REVISIONS

REV.	DESCRIPTION	DATE	APPROVED
D	RELEASED ON ECN #E1478	03/25/03	MA
E	Released on ECN #E1581	11/04/03	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 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 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 2 LINE X 16 CHARACTERS	
	ISSUED		DWG. NO. LM4047	SHEET 1 OF 8

1.0 DESCRIPTION

Dot matrix display module consisting of a Liquid Crystal Display, KS0066 controller, and printed circuit board. Light Emitting Diode (LED) backlight.

Available LC filuids types are: NTN-H (extended temperature range NTN).

2.0 MECHANICAL CHARACTERISTICS

Item	Specifications	Unit
Package Dimensions	74.0 (W) x 19.5 (H) x (3V) 8.5, (5V) 7.8 (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	.55 (W) x .50 (H)	mm
Dot pitch	.60 (W) x .55 (H)	mm
Character Size	2.95 (W) x 4.35 (H)	mm
Active display area	54.7 (W) x 9.0 (H)	mm
Viewing area	60.0 (W) x 11.5 (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	NTN-H		Unit
		Min.	Max.	
Logic supply voltage	V_{DD}-V_{SS}	0	7	V
LC driver supply voltage	V_{DD}-V_O	0	13	V
Operating temperature Storage temperature (Note 1)	T_{OP} T_{ST}	-20 -30	+70 (Note 3) +80	°C
Humidity: Operating (@40°C) Non-operating (@40°C)	- -	- -	85% 95%	RH (Note 2) RH (Note 2)

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

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}	-	2.2	-	V_{DD}	V
Input “Low” voltage	V_{IL}	-	-	-	0.6	V
Output “High” voltage	V_{OH}	I_{OH}=0.205mA	2.4	-	-	V
Output “Low” voltage	V_{OL}	I_{OL}=1.2mA	-	-	0.4	V
Power supply current	I_{DD}	V_{DD}=3.0V	-	6	-	mA
Power supply current	I_{DD}	V_{DD}=5.0V	-	1	-	mA

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

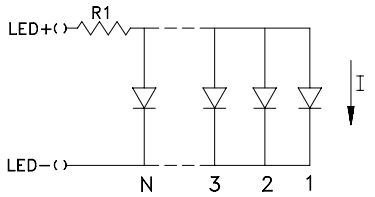
V_{DD}=5.0±0.25V

Temperature	NTN-H
Ta= -20°C	4.5
Ta= 0°C	4.5
Ta= 25°C	4.5
Ta= 50°C	4.5
Ta=70°C	4.5

6.0 BACKLIGHT SPECIFICATIONS:

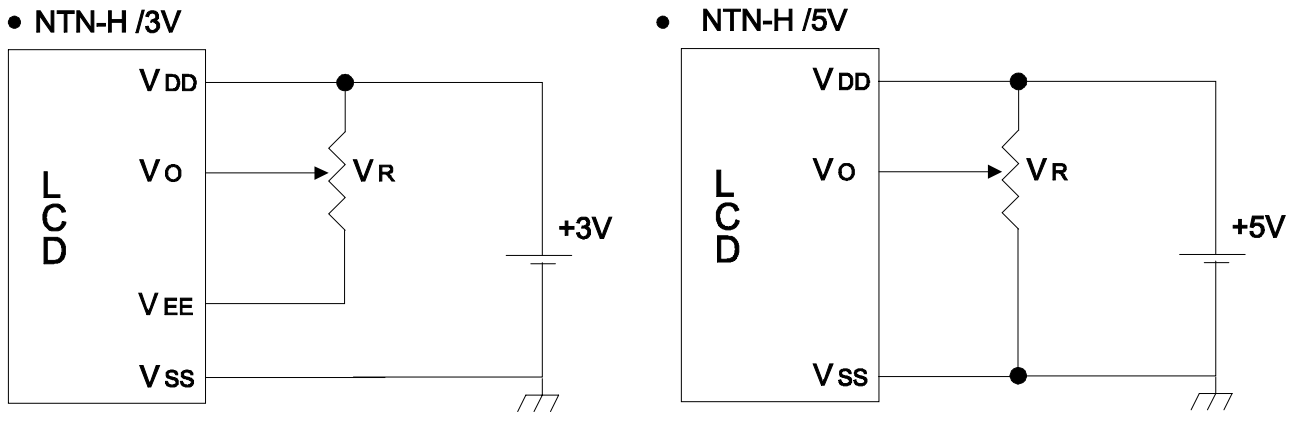
Ta=20°C,60%RH,Darkroom.

