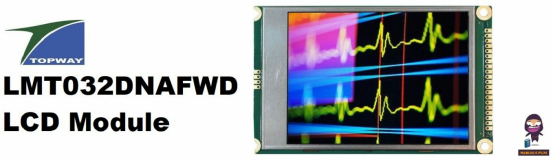


TOPWAY LMT032DNAFWD LCD Module User Manual

Contents

TOPWAY LMT032DNAFWD LCD Module

Specifications

- **Screen Size(Diagonal):** 3.2″
- **Active Area:** 64.8 x 48.6 (mm)
- **Number of dots:** 320 x 240 (RGB)
- **Pixel Pitch:** 0.2025 x 0.2025 (mm)
- **Color Depth:** 16.7M colors
- **Display Technology:** TFT Panel
- **Display Mode:** RGB
- **Display Interface:** ILI9341 or equivalent
- **Viewing Direction:** TBD
- **Surface Treatment:** TBD
- **Operating Temperature:** TBD
- **Storage Temperature:** TBD

FAQs

- **Q: What is the screen size of the LCD module?**
  - **A:** The screen size is 3.2 inches diagonally.
- **Q: What is the resolution of the display?**
  - **A:** The display has a resolution of 320×240 pixels (RGB).

Descriptions

Rev.	Descriptions	Edit	Release Date
0.1	Preliminary	Yang	2012-12-17
0.2	Typing Correction Block Diagram	Yang	2013-01-15
0.3	Update General Specification	Yang	2013-03-07
0.4	Add Backlight Function	Lin	2013-05-31
0.5	Update Viewing Direction	Li Keke	2019-12-31
0.6	Update 1. General Specification BLEN Descriptions of 3.1 Interface 5. 1 DC Characteristics 8. Optical Characteristics 9.LCD Module Design and Handling Precautions and Outline	Caiwei	2024-03-05

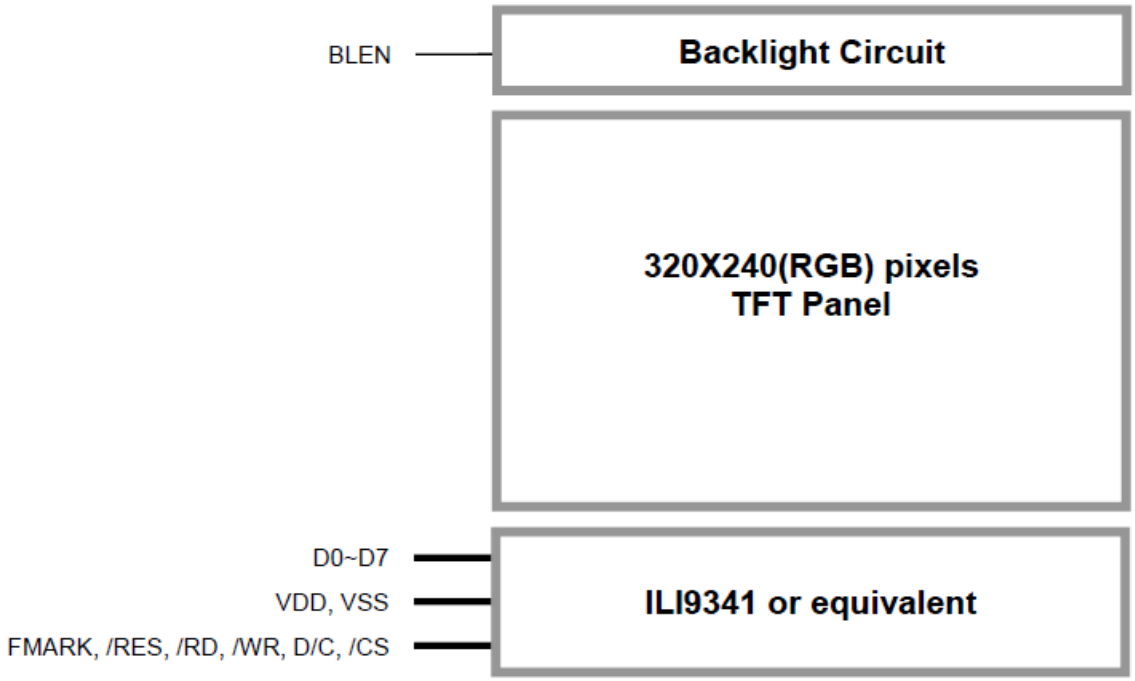
General Specification

- **Screen Size(Diagonal):** 3.2”
- **Active Area:** 64.8 x 48.6 (mm)
- **Number of dots:** 320 x 240(RGB)
- **Pixel Pitch** 0.2025 x 0.2025 (mm)
- **Color Depth:** 65k colors
- **Display Technology:** a-Si TFT active matrix
- **Display Mode:** Normal White, Transmissive
- **Display Interface:** MCU_8bit
- **Viewing Direction:** 3 o’clock(Grayscale Inversion) (*1) 9 o’clock (*2)
- **Surface Treatment:** Anti-Glare(Cover glass)
- **Operating Temperature:** -20 ~ +70°C
- **Storage Temperature:** -30 ~ +80°C

Note:

1. For saturated color display content (eg. pure-red, pure-green, pure-blue, or pure-colors-combinations).
2. For “color scales” display content.
3. Color tone may slightly change by Temperature and Driving Conditions.

Block Diagram



Terminal Functions

Interface

Pin No.	Pin Name	I/O	Descriptions
1	VSS	P	Power Ground (0V)
2	VSS		
3	BEN	I	Backlight enable BLEN=L, turn off Backlight BLEN=H, turn on Backlight PWM(*1) brightness control
4	VDD	P	Positive Power Supply
5	VDD		
6	/RD	I	/WR=H, /RD=L; Data or Status read from the LCD module
7	/WR	I	/WR=LàH, RD=H; Data or Instruction latch into the LCD module
8	D/C	I	Register Select D/C = H, Transferring the Display Data D/C = L, Transferring the Control Data
9	/CS	I	Chip Select /CS=L, enable access to the LCD interface /CS=H, disable access to the LCD interface
10	D0	I	Data Input
:	:	:	:
17	D7	I	Data Input
18	/RES	I	Reset signal /RES = L, Initialization is executed /RES = H, Normal runnings
19	DENMARK	O	Displaying Timing Frame Signal
20	NC	–	–
:	:	–	–
24	NC	–	–

Note:

1. The PWM frequency is between 5kHz and 10kHz.

Absolute Maximum Ratings

Items	Symbol	Min.	Max.	Unit	Condition
Supply Voltage	VDD	-0.3	+4.0	V	GND = 0V
Operating Temperature	TOP	-20	+70	°C	No Condensation
Storage Temperature	TEST	-30	+80	°C	No Condensation

Cautions:
Any Stresses exceeding the Absolute Maximum Ratings may cause substantial damage to the device. Functional operation of this device at other conditions beyond those listed in the specification is not implied and prolonged exposure to extreme conditions may affect device reliability.

