Noritake itron

RoHS 2011/65/EU

VACUUM FLUORESCENT DISPLAY

MODULE

SPECIFICATION

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1. General Description

1.1. Application

Readout of computer, micro-computer, communication terminal and automatic instruments.

1.2. Construction

Single board display module consists of 40 characters (2 × 20) VFD, refresh memory, character generator, control circuit, DC/DC converter and all necessary control logics. Interface level is CMOS compatible and the module can be connected to the CPU bus of host directly. +5V single power supply is required.

1.3. Drawing

See attached drawings. ("12 Outline dimension")

2. Absolute Maximum Ratings

Parameter	Symbol	Min.	Typ.	Max.	Unit	Condition
Logic Input Voltage	V_I	0	-	V_{CC}+0.3	V_{DC}	V_I<V_{CC}+0.2
Power Supply Voltage	V_{CC}	0	-	6.5	V_{DC}	-

3. Electrical Ratings

Parameter		Symbol	Min.	Typ.	Max.	Unit	Condition
Logic Input Voltage	"H"	V_{IH}	0.8V_{CC}	-	V_{CC}	V_{DC}	V_{CC}=5.0V TA=25degrees
	"L"	V_{IL}	0	-	0.3V_{CC}		
Power Supply Voltage		V_{CC}	4.75	5.0	5.25	V_{DC}	-

4. Electrical Characteristics

Measuring Conditions: TA (Ambient temperature) = 25 degrees, V_{CC} = 5.0V

Parameter		Symbol	Min.	Typ.	Max.	Unit	Condition
Logic Output Voltage	"H"	V_{OH}	V_{CC}-1.5	-	-	V_{DC}	I_{OH}=-5mA
	"L"	V_{OL}	-	-	1.5	V_{DC}	I_{OL}=5mA
Power Supply Current 1		I_{CC1}	-	260	320	mADC	All dots on
Power Supply Current 2		I_{CC2}	-	220	270	mA_{DC}	All dots off

Note: Slow start power supply may cause erroneous operation.
The rise time of V_{CC} should not exceed 100ms.
I_{CC} might be anticipated twice as usual at power on rush.

5. Optical Specifications

Number of characters	: 40 (2 lines × 20 chars)
Matrix format	: 5×7 dot with UL
Display area	: 78.65 × 12.90 mm (X × Y)
Character size	: 2.65 × 5.70 mm (X × Y, Including UL) (2.65 × 4.70 mm for 5×7dot)
Character pitch	: 4.0 × 7.2 mm (X × Y)
Dot size	: 0.45 × 0.50 mm (X × Y)
Dot pitch	: 0.55 × 0.70 mm (X × Y)
Luminance	: 350 cd/m^2 (102fL) Min.
Color of illumination	: Green (Blue-green)

6. Environmental Specifications

Operating temperature	: -40 to + 85 degrees
Storage temperature	: -40 to + 85 degrees
Operating humidity	: 20 to 80 % R.H (non-condensing)
Vibration (non-operating)	: 10–55-10Hz, all amplitude 1mm, 30 minutes, X-Y-Z
Shock (non-operating)	: 980m/s^2 (100G), 9ms, X-Y-Z, 3 times each direction

7. Functional Descriptions

This module provides the functions of 8 bit parallel and serial data write.
Each control data and character fonts are shown in Character Table 0 and Character Table 1.
All data write should be done during BUSY line is low.

$\overline{CS}$	$\overline{WR}$	Function	Bus direction
0	↑	Data write	Module ← Host
1	X	No operation	Module X Host

↑: Rising edge of pulse. X: Don't care.

7.1. Character data write

Character font is displayed on the screen, and HT is executed. (Refer to "7.2.2 HT".)

7.2. Control data write

Detail of control data are shown in this clause.
The term "Cursor" is the same meaning of "Writing Position".

7.2.1. BS: Back Space (08 Hex)

The cursor moves one character to the left.

When the cursor is at the top left end, it doesn't move.

When the cursor is at the left end on the other line, it motion depends upon DC1, DC2 and DC3 mode.

