

Genda LCD LCM

www.GendaLCD.com



VELCO s.p.a.

Via Divisione Folgore 9M - 36100 - Vicenza - ITALY

Tel. (+39) 0444 922922 ; Fax (+39) 0444 922338

web: www.velco-electronic.com e-mail: sales@velco-electronic.com

PART NO. : GS-CB16277BNWJ/R

DATE : 12-17-2007



Genda Microelectronics

ADDRESS: *Friendship Industrial Building, 71 District,*

Baoan, Shenzhen, P.R.China.

公司地址: 中国深圳市宝安 71 区友谊工业大厦

POST CODE: 518101

TEL: 86-755-27865012

FAX: 86-755-27865217

E-MAIL: gme.43@gendalc.com

Genda LCD LCM www.GendaLCD.com	MODEL NO.	STANDARD DOC
	GS-CB16277BNWJ/R	PRODUCT SPEC.

TABLE OF CONTENTS

<u>ITEM</u>	<u>PAGE</u>
1. <i>COVER</i> _____	<1>
2. <i>TABLE OF CONTENTS</i> _____	<2>
3. <i>GENERAL INFORMATION</i> _____	<3>
4. <i>OPTICAL DEFINITIONS</i> _____	<4>
5. <i>OUTLINE AND MECHANICAL DESCRIPTION</i> _____	<4>
6. <i>ELECTRICAL DESCRIPTION</i> _____	<6>
7. <i>QUALITY AND RELIABILITY</i> _____	<27>
8. <i>CAUTION FOR USING LCM</i> _____	<33>

Genda LCD LCM www.GendaLCD.com	MODEL NO.	STANDARD DOC
	GS-CB16277BNWJ/R	PRODUCT SPEC.

1. GENERAL INFORMATION

1.1 SCOPE:

This specification covers the delivery requirements for the LCM delivered by Genda Microelectronics to Customer.

1.2 PRODUCT ELEMENT

LCD, PCB, FRAME, RUBBER, LED BACKLIGHT, FFC, IC.ETC

1.3 MODULE NAME

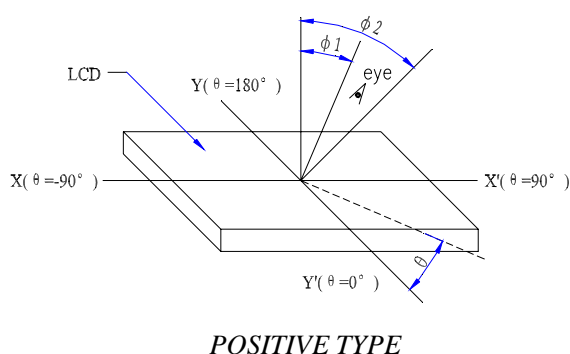
GS-CB16277BNWJ/R

1.4 ENVIRONMENT DESCRIPTION.

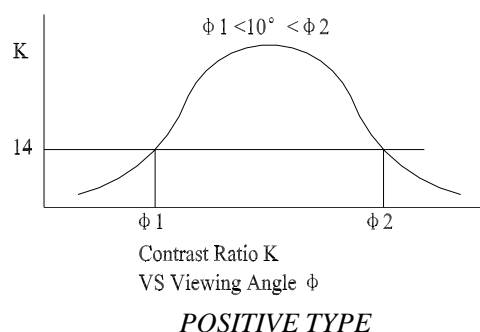
RoHS Compliant.

2. OPTICAL DEFINITIONS

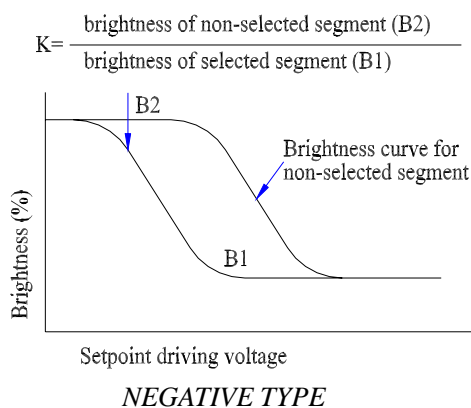
2.1 Definition of angle θ and ϕ



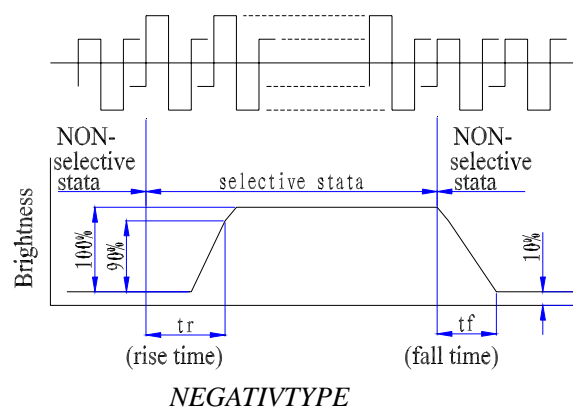
2.2 Definition of viewing angle $\phi 1$ and $\phi 2$



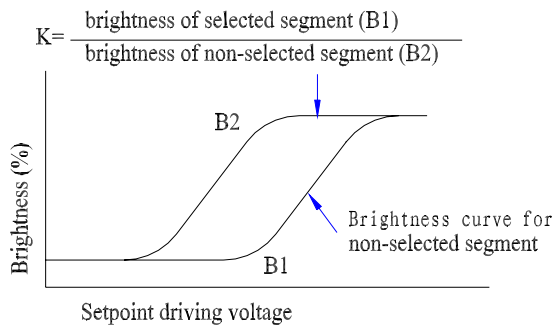
2.3 Definition of contrast “K”



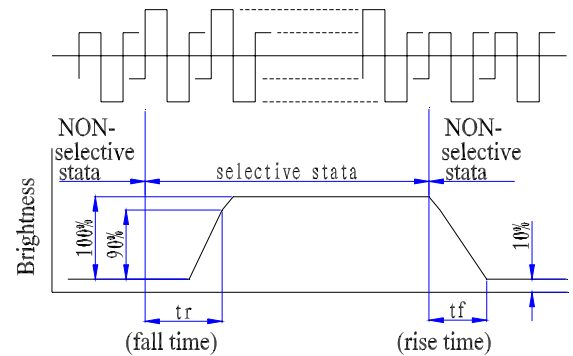
2.4 Definition of optical response



2.5 Definition of contrast “K”

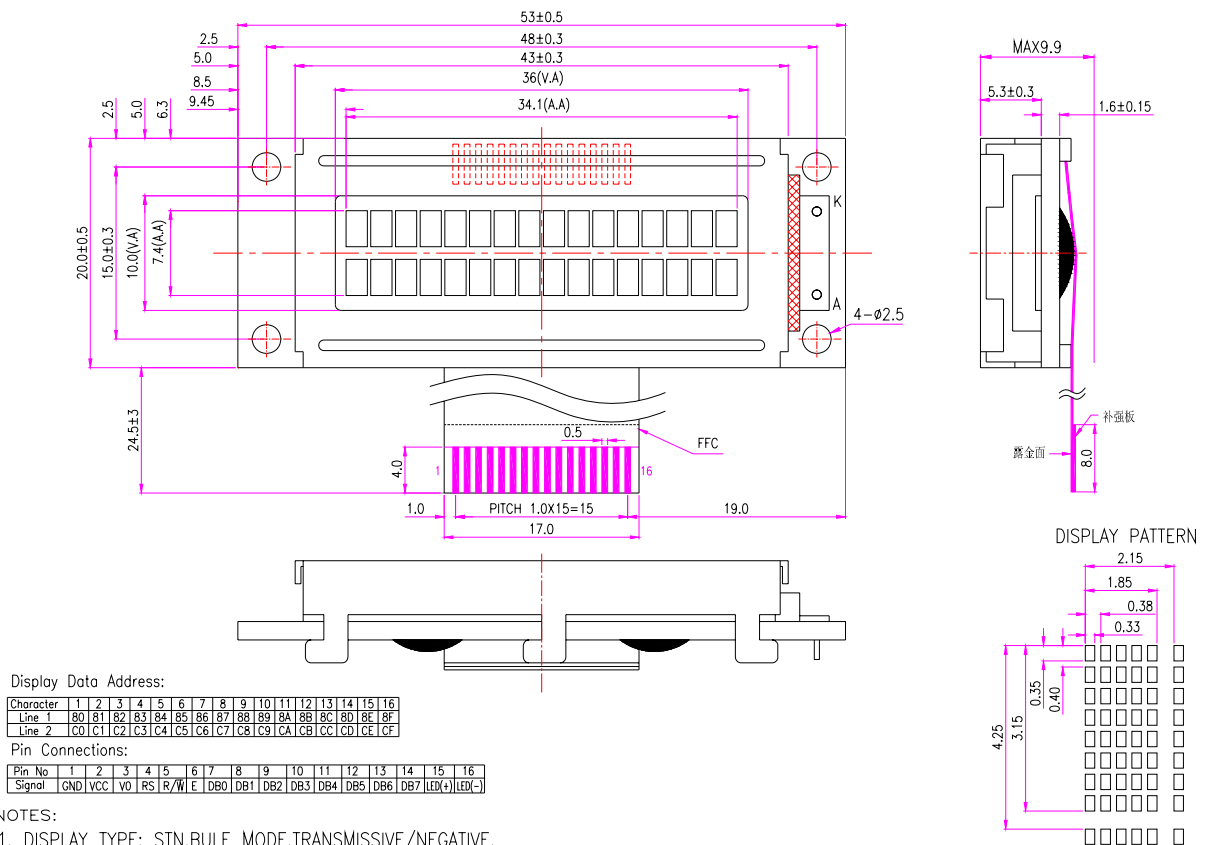


2.6 Definition of optical response



3.OUTLINE AND MECHANICAL DESCRIPTION

3.1 OUTLINE



Genda LCD LCM www.GendaLCD.com	MODEL NO.	STANDARD DOC
	GS-CB16277BNWJ/R	PRODUCT SPEC.

