FORCE TECHNOLOGIES LTD

FT28C17

16K (2K x 8) Parallel EEPROMs

Features

- Fast Read Access Time - 150 ns
- Fast Byte Write - 1 ms
- Self-Timed Byte Write Cycle
  - Internal Address and Data Latches
  - Internal Control Timer
  - Automatic Clear Before Write
- Direct Microprocessor Control
  - $\overline{\text{DATA}}$ POLLING
  - READY/$\overline{\text{BUSY}}$ Open Drain Output
- Low Power
  - 30 mA Active Current
  - 100 µa CMOS Standby Current
- High Reliability
  - Endurance: 10^4 or 10^5 Cycles
  - Data Retention: 10 Years
- 5V ± 10% Supply
- CMOS & TTL Compatible Inputs and Outputs
- JEDEC Approved Byte Wide Pinout
- Commercial and Industrial Temperature Ranges
- Full Military, Commercial and Industrial Temperature Ranges Including High Rel

Description

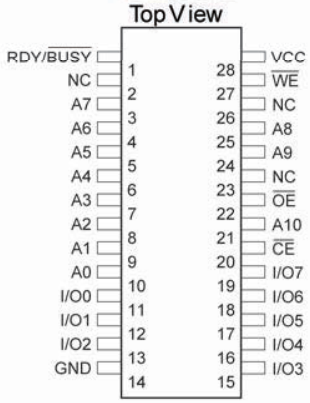
The FT28C17 is a low-power, high-performance Electrically Erasable and Programmable Read Only Memory with easy to use features. The FT28C17 is a 16K memory organised as 2,048 words by 8 bits. The device is manufactured with Force's reliable nonvolatile CMOS technology.

(continued)

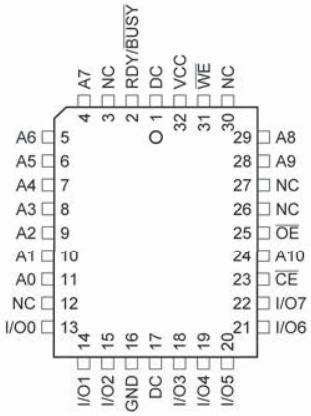
Pin Configurations

Pin Name	Function
A0 - A10	Addresses
$\overline{\text{CE}}$	Chip Enable
$\overline{\text{OE}}$	Output Enable
$\overline{\text{WE}}$	Write Enable
I/O0 - I/O7	Data Inputs/Outputs
RDY/$\overline{\text{BUSY}}$	Ready/Busy Output
NC	No Connect
DC	Don't Connect

PDIP, SOIC
Top View



PLCC
Top View



Note: PLCC package pins 1 and 17 are DON'T CONNECT.

FORCE TECHNOLOGIES LTD

FT28C17

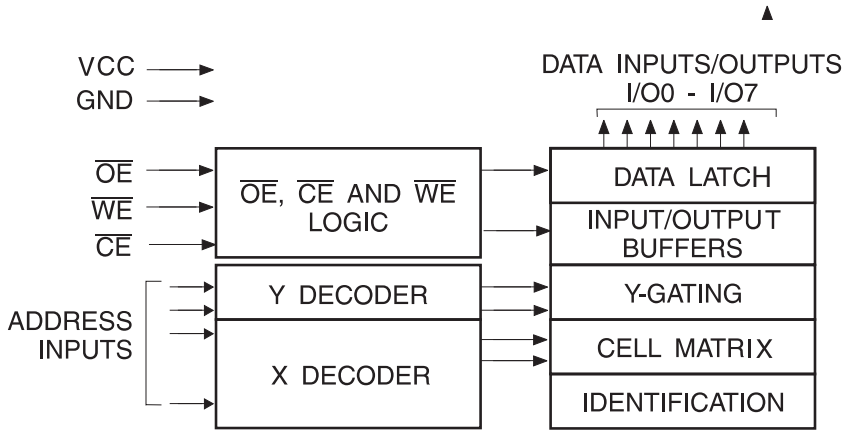
16K (2K x 8) Parallel

The FT28C17 is accessed like a static RAM for the read or write cycles without the need of external components. During a byte write, the address and data are latched internally, freeing the microprocessor address and data bus for other operations. Following the initiation of a write cycle, the device will go to a busy state and automatically clear and write the latched data using an internal control timer. The device includes two methods for detecting the end of a write cycle, level detection of RDY/$\overline{BUSY}$ and $\overline{DATA}$ POLLING of I/O_7. Once the end of a write cycle has been detected, a new access for a read or a write can begin.

