Noritake itron

RoHS 2002/95/EC

Vacuum Fluorescent Display Module Specification

Model: GU128X32-800B

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This product complies with RoHS Directive 2002/95/EC

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1. General Description

1.1 Construction: A 128X32 dot BD-VFD single board display module consisting of an 8 bit micro-computer, and a DC/DC converter.

1.2 Features: Simultaneous display of graphic.
Flexible Display and Editing Functions.
Compact design due to the application of a BD-VFD tube.

1.3 Dimensions: See attached drawings.

2. Absolute Maximum Ratings

Parameter	Symbol	Min.	Typ.	Max.	Unit	Condition
Logic Input Voltage	VI	-0.5	—	Vcc +0.3	V	—
Power Supply Voltage	Vcc	0	—	6.5	VDC	—

3. Electrical Characteristics

Measurement Conditions: 25°C / Vcc=5.0V

Parameter		Symbol	Min.	Typ.	Max.	Unit	Condition
Logic Input Voltage	"H"	VIH	4.0	—	—	VDC	IIH= 2 μA
	"L"	VIL	—	—	1.0		IIL= - 600 μA
Logic Output Voltage	"H"	VOH	4.7	—	—	VDC	IOH= - 300 μA
	"L"	VOL	—	—	0.3		IOL= 300 μA
Reset Input Voltage	"H"	VRH	4.0	—	—	VDC	IRH= 5 μA
	"L"	VRL	—	—	0.6	VDC	IRL= - 600 μA
Power Supply Voltage		Vcc	4.75	5.00	5.25	VDC	—
Power Supply Current		Icc	—	450	600	mA	VCC=+5V, All dots ON
			—	350	450		VCC=+5V, All dots OFF

Notes:

The rise time of **Vcc** should not exceed **100 ms**.

Icc may peak at power up may be more than twice the normal operating current

4. Optical Specifications

Number of dots: 4096 (128X32)
Display area: 83.05 mm x 20.65 mm (X x Y)
Dot size: 0.5 mm x 0.5 mm (X x Y)
Dot pitch: 0.65 mm x 0.65 mm (X x Y)
Luminance: 350cd/m^2 (Min.)
Color of illumination: Green (Blue Green)

5. Environmental Specifications

Operating temperature: -40 to +85°C
Storage temperature: -40 to +85°C
Storage humidity: 20 to 80 % R.H(Non Condensation)
Vibration: 10-55-10Hz, all amplitude 1mm, 30Min., X-Y-Z (Non operating)
Shock: 539m/s^2 10mS (Non operating)

6. Description of Bus and Signals

This module has serial and 2 types of parallel interface.
Type of interface can be selected by jumper settings. Refer to 11 on page # 18 for details.

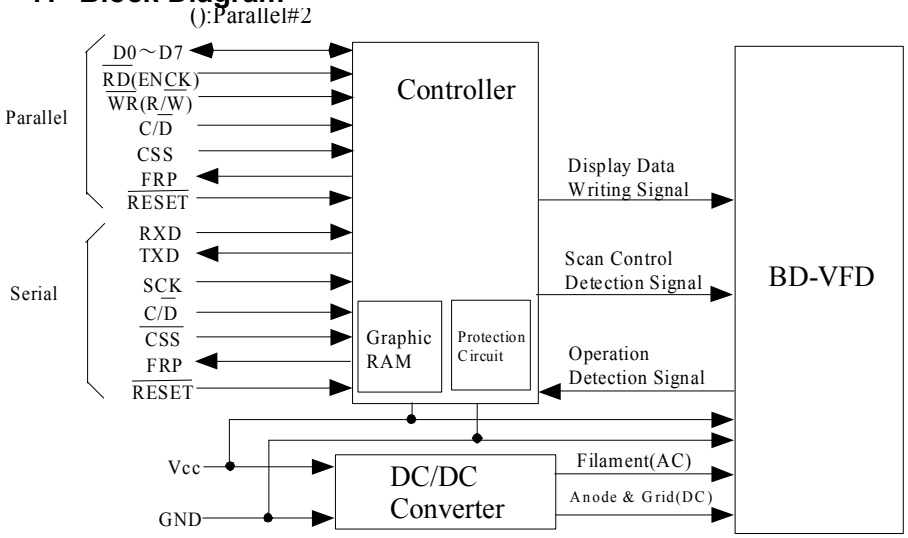
6.1 Parallel Interface

Data Line	Function
D0 ～ D7	Data Bus (Input / Output)
$\overline{WR}$ ($R/\overline{W}$)	Parallel #1: $\overline{\text{Write Signal}}$, Parallel #2: $R/\overline{W}$ (Input)
$\overline{RD}$ (ENCK)	Parallel #1: $\overline{\text{Read Signal}}$, Parallel #2: ENCK (Input)
$\overline{CSS}$	Chip Select (Input)
$\overline{C/D}$	Command / Data Select Signal (Input) $C/\overline{D}$ = "1" ⋯ Command $C/\overline{D}$ = "0" ⋯ Data
FRP	**Fr**ame **P**ulse Signal (**O**utput)
$\overline{RESET}$	$\overline{RESET}$="0"⋯ Reset (Input)
Vcc	Power Supply
GND	Ground

6.2 Serial Interface

Data Line	Function
RXD	Serial Input
TXD	Serial Output
SCK	Clock (Input)
$\overline{CSS}$	Chip Select (Input)
$\overline{C/D}$	Command / Data Select Signal (Input) $C/\overline{D}$ = "1" ⋯ Command $C/\overline{D}$ = "0" ⋯ Data
FRP	Frame Pulse Signal (Output)
$\overline{RESET}$	$\overline{RESET}$="0"⋯ Reset (Input) Active Low
Vcc	Power Supply
GND	Ground

7. Block Diagram

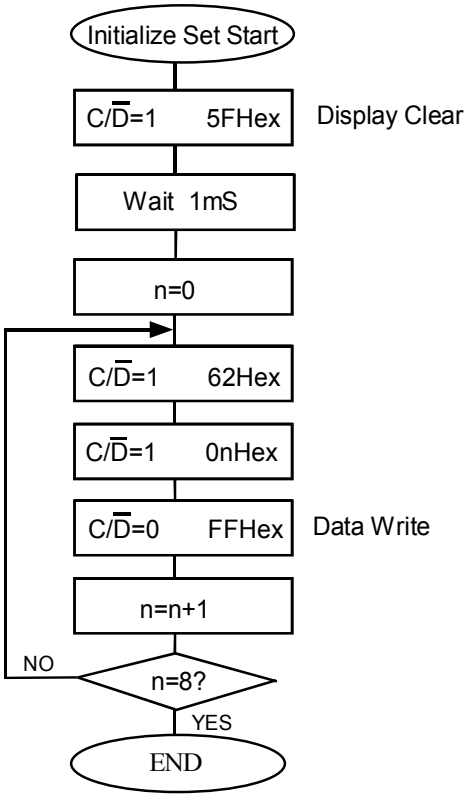


8. Display Screen and Initialize Set

The Display screen consists of 4,096 dots arranged as 128 by 32 dots. It is divided into 32 display area blocks of 16 by 8 dots each. Each display area block can be assigned to GRAM (Graphic mode) or DDRAM (Character mode) by the Display Area Set command. (9.5 Page #10)

But, this is the version which has no Font ROM. Therefore, DDRAM is not available, all of display area block must be assigned to GRAM as the initialize setting, and this must be done when the module is powered up and also every time the reset is applied, because all display area blocks are set to DDRAM area as default setting.

