



SE6432
RGB-backlit
inverse DFSTN LCD Keyswitch
with Multi-Segment Color MSC™

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GENERAL DESCRIPTION



The SE switch family introduces new switch variants into the Sxnnnn Series of **RGB**-backlit LCD switches. The SE6432 features **Multi Segment Color MSC™** allowing for different **RGB** background colors in the upper and lower segments of the display.

The SE6432 with command driven serial interfaces integrates a graphical negative DFSTN 64 by 32 pixel liquid crystal display with **RGB** background lighting in a push-button switch design. The SE6432 keys are controlled via a serial interface to the integrated **MSC™** electronics, which control the interface, display and backlighting. SE6432 keys self-initialize without external setup commands. Data only needs to be transmitted when a change is made to the display or background colors.

Only six contact terminals are used to provide power, clock and data lines as well as the switch contacts. The contact pins of the switch mechanism are isolated from the internal electronics.

IMPROVEMENTS AND INNOVATIONS

- **Multi Segment Color MSC™**
- Mode command for Standard and Positive Mode
- NEW - extended input voltage range of 4.5 – 5.5 Volt
- IMPROVED - contrast ratio
- IMPROVED - viewing angle

COMPATIBILITY

The SE6432 switches have the same form factor as the SA/SB/SI/SM switches and are pin and command compatible for drop-in replacement into existing system designs. They are, of course, fully compatible with the SC6432 (without **Multi Segment Color MSC™**).

Note: **Mixed installation of SA/SB/SI/SM and SC/SD/SE switches in the same key matrix is NOT recommended since the different AT and MSC™ electronics packages may cause unintended timing and communications issues.**

PRODUCT FEATURES

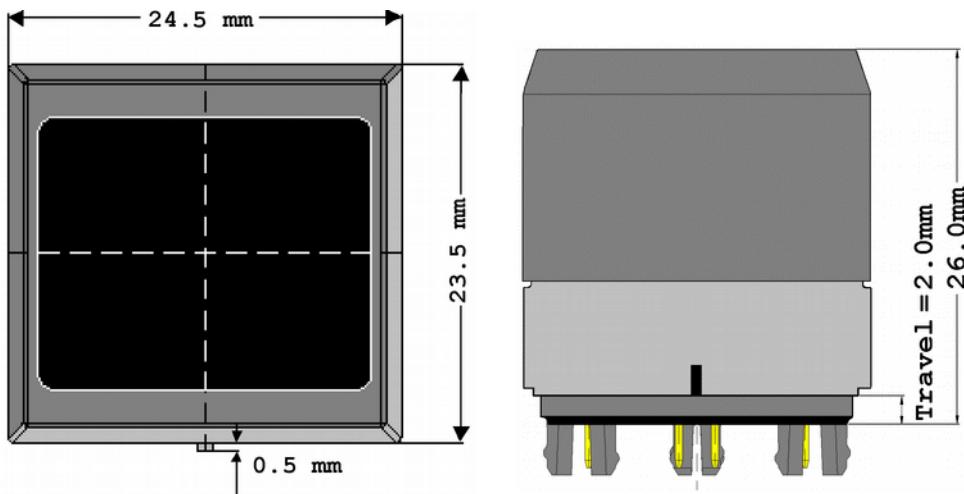
Feature	Description
Resolution	64 x 32 pixels
Multi Segment Color MSC™ RGB Colors	more than 1 million RGB background colors each in the upper and lower segment
Color Calibration	Improved color calibration results in maximum uniformity across RGB color spectrum based on MSC™ electronics.
Self-Initialisation	All keys self-initialise. No external setup commands required.
Low Power Consumption	Less than 60mA maximum current is needed when bright white backlighting is selected. Typical value is less than 25mA with one of the RGB colors.
Interfaces	Synchronous serial 16-bit interfaces <i>(custom protocols available upon request)</i>
External clock	128 kHz up to 4MHz
Maximum speed	up to 4 Mbaud
Operating supply	4.5V - 5.5V
Keyswitch type	tactile, 2.0 mm travel with over-travel protection
Keyswitch life time	> 3.0 million cycles
Contact resistance	< 200 Ohm
Operating temperature	0°C to 55°C
Storage temperature	-20°C to 65°C

MECHANICAL CHARACTERISTICS

Dimensions

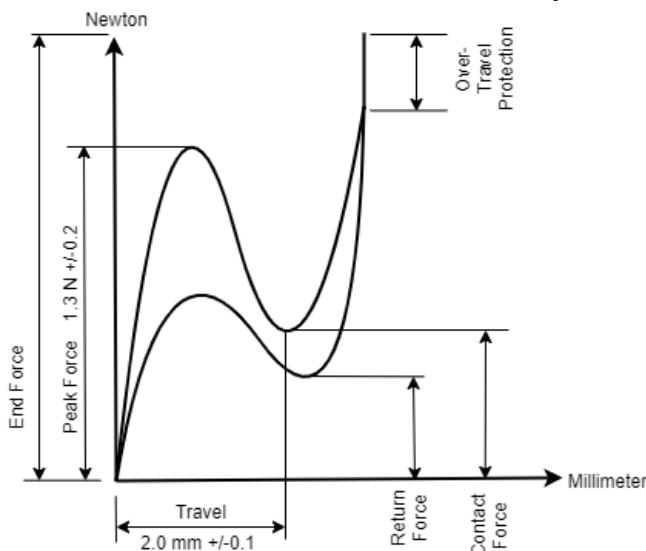
Dimensions (X x Y x Z) 24.5 x 23.5 x 26.0 mm + / - 0,2 mm