The CMOS technology offers fast access times of 150 ns at low power dissipation. When the chip is deselected the standby current is less than 100 μA.

Force's FT28C17 has additional features to ensure high quality and manufacturability. The device utilises error correction internally for extended endurance and for improved data retention characteristics. An extra 32 bytes of EEPROM are available for device identification or tracking.

Block Diagram



Absolute Maximum Ratings*

Temperature Under Bias	-55°C to +125°C
Storage Temperature	-65°C to +150°C
All Input Voltages (including NC Pins) with Respect to Ground	-0.6V to +6.25V
All Output Voltages with Respect to Ground	-0.6V to V_{CC} + 0.6V
Voltage on $\overline{OE}$ and A9 with Respect to Ground	-0.6V to +13.5V

*NOTICE: Stresses beyond 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 beyond those indicated in the operational sections of this specification is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability

Device Operation

READ: The FT28C17 is accessed like a Static RAM. When $\overline{CE}$ and $\overline{OE}$ are low and $\overline{WE}$ is high, the data stored at the memory location determined by the address pins is asserted on the outputs. The outputs are put in a high impedance state whenever $\overline{CE}$ or $\overline{OE}$ is high. This dual line control gives designers increased flexibility in preventing bus contention.

BYTE WRITE: Writing data into the FT28C17 is similar to writing into a Static RAM. A low pulse on the $\overline{WE}$ or $\overline{CE}$ input with $\overline{OE}$ high and $\overline{CE}$ or $\overline{WE}$ low (respectively) initiates a byte write. The address location is latched on the last falling edge of $\overline{WE}$ (or $\overline{CE}$); the new data is latched on the first rising edge. Internally, the device performs a self-clear before write. Once a byte write has been started, it will automatically time itself to completion. Once a programming operation has been initiated and for the duration of t_{WC}, a read operation will effectively be a polling operation.

READY/$\overline{BUSY}$: Pin 1 is an open drain READY/$\overline{BUSY}$ output that can be used to detect the end of a write cycle. RDY/$\overline{BUSY}$ is actively pulled low during the write cycle and is released at the completion of the write. The open drain connection allows for OR-tying of several devices to the same RDY/$\overline{BUSY}$ line.

$\overline{DATA}$ POLLING: The FT28C17 provides $\overline{DATA}$ POLLING to signal the completion of a write cycle. During a write cycle, an attempted read of the data being written results in the complement of that data for I/O_7 (the other outputs are indeterminate). When the write cycle is finished, true data appears on all outputs.

WRITE PROTECTION: Inadvertent writes to the device are protected against in the following ways: (a) V_{CC} sense—if V_{CC} is below 3.8V (typical) the write function is inhibited; (b) V_{CC} power on delay once V_{CC} has reached 3.8V the device will automatically time out 5 ms (typical) before allowing a byte write; and (c) write inhibit—holding any one of $\overline{OE}$ low, $\overline{CE}$ high or $\overline{WE}$ high inhibits byte write cycles.

CHIP CLEAR: The contents of the entire memory of the FT28C17 may be set to the high state by the CHIP CLEAR operation. By setting $\overline{CE}$ low and $\overline{OE}$ to 12 volts, the chip is cleared when a 10 msec low pulse is applied to $\overline{WE}$.

DEVICE IDENTIFICATION: An extra 32 bytes of EEPROM memory are available to the user for device identification. By raising A9 to 12 ± 0.5V and using address locations 7E0H to 7FFH the additional bytes may be written to or read from in the same manner as the regular memory array.

DC and AC Operating Range

		FT28C17
Operating Temperature (Case)	Com.	0°C - 70°C
	Ind.	-40°C - 85°C
	Mil	-55ºC - 125ºC
V_{CC} Power Supply		5V ± 10%

Operating Modes

Mode	$\overline{CE}$	$\overline{OE}$	$\overline{WE}$	I/O
Read	V_{IL}	V_{IL}	V_{IH}	D_{OUT}
Write(2)	V_{IL}	V_{IH}	V_{IL}	D_{IN}
Standby/Write Inhibit	V_{IH}	X(1)	X	High
Write Inhibit	X	X	V_{IH}	
Write Inhibit	X	V_{IL}	X	
Output Disable	X	V_{IH}	X	High
Chip Erase	V_{IL}	V_H(3)	V_{IL} Hi	gh Z

Notes: 1. X can be V_{IL} or V_{IH}.
2. Refer to AC Programming Waveforms.
3. V_H = 12.0V ± 0.5V.

