



LCD Module Technical Specification

First Edition
Jan 18, 2002

Final Revision

Type No. **F-51477GNF-SLY-AA**

Approved by (Production Div.)

Checked by (Quality Assurance Div.)

Checked by (Design Engineering Div.)

Prepared by (Production Div.)

Table of Contents

1. General Specifications	2
2. Electrical Specifications.....	3
3. Optical Specifications	7
4. I/O Terminal.....	9
5. Test.....	11
6. Appearance Standards.....	12
7. Code System of Production Lot	15
8. Type Number.....	15
9. Applying Precautions	15
10. Precautions Relating Product Handling.....	16
11. Warranty.....	17

Revision History

Rev.	Date	Page	Comment

PRELIMINARY

1. General Specifications

Operating Temp.	:	min. 0°C ~max. 50°C
Storage Temp.	:	min. -20°C ~max. 60°C
Dot Pixels	:	320 (W) × 240 (H) dots
Dot Size	:	0.285 (W) × 0.285 (H) mm
Dot Pitch	:	0.3 (W) × 0.3 (H) mm
Viewing Area	:	99.85 (W) × 77.0 (H) mm
Outline Dimensions	:	116.4* (W) × 94.0 (H) × 6.0 max. (D) mm * Without FPC
Weight	:	TBDg max.
LCD Type	:	NSD-21295 (F-STN / Black&White-mode / Transflective)
Viewing Angle	:	6:00
Data Transfer	:	4-bit parallel data transfer
Backlight	:	LED Backlight / Yellow-green
Drawings	:	Dimensional Outline UE-310885-02

PRELIMINARY

2. Electrical Specifications

2.1. Absolute Maximum Ratings

V_{SS}=0V

Parameter	Symbol	Conditions	Min.	Max.	Units
Supply Voltage (Logic)	V _{DD} -V _{SS}	-	-0.3	7.0	V
Supply Voltage (LCD Drive)	V ₀ -V ₅	-	-0.3	30.0	V
Input Voltage	V _I	-	-0.3	V _{DD} +0.3	V

2.2. DC Characteristics

T_a=25°C, V_{SS}=0V

Parameter	Symbol	Conditions	Min.	Typ.	Max.	Units
Supply Voltage (Logic)	V _{DD} -V _{SS}	-	4.5	-	5.5	V
Supply Voltage (LCD Drive)	V ₀ -V ₅	Shown in 3.1				V
High Level Input Voltage	V _{IH}	V _{DD} =4.5~5.5V	0.8×V _{DD}	-	-	V
High Level output Voltage	V _{OH}	I _{OH} =-0.4mA	V _{DD} -0.4	-	-	V
Low Level Input Voltage	V _{IL}	V _{DD} =4.5~5.5V	0	-	0.2×V _{DD}	V
Low Level output Voltage	V _{OL}	I _{OH} =0.4mA	-	-	0.4	V
Supply Current	I _{DD}	V _{DD} -V _{SS} =5.0V	-	1.0	5.0	mA
	I ₀	V ₀ -V ₅ =22.4V	-	2.0	10.0	mA

PRELIMINARY

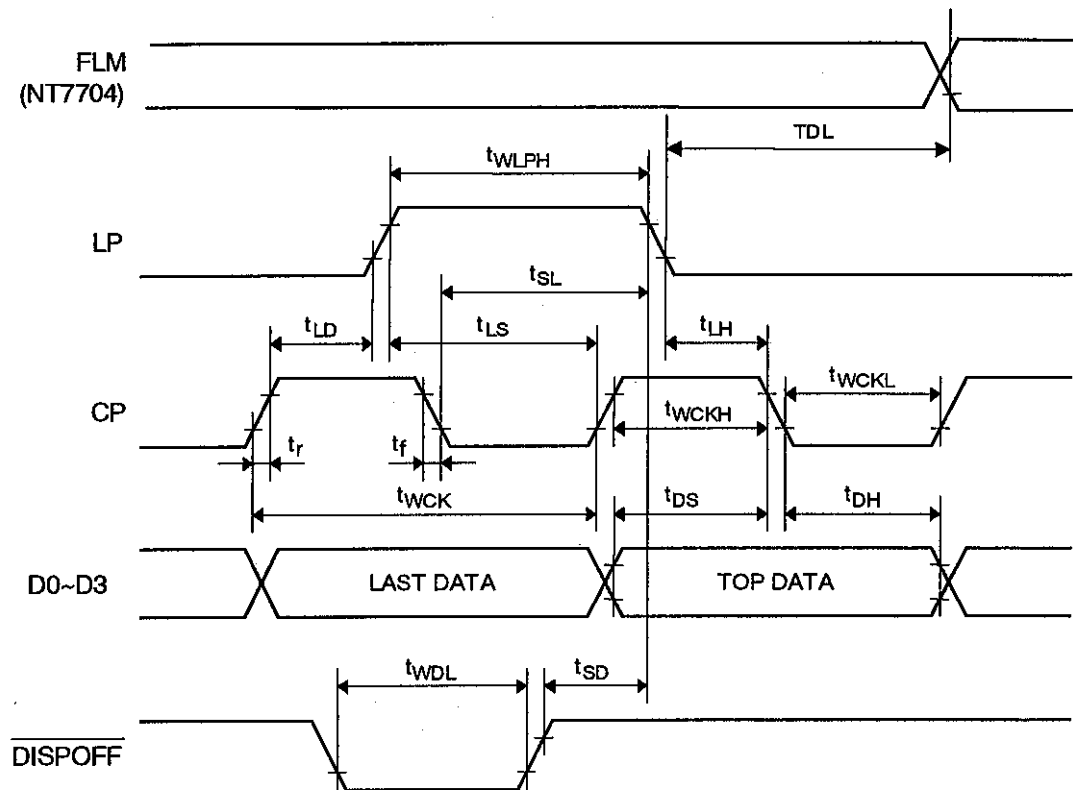
2.3.AC Characteristics

V_{DD}=4.5~5.5V

Parameter	Symbol	Min.	Max.	Units
Shift Clock Period	t _{WCK}	71	-	ns
Shift Clock "H" Pulse Width	t _{WCKH}	23	-	ns
Shift Clock "L" Pulse Width	t _{WCKL}	23	-	ns
Data Setup Time	t _{DS}	10	-	ns
Data Hold Time	t _{DH}	20	-	ns
Latch Pulse "H" Pulse Width	t _{WLPH}	15	-	ns
Shift Clock Rise to Latch Pulse Rise Time	t _{LD}	0	-	ns
Shift Clock Fall to Latch Pulse Fall Time	t _{SL}	25	-	ns
Latch Pulse Rise to Shift Clock Rise Time	t _{LS}	25	-	ns
Latch Pulse Fall to Shift Clock Rise Time	t _{LH}	25	-	ns
Input Signal Rise, Fall Time	t _r , t _f	-	50 Note.1	ns
DISPOFF Removal Time	t _{SD}	100	-	ns
DISPOFF Enable Pulse Width	t _{WDL}	1.2	-	μs
Output Delay Time	t _{DL}	-	200 Note.2	ns

