NEWHAVEN DISPLAY INTERNATIONAL

Product Specification

NHD-2.4-240320DA-CTXN

TFT Liquid Crystal Display Module

NHD-	Newhaven Display
2.4-	2.4" Diagonal
240320-	240 x 320 Pixels
DA-	Model
C-	Built-in Controller
T-	White LED Backlight
X-	TFT
N-	TN, 6:00 Optimal View, Wide Temperature

Newhaven Display International, Inc.
2661 Galvin Court, Elgin, IL 60124 USA

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REACH Compliant

RoHS Compliant

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Table of Contents

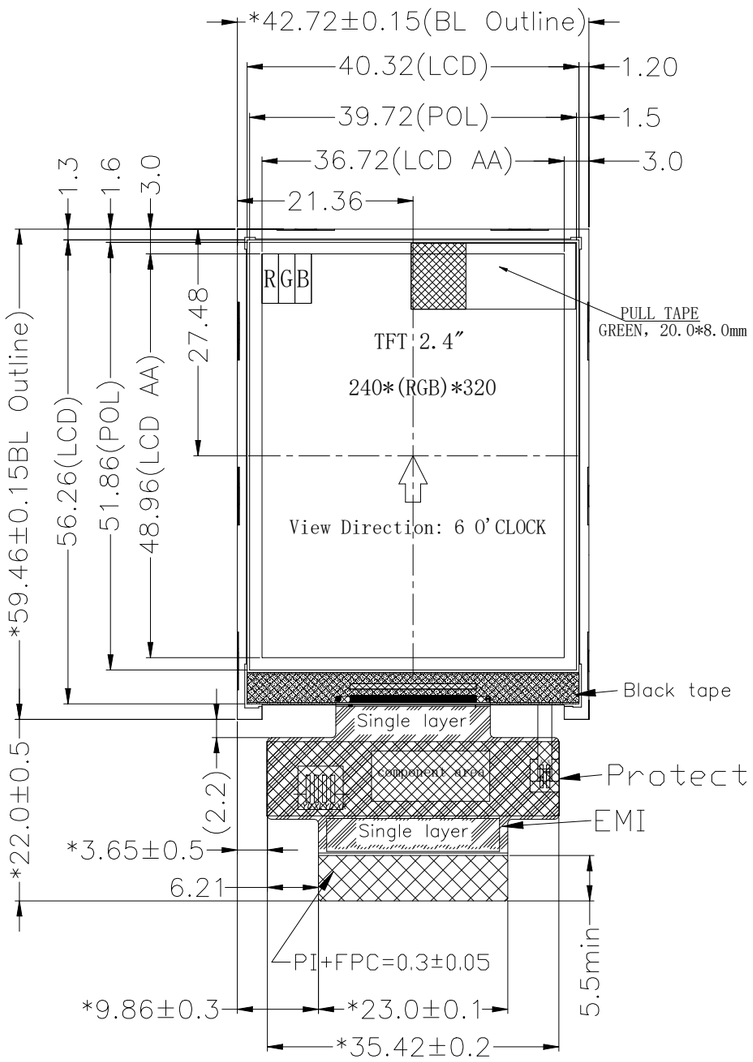
Additional Resources

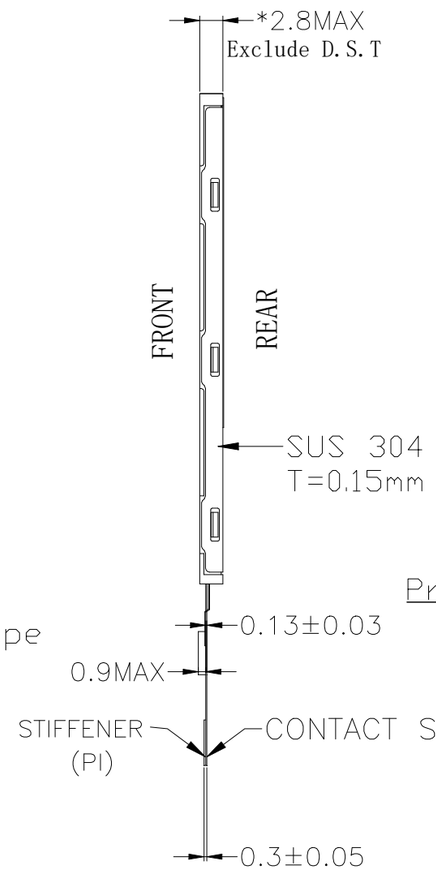
- **Support Forum:** https://support.newhavendisplay.com/hc/en-us/community/topics
- **GitHub:** https://github.com/newhavendisplay
- **Example Code:** https://support.newhavendisplay.com/hc/en-us/categories/4409527834135-Example-Code/
- **Knowledge Center:** https://www.newhavendisplay.com/knowledge_center.html
- **Quality Center:** https://www.newhavendisplay.com/quality_center.html
- **Precautions for using LCDs/LCMs:** https://www.newhavendisplay.com/specs/precautions.pdf
- **Warranty / Terms & Conditions:** https://www.newhavendisplay.com/terms.html

