LIQUID CRYSTAL DISPLAY MODULE

Product Specification

CUSTOMER	
PRODUCT NUMBER	**LMR4900**

CUSTOMER APPROVAL		**Date** **26 June 2006**

INTERNAL APPROVALS		
Product Mgr	Document Control	Electr. Eng
Bruno Recaldini	**Anthony Perkins**	**Bazile Peter**
Date: 26 June 2006	Date: 26 June 2006	Date: 26 June 2006

☐ **Approval for Specification only**

☐ **Approval for Specification and Sample**

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REVISION RECORD

Rev.	Date	Page	Chapt.	Comment	ECR no.
B				Change to RoHS compliant	
C		8 9 25	3.2 3.3 8	Added 3.3V VDD option supply voltage option	
		4	1	Added backlight type information	
		9	3.3	Amended VLED from 5V to 4.2V	

1 MAIN FEATURES

ITEM	CONTENTS
Display Format	100 x 33
Overall Dimensions	97.5 x 35 x 8.6 mm
Viewing Area	67.15 x 25 mm
LCD type	STN
Mode	Transflective
Viewing Angle	6 O'clock
Duty ratio	1 / 33
Driver IC	S1D15300D00A
Backlight type	LED
DC/DC converter	Included
Operating temperature	-20˚C ~ 70˚C
Storage temperature	-30˚C ~ 80˚C
RoHS compliant	Yes

2 MECHANICAL SPECIFICATION

2.1 MECHANICAL CHARACTERISTICS

ITEM	CHARACTERISTIC	UNIT
Display Format	100 x 33	
Overall Dimensions	97.5 x 35 x 8.6	mm
Viewing Area	67.15 x 25	mm
Active Area	59.96 x 21.74	mm
Dot Size	0.56 x 0.62	mm
Dot Pitch	0.6 x 0.66	mm
Weight	25	g
IC Controller/Driver	S1D15300D00A	

