

# Vacuum Fluorescent Display Module Specification

Model: GU256X16-333A

Specification No: DS-870-0001-00

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## Index.

Index.....	1
<b>1. SCOPE</b> .....	<b>2</b>
<b>2. General Description</b> .....	<b>2</b>
<b>3. Absolute Maximum Ratings</b> .....	<b>2</b>
<b>4. Electrical Ratings</b> .....	<b>2</b>
<b>5. Electrical Characteristics</b> .....	<b>2</b>
<b>6. Optical Ratings</b> .....	<b>3</b>
<b>7. Environmental Conditions</b> .....	<b>3</b>
<b>8. Function of Data Lines</b> .....	<b>4</b>
<b>9. Functions</b> .....	<b>5</b>
9.1 Block Diagram.....	7
9.2 The Relationship of Display Memory and Command .....	8
<b>10.Commands</b> .....	<b>9</b>
10.1 Screen Control.....	10
10.1.1 Screen ON/OFF Control.....	10
10.1.2 OR/EX-OR/AND Display (Screen Merge).....	10
10.2 Automatic increment/Hold cursor address .....	10
10.3 Graphic display .....	10
10.4 Data write/ read .....	11
10.5 Setting display start address.....	12
10.6 Cursor address set .....	12
10.7 FRP signal and DC/DC Converter ON/OFF .....	13
10.8 Brightness Control .....	13
<b>11. Reset</b> .....	<b>13</b>
<b>12. Blanking</b> .....	<b>13</b>
<b>13. FRP signal</b> .....	<b>14</b>
<b>14. Display Address Map</b> .....	<b>14</b>
<b>15. Interface</b> .....	<b>15</b>
<b>16.Timing Chart</b> .....	<b>16</b>
16.1 Write operation.....	16
16.2 Read operation .....	16
16.3 Reset timing .....	16
16.4 FRP timing (output).....	17
16.5 Power ON/OFF Sequence.....	17
16.6 The others .....	17
<b>17. Pin assignment</b> .....	<b>18</b>
17.1 Signal Connector .....	18
17.2 Power Connector .....	18
<b>18. Outline Dimensions</b> .....	<b>19</b>

## 1. SCOPE

This specification covers the vacuum fluorescent graphics display module, GU256X16-330A.

## 2. General Description

The module consists of a graphic V.F.Display which is having the dot configuration of 256X16, drivers, a refresh RAM, a display controller, a DC/DC converter and all necessary control logic on a P.C.Board. The module can indicate graphics patterns on the screen of V.F.Display.

Power supply for logic ICs( Vcc1,+5V ) and for DC/DC Converter( Vcc2,+24V ) are needed.

## 3. Absolute Maximum Ratings

Parameter	Symbol	Absolute Max.	Unit
Power Supply Voltage1	Vcc1	-0.3~+6.0	V
Power Supply Voltage2	Vcc2	-0.3~+28.0	V
Input Voltage	VIN	-0.3~Vcc1+0.3	V

## 4. Electrical Ratings

Parameter	Symbol	Min.	Typ.	Max.	Unit
Power Supply Voltage1	Vcc1	4.75	5.0	5.25	V
Power Supply Voltage2	Vcc2	22.8	24.0	25.2	V

## 5. Electrical Characteristics

( Vcc1=5.0V, Vcc2=24.0V, Ta=25 degrees )

Parameter	Symbol	Condition	Min.	Typ.	Max.	Unit
High level input voltage	VIH	-	3.5	-	Vcc1	V
Low level input voltage	VIL	-	0	-	1.5	V
High level output voltage	VOH	I <sub>OH</sub> =-40uA	4.2	-	-	V
Low level output voltage	VOL	I <sub>OL</sub> =1.6mA	-	-	0.5	V
Power Supply Current1	Icc1	-	-	22	27	mA
Power Supply Current2	Icc2-1	all dots ON	-	1100	1400	mA
Power Supply Current2	Icc2-2	all dots OFF	-	750	900	mA
Power Supply Current2	Icc2-3	converter OFF	-	30	50	mA

NOTE: Provide the power supply(Vcc1,Vcc2) which has quick rise time ( less than 100mSec.).

## 6. Optical Ratings

Display area (XxY)	: 575.5 X 50.7 mm
Number of Dots (XxY)	: 256 X 16
Dot size (XxY)	: 1.75 X 2.7 mm
Dots Pitch (XxY)	: 2.25 X 3.2 mm
Luminance	: 350 cd/m <sup>2</sup> Min.
Illuminating color Green (Blue-Green)	

## 7. Environmental Conditions

Operating Temperature	: 0 to +50 degrees
Storage Temperature	: -20 to +70 degrees
Operating Humidity	: 20 to 80% R.H.( Non condensation )
Vibration ( Non operation)	: 10 to 55Hz , 0.5 G , 3 directions, 10 min.each
Shock ( Non operation)	: 30G, 9mSec, 3 directions , 3 times each

## 8. Function of Data Lines

Data Line	Function
DO ~ D7	Data Bus Lines ( Input/output )
*WR	Write Signal ( Input )
*RD	Read Signal ( Input )
*CS	Select Signal ( Input )
C/*D	Command/Data Select ( Input ) C/*D="1"... Command C/*D="0"... Data
FRP	Frame Signal ( Output ) It is possible to disable output by DIP SW, S4 or command.
*BL	Display Blanking ( Input )
*RESET	Reset (Input)
DS0 ~ DS3	Display select ( Input )
EXCS1	Controller select "0"...Controller A ( Left half of Display area. ) "1"...Controller B ( Right half of Display area. )
Vcc1	Power Supply ( logic ) + 5 VDC
Vcc2	Power Supply( Display ) + 24 VDC
GND	System ground
*LAMP_TEST	Module test "0"... all dots on normal operation... open or "1"
IC	Internal connection. ( do not connect )

NOTE : \*xx= $\overline{\text{xx}}$   
 "0" : Low level input logic voltage  
 "1" : High level input logic voltage

## 9. Functions

The module consists of a graphic V.F.Display which is having the dot configuration of 256X16, drivers, a refresh RAM, a display controller, a DC/DC convertor.

The display memory (RAM) has capacity of 8k bytes and it can memorize 16 screen pages(1 screen page = 256X16 dots). The user can assign any 2 screens out of 16 pages for displaying.

This module has two controllers (Controller A and B).

Controller A controls left half of display area. Controller B controls right half of display area. They are work as two separated display, and two screens (128X16 dots) stand side by side. Display memory can be controlled from either controllers (A or B). Therefore Data write, Data read, cursor automatic increment and cursor address can set up from either controllers (A or B). Other commands should be given to both controllers (A and B).