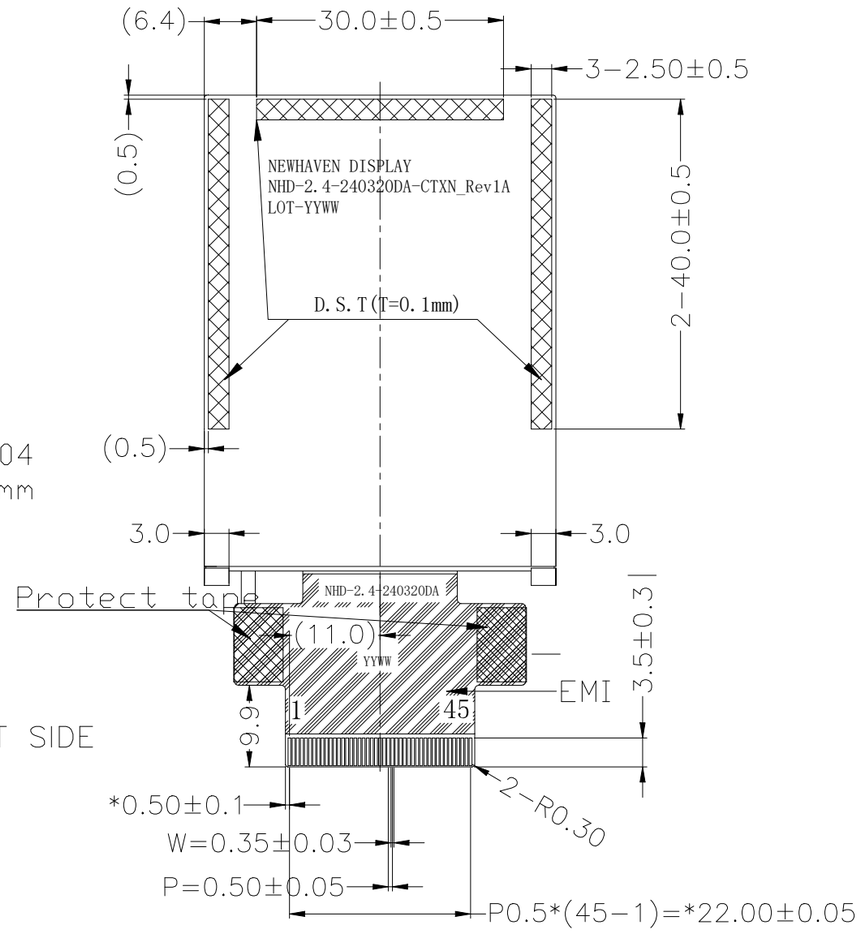
Document Revision History

Revision	Date	Description	Changed By
-	02/05/2025	Initial Release	KL

Mechanical Drawing



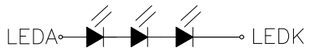




Pin No.	Symbol
1	NC
2	IM0
3	IM1
4	IM2
5	IM3
6	RESX
7	VSYNC
8	HSYNC
9	DOTCLK
10	DE
11-28	DB17-DB0
29	SDO
30	SDI/SDA
31	RDX
32	D/CX (SCL)
33	WRX (D/CX)
34	CSX
35	TE
36	VDD
37	VDD
38	GND
39	GND
40	LED-A
41	LED-K
42	NC
43	NC
44	NC
45	NC

Product Description: 2.4” 240x320 TN TFT

1. Driver IC: ILI9341V
2. Interface: 8/9/16/18-bit Parallel, 6/16/18-bit RGB, 3/4-wire SPI
3. Power Requirement: 3.0V TFT, 9.0V/20mA Backlight
4. Optical Features: Normally White, Transmissive, 6:00 View, 270cd/m²
5. Recommended FFC Connector: 45pin 0.5mm pitch; Ex. Molex 0512964594
6. Built-in EMI Shielding



LED CIRCUIT DIAGRAM

Standard Tolerance:
(Unless otherwise specified)
Linear: ±0.3mm

NEWHAVEN DISPLAY INTERNATIONAL

Drawing/Part Number: NHD-2.4-240320DA-CTXN
Revision: 1A

Unless otherwise specified:
• Dimensions are in Millimeters
• Third Angle Projection

Drawn By: K. Lewis
Approved By: K. Lewis
Drawn Date: 02/05/2025
Approved Date: 02/05/2025

Pin Description

Pin No.	Symbol	External Connection	Function Description
1	NC	-	No Connect
2	IM0	MPU	Interface Mode select
3	IM1	MPU	Interface Mode select
4	IM2	MPU	Interface mode select
5	IM3	MPU	Interface mode select
6	RESX	MPU	Active LOW Reset signal
7	VSYNC	MPU	Vertical (Frame) sync signal for RGB interface
8	HSYNC	MPU	Horizontal (Line) sync signal for RGB interface
9	DOTCLK		Dot Clock signal for RGB interface (Rising Edge)
10	DE	MPU	Data Enable signal for RGB interface
11-28	DB17-DB0	MPU	Bi-directional data bus
29	SDO	MPU	Serial Data Out
30	SDI/SDA	MPU	Serial Data In
31	RDX	MPU	Active LOW Read signal
32	D/CX (SCL)	MPU	**Parallel Interface:** Data/command selection: 1 = Data; 0 = Command **Serial Interface:** Serial Clock signal
33	WRX (D/CX)	MPU	**Parallel Interface:** Active LOW write signal **Serial Interface:** Data/command selection: 1 = Data; 0 = Command
34	CSX	MPU	Active LOW Chip Select signal
35	TE	MPU	Tearing Effect output signal to synchronize MPU to frame
36	VDD	Power Supply	Supply Voltage for LCD and Logic (3.0V)
37	VDD	Power Supply	Supply Voltage for LCD and Logic (3.0V)
38	GND	Power Supply	Ground
39	GND	Power Supply	Ground
40	LED-A	Power Supply	Backlight Anode (9.0V/20mA)
41	LED-K	Power Supply	Backlight Cathode (Ground)
42	NC	-	No Connect
43	NC	-	No Connect
44	NC	-	No Connect
45	NC	-	No Connect

Recommended LCD connector: 45-pin, 0.5mm pitch FFC connector **Molex P/N**: 0512964594or similar

MCU Interface Mode Selection

Pin Name	Interface Mode I						Interface Mode II					
	8080 8-bit	8080 16-bit	8080 9-bit	8080 18-bit	3-wire SPI	4-wire SPI	8080 8-bit	8080 16-bit	8080 9-bit	8080 18-bit	3-wire SPI	4-wire SPI
IM0	0	1	0	1	1	0	1	0	1	0	1	0
IM1	0	0	1	1	0	1	0	0	1	1	0	1
IM2	0	0	0	0	1	1	0	0	0	0	1	1
IM3	0	0	0	0	0	0	1	1	1	1	1	1

