

# APPLICATION NOTE

## VACUUM FLUORESCENT DISPLAY MODULE

### GRAPHIC DISPLAY MODULE

### GP1128A01B

#### GENERAL DESCRIPTION

FUTABA GP1128A01B is a graphic display module using a FUTABA 160×64 dots VFD.

It consists of a driver a control and power source.

The module can be connected directly to the bus line of the host system CPU.

## Important Safety Notice

Please read this note carefully before using the product.

### Warning

- The module should be disconnected from the power supply before handling.
- The power supply should be switched off before connecting or disconnecting the power or interface cables.
- The module contains electronic components that generate high voltages (approx.65V) which may cause an electrical shock when touched.
- Do not touch the electronic components of the module with any metal objects.
- The VFD used on the module is made of glass and should be handled with care. When handling the VFD, it is recommended that cotton gloves be used.
- The module is equipped with a circuit protection fuse.
- Under no circumstances should the module be modified or repaired. Any unauthorized modifications or repairs will invalidate the product warranty.
- The module should be abolished as the factory waste.

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## 1. FEATURES

- 1-1. High quality and long life can be achieved FUTABA VFD.
- 1-2. Compact and light-weight unit by using display drivers and one-chip VFD control.
- 1-3. Driven through a simple interface.
- 1-4. High speed 8 bits data write-in capability.

## 2. GENERAL DESCRIPTION

### 2-1. DIMENSIONS, WEIGHT (Refer to FIGURE-1)

Table-1

Item	Specification	Unit
Outer dimensions	(W) 125.0±1 (H) 56.3±1 (T) 29.6 MAX.	mm
Weight	Approx. 150	g

### 2-2. SPECIFICATIONS OF THE DISPLAY PANEL

Table-2

Item	Specification	Unit
Display Area	71.9(W)×28.7(H)	mm
Number of Dots	160×64	Dot
Dot Size (H×W)	0.35×0.35	mm
Dot Pitch (H×W)	0.45×0.45	mm
Color Illumination	Green ( $\lambda_p=505\text{nm}$ )	–
Luminance	500 (Typ)	cd/m <sup>2</sup>

Note) By using a filter, uniform color range from blue to orange (including white) can be obtained.

### 2-3. ENVIRONMENT CONDITIONS

Table-3

Item	Symbol	Min.	Max.	Unit
Operation Temperature	<i>T<sub>opr</sub></i>	-20	+70	°C
Storage Temperature	<i>T<sub>stg</sub></i>	-30	+80	°C
Operating Humidity	<i>H<sub>opr</sub></i>	20	85	%
Storage Humidity	<i>H<sub>stg</sub></i>	20	90	%
Vibration (10 ~ 55Hz)	–	–	4	G
Shock	–	–	40	G

Note) Avoid operations and or storage in moist environmental conditions.

## 2-4. ABSOLUTE MAXIMUM RATINGS

Table-4

Item	Symbol	Min.	Max.	Unit
Supply Voltage	$V_{CC}$	-0.3	6.0	Vdc
Input Signal Voltage	$V_{IS}$	-0.3	$V_{CC}+0.3$	V

## 2-5. RECOMMEND OPERATING CONDITIONS

Table-5

Item	Symbol	Min.	Typ.	Max.	Unit
Supply Voltage	$V_{CC}$	4.5	5.0	5.5	Vdc
H-Level Input Voltage	$V_{IH}$	2.6	–	–	V
L-Level Input Voltage	$V_{IL}$	–	–	0.7	V

## 2-6. ELECTRICAL CHARACTERISTICS

Table-6

Item	Symbol	Condition	Min.	Typ.	Max.	Unit
Supply Current (Note 1)	$I_{CC}$	$V_{CC} = 5.0V_{dc}$ All on	–	750	1000	mA
Power Consumption	–		–	3.75	5.0	W
Luminance	$L$		250	500	–	cd/m <sup>2</sup>
H-Level Output Voltage	$V_{OH}$	$V_{CC} = 4.5V_{dc}$ $I_{OH} = -2mA$	3.6	–	–	V
L-Level Output Voltage	$V_{OL}$	$V_{CC} = 4.5V_{dc}$ $I_{OL} = 3.2mA$	–	–	0.5	V

Note) The surge current can be approx. 5 times the specified supply current at power on.

