Noritake itron

Vacuum Fluorescent Display Module Specification

Model: GU128X32D-D903S

Specification No.:	DS-1900-0000-01R
Date of Issue:	December 26, 2014 (00R)
Revision:	February 10, 2015 (01R)

This specification is subject to change without prior notice.

This product complies with RoHS Directive 2011/65/EU

Contents

1   General Description

1.1   Scope

This specification covers the software aspects of the GU128X32D-D903S vacuum fluorescent graphic display modules.

1.2   Outline

・Power supply: +5V$_{DC}$ only
・Interface: Asynchronous serial, SPI, I^{2}C interface (+3.3V level-every interface)
・User interface: 8×2 Matrix Touch Switch Panel
・Function: Character display, Graphic displasy, Control command,
                        Display action command, Draw command, Bit Image download function,
                        Window function, Download (user-definable) font, Macro / Program Macro function,
                        Memory SW Data, I/O port control, Touch information read, Touch sensitivity adjustment

For full details, refer to follows;
    GU-D900x Series "General Function" Software Specification: DS-1900-0002-XX
    GU-D900x Series "Program Macro" Software Specification: DS-1900-0004-XX

1.3   Block Diagram

- 2 -
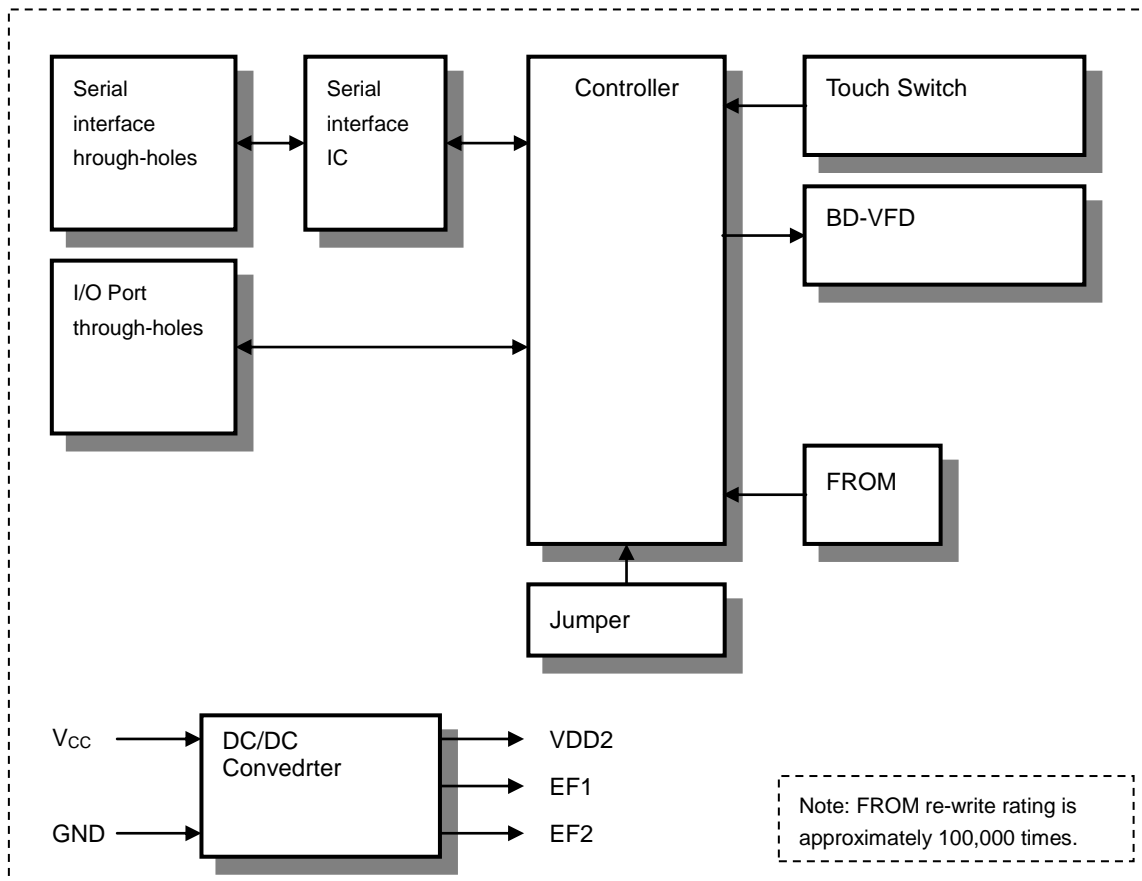
2   Electrical Specifications

2.1   Absolute Maximum Ratings

Parameter	Symbol	Min.	Typ.	Max.	Unit
Power Supply Voltage	V_{CC}	-0.3	-	6.0	V_{DC}
Logic Input Voltage RXD,TXD,MOSI,MISO,SCK,/CS, SDA,SCL,MBUSY,/TRDY, /RESET,P00-P03	V_{IN}	-0.3	-	3.5	V_{DC}

2.2   Electrical Ratings

Parameter	Symbol	Min.	Typ.	Max.	Unit
Power Supply Voltage	V_{CC}	4.75	5.00	5.25	V_{DC}

