DISPLAY Elektronik GmbH

DATA SHEET

LCD MODULE

DEM 20488 SBH-PW-N

Product Specification   *Version: 10*

08.01.2018

GENERAL SPECIFICATION

MODULE NO. :

DEM 20488 SBH-PW-N

CUSTOMER   P/N

VERSION NO.	CHANGE DESCRIPTION	DATE
0	ORIGINAL VERSION	08/03/2005
1	ADD PCB DRAWING AND DESCRIPTION	14/03/2005
2	CHANGED SERIES	11/04/2005
3	CHANGED PCB DRAWING AND DESCRIPTION	20/04/2005
4	CHANGED LCD TYPE	15/10/2005
5	ADD VERSION	22/12/2005
6	ADD VERSION	22/03/2007
7	CHANGED BACKLIGHT PARAMETER AND STORAGE TEMPERATURE	28/03/2007
8	MODIFY SECTION 6	24/04/2007
9	UPDATE PCB	23.08.2017
10	CHANGE MAXIMUM PARAMETER	08.01.2018

PREPARED BY: WJN   DATE: 08.01.2018

APPROVED BY: MH   DATE: 08.01.2018

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1. FUNCTIONS & FEATURES

MODULE	LCD TYPE
DEM 20488 SBH-PW-N	STN-BLUE Transmissive Negative Mode

- Viewing Direction : 6 o'clock
- Driving Scheme : 1/16 Duty Cycle, 1/5 Bias
- Power Supply Voltage : +5.0Volt (typ.)
- V_{LCD} (V_{DD}-V_0) : 4.5Volt (typ.)
- Display Format : 20 x 4 Characters (5x8 dots Format: 208 Kinds)
- Internal Memory : CGROM (10,080 Bits)

  : CGRAM (64 x 8 Bits)

  : DDRAM (80 x 8 Bits for Digits)
- CGROM : CGROM of the ST7066U-0A
- Interface : Easy Interface with a 4-bit or 8-bit MPU
- Operating Temperature : -20°C to +70°C
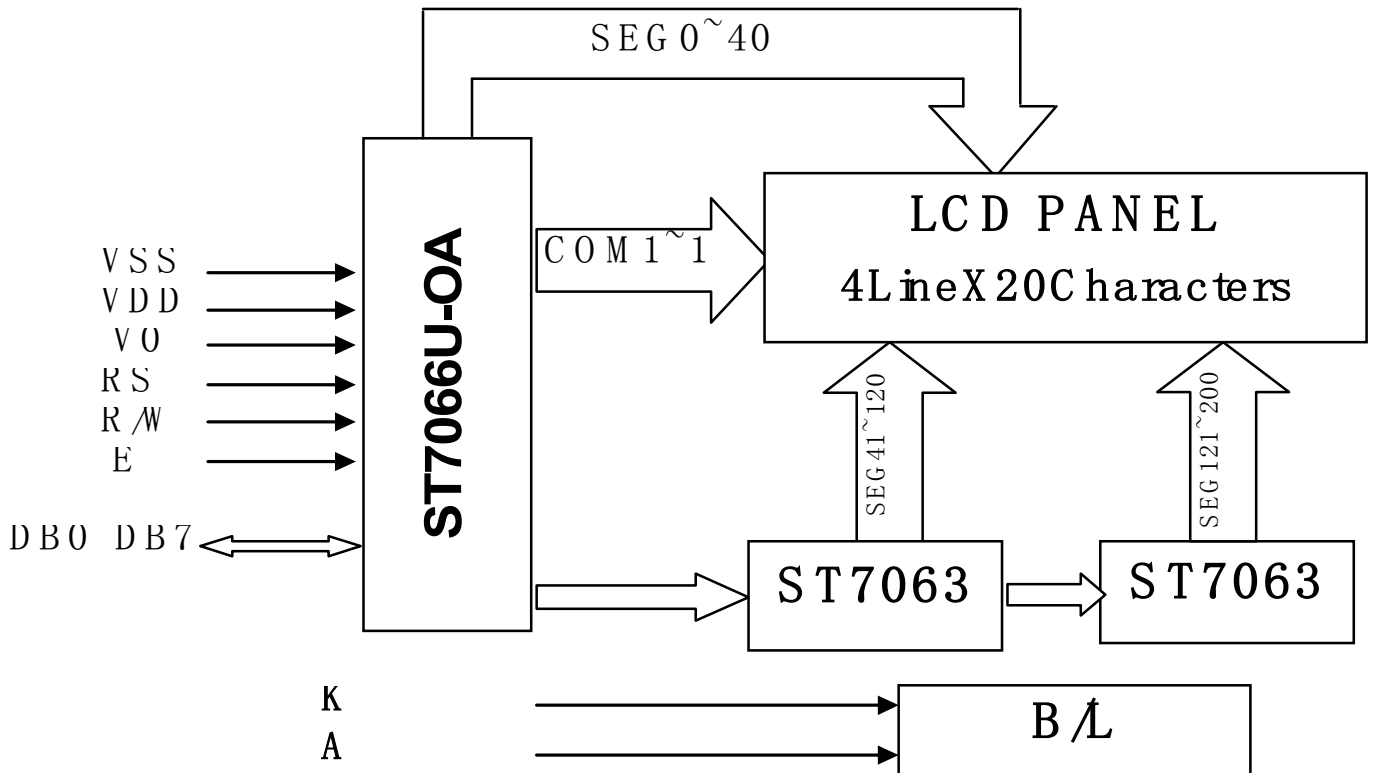- Storage Temperature : -30°C to +80°C

