NEWHAVEN DISPLAY INTERNATIONAL

Product Specification

NHD-C160100DiZ-FSW-FBW

COG (Chip-On-Glass) Liquid Crystal Display Module

NHD-	Newhaven Display
C160100-	160 x 100 Pixels
DiZ-	Model
F-	Transflective
SW-	Side white LED Backlight
F-	FSTN (+)
B-	6:00 Optimal View
W-	Wide Temperature

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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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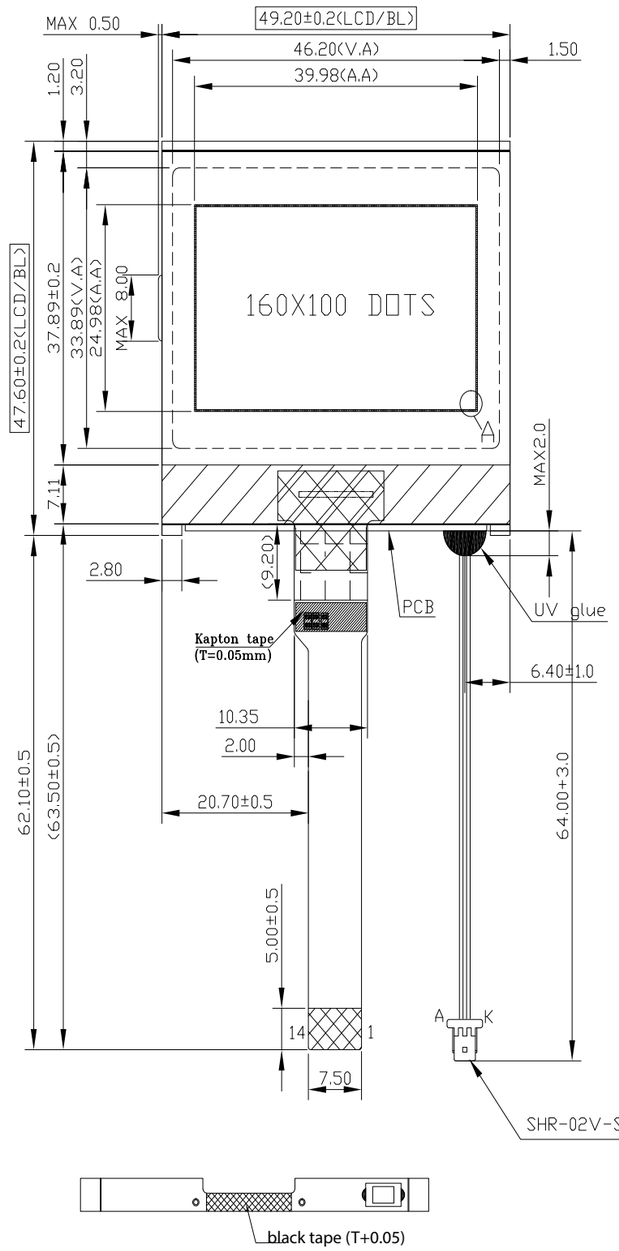
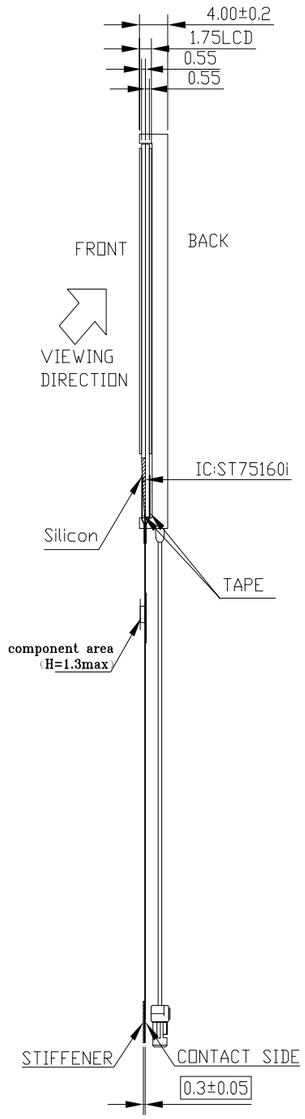
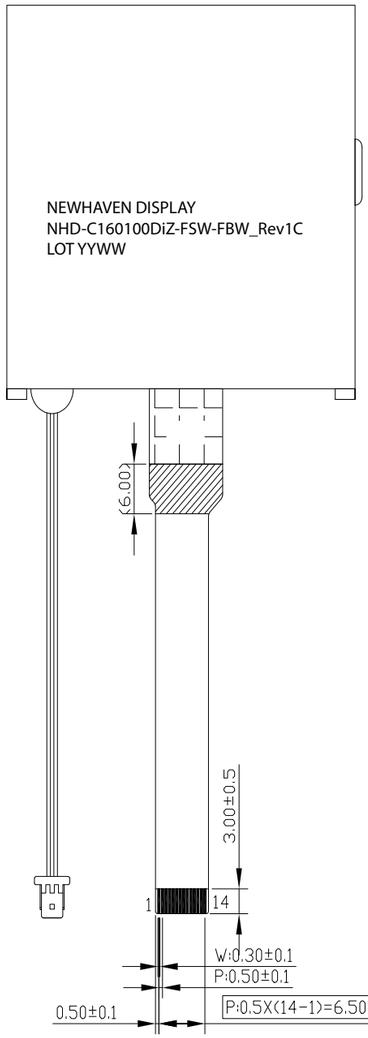
Document Revision History

