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REVISIONS			
REV.	DESCRIPTION	DATE	APPROVED

1. **Specification subject to change without notice.**
2. **All dimensions and specifications apply to standard modules. This information may vary for modules with optional features.**
3. **All dimensions are in millimeters.**
4. **Precautions: These precautions apply equally to modules from all makers, not just Densitron. Violation of these guidelines may void the warranty and can cause problems ranging from erratic operation to catastrophic display failure.**

Handling precautions:

- ◆ This device is susceptible to Electro-Static Discharge (ESD) damage. Observe Anti-Static precautions.

Power supply precautions:

- ◆ Identify and, at all times, observe absolute maximum ratings for both logic and LC drivers. Note that there is some variance between models.
- ◆ Prevent the application of reverse polarity to VDD and VSS, however briefly.
- ◆ Use a clean power source free from transients. Power up conditions are occasionally "jolting" and may exceed the maximum ratings of the module.
- ◆ The +5V power of the module should also supply the power to all devices which may access the display. Don't allow the data bus to be driven when the logic supply to the module is turned off.
- ◆ DO NOT install a capacitor between the VO (contrast) pin and ground. VDD must, at all times, exceed the Vo voltage level. The capacitor combines with the contrast potentiometer to form an R-C network which "holds-up" Vo, at power-down, possibly damaging the module.

Operating precautions:

- ◆ DO NOT plug or unplug the module when the system is powered up.
- ◆ Minimize the cable length between the module and host MPU. (Recommended max. length 30 cm).
- ◆ For models with EL backlights, do not disable the backlight by interrupting the HV line. Unloaded inverters produce voltage extremes which may arc within a cable or at the display.
- ◆ Operate the module within the limits of the modules temperature specifications.

Mechanical / Environmental precautions:

- ◆ Improper soldering is the major cause of module difficulty. Use of flux cleaner is not recommended as they may seep under the elastomeric connection and cause display failure. Densitron recommends the use of Kester "245" no-clean solder.
- ◆ Mount the module so that it is free from torque and mechanical stress.
- ◆ Surface of LCD panel should not be touched or scratched. The display front surface is an easily scratched, plastic polarizer. Avoid contact and clean only when necessary with soft, absorbent cotton dampened with petroleum benzene.
- ◆ ALWAYS employ anti-static procedure while handling the module.
- ◆ Prevent moisture build-up upon the module and observe the environmental constraints for storage temperature and humidity.
- ◆ DO NOT store in direct sunlight.
- ◆ If leakage of the liquid crystal material should occur, avoid contact with this material, particularly ingestion. If the body or clothing becomes contaminated by the liquid crystal material, wash thoroughly with water and soap.

Notes: (unless otherwise specified)

Unless otherwise specified: Dimensions are mm Tolerances are: X = ± 3 .X = ± 0.5 .XX = ± 0.05	APPROVALS	DATE	DENSITRON INTERNATIONAL PLC	
	DRAWN			
	CHECKED		TITLE	33 X 100 GRAPHIC LCD MODULE
	ISSUED		DWG. NO.	LM4900BG33G100SNY
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1.0 DESCRIPTION

Dot matrix display module consisting of a Liquid Crystal Display, 3 volt CMOS driver and controller LSI, printed circuit board, edge type Light Emitting Diode (LED) backlight.

Available LC fluids types are: NTN (supertwisted nematic)

Options include on-board negative voltage generation, software contrast control and low power standby function.

2.0 MECHANICAL CHARACTERISTICS

Item	Specifications	Unit
Package Dimensions	75.0 x 35.0 x 8.6	mm
Display format	100x33 pixels	-
Character font format	n/a	dots
Driving method	8 bit parallel	duty
Dot size	0.56 x 0.62	mm
Dot pitch	0.6 x 0.66	mm
Character Size	n/a	mm
Active display area	59.96 x 21.74	mm
Viewing area	67.15 x 25.0	mm
Weight	-	g

Notes: W-Width; H-Height; D-Depth.