The display screen is alterable as the screen #1, the screen #2 and combination of 2 screens as follows ;

- Show on screen either #1 or #2.
- Merge 2 screens such as OR/EX-OR/AND

Display start address of Screen #1 and #2 can be set and changed independently. Both or either screen(s) can be scrolled by changing the display start address.

Controls of Display Blanking and Reset are available through signal connector, and while Reset input is active, DC/DC Converter is inhibited, too.

Brightness of VFD can be changed by command.

In order to combine left half and right, and use entire 256X16 dot as one screen, set start address of controller "B" equal to start address of "A" + 0400H.

The module has a DIP Switch(S0-S4). The display accept data or command writing, when \*CS is "0" and address line ( DS0-DS3) is equal to DIP Switch setting (S0~S3).

### 9 Functions (Cont'd)

The relationship between DS0-DS3 and S0-S3 is as follows.

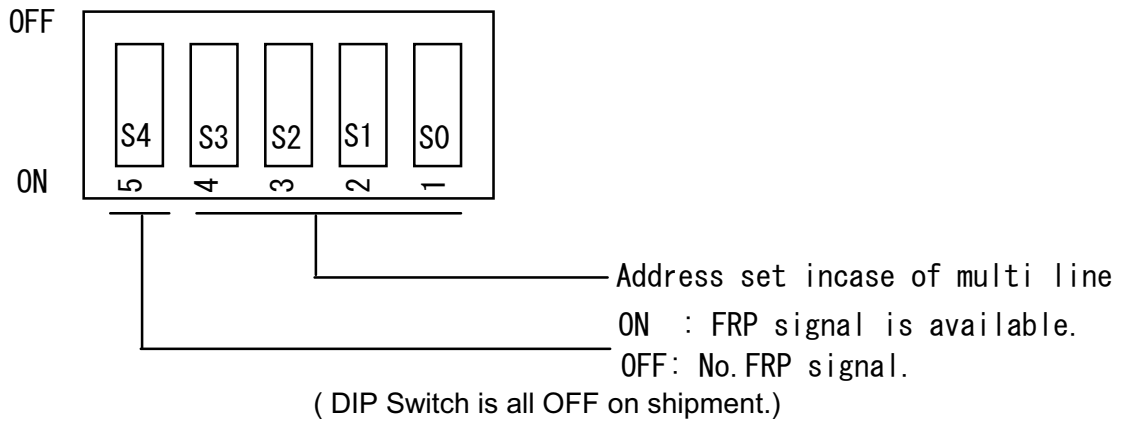
Setting of DIP Switch				Device Select Signal				Module Address
S3	S2	S1	S0	DS3	DS2	DS1	DS0	
OFF	OFF	OFF	OFF	1	1	1	1	#0
OFF	OFF	OFF	ON	1	1	1	0	#1
OFF	OFF	ON	OFF	1	1	0	1	#2
OFF	OFF	ON	ON	1	1	0	0	#3
OFF	ON	OFF	OFF	1	0	1	1	#4
OFF	ON	OFF	ON	1	0	1	0	#5
OFF	ON	ON	OFF	1	0	0	1	#6
OFF	ON	ON	ON	1	0	0	0	#7
ON	OFF	OFF	OFF	0	1	1	1	#8
ON	OFF	OFF	ON	0	1	1	0	#9
ON	OFF	ON	OFF	0	1	0	1	#10
ON	OFF	ON	ON	0	1	0	0	#11
ON	OFF	OFF	ON	0	1	1	0	#12
ON	ON	OFF	ON	0	0	1	0	#13
ON	ON	ON	OFF	0	0	0	1	#14
ON	ON	ON	ON	0	0	0	0	#15

Example of module address setting.

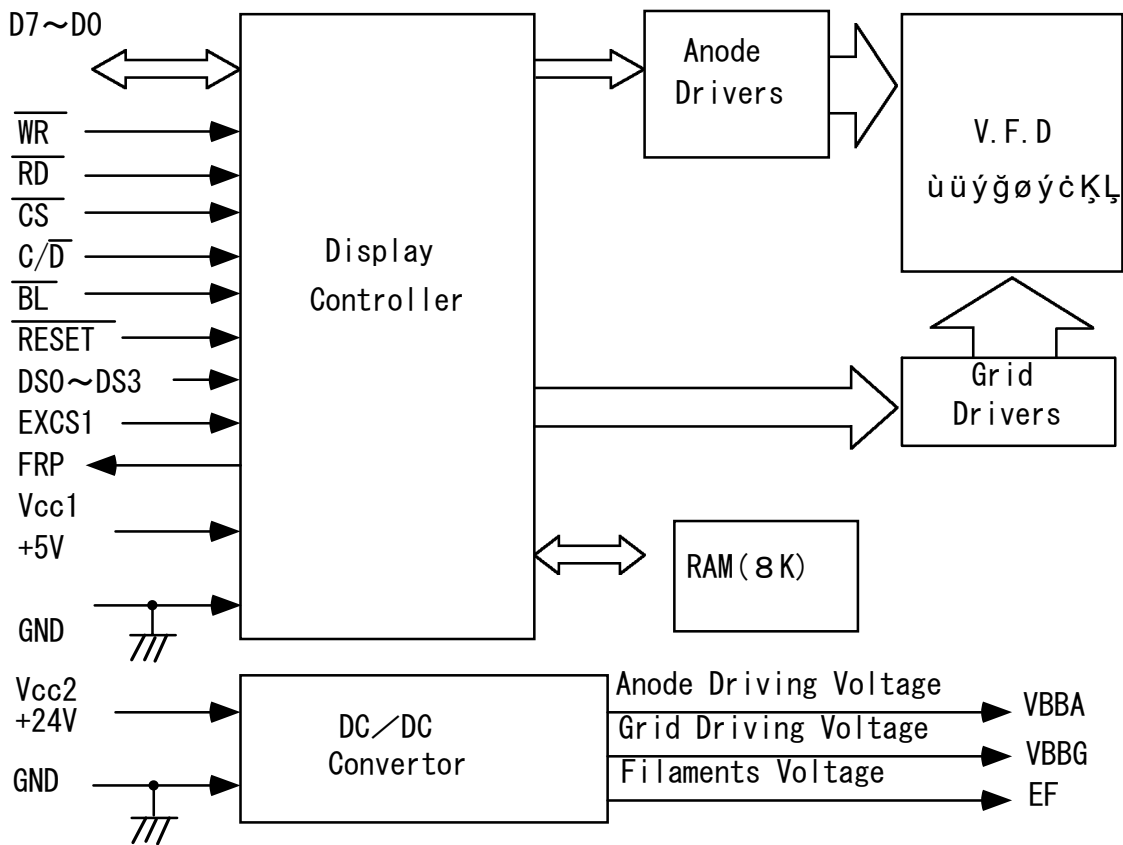
		DS3	DS2	DS1	DS0
Module Address#0		1	1	1	1
Module Address#1		1	1	1	0
Module Address#2		1	1	0	1