2.2 MECHANICAL DRAWING
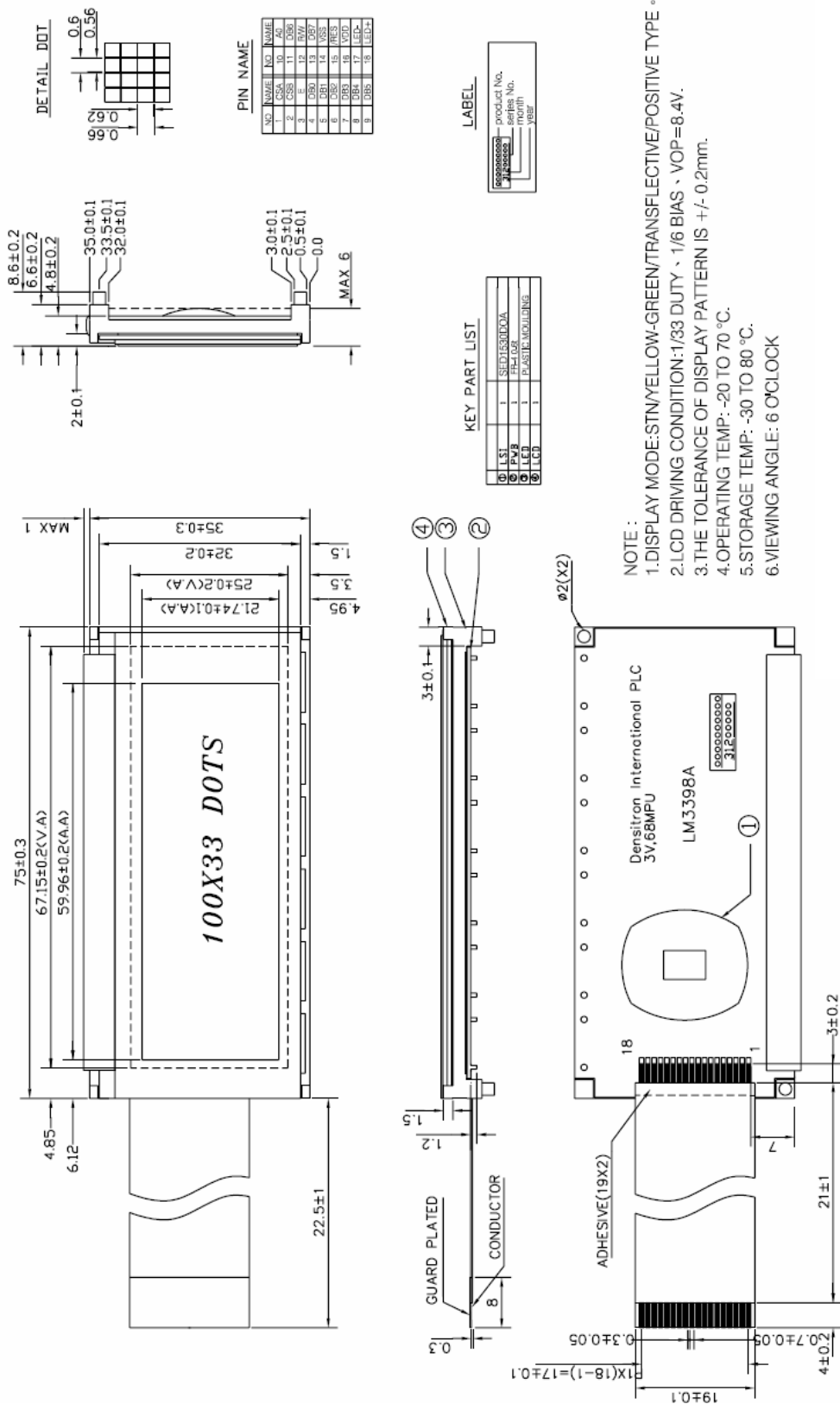
3 ELECTRICAL SPECIFICATION

3.1 ABSOLUTE MAXIMUM RATINGS

VSS = 0 V, Ta = 25 °C

Item		Symbol	Min	Max	Unit
Power Supply Voltage		V_{DD}	-0.3	+7	V
	Triple boosting		-0.3	+6	
	Quadruple boosting		-0.3	+4.5	
Power Supply Voltage range 1 (V_{DD} level)		$V_5\ V_{OUT}$	-18	+0.3	V
Power Supply Voltage range 2 (V_{DD} level)		V1, V2, V3, V4	V5	+0.3	V
Input voltage range		V_{IN}	-0.3	V_{DD}+0.3	V
Output voltage range		V_O	-0.3	V_{DD}+0.3	V
Operating Temperature		Top	-20	+70	°C
Storage Temperature		Tstr	-30	+80	°C
Static Electricity		Be sure that you are grounded when handling displays.			

Note 1: V1 to V5, VOUT voltages are based on V_{DD} = 0V

Note 2: Voltages V_{DD} ≥V1≥V2≥V3≥V4≥V5 must always be satisfied.

Note 3: If an LSI exceeds its absolute maximum rating, it may be damaged permanently. It is desirable to use it under electrical characteristics conditions during general operation. Otherwise an LSI malfunction or reduced LSI reliability may result.

3.2 ELECTRICAL D.C. CHARACTERISTICS

Item	Symbol	Condition	Min	Typ	Max	Unit
Power supply for logic	V_{DD}-V_{SS}	5V version	4.5	5	5.5	V
		3V version	--	3.3	--	
Input Voltage	V_{IL}	Ta = 25C	V_{SS}	--	0.3 x V_{DD}	V
	V_{IH}		0.8 x V_{DD}	--	V_{DD}	V
Output Voltage	V_{OL}	Ta = 25C	V_{SS}	--	0.2 x V_{DD}	V
	V_{OH}		0.8 x V_{DD}	--	V_{DD}	V
LCD module driving voltage	V_{OP}	Ta = 25C	8.35	8.5	8.65	V
Current consumption	*I_{DD}		--	1.5	2	mA
Frame frequency	FLM		--	64	--	Hz

*I_{DD} measurement condition is for all pattern on

3.3 INTERFACE PIN ASSIGNMENT

No.	Symbol	I/O	Function
1	CSA	I	Chip select input
2	CSB	I	Chip select input
3	E	I	Read / Write enable
4	DB0	I	Input data signal
5	DB1	I	Input data signal
6	DB2	I	Input data signal
7	DB3	I	Input data signal
8	DB4	I	Input data signal
9	DB5	I	Input data signal
10	A0	I	Selects display data or instruction
11	DB6	I	Input data signal
12	R/W	I	Read / Write signal
13	DB7	I	Input data signal
14	VSS	I	Ground supply for LCD
15	RES	I	Reset signal
16	VDD	I	Power supply for logic (+5V or +3.3V)
17	LED	I	Ground supply for LED
18	LED+	I	Voltage for LED (+4.2V)

