SmartSwitch™

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)

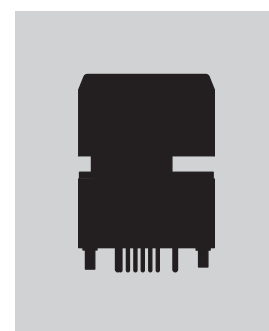Variety of LED backlighting with 64 colors and 8 steps brightness

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

ATTENTION
ELECTROSTATIC
SENSITIVE DEVICES

PART NUMBER & DESCRIPTION

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

4.1.15

# SmartSwitch™

Wide View Compact LCD 64 x 32 Pushbutton

IS15ESBFP4RGB
RGB LED Backlight
Black and White LCD

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 (.177")

TYPICAL SWITCH DIMENSIONS
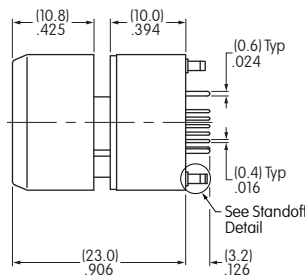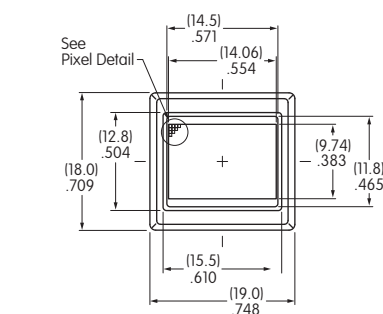
Terminal numbers are not on the switch.

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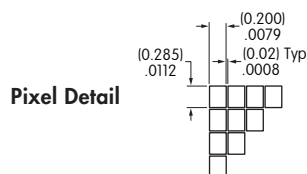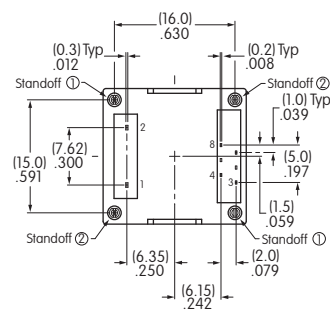
Standoff Detail
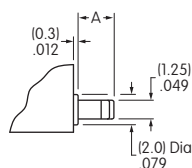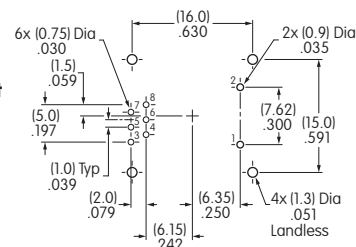
Dimension A
Standoff 1 = (2.7)   Standoff 2 = (2.3)
.106   .091

Footprint

NKK SWITCHES

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 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.

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	—	*** 60mA

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

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_{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
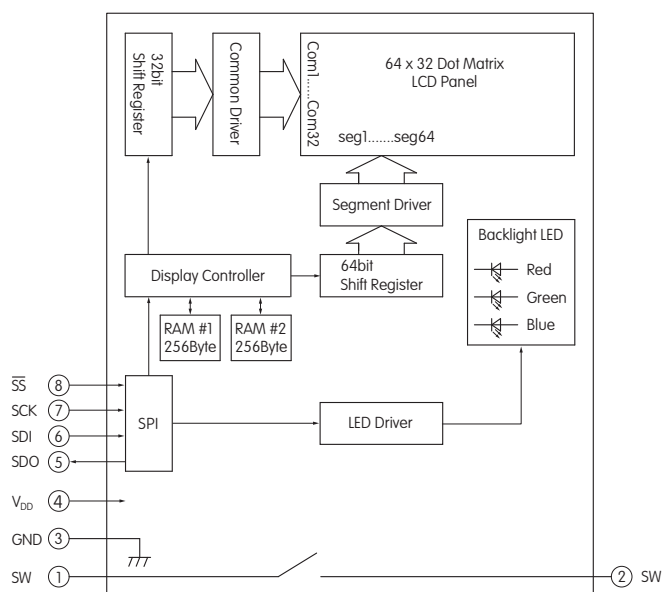
TIMING SPECIFICATIONS

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	tsSS	10ns	
SPI_$\overline{SS}$ Hold Time	thSS	10ns	
SPI_CLK Cycle	tcycCK		8MHz
SPI_CLK Width	thwCK	10ns	
SPI_DI Set Up Time	tsDI	10ns	
SPI_DI Hold Time	thDI	10ns	
SPI_DO Delay Time	tdDO	10ns	

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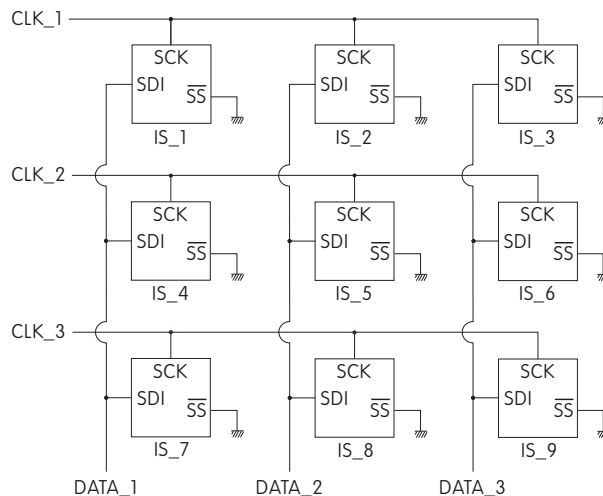
It is recommended that all $\overline{SS}$ pins be connected to a controller pin instead of ground. A clock glitch during power up could cause the communication to fall out of sync. Toggling the $\overline{SS}$ line resets the communication.

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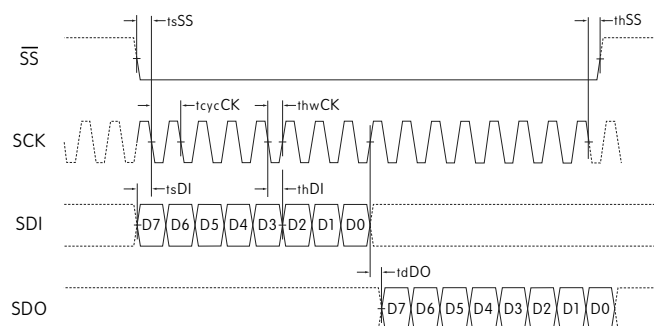
SPI Timing Chart ($\overline{SS}$ Low Level Fixed)

SDI and SCK shall be kept high when idle.

NKK SWITCHES

BITMAP

Common	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

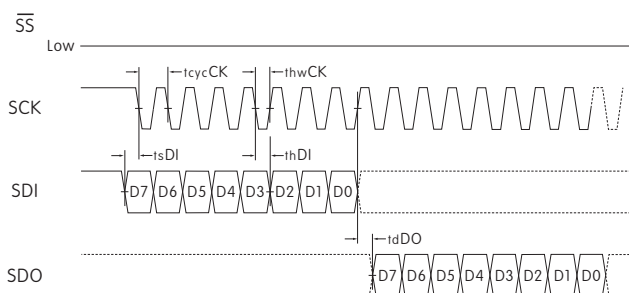### Transferring Display Data/Displaying LCD Command and Data Sequence

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

- 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

ATTENTION
ELECTROSTATIC
SENSITIVE DEVICES

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: see Profile A 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.

NKK
SWITCHES

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