## 9 Functions (Cont'd)

### DIP Switch

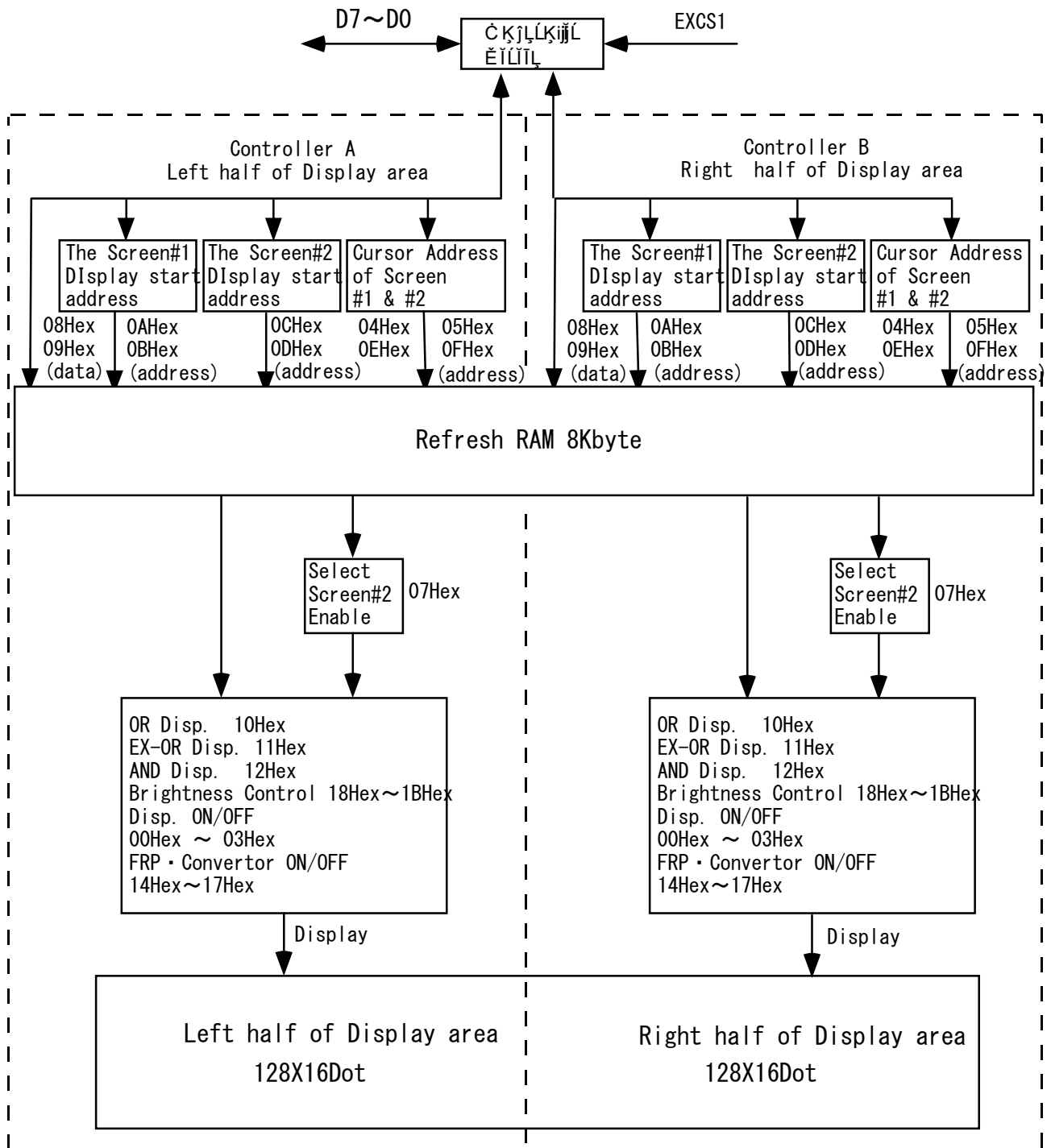


### 9.1 Block Diagram





## 9.2 The Relationship of Display Memory and Command



## 10. Commands

Command Table

Command( $\overline{C/D}$ ="1")					HEX	Setting Data $\overline{C/D}$ ="0"								Function	De-fault
D4	D3	D2	D1	D0		D7	D6	D5	D4	D3	D2	D1	D0		
0	0	0	0	0	00					-				Screen #1 & #2 are set to OFF.	⊙
0	0	0	0	1	01					-				Screen #1 is set to ON & #2 is OFF.	-
0	0	0	1	0	02					-				Screen #1 is set to OFF & #2 is ON.	-
0	0	0	1	1	03					-				Screen #1 & #2 are set to ON.	-
-----															
0	0	1	0	0	04					-				Select " Cursor auto-Increment"	⊙
0	0	1	0	1	05					-				Select " Cursor hold" mode	-
0	0	1	1	1	07					-				Set Screen #2 to enable.	-
-----															
0	1	0	0	0	08	X	X	X	X	X	X	X	X	Data write mode.	-
0	1	0	0	1	09	X	X	X	X	X	X	X	X	Data read mode.	-
-----															
0	1	0	1	0	0A	A7	A6	A5	A4	A3	A2	A1	A0	Set lower byte of display start adrs of #1.	-
0	1	0	1	1	0B	X	X	X	A12	A11	A10	A9	A8	Set upper byte of display start adrs of #1.	-
0	1	1	0	0	0C	A7	A6	A5	A4	A3	A2	A1	A0	Set lower byte of display start adrs of #2.	-
0	1	1	0	1	0D	X	X	X	A12	A11	A10	A9	A8	Set upper byte of display start adrs of #2.	-
-----															
0	1	1	1	0	0E	A7	A6	A5	A4	A3	A2	A1	A0	Set lower byte of cursor address.	-
0	1	1	1	1	0F	X	X	X	A12	A11	A10	A9	A8	Set upper byte of cursor address.	-
-----															
1	0	0	0	0	10					-				Select screens merge mode, OR.	⊙
1	0	0	0	1	11					-				Select screens merge mode, Exclusive-OR.	-
1	0	0	1	0	12					-				Select screens merge mode, AND.	-
-----															
1	0	1	0	0	14					-				FRP signal ON, DC/DC Conv. OFF	⊙
1	0	1	0	1	15					-				FRP signal ON, DC/DC Conv. ON	-
1	0	1	1	0	16					-				FRP signal OFF, DC/DC Conv. OFF	-
1	0	1	1	1	17					-				FRP signal OFF, DC/DC Conv. ON	-
-----															
1	1	0	0	0	18					-				Set brightness 100%.	⊙
1	1	0	0	1	19					-				Set brightness 87.5%.	-
1	1	0	1	0	1A					-				Set brightness 75%.	-
1	1	0	1	1	1B					-				Set brightness 62.5%.	-

NOTE : The term of "Cursor" means the writing or reading pointer.