Screen size (X x Y) 20.0 x 16.5 mm + / - 0,1 mm



Keyswitch

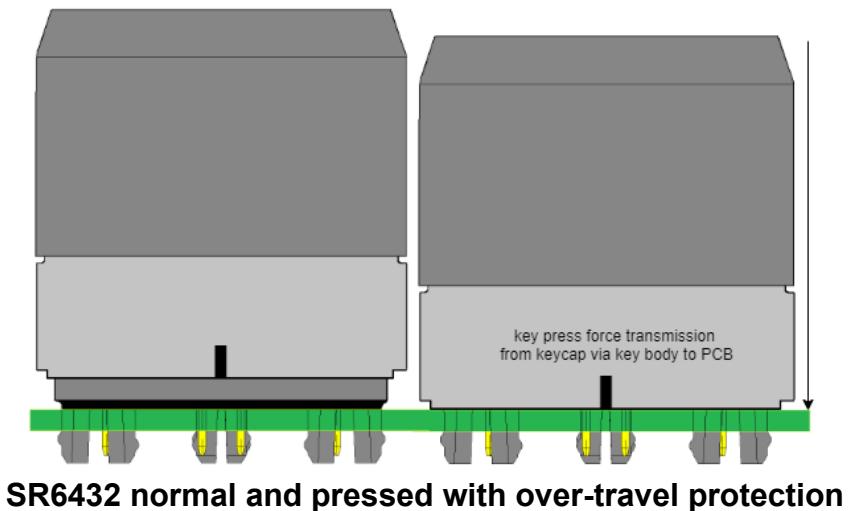
Keyswitch	Key stroke	2.0 mm +/- 0.1 mm; tactile
Operation force:		1.3 N +/- 0.2 N
Over travel protection:		yes
Lifetime:		> 3 million cycles



Over-Travel Protection

In order to protect the carbon pill contact element and extend the lifetime of the keyswitch element, SD/SE6432 switches are over-travel protected by the design of the keyswitch housing.

When the keyswitch is pressed and before the carbon pill element is fully compressed, the force is transmitted from the keycap through the keyswitch housing onto the circuit board. Any additional force that is applied to the switch is not transmitted to the contact element, but to the PCB, protecting the contact element from excessive wear and damage.

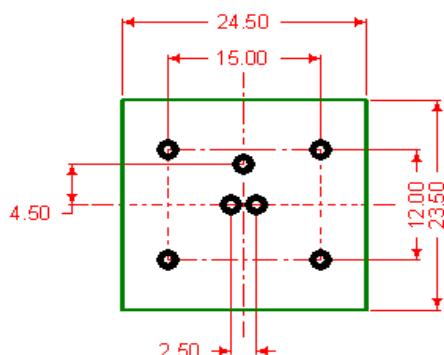


SR6432 normal and pressed with over-travel protection

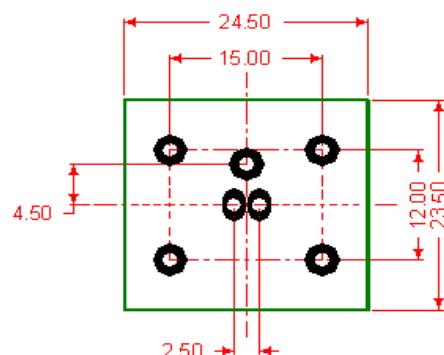
PCB Footprint

Direct PCB Mount Socket Mount

(top view) (top view)



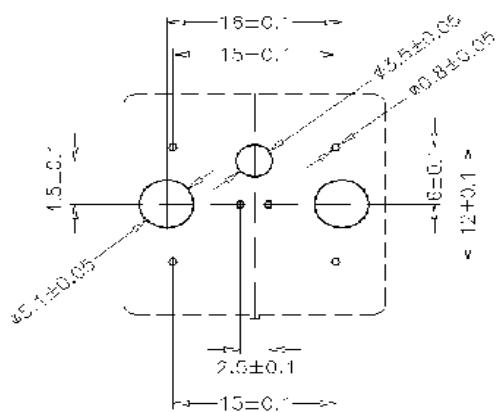
● Ø1.00 PTH HOLE x Ø2.00 PADS
● Ø1.50 PTH HOLE x Ø2.00x3.20 PADS
● Ø1.50 PTH HOLE x Ø3.20 PADS



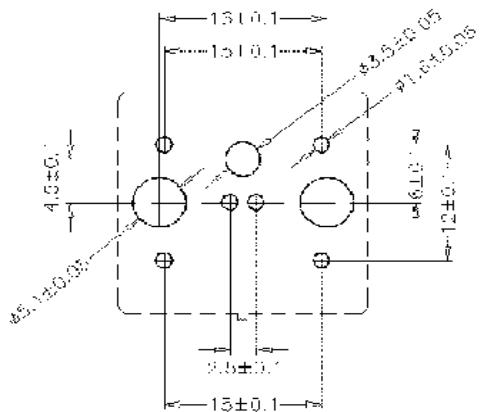
- Ø1.00 PTH HOLE x Ø2.00 PADS
- Ø1.50 PTH HOLE x Ø2.00x3.20 PADS
- Ø1.50 PTH HOLE x Ø3.20 PADS

