To : ABS Computer

SPECIFICATION

Rev 2.0

Application:* *Pole Display (POS/ECR)

VACUUM FLUORESCENT DISPLAY MODULE

Model No.:* *20L203DA6C

Rev. No	Issued Date	Description	Note
Tentative	April, 26, 2000	* First Edition	
1.0	July, 01, 2004	* 2nd Edition - Change of "4.13 System Block Diagram" - Change of Self Test Mode	 Page_7 Page_9
2.0	Apr, 08, 2005	* 3rd Edition - Addition of Index Page - Change of Document Format	 Page_2,3 All Pages

Issued by	
Checked by	
Approved by	

Customer's Approval

~~~~~~~~~~~~~Index~~~~~~~~~~~~~

1. SCOPE

This specification applies to VFD module (Model No. 20L203DA6C) manufactured by Samsung SDI or SSVD (Shanghai Samsung Vacuum Devices).

2. FEATURES

* Simple connection to the host system.
The serial input interface is possible to choose 300 to 19,200 bps by combination of soldering switches(B0~B2). Besides, parity bit (even, odd or non parity) can be selected by 2 soldering switches(P0~P1).

* Since a DC/DC, AC converter is used, only +5VDC power source is required to operate the module.

* One chip MCU offers ASCII(96 characters) + European(126 characters) or ASCII + Japanese Katakana(126 characters) Font.

* Four brightness levels can be selected by dimming function.

* High quality blue-green(505 nm) vacuum fluorescent display provides an attractive and readable medium. Other colors can be achieved by simple wavelength filters.

3. PRECAUTIONS (OPERATING RECOMMENDATIONS)

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

* Since VFD is 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.

* 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. In other words, the compulsory short-circuit of mounted components on PCB within 30 seconds after power-off may cause damage to the module.

* The power supply must be capable of providing at least 10 times the rated current, because the inrush current maybe 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 15 meters (50 feet).

4. PRODUCT SPECIFICATIONS

4.1 Type

Type	20L203DA6C
Digit Format	5 *7 Dot Matrix with Annunciator

4.2 Outer Dimensions, Weight

Parameters	Symbols	Specification	Unit
Outer Dimensions	W * H * t	190.0 * 64.0 * 24.6	mm
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. 200	g

4.3 Environment Conditions

Parameters	Symbols	Min.	Max.	Unit
Operating Temperature	T_{OPR}	-0	+75	^{O}C
Storage Temperature	T_{STG}	-40	+85	^{O}C
Humidity (Operating)	H_{OPR}	30	85	%
Humidity (Non-operating)	H_{STG}	30	90	%
Vibration (10 ~ 55 Hz)	-	-	4	G
Shock	-	-	40	G

4.4 Absolute Maximum Ratings

Parameters	Symbols	Min.	Max.	Unit
Supply Voltage	V_{CC}	-	7.0	V_{DC}
Input Signal Voltage	V_{IN}	-30.0	+30.0	V_{DC}

4.5 Recommend Operating Conditions

Parameters	Symbols	Min.	Typ.	Max.	Unit
Supply Voltage	V_{CC}	4.5	5.0	5.5	V_{DC}
Input Signal Voltage	SPACE MARK	+3.0 -15.0	12.0 12.0	+15.0 -3.0	V_{DC} V_{DC}

4.6 DC Characteristics

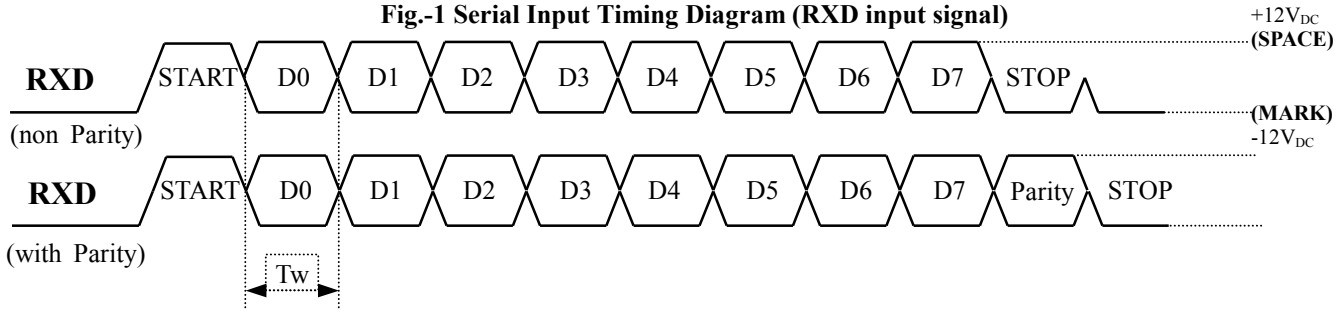
Test condition: Ta=25 ^{o}C, Vcc=+5.0Vdc

Parameters	Symbol	Min.	Typ.	Max.	Unit
Supply Current (All dots are lit)	Icc	-	800	1200	mA
Input Signal Current	I_{SPACE}	-	-	+8.3	mA
	I_{MARK}	-	-	-8.3	mA
Brightness	L	102(350)	200(700)	-	ft-L(cd/m^2)
Display Color	-	x = 0.250, y = 0.439 (Green)			-

(*) Note-1; The inrush current can be 5 times the specified maximum supply current at power on.