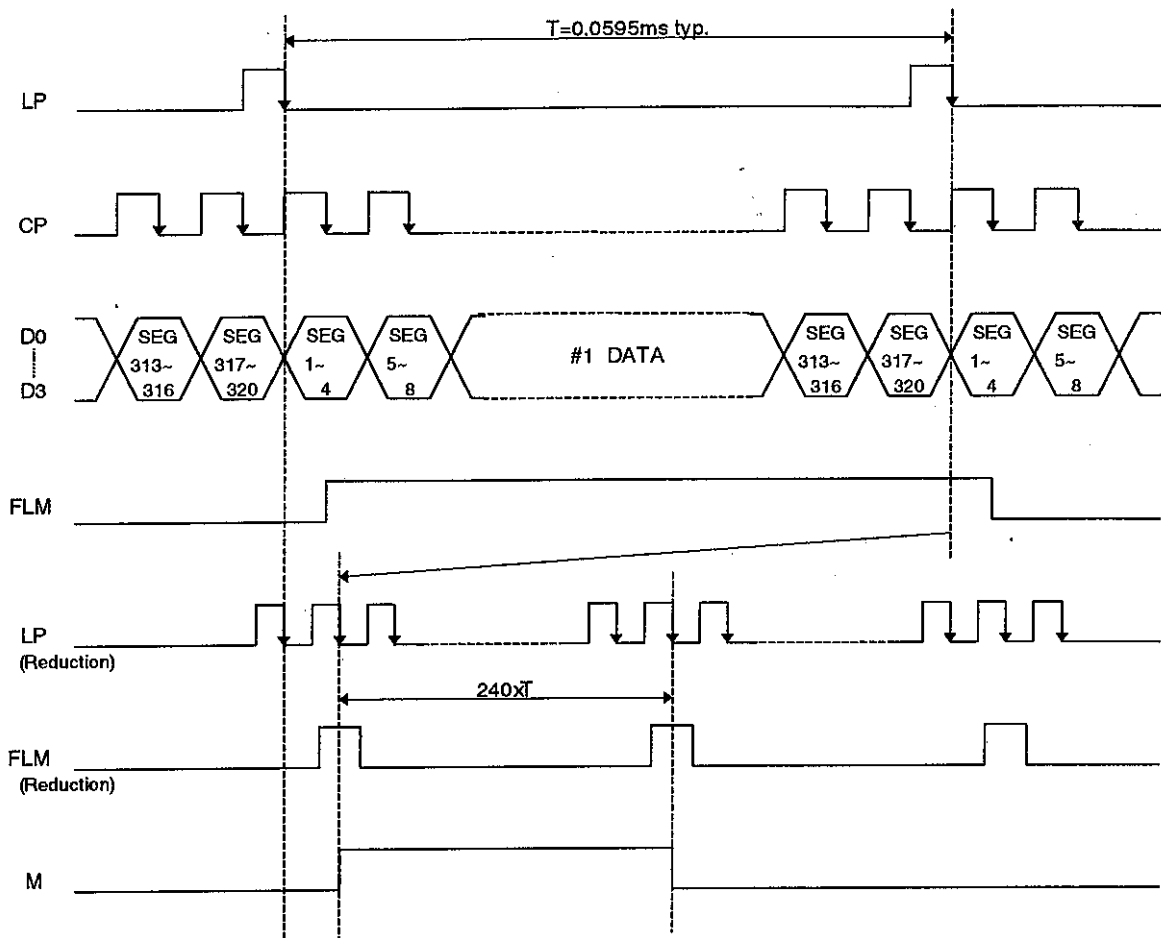
Note.1 : $(t_{CK} - t_{wckl} - t_{wckh})/2$ is the maximum in case of high speed operation.

