REVISIONS			
REV.	DESCRIPTION	DATE	APPROVED
C	RELEASED ON ECN #E0495	8/5/96	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 V_{DD} and V_{SS}, 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 V_O (contrast) pin and ground. V_{DD} must, at all times, exceed the V_O voltage level. The capacitor combines with the contrast potentiometer to form an R-C network which “holds-up” V_O, 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:	APPROVALS	DATE	DENSITRON INTERNATIONAL PLC.	
Dimensions are mm Tolerances are: X = ± 3 .X = ± 0.5 .XX = ± 0.05 FSCM NO. 62483	DRAWN			
	CHECKED		TITLE: 240 X 128 GRAPHICS LCD MODULE	
	ISSUED		DWG. NO. LM4229	SHEET 1 OF 8

1.0 DESCRIPTION

Dot matrix display module consisting of liquid Crystal Display, CMOS driver and Toshiba T6963C controller LSI, printed circuit board, metal support frame and Light Emitting Diode (LED) backlight.

Available LC fluid type is: NTN (supertwisted nematic), NTN-H (extended temperature range NTN).

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

2.0 MECHANICAL CHARACTERISTICS

Item	Specifications	Unit
Package Dimensions	144.0 (W) x 104.0 (H) x 15.6 max (D)	mm
Display format	128 dots (H) x 240 dots (W)	-
Driving method	1/128	duty
Dot size	0.40 (W) x 0.40 (H)	mm
Dot pitch	0.45 (W) x 0.45 (H)	mm
Active display area	107.95 (W) x 57.55 (H)	mm
Viewing area	114.0 (W) x 64.0 (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,NTN		FSTN-H,NTN-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	25	0	25	V
Operating temperature Storage temperature (Note 1)	T_{OP} T_{ST}	0 -20	+50 +70	-20 -30	+70 (Note 3) +80	°C
Humidity: Operating (@40°C) Non-operating (@40°C)	- -	- -	85% 95%	- -	85% 95%	RH (Note 2) 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}	-	0.8V_{DD}	-	V_{DD}	V
Input “Low” voltage	V_{IL}	-	V_{SS}	-	0.2V_{DD}	V
Output “High” voltage	V_{OH}	I_{OH}=0.205mA	2.2	-	-	V
Output “Low” voltage	V_{OL}	I_{OL}=1.2mA	-	-	0.8	V
Power supply current	I_{EE}	V_{EE}=-15V	-	7.0	-	mA
Power supply current	I_{DD}	V_{DD}=5.0V	-	30.0	-	mA

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

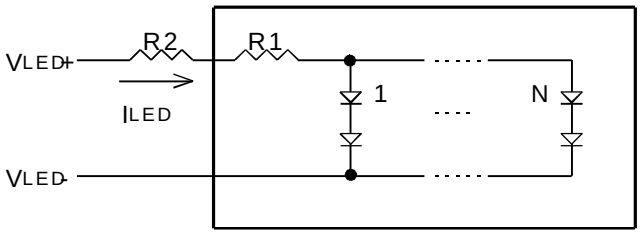
V_{DD}=5.0±0.25V

Temperature	NTN	NTN-H
Ta= -20°C	-	24.3
Ta= 0°C	21.0	21.0
Ta= 25°C	18.5	18.5
Ta= 50°C	16.8	16.8
Ta= 70°C	-	15.7

6.0 BACKLIGHT SPECIFICATIONS:

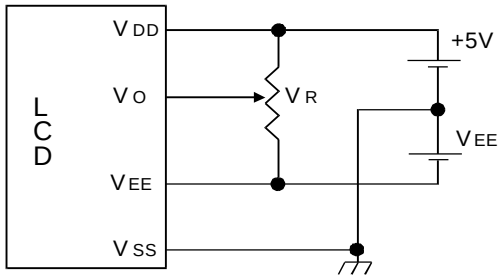
Ta=20°C,60%RH,Darkroom.