Electrical Characteristics

DC Characteristics (MCU terminal)

VDD=3.0V, VSS=0V, TOP =25C

Items	Symbol	MIN.	TYP.	MAX.	Unit	Applicable Pin
Operating Voltage	VDD	2.7	3.0	3.3	V	VDD
Input High Voltage	VIA	0.8VDD	–	VDD	V	/RD, /WR, D/C, /CS, D0~D7, /RES,BLEN
Input Low Voltage	VIL	VSS	–	0.2VDD	V	
Output Signal High Voltage	VOH	0.8VDD	–	VDD	V	D0~D7
Output Signal Low Voltage	VOL	VSS	–	0.2VDD	V	
Operating Current	ADD	–	110	–	mA	All black, Backlight ON (BLEN=H)
		–	9.5	–	mA	All black, Backlight OFF (BLEN=L)

AC Characteristics

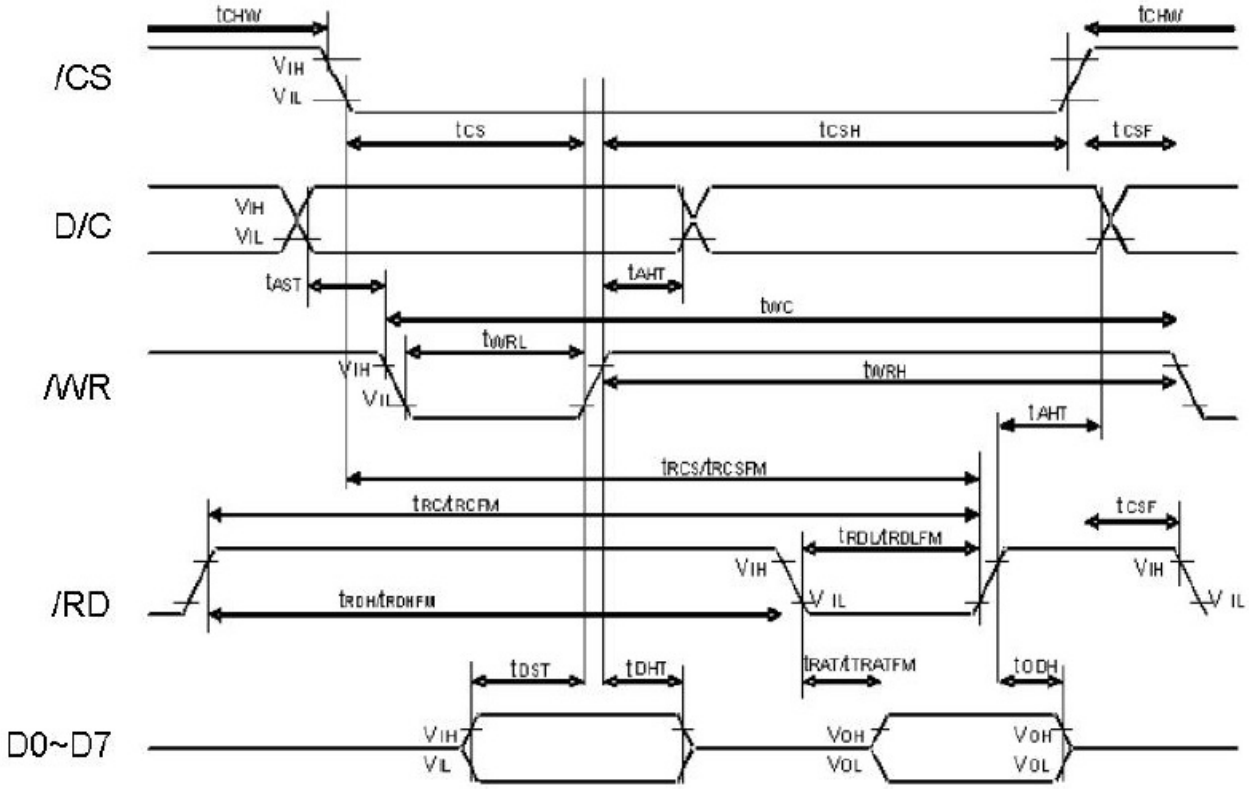
AC Timing

Signal	Symbol	Parameter	Spec.			Unit	Description
			Min.	Typ	Max.		
D/C	test	Address setup time	10	–	–	ns	
	that	Address hole time(Write/Read)	10	–	–		
/CS	tCHW	Chip select “H” pulse width	10	–	–	ns	
	tCS	Chip select setup time(Write)	56	–	–		
	tRCSFM	Chip select setup time(Read FM)	440	–	–		
	CSF	Chip select wait time(Write/Read)	12.5	–	–		
	that	Chip select hold time	12.5	–	–		
/WR	tWC	Write cycle	82.5	–	–	ns	
	tWRH	Control pulse “H” duration	18.75	–	–		
	twirl	Control pulse “L” duration	18.75	–	–		
/RD (FM)	CFNM	Read cycle(FM)	560	–	–	ns	When read from frame memory
	DFM	Control pulse “H” duration(FM)	112	–	–		
	RDF	Control pulse “L” duration(FM)	440	–	–		
D[7:0]	DST	Data setup time	12.5	–	–	ns	For maximum CL=30pF For minimum CL=8 pF
	DHT	Data hold time	8	–	–		
	tractor	Read access time(FM)	–	–	425		
	tODH	Output disable time	16	–	64		

Note:

1. The input signal rise time and fall time(tr, tf) are specified at 15 ns or less.
2. Logic high and low levels are specified as 30% and 70% of VDD for input signals.
3. Refer to the ILI9341 datasheet for more details.

Register Write/Read timing (for CPU 8 Bit)


/CS
D/C
/WR
/RD
D0~D7
tCHW
tCHW
VIH
VIL
tCS
tCSH
tCSF
VIH
VIL
tAST
tAHT
tWC
tWRL
tWRH
VIH
VIL
tAHT
tRCS/tRCSFM
tRC/tRCFM
tCSF
tRDL/tRDLFM
VIH
VIL
VIH
VIL
tRDH/tRDHFM
tDST
tDHT
tRAT/tRATFM
tODH
VIH
VIL
VOH
VOL
VOH
VOL

