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REVISIONS			
REV.	DESCRIPTION	DATE	APPROVED
A	RELEASED ON ECN #E1564	04/07/03	MA

- 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 Cage Code #OWS52	APPROVALS	DATE	DENSITRON TECHNOLOGIES PLC	
	DRAWN			
	CHECKED		TITLE	LCD MODULE COB 2 LINE X 16 CHARACTERS
	ISSUED		DWG. NO.	LC4422

## 1.0 DESCRIPTION

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

Available LC fluids types are: STN-H (Extended temperature range STN).

## 2.0 MECHANICAL CHARACTERISTICS

Item	Specifications	Unit
Package Dimensions	85.0 (W) x 36.0 (H) x 13.6 max.(D)	mm
Display format	2 line x 16 characters	-
Character font format	5 (W) x 7 (H) with attached cursor	dots
Driving method	1/16	duty
Dot size	0.55 (W) x 0.65 (H)	mm
Dot pitch	0.60 (W) x 0.70 (H)	mm
Character Size	2.95 (W) x 5.55 (H)	mm
Active display area	56.2 (W) x 11.5 (H)	mm
Viewing area	60.0 (W) x 15.8 (H)	mm
Weight		g

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

## 3.0 ABSOLUTE MAXIMUM RATINGS

V<sub>SS</sub>=0V;T<sub>a</sub>=25°C

Item	Symbol	STN-H		Unit
		Min.	Max.	
Logic supply voltage	V <sub>DD</sub> -V <sub>SS</sub>	0	7	V
LC driver supply voltage	V <sub>DD</sub> -V <sub>O</sub>	0	10	V
Operating temperature	T <sub>OP</sub>	-20	+70 (Note 3)	°C
Storage temperature (Note 1)	T <sub>ST</sub>	-30	+80	
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 ELECTRICAL CHARACTERISTICS

V<sub>DD</sub>=5±0.25V;T<sub>a</sub>=25°C

Item	Symbol	Test Condition	Min.	Typ.	Max.	Unit
Input "High" voltage	V <sub>IH</sub>	-	2.2	-	V <sub>DD</sub>	V
Input "Low" voltage	V <sub>IL</sub>	-	-	-	0.6	V
Output "High" voltage	V <sub>OH</sub>	I <sub>OH</sub> =0.205mA	2.4	-	-	V
Output "Low" voltage	V <sub>OL</sub>	I <sub>OL</sub> =1.2mA	-	-	0.4	V
Power supply current	I <sub>DD</sub>	V <sub>DD</sub> =5.0V	-	2.0	-	mA

## 5.0 RECOMMENDED LC DRIVE VOLTAGE ( $V_{DD}-V_o$ )

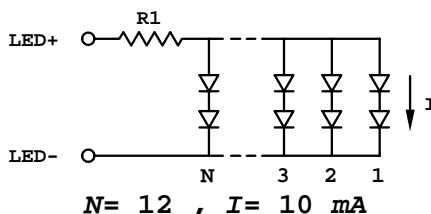
$V_{DD}=5.0\pm 0.25V$

Temperature	STN-H
$T_a = -20^\circ C$	4.7
$T_a = 0^\circ C$	4.3
$T_a = 25^\circ C$	4.1
$T_a = 50^\circ C$	4.0
$T_a = 70^\circ C$	3.9

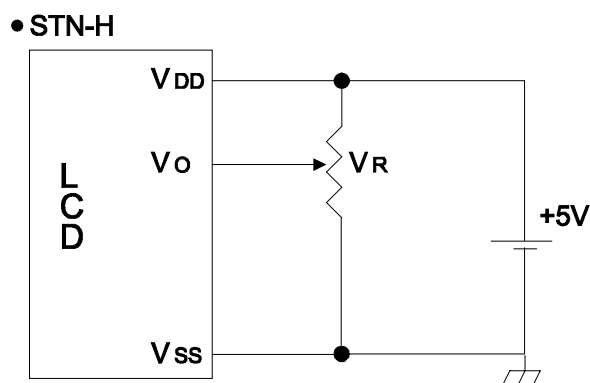
## 6.0 BACKLIGHT SPECIFICATIONS:

