

AT28C64

T-46-13-27

Features

- Fast Read Access Time - 150ns
- Fast Byte Write - 200µs or 1 ms
- Self-Timed Byte Write Cycle
 - Internal Address and Data Latches
 - Internal Control Timer
 - Automatic Clear Before Write
- Direct Microprocessor Control
 - READY/BUSY Open Drain Output
 - DATA Polling
- Low Power
 - 30mA Active Current
 - 100µA CMOS Standby Current
- High Reliability
 - Endurance: 10^4 or 10^5 Cycles
 - Data Retention: 10 years
- 5V $\pm$ 10% Supply
- CMOS and TTL Compatible Inputs and Outputs
- JEDEC Approved Byte-Wide Pinout
- Full Military, Commercial, and Industrial Temperature Ranges

64K (8K x 8)
CMOS
E²PROM

Description

The AT28C64 is a low-power, high-performance 8,192 words x 8 bit non-volatile Electrically Erasable and Programmable Read Only Memory with popular, easy to use features. The device is manufactured with Atmel's reliable non-volatile technology.

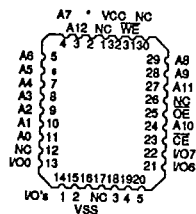
The AT28C64 is accessed like a Static RAM for the read or write cycles without the need for external components. During a byte write, the address and data are latched internally, freeing the microprocessor address and data bus for other operations. Following the initiation of a write cycle, the device 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/BUSY (unless pin 1 is N.C.) and DATA polling of I/O7. Once the end of a write cycle has been detected, a new access for a read or write can begin.

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

Atmel's 28C64 has additional features to ensure high quality and manufacturability. The device utilizes error correction internally for extended endurance and for improved data retention characteristics. An extra 32 bytes of E²PROM are available for device identification or tracking.

Pin Configurations

Pin Name	Function
A0 - A12	Addresses
CE	Chip Enable
OE	Output Enable
WE	Write Enable
I/O0 - I/O7	Data Inputs/Outputs
RDY/BUSY	Ready/Busy Output
NC	No Connect



* = RDY/BUSY (or NC)

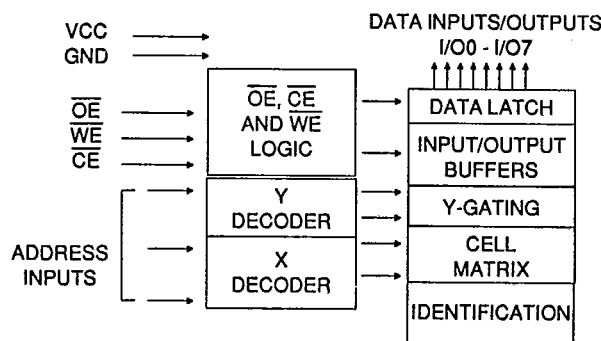
Note: PLCC package pins 1 and 17 are DON'T CONNECT.





T-46-13-27

Block Diagram



Operating Modes

Mode	$\overline{OE}$	$\overline{OE}$	WE	I/O
Read	V_{IL}	V_{IL}	V_{IH}	DOUT
Write ⁽²⁾	V_{IL}	V_{IH}	V_{IL}	DIN
Standby/Write Inhibit	V_{IH}	$X^{(1)}$	X	High Z
Write Inhibit	X	X	V_{IH}	
Write Inhibit	X	V_{IL}	X	
Output Disable	X	V_{IH}	X	High Z
Chip Erase	V_{IL}	$V_{H}^{(3)}$	V_{IL}	High Z

Notes: 1. X can be V_{IL} or V_{IH} .

2. Refer to A.C. Programming Waveforms.

3. $V_H = 12.0V \pm 0.5V$.

Device Operation

READ: The AT28C64 is accessed like a Static RAM. When CE and OE are low and 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 CE or OE is high. This dual line control gives designers increased flexibility in preventing bus contention.

