

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)

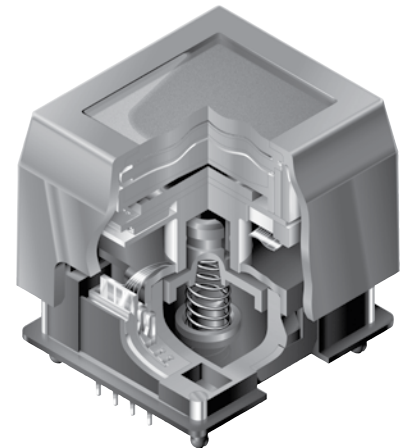
High reliability and long life of three million actuations minimum

Epoxy sealed straight PC terminals

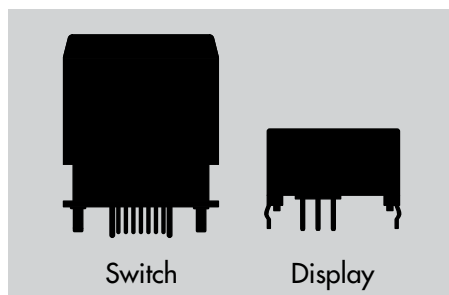
Snap-in standoff for easy, secure mounting and alignment

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



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

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SWITCH PART NUMBER & DESCRIPTION

Part Number	Switch Description	LCD Mode	LED Color
IS15DBFP4RGB	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	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).

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	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 _{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	—	*** 50mA

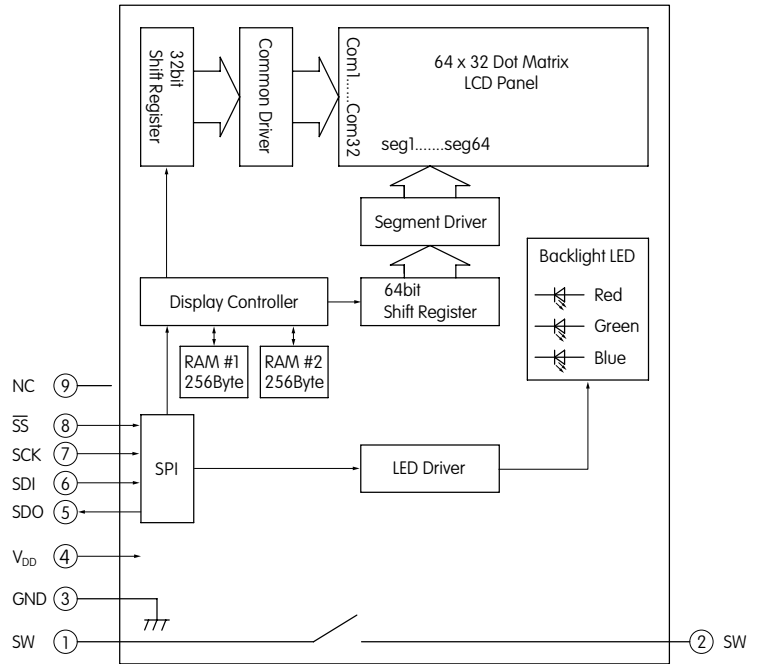
** 10mA: Backlighting LED is off

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

SWITCH BLOCK DIAGRAM & PIN CONFIGURATIONS

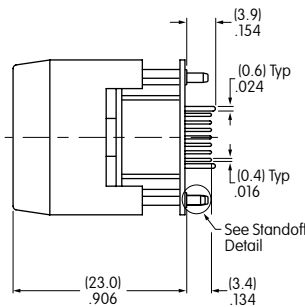
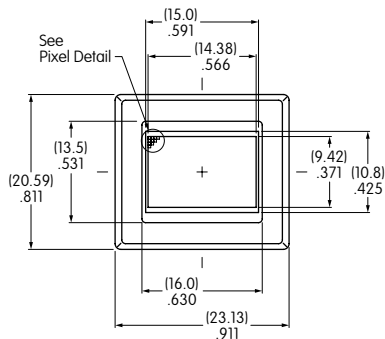