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

Item	Symbol	Typ.	Max.	Unit
LED lamp input voltage	$V_{LED+}$	5	6	Vrms
LED lamp input current	$I_{LED}$	120	130	mA
Build-in current limiting resistor	R1	6.8 Ohms, 1/8W	-	Ohms, W
External current limiting resistor (recommended)	R2	-	-	Ohms, W
Number of nodes	N	12	-	-



## 7.0 POWER SUPPLY

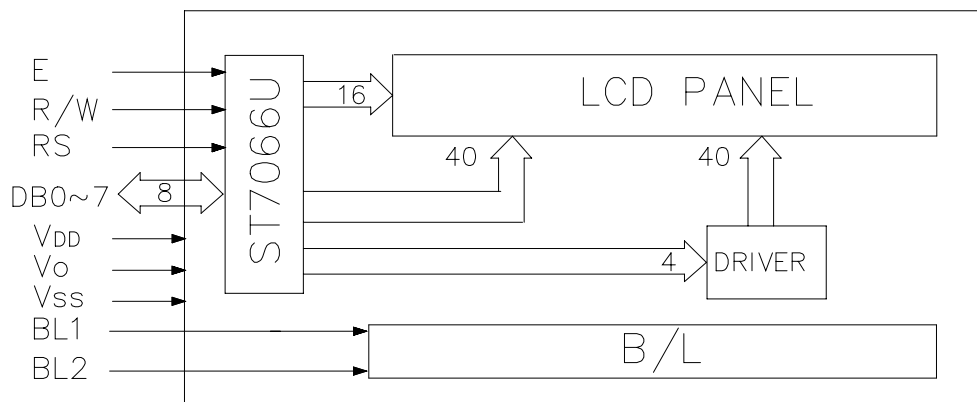


$V_R = 10K - 20K \text{ ohm}$

## 8.0 INTERFACE DESCRIPTION

Pin No.	Symbol	I/O	Function
1	V <sub>SS</sub>	-	Ground (0V)
2	V <sub>DD</sub>	-	Logic Supply Voltage (+5V)
3	V <sub>O</sub>	-	LC Drive voltage for contrast adjustment
4	RS	I	Register Select 0: Instruction Register 1: Data Register
5	R/W	I	Read / Write 0: Data Write (Module←MPU) 1: Data Read (Module→MPU)
6	E	I	Enable Signal Active High (H→L)
7	DB0	I/O	Bi-directional data bus line 0
8	DB1	I/O	Bi-directional data bus line 1
9	DB2	I/O	Bi-directional data bus line 2
10	DB3	I/O	Bi-directional data bus line 3
11	DB4	I/O	Bi-directional data bus line 4
12	DB5	I/O	Bi-directional data bus line 5
13	DB6	I/O	Bi-directional data bus line 6
14	DB7	I/O	Bi-directional data bus line 7
15	V <sub>LED+</sub>	-	Anode (+): LED backlight input voltage
16	V <sub>LED-</sub>	-	Cathode (-): LED backlight input voltage
BL1	V <sub>LED+</sub>	-	Anode (+): LED backlight input voltage
BL2	V <sub>LED-</sub>	-	Cathode (-): LED backlight input voltage