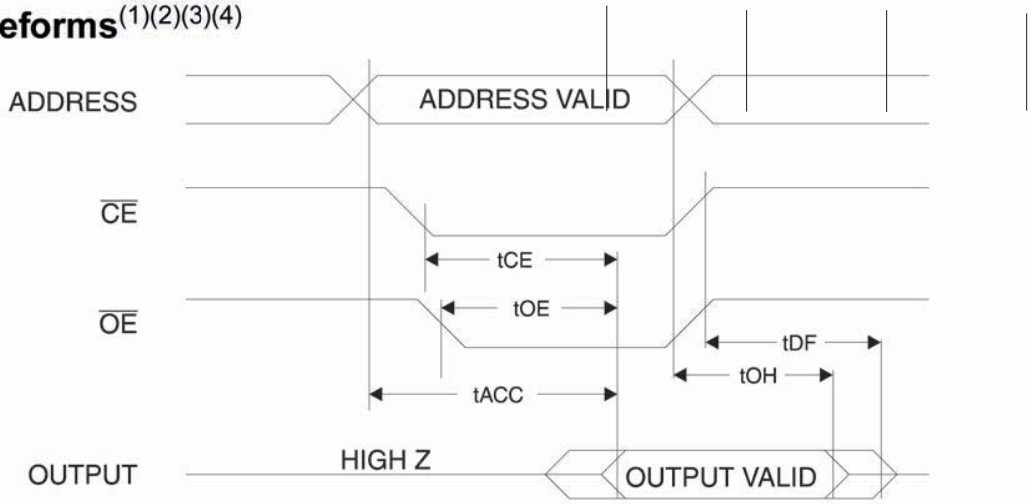
DC Characteristics

Symbol	Parameter	Condition		Min	Max	Units
I_{LI}	Input Load Current	V_{IN} = 0V to V_{CC} + 1V			10	µA
I_{LO}	Output Leakage Current	$V_{I/O}$ = 0V to V_{CC}			10	µA
I_{SB1}	V_{CC} Standby Current CMOS	$\overline{CE}$ = V_{CC} - 0.3V to V_{CC} + 1.0V			100	µA
I_{SB2}	V_{CC} Standby Current TTL	$\overline{CE}$ = 2.0V to V_{CC} + 1.0V	Com.		2	mA
			Ind.		3	mA
I_{CC}	V_{CC} Active Current AC	f = 5 MHz; I_{OUT} = 0 mA $\overline{CE}$ = V_{IL}	Com.		30	mA
			Ind.		45	mA
V_{IL}	Input Low Voltage				0.8	V
V_{IH}	Input High Voltage			2.0		V
V_{OL}	Output Low Voltage	I_{OL} = 2.1 mA = 4.0 for RDY/$\overline{BUSY}$			.4	V
V_{OH}	Output High Voltage	I_{OH} = -400 µA		2.4		V

AC Read Characteristics

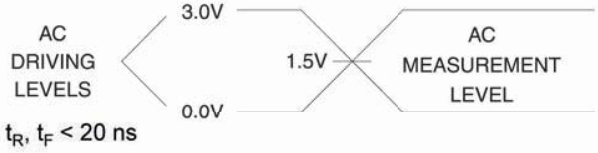
Symbol	Parameter	Typical		Units
		Min	Max	
t_{ACC}	Address to Output Delay		150	ns
t_{CE} (1)	$\overline{CE}$ to Output Delay		150	ns
t_{OE} (2)	$\overline{OE}$ to Output Delay	10	70	ns
t_{DF} (3)(4)	$\overline{CE}$ or $\overline{OE}$ High to Output Float	0	50	ns
t_{OH}	Output Hold from $\overline{OE}$, $\overline{CE}$ or Address, whichever occurred first	0		ns

AC Read Waveforms (1)(2)(3)(4)



