LIQUID CRYSTAL DISPLAY MODULE

Product Specification

CUSTOMER	Standard	
PRODUCT NUMBER	**LMR4855 / LMR6855**	
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	320 x 240 dots
Overall Dimensions	165.5 x 109.0 x 14.0 (w/o NV and TC) LED 165.5 x 109.0 x 18.2 (with NV and TC) LED 173.0 x 109.0 x 14.0 (w/o NV and TC) CCFL 173.0 109.0 18.2 (with NV and TC) CCFL
Viewing Area	122 x 92
LCD type	STN Blue mode or FSTN
Mode	Transflective or Transmissive
Viewing Angle	6 O clock
Duty ratio	1 / 240
Driver IC	Raio RA8835
Backlight type	LED LMR4855 CCFL LMR6855
Backlight colour	White
DC/DC converter	Optional
Temperature compensation	Optional
Operating temperature wide	-20 ~ +70˚C
Operating temperature standard	0 ~ 50˚C
Storage temperature wide	-30 ~ +80˚C
Storage temperature standard	-20 ~ +70˚C
RoHS status	Compliant

2 MECHANICAL SPECIFICATION

2.1 MECHANICAL CHARACTERISTICS

ITEM	CHARACTERISTIC	UNIT
Display Format	320 x 240 dots	
Overall Dimensions	165.5 x 109.0 x 14.0 (w/o NV and TC) LED type 165.5 x 109.0 x 18.2 (with NV and TC) LED type 173.0 x 109.0 x 14.0 (w/o NV and TC) CCFL type 173 x 109.0 x 18.2 (with NV and TC) CCFL type	mm
Viewing Area	122 x 92	mm
Active Area	115.185 x 86.385	mm
Dot Size	0.345 x 0.345	mm
Dot spacing	0.015	mm
IC Controller/Driver	Raio RA8835	

2.2 MECHANICAL DRAWING

320X240 Dots

Interface Pin				1	2	3	4	5	6	7	~	14	15	16	17	18	19	20	BL1	BL2
CCFT	*(NV)	**(TC)	***(NT)	Vss	VDD	Vo	/RD	/WR	AO	DB0	~	DB7	/CS	/RST	VEE	NC	NC	NC	CCFT	CCFT
LED(EDGE)	*(NV)	**(TC)	***(NT)							Ditto									LED(+)	LED(−)

