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REVISIONS			
REV.	DESCRIPTION	DATE	APPROVED
A	Released on ECN #E1518	07/03/04	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 or CCFL 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	240 X 320 GRAPHICS LCD MODULE
	ISSUED		DWG. NO.	LM4755

1.0 DESCRIPTION

Dot matrix display module consisting of liquid Crystal Display, CMOS driver and Seiko Epson SED1335 controller LSI, printed circuit board, metal support frame and metal support frame and Light Emitting Diode (LED) backlight.

Available LC fluid types are: NTN (Supertwisted nematic) and NTN-H (Extended temperature range NTN), FSTN-Positive,Negative (Film supertwisted nematic), FSTN-H Positive,Negative (Extended Film supertwisted nematic FSTN).

Other options include on-board negative voltage generation circuitry and on-board temperature compensation circuitry.

2.0 MECHANICAL CHARACTERISTICS

Item	Specifications	Unit
Package Dimensions	165.5 (W) x 109.0 (H) x 17.0 max (D)	mm
Display format	320 dots (W) x 240 dots (H)	-
Driving method	1/240	duty
Dot size	0.345 (W) x 0.345 (H)	mm
Dot pitch	0.360 (W) x 0.360 (H)	mm
Active display area	115.185 (W) x 86.385 (H)	mm
Viewing area	122.0 (W) x 92.0 (H)	mm
Weight		g

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

3.0 ABSOLUTE MAXIMUM RATINGS

V_{SS}=0V;T_a=25°C

Item	Symbol	FSTN,STN		FSTN-H,STN-H		Unit
		Min.	Max.	Min.	Max.	
Logic supply voltage	V _{DD} -V _{SS}	0	7	0	7	V
LC driver supply voltage	V _{DD} -V _O	0	28	0	28	V
Operating temperature	T _{OP}	0	+50	-20	+70 (Note 3)	°C
Storage temperature (Note 1)	T _{ST}	-10	+60	-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. It is not recommended to operate CCF lamp below 0°C.

4.0 ELECTRICAL CHARACTERISTICS

V_{DD}=5±0.25V;T_a=25°C

Item	Symbol	Test Condition	Min.	Typ.	Max.	Unit
Input "High" voltage	V _{IH}	-	3.8	-	V _{DD} +0.3	V
Input "Low" voltage	V _{IL}	-	-	-	1.0	V
Output "High" voltage	V _{OH}	I _{OH} =0.205mA	2.2	-	-	V
Output "Low" voltage	V _{OL}	I _{OL} =1.2mA	-	-	0.4	V
Power supply current	I _{EE}	V _{EE} =-23V	-	6.0	-	mA
Power supply current	I _{DD}	V _{DD} =5.0V	-	10.0	*100	mA

* With Negative Voltage and Temperature Compensation installed.

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

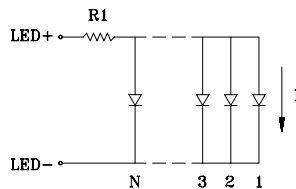
V_{DD}=5.0±0.25V

Temperature	NTN	NTN-H	FSTN-POSITIVE	FSTN-H-POSITIVE	FSTN-NEGATIVE	FSTN-H-NEGATIVE
T _a = -20°C	-	26.5	-	27.0	-	27.5
T _a = 0°C	25.5	25.5	26.2	26.2	26.0	26.0
T _a = 25°C	25.0	25.0	25.5	25.5	25.0	25.0
T _a = 50°C	24.0	24.0	24.0	24.0	24.2	24.2
T _a = 70°C	-	23.0	-	22.5	-	23.0

6.0 BACKLIGHT SPECIFICATIONS:

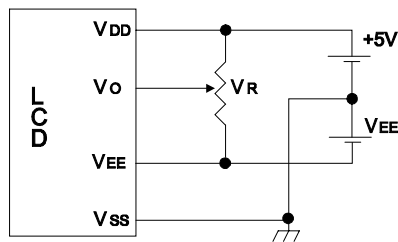
T_a=20°C,60%RH,Darkroom.

