SPECIFICATION FOR APPROVAL

PRODUCT	VFD MODULE
MODEL NUMBER	20L203DA2M
CUSTOMER	DD
APPLICATION	MODULE

Presented by

Alex Liu

Approved by

CONTACT INFORMATION		
DISTRIBUTOR	SALES DEPARTMENT	CUSTOMER SATISFACTION GROUP
	Lin Han Sales Staff Shanghai Samsung Vacuum Devices 389 East Rongledong-Road Songjiang Industrial Area, Shanghai China Tel.: +86-21-5774-6000 (Ext. 8201) Fax.: +86-21-5774-2244 e-mail: han.lin@samsung.com	**Alex Liu** Q.A Engineer Shanghai Samsung Vacuum Devices 389 East Rongledong-Road Songjiang Industrial Area, Shanghai China Tel.: +86-21-5774-6000 (Ext. 6011) Fax.: +86-21-5774-2244 e-mail: pinzhi.04@samsung.com

REVISION HISTORY				
Rev. No	Revised Date	Revision Description	Page	Issued by
00	Mar.24, 2006	* Created	-	Alex Liu

1. SCOPE

1.1 This specification applies to VFD modules manufactured by SSVD (Shanghai Samsung Vacuum Devices).
1.2 This specification becomes effective upon the customer's approval.
1.3 When any conflicts are found in this specification, appropriate action shall be taken upon the agreement of both parties, the customer and SSVD.
1.4 SSVD is responsible for presenting the reference samples of defects (for example, brightness uniformity, uneven brightness and brightness ratio between digits and dark spot etc.) when necessary.

2. QUALITY ASSURANCE

2.1 Warranty Period:
Warranty period is 12 months from the receipt date of customer.

2.2 Quality Assurance:
Statistical sampling and inspection will be performed in accordance with ANSI/ASQC Z1.4-1993 INSPECTION LEVEL-II. The acceptable quality level (AQL) is specified as below;
* Major Defects: AQL 0.4 %
* Minor Defects: AQL 1.0 %

2.2.1 Major defect item is defined as follows;
Effected item for fundamental function of VFD module such as broken filament, air leakage, broken glass, open/short segment, signal fault and not working.

2.2.2 Minor defect item is defined as follows;
Effected item for validation used of VFD module such as uneven luminance, dark spot on segment, outside scratch and blemish out of display surface.

2.3 Inspection Items:
The inspection will be classified as follows.

2.3.1 Display Inspection:
Display appearance will be inspected by unaided eyes under the normal operating condition, all segment on, and ambient luminosity is approximately 100 lx.
-. Uneven Brightness:
The brightness ratio between the brightest digit and the dimmest one shall not exceed 2.
-. Black Spot on a Segment:
The diameter of a black spot shall be less than 0.3mm.
-. Luminance:
The luminance shall be more than the minimized value in the specification.

2.3.2 Function Inspection:
The module shall satisfy the basic function and/or control commands, which are described in the specification.

2.4 Inspection Condition:
Unless otherwise specified, above inspection items (display and function inspection) will be performed in accordance with the recommended operating conditions in the specification at room temperature (25 ^{o}C +/- 5 ^{o}C).

3. DESIGN CHANGE

3.1 A customer has to inform the supplier, SSVD, if he is willing to use beyond the recommended operating conditions.
3.2 The manufacturer, SSVD, reserves the right to change any design and/or components for the product, VFD module, unless it causes any trouble for using it. We will discuss it with the customer when we have to change the specification, as a result of critical design and/or components.

4. PRODUCT SPECIFICATION

The product specification will be applied in accordance with the attached spec sheet.

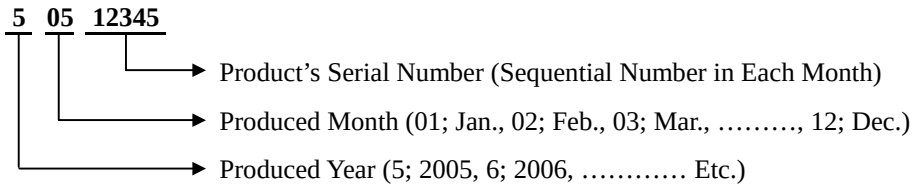
5. PRODUCT INDENTIFICATION & PACKING

5.1 Product Identification

The module should have the following information on PC-board.

* Model Number……...20L203DA2M
* Production Serial Number……..Refer to Following Example

Example; Produced in May 2005



5.2 Packing & Weight

Every VFD module has to be enclosed in an anti-static poly bag to prevent the electronic components from electro-static damage and VF-glass's scratch.

Four paper-trays are stacked in a carton box and 12 VFD modules are packed in a paper-tray. Consequently, a carton box contains 48 VFD modules as long as the carton is fully packed.

Outer dimension and total weight of the carton box is specified as below.