2. MECHANICAL SPECIFICATIONS

- Module Size : 77.00 x 47.00 x 10.10 mm
- Character Pitch : 2.80 x 5.03 mm
- Character Size : 2.30 x 4.03 mm
- Dot Pitch : 0.47 x 0.51 mm
- Dot Size : 0.42 x 0.46 mm
- Dot Gap : 0.05 mm

3. EXTERNAL DIMENSIONS

Unless tolerance is ±0.2mm
The material is lead-free
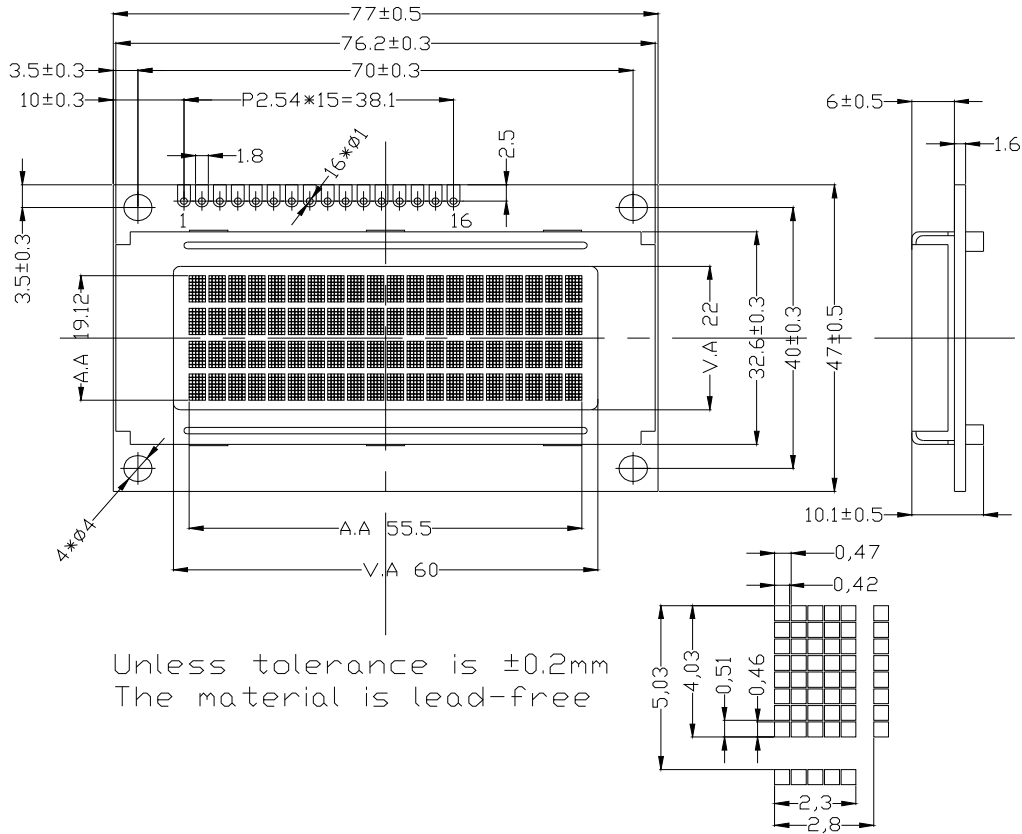
4. BLOCK DIAGRAM

5. PIN ASSIGNMENT

Pin No.	Symbol	Function
1	VSS	Ground (0V)
2	V_{DD}	Power supply(V_{DD}>V_{SS})
3	V_0	Operating voltage for LCD
4	RS	Select registers. 0: Instruction register (for write) busy flag: address counter (for read); 1: Data register (for write and read)
5	R/W	Select read or write. 0: Write mode; 1: Read mode
6	E	Start enable signal to read or write the data
7~10	DB0~DB3	Four low order bi-directional there-state data bus lines. Use for data transfer between the MPU and the LCD module. These four are not used during 4-bit operation.
11~14	DB4~DB7	Four high order bi-directional there-state data bus lines. Used for data transfer between the MPU and the LCD module. DB7 can be used as a busy flag.
15	LED(-)	Please refer to 6-2-1
16	LED(+)	Please refer to 6-2-1

