



Programmable LCD Keys

LCD push-button Switches with RGB backlighting

SC6432

Programmable,

RGB-backlit

LCD Keyswitch

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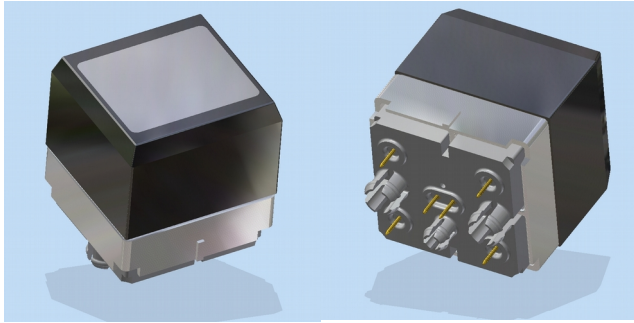
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GENERAL DESCRIPTION



The SC switch family introduces a new switch variant into the SXnnnn Series of **RGB**-backlit LCD switches.

The SC6432 with command driven serial interfaces integrates a graphical DFSTN 64 by 32 pixel liquid crystal display with **RGB** background lighting in a push-button switch design.

The SC6432 keys are controlled via a serial interface to the integrated **MSC™** electronics, which control the interface, display and backlighting. SC6432 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

- NEW - extended input voltage range of 4.5 – 5.5 Volt
- IMPROVED - contrast ratio
- IMPROVED - viewing angle

COMPATIBILITY

The SC6432 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.

CAUTION 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

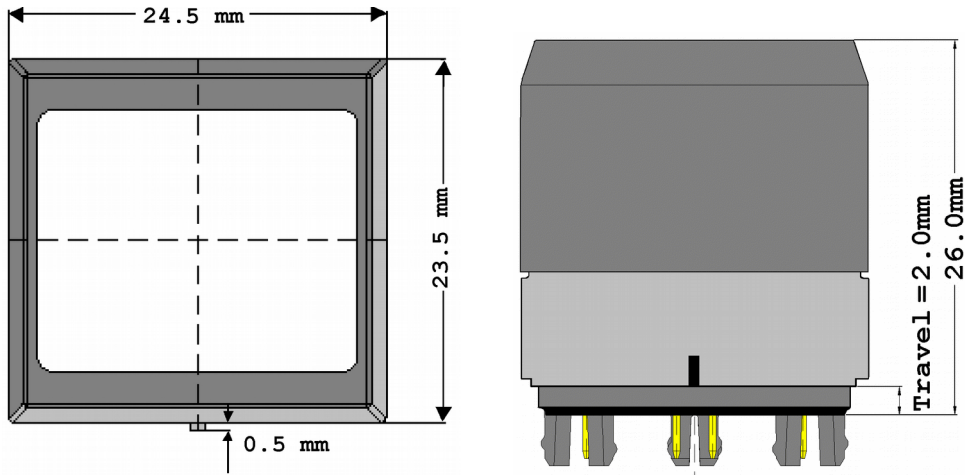
Feature	Description
Resolution	64 x 32 pixels
RGB Colors	more than 1 million RGB background colors
Color Calibration	Improved color calibration results in maximum uniformity across RGB color spectrum based on MSC™ electronics.
Self-Initialisation	All keys self-initialise. No external setup commands required.
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.
Interface	Synchronous serial 16-bit interface <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

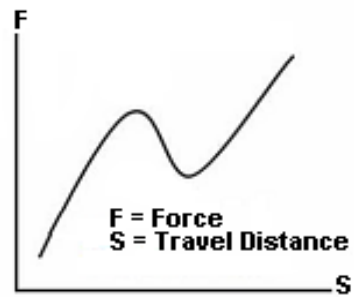
Dimensions (X x Y x Z) 24.5 x 23.5 x 26.0 mm + / - 0,2 mm