Item	Symbol	Typ.	Max.	Unit
LED input voltage	V _{LED}	5.0	6.0	V _{rms}
LED input current	V _{LED}	120	130	mA
Built-in current limit resistor	R1	-	-	Ohms, W
Recommended external current limit resistor	R2	-	-	Ohms, W
Number of Nodes	N	1	-	-

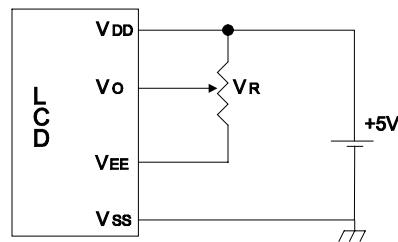


7.0 POWER SUPPLY

- NTN, NTN-H, FSTN-H

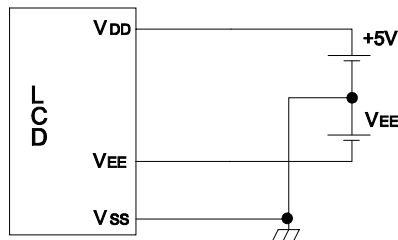


- NTN, NTN-H, FSTN-H with on-board negative voltage generator

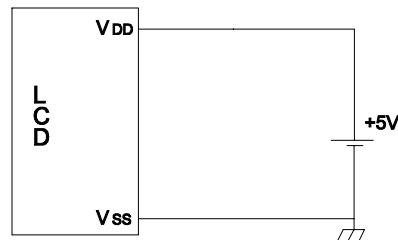


V_R = 10K - 20K ohm

- NTN, NTN-H, FSTN-H with temperature compensation



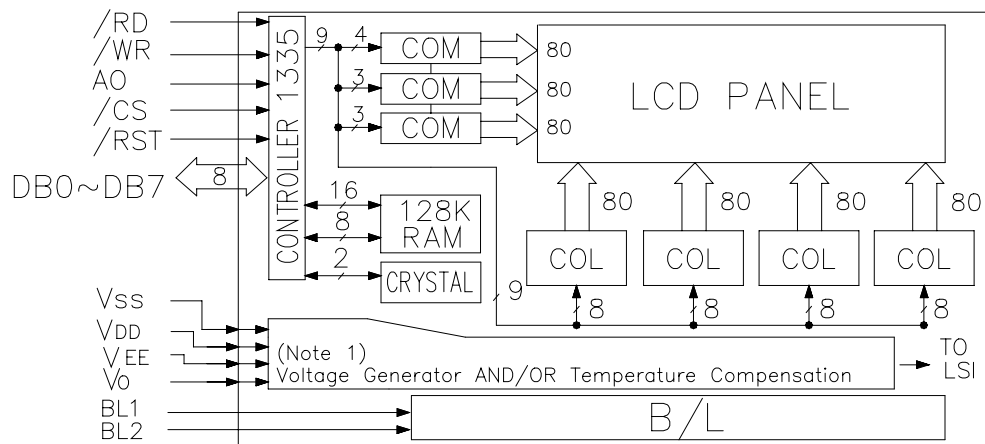
- NTN, NTN-H, FSTN-H with on-board negative voltage generator and temperature compensation



8.0 INTERFACE DESCRIPTION

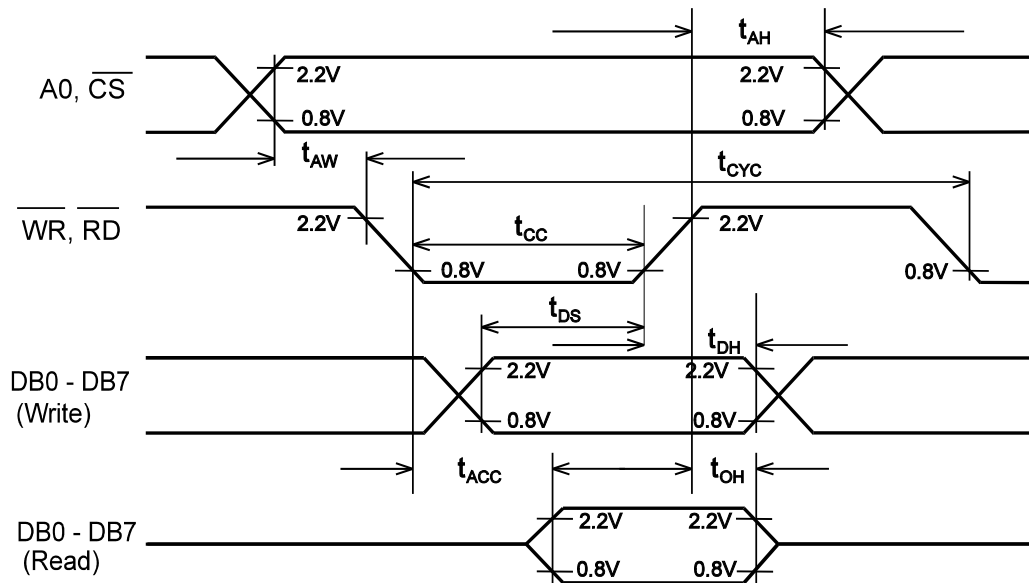
Pin No.	Symbol	I/O	Function
1	VSS	-	Ground (0V)
2	VDD	-	Logic Supply Voltage (+5V)
3	VO	-	LC drive voltage for contrast adjustment
4	RD	I	Read strobe signal (Active low)
5	WR	I	Write strobe signal (Active low)
6	AO	I	Data type selection
7	DB0	I/O	Bi-directional data bus line 0
8	DB1	I/O	Bi-directional 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	CS	I	Chip Select (Active low)
16	RST	I	Reset (Active low)
17	VEE	I(O)	Negative voltage input for LC drive (Negative voltage output for models with on-board negative voltage generator)
18	N/C	-	No connection
19	N/C	-	No connection
20	N/C	-	No connection
BL1	VLED+	-	LED+ backlight input voltage (from output of DC-AC inverter)
BL2	VLED-	-	LED- backlight input voltage (from output of DC-AC inverter)

