

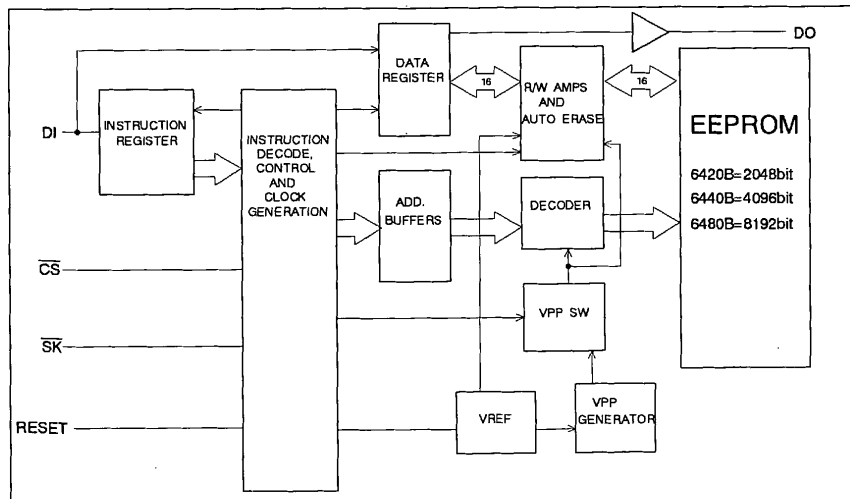


AK6420B / 40B / 80B

2K / 4K / 8Kbit Serial CMOS EEPROM

Features

- ADVANCED CMOS EEPROM TECHNOLOGY
- Wide Vcc (1.8V ~ 5.5V) operation
- AK6420B · · 2048 bits: 128 × 16 organization
 AK6440B · · 4096 bits: 256 × 16 organization
 AK6480B · · 8192 bits: 512 × 16 organization
- ONE CHIP MICROCOMPUTER INTERFACE
 - Interface with one chip microcomputer's serial communication port directly
- LOW POWER CONSUMPTION
 - 0.8μA Max (Standby mode)
- HIGH RELIABILITY
 - Endurance : 100K cycles
 - Data Retention : 10 years
- SPECIAL FEATURES
 - High speed operation (f_{MAX}=1MHz: V_{CC}=2.5V)
 - Automatic write cycle time-out with auto-ERASE
 - Automatic address increment (READ)
 - Software and Hardware controlled write protection
- IDEAL FOR LOW DENSITY DATA STORAGE
 - Low cost, space saving, 8-pin package (MSOP)



Block diagram

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|----------------------------|
| General Description |
|----------------------------|

The AK6420B/40B/80B is a 2048/4096/8192bit, serial, read/write, non-volatile memory device fabricated using an advanced CMOS E2PROM technology. The AK6420B has 2048bits of memory organized into 128 registers of 16 bits each. The AK6440B has 4096bits of memory organized into 256 registers of 16 bits each. The AK6480B has 8192bits of memory organized into 512 registers of 16 bits each. The AK6420B/40B/80B can operate full function under wide operating voltage range from 1.8V to 5.5V. The charge up circuit is integrated for high voltage generation that is used for write operation.

The AK6420B/40B/80B can connect to the serial communication port of popular one chip microcomputer directly (3 line negative clock synchronous interface). At write operation, AK6420B/40B/80B takes in the write data from data input pin (DI) to a register synchronously with rising edge of input pulse of serial clock pin (\overline{SK}). And at read operation, AK6420B/40B/80B takes out the read data from a register to data output pin (DO) synchronously with falling edge of \overline{SK} .

The AK6420B/40B/80B has 4 instructions such as READ, WRITE, WREN (write enable) and WRDS (write disable). Each instruction is organized by op-code block (8bits), address block (8bits) and data (8bits \times 2). When input level of \overline{SK} pin is high level and input level of chip select (\overline{CS}) pin is changed from high level to low level, AK6420B/40B/80B can receive the instructions.

Special features of the AK6420B/40B/80B include : automatic write time-out with auto-ERASE, Ready/ \overline{Busy} status signal output and ultra-low standby power mode when deselected (\overline{CS} =high).

- Software and Hardware controlled write protection

The AK6420B/40B/80B has 2 (hardware and software) write protection functions.

After power on or after execution of WRDS (write disable) instruction, execution of WRITE instruction will be disabled. This write protection condition continues until WREN instruction is executed or Vcc is removed from the part.

