

1K-byte EEPROM microcircuit with function of protection for writing and programmable secret code.

Microcircuit IZ4428 is designed to use in intellectual plastic cards. Sphere of application: medical insurance, excess control systems, member cards, smart cards.

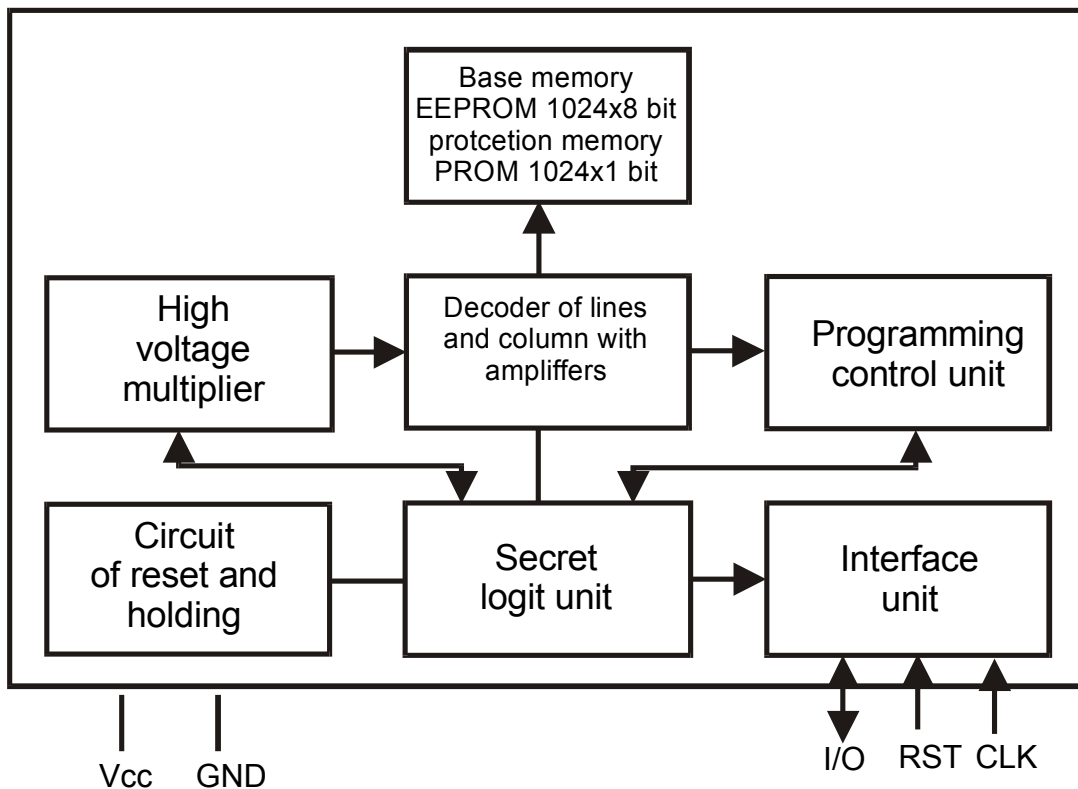
Features:

1024 x 8 - arrangement of EEPROM;
Byte - directed addressing;
Protection of memory writing;
1024 x 1 bit arrangement of memory protection ;
Response for reset;
Minimum 10000 cycles of erasure / writing ;
Information storage time - 5 years ;
Location of contact pads and serial interface in accordance with ISO 7816 standard;
Data in memory can be changed only after introduction of correct 2-byte programmable secret code (PSC);

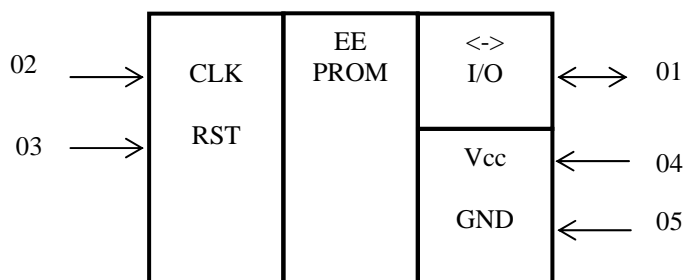
Purpose of IC contact pads

| CP | Symbol | Function |
|----|--------|---------------------------------------|
| 01 | I/O | Bidirectional data line (open drain) |
| 02 | CLK | clock rate input |
| 03 | RST | control input (reset) |
| 04 | Vcc | supply voltage |
| 05 | GND | general |

Block diagram



Graphical symbol of IC



Operating temperature range

Operating temperature range from -35°C to +100°C.