BYTE WRITE: Writing data into the AT28C64 is similar to writing into a Static RAM. A low pulse on the WE or CE input with OE high and CE or WE low (respectively) initiates a byte write. The address location is latched on the falling edge of WE (or CE); the new data is latched on the 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.

FAST BYTE WRITE: The AT28C64F offers a byte write time of 200 μ s maximum. This feature allows the entire device to be rewritten in 1.6 seconds.

READY/BUSY: Pin 1 is an open drain READY/BUSY output that can be used to detect the end of a write cycle. RDY/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/BUSY line. Pin 1 is not connected for the AT28C64X.

DATA POLLING: The AT28C64 provides 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/O7 (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) Vcc sense— if Vcc is below 3.8V (typical) the write function is inhibited. (b) Vcc power on delay— once Vcc has reached 3.8V the device will automatically time out 5ms (typical) before allowing a byte write. (c) Write Inhibit— holding any one of OE low, CE high or WE high inhibits byte write cycles.

CHIP CLEAR: The contents of the entire memory of the AT28C64 may be set to the high state by the CHIP CLEAR operation. By setting CE low and OE to 12 volts, the chip is cleared when a 10 msec low pulse is applied to WE.

DEVICE IDENTIFICATION: An extra 32 bytes of E²PROM memory are available to the user for device identification. By raising A9 to $12 \pm 0.5V$ and using address locations 1FE0H to 1FFFH the additional bytes may be written to or read from in the same manner as the regular memory array.

AT28C64

T-46-13-27

Absolute Maximum Ratings*

Temperature Under Bias.....	-55°C to +125°C
Storage Temperature.....	-65°C to +150°C
All Input Voltages (Including N.C. 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 A ₉ 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.

2

D.C. and A.C. Operating Range

		AT28C64-15	AT28C64-20	AT28C64-25
Operating Temperature (Case)	Com.	0°C - 70°C	0°C - 70°C	0°C - 70°C
	Ind.	-40°C - 85°C	-40°C - 85°C	-40°C - 85°C
	Mil.	-55°C - 125°C	-55°C - 125°C	-55°C - 125°C
V _{CC} Power Supply		5V±10%	5V±10%	5V±10%

D.C. 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., Mil.	3	mA
I _{CC}	V _{CC} Active Current A.C.	f=5MHz; I _{OUT} =0mA $\overline{CE}$ =V _{IL}	Com.	30	mA
			Ind., Mil.	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} =2.1mA =4.0mA for RDY/ $\overline{BUSY}$		.45	V
V _{OH}	Output High Voltage	I _{OH} =-400μA	2.4		V

Pin Capacitance (f=1MHz T=25°C) ⁽⁴⁾

	Typ	Max	Units	Conditions
C _{IN}	4	6	pF	V _{IN} = 0V
C _{OUT}	8	12	pF	V _{OUT} = 0V

ATMEL

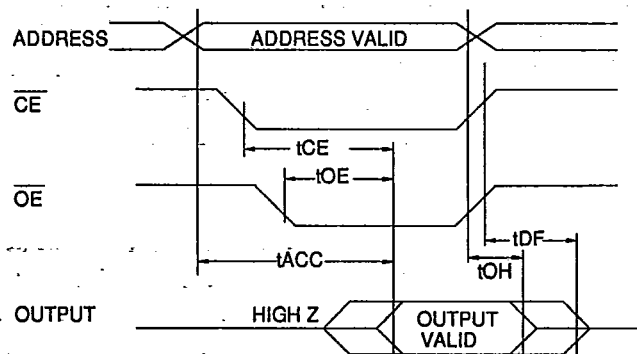


T-46-13-27

A.C. Read Characteristics

Symbol	Parameter	AT28C64-15		AT28C64-20		AT28C64-25		Units
		Min	Max	Min	Max	Min	Max	
t_{ACC}	Address to Output Delay		150		200		250	ns
$t_{CE}^{(1)}$	$\overline{CE}$ to Output Delay		150		200		250	ns
$t_{OE}^{(2)}$	$\overline{OE}$ to Output Delay	10	70	10	80	10	100	ns
$t_{DF}^{(3,4)}$	$\overline{CE}$ or $\overline{OE}$ High to Output Float	0	50	0	55	0	60	ns
t_{OH}	Output Hold from $\overline{OE}$, $\overline{CE}$ or Address, whichever occurred first	0		0		0		ns