IS15DBFP4RGB
RGB LED and
Black and White LCD Mode

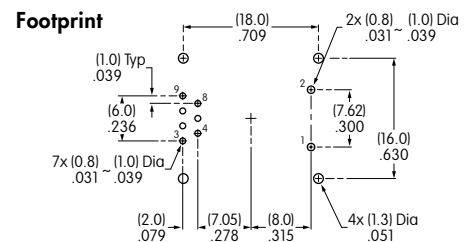
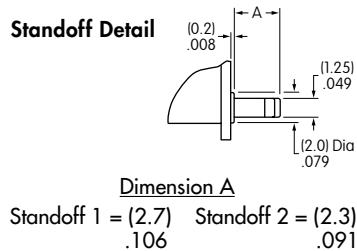
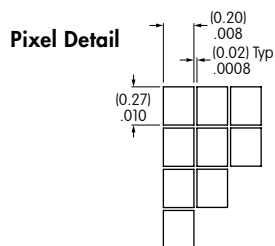
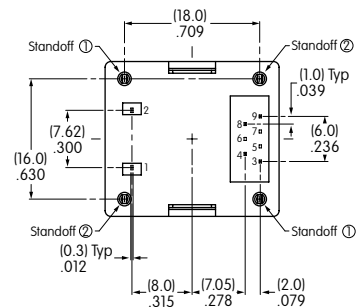


Pin No.	Symbol	Name	Function
①	SW	Terminal of Switch	Normally open
②	SW	Terminal of Switch	Normally open
③	GND	Ground	
④	V _{DD}	Power	Power source for logic circuit and LCD
⑤	SDO	Data Out	Data output line for SPI
⑥	SDI	Data In	Data input line for SPI
⑦	SCK	Serial Clock	Clock line for SPI that synchronizes 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
IS01DBFRGB	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	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).

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	Cr	—	3.0	—
Viewing Angle (Cr ≥ 1.1)	Up & Down	θ	—	90°
	Right & Left	ϕ	—	90°

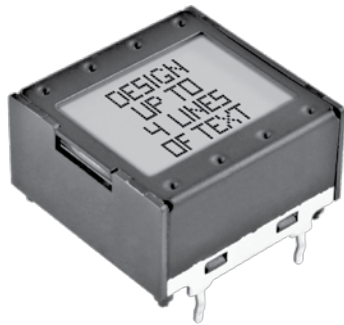
Recommended Operating Conditions (Temperature at 25°C)

Items	Symbols	Minimum	Typical	Maximum
Supply Voltage	V_{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

