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Display Specification

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TFT COLOR LCD MODULE

Type No. NL10276BC24-04

31cm (12.1 Type), XGA
LVDS interface

| PRELIMINARY |

This document is preliminary. All informations in this document are subject to change without prior notice.

Note: The former specifications (DOD-H-3255, issued Dec. 18, 1995) shall be abandoned.

NEC Corporation Display Device Operations Unit Color LCD Division Application Engineering Department		
Approved	*M. I.*	Mar. 27, 1996
Checked	*M. Hiroshima*	Mar. 25, 1996
Prepared	*N. Nishimura*	Mar. 22, 1996

The devices listed in this document are not suitable for use of aerospace equipment, submarine cables, nuclear reactor control systems and life support systems.

If customers intend to use NEC devices for above applications or they intend to use "Standard" quality grade NEC devices for applications not intended by NEC, please contact our sales people in advance.

Application examples recommended by NEC Corporation.

Standard: Computer, Office equipment, Communication equipment, Test and Measurement equipment, Machine tools, Industrial robots, Audio and Visual equipment, other consumer products, and etc.

Special : Automotive and Transportation equipment, Traffic control systems, Anti-disaster systems, Anti-crime systems, and etc.

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1. DESCRIPTION

NL10276BC24-04 is a TFT(thin film transistor) active matrix color liquid crystal display (LCD) comprising amorphous silicon TFT attached to each signal electrode, a driving circuit and a backlight. NL10276BC24-04 has a built-in backlight.
The 31cm diagonal display area contains 1024×768 pixels and can display 262,144 colors simultaneously.

2. FEATURES

· LVDS interface (Adapted for DS90CF561, National semiconductor CO.,LTD.)
· High contrast, Low power consumption, Low reflection
· Thin and light weight
· Incorporated edge-light type backlight (One lamp, Inverter-less)

3. APPLICATIONS

· Engineering workstation (EWS), Personal computer (PC)
· Monitor

4. OUTLINE OF CHARACTERISTICS (at room temperature)

Display area	245.76(H)×184.32(V)mm
Drive system	a-Si TFT active matrix
Display colors	262,144 colors (6 bit)
Number of pixels	1024×768
Pixel arrangement	RGB vertical stripe
Pixel pitch	0.24(H)×0.24(V)mm
Module size	277.5(H)×202.5(V)×9.0 TYP. (D)mm
Weight	500g(TYP.)
Contrast ratio	150:1(TYP.)

Viewing angle (more than the contrast ratio of 10:1)
          Horizontal: 45° (TYP. left side, right side)
          Vertical : 25° (TYP. upper side), 35(TYP. lower side)
Designed viewing direction
     ·wider viewing angle with contrast ratio   : down side (6 o'clock)
     ·wider viewing angle without image reversal : up side (12 o'clock)
     ·optimum grayscale (γ=2.2)   : perpendicular

Color gamut	35%(MIN., center to NTSC)
Response time	40ms(MAX.), "white" to "black"
Luminance	70cd/m^2(TYP.)
Signal system	6-bit digital signal RGB signals, Synchronous signals(Hsync, Vsync) Dot-clock(CLK)adapted for DS90CF561 (National semiconductor CO.,LTD.)
Supply voltage	5.0V
Backlight	Edge light type, 1 CCF lamp (inverter-less)
Power consumption	3.8*W (TYP.)