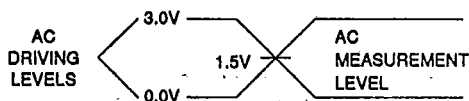
A.C. Read Waveforms



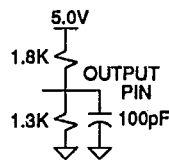
Notes:

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 $t_{CE} - t_{OH}$ after the falling edge of $\overline{CE}$ without impact on t_{CE} or by $t_{ACC} - t_{OH}$ after an address change without impact on t_{ACC} .
3. t_{DF} is specified from $\overline{OE}$ or $\overline{CE}$ whichever occurs first ($C_L = 5pF$).
4. This parameter is characterized and is not 100% tested.

Input Test Waveforms and Measurement Level

 $t_R, t_F < 20ns$

Output Test Load

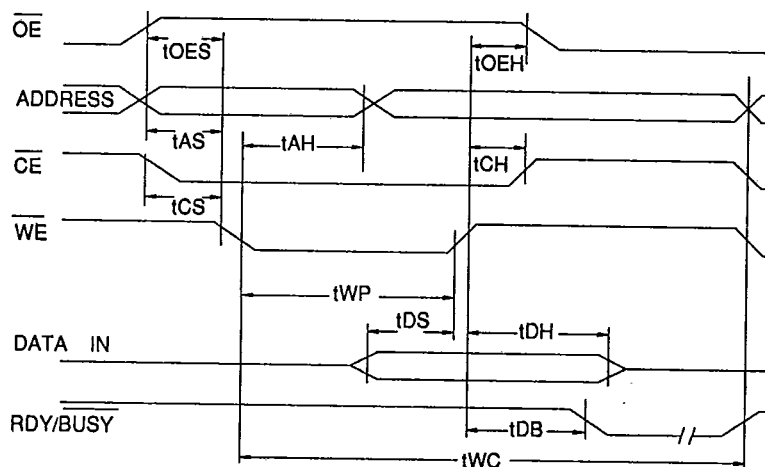
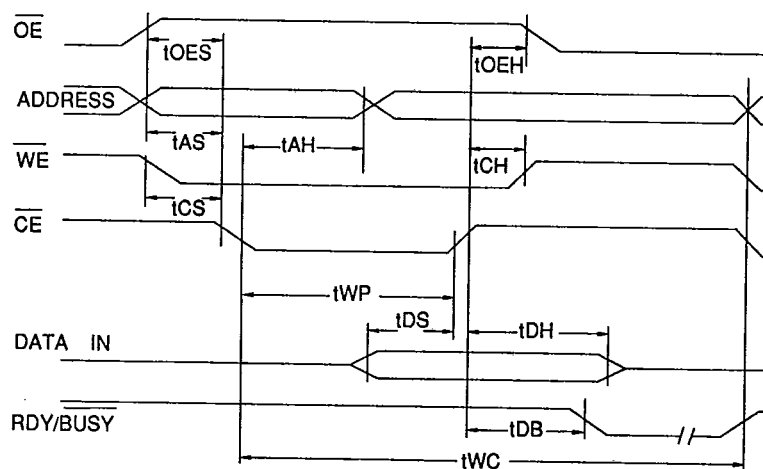


AT28C64

T-46-13-27

A.C. 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_{DB}	Time to Device Busy			50	ns
t_{WC}	Write Cycle Time	AT28C64		0.5	1.0
		AT28C64E/F		100	200
					μs

A.C. Write Waveforms- $\overline{WE}$ ControlledA.C. Write Waveforms- $\overline{CE}$ Controlled