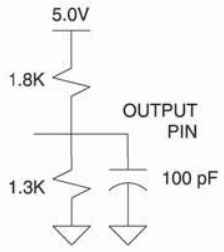
Notes:
1. $\overline{CE}$ may be delayed up to $t_{ACC} - t_{CE}$ after the address transition without impact on t_{ACC}.
2. $\overline{OE}$ may be delayed up to $t_{CE} - t_{OE}$ after the falling edge of $\overline{CE}$ without impact on t_{CE} or by $t_{ACC} - t_{OE}$ after an address change without impact on t_{ACC}.
3. t_{DF} is specified from $\overline{OE}$ or $\overline{CE}$ whichever occurs first (C_L = 5 pF).
4. This parameter is characterised and is not 100% tested.

Input Test Waveforms and Measurement Level



t_R, t_F < 20 ns

Output Test Load



Pin Capacitance

f = 1 MHz, T = 25°C (1)

Symbol	Typ	Max	Units	Conditions
C_{IN}	4	6	pF	V_{IN} = 0V
C_{OUT}	8	12	pF	V_{OUT} = 0V

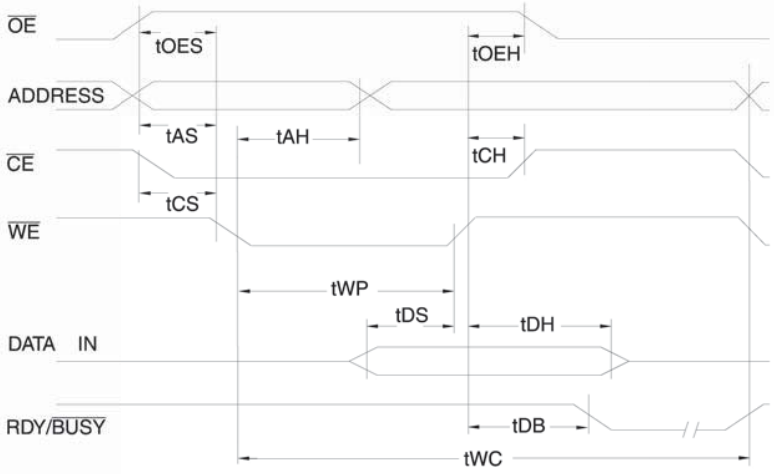
Note: 1. This parameter is characterised and is not 100% tested.

AC Write Characteristics

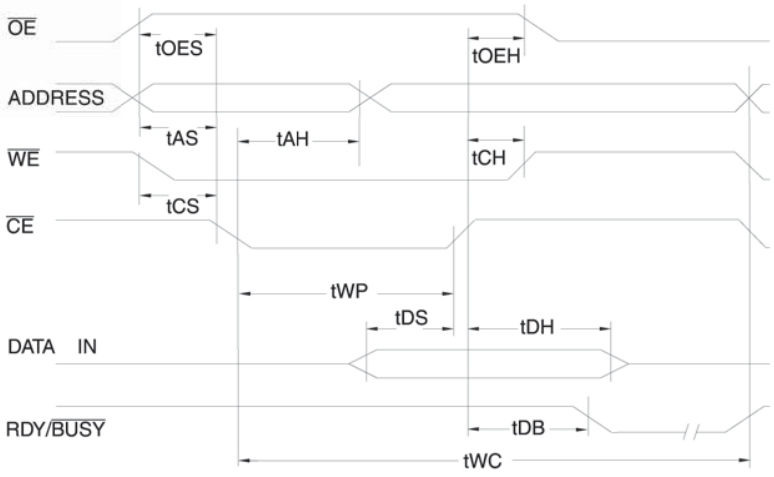
Symbol	Parameter		Min	Typ	Max	Units
t_{AS}, t_{OES}	Address, $\overline{OE}$ Set-up Time		10			ns
t_{AH}	Address Hold Time		50			ns
t_{WP}	Write Pulse Width ($\overline{WE}$ or $\overline{CE}$)		100		1000	ns
t_{DS}	Data Set-up Time		50			ns
t_{DH}, t_{OEH}	Data, $\overline{OE}$ Hold Time		10			ns
t_{CS}, t_{CH}	$\overline{CE}$ to $\overline{WE}$ and $\overline{WE}$ to $\overline{CE}$ Set-up and Hold Time		0			ns
t_{DB}	Time to Device Busy				50	ns
t_{WC}	Write Cycle Time	FT28C17		0.5	1.0	ms

