

**DISTINCTIVE CHARACTERISTICS****Enhanced LED Illumination with:**

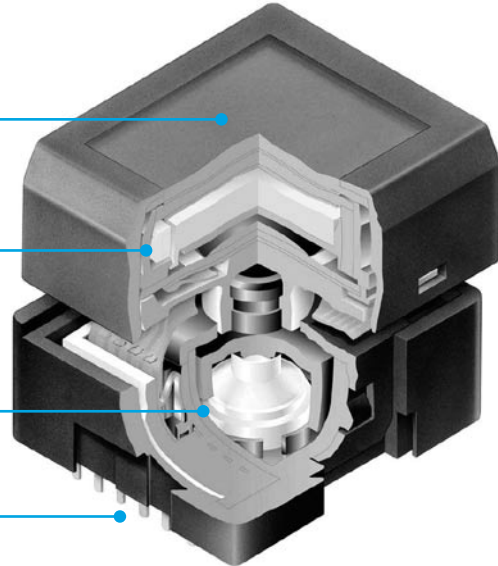
- Broad and even light distribution
- Consistent bright backlighting
- Lower energy consumption

Programmable LC Display

White LED Backlighting

Rubber Dome

Epoxy Sealed Straight PC Terminals



Programmable to display graphics, alphanumeric characters, and animated sequences.

Integrated liquid crystal display provides wide viewing angle with high contrast and clarity.

Wide viewing area 15.0mm x 10.8mm (horizontal x vertical) at 36 x 24 pixels.

Dome gives crisp tactile feedback to positively indicate circuit transfer.

High reliability and long life of one million actuations minimum.

Epoxy sealed terminals prevent entry of solder flux and other contaminants.

Optional accessories available to enhance panel design and simplify production process.

**SWITCH SPECIFICATIONS**

Circuit	SPST normally open
Electrical Capacity (Resistive Load)	100mA @ 12V DC
Contact Resistance	200 milliohms maximum @ 20mV 10mA
Insulation Resistance	100 megohms minimum @ 100V DC
Dielectric Strength	125V AC for 1 minute minimum
Mechanical Endurance	1,000,000 operations minimum
Electrical Endurance	1,000,000 operations minimum
Operating Force	2.2 ± 0.5 Newtons
Total Travel	1.8mm (.071")
Operating Temperature Range	0°C ~ +40°C (+32°F ~ +104°F); contact factory for wide temperature range options
Storage Temperature Range	-10°C ~ +60°C (+14°F ~ +140°F); contact factory for wide temperature range options

## LCD SPECIFICATIONS

### Characteristics of Display

Display Operation Mode	FSTN positive
Display Condition	Transflective with built-in LED backlight
Viewing Angle	Adjustable
Driving Method	1/24 duty, 1/5 bias (built-in driving circuit)
Viewing Area	15.0mm x 10.8mm (horizontal x vertical)
Pixel Format	36 x 24 dots (horizontal x vertical)
Pixel Size	0.36mm x 0.36mm (horizontal x vertical)
Backlight LED	White



White LED with  
Black & White LCD Mode

### Absolute Maximum Ratings (Temperature at 25°C)

Items	Symbols	Ratings
Supply Voltage for Logics	$V_{DD}$	-0.3V to +7.0V
Supply Voltage for LCD	$V_{LC}$	-0.3V to +12.0V
Input Voltage	$V_I$	-0.3V to $V_{DD}$ +0.3V
Output Voltage	$V_O$	-0.3V to $V_{DD}$ +0.3V

### Recommended Operating Conditions (Temperature at 25°C)

Items	Symbols	Minimum	Typical	Maximum
Supply Voltage for Logics	$V_{DD}$	4.5V	5.0V	5.5V
Supply Voltage Black/White	$V_{LC}$	—	7.3V	—
Input Voltage	$V_I$	0V	—	$V_{DD}$
Driving Frequency	$f_{FLM}$	—	150Hz	—