Note.2 : C_L=15pF

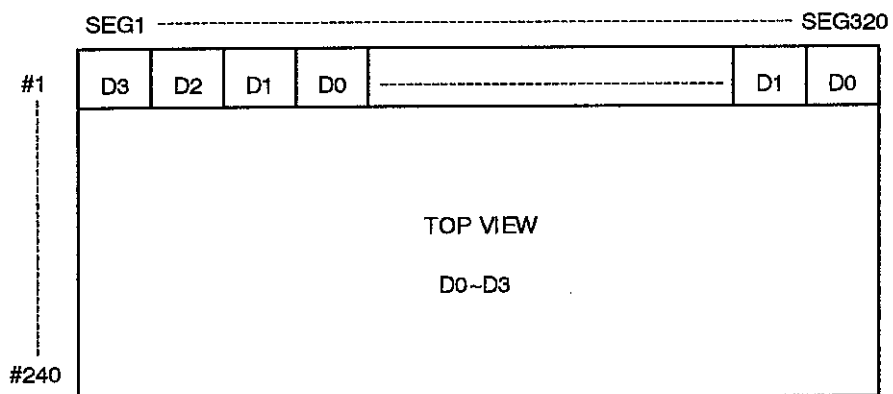


PRELIMINARY

2.4. Timing Chart



2.5. Comparison of Display and Data



PRELIMINARY

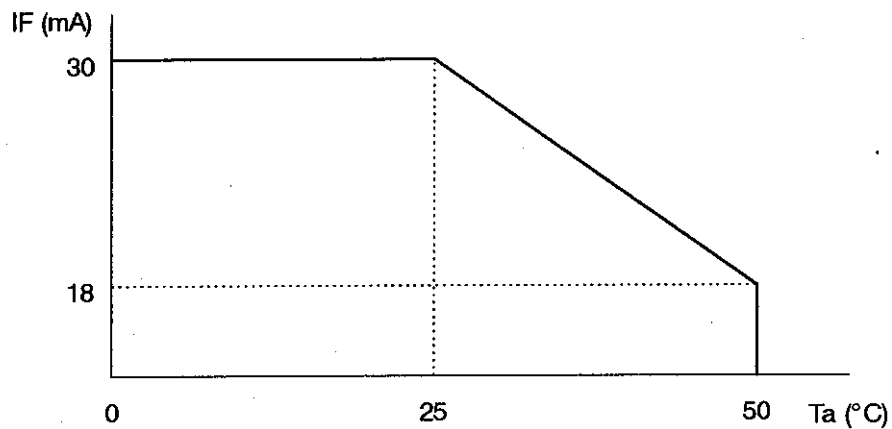
2.6. Lighting Specifications

2.6.1. Absolute Maximum Ratings ()

Ta=25°C

Parameter	Symbol	Conditions	Min.	Typ.	Max.	Units
Foward Current	I _F	Note 1	-	-	30	mA
Reverse Voltage	V _R	-	-	-	4.0	V
LED Power Dissipation	P _D	-	-	-	78	mW

Note 1 : Refer to the foward current derating curve.



2.6.2. Operating Characteristic()

Ta=25°C

Parameter	Symbol	Conditions	Min.	Typ.	Max.	Units
Foward Voltage	V _F	I _F =20mA	-	4.4	TBD	V
Luminance of Backlight Surface	L	I _F =20mA	TBD	-	-	cd/m ²

PRELIMINARY

3. Optical Specifications

3.1. LCD Driving Voltage

Parameter	Symbol	Conditions	Min.	Typ.	Max.	Units
Recommended LCD Driving Voltage Note 1	V0-V5	Ta= 0°C	-	-	25.4	V
		Ta=25°C	20.8	22.4	24.0	V
		Ta=50°C	19.4	-	-	V

Note 1 : Voltage (Applied actual waveform to LCD Module) for the best contrast. The range of minimum and maximum shows tolerance of the operating voltage. The specified contrast ratio and response time are not guaranteed over the entire range.

3.2. Optical Characteristics

Ta=25°C, 1/240 Duty, 1/14 Bias, V_{OD}=22.4V (Note 4), θ= 0°, φ=-°

Parameter	Symbol	Conditions	Min.	Typ.	Max.	Units
Contrast Ratio Note 1	CR	θ= 0°, φ = -°	-	3.5	-	
Viewing Angle		Shown in 3.3				
Response Time	Rise Note 2 Decay Note 3	T _{ON} T _{OFF}	- -	360 280	540 420	ms ms

Note 1 : Contrast ratio is defined as follows. (CR = L_{OFF} / L_{ON})

L_{ON} : Luminance of the ON segments

L_{OFF} : Luminance of the OFF segments

Measuring Spot : 3.0mmφ

Note 2 : The time that the luminance level reaches 90% of the saturation level from 0% when ON signal is applied.

Note 3 : The time that the luminance level reaches 10% of the saturation level from 100% when OFF signal is applied.

Note 4 : Definition of Driving Voltage V_{OD}

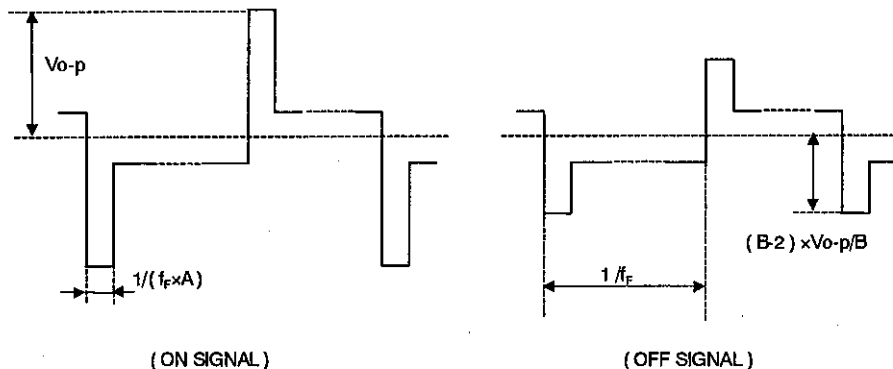
$$V_{OD} = V_0 - V_5$$

Assuming that the typical driving waveforms shown below are applied to the LCD Panel at 1/A Duty - 1/B Bias (A: Duty Number, B: Bias Number). Driving voltage V_{OD} is defined as follows.

$$V_{OD} = (V_{th1} + V_{th2}) / 2$$

V_{th1}: The voltage V_{O-P} that should provide 70% of the saturation level in the luminance at the segment which the ON signal is applied to.

V_{th2}: The voltage V_{O-P} that should provide 20% of the saturation level in the luminance at the segment which the OFF signal is applied to.