3.4 BLOCK DIAGRAM
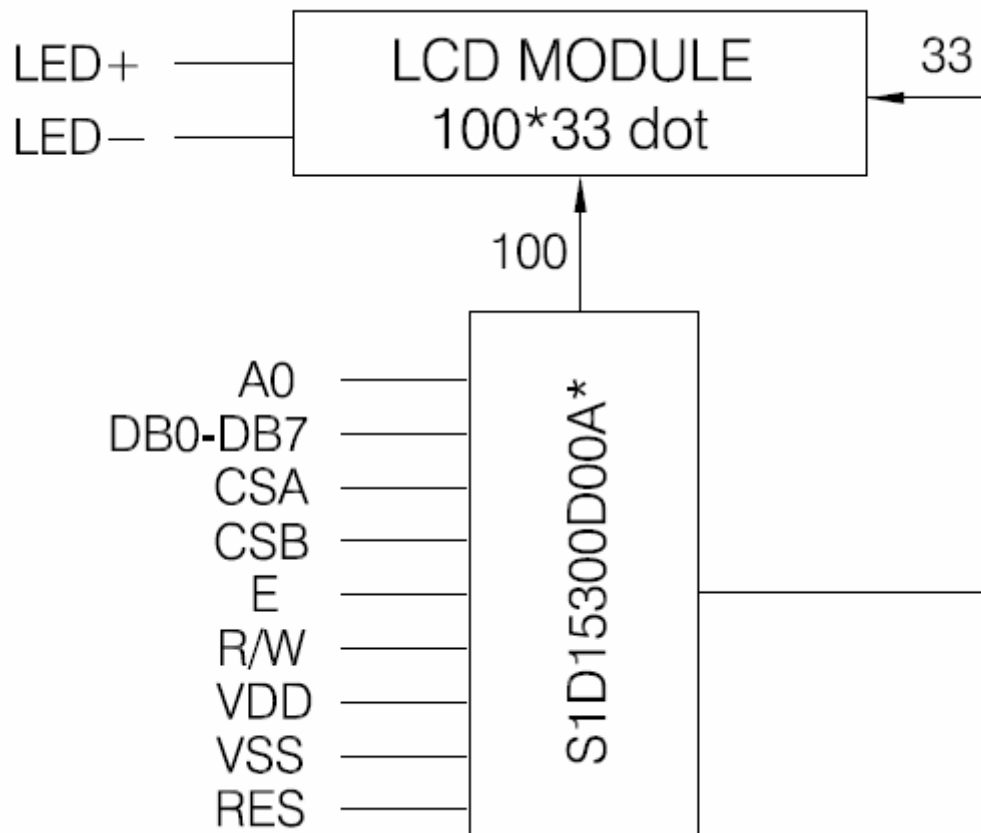
3.5 AC CHARACTERISTICS

(1)System buses Read/write characteristics (6800-series microprocessor)
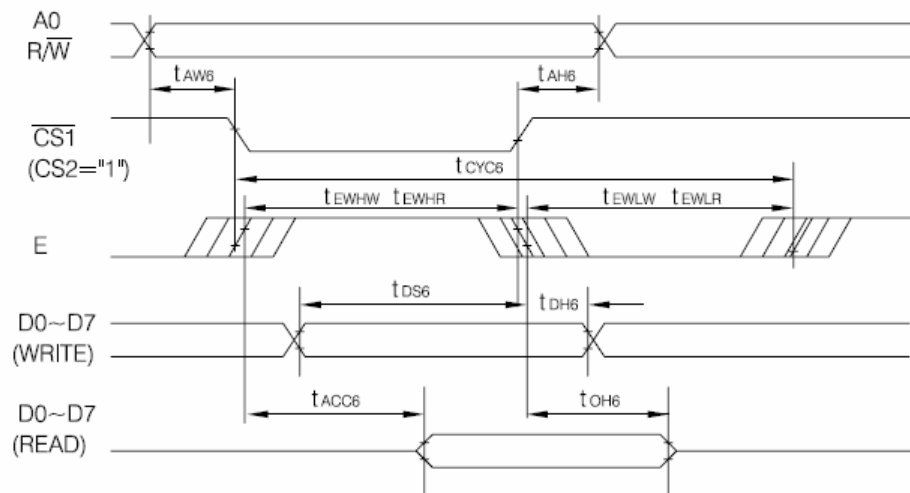
$V_{DD}= 5.0V\pm10\%, Ta= -40$ to $+85℃$

Item		Signal	Symbol	Condition	Min.	Max.	Unit
System cycle time			t_{CYC6}		166	—	ns
Address setup time		A0	t_{AW6}		10	—	ns
Address hold time		W/$\overline{R}$	t_{AH6}		10	—	ns
Data setup time			t_{DS6}		20	—	ns
Data hold time			t_{DH6}		10	—	ns
Output disable time		D0 to D7	t_{OH6}	CL=100pF	10	50	ns
Access time			t_{ACC6}		—	70	ns
Enable low pulse width	READ	E	t_{EWHR}		70	—	ns
	WRITE		t_{EWHW}		30	—	ns
Enable high pulse width	READ	E	t_{EWLR}		70	—	ns
	WRITE		t_{EWLW}		100	—	ns

$V_{DD}= 2.7V$ to $4.5V, Ta= -40$ to $+85℃$

Item		Signal	Symbol	Condition	Min.	Max.	Unit
System cycle time			t_{CYC6}		450	—	ns
Address setup time		A0	t_{AW6}		15	—	ns
Address hold time		R/$\overline{W}$	t_{AH6}		19	—	ns
Data setup time			t_{DS6}		40	—	ns
Data hold time			t_{DH6}		15	—	ns
Output disable time		D0 to D7	t_{OH6}	CL=100pF	10	100	ns
Access time			t_{ACC6}		—	140	ns
Enable low pulse width	READ	E	t_{EWHR}		140	—	ns
	WRITE		t_{EWHW}		60	—	ns
Enable high pulse width	READ	E	t_{EWLR}		140	—	ns
	WRITE		t_{EWLW}		200	—	ns

