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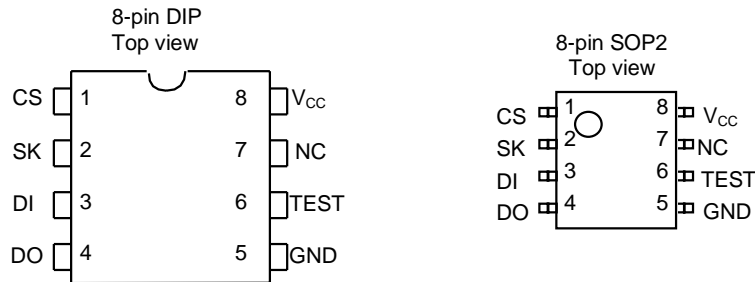
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The S-29530A / 630A series are low power 16K / 32K-bit E<sup>2</sup>PROM with a low operating voltage range. They are organized as 1024-word×16-bit and 2048-word×16bit, respectively. Each is capable of sequential read, at which time addresses are automatically incremented in 16-bit blocks.

■ Features

- Low power consumption
  - Standby : 1.0μA Max.
  - Operating : 1.2 mA Max. (VCC=5.5 V)
  - : 0.4 mA Max. (VCC=2.5 V)
- Wide operating voltage range
  - Write : 1.8 to 5.5 V
  - Read : 1.8 to 5.5 V
- Sequential read capable
- Endurance : 10<sup>6</sup> cycles/word
- Data retention : 10 years

■ Pin Assignment



\* See Dimensions

Figure 1

■ Pin Functions

Table 1

Name	Pin Number		Function
	SOP2	SSOP	
CS	1	1	Chip select input
SK	2	2	Serial clock input
DI	3	3	Serial data input
DO	4	4	Serial data output
GND	5	5	Ground
TEST	6	6	Test pin (normally kept open) (can be connected to GND or Vcc)
NC	7	7	No Connection
V <sub>CC</sub>	8	8	Power supply

# CMOS SERIAL E<sup>2</sup>PROM

## S-29530A / 29630A

### ■ Block Diagram

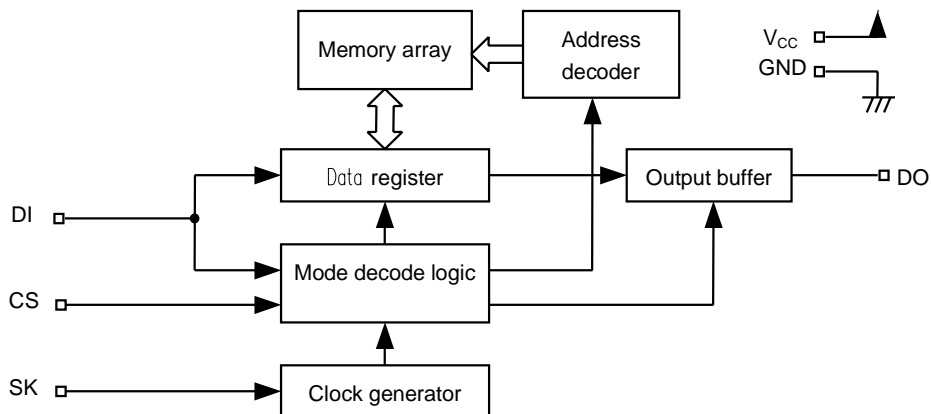


Figure 2

### ■ Instruction Set

Table 2

Instruction	Start Bit	Opo Code	Address		Data
			S-29530A	S-29630A	
READ (Read data)	1	10	A <sub>9</sub> to A <sub>0</sub>	xA <sub>10</sub> to A <sub>0</sub>	D <sub>15</sub> to D <sub>0</sub> Output*
WRITE (Write data)	1	01	A <sub>9</sub> to A <sub>0</sub>	xA <sub>10</sub> to A <sub>0</sub>	D <sub>15</sub> to D <sub>0</sub> Input
ERASE (Erase data)	1	11	A <sub>9</sub> to A <sub>0</sub>	xA <sub>10</sub> to A <sub>0</sub>	—
EWEN (Program enable)	1	00	11xxxxxxxx	11xxxxxxxxxx	—
EWDS (Program disable)	1	00	00xxxxxxxx	00xxxxxxxxxx	—

x : Doesn't matter.

\* : Addresses are continuously incremented.

### ■ Absolute Maximum Ratings

Table 3

Parameter	Symbol	Ratings	Unit
Power supply voltage	V <sub>CC</sub>	-0.3 to +7.0	V
Input voltage	V <sub>IN</sub>	-0.3 to V <sub>CC</sub> +0.3	V
Output voltage	V <sub>OUT</sub>	-0.3 to V <sub>CC</sub>	V
Storage temperature under bias	T <sub>bias</sub>	-50 to +95	°C
Storage temperature	T <sub>stg</sub>	-65 to +150	°C

■ **Recommended Operating Conditions**

**Table 4**

Parameter	Symbol	Conditions	Min.	Typ.	Max.	Unit
Power supply voltage	VCC	READ/WRITE/ERASE EWEN/EWDS	1.8	—	5.5	V
High level input voltage	V <sub>IH</sub>	V <sub>CC</sub> = 2.5 to 5.5 V	0.8×V <sub>CC</sub>	—	V <sub>CC</sub>	V
		V <sub>CC</sub> = 1.8 to 2.5 V	0.8×V <sub>CC</sub>	—	V <sub>CC</sub>	V
Low level input voltage	V <sub>IL</sub>	V <sub>CC</sub> = 2.5 to 5.5 V	0.0	—	0.2×V <sub>CC</sub>	V
		V <sub>CC</sub> = 1.8 to 2.5 V	0.0	—	0.15-V <sub>CC</sub>	V
Operating temperature	T <sub>opr</sub>		- 40	—	+ 85	°C

■ **Pin Capacitance**

**Table 5**

(T<sub>a</sub>=25 °C, f=1.0 MHz, V<sub>CC</sub>=5 V)

Parameter	Symbol	Conditions	Min.	Typ.	Max.	Unit
Input Capacitance	C <sub>IN</sub>	V <sub>IN</sub> =0 V	—	—	8	pF
Output Capacitance	C <sub>OUT</sub>	V <sub>OUT</sub> =0 V	—	—	10	pF

■ **Endurance**

**Table 6**

Parameter	Symbol	Min.	Typ.	Max.	Unit
Endurance	N <sub>w</sub>	10 <sup>6</sup>	—	—	cycles/word