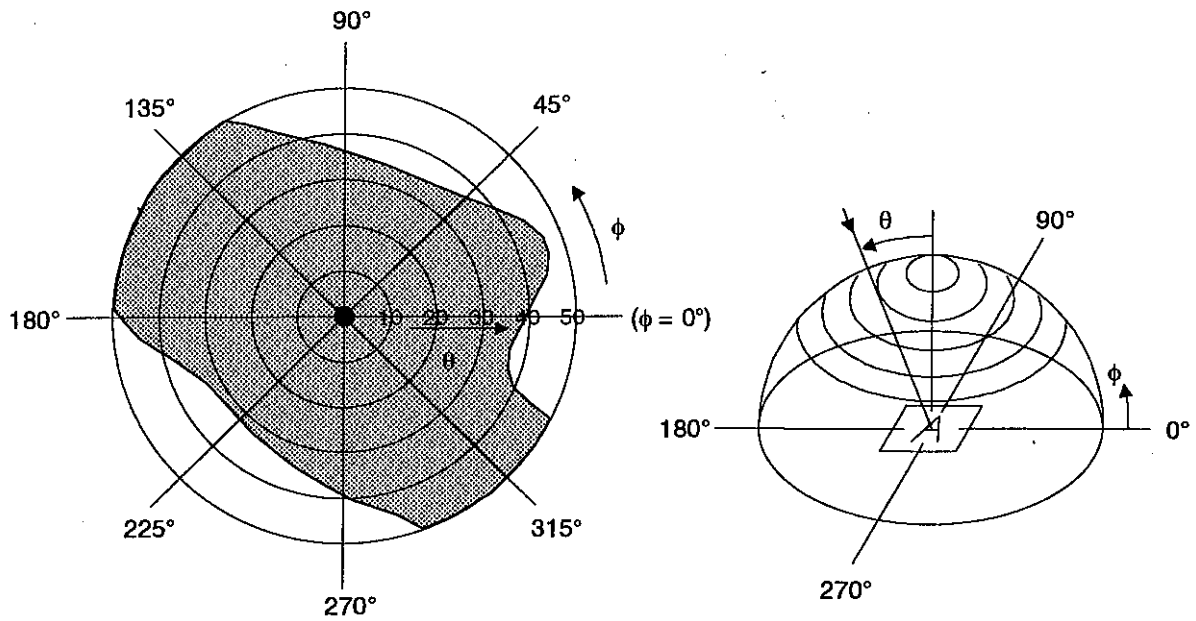



PRELIMINARY

3.3. Definition of Viewing Angle and Optimum Viewing Area

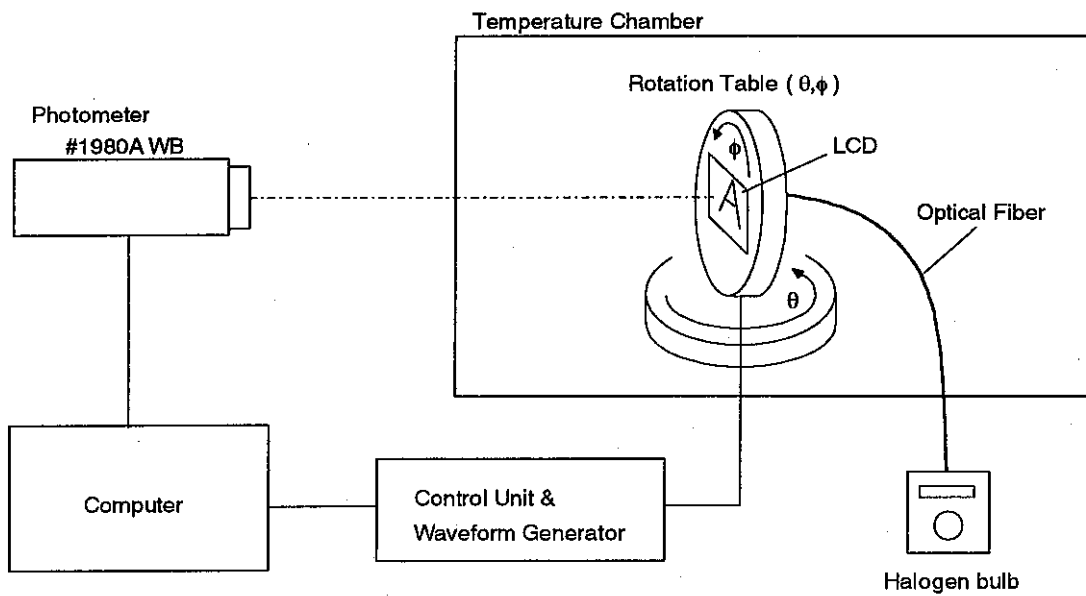
*Point • shows the point where contrast ratio is measured. : $\theta = 0^\circ, \phi = -^\circ$

*Driving condition: 1/240 Duty, 1/14 Bias, $V_{OD}=22.4V, f_F=70Hz$



*Area  shows typ. $CR \geq 1.5$ (Measuring Spot : 3.0mm ϕ)

3.4. System Block Diagram



PRELIMINARY

4.I/O Terminal

4.1.Pin Assignment

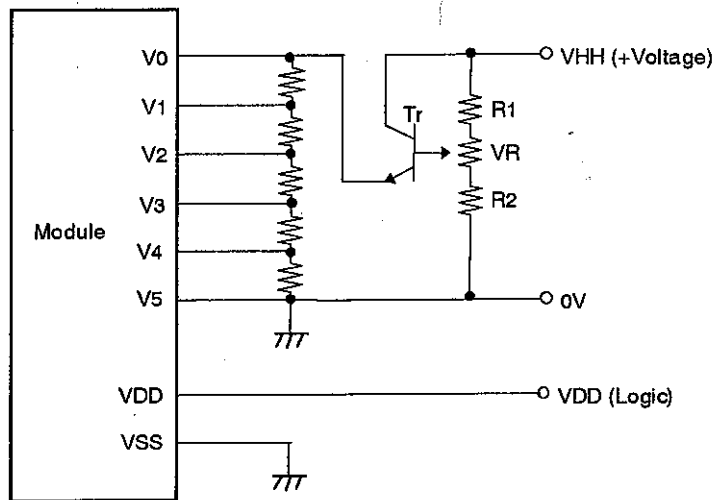
CN1

No.	Symbol	Function
1	NC	Non-connection
2	V ₀	Power Supply for LCD Drive
3	V ₁	Power Supply for LCD Drive V ₁ = 1/5,V ₅
4	V ₂	Power Supply for LCD Drive V ₂ = 2/5,V ₅
5	V ₃	Power Supply for LCD Drive V ₃ = 3/5,V ₅
6	V ₄	Power Supply for LCD Drive V ₄ = 4/5,V ₅
7	V ₅	Power Supply for LCD Drive V ₅ ,V _{OUT}
8	V _{SS}	Power Supply (0V, GND)
9	M	Alternate Signal for LCD Drive
10	FLM	First Line Marker
11	LP	Data Latch Signal
12	DISPOFF	Display Control Signal H : Display on L : Display off
13	CP	Clock Signal for Shifting Data
14	D0	Data Bus Line
15	D1	Data Bus Line
16	D2	Data Bus Line
17	D3	Data Bus Line
18	V _{DD}	Power Supply for Logic
19	V _{SS}	Power Supply (0V, GND)
20	NC	Non-connection
21	NC	Non-connection
22	LED ANODE	LED Anode Terminal
23	LED CATHODE	LED Cathode Terminal

