

LCD MODULE SPECIFICATION

MODEL NO.

BC1602B2 series

FOR MESSRS:

ON DATE OF:

APPROVED BY:

C O N T E N T S

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1. Numbering System

<u>B</u>	<u>C</u>	<u>1602</u>	<u>B2</u>	<u>G</u>	<u>P</u>	<u>L</u>	<u>E</u>	<u>B</u>	<u>xxx</u>
0	1	2	3	4	5	6	7	8	9

0	Brand				Bolymin				
1	Module Type				C= character type G= graphic type P= TAB/TCP type		O= COG type F= COF type		
2	Format				2002=20 characters, 4 lines 12232= 122 x 32 dots				
3	Version No.				A type				
4	LCD Color				G=STN/gray Y=STN/yellow-green C=color STN		B=STN/blue F=FSTN T=TN		
5	LCD Type				R=positive/reflective P=positive/transflective		M=positive/transmissive N=negative/transmissive		
6	Backlight type/color				L=LED array/ yellow-green H=LED edge/white R=LED array/red G=LED edge/yellow-green		D=LED edge/blue E=EL/white B=EL/blue C=CCFL/white		
7	CGRAM Font				J=English/Japanese Font E=English/European Font		C=English/Cyrillic Font H=English/Hebrew Font		
8	View Angle/ Operating Temperature				B=Bottom/Normal Temperature H=Bottom/Wide Temperature U=Bottom/Ultra wide Temperature		T=Top/Normal Temperature W=Top/Wide Temperature C=9H/Normal Temperature		
9	Special Code				3=3 volt logic power supply n=negative voltage for LCD c=cable/connector xxx=to be assigned on data sheet		t=temperature compensation for LCD p=touch panel		

2. General Specification

(1) Mechanical Dimension

Item	Dimension	Unit
Number of Characters	16characters x 2 Lines	-
View area	64.0 x 17.2	mm
Dot size	0.55 x 0.65	mm
Dot pitch	0.60 x 0.70	mm
Character size (W x H)	2.95 x 5.55	mm
Module size (EL or No B/L)	85.0(W) x 29.5(H) x 8.8 max (T)	mm
Module size (LED array B/L)	85.0(W) x 29.5(H) x 12.7 max (T)	mm

(2) Controller IC: **KS0066 (or Equivalent) controller**

(3) Temperature Range

	Normal	Wide
Operating	0 ~+50	-20 ~+70
Storage	-10 ~+60	-30 ~+80

3. Absolute Maximum Ratings

(V_{ss}=0V, Ta=25)

Item	Symbol	Min	Max	Unit
Supply Voltage (Logic)	V _{dd} -V _{ss}	-0.3	7.0	V
Supply Voltage (LCD driver)	V _{dd} -V _o	-0.3	10.0	V
Input Voltage	V _I	-0.3	V _{dd} +0.3	V
Normal Type	TOP	0	+50	
	TSTG	-10	+60	
Wide Temperature Type	Top	-20	+70	
	Tstg	-30	+80	

