RCL DISPLAY LTD.

DATA SHEET

LCD MODULE

MBC20201B SERIES

Product specification

Version: 6

20/Dec/2005

GENERAL SPECIFICATION

MODULE NO. :

MBC20201B SERIES

CUSTOMER   P/N

VERSION NO.	CHANGE DESCRIPTION	DATE
0	ORIGINAL VERSION	1998/10/09
1	ADDING VERSION	2003/05/08
2	CHANGE NEW FORMAT	2004/08/04
3	ADD MBC20201B04 VERSION	2004/11/24
4	ADDING MBCF20201B05~B07 VERSION	2005/06/27
5	ADD OPTICAL CHARACTERISTICS DATA	2005/07/08
6	ADD PCB FOR MODULE	2005/12/20

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CONTENTS

1. FUNCTIONS & FEATURES

- MBC20201B Series LCD Type :

MODULE	LCD MODEL	LCD TYPE	OPERATION TEMPERATURE	STORAGE TEMPERATURE	REMARK
MBC20201B00	DC20210E00	TN Transflective Positive Mode	0 ~+50	-10 ~+60	
MBC20201B01	DC20208E00	STN Green Transflective Positive Mode			
MBC20201B02	DC20208E01	STN Grey Transflective Positive Mode			
MBC20201B03	DC20208E05	FSTN Transflective Positive Mode			
MBC20201B04	DC20208E08	STN Grey Transflective Positive Mode	-20 ~+60	-30 ~+70	
MBCF20201B05	DC20210E00	TN Transflective Positive Mode	0 ~+50	-10 ~+60	RoHS version of MBC20201B00
MBCF20201B06	DC20208E00	STN Green Transflective Positive Mode			RoHS version of MBC20201B01
MBCF20201B07	DC20208E01	STN Grey Transflective Positive Mode			RoHS version of MBC20201B02

- Viewing Direction   : 6 O'clock
- Driving Scheme   : 1/16 Duty Cycle, 1/5 Bias
- Power Supply Voltage   : 5.0V
- VLCD Adjustable for Best Contrast   : 4.5V
- Backlight Color   : Yellow Green
- Display contents   : 20*2 Characters (5 * 8 dots, Format: 208 Kinds)
- Internal Memory   : CGROM (10,080 bits)
  : CGRAM (64 x 8 bits)
  : DDRAM (80 x 8 bits for Digits)
- Easy Interface with a 4-bit or 8-bit MPU
- MBCF20201B05/B06/B07 is ROHS Conformed

2. MECHANICAL SPECIFICATIONS
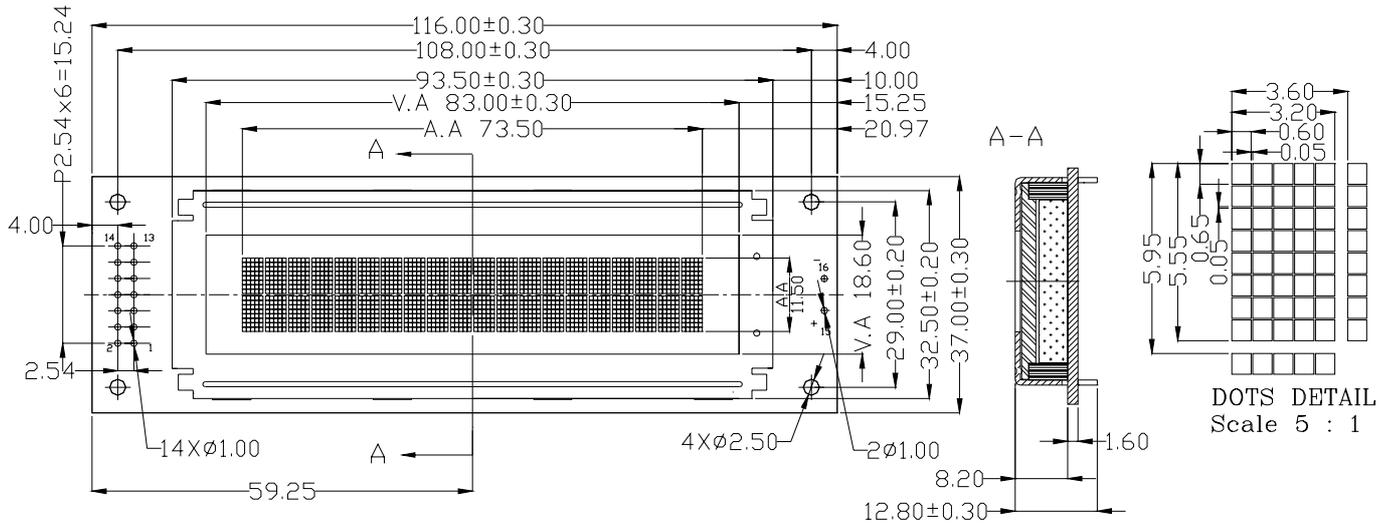
- Module Size   : 116(L) x 37.0(W) x 12.8(H)mm
- Character Pitch   : 3.6 (W) x 5.95 (H) mm
- Character Size   : 3.2 (W) x 5.55 (H) mm
- Character Font   : 5 x 8 dots
- Dot Size   : 0.6 (W) x 0.65 (H) mm
- Dot Pitch   : 0.65 (W) x 0.70 (H) mm