AC Write Waveforms

$\overline{WE}$ Controlled



$\overline{CE}$ Controlled

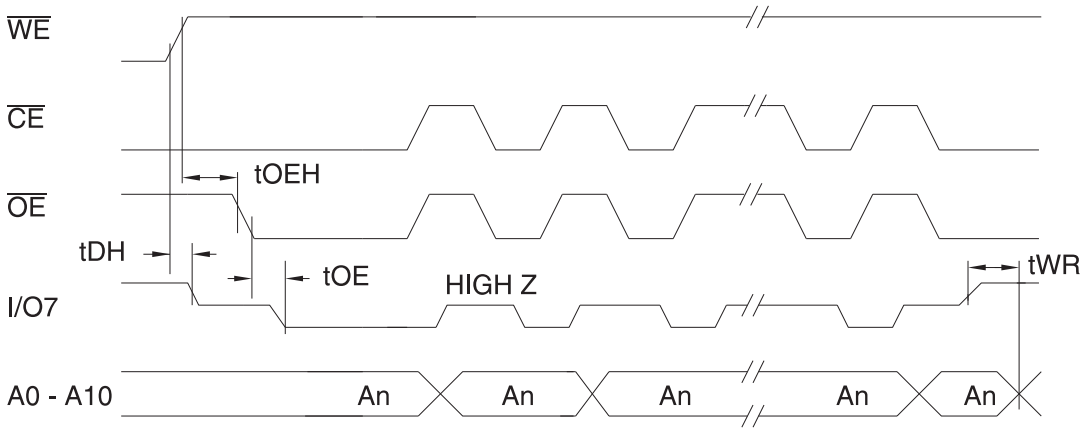


$\overline{\text{Data}}$ Polling Characteristics(1)

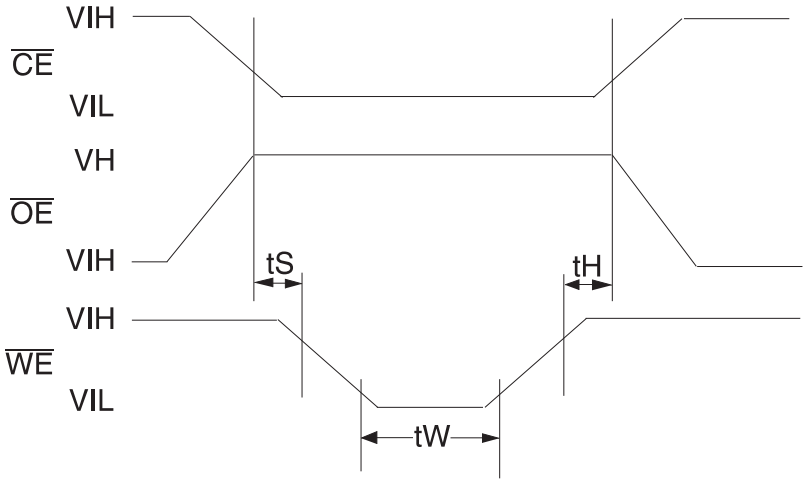
Symbol	Parameter	Min	Typ	Max	Units
t_{DH}	Data Hold Time	10			ns
t_{OEH}	$\overline{OE}$ Hold Time	10			ns
t_{OE}	$\overline{OE}$ to Output Delay(2)				ns
t_{WR}	Write Recovery Time	0			ns

Notes: 1. These parameters are characterised and not 100% tested.
2. See AC Read Characteristics.

$\overline{\text{Data}}$ Polling Waveforms



Chip Erase Waveforms



$t_S = t_H = 1$ µsec (min.)
$t_W = 10$ msec (min.)
$V_H = 12.0 \pm 0.5V$

Ordering Information(1)

