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REVISIONS			
REV.	DESCRIPTION	DATE	APPROVED
-	New release on ECN #E0766	11/13/98	MA
A	Updated sht. 8 of 8 on ECN #E0981	5/4/00	MA
B	Add suffix to part number. ECN #E1786	11/08/04	RM
C	Revise Sec. 5.0. LED Input Current ECN #E1850	02/22/05	RM

- 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 FSCM NO. 62483	APPROVALS	DATE	DENSITRON INTERNATIONAL PLC	
	DRAWN			
	CHECKED <i>[Signature]</i>	11/13/05	TITLE	100 X 64 PIXEL MINI-GRAPHIC ARRAY WITH EDGELIT LED BACKLIGHT
	ISSUED		DWG. NO.	LM4068

1.0 DESCRIPTION

Graphic matrix display module consisting of a Liquid Crystal Display, CMOS driver and controller LSI, printed circuit board and edgelit Light Emitting Diode (LED) backlight.

Available LC fluids types are: STN (supertwisted nematic) yellow.

Options include on-board negative voltage generation and software contrast control, serial or 8-bit parallel interface.

2.0 MECHANICAL CHARACTERISTICS

Item	Specifications	Unit
Package Dimensions	71.0 x 49.7 x 7.9	mm
Display format	100 x 64	-
Character font format	defined by on-board controller (SED1560)	dots
Driving method	1/64	duty
Dot size	0.51 x 0.54	mm
Dot pitch	0.56 x 0.59	mm
Character Size	2.98	mm
Active display area	55.95 x 37.71	mm
Viewing area	67.0 x 45.1	mm
Weight	15 approx	g

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

3.0 ABSOLUTE MAXIMUM RATINGS

V_{SS}=0V;T_a=25°C

Item	Symbol	STN		Unit
		Min.	Max.	
Logic supply voltage	V _{DD} -V _{SS}	0	7	V
LC driver supply voltage	V _{DD} -V _O	0	6	V
Operating temperature	T _{OP}	0	+60	°C
Storage temperature (Note 1)	T _{ST}	-20	+70	
Humidity: Operating (@40°C)	-	-	85%	RH (Note 2)
Non-operating (@40°C)	-	-	95%	RH (Note 2)

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

4.0 RECOMMENDED LC DRIVE VOLTAGE (V_{DD}-V_O)

V_{DD}=5.0±0.25V

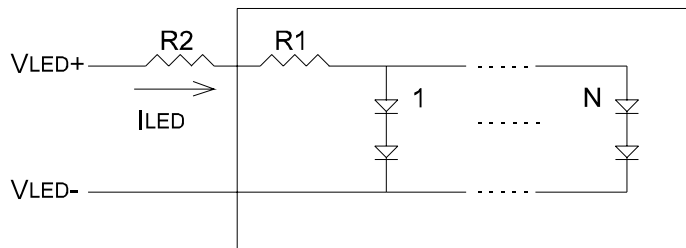
Temperature	TN	TN-H	STN	NTN-H
T _a = -20°C			-	
T _a = 0°C			9.2	
T _a = 25°C			8.9	
T _a = 50°C			8.6	
T _a =70°C			-	