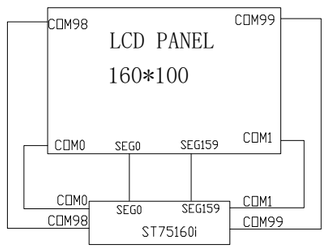
Revision	Date	Description	Changed By
0	01/06/2008	Initial Release	-
1	09/18/2009	User Guide Reformat	BE
2	10/14/2009	Updated Electrical Characteristic	MC
3	11/09/2009	Slave Address Updated	BE
4	11/17/2009	Slave Address Updated	MC
5	11/20/2009	Updated Backlight Supply Current Max / Updated Table of Commands	MC
6	12/14/2010	Updated Backlight Cable Length	CL
7	08/25/2016	Mechanical Drawing, Electrical & Optical Char. Updated	SB
8	03/24/2017	Mechanical Drawing Updated	SB
9	05/25/2017	Electrical Characteristics Updated	TM
10	05/10/2018	Module Redesign	SB
11	09/11/2019	Backlight Characteristics and Supply Current Updated	SB
12	04/15/2020	Supply Voltage Updated	SB
13	04/21/2023	Date Code Format Updated on Mechanical Drawing	KL
14	04/18/2024	Updated Controller IC from ST7528i to ST75160i Part Revision Upgraded to Rev1C	KL
15	06/27/2024	Updated Electrical Characteristics and Mechanical Drawing	KL
16	10/10/2024	Added Wiring Diagram/Example Initialization Program	KL

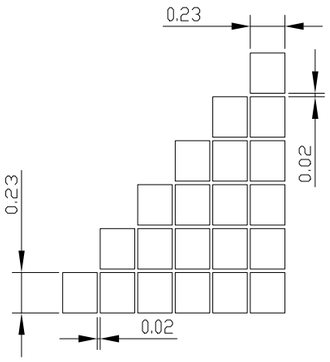
Mechanical Drawing



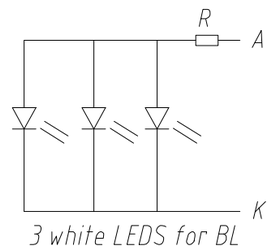








Detail A 20:1



3 white LEDS for BL

PIN	SYMBOL
1	NC
2	RST
3	NC
4	SCL
5	SDA
6	VDD
7	VSS
8	NC
9	NC
10	NC
11	NC
12	NC
13	NC
14	NC

Product Description: 160x100 Graphic LCD

1. Driver IC: ST75160i
2. Driving Mode: 1/100 Duty, 1/11 Bias
3. Interface: I²C
4. Power Requirement: 3.3V LCD
5. Optical Features: FSTN (+), Transflective, 6:00 View, White Backlight
6. Recommended FFC Connector: 14pin 0.5mm pitch