3. BLOCK DIAGRAM
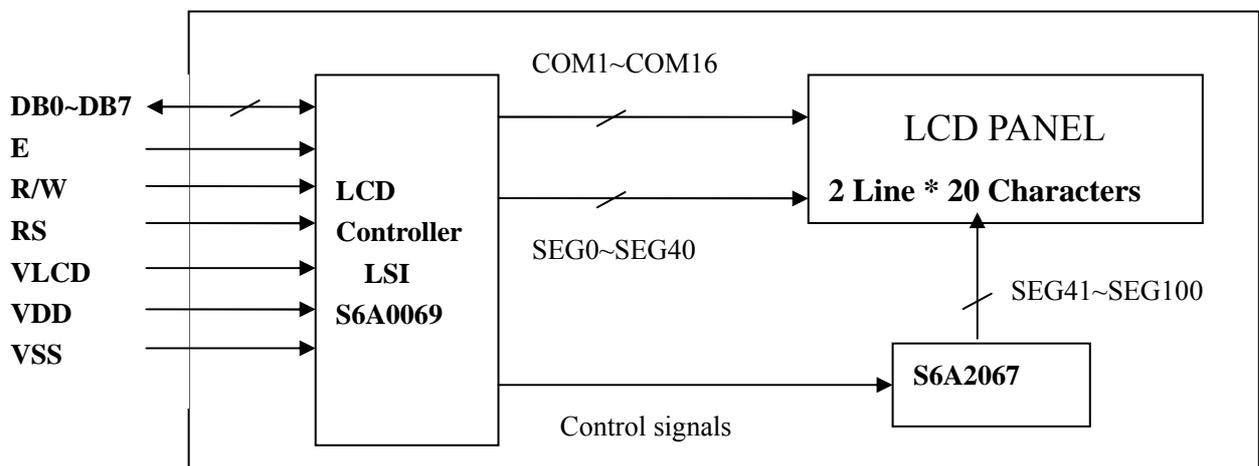
4. EXTERNAL DIMENSIONS (⊕⊟ unit: mm)

5. PIN ASSIGNMENT

Pin No.	Symbol	Function
1	VSS	Ground
2	VDD	Power supply
3	VLCD	Power Supply for LCD
4	RS	Select Display Data ("H") or Instructions ("L")
5	R/W	Read or Write Select Signal
6	E	Read/Write Enable Signal
7	DB0	Display Data Signal
8	DB1	
9	DB2	
10	DB3	
11	DB4	
12	DB5	
13	DB6	
14	DB7	
15	A	Anode of Backlight
16	K	Cathode of Backlight

6. MAXIMUM ABSOLUTE LIMIT

Item	Symbol	Standard value	Unit
Power supply voltage (1)	V_{DD}	-0.3~+7.0	V
Power supply voltage (2)	V_{LCD}	V_{DD}-13.5~V_{DD}+0.3	V
Input voltage	V_{IN}	-0.3~V_{DD}+0.3	V
Volt. For BL	V_{LED1}	4~4.5	V
Operating temperature	Topr	0~+50(MBC20201B00~B03,MBCF20201B05~B07)	
Operating temperature	Topr	-20~+60(MBC20201B04)	
Storage temperature	Tstg	-10~+60(MBC20201B00~B03, MBCF20201B05~B07)	
Storage temperature	Tstg	-30~+70(MBC20201B04)	

*Voltage greater than above may damage to the Circuit.

VDD≥V1≥ V2≥V3≥V4≥V5

7. ELECTRICAL CHARACTERISTICS

7-1   DC Characteristics(VDD=4.5V~5.5V,Ta=-20~+60   )

Item	Symbol	Standard Value			Test Condition	Unit
		MIN	TYP	MAX		
Operating Voltage	V_{DD}	4.5	5	5.5	-------	V
Supply Current	I_{DD}	----	0.35	0.6	VDD=5V,fosc=270kHz	mA
Input Voltage (1) (except OSC1)	V_{IL1}	-0.3	--	0.6	--------	V
	V_{IH1}	2.2	--	V_{DD}	---------	
Input Voltage (2) (OSC1)	V_{IL2}	-0.2	--	1.0	---------	V
	V_{IH2}	VDD-1.0	--	V_{DD}	---------	
Output Voltage (1) (DB0 to DB7)	V_{OL1}	---	----	0.4	I_{OL}=1.2mA	V
	V_{OH1}	2.4	---	----	I_{OH}=-0.205mA	
Output Voltage (2) (except DB0 to DB7)	V_{OL2}	------	---	0.1VDD	I_{OL}=40uA	V
	V_{OH2}	0.9VDD	---	-----	I_{OH}=-40uA	
Voltage Drop	Vd_{COM}	-----	---	1	IO=±0.1 mA	V
	Vd_{SEG}	------	---	1		
Input Leakage Current	I_{IKG}	-1	---	1	VIN=0 V to VDD	uA
Input Low Current	I_{IL}	-50	-125	-250	VIN=0V,VDD=5V(pull up)	uA
Internal Clock (external Rf)	f_{OSC1}	190	270	350	Rf = 91k±2 (VDD=5V)	kHz
External Clock	f_{OSC}	125	270	410	----	kHz
	Duty	45	50	55	----	
	t_R,t_F	---	---	0.2	----	us
LCD Driving Voltage	VLCD	3.0	4.5	13.0	VDD-V5 (1/5 Bias)	V

7-2 BACKLIGHT ELECTRICAL/OPTICAL SPECIFICATIONS

7-2-1 Absolute Maximum Rating(Ta=25℃):

Parameter	Symbol	Rating	Units
Power dissipation	P_d	2.2	W
Peak Forward Current	I_F	480	mA
Reverse Voltage	V_R	10	V

7-2-2 Electrical/Optical Characteristics Rating:

Item	Symbol	Rating			Units	Test Condition Condition
		Min.	Typ	Max.		
Luminance	L	100	150	-	cd/m2	I_F=240mA
Forward Voltage	V_F	-	4.2	4.6	V	
Luminous Tolerance	-	-	-	30	%	
Dominant Wavelength	D	-	573	-	nm	I_R=20mA
Spectral Line Half Wavelength		-	35	-	nm	
Reverse Current	I_R	-	-	0.4	mA	V_R=10V