Extreme modes

| Symbol | Name of parameter | Standard | | Measurement unit |
|----------|-----------------------------|----------|----------|------------------|
| | | min | max | |
| V_{CC} | Supply voltage | 4,5 | 5,5 | V |
| V_{IH} | Input voltage of high level | 3,5 | V_{CC} | V |
| V_{IL} | Input voltage of low level | 0 | 0,8 | V |
| T | Operating temperature range | -35 | +100 | °C |

Limiting modes

| Symbol | Name of parameter | Standard | | Measurement unit |
|-----------|-----------------------------|----------|------|------------------|
| | | min | max | |
| V_{CC} | Supply voltage | -0,3 | 6,0 | V |
| V_{IH} | Input voltage of high level | - | 6,0 | B |
| V_{IL} | Input voltage of low level | -0,3 | - | V |
| T_{stg} | Storage temperature | -40 | +125 | °C |

They do not guarantee efficiency of ICs at limiting modes. After removal of limiting modes they guarantee efficiency in extreme mode.

Static parameters

T_A = from -35 to +100°C

| Symbol | Name of parameter | measurement conditions | Standard | | unit of measurement |
|----------|---|--|----------|----------|---------------------|
| | | | min | max | |
| V_{IL} | Input voltage of low level | V_{CC} =from 4,5 to 5,5V | 0 | 0,8 | V |
| V_{IH} | Input voltage of high level | V_{CC} =from 4,5 to 5,5V | 3,5 | V_{CC} | V |
| I_{OL} | Output current of low level | V_{CC} =from 4,5 to 5,5V V_{OL} = 0,4V | 0,5 | - | mA |
| I_{OH} | Output leakage current of high level | V_{CC} =5,5V V_{OH} =5,5V | - | 10 | μA |
| I_{IH} | Input current of high level (I/O,CLK,RST) | V_{CC} =5,5V V_{IH} =5,5V | - | 10 | μA |
| I_{CC} | consumption current | V_{CC} =5,5V, V_{IL} =0V, V_{IH} = V_{CC} | - | 10 | mA |

Dynamic parameters

V_{CC} = from 4,5 to 5,5V, T_A = from -35 to +100°C

| Symbol | Name of parameter | Standard | | Unit of measurement |
|----------|---------------------------------------|----------|-----|---------------------|
| | | min | max | |
| t_{d1} | setting up time (D/CLK) | 4,0 | - | μ S |
| t_{d2} | delay time (CLK/D) | 6,0 | - | μ S |
| t_{d3} | setting up time (CLK/RST) | | - | μ S |
| t_{d4} | setting up time (RST/CLK) | 4,0 | - | μ S |
| t_{d5} | hold-in time (D/CLK) | 4,0 | - | μ S |
| t_{d6} | hold-in time (RST) | 20,0 | - | μ S |
| t_L | CLK low level | 10,0 | - | μ S |
| t_H | CLK high level | 10,0 | - | μ S |
| t_W | writing time (fc=20 kHz) | 5,0 | - | μ S |
| t_E | erasure time (fc=20 kHz) | 5,0 | - | μ S |
| t_{RE} | delay time | 9,0 | - | μ S |
| t_R | Time of rise front (I/O, CLK, RST) | - | 1,0 | μ S |
| t_F | Time of fall (I/O, CLK, RST) | - | 1,0 | μ S |

Memory

Memory of microcircuit consists of base memory with the structure of 1024 x 8 bit EEPROM and protection memory with the structure of 1024 x 1 bit PROM. Every byte of memory can be protected separately from erasure/writing by the way of programming the corresponding bit of protection memory. They programm Bit of protection only one time and it can not be erased.

Also microcircuit has protection with programmable secret code (PSC), which controls excess to erasure/writing of memory. For this purpose the last three bytes of the base memory intended for error counter (one byte with the address 1021) and PSC (two byte with addresses 1022 and 1023).

Without verification of PSC only reading of base memory from the address 0 to address 1021 is possible (storage range of PSC is zero notated) and error counter writing. After successful verification of PSC all base memory from address 0 to address 1023 is readable and available for operations of erasure/writing. This state of microcircuit retain to power supply switch off. After switching on of power supply the PSC verification procedure should be carried out again.

After eight unsuccessful attempts to verify PSC, error counter blocks irreversibly any possibility to change contents of memory.