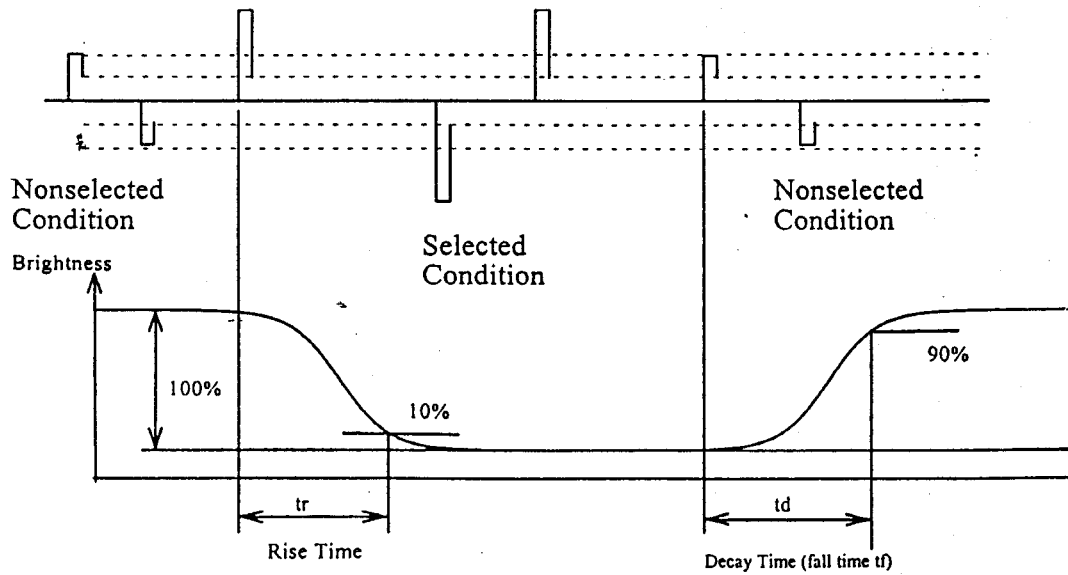
4. Electrical Characteristics

Parameter	Symbol	Condition	Min	Typ	Max	Unit	Note
----- Electronic Characteristics -----							
Logic Circuit Supply Voltage	Vdd-Vss	--	2.7	--	5.5	V	
LCD driving Voltage (TN)	Vdd-Vo	0 °C	4.4	4.7	5.0	V	TN type LCD could only be operated on Normal Temp.
		25 °C	4.2	4.5	4.8		
		50 °C	3.9	4.2	4.5		
LCD driving Voltage (STN)	Vdd-Vo	-20 °C	4.75	5.0	5.25	V	0 ~ 50 °C for Normal Temp. type -20 ~ +70 °C for WideTemp. type
		0 °C	4.75	5.0	5.25		
		25 °C	4.75	5.0	5.25		
		50 °C	4.75	5.0	5.25		
		+70 °C	4.75	5.0	5.25		
Input Voltage	V _{IH}	--	0.7 Vdd	--	Vdd	V	
	V _{IL}	--	Vss	--	0.3Vdd	V	
Logic Supply Current	I _{dd}	Vdd= 5V	--	1.0	1.5	mA	
----- Optical Characteristics (TN) -----							
Contrast	CR	25°C	--	3	--		Note 1
Rise Time	t _r	25°C	--	150	--	ms	Note 2
Fall Time	t _f	25°C	--	150	--	ms	
Viewing Angle Range	θ _f	25°C & CR≥1.4	--	35	--	Deg.	Note 3
	θ _b		--	10	--		
	θ _l		--	30	--		
	θ _r		--	30	--		
Frame Frequency	f _F	25°C	--	64	--	Hz	
----- Optical Characteristics (STN) -----							
Contrast	CR	25°C	--	5	--		Note 1
Rise Time	t _r	25°C	--	80	120	ms	Note 2
Fall Time	t _f	25°C	--	150	300	ms	
Viewing Angle Range	θ _f	25°C & CR≥2	--	40	--	Deg.	Note 3
	θ _b		--	35	--		
	θ _l		--	35	--		
	θ _r		--	35	--		
Frame Frequency	f _F	25°C	--	64	--	Hz	

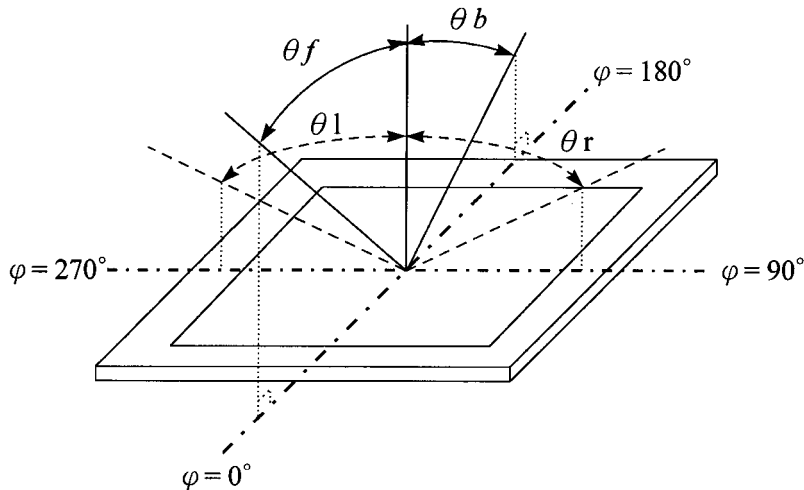
(Note1) Contrast ratio :

$$CR = (\text{Brightness in OFF state}) / (\text{Brightness in ON state})$$

(Note 2) Response time :