3.2 MECHANICAL DESCRIPTION

Item.	Standard Value		Unit
Lcm Size	53*20		mm
Dot Size	0.33*0.35		mm
Dot Number	16*2		dots
Dot Pitch	0.38*0.40		mm
View Area	36*10		mm
Action Area	34.1*7.4		mm
Assy.Type	COB		--
View Direction	<input type="checkbox"/> 3H <input checked="" type="checkbox"/> 6H <input type="checkbox"/> 9H <input type="checkbox"/> 12H <input type="checkbox"/> OTHER		--
Lcd Type	<input type="checkbox"/> TN <input type="checkbox"/> HTN <input type="checkbox"/> STN GRAY <input checked="" type="checkbox"/> STN BLUE <input type="checkbox"/> STN YELLOW-GREEN <input type="checkbox"/> FSTN B/W <input type="checkbox"/> OTHER		--
Display Mode	<input type="checkbox"/> Positive <input checked="" type="checkbox"/> Negative		--
Rear Polarizer	<input type="checkbox"/> Reflective <input type="checkbox"/> Transflective <input checked="" type="checkbox"/> Transmissive		--
Backlight Type	<input checked="" type="checkbox"/> LED <input type="checkbox"/> EL <input type="checkbox"/> CCFL	<input type="checkbox"/> Bottom <input checked="" type="checkbox"/> Edge	--
	Led Voltage: 3.1V Lightness: --		--
Backlight Color	<input checked="" type="checkbox"/> White <input type="checkbox"/> Yellow-Green <input type="checkbox"/> Blue <input type="checkbox"/> Amber <input type="checkbox"/> Other		--
Temperature Range	<input type="checkbox"/> Normal <input checked="" type="checkbox"/> Wide <input type="checkbox"/> Super Wide		--
	Operating Temp: -20℃~70℃ Store Temp: -30℃~80℃		--
Drive Method	Duty: 1/16 Bias: 1/5		--
	VDD: 5.0 VOP: 4.1		V
Drive IC	ST7066 And ST7065 Or Equivalent		--
Weight	<input type="checkbox"/> CheckBox24		g

Genda LCD LCM www.GendaLCD.com	MODEL NO.	STANDARD DOC
	GS-CB16277BNWJ/R	PRODUCT SPEC.

4.3 Instruction (ST7066)

The ST7066 dot-matrix liquid crystal display controller and driver LSI displays alphanumeric, Japanese kana characters, and symbols. It can be configured to drive a dot-matrix liquid crystal display under the control of a 4- or 8-bit microprocessor. Since all the functions such as display RAM, character generator, and liquid crystal driver, required for driving a dot-matrix liquid crystal display are internally provided on one chip, a minimal system can be interfaced with this controller/driver. The ST7066 has pin function compatibility with the HD44780, KS0066U and SED1278 that allows the user to easily replace it with an ST7066. The ST7066 character generator ROM is extended to generate 208 5 x 8 dot character fonts and 32 5 x 11 dot character fonts for a total of 240 different character fonts. The low power supply (2.7V to 5.5V) of the ST7066 is suitable for any portable battery-driven product requiring low power dissipation.


The ST7066 LCD driver consists of 16 common signal drivers and 40 segment signal drivers which can extend display size by cascading segment driver ST7065 or ST7063. The maximum display size can be either 80 characters in 1-line display or 40 characters in 2-line display. A single ST7066 can display up to one 8-character line or two 8-character lines.

4.4 FEATURES

- 5 x 8 and 5 x 11 dot matrix possible
- Low power operation support:
-- 2.7 to 5.5V
- Wide range of LCD driver power
-- 3.0 to 11V
- Correspond to high speed MPU bus interface
-- 2 MHz (when $V_{CC} = 5V$)
- 4-bit or 8-bit MPU interface enabled
- 80 x 8-bit display RAM (80 characters max.)
- 9,920-bit character generator ROM for a total of 240 character fonts
-- 208 character fonts (5 x 8 dot)
-- 32 character fonts (5 x 11 dot)
- 64 x 8-bit character generator RAM
-- 8 character fonts (5 x 8 dot)
-- 4 character fonts (5 x 11 dot)
- 16-common x 40-segment liquid crystal display driver
- Programmable duty cycles
-- 1/8 for one line of 5 x 8 dots with cursor
-- 1/11 for one line of 5 x 11 dots & cursor
-- 1/16 for two lines of 5 x 8 dots & cursor
- Wide range of instruction functions:
Display clear, cursor home, display on/off, cursor on/off, display character blink, cursor shift, display shift
- Pin function compatibility with HD44780, KS0066 and SED1278
- Automatic reset circuit that initializes the controller/driver after power on
- Internal oscillator with external resistors
- Low power consumption
- QFP80 and Bare Chip available

4.5 Electrical Absolute Maximum Rating

Characteristics	Symbol	Value
Power Supply Voltage	V_{CC}	-0.3V to +7.0V
LCD Driver Voltage	V_{LCD}	-0.3V to +13.0V
Input Voltage	V_{IN}	-0.3V to $V_{CC}+0.3V$
Operating Temperature	T_A	-20°C to +70°C
Storage Temperature	T_{STO}	-55°C to +125°C

 www.GendaLCD.com	MODEL NO.	STANDARD DOC
	GS-CB16277BNWJ/R	PRODUCT SPEC.

4.6 Function Description

System Interface

This chip has all two kinds of interface type with MPU : 4-bit bus and 8-bit bus. 4-bit bus or 8-bit bus is selected by DL bit in the instruction register.

During read or write operation, two 8-bit registers are used. One is data register (DR), the other is instruction register(IR).

The data register(DR) is used as temporary data storage place for being written into or read from DDRAM/CGRAM, target RAM is selected by RAM address setting instruction. Each internal operation, reading from or writing into RAM, is done automatically. So to speak, after MPU reads DR data, the data in the next DDRAM/CGRAM address is transferred into DR automatically. Also after MPU writes data to DR, the data in DR is transferred into DDRAM/CGRAM automatically.

The Instruction register(IR) is used only to store instruction code transferred from MPU. MPU cannot use it to read instruction data.

To select register, use RS input pin in 4-bit/8-bit bus mode.

Table 1. Various kinds of operations according to RS and R/W bits.

RS	RW	Operation
L	L	Instruction Write operation (MPU writes Instruction code into IR)
L	H	Read Busy Flag(DB7) and address counter (DB0 ~ DB6)
H	L	Data Write operation (MPU writes data into DR)
H	H	Data Read operation (MPU reads data from DR)

Busy Flag (BF)

When BF = "High", it indicates that the internal operation is being processed. So during this time the next instruction cannot be accepted. BF can be read, when RS = Low and R/W = High (Read Instruction Operation), through DB7 port. Before executing the next instruction, be sure that BF is not High.

Address Counter (AC)

Address Counter(AC) stores DDRAM/CGRAM address, transferred from IR.

After writing into (reading from) DDRAM/CGRAM, AC is automatically increased (decreased) by 1.

When RS = "Low" and R/W = "High", AC can be read through DB0 ~ DB6 ports.

Display Data RAM (DDRAM)

Display data RAM (DDRAM) stores display data represented in 8-bit character codes. Its extended capacity is 80 x 8 bits, or 80 characters. The area in display data RAM (DDRAM) that is not used for display can be used as general data RAM. See Figure 1 for the relationships between DDRAM addresses and positions on the liquid crystal display.

The DDRAM address (A_{DD}) is set in the address counter (AC) as hexadecimal.

- 1-line display ($N = 0$) (Figure 2)

When there are fewer than 80 display characters, the display begins at the head position. For example, if using only the ST7066, 8 characters are displayed. See Figure 3. When the display shift operation is performed, the DDRAM address shifts. See Figure 3.

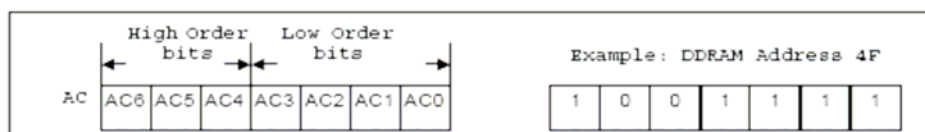


Figure 1 DDRAM Address

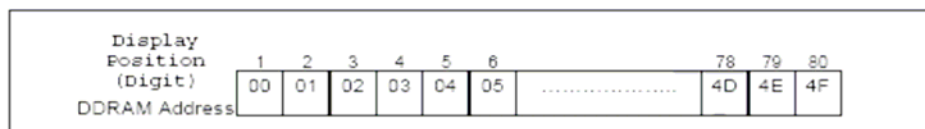


Figure 2 1-Line Display

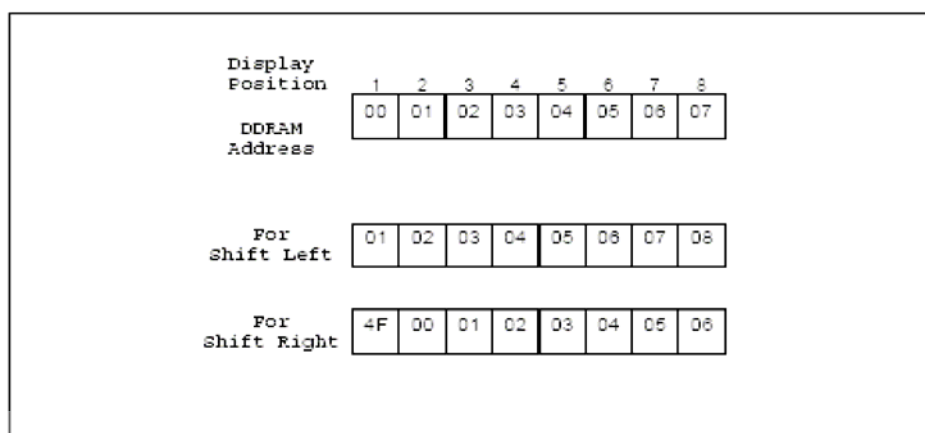


Figure 3 1-Line by 8-Character Display Example

- 2-line display ($N = 1$) (Figure 4)

Case 1: When the number of display characters is less than 40×2 lines, the two lines are displayed from the head. Note that the first line end address and the second line start address are not consecutive. For example, when just the ST7066 is used, 8 characters \times 2 lines are displayed. See Figure 5.