*:Target value

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5. BLOCK DIAGRAM

I/F | LCD module

DA0+/-
DA1+/-
DA2+/-

CKA+/-

DB0+/-
DB1+/-
DB2+/-

CKB+/-

VCC

VHV

GND

DS90CF562

Controller

LCD power

DC/DC conver-ter

V-driver

H-driver

312 × 10

3072lines

768lines

TFT LCD panel

H:1024×3(R,G,B)
V:768

Backlight (Edge light type)
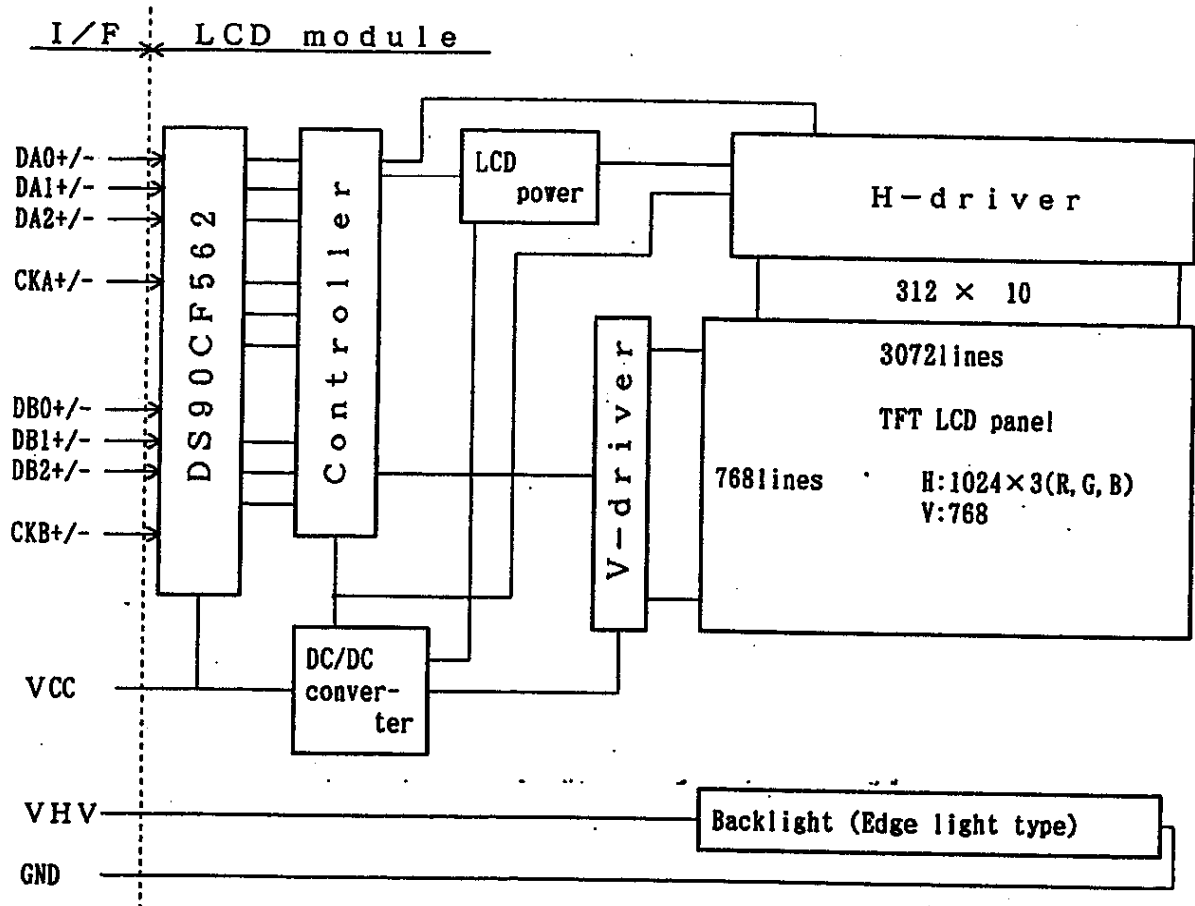
6. GENERAL SPECIFICATIONS

Item	Specifications	Unit
Module size	277.5±0.5 (H) × 205.5±0.5 (V) × 9.5 MAX.(D)	mm
Display area	245.76 (H) × 184.32 (V)	mm
Number of pixels	1024 (H) × 768 (V)	pixel
Dot pitch	0.08 (H) × 0.24 (V)	mm
Pixel pitch	0.24 (H) × 0.24 (V)	mm
Pixel arrangement	RGB (Red, Green, Blue) vertical stripe	–
Display colors	262,144	color
Weight	520 (MAX.)	g

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7. ABSOLUTE MAXIMUM RATINGS

Parameter	Symbol	Ratings	Unit	Remarks
Supply voltage	VCC	-0.3 to +6.5	V	Ta = 25℃
Logic input voltage	VI	-0.3 to VCC+0.3	V	
Storage temp.	TST	-20 to +60	℃	—
Operating temp.	TOP	0 to +50	℃	Module surface *
Humidity		≦ 95% relative humidity	Ta=40℃	no condensation
		≦ 85% relative humidity	Ta=50℃	
		Absolute humidity shall not exceed Ta=50℃, 85% relative humidity level.	Ta>50℃	

* Measured at the center of the LCD panel

8. ELECTRICAL CHARACTERISTICS
Logic/ LCD driving

Ta = 25℃

Parameter	Symbol	Min.	Typ.	Max.	Unit	Remarks
Supply voltage	VCC	4.75	5.0	5.25	V	—
LVDS signal input "L" voltage	VIL	-100	–	–	mV	VCM=1.2V
LVDS signal input "H" voltage	VIH	–	–	+100	mV	
Supply current (@ dot-checkered pattern)	ICC	–	(400)*	TBD	mA	@ VCC=5.0V

* Target value

(2) Backlight

Ta = 25℃

Parameter	Symbol	MIN.	TYP.	MAX.	Unit	Remarks
Lamp current	VL	–	3.0	5.5	mArms	–
Lamp voltage	VL	–	600	–	Vrms	IL=3mA
Lamp turn on voltage	VS	–	1500	–	Vrms	–
Oscillator frequency	Ft	–	60	–	KHz	–

note: Recommended value of "Ft"
 ·Ft is within the specification.
  and

 ·Ft = $\frac{1}{4Th}$ × (2n-1)   Th: Hsync period
                n: a natural number (1,2,3,····)

If Ft is out of the recommended value, interference between Ft frequency and Hsync frequency may cause beat on the display.

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9. SUPPLY VOLTAGE SEQUENCE
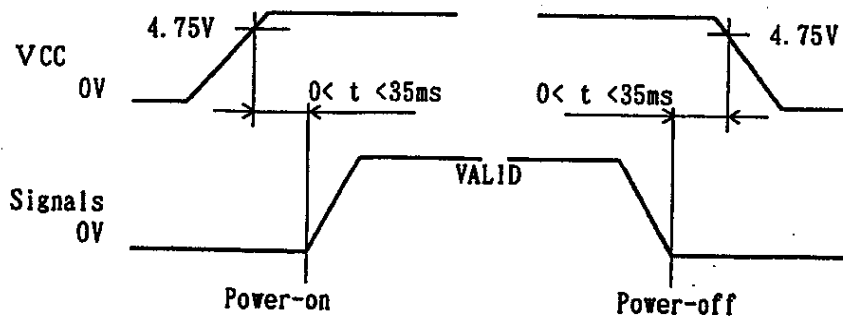
*1 The supply voltage for input signals should be the same as VCC.

*2 Apply VHV within the LCD operation period. When the backlight turns on before LCD operation or the LCD operation turns off before the backlight turns off, the display may momentarily become white.