### 3. BASIC FUNCTION

- 3-1. Function Table
- 3-2. Function of Signal Lines
- 3-3. Command Table
- 3-4. Relationship of The Display Area to Address and Data
- 3-5. Function of Commands

#### 3-1. Function Table

Table-7

$\overline{\text{CS}}$	$\overline{\text{WR}}$	$\overline{\text{RD}}$	$\text{C}/\overline{\text{D}}$	MODE
L	↑	H	H	Command Write-in
L	↑	H	L	Data Write-in
L	H	L	H	—
L	H	L	L	Data Read-out

#### 3-2. Function of Signal Lines

Table-8

Signal	I/O	Function
D0~D7	I/O	8bit Data Bus
$\overline{\text{WR}}$	I	Write Signal
$\overline{\text{RD}}$	I	Read Signal
$\overline{\text{CS}}$	I	Chip Select Signal
$\text{C}/\overline{\text{D}}$	I	Command / Data Select Signal $\text{C}/\overline{\text{D}} = \text{"H"}$ : Command $\text{C}/\overline{\text{D}} = \text{"L"}$ : Data Write and Data Read
INT	O	Frame Signal (One output pulse per one display frame)
$\overline{\text{RESET}}$	I	Module Reset Signal $\overline{\text{RESET}} = \text{"L"}$ : Initialize the register (At the time, there is no change in the memory (RAM).)
Vcc1	—	+5V
GND	—	GND

### 3-3. Command Table

The followings are all commands of this module.

Table-9

Command (C/ $\bar{D}$ ="H")	Setting Data (C/ $\bar{D}$ ="L")	Function	Default Select
00H	—	Screen 1 & Screen 2 are Displayed off	○
01H	—	Screen1 is Displayed on	
02H	—	Screen2 is Displayed on	
03H	—	Screen 1 & Screen 2 are Displayed on	
04H	—	Read/Write address is automatically incremented	○
05H	—	Read/Write address is holed	
07H	D0~D7	Character code set	
08H	D0~D7	Display data write-in	
09H	D0~D7	Display data read-out	
0AH	D0~D7	Setting lower address for Screen 1 started	00H
0BH	D0~D3	Setting upper address for Screen 1 started	00H
0CH	D0~D7	Setting lower address for Screen 2 started	00H
0DH	D0~D3	Setting upper address for Screen 2 started	00H
0EH	D0~D7	Setting lower address of Write Read/Write	00H
0FH	D0~D3	Setting upper address of Write Read/Write	00H
10H	—	OR display of Screen 1 & 2	○
11H	—	EX-OR display of Screen 1 & 2	
12H	—	AND display of Screen 1 & 2	
13H	D0~D7	Brightness Adjustment	FFH
14H	D0~D7	Internal function set	00H

Note) "—" in the above table is shown that the setting data is not needed.





### 3-5. Function of Commands

#### 3-5-1. Screen Display on / off Control (00H, 01H, 02H, 03H)

The latest command becomes effective.

At power on, screen 1 and 2 are set to Display off mode.

Therefore, the Display on mode command should be written in, after display pattern data input. In case of executing Display on mode before display data input at initial, random pattern may be displayed.

#### 3-5-2. Setting of Write Address Mode (04H, 05H)

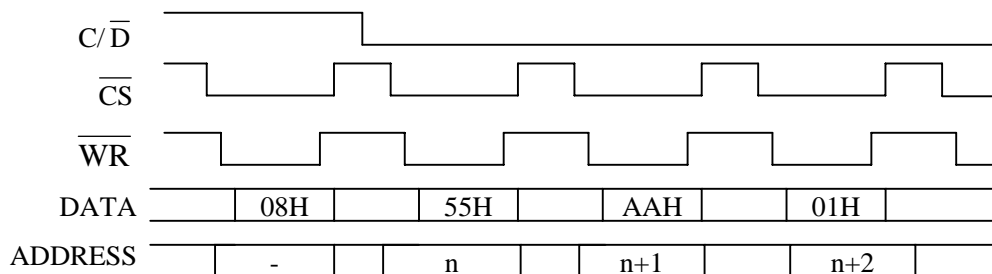
These commands select either the write or read address is incremented by single step automatically or is held after data write and data read.

