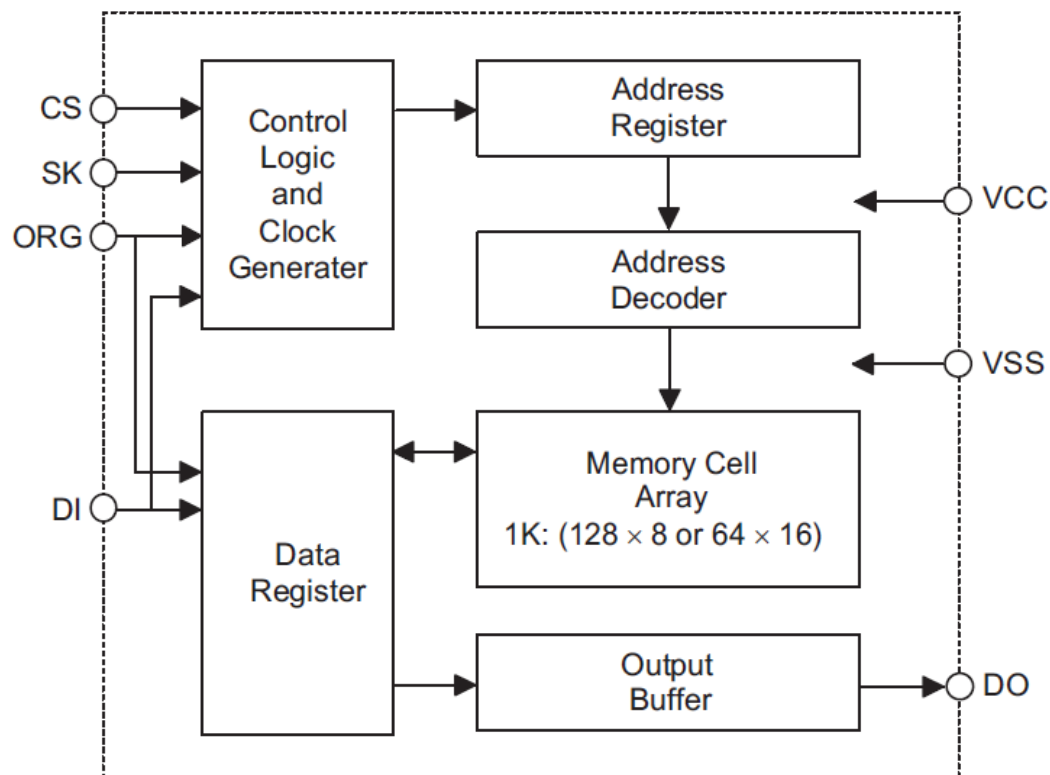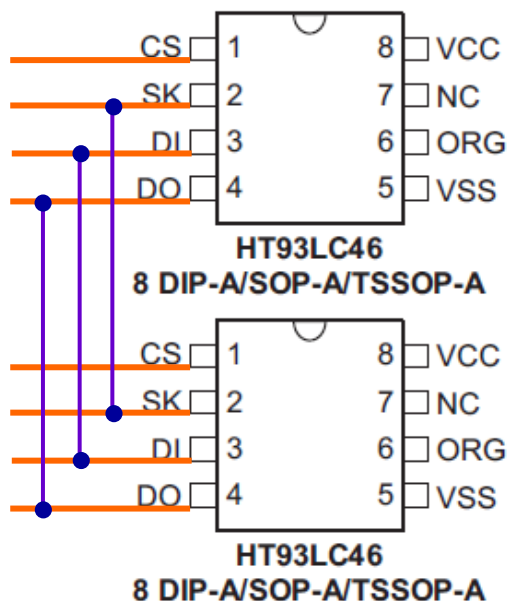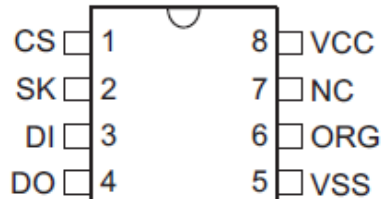# Holtek – Serial EEPROM (HT93LC46)

❑ The **HT93LC46** is a **1K-bit low voltage nonvolatile, serial electrically** erasable programmable read only memory device using the CMOS floating gate process.

