PRODUCT SPECIFICATION

1.8” TFT LCD Module with SPI Interface

DT018BTFT, DT018BTFT-SHB

Displaytech

a seacomp company

Revision 1.1

15 November 2023

Displaytech, a SEACOMP company
Phone: 1.760.918.6722
sales@seacomp.com
www.seacomp.com

Revision History

REV	CHANGE DESCRIPTION	DATE	APPR
1.0	Initial Release	12 JUN 2023	PRW
1.1	Corrected viewing direction (s/b 6:00)	15 NOV 2023	PRW

Table of Contents

1 Overview

The Displaytech **DT018BTFT** & **DT018BTFT-SHB** are 1.8” color LCD modules, each composed of an active-matrix TFT panel, TFT driver, FPC cable with SPI interface, and adjustable LED backlight. The display area has a RGB pixel resolution of 128 x 160 pixels. The DT018BTFT-SHB, with twice the number of backlight LEDs, is available as a “super high-bright” alternative to the DT018BTFT.

1.1 Applications

- Video systems
- Mobile devices
- Wearable devices

1.2 LCD Features

- Size — 1.8 Inches
- Resolution — 128 (RGB) x 160 Pixels
- Type — a-Si, Transmissive, Normally white
- Interface(s) — 3-Line SPI, 4-Line SPI
- Module Dimensions
  - DT018BTFT — 34.00 mm (W) x 43.78 mm (L) x 2.75 mm (H)
  - DT01BTFT-SHB — 34.00 mm (W) x 43.78 mm (L) x 2.85 mm (H)
- Active Area — 28.03 mm (W) x 35.04 mm (L)
- Pixel Pitch — 0.219 mm (W) x 0.219 mm (L)
- Viewing Direction — 6:00 O’Clock
- Backlight Type — LED, White
- TFT Driver — ILI9163

1.3 Acronyms

- FPC — Flexible Printed Circuit
- LCD — Liquid Crystal Display
- LED — Light Emitting Diode
- RGB — Red-Green-Blue
- SPI — Serial-Peripheral Interface
- TFT — Thin-Film Transistor

2 Pin Descriptions

LCD INTERFACE[1]			
PIN	NAME	TYPE	DESCRIPTION
1	GND	PWR	Ground
2	VDDIO	PWR	Logic supply
3	VDD	PWR	Analog supply
4	$\overline{CS}$	I	Chip select (active low)
5	$\overline{RST}$	I	Display reset (active low)
6	SDIO	I/O	Serial in/out
7	GND	PWR	Ground
8	D/CX	I/O	Display data/Command selection
9	SCL	I	Serial clock
10	SPI4W	I	SPI interface selection (Low: 3-line, High: 4-line)
11	GND	PWR	Ground
12	TE	O	Tearing effect (leave floating when not in use)[2]
13	LED-A	PWR	LED backlight, anode
14	LED-K	PWR	LED backlight, cathode
15	LED-K	PWR	LED backlight, cathode

[1] Recommended mating connector: FH12A-15S-0.5SH(55) or equivalent
[2] See ILI9163 datasheet for details

3 Specifications

3.1 Absolute Maximum Ratings

Operation outside of the maximum ratings listed below may result in permanent damage to the LCD.

ELECTRICAL				
PARAMETER		MIN	MAX	UNIT
Supply Voltage, Analog	V_{DD}	-0.3	4.0	V
Supply Voltage, Logic	V_{DDIO}	-0.3	3.3	V
Logic Input Voltage	V_{IN}	-0.3	V_{DDIO} + 0.3	V
Logic Output Voltage	V_{OUT}	-0.3	V_{DDIO} + 0.3	V
Backlight Current	I_F	–	60	mA

ENVIRONMENTAL				
PARAMETER		MIN	MAX	UNIT
Operating Temperature	T_{OP}	-20	+70	°C
Storage Temperature	T_{ST}	-30	+80	°C

3.2 Electrical Characteristics

POWER					
PARAMETER		MIN	TYP	MAX	UNIT
Supply Voltage, Analog	V_{DD}	2.5	2.8	4.0	V
Supply Voltage, Logic	V_{DDIO}	2.5	2.8	3.3	V
Supply Current	I_{DD}	–	5	10	mA

LOGIC					
PARAMETER		MIN	TYP	MAX	UNIT
Input Voltage, High	V_{IH}	0.7 x V_{DDIO}	–	V_{DDIO}	V
Input Voltage, Low	V_{IL}	0	–	0.3 x V_{DDIO}	V
Output Voltage, High	V_{OH}	0.8 x V_{DDIO}	–	V_{DDIO}	V
Output Voltage, Low	V_{OL}	0	–	0.2 x V_{DDIO}	V

