APEX

APEX SCIENCE ＆ ENGINEERING CORP.

（OPTOELECTRONIC DIV.）

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HG322481BNHDWB-V2
ROHS
DATA SHEET

Acceptance	

ISSUE	VERSION	APPROVER	CHECKER	ENGINEER
夆典 02/25 Jy-Hao	A	夆典 02/25 Edward		夆典 02/25 Alan

Records of Revision

Revision	Revision Date	Contents	Approved
A	2013/02/25	Initial Release and Issue Full Specification	Alan

CONTENTS

1. SCOPE

This specification covers the engineering requirements for the HG322481BNHDWB-V2 liquid crystal module.

2. PRODUCT SPECIFICATIONS

2.1   General

- 320×240 dot matrix LCD
- STN, blue mode transmissive type
- Negative , Wide temperature type
- Back-light: LED edge light , White ,High brightness
- Multiplexing driving : 1/240 duty, 1/14 bias
- Drive IC: Neotec (NT7086PQ)
- R23 : 0 ohm

. ROHS

2.2   Mechanical Characteristics

Item	Characteristic
Dot configuration	320×240
Dot dimensions(mm)	0.34×0.34
Dot spacing (mm)	0.02
Module dimensions (Horizontal $\times$ Vertical $\times$ Thickness, mm)	$167.0 \times 109.0 \times 11.0$ max.
Viewing area (Horizontal $\times$ Vertical, mm)	120.0×90.0
Active area (Horizontal $\times$ Vertical, mm)	115.17×86.37

2.3 Absolute Maximum Ratings (Without LED back-light)

Characteristic	Symbol	Unit	Value
Power Supply Voltage (logic)	V_{DD}	V	-0.3 to +0.7
Power Supply Voltage (LCD)	V_{DD}-V_{EE}	V	0 to 35
Input Voltage	V_I	V	-0.3 to V_{DD}+0.3

Note 1: $V_{DD} \geq V_1 > V_3 > V_4 > V_{EE}$

2.4 Electrical Characteristics (Without LED back-light)

Characteristic	Symbol	Condition	Min.	Typ.	Max.	Unit
Operating Voltage(logic)	V_{DD}	--	2.7	--	5.5	V
Supply Voltage(LCD)	V_{DD}-V_{EE}	Note 2,3	12	--	32	V
Input Voltage	V_{IH}	--	0.8 V_{DD}	--	V_{DD}	V
	V_{IL}	--	0	--	0.2 V_{DD}	
Output Voltage	V_{OH}	--	V_{DD} -0.4	--	VDD	V
	V_{HL}	--	0	--	0.4	
CP (shift clock)	f_{CP}	CP	--	--	6.0	MHz
CP pulse width	t_{WC}	CP	50	--	--	ns
Load pulse width	t_{WL}	LOAD	50	--	--	ns
Setup time	t_{SETUP}	D11 to D14→CP	30	--	--	ns
Hold time	t_{HOLD}	D11 to D14→CP	30	--	--	ns
CP→LOAD	t_{CL}	CP→LOAD	80	--	--	ns
LOAD→CP	t_{LC}	LOAD→CP	110	--	--	ns
CP and LOAD rise time	t_R	CP,LOAD			Note 4	ns
CP and LOAD fall time	t_F	CP,LOAD			Note 4	ns

Note 2: $V_{DD} \geq V_1 > V_3 > V_4 > V_{EE}$

Note 3: When the power is turned on ,either the logic system power must e turned on before the LCD drive system power or else they must both be turned on at the same time. When the power is turned off, either the LCD drive system power must be turned off before the logic system power, or else both must be turned off at the same time.