Notes: 1. The input rise/fall time (tr,tf) is specified at 15 ns or less. When system cycle time is used at a high speed, it is specified by $tr+tf\leqq(tcyc6-tEWLW-tEWHW)$ or $tr+tf\leqq(tcyc6-tEWLR-tEWHR)$.
2. Every timing is specified on the basis of 20% and 80% of VDD.
3. tEWHR and tEWHW are specified by the overlap period in which CS1 is "0" (CS2="1") and E is "1".

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(2) Display control timing
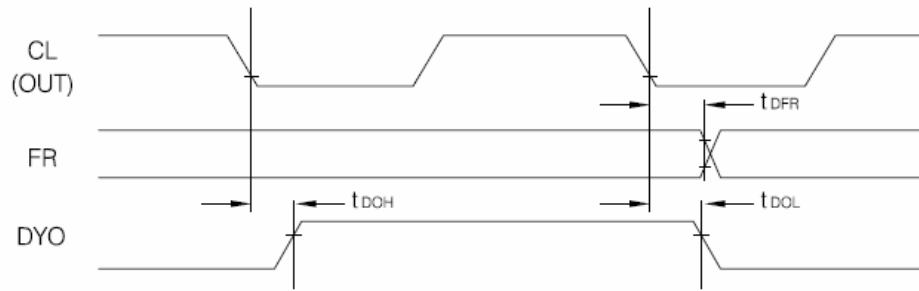
Output timing V_{DD} = 5.0V±10%, Ta= -40 to 85℃

Item	Signal	Symbol	Condition	Min.	Typ.	Max.	Unit
FR delay time	FR	t_{DFR}	CL=50pF	—	10	40	ns
DYO "H" delay time	DYO	t_{DOH}		—	40	100	ns
DYO "L" delay time		t_{DOL}		—	40	100	ns

Output timing V_{SS} = 0V, V_{DD} = 2.7V to 4.5V, Ta= -40 to +85℃

Item	Signal	Symbol	Condition	Min.	Typ.	Max.	Unit
FR delay time	FR	t_{DFR}	CL=50pF	—	15	80	ns
DYO "H" delay time	DYO	t_{DOH}		—	70	200	ns
DYO "L" delay time		t_{DOL}		—	70	200	ns

Notes: 1. The output timing is valid in master mode.
2. Every timing is specified on the basis of 20% and 80% of VDD.

(3) Reset timing

V_{DD} = 5.0V±10%, Ta= -40 to 85℃

Item	Signal	Symbol	Condition	Min.	Typ.	Max.	Unit
Reset time		t_R		0.5	—	—	μs
Reset low pulse width	$\overline{RES}$	t_{RW}		0.5	—	—	μs

V_{DD} = 2.7V to 4.5V, Ta= -40 to +85℃

Item	Signal	Symbol	Condition	Min.	Typ.	Max.	Unit
Reset time		t_R		1.0	—	—	μs
Reset low pulse width	$\overline{RES}$	t_{RW}		1.0	—	—	μs

Notes: 1. The reset timing is specified on the basis of 20% and 80% of VDD.

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3.6 COMMAND LIST

Command	A0	RD	WR	D7	D6	D5	D4	D3	D2	D1	D0	Function
(1)Display ON/OFF	0	1	0	1	0	1	0	1	1	1	0 1	Turns on LCD panel when goes high, and turns off when goes low.
(2)Initial Display Line	0	1	0	0	1	Start display address						Specifies RAM display line for COM0.
(3)Set Page Address	0	1	0	1	0	1	1	Page address				Sets the display RAM page in page Address register.
(4)Set Column Address 4 higher bits	0	1	0	0	0	0	1	Higher column address				Sets 4 higher bits of column address of display RAM In register
(4)Set Column Address 4 lower bits	0	1	0	0	0	0	0	Lower column address				Sets 4 lower bits of column address of display RAM in register
(5)Read Status	0	0	1	Status				0	0	0	0	Reads the status information.
(6)Write Display Data	1	1	0	Write data								Writes data in display RAM.
(7)Read Display Data	1	0	1	Read data								Reads data in from display RAM.
(8)ADC Select	0	1	0	1	0	1	0	0	0	0	0 1	Sets normal relationship between RAM column address and segment driver when low, but reverses the relationship when high.
(9)Normal/Reverse Display	0	1	0	1	0	1	0	0	1	1	0 1	Normal indication when low, but full indication when high.
(10)Entire Display ON/OFF	0	1	0	1	0	1	0	0	1	0	0 1	Selects normal display (0) or Entire Display ON (1)
(11)Set LCD Bias	0	1	0	1	0	1	0	0	0	1	0 1	Sets LCD driver voltage bias ratio.
(12)Read-Modify-Write	0	1	0	1	1	1	0	0	0	0	0	Increments Column Address counter during each write when high and during each read when low.
(13)Ead	0	1	0	1	1	1	0	1	1	1	0	Releases the Read-Modify-Write.
(14)Reset	0	1	0	1	1	1	0	0	0	1	0	Resets internal functions.
(15)Set Output Status Register	0	1	0	1	1	0	0	0 1	*	*	*	Selects COM output scan direction. *Invalid data
(16)Set Powerl Control	0	1	0	0	0	1	0	1	Operation status			Selects the power circuit operation mode.
(17)Set Electronic Control Register	0	1	0	1	0	0	Electronic control value					Sets V5 output voltage to Electronic Control register.
(18)Set Standby	0	1	0	1	0	1	0	1	1	0	0 1	Selects standby status. 0:OFF 1:ON
(19)Power Save	—	—	—	—	—	—	—	—	—	—	—	Compound command of display OFF and entire display ON
(20)Test Command	0	1	0	1	1	1	1	*	*	*	*	IC Test command, Do not use!
(21)Test Mode Reset	0	1	0	1	1	1	1	0	0	0	0	Command of test mode reset.