LED BACKLIGHT					
PARAMETER		MIN	TYP	MAX	UNIT
Forward Current[3]	I_F	–	40	60	mA
Forward Voltage, DT018BTFT	V_F	2.8	3.0	3.3	V
Forward Voltage, DT018BTFT-SHB	$V_{F,SHB}$	5.6	6.0	6.6	
LED Lifetime[4]	–	–	30,000	–	Hr

3.2.1 LED Backlight Circuit Diagram

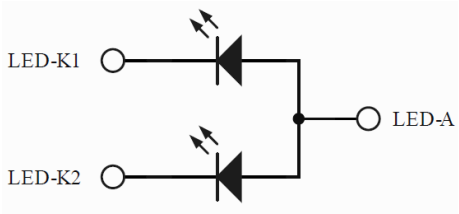


Figure 1: DT018BTFT Backlight
1 x 2 = 2 LEDs, I_F = 40 mA

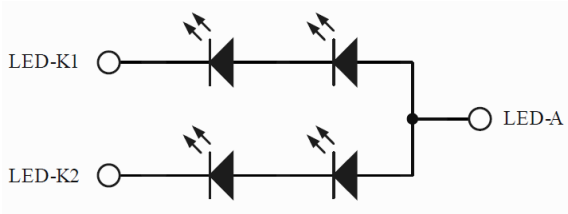


Figure 2: DT018BTFT-SHB Backlight
2 x 2 = 4 LEDs, I_F = 40 mA

[3] Backlight Power Consumption: 140mW
[4] LED lifetime is defined as the amount of time it takes for brightness to decrease to 50% of its original value at T_A=25°C and I_F=40mA. LED lifetime may decrease if operating current, I_F, is higher than 40mA.

4 Timing Characteristics[5]

4.1 3-Wire Serial Interface

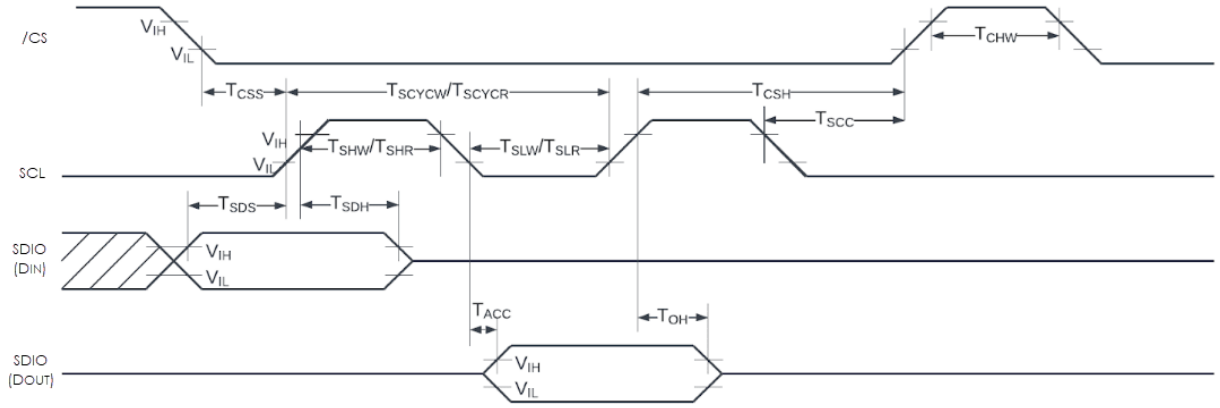


Figure 3: Timing Diagram, 3-Wire Serial Interface

TIMING CHARACTERISTICS, 3-WIRE SERIAL INTERFACE[6]					
SIGNAL	PARAMETER		MIN	MAX	UNIT
$\overline{CS}$	T_{CSS}	Chip select setup time	10	–	nS
	T_{CSH}	Chip select hold time	30	–	nS
	T_{CHW}	Chip select H pulse width	30	–	nS
SCL	T_{SCYCW}	Serial clock cycle, write	66	–	nS
	T_{SHW}	S L H pulse width, Write	15	–	nS
	T_{SLW}	S L L pulse width, Write	15	–	nS
	T_{SCYCR}	Serial clock cycle, Read	150	–	nS
	T_{SHR}	S L H pulse width, Read	60	–	nS
	T_{SLR}	S L L pulse width, Read	60	–	nS
SDIO	T_{SDS}	Data setup time	5	–	nS
	T_{SDH}	Data hold time	5	–	nS
	T_{ACC}	Access time[7]	5	50	nS
	T_{OH}	Output disable time[6]	10	–	nS