Commands

Regulative Command Set													
Command Function	D/CX	RDX	WRX	D17-8	D7	D6	D5	D4	D3	D2	D1	D0	Hex
No Operation	0	1	↑	XX	0	0	0	0	0	0	0	0	00h
Software Reset	0	1	↑	XX	0	0	0	0	0	0	0	1	01h
Read Display Identification Information	0	1	↑	XX	0	0	0	0	0	1	0	0	04h
	1	↑	1	XX	X	X	X	X	X	X	X	X	XX
	1	↑	1	XX	ID1 [7:0]								XX
	1	↑	1	XX	ID2 [7:0]								XX
	1	↑	1	XX	ID3 [7:0]								XX
Read Display Status	0	1	↑	XX	0	0	0	0	1	0	0	1	09h
	1	↑	1	XX	X	X	X	X	X	X	X	X	XX
	1	↑	1	XX	D [31:25]							0	00
	1	↑	1	XX	0	D [22:20]			D [19:16]				61
	1	↑	1	XX	D [15]	0	D [13]	0	0	D [10:8]			00
	1	↑	1	XX	D [7:5]				D [4:1]			0	00
Read Display Power Mode	0	1	↑	XX	0	0	0	0	1	0	1	0	0Ah
	1	↑	1	XX	X	X	X	X	X	X	X	X	XX
	1	↑	1	XX	D [7:2]						0	0	08
Read Display MADCTL	0	1	↑	XX	0	0	0	0	1	0	1	1	0Bh
	1	↑	1	XX	X	X	X	X	X	X	X	X	XX
	1	↑	1	XX	D [7:2]						0	0	00
Read Display Pixel Format	0	1	↑	XX	0	0	0	0	1	1	0	0	0Ch
	1	↑	1	XX	X	X	X	X	X	X	X	X	XX
	1	↑	1	XX	0	DPI [2:0]			0	DBI [2:0]			06
Read Display Image Format	0	1	↑	XX	0	0	0	0	1	1	0	1	0Dh
	1	↑	1	XX	X	X	X	X	X	X	X	X	XX
	1	↑	1	XX	0	0	0	0	0	D [2:0]			00
Read Display Signal Mode	0	1	↑	XX	0	0	0	0	1	1	1	0	0Eh
	1	↑	1	XX	X	X	X	X	X	X	X	X	XX
	1	↑	1	XX	D [7:2]						0	0	00
Read Display Self-Diagnostic Result	0	1	↑	XX	0	0	0	0	1	1	1	1	0Fh
	1	↑	1	XX	X	X	X	X	X	X	X	X	XX
	1	↑	1	XX	D [7:6]		0	0	0	0	0	0	00
Enter Sleep Mode	0	1	↑	XX	0	0	0	1	0	0	0	0	10h
Sleep OUT	0	1	↑	XX	0	0	0	1	0	0	0	1	11h
Partial Mode ON	0	1	↑	XX	0	0	0	1	0	0	1	0	12h
Normal Display Mode ON	0	1	↑	XX	0	0	0	1	0	0	1	1	13h
Display Inversion OFF	0	1	↑	XX	0	0	1	0	0	0	0	0	20h
Display Inversion ON	0	1	↑	XX	0	0	1	0	0	0	0	1	21h
Gamma Set	0	1	↑	XX	0	0	1	0	0	1	1	0	26h
	1	1	↑	XX	GC [7:0]								01
Display OFF	0	1	↑	XX	0	0	1	0	1	0	0	0	28h
Display ON	0	1	↑	XX	0	0	1	0	1	0	0	1	29h
Column Address Set	0	1	↑	XX	0	0	1	0	1	0	1	0	2Ah
	1	1	↑	XX	SC [15:8]								XX
	1	1	↑	XX	SC [7:0]								XX
	1	1	↑	XX	EC [15:8]								XX
	1	1	↑	XX	EC [7:0]								XX
Page Address Set	0	1	↑	XX	0	0	1	0	1	0	1	1	2Bh
	1	1	↑	XX	SP [15:8]								XX
	1	1	↑	XX	SP [7:0]								XX
	1	1	↑	XX	EP [15:8]								XX
	1	1	↑	XX	EP [7:0]								XX

Memory Write	0	1	↑	XX	0	0	1	0	1	1	0	0	2Ch
	1	1	↑	D [17:0]									XX
Color SET	0	1	↑	XX	0	0	1	0	1	1	0	1	2Dh
	1	1	↑	XX	0	0	R00 [5:0]						XX
	1	1	↑	XX	0	0	Rnn [5:0]						XX
	1	1	↑	XX	0	0	R31 [5:0]						XX
	1	1	↑	XX	0	0	G00 [5:0]						XX
	1	1	↑	XX	0	0	Gnn [5:0]						XX
	1	1	↑	XX	0	0	G64 [5:0]						XX
	1	1	↑	XX	0	0	B00 [5:0]						XX
	1	1	↑	XX	0	0	Bnn [5:0]						XX
	1	1	↑	XX	0	0	B31 [5:0]						XX
Memory Read	0	1	↑	XX	0	0	1	0	1	1	1	0	2Eh
	1	↑	1	XX	X	X	X	X	X	X	X	X	XX
	1	↑	1	D [17:0]									XX
Partial Area	0	1	↑	XX	0	0	1	1	0	0	0	0	30h
	1	1	↑	XX	SR [15:8]								00
	1	1	↑	XX	SR [7:0]								00
	1	1	↑	XX	ER [15:8]								01
	1	1	↑	XX	ER [7:0]								3F
Vertical Scrolling Definition	0	1	↑	XX	0	0	1	1	0	0	1	1	33h
	1	1	↑	XX	TFA [15:8]								00
	1	1	↑	XX	TFA [7:0]								00
	1	1	↑	XX	VSA [15:8]								01
	1	1	↑	XX	VSA [7:0]								40
	1	1	↑	XX	BFA [15:8]								00
	1	1	↑	XX	BFA [7:0]								00
Tearing Effect Line OFF	0	1	↑	XX	0	0	1	1	0	1	0	0	34h
Tearing Effect Line ON	0	1	↑	XX	0	0	1	1	0	1	0	1	35h
	1	1	↑	XX	0	0	0	0	0	0	0	M	00
Memory Access Control	0	1	↑	XX	0	0	1	1	0	1	1	0	36h
	1	1	↑	XX	MY	MX	MV	ML	BGR	MH	0	0	00
Vertical Scrolling Start Address	0	1	↑	XX	0	0	1	1	0	1	1	1	37h
	1	1	↑	XX	VSP [15:8]								00
	1	1	↑	XX	VSP [7:0]								00
Idle Mode OFF	0	1	↑	XX	0	0	1	1	1	0	0	0	38h
Idle Mode ON	0	1	↑	XX	0	0	1	1	1	0	0	1	39h
Pixel Format Set	0	1	↑	XX	0	0	1	1	1	0	1	0	3Ah
	1	1	↑	XX	0	DPI [2:0]			0	DBI [2:0]			66
Write Memory Continue	0	1	↑	XX	0	0	1	1	1	1	0	0	3Ch
	1	1	↑	D [17:0]									XX
Read Memory Continue	0	1	↑	XX	0	0	1	1	1	1	1	0	3Eh
	1	↑	1	XX	X	X	X	X	X	X	X	X	XX
	1	↑	1	D [17:0]									XX
Set Tear Scanline	0	1	↑	XX	0	1	0	0	0	1	0	0	44h
	1	1	↑	XX	0	0	0	0	0	0	0	STS [8]	XX
	1	1	↑	XX	STS [7:0]								XX
Get Scanline	0	1	↑	XX	0	1	0	0	0	1	0	1	45h
	1	↑	1	XX	X	X	X	X	X	X	X	X	XX
	1	↑	1	XX	0	0	0	0	0	0	GTS [9:8]		XX
	1	↑	1	XX	GTS [7:0]								XX
Write Display Brightness	0	1	↑	XX	0	1	0	1	0	0	0	1	51h
	1	1	↑	XX	DBV [7:0]								00

Read Display Brightness	0	1	↑	XX	0	1	0	1	0	0	1	0	52h
	1	↑	1	XX	X	X	X	X	X	X	X	X	XX
	1	↑	1	XX	DBV [7:0]								00
Write CTRL Display	0	1	↑	XX	0	1	0	1	0	0	1	1	53h
	1	1	↑	XX	0	0	BCTRL	0	DD	BL	0	0	00
Read CTRL Display	0	1	↑	XX	0	1	0	1	0	1	0	0	54h
	1	↑	1	XX	X	X	X	X	X	X	X	X	XX
	1	↑	1	XX	0	0	BCTRL	0	DD	BL	0	0	00
Write Content Adaptive Brightness Control	0	1	↑	XX	0	1	0	1	0	1	0	1	55h
	1	1	↑	XX	0	0	0	0	0	0	C [1:0]		00
Read Content Adaptive Brightness Control	0	1	↑	XX	0	1	0	1	0	1	1	0	56h
	1	↑	1	XX	X	X	X	X	X	X	X	X	XX
	1	↑	1	XX	0	0	0	0	0	0	C [1:0]		00
Write CABC Minimum Brightness	0	1	↑	XX	0	1	0	1	1	1	1	0	5Eh
	1	1	↑	XX	CMB [7:0]								00
Read CABC Minimum Brightness	0	1	↑	XX	0	1	0	1	1	1	1	1	5Fh
	1	↑	1	XX	X	X	X	X	X	X	X	X	XX
	1	↑	1	XX	CMB [7:0]								00
Read ID1	0	1	↑	XX	1	1	0	1	1	0	1	0	DAh
	1	↑	1	XX	X	X	X	X	X	X	X	X	XX
	1	↑	1	XX	Module's Manufacture [7:0]								XX
Read ID2	0	1	↑	XX	1	1	0	1	1	0	1	1	DBh
	1	↑	1	XX	X	X	X	X	X	X	X	X	XX
	1	↑	1	XX	LCD Module / Driver Version [7:0]								XX
Read ID3	0	1	↑	XX	1	1	0	1	1	1	0	0	DCh
	1	↑	1	XX	X	X	X	X	X	X	X	X	XX
	1	↑	1	XX	LCD Module / Driver ID [7:0]								XX