Execution of READ instruction is independent of both WREN and WRDS instructions.

Reset pin should be low level when WRITE instruction is executed. When the Reset pin is high level, the WRITE instruction is not executed.

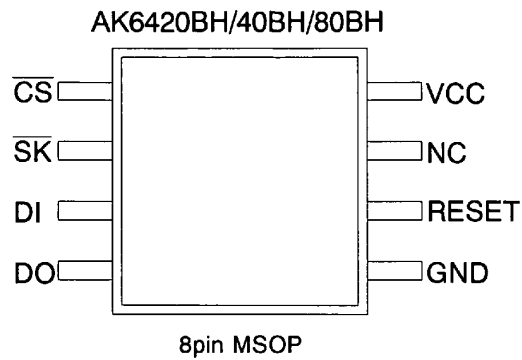
- Ready/ \overline{Busy} status signal

The DO pin indicates the \overline{Busy} status. When input level of \overline{SK} pin is low level and input level of \overline{CS} pin is changed from high level to low level, the AK6420B/40B/80B is in the status output mode and the DO pin indicates the Ready/ \overline{Busy} status. The Ready/ \overline{Busy} status outputs on DO pin until \overline{CS} pin is changed from low level to high level, or first bit ("1") of op-code of next instruction is given to the part. Except when the device is in the status output mode or outputs data, the DO pin is in the high impedance state.

■ Type of Products

| Model | Memory size | Temp.Range | Vcc | Package |
|----------|-------------|------------|-----------|-------------------|
| AK6420BH | 2Kbits | -40°C~85°C | 1.8V~5.5V | 8pin Plastic MSOP |
| AK6440BH | 4Kbits | -40°C~85°C | 1.8V~5.5V | 8pin Plastic MSOP |
| AK6480BH | 8Kbits | -40°C~85°C | 1.8V~5.5V | 8pin Plastic MSOP |

Pin arrangement



| Pin Name | Function |
|-----------------|--------------------|
| \overline{CS} | Chip Select |
| \overline{SK} | Serial Data Clock |
| DI | Serial Data Input |
| DO | Serial Data Output |
| RESET | RESET Input |
| Vcc | Power Supply |
| GND | Ground |
| NC | Not Connected |

■ Pin Description **\overline{CS}** (Chip Select)

When \overline{SK} is high level and \overline{CS} is changed from high level to low level, AK6420B/40B/80B can receive the instructions. \overline{CS} should be kept low level while receiving op-code, address and data and while outputting data. If \overline{CS} is changed to high level during the above period, AK6420B/40B/80B stops the instruction execution. When \overline{SK} is low and \overline{CS} is changed from high level to low level, AK6420B/40B/80B will be in status output mode. The \overline{CS} need not be low level during the automatic write time-out period (\overline{BUSY} status).

 \overline{SK} (Serial Clock)

The \overline{SK} clock pin is the synchronous clock input for input/output data. At write operation, AK6420B/40B/80B takes in the write data from data input pin (DI) synchronously with rising edge of input pulse of serial clock pin (\overline{SK}). And at read operation, AK6420B/40B/80B takes out the read data to data output pin (DO) synchronously with falling edge of \overline{SK} . The \overline{SK} clock is not needed during the automatic write time-out period (\overline{BUSY} status), the status output period and when the device isn't selected (\overline{CS} = high level).

DI (Data Input)

The op-code, address and write data is input to the DI pin.

DO (Data Output)

The DO pin outputs the read data and status signal and will be high impedance except for this timing.

RESET (Reset)

The AK6420B/40B/80B stops executing the write instruction when the RESET pin is high level. The RESET pin should be low level while the write instruction input period and the automatic write time-out period. If the RESET pin is high level while the automatic write time-out period, the AK6420B/40B/80B stops execution of internal programming and the device returns to ready status. In this case the word data of the specified address will be incomplete. When inputting the new instruction after RESET, the \overline{CS} pin should be set to high level. The read, write enable and write disable instructions are not affected by RESET pin status.

Vcc (Power Supply)**GND** (Ground)

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|-------------------------------|
| Functional Description |
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The AK6420B/40B/80B has 4 instructions such as READ, WRITE, WREN (write enable) and WRDS (write disable). Each instruction is organized by op-code block (8bits), address block (8bits) and data (8bits×2). When input level of \overline{SK} pin is high level and input level of chip select (\overline{CS}) pin is changed from high level to low level, AK6420B/40B/80B can receive the instructions.

