

Toggle



Frameless OLED Pushbutton.....E4

Switch with 96 x 64 Programmable Color Display  
Video Capability; 180° Viewing Angle; High Contrast

← **NEW**

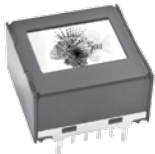
Rockers



OLED Pushbutton.....E8

Switch with 64 x 48 Programmable Color Display  
Video Capability; 180° Viewing Angle; High Contrast

Pushbuttons



OLED Display.....E11

52 x 36 Programmable Color Display  
Video Capability; 180° Viewing Angle; High Contrast

Illuminated PB

**Programmable**  
**E**



OLED Rocker.....E15

Switch with 96 x 64 Programmable Display  
White Monochrome OLED Display; 180° Viewing Angle; IP64

Keylocks

Rotaries

Wide View LCD 64 x 32 Pushbutton.....E21

Switch with Programmable Display; Short & Long Travel Options  
RGB 64 Colors; Long Life LCD; up to 4 Lines with 10 Characters Each

← **NEW**

Slides



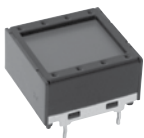
Wide View LCD 64 x 32 Display.....E26

Programmable Display  
RGB 64 Colors; Long Life LCD; up to 4 Lines with 10 Characters Each

Tactiles

← **NEW**

Tilt



Wide View Compact LCD 64 x 32 Pushbutton..E30

Switch with Programmable Display  
RGB 64 Colors; Long Life LCD; up to 4 Lines with 10 Characters Each

Touch

← **NEW**

Indicators



Wide View LCD 36 x 24 Pushbutton.....E35

Switch with Programmable Display  
RGB Backlight; Long Life LCD; up to 3 Lines with 6 Characters Each

Accessories

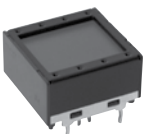
← **NEW**



Wide View LCD 36 x 24 Display.....E39

Programmable Display  
RGB Backlight; Long Life LCD; up to 3 Lines with 6 Characters Each

Supplement



← **NEW**



Wide View Compact LCD 36 x 24 Pushbutton..E43

Switch with Programmable Display  
 RGB Backlight; Long Life LCD; up to 3 Lines with 6 Characters Each

← **NEW**



LCD 64 x 32 Pushbutton.....E48

\* Switch with Programmable Display  
 RGB 64 Colors; Long Life LCD; up to 4 Lines with 10 Characters Each



LCD 64 x 32 Display.....E51

\* Programmable Display  
 RGB 64 Colors; Long Life LCD; up to 4 Lines with 10 Characters Each



Compact LCD 64 x 32 Pushbutton.....E55

\* Switch with Programmable Display; 28% Smaller than Standard Size  
 RGB 64 Colors; Long Life LCD; up to 4 Lines with 10 Characters Each



LCD 36 x 24 Pushbutton.....E60

\* Switch with Programmable Display  
 Single, Bicolor or RGB Backlight; up to 3 Lines with 6 Characters Each



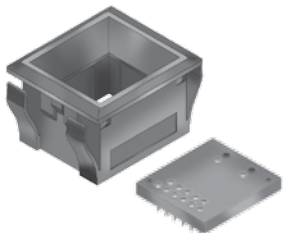
LCD 36 x 24 Display.....E67

\* Programmable Display  
 Single, Bicolor or RGB Backlight; up to 3 Lines with 6 Characters Each



Compact LCD 36 x 24 Pushbutton.....E73

\* Switch with Programmable Display; 28% Smaller than Standard Size  
 Single, Bicolor or RGB Backlight; up to 3 Lines with 6 Characters Each



Accessories.....E78

Enhance Your Applications

Development Tools & Support

NKK provides numerous development tools to get any SmartSwitch project started easily. Please visit our web site or contact a sales representative.

\* These switches and displays will be available until March 31, 2015.

Toggle

Rockers

Pushbuttons

Illuminated PB

**E** Programmable

Keylocks

Rotaries

Slides

Tactiles

Tilt

Touch

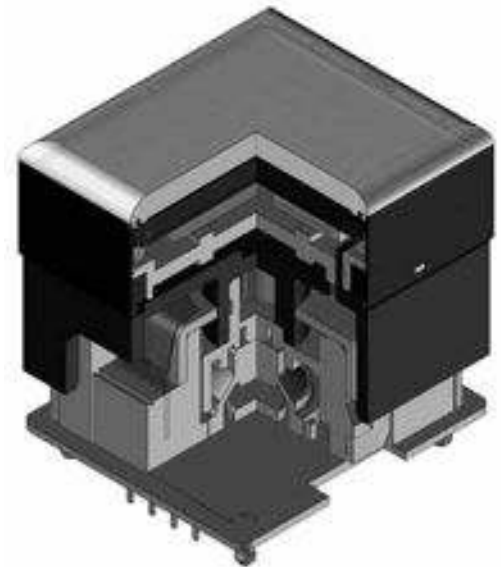
Indicators

Accessories

Supplement

## DISTINCTIVE CHARACTERISTICS

- High definition, contrast and resolution of 96RGB x 64 pixels in compact screen and minimal frame
- Range of 65,536 colors in 16 bit mode
- Operating life of 50,000 hours minimum
- Maximum use of display lens with ultra-thin frame provides full screen capacity
- Multiple units easily combine to form one screen, offering flexibility in size and layout
- Smooth, silent operation with short stroke of 0.07" lends to tactile feedback unparalleled to touch panels
- Same outer dimensions of switch and footprint, enabling ease of replacement with current switches
- Operated by commands and data supplied via serial communications (SPI)
- Incorporates bitmap display function
- Low energy consumption
- Dust tight construction
- Snap-in standoff for easy, secure mounting and alignment; aids in prevention of dislodging during wave soldering



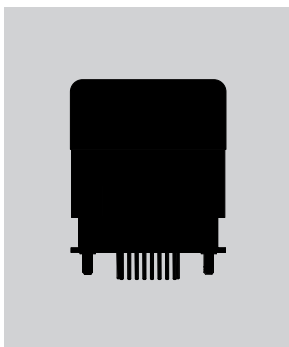
Viewing area: 21.28mm x 18.7mm (horizontal x vertical)

High reliability and long life of one million actuations minimum

Highly reliable gold plated twin contacts

Epoxy sealed straight PC terminals

Actual Size





**SWITCH PART NUMBER & DESCRIPTION**

Part Number	Switch Description	OLED	Pixel Format
<b>ISF15ACP4</b>	SPST, Momentary ON Gold Contacts Straight PC Terminals	Color OLED Display Module 65,536 Colors	96RGB x 64 Pixels Horizontal x Vertical

**SWITCH SPECIFICATIONS**

<b>Circuit</b>	SPST normally open
<b>Contact Position</b>	Leave actuator: ① – ② OFF Push actuator: ① – ② ON
<b>Electrical Capacity (Resistive Load)</b>	100mA @ 12V DC (resistive circuit)
<b>Contact Resistance</b>	200 milliohms maximum @ 20mV 10mA
<b>Insulation Resistance</b>	100 megohms minimum @ 100V DC
<b>Dielectric Strength</b>	125V AC for 1 minute minimum
<b>Mechanical Endurance</b>	1,000,000 operations minimum
<b>Electrical Endurance</b>	1,000,000 operations minimum
<b>Operating Force</b>	2.0 ± 0.5 Newtons
<b>Total Travel</b>	1.8mm (0.07")

**OLED SPECIFICATIONS**

**Characteristics of Display**

<b>Display Device</b>	Color OLED display module
<b>Display Mode</b>	Passive matrix
<b>Viewing Area</b>	21.28mm x 18.74mm (horizontal x vertical)
<b>Pixel Format</b>	96RGB x 64 pixels (horizontal x vertical)
<b>Pixel Size</b>	0.044mm x 0.263mm (horizontal x vertical)
<b>Interface</b>	Serial (SPI) interface
<b>Number of Colors</b>	65,536 Colors (16bit: R 5bit/G 6bit/B 5bit) or 256 Colors (8bit: R 2bit/G 3bit/B 3bit)
<b>Operating Temperature Range</b>	-20°C ~ +70°C (-4°F ~ +158°F)
<b>Storage Temperature Range</b>	-30°C ~ +80°C (-22°F ~ +176°F)
<b>Operating Life (Display)</b>	50,000 hours @ 100cd/m <sup>2</sup> (based on 40% pixels ON; Ta = 77°F)

**Absolute Maximum Ratings**

Items	Symbols	Ratings
<b>Supply Voltage for Logic/Interface</b>	V <sub>DD</sub>	-0.3V to +4.0V
<b>Supply Voltage for Drive</b>	V <sub>CC</sub>	-0.0V to +19.0V
<b>Input Voltage</b>	V <sub>I</sub>	-0.3V to V <sub>DD</sub> +0.3V

**Current Consumption**

(Temperature at 25°C, V<sub>DD</sub> = 2.8V, V<sub>CC</sub> = 15.0V)

Items	Symbols	Min	Typical	Max
<b>All-Pixels-On Mode</b> *Drive System Power Current	I <sub>CC1</sub>	—	11.0mA	13.2mA
<b>All-Pixels-On Mode</b> *Logic/IF System Power Current	I <sub>DD1</sub>	—	0.17mA	0.20mA
<b>Sleep Mode</b> **Drive System Power Current	I <sub>CC2</sub>	—	—	10µA
<b>Sleep Mode</b> **Logic/IF System Power Current	I <sub>DD2</sub>	—	—	10µA

\* All pixels shall be turned on with the maximum level gray scale  
\*\* All pixels shall be turned off (while chip is operating)

**Recommended Operating Conditions**

Items	Symbols	Minimum	Typical	Maximum
<b>Supply Voltage for Logic/Interface</b>	V <sub>DD</sub>	2.4V	2.8V	3.5V
<b>Supply Voltage for Drive</b>	V <sub>CC</sub>	14.0V	15.0V	16.0V
<b>Input High Level Voltage</b>	V <sub>IH</sub>	0.8 x V <sub>DD</sub>	—	—
<b>Input Low Level Voltage</b>	V <sub>IL</sub>	—	—	0.2 x V <sub>DD</sub>

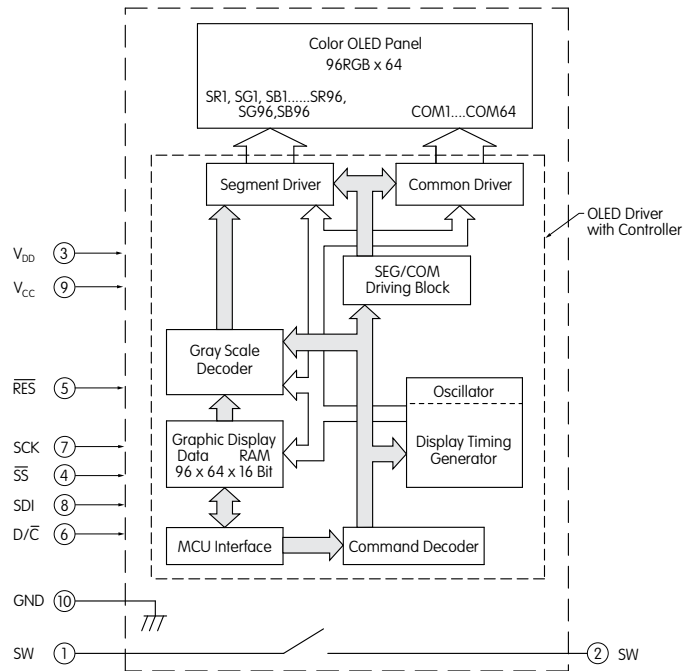
**Optical Characteristics** (Temperature at 25°C, Initial Value: 87 x 0F)

Items	Min	Typical	Max	Unit	Remarks
<b>Luminosity</b>	80	105	130	cd/m <sup>2</sup>	White (All pixels on)
<b>White Color Coordinate</b>	(x)	0.26	0.30	0.34	—
	(y)	0.31	0.36	0.41	—
<b>Red Color Coordinate</b>	(x)	0.62	0.66	0.70	—
	(y)	0.30	0.34	0.38	—
<b>Green Color Coordinate</b>	(x)	0.24	0.29	0.33	—
	(y)	0.59	0.63	0.67	—
<b>Blue Color Coordinate</b>	(x)	0.10	0.15	0.19	—
	(y)	0.10	0.17	0.23	—
<b>Contrast Ratio</b>	100	—	—	—	—

## BLOCK DIAGRAM & PIN CONFIGURATIONS

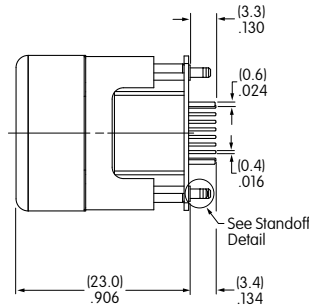
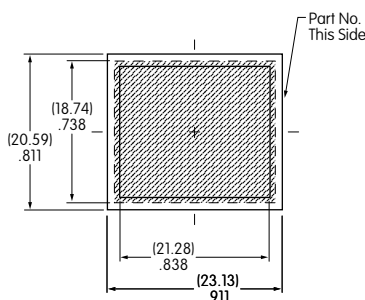


**ISF15ACP4**

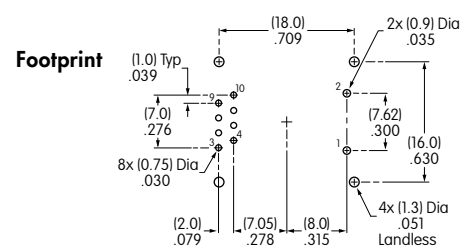
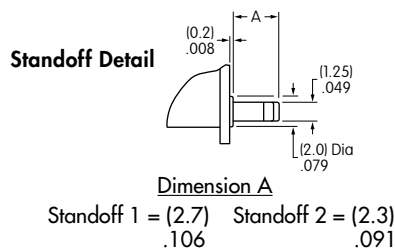
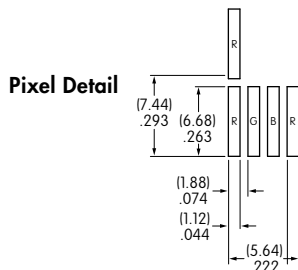
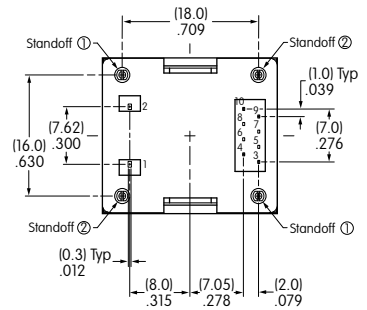


Pin No.	Symbol	Name	Function
①	SW	Terminal of Switch	Normally open
②	SW	Terminal of Switch	Normally open
③	V <sub>DD</sub>	Power	Power source for logic circuit
④	SS	Slave Select	Slave select for SPI. This line is active low.
⑤	RES	Reset	Reset signal input. When pin is low, initialization of chip is executed.
⑥	D/C	Data/Command	Data/Command Control. When pin is pulled low, data will be interpreted as Command; when pulled high, data will be interpreted as Data.
⑦	SCK	Serial Clock	Clock line for SPI that synchronizes command and data
⑧	SDI	Serial Data In	Data input line for SPI
⑨	V <sub>CC</sub>	Power	Power source for drive circuit
⑩	GND	Ground	Connect to Ground

## TYPICAL SWITCH DIMENSIONS



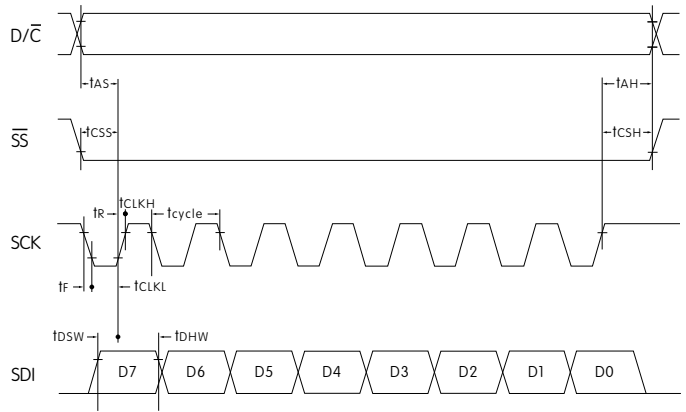
Terminal numbers are not on the switch.



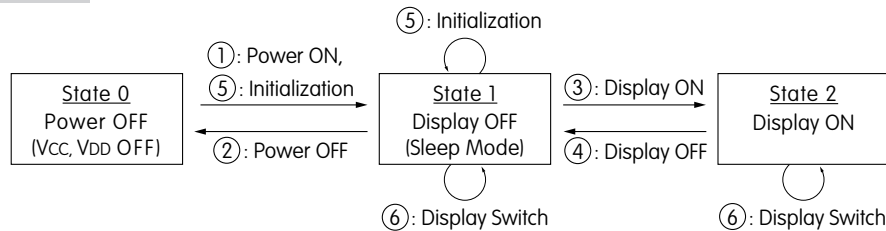
**TIMING SPECIFICATIONS**

**AC Characteristics** (Temperature at 25°C),  $V_{DD} = 2.4V \sim 3.5V$

Items	Symbols	Minimum	Typical	Maximum
Clock Cycle Time	$t_{cycle}$	150ns	—	—
D/ $\bar{C}$ Setup Time	$t_{AS}$	40ns	—	—
D/ $\bar{C}$ Hold Time	$t_{AH}$	40ns	—	—
$\bar{SS}$ Setup Time	$t_{CSS}$	75ns	—	—
$\bar{SS}$ Hold Time	$t_{CSH}$	60ns	—	—
Write Data Setup Time	$t_{DSW}$	40ns	—	—
Write Data Hold Time	$t_{DHW}$	40ns	—	—
SCK Low Time	$t_{CLKL}$	75ns	—	—
SCK High Time	$t_{CLKH}$	75ns	—	—
SCK Rise Time	$t_R$	—	—	15ns
SCK Fall Time	$t_F$	—	—	15ns



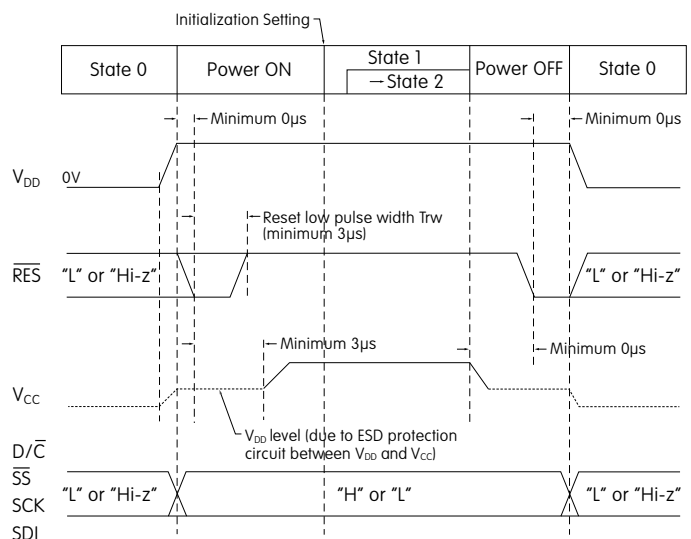
**STATE TRANSITION**



State Number	State	Display	Sleep	$V_{CC}$	$V_{DD}$	Changing the Display
0	Power OFF	OFF	—	OFF	OFF	Disable
1	Display OFF	OFF	ON	ON	ON	Enable
2	Display ON	ON	OFF	ON	ON	Enable

State Transition	Transition	Index
①	Power ON	Refer to "Power ON/OFF Sequence"
②	Power OFF	
③	Display ON	
④	Display OFF	
⑤	Initialization	Initialize Setting of Command/Data
⑥	Image Rewriting	Send Display Data
	Display Settings	Dimmer, Scroll, etc.

**Power ON/OFF Sequence**



### DISTINCTIVE CHARACTERISTICS

- Organic LED technology
- Life 30,000 hours @ 100cd/m<sup>2</sup> (based on 40% pixels on) or 60,000 hours @ 50cd/m<sup>2</sup> (based on 40% pixels on)
- Power consumption only 3.8mA (30% less than previous product)
- Range of 65,536 colors in 16 bit mode, 256 colors in 8 bit mode
- Full viewing angle of 180°
- Exceptional contrast: 50 times greater than LCD products
- Four times more enhanced resolution
- High resolution provides sharp, clear images of very small characters
- Operated by commands and data supplied via serial communications (SPI)
- Distinct, long travel of 4.5mm (same as KP01 series pushbuttons)
- Dust tight construction
- Stylish, translucent black housing design

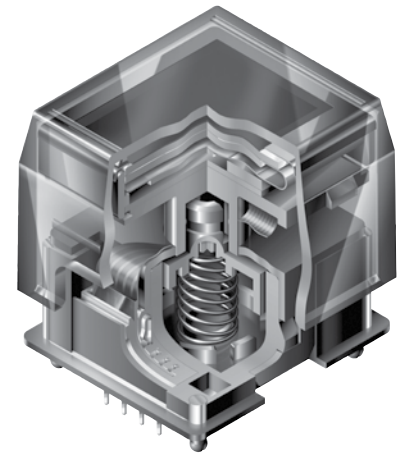
Viewing area: 15.5mm x 11.6mm (horizontal x vertical)

High reliability and long life of three million actuations minimum

High resolution of 64RGB x 48 pixels

Epoxy sealed straight PC terminals

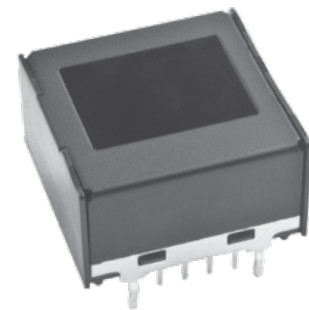
Snap-in standoff for easy, secure mounting and alignment



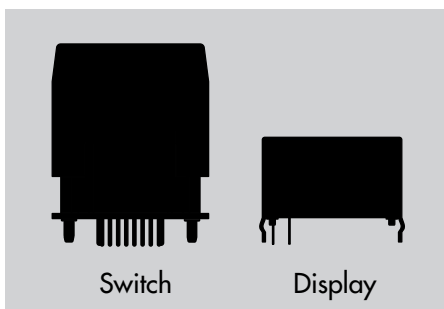
Viewing area: 12.9mm x 9.9mm (horizontal x vertical)

High resolution of 52RGB x 36 pixels

Bracket has crimped legs to ensure secure PC mounting and prevent dislodging during wave soldering



Actual Sizes



## SWITCH PART NUMBER & DESCRIPTION



Part Number	Switch Description	OLED	Pixel Format
<b>ISC15ANP4</b>	SPST, Momentary ON Gold Contacts Straight PC Terminals	Color OLED Display Module 65,536 Colors	64RGB x 48 Pixels Horizontal x Vertical

## SWITCH SPECIFICATIONS

Circuit	SPST normally open
Contact Position	Leave actuator: ① – ② OFF Push actuator: ① – ② ON
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	3,000,000 operations minimum
Electrical Endurance	3,000,000 operations minimum
Operating Force	2.0 ± 0.5 Newtons
Total Travel	4.5mm (.177")

## OLED SPECIFICATIONS

### Characteristics of Display

Display Device	Color OLED display module
Display Mode	Passive matrix
Viewing Area	15.5mm x 11.6mm (horizontal x vertical)
Pixel Format	64RGB x 48 pixels (horizontal x vertical)
Pixel Size	0.21mm x 0.20mm (horizontal x vertical)
Interface	Serial (SPI) interface
Number of Colors	65,536 Colors (16bit: R 5bit/G 6bit/B 5bit) or 256 Colors (8bit: R 2bit/G 3bit/B 3bit)
Operating Temperature Range	-20°C ~ +70°C (-4°F ~ +158°F)
Storage Temperature Range	-30°C ~ +80°C (-22°F ~ +176°F)
Operating Life (Display)	30,000 hours @ 100cd/m <sup>2</sup> (based on 40% pixels ON) 60,000 hours @ 50cd/m <sup>2</sup> (based on 40% pixels ON)

### Absolute Maximum Ratings

Items	Symbols	Ratings
Supply Voltage for Logic/Interface	V <sub>DD</sub>	-0.3V to +4.0V
Supply Voltage for Drive	V <sub>CC</sub>	-0.0V to +19.0V
Input Voltage	V <sub>I</sub>	-0.3V to V <sub>DD</sub> +0.3V

### Current Consumption

(Temperature at 25°C, V<sub>DD</sub> = 2.8V, V<sub>CC</sub> = 16.0V)

Items	Symbols	Min	Typical	Max
All-Pixels-On Mode *Drive System Power Current	I <sub>CC1</sub>	—	3.8mA	4.6mA
All-Pixels-On Mode *Logic/IF System Power Current	I <sub>DD1</sub>	—	0.16mA	0.19mA
Sleep Mode **Drive System Power Current	I <sub>CC2</sub>	—	—	10µA
Sleep Mode **Logic/IF System Power Current	I <sub>DD2</sub>	—	—	10µA

\* All pixels shall be turned on with the maximum level gray scale

\*\* All pixels shall be turned off (while chip is operating)

### Recommended Operating Conditions

Items	Symbols	Minimum	Typical	Maximum
Supply Voltage for Logic/Interface	V <sub>DD</sub>	2.4V	2.8V	3.5V
Supply Voltage for Drive	V <sub>CC</sub>	15.0V	16.0V	17.0V
Input High Level Voltage	V <sub>IH</sub>	0.8 x V <sub>DD</sub>	—	—
Input Low Level Voltage	V <sub>IL</sub>	—	—	0.2 x V <sub>DD</sub>

### Optical Characteristics (Temperature at 25°C, Initial Value: 87 x 0F)

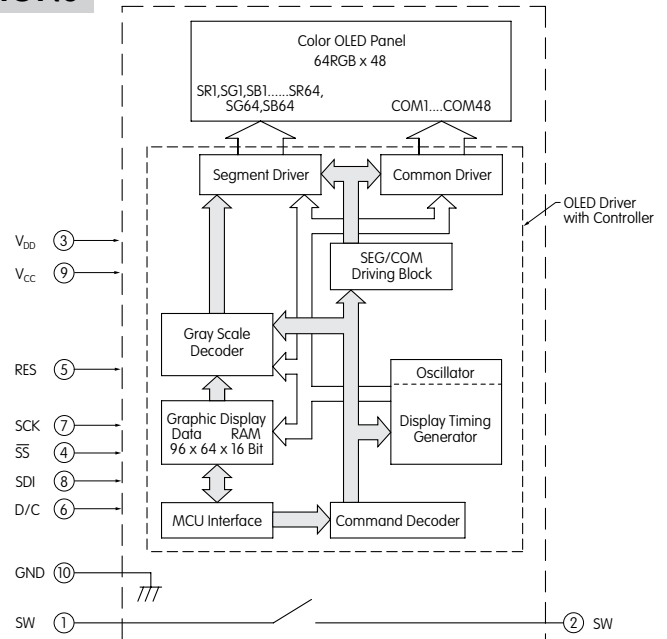
Items	Min	Typical	Max	Unit	Remarks
Luminosity	75	100	125	cd/m <sup>2</sup>	White (All pixels on)
White Color Coordinate	(x)	0.26	0.30	0.34	—
	(y)	0.32	0.37	0.42	—
Red Color Coordinate	(x)	0.63	0.67	0.71	—
	(y)	0.29	0.33	0.37	—
Green Color Coordinate	(x)	0.19	0.23	0.27	—
	(y)	0.61	0.65	0.69	—
Blue Color Coordinate	(x)	0.10	0.14	0.18	—
	(y)	0.14	0.20	0.26	—
Contrast Ratio	100	—	—	—	—



## SWITCH BLOCK DIAGRAM & PIN CONFIGURATIONS

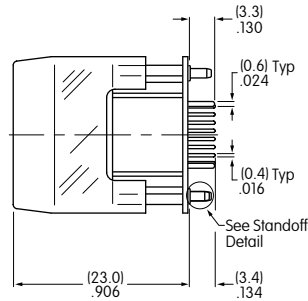
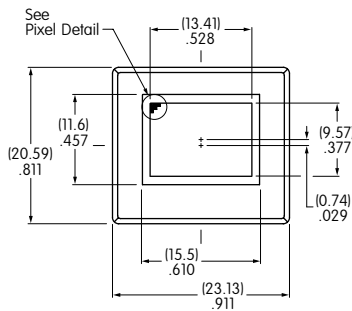


ISC15ANP4

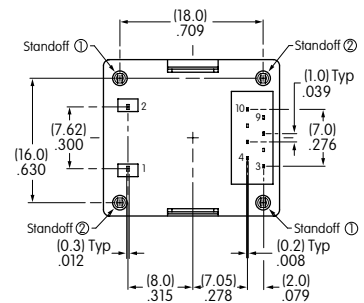


Pin No.	Symbol	Name	Function
①	SW	Terminal of Switch	Normally open
②	SW	Terminal of Switch	Normally open
③	V <sub>DD</sub>	Power	Power source for logic circuit
④	SS	Slave Select	Slave select for SPI. This line is active low.
⑤	RES	Reset	Reset signal input. When pin is low, initialization of chip is executed.
⑥	D/C	Data/Command	Data/Command Control. When pin is pulled low, data will be interpreted as Command; when pulled high, data will be interpreted as Data.
⑦	SCK	Serial Clock	Clock line for SPI that synchronizes command and data
⑧	SDI	Serial Data In	Data input line for SPI
⑨	V <sub>CC</sub>	Power	Power source for drive circuit
⑩	GND	Ground	Connect to Ground

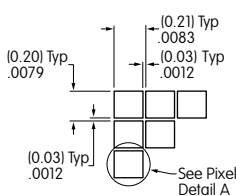
## TYPICAL SWITCH DIMENSIONS



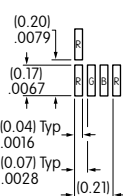
Terminal numbers are not on the switch.



