Wide View Compact LCD 36 x 24 Pushbuttons

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.

PART NUMBERS & DESCRIPTIONS

<table>
<thead>
<tr>
<th>Part Number</th>
<th>Switch Description</th>
<th>LCD Mode</th>
<th>LED Color</th>
</tr>
</thead>
<tbody>
<tr>
<td>IS15BSBFP4RGB</td>
<td>SPST Momentary ON Gold Contacts Straight PC Terminals</td>
<td>Black &amp; White FSTN Positive</td>
<td>* Red/Green/Blue</td>
</tr>
<tr>
<td>IS15BSAFP4CF</td>
<td>SPST Momentary ON Gold Contacts Straight PC Terminals</td>
<td>Black &amp; White FSTN Positive</td>
<td>* Red/Green</td>
</tr>
</tbody>
</table>

* Simultaneous illumination of LEDs achieves infinite colors.

CHARACTERISTICS OF DISPLAY

Viewing Area 14.5mm x 11.8mm (horizontal x vertical)
Pixel Size 0.371mm x 0.445mm (horizontal x vertical)
Backlight LED RGB: red/green/blue  Bicolor: red/green
**Block Diagram & Pin Configurations for RGB**

**IS158S8FP4RGB**
RGB LED Backlight
Block 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 | Power source for logic circuit |
11 | V_do | Power | Power source for LCD drive |
12 | V_LC | Power | Anode for common |
13 | BL-LED (+) | Terminal of Backlight LED | Cathode for green |
## TYPICAL COMPACT SWITCH DIMENSIONS

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

<table>
<thead>
<tr>
<th>Items</th>
<th>Symbols</th>
<th>Minimum</th>
<th>Typical</th>
<th>Maximum</th>
</tr>
</thead>
<tbody>
<tr>
<td>Contrast Ratio</td>
<td>Cr</td>
<td>—</td>
<td>3.0</td>
<td>—</td>
</tr>
<tr>
<td>Viewing Angle (Cr ≥ 1.1)</td>
<td>θ</td>
<td>—</td>
<td>90°</td>
<td>—</td>
</tr>
<tr>
<td></td>
<td>φ</td>
<td>—</td>
<td>90°</td>
<td>—</td>
</tr>
</tbody>
</table>

### 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 (0.071”)
- **Operating Temp. Range**: –20°C ~ +60°C (–4°F ~ +140°F)
- **Storage Temp. Range**: –30°C ~ +70°C (–22°F ~ +158°F)
# Wide View LCD 36 x 24 Pushbuttons, Display & Compacts

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

<table>
<thead>
<tr>
<th>Items</th>
<th>Symbols</th>
<th>Ratings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Supply Voltage for Logics</td>
<td>$V_{DD}$</td>
<td>$-0.3V$ to $+7.0V$</td>
</tr>
<tr>
<td>Supply Voltage for LCD</td>
<td>$V_{LC}$</td>
<td>$-0.3V$ to $+12.0V$</td>
</tr>
<tr>
<td>Input Voltage</td>
<td>$V_I$</td>
<td>$-0.3V$ to $V_{DD} +0.3V$</td>
</tr>
<tr>
<td>Output Voltage</td>
<td>$V_O$</td>
<td>$-0.3V$ to $V_{DD} +0.3V$</td>
</tr>
</tbody>
</table>

**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)
- **Pixel Format**: 36 x 24 pixels (horizontal x vertical)
- **Backlight LED**: RGB: red/green/blue Bicolor: red/green

