

LIQUID CRYSTAL DISPLAY MODULE

Product Specification

CUSTOMER	Standard	
PRODUCT NUMBER	LMR4836	
CUSTOMER APPROVAL		Date

INTERNAL APPROVALS		
Product Mgr	Doc Control	Electr. Eng
Bruno Recaldini	Anthony Perkins	Bazile Peter
Date:20/09/06	Date: 20/09/06	Date: 20/09/06

- Approval for Specification only
- Approval for Specification and Sample

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REVISION RECORD

Rev.	Date	Page	Chapt.	Comment	ECR no.
A	20/09/06			Product release	

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1 MAIN FEATURES

ITEM	CONTENTS
Display Format	160 x 160 dots
Overall Dimensions	74.5 x 70.5 x 12.2 (w/o PV and TC) 74.5 x 70.5 x 14.6 (with PV and TC)
Viewing Area	58 x 58
LCD type	STN or FSTN
Mode	Transflective
Viewing Angle	6 O clock
Duty ratio	1 / 160
Driver IC	Raio RA8835
Backlight type	LED
Backlight colour	Yellow Green
DC/DC converter	Optional
Temperature compensation	Optional
Operating temperature	-20 ~ +70°C
Storage temperature	-30 ~ +80°C
RoHS status	Compliant

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2 MECHANICAL SPECIFICATION

2.1 MECHANICAL CHARACTERISTICS

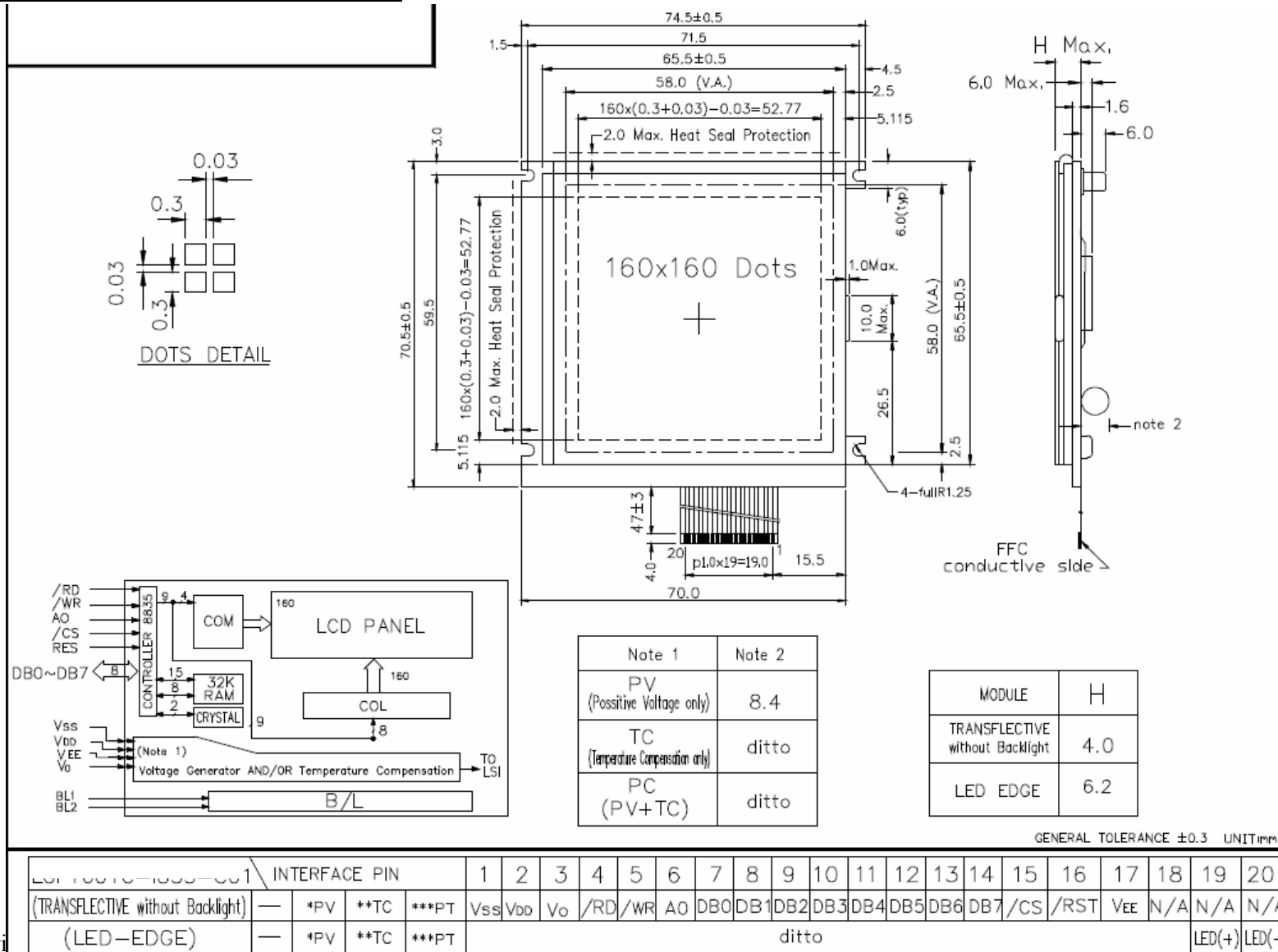
ITEM	CHARACTERISTIC	UNIT
Display Format	160 x 160 dots	
Overall Dimensions	74.5 x 70.5 x 12.2 (w/o PV and TC) 74.5 x 70.5 x 14.6 (with PV and TC)	mm
Viewing Area	58 x 58	mm
Active Area	52.77 x 52.77	mm
Dot Size	0.3 x 0.3	mm
Dot spacing	0.03	mm
IC Controller/Driver	Raio RA8835	

