

PRODUCT SPECIFICATION

1.8" TFT LCD Module with SPI Interface
DT018BTFT, DT018BTFT-SHB



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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

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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)
 - DT018BTFT-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	$\overline{\text{CS}}$	I	Chip select (active low)
5	$\overline{\text{RST}}$	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}	$0.7 \times V_{DDIO}$	–	V_{DDIO}	V
Input Voltage, Low	V_{IL}	0	–	$0.3 \times V_{DDIO}$	V
Output Voltage, High	V_{OH}	$0.8 \times V_{DDIO}$	–	V_{DDIO}	V
Output Voltage, Low	V_{OL}	0	–	$0.2 \times V_{DDIO}$	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

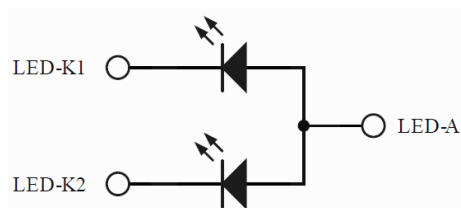


Figure 1: DT018BTFT Backlight
1 x 2 = 2 LEDs, $I_F = 40$ mA

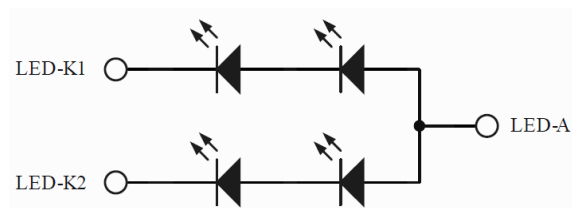


Figure 2: DT018BTFT-SHB Backlight
2 x 2 = 4 LEDs, $I_F = 40$ mA

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 $T_A=25^\circ\text{C}$ and $I_F=40\text{mA}$. LED lifetime may decrease if operating current, I_F , is higher than 40mA.

4 Timing Characteristics⁵

4.1 3-Wire Serial Interface

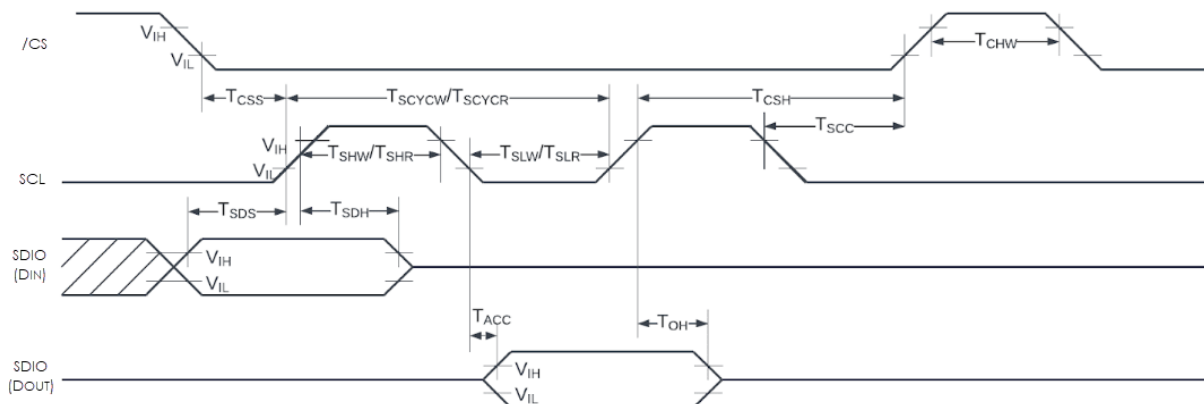


Figure 3: Timing Diagram, 3-Wire Serial Interface

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
	T_{SDS}	Data setup time	5	–	nS
SDIO	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 $GND = 0V$, $V_{DDIO} = 1.65V \sim 3.3V$, $V_{DD} = 2.6V \sim 3.3V$, $T_A = -30^\circ C \sim 70^\circ C$

