



Type TD Subminiature LCD Display Switch

INSTRUCTIONS MANUAL

Rev. 3 December 2007.

Sunmulon Co., Ltd.

<SPECIFICATIONS>

Switch	Contact	Gold plated silver contact		
	Electrical Rating	DC12V 100mA (Resistive) ※Minimum DC5V 1mA (Resistive)		
	Insulation Resistance	More than 100MΩ at 500V DC		
	Dielectric Strength	300V AC RMS between NC and NO terminal (switch) 1000V AC RMS between terminals and ground (switch) 50/60Hz for 60sec. At normal ambient temperature and humidity		
	Mechanical Life	More than 1,000,000 operations More than 3,000,000 operations (push type C)		
	Electrical Life	More than 200,000 operations at max. rated load		
	Very little current loaded	More than 500,000 operations at DC5V 1mA, less than 100Ω		
	Operation Force (MAX)	2.5N	Total Travel(MAX)	3.0mm
LCD	Display	FSTN type LCD (1/6 bias 1/25 duty)	Dot Area	5.98mm×13.5mm
	Display capacity	20×52 dots (1,040dots)	Display Data	Anti-synchronous latch type
	Dot Size	0.24mm×0.28mm	Display Mode	Graphics/Characters
Ambient Temperature		-10℃~40℃		
Ambient Humidity		80%RH(max.)		

<ELECTRICAL&OPTICAL CHARACTERISTICS>

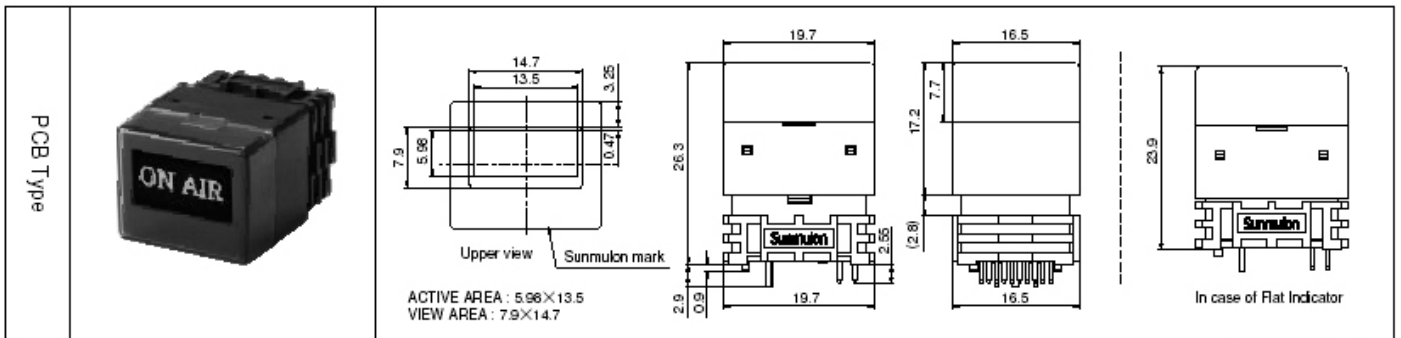
PARAMETER	SYMBOL	CONDITION	MIN	TYP	MAX	UNIT
Operating Voltage	V _{DD}	-	+4.75	+5	+5.25	V
Hi-level Input Voltage	V _{IH}	-	0.8V _{DD}	-	-	V
Low-level Input Voltage	V _{IL}	-	-	-	0.2V _{DD}	V
Driver IC Operating Current		Display Checkerd Pattern	-	50	105	uA
Most visible point			6 o'clock point			
Visible Degrees	θ Note 1)	Ta 25 °C	-50 ~ +60			deg
	φ Note 2)	Ta 25 °C	-50 ~ +50			deg
Contrast Ratio	C.R.	Ta 25 °C	-	25	-	-
Response Time	tf	Ta 25 °C	-	200	250	ms
	tr	Ta 25 °C	-	200	250	ms

Note 1) θ : Up / Down direction Note 2) φ : Left / Right direction

LCD Driving Circuit: New Japan Radio Co., LTD (JRC)LCD Control Driver IC
 NJU6673 (built-in Booster Circuits)
 Selectable Duty and Bias Ratio: 1/25 Duty, 1/6 Bias
 Frame frequency (Ff): TYP76Hz (Min.62Hz,Max.90Hz)
 Serial Interface (SI, SCL, A0, CS)
 Asynchronous Lutch Type