*Negative Voltage Built In Pin 17 ; Pin 3 To External Contrast VR.
**Temperature Compensation Built In Pin 3 N/C;Pin 17(VEE) To External Voltage.
***Negative Voltage & Temperature Compensation Built In Both Pin 17 & Pin 3 N/C.
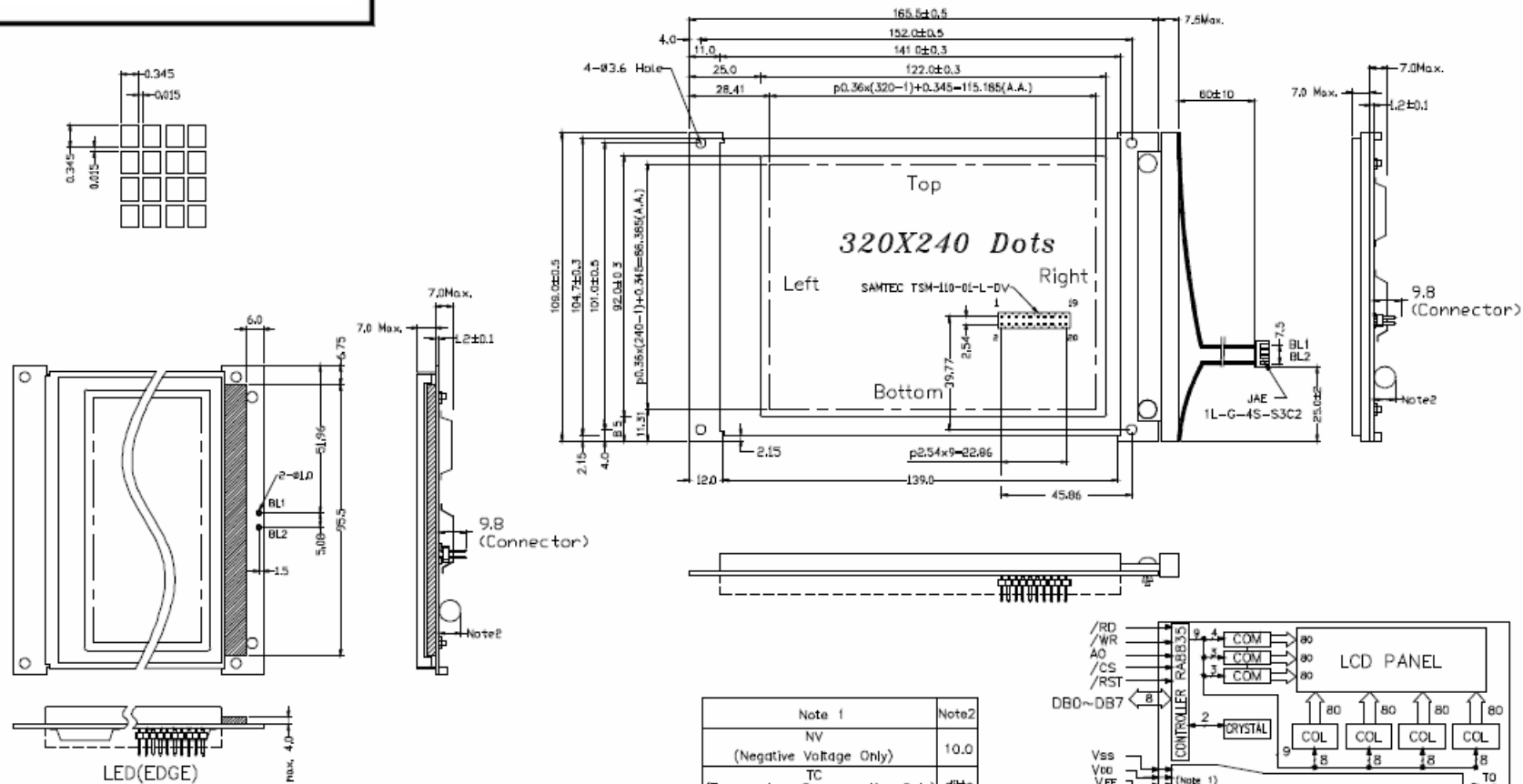
Note:1.Pls reference the right drawing if missing dimension.
     2. 1/13 BIOS

General tollerance ±;0.2 , Unit:mm

	Note 1	Note2
NV (Negative Voltage Only)		10.0
TC (Temperature Compensation Only)		ditto
NT (NV+TC)		ditto

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	
Operating Temperature	Topr	0	50	°C	<65%RH (standard temp)
		-20	+70	°C	<65%RH (wide temp)
Storage Temperature	Tstg	-20	+70	°C	<65%RH (standard temp)
		-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	-	5.25	V
Input voltage High	V_{IHC}		3.8	-	V_{DD}	V
Input voltage Low	V_{ILC}		0	-	1.0	V
LCD driving voltage	$V_{DD}-V_O$		6.0	V	28	V

3.2.1 Current Consumption & Driving Voltage

	FSTN Temperature (Positive)		FSTN Temperature (Negative)		STN Temperature	
	Standard	Wide	Standard	Wide	Standard	Wide
Supply Current (I$_{DD}$) Typ mA	10	10	10	10	10	10
Supply Current (IEE) Typ mA	6	6	6	6	6	6
Supply Voltage (VEE) Typ	-22	-22	-22	-22	-22	-22