**CMOS SERIAL E<sup>2</sup>PROM**  
**S-29530A / 29630A**

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■ **DC Electrical Characteristics**

**Table 7**

Parameter	SmbI	Conditions	V <sub>CC</sub> =4.5 V to 5.5 V			V <sub>CC</sub> =2.5 V to 4.5 V			V <sub>CC</sub> =1.8 to 2.5 V			Unit
			Min.	Typ.	Max.	Min.	Typ.	Max.	Min.	Typ.	Max.	
Current consumption (READ)	I <sub>CC1</sub>	DO unloaded	—	—	1.2	—	—	0.5	—	—	0.4	mA
Current consumption (PROGRAM)	I <sub>CC2</sub>	DO unloaded	—	—	5.0	—	—	2.0	—	—	1.5	mA

**Table 8**

Parameter	SmbI	Conditions	V <sub>CC</sub> =4.5 V to 5.5 V			V <sub>CC</sub> =2.5 to 4.5 V			V <sub>CC</sub> =1.8 to 2.5 V			Unit
			Min.	Typ.	Max.	Min.	Typ.	Max.	Min.	Typ.	Max.	
Standby current consumption	I <sub>SB</sub>	CS=GND DO=Open Connected to V <sub>CC</sub> or GND	—	—	1.0	—	—	1.0	—	—	1.0	μA
Input leakage current	I <sub>LI</sub>	V <sub>IN</sub> =GND to V <sub>CC</sub>	—	0.1	1.0	—	0.1	1.0	—	0.1	1.0	μA
Output leakage current	I <sub>LO</sub>	V <sub>OUT</sub> =GND to V <sub>CC</sub>	—	0.1	1.0	—	0.1	1.0	—	0.1	1.0	μA
Low level output voltage	V <sub>OL</sub>	CMOS I <sub>OL</sub> = 100μA	—	—	0.1	—	—	0.1	—	—	—	V
High level output voltage	V <sub>OH</sub>	CMOS V <sub>CC</sub> =2.5 to 5.5V:I <sub>OH</sub> = -100μA V <sub>CC</sub> =1.8 to 2.5V:I <sub>OH</sub> = -10μA	V <sub>CC</sub> -0.7	—	—	V <sub>CC</sub> -0.7	—	—	V <sub>CC</sub> -0.3	—	—	V
Write enable latch data hold voltage	V <sub>DH</sub>	Only when write disable mode	1.5	—	—	1.5	—	—	1.5	—	—	V

■ AC Electrical Characteristics

Table 9

Input pulse voltage	$0.1 \times V_{CC}$ to $0.9 \times V_{CC}$
Output reference voltage	$0.5 \times V_{CC}$
Output load	100pF

Table 10

Parameter	Symble	$V_{CC}=4.5$ to $5.5$ V			$V_{CC}=2.5$ to $4.5$ V			$V_{CC}=1.8$ to $2.5$ V			Unit
		Min.	Typ.	Max.	Min.	Typ.	Max.	Min.	Typ.	Max.	
CS setup time	$t_{CSS}$	0.2	—	—	0.4	—	—	1.0	—	—	$\mu$ s
CS hold time	$t_{CSH}$	0.2	—	—	0.4	—	—	1.0	—	—	$\mu$ s
CS deselect time	$t_{CDS}$	0.2	—	—	0.2	—	—	0.4	—	—	$\mu$ s
Data setup time	$t_{DS}$	0.2	—	—	0.4	—	—	0.8	—	—	$\mu$ s
Data hold time	$t_{DH}$	0.2	—	—	0.4	—	—	0.8	—	—	$\mu$ s
Output delay	$t_{PD}$	—	—	0.5	—	—	1.0	—	—	2.0	$\mu$ s
Clock frequency	$f_{SK}$	0	—	1.4	0	—	0.5	0	—	0.2	MHz
Clock pulse width	$t_{SKH}, t_{SKL}$	0.35	—	—	1.0	—	—	2.5	—	—	$\mu$ s
Output disable time	$t_{HZ1}, t_{HZ2}$	0	—	0.15	0	—	0.5	0	—	1.0	$\mu$ s
Output enable time	$t_{SV}$	0	—	0.15	0	—	0.5	0	—	1.0	$\mu$ s
Programming time	$t_{PR}$	—	4.0	10.0	—	4.0	10.0	—	4.0	10.0	ms

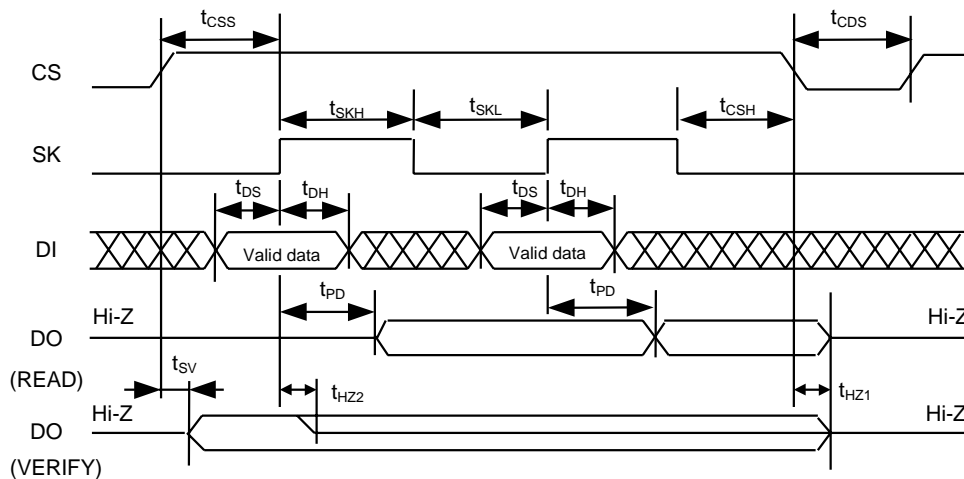


Figure 3 Timing Chart

# CMOS SERIAL E<sup>2</sup>PROM

## S-29530A / 29630A

### ■ Operation

Instructions (in the order of start-bit, instruction, address, and data) are latched to DI in synchronization with the rising edge of SK after CS goes high. A start-bit can only be recognized when the high of DI is latched to the rising edge of SK when CS goes from low to high, it is impossible for it to be recognized as long as DI is low, even if there are SK pulses after CS goes high. Any SK pulses input while DI is low are called "dummy clocks." Dummy clocks can be used to adjust the number of clock cycles needed by the serial IC to match those sent out by the CPU. Instruction input finishes when CS goes low, where it must be low between commands during  $t_{CDS}$ .