Drill Masks

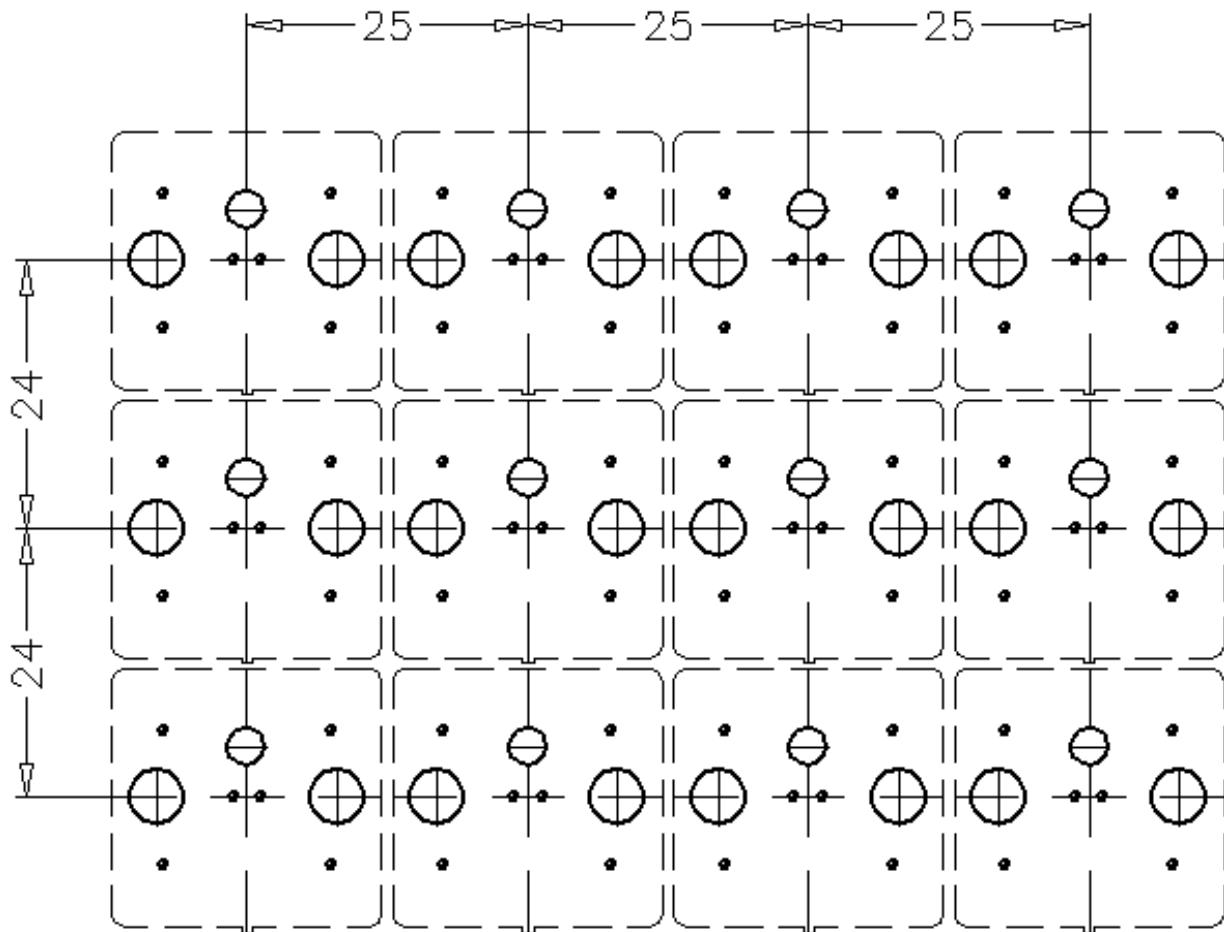
for direct soldering
(top view)



for use with socket pins
(top view)



NOTE: Recommended distance for array assembly is 1mm between each key.



Mounting Methods

Socket mountable (see corresponding Drill Mask). Socket pins (**SP0000**) are used for field-exchangeable mounting.

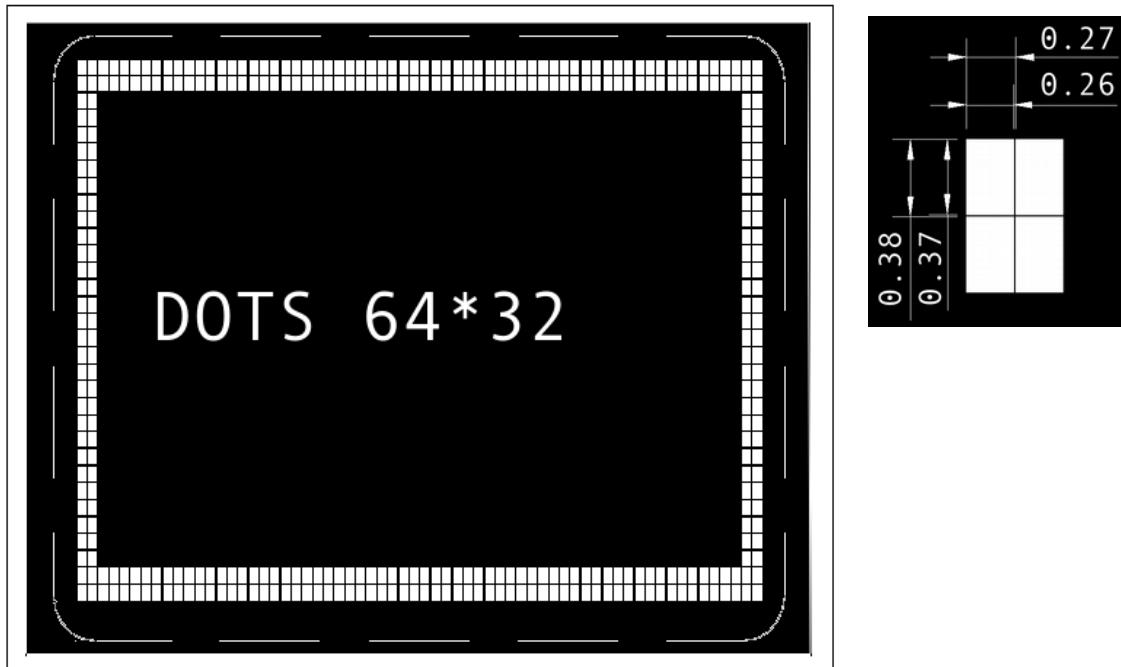
Through-hole mountable on PCBs with 1.6mm and 2.0mm thickness.