❑ The **HT93LC46** is accessed via **a three-wire serial communication interface**.

❑ The device is arranged into **64 words by 16 bits** or **128 words by 8 bits** depending whether the ORG pin is connected to VCC or VSS. $2^6 \times 2^4$ $2^7 \times 2^3$

❑ The **HT93LC46** contains seven instructions: **READ, ERASE, WRITE, EWEN, EWDS, ERAL and WRAL**.

❑ When the user selectable internal organization is arranged into 64×16 (128×8), these instructions are all made up of 9(10) bits data: **1 start bit**, **2 op code bits** and **6(7) address bits**.

HT93LC46
8 DIP-A/SOP-A/TSSOP-A

A.C. Characteristics

HT93LC46
8 DIP-A/SOP-A/TSSOP-A

Pin layout:
- CS — 1 — 8 — VCC
- SK — 2 — 7 — NC
- DI — 3 — 6 — ORG
- DO — 4 — 5 — VSS

Pin Name	I/O	Description
CS	I	Chip select input
SK	I	Serial clock input
DI	I	Serial data input
DO	O	Serial data output
VSS	—	Negative power supply, ground
ORG	I	Internal Organization **When ORG is connected to VDD or ORG is floated**, the **(16)** memory organization is selected. **When ORG is tied to VSS,** the **(8)** memory organization is selected. There is an **internal pull-up resistor** on the ORG pin.
VCC	—	Positive power supply

Symbol	Parameter	V_{CC}=5V±10% Min.	V_{CC}=5V±10% Max.	V_{CC}=3V±10% Min.	V_{CC}=3V±10% Max.	V_{CC}=2.2V Min.	V_{CC}=2.2V Max.	Unit
f_{SK}	Clock Frequency	0	2000	0	1000	0	500	kHz
t_{SKH}	SK High Time	250	—	500	—	1000	—	ns
t_{SKL}	SK Low Time	250	—	500	—	1000	—	ns
t_{CSS}	CS Setup Time	50	—	100	—	100	—	ns
t_{CSH}	CS Hold Time	0	—	0	—	0	—	ns
t_{CDS}	CS Deselect Time	250	—	250	—	500	—	ns
t_{DIS}	DI Setup Time	100	—	150	—	200	—	ns
t_{DIH}	DI Hold Time	100	—	150	—	200	—	ns
t_{PD1}	DO Delay to "1"	—	250	—	500	—	1000	ns
t_{PD0}	DO Delay to "0"	—	250	—	500	—	1000	ns
t_{SV}	Status Valid Time	—	250	—	250	—	250	ns
t_{HZ}	DO Disable Time	—	100	—	200	—	400	ns
t_{PR}	Write Cycle Time	—	5	—	5	—	5	ms

Holtek – Serial EEPROM (HT93LC46)

Instruction	Comments	Start bit	Op Code	Address ORG=0 X8	Address ORG=1 X16	Data ORG=0 X8	Data ORG=1 X16
READ	Read data	1	10	A6~A0	A5~A0	D7~D0	D15~D0
ERASE	Erase data	1	11	A6~A0	A5~A0	—	
WRITE	Write data	1	01	A6~A0	A5~A0	D7~D0	D15~D0
EWEN	Erase/Write Enable	1	00	11XXXXX	11XXXX	—	
EWDS	Erase/Write Disable	1	00	00XXXXX	00XXXX	—	
ERAL	Erase All	1	00	10XXXXX	10XXXX	—	
WRAL	Write All	1	00	01XXXXX	01XXXX	D7~D0	D15~D0

Note: X stands for don't care

Data should be written to the EEPROM in the format (8-bit or 16-bit mode) in which it is to be read.