### DC Characteristics of LCD Drive IC (Temperature at 0°C to 40°C and $V_{DD} = 5.0V \pm 10\%$ )

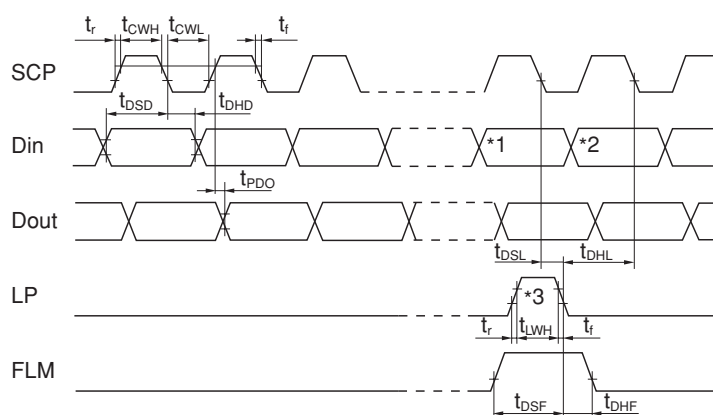
Items	Symbols	Test Conditions	Minimum	Typical	Maximum	Unit
High Level Input Voltage	$V_{IH}$		0.7 $V_{DD}$		$V_{DD}$	V
Low Level Input Voltage	$V_{IL}$		0		0.3 $V_{DD}$	V
High Level Input Leakage Current	$I_{LIH}$	$V_I = V_{DD}$			10	$\mu A$
Low Level Input Leakage Current	$I_{LIL}$	$V_I = 0V$			-10	$\mu A$
High Level Output Voltage	$V_{OH}$	$I_{OH} = -500\mu A$	$V_{DD} - 0.5$			V
Low Level Output Voltage	$V_{OL}$	$I_{OL} = 500\mu A$			0.5	V
High Level Output Leakage Current	$I_{LOH}$	$V_O = V_{DD}$			10	$\mu A$
Low Level Output Leakage Current	$I_{LOL}$	$V_O = 0V$			-10	$\mu A$
Supply Current	$I_{DD}$	$f_{SCP} = 1.0MHz$			500	$\mu A$
LCD Drive Current	$I_{LC}$	$f_{LP} = 2.4kHz$ $V_{LC} = 7.3V \sim 7.5V$		500	2,000	$\mu A$

### Timing Characteristics of LCD Drive IC

(Temperature at 0°C to 40°C and  $V_{DD} = 5.0V \pm 10\%$ )

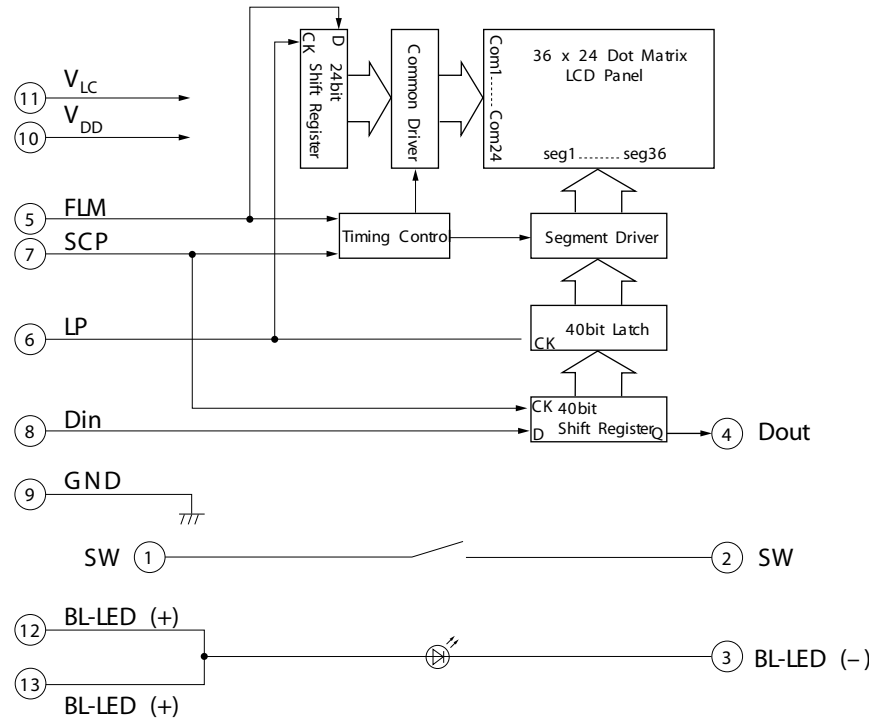
Items	Symbols	Minimum	Maximum
Clock Operation Frequency	$f_{SCP}$		6.0MHz
Latch Pulse Frequency	$f_{LP}$		50kHz
Clock High Level Pulse Width	$t_{CWH}$	70ns	
Clock Low Level Pulse Width	$t_{CWL}$	70ns	
Data Setup Time	$t_{DSD}$	45ns	
Data Hold Time	$t_{DHD}$	50ns	
Data Output Delay Time	$t_{PDO}$		25ns
Latch Setup Time	$t_{DSL}$	50ns	
Latch Hold Time	$t_{DHL}$	50ns	
Latch High Level Width	$t_{LWH}$	200ns	
FLM Setup Time	$t_{DSF}$	50ns	
FLM Hold Time	$t_{DHF}$	50ns	
SCP, LP Rise/Fall Time	$t_r/t_f$		15ns