DC1: The cursor moves to the right end of one upper line.
DC2: The cursor moves to the right end of one upper line.
DC3: The cursor doesn't move.

7.2.2. HT: Horizontal Tab (09 Hex)

The cursor moves one character to the right.

When the cursor is at the bottom right end, it motion depends upon DC1, DC2 and DC3 mode.

DC1: The cursor moves to the top left end.
DC2: All displayed characters are scrolled up one line, and the bottom line is cleared. The cursor moves to the bottom left end.
DC3: The cursor overflow. Furthermore, if HT is inputted continuously, all displayed characters on the cursor line are scrolled to the left one character, and the blank is appeared at the right end of cursor line. The displayed characters on the other line are not changed.

When the cursor is at the right end on the other line, it motion depends upon DC1, DC2 and DC3 mode.

DC1: The cursor moves to the left end of one lower line.
DC2: The cursor moves to the left end of one lower line.
DC3: The cursor overflow. Furthermore, if HT is inputted continuously, all displayed characters on the cursor line are scrolled to the left one character, and the blank is appeared at the right end of cursor line. The displayed characters on the other line are not changed.

7.2.3. LF: Line Feed (0A Hex)

The cursor moves to the same column on the one lower line except DC3 mode.
At the DC3 mode, all displayed characters and cursor position are not changed in any line.

When the cursor is at the bottom line, it motion depends upon DC1 and DC2 mode.

DC1: The cursor moves to the same column on the top line.
DC2: All displayed characters are scrolled up one line. The cursor doesn't move, and the bottom line is cleared.

7.2.4. FF: Form Feed (0C Hex)

The cursor moves to the top left end.

7.2.5. CR: Carriage Return (0D Hex)

The cursor moves to the left end on the same line.

7.2.6. CLR: Clear (0E Hex)

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

7.2.7. CAN: Cancel (0F Hex)

All displayed characters on the cursor line are cleared.
The displayed characters on the other line are not changed.
The cursor doesn't move.

7.2.8. DC1: Device Control 1 (11 Hex) …Character over write mode (Default)

When the cursor is at the right end, the next data write makes the cursor moves to the one lower left end. In addition, when the cursor is at the bottom right end, it moves to the top left end.

7.2.9. DC2: Device Control 2 (12 Hex) …Scroll up mode

When the cursor is at the bottom right end, the next data write makes all displayed characters are scrolled up one line, and the characters on the bottom line is cleared. The cursor moves to the bottom left end.

7.2.10. DC3: Device Control 2 (13 Hex) … Horizontal Scroll mode

When the cursor is at the right end, the next character write makes the cursor overflow, all displayed characters in the cursor line are scrolled to the left by one character, and the new character is written to the right end in the cursor line. The displayed characters in the other line are not changed. This operation is released when CR, FF, BS or the "Cursor moving command" (Refer to 7.2.18 (2)) is inputted. Also, it is released when the DC1 or DC2 is written, but the cursor moves to the left end of the same line in this case.

At after power on or initialize, DC1 is selected (Default Mode).

7.2.11. DC4: Device Control 4 (14 Hex) … Cursor is displayed on Underline (Default)

7.2.12. DC5: Device Control 5 (15 Hex) … Cursor is displayed as a blinking all dot character

7.2.13. DC6: Device Control 6 (16 Hex) … Cursor is turned to invisible

7.2.14. DC7: Device Control 7 (17 Hex) … Cursor is displayed as a blinking Underline

Above four codes control the cursor rendition.
At after power on or initialize, DC4 is selected (Default Mode).
The mode is maintained until other mode is selected.
The blinking speed can be varied by "Blink Speed Control" command.
(Refer to 7.2.18 (5))

7.2.15. CT0: Character Table 0 (18 Hex) … International character font (Default)

7.2.16. CT1: Character Table 1 (19 Hex) … KATAKANA character font

Above two codes select Character Table.
At after power on or initialize, CT0 is selected (Default Mode).
Any characters from those 2 tables can be displayed on the screen by the bank selection.

