NEWHAVEN DISPLAY INTERNATIONAL

Product Specification

NHD-C12864LZ-FSW-FBW-3V3

COG (Chip-on Glass) Liquid Crystal Display Module

NHD-	Newhaven Display
C12864-	128 x 64 Pixels
LZ-	Model
F-	Transflective
SW-	Side white LED Backlight
F-	FSTN (+)
B-	6:00 Optimal View
W-	Wide Temperature
3V3-	3.0V LCD, 3.0V Backlight

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REACH Compliant

RoHS Compliant

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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

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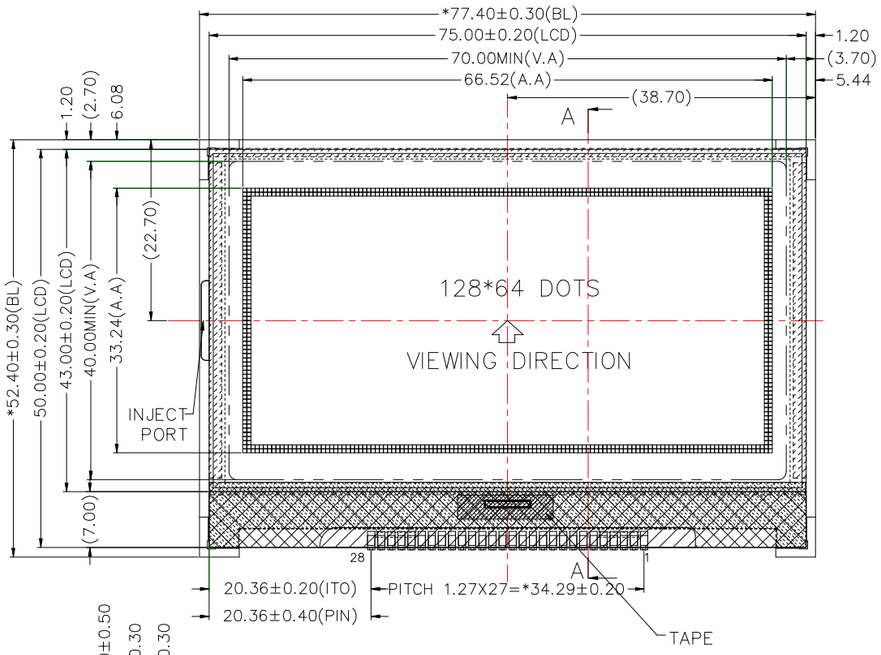
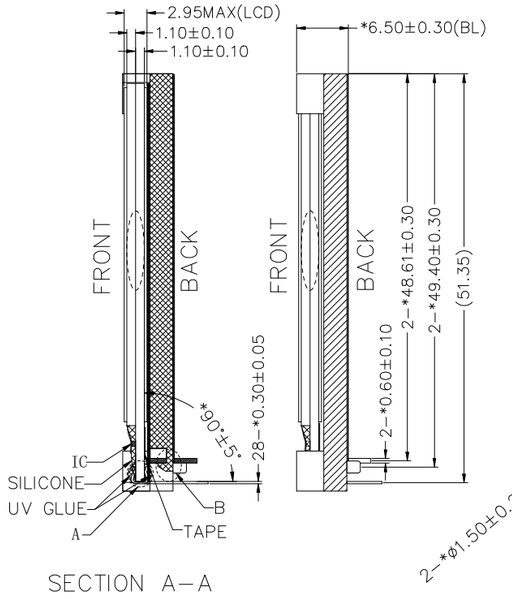
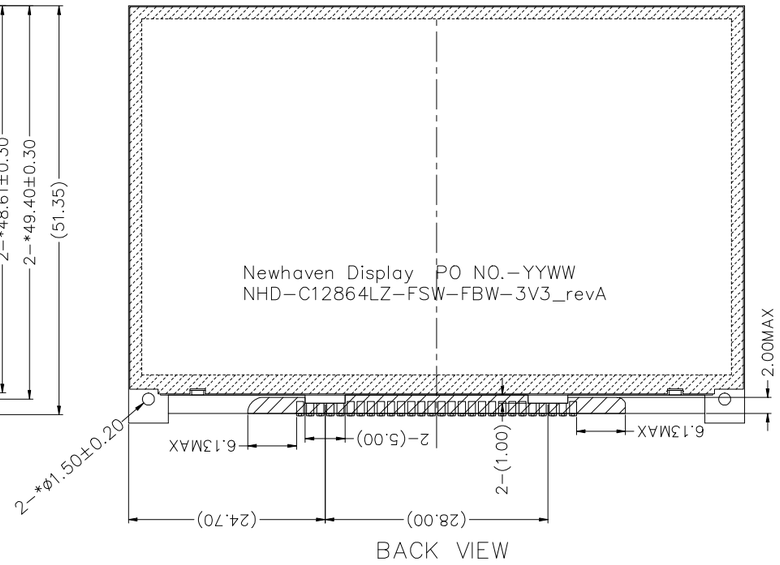
Document Revision History

