TMS27C128 131 072-BIT UV ERASABLE PROGRAMMABLE READ-ONLY MEMORY
TMS27PC128 131 072-BIT PROGRAMMABLE READ-ONLY MEMORY

SMLS128E–OCTOBER 1984–REVISED JANUARY 1993

This Data Sheet is Applicable to All TMS27C128s and TMS27PC128s Symbolized with Code "B" as Described on Page 12.

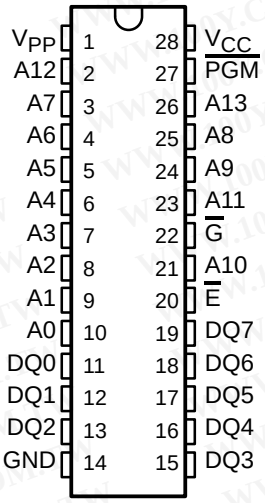
- **Organization . . . 16K × 8**
- **Single 5-V Power Supply**
- **Pin Compatible With Existing 128K MOS ROMs, PROMs, and EPROMs**
- **All Inputs/Outputs Fully TTL Compatible**
- **Max Access/Min Cycle Times**

  V_{CC} ± 10%

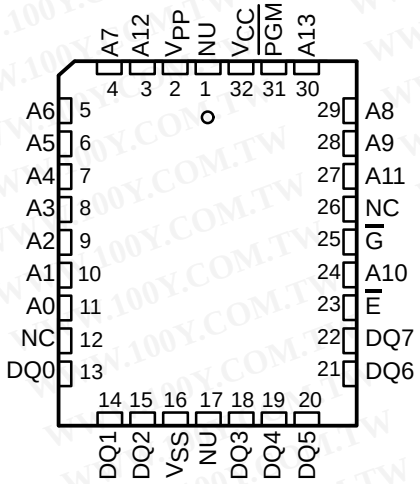
'27C128-12	120	ns
'27C/PC128-15	150	ns
'27C/PC128-20	200	ns
'27C/PC128-25	250	ns

- **Power Saving CMOS Technology**
- **Very High-Speed SNAP! Pulse Programming**
- **3-State Output Buffers**
- **400-mV Minimum DC Noise Immunity With Standard TTL Loads**
- **Latchup Immunity of 250 mA on All Input and Output Lines**
- **Low Power Dissipation (V_{CC} = 5.25 V)**
  - **Active . . . 158 mW Worst Case**
  - **Standby . . . 1.4 mW Worst Case (CMOS Input Levels)**
- **PEP4 Version Available With 168-Hour Burn-In and Choices of Operating Temperature Ranges**
- **128K EPROM Available With MIL-STD-883C Class B High-Reliability Processing (SMJ27C128)**

J AND N PACKAGES
(TOP VIEW)



FM PACKAGE
(TOP VIEW)



description

The TMS27C128 series are 131 072-bit, ultraviolet-light erasable, electrically programmable read-only memories.

The TMS27PC128 series are 131 072-bit, one time electrically programmable read-only memories.

PIN NOMENCLATURE

A0–A13	Address Inputs
$\overline{E}$	Chip Enable/Powerdown
$\overline{G}$	Output Enable
GND	Ground
NC	No Connection
NU	Make No External Connection
$\overline{PGM}$	Program
DQ0–DQ7	Inputs (programming)/Outputs
V_{CC}	5-V Power Supply
V_{PP}	12-13 V Programming Power Supply

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These devices are fabricated using power-saving CMOS technology for high speed and simple interface with MOS and bipolar circuits. All inputs (including program data inputs) can be driven by Series 74 TTL circuits without the use of external pull-up resistors. Each output can drive one Series 74 TTL circuit without external resistors.

The data outputs are three-state for connecting multiple devices to a common bus. The TMS27C128 and the TMS27PC128 are pin compatible with 28-pin 128K MOS ROMs, PROMs, and EPROMs.

The TMS27C128 EPROM is offered in a dual-in-line ceramic package (J suffix) designed for insertion in mounting hole rows on 15,2-mm (600-mil) centers. The TMS27C128 is offered with two operating temperature ranges of 0°C to 70°C (JL suffix) and – 40°C to 85°C (JE suffix). The TMS27C128 is also offered with 168-hour burn-in temperature ranges (JL4 and JE4 suffixes). (See table below).

The TMS27PC128 PROM is offered in a dual-in-line plastic package (N suffix) designed for insertion in mounting hole rows on 15,2-mm (600-mil) centers. The TMS27PC128 is also supplied in a 32-lead plastic leaded chip carrier package using 1,25-mm (50-mil) lead spacing (FM suffix). The TMS27PC128 is also offered with two operating temperature ranges of 0°C to 70°C (NL and FML suffixes) and –40°C to 85°C (NE and FME suffixes). The TMS27PC128 is also offered with 168 hour burn-in temperature ranges (NL4, FML4, NE4, and FME4 suffixes). (See table below).

All package styles conform to JEDEC standards.