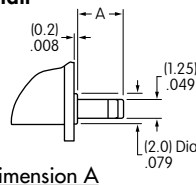
Pixel Detail



Pixel Detail A

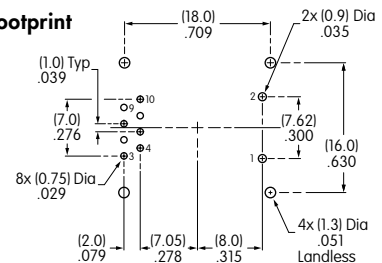


Standoff Detail



Standoff 1 = (2.7) .106  
Standoff 2 = (2.3) .091

Footprint





## DISPLAY PART NUMBER & DESCRIPTION

Part Number	Display Description	OLED	Pixel Format
<b>ISC01P</b>	Straight PC Terminals	Color OLED Display Module 65,536 Colors	52RGB x 36 Pixels Horizontal x Vertical

## OLED SPECIFICATIONS

### Characteristics of Display

Display Device	Color OLED display module
Display Mode	Passive matrix
Viewing Area	12.9mm x 9.9mm (horizontal x vertical)
Pixel Format	52RGB x 36 pixels (horizontal x vertical)
Pixel Size	0.21mm x 0.22mm (horizontal x vertical)
Interface	Serial (SPI) interface
Number of Colors	65,536 Colors (16bit: R 5bit/G 6bit/B 5bit) or 256 Colors (8bit: R 2bit/G 3bit/B 3bit)
Operating Temperature Range	-20°C ~ +70°C (-4°F ~ +158°F)
Storage Temperature Range	-30°C ~ +80°C (-22°F ~ +176°F)
Operating Life (Display)	30,000 hours @ 100cd/m <sup>2</sup> (based on 40% pixels ON) 60,000 hours @ 50cd/m <sup>2</sup> (based on 40% pixels ON)

### Absolute Maximum Ratings

Items	Symbols	Ratings
Supply Voltage for Logic/Interface	V <sub>DD</sub>	-0.3V to +4.0V
Supply Voltage for Drive	V <sub>CC</sub>	0.0V to +19.0V
Input Voltage	V <sub>I</sub>	-0.3V to V <sub>DD</sub> +0.3V

### Current Consumption

(Temperature at 25°C, V<sub>DD</sub> = 2.8V, V<sub>CC</sub> = 16.0V)

Items	Symbols	Min	Typical	Max
All-Pixels-On Mode *Drive System Power Current	I <sub>CC1</sub>	—	2.4mA	2.9mA
All-Pixels-On Mode *Logic/IF System Power Current	I <sub>DD1</sub>	—	0.15mA	0.18mA
Sleep Mode **Drive System Power Current	I <sub>CC2</sub>	—	—	10µA
Sleep Mode **Logic/IF System Power Current	I <sub>DD2</sub>	—	—	10µA

\*All pixels shall be turned on with the maximum level gray scale  
\*\*All pixels shall be turned off (while chip is operating)

### Recommended Operating Conditions

Items	Symbols	Minimum	Typical	Maximum
Supply Voltage for Logic/Interface	V <sub>DD</sub>	2.4V	2.8V	3.5V
Supply Voltage for Drive	V <sub>CC</sub>	15.0V	16.0V	17.0V
Input High Level Voltage	V <sub>IH</sub>	0.8 x V <sub>DD</sub>	—	—
Input Low Level Voltage	V <sub>IL</sub>	—	—	0.2 x V <sub>DD</sub>

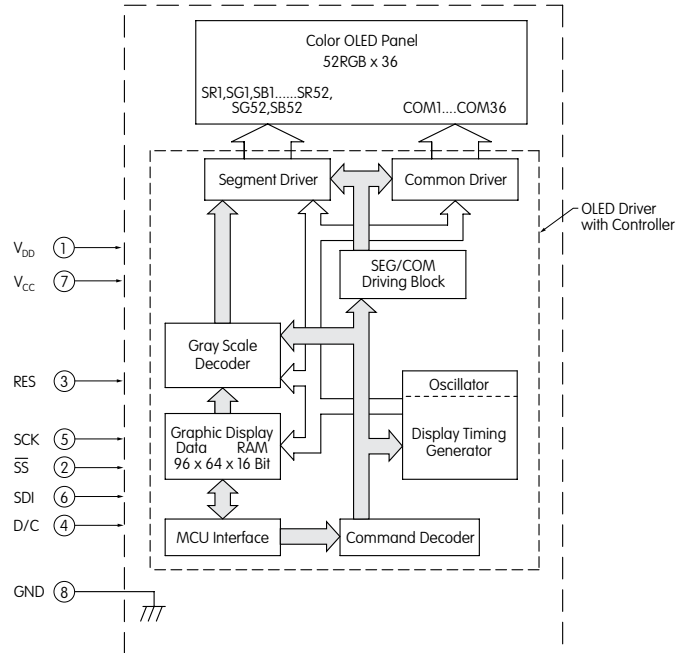
### Optical Characteristics (Temperature at 25°C, Initial Value: 87 x 0F)

Items	Min	Typical	Max	Unit	Remarks
Luminosity	75	100	125	cd/m <sup>2</sup>	White (All pixels on)
White Color Coordinate	(x)	0.25	0.29	0.33	—
	(y)	0.31	0.36	0.41	—
Red Color Coordinate	(x)	0.63	0.67	0.71	—
	(y)	0.29	0.33	0.37	—
Green Color Coordinate	(x)	0.19	0.23	0.27	—
	(y)	0.60	0.64	0.68	—
Blue Color Coordinate	(x)	0.10	0.14	0.18	—
	(y)	0.14	0.20	0.26	—
Contrast Ratio	100	—	—	—	—

## DISPLAY BLOCK DIAGRAM & PIN CONFIGURATIONS

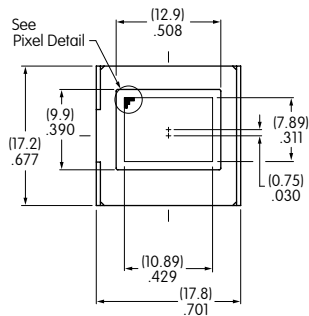


ISC01P

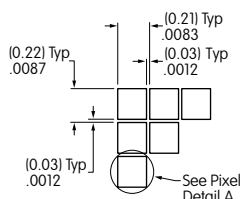


Pin No.	Symbol	Name	Function
①	V <sub>DD</sub>	Power	Power source for logic circuit
②	SS	Slave Select	Slave select for SPI. This line is active low.
③	RES	Reset	Reset signal input. When pin is low, initialization of chip is executed.
④	D/C	Data/Command	Data/Command Control. When pin is pulled low, data will be interpreted as Command; when pulled high, data will be interpreted as Data.
⑤	SCK	Serial Clock	Clock line for SPI that synchronizes command and data
⑥	SDI	Serial Data In	Data input line for SPI
⑦	V <sub>CC</sub>	Power	Power source for drive circuit
⑧	GND	Ground	Connect to Ground

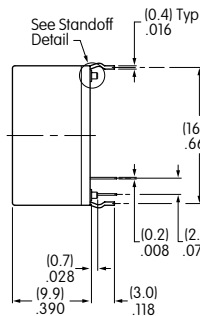
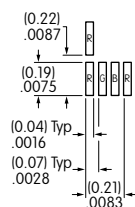
## TYPICAL DISPLAY DIMENSIONS



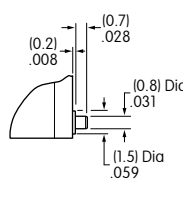
Pixel Detail



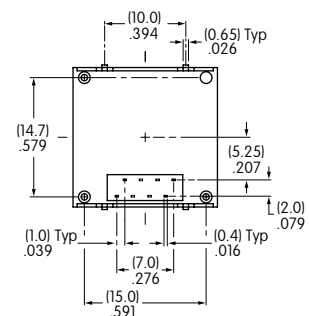
Pixel Detail A



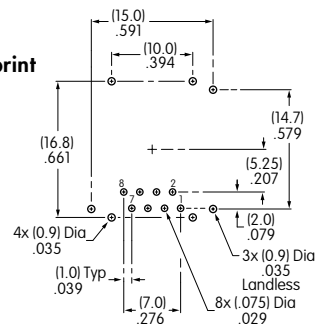
Standoff Detail



Terminal numbers are not on the switch.



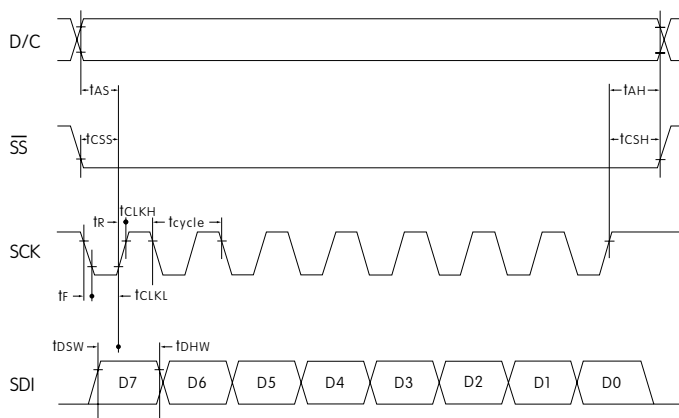
Footprint



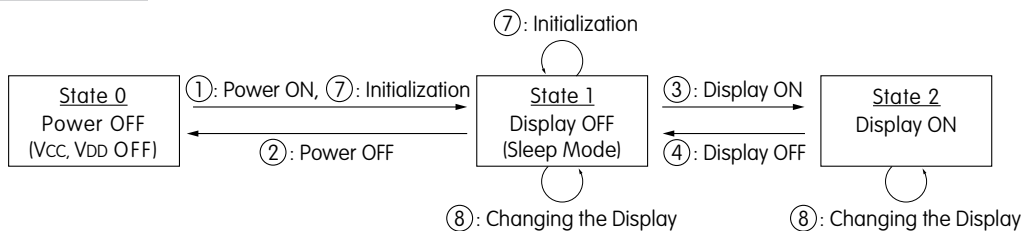
## TIMING SPECIFICATIONS FOR SWITCH & DISPLAY

**AC Characteristics** (Temperature at 25°C,  $V_{DD} = 2.4V \sim 3.5V$ )

Items	Symbols	Minimum	Typical	Maximum
Clock Cycle Time	$t_{cycle}$	150ns	—	—
D/C Setup Time	$t_{AS}$	40ns	—	—
D/C Hold Time	$t_{AH}$	40ns	—	—
$\overline{SS}$ Setup Time	$t_{CSS}$	75ns	—	—
$\overline{SS}$ Hold Time	$t_{CSH}$	60ns	—	—
Write Data Setup Time	$t_{DSW}$	40ns	—	—
Write Data Hold Time	$t_{DHW}$	40ns	—	—
SCK Low Time	$t_{CLKL}$	75ns	—	—
SCK High Time	$t_{CLKH}$	75ns	—	—
SCK Rise Time	$t_R$	—	—	15ns
SCK Fall Time	$t_F$	—	—	15ns



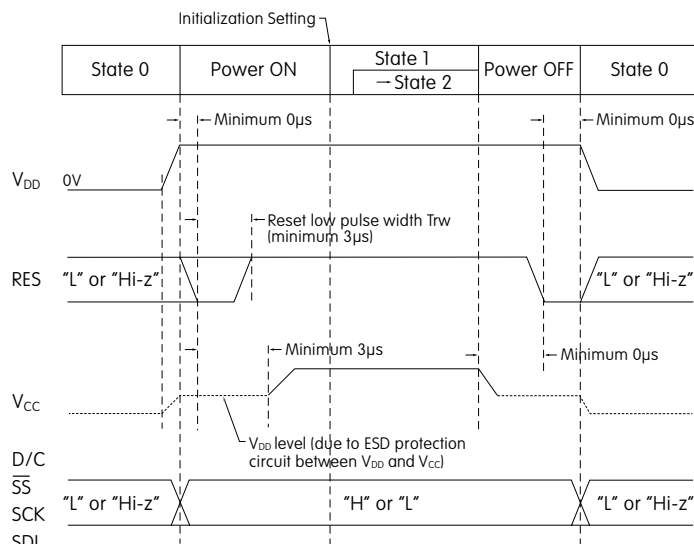
## STATE TRANSITION



State Number	State	Display	Sleep	$V_{CC}$	$V_{DD}$	Changing the Display
0	Power OFF	OFF	—	OFF	OFF	Disable
1	Display OFF	OFF	ON	ON	ON	Enable
2	Display ON	ON	OFF	ON	ON	Enable

State Transition	Transition	Index
①	Power ON	Refer to "Power ON/OFF Sequence"
②	Power OFF	
③	Display ON	
④	Display OFF	
⑦	Initialization	Initialize Setting of Command/Data
⑧	Image Rewriting	Send Display Data
	Display Settings	Dimmer, Scroll, etc.

## Power ON/OFF Sequence



Note: Refer to Application Notes on web site.

## PRECAUTIONS FOR HANDLING & STORAGE OF OLED DEVICES

### Handling

1. The IS Series OLED devices are electrostatic sensitive. To avoid damage to IC, do not touch terminals unless properly isolated from static electricity.
2. Signal input under conditions not recommended may cause damage to the OLED unit or deterioration of the display. Follow directions regarding supply sequences of power and signal voltages.
3. If the OLED panel is broken, avoid touching the contents. Wash off any contact to the skin or clothing.
4. Limit operating force to switch keytop to 100.0N maximum, as excessive pressure may damage the OLED.
5. For OLED display, it is necessary for bracket legs to be Grounded.
6. Recommended soldering time and temperature limits for OLED switch or display:



Avoid temperatures exceeding 80°C at the OLED.  
Wave Soldering: see Profile A in Supplement section.  
Manual Soldering: see Profile A in Supplement section.

7. The IS series OLED devices are not process sealed.
8. Pixels acquire diminished brightness over time and use, and those most frequently habituated have greater reduction of brightness than those less used. To minimize this difference, operate OLED unit so that all pixels are used as consistently as possible.
9. For switch, 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. For display, avoid contact with any flux or detergent. If any liquids spill on display surface, immediately wipe with soft absorbent cloth.
10. Proper serial resistors and buffers for signals should be used to prevent noise problems.

### 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.

## DISTINCTIVE CHARACTERISTICS

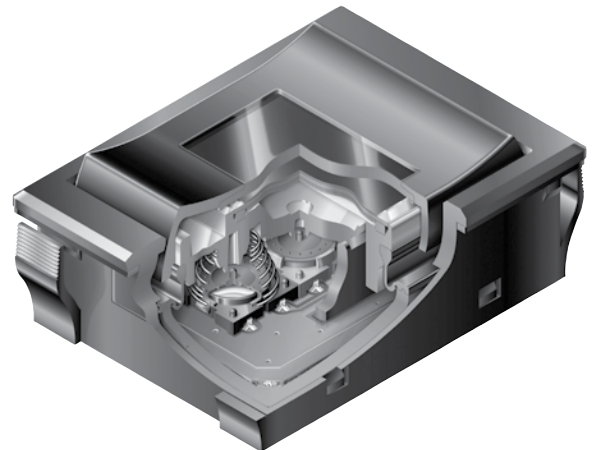
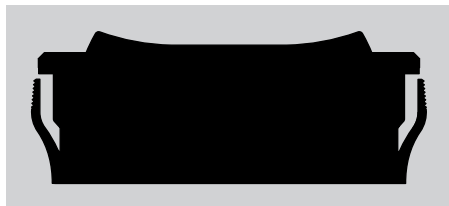
- Organic LED technology in display rocker (patent pending)
- Multifunction programmable device: select with rocker, push for activation
- Replaces multiple switches and displays with one device in a small package
- Broad display aids in navigation, both forward and reverse and up and down, in structured menus
- Wide viewing angle of 180° and large 0.92" display with exceptional contrast
- Conforms to IP64 of IEC60529 Standards on panel surface; dust tight construction of switch prevents entry of dust and improves contact reliability
- Commands and data supplied via serial communications protocol (SPI)
- Long life OLED with 52,000 hours at 30% illumination
- High reliability and long mechanical and electrical life of one million actuations minimum
- Stylish black housing design with matte finish complements any application

Monochrome OLED featuring sharp contrast and high resolution with 96 x 64 pixels

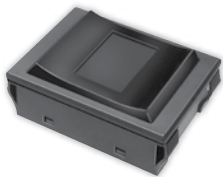
Panel mount with easy, snap-in installation

Short 14.6mm (.575") behind-panel height for compact spaces

Actual Size



## SMARTSWITCH PART NUMBER & DESCRIPTION

Part Number	Description
<p><b>IS18WWC1W</b></p>	<p><b>OLED Rocker Switch:</b> SP3T Switch                      Rocker (ON) (ON) (ON)                      Pushbutton Normally OFF</p> 

## SWITCH SPECIFICATIONS

<b>Circuit</b>	Single Pole Three Throw (Momentary)					
<b>Contact Position</b>	Top		Center		Bottom	
	Normal OFF	Down (ON) 9-12	Normal OFF	Down (ON) 10-12	Normal OFF	Down (ON) 11-12
<b>Electrical Capacity (Resistive Load)</b>	3VA maximum DC					
<b>Contact Resistance</b>	200 milliohms maximum					
<b>Insulation Resistance</b>	500 megohms minimum @ 250V DC					
<b>Dielectric Strength</b>	250V AC for 1 minute minimum					
<b>Electrostatic Resisting Pressure</b>	15kV minimum					
<b>Mechanical Endurance</b>	1,000,000 operations minimum					
<b>Electrical Endurance</b>	1,000,000 operations minimum					
<b>Operating Force</b>	5±2 Newtons at center of cap; 3.7±1.7 Newtons at top and bottom					
<b>Total Travel</b>	1.3±0.5mm (.051"±.020") at center of cap; 1.8±0.6mm (.71"±.024") at top and bottom					

## OLED SPECIFICATIONS

### Characteristics of Display

<b>Display Device</b>	Single color OLED display
<b>Display Mode</b>	Passive matrix
<b>Pixel Format</b>	96 x 64 pixels (horizontal x vertical)
<b>Pixel Size</b>	0.16mm x 0.177mm (horizontal x vertical)
<b>Interface</b>	Serial (SPI) interface
<b>Color</b>	White/Black (normally White)
<b>Splash &amp; Dust Proof</b>	Conforms to IP64 of IEC60529 standards on panel surface
<b>Operating Temperature Range</b>	-20°C ~ +70°C (-4°F ~ +158°F)
<b>Storage Temperature Range</b>	-25°C ~ +80°C (-13°F ~ +176°F)
<b>Operating Life Time (Display)</b>	52,000 hours (30% brightness); 15,600 hours (100% brightness)

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

Items	Symbols	Ratings
Supply Voltage for Logic/Interface	VDDA	-0.3V to +3.6V
Supply Voltage for Drive	VAH	-0.3V to +18.0V
Input Voltage	V <sub>in</sub>	-0.3V to VDDA +0.3V

### Current Consumption

(Temperature at 25°C, VDDA = 2.8V, VAH = 15.0V)

Items	Symbols	Min	Typical	Max
All-Pixels-On Mode *Drive System Power Current	I <sub>H1</sub>	—	11.0mA	13.2mA
All-Pixels-On Mode *Logic/IF System Power Current	I <sub>DD1</sub>	—	0.58mA	0.72mA
Sleep Mode **Drive System Power Current	I <sub>H2</sub>	—	—	10µA
Sleep Mode **Logic/IF System Power Current	I <sub>DD2</sub>	—	—	10µA

\* All pixels shall be turned on with the maximum level gray scale  
 \*\* All pixels shall be turned off (while chip is operating)

### Recommended Operating Conditions

Items	Symbols	Minimum	Typical	Maximum
Supply Voltage for Logic/Interface	VDDA	2.7V	2.8V	2.9V
Supply Voltage for Drive	VAH	14.5V	15.0V	15.5V
Input High Level Voltage	V <sub>IH</sub>	0.75 x VDDA	—	VDDA
Input Low Level Voltage	V <sub>IL</sub>	0.0	—	0.25V x VDDA

### Optical Characteristics

(Temperature at 25°C, Initial Value: depends on initial setting)

Items	Minimum	Typical	Maximum
Brightness	75 cd/m <sup>2</sup>	100 cd/m <sup>2</sup>	125 cd/m <sup>2</sup>
Chromaticity	(x)	*1	*1
	(y)	*1	*1
Contrast	100	—	—

\* Chromaticity range is the area of the ellipse. (See Chromaticity Diagram next page) The ellipse passes through points A, B, C and D and designates the center of each side of the quadrangle.

## Chromaticity Diagram

Point	Chromaticity X	Chromaticity Y
A	0.3441	0.3663
B	0.2983	0.3384
C	0.2799	0.2881
D	0.3257	0.3160

## TIMING SPECIFICATIONS

### AC Characteristics

(Temperature at  $-20^{\circ}\text{C} \sim +70^{\circ}\text{C}$ ),  $V_{DDA} = 2.8\text{V}$ ,  $V_{AH} = 16\text{V}$

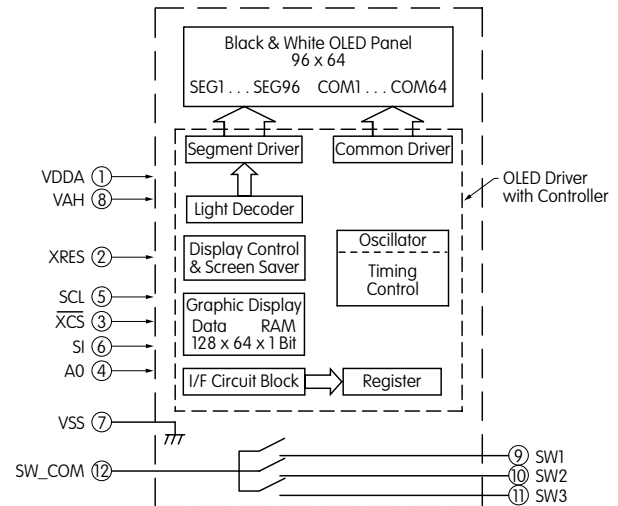
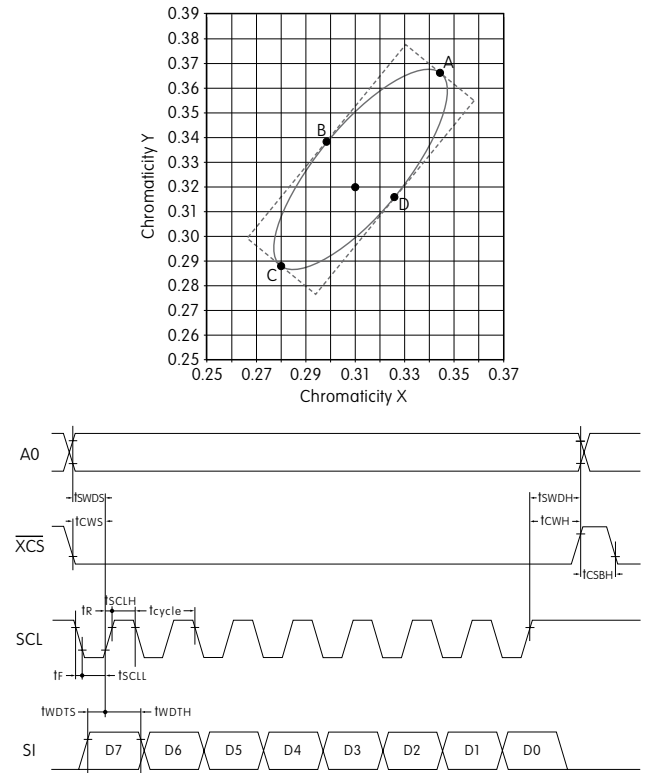
Items	Symbols	Minimum	Typical	Maximum
Clock Cycle Time	$t_{\text{cycle}}$	100ns	—	—
A0 Setup Time	$t_{\text{SWDS}}$	65ns	—	—
A0 Hold Time	$t_{\text{SWDH}}$	35ns	—	—
$\overline{\text{XCS}}$ Setup Time	$t_{\text{CWS}}$	65ns	—	—
$\overline{\text{XCS}}$ Hold Time	$t_{\text{CWH}}$	95ns	—	—
High Level $\overline{\text{XCS}}$ Pulse Width	$t_{\text{CSBH}}$	*10ns	—	—
Write Data Setup Time	$t_{\text{WDTS}}$	10ns	—	—
Write Data Hold Time	$t_{\text{WDTH}}$	20ns	—	—
SCL Low Time	$t_{\text{SCLL}}$	45ns	—	—
SCL High Time	$t_{\text{SCLH}}$	45ns	—	—
SCL Rise Time	$t_{\text{r}}$	—	—	15ns
SCL Fall Time	$t_{\text{f}}$	—	—	15ns

\* Requires more than 100ns after resetting software

## BLOCK DIAGRAM & PIN CONFIGURATIONS



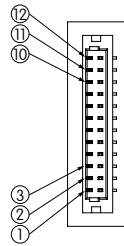
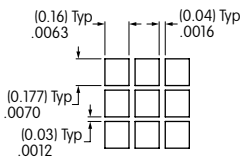
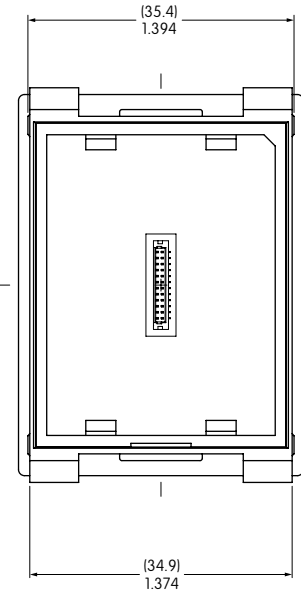
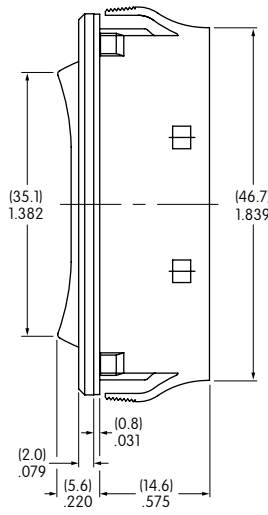
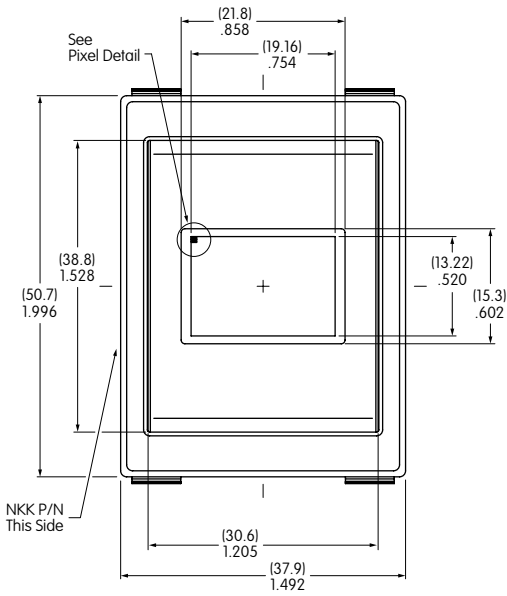
IS18WWC1W



Pin No.	Symbol	Name	Function
①	VDDA	Logic Type Power Source	
②	XRES	Reset	Terminal to initialize IC built-in logic; initializes with low level
③	$\overline{\text{XCS}}$	Chip Select	Slave select for SPI. This line is active low.
④	A0	Address	Terminal to input control signals of command/parameter Set low at time of command input and high level at the time of parameter input.
⑤	SCL	Serial Clock	Read command/parameter at time of SCL signal standing up
⑥	SI	Serial Data Input	Terminal to input command/parameter by SPI
⑦	VSS	Ground	
⑧	VAH	Drive Type Power Source	
⑨	SW1	Switch Terminal 1	N/O
⑩	SW2	Switch Terminal 2	N/O
⑪	SW3	Switch Terminal 3	N/O
⑫	SW_COM	Switch Common Terminal	



## SMARTSWITCH TYPICAL DIMENSIONS

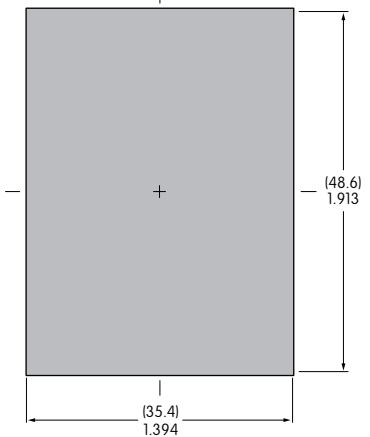


Pixel Detail

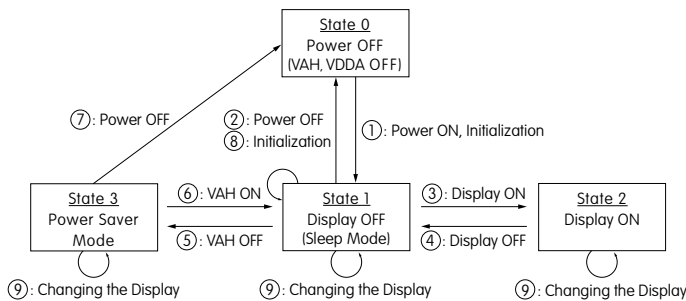
Terminal Connector Detail

### Panel Thickness Range

.039 ~ .157"  
(1.0mm ~ 4.0mm)

