

### DISTINCTIVE CHARACTERISTICS

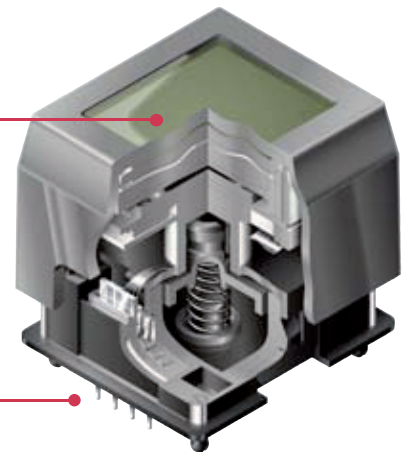
- High resolution of 64 x 32 pixels
- 64 colors of backlighting can be controlled dynamically
- Pushbutton switch or display with LCD, RGB LED backlighting
- General brightness of backlight is dynamically controlled in eight steps from dark to bright
- Operated by commands and data supplied via SPI communications protocol
- 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: 15.5mm x 11.6mm (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: 12.9mm x 9.9mm (horizontal x vertical)

High resolution of 52RGB x 36 pixels

Crimped terminals ensure secure PC mounting and prevent dislodging during wave soldering



### APPLICATIONS


The High Resolution SMARTSWITCH™ Series complements multiple applications, including:

- Broadcast equipment
- Education equipment
- Audio equipment
- Automation control equipment
- Image equipment
- Vending machines
- POS

Actual Sizes



### SMARTSWITCH PART NUMBER & DESCRIPTION

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

### SMARTSWITCH 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")                     |

### SMARTSWITCH OLED 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 (+32°F ~ +122°F)                  |
| Storage Temperature Range     | -20°C ~ +60°C (-4°F ~ +140°F)                   |
| Backlight LED                 | RGB: red/green/blue                             |

\* In 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).

#### Absolute Maximum Ratings

| 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<br>(Cr ≥ 1.1) | Up & Down    | θ   | 90°     | --  |
|                             | Right & Left | Φ   | 90°     | --  |

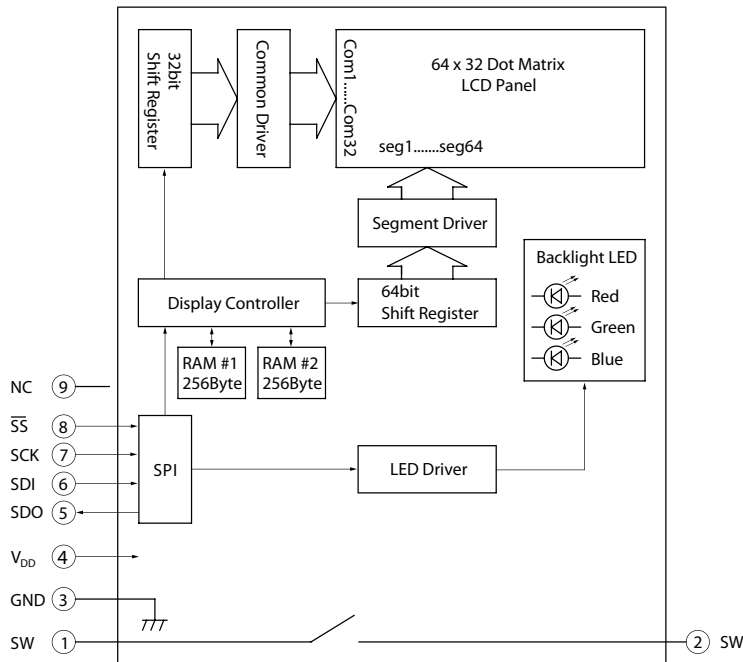
#### Recommended Operating Conditions

| Items               | Symbols          | Minimum | Typical | Maximum         |
|---------------------|------------------|---------|---------|-----------------|
| Supply Voltage      | V <sub>DD</sub>  | 4.9V    | 5.0V    | 5.1V            |
| Input Voltage       | V <sub>I</sub>   | 0V      | --      | V <sub>DD</sub> |
| SPI Clock Frequency | f <sub>SCK</sub> | --      | --      | 8MHz            |
| Current Consumption | I <sub>DD</sub>  | ** 10mA | --      | *** 50mA        |