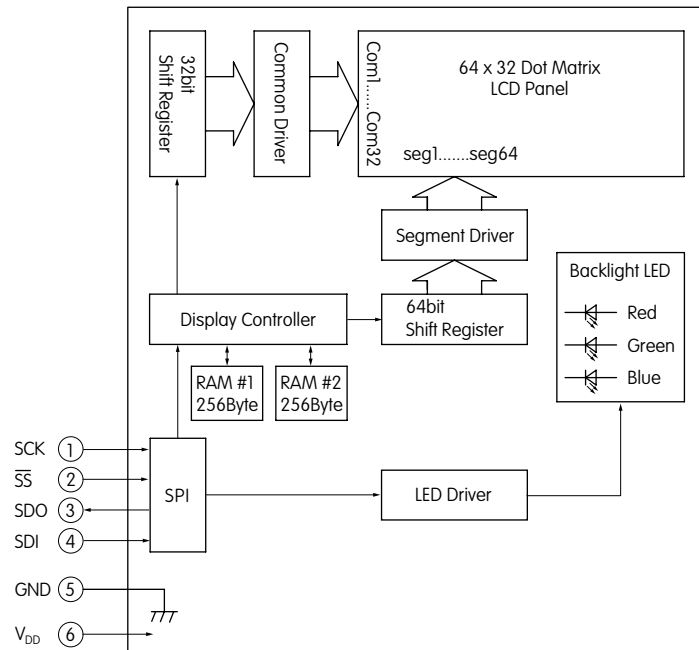
** 10mA: Backlighting LED is off

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

DISPLAY BLOCK DIAGRAM & PIN CONFIGURATIONS

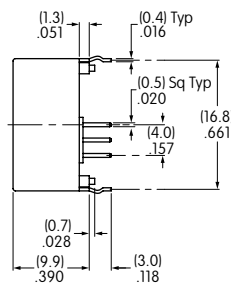
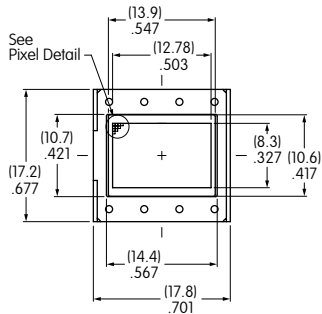


ISO1DBFRGB
RGB LED and
Black and White LCD Mode

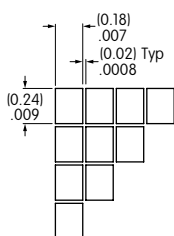
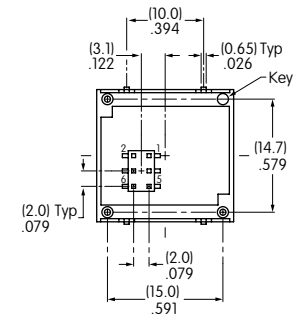


Pin No.	Symbol	Name	Function
①	SCK	Serial Clock	Clock line for SPI that synchronizes commands and data
②	\overline{SS}	Slave Select	Chip select for SPI; line is active low
③	SDO	Data Out	Data output line for SPI
④	SDI	Data In	Data input line for SPI
⑤	GND	Ground	
⑥	V _{DD}	Power	Power source for logic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

TYPICAL DISPLAY DIMENSIONS

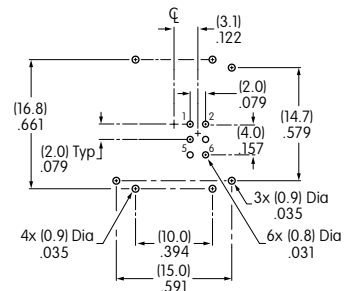


Terminal numbers are not on the device.



Pixel Detail

Footprint



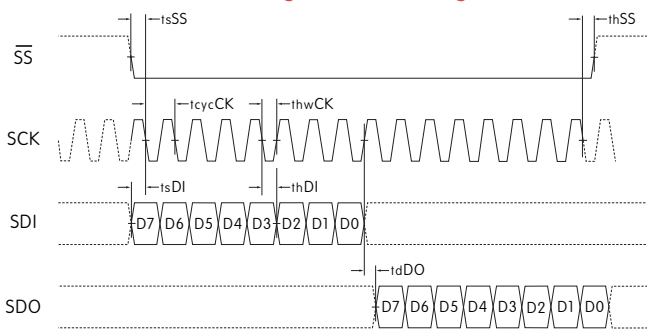
TIMING SPECIFICATIONS FOR SWITCH & DISPLAY

SPI Characteristics (See Timing Diagram)

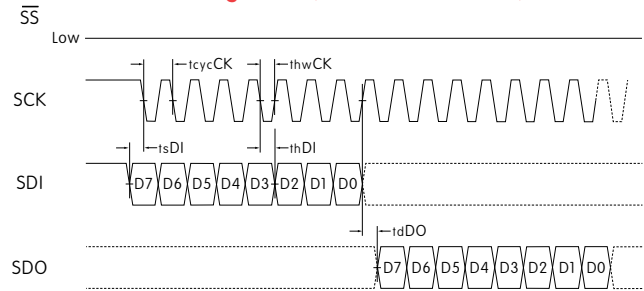
(Temperature at -15°C ~ +50°C and $V_{DD} = 5.0V \pm 2\%$)

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)