When a memory address is set to 90Fh, next memory address is set to 000h.

#### 3-5-3. Data Write (08H)

After executing the Write address setting command, this command shall be executed.

The following indicate the display data 55H, AAH and 01H write-in.

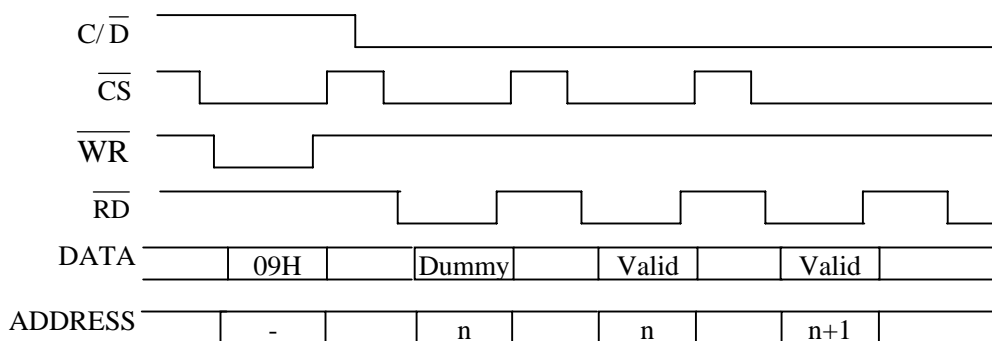


#### 3-5-4. Data Read (09H)

After executing the Read address setting command, this command shall be executed.

Dummy read is necessary. The correct data can be read from the second byte.

The following indicate the display data read out.



### 3-5-5. Setting of Display Start Address (0AH, 0BH, 0CH, 0DH)

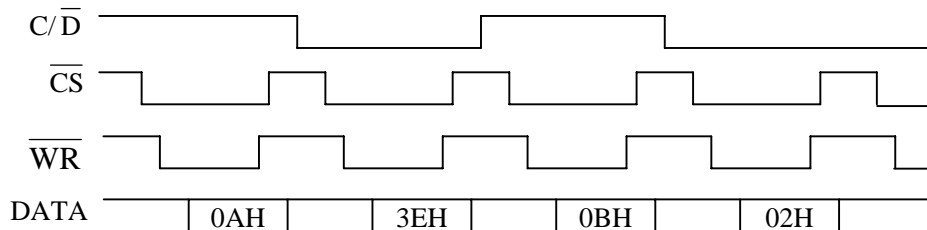
The display start address is just pointed to the left and top line of the display area.

Screen 1 and 2 can be independently set the display start address each other.

This address is divided to the two portions with upper (five bits) and lower (eight bits) address, and lower address shall be set first, then set the upper address.

The smooth scroll of displaying can be achieved by synchronizing with the change of display address by the INT signal at every frame.

The following indicate the display start address of screen1 to set to 23EH.



### 3-5-6. Setting of Write/Read Address (0EH, 0FH)

This command is set the write/read address of displaying data.

This address is divided the two portions with upper (five bits) and lower (eight bits) address, and lower address shall be set first, then set the upper address.

Only the upper address is available to be changed independently.

When the lower address is changed, it is required to change the both address.

### 3-5-7. Screen OR / EX-OR / AND Display Select (10H, 11H, 12H)

The latest command becomes effective.

### 3-5-8. Luminance Adjustment (13H)

Write-in data (00H~50H) allows luminance to be adjusted.

When the module is turned on, it is set to dimming level 0%.

Table-10

Input Data	Luminance
00H	100% (Max.)
0AH	90%
14H	80%
1EH	70%
28H	60%
32H	50%
3CH	40%
46H	30%
50H	20%
64H~FFH	0% (Display blank)

Note1) Write-in data (64H~FFH) allows luminance to be 0%.