Driving voltage for the VFD is obtained from the on-board DC/DC converter.
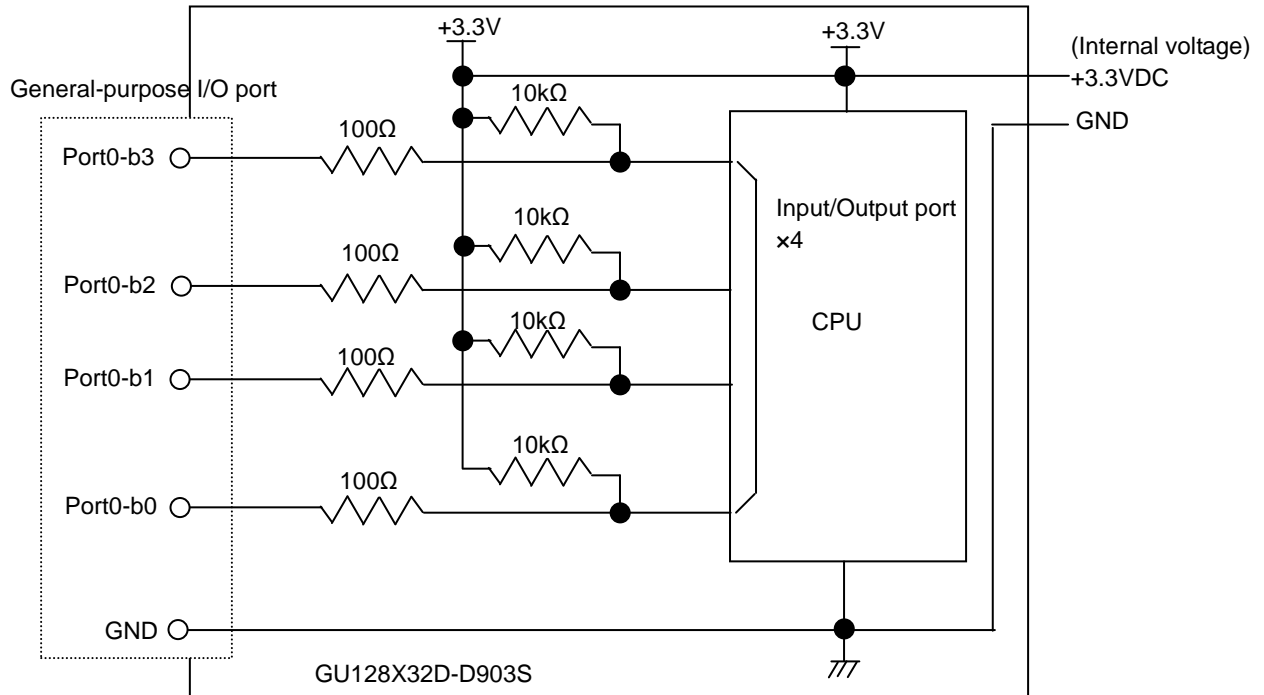
2.3   Electrical Characteristics

Mesuring Conditions: Ambient temperature = 25ºC, V_{CC} = 5.0V_{DC}

Parameter		Symbol	Min.	Typ.	Max.	Unit	Note
Logic Input Current RXD,TXD,MOSI,MISO,SCK, /CS,SDA,SCL,MBUSY,HBUSY, /TRDY,/RESET,P00-P03	"H"	I_{IH}	-	-	1.0	μA_{DC}	V_{IN}=3.3V
	"L"	I_{IL}	-	-	-0.5	mA_{DC}	V_{IN}=0V
Logic Input Voltage RXD,TXD,MOSI,MISO,SCK, /CS,SDA,SCL,MBUSY,HBUSY, /TRDY,/RESET,P00-P03	"H"	V_{IH}	2.5	-	-	V_{DC}	-
	"L"	V_{IL}	-	-	0.6	V_{DC}	-
Logic Output Voltage TXD,MISO,SDA,SCL,MBUSY, /TRDY,P00-P03 ***1**	"H"	V_{OH}	2.6	-	-	V_{DC}	I_{OH}=-0.5mA
	"L"	V_{OL}	-	-	0.5	V_{DC}	I_{OL}=0.5mA
General-porpose I/O port Output permissible current P00-P03 (Single port)	"H"	I_{iOH}-1	-	-	1.5 (TBD)	mA_{DC}	-
	"L"	I_{iOL}-1	-	-	3 (TBD)	mA_{DC}	-
General-porpose I/O port Output permissible current P00-P03 (Sum of all ports)	"H"	I_{iOH}-2	-	-	8 (TBD)	mA_{DC}	-
	"L"	I_{iOL}-2	-	-	30 (TBD)	mA_{DC}	-
Internal pull-up resistor RXD,TXD,MOSI,MISO,SCK,/CS, SDA,SCL,MBUSY,HBUSY,/TRDY, /RESET,P00-P03		R_p	-	10	-	kΩ	-
Power Supply Current 1		I_{CC}-1	-	230 (TBD)	300 (TBD)	mA_{DC}	All dots ON
Power Supply Current 2		I_{CC}-2	-	140 (TBD)	180 (TBD)	mA_{DC}	All dots OFF
Power Supply Current 3		I_{CC}-3	-	7 (TBD)	9 (TBD)	mA_{DC}	Display power OFF (Power-save mode)
Power Consumption		-	-	1.15 (TBD)	1.50 (TBD)	W	All dots ON

*1: SDA and SCL terminal is set to open-drain output when the data-read sequence by I²C interface is selected. (pull-up by 10kΩ resistor)

・The rise time of supply voltage should not exceed 100ms.
・Inrush current at power-on may exceed twice normal current.
・Display power OFF: Refer to "General Function" Software Specification.
・Output current should not exceed the values in the above table.   If driving LED or other device directly, insert appropriate current limiter into output line.