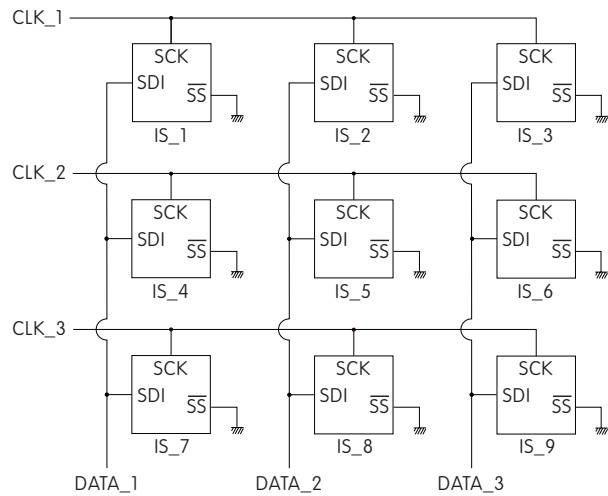


SPI Timing Chart (\overline{SS} Low Level Fixed)



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	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 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 = 1/20 100 = 1/3 (dark) 101 = 1/2 001 = 1/10 110 = 2/3 010 = 1/7 111 = full 011 = 1/5 (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

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

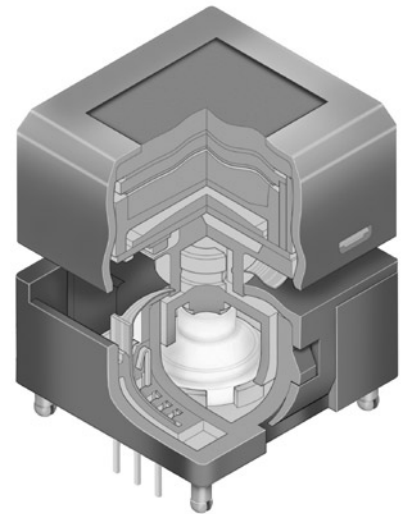
Viewing area: 13.0mm x 10.7mm (horizontal x vertical)

Variety of LED backlighting with 64 colors and 8 steps brightness

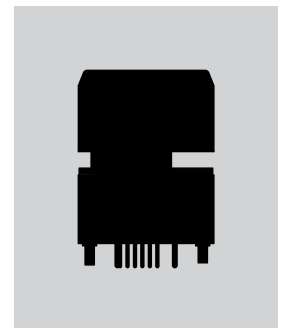
Dome gives crisp tactile feedback to positively indicate circuit transfer

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
IS15DSBFP4RGB	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 _{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 (Cr ≥ 1.1)	Up & Down	θ	90°	—
	Right & Left	φ	90°	—

BLOCK DIAGRAM & PIN CONFIGURATIONS



IS15DSBFP4RGB
RGB LED and
Black and White LCD Mode

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	13.0mm x 10.7mm (horizontal x vertical)
Pixel Format	64 x 32 pixels (horizontal x vertical)
Pixel Size	0.18mm x 0.24mm (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

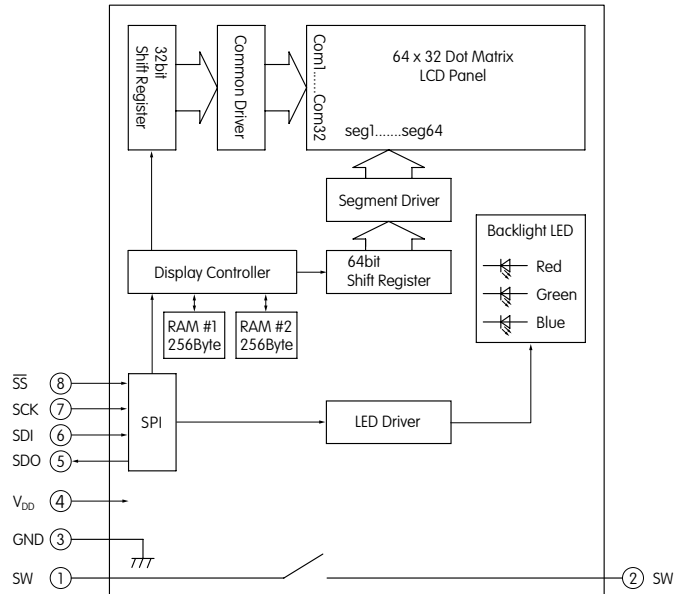
* In a low temperature environment (below 0°C), speed and contrast decrease when image changes. The non-indicator dot may become dense in a high temperature environment (about +50°C).