EPROM AND PROM	SUFFIX FOR OPERATING TEMPERATURE RANGES WITHOUT PEP4 BURN-IN		SUFFIX FOR OPERATING TEMPERATURE RANGES WITH PEP4 168 HR. BURN-IN	
	0°C TO 70°C	–40 °C TO 85°C	0°C TO 70°C	–40 °C TO 85°C
TMS27C128-XXX	JL	JE	JL4	JE4
TMS27PC128-XXX	NL	NE	NL4	NE4
TMS27PC128-XXX	FML	FME	FML4	FME4

These EPROMs and PROMs operate from a single 5-V supply (in the read mode), thus are ideal for use in microprocessor-based systems. One other 12-13-V supply is needed for programming . All programming signals are TTL level. These devices are programmable by using the SNAP! Pulse programming algorithm.The SNAP! Pulse programming algorithm uses a V_{PP} of 13.0 V and a V_{CC} of 6.5 V for a nominal programming time of two seconds. For programming outside the system, existing EPROM programmers can be used. Locations may be programmed singly, in blocks, or at random.

operation

The seven modes of operation are listed in the following table. Read mode requires a single 5-V supply. All inputs are TTL level except for V_{PP} during programming (13 V for SNAP! Pulse), and 12 V on A9 for the signature mode.

FUNCTION	MODE							
	READ	OUTPUT DISABLE	STANDBY	PROGRAMMING	VERIFY	PROGRAM INHIBIT	SIGNATURE MODE	
$\overline{E}$	V_{IL}	V_{IL}	V_{IH}	V_{IL}	V_{IL}	V_{IH}	V_{IL}	
$\overline{G}$	V_{IL}	V_{IH}	X†	V_{IH}	V_{IL}	X	V_{IL}	
$\overline{PGM}$	V_{IH}	V_{IH}	X	V_{IL}	V_{IH}	X	V_{IH}	
V_{PP}	V_{CC}	V_{CC}	V_{CC}	V_{PP}	V_{PP}	V_{PP}	V_{CC}	
V_{CC}	V_{CC}	V_{CC}	V_{CC}	V_{CC}	V_{CC}	V_{CC}	V_{CC}	
A9	X	X	X	X	X	X	V_H	V_H‡
A0	X	X	X	X	X	X	V_{IL}	V_{IH}
DQ0–DQ7	Data Out	HI-Z	HI-Z	Data In	Data Out	HI-Z	CODE	
							MFG	DEVICE
							97	83

† X can be V_{IL} or V_{IH}.
V_H = 12 V ± 0.5 V.

read/output disable

When the outputs of two or more TMS27C128s or TMS27PC128s are connected in parallel on the same bus, the output of any particular device in the circuit can be read with no interference from the competing outputs of the other devices. To read the output of a single device, a low-level signal is applied to the $\overline{E}$ and $\overline{G}$ pins. All other devices in the circuit should have their outputs disabled by applying a high-level signal to one of these pins. Output data is accessed at pins DQ0 through DQ7.

latchup immunity

Latchup immunity on the TMS27C128 and TMS27PC128 is a minimum of 250 mA on all inputs and outputs. This feature provides latchup immunity beyond any potential transients at the P.C. board level when the devices are interfaced to industry-standard TTL or MOS logic devices. Input/output layout approach controls latchup without compromising performance or packing density.

power down

Active I_{CC} supply current can be reduced from 30 mA to 500 µA (TTL-level inputs) or 250 µA (CMOS-level inputs) by applying a high TTL or CMOS signal to the $\overline{E}$ pin. In this mode all outputs are in the high-impedance state.

erasure (TMS27C128)

Before programming, the TMS27C128 EPROM is erased by exposing the chip through the transparent lid to a high intensity ultraviolet light (wavelength 2537 Å). EPROM erasure before programming is necessary to assure that all bits are at the logic high level. Logic lows are programmed into the desired locations. A programmed logic low can be erased only by ultraviolet light. The recommended minimum ultraviolet light exposure dose (UV intensity × exposure time) is 15-W·s/cm^2. A typical 12-mW/cm^2, filterless UV lamp will erase the device in 21 minutes. The lamp should be located about 2.5 cm above the chip during erasure. It should be noted that normal ambient light contains the correct wavelength for erasure. Therefore, when using the TMS27C128, the window should be covered with an opaque label.

initializing (TMS27PC128)

The one-time programmable TMS27PC128 PROM is provided with all bits at the logic high level. The logic lows are programmed into the desired locations. Logic lows programmed into a PROM cannot be erased.

SNAP! Pulse programming

The 128K EPROM and PROM are programmed using the TI SNAP! Pulse programming algorithm, illustrated by the flowchart in Figure 1, which programs in a nominal time of two seconds. Actual programming time will vary as a function of the programmer used.

Data is presented in parallel (eight bits) on pins DQ0 to DQ7. Once addresses and data are stable, $\overline{PGM}$ is pulsed.

The SNAP! Pulse programming algorithm uses initial pulses of 100 microseconds (µs) followed by a byte verification to determine when the addressed byte has been successfully programmed. Up to 10 (ten) 100-µs pulses per byte are provided before a failure is recognized.