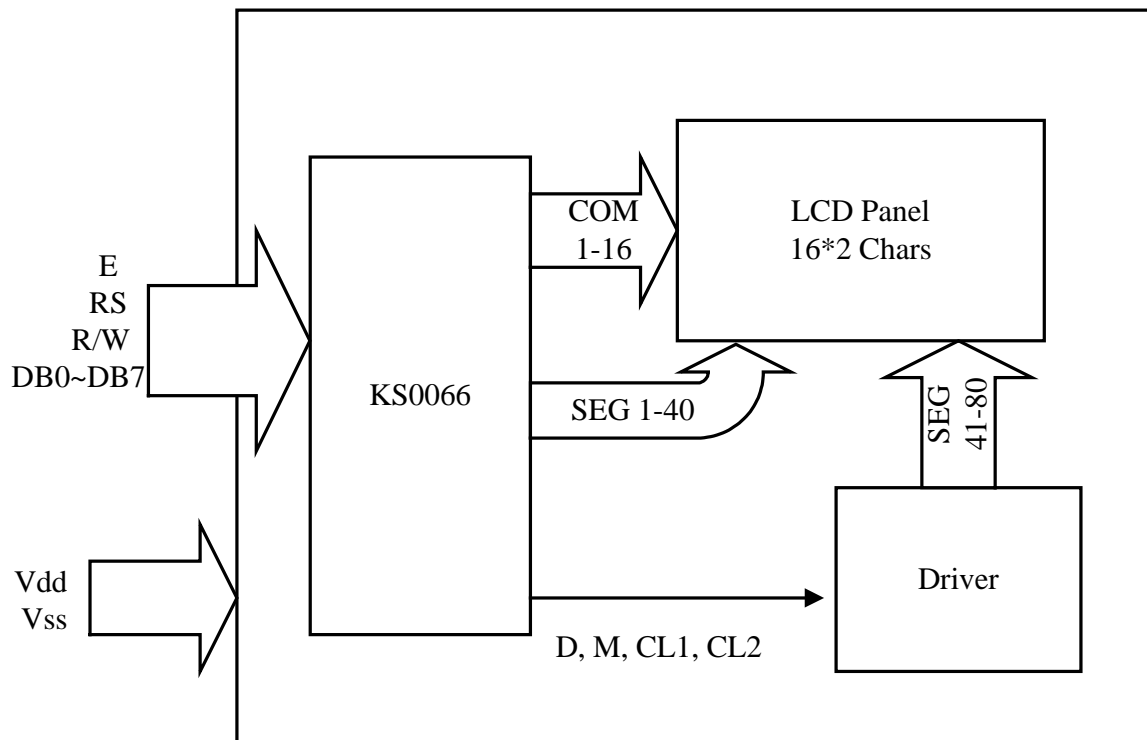
(Note 3) Viewing angle



5. Interface Pin Function

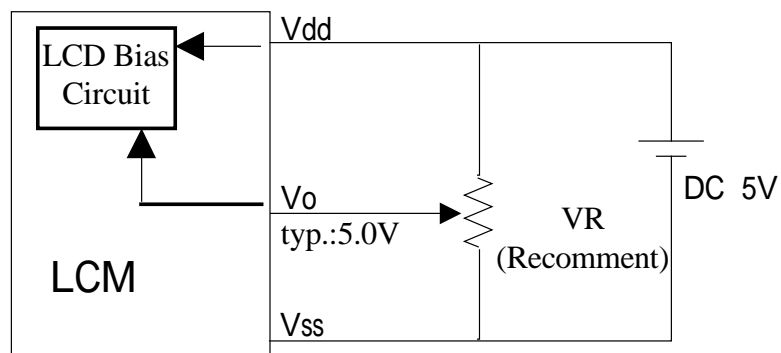
No.	Symbol	Level	Function
1	Vdd	5V	Supply Voltage For Logic
2	Vss	0V	Ground
3	Vo	Variable	Contrast Adjustment
4	RS	--	Data/Instruction Select
5	R/W	--	Read/Write Select
6	E	--	Enable Signal
7	DB0	--	Data Bus line
8	DB1	--	Data Bus line
9	DB2	--	Data Bus line
10	DB3	--	Data Bus line
11	DB4	--	Data Bus line
12	DB5	--	Data Bus line
13	DB6	--	Data Bus line
14	DB7	--	Data Bus line

6. Block Diagram



7. Power Supply for LCD Module and LCD Operating Voltage a Adjustment

* Standart Type





8.Backlight Information

8.1 Specification

(1) LED array / yellow-green

Parameter	Symbol	Min	Typ	Max	Unit	Test Condition
Supply Current	I _{LED}	—	100		mA	V=4.2V
Supply Voltage	V	—	4.2	4.3	V	
Reverse Voltage	V _R	—	—	8	V	
Luminous Intensity	I _V	60	—	—	cd/m ²	I _{LED} =100mA
Wave Length	λ _p		574		nm	I _{LED} =100mA
Life Time		—	100000	—	Hr.	V ≤ 4.2V
Color	Yellow Green					

(2) LED edge/white/blue

Parameter	Symbol	Min	Typ	Max	Unit	Test Condition
Supply Current	I _{LED}	—	20	25	mA	V=3.4V
Supply Voltage	V	—	3.4	3.5	V	
Reverse Voltage	V _R	—	—	8	V	
Luminous Intensity	I _V	50	—	—	cd/m ²	I _{LED} =20mA
Life Time		—	10000-white 50000-blue	—	Hr.	V ≤ 3.4 V
Color	White/Blue					



(3) LED edge/ yellow-green

Parameter	Symbol	Min	Typ	Max	Unit	Test Condition
Supply Current	I _{LED}	—	20		mA	V=3.9V
Supply Voltage	V	—	3.9	4.1	V	
Reverse Voltage	V _R	—	—	6	V	
Luminous Intensity	I _V	—	—	—	cd/ m ²	I _{LED} =20mA
Wave Length	λ _p		573		nm	I _{LED} =20mA
Life Time		—	100000	—	Hr.	V ≤ 3.9V
Color	Yellow Green					

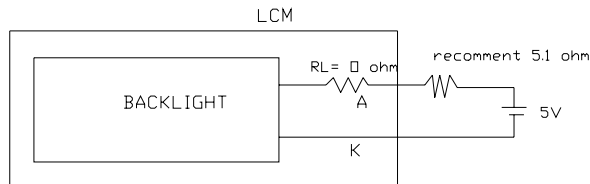
(4) EL / Blue

Parameter	Symbol	Min	Typ	Max	Unit	Test Condition
Voltage	V _{rms}	--	110 (AC)		--	
Frequency	HZ	--	400		--	
Brightness*	cd/m ²	48	60		--	110V _{rms} 400Hz
CIE Chromaticity Diagram	X	--	0.330		--	
	Y	--	0.365		--	
Current Dissipation	mA/cm ²	--	1.33		--	
Power Dissipation	mW/cm ²	--	26.29		--	
Color	Blue					