3.2.2 Recommended LCD drive voltage

		FSTN Temperature (Positive)		FSTN Temperature (Negative)		STN Temperature	
		Standard	Wide	Standard	Wide	Standard	Wide
LCD driving voltage	Ta=70ºC	N/A	24.5	N/A	24.4	N/A	25.3
	Ta=50 ºC	23.3	23.3	23.0	23.0	23.7	23.7
	Ta=25 ºC	22.5	22.5	22.2	22.2	22.8	22.7
	Ta=0 ºC	21.7	21.7	21.4	21.4	21.7	21.4
	Ta=-20 ºC	N/A	21.7	N/A	20.4	N/A	20.4

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

Negative voltage (NV) built in. I$_{DD}$ = 85mA typ
Negative voltage (NV) and Temperature compensation (TC) built in. I$_{DD}$ = 85mA typ.

3.3 INTERFACE PIN ASSIGNMENT CCFL

No.	Symbol	Level	Function
1	V$_{SS}$	-	Ground
2	V$_{DD}$	-	Power supply for logic
3	Vo	-	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	Vee	-	Alternative power supply
18	N/C		No connection
19	N/C		No connection
20	N/C		No connection
BL1	CCFT		CCFT
BL2	CCFT		CCFT

3.4 INTERFACE PIN ASSIGNMENT LED

| No.	Symbol	Level	Function
1	V$_{SS}$	-	Ground
2	V$_{DD}$	-	Power supply for logic
3	Vo	-	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	Vee	-	Alternative power supply
18	N/C	-	No connection
19	N/C		No connection
20	N/C		No connection
BL1	LED(+)	H	Anode of LED B/L
BL2	LED(-)	L	Cathode of LED B/L

Note 1: A0, in conjuction 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

## 3.5 POWER SUPPLY CIRCUIT
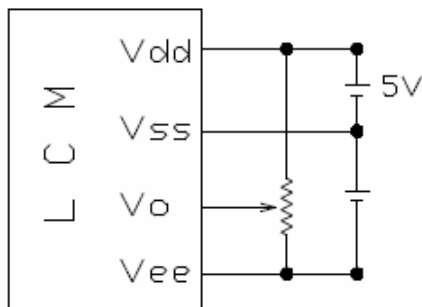
NEGATIVE VOLTAGE NOT BUILD IN
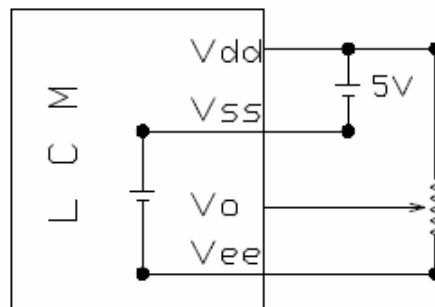
NEGATIVE VOLTAGE BUILD IN
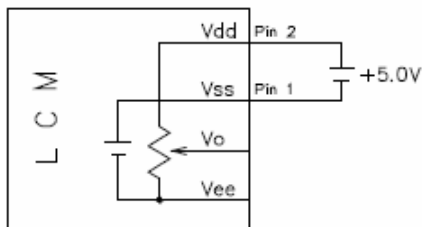
Negative Voltage and Temperature Compensation built in