The programming mode is achieved when V_{PP} = 13 V, V_{CC} = 6.5 V, $\overline{G}$ = V_{IH}, and $\overline{E}$ = V_{IL}. More than one device can be programmed when the devices are connected in parallel. Locations can be programmed in any order. When the SNAP! Pulse programming routine is complete, all bits are verified with V_{CC} = V_{PP} = 5 V.

program inhibit

Programming may be inhibited by maintaining a high level input on the $\overline{E}$ or $\overline{PGM}$ pin.

program verify

Programmed bits may be verified with V_{PP} = 13 V when $\overline{G} = V_{IL}$, $\overline{E} = V_{IL}$, and $\overline{PGM} = V_{IH}$.

signature mode

The signature mode provides access to a binary code identifying the manufacturer and type. This mode is activated when A9 is forced to 12 V ± 0.5 V. Two identifier bytes are accessed by A0; i.e., A0 = V_{IL} accesses the manufacturer code, which is output on DQ0–DQ7; A0 = V_{IH} accesses the device code, which is output on DQ0–DQ7. All other addresses must be held at V_{IL}. The manufacturer code for these devices is 97, and the device code is 83.

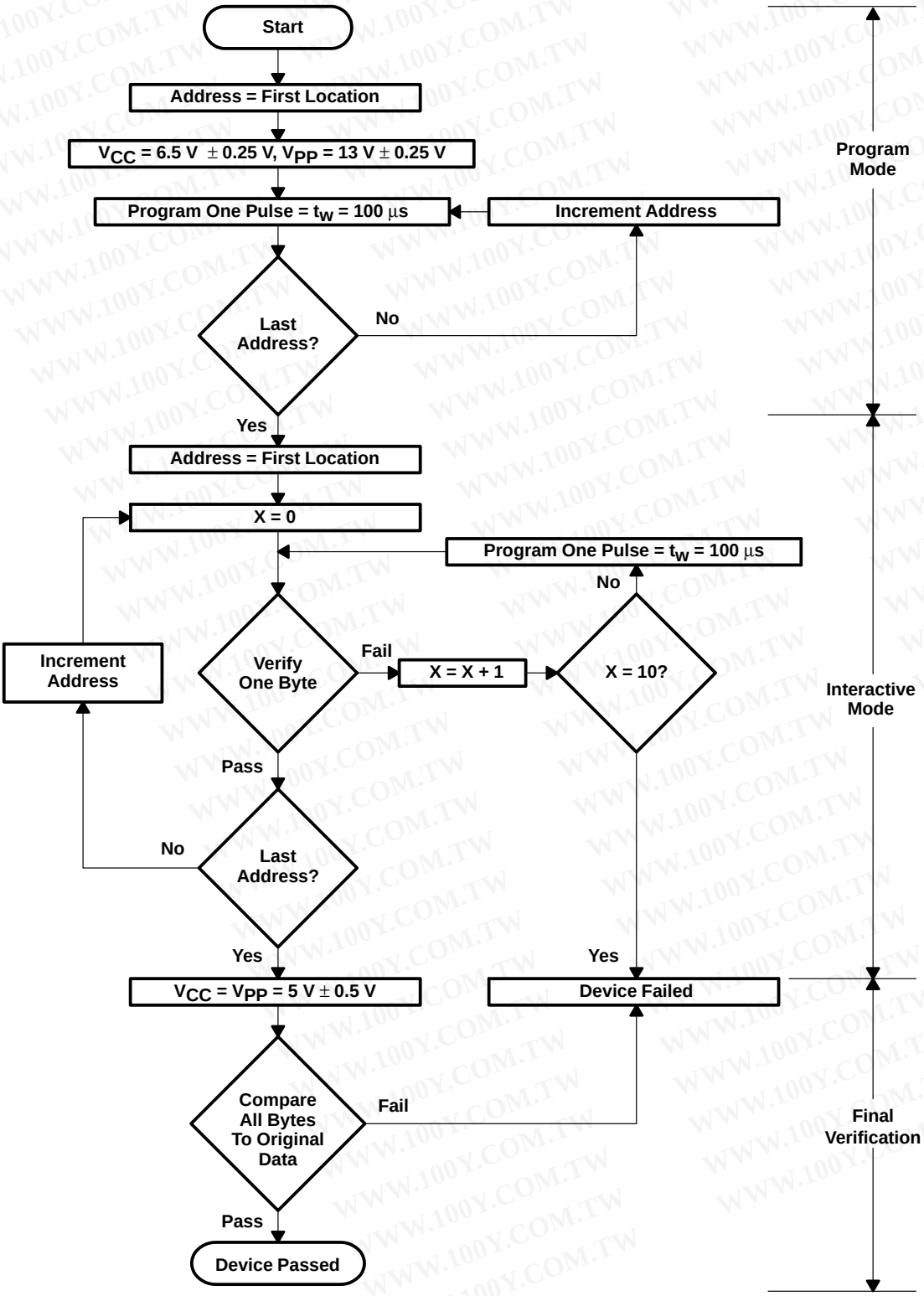

Figure 1. SNAP! Pulse Programming Flowchart

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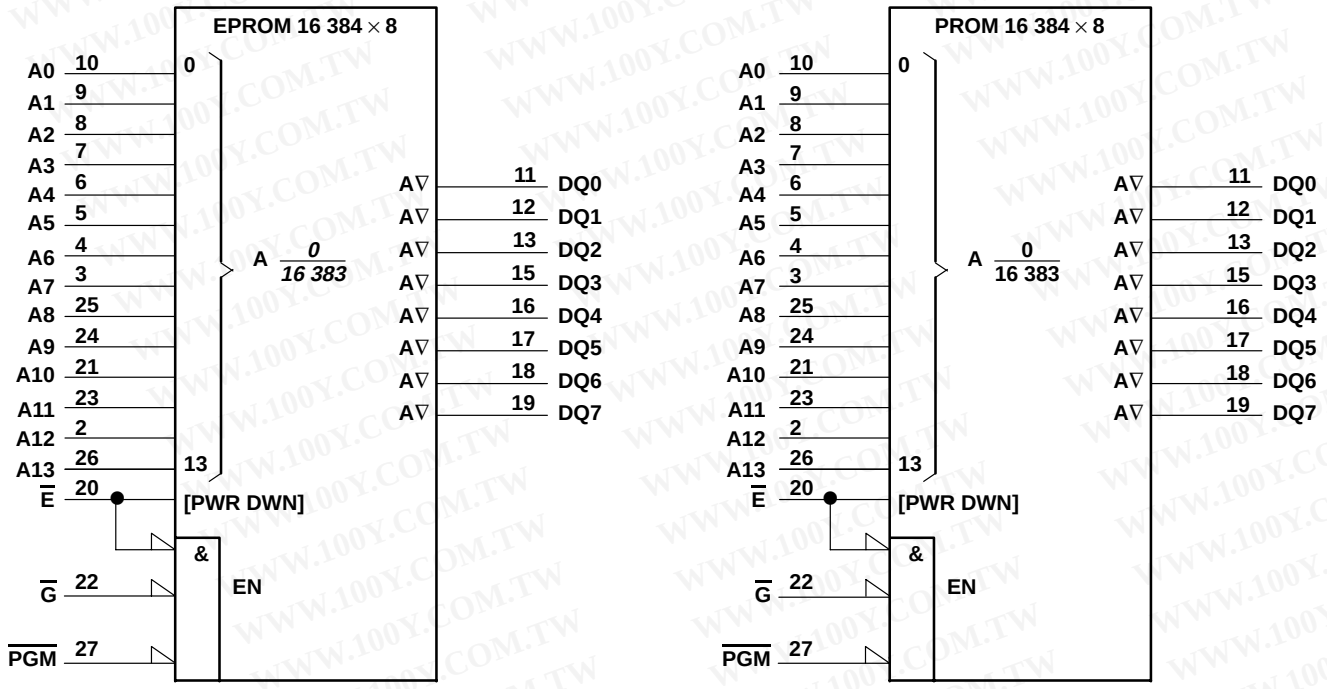
logic symbol†



† These symbols are in accordance with ANSI/IEEE Std 91-1984 and IEC Publication 617-12.
Pin numbers shown are J and N packages.

absolute maximum ratings over operating free-air temperature range (unless otherwise noted)‡

Supply voltage range, V_{CC} (see Note 1) . . . . . –0.6 V to 7 V
Supply voltage range, V_{PP} (see Note 1) . . . . . –0.6 V to 14 V