When the instructions are executed consecutively, the \overline{CS} pin should be brought to high level for a minimum of 250ns(Tcs) between consecutive instruction cycle.

■ Instruction Set For 6420B

| Instruction | Op-Code | Address | Data |
|-------------|-----------------|------------------------|---------|
| READ | 1 0 1 0 1 0 0 0 | A6 A5 A4 A3 A2 A1 A0 0 | D15 -D0 |
| WRITE | 1 0 1 0 0 1 0 0 | A6 A5 A4 A3 A2 A1 A0 0 | D15 -D0 |
| WREN | 1 0 1 0 0 0 1 1 | x x x x x x x x | |
| WRDS | 1 0 1 0 0 0 0 0 | x x x x x x x x | |
| (WRAL) | 1 0 1 0 1 1 1 1 | x x x x x x x x | D15 -D0 |

■ Instruction Set For 6440B

| Instruction | Op-Code | Address | Data |
|-------------|-----------------|-------------------------|---------|
| READ | 1 0 1 0 1 0 0 0 | A7 A6 A5 A4 A3 A2 A1 A0 | D15 -D0 |
| WRITE | 1 0 1 0 0 1 0 0 | A7 A6 A5 A4 A3 A2 A1 A0 | D15 -D0 |
| WREN | 1 0 1 0 0 0 1 1 | x x x x x x x x | |
| WRDS | 1 0 1 0 0 0 0 0 | x x x x x x x x | |
| (WRAL) | 1 0 1 0 1 1 1 1 | x x x x x x x x | D15 -D0 |

■ Instruction Set For 6480B

| Instruction | Op-Code | Address | Data |
|-------------|------------------|-------------------------|---------|
| READ | 1 0 1 0 1 0 0 A8 | A7 A6 A5 A4 A3 A2 A1 A0 | D15 -D0 |
| WRITE | 1 0 1 0 0 1 0 A8 | A7 A6 A5 A4 A3 A2 A1 A0 | D15 -D0 |
| WREN | 1 0 1 0 0 0 1 1 | x x x x x x x x | |
| WRDS | 1 0 1 0 0 0 0 0 | x x x x x x x x | |
| (WRAL) | 1 0 1 0 1 1 1 1 | x x x x x x x x | D15 -D0 |

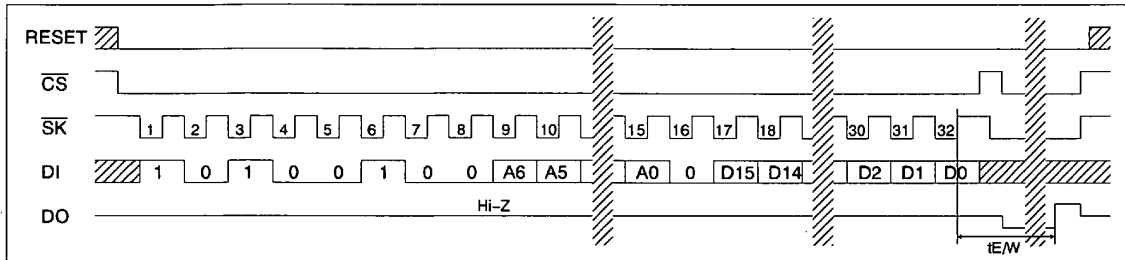
x:don't care

(Note) The WRAL instruction is used for factory function test only. User can't use this instruction .