Read

Write
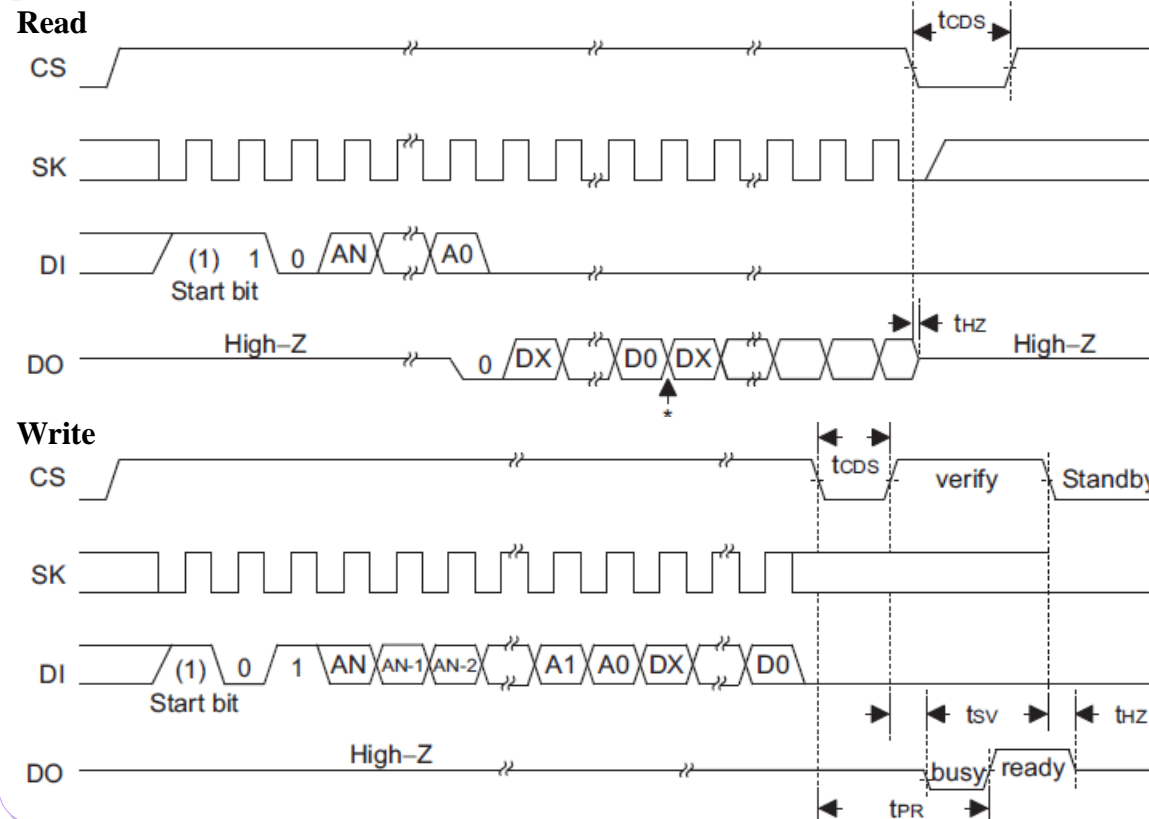
* Address pointer automatically cycles to the next word

Mode	(X16)	(X8)
AN	A5	A6
DX	D15	D7

Symbol	Parameter	V_{CC}=5V±10% Min.	V_{CC}=5V±10% Max.	Unit
f_{SK}	Clock Frequency	0	2000	kHz
t_{SKH}	SK High Time	250	—	ns
t_{SKL}	SK Low Time	250	—	ns
t_{CSS}	CS Setup Time	50	—	ns
t_{CSH}	CS Hold Time	0	—	ns
t_{CDS}	CS Deselect Time	250	—	ns
t_{DIS}	DI Setup Time	100	—	ns
t_{DIH}	DI Hold Time	100	—	ns
t_{PD1}	DO Delay to "1"	—	250	ns
t_{PD0}	DO Delay to "0"	—	250	ns
t_{SV}	Status Valid Time	—	250	ns
t_{HZ}	DO Disable Time	—	100	ns
t_{PR}	Write Cycle Time	—	5	ms