Input voltage range (see Note 1), All inputs except A9 . . . . . –0.6 V to V_{CC} + 1 V
A9 . . . . . –0.6 V to 13.5 V
Output voltage range (see Note 1) . . . . . –0.6 V to V_{CC} + 1 V
Operating free-air temperature range ('27C128-_ _JL and JL4, '27PC128-_ _NL, and NL4 FML, and FML4) . . . . . 0°C to 70°C
Operating free-air temperature range ('27C128-_ _JE and JE4, '27PC128-_ _NE, NE4, FME, and FME4) . . . . . –40°C to 85°C
Storage temperature range . . . . . –65°C to 150°C

‡ Stresses beyond those listed under "absolute maximum ratings" may cause permanent damage to the device. These are stress ratings only and functional operation of the device at these or any other conditions beyond those indicated under "recommended operating conditions" is not implied. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.

NOTE 1: Under absolute maximum ratings, voltage values are with respect to GND.

recommended operating conditions

			MIN	NOM	MAX	UNIT
V_{CC}	Supply voltage	Read mode (see Note 2)	4.5	5	5.5	V
		SNAP! Pulse programming algorithm	6.25	6.5	6.75	
V_{PP}	Supply voltage	Read mode	$V_{CC}-0.6$		$V_{CC}+0.6$	V
		SNAP! Pulse programming algorithm	12.75	13	13.25	
V_{IH}	High-level dc input voltage	TTL	2		$V_{CC}+1$	V
		CMOS	$V_{CC}-0.2$		$V_{CC}+1$	
V_{IL}	Low-level dc input voltage	TTL	−0.5		0.8	V
		CMOS	−0.5		0.2	V
T_A	Operating free-air temperature	'27C128-_ _JL,JL4 '27PC128_ _NL,NL4 FML, FML4	0		70	°C
T_A	Operating free-air temperature	'27C128-_ _JE,JE4 '27PC128_ _NE,NE4 FME, FME4	−40		70	°C

NOTES: 2. V_{CC} must be applied before or at the same time as V_{PP} and removed after or at the same time as V_{PP}. The device must not be inserted into or removed from the board when V_{PP} or V_{CC} is applied.

