

SmartSwitch™ OLED & LCD Programmable Switches & Displays

NKK SWITCHES HONG KONG CO., LTD.

What is SmartSwitch?

NKK's SmartSwitch products are user-friendly interfaces which combine a pushbutton or rocker switch with a programmable OLED or LCD display in one device. There are three product categories within the SmartSwitch family:

- Pushbutton switch with built-in display
- Rocker switch with built-in display
- Stand-alone display

Why SmartSwitch?

- Smallest off-the-shelf OLED and LCD devices in the industry
- Widest offering of products and development tools
- In-house engineering for design support
- Re-configure switches and entire panels instantly
- Achieve complex designs with fewer devices and less inventory
- Based on NKK customers' ROI: significant reduction of panel space, switches, installation time, and cost
- Display industry specific graphics and moving images
- Use multiple languages without need for language specific labels
- Simplifies complex, multi-decision operations

Main Applications

Broadcast Panels Lighting Theater controls Process Control Test Equipment Military Simulation Rael Time Data Monitoring Medical Emargency Call Dispatch Machine Control/Robotics Security Systems



Product Overview

	Special Features	Outer Dimensions	Basic Specifications
Full Screen OLED Pushbutton	Display Videos 65K Colors Sharp Display of Small Text/Graphics 180° Viewing Angle Controller on Board/SPI Best Contrast in the Market Up to 6 Lines with 10 Characters Each	Pushbutton: 23.13 x 20.59 x 23 mm	Display Luminance Half-life: 100,000 hrs. @ 50cd/m ² with 40% pixels on 50,000 hrs. @ 100cd/m ² with 40% pixels on Operating Temperature: -20°C to +70°C Mechanical/Electrical Life: 1,000,000 actuations min.
OLED Pushbutton	Display Videos 65K Colors Sharp Display of Small Text/Graphics 180° Viewing Angle Controller on Board/SPI Best Contrast in the Market Up to 6 Lines with 10 Characters Each	Pushbutton: 23.13 x 20.59 x 23 mm Display : 17.8 x 17.2 x 9.9 mm	Display Luminance Half-life: 60,000 hrs. @ 50cd/m ² with 40% pixels on 30,000 hrs. @ 100cd/m ² with 40% pixels on Operating Temperature: -20°C to +70°C Mechanical/Electrical Life: 3,000,000 actuations min.
ICD 64 × 32	RGB LED Backlight, 64 Colors • Controlled via Software Controller on Board/SPI Long Life LCD Up to 4 Lines with 10 Characters Each	Pushbutton: 23.13 × 20.59 × 23 mm Compact Pushbutton: 19 × 18 × 23 mm Display: 17.8 × 17.2 × 9.9 mm	Operating Temperature: -15°C to +50°C (-20°C to +60°C available) Mechanical/Electrical Life: 3,000,000 operations min. 1,000,000 actuations min. For Compact
LCD 36 × 24	Bicolor or RGB Backlight LCD Driver on Board Long Life LCD Flexible Control of Backlight and LCD Up to 3 Lines with 6 Characters Each	Pushbutton: 23.13 x 20.59 x 23 mm Compact Pushbutton: 19 x 18 x 23 mm Display: 17.8 x 17.2 x 9.9 mm	Operating Temperature: 0°C to +40°C (-20°C to +60°C available) Mechanical/Electrical Life: 1,000,000 actuations min.
OLED Rocker	OLED Rocker Switch, SP3T Momentary IP64 Dust & Water Protection Controller on Board/SPI Largest SmartSwitch Display Area 180° Viewing Angle Up to 8 Lines with 16 Characters Each	Rocker: 37.9 x 50.7 x 5.6 mm	Display Luminance Half-life: 52,000 hrs. @ 100cd/m ² with 30% pixels on Operating Temperature: -20°C to +70°C Mechanical/Electrical Life: 1,000,000 actuations min.

All Pushbutton Versions: SPST, Momentary ON, Gold Contacts and Straight PC Terminals. Visit www.nkksmartswitch.com for complete specifications.



