SPECIFICATIONS

CUSTOMER : _____

MODEL NO. : GFC2002P-BNFEJSB04

VERSION : E

DATE : 2022.11.15

CERTIFICATION : ROHS

Quality warranty period:

Customer Sign	Approved By	Prepared By	Prepared By
	GIFAR 2022.11.15 Sidney	GIFAR 2022.11.15 Roger	GIFAR 2022.11.15 Hazel

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Revision Record

Data(y/m/d)	Ver.	Description	Note	page
2014.09.22	A	Specification released		
2015.01.12	B	拿掉 D1 LED		21
2015.11.17	C	增加包裝資料		20
2016.12.29	D	修改公司抬頭、格式統一		
2022.11.15	E	更新公司抬頭認證圖示		

CONTENTS

1. SCOPE

This specification covers the engineering requirements for the GFC2002P-BNFEJSB04 liquid crystal module.

2. PRODUCT SPECIFICATIONS

2.1 General

- 20 × 2 dot matrix LCD
- STN(Blue), Negative mode LCD panel
- Transmissive , Wide temperature type
- 6 o'clock
- Multiplexing driving : 1/16duty, 1/5bias
- Controller IC : ST7066U-0A or Compatible
- Backlight: White

2.2 Mechanical Characteristics

Item	Characteristic
Dot configuration	20 × 2
Character Format	5X8 Dots
Character Pitch	2.5(W)X5.34(H)
Character Size	1.95(W) X4.51(H)
Dot size	0.35(W)X0.52(H)
Dot pitch	0.4(W)X0.57(H)
Module dimensions (Horizontal × Vertical × Thickness, mm)	72 (W)X32(H)X11.5 MAX(T)
Viewing area (Horizontal × Vertical, mm)	54(W) X 15(H)
Active area (Horizontal × Vertical, mm)	49.45(W)X9.85(H)
Remark	LED(藍 D3， 藍+紅 D2)加熱縮套管

2.3 Absolute Maximum Ratings (Without LED back-light)

Characteristic	Symbol	Unit	Value
Operating Voltage (logic)	V_{DD}	V	-0.3 to +5.0
Input Voltage	V_{IN}	V	-0.3 to V_{DD}+0.3

Note 1: Referenced to V_{SS}=0V

2.4 Electrical Characteristics (Without LED back-light)

Characteristic	Symbol	Condition	Min.	Typ.	Max.	Unit
Operating Voltage(logic)	V_{DD}-V_{SS}	--	4.5	5.0	5.5	V
Input Voltage	V_{IH}	--	0.8V_{DD}	--	V_{DD}	V
	V_{IL}	--	V_{SS}	--	0.2V_{DD}	
Output Voltage	V_{OH}	I_{OH}=-0.1mA	0.8V_{DD}	--	V_{DD}	V
	V_{HL}	I_{OL}=0.1mA	V_{SS}	--	0.2V_{DD}	
Current Consumption	I_{DD}	V_{IN}=V_{DD}	--	0.05	1	mA

2.5 Optical Characteristics Absolute maximum ratings

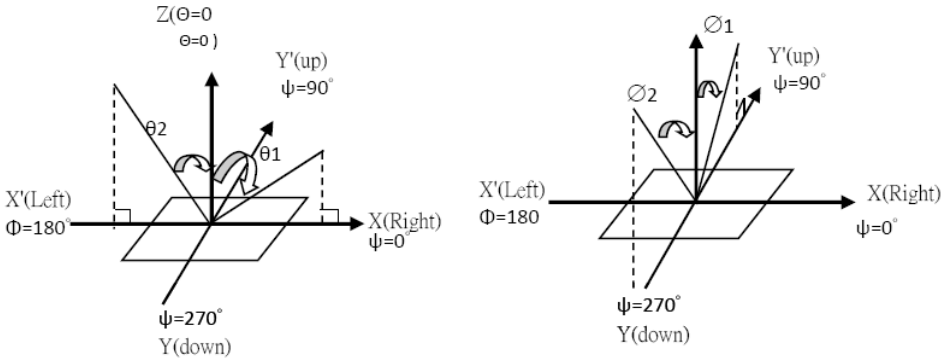
Item	Symbol	Rating	Unit
Operating temperature range	Top	-20~70	°C
Storage temperature range	Tst	-30~80	°C