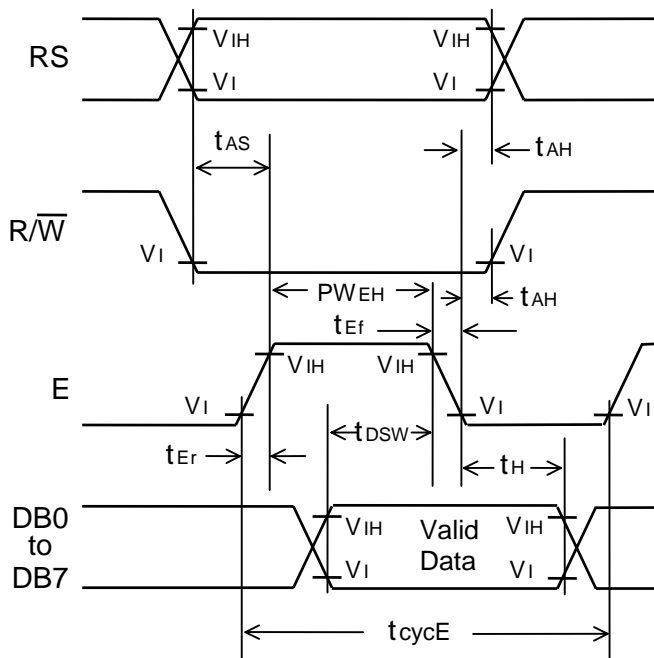
## 9.0 BLOCK DIAGRAM:



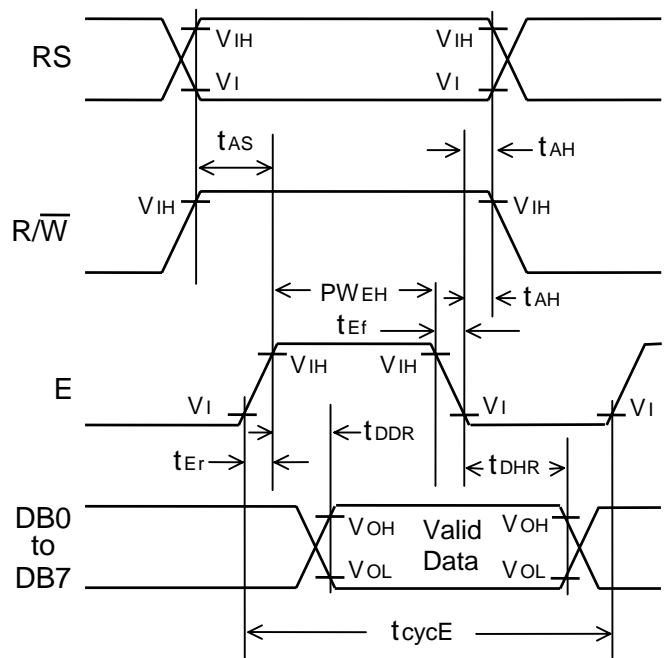
## 10.0 TIMING CHARACTERISTICS

Item	Symbol	Min.	Typ.	Max.	Unit
Enable cycle time	$T_{cycE}$	1.0	-	-	nS
Enable pulse width	$PW_{EH}$	450	-	-	nS
Enable rise / fall time	$t_{Er}/t_{Ef}$	-	-	25	nS
Address set-up time	$t_{AS}$	140	-	-	nS
Address hold time	$t_{AH}$	10	-	-	nS
Data delay time	$t_{DDR}$	-	-	320	nS
Data hold time (Write)	$t_{DHW}$	10	-	-	nS
Data hold time (Read)	$t_{DHR}$	20	-	-	nS
Data set-up time	$t_{DSW}$	195	-	-	nS

### WRITE OPERATION



### READ OPERATION



## 11.0 DD RAM ADDRESS vs. DISPLAY POSITION

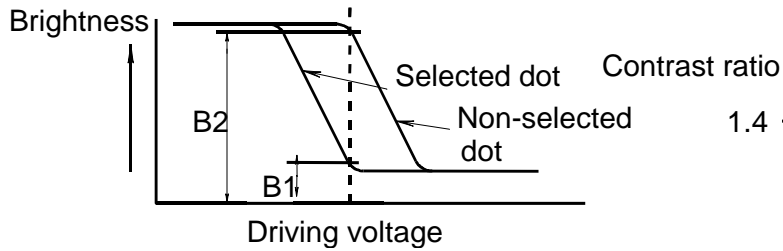
Character	1	2	3	4	5	6	7	8	9	10	11	---	14	15	16
Line 1	00	01	02	03	04	05	06	07	08	09	0A	---	0D	0E	0F
Line 2	40	41	42	43	44	45	46	47	48	49	4A	---	4D	4E	4F