7-2-3 Backlight Drawing (⊕⊏ unit: mm)
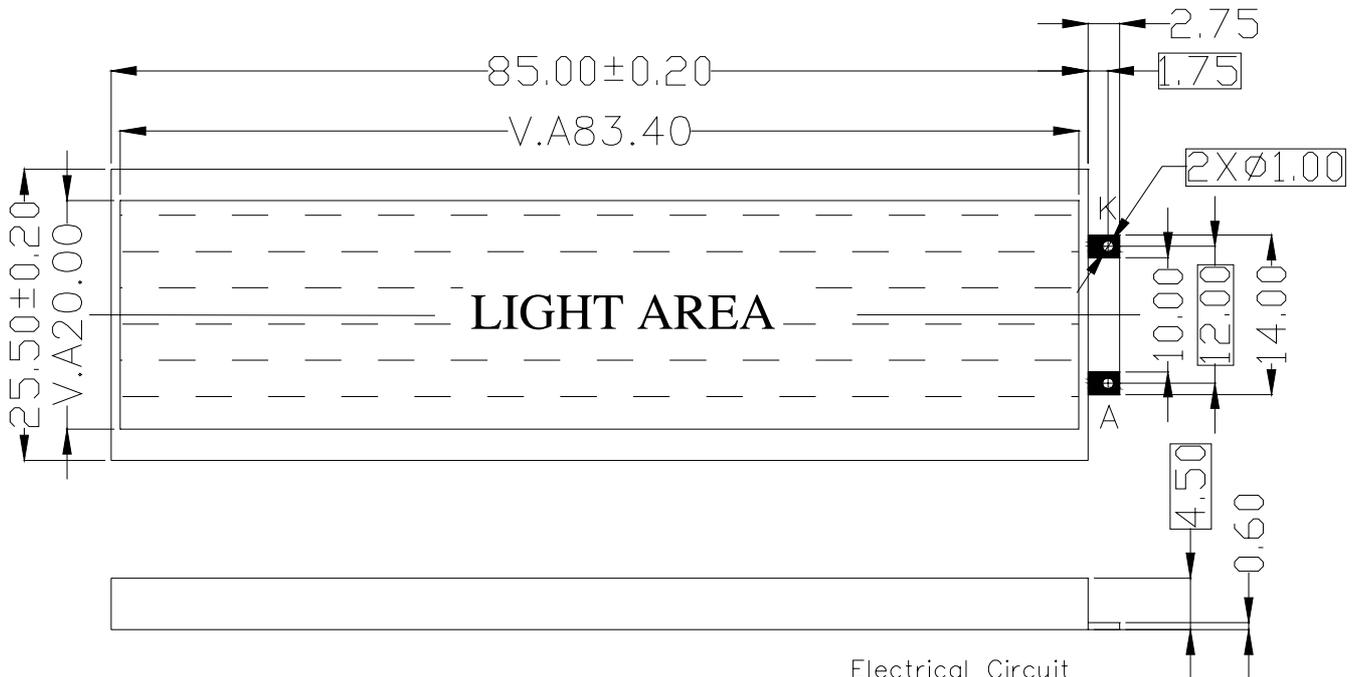
REMARKES:
UNMARKED TOLERANCE: ±0.20
TYPE:BL048-083020-GU11

Electrical Circuit

24x2=48PCS
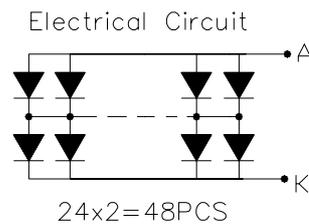
7-3 AC Characteristics (VDD=4.5V~5.5V, Ta=-20~+60)

7-3-1 Write mode (writing data from MPU to MBC20201B Series)

Characteristic	Symbol	Min	Type	Max	Unit	Test PIN
E Cycle Time	t_C	500	---	---	ns	E
E Rise Time	t_R	---	---	20	ns	E
E Fall Time	t_F	---	---	20	ns	E
E Pulse width (High, Low)	t_W	230	---	---	ns	E
R/W and RS Set-up Time	t_{SU1}	40	---	---	ns	R/W,RS
R/W and RS Hold Time	t_{H1}	10	---	---	ns	R/W,RS
Data Set-up Time	t_{SU2}	80	---	---	ns	DB0~DB7
Data Hold Time	t_{H2}	10	---	---	ns	DB0~DB7
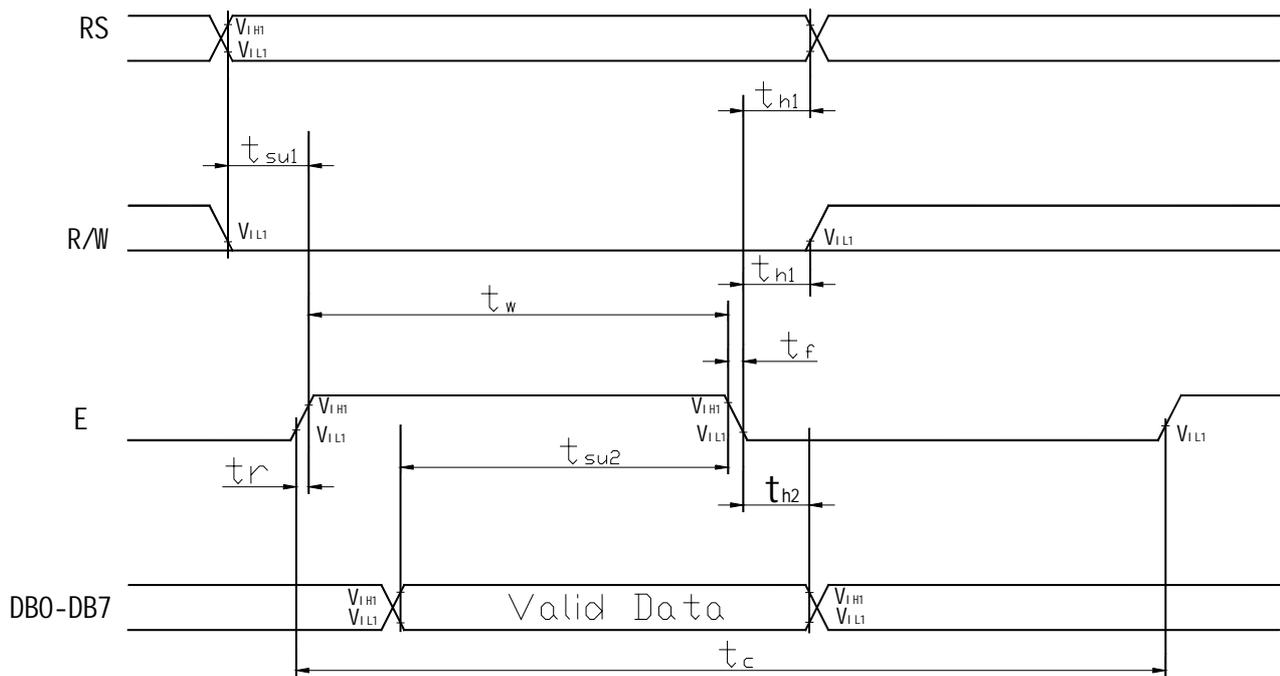
7-3-2 Read mode (Reading data from MBC20201B Series to MPU)