Response for reset

Reset can be supplied at any time during microcircuit operates. After reset during 32-clock pulses to the line I/O, contents of first 4 bytes of memory are read.

System of commands

Base commands of introduction Base enter commands

| Byte 1 | | | | | | Byte 2 | Byte 3 | Operation | |
|--------|----|----|----|----|----|-----------------------------|-------------------------|---------------|--|
| S0 | S1 | S2 | S3 | S4 | S5 | A8 A9 | A0-A7 | | D0-D7 |
| 1 | 0 | 0 | 0 | 1 | 1 | address bits 8 and 9 | address bits 0-7 | input data | writing and erasure with protection bit |
| 1 | 1 | 0 | 0 | 1 | 1 | | | input data | writing and erasure without protection bit |
| 0 | 0 | 0 | 0 | 1 | 1 | | | data compared | writing of protection bit with data verification |
| 0 | 0 | 1 | 1 | 0 | 0 | | | have no value | reading of 9 bit, data with protection bit |
| 0 | 1 | 1 | 1 | 0 | 0 | | | have no value | reading of 8 bit, data without protection bit |

Commands of enter for PSC verification

| byte 1 | | | | | | byte 2 | byte 3 | operation | | |
|--------|----|----|----|----|----|--------|--------|-----------|------------|-------------------------------------|
| S0 | S1 | S2 | S3 | S4 | S5 | A8 A9 | A0-A7 | | D0-D7 | |
| 0 | 1 | 0 | 0 | 1 | 1 | 1 | 1 | 253 | mask bit | writing of error counter |
| 1 | 0 | 1 | 1 | 0 | 0 | 1 | 1 | 254 | byte 1 ПСК | verification of the first byte PSC |
| 1 | 0 | 1 | 1 | 0 | 0 | 1 | 1 | 255 | byte 2 ПСК | verification of the second byte PSC |

In erased state memory cells shall be read as logic "1". After operation of writing memory cells shall be read as logic "0".

There are three kind of operations of writing /erasure, that are implemented automatically by the microcircuit:

- erasure and following writing (duration is 203 timing pulses CLK, f=20 kHz);
- only writing, if no one of the 8 bit in addressed byte requires to be turned from "0" into "1" (duration is 103 timing pulses CLK, f=20 kHz);
- only erasure - if there are no turns from "1" into "0" in addressed byte (duration is 103 timing pulses CLK, f=20 kHz).