t_{ACC} (ns)	I_{CC} (mA)		Ordering Code	Package	Operation Range
	Active	Standby			
150	30	0.1	FT28C17(E)-15JC FT28C17(E)-15PC FT28C17(E)-15SC	32J 28P6 28S	Commercial (0°C to 70°C)
	45	0.1	FT28C17(E)-15JI FT28C17(E)-15PI FT28C17(E)-15SI	32J 28P6 28S	Industrial (-40°C to 85°C)
			FT28C17(E)-15DMB	28D6	Military/883 M5004 (-55°C to 125°C)
200	30	0.1	FT28C17(E)-20DC FT28C17(E)-20JC FT28C17(E)-20PC FT28C17(E)-20SC	32J 28P6 28S	Commercial (0°C to 70°C)
200	45	0.1	FT28C17(E)-20DI FT28C17(E)-20JI FT28C17(E)-20PI FT28C17(E)-20DI	32J 28P6 28S	Industrial (-40°C to 85°C)
			FT28C17(E)-20DMB	28D6	Military/883 M5004 (-55°C to 125°C)
250	30	0.1	FT28C17(E)-25DC FT28C17(E)-25JC FT28C17(E)-25PC FT28C17(E)-25SC	32J 28P6 28S	Commercial (0°C to 70°C)
250	45	0.1	FT28C17(E)-25DI FT28C17(E)-25DI FT28C17(E)-25PI FT28C17(E)-25SI	32J 28P6 28S	Industrial (-40°C to 85°C)
			FT28C17(E)-25DMB	28D6	Military/883 M5004 (-55°C to 125°C)

Note : 1. See Valid Part Number Table On Next Page

FT28C17

16K (2K x 8) Parallel EEPROMs

Valid Part Numbers

The following table lists standard Force products that can be ordered.

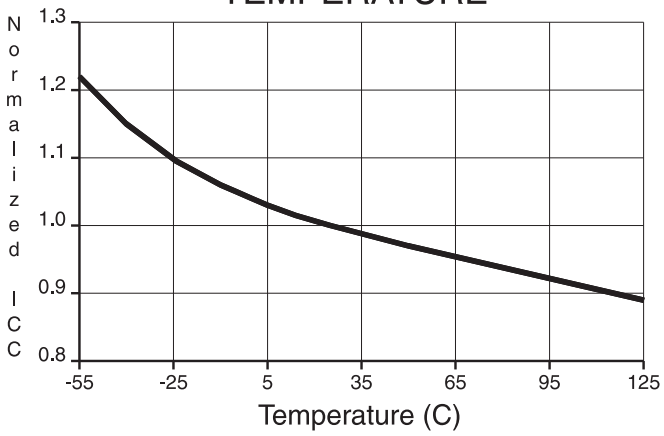
Device Numbers	Speed	Package and Temperature Combinations
FT28C17	15	DC,JC,JI,PC,PI,SC,SI,DM/DMB
FT28C17E	15	DC,JC,JI,PC,PI,SC,SI,DM/DMB
FT7C17	20	DC,JC,JI,PC,PI,SC,SI,DM/DMB
FT28C17E	20	DC,JC,JI,PC,PI,SC,SI,DM/DMB
FT28C17	25	DC,JC,JI,PC,PI,SC,SI,DM/DMB
FT28C17E	25	DC,JC,JI,PC,PI,SC,SI,DM/DMB
FT7C17	35	DC,JC,JI,PC,PI,SC,SI,DM/DMB
FT28C17E	35	DC,JC,JI,PC,PI,SC,SI,DM/DMB

Die Products

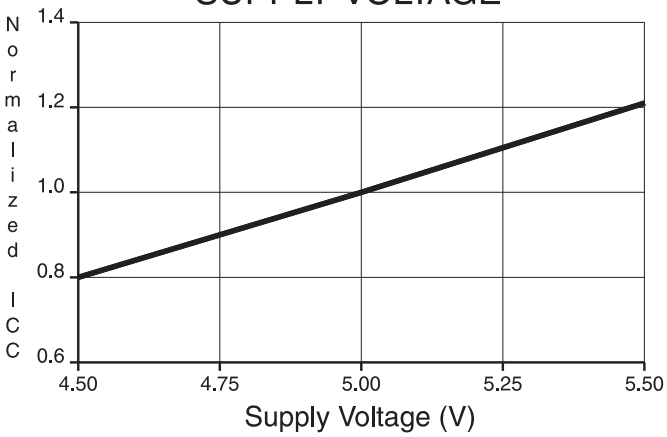
Reference Section: Parallel EEPROM Die Products