6. PCB DRAWING AND DESCRIPTION

6.1 PCB DRAWING
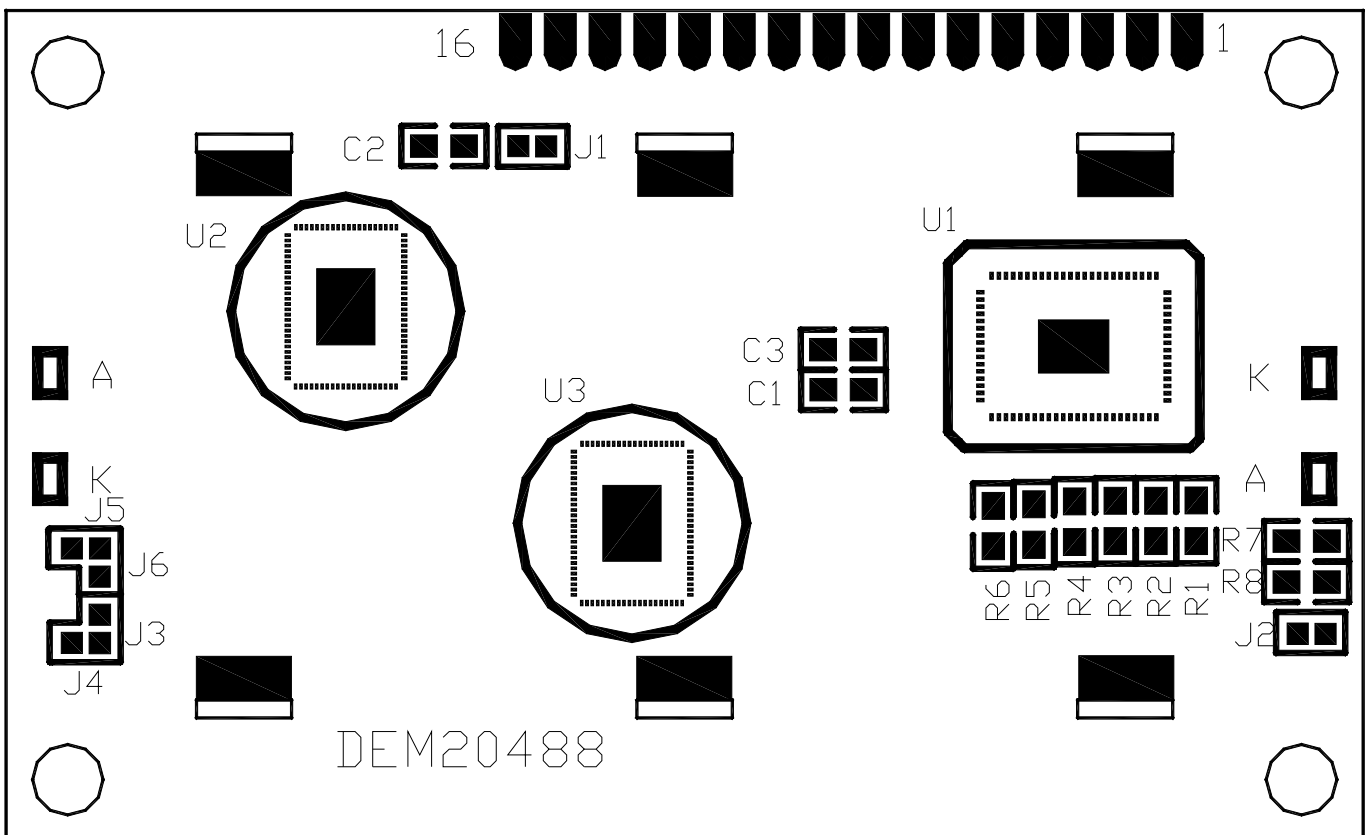
6.2 DESCRIPTION:

6-2-1. The polarity of the pin 15 and the pin 16:

symbol / state	J3, J5	J4, J6	LED Polarity	
			15 Pin	16 Pin
Each solder-bridge	Each open	Each closed	Anode	Cathode
Each solder-bridge	Each closed	Each open	Cathode	Anode

Note: In application, J3＝J5＝0 Ohm, J2＝J4＝J6＝open

6-2-2. The metal-bezel is set on ground when the J1 is closed.

Note: In application module, J1＝0 Ohm

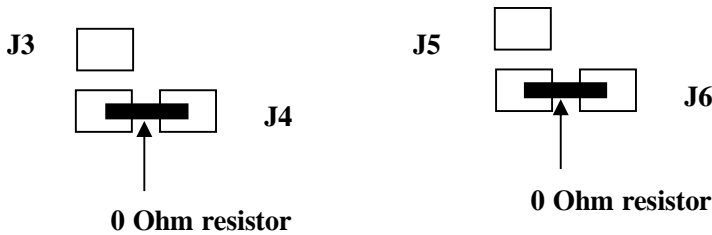### 6-2-3. The LED resistor can be bridged when the J2 is closed

Note: In application module, J2＝open

6-2-4. The R7 and the R8 are the LED resistor.
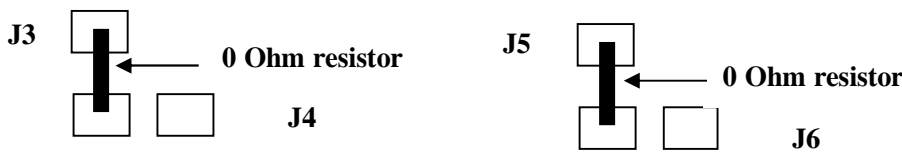
Note: In application module, R7＝ 100 Ohm, R8＝open.