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DENSITRON® DISPLAYS

2.2 MECHANICAL DRAWING



Copyri

- * Positive Voltage Built In , Pin 3 ;Pin 17 To External Contrast VR.
- **Temperature Compensation Built In , Pin 3 N/C ; Pin 17(VEE) To External Voltage.
- *** Positive Voltage & Temperature Compensation Built In , Both Pin 3 & Pin 17 N/C.

M No.

3 ELECTRICAL SPECIFICATION

3.1 ABSOLUTE MAXIMUM RATINGS

Ta = 25 °C

Item	Symbol	Min	Max	Unit	Note
Power Supply Voltage	V _{DD}	0	7	V	50±10%RH
Operating Temperature		-20	+70	°C	<65%RH (wide temp)
Storage Temperature		-30	+80	°C	<65%RH (wide temp)
Humidity	H	20	+90	%RH	<48Hrs
		20	+65	%RH	<1000hrs
Static Electricity	Be sure that you are grounded when handling displays.				

3.2 ELECTRICAL CHARACTERISTICS

VSS = 0 V, Ta = 25 °C

Item	Symbol	Condition	Min	Typ	Max	Unit
Operating voltage	V _{DD}		4.75	5.0	5.25	V
Input voltage High	V _{IHC}		0.8 V _{DD}	-	V _{DD}	V
Input voltage Low	V _{ILC}		0	-	0.2 V _{DD}	V
LCD driving voltage	V _O - V _{SS}		6.0	V	28	V

3.2.1 Current Consumption & Driving Voltage

	FSTN Temperature	STN Temperature
Supply Current (IDD) Typ mA	9	9
Supply Current (IEE) Typ mA	2	2
Supply Voltage (VEE) Typ	+24	+24

3.2.2 Recommended LCD drive voltage

		FSTN Temperature	STN Temperature
LCD driving voltage	Ta=70°C	20.6	18.6
	Ta=50 °C	18.0	17.7
	Ta=25 °C	16.5	17.0
	Ta=0 °C	15.6	16.2
	Ta=-20 °C	14.7	15.1

3.2.3 Single +5V Operation (with optional DC/DC not including B/L)

Negative voltage (NV) built in. IDD = 120mA typ

Negative voltage (NV) and Temperature compensation (TC) built in. IDD = 85mA typ.

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3.3 INTERFACE PIN ASSIGNMENT

No.	Symbol	Level	Function
1	V _{SS}	-	Ground
2	V _{DD}	-	Power supply for logic
3	V _O	-	Voltage level for LCD Control adjustment
4	/RD	H/L	8080 family: Read signal 6800 family: Enable clock (E)
5	/WR	H/L	8080 family: Write signal 6800 family: R/W signal
6	A0	H/L	Data type select Note 1
7	DB0	H/L	Display data 0
8	DB1	H/L	Display data 1
9	DB2	H/L	Display data 2
10	DB3	H/L	Display data 3
11	DB4	H/L	Display data 4
12	DB5	H/L	Display data 5
13	DB6	H/L	Display data 6
14	DB7	H/L	Display data 7
15	/CS	H/L	Chip select
16	/RST	L	Reset signal
17	V _{ee}	-	Alternative power supply
18	N/C		No connection
19	LED+	-	Anode of LED B/L
20	LED-		Cathode of LED B/L

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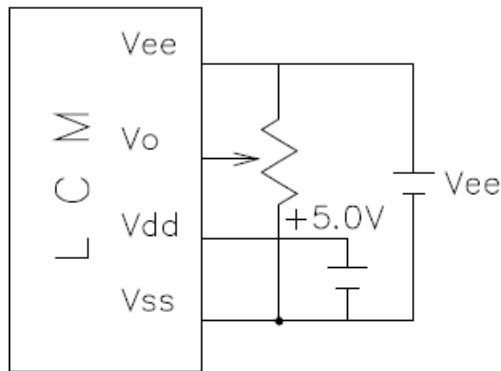
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Note 1: A0, in conjunction with the /RD and /WR or R/W and E signals control the type of access to the RA8835. The description is below.