Manual soldering: max. 350° C for max. 3.5 seconds per pin

Wave soldering: 260° C for 10 seconds

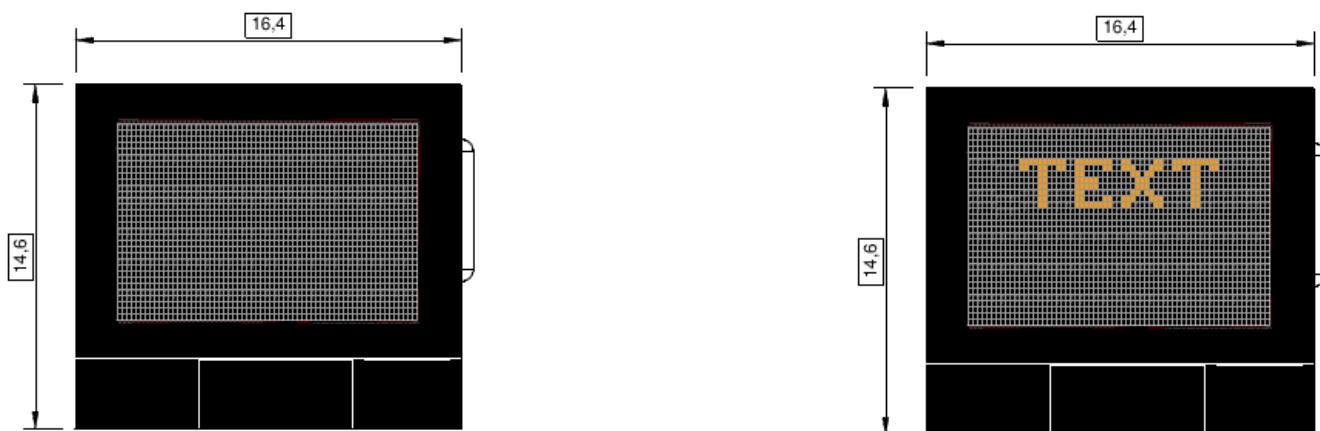
LIQUID CRYSTAL DISPLAY

LCD Type	DFSTN transmissive negative
Active area (X x Y)	17.27 mm x 12.15 mm
Pixel Size (X x Y)	0.26 mm x 0.37 mm
Pixel Pitch	0.01 mm
Viewing Direction	6 o'clock

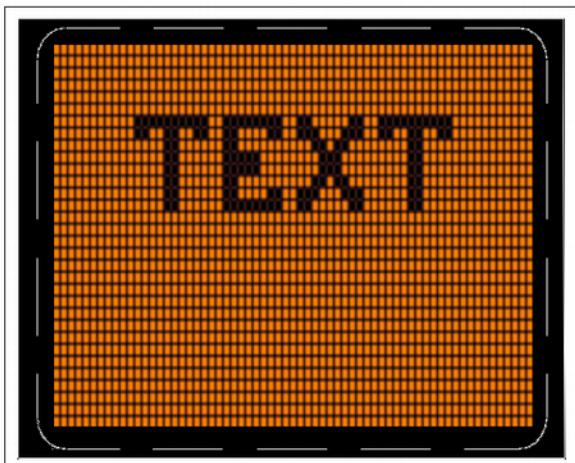
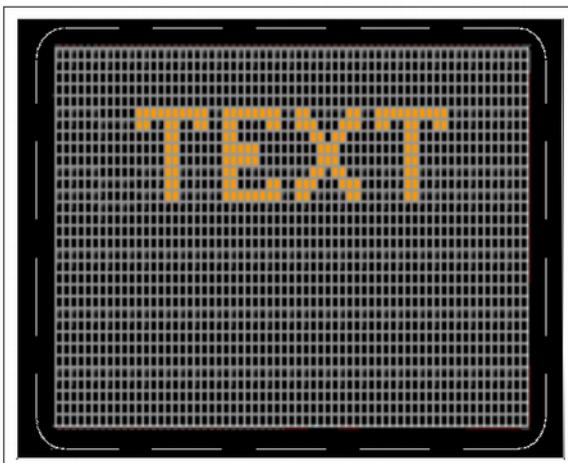
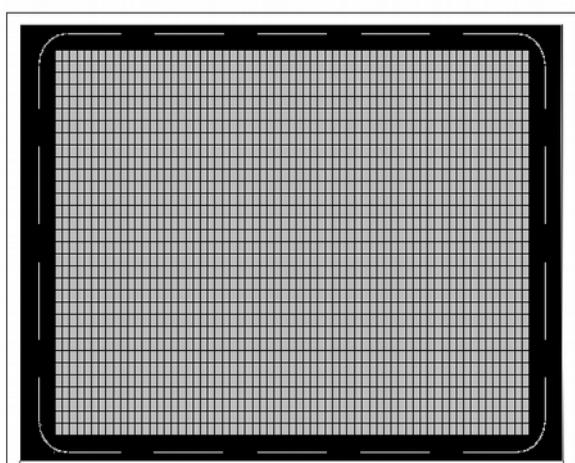
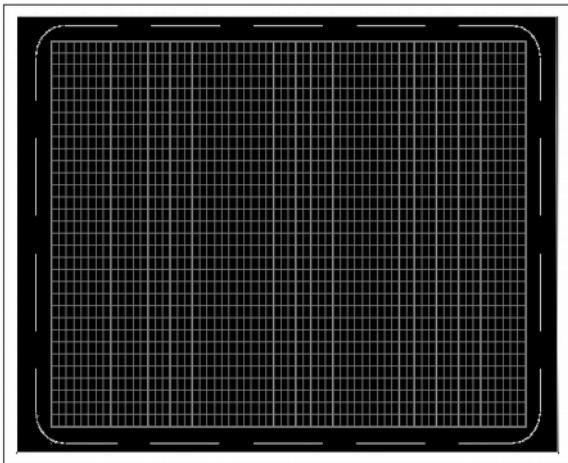


Standard Mode vs. Positive Mode

The SE6432 use a transmissive inverse DFSTN LCD. In **Standard Mode** and on Power ON or RESET, all pixels are black and text is displayed in the selected background color as shown in the drawings below.



Positive Mode inverts the active area to make the pixels transmissive and shows black text on color background as shown in the drawings below.



Standard Mode

Positive Mode

You may switch between Standard and Positive Mode by using the Set Mode command 0x47 as described on pages 18 and 21.

NOTE: **On Power OFF or RESET the setting will NOT be retained and the switches will revert to Standard Mode on Power ON.**

RGB BACKLIGHTING

The SE6432 switches feature **RGB** backlighting in over 1 million colors. In order to achieve uniform colors for switches installed in large consoles or operator panels, the Sxnnnn switches are programmed during production in a proprietary calibration process to produce the same color values even though there are differences in color for each LED.

The SE6432 switches use quad **RGB** LEDs that are calibrated for color uniformity using an updated calibration system.

The backlighting is under software control and modulating the operating voltage will not affect the brightness of the LEDs.

Multi-Segment Color MSC™



The SE6432 switches introduce Multi-Segment Color MSC™ by allowing different backlight colors in the upper and lower segment of the LCD. For the MSC™ command and an example see pages 18 and 21 respectively.



Multi-Segment Color MSC™ allows you to use color, for example, for grouping switches with similar functions (same color in upper segment) and, at the same time, provide operating status information via a different color in the lower segment of the LCD.

Since the colors of the upper and lower segment mix at the transition between the segments, care should be given to the bitmap and color selection.