PRELIMINARY

4.2.Example of Power Supply

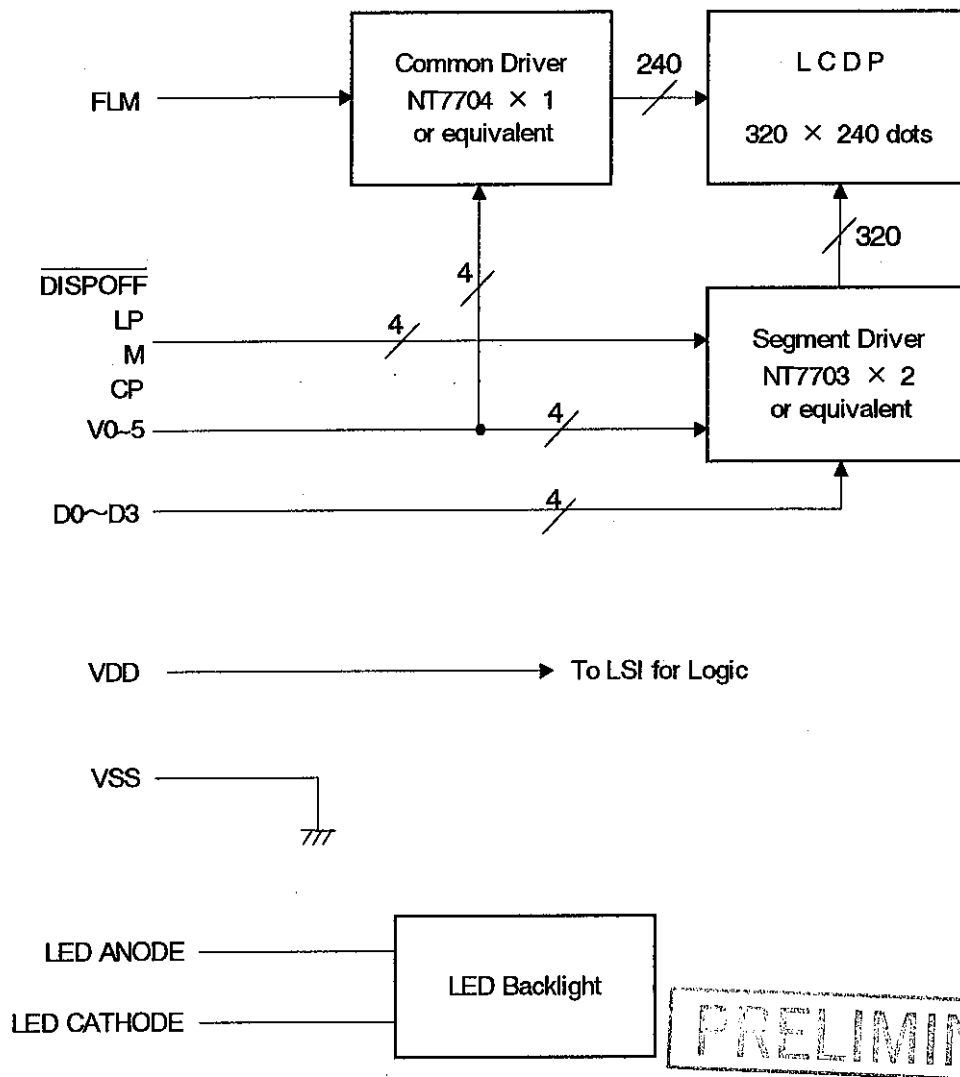
It is recommended to apply a potentiometer for the contrast adjust due to the tolerance of the driving voltage and its temperature dependence.



$$R1+R2+VR=10\sim20K\Omega$$

$$R=1K\Omega\sim10K\Omega$$

4.3.Block Diagram



PRELIMINARY

5. Test

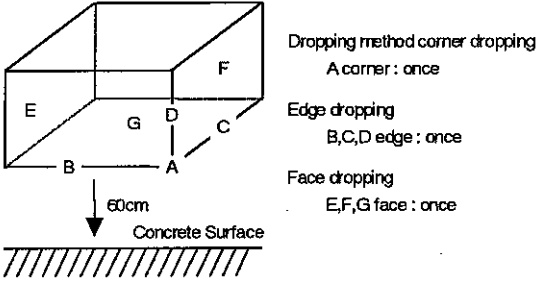
No change on display and in operation under the following test condition.

Conditions: Unless otherwise specified, tests will be conducted under the following condition.

Temperature: $20 \pm 5^\circ\text{C}$

Humidity : $65 \pm 5\% \text{RH}$

tests will be not conducted under functioning state.

No.	Parameter	Conditions	Notes
1	High Temperature Operating	$50^\circ\text{C} \pm 2^\circ\text{C}$, 96hrs (operation state)	
2	Low Temperature Operating	$0^\circ\text{C} \pm 2^\circ\text{C}$, 96hrs (operation state)	1
3	High Temperature Storage	$60^\circ\text{C} \pm 2^\circ\text{C}$, 96hrs	2
4	Low Temperature Storage	$-20^\circ\text{C} \pm 2^\circ\text{C}$, 96hrs	1,2
5	Damp Proof Test	$40^\circ\text{C} \pm 2^\circ\text{C}$, 90~95%RH, 96hrs	1,2
6	Vibration Test	Total fixed amplitude : 1.5mm Vibration Frequency : 10~55Hz One cycle 60 seconds to 3 directions of X, Y, Z each 15 minutes	3
7	Shock Test	To be measured after dropping from 60cm high the concrete surface in packing state. 	

Note 1 :No dew condensation to be observed.

Note 2 :The function test shall be conducted after 4 hours storage at the normal
Temperature and humidity after removed from the test chamber.

Note 3 :Vibration test will be conducted to the product itself without putting it in a container.

PRELIMINARY

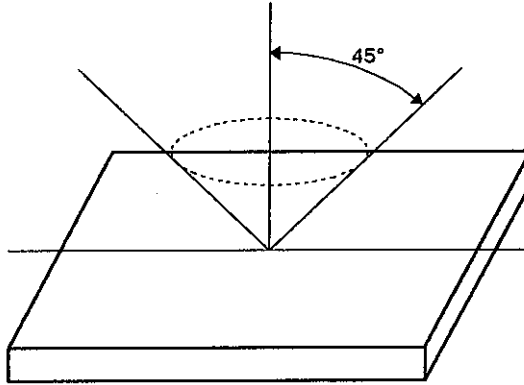
6. Appearance Standards

6.1. Inspection conditions

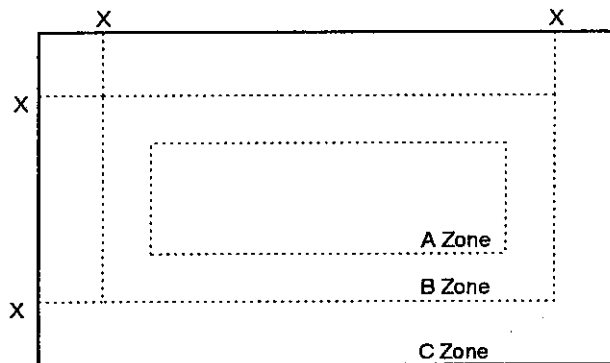
The LCD shall be inspected under 40W white fluorescent light.