MPU Interface Pin Assignment Summary

Bus Interface	Data/Command Interface																		Control Signals					
	D 17	D 16	D 15	D 14	D 13	D 12	D 11	D 10	D 9	D 8	D 7	D 6	D 5	D 4	D 3	D 2	D 1	D 0	/WRX	/RDX	/CSX	D/CX	SDO	SDI/ SDA
Interface Mode I																								
8080 8-bit	Tie LOW										D [7:0]								/WRX	/RDX	/CSX	D/CX	NC	LOW
8080 16-bit	Tie LOW	D [15:0]																	/WRX	/RDX	/CSX	D/CX	NC	LOW
8080 9-bit	Tie LOW									D [8:0]									/WRX	/RDX	/CSX	D/CX	NC	LOW
8080 18-bit	D [17:0]																		/WRX	/RDX	/CSX	D/CX	NC	LOW
3-wire SPI	Tie LOW																		HIGH	HIGH	/CSX	SCL	NC	SDA
4-wire SPI	Tie LOW																		D/CX	HIGH	/CSX	SCL	NC	SDA
Interface Mode II																								
8080 8-bit	D [17:10]								Tie LOW										/WRX	/RDX	/CSX	D/CX	NC	LOW
8080 16-bit	D [17:10]								D [8:1]									LOW	/WRX	/RDX	/CSX	D/CX	NC	LOW
8080 9-bit	D [17:9]									Tie LOW									/WRX	/RDX	/CSX	D/CX	NC	LOW
8080 18-bit	D [17:0]																		/WRX	/RDX	/CSX	D/CX	NC	LOW
3-wire SPI	Tie LOW																		HIGH	HIGH	/CSX	SCL	SDO	SDI
4-wire SPI	Tie LOW																		D/CX	HIGH	/CSX	SCL	SDO	SDI

RGB Interface Mode Selection

The Ilitek ILI9341V driver IC is user configurable for DE Mode and SYNC mode RGB interface.

DE Mode is enabled when the RCM [1:0] bits of B0h command are set to “10”, and DE signal is high for valid pixel data. Data is clocked in using rising edge of DOTCLK signal. DE mode is recommended to enable the ILI9341V driver IC to synchronize the display image on TFT panel without depending on specific horizontal and vertical sync timing from host controller.

SYNC mode is enabled when the RCM [1:0] bits of B0h command are set to “11”, DE signal is ignored, and HSYNC and VSYNC signals are used to explicitly define the horizontal and vertical sync timing to synchronize the display image on TFT panel. Data is clocked in using rising edge of DOTCLK signal. Any change to the HSYNC or VSYNC values may prevent the image from correctly appearing on the display.

ILI9341V supports several pixel formats that can be selected by DPI [2:0] bits of “Pixel Format Set (3Ah)” and RIM bit of F6h command.

RCM[1:0]		RIM	DPI[2:0]			RGB Interface Mode	RGB Mode	Used Pins
1	0	0	1	1	0	18-bit RGB interface (262K colors)	**DE Mode** Valid data is determined by the DE signal	VSYNC, HSYNC, DE, DOTCLK,D[17:0]
1	0	0	1	0	1	16-bit RGB interface (65K colors)		VSYNC, HSYNC, DE, DOTCLK, D[17:13] & D[11:1]
1	0	1	1	1	0	6-bit RGB interface (262K colors)		VSYNC, HSYNC, DE, DOTCLK, D[5:0]
1	0	1	1	0	1	6-bit RGB interface (65K colors)		VSYNC, HSYNC, DE, DOTCLK, D[5:0]
1	1	0	1	1	0	18-bit RGB interface (262K colors)	**SYNC Mode** In SYNC mode, DE signal is ignored; blanking porch is determined by B5h command.	VSYNC, HSYNC, DOTCLK, D[17:0]
1	1	0	1	0	1	16-bit RGB interface (65K colors)		VSYNC, HSYNC, DOTCLK, D[17:13] & D[11:1]
1	1	1	1	1	0	6-bit RGB interface (262K colors)		VSYNC, HSYNC, DOTCLK, D[5:0]
1	1	1	1	0	1	6-bit RGB interface (65K colors)		VSYNC, HSYNC, DOTCLK, D[5:0]

Electrical Characteristics

Item	Symbol	Condition	Min.	Typ.	Max.	Unit
Operating Temperature Range	T_{OP}	Absolute Max	-20	-	+70	°C
Storage Temperature Range	T_{ST}	Absolute Max	-30	-	+80	°C
Supply Voltage for LCD	V_{DD}	-	2.5	3.0	3.3	V
Supply Current	I_{DD}	V_{DD} = 3.0V	5	10	15	mA
"H" Level input	V_{IH}	-	0.7 * V_{DD}	-	V_{DD}	V
"L" Level input	V_{IL}	-	V_{SS}	-	0.3 * V_{DD}	V
"H" Level output	V_{OH}	-	0.8 * V_{DD}	-	V_{DD}	V
"L" Level output	V_{OL}	-	V_{SS}	-	0.2 * V_{DD}	V
Backlight Supply Current	I_{LED}	-	10	20	25	mA
Backlight Supply Voltage	V_{LED}	I_{LED} = 20mA	8.1	9.0	10.2	V
Backlight Lifetime*	-	I_{LED} = 20mA T_{OP} = 25°C	30,000	50,000	-	Hrs.

*Backlight Lifetime is rated as Hours until **half-brightness**, under normal operating conditions. The LED of the backlight is driven by current drain; drive voltage is for reference only. Drive voltage must be selected to ensure backlight current drain is below MAX level stated.