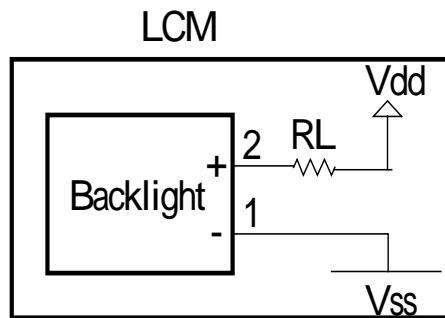
8.2 Backlight driving methods

a. LED B/L drive from A.K directly

a.1 array / yellow-green

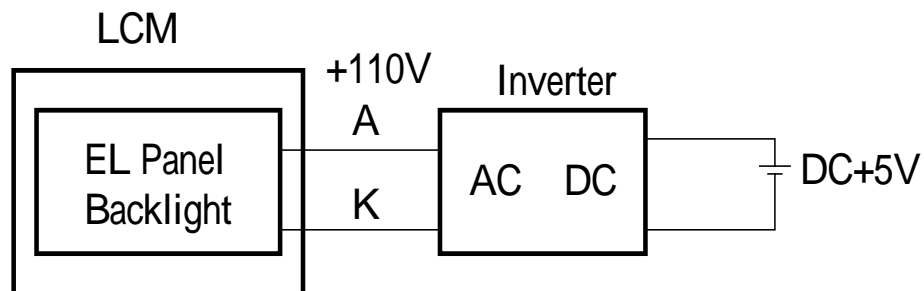


b. * (Option) LED B/L drive from pin1 (Vss) pin2 (Vdd)



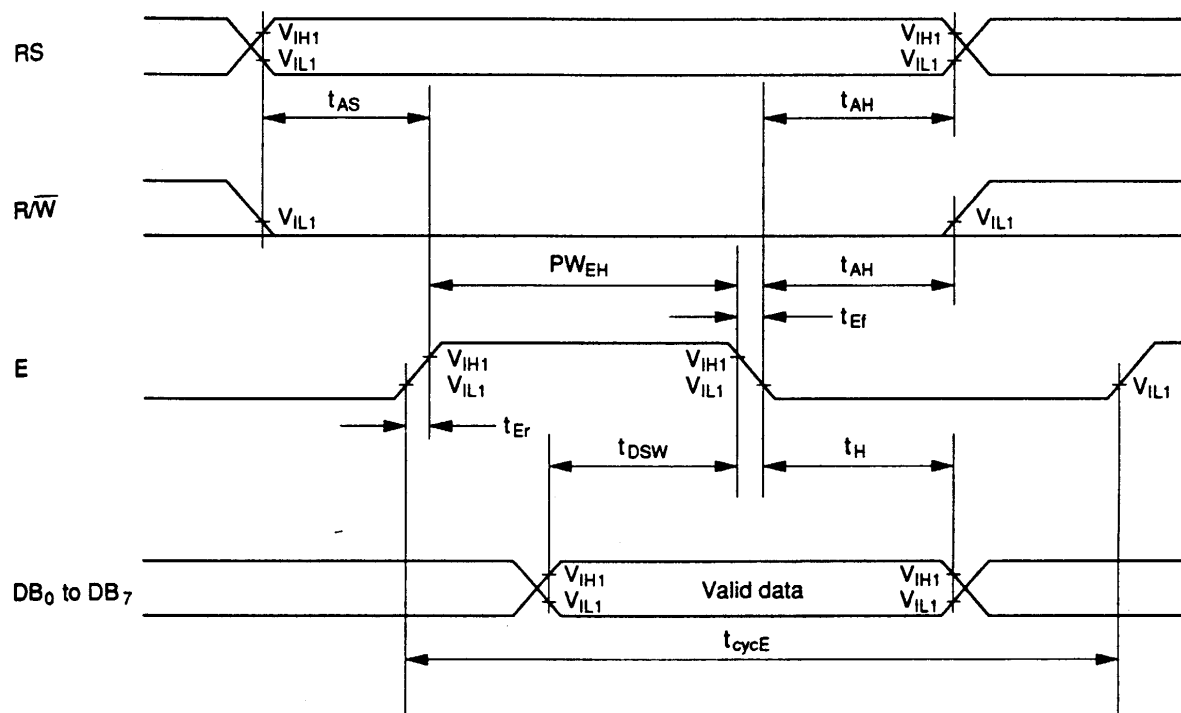
- (1) Jump 1,2 Short
- (2) Current Resistor required on R_L
- (3) To be sure of enough current supply for both Vdd + LED B/L