RECOMMENDED VR : 10K ohm ~ 20K ohm

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3.6 CHARACTER GENERATOR ROM MAP
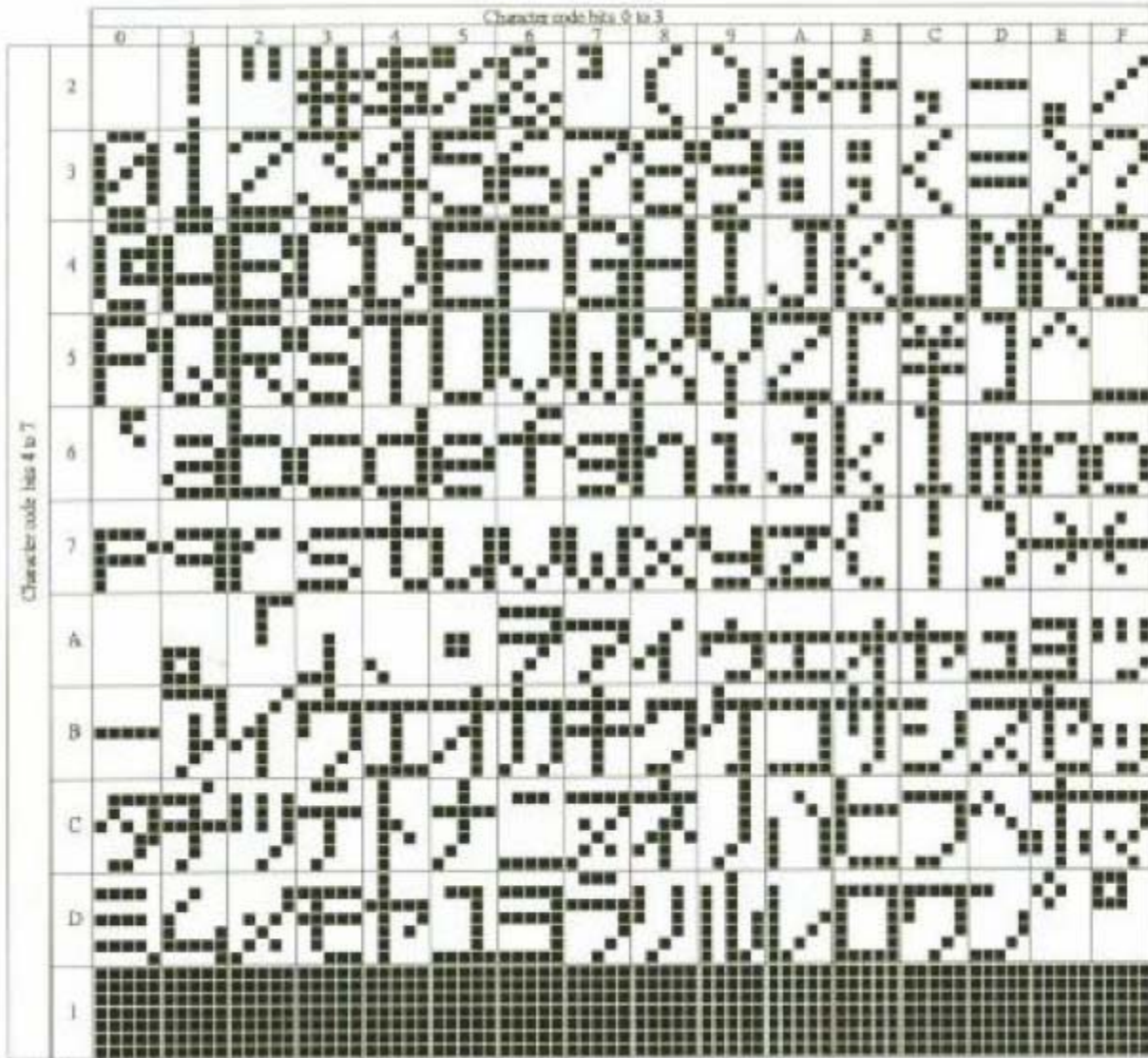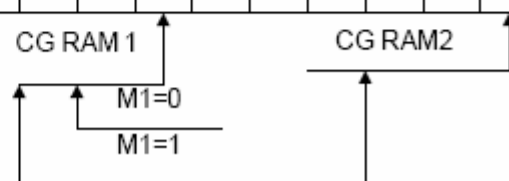
3.7 Character Codes

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 4bites	Upper 4bites															
	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	←								