Screen size (X x Y) 20.0 x 16.5 mm + / - 0.1 mm



Keyswitch

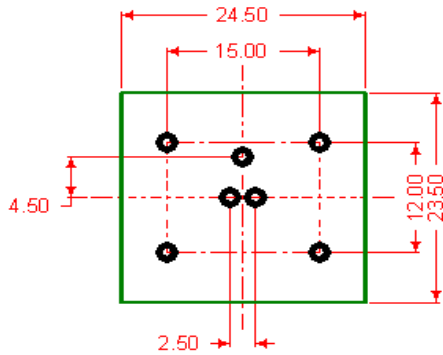
Key stroke 2.0 mm +/- 0.1 mm; tactile
Operation force: 1.3 N +/- 0.2 N
Over travel protection: yes
Lifetime: > 3 million cycles



Tactile Force Curve

PCB Footprint

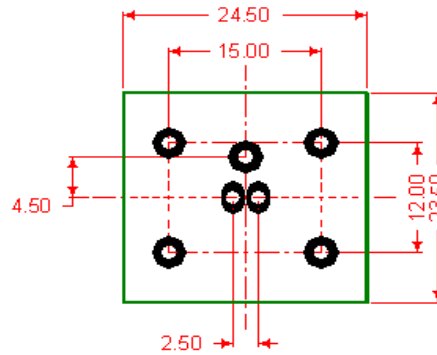
Direct PCB Mount
(top view)



ALL DIMENSIONS IN mm
ALL DIMENSIONS ± 0.10 mm
ALL HOLE SIZES $+0.10/-0.00$ mm

● $\varnothing 1.00$ PTH HOLE x $\varnothing 2.00$ PADS

Socket Mount
(top view)

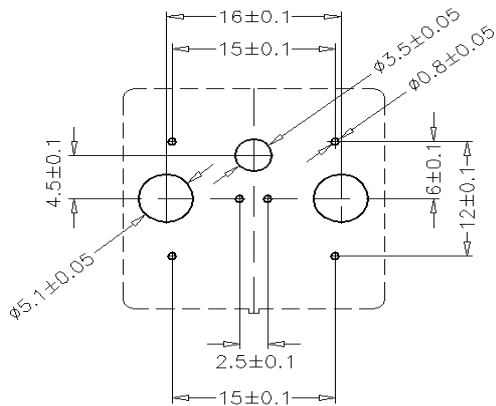


● $\varnothing 1.50$ PTH HOLE x $\varnothing 2.00 \times 3.20$ PADS

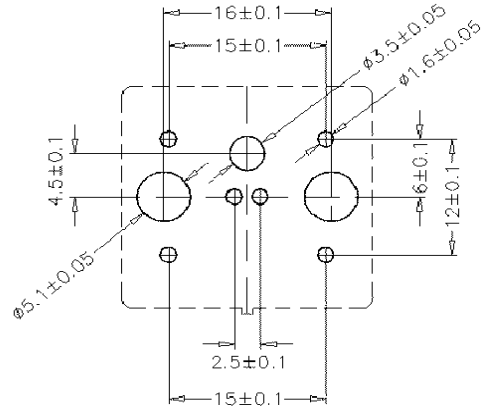
● $\varnothing 1.50$ PTH HOLE x $\varnothing 3.20$ PADS

