

DISTINCTIVE CHARACTERISTICS

Standard with Enhanced Illumination:

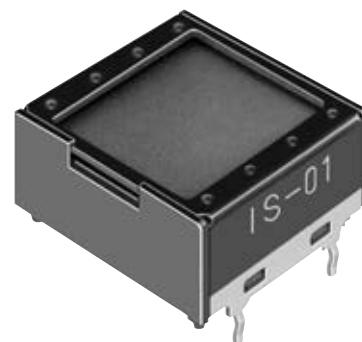
Programmable to display graphics, alphanumeric characters and animated sequences.

Standard SMARTDISPLAY™ can be used alone or in conjunction with electromechanical switches.

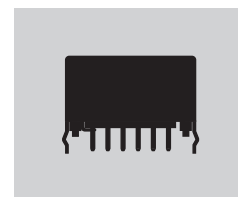
Integrated liquid crystal display provides wide viewing angle with high contrast and clarity.

RGB LED provides numerous color variations.

Viewing area 14.4mm x 11.8mm (horizontal x vertical) at 36 x 24 pixels.



Actual Size



PART NUMBER & DESCRIPTION

| Part Number | Terminals | LCD Mode | LED Color |
|-------------------|-------------|--------------------------------|------------------|
| IS01BBFRGB | Straight PC | Black & White FSTN Positive | * Red/Green/Blue |

* Simultaneous RGB illumination achieves infinite colors.

LCD & LED SPECIFICATIONS

Characteristics of Display

| | |
|------------------------|--|
| Display Operation Mode | STN positive, FSTN positive |
| Display Condition | Transflective with built-in LED backlight |
| Viewing Angle | 6 o'clock |
| Driving Method | 1/24 duty, 1/5 bias (built-in driving circuit) |
| Viewing Area | 14.4mm x 11.8mm (horizontal x vertical) |
| Pixel Format | 36 x 24 pixels (horizontal x vertical) |
| Pixel Size | 0.371mm x 0.445mm (horizontal x vertical) |
| Operating Temp. Range | -20°C ~ +60°C (-4°F ~ +140°F) |
| Storage Temp. Range | -30°C ~ +70°C (-22°F ~ +158°F) |
| Backlight LED | RGB: red/green/blue |

LCD Absolute Maximum Ratings (Temperature at 25°C)

| Items | Symbols | Ratings |
|------------------------------|----------|-------------------------|
| Supply Voltage for Logistics | 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} | 3.0V | — | 5.5V |
| Supply Voltage LCD | V_{LC} | — | * 7.3V | — |
| Input Voltage | V_I | 0V | — | V_{DD} |
| Driving Frequency | f_{FLM} | — | 150Hz | — |

* LCD voltage (V_{LC}) level depends on refreshing frequency and temperature. The optimal V_{LC} can differ slightly from the stated typical value.

LED Absolute Maximum Ratings (Temperature at 25°C)

| Items | Symbols | Ratings | | |
|-------------------|----------------|---------|------|------|
| Forward Current | I_F | 20mA | | |
| Power Dissipation | P_d | mW | | |
| Color | Red/Green/Blue | | | |
| | Red | Green | Blue | |
| | Unicolor | 40mW | 60mW | 60mW |
| LED Overall | 115mW | | | |

LCD & LED SPECIFICATIONS

DC Characteristics of LCD Drive IC (Temperature at -20°C to $+60^{\circ}\text{C}$ and $V_{DD} = 5.0\text{V} \pm 10\%$)

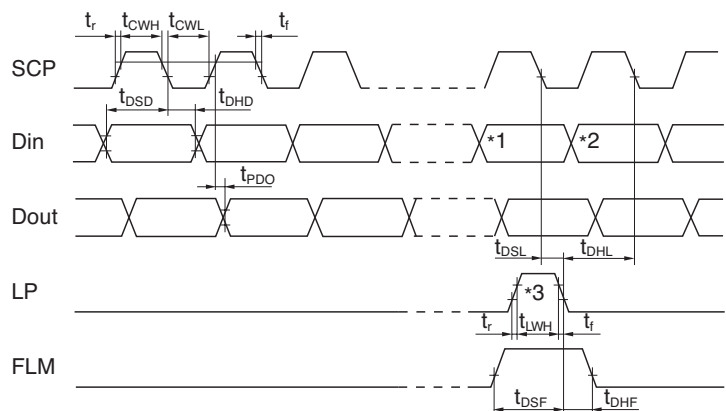
| Items | Symbols | Test Conditions | Minimum | Typical | Maximum | Unit |
|-----------------------------------|-----------|---|--------------|---------|-------------|---------------|
| High Level Input Voltage | V_{IH} | | $0.7V_{DD}$ | | V_{DD} | V |
| Low Level Input Voltage | V_{IL} | | 0 | | $0.3V_{DD}$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