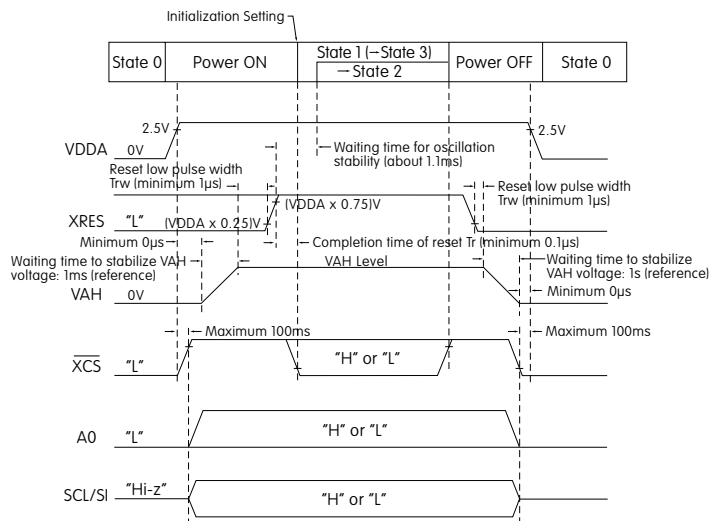


## STATE TRANSITION



State Number	State	Display	Sleep	VAH	VDDA	Changing the Display
0	Power OFF	OFF	—	OFF	OFF	Disable
1	Display OFF	OFF	ON	ON	ON	Enable
2	Display ON	ON	OFF	ON	ON	Enable
3	Power Saver	OFF	ON	OFF	ON	Enable

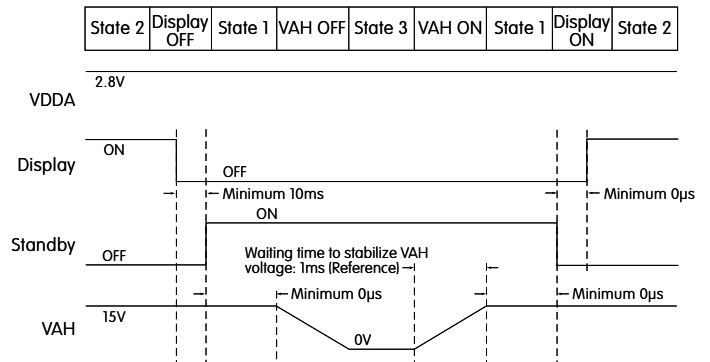
### Power ON/OFF Sequence



STATE TRANSITION (CONTINUED)

State Transition	Transition	Reference or Setting Procedure
①	Power ON	Refer to "Power ON/OFF Sequence" → Refer to "Initialization Setting"
②	Power OFF	Refer to "Power ON/OFF Sequence"
③	Display ON	Refer to "Display ON/OFF Sequence"
④	Display OFF	
⑤	VAH OFF	Wait until VAH becomes stable
⑥	VAH ON	
⑦	Power OFF	Refer to "Power ON/OFF Sequence"
⑧	Initialization	Refer to "Initialization Setting"
⑨	Display Change	Image Rewriting 96 x 64 Image Data Sending
		Display Settings Dimmer/Screen Saver/Indication 180° Reversal

Display ON/OFF Sequence



INITIALIZATION SETTING

Command Name	Command Address	Parameter (1 or 2Byte)	Remarks
Software Reset	01		
Dot Matrix Display ON/OFF	02	00	Note 1
Read/Write Operation Wetting	07	00	Note 1
Display Direction Set Command	09	00	Note 1
Reserved 1	10	03	Note 2
Reserved 2	12	63	Note 2
Reserved 3	13	00	Note 2
Dot Matrix Display Standby ON/OFF	14	00	
Reserved 4	16	00	Note 2
Reserved 5	17	00	Notes 1 & 2
Reserved 6	18	09	Note 2
Reserved 7	1A	04	Notes 1 & 2
Reserved 8	1C	00	Notes 1 & 2
Graphic Memory Writing Direction	1D	00	Note 1
Setting Column Output Range	30	005F	Note 1
Setting Row Output Range	32	003F	Note 1
X Axis Reading/Writing Start Point	34	00	Note 1
X Axis Reading/Writing End Point	35	0B	Note 1
Y Axis Reading/WritingStart Point	36	00	Note 1
Y Axis Reading/Writing End Point	37	3F	Note 1

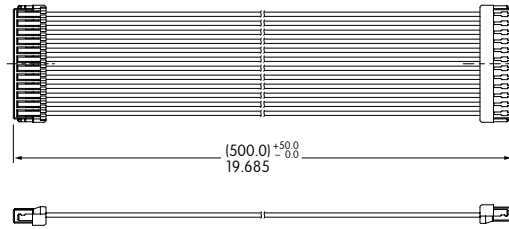
Notes: 1. Same as default value  
2. Do not change setting value

Command Name	Command Address	Parameter (1 or 2Byte)	Remarks
X Axis Reading Start Address	38	00	Note 1
Y Axis Reading Start Address	39	00	Note 1
Reserved 9	48	03	Note 2
Screen Saver Event Timer Setting Command	C3	00	Note 1
Screen Saver Event Timer Setting Command	C4	00	Note 1
One Time, Repeat or Direction Setting for Screen Saver	CC	00	Note 1
Start/Stop Setting for Screen Saver	CD	00	Note 1
System Clock Division Ratio Setting	D0	80	Note 2
Setting the STBY Pin	D2	00	Notes 1 & 2
DACA Setting	D4	00	Note 2
DACB Setting	D5	00	Note 2
DACC Setting	D6	00	Note 2
DACD Setting	D7	00	Note 2
Reserved 10	D9	00	Notes 1 & 2
Dimmer Setting	DB	0F	Note 1
Reserved 11	DD	88	Note 2
Image Writing	08	Image data	

Notes: 1. Same as default value  
2. Do not change setting value

## ACCESSORIES

### AT715 Cable for Connection



## PRECAUTIONS FOR HANDLING & STORAGE

### Handling



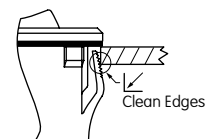
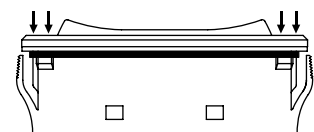
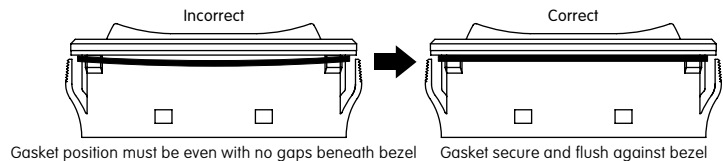
1. OLED devices are electrostatic sensitive.
2. Signal input under conditions not recommended may cause damage to the OLED unit or deterioration of the display. Follow directions regarding supply sequences of power and signal voltages.
3. If the OLED panel is broken, avoid touching the contents. Wash off in case of contact to the skin or clothing.
4. Limit operating force to 100.0N maximum, as excessive pressure may damage the display.
5. Under certain actuation conditions, one side of the rocker and the center switch can both send actuation signals.
6. Pixels acquire diminished brightness over time and use, and those most frequently habituated have greater reduction of brightness than those less used. To minimize this difference, operate OLED unit so that all pixels are used as consistently as possible.
7. Clean actuator 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 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.

### Panel Mounting

- Before snapping a switch into the panel, align the gasket evenly under the bezel of the switch.
- When mounting into a panel, apply equal pressure to sides of bezel and insert parallel to the panel.
- After mounting, be sure there are no gaps between switch and panel. Lightly push into panel.
- After installing into panel, do not apply excessive force.
- After panel installation and wiring is completed, do not apply force horizontally or vertically from behind panel.
- Behind the panel, cut area should be squared. If front of panel is painted, do not allow any paint to collect in corners of cutout to prevent level mounting.
- Avoid reinstalling a switch once it has been mounted into panel. This may cause deterioration of panel sealability.



## DISTINCTIVE CHARACTERISTICS

- Same outer dimensions of switch and footprint, enabling ease of replacement with current switches
- Programmable display graphics for alphanumeric characters and animated sequences
- 64 colors of backlighting can be controlled dynamically
- Pushbutton switch or display with LCD, RGB LED backlighting
- General brightness of backlight is dynamically controlled in eight steps from dark to bright
- Operated by commands and data supplied via serial communications (SPI)
- Incorporates bitmap display function
- Dual image VRAM for quick change of displayed images
- Travel options: Short travel of 1.8mm, or long travel of 4.5mm (same as KP01 Series)
- Low energy consumption
- Dust tight construction

Viewing area: 17.0mm x 13.0mm (horizontal x vertical)

High reliability and long life of one million (short travel) or three million (long travel) actuations

High resolution of 64 x 32 pixels

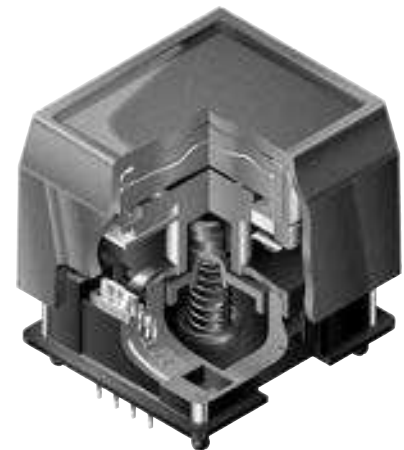
Epoxy sealed straight PC terminals

Snap-in standoff legs ensure secure mounting and alignment, and prevents dislodging during wave soldering.

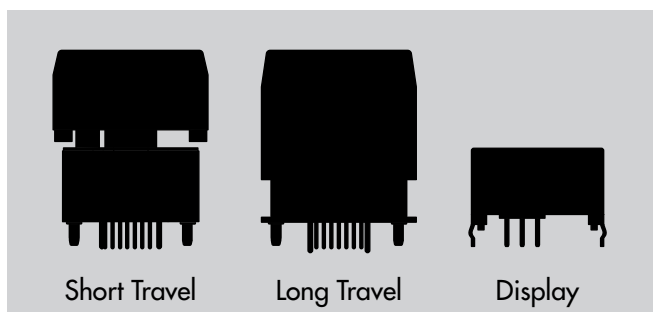
Viewing area: 14.4mm x 11.8mm (horizontal x vertical)

High resolution of 64 x 32 pixels

Bracket has crimped legs to ensure secure PC mounting and prevent dislodging during wave soldering



Actual Sizes of Switches & Display



# SmartSwitch™ NEW → Wide View/Short Travel LCD 64 x 32 Pushbutton



**IS15EBFP4RGB-09YN**  
**RGB LED Backlight**  
**Black and White LCD**  
**Short Travel**

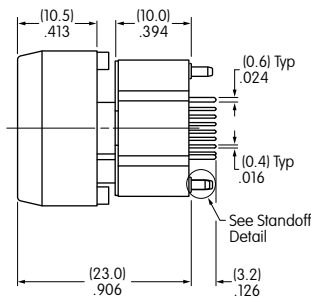
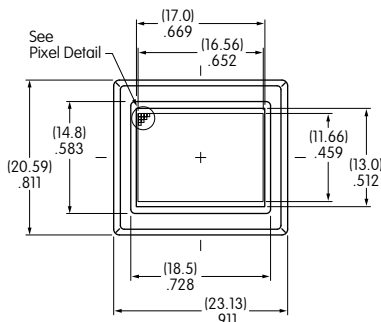
## SWITCH PART NUMBER & DESCRIPTION

Part Number	Switch Description	LCD Mode	LED Color
<b>IS15EBFP4RGB-09YN</b>	SPST Momentary ON Gold Contacts Straight PC Terminals	Black & White FSTN Positive	Red/Green/Blue

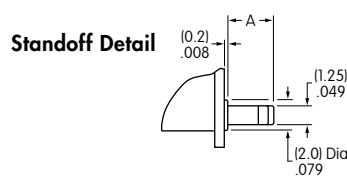
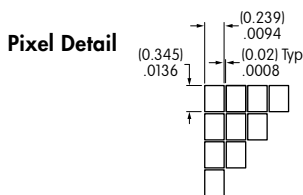
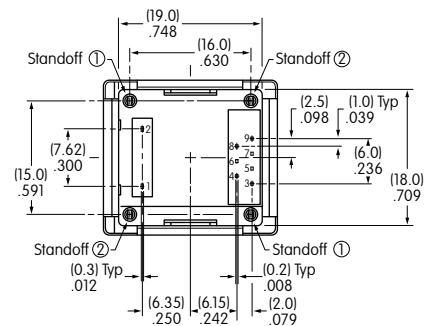
## SWITCH SPECIFICATIONS

<b>Circuit</b>	SPST normally open
<b>Electrical Capacity (Resistive Load)</b>	100mA @ 12V DC
<b>Contact Resistance</b>	200 milliohms maximum @ 20mV 10mA
<b>Insulation Resistance</b>	100 megohms minimum @ 100V DC
<b>Dielectric Strength</b>	125V AC for 1 minute minimum
<b>Mechanical Endurance</b>	1,000,000 operations minimum
<b>Electrical Endurance</b>	1,000,000 operations minimum
<b>Operating Force</b>	1.7 ± 0.5 Newtons
<b>Total Travel</b>	1.8mm (.071")

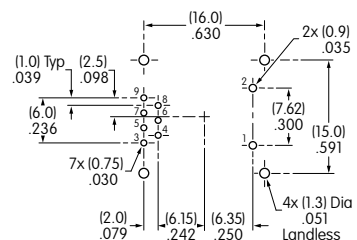
## TYPICAL SWITCH DIMENSIONS



Terminal numbers are not on the switch.



### Footprint



**Dimension A**  
 Standoff 1 = (2.7) .106  
 Standoff 2 = (2.3) .091

The Wide View Compact LCD 64 x 32 Pushbutton may utilize the same footprint as the Wide View/Short Travel LCD 64 x 32 Pushbutton.



**IS15EBFP4RGB**  
**RGB LED Backlight**  
**Black and White LCD**  
**Long Travel**

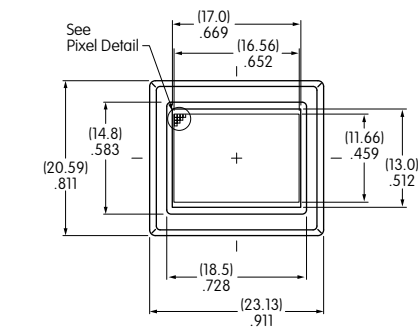
**SWITCH PART NUMBER & DESCRIPTION**

Part Number	Switch Description	LCD Mode	LED Color
<b>IS15EBFP4RGB</b>	SPST Momentary ON Gold Contacts Straight PC Terminals	Black & White FSTN Positive	Red/Green/Blue

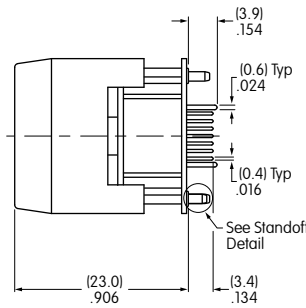
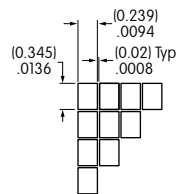
**SWITCH SPECIFICATIONS**

<b>Circuit</b>	SPST normally open
<b>Electrical Capacity (Resistive Load)</b>	100mA @ 12V DC
<b>Contact Resistance</b>	200 milliohms maximum @ 20mV 10mA
<b>Insulation Resistance</b>	100 megohms minimum @ 100V DC
<b>Dielectric Strength</b>	125V AC for 1 minute minimum
<b>Mechanical Endurance</b>	3,000,000 operations minimum
<b>Electrical Endurance</b>	3,000,000 operations minimum
<b>Operating Force</b>	2.0 ± 0.5 Newtons
<b>Total Travel</b>	4.5mm (.177")

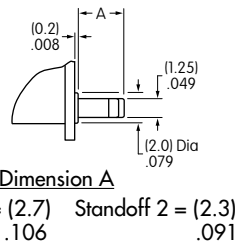
**TYPICAL SWITCH DIMENSIONS**



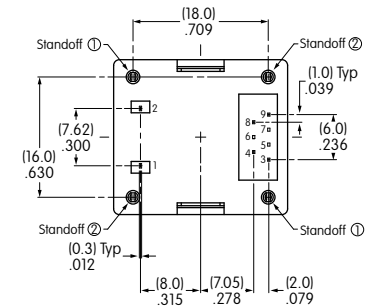
**Pixel Detail**



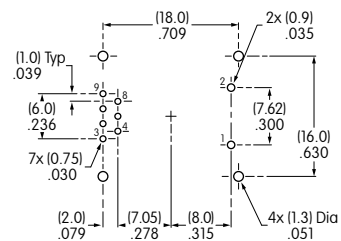
**Standoff Detail**



Terminal numbers are not on the switch.



**Footprint**



The following pages for Wide View LCD 64 x 32 Pushbuttons apply to the both Short Travel and Long Travel LCD 64 x 32 Pushbuttons.

## LCD SPECIFICATIONS

### Characteristics of Display

<b>Display Operation Mode</b>	FSTN positive; background colors, black & white
<b>Display Condition</b>	Transflective with built-in LED backlight
<b>Viewing Angle Direction</b>	6 o'clock
<b>Viewing Area</b>	17.0mm x 13.0mm (horizontal x vertical)
<b>Pixel Format</b>	64 x 32 pixels (horizontal x vertical)
<b>Pixel Size</b>	0.239mm x 0.345mm (horizontal x vertical)
<b>* Operating Temperature Range</b>	-15°C ~ +50°C (+5°F ~ +122°F)
<b>Storage Temperature Range</b>	-20°C ~ +60°C (-4°F ~ +140°F)
<b>Backlight LED</b>	<b>RGB:</b> red/green/blue

\* In a low temperature environment (below 0°C), speed and contrast decrease when image changes. The non-indicator dot may become dense in a high temperature environment (about +50°C). Highest backlight brightness level should not be used for temperatures above +35°C.

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

Items	Symbols	Ratings
<b>Supply Voltage</b>	$V_{DD}$	-0.3V to +7.0V
<b>Input Voltage</b>	$V_I$	-0.3V to $V_{DD} + 0.3V$
<b>Output Voltage</b>	$V_O$	-0.3V to $V_{DD} + 0.3V$

### Optical Characteristics (Temperature at 25°C)

Items	Symbols	Min	Typical	Max
<b>Contrast Ratio</b>	$C_r$	—	3.0	—
<b>Viewing Angle (Cr ≥ 1.1)</b>	Up & Down	$\theta$	—	90°
	Right & Left	$\phi$	—	90°

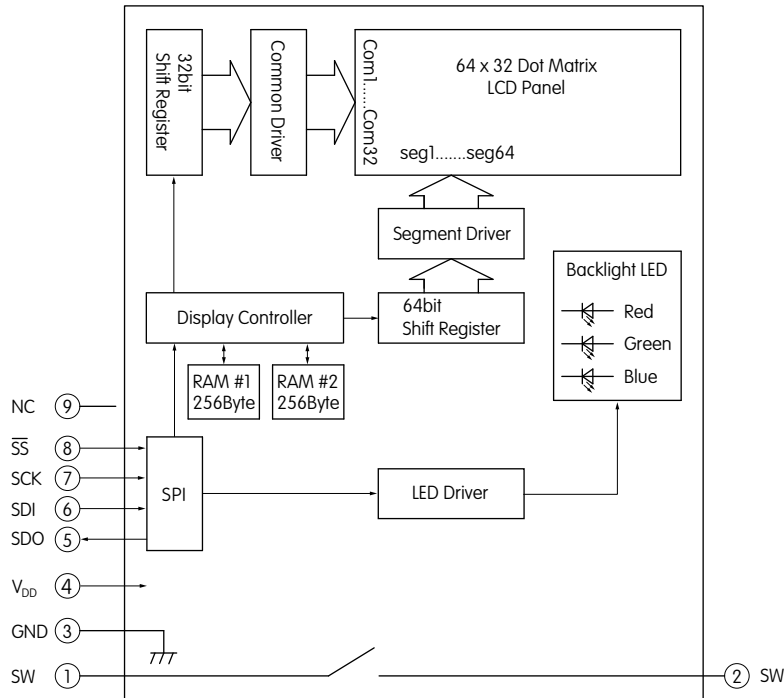
### Recommended Operating Conditions (Temperature at 25°C)

Items	Symbols	Minimum	Typical	Maximum
<b>Supply Voltage</b>	$V_{DD}$	4.9V	5.0V	5.1V
<b>High Level Input Voltage</b>	$V_{IH}$	0.8 $V_{DD}$	—	—
<b>Low Level Input Voltage</b>	$V_{IL}$	—	—	0.2 $V_{DD}$
<b>SPI Clock Frequency</b>	$f_{SCK}$	—	—	8MHz
<b>Current Consumption</b>	$I_{DD}$	** 10mA	—	*** 60mA

\*\* 10mA: Backlighting LED is off

\*\*\* 60mA: Backlighting LEDs (Red, Green, Blue) are maximum brightness

**SWITCH BLOCK DIAGRAM & PIN CONFIGURATIONS**



Pin No.	Symbol	Name	Function
①	SW	Terminal of Switch	Normally open
②	SW	Terminal of Switch	Normally open
③	GND	Ground	
④	V <sub>DD</sub>	Power	Power source for logic circuit and LCD
⑤	SDO	Data Out	Data output line for SPI
⑥	SDI	Data In	Data input line for SPI
⑦	SCK	Serial Clock	Clock line for SPI that synchronizes commands and data
⑧	SS	Slave Select	Chip select for SPI; line is active low
⑨	NC	None	No connection



## DISPLAY PART NUMBER & DESCRIPTION

Part Number	Terminals	LCD Mode	LED Color
<b>ISO1EBFRGB</b>	Straight PC	Black & White FSTN Positive	Red/Green/Blue

## LCD SPECIFICATIONS

### Characteristics of Display

<b>Display Operation Mode</b>	FSTN positive; background colors, black & white
<b>Display Condition</b>	Transflective with built-in LED backlight
<b>Viewing Angle Direction</b>	6 o'clock
<b>Viewing Area</b>	14.4mm x 11.8mm (horizontal x vertical)
<b>Pixel Format</b>	64 x 32 pixels (horizontal x vertical)
<b>Pixel Size</b>	0.200mm x 0.285mm (horizontal x vertical)
<b>* Operating Temperature Range</b>	-15°C ~ +50°C (+5°F ~ +122°F)
<b>Storage Temperature Range</b>	-20°C ~ +60°C (-4°F ~ +140°F)
<b>Backlight LED</b>	<b>RGB:</b> red/green/blue

\* In a low temperature environment (below 0°C), speed and contrast decrease when image changes. The non-indicator dot may become dense in a high temperature environment (about +50°C). Highest backlight brightness level should not be used for temperatures above +35°C.

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

Items	Symbols	Ratings
<b>Supply Voltage</b>	$V_{DD}$	-0.3V to +7.0V
<b>Input Voltage</b>	$V_I$	-0.3V to $V_{DD} + 0.3V$
<b>Output Voltage</b>	$V_O$	-0.3V to $V_{DD} + 0.3V$

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

Items	Symbols	Minimum	Typical	Maximum
<b>Supply Voltage</b>	$V_{DD}$	4.9V	5.0V	5.1V
<b>High Level Input Voltage</b>	$V_{IH}$	0.8 $V_{DD}$	—	—
<b>Low Level Input Voltage</b>	$V_{IL}$	—	—	0.2 $V_{DD}$
<b>SPI Clock Frequency</b>	$f_{SCK}$	—	—	8MHz
<b>Current Consumption</b>	$I_{DD}$	** 10mA	—	*** 60mA

\*\* 10mA: Backlighting LED is off

\*\*\* 60mA: Backlighting LEDs (Red, Green, Blue) are maximum brightness

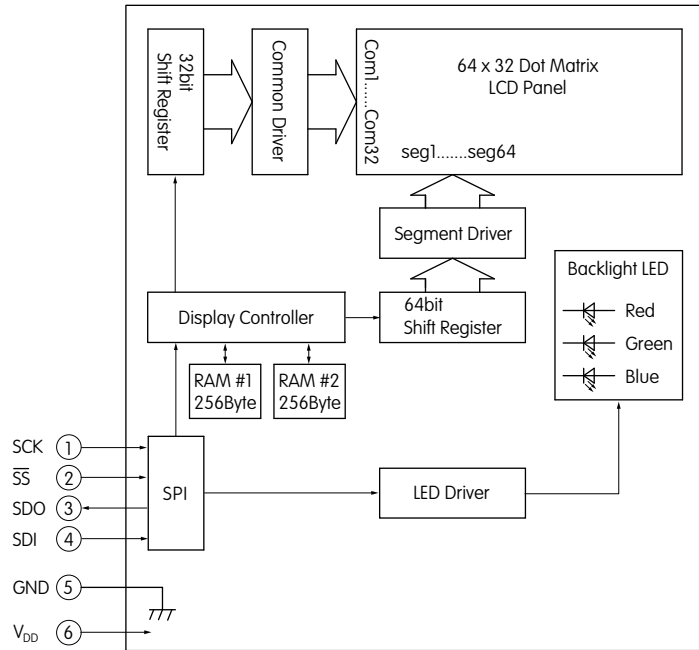
### Optical Characteristics (Temperature at 25°C)

Items	Symbols	Min	Typical	Max
<b>Contrast Ratio</b>	$Cr$	—	3.0	—
<b>Viewing Angle (Cr ≥ 1.1)</b>	Up & Down	$\theta$	—	90°
	Right & Left	$\phi$	—	90°

**DISPLAY BLOCK DIAGRAM & PIN CONFIGURATIONS**



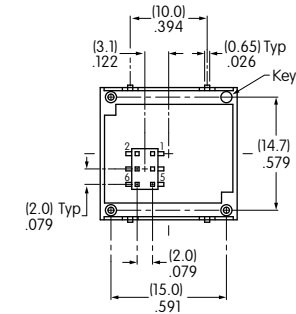
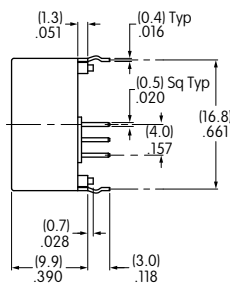
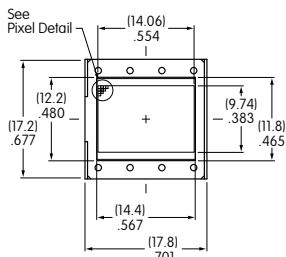
**IS01EBFRGB**  
RGB LED Backlight  
Black and White LCD



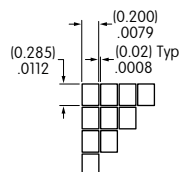
Pin No.	Symbol	Name	Function
①	SCK	Serial Clock	Clock line for SPI that synchronizes commands and data
②	$\overline{SS}$	Slave Select	Chip select for SPI; line is active low
③	SDO	Data Out	Data output line for SPI
④	SDI	Data In	Data input line for SPI
⑤	GND	Ground	
⑥	V <sub>DD</sub>	Power	Power source for logic circuit and LCD

**TYPICAL DISPLAY DIMENSIONS**

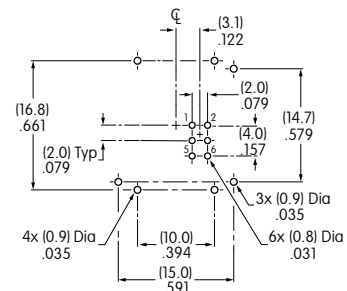
Terminal numbers are not on the device.



**Pixel Detail**



**Footprint**



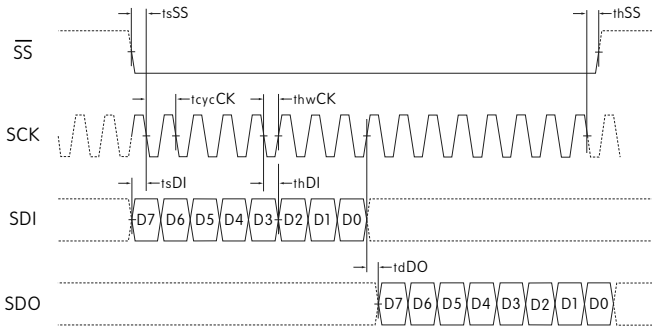
### TIMING SPECIFICATIONS FOR SWITCH & DISPLAY

#### SPI Characteristics (See Timing Diagram)

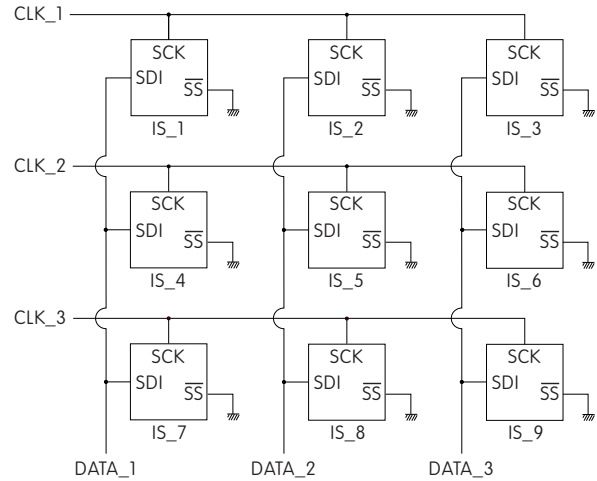
(Temperature at -15°C ~ +50°C and  $V_{DD} = 5.0V \pm 2\%$ )

Items	Symbols	Minimum	Maximum
SPI $\overline{SS}$ Set Up Time	$t_{sSS}$	10ns	
SPI $\overline{SS}$ Hold Time	$t_{hSS}$	10ns	
SPI_CLK Cycle	$t_{cycCK}$		8MHz
SPI_CLK Width	$t_{hwCK}$	10ns	
SPI_DI Set Up Time	$t_{sDI}$	10ns	
SPI_DI Hold Time	$t_{hDI}$	10ns	
SPI_DO Delay Time	$t_{dDO}$	10ns	

SPI Timing Chart ( $\overline{SS}$  Using)

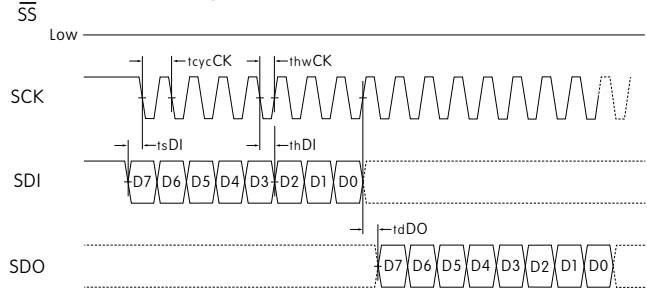


Circuit Example



It is recommended that all  $\overline{SS}$  pins be connected to a controller pin instead of ground. A clock glitch during power up could cause the communication to fall out of sync. Toggling the  $\overline{SS}$  line resets the communication.