Note: Do not use any other command, or the system malfunction may result.

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4 OPTICAL SPECIFICATION

4.1 OPTICAL CHARACTERISTICS

Ta = 25 °C

Item	Symbol	Condition	Min	Typ	Max	Unit	Note
Viewing Angle	θ1	CR≥2	40	-	-	deg	1
	θ2	CR≥2	40	-	-	deg	1
	θ3	CR≥2	45	-	-	deg	2
	θ4	CR≥2	45	-	-	deg	2
Frame frequency	fF	Ta = 25 °C	-	64	-	Hz	
Contrast Ratio	CR	Ta = 25 °C	9	11	-	-	3
Response Time	Tr	Ta = 25 °C	-	60	90	ms	4
	Tf	Ta = 25 °C	-	160	240		
Driving Method	Duty	1/33					
	Bias	1/6					
LCD Type	STN – Yellow (Positive / Reflective)						
Viewing Direction	6 O'CLOCK						

Note 1: definition of viewing angle θ1 & θ2   Note 2: definition of viewing angle θ3 & θ4
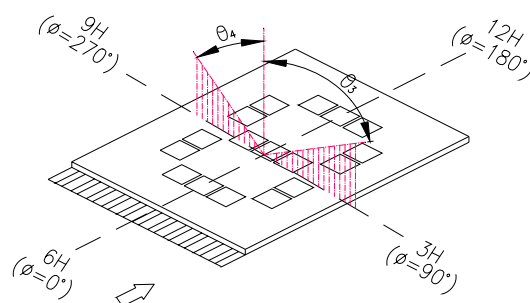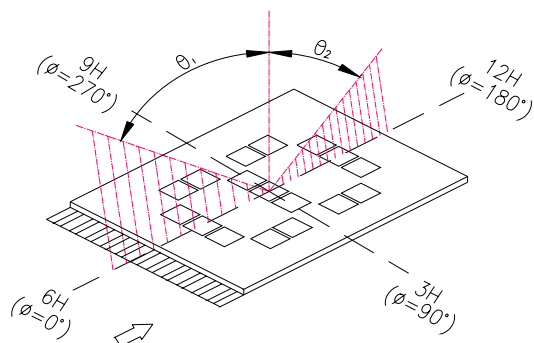
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Note 3: definition of contrast ratio (CR)

Intensity

100

Selected Wave

Non-selected Wave

Cr Max

Cr = Loff / Lon

Vop

Driving Voltage(V)

[positive type]

Intensity

100%

Selected Wave

Non-selected Wave

Cr Max

Cr = Lon / Loff

Vop

Driving Voltage(V)

[Negative type]
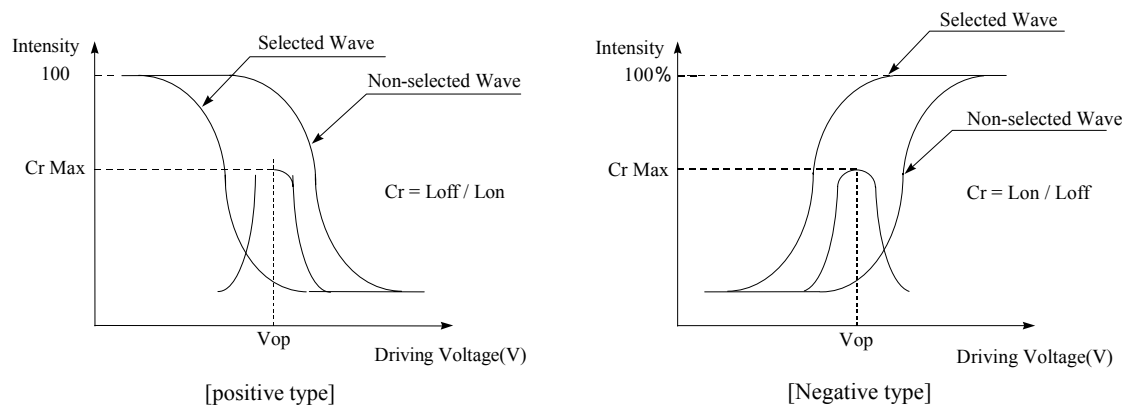
Note 4: definition of response time