c. EL B/L drive from A.K directly



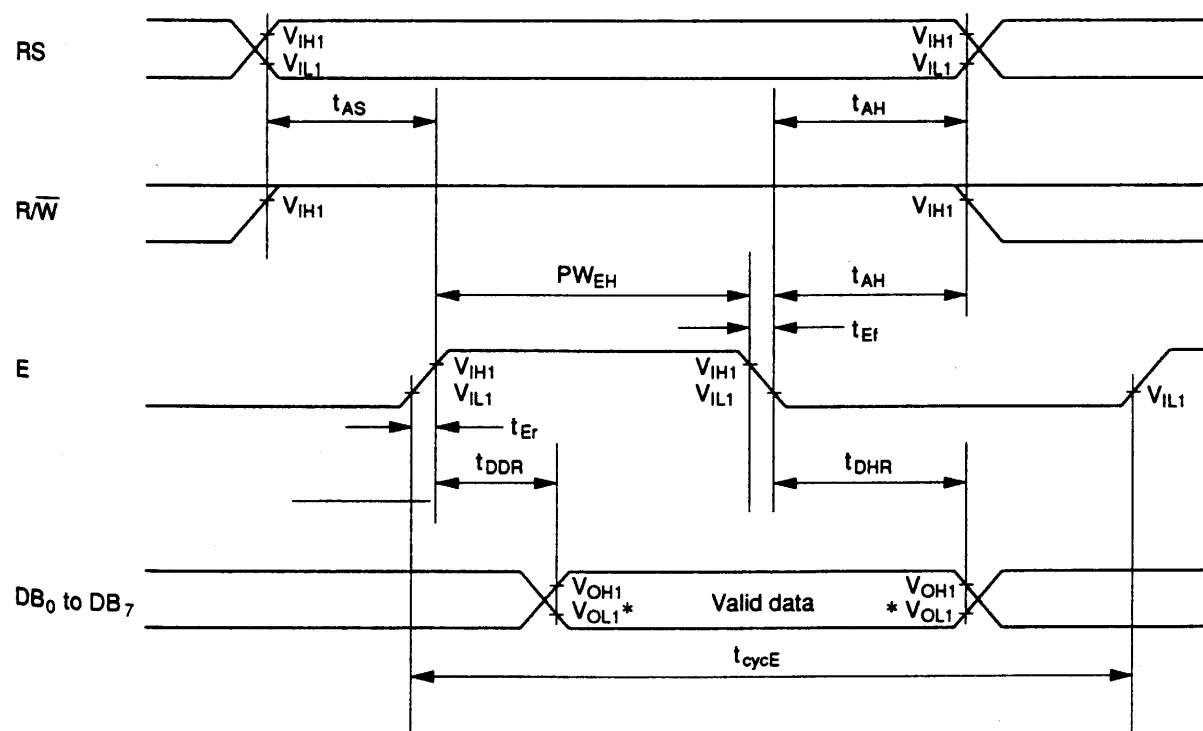
9. Timing Characteristics

9-1 Write Operation



Item	Symbol	Min	Typ	Max	Unit
Enable cycle time	t_{cycE}	500	-	-	ns
Enable pulse width (high level)	PW_{EH}	230	-	-	ns
Enable rise/fall time	t_{Er}, t_{Ef}	-	-	20	ns
Address set-up time (RS, R/W to E)	t_{AS}	40	-	-	ns
Address hold time	t_{AH}	10	-	-	ns
Data set-up time	t_{DSW}	80	-	-	ns
Data hold time	t_H	10	-	-	ns

9-2 Read Operation



Item	Symbol	Min	Typ	Max	Unit
Enable cycle time	t_{cycE}	500	-	-	ns
Enable pulse width (high level)	PW_{EH}	230	-	-	ns
Enable rise/fall time	t_{Er}, t_{Ef}	-	-	20	ns
Address set-up time (RS, R/W to E)	t_{AS}	40	-	-	ns
Address hold time	t_{AH}	10	-	-	ns
Data delay time	t_{DDR}	-	-	120	ns
Data hold time	t_{DHR}	5	-	-	ns

10. Quality

10-1 Test Conditions

Tests should be conducted under the following conditions :

Ambient temperature : $25\pm 5^{\circ}\text{C}$

Humidity : $60\pm 25\%$ RH.

10-2 Sampling Plan

Sampling method shall be in accordance with MIL-STD-105E, inspection level II, normal inspection, and single sampling plan tables for normal, tightened, and reduced inspection.

10-3. Acceptable Quality Level

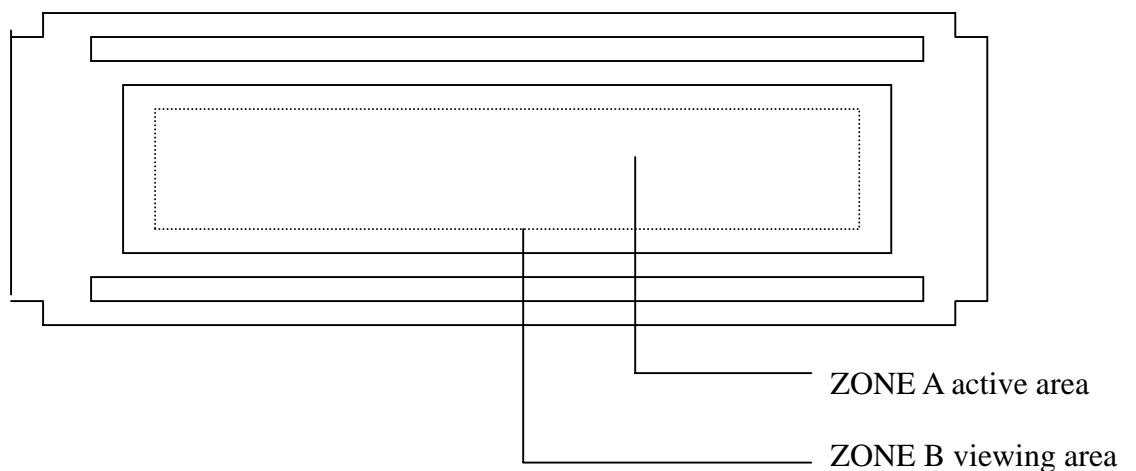
A major defect is defined as one that could cause failure to or materially reduce the usability of the unit for its intended purpose. A minor defect is one that does not materially reduce the usability of the unit for its intended purpose or is an infringement from established standards and has no significant bearing on its effective use or operation.

10-4. Appearance

An appearance test should be conducted by human sight at approximately 30 cm distance from the LCD module under fluorescent light. The inspection area of LCD panel shall be within the range of following limits.