SPI Timing Chart ( $\overline{SS}$  Low Level Fixed)



SDI and SCK shall be kept high when idle.

### BITMAP

Segment	1	2	3	4	5	6	7	8	9	...	16	...	49	...	56	...	57	58	59	60	61	62	63	64								
Common	Byte8								Byte7								Byte2								Byte1							
COM1	D0	D1	D2	D3	D4	D5	D6	D7	D0	...	D7	...	D0	...	D7	D0	D1	D2	D3	D4	D5	D6	D7									
COM2	Byte16																Byte9															
COM2	D0	D1	D2	D3	D4	D5	D6	D7																	D0	D1	D2	D3	D4	D5	D6	D7
•																																
•																																
•																																
COM32	Byte256								...								...								Byte249							
COM32	D0	D1	D2	D3	D4	D5	D6	D7																	D0	D1	D2	D3	D4	D5	D6	D7

#### Transferring Display Data/Displaying LCD Command and Data Sequence

Command	Data (256 Bytes)																															
0 x 55	Byte1								Byte2 ... Byte255																Byte256							
0 1 0 1 0 1 0 1	D7	D6	D5	D4	D3	D2	D1	D0	D7	D6	...	D1	D0	D7	D6	D5	D4	D3	D2	D1	D0											

**Notes:** Display RAM has two screen areas. The first area is for the display on the data to be displayed next. The screens are changed when the second area is fully stored.

**COMMANDS & DATA FOR SWITCH & DISPLAY**

- Transferring display data/displaying on LCD: command (1 Byte) + data (256 Bytes)
- Others: command (1 Byte) + data (1 Byte)
- Commands can be accepted only when all bits coincide; otherwise, they are not acknowledged
- Additional commands will not be received until the communication of commands (1 Byte) and data (256 or 1 Byte) is completed
- There is no time limit from the beginning to end of data receipt
- Commands may be executed consecutively (no need to wait between commands)
- Irregular commands or data are not recognized
- Initial status at power activation: LCD display off, LED off (brightness 1/20, color off)

**Transferring Display Data/Displaying on LCD**

Command		Data	Remarks
Hex	Binary		
0 x 55	01010101	256 Bytes (64 x 32 = 2,048 bits)	See previous page for details of bitmap data

**LED (Backlight) Color Set**

Command		Data	Remarks
Hex	Binary		
0 x 40	01000000	R R G G B B 1 1 2 bits x 3	For each of RGB: 00 = off                    10 = 1/2 01 = 1/4                    11 = full

**LED (Backlight) Brightness Set**

Command		Data	Remarks
Hex	Binary		
0 x 41	01000001	* * * 1 1 1 1 1 3 bits	For leading 3bits: 000 = 1/20 (dark)    100 = 1/3 001 = 1/10            101 = 1/2 010 = 1/7              110 = 2/3 011 = 1/5              111 = full (bright)

**Reset (Returning to Initial Status at Power Activation)**

Command		Data	Remarks
Hex	Binary		
0 x 5E	01011110	0000011	Returning to initial status at power activation

Toggles  
Rockers  
Pushbuttons  
Illuminated PB  
Programmable  
Keylocks  
Rotaries  
Slides  
Tactiles  
Tilt  
Touch  
Indicators  
Accessories  
Supplement

Toggles

Rockers

Pushbuttons

Illuminated PB

Programmable **E**

Keylocks

Rotaries

Slides

Tactiles

Tilt

Touch

Indicators

Accessories

Supplement

### DISTINCTIVE CHARACTERISTICS

#### Compact Size Combined with High Resolution

- High resolution of 64 x 32 pixels
- 64 colors of backlighting can be controlled dynamically
- Pushbutton switch with LCD, RGB LED backlighting
- General brightness of backlight is dynamically controlled in eight steps from dark to bright
- Operated by commands and data supplied via serial communications (SPI)
- Can display as many as four lines of text with ten characters each
- Incorporates bitmap display function
- Programmable display graphics for alphanumeric characters and animated sequences
- Dual image VRAM for quick change of displayed images
- Low energy consumption
- Dust tight construction

Viewing area: 14.5mm x 11.8mm (horizontal x vertical)

Variety of LED backlighting with 64 colors and 8 steps brightness

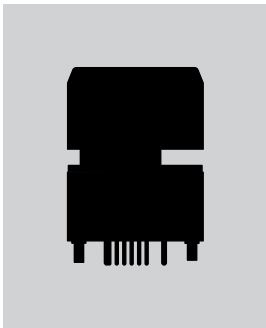
Dome gives crisp tactile feedback to positively indicate circuit transfer

Epoxy sealed straight PC terminals

Snap-in standoff for easy, secure mounting and alignment



Actual Size



### PART NUMBER & DESCRIPTION

Part Number	Switch Description	LCD Mode	LED Color
<b>IS15ESBFP4RGB</b>	SPST Momentary ON Gold Contacts Straight PC Terminals	Black & White FSTN Positive	Red/Green/Blue

**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	1.7 ± 0.5 Newtons
Total Travel	1.8mm (.071")

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

Items	Symbols	Ratings
Supply Voltage	V <sub>DD</sub>	-0.3V to +7.0V
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

**Optical Characteristics** (Temperature at 25°C)

Items	Symbols	Min	Typical	Max
Contrast Ratio	Cr	—	3.0	—
Viewing Angle (Cr ≥ 1.1)	Up & Down	θ	90°	—
	Right & Left	φ	90°	—

**LCD SPECIFICATIONS**

**Characteristics of Display**

Display Operation Mode	FSTN positive; background colors, black & white
Display Condition	Transflective with built-in LED backlight
Viewing Angle Direction	6 o'clock
Viewing Area	14.5mm x 11.8mm (horizontal x vertical)
Pixel Format	64 x 32 pixels (horizontal x vertical)
Pixel Size	0.200mm x 0.285mm (horizontal x vertical)
* Operating Temp Range	-15°C ~ +50°C (+5°F ~ +122°F)
Storage Temp Range	-20°C ~ +60°C (-4°F ~ +140°F)
Backlight LED	RGB: red/green/blue

\* In a low temperature environment (below 0°C), speed and contrast decrease when image changes. The non-indicator dot may become dense in a high temperature environment (about +50°C). Highest backlight brightness level should not be used for temperatures above +35°C.

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

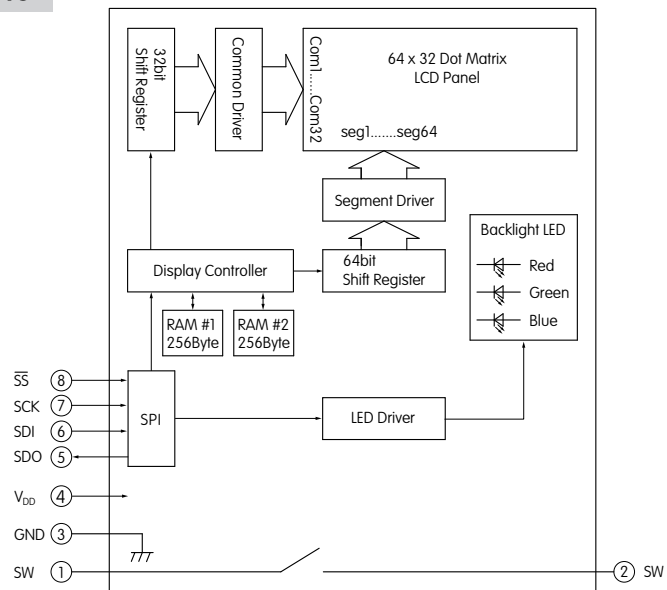
Items	Symbols	Min	Typical	Max
Supply Voltage	V <sub>DD</sub>	4.9V	5.0V	5.1V
High Level Input Voltage	V <sub>IH</sub>	0.8 V <sub>DD</sub>	—	—
Low Level Input Voltage	V <sub>IL</sub>	—	—	0.2V <sub>DD</sub>
SPI Clock Frequency	f <sub>SCK</sub>	—	—	8MHz
Current Consumption	I <sub>DD</sub>	** 10mA	—	*** 60mA

\*\* 10mA: Backlighting LED is off  
 \*\*\* 60mA: Backlighting LEDs (Red, Green, Blue) are maximum brightness

**BLOCK DIAGRAM & PIN CONFIGURATIONS**

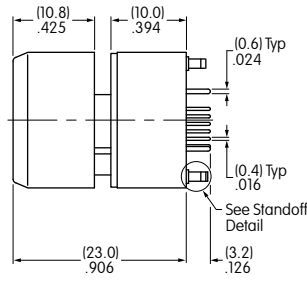
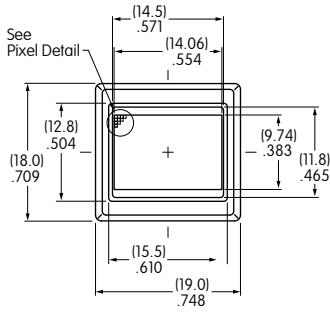


**IS15ESBFP4RGB**  
 RGB LED Backlight  
 Black and White LCD

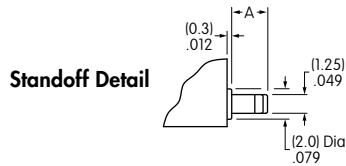
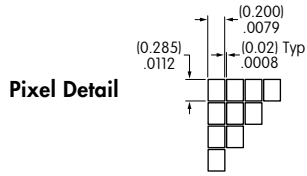
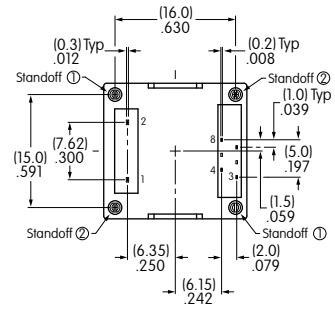


Pin No.	Symbol	Name	Function
①	SW	Terminal of Switch	Normally open
②	SW	Terminal of Switch	Normally open
③	GND	Ground	
④	V <sub>DD</sub>	Power	Power source for logic circuit and LCD
⑤	SDO	Data Out	Data output line for SPI
⑥	SDI	Data In	Data input line for SPI
⑦	SCK	Serial Clock	Clock line for SPI that synchronizes commands and data
⑧	$\bar{SS}$	Slave Select	Chip select for SPI; line is active low

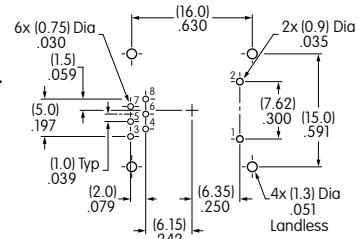
### TYPICAL SWITCH DIMENSIONS



Terminal numbers are not on the switch.



### Footprint



### Dimension A

Standoff 1 = (2.7) .106 Standoff 2 = (2.3) .091

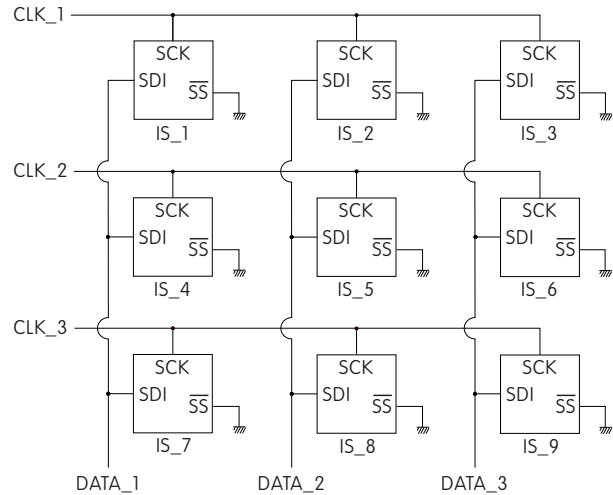
### TIMING SPECIFICATIONS

#### SPI Characteristics (See Timing Diagram)

(Temperature at -15°C ~ +50°C and V<sub>DD</sub> = 5.0V ± 2%)

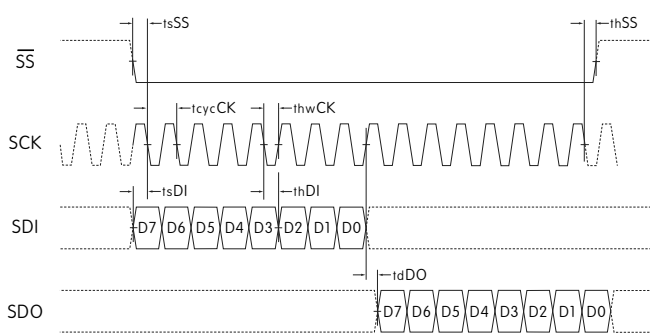
Items	Symbols	Minimum	Maximum
SPI $\overline{SS}$ Set Up Time	$t_{sSS}$	10ns	
SPI $\overline{SS}$ Hold Time	$t_{hSS}$	10ns	
SPI CLK Cycle	$t_{cycCK}$		8MHz
SPI CLK Width	$t_{hwCK}$	10ns	
SPI DI Set Up Time	$t_{sDI}$	10ns	
SPI DI Hold Time	$t_{hDI}$	10ns	
SPI DO Delay Time	$t_{dDO}$	10ns	

### Circuit Example

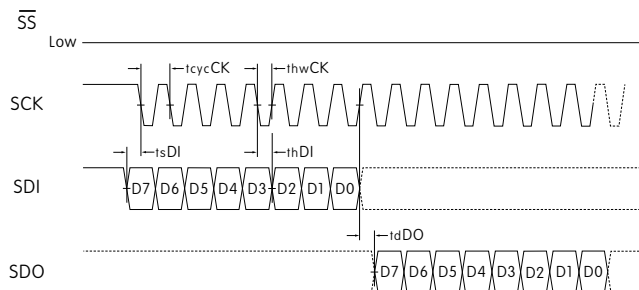


It is recommended that all  $\overline{SS}$  pins be connected to a controller pin instead of ground. A clock glitch during power up could cause the communication to fall out of sync. Toggling the  $\overline{SS}$  line resets the communication.

### SPI Timing Chart ( $\overline{SS}$ Using)



### SPI Timing Chart ( $\overline{SS}$ Low Level Fixed)



SDI and SCK shall be kept high when idle.





**PRECAUTIONS FOR HANDLING & STORAGE OF LCD 64 x 32 DEVICES****Handling**

1. The IS Series devices are electrostatic sensitive.
2. Limit operating force to keytop to 100.0N maximum, as excessive pressure may damage the LCD device.
3. The IS series devices are not process sealed.
4. If the LCD is accidentally broken, avoid contact with the liquid and wash off any liquid spills to the skin or clothing.
5. 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.
6. Recommended soldering time and temperature limits:  
Do not exceed 60°C at the LCD level.  
Wave Soldering: see Profile B in Supplement section.  
Manual Soldering for Switch: see Profile A in Supplement section.  
Manual Soldering for Display: see Profile B in Supplement section.
7. Excessive images may result after the same image is emitted continuously for an extended period of time.
8. The highest backlight brightness level should not be used for temperatures above +35°C.

**Storage**

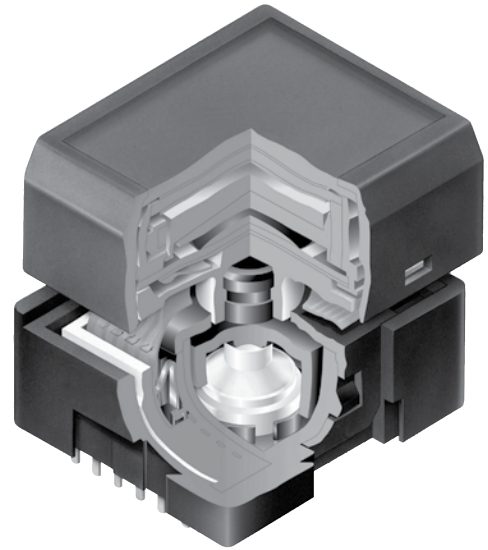
1. Store in original container and away from direct sunlight.
2. Keep away from static electricity.
3. Avoid extreme temperatures, high humidity, gaseous substances, and all forms of chemical contamination.

**DISTINCTIVE CHARACTERISTICS**

**Standard with Enhanced LED Illumination:**

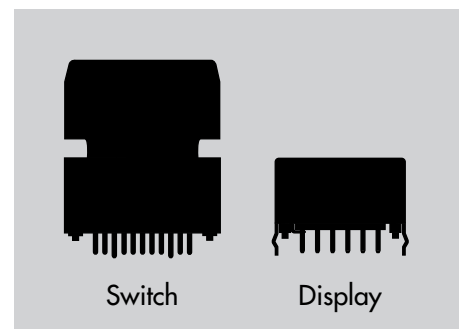
- Broad and even light diffusion
- Consistent backlighting
- Low energy consumption

- Programmable LCD
- Variety of LED Backlighting Colors
- Rubber Dome
- Epoxy Sealed Straight PC Terminals



RGB backlighting provides infinite color availability.  
 Programmable to display graphics, alphanumeric characters and animated sequences.  
 Integrated liquid crystal display provides wide viewing angle with high contrast and clarity.  
 Wider viewing area for switch 17.0mm x 13.0mm (horizontal x vertical) at 36 x 24 pixels;  
 Display viewing area 14.4mm x 11.8mm.  
 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.

Actual Sizes



**RGB LED BACKLIGHTING**

Part Number	Switch Description	LCD Mode	LED Color
<b>IS15BBFP4RGB</b>	SPST Momentary ON Gold Contacts Straight PC Terminals	Black & White FSTN Positive	* Red/Green/Blue

\* Simultaneous RGB illumination achieves infinite colors.

Toggle  
 Rockers  
 Pushbuttons  
 Illuminated PB  
 Programmable  
 Keylocks  
 Rotaries  
 Slides  
 Tactiles  
 Tilt  
 Touch  
 Indicators  
 Accessories  
 Supplement

## SWITCH SPECIFICATIONS

Circuit	SPST normally open
Electrical Capacity (Resistive Load)	100mA @ 12V DC
Contact Resistance	200 milliohms max @ 20mV 10mA
Insulation Resistance	100 megohms min @ 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 Temp. Range	-20°C ~ +60°C (-4°F ~ +140°F)
Storage Temp. Range	-30°C ~ +70°C (-22 °F ~ +158°F)

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

Items	Symbols	Ratings
Supply Voltage for Logics	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

### DC Characteristics of LCD Drive (Temperature at -20°C to +60°C and V<sub>DD</sub> = 5.0V ±10%)

Items	Symbols	Test Conditions	Minimum	Typical	Maximum	Unit
High Level Input Voltage	V <sub>IH</sub>		0.7V <sub>DD</sub>		V <sub>DD</sub>	V
Low Level Input Voltage	V <sub>IL</sub>		0		0.3V <sub>DD</sub>	V
High Level Input Leakage Current	I <sub>IH</sub>	V <sub>I</sub> = V <sub>DD</sub>			10	μA
Low Level Input Leakage Current	I <sub>IL</sub>	V <sub>I</sub> = 0V			-10	μA
High Level Output Voltage	V <sub>OH</sub>	I <sub>OH</sub> = -500μA	V <sub>DD</sub> -0.5			V
Low Level Output Voltage	V <sub>OL</sub>	I <sub>OL</sub> = 500μA			0.5	V
High Level Output Leakage Current	I <sub>LOH</sub>	V <sub>O</sub> = V <sub>DD</sub>			10	μA
Low Level Output Leakage Current	I <sub>LOL</sub>	V <sub>O</sub> = 0V			-10	μA
Supply Current	I <sub>DD</sub>	f <sub>SCP</sub> = 1.0MHz			500	μA
LCD Drive Current	I <sub>LC</sub>	f <sub>LP</sub> = 2.4kHz V <sub>LC</sub> = 7.3V		500	2,000	μA

### Timing Characteristics of LCD Drive IC

(Temperature at -20°C to +60°C and V<sub>DD</sub> = 5.0V ±10%)

Items	Symbols	Minimum	Maximum
Clock Operation Frequency	f <sub>SCP</sub>		6.0MHz
Latch Pulse Frequency	f <sub>LP</sub>		50kHz
Clock High Level Pulse Width	t <sub>CWH</sub>	70ns	
Clock Low Level Pulse Width	t <sub>CWL</sub>	70ns	
Data Setup Time	t <sub>DSD</sub>	45ns	
Data Hold Time	t <sub>DHD</sub>	50ns	
Data Output Delay Time	t <sub>PDO</sub>		25ns
Latch Setup Time	t <sub>DSL</sub>	50ns	
Latch Hold Time	t <sub>DHL</sub>	50ns	
Latch High Level Width	t <sub>LWH</sub>	200ns	
FLM Setup Time	t <sub>DSF</sub>	50ns	
FLM Hold Time	t <sub>DHF</sub>	50ns	
SCP, LP Rise/Fall Time	t <sub>r</sub> /t <sub>f</sub>		15ns

## LCD SPECIFICATIONS

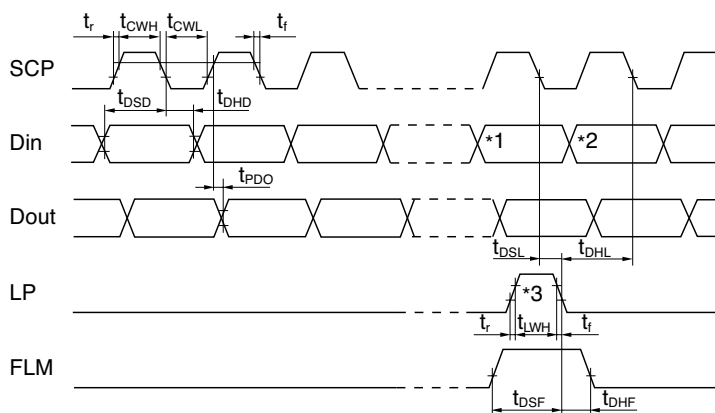
### Characteristics of Display

Display Operation Mode	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	17.0mm x 13.0mm (horizontal x vertical)
Pixel Format	36 x 24 pixels (horizontal x vertical)
Pixel Size	0.440mm x 0.495mm (horizontal x vertical)
Backlight LED	RGB: red/green/blue

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

Items	Symbols	Minimum	Typical	Maximum
Supply Voltage for Logics	V <sub>DD</sub>	4.5V	5.0V	5.5V
Supply Voltage Black/White	V <sub>LC</sub>	7.1V	7.3V	7.5V
Input Voltage	V <sub>I</sub>	0V	—	V <sub>DD</sub>
Driving Frequency	f <sub>FLM</sub>	—	150Hz: black/white	—

### Timing Diagram

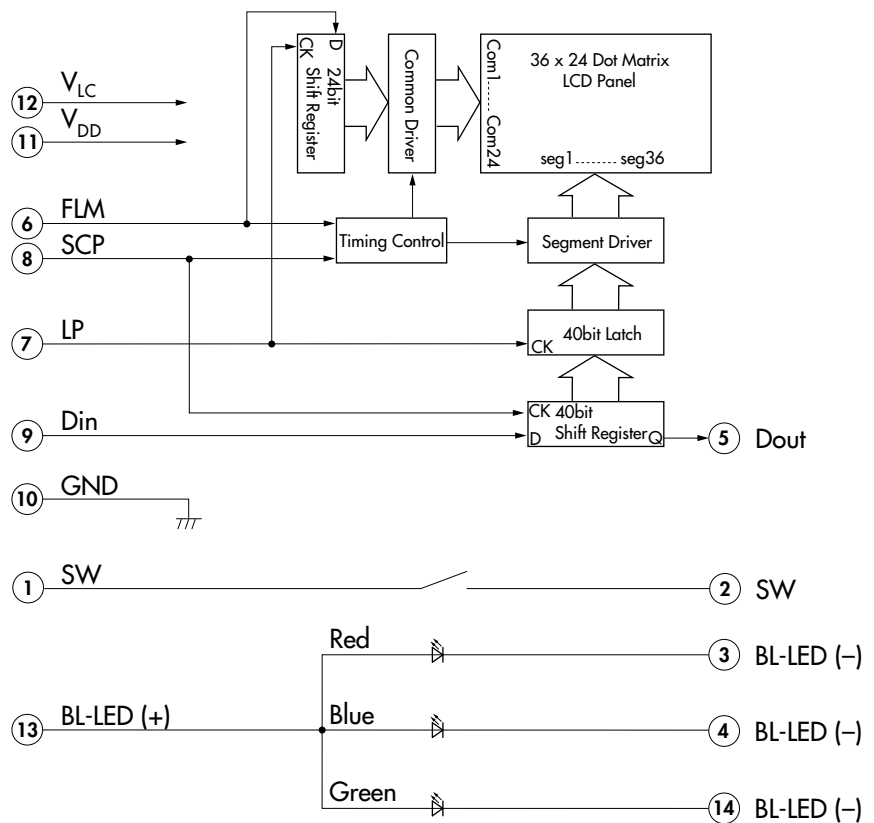


- \*1 Last data on first line
- \*2 Beginning data on second line
- \*3 Location of LP signal on first line

**BLOCK DIAGRAM & PIN CONFIGURATIONS FOR RGB LEDs**



**IS15BBFP4RGB**  
RGB LED Backlight  
Black and White LCD



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 for red
④	BL-LED (-)	Terminal of Backlight LED	Cathode for blue
⑤	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.
⑥	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).
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	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.
⑨	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.
⑩	GND	Ground	
⑪	V <sub>DD</sub>	Power	Power source for logic circuit
⑫	V <sub>LC</sub>	Power	Power source for LCD drive
⑬	BL-LED (+)	Terminal of Backlight LED	Anode for common
⑭	BL-LED (-)	Terminal of Backlight LED	Cathode for green

### 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

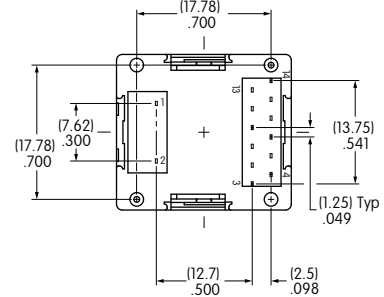
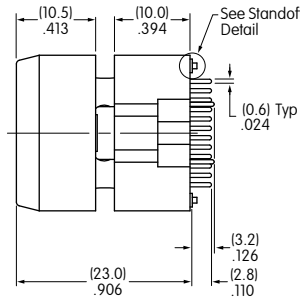
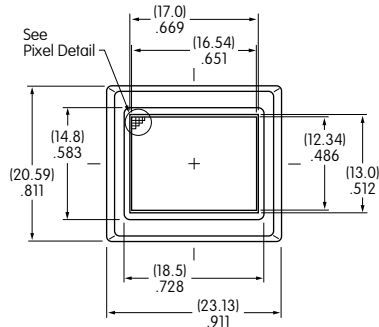
### ABSOLUTE MAXIMUM FOR RGB LED

#### Electrical Characteristics (Temperature at 25°C)

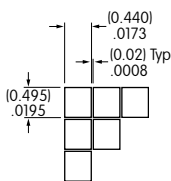
Backlight Color	Symbols	Red	Green	Blue	Unit
Forward Current	$I_F$	20	20	20	mA
Forward Voltage	$V_F$	2.0 ( $I_F = 10\text{mA}$ )	2.8 ( $I_F = 8.5\text{mA}$ )	2.8 ( $I_F = 8.0\text{mA}$ )	V
Reverse Voltage	$V_R$	4.0	4.0	4.0	V
Current Reduction Rate Above 25°C	$\Delta I_F(\text{DC})$	-0.33	-0.33	-0.33	mA/°C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

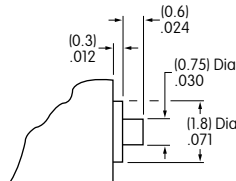
### TYPICAL SWITCH DIMENSIONS WITH RGB LED



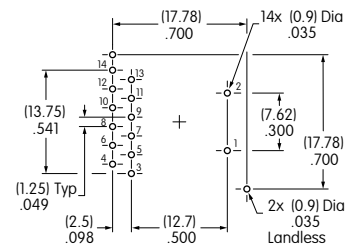
Terminal numbers are not on the switch.