7.2.17. EUR: Euro Currency mark (1A Hex)

Euro Currency mark is stored instead of Blank in character code location AD Hex of CT0. This is replaced to Blank if CT0 is selected again, and it affects displayed character of AD Hex.

7.2.18. ESC: Escape (1B Hex)

The character or data strings succeeding of ESC code control the various functions such as user definable font, cursor addressing, screen luminance control, selection of data writing mode, blink speed control and initialize.

(1) User Definable Font (UDF)

Users desired fonts can be defined by software.
The fonts will be memorized in RAM of the CPU.

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

Any 5×7 dot patterns consisted of data from PT1 thru PT5 can be stored in character code location specified by CHR.
Maximum number of UDF is 16 characters at once. Storing more than 16 will kill the oldest font. However, within the 16 character codes where already defined by UDF, the over-write-latest font replaces the former font.

1st byte : ESC (1B Hex)
2nd byte : "C" (43 Hex)
3rd byte : CHR (00 Hex to FF Hex)
Specify the character code location from 00 Hex to FF Hex by CHR.
If CHR overlaps the control codes such as BS, HT, etc., the control function will be lost.
And therefore, the overlap to the ESC code may not avail further UDF.
4th to 8th byte: PT 1 through PT5
Specify ON or OFF of 36 dot position. (5×7 dot + Underline)
Following table shows the relation of dot position and the data formation.
("1" = dot turn on, "0" = dot turn off)

	7(MSB)	6	5	4	3	2	1	0(LSB)
4th byte	P8	P7	P6	P5	P4	P3	P2	P1
5th byte	P16	P15	P14	P13	P12	P11	P10	P9
6th byte	P24	P23	P22	P21	P20	P19	P18	P17
7th byte	P32	P31	P30	P29	P28	P27	P26	P25
8th byte	*	*	*	*	UL	P35	P34	P33

*: Don't care. UL: Underline

Following is the dot assignment.

P1	P2	P3	P4	P5
P6	P7	P8	P9	P10
P11	P12	P13	P14	P15
P16	P17	P18	P19	P20
P21	P22	P23	P24	P25
P26	P27	P28	P29	P30
P31	P32	P33	P34	P35

		UL		

8th line (P36) is used for Underline.

After execution of above sequence, a defined font will be stored in the character code location "CHR" (Hex)

Following is an example of UDF sequence.
Example: "!" dot pattern should be stored in character code location A0 Hex.

Desired Dot Pattern

		●		
		●		
		●		
		●		
		●		

Turn on dot number

P3

P8

P13

P18

P33

Assign turn on dot number to the bit table as follows.

	b7	b6	b5	b4	b3	b2	b1	b0	Data (Hex)
4th byte	1	0	0	0	0	1	0	0	84
5th byte	0	0	0	1	0	0	0	0	10
6th byte	0	0	0	0	0	0	1	0	02
7th byte	0	0	0	0	0	0	0	0	00
8th byte	0	0	0	0	0	0	0	1	01

Then Syntax should be written: 1B + 43 + A0 + 84 + 10 + 02 + 00 + 01 (Hex)

(2) Cursor Moving

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

Syntax: ESC (1B Hex) + "H" (48 Hex) + 1 Byte data

Column / Line	Left end	2nd	3rd	----------	Right end
Top	00	01	02	----------	13 Hex
Bottom	14	15	16	----------	27 Hex

Data = 28 Hex to FF Hex: The cursor doesn't move.

(3) Luminance Control

The screen luminance can be varied by following ESC sequence.
At after power on or initialize, the screen luminance is set to 100%.

Syntax: ESC (1B Hex) + "L" (4C Hex) + 1 Byte data

Data = 00 Hex to 3F Hex: approx.30%
40 Hex to 7F Hex: approx.50%
80 Hex to BF Hex: approx.75%
C0 Hex to FF Hex: 100%

(4) Selection of Writing Mode
Flickerless Mode can be selected by following ESC sequence.

Syntax: ESC (1B Hex) + "S" (53 Hex) … Flickerless Mode

Within Flickerless Mode, although BUSY might become longer, flicker less-high speed-continuous-data write can be achieved since refreshing of the screen has priority over the data acceptance.