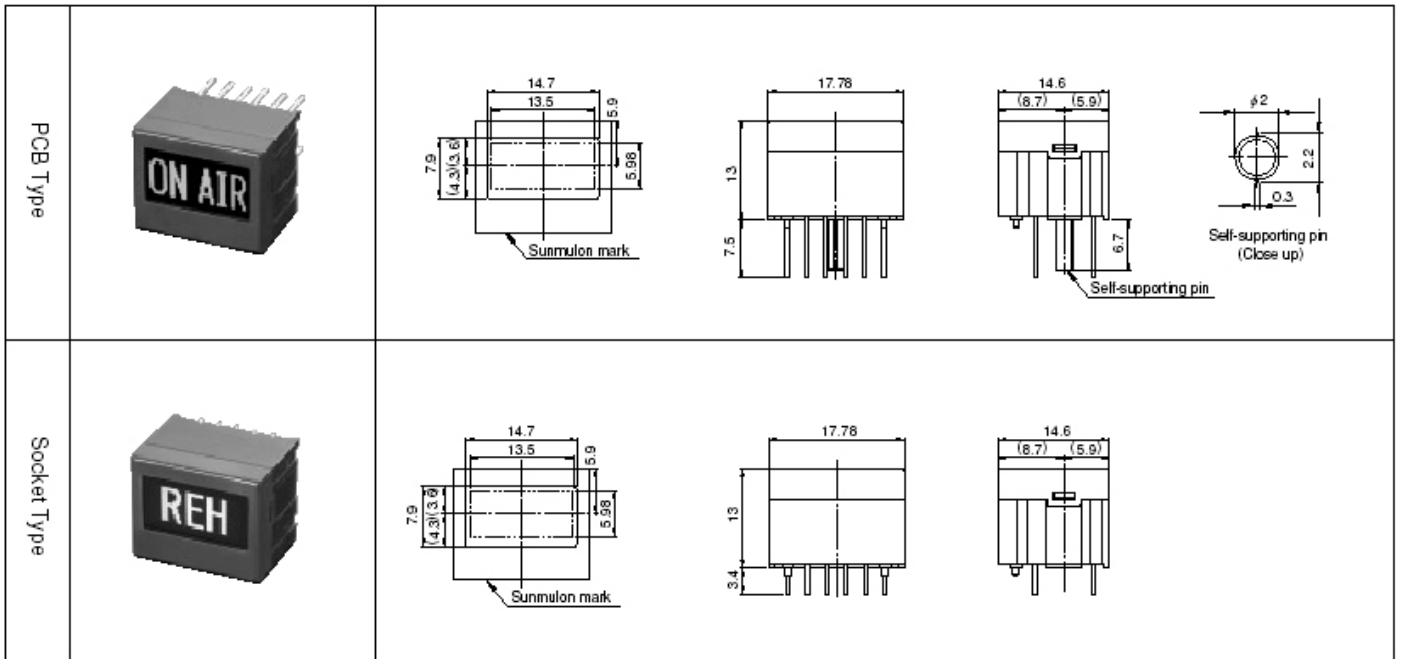
<DIMENSIONS>

SWITCH TYPE



Tolerance : ±0.4mm

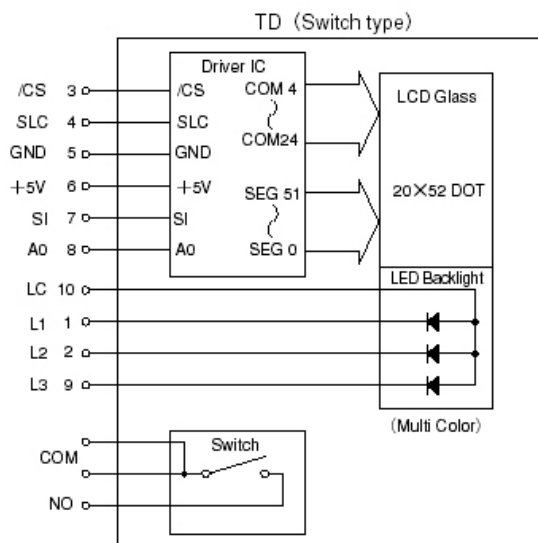
LCD MODULE TYPE



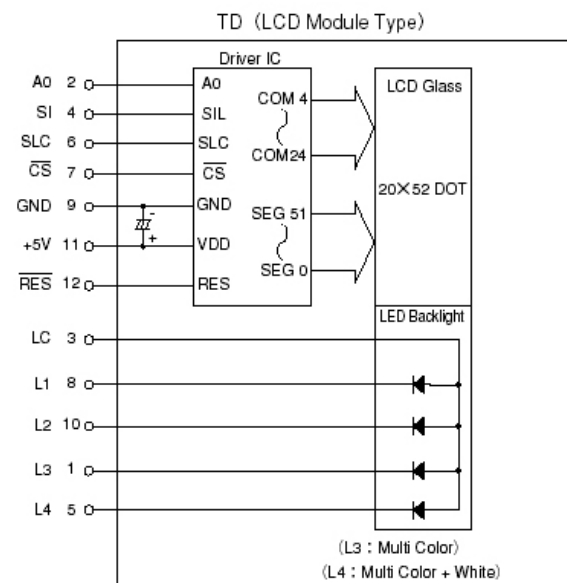
Tolerance : ±0.4mm

<INTERNAL CURCUIT>

SWITCH TYPE

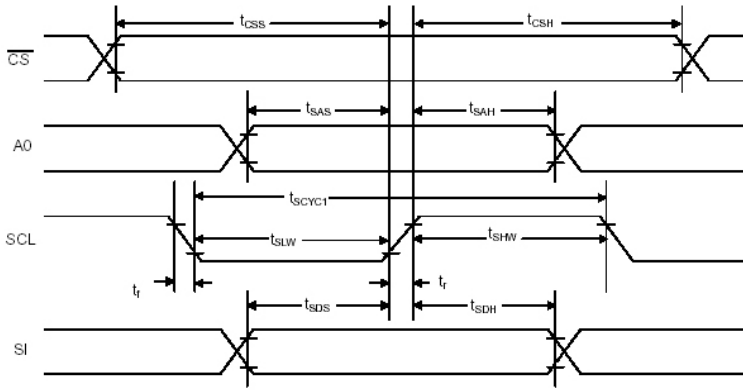


LCD MODULE TYPE



<WRITE OPERATION SEQUENCE>

Write operation sequence(Serial Interface)