Note2) Write-in data is available from 00H to 50H.

Note3) Write-in data (51H~63H) prohibits.

### 3-5-9. Character Code Write-in (07H)

By using this command, a character of a font ROM can be displayed.

①	②	③	④
Command 07H	Character code Lower byte	Character code Upper byte	Offset data
1byte	1byte	1byte	1byte

- ① Write command 『07H』
- ② Write lower byte character code data.
- ③ Write upper byte character code data.
- ④ Write offset data.

Note) Write continuously from ① to ④.

### 3-5-10. Setting of Character Code

Lower byte (c1~c7) shall be set first, then set the upper byte (c8 and d1~d5).

The below table is the relationship between c1~c8, d1~d5 and write-in data D7~D0 bit.

Lower byte								Upper byte							
D7	D6	D5	D4	D3	D2	D1	D0	D7	D6	D5	D4	D3	D2	D1	D0
—	c7	c6	c5	c4	c3	c2	c1	—	—	d5	d4	d3	d2	d1	c8
0	*	*	*	*	*	*	*	0	0	*	*	*	*	*	*

\* :Select by character code.

0 :Set to 『0』

The following is for example to be displayed 『漢字』 characters with 16×16 dot format.

Character code of 『漢』 is 41h(lower byte) and 04h(upper byte).

Character code of 『字』 is 7Ah(lower byte) and 0Bh(upper byte).

	Lower byte								Upper byte							
	D7	D6	D5	D4	D3	D2	D1	D0	D7	D6	D5	D4	D3	D2	D1	D0
	—	c7	c6	c5	c4	c3	c2	c1	—	—	d5	d4	d3	d2	d1	c8
漢	0	1	0	0	0	0	0	1	0	0	0	0	0	1	0	0
字	0	1	1	1	1	0	1	0	0	0	0	0	1	0	1	1

- ① 『漢』 character is displayed.  
07h(command)→41h(lower data)→04h(upper data)→48h(offset data)
- ② 『字』 character is displayed.  
07h(command)→7Ah(lower data)→0Bh(upper data)→48h(offset data)

### 3-5-11. Setting of Font Size

Font size can be selected by setting a offset data.

The table-11 indicates the relationship between a offset data and font size.

Table-11

Offset Data	Font Size	The Number of Read-out Bytes	Note	Conversion Time (uS) (*2)
00H	24×24 dots	72	—	65
80H (*1)	12×24 dots (Half size of 24×24)	32	—	34
48H	16×16dots	32	—	30
C8H (*1)	8×16 dots (Half size of 16×16)	16	—	16
68H	5×7 dots	5	Japanese-font type Alphabet, Numerals, Katakana	6
70H	5×7 dots	5	European-font type Alphabet, Numerals	6

\*1: When a half size letter is displayed, D7 bit of a offset data is set to "1".

\*2: It indicates the time to complete the conversion of character generator ROM data after the command data is write-in. And the command of 08h, 0Eh and 0Fh are ignored within this conversion time.

### 3-5-12. Conversion table, from JIS Code to a Character Code

The following indicates the data exchange from JIS code to a character code.

Classification (JIS code)	b7	b6	b5	Upper byte								Lower byte							
				-	-	d5	d4	d3	d2	d1	c8	-	c7	c6	c5	c4	c3	c2	c1
Alphabet and Numerals	0	1	0	0	0	0	a7	a6	b3	b2	b1	0	0	0	a5	a4	a3	a2	a1
Kanji (level 1)	0	1	1	0	0	0	b7	b4	b3	b2	b1	0	a7	a6	a5	a4	a3	a2	a1
Kanji (level 1)	1	0	0	0	0	0	b7	b4	b3	b2	b1	0	a7	a6	a5	a4	a3	a2	a1
Kanji (level 2)	1	0	1	0	0	1	b6	b4	b3	b2	b1	0	a7	a6	a5	a4	a3	a2	a1
Kanji (level 2)	1	1	0	0	0	1	b6	b4	b3	b2	b1	0	a7	a6	a5	a4	a3	a2	a1
Kanji (level 2)	1	1	1	0	0	1	a7	a6	b3	b2	b1	0	0	0	a5	a4	a3	a2	a1
Katakana	0	1	0	0	0	1	a7	a6	1	b3	b1	0	0	0	a5	a4	a3	a2	a1

Note 1) b7~b1 is first byte of JIS code, a7~a1 is second byte of JIS code.