Item	Symbol	Typ.	Max.	Unit
LED input voltage	V_{LED}	V_{DD}	-	Vrms
LED input current	I_{LED}	40 mA	-	mA
Built-in current limiting resistor	R1 @ 3V	24.9 Ohms, 1/8W	-	Ohms, W
Built-in current limiting resistor	R1 @ 5V	75 Ohms, 1/8W	-	Ohms, W
Number of nodes	N	4	-	-



N= 4 , I= 10 mA

7.0 POWER SUPPLY

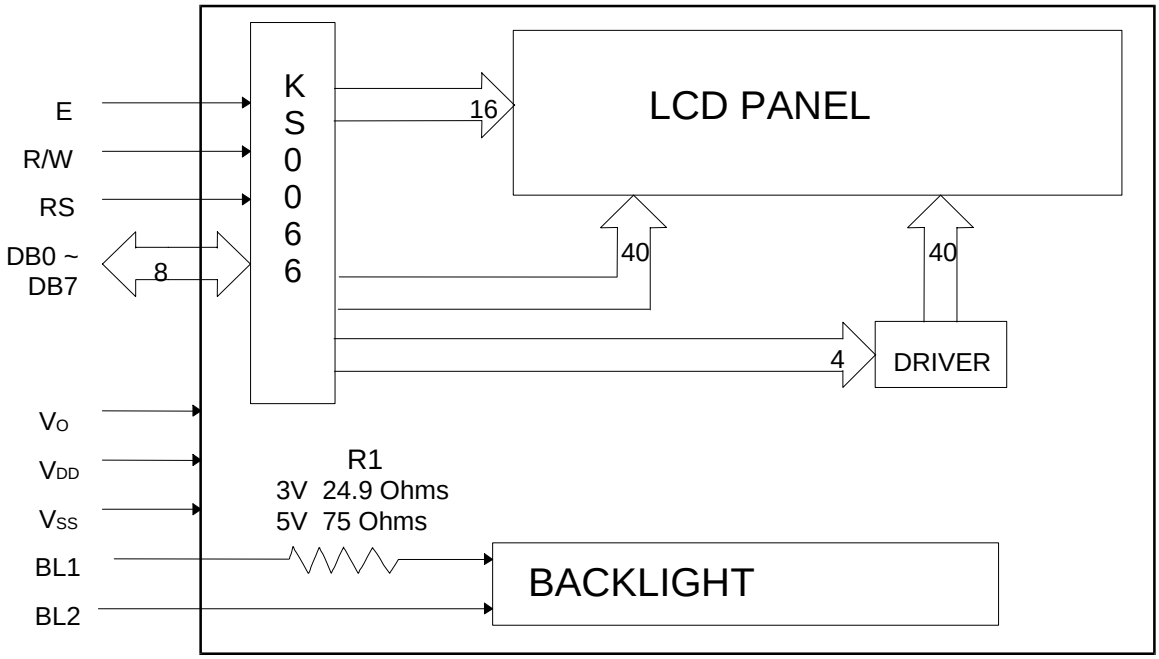


V_R = 10K - 20K ohm

8.0 INTERFACE DESCRIPTION

Pin No.	Symbol	I/O	Function
1	N/C	-	No Connection
2	N/C	-	No Connection
3	V_{SS}	-	Ground (0V)
4	V_{DD}	-	Logic Supply Voltage (+5V) / (+3V)
5	V_O	-	LC Drive voltage for contrast adjustment
6	RS	I	Register Select 0: Instruction Register 1: Data Register
7	R/W	I	Read / Write 0: Data Write (Module←MPU) 1: Data Read (Module→MPU)
8	E	I	Enable Signal Active High (H → L)
9	DB0	I/O	Bi-directional data bus line 0
10	DB1	I/O	Bi-directional data bus line 1
11	DB2	I/O	Bi-directional data bus line 2
12	DB3	I/O	Bi-directional data bus line 3
13	DB4	I/O	Bi-directional data bus line 4
14	DB5	I/O	Bi-directional data bus line 5
15	DB6	I/O	Bi-directional data bus line 6
16	DB7	I/O	Bi-directional data bus line 7
17	V_{LED+}	-	Anode (+): LED backlight input voltage
18	V_{LED-}	-	Cathode (-): LED backlight input voltage
19	V_{EE}	-	Negative voltage output for models with on-board negative voltage generators
20	N/C	-	No Connection

