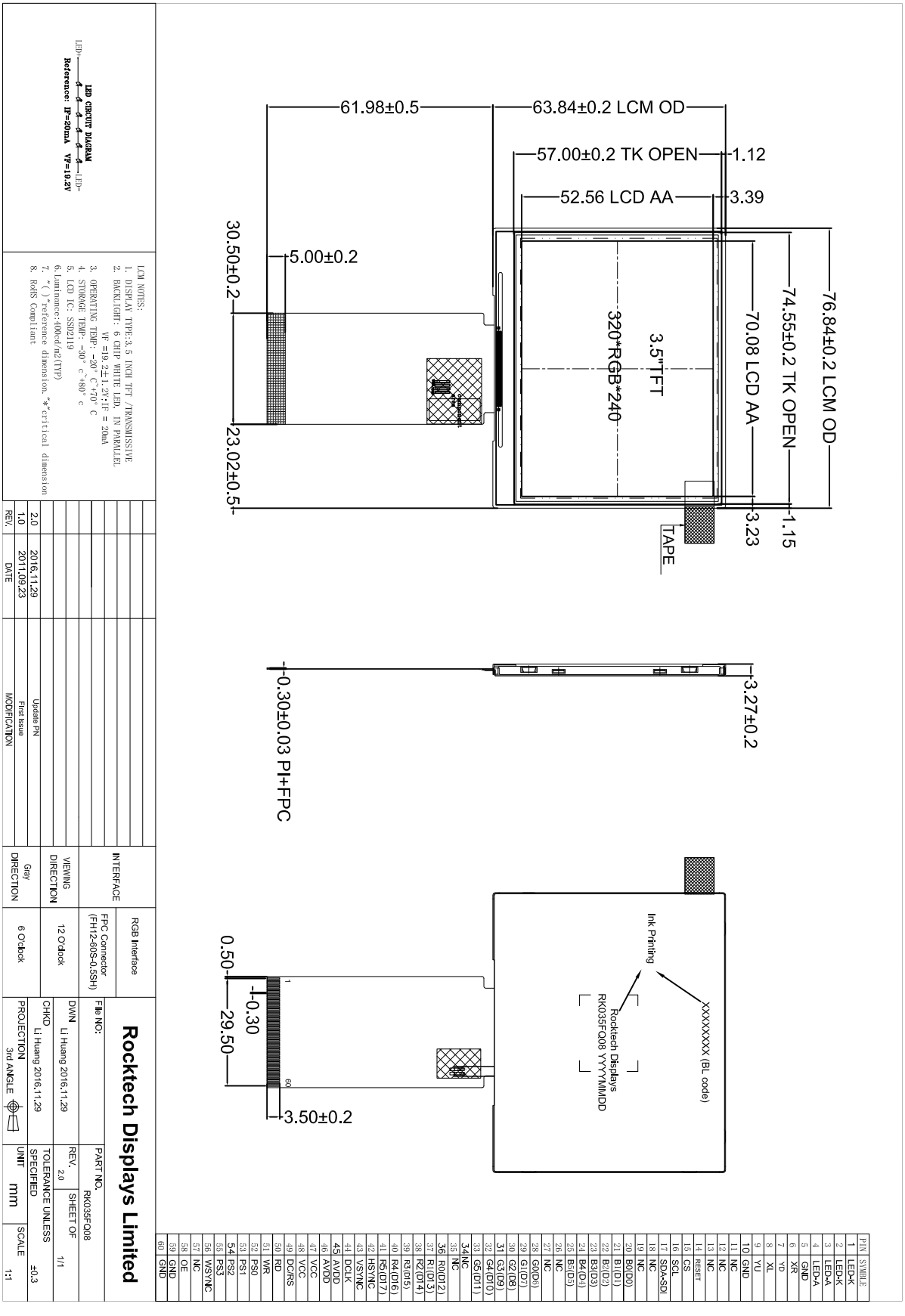


Note:
1. VDDIO should be the last to fall, or VCI/VDDIO could be power off at the same time
2. If OTP is active in the application, the OTP programming voltage should be turned off and cap

3.Sleep Mode Display Sequence



8.Outline Dimension



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.