Pixel Detail



Standoff Detail



Footprint

Toggles  
Rockers  
Pushbuttons  
Illuminated PB  
Programmable  
Keylocks  
Rotaries  
Slides  
Tactiles  
Tilt  
Touch  
Indicators  
Accessories  
Supplement

**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.



**RGB LED BACKLIGHTING**

Part Number	Terminals	LCD Mode	LED Color
<b>ISO1BBFRGB</b>	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 <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>	4.5V	5.0V	5.5V
Supply Voltage LCD	V <sub>LC</sub>	7.1V	7.3V	7.5V
Input Voltage	V <sub>I</sub>	0V	—	V <sub>DD</sub>
Driving Frequency	f <sub>FLM</sub>	—	150Hz	—

**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°C to +60°C and  $V_{DD} = 5.0V \pm 10\%$ )

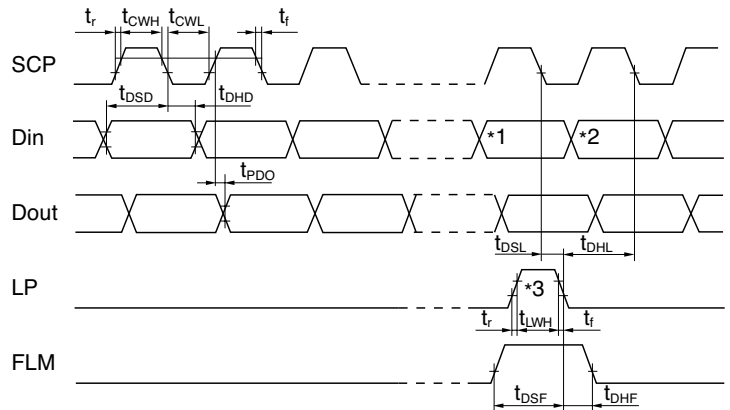
Items	Symbols	Test Conditions	Minimum	Typical	Maximum	Unit
High Level Input Voltage	$V_{IH}$		$0.7V_{DD}$		$V_{DD}$	V
Low Level Input Voltage	$V_{IL}$		0		$0.3V_{DD}$	V
High Level Input Leakage Current	$I_{LIH}$	$V_I = V_{DD}$			10	$\mu A$
Low Level Input Leakage Current	$I_{LIL}$	$V_I = 0V$			-10	$\mu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

### Timing Characteristics of LCD Drive IC

(Temperature at -20°C to +60°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

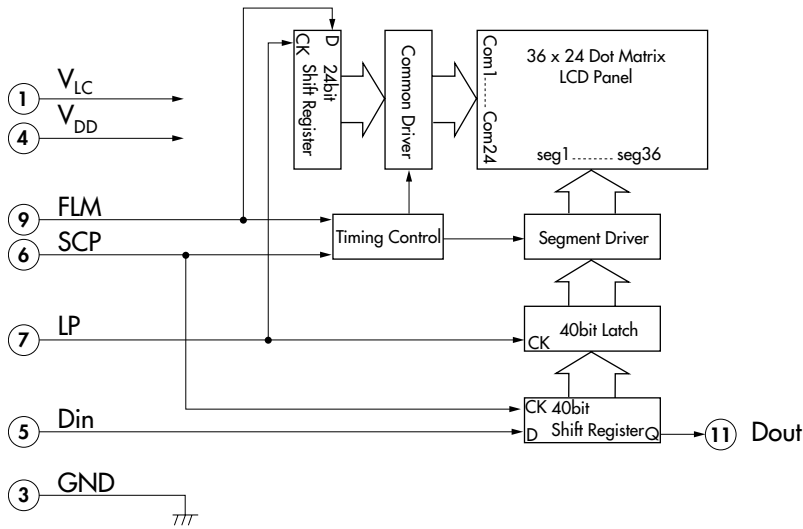


- \*1 Last data on first line
- \*2 Beginning data on second line
- \*3 Location of LP signal on first line

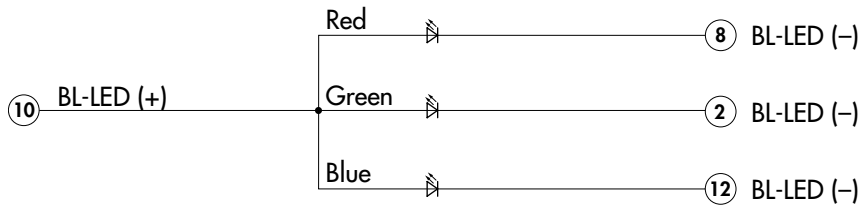
### Display Electrical Characteristics

Items		Symbols	Test Condition	Minimum	Typical	Maximum	
LCD	Supply Voltage	Logic Circuit	$V_{DD}$	4.5	5.0	5.5	
		LCD Circuit	$V_{LC}$	7.1	7.3	7.5	
	Input Voltage	H	$V_{IH}$	$0.7V_{DD}$	—	$V_{DD}$	
		L	$V_{IL}$	0	—	$0.3V_{DD}$	
	Output Voltage	H	$V_{OH}$	$D_{OUT}, I_{OH} = 500 \mu A$	$V_{DD}-0.5$	—	—
		L	$V_{OL}$	$D_{OUT}, I_{OL} = 500 \mu A$	—	—	0.5
Power	Logic Circuit	$I_{DD}$	$f_{SCP} = 1.0MHz$	—	—	500	
	LCD Circuit	$I_{LC}$	$f_{LP} = 2.4kHz$ $V_{LC} = 7.3V$	—	500	2,000	
Items		Symbols	Test Condition	Red/Green/Blue			
LED	Forward Current	$I_F$		Red	Green	Blue	
				10mA	8.5mA	8mA	
	Forward Voltage	$V_F$	$I_F = \text{Forward Current}$ $T_a = 25^\circ C$	Red	Green	Blue	
				2.0V	2.8V	2.8V	
Current Reduction Rate	$\Delta I_F(DC)$	$T_a = 25^\circ C \text{ above}$	-0.33mA/°C				

**BLOCK DIAGRAM & 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

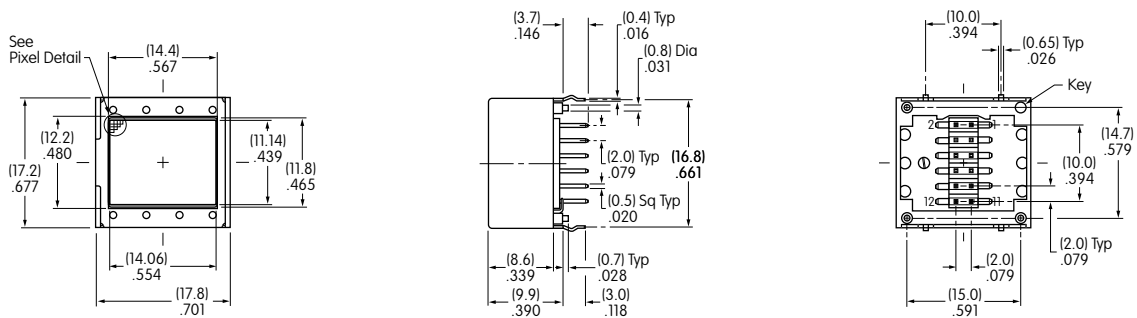
## ABSOLUTE MAXIMUM FOR RGB LED

### Electrical Characteristics (Temperature at 25°C)

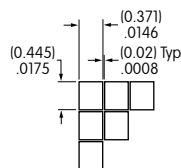
Backlight Color	Symbols	Red	Green	Blue	Unit
Forward Current	$I_F$	20	20	20	mA
Forward Voltage	$V_F$	2.0 ( $I_F = 10\text{mA}$ )	2.8 ( $I_F = 8.5\text{mA}$ )	2.8 ( $I_F = 8.0\text{mA}$ )	V
Reverse Voltage	$V_R$	4.0	4.0	4.0	V
Current Reduction Rate Above 25°C	$\Delta I_F(\text{DC})$	-0.33	-0.33	-0.33	mA/°C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

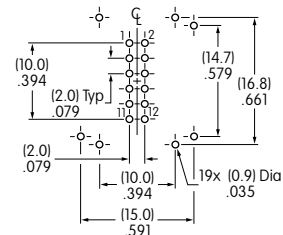
## TYPICAL DISPLAY DIMENSIONS WITH RGB LED



Terminal numbers are not on the device.



Pixel Detail



Footprint

**DISTINCTIVE CHARACTERISTICS**

**Compact Size**

- Perfect for rack mount router and other applications with space limitations.  
 Compact body size: 19.0mm (.748") x 18.0mm (.709") compared to  
 Standard body size: 23.13mm (.911") x 20.59mm (.811")
- Vibrant Illumination
- Low Energy Consumption

Programmable LCD

Variety of LED Backlighting Colors

Rubber Dome

Epoxy Sealed Straight PC Terminals

Snap-in standoff for easy, secure mounting and alignment



Programmable to display graphics, alphanumeric characters and animated sequences.

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

Viewing area 14.5mm x 11.8mm (horizontal x vertical) at 36 x 24 pixels.

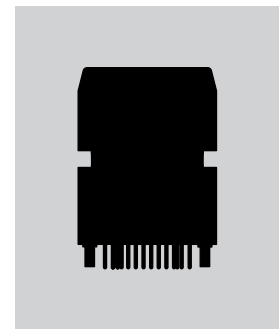
Dome gives crisp tactile feedback to positively indicate circuit transfer.

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 simplify production process.

Actual Size



**PART NUMBER & DESCRIPTION**

Part Number	Switch Description	LCD Mode	LED Color
<b>IS15BSBFP4RGB</b>	SPST Momentary ON Gold Contacts Straight PC Terminals	Black & White FSTN Positive	* Red/Green/Blue RGB

\* Simultaneous RGB illumination achieves infinite colors.  
 Note: Contact factory for additional options.

### 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")

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

Items	Symbols	Ratings
Supply Voltage for Logics	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

### Optical Characteristics (Temperature at 25°C)

Items	Symbols	Min	Typical	Max
Contrast Ratio	Cr	—	3.0	—
Viewing Angle (Cr ≥ 1.1)	Up & Down	θ	90°	—
	Right & Left	φ	90°	—

### DC Characteristics of LCD Drive IC (Temperature at -20°C to +60°C and V<sub>DD</sub> = 5V ±10%)

Items	Symbols	Test Conditions	Minimum	Typical	Maximum	Unit
High Level Input Voltage	V <sub>IH</sub>		0.7 V <sub>DD</sub>		V <sub>DD</sub>	V
Low Level Input Voltage	V <sub>IL</sub>		0		0.3 V <sub>DD</sub>	V
High Level Input Leakage Current	I <sub>LIH</sub>	V <sub>I</sub> = V <sub>DD</sub>			10	μA
Low Level Input Leakage Current	I <sub>LIL</sub>	V <sub>I</sub> = 0V			10	μA
High Level Output Voltage	V <sub>OH</sub>	I <sub>OH</sub> = -500μA	V <sub>DD</sub> -0.5			V
Low Level Output Voltage	V <sub>OL</sub>	I <sub>OL</sub> = 500μA			0.5	V
High Level Output Leakage Current	I <sub>LOH</sub>	V <sub>O</sub> = V <sub>DD</sub>			10	μA
Low Level Output Leakage Current	I <sub>LOL</sub>	V <sub>O</sub> = 0V			10	μA
Supply Current	I <sub>DD</sub>	f <sub>SCP</sub> = 1.0MHz			500	μA
LCD Drive Current	I <sub>LC</sub>	f <sub>LP</sub> = 2.4kHz V <sub>LC</sub> = 7.3V		500	2,000	μA

### Timing Characteristics of LCD Drive IC

(Temperature at -20°C to +60°C and V<sub>DD</sub> = 5.0V ±10%)

Items	Symbols	Minimum	Maximum
Clock Operation Frequency	f <sub>SCP</sub>		6.0MHz
Latch Pulse Frequency	f <sub>LP</sub>		50kHz
Clock High Level Pulse Width	t <sub>CWH</sub>	70ns	
Clock Low Level Pulse Width	t <sub>CWL</sub>	70ns	
Data Setup Time	t <sub>DSD</sub>	45ns	
Data Hold Time	t <sub>DHD</sub>	50ns	
Data Output Delay Time	t <sub>PDO</sub>		25ns
Latch Setup Time	t <sub>DSL</sub>	50ns	
Latch Hold Time	t <sub>DHL</sub>	50ns	
Latch High Level Width	t <sub>LWH</sub>	200ns	
FLM Setup Time	t <sub>DSF</sub>	50ns	
FLM Hold Time	t <sub>DHF</sub>	50ns	
SCP, LP Rise/Fall Time	t <sub>r</sub> /t <sub>f</sub>		15ns

### LCD SPECIFICATIONS

#### Characteristics of Display

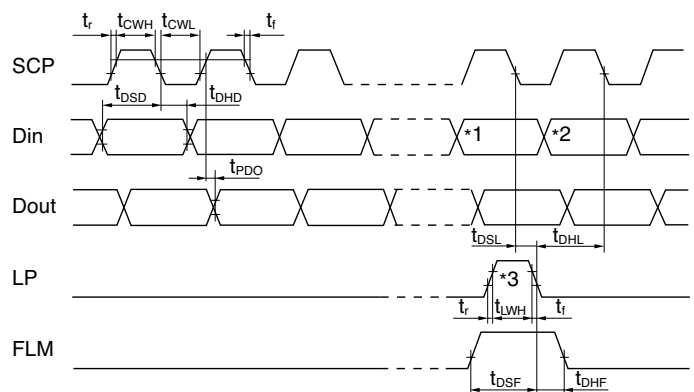
Display Operation Mode	FSTN positive
Display Condition	Transflective with built-in LED backlight
Viewing Angle Direction	6 o'clock
Driving Method	1/24 duty, 1/5 bias (built-in driving circuit)
Viewing Area	14.5mm x 11.8mm (horizontal x vertical)
Pixel Format	36 x 24 pixels (horizontal x vertical)
Pixel Size	0.371mm x 0.445mm (horizontal x vertical)
* Operating Temperature Range	-20°C ~ +60°C (-4°F ~ +140°F)
Storage Temperature Range	-30°C ~ +70°C (-22°F ~ +158°F)
Backlight LED	RGB: red/green/blue

\* In a low temperature environment (below 0°C), speed and contrast decrease when image changes. The non-indicator dot may become dense in a high temperature environment (about +50°C).

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

Items	Symbols	Minimum	Typical	Maximum
Supply Voltage for Logics	V <sub>DD</sub>	4.5V	5.0V	5.5V
Supply Voltage	V <sub>LC</sub>	7.1	7.3V	7.5
Input Voltage	V <sub>I</sub>	0V	—	V <sub>DD</sub>
Driving Frequency	f <sub>FELM</sub>	—	150Hz	—
Clock Operation Frequency	f <sub>SCP</sub>	—	—	6.0MHz

### Timing Diagram

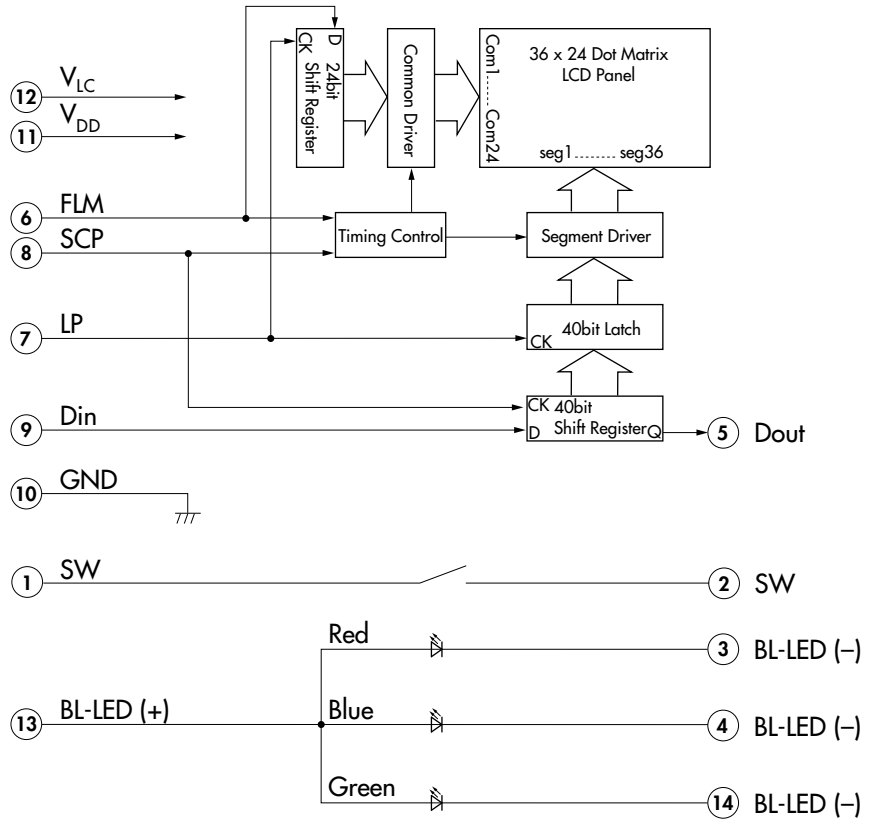


- \*1 Last data on first line
- \*2 Beginning data on second line
- \*3 Location of LP signal on first line

**BLOCK DIAGRAM & PIN CONFIGURATIONS**



**IS15BSBFP4RGB**  
RGB LED Backlight  
Black and White LCD



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 for red
④	BL-LED (-)	Terminal of Backlight LED	Cathode for blue
⑤	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.
⑥	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).
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	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.
⑨	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.
⑩	GND	Ground	
⑪	V <sub>DD</sub>	Power	Power source for logic circuit
⑫	V <sub>LC</sub>	Power	Power source for LCD drive
⑬	BL-LED (+)	Terminal of Backlight LED	Anode for common
⑭	BL-LED (-)	Terminal of Backlight LED	Cathode for green

### RGB LED CHARACTERISTICS

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

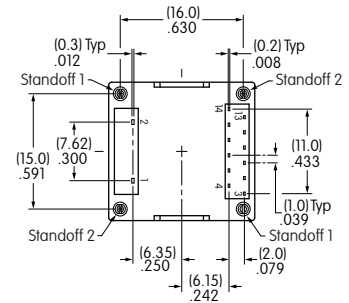
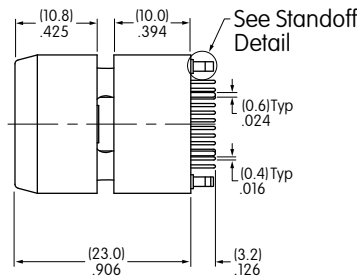
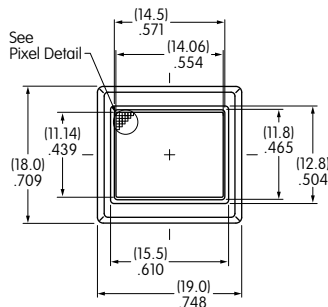
### ABSOLUTE MAXIMUM FOR LEDs

Electrical Characteristics (Temperature at 25°C)

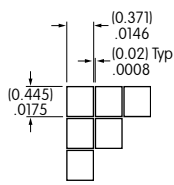
Backlight Color	Symbols	Red	Green	Blue	Unit
Forward Current	$I_F$	20	20	20	mA
Forward Voltage	$V_F$	2.0 ( $I_F = 10\text{mA}$ )	2.8 ( $I_F = 8.5\text{mA}$ )	2.8 ( $I_F = 8.0\text{mA}$ )	V
Reverse Voltage	$V_R$	4.0	4.0	4.0	V
Current Reduction Rate Above 25°C	$\Delta I_F(\text{DC})$	-0.33	-0.33	-0.33	mA/°C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

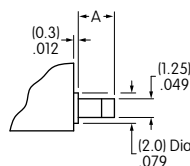
### TYPICAL SWITCH DIMENSIONS



Terminal numbers are not on the switch.



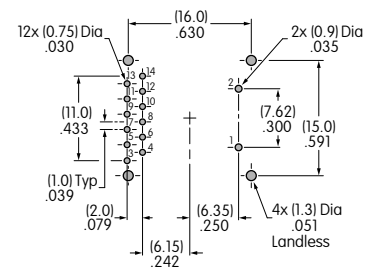
Pixel Detail



Standoff Detail

Dimension A

Standoff 1 = (2.7) .106 Standoff 2 = (2.3) .091



Footprint

## PRECAUTIONS FOR HANDLING & STORAGE OF LCD 36 x 24 DEVICES

### Handling



1. The IS Series devices are electrostatic sensitive.
2. Limit operating force to keytop to 100.0N maximum, as excessive pressure may damage the LCD device.
3. The IS series devices are not process sealed.
4. If the LCD is accidentally broken, avoid contact with the liquid and wash off any liquid spills to the skin or clothing.
5. 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.
6. 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 for Switch: see Profile A in the Supplement section.  
Manual Soldering for Display: see Profile B in the Supplement section.
7. 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.
8. 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.
9. Backlight Forward Current should not exceed the derated Absolute Maximum Forward Current based on the temperature.
10. 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.

### DISTINCTIVE CHARACTERISTICS

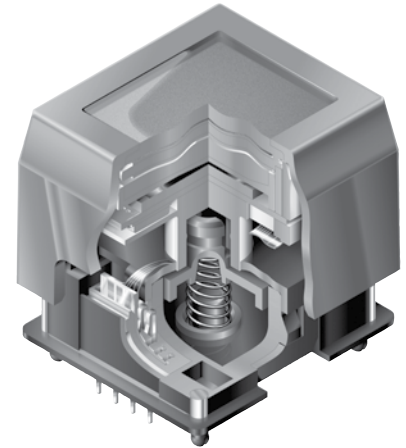
- High resolution of 64 x 32 pixels
- 64 colors of backlighting can be controlled dynamically
- Pushbutton switch or display with LCD, RGB LED backlighting
- General brightness of backlight is dynamically controlled in eight steps from dark to bright
- Operated by commands and data supplied via serial communications (SPI)
- Can display as many as four lines of text with ten characters each
- Incorporates bitmap display function
- Programmable display graphics for alphanumeric characters and animated sequences
- Dual image VRAM for quick change of displayed images
- Distinct, long travel of 4.5mm (same as KP01 Series)
- Low energy consumption
- Dust tight construction

Viewing area: 15.0mm x 10.8mm (horizontal x vertical)

High reliability and long life of three million actuations minimum

Epoxy sealed straight PC terminals

Snap-in standoff for easy, secure mounting and alignment

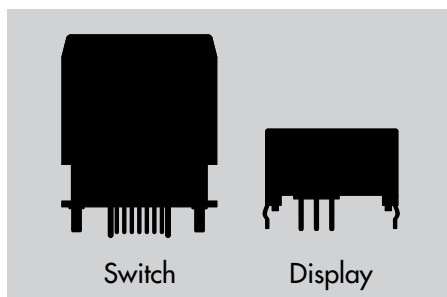


Viewing area: 13.9mm x 10.6mm (horizontal x vertical)

Bracket has crimped legs to ensure secure PC mounting and prevent dislodging during wave soldering



Actual Sizes



**SWITCH PART NUMBER & DESCRIPTION**

Part Number	Switch Description	LCD Mode	LED Color
<b>IS15DBFP4RGB</b>	SPST Momentary ON Gold Contacts Straight PC Terminals	Black & White FSTN Positive	Red/Green/Blue

**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	3,000,000 operations minimum
Electrical Endurance	3,000,000 operations minimum
Operating Force	2.0 ± 0.5 Newtons
Total Travel	4.5mm (.177")

**LCD SPECIFICATIONS**

**Characteristics of Display**

Display Operation Mode	FSTN positive; background colors, black & white
Display Condition	Transflective with built-in LED backlight
Viewing Angle Direction	6 o'clock
Viewing Area	15.0mm x 10.8mm (horizontal x vertical)
Pixel Format	64 x 32 pixels (horizontal x vertical)
Pixel Size	0.20mm x 0.27mm (horizontal x vertical)
*Operating Temperature Range	-15°C ~ +50°C (+5°F ~ +122°F)
Storage Temperature Range	-20°C ~ +60°C (-4°F ~ +140°F)
Backlight LED	<b>RGB:</b> red/green/blue

\* In a low temperature environment (below 0°C), speed and contrast decrease when image changes. The non-indicator dot may become dense in a high temperature environment (about +50°C). Highest backlight brightness level should not be used for temperatures above +35°C.

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

Items	Symbols	Ratings
Supply Voltage	V <sub>DD</sub>	-0.3V to +7.0V
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

**Optical Characteristics** (Temperature at 25°C)

Items	Symbols	Min	Typical	Max
Contrast Ratio	Cr	—	3.0	—
Viewing Angle (Cr ≥ 1.1)	Up & Down	θ	90°	—
	Right & Left	φ	90°	—

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

Items	Symbols	Minimum	Typical	Maximum
Supply Voltage	V <sub>DD</sub>	4.9V	5.0V	5.1V
High Level Input Voltage	V <sub>IH</sub>	0.8 V <sub>DD</sub>	—	—
Low Level Input Voltage	V <sub>IL</sub>	—	—	0.2V <sub>DD</sub>
SPI Clock Frequency	f <sub>CLK</sub>	—	—	8MHz
Current Consumption	I <sub>DD</sub>	** 10mA	—	*** 50mA

\*\* 10mA: Backlighting LED is off

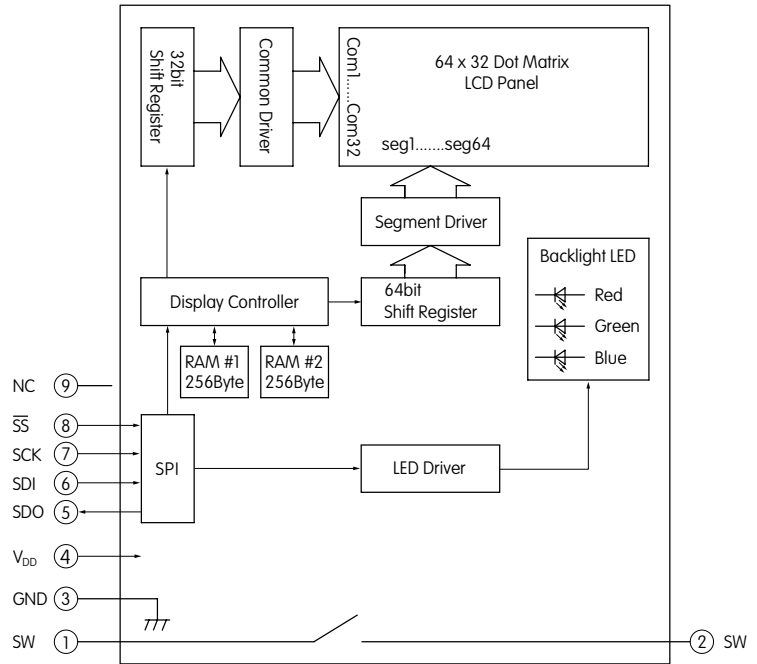
\*\*\* 50mA: Backlighting LEDs (Red, Green, Blue) are maximum brightness



### SWITCH BLOCK DIAGRAM & PIN CONFIGURATIONS

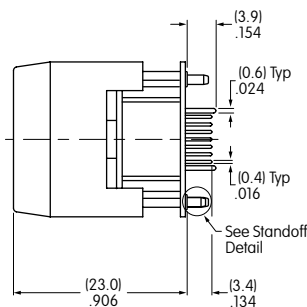
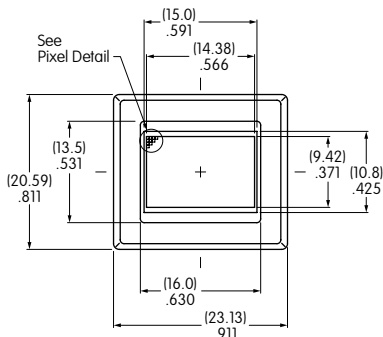


**IS15DBFP4RGB**  
RGB LED Backlight  
Black and White LCD

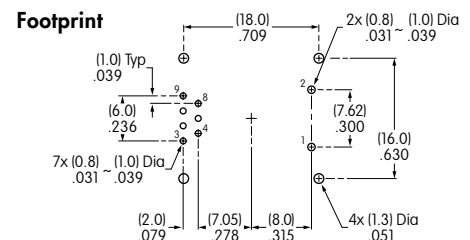
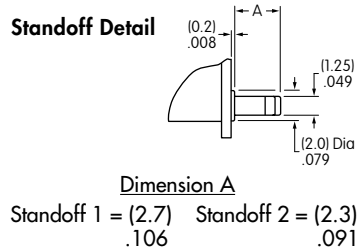
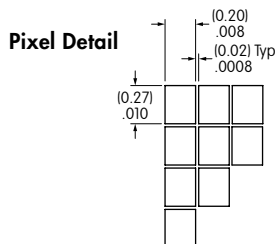
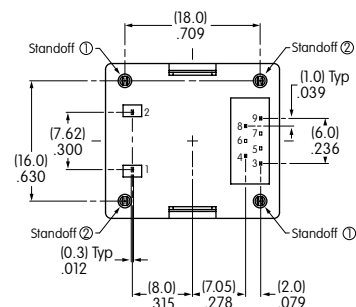


Pin No.	Symbol	Name	Function
①	SW	Terminal of Switch	Normally open
②	SW	Terminal of Switch	Normally open
③	GND	Ground	
④	V <sub>DD</sub>	Power	Power source for logic circuit and LCD
⑤	SDO	Data Out	Data output line for SPI
⑥	SDI	Data In	Data input line for SPI
⑦	SCK	Serial Clock	Clock line for SPI that synchronizes commands and data
⑧	$\overline{SS}$	Slave Select	Chip select for SPI; line is active low
⑨	NC	None	No connection

### TYPICAL SWITCH DIMENSIONS



Terminal numbers are not on the switch.