Holtek – Serial EEPROM (HT93LC46) / Read

Instruction	Comments	Start bit	Op Code	Address ORG=0 X8	ORG=1 X16	Data ORG=0 X8	ORG=1 X16
READ	Read data	1	10	A6~A0	A5~A0	D7~D0	D15~D0

Read
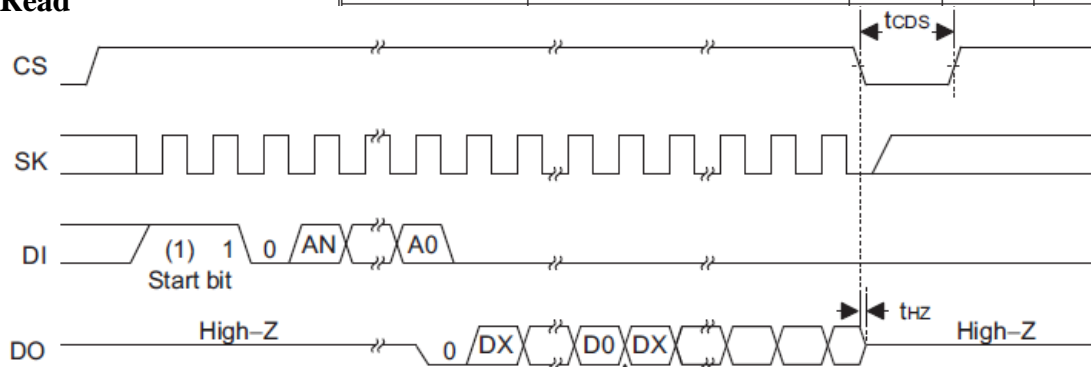

```
unsigned char EEPROM_Serial_RD(unsigned char ee_addr)
{
        unsigned char get_sda ;
        unsigned char read_data ;
        get_sda=0b01000000;
        read_data=0b00000000;
        CS0=0; SK0=0;
        delay_rom();
        CS0=1;
        DI0=1;  delay_rom();  SK0=1;  //send '1'
        delay_rom();  SK0=0;
        DI0=1;  delay_rom(); SK0=1;  //send '1'
        delay_rom();  SK0=0;
        DI0=0;  delay_rom();  SK0=1;  //send '0'
        delay_rom();  SK0=0;

        do
        {
                if (ee_addr & get_sda)
                        DI0=1;
                else
                        DI0=0;
                delay_rom();  SK0=1;
                delay_rom();  SK0=0;
                get_sda>>=1;
        //send ADDR(6)
        } while (get_sda != 0);
        get_sda=0b10000000;
        do
        {
                delay_rom();  SK0=1;
                delay_rom();  SK0=0;
                if (DO0) read_data |= get_sda;
                get_sda>>=1;
        } while (get_sda!=0);
        delay_rom();  CS0=0; delay_rom();
        return read_data;
}
```
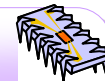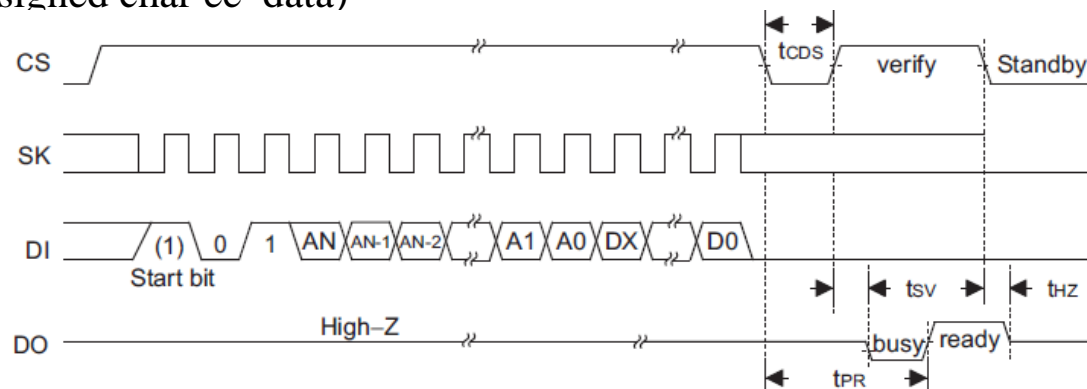
```c
void EEPROM_Serial_WR(unsigned char ee_addr, unsigned char ee  data)
{
        unsigned char get_sda;
        get_sda=0b01000000;
        CS0=0; SK0=0;
        delay_rom();
        CS0=1;
        DI0=1;  delay_rom();  SK0=1;  //send '1'
        delay_rom();  SK0=0;
        DI0=0;  delay_rom(); SK0=1;  //send '0'
        delay_rom();  SK0=0;
        DI0=1;  delay_rom();  SK0=1;  //send '1'
        delay_rom();  SK0=0;
        do
        {
                if (ee_addr & get_sda)
                        DI0=1;
                else
                        DI0=0;
                delay_rom();  SK0=1;
                delay_rom();  SK0=0;
                get_sda>>=1;          //send ADDR