| Characteristic	Symbol	Min	Type	Max	Unit	Test PIN
E Cycle Time	t_C	500	---	---	ns	E
E Rise Time	t_R	---	---	20	ns	E
E Fall Time	t_F	---	---	20	ns	E
E Pulse width (High, Low)	t_W	230	---	---	ns	E
R/W and RS Set-up Time	t_{SU}	40	---	---	ns	R/W,RS
R/W and RS Hold Time	t_H	10	---	---	ns	R/W,RS
Data Output Delay Time	t_D	---	---	120	ns	DB0~DB7
Data Hold Time	t_{DH}	5	---	---	ns	DB0~DB7
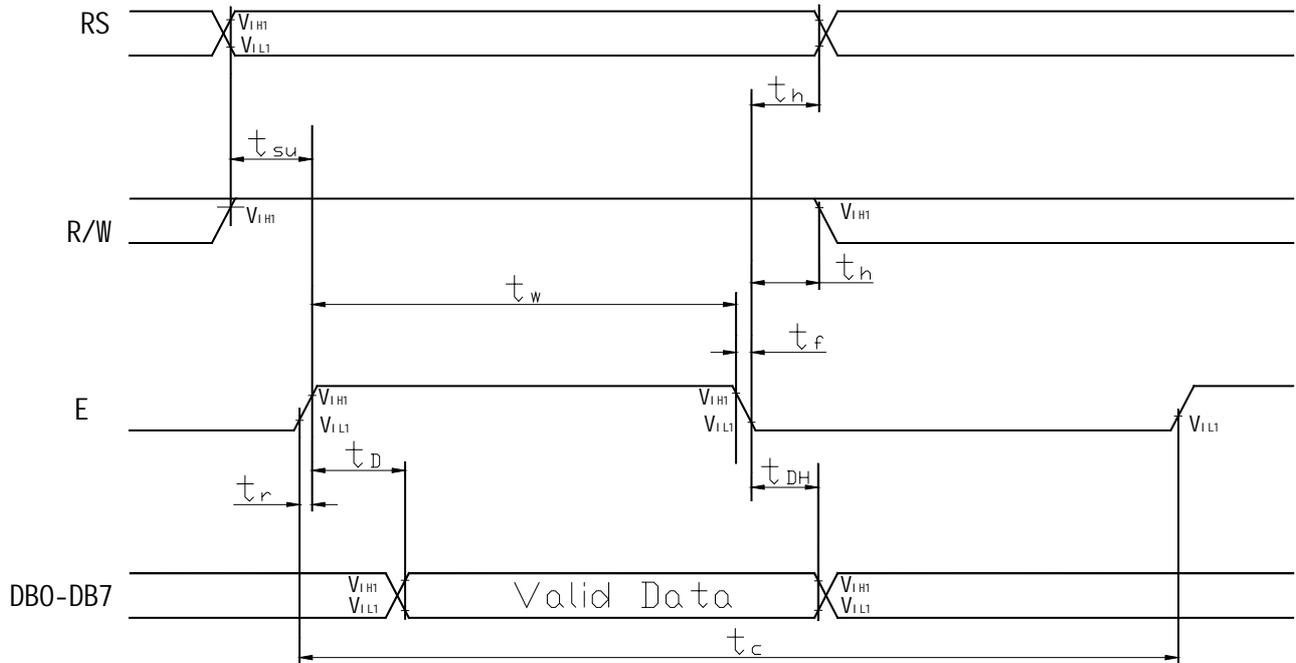
8. PCB FOR MODULE

8.1   TOP LAYER
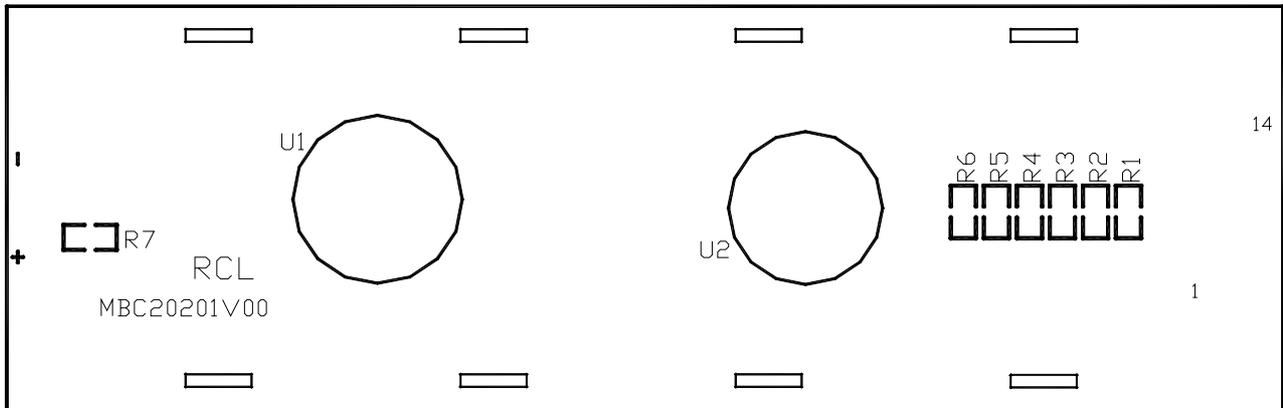
Remark: the material is lead-free

R1=R2=R3=R4=R5=2.2K R6=91K R7=0

8.2   BOTTOM LAYER
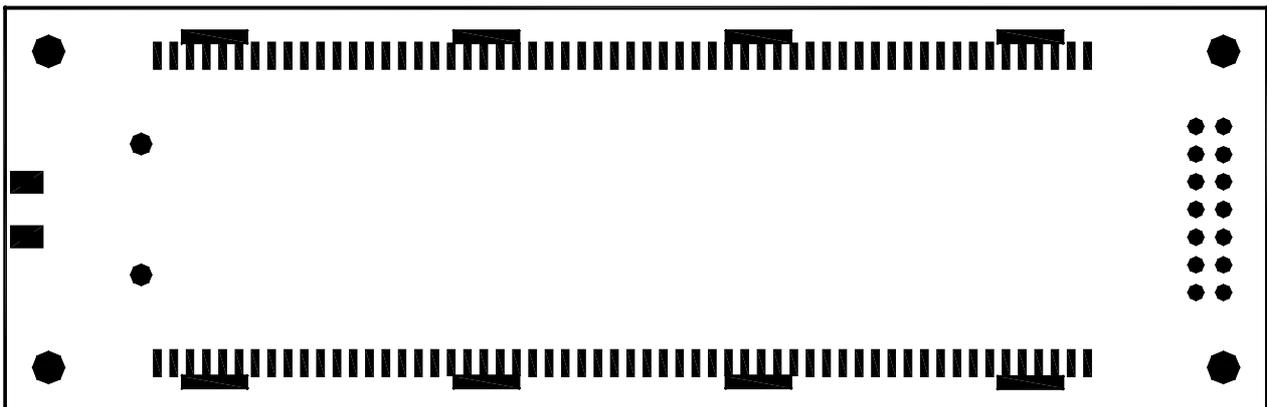
9. CONTROL AND DISPLAY COMMAND

Command	RS	R/W	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0	Execution time (fosc=270KHz)	Remark		
clear Display	L	L	L	L	L	L	L	L	L	H	1.53ms			
Return home	L	L	L	L	L	L	L	L	H	---	1.53ms	Cursor move to first digit		
Entry mode set	L	L	L	L	L	L	L	H	I/D	SH	39us	I/D: set cursor move direction SH: Specifies shift of display		
												I/D	H	Increase
													1	Decrease
												SH	H	Display is shifted
													L	Display is not shifted
Display on/off control	L	L	L	L	L	L	H	D	C	B	39us	Display		
												D	H	Display on
													L	Display off