## 12.0 OPTICAL CHARACTERISTICS

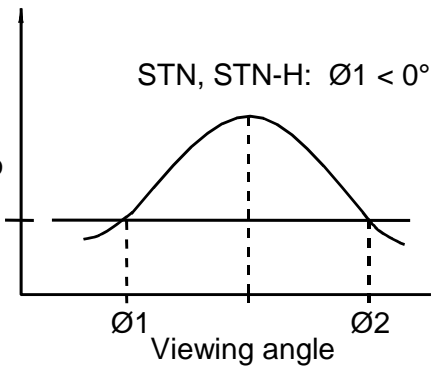
Item	Symbol	Test Condition	Min.	Typ.	Max.	Unit
Contrast ratio STN-H	K	$\theta=20^\circ \theta=0^\circ$	5	-	-	-
Viewing angle STN-H	$\theta_2-\theta_1$	$\theta=0^\circ K \geq 1.4$	40	-	-	Deg.
	$\theta$	$\theta=20^\circ K=1.4$	$\pm 40$	-	-	Deg.
Response time Rise	$t_r$	$\theta=20^\circ \theta=0^\circ$	-	150	250	mS
	Fall	$t_f$	$\theta=20^\circ \theta=0^\circ$	-	150	250

### DEFINITION OF CONTRAST

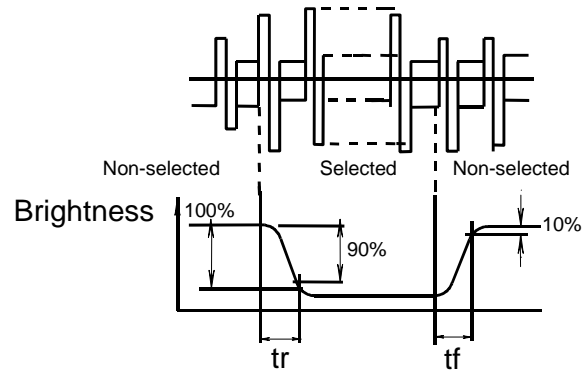
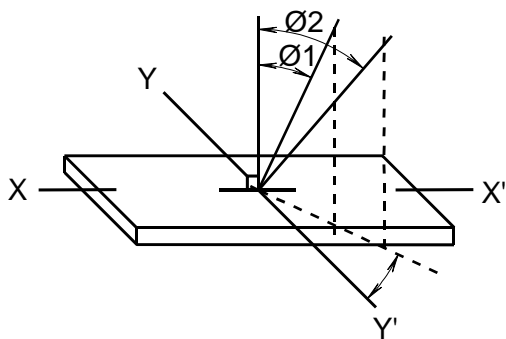
$$K = \frac{\text{Brightness of non-selected}}{\text{Brightness of selected}}$$