        } while (get_sda!=0);
        get_sda=0b10000000;

                                do
                                {
                                        DI0=ee_data & get_sda;
                                        delay_rom();  SK0=1;
                                        delay_rom();  SK0=0;
                                        get_sda>>=1;   //send DATA
                                } while (get_sda!=0);
                                delay_rom();  CS0=0; delay_rom();
                                delay(1000);

}
```
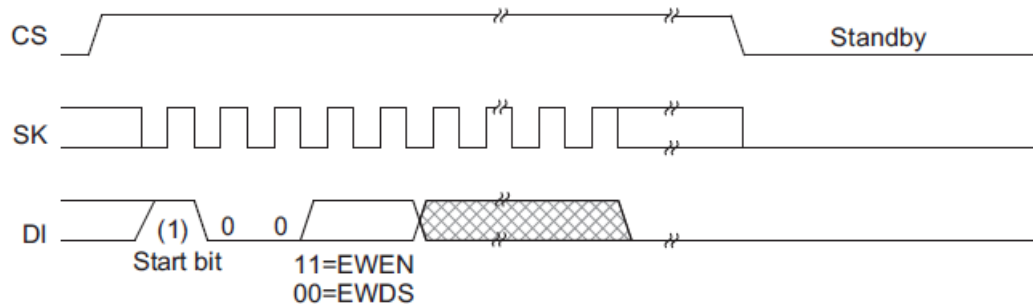
Holtek – Serial EEPROM (HT93LC46) / Erase/Write Enable

```
void EEPROM_Serial_EWEN(unsigned char en_dn)          //en_dn=1:enable/0:DI0sable
{
            unsigned char get_sda;
            unsigned char fun_data;
            get_sda=0b01000000;
            if (en_dn==1)
                        fun_data=0b01100000;
            else
                        fun_data=0b00000000;
            CS0=0; SK0=0;
            delay_rom();
            CS0=1;
            DI0=1;  delay_rom();  SK0=1;  //send '1'
            delay_rom();  SK0=0;
            DI0=0;  delay_rom();     SK0=1;  //send '0'
            delay_rom();  SK0=0;
            DI0=0;  delay_rom();  SK0=1;  //send '0'
            delay_rom();  SK0=0;
            do
            {           if (fun_data & get_sda)
                                    DI0=1;
                        else
                                    DI0=0;
                        delay_rom();  SK0=1;
                        delay_rom();  SK0=0;
                        get_sda>>=1;            //send ADDR(6)
            } while (get_sda!=0);
            delay_rom();  CS0=0;  delay_rom();
}
```
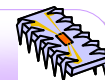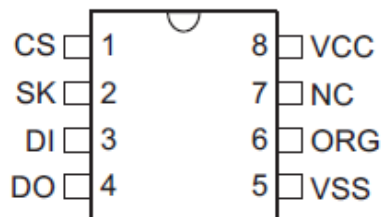
Instruction	Comments	Start bit	Op Code	Address ORG=0 X8 ORG=1 X16		Data ORG=0 X8 ORG=1 X16	
EWEN	Erase/Write Enable	1	00	11XXXXX	11XXXX	—	
EWDS	Erase/Write Disable	1	00	00XXXXX	00XXXX	—	
WRITE	Write data	1	01	A6~A0	A5~A0	D7~D0	D15~D0