Extended Command Set													
Command Function	D/CX	RDX	WRX	D17-8	D7	D6	D5	D4	D3	D2	D1	D0	Hex
RGB Interface Signal Control	0	1	↑	XX	1	0	1	1	0	0	0	0	B0h
	1	1	↑	XX	ByPass_MODE	RCM [1:0]		0	VSPL	HSPL	DPL	EPL	00
Frame Control (In Normal Mode)	0	1	↑	XX	1	0	1	1	0	0	0	1	B1h
	1	1	↑	XX	0	0	0	0	0	0	DIVA [1:0]		00
	1	1	↑	XX	0	0	0	RTNA [4:0]					1B
Frame Control (In Idle Mode)	0	1	↑	XX	1	0	1	1	0	0	1	0	B2h
	1	1	↑	XX	0	0	0	0	0	0	DIVB [1:0]		00
	1	1	↑	XX	0	0	0	RTNB [4:0]					1B
Frame Control (In Partial Mode)	0	1	↑	XX	1	0	1	1	0	0	1	1	B3h
	1	1	↑	XX	0	0	0	0	0	0	DIVC [1:0]		00
	1	1	↑	XX	0	0	0	RTNC [4:0]					1B
Display Inversion Control	0	1	↑	XX	1	0	1	1	0	1	0	0	B4h
	1	1	↑	XX	0	0	0	0	0	NLA	NLB	NLC	02
Blanking Porch Control	0	1	↑	XX	1	0	1	1	0	1	0	1	B5h
	1	1	↑	XX	0	VFP [6:0]							02
	1	1	↑	XX	0	VBP [6:0]							02
	1	1	↑	XX	0	0	0	HFP [4:0]					0A
	1	1	↑	XX	0	0	0	HBP [4:0]					14

Display Function Control	0	1	↑	XX	1	0	1	1	0	1	1	0	B6h
	1	1	↑	XX	0	0	0	0	PTG [1:0]		PT [1:0]		0A
	1	1	↑	XX	REV	GS	SS	SM	ISC [3:0]				82
	1	1	↑	XX	0	0	NL [5:0]						27
	1	1	↑	XX	0	0	PCDIV [5:0]						04
Entry Mode Set	0	1	↑	XX	1	0	1	1	0	1	1	1	B7h
	1	1	↑	XX	0	0	0	0	0	GON	DTE	GAS	06
Backlight Control 1	0	1	↑	XX	1	0	1	1	1	0	0	0	B8h
	1	1	↑	XX	0	0	0	0	TH_UI [3:0]				0C
Backlight Control 2	0	1	↑	XX	1	0	1	1	1	0	0	1	B9h
	1	1	↑	XX	TH_MV [3:0]				TH_ST [3:0]				CC
Backlight Control 3	0	1	↑	XX	1	0	1	1	1	0	1	0	BAh
	1	1	↑	XX	0	0	0	0	DTH_UI [3:0]				04
Backlight Control 4	0	1	↑	XX	1	0	1	1	1	0	1	1	BBh
	1	1	↑	XX	DTH_MV [3:0]				DTH_ST [3:0]				65
Backlight Control 5	0	1	↑	XX	1	0	1	1	1	1	0	0	BCh
	1	1	↑	XX	DIM2 [3:0]				0	DIM1 [2:0]			44
Backlight Control 7	0	1	↑	XX	1	0	1	1	1	1	1	0	BEh
	1	1	↑	XX	PWM_DIV [7:0]								0F
Backlight Control 8	0	1	↑	XX	1	0	1	1	1	1	1	1	BFh
	1	1	↑	XX	0	0	0	0	0	LEDONR	LEDONPOL	LEDPWMOPL	00
Power Control 1	0	1	↑	XX	1	1	0	0	0	0	0	0	C0h
	1	1	↑	XX	0	0	VRH [5:0]						21
Power Control 2	0	1	↑	XX	1	1	0	0	0	0	0	1	C1h
	1	1	↑	XX	0	0	0	1	0	BT [2:0]			10
VCOM Control 1	0	1	↑	XX	1	1	0	0	0	1	0	1	C5h
	1	1	↑	XX	0	VMH [6:0]							31
	1	1	↑	XX	0	VML [6:0]							3C
VCOM Control 2	0	1	↑	XX	1	1	0	0	0	1	1	1	C7h
	1	1	↑	XX	nVM	VMF [6:0]							C0
NV Memory Write	0	1	↑	XX	1	1	0	1	0	0	0	0	D0h
	1	1	↑	XX	0	0	0	0	0	PGM_ADR [2:0]			00
	1	1	↑	XX	PGM_DATA [7:0]								XX
NV Memory Protection Key	0	1	↑	XX	1	1	0	1	0	0	0	1	D1h
	1	1	↑	XX	KEY [23:16]								XX
	1	1	↑	XX	KEY [15:8]								XX
	1	1	↑	XX	KEY [7:0]								XX
NV Memory Status Read	0	1	↑	XX	1	1	0	1	0	0	1	0	D2h
	1	↑	1	XX	X	X	X	X	X	X	X	X	XX
	1	↑	1	XX	0	ID2_CNT [2:0]			0	ID1_CNT [2:0]			XX
	1	↑	1	XX	BUSY	VMF_CNT [2:0]			0	ID3_CNT [2:0]			XX