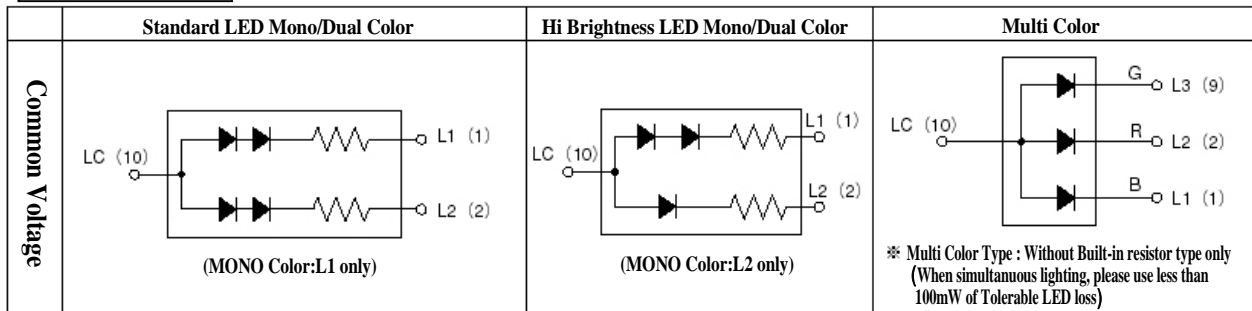
(V_{DD}=2.4V-3.6V, Ta=-20 to 75°C)

PARAMETER	SYMBOL	SIGNAL	CONDITION	MIN	TYP	MAX	UNIT
Serial Clock cycle	t _{scyc}			1000			ns
SCL "H" Pulse width	t _{shw}	SCL		300			
SCL "L" Pulse width	t _{slw}	SCL		300			
Address Setup Time	t _{sas}	A0		250			
Address Hold Time	t _{сах}	A0		400			
Data Setup Time	t _{sdс}	SI		250			
Data Hold Time	t _{sdh}	SI		100			
CS-SCL Time	t _{css}	CS		60			
	t _{сsh}	CS		800			
Rise time, Fall Time	t _r , t _f	CS, SCL SI, A0				15	

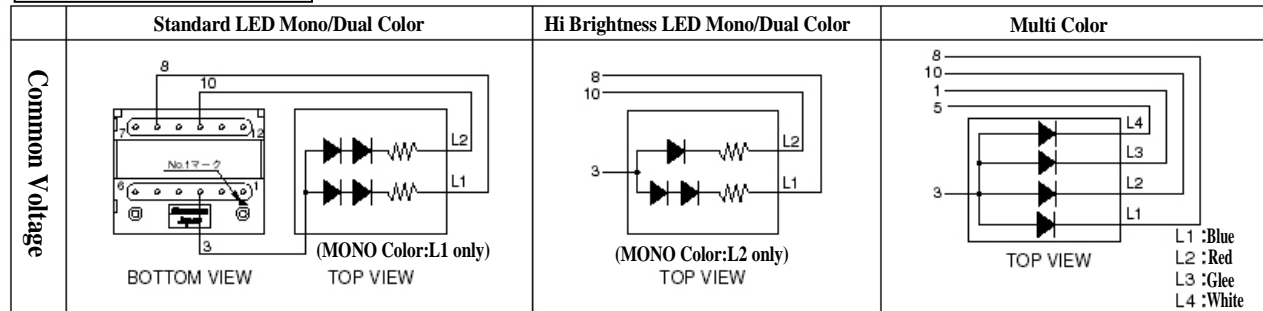
Note 1) All timing are based on 20% and 80% of V_{DD} voltage level.

<INTERNAL CONNECTION ARRANGEMENTS FOR BACKLIGHT LED>

SWITCH TYPE

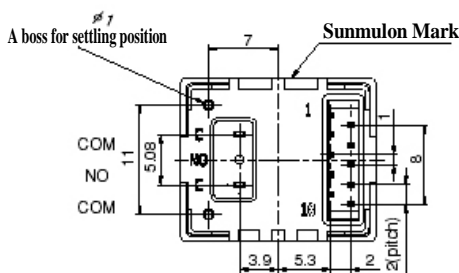


LCD MODULE TYPE



<TERMINALS LAYOUT/TERMINAL FUNCTIONS>

SWITCH TYPE



(BOTTOM VIEW)

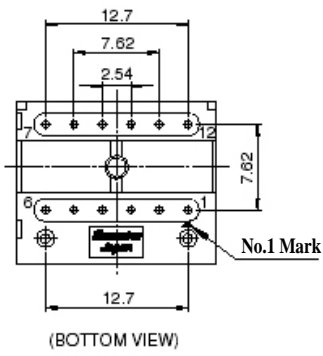
TERMINALS LAYOUT/TERMINAL FUNCTIONS

TERMINAL No.	SIGNAL	FUNCTION
1	L1	LED1 Cathode
2	L2	LED2 Cathode
3	/CS	Chip Select
4	SCL	Serial Clock
5	GND	Power Supply Terminal (Basic Potential)
6	+5V	Power Supply Input Terminal (+5V)
7	SI	Serial Data
8	A0	COMMAND/DATA Change
9	L3	LED3 Cathode
10	LC	LED Anode

*Switch Type has no functions of L4 and RES.