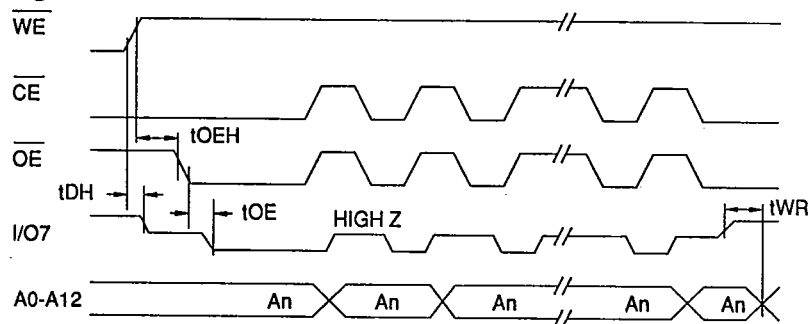
T-46-13-27

Data Polling Characteristics⁽¹⁾

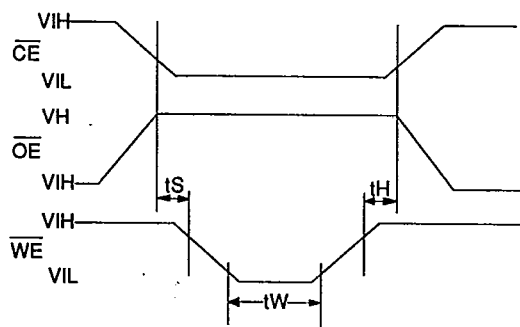
Symbol	Parameter	Min	Typ	Max	Units
t _{DH}	Data Hold Time	10			ns
t _{OE}	$\overline{\text{OE}}$ Hold Time	10			ns
t _{OE}	$\overline{\text{OE}}$ to Output Delay			100	ns
t _{WR}	Write Recovery Time	0			ns

Note: 1. These parameters are characterized and not 100% tested.

Data Polling Waveforms



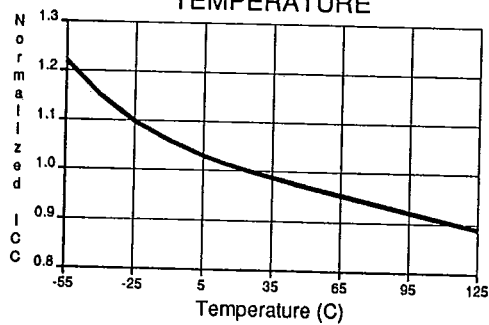
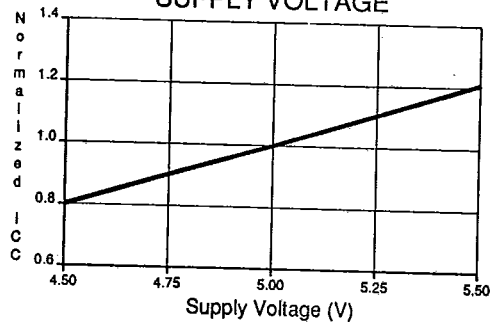
Chip Erase Waveforms