3.0 ABSOLUTE MAXIMUM RATINGS

VSS=0V; Ta=25°C

Item	Symbol	TN, NTN		TN-H, NTN-H		Unit
		Min.	Max.	Min.	Max.	
Logic supply voltage	VDD-VSS	0	7	0	7	V
LC driver supply voltage	VDD-VO	0	6	0	13	V
Operating temperature	TOP	0	+50	-20	+70 (Note 3)	°C
Storage temperature (Note 1)	TST	-20	+70	-30	+80	
Humidity: Operating (@40°C)	-	-	85%	-	85%	RH (Note 2)
Non-operating (@40°C)	-	-	95%	-	95%	RH (Note 2)

Notes: 1: Tested to 100 hrs.
2: Refers to non-condensing conditions.
3: With backlight off.

4.0 ELECTRICAL CHARACTERISTICS

VDD=5±0.25V; Ta=25°C

Item	Symbol	Test Condition	Min.	Typ.	Max.	Unit
Input "High" voltage	VIH	-	0.7 x VDD	-	VDD	V
Input "Low" voltage	VIL	-	VSS	-	0.3 x VDD	V
Power supply current	IDD	VDD=5.0V	-	1	-	mA

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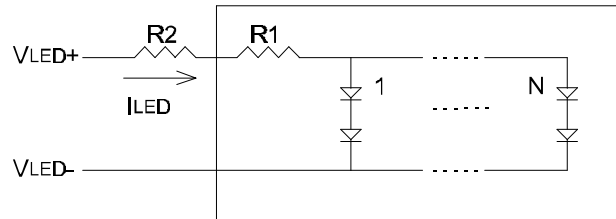
5.0 RECOMMENDED LC DRIVE VOLTAGE (V_{DD-V_0})

Display contrast is software selectable via the controller.

6.0 BACKLIGHT SPECIFICATIONS:

$T_a=20^{\circ}\text{C}, 60\%RH, \text{Darkroom.}$

Item	Symbol	Typ.	Max.	Unit
LED input voltage	VLED	6	8	V
LED input current	ILED	90	180	mA
Built-in current limiting resistor	R1	n/a	-	Ohms, W
External current limiting resistor (recommended)	R2	10	-	Ohms, W
Number of nodes	N	6	-	-



7.0 INTERFACE DESCRIPTION

Pin No.	Symbol	I/O	Function
1	CSA	I	Chip Select A
2	CSB	I	Chip Select B
3	E	I	Enable
4	DB0	I/O	Data Bit 0
5	DB1	I/O	Data Bit 1
6	DB2	I/O	Data Bit 2
7	DB3	I/O	Data Bit 3
8	DB4	I/O	Data Bit 4
9	DB5	I/O	Data Bit 5
10	AO	I	Address Bus
11	DB6	I/O	Data Bit 6
12	R/W	I/O	Read Write
13	DB7	I/O	Data Bit 7
14	Vss	I	Ground
15	/RES	I	Reset
16	Vdd	I	Power
17	LED-	I	LED cathode
18	LED+	!	LED anode

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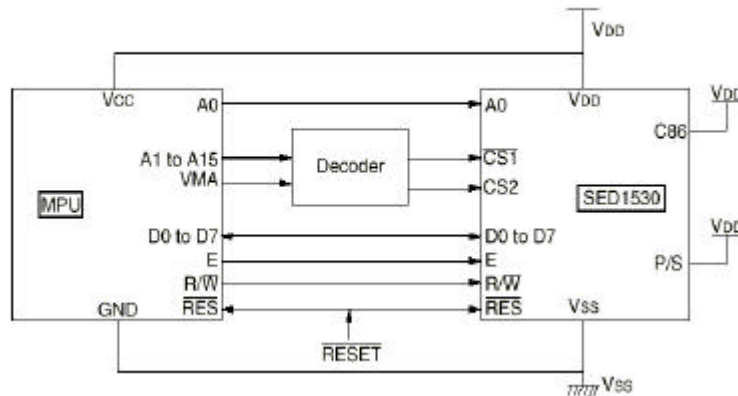
8.0 COMMAND SET