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

NEWHAVEN DISPLAY INTERNATIONAL

Drawing/Part Number: NHD-C160100DiZ-FSW-FBW
Revision: 1C

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

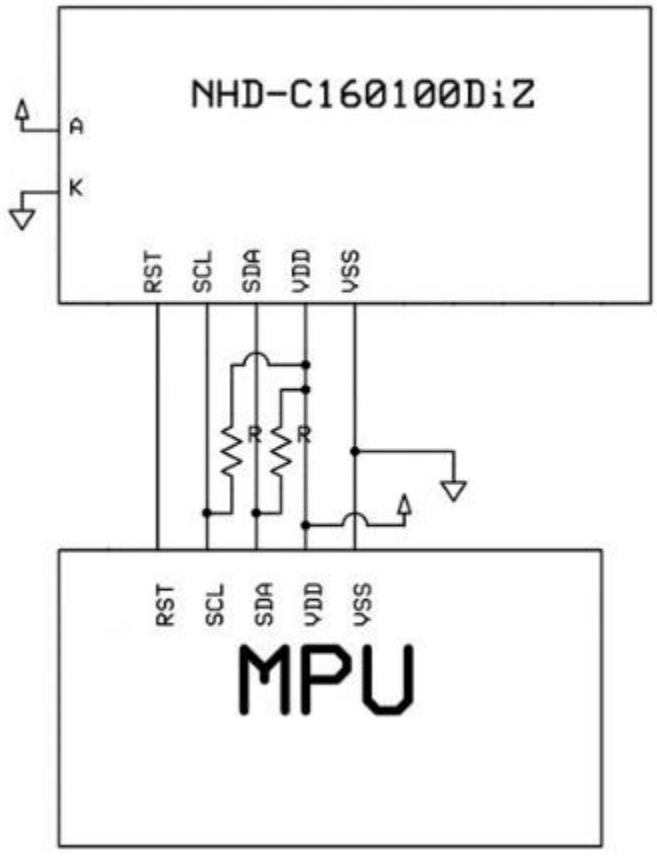
Drawn By: K. Lewis
Approved By: K. Lewis
Drawn Date: 06/27/2024
Approved Date: 06/27/2024

Pin Description

Pin No.	Symbol	External Connection	Function Description
1	NC	-	No Connect
2	RST	MPU	Active Low Reset signal
3	NC	-	No Connect
4	SCL	MPU	Serial Clock input (requires pull-up)
5	SDA	MPU	Serial Data input (requires pull-up)
6	V_{DD}	Power Supply	Supply Voltage for LCD and logic (3.3V)
7	V_{SS}	Power Supply	Ground
8	NC	-	No Connect
9	NC	-	No Connect
10	NC	-	No Connect
11	NC	-	No Connect
12	NC	-	No Connect
13	NC	-	No Connect
14	NC	-	No Connect

Recommended LCD connector: 0.5mm pitch pins. Molex p/n: 52892-1495
Backlight connector: SHR-02V-S-B **Mates with**: SM02B-SRSS-TB

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	-40	-	+80	°C
Supply Voltage	V_{DD}	-	2.6	3.3	3.6	V
Supply Current	I_{DD}	V_{DD}=3.3V	0.5	1.1	2	mA
Supply for LCD (contrast)	V_{LCD}	T_{OP}=25°C	11.3	11.6	11.9	V
"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 Voltage	V_{LED}	-	2.8	3.0	3.2	V
Backlight Supply current	I_{LED}	V_{LED} = 3.0V	30	50	70	mA

Optical Characteristics

Item		Symbol	Condition	Min.	Typ.	Max.	Unit
Optimal Viewing Angles	Top	φY+	CR ≥ 2	-	15	-	º
	Bottom	φY-		-	40	-	º
	Left	θX-		-	30	-	º
	Right	θX+		-	30	-	º
Contrast Ratio		CR	-	2	4	-	-
Response Time	Rise	T_R	T_{OP} = 25°C	-	50	200	ms
	Fall	T_F		-	105	250	ms

Controller Information

Built-in ST75160i Controller at: https://support.newhavendisplay.com/hc/en-us/articles/22405075978007-ST75160

I²C Interface:

I2C interface requires 2 lines, Serial Data and Serial Clock. Both lines must be connected to the positive supply via a pull-up resistor. Data transfer may be initiated only when the bus is not busy.