6.3 Example application

6-3-1. The 15 pin is the anode and the 16 pin is the cathode as following.

6-3-2. The 15 pin is the cathode and the 16 pin is the anode as following.

7. BACKLIGHT ELECTRICAL/OPTICAL SPECIFICATIONS

7.1 Backlight Characteristics Description

Electrical-Optical Characteristics

ITEM	SYMBOL	MIN.	TYP.	MAX	UNIT	CONDITION
Forward Current	I_f	---	15	20	mA	V_f=3.0V
Reverse Current	I_r	---	30	---	uA	V_r=0.8V
Peak Wave length	λ_P	---	---	---	nm	
Spectral Line Half Width	$\Delta\lambda$	---	---	---	nm	
Luminance	L_V	---	150	---	cd/m^2	V_f=3.0V
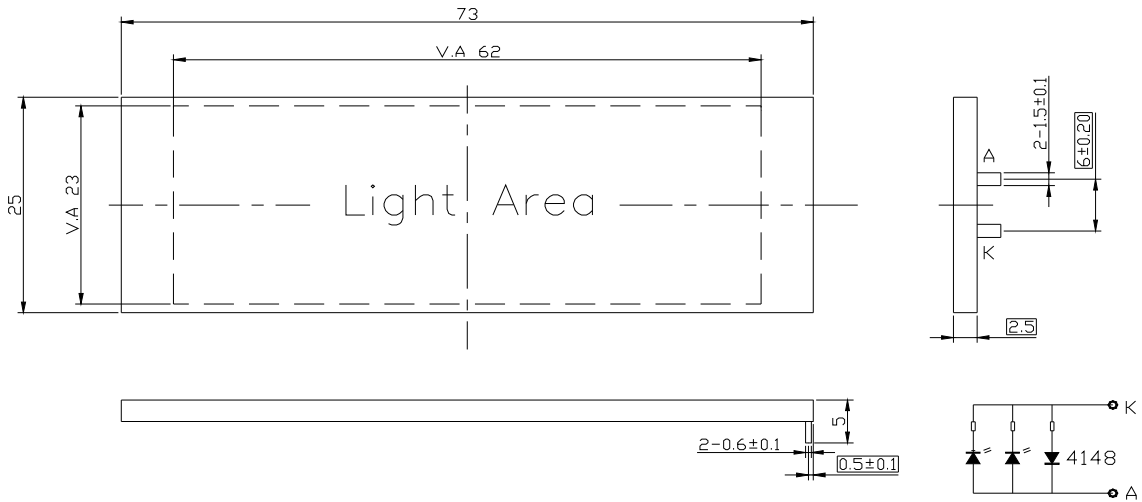