Non-selected Condition

Selected Condition

Non-selected Condition

Intensity

10 %

100 %

90 %

Tr

Tf

[positive type]

Non-selected Condition

Selected Condition

Non-selected Condition

Intensity

100 %

90 %

10 %

Tr

Tf

[Negative type]

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4.2 BACKLIGHT SPECIFICATION

4.3 BACKLIGHT CHARACTERISTICS

Ta = 25 °C

Item	Symbol	Condition	Min	Typ	Max	Unit	Note
LED Input Voltage	VF	I_{LED} = 120mA	-	4.2	4.6	V	
LED Input Current	IF		-	120	180	mA	
Luminous Intensity	I_V	I_{LED} = 120mA	-	25	-	cd/m²	(on LCD)
LED Peak Emission Wavelength	λp	I_{LED} = 120mA		570		nm	
Brightness uniformity		I_{LED} = 120mA	80			%	
Colour	Yellow / Green						

4.4 INTERNAL CIRCUIT DIAGRAM

5 PACKAGING AND LABELLING SPECIFICATION

5.1 PACKAGING

5.1.1 Material

	Item	Part code	Unit weight (kg)	Quantity
1	Outer box			1
2	Inner box			5
3	Packing tray			5
4	UP card board			5
5	Antistatic bag			60
6	Display	LMR4900		300

5.2 PACKAGING SKETCH

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5.3 LABELLING & MARKING

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DENSITRON
LMR4900
Taiwan YYMM
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6   QUALITY ASSURANCE SPECIFICATION

6.1 CONFORMITY

The performance, function and reliability of the shipped products conform to the Product Specification.

6.2 DELIVERY ASSURANCE

6.2.1 Delivery inspection standards

- MIL-STD-105E, general inspection level II, single sampling level;
- IPC-AA610 rev. C, class 2 electronic assemblies standard

The quality assurance levels are shown below:

Class	AQL (%)
Critical defect	0.65%
Major defect	1.0%
Minor defect	2.5%
TOTAL	2.5%

6.2.2 Zone definition

A   Viewing area

B   Outside viewing area
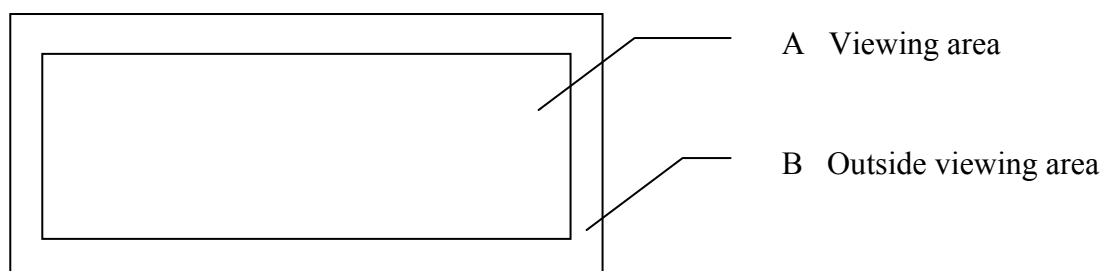
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## 6.2.3 Visual inspection

- Inspect under 2x20W or 40W fluorescent lamp (approximately 3000 lux) leaving 25 to 30 cm between the module and the lamp and 30 cm between the module and the eye (measuring position).
- Appearance is inspected at the best contrast voltage (best contrast is adjusted considering clearness and crosstalk on screen).
- Inspect the module at 45° right and left, top and bottom.
- Use the optimum viewing angle during the contrast inspection.
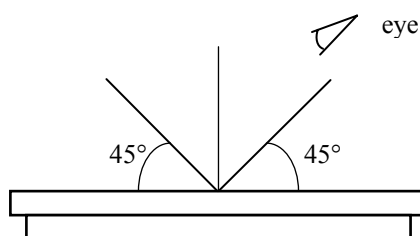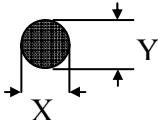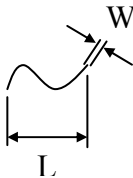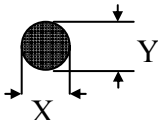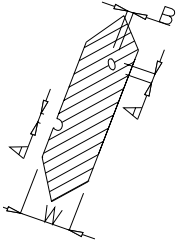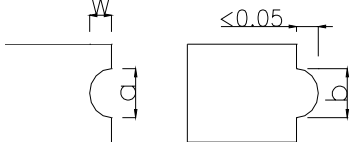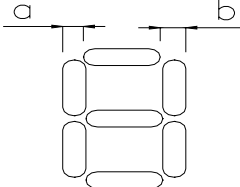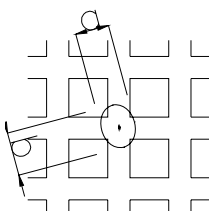
6.2.3.1 Standard of appearance inspection