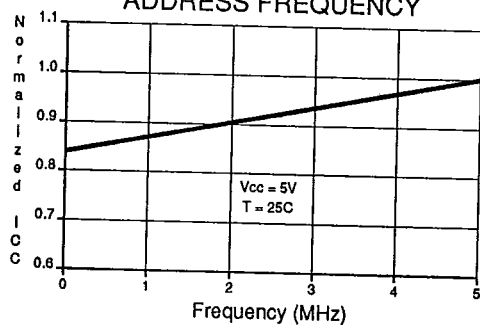
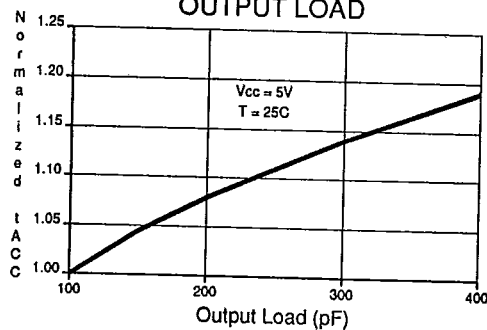
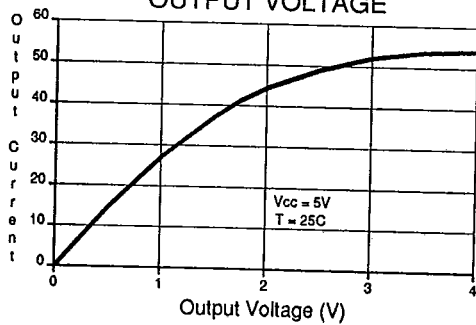
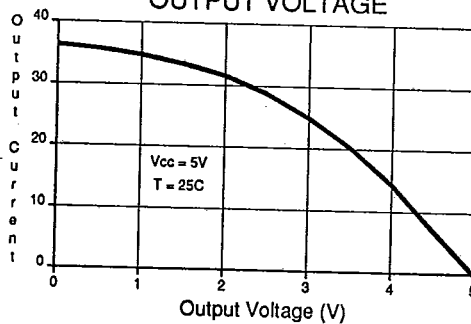
$t_{\text{S}} = t_{\text{H}} = 1\mu\text{sec (min.)}$
 $t_{\text{W}} = 10\text{msec (min.)}$
 $V_{\text{H}} = 12.0\text{V} \pm 0.5\text{V}$

AT28C64

T-46-13-27

NORMALIZED SUPPLY CURRENT vs.
TEMPERATURENORMALIZED SUPPLY CURRENT vs.
SUPPLY VOLTAGE

2

NORMALIZED SUPPLY CURRENT vs.
ADDRESS FREQUENCYNORMALIZED ACCESS TIME vs.
OUTPUT LOADOUTPUT SINK CURRENT vs.
OUTPUT VOLTAGEOUTPUT SOURCE CURRENT vs.
OUTPUT VOLTAGE

ATMEL



T-46-13-27

Ordering Information

t _{acc} (ns)	I _{cc} (mA)		Ordering Code	Package	Operation Range
	Active	Standby			
150	30	0.1	AT28C64(E,F)-15DC	28D6	Commercial (0°C to 70°C)
			AT28C64(E,F)-15FC	28F	
			AT28C64(E,F)-15JC	32J	
			AT28C64(E,F)-15LC	32L	
			AT28C64(E,F)-15PC	28P6	
			AT28C64(E,F)-15SC	28S	
150	45	0.1	AT28C64(E,F)-15DI	28D6	Industrial (-40°C to 85°C)
			AT28C64(E,F)-15FI	28F	
			AT28C64(E,F)-15JI	32J	
			AT28C64(E,F)-15LI	32L	
			AT28C64(E,F)-15PI	28P6	
			AT28C64(E,F)-15SI	28S	
			AT28C64(E,F)-15DM	28D6	Military (-55°C to 125°C)
			AT28C64(E,F)-15FM	28F	
			AT28C64(E,F)-15LM	32L	
200	45	0.1	AT28C64(E,F)-15DM/883	28D6	Military/883C Class B, Fully Compliant (-55°C to 125°C)
			AT28C64(E,F)-15FM/883	28F	
			AT28C64(E,F)-15LM/883	32L	
			AT28C64(E,F)-20DC	28D6	Commercial (0°C to 70°C)
			AT28C64(E,F)-20FC	28F	
			AT28C64(E,F)-20JC	32J	
			AT28C64(E,F)-20LC	32L	
			AT28C64(E,F)-20PC	28P6	
			AT28C64(E,F)-20SC	28S	
200	30	0.1	AT28C64(E,F)-20DI	28D6	Industrial (-40°C to 85°C)
			AT28C64(E,F)-20FI	28F	
			AT28C64(E,F)-20JI	32J	
			AT28C64(E,F)-20LI	32L	
			AT28C64(E,F)-20PI	28P6	
			AT28C64(E,F)-20SI	28S	
			AT28C64(E,F)-20DM	28D6	Military (-55°C to 125°C)
			AT28C64(E,F)-20FM	28F	
			AT28C64(E,F)-20LM	32L	
250	30	0.1	AT28C64(E,F)-20DM/883	28D6	Military/883C Class B, Fully Compliant (-55°C to 125°C)
			AT28C64(E,F)-20FM/883	28F	
			AT28C64(E,F)-20LM/883	32L	
			AT28C64(E,F)-25DC	28D6	Commercial (0°C to 70°C)
			AT28C64(E,F)-25FC	28F	
			AT28C64(E,F)-25JC	32J	
			AT28C64(E,F)-25LC	32L	
			AT28C64(E,F)-25PC	28P6	
			AT28C64(E,F)-25SC	28S	
250	30	0.1	AT28C64-W	DIE	