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NOTE:
1.UNMARKED TOLERANCE IS ±0.30,
2.BACKLIGHT COLOR: WHITE,
3.THE MATERIAL IS LEAD-FREE.
```

8. MAXIMUM ABSOLUTE POWER RATINGS (Ta = 25°C)

Item	Symbol	Standard value	Unit
Power supply voltage	V_{DD}	-0.3~+6.0	V
LCD Driver voltage	V_{LCD}	V_{DD}-10.0~V_{DD}+0.3	V
Input voltage	V_{IN}	-0.3~V_{DD}+0.3	V
Operating temperature	Topr	-20~+70	°C
Storage temperature	Tstg	-30~+80	°C

9. DISPLAY DATA RAM (DDRAM)

10. ELECTRICAL CHARACTERISTICS

10-1. DC Characteristics (V_{DD}=4.5V~5.5V)

Item	Symbol	Standard Value			Test Condition	Unit
		MIN	TYP	MAX		
Operating Voltage	V_{DD}	4.5	5.0	5.5	-------	V
LCD Voltage	V_{LCD}	3.0	4.5	7.0	$V_{DD} - V5$	V
Supply Current	I_{DD}	---	0.2	0.5	V_{DD}=5V,fosc=270kHz	mA

10-2. AC Characteristics (V_{DD}=5V)
10-2-1 Write Mode (Writing Data from MPU to Module)

Characteristic	Symbol	Min	Typ	Max	Unit	Test PIN
E Cycle Time	t_C	1200	---	---	ns	E
E Rise Time	t_R	---	---	25	ns	E
E Fall Time	t_F	---	---	25	ns	E
E Pulse width	tp_W	140	---	---	ns	E
Address Setup Time	t_{AS}	0	---	---	ns	R/W,RS,E
Address Hold Time	t_{AH}	10	---	---	ns	R/W,RS,E
Data Setup Time	T_{DSW}	40	---	---	ns	DB0~DB7
Data Hold Time	t_H	10	---	---	ns	DB0~DB7
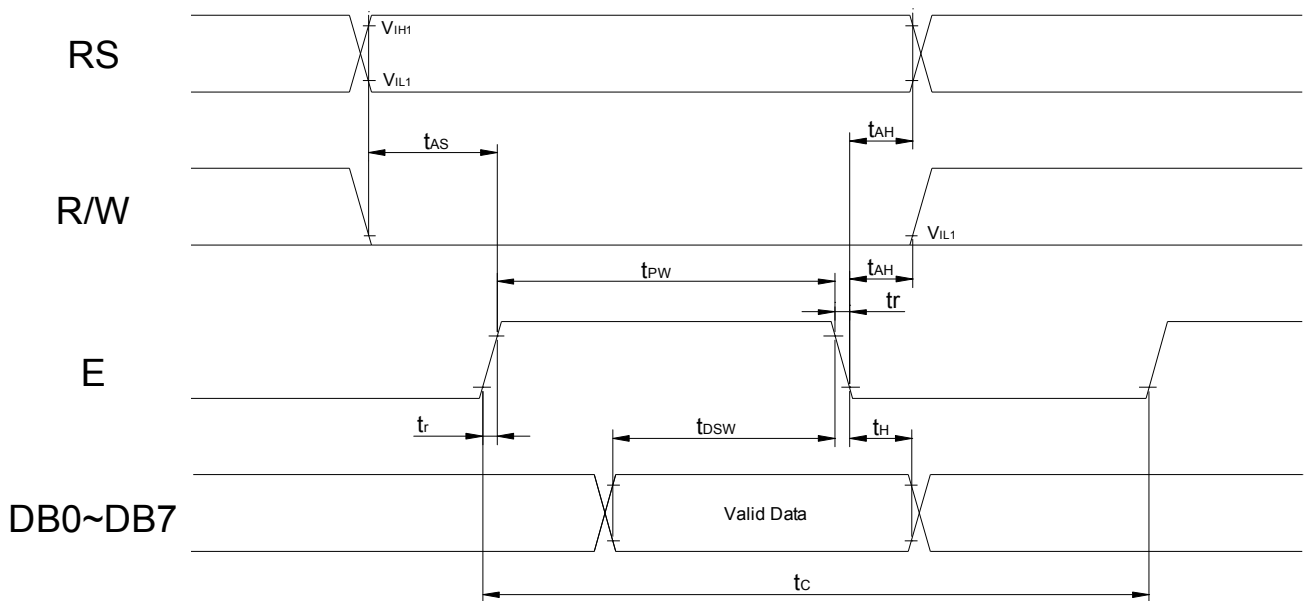
10-2-2 Read Mode (Reading Data from Module to MPU)

Characteristic	Symbol	Min	Typ	Max	Unit	Test PIN
E Cycle Time	t_C	1200	---	---	ns	E
E Rise Time	t_R	---	---	25	ns	E
E Fall Time	t_F	---	---	25	ns	E
E Pulse width	t_{PW}	140	---	---	ns	E
Address Setup Time	t_{AS}	0	---	---	ns	R/W,RS,E
Address Hold Time	t_{AH}	10	---	---	ns	R/W,RS,E
Data Setup Time	t_{DDR}	---	---	100	ns	DB0~DB7
Data Hold Time	t_H	10	---	---	ns	DB0~DB7
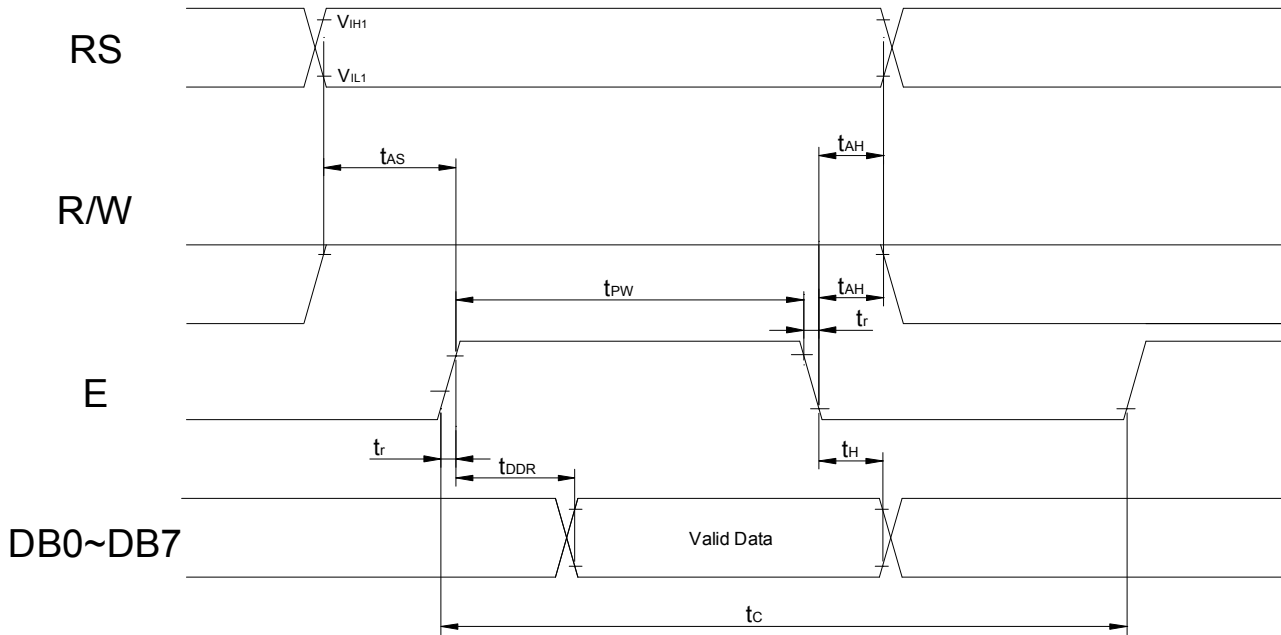
11. CONTROL AND DISPLAY COMMAND

Command	RS	R/W	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0	Execution time (fosc=270KHz)	Remark
Clear Display	0	0	0	0	0	0	0	0	0	1	1.52ms	Write"20H" to DDRAM. And set DDRAM address to "00H" from AC
Return home	0	0	0	0	0	0	0	0	1	x	1.52ms	Set DDRAM address to "00H" from AC and return cursor to its original position if shifted. The contents of DDRAM are not changed.
Entry mode Set	0	0	0	0	0	0	0	1	I/D	S	37us	Sets cursor move direction and specifies display shift. These operations are performed during data write and read.
Display on/off control	0	0	0	0	0	0	1	D	C	B	37us	D=1: entire display on C=1: cursor on B=1: cursor position on
Cursor or Display Shift	0	0	0	0	0	1	S/C	R/L	x	x	37us	Set cursor moving and display shift control bit, and the direction, without changing DDRAM data.
function Set	0	0	0	0	1	DL	N	F	x	x	37us	DL: interface data is 8/4 bits N: number of line is 2/1 F: font size is 5x11/5x8