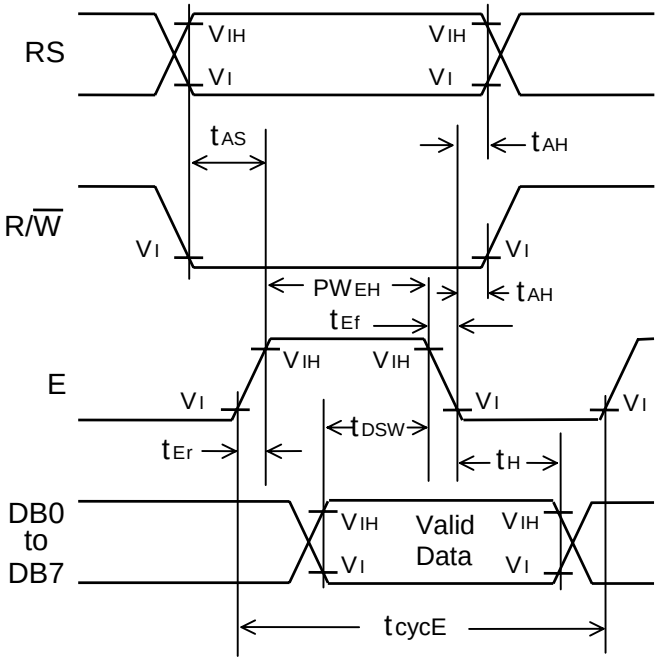
9.0 BLOCK DIAGRAM:



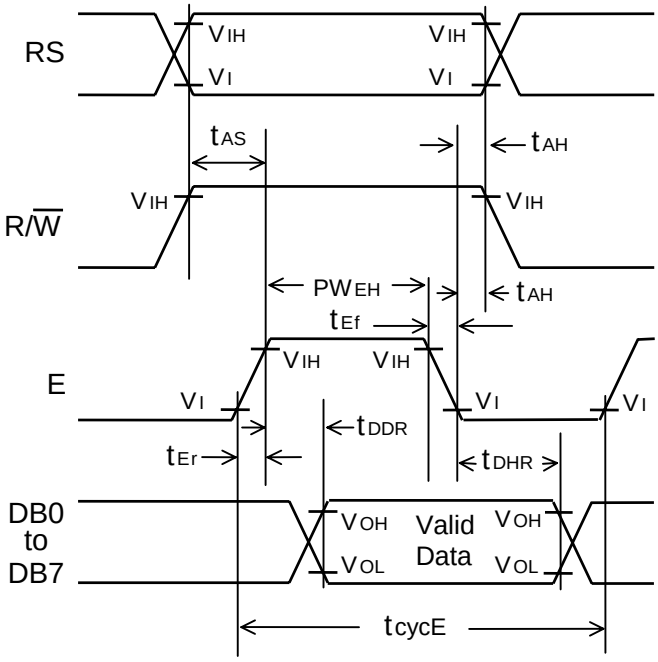
10.0 TIMING CHARACTERISTICS

Item	Symbol	Min.	Typ.	Max.	Unit
Enable cycle time	T_{cycE}	500	-	-	nS
Enable pulse width	PW_{EH}	220	-	-	nS
Enable rise / fall time	t_{Er}/t_{Ef}	-	-	25	nS
Address set-up time	t_{AS}	40	-	-	nS
Address hold time	t_{AH}	10	-	-	nS
Data delay time	t_{DDR}	-	-	120	nS
Data hold time (Write)	t_{DHW}	10	-	-	nS
Data hold time (Read)	t_{DHR}	10	-	-	nS
Data set-up time	t_{DSW}	60	-	-	nS

WRITE OPERATION



READ OPERATION



11.0 DD RAM ADDRESS vs. DISPLAY POSITION

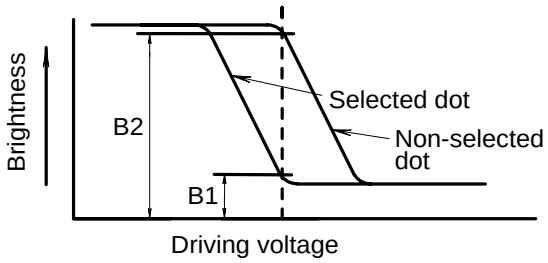
Character	1	2	3	4	5	6	7	8	9	10	11	---	14	15	16
Line 1	00	01	02	03	04	05	06	07	08	09	0A	---	0D	0E	0F
Line 2	40	41	42	43	44	45	46	47	48	49	4A	---	4D	4E	4F