Item	Symbol	Typ.	Max.	Unit
LED lamp input voltage	V_{LED}	5.0	6.0	Vrms
LED input current	I_{LED}	660	825	mA
Build-in current limit resistor	R1	-	-	Ohms, W
Recommended external current limit resistor	R2	1 Ohms, 1W	-	Ohms, W
Number of Led nodes	N	110	-	-

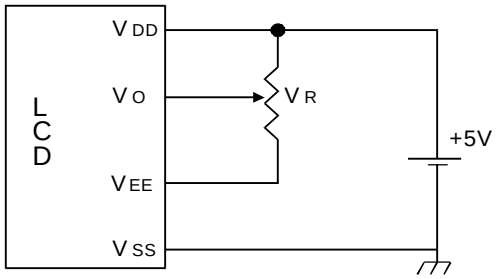


7.0 POWER SUPPLY

● NTN

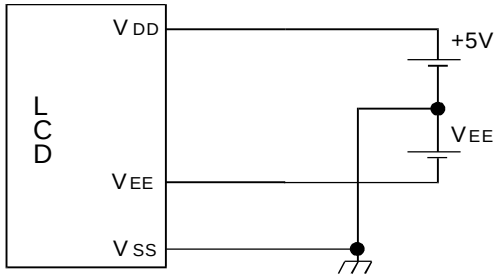


● NTN with on-board negative voltage generator

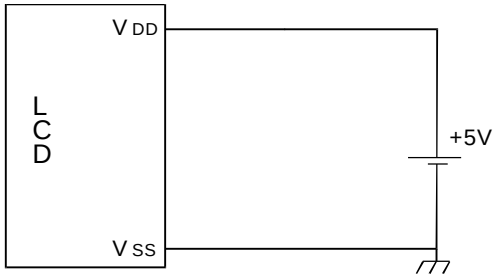


V_R = 10K - 20K ohm

● NTN with temperature compensation



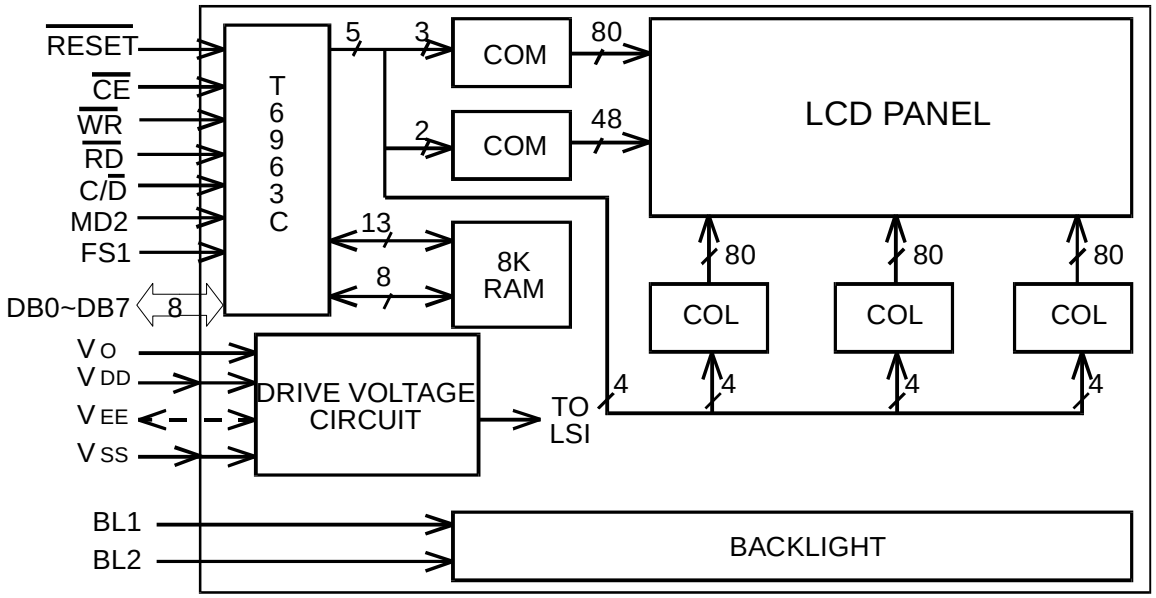
● NTN with on-board negative voltage generator and temperature compensation