9.0 BLOCK DIAGRAM:



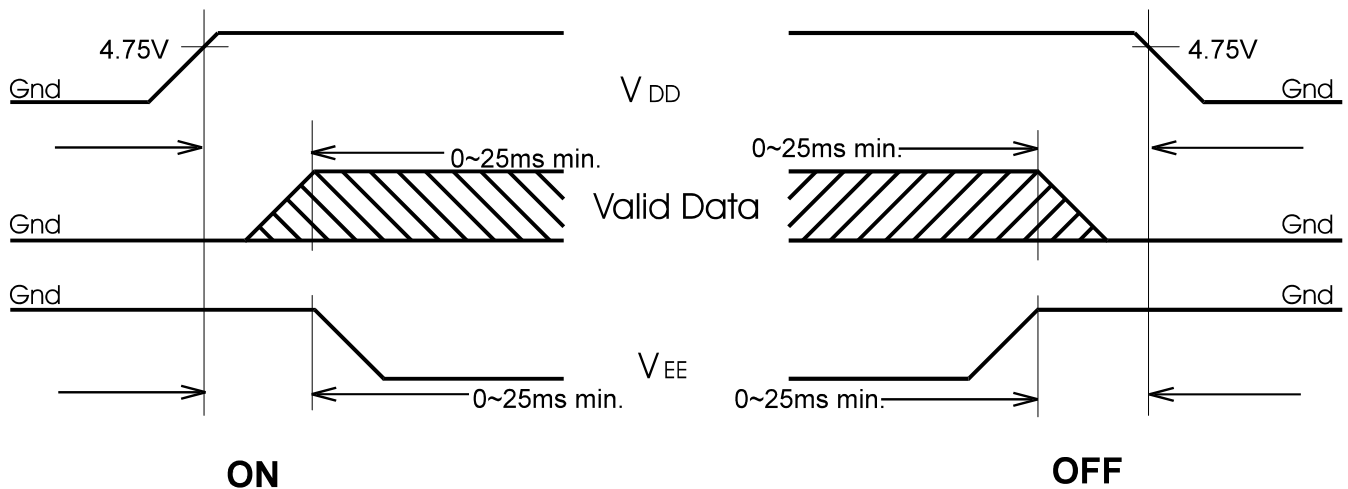
10.0 TIMING CHARACTERISTICS

Item	Symbol	Min.	Typ.	Max.	Unit
System cycle time	t_{CYC}	575	-	-	nS
Control pulse width	t_{CC}	220	-	-	nS
Address setup time	t_{AW}	30	-	-	nS
Address hold time	t_{AH}	10	-	-	nS
Data setup time	t_{DS}	120	-	-	nS
Data hold time	t_{DH}	10	-	-	nS
RD access time	t_{ACC}	-	-	120	nS
Output disable time	t_{OH}	10	-	50	nS



11.0 VOLTAGE SEQUENCING

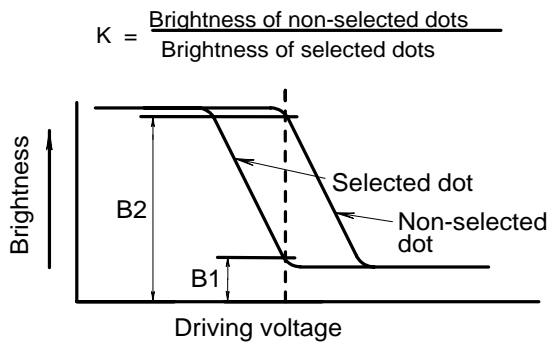
Always observe the following power supply ON/OFF sequence. Failure to so may cause latch up of CMOS LSI circuits or DC induced damage to LC panel.