Bit transfer:

One data bit is transferred during each clock pulse. The data on the SDA line must remain stable during the HIGH period of the clock pulse, changes in the data line at this time will be interpreted as a control signal.

Start and Stop conditions:

Both data and clock lines remain HIGH when the bus is not busy. A HIGH-to-LOW transition of the data line while the clock is HIGH is define as the START condition. A LOW-to-HIGH transition of the data line while the clock is HIGH is defined as the STOP condition.

Acknowledge:

Each byte of eight bits is followed by an acknowledge bit. The ACK bit is a HIGH signal put on the bus by the transmitter, during which time the master generates an extra ACK related clock pulse. The LCD generates an ACK after the reception of each byte. The LCD will pull-down the SDA line during the ACK clock pulse, so that the SDA line is stable LOW during the HIGH period of the ACK clock pulse.

Slave Address = 0x3F

Table of Commands

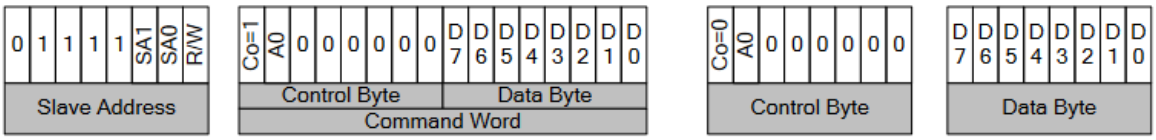
INSTRUCTION	A0	R/W	COMMAND BYTE								DESCRIPTION
			D7	D6	D5	D4	D3	D2	D1	D0	
1.Extension Command	0	0	0	0	1	1	EXT1	0	0	EXT0	Set extension instruction
Ext[1:0]=0,0 (Extension Command 1)											
2.Display ON/OFF	0	0	1	0	1	0	1	1	1	DSP	Set LCD display DSP=0: Display off DSP=1: Display on
3.Inverse Display	0	0	1	0	1	0	0	1	1	INV	Set inverse display INV=0: Normal display INV=1: Inverse display
4.All Pixel ON/OFF	0	0	0	0	1	0	0	0	1	AP	Set all pixel on mode AP=0: All pixel off mode AP=1: All pixel on mode
5.Display Control	0	0	1	1	0	0	1	0	1	0	Set display control CLD :Set CL dividing ratio LF[4:0] : Set N-line inversion counter FI : Set the inversion type of frame at the end of common scan cycle
	1	0	0	0	0	0	0	CLD	0	0	
	1	0	1	0	0	1	1	1	1	1	
	1	0	0	0	LF4	FI	LF3	LF2	LF1	LF0	
6.Power Save	0	0	1	0	0	1	0	1	0	SLP	Set power save mode SLP=0: Sleep out mode SLP=1: Sleep in mode
7.Set Page Address	0	0	0	1	1	1	0	1	0	1	Set Page Address Starting Page address: 00h≦XS≦27h Ending Page address: XS≦XE≦27h
	1	0	XS7	XS6	XS5	XS4	XS3	XS2	XS1	XS0	
	1	0	XE7	XE6	XE5	XE4	XE3	XE2	XE1	XE0	
8.Set Column Address	0	0	0	0	0	1	0	1	0	1	Set Column Address Starting Column address: 00h≦YS≦9Fh Ending Column address: YS≦YE≦9Fh
	1	0	YS7	YS6	YS5	YS4	YS3	YS2	YS1	YS0	
	1	0	YE7	YE6	YE5	YE4	YE3	YE2	YE1	YE0	
9.Data Scan Direction	0	0	1	0	1	1	1	1	0	0	Set normal/ inverse display of address and address scan direction
	1	0	0	0	0	0	0	C/L	MX	0	
10.Write Data	0	0	0	1	0	1	1	1	0	0	Write data to DDRAM
	1	0	D7	D6	D5	D4	D3	D2	D1	D0	
11.Read Data	0	0	0	1	0	1	1	1	0	1	Read data from DDRAM
	1	1	D7	D6	D5	D4	D3	D2	D1	D0	
12.Partial In	0	0	1	0	1	0	1	0	0	0	Set partial area Starting partial display address: 00h≦PTS≦9Fh Ending partial display address: 00h≦PTE≦9Fh
	1	0	PTS7	PTS6	PTS5	PTS4	PTS3	PTS2	PTS1	PTS0	
	1	0	PTE7	PTE6	PTE5	PTE4	PTE3	PTE2	PTE1	PTE0	
13.Partial Out	0	0	1	0	1	0	1	0	0	1	Exit the partial mode