*3 When the power is off, please keep whole signals(Hsync, Vsync, CLK, DE, MODE, DATA) low level or high impedance.

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10. INTERFACE PIN CONNECTION

(1) Interface connector for signal and power

Part No.   : LZ-20P-SL-SMT
Adaptable socket: LZ-20P-SC3
Supplier   : Japan Aviation Electronics Industry Limited (JAE)

Pin No.	Symbol	Signal type	Function
1	CKB+	An odd number pixel clock	CLK for an odd number pixel f=32.5MHz (TYP.) (LVDS level)
2	CKB-		
3	DB2+	An odd number pixel data	D1,D3,D5···D1023 pixels data (LVDS level)
4	DB2-		
5	DB1+		
6	DB1-		
7	DB0+		
8	DB0-		
9	CKA+	An even number pixel clock	CLK for an even number pixel f=32.5MHz (TYP.) (LVDS level)
10	CKA-		
11	DA2+	An even number pixel data	D0,D2,D4···D1022 pixels data (LVDS level)
12	DA2-		
13	DA1+		
14	DA1-		
15	DA0+		
16	DA0-		
17	GND	Ground	Connect system ground
18	GND		
19	VCC	+5.0V power supply	Supply +5V±5%
20	VCC		

(2) Connector for backlight unit

Part No.   : BHR-03VS-1
Adaptable socket: SM02(8.0)B-BHS-TB
Supplier   : J.S.T TRADING COMPANY, LTD.

Pin No.	Symbol	Function
1	VHV	High voltage terminal
2	N.C.	Non-connection
3	GND	Backlight ground

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11. Method of connection for DS90CF561

DS90CF561 (NS co.)   NL10276BC24-04

Upper block DS90CF561 (NS co.):

RA0 → TxIN0
RA1 → TxIN1
:
RA5 → TxIN5
GA0 → TxIN6
:
GA5 → TxIN11
BA0 → TxIN12
:
BA5 → TxIN17
HSYNC → TxIN18
VSYNC → TxIN19
DE → TxIN20
DCLK → TxCLKIN

TxOUT0+ → DA0+
TxOUT0- → DA0-
TxOUT1+ → DA1+
TxOUT1- → DA1-
TxOUT2+ → DA2+
TxOUT2- → DA2-
TxCLKOUT+ → CKA+
TxCLKOUT- → CKA-

100Ω twist pair

Lower block DS90CF561 (NS co.):

RB0 → TxIN0
RB1 → TxIN1
:
RB5 → TxIN5
GB0 → TxIN6
:
GB5 → TxIN11
BB0 → TxIN12
:
BB5 → TxIN17
MODE0 → TxIN18
MODE1 → TxIN19
MODE2 → TxIN20
→ TxCLKIN

TxOUT0+ → DB0+
TxOUT0- → DB0-
TxOUT1+ → DB1+
TxOUT1- → DB1-
TxOUT2+ → DB2+
TxOUT2- → DB2-
TxCLKOUT+ → CKB+
TxCLKOUT- → CKB-

VCC(+5V) → VCC
GND → GND

RAx, GAx, BAx ; D0, 2, 4, ·····D1022 pixel data
RBx, GBx, BBx ; D1, 3, 5, ·····D1023 pixel data
MODE0 : "H"
MODE1 : "L"(DE), "H"(FIX)
MODE2 : "L"

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12. DISPLAY COLORS vs. INPUT DATA SIGNALS