All input, including DI and SK signals, is ignored while CS is low, which is stand-by mode.

#### 1. Read

The READ instruction reads data from a specified address. After A0 is latched at the rising edge of SK, DO output changes from a high-impedance state (Hi-Z) to low level output. Data is continuously output in synchronization with the rise of SK.

When all of the data (D15 to D0) in the specified address has been read, the data in the next address can be read with the input of another SK clock. Thus, it is possible for all of the data addresses to be read through the continuous input of SK clocks as long as CS is high.

The last address ( $A_n \dots A_1 A_0 = 1 \dots 11$ ) rolls over to the top address ( $A_n \dots A_1 A_0 = 0 \dots 00$ ).

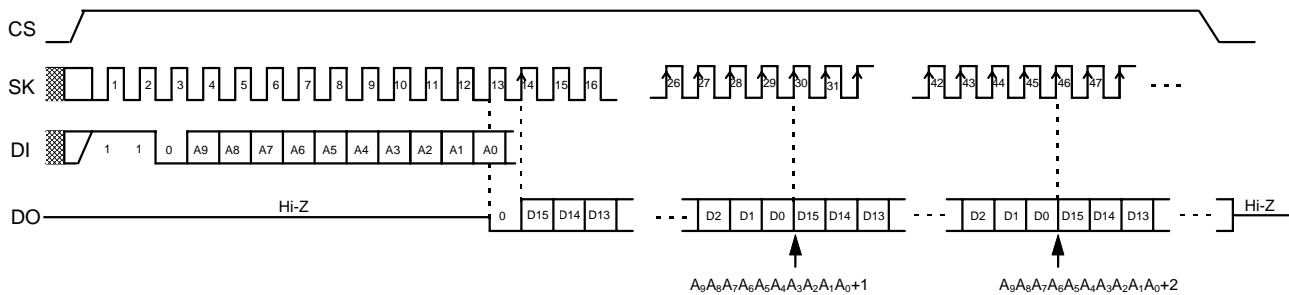


Figure 4 Read Timing (S-29530A)

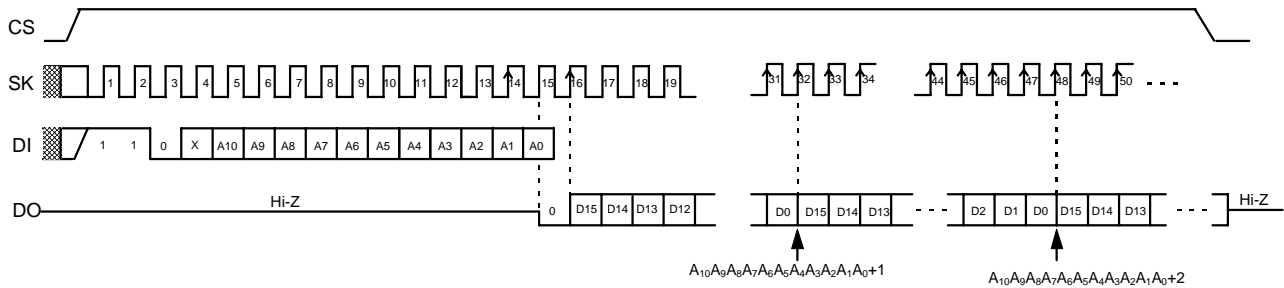


Figure 5 Read Timing (S-29630A)

## 2. Write (WRITE, ERASE)

There are two write instructions, WRITE and ERASE. Each automatically begins writing to the non-volatile memory when CS goes low at the completion of the specified clock input.

The write operation is completed in 10 ms ( $t_{PR}$  Max.), and the typical write period is less than 4 ms. In the S-29530A / 630A series, it is easy to VERIFY the completion of the write operation in order to minimize the write cycle by setting CS to high and checking the DO pin, which is low during the write operation and high after its completion. This VERIFY procedure can be executed over and over again. There are two methods to detect a change in the DO output. One is to detect a change from low to high setting CS to high, and the other is to detect a change from low to high as a result of repetitious operations of returning the CS to low after setting CS to high and checking the DO output.

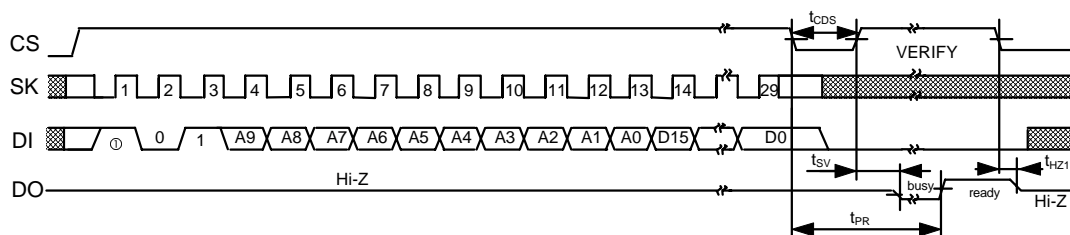
Because all SK and DI inputs are ignored during the write operation, any input of instruction will also be disregarded. When DO outputs high after completion of the write operation or if it is in the high-impedence state (Hi-Z), the input of instructions is available. Even if the DO pin remains high, it will enter the high-impedence state upon the recognition of a high of DI (start-bit) attached to the rising edge of an SK pulse. (see Figure 3).

DI input should be low during the VERIFY procedure.

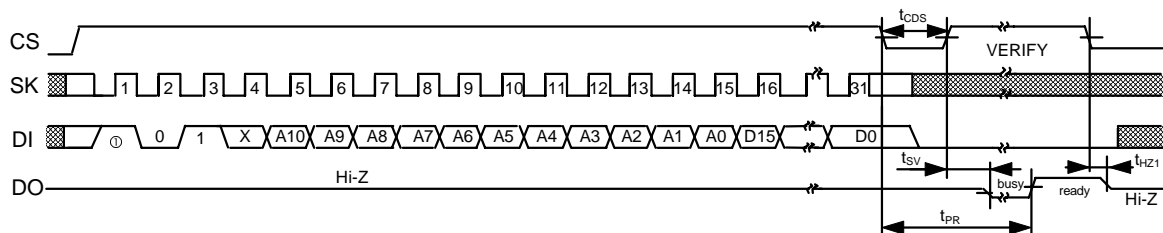
### 2.1 WRITE

This instruction writes 16-bit data to a specified address.