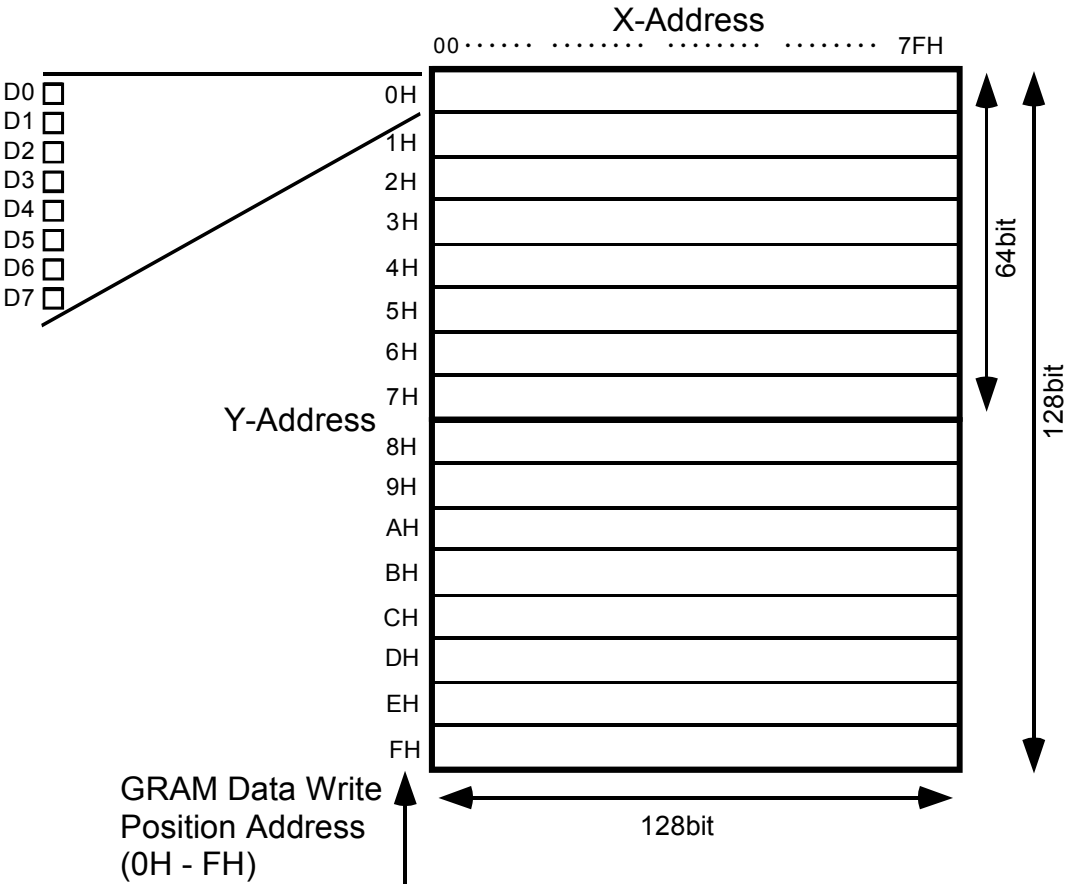
Initialize sequence is as follows;



8.1 Graphic Display (GRAM)

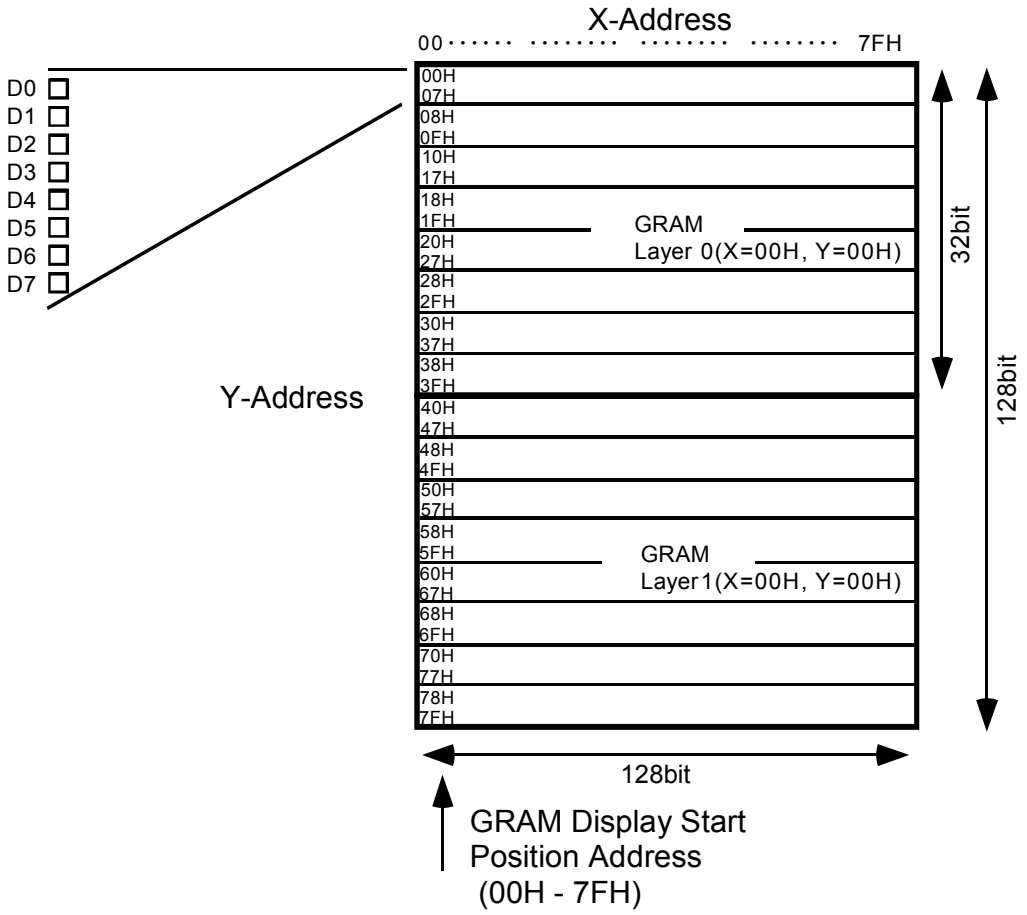
GRAM consists of 16,384 bits arranged in 128 by 128 bit blocks with access is structured as 8 bits of vertical data. The detail of GRAM is as follows:

GRAM Data Write Position Address



8.1 Cont'd

GRAM Display Start Position Address



This module has 2 layers - Layer 0 and Layer 1. Each layer in this display consists of 128 by 64 dots. Display merging using these 2 layers can be done with the Display ON/OFF command. Refer to 9.2 on page # 8 for details.

Layer 0 has an area of 128x64 dots that starts from top left point defined by the GRAM Start Position Address. The area of Layer 1 is the next 128x64 dots.

When the value of the GRAM Start Position Address X overflow = 7FH, the next position goes to 00H. When the value of the GRAM Start Position Address Y overflow = 7FH, the next position goes to 00H.