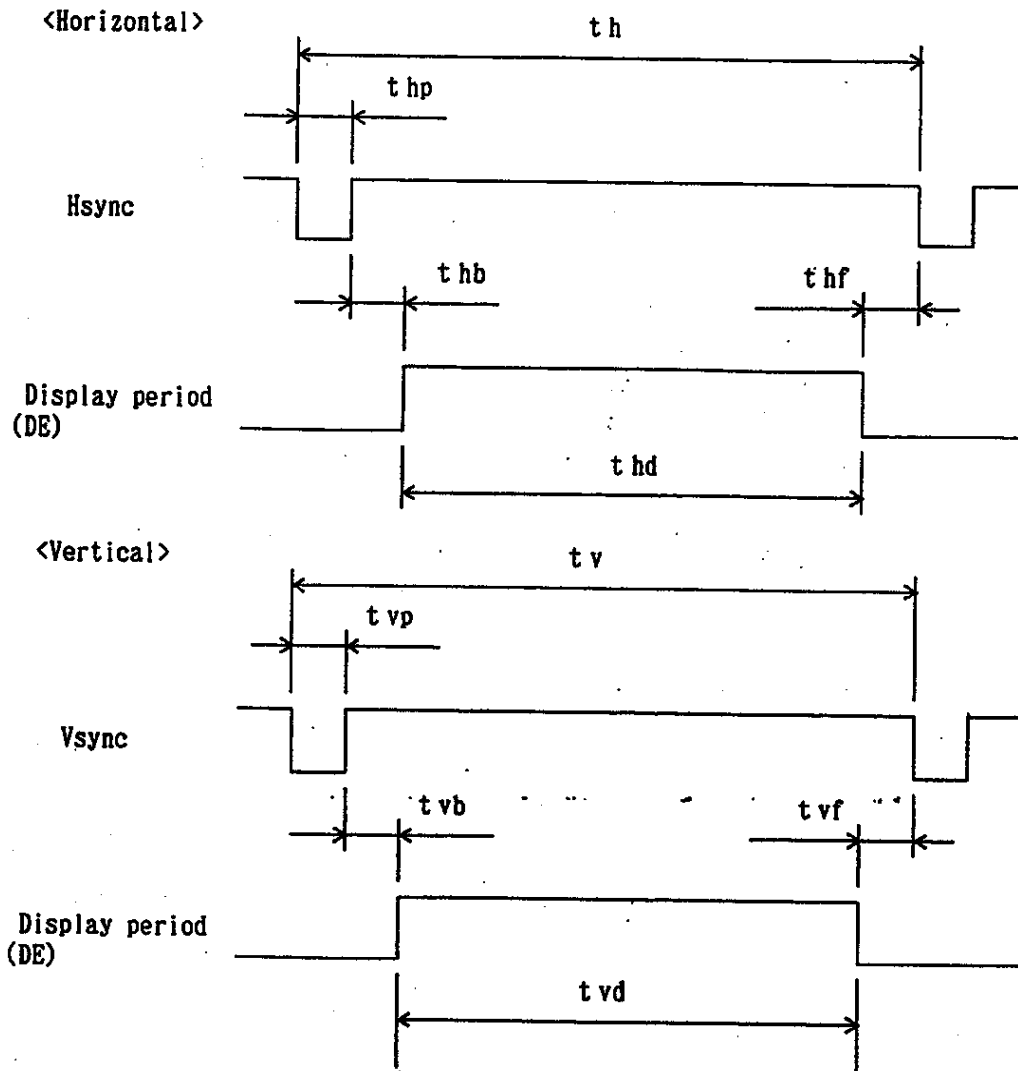| Display colors		Data signal(0: Low level, 1: High level)		
		R5 R4 R3 R2 R1 R0	G5 G4 G3 G2 G1 G0	B5 B4 B3 B2 B1 B0
Basic colors	Black	0 0 0 0 0 0	0 0 0 0 0 0	0 0 0 0 0 0
	Blue	0 0 0 0 0 0	0 0 0 0 0 0	1 1 1 1 1 1
	Red	1 1 1 1 1 1	0 0 0 0 0 0	0 0 0 0 0 0
	Magenta	1 1 1 1 1 1	0 0 0 0 0 0	1 1 1 1 1 1
	Green	0 0 0 0 0 0	1 1 1 1 1 1	0 0 0 0 0 0
	Cyan	0 0 0 0 0 0	1 1 1 1 1 1	1 1 1 1 1 1
	Yellow	1 1 1 1 1 1	1 1 1 1 1 1	0 0 0 0 0 0
	White	1 1 1 1 1 1	1 1 1 1 1 1	1 1 1 1 1 1
Red grayscale	Black	0 0 0 0 0 0	0 0 0 0 0 0	0 0 0 0 0 0
		0 0 0 0 0 1	0 0 0 0 0 0	0 0 0 0 0 0
	dark	0 0 0 0 1 0	0 0 0 0 0 0	0 0 0 0 0 0
	↑ ↓	⋮	⋮	⋮
	bright	1 1 1 1 0 1	0 0 0 0 0 0	0 0 0 0 0 0
		1 1 1 1 1 0	0 0 0 0 0 0	0 0 0 0 0 0
	Red	1 1 1 1 1 1	0 0 0 0 0 0	0 0 0 0 0 0
Green grayscale	Black	0 0 0 0 0 0	0 0 0 0 0 0	0 0 0 0 0 0
		0 0 0 0 0 0	0 0 0 0 0 1	0 0 0 0 0 0
	dark	0 0 0 0 0 0	0 0 0 0 1 0	0 0 0 0 0 0
	↑ ↓	⋮	⋮	⋮
	bright	0 0 0 0 0 0	1 1 1 1 0 1	0 0 0 0 0 0
		0 0 0 0 0 0	1 1 1 1 1 0	0 0 0 0 0 0
	Green	0 0 0 0 0 0	1 1 1 1 1 1	0 0 0 0 0 0
Blue grayscale	Black	0 0 0 0 0 0	0 0 0 0 0 0	0 0 0 0 0 0
		0 0 0 0 0 0	0 0 0 0 0 0	0 0 0 0 0 1
	dark	0 0 0 0 0 0	0 0 0 0 0 0	0 0 0 0 1 0
	↑ ↓	⋮	⋮	⋮
	bright	0 0 0 0 0 0	0 0 0 0 0 0	1 1 1 1 0 1
		0 0 0 0 0 0	0 0 0 0 0 0	1 1 1 1 1 0
	Blue	0 0 0 0 0 0	0 0 0 0 0 0	1 1 1 1 1 1