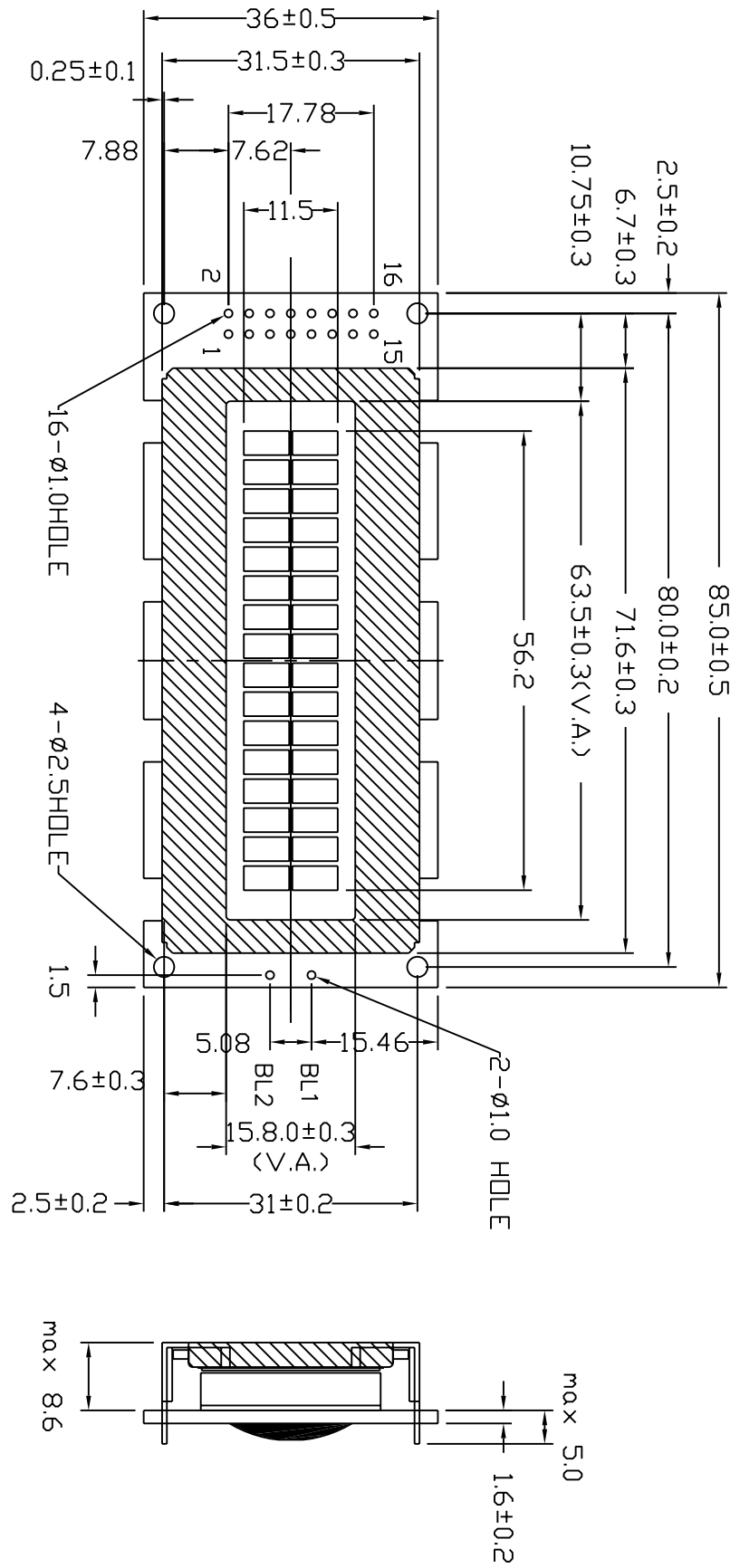
### CONTRAST VERSUS



### DEFINITION OF ANGLES $\theta$ AND DEFINITION OF OPTICAL RESPONSE



# 13.0 MODULE DIMENSIONS



Cage Code #DWSS2

DWG. NO.

LC4422

SHEET 7 OF 8

REV. A

## 14.0 PART NUMBER DESCRIPTION FOR AVAILABLE OPTIONS

**LC4422**①②**2C16**③④⑤

①

**Polarizer Type**

B = Transflective: light background with blue-green LED= backlight

②

**Backlight Color**

G = Yellow-green (standard)

③

**Fluid Type and Power Supply**

H = STN-H with  $\pm 5$ VDC operation

④

**Fluid Type Viewing Direction**

N = STN-H

⑤

**Background Color for STN Temperature Range**

G = Gray background

Y = Yellow background