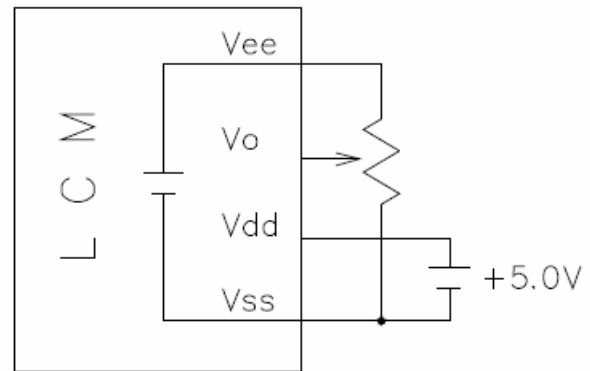
A0	/RD	/WR	Function
0	0	1	Status flag read
1	0	1	Display data and cursor address read
0	1	0	Display data and parameter write
1	1	0	Command

This LCM is set to be controlled by 8080 family MPU

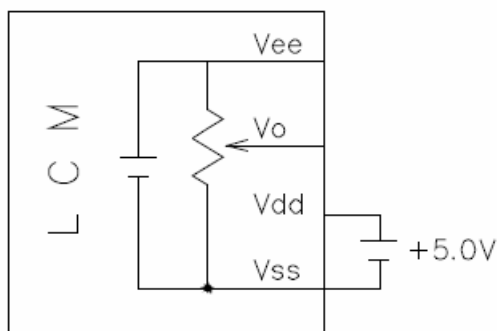
3.4 POWER SUPPLY CIRCUIT



Positive Voltage not built in



Positive Voltage built in



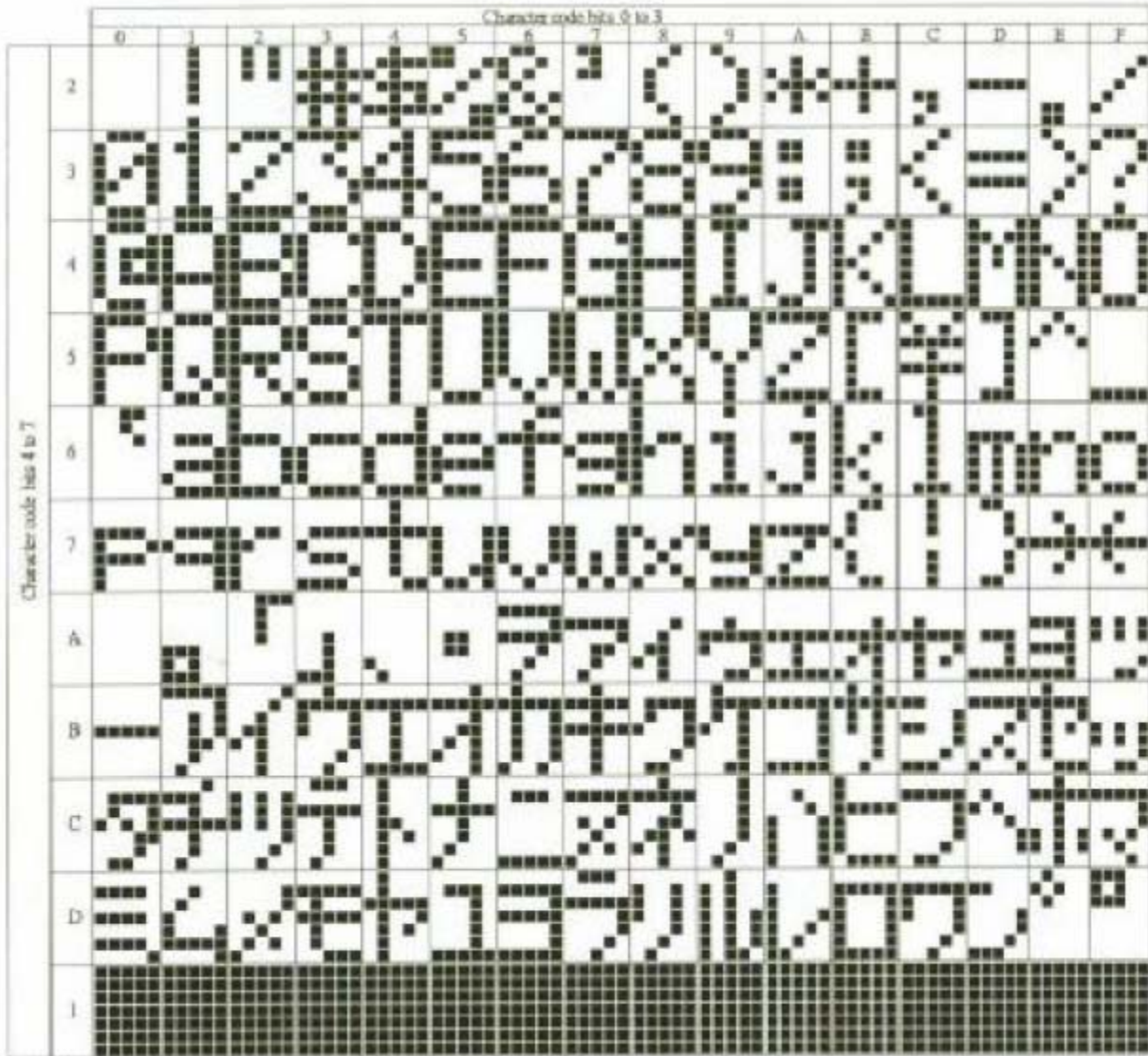
Positive Voltage and Temperature Compensation built in