2.6. Optical Characteristics

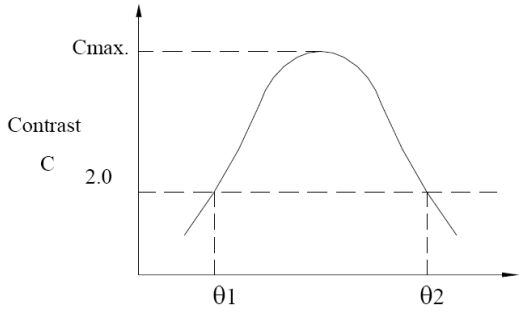
1/16 duty, 1/5 bias, Vop=4.4V, Ta=25℃

Item	Symbol	Conditions	Min.	Typ.	Max	Reference
Driving voltage	Vop		4.1	4.4	4.7	
Viewing angle	θ1、θ2	C≥2.0,∅=0° C	30°	-		Notes 1 & 2
Contrast	C	θ=5°, ∅=0°	3.0	-	-	Note 3
Response time(rise)	ton	θ=5°, ∅=0°	-	80	160ms	Note 4
Response time(fall)	toff	θ=5°, ∅=0°	-	100	200ms	Note 4

Note 1: Definition of angles θ and ∅

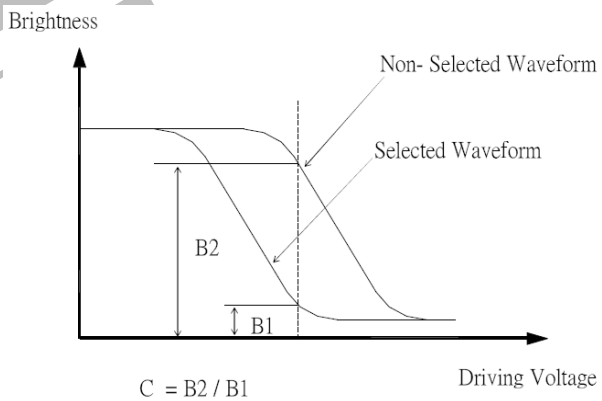


Note 2: Definition of viewing angles θ1 and θ2



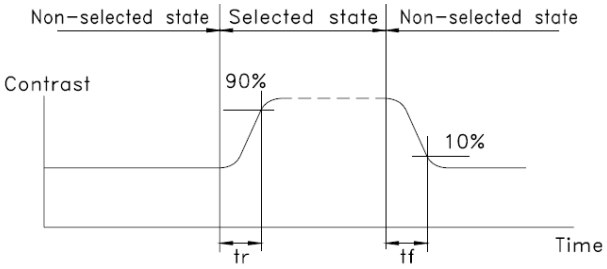
Note : Optimum viewing angle with the naked eye and viewing angle θ at Cmax. Above are not always the same

Note 3: Definition of contrast C



C = B2 / B1

Note 4: Definition of response time



Note: Measured with a transmissive LCD panel which is displayed 1 cm^2

V_{OPR} : Operating voltage f_{FRM} : Frame frequency
t_{ON} : Response time (rise) t_{OFF} : Response time (fall)

2.7 LED Back-light Characteristics

2.7.1 Electrical / optical specifications

Ta = 25°C

Item	Symbol	Condition	Min.	Typ.	Max.	Unit
Forward voltage	V_f	If=60mA, White	2.8	3.1	3.4	V
LED *Luminous Intensity	I_V	If=60mA, White	1100	1600		cd/m^2
Chromaticity Coordinate	x	If=60mA, White	0.26	-	0.32	
	y		0.26	-	0.32	
Uniformity	Avg	If=60mA, White	70			%
Reverse Current	I_R	VR=5V, White	--	10	--	uA

