

## DISTINCTIVE CHARACTERISTICS

### Enhanced LED Illumination with:

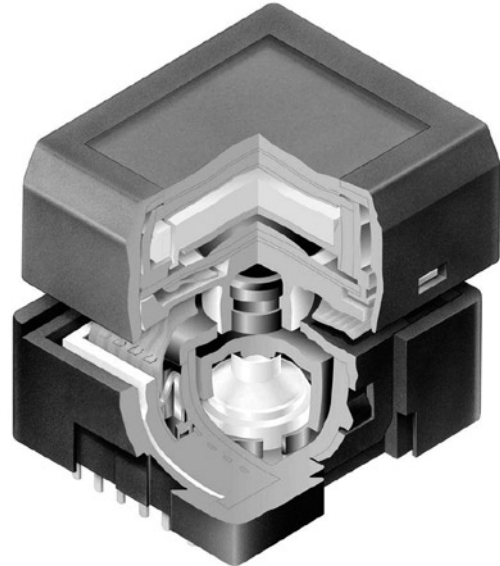
- Broad and even light distribution
- Consistent bright backlighting
- Lower energy consumption

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 $V_{DD} = 5.0V \pm 10\%$ )

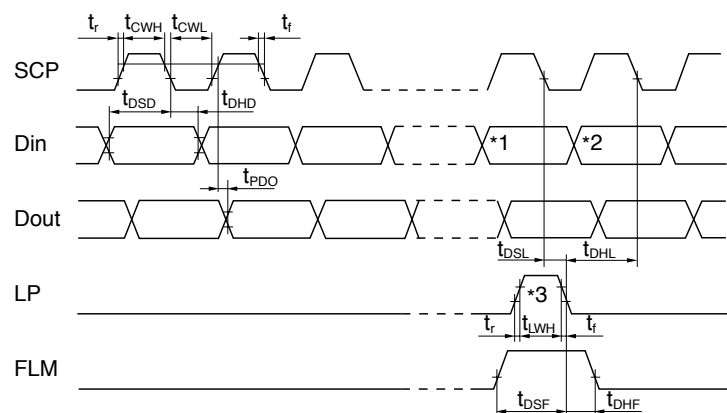
| Items                             | Symbols   | Test Conditions                             | Minimum        | Typical | Maximum      | Unit    |
|-----------------------------------|-----------|---|----------------|---------|--------------|---------|
| High Level Input Voltage          | $V_{IH}$  |   | $0.7 V_{DD}$   |         | $V_{DD}$     | V       |
| Low Level Input Voltage           | $V_{IL}$  |   | 0              |         | $0.3 V_{DD}$ | V       |
| High Level Input Leakage Current  | $I_{LH}$  | $V_I = V_{DD}$                              |                |         | 10           | $\mu A$ |
| Low Level Input Leakage Current   | $I_{LL}$  | $V_I = 0V$                                  |                |         | -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  $V_{DD} = 5.0V \pm 10\%$ )

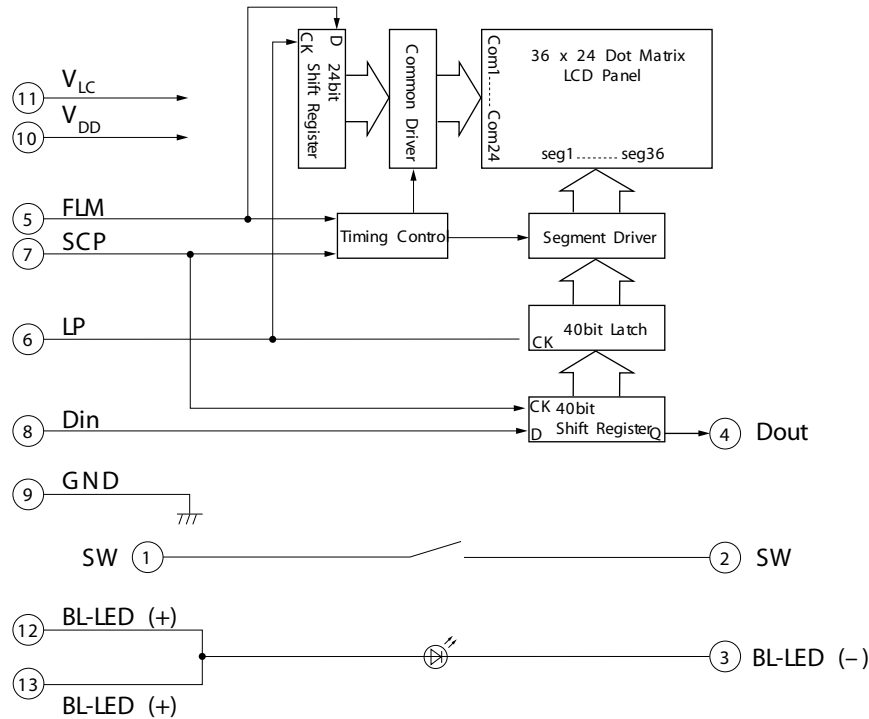
| Items                        | Symbols   | Minimum | Maximum |
|------------------------------|-----------|---------|---------|
| Clock Operation Frequency    | $f_{SCP}$ |         | 6.0MHz  |
| Latch Pulse Frequency        | $f_{LP}$  |         | 50kHz   |
| Clock High Level Pulse Width | $t_{CWH}$ | 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    |

