Messrs.					
Product Specification	Model	MTF-TQ020SN1831-LB	Rev. No.	Issued Date.	Page.
			A.	*Nov,14,18*	*1 / 23*

LIQUID CRYSTAL DISPLAY MODULE
MODEL: MTF-TQ020SN1831-LB
Customer's No.:

Acceptance

Microtips Technology Inc.
12F. No.31 Lane 169, Kang Ning St.,
His-Chih, Taipei Hsien, Taiwan
FAX: 886-2-26958625

Approved and Checked by

Approved by	Checked by		Made by
微 端 2018/11/14 連 俊 傑	微 端 2018/11/14 尹 煜 明	微 端 2018/11/14 洪 振 益	微 端 2018/11/14 許 瓊 窈

Revise Records

Rev.	Date	Contents	Written	Approved
A.	2018/11/14	See Note 1.	Jill Hsu	Danny Lien

Special Notes

Note 1.	The LCD module is compliant with RoHS.
Note 2.	
Note 3.	
Note 4.	
Note 5.	

Contents

1. GENERAL SPECIFICATIONS

Feature	Specification	Unit
Drive Element	a – Si TFT active matrix	--
Resolution	240 x RGB x 320	Dot
Data Interface	RGB / MCU	--
Pixel Arrangement	R. G. B Vertical Stripe	--
LCD Display Type	Transmissive Normally Black	--
Outline Dimension	35.60 (W) × 48.20 (H) × 2.40 (D)	mm
Dot Size	0.180 (W) × 0.180 (H)	mm
Active Area	30.60 (W) × 40.80 (H)	mm
Viewing Direction	6 o'clock	--
Backlight	LED	--
Controller Driver	ST 7789V	--
Weight	TBD	gram

2. OUT/OUTPUT TERMINALS

2.1 TFT LCD Panel

No.	Symbol	I/O	Description	Remarks
1.	LED – K	P	Cathode for back – light.	--
2. ~ 5.	LED – A	P	Anode for back – light.	--
6. ~ 9.	IM0 ~ IM3	I	System interface select.	Note 1.
10.	RESET	I	Reset signal.	--
11.	VSYNC	I	Vertical (Frame) synchronizing input signal for RGB interface operation.	--
12.	HSYNC	I	Horizontal (Line) synchronizing input signal for RGB interface operation.	--
13.	DOTCLK	I	Dot clock signal for RGB interface operation.	--
14.	DE	I	Data enable signal for RGB interface operation.	--
15. ~ 32.	DB17 ~ DB0	I	Data Bus.	--
33.	SDO	O	SPI interface output pin.	--
34.	SDI	I	SPI interface input pin.	--
35.	RD	I	Read enable in 8080 MCU parallel interface.	--
36.	WRX (D / CX)	I	Write enable in MCU parallel interface. Display data / command selection pin in 4 – line serial interface. Second data lane in 2 data lane serial interface.	--
37.	SCL (D / CX)	I	Display data / command selection pin in parallel interface. The pin is used to serial interface clock. DCX = “1”: display data or parameter. DCX = “0”: command data.	--
38.	CSX	I	Chip select pin.	--
39.	TE	O	Tearing effect signal is used to synchronize MCU to frame memory writing.	--
40.	VDDI	P	Power supply for I / O system.	--
41.	VDDI	P	Power supply for I / O system.	--
42.	VCI	P	Power supply for Analog and Digital System.	--
43.	GND	P	Ground	--

No.	Symbol	I/O	Description	Remarks
44.	X+ (XR)	O	Touch control pin (No connection)	--
45.	Y+ (YD)	O		--
46.	X- (XL)	O		--
47.	Y- (YU)	O		--
48. ~ 50.	GND	P	Ground	--

Note 1: The MCU interface mode select

IM3	IM2	IM1	IM0	MPU Interface Mode	Data pin
0	0	0	0	80 – 8 bit parallel I / F	DB [7:0]
0	0	0	1	80 – 16 bit parallel I / F	DB [15:0]
0	0	1	0	80 – 9 bit parallel I / F	DB [8:0]
0	0	1	1	80 – 18 bit parallel I / F	DB [17:0]
0	1	0	1	3 – line 9 bit serial I / F	SDA: in / out
0	1	0	1	2 – data lane serial I / F	SDA: in / out WRX: in
0	1	1	0	4 – line 8 bit serial I / F	SDA: in / out
1	0	0	0	80 – 16 bit parallel I / F II	DB [17:0] DB [8:1]
1	0	0	1	80 – 8 bit parallel I / F II	DB [17: 10]
1	0	1	0	80 – 18 bit parallel I / F II	DB [17:0]
1	0	1	1	80 – 9 bit parallel I / F II	DB [17:9]
1	1	0	1	3 – line 9 bit serial I / F II	SDA: in SDO: out
1	1	1	0	4 – line 8 bit serial I / F II	SDA: in SDO: out

3. ABSOLUTE MAXIMUM RATINGS

3.1 Driving TFT LCD Panel

Ta = 25°C

Item	Symbol	Min	Typ	Max	Unit	Remark
System Power Supply Voltage	VCI	0.3	--	4.6	V	--
	VDDI	0.3	--	4.6	V	--
Operating Temperature	TOPR	-20	--	+70	℃	1, 3
Storage Temperature	TSTG	-30	--	+80	℃	2, 3

Note 1: In case of below 0℃, the response time of liquid crystal (LC) becomes slower and the color of panel becomes darker than normal one. Level of retardation depends on temperature, because of the LC characteristics.