Recommended Operating Conditions (Temperature at 25°C)

Items	Symbols	Min	Typical	Max
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	—	*** 50mA

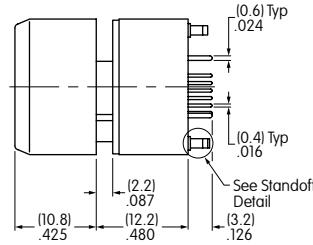
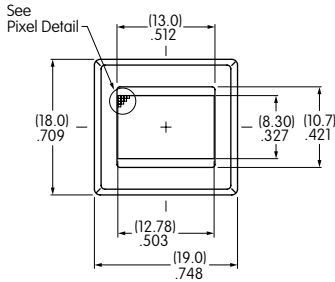
** 10mA: Backlighting LED is off

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

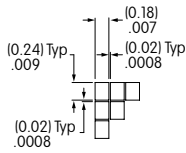
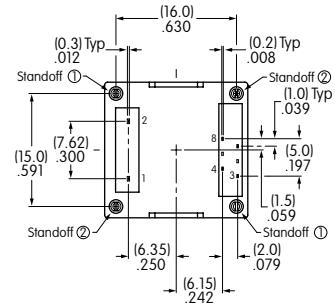


Pin No.	Symbol	Name	Function
①	SW	Terminal of Switch	Normally open
②	SW	Terminal of Switch	Normally open
③	GND	Ground	
④	V _{DD}	Power	Power source for logic circuit and LCD
⑤	SDO	Data Out	Data output line for SPI
⑥	SDI	Data In	Data input line for SPI
⑦	SCK	Serial Clock	Clock line for SPI that synchronizes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

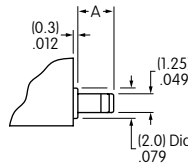
TYPICAL SWITCH DIMENSIONS



Terminal numbers are not on the switch.



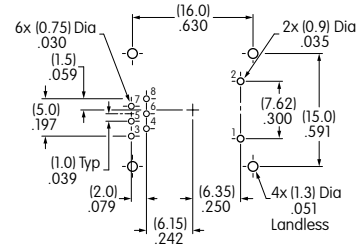
Pixel Detail



Standoff Detail

Dimension A

$$\text{Standoff 1} = (2.7) .106 \quad \text{Standoff 2} = (2.3) .091$$



Footprint

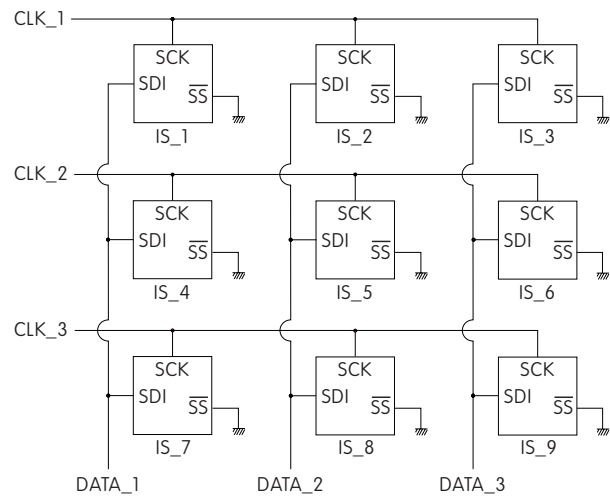
TIMING SPECIFICATIONS

SPI Characteristics (See Timing Diagram)