Note 4: The CP and LOAD rise time (t_R) and the CP and LOAD fall time (t_F) must satisfy equations ① and ②　below at the same time.

$$① \ t_R, t_F < \frac{1}{2t_{CP}} - t_{WC}$$

$$② \ t_R, t_F < 50ns$$

2.5   Optical Characteristics Absolute maximum ratings

Item	Symbol	Rating	Unit
Operating temperature range	Top	-20~70	°C
Storage temperature range	Tst	-30~80	°C

2.6   Optical Characteristics

1/240 duty, 1/14 bias, Vop=23.5V

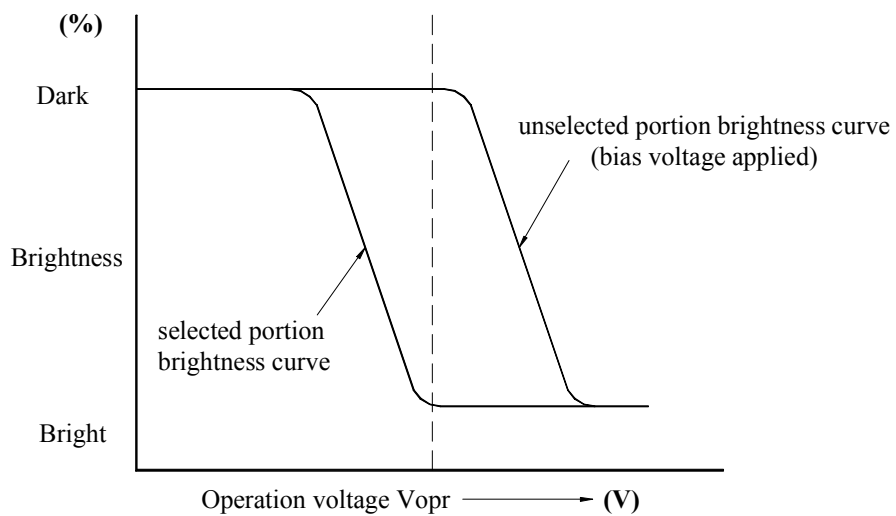| Item	Symbol	Temp.	Min.	Typ.	Max.	Unit
Driving voltage	Vop	-20 °C	22.8	23.5	24.2	V
		25 °C	23.0	23.5	24.0	
		70 °C	20.8	21.5	22.1	
Contrast ratio	CR	$\theta=0°$ $\phi=0°$	4.5	6.0	8.0	--
Frame freq.	fF	--	--	70	--	Hz
Viewing angle*	θ_1	25 °C	--	43	--	deg.
	θ_2		--	23	--	
Response time	t_{on}	25 °C	--	157	--	ms
	t_{off}		--	255	--	

2.6.1 Definition of optical characteristics

*Definition of angles ϕ and θ
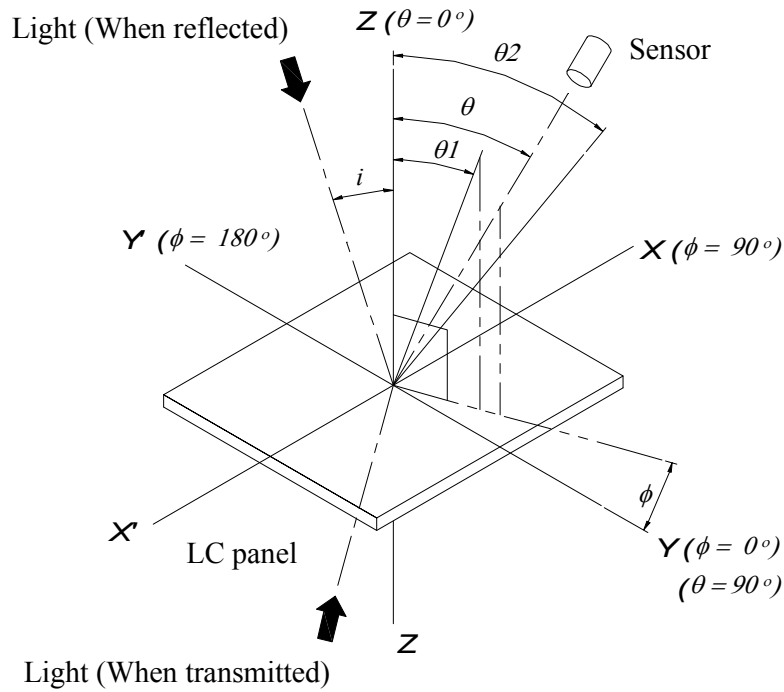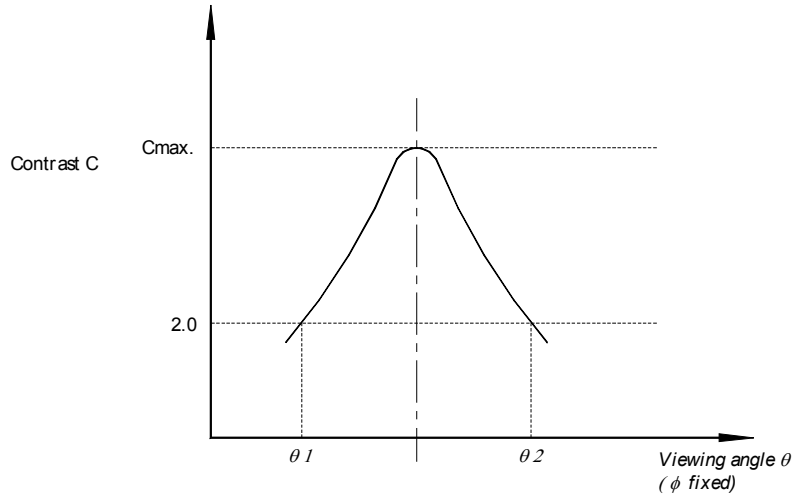