4.7 Timing Chart

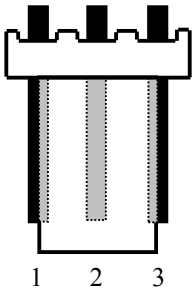
Fig.-1 Serial Input Timing Diagram (RXD input signal)



4.8 Interfacing Connectors $Tw = 10^6/\text{Baud-rate [us]}$

* Connector (Male): **7395-03** (by MOLEX) - Single 3 Pins (Right Angled)

⟶ Mate socket (Female): **5051-03** (by MOLEX) or equivalent



[Top VIEW]

Pin No.	Signal
1	V_{CC}
2	RXD
3	GND

4.9 System Block Diagram

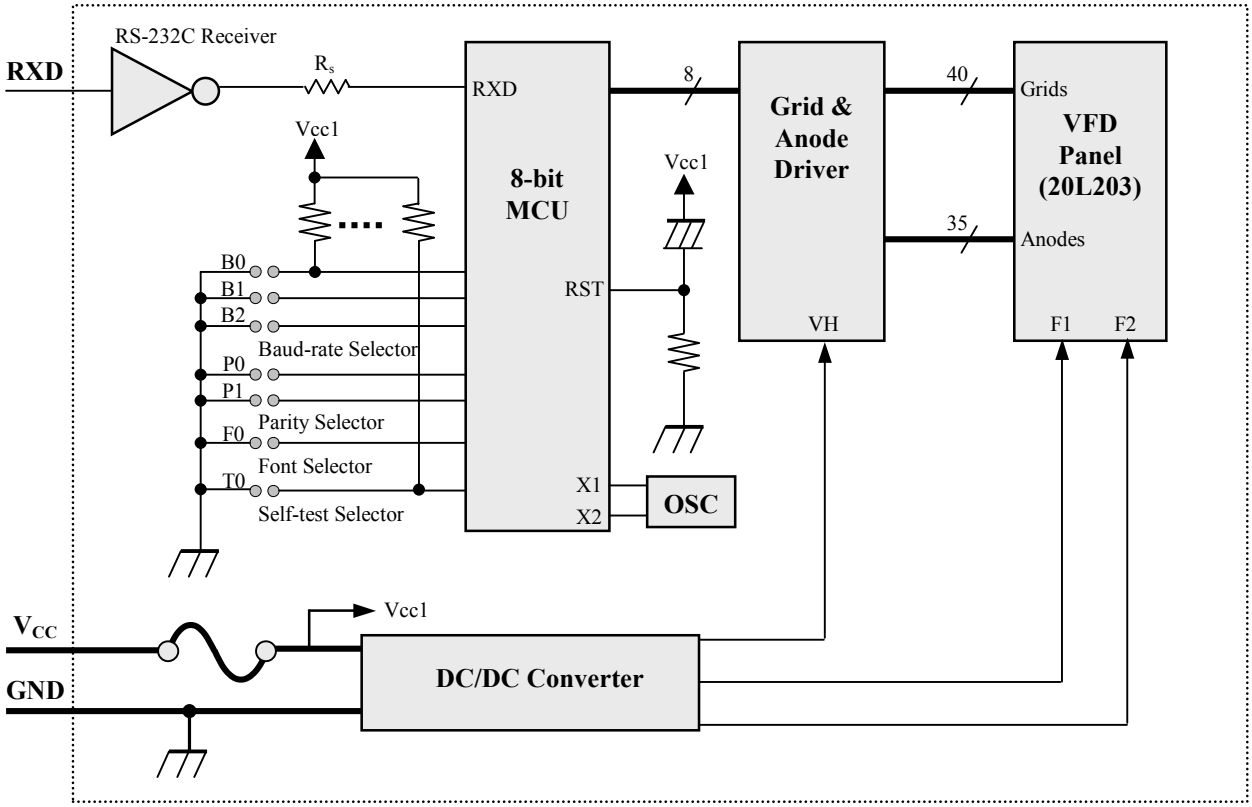


Fig.-2 System Block Diagram

4.10 Outer Dimensions

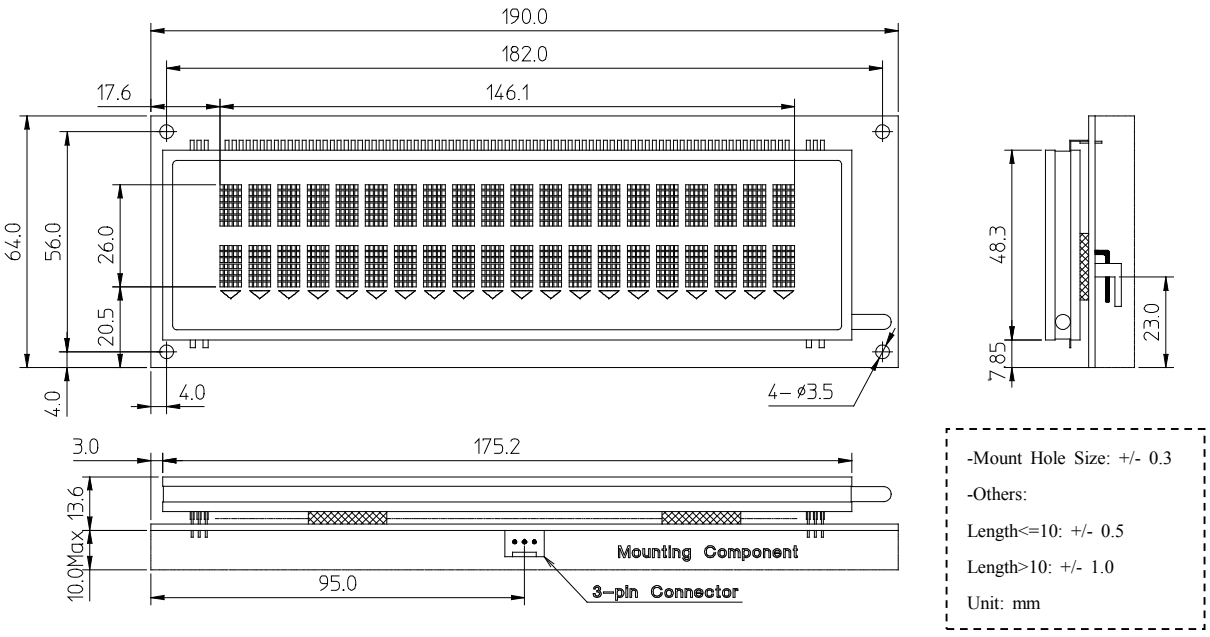
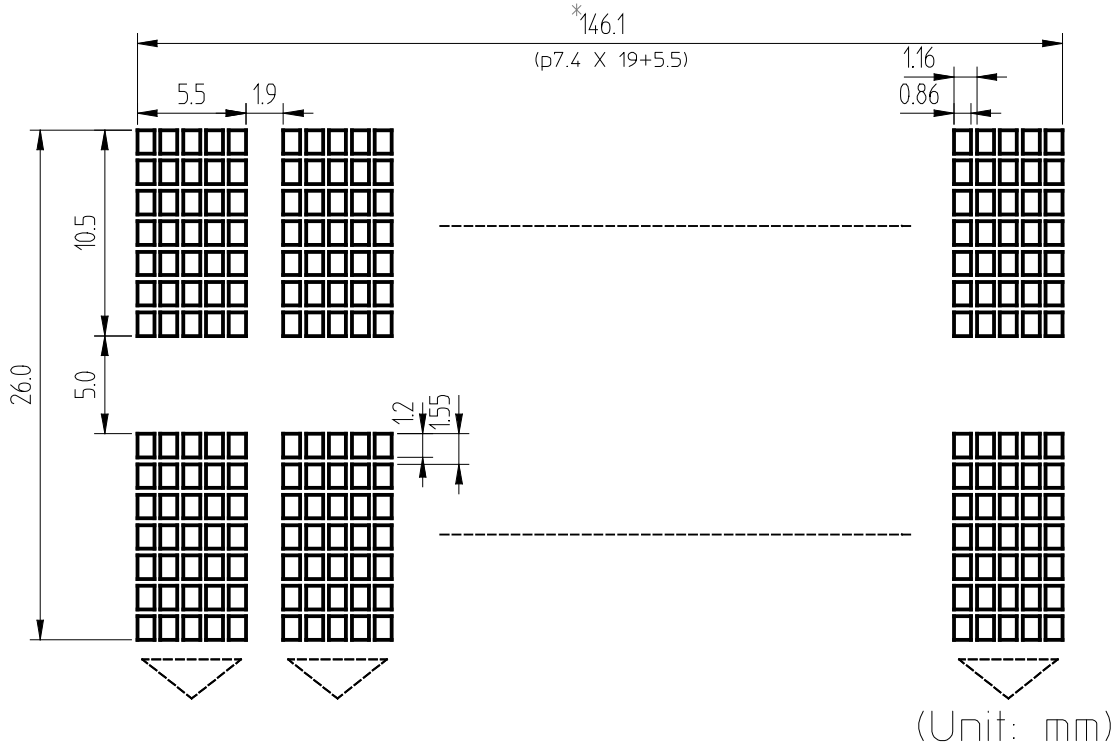


Fig.-3 outer Dimension

4.11 Pattern Details



There are 20 annunciators blow the patterns, but those are not displayed because the MCU inhibit displaying.
Consequently, visible display area is 146.1x26.0 [mm]