\*\* 10mA: Backlighting LED is off

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

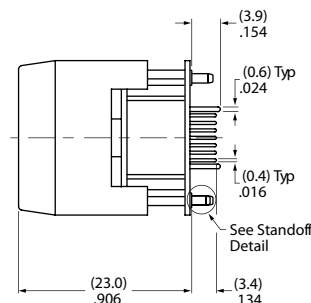
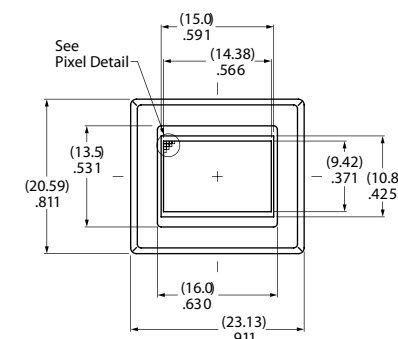
### SMARTSWITCH BLOCK DIAGRAM & PIN CONFIGURATIONS



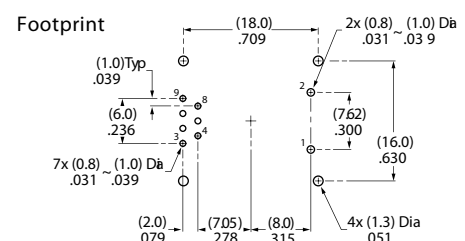
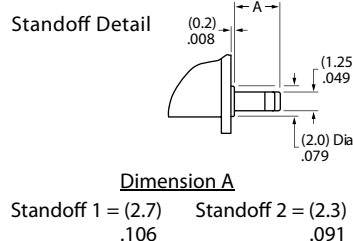
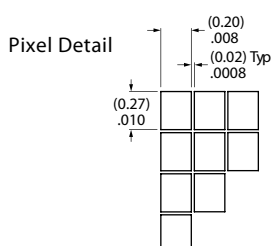
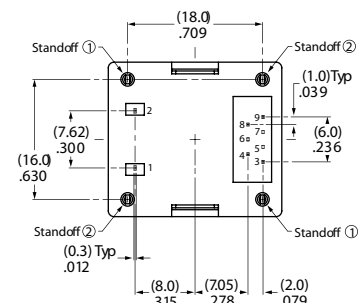
IS15DBFP4RGB  
with RGB LED and  
Black and White LCD Mode

| 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  |


### SMARTSWITCH TYPICAL DIMENSIONS



Terminal numbers are not on the switch.



### SMARTSWITCH PART NUMBER & DESCRIPTION

| Part Number | Terminals   | LCD Mode                       | LED Color      | LCD/LED   |
|-------------|-------------|--------------------------------|----------------|---|
| IS01DBFRGB  | Straight PC | Black & White<br>FSTN Positive | Red/Green/Blue |  |

### SMARTSWITCH 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                 | RGB: red/green/blue                             |

\* In 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).