Quick data write with minimum BUSY time will be given by Quick Write Mode since the data acceptance has the priority over the refreshing of the screen.
Within this mode, continuous high speed data write may cause flicker display.

Note:
When serial data write with high speed baud rate at Flickerless Mode, it may have the read error of the data. Busy check within Flickerless Mode or setting to the Quick Write Mode is recommended for serial data write.
At after power on or initialize, Quick Write Mode is selected (Default Mode).
After selected Flickerless Mode, Quick Write Mode can't be selected unless otherwise initialize.

(5) Blink Speed Control
Blinking speed of cursor can be varied by following ESC sequence.

Syntax: ESC (1B Hex) + "T" (54 Hex) + 1 Byte Data

Data = 00 Hex … 256
FF Hex … 255
FE Hex … 254
:
01 Hex … 1

Period of Blinking = Data Value × Approx.30ms
At after power on or initialize, 20 (14 Hex) is set to data.

(6) Initialize
All displayed characters and all setting factors are cleared by following ESC sequence.

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

Execution of above sequence, module is reset as just after power on.

7.3. Test Mode

Test Mode is set by keeping SIN (T0) is low for more than 100ms at power on or initialize. During Test Mode, all character fonts are displayed automatically, and no any data are acceptable.

7.4. Character and control code table

Following 2 character tables can be selected.
(Refer to "7.2.15", "7.2.16" and "7.2.17".)

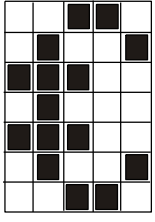
7.4.1. International character font

D3 D2 D1 D0	D7 D6 D5 D4	0 0 0 0	0 0 0 1	0 0 1 0	0 0 1 1	0 1 0 0	0 1 0 1	0 1 1 0	0 1 1 1	1 0 0 0	1 0 0 1	1 0 1 0	1 0 1 1	1 1 0 0	1 1 0 1	1 1 1 0	1 1 1 1
		0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
0 0 0 0	0			SP													
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	EUR														
1 0 1 1	B		ESC														
1 1 0 0	C	FF															
1 1 0 1	D	CR															
1 1 1 0	E	CLR															
1 1 1 1	F	CAN															

CFX101-2

Character Table 0

Note: When EUR (1A Hex) is selected, Euro Currency mark is stored instead of Blank in character code location AD Hex of CT0. This is replaced to Blank if CT0 is selected again, and it affects displayed character of AD Hex.