Fig.-4 Pattern Details

5. FUNCTIONS

5.1 Soldering Switches Setting

Baud-rate, parity, character font table, and self test mode can be set by opening or shorting the soldering switch. The switch setting values are read only when the power is turned on. Therefore, changing the settings while the power is on has no effect.

Soldering Switches OPEN/SHORT Function Table

T0	F0	P1	P0	B2	B1	B0	Setting Value	Description
X	X	X	X	**Open**	**Open**	**Open**	**19.200 bps**	Baud-rate Selection
X	X	X	X	Open	Open	Short	9,600 bps	
X	X	X	X	Open	Short	Open	4,800 bps	
X	X	X	X	Open	Short	Short	2,400 bps	
X	X	X	X	Short	Open	Open	1,200 bps	
X	X	X	X	Short	Open	Short	600 bps	
X	X	X	X	Short	Short	X	300 bps	
X	X	**Open**	**Open**	X	X	X	**Even Parity**	Parity Selection
X	X	Open	Short	X	X	X	Odd Parity	
X	X	Short	X	X	X	X	Non Parity	
X	**Open**	X	X	X	X	X	**CT0**	Font Selection
X	X	X	X	X	X	X	CT1	
Open	X	X	X	X	X	X	**Disable**	Self-test Mode
Short	X	X	X	X	X	X	Enable	
Open	**Open**	**Open**	**Open**	**Open**	**Open**	**Open**	**Setting at Factory**	
Note) X: Don't Care								

5.2 Self Test Mode

5.2.1 Self Test Disable Mode (Default)

When the 'T0' solder jumper switch is open, the self test mode is disabled.

5.2.2 Self Test Enable Mode

When the 'T0' Solder jumper switch is short, the self test starts when RXD= "1" is more than 100ms at power on or initialization.

During self test, all character fonts are displayed automatically and neither character data (20 Hex to FF Hex) nor control command (00 Hex to 1F Hex) is acceptable.