Timing Characteristics of LCD Drive IC

(Temperature at -20°C to $+60^{\circ}\text{C}$ and $V_{DD} = 5.0\text{V} \pm 10\%$)

| Items | Symbols | Minimum | Maximum |
|------------------------------|-----------|---------|---------|
| Clock Operation Frequency | f_{SCP} | | 8.0MHz |
| Latch Pulse Frequency | f_{LP} | | 50kHz |
| Clock High Level Pulse Width | t_{CWH} | 50ns | |
| Clock Low Level Pulse Width | t_{CWL} | 50ns | |
| 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} | 50ns | |
| FLM Setup Time | t_{DSF} | 50ns | |
| FLM Hold Time | t_{DHF} | 50ns | |
| SCP, LP Rise/Fall Time | t_r/t_f | | 15ns |

Timing Diagram



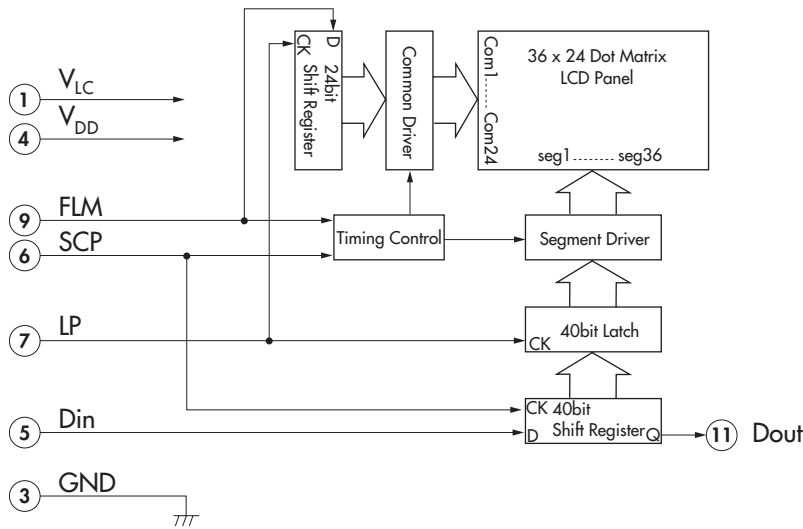
- *1 Last data on first line
- *2 Beginning data on second line
- *3 Location of LP signal on first line

Display Electrical Characteristics

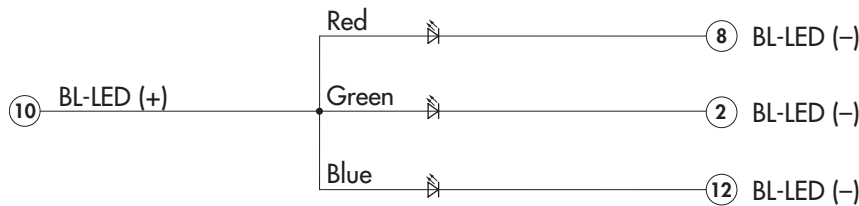
| Items | | Symbols | Test Condition | Minimum | Typical | Maximum | |
|------------------------|-------------------------|----------------------------------|--|------------------------------------|--------------|-------------|-----|
| LCD | Supply Voltage | Logic Circuit | V_{DD} | 3.0 | — | 5.5 | |
| | | LCD Circuit | V_{LC} | — | * 7.3 | — | |
| | Input Voltage | H | V_{IH} | $0.7V_{DD}$ | — | V_{DD} | |
| | | L | V_{IL} | 0 | — | $0.3V_{DD}$ | |
| | Output Voltage | H | V_{OH} | $D_{OUT}, I_{OH} = 500\mu\text{A}$ | $V_{DD}-0.5$ | — | — |
| | | L | V_{OL} | $D_{OUT}, I_{OL} = 500\mu\text{A}$ | — | — | 0.5 |
| Power | Logic Circuit | I_{DD} | $f_{SCP} = 1.0\text{MHz}$ | — | — | 500 | |
| | LCD Circuit | I_{LC} | $f_{LP} = 2.4\text{kHz}$ $V_{LC} = 7.3\text{V}$ | — | 500 | 2,000 | |
| Items | | Symbols | Test Condition | Red/Green/Blue | | | |
| LED | Forward Current | I_F | $I_F = \text{Forward Current}$ $T_a = 25^{\circ}\text{C}$ | Red | Green | Blue | |
| | | | | 10mA | 8.5mA | 8mA | |
| | Forward Voltage | V_F | | Red | Green | Blue | |
| | | | | 2.0V | 2.8V | 2.8V | |
| Current Reduction Rate | $\Delta I_F(\text{DC})$ | $T_a = 25^{\circ}\text{C}$ above | -0.33mA/ $^{\circ}\text{C}$ | | | | |

* LCD voltage (V_{LC}) level depends on refreshing frequency and temperature. The optimal V_{LC} can differ slightly from the stated typical value.