Note 2: If product is exposed to high temperatures for extended time, there is a possibility of the polarizer film damage which could degrade the optical characteristics.

Note 3: Ta < = 40°C: 85% RH MAX.
Ta < = 40°C: Absolute humidity must be lower than the humidity of 85% RH at 40°C.

4. ELECTRICAL CHARACTERISTICS

4.1 Driving TFT LCD Panel

Ta = 25°C, GND = 0V

Item		Symbol	Condition	Min.	TYP	Max.	Unit
Logic Operating Voltage		VDDIO	--	1.65	1.8	3.6	V
Analog Operating Voltage		VCI	--	2.4	2.8	3.6	V
Input Signal Voltage	Low Level	V_{IL}	VDDI = 2.8V	0	--	0.2*VDDI	V
	High Level	V_{IH}		0.8*VDDI	--	VDDI	V
Current Consumption		I_{DD}	Normal mode	--	--	--	mA
		$I_{DD-SLEEP}$	Sleep mode	--	--	--	uA

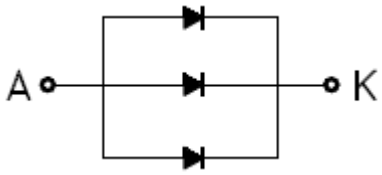
4.2 Driving Backlight

Ta = 25°C

Item	Symbol	Min	Typ	Max	Unit	Condition
Forward Voltage	V_F	--	3.0	--	V	--
Forward Current	I_L	--	60	--	mA	--

Note 1: The "LED life time" is defined as the module brightness decrease to 50% of original brightness at I_L = 80mA. The LED life time could be decreased if operating I_L is larger than 120mA.

Backlight circuit diagram shown in below:



3EA If = 60mA

5. TIMING CHART

5.1 8080 Series MCU Parallel Interface Characteristics: 18 / 16 / 9 / 8 – bit Bus

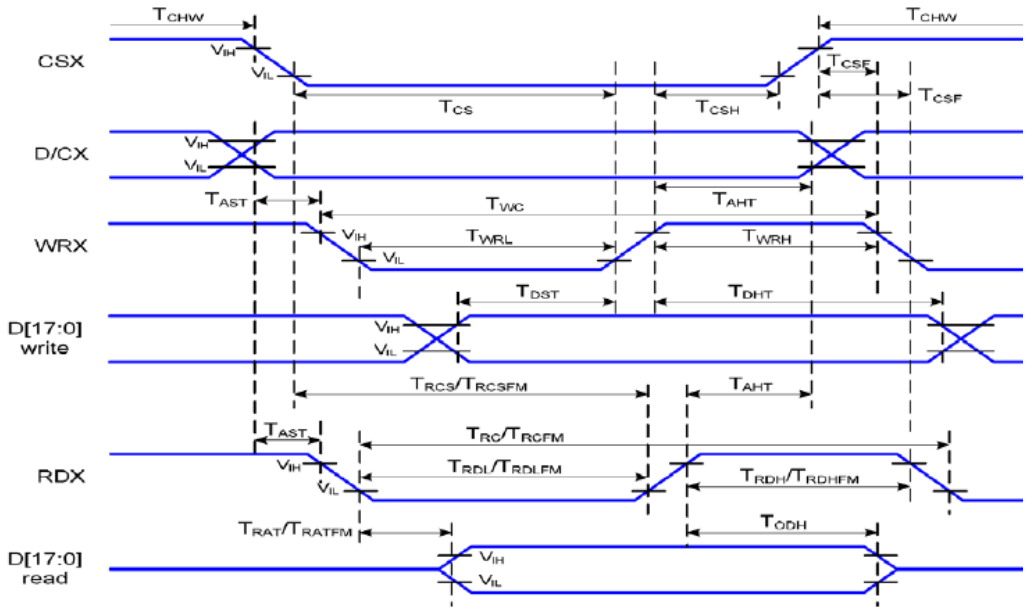


Figure: Parallel Interface Timing Characteristics (8080 – Series MCU Interface)

VDDI = 1.65 to 3.3V, VDD = 2.4 to 3.3V, AGND = DGND = 0V, Ta = -30 to 70°C

Signal	Symbol	Parameter	MIN	MAX	Unit	Description
D / CX	tAST	Address setup time	0	--	ns	--
	tAHT	Address hold time (Write / Read)	10	--	ns	
CSX	tCHW	Chip select "H" pulse width	0	--	ns	(3 – transfer for one pixel)
	tCS	Chip select setup time (Write)	15	--	ns	
	tRCS	Chip select setup time (Read ID)	45	--	ns	
	tRCSFW	Chip select setup time (Read FM)	355	--	ns	
	tCSF	Chip select wait time (Write / Read)	10	--	ns	
	tCSH	Chip select hold time	10	--	ns	
WRX	tWC	Write cycle	66	--	ns	--
	tWRH	Control pulse "H" duration	15	--	ns	
	tWRL	Control pulse "L" duration	15	--	ns	