Note: DC is generated on-board

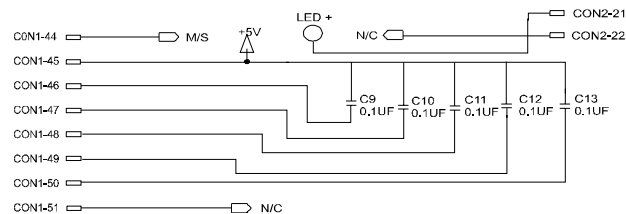
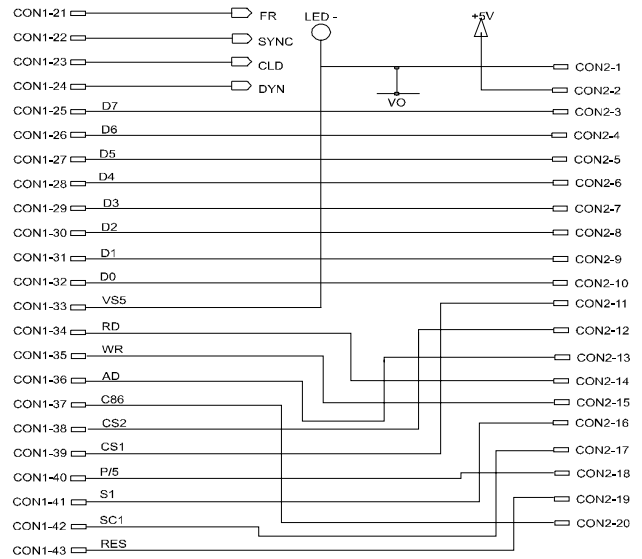
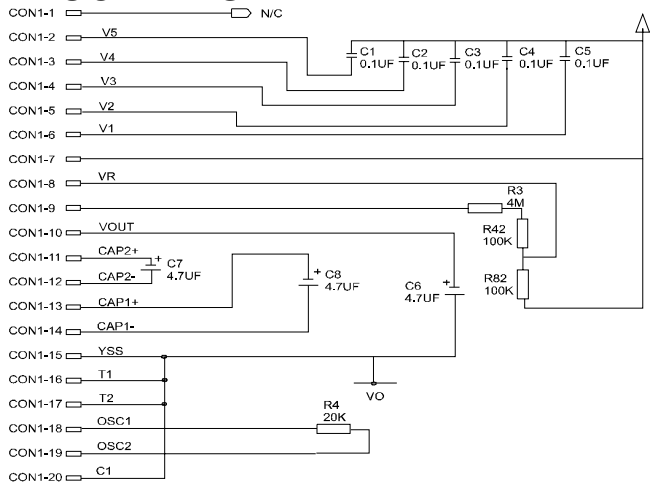
5.0 BACKLIGHT SPECIFICATIONS:

T_a=20°C,60%RH,Darkroom.

Item	Symbol	Typ.	Max.	Unit
LED input voltage	V _{LED}	4.2		V
LED input current	I _{LED}	120		mA
Built-in current limiting resistor	R1	n/a		Ohms, W
External current limiting resistor (recommended)	R2	10		Ohms, W
Number of nodes	N	4		-



6.0 BLOCK DIAGRAM



DWG. NO.

LM4068

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REV. C

7.0 INTERFACE DESCRIPTION

Pin No.	Symbol	I/O	Function																					
1	V _{SS}	-	Ground (0V)																					
2	V _{DD}	-	Logic Supply Voltage (+5V)																					
3	D7	I/O	Bi-directional data bus line 7																					
4	D6	I/O	Bi-directional data bus line 6																					
5	D5	I/O	Bi-directional data bus line 5																					
6	D4	I/O	Bi-directional data bus line 4																					
7	D3	I/O	Bi-directional data bus line 3																					
8	D2	I/O	Bi-directional data bus line 2																					
9	D1	I/O	Bi-directional data bus line 1																					
10	D0	I/O	Bi-directional data bus line 0																					
11	CS1	I/O	Chip select inputs. Data input/output is enabled when CS1 is LOW and CS2 is HIGH.																					
12	CS2	I/O	Chip select inputs. Data input/output is enabled when CS1 is LOW and CS2 is HIGH.																					
13	A0	I/O	Control/display data flag input. This is connected to the LSB of the microprocessor address bus. <ul style="list-style-type: none"> • When LOW, the data on D0 to D7 is command data • When HIGH, the data on D0 to D7 is display data 																					
14	RD	I/O	Read																					
15	WR	I/O	Write																					
16	SI	I	Serial data input																					
17	SCL	I	Serial clock input. Data is read on the rising edge of SCL and converted to 8-bit parallel data.																					
18	P/S	I	Parallel/serial data input select <table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th>P/S</th> <th>OPERATING MODE</th> <th>CHIP SELECT</th> <th>DATA/ COMMAND</th> <th>DATA I/O</th> <th>READ/ WRITE</th> <th>SERIAL CLOCK</th> </tr> </thead> <tbody> <tr> <td>HIGH</td> <td>Parallel</td> <td>$\overline{CS1}, CS2$</td> <td>A0</td> <td>D0 to D7</td> <td>RD, WR</td> <td>-</td> </tr> <tr> <td>LOW</td> <td>Serial</td> <td>$\overline{CS1}, CS2$</td> <td>A0</td> <td>SI</td> <td>Write only</td> <td>SCL</td> </tr> </tbody> </table> <p>In serial mode, data cannot be read from the RAM, and D0 to D7, HZ, RD and WR must be HIGH or LOW. In parallel mode, SI and SCL must be HIGH or LOW.</p>	P/S	OPERATING MODE	CHIP SELECT	DATA/ COMMAND	DATA I/O	READ/ WRITE	SERIAL CLOCK	HIGH	Parallel	$\overline{CS1}, CS2$	A0	D0 to D7	RD, WR	-	LOW	Serial	$\overline{CS1}, CS2$	A0	SI	Write only	SCL
P/S	OPERATING MODE	CHIP SELECT	DATA/ COMMAND	DATA I/O	READ/ WRITE	SERIAL CLOCK																		
HIGH	Parallel	$\overline{CS1}, CS2$	A0	D0 to D7	RD, WR	-																		
LOW	Serial	$\overline{CS1}, CS2$	A0	SI	Write only	SCL																		
19	RES	I	Reset input. Setting this pin low initializes the SED156X.																					
20	C86	I	Microprocessor interface select input. <ul style="list-style-type: none"> • LOW when interfacing to 8080-series • HIGH when interfacing to 6800-series 																					
21	N/C	-	Not connected																					
22	N/C	-	Not connected																					