*Definition of contrast C

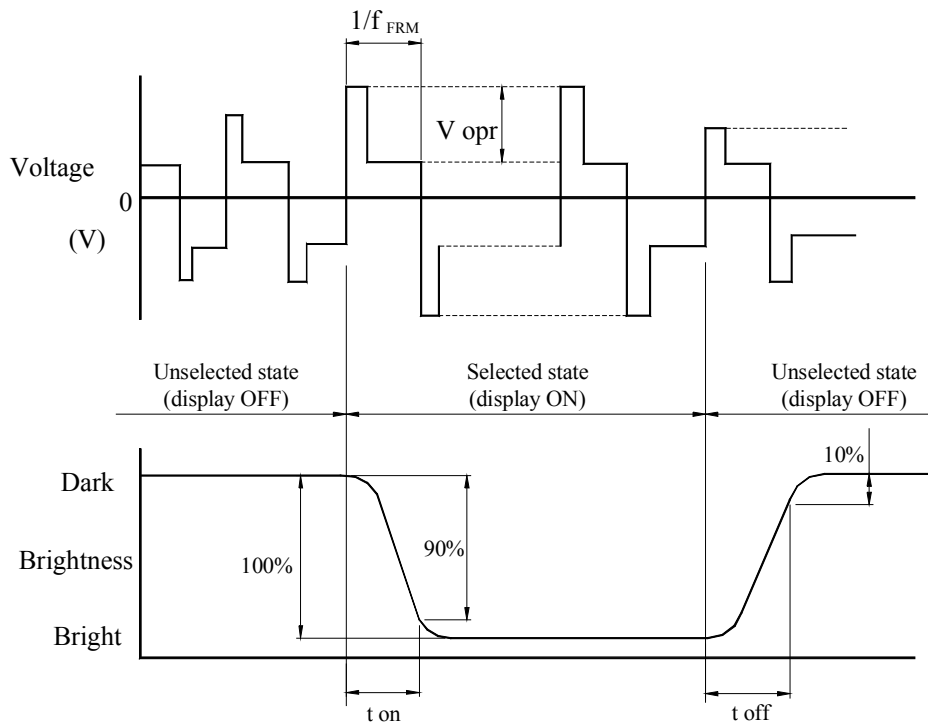$$C = \frac{B1}{B2} = \frac{\text{Brightness of selected portion}}{\text{Brightness of unselected portion}}$$

*Definition of viewing angles θ1 and θ2

Note : Optimum vision with the naked eye and viewing angle θ at Cmax above are not always the same.

*Definition of response time

Vop   : Operating voltage (V)   ton : Response time (rise) (ms)

fFRM : Frame frequency (Hz)   toff : Response time (fall) (ms)

2.7 LED Back-light Characteristics

2.7.1 Absolute maximum ratings

Ta = 25°C

Item	Symbol	Condition	Min.	Typ.	Max.	Unit
Forward voltage	V_f	If=200mA, White	--	3.3	4.0	V
*Luminous Intensity	I_V	If=200mA, White	--	600	--	cd/m*2
Reverse Current	I_R	VR=5V, White	--	--	0.5	mA
*Chromaticity coordinate	X	If=200mA, White	0.26	0.31	0.36	
	Y		0.26	0.32	0.36	
Luminous Tolerance	IV-m	If=200mA White	70	--	%	(Min/Max) *100%

Note: * Measured at the bare LED back-light unit.