Optical Characteristics

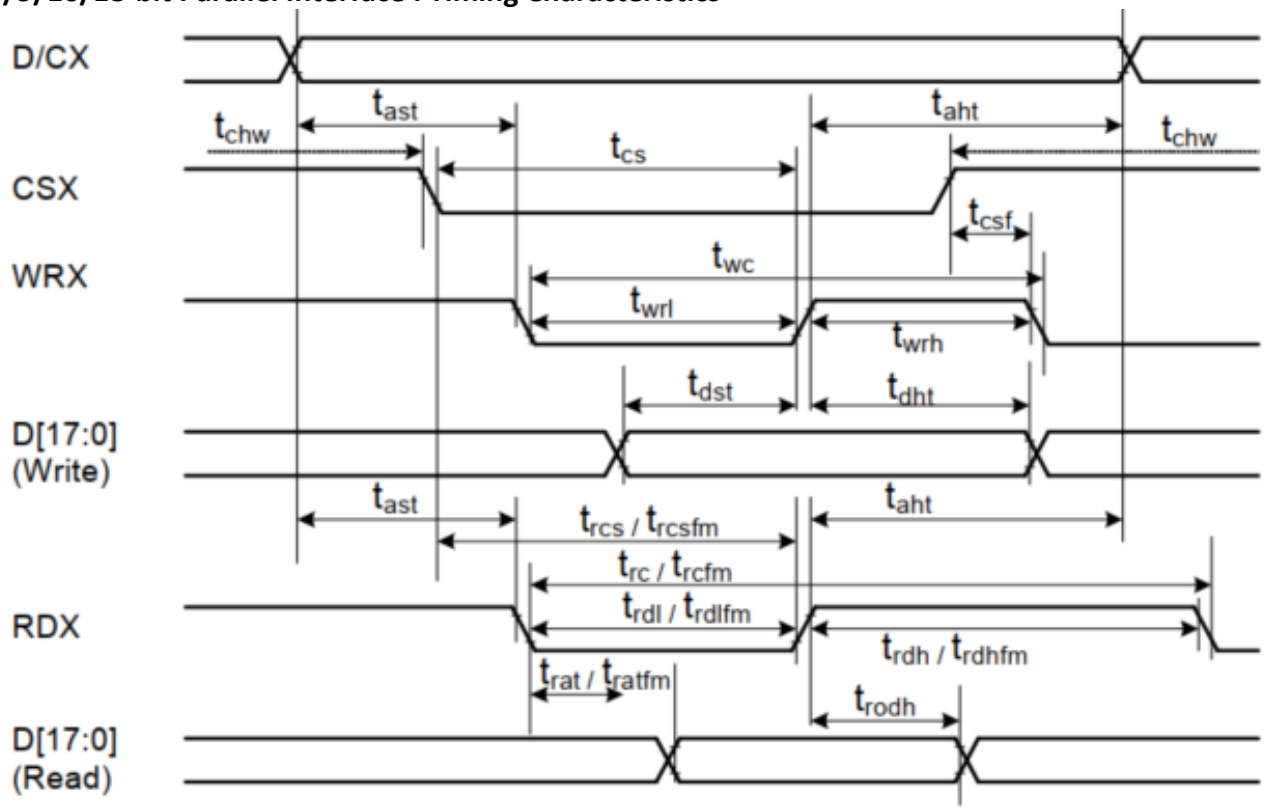
Item		Symbol	Condition	Min.	Typ.	Max.	Unit
Optimal Viewing Angles	Top	φY+	CR ≥ 10	-	20	-	°
	Bottom	φY-		-	45	-	°
	Left	θX-		-	45	-	°
	Right	θX+		-	45	-	°
Contrast Ratio		CR	-	-	350	-	-
Luminance		L_V	I_{LED} = 20mA	220	270	-	cd/m²
Response Time		$T_R + T_F$	T_{OP} = 25°C	-	30	45	ms
Chromaticity	Red	X_R	-	0.525	0.575	0.625	-
		Y_R	-	0.297	0.347	0.397	-
	Green	X_G	-	0.282	0.332	0.382	-
		Y_G	-	0.556	0.606	0.656	-
	Blue	X_B	-	0.101	0.151	0.201	-
		Y_B	-	0.026	0.062	0.126	-
	White	X_W	-	0.239	0.289	0.339	-
		Y_W	-	0.249	0.299	0.349	-

Controller Information

Built-in ILI9341V Controller: https://support.newhavendisplay.com/hc/en-us/articles/26623027048343-ILI9341V