*Indicator has no COM terminal.

LCD MODULE TYPE



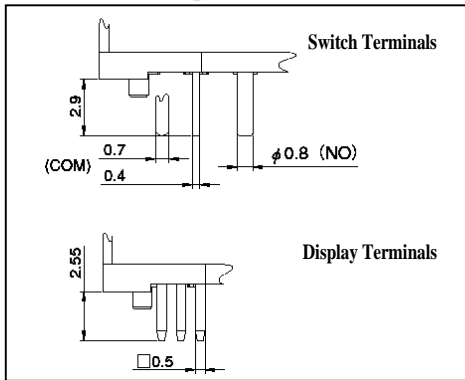
TERMINAL No.	SIGNAL	FUNCTION
1	L3	LED3 Cathode
2	A0	COMMAND/DATA Change
3	LC	LED Anode
4	SI	Serial Data
5	L4	LED4 Cathode
6	SLC	Serial Clock
7	/CS	Chip Select
8	L1	LED1 Cathode
9	GND	- Power Supply Terminal (Basic Potential)
10	L2	LED2 Cathode
11	+5V	+ Power Supply Input Terminal (+5V)
12	/RES	RESET

Caution: It may damage the Driver IC, if you input more than +DC5V to VDD+5V terminal. Please never input overdue voltage.

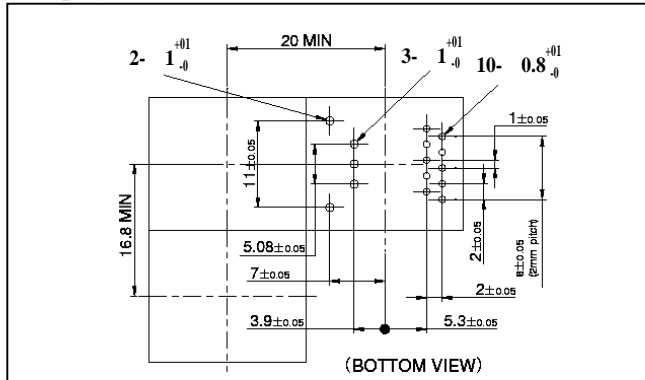
<TERMINAL SHAPE/PCB HOLE DIMENSIONS>

SWITCH TYPE

-Terminal Shape-



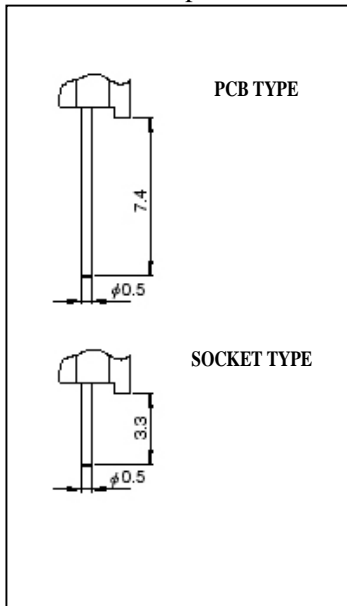
-Display Terminals-



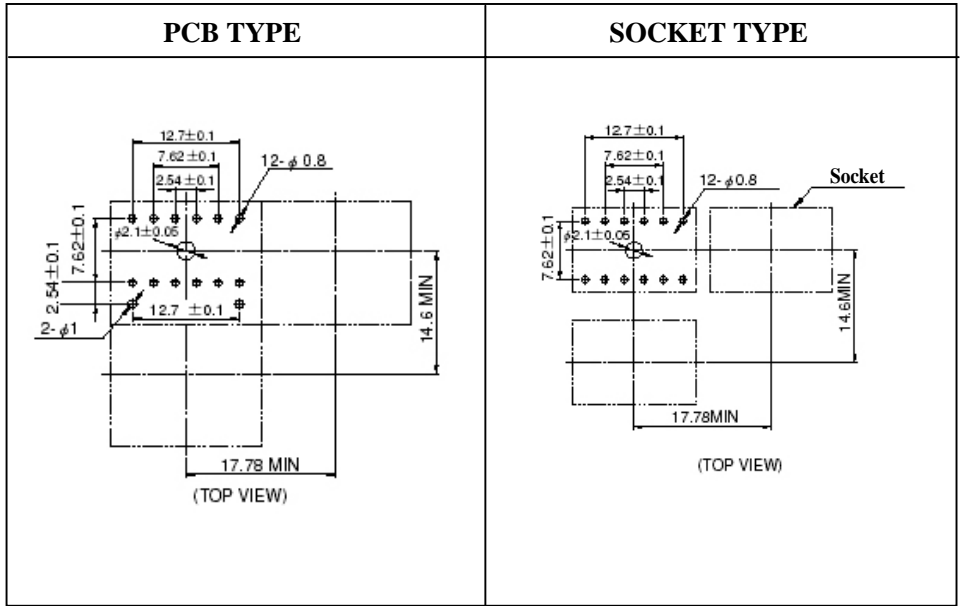
*Indicator has no COM terminal.