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

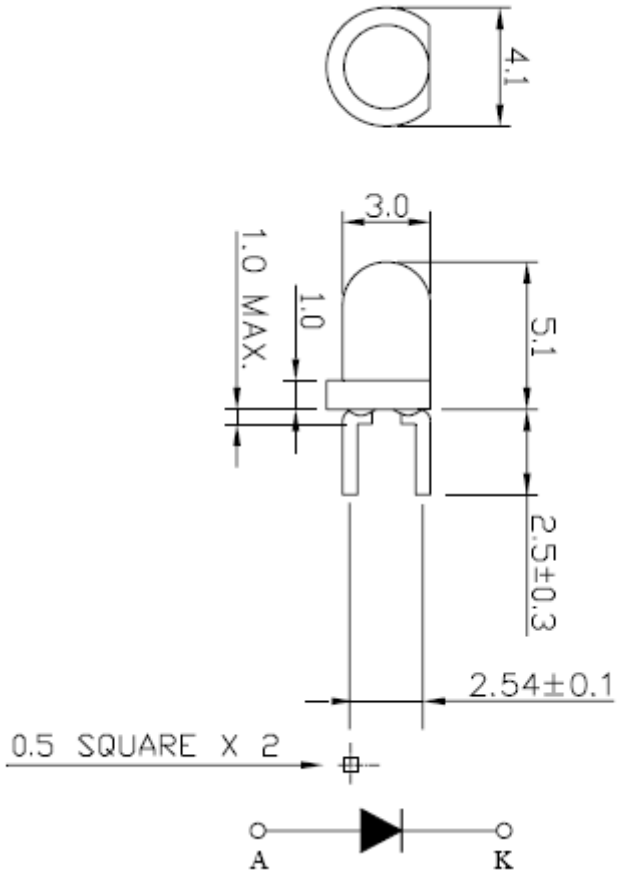
2.7.2 LED Maximum Operating Range

Item	Symbol	WHITE	Unit
Power Dissipation	P_{AD}	198	mW
Forward Current	I_F	60	mA
Reverse Voltage	V_R	5	V

3. LED Description

3.1 D3 Description

This blue lamp is made with InGaN chip and water clear epoxy resin.



Notes:

1. All dimensions are in mm.
2. The specifications, characteristics and technical data described in the datasheet are subject to change without notice.
3. Tolerance is ±0.25mm unless otherwise noted.

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Description

LED Chip		Lens Color
Material	Emitting Color	
InGaN	Blue	Water clear

3.1.1Absolute Maximum Ratings at Ta=25℃

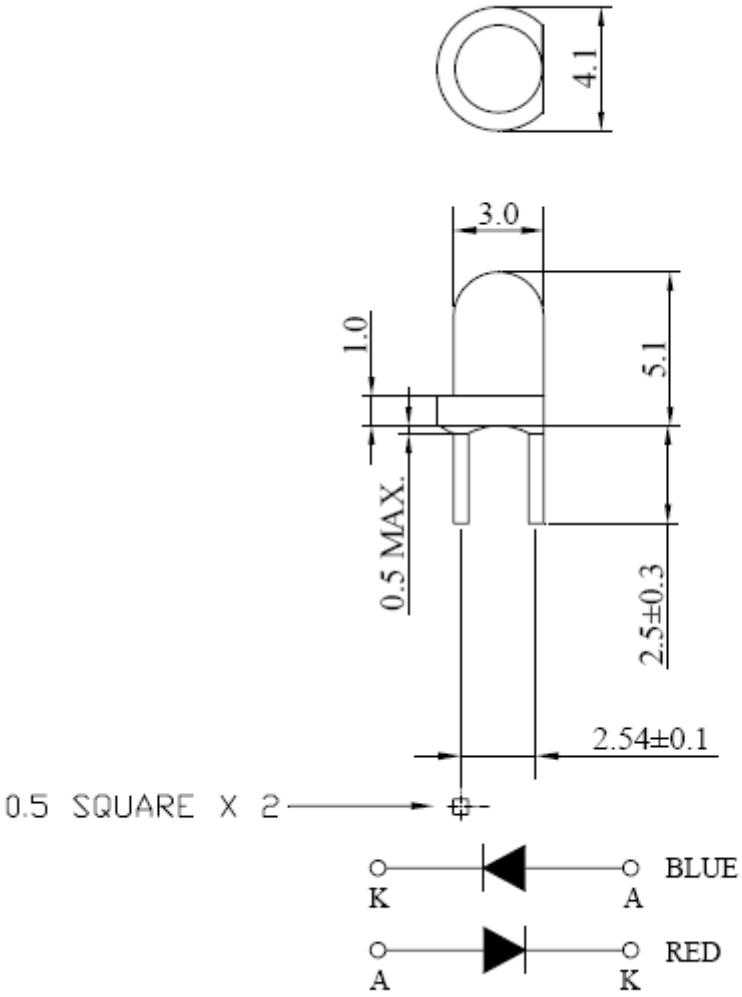
Parameter	Symbol	Rating	Unit
Power Dissipation	PD	120	mW
Reverse Voltage	VR	5	V
D.C. Forward Current	If	30	mA
Reverse (Leakage) Current	Ir	50	μA
Peak Current(1/10Duty Cycle,0.1ms Pulse Width.)	If(Peak)	100	mA
Operating Temperature Range	Topr.	-25 to +85	℃
Storage Temperature Range	Tstg.	-40 to +100	℃
Soldering Temperature(1.6mm from body)	Tsol.	Dip Soldering : 260℃ for 5 sec. Hand Soldering : 350℃ for 3 sec.	
Electrostatic discharge	ESD	6000	V