2.7.2 LED Maximum Operating Range

Item	Symbol	White	Unit
Power Dissipation	P_{AD}	800	mW
Forward Current	I_F	200	mA
Reverse Voltage	V_R	5	V

3. OPERATING INSTRUCTIONS

3.1 Input signal Function

CN2

NO.	Symbol	Function
1-4	D0-D3	Display Data
5	/DISPOFF	H: on L: off
6	FLM/NC	First line market signal / not connecting
7	M	Frame reverse signal
8	LP	Data latch frequency
9	CP	Data shift frequency
10	VDD	Power supply for Logic circuit (+)
11	VSS	Ground (0V)
12	VEE	Power supply for LCD
13	VO	Contrast adjust for LCD
14	FGND	Front panel ground(Bezel ground)

CN3

NO.	Symbol	Function
1	FG	Front panel ground(Bezel ground)
2	/DISPOFF	H: on L: off
3	FLM/NC	First line market signal / not connecting
4	CL1	Data latch frequency
5	CL2	Data shift frequency
6	VSS	Ground (0V)
7-10	D0-D3	Display Data
11	VSS	Ground (0V)
12	VDD	Power supply for Logic circuit (+)
13	VO	Contrast adjust for LCD
14	VEE	Power supply for LCD
15	VSS	Ground (0V)
16	VSS	Ground (0V)

3.2 Voltage Generator Circuit
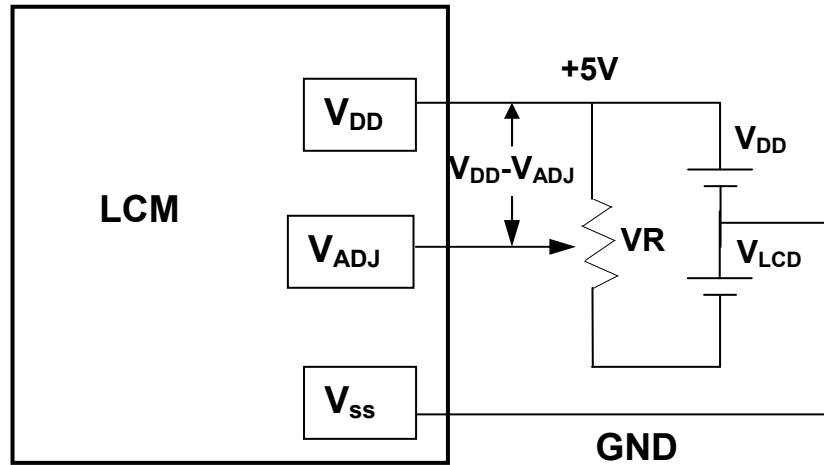
V$_{DD}$ – V$_{ADJ}$: LCD Operating Voltage
VR   : 10K~20K
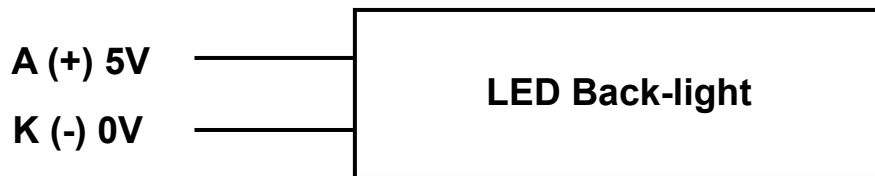
3.3 Circuit Block Diagram

3.4 Timing Characteristics

4. Unit driving method

4.1 Ration Circuit configuration

Fig. 8-1 shows the block diagram of the unit circuitry.

4.2 Input data and control signal

The LCD driver is 48 bits LSI, consisting of shift registers, latch circuits and LCD driver circuits.

Display data which are externally divided into data for each row (48 dots) will be sequentially transferred in the from of serial data .