To release this mode, RXD must be set to "0" and the power must be turned on again.

5.3 Character Data Write-in

When the character data code (20 Hex ~ FF Hex) is transferred to the module, the character font is displayed on the screen. At this time, the cursor will be shifted to the right one digit automatically.

5.4 Control Code Write-in

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

(1) BS : Back Space ..... 08 Hex
(2) HT : Horizontal Tab ..... 09 Hex
(3) LF : Line Feed ..... 0A Hex
(4) CH : Cursor Home ..... 0C Hex

(5) CR : Carriage Return ..... 0D Hex
(6) CLR : Clear Display ..... 0E Hex
(7) DC1 : Normal Display Mode ..... 11 Hex
(8) DC2 : Over Write Mode ..... 12 Hex
(9) DC4 : Cursor off mode ..... 14 Hex
(10) DC5 : All Dot Cursor Blinking Mode ..... 15 Hex
(11) DC6 : Cursor off mode ..... 16 Hex
(12) DC7 : Cursor off mode ..... 17 Hex
(13) CT0 : General European Font ..... 18 Hex
(14) CT1 : Japanese Katakana Font ..... 19 Hex
(15) ESC : Escape Sequence ..... 1B Hex
[15_1] UDF : Save a User Definable Character ..... 1B Hex + 43 Hex
[15_2] DP : Display Position ..... 1B Hex + 48 Hex
[15_3] DIM : Dimming ..... 1B Hex + 4C Hex
[15_4] BSC : Blink Speed Control ..... 1B Hex + 54 Hex
[15_5] RST : Reset (Initialization) ..... 1B Hex + 49 Hex

5.4.1 BS (08 Hex): Back Space

Normal Display Mode : The write-in position is shifted to the left one digit.
(Beyond this point, the position of cursor is identical with write-in position of the display unless otherwise specified. DC4,DC6 and DC7 mode, the cursor will not be shown up.)
When the write-in position is on left end the second row, the cursor moves to the right end of the first row.
When the cursor is on the left end of the first row, the cursor doesn't move.
Over Write Mode : The same as above.

5.4.2 HT (09 Hex): Horizontal Tab

Normal Display Mode : The write-in position is shifted to the right one digit.
When the write-in position is on the right end of the first row, the cursor moves to the left end of the second row.
When the cursor is on the right end of the second row, the cursor moves to the left endof the first row.
Over Write Mode : When the cursor is on the right end of the second row, the characters displayed on the second row are shifted up to the first row and the cursor moves to left end of the second row. Simultaneously, the second row is cleared.

5.4.3 LF (0A Hex): Line Feed

Normal Display Mode : When the cursor is on the first row, the cursor moves down to the same column of the second row. When the cursor is on the second row the cursor moves to the same column of the first row.
Over Write Mode : When the cursor is on the second row, the characters displayed on the second row are shifted up to the first row and the second row is cleared. But the cursor doesn't move. When the cursor is on the first row, the same as normal display mode operation.

5.4.4 CH (0C Hex): Cursor Home

The cursor move to the left end of the first row.

5.2.5 CR (0D Hex): Carriage Return

The cursor moves to left end of the same row.

5.2.6 CLR (0E Hex): Clear

All the characters displayed are cleared. The cursor doesn't move.

DC1 and DC2 select the display mode. When the power is turned on, DC1 mode is selected as default and will be held until the other mode (DC2 Mode) is selected.

5.2.7 DC1 (11 Hex): Normal Display Mode

After writing a character, the cursor is shifted to the right one digit automatically. When the cursor is on the right end of the first row, the cursor moves to the left end of the second row. When the cursor is on the right end of the second row, the cursor moves to the left end of the first row.

5.2.8 DC2 (12 Hex): Vertical Scroll Mode

After writing a character up to the left end of the second row, all characters displayed on the second row are shifted up to the first row, clearing the second row.

DC4~DC7 are the cursor control command. In case of DC5 & DC7, the blinking speed can be varied by ESC sequence. (See section 5.2.15-[4] Blinking Speed Control.) When the power is turned on, DC4 mode is selected as default and will be held until another mode (DC5~DC7) is selected.

5.2.9 DC4 (14 Hex): Cursor Off Mode

The cursor won't be displayed.