ENVIRONMENTAL SPECIFICATIONS

Operating temperature 0°C to +55°C
Humidity up to 75% relative humidity at 65°C

ELECTRICAL SPECIFICATIONS

Operating voltage 4.5V to 5.5 V
Current consumption max. 60 mA; typ. < 25 mA; min. 12 mA (backlite off)
Contact resistance < 200 Ohm
Insulating resistance > 100 MOhm

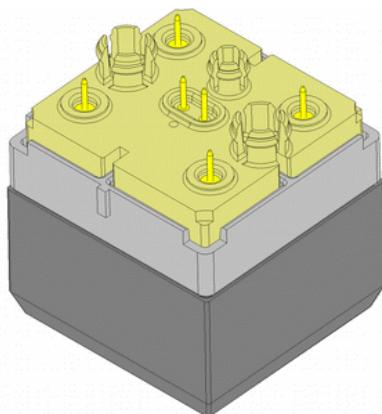
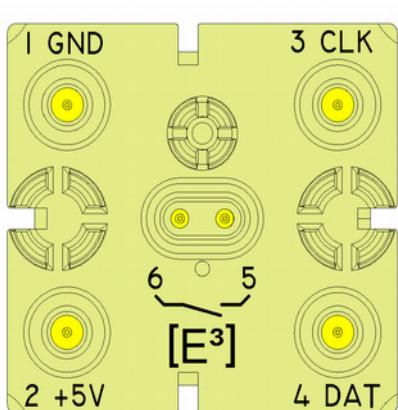
Symbol	Parameter	Min.	Typ.	Max.	Unit
V_{DD}^*	Operating voltage	4.5		5.5	V
I_{DD}	Supply current	8	<25	65	mA
V_{IN}	Input voltage on any pin			$V_{SS} - 0.3 - V_{DD} + 0.3$	V
I_{DIO}	Output data current sunk/source			+/- 5	mA
I_{CIO}	Output clock current sunk/source			+/- 5	mA
V_{IL}	Input low level voltage	$V_{SS} - 0.3$		$0.3 \times V_{DD}$	V
V_{IH}	Input high level voltage	$0.7 \times V_{DD}$		$V_{DD} + 0.3$	V
C_{CIO}	I/O clock pin capacitance		15		pF
$C_{DIO}^{*3)}$	I/O data pin capacitance		15		pF

* Display contrast is hardware controlled and does not depend on the operating voltage

INTERFACING

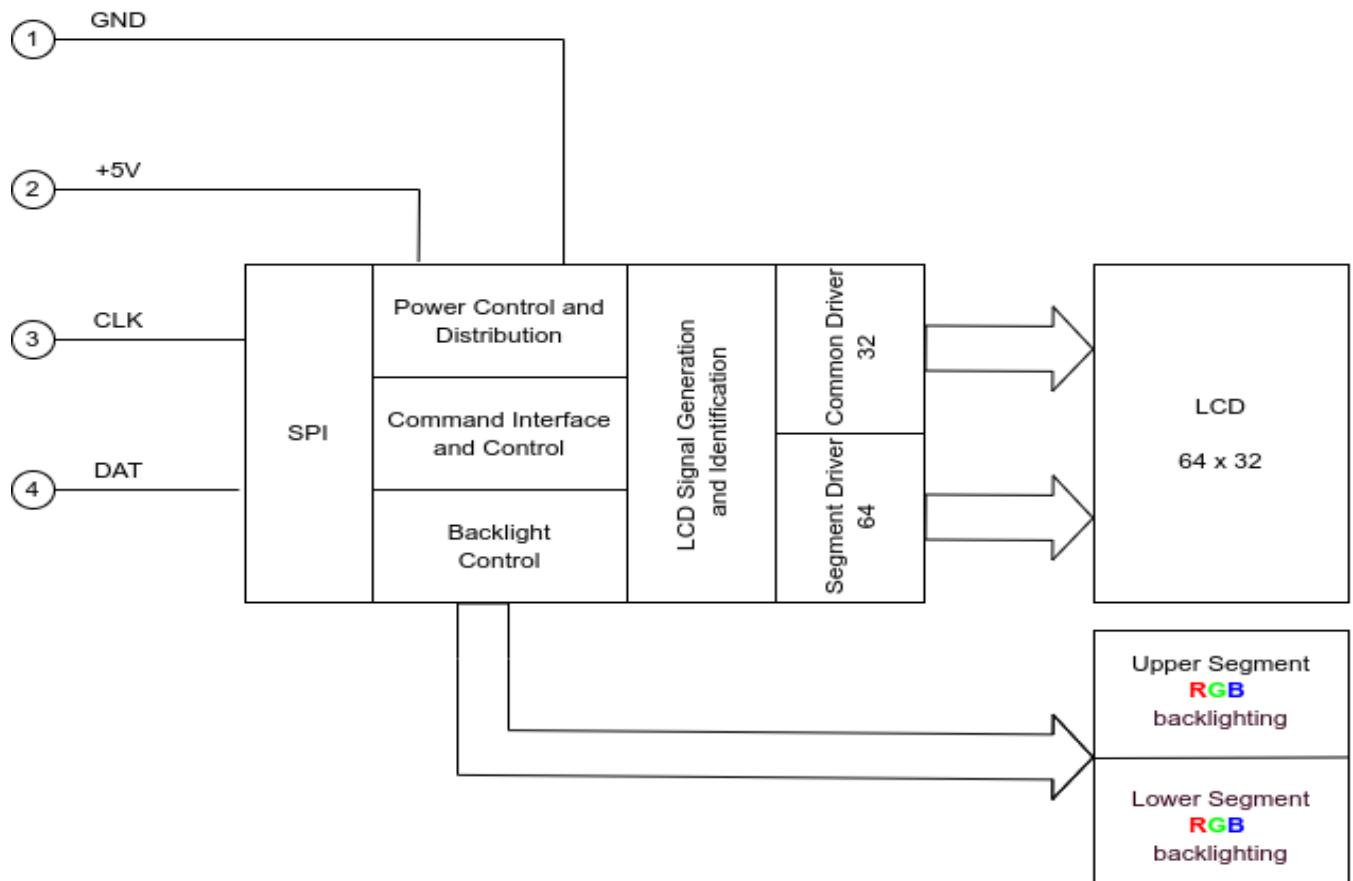
Contact Terminals

Pin	Symbol	Description	Comment
1	GND	negative (ground) power terminal	0.0 V
2	+ 5V	positive power terminal	+4.5 V – +5.5 V
3	CLOCK	clock line to synchronize data write and for internal use	128 kHz – 4 Mhz HIGH when inactive
4	DATA	command and data line to internal MSC™ electronics	HIGH when inactive; see data format for details
5	SW1	switch contact	contact resistance < 200 Ohm
6	SW2	switch contact	contact resistance < 200 Ohm