After changing CS to high, input a start-bit, op-code (WRITE), address, and 16-bit data. If there is a data overflow of more than 16 bits, only the last 16-bits of the data is considered valid. Changing CS to low will start the WRITE operation. It is not necessary to make the data "1" before initiating the WRITE operation.



**Figure 6** Write Timing (S-29530A)



**Figure 7** Write Timing (S-29630A)



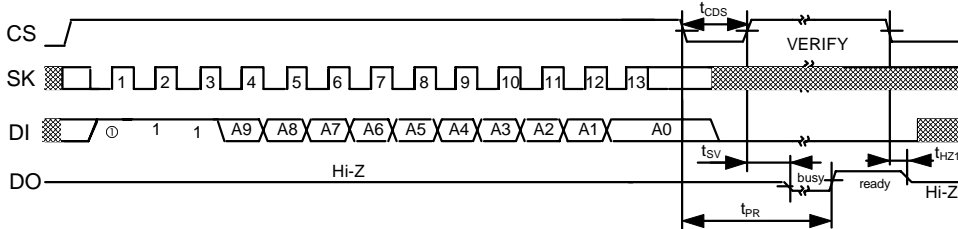
# CMOS SERIAL E<sup>2</sup>PROM

## S-29530A / 29630A

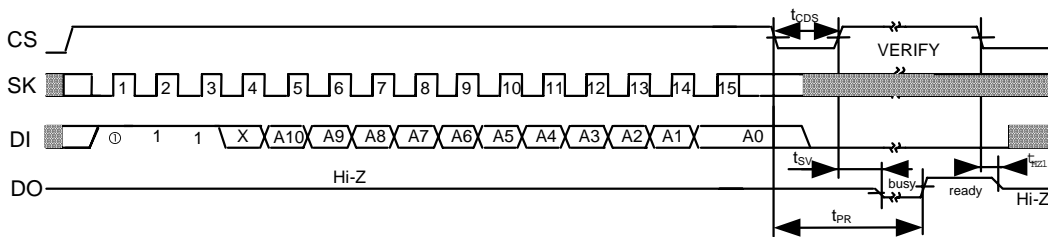
### 2.2 ERASE

This command erases 16-bit data in a specified address.

After changing CS to high, input a start-bit, op-code (ERASE), and address. It is not necessary to input data. Changing CS to low will start the ERASE operation, which changes every bit of the 16 bit data to "1."



**Figure 8** ERASE Timing (S-29530A)

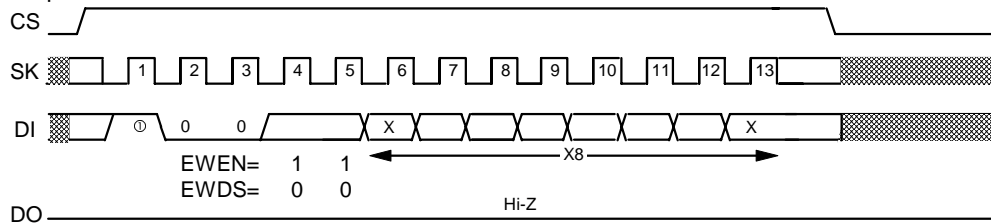


**Figure 9** ERASE Timing (S-29630A)

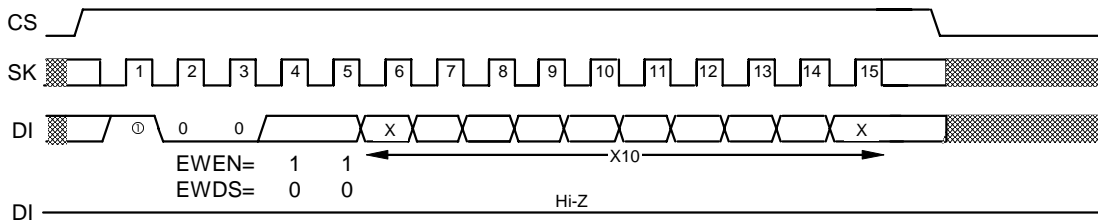
3. Write enable (EWEN) and Write disable (EWDS)

The EWEN instruction puts the S-29530A / 630A series into write enable mode, which accepts WRITE and ERASE instructions. The EWDS instruction puts the S-29530A / 630A series into write disable mode, which refuses WRITE and ERASE instructions.

The S-29530A / 630A series powers on in write disable mode, which protects data against unexpected, erroneous write operations caused by noise and/or CPU malfunctions. It should be kept in write disable mode except when performing write operations.



**Figure 10** EWEN/EWDS Timing (S-29530A)



**Figure 11** EWEN/EWDS Timing (S-29630A)

## CMOS SERIAL E<sup>2</sup>PROM S-29530A / 29630A

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### ■ Receiving a Start-Bit

A start bit can be recognized by latching the high level of DI at the rising edge of SK after changing CS to high (Start-bit Recognition). The write operation begins by inputting the write instruction and setting CS to low. The DO pin then outputs low during the write operation and high at its completion by setting CS to high (Verify Operation). Therefore, only after a write operation, in order to accept the next command by having CS go high, the DO pin switch from a state of high-impedence to a state of data output; but if it recognizes a start-bit, the DO pin returns to a state of high-impedence (see Figure 3).

### ■ Three-wire Interface (DI-DO direct connection)

Although the normal configuration of a serial interface is a 4-wire interface to CS, SK, DI, and DO, a 3-wire interface is also a possibility by connecting DI and DO. However, since there is a possibility that the DO output from the serial memory IC will interfere with the data output from the CPU with a 3-wire interface, install a resistor between DI and DO in order to give preference to data output from the CPU to DI (See Figure 12).