* Outer Dimension ……470(W) x 370(D) x 400(H) mm
* Weight ……approx.11 kg

6. AGING (RECOVER BRIGHTNESS)

Long-term storage can lead the VF-display to brightness decrease since small amount of gas might be come out from the chemical compounds inside the VF-glass. In this case, it is usually recommended for a user to turn-on all segments/dots during several hours under the specified supply voltage.

In the same way, a user can recover the severe brightness difference between l0.0it and unlit segments, after long-term operating with fixed pattern. (We strongly recommend that a user should not operate the VF-display with fixed-pattern continuously. A user should scroll or change the pattern not to be fixed during useless information is being displayed on the VFD for long time.)

To: _____

SPECIFICATION

Rev. 1.0

Application: _____

VACUUM FLUORESCENT DISPLAY MODULE

Model No.: 20L203DA2M

Rev. No.	Issued Date	Descriptions	Remark
Tentative	Jul. 29, 1999	* Original (First Edition)	
Rev. 1.0	Nov. 22, 2005	* Change of Document Format	All Pages

Issued by	Customer's Approval
Checked by	
Confirmed by	

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1. SCOPE

This specification applies to VFD module (Model No: 20L203DA2M) manufactured by SSVD (Shanghai Samsung Vacuum Devices).

2. FEATURES

* Vacuum Fluorescent Display: Self Luminous, High Quality and Readable Display

* +5VDC Single Power Supply: Built in DC/DC Converter

* Interface: RS-232C Serial Interfacing (Baud-rate: 1,200 ~ 9,600 bps)

* Two kinds of CG-ROM Font: ASCII + Japanese and ASCII + European

* 6 Brightness Level

* Character Format: 5 * 7 Dot Matrix

* The module has up to sixteen user definable characters

3. PRECAUTIONS (OPERATING RECOMMENDATIONS)

* Avoid applying excessive shock or vibration beyond the specification for the VFD module.

* Since VFDs are made of glass material, careful handling is required. i.e. Direct impact with hard material to the glass surface(especially exhaust tip) may crack the glass.

* When mounting the VFD module to your system, leave a slight gap between the VFD glass and your front panel. The module should be mounted without stress to avoid flexing of the PCB.

* Avoid plugging or unplugging the interface connection with the power on, otherwise it may cause the severe damage to input circuitry.

* Slow starting power supply may cause non-operation because one-chip MCU won't be reset.

* Exceeding any of maximum ratings may cause the permanent damage.

* Since the VFD modules contain high voltage source, careful handling is required during powered on.

* When the power is turned off, the capacitor does not discharge immediately. The high voltage applied to the VFD must not contact to the ICs. And the short-circuitry of mounted components on PCB within 30 seconds after power-off may cause damage to those.

* The power supply must be capable of providing at least 10 times the rated current, because the surge current can be more than 5 times the specified current consumption when the power is turned on.

* Avoid using the module where excessive noise interference is expected. Noise may affects the interface signal and causes improper operation. And it is important to keep the length of the interface cable less than 50cm.

* Since all VFD modules contain C-MOS ICs, anti-static handling procedures are always required.

4. PRODUCT SPECIFICATIONS

4.1 Type

Type Number (Model)	20L203DA2M
Character Format	5 * 7 Dot Matrix with Descriptor
Number of Digits	40 (2 lines * 20 characters)

4.2 Outer Dimensions, Weight

Parameters	Symbols	Specification	Unit
Outer Dimensions	W * H * t	190.0 * 64.0 * 24.6	mm
VFD Glass Size	W * H	175.2 * 48.3	mm
Display Area	W * H	146.1 * 29.0	mm
Character Size	W * H	5.5 * 10.5	mm
Character Pitch	W * H	7.4 * 15.5	mm
Weight	-	Approx. 220	g

4.3 Environment Conditions

Parameters	Symbols	Min.	Max.	Unit
Operating Temperature	T_{OPR}	- 20	+ 70	^{O}C
Storage Temperature	T_{STG}	- 40	+ 85	^{O}C
Humidity (Operating)	H_{OPR}	0	85	%
Humidity (Non-operating)	H_{STG}	0	90	%
Vibration (10 ~ 55 Hz)	-	-	4	G
Shock	-	-	40	G

4.4 Absolute Maximum Ratings

Parameters	Symbols	Min.	Max.	Unit
Supply Voltage	VCC	-	+ 7.0	V_{DC}
Logic Signal Voltage	-	-0.3	VCC+0.3	V_{DC}

4.5 Recommended Operating Conditions

Parameters	Symbols	Min.	Typ.	Max.	Unit
Supply Voltage	VCC	4.5	5.0	5.5	V_{DC}
High Level Input Voltage	V_{IH}	3.5	-	VCC+0.3	V_{DC}
Low Level Input Voltage	V_{IL}	-0.3	-	0.8	V_{DC}