5. Quality level

5.1 Inspection conditions

5.1.1 The environmental conditions for inspection shall be as follows.

Room temperature : 20 ±3 °C

Humidity : 65 ±20%RH

5.1.2 The external visual inspection

The inspection shall be performed by suing a single 20W fluorescent lamp for illumination and the distance from LCD to eyes of the inspector should be 30cmj or more.
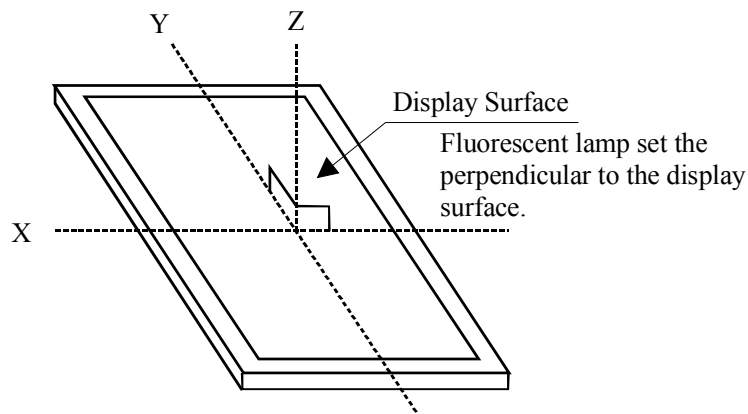
5.1.3 (1) Light method

(2) Inspection distance and angle
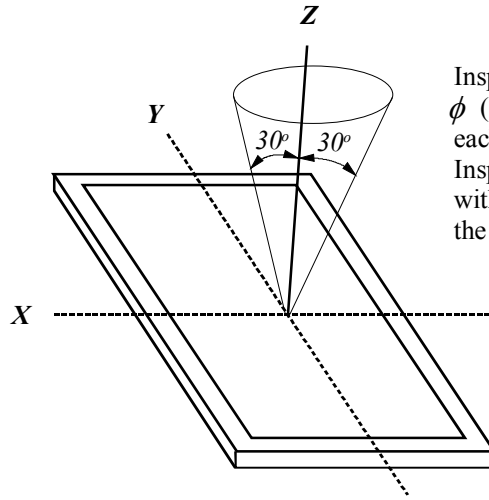
Inspection should be performed with ϕ (ϕ is usually 30º) from Z axis to each X and Y axis.
Inspection distance of any direction within ϕ must be kept 30+-5cm to the display surface.

5.2 Sampling procedures for each item's acceptance level table.

Defect type	Sampling procedures	AQL
Major defect	MIL-STD-105D Inspection level I Normal inspection Single sample inspection	1.0
Minor defect	MIL-STD-105D Inspection level I Normal inspection Single sample inspection	2.5

5.3 Classification of defects

  5.3.1 Major defect

    A major defect refers to a defect which is not considered to substantially degrade usability for project applications.

  5.3.2 Minor defect

    A minor defect refers to a defect which is not considered to substantially degrade usability applications, or a defect which deviates from existing standards almost unrelated to the effective use of the product or it's operations.

5.4 Incoming Inspection standards

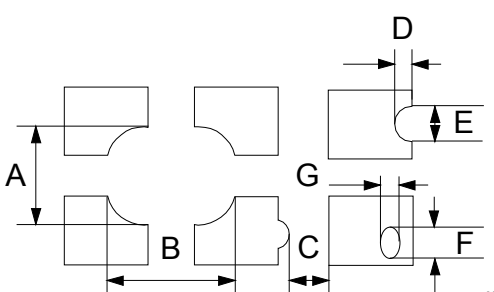| Item		Criterion for defects			Defect type
(1)	Display on inspection	(1) Non display (2) Vertical line is deficient (3) Horizontal line is deficient (4) Cross line is deficient			Major

Item		Criterion for defects		Defect type
(2)	Black/ White spot	Size (mm)	Acceptable number	Minor
		≤ 0.15	Ignore (note)	
		0.15 < ≤ 0.20	3	
		0.20 < ≤ 0.30	1	
		0.30 <	0	
		(Note) If more than 4 spot all together : NG		

Item		Criterion for defects			Defect type
(3)	Black/ White line	Length (mm)	Width (mm)	Acceptable number	
		L ≤ 10	W ≤ 0.03	Ignore (note)	
		10 < L ≤ 5.0	0.03 < W ≤ 0.06	3	
		5.0 < L ≤ 3.0	0.06 < W ≤ 0.08	2	
		Defects separate at interval if 30mm each other			Minor