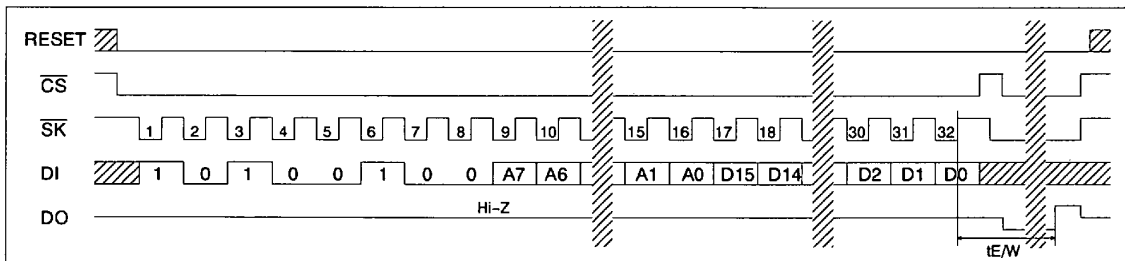
Write

The write instruction is followed by 16 bits of data to be written into the specified address. After the 32nd rising edge of \overline{SK} to read D0 in, the AK6420B/40B/80B will be put into the automatic write time-out period. During the automatic write time-out period (\overline{BUSY} status) and while entering write instruction, the RESET pin should be low level. If the RESET pin is set to high level during the automatic write time-out period, the AK6420B/40B/80B stops execution of internal programming and the device returns to ready status. In this case the word data of the specified address will be incomplete. When inputting the new instruction after RESET, the \overline{CS} pin should be set to high level. When the RESET pin is kept at high level, the write is not executed. This becomes write protection function.

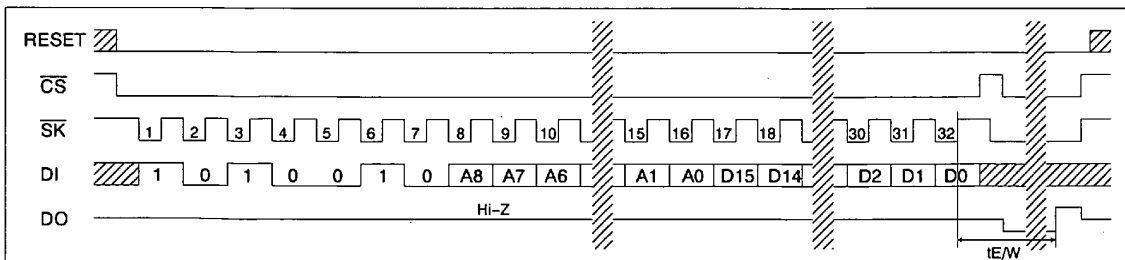
The \overline{CS} pin need not be high level during automatic write time-out period (\overline{BUSY} status).



WRITE (AK6420B)



WRITE (AK6440B)



WRITE (AK6480B)

Read

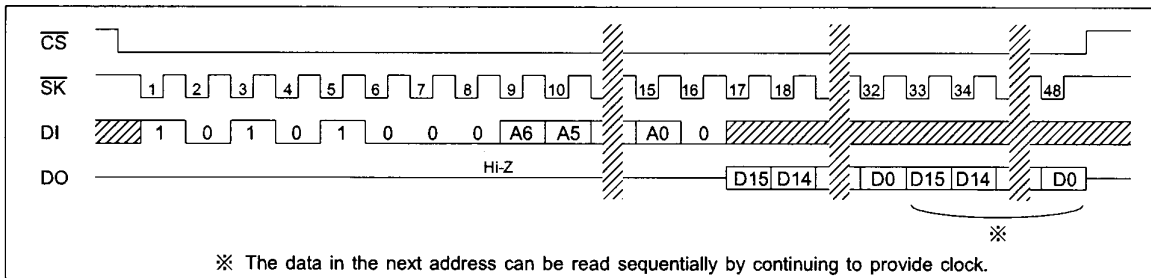
The read instruction is the only instruction which outputs serial data on the DO pin. When the 17th falling edge of \overline{SK} is received, the DO pin will come out of high impedance state and shift out the data from D15 first in descending order which is located at the address specified in the instruction.

The data in the next address can be read sequentially by continuing to provide clock. The address automatically cycles to the next higher address after the 16bit data shifted out.

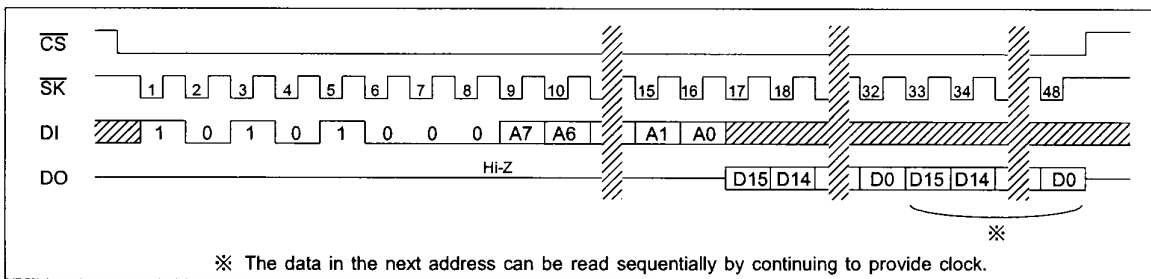
AK6420B · · When the highest address is reached (\$7F), the address counter rolls over to address \$00 allowing the read cycle to be continued indefinitely.