CG RAM 1   CG RAM2

M1=0
M1=1

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3.8 TIMING CHARECTERISTICS

3.8.1 8080 Family Interface timing
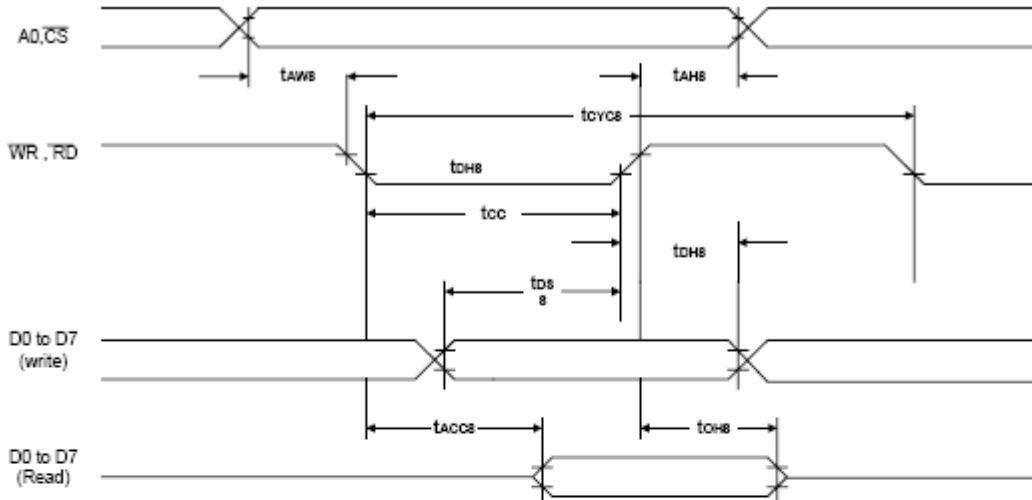
Ta = −20 to 75°C

Signal	Symbol	Parameter	V_{DD} = 4.5 to 5.5V		V_{DD} = 2.7 to 4.5V		Unit	Condition
			Min.	Max.	Min.	Max.		
A0, $\overline{CS}$	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:

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

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		35		deg	1
	θ2	CR≥2		30		deg	1
	θ3	CR≥2		35		deg	2
	θ4	CR≥2		35		deg	2
Contrast Ratio	CR	Ta = 25 °C	4.0	5.5	8.0	-	3
Response Time	Tr	Ta = 25 °C	100	120	180	ms	4
	Tf	Ta = 25 °C	110	140	210		
Driving Method	Duty	1/240					
	Bias	1/13					
LCD Type	STN						
Viewing Direction	6 O'CLOCK						

4.1.2 FSTN Type

Item	Symbol	Condition	Min	Typ	Max	Unit	Note
Viewing Angle	θ1	CR≥2		30		deg	1
	θ2	CR≥2		25		deg	1
	θ3	CR≥2		25		deg	2
	θ4	CR≥2		25		deg	2
Contrast Ratio	CR	Ta = 25 °C	4.5	6.5	8.5	-	3
Response Time	Tr	Ta = 25 °C	200	250	380	ms	4
	Tf	Ta = 25 °C	120	150	230		
Driving Method	Duty	1/240					
	Bias	1/13					
LCD Type		FSTN					
Viewing Direction		6 O'CLOCK					

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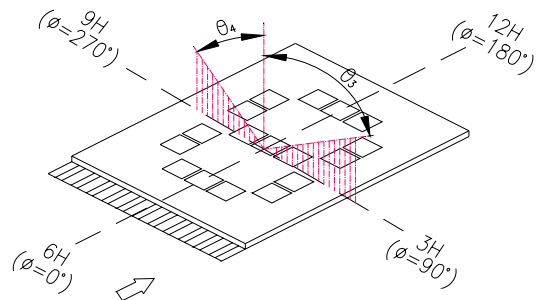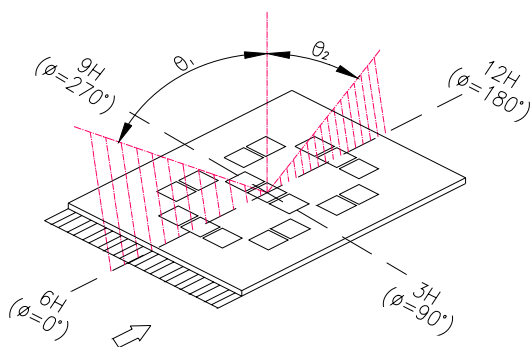
Note 3: definition of contrast ratio (CR)