Units: mm

Class	Item	Criteria			
Minor	Packing & Label	Outside & inside package	Presence of product no., lot no., quantity		
Critical		Product must not be mixed with others and quantity must not be different from that indicated on the label			
Major	Dimension	Product dimensions must be according to specification and drawing			
Major	Electrical	Product electrical characteristics must be according to specification			
Critical	LCD Display	Missing lines or wrong patterns on LCD display are not allowed			
Minor	Black spot, white spot, dust	Round type: as per following drawing $\varnothing = (X+Y)/2$			

Round type table:

Acceptable quantity		
Size	Zone A	Zone B
$\varnothing<0.1$	Any number	
$0.1<\varnothing<0.2$	2	
$0.2<\varnothing<0.25$	1	Any number
$0.25<\varnothing$	0	

Line type: as per following drawing

Acceptable quantity			
Length	Width	Zone A	Zone B
- -	$W\leq0.02$	Any number	
$L\leq3.0$	$0.02<W\leq0.03$	2	Any number
$L\leq2.5$	$0.03<W\leq0.05$		
- -	$0.05<W$	As round type	

Total acceptable quantity: 3

Class	Item	Criteria			
Minor	Polariser scratch	Scratch on protective film is permitted. Scratch on polariser: same as No. 1			
Minor	Polariser bubble	$\varnothing = (X+Y)/2$			

Polariser bubble table:

Acceptable quantity		
Size	Zone A	Zone B
$\varnothing<0.2$	Any number	
$0.2<\varnothing<0.5$	2	
$0.5<\varnothing<1.0$	1	Any number
$1.0<\varnothing$	0	
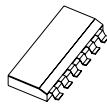
Total acceptable quantity: 3

Class	Item	Criteria
Minor	Segment deformation	1.a. Pin hole on segmented display W: segment width $\varnothing = (A+B)/2$ <table><tr><td colspan="2">Acceptable quantity</td></tr><tr><td>Width</td><td>$\varnothing$</td></tr><tr><td>W≤0.4</td><td>$\varnothing$≤0.2 and $\varnothing$≤1/2W</td></tr><tr><td>W>0.4</td><td>$\varnothing$≤0.25 and $\varnothing$≤1/3W</td></tr></table>Total acceptable quantity: 1 defect per segment Pin holes with $\varnothing$ under 0.10 mm are acceptable
Minor	Segment deformation	1b. Pin hole on dot matrix display <table><tr><td colspan="2">Acceptable quantity</td></tr><tr><td>Size</td><td></td></tr><tr><td>a,b<0.1</td><td>Any number</td></tr><tr><td>(a+b)/2≤0.1</td><td>Any number</td></tr><tr><td>0.5<$\varnothing$<1.0</td><td>3</td></tr></table>Total acceptable quantity: 7 2. Segments / dots with different width <table><tr><td colspan="2">Acceptable</td></tr><tr><td>a≥b</td><td>a/b≤4/3</td></tr><tr><td>a<b</td><td>a/b>4/3</td></tr></table> 3. Alignment layer defect $\varnothing = (a+b)/2$ <table><tr><td colspan="2">Acceptable quantity</td></tr><tr><td>Size</td><td></td></tr><tr><td>$\varnothing$≤0.4</td><td>Any number</td></tr><tr><td>0.4<$\varnothing$≤1.0</td><td>5</td></tr><tr><td>1.0<$\varnothing$≤1.5</td><td>3</td></tr><tr><td>1.5<$\varnothing$≤2.0</td><td>2</td></tr></table>Total acceptable quantity: 7
Minor	Colour uniformity	Level of sample for approval set as limit sample
Critical	Backlight	The backlight colour should correspond to the product specification
Critical		Flashing and or unlit backlight is not allowed
Minor		Dust larger than 0.25 mm is not allowed
Major	COB	Exposed wire bond pad is not allowed
Major		Insufficient covering with resin is not allowed (wire bond line exposed)
Minor		Dust or bubble on the resin are not allowed

Class	Item	Criteria		
Major	PCB	No unmelted solder paste should be present on PCB		
Critical		Cold solder joints, missing solder connections, or oxidation are not allowed		
Minor		No residue or solder balls on PCB are allowed		
Critical		Short circuits on components are not allowed		
Minor	Tray particles		Size	Quantity
		On tray	$\varnothing<0.2$	Any number
			$\varnothing>0.25$	4
		On display	$\varnothing\geq0.25$	2
			L = 3	1

6.3 DEALING WITH CUSTOMER COMPLAINTS

6.3.1 Non-conforming analysis

Purchaser should supply Densitron with detailed data of non-conforming sample.
After accepting it, Densitron should complete the analysis in two weeks from receiving the sample.
If the analysis cannot be completed on time, Densitron must inform the purchaser.