For example:
If the GRAM Start Position Address is set as X=02H, Y=08H, the area of Layer 0 is as follows;

X=02H,03H,04H……7FH,00H,01H
Y=08H,09H……46H, 47H

In this case, the area of Layer1 is as follows;
X=02H,03H,04H……7FH,00H,01H
Y=48H,49H……06H,07H

9. Function

9.1 Commands

Command	C/D	D7	D6	D5	D4	D3	D2	D1	D0	Comments	
Display ON/OFF	1	0	0	1	0	L1	L0	*	*	1st Byte	Display ON/OFF Control、2 Byte Command
		0	GS	0	GRV	AND	EXOR	*	*	2nd Byte	
Brightness Set	1	0	1	0	0	BW3	BW2	BW1	BW0	1 Byte	1 Byte Command
Display Clear	1	0	1	0	1	G1C	G0C	1	HM	1 Byte	1 Byte Command
Display Area SET (Initialize)	1	0	1	1	0	0	0	1	0	1st Byte	Display Area is assigned 3 Byte Command
		0	0	0	0	0	(A2 – A0)			2nd Byte	
	0	1	1	1	1	1	1	1	1	3rd Byte	
Data Write Position Address Set	1	0	1	1	0	0	1	0	*	1st Byte	Graphic Display X-Address Set, 2 Byte Command
		GRAM X-Address (GXA6～GXA0)								2nd Byte	
	1	0	1	1	0	0	0	0	*	1st Byte	Graphic Address Y-Address Set, 2-Byte Command
		*	*	*	*	GYA3	GYA2	GYA1	GYA0	2nd Byte	
Display Start Position Address Set	1	0	1	1	1	*	*	*	*	1st Byte	Graphic Display Horizontal Shift, 2-Byte Command
		XA7	XA6	XA5	XA4	XA3	XA2	XA1	XA0	2nd Byte	
	1	1	0	1	1	UD	S1	S0	*	1 Byte	Graphic Display Vertical Shift, 1 Byte Command
Address Mode Set	1	1	0	0	0	*	IGX	IGY	*	1 Byte	Address Increment, 1 Byte Command
Address Read	1	1	1	0	1	0	1	*	*	1st Byte	Graphic Display (GRAM) Horizontal And Vertical Display Start Address, 3 Byte Command
		*	VG6	VG5	VG4	VG3	VG2	VG1	VG0	2nd Byte	
		HG7	HG6	HG5	HG4	HG3	HG2	HG1	HG0	3rd Byte	
Data Write	0	WRITE DATA									Writes Data Graphic Data is 1 Byte

***** Either a “0” or a “1” is acceptable

9.2 Display On/Off (C/$\overline{D}$= "1")

The GRAM Layer is selected with the 1st Byte of data. DDRAM (**On/Off**), GRAM (**On/Off**), DDRAM (**reverse** or **normal** modes), GRAM (**reverse** or **normal** modes) and display merge are selected by the 2nd Byte. Reverse mode toggles the representation of green in the foreground and black in the background to the exact opposite - green to back and black to the foreground. This is similar to the concept of reverse video.

1st Byte:

MSB							LSB
0	0	1	0	L1	L0	*	*
< ---------- >				< --------- >			
Command Select				Display Control Data			

* Either a "0" or a "1" is acceptable

L1= (**1** OR **0) =** GRAM Layer 1 (**Active** OR **Inactive**)
L0= (**1** OR **0) =** GRAM Layer 0 (**Active** OR **Inactive**)

2nd Byte:

MSB							LSB
0	GS	0	GRV	AND	EXOR	*	*
< ---------- ---------- >							
Display Control Data							

* Either a "0" or a "1" is acceptable

GS= (**1** OR **0)** Graphic Display Area (GRAM) = (**On** OR **Off**)
GRV= (**1** OR **0)** Graphic Display Area (GRAM) = (**Reverse** OR **Norma**l)

DS="0", GS= "0": Stand-by mode

1st Byte		2nd Byte		Action
L1	L0	AND	EXOR	
*	*	1	*	AND Display of Layer 1& 0
*	*	0	1	EXOR Display of Layer 1& 0
1	1	0	0	OR Display of Layer 1& 0
1	0	0	0	Only Layer1 selected for display
0	1	0	0	Only Layer0 selected for display
0	0	0	0	Graphic Display Off

* Either a "0" or a "1" is acceptable

9.3 Brightness Set (C/$\overline{D}$= "1")

The Brightness level of the display screen can be scaled by the following four bit control. Please note that the brightness is consistent across the illuminated pixels. There is no scaling of individual pixels. The display self-initializes to 100% brightness.

MSB							LSB
0	1	0	0	BW3	BW2	BW1	BW0
< ---------- >				< ---------- >			
Command Select				Brightness Level Data			

9.3 Cont'd

Brightness levels are set by the following:

BW3	BW2	BW1	BW0	Brightness Level
0	0	0	0	100%(Light)
0	0	0	1	94%
0	0	1	0	87%
0	0	1	1	81%
0	1	0	0	75%
0	1	0	1	69%
0	1	1	0	62%
0	1	1	1	56%
1	0	0	0	50%
1	0	0	1	44%
1	0	1	0	37%
1	0	1	1	31%
1	1	0	0	25%
1	1	0	1	19%
1	1	1	0	12%
1	1	1	1	6%(Dark)

9.4 Display Clear (C/$\overline{D}$= "1") This command clears the GRAM.

This command should always be applied at power on or reset. In the period of 1mS following the issue of this command, the module requires internal processing and does not accept any commands.

MSB							**LSB**
0	1	0	1	G1C	G0C	1	HM
< ---------- >				< ---------- >			
Command Select				Clear Control Code			

To clear the GRAM area, G1C or G0C bit must be asserted. By asserting HM bit, both data write position address and display start position address which selected by G1C, G0C, DC also be reset.

HM = (1 or 0) equals (Initialize data write position address and display start position address or Not initialize).

G1C= (1 or 0) equals (GRAM area 1 is cleared or GRAM area 1 not cleared)
G0C= (1 or 0) equals (GRAM area 0 cleared or GRAM area 0 not cleared)
GRAM area 1: X= 00H-7FH, Y=0H – 7H (Display data write position address)
GRAM area 2: X= 00H-7FH, Y=8H – FH (Display data write position address)

9.5 Display Area Set (C/$\overline{D}$="1", only used for Initialize Set)

This command sets the display area block as Graphic Display (GRAM) or Character display (DDRAM). But, this is version which has no Font ROM. Therefore, DDRAM is not available, all of display area block must be assigned to GRAM as the initialize setting, and this must be done when the module is powered up and also every time the reset is applied. Setup is performed by 3-byte command.

1st Byte: (C/$\overline{D}$="1") Command Select

MSB							LSB
0	1	1	0	0	0	1	0
< ---------- >							

Command Select

2nd Byte: (C/$\overline{D}$="1") Display Area Data Address Select

MSB							LSB	
0	0	0	0	0	A2	A1	A0	(0H – 7H)
					< ---------- >			

Display Area Data Address

3rd Byte: (C/$\overline{D}$="0") Display Area Block Select

MSB							LSB
1	1	1	1	1	1	1	1
< ---------- >							

Display Data

D0 to D7 = "1": Graphic Display (GRAM)
D0 to D7 = "0": Character Display (DDRAM, **Not available**)

Display area block is assigned as follows on a screen.

9.6 GRAM Data Write position Address Set (Graphic Display) (C/$\overline{D}$="1")

This command specifies both X & Y data write position address.

9.6.1 GRAM Data Write Position X Address Set

Data write position X address of GRAM expressed with 8 bits (00Hex-7FHex) is specified.
Refer to 8.1 Graphic Display (GRAM) on Page #5.

1st Byte: Command Select

MSB							LSB	
0	1	1	0	0	1	0	*	* Either a “0” or a “1” is acceptable
< ---------- >								

2nd Byte: GRAM Data Write Position X Address

MSB							LSB
0	GXA6	GXA5	GXA4	GXA3	GXA2	GXA1	GXA0
< ---------- >							

9.6.2 GRAM Data Write Position Y Address Set

Data write position Y address of GRAM expressed with 4 bits (0Hex-FHex) is specified.