Item		Criterion for defects	Defect type

Item		Criterion for defects	Defect type
(4)	Display pattern	 (Unit: mm)	Minor

$$\frac{A+B}{2} \le 0.3 \qquad 0 < C \qquad \frac{D+E}{2} \le 0.2 \qquad \frac{F+G}{2} \le 0.2$$

Note: 1) Up to 3 damages acceptable

2) NG if there are two or more pin holes per one digit

Item		Size (mm)	Acceptable number	Defect type
(5)	Spot-like contrast irregularity	0.5 < ≤ 0.5		Minor
		0.5 < ≤ 0.8		
		0.8 < 1.2		
		1.2		

Note: 1) Conformed to limit samples.

2) Defects separate at intervals of 50mm each other

Item		Size (mm)	Acceptable number	Defect type
(6)	Bubble in polarizer	< ≤ 0.20	Ignore	Minor
		0.20 < ≤ 0.50	3	
		0.50 < 0.80	2	
			0	

		Note: 1) Conformed to limit samples. 2) Defects separate at intervals of 50mm each other	
(7)	Scratches and dent on the polarizer	Scratches and dent on the polarizer shall be in the accordance with "2) Black/White spot, 3) Black/White line".	Minor
(8)	Stains on LCD panel surface	Stains which cannot be removed even when wiped lightly with a soft cloth or similar cleaning too.	Minor
(9)	Rainbow color	No rainbow color is allowed in the optimum contrast on state within the active area.	Minor
(10)	Viewing area encroachment	Polarizer edge or line is visible in the opening viewing area due to polarizer shortness or sealing line.	Minor
(11)	Bezel appearance	Rust and deep damage which are visible in the bezel is rejectable.	Minor
(12)	Defect of land surface contact (Poor soldering)	Evident crevices which is visible are rejectable	Minor
(13)	Part mounting	1. Failure to mount parts 2. Parts not in the specifications are mounted 3. Polarity, for example, is reversed	Major
(14)	Parts alignment	1. LSI, IC lead width is more then 50% beyond pad outline. 2. Chip component is off center and more then 50% of the leads is off the pad outline.	Minor
(15)	Conductive foreign matter (Solder ball, Solder chips)	1. $0.45 <$, $N \geq 1$ 2. $0.30 < $ ≤ 0.45, $N \geq 1$, : Average diameter of solder ball (Unit: mm) 3. $0.50 < L$, $N \geq 1$, L: Average length of solder chip (Unit: mm)	Major Minor Minor
(16)	PWB pattern correction	1. Deep damage is found on copper foil and the pattern is nearly broken. 2. Damage on copper foil other than 1. above	Major Minor
(17)	Faulty PWB correction	1. Due to PWB copper foil pattern burnout, the pattern is connected, using a jumper wire for repair; 2 or more places are corrected per PWB. 2. Short circuited part is cut, and no resist coating has been performed.	Minor
(18)	Bezel Claw	Bezel claw missing or not bent	Minor

(19) Indication of name plate (sampling indication label)	Rust and deep damage which are visible in the bezel is reflect able.	Minor

6. Reliability

6.1 Life time

10,000 Hrs (The definition of half-brightness life is either average brightness reach to 50% of initial average brightness or lamp stopping light emission.)

6.2 Items of reliability

Item	Condition	Criterion
1. High temperature operating	50 ^{o}C, 96 hrs	No cosmetic failure are allowable. Contrast ratio should be between initial value ± 10% Total current consumption should be below double of initial value.
2. Low temperature operating	0 ^{o}C, 96 hrs	
3. Humidity	40 ^{o}C, 90%RH, 96 hrs	No cosmetic failure are allowable. Contrast ratio should be between initial value ± 20% Total current consumption should be below double of initial value.
4. High temperature storage	70 ^{o}C, 96 hrs	
5. Low temperature storage	-20 ^{o}C, 96 hrs	
6. Thermal shock storage	25 ^{o}C → 20 ^{o}C → 25 ^{o}C → 70 ^{o}C 5(min)　30(min)　5(min) 30(min) 5 cycle, 55 ~ 60%RH	
7. Vibration	10 ~ 55 ~ 10hz amplitude ; 1.5mm 2hrs for each direction (X, Y, Z)	No cosmetic failure are allowable. Total current consumption should be below double of initial value.