2.4 General-purpose I/O port

・Refer to "2.3 Electrical Characteristics", Logic Input/Output Voltage.
・For controlling I/O port, "I/O Port Input / Output setting" command, "I/O Port Output" command, and "I/O Port Input" command.
  Note: Refer to "General Function" Software Specification.

3 Optical Specifications

Luminance: 350 cd/m^2 Min. (700 cd/m^2 Typ.) (TBD)
Color of illumination: Green (Blue Green)

4 Physical Specifications

Number of dots: 4,096 (128✕32)
Display area: 57.45 mm ✕ 13.93 mm (X✕Y)
Dot size: 0.30 mm ✕ 0.29 mm (X✕Y)
Dot pitch: 0.45 mm ✕ 0.44 mm (X✕Y)
Weight: Approximately 38g (TBD)

5 Environmental Specifications

Operating temperature: -40 to +85 ºC* (TBD)
Storage temperature: -40 to +85 ºC* (TBD)
Operating humidity: 20 to 80% RH (non-condensing)
Storage humidity: 20 to 80% RH (non-condensing)
Vibration (non-operating): 10-55-10Hz, all amplitude 1.0mm, 30 minutes, X-Y-Z
Shock (non-operating):   392m/s^2 (40G), 9ms, X-Y-Z, 3 times each direction

   * Safety standard for bare finger touch to the touch switch area is maximum +70ºC (short touch), or +65ºC (continuous touch).
   * If stored or operated for a long time at high temperatures, some parts of the display area may become discolored.

6 Applicable Specifications

Applicable VFD Module reliability specification: TT-99-3102x
Applicable VFD Module quality specification: TT-93-3413x
Applicable VFD quality specification: TT-93-3336x

7   Touch-Switch

7.1   Basic Operation

7.2   Cautions
to be determined

8 Interface

8.1 Type of interface

There are three Serial interfaces: C-MOS Ssynchronous, SPI or I^{2}C and they are selectable by jumper.
Refer to "9 Jumper".

8.2 Basic function

・ Data received is stored in the internal receive buffer, and processed in order of receipt.
・ MBUSY signal changes according to receive buffer state.　The host should send data when MBUSY=READY.
・ When there is data in the transmit buffer, /TRDY = READY.

○MBUSY signal change timing;

MBUSY	BUSY ("H")	READY ("L")
Condition	Data in receive buffer	No data in receive buffer

○TRDY signal change timing;

/TRDY	EMPTY ("H")	READY ("L")
condition	No data in transmit buffer	Data in transmit buffer

○Buffer Capacity;

Receive buffer	60 bytes
Transmit buffer	60 bytes

8.2.1 Asyncronous serial interface

○Interface conditions;

| Baud rate	9600 to 115200bps (set by Jumper and Memory SW) **Default setting: 38400bps**
Parity	None, Even, Odd (set by Memory SW) **Default setting: None**
Format	Start (1bit) + Data (8bit) + Stop (1bit)
Communication control signal	MBUSY, HBUSY, /TRDY

・ Data transmitted from the display is placed in the internal transmit buffer and sent, in order, when HBUSY=READY.

○Timing **(TBD)**

[Data write]
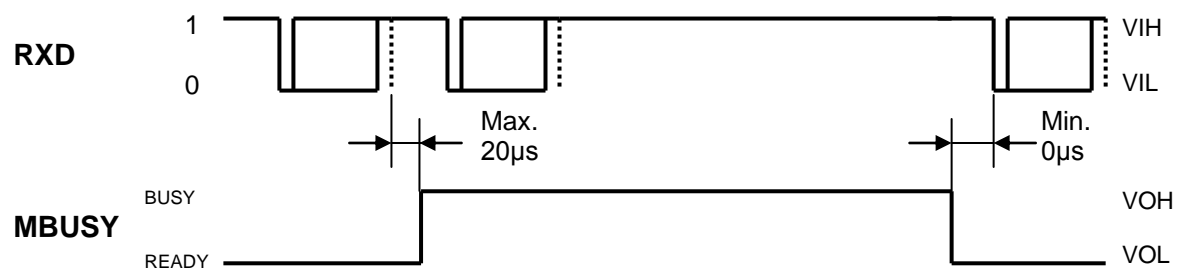
[Data read]
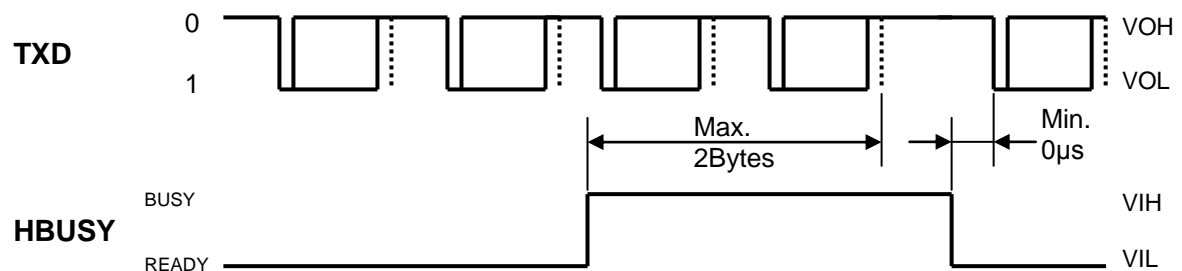
8.2.2 SPI