											Cursor C — H: Cursor on / L: Cursor off Blinking B — H: Blinking on / L: Blinking off
Cursor or Display Shift	L	L	L	L	L	H	S/C	R/L	---	---	39us	SC — H: Display shift / L: Cursor move R/L — H: Right shift / L: Left shift
function Set	L	L	L	L	H	DL	N	F	---	---	39us	DL — H: 8bits interface / L: 4bits interface N — H: 2 line display / L: 1 line display F — H: 5 x 11 dots / L: 5 x 8 dots
Set CGRAM address	L	L	L	H	AC5	AC4	AC3	AC2	AC1	AC0	39us	CGRAM data is sent and received after this setting
Set DDRAM address	L	L	H	AC6	AC5	AC4	AC3	AC2	AC1	AC0	39us	DDRAM data is sent and received after this setting
Read busy flag& address	L	H	BF	AC6	AC5	AC4	AC3	AC2	AC1	AC0	0us	BF — H: Busy / L: Ready -Reads BF indication internal operating is being performed -Reads address counter contents
Write data to RAM	H	L	D7	D6	D5	D4	D3	D2	D1	D0	43us	Write data into DDRAM or CGRAM
Read data from RAM	H	H	D7	D6	D5	D4	D3	D2	D1	D0	43us	Read data from DDRAM or CGRAM

*X: Don't care

10.STANDARD CHARACTER PATTERN

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

11. LCM INITIALIZING BY INSTRUCTION

11-1 8-bit interface mode

Power on

↓

Wait for more than 30ms
after V_{DD} rises to 4.5v
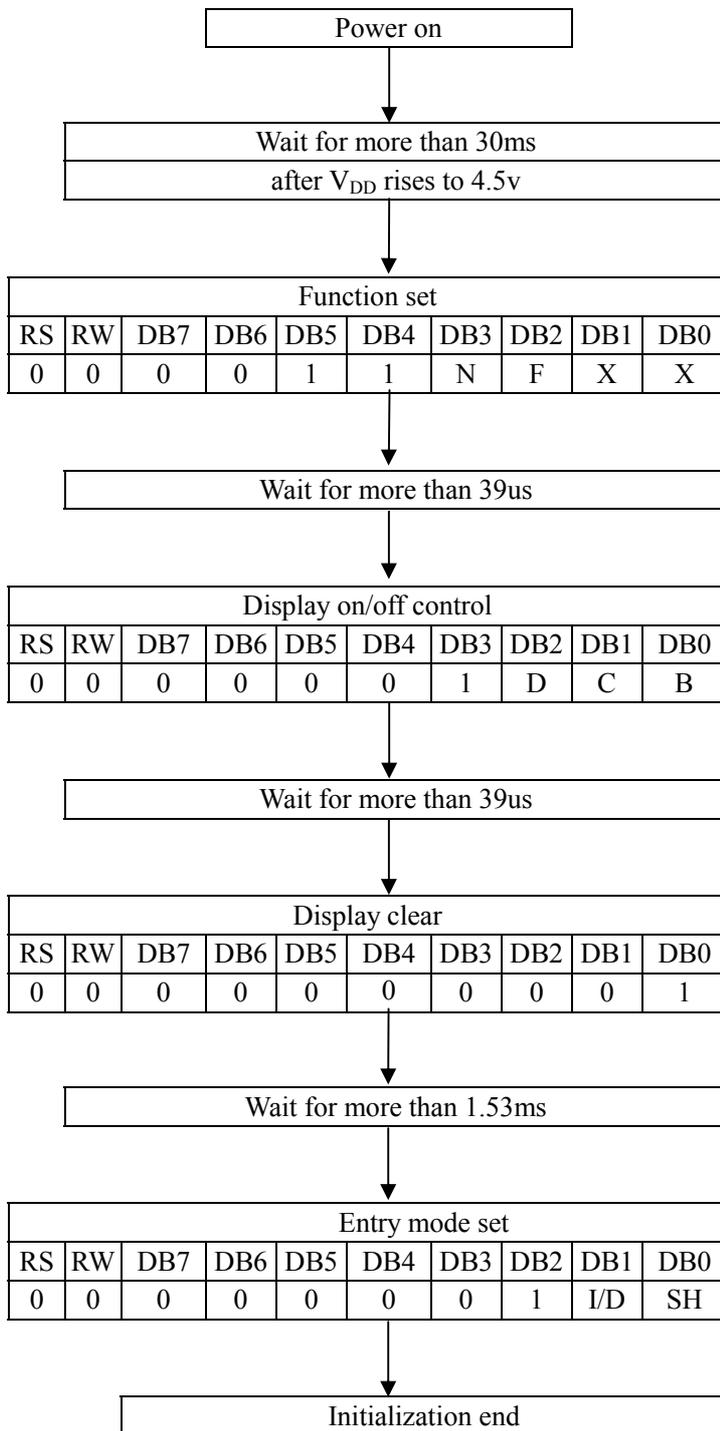
Condition: fosc=270khz

N	0	1-line mode
	1	2-line mode

↓

Function set

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

F	0	5 x 8 font
	1	5 x 11 font

↓

Wait for more than 39us

↓

Display on/off control

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

D	0	display off
	1	display on

C	0	cursor off
	1	cursor on

↓

Wait for more than 39us

B	0	blink off
	1	blink on

↓

Display clear

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

↓

Wait for more than 1.53ms

I/D	0	decrement mode
	1	increment mode

↓

Entry mode set

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

SH	0	entire shift off
	1	entire shift on

↓

Initialization end

11-2 4-bit interface mode

Power on

↓

Wait for more than 30ms
after V_{DD} rises to 4.5v

Condition: fosc=270khz

↓

Function set

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

N	0	1-line mode
	1	2-line mode
F	0	5 x 8 font
	1	5 x 11 font

↓

Wait for more than 39us

↓

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

D	0	display off
	1	Display on
C	0	cursor off
	1	cursor on
B	0	blink off
	1	blink on

↓

Wait for more than 39us

↓

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 for more than 1.53ms

↓

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	SH	X	X	X	X

I/D	0	decrement mode
	1	increment mode
SH	0	entire shift off
	1	entire shift on

↓

Initialization end

12. OPTICAL CHARACTERISTICS

12.1 FSTN Response times at different temperatures

Response times t_{on} and t_{off} are measured using simulated MUX at $f=f_{FRAME}$. Vop (+25°C) will be identical to Vop (+25°C) as specified for the viewing angles.