electrical characteristics over full ranges of operating conditions

PARAMETER			TEST CONDITIONS	MIN	TYP†	MAX	UNIT
V_{OH}	High-level dc output voltage		I_{OH} = −2.5 mA	3.5			V
			I_{OH} = −20 µA	$V_{CC}-0.1$			V
V_{OL}	Low-level dc output voltage		I_{OL} = 2.1 mA			0.4	V
			I_{OL} = 20 µA			0.1	V
I_I	Input current (leakage)		V_I = 0 to 5.5 V			±1	µA
I_O	Output current (leakage)		V_O = 0 to V_{CC}			±1	µA
I_{PP1}	V_{PP} supply current		V_{PP} = V_{CC} = 5.5 V		1	10	µA
I_{PP2}	V_{PP} supply current (during program pulse)		V_{PP} = 13 V		35	50	mA
I_{CC1}	V_{CC} supply current (standby)	TTL-input level	V_{CC} = 5.5 V, $\overline{E}$ = V_{IH}		250	500	µA
		CMOS-input level	V_{CC} = 5.5 V, $\overline{E}$ = V_{CC}		100	250	µA
I_{CC2}	V_{CC} supply current (active)		V_{CC} = 5.5 V, $\overline{E}$ = V_{IL}, t_{cycle} = minimum cycle time, outputs open		15	30	mA

† Typical values are at T_A = 25°C and nominal voltages.

capacitance over recommended ranges of supply voltage and operating free-air temperature, f = 1 MHz‡

PARAMETER		TEST CONDITIONS	MIN	TYP†	MAX	UNIT
C_i	Input capacitance	V_I = 0, f = 1 MHz		6	10	pF
C_O	Output capacitance	V_O = 0, f = 1 MHz		10	14	pF

† Typical values are at T_A = 25°C and nominal voltages.
Capacitance measurements are made on sample basis only.

switching characteristics over full ranges of recommended operating conditions (see Notes 3 and 4)

PARAMETER		TEST CONDITIONS (SEE NOTES 3 AND 4)	'27C128-12		'27C/PC128-15		UNIT
			MIN	MAX	MIN	MAX	
$t_{a(A)}$	Access time from address	C_L = 100 pF, 1 Series 74 TTL Load, Input $t_r \le 20$ ns, Input $t_f \le 20$ ns		120		150	ns
$t_{a(E)}$	Access time from chip enable			120		150	ns
$t_{en(G)}$	Output enable time from $\overline{G}$			55		75	ns
t_{dis}	Output disable time from $\overline{G}$ or $\overline{E}$, whichever occurs first†		0	45	0	60	ns
$t_{v(A)}$	Output data valid time after change of address, $\overline{E}$, or $\overline{G}$, whichever occurs first†		0		0		ns

		TEST CONDITIONS (SEE NOTES 3 AND 4)	'27C/PC128-20		'27C/PC128-25		UNIT
			MIN	MAX	MIN	MAX	
$t_{a(A)}$	Access time from address	C_L = 100 pF, 1 Series 74 TTL Load, Input $t_r \le 20$ ns, Input $t_f \le 20$ ns		200		250	ns
$t_{a(E)}$	Access time from chip enable			200		250	ns
$t_{en(G)}$	Output enable time from $\overline{G}$			75		100	ns
t_{dis}	Output disable time from $\overline{G}$o r $\overline{E}$, whichever occurs first†		0	60	0	60	ns
$t_{v(A)}$	Output data valid time after change of address, $\overline{E}$, or $\overline{G}$, whichever occurs first†		0		0		ns

† Value calculated from 0.5 V delta to measured level. This parameter is only sampled and not 100% tested.

switching characteristics for programming: V_{CC} = 6.5 V and V_{PP} = 13 V (SNAP! Pulse), T_A = 25°C (see Note 3)

PARAMETER		MIN	NOM	MAX	UNIT
$t_{dis(G)}$	Output disable time from $\overline{G}$	0		130	ns
$t_{en(G)}$	Output enable time from $\overline{G}$			150	ns

recommended timing requirements for programming: V_{CC} = 6.5 V and V_{PP} =13 V (SNAP! Pulse), T_A = 25°C (see Note 3)

			MIN	NOM	MAX	UNIT
$t_{w(IPGM)}$	Initial program pulse duration	SNAP! Pulse programming algorithm	95	100	105	µs
$t_{su(A)}$	Address setup time		2			µs
$t_{su(E)}$	$\overline{E}$ setup time		2			µs
$t_{su(G)}$	$\overline{G}$ setup time		2			µs
$t_{su(D)}$	Data setup time		2			µs
$t_{su(VPP)}$	V_{PP} setup time		2			µs
$t_{su(VCC)}$	V_{CC} setup time		2			µs
$t_{h(A)}$	Address hold time		0			µs
$t_{h(D)}$	Data hold time		2			µs

NOTES: 3. For all switching characteristics the input pulse levels are 0.4 V to 2.4 V. Timing measurements are made at 2 V for logic high and 0.8 V for logic low (reference page 10).
4. Common test conditions apply for t_{dis} except during programming.