○Interface conditions;

・ Display module operates as the SPI slave, sending and receiving of data is performed with respect to the operation of the host. /CS = High → Low → High is one command sequence.

1st byte	Operation mode
44h	Data write (Host → Module)
54h	Data read (Host → Moduel)
58h	Status read

[Data-Write]

・ When the operation mode (44h) is set, the controller writes data to the 2nd and subsequent bytes.

	1st byte	2nd byte	3rd byte	---	n byte
MOSI	44h	Data(1)	Data(2)	---	Data(n-1)
MISO	-	-	-	---	-

[Data-Read]

・ When the operation mode (54h) is set, the controller outputs valid data on the 3rd and subsequent bytes.
・ The host must read the number of bytes reported by the immediately preceding Status Read command.
(**The number of bytes reported by the Status read command will be transmitted, with any unread bytes discarded.**)

	1st byte	2nd byte	3rd byte	---	n byte
MOSI	54h	-	-	---	-
MISO	-	00h	Data(1)	---	Data(n-2)

[Status-Read]

・ When the operation mode (58h) is set, the controller outputs the status data. **3rd byte onward, Module sends the latest status data every time when host perform the Data read.**

	1st byte	2nd byte	3rd byte	---	n byte
MOSI	58h	-	-	---	-
MISO	-	Status	Status	---	Status

Status bit assignment

bit7	bit6	bit5	bit4	bit3	bit2	bit1	bit0
MBUSY	0 *	TL(bit5)	TL(bit4)	TL(bit3)	TL(bit2)	TL(bit1)	TL(bit0)

・ MBUSY: MBUSY signal status (MBUSY = 0: Low, MBUSY = 1: High)

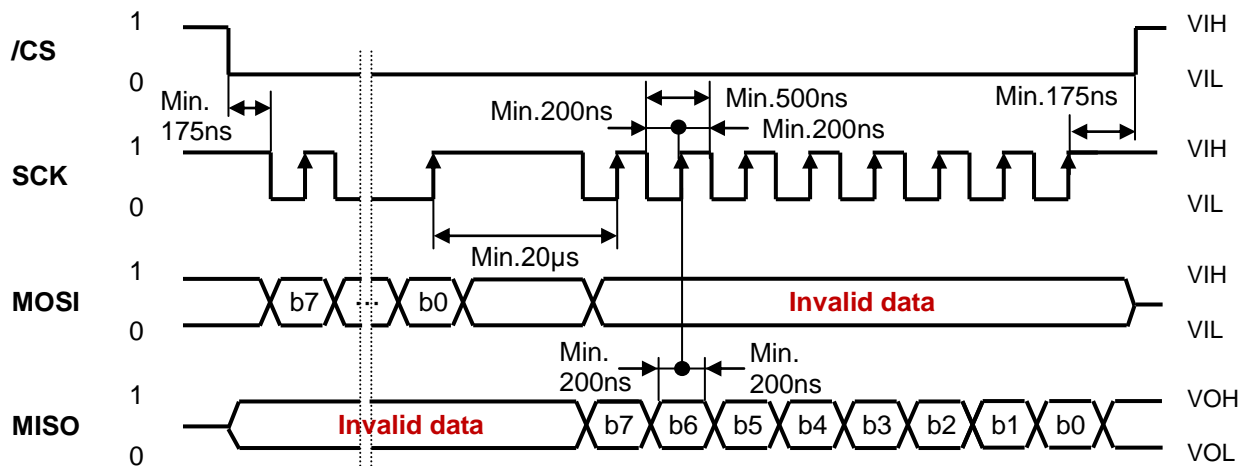・ TL: Number of Transmit data bytes available (maximum 63 bytes)

*: If bit6 = 1, the Status data is invalid.