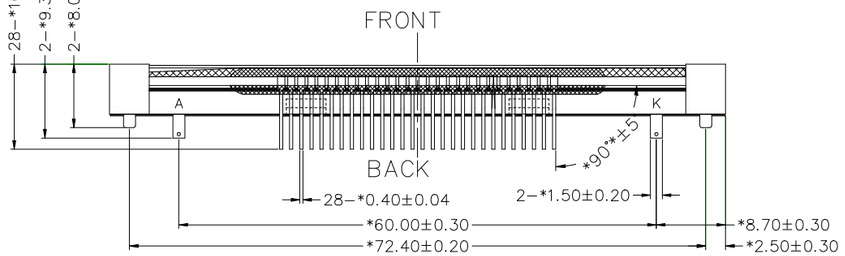
Revision	Date	Description	Changed By
0	01/10/2010	Initial Release	MC
1	07/07/2011	Packaging Procedure Added	AK
2	12/12/2012	Example Initialization Program Updated	AK
3	04/10/2013	Serial Interface Timing Added	AK
4	03/17/2015	Pin Description Updated	RM
5	10/16/2015	Mechanical Drawing Updated	TJ
6	06/29/2016	Electrical and Optical Characteristics Updated	SB
7	10/27/2016	Electrical Characteristics and Mechanical Drawing Updated	TM
8	07/26/2017	Backlight Redesign & LCD Panel Changed for Improved Contrast	SB
9	08/24/2018	Note Added to Drawing	SB
10	05/28/2019	Added PCB Footprint Drawing & Recommended Breakout Board	AS
11	08/11/2023	Updated Optical Characteristics, Quality Information, Timing Characteristics, and Date Code Format on Mechanical Drawing	KL
12	10/30/2023	PCB Footprint Added	KL

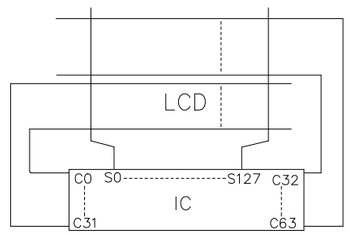
Mechanical Drawing



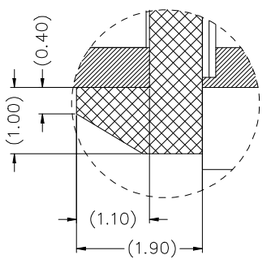




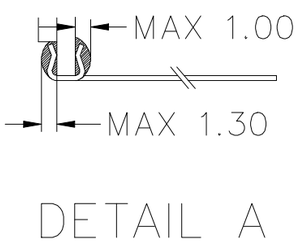




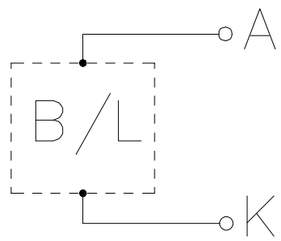
COM&SEG LAYOUT

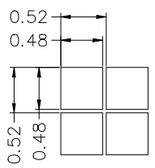


DETAIL B
SCALE: 8/1



DETAIL A





DOTS DETAIL
SCALE: 10/1

PIN	1	2	3	4	5	6	7	8	9	10	11	12	13	14
CONNECTION	CS1	/RES	A0	/WR	/RD	DB0	DB1	DB2	DB3	DB4	DB5	DB6	DB7	VDD
PIN	15	16	17	18	19	20	21	22	23	24	25	26	27	28
CONNECTION	VSS	VOUT	CAP3P	CAP1N	CAP1P	CAP2P	CAP2N	V4	V3	V2	V1	V0	C86	P/S

Product Description: 128x64 Graphic COG LCD

1. Driver IC: ST7565R
2. Driving Mode: 1/65 Duty, 1/9 Bias
3. Interface: 8-bit 6800/8080 Parallel, 4-wire SPI
4. Power Requirement: 3.0V LCD
5. Optical Features: FSTN (+), Transflective, 6:00 View, White Backlight

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

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Drawing/Part Number: NHD-C12864LZ-FSW-FBW-3V3		Revision: A
Unless otherwise specified: • Dimensions are in Millimeters • Third Angle Projection	Drawn By: K. Lewis	Approved By: K. Lewis
	Drawn Date: 08/11/2023	Approved Date: 08/11/2023