Full Screen OLED



OLED Pushbutton & Display



LCD Pushbutton



OLED Rocker

Full Screen OLED Pushbutton

- High definition, contrast and resolution of 96 x 64 pixels in compact screen and minimal frame
- Range of 65,536 colors in 16 bit mode
- Maximum use of display lens with ultra-thin frame provides full screen capacity
- Multiple units easily combine to form one screen, offering flexibility in size and layout
- Smooth, silent operation with short stroke of 1.8 mm (0.07") lends to tactile feedback unparalleled to touch panels
- Same outer dimensions of switch and footprint, enabling ease of replacement with current switches
- Operated by commands and data supplied via serial communications (SPI)
- Incorporates bitmap display function
- High reliability and long life of one million actuations
- Epoxy sealed straight PC terminals
- Snap-in standoff for easy, secure mounting and alignment; aids in prevention of dislodging during wave soldering
- Viewing area (horizontal x vertical): 21.28 mm x 18.74 mm



SWITCH PART NUMBER & DESCRIPTION

Part Number	Switch Description	OLED	Pixel Format
ISF15ACP4	SPST, Momentary ON Gold Contacts Straight PC Terminals	Color OLED Display Module 65,536 Colors	96RGB x 64 Pixels Horizontal x Vertical

OLED Pushbutton & Display

- High definition, contrast and resolution of 64 x 48 pixels in compact screen and minimal frame
- Range of 65,536 colors in 16 bit mode, 256 colors in 8 bit mode
- Same outer dimensions of switch and footprint, enabling ease of replacement with current switches
- Operated by commands and data supplied via serial communications (SPI)
- Low power consumption of only 3.8 mA 52RGB x 36 pixels
- Viewing area (horizontal x vertical):
 - Pushbutton 15.5 mm x 11.6 mm Display 12.9 mm x 9.6 mm



Part Number	Switch Description	OLED	Pixel Format
ISC15ANP4	SPST, Momentary ON Gold Contacts Straight PC Terminals	Color OLED Display Module 65,536 Colors	64RGB x 48 Pixels Horizontal x Vertical
ISC01P	Straight PC Terminals	Color OLED Display Module 65,536 Colors	52RGB x 36 Pixels Horizontal x Vertical



SWITCH SPECIFICATIONS

	ISF15ACP4	ISC15ANP4				
Circuit	SPST norr	nally open				
Contact Position	Leave actuator: 1) – 2) OFF	Push actuator: 1) – 2) ON				
Electrical Capacity (Resistive Load)	100mA @ 12V DC					
Contact Resistance	200 milliohms maximum @ 20mV 10mA					
Insulation Resistance	100 megohms mir	nimum @ 100V DC				
Dielectric Strength	125V AC for 1	minute minimum				
Mechanical Endurance	1,000,000 operations minimum	3,000,000 operations minimum				
Electrical Endurance	1,000,000 operations minimum 3,000,000 operations mini					
Operating Force	2.0 ± 0.5 Newtons					
Total Travel	1.8mm (0.07″)	4.5mm (0.177″)				

OLED SPECIFICATIONS

Characteristics of Display

	ISF15ACP4	ISC15ANP4			
Display Device	Color OLED c	lisplay module			
Display Mode	Passive	e matrix			
Viewing Area	21.28mm x 18.74mm (horizontal x vertical)	15.5mm x 11.6mm (horizontal x vertical)			
Pixel Format	96RGB x 64 pixels (horizontal x vertical)	64RGB x 48 pixels (horizontal x vertical)			
Pixel Size	0.222mm x 0.293mm (horizontal x vertical)	0.21mm x 0.20mm (horizontal x vertical)			
Interface	Serial (SPI) interface				
Number of Colors	65,536 Colors (16bit: R 5bit/G 6bit/B 5bit) or 256 Colors (8bit: R 2bit/G 3bit/B 3bit)				
Operating Temperature Range	−20°C ~ +70°C	(−4°F ~ +158°F)			
Storage Temperature Range	-30°C ~ +80°C (-22°F ~ +176°F)				
Operating Life (Display)	50,000 hours @ 100cd/m ² (based on 40% pixels ON)	30,000 hours (based on 40% pixels ON)			

Absolute Maximum Ratings

Recommended Operating Conditions

ltems	Symbols	Ratings	ltems S	Symbols	Minimum	Typical	Maximum
Supply Voltage for Logic/	/	$-0.3V$ to $\pm 1.0V$	Supply Voltage for Logic/Interface	V_{DD}	2.4V	2.8V	3.5V
Interface	♥ DD	0.01 10 +4.01	Supply Voltage for Drive	V_{cc}	15.0V	16.0V	17.0V
Supply Voltage for Drive	V _{cc}	-0.0V to +19.0V	Input High Level Voltage	VIH	$0.8 \times V_{DD}$		
Input Voltage	V	–0.3V to V_{DD} +0.3V	Input Low Level Voltage	V			0.2 x V _{DD}