⁷ For maximum $C_L = 30pF$, Minimum $C_L = 8pF$

4.2 4-Wire Serial Interface

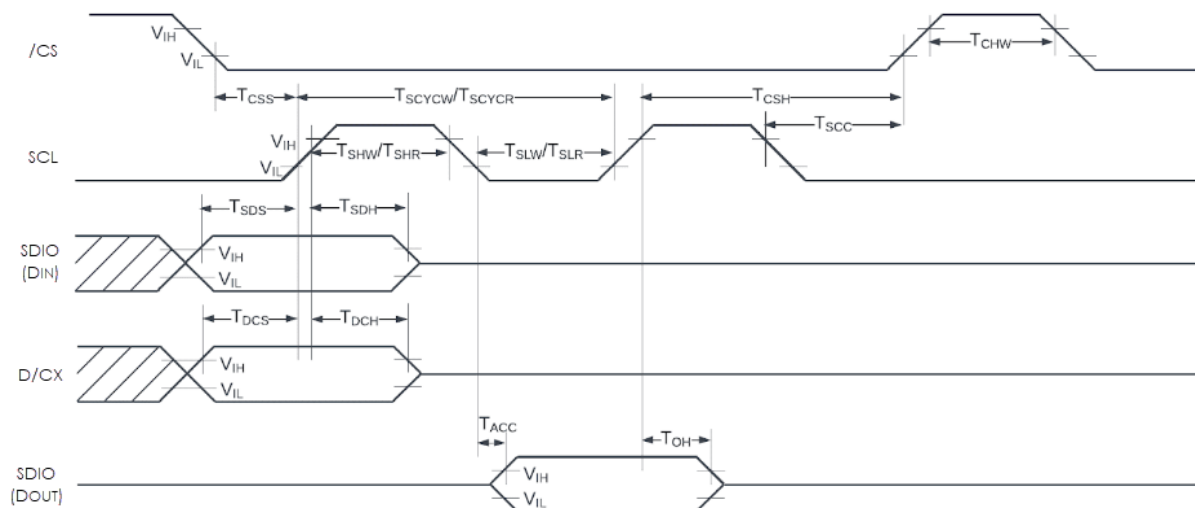


Figure 4: Timing Diagram, 4-Wire Serial Interface

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

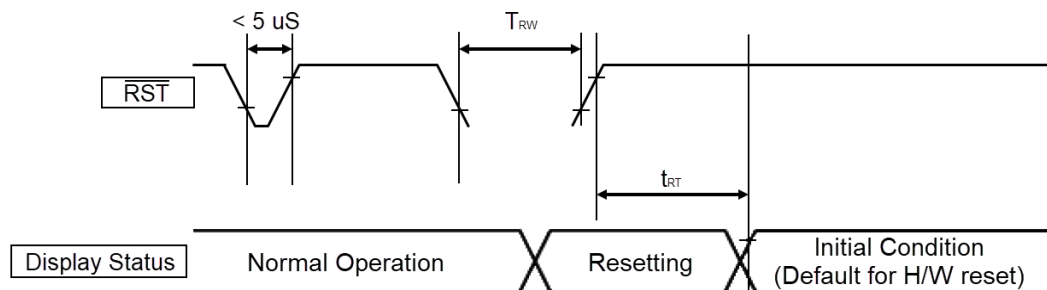


Figure 5: Reset Timing

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}	Θ _T	35	45	–	°C
	Θ _B	10	20	–	
	Θ _L	35	45	–	
	Θ _R	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