7.4.2. KATAKANA character font

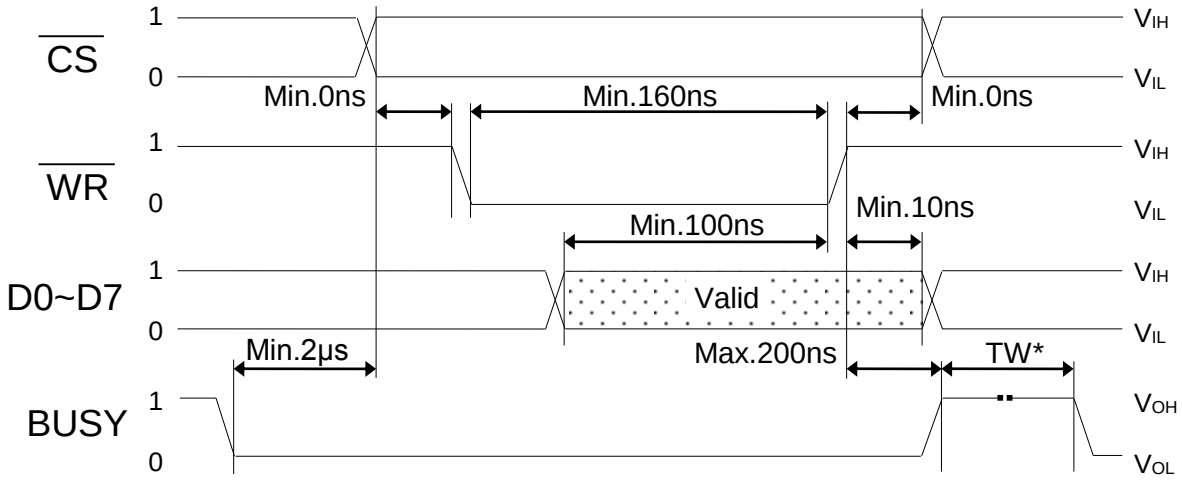
D3 D2 D1 D0	D7 D6 D5 D4 →	0 0 0 0	0 0 0 1	0 0 1 0	0 0 1 1	0 1 0 0	0 1 0 1	0 1 1 0	0 1 1 1	1 0 0 0	1 0 0 1	1 0 1 0	1 0 1 1	1 1 0 0	1 1 0 1	1 1 1 0	1 1 1 1
		0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
0 0 0 0	0			SP	0	@	P	`	p	｢	ﾀ		ｰ	ﾁ	ﾐ	ﾘ	
0 0 0 1	1		DC1	!	1	A	Q	a	q	｡	ﾁ	､	ｱ	ﾄ	ﾑ	ﾙ	
0 0 1 0	2		DC2	"	2	B	R	b	r	｢	ﾂ	｢	ｲ	ﾅ	ﾒ	ﾚ	
0 0 1 1	3		DC3	#	3	C	S	c	s	｣	ﾃ	｣	ｳ	ﾆ	ﾓ	ﾛ	
0 1 0 0	4		DC4	$	4	D	T	d	t	､	ﾄ	･	ｴ	ﾇ	ﾔ	ﾜ	
0 1 0 1	5		DC5	%	5	E	U	e	u	･	ﾅ	ｦ	ｵ	ﾈ	ﾕ	ﾝ	
0 1 1 0	6		DC6	&	6	F	V	f	v	ｦ	ﾆ	ｧ	ｶ	ﾉ	ﾖ	ﾞ	
0 1 1 1	7		DC7	'	7	G	W	g	w	ｧ	ﾇ	ｨ	ｷ	ﾊ	ﾗ	ﾟ	
1 0 0 0	8	BS	CT0	(	8	H	X	h	x	ｨ	ﾈ	ｩ	ｸ	ﾋ	ﾘ	ｱ	
1 0 0 1	9	HT	CT1	)	9	I	Y	i	y	ｩ	ﾉ	ｪ	ｹ	ﾌ	ﾙ	ｲ	
1 0 1 0	A	LF	EUR	*	:	J	Z	j	z	ｪ	ﾊ	ｫ	ｺ	ﾍ	ﾚ	ｴ	
1 0 1 1	B		ESC	+	;	K	[	k	{	ｫ	ﾋ	ｬ	ｻ	ﾎ	ﾛ	ｵ	
1 1 0 0	C	FF		,	<	L	¥	l	|	ｬ	ﾌ	ｭ	ｼ	ﾏ	ﾜ	ｶ	
1 1 0 1	D	CR		-	=	M	]	m	}	ｭ	ﾍ	ｮ	ｽ	ﾐ	ﾝ	ｷ	
1 1 1 0	E	CLR		.	>	N	^	n	~	ｮ	ﾎ	ｯ	ｾ	ﾑ	ﾞ	ｸ	
1 1 1 1	F	CAN		/	?	O	_	o	ｰ	ｯ	ﾏ	ｰ	ｿ	ﾒ	ﾟ	ｹ	

