

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.

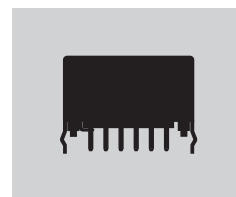
Integrated liquid crystal display provides wide viewing angle with high contrast and clarity.

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

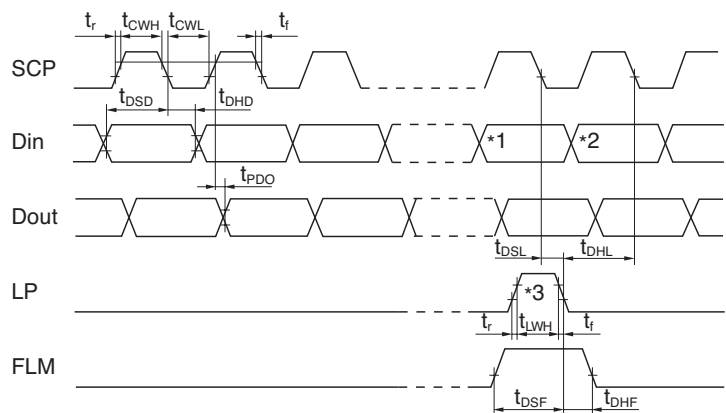
Items	Symbols	Test Conditions	Minimum	Typical	Maximum	Unit
High Level Input Voltage	V_{IH}		$0.7V_{DD}$		V_{DD}	V
Low Level Input Voltage	V_{IL}		0		$0.3V_{DD}$	V
High Level Input Leakage Current	I_{LIH}	$V_I = V_{DD}$			10	μA
Low Level Input Leakage Current	I_{LIL}	$V_I = 0\text{V}$			-10	μA
High Level 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

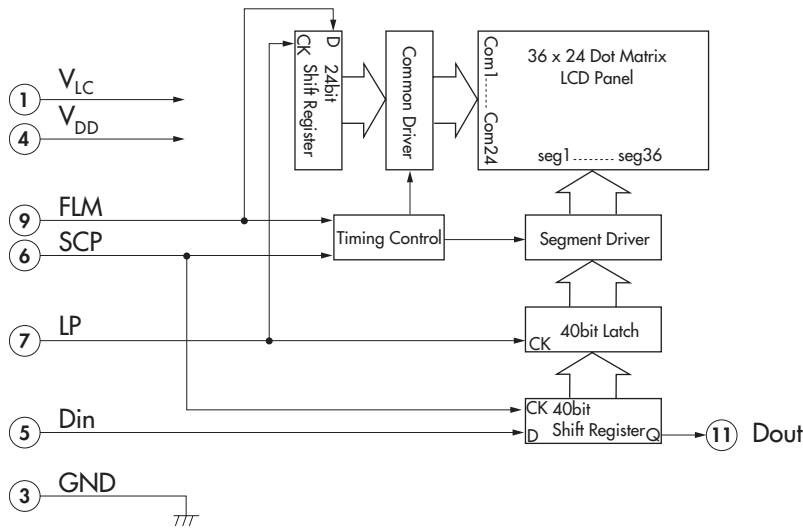
*3 Location of LP signal on first line

Display Electrical Characteristics

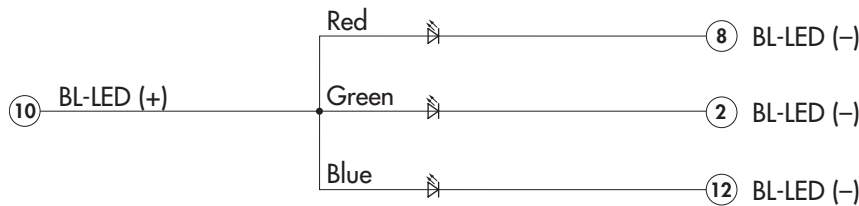
Items		Symbols	Test Condition	Minimum	Typical	Maximum	
LCD	Supply Voltage	Logic Circuit	V_{DD}	3.0	—	5.5	
		LCD Circuit	V_{LC}	—	* 7.3	—	
	Input Voltage	H	V_{IH}	$0.7V_{DD}$	—	V_{DD}	
		L	V_{IL}	0	—	$0.3V_{DD}$	
	Output Voltage	H	V_{OH}	$D_{OUT}, I_{OH} = 500 \mu\text{A}$	$V_{DD}-0.5$	—	—
		L	V_{OL}	$D_{OUT}, I_{OL} = 500 \mu\text{A}$	—	—	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	$I_F = \text{Forward Current}$ $T_a = 25^{\circ}\text{C}$	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 SMARTDISPLAYS. 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

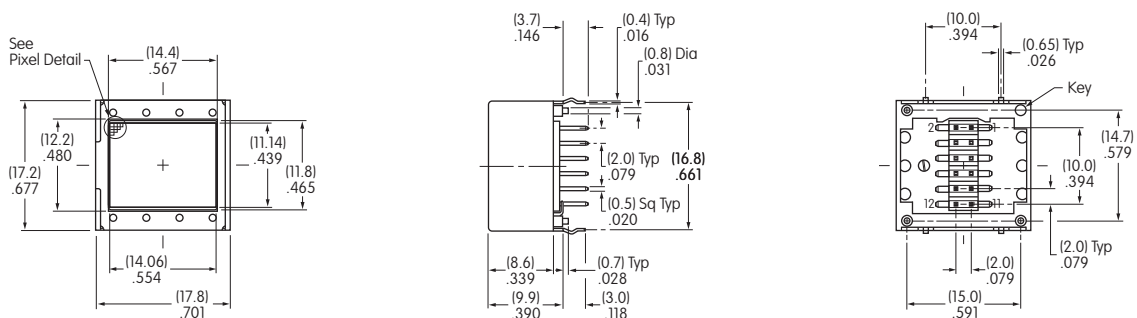
ABSOLUTE MAXIMUM FOR RGB LED

Electrical Characteristics (Temperature at 25°C)

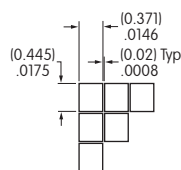
Backlight Color	Symbols	Red	Green	Blue	Unit
Forward Current	I_F	20	20	20	mA
Forward Voltage	V_F	2.0 ($I_F = 10\text{mA}$)	2.8 ($I_F = 8.5\text{mA}$)	2.8 ($I_F = 8.0\text{mA}$)	V
Reverse Voltage	V_R	4.0	4.0	4.0	V
Current Reduction Rate Above 25°C	$\Delta I_F(\text{DC})$	-0.33	-0.33	-0.33	mA/°C
*Power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

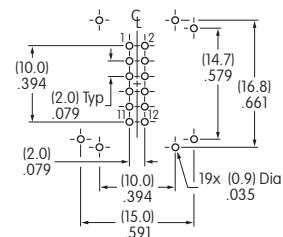
TYPICAL DISPLAY DIMENSIONS WITH RGB LED



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.