#### Absolute Maximum Ratings

| 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              | Cr           | --       | 3.0     | --  |
| Viewing Angle<br>(Cr ≥ 1.1) | Up & Down    | $\theta$ | --      | 90° |
|                             | Right & Left | $\Phi$   | --      | 90° |

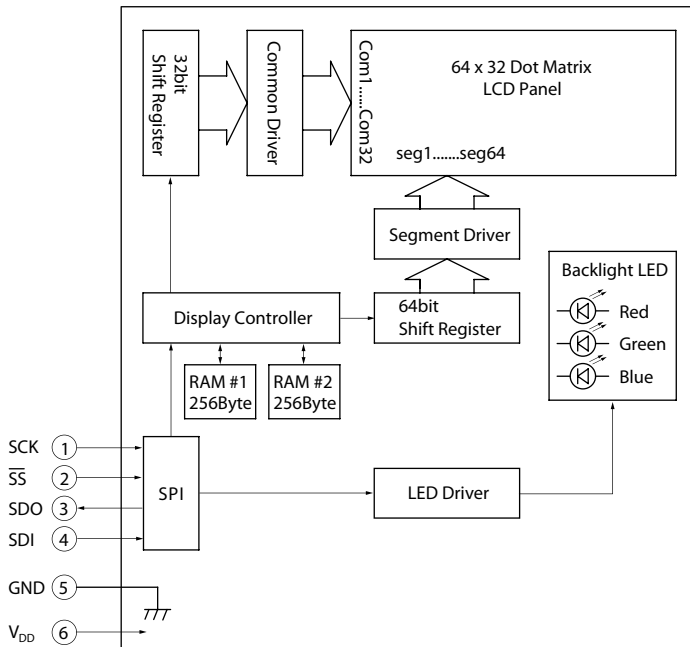
#### Recommended Operating Conditions

| Items               | Symbols   | Minimum | Typical | Maximum  |
|---------------------|-----------|---------|---------|----------|
| Supply Voltage      | $V_{DD}$  | 4.9V    | 5.0V    | 5.1V     |
| Input Voltage       | $V_I$     | 0V      | --      | $V_{DD}$ |
| 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

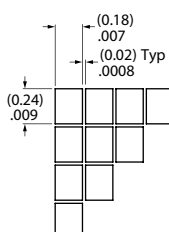
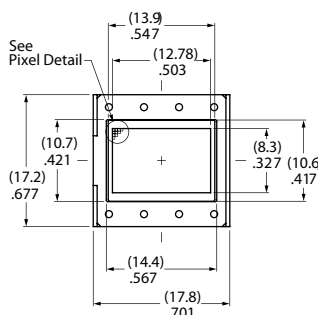
### SMARTSWITCH BLOCK DIAGRAM & PIN CONFIGURATIONS



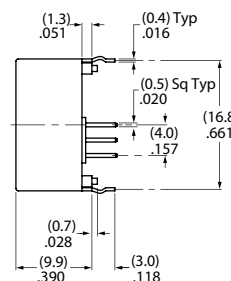
IS01DBFRGB  
with RGB LED and  
Black and White LCD Mode

| 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                 |

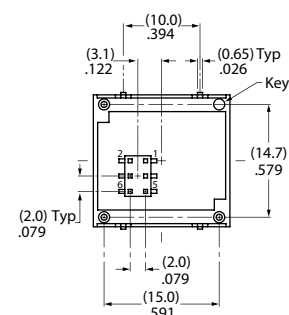
### SMARTSWITCH TYPICAL DIMENSIONS



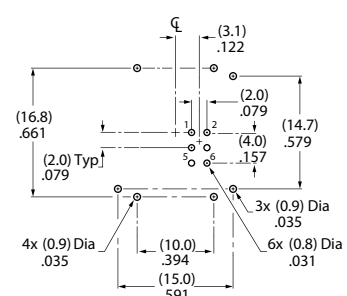
Pixel Detail



Terminal numbers are not on the device.