AK6440B · · When the highest address is reached (\$FF), the address counter rolls over to address \$00 allowing the read cycle to be continued indefinitely.

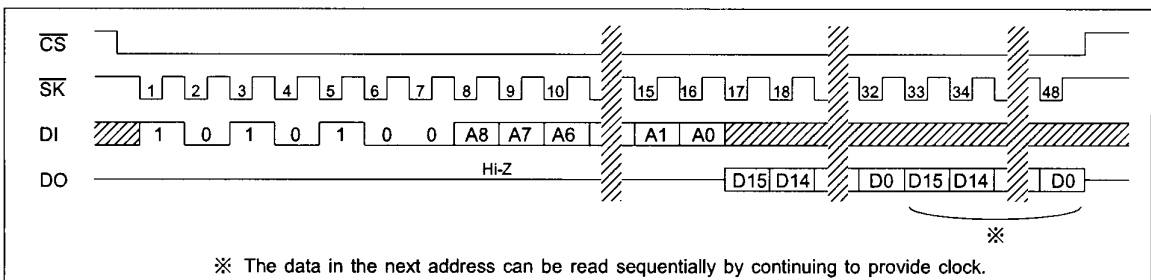
AK6480B · · When the highest address is reached (\$1FF), the address counter rolls over to address \$000 allowing the read cycle to be continued indefinitely.



READ (AK6420B)



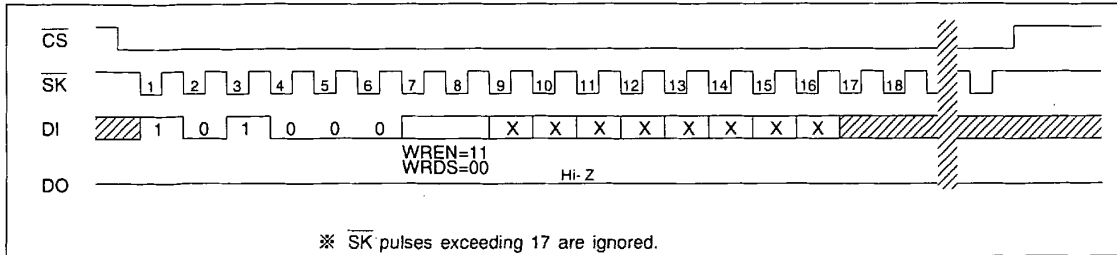
READ (AK6440B)



READ (AK6480B)

WREN / WRDS (Write Enable and Write Disable)

When Vcc is applied to the part, it powers up in the programming disable (WRDS) state. Programming must be preceded by a programming enable (WREN) instruction. Programming remains enabled until a programming disable (WRDS) instruction is executed or Vcc is removed from the part. The programming disable instruction is provided to protect against accidental data disturb. Execution of a read instruction is not affected by both WREN and WRDS instructions.



WREN / WRDS (AK6420B/40B/80B)

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|---------------------------------|
| Absolute Maximum Ratings |
|---------------------------------|

| Parameter | Symbol | Min | Max | Unit |
|--|--------|------|---------|------|
| Power Supply | VCC | -0.6 | +7.0 | V |
| All Input Voltages with Respect to Ground | VIO | -0.6 | VCC+0.6 | V |
| Ambient storage temperature | Tst | -65 | +150 | °C |

Stress above those listed under "Absolute Maximum Ratings" may cause permanent damage to the device. This is a stress rating only and functional operation of the device at these or any other conditions above those indicated in the operational sections of the specification is not implied. Exposure to absolute maximum conditions for extended periods may affect device reliability.

| |
|--|
| Recommended Operating Condition |
|--|

| Parameter | Symbol | Min | Max | Unit |
|-------------------------------|--------|-----|-----|------|
| Power Supply | VCC | 1.8 | 5.5 | V |
| Ambient Operating Temperature | Ta | -40 | +85 | °C |

| |
|-----------------------------------|
| Electrical Characteristics |
|-----------------------------------|