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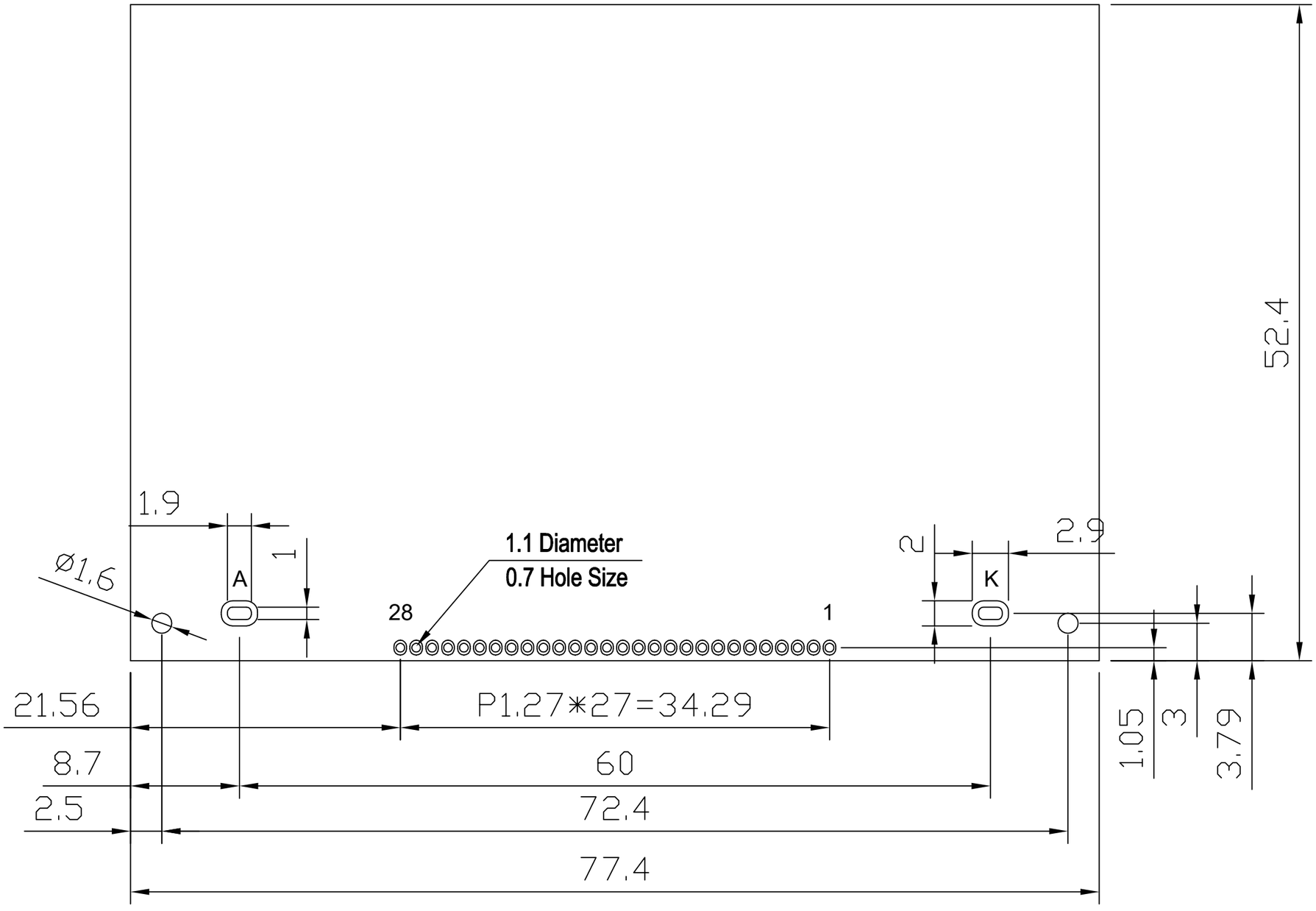
Mechanical Drawing

Recommended PCB Footprint



Applicable Displays:

1) NHD-C12864LZ-FSW-FBW-3V3
2) NHD-C12864LZ-NSW-BBW-3V3

Standard Tolerance: (Unless otherwise specified) Linear: ±0.3mm	NEWHAVEN DISPLAY INTERNATIONAL		
	Drawing/Part Number: NHD-C12864LZ_Footprint		Revision: -
Unless otherwise specified: • Dimensions are in Millimeters • Third Angle Projection	Drawn By: K. Lewis	Approved By: K. Lewis	
	Drawn Date: 10/30/2023	Approved Date: 10/30/2023	

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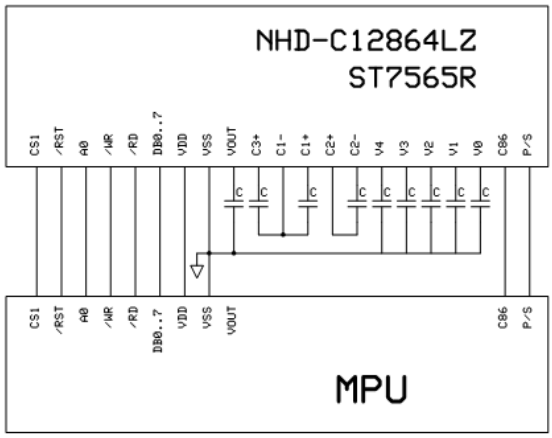
Pin Description

Pin No.	Symbol	External Connection	Function Description
1	/CS1	MPU	Active LOW chip select
2	/RES	MPU	Active LOW Reset signal
3	A0	MPU	Register select signal. 0: instruction; 1: data register
4	R/W /WR	MPU	6800 Mode: Read/Write select signal. R/W=1: Read R/W: =0: Write 8080 Mode: Active LOW Write Signal
5	E /RD	MPU	6800 Mode: Active HIGH Enable Signal 8080 Mode: Active LOW Read Signal
6	DB0	MPU	**Parallel Interface:** DB0-DB7: Bi-directional 8-bit data bus **Serial Interface:** DB0-DB5: No connect in serial mode DB6= Serial clock (SCL) DB7= Serial data input (SI)
7	DB1	MPU	
8	DB2	MPU	
9	DB3	MPU	
10	DB4	MPU	
11	DB5	MPU	
12	DB6	MPU	
13	DB7	MPU	
14	V_{DD}	Power Supply	Supply Voltage for LCD and logic (+3.0V)
15	V_{SS}	Power Supply	Ground
16	V_{OUT}	Power Supply	Connect to 1uF cap to VSS
17	CAP3+	Power Supply	Connect to 1uF cap to CAP1- (PIN-18)
18	CAP1-	Power Supply	Connect to 1uF cap to CAP3+(PIN17) and CAP1+(PIN19)
19	CAP1+	Power Supply	Connect to 1uF cap to CAP1- (PIN-18)
20	CAP2+	Power Supply	Connect to 1uF cap to CAP2- (PIN-21)
21	CAP2-	Power Supply	Connect to 1uF cap to CAP2+ (PIN-20)
22	V_4	Power Supply	1.0uF-2.2uF cap to VSS
23	V_3	Power Supply	1.0uF-2.2uF cap to VSS
24	V_2	Power Supply	1.0uF-2.2uF cap to VSS
25	V_1	Power Supply	1.0uF-2.2uF cap to VSS
26	V_0	Power Supply	1.0uF-2.2uF cap to VSS
27	C86	MPU	MPU interface Select pin. C86=H: 6800; C86=L: 8080
28	PS	MPU	Parallel/Serial select. PS= H: Parallel; PS=L: Serial