1st Byte:

MSB							LSB	
0	1	1	0	0	0	0	*	* Either a “0” or a “1” is acceptable
< ---------- >								
Command Select								

2nd Byte:

MSB							LSB	
*	*	*	*	GYA3	GYA2	GYA1	GYA0	* Either a “0” or a “1” is acceptable
				< ---------- >				

9.7 GRAM Display Start Position Address Set (C/$\overline{D}$="1")

9.7.1 Horizontal Shift

This command specifies the address that a display pattern can be positioned to by **8 bits (00Hex to 7FHex)**. This is equivalent to an offset in the X-axis.

1st Byte:

MSB							LSB	
0	1	1	1	*	*	*	*	* Either a “0” or a “1” is acceptable
< ---------- >								
Command Select								

2nd Byte:

MSB							LSB
XA7	XA6	XA5	XA4	XA3	XA2	XA1	XA0
< ---------- >							
GRAM Display Start Position Address							

9.7.2 Vertical Shift

This is equivalent to an offset Y-axis.

MSB							LSB	
1	0	1	1	UD	S1	S0	*	* Either a “0” or a “1” is acceptable
< ---------- >				< ---------- >				
Command Select				Display Shift Data				

UD= "1": Display scrolled up.
UD= "0": Display scrolled down.
S1= "0", S0= "1": Display shift by 8 dots.
S1= "1", S0= "0": Display shift by 1 dot.
S1= "1", S0= "1": Display shift by 2 dots.

9.8 Address Mode Set（C/$\overline{D}$="1"）

This command specifies the GRAM data write position address auto increment mode.

MSB							LSB	
1	0	0	0	*	IGX	IGY	*	* Either a “0” or a “1” is acceptable
< ---------- >				< ---------- >				
Command Select				Address Mode data				

IGX = "1" : X-Address +1(increment) when writing to GRAM.(It not affect to Y-Address.)
IGX = "0" : GRAM X address fixed mode
IGY = "1" : Y-Address +1(increment) when writing to GRAM.(It not affect to X-Address
IGY = "0" : GRAM Y address fixed mode.

9.9 Address Read （C/$\overline{D}$ ="1"）

This command reads both vertical and horizontal display start position addresses of GRAM *(Refer to sect. 8 - Display Screen and Initialize set on Page # 4)*. On the parallel interface, the data bus outputs the address until CSS goes high after the READY signal goes active (Parallel #1:RD=LOW, Parallel #2:R/W=HIGH). The Data bus becomes an input when other. On the serial interface, TXD outputs the data from SCK rising after command is issued until the CSS goes high. Refer to 10.Interface on Page #15.

1st Byte:

MSB							LSB	
1	1	0	1	0	1	*	*	* Either a “0” or a “1” is acceptable
< ---------- >								
Command Select								

	MSB							LSB	
2nd Byte:	*	VG6	VG5	VG4	VG3	VG2	VG1	VG0	(Read)
3rd Byte:	HG7	HG6	HG5	HG4	HG3	HG2	HG1	HG0	(Read)
	< ---------- >								
	Vertical & Horizontal display start position address (GRAM)								

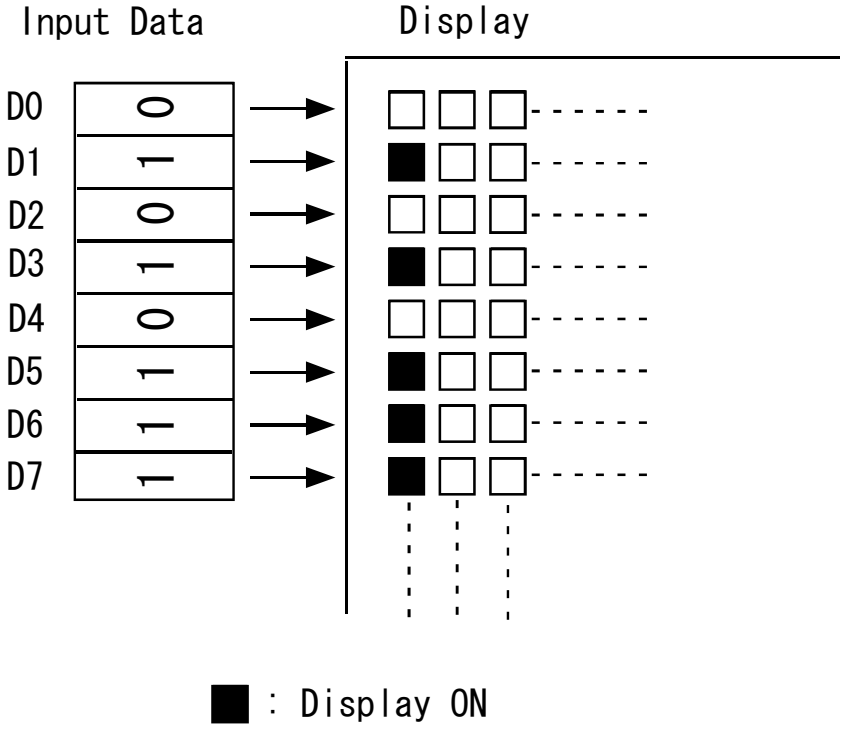
VG0 to VG6: Vertical display start position address
HG0 to HG7: Horizontal display start position address

9.10 Data Write to Graphic Display(GRAM) (C/$\overline{D}$="0")

Can be written into GRAM by setting GRAM X or Y data write position address.

Example:

Writing "EA Hex" sets "D1, 3, 5, 6, 7 =1" and "D0, 2, 4 =0".



9.11 Default Status at Reset

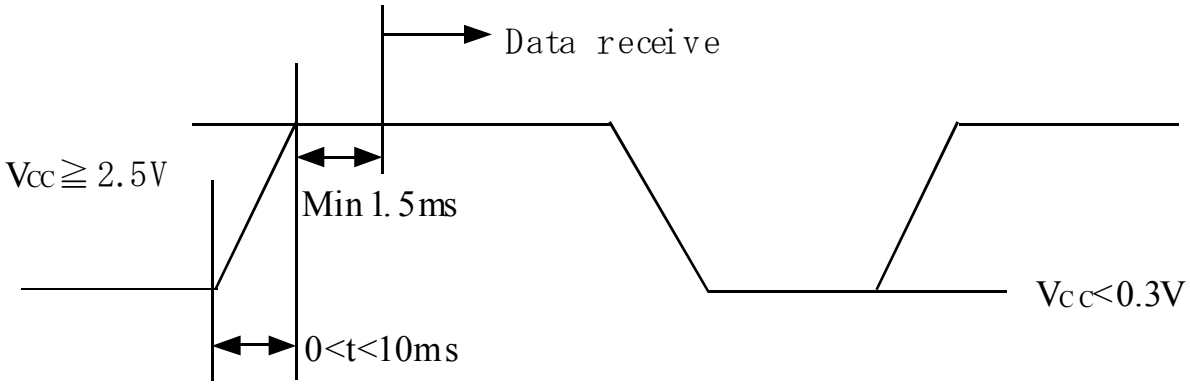
When the reset is applied, the display self-initializes into the following status:

GRAM Layer:	Layer (0)
Display ON/OFF:	Display (Off)
Display Area:	All DDRAM (Character display area)

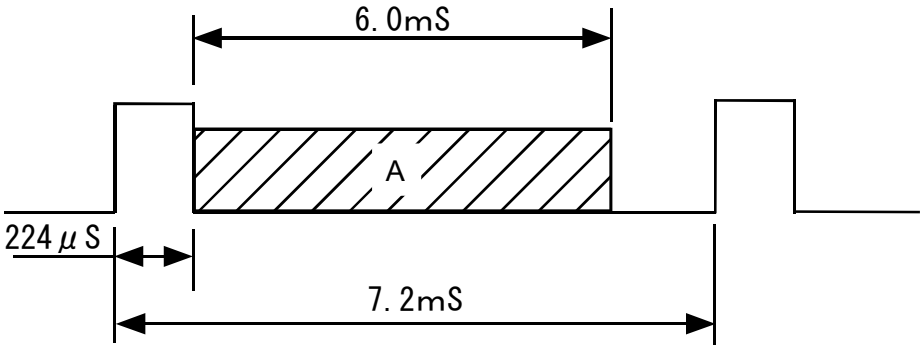
All of display area block must be assigned to GRAM again as the initialize setting after reset is applied because DDRAM is not available.