Item	Symbol	Conditions	Typ.	Max.	Unit	Remarks
Response Times	t_{on}	T_{amb}= +25°C	150	200	ms	α =10°, $\Phi = \Phi_{opt}$
		0°C	800	1300	ms	
		-10°C	2000	3000	ms	
		-20°C	4000	5000	ms	
	t_{off}	T_{amb}=+25°C	280	350	ms	
		0°C	1500	2000	ms	
		-10°C	3000	5000	ms	
		-20°C	4500	6000	ms	

Definition of response times
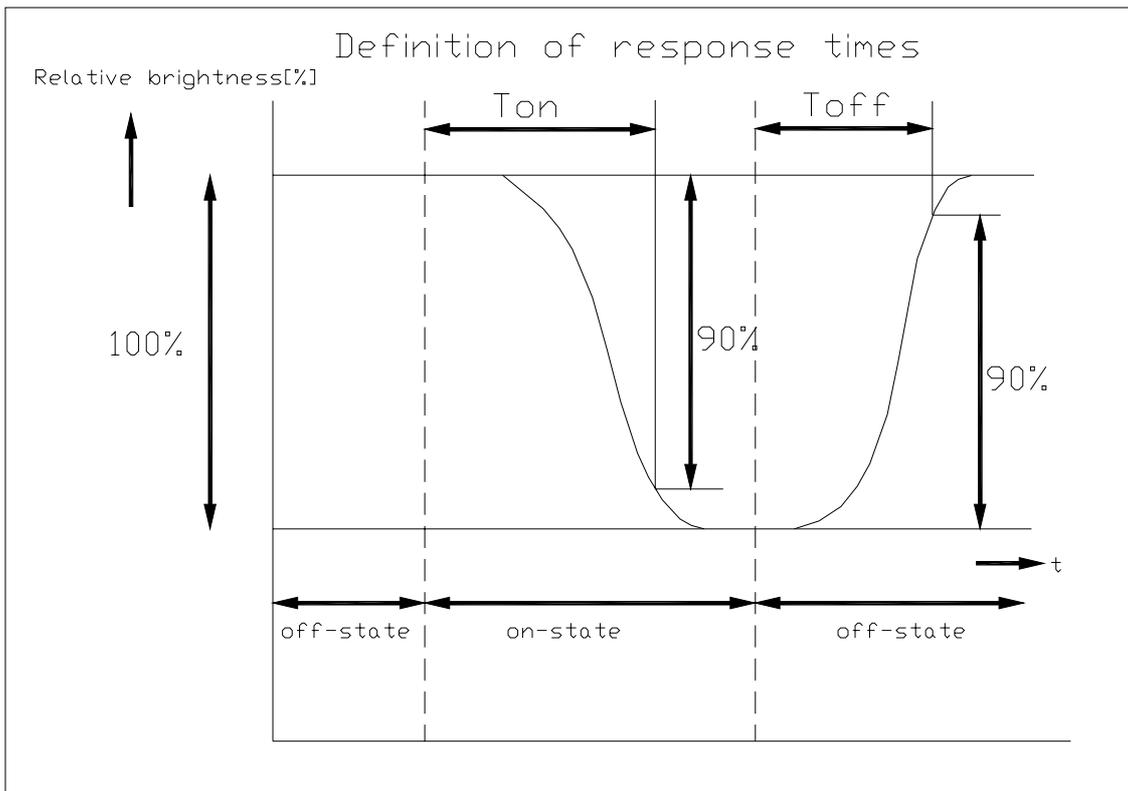
12.2 FSTN Overall optical performance

Positive display

ITEM	SYMBOL	CONDITIONS	TYP.	UNIT	REMARKS
Viewing angles for Contrast Ratio CR > 3	α	Φ = 0° Φ = 90° Φ = 180° Φ = 270°	40 35 40 15	°	Transflective operation

Definition of viewing angles , and contrast ratio ☐R
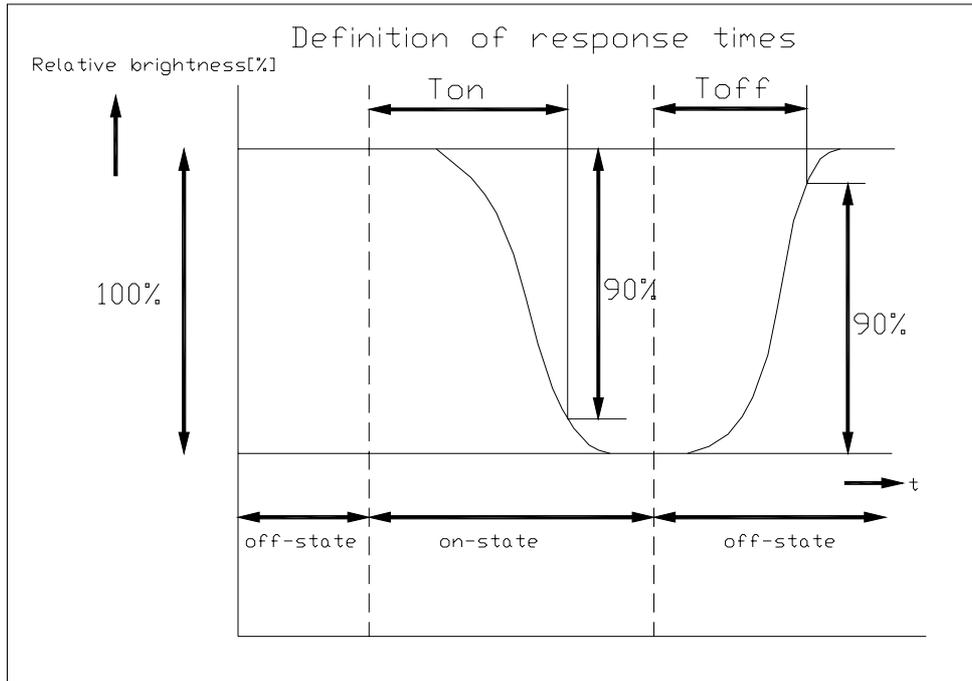

$$\text{Contrast ratio } \square R = \frac{\text{Brightness of } \square FF-\text{segmebts}}{\text{Brightness of } \square N-\text{segmebts}}$$

12.3 TN Response times at different temperatures

Response times t_{on} and t_{off} are measured using simulated MUX at f=f$_{FRAME}$. Vop (+25°C) will be identical to Vop (+25°C) as specified for the viewing angles.