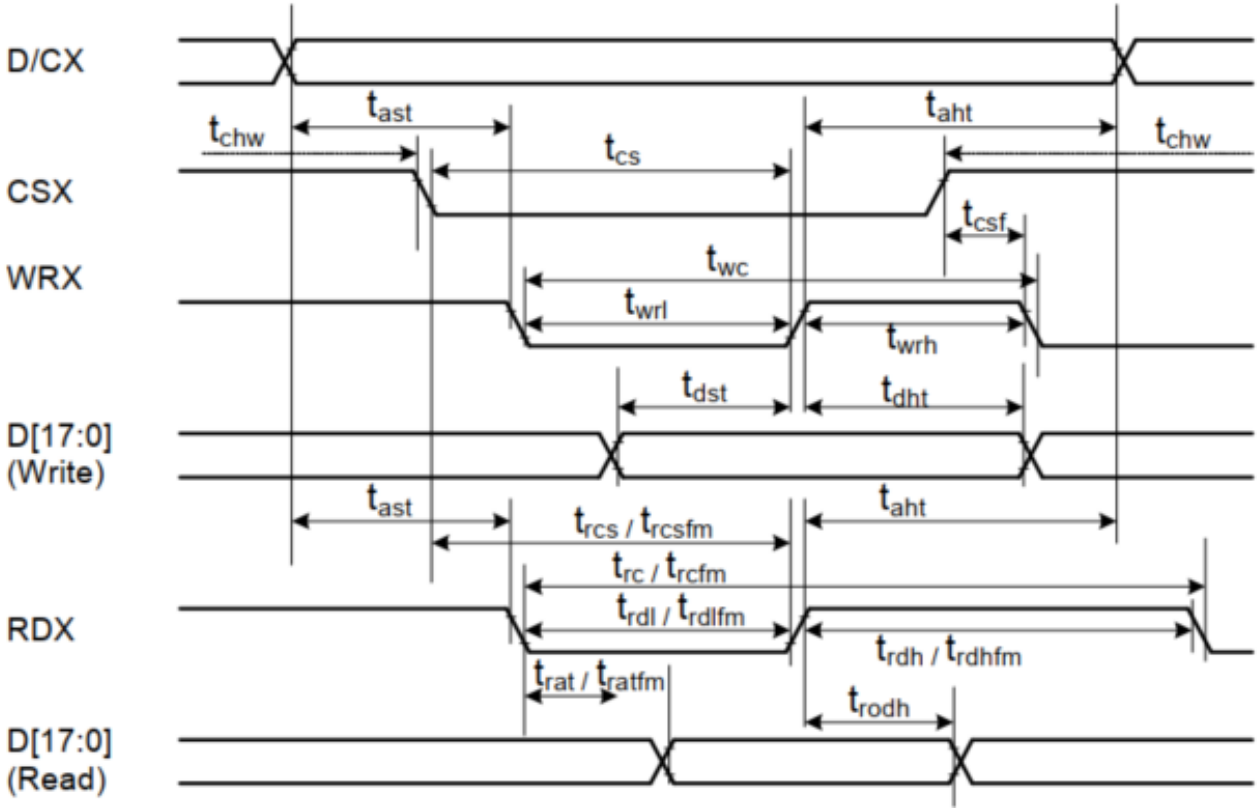
Timing Characteristics for TFT

8/9/16/18-bit Parallel Interface I Timing Characteristics



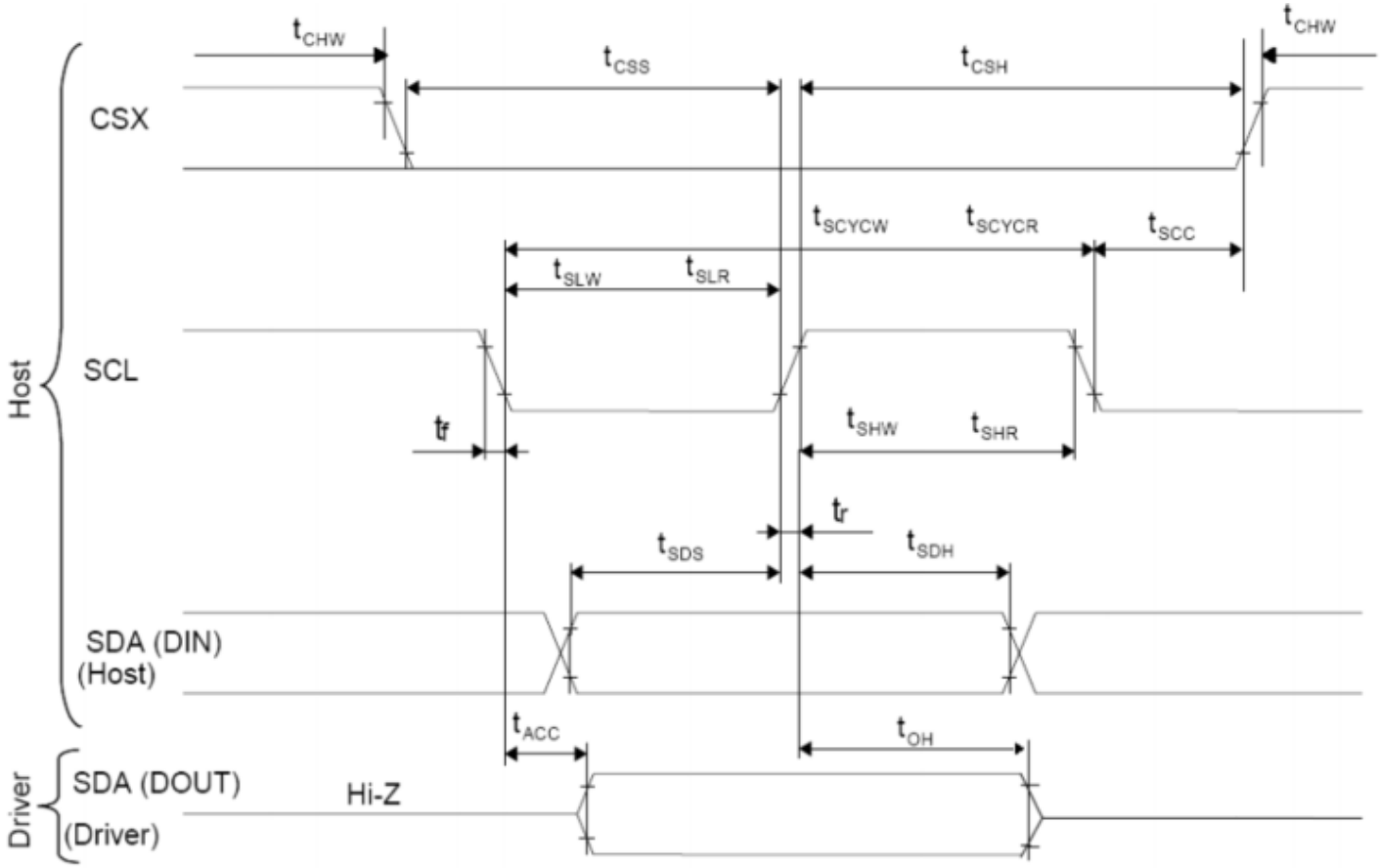
Signal	Symbol	Parameter	min	max	Unit	Description
DCX	tast	Address setup time	0	-	ns	
	taht	Address hold time (Write/Read)	0	-	ns	
CSX	tchw	CSX "H" pulse width	0	-	ns	
	tcs	Chip Select setup time (Write)	15	-	ns	
	trcs	Chip Select setup time (Read ID)	45	-	ns	
	trcsfm	Chip Select setup time (Read FM)	355	-	ns	
	tcsf	Chip Select Wait time (Write/Read)	10	-	ns	
WRX	twc	Write cycle	66	-	ns	
	twrh	Write Control pulse H duration	15	-	ns	
	twrl	Write Control pulse L duration	15	-	ns	
RDX (FM)	trcfm	Read Cycle (FM)	450	-	ns	
	trdhfm	Read Control H duration (FM)	90	-	ns	
	trdlfm	Read Control L duration (FM)	355	-	ns	
RDX (ID)	trc	Read cycle (ID)	160	-	ns	
	trdh	Read Control pulse H duration	90	-	ns	
	trdl	Read Control pulse L duration	45	-	ns	
D[17:0], D[15:0], D[8:0], D[7:0]	tdst	Write data setup time	10	-	ns	For maximum CL=30pF For minimum CL=8pF
	tdht	Write data hold time	10	-	ns	
	trat	Read access time	-	40	ns	
	tratfm	Read access time	-	340	ns	
	trod	Read output disable time	20	80	ns	