Time diagrams

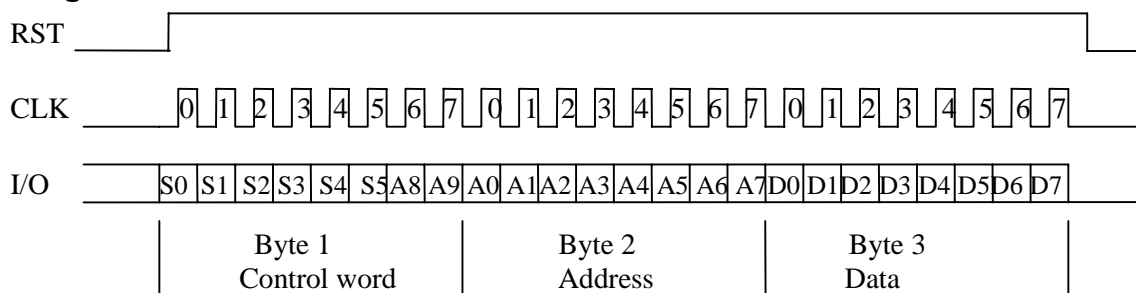


Figure 1 - introduction of the command

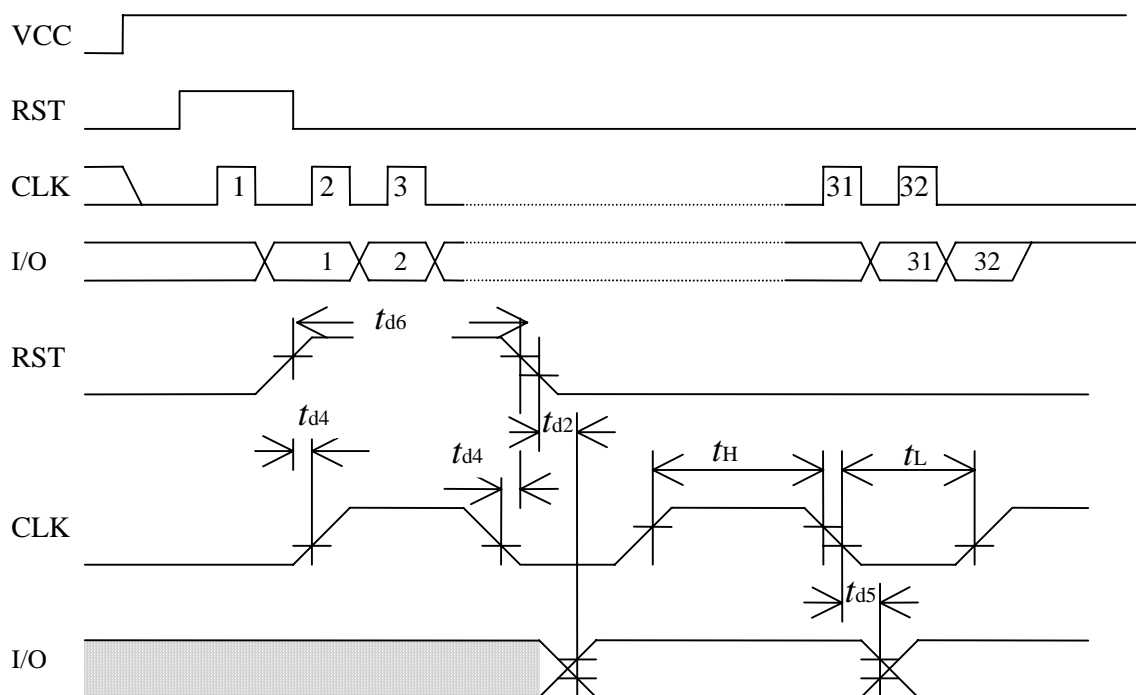


Figure 2 - Reset and response for reset

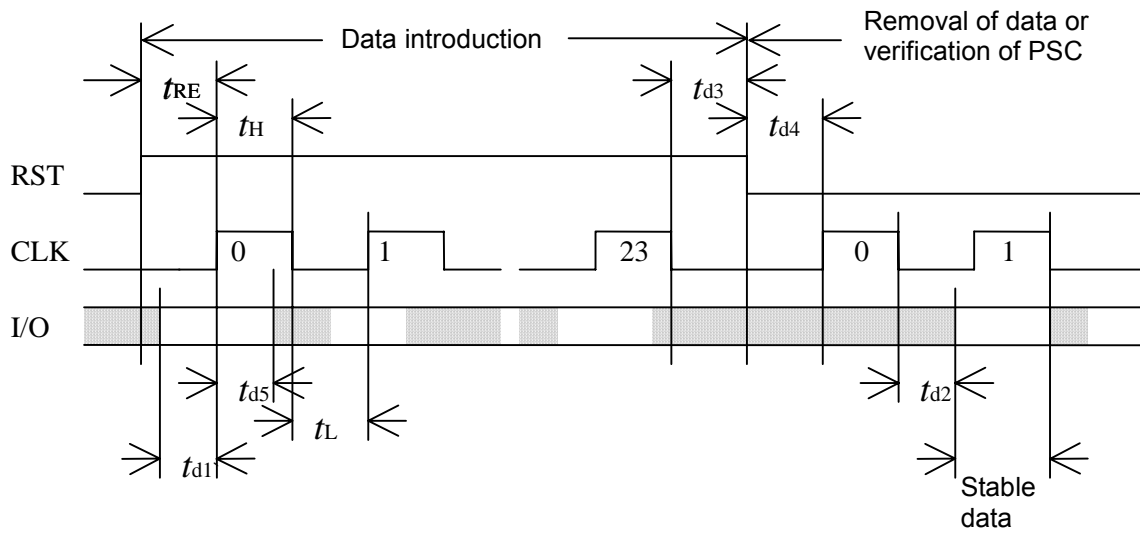


Figure 3 - Data introduction, removal of data and verification of programmable secret code