GRAM X-address:	Fixed mode
GRAM Y-address:	Fixed mode
Brightness Level:	100% Brightness

The following precautions should be observed at power on, and after a reset:
External Reset: After Vcc reaches 2.5V, the Reset level is "Low" for more than 1.5mS.
Power-Up: The following sequence occurs:



9.12 FRP (Frame Pulse)

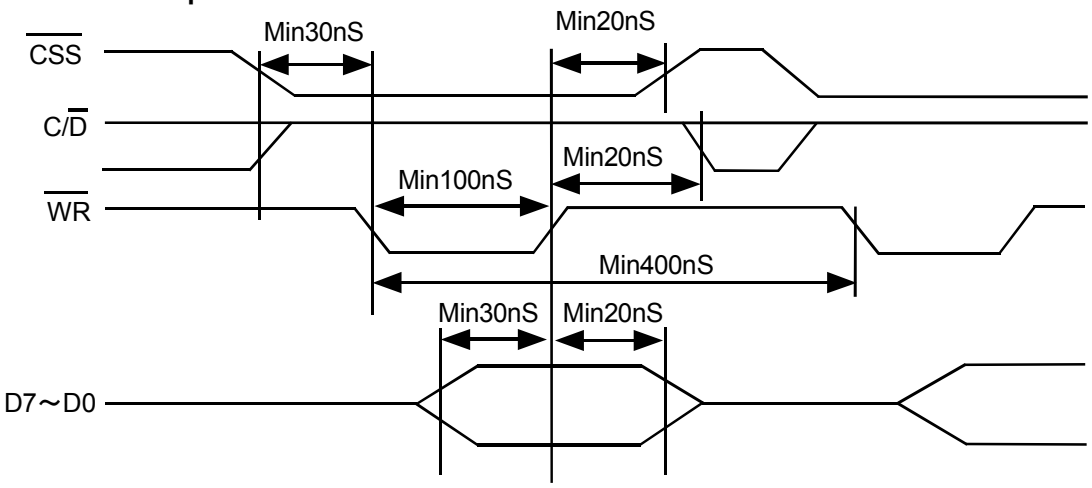


An FRP signal is triggered each time the display is refreshed by the module from its own memory. Smooth scrolling can be achieved by synchronizing the change of display start address with of the FRP signal from module. The area marked as “A” is optimal for writing commands.