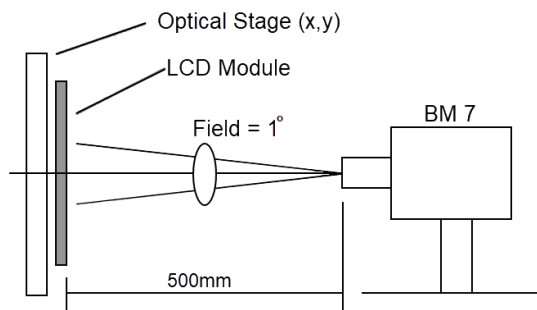
¹⁵ Contrast Ratio (CR) ≥ 10

¹⁶ See Section 5.1, Figure 5

¹⁷ See Section 5.1, Figure 6

5.1 Figures

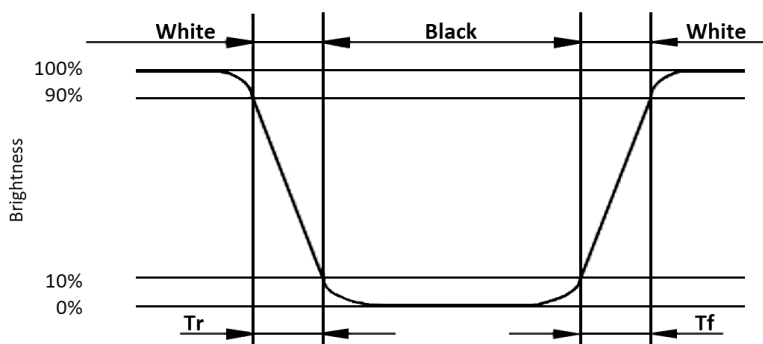
Figure 3: Optical Measurement System



Conditions:

$I_F = 40 \text{ mA}$, $T_A = 25 \text{ }^\circ\text{C}$, ambient brightness $< 150 \text{ lx}$

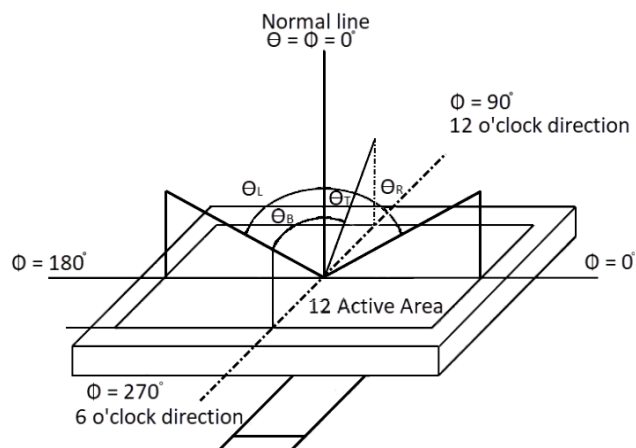
Figure 4: Response Times



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

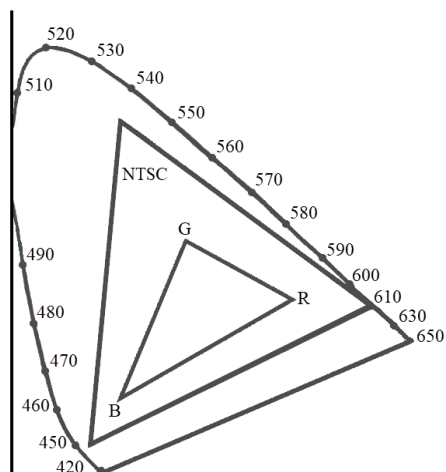
Rise Time (TR) = Time required for display to transition from black to white

Figure 5: Viewing Angles



Viewing angle is measured from center point of LCD

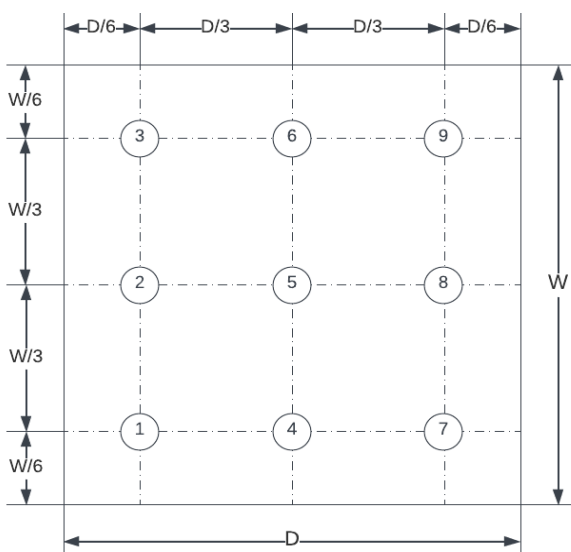
Figure 6: Chromaticity (CIE 1931)



$$\text{Chromaticity} = \text{Area of } \Delta_{\text{RGB}} / \text{Area of } \Delta_{\text{NTSC}}$$

* 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 $\text{Luminance}_{\text{MIN}} / \text{Luminance}_{\text{MAX}}$

$$\text{Contrast Ratio} = \frac{\text{Surface Luminance}_{\text{WhitePixels}}}{\text{Surface Luminance}_{\text{BlackPixels}}}$$

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 $25^{\circ}\text{C} \pm 10^{\circ}\text{C}$ 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