○Timing **(TBD)**

[Data write] Data-Write
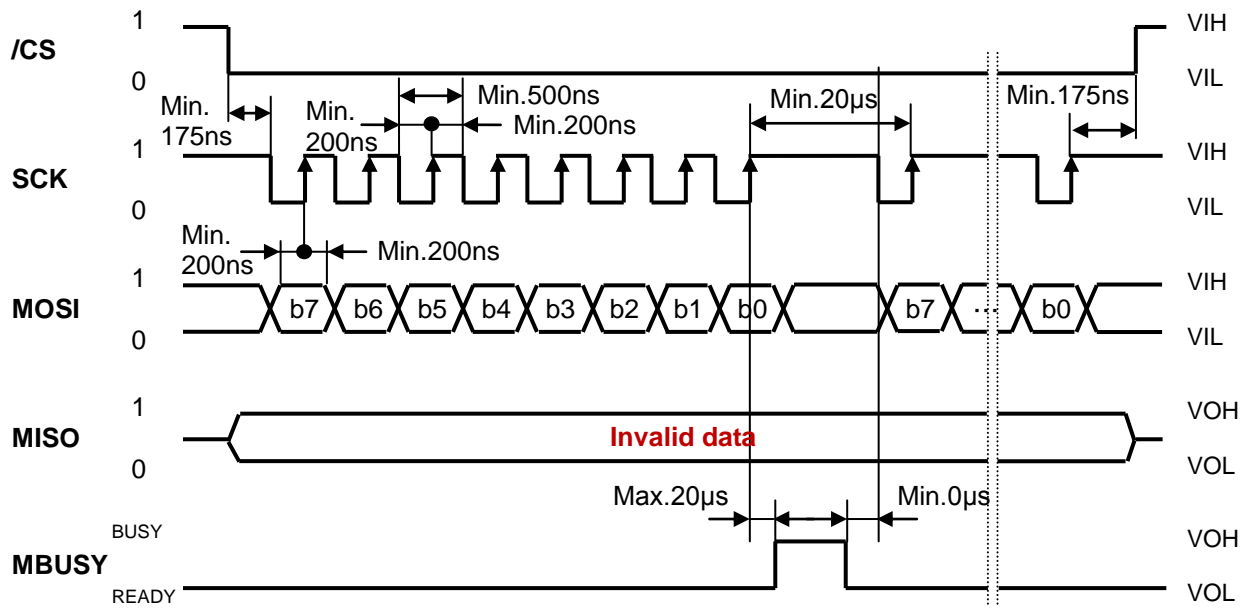
[Data read] Data-Read / Status-Read

8.2.3   I²C interface

○Interface conditions;

・ Display module operates as the I²C slave, sending and receiving of data is performed with respect to the operation of the host.

Clock frequency	Max.400kHz
Format	Conforms to the I²C Standard
Slave address	08h to 77h (set by Jumper and Memory SW) **Default setting: 50h**
Corresponding function	ACK response, Clockstretch
Communication control signal	MBUSY, /TRDY

*Note: If Clock Stretch is applied when display action command is executing, the host will not be able to send more data until the display action has finished.

・ In addition to the configured Slave address, the VFD module also responds to the General call address (00h), however the "second byte" functions (06h and 04h) are not supported (the second, and any subsequent bytes, are treated as ordinary data).

・ When If using the Data read sequence when /TRDY = EMPTY, FFh is transmitted from the VFD module.

・ In addition to the Clock Stretch, handshake can be controlled by MBUSY signal.   MBUSY signal changes according to receive buffer state. The host should send data when MBUSY=READY. (For details, refer t "8.2 Basic function".)

[Data write sequence]

ST	SLAVE ADDRESS			R/*W	ACK	DATA			ACK	・・・	DATA			ACK	SP
	b7	...	b1	b0		b7	...	b0			b7	...	b0		

[Data read sequence]

ST	SLAVE ADDRESS			R/*W	ACK	DATA			ACK	・・・	DATA			NACK	SP
	b7	...	b1	b0		b7	...	b0			b7	...	b0		

☐ The host is transmitter, VFD module is receiver
▨ The host is receiver, VFD module is transmitter

○Timing **(TBD)**
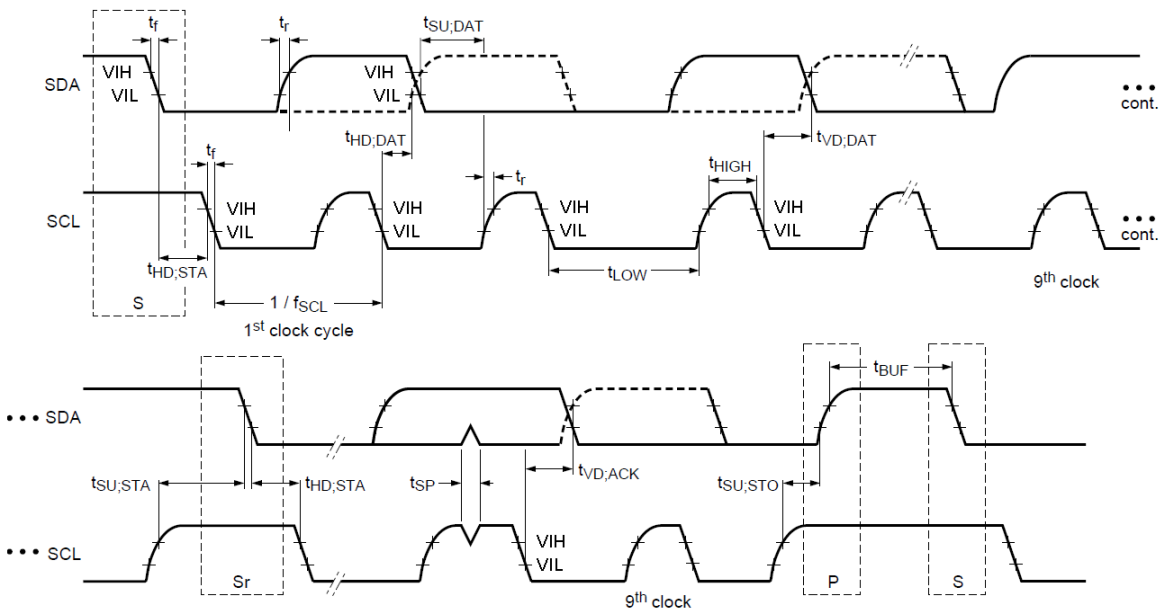
(TBD)