LCD connector: 1.27mm pitch pins.
Backlight connector: 1.5mm wide pins.
Recommended Breakout Board: NHD-PCB40

Wiring Diagram



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	V_{DD}	-	2.7	3.0	3.3	V
Supply Current	I_{DD}	V_{DD} = 3.0V	0.2	0.5	2.0	mA
Supply for LCD (contrast)	V_{LCD}	T_{OP} = 25°C	8.2	8.5	8.8	V
"H" Level input	V_{IH}	-	0.8 * V_{DD}	-	V_{DD}	V
"L" Level input	V_{IL}	-	V_{SS}	-	0.2 * 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_{SS}	V
LED Backlight current	I_{LED}	-	60	80	100	mA
LED Backlight voltage	V_{LED}	I_{LED} = 80mA	2.7	3.0	3.3	V

*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 ≥ 2	-	40	-	º
	Bottom	φY-		-	40	-	º
	Left	θX-		-	35	-	º
	Right	θX+		-	35	-	º
Contrast Ratio		CR	-	-	5	-	-
Response Time	Rise	T_r	T_{OP} = 25°C	-	150	-	ms
	Fall	T_f		-	110	-	ms

Controller Information

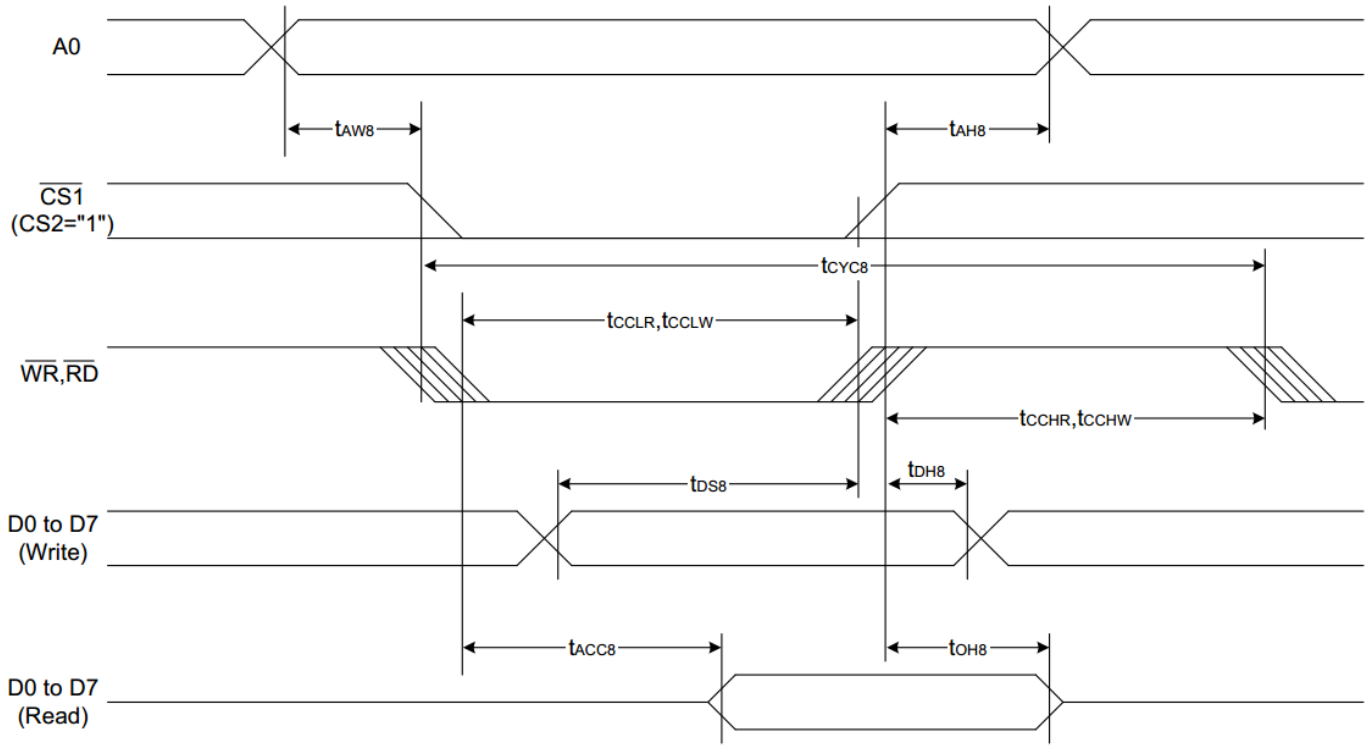
Built-in ST7565R Controller: https://support.newhavendisplay.com/hc/en-us/articles/4414899357591-ST7565R