RECOMMENDED V_R : 10K ohm ~ 20K ohm

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3.5 CHARACTER GENERATOR ROM MAP



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3.6 Character Codes

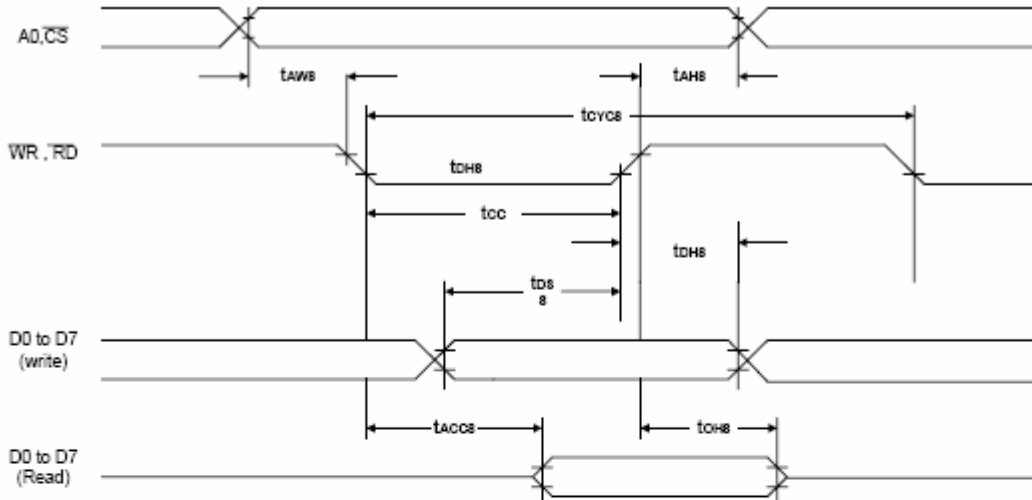
The following figures shows the character codes and the codes allocated to CG RAM. All codes can be used by the CG RAM if not using the internal ROM.

Lower 4bits	Upper 4bits															
	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
0				0	@	P	'	p								
1			!	1	A	Q	a	q								
2			"	2	B	R	b	r								
3			#	3	C	S	c	s								
4			\$	4	D	T	d	t								
5			&	5	E	U	e	u								
6			%	6	F	V	f	v								
7			·	7	G	W	g	w								
8			(	8	H	X	h	x								
9			)	9	I	Y	i	y								
A			*	:	J	Z	j	z								
B			+	;	K	[	k	{								
C			,	<	L	¥	l	!								
D			·	=	M	]	m	}								
E			-	>	N	^	n	→								
F			/	?	O	_	o	←								

The diagram below the table shows two memory blocks, CG RAM 1 and CG RAM 2. Arrows point from the bottom of the table to these blocks. A control signal M1 is shown with two states: M1=0 and M1=1. M1=0 is connected to CG RAM 1, and M1=1 is connected to CG RAM 2.

3.7 TIMING CHARECTERISTICS

3.7.1 8080 Family Interface timing



$T_a = -20 \text{ to } 75^\circ\text{C}$

Signal	Symbol	Parameter	$V_{DD} = 4.5 \text{ to } 5.5\text{V}$		$V_{DD} = 2.7 \text{ to } 4.5\text{V}$		Unit	Condition
			Min.	Max.	Min.	Max.		
A_0, \overline{CS}	t_{AH8}	Address hold time	10	—	10	—	ns	CL = 100pF
	t_{AW8}	Address setup time	0	—	0	—	ns	
$\overline{WR}, \overline{RD}$	t_{CYC8}	System cycle time	note.	—	note.	—	ns	
	t_{CC}	Strobe pulse width	120	—	150	—	ns	
D0 to D7	t_{DS8}	Data setup time	120	—	120	—	ns	
	t_{DH8}	Data hold time	5	—	5	—	ns	
	t_{ACC8}	\overline{RD} access time	—	50	—	80	ns	
	t_{OH8}	Output disable time	10	50	10	55	ns	