X... 0 or 1

## 10.1 Screen Control

### 10.1.1 Screen ON/OFF Control

Command (C/*D = "1")					HEX	Function	Default
D4	D3	D2	D1	D0			
0	0	0	0	0	00	Both Screen #1 & #2 are OFF.	⊙
0	0	0	0	1	01	Screen #1 ON.	-
0	0	0	1	0	02	Screen #2 ON.	-
0	0	0	1	1	03	Both Screen #1 & #2 are ON.	-

The latest command is valid from above table. At power on, Screen #1 and #2 are set to OFF. Therefore, appropriate ON command should be set after writing of pattern data. When Screen #2 is used, Command 07H should be set before writing Screen ON command.

### 10.1.2 OR/EX-OR/AND Display (Screen Merge)

Command (C/*D = "1")					HEX	Function	Default
D4	D3	D2	D1	D0			
1	0	0	0	0	10	OR display of Screen #1 & #2.	⊙
1	0	0	0	1	11	EX-OR display of Screen #1 & #2 .	-
1	0	0	1	0	12	AND display of Screen #1 & #2.	-

The latest command is valid from the above table. These commands are effective when both screen #1 & #2 are selected(03Hex). If one screen is selected, the selected screen is displayed without merge.

## 10.2 Automatic increment/Hold cursor address

Command (C/*D = "1")					HEX	Function	Default
D4	D3	D2	D1	D0			
0	0	1	0	0	04	Cursor address is incremented automatically.	⊙
0	0	1	0	1	05	Cursor address is held.	-

The cursor address manipulation which will be executed after Data Write or Data Read, can be selected from Automatic Increment or Hold by writing a above command. Under automatic-Increment mode, the cursor is incremented by one covering all RAM area.

## 10.3 Graphic display

Command (C/*D = "1")					HEX	Function	Default
D4	D3	D2	D1	D0			
0	0	1	1	1	07	Enable Screen #2.	-

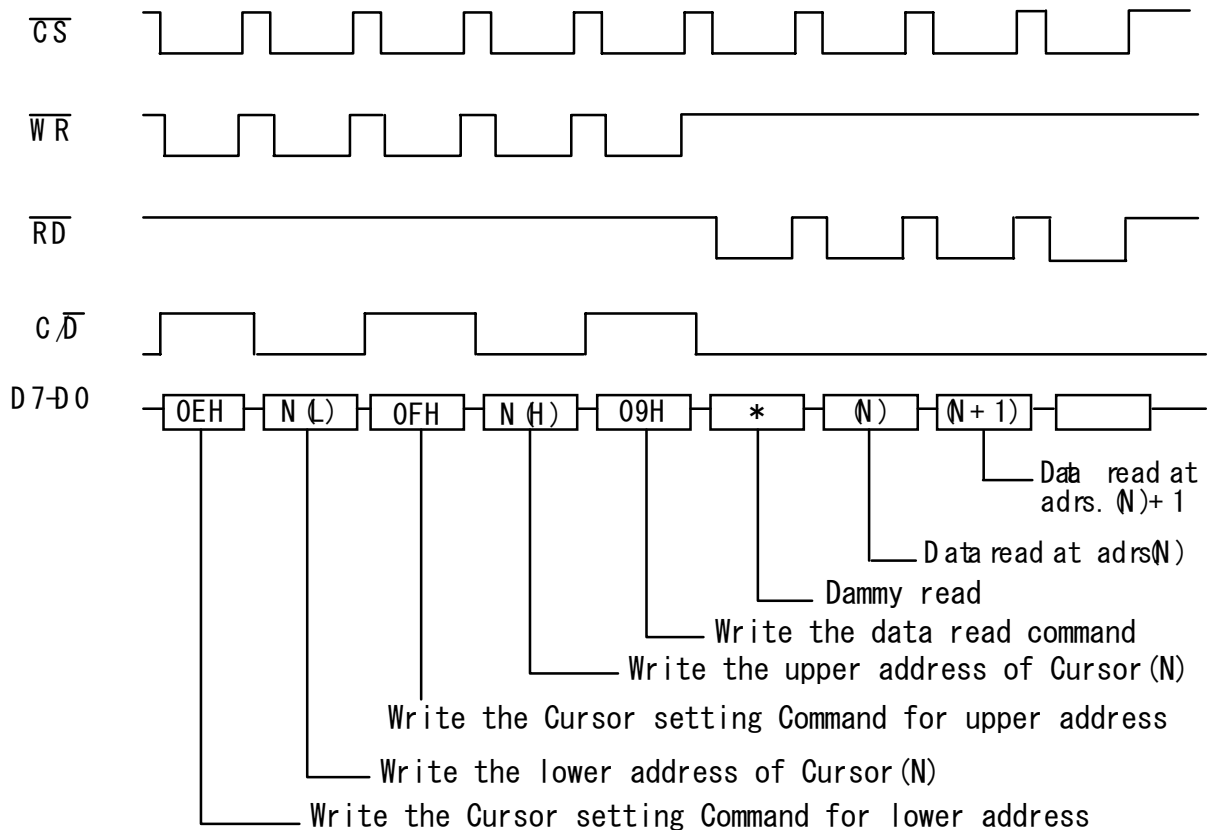
When Screen #2 is used, Screen #2 should be enabled before Data Write.

### 10.4 Data write/ read

Command (C/*D = "1")					HEX	Function	Default
D4	D3	D2	D1	D0			
0	1	0	0	0	08	Data Write.	-
0	1	0	0	1	09	Data Read.	-

After Cursor Address is set, the above Data Write or Data Read Commands is given. The one byte data shall be written or be read during the line C/\*D="0" sequentially. The cursor address is automatically incremented one address count after the Data Write or the Data Read when the command of 04H is selected. If 05Hex command is given, cursor stay same address even after write or read data operation.

**CAUTION!** Within data read mode, first byte (right after "DATA READ COMMAND") is invalid. And 2'nd byte is a data from cursor address. It is necessary **a dummy read** right after the "DATA READ COMMAND".