Note 2) d5~d1 and c8~c1 is character code.

### 3-5-13. The Display Position of a Character

A character is displayed from the address where is set by the read/write address command.

When  $16 \times 16$  font,  $24 \times 24$  font and  $5 \times 7$  font is displayed in order, the read/write address is automatically shifted as follows.

- ① The read/write address is 000h at first
- ②  $16 \times 16$  font write-in → Read/Write address is shifted to 080h
- ③  $24 \times 24$  font write-in → Read/Write address is shifted to 140h
- ④  $5 \times 7$  font write-in → Read/Write address is shifted to 168h

16×16 Font				24×24 Font				5×7 Font					
1	2	15	16	17	18	19	38	39	40	41	42	45	46
000	001	002	003	008	009	00A	00B	070	071	072	073	078	079
080	081	082	083	088	089	08A	08B	090	091	092	093	128	129
130	131	132	133	138	139	13A	13B	140	141	142	143	148	149
160	161	162	163	168	169	16A	16B						

Note 1) A character is displayed from the position of the latest address by read/write address setting command.

Note 2) Read/Write address is shifted by offset data (font size).

Note 3) Even if 05h command mode is selecting, read/write address is shifted.

#### 〈Other note〉

- (1). The characters from 0000h to 021Fh in character code table (1) can only be displayed by half-size letter code.  
And it becomes blank display at the right half area if it is set by full-size letter code.
- (2). The half-letter katakana characters from 2500h to 261Fh in character code table (5) can only be displayed.  
A half-letter hiragana character can not be displayed properly.
- (3). The  $5 \times 7$  dot format characters from 2500h to 261Fh in character code table (5) can only be displayed by offset data 68h.
- (4). The half-letter katakana characters ( $24 \times 12$ ,  $16 \times 8$ ) from 2700h to 271Fh in character code table (5) can only be displayed.  
The  $5 \times 7$  dot format character can not be displayed.

### 3-5-14. Internal Function Set (14H)

When the module is turned on, it has to be written 20H after this command data (14H) is sent to a module.

Note) Do not write an other data instead of 20H.