8.0 ELECTRICAL CHARACTERISTICS

● DC Characteristics

VDD= 0 V, Vss = -5V±10%, Ta = -30 to +85°C unless otherwise noted.)

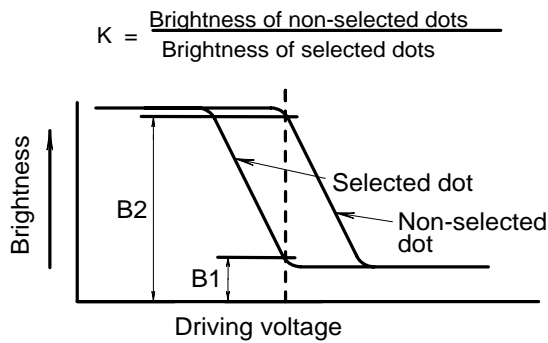
Item		Symbol	Condition	Min.	Typ.	Max.	Unit	Pin used
Power Voltage (1)	Recommended operation	Vss		-5.5	-5.0	-4.5	V	Vss
	Operational			-6.0		-2.4		*1
Operating Voltage (2)	Operational	V5		-16.0		-4.0	V	V5 *2
	Operational	V1,V2		0.4 x V5		VDD	V	V1, V2
	Operational	V3, V4		V5		0.6 x V5	V	V3, V4
High-level input voltage		VIHC1		0.3 X Vss		VDD	V	*3
		VIHC2		0.15 X Vss		VDD		*4
		VIHC1	VSS = -2.7V	0.3 X Vss		VDD		*3
		VIHC2	Vss = -2.7V	0.2 X Vss		VDD		*4
Low-level input voltage		VILC1		Vss		0.7 X Vss	V	*3
		VILC2		Vss		0.85 X Vss		*4
		VILC1	VSS = -2.7V	Vss		0.7 X Vss		*3
		VILC2	Vss = -2.7V	Vss		0.8 X Vss		*4
High-level output voltage		VIHC1	IOH = -1 mA	0.2 X Vss		VDD	V	*5
		VIHC2	IOH = -120 μA	0.2 X Vss		VDD		OSC2
		VIHC1	VSS = -2.7V IOH = -0.5 mA	0.2 X Vss		VDD	V	*5
		VIHC2	Vss = -2.7V IOH = -50 μA	0.2 X Vss		VDD		OSC2
Low-level output voltage		VILC1	IOH = -1 mA	Vss		0.8 X Vss	V	*5
		VILC2	IOH = -120 μA	Vss		0.8 X Vss		OSC2
		VILC1	VSS = -2.7V IOH = -0.5 mA	Vss		0.8 X Vss	V	*5
		VILC2	Vss = -2.7V IOH = -50 μA	Vss		0.8 X Vss		OSC2
Input leakage current		ILI	VIN = VDD OR Vss	-1.0		1.0	μA	*6
Output leakage current		ILO		-3.0		3.0	μA	*7
LCD driver ON resistance		RON	Ta = 25°C	V5 = -14.0V	2.0	3.0	KΩ	O0 TO O166 *8
				V5 = -8.0V	3.0	4.5		
Static power consumption		IssQ			0.00	5.0	μA	Vss
					I5Q	V5 = -18.0V	0.01	15.0
Input terminal capacity		Cin	Ta = 25°C	f=1HMZ	5.0	8.0	pF	*3 *4
Oscillation frequency		fosc	Rf=1MΩ ±2%	Vss = -5V	15	18	KHZ	*9
				Vss = -2.7V	11	16		
Reset time	*R				1.0		μS	*10
Reset "L" pulse width	*RW				1.0		μS	*11