LCD MODULE TYPE

-Terminal Shape-



-PCB Hole Dimensions-



<Setting up the driver IC> (Please also see the driver IC data book.)

- Setting up the page address

The high order 4 dots (D0 – D3) of “Page 0” and “Page 3” of the page address are not wired to the LCD panel. Send dummy data or change “Page address setting” when sending data.

Lines (column addresses) will be incremented (+1) automatically after every 8-bit.

- Setting up the segment output

Only 52 dots in S0 – S51 are used for segment output, and S52 – S99 are not wired to the LCD panel. Send dummy data or change “Page address setting” to a different start line after sending 52 dots of segment data. In addition, the output terminals of driver IC and LCD glass terminals are assigned in reverse order as shown in the table below. Set up “D0 = 1 : invert” in “Select ADC” of the initial setting commands.

<Table of corresponding segments>

driver IC	LCD	driver IC	LCD	driver IC	LCD	driver IC	LCD	driver IC	LCD
S0	SEG52	S10	SEG42	S20	SEG32	S30	SEG22	S40	SEG12
S1	SEG51	S11	SEG41	S21	SEG31	S31	SEG21	S41	SEG11
S2	SEG50	S12	SEG40	S22	SEG30	S32	SEG20	S42	SEG10
S3	SEG49	S13	SEG39	S23	SEG29	S33	SEG19	S43	SEG9
S4	SEG48	S14	SEG38	S24	SEG28	S34	SEG18	S44	SEG8
S5	SEG47	S15	SEG37	S25	SEG27	S35	SEG17	S45	SEG7
S6	SEG46	S16	SEG36	S26	SEG26	S36	SEG16	S46	SEG6
S7	SEG45	S17	SEG35	S27	SEG25	S37	SEG15	S47	SEG5
S8	SEG44	S18	SEG34	S28	SEG24	S38	SEG14	S48	SEG4
S9	SEG43	S19	SEG33	S29	SEG23	S39	SEG13	S49	SEG3

driver IC	LCD	driver IC	LCD	driver IC	LCD	driver IC	LCD	driver IC	LCD
S50	SEG2	S60	NC	S70	NC	S80	NC	S90	NC
S51	SEG1	S61	NC	S71	NC	S81	NC	S91	NC
S52	NC	S62	NC	S72	NC	S82	NC	S92	NC
S53	NC	S63	NC	S73	NC	S83	NC	S93	NC
S54	NC	S64	NC	S74	NC	S84	NC	S94	NC
S55	NC	S65	NC	S75	NC	S85	NC	S95	NC
S56	NC	S66	NC	S76	NC	S86	NC	S96	NC
S57	NC	S67	NC	S77	NC	S87	NC	S97	NC
S58	NC	S68	NC	S78	NC	S88	NC	S98	NC
S59	NC	S69	NC	S79	NC	S89	NC	S99	NC

* NC = No circuit

- (j) Setting up the electronic volume register

The reference voltage setting at shipment is at the center of the setting range. If there is no special need to change the setting, set it to “89h” (10001001).

- (n) Built-in power supply ON/OFF

TD types drive LCD using the built-in boosting power supply (power supply for LCD operation) in the driver IC.
Set up “D0 = 1 : built-in power supply ON.”

- (g) Reading the display data

TD types have serial wiring control and they cannot read the display data.

- Other settings

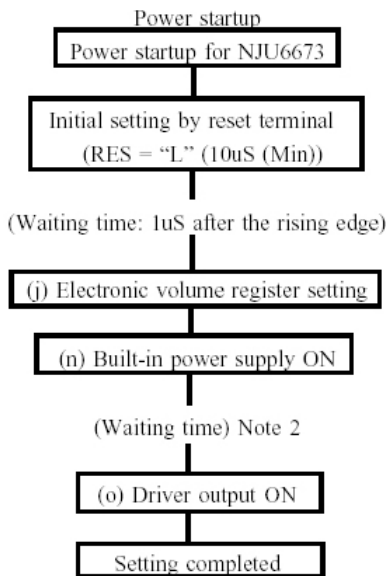
- (a) Display ON/OFF → D0 = 1 : ON
- (h) Display without/with highlighting → D0 = 0 : without highlighting (negative display)
- (i) Static drive ON/OFF → D0 = 0 : Normal lighting
- (m) Reset → “Power on Reset circuit” is configured by internal circuit. It is automatically initialized at power startup.

It is also possible to initialize RES terminal intentionally by dropping it to GND.