### 10.5 Setting display start address

Command (C/*D = "1")					HEX	Setting Data(C/*D = "0")								Function	De -fault
D4	D3	D2	D1	D0		D7	D6	D5	D4	D3	D2	D1	D0		
0	1	0	1	0	0A	A7	A6	A5	A4	A3	A2	A1	A0	Lower address of #1	-
0	1	0	1	1	0B	X	X	X	A12	A11	A10	A9	A8	Upper address of #1	-
0	1	1	0	0	0C	A7	A6	A5	A4	A3	A2	A1	A0	Lower address of #2	-
0	1	1	0	1	0D	X	X	X	A12	A11	A10	A9	A8	Upper address of #2	-

A setting sequence of display start address of #1 and #2 should be as follows ;

Controller A

Setting of Lower/Upper address of controller A. (#1)

Setting of Lower/Upper address of controller A. (#2)

Controller B

Setting of Lower/Upper address of controller B. (#1)

Setting of Lower/Upper address of controller B. (#2)

After writing of appropriate command from the above, the display start address is written into the display start address register.

The RAM content pointed display start address of controller A is located at the top left corner on the display screen. The RAM content pointed display start address of controller B is located at the top center on the display screen. Using with these commands, page switching and one-dot left/right scrolling are available. Since FRP line indicate at each frame of display refresh, the smooth scrolling can be achieved by changing display start address synchronizing to FRP signal from module.

In order to combine left half and right, and use entire 256X16 dot as one screen, set start address of controller "B" equal to start address of "A" + 0400H.

It is necessary to set the lower address first and upper address should be set later.

### 10.6 Cursor address set

Command (C/*D = "1")					HEX	Function	Default
D4	D3	D2	D1	D0			
0	1	1	1	0	0E	Lower address of cursor.	-
0	1	1	1	1	0F	Upper address of cursor.	-

The cursor address is written into the cursor address counter. The cursor address means the address for Read/Write of display pattern in the RAM.

It is necessary to set the cursor address before execution of Data Write commands(08H) or Data Read command(09H).

### 10.6 Cursor address set (Cont'd)

When address is given to display controller, the cursor address is divided into the 2 portions which are upper(5bits) and lower(8bits) address and the followings are restriction to set.

CASE	Manner
Change (set) the both(upper and lower) address.	First,set the lower cursor address and upper address.
Change (set) the lower address only.	Same as above.
Change (set) the upper address only.	Set the upper address only. Do not need to set the lower address.

### 10.7 FRP signal and DC/DC Converter ON/OFF

Command (C/*D = "1")					HEX	Function	Default
D4	D3	D2	D1	D0			
1	0	1	0	0	14	FRP signal=ON, DC/DC Conv.=OFF.	⊙
1	0	1	0	1	15	FRP signal=ON, DC/DC Conv.=ON.	-
1	0	1	1	0	16	FRP signal=OFF, DC/DC Conv.=OFF.	-
1	0	1	1	1	17	FRP signal=OFF, DC/DC Conv.=ON.	-

Concerning ON/OFF of FRP signal, it is controlled by DIP Switch(S4), too. FRP output is turned on, when DIP Switch (S4) is set on and FRP signal is set on by above command. When S4 is OFF or FRP signal = OFF, FRP output is kept High level.

### 10.8 Brightness Control

Command (C/*D = "1")					HEX	Function	Default
D4	D3	D2	D1	D0			
1	1	0	0	0	18	Set brightness 100%.	⊙
1	1	0	0	1	19	Set brightness 87.5%.	-
1	1	0	1	0	1A	Set brightness 75%.	-
1	1	0	1	1	1B	Set brightness 62.5%.	-

4 steps of Screen Brightness Control are available by the above commands.

### 11. Reset

When \*Reset is "0", a controller on the module is initialized.

All commands are set to default selection and during Reset="0", output of DC/DC converter is stopped.

### 12. Blanking

Display is blanked by \*BL="0". The RAM data in the module does not change during blanking and previous display is recovered by \*BL="1", unless controller write some data.

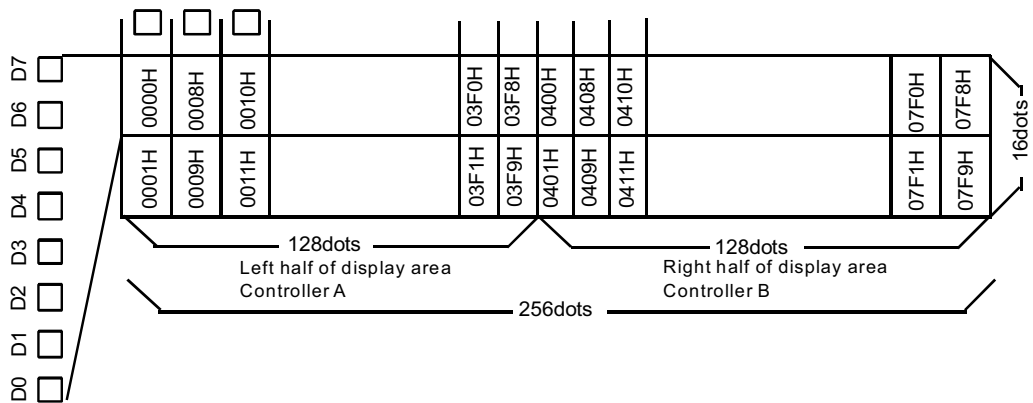
### 13. FRP signal

When DIP Switch( S4) is ON , one pulse comes out per one display frame, refresh cycle. Since FRP line is triggered at each frame of display refresh, the smooth scrolling can be achieved by change of display start address with synchronizing of FRP signal from module.

### 14. Display Address Map

Each memory address contain 8 bit data which cover 8 dots on a screen. The following address map is an example, when the display start address of controller "A" is set 0000 Hex and display start address "B" set 0400 Hex.