Built-in power circuit	Input voltage	Vss		-6.0		-2.4	V	*12
	Amplified output voltage	Vout	Triple voltage boosting	-18.0			V	Vout
	Voltage regulator circuit operation voltage	Vout		-18.0		-6.0	V	Vout
	Voltage follower operation voltage	V5 1	Supplied to SED1560D OB	-16.0		-6.0	V	*13
		V5 2	Supplied to SED1560D OB	-16.0		-5.0	V	
		V5 3	Supplied to SED1560D AB	-16.0		-4.0	V	
		V5 4	Supplied to SED1560D OB	-16.0		-4.5	V	
	Reference voltage	VREG	Ta = 25°C	-2.35	-2.5	-2.65	V	

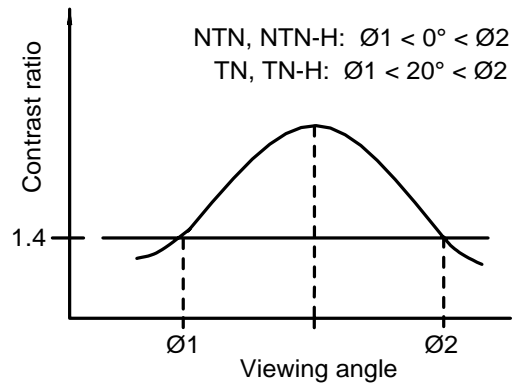
9.0 OPTICAL CHARACTERISTICS

Item	Symbol	Test Condition	Min.	Typ.	Max.	Unit
Contrast ratio TN, TN-H	K	$\varnothing=20^\circ \theta=0^\circ$	3	-	-	-
Contrast ratio STN	K	$\varnothing=20^\circ \theta=0^\circ$	4	-	-	-
Contrast ratio NTN-H	K	$\varnothing=20^\circ \theta=0^\circ$	5	-	-	-
Viewing angle TN, TN-H	$\varnothing 2-\varnothing 1$ θ	$\theta=0^\circ K \geq 1.4$ $\varnothing=20^\circ K=1.4$	20 ± 30	-	-	Deg. Deg.
Viewing angle STN	$\varnothing 2-\varnothing 1$ θ	$\theta=0^\circ K \geq 1.4$ $\varnothing=20^\circ K=1.4$	40 ± 30	-	-	Deg. Deg.
Viewing angle NTN-H	$\varnothing 2-\varnothing 1$ θ	$\theta=0^\circ K \geq 1.4$ $\varnothing=20^\circ K=1.4$	40 ± 40	-	-	Deg. Deg.
Response time Rise	t_r	$\varnothing=20^\circ \theta=0^\circ$	-	150	240	mS
Fall	t_f	$\varnothing=20^\circ \theta=0^\circ$	-	350	360	mS

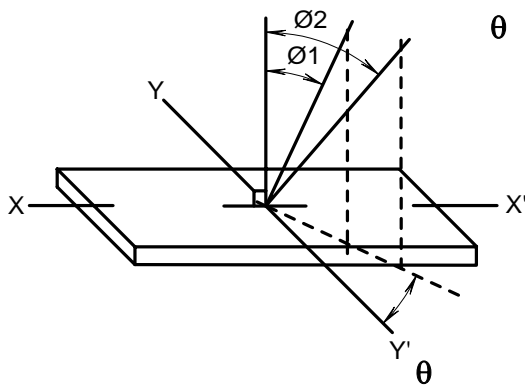
DEFINITION OF CONTRAST RATIO (K)