Set CGRAM address	0	0	0	1	AC5	AC4	AC3	AC2	AC1	AC0	37us	Set CGRAM address in address counter
Set DDRAM address	0	0	1	AC6	AC5	AC4	AC3	AC2	AC1	AC0	37us	Set DDRAM address in address counter
Read busy flag& address	0	1	BF	AC6	AC5	AC4	AC3	AC2	AC1	AC0	0us	Whether during internal operation or not can be known by reading BF. The contents of address counter can also be read.
Write data to RAM	1	0	D7	D6	D5	D4	D3	D2	D1	D0	37us	Write data into internal RAM (DDRAM/CGRAM)
Read data from RAM	1	1	D7	D6	D5	D4	D3	D2	D1	D0	37us	Read data from internal RAM (DDRAM / CGRAM)

Note:

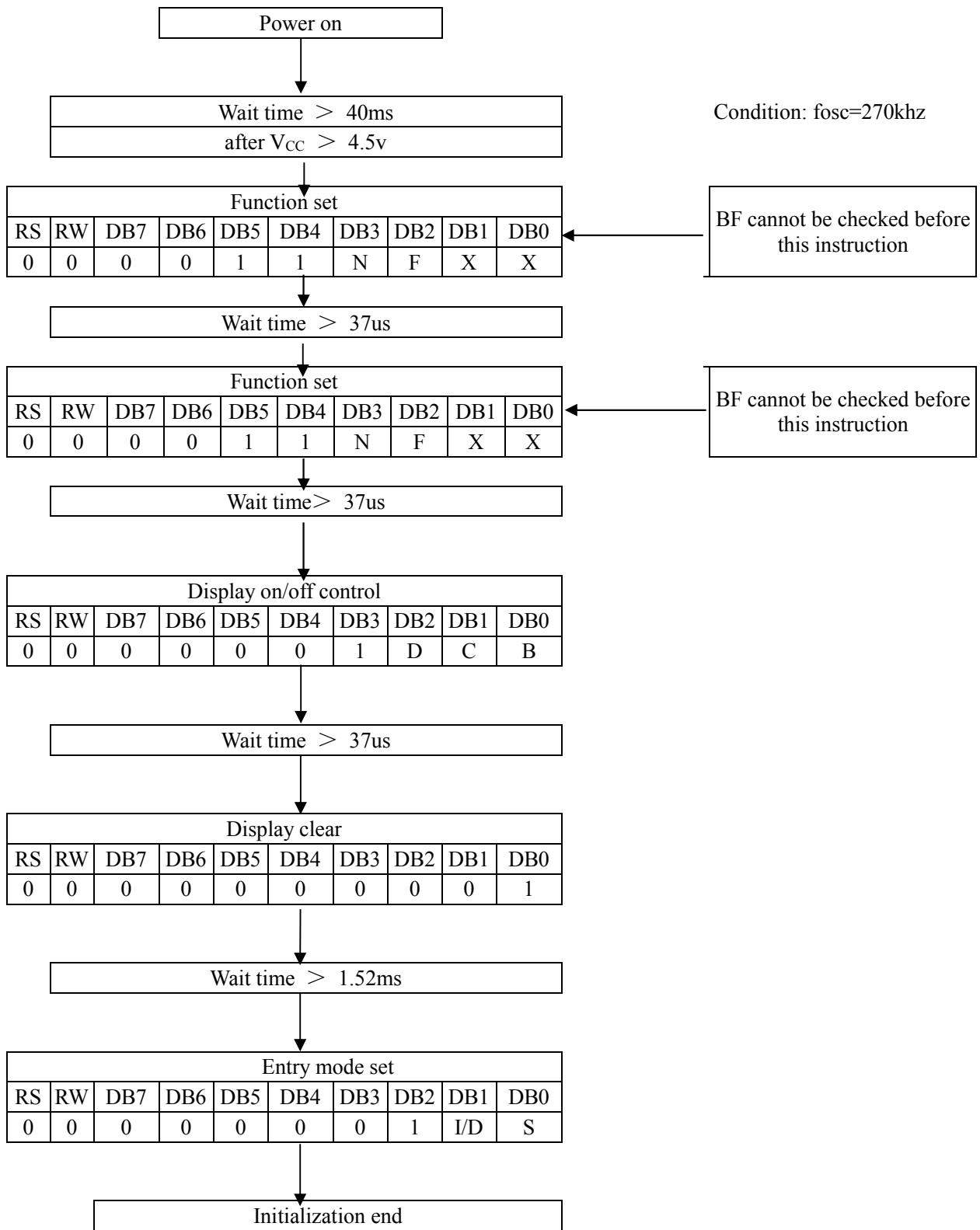Be sure the ST7066U is not is not in the busy state (BF=00 before sending an instruction from the MPU to the ST7066U. If an instruction is sent without checking the busy flag, the time between the first instruction and next instruction will take much longer than the instruction time itself. Refer to instruction table for the list of each instruction execution time.

12. STANDARD CHARACTER PATTERN (ST7066U-OA)

13. LCM INITIALIZING BY INSTRUCTION

13.1. 8-Bit Interface Mode

Power on

↓

Wait time ＞ 40ms
after V_CC ＞ 4.5v

Condition: fosc=270khz

↓

Function set									
RS	RW	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0
0	0	0	0	1	1	N	F	X	X

← | BF cannot be checked before this instruction |

↓

Wait time ＞ 37us

↓

Function set									
RS	RW	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0
0	0	0	0	1	1	N	F	X	X

← | BF cannot be checked before this instruction |

↓

Wait time＞ 37us

↓

Display on/off control									
RS	RW	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0
0	0	0	0	0	0	1	D	C	B

↓

Wait time ＞ 37us

↓

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

↓

Wait time ＞ 1.52ms

↓

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

↓

Initialization end

13-2. 4-Bit Interface Mode

Power on

↓

Wait time ＞ 40ms after V$_{CC}$ ＞ 4.5v

Condition: fosc=270khz

↓

Function set									
RS		RW	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0
0		0	0	0	1	1	X	X	X	X

← | BF cannot be checked before this instruction |

↓

Wait time ＞ 37us

↓

Function set									
RS		RW	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0
0		0	0	0	1	0	X	X	X	X
0		0	N	F	X	X	X	X	X	X

← | BF cannot be checked before this instruction |

↓

Wait time ＞ 37us

↓

Function set									
RS		RW	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0
0		0	0	0	1	0	X	X	X	X
0		0	N	F	X	X	X	X	X	X

← | BF cannot be checked before this instruction |

↓

Wait time ＞ 37us

↓

Display on/off control									
RS		RW	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0
0		0	0	0	0	0	X	X	X	X