Package Type	
32J	32-Lead, Plastic J-Leaded Chip Carrier (PLCC)
28P6	28-Lead, 0.600" Wide, Plastic Dull Inline Package (PDIP)
28S	28-Lead, 0.300" Wide, Plastic Gull Wing, Small Outline (SOIC)
Options	
Blank	Standard Device: Endurance = 10K Write Cycles; Write Time = 1 ms
E	High Endurance Option: Endurance = 100K Write Cycles

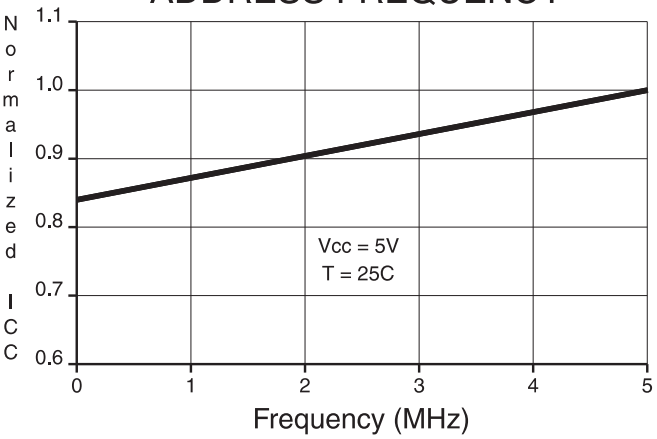
NORMALIZED SUPPLY CURRENT vs. TEMPERATURE



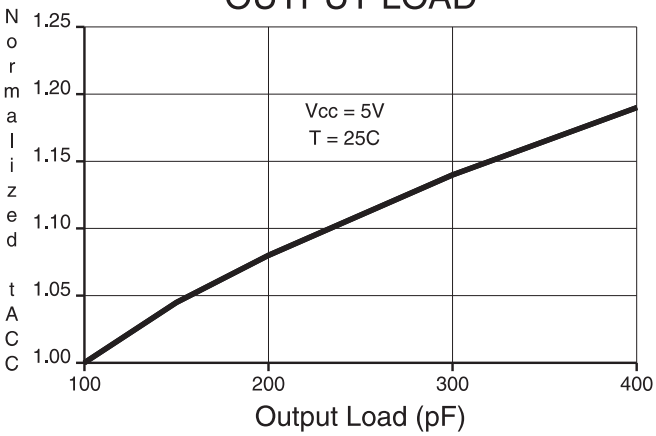
NORMALIZED SUPPLY CURRENT vs. SUPPLY VOLTAGE



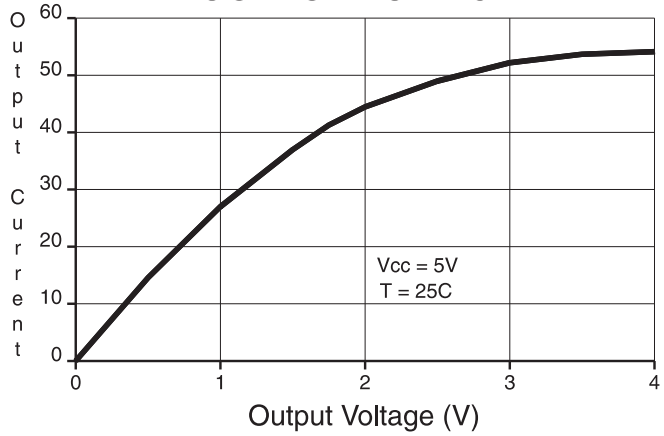
NORMALIZED SUPPLY CURRENT vs. ADDRESS FREQUENCY