*** There is no RES terminal in switch types.**

- (o) Driver output ON/OFF → D0 = 1 : ON

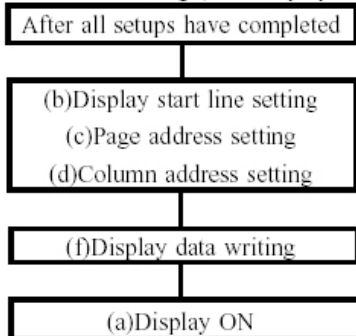
<Initialization setting example>



- Note 1) - Initial setting status
- (1) Display OFF
 - (2) Display without highlighting
 - (3) Select ADC: Display without highlighting (ADC instruction D₀ = “0”)
 - (4) Read-modify-write off
 - (5) Built-in power supply OFF
 - (6) Register data in serial interface cleared
 - (7) Driver output OFF
 - (8) Display start line address set to 00_H
 - (9) Column address counter set to 00_H
 - (10) Page address register set to 0 page
 - (11) Electronic volume register set to 0_H

Note 2) Time for built-in power supply to become stable. While 100ms is given in the reference program “Targetssample,” it should cause no problem if it is set to 50ms or longer.

2. RAM data writing (until display ON)



*** For settings other than the above, see the driver IC data book and reference program “Targetssample.”**

<About address map>

Please also see description in “void td_puts (unsigned char *dat)” of “main.C” in reference program “Targetsamle.”

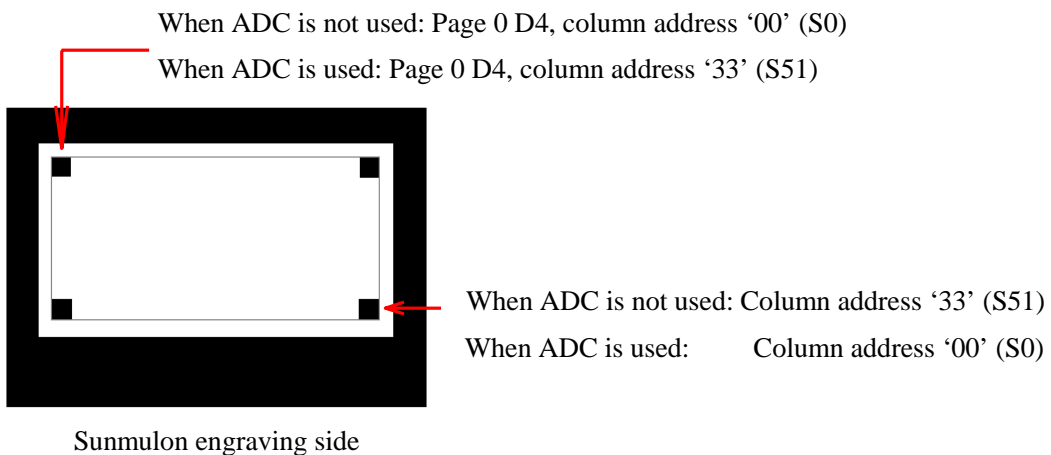
Page Address	Data	Display Pattern	Line Address							
D ₁ , D ₀ (0, 0)	D ₀		00							
	D ₁		01							
	D ₂		02							
	D ₃		03							
	D ₄		04							
	D ₅		05							
	D ₆		06							
	D ₇		07							
D ₁ , D ₀ (0, 1)	D ₀		08							
	D ₁		09							
	D ₂		0A							
	D ₃		0B							
	D ₄		0C							
	D ₅		0D							
	D ₆		0E							
	D ₇		0F							
D ₁ , D ₀ (1, 0)	D ₀		10							
	D ₁		11							
	D ₂		12							
	D ₃		13							
	D ₄		14							
	D ₅		15							
	D ₆		16							
	D ₇		17							
D ₁ , D ₀ (1, 1)	D ₀	Page 3	18							
Column	D ₀ =0	00	01	02	03	04	05	62	63
Address(ADC)	D ₀ =1	63	62	61	60	5F	5E	01	00

} D0 – D3 are not wired

} Page 3 is not wired as well

S52 – S99 of segment output is not wired

- The display area for TD types is Page 0 D4 – D7 + Page 1 + Page 2 S0 – S51.
- When “ADC (highlighted output)” is not used, the column address is ‘00’ → ‘33.’
When “ADC (highlighted output)” is used, the address is ‘33’ → ‘00.’



- Send dummy data or set “display start line address” in ‘D4’ in the unconnected display areas of Page 0 D0 – D3.
- Send dummy data to the unconnected display areas of S52 – S99 segment output or switch the page for each 52 dots transmitted.

<Backlight LED setting>

- Backlight LED has an independent circuit configuration from the LCD driver control circuit.
- When “there is no resistor,” provide a LED protection resistor based on “backlight LED setting value.”

Note: Internal temperature increase may reach high in successive installation or concentrated installation. Please select “no resistor” and use an external resistor.

- To use for pulse lighting, set up with reference to “pulse lighting setup conditions.”
- Only “no resistor” type can be selected for multi-color types.

Built-in resistor types Rated current value for backlight LED

Rated voltage (V)	Rated current (mA)					
	Standard type			High brightness type		
	Red	Green	Yellow	Blue	Super Green	White
5V, 12V(±)5%	3.6	11.7	10.6	10.2	4.1	12

Note) To use at 24V, use “no resistor” type with external resistor.

Without Built-in resistor types LED rating table (Calculate the external resistance value with reference to below.)