[5] Input signal rise & fall times are specified at 15 nS or less.
Logic high & low levels are specified as 10% - 90% of V_{DDIO} for input signals.
[6] GND = 0V, V_{DDIO} = 1.65V ~ 3.3V, V_{DD} = 2.6V ~ 3.3V, T_A = -30°C ~ 70°C
[7] For maximum C_L = 30pF, Minimum C_L = 8pF

4.2 4-Wire Serial Interface

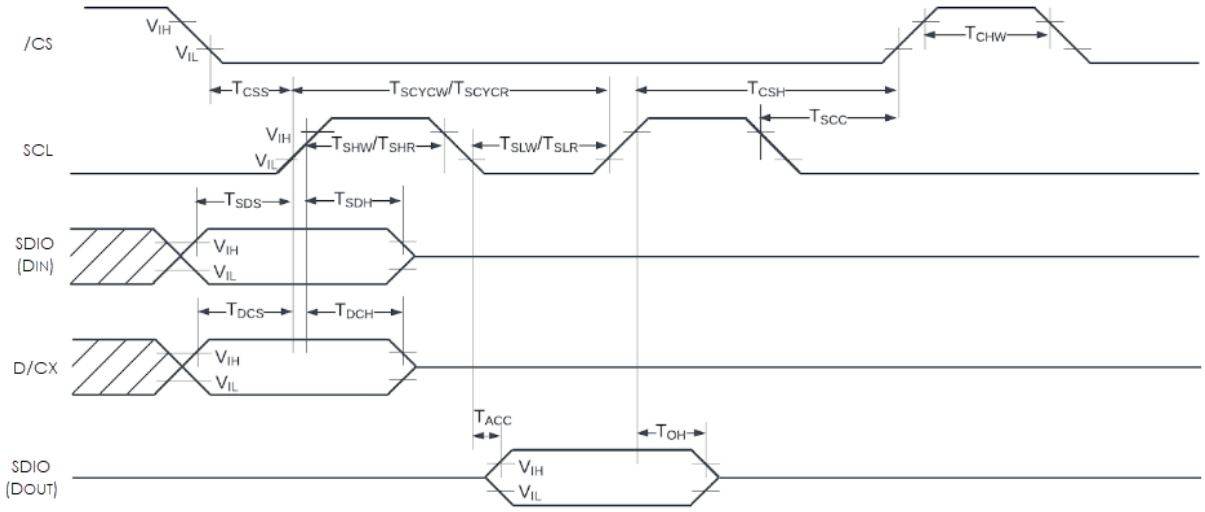


Figure 4: Timing Diagram, 4-Wire Serial Interface

TIMING CHARACTERISTICS: 4-WIRE SERIAL INTERFACE[8]					
SIGNAL	PARAMETER		MIN	MAX	UNIT
$\overline{CS}$	T_{CSS}	Chip select setup time	10	–	nS
	T_{CSH}	Chip select hold time	30	–	nS
	T_{CHW}	Chip select H pulse width	30	–	nS
SCL	T_{SCYCW}	Serial clock cycle, Write	66	–	nS
	T_{SHW}	S L H pulse width, Write	15	–	nS
	T_{SLW}	S L L pulse width, Write	15	–	nS
	T_{SCYCR}	Serial clock cycle, Read	150	–	nS
	T_{SHR}	S L H pulse width, Read	60	–	nS
	T_{SLR}	S L L pulse width, Read	60	–	nS
D/CX	T_{DCS}	D/CX Setup time	5	–	nS
	T_{DCH}	D/CX Hold time	5	–	nS
SDIO	T_{SDS}	Data setup time	5	–	nS
	T_{SDH}	Data hold time	5	–	nS
	T_{ACC}	Access time[9]	5	50	nS
	T_{OH}	Output disable time[7]	10	–	nS

[8] GND = 0V, V_{DDIO} = 1.65V ~ 3.3V, V_{DD} = 2.6V ~ 3.3V, T_A = -30°C ~ 70°C
[9] For maximum C_L = 30pF, Minimum C_L = 8pF

