READ Commands

Application Note

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General Description

The SA switch family includes the SA3216, SA3624 and SA6432 LCD Keyswitches with command driven serial interfaces. They integrate a graphical liquid crystal display with **RGB** backlighting in a keyswitch. The SA keys are controlled via a serial interface to the integrated *Advanced Technology*™ electronics, which control the interface, display and backlighting. SA keys self-initialise without external setup commands. Data is only transmitted when a change is made to the display or background colors. Only six contact terminals are required to provide power, clock and data lines as well as switch contacts. The contact pins of the internal switch are isolated from the internal electronics.

This document describes the **READ COMMANDS (ID & Serial Number)**. The purpose of this enhancement is it to enable customer systems to automatically detect which version is in use since identical hardware set-ups can be used for SA3216, SA3624 and SA6432 switches.

READ Commands

Command	Command Name / Description	Comments
0x44	Read Keyswitch ID* THIS COMMAND FORCES THE KEYSWITCH TO ANSWER ON THE CLOCK AND DATA LINE. (The clock is generated by the SA switch; see Application Notes at www.e3-keys.com)	The answer is consisting of ASCII characters representing the Keyswitch ID and is terminated with CR (0x0D): SA3216 SA3624 SA6432 SB6432 **(not supported in *Legacy Mode*™)**
0x45	Read Serial Number * THIS COMMAND FORCES THE KEYSWITCH TO ANSWER ON THE CLOCK AND DATA LINE. (The clock is generated by the SA switch; see Application Notes at www.e3-keys.com)	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) **(not supported in *Legacy Mode*™)**

NOTE: *** To take advantage of these advanced functions your hardware must ensure that the SA keys are actively driving the serial data lines in *Advanced Technology*™ mode.**

Command Examples

Read Keyswitch ID: 01001000 (0x44)		
Binary	**HEX**	**Comments**
01001000	0x44	Read Keyswitch ID
The Key will answer by generating its own clock and data signals The following examples show the answers for the different SAxxxx types: 0x53 0x41 0x33 0x32 0x31 0x36 0x0D = SA3216 CR 0x53 0x41 0x33 0x36 0x32 0x34 0x0D = SA3624 CR 0x53 0x41 0x36 0x34 0x33 0x32 0x0D = SA6432 CR		

Read Serial Number: 01001001 (0x49)		
Binary	**HEX**	**Comments**
01001001	0x45	Read Serial Number (SNYYWW#####)
The Key will answer by generating its own clock and data signals The following example shows the format of the answer: **0x53 0x4E 0x30 0x34 0x30 0x33 0x30 0x35 0x30 0x39 0x33 0x0D = SN040305093CR**		

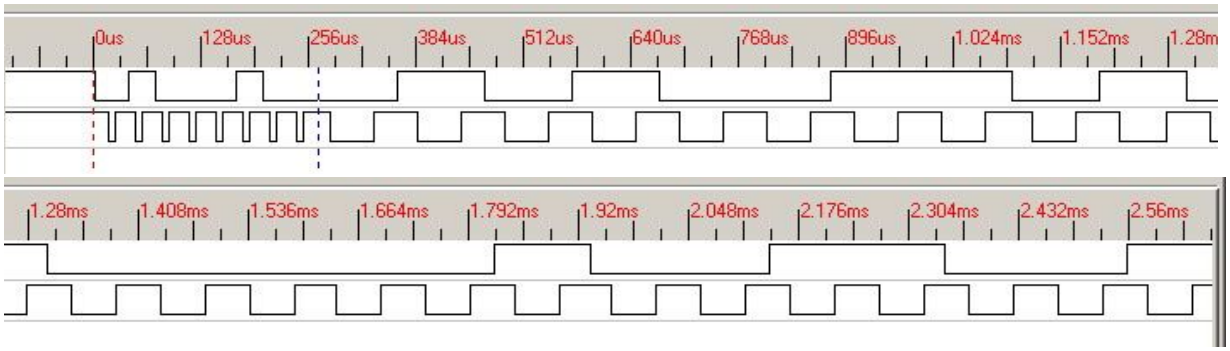
Special Considerations

Since the keyswitches will respond on their own to these 2 commands special considerations have to be taken when designing the hardware and software.

In order to minimize the hardware and software constraints the keyswitches will respond regardless of the prior communication speed with a relatively low speed. The issued clock frequency will be roughly 10kHz ensuring that even slow microprocessors should be able to read back the data.