Note: For memory control and system control commands:

$$t_{CYC8} = 2t_c + t_{CC} + t_{CEA} + 75 > t_{ACV} + 245$$

For all other commands:

$$t_{CYC8} = 4t_c + t_{CC} + 30$$

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4 OPTICAL SPECIFICATION

4.1 OPTICAL CHARACTERISTICS

4.1.1 STN Type

Ta = 25 °C

Item	Symbol	Condition	Min	Typ	Max	Unit	Note
Viewing Angle	θ1	CR≥2	-	40	-	deg	1
	θ2	CR≥2	-	35	-	deg	1
	θ3	CR≥2	-	35	-	deg	2
	θ4	CR≥2	-	35	-	deg	2
Contrast Ratio	CR	Ta = 25 °C	-	2.5	-	-	3
Response Time	Tr	Ta = 25 °C	-	220	-	ms	4
	Tf	Ta = 25 °C	-	300	-		
Driving Method	Duty	1/160					
	Bias	1/15					
LCD Type	STN						
Viewing Direction	6 O'CLOCK						

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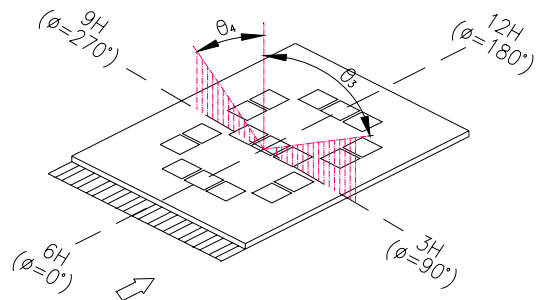
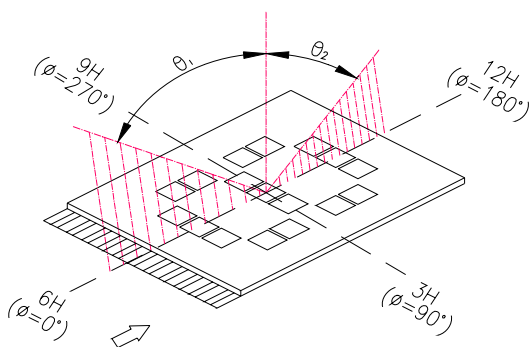
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4.1.2 FSTN Type

Item	Symbol	Condition	Min	Typ	Max	Unit	Note
Viewing Angle	θ_1	$CR \geq 2$	-	40	-	deg	1
	θ_2	$CR \geq 2$	-	40	-	deg	1
	θ_3	$CR \geq 2$	-	40	-	deg	2
	θ_4	$CR \geq 2$	-	40	-	deg	2
Contrast Ratio	CR	$T_a = 25\text{ }^\circ\text{C}$	-	3	-	-	3
Response Time	Tr	$T_a = 25\text{ }^\circ\text{C}$	-	260	-	ms	4
	Tf	$T_a = 25\text{ }^\circ\text{C}$	-	280	-		
Driving Method	Duty	1/160					
	Bias	1/15					
LCD Type	FSTN						
Viewing Direction	6 O'CLOCK						

Note 1: definition of viewing angle θ_1 & θ_2

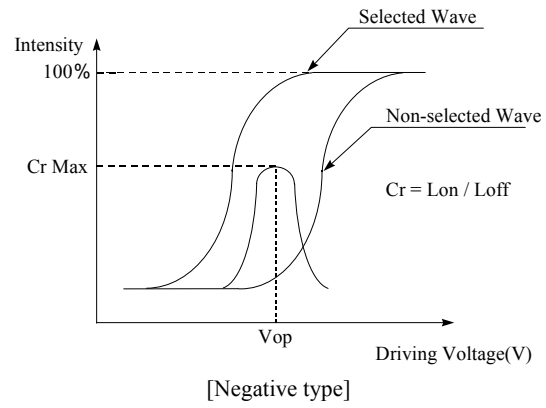
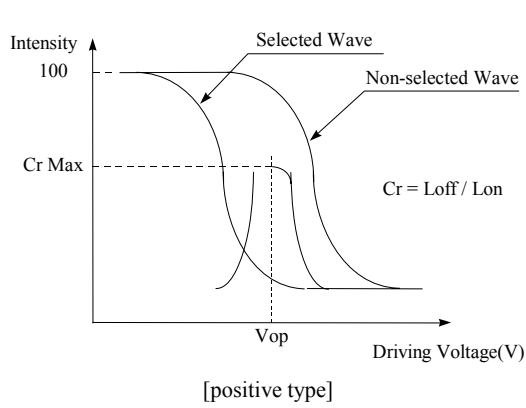
Note 2: definition of viewing angle θ_3 & θ_4



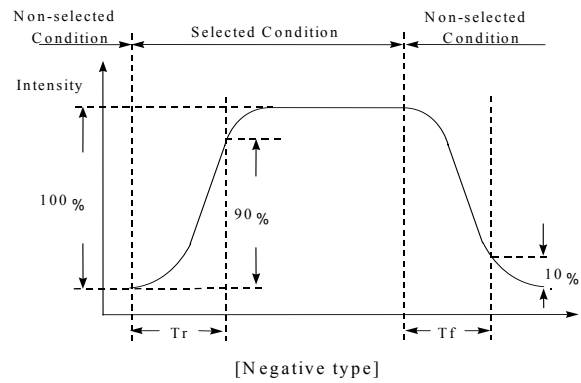
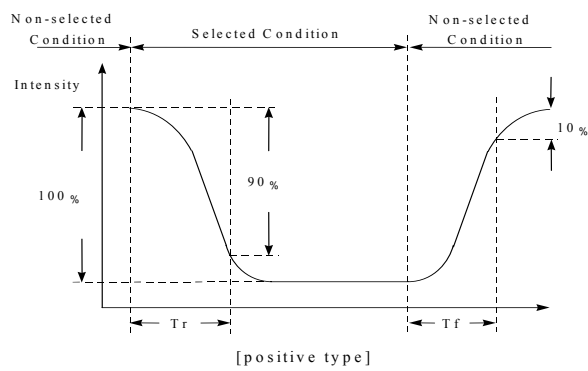
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Note 3: definition of contrast ratio (CR)