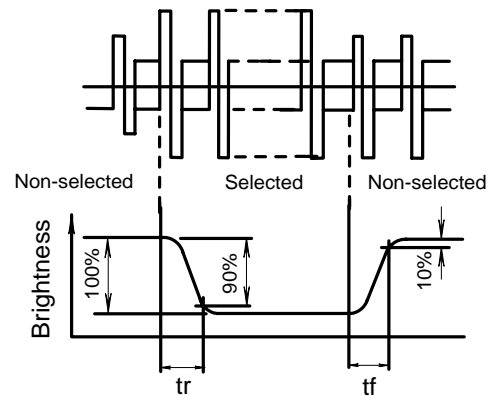
CONTRAST VERSUS VIEWING ANGLE



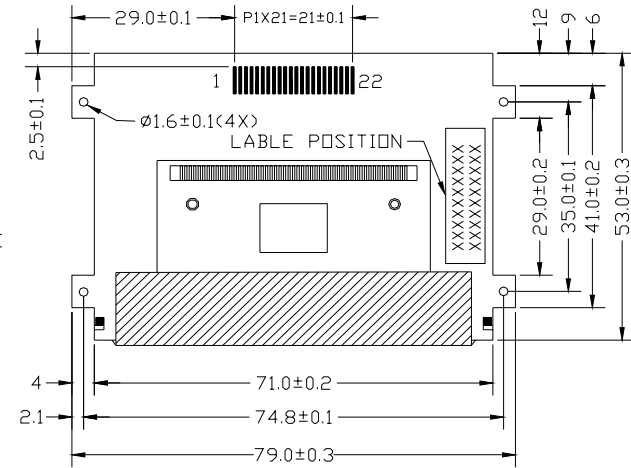
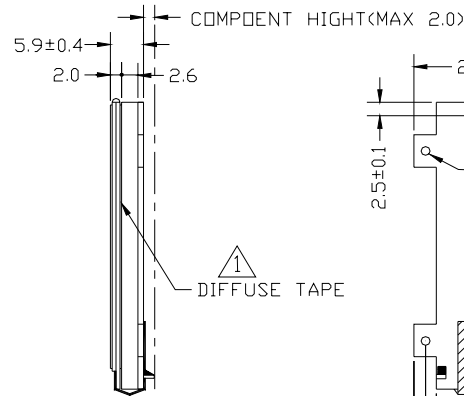
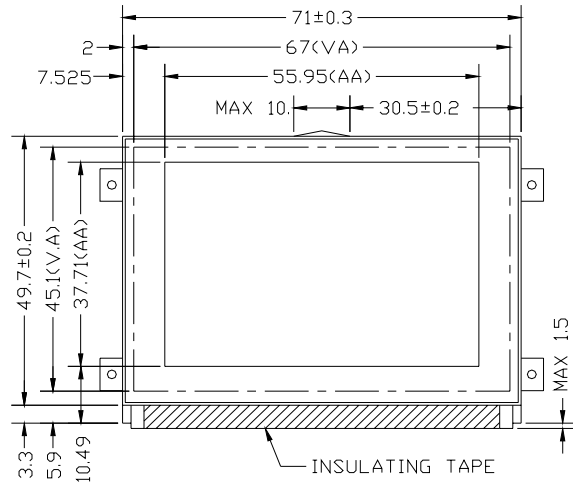
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DEFINITION OF OPTICAL RESPONSE



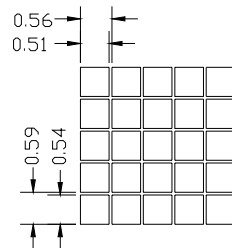
10.0 MODULE DIMENSIONS



INTERFACE

PIN NO.	FUNCTION	PIN NO.	FUNCTION
1	GND	12	CS2
2	VDD	13	AO
3	DB7	14	RD
4	DB6	15	WR
5	DB5	16	SI
6	DB4	17	SCL
7	DB3	18	P/S
8	DB2	19	RES
9	DB1	20	C86
10	DB0	21	LED1
11	CS1	22	NC

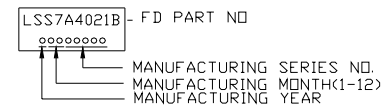
DOT DETAILED



NOTE:

- 1.LCD DISPLAY MODE:STN/YELLOW-GREEN/TRANSFLECTIVE TYPE.
- 2.VIEWING ANGLE: 6 O'CLOCK.
- 3.OPERATING TEMP:0 TO 50 DEGREE.
- 4.STORAGE TEMP:-20 TO 60 DEGREE.
- 5.THE LCD DRIVING CODITION IS:1/64D,1/9B,Vop=9.4V.

MANUFACTURE LABEL



DWG. NO.

LM4068

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REV. C

11.0 PART NUMBER DESCRIPTION FOR AVAILABLE OPTIONS

LM4068①②64G100③④⑤/⑥⑦

①

Polarizer Type

B = Transflective LED backlight

②

G = Green Colour

③

Fluid Type and Power Supply

S = NTN with +5VDC operation

④

Fluid Type/TN Viewing Direction

N = STN (Supertwisted Nematic)

C = STN with on-board temperature compensation circuit

⑤

Background Color for NTN Fluid

G = Gray background

Y = Yellow background

⑥

Operating Voltage

Blank = 5VDC operation

3 = 3VDC operation

⑦

Revision level.