Display Position	1	2	3	4	5	6		38	39	40
DDRAM Address	00	01	02	03	04	05	.....	25	26	27
Address (hexadecimal)	40	41	42	43	44	45	.....	65	66	67

Figure 4 2-Line Display

Display Position	1	2	3	4	5	6	7	8
DDRAM Address	00	01	02	03	04	05	06	07
	40	41	42	43	44	45	46	47
For Shift Left	01	02	03	04	05	06	07	08
	41	42	43	44	45	46	47	48
For Shift Right	27	00	01	02	03	04	05	06
	67	40	41	42	43	44	45	46

Figure 5 2-Line by 8-Character Display Example

Case 2: For a 16-character × 2-line display, the ST7066 can be extended using one 40-output extension driver. See Figure 6.

When display shift operation is performed, the DDRAM address shifts. See Figure 6.

Display Position	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
DDRAM Address	00	01	02	03	04	05	06	07	08	09	0A	0B	0C	0D	0E	0F
	40	41	42	43	44	45	46	47	48	49	4A	4B	4C	4D	4E	4F
For Shift Left	01	02	03	04	05	06	07	08	09	0A	0B	0C	0D	0E	0F	10
	41	42	43	44	45	46	47	48	49	4A	4B	4C	4D	4E	4F	50
For Shift Right	27	00	01	02	03	04	05	06	07	08	09	0A	0B	0C	0D	0E
	67	40	41	42	43	44	45	46	47	48	49	4A	4B	4C	4D	4E

Figure 6 2-Line by 16-Character Display Example

Genda LCD LCM www.GendaLCD.com	MODEL NO.	STANDARD DOC
	GS-CB16277BNWJ/R	PRODUCT SPEC.

Character Generator ROM (CGROM)

The character generator ROM generates 5 x 8 dot or 5 x 11 dot character patterns from 8-bit character codes. It can generate 208 5 x 8 dot character patterns and 32 5 x 11 dot character patterns. User-defined character patterns are also available by mask-programmed ROM.

Character Generator RAM (CGRAM)

In the character generator RAM, the user can rewrite character patterns by program. For 5 x 8 dots, eight character patterns can be written, and for 5 x 11 dots, four character patterns can be written.

Write into DDRAM the character codes at the addresses shown as the left column of Table 4 to show the character patterns stored in CGRAM.

See Table 5 for the relationship between CGRAM addresses and data and display patterns. Areas that are not used for display can be used as general data RAM.

Timing Generation Circuit

The timing generation circuit generates timing signals for the operation of internal circuits such as DDRAM, CGROM and CGRAM. RAM read timing for display and internal operation timing by MPU access are generated separately to avoid interfering with each other. Therefore, when writing data to DDRAM, for example, there will be no undesirable interference, such as flickering, in areas other than the display area.

LCD Driver Circuit

LCD Driver circuit has 16 common and 40 segment signals for LCD driving. Data from CGRAM/CGROM is transferred to 40 bit segment latch serially, and then it is stored to 40 bit shift latch. When each common is selected by 16 bit common register, segment data also output through segment driver from 40 bit segment latch. In case of 1-line display mode, COM1 ~ COM8 have 1/8 duty or COM1 ~ COM11 have 1/11duty, and in 2-line mode, COM1 ~ COM16 have 1/16 duty ratio.

Cursor/Blink Control Circuit

It can generate the cursor or blink in the cursor/blink control circuit. The cursor or the blink appears in the digit at the display data RAM address set in the address counter.

NO.7066-0A

b7-b4 b3-b0	0000	0001	0010	0011	0100	0101	0110	0111	1000	1001	1010	1011	1100	1101	1110	1111
0000	CG RAM (1)			0	@	P	\	P				-	9	E	α	p
0001	(2)		!	1	A	Q	a	9			6	7	7	4	ä	q
0010	(3)		"	2	B	R	b	r			r	イ	ウ	×	ρ	θ
0011	(4)		#	3	C	S	c	s			」	ウ	7	E	ε	×
0100	(5)		\$	4	D	T	d	t			√	E	ト	ト	μ	Ω
0101	(6)		%	5	E	U	e	u			*	オ	オ	1	ε	U
0110	(7)		&	6	F	V	f	v			ヲ	カ	ニ	ヨ	ρ	Σ
0111	(8)		'	7	G	W	g	w			フ	キ	又	ウ	g	π
1000	(1)		<	8	H	X	h	x			イ	ウ	※	リ	5	又
1001	(2)		)	9	I	Y	i	y			6	7	リ	ル	°	y
1010	(3)		*	:	J	Z	j	z			エ	コ	ン	レ	j	7
1011	(4)		+	;	K	L	k	l			★	ウ	E	ロ	×	ア
1100	(5)		,	<	L	¥	1	1			ト	ヨ	フ	フ	φ	ア
1101	(6)		-	=	M	J	m	>			ユ	ズ	△	△	±	÷
1110	(7)		.	>	N	^	n	÷			ヨ	E	ホ	°	ん	
1111	(8)		/	?	O	_	o	+			ウ	ウ	マ	"	ö	■

Character Code (DDRAM Data)								CGRAM Address						Character Patterns (CGRAM Data)							
b7	b6	b5	b4	b3	b3	b1	b0	b5	b4	b3	b2	b1	b0	b7	b6	b5	b4	b3	b2	b1	b0
0	0	0	0	-	0	0	0	0	0	0	0	0	0	-	-	-	1	1	1	1	1
					0	0	0				0	0	1				0	0			
					0	0	0				0	1	0				0	0			
					0	0	0				0	1	1				0	0			
					0	0	0				1	0	0				0	0			
					0	0	0				1	0	1				0	0			
					0	0	0				1	1	0				0	0			
					0	0	0				1	1	1				0	0			
0	0	0	0	-	0	0	1	0	0	0	0	0	0	-	-	-	1	1	1	1	0
					0	0	1				0	0	1				1	0	0	1	
					0	0	1				0	1	0				0	0	1		
					0	0	1				0	1	1				1	1	1	0	
					0	0	1				1	0	0				1	0	0		
					0	0	1				1	0	1				0	0			
					0	0	1				1	1	0				0	1			
					0	0	1				1	1	1				0	0			

Table 5 Relationship between CGRAM Addresses, Character Codes (DDRAM) and Character patterns (CGRAM Data)
Notes:

1. Character code bits 0 to 2 correspond to CGRAM address bits 3 to 5 (3 bits: 8 types).
 2. CGRAM address bits 0 to 2 designate the character pattern line position. The 8th line is the cursor position and its display is formed by a logical OR with the cursor. Maintain the 8th line data, corresponding to the cursor display position, at 0 as the cursor display. If the 8th line data is 1, 1 bits will light up the 8th line regardless of the cursor presence.
 3. Character pattern row positions correspond to CGRAM data bits 0 to 4 (bit 4 being at the left).
 4. As shown Table 5, CGRAM character patterns are selected when character code bits 4 to 7 are all 0. However, since character code bit 3 has no effect, the R display example above can be selected by either character code 00H or 08H.
 5. 1 for CGRAM data corresponds to display selection and 0 to non-selection.
- "-": Indicates no effect.