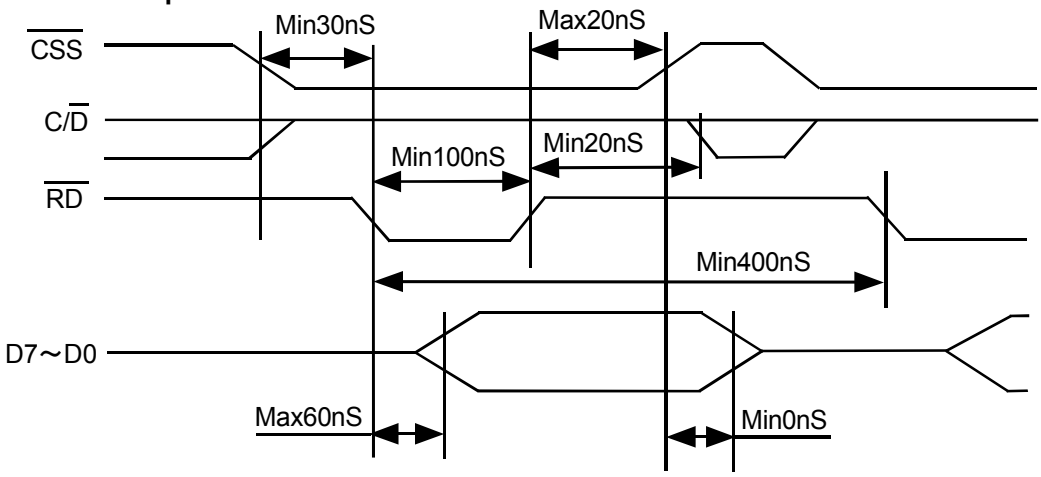
10. Interface

10.1 Parallel Interface (Parallel #1)

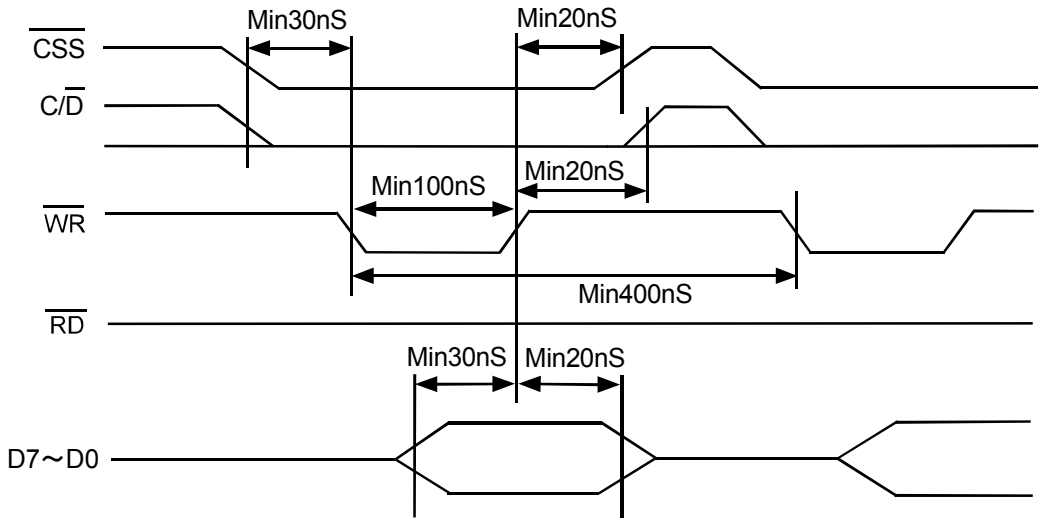
10.1.1 Command Write operation



10.1.2 Command Read operation

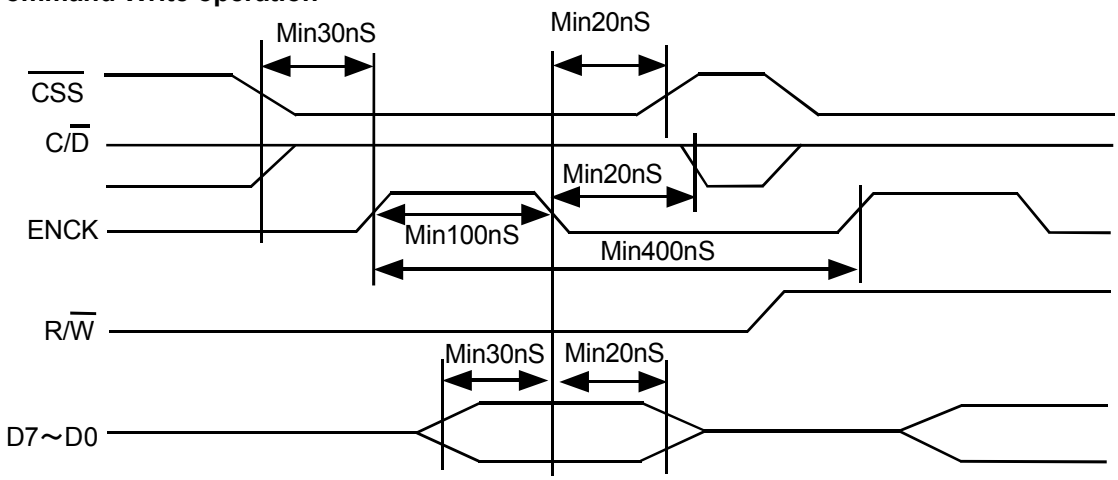


10.1.3 Data Write operation

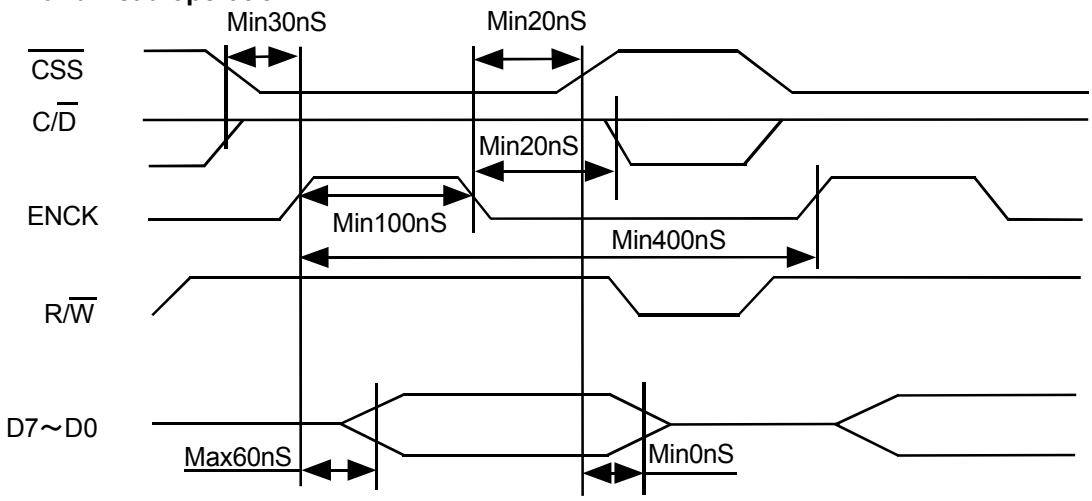


10.2 Parallel Interface(Parallel #2)

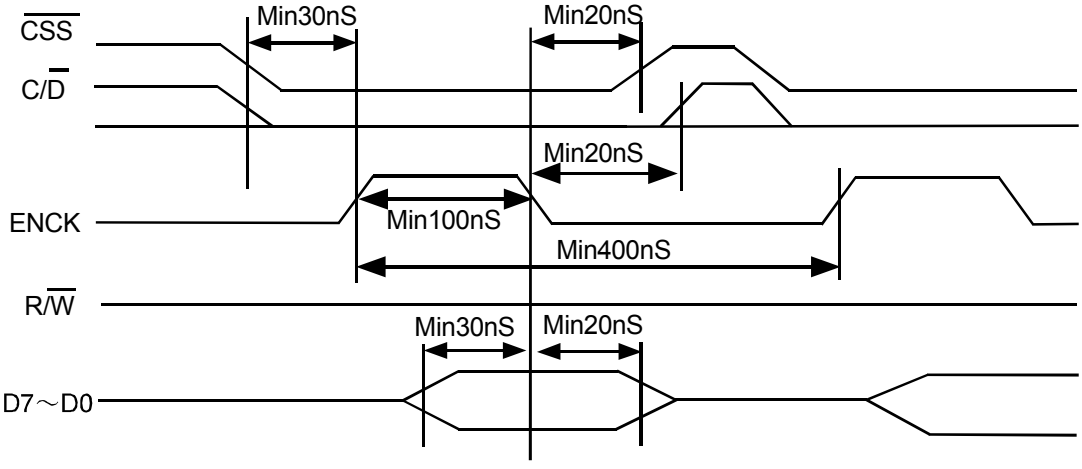
10.2.1 Command Write operation



10.2.2 Command Read operation

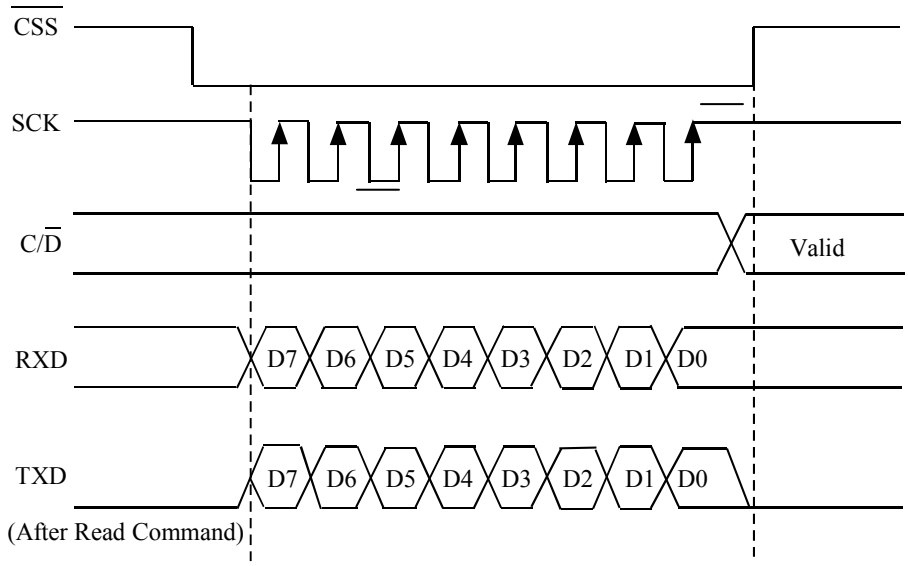


10.2.3 Data Write operation

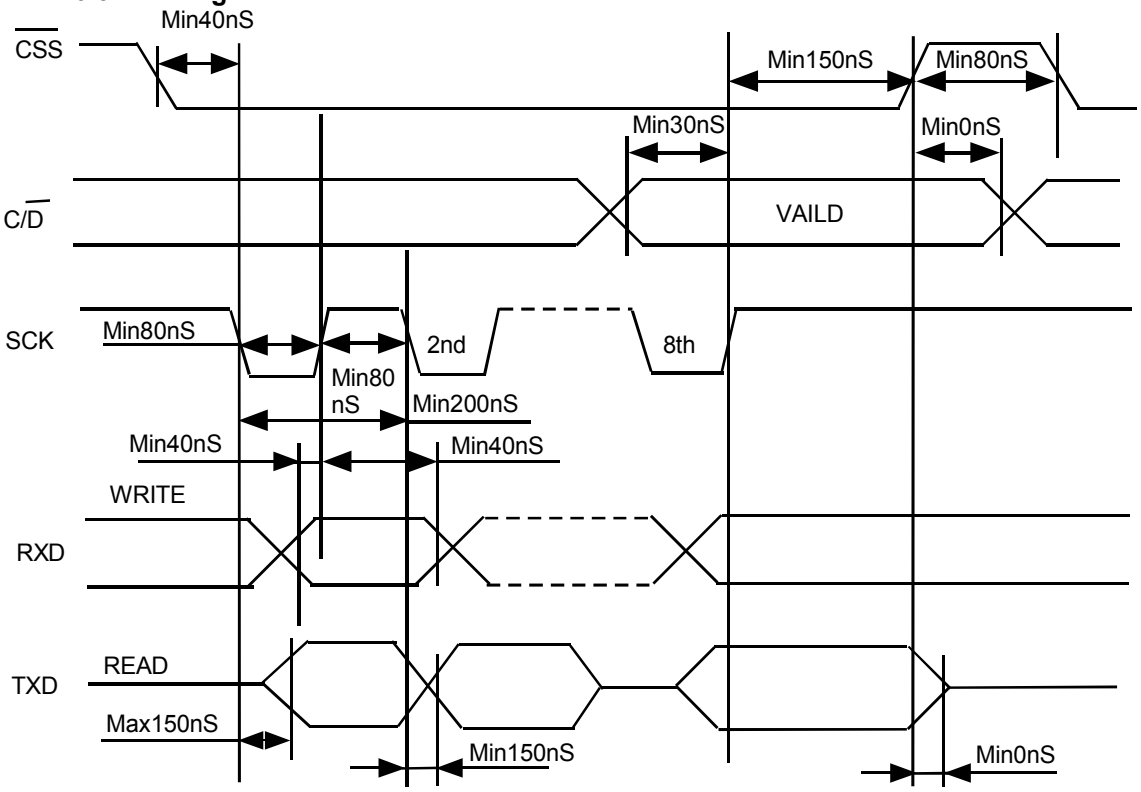


10.3 Serial Interface

To use the serial interface of this module, **(RXD,TXD and SCK)** will be activated by **CSS= "L"**.
The internal shift registers and counters will be reset by CSS= "H". Serial data is transferred from MSB to LSB (D7->D0) on the rising edge of SCK. After the 8th clock edge, the data stream is converted to 8 bit parallel data. Recognition of the RXD input as either data or command is determined by C/D on the 8th pulse SCK.