Item	Symbol	Conditions	Typ.	Max.	Unit	Remarks
Response Times	t_{on}	T_{amb}= +25°C	120	180	ms	α =10°, $\Phi = \Phi_{opt}$
		0°C	900	1500	ms	
		-10°C	2500	3000	ms	
		-20°C	5000	6000	ms	
	t_{off}	T_{amb}=+25°C	80	150	ms	
		0°C	500	1000	ms	
		-10°C	2000	3000	ms	
		-20°C	3000	4000	ms	

Definition of response times

Relative brightness[%]

Ton   Toff

100%   90%   90%

t

off-state   on-state   off-state

12.4 TN Overall optical performance

Positive display

ITEM	SYMBOL	CONDITIONS	TYP.	UNIT	REMARKS
Viewing angles for Contrast Ratio CR > 3	α	$\Phi = 0°$ $\Phi = 90°$ $\Phi = 180°$ $\Phi = 270°$	40 20 40 0	°	Transflective operation

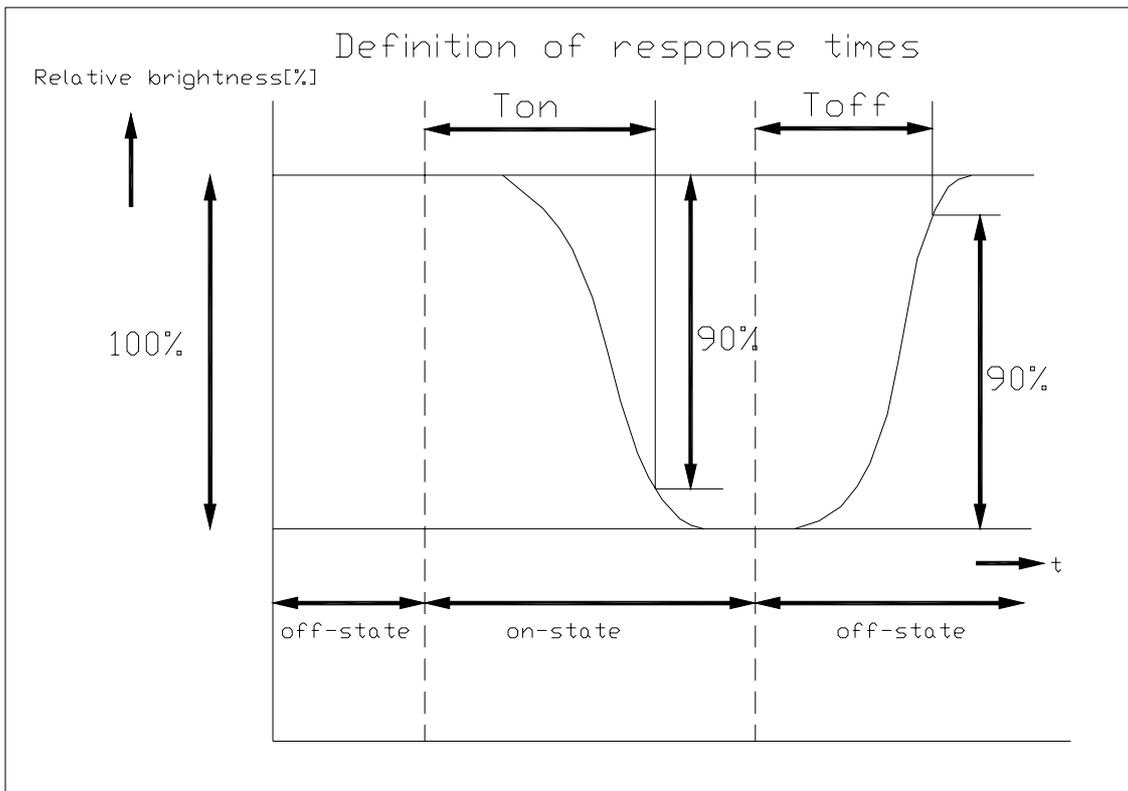Definition of viewing angles , and contrast ratio ⊡R

=90°

=180°

=0°

=270°

Contrast ratio ⊡R = $\dfrac{\text{Brightness of ⊡FF-segmebts}}{\text{Brightness of ⊡N-segmebts}}$

12.5 STN Response times at different temperatures

Response times t_{on} and t_{off} are measured using simulated MUX at f=f$_{FRAME}$. Vop (+25°C) will be identical to Vop (+25°C) as specified for the viewing angles.

Item	Symbol	Conditions	Typ.	Max.	Unit	Remarks
Response Times	t_{on}	T$_{amb}$= +25°C	100	150	ms	α =10°, $\Phi = \Phi_{opt}$
		0°C	300	400	ms	
		-10°C	700	800	ms	
		-20°C	2000	2200	ms	
	t_{off}	T$_{amb}$=+25°C	200	250	ms	
		0°C	900	1000	ms	
		-10°C	2000	2200	ms	
		-20°C	5000	6000	ms	

Definition of response times

12.6 STN Overall optical performance

Positive display

ITEM	SYMBOL	CONDITIONS	TYP.	UNIT	REMARKS
Viewing angles for Contrast Ratio CR > 3	α	Φ = 0° Φ = 90° Φ = 180° Φ = 270°	20 40 20 30	°	Transflective operation

Definition of viewing angles , and contrast ratio CR
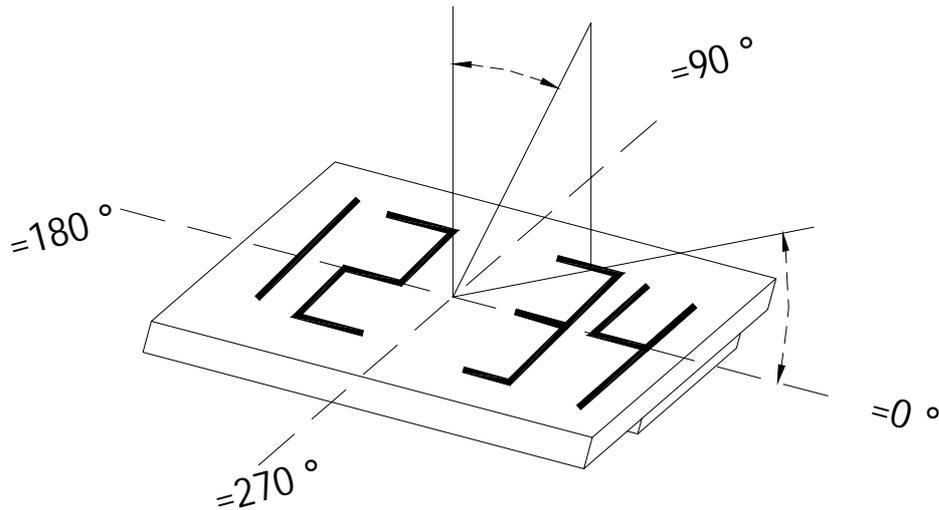
$$\text{Contrast ratio } CR = \frac{\text{Brightness of OFF-segmebts}}{\text{Brightness of ON-segmebts}}$$