Current Consumption (ISF15ACP4: Temperature at 25°C, V_{DD} = 2.8V, V_{CC} = 15.0V) (ISC15ANP4: Temperature at 25°C, V_{DD} = 2.8V, V_{CC} = 16.0V)

llama	S	ISF15ACP4			ISC15ANP4		
items	Symbols	Min	Typical	Max	Min	Typical	Max
All-Pixels-On Mode *Drive System Power Current	I _{cc1}	8.6mA	10.8mA	13.0mA		3.8mA	4.6mA
All-Pixels-On Mode *Logic/IF System Power Current	I _{DD1}	0.15mA	0.18mA	0.21mA	_	0.16mA	0.19mA
Sleep Mode **Drive System Power Current	I _{CC2}			10µA		—	10µA
Sleep Mode **Logic/IF System Power Current	I _{DD2}			10µA			10µA

* All pixels shall be turned on with the maximum level gray scale ** All pixels shall be turned off (while chip is operating)

Optical Characteristics (Temperature at 25°C, Initial Value: 87 x 0F)

ltems		ISF15ACP4		ISC15ANP4					
		Min	Typical	Max	Min	Typical	Max	Unif	Remarks
Luminosity		80	105	130	75	100	125	cd/m ²	White (All pixels on)
White Color	(x)	0.26	0.30	0.34	0.26	0.30	0.34		
Coordinate	(y)	0.32	0.36	0.41	0.32	0.37	0.42		
Red Color	(x)	0.62	0.66	0.70	0.63	0.67	0.71		
Coordinate	(y)	0.30	0.34	0.38	0.29	0.33	0.37		
Green Color	(x)	0.24	0.28	0.33	0.19	0.23	0.27		
Coordinate	(y)	0.60	0.63	0.66	0.61	0.65	0.69		
Blue Color	(x)	0.10	0.15	0.19	0.10	0.14	0.18		
Coordinate	(y)	0.10	0.17	0.23	0.14	0.20	0.26		
Contrast Ratio		100			100	_			

SWITCH BLOCK DIAGRAM & PIN CONFIGURATIONS





ISF15ACP4

ISC15ANP4



Pin No.	Symbol	Name	Function
1)	SW	Terminal of Switch	Normally open
2	SW	Terminal of Switch	Normally open
3	V _{DD}	Power	Power source for logic circuit
4	SS	Slave Select	Slave select for SPI. This line is active low.
5	RES	Reset	Reset signal input. When pin is low, initialization of chip is executed.
6	D/Ĉ	Data/Command	Data/Command Control. When pin is pulled low, data will be interpreted as Command; when pulled high, data will be interpreted as Data.
7	SCK	Serial Clock	Clock line for SPI that synchronizes command and data
8	SDI	Serial Data In	Data input line for SPI
9	V _{cc}	Power	Power source for drive circuit
10	GND	Ground	Connect to Ground

TYPICAL SWITCH DIMENSIONS



(0, 6)













www.nkkswitches.com.hk

_(3.4) .134

(23.0) .906

TIMING SPECIFICATIONS

ltems	Symbols	Minimum	Typical	Maximum
Clock Cycle Time	tcycle	150ns		_
D/C Setup Time	tAS	40ns		
D/C Hold Time	tан	40ns		
SS Setup Time	tcss	75ns		
SS Hold Time	tcsh	60ns		
Write Data Setup Time	tDSW	40ns		_
Write Data Hold Time	t DHW	40ns	_	_
SCK Low Time	† CLKL	75ns		—
SCK High Time	tсікн	75ns		—
SCK Rise Time	tr	_		15ns
SCK Fall Time	tF	_		15ns

AC Characteristics (Temperature at 25°C), $V_{DD} = 2.4V \sim 3.5V$)



STATE TRANSITION



State Number	State	Display	Sleep	\mathbf{V}_{cc}	\mathbf{V}_{dd}	Changing the Display
0	Power OFF	OFF		OFF	OFF	Disable
1	Display OFF	OFF	ON	ON	ON	Enable
2	Display ON	ON	OFF	ON	ON	Enable

State Transition	Transition	Index
1	Power ON	
2	Power OFF	Refer to
3	Display ON	"Power ON/OFF Sequence"
4	Display OFF	
$\overline{\mathcal{O}}$	Initialization	Initialize Setting of Command/Data
	Image Rewriting	Send Display Data
8	Display Settings	Dimmer, Scroll, etc.

Power ON/OFF Sequence



Note: Refer to Application Notes on web site.