Note 4: definition of response time



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5 BACKLIGHT SPECIFICATION

5.1 BACKLIGHT CHARACTERISTICS

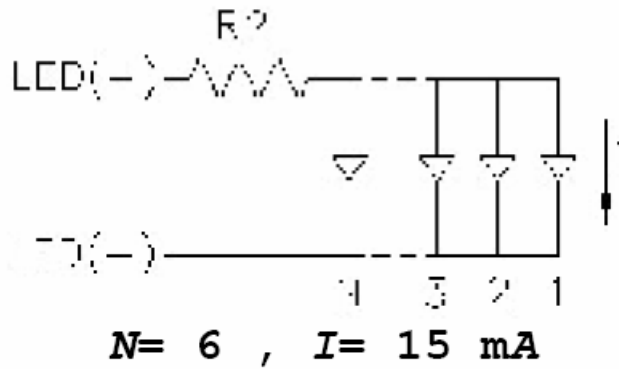
5.1.1 LED backlight

Ta=25°C

Item	Symbol	Condition	Min	Typ	Max	Unit	Note
Input Voltage	V _{LED}		--	5	--	V	
Input Current	I _{LED}		--	100	--	mA	
Average Brightness Ta=25°C IL=120mA Backlight only	Test when connecting after 3min. (max contrast)		10	--	--	cd/m ²	2
Emission wave length	I _{LED} = 100mA		570	--	575		
Brightness Uniformity	I _{LED} = 100mA		75	--	--	%	3
Life time	I _{LED} = 100mA Humidity: 30%RH ~ 85%RH		--	40000	--	hrs	4
Colour	Yellow Green						
Operating Temp	Humidity: 30%RH ~85%RH		-20	-	70	°C	
Storage Temp	Humidity: 30%RH ~85%RH		-30	-	80	°C	
Limit resistor (R2)	Ta=25°C		-	30		Ohm	1

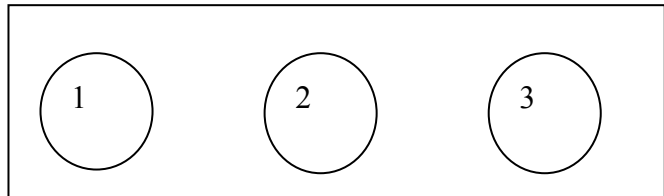
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Note:

1. R2 resistor is built in B/L
2. Average brightness of 3 points when B/L is used at the beginning
3. Brightness uniformity = (Min/Max) x 100%
4. Half of the original average brightness



6 LABELLING & MARKING

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7 QUALITY ASSURANCE SPECIFICATION

7.1 CONFORMITY

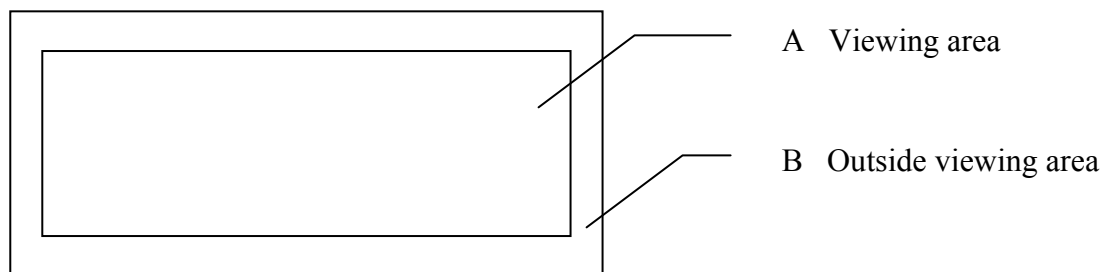
The performance, function and reliability of the shipped products conform to the Product Specification.

7.2 DELIVERY ASSURANCE

7.2.1 Delivery inspection standards

- IPC-AA610 class 2 electronic assemblies standard

7.2.2 Zone definition

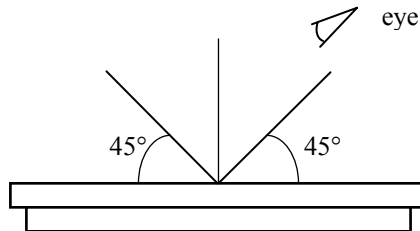


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7.2.3 Visual inspection

- 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.