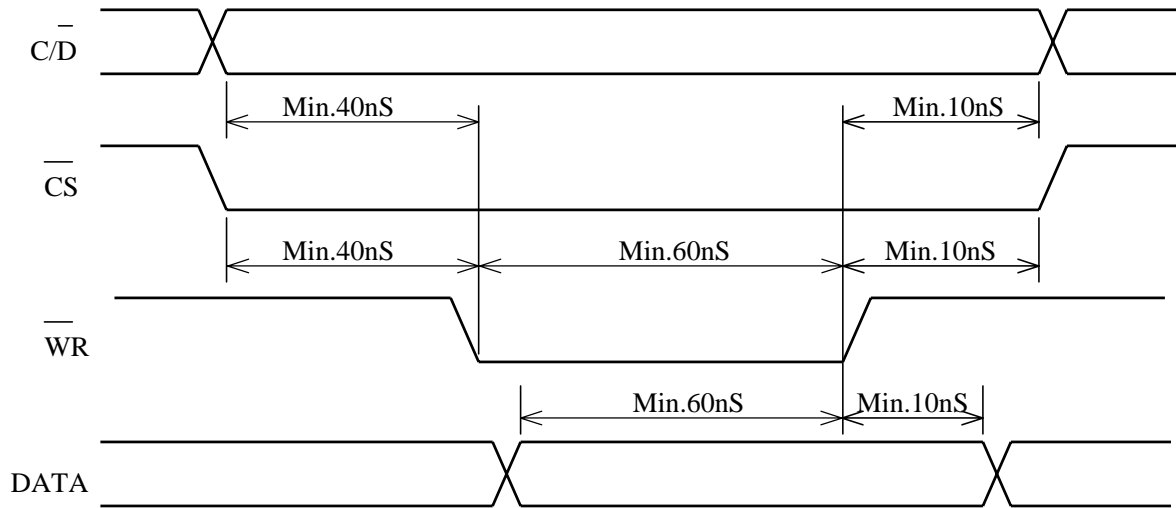
#### 4. INTERFACE CONNECTION

Table-12

Pin No.	Description	Pin No.	Description
1	D0	2	D1
3	D2	4	D3
5	D4	6	D5
7	D6	8	D7
9	GND	10	INT
11	$\overline{\text{WR}}$	12	$\overline{\text{RD}}$
13	$\overline{\text{CS}}$	14	C/D
15	Vcc	16	Vcc
17	Vcc	18	GND
19	GND	20	N.C

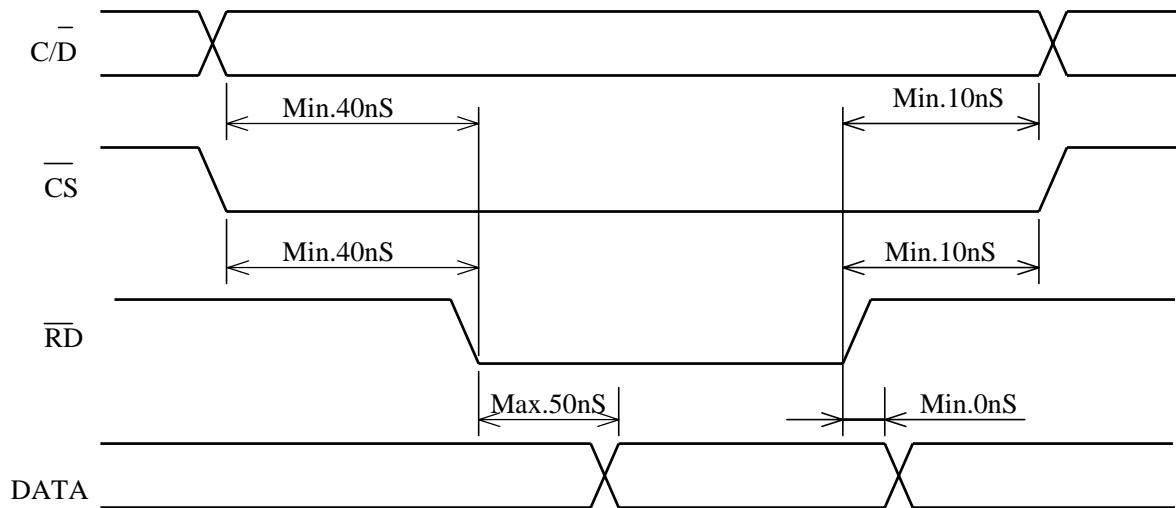
## 5. TIMING CHART

### 5-1. Write-in timing



1) The time of each one byte access is necessary with 1us min.

### 5-2. Read-out timing

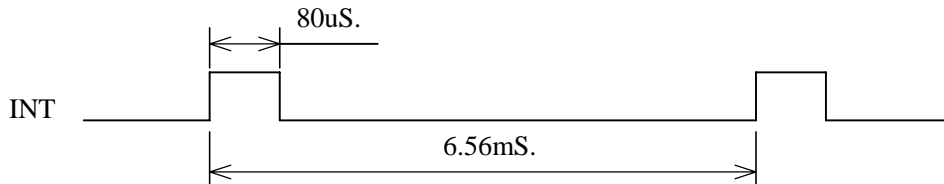


1) The time of each one byte access is necessary with 1us min.