10-5. Inspection Quality Criteria

Item	Description of defects			Class of Defects	Acceptable level (%)
Function	Short circuit or Pattern cut			Major	0.65
Dimension	Deviation from drawings			Major	1.5
Black spots	Ave . dia . D	area A	area B	Minor	2.5
	D < 0.2	Disregard			
	0.2 < D < 0.3	3	4		
	0.3 < D < 0.4	2	3		
	0.4 < D	0	1		
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		
	See line criteria				
Bubbles in polarizer	Average diameter D 0.2 < D < 0.5 mm for N = 4 , D > 0.5 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	See note 3			Minor	2.5
Contrast ratio	See note 1			Minor	2.5
Response time	See note 2			Minor	2.5



11. Reliability

Test Item	Test Conditions	Note
High Temperature Operation	50±3°C , t=96 hrs	
Low Temperature Operation	0±3°C , t=96 hrs	
High Temperature Storage	70±3°C , t=96 hrs	1,2
Low Temperature Storage	-20±3°C , t=96 hrs	1,2
Humidity Test	40 °C, Humidity 90%, 96 hrs	1,2
Thermal Shock Test	-20°C (30 min.) ~ 25°C (5 min.) ~ 70°C (30 min.) (1 cycle) Total 5 cycle	1,2
Vibration Test (Packing)	Sweep frequency : 10 55 10 Hz/1min Amplitude : 0.75mm Test direction : X.Y.Z/3 axis Duration : 30min/each axis	2

Note 1 : Condensation of water is not permitted on the module.

Note 2 : The module should be inspected after 1 hour storage in normal conditions
(15-35°C , 45-65%RH).

Definitions of life end point :

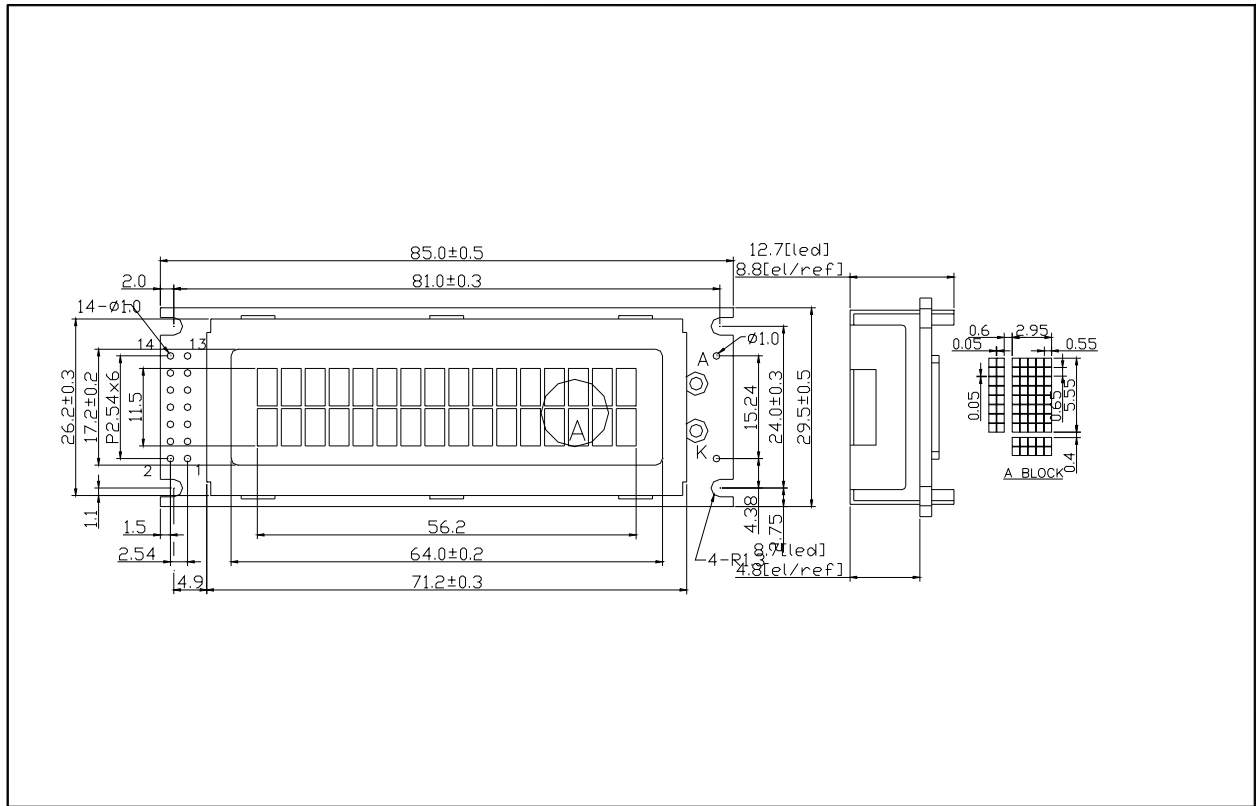
- Current drain should be smaller than the specific value.
- Function of the module should be maintained.
- Appearance and display quality should not have degraded noticeably.
- Contrast ratio should be greater than 50% of the initial value.