3.1.2 Electrical and Optical Characteristics:

Parameter	Symbol	Condition	Min.	Typ.	Max.	Unit
Luminous Intensity	IV	If=20mA	1000	5000		cd/m^2
Forward Voltage	Vf	If=20mA		3.2	4.0	V
Dominant Wavelength	λd	If=20mA		465		nm
Reverse (Leakage) Current	Ir	Vr=5V			50	*μA*
Viewing Angle	2θ1/2	If=20mA		30		deg
Spectrum Line Halfwidth	Δλ	If=20mA		26		nm

3.2 D2 Description

This blue and red bi-color lamp is made with InGaN blue chip, AlGaInP hyper red chip and water clear epoxy resin.



Notes:

1. All dimensions are in mm.
2. Tolerance is±0.25mm unless otherwise noted.

Description

LED Chip		Lens Color
Material	Emitting Color	
InGaN	Blue	Water clear
AlGaInP/GaAs	Hyper red	

3.2.1 Absolute Maximum Ratings at Ta=25℃

Parameter	Symbol	Rating	Unit
Power Dissipation	PD	120	mW
Reverse Voltage	VR	5	V
D.C. Forward Current	If	30	mA
Reverse (Leakage) Current	Ir	50	μA
Peak Current(1/10Duty Cycle,0.1ms Pulse Width.)	If(Peak)	100	mA
Operating Temperature Range	Topr.	-25 to +85	℃
Storage Temperature Range	Tstg.	-40 to +100	℃
Soldering Temperature(1.6mm from body)	Tsol.	Dip Soldering : 260℃ for 5 sec. Hand Soldering : 350℃ for 3 sec.	
Electrostatic discharge	ESD.	1000	V

3.2.2 Electrical and Optical Characteristics: **Blue**

Parameter	Symbol	Condition	Min.	Typ.	Max.	Unit
Luminous Intensity	IV	If=20mA	35.0	60.0		mcd
Forward Voltage	Vf	If=20mA		3.2	4.0	V
Dominant Wavelength	λd	If=20mA		465		nm
Reverse (Leakage) Current	Ir	Vr=5V			50	*μA*
Viewing Angle	2θ1/2	If=20mA		50		deg
Spectrum Line Halfwidth	Δλ	If=20mA		26		nm

Notes:1. Tolerance of Luminous Intensity is ±15%
2. Tolerance of Forward Voltage is ±0.1V
3. Tolerance of Dominant Wavelength is ±1nm
4. Customer's special requirements are also welcome.

3.2.3 Absolute Maximum Ratings at Ta=25℃

Parameter	Symbol	Rating	Unit
Power Dissipation	PD	72	mW
Reverse Voltage	VR	5	V
D.C. Forward Current	If	30	mA
Reverse (Leakage) Current	Ir	100	μA
Peak Current(1/10Duty Cycle,0.1ms Pulse Width.)	If(Peak)	100	mA
Operating Temperature Range	Topr.	-25 to +85	℃
Storage Temperature Range	Tstg.	-40 to +100	℃
Soldering Temperature(1.6mm from body)	Tsol.	Dip Soldering : 260℃ for 5 sec. Hand Soldering : 350℃ for 3 sec.	

