

## 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.

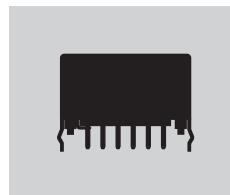
Integrated liquid crystal display provides wide viewing angle with high contrast and clarity.

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 &amp; 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 &amp; 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 <sub>DD</sub>	-0.3V to +7.0V
Supply Voltage for LCD	V <sub>LC</sub>	-0.3V to +12.0V
Input Voltage	V <sub>I</sub>	-0.3V to V <sub>DD</sub> + 0.3V
Output Voltage	V <sub>O</sub>	-0.3V to V <sub>DD</sub> + 0.3V

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

Items	Symbols	Minimum	Typical	Maximum
Supply Voltage for Logics	V <sub>DD</sub>	3.0V	—	5.5V
Supply Voltage LCD	V <sub>LC</sub>	—	* 7.3V	—
Input Voltage	V <sub>I</sub>	0V	—	V <sub>DD</sub>
Driving Frequency	f <sub>FLM</sub>	—	150Hz	—

\* LCD voltage (V<sub>LC</sub>) level depends on refreshing frequency and temperature. The optimal V<sub>LC</sub> can differ slightly from the stated typical value.

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

Items	Symbols	Ratings
Forward Current	I <sub>F</sub>	20mA
Power Dissipation	P <sub>d</sub>	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 $-20^{\circ}\text{C}$ to $+60^{\circ}\text{C}$ and $V_{\text{DD}} = 5.0\text{V} \pm 10\%$ )

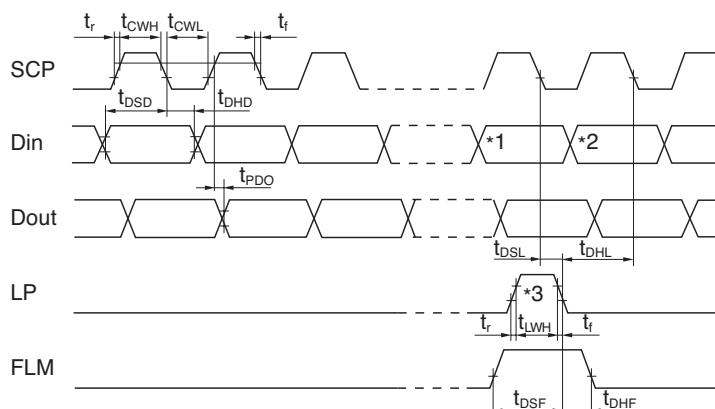
Items	Symbols	Test Conditions	Minimum	Typical	Maximum	Unit
High Level Input Voltage	$V_{\text{IH}}$		$0.7V_{\text{DD}}$		$V_{\text{DD}}$	V
Low Level Input Voltage	$V_{\text{IL}}$		0		$0.3V_{\text{DD}}$	V
High Level Input Leakage Current	$I_{\text{LH}}$	$V_I = V_{\text{DD}}$		10		$\mu\text{A}$
Low Level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

#### Timing Characteristics of LCD Drive IC

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

Items	Symbols	Minimum	Maximum
Clock Operation Frequency	$f_{\text{SCP}}$		8.0MHz
Latch Pulse Frequency	$f_{\text{LP}}$		50kHz
Clock High Level Pulse Width	$t_{\text{CWH}}$	50ns	
Clock Low Level Pulse Width	$t_{\text{CWL}}$	50ns	
Data Setup Time	$t_{\text{DSD}}$	45ns	
Data Hold Time	$t_{\text{DHD}}$	50ns	
Data Output Delay Time	$t_{\text{PDO}}$	25ns	
Latch Setup Time	$t_{\text{DSL}}$	50ns	
Latch Hold Time	$t_{\text{DHL}}$	50ns	
Latch High Level Width	$t_{\text{LWH}}$	50ns	
FLM Setup Time	$t_{\text{DSF}}$	50ns	
FLM Hold Time	$t_{\text{DHF}}$	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