### Timing Diagram



- \*1 Last data on first line
- \*2 Beginning data on second line
- \*3 Location of LP signal on first line

## BLOCK DIAGRAM & PIN CONFIGURATIONS



Pin No.	Symbol	Name	Function
①	SW	Terminal of Switch	Normally open
②	SW	Terminal of Switch	Normally open
③	BL-LED (-)	Terminal of Backlight LED	Cathode
④	Dout	Data Output	Display serial output. Can be used to connect to Din of the next SMARTSWITCH. As a result, many SMARTSWITCHES can be controlled with one clock and data signal.
⑤	FLM	First Line Marker	The marking signal for the first line data of LCD display. The first line of LCD will be selected by the falling edge of LP signal during the high level (FLM).
⑥	LP	Latch Pulse	Line data latch pulse will latch content of internal 40-bit shift register at falling edge for one line of display. LP will also increment the display line by one.
⑦	SCP	Serial Clock Pulse	Clock used by 40-bit internal shift register of the switch, shifting the display data bit presented at Din at falling edge.
⑧	Din	Data Input	Display serial data bit. Note: to map the display data, because of the difference between the number of internal shift register data (40) and the single line of LCD pixels (36), the first four bits of data shifted will be dummy bits.
⑨	GND	Ground	
⑩	V <sub>DD</sub>	Power	Power source for logic circuit
⑪	V <sub>LC</sub>	Power	Power source for LCD drive
⑫	BL-LED (+)	Terminal of Backlight LED	Anode for common
⑬	BL-LED (+)	Terminal of Backlight LED	Anode

## SUPER BRIGHT LED SPECIFICATIONS

Typical Electrical Characteristics (Temperature at 25°C)

Backlight Color	Symbols	White	Unit
Forward Current	$I_F$	20	mA
Forward Voltage	$V_F$	3.6	V