6.3.2 Handling of non-conforming displays

If any non-conforming displays are found during customer acceptance inspection which Densitron is clearly responsible for, return them to Densitron.
Both Densitron and customer should analyse the reason and discuss the handling of non-conforming displays when the reason is not clear.
Equally, both sides should discuss and come to agreement for issues pertaining to modification of Densitron quality assurance standard.

7 RELIABILITY SPECIFICATION

7.1 RELIABILITY TESTS

Test Item	Test Condition	Evaluation and assessment
High Temperature Operation	70˚C for 120 hours	No abnormalities in function* and appearance
Low Temperature Operation	-20˚C for 120 hours	No abnormalities in function* and appearance
High Temperature Storage	80˚C for 120 hours	No abnormalities in function* and appearance
Low Temperature Storage	-30˚C for 120 hours	No abnormalities in function* and appearance
High Temperature & High Humidity Storage	40C for 120 hours 90% R.H.	No abnormalities in function* and appearance
Vibration	10~55Hz at 5g 1 min cycle time 15	No abnormalities in function* and appearance

* Current consumption < 2 times initial value

* Contrast > ½ initial value

7.2 LIFE TIME

Item	Description
1	Function, performance, appearance, etc. shall be free from remarkable deterioration within 50,000 hours under ordinary operating and storage conditions of room temperature (25±10 °C), normal humidity (45±20% RH), and in area not exposed to direct sunlight.
2	Function, performance, appearance, etc. shall be free from remarkable deterioration within 5,000 hours under ordinary operating and storage conditions of 70 °C temperature, normal humidity (45±20% RH), and in area not exposed to direct sunlight.

8 PART NUMBER DESCRIPTIONS FOR AVAILABLE OPTIONS

LMR4900①②33G100③④⑤/ ⑥

①   **POLARIZER TYPE**
B = Transflective

②   **BACKLIGHT COLOUR**
G = Green

③   **FLUID TYPE AND TEMPERATURE RANGE**
W = Wide Temperature Range; on-board negative supply voltage generator

④   **FLUID TYPE AND TEMPERATURE COMPENSATION**
N = STN

⑤   **BACKGROUND COLOUR**
Y= Yellow background

⑥   **VDD SUPPLY VOLTAGE**
Blank = 5V
/ 3 = 3.3V

9 HANDLING PRECAUTIONS

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

Mounting and Design
Place a transparent plate (e.g. acrylic, polycarbonate or glass) on the display surface to protect the display from external pressure. Leave a small gap between the transparent plate and the display surface.
When assembling with a zebra connector, clean the surface of the pads with alcohol and keep the surrounding air very clean.
Design the system so that no input signal is given unless the power supply voltage is applied.

Caution during LCD cleaning
Lightly wipe the display surface with a soft cloth soaked with Isopropyl alcohol, Ethyl alcohol or Trichlorotriflorothane.
Do not wipe the display surface with dry or hard materials that will damage the polariser surface.
Do not use aromatic solvents (toluene and xylene), or ketonic solvents (ketone and acetone).

Caution against static charge
As the display uses C-MOS LSI drivers, connect any unused input terminal to VDD or VSS. Do not input any signals before power is turned on.
Also, ground your body, work/assembly table and assembly equipment to protect against static electricity.

Packaging
Displays use LCD elements, and must be treated as such. Avoid strong shock and drop from a height.
To prevent displays from degradation, do not operate or store them exposed directly to sunshine or high temperature/humidity.

Caution during operation
It is indispensable to drive the display within the specified voltage limit since excessive voltage shortens its life.
Direct current causes an electrochemical reaction with remarkable deterioration of the display quality. Give careful consideration to prevent direct current during ON/OFF timing and during operation.
Response time is extremely delayed at temperatures lower than the operating temperature range while, at high temperatures, displays become dark. However, this phenomenon is reversible and does not mean a malfunction or a display that has been permanently damaged.
If the display area is pushed on hard during operation, some graphics will be abnormally displayed but returns to a normal condition after turning off the display once.
Even a small amount of condensation on the contact pads (terminals) can cause an electro-chemical reaction which causes missing rows and columns. Give careful attention to avoid condensation.

Storage
Store the display in a dark place where the temperature is 25°C ± 10°C and the humidity below 50%RH.
Store the display in a clean environment, free from dust, organic solvents and corrosive gases.
Do not crash, shake or jolt the display (including accessories).

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