8.0 INTERFACE DESCRIPTION

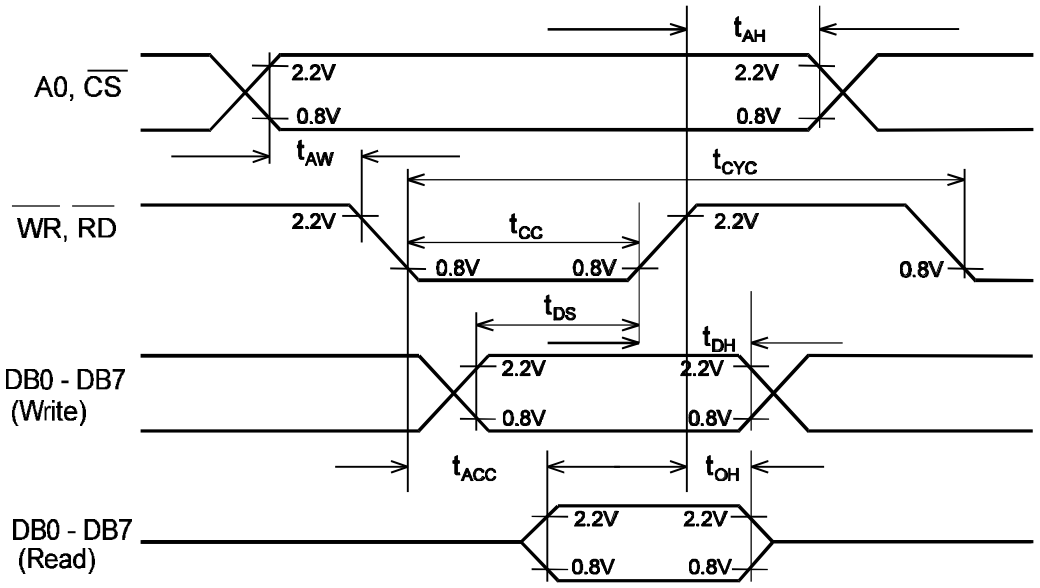
Pin No.	Symbol	I/O	Function
1	V_{SS}	-	Ground (0V)
2	V_{DD}	-	Logic Supply Voltage (+5V)
3	V_0	-	LC drive voltage for contrast adjustment
4	C/D	I	WR="L"…C/D="H": Command write C/D="L": Data write RD="L"…C/D="H": Status read C/D="L": Data read
5	RD	I	Data read Active Low
6	WR	I	Data write Active Low
7	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	CE	I	Chip enable Active low
16	RESET	I	Chip reset Active low
17	V_{EE}	I(O)	Negative voltage input for LC drive (Negative voltage output for models with on-board negative voltage generator)
18	MD2	I	Mode Selection (see below)
19	FS1	I	Terminals for selection of font size
20	HALT	-	Halt function (H = Normal, L = Stop oscillation)
BL1	V_{LED+}	-	Anode (+): LED backlight input voltage
BL2	V_{LED-}	-	Cathode (-): LED backlight input voltage

9.0 BLOCK DIAGRAM:



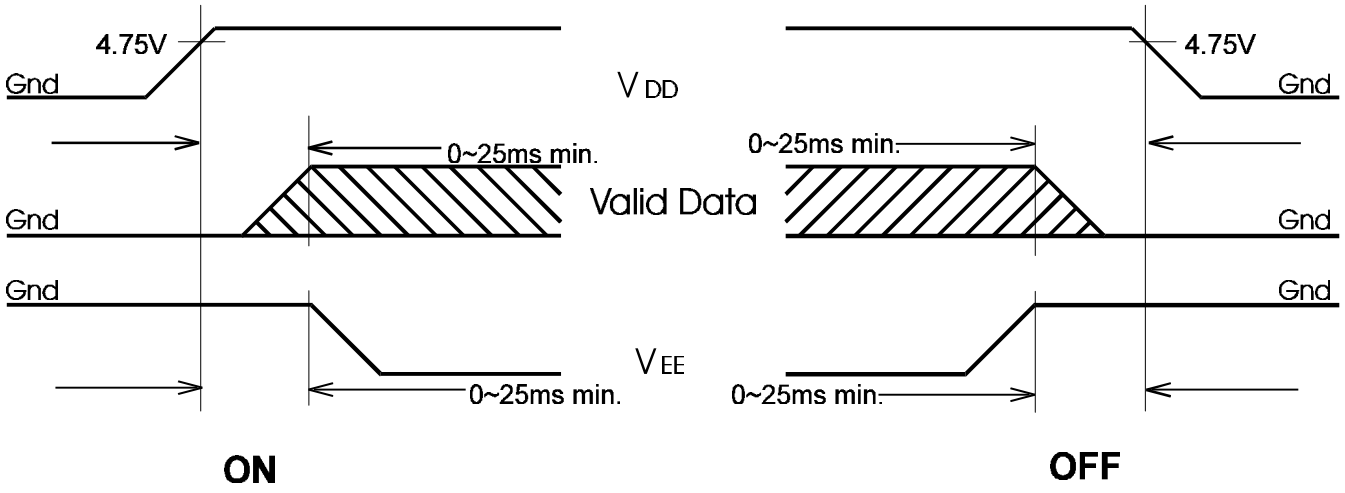
10.0 TIMING CHARACTERISTICS

Item	Symbol	Min.	Typ.	Max.	Unit
C/D Set up time	t_{CDS}	100	-	-	nS
C/D Hold time	t_{CDH}	10	-	-	nS
CE, RD, WR pulse width	t_{DS}, t_{RD}, t_{WR}	80	-	-	nS
Data setup time	t_{DS}	80	-	-	nS
Data hold time	t_{DH}	40	-	-	nS
access time	t_{ACC}	-	-	150	nS
Output hold 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.