Table of Commands

Command	Command Code										Function
	A0	/RD	/WR	D7	D6	D5	D4	D3	D2	D1	D0	
(1) Display ON/OFF	0	1	0	1	0	1	0	1	1	1	0 1	LCD display ON/OFF 0: OFF, 1: ON
(2) Display start line set	0	1	0	0	1	Display start address						Sets the display RAM display start line address
(3) Page address set	0	1	0	1	0	1	1	Page address				Sets the display RAM page address
(4) Column address set upper bit Column address set lower bit	0	1	0	0	0	0	1	Most significant column address				Sets the most significant 4 bits of the display RAM column address. Sets the least significant 4 bits of the display RAM column address.
				0	0	0	0	Least significant column address				
(5) Status read	0	0	1	Status				0	0	0	0	Reads the status data
(6) Display data write	1	1	0	Write data								Writes to the display RAM
(7) Display data read	1	0	1	Read data								Reads from the display RAM
(8) ADC select	0	1	0	1	0	1	0	0	0	0	0 1	Sets the display RAM address SEG output correspondence 0: normal, 1: reverse
(9) Display normal/ reverse	0	1	0	1	0	1	0	0	1	1	0 1	Sets the LCD display normal/ reverse 0: normal, 1: reverse
(10) Display all points ON/OFF	0	1	0	1	0	1	0	0	1	0	0 1	Display all points 0: normal display 1: all points ON
(11) LCD bias set	0	1	0	1	0	1	0	0	0	1	0 1	Sets the LCD drive voltage bias ratio 0: 1/9 bias, 1: 1/7 bias (ST7565R)
(12) Read-modify-write	0	1	0	1	1	1	0	0	0	0	0	Column address increment At write: +1 At read: 0
(13) End	0	1	0	1	1	1	0	1	1	1	0	Clear read/modify/write
(14) Reset	0	1	0	1	1	1	0	0	0	1	0	Internal reset
(15) Common output mode select	0	1	0	1	1	0	0	0 1	*	*	*	Select COM output scan direction 0: normal direction 1: reverse direction
(16) Power control set	0	1	0	0	0	1	0	1	Operating mode			Select internal power supply operating mode
(17) V_0 voltage regulator internal resistor ratio set	0	1	0	0	0	1	0	0	Resistor ratio			Select internal resistor ratio(Rb/Ra) mode
(18) Electronic volume mode set Electronic volume register set	0	1	0	1	0	0	0	0	0	0	1	Set the V_0 output voltage electronic volume register
				0	0	Electronic volume value						
(19) Sleep mode set	0	1	0	1	0	1	0	1	1	0	0 1	0: Sleep mode, 1: Normal mode
				*	*	*	*	*	*	0	0	
(20) Booster ratio set	0	1	0	1	1	1	1	1	0	0	0	select booster ratio 00: 2x,3x,4x 01: 5x 11: 6x
				0	0	0	0	0	0	step-up value		
(21) NOP	0	1	0	1	1	1	0	0	0	1	1	Command for non-operation
(22) Test	0	1	0	1	1	1	1	*	*	*	*	Command for IC test. Do not use this command

Timing Characteristics

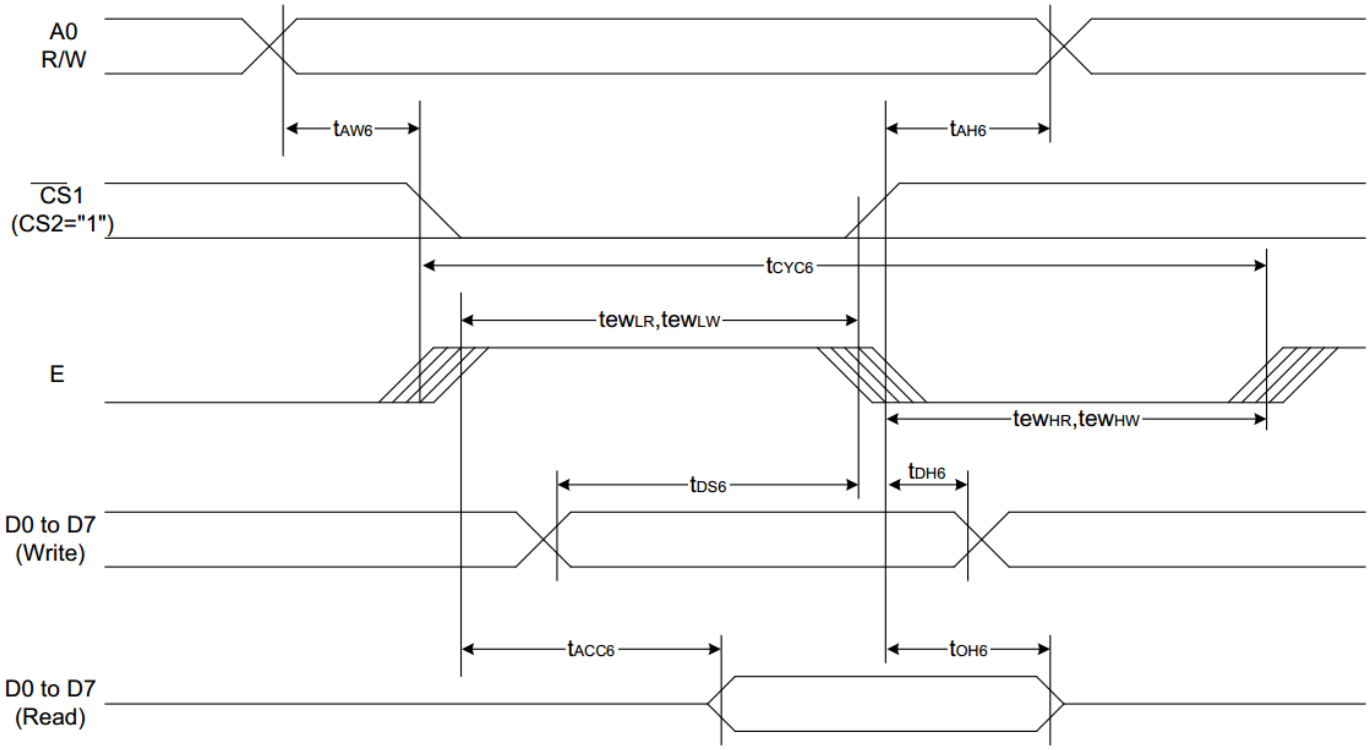
System Bus Read/Write Characteristics 1 (For the 8080 Series MPU)