(1) D.C. ELECTRICAL CHARACTERISTICS

(1.8V≤Vcc≤5.5V, -40°C≤Ta≤85°C, unless otherwise specified)

| Parameter | Symbol | Condition | Min. | Max. | Unit |
|--|----------------------------|---|-----------|---------|------|
| Current Dissipation (WRITE) | ICC1 | VCC=5.5V, tSKP=500ns, *1 | | 4.0 | mA |
| | ICC2 | VCC=2.5V, *1 tSKP=500ns | 6420B | 2.0 | mA |
| | | | 6440B/80B | 2.5 | mA |
| ICC3 | VCC=1.8V, *1 tSKP=1.5us | 6420B | | 1.5 | mA |
| | | 6440B/80B | | 2.0 | mA |
| Current Dissipation (READ,WREN, WRDS) | ICC4 | VCC=5.5V, tSKP=500ns, *1 | | 0.75 | mA |
| | ICC5 | VCC=2.5V, tSKP=500ns, *1 | | 0.3 | mA |
| | ICC6 | VCC=1.8V, tSKP=1.5us, *1 | | 0.15 | mA |
| Current Dissipation (Standby) | ICCSB | VCC=5.5V *2 | | 0.8 | uA |
| Input High Voltage1 \overline{CS} , \overline{SK} , RESET pin | VIH1 | 1.8V≤VCC≤5.5V | 0.8×VCC | VCC+0.5 | V |
| Input High Voltage2 DI pin | VIH2 | 2.5V≤VCC≤5.5V | 0.7×VCC | VCC+0.5 | V |
| | VIH3 | 1.8V≤VCC<2.5V | 0.8×VCC | VCC+0.5 | V |
| Input Low Voltage1 \overline{CS} , \overline{SK} , RESET pin | VIL1 | 1.8V≤VCC≤5.5V | 0 | 0.2×VCC | V |
| | | 2.5V≤VCC≤5.5V | 0 | 0.3×VCC | V |
| Input Low Voltage2 DI pin | VIL3 | 1.8V≤VCC<2.5V | 0 | 0.2×VCC | V |
| | | 2.5V≤VCC≤5.5V | | | |
| Output High Voltage | VOH1 | 2.5V≤VCC≤5.5V IOH=-50μA | VCC-0.3 | | V |
| | | 1.8V≤VCC<2.5V IOH=-50μA | VCC-0.3 | | V |
| Output Low Voltage | VOL1 | 2.5V≤VCC≤5.5V IOL=1.0mA | | 0.4 | V |
| | | 1.8V≤VCC<2.5V IOL=0.1mA | | 0.4 | V |
| Input Leakage | ILI | VCC=5.5V, VIN=5.5V | | ±1.0 | uA |
| Output Leakage | ILO | VCC=5.5V VOUT=5.5V, \overline{CS} =VCC | | ±1.0 | uA |

*1: VIN=VIH/VIL, DO=Open

*2: \overline{CS} =Vcc, \overline{SK} /DI/RESET=Vcc/GND, DO=Open

(2) A.C. ELECTRICAL CHARACTERISTICS

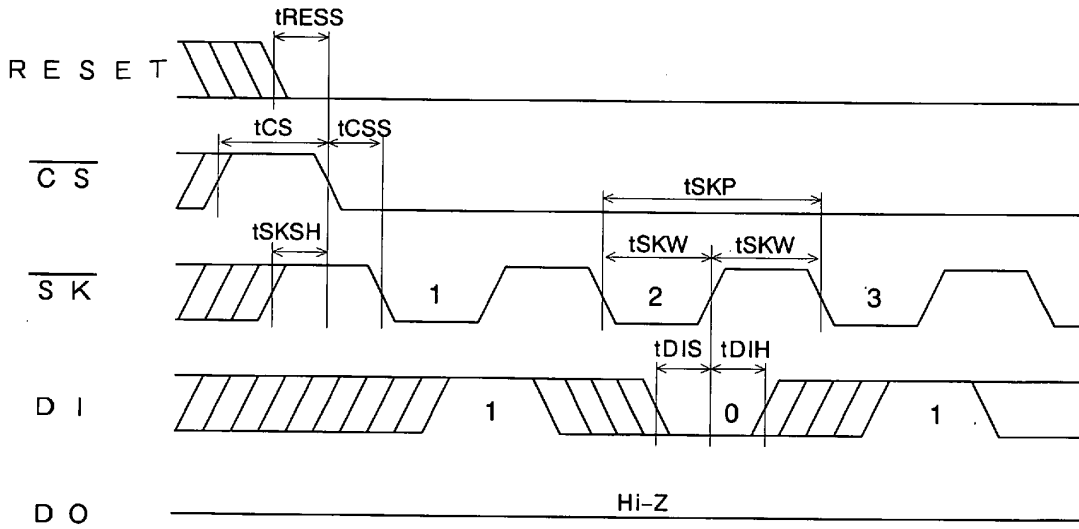
(1.8V≤VCC≤5.5V, -40°C≤Ta≤85°C, unless otherwise specified)