note: Colors are developed in combination with 6 bit signals (64 steps in grayscale) of each primary red, green, and blue color.
This process can result in up to 262,144 (64×64×64) colors.
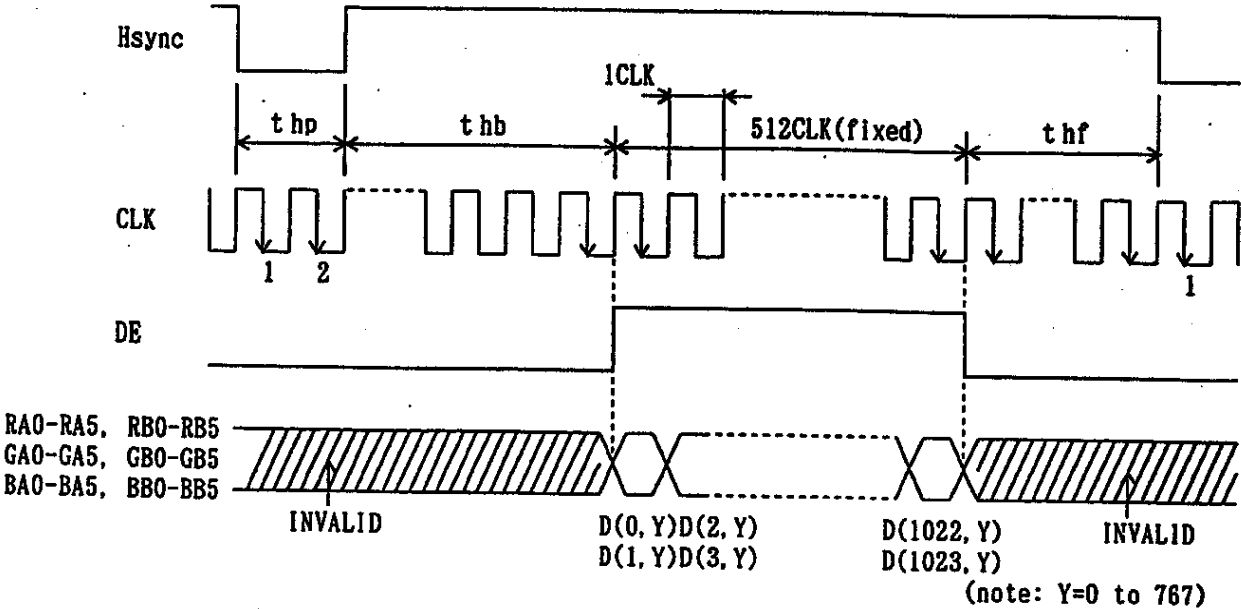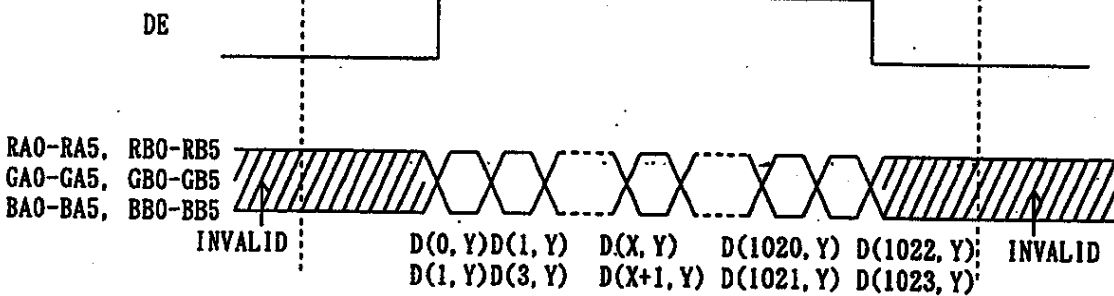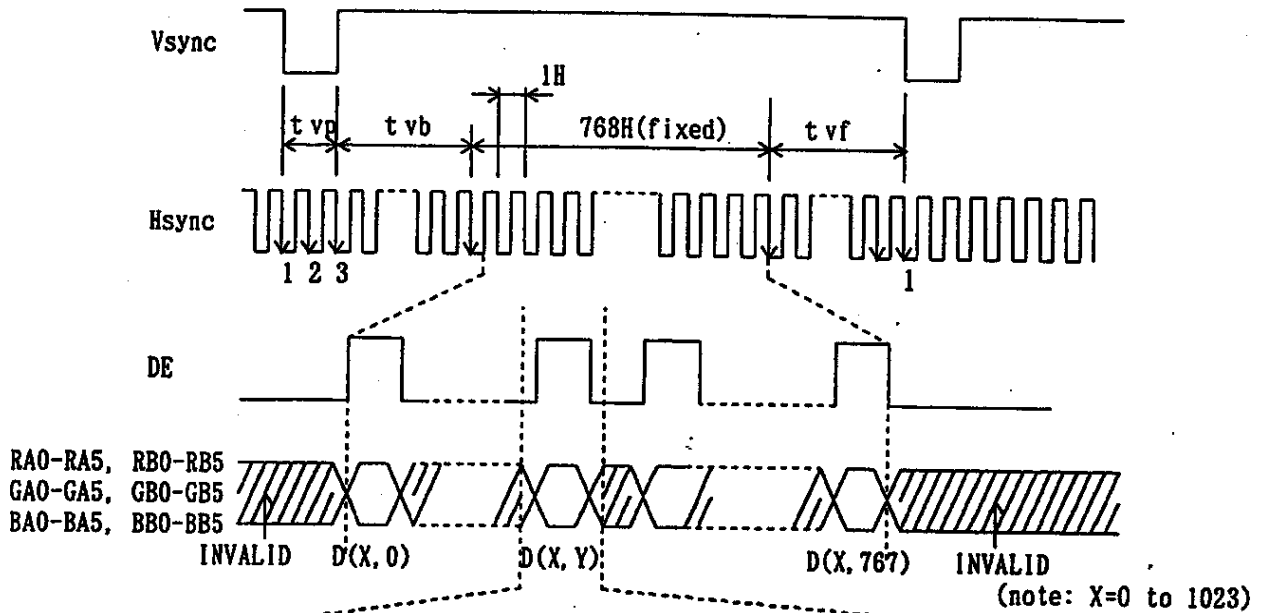
13. INPUT SIGNAL TIMING
(1) Timing spec