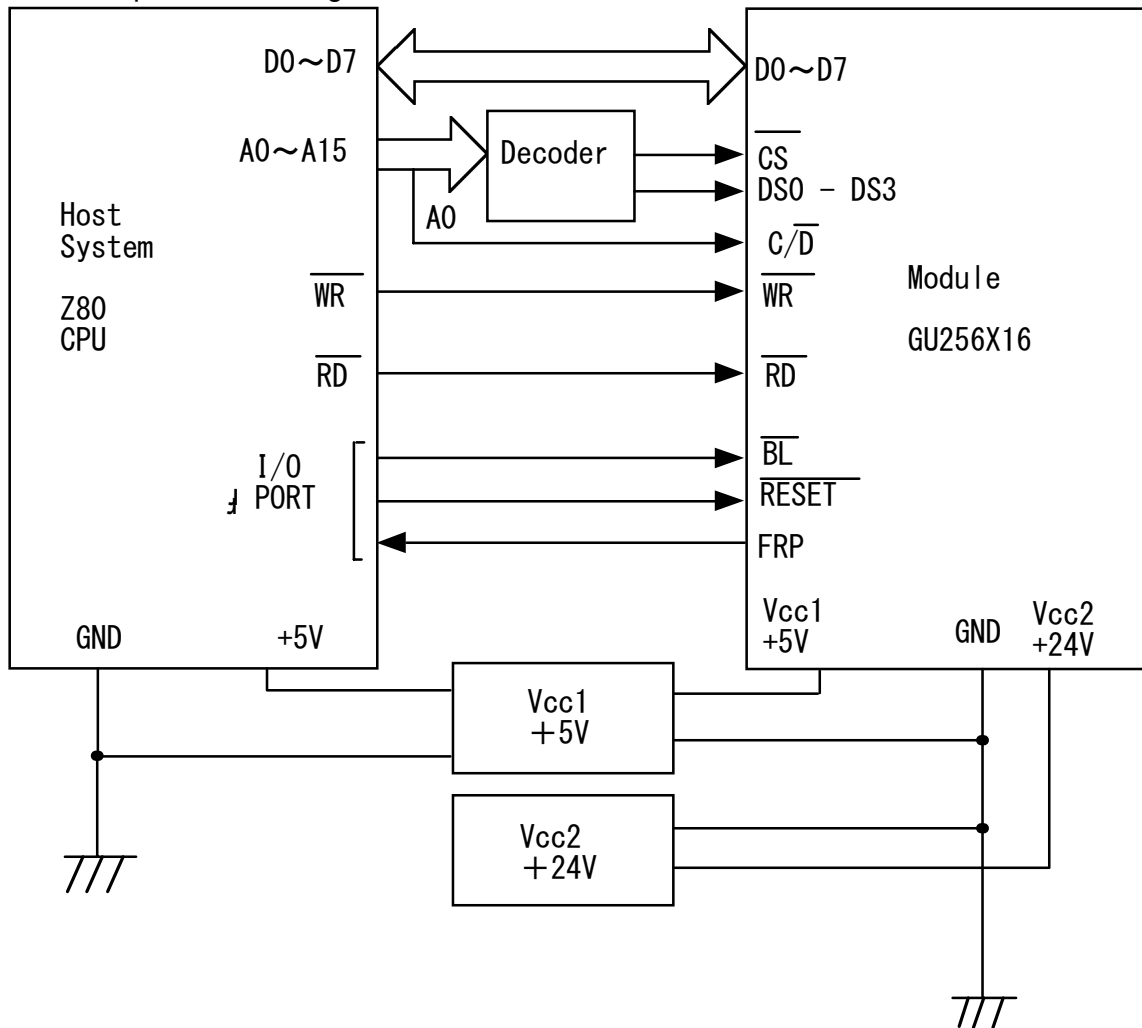
In case this module displays as one screen, display start address of controller B should be set to the start address A + 0400H.



As shown the above, the display address is incremented 8 bytes horizontally. When display start address is changed, the display address adds the display start address and the above address.

### 15. Interface

<An example of interfacing>



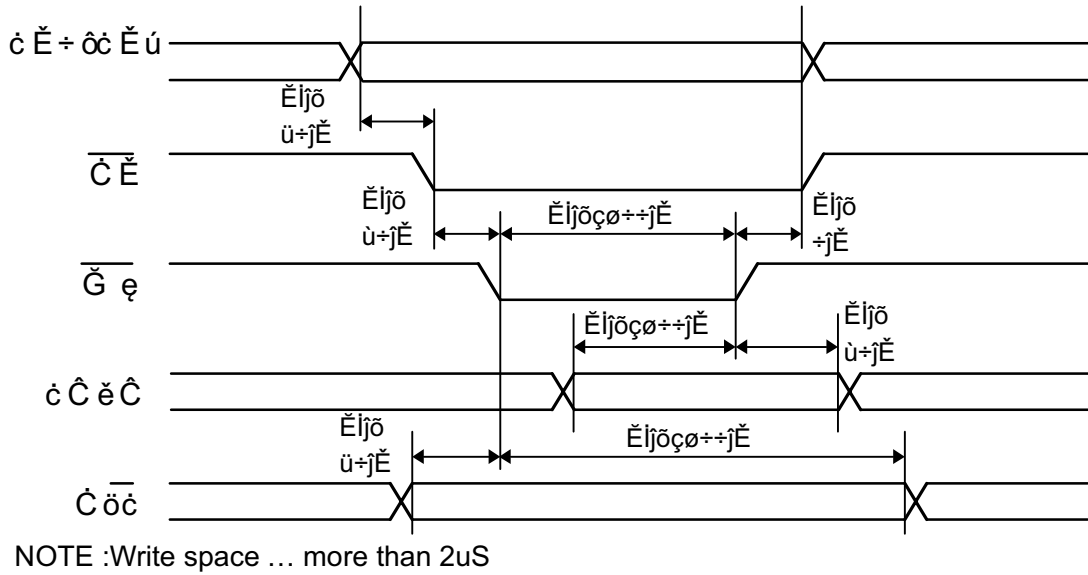
Since data execution time of the module is 2u Sec.(MAX.), there are no BUSY or READY output. Therefore more than 2u Sec. time period is required between module access.

$\overline{CS}$	$\overline{WR}$	$\overline{RD}$	$C/\overline{D}$	$\overline{BL}$	$\overline{RESET}$	Function
0	0→1	1	1	-	1	Command write(Host→Module)
0	0→1	1	0	-	1	Setting Data write(Host→Module)
0	1	0	1	-----	1	
0	1	0	0	-	1	Display data read(Host←Module)
-	-	-	-	0	1	Display blanking
--	Module					When Module Reset, DC/DC converter is OFF.