[positive type] — Intensity vs Driving Voltage(V)
- Selected Wave
- Non-selected Wave
- Intensity: 100, Cr Max
- $Cr = Loff / Lon$
- Vop

[Negative type] — Intensity vs Driving Voltage(V)
- Selected Wave
- Non-selected Wave
- Intensity: 100%, Cr Max
- $Cr = Lon / Loff$
- Vop
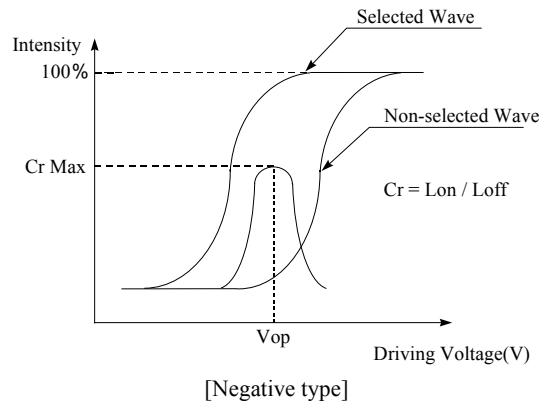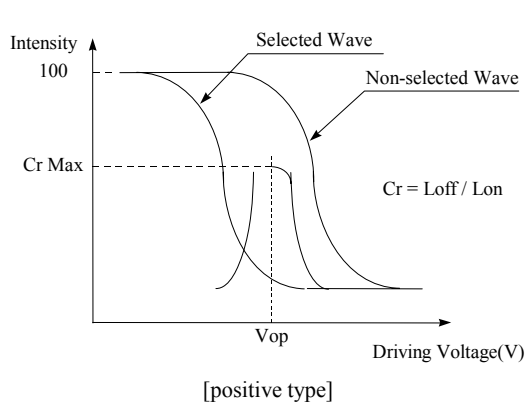
Note 4: definition of response time

[positive type]
- Non-selected Condition
- Selected Condition
- Non-selected Condition
- Intensity: 100%, 90%, 10%
- Tr, Tf

[Negative type]
- Non-selected Condition
- Selected Condition
- Non-selected Condition
- Intensity: 100%, 90%, 10%
- Tr, Tf
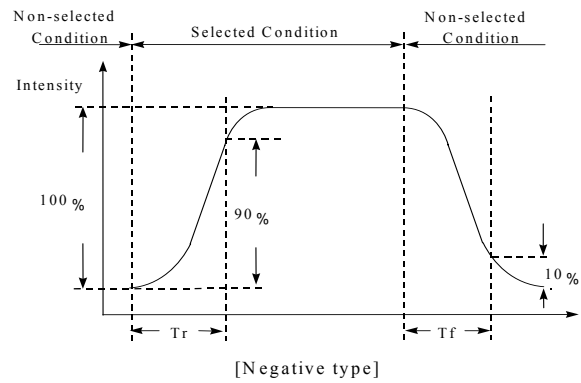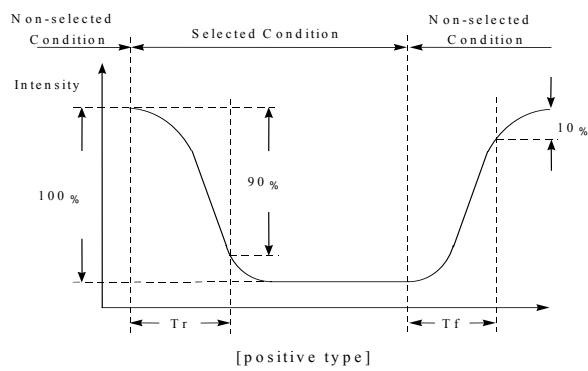
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5 BACKLIGHT SPECIFICATION