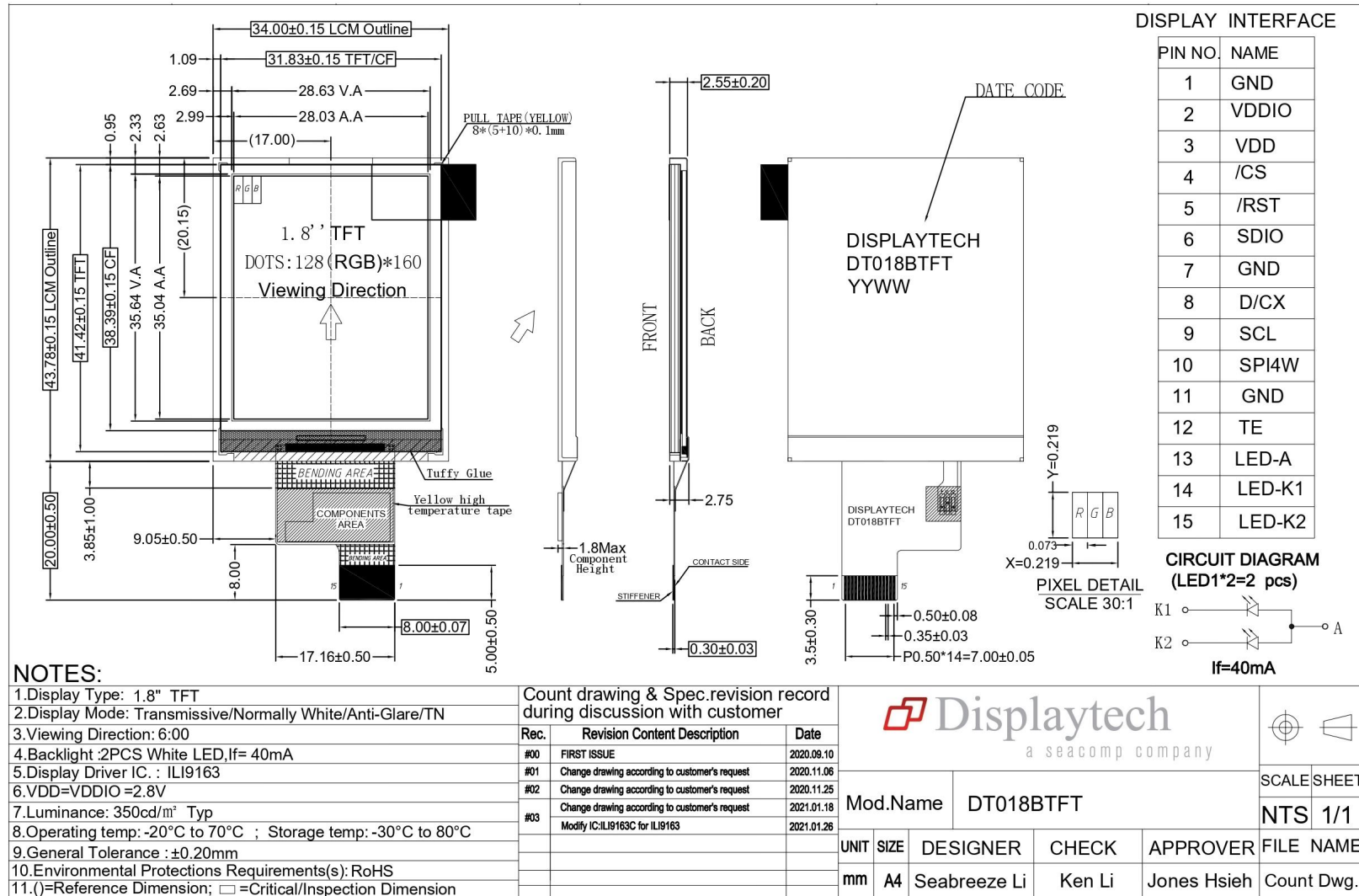
- A. To clean the product, wipe with a soft cloth moistened with ethanol. Do not allow ethanol to get between upper film and bottom glass, as this may cause peeling issues and/or defective operation. Do not use any organic solvent or detergent other than ethanol.