## DISPLAY PART NUMBER & DESCRIPTION

Part Number	Terminals	LCD Mode	LED Color
<b>ISO1DBFRGB</b>	Straight PC	Black & White FSTN Positive	Red/Green/Blue

## LCD SPECIFICATIONS

### Characteristics of Display

Display Operation Mode	FSTN positive; background colors, black & white
Display Condition	Transflective with built-in LED backlight
Viewing Angle Direction	6 o'clock
Viewing Area	13.9mm x 10.6mm (horizontal x vertical)
Pixel Format	64 x 32 pixels (horizontal x vertical)
Pixel Size	0.18mm x 0.24mm (horizontal x vertical)
* Operating Temperature Range	-15°C ~ +50°C (+5°F ~ +122°F)
Storage Temperature Range	-20°C ~ +60°C (-4°F ~ +140°F)
Backlight LED	<b>RGB:</b> red/green/blue

\* In a low temperature environment (below 0°C), speed and contrast decrease when image changes. The non-indicator dot may become dense in a high temperature environment (about +50°C). Highest backlight brightness level should not be used for temperatures above +35°C.

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

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

### Optical Characteristics (Temperature at 25°C)

Items	Symbols	Min	Typical	Max
Contrast Ratio	$C_r$	—	3.0	—
Viewing Angle ( $C_r \geq 1.1$ )	Up & Down	$\theta$	—	90°
	Right & Left	$\phi$	—	90°

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

Items	Symbols	Minimum	Typical	Maximum
Supply Voltage	$V_{DD}$	4.9V	5.0V	5.1V
High Level Input Voltage	$V_{IH}$	0.8 $V_{DD}$	—	—
Low Level Input Voltage	$V_{IL}$	—	—	0.2 $V_{DD}$
SPI Clock Frequency	$f_{SCK}$	—	—	8MHz
Current Consumption	$I_{DD}$	** 10mA	—	*** 50mA

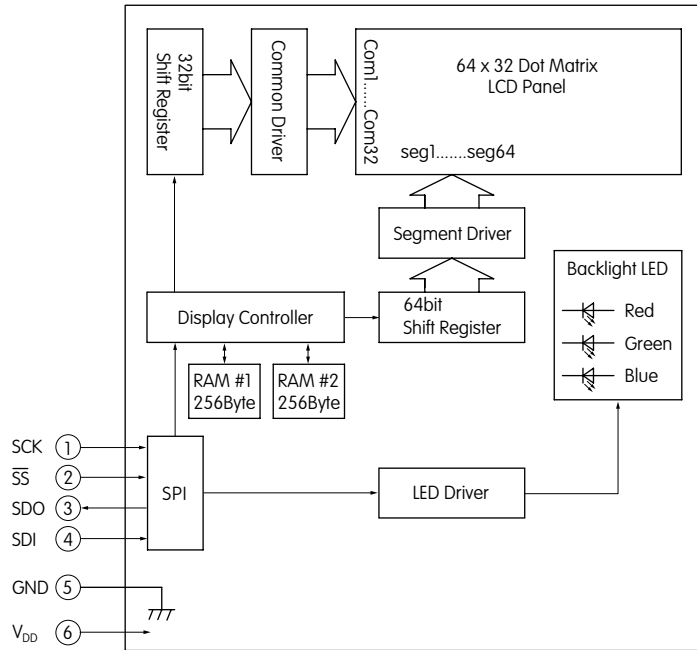
\*\* 10mA: Backlighting LED is off

\*\*\* 50mA: Backlighting LEDs (Red, Green, Blue) are maximum brightness

### DISPLAY BLOCK DIAGRAM & PIN CONFIGURATIONS

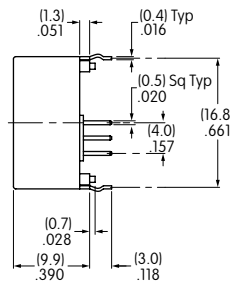
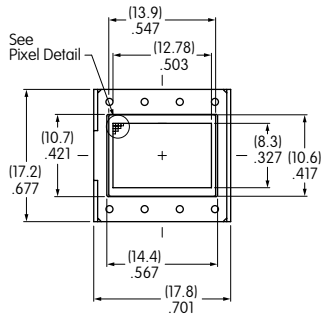


**ISO1DBFRGB**  
**RGB LED Backlight**  
**Black and White LCD**

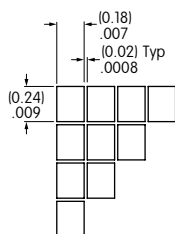
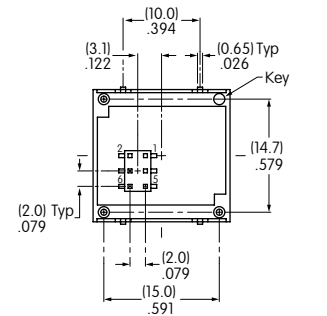


Pin No.	Symbol	Name	Function
①	SCK	Serial Clock	Clock line for SPI that synchronizes commands and data
②	$\overline{SS}$	Slave Select	Chip select for SPI; line is active low
③	SDO	Data Out	Data output line for SPI
④	SDI	Data In	Data input line for SPI
⑤	GND	Ground	
⑥	V <sub>DD</sub>	Power	Power source for logic circuit and LCD

### TYPICAL DISPLAY DIMENSIONS

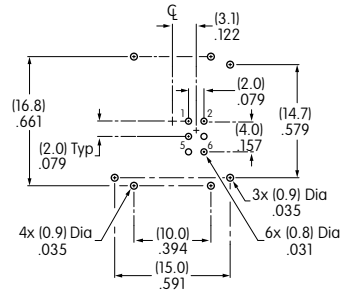


Terminal numbers are not on the device.



Pixel Detail

Footprint



Toggles  
 Rockers  
 Pushbuttons  
 Illuminated PB  
 Programmable  
 Keylocks  
 Rotaries  
 Slides  
 Tactiles  
 Tilt  
 Touch  
 Indicators  
 Accessories  
 Supplement

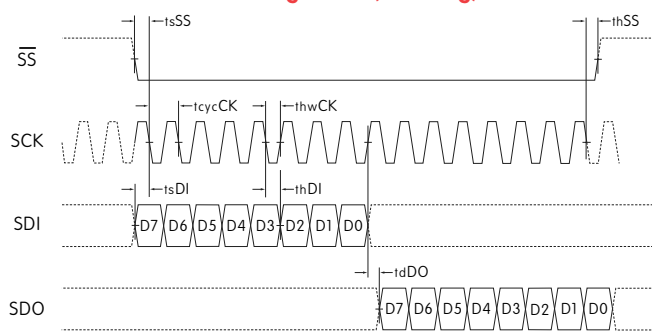
## TIMING SPECIFICATIONS FOR SWITCH & DISPLAY

### SPI Characteristics (See Timing Diagram)

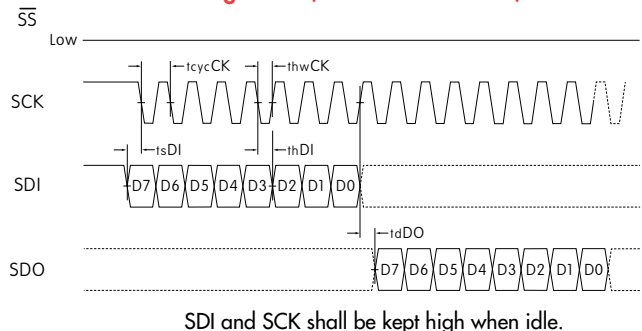
(Temperature at -15°C ~ +50°C and  $V_{DD} = 5.0V \pm 2\%$ )

Items	Symbols	Minimum	Maximum
SPI $\overline{SS}$ Set Up Time	$t_{sSS}$	10ns	
SPI $\overline{SS}$ Hold Time	$t_{hSS}$	10ns	
SPI_CLK Cycle	$t_{cycCK}$		8MHz
SPI_CLK Width	$t_{hwCK}$	10ns	
SPI_DI Set Up Time	$t_{sDI}$	10ns	
SPI_DI Hold Time	$t_{hDI}$	10ns	
SPI_DO Delay Time	$t_{dDO}$	10ns	

SPI Timing Chart ( $\overline{SS}$  Using)

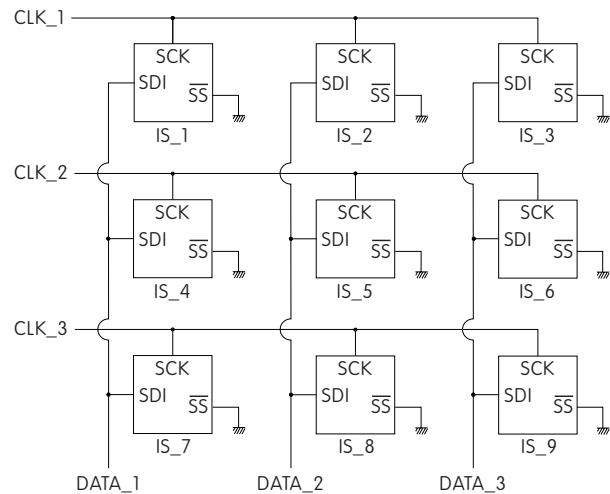


SPI Timing Chart ( $\overline{SS}$  Low Level Fixed)



SDI and SCK shall be kept high when idle.

Circuit Example



## BITMAP

Segment	1	2	3	4	5	6	7	8	9	...	16	...	49	...	56	57	58	59	60	61	62	63	64									
Common	Byte8								Byte7								Byte2								Byte1							
COM1	D0	D1	D2	D3	D4	D5	D6	D7	D0	...	D7	...	D0	...	D7	D0	D1	D2	D3	D4	D5	D6	D7									
COM2	Byte16								Byte9																							
COM32	D0	D1	D2	D3	D4	D5	D6	D7									D0	D1	D2	D3	D4	D5	D6	D7								
	Byte256								...								Byte249															
COM32	D0	D1	D2	D3	D4	D5	D6	D7									D0	D1	D2	D3	D4	D5	D6	D7								

### Transferring Display Data/Displaying LCD Command and Data Sequence

Command	Data (256 Bytes)																							
0 x 55	Byte1								Byte2 ... Byte255								Byte256							
0 1 0 1 0 1 0 1	D7	D6	D5	D4	D3	D2	D1	D0	D7	D6	...	D1	D0	D7	D6	D5	D4	D3	D2	D1	D0			

**Notes:** Display RAM has two screen areas. The first area is for the display on current LCD; the second area is for the data to be displayed next. The screens are changed when the second area is fully stored.

### COMMANDS & DATA FOR SWITCH & DISPLAY

- Transferring display data/displaying on LCD: command (1 Byte) + data (256 Bytes)
- Others: command (1 Byte) + data (1 Byte)
- Commands can be accepted only when all bits coincide; otherwise, they are not acknowledged
- Additional commands will not be received until the communication of commands (1 Byte) and data (256 or 1 Byte) is completed
- There is no time limit from the beginning to end of data receipt
- Commands may be executed consecutively (no need to wait between commands)
- Irregular commands or data are not recognized
- Initial status at power activation: LCD display off, LED off (brightness 1/20, color off)

#### Transferring Display Data/Displaying on LCD

Command		Data	Remarks
Hex	Binary		
0 x 55	01010101	256 Bytes (64 x 32 = 2,048 bits)	See previous page for details of bitmap data

#### LED (Backlight) Color Set

Command		Data	Remarks
Hex	Binary		
0 x 40	01000000	R R G G B B 1 1 2 bits x 3	For each of RGB: 00 = off      10 = 1/2 01 = 1/4      11 = full

#### LED (Backlight) Brightness Set

Command		Data	Remarks
Hex	Binary		
0 x 41	01000001	* * * 1 1 1 1 1 3 bits	For leading 3bits: 000 = 1/2 (dark)      100 = 1/3 001 = 1/10            101 = 1/2 010 = 1/7              110 = 2/3 011 = 1/5              111 = full (bright)

#### Reset (Returning to Initial Status at Power Activation)

Command		Data	Remarks
Hex	Binary		
0 x 5E	01011110	0000011	Returning to initial status at power activation

Toggles  
 Rockers  
 Pushbuttons  
 Illuminated PB  
 Programmable  
 Keylocks  
 Rotaries  
 Slides  
 Tactiles  
 Tilt  
 Touch  
 Indicators  
 Accessories  
 Supplement

## DISTINCTIVE CHARACTERISTICS

### Compact Size Combined with High Resolution

- High resolution of 64 x 32 pixels
- 64 colors of backlighting can be controlled dynamically
- Pushbutton switch with LCD, RGB LED backlighting
- General brightness of backlight is dynamically controlled in eight steps from dark to bright
- Operated by commands and data supplied via serial communications (SPI)
- Can display as many as four lines of text with ten characters each
- Incorporates bitmap display function
- Programmable display graphics for alphanumeric characters and animated sequences
- Dual image VRAM for quick change of displayed images
- Low energy consumption
- Dust tight construction

Viewing area: 13.0mm x 10.7mm (horizontal x vertical)

Variety of LED backlighting with 64 colors and 8 steps brightness

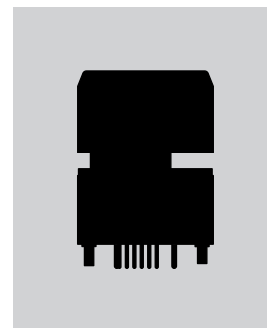
Dome gives crisp tactile feedback to positively indicate circuit transfer

Epoxy sealed straight PC terminals

Snap-in standoff for easy, secure mounting and alignment



Actual Size



## PART NUMBER & DESCRIPTION

Part Number	Switch Description	LCD Mode	LED Color
<b>IS15DSBFP4RGB</b>	SPST Momentary ON Gold Contacts Straight PC Terminals	Black & White FSTN Positive	Red/Green/Blue

### SWITCH SPECIFICATIONS

<b>Circuit</b>	SPST normally open
<b>Electrical Capacity (Resistive Load)</b>	100mA @ 12V DC
<b>Contact Resistance</b>	200 milliohms maximum @ 20mV 10mA
<b>Insulation Resistance</b>	100 megohms minimum @ 100V DC
<b>Dielectric Strength</b>	125V AC for 1 minute minimum
<b>Mechanical Endurance</b>	1,000,000 operations minimum
<b>Electrical Endurance</b>	1,000,000 operations minimum
<b>Operating Force</b>	1.7 ± 0.5 Newtons
<b>Total Travel</b>	1.8mm (.071")

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

Items	Symbols	Ratings
<b>Supply Voltage</b>	V <sub>DD</sub>	-0.3V to +7.0V
<b>Input Voltage</b>	V <sub>I</sub>	-0.3V to V <sub>DD</sub> +0.3V
<b>Output Voltage</b>	V <sub>O</sub>	-0.3V to V <sub>DD</sub> +0.3V

#### Optical Characteristics (Temperature at 25°C)

Items	Symbols	Min	Typical	Max
<b>Contrast Ratio</b>	Cr	—	3.0	—
<b>Viewing Angle (Cr ≥ 1.1)</b>	Up & Down	θ	90°	—
	Right & Left	φ	90°	—

### LCD SPECIFICATIONS

#### Characteristics of Display

<b>Display Operation Mode</b>	FSTN positive; background colors, black & white
<b>Display Condition</b>	Transflective with built-in LED backlight
<b>Viewing Angle Direction</b>	6 o'clock
<b>Viewing Area</b>	13.0mm x 10.7mm (horizontal x vertical)
<b>Pixel Format</b>	64 x 32 pixels (horizontal x vertical)
<b>Pixel Size</b>	0.18mm x 0.24mm (horizontal x vertical)
<b>* Operating Temp Range</b>	-15°C ~ +50°C (+5°F ~ +122°F)
<b>Storage Temp Range</b>	-20°C ~ +60°C (-4°F ~ +140°F)
<b>Backlight LED</b>	RGB: red/green/blue

\* In a low temperature environment (below 0°C), speed and contrast decrease when image changes. The non-indicator dot may become dense in a high temperature environment (about +50°C). Highest backlight brightness level should not be used for temperatures above +35°C.

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

Items	Symbols	Min	Typical	Max
<b>Supply Voltage</b>	V <sub>DD</sub>	4.9V	5.0V	5.1V
<b>High Level Input Voltage</b>	V <sub>IH</sub>	0.8 V <sub>DD</sub>	—	—
<b>Low Level Input Voltage</b>	V <sub>IL</sub>	—	—	0.2V <sub>DD</sub>
<b>SPI Clock Frequency</b>	f <sub>SCK</sub>	—	—	8MHz
<b>Current Consumption</b>	I <sub>DD</sub>	** 10mA	—	*** 50mA

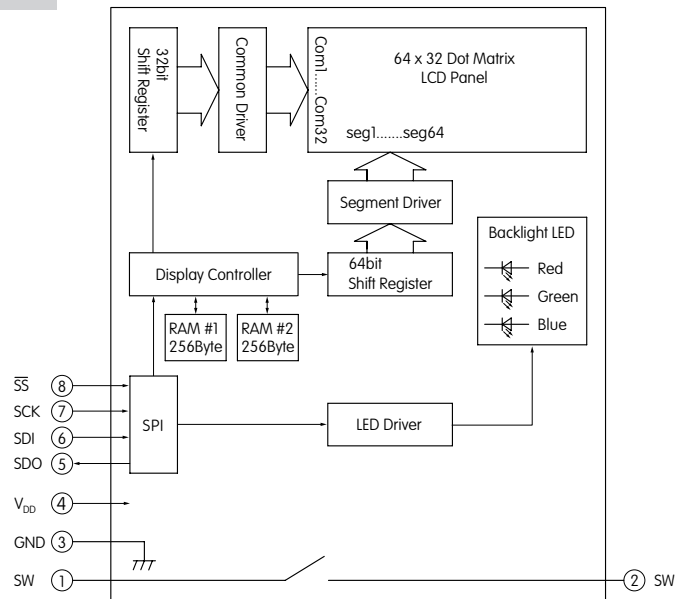
\*\* 10mA: Backlighting LED is off

\*\*\* 50mA: Backlighting LEDs (Red, Green, Blue) are maximum brightness

### BLOCK DIAGRAM & PIN CONFIGURATIONS

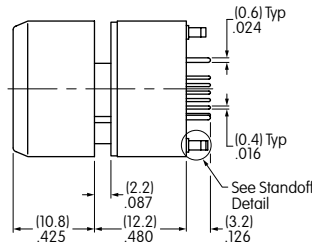
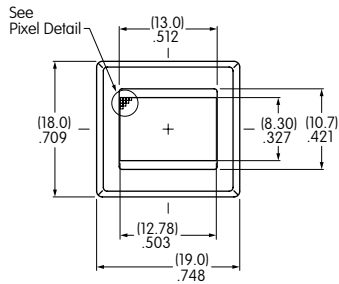


**IS15DSBFP4RGB**  
RGB LED Backlight  
Black and White LCD

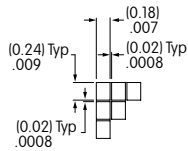
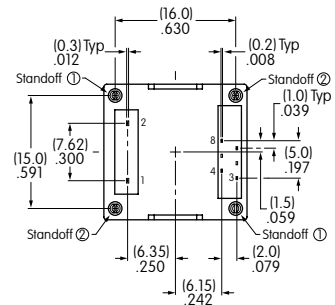


Pin No.	Symbol	Name	Function
①	SW	Terminal of Switch	Normally open
②	SW	Terminal of Switch	Normally open
③	GND	Ground	
④	V <sub>DD</sub>	Power	Power source for logic circuit and LCD
⑤	SDO	Data Out	Data output line for SPI
⑥	SDI	Data In	Data input line for SPI
⑦	SCK	Serial Clock	Clock line for SPI that synchronizes commands and data
⑧	SS	Slave Select	Chip select for SPI; line is active low

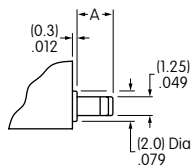
## TYPICAL SWITCH DIMENSIONS



Terminal numbers are not on the switch.



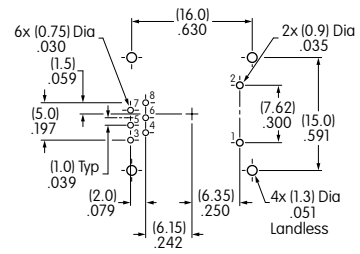
Pixel Detail



Standoff Detail

Dimension A

Standoff 1 = (2.7) .106      Standoff 2 = (2.3) .091



Footprint

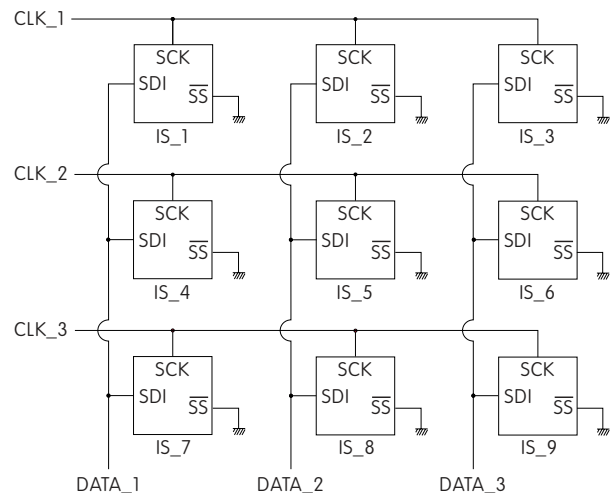
## TIMING SPECIFICATIONS

### SPI Characteristics (See Timing Diagram)

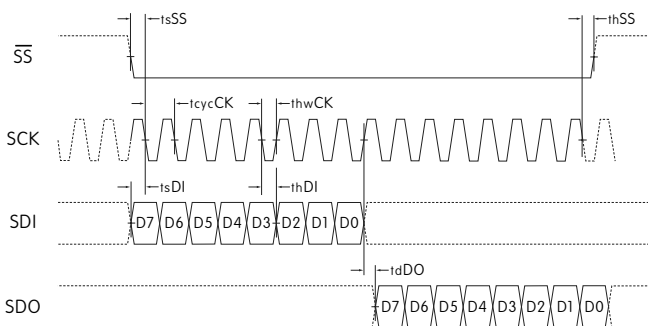
(Temperature at -15°C ~ +50°C and V<sub>DD</sub> = 5.0V ± 2%)

Items	Symbols	Minimum	Maximum
SPI $\overline{SS}$ Set Up Time	$t_{sSS}$	10ns	
SPI $\overline{SS}$ Hold Time	$t_{hSS}$	10ns	
SPI CLK Cycle	$t_{cycCK}$		8MHz
SPI CLK Width	$t_{hwCK}$	10ns	
SPI DI Set Up Time	$t_{sDI}$	10ns	
SPI DI Hold Time	$t_{hDI}$	10ns	
SPI DO Delay Time	$t_{dDO}$	10ns	

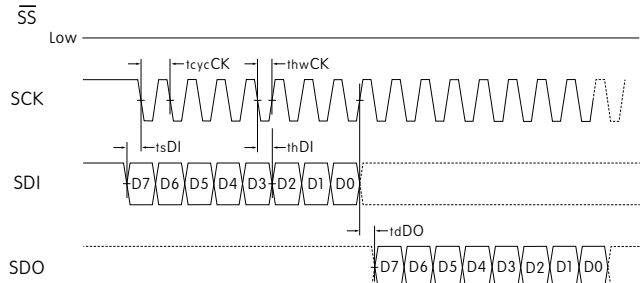
### Circuit Example



### SPI Timing Chart ( $\overline{SS}$ Using)



### SPI Timing Chart ( $\overline{SS}$ Low Level Fixed)



SDI and SCK shall be kept high when idle.

Toggle  
Rockers  
Pushbuttons  
Illuminated PB  
Programmable  
Keylocks  
Rotaries  
Slides  
Tactiles  
Tilt  
Touch  
Indicators  
Accessories  
Supplement



Toggles

Rockers

Pushbuttons

Illuminated PB

Programmable

Keylocks

Rotaries

Slides

Tactiles

Tilt

Touch

Indicators

Accessories

Supplement

### BITMAP

Segment		1	2	3	4	5	6	7	8	9	•	•	•	•	•	•	•	•	•	49	•	•	•	•	•	•	•	•	•	57	58	59	60	61	62	63	64
Common		Byte8							Byte7							Byte2							Byte1														
	COM1	D0	D1	D2	D3	D4	D5	D6	D7	D0	•	•	•	•	•	•	•	•	•	D0	•	•	•	•	•	•	•	•	•	D0	D1	D2	D3	D4	D5	D6	D7
COM2		Byte16														Byte9																					
		D0	D1	D2	D3	D4	D5	D6	D7															D0	D1	D2	D3	D4	D5	D6	D7						
COM32		Byte256														Byte249																					
		D0	D1	D2	D3	D4	D5	D6	D7															D0	D1	D2	D3	D4	D5	D6	D7						

### Transferring Display Data/Displaying LCD Command and Data Sequence

Command	Data (256 Bytes)		
0 x 55	Byte1	Byte2 • • • Byte255	Byte256
0 1 0 1 0 1 0 1	D7 D6 D5 D4 D3 D2 D1 D0	D7 D6 • • • D1 D0	D7 D6 D5 D4 D3 D2 D1 D0

**Notes:** Display RAM has two screen areas. The first area is for the display on current LCD; the second area is for the data to be displayed next. The screens are changed when the second area is fully stored.

### COMMANDS & DATA

- Transferring display data/displaying on LCD: command (1 Byte) + data (256 Bytes)
- Others: command (1 Byte) + data (1 Byte)
- Commands can be accepted only when all bits coincide; otherwise, they are not acknowledged
- Additional commands will not be received until the communication of commands (1 Byte) and data (256 or 1 Byte) is completed
- There is no time limit from the beginning to end of data receipt
- Commands may be executed consecutively (no need to wait between commands)
- Irregular commands or data are not recognized
- Initial status at power activation: LCD display off, LED off (brightness 1/20, color off)

### Transferring Display Data/Displaying on LCD

Command		Data	Remarks
Hex	Binary		
0 x 55	01010101	256 Bytes (64 x 32 = 2,048 bits)	See above for details of bitmap data

### LED (Backlight) Color Set

Command		Data	Remarks
Hex	Binary		
0 x 40	01000000	R R G G B B 1 1 2 bits x 3	For each of RGB: 00 = off      10 = 1/2 01 = 1/4      11 = full

### LED (Backlight) Brightness Set

Command		Data	Remarks
Hex	Binary		
0 x 41	01000001	* * * 1 1 1 1 1 3 bits	For leading 3bits: 000 = 1/20 (dark)      100 = 1/3 001 = 1/10              101 = 1/2 010 = 1/7                110 = 2/3 011 = 1/5                111 = full (bright)

### Reset (Returning to Initial Status at Power Activation)

Command		Data	Remarks
Hex	Binary		
0 x 5E	01011110	00000011	Returning to initial status at power activation

## PRECAUTIONS FOR HANDLING & STORAGE OF LCD 64 x 32 DEVICES

### Handling



1. The IS Series devices are electrostatic sensitive.
2. Limit operating force to keytop to 100.0N maximum, as excessive pressure may damage the LCD device.
3. The IS series devices are not process sealed.
4. If the LCD is accidentally broken, avoid contact with the liquid and wash off any liquid spills to the skin or clothing.
5. 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.
6. Recommended soldering time and temperature limits:  
Do not exceed 60°C at the LCD level.  
Wave Soldering: see Profile B in Supplement section.  
Manual Soldering for Switch: see Profile A in Supplement section.  
Manual Soldering for Display: see Profile B in Supplement section.
7. Excessive images may result after the same image is emitted continuously for an extended period of time.
8. The highest backlight brightness level should not be used for temperatures above +35°C.

### 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.

### DISTINCTIVE CHARACTERISTICS

#### Standard with Enhanced LED Illumination:

- Broad and even light diffusion
- Consistent backlighting
- Low energy consumption

Programmable LCD

Variety of LED Backlighting Colors

Rubber Dome

Epoxy Sealed Straight PC Terminals



RGB backlighting provides infinite color availability.

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.

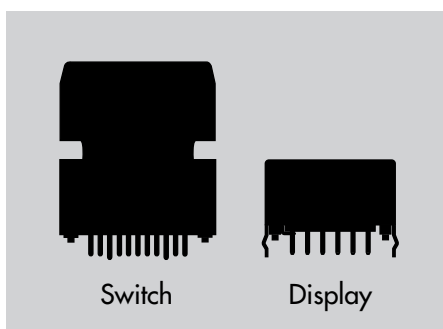
Dome gives crisp tactile feedback to positively indicate circuit transfer.

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.

Actual Sizes



**STANDARD LED BACKLIGHTING**

Part Number	Switch Description	LCD Mode	LED Color
<b>IS15AACP4CF</b>	SPST Momentary ON Gold Contacts Straight PC Terminals	Yellow STN Positive	* Red/Green

\* Simultaneous illumination of both colors achieves third color.

**SUPER BRIGHT LED BACKLIGHTING**

Part Number	Switch Description	LCD Mode	LED Color
<b>IS15ABCP4CF</b>	SPST Momentary ON Gold Contacts Straight PC Terminals	Yellow STN Positive	* Red/Green
<b>IS15ABCP4E</b>		Yellow STN Positive	Yellow
<b>IS15ABCP4EF</b>		Yellow STN Positive	* Yellow/Green
<b>IS15ABDP4E</b>		Blue STN Negative	Yellow
<b>IS15ABDP4EG</b>		Blue STN Negative	* Yellow/Blue
<b>IS15ABDP4B</b>		Blue STN Negative	White
<b>IS15ABFP4B</b>		Black & White FSTN Positive	White

\* Simultaneous illumination of both colors achieves third color.