8/9/16/18-bit Parallel Interface II Timing Characteristics



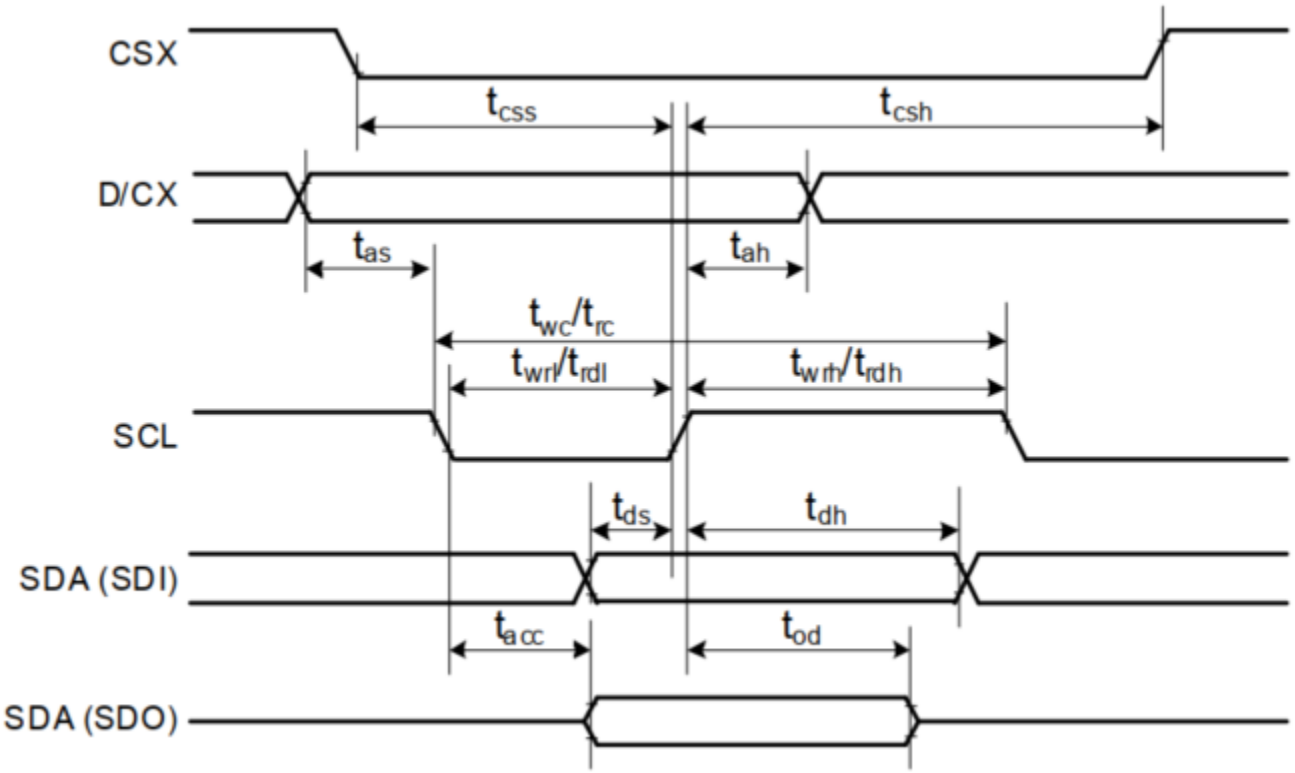
Signal	Symbol	Parameter	min	max	Unit	Description
DCX	tast	Address setup time	0	-	ns	
	taht	Address hold time (Write/Read)	0	-	ns	
CSX	tchw	CSX "H" pulse width	0	-	ns	
	tcs	Chip Select setup time (Write)	15	-	ns	
	trcs	Chip Select setup time (Read ID)	45	-	ns	
	trcsfm	Chip Select setup time (Read FM)	355	-	ns	
	tcsf	Chip Select Wait time (Write/Read)	10	-	ns	
WRX	twc	Write cycle	66	-	ns	
	twrh	Write Control pulse H duration	15	-	ns	
	twrl	Write Control pulse L duration	15	-	ns	
RDX (FM)	trcfm	Read Cycle (FM)	450	-	ns	
	trdhfm	Read Control H duration (FM)	90	-	ns	
	trdlfm	Read Control L duration (FM)	355	-	ns	
RDX (ID)	trc	Read cycle (ID)	160	-	ns	
	trdh	Read Control pulse H duration	90	-	ns	
	trdl	Read Control pulse L duration	45	-	ns	
D[17:0], D[17:10]&D[8:1], D[17:10], D[17:9]	tdst	Write data setup time	10	-	ns	For maximum CL=30pF For minimum CL=8pF
	tdht	Write data hold time	10	-	ns	
	trat	Read access time	-	40	ns	
	tratfm	Read access time	-	340	ns	
	trod	Read output disable time	20	80	ns	

3-wire Serial interface Timing Characteristics



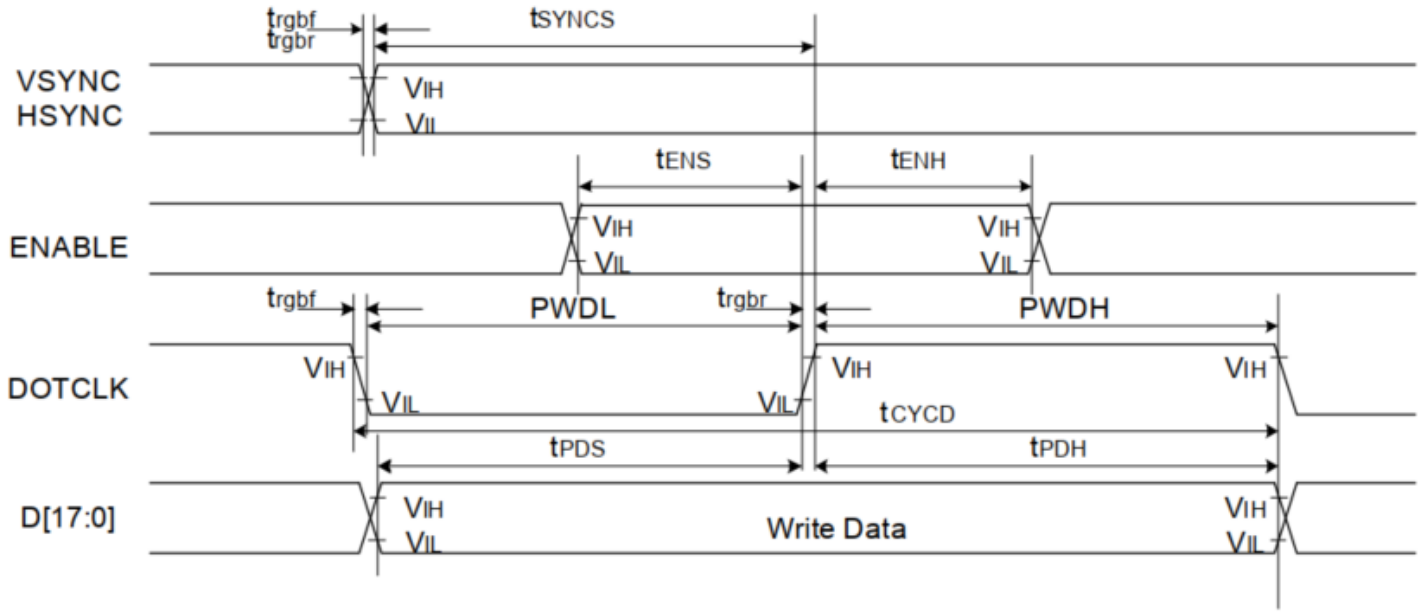
Signal	Symbol	Parameter	min	max	Unit	Description
SCL	tscycw	Serial Clock Cycle (Write)	100	-	ns	
	tshw	SCL "H" Pulse Width (Write)	40	-	ns	
	tslw	SCL "L" Pulse Width (Write)	40	-	ns	
	tscycr	Serial Clock Cycle (Read)	150	-	ns	
	tshr	SCL "H" Pulse Width (Read)	60	-	ns	
	tslr	SCL "L" Pulse Width (Read)	60	-	ns	
SDA / SDI (Input)	tsds	Data setup time (Write)	30	-	ns	
	tsdh	Data hold time (Write)	30	-	ns	
SDA / SDO (Output)	tacc	Access time (Read)	10	-	ns	
	toh	Output disable time (Read)	10	50	ns	
CSX	tscc	SCL-CSX	20	-	ns	
	tchw	CSX "H" Pulse Width	40	-	ns	
	tcss	CSX-SCL Time	60	-	ns	
	tcsh		65	-	ns	