そ t_h

大文字に はったり小文字に 出たりどちらを 使うのが？

Name		Symbol	Min.	Typ.	Max.	Unit	Remarks
CLK	Frequency	1/ t c	30.0 —	32.5 30.769	35.0 —	MHz ns	Input LVDS device
Hsync	Period	t h	— —	20.676 672	— —	μs CLK	48.363kHz (TYP.)
	Display	t hd		512		CLK	—
	Front-porch	t hf	0	—	—	CLK	—
	Pulse-width	t hp	12	—	127	CLK	—
	Back-porch	t hb	2	—	—	CLK	—
	Pulse-width + Back-porch	t hpb	15	—	160	CLK	DE mode
			—	140	—	CLK	Fixed mode
	V-Hsync timing hold/setup time	t hvh	1	—	—	CLK	—
		t hvs	15	—	—	ns	—
Vsync	Period	t v	— —	16.666 806	— —	ms H	60.004Hz (TYP.)
	Display	t vd		768		H	—
	Front-porch	t vf	1	—	—	H	—
	Pulse-width	t vp	1	3	36	H	—
	Back-porch	t vb	1	—	36	H	—
	Pulse-width + Back-porch	t vpb	2	—	38	CLK	DE mode
			—	35	—	CLK	Fixed mode

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(2) Input signal timing

<Horizontal>

Hsync

Display period
(DE)

<Vertical>

Vsync

Display period
(DE)

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(3) Input signal timing chart ～DE mode～

Vsync

t vp | t vb | 1H | 768H(fixed) | t vf

Hsync

1 2 3   1

DE

RA0-RA5, RB0-RB5
GA0-GA5, GB0-GB5
BA0-BA5, BB0-BB5

INVALID   D(X,0)   D(X,Y)   D(X,767)   INVALID

(note: X=0 to 1023)

DE

RA0-RA5, RB0-RB5
GA0-GA5, GB0-GB5
BA0-BA5, BB0-BB5

INVALID   D(0,Y)D(1,Y) D(X,Y) D(1020,Y) D(1022,Y) INVALID
           D(1,Y)D(3,Y) D(X+1,Y) D(1021,Y) D(1023,Y)

Hsync

t hp | t hb | 1CLK | 512CLK(fixed) | t hf

CLK

1 2   1

DE

RA0-RA5, RB0-RB5
GA0-GA5, GB0-GB5
BA0-BA5, BB0-BB5

INVALID   D(0,Y)D(2,Y)   D(1022,Y)   INVALID
                D(1,Y)D(3,Y)   D(1023,Y)

(note: Y=0 to 767)

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(4) Display position of input data

D(0, 0)	D(1, 0)	· · ·	D(X, 0)	· · ·	D(1023, 1)
D(1, 0)	D(1, 1)	· · ·	D(X, 1)	· · ·	D(1023, 2)
· · ·	· · ·	· · ·	· · ·	· · ·	· · ·
D(0, Y)	D(1, Y)	· · ·	D(X, Y)	· · ·	D(1023, Y)
· · ·	· · ·	· · ·	· · ·	· · ·	· · ·
D(0, 767)	D(1, 767)	· · ·	D(X, 767)	· · ·	D(1023, 767)

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14. GENERAL CAUTION

> Liquid Crystal Display has the following specific characteristics. These are not defects or malfunctions.
> The display condition of LCD module may be affected by the ambient temperature.
> The LCD module uses cold cathode tubes for backlighting. Optical characteristics, like luminance or uniformity, will change during time.
> Uneven brightness and/or small spots may be noticed depending on different display patterns.

(1) Caution when taking out the module
① Pick the pouch only, when taking out module from a shipping package.

(2) Cautions for handling the module
① As the electrostatic discharges may break the LCD module, handle the LCD module with care. Peel a protection sheet off from the LCD panel surface as slowly as possible.
② As the LCD panel and back-light element are made from fragile glass material, impulse and pressure to the LCD module should be avoided.
③ As the surface of polarizer is very soft and easily scratched, use a soft dry cloth without chemicals for cleaning.
④ Do not pull the interface connectors in or out while the LCD module is operating.
⑤ Put the module display side down on a flat horizontal plane.
⑥ Handle connectors and cables with care.
⑦ When the module is operating, do not lose DOTCLK, Hsync, or Vsync signal. If any one of these signals is lost, the LCD panel would be damaged.
⑧ The torque of mounting screw should be 0.294 N·m (3 Kgf·cm) less.

(3) Cautions for the operation
① When the module is operating, do not lose CLK, Hsync, or Vsync signals. If any one of these signals is lost, the LCD panel would be damaged.
② Obey the supply voltage sequence. If wrong sequence is applied, the module would be damaged.

(4) Cautions for the atmosphere
① Dew drop atmosphere should be avoided.
② Do not store and/or operate the LCD module in a high temperature and/or humidity atmosphere. Storage in an electro-conductive polymer packing pouch and under relatively low temperature atmosphere is recommended.