Drill Masks

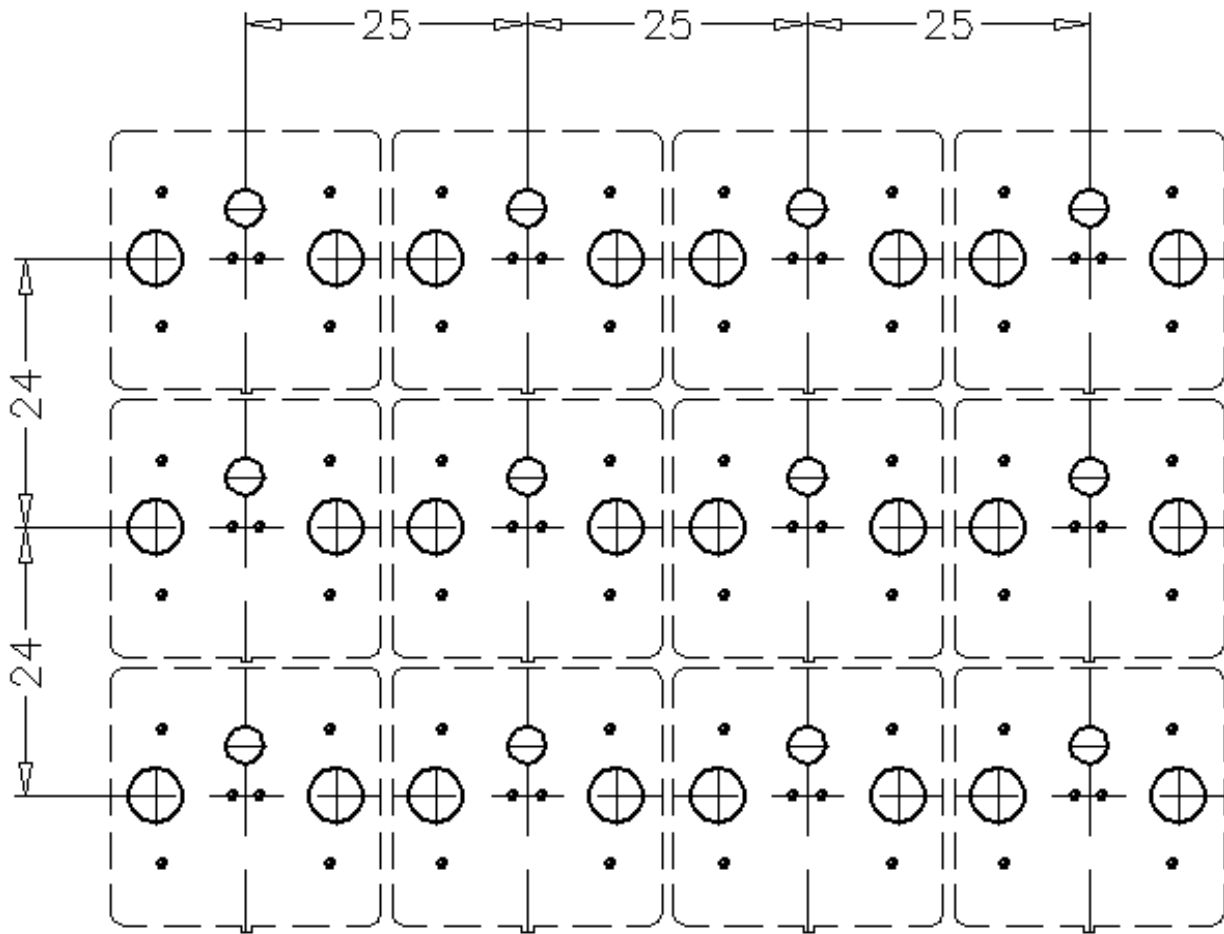
for direct soldering
(top view)



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.

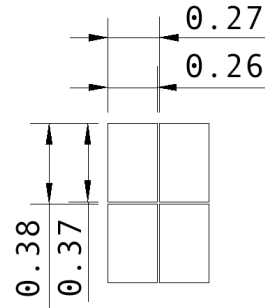
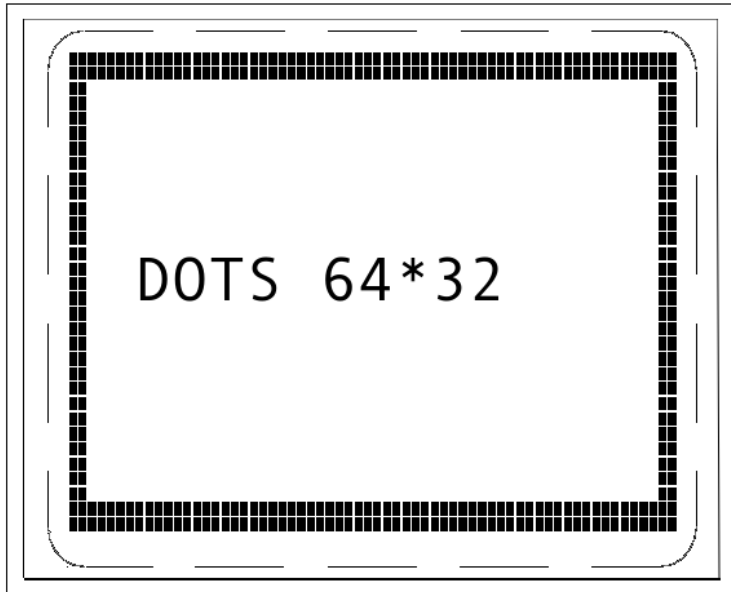
Through-hole mountable on PCBs with 1.6mm and 2.0mm thickness.