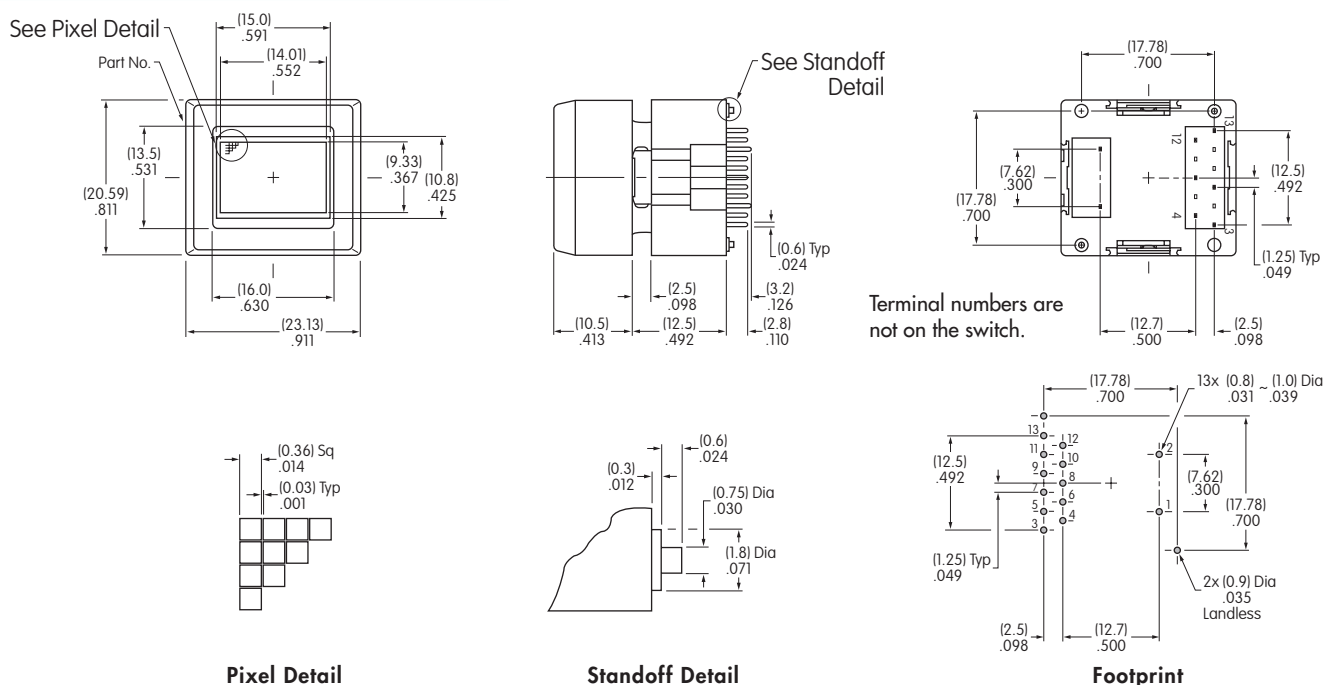
## ABSOLUTE MAXIMUM FOR LEDs

Electrical Characteristics (Temperature at 25°C)

Backlight Color	Symbols	White	Unit
Forward Current	$I_F$	30	mA
Reverse Voltage	$V_R$	5.0	V
Current Reduction Rate Above 25°C	$\Delta I_F$ (DC)	-0.50	mA/°C
Power Dissipation*	$P_D$	120 maximum	mW

\*For uniform light emission, Power Dissipation should not exceed the Absolute Maximum Rating.

## TYPICAL SWITCH DIMENSIONS



## PRECAUTIONS FOR HANDLING & STORAGE

### Handling

1. The VLC voltage should not be applied before logic voltage. If VLC voltage is present before logic voltage, it may cause the driver logic to freeze and damage the LCD, and the driver logic itself may become damaged.
2. The IS Series devices are electrostatic sensitive.
3. Limit operating force to keytop to 100.0N maximum, as excessive pressure may damage LCD device.
4. Recommended soldering time and temperature limits are 5 seconds maximum @ 270°C maximum.
5. Do not exceed 60°C at the LCD level.
6. The IS series devices are not process sealed.
7. If the LCD is accidentally broken, avoid contact with the liquid and wash off any liquid spills to the skin or clothing.
8. Clean cap surface with dry cloth. If further cleaning is needed, wipe with dampened cloth using neutral cleanser and dry with clean cloth. Do not use organic solvent.

### Storage

1. Store away from direct sunlight.
2. Keep away from static electricity.
3. Avoid extreme temperatures, high humidity, gaseous substances, and all forms of chemical contamination.