4.6 DC Characteristics **(when Ta = +25^{o}C, VCC = +5.0VDC)**

Parameters	Test Conditions	Min.	Typ.	Max.	Unit
Supply Current (*)	VCC=+ 5.0V (All dots are lit.)	-	800	1,200	mA
High Level Input Current	VCC=+ 5.0V	-	-	20.0	uA
Low Level Input Current	VCC=+ 5.0V	-	-	-0.36	mA
High Level Output Voltage	VCC=+ 5.0V	3.6	-	-	V_{DC}
Low Level Output Voltage	VCC=+ 5.0V	-	-	0.4	V_{DC}
Brightness	VCC=+5.0VDC	100 (340)	200 (680)	- -	ft-L (cd/m^2)
Display Color	-	Blue-green (peak wave=505nm)			-

(*) Note-1: The in-rush current can be approx. 5 times the specified supply current at power on. The peak in-rush current amplitude and duration are dependent on the characteristics of the host power supply.

4.7 AC Characteristics (when Ta = +25°C, VCC = +5.0VDC; Parallel Input)

Parameters	Symbol	Min.	Typ.	Max.	Unit
Pulse width of WR	Tpw (WR)	50	-	-	ns
Set up time of /SEL	Tsu (/SEL)	50	-	-	ns
Holding time of /SEL	Th (/SEL)	50	-	-	ns
Set up time of data bus	Tsu (DATA)	50	-	-	ns
Holding time of data bus	Th (DATA)	50	-	-	ns
Delay time of BUSY	Tdelay	-	-	50	ns
Execution time of data	Texe	-	-	350	us
Wait time of next WR	Twait	20	-	-	ns

4.8 Timing Chart

4.8.1 Starting the Self-Test

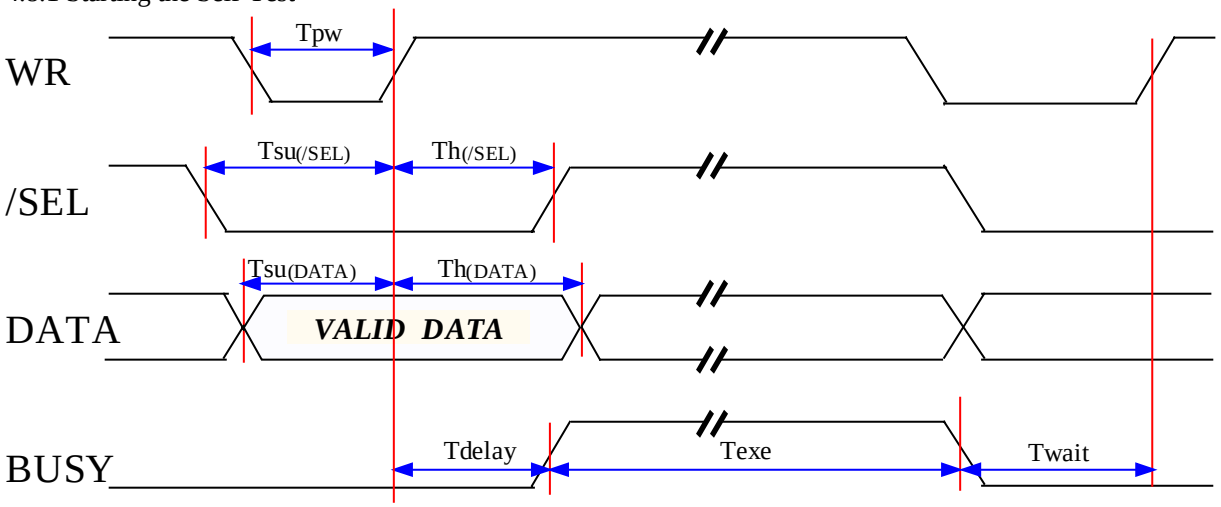


Fig.-1 Parallel Input Timing Diagram

4.8.2 Serial Input Timing Chart

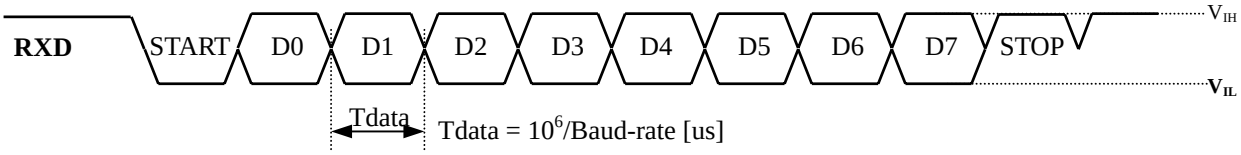


Fig.-2 Serial Input Timing Diagram

4.9 Signal Interfacing

* Connector (Male): A120PA-2.54DA (HIROSE) or equivalent

→ Mate Socket (Female): HIF3B-20D-2.54R (HIROSE) or equivalent is recommended

Pin No.	Signal	Pin Description
1	D7	Parallel data bus
3	D6	
5	D5	
7	D4	
9	D3	
11	D2	
13	D1	
15	D0	
17	WR	Write enable
19	RXD	Serial data input