Footprint



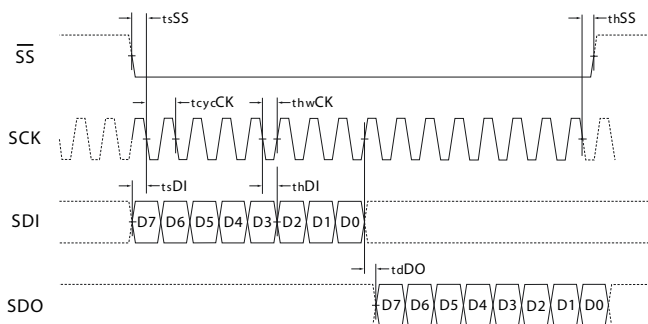
### TIMING SPECIFICATIONS FOR SMARTSWITCH & SMARTDISPLAY

#### SPI Characteristics (See Timing Diagram)

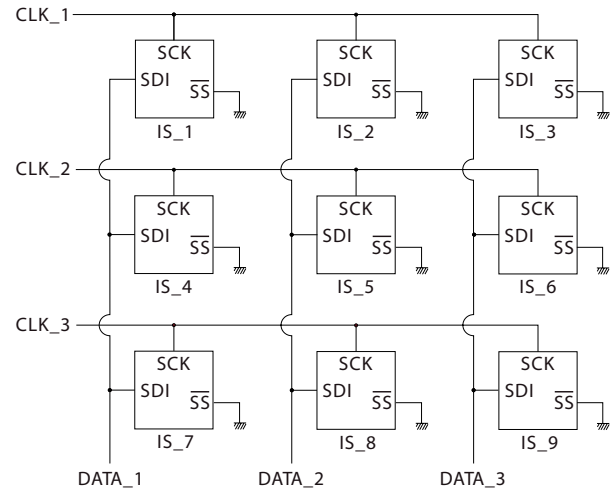
(Temperature at  $-15^{\circ}\text{C} \sim +50^{\circ}\text{C}$  and  $V_{DD} = 5.0\text{V} \pm 2\%$ )

| Items                                  | Symbols     | Minimum | Maximum |
|--|-------------|---------|---------|
| SPI $\overline{\text{SS}}$ Set Up Time | $t_{sSS}$   | 10ns    |         |
| SPI $\overline{\text{SS}}$ 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    |         |

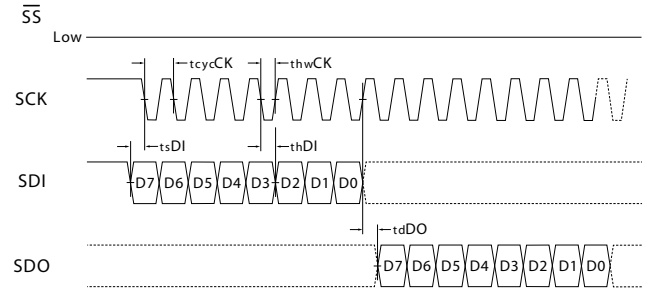
SPI Timing Chart ( $\overline{\text{SS}}$  Using)



Circuit Example



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



SDI and SCK shall be kept high when the communication is not complete.

### BITMAP

| Segment | 1 2 3 4 5 6 7 8         | 9...16  | ... | 49...56 | 57 58 59 60 61 62 63 64 |
|---------|-------------------------|---------|-----|---------|-------------------------|
|         | 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 |
|         | Byte16                  |         |     |         | Byte9                   |
| COM2    | 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 SMARTSWITCH & SMARTDISPLAY

- 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 is 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 below 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<br>2 bits x 3 | For each of RGB:<br>00 = off      10 = 1/2<br>01 = 1/4      11 = full |

#### LED (Backlight) Brightness Set

| Command |          | Data                      | Remarks   |
|---------|----------|---------------------------|---|
| Hex     | Binary   |                           |   |
| 0 x 41  | 01000001 | * * * 1 1 1 1 1<br>3 bits | For leading 3bits:<br>000 = 1/20 (dark)      100 = 1/3<br>001 = 1/10      101 = 1/2<br>010 = 1/7      110 = 2/3<br>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 |

### PRECAUTIONS FOR HANDLING & STORAGE

#### 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: 5 seconds maximum @ 270°C maximum
7. Do not exceed 60°C at the LCD level.



#### 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.