7. Handling Precautions

7.1 Mounting Method

The LCD panel of APEX SCIENCE & ENGINEERING CORP. LCD module consists of two thin glass plates with polarizers which easily get damaged and the module is so constructed as to be fixed by utilizing fitting holes in the plastic cases. Extreme care should be used when handling the LCD modules.

7.2 Caution of LCD handling are cleaning

When cleaning the display surface, use soft cloth with solvent (recommended below) and wipe lightly.
- ◆ Isopropyl alcohol
- ◆ Ethyl alcohol
- ◆ Trichlorotriflorothane

Do not wipe the display surface with dry or hard materials that will damage the polarizer surface.

Do not use the following solvent:
- ◆ Water
- ◆ Ketone
- ◆ Aromatic

7.3 Caution against static charge

The LCD module use C-MOS LSI drivers, so we recommended that you; Connect any unused input terminal to V_{DD} or V_{SS}, do not input any signals before power is turned on, and ground your body, work/assembly areas, assembly equipment to protect against static electricity.

7.4 Packing

Module employ LCD elements, and must be treated as such. Avoid intense shock and falls from a height.

To prevent modules from degradation, Do not operate or store them exposed direct to sunshine or high temperature/ humidity.

7.5 Caution for operation

It is an indispensable condition to drive LCD's within the specified voltage limit since the higher voltage then the limit cause the shorter LCD life. Response time will be extremely delayed at lower temperature then the operating temperature range and on the other hand at higher temperature LCD's show dark color in them.

However those phenomena do not mean malfunction or out of order with LCD's, which will come back in the specified operating temperature.

If the display area is pushed hard during operation, Some font will be abnormally displayed but it resumes normal condition after turning off once. A slight dew depositing on terminals is a cause for electro-chemical reaction resulting in terminal open circuit.

7.6 Storage

In the case of storing for a long period of time (for instance, for years) for the purpose or replacement use, the following ways are recommended.

◆ Storage in a polyethylene bag with the opening sealed so as not to enter fresh air outside in it. And with no desiccant.

◆ Placing in a dark place where neither exposure to direct sunlight nor light is, keeping the storage temperature.

◆ Storing with no touch on polarizer surface by the anything else. (It's recommended to store them as they have been contained in the inner container at the time of delivery from use.)

7.7 Safety

◆ It is recommendable to crash damaged or unnecessary LCD's into pieces and wash off liquid crystal by either of solvents such as acetone and ethanol, which should be burned up later.