12.0 OPTICAL CHARACTERISTICS

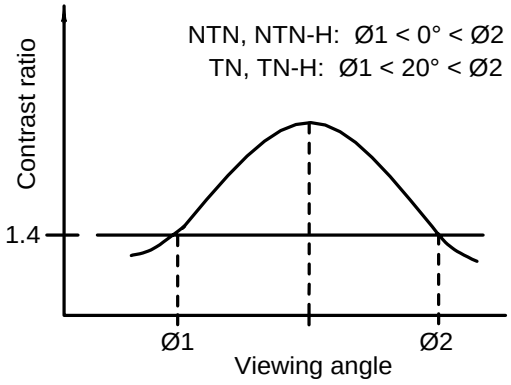
Item	Symbol	Test Condition	Min.	Typ.	Max.	Unit
Contrast ratio NTN-H	K	Ø=20° θ=0°	5	-	-	-
Viewing angle	Ø2-Ø1	θ=0° K≥1.4	40	-	-	Deg.
NTN-H	θ	Ø=20° K=1.4	±40	-	-	Deg.
Response time Rise	t_r	Ø=20° θ=0°	-	150	250	mS
Fall	t_f	Ø=20° θ=0°	-	150	250	mS

DEFINITION OF CONTRAST RATIO (K)

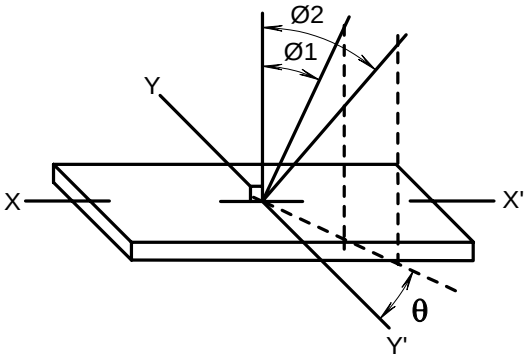
$$K = \frac{\text{Brightness of non-selected dots}}{\text{Brightness of selected dots}}$$