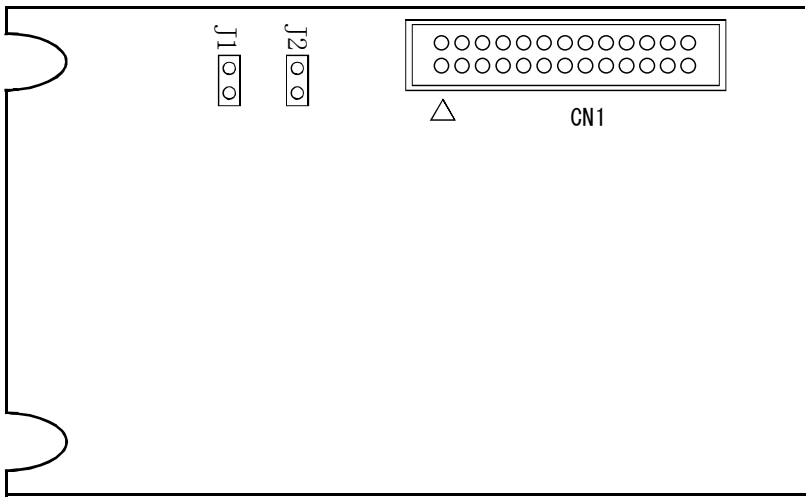
10.3.1 Timing



11. Jumper

11.1 Jumper Position

Component side of board



11.2 Jumper Setting (Must be done when power is **OFF**)

	J1	J2	Function
Interface	0	X	Serial Interface
	1	1	Parallel #1 Interface (Default)
	1	0	Parallel #2 Interface

1:Open 0:Short X: Open or Short

12. Pin Assignment *(See connector diagrams below)*

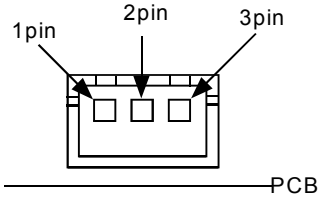
12.1 Signal Connection

Pin No.	Description		
	Parallel #1	Parallel #2	Serial
1	D7	D7	×
3	D6	D6	×
5	D5	D5	×
7	D4	D4	×
9	D3	D3	×
11	D2	D2	×
13	D1	D1	TXD
15	D0	D0	RXD
17	$\overline{WR}$	$\overline{R/W}$	×
19	$\overline{C/D}$	$\overline{C/D}$	$\overline{C/D}$
21	$\overline{RD}$	ENCK	SCK
23	$\overline{CSS}$	$\overline{CSS}$	$\overline{CSS}$
25	FRP	FRP	FRP

Pin No.	Description		
	Parallel #1	Parallel #2	Serial
2	GND	GND	GND
4	GND	GND	GND
6	GND	GND	GND
8	GND	GND	GND
10	GND	GND	GND
12	GND	GND	GND
14	GND	GND	GND
16	GND	GND	GND
18	GND	GND	GND
20	GND	GND	GND
22	GND	GND	GND
24	GND	GND	GND
26	$\overline{RESET}$	$\overline{RESET}$	$\overline{RESET}$