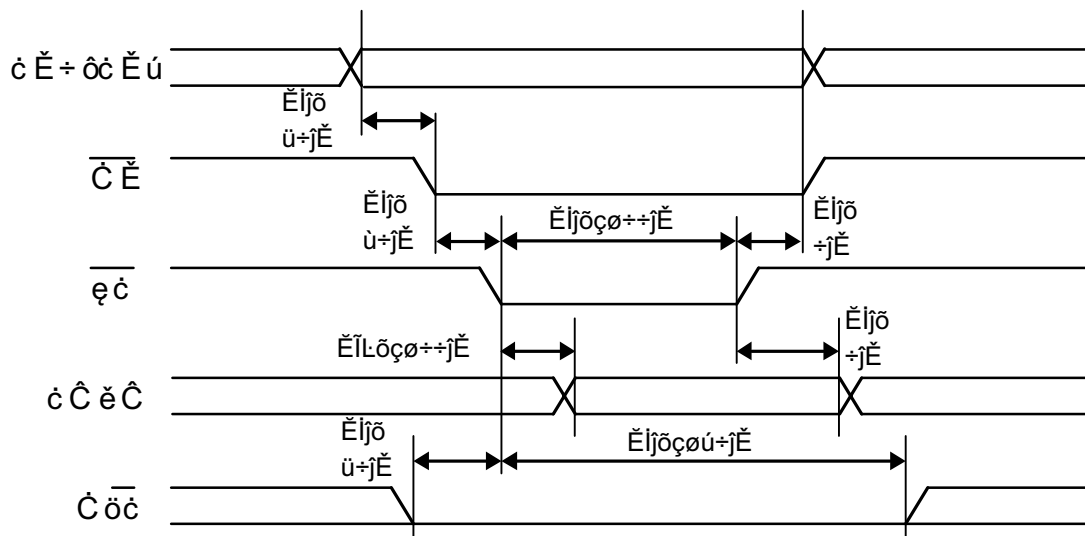


## 16. Timing Chart

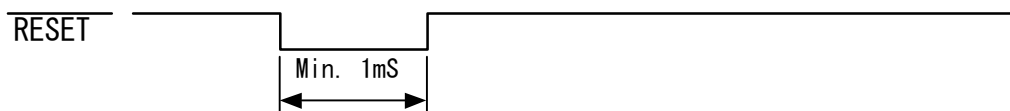
### 16.1 Write operation



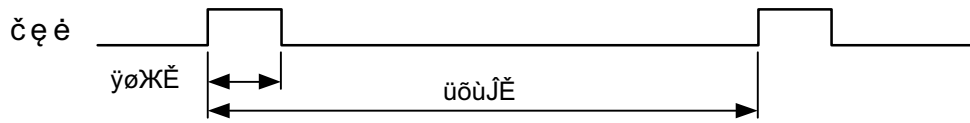
### 16.2 Read operation



### 16.3 Reset timing



### 16.4 FRP timing (output)

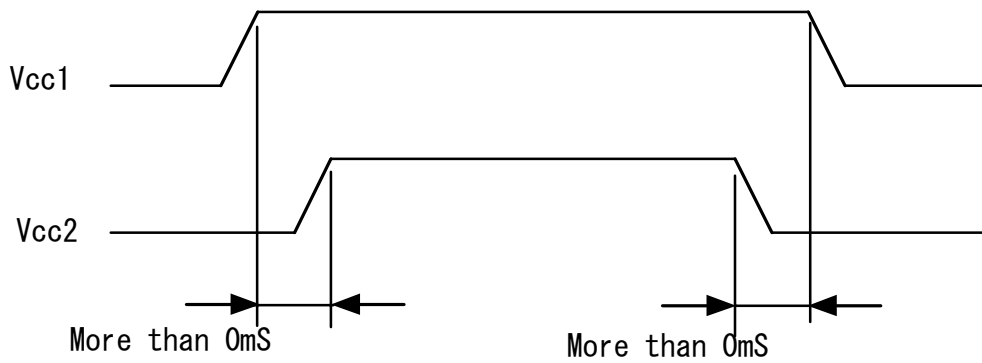


(FRP : Open collector outputs)

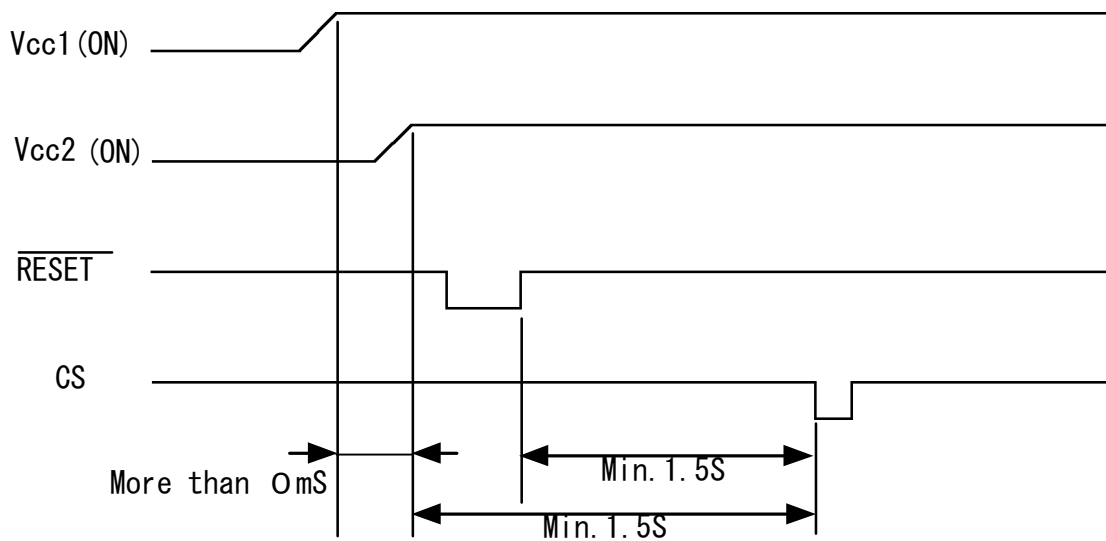
During FRP signal is at OFF by S4 or command, the level of FRP terminal is High("1").

### 16.5 Power ON/OFF Sequence

At power ON/OFF sequence must keep timing as follows;



### 16.6 The others



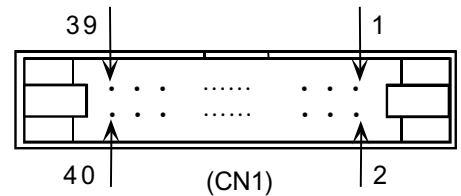
Caution !

Wait 1.5 Sec before accessing the module, after turn on DC/DC converter by command.

## 17. Pin assignment

### 17.1 Signal Connector

Pin No.	Description	Pin No.	Description
1	D7	2	GND
3 D6 4	GND		
5 D5 6	GND		
7 D4 8	GND		
9 D3 10	GND		
11	D2	12	GND
13	D1	14	GND
15 D0 16	GND		
17	*WR	18	GND
19	C/*D	20	GND
21	*RD	22	GND
23	*CS	24	GND
25	FRP	26	VCC1(+5V)
27	*BL	28	VCC1(+5V)
29	DS2	30	VCC1(+5V)
31	DS1	32	VCC1(+5V)
33	DS0	34	*RESET
35	DS3	36	NC (no pin)
37	EXCS1	38	GND
39	NC	40	GND



Type of connector:  
FCN-604Q040-G/S (Fujitsu) or Equivalent.