### 5-3. INT timing

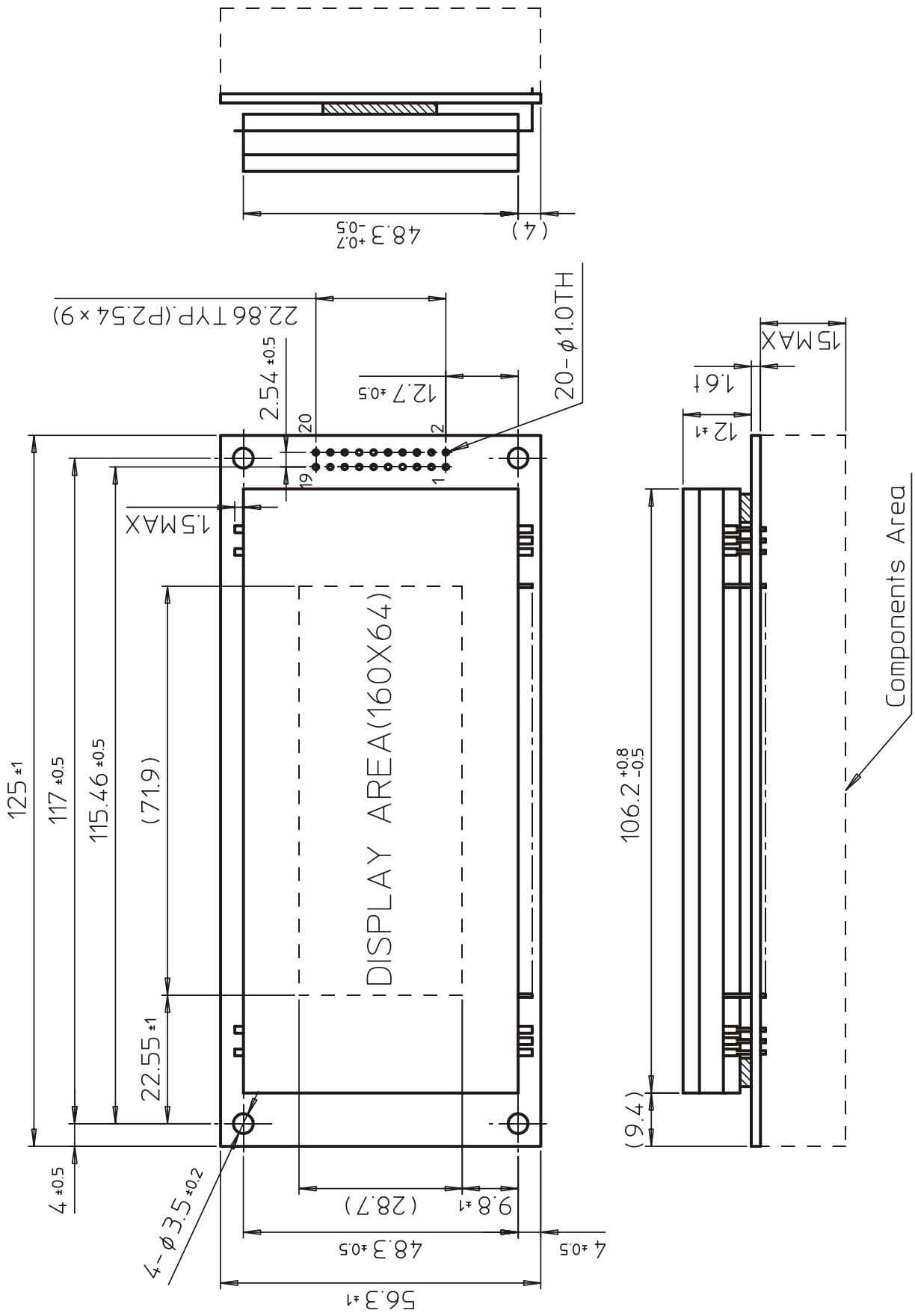
The module generates 80usec of INT signal at every 6.56msec of refresh timing.

Display start address should be executed during period of INT = "H" for smooth scroll.