The distance between the eyes and the sample shall be more than 30cm.

All directions for inspecting the sample should be within 45° against perpendicular line.



6.2. Definition of applicable Zones



X : Maximum Seal Line

A Zone : Active display area

B Zone : Out of active display area ~ Maximum seal line

C Zone : Rest parts

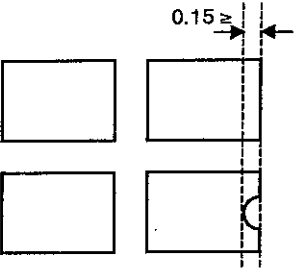
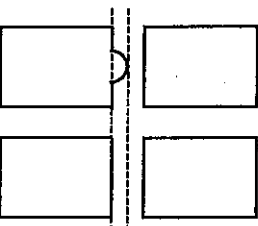
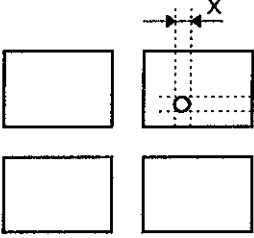
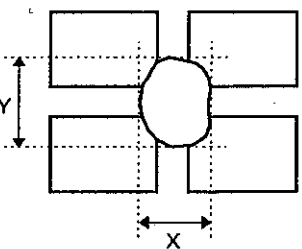
A Zone + B Zone = Validity viewing area

PRELIMINARY

6.3.Standards

No.	Parameter	Criteria																																																							
1	Black and White Spots, Foreign Substances	<p>(1) Round Shape</p> <table border="1" data-bbox="611 320 1385 656"> <thead> <tr> <th rowspan="2">Dimension (mm) \ Zone</th> <th colspan="3">Acceptable Number</th> </tr> <tr> <th>A</th> <th>B</th> <th>C</th> </tr> </thead> <tbody> <tr> <td>$D \leq 0.1$</td> <td>*</td> <td>*</td> <td>*</td> </tr> <tr> <td>$0.1 < D \leq 0.2$</td> <td>3</td> <td>5</td> <td>*</td> </tr> <tr> <td>$0.2 < D \leq 0.25$</td> <td>2</td> <td>3</td> <td>*</td> </tr> <tr> <td>$0.25 < D \leq 0.3$</td> <td>0</td> <td>1</td> <td>*</td> </tr> <tr> <td>$0.3 < D$</td> <td>0</td> <td>0</td> <td>*</td> </tr> </tbody> </table> <p>$D = (\text{Long} + \text{Short}) / 2$ * : Disregard</p> <p>(2) Line Shape</p> <table border="1" data-bbox="611 750 1385 1037"> <thead> <tr> <th colspan="2" rowspan="2">X (mm) \ Y (mm) \ Zone</th> <th colspan="3">Acceptable Number</th> </tr> <tr> <th>A</th> <th>B</th> <th>C</th> </tr> </thead> <tbody> <tr> <td>-</td> <td>$0.03 \geq W$</td> <td>*</td> <td>*</td> <td>*</td> </tr> <tr> <td>$2.0 \geq L$</td> <td>$0.05 \geq W$</td> <td>3</td> <td>3</td> <td>*</td> </tr> <tr> <td>$1.0 \geq L$</td> <td>$0.1 \geq W$</td> <td>3</td> <td>3</td> <td>*</td> </tr> <tr> <td>-</td> <td>$0.1 < W$</td> <td colspan="3">In the same way (1)</td> </tr> </tbody> </table> <p>X : Length Y : Width * : Disregard</p> <p>Total defects shall not exceed 5.</p>	Dimension (mm) \ Zone	Acceptable Number			A	B	C	$D \leq 0.1$	*	*	*	$0.1 < D \leq 0.2$	3	5	*	$0.2 < D \leq 0.25$	2	3	*	$0.25 < D \leq 0.3$	0	1	*	$0.3 < D$	0	0	*	X (mm) \ Y (mm) \ Zone		Acceptable Number			A	B	C	-	$0.03 \geq W$	*	*	*	$2.0 \geq L$	$0.05 \geq W$	3	3	*	$1.0 \geq L$	$0.1 \geq W$	3	3	*	-	$0.1 < W$	In the same way (1)		
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2	Air Bubbles (between glass & polarizer)	<table border="1" data-bbox="611 1180 1385 1467"> <thead> <tr> <th rowspan="2">Dimension (mm) \ Zone</th> <th colspan="3">Acceptable Number</th> </tr> <tr> <th>A</th> <th>B</th> <th>C</th> </tr> </thead> <tbody> <tr> <td>$D \leq 0.3$</td> <td>*</td> <td>*</td> <td>*</td> </tr> <tr> <td>$0.3 < D \leq 0.4$</td> <td>3</td> <td>*</td> <td>*</td> </tr> <tr> <td>$0.4 < D \leq 0.6$</td> <td>2</td> <td>3</td> <td>*</td> </tr> <tr> <td>$0.6 < D$</td> <td>0</td> <td>0</td> <td>*</td> </tr> </tbody> </table> <p>* : Disregard</p> <p>Total defects shall not exceed 3.</p>	Dimension (mm) \ Zone	Acceptable Number			A	B	C	$D \leq 0.3$	*	*	*	$0.3 < D \leq 0.4$	3	*	*	$0.4 < D \leq 0.6$	2	3	*	$0.6 < D$	0	0	*																																
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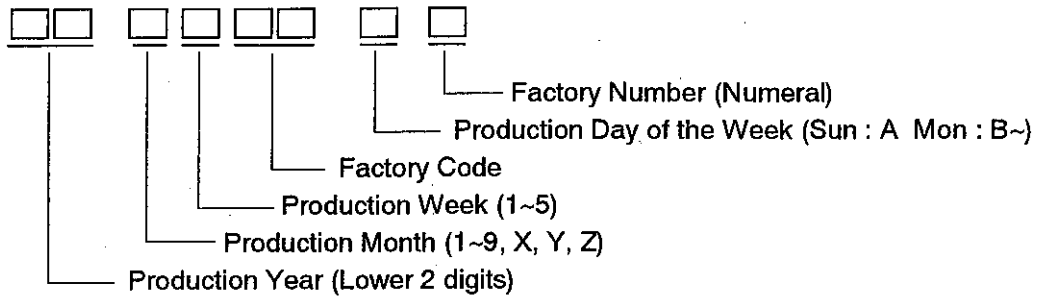
PRELIMINARY

