

DISPLAY PART NUMBER & DESCRIPTION

| Part Number | Terminals | LCD Mode | LED Color |
|-------------------|-------------|--------------------------------|----------------|
| IS01EBFRGB | 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 | 14.4mm 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 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 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 | 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} | — | — | 0.2V _{DD} |
| SPI Clock Frequency | f _{SCK} | — | — | 8MHz |
| Current Consumption | I _{DD} | ** 10mA | — | *** 60mA |

** 10mA: Backlighting LED is off

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

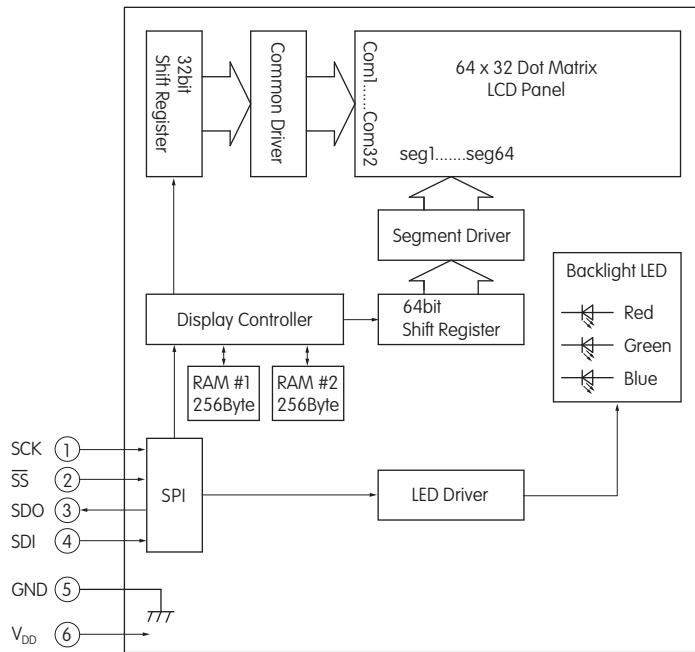
Absolute Maximum Ratings (Temperature at 25°C)

| 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 | Minimum | Typical | Maximum |
|-----------------------------|--------------|---------|---------|---------|
| Contrast Ratio | Cr | — | 3.0 | — |
| Viewing Angle (Cr ≥ 1.1) | Up & Down | θ | 90° | — |
| | Right & Left | φ | 90° | — |

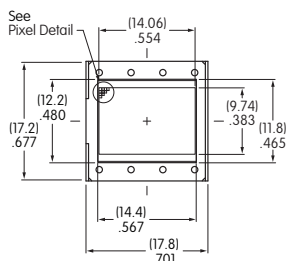
DISPLAY BLOCK DIAGRAM & PIN CONFIGURATIONS



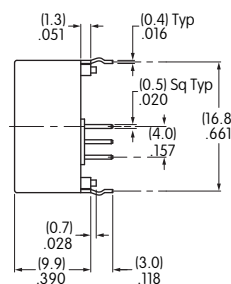
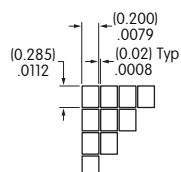
ISO1EBFRGB
RGB LED Backlight
Black and White LCD

| 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 _{DD} | Power | Power source for logic circuit and LCD |

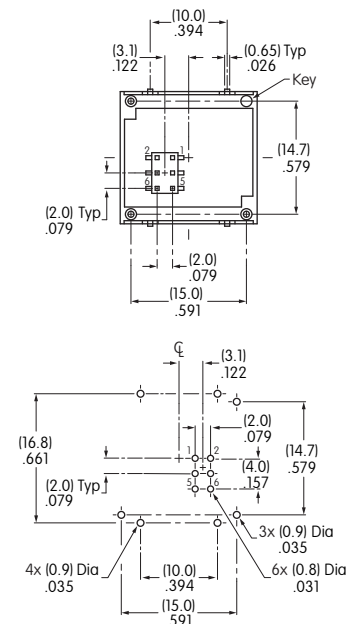
TYPICAL DISPLAY DIMENSIONS



Pixel Detail



Footprint



Terminal numbers are not on the device.

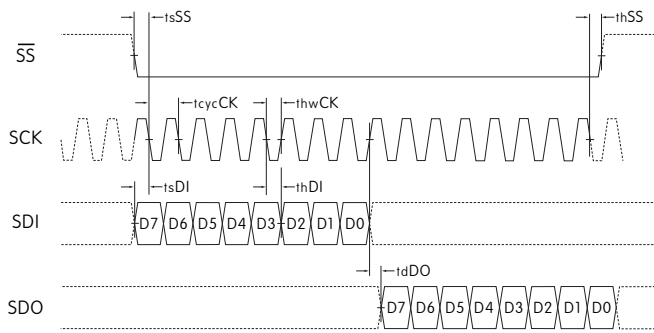
TIMING SPECIFICATIONS FOR SWITCHES & DISPLAY

SPI Characteristics (See Timing Diagram)

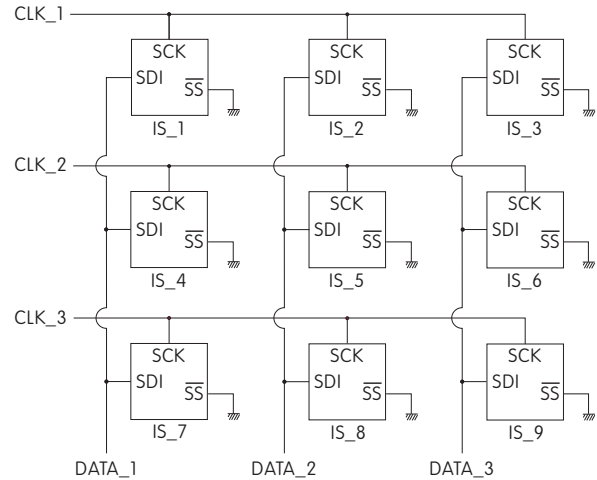
(Temperature at -15°C ~ +50°C and V_{DD} = 5.0V ± 2%)

| 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 | |

SPI Timing Chart (\overline{SS} Using)

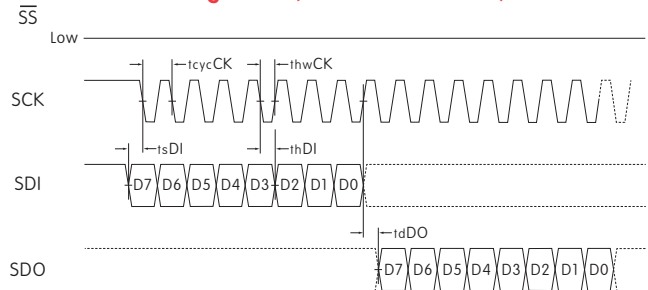


Circuit Example



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 | | | | | | | | | | | | | | | |
| COM32 | 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 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 | 0000011 | 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.