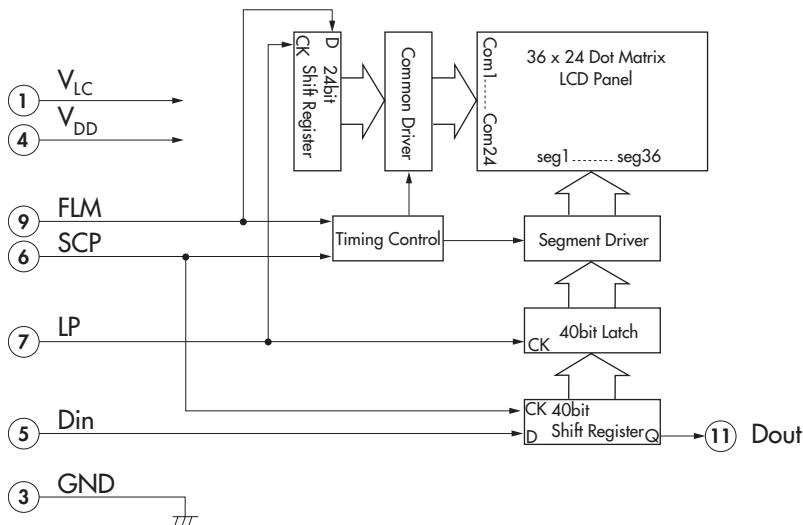
\*3 Location of LP signal on first line

#### Display Electrical Characteristics

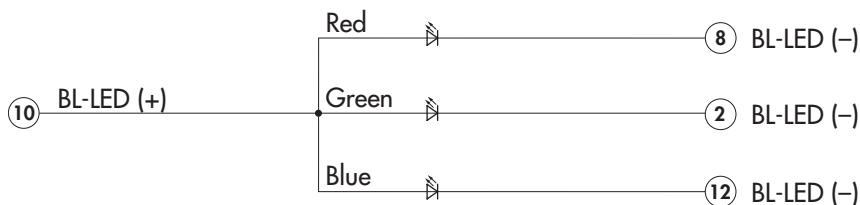
Items		Symbols	Test Condition	Minimum	Typical	Maximum
LCD	Supply Voltage	Logic Circuit	$V_{\text{DD}}$	3.0	—	5.5
		LCD Circuit	$V_{\text{LC}}$	—	* 7.3	—
Input Voltage	H	$V_{\text{IH}}$		$0.7V_{\text{DD}}$	—	$V_{\text{DD}}$
	L	$V_{\text{IL}}$		0	—	$0.3V_{\text{DD}}$
Output Voltage	H	$V_{\text{OH}}$	$D_{\text{OUT}},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

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

## BLOCK DIAGRAM &amp; PIN CONFIGURATIONS FOR RGB LEDs



**ISO1BBFRGB**  
RGB LED Backlight  
Black and White LCD



Pin No.	Symbol	Name	Function
①	V <sub>LC</sub>	Power	Power source for LCD drive
②	BL-LED (-)	Terminal of Backlight LED	Cathode for green
③	GND	Ground	
④	V <sub>DD</sub>	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

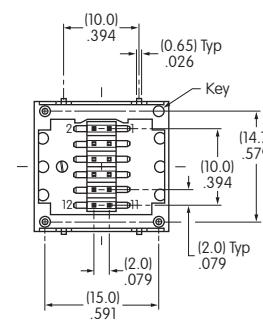
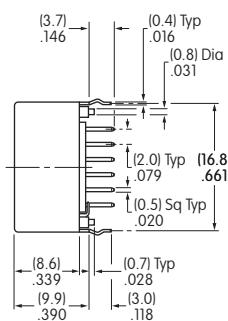
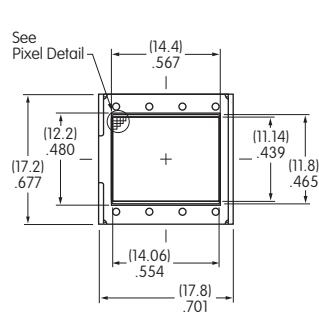
### ABSOLUTE MAXIMUM FOR RGB LED

Electrical Characteristics (Temperature at 25°C)

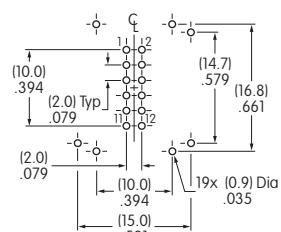
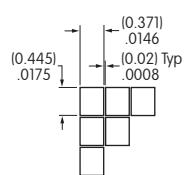
Backlight Color	Symbols	Red	Green	Blue	Unit
Forward Current	$I_F$	20	20	20	mA
Forward Voltage	$V_F$	2.0 ( $I_F = 10\text{mA}$ )	2.8 ( $I_F = 8.5\text{mA}$ )	2.8 ( $I_F = 8.0\text{mA}$ )	V
Reverse Voltage	$V_R$	4.0	4.0	4.0	V
Current Reduction Rate Above 25°C	$\Delta I_F(\text{DC})$	-0.33	-0.33	-0.33	$\text{mA}/^\circ\text{C}$
*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.