AT28C64/X

T-46-13-27

Ordering Information

tACC (ns)	Icc (mA)		Ordering Code	Package	Operation Range
	Active	Standby			
250	45	0.1	AT28C64(E,F)-25DI AT28C64(E,F)-25FI AT28C64(E,F)-25JI AT28C64(E,F)-25LI AT28C64(E,F)-25PI AT28C64(E,F)-25SI	28D6 28F 32J 32L 28P6 28S	Industrial (-40°C to 85°C)
			AT28C64(E,F)-25DM AT28C64(E,F)-25FM AT28C64(E,F)-25LM	28D6 28F 32L	Military (-55°C to 125°C)
			AT28C64(E,F)-25DM/883 AT28C64(E,F)-25FM/883 AT28C64(E,F)-25LM/883	28D6 28F 32L	Military/883C Class B, Fully Compliant (-55°C to 125°C)
300	45	0.1	AT28C64(E,F)-30DM/883 AT28C64(E,F)-30FM/883 AT28C64(E,F)-30LM/883	28D6 28F 32L	Military/883C Class B, Fully Compliant (-55°C to 125°C)
350	45	0.1	AT28C64(E,F)-35DM/883 AT28C64(E,F)-35FM/883 AT28C64(E,F)-35LM/883	28D6 28F 32L	Military/883C Class B, Fully Compliant (-55°C to 125°C)
450	45	0.1	AT28C64(E,F)-45DM/883 AT28C64(E,F)-45FM/883 AT28C64(E,F)-45LM/883	28D6 28F 32L	Military/883C Class B, Fully Compliant (-55°C to 125°C)
150	45	0.1	5962-87514 17 UX 5962-87514 17 XX 5962-87514 17 YX	32K 28D6 32L	Military/883C Class B, Fully Compliant (-55°C to 125°C)
200	45	0.1	5962-87514 16 UX 5962-87514 16 XX 5962-87514 16 YX	32K 28D6 32L	Military/883C Class B, Fully Compliant (-55°C to 125°C)
250	45	0.1	5962-87514 15 UX 5962-87514 15 XX 5962-87514 15 YX 5962-87514 15 ZX	32K 28D6 32L 28F	Military/883C Class B, Fully Compliant (-55°C to 125°C)
300	45	0.1	5962-87514 14 UX 5962-87514 14 XX 5962-87514 14 YX	32K 28D6 32L	Military/883C Class B, Fully Compliant (-55°C to 125°C)
350	45	0.1	5962-87514 13 UX 5962-87514 13 XX 5962-87514 13 YX 5962-87514 13 ZX	32K 28D6 32L 28F	Military/883C Class B, Fully Compliant (-55°C to 125°C)





T-46-13-27

Ordering Information

Package Type	
28D6	28 Lead, 0.600" Wide, Non-Windowed, Ceramic Dual Inline Package (Cerdip)
28F	28 Lead, Non-Windowed, Ceramic Bottom-Brazed Flat Package (Flatpack)
32J	32 Lead, Plastic J-Leaded Chip Carrier (PLCC)
32K	32 Lead, Non-Windowed, Ceramic J-Leaded Chip Carrier (JLCC)
32L	32 Pad, Non-Windowed, Ceramic Leadless Chip Carrier (LCC)
28P6	28 Lead, 0.600" Wide, Plastic Dual Inline Package (PDIP)
28S	28 Lead, 0.300" Wide, Plastic Gull Wing, Small Outline (SOIC)
W	Die
Options	
Blank	Standard Device: Endurance = 10K Write Cycles; Write Time = 1 ms
E	High Endurance Option: Endurance = 100K Write Cycles; Write Time = 200 μ s
F	Fast Write Option: Write Time = 200 μ s