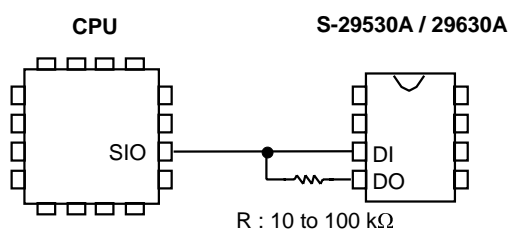


Figure 12

■ Dimensions (Unit : mm)

1. 8-pin DIP

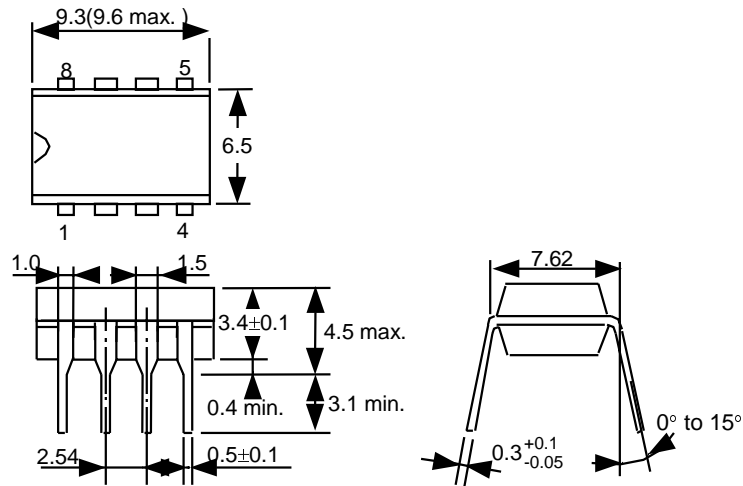


Figure 13

Markings

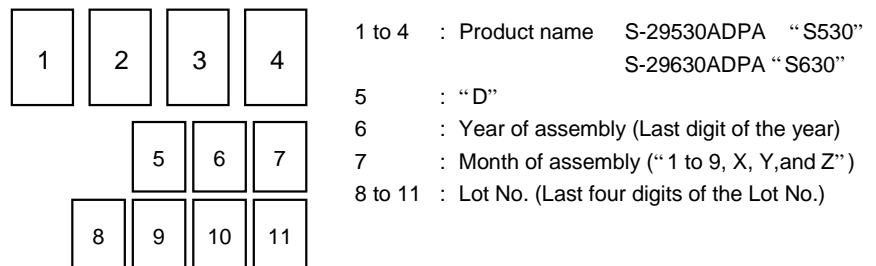
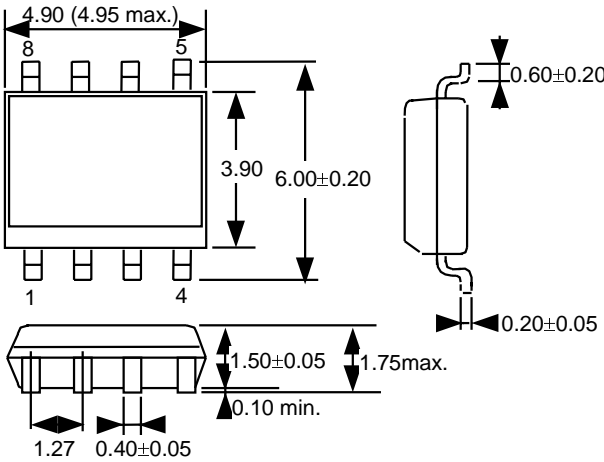


Figure 14

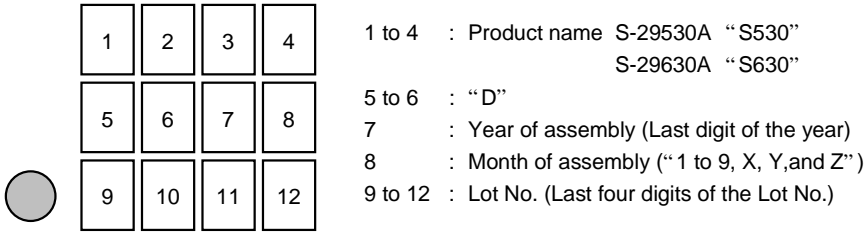
**CMOS SERIAL E<sup>2</sup>PROM**  
**S-29530A / 29630A**

2. 8-pin SOP



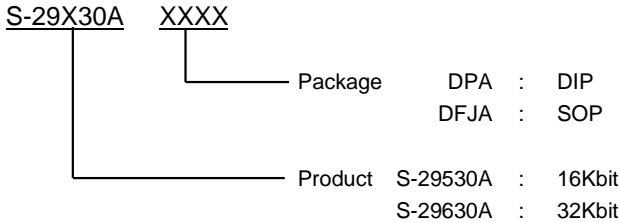
**Figure 15**

Markings



**Figure 16**

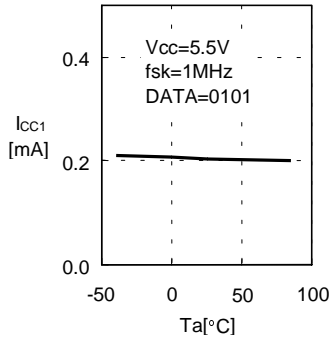
■ **Ordering Information**



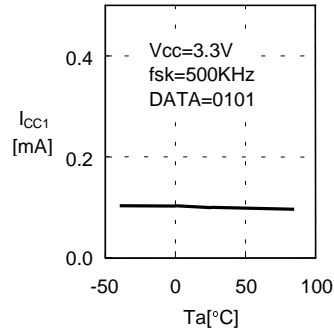
■ Characteristics

1. DC Characteristics

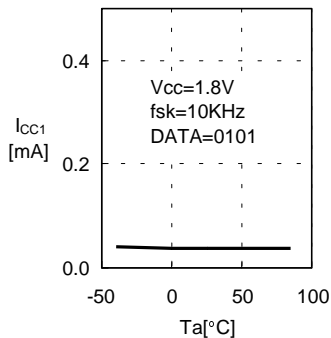
1.1 Current consumption (READ)  $I_{CC1}$  – Ambient temperature  $T_a$



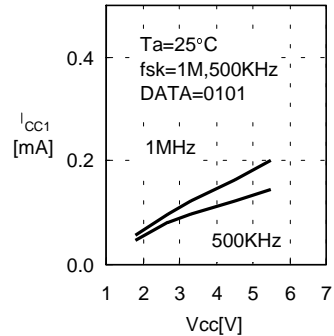
1.2 Current consumption (READ)  $I_{CC1}$  – Ambient temperature  $T_a$



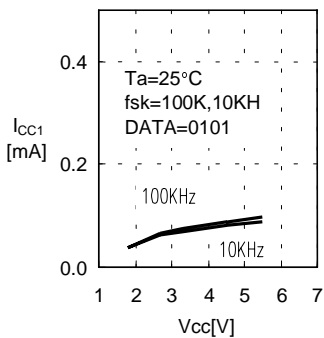
1.3 Current consumption (READ)  $I_{CC1}$  – Ambient temperature  $T_a$