Read ID4	0	1	↑	XX	1	1	0	1	0	0	1	1	D3h
	1	↑	1	XX	X	X	X	X	X	X	X	X	XX
	1	↑	1	XX	0	0	0	0	0	0	0	0	00
	1	↑	1	XX	1	0	0	1	0	0	1	1	93
	1	↑	1	XX	0	1	0	0	0	0	0	1	41
Positive Gamma Correction	0	1	↑	XX	1	1	1	0	0	0	0	0	E0h
	1	1	↑	XX	0	0	0	0	VP0 [3:0]				0F
	1	1	↑	XX	0	0	VP1 [5:0]						16
	1	1	↑	XX	0	0	VP2 [5:0]						14
	1	1	↑	XX	0	0	0	0	VP4 [3:0]				0A
	1	1	↑	XX	0	0	0	VP6 [4:0]					0D
	1	1	↑	XX	0	0	0	0	VP13 [3:0]				06
	1	1	↑	XX	0	VP20 [6:0]							43
	1	1	↑	XX	VP36 [3:0]				VP27 [3:0]				75
	1	1	↑	XX	0	VP43 [6:0]							33
	1	1	↑	XX	0	0	0	0	VP50 [3:0]				06
	1	1	↑	XX	0	0	0	VP57 [4:0]					0E
	1	1	↑	XX	0	0	0	0	VP59 [3:0]				00
	1	1	↑	XX	0	0	VP61 [5:0]						0C
	1	1	↑	XX	0	0	VP62 [5:0]						09
	1	1	↑	XX	0	0	0	0	VP63 [3:0]				08
Negative Gamma Correction	0	1	↑	XX	1	1	1	0	0	0	0	1	E1h
	1	1	↑	XX	0	0	0	0	VN0 [3:0]				08
	1	1	↑	XX	0	0	VN1 [5:0]						2B
	1	1	↑	XX	0	0	VN2 [5:0]						2D
	1	1	↑	XX	0	0	0	0	VN4 [3:0]				04
	1	1	↑	XX	0	0	0	VN6 [4:0]					10
	1	1	↑	XX	0	0	0	0	VN13 [3:0]				04
	1	1	↑	XX	0	VN20 [6:0]							3E
	1	1	↑	XX	VN36 [3:0]				VN27 [3:0]				24
	1	1	↑	XX	0	VN43 [6:0]							4E
	1	1	↑	XX	0	0	0	0	VN50 [3:0]				04
	1	1	↑	XX	0	0	0	VN57 [4:0]					0F
	1	1	↑	XX	0	0	0	0	VN59 [3:0]				0E
	1	1	↑	XX	0	0	VN61 [5:0]						35
	1	1	↑	XX	0	0	VN62 [5:0]						38
	1	1	↑	XX	0	0	0	0	VN63 [3:0]				0F
Digital Gamma Control 1	0	1	↑	XX	1	1	1	0	0	0	1	0	E2h
1st Parameter	1	1	↑	XX	RCA0 [3:0]				BCA0 [3:0]				XX
2nd Parameter	1	1	↑	XX	RCA1 [3:0]				BCA1 [3:0]				XX
3rd Parameter	1	1	↑	XX	RCA2 [3:0]				BCA2 [3:0]				XX
4th Parameter	1	1	↑	XX	RCA3 [3:0]				BCA3 [3:0]				XX
5th Parameter	1	1	↑	XX	RCA4 [3:0]				BCA4 [3:0]				XX
6th Parameter	1	1	↑	XX	RCA5 [3:0]				BCA5 [3:0]				XX
7th Parameter	1	1	↑	XX	RCA6 [3:0]				BCA6 [3:0]				XX
8th Parameter	1	1	↑	XX	RCA7 [3:0]				BCA7 [3:0]				XX
9th Parameter	1	1	↑	XX	RCA8 [3:0]				BCA8 [3:0]				XX
10th Parameter	1	1	↑	XX	RCA9 [3:0]				BCA9 [3:0]				XX
11th Parameter	1	1	↑	XX	RCA10 [3:0]				BCA10 [3:0]				XX
12th Parameter	1	1	↑	XX	RCA11 [3:0]				BCA11 [3:0]				XX
13th Parameter	1	1	↑	XX	RCA12 [3:0]				BCA12 [3:0]				XX
14th Parameter	1	1	↑	XX	RCA13 [3:0]				BCA13 [3:0]				XX
15th Parameter	1	1	↑	XX	RCA14 [3:0]				BCA14 [3:0]				XX
16th Parameter	1	1	↑	XX	RCA15 [3:0]				BCA15 [3:0]				XX

Digital Gamma Control 2	0	1	↑	XX	1	1	1	0	0	0	1	1	E3h
1st Parameter	1	1	↑	XX	RFA0 [3:0]				BFA0 [3:0]				XX
2nd Parameter	1	1	↑	XX	RFA1 [3:0]				BFA1 [3:0]				XX
3rd Parameter	1	1	↑	XX	RFA2 [3:0]				BFA2 [3:0]				XX
4th Parameter	1	1	↑	XX	RFA3 [3:0]				BFA3 [3:0]				XX
5th Parameter	1	1	↑	XX	RFA4 [3:0]				BFA4 [3:0]				XX
6th Parameter	1	1	↑	XX	RFA5 [3:0]				BFA5 [3:0]				XX
7th Parameter	1	1	↑	XX	RFA6 [3:0]				BFA6 [3:0]				XX
8th Parameter	1	1	↑	XX	RFA7 [3:0]				BFA7 [3:0]				XX
9th Parameter	1	1	↑	XX	RFA8 [3:0]				BFA8 [3:0]				XX
10th Parameter	1	1	↑	XX	RFA9 [3:0]				BFA9 [3:0]				XX
11th Parameter	1	1	↑	XX	RFA10 [3:0]				BFA10 [3:0]				XX
12th Parameter	1	1	↑	XX	RFA11 [3:0]				BFA [3:0]				XX
13th Parameter	1	1	↑	XX	RFA12 [3:0]				BFA12 [3:0]				XX
14th Parameter	1	1	↑	XX	RFA13 [3:0]				BFA13 [3:0]				XX
15th Parameter	1	1	↑	XX	RFA14 [3:0]				BFA14 [3:0]				XX
16th Parameter	1	1	↑	XX	RFA15 [3:0]				BFA15 [3:0]				XX
17th Parameter	1	1	↑	XX	RFA16 [3:0]				BFA16 [3:0]				XX
18th Parameter	1	1	↑	XX	RFA17 [3:0]				BFA17 [3:0]				XX
19th Parameter	1	1	↑	XX	RFA18 [3:0]				BFA18 [3:0]				XX
20th Parameter	1	1	↑	XX	RFA19 [3:0]				BFA19 [3:0]				XX
21st Parameter	1	1	↑	XX	RFA20 [3:0]				BFA20 [3:0]				XX
22nd Parameter	1	1	↑	XX	RFA21 [3:0]				BFA21 [3:0]				XX
23rd Parameter	1	1	↑	XX	RFA22 [3:0]				BFA22 [3:0]				XX
24th Parameter	1	1	↑	XX	RFA23 [3:0]				BFA23 [3:0]				XX
25th Parameter	1	1	↑	XX	RFA24 [3:0]				BFA24 [3:0]				XX
26th Parameter	1	1	↑	XX	RFA25 [3:0]				BFA25 [3:0]				XX
27th Parameter	1	1	↑	XX	RFA26 [3:0]				BFA26 [3:0]				XX
28th Parameter	1	1	↑	XX	RFA27 [3:0]				BFA27 [3:0]				XX
29th Parameter	1	1	↑	XX	RFA28 [3:0]				BFA28 [3:0]				XX
30th Parameter	1	1	↑	XX	RFA29 [3:0]				BFA29 [3:0]				XX
31st Parameter	1	1	↑	XX	RFA30 [3:0]				BFA30 [3:0]				XX
32nd Parameter	1	1	↑	XX	RFA31 [3:0]				BFA31 [3:0]				XX
33rd Parameter	1	1	↑	XX	RFA32 [3:0]				BFA32 [3:0]				XX
34th Parameter	1	1	↑	XX	RFA33 [3:0]				BFA33 [3:0]				XX
35th Parameter	1	1	↑	XX	RFA34 [3:0]				BFA34 [3:0]				XX
36th Parameter	1	1	↑	XX	RFA35 [3:0]				BFA35 [3:0]				XX
37th Parameter	1	1	↑	XX	RFA36 [3:0]				BFA36 [3:0]				XX
38th Parameter	1	1	↑	XX	RFA37 [3:0]				BFA37 [3:0]				XX