INSTRUCTION	A0	R/W	COMMAND BYTE								DESCRIPTION
			D7	D6	D5	D4	D3	D2	D1	D0	
14.Read/Modify/Write In	0	0	1	1	1	0	0	0	0	0	Enable read modify write
15.Read/Modify/Write Out	0	0	1	1	1	0	1	1	1	0	Disable read modify write
16.Scroll Area	0	0	1	0	1	0	1	0	1	0	Set scroll area
	1	0	TL7	TL6	TL5	TL4	TL3	TL2	TL1	TL0	
	1	0	BL7	BL6	BL5	BL4	BL3	BL2	BL1	BL0	
	1	0	NSL7	NSL6	NSL5	NSL4	NSL3	NSL2	NSL1	NSL0	
	1	0	0	0	0	0	0	0	SCM1	SCM0	
17.Set Start Line	0	0	1	0	1	0	1	0	1	1	Set scroll start address 00h≦SL≦9Fh
	1	0	SL7	SL6	SL5	SL4	SL3	SL2	SL1	SL0	
18.OSC ON	0	0	1	1	0	1	0	0	0	1	Turn on the internal oscillator
19.OSC OFF	0	0	1	1	0	1	0	0	1	0	Turn off the internal oscillator
20.Power Control	0	0	0	0	1	0	0	0	0	0	Power circuit operation VB=0: OFF, VB=1: ON VF=0: OFF, VF=1: ON VR=0: OFF, VR=1: ON
	1	0	0	0	0	0	VB	0	VF	VR	
21.Set Vop	0	0	1	0	0	0	0	0	0	1	Set Vop
	1	0	0	0	VPR5	VPR4	VPR3	VPR2	VPR1	VPR0	
	1	0	0	0	0	0	0	VPR8	VPR7	VPR6	
22.Vop Control	0	0	1	1	0	1	0	1	1	VOL	Control Vop VOL=0: Vop increase one step VOL=1: Vop decrease one step
23.Read Register Mode	0	0	0	1	1	1	1	1	0	REG	Set read register mode REG=0: read the register value of VPR[5:0] REG=1: read the register value of VPR[8:6]
24.Nop	0	0	0	0	1	0	0	1	0	1	No operation
25.Read Status	0	1	D7	D6	D5	D4	D3	D2	D1	D0	Read status byte
26.Data Format Select	0	0	0	0	0	0	1	DO	0	0	DO=0; LSB on bottom (Default) DO=1; LSB on top
27. Display Mode	0	0	1	1	1	1	0	0	0	0	Set display mode DM=0 :Mono(Default) DM=1 :4Gray Scale Mode
	1	0	0	0	0	1	0	0	0	DM	
28.ICON Control	0	0	0	1	1	1	0	1	1	ICON	Enable/Disable ICON ICON=1 ; Enable ICON=0 ; Disable
Ext[1:0]=0,1 (Extension Command 2)											
29.Analog Circuit Set	0	0	0	0	1	1	0	0	1	0	Set analog set BE[1:0]: Booster efficiency set BS[2:0]: Set bias ratio
	1	0	0	0	0	0	0	0	0	0	
	1	0	0	0	0	0	0	0	BE1	BE0	
	1	0	0	0	0	0	0	BS2	BS1	BS0	