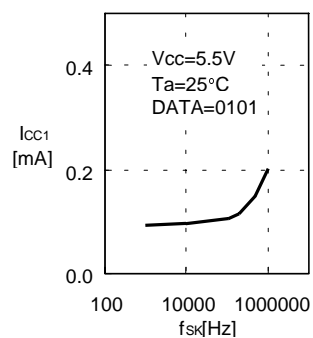
1.4 Current consumption (READ)  $I_{CC1}$  – Power supply voltage  $V_{CC}$



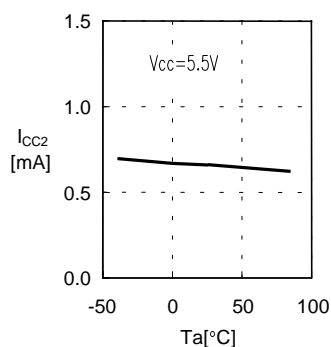
1.5 Current consumption (READ)  $I_{CC1}$  – Power supply voltage  $V_{CC}$



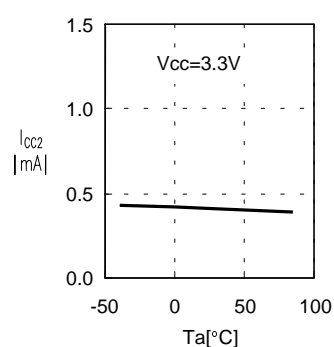
1.6 Current consumption (READ)  $I_{CC1}$  – Clock frequency  $f_{SK}$



1.7 Current consumption (PROGRAM)  $I_{CC2}$  – Ambient temperature  $T_a$

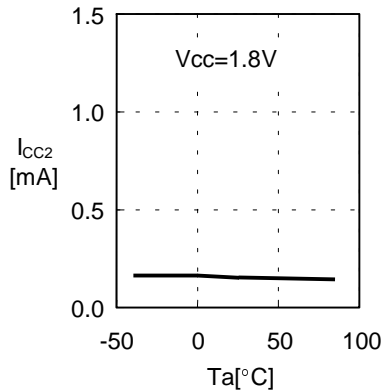


1.8 Current consumption (PROGRAM)  $I_{CC2}$  – Ambient temperature  $T_a$

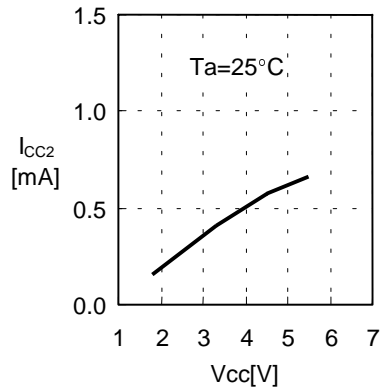


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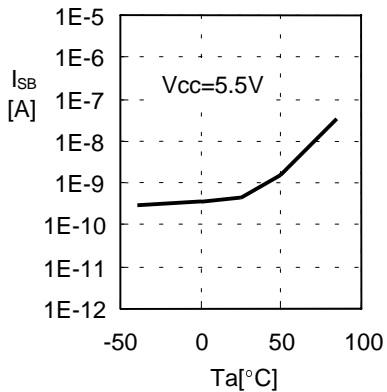
1.9 Current consumption (PROGRAM)  $I_{CC2}$  – Ambient temperature  $T_a$



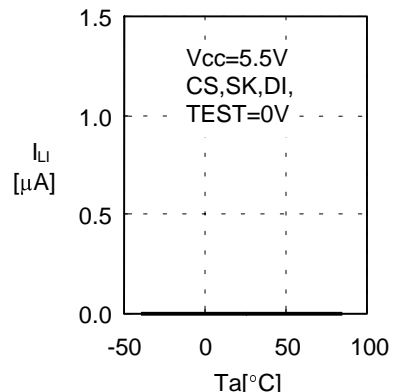
1.10 Current consumption (PROGRAM)  $I_{CC2}$  – Power supply voltage  $V_{CC}$



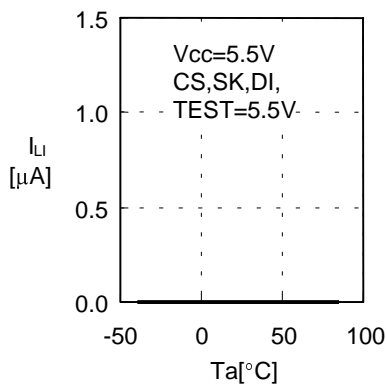
1.11 Stand by current consumption  $I_{SB}$  – Ambient temperature  $T_a$



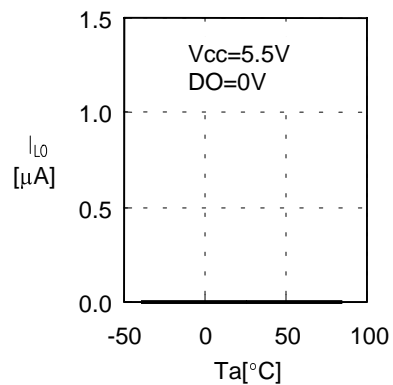
1.12 Input leakage current  $I_{LI}$  – Ambient temperature  $T_a$



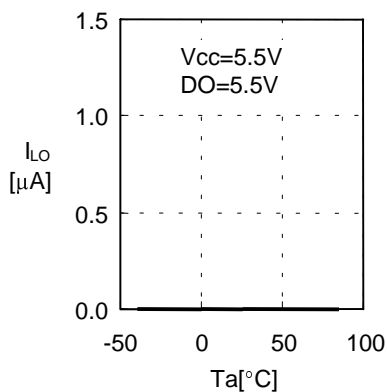
1.13 Input leakage current  $I_{LI}$  – Ambient temperature  $T_a$



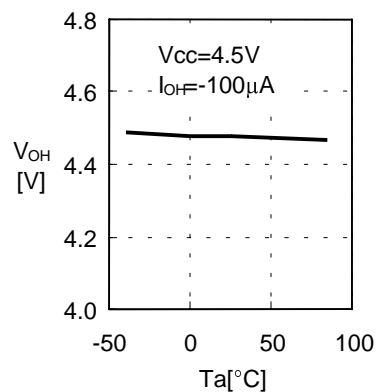
1.14 Output leakage current  $I_{LO}$  – Ambient temperature  $T_a$