0		0	1	D	C	B	X	X	X	X

↓

Wait time ＞ 37us

↓

Display clear									
RS		RW	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0
0		0	0	0	0	0	X	X	X	X
0		0	0	0	0	1	X	X	X	X

↓

Wait time ＞ 1.52ms

↓

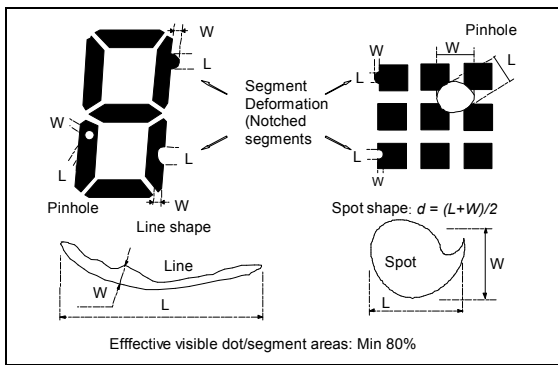| Entry mode set									
RS		RW	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0
0		0	0	0	0	0	X	X	X	X
0		0	0	1	I/D	S	X	X	X	X

↓

Initialization end

14. QUALITY DESCRIPTION

DEFECT SPECIFICATION:

Specific type-related items are covered in this sheet.

a: Table for Cosmetic defects
(Note: nc = not counted).
Sizes and number of defects
(Max. Qty)
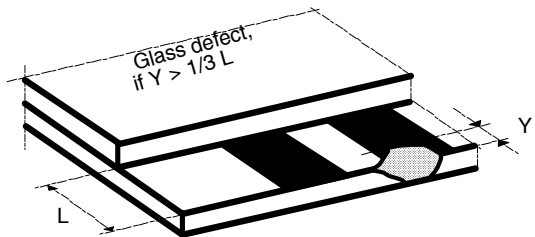

Effective visible dot/segment areas: Min 80%

Examples/ Shapes

b: Glass defects
b1:Glass defects at contact ledge

Defect Type	Max. defect size [μm] d or L / W	Max. Quantity.
Black or White Spots	$d \le 100$	nc
	$100 < d \le 200$	5
Black or White Lines	-- / $W \le 10$	nc
	$L \le 5000$ / $W \le 30$	3
	$L \le 2000$ / $W \le 50$	2
Pinhole	$d \le 100$ / $100 < d \le 200$	nc / 1/segment
(Total defects)		(5)
Segment Deformation	$W \le 100$	nc
Bubble (e.g. under pola)	$d \le 150$	nc
	$200 < d \le 400$	3
	$400 < d \le 600$	1

Glass defect, if Y > 1/3 L

b2:Glass chipping in other areas shall not be in conflict with the product's function.

15. MODULE ACCEPT QUALITY LEVEL (AQL)

15.1 AQL Standard Value: Fatal Defect =0.1, Major Defect=0.65; Minor Defect =2.5.

15.2 Curtailed Inspection Scheme

Type	Batch Qty	inspection Qty	inspection rate	AQL value	pass	Reject
module product	350PCS＜1000PCS	125pcs	＞25%	0.1	0	1
				0.65	2	3
				2.5	7	8
	200PCS＜350PCS	80pcs	＞23%	0.1	0	1
				0.65	1	2
				2.5	5	6
	＜200PCS	32pcs	＞16%	0.1	0	1
				0.65	0	1
				2.5	4	5
Module sample	＜200PCS	All inspected	/	/	/	The sample will be reject when the fateful defect>2pcs or main defect>5pcs.
	＞200PCS	125pcs				

Notes: 1). Batch QTY is the production amount that Production department ship to QA department.

         2). All of product will be inspected if the batch QTY less than inspected QTY.

         3). Each batch fixed to be 500pcs.

16. RELIABILITY TEST

Operating life time: Longer than 50000 hours (at room temperature without direct irradiation of sunlight)

Reliability characteristics shall meet following requirements.

TEMPERATURE TESTS	NORMAL GRADE
High Temperature Storage	+80°C x 96hrs (Without Polarizer)
Low Temperature Storage	-30°C x 96hrs
High Temperature Operation	+70°C x 96hrs
Low Temperature Operation	-20°C x 96hrs
High Temperature, High Humidity	+70°C x 95%RH x 96hrs (Without Polarizer)
Thermal Shock	-20°C x 30min. 10s 5Cycles +70°C x 30min.
Vibration Test	Frequency x Swing x Time 40Hz x 4mm x 4hrs