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 positive
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



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

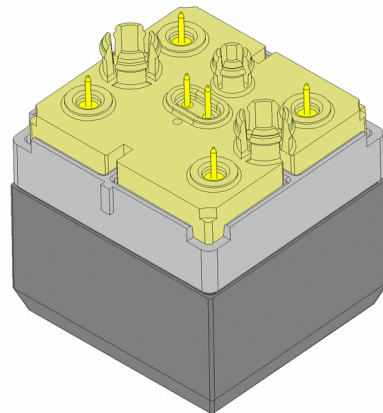
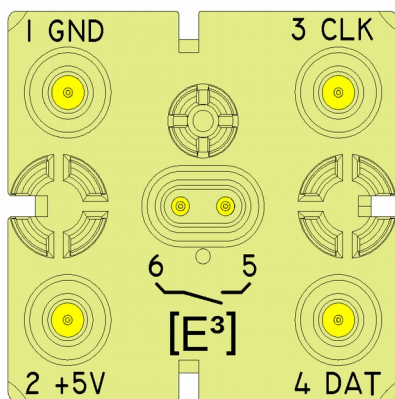
<i>Symbol</i>	<i>Parameter</i>	<i>Min.</i>	<i>Typ.</i>	<i>Max.</i>	<i>Unit</i>
V _{DD} *	Operating voltage	4.5		5.5	V
I _{DD}	Supply current	8	<25	65	mA
V _{IN}	Input voltage on any pin			V _{SS} -0.3 - V _{DD} +0.3	V
I _{DIO}	Output data current sunk/source			+/- 5	mA
I _{CIO}	Output clock current sunk/source			+/- 5	mA
V _{IL}	Input low level voltage	V _{SS} -0.3		0.3 x V _{DD}	V
V _{IH}	Input high level voltage	0.7 x 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