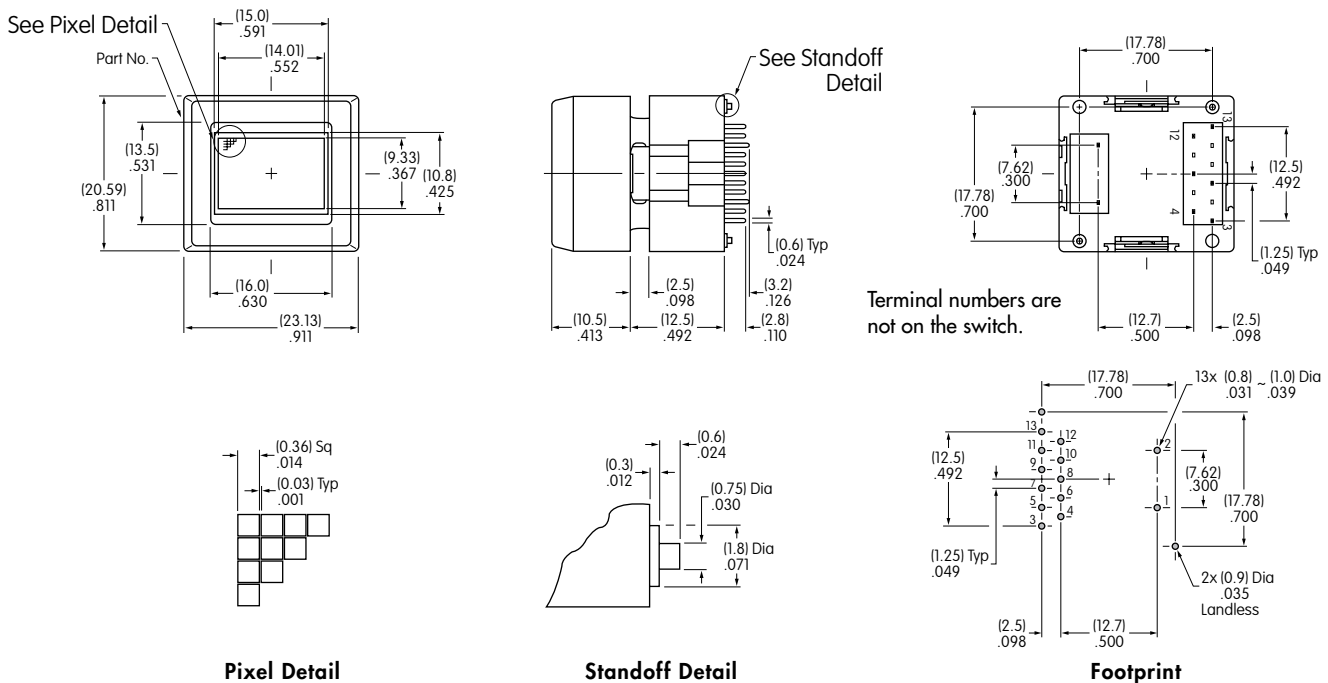
## ABSOLUTE MAXIMUM FOR LEDS

**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 | $\Delta I_F(\text{DC})$ | -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.