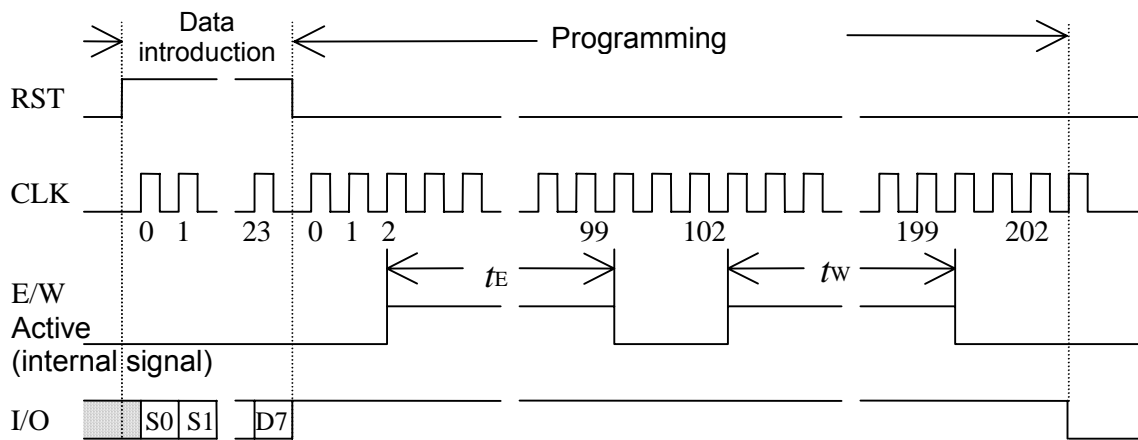


Figure 4 - programming: erasure and writing

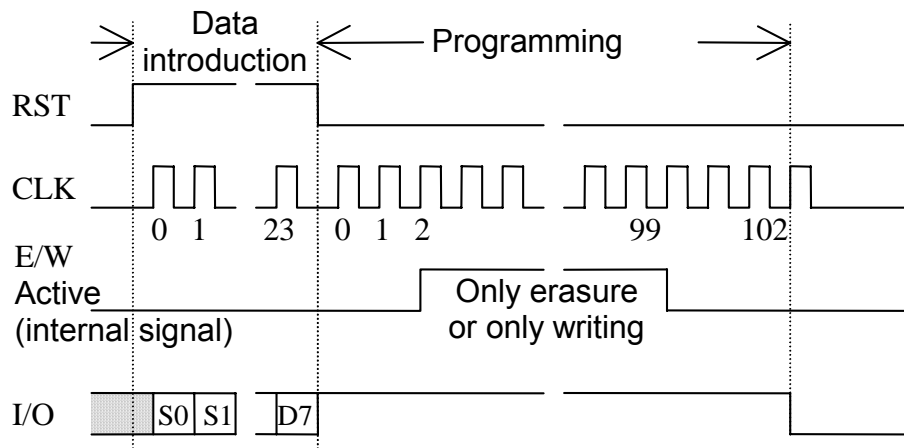


Figure 5 - programming: erasure or writing

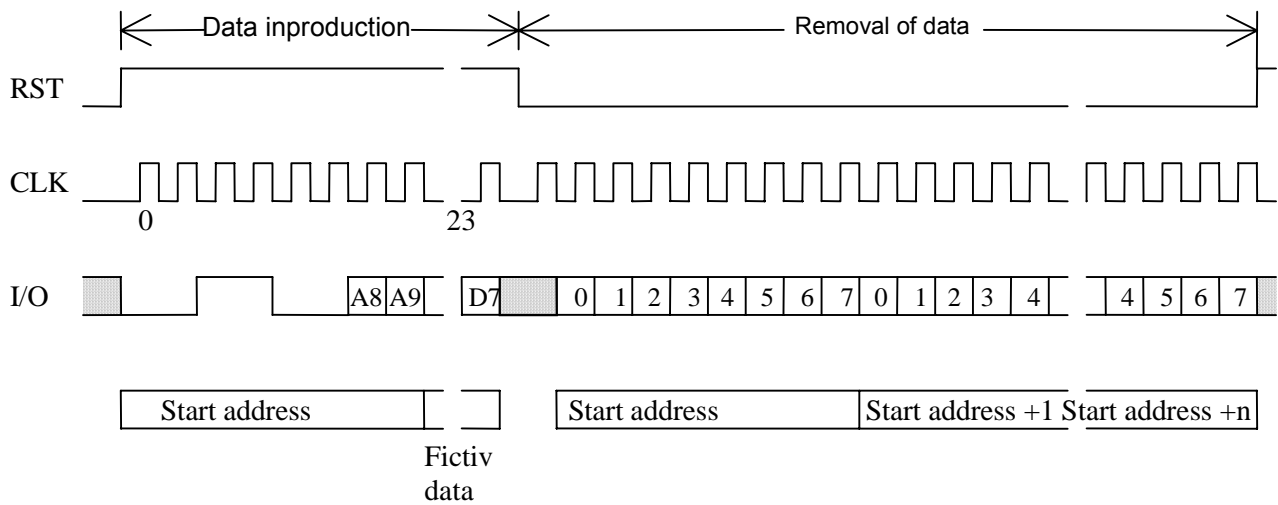