(5) Cautions for the module characteristics
① Do not apply fixed pattern data signal to the LCD module at product aging. Applying fixed pattern for a long time may cause image sticking.
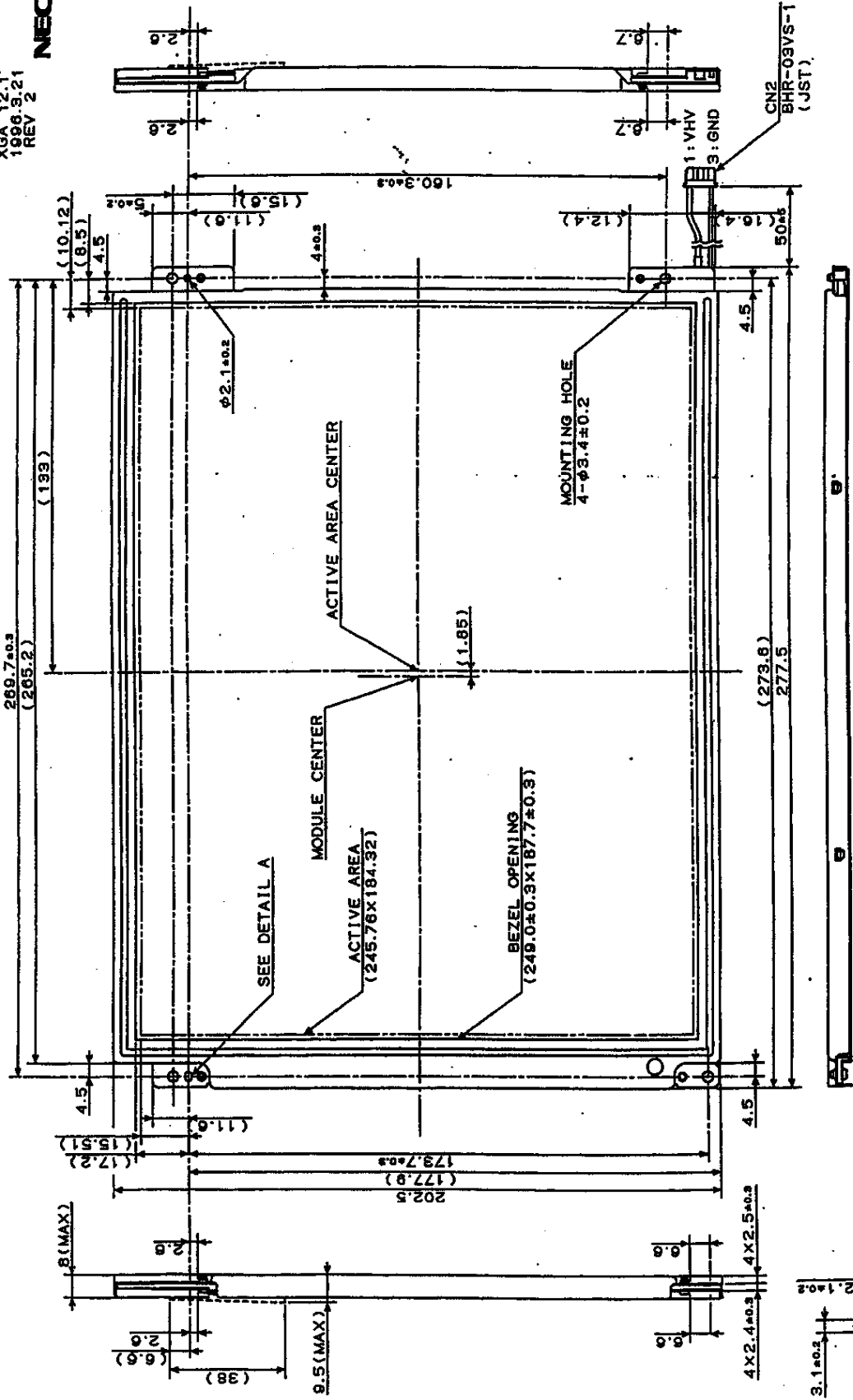
(6) Other cautions
① Do not disassemble and/or re-assemble LCD module.
② Do not re-adjust variable resistor or switch etc.
③ When returning the module for repair or etc., Please pack the module not to be broken. We recommend to use the original shipping packages.

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XGA 12.1"
1996.3.21
REV 2

OUTLINE DRAWING (Unit in mm)

CN2
BHR-03VS-1
(JST)

1:VHV
3:GND

ACTIVE AREA CENTER

MODULE CENTER

MOUNTING HOLE
4-φ3.4±0.2

SEE DETAIL A

ACTIVE AREA
(245.76×184.32)

BEZEL OPENING
(249.0±0.3×187.7±0.3)

φ2.1±0.2

(11.85)

160.3±0.3

269.7±0.3
(265.2)

(133)

(273.6)
277.5

50±3

4±0.3

4.5

202.5
(177.9)
179.7±0.3
(15.5)
(17.2)
(11.6)

8(MAX)
9.5(MAX)
(38)
4×2.4±0.3
4×2.5±0.3

DETAIL A
(MEASURE 2/1)