Pin No.	Signal	Pin Description
2	VCC	Power Supply
4	VCC	Power Supply
6	VCC	Power Supply
8	/RST	External reset
10	GND	Ground
12	GND	Ground
14	GND	Ground
16	/TEST	Self test control
18	/SEL	Select
20	BUSY	System status

4.10 System Block Diagram

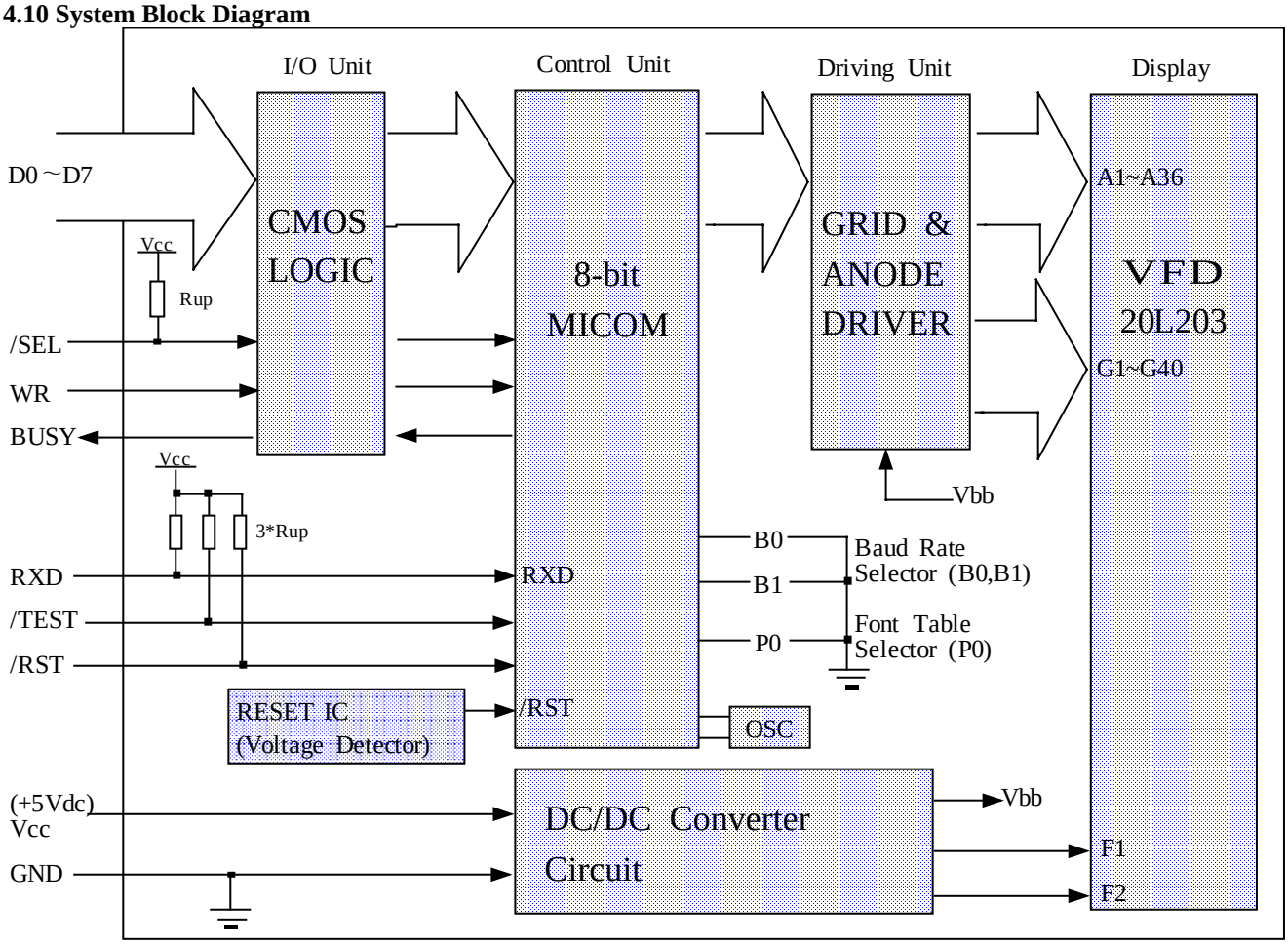


Fig.-3 System Block Diagram

4.11 Outer Dimensions

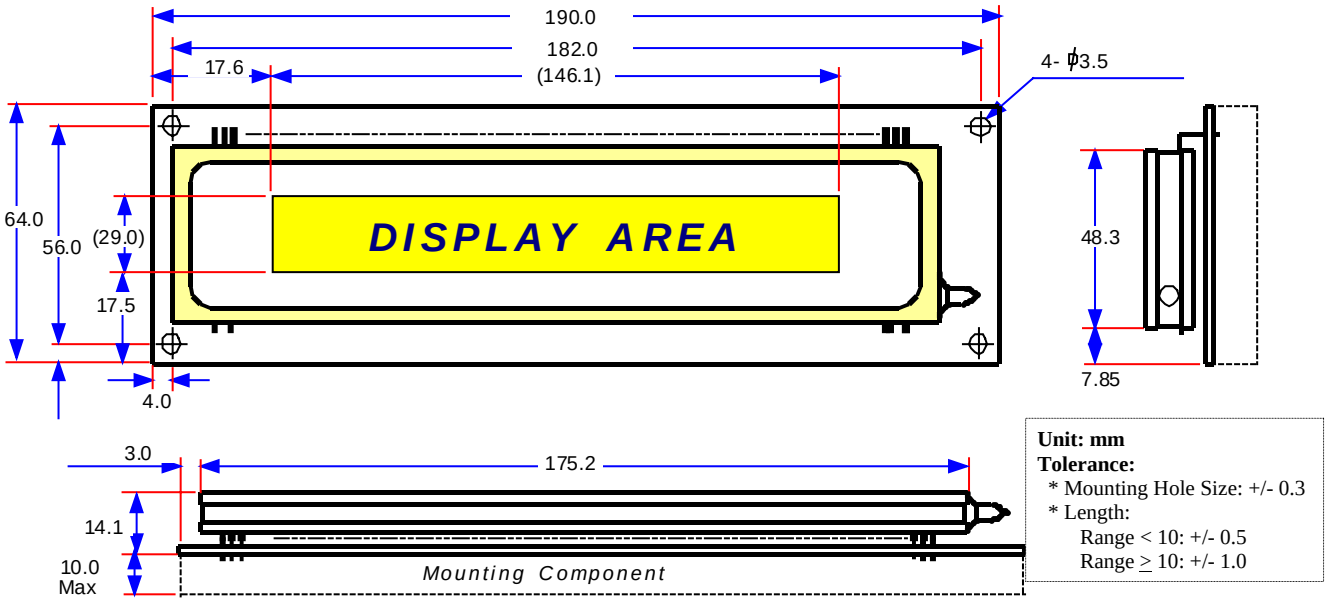


Fig.-4 Outer Dimensions

4.12 Pattern Details

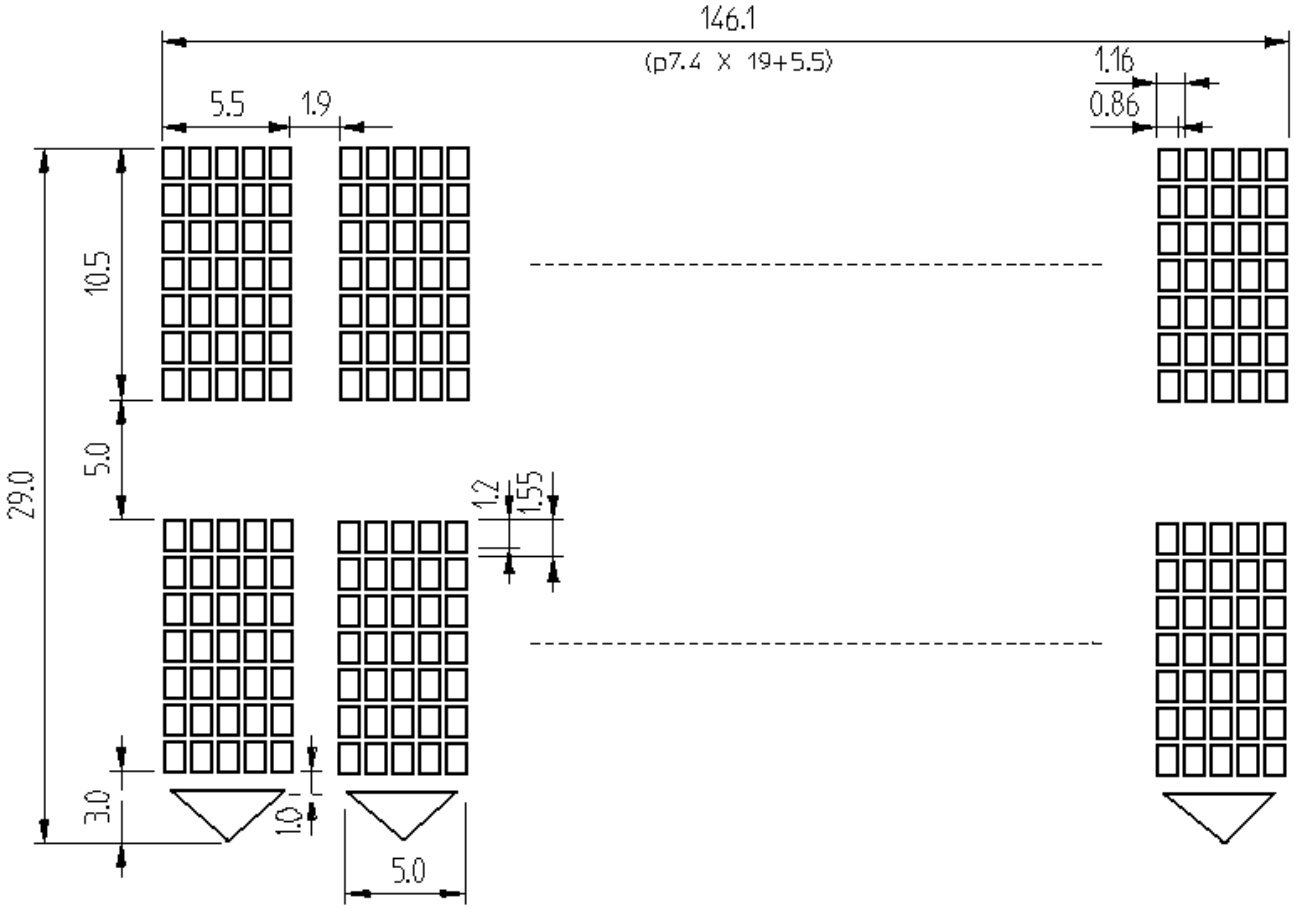


Fig.-5 Pattern Details

5. FUNCTIONS

The module has data and control code write-in, self test and power on reset function.

/RESET	/TEST	WR	/SEL	Function
1 or Open	1 or Open	0 to 1	0	Data and control code write-in
1 or Open	0	×	×	Self-test mode
0	×	×	×	External reset

×: Don't care.

When the data is being written-in, the BUSY signal is active(High) which indicates that the module is processing the data.

5.1 Character Data Write-in

When the character data code (20 Hex ~ FF Hex) is transferred to the module, the character font (See Page 12/13 ~ 13/13) is displayed on the screen.

At this time, the cursor will be shifted to the right one digit automatically.

5.2 Control Commands