(VDD = 3.3V, Ta = –30 to 85℃)

Item	Signal	Symbol	Condition	Rating		Units
				Min.	Max.	
Address hold time	A0	tAH8		0	—	Ns
Address setup time		tAW8		0	—	
System cycle time		tCYC8		240	—	
Enable L pulse width (WRITE)	WR	tCCLW		80	—	
Enable H pulse width (WRITE)		tCCHW		80	—	
Enable L pulse width (READ)	RD	tCCLR		140	—	
Enable H pulse width (READ)		tCCHR		80		
WRITE Data setup time	D0 to D7	tDS8		40	—	
WRITE Address hold time		tDH8		0	—	
READ access time		tACC8	CL = 100 pF	—	70	
READ Output disable time		tOH8	CL = 100 pF	5	50	

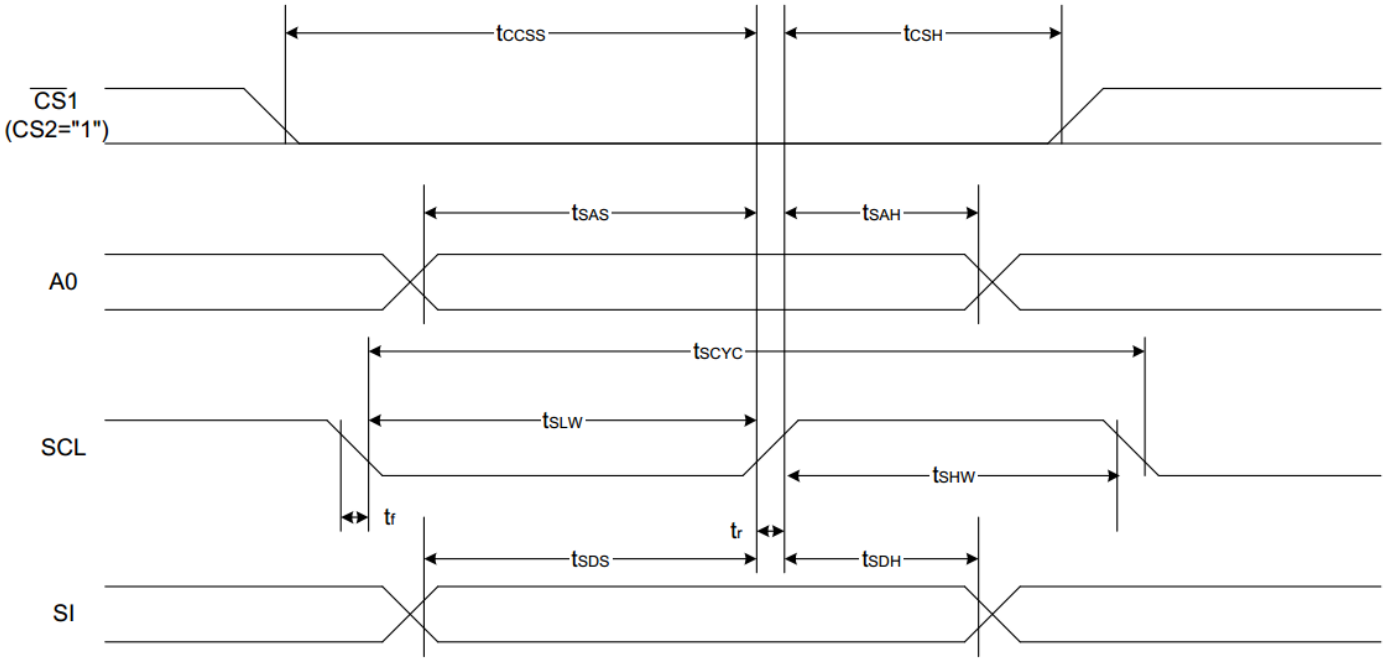
System Bus Read/Write Characteristics 2 (For the 6800 Series MPU)



(V_{DD} = 3.3V, Ta = –30 to 85℃)