Item	Standard type			High brightness type			Multi-color, multi-color + white			
	Common voltage			Common voltage			Common voltage			
	Red	Green	Yellow	Blue	Super Green	White	Red	Blue	Super Green	White
Max. operation current I_{FM} (mA)	50	30	50	20	40	20	30	20	20	20
Reverse DC voltage V_R (V)	5	5	5	-	-	-	5	-	-	-
Forward voltage V_F (V) Standard value	4	4.2	4.2	2.8	3	3.3	1.85	2.8	3	3.3
Recommended operation current I_F (mA)	3.6	11.7	10.6	10.2	4.1	12	9.2	10.2	6	12
Wiring diagram	Mono color (Fig.1), Dual colors (Fig.2)			Mono color (Fig.1), Dual colors (Fig.2)			Fig.3			Fig.4

* There is no blue switch type.

- Current reduction rate at $T_a = 25^\circ\text{C}$ or higher: $0.33\text{mA}/^\circ\text{C}$ (DC)
: $1.6\text{mA}/^\circ\text{C}$ (PULSE)

Pulse lighting setup conditions

- Operating conditions for pulse lighting ($T_a = 25^\circ\text{C}$)

Common for each color $I_{FM} = 100\text{mA}$ with pulse width $P_w = 100\mu\text{s}$ and duty ratio $DR = 10^{-1}$

- Tolerable LED loss (mW) (per chip)

Standard type (red, green, yellow)	50mW for each color
High brightness type (blue, Super green)	80mW for each color
High brightness type (white)	60mW
Multi-color type (blue, green, red)	80mW for each color

* It is 105mW or lower when 2 or more colors are lit with multi-color type.

Dual color emission combinations (common for switch type and LCD module type) (common for each voltage)

	Standard type		High brightness type		
	Between LC(+)-L1	Red	Green	Yellow	Yellow
Between LC(+)-L2	Green	Yellow	Super Green	White	Super Green

Reference calculation diagram for external protective resistor

$$R = \frac{V_{cc} - V_F}{I_F}$$

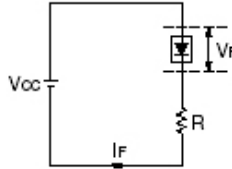


Fig 1

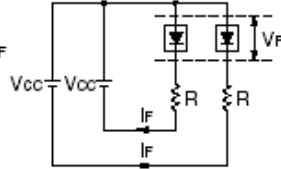


Fig 2

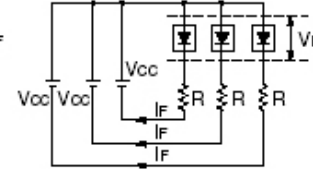


Fig 3

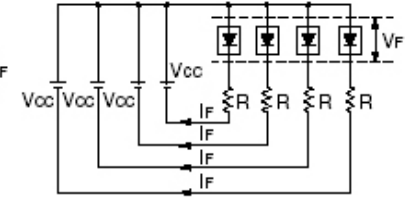


Fig 4 (LCD module type only)

V_{cc}: Power supply voltage
 V_F: Forward voltage
 I_F: Recommended operation current

Multi-color + W type

- In multi-color + W type (TD-M2216C-4), white LED is added at the L4 terminal in addition to L1, L2 and L3 terminals with multiple colors. (L4 terminal does not support color emission types other than multi-color + W type).

There is no built-in resistor for white LED. Please install a protective resistor with reference to “backlight LED setting value.”

- Switch types do not have the L4 terminal.

Backlight LED setting value (reference)

Emission color	Standard type			High brightness type			Multi-color, multi-color + White			
	Red	Green	Yellow	Blue	Super Green	White	Red	Blue	Super Green	White
Setting current value (mA)	3.6	11.7	10.6	10.2	4.1	11.3	9.2	10.2	6	11.3
DC5V setting resistance value	270Ω	82Ω	100Ω	220Ω	470Ω	160Ω	370Ω	220Ω	330Ω	160Ω
DC12V setting resistance value	2.2KΩ	680Ω	750Ω	1KΩ	2.2KΩ	750Ω	1.1KΩ	1KΩ	1.5KΩ	750Ω
DC24V setting resistance value	5.6KΩ	1.8KΩ	1.8KΩ	2.1KΩ	5.1KΩ	1.8KΩ	2.4KΩ	2KΩ	3.6KΩ	1.8KΩ

< ORDERING CODE >

SWITCH TYPE

TD KC

● OPERATION

M	Momentary
F	Flat Indicator

● PUSH FEELING

A	Click
B	Click (Small)
C	Non Click(Silent)
X	Flat Indicator

● COLOR CODE FOR BACKLIGHT LED

7	Red	Mono Color (Note 1)
8	Green	
9	Yellow	
16	White	
78	Red/Green	Dual Color (Note 1, Note 2)
89	Green/Yellow	
718	Red/Super Green	
916	Yellow/White	
918	Yellow/Super Green	
22	Multi Color	(Note 3)

◆ Yellow = Actually Orange Yellow

● BACKLIGHT LED Voltage

1	5V Built-in Resistor
2	12V Built-in Resistor
4	Without Built-in Resistor

Note 4)

● TERMINAL SHAPE

C	PCB Type
---	----------

● Button Color

K	Black
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Note 1) In case of 24V use for Backlight LED, please select Without Built-in Resistor type(4) and apply external resistor.