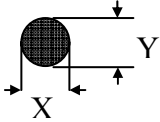
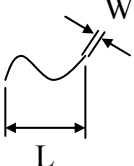
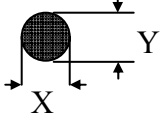


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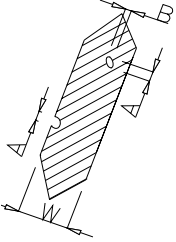
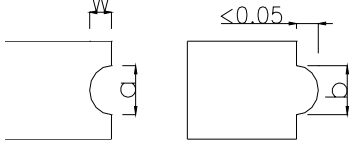
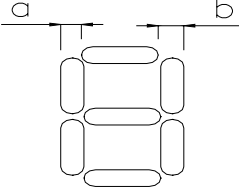
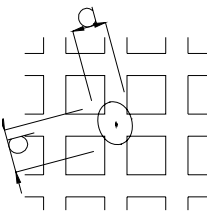
7.2.3.1 Standard of appearance inspection

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	<p>Round type: as per following drawing $\varnothing = (X+Y)/2$</p> <div style="display: flex; align-items: center; justify-content: center;">  <table border="1" style="margin-left: 20px;"> <thead> <tr> <th colspan="3">Acceptable quantity</th> </tr> <tr> <th>Size</th> <th>Zone A</th> <th>Zone B</th> </tr> </thead> <tbody> <tr> <td>$\varnothing < 0.2$</td> <td>Any number</td> <td rowspan="3">Any number</td> </tr> <tr> <td>$0.2 < \varnothing < 0.25$</td> <td>3</td> </tr> <tr> <td>$0.25 < \varnothing$</td> <td>0</td> </tr> </tbody> </table> </div> <p>Line type: as per following drawing</p> <div style="display: flex; align-items: center; justify-content: center;">  <table border="1" style="margin-left: 20px;"> <thead> <tr> <th colspan="4">Acceptable quantity</th> </tr> <tr> <th>Length</th> <th>Width</th> <th>Zone A</th> <th>Zone B</th> </tr> </thead> <tbody> <tr> <td>--</td> <td>$W \leq 0.03$</td> <td>Any number</td> <td rowspan="3">Any number</td> </tr> <tr> <td>$L \leq 3.0$</td> <td>$0.03 < W \leq 0.05$</td> <td rowspan="2">2</td> </tr> <tr> <td>--</td> <td>$0.05 < W$</td> </tr> <tr> <td>--</td> <td>--</td> <td>As round type</td> <td></td> </tr> </tbody> </table> </div> <p style="text-align: center;">Total acceptable quantity: 5</p>	Acceptable quantity			Size	Zone A	Zone B	$\varnothing < 0.2$	Any number	Any number	$0.2 < \varnothing < 0.25$	3	$0.25 < \varnothing$	0	Acceptable quantity				Length	Width	Zone A	Zone B	--	$W \leq 0.03$	Any number	Any number	$L \leq 3.0$	$0.03 < W \leq 0.05$	2	--	$0.05 < W$	--	--	As round type	
Acceptable quantity																																				
Size	Zone A	Zone B																																		
$\varnothing < 0.2$	Any number	Any number																																		
$0.2 < \varnothing < 0.25$	3																																			
$0.25 < \varnothing$	0																																			
Acceptable quantity																																				
Length	Width	Zone A	Zone B																																	
--	$W \leq 0.03$	Any number	Any number																																	
$L \leq 3.0$	$0.03 < W \leq 0.05$	2																																		
--	$0.05 < W$																																			
--	--	As round type																																		
Minor	Polariser scratch	Scratch on protective film is permitted Scratch on polariser: same as No. 1																																		
Minor	Polariser bubble	<p>$\varnothing = (X+Y)/2$</p> <div style="display: flex; align-items: center; justify-content: center;">  <table border="1" style="margin-left: 20px;"> <thead> <tr> <th colspan="3">Acceptable quantity</th> </tr> <tr> <th>Size</th> <th>Zone A</th> <th>Zone B</th> </tr> </thead> <tbody> <tr> <td>$\varnothing < 0.2$</td> <td>Any number</td> <td rowspan="4">Any number</td> </tr> <tr> <td>$0.2 < \varnothing < 0.5$</td> <td>3</td> </tr> <tr> <td>$0.5 < \varnothing < 1.0$</td> <td>1</td> </tr> <tr> <td>$1.0 < \varnothing$</td> <td>0</td> </tr> </tbody> </table> </div> <p style="text-align: center;">Total acceptable quantity: 4</p>	Acceptable quantity			Size	Zone A	Zone B	$\varnothing < 0.2$	Any number	Any number	$0.2 < \varnothing < 0.5$	3	$0.5 < \varnothing < 1.0$	1	$1.0 < \varnothing$	0																			
Acceptable quantity																																				
Size	Zone A	Zone B																																		
$\varnothing < 0.2$	Any number	Any number																																		
$0.2 < \varnothing < 0.5$	3																																			
$0.5 < \varnothing < 1.0$	1																																			
$1.0 < \varnothing$	0																																			