Command	Code												Function
	AO	/RD	/WR	D7	D6	D5	D4	D3	D2	D1	D0		
Display ON/OFF	0	1	0	1	0	1	0	1	1	1	0	1	Turns the LCD display on and off. "0" : OFF "1" : ON
Display start line set	0	1	0	0	1	Display start address						Determines the RAM display line displayed to COM0	
Page address set	0	1	0	1	0	1	1	Page address					Sets the display RAM page to the page address register
Column address set, first 4 bits	0	1	0	0	0	0	0	Most significant column address bits					Sets the 4 most significant bits of the display RAM column address to the register
Column address set, last 4 bits	0	1	0	0	0	0	0	Least significant column address bits					Sets the 4 least significant bits of the display RAM column address to the register
Status read	0	0	1	Status				0	0	0	0	0	Read status data.
Write display data	1	1	0	Write data								Writes to the display RAM	
Read display data	1	0	1	Read data								Reads from the display RAM	
ADC select	0	1	0	1	0	1	0	0	0	0	0	1	Sets the relationship between the display RAM address and the SEG output "0" : Normal "1" : Reverse
Display: Normal/Reverse	0	1	0	1	0	1	0	0	1	1	0	1	Sets the LCD display to normal/reverse "0" : Normal "1" : Reverse
Display: All Pixel Lit: On/Off	0	1	0	1	0	1	0	0	1	0	0	1	Display: All pixels lit "0" : Normal display "1" : reverse
LCD bias set	0	1	0	1	0	1	0	0	0	1	0	0	Sets the LCD drive voltage ratio
Read/Modify/Write	0	1	0	1	1	1	0	0	0	0	0	0	Increases the column address counter by 1 when write, zero when read
End	0	1	0	1	1	1	0	1	1	1	0	0	Gets out of read/modify/write mode
Reset	0	1	0	1	1	1	0	1	1	1	0	0	Internal reset
Output mode register set	0	1	0	1	1	0	0	0	*	*	*	*	Selects the direction of the COM output scan * = disabled
Power control set	0	1	0	0	0	1	0	1	Operating mode			0	Selects the power supply circuit operating mode
Electronic volume register set	0	1	0	1	0	0	Electronic volume level					0	Sets the V5 output voltage to the electronic volume register
Standby set	0	1	0	1	0	1	0	1	1	0	0	1	Selects the standby mode "0" : OFF "1" : ON
Power save													A composite command with display: OFF and display: All pixels ON.

NOTE: Do not use any other command, or a system malfunction may result

9.0 BLOCK DIAGRAM:

6800-series microprocessors



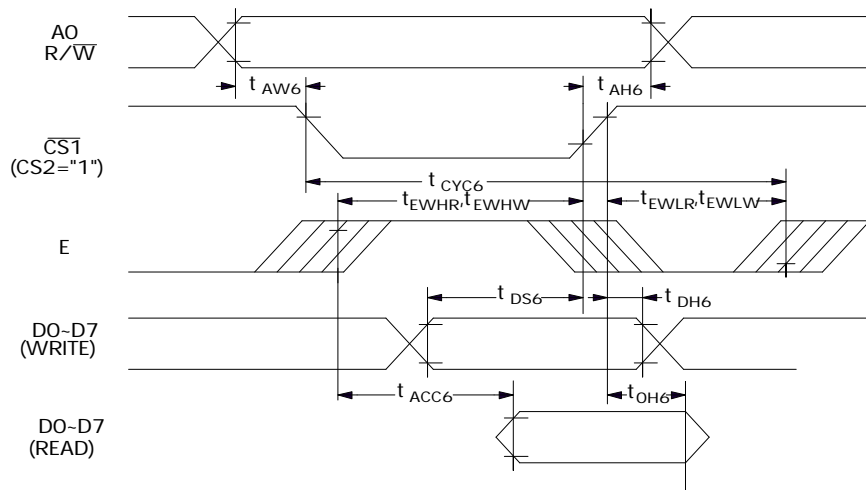
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10.0 TIMING CHARACTERISTICS



VDD = 5.0V ± 10%, T _a = - 40 to 85 °C							
Parameter	Signal	Symbol	Conditions	Min	Max	Unit	
System cycle time		t_{CYC6}		200	-	ns	
Address set up time	A0	t_{AW6}		10	-	ns	
Address hold time	R/W	t_{AH6}		10	-	ns	
Data setup time	D0 ~ D7	t_{DS6}		20	-	ns	
Data hold time		t_{DH6}		10	-	ns	
Output disable time		t_{OH6}	CL=100pF	10	50	ns	
Access time		t_{ACC6}		-	70	ns	
Enable H	Read	E		t_{EWHR}	77	-	ns
Pulse width	Write			t_{EWHW}	22	-	ns
Enable L	Read	E		t_{EWLR}	117	-	ns
Pulse width	Write			t_{EWLW}	172	-	ns