| Parameter | Symbol | Condition | Min. | Max. | Unit |
|-------------------------------|-----------------|-------------------|------|------|------|
| SK Cycle Time | tSKP1 | 2.5V≤VCC≤5.5V | 500 | | ns |
| | tSKP2 | 1.8V≤VCC<2.5V | 1.5 | | us |
| SK Pulse Width | tSKW1 | 2.5V≤VCC≤5.5V | 250 | | ns |
| | tSKW2 | 1.8V≤VCC<2.5V | 750 | | ns |
| SK High Pulse Width | tSKH1 | 4.5V≤VCC≤5.5V | 250 | | ns |
| | tSKH2 | 2.5V≤VCC<4.5V | 500 | | ns |
| | *3 tSKH3 | 1.8V≤VCC<2.5V | 750 | | ns |
| CS Setup Time | tCSS | | 100 | | ns |
| CS Hold Time | tCSH | | 100 | | ns |
| SK Setup Time | tSKSH /tSKSL | | 100 | | ns |
| RESET Setup Time | tRESS | | 0 | | ns |
| Data Setup Time | tDIS1 | 4.5V≤VCC≤5.5V | 100 | | ns |
| | tDIS2 | 1.8V≤VCC<4.5V | 200 | | ns |
| Data Hold Time | tDIH1 | 4.5V≤VCC≤5.5V | 100 | | ns |
| | tDIH2 | 1.8V≤VCC<4.5V | 200 | | ns |
| DO pin Output delay | tPD1 | 4.5V≤VCC≤5.5V, *4 | | 150 | ns |
| | tPD2 | 2.5V≤VCC<4.5V, *4 | | 300 | ns |
| | tPD3 | 1.8V≤VCC<2.5V, *4 | | 500 | ns |
| Selftimed Programming Time | tE/W | | | 10 | ms |
| Min CS High Time | tCS | | 250 | | ns |
| DO High-Z Time | tOZ | | | 500 | ns |

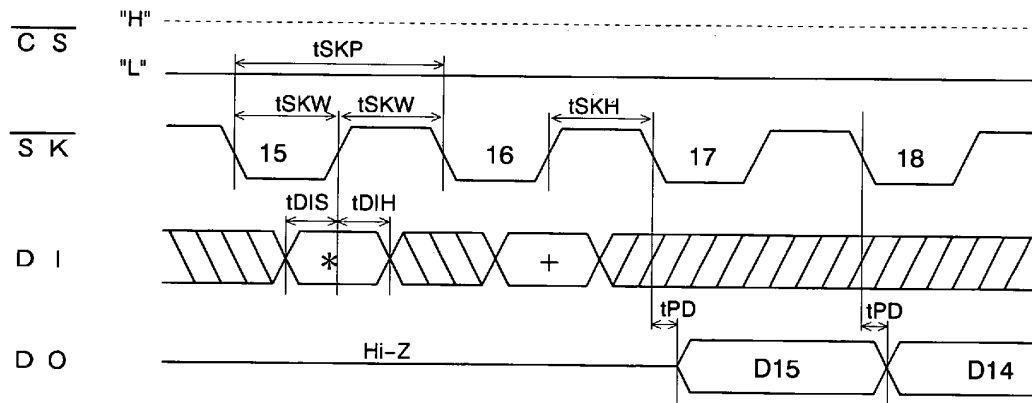
*3: tSKH is the high pulse width of 16th SK pulse in READ operation. When the data in the next address are read sequentially by continuing to provide clock, tSKH are applied to the high pulse width of 32nd and 48th (multiple of 16) SK pulse in READ operation.