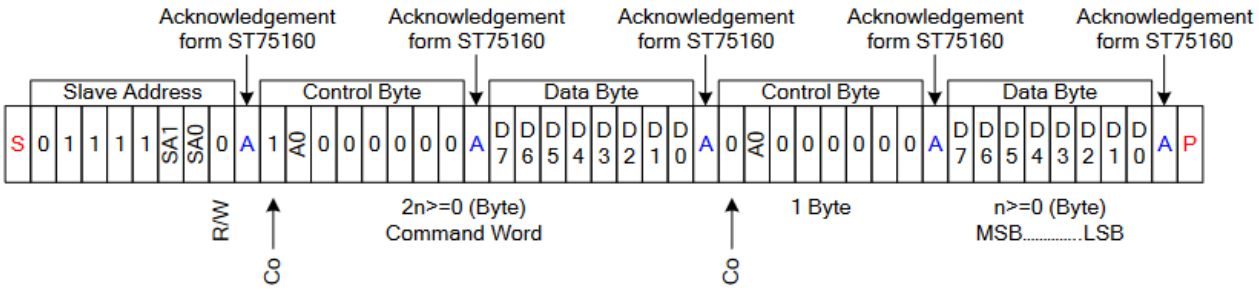
INSTRUCTION	A0	R/W	COMMAND BYTE								DESCRIPTION
			D7	D6	D5	D4	D3	D2	D1	D0	
30.Booster Level	0	0	0	1	0	1	0	0	0	1	Set booster level
	1	0	1	1	1	1	1	0	1	BST	
31. Driving Select	0	0	0	1	0	0	0	0	0	DS	Power type DS=0: Internal (Default) DS=1 :External
32.High Power Mode	0	0	0	1	0	0	1	0	0	HPM	Set high power mode HPM=0 ; Normal Mode HPM =1 ; High Power Mode
33.Auto Read Control	0	0	1	1	0	1	0	1	1	1	Set auto-read instruction XARD=0: Enable auto read XARD=1: Disable auto read
	1	0	1	0	0	XARD	1	1	1	1	
34.OTP WR/RD Control	0	0	1	1	1	0	0	0	0	0	OTP WR/RD control WR/RD=0: Enable OTP read WR/RD=1: Enable OTP write
	1	0	0	0	WR/ RD	0	0	0	0	0	
35.OTP Control Out	0	0	1	1	1	0	0	0	0	1	OTP control out
36.OTP Write	0	0	1	1	1	0	0	0	1	0	OTP write
37.OTP Read	0	0	1	1	1	0	0	0	1	1	OTP read
38.OTP Selection Control	0	0	1	1	1	0	0	1	0	0	OTP selection control Ctrl=0: Disable OTP Ctrl=1: Enable OTP
	1	0	1	Ctrl	0	1	1	0	0	1	
39.OTP Programming Setting	0	0	1	1	1	0	0	1	0	1	OTP programming setting
	1	0	0	0	0	0	1	1	1	1	
40.Frame Rate	0	0	1	1	1	1	0	0	0	0	Frame rate setting in different temperature range
	1	0	0	0	0	FRA4	FRA3	FRA2	FRA1	FRA0	
	1	0	0	0	0	FRB4	FRB3	FRB2	FRB1	FRB0	
	1	0	0	0	0	FRC4	FRC3	FRC2	FRC1	FRC0	
	1	0	0	0	0	FRD4	FRD3	FRD2	FRD1	FRD0	
41.Temperature Range	0	0	1	1	1	1	0	0	1	0	Temperature range setting
	1	0	0	TA6	TA5	TA4	TA3	TA2	TA1	TA0	
	1	0	0	TB6	TB5	TB4	TB3	TB2	TB1	TB0	
	1	0	0	TC6	TC5	TC4	TC3	TC2	TC1	TC0	
42.Temperature Gradient Compensation	0	0	1	1	1	1	0	1	0	0	Set temperature gradient compensation coefficient
	1	0	MT13	MT12	MT11	MT10	MT03	MT02	MT01	MT00	
	1	0	MT33	MT32	MT31	MT30	MT23	MT22	MT21	MT20	
	1	0	MT53	MT52	MT51	MT50	MT43	MT42	MT41	MT40	
	1	0	MT73	MT72	MT71	MT70	MT63	MT62	MT61	MT60	
	1	0	MT93	MT92	MT91	MT90	MT83	MT82	MT81	MT80	
	1	0	MTB3	MTB2	MTB1	MTB0	MTA3	MTA2	MTA1	MTA0	
	1	0	MTD3	MTD2	MTD1	MTD0	MTC3	MTC2	MTC1	MTC0	
	1	0	MTF3	MTF2	MTF1	MTF0	MTE3	MTE2	MTE1	MTE0	
Ext[1:0]=1,0(Extension Command 3)											
43.Set ID	0	0	1	1	0	1	0	1	0	1	Set ID
	1	0	ID7	ID6	ID5	ID4	ID3	ID2	ID1	ID0	