**RGB LED BACKLIGHTING**

Part Number	Switch Description	LCD Mode	LED Color
<b>IS15ABFP4RGB</b>	SPST Momentary ON Gold Contacts Straight PC Terminals	Black & White FSTN Positive	* Red/Green/Blue

\* Simultaneous RGB illumination achieves infinite colors.

**SWITCH SPECIFICATIONS**

<b>Circuit</b>	SPST normally open
<b>Electrical Capacity (Resistive Load)</b>	100mA @ 12V DC
<b>Contact Resistance</b>	200 milliohms maximum @ 20mV 10mA
<b>Insulation Resistance</b>	100 megohms minimum @ 100V DC
<b>Dielectric Strength</b>	125V AC for 1 minute minimum
<b>Mechanical Endurance</b>	1,000,000 operations minimum
<b>Electrical Endurance</b>	1,000,000 operations minimum
<b>Operating Force</b>	2.2 ± 0.5 Newtons
<b>Total Travel</b>	1.8mm (.071")
<b>Operating Temperature Range</b>	-20°C ~ +60°C (-4°F ~ +140°F); contact factory for wide temperature range options
<b>Storage Temperature Range</b>	-30°C ~ +70°C (-22°F ~ +158 °F); contact factory for wide temperature range options

### LCD SPECIFICATIONS

#### Characteristics of Display

Display Operation Mode	STN positive, STN negative, 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 pixels (horizontal x vertical)
Pixel Size	0.37mm x 0.37mm (horizontal x vertical)
Backlight LED	<b>Single color:</b> yellow, white <b>Bicolor:</b> red/green, yellow/green, yellow/blue <b>RGB:</b> red/green/blue

#### 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 Yellow	$V_{LC}$	—	7.3V	—
Supply Voltage Blue	$V_{LC}$	—	7.5V	—
Supply Voltage Black/White	$V_{LC}$	—	7.3V	—
Input Voltage	$V_I$	0V	—	$V_{DD}$
Driving Frequency	$f_{FLM}$	—	64Hz: yellow/blue 150Hz: black/white	—

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

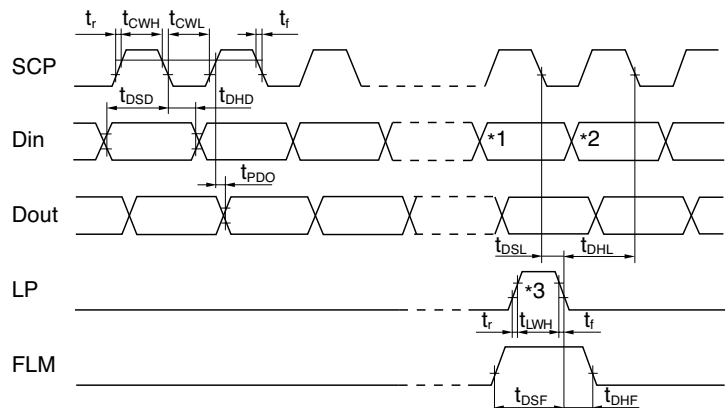
Items	Symbols	Test Conditions	Minimum	Typical	Maximum	Unit
High Level Input Voltage	$V_{IH}$		$0.7V_{DD}$		$V_{DD}$	V
Low Level Input Voltage	$V_{IL}$		0		$0.3V_{DD}$	V
High Level Input Leakage Current	$I_{LIH}$	$V_I = V_{DD}$			10	$\mu A$
Low Level Input Leakage Current	$I_{LIL}$	$V_I = 0V$			-10	$\mu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

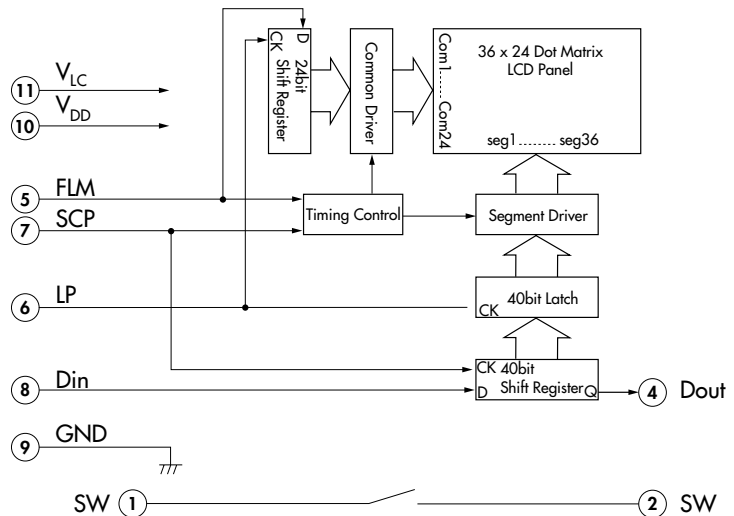


- \*1 Last data on first line
- \*2 Beginning data on second line
- \*3 Location of LP signal on first line

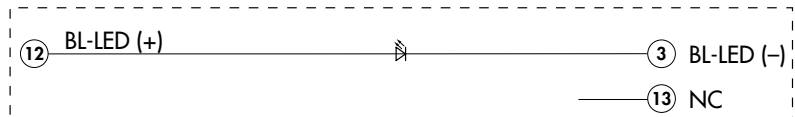
BLOCK DIAGRAM & PIN CONFIGURATIONS FOR STANDARD OR SUPER BRIGHT LEDs



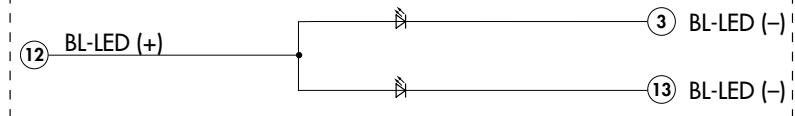
IS15ABCP4CF  
Yellow LCD



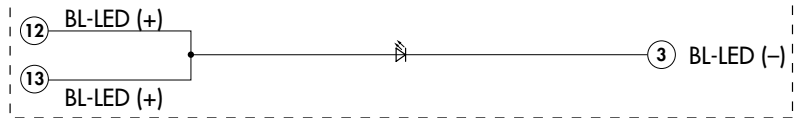
Single Color  
Yellow



Bicolor



Single Color  
White



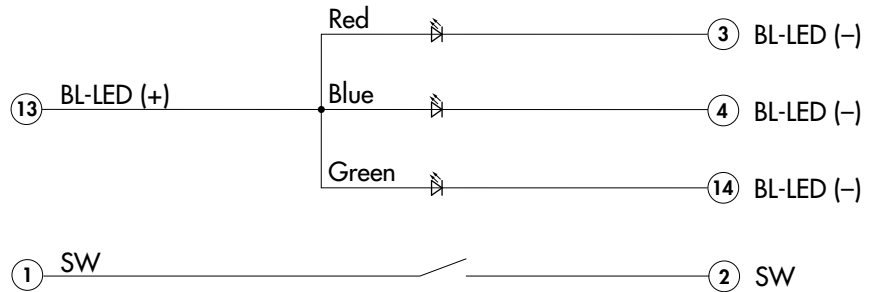
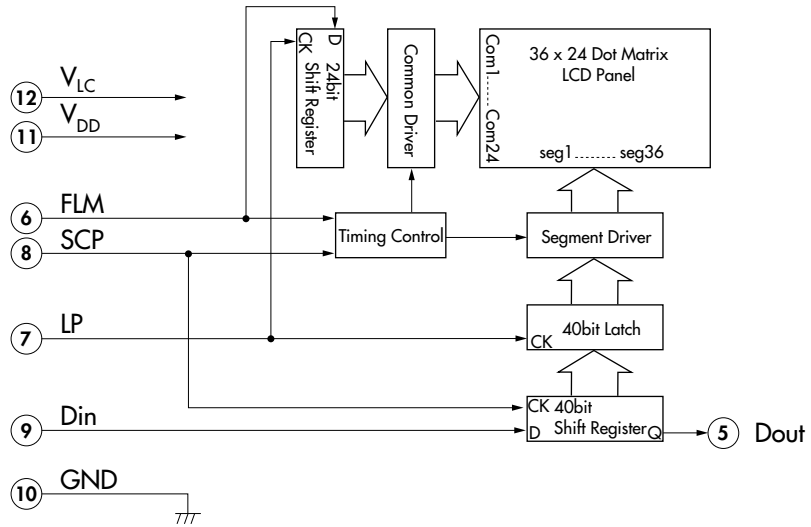
Pin No.	Symbol	Name	Function
①	SW	Terminal of Switch	Normally open
②	SW	Terminal of Switch	Normally open
③	BL-LED (-)	Terminal of Backlight LED	Cathode: <b>standard bicolor</b> - green for red/green. <b>super bright bicolor</b> - red for red/green; yellow for yellow/green or yellow/blue.
④	Dout	Data 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	NC	None	No connection for single color yellow
	BL-LED (-)	Terminal of Backlight LED	Cathode for bicolor
	BL-LED (+)	Terminal of Backlight LED	Anode for single color white

Toggles  
Rockers  
Pushbuttons  
Illuminated PB  
Programmable  
Keylocks  
Rotaries  
Slides  
Tactiles  
Tilt  
Touch  
Indicators  
Accessories  
Supplement

### BLOCK DIAGRAM & PIN CONFIGURATIONS FOR RGB LEDs



**IS15ABFP4RGB**  
RGB LED Backlight  
Black and White LCD



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 for red
④	BL-LED (-)	Terminal of Backlight LED	Cathode for blue
⑤	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.
⑥	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).
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	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.
⑨	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.
⑩	GND	Ground	
⑪	V <sub>DD</sub>	Power	Power source for logic circuit
⑫	V <sub>LC</sub>	Power	Power source for LCD drive
⑬	BL-LED (+)	Terminal of Backlight LED	Anode for common
⑭	BL-LED (-)	Terminal of Backlight LED	Cathode for green

## STANDARD LED SPECIFICATIONS

**Typical Electrical Characteristics** (Temperature at 25°C)

Backlight Color	Symbols	Red/Green	Unit
Forward Current	$I_F$	15/15	mA
Forward Voltage	$V_F$	2.1/2.2	V

## SUPER BRIGHT LED SPECIFICATIONS

**Typical Electrical Characteristics** (Temperature at 25°C)

Backlight Color	Symbols	Red/Green	Yellow/Green	Yellow	Yellow/Blue	White	Unit
Forward Current	$I_F$	15/15	15/15	15	15/15	20	mA
Forward Voltage	$V_F$	2.1/3.3	2.2/3.3	2.2	2.2/3.4	3.6	V

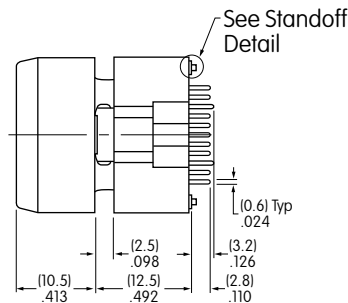
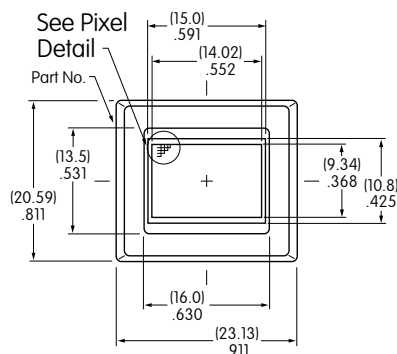
## ABSOLUTE MAXIMUM FOR ALL STANDARD OR SUPER BRIGHT LEDs

**Electrical Characteristics** (Temperature at 25°C)

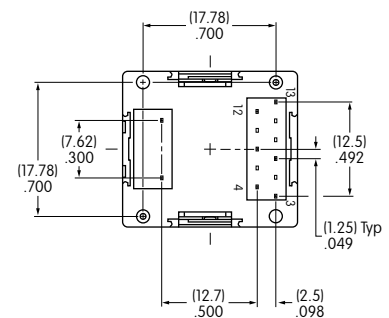
Backlight Color	Symbols	White	All Others	Unit
Forward Current	$I_F$	30	20	mA
Reverse Voltage	$V_R$	5.0	4.0	V
Current Reduction Rate Above 25°C	$\Delta I_F(\text{DC})$	-0.50	-0.26	mA/°C
*Power Dissipation	$P_D$	120	130	mW

\*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.

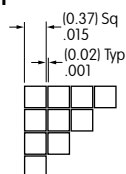
## TYPICAL SWITCH DIMENSIONS WITH STANDARD OR SUPER BRIGHT LEDs



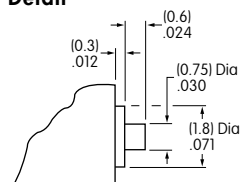
Terminal numbers are not on the switch.



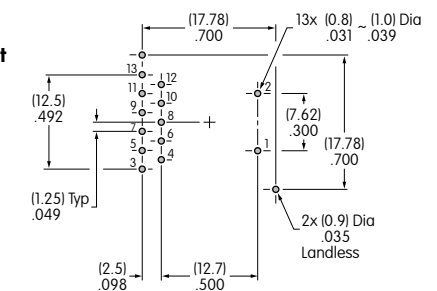
Pixel Detail



Standoff Detail



Footprint





### SUPER BRIGHT RGB LED SPECIFICATIONS

#### Typical Electrical Characteristics (Temperature at 25°C)

Backlight Color	Symbols	Red	Green	Blue	Unit
Forward Current	$I_F$	10	10	10	mA
Forward Voltage	$V_F$	2.0	2.8	2.8	V

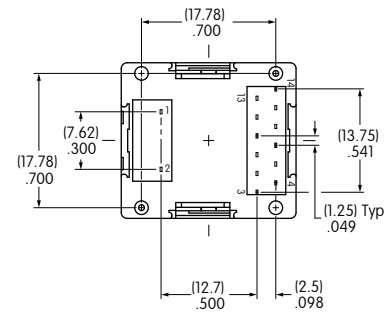
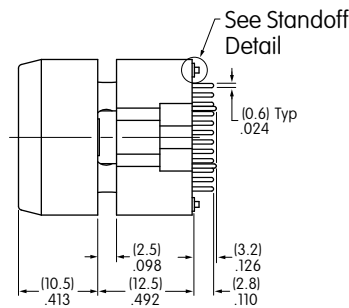
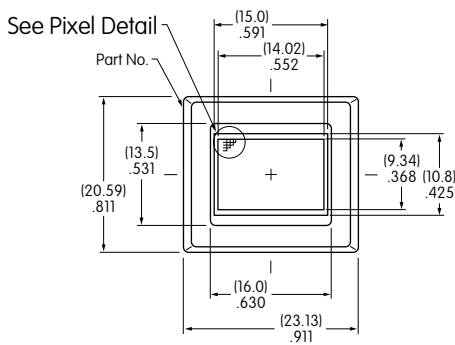
### ABSOLUTE MAXIMUM FOR RGB LED

#### Electrical Characteristics (Temperature at 25°C)

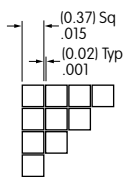
Backlight Color	Symbols	Red/Green/Blue	Unit
Forward Current	$I_F$	20	mA
Reverse Voltage	$V_R$	4.0	V
Current Reduction Rate Above 25°C	$\Delta I_f(\text{DC})$	-0.33	mA/°C
*Power Dissipation	$P_D$	115	mW

\*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.

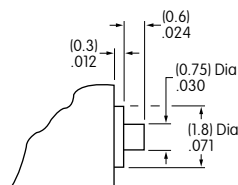
### TYPICAL SWITCH DIMENSIONS WITH RGB LED



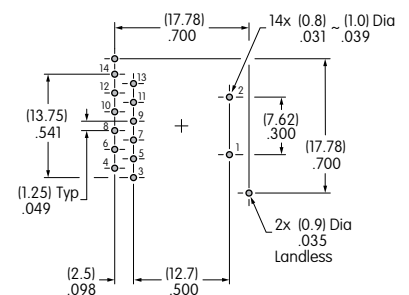
Terminal numbers are not on the switch.



Pixel Detail



Standoff Detail



Footprint

## 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.

Built-in single or bicolor LED backlighting enhances display and enables multifunctional uses. RGB LED provides numerous color variations.

Viewing area 13.9mm x 10.6mm (horizontal x vertical) at 36 x 24 pixels.



## SUPER BRIGHT LED BACKLIGHTING

Part Number	Terminals	LCD Mode	LED Color
<b>ISO1BCCF</b>	Straight PC	Yellow STN Positive	* Red/Green
<b>ISO1BCE</b>	Straight PC	Yellow STN Positive	Yellow
<b>ISO1BCEF</b>	Straight PC	Yellow STN Positive	* Yellow/Green

\* Simultaneous illumination of both colors achieves third color.

## RGB LED BACKLIGHTING

Part Number	Terminals	LCD Mode	LED Color
<b>ISO1BFRGB</b>	Straight PC	Black & White FSTN Positive	** Red/Green/Blue

\*\* Simultaneous RGB illumination achieves infinite colors.

Toggles  
 Rockers  
 Pushbuttons  
 Illuminated PB  
**E** Programmable  
 Keylocks  
 Rotaries  
 Slides  
 Tactiles  
 Tilt  
 Touch  
 Indicators  
 Accessories  
 Supplement

### LCD SPECIFICATIONS

#### Characteristics of Display

Display Operation Mode	STN positive, 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	13.9mm x 10.6mm (horizontal x vertical)
Pixel Format	36 x 24 pixels (horizontal x vertical)
Pixel Size	0.33mm x 0.33mm (horizontal x vertical)
Operating Temperature Range	-20°C ~ +60°C (-4°F ~ +140°F)
Storage Temperature Range	-30°C ~ +70°C (-22°F ~ +158°F)
Backlight LED	Single color: yellow; Bicolor: red/green, yellow/green; RGB: red/green/blue

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

Items	Symbols	Ratings
Supply Voltage for Logics	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>	4.5V	5.0V	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	—

#### DC Characteristics of LCD Drive IC (Temperature at 0°C to 40°C and V<sub>DD</sub> = 5.0V ±10%)

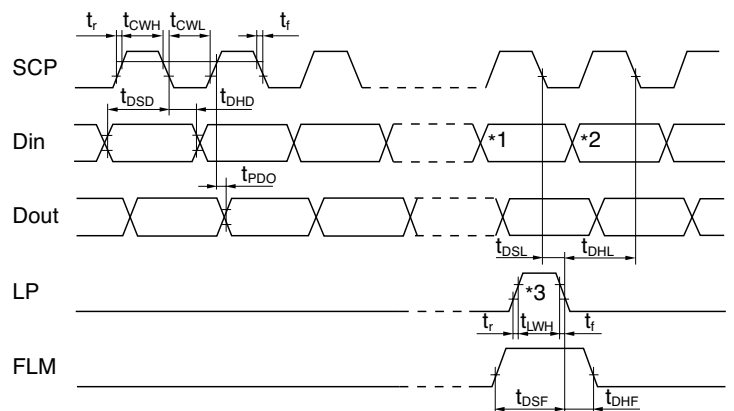
Items	Symbols	Test Conditions	Minimum	Typical	Maximum	Unit
High Level Input Voltage	V <sub>IH</sub>		0.7V <sub>DD</sub>		V <sub>DD</sub>	V
Low Level Input Voltage	V <sub>IL</sub>		0		0.3 V <sub>DD</sub>	V
High Level Input Leakage Current	I <sub>IH</sub>	V <sub>I</sub> = V <sub>DD</sub>			10	μA
Low Level Input Leakage Current	I <sub>IL</sub>	V <sub>I</sub> = 0V			-10	μA
High Level Output Voltage	V <sub>OH</sub>	I <sub>OH</sub> = -500μA	V <sub>DD</sub> -0.5			V
Low Level Output Voltage	V <sub>OL</sub>	I <sub>OL</sub> = 500μA			0.5	V
High Level Output Leakage Current	I <sub>LOH</sub>	V <sub>O</sub> = V <sub>DD</sub>			10	μA
Low Level Output Leakage Current	I <sub>LOL</sub>	V <sub>O</sub> = 0V			-10	μA
Supply Current	I <sub>DD</sub>	f <sub>SCP</sub> = 1.0MHz			500	μA
LCD Drive Current	I <sub>LC</sub>	f <sub>LP</sub> = 2.4kHz V <sub>LC</sub> = 7.3V		500	2,000	μA

#### Timing Characteristics of LCD Drive IC

(Temperature at 0°C to 40°C and V<sub>DD</sub> = 5.0V ±10%)

Items	Symbols	Minimum	Maximum
Clock Operation Frequency	f <sub>SCP</sub>		6.0MHz
Latch Pulse Frequency	f <sub>LP</sub>		50kHz
Clock High Level Pulse Width	t <sub>CWH</sub>	70ns	
Clock Low Level Pulse Width	t <sub>CWL</sub>	70ns	
Data Setup Time	t <sub>DSD</sub>	45ns	
Data Hold Time	t <sub>DHD</sub>	50ns	
Data Output Delay Time	t <sub>PDO</sub>		25ns
Latch Setup Time	t <sub>DSL</sub>	50ns	
Latch Hold Time	t <sub>DHL</sub>	50ns	
Latch High Level Width	t <sub>LWH</sub>	200ns	
FLM Setup Time	t <sub>DSF</sub>	50ns	
FLM Hold Time	t <sub>DHF</sub>	50ns	
SCP, LP Rise/Fall Time	t <sub>r</sub> /t <sub>f</sub>		15ns

#### Timing Diagram

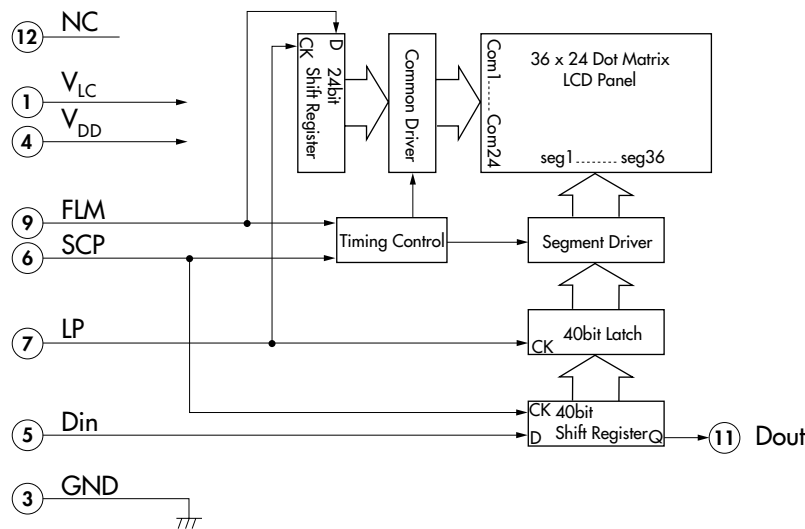


\*1 Last data on first line

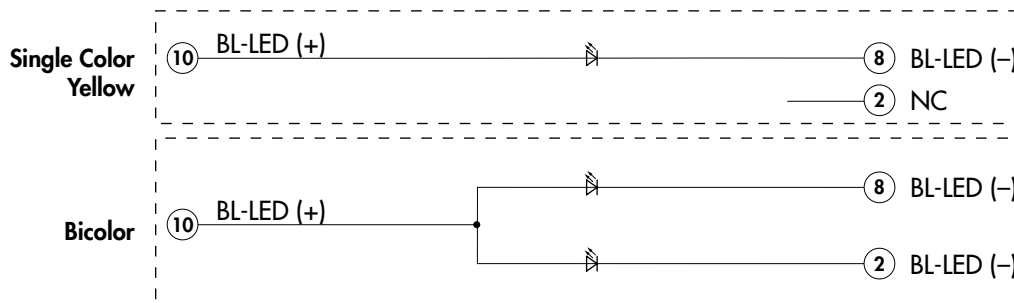
\*2 Beginning data on second line

\*3 Location of LP signal on first line

## BLOCK DIAGRAM & PIN CONFIGURATIONS FOR SUPER BRIGHT LEDs



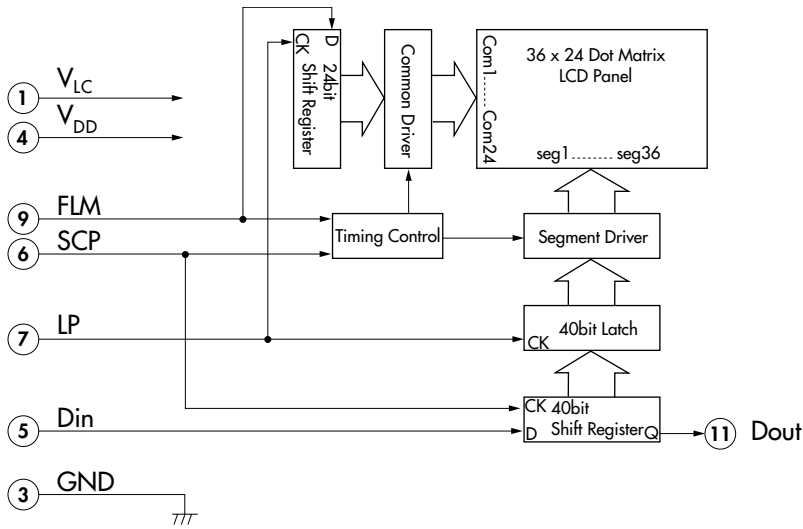
**IS01BCCF**  
**Yellow LCD Mode**



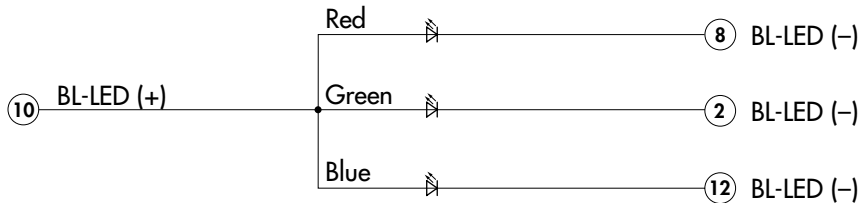
Pin No.	Symbol	Name	Function
①	V <sub>LC</sub>	Power	Power source for LCD drive
②	NC	None	No connection for single color
	BL-LED (-)	Terminal of Backlight LED	Cathode for bicolor
③	GND	Ground	
④	V <sub>DD</sub>	Power	Power source for logic circuit
⑤	Din	Data Input	Display serial data bit. Note: to map 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: <b>super bright bicolor</b> - red for red/green or yellow for yellow/green
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	NC	None	No connection

Toggles  
Rockers  
Pushbuttons  
Illuminated PB  
Programmable  
Keylocks  
Rotaries  
Slides  
Tactiles  
Tilt  
Touch  
Indicators  
Accessories  
Supplement

### BLOCK DIAGRAM & PIN CONFIGURATIONS FOR RGB LEDs



**ISO1BFRGB**  
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 LED SPECIFICATIONS

**Typical Electrical Characteristics** (Temperature at 25°C)

Backlight Color	Symbols	Red/Green	Yellow	Yellow/Green	Unit
Forward Current	$I_F$	15/15	15	15/15	mA
Forward Voltage	$V_F$	2.1/3.3	2.2	2.2/3.3	V

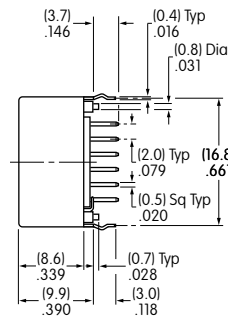
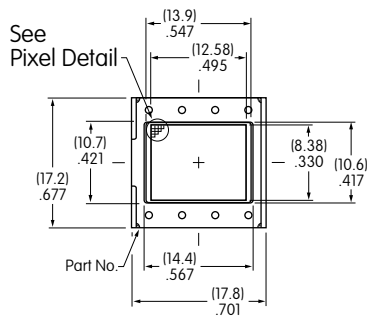
## ABSOLUTE MAXIMUM FOR SUPER BRIGHT LEDS

**Electrical Characteristics** (Temperature at 25°C)

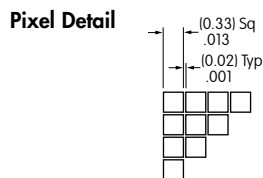
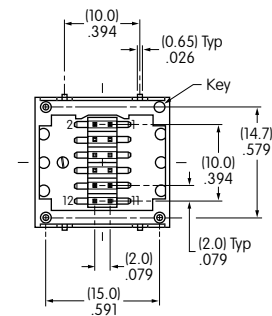
Backlight Color	Symbols	All	Unit
Forward Current	$I_F$	20	mA
Reverse Voltage	$V_R$	4.0	V
Current Reduction Rate Above 25°C	$\Delta I_F(\text{DC})$	-0.26	mA/°C
Power Dissipation*	$P_D$	130	mW

\*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.

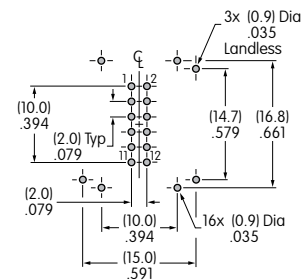
## TYPICAL DISPLAY DIMENSIONS



Terminal numbers are not on the device.