The control commands are available as follows and details are will be explained.

(1) DIM: Dimming.....04 Hex
(2) BS : Back Space.....08 Hex
(3) HT : Horizontal Tab.....09 Hex
(4) CR : Carriage Return.....0D Hex
(5) ALD: All Display.....0F Hex
(6) DP : Display Position.....10 Hex
(7) DC : Cursor Mode.....17 Hex
(8) TON: Triangle Mark On.....18 Hex
(9) TOF: Triangle Mark Off.....19 Hex
(10) TFF : Triangle Mark All Off.....1A Hex
(11) UDF: Store a User-Definable Font.....1B Hex
(12) DUF: Display a User-Definable Font.....1C Hex
(13) FC : Japanese Katakana Font.....1D Hex
(14) FA : General European Font.....1E Hex
(16) RST : Reset (Initialization) .....1F Hex

5.2.1 DIM (04 Hex): Dimming

Brightness can be controlled into six levels by using this function. After writing 04 Hex, the successive Hex byte mentioned under is written to change the brightness level.

* Syntax: DIM Command (04 Hex) + Dimming Level Data (Refer to below table.)

Brightness Level	100 %	80 %	60%	40 %	20 %	0 %
Data	FF Hex	80 Hex	60 Hex	40 Hex	20 Hex	00 Hex

5.2.2 BS (08 Hex): Back Space

The write-in position is shifted to the left one digit and the character previously displayed on the digit will be cleared.

When the write-in position is on the left end digit of lower row, the cursor moves to the right end digit of upper row. When the write-in position is on the left end digit of upper row, the cursor moves to the right end digit of lower row.

5.2.3 HT (09 Hex): Horizontal Tab

The write-in position is shifted to the right one digit.

When the write-in position is on the right end digit of upper row, the cursor moves to the left end digit of lower row. When the write-in position is on the right end digit of lower row, the cursor moves to the left end digit of upper row.

5.2.4 CR (0D Hex): Carriage Return

All the characters displayed are erased, the write-in position moves to the left end digit of upper row. But the dimming level and cursor mode is kept.

5.2.5 ALD (0F Hex): All Display

The full dots in all digits are displayed. The dimming level is set for 100 %.
To release this mode, the module should be turned off or the RST command should be written.

5.2.6 DP (10 Hex): Display Position

Instead of writing the character from the first digit, the write-in starting position can be pointed out by using this command. After writing data 10 Hex, the successive Hex byte is written to specify the position desired.