39th Parameter	1	1	↑	XX	RFA38 [3:0]				BFA38 [3:0]				XX
40th Parameter	1	1	↑	XX	RFA39 [3:0]				BFA39 [3:0]				XX
41st Parameter	1	1	↑	XX	RFA40 [3:0]				BFA40 [3:0]				XX
42nd Parameter	1	1	↑	XX	RFA41 [3:0]				BFA41 [3:0]				XX
43rd Parameter	1	1	↑	XX	RFA42 [3:0]				BFA42 [3:0]				XX
44th Parameter	1	1	↑	XX	RFA43 [3:0]				BFA43 [3:0]				XX
45th Parameter	1	1	↑	XX	RFA44 [3:0]				BFA44 [3:0]				XX
46th Parameter	1	1	↑	XX	RFA45 [3:0]				BFA45 [3:0]				XX
47th Parameter	1	1	↑	XX	RFA46 [3:0]				BFA46 [3:0]				XX
48th Parameter	1	1	↑	XX	RFA47 [3:0]				BFA47 [3:0]				XX
49th Parameter	1	1	↑	XX	RFA48 [3:0]				BFA48 [3:0]				XX
50th Parameter	1	1	↑	XX	RFA49 [3:0]				BFA49 [3:0]				XX
51st Parameter	1	1	↑	XX	RFA50 [3:0]				BFA50 [3:0]				XX
52nd Parameter	1	1	↑	XX	RFA51 [3:0]				BFA51 [3:0]				XX
53rd Parameter	1	1	↑	XX	RFA52 [3:0]				BFA52 [3:0]				XX
54th Parameter	1	1	↑	XX	RFA53 [3:0]				BFA53 [3:0]				XX
55th Parameter	1	1	↑	XX	RFA54 [3:0]				BFA54 [3:0]				XX
56th Parameter	1	1	↑	XX	RFA55 [3:0]				BFA55 [3:0]				XX
57th Parameter	1	1	↑	XX	RFA56 [3:0]				BFA56 [3:0]				XX
58th Parameter	1	1	↑	XX	RFA57 [3:0]				BFA57 [3:0]				XX
59th Parameter	1	1	↑	XX	RFA58 [3:0]				BFA58 [3:0]				XX
60th Parameter	1	1	↑	XX	RFA59 [3:0]				BFA59 [3:0]				XX
61st Parameter	1	1	↑	XX	RFA60 [3:0]				BFA60 [3:0]				XX
62nd Parameter	1	1	↑	XX	RFA61 [3:0]				BFA61 [3:0]				XX
63rd Parameter	1	1	↑	XX	RFA62 [3:0]				BFA62 [3:0]				XX
64th Parameter	1	1	↑	XX	RFA63 [3:0]				BFA63 [3:0]				XX
Interface Control	0	1	↑	XX	1	1	1	1	0	1	1	0	F6h
	1	1	↑	XX	MY_EOR	MX_EOR	MV_EOR	0	BGR_EOR	0	0	WEMODE	01
	1	1	↑	XX	0	0	FPF [1:0]		0	0	MDT [1:0]		00
	1	1	↑	XX	0	0	ENDIAN	0	DM [1:0]		RM	RIM	00
Power Control A	0	1	↑	XX	1	1	0	0	1	0	1	1	CBh
	1	1	↑	XX	0	0	1	1	1	0	0	1	39
	1	1	↑	XX	0	0	1	0	1	1	0	0	2C
	1	1	↑	XX	0	0	0	0	0	0	0	0	00
	1	1	↑	XX	0	0	1	1	0	REG_VD[2:0]			30
	1	1	↑	XX	0	0	0	0	0	VBC[2:0]			01
Power Control B	0	1	↑	XX	1	1	0	0	1	1	1	1	CFh
	1	1	↑	XX	0	0	0	0	0	0	0	0	00
	1	1	↑	XX	1	PCEQ	DRV_ena	Power control[1:0]		0	0	1	81
	1	1	↑	XX	DRV_vml[2:1]		1	DC_ena	DRV_vml[0]	DRV_vmh[2:0]			30
Driver timing control A	0	1	↑	XX	1	1	1	0	1	0	0	0	E8h
	1	1	↑	XX	CR/EQ/PC	SDT[1:0]		0	0	1	0	NOW	84
	1	1	↑	XX	0	0	EQ[2:0]			CR[2:0]			11
	1	1	↑	XX	0	1	1	1	1	PC[1:0]			7A
Driver timing control B	0	1	↑	XX	1	1	1	0	1	0	0	1	E9h
	1	1	↑	XX	CRE/EQE/PCE	SDT[1:0]		0	0	1	0	NOWE	04
	1	1	↑	XX	0	0	EQ[2:0]			CR[2:0]			11
	1	1	↑	XX	0	1	1	1	1	PC[1:0]			7A
Driver timing control C	0	1	↑	XX	1	1	1	0	1	0	1	0	EAh
	1	1	↑	XX	VG_SW_T4		VG_SW_T3		VG_SW_T2		VG_SW_T1		66
Power on sequence control	0	1	↑	XX	1	1	1	0	1	1	0	1	EDh
	1	1	↑	XX	0	1	CP1 soft start		0	1	CP23 soft start		55
	1	1	↑	XX	0	0	En_vcl		0	0	En_ddvdh		01
	1	1	↑	XX	0	0	En_vgh		0	0	En_vgl		23
	1	1	↑	XX	DDVDH_ENH		0	0	0	0	0	1	01
Enable 3G	0	1	↑	XX	1	1	1	1	0	0	1	0	F2h
	1	1	↑	XX	0	0	0	0	0	0	1	3G_enb	02

Note: Please refer to the ILI9341 data sheet for details.

Optical Characteristics

Item		Symbol	Condition	MIN.	TYP.	MAX.	UNIT	Note.
Viewing angle		θ=0o	(CR≥10)	35	45	–	degree	Note 2
		θ=90o		35	45	–		
		θ=180o		10	20	–		
		θ=270o		35	45	–		
Contrast ratio		CR	Φ=0° θ=0° 25°C	400	500	–	–	Note 3
Response Time		Ton		–	16	–	msec	Note 4
		Toff					msec	
Chromaticity	White	X	Φ=0° θ=0°	0.255	0.305	0.355		Note 1,5
		Y		0.275	0.325	0.375		
	Red	X		0.576	0.626	0.676		
		Y		0.284	0.334	0.384		
	Green	X		0.227	0.277	0.327		
		Y		0.499	0.549	0.599		
	Blue	X		0.092	0.142	0.192		
		Y		0.072	0.122	0.172		
NTSC Ratio	S			–	60	–	%	
Luminance		L	Φ=0° θ=0o	–	250	–	cd/m^2	Note 7
Luminance uniformity		U		80	–	–	%	Note 6

Note The parameter is slightly changed by temperature, driving voltage, and material.