4-wire Serial interface Timing Characteristics



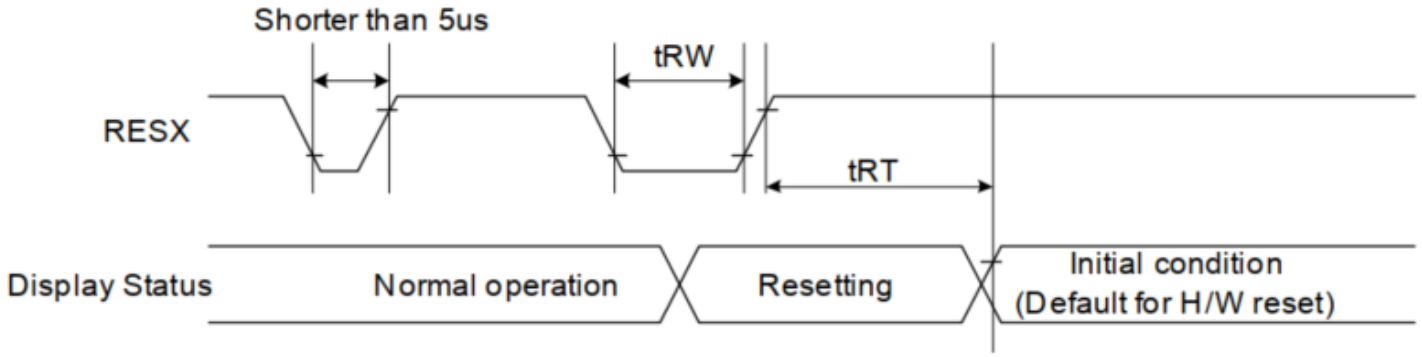
Signal	Symbol	Parameter	min	max	Unit	Description
CSX	tcss	Chip select time (Write)	40	-	ns	
	tcsh	Chip select hold time (Read)	40	-	ns	
SCL	twc	Serial clock cycle (Write)	100	-	ns	
	twrh	SCL "H" pulse width (Write)	40	-	ns	
	twrl	SCL "L" pulse width (Write)	40	-	ns	
	trc	Serial clock cycle (Read)	150	-	ns	
	trdh	SCL "H" pulse width (Read)	60	-	ns	
	trdl	SCL "L" pulse width (Read)	60	-	ns	
D/CX	tas	D/CX setup time	10	-		
	tah	D/CX hold time (Write / Read)	10	-		
SDA / SDI (Input)	tds	Data setup time (Write)	30	-	ns	
	tdh	Data hold time (Write)	30	-	ns	
SDA / SDO (Output)	tacc	Access time (Read)	10	-	ns	For maximum CL=30pF
	tod	Output disable time (Read)	10	50	ns	For minimum CL=8pF