Footprint



### SUPER BRIGHT RGB LED SPECIFICATIONS

#### Typical Electrical Characteristics (Temperature at 25°C)

Backlight Color	Symbols	Red	Green	Blue	Unit
Forward Current	$I_F$	10	10	10	mA
Forward Voltage	$V_F$	2.0	2.8	2.8	V

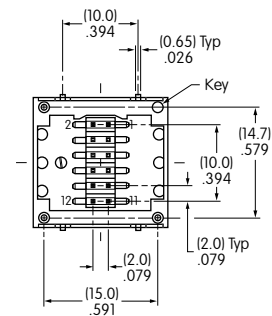
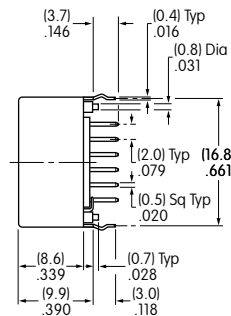
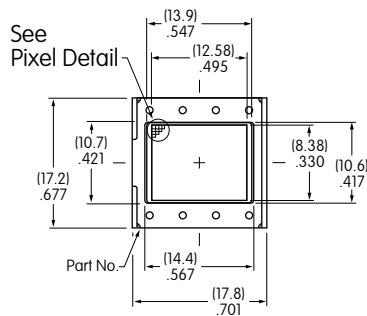
### ABSOLUTE MAXIMUM FOR RGB LED

#### Electrical Characteristics (Temperature at 25°C)

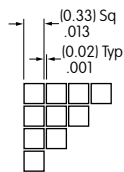
Backlight Color	Symbols	Red/Green/Blue	Unit
Forward Current	$I_F$	20	mA
Reverse Voltage	$V_R$	4.0	V
Current Reduction Rate Above 25°C	$\Delta I_F(\text{DC})$	-0.33	mA/°C
*Power Dissipation	$P_D$	115	mW

\*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.

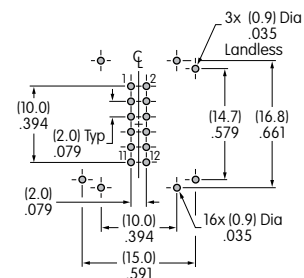
### TYPICAL DISPLAY DIMENSIONS WITH RGB LED



Terminal numbers are not on the device.



Pixel Detail



Footprint

Toggles  
 Rockers  
 Pushbuttons  
 Illuminated PB  
 Programmable E  
 Keylocks  
 Rotaries  
 Slides  
 Tactiles  
 Tilt  
 Touch  
 Indicators  
 Accessories  
 Supplement

## DISTINCTIVE CHARACTERISTICS

### Compact Size

- Perfect for rack mount router and other applications with space limitations.  
Compact body size: 19.0mm (.748") x 18.0mm (.709") compared to  
Standard body size: 23.13mm (.911") x 20.59mm (.811")
- Vibrant Illumination
- Low Energy Consumption

Programmable LCD

Variety of LED Backlighting Colors

Rubber Dome

Epoxy Sealed Straight PC Terminals

Snap-in standoff for easy, secure mounting and alignment



Programmable to display graphics, alphanumeric characters and animated sequences.

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

Viewing area 13.0mm x 10.7mm (horizontal x vertical) at 36 x 24 pixels.

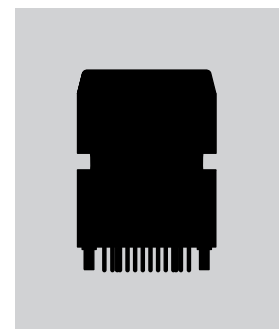
Dome gives crisp tactile feedback to positively indicate circuit transfer.

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 simplify production process.

Actual Size



## PART NUMBER & DESCRIPTION

Part Number	Switch Description	LCD Mode	LED Color
<b>IS15SACP4CF</b>	SPST Momentary ON Gold Contacts Straight PC Terminals	Yellow STN Positive	* Red/Green Standard
<b>IS15SBP4CF</b>		Yellow STN Positive	* Red/Green Super Bright
<b>IS15SBP4EF</b>		Yellow STN Positive	* Yellow/Green Super Bright
<b>IS15SBFP4B</b>		Black & White FSTN Positive	White Super Bright
<b>IS15SBFP4RGB</b>		Black & White FSTN Positive	** Red/Green/Blue RGB

\* Simultaneous illumination of both colors achieves third color. \*\* Simultaneous RGB illumination achieves infinite colors.

Note: Contact factory for additional options.



### 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	-20°C ~ +60°C (-4°F ~ +140°F)
Storage Temperature Range	-30°C ~ +70°C (-22°F ~ +158°F)

### LCD SPECIFICATIONS

#### Characteristics of Display

Display Operation Mode	STN positive, 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	13.0mm x 10.7mm (horizontal x vertical)
Pixel Format	36 x 24 pixels (horizontal x vertical)
Pixel Size	0.33mm x 0.33mm (horizontal x vertical)
Backlight LED	Single color: white. Bicolor: red/green, yellow/green. RGB: red/green/blue

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

Items	Symbols	Ratings
Supply Voltage for Logics	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>	4.5V	5.0V	5.5V
Supply Voltage	V <sub>LC</sub>	—	7.3V	—
Input Voltage	V <sub>I</sub>	0V	—	V <sub>DD</sub>
Driving Frequency	f <sub>FLM</sub>	—	150Hz	—

#### DC Characteristics of LCD Drive IC (Temperature at 0°C to 40°C and V<sub>DD</sub> = ±10%)

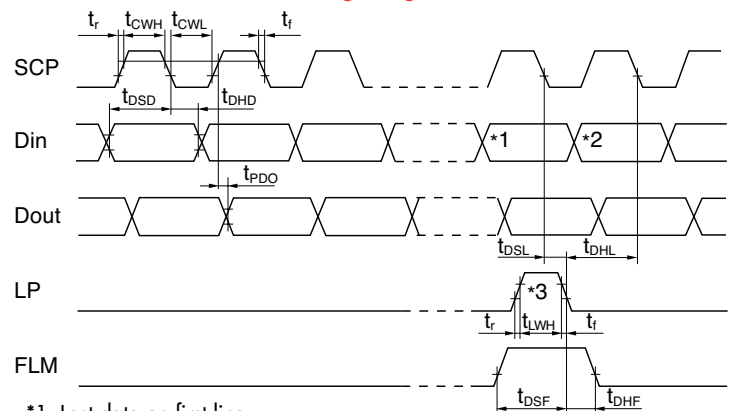
Items	Symbols	Test Conditions	Minimum	Typical	Maximum	Unit
High Level Input Voltage	V <sub>IH</sub>		0.7 V <sub>DD</sub>		V <sub>DD</sub>	V
Low Level Input Voltage	V <sub>IL</sub>		0		0.3 V <sub>DD</sub>	V
High Level Input Leakage Current	I <sub>LIH</sub>	V <sub>I</sub> = V <sub>DD</sub>			10	μA
Low Level Input Leakage Current	I <sub>LIL</sub>	V <sub>I</sub> = 0V			-10	μA
High Level Output Voltage	V <sub>OH</sub>	I <sub>CH</sub> = -500μA	V <sub>DD</sub> -0.5			V
Low Level Output Voltage	V <sub>OL</sub>	I <sub>OL</sub> = 500μA			0.5	V
High Level Output Leakage Current	I <sub>LOH</sub>	V <sub>O</sub> = V <sub>DD</sub>			10	μA
Low Level Output Leakage Current	I <sub>LOL</sub>	V <sub>O</sub> = 0V			-10	μA
Supply Current	I <sub>DD</sub>	f <sub>SCP</sub> = 1.0MHz			500	μA
LCD Drive Current	I <sub>LC</sub>	f <sub>LP</sub> = 2.4kHz V <sub>LC</sub> = 7.3V		500	2,000	μA

#### Timing Characteristics of LCD Drive IC

(Temperature at 0°C to 40°C and V<sub>DD</sub> = 5.0V ±10%)

Items	Symbols	Minimum	Maximum
Clock Operation Frequency	f <sub>SCP</sub>		6.0MHz
Latch Pulse Frequency	f <sub>LP</sub>		50kHz
Clock High Level Pulse Width	t <sub>CWH</sub>	70ns	
Clock Low Level Pulse Width	t <sub>CWL</sub>	70ns	
Data Setup Time	t <sub>DSD</sub>	45ns	
Data Hold Time	t <sub>DHD</sub>	50ns	
Data Output Delay Time	t <sub>PDO</sub>		25ns
Latch Setup Time	t <sub>DSL</sub>	50ns	
Latch Hold Time	t <sub>DHL</sub>	50ns	
Latch High Level Width	t <sub>LWH</sub>	200ns	
FLM Setup Time	t <sub>DSF</sub>	50ns	
FLM Hold Time	t <sub>DHF</sub>	50ns	
SCP, LP Rise/Fall Time	t <sub>r</sub> /t <sub>f</sub>		15ns

#### Timing Diagram



\*1 Last data on first line

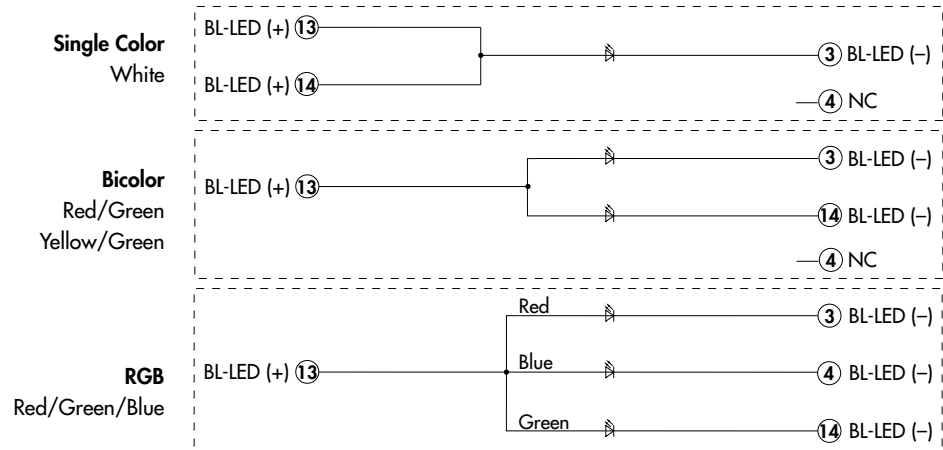
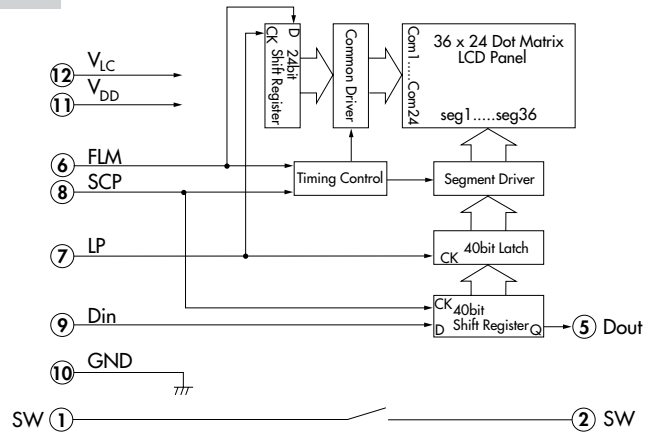
\*2 Beginning data on second line

\*3 Location of LP signal on first line

## BLOCK DIAGRAM & PIN CONFIGURATIONS



**IS155BCP4CF**  
Yellow LCD Mode



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: <b>single color</b> - white; <b>standard bicolor</b> - green for red/green; <b>super bright bicolor</b> - red for red/green; yellow for yellow/green; <b>RGB</b> - red
④	NC	None	No connection for single color white. No connection for bicolor.
④	BL-LED (-)	Terminal of Backlight LED	Cathode: <b>RGB</b> - blue
⑤	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.
⑥	FLM	First Line Marker	The marking signal for the first line data of LCD display. The first line of LCD will be selected by falling edge of LP signal during the high level (FLM).
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	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.
⑨	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.
⑩	GND	Ground	
⑪	V <sub>DD</sub>	Power	Power source for logic circuit
⑫	V <sub>LC</sub>	Power	Power source for LCD drive
⑬	BL-LED (+)	Terminal of Backlight LED	Anode for common
⑭	BL-LED (+)	Terminal of Backlight LED	Anode: <b>single color</b> - white
⑭	BL-LED (-)	Terminal of Backlight LED	Cathode: <b>standard bicolor</b> - red for red/green; <b>super bright bicolor</b> - green for red/green; green for yellow/green; <b>RGB</b> - green

### STANDARD LED SPECIFICATIONS

Typical Electrical Characteristics (Temperature at 25°C)

Backlight Color	Symbols	Red/Green	Unit
Forward Current	$I_F$	15/15	mA
Forward Voltage	$V_F$	2.1/2.2	V

### SUPER BRIGHT LED SPECIFICATIONS

Typical Electrical Characteristics (Temperature at 25°C)

Backlight Color	Symbols	Red/Green	Yellow/Green	White	Unit
Forward Current	$I_F$	15/15	15/15	20	mA
Forward Voltage	$V_F$	2.1/3.3	2.2/3.3	3.6	V

### RGB LED CHARACTERISTICS

Typical Electrical Characteristics (Temperature at 25°C)

Backlight Color	Symbols	Red	Green	Blue	Unit
Forward Current	$I_F$	10	10	10	mA
Forward Voltage	$V_F$	2.0	2.8	2.8	V

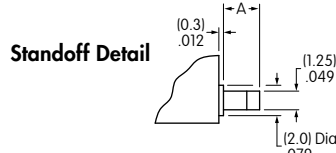
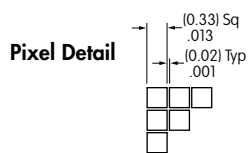
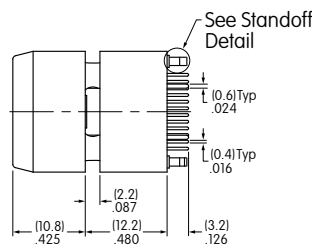
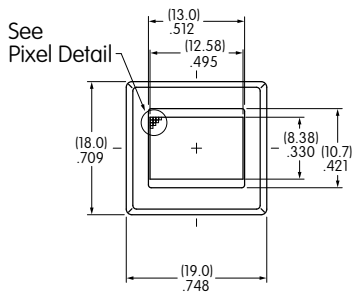
### ABSOLUTE MAXIMUM FOR ALL LEDS

Electrical Characteristics (Temperature at 25°C)

Backlight Color	Symbols	White	Bicolor	RGB	Unit
Forward Current	$I_F$	30	20	20	mA
Reverse Voltage	$V_R$	5.0	4.0	4.0	V
Current Reduction Rate Above 25°C	$\Delta I_F(\text{DC})$	-0.50	-0.26	-0.33	mA/°C
*Power Dissipation	$P_D$	120	130	115	mW

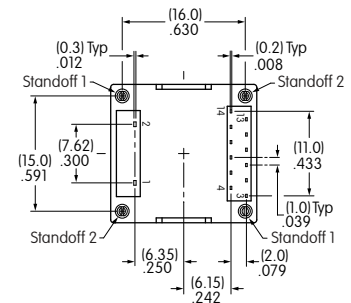
\*For uniform light emission, Power Dissipation should not exceed the Absolute Maximum Rating, and the Forward Current should not exceed the derated Absolute Forward Current.

### TYPICAL SWITCH DIMENSIONS

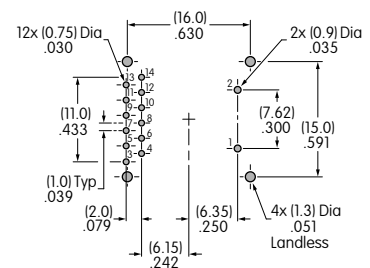


Dimension A  
Standoff 1 = (2.7) .106    Standoff 2 = (2.3) .091

Terminal numbers are not on the switch.



#### Footprint



Toggles  
Rockers  
Pushbuttons  
Illuminated PB  
Programmable  
Keylocks  
Rotaries  
Slides  
Tactiles  
Tilt  
Touch  
Indicators  
Accessories  
Supplement

## PRECAUTIONS FOR HANDLING & STORAGE OF LCD 36 x 24 DEVICES

### Handling



1. The IS Series devices are electrostatic sensitive.
2. Limit operating force to keytop to 100.0N maximum, as excessive pressure may damage the LCD device.
3. The IS series devices are not process sealed.
4. If the LCD is accidentally broken, avoid contact with the liquid and wash off any liquid spills to the skin or clothing.
5. 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.
6. 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 for Switch: see Profile A in the Supplement section.  
Manual Soldering for Display: see Profile B in the Supplement section.
7. 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.
8. 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.
9. Backlight Forward Current should not exceed the derated Absolute Maximum Forward Current based on the temperature.
10. 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.

Toggles

Rockers

Pushbuttons

Illuminated PB

**E** Programmable

Keylocks

Rotaries

Slides

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Tilt

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Toggles

Rockers

Pushbuttons

Illuminated PB

Programmable **E**

Keylocks

Rotaries

Slides

Tactiles

Tilt

Touch

Indicators

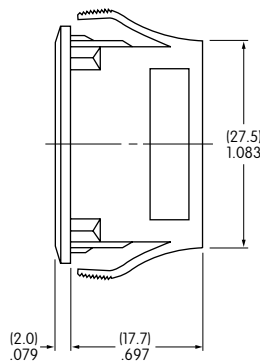
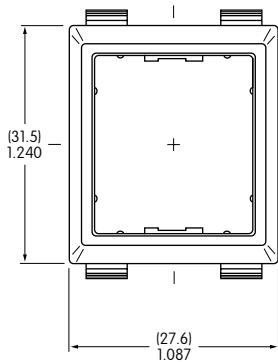
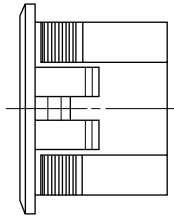
Accessories

Supplement

### OPTIONAL ACCESSORIES

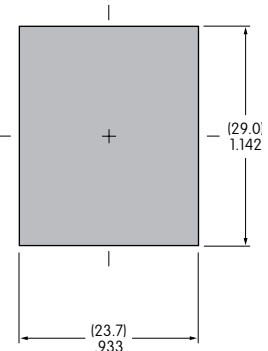
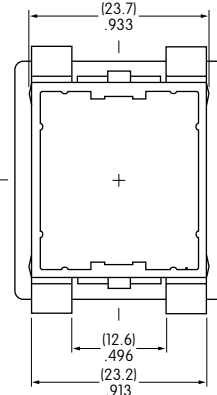
#### AT548 Panel Mount Housing

Material: Polyamide



#### Compatible Part Numbers for AT548

Wide View LCD 36 x 24	LCD 36 x 24	
IS15BAFP4CF	IS15AACP4CF	IS15ABDP4E
IS15BBFP4RGB	IS15ABCP4CF	IS15ABDP4EG
	IS15ABCP4EF	IS15ABFP4B
	IS15ABDP4B	IS15ABFP4RGB



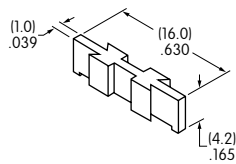
The Panel Mount Housing is available for the LCD 36 x 24 Pushbutton only.

Panel Thickness Range:  
(1.5 ~ 4.0mm) .059 ~ .157"

Panel mount housing allows the LCD 36 x 24 Pushbutton to be snapped into a panel cutout for quick, secure mounting. It gives flexibility in locating the devices anywhere on the panel. It also allows using the LCD 36 x 24 Pushbutton on an existing panel.

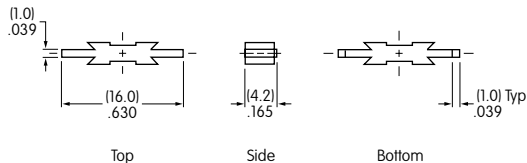
#### AT542 Coupler

Material: PBT



#### Compatible Part Numbers for AT542

Wide View LCD 36 x 24	LCD 36 x 24	
IS15BAFP4CF	IS15AACP4CF	IS15ABDP4E
IS15BBFP4RGB	IS15ABCP4CF	IS15ABDP4EG
	IS15ABCP4EF	IS15ABFP4B
	IS15ABDP4B	IS15ABFP4RGB



This coupler is for connecting the LCD 36 x 24 Pushbutton into precise, tight groupings that maintain an even distance from PCB to top of the actuator.

The Coupler is available for the LCD 36 x 24 Pushbutton only.

## OPTIONAL ACCESSORIES

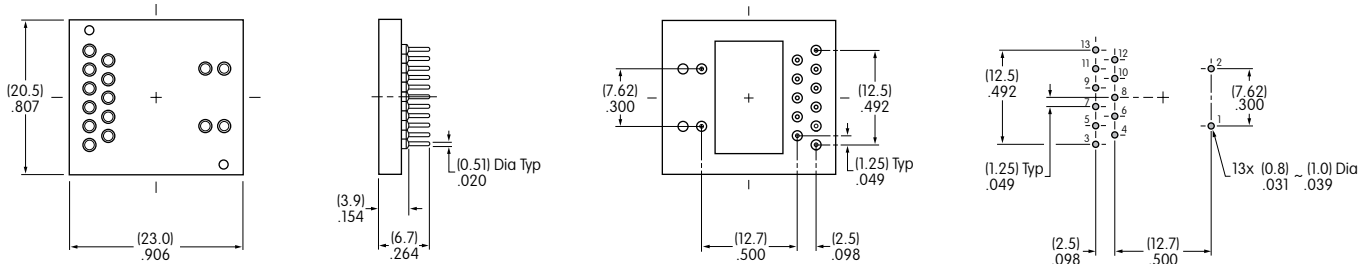
### AT9704-02YC Socket for Single and Bicolor LCD 36 x 24 Pushbutton

Materials:

Base - Glass Fiber Reinforced PBT

Terminals - Brass/Beryllium Copper

- The socket permits the SMARTSWITCH™ to be plugged in after automated processing.
- Use of the socket enables easy field replacement of the device.



### Compatible Part Numbers for AT9704-02YC

#### Single & Bicolor LCD 36 x 24

IS15AACP4CF	IS15ABCP4EF	IS15ABDP4EG
IS15ABCP4CF	IS15ABDP4B	IS15ABFP4B
IS15ABCP4E	IS15ABDP4E	

#### Wide View LCD 36 x 24

IS15BAFP4CF

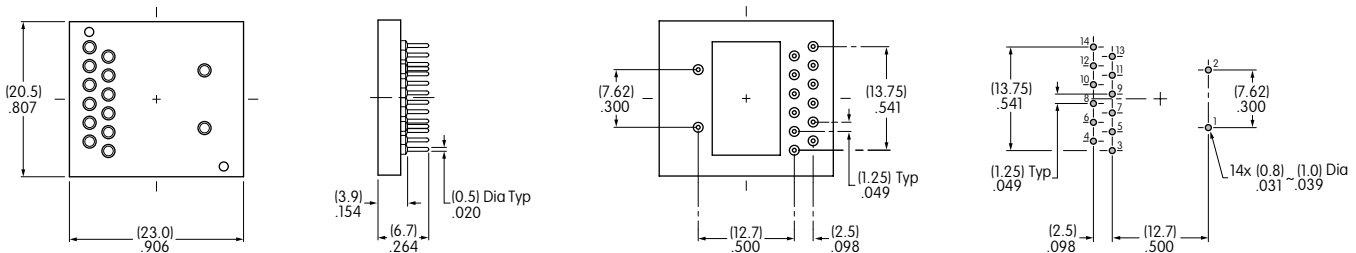
### AT9704-065E Socket for RGB LCD 36 x 24 Pushbutton

Materials:

Base - Glass Fiber Reinforced PBT

Terminals - Brass/Beryllium Copper

- The socket permits the RGB SMARTSWITCH™ to be plugged in after automated processing.
- Use of the socket enables easy field replacement of the device.



### Compatible Part Numbers for AT9704-065E

#### RGB LCD 36 x 24

IS15ABFP4RGB	IS15BBFP4RGB
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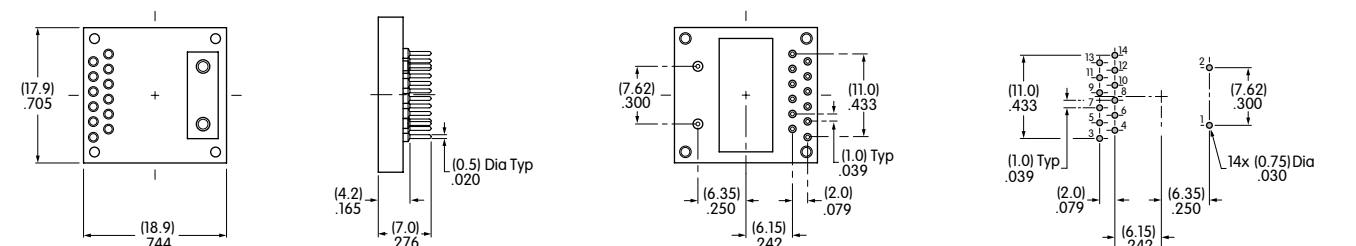
### AT9704-065F Socket for Compact Pushbutton (All Models)

Materials:

Base - Glass Fiber Reinforced PBT

Terminals - Brass/Beryllium Copper

- The socket permits the Compact SMARTSWITCH™ to be plugged in after automated processing.
- Use of the socket enables easy field replacement of the device.



### Compatible Part Numbers for AT9704-065F

Wide View/Short Travel LCD 64 x 32	LCD 36 x 24 Compact
IS15EBFP4RGB-09YN	IS15SACP4CF
Wide View LCD 64 x 32 Compact	IS15SBP4CF
IS15ESBFP4RGB	IS15SBP4EF
Short Travel LCD 64 x 32	IS15SBP4B
IS15DBFP4RGB-09YN	IS15SBFP4RGB
LCD 64 x 32 Compact	Wide View LCD 36 x 24 Compact
IS15DSBFP4RGB	IS15BSBFP4RGB

Note: AT9704-065F Socket may be used with the LCD 64 x 32 SMARTSWITCH™ by removing pins 3, 4, 11, 12, 13 and 14.

### OPTIONAL ACCESSORIES

#### AT9704-085K Socket for LCD 64 x 32 Pushbutton

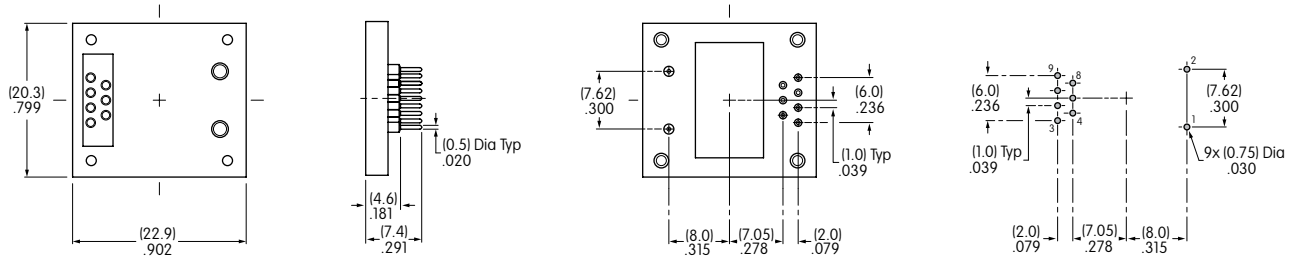
Materials:

Base - Glass Fiber Reinforced PBT  
 Terminals - Brass/Beryllium Copper

#### Compatible Part Numbers for AT9704-085K

Wide View LCD 64 x 32	LCD 64 x 32
IS15EBFP4RGB	IS15DBFP4RGB

- The socket permits the SMARTSWITCH™ to be plugged in after automated processing.
- Use of the socket enables easy field replacement of the device.



#### AT9704-085L Socket for OLED Pushbutton

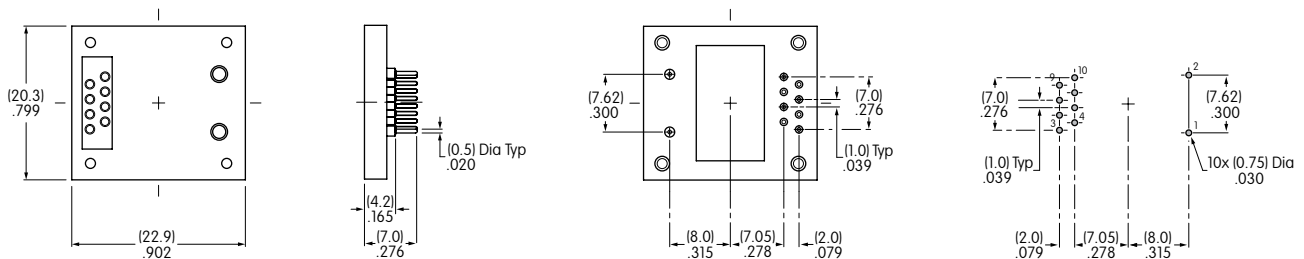
Materials:

Base - Glass Fiber Reinforced PBT  
 Terminals - Brass/Beryllium Copper

#### Compatible Part Numbers for AT9704-085L

OLED Pushbutton	Frameless OLED
ISC15ANP4	ISF15ACP4

- The socket permits the OLED SMARTSWITCH™ to be plugged in after automated processing.
- Use of the socket enables easy field replacement of the device.



#### AT9704-085M Socket for OLED Display

Materials:

Base - Glass Fiber Reinforced PBT  
 Terminals - Brass/Beryllium Copper

#### Compatible Part Number for AT9704-085M

OLED Display
ISC01P

- The socket permits the OLED SMARTDISPLAY™ to be plugged in after automated processing.
- Use of the socket enables easy field replacement of the device.