12. Handling Precautions

- (1) An LCD module is a fragile item and should not be subjected to strong mechanical shocks.
- (2) Avoid applying pressure to the module surface. This will distort the glass and cause a change in colour.
- (3) Under no circumstances should the position of the bezel tabs or their shape be modified.
- (4) Do not modify the display PCB in either shape or positioning of components.
- (5) Do not modify or move location of the zebra or heat seal connectors.
- (6) The device should only be soldered to during interfacing. Modification to other areas of the board should not be carried out.
- (7) In the event of LCD breakage and resultant leakage of fluid do not inhale, ingest or make contact with the skin. If contact is made rinse immediately.
- (8) When cleaning the module use a soft damp cloth with a mild solvent, such as Isopropyl or Ethyl alcohol. The use of water, ketone or aromatic is not permitted.
- (9) Prior to initial power up input signals should not be applied.
- (10) Protect the module against static electricity and observe appropriate anti-static precautions.

13. Appendix (Drawing , Data)

13-1 Drawing



13-2 Data

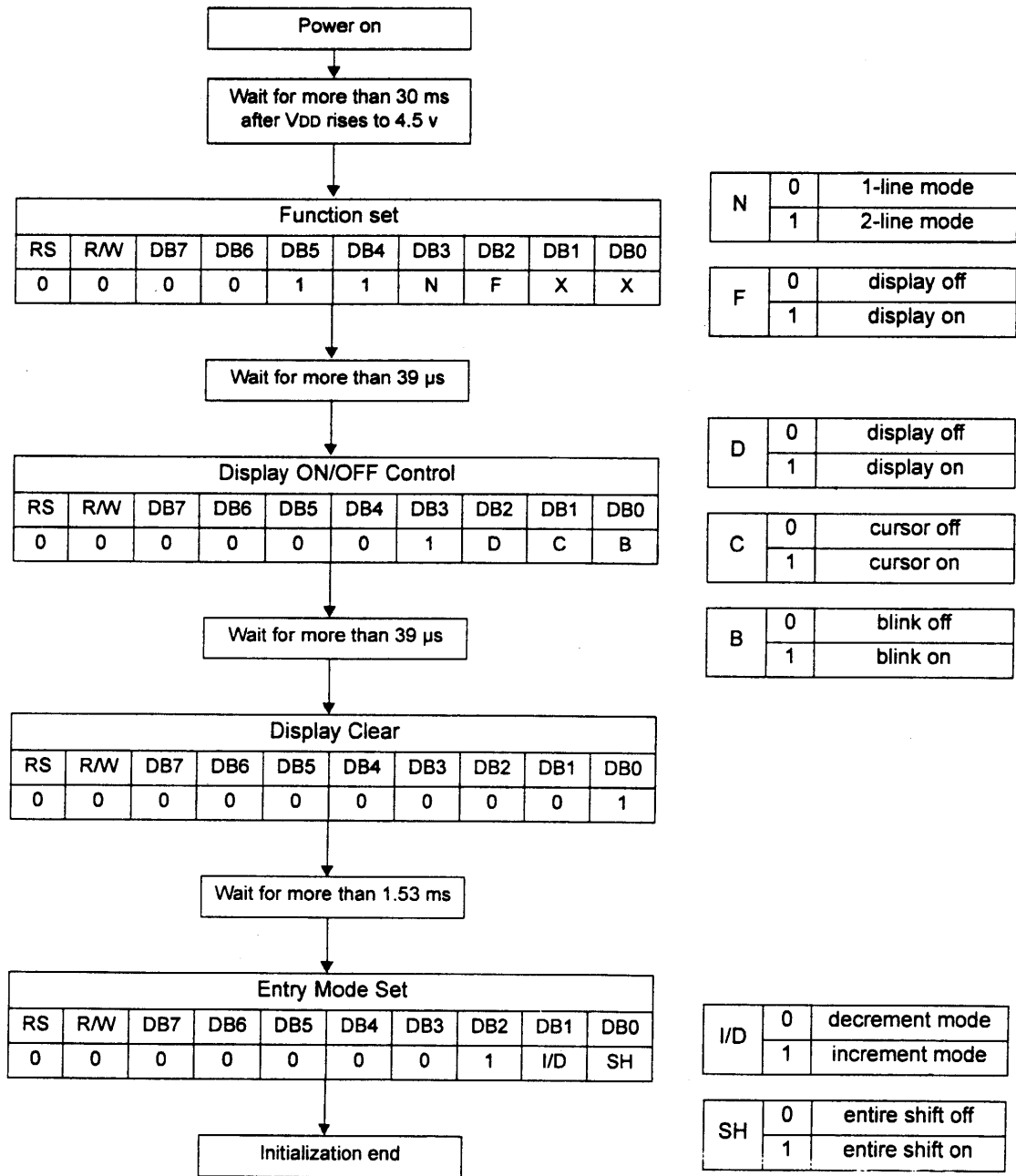
13-2.1 Instruction set

Instruction	Code										Description	E.T.(fosc =270 KHZ)
	RS	R/W	D7	D6	D5	D4	D3	D2	D1	D0		
Clear Display	0	0	0	0	0	0	0	0	0	1	Write"20H" to DDRAM and set DDRAM address to "00H" from AC	1.53 ms
Return Home	0	0	0	0	0	0	0	0	0	--	Sets DD RAM address to "00H" from AC and return cursor to its original position if shifted. The contents of DDRAM are not changed.	1.53 ms
Entry Mode SET	0	0	0	0	0	0	0	1	I/D	SH	Assign cursor moving direction and enable the shift of entire display.	39 μS
Display ON/OFF Control	0	0	0	0	0	0	1	D	C	B	Set display (D), cursor (C), and blink of cursor (B) on/off control bit.	39 μS
Cursor or Display Shift	0	0	0	0	0	1	S/C	R/L	--	--	Set cursor moving and display shift control bit, and the direction, without changing of DDRAM data.	39 μS
Function Set	0	0	0	0	1	DL	N	F	--	--	Sets interface data length (DL:8-bit/4-bit), number of display lines (N:2-line/1-line) and , display font type (F:5x11 dots/5x8 dost).	39 μS
Set CG RAM Address	0	0	0	1	AC5	AC4	AC3	AC2	AC1	AC0	Sets CG RAM address in address counter.	39 μS
Set DD RAM Address	0	0	1	AC6	AC5	AC4	AC3	AC2	AC1	AC0	Sets DD RAM address in address counter.	39 μS