Figure 6 - data byte reading: reading of 8 bit data D0-D7

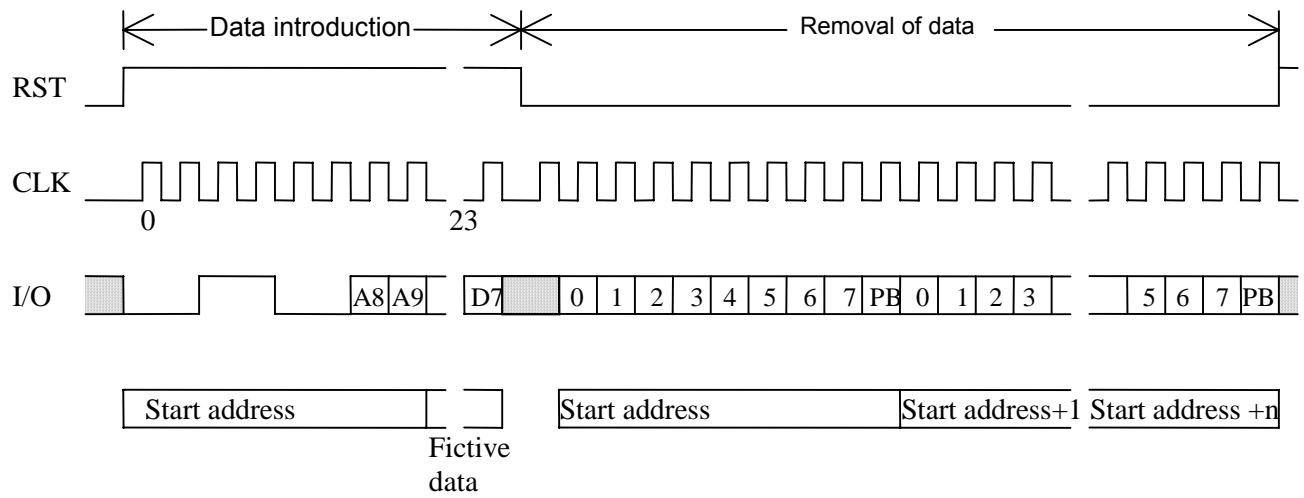


Figure 7 - reading of 9 bit: D0-D7 data byte and PB protection byte

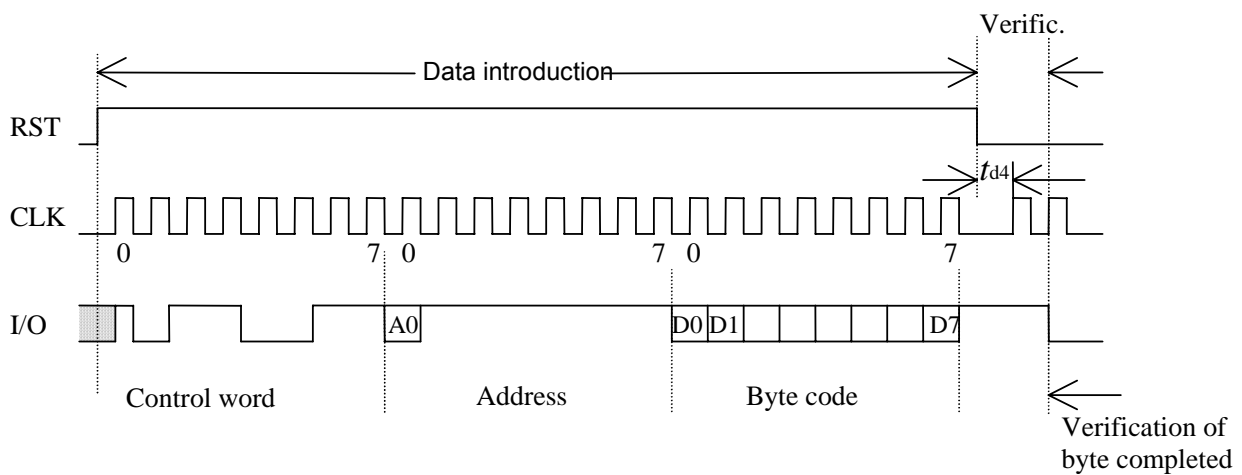


Figure 8 - Verification of programmable secret code byte