No.	Parameter	Criteria
3	The Shape of Dot	<p>(1) Dot Shape (with Dent)</p>  <p>As per the sketch of left hand.</p> <p>(2) Dot Shape (with Projection)</p>  <p>Should not be connected to next dot.</p> <p>(3) Pin Hole</p>  <p>$(X+Y) / 2 \leq 0.2\text{mm}$ (Less than 0.1mm is no counted.)</p> <p>(4) Deformation</p>  <p>$(X+Y) / 2 \leq 0.2\text{mm}$</p> <p>Total acceptable number : 1/dot, 5/cell (Defect number of (4) : 1pc.)</p>
4	Polarizer Scratches	Not to be conspicuous defects.
5	Polarizer Dirts	If the stains are removed easily from LCDP surface, the module is defective.
6	Complex Foreign Substance Defects	Black spots, line shaped foreign substances or air bubbles between glass & polarizer should be 5pcs maximum in total.
7	Distance between Different Foreign Substance Defects	$D \leq 0.2$: 20mm or more $0.2 < D$: 40mm or more

PRELIMINARY

7.Code System of Production Lot

The production lot of module is specified as follows.



8.Type Number

The type number of module is specified as follows.

F-51477GNF-SLY-AA

9.Applying Precautions

Please contact us when questions and/or new problems not specified in this Specifications arise.

PRELIMINARY

10. Precautions Relating Product Handling

The Following precautions will guide you in handling our product correctly.

1) Liquid crystal display devices

1. The liquid crystal display device panel used in the liquid crystal display module is made of plate glass. Avoid any strong mechanical shock. Should the glass break handle it with care.
2. The polarizer adhering to the surface of the LCD is made of a soft material. Guard against scratching it.

2) Care of the liquid crystal display module against static electricity discharge.

1. When working with the module, be sure to ground your body and any electrical equipment you may be using. We strongly recommend the use of anti static mats (made of rubber), to protect work tables against the hazards of electrical shock.
2. Avoid the use of work clothing made of synthetic fibers. We recommend cotton clothing or other conductivity-treated fibers.
3. Slowly and carefully remove the protective film from the LCD module, since this operation can generate static electricity.

3) When the LCD module alone must be stored for long periods of time:

1. Protect the modules from high temperature and humidity.
2. Keep the modules out of direct sunlight or direct exposure to ultraviolet rays.
3. Protect the modules from excessive external forces.

4) Use the module with a power supply that is equipped with an overcurrent protector circuit, since the module is not provided with this protective feature.

5) Do not ingest the LCD fluid itself should it leak out of a damaged LCD module. Should hands or clothing come in contact with LCD fluid, wash immediately with soap.

6) Conductivity is not guaranteed for models that use metal holders where solder connections between the metal holder and the PCB are not used. Please contact us to discuss appropriate ways to assure conductivity.

7) For models which use CFL:

1. High voltage of 1000V or greater is applied to the CFL cable connector area. Care should be taken not to touch connection areas to avoid burns.
2. Protect CFL cables from rubbing against the unit and thus causing the wire jacket to become worn.
3. The use of CFLs for extended periods of time at low temperatures will significantly shorten their service life.

8) For models which use touch panels:

1. Do not stack up modules since they can be damaged by components on neighboring modules.
2. Do not place heavy objects on top of the product. This could cause glass breakage.

9) For models which use COG, TAB, or COF:

1. The mechanical strength of the product is low since the IC chip faces out unprotected from the rear. Be sure to protect the rear of the IC chip from external forces.
2. Given the fact that the rear of the IC chip is left exposed, in order to protect the unit from electrical damage, avoid installation configurations in which the rear of the IC chip runs the risk of making any electrical contact.

PRELIMINARY

- 10) Models which use flexible cable, heat seal, or TAB:
 1. In order to maintain reliability, do not touch or hold by the connector area.
 2. Avoid any bending, pulling, or other excessive force, which can result in broken connections.

- 11) have an adverse effect on connecting parts (LCD panel-TCP / HEAT SEAL / FPC / etc., PCB-TCP / HEAT SEAL / FPC etc., TCP-HEAT SEAL, TCP-FPC, HEAT SEAL-FPC, etc..) depending on its materials.
Please check and evaluate these materials carefully before use.

- 12) In case of acrylic plate is attached to front side of LCD panel, cloudiness (very small cracks) can occur on acrylic plate, being influenced by some components generated from polarizer film..
Please check and evaluate those acrylic materials carefully before use.

11. Warranty

This product has been manufactured to your company's specifications as a part for use in your company's general electronic products. It is guaranteed to perform according to delivery specifications. For any other use apart from general electronic equipment, we cannot take responsibility if the product is used in medical devices, nuclear power control equipment, aerospace equipment, fire and security systems, or any other applications in which there is a direct risk to human life and where extremely high levels of reliability are required. If the product is to be used in any of the above applications, we will need to enter into a separate product liability agreement.

1. We cannot accept responsibility for any defect, which may arise from additional manufacturing of the product (including disassembly and reassembly), after product delivery.

2. We cannot accept responsibility for any defect, which may arise after the application of strong external force to the product.

3. We cannot accept responsibility for any defect, which may arise due to the application of static electricity after the product has passed your company's acceptance inspection procedures.

4. When the product is in CFL models, CFL service life and brightness will vary According to the performance of the inverter used, leaks, etc. We cannot accept responsibility for product performance, reliability, or defect, which may arise.