Signal	Symbol	Parameter	MIN	MAX	Unit	Description
RDX (ID)	tRC	Read cycle (ID)	160	--	ns	When read ID data
	tRDH	Control pulse "H" duration (ID)	90	--	ns	
	tRDL	Control pulse "L" duration (ID)	45	--	ns	
RDX (FM)	tRCFM	Read cycle (FM)	450	--	ns	When read from frame Memory
	tRDHFM	Control pulse "H" duration (FM)	90	--	ns	
	tRDLFM	Control pulse "L" duration (FM)	355	--	ns	
DB[17:0] DB[17:10] &DB[8:1] DB[17:10] DB[17:9]	tDST	Data setup time	10	--	ns	For maximum CL = 30pF For Minimum CL = 8pF
	tDHT	Data hold time	10	--	ns	
	tRAT	Read access time (ID)	--	40	ns	
	tRATFM	Read access time (FM)	--	340	ns	
	tODT	Output disable time	20	80	ns	

Table: 8080 Parallel Interface Characteristics

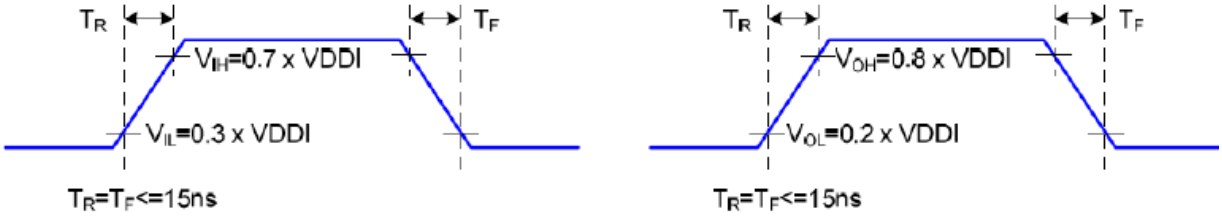


Figure: Rising and Falling Timing for I / O Signal

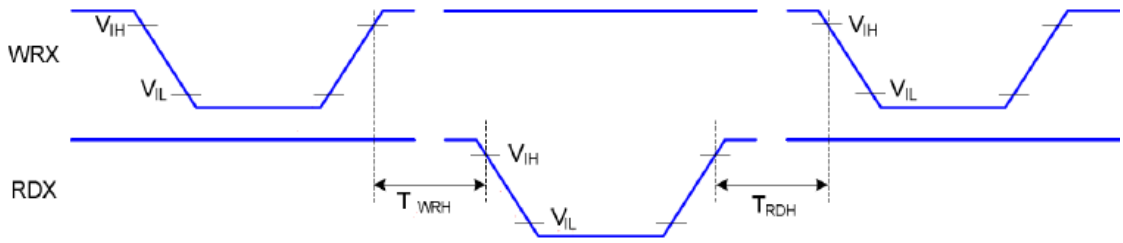


Figure: Write – to – Read and Read to Write Timing

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.