3.2.4 Electrical and Optical Characteristics:

Hyper red

Parameter	Symbol	Condition	Min.	Typ.	Max.	Unit
Luminous Intensity	IV	If=20mA	30.0	70.0		mcd
Forward Voltage	Vf	If=20mA		1.9	2.4	V
Peak Wavelength	λp	If=20mA		632		
Dominant Wavelength	λd	If=20mA		625		nm
Reverse (Leakage) Current	Ir	Vr=5V			100	*μA*
Viewing Angle	2θ1/2	If=20mA		50		deg
Spectrum Line Halfwidth	Δλ	If=20mA		20		nm

Notes:1. Tolerance of Luminous Intensity is ±15%

2. Tolerance of Forward Voltage is ±0.1V

3. Tolerance of Dominant Wavelength is ±1nm

4. Customer's special requirements are also welcome.

4. RELIABILITY

NO.	ITEM	CONDITION		STANDARD	NOTE
1	High Temp. Storage	80℃	120 hrs	Appearance Without defect	
2	Low Temp. Storage	-30℃	120 hrs	Appearance Without defect	
3	High Temp. & High Humi. Storage	40℃ 90% RH	120 hrs	Appearance Without defect	
4	High Temp. Operating Display	70℃	120 hrs	Appearance Without defect	
5	Low Temp. Operating Display	-20℃	120 hrs	Appearance Without defect	
6	Thermal Shock	-20℃, 30min. → 70℃,30min. (1cycle)		Appearance Without defect	10 cycles

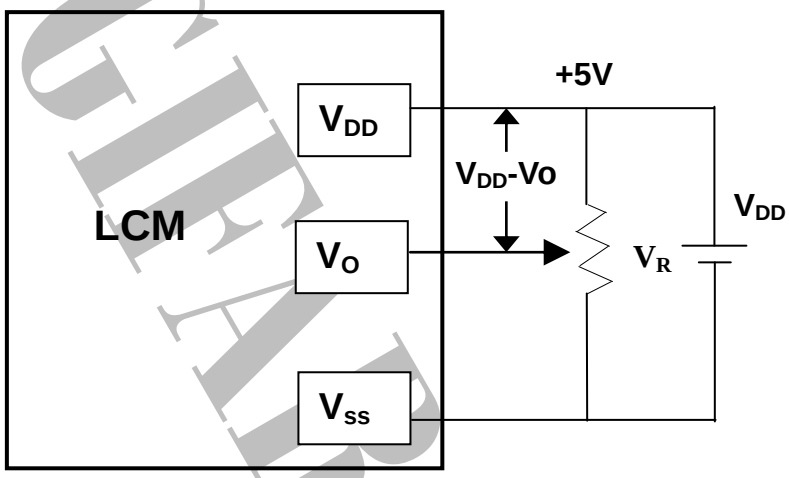
** Dissipation current, contrast and display functions
** Polarizing filter deterioration, other appearance defects
** The function test shall be conducted after 4hours storage at the normal temperature and humidity after remove from the test chamber.

5. OPERATING INSTRUCTIONS

5.1 Input signal Function

NO.	Symbol	Function
1	VSS	Ground (0V)
2	VDD	Power supply for Logic circuit
3	VO	Power Supply for Driving the LCD
4	RS	Data / Instruction select
5	R/W	Read / Write select
6	E	Enable signal
7-14	DB0-DB7	Data Bus line
15	LED+	Power supply for LED backlight (+)
16	LED-	Power supply for LED backlight (-)
17	KAP1	S1 and S2 Key Scan
18	KAP2	S2 and S3 Key Scan
19	KAP3	S3 and S4 Key Scan
20	KAP4	S1 and S4 Key Scan
21	CT_GRN	LED D2 RED (-) OR BLUE (+)
22	NC	NC
23	NC	NC
24	CTR_YELL	LED D2 RED (+) OR BLUE (-)