4.7 Instruction Description

There are four categories of instructions that:

- Designate ST7066 functions, such as display format, data length, etc.
- Set internal RAM addresses
- Perform data transfer with internal RAM
- Others

Instruction Table:

Instruction	Instruction Code										Description	Description Time (270KHZ)
	RS	RW	DB 7	DB 6	DB 5	DB 4	DB 3	DB 2	DB 1	DB 0		
Clear Display	0	0	0	0	0	0	0	0	0	1	Write "20H" to DDRAM, and set DDRAM address to "00H" from AC	1.62 ms
Return Home	0	0	0	0	0	0	0	0	1	x	Set DDRAM address to "00H" from AC and return cursor to its original position if shifted. The contents of DDRAM are not changed.	1.62 ms
Entry Mode Set	0	0	0	0	0	0	0	1	I/D	S	Sets cursor move direction and specifies display shift. These operations are performed during data write and read.	37 us
Display ON/OFF	0	0	0	0	0	0	1	D	C	B	D=1: entire display on C=1: cursor on B=1: cursor position on	37 us
Cursor or Display Shift	0	0	0	0	0	1	S/C	R/L	x	x	Set cursor moving and display shift control bit, and the direction, without changing DDRAM data.	37 us
Function Set	0	0	0	0	1	DL	N	F	x	x	DL: interface data is 8/4 bits NL: number of line is 2/1 F: font size is 5x11/5x8	37 us
Set CGRAM address	0	0	0	1	AC 5	AC 4	AC 3	AC 2	AC 1	AC 0	Set CGRAM address in address counter	37 us
Set DDRAM address	0	0	1	AC 6	AC 5	AC 4	AC 3	AC 2	AC 1	AC 0	Set DDRAM address in address counter	37 us
Read Busy flag and address	0	1	BF	AC 6	AC 5	AC 4	AC 3	AC 2	AC 1	AC 0	Whether during internal operation or not can be known by reading BF. The contents of address counter can also be read.	0 us
Write data to RAM	1	0	D7	D6	D5	D4	D3	D2	D1	D0	Write data into internal RAM (DDRAM/CGRAM)	43 us
Read data from RAM	1	1	D7	D6	D5	D4	D3	D2	D1	D0	Read data from internal RAM (DDRAM/CGRAM)	43 us

Note:

Be sure the ST7066 is not in the busy state (BF = 0) before sending an instruction from the MPU to the ST7066. If an instruction is sent without checking the busy flag, the time between the first instruction and next instruction will take much longer than the instruction time itself. Refer to Instruction Table for the list of each instruction execution time.

- Clear Display

	RS	RW	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0
Code	0	0	0	0	0	0	0	0	0	1

Clear all the display data by writing "20H" (space code) to all DDRAM address, and set DDRAM address to "00H" into AC (address counter). Return cursor to the original status, namely, bring the cursor to the left edge on first line of the display. Make entry mode increment (I/D = "1").

- Return Home

	RS	RW	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0
Code	0	0	0	0	0	0	0	0	1	x

Return Home is cursor return home instruction. Set DDRAM address to "00H" into the address counter. Return cursor to its original site and return display to its original status, if shifted. Contents of DDRAM does not change.

- Entry Mode Set

	RS	RW	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0
Code	0	0	0	0	0	0	0	1	I/D	S

Set the moving direction of cursor and display.

I/D : Increment / decrement of DDRAM address (cursor or blink)

When I/D = "High", cursor/blink moves to right and DDRAM address is increased by 1.

When I/D = "Low", cursor/blink moves to left and DDRAM address is decreased by 1.

* CGRAM operates the same as DDRAM, when read from or write to CGRAM.

S: Shift of entire display

When DDRAM read (CGRAM read/write) operation or S = "Low", shift of entire display is not performed. If S = "High" and DDRAM write operation, shift of entire display is performed according to I/D value (I/D = "1" : shift left, I/D = "0" : shift right).

S	I/D	DESCRIPTION
H	H	Shift the display to the left
H	L	Shift the display to the right

● Display ON/OFF

	RS	RW	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0
Code	0	0	0	0	0	0	1	D	C	B

Control display/cursor/blink ON/OFF 1 bit register.

D : Display ON/OFF control bit

When D = "High", entire display is turned on.

When D = "Low", display is turned off, but display data is remained in DDRAM.

C : Cursor ON/OFF control bit

When C = "High", cursor is turned on.

When C = "Low", cursor is disappeared in current display, but I/D register remains its data.

B : Cursor Blink ON/OFF control bit

When B = "High", cursor blink is on, that performs alternate between all the high data and display character at the cursor position.

When B = "Low", blink is off.

● Cursor or Display Shift

	RS	RW	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0
Code	0	0	0	0	0	1	S/C	R/L	x	x

Without writing or reading of display data, shift right/left cursor position or display. This instruction is used to correct or search display data. During 2-line mode display, cursor moves to the 2nd line after 40th digit of 1st line. Note that display shift is performed simultaneously in all the line. When displayed data is shifted repeatedly, each line shifted individually. When display shift is performed, the contents of address counter are not changed.

S/C	R/L	Description	AC Value
L	L	Shift cursor to the left	AC=AC-1
L	H	Shift cursor to the right	AC=AC+1
H	L	Shift display to the left. Cursor follows the display shift	AC=AC
H	H	Shift display to the right. Cursor follows the display shift	AC=AC

● Function Set

	RS	RW	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0
Code	0	0	0	0	1	DL	N	F	x	x

Control display/cursor/blink ON/OFF 1 bit register.

DL : Interface data length control bit

When DL = "High", it means 8-bit bus mode with MPU.

When DL = "Low", it means 4-bit bus mode with MPU. So to speak, DL is a signal to select 8-bit or 4-bit bus mode.

When 4-bit bus mode, it needs to transfer 4-bit data by two times.

N : Display line number control bit

When N = "Low", it means 1-line display mode.

When N = "High", 2-line display mode is set.

F : Display font type control bit

When F = "Low", it means 5 x 8 dots format display mode

When F = "High", 5 x 11 dots format display mode.

N	F	No. of Display Lines	Character Font	Duty Factor
L	L	1	5x8	1/8
L	H	1	5x11	1/11
H	x	2	5x8	1/16

● **Set CGRAM Address**

	RS	RW	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0
code	0	0	0	1	AC5	AC4	AC3	AC2	AC1	AC0

Set CGRAM address to AC.

This instruction makes CGRAM data available from MPU.

● **Set DDRAM Address**

	RS	RW	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0
code	0	0	1	AC6	AC5	AC4	AC3	AC2	AC1	AC0

Set DDRAM address to AC.

This instruction makes DDRAM data available from MPU.

When 1-line display mode (N = 0), DDRAM address is from "00H" to "4FH".

In 2-line display mode (N = 1), DDRAM address in the 1st line is from "00H" to "27H", and DDRAM address in the 2nd line is from "40H" to "67H".

- Read Busy Flag and Address

	RS	RW	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0
Code	0	1	BF	AC6	AC5	AC4	AC3	AC2	AC1	AC0

When BF = "High", indicates that the internal operation is being processed. So during this time the next instruction cannot be accepted.

The address Counter (AC) stores DDRAM/CGRAM addresses, transferred from IR.

After writing into (reading from) DDRAM/CGRAM, AC is automatically increased (decreased) by 1.

- Write Data to CGRAM or DDRAM

	RS	RW	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0
Code	1	0	D7	D6	D5	D4	D3	D2	D1	D0

Write binary 8-bit data to DDRAM/CGRAM.

The selection of RAM from DDRAM, CGRAM, is set by the previous address set instruction : DDRAM address set, CGRAM address set. RAM set instruction can also determine the AC direction to RAM.

After write operation, the address is automatically increased/decreased by 1, according to the entry mode.

- Read Data from CGRAM or DDRAM

	RS	RW	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0
Code	1	1	D7	D6	D5	D4	D3	D2	D1	D0

Read binary 8-bit data from DDRAM/CGRAM.

The selection of RAM is set by the previous address set instruction. If address set instruction of RAM is not performed before this instruction, the data that read first is invalid, because the direction of AC is not determined. If you read RAM data several times without RAM address set instruction before read operation, you can get correct RAM data from the second, but the first data would be incorrect, because there is no time margin to transfer RAM data.

In case of DDRAM read operation, cursor shift instruction plays the same role as DDRAM address set instruction : it also transfer RAM data to output data register. After read operation address counter is automatically increased/decreased by 1 according to the entry mode. After CGRAM read operation, display shift may not be executed correctly.

* In case of RAM write operation, after this AC is increased/decreased by 1 like read operation. In this time, AC indicates the next address position, but you can read only the previous data by read instruction.

Reset Function

Initializing by Internal Reset Circuit

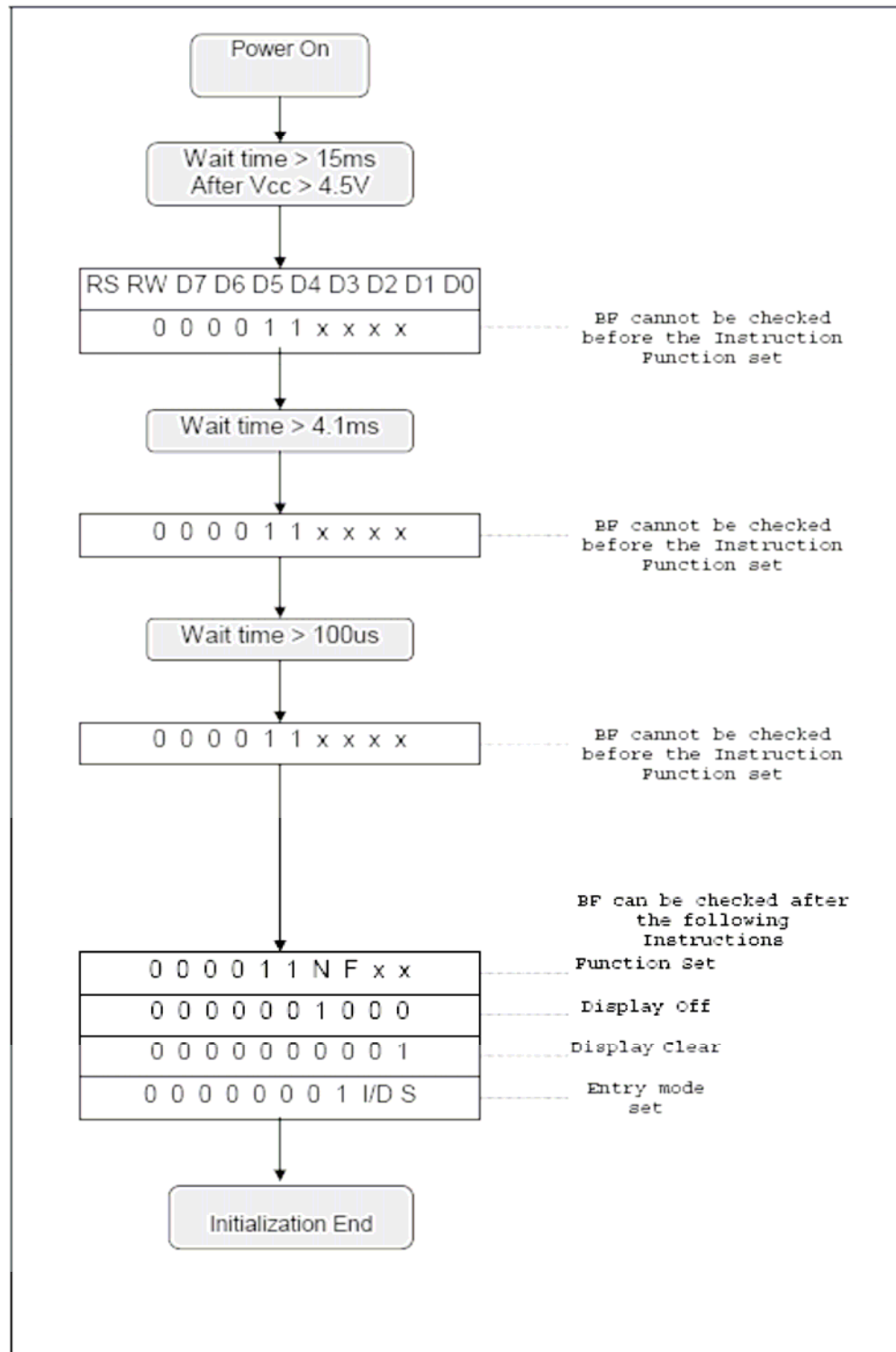
An internal reset circuit automatically initializes the ST7066 when the power is turned on. The following instructions are executed during the initialization. The busy flag (BF) is kept in the busy state until the initialization ends (BF = 1). The busy state lasts for 10 ms after VCC rises to 4.5 V.