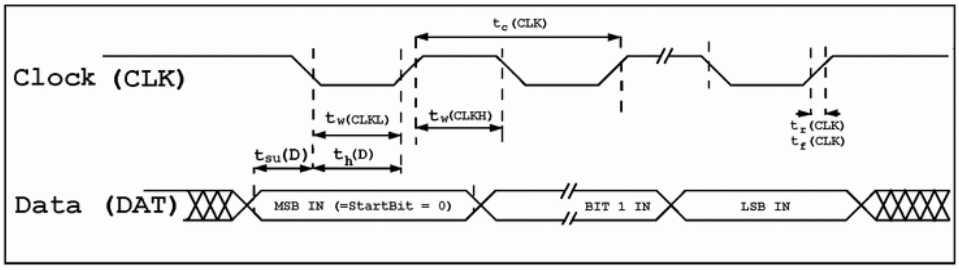
Sample Transmission

The following diagram shows the clock line taken by logic analyzer from an actual data transmission. Please note that the transmission is only partially shown and starts with the issued command **Read Keyswitch ID.**



For detailed timing descriptions for signal phase and general timing please review the corresponding section in the datasheet.

Timing Diagram for Signals generated by SAxxxx Keys



Symbol	Parameter	Min	Max	Unit
t_c(CLK)	Key generated CLK	9	11	kHz
t_w(CLKH)	Clock high time	40	60	µs
t_w(CLKL)	Clock low time	40	60	µs
t_{su}(D)	Data input setup time	140		ns
t_h(D)	Data input hold time	100		ns
t_r(CLK)	Clock rise time		25	ns
t_f(CLK)	Clock fall time		25	ns