INSTRUCTION	A0	R/W	COMMAND BYTE								DESCRIPTION
			D7	D6	D5	D4	D3	D2	D1	D0	
44 Read ID	0	0	0	1	1	1	1	1	1	RID	Read ID RID=1 ; Enable RID=0 ; Disable
	0	1	D7	D6	D5	D4	D3	D2	D1	D0	

Timing Characteristics

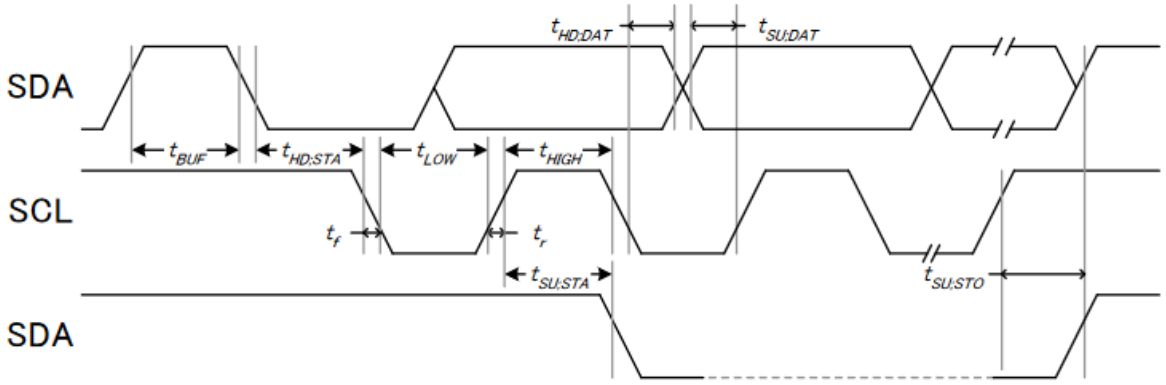


Write Mode (R/W="0")



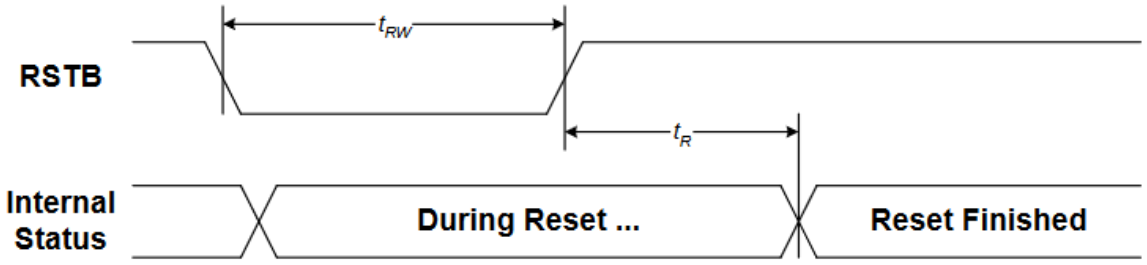
Co	0	Last control byte. Only a stream of data bytes is allowed to follow. This stream may only be terminated by a STOP or RE-START condition.
	1	Another control byte will follow the data byte.