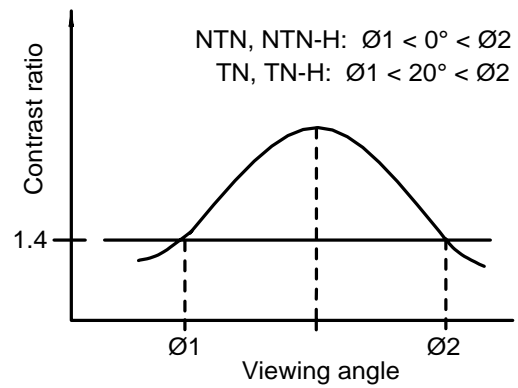
12.0 OPTICAL CHARACTERISTICS

Item	Symbol	Test Condition	Min.	Typ.	Max.	Unit
Contrast ratio	K	$\theta=20^\circ \theta=0^\circ$	4	-	-	-
Viewing angle	$\theta_2-\theta_1$	$\theta=0^\circ K \geq 1.4$	40	-	-	Deg.
	θ	$\theta=20^\circ K=1.4$	± 30	-	-	Deg.
Response time	Rise	$\theta=20^\circ \theta=0^\circ$	-	150	250	mS
	Fall	$\theta=20^\circ \theta=0^\circ$	-	150	250	mS

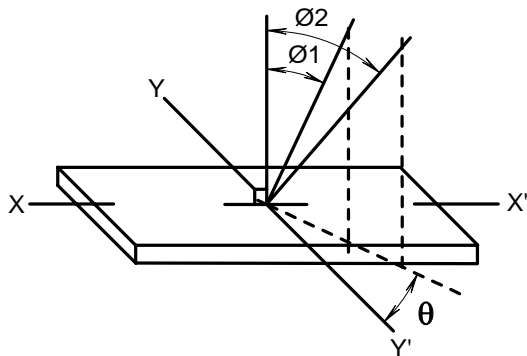
DEFINITION OF CONTRAST RATIO (K)