5.2.10 DC5 (15 Hex): All Dot Cursor Blinking Mode

The cursor is displayed as a blinking all dot cursor.

5.2.11 DC6 (16 Hex): Cursor off Mode

The cursor won't be displayed.

5.2.12 DC7 (17 Hex): Cursor off Mode

The cursor won't be displayed.

CTO and CT1 select the character font table. When the power is turned on, CTO is selected as default and will be held until the other table is selected as below.

5.2.13 CTO (18 Hex): General European Font Table

The CT0 Font table (Page-14/15) is selected.

5.2.14 CT1 (19 Hex): Japanese Katakana Font Table

The CT1 Font table (Page-15/15) is selected.

5.2.15 ESC (1B Hex): Escape Sequence

This command is used to define font, move cursor, change luminance, blinking speed control and/or initialize the module.

[1] UDF (43 Hex): User Definable Font

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

Syntax: ESC(1B Hex) + "C"(43 Hex) + CHR(00~FF Hex) + PT1+PT2+PT3+PT4+PT5

Any 5x7 dots pattern consisted of data from PT1 to PT5 (4th~8th byte) can be stored in the character code location specified by CHR (3rd byte). And the maximum kinds of UDFs(User Definable Font) are 16 characters at once. Storing more than 16 will erase the oldest font. Within 16 characters codes which were already defined by user, the over-write-latest font will replace the former font.

. 1st byte : ESC (1B Hex) ..... Specify Escape command.
. 2nd byte : "C" (43 Hex) ..... Specify User-Definable-Font Command.
. 3rd byte : CHR (00 Hex ~ FF Hex) .....Specify the character code location from 00 Hex to FF Hex by CHR. If CHR overlaps control codes such as BS, HT, LF etc., the control function will be lost. Therefore, overlaps to the ESC codes may not avail further UDF function.
. 4th ~ 8th byte (00 Hex ~ FF Hex) .....Specify ON or OFF of 35 dot positions(5x7dot).
The table below(Anode Assignment Map) shows the relation between dot position an data formation.
The notation of "X.Y" means the Yth bit of Xth byte. For example, 4.0 means LSB (Least Significant 1Bit) of 4th byte and 7.7 means MSB (Most Significant Bit) of 7th byte. ("1" = dot turn on, "0" = dot turn off)

*Anode Assignment Map

4.0	4.1	4.2	4.3	4.4
4.5	4.6	4.7	5.0	5.1
5.2	5.3	5.4	5.5	5.6
5.7	6.0	6.1	6.2	6.3
6.4	6.5	6.6	6.7	7.0
7.1	7.2	7.3	7.4	7.5
7.6	7.7	8.0	8.1	8.2

*) 8.3~8.7 don't care

*Example, define "$" as a UDF

0	0	**1**	0	0	
0	**1**	**1**	**1**	**1**	**. 4th byte: C4 Hex**
1	0	**1**	0	0	**. 5th byte: 17 Hex**
0	**1**	**1**	**1**	0	**. 6th byte: 47 Hex**
0	0	**1**	0	**1**	**. 7th byte: 1F Hex**
1	**1**	**1**	**1**	0	**. 8th byte: 01 Hex**
0	0	**1**	0	0	

[2] Display Position (48 Hex)

The cursor can be moved to any position of screen by following ESC sequence.

Syntax: ESC(1B Hex) + "H"(48 Hex) + Cursor Position Data(See the table below)

Left End	2nd Column	3rd Column	~~~~~~	Right End
00 Hex	01 Hex	02 Hex	~~~~~~	13 Hex
14 Hex	15 Hex	16 Hex	~~~~~~	27 Hex

Just only the 00 Hex to 27 Hex are available as a cursor position data. The others are ignored.

[3] Dimming (4C Hex)

The screen luminance can be varied into 4 levels by following ESC sequence.
When the power is turned on, the brightness level is set to 100%.

Syntax: ESC(1B Hex) + "L"(4C Hex) + Luminance Data(00 Hex ~ FF Hex)

Luminance Data = 00 Hex to 3F Hex : approx. 25 % (Brightness level)
40 Hex to 7F Hex : approx. 50 %
80 Hex to BF Hex : approx. 75 %
C0 Hex to FF Hex : approx. 100 %

[4] Blinking Speed Control (54 Hex)

Blinking speed of cursor can be varied by following sequence.