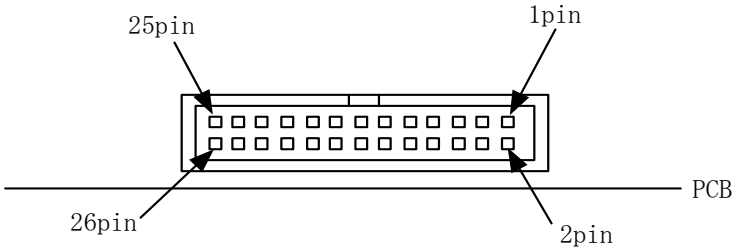
12.2 Connectors

Power Connector:
JST: B3B-XH-A or equivalent

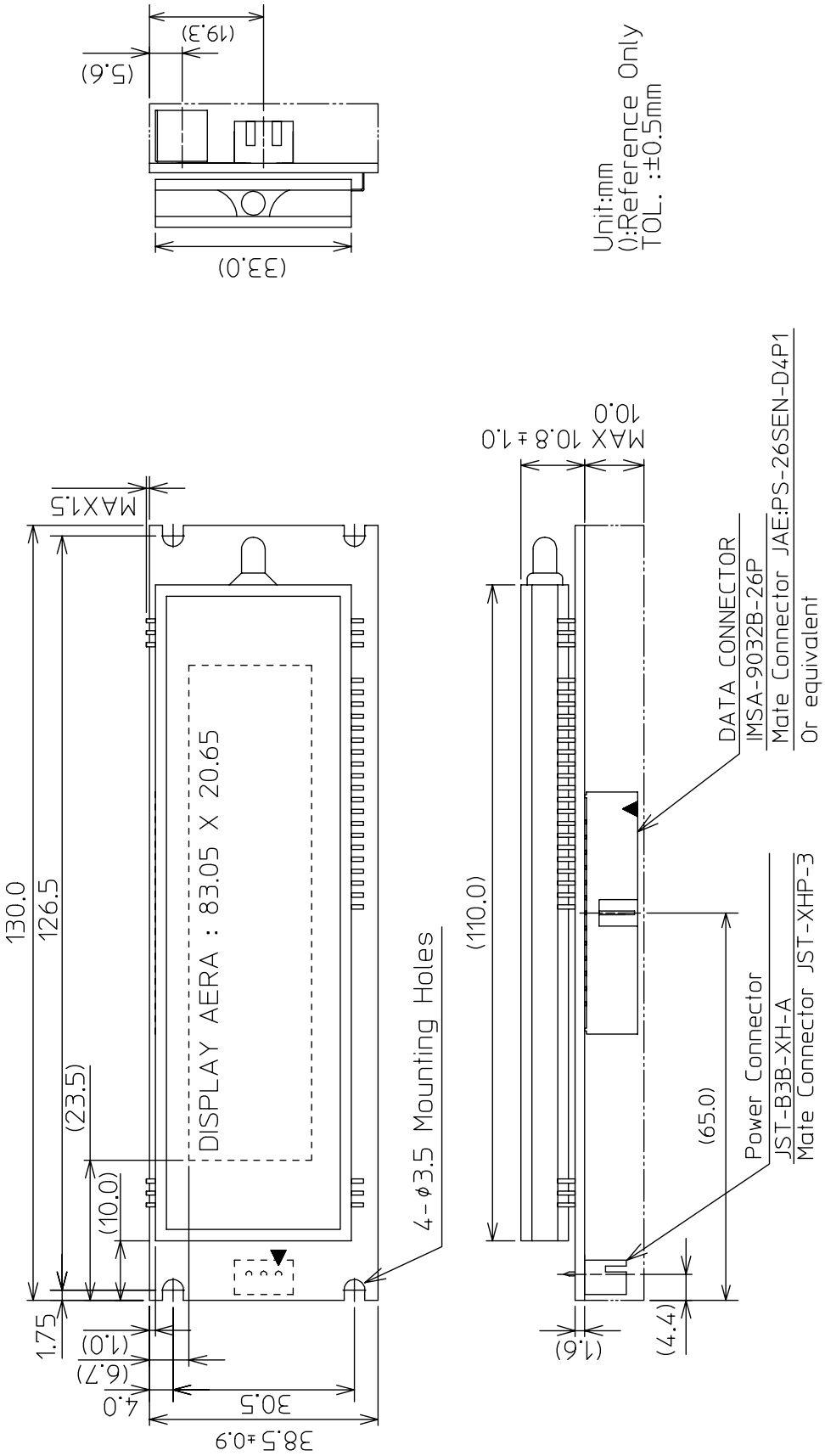


Pin No.	Description
1	Vcc
2	Test (Factory Only)
3	GND

Data Connector
IMSA: 9032B-26P or Equivalent



13. Outline Dimension



Notice for the Cautious Handling VFD Modules

Handling and Usage Precautions:
Please carefully follow the appropriate product application notes for proper usage, safety handling, and operation standards for maximum performance.

[VFD tubes are made of glass]

- Because the edges of the VFD glass-envelop are not smooth, it is necessary to handle carefully to avoid injuries to your hands
- Please avoid breaking the VFD glass-envelop to prevent injury from sharp glass particles.
- The tip of the exhaust pipe is fragile so avoid shock from impact.
- It is recommended to allow sufficient open space surrounding the exhaust pipe to avoid possible damage.
- Please design the PCB for the VFD-module within 0.3 mm warping tolerance to avoid any forces that may damage the display due to PCB distortion causing a breakdown of the electrical circuit leading to VFD failure.

[High voltage]

- Avoid touching conductive electrical parts, because the VFD-module uses high voltage exceeding 30～100 volts.
- Even when electric power is turned off, it may take more than one minute for the electrical current to discharge.

[Cable connection]

- Do not unplug the power and/or data cables of VFD-modules during operating condition because unrecoverable damage may result.
- Sending input signals to the VFD-module during a power off condition sometimes causes I/O port damage.
- It is recommended to use a 30 cm or shorter signal cable to prevent functional failures.

[Electrostatic charge]

- VFD-modules needs electrostatic free packaging and protection from electrostatic charges during handling and usage.

[Structure]

- During operation, VFD and VFD-modules generate heat. Please consider sufficient heat radiation dissipation using heat sink solutions.
- We prefer to use UL grade materials or components in conjunction with VFD-modules.
- Wrap and twist motion causes stress and may break VFDs & VFD modules. Please adhere to allowances within 0.3mm at the point of attachment.

[Power]

- Apply regulated power to the VFD-module within specified voltages to protect from failures.
- Because some VFD-modules may consume in rush current equal to twice the typical current at power-on timing, we recommend using a sufficient power capability and quick starting of the power regulator.
- VFD-module needs a specified voltage at the point of connection. Please use an adequate power cable to avoid a decrease in voltage. We also recommend inserting a power fuse for extra protection.

[Operating consideration]

- Illuminating phosphor will decrease in brightness during extended operation. If a fixed pattern illuminates for an extended period,(several hours), the phosphor efficiency will decrease compared to the non operating phosphor causing a non uniform brightness among pixels. Please consider programming the display patterns to use all phosphor segments evenly. Scrolling may be a consideration for a period of time to refresh the phosphor condition and improve even illumination to the pixels.
- We recommend using a signal cable 30cm or less to avoid some possible disturbances to the signal.

[Storage and operating environment]

- Please use VFD-modules under the recommended specified environmental conditions. Salty, sulfur and dusty environments may damage the VFD-module even during storage.

[Discard]

- Some VFDs contain a small amount of cadmium in the phosphor and lead in the solder. When discarding VFDs or VFD-modules, please adhere to governmental related laws or regulations.

[Others]

- Although the VFD-module is designed to be protected from electrical noise, please plan your circuitry to exclude as much noise as possible.
- Do not reconstruct or repair the VFD-module without our authorization. We cannot assure the quality or reliability of unauthorized reconstructed VFD-modules.

Notice:

・We do not authorize the use of any patents that may be inherent in these specifications.

・Neither whole nor partial copying of these specifications are permitted without our approval.
If necessary , please ask for assistance from our sales consultant.

・This product is not designed for military, aerospace, medical or other life-critical applications. If you choose to use this product for these applications, please ask us for prior consultation or we cannot take responsibility for problems that may occur.

Mouser Electronics

Authorized Distributor

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Noritake:
GU128X32-800B

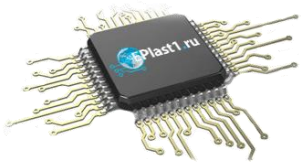
Компания «ЭлектроПласт» предлагает заключение долгосрочных отношений при поставках импортных электронных компонентов на взаимовыгодных условиях!

Наши преимущества:

- Оперативные поставки широкого спектра электронных компонентов отечественного и импортного производства напрямую от производителей и с крупнейших мировых складов;
- Поставка более 17-ти миллионов наименований электронных компонентов;
- Поставка сложных, дефицитных, либо снятых с производства позиций;
- Оперативные сроки поставки под заказ (от 5 рабочих дней);
- Экспресс доставка в любую точку России;
- Техническая поддержка проекта, помощь в подборе аналогов, поставка прототипов;
- Система менеджмента качества сертифицирована по Международному стандарту ISO 9001;
- Лицензия ФСБ на осуществление работ с использованием сведений, составляющих государственную тайну;
- Поставка специализированных компонентов (Xilinx, Altera, Analog Devices, Intersil, Interpoint, Microsemi, Aeroflex, Peregrine, Syfer, Eurofarad, Texas Instrument, Miteq, Cobham, E2V, MA-COM, Hittite, Mini-Circuits,General Dynamics и др.);

Помимо этого, одним из направлений компании «ЭлектроПласт» является направление «Источники питания». Мы предлагаем Вам помощь Конструкторского отдела:

- Подбор оптимального решения, техническое обоснование при выборе компонента;
- Подбор аналогов;
- Консультации по применению компонента;
- Поставка образцов и прототипов;
- Техническая поддержка проекта;
- Защита от снятия компонента с производства.



Как с нами связаться

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