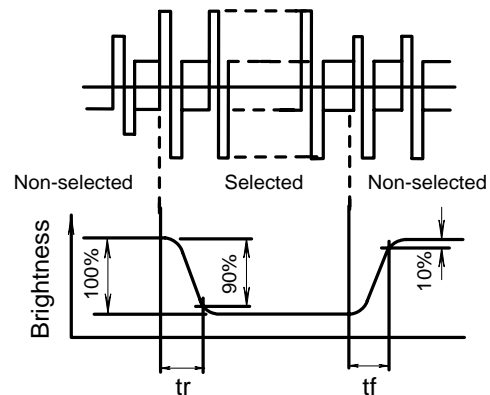
CONTRAST VERSUS VIEWING ANGLE



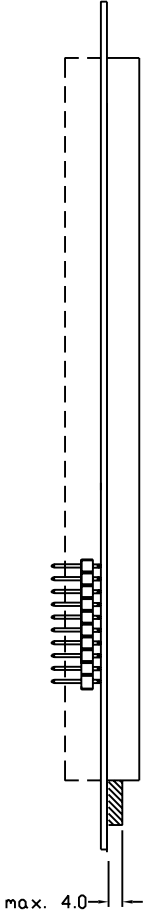
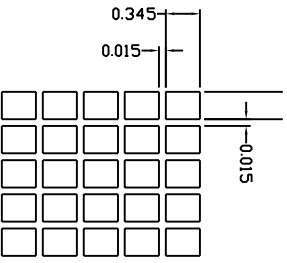
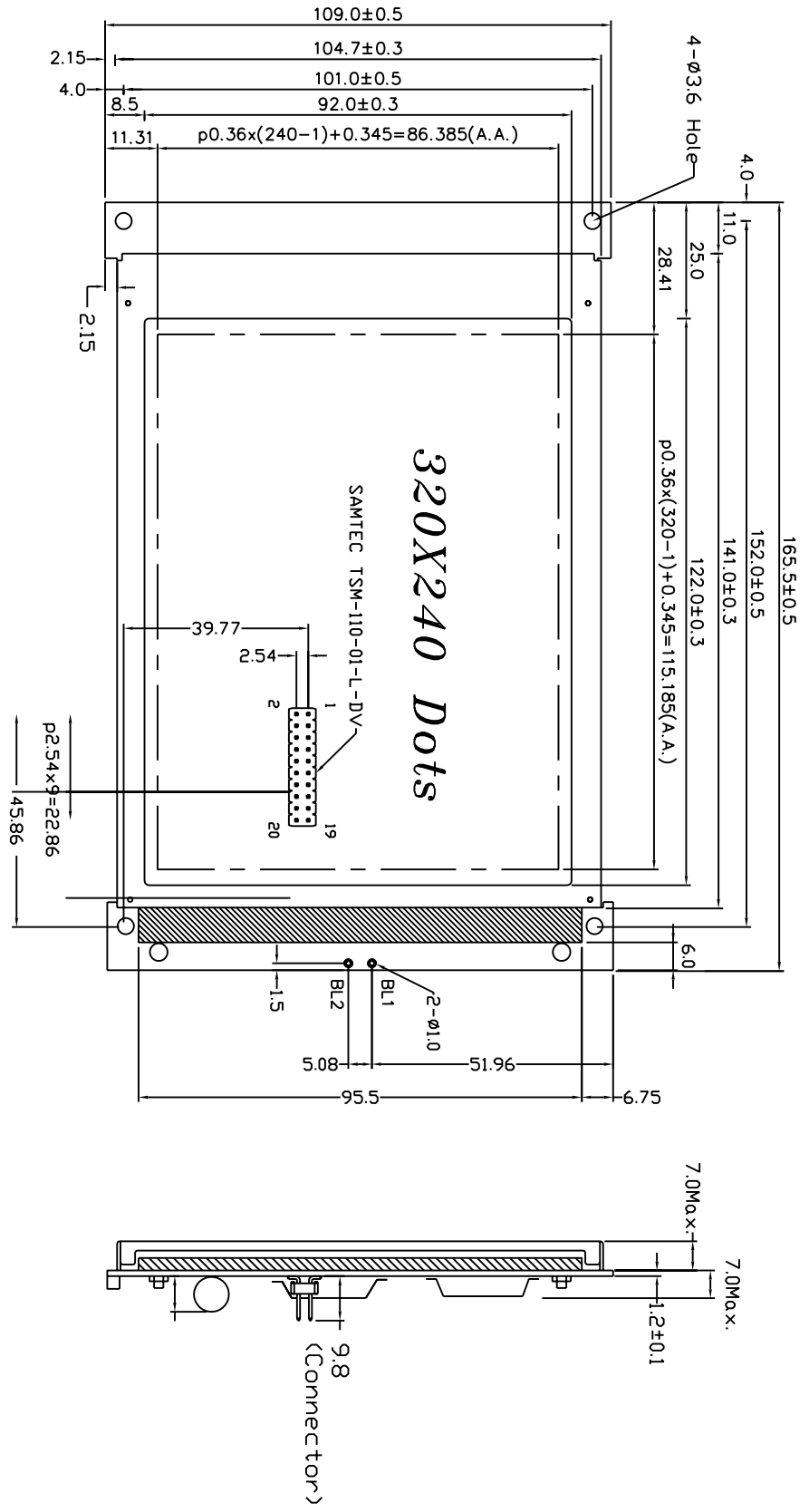
DEFINITION OF ANGLES θ AND θ



DEFINITION OF OPTICAL RESPONSE



13.0 MODULE DIMENSIONS



Cage Code #DWSS2

DWG. NO.

LM4755

SHEET 7 OF 8

REV. A

14.0 PART NUMBER DESCRIPTION FOR AVAILABLE OPTIONS

LM4755①②240G320③④⑤

①

POLARIZER TYPE

B = Transflective: light background with white LED backlight

E = Transmissive: dark background with white LED backlight

②

W = White backlight

③

FLUID TYPE AND POWER SUPPLY

D = NTN with +5VDC and external negative voltage operation

S = NTN with +5VDC operation (on-board negative voltage generation)

H = NTN extended temp. with +5VDC and external negative voltage operation

W = NTN extended temp. with +5VDC operation (on-board negative voltage generation)

④

FLUID TYPE

C = NTN with on-board temperature compensation circuitry

N = NTN

F = FSTN, FSTN-H

⑤

COLOR FOR NTN FLUID

G = Gray background

Y = Yellow background