Note 2) In case of Dual Color type simultaneous lighting for Backlight LED, please select Without Built-in Resistor type (4) and apply external resistor.

Note 3) In case of Multi Color type use for Backlight LED, please select Without Built-in Resistor type (4) and apply external resistor.

Note 4) Connecting arrangement of Without Built-in Resistor type (4) is all the same.

LCD MODULE TYPE

TD-M

● COLOR CODE FOR BACKLIGHT LED

7	Red	Mono Color (Note 1)
8	Green	
9	Yellow	
14	Blue	
16	White	
18	Super Green	Dual Color (Note 1, Note 2)
78	Red/Green	
89	Green/Yellow	
718	Red/Super Green	
916	Yellow/White	
918	Yellow/Super Green	
22	Multi Color	(Note 3)
2216	Multi Color/White	(Note 3)

◆ Yellow = Actually Orange Yellow

● BACKLIGHT LED Voltage

1	5V Built-in Resistor
2	12V Built-in Resistor
4	Without Built-in Resistor

Note 4)

● TERMINAL SHAPE

C	PCB Type (with Supporting pin)
T	Socket Type (without Supporting pin)

Note 1) In case of 24V use for Backlight LED, please select Without Built-in Resistor type(4) and apply external resistor.

Note 2) In case of Dual Color type simultaneous lighting for Backlight LED, please select Without Built-in Resistor type (4) and apply external resistor.

Note 3) In case of Multi Color type/Multi Color-White) use for Backlight LED, please select Without Built-in Resistor type (4) and apply external resistor.

Note 4) Connecting arrangement Without Built-in Resistor type (4) is all the same.

< Precautions before use >

1. Caution is required in handling not to cause static to be applied on the main unit.
2. The LCD block may become damaged if excessive force is applied. Do not apply force.
3. Use a protective cover not to expose the display surface when using this product.
4. Never disassemble or modify the product. It may lead to product failure.
5. Due caution is required to prevent noise from entering the power supply or control lines. It may lead to display failure or product damage.
6. Dip soldering in solder bath is not supported by "T: For socket" in "Terminal shape code" type name specification. Only manual soldering is supported. If you wish to perform dip soldering in solder bath, use "C: For printed board" or a special socket.

7. The polarizer on the display surface of LCD panel may be affected by organic solvents. Adhere dust using Scotch tape or wipe lightly with soft materials such as absorbent cotton if the display surface becomes soiled.
8. Do not drink the leaking liquid crystal if LCD panel becomes damaged. If there is contact with skin or clothes, wash off with soap and water.
9. Do not connect or remove the product with power supply ON. It may cause product failure.
10. If this product is used outside the environmental conditions for use -10°C to $+40^{\circ}\text{C}$ and 80%RH, it may facilitate liquid crystal deterioration and cause lifetime to reduce or defects. Avoid using the product outside the environmental conditions for use.
11. Note that due caution will be required since inputting the signals before VDD stabilizes may cause the driver IC to be damaged by floating phenomena or latch-up phenomena.
12. Depending on the fluctuation of VDD input power supply, there may be effects on LCD contrast. Insert a stabilization circuit for input power supply to suppress the fluctuation to about $\pm 2\%$.

<Precautions on solder work>

- Manual soldering: 350°C , within 3 seconds
- Solder bath: 260°C , within 3 seconds (**Note: Terminal shape "T" types does not support use of solder bath.**)

* Prevent heat from being applied to LCD display elements during soldering.

* It cannot be immersed and washed entirely after soldering.

* Soldering in reflow furnace is not supported.

<Precautions in storage>

1. Under high temperature and humidity, it may cause polarization deterioration, bubble generation or polarizer peeling. Do not use or store the product under such conditions.
2. Do not store the product in spaces where there may be direct sunlight or ultraviolet.
3. Avoid storing the product in conditions where external forces may be applied.

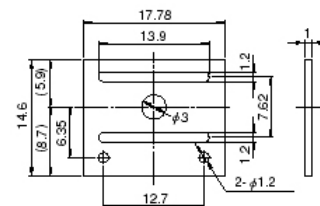
<Precautions on accessories>

● About the spacer

- By using terminal shape "C" type, it is possible to adjust the height to 1mm – 4mm.

* It cannot be used for terminal shape "T" for sockets.

* It cannot be used in combination with the socket.



* By using the spacer, it is possible to adjust the height to 1mm – 4mm.

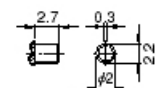
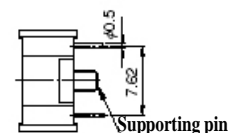
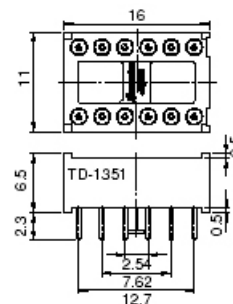
* It cannot be used in combination with the socket.

● About the socket

- Supported board thickness: Max 1.6mm (recommended)
- Mechanical lifetime of contact section: 100 times (minimum)

Note: Caution is required that there is no room for terminal length in the socket when board thickness is 2mm although it is possible to use.

Note: Soldering in reflow furnace is not supported.



Dimensions of Supporting pin



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