Drop Test	Drop height x Times 1.0m x 6times

17. LCD MODULES HANDLING PRECAUTIONS

- Please remove the protection foil of polarizer before using.
- The display panel is made of glass. Do not subject it to a mechanical shock by dropping it from a high place, etc.
- If the display panel is damaged and the liquid crystal substance inside it leaks out, do not get any in your mouth. If the substance come into contact with your skin or clothes promptly wash it off using soap and water.
- Do not apply excessive force to the display surface or the adjoining areas since this may cause the color tone to vary.
- The polarizer covering the display surface of the LCD module is soft and easily scratched. Handle this polarize carefully.
- To prevent destruction of the elements by static electricity, be careful to maintain an optimum work environment.
  -Be sure to ground the body when handling the LCD module.
  -Tools required for assembly, such as soldering irons, must be properly grounded.
  -To reduce the amount of static electricity generated, do not conduct assembly and other work under dry conditions.
  -The LCD module is coated with a film to protect the display surface. Exercise care when peeling off this protective film since static electricity may be generated.
- Storage precautions

  When storing the LCD modules, avoid exposure to direct sunlight or to the light of fluorescent lamps. Keep the modules in bags designed to prevent static electricity charging under low temperature / normal humidity conditions (avoid high temperature / high humidity and low temperatures below 0°C). Whenever possible, the LCD modules should be stored in the same conditions in which they were shipped from our company.

18. OTHERS

- Liquid crystals solidify at low temperature (below the storage temperature range) leading to defective orientation of liquid crystal or the generation of air bubbles (black or white). Air bubbles may also be generated if the module is subjected to a strong shock at a low temperature.
- If the LCD modules have been operating for a long time showing the same display patterns may remain on the screen as ghost images and a slight contrast irregularity may also appear. Abnormal operating status can be resumed to be normal condition by suspending use for some time. It should be noted that this phenomena does not adversely affect performance reliability.
- To minimize the performance degradation of the LCD modules resulting from caused by static electricity, etc. exercise care to avoid holding the following sections when handling the modules:
  - Exposed area of the printed circuit board
  - Terminal electrode sections