◆ When any liquid leaked out of a damaged glass cell comes in contact with your hands, please wash it off well with soap and water.
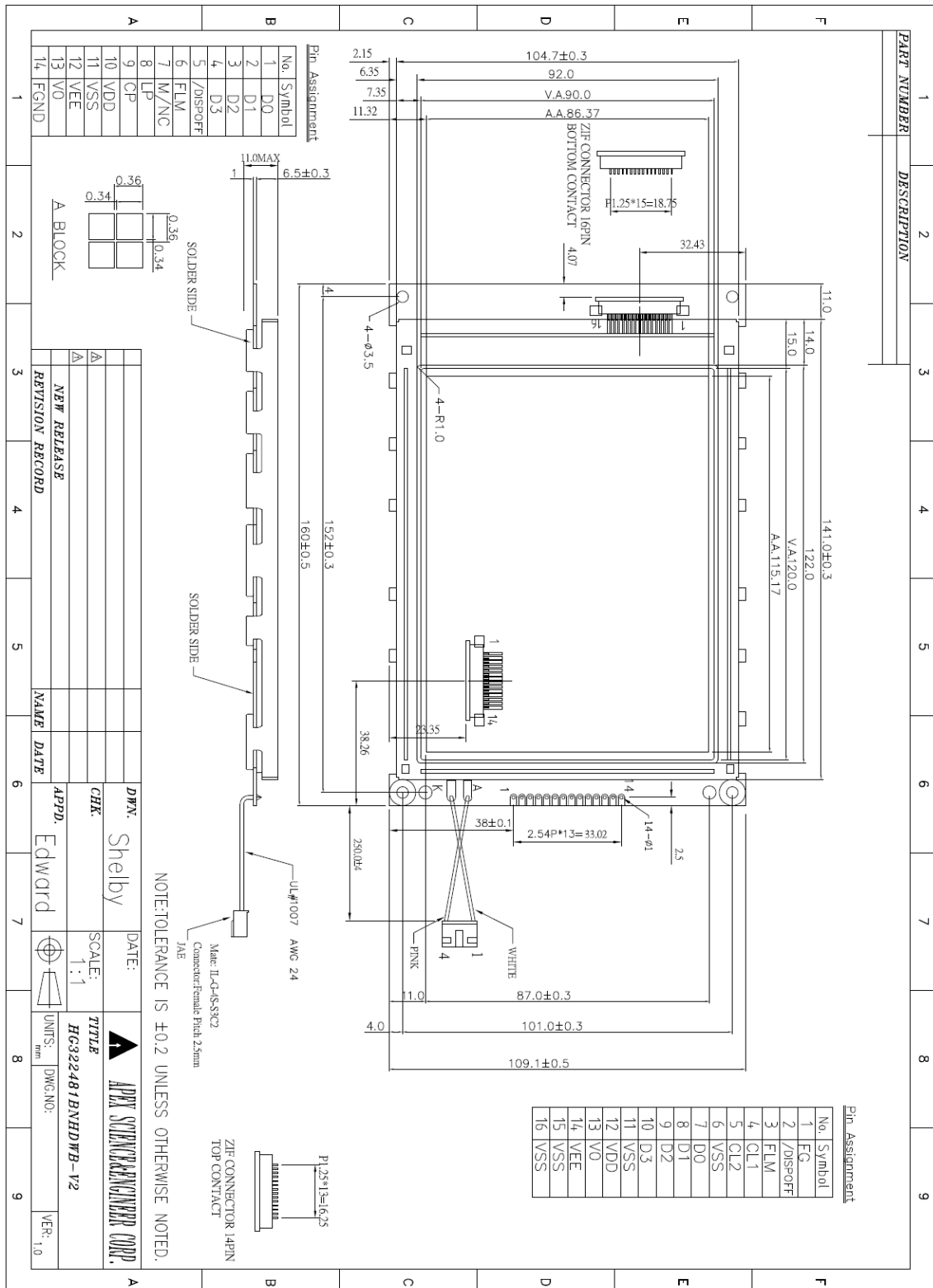
8. Precautions for use

8.1 A limit sample should be provided by the both parties on an occasion when the both parties agreed its necessity.

Judgement by a limit sample shall take effect after the limit sample has been established and confirmed by the both parties.

8.2 On the following occasions, the handling of problem should be decided through discussion and agreement between responsible of the both parties.

◆ When a question is arisen in this specifications.

◆ When a new problem is arisen which is not specified in this specifications.

◆ When an inspection specification change or operating condition change in customer is reported to APEX, and some problem is arisen in this specification due to the change.

◆ When a new problem is arisen at the customer's operating set for sample evaluation in the customer site.

9. LCM Dimension

NOTE:TOLERANCE IS ±0.2 UNLESS OTHERWISE NOTED.

APEX SCIENCE&ENGINEER CORP.

TITLE: HG322481 FFC

DWG.NO: FFC-16pin 14PIN   VER: 1.0

UNITS: mm

DWN. Nobi   DATE: 7/07/11'   SCALE: 1:1   PAGE: 1/1

CHK.

APPD. Edward

		NAME	DATE
	NEW RELEASE		
	REVISION RECORD		

PART NUMBER	DESCRIPTION
123332240115R	14PX225
123332240116R	16PX255

P1.25*15=18.75
1.0
3.0±0.5
4.8±0.8
255±5
5
10
1.25*15=18.75
1.0
20.75

P1.25*13=16.25
1.0
5
10
225±5
10
1.0
P1.25*13=16.25
18.25±0.2

0.3±0.05

CONDUCTOR SIDE
STRENGTHEN SIDE
CONDUCTOR SIDE
STRENGTHEN SIDE