PARAMETER MEASUREMENT INFORMATION

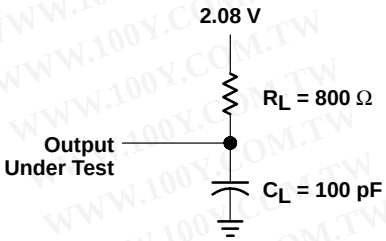
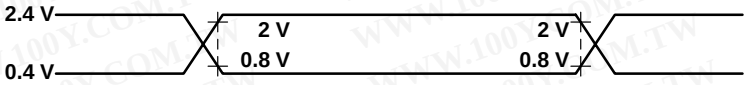


Figure 2. AC Testing Output Load Circuit

AC testing input/output wave forms



AC testing inputs are driven at 2.4 V for logic high and 0.4 V for logic low. Timing measurements are made at 2 V for logic high and 0.8 V for logic low for both inputs and outputs.

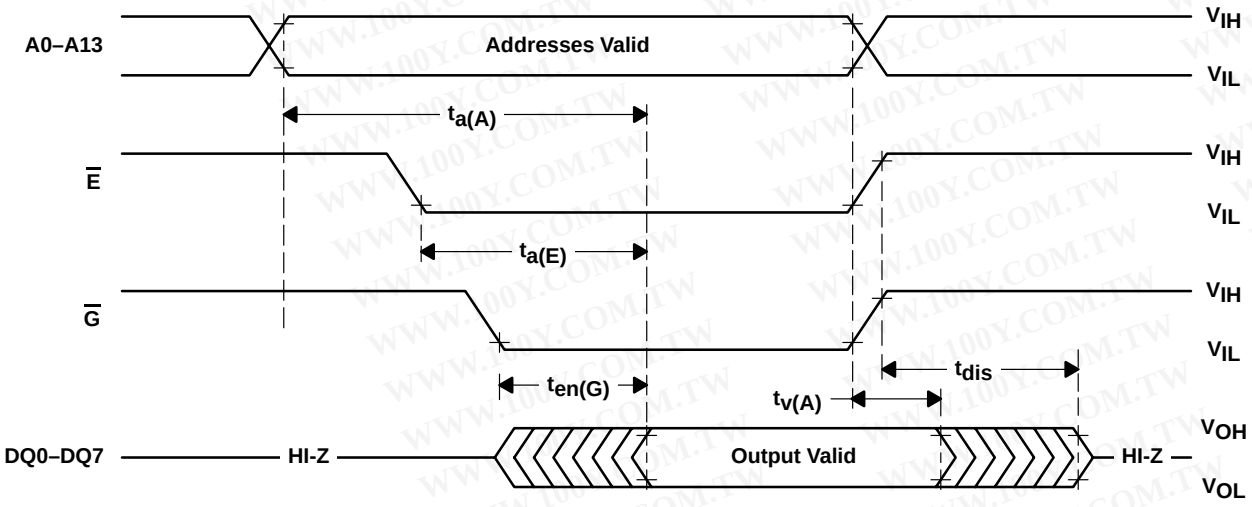


Figure 3. Read Cycle Timing

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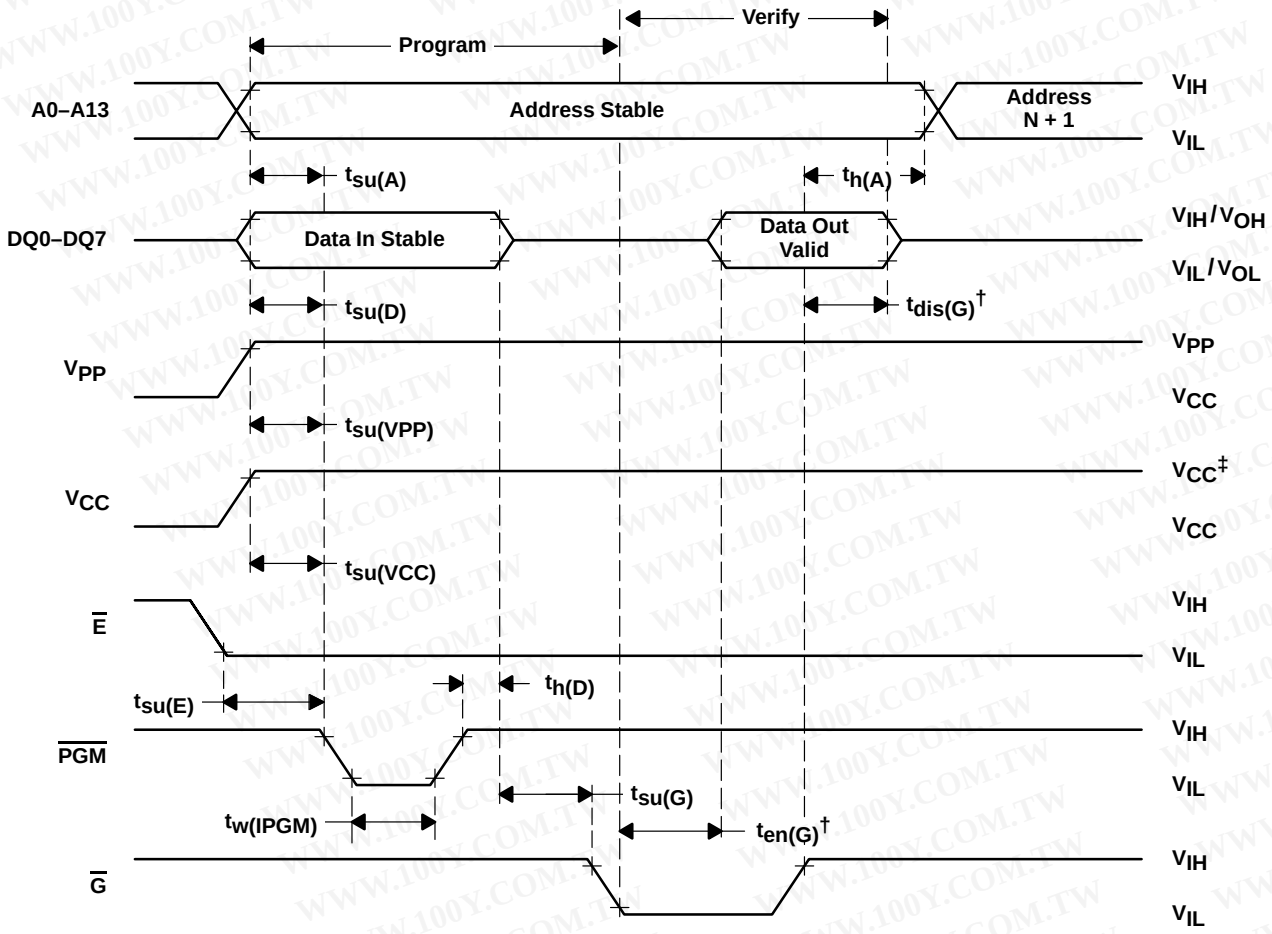
PARAMETER MEASUREMENT INFORMATION