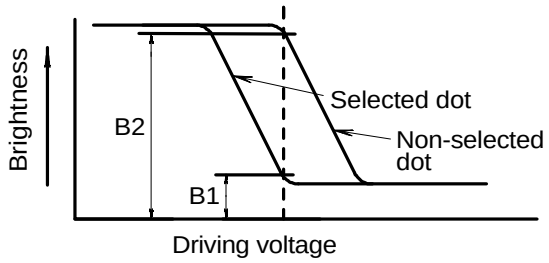


12.0 OPTICAL CHARACTERISTICS

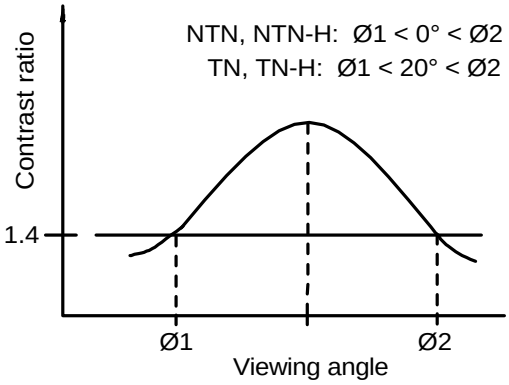
Item	Symbol	Test Condition	Min.	Typ.	Max.	Unit
Contrast ratio	K	Ø=20° θ=0°	4	-	-	-
Viewing angle	Ø2-Ø1	θ=0° K≥1.4	40	-	-	Deg.
	θ	Ø=20° K=1.4	±30	-	-	Deg.
Response time Rise	t_r	Ø=20° θ=0°	-	150	250	mS
Fall	t_f	Ø=20° θ=0°	-	150	250	mS

DEFINITION OF CONTRAST RATIO (K)

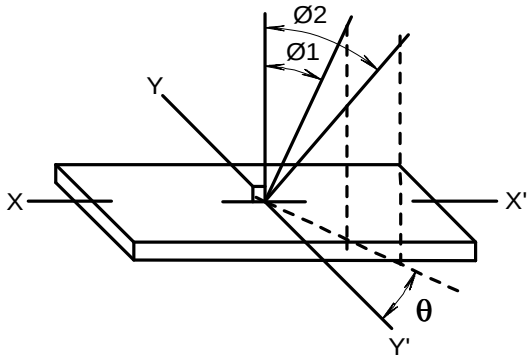
$$K = \frac{\text{Brightness of non-selected dots}}{\text{Brightness of selected dots}}$$