CFX102

Character Table 1

8. Timing

8.1. Parallel interface Timing



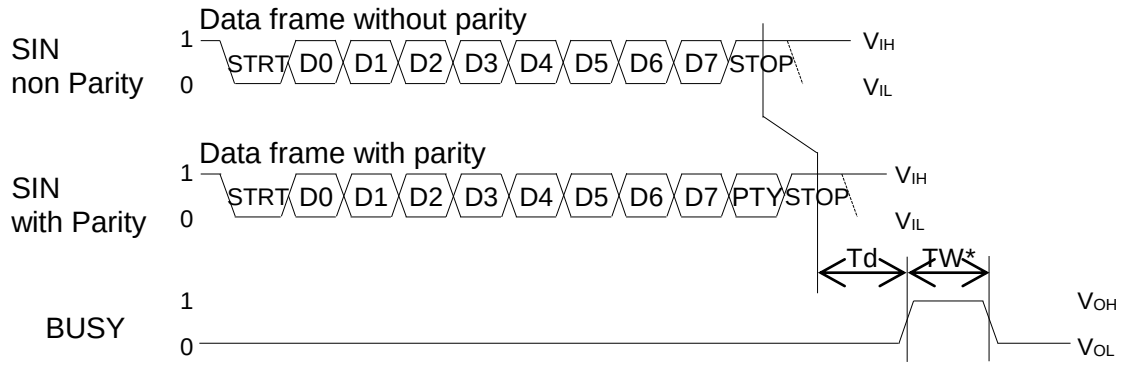
TW*: Refer to "9.BUSY Time".

8.2. Serial Interface Timing

Serial data write, asynchronous-8bit CMOS level is also acceptable.
Following baud rates can be selected by combination of the Jumper wires.
(Refer to "10. Jumper wires".)

600, 1200, 2400, 4800, 9600, 19200 BPS

Besides, parity bit-Even, Odd and Non Parity can be selected by 2 jumper wires.
(Refer to "10. Jumper wires".)



STRT : Start Bit
D0 : LSB
:
D7 : MSB
PTY : Parity Bit
STOP : Stop Bit

Td: 10µs (Typ.) at Quick Write Mode
0µs (Min.) - 900µs (Max.) at Flickerless Mode

TW*: Refer to "9.BUSY Time".

9. BUSY Time

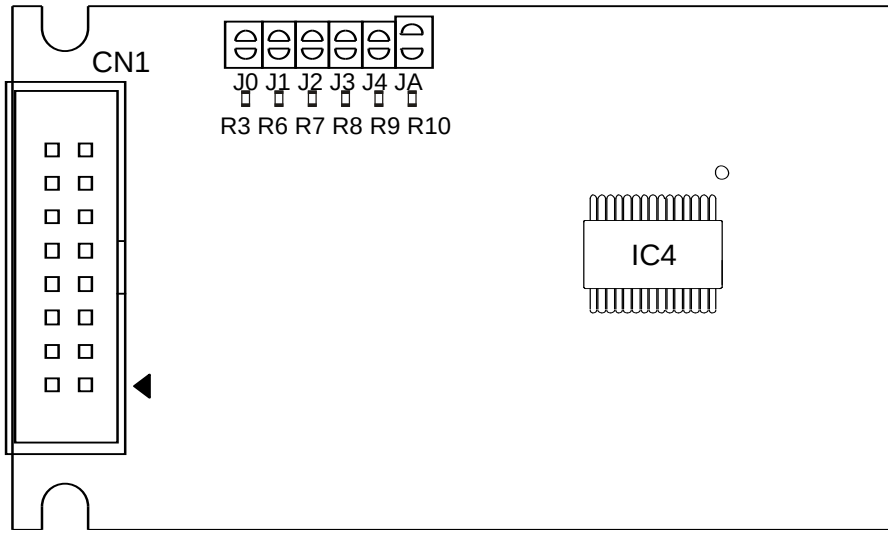
Input data execution time (TW*) at Quick Write Mode are shown as follows.

Data			Excution time (TW)			Data Writing Mode
			DC1 Mode	DC2 Mode	DC3 Mode	
Character Data, HT, LF			200µs (Max.)	1000µs (Max.) at scrolling	300µs (Max.) at scrolling	Quick Write Mode
BS,FF,CR,CT0,CT1,EUR, DC1,DC2,DC3,DC4,DC5,DC6,DC7,			200µs (Max.)			
CLR			900µs (Max.)			
CAN			300µs (Max.)			
ESC	1st byte		200µs (Max.)			
	2nd byte	"C"	200µs (Max.)			
		"I"	1400µs (Max.)			
		Expect "C","I"	200µs (Max.)			
	3rd byte -		200µs (Max.)			