| Parameter	Symbol	Condition	Min.	Typ.	Max.	Unit
pulse width of spikes that must be suppressed by the input filter	t_{SP}	-	0	-	50	ns
SCL clock frequency	f_{SCL}	-	0	-	400	kHz
(Repeat)Start condition hold time	$t_{HD;STA}$	-	0.6	-	-	µs
SCL LOW time	t_{LOW}	-	1.3	-	-	µs
SCL HIGH time	t_{HIGH}	-	0.6	-	-	Ms
Repeat Start condition setup time	$t_{SU;STA}$	-	0.6	-	-	µs
Data hold time	$t_{HD;DAT}$	-	10	-	-	ns
Data setup time	$t_{SU;DAT}$	-	100	-	-	ns
SCL, SDA rise time	t_r	-	20	-	300	ns
SCL, SDA fall time	t_f	V_{IN}=5.5V	20	-	300	ns
Stop condition setup time	$t_{SU;STO}$	-	0.6	-	-	µs
Stop condition - Sart condition bus idle time	t_{BUF}	-	20	-	-	µs
Data valid time	$t_{VD;DAT}$	-	-	-	0.9	µs
Data valid acknowledge valid time	$t_{VD;ACK}$	-	-	-	0.9	µs

*: When selecting the external resistor(s), ensure the requirements in the above table are satisfied. (Refer to "2.3 Electrical Characteristics", for internal resistor.)

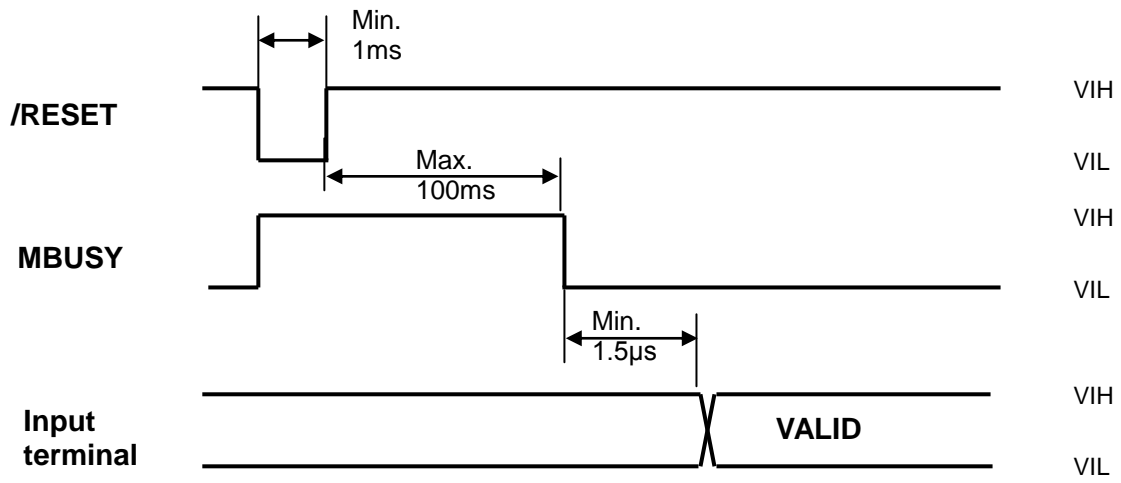**MBUSY timing (TBD)**

/TRDY timing (TBD)