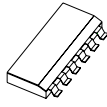
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Class	Item	Criteria																												
Minor	Segment deformation	<p>1.a. Pin hole on segmented display</p> <p>W: segment width $\varnothing = (A+B)/2$</p>  <table border="1" style="margin-left: auto; margin-right: auto;"> <thead> <tr> <th colspan="2">Acceptable quantity</th> </tr> <tr> <th>Width</th> <th>Ø</th> </tr> </thead> <tbody> <tr> <td>W ≤ 0.4</td> <td>Ø ≤ 0.2 and Ø ≤ 1/2W</td> </tr> <tr> <td>W > 0.4</td> <td>Ø ≤ 0.25 and Ø ≤ 1/3W</td> </tr> </tbody> </table> <p>Total acceptable quantity: 1 defect per segment Pin holes with Ø under 0.10 mm are acceptable</p>	Acceptable quantity		Width	Ø	W ≤ 0.4	Ø ≤ 0.2 and Ø ≤ 1/2W	W > 0.4	Ø ≤ 0.25 and Ø ≤ 1/3W																				
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Minor	Segment deformation	<p>1b. Pin hole on dot matrix display</p>  <table border="1" style="margin-left: auto; margin-right: auto;"> <thead> <tr> <th colspan="2">Acceptable quantity</th> </tr> <tr> <th>Size</th> <th></th> </tr> </thead> <tbody> <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 < Ø < 1.0</td> <td>3</td> </tr> </tbody> </table> <p>Total acceptable quantity: 7</p> <p>2. Segments / dots with different width</p>  <table border="1" style="margin-left: auto; margin-right: auto;"> <thead> <tr> <th colspan="2">Acceptable</th> </tr> <tr> <th>a ≥ b</th> <th>a/b ≤ 4/3</th> </tr> <tr> <th>a < b</th> <th>a/b > 4/3</th> </tr> </thead> </table> <p>3. Alignment layer defect</p> <p>Ø = (a+b)/2</p>  <table border="1" style="margin-left: auto; margin-right: auto;"> <thead> <tr> <th colspan="2">Acceptable quantity</th> </tr> <tr> <th>Size</th> <th></th> </tr> </thead> <tbody> <tr> <td>Ø ≤ 0.4</td> <td>Any number</td> </tr> <tr> <td>0.4 < Ø ≤ 1.0</td> <td>5</td> </tr> <tr> <td>1.0 < Ø ≤ 1.5</td> <td>3</td> </tr> <tr> <td>1.5 < Ø ≤ 2.0</td> <td>2</td> </tr> </tbody> </table> <p>Total acceptable quantity: 7</p>	Acceptable quantity		Size		a, b < 0.1	Any number	(a+b)/2 ≤ 0.1	Any number	0.5 < Ø < 1.0	3	Acceptable		a ≥ b	a/b ≤ 4/3	a < b	a/b > 4/3	Acceptable quantity		Size		Ø ≤ 0.4	Any number	0.4 < Ø ≤ 1.0	5	1.0 < Ø ≤ 1.5	3	1.5 < Ø ≤ 2.0	2
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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																												

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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

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7.3 DEALING WITH CUSTOMER COMPLAINTS

7.3.1 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.

7.3.2 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.

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8 RELIABILITY SPECIFICATION

8.1 RELIABILITY TESTS

Test Item	Test Condition	Evaluation and assessment
High Temperature Operation	70°C ±2°C for 240 hours	No abnormalities in function* and appearance
Low Temperature Operation	-20°C ±2°C for 240 hours	No abnormalities in function* and appearance
Thermal Shock Storage	-30°C (30 min) ->25°C (5 min) - >80°C (30 min) - >25°C (5 min) 5 cycles	No abnormalities in function* and appearance
Vibration	10Hz ~ 55Hz 0.3mm / 1 Octave 55Hz ~ 500Hz 3g / 1 Octave 20 cycle / per axis	No abnormalities in function* and appearance

* Current consumption 3 times initial value

* Contrast > ½ initial value

8.2 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.

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9 PART NUMBER DESCRIPTIONS FOR AVAILABLE OPTIONS

LMR4836①②160G160③④⑤

- ① **POLARIZER TYPE**
B = Transflective: light background
- ② **BACKLIGHT COLOUR**
G = Green Yellow
- ③ **FLUID TYPE AND POWER SUPPLY**
W = Wide Temperature Range; on-board negative supply voltage generator
H = Wide Temperature Range
- ④ **TEMPERATURE COMPENSATION**
C = with on board temperature compensation circuitry
N = No on board temperature compensation and NTN Fluid
- ⑤ **FLUID TYPE**
F = FSTN
Y = STN (Yellow)
G = STN (Gray)

10 HANDLING PRECAUTIONS

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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 Trichlorotrifluoroethane.

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 $25^{\circ}\text{C} \pm 10^{\circ}\text{C}$ 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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