* Syntax: DP (10 Hex) + Cursor Position Data (Refer to below table.)

	Left End	2nd Digit	3rd Digit	.....	19th Digit	Right End
Upper Row	00 Hex	01 Hex	02 Hex	.....	12 Hex	13 Hex
Lower Row	14 Hex	15 hex	16 Hex	.....	26 Hex	27 Hex

5.2.7 DC (17 Hex): Cursor Mode

After writing 17 Hex, the successive Hex byte mentioned under is written to change the cursor mode.

* Syntax: DC Command (17 Hex) + Cursor Mode Data (Refer to below table.)

Cursor Mode	Data
Cursor ON Mode	FF Hex
Cursor Blinking Mode	88 Hex
Cursor OFF Mode	00 Hex

The cursor is always displayed at the write-in position. The cursor is formed by the five dots located on the bottom of 5*7 dots matrix character font. The cursor will be displayed as an over writing mode and the behavior of the cursor under the cursor on mode and blinking mode are explained as follows.

(1) Cursor ON Mode
When the non displayed position is assigned as a write-in position, the cursor will be displayed there. But, the position that only one of the characters has already been located is assigned, this character will be eliminated and the cursor will be displayed.

(2) Cursor Blinking Mode
The cursor will be repeated ON and OFF every 0.3 second when the non displayed position is selected as a write-in position. And the position that the character has already been located on is selected as a write-in position, the character and the cursor will be displayed alternately.

(3) Cursor OFF Mode
The cursor off mode means that the cursor will not be displayed. When the power is turned on, the cursor off mode will be selected automatically. Therefore, if the cursor is required, DC command should be sent to select the cursor on or blinking mode.

5.2.8 TON (18 Hex): Triangle Mark On

This command is Triangle Mark control code. After writing 18 Hex, the successive Hex byte of data will be accepted as the turn on position.

* Syntax: TON Command (18 Hex) + Position Data (14 Hex ~ 27 Hex)

	Most Significant Digit	Least Significant Digit
Position Data:	14 Hex	27 Hex

5.2.9 TOF (19 Hex): Triangle Mark Off

This command is Triangle Mark control code. After writing 19 Hex, the successive Hex byte of data will be accepted as the turn off position.

* Syntax: TOF Command (19 Hex) + Position Data (14 Hex ~ 27 Hex)

	Most Significant Digit	Least Significant Digit
Position Data:	14 Hex	27 Hex

5.2.10 TFF (1A Hex): Triangle Mark All Off

All the Triangle Marks displayed are erased.

5.2.11 UDF (1B Hex): Store a User Definable Font

The characters can be designed by using this command. These font data are memorized in the RAM of the module.

* Syntax: UDF(1B Hex) + CHR(00 ~ 0F Hex) + PT1 + PT2 + PT3 + PT4 + PT5

Any 5x7 dots pattern consisted of data form PT1 through PT5 (3rd ~ 7th byte) can be stored in the character code location specified by CHR (2nd byte). And the maximum kinds of UDFs (User Definable Fonts) are 16 characters at once.

* 1st byte: UDF (1B Hex)..... Specify UDF command.
* 2nd byte: CHR (00 Hex ~ 0F Hex)..... Specify the character code location.
* 3rd ~ 7th byte: (00 Hex ~ FF Hex)..... Specify ON or OFF of 35 dots position

Below table shows the relation between dot position and data formation. The notation of "*x.y*" means the *y*th bit of *x*th byte. For example, the 3.0 means LSB of 3rd byte. ("1"= dot turn on, "0"= dot turn off)

5x7 Dot Matrix				
3.7	3.6	3.5	3.4	3.3
3.2	3.1	3.0	4.7	4.6
4.5	4.4	4.3	4.2	4.1
4.0	5.7	5.6	5.5	5.4
5.3	5.2	5.1	5.0	6.7
6.6	6.5	6.4	6.3	6.2
6.1	6.0	7.7	7.6	7.5

*) 7.4~7.0: Don't Care

Design Example				
0	0	**1**	**1**	0
0	**1**	0	0	0
1	**1**	**1**	0	0
0	**1**	0	0	0
1	**1**	**1**	0	0
0	**1**	0	0	**1**
0	0	**1**	**1**	0

UDF Data Coding Example of Left Design
1st Byte: 1B Hex (specify UDF)
2nd Byte: nn Hex (specify address)
3rd Byte: 00110010b = 32 Hex
4th Byte: 00011100b = 1C Hex
5th Byte: 10001110b = 8E Hex
6th Byte: 00100100b = 24 Hex
7th Byte: 11000000b = C0 Hex

5.2.12 DUF (1C Hex): Display a User Definable Font

The character defined by UDF is displayed by this command. After writing 1C Hex, the successive CHR Hex byte is written to display User Definable Font. The CHRs are character codes defined by UDF.