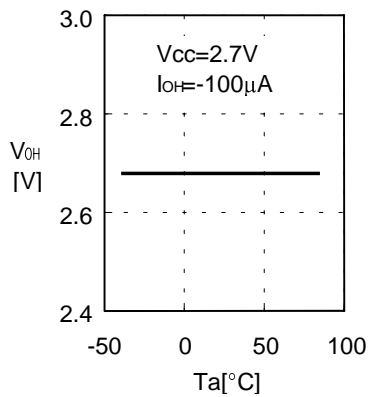
1.15 Output leakage current  $I_{LO}$  – Ambient temperature  $T_a$



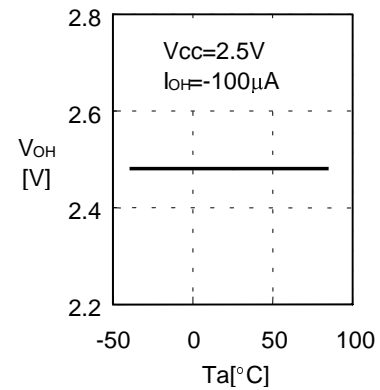
1.16 High level output voltage  $V_{OH}$  – Ambient temperature  $T_a$



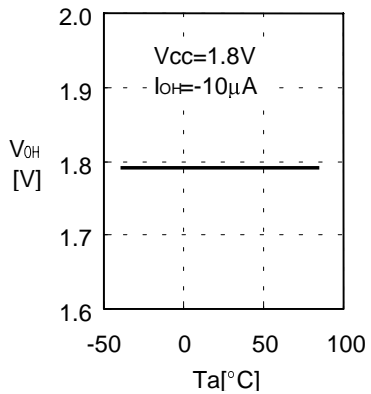
1.17 High level output voltage  $V_{OH}$  – Ambient temperature  $T_a$



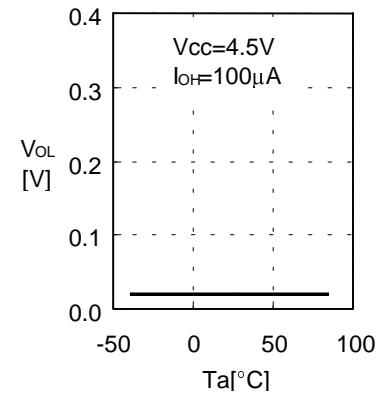
1.18 High level output voltage  $V_{OH}$  – Ambient temperature  $T_a$



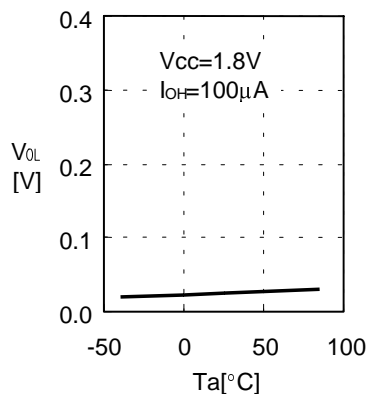
1.19 High level output voltage  $V_{OH}$  – Ambient temperature  $T_a$



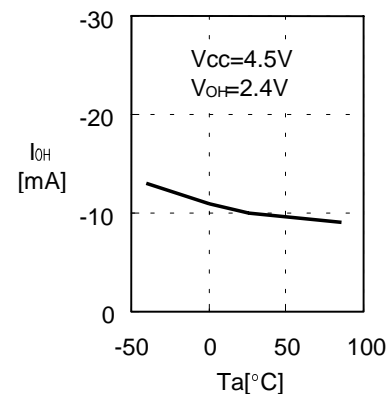
1.20 Low level output voltage  $V_{OL}$  – Ambient temperature  $T_a$



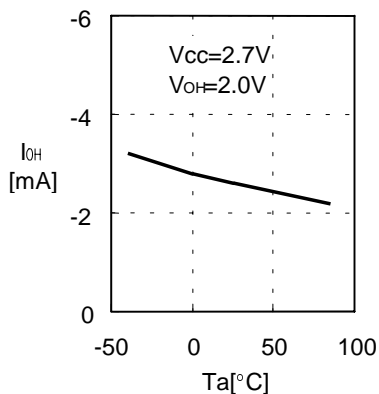
1.21 Low level output voltage  $V_{OL}$  – Ambient temperature  $T_a$



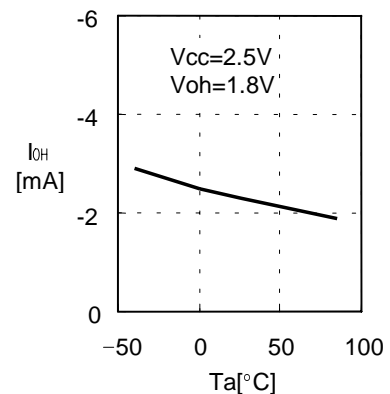
1.22 High level output current  $I_{OH}$  – Ambient temperature  $T_a$



1.23 High level output current  $I_{OH}$  – Ambient temperature  $T_a$



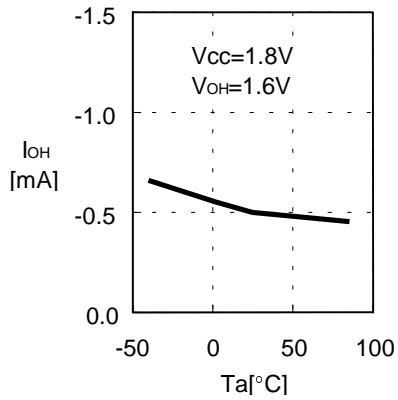
1.24 High level output current  $I_{OH}$  – Ambient temperature  $T_a$



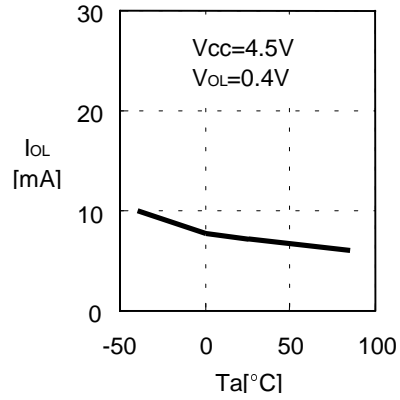


**CMOS SERIAL E<sup>2</sup>PROM**  
**S-29530A / 29630A**

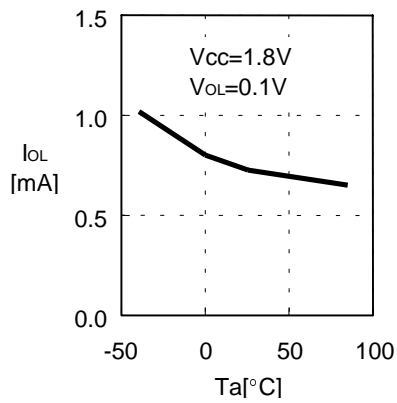
1.25 High level output current  $I_{OH}$  – Ambient temperature  $T_a$