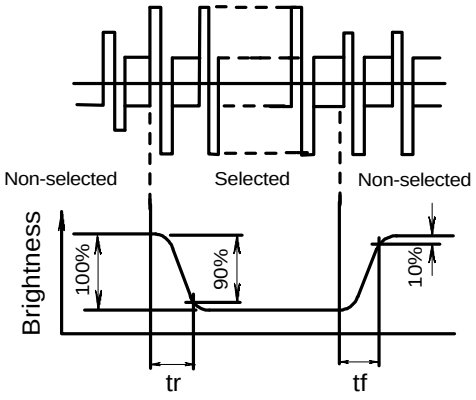
CONTRAST VERSUS VIEWING ANGLE



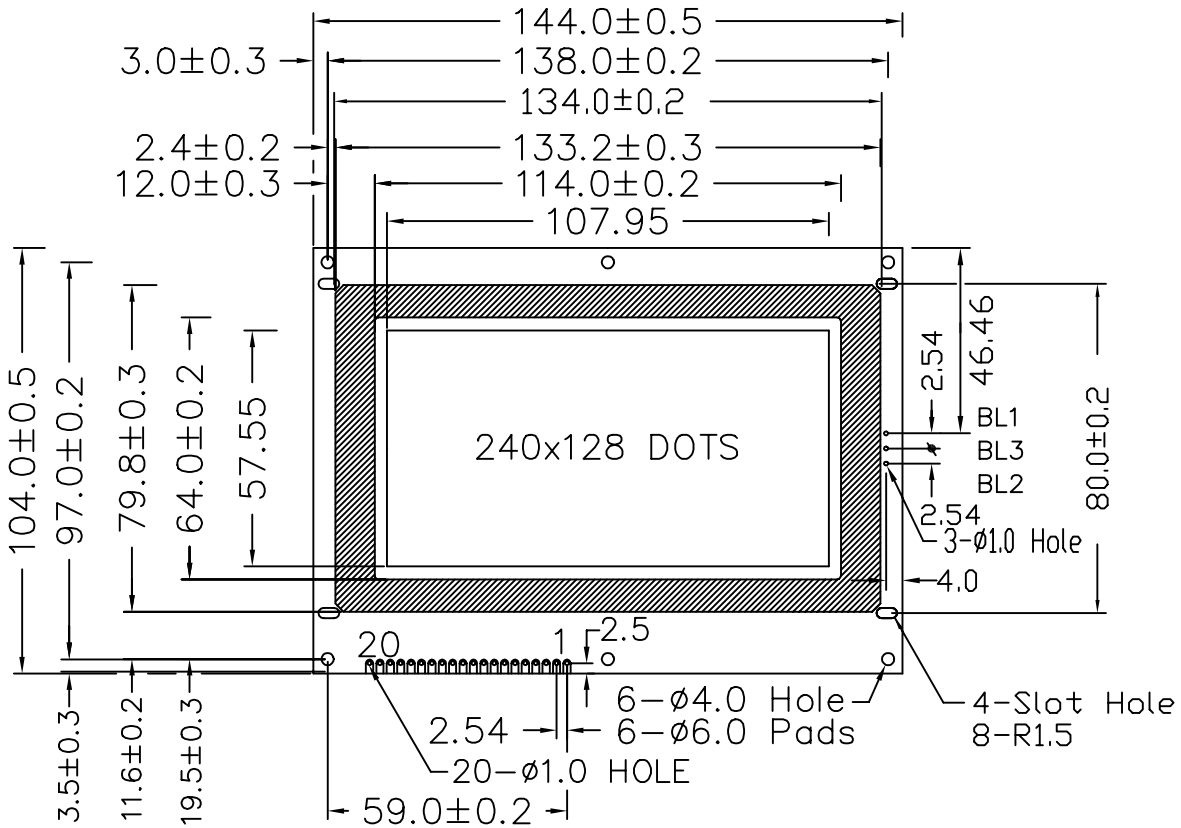
DEFINITION OF ANGLES Ø AND θ

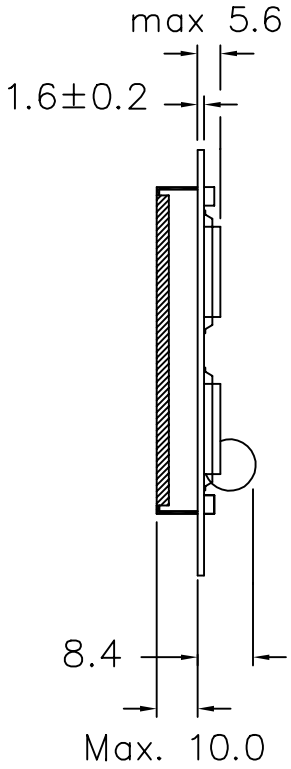


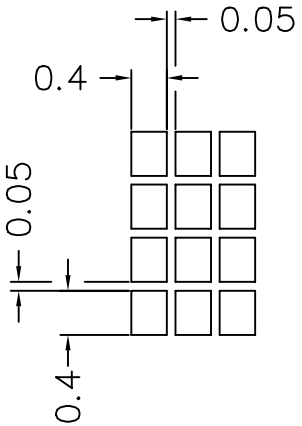
DEFINITION OF OPTICAL RESPONSE



13.0 MODULE DIMENSIONS







14.0 PART NUMBER DESCRIPTION FOR AVAILABLE OPTIONS

LM4229①②128G240③④⑤

① **POLARIZER TYPE**
B = Transflective: light background with LED backlight
E = Transmissive: dark background with LED backlight

② **BACKLIGHT COLOR**
G = Yellow-Green (Standard)

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-H with +5VDC and external negative voltage operation
W = Wide temperture range: on-board negative voltage generator

④ **FLUID TYPE**
N = NTN, NTN-H

⑤ **COLOR FOR NTN FLUID**
B = Blue background (available for E polarizer type only)
G = Gray background (available for B polarizers types only)
Y = Yellow background (available for B polarizers types only)