*4: CL=100pF

Synchronous Data Timing

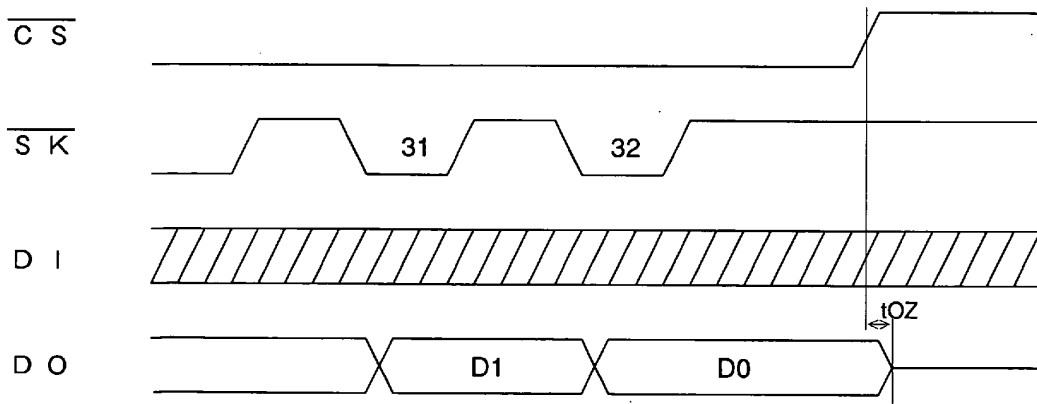


Instruction Input

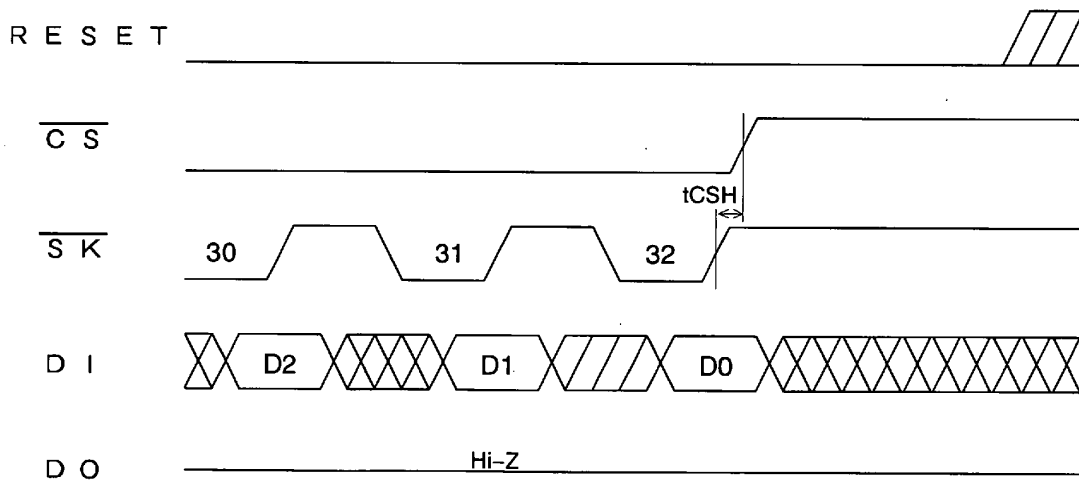


(note) * = "A0" for AK6420B, "A1" for AK6440B/80B
 + = "0" for AK6420B, "A0" for AK6440B/80B

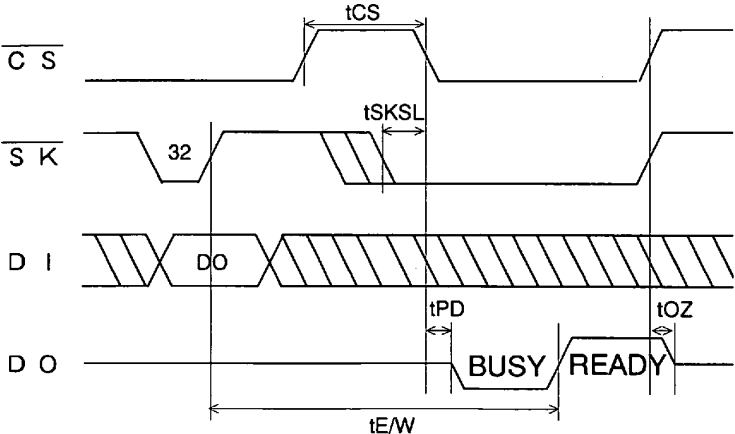
Data Output (READ)



Data Output (READ)



Data Input (WRITE)



Ready / \overline{BUSY} Signal Output (DO pin)

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