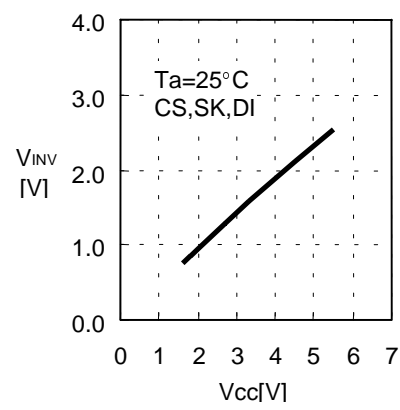
1.26 Low level output current  $I_{OL}$  – Ambient temperature  $T_a$



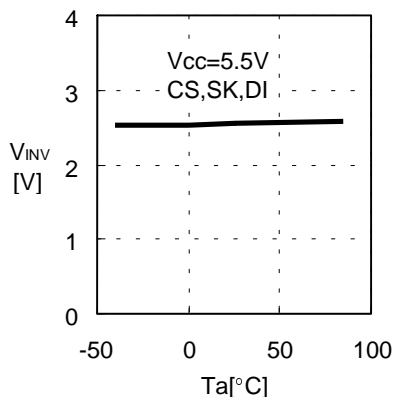
1.27 Low level output current  $I_{OL}$  – Ambient temperature  $T_a$



1.28 Input inversion voltage  $V_{INV}$  – Power supply voltage  $V_{CC}$

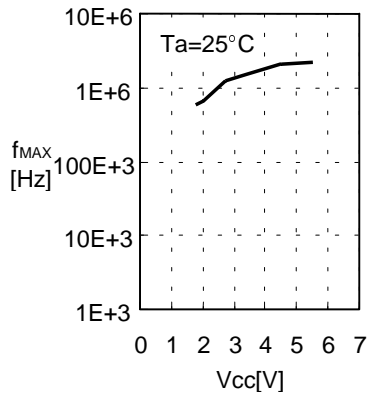


1.29 Input inversion voltage  $V_{INV}$  – Ambient temperature  $T_a$

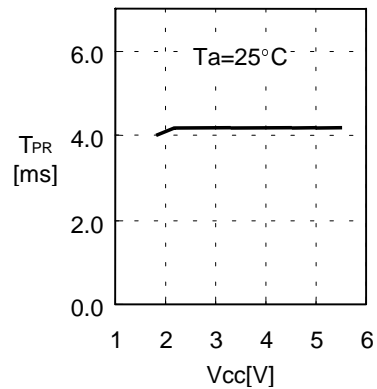


2.AC Characteristics

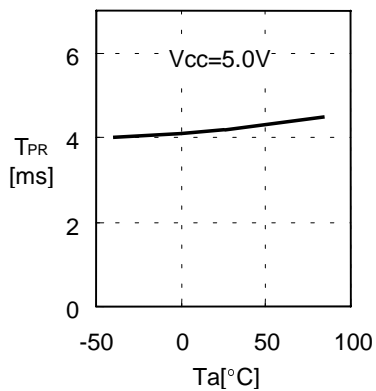
2.1 Maximum operation frequency  $f_{MAX}$  – Power supply voltage  $V_{CC}$



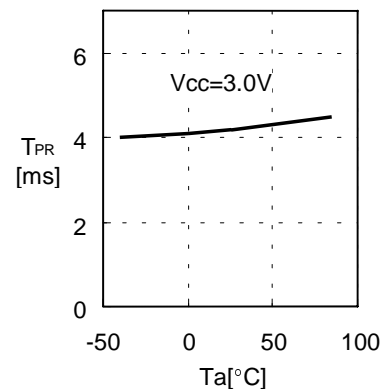
2.2 Program time  $T_{PR}$  – Power supply voltage  $V_{CC}$



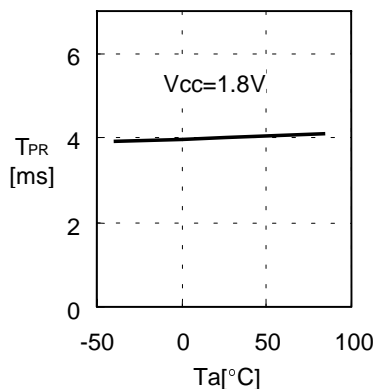
2.3 Program time  $T_{PR}$  – Ambient temperature  $T_a$



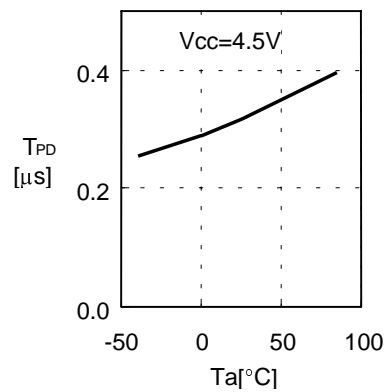
2.4 Program time  $T_{PR}$  – Ambient temperature  $T_a$



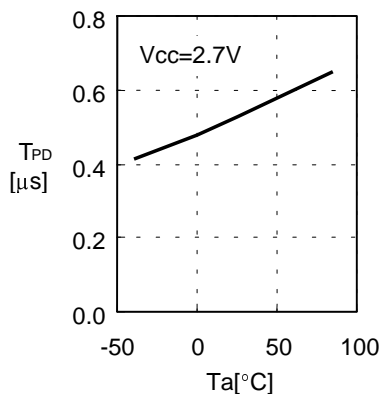
2.5 Program time  $T_{PR}$  – Ambient temperature  $T_a$



2.6 Data output delay time  $T_{PD}$  – Ambient temperature  $T_a$



2.7 Data output delay time  $T_{PD}$  – Ambient temperature  $T_a$



2.8 Data output delay time  $T_{PD}$  – Ambient temperature  $T_a$