\*XX= $\overline{XX}$

NC : no connection

### 17.2 Power Connector

Pin No.	Description	1	2	3	4	5	6
1	Vcc2 (+24V)	□	□	□	□	□	□
2	Vcc2 (+24V)						
3	*LAMP_TEST						
4	GND						
5	GND						
6	IC						

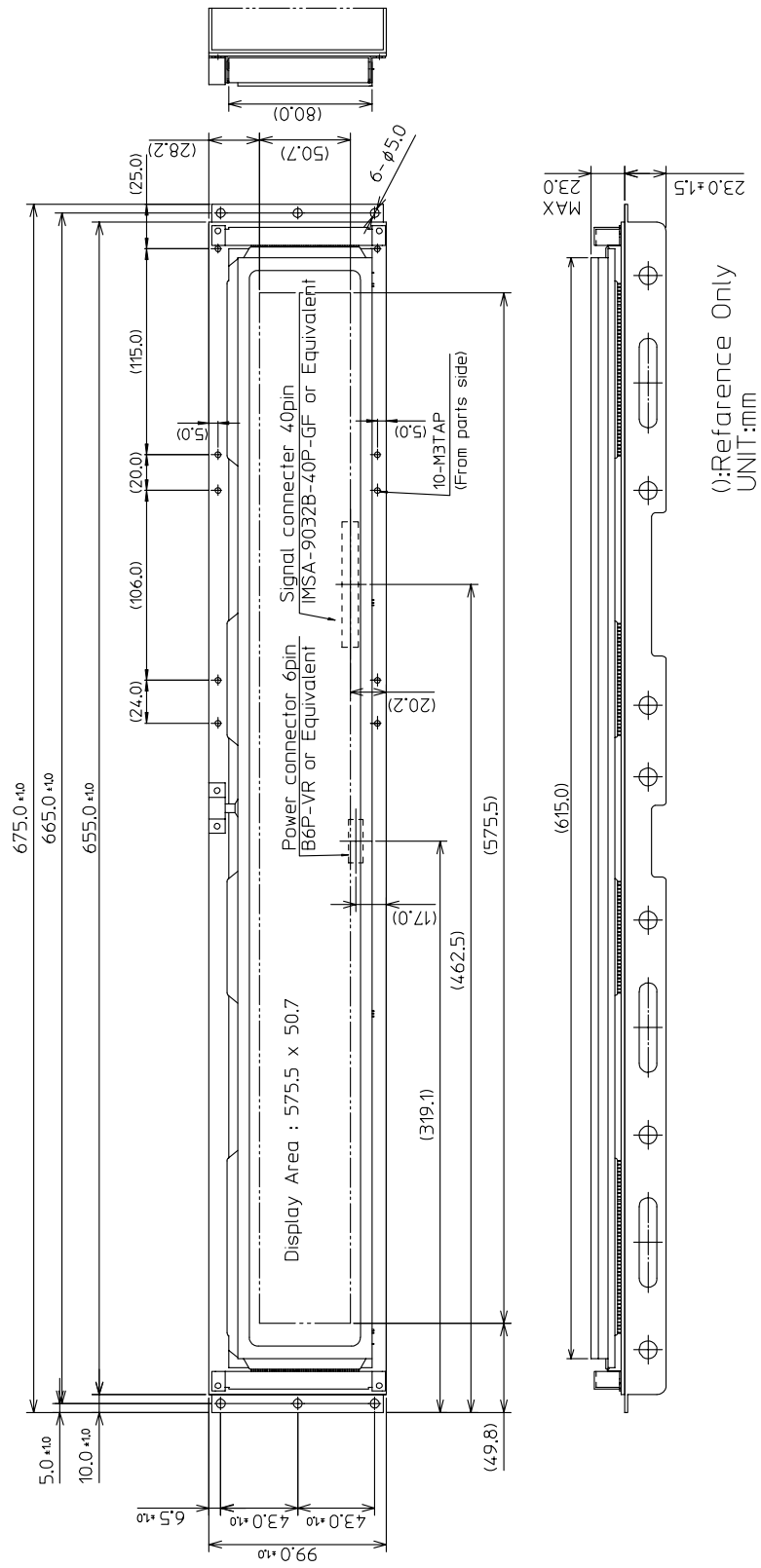
(CN2)

\*XX= $\overline{XX}$

IC : Internal connection. ( do not connect )

Type of Connector : B6P-VR (JST)

## 18. Outline Dimensions



## IMPORTANT PRECAUTIONS

This module is technically able to connect parallel maximum 16 modules with combination of DS0-DS3 and DIP switch (S0-S3). However, the module is affected by actual circumstance. Therefore, total reliability test should be taken by customer as a system.

Concerning ON/OFF of DC/DC Converter by command and Reset, more than 10 Sec. period between ON and OFF is required to avoid permanent damages into module

All VFD Modules contain MOS-LSI's ICs. Anti-Static handling is required.

A VF Display is made with Soda-Lime glass. Heavy shock loads exceeding 55G, thermal shock greater than 10°C/minute, or a direct blow to the glass surface - especially to the EXHAUST PIPE; may CRACK the glass.

Do not apply excessive pressure or torque to the display. When the factory builds the system frame, a slight gap between the display glass face and the front panel is necessary to avoid a contact failure of the lead pins of the display. Excessive pressure or torque will make the glass **CRACK** around the lead pins of the display.

Neither the **DATA CONNECTOR** nor the **POWER CONNECTOR** should be connected or disconnected while power is applied. As is often the case with most subsystems, caution should be exercised in selectively disconnecting power to a computer-based system. The module receives high logic on its strobe lines as random signals to all data ports. Removal of the primary power with logic signals applied may damage input circuitry.

Stress exceeding the specification listed under the Absolute Maximum Ratings may cause PERMANENT DAMAGE of the modules.

\*The Data cable length between the module and the host system is recommended to be **less than 300 mm** to eliminate noise.

Do not place the module on a conductive surface (metal or ESD conductive) immediately after power off. Large filter capacitors on the module store energy and require more than 1 min. of discharging time to avoid a short circuit condition.

When power is not applied for more than 2 months, several hours of operation under the test mode may help the stability of the brightness of the VFD

A fixed (static) message displayed longer than 5 hours continuously may cause phosphor burn-in. Some methods of avoiding this include: a sleep mode and "wake-up" event or periodically shifting the display pattern or periodically reversing the mode of green/black.

The module contains a high voltage power source (100 VDC). Handle with caution when power is applied.

+5Volts power line must be regulated completely since all control logic depend on this line. Do not apply slow start for both +5V and +24V power line. Provide more than two times current capacity power supply for 24V to avoid trouble of RUSH CURRENT at power on.