CS ___/‾‾‾...‾‾‾___ Standby

SK

DI ___/ (1) \ 0   0 /
    Start bit   11=EWEN
                00=EWDS

Holtek – Serial EEPROM (HT93LC46)

A.C. Characteristics

Symbol	Parameter	V_{CC}=5V±10%		V_{CC}=3V±10%		V_{CC}=2.2V		Unit
		Min.	Max.	Min.	Max.	Min.	Max.	
f_{SK}	Clock Frequency	0	2000	0	1000	0	500	kHz
t_{SKH}	SK High Time	250	—	500	—	1000	—	ns
t_{SKL}	SK Low Time	250	—	500	—	1000	—	ns
t_{CSS}	CS Setup Time	50	—	100	—	100	—	ns
t_{CSH}	CS Hold Time	0	—	0	—	0	—	ns
t_{CDS}	CS Deselect Time	250	—	250	—	500	—	ns
t_{DIS}	DI Setup Time	100	—	150	—	200	—	ns
t_{DIH}	DI Hold Time	100	—	150	—	200	—	ns
t_{PD1}	DO Delay to "1"	—	250	—	500	—	1000	ns
t_{PD0}	DO Delay to "0"	—	250	—	500	—	1000	ns
t_{SV}	Status Valid Time	—	250	—	250	—	250	ns
t_{HZ}	DO Disable Time	—	100	—	200	—	400	ns
t_{PR}	Write Cycle Time	—	5	—	5	—	5	ms

HT93LC46
8 DIP-A/SOP-A/TSSOP-A

CS 1 — 8 VCC
SK 2 — 7 NC
DI 3 — 6 ORG
DO 4 — 5 VSS

Pin Name	I/O	Description
CS	I	Chip select input
SK	I	Serial clock input
DI	I	Serial data input
DO	O	Serial data output
VSS	—	Negative power supply, ground
ORG	I	Internal Organization When ORG is connected to VDD or ORG is floated, the (16) memory organization is selected. When ORG is tied to VSS, the (8) memory organization is selected. There is an internal pull-up resistor on the ORG pin.
VCC	—	Positive power supply

```
for(i_chg=0; i_chg<4; i_chg++)
{

    pwd[i_chg]=key_bcd[i_chg];

    EEPROM_WR(i_chg, key_bcd[i_chg]);

}
```

⟷

```
EEPROM_Serial_EWEN(1);
for(i_chg=0; i_chg<4; i_chg++)
{
        EEPROM_Serial_ER(i_chg);

}
for(i_chg=0; i_chg<4; i_chg++)
{
        data_bcd[i_chg]=dig_bcd[i_chg];
        EEPROM_Serial_WR(i_chg, dig_bcd[i_chg]);
        dig_bcd_show[i_chg]=dig_bcd[i_chg];

}
EEPROM_Serial_EWEN(0);
```

```
for(i_chg=0; i_chg<4; i_chg++)
{

    pwd[i_chg]=EEPROM_RD(i_chg);

}
```

⟷

```
for(i_chg=0; i_chg<4; i_chg++)
{

        data_bcd[i_chg]=EEPROM_Serial_RD(i_chg);

        dig_bcd_show[i_chg]=data_bcd[i_chg];

}
```