BLOCK DIAGRAM & PIN CONFIGURATIONS FOR RGB LEDs



ISO1BBFRGB
RGB LED Backlight
Black and White LCD



| Pin No. | Symbol | Name | Function |
|---------|-----------------|---------------------------|---|
| ① | V _{LC} | Power | Power source for LCD drive |
| ② | BL-LED (-) | Terminal of Backlight LED | Cathode for green |
| ③ | GND | Ground | |
| ④ | V _{DD} | Power | Power source for logic circuit |
| ⑤ | 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. |
| ⑥ | 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. |
| ⑦ | 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. |
| ⑧ | BL-LED (-) | Terminal of Backlight LED | Cathode for red |
| ⑨ | 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). |
| ⑩ | BL-LED (+) | Terminal of Backlight LED | Anode for common |
| ⑪ | Dout | Data Output | Display serial output. Can be used to connect to Din of the next SMARTDISPLAY. As a result, many SMARTDISPLAYS can be controlled with one clock and data signal. |
| ⑫ | BL-LED (-) | Terminal of Backlight LED | Cathode for blue |

SUPER BRIGHT RGB LED SPECIFICATIONS

Typical Electrical Characteristics (Temperature at 25°C)

| Backlight Color | Symbols | Red | Green | Blue | Unit |
|-----------------|---------|-----|-------|------|------|
| Forward Current | I_F | 10 | 8.5 | 8.0 | mA |
| Forward Voltage | V_F | 2.0 | 2.8 | 2.8 | V |

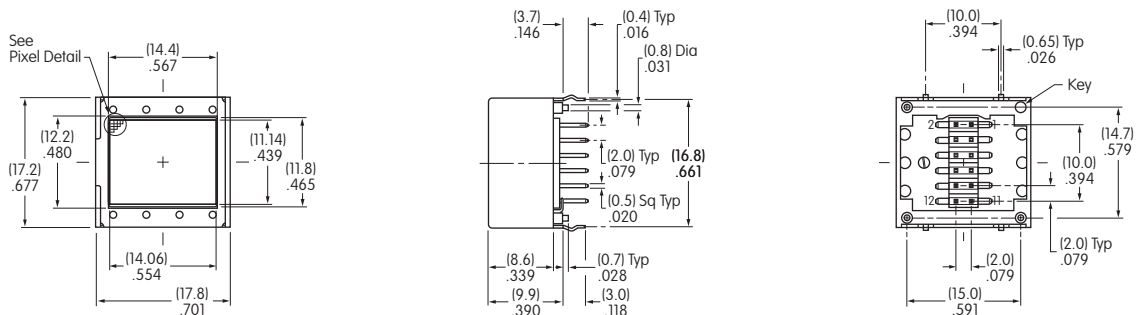
ABSOLUTE MAXIMUM FOR RGB LED

Electrical Characteristics (Temperature at 25°C)

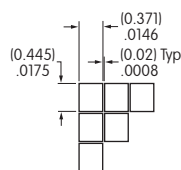
| Backlight Color | Symbols | Red | Green | Blue | Unit |
|---|-------------------------|--------------------------------|---------------------------------|---------------------------------|-------|
| Forward Current | I_F | 20 | 20 | 20 | mA |
| Forward Voltage | V_F | 2.0 ($I_F = 10\text{mA}$) | 2.8 ($I_F = 8.5\text{mA}$) | 2.8 ($I_F = 8.0\text{mA}$) | V |
| Reverse Voltage | V_R | 4.0 | 4.0 | 4.0 | V |
| Current Reduction Rate Above 25°C | $\Delta I_F(\text{DC})$ | -0.33 | -0.33 | -0.33 | mA/°C |
| *Power Dissipation (LED Overall 115mW) | P_D | 40 | 60 | 60 | mW |

*For uniform light emission, Power Dissipation should not exceed the Absolute Maximum Rating, and the Forward Current should not exceed the derated Absolute Forward Current.

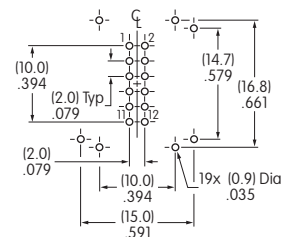
TYPICAL DISPLAY DIMENSIONS WITH RGB LED



Terminal numbers are not on the device.



Pixel Detail



Footprint

PRECAUTIONS FOR HANDLING & STORAGE OF LCD 36 x 24 DEVICES

Handling



1. The IS Series devices are electrostatic sensitive.
2. The IS series devices are not process sealed.
3. If the LCD is accidentally broken, avoid contact with the liquid and wash off any liquid spills to the skin or clothing.
4. 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.
5. Recommended soldering time and temperature limits:
Do not exceed 70°C at the LCD level.
Wave Soldering: see Profile B in the Supplement section.
Manual Soldering: see Profile B in the Supplement section.
6. Recommendation for backlight color uniformity: Use constant current driver. For current limiting resistor method, the power source should be at least twice the backlight LED forward voltage.
7. 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 may become damaged.
8. Backlight Forward Current should not exceed the derated Absolute Maximum Forward Current based on the temperature.
9. Excessive images may result after the same image is emitted continuously for an extended period of time.

Storage

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