Above execution time are only talking about Quick Write Mode as mentioned.
Within Flicker less Mode, Approximately 2 to 15 times of above table should be considered.
Operating with Flickerless Mode, therefore, always watching of BUSY line is recommended.

10. Jumper wires

Position of jumper wire



PCB Parts Side

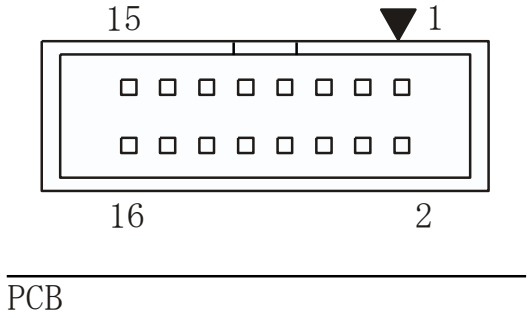
Jumper Function Table

JA / R10	J4 / R9	J3 / R8	J2 / R7	J1 / R6	J0 / R3	Function	
X	X	X	1	1	1	Baud rate	19200 BPS
X	X	X	1	1	0		9600 BPS
X	X	X	1	0	1		4800 BPS
X	X	X	1	0	0		2400 BPS
X	X	X	0	1	1		1200 BPS
X	X	X	0	1	0		600 BPS
X	X	X	0	0	1		600 BPS
X	X	X	0	0	0		600 BPS
X	1	1	X	X	X	Parity selection	Even Parity
X	1	0	X	X	X		Odd Parity
X	0	X	X	X	X		Non Parity
0	X	X	X	X	X	Character fonts selection	International Font(CT0)
1	X	X	X	X	X		JIS Font(CT1)
0	1	1	1	1	1	Setting at Factory	

0: Jx short or(and) Rx mount
1: Jx open and Rx no-mount
X: Don't care.

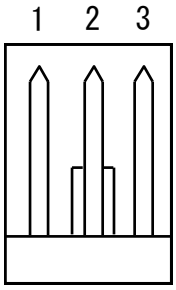
11. Connector Pin assignment

11.1. 16pin Connector (CN1)