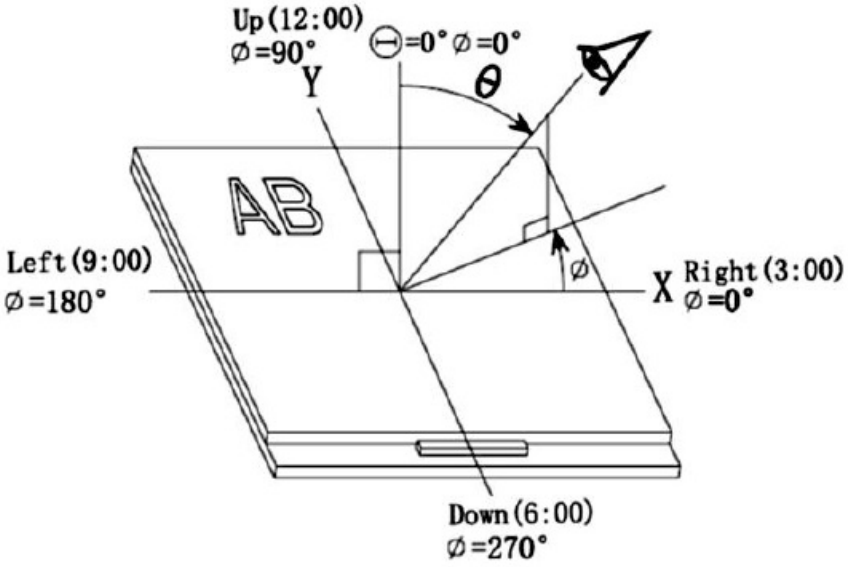
Note 1: The data are measured after LEDs are turned on for 5 minutes. LCM displays full white. The brightness is the average value of 9 measured spots. Measurement equipment PR-705

Measuring condition:

- **Measuring surroundings:** Darkroom
- **Measuring temperature:** Ta=25°C.

Adjust the operating voltage to get optimum contrast at the center of the display.

Note 2: The definition of viewing angle: Refer to the graph below marked by θ and Φ



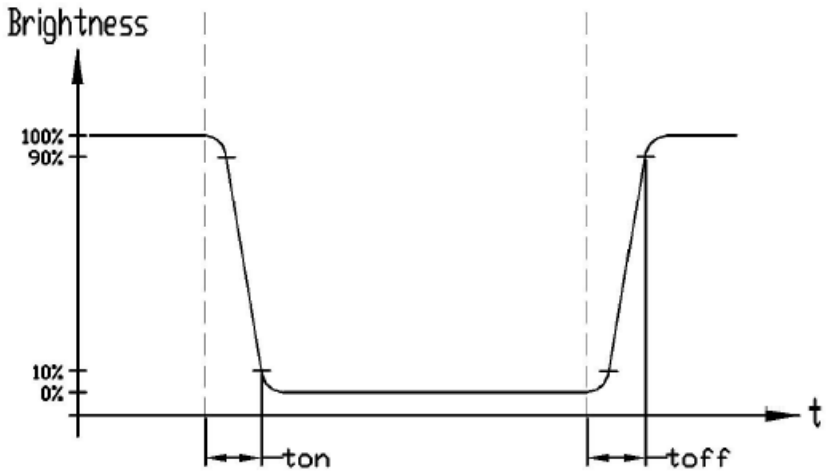
Note 3: The definition of contrast ratio (Test LCM using PR-705): Contrast

$$\text{Contrast Ratio(CR)} = \frac{\text{Luminance When LCD is at “White” state}}{\text{Luminance When LCD is at “Black” state}}$$

(Contrast Ratio is measured in optimum common electrode voltage)

Note 4: Definition of Response time. (Test LCD using DMS501):

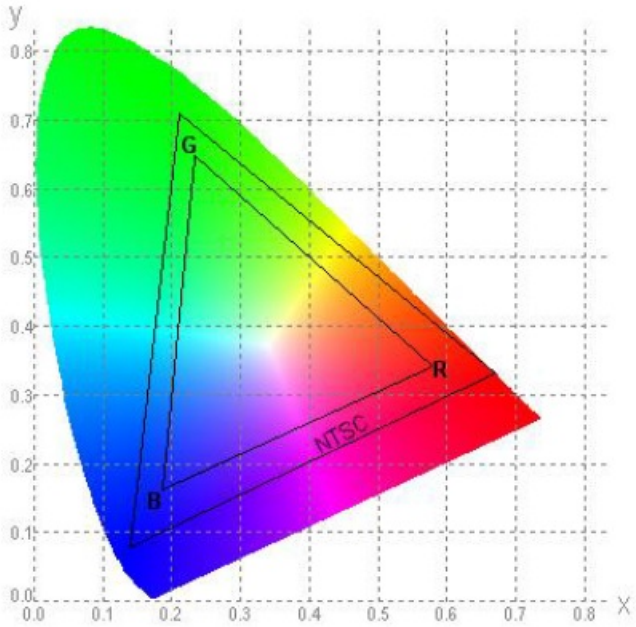
- The output signals of the photodetector are measured when the input signals are changed from “black” to “white”(falling time) and from “white” to “black”(rising time), respectively.
- The response time is defined as the time interval between the 10% and 90% of amplitudes. Refer to the figure below.



Note 5: Definition of Color of CIE1931 Coordinate and NTSC Ratio.

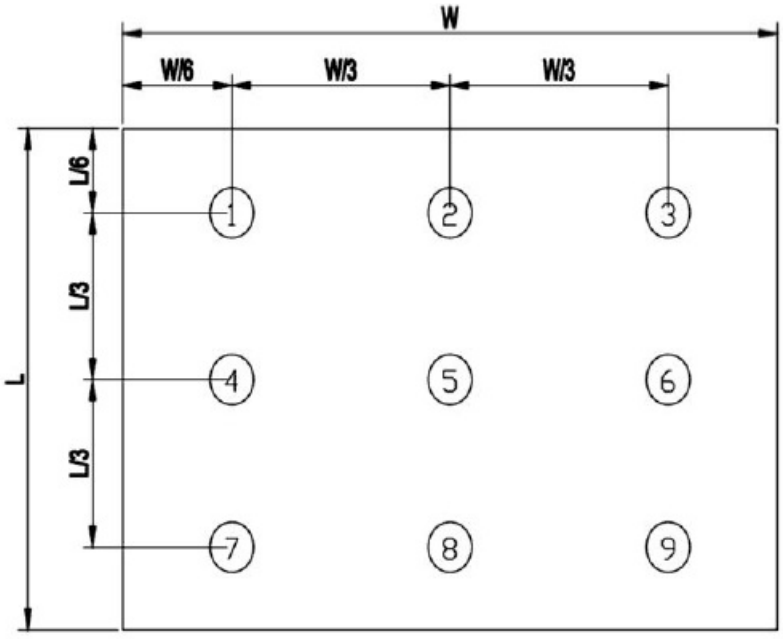
Color gamut:

$$S = \frac{\text{Area of RGB triangle}}{\text{Area of NTSC triangle}} \times 100\%$$



Note 6: The luminance uniformity is calculated by using the following formula.

- **Bp =** Bp (Min.) / Bp (Max.)×100 (%)
- **Bp (Max.) =** Maximum brightness in 9 measured spots
- **Bp (Min.) =** Minimum brightness in 9 measured spots.



Note 7: Measured the luminance of the white state at the center point.