Pin View (terminal name and number are marked on the keyswitch)

Block Diagram

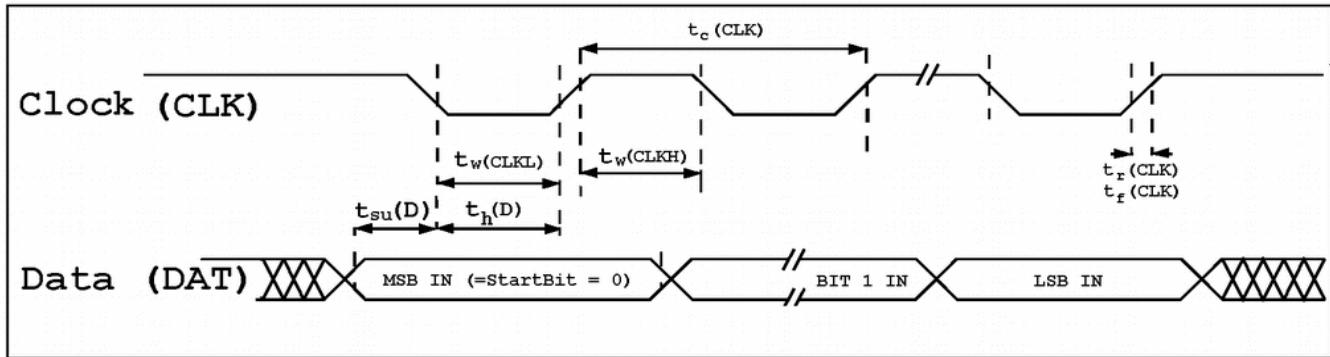


Serial Protocols

The SE6432 keyswitches are connected to the controlling central processing unit (host system) by a 2-wire SPI connection using a conventional synchronous protocol. A permanently applied clock is not necessary.

Legacy Mode™ is not supported in the SE6432 switches.

Timing Diagram



Symbol	Parameter	Min	Max	Unit
$t_c(\text{CLK})$	SPI Clock frequency	0.128	4	MHz
$t_w(\text{CLKH})$	Clock high time	45		ns
$t_w(\text{CLKL})$	Clock low time	45		ns
$t_{su}(D)$	Data input setup time	10		ns
$t_h(D)$	Data input hold time	10		ns
$t_r(\text{CLK})$	Clock rise time	5		ns
$t_f(\text{CLK})$	Clock fall time	5		ns

COMMAND SET

Synchronous Protocol

The command structure is quite simple as you can see in the following table. Due to the possibility of a permanently applied clock each transmitted data must have a leading “0”.

To distinguish between command and data the sixth bit is reserved. There are three sets of commands:

- **Write Data to the LCD Display**
- **Set Backlight Color**
- **Extended Command Set**

The first two command sets imply the required data and do not expect a return value from the key. Some commands in the Extended Command set, however, request information to be returned by the key. In this case, the **MSC™** electronics will generate their own clock signal for the data transmission.

For details on this scenario, see the **FAQ Section** on our website www.e3-keys.com/faqs.html.

Commands

Command Data	Command Name / Description	Comments
0x40	Set Display Address & Write Display Data	<p>All writes to the display must be initiated by this command. Address pointer is auto-incremented by data transmission.</p> <p>The command expects min. 4 data words to follow:</p> <p>0000000A₈ 0000A₇A₆A₅A₄ 0000A₃A₂A₁A₀ 0000D₃D₂D₁D₀</p> <p>Multiple Data Bytes may follow without additional addressing in one sequence since the controller will perform auto-increment</p> <p>Command can be terminated with 0x43 command Details are found in the Bit/Pixel Mapping Table on page 23.</p>
0x41	Set Color	<p>There is one data word to follow:</p> <p>00R₁R₀G₁G₀B₁B₀</p> <p>The 2 bits for each color intensity have the following values: 00 = off 01 = low 10 = medium 11 = high</p>
0x42	Set RGB Color	<p>There are 3 data bytes to follow:</p> <p>0D₆D₅D₄D₃D₂D₁D₀ 0D₆D₅D₄D₃D₂D₁D₀ 0D₆D₅D₄D₃D₂D₁D₀</p> <p>Note: The lower 10 values on each color brightness value should only be used for single color applications due to restrictions in the color calibration.</p>
0x43	End Transmission	<p>Ends data transmission to keys and awaits next command sequence. Transmitted commands are processed and displayed.</p> <p>This command should be placed at the end of a sequence.</p> <p>Note: The key will not respond to any command issued within 50µs after this command.</p>
0x44	Read Keyswitch ID THIS COMMAND FORCES THE KEYSWITCH TO ANSWER ON THE CLOCK AND DATA LINE.	<p>The answer is consisting of ASCII characters representing the Keyswitch ID and is terminated with CR (0x0D):</p> <p>SD6432 or SE6432</p> <p>Note: Care should be taken when implementing this command since the clock signal is generated by the SE6432 switch!</p>