GP1128A01B OUTER DIMENSION

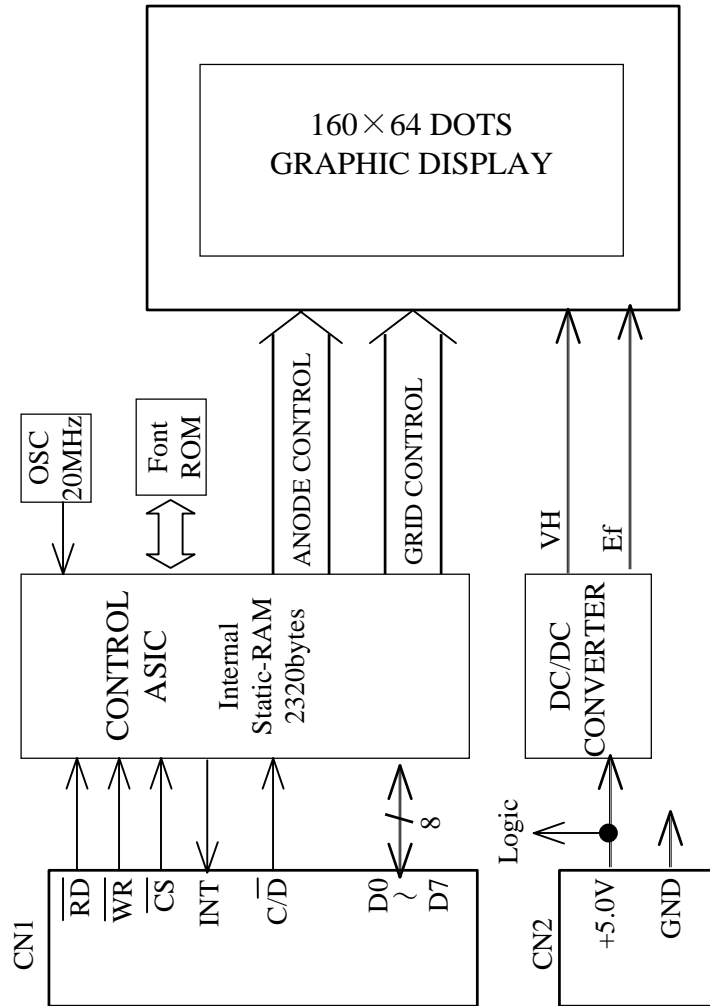
FIGURE-4





GP1128A01B CIRCUIT BLOCK DIAGRAM

FIGURE-5





















## 6. WARRANTY

This display module is guaranteed for 1 year after the shipment from FUTABA.

## 7. CAUTIONS FOR DETERMINING AND EXPORTING REGULATED GOODS OR SERVICES

This product does not correspond to the goods or services regulated by Japan's Foreign Exchange and Foreign Trade Law. If this product is combined with other products in order to make equipment, whether this product is regulated or not is judged by such newly made equipment. We ask you to determine by yourself whether the equipment corresponds to the regulated goods when this product is incorporated in the equipment.

We also ask you to confirm that this product will not be incorporated in any weapon or used for manufacturing any weapon.

If you export or re-export this product, we recommend you to adopt measures for appropriate export procedures, if any.

## 8. CAUTIONS FOR OPERATION

8-1. Applying lower voltage than the specified may cause non activation for selected pixels. Conversely, higher voltage may cause non-selected pixel to be activated.

If such a phenomenon is observed, check the voltage level of the power supply.

8-2. The DC/DC converter generates approximately 65Vdc, avoid touching it with bare hands, or to other circuits.

8-3. Avoid using the module where excessive noise interface is expected.

Noise affects the interface signal and causes improper operation.

Keep the length of the interface cable less than 30cm.

(When the longer cable is required, please confirm there is no noise affection.)

8-4. When power is turned off, the capacitor will not discharge immediately.

Avoid touching IC and others.

The shorting of the mounted components within 30 sec., after power off, may cause damage.

8-5. When fixed pattern is displayed for a long time, you may see uneven luminance.

It is recommended to change the display patterns sometimes in order to keep best display quality.

8-6. DC/DC converter is equipped on the module, the surge current may be approximately 5 times the specified supply current at the power on.

### REMARKS :

The specification is subject to change without prior notice.

Your consultation with FUTABA sales office is recommended for the use of this module.