Read Busy Flag and Address	0	1	BF	AC6	AC5	AC4	AC3	AC2	AC1	AC0	Whether during internal operation or not can be known by reading BF. The contents of address counter can also be read.	0 μS
Write Data to RAM	1	0	D7	D6	D5	D4	D3	D2	D1	D0	Writes data into internal RAM (DD RAM /CG RAM).	43 μS
Read Data from RAM	1	1	D7	D6	D5	D4	D3	D2	D1	D0	Reads data from internal RAM (DD RAM /CG RAM).	43 μS

* "--" : don't care

Note : When an MPU program with checking the Busy Flag(DB7) is made, it must be necessary 1/2Fosc is necessary for executing the next instruction by the falling edge of the 'E' signal after the Busy Flag(DB7) goes to "LOW".

13-2.2 Initialization sequence



DD RAM Address

DIGIT	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1 LINE	00	01	02	03	04	05	06	07	08	09	0A	0B	0C	0D	0E	0F
2 LINE	40	41	42	43	44	45	46	47	48	49	4A	4B	4C	4D	4E	4F

DD RAM Address

13-2.3 Font table

Code J: English – Japanese Font

Upper 4 bit Lower 4 bit	LLLL	LLLH	LLHL	LLHH	LHLL	LHLH	LHHL	LHHH	HLLL	HLLH	HLHL	HLHH	HHLL	HHLH	HHHL	HHHH
LLLL	CG RAM (1)			0	1	2	3	4				5	6	7	8	9
LLLH	(2)		.	1	2	3	4	5			6	7	8	9	0	1
LLHL	(3)		"	2	3	4	5	6			7	8	9	0	1	2
LLHH	(4)		*	3	4	5	6	7			8	9	0	1	2	3
LHLL	(5)		*	4	5	6	7	8			9	0	1	2	3	4
LHLH	(6)		*	5	6	7	8	9			0	1	2	3	4	5
LHHL	(7)		0	1	2	3	4	5			6	7	8	9	0	1
LHHH	(8)		1	2	3	4	5	6			7	8	9	0	1	2
HLLL	(1)		2	3	4	5	6	7			8	9	0	1	2	3
HLLH	(2)		3	4	5	6	7	8			9	0	1	2	3	4
HLHL	(3)		*	4	5	6	7	8			9	0	1	2	3	4
HLHH	(4)		*	5	6	7	8	9			0	1	2	3	4	5
HHLL	(5)		.	6	7	8	9	0			1	2	3	4	5	6
HHLH	(6)		1	2	3	4	5	6			7	8	9	0	1	2
HHHL	(7)		.	3	4	5	6	7			8	9	0	1	2	3
HHHH	(8)		4	5	6	7	8	9			0	1	2	3	4	5

Code C: English - Cyrillic Font

Upper 4 bit Lower 4 bit	LLLL	LLLH	LLHL	LLHH	LHLL	LHLH	LHHL	LHHH	HLLL	HLLH	HLHL	HLHH	HHLL	HHLH	HHHL	HHHH
LLLL	CG RAM (1)			0	1	2	3	4			5	6	7	8	9	0
LLLH	CG RAM (2)	!	.	1	2	3	4	5			6	7	8	9	0	1
LLHL	CG RAM (3)		"	2	3	4	5	6			7	8	9	0	1	2
LLHH	CG RAM (4)		*	3	4	5	6	7			8	9	0	1	2	3
LHLL	CG RAM (5)		\$	4	5	6	7	8			9	0	1	2	3	4
LHLH	CG RAM (6)		%	5	6	7	8	9			0	1	2	3	4	5
LHHL	CG RAM (7)		&	6	7	8	9	0			1	2	3	4	5	6
LHHH	CG RAM (8)		'	7	8	9	0	1			2	3	4	5	6	7
HLLL	CG RAM (1)		(8	9	0	1	2			3	4	5	6	7	8
HLLH	CG RAM (2))	9	0	1	2	3			4	5	6	7	8	9
HLHL	CG RAM (3)		*	0	1	2	3	4			5	6	7	8	9	0
HLHH	CG RAM (4)		+	1	2	3	4	5			6	7	8	9	0	1
HHLL	CG RAM (5)		,	2	3	4	5	6			7	8	9	0	1	2
HHLH	CG RAM (6)		-	3	4	5	6	7			8	9	0	1	2	3
HHHL	CG RAM (7)		.	4	5	6	7	8			9	0	1	2	3	4
HHHH	CG RAM (8)		/	5	6	7	8	9			0	1	2	3	4	5