Parallel 6/16/18-bit RGB Interface Timing Characteristics



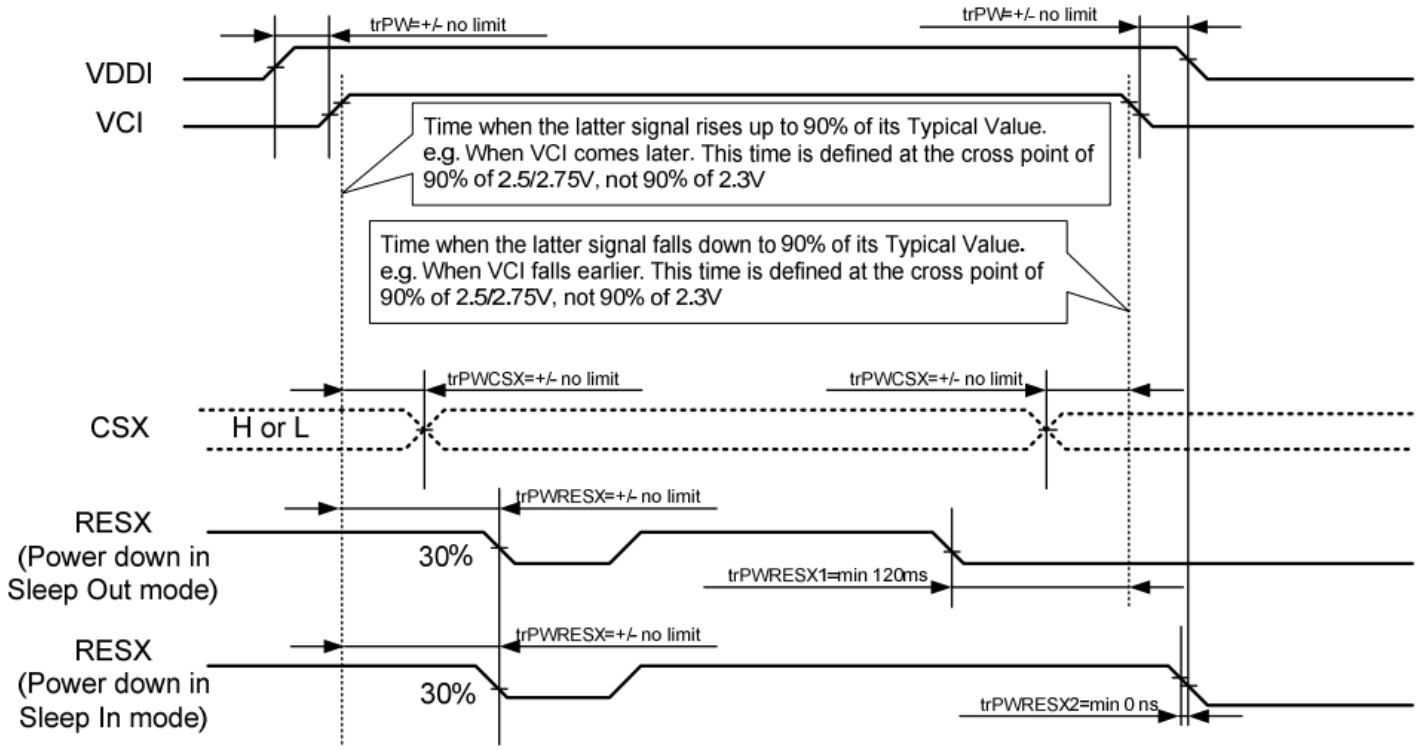
Signal	Symbol	Parameter	min	max	Unit	Description
VSYNC / HSYNC	t_{SYNCS}	VSYNC/HSYNC setup time	15	-	ns	18/16-bit bus RGB interface mode
	t_{SYNCH}	VSYNC/HSYNC hold time	15	-	ns	
DE	t_{ENS}	DE setup time	15	-	ns	
	t_{ENH}	DE hold time	15	-	ns	
D[17:0]	t_{POS}	Data setup time	15	-	ns	
	t_{PDH}	Data hold time	15	-	ns	
DOTCLK	PWDH	DOTCLK high-level period	15	-	ns	
	PWDL	DOTCLK low-level period	15	-	ns	
	t_{CYCD}	DOTCLK cycle time	100	-	ns	
	t_{rgbr} , t_{rgbf}	DOTCLK,HSYNC,VSYNC rise/fall time	-	15	ns	
VSYNC / HSYNC	t_{SYNCS}	VSYNC/HSYNC setup time	15	-	ns	6-bit bus RGB interface mode
	t_{SYNCH}	VSYNC/HSYNC hold time	15	-	ns	
DE	t_{ENS}	DE setup time	15	-	ns	
	t_{ENH}	DE hold time	15	-	ns	
D[17:0]	t_{POS}	Data setup time	15	-	ns	
	t_{PDH}	Data hold time	15	-	ns	
DOTCLK	PWDH	DOTCLK high-level pulse period	15	-	ns	
	PWDL	DOTCLK low-level pulse period	15	-	ns	
	t_{CYCD}	DOTCLK cycle time	50	-	ns	
	t_{rgbr} , t_{rgbf}	DOTCLK,HSYNC,VSYNC rise/fall time	-	15	ns	

Reset Timing



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

Power ON/OFF Sequence



trPWRESX1 is applied to RESX falling in the Sleep Out Mode
trPWRESX2 is applied to RESX falling in the Sleep In Mode

Example Initialization Code

```
void TFT_Init() {
  command(0x28);  // Display off
  command(0x11);  // Exit SLEEP mode

  command(0xCB);  // Power Control A
  data(0x39);
  data(0x2C);
  data(0x00);
  data(0x34);
  data(0x02);

  command(0xCF);  // Power Control B
  data(0x00);
  data(0x81);
  data(0x30);

  command(0xC0);  // Power Control 1
  data(0x26);
  data(0x04);

  command(0xC1);  // Power Control 2
  data(0x11);

  command(0xC5);  // VCOM Control 1
  data(0x35);
  data(0x3E);

  command(0x36);  // Memory Access Control (BGR)
  data(0x88);

  command(0xB1);  // Frame Rate Control
  data(0x00);
  data(0x18);

  command(0xB6);  // Display Function Control
  data(0x0A);
  data(0xA2);

  command(0xC7);  // VCOM Control 2
  data(0xBE);

  command(0x3A);  // Pixel Format (16-bit)
  data(0x55);

  command(0xF2);  // 3G Gamma Control (Off)
  data(0x02);
```

```
    command(0x26);  // Gamma Curve 3
    data(0x01);

    command(0x2A);  // Column Address Set
    data(0x00);
    data(0x00);
    data(0x00);
    data(0xEF);

    command(0x2B);  // Page Address Set
    data(0x00);
    data(0x00);
    data(0x01);
    data(0x3F);

    command(0x29);  // Display ON
}
```

Quality Information

Test Item	Content of Test	Test Condition	Note
High Temperature Storage	Endurance test applying the high storage temperature for a long time.	+80°C, 240hrs	2
Low Temperature Storage	Endurance test applying the low storage temperature for a long time.	-30°C, 240hrs	1,2
High Temperature Operation	Endurance test applying the electric stress (voltage & current) and the high thermal stress for a long time.	+70°C, 240hrs	2
Low Temperature Operation	Endurance test applying the electric stress (voltage & current) and the low thermal stress for a long time.	-20°C, 240hrs	1,2
High Temperature / Humidity Operation	Endurance test applying the electric stress (voltage & current) and the high thermal with high humidity stress for a long time.	+60°C, 90% RH, 240hrs	1,2
Thermal Shock resistance	Endurance test applying the electric stress (voltage & current) during a cycle of low and high thermal stress.	-30°C 30min -> 25°C 3min -> 80°C 30min = 1 cycle. For 100 cycles	
Vibration test	Endurance test applying vibration to simulate transportation and use.	10Hz-55Hz,(1 min) 1.5mm amplitude. Accelerated Velocity:2G 30 min in each of 3 directions X,Y,Z	3
Static electricity test	Endurance test applying electric static discharge.	Air discharge: ±8kV 10 Times Contact discharge: ±4kV 10 Times (RS=330kΩ ,CS=150pF)	

Note 1: No condensation to be observed.
Note 2: Conducted after 4 hours of storage at 25°C, 0%RH.
Note 3: Test performed on product itself, not inside a container.