Command Data	Command Name / Description	Comments
0x45	Read Serial Number THIS COMMAND FORCES THE KEYSWITCH TO ANSWER ON THE CLOCK AND DATA LINE.	The answer is consisting of 4 Bytes which give the serial Number in the following format and is terminated with CR (0xD): SNYYWW##### Year (04-99) - Week (01-52) - Number (00000 .. 99999) Note: Care should be taken when implementing this command since the clock signal is generated by the SE6432 switch!
0x47 0x00	Extended command, NOOP	No Operation
0x47 0x01 0xXX 01000111 00000001 D ₇ D ₆ D ₅ D ₄ D ₃ D ₂ D ₁ D ₀	SetMode*	The display and/or backlight is enabled/disabled while the bitmap data is maintained D ₇ = 1 set Group / = 0 select Group D ₆ = 1 Display ON* / = 0 Display OFF D ₅ = 1 Backlite ON* / = 0 Backlite OFF D ₄ = 1 set Display to Positive Mode* / = 0 set Display to Standard Mode D _{3..0} = Group Number Note¹: D ₇ = 1 not only specifies group, but executes command as well Note²: Please allow for 2μsec pause as this command has to be performed immediately * Group settings will be lost after Power OFF
0x47 0x7F 0xFF 256 x D ₇ D ₆ D ₅ D ₄ D ₃ D ₂ D ₁ D ₀ 01000111 01111111 11111111 256 x Pixel Bytes	Write Display Data	The display is completely rewritten. 256 bytes of pixel data must follow. First byte is written to Pixel Position 0. D₇D₆D₅D₄D₃D₂D₁D₀ Note¹: The amount of Data Bytes must exactly match 256. Note²: status of display on/off is unaffected.
0x48 0xXX 0xXX 0xXX 0xXX 0xXX 0xXX 0x00 0x00 0x00	Multi Segment Color MSC™	Sets the RGB colors for Multi Segment Color in up to 3 segments (= 9 RGB color values) with color values of 0x00 to 0x7F for each color channel. 0xXX 0xXX 0xXX (RGB colors for segment 1) 0xXX 0xXX 0xXX (RGB colors for segment 2) 0x00 0x00 0x00 (RGB colors for segment 3*) * Multi Segment Color MSC™ in SE6432 switches available only for segments 1 and 2. Segment 3 RGB color values will be ignored and should be set to 0x00 0x00 0x00.

Command Examples

Command Data	Comments
0x41	Set color with 1 byte color command
0x38	Red: high intensity, Green medium intensity, Blue off 00111000 = 0x38

Command Data	Comments
0x42	Set color with 3 byte color command
0x 70 0x 30 0x 00	Set color with values 70 Red , 30 Green , 00 Blue .

Command Data	Comments
0x47 0x01	Sets key modes for display, backlite and group and terminate command (0x43)
0x47 0x01 0xE1 0x43	Set Group, Display ON, Backlite ON, Standard Mode, Group 1 = 11100001
0x47 0x01 0xC2 0x43	Set Group, Display OFF, Backlite ON, Standard Mode, Group 2 = 11000010
0x47 0x01 0x01 0x43	Select Group, Display OFF, Backlite OFF, Standard Mode, Group 1 = 00000001
0x47 0x01 0xE2 0x43	Set Group, Display ON, Backlite ON, Standard Mode, Group 2 = 11100010
0x47 0x01 0x72 0x43	Select Group, Display ON, Backlite ON, Positive Mode, Group 2 = 01110010
0x47 0x01 0x62 0x43	Select Group, Display ON, Backlite ON, Standard Mode, Group 2 = 01100010

Command Data	Comments
0x48	Set MSC™ colors for upper and lower segments
0x 20 0x 00 0x 20	Segment 1: sets color to dark purple
0x 40 0x 40 0x 00	Segment 2: sets color to pale yellow
0x 00 0x 00 0x 00	Segment 3: not supported in SD6432 switches; should be 0x00 0x00 0x00

BIT / PIXEL MAPPING

Display Memory – Internal RAM Structure

The static display RAM holds the data for the LCD display. This data is displayed automatically and is continuously refreshed without further interference from the host controller.

The display RAM is organized into 512 x 4 bits and stores the display data in the SE6432 switch. The content of the display RAM is mapped directly to the LCD display. This RAM can be accessed by the Write LCD Data command, which must be preceded by the Set LCD Address command. The SET LCD Address command tells the key where to write the data and where to display it on the LCD. For actual RAM-Display mapping please refer to the following Bit/Pixel mapping table.