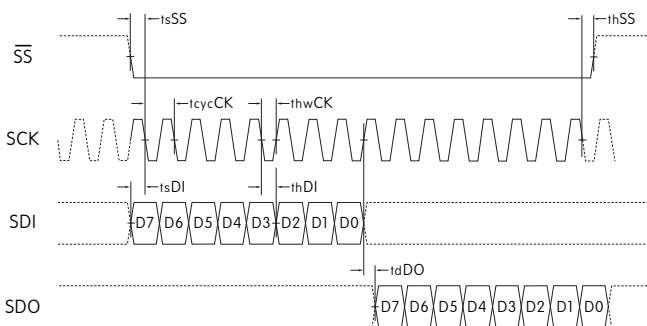
(Temperature at $-15^{\circ}\text{C} \sim +50^{\circ}\text{C}$ and $V_{DD} = 5.0\text{V} \pm 2\%$)

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	

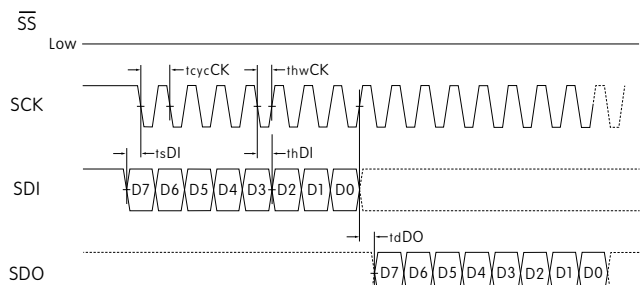
Circuit Example



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



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



SDI and SCK shall be kept high when idle.

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

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

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:
Wave Soldering: see Profile B in Supplement section.
Manual Soldering Switches: see Profile A in Supplement section.
Manual Soldering Display: see Profile B in Supplement section.
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.

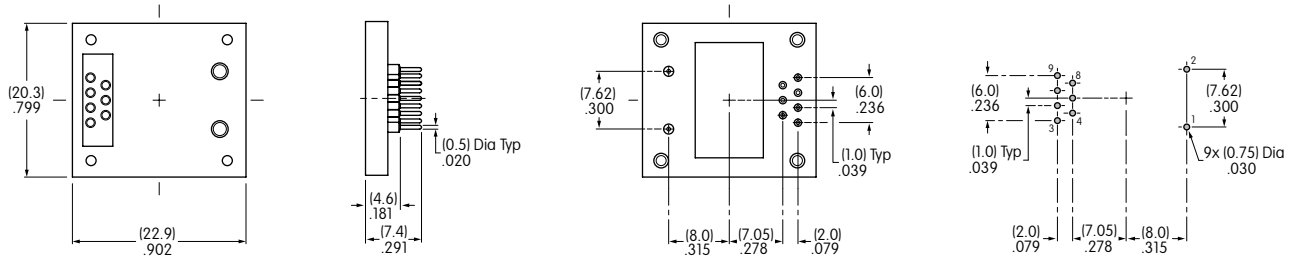
OPTIONAL ACCESSORIES

AT9704-085K Socket for LCD 64 x 32 Pushbutton ← NEW

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.

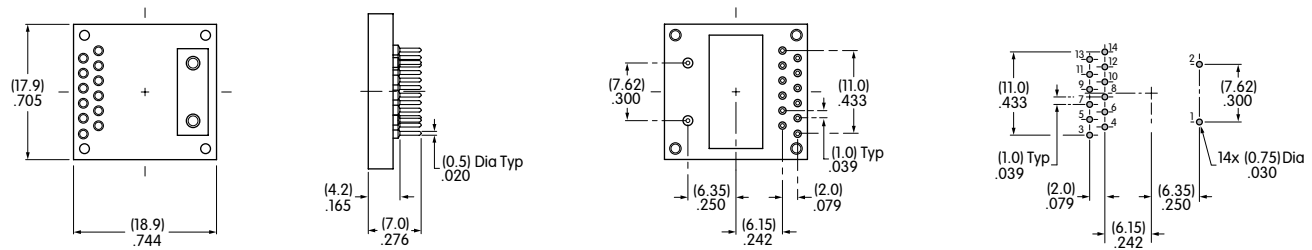


AT9704-065F Socket for Compact Pushbutton

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.



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

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