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}		--	120	--	mA	
Average Brightness Ta=25˚C IL=120mA Backlight only		Test when connecting after 3min. (max contrast) White LED	150	180	--	cd/m²	2
Brightness Uniformity		I_{LED} = 120mA	80	--	--	%	3
Life time		I_{LED} = 120mA Humidity: 30%RH ~ 85%RH	--	40000	--	hrs	4
Colour	White						
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		-	N/A		Ohm	1

5.1.2 CCFL Backlight

Ta=25˚C

Item	Symbol	Condition	Min	Typ	Max	Unit	Note
Starting Voltage		Ta=0˚C	--	--	680	Vrms	
Lamp Voltage		Ta=25˚C	--	296	--	Vrms	
Lamp Current		Ta=25˚C	4.5	5.0	5.5	mA	
Oscillation frequency		Ta=25˚C	50.0	55.0	60.0	Khz	
Average Brightness Ta=25˚C IL=5mA Backlight only		Test when connecting after 3min. (max contrast) White LED	-	650	-	cd/m²	2
Life time		Ta=25˚C IL = 5mA Humidity: 30%RH ~ 85%RH	--	17000	--	hrs	4
Operating Temp		Humidity: 30%RH ~85%RH	0	-	60	˚C	
Storage Temp		Humidity: 30%RH ~85%RH	-30	-	80	˚C	

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
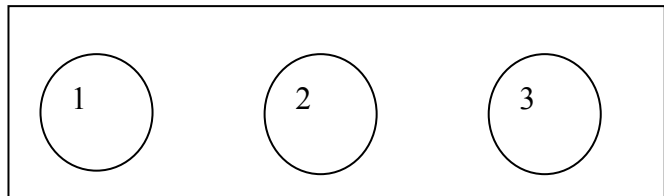
6 LABELLING & MARKING

DENSITRON
LMR4855 or LMR6855
Taiwan YYMM

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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

A   Viewing area

B   Outside viewing area
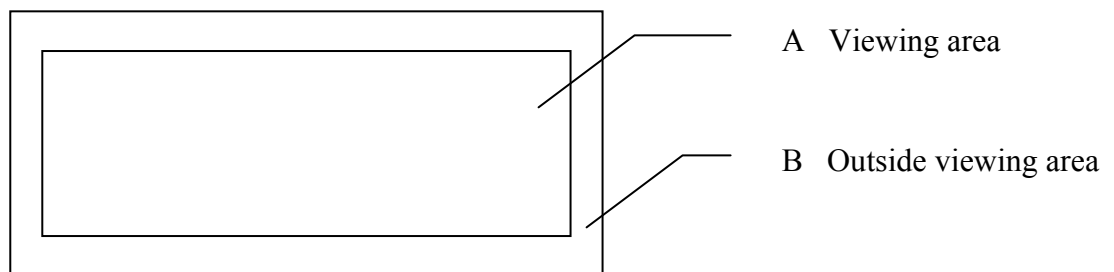
7.2.3 Visual inspection

- 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.
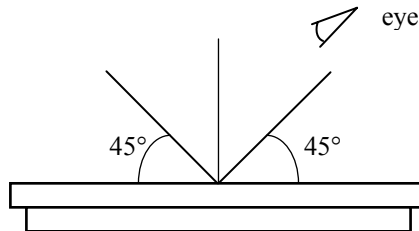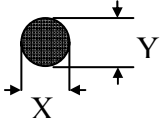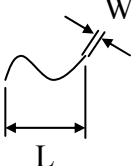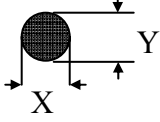
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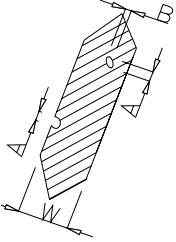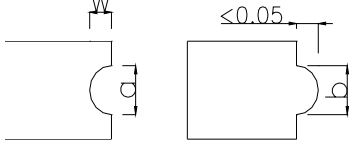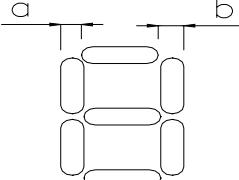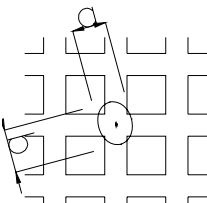
7.2.3.1 Standard of appearance inspection