13. RELIABILITY TEST

Operating life time: Longer than 50000 hours

(at room temperature without direct irradiation of sunlight)

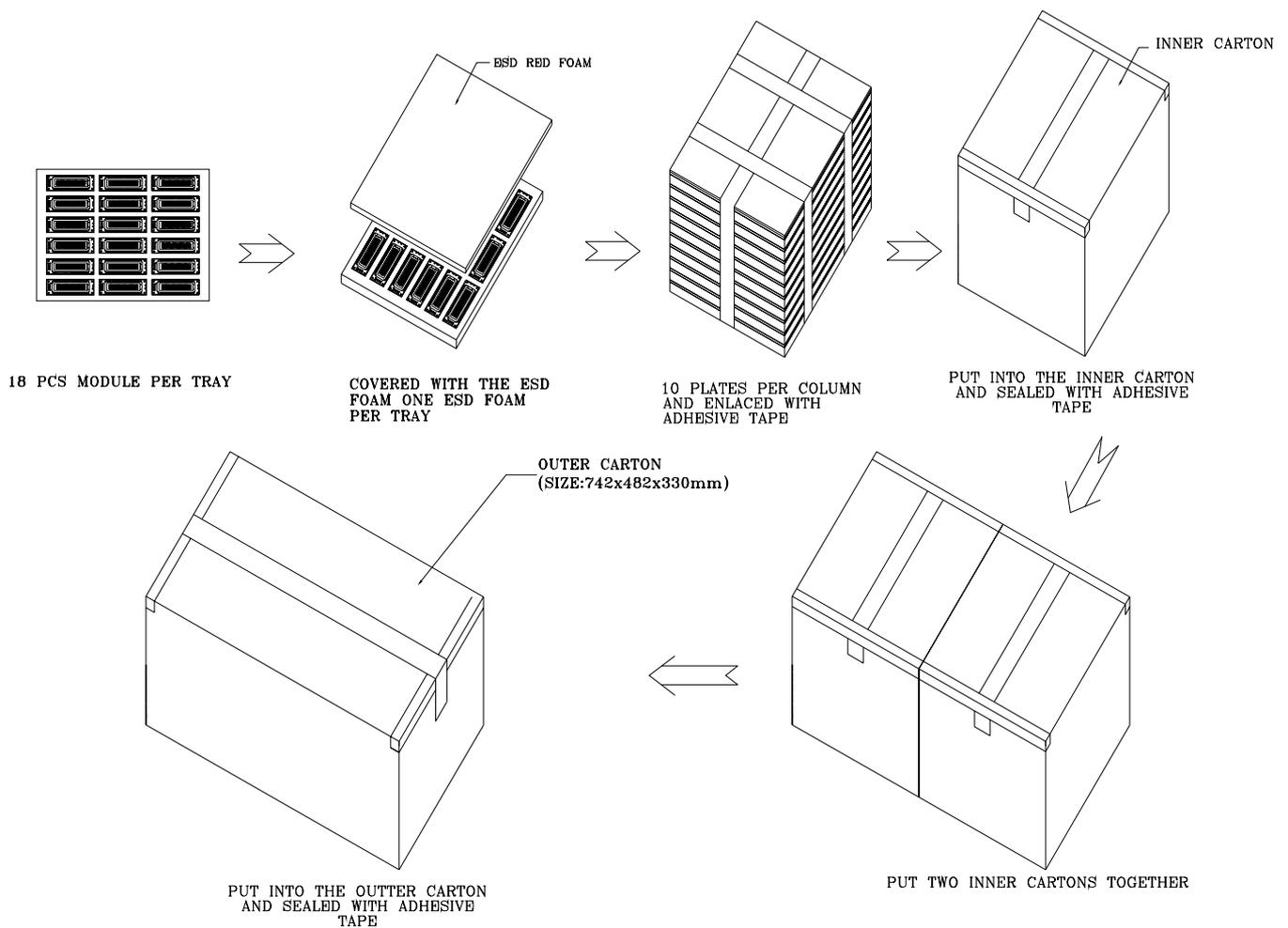Reliability characteristics shall meet following requirements.

TEMPERATURE TESTS	NORMAL GRADE
High temperature storage	+60 *96hrs (Without Polarizer)
Low temperature storage	-10 * 4hrs
High temperature operation	+50 *96hrs
Low temperature operation	0 *4hrs
High temperature, High humidity	+50 * 95%RH *96hrs (Without Polarizer)
Thermal shock	0 *30min. 10s ↓ 5Cycles +50 *30min.
Vibration test	Frequency *Swing * Time 40Hz * 4mm * 4hrs
Drop test	Drop height*Times 1.0m * 6times

For MBC20201B00~B03and MBCF20201B05~B07 Module

TEMPERATURE TESTS	NORMAL GRADE
High temperature storage	+70 *96hrs (Without Polarizer)
Low temperature storage	-30 * 4hrs
High temperature operation	+60 *96hrs
Low temperature operation	-20 *4hrs
High temperature, High humidity	+60 * 95%RH *96hrs (Without Polarizer)
Thermal shock	-20 *30min. 10s ↓ 5Cycles +60 *30min.
Vibration test	Frequency *Swing * Time 40Hz * 4mm * 4hrs
Drop test	Drop height*Times 1.0m * 6times

For MBC20201B04 Module

14. PACKING METHOD

ESD RED FOAM

INNER CARTON

18 PCS MODULE PER TRAY

COVERED WITH THE ESD FOAM ONE ESD FOAM PER TRAY

10 PLATES PER COLUMN AND ENLACED WITH ADHESIVE TAPE

PUT INTO THE INNER CARTON AND SEALED WITH ADHESIVE TAPE

OUTER CARTON (SIZE:742x482x330mm)

PUT INTO THE OUTTER CARTON AND SEALED WITH ADHESIVE TAPE

PUT TWO INNER CARTONS TOGETHER

15. THE 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
	200 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. 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　).Whenever possible, the LCD modules should be stored in the same conditions in which they were shipped from our company.

17. 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