5.2 RGB Interface Characteristics

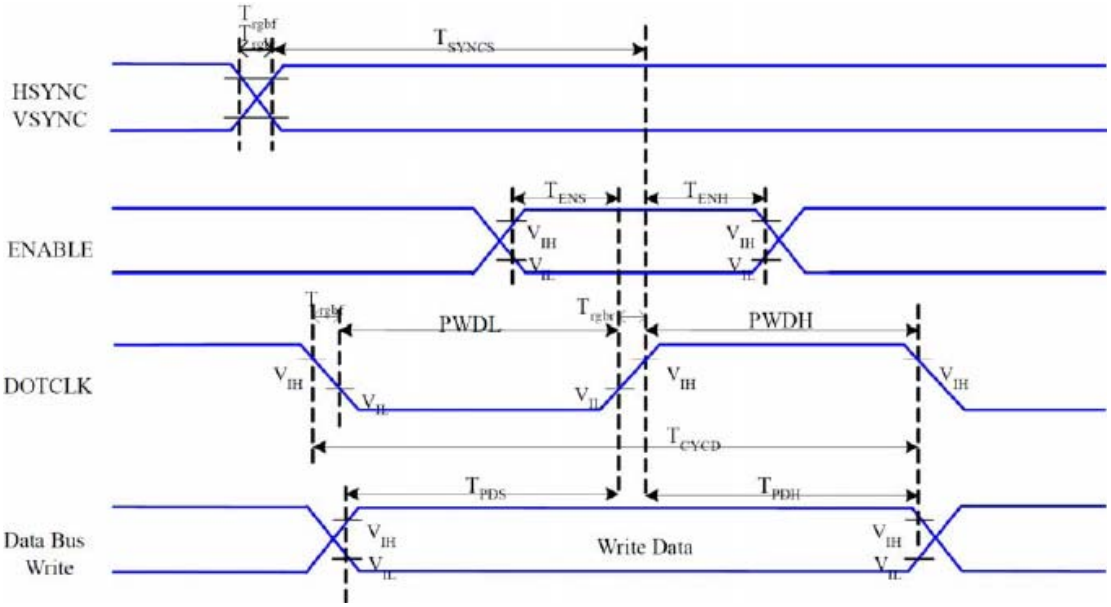


Figure: RGB Interface Timing Characteristics

VDDI = 1.65 to 3.3V, VDD = 2.4 to 3.3V, AGND = DGND = 0V, Ta = -30 to 70°C

Signal	Symbol	Parameter	MIN	MAX	Unit	Description
HSYNC VSYNC	TSYNCS	VSYNC, HSYNC Setup Time	30	--	ns	--
ENABLE	TENS	Enable Setup Time	25	--	ns	--
	TENH	Enable Hold Time	25	--	ns	
DOTCLK	PWDH	DOTCLK High – level Pulse Width	60	--	ns	
	PWDL	DOTCLK Low – level Pulse Width	60	--	ns	
	TCYCD	DOTCLK Cycle Time	120	--	ns	
	Trghr, Trghf	DOTCLK Rise / Fall Time	--	20	ns	
DB	TPDS	PD Data Setup Time	50	--	ns	--
	TPDH	PD Data Hold Time	50	--	ns	

Table: 18 / 16 Bits RGB Interface Timing Characteristics

5.3 Reset Timing

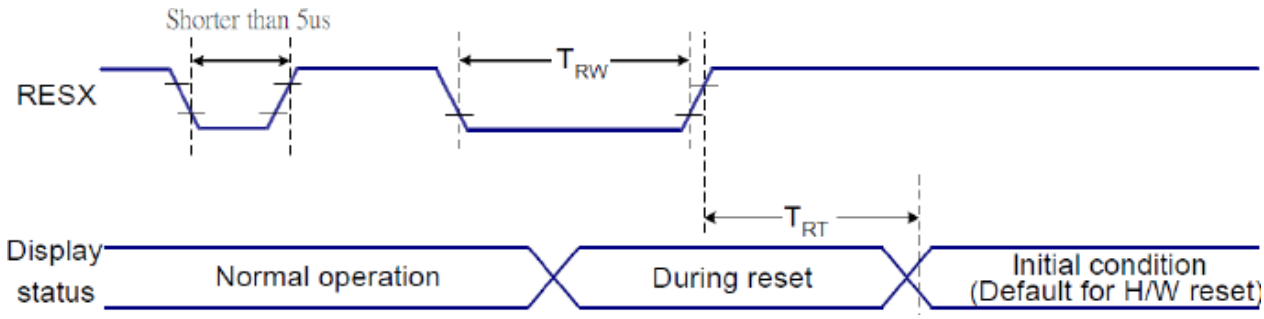


Figure: Reset Timing

VDDI = 1.65 to 3.3V, VDD = 2.4 to 3.3V, AGND = DGND = 0V, Ta = -30 to 70°C

Signal	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: Rest Timing

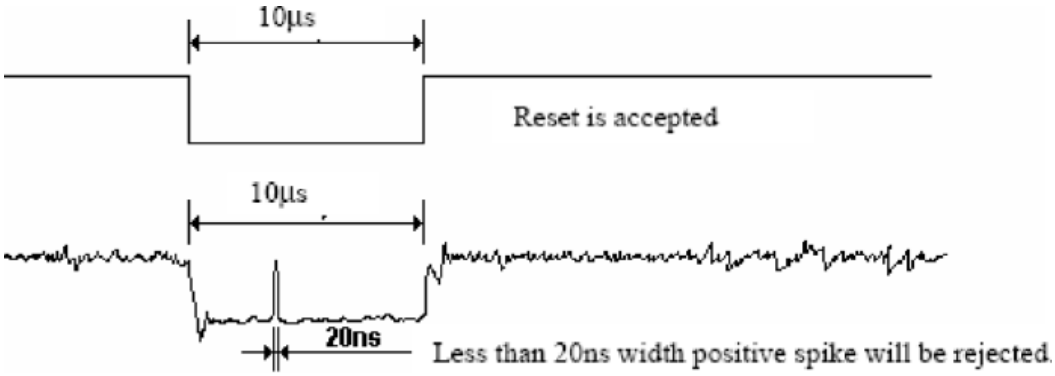
Note 1: The reset cancel includes also required time for loading ID bytes, VCOM setting and other settings from NVM (or similar device) to registers. This loading is done every time when there is HW reset cancel time (TRT) within 5 ms after a rising edge of RESX.

Note 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

Note 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.