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	Round type: as per following drawing $\varnothing = (X+Y)/2$ **Acceptable quantity** Size / Zone A / Zone B $\varnothing<0.2$ / Any number / — $0.2<\varnothing<0.25$ / 3 / Any number $0.25<\varnothing$ / 0 / Line type: as per following drawing **Acceptable quantity** Length / Width / Zone A / Zone B – – / $W\leq0.03$ / Any number / — $L\leq3.0$ / $0.03<W\leq0.05$ / 2 / Any number / $0.05<W$ / / – – / / As round type / Total acceptable quantity: 5		
Minor	Polariser scratch	Scratch on protective film is permitted Scratch on polariser: same as No. 1		
Minor	Polariser bubble	$\varnothing = (X+Y)/2$ **Acceptable quantity** Size / Zone A / Zone B $\varnothing<0.2$ / Any number / — $0.2<\varnothing<0.5$ / 3 / Any number $0.5<\varnothing<1.0$ / 1 / $1.0<\varnothing$ / 0 / Total acceptable quantity: 4		

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Class	Item	Criteria
Minor	Segment deformation	1.a. Pin hole on segmented display W: segment width $\varnothing = (A+B)/2$ Acceptable quantity: <table><tr><td colspan="2">Acceptable quantity</td></tr><tr><td>Width</td><td>∅</td></tr><tr><td>W≤0.4</td><td>∅≤0.2 and ∅≤1/2W</td></tr><tr><td>W>0.4</td><td>∅≤0.25 and ∅≤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 2. Segments / dots with different width 3. Alignment layer defect $\varnothing = (a+b)/2$
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

The criteria tables within the cells:

1b. Pin hole on dot matrix display

Acceptable quantity	
Size	
a,b<0.1	Any number
(a+b)/2≤0.1	Any number
0.5<∅<1.0	3

Total acceptable quantity: 7

2. Segments / dots with different width

Acceptable	
a≥b	a/b≤4/3
a<b	a/b>4/3

3. Alignment layer defect

Acceptable quantity	
Size	
∅≤0.4	Any number
0.4<∅≤1.0	5
1.0<∅≤1.5	3
1.5<∅≤2.0	2

Total acceptable quantity: 7

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

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.

8 RELIABILITY SPECIFICATION

8.1 RELIABILITY TESTS

Standard Temp

Test Item	Test Condition	Evaluation and assessment
High Temperature Operation	50˚C ±2˚C for 240 hours	No abnormalities in function* and appearance
Low Temperature Operation	0˚C ±2˚C for 240 hours	No abnormalities in function* and appearance
Thermal Shock Storage	-20˚C (30 min) ->25˚C (5 min) ->70˚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

Wide Temp

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.

9 PART NUMBER DESCRIPTIONS FOR AVAILABLE OPTIONS

LMR①855②③240G320④⑤⑥

① 4 = LED backlight version
6 = CCFL backlight version

② **POLARIZER TYPE**
B = Transflective: light background
E = Transmissive: dark background

③ **BACKLIGHT COLOUR**
W = White or left blank for CCFL type

④ **FLUID TYPE AND POWER SUPPLY**
W = Wide Temperature Range; on-board negative supply voltage generator
H = Wide Temperature Range
S = Standard Temperature range; on board negative supply voltage generator
D = Standard Temperature range; negative supply voltage required

⑤ **TEMPERATURE COMPENSATION**
C = with on board temperature compensation circuitry
N = **No** on board temperature compensation and NTN Fluid

⑥ **FLUID TYPE**
F = FSTN
B = STN (Blue Mode)

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10 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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