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

<table>
<thead>
<tr>
<th>Items</th>
<th>Symbols</th>
<th>Minimum</th>
<th>Typical</th>
<th>Maximum</th>
</tr>
</thead>
<tbody>
<tr>
<td>Supply Voltage for Logics</td>
<td>$V_{DD}$</td>
<td>3.0V</td>
<td>—</td>
<td>5.5V</td>
</tr>
<tr>
<td>Supply Voltage</td>
<td>$V_{LC}$</td>
<td>—</td>
<td><em>7.3V</em></td>
<td>—</td>
</tr>
<tr>
<td>Input Voltage</td>
<td>$V_I$</td>
<td>0V</td>
<td>—</td>
<td>$V_{DD}$</td>
</tr>
<tr>
<td>Driving Frequency</td>
<td>$f_{FLM}$</td>
<td>—</td>
<td>150Hz</td>
<td>—</td>
</tr>
<tr>
<td>Clock Operation Frequency</td>
<td>$f_{SCP}$</td>
<td>—</td>
<td>8.0MHz</td>
<td>—</td>
</tr>
</tbody>
</table>

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

**DC Characteristics of LCD Drive** *(Temperature at −20°C to +60°C and $V_{DD} = 5.0V ±10%)*

<table>
<thead>
<tr>
<th>Items</th>
<th>Symbols</th>
<th>Test Conditions</th>
<th>Minimum</th>
<th>Typical $V_{DD}$</th>
<th>Maximum $V_{DD}$</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>High Level Input Voltage</td>
<td>$V_{IH}$</td>
<td>$0.7V_{DD}$</td>
<td>$V_{DD}$</td>
<td>V</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Low Level Input Voltage</td>
<td>$V_{IL}$</td>
<td>0</td>
<td>0.3$V_{DD}$</td>
<td>V</td>
<td></td>
<td></td>
</tr>
<tr>
<td>High Level Input Leakage Current</td>
<td>$I_{IH}$</td>
<td>$V_I = V_{DD}$</td>
<td>10</td>
<td>μA</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Low Level Input Leakage Current</td>
<td>$I_{IL}$</td>
<td>$V_I = 0V$</td>
<td>10</td>
<td>μA</td>
<td></td>
<td></td>
</tr>
<tr>
<td>High Level Output Voltage</td>
<td>$V_{OH}$</td>
<td>$I_{OH} = -500\mu A$</td>
<td>$V_{DD} -0.5$</td>
<td>V</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Low Level Output Voltage</td>
<td>$V_{OL}$</td>
<td>$I_{OL} = 500\mu A$</td>
<td>0.5</td>
<td>V</td>
<td></td>
<td></td>
</tr>
<tr>
<td>High Level Output Leakage Current</td>
<td>$I_{OH}$</td>
<td>$V_O = V_{DD}$</td>
<td>10</td>
<td>μA</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Low Level Output Leakage Current</td>
<td>$I_{OL}$</td>
<td>$V_O = 0V$</td>
<td>10</td>
<td>μA</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Supply Current</td>
<td>$I_{DD}$</td>
<td>$f_{SCP} = 1.0\text{MHz}$</td>
<td>500</td>
<td>2,000 μA</td>
<td></td>
<td></td>
</tr>
<tr>
<td>LCD Drive Current</td>
<td>$I_{LC}$</td>
<td>$f_P = 2.4\text{kHz}$</td>
<td>$V_{LC} = 7.3V$</td>
<td>500 2,000</td>
<td>μA</td>
<td></td>
</tr>
</tbody>
</table>
Timing Characteristics of LCD Drive IC
(Temperature at –20°C to +60°C and V_DD = 5.0V ±10%)