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



Note 5: When Reset applied during Sleep In Mode.
Note 6: When Reset applied during Sleep Out Mode.
Note 7: It is necessary to wait 5msec after releasing RESX before sending commands.
Also Sleep Out command cannot be sent for 120msec.

6. OPTICAL CHARACTERISTICS

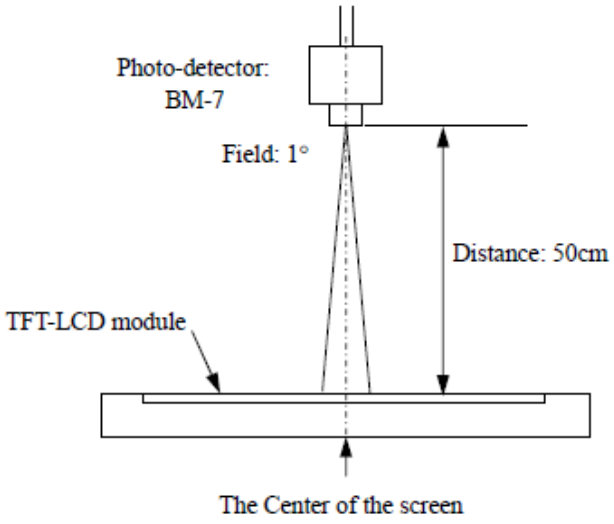
6.1 Optical Specification

Ta = 25°C

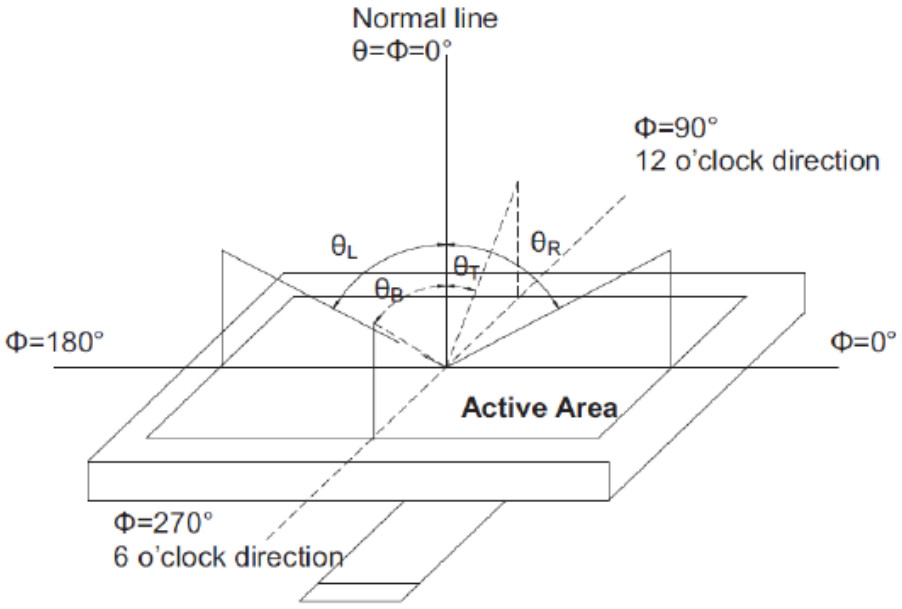
Item		Symbol	Condition	Min.	Typ.	Max.	Unit	Remark
Viewing Angle		θ_T	CR≧10	--	80	--	Degree	Note5
		θ_B		--	80	--		
		θ_L		--	80	--		
		θ_R		--	80	--		
Contrast Ratio		CR	θ = 0°	640	800	--	--	Note1 Note3
Response Time		Tr + Tf	Ta = 25°C	--	30	40	ms	Note4
Chromaticity	White	W_X	Brightness is on	--	0.296	--	--	Note1 Note2
		W_Y		--	0.325	--		
	Red	R_X		--	0.647	--		
		R_Y		--	0.329	--		
	Green	G_X		--	0.279	--		
		G_Y		--	0.550	--		
	Blue	B_X		--	0.134	--		
		B_Y		--	0.123	--		
Luminance Uniformity		U_W	--	75	--	--	%	Note1 Note7
Luminance of white		L_W	B/L on	--	250	--	cd/m^2	--
NTSC		S	--	54	60	--	%	--

Note 1: Definition of Optical Measurement System.

After stabilizing and leaving the panel alone at a given temperature for 30min, the measurement should be executed. Measurement should be executed in a stable, windless, and dark room 30min after lighting the back – light. This should be measured in the center of screen.