Item	Signal	Symbol	Condition	Rating		Units
				Min.	Max.	
Address hold time	A0	t_{AH6}		0	—	ns
Address setup time		t_{AW6}		0	—	
System cycle time		t_{CYC6}		240	—	
Enable L pulse width (WRITE)	WR	t_{EWLW}		80	—	
Enable H pulse width (WRITE)		t_{EWHW}		80	—	
Enable L pulse width (READ)	RD	t_{EWLR}		80	—	
Enable H pulse width (READ)		t_{EWHR}		140		
WRITE Data setup time	D0 to D7	t_{DS6}		40	—	
WRITE Address hold time		t_{DH6}		0	—	
READ access time		t_{ACC6}	C_L = 100 pF	—	70	
READ Output disable time		t_{OH6}	C_L = 100 pF	5	50	

The 4-line SPI Interface



(VDD = 3.3V,Ta = –30 to 85℃)

Item	Signal	Symbol	Condition	Rating		Units
				Min.	Max.	
4-line SPI Clock Period	SCL	Tscyc		50	—	ns
SCL “H” pulse width		Tshw		25	—	
SCL “L” pulse width		TSLW		25	—	
Address setup time	A0	TSAS		20	—	
Address hold time		Tsah		10	—	
Data setup time	SI	Tsds		20	—	
Data hold time		TSDH		10	—	
CS-SCL time	CS	Tcss		20	—	
CS-SCL time		Tcsh		40	—	

Reset Timing

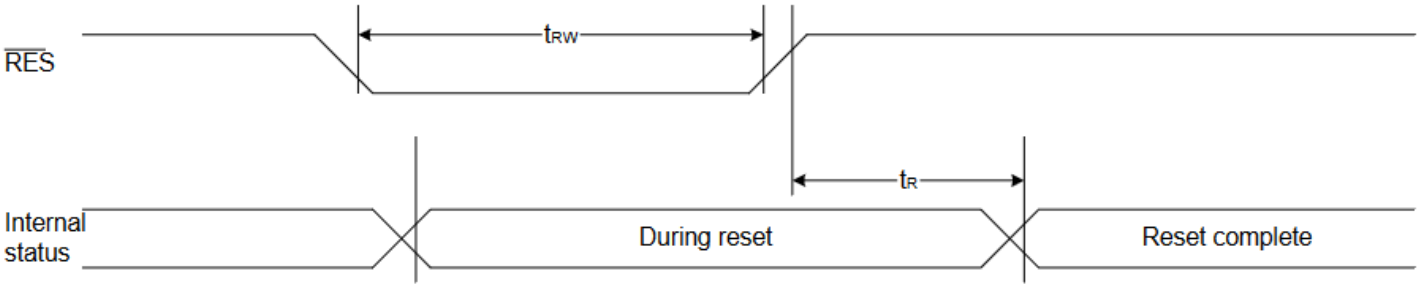


Figure 41

Table 30

(VDD = 3.3V, Ta = –30 to 85℃)

Item	Signal	Symbol	Condition	Rating			Units
				Min.	Typ.	Max.	
Reset time		tR		—	—	1.0	us
Reset "L" pulse width	/RES	tRW		1.0	—	—	us

Table 31

(VDD = 2.7V, Ta = –30 to 85℃)

Item	Signal	Symbol	Condition	Rating			Units
				Min.	Typ.	Max.	
Reset time		tR		—	—	2.0	us
Reset "L" pulse width	/RES	tRW		2.0	—	—	us

Example Initialization Program

```
void comm_out(unsigned int c)
{
        CS1 = 0;                //Active Low
        AO = 0;                 //LOW = instruction
        delay(1);
        WRT = 0;                // /WR in 8080 mode; R/W in 6800 mode
        P1 = c;
        delay(1);
        WRT = 1;                // /WR in 8080 mode; R/W in 6800 mode
        CS1 = 1;                //inactive
        delay(5);
}

void data_out(unsigned int d)
{
        CS1 = 0;                //Active Low
        AO = 1;                 //High = Data
        delay(1);
        WRT = 0;
        //RDD = 1;
        P1 = d;
        delay(1);
        WRT = 1;
        CS1 = 1;                //inactive

}

void init()
{
        RDD = 1;                // /RD in 8080 mode; E in 6800 mode
        WRT = 1;                // /WR in 8080 mode; R/W in 6800 mode
        CS1 = 0;
        RST = 1;                // /RST in 8080 mode; /RES in 6800 mode
        RST = 0;                // /RST in 8080 mode; /RES in 6800 mode
        delay(2);
        RST = 1;                // /RST in 8080 mode; /RES in 6800 mode
        delay(2);
        comm_out(0xA2);         //added 1/9 bias

        comm_out(0xA0);         //ADC segment driver direction (A0=Normal)
        comm_out(0xC8);         //added
        comm_out(0xC0);         //COM output scan direction (C0= Normal)
        comm_out(0x40);         //Operating Mode
        delay(0);
        comm_out(0x25);         //resistor ratio
        delay(0);

        comm_out(0x81);         //electronic volume mode set
        delay(0);
        comm_out(0x19);         //electronic volume register set
        delay(0);
        comm_out(0x2F);         //power control set
        delay(0);
        comm_out(0xAF);         //display ON/OFF - set to ON
```