Serial Interface



Item	Signal	Symbol	Condition	Rating		Unit
				Min.	Max.	
SCL clock frequency	SCL	fSCL		-	400	KHZ
SCL clock low period		tLOW		1.3	-	ns
SCL clock high period		tHIGH		0.6	-	
Data set-up time	SDA	tSU;Data		0.1	-	
Data hold time		tHD;Data		0	0.9	
Setup time for a repeated START condition	SDA	tSU;STA		0.6	-	
Start condition hold time		tHD;STA		0.6	-	
Setup time for STOP condition		tSU;STO		0.6	-	
Bus free time between a STOP and START		tBUF		0.1	-	

14.5 Reset Timing



VDD1 = 1.8~3.3V, Ta = 25°C

Item	Symbol	Condition	Min.	Max.	Unit
Reset time	tR		—	1	ms
Reset “L” pulse width	tRW		1	—	us

Example Initialization Program

```
void init_LCD() {
 command(0x31);  //Extension Command 2
 command(0xD7);  //Disable Auto Read
 data(0x9F);
 command(0xE0);  //Enable OTP read (One-Time Programmable (OTP) ROM)
 data(0x00);
 delay(10);
 command(0xE3);  //OTP Up-Load
 delay(20);
 command(0xE1);  //OTP Control Out
 command(0x30);  //Extension Command 1
 command(0x94);  //Sleep Out
 command(0xAE);  //Display OFF
 delay(50);
 command(0x20);  //Power Control
 data(0x0B);     //VB, VR, VF All on
 delay(100);
 command(0x81);  //Set Vop = 11.6V
 data(0x08);
 data(0x03);
 command(0x31);  //Extension Command 2
 command(0x20);  //Set Gray Scale Level
 data(0x00);
 data(0x00);
 data(0x00);
 data(0x17);     //Light Gray Level Setting
 data(0x17);     //Light Gray Level Setting
 data(0x17);     //Light Gray Level Setting
 data(0x00);
 data(0x00);
 data(0x1D);     //Dark Gray Level Setting
 data(0x00);
 data(0x00);
 data(0x1D);     //Dark Gray Level Setting
 data(0x1D);     //Dark Gray Level Setting
 data(0x1D);     //Dark Gray Level Setting
 data(0x00);
 data(0x00);
 command(0x32);  //Analog Circuit Set
 data(0x00);
 data(0x01);     //Booster Efficiency = Level 1 (default)
 data(0x03);     //Bias=1/11
 command(0x51);  //Booster Level x10 (default)
 data(0xFB);
 command(0x30);  //Extension Command 1
 command(0xF0);  //Display Mode
```

```
  data(0x10);    //4Gray Mode 0x11 / monochrome 0x10
  command(0xCA);  //Display Control
  data(0x00);    //CL Dividing Ratio Not Divide
  data(0x63);    //Duty Set 160 Duty
  data(0x00);    //Frame Inversion
  command(0xBC);  //Data Scan Direction
  data(0x00);
  command(0xA6);  //Normal Display
  command(0x31);  //Extension Command 2
  command(0x40);  //Internal Power Supply (default)
  command(0x30);  //Extension Command 1
  command(0x77);  //Enable ICON RAM
  command(0x15);  //Column Address Setting
  data(0x00);    //SEG0 -> SEG159
  data(0x9F);
  command(0x76);  //Disable ICON RAM
  command(0x30);  //Extension Command 1
  command(0x75);  //Row Address Setting
  data(0x00);    //COM0 -> COM100
  data(0x18);
  command(0xAF);  //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 , 96hrs	2
Low Temperature storage	Endurance test applying the low storage temperature for a long time.	-40°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.	60°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.	25°C -> 70°C 1hr -> 25°C 1hr -> -20°C -> -20°C 1hr -> 25°C 1hr = 1 cycle For 10 cycles	
Vibration test	Endurance test applying vibration to simulate transportation and use.	10-55Hz Max. Acceleration: 5G X.Y.X. each direction For 10 minutes	3
Static electricity test	Endurance test applying electric static discharge.	VS=800V, RS=1.5kΩ, CS=100pF One time	

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.