Note 2: Definition of Viewing Angle

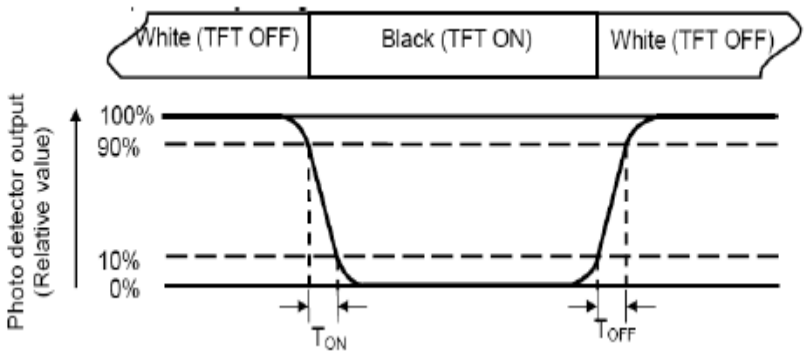


Note 3: Definition of Contrast Ratio

$$\text{Contrast Ratio (CR)} = \frac{\text{Luminance Measured when LCD is on the “White” State}}{\text{Luminance Measured when LCD is on the “Black” State}}$$

Note 4: Definition of Response Time

The Response Time is Defined as The LCD Optical Switching Time Interval Between “White” State And “Black” State Rise Time (TON) is The Time Between Photo Detector Output Intensity Changed From 90% to 10% and fall (TO) is The Time Between Photo Detector Output Intensity Changed From 90% to 10%



Note 5: Definition of Color Chromaticity (CIE1931)

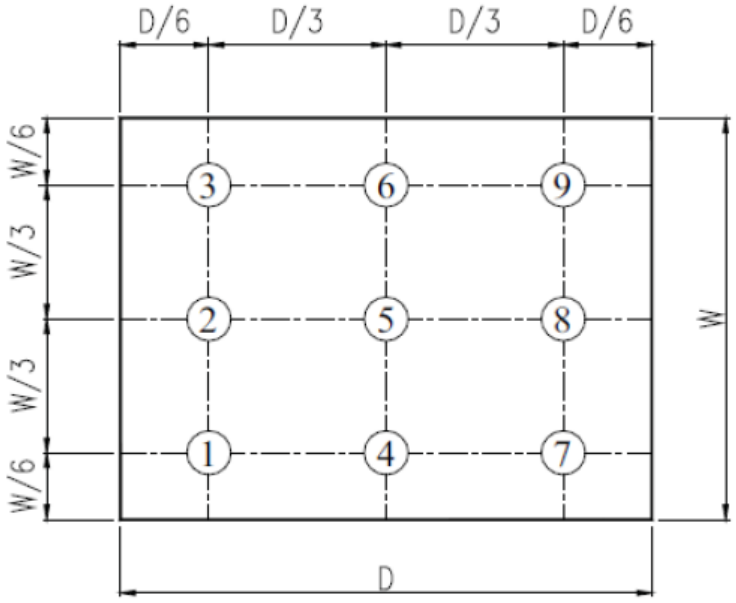
Color coordinate of white & red, green, blue at center point.

Note 6: The different Rubbing Direction will cause the different optima view direction

Note 7: Definition of Luminance Uniformity

Active area is divided into 9 measuring areas (Shown in below) every measuring point is placed at the center of each measuring area.

$$\text{Luminance Uniformity} = \frac{\text{Min Luminance of white among 9 – points}}{\text{Max Luminance of white among 9 – points}} * 100\%$$



7. ENVIRONMENTAL / RELIABILITY TESTS

No.	Test Item	Description	Condition	Note
1.	High Temperature (Operation)	Durability test under long time high temperature with electrical stress (voltage, current)	70°C ± 2°C, 96hrs	--
2.	High Temperature (Storage)	Durability test under long time high temperature storage	80°C ± 2°C, 96hrs	--
3.	Low Temperature (Operation)	Durability test under long time low temperature with electrical stress (voltage, current)	-20°C ± 2°C, 96hrs	--
4.	Low Temperature (Storage)	Durability test under long time low temperature storage	-30°C ± 2°C, 96hrs	--
5.	Damp Proof Test	Durability test under long time high temperature and high humidity	60°C, 90% RH 96hrs	--
6.	Vibration Test	Total fixed amplitude: 1.5mm Vibration frequency: 10～55Hz One cycle 60 seconds to 3 directions of X, Y, Z for each 15 minutes	--	--
7.	Packing Drop Test	Drop to the ground from 1m height, 1 corner , 3 edges, 6 surfaces.	--	--
8.	ESD Test	Voltage: ± 8KV, R: 330 Ω, C: 150pF Air discharge, 5time Contact: ± 4KV, 5time	--	--
9.	Shock Non – operation	Half – sine wave, 300 / s 2,11ms	--	--

Remarks:

(1) The test samples should be applied to only one test item.
(2) Sample size for each test item is 5~10pcs.
(3) For High Temperature / Humidity storage test, pure water (resistance>10MΩ) should be used.
(4) In case of malfunction defect caused by ESD damage, if it would be recovered to normal state after resetting, it would be judge as a good part.
(5) Failure judgment criterion: basic specification, electrical characteristic, mechanical characteristic, optical characteristic.