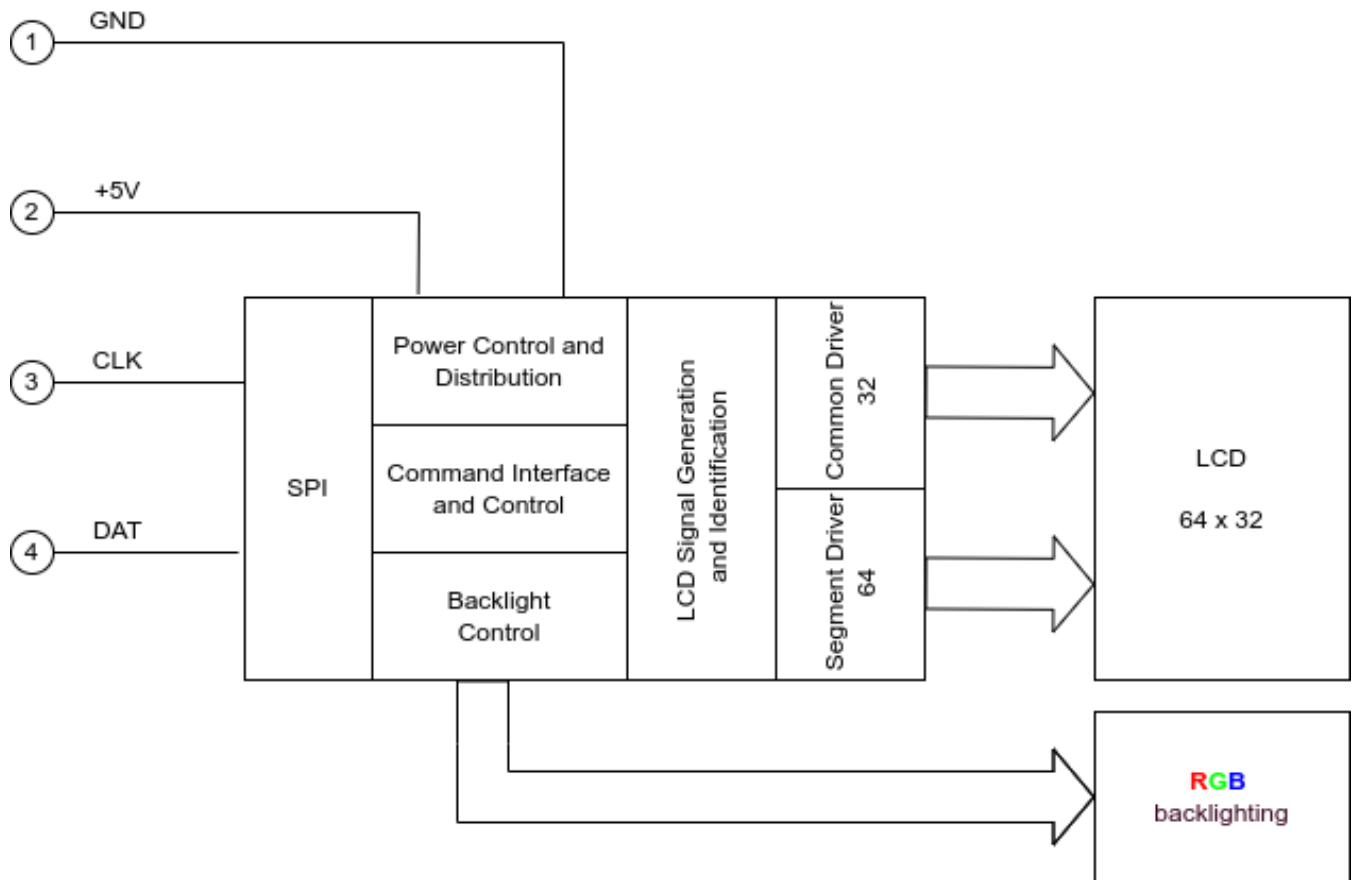
Contact Terminals

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

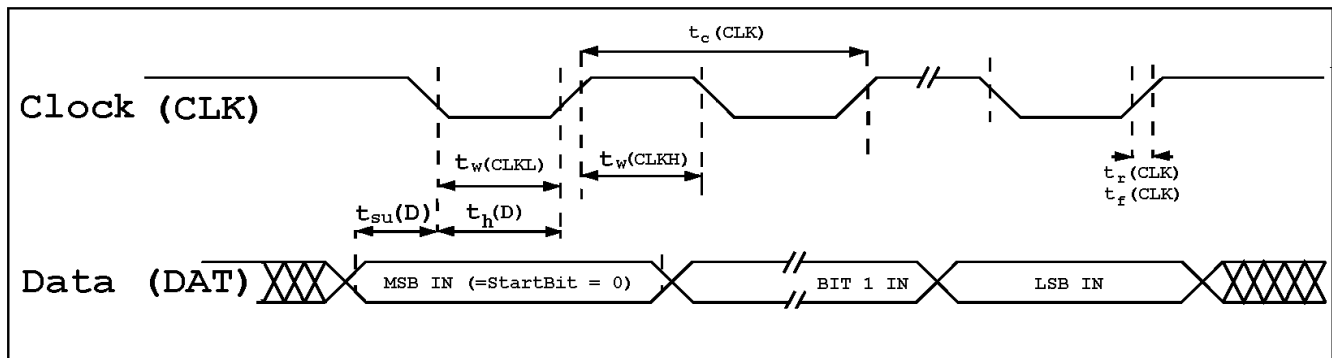


Serial Protocols

The SC6432 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 SC6432 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
$t_{su}(\text{D})$	Data input setup time	10		ns
$t_h(\text{D})$	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 commands 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</p> <p>Details are found in the Bit/Pixel Mapping Table on page 20.</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>SC6432</p> <p>Note: Care should be taken when implementing this command since the clock signal is generated by the SC6432 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 (0x0D): 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 SC6432 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 = Reserve 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.