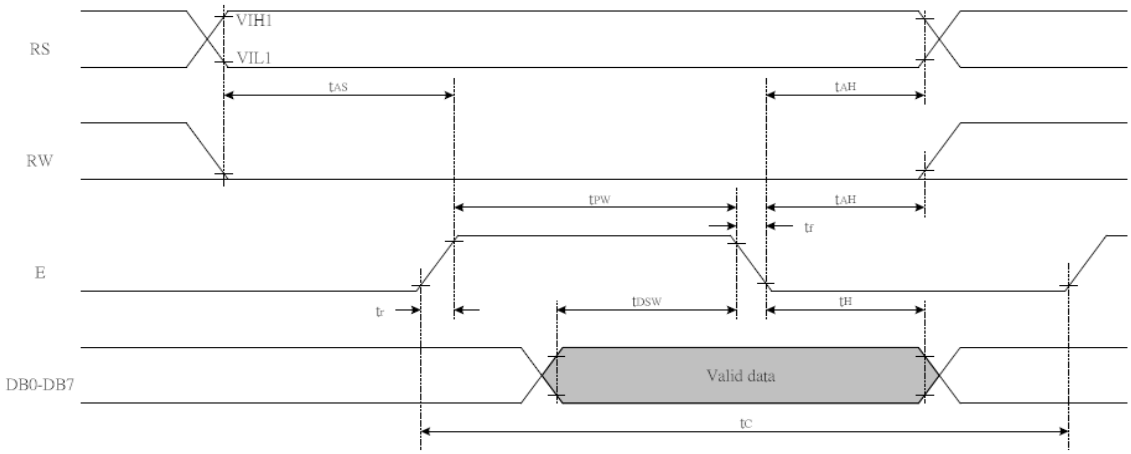
5.2 Voltage Generator Circuit



V_{DD}-Vo : LCD Driving Voltage
V_R : 10K~20K

5.3 Timing Diagram

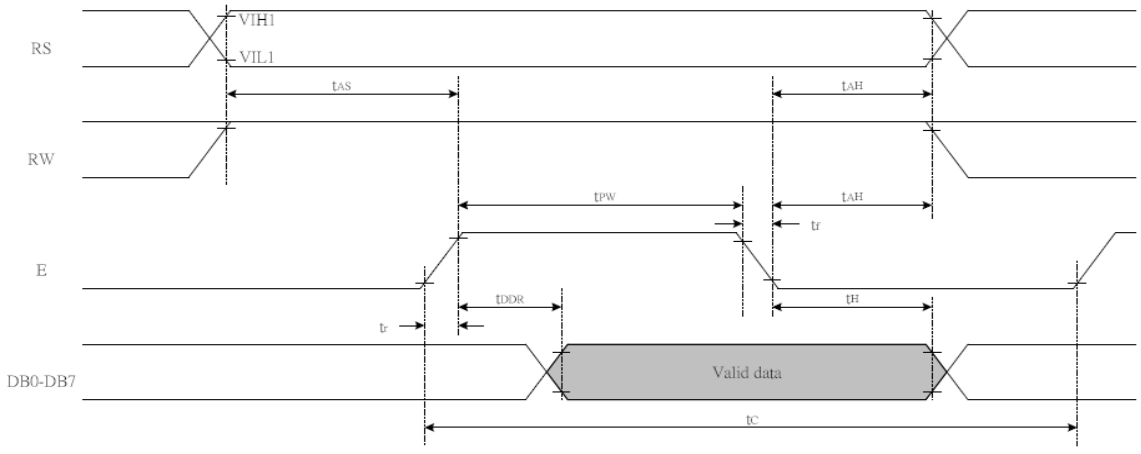
Writing data from MPU to ST7066U



Write Mode (Writing data from MPU to ST7066U)

T_C	Enable Cycle Time	Pin E	1200	-	-	ns
T_{PW}	Enable Pulse Width	Pin E	140	-	-	ns
T_R, T_F	Enable Rise/Fall Time	Pin E	-	-	25	ns
T_{AS}	Address Setup Time	Pins: RS,RW,E	0	-	-	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

Reading data from ST7066U to MPU



Read Mode (Reading Data from ST7066U to MPU)

T_C	Enable Cycle Time	Pin E	1200	-	-	ns
T_{PW}	Enable Pulse Width	Pin E	140	-	-	ns
T_R, T_F	Enable Rise/Fall Time	Pin E	-	-	25	ns
T_{AS}	Address Setup Time	Pins: RS,RW,E	0	-	-	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

5.4.Display Command

Instruction	Instruction Code										Description	Description Time (270KHz)
	RS	R/W	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0		
Clear Display	0	0	0	0	0	0	0	0	0	1	Write "20H" to DDRAM. and set DDRAM address to "00H" from AC	1.52 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.	1.52 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 N:number of line is 2/1 F:font size is 5x11/5x8	37 us
Set CGRAM address	0	0	0	1	AC5	AC4	AC3	AC2	AC1	AC0	Set CGRAM address in address counter	37 us
Set DDRAM address	0	0	1	AC6	AC5	AC4	AC3	AC2	AC1	AC0	Set DDRAM address in address counter	37 us
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 us
Write data to RAM	1	0	D7	D6	D5	D4	D3	D2	D1	D0	Write data into internal RAM (DDRAM/CGRAM)	37 us
Read data from RAM	1	1	D7	D6	D5	D4	D3	D2	D1	D0	Read data from internal RAM (DDRAM/CGRAM)	37 us