8. PRECAUTIONS

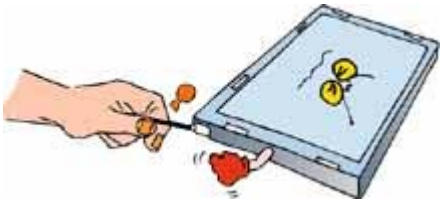
8.1 Operation

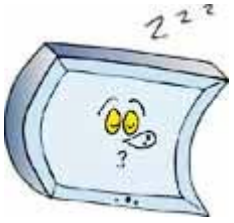
Burn-in sometimes happens when the same character was displayed at along time. Therefore, to prevent Burn-in, it is recommended to set up a Screen-saver function.

8.2 Safety

The liquid crystal in the LCD is poisonous, DO NOT put it in your mouth. If the liquid crystal touches your skin or clothes, wash it off immediately using soap and water.

8.3 Handling

	a. The LCD module shall be installed flat, without twisting or bending. b. COF or FPC has narrow pattern width, so easily become open circuit by external force. DO NOT apply pressure to COF or FPC especially in bending area.
	c. To avoid damage in appearance or malfunction, DO NOT subject the module to mechanical shock or to excessive force on its surface.
	d. The polarizer attached to the display is very easy to be damaged, handle it with care to avoid scratching.
	e. To avoid contamination on the display surface, DO NOT touch the display surface with bare hands. f. Provide a space so that the LCD module does not come into contact with other components.

	g. To protect the LCD panel from external pressure, put covering glass (acrylic board or similar board) to keep appropriate space between them.
	h. Be careful for condensation at sudden temperature change. Condensation makes damage to polarizer or electrical contacted parts. And after fading condensation, smear or spot will occur.
	i. Property of semiconductor devices may be affected when they are exposed to light possibly resulting in malfunctioning of the ICs. To prevent such malfunctioning of the ICs, your design and mounting layout done are so that the IC is not exposed to light in actual use.
	j. Strong light exposure causes degradation of color filter. It may not recover
	k. DO NOT contact with water to avoid Metal corrosion. l. When it is not in use, the screen must be turned off or the pattern must be frequently changed by a screen saver. If it displays the same pattern for a long period of time, brightness down/image sticking may develop due to the LCD structure.
	m. Never disassemble LCD product under any circumstances. If unqualified operators or users assemble the product after disassembling it, it may not function or its operation may be seriously affected.

8.4 Static electricity

Since a module is composed of electronic circuits, it is not strong to electrostatic discharge.

	a. The LCD module shall be installed flat, without twisting or bending. Ground soldering iron tips, tools and testers when they operate. b. Ground your body when handling the products. c. DO NOT apply voltage to the input terminal without applying power supply. d. DO NOT apply voltage that exceeds the absolute maximum rating. e. Store the products in an anti-electrostatic container. f. Peel off protect tape, attached to polarizer, slowly to minimize ESD damage.

8.5 Storage

	Store the products in a dark place at +5 ~ +25 degree C, low humidity (50%RH or less). DO NOT store the products in an atmosphere containing organic solvents or corrosive gases.

8.6 Cleaning

	a. DO NOT wipe the polarizer with dry cloth, as it might cause scratch. b. Wipe the polarizer with a soft cloth soaked with petroleum IPA, other chemical might damage.

8.7 Waste

	When dispose of LCD module, manage it at the production waste according to the relevant laws and regulations.

9. WARRANTY

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

1 13 months guarantee starts from the date code

2 We cannot accept responsibility for any defect, which may arise from additional manufacturing of the product (including disassembly and reassembly), after product delivery.