1. Display clear
2. Function set:
 - DL = 1; 8-bit interface data
 - N = 0; 1-line display
 - F = 0; 5 × 8 dot character font
3. Display on/off control:
 - D = 0; Display off
 - C = 0; Cursor off
 - B = 0; Blinking off
4. Entry mode set:
 - I/D = 1; Increment by 1
 - S = 0; No shift

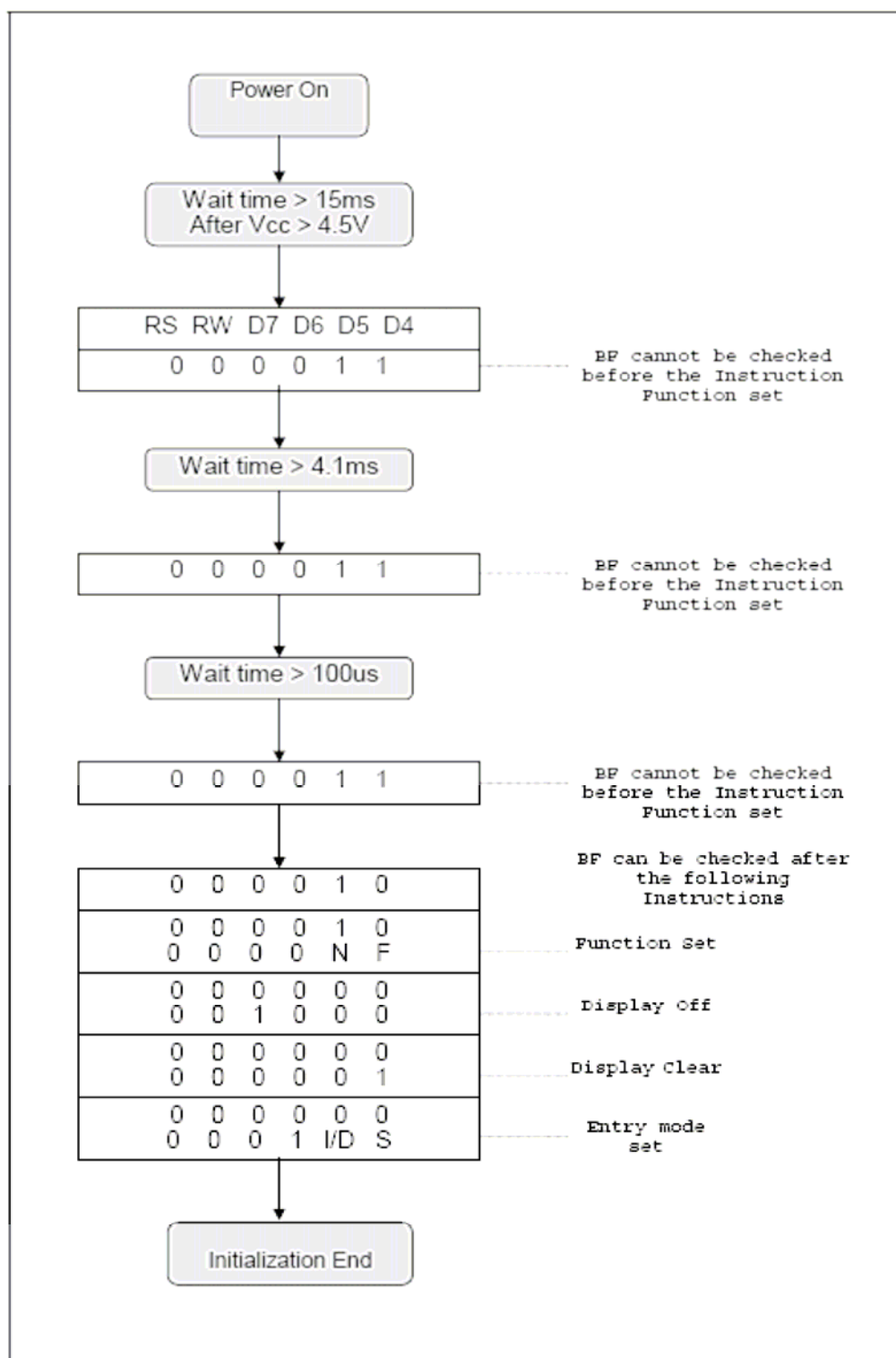
Note:

If the electrical characteristics conditions listed under the table Power Supply Conditions Using Internal Reset Circuit are not met, the internal reset circuit will not operate normally and will fail to initialize the ST7066. For such a case, initialization must be performed by the MPU as explain by the following figure.

8-bit Interface:



4-bit Interface:



Interfacing to the MPU

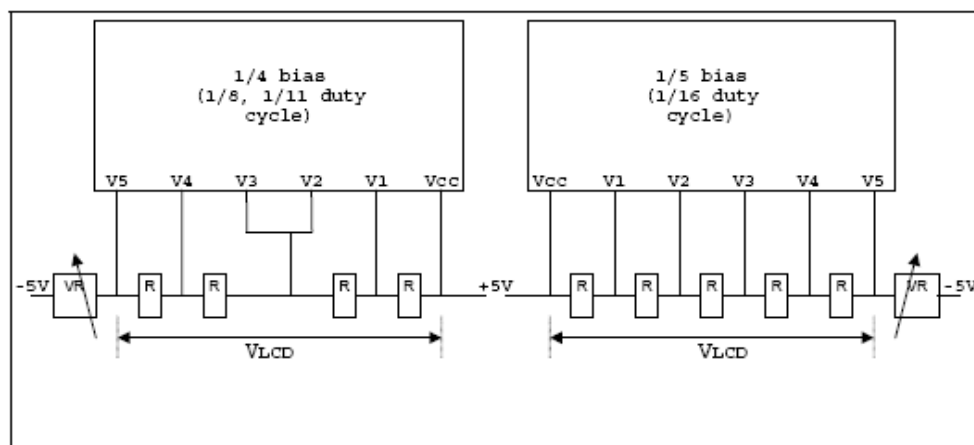
The ST7066 can send data in either two 4-bit operations or one 8-bit operation, thus allowing interfacing with 4- or 8-bit MPU.

- For 4-bit interface data, only four bus lines (DB4 to DB7) are used for transfer. Bus lines DB0 to DB3 are disabled. The data transfer between the ST7066 and the MPU is completed after the 4-bit data has been transferred twice. As for the order of data transfer, the four high order bits (for 8-bit operation, DB4 to DB7) are transferred before the four low order bits (for 8-bit operation, DB0 to DB3). The busy flag must be checked (one instruction) after the 4-bit data has been transferred twice. Two more 4-bit operations then transfer the busy flag and address counter data.
- For 8-bit interface data, all eight bus lines (DB0 to DB7) are used.