- 10 -
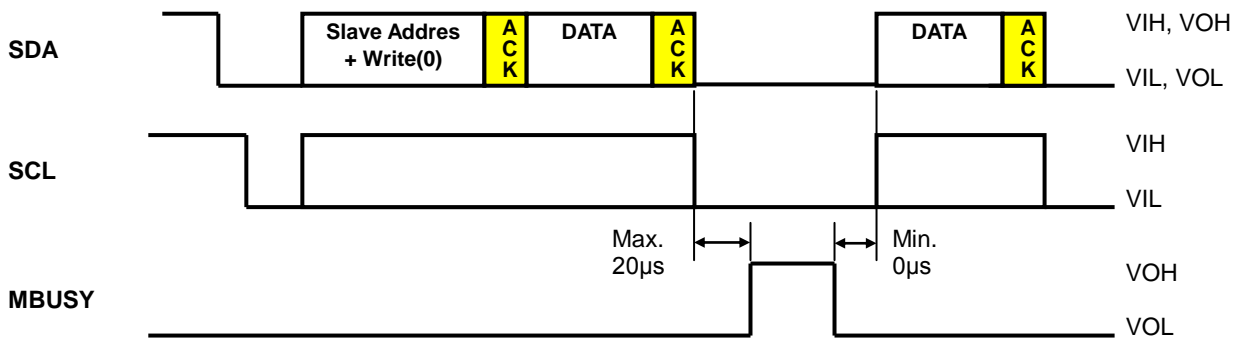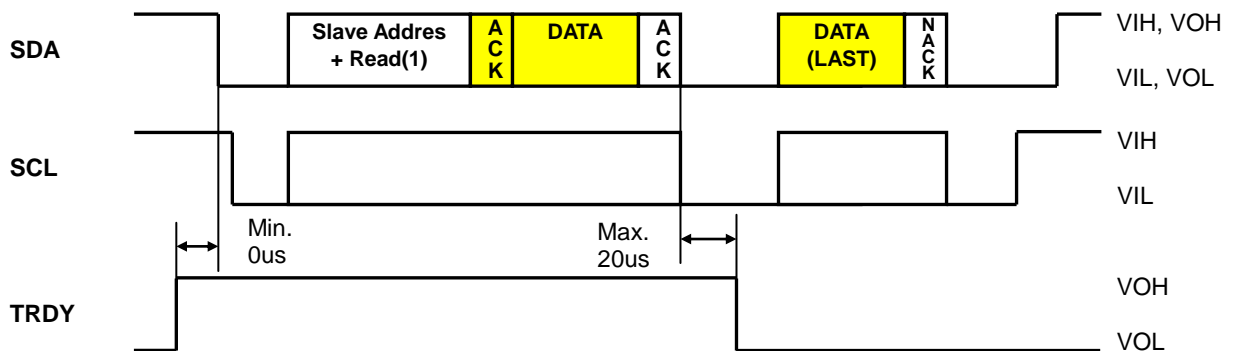
8.3   Reset timing (TBD)

Reset pulse (active low) should be longer than 1ms.

The module sets the MBUSY line upon receipt of /RESET signal and clears the line when ready to receive data.

9   Jumper

*: Memory SW(MSW) details: Refer to "General Function" Software Specification.

No.	Function	Default
J0	Async serial baud rate setting /	OPEN
J1	I^{2}C slave address setting	OPEN
J2	Serial interfacd setting	OPEN
J3		OPEN
TEST	Operating Mode select	OPEN
JRW		OPEN
BT	Factory use only (do not change)	OPEN

Parts side
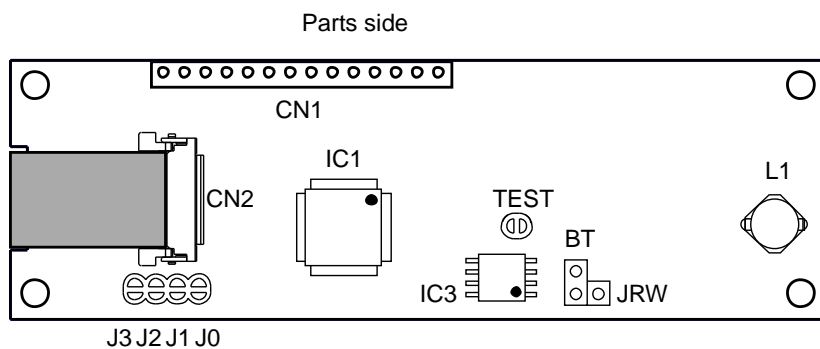
9.1   Serial interface setting

J2	J3	Interface type at power-on
-	OPEN	Asynchronous serial Interface
OPEN	SHORT	I^{2}C Interface
SHORT	SHORT	SPI

9.2   I^{2}C slave address setting

I^{2}C slave address setting at power-on is set by a combination of Memory SW and Jumper.

J0	J1	Slave address
OPEN	OPEN	50h
SHORT	OPEN	51h
OPEN	SHORT	70h
SHORT	SHORT	**MSW47 setting**

9.3   Async serial baud rate setting

Async serial baud rate setting at power-on is set by a combination of Memory SW and Jumper.

J0	J1	Baud rate
OPEN	OPEN	38400bps
SHORT	OPEN	19200bps
OPEN	SHORT	9600bps
SHORT	SHORT	**MSW48 setting**

10 Connector

10.1 Serial interface & I/O port 14 through-holes (CN1)

※IC: Don't connect.

10.1.1 Intareface type: Asynchronous serial interface

Pin No.	Signal name	Function	Direction	Pin No.	Signal name	Function	Direction
1	V_{CC}	Power supply	Input	8	TXD	Data send	Output
2	RXD	Data receive	Input	9	/TRDY	Transmit ready	Output
3	GND	Ground	Input	10	GND	Ground	Input
4	MBUSY	Module busy	Output	11	P00	I/O port0_bit0	Input/Output
5	IC	Internal connection	-	12	P01	I/O port0_bit1	Input/Output
6	/RESET	Reset	Input	13	P02	I/O port0_bit2	Input/Output
7	HBUSY	Host busy	Input	14	P03	I/O port0_bit3	Input/Output

10.1.2 Interface type: SPI

Pin No.	Signal name	Function	Direction	Pin No.	Signal name	Function	Direction
1	V_{CC}	Power supply	Input	8	MISO	Data send	Output
2	MOSI	Data receive	Input	9	/TRDY	Transmit ready	Output
3	GND	Ground	Input	10	GND	Ground	Input
4	MBUSY	Module busy	Output	11	P00	I/O port0_bit0	Input/Output
5	SCK	Serial clock	Input	12	P01	I/O port0_bit1	Input/Output
6	/RESET	Reset	Input	13	P02	I/O port0_bit2	Input/Output
7	/CS	Chip select	Input	14	P03	I/O port0_bit3	Input/Output