※ "×":don't care

6. Relationship between Character Code(DDRAM) and Character Pattern(CGRAM)

Figure 1

Character Code (DDRAM data)								CGRAM Address						CGRAM Data								Pattern number
D7	D6	D5	D4	D3	D2	D1	D0	A5	A4	A3	A2	A1	A0	P7	P6	P5	P4	P3	P2	P1	P0	
0	0	0	0	×	0	0	0	0	0	0	0	0	0	×	×	×	0	■	■	■	0	pattern 1
											0	0	1				■	0	0	0	■	
											0	1	0				■	0	0	0	■	
				.							.					.	■	■	■	■	■	
				.							0	1	1			.	■	■	■	■	■	
				.							1	0	0			.	■	0	0	0	■	
				.							1	0	1			.	■	0	0	0	■	
											1	1	0				■	0	0	0	■	
											1	1	1				0	0	0	0	0	
				.						.						.						
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				.						.						.						
				.						.						.						
0	0	0	0	×	1	1	1	1	1	1	0	0	0	×	×	×	■	0	0	0	■	pattern 8
											0	0	1				■	0	0	0	■	
											0	1	0				■	0	0	0	■	
				.						.						.	■	■	■	■	■	
				.						.	0	1	1			.	■	■	■	■	■	
				.						.	1	0	0			.	■	0	0	0	■	
				.						.	1	0	1			.	■	0	0	0	■	
											1	1	0				■	0	0	0	■	
											1	1	1				0	0	0	0	0	

* "×": dont care

7. Character Pattern

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)															
0001	(2)															
0010	(3)															
0011	(4)															
0100	(5)															
0101	(6)															
0110	(7)															
0111	(8)															
1000	(1)															
1001	(2)															
1010	(3)															
1011	(4)															
1100	(5)															
1101	(6)															
1110	(7)															
1111	(8)															

8. PACKAGE INFORMATION

1	1 Tray	:	24 pcs (modules)
2	1 stack	:	6 tray +1 Cover tray
3	1 Carton	:	(1 Cover tray + 6 tray)x 3 stack
4	Total pcs	:	1 Carton (24pcs*6tray * 3 stack) = 432 pcs
5	Carton size = NO. 17	:	495*315*435mm
7	Net weight	:	7.6 KG
8	Gross weight	:	11.5 KG

** llustration

- 1 Tray= 24 pcs (modules)

- 1 stack=6 tray+1 Cover tray **Each layer of tray should be staggered stacked

- 1 Carton = 3 stack, Total pcs = 432 pcs

9. NOTES

- Safety
  - If the LCD panel breaks, be careful not to get the liquid crystal in your mouth. If the liquid crystal touches your skin or clothes, wash it off immediately using soap and plenty of water.

Handling

- Avoid static electricity as this can damage the CMOS LSI.
- The LCD panel is plate glass; do not hit or crush it.
- Do not remove the panel or frame from the module.
- The polarizing plate of the display is very fragile; handle it very carefully

Mounting and Design

- Mount the module by using the specified mounting part and holes.
- To protect the module from external pressure, leave a small gap by placing transparent plates (e.g. acrylic or glass) on the display surface, frame, and polarizing plate
- Design the system so that no input signal is given unless the power-supply voltage is applied.
- Keep the module dry. Avoid condensation, otherwise the transparent electrodes may break.

Storage

- Store the module in a dark place where the temperature is 25 ^{o}C±10 ^{o}C and the humidity below 65% RH.
- Do not store the module near organic solvents or corrosive gases.
- Do not crush, shake, or jolt the module (including accessories).