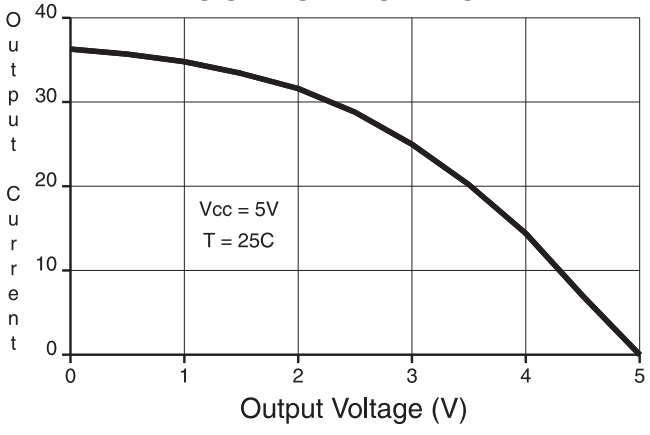
NORMALIZED ACCESS TIME vs. OUTPUT LOAD



OUTPUT SINK CURRENT vs. OUTPUT VOLTAGE

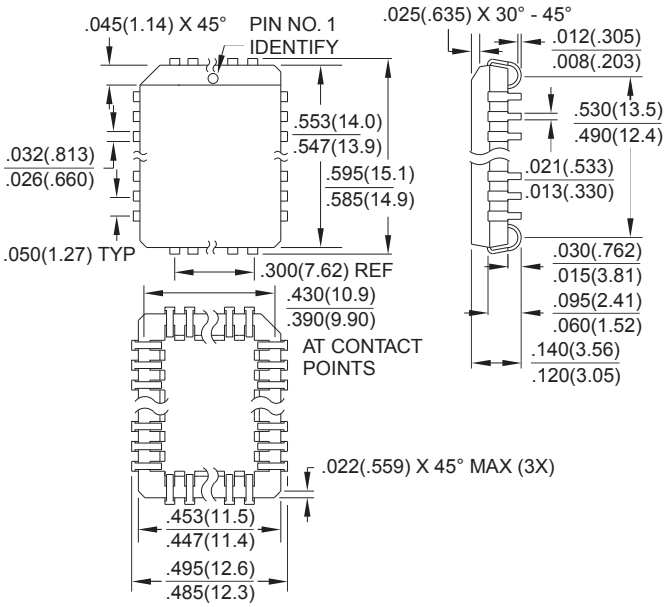


OUTPUT SOURCE CURRENT vs. OUTPUT VOLTAGE

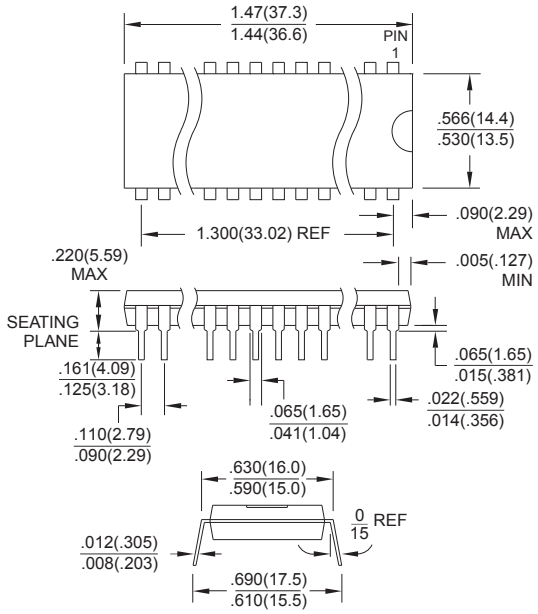


Packaging Information

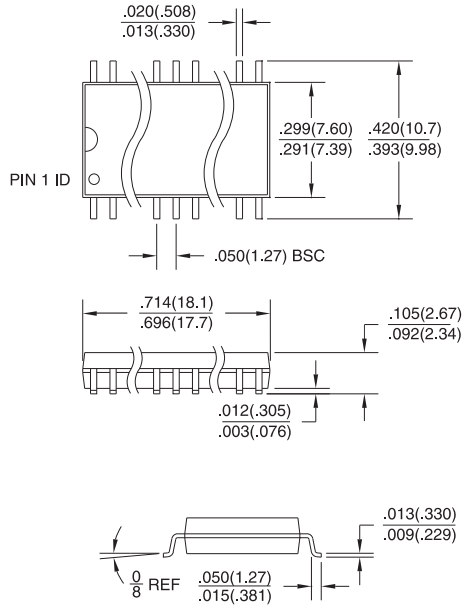
32J, 32-Lead, Plastic J-Leaded Chip Carrier (PLCC)
Dimensions in Inches and (Millimeters)
JEDEC STANDARD MS-018 AA



28P6, 28-Lead, 0.600" Wide, Plastic Dual Inline Package (PDIP)
Dimensions in Inches and (Millimeters)
JEDEC STANDARD MS-011 AB



28S, 24-Lead, 0.300" Wide, Plastic Gull Wing Small Outline (SOIC)
Dimensions in Inches and (Millimeters)



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