VDD=2.7 to 4.5V. T _a = - 40 to 85 C							
Parameter	Signal	Symbol	Conditions	Min	Max	Unit	
System cycle time		t_{CYC6}		450	-	ns	
Address setup time	A0	t_{AW6}		25	-	ns	
Address hold time	R/W	t_{AH6}		25	-	ns	
Data setup time	D0 ~ D7	t_{DS6}		40	-	ns	
Data hold time		t_{DH6}		20	-	ns	
Output disable time		t_{OH6}	CL=100pF	20	50	ns	
Access time		t_{ACC6}		-	70	ns	
Enable H	Read	E		t_{EWHR}	194	-	ns
Pulse width	Write			t_{EWHW}	44	-	ns
Enable L	Read	E		t_{EWLR}	244	-	ns
Pulse width	Write			t_{EWLW}	394	-	ns

*1. The input signal rise time and fall time (tr, tf) are specified at 15 ns or less. When the cycle time is used at high speed, the specification is

$tr + tf \leq (t_{CYC6} - t_{EWLW} - t_{EWHW})$ or is $tr + tf \leq (t_{CYC6} - t_{EWLR} - t_{EWHR})$

*2. All timings are specified based on 20% and 80% of V_{DD}.

*3. t_{EWHR} and t_{EWHW} are specified by the overlap period of CS1 = "0" (CS2 = "1") and E = "1" level.

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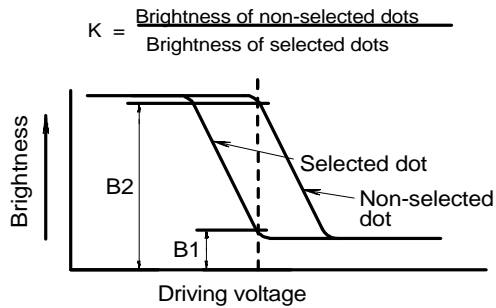
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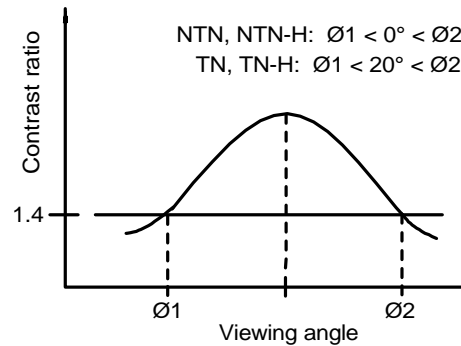
12.0 OPTICAL CHARACTERISTICS

Item	Symbol	Test Condition	Min.	Typ.	Max.	Unit
Contrast ratio STN	K	$\varnothing=20^\circ \theta=0^\circ$	5	-	-	-
Viewing angle STN	$\varnothing2-\varnothing1$ θ	$\theta=0^\circ K \geq 1.4$ $\varnothing=20^\circ K=1.4$	40 ± 30	- -	- -	Deg. Deg.
Response time Rise	t_r	$\varnothing=20^\circ \theta=0^\circ$	-	150	250	mS
Fall	t_f	$\varnothing=20^\circ \theta=0^\circ$	-	150	250	mS

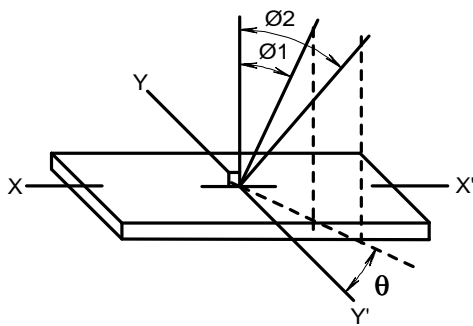
DEFINITION OF CONTRAST RATIO (K)