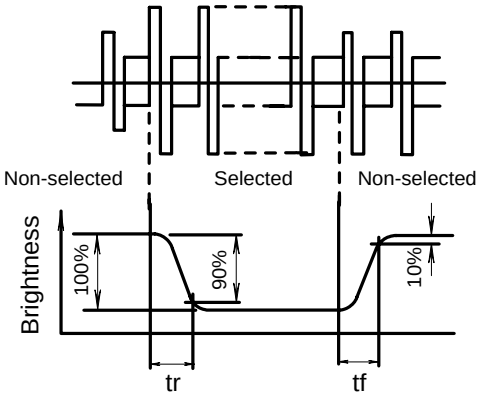
CONTRAST VERSUS VIEWING ANGLE



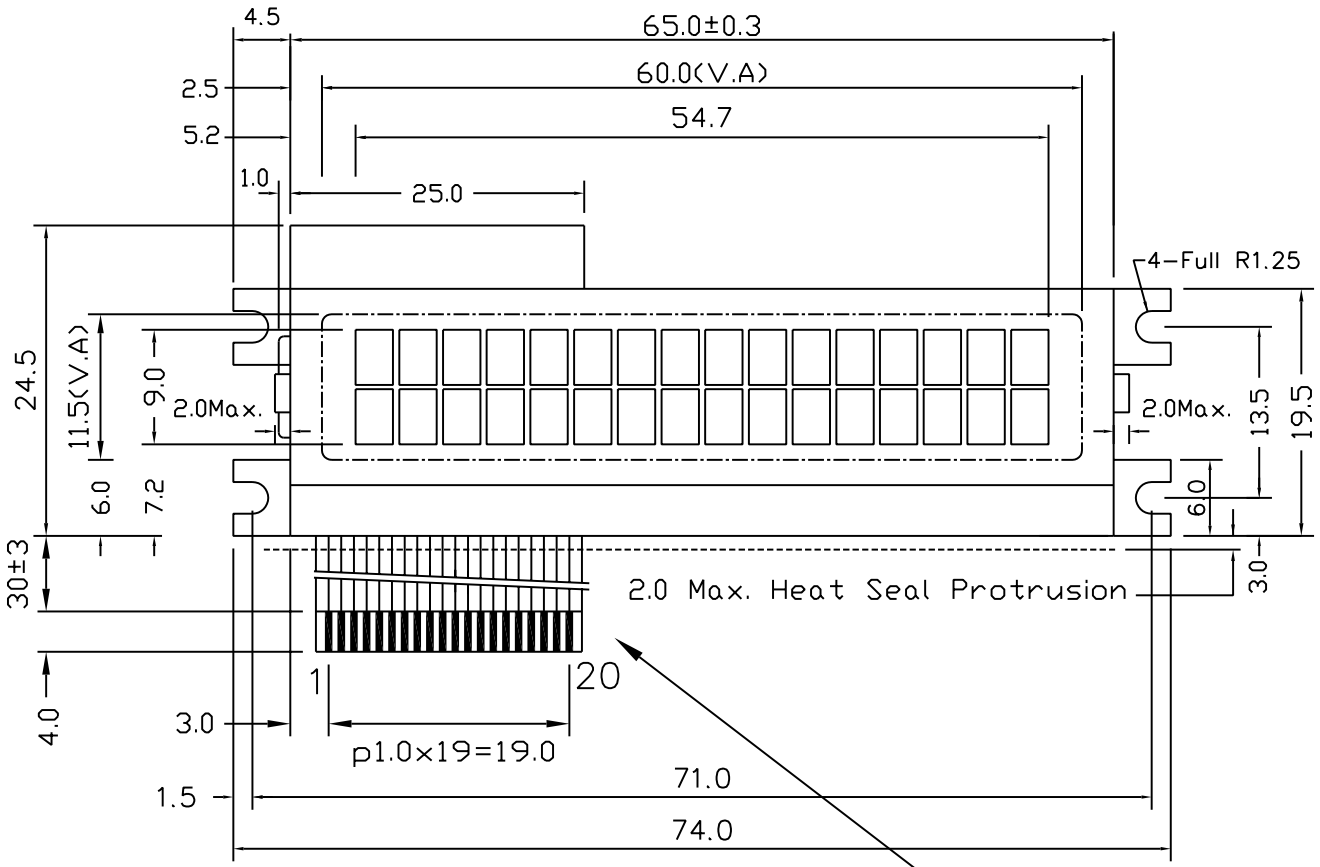
DEFINITION OF ANGLES Ø AND θ

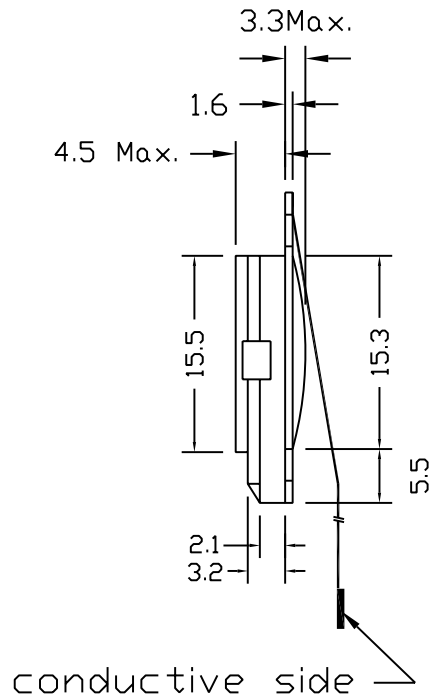


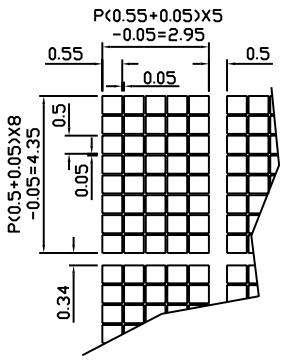
DEFINITION OF OPTICAL RESPONSE



13.0 MODULE DIMENSIONS







DOTS DETAIL

Module	A
/3	Max. 4.0
/5	Max. 3.3

*Note:
Recommended Mating Connector
Maxconn P/N; MFPC-20-R-B-T
(B for bottom entry type)
Maxconn P/N: MFPC-20-R-T-T
(T for top entry type)
HIROSE P/N: FH10A-20S-1SH)
(Top entry only)

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14.0 PART NUMBER DESCRIPTION FOR AVAILABLE OPTIONS

LM4047①②2C16③④⑤⑥

①

Polarizer Type

B = Transflective: light background with dark characters

②

Backlight Color

G = Yellow-green (standard)

③

Fluid Type and Power Supply

H = NTN-H with +5VDC or +3VDC operation

④

Fluid Type

N = NTN-H

⑤

Background Color for NTN

G = Gray background

⑥

Supply Voltage

/3 = 3VDC Supply voltage (with negative voltage generation)
/5 = 5VDC Supply Voltage