4.3 Reset Timing

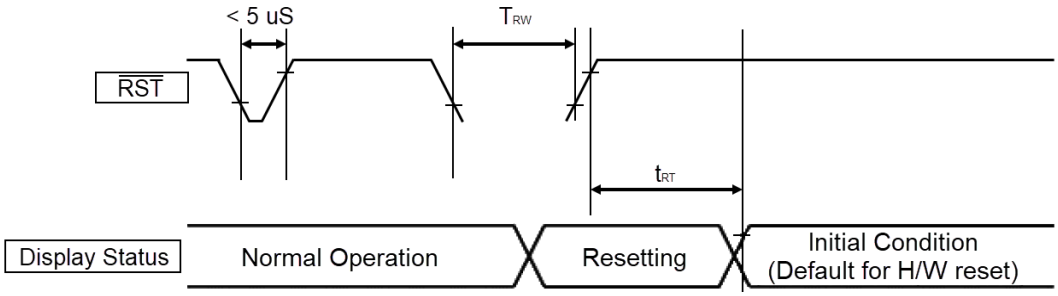


Figure 5: Reset Timing

RESET TIMING CHARACTERISTICS[10]					
PARAMETER		MIN	TYP	MAX	UNIT
Pulse width, Reset low	t_{RSTWW}	10	–	–	uS
Pulse width, Reset complete					
Sleep In mode	$t_{RST(I)}$	–	–	5	mS
Sleep Out mode	$t_{RST(O)}$	–	–	120	mS

[10] GND = 0V, V_{DDIO} = 1.65V ~ 1.95V, V_{DD} = 2.6V ~ 2.9V, T_A = -30°C ~ 70°C

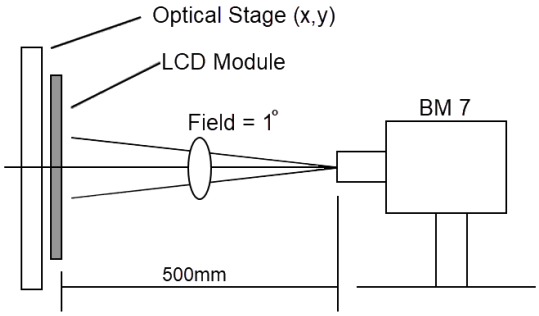
5 Optical Characteristics

OPTICAL CHARACTERISTICS[11]						
PARAMETER			MIN	TYP	MAX	UNIT
Contrast Ratio[12,13]		CR	200	300	–	–
Response Time[14]		T_{ON} / T_{OFF}	–	20	–	mS
Viewing Angles[15,16]		ΘT	35	45	–	°C
		ΘB	10	20	–	
		ΘL	35	45	–	
		ΘR	35	45	–	
Chromaticity[17]		X_{RED}	–	.32	–	–
		Y_{RED}	–	.36	–	
		X_{GRN}	–	.63	–	
		Y_{GRN}	–	.35	–	
		X_{BLU}	–	.33	–	
		Y_{BLU}	–	.60	–	
		X_{WHT}	–	.11	–	
		Y_{WHT}	–	.10	–	
NTSC[5]		–	–	60	–	%
Luminance[13]	DT018BTFT	L	280	350	–	cd/m^2
	DT018BTFT-SHB		800	1000	–	
Uniformity[13]		U	80	–	–	%

[11] See Section 5.1, Figure 3
[12] Viewing Angle (Θ) = 0°
[13] See Section 5.1, Figure 7
[14] See Section 5.1, Figure 4
[15] Contrast Ratio (CR) ≥ 10
[16] See Section 5.1, Figure 5
[17] See Section 5.1, Figure 6

5.1 Figures

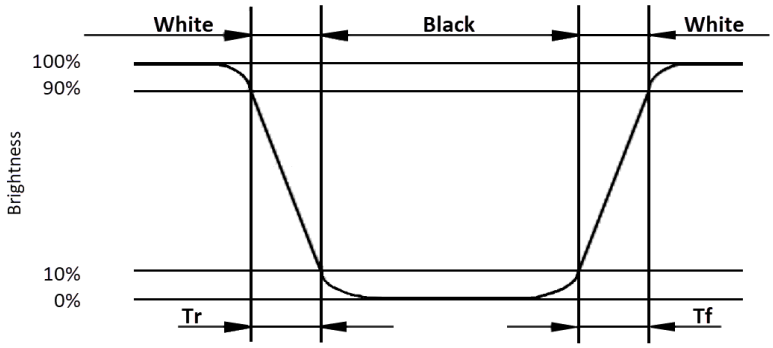
Figure 3: Optical Measurement System



Conditions:

I_F = 40 mA, T_A = 25 °C, ambient brightness < 150 lx

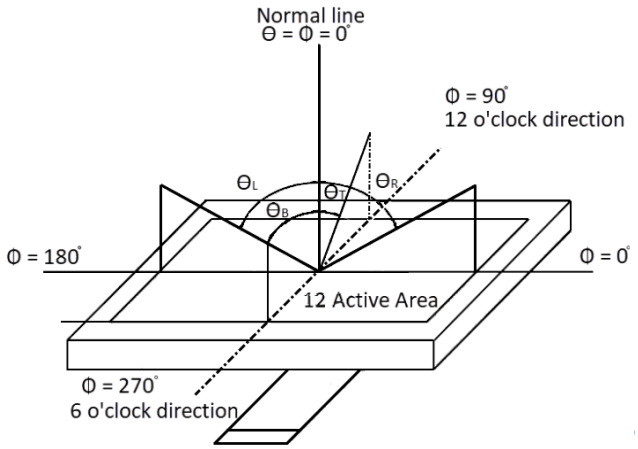
Figure 4: Response Times



Decay Time (TF) = Time required for display to transition from white to black

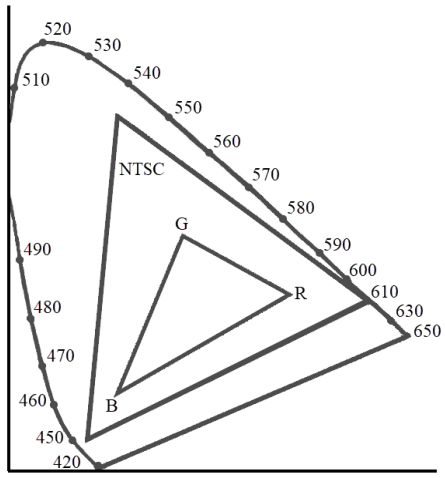
Rise Time (TR) = Time required for display to transition from black to white

Figure 5: Viewing Angles



Viewing angle is measured from center point of LCD

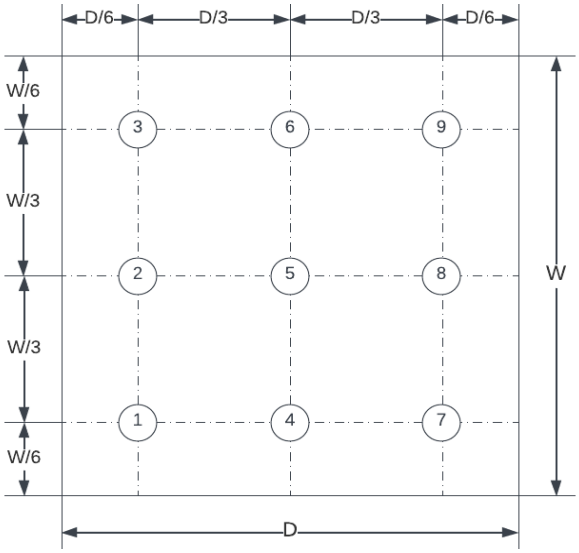
Figure 6: Chromaticity (CIE 1931)



Chromaticity = Area of $\triangle_{RGB}$ / Area of $\triangle_{NTSC}$

* Color coordinates measured at center point of LCD

Figure 7: Luminance Uniformity



Luminance is defined as the brightness of all white pixels at the center of the display area at optimum contrast.

Uniformity is determined by measuring Luminance at 9 points and calculating $Luminance_{MIN}$ / $Luminance_{MAX}$

$$\textbf{Contrast Ratio} = \frac{Surface\ Luminance_{WhitePixels}}{Surface\ Luminance_{BlackPixels}}$$

6 Environmental/Reliability Testing

Judgment is based on inspection performed after test, per the Inspection Criteria table.[18]

ITEM UNDER TEST	TEST CONDITION
High Temperature Operation	T_A = 70°C, 120 Hrs
Low Temperature Operation	T_A = -20°C, 120 Hrs
High Temperature Storage	T_S = 80°C, 120 Hrs
Low Temperature Storage	T_S = -30°C, 120 Hrs
High Temperature & Humidity Storage	T_S = 60°C, 120 Hrs, 90% RH
Thermal Shock (Non-Operation)	-30°C (30 min) ~ 80°C (30 min) Change time: 5 min, 10 cycles
ESD (Operation)	C = 150pF, R = 330Ω, 5 points/panel Air: 8KV (5x), Contact: 4KV (5x)
Vibration (Non-Operation)	Frequency Range: 10Hz ~ 55Hz Stroke: 1.5mm Sweep: 10Hz ~ 55Hz ~ 10Hz 2 Hrs each in X, Y, Z directions
Package Drop Test	Height: 80cm 1 corner, 3 edges, 6 surfaces

6.1 Inspection Criteria

INSPECTION ITEM	CRITERIA
Appearance	No cracks present on FPC No cracks present on LCD panel
LCD Panel Alignment	No bubbles present on/in LCD panel No alignment defects in active area
Electrical Current	Within device specifications
Function/Display	No broken circuits nor short circuits present No black lines present on LCD panel No other display defects

[18] Functional test shall be conducted after 4 hours of storage at normal temperature and humidity, after LCD is removed from test chamber.