7.6 Cautions for installation and assembly

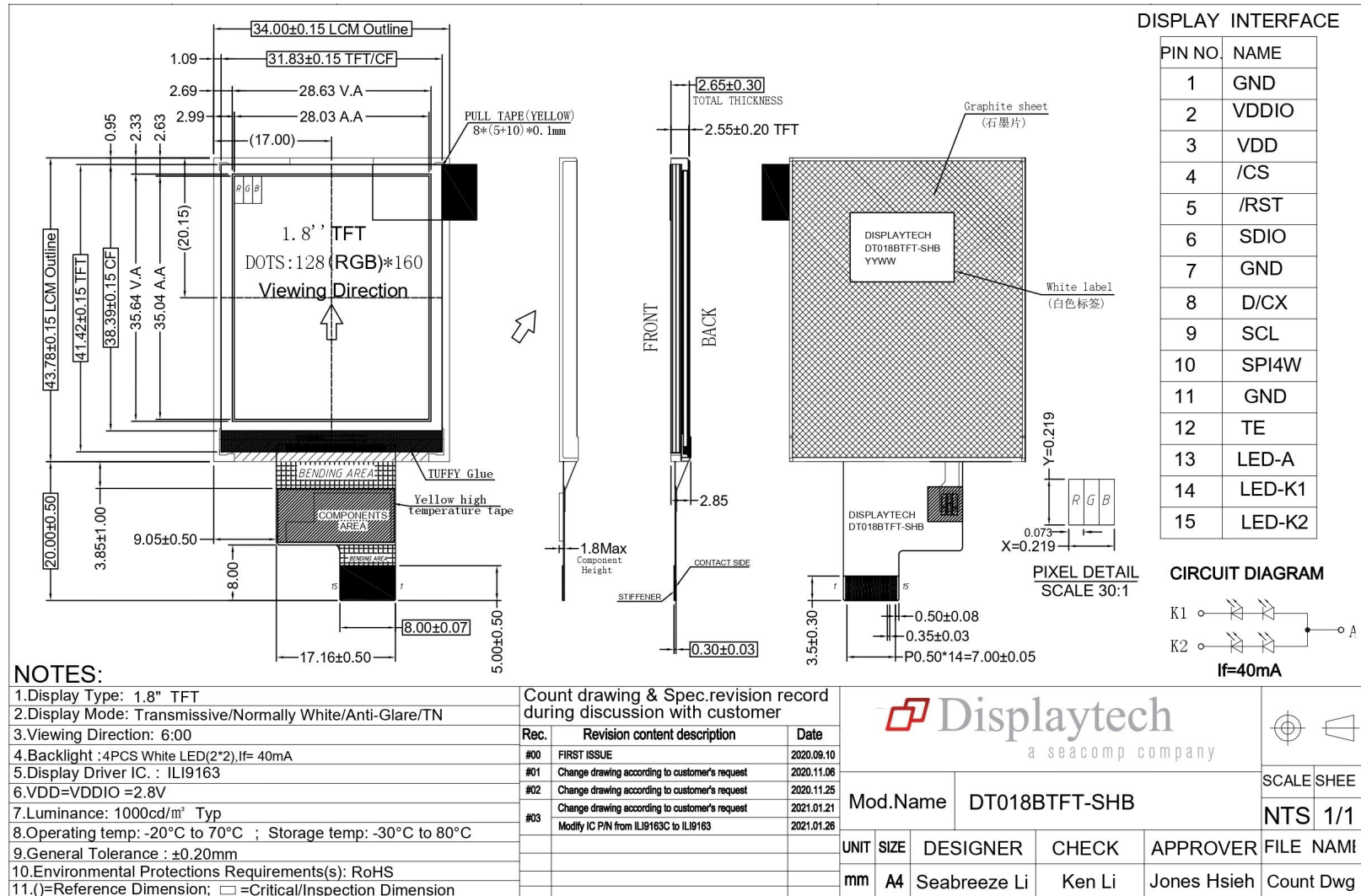
- A. Bezel edge must be positioned between Active area and Viewing area.
- B. For stable display assembly, Displaytech recommends designing a support for the backside of the display.
- C. Do not display any fixed pattern for long periods of time. If a fixed pattern must be displayed, use a screen saver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

8 Mechanical Drawings

8.1 DT018BTFT



8.2 DT018BTFT-SHB



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