Source Code Sample for Receiving Serial Data from Key

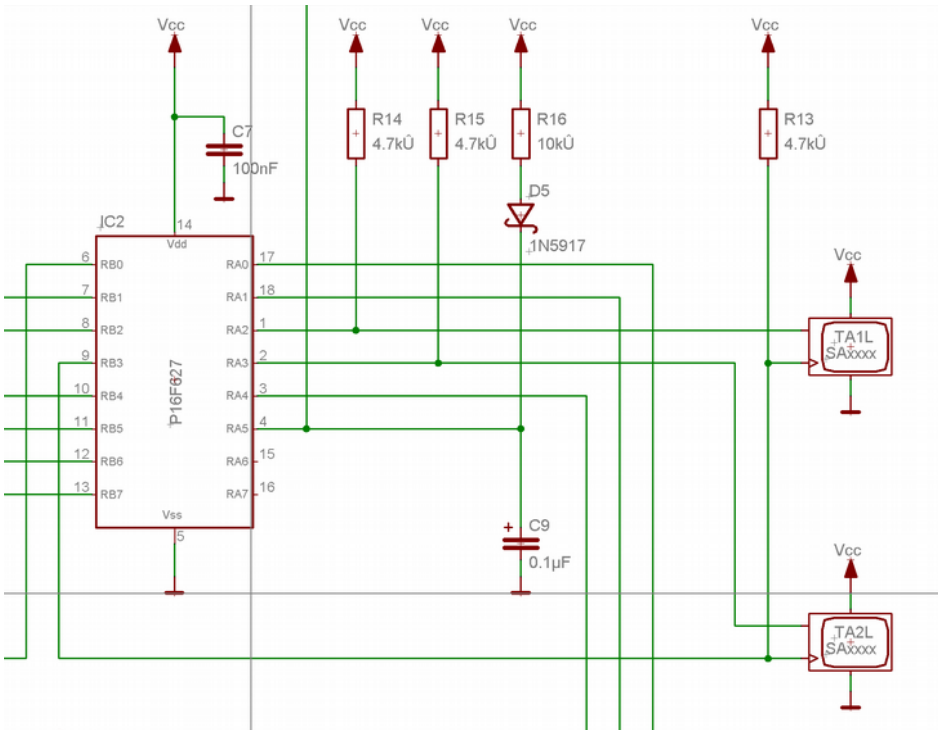
The following source is an excerpt of the DemoBoard firmware. The DemoBoard is controlled by a PIC16F627 controller. The relevant part of the schematic is shown following the source listing.

```
;
;*****************************************************************
;           SARead
;*****************************************************************
;
SARead:             ; Read Data = W from SA Key
                    ;           = and SABuf
;    SA_CLOCK_Stopp      ; Stop permanent clock on LCD Keys if active

                    ; functions
     movlw     b'11101111'    ; I: RA0 Key1
                      ; I: RA1 Key2
                         ; I: RA2 Key1Data
                         ; I: RA3 Key2Data
                         ; O: RA4 PowerON
                         ; I: RA5 VPP
                         ; I: RA6 CLK
                         ; I: RA7 CLK
     movwf     PortAMask ; Save Default TRISA Setting
     banksel   TRISA
     movwf     TRISA
                       ;
     movlw     b'11001011'    ; I: RB0 PowerFail
                         ; I: RB1 RxD
                         ; O: RB2 TxD
                         ; 1: RB3 LCDClock
                         ; O: RB4 EEClock
                         ; O: RB5 EEDATA
                         ; I: RB6 PGClock
                         ; I: RB7 PGData
     movwf TRISB
     banksel PortBMask
     movwf PortBMask     ; Save Default TRISB Setting
     banksel PORTB

rdloop
     movlw   .8
     movwf   SABitCount  ; set the #bits to 8
     clrf Time      ; Reset Time to check for ReadError
```

```
bitin                   ; wait for clock high
     btfsc     Time,2         ; if timeout back with error
      goto     rderr
     btfss     PORTB,3   ; wait for clock high
      goto     bitin
wclklow
     btfsc     Time,2         ; if timeout back with error
      goto     rderr
     btfsc     PORTB,3   ; wait for clock low to shift in data
      goto     wclklow   ; if not wait again for clock low

sard
     clrf Time      ; Reset Timeout

     bcf  STATUS,C  ; clear Carry

     btfss     KeyMask, Key1  ; if Key1 selected
      goto     bitink2
     btfsc     PORTA, Key1    ; set carry equal to Key1
      bsf STATUS,C
     goto shiftin
bitink2
     btfss     KeyMask, Key2  ; if Key2 selected
      goto     shiftin
     btfsc     PORTA, Key2    ; set carry equal to Key1
      bsf STATUS,C
shiftin
     rlf  SABuf,f   ; shift in bit

sard2
     decfsz  SABitCount, F    ; 8 bits done?
      goto     bitin     ; no - nxt bit

     movf SABuf,W   ;
     goto SAReadx

rderr
     clrf SABuf
     goto SAReadx2

SAReadx
     call TX
     movf SABuf,w   ;
     sublw     0x0d
     btfss     STATUS,Z
 goto     rdloop
SAReadx2
     movlw     0x0a      ; new line
```

```
call TX
                ; functions
movlw b'11100011'   ; I: RA0 Key1
                  ; I: RA1 Key2
                     ; O: RA2 Key1Data
                     ; O: RA3 Key2Data
                     ; O: RA4 PowerON
                     ; I: RA5 VPP
                     ; I: RA6 CLK
                     ; I: RA7 CLK
movwf PortAMask          ; Save Default TRISA Setting
banksel TRISA
movwf TRISA
                  ;
movlw b'11000011'   ; I: RB0 PowerFail
                     ; I: RB1 RxD
                     ; O: RB2 TxD
                     ; O: RB3 LCDClock
                     ; O: RB4 EEClock
                     ; O: RB5 EEDATA
                     ; I: RB6 PGClock
                     ; I: RB7 PGData
movwf TRISB
banksel PortBMask
movwf PortBMask          ; Save Default TRISB Setting

return
```

Partial Schematic of the DemoBoard



The SAxxxx keys are directly connected to the PIC16F627 controller. In this schematic we just see the clock and data lines of the SAxxxx switches. The contact matrix is not shown since it is not relevant for the communication.

The Clock signal is generated on PortPin RB3 of the PIC16F627 and is common for both SAxxxx keys.

Data is sent and received through RA2 and RA3 respectively of the PIC16F627 microcontroller.

Notices

Copyright Notice

Technical Notice

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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Change History

Version	Date	Comments
0.1	03/08/04	Initial draft document derived from Technical Datasheet 1.1
1.0	06/07/04	Release
2.0	11/01/05	Updated document and layout
2.1	03/14/06	Updated layout
2.2	02/15/11	Command IDs corrected
2.3	10/31/19	New Formatting
2.4	06/30/20	Minor corrections
3.0	06/20/22	Updated release version
3.1	10/24/24	New corporate address

[E³] Engstler Elektronik Entwicklung GmbH
Auweg 27 ● 63920 Grossheubach ● Germany

WWW.E3-KEYS.COM