Supply Voltage for LCD Drive

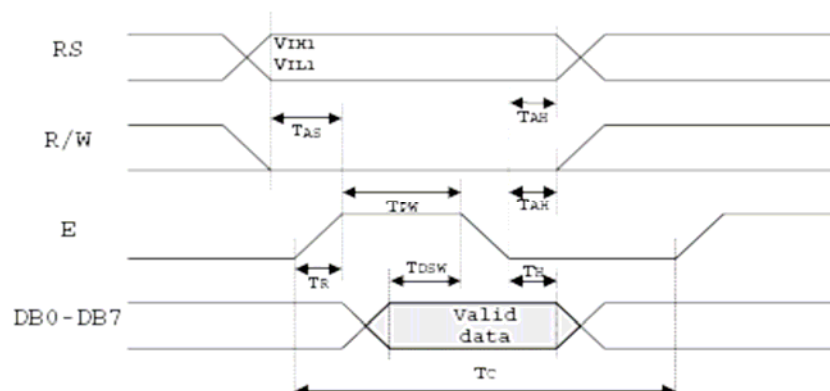
There are different voltages that supply to ST7066's pin (V1 - V5) to obtain LCD drive waveform. The relations of the bias, duty factor and supply voltages are shown as below:

	Duty Factor	
	1/8, 1/11	1/16
	Bias	
Supply Voltage	1/4	1/5
V1	$V_{CC} - 1/4V_{LCD}$	$V_{CC} - 1/5V_{LCD}$
V2	$V_{CC} - 1/2V_{LCD}$	$V_{CC} - 2/5V_{LCD}$
V3	$V_{CC} - 1/2V_{LCD}$	$V_{CC} - 3/5V_{LCD}$
V4	$V_{CC} - 3/4V_{LCD}$	$V_{CC} - 4/5V_{LCD}$
V5	$V_{CC} - V_{LCD}$	$V_{CC} - V_{LCD}$

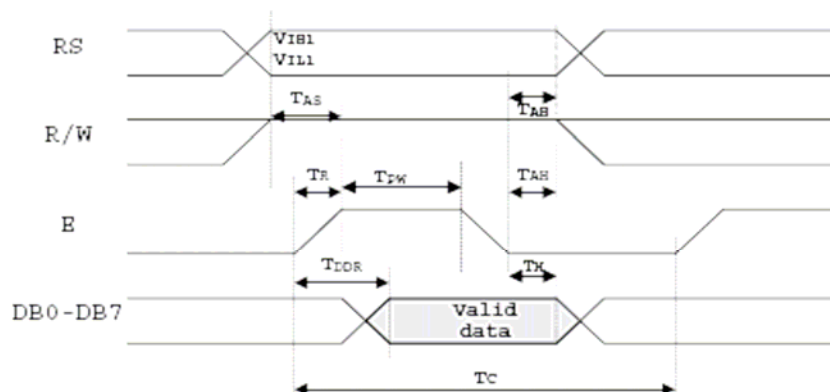


Timing Characteristics

- Writing data from MPU to ST7066



- Reading data from ST7066 to MPU



4.8 Electrical Characteristics

DC Characteristics ($T_A = 25^{\circ}\text{C}$, $V_{CC} = 2.7\text{V} - 5.5\text{V}$)

Symbol	Characteristics	Test Condition	Min.	Typ.	Max.	Unit
V_{CC}	Operating Voltage	-	2.7	-	5.5	V
V_{LCD}	LCD Voltage	$V_{CC}-V_5$	3.0	-	11	V
I_{CC}	Power Supply Current	$f_{OSC} = 270\text{KHz}$, $V_{CC}=5\text{V}$	-	0.3	0.6	mA
V_{IH1}	Input High Voltage (Except OSC1)	-	2.2	-	V_{CC}	V
V_{IL1}	Input Low Voltage (Except OSC1)	-	-0.3	-	0.6	V
V_{IH2}	Input High Voltage (OSC1)	-	$V_{CC}-1$	-	V_{CC}	V
V_{IL2}	Input Low Voltage (OSC2)	-	-	-	1.0	V
V_{OH1}	Output High Voltage (DB0 - DB7)	$I_{OH} = -0.1\text{mA}$	2.4	-	V_{CC}	V
V_{OL1}	Output Low Voltage (DB0 - DB7)	$I_{OL} = 0.1\text{mA}$	-	-	0.4	V
V_{OH2}	Output High Voltage (Except DB0 - DB7)	$I_{OH} = -0.04\text{mA}$	$0.9V_{CC}$	-	V_{CC}	V
V_{OL2}	Output Low Voltage (Except DB0 - DB7)	$I_{OL} = 0.04\text{mA}$	-	-	$0.1V_{CC}$	V
R_{COM}	Common Resistance	$V_{LCD} = 4\text{V}$, $I_d = 0.05\text{mA}$	-	2	20	$K\Omega$
R_{SEG}	Segment Resistance	$V_{LCD} = 4\text{V}$, $I_d = 0.05\text{mA}$	-	2	30	$K\Omega$
I_{LEAK}	Input Leakage Current	$V_{IN} = 0\text{V to } V_{CC}$	-1	-	1	μA
I_{PUP}	Pull Up MOS Current	$V_{CC} = 5\text{V}$	10	50	120	μA

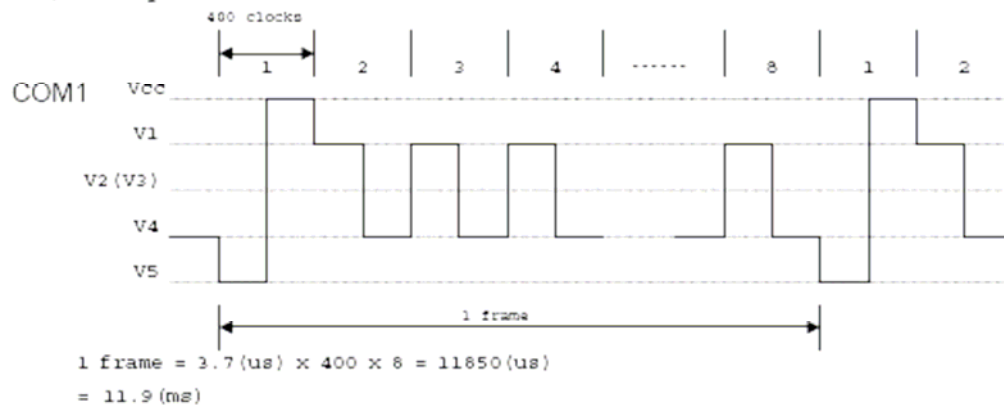
AC Characteristics ($T_A = 25^\circ\text{C}$, $V_{CC} = 5\text{V}$)

Symbol	Characteristics	Test Condition	Min.	Typ.	Max.	Unit
<i>Internal Clock Operation</i>						
f_{OSC}	OSC Frequency	$R = 91\text{K}\Omega$	190	270	350	KHz
<i>External Clock Operation</i>						
f_{EX}	External Frequency	-	125	250	350	KHz
	Duty Cycle	-	45	50	55	%
T_R, T_F	Rise/Fall Time	-	-	-	0.2	μs
<i>Write Mode (Writing data from MPU to ST7066)</i>						
T_C	Enable Cycle Time	Pin E	400	-	-	ns
T_{PW}	Enable Pulse Width	Pin E	150	-	-	ns
T_R, T_F	Enable Rise/Fall Time	Pin E	-	-	25	ns
T_{AS}	Address Setup Time	Pins: RS, RW, E	30	-	-	ns
T_{AH}	Address Hold Time	Pins: RS, RW, E	10	-	-	ns
T_{DSW}	Data Setup Time	Pins: DB0 - DB7	40	-	-	ns
T_H	Data Hold Time	Pins: DB0 - DB7	10	-	-	ns
<i>Read Mode (Reading Data from ST7066 to MPU)</i>						
T_C	Enable Cycle Time	Pin E	400	-	-	ns
T_{PW}	Enable Pulse Width	Pin E	150	-	-	ns
T_R, T_F	Enable Rise/Fall Time	Pin E	-	-	25	ns
T_{AS}	Address Setup Time	Pins: RS, RW, E	30	-	-	ns
T_{AH}	Address Hold Time	Pins: RS, RW, E	10	-	-	ns
T_{DDR}	Data Setup Time	Pins: DB0 - DB7	-	-	100	ns
T_H	Data Hold Time	Pins: DB0 - DB7	10	-	-	ns
<i>Interface Mode with LCD Driver(ST7065)</i>						
T_{CWH}	Clock Pulse with High	Pins: CL1, CL2	800	-	-	ns
T_{CWL}	Clock Pulse with Low	Pins: CL1, CL2	800	-	-	ns
T_{CST}	Clock Setup Time	Pins: CL1, CL2	500	-	-	ns
T_{SU}	Data Setup Time	Pin: D	300	-	-	ns
T_{DH}	Data Hold Time	Pin: D	300	-	-	ns
T_{DM}	M Delay Time	Pin: M	-1000	-	1000	ns

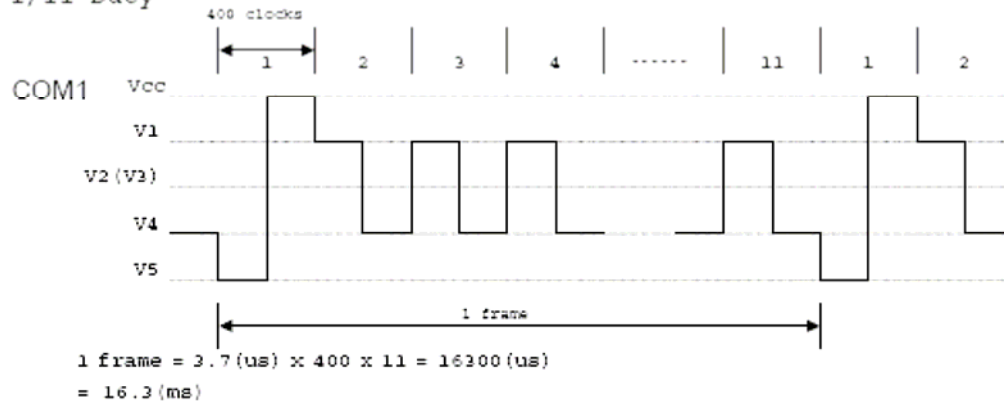
The relations between Oscillation Frequency and LCD Frame Frequency