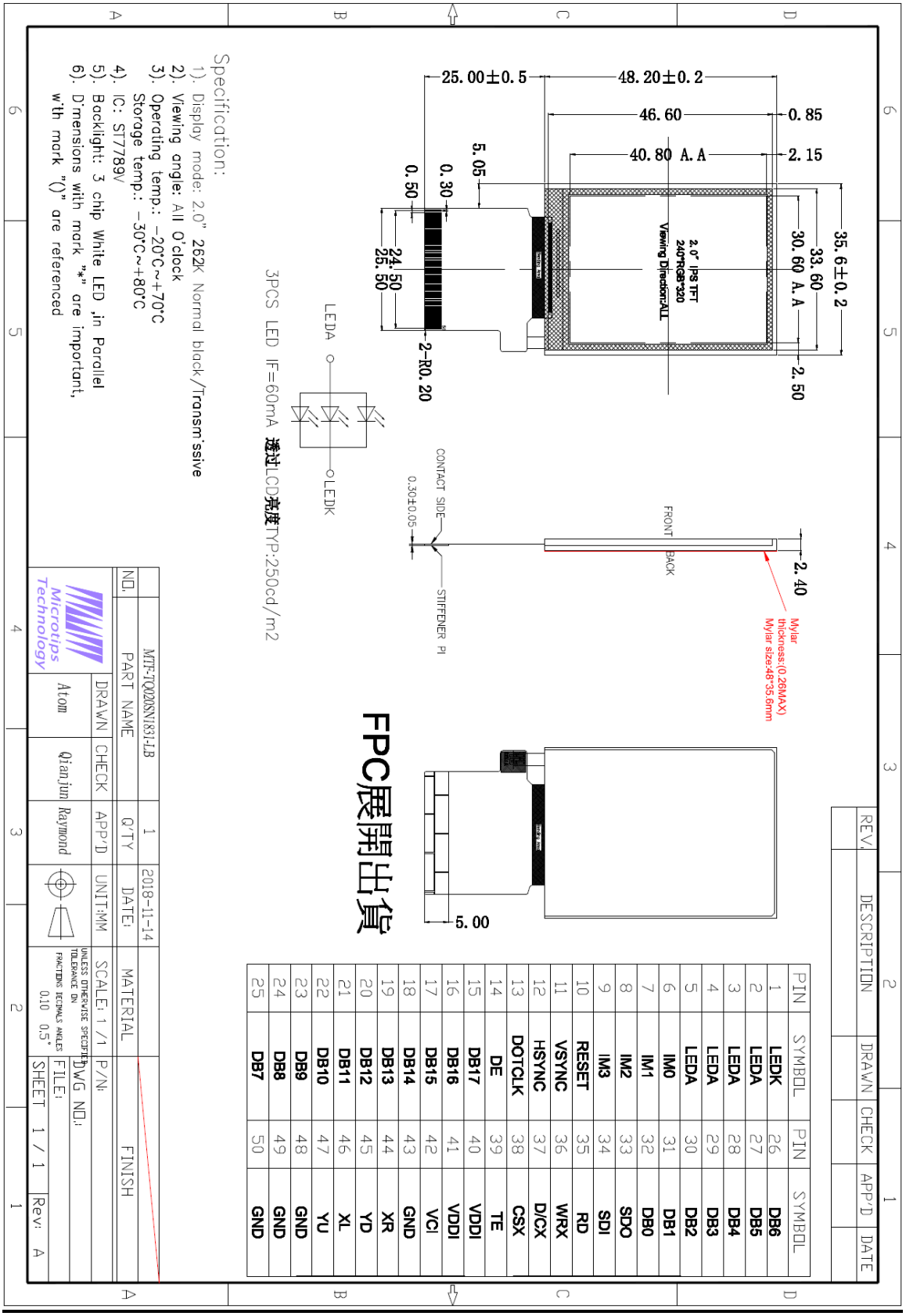
3 We cannot accept responsibility for any defect, which may arise after the application of strong external force to the product.

4 We cannot accept responsibility for any defect, which may arise due to the application of static electricity after the product has passed your company's acceptance inspection procedures.

5 We cannot accept responsibility for industrial property, which may arise through the use of your product, with exception to those issues relating directly to the structure or method of manufacturing of our product. Microtips-origin longer than one year from Microtips production.

10. DIMENSIONAL OUTLINES

Please see the next page…….


Specification:
1). Display mode: 2.0" 262K Normal black/Transmissive
2). Viewing angle: All O'clock
3). Operating temp.: -20°C~+70°C
Storage temp.: -30°C~+80°C
4). IC: ST7789V
5). Backlight: 3 chip White LED ,in Parallel
6). Dimensions with mark "*" are important,
with mark "()" are referenced
3PCS LED IF=60mA 透过LCD亮度TYP:250cd/m2
25.00±0.5
48.20±0.2
46.60
0.85
40.80 A.A
2.15
5.05
0.30
0.50
30.60 A.A
33.60
35.6±0.2
24.50
25.50
2-R0.20
2.50
2.0" IPS TFT
240*RGB*320
Viewing Direction:ALL
LEDA
LEDK
CONTACT SIDE
0.30±0.05
STIFFENER PI
FRONT
BACK
2.40
Mylar
thickness:(0.26MAX)
Mylar size:48*35.6mm
5.00
FPC展開出貨
PIN SYMBOL PIN SYMBOL
1 LEDK 26 DB6
2 LEDA 27 DB5
3 LEDA 28 DB4
4 LEDA 29 DB3
5 LEDA 30 DB2
6 IM0 31 DB1
7 IM1 32 DB0
8 IM2 33 SDO
9 IM3 34 SDI
10 RESET 35 RD
11 VSYNC 36 WRX
12 HSYNC 37 D/CX
13 DOTCLK 38 CSX
14 DE 39 TE
15 DB17 40 VDDI
16 DB16 41 VDDI
17 DB15 42 VCI
18 DB14 43 GND
19 DB13 44 XR
20 DB12 45 YD
21 DB11 46 XL
22 DB10 47 YU
23 DB9 48 GND
24 DB8 49 GND
25 DB7 50 GND
REV. DESCRIPTION DRAWN CHECK APP'D DATE
NO. PART NAME Q'TY DATE: MATERIAL FINISH
MTF-TQ020SN1831-LB 1 2018-11-14
DRAWN Atom
CHECK Qianjun
APP'D Raymond
UNIT:MM
SCALE: 1/1 P/N:
UNLESS OTHERWISE SPECIFIED TOLERANCE ON FRACTIONS DECIMALS ANGLES 0.10 0.5°
DWG NO.:
FILE:
SHEET 1 / 1
Rev: A
Microtips Technology