Command Examples

Command Data	Comments
0x40 0x00 0x00 0x00	Set display address with 512 bytes of data following
0x00 0x00 0x00 0x00 0x00 0x00 0x00 0x00	Write Data to Display for [E ³ GmbH] bitmap
0x00 0x00 0x00 0x00 0x00 0x00 0x00 0x00	
0x00 0x00 0x00 0x00 0x00 0x00 0x00 0x00	
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0x00 0x00 0x00 0x00 0x00 0x00 0x00 0x00	
0x00 0x00 0x00 0x00 0x00 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 SC6432 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.

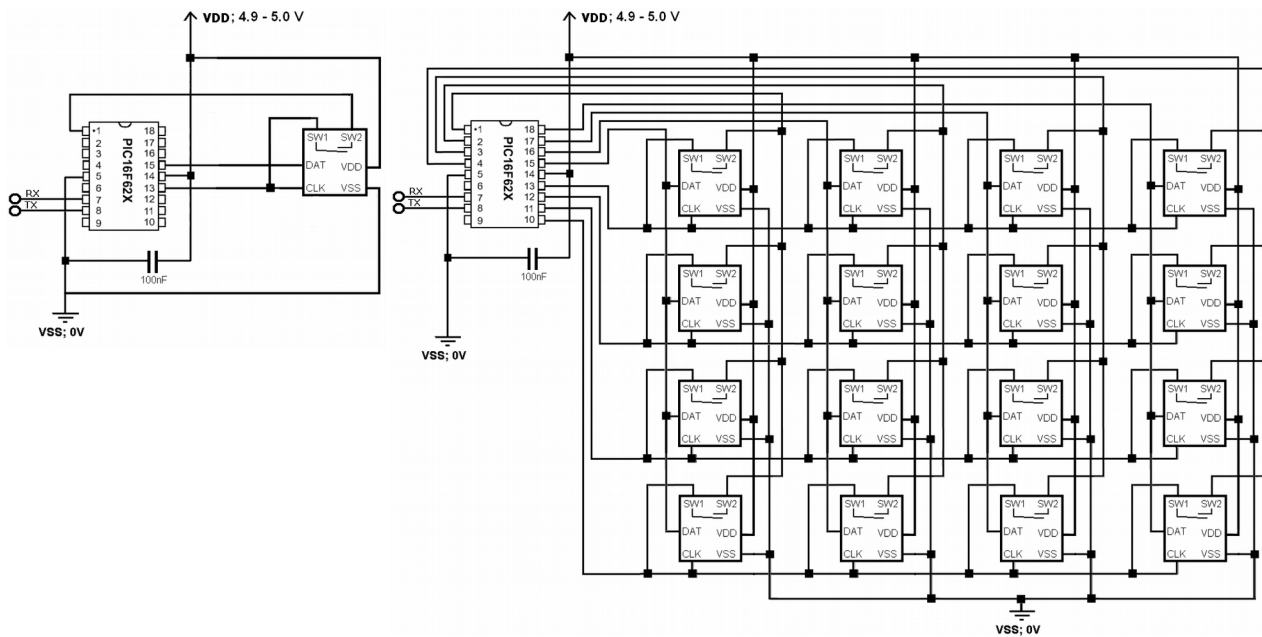
Bit/Pixel Mapping Table

	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 SC6432 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.

NOTICES

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Technical Notices

This datasheet is intended for technically qualified personnel trained in the field of electronics.

The knowledge of electronics and the technically correct implementation of the content of this datasheet are required for problem free installation, implementation and safe operation of the described product. Only qualified personnel have the required know-how to implement the specifications given in this data sheet.

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Flammability Ratings

The SC6432 is rated UL94-HB

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ORDER INFORMATION

Part Number	Description
SC6432-B	SC pushbutton keyswitch with 64 x 32 pixel display Black housing (RAL 9005)

CHANGE HISTORY

Version	Date	Comments
0.1	03/12/19	Initial draft document
0.2	07/14/20	Updated draft
0.3	03/02/21	Updated technical features
0.4	03/18/22	Revised draft
0.5	05/23/22	Pre-release revisions

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