Assume the oscillation frequency is 270KHZ, 1 clock cycle time = 3.7us

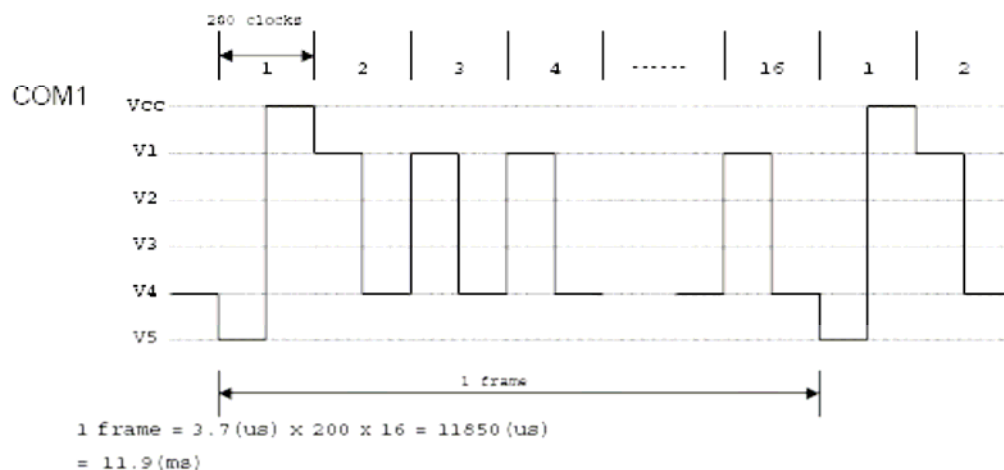
1. 1/8 Duty



2. 1/11 Duty



3. 1/16 Duty



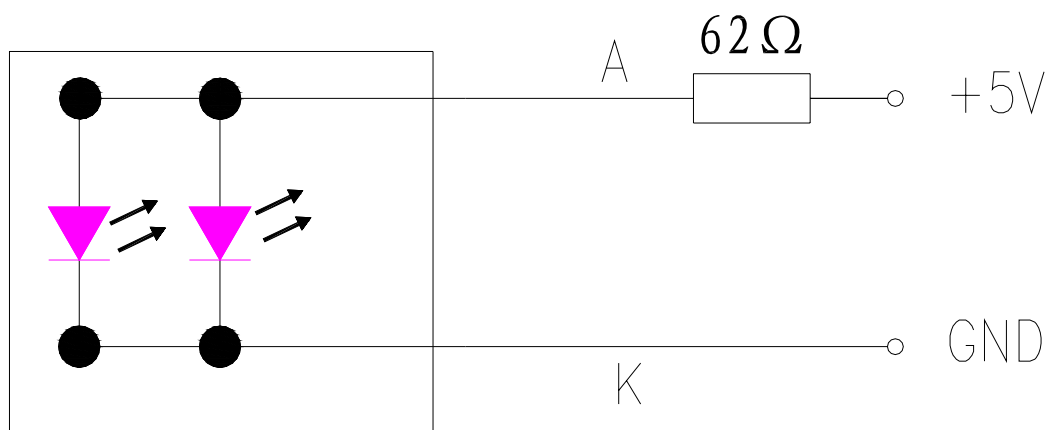
4.11 Backlight Description

ELECTRICAL/OPTICAL CHARACTERISTICS (T=25 °C):

ITEM	MIN.	TYPE	MAX.	UNIT	CONDITION
Forward Voltage	2.9	3.1	3.3	V	
Forward Current	--	30	40	mA	5V
Power Dissipation	--	93	132	mW	5V
Luminance	150	200	--	cd/m ²	5V
Wave length Range	--	--	--	nm	WHITE
Operating Temp Range	-30	--	70	°C	
Storage Temp Range	-30	--	80	°C	

Test Circuit:

LED: 1*2=2 DIES



5. QUALITY AND RELIABILITY

5.1 Test Condition

Test should be conducted under the following conditions:

Ambient Temperature: 25 ± 5 °C

Humidity : $60 \pm 20\%$ RH

5.2 Sampling Plan

Sampling method shall be in accordance with GS-CB16277BNWJ/R, inspection level II, normal inspection, and single sampling plan tables for normal tightened, and reduced inspection.

5.3 Acceptable Quality Level

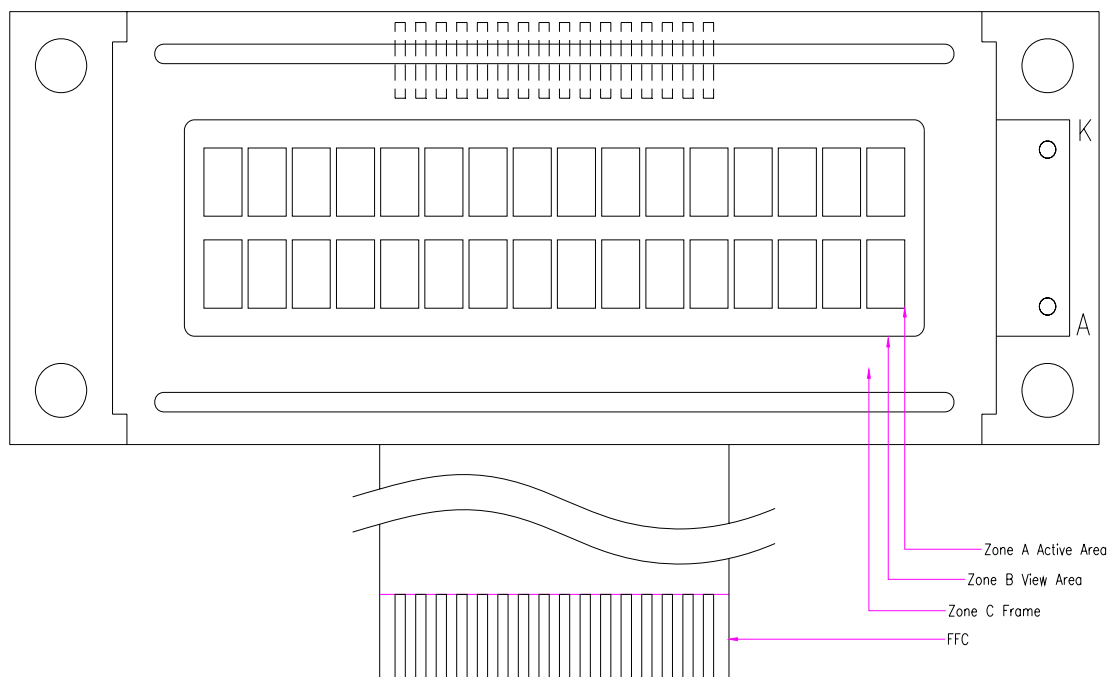
A major defect is a defect that could result in failure or materially reduce that the usability of the unit of product for its intended purpose.

A minor defect is one that does not materially reduce the usability of the unit of product for its intended purpose or is a departure from established standards having no significant bearing on the effective use or operation of the unit.

5.4 Appearance and Checking Standard

5.4.1 Appearance

Appearance test is to be conducted by eyes at approximately 30cm distance from LCD module under the single fluorescent light.



Genda LCD LCM www.GendaLCD.com	MODEL NO.	STANDARD DOC
	GS-CB16277BNWJ/R	PRODUCT SPEC.

5.4.2 Checking Standard

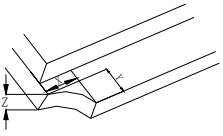
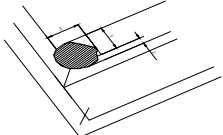
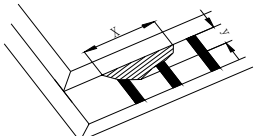
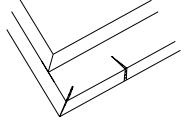
Inspection level:

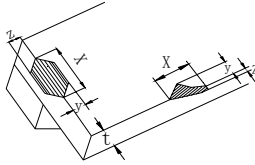
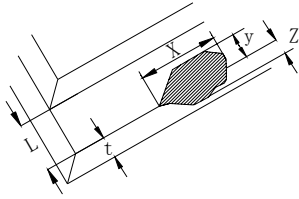
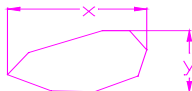
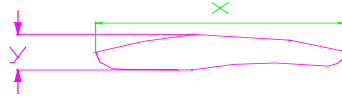
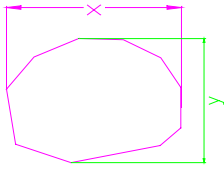
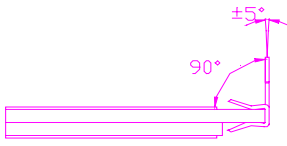
Sampling procedure: General inspection levels II and single sampling plans for normal inspection of ISO2859.