7 Precautions for Use of LCD Modules

7.1 Safety

Liquid crystal in LCD is poisonous. Do not put in mouth. If liquid crystal comes in contact with skin or clothes, wash off immediately using soap and water.

7.2 Handling

A. LCD panel is made of plate glass. Do not subject panel to mechanical shock or excessive force on its surface.
B. In order to ensure reliability, do not hold product by flexible printed circuit (FPC) cable.
C. Provide space so that panel does not come into contact with other components.
D. Transparent electrodes may be disconnected if panel is used in an environment where dew condensation is present.
E. Properties of semiconductor devices may be affected when exposed to light, possibly resulting in integrated circuit (IC) malfunctions. To prevent such malfunctions, design and mounting layout should be done in such a way that IC is not exposed to light during use.

7.3 Static electricity

A. Ground soldering iron tips, tools, and testers while in use.
B. Ground your body when handling LCD products.
C. Power on the LCD module before applying the voltage to the input terminals.
D. Do not apply any voltage that exceeds absolute maximum rating.
E. Store products in an anti-electrostatic bag or container.

7.4 Storage

A. Store product in a dark place at 25°C ± 10°C with low humidity (40% RH ~ 60% RH). Do not expose display to sunlight or fluorescent light.
B. Storage in a clean environment, free from dust, active gas, and solvents.

7.5 Cleaning

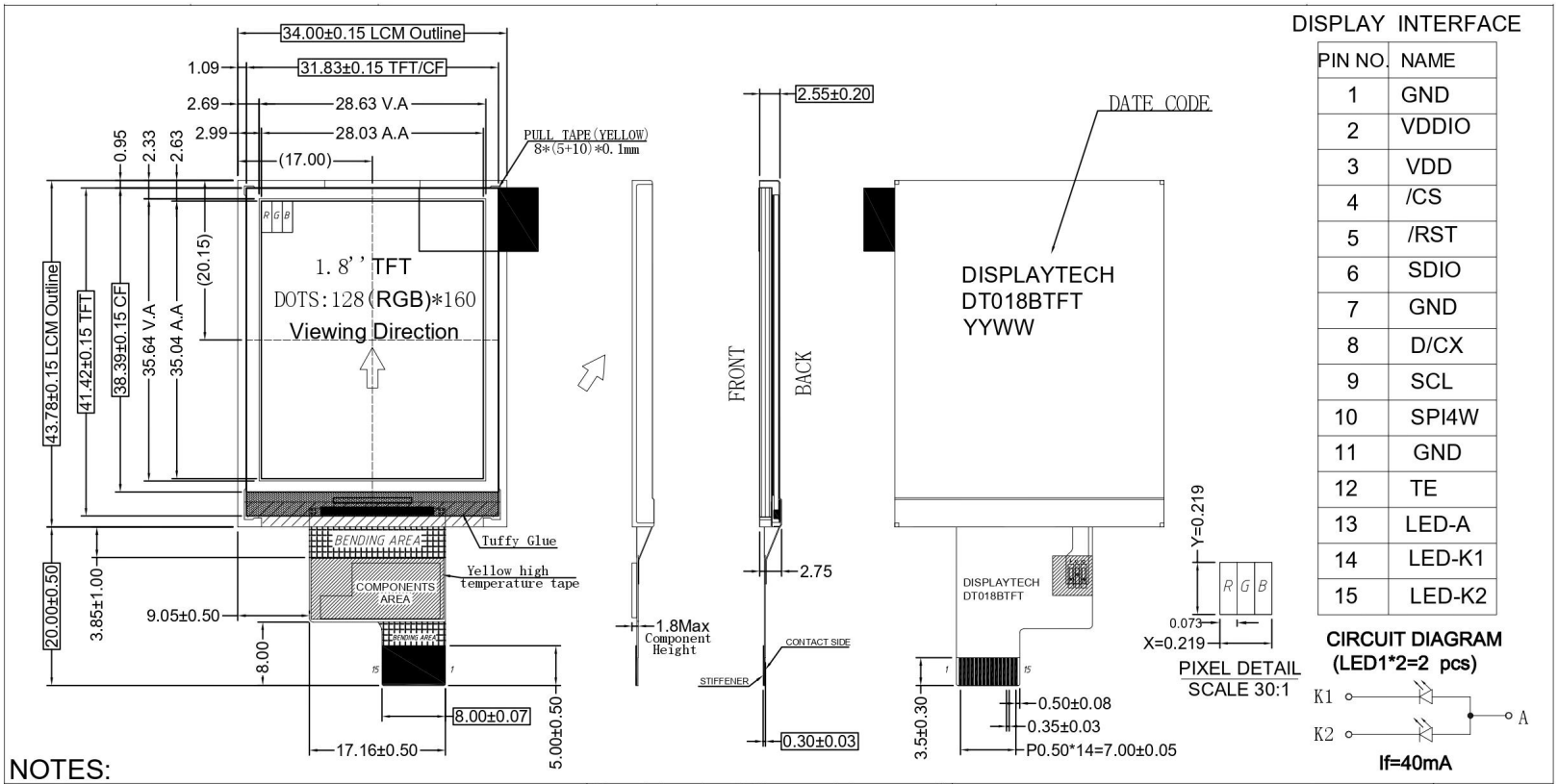
A. To clean the product, wipe with a soft cloth moistened with ethanol. Do not allow ethanol to get between upper film and bottom glass, as this may cause peeling issues and/or defective operation. Do not use any organic solvent or detergent other than ethanol.