Handling Precautions

LCD Module Design and Handling Precautions

- Please ensure V0, and VCOM are adjustable, to enable the LCD module get the best contrast ratio under different temperatures, view angles, and positions.
- Normally display quality should be judged under the best contrast ratio within the viewable area. Unexpected display patterns may come out under an abnormal contrast ratio.
- Never operate the LCD module to exceed the absolute maximum ratings.
- Never apply a signal to the LCD module without a power supply.
- Keep the signal line as short as possible to reduce external noise interference.
- IC chip (e.g. TAB or COG) is sensitive to light. Strong light might cause malfunction. Light-sealing structure casing is recommended.
- Make sure there is enough space (with cushion) between the case and LCD panel, to prevent external force from passing on to the panel; otherwise, that may cause damage to the LCD and degrade its display result.
- Avoid showing a display pattern on the screen for a long time (continuous ON segment).
- LCD module reliability may be reduced by temperature shock.
- When storing and operating LCD modules, avoid exposure to direct sunlight, high humidity, and high or low temperature. They may damage or degrade the LCD module.
- Never leave the LCD module in extreme condition (max./min storage/operating temperature) for more than 48hr.
- Recommend LCD module storage conditions are 0 C~40 C <80%RH.
- LCD modules should be stored in a room without acid, alkali, and harmful gas.
- Avoid dropping & violent shocking during transportation, and no excessive pressure press, moisture, and sunlight.
- LCD modules can be easily damaged by static electricity. Please maintain an optimum anti-static working environment to protect the LCD module. (eg. ground the soldering irons properly)
- Be sure to ground the body when handling the LCD module.
- Only hold the LCD module by its sides. Never hold the LCD module by applying force on the heat seal or TAB.
- When soldering, control the temperature and duration to avoid damaging the backlight guide or diffuser which might degrade the display result such as uneven display.
- Never let the LCD module contact with corrosive liquids, which might cause damage to the backlight guide or the electric circuit of the LCD module.
- Only clean LCD with a soft dry cloth, Isopropyl Alcohol, or Ethyl Alcohol. Other solvents (e.g. water) may damage the LCD.
- Never add force to components of the LCD module. It may cause invisible damage or degrade the module's reliability.
- When mounting the LCD module, please make sure it is free from twisting, warping, and bending.
- Do not add excessive force on the surface of the LCD, which may cause the display color to change abnormally.
- LCD panel is made of glass. Any mechanical shock (e.g. dropping from a high place) will damage the LCD module.
- The protective film is attached to the LCD screen. Be careful when peeling off this protective film, since static electricity may be generated.
- The polarizer on the LCD gets scratched easily. If possible, do not remove the LCD protective film until the last step of installation.
- When peeling off protective film from LCD, a static charge may cause abnormal display patterns. The

symptoms are normal, and they will turn back to normal in a short while.

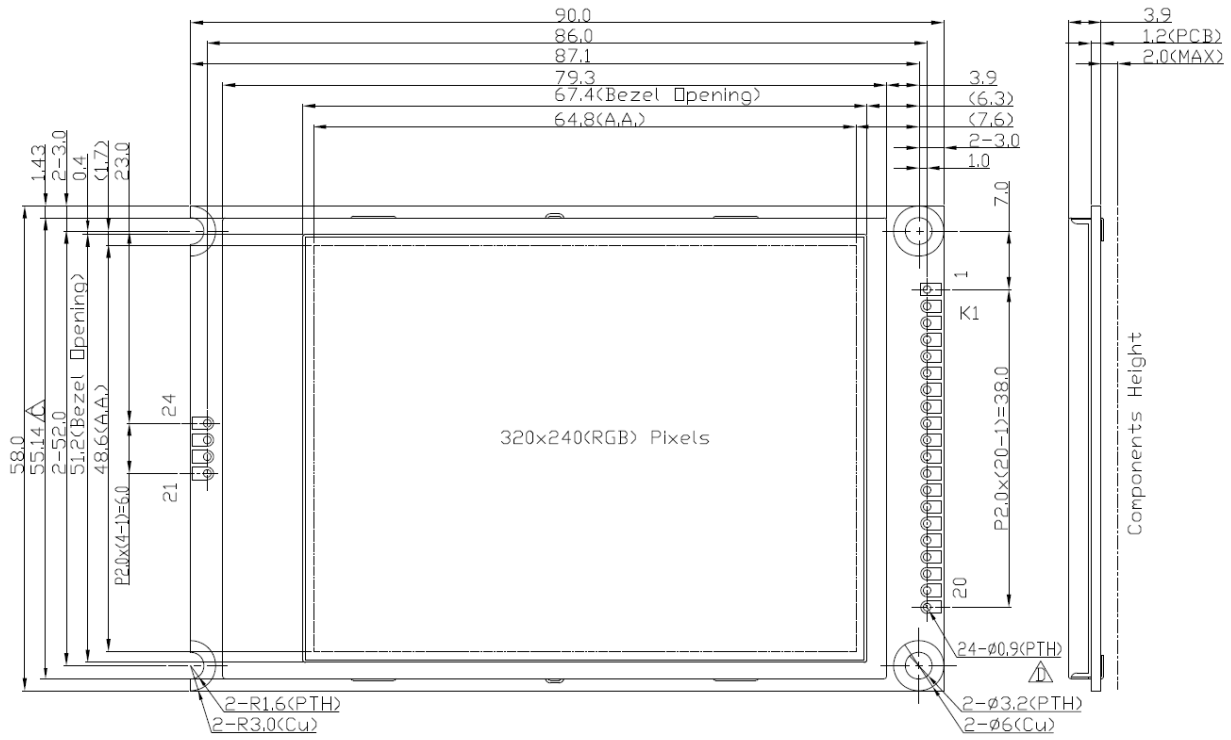
- The LCD panel has sharp edges, please handle it with care.
- Never attempt to disassemble or rework the LCD module.
- If the display panel is damaged and a liquid crystal substance leaks out, be sure not to get any in your mouth, if the substance comes into contact with your skin or clothes promptly wash it off using soap and water.

Warranty

This product has been manufactured to our company's specifications as a part for use in your company's general electronic products. It is guaranteed to perform according to delivery specifications. For any other use apart from general electronic equipment, we cannot take responsibility if the product is used in medical devices, nuclear power control equipment, aerospace equipment, fire and security systems, or any other applications in which there is a direct risk to human life and where extremely high levels of reliability are required. If the product is to be used in any of the above applications, we will need to enter into a separate product liability agreement.

- We cannot accept responsibility for any defect, which may arise from additional manufacturing of the product (including disassembly and reassembly), after product delivery.
- We cannot accept responsibility for any defect, which may arise after the application of strong external force to the product.
- We cannot accept responsibility for any defect, which may arise due to the application of static electricity after the product has passed our company's acceptance inspection procedures.
- When the product is in CCFL models, CCFL service life and brightness will vary according to the performance of the inverter used, leaks, etc.
- We cannot accept responsibility for product performance, reliability, or defects, that may arise.
- We cannot accept responsibility for the intellectual property of a third party, which may arise through the application of our product to our assembly with the exception to those issues relating directly to the structure or method of manufacturing of our product.

DIMENSION



K1 Terminal	
No	Pin Name
1	VSS
2	VSS
3	BLEN
4	VDD
5	VDD
6	/RD
7	/WR
8	D/C
9	/CS
10	D0
11	D1
12	D2
13	D3
14	D4
15	D5
16	D6
17	D7
18	/RES
19	FMARK
20	NC
21	NC
22	NC
23	NC
24	NC

Note:

1. **LCD Display Type:** TFT, Transmissive
2. **Pixel Arrangement:** RGB-STRIPE
3. **Color Depth:** 65k colors
4. **Operating Voltage:** 3.0V B
5. **Backlight:** White LED
6. **Interface:** MCU_8bit
7. **Connector:** K1: P2.0, 20+4Pin PCB Pad
8. **Operating Temperature:** -20°C~70°CA
9. **Storage Temperature:** -30°C~80°C

URL: www.topwaydisplay.com.
Document Name: LMT032DNAFWD-NBN-Manual-Rev0.6.doc

Documents / Resources

	TOPWAY LMT032DNAFWD LCD Module [pdf] User Manual LMT032DNAFWD-NBN, LMT032DNAFWD LCD Module, LMT032DNAFWD, LCD Module, Module

References

- User Manual