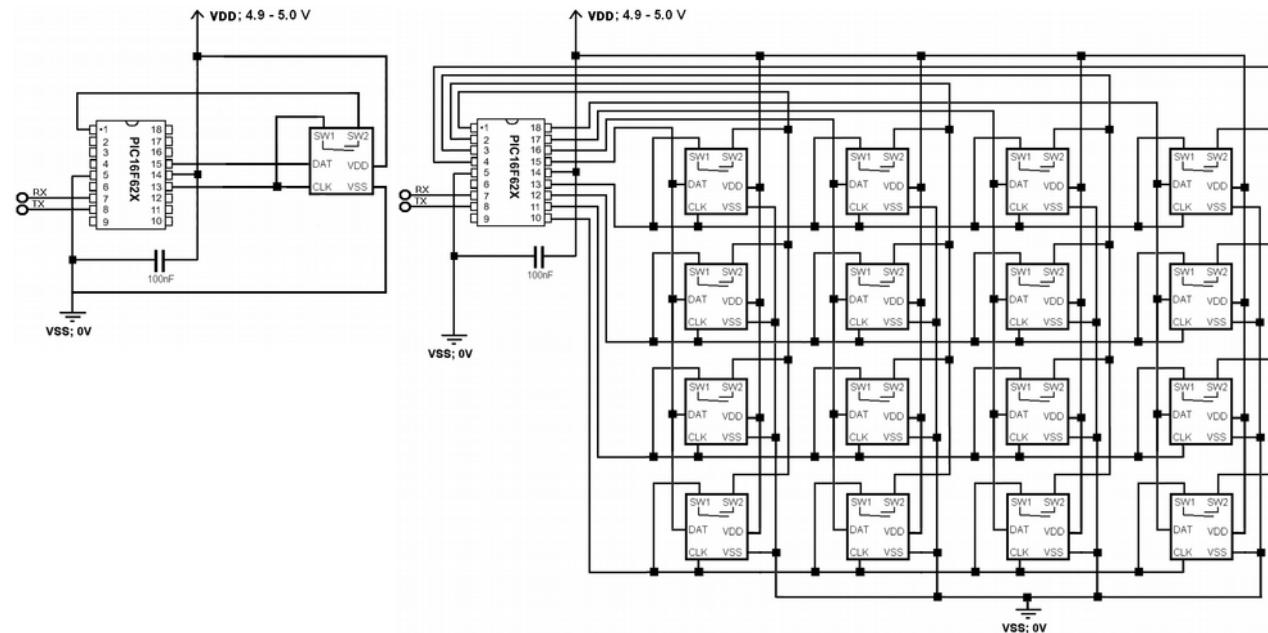
Bit/Pixel Mapping Table

	Column 63	Column 62	Column 61	Column 60	...	Column 3	Column 2	Column 1	Column 0
Address	1FCH	1F4H	1ECH	1E4H	...	1CH	14H	0CH	04H
Row 16	D ₀	D ₀	D ₀	D ₀	...	D ₀	D ₀	D ₀	D ₀
Row 17	D ₁	D ₁	D ₁	D ₁	...	D ₁	D ₁	D ₁	D ₁
Row 18	D ₂	D ₂	D ₂	D ₂	...	D ₂	D ₂	D ₂	D ₂
Row 19	D ₃	D ₃	D ₃	D ₃	...	D ₃	D ₃	D ₃	D ₃
Address	1FDH	1F5H	1EDH	1E5H	...	1DH	15H	0DH	05H
Row 20	D ₀	D ₀	D ₀	D ₀	...	D ₀	D ₀	D ₀	D ₀
Row 21	D ₁	D ₁	D ₁	D ₁	...	D ₁	D ₁	D ₁	D ₁
Row 22	D ₂	D ₂	D ₂	D ₂	...	D ₂	D ₂	D ₂	D ₂
Row 23	D ₃	D ₃	D ₃	D ₃	...	D ₃	D ₃	D ₃	D ₃
Address	1FEH	1F6H	1EEH	1E6H	...	1EH	16H	0EH	06H
Row 24	D ₀	D ₀	D ₀	D ₀	...	D ₀	D ₀	D ₀	D ₀
Row 25	D ₁	D ₁	D ₁	D ₁	...	D ₁	D ₁	D ₁	D ₁
Row 26	D ₂	D ₂	D ₂	D ₂	...	D ₂	D ₂	D ₂	D ₂
Row 27	D ₃	D ₃	D ₃	D ₃	...	D ₃	D ₃	D ₃	D ₃
Address	1FFH	1F7H	1EFH	1E7H	...	1FH	17H	0FH	07H
Row 28	D ₀	D ₀	D ₀	D ₀	...	D ₀	D ₀	D ₀	D ₀
Row 29	D ₁	D ₁	D ₁	D ₁	...	D ₁	D ₁	D ₁	D ₁
Row 30	D ₂	D ₂	D ₂	D ₂	...	D ₂	D ₂	D ₂	D ₂
Row 31	D ₃	D ₃	D ₃	D ₃	...	D ₃	D ₃	D ₃	D ₃
Address	1F8H	1F0H	1E8H	1E0H	...	18H	10H	08H	00H
Row 0	D ₀	D ₀	D ₀	D ₀	...	D ₀	D ₀	D ₀	D ₀
Row 1	D ₁	D ₁	D ₁	D ₁	...	D ₁	D ₁	D ₁	D ₁
Row 2	D ₂	D ₂	D ₂	D ₂	...	D ₂	D ₂	D ₂	D ₂
Row 3	D ₃	D ₃	D ₃	D ₃	...	D ₃	D ₃	D ₃	D ₃
Address	1F9H	1F1H	1E9H	1E1H	...	19H	11H	09H	01H
Row 4	D ₀	D ₀	D ₀	D ₀	...	D ₀	D ₀	D ₀	D ₀
Row 5	D ₁	D ₁	D ₁	D ₁	...	D ₁	D ₁	D ₁	D ₁
Row 6	D ₂	D ₂	D ₂	D ₂	...	D ₂	D ₂	D ₂	D ₂
Row 7	D ₃	D ₃	D ₃	D ₃	...	D ₃	D ₃	D ₃	D ₃
Address	1FAH	1F2H	1EAH	1E2H	...	1AH	12H	0AH	02H
Row 8	D ₀	D ₀	D ₀	D ₀	...	D ₀	D ₀	D ₀	D ₀
Row 9	D ₁	D ₁	D ₁	D ₁	...	D ₁	D ₁	D ₁	D ₁
Row 10	D ₂	D ₂	D ₂	D ₂	...	D ₂	D ₂	D ₂	D ₂
Row 11	D ₃	D ₃	D ₃	D ₃	...	D ₃	D ₃	D ₃	D ₃
Address	1FBH	1F3H	1EBH	1E3H	...	1BH	13H	0BH	03H
Row 12	D ₀	D ₀	D ₀	D ₀	...	D ₀	D ₀	D ₀	D ₀
Row 13	D ₁	D ₁	D ₁	D ₁	...	D ₁	D ₁	D ₁	D ₁
Row 14	D ₂	D ₂	D ₂	D ₂	...	D ₂	D ₂	D ₂	D ₂
Row 15	D ₃	D ₃	D ₃	D ₃	...	D ₃	D ₃	D ₃	D ₃

CONTROLLING SE6432 SWITCH ARRAYS

Below are sample schematics for controlling one or sixteen SXnnnn keyswitches in an array using a PIC16F62X controller to illustrate the simplicity of the control circuitry.

For additional technical support with your own design implementation, please contact your local [E³] distributor or [E³] at techsupport@e3-keys.com.



In the above examples the clock and data signals are generated on the corresponding I/O pins of the PIC controller.

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Flammability Ratings

The SE6432 are rated UL94-HB

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ORDER INFORMATION

Part Number	Description
SD6432-B	SD pushbutton keyswitch with 64 x 32 pixel display inverse DFSTN LCD in Positive Mode Black housing (RAL 9005)
SE6432-B	SE pushbutton keyswitch with 64 x 32 pixel display inverse DFSTN LCD Black housing (RAL 9005)

CHANGE HISTORY

Versio n	Date	Comments
0.1	03/12/19	Initial draft document for SC/SD/SE variants
0.2	05/31/22	Pre-release revisions incorporating all updates since initial draft
0.3	01/24/23	SD and SE version merge and update; SD Positive Mode, RGB backlighting and MSC™ added.
0.4	02/28/24	Mode command for Standard and Positive Mode updated
0.5	10/09/24	New corporate address
1.0	10/29/24	Release Document

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