7.6 Cautions for installation and assembly

A. Bezel edge must be positioned between Active area and Viewing area.
B. For stable display assembly, Displaytech recommends designing a support for the backside of the display.
C. Do not display any fixed pattern for long periods of time. If a fixed pattern must be displayed, use a screen saver in order to avoid image persistence.

8 Mechanical Drawings

8.1 DT018BTFT



DISPLAY INTERFACE

PIN NO.	NAME
1	GND
2	VDDIO
3	VDD
4	/CS
5	/RST
6	SDIO
7	GND
8	D/CX
9	SCL
10	SPI4W
11	GND
12	TE
13	LED-A
14	LED-K1
15	LED-K2

CIRCUIT DIAGRAM
(LED1*2=2 pcs)

If=40mA

NOTES:

1. Display Type: 1.8" TFT
2. Display Mode: Transmissive/Normally White/Anti-Glare/TN
3. Viewing Direction: 6:00
4. Backlight :2PCS White LED,If= 40mA
5. Display Driver IC. : ILI9163
6. VDD=VDDIO =2.8V
7. Luminance: 350cd/㎡ Typ
8. Operating temp: -20°C to 70°C ; Storage temp: -30°C to 80°C
9. General Tolerance : ±0.20mm
10. Environmental Protections Requirements(s): RoHS
11. ()=Reference Dimension; ▭ =Critical/Inspection Dimension

Count drawing & Spec.revision record during discussion with customer

Rec.	Revision Content Description	Date
#00	FIRST ISSUE	2020.09.10
#01	Change drawing according to customer's request	2020.11.06
#02	Change drawing according to customer's request	2020.11.25
#03	Change drawing according to customer's request	2021.01.18
	Modify IC:ILI9163C for ILI9163	2021.01.26