Wide View LCD 64 x 32 Pushbutton, Compact Pushbutton & Display

- High resolution of 64 x 32 pixels
- Pushbutton switch / 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)
- Incorporates bitmap display function
- Programmable display graphics for alphanumeric characters and animated sequences
- Low energy consumption, Dust tight construction
- Snap-in standoff for easy, secure mounting and alignment; aids in prevention of dislodging during wave soldering
- Viewing area (horizontal x vertical):

Pushbutton	17.0 mm x 13.0 mm
Compact Pushbutton	14.5 mm x 11.8 mm
Display	14.4 mm x 11.8 mm



64 x 32 Pushbutton

64 x 32 Display

Wide View LCD 64 x 32, 36 x 24 Pushbutton, Compact Pushbutton & Display





64 x 32 Compact Pushbutton

Wide View LCD 36 x 24 Pushbutton, Compact Pushbutton (Custom), & Display

- RGB Backlighting provides infinite color availability (RGB Type)
- Programmable to display graphics, alphanumeric characters, and animated sequences
- Integrated liquid crystal display provides wide viewing angle with high contrast and clarity
- 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 enhance panel design and simplify production process
- Compact model saves space and accommodates smaller form factor design requirements
- Snap-in standoff for easy, secure mounting and alignment; aids in prevention of dislodging during wave soldering
- Viewing area (horizontal x vertical):

Pushbutton17.0 mCompact Pushbutton14.4 mDisplay14.4 m

17.0 mm x 13.0 mm 14.4 mm x 11.8 mm 14.4 mm x 11.8 mm





36 x 24 Display

36 x 24 Compact Pushbutton (Custom)

OLED Rocker

- White monochrome OLED featuring sharp contrast and high resolution with 96 x 64 pixels
- Wide viewing angle of 180° and large 0.92" display with exceptional contrast
- Organic LED technology in display rocker (patent pending)
- Multifunction programmable device: select with rocker, push for activation
- All-in-one solution: replaces multiple switches and displays with one device in a small package
- Easy navigation through structured menus, both forward and reverse and up and down
- Waterprotected and dust tight; conforms to IP64 of IEC60529 Standards on panel surface
- Displays up to 8 lines with 16 characters 5 x 7 each, or 5 lines with 12 characters 7 x 10 each
- Graphics and animations
- Long life OLED with 52,000 hours at 30% illumination
- Panel mount with easy snap-in installation
- Short 14.6 mm (.575") behind-panel depth for compact spaces
- Stylish black housing design with matter finish complements any application
- Operated by commands and data supplied via serial communications (SPI)
- High reliability and long mechanical and electrical life of one million actuations minimum

Part Number	Description
IS18WWC1W	OLED Rocker Switch: SP3T Switch Rocker (ON) (ON) (ON) Pushbutton Normally OFF



System Configuration

SUPPORT PRODUCTS

IS Color Editor (image data creation and editing tool): IS Color Editor is software for creating and editing images on Windows, for one page of an image file. It is used with OLED Full Screen Color IS, OLED Color IS, OLED Rocker IS, High Resolution IS, and High Resolution Compact IS. Download it from our website, or contact our sales department.



ISGU16 Graphic Board for OLED Full Screen Color Pushbutton: The ISGU16 Graphic Board for OLED Full Screen Color Pushbutton (hereinafter ISGU16) is available as a development design support tool.



Sockets for switches (by custom order):

Use of sockets makes it possible to mount only the socket by flow soldering (after the socket is mounted, fit the IS body into the socket), making soldering work more efficient.









PRECAUTIONS FOR HANDLING & STORAGE OF OLED DEVICES

ATTENTION

ELECTROSTATIC SENSITIVE DEVICES

SmartSwitch

Handling

- 1. The IS Series OLED devices are electrostatic sensitive. To avoid damage to IC, do not touch terminals unless properly isolated from static electricity.
- 2. Signal input under conditions not recommended may cause damage to the OLED unit or deterioration of the display. Follow directions regarding supply sequences of power and signal voltages.
- 3. If the OLED panel is broken, avoid touching the contents. Wash off any contact to the skin or clothing.
- 4. Limit operating force to switch keytop to 100.0N maximum, as excessive pressure may damage the OLED.
- 5. For OLED display, it is necessary for bracket legs to be Grounded.
- Recommended soldering time and temperature limits for OLED switch or display: Wave Soldering: see Profile A in Supplement section. Manual Soldering: see Profile A in Supplement section. Avoid temperatures exceeding 80°C at the OLED.
- 7. The IS series OLED devices are not process sealed.
- 8. Pixels acquire diminished brightness over time and use, and those most frequently habituated have greater reduction of brightness than those less used. To minimize this difference, operate OLED unit so that all pixels are used as consistently as possible.
- 9. For switch, 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. For display, avoid contact with any flux or detergent. If any liquids spill on display surface, immediately wipe with soft absorbent cloth.

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.

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