<table>
<thead>
<tr>
<th>Items</th>
<th>Symbols</th>
<th>Minimum</th>
<th>Maximum</th>
</tr>
</thead>
<tbody>
<tr>
<td>Clock Operation Frequency</td>
<td>f_SCPr</td>
<td>8.0MHz</td>
<td></td>
</tr>
<tr>
<td>Latch Pulse Frequency</td>
<td>f_Lp</td>
<td>50kHz</td>
<td></td>
</tr>
<tr>
<td>Clock High Level Pulse Width</td>
<td>t_CWH</td>
<td></td>
<td>50ns</td>
</tr>
<tr>
<td>Clock Low Level Pulse Width</td>
<td>t_CWkl</td>
<td></td>
<td>50ns</td>
</tr>
<tr>
<td>Data Setup Time</td>
<td>t_DSD</td>
<td>45ns</td>
<td></td>
</tr>
<tr>
<td>Data Hold Time</td>
<td>t_DHD</td>
<td>50ns</td>
<td></td>
</tr>
<tr>
<td>Data Output Delay Time</td>
<td>t_DDO</td>
<td>25ns</td>
<td></td>
</tr>
<tr>
<td>Latch Setup Time</td>
<td>t_DSL</td>
<td>50ns</td>
<td></td>
</tr>
<tr>
<td>Latch Hold Time</td>
<td>t_DHl</td>
<td>50ns</td>
<td></td>
</tr>
<tr>
<td>Latch High Level Width</td>
<td>t_WH</td>
<td></td>
<td>50ns</td>
</tr>
<tr>
<td>FLM Setup Time</td>
<td>t_DSF</td>
<td>50ns</td>
<td></td>
</tr>
<tr>
<td>FLM Hold Time</td>
<td>t_DHF</td>
<td>50ns</td>
<td></td>
</tr>
<tr>
<td>SCP, LP Rise/Fall Time</td>
<td>t_f/I</td>
<td>15ns</td>
<td></td>
</tr>
</tbody>
</table>

Timing Diagram

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

LED CHARACTERISTICS

Typical Electrical Characteristics (Temperature at 25°C)

<table>
<thead>
<tr>
<th>Backlight Color</th>
<th>Symbols</th>
<th>Red</th>
<th>Green</th>
<th>Blue</th>
<th>Red/Green</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Forward Current</td>
<td>l_F</td>
<td>10</td>
<td>8.5</td>
<td>8.0</td>
<td>15/15</td>
<td>mA</td>
</tr>
</tbody>
</table>

ABSOLUTE MAXIMUM FOR LEDS

Electrical Characteristics (Temperature at 25°C)

<table>
<thead>
<tr>
<th>Backlight Color</th>
<th>Symbols</th>
<th>Red</th>
<th>Green</th>
<th>Blue</th>
<th>Red/Green</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Forward Current</td>
<td>l_F</td>
<td>20</td>
<td>20</td>
<td>20</td>
<td>20</td>
<td>mA</td>
</tr>
<tr>
<td>Forward Voltage</td>
<td>V_F</td>
<td>2.0</td>
<td>2.8</td>
<td>2.8</td>
<td>1.9/1.9</td>
<td>V</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(l_F = 10mA)</td>
<td>(l_F = 8.5mA)</td>
<td>(l_F = 8.0mA)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Reverse Voltage</td>
<td>V_R</td>
<td>4.0</td>
<td>4.0</td>
<td>4.0</td>
<td>4.0</td>
<td>V</td>
</tr>
<tr>
<td>Current Reduction Rate Above 25°C</td>
<td>ΔI_F(DC)</td>
<td>–0.33</td>
<td>–0.33</td>
<td>–0.33</td>
<td>–0.26</td>
<td>mA/^°C</td>
</tr>
</tbody>
</table>

*Power Dissipation (LED Overall 115mW)

| l_P       | 40  | 60  | 60  | 130 maximum | 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.
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.
Optional Accessories

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 Number for AT9704-02YC
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
Wide View RGB LCD 36 x 24
IS15BFP4RGB
Wide View Bicolor LCD 36 x 24
* IS15BAFP4CF

* AT9704-065E Socket may be used with IS15BAFP4CF by removing pin 3.

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 LCD 64 x 32
IS15EFP4RGB-09YN
Wide View LCD 64 x 32 Compact
IS15ESFP4RGB
Wide View LCD 36 x 24
IS15BAFP4CF
Wide View LCD 36 x 24 Compact
IS15BSFP4RGB
IS15BSAFP4CF

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

Note: AT9704-065E Socket may be used with IS15BAFP4CF by removing pin 3.