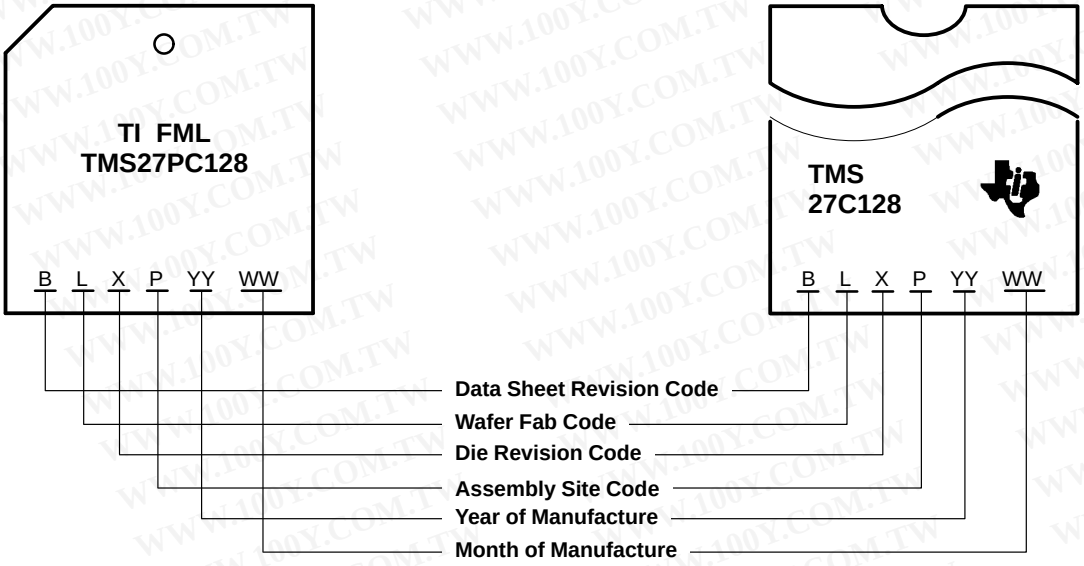


† $t_{dis(G)}$ and $t_{en(G)}$ are characteristics of the device but must be accommodated by the programmer.
13-V V_{PP} and 6.5-V V_{CC} for SNAP! Pulse programming.

Figure 4. Program Cycle Timing

device symbolization

This data sheet is applicable to all TI TMS27C128 CMOS EPROMs and TMS27PC128 PROMs with the data sheet revision code “B” as shown below.



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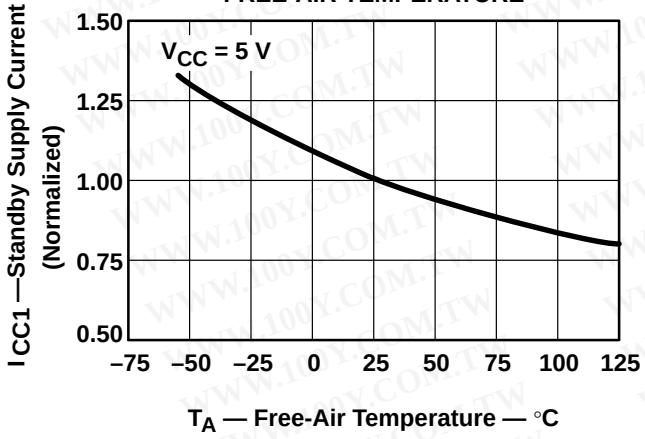
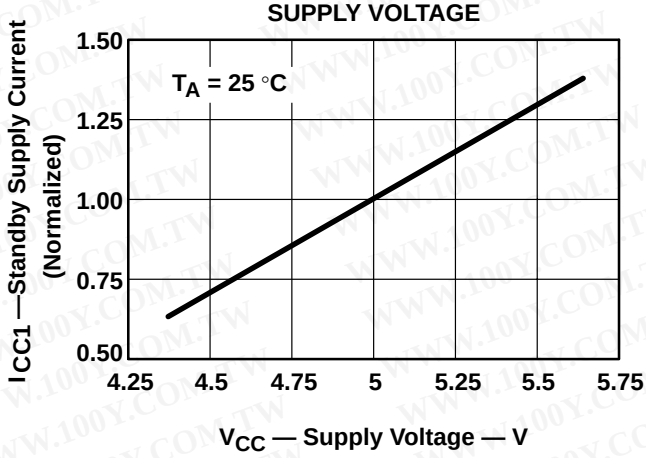
TYPICAL TMS27C/PC128 CHARACTERISTICS