10.1.3 Interface type: I^{2}C interface

Pin No.	Signal name	Function	Direction	Pin No.	Signal name	Function	Direction
1	V_{CC}	Power supply	Input	8	IC	Internal connection	-
2	SDA	Data receive	Input/Output	9	/TRDY	Transmit ready	Output
3	GND	Ground	Input	10	GND	Ground	Input
4	MBUSY	Module busy	Output	11	P00	I/O port0_bit0	Input/Output
5	SCL	Serial clock	-	12	P01	I/O port0_bit1	Input/Output
6	/RESET	Reset	Input	13	P02	I/O port0_bit2	Input/Output
7	IC	Internal connection	-	14	P03	I/O port0_bit3	Input/Output

11   Firmware Version Notation

The firmware version is written in the following position.

Soldering Side

Part Number

Date Code ———

Firmware
Version

VFD
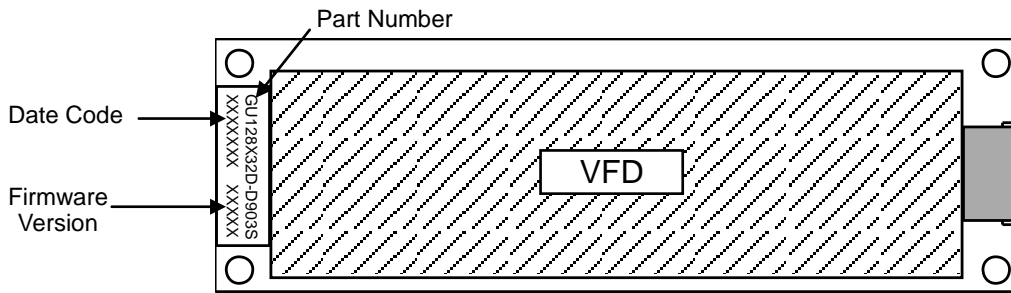
12   Touch Switch position

x. [dot]
0   17   33   49   65   81   97   113

y. [dot] 0

| SW1 | SW2 | SW3 | SW4 | SW5 | SW6 | SW7 | SW8 |

16

| SW9 | SW10 | SW11 | SW12 | SW13 | SW14 | SW15 | SW16 |

——— Display Area

— — — Touch Switch valid area

● Touch Switch start offset x y
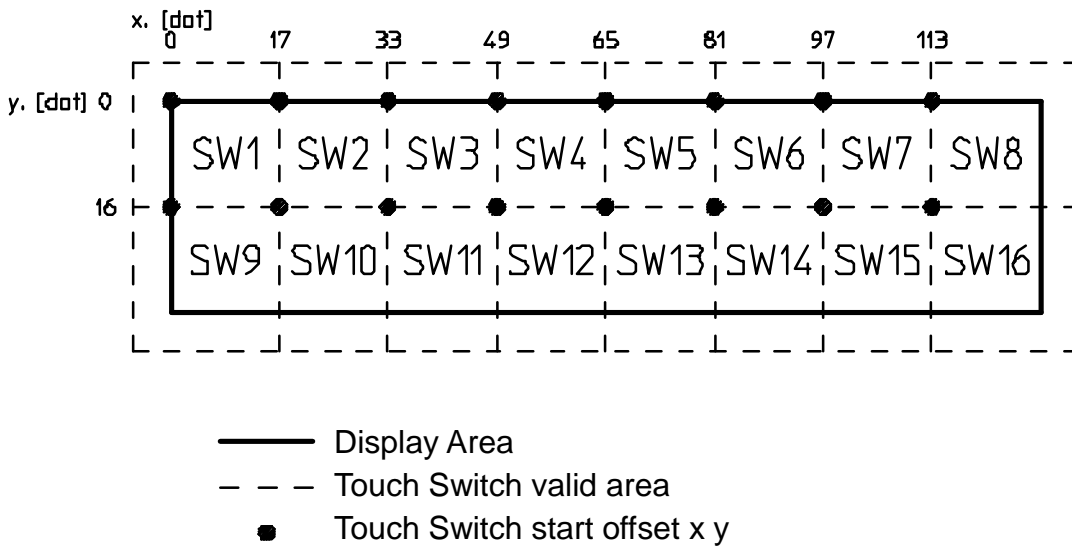
* There is a case in which touch switch start coordinates are shifted several dots, when you want to use the adjacent switch, consider the display contents.

13 Physical Dimensions

( ) : Reference only

Unit : mm

*a Included extra frit glass
*b Display area
*c Touch Switch valid Area

DS-1900-0110-01

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

Specification No.	Date	Revision
DS-1900-0000-00R	Dec. 26, 2014	Initial issue.

DS-1900-0000-01R	Feb. 10, 2015	"2.3 Electrical Characteristics"
		  The error has been corrected.
		    Refer to "Logic Input Current", "Logic Input Voltage" and "Logic Output Voltage".
		"3 Optical Specifications"
		  Luminance parameter has been appended.
		
		Other minor corrections.