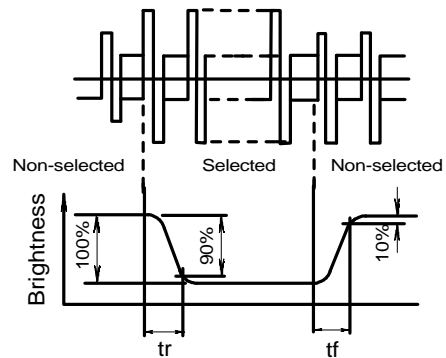
CONTRAST VERSUS VIEWING ANGLE



DEFINITION OF ANGLES \varnothing AND θ



DEFINITION OF OPTICAL RESPONSE



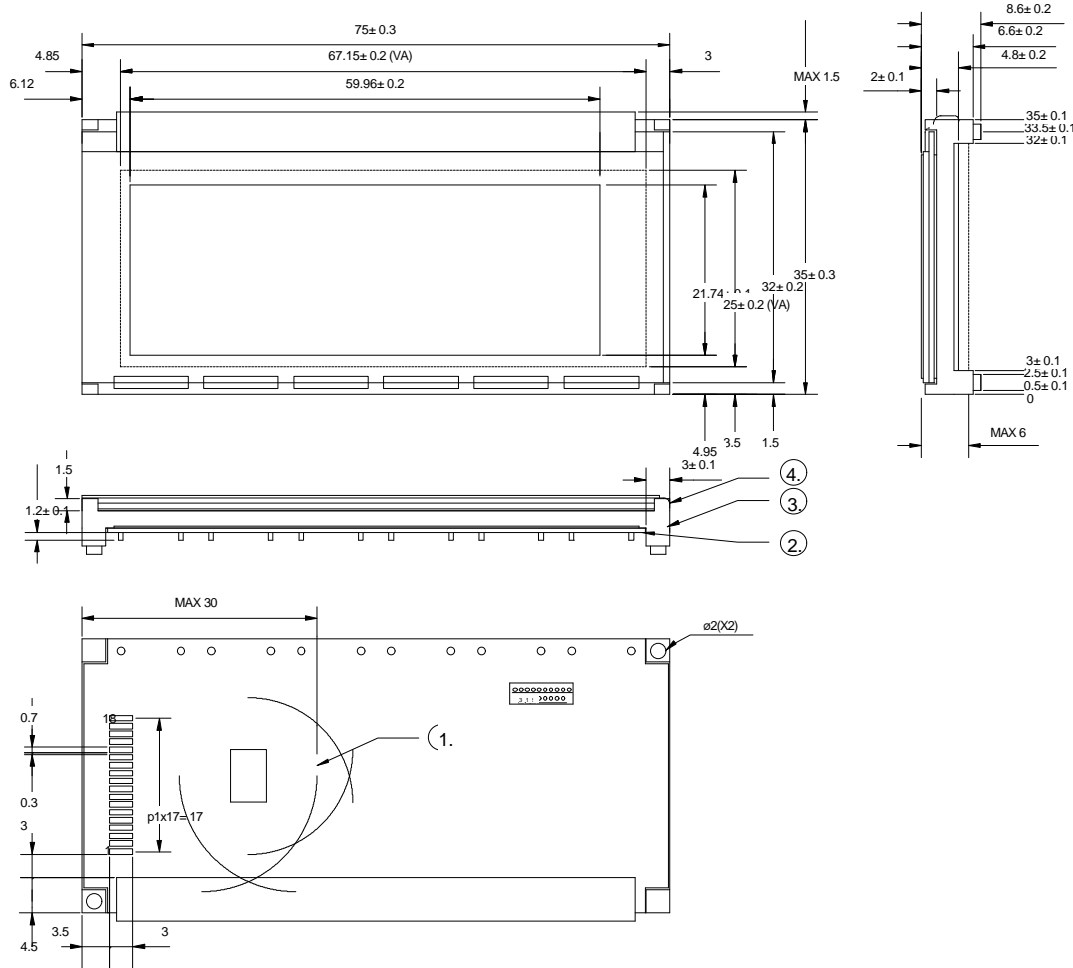
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13.0 MODULE DIMENSIONS



14.0 PART NUMBER DESCRIPTION FOR AVAILABLE OPTIONS

LM4900①②**33G100**③④⑤

①

Polarizer Type

B = Transflective: light background with LED backlight

②

Backlight Color

G = Yellow-green (standard)

③

Fluid Type and Power Supply

S = NTN with +5VDC operation

④

Fluid Type/TN Viewing Direction

N = STN

⑤

Background Color for NTN Fluid

G = Gray background

Y = Yellow background

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