Cleaning

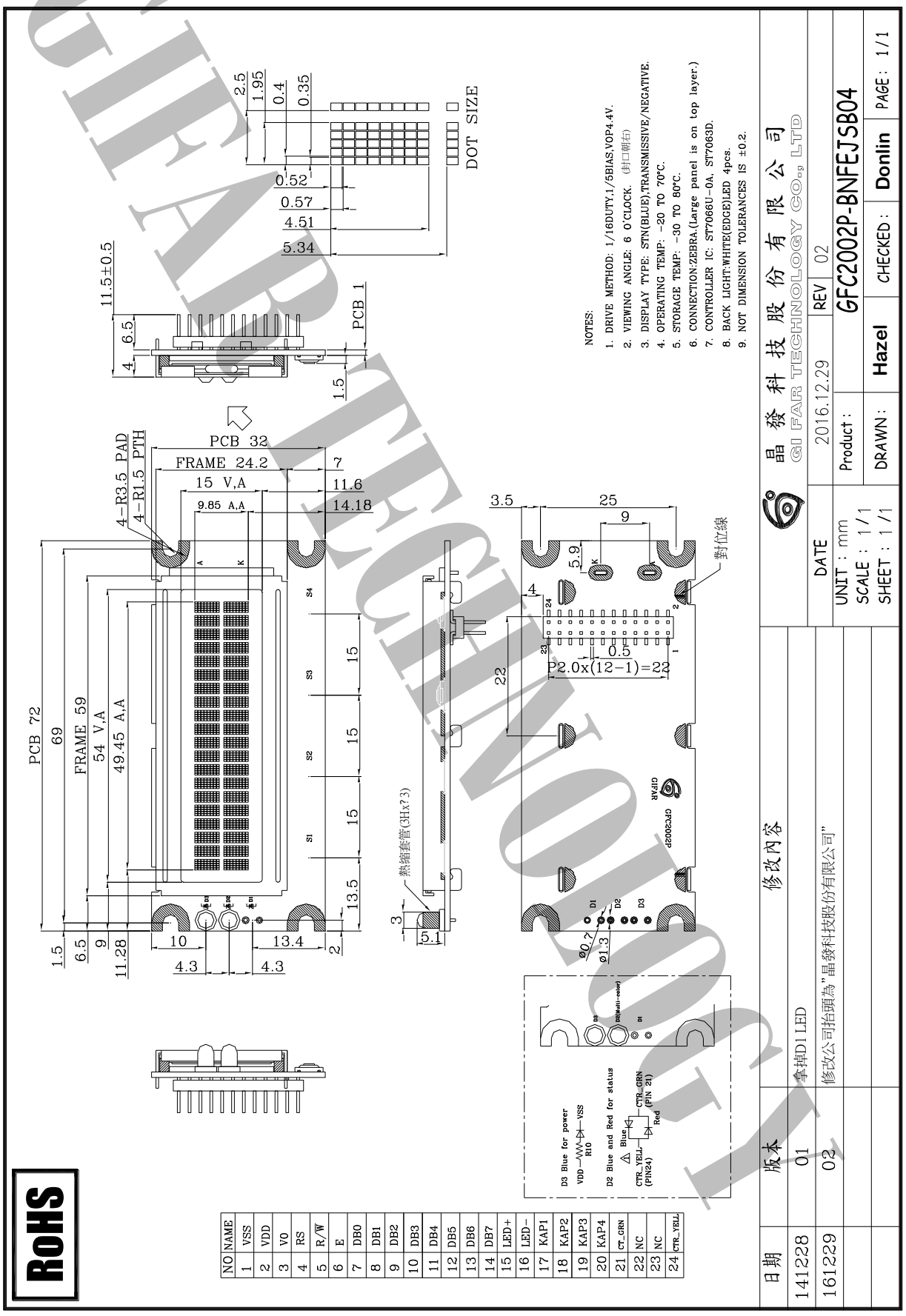
- Do not wipe the polarizing plate with a dry cloth, as it may scratch the surface.
- Wipe the module gently with soft cloth soaked with a petroleum benzine.
- Do not use ketonic solvents (ketone and acetoe) or aromatic solvents (toluene and xylene), as they may damage the polarizing plate.

10. OPERATION PRECAUTIONS

Any changes that need to be made in this specification or any problems arising from it will be dealt with quickly by discussion between both companies.

Quality warranty period: Within one year after shipment date (excluding abnormal usage way and abnormal environments.)

11. LCM Dimension



NO	NAME
1	VSS
2	VDD
3	V0
4	RS
5	R/W
6	E
7	DB0
8	DB1
9	DB2
10	DB3
11	DB4
12	DB5
13	DB6
14	DB7
15	LED+
16	LED-
17	KAP1
18	KAP2
19	KAP3
20	KAP4
21	CT_GRN
22	NC
23	NC
24	CTR_YELL

RoHS