Item	Indication	AQL
Major Nonconformity (MA)	Function	0.4
	Size	
Minor Nonconformity (MI)	Effects on LCD appearance but not on function	1.0

5.4.2.1 Inspection condition:

1. The inspection should be done under 40W fluorescent light and visual inspection distance is 30cm.
2. Back-Lights or reflective boards should be adopted for inspecting transmissive LCDs.
3. The visual direction should be viewing angle range
4. This kind of situation will be judged qualificatory one that defection of product in B area won't effect customer's assembly and product quality

Item		Figure 示意图	Criteria 判断标准	MA MI
Glass Nonconformity 玻璃不良	Glass Corner Breakage 角破损		1、X≤3mm and don't touch pin X≤3mm 和不到达 PIN 的引线 2、Y out of seal resin Y 不进入框线 3、Z ignore ACC Z 不计 接收	MI
			1、X≤1/8 Length of LCD side X≤1/8 边长 2、Y out of area A Y 不进入可视区 3、Z≤t Z don't touch seal resin ACC Z≤t Z 不到达框线 接收	
	Extra Glass Ledge 突出		1、X ignore X 不计 2、Y≤1/3 Length of conductor ACC Y≤1/3 PIN 长 接收	MI
Glass Nonconformity 玻璃破损	Crack 裂缝		Any crack any where 任何区域有裂痕 REJ 拒收	MA

<div>GendaLCD LCM</div> <div>www.GendaLCD.com</div>		MODEL NO.	STANDARD DOC				
		GS-CB16277BNWJ/R	PRODUCT SPEC.				
Glass Nonconform-ity 玻璃不良	Glass Side Breakage 边破损		1、X≤1/4 Length of LCD side X≤1/4 边长 2、Y out of area A Y 不进入可视区 3、Z≤t Z don't touch seal resin ACC Z≤t Z 不到达框线 接收	MI			
			1、X≤1/4 Length of LCD side X≤1/4 LCD 边长 Y≤1/3L (L: Length of conductor) Y≤1/3 PIN 宽 3、Z≤t Z don't touch seal resin ACC Z≤t Z 不到达框线 接收	MI			
Color Variation 彩虹			At most 2-color samples are acceptable but have no color difference in the brightest state. ACC 无明显两色之分 接收	MI			
Point Like flaw 点状不良			Φ = (x+y) / 2 Φ ≤0.25mm Distance between 2 spots>5mm Φ = (x+y) / 2 Φ ≤0.25mm 两点间距 >5mm	ACC 接收 MI			
Scratching Line 线状刮伤			X≤6mm Y≤0.08mm X≤6mm Y≤0.08mm	ACC 接收 MI			
Polarizer Nonconform-ity 偏光片不良	Deflectiv e Sticking 贴歪		According to the tolerance specified in engineering drawing. 符合工程图要求的公差	ACC 接收 MI			
	Faulty Sticking 贴错			REJ 拒收 MA			
	Air Bubble 气泡		Φ= (X+Y) / 2 <table border="1"><tr><td>Size (mm) 尺寸</td><td>Qty allowed 允许个数</td></tr><tr><td>0.2<Φ≤0.5</td><td>2</td></tr></table> Distance between 2 spots>5mm 两点间距>5mm Ignore if out of viewing area. 可视区外忽略不计	Size (mm) 尺寸	Qty allowed 允许个数	0.2<Φ≤0.5	2
Size (mm) 尺寸	Qty allowed 允许个数						
0.2<Φ≤0.5	2						
Electrode & pin Nonconform-ity 电极与PIN脚不良	Pin Length PIN 长		Non-conformity with engineering drawing 与工程图不符	REJ 拒收 MA			
	Pin Deflec-tion PIN 歪斜		Deviation exceeds 5 degree 偏差>5° According to the tolerance specified in engineering drawing 若工程图有规定范围，则依图面规格	REJ 拒收 MI			
	Pin body With resin PIN 上有胶			REJ 拒收 MI			
	Deflec-tion Frame Lines 切斜		Deviation between two ends exceeds 0.25mm 两端相差 0.25mm	REJ 拒收 MI			

Genda LCD LCM www.GendaLCD.com	MODEL NO.	STANDARD DOC
	GS-CB16277BNWJ/R	PRODUCT SPEC.

Contact Pad Unclean 导电层不洁		REJ 拒收	MI
Silk Printing Nonconformity 表面丝印不良		1、 Unspecified tolerance of width of line $\leq 1/4$ width. ACC 接收 线宽均匀性 $\leq 1/4$ 线宽 2、 Silk printing location: According to the Tolerance specified in engineering drawing 丝印位置依工程图要求的公差 3、 Diameter of broken pattern $\leq 0.25\text{mm}$. ACC 接收 缺失图案直径 $\leq 0.25\text{mm}$.	MI

5.5 Inspection Quality Criteria

ITME	DESCRIPTION OF DEFECTS			Class of defects	Acceptable level (%)
FUNCTION	Short circuit or Pattern cut			Major	0.65
DIMENSION	Refer to individual acceptance specification			Major	2.5
BLACK SPOTS	Ave. Dia. D	area A	area B	Minor	2.5
	D≤0.2	Disregard			
	0.2<D≤0.3	2	3		
	0.3<D≤0.4	0	1		
	0.4<D	0	0		
BLACK LINES	Width W, Length L	A	B	Minor	2.5
	W≤0.03	disregard			
	0.03<W≤0.05	3	4		
	0.05<W≤0.07, L≤3.0	1	1		
BUBBLES IN POLARIZER	Average diameter D 0.2 < D < 0.5mm for N = 4 0.5 < D < 0.7mm for N=1			Minor	2.5
COLOR UNIFORMITY	Rainbow color or Newton ring.			Minor	2.5
GLASS SCRATCHES	Obvious visible damage.			Minor	2.5
VIEWING ANGLE	Refer to individual acceptance specification			Minor	2.5
CONTRAST RATIO	Refer to individual acceptance specification			Minor	2.5
RESPONSE TIME	Refer to individual acceptance specification			Minor	2.5

Genda LCD LCM www.GendaLCD.com	MODEL NO.	STANDARD DOC
	GS-CB16277BNWJ/R	PRODUCT SPEC.


5.6 Reliability

The LCD module should have no failure in the following reliability test.

TEST ITEM	TEST CONDITIONS
HIGH TEMPERATURE STORAGE	80℃, 200hr.
LOW TEMPERATURE STORAGE	-30℃, 200hr
HUMIDITY STORAGE	80℃, 90%RH, 96hr.
HIGH TEMPERATURE OPERATION	70℃, typical operating conditions, 200hr.
LOW TEMPERATURE OPERATION	-20℃, typical operating conditions, 200hr.
TEMPERATURE CYCLING	-20℃ ~70℃ 10min, between each step temp. 50min, at each step temp. 5 cycles.
MECHANICAL VIBRATION	10 ~ 100 Hz sweep, 4G, amp1 = 10mm(max) XYZ for 60min, each.
MECHANICAL SHOCK	10 ~ 55Hz, 50G. XYZ for 1 time, each.

NOTE 1: The module should not have condensation of water on the module.

NOTE 2: The module should be inspected after 1 hour storage in normal conditions (15~35℃, 45~65%RH).

	MODEL NO.	STANDARD DOC
	GS-CB16277BNWJ/R	PRODUCT SPEC.

6. CAUTION FOR USING LCM

6.1 Precautions in handling LCD Modules

Lcms have been assembled and accurately calibrated before delivery.

Please observe the following criteria when handling.

- A. Do not subject the module to excessive shock.
- B. Do not modify the tab on the metal holder.
- C. Do not tamper with the printed circuit board.
- D. Limit the soldering of the printed circuit board to I/O terminals only.

Do not touch the zebra strip nor modify its location.

6.2 Static electricity warning

LCM uses CMOS LSI technology. Therefore, strict measures to avoid static electricity discharge are followed through all processes from manufacturing to shipping. When handling a LCM, take sufficient care to prevent static electricity discharge as you would any CMOS IC.

- A. Do not take the LCM from its anti-static bag until it's to be assembled.

LCMs are individually packaged in bags specially treated to resist static electricity. When storing, keep the LCM packed in the original bags, or store them in a container processed to be resistant to static electricity, or in an electric conductive container.

- B. Always use a ground strap when handling a LCM.

Always use a ground strap while working with the module, from the time it is taken out of the anti-static bag until it is assembled. If it is necessary to transfer the LCM, once it has been taken out of the bag, always place it in an electric conductive container. Avoid wearing clothes made of chemical fibers, the use of cotton or conductive treated fiber clothing is recommended.

- C. Use a no-leak iron for soldering the LCM.

The soldering iron to be used for soldering the I/O terminals to the LCM are to be insulated or grounded at the iron tip.

Genda LCD LCM www.GendaLCD.com	MODEL NO.	STANDARD DOC
	GS-CB16277BNWJ/R	PRODUCT SPEC.

D. Always ground electrical apparatuses required for assembly.

Electrical apparatuses required to assemble the LCM into a product, i.e. electrical screw drivers, are to be first grounded to avoid transmitting spike noises from the motor.

E. Assure that the work bench is properly grounded.

F. Peel off the LCM protective film slowly.

The module is attached with a film to protect the display surface from contamination, damage, adhesion of flux, etc. Peeling off this film abruptly could cause static electricity to be generated, so peel the tape slowly.

G. Pay attention to the humidity in the work area. 50~60% RH is recommended.

6.3 Storage

If the correct method of storage is not followed, deterioration of the display material (polarizer) and oxidation of the I/O terminal plating may make the process of soldering difficult. Please comply with the following procedure.

A. Store in the shipping container.

B. If the shipping container is not available, place in anti-static bags and seal the opening.

C. Store the modules where they are not subjected to direct sunlight or a fluorescent lamp.

D. Store in a temperature range of 0°C – 35°C with low relative humidity.

6.4 Caution

A. Do not give any external shock.

B. Do not wipe the surface with hard materials.

C. Do not apply excessive force on the surface.

D. Do not expose to direct sunlight or fluorescent light for a long time.

E. Avoid storage in high temperature and high humidity.

F. When storage for a long time at 40°C or higher is required, R/H should be less than 60%.

Liquid in LCD is hazardous substance. Do not lick, swallow when the liquid is attached to your hands, skin, clothes etc. Wash it out thoroughly.