* Syntax: DUF Command (1C Hex) + CHR Code (00 ~ 0F Hex)

5.2.13 FC (1D Hex): Japanese Font Selection

The FC Font table (Refer to the Appendix-1 on page 12.) is selected.

5.2.14 FA (1E Hex): General European Font Selection

The FA Font table (Refer to the Appendix-2 on page 13.) is selected.

5.2.15 RST (1F Hex): Reset

This command is used to initialize the module.

All the characters displayed are erased. The write-in position will be set on the right end digit of the first row but the cursor isn't displayed and the dimming level is set for 100%..

5.3 Power On Reset

When the module is turned on, the display and memory are cleared and the module is initialized. The displaying status is the same as RST command. (Refer to section 5.2.15) Also, the Baud-Rate and Font table are set by combination of the following table.

* Soldering Jumper Switch Selection

B0	B1	P0	T0	Function	Setting
open	open	*	*	Baud-rate Selection	9,600 bps
short	open	*	*		4,800 bps
open	short	*	*		2,400 bps
short	short	*	*		1,200 bps
*	*	open	*	CG-ROM Font Selection	FC Font
*	*	short	*		FA Font
*	*	*	short	Serial Input Signal Level Selection	TTL Level
*	*	*	open		RS-232 Level
open	open	open	short	Factory Setting	

5.4 External Reset

An external reset is accomplished by /RST = “0” (Connector Pin #8 is connected to GND.) at least for 2.0us.
After executing external reset, all operations are the same as those of power on reset.

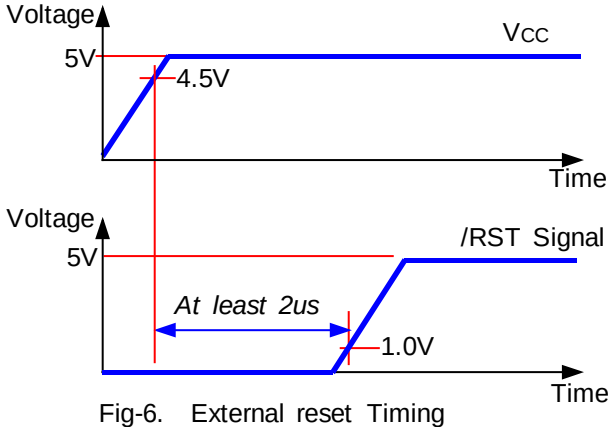


Fig-6. External reset Timing

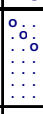
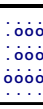
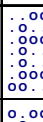
5.5 Self Test Mode

Self test starts when /TEST="0". (Connector pin #16 is connected to GND.) The display shows all characters, Alphabet, numeric and symbols in that order. Forty (2x20) characters are displayed at a time. In using this mode, neither data nor control code write-in is allowed. To release this mode, /TEST must be set to "1".

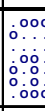
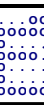
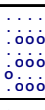
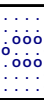
5.6 Selection of Input Mode

Section 4.9 shows the combinations of the signal lines for the parallel or serial input. Users must choose one of the combinations. Unused signal lines are to be open-circuited. In case of serial input, the baud-rate is selected by “B0” and “B1” marked on PCB.

* Appexdix-1 "FC (Japanese Katakana)" Font Table

Upper / Lower Nibble	D7	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1
	D6	0	0	0	0	1	1	1	1	0	0	0	0	1	1	1	1
	D5	0	0	1	1	0	0	1	1	0	0	1	1	0	0	1	1
	D4	0	1	0	1	0	1	0	1	0	1	0	1	0	1	0	1
D3 D2 D1 D0		0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
0 0 0 0	0		DP															
0 0 0 1	1																	
0 0 1 0	2																	
0 0 1 1	3																	
0 1 0 0	4	DIM																
0 1 0 1	5																	
0 1 1 0	6																	
0 1 1 1	7		DC															
1 0 0 0	8	BS	TON															
1 0 0 1	9	HT	TOF															
1 0 1 0	A		TFF															
1 0 1 1	B		UDF															
1 1 0 0	C		DUF															
1 1 0 1	D	CR	FC															
1 1 1 0	E		FA															
1 1 1 1	F	ALD	RST															

* Appexdix-2 "FA (General European)" Font Table

Upper / Lower Nibble	D7	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1
	D6	0	0	0	0	1	1	1	1	0	0	0	0	1	1	1	1
	D5	0	0	1	1	0	0	1	1	0	0	1	1	0	0	1	1
	D4	0	1	0	1	0	1	0	1	0	1	0	1	0	1	0	1
D3 D2 D1 D0		0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
0 0 0 0	0		DP															
0 0 0 1	1																	
0 0 1 0	2																	
0 0 1 1	3																	
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0 1 0 1	5																	
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1 1 1 1	F	ALD	RST															