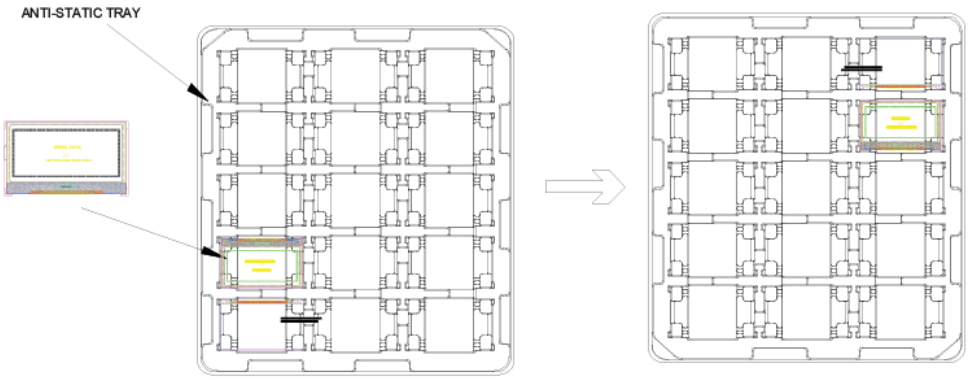
Packing Procedure

1. Packing Materials

NO.	Item	Dimensions (LxWxH) (mm)	Quantity
1	Tray	366x296x21.1	15
2	Box	382x310x165	105
3	Carton	400x321x363	210

2. Packing Method

A. Place display on the tray & Rotate Stacked trays by 180°



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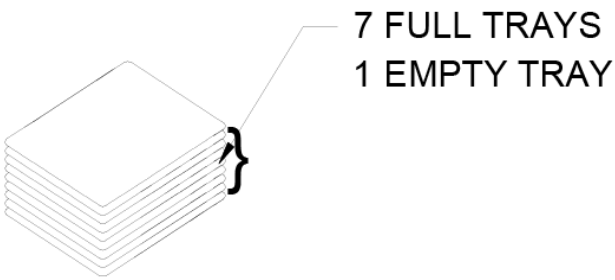
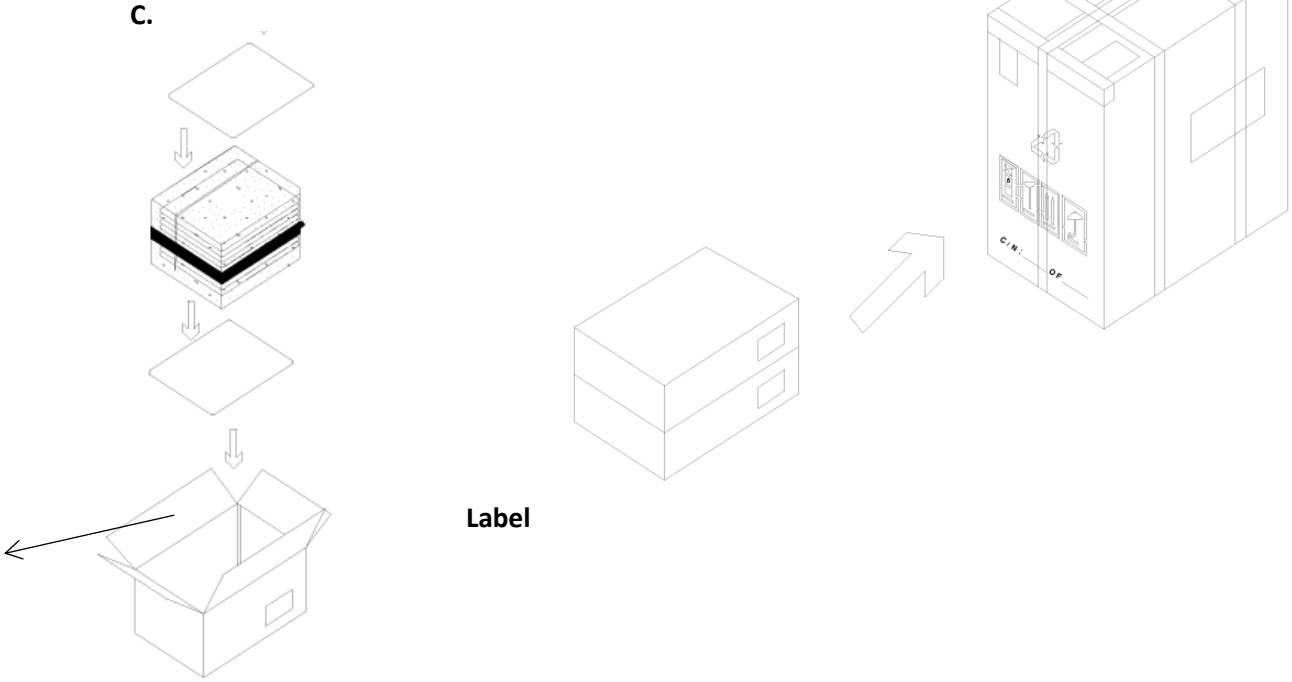


C.



Label

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 , 96hrs	2
Low Temperature storage	Endurance test applying the low storage temperature for a long time.	-30°C , 96hrs	1,2
High Temperature Operation	Endurance test applying the electric stress (voltage & current) and the high thermal stress for a long time.	+70°C , 96hrs	2
Low Temperature Operation	Endurance test applying the electric stress (voltage & current) and the low thermal stress for a long time.	-20°C , 96hrs	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.	+40°C , 90% RH , 96hrs	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, 5min -> 80°C, 30min = 1 cycle For 10 cycles	
Vibration test	Endurance test applying vibration to simulate transportation and use.	Frequency: 250 times/minute Swing Distance: 1 inch Direction: Stochastic For 45 min	3
Static electricity test	Endurance test applying electric static discharge.	AIR:± 8KV;Touch Glass± 4KV 5 times	

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.