Syntax : ESC(1B Hex) + "T"(54 Hex) + Blinking Speed (00 Hex to FF Hex)

Blinking Speed Data = 00 Hex ……... 256 (Data Value)
FF Hex …….. 255
FE Hex …….. 254
FD Hex ……..253
. .
. .
. .
. .
01 Hex …… 1

Period of Blinking = Data Value x approx. 30ms.

When the power is turned on, blinking speed data is set to 14 Hex (Data Value=20) i.e. The period of cursor blinking is set to 600 milliseconds.

[5] Initialization (49 Hex)

All characters displayed and all setting factors are cleared by following ESC sequence.

Syntax : ESC (1B Hex) + "I" (49 Hex)

By executing the above sequence. Module is reset as following status.

1) All characters displayed are cleared.
2) Cursor position is located on the most significant digit of upper row.
3) Display mode is set to DC1 Mode (Normal Display Mode)
4) Cursor mode is set to DC4 Mode (Cursor is turned invisible)
5) Cursor blinking period is set to 600 milliseconds.
6) Baud-rate, parity, character font table, and self test mode are set by soldering jumper switches(Refer to section 5.1)

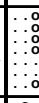
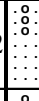
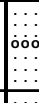
5.4 Power on Reset

When the module is turned on, the display and memory are cleared and the module is initialized.
The displaying status is the same as the status of initialization. (See section 5.2.15-[5])

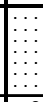
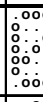
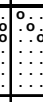
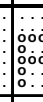
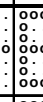
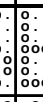
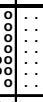
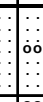
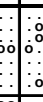
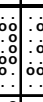
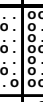
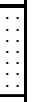
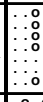
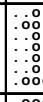
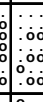
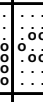
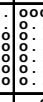
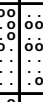
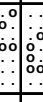
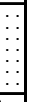
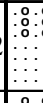
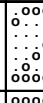
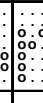
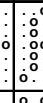
6. CG-ROM Font (Character Code Table)

CG-ROM fonts are composed of ASCII (20h~7Fh) and optional font (80h~FFh). This module offers ASCII(96 characters) + European(126 characters) or ASCII + Japanese Katakana(126 characters) Font.
The font can be chosen by setting “F0” of the soldering switches(Refer to section 5.1)

6.1 "CT0" Font Table

Upper / Lower	D_7	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1
	D_6	0	0	0	0	1	1	1	1	0	0	0	0	1	1	1	1
	D_5	0	0	1	1	0	0	1	1	0	0	1	1	0	0	1	1
	D_4	0	1	0	1	0	1	0	1	0	1	0	1	0	1	0	1
D_3 D_2 D_1 D_0		0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
0 0 0 0	0																
0 0 0 1	1		DC1														
0 0 1 0	2		DC2														
0 0 1 1	3		DC3														
0 1 0 0	4		DC4														
0 1 0 1	5		DC5														
0 1 1 0	6		DC6														
0 1 1 1	7		DC7														
1 0 0 0	8	BS	CT0														
1 0 0 1	9	HT	CT1														
1 0 1 0	A	LF															
1 0 1 1	B		ESC														
1 1 0 0	C	CH															
1 1 0 1	D	CR															
1 1 1 0	E	CLR															
1 1 1 1	F																

6.2 "CT1" Font Table

Upper / Lower	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																		
0 0 0 1	1		DC1																
0 0 1 0	2		DC2																
0 0 1 1	3		DC3																
0 1 0 0	4		DC4																
0 1 0 1	5		DC5																
0 1 1 0	6		DC6																
0 1 1 1	7		DC7																
1 0 0 0	8	BS	CT0																
1 0 0 1	9	HT	CT1																
1 0 1 0	A	LF																	
1 0 1 1	B		ESC																
1 1 0 0	C	CH																	
1 1 0 1	D	CR																	
1 1 1 0	E	CLR																	
1 1 1 1	F																		