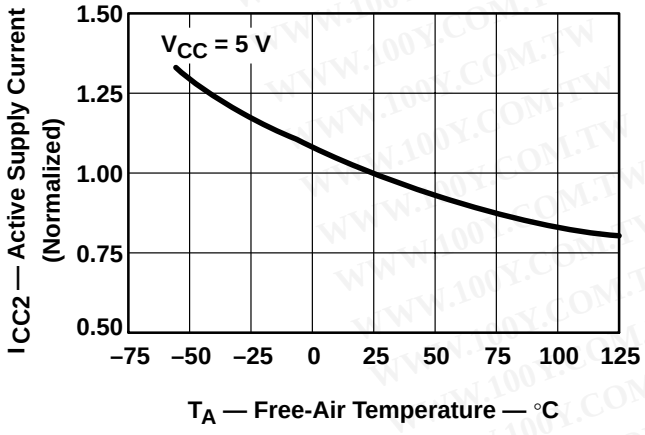
STANDBY SUPPLY CURRENT vs FREE-AIR TEMPERATURE



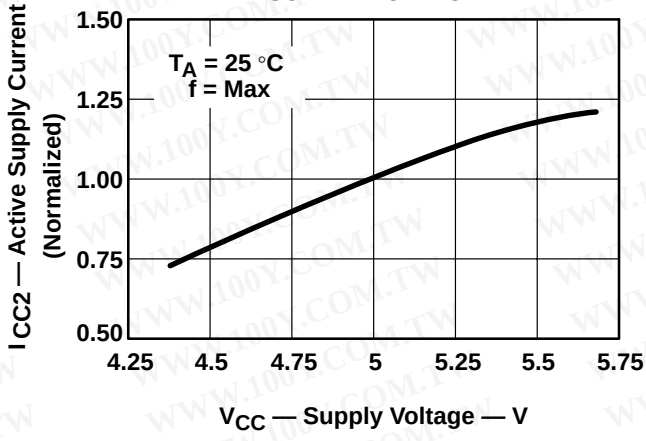
STANDBY SUPPLY CURRENT vs SUPPLY VOLTAGE



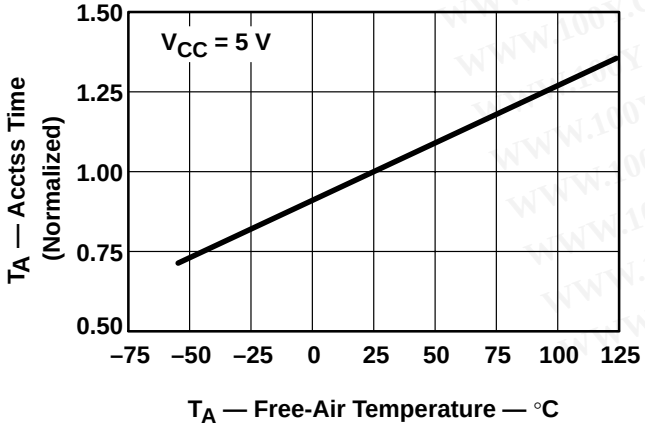
ACTIVE SUPPLY CURRENT vs FREE-AIR TEMPERATURE



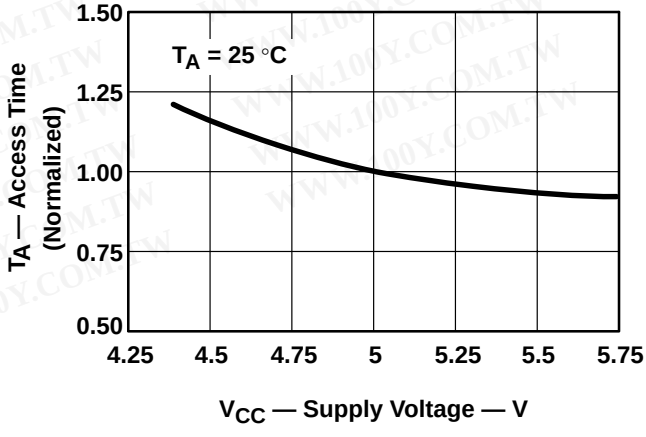
ACTIVE SUPPLY CURRENT vs SUPPLY VOLTAGE



ACCESS TIME vs FREE-AIR TEMPERATURE



ACCESS TIME vs SUPPLY VOLTAGE



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