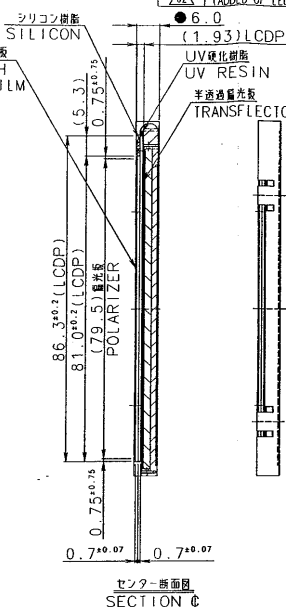
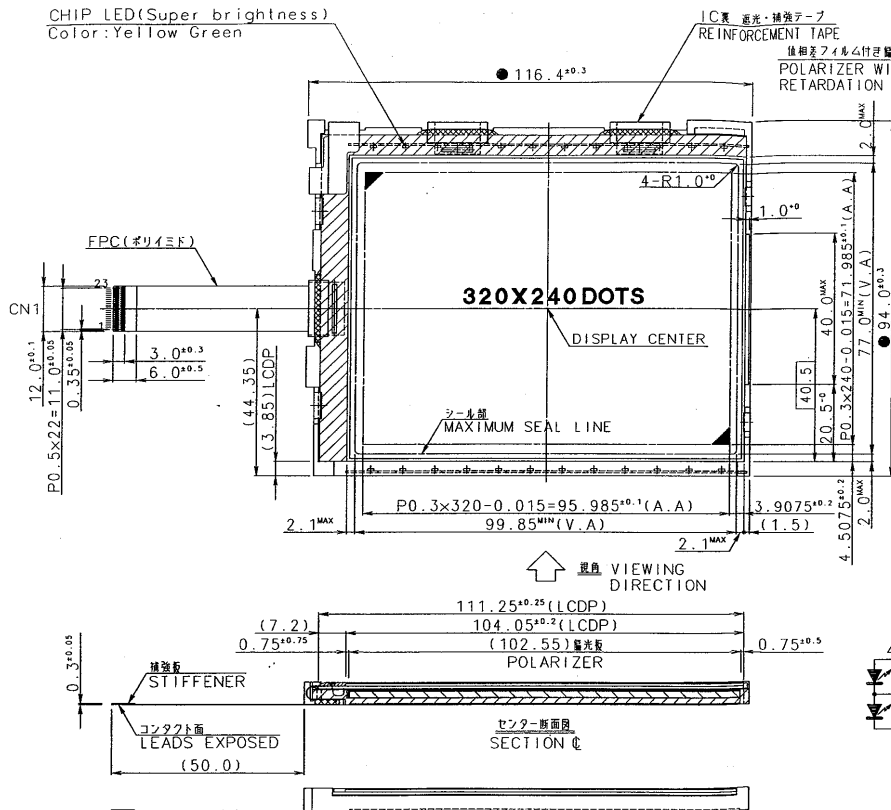
5. We cannot accept responsibility for intellectual property of a third party, which may arise through the application of our product to your assembly with exception to those issues relating directly to the structure or method of manufacturing of our product.

6. Optrex will not be held responsible for any quality guarantee issue for defect products judged as Optrex-origin longer than 2 (two) years from Optrex production or 1 (one) year from Optrex, Optrex America, Optrex Europe, Display LC delivery which ever comes later.

PRELIMINARY

ISSUE	REVISIONS	DRAWN	APPROVED	DATE
△	全面寸法見直し(REDESIGNED)	M. MOTOHASHI	S. MATSUOKA	NOV. 16 '01
△	■寸法修正(LED回路追加) (ADDED OF LED CIRCUIT & CONNECTION)	M. NAKAYAMA		JAN. 22 '02

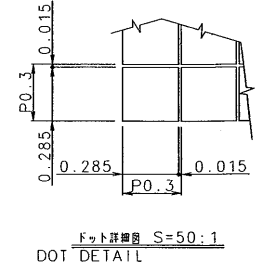
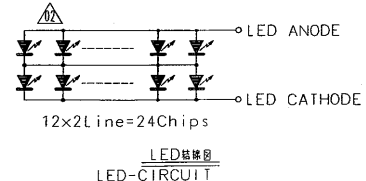
CHIP LED(Super brightness)
Color:Yellow Green



PIN ASSIGNMENT
CN1:

No.	SYMBOL
1	NC
2	V0
3	V1
4	V2
5	V3
6	V4
7	V5
8	VSS
9	M
10	≠FLM
11	LP
12	DISPOFF
13	CP
14	D0
15	D1
16	D2
17	D3
18	VDD
19	VSS
20	NC
21	NC
22	LED ANODE
23	LED CATHODE

PRELIMINARY



- 注記
- 1) 視角: 液晶表示が最も良く見える方向
 - 2) 斜線はシリコン塗布の最大範囲とし高さは透光層より上へ出さないものとする。
 - 3) 点線はUV硬化樹脂及びシリコンの最大塗布範囲とする。
 - 4) ●印付寸法は重要管理寸法とする。

- NOTES
- 1) VIEWING DIRECTION: DIRECTION THAT YOU CAN SEE THE DISPLAY MOST CLEARLY.
 - 2) THE MARK OF SHOWS THE AREA OF SILICON MAX COATING. THE SILICON SHOULD NOT BE PROTRUDE FROM THE EDGE OF LCDP AND SHOULD NOT INCREASE THE THICKNESS OF THE FRONT POLARIZER.
 - 3) THE MARK OF SHOWS THE MOLD AREA OF UV RESIN & SILICON. (MAX.)
 - 4) THE DIMENSIONS WITH THE MARK ● ARE CONTROLLED AS A PARTICULAR CHARACTERISTIC.

MEASURE	TOLERANCE			THIRD ANGLE PROJECTION	DATE
	A	B	C		
L ≤ 16	±0.1	±0.3	±1.0	UNIT	OC. 24 '01
16 < L ≤ 63	±0.2	±0.5	±1.5	mm	APPROVED
63 < L ≤ 250	±0.3	±0.8	±2.0	SCALE	S. MATSUOKA
250 < L ≤ 500	±0.5	±1.2	±3.0	1:1	CHECKED
500 < L	±0.8	±2.0	±4.0		T. OKAMOTO
ANGLE	±1'	±5'	±10'	DRAWN	M. MOTOHASHI

OPTREX CORPORATION

TITLE DIMENSIONAL OUTLINE

CODE F-51477GNF-SLY-AA

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