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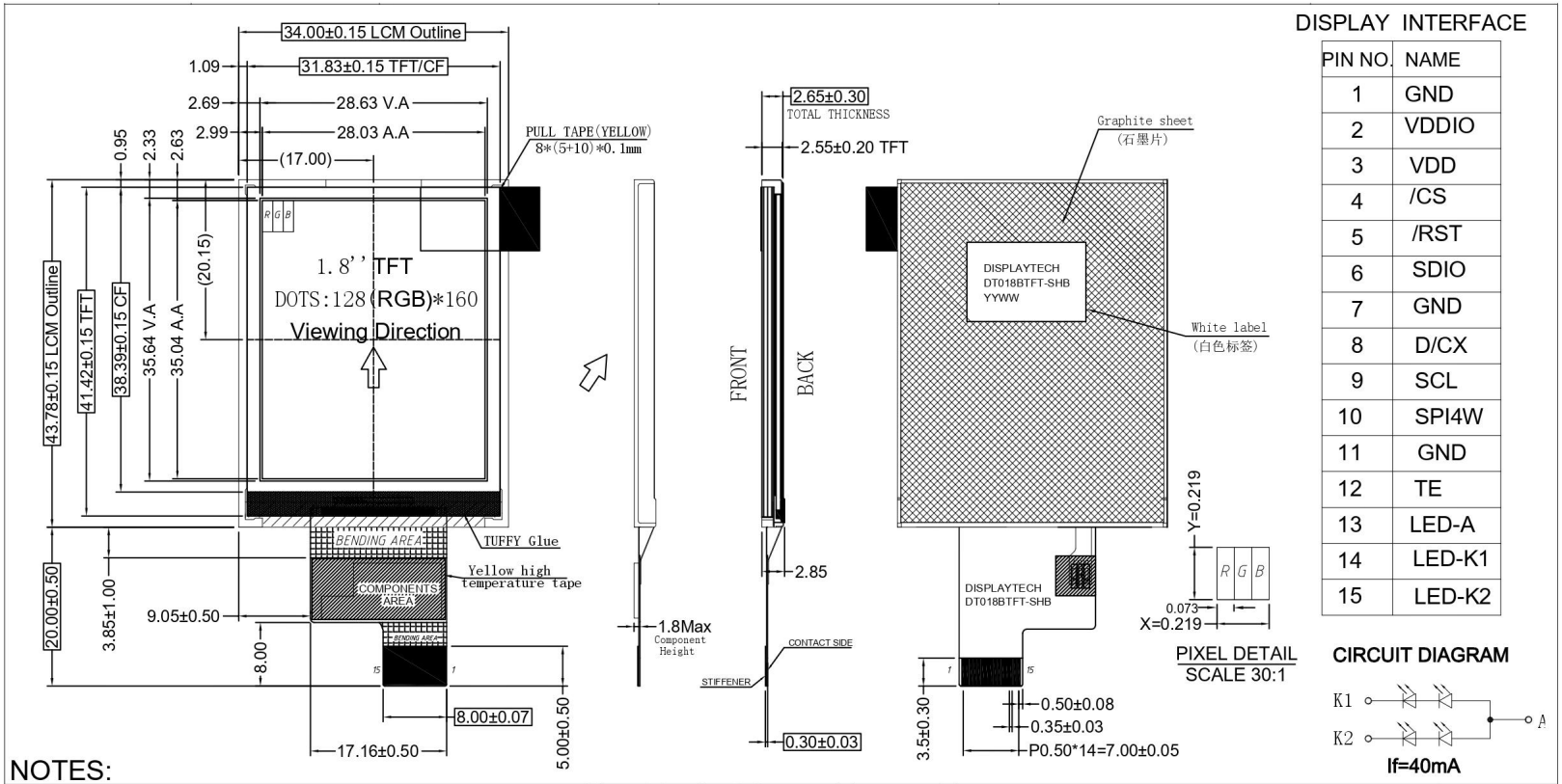
Mod.Name	DT018BTFT	SCALE	SHEET
		NTS	1/1

UNIT	SIZE	DESIGNER	CHECK	APPROVER	FILE NAME
mm	A4	Seabreeze Li	Ken Li	Jones Hsieh	Count Dwg.

8.2 DT018BTFT-SHB



DISPLAY INTERFACE

PIN NO.	NAME
1	GND
2	VDDIO
3	VDD
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7	GND
8	D/CX
9	SCL
10	SPI4W
11	GND
12	TE
13	LED-A
14	LED-K1
15	LED-K2

CIRCUIT DIAGRAM

If=40mA

NOTES:

1. Display Type: 1.8" TFT
2. Display Mode: Transmissive/Normally White/Anti-Glare/TN
3. Viewing Direction: 6:00
4. Backlight :4PCS White LED(2*2),If= 40mA
5. Display Driver IC. : ILI9163
6. VDD=VDDIO =2.8V
7. Luminance: 1000cd/㎡ Typ
8. Operating temp: -20°C to 70°C ; Storage temp: -30°C to 80°C
9. General Tolerance : ±0.20mm
10. Environmental Protections Requirements(s): RoHS
11. ()=Reference Dimension; ▭ =Critical/Inspection Dimension

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#03	Change drawing according to customer's request	2021.01.21
	Modify IC P/N from ILI9163C to ILI9163	2021.01.26

Displaytech a seacomp company

Mod.Name	DT018BTFT-SHB	SCALE	SHEE
		NTS	1/1

UNIT	SIZE	DESIGNER	CHECK	APPROVER	FILE NAME
mm	A4	Seabreeze Li	Ken Li	Jones Hsieh	Count Dwg