3.1±0.2

*THE TOLERANCE THAT IS NOT SHOW±0.5mm IN THE DRAWING

NOTES;The torque of mounting screw should be 0.294N·m
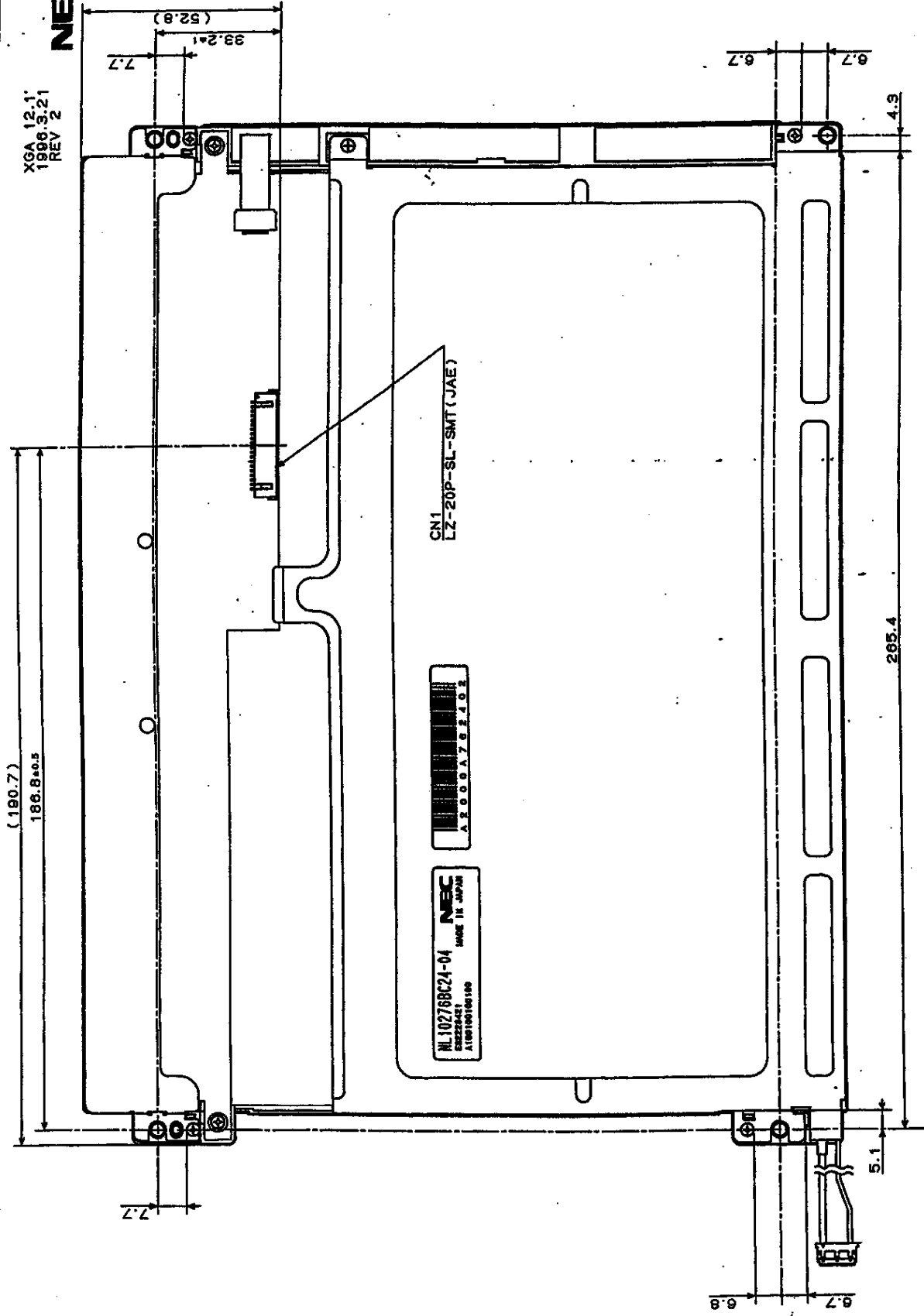(3K±f·cm) less.
The values in parenthesis are for reference.

NL10276BC24-04 OUTLINE (PRELIMINARY) 1/2

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XGA 12.1″
1996.3.21
REV.2

(52.8)

33.2±1

7.7

6.7

6.7

4.3

*THE TOLERANCE THA
IS NOT SHOW : ±0.5m
IN THE DRAWING

CN1
LZ-20P-SL-SMT (JAE)

NEC
MADE IN JAPAN

NL10276BC24-04
E302284E1
A106106106100

A2000A782402

265.4

(190.7)

186.8±0.5

5.1

7.7

6.8

6.7

NL10276BC24-04 OUTLINE (PRELIMINARY) 2/2

Rev.	Issued date	Revised contents	Approved	Checked	Prepared
1	Jun. 2, 1995	File NO. DOD-H-2556(abstract)	M. Akiyo-shi	-	A. Okamo-to
2	Jun. 16, 1995	File NO. DOD-H-2609(abstract) ·Module size 274.5(H) → 277.5(H) ·Color gamut 55% → 42%	M. Akiyo-shi	-	A. Okamo-to
3	Jun. 20, 1995	File NO. DOD-H-2613 ·Viewing angle Vertical : 25° (TYP. down side) → 35° (TYP. down side) ·Designed viewing direction 12 o'clock (Upper direction) ↓ ·wider viewing angle with contrast ratio : down side (6 o'clock) ·wider viewing angle without image reversal : up side (12 o'clock) ·optimum grayscale (γ=2.2) : perpendicular	M. Akiyo-shi	-	A. Okamo-to
4	Dec. 18, 1995	File NO. DOD-H-3255 ·Adapted LVDS device ·Module size 8.5(D) → 9.5(D) ·Weight TBD → 500g(TYP.) 520(MAX.) ·Viewing angle Vertical : 25° (TYP. up side) → TBD (TYP. down side) Vertical : 35° (TYP. down side) → TBD (TYP. down side) Horizontal : 45° (TYP.) → TBD (TYP.) ·Designed viewing direction 12 o'clock (Upper direction) ·Add timing spec, block diagram, etc.	A. Okamo-to	M. Hiro-shima	M. Nishi-mura
5	Mar. 27, 1996	File NO. DOD-H-3578 P 3 Viewing angle Horizontal : TBD→45° (left, right side) Vertical : TBD→25° (upper) TBD→35° (lower) P 5 Supply voltage : +4.5→+6.5V Backlight Ft : TBD→60KHz P 8 MODE0 : "H" MODE1 : "L"(DE), "H"(FIX) MODE2 : "L" P10 Timing spec Hsync thb : 2→12(MIN.), 127(MAX.) P14 GENERAL CAUTION Add torque value P15,16 OUTLINE DRAWING Revise outline drawing	M.A	M.Hiroshima	M.N