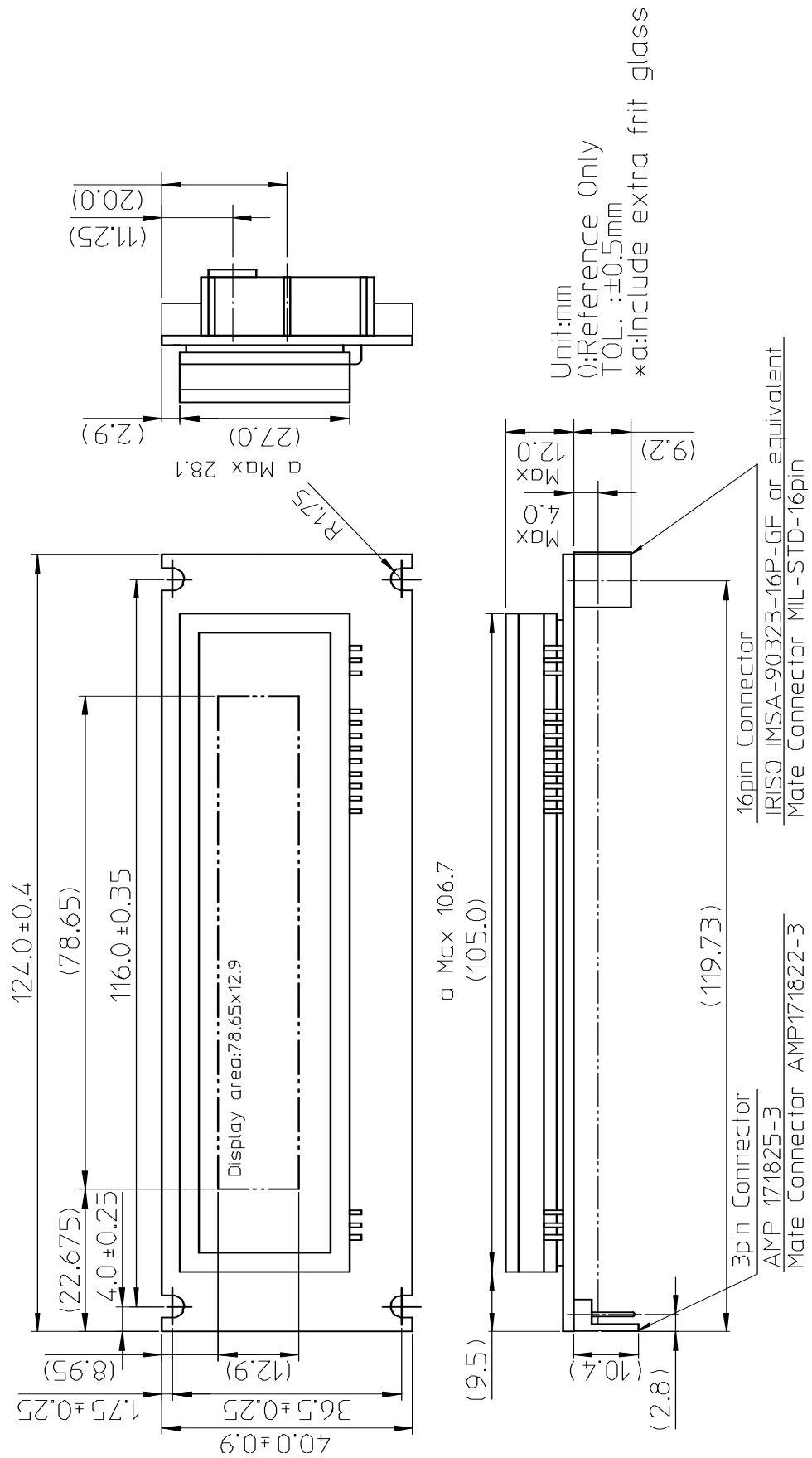
No.	Terminal	No.	Terminal
1	D7	2	D6
3	D5	4	D4
5	D3	6	D2
7	D1	8	D0
9	$\overline{WR}$	10	$\overline{CS}$
11	SIN/T0	12	BUSY
13	GND	14	GND
15	V_{CC}	16	V_{CC}

11.2. 3pin Connector (CN2)



No.	Terminal
1	V_{CC}
2	SIN/T0
3	GND

12. Outline dimension



Notice for the Cautious Handling of VFD Modules

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

[VFD tubes are made of glass]
- The edges of the VFD glass envelope are not smooth, so it is necessary to handle carefully to avoid injuries to hands.
- Use caution to avoid breaking the VFD glass envelope, 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 operation, because unrecoverable damage may result.
- Sending input signals to the VFD module when not powered can cause I/O port damage.
- It is recommended to use a 30cm or shorter signal cable to prevent functional failures.

[Electrostatic charge]
- VFD modules need 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.
- Preferably, use UL-grade materials or components in conjunction with VFD modules.
- Warp and twist movement causes stress and may break VFDs and 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.
- VFD modules may draw in-rush current exceeding twice the typical current at power-on, so a power supply with sufficient capacity and quick starting of the power regulator is recommended.
- VFD module needs a specified voltage at the point of connection. Please use an adequate power cable to avoid a decrease in voltage. As a safety measure, a fuse or other over-current protection is recommended.

[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 non-uniform brightness. 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 of the pixels.
- A signal cable 30cm or less is recommended to avoid possible disturbances to the signal.

[Storage and operating environment]
- Please use VFD modules under the recommended specified environmental conditions. Salty, sulfuric and dusty environments may damage the VFD module even during storage.

[Disposal]
- VFD uses lead-containing materials (RoHS directive exempts these lead compounds in the glass for electronic devices). When discarding VFDs or VFD modules, please adhere to applicable laws and regulations.

[Other cautions]
- 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 is 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 accept responsibility for problems that may occur.

MBBZ-009-S18A

Revision Note

Spec. No.	Data	Revision
DS-1837-0000-00	Dec. 16, 2013	Initial release.