AT28C64/X

T-46-13-27

Ordering Information

t _{acc} (ns)	I _{cc} (mA)		Ordering Code	Package	Operation Range
	Active	Standby			
150	30	0.1	AT28C64X-15DC AT28C64X-15FC AT28C64X-15JC AT28C64X-15LC AT28C64X-15PC AT28C64X-15SC	28D6 28F 32J 32L 28P6 28S	Commercial (0°C to 70°C)
150	45	0.1	AT28C64X-15DI AT28C64X-15FI AT28C64X-15JI AT28C64X-15LI AT28C64X-15PI AT28C64X-15SI	28D6 28F 32J 32L 28P6 28S	Industrial (-40°C to 85°C)
			AT28C64X-15DM AT28C64X-15FM AT28C64X-15LM	28D6 28F 32L	Military (-55°C to 125°C)
			AT28C64X-15DM/883 AT28C64X-15FM/883 AT28C64X-15LM/883	28D6 28F 32L	Military/883C Class B, Fully Compliant (-55°C to 125°C)
			AT28C64X-20DC AT28C64X-20FC AT28C64X-20JC AT28C64X-20LC AT28C64X-20PC AT28C64X-20SC	28D6 28F 32J 32L 28P6 28S	Commercial (0°C to 70°C)
200	45	0.1	AT28C64X-20DI AT28C64X-20FI AT28C64X-20JI AT28C64X-20LI AT28C64X-20PI AT28C64X-20SI	28D6 28F 32J 32L 28P6 28S	Industrial (-40°C to 85°C)
			AT28C64X-20DM AT28C64X-20FM AT28C64X-20LM	28D6 28F 32L	Military (-55°C to 125°C)
			AT28C64X-20DM/883 AT28C64X-20FM/883 AT28C64X-20LM/883	28D6 28F 32L	Military/883C Class B, Fully Compliant (-55°C to 125°C)
			AT28C64X-25DC AT28C64X-25FC AT28C64X-25JC AT28C64X-25LC AT28C64X-25PC AT28C64X-25SC	28D6 28F 32J 32L 28P6 28S	Commercial (0°C to 70°C)





T-46-13-27

Ordering Information

tACC (ns)	Icc (mA)		Ordering Code	Package	Operation Range
	Active	Standby			
250	45	0.1	AT28C64X-25DI	28D6	Industrial (-40°C to 85°C)
			AT28C64X-25FI	28F	
			AT28C64X-25JI	32J	
			AT28C64X-25LI	32L	Military (-55°C to 125°C)
			AT28C64X-25PI	28P6	
			AT28C64X-25SI	28S	
			AT28C64X-25DM	28D6	Military/883C Class B, Fully Compliant (-55°C to 125°C)
			AT28C64X-25FM/883	28F	
			AT28C64X-25LM/883	32L	
300	45	0.1	AT28C64X-30DM/883	28D6	Military/883C Class B, Fully Compliant (-55°C to 125°C)
			AT28C64X-30FM/883	28F	
			AT28C64X-30LM/883	32L	
350	45	0.1	AT28C64X-35DM/883	28D6	Military/883C Class B, Fully Compliant (-55°C to 125°C)
			AT28C64X-35FM/883	28F	
			AT28C64X-35LM/883	32L	
450	45	0.1	AT28C64X-45DM/883	28D6	Military/883C Class B, Fully Compliant (-55°C to 125°C)
			AT28C64X-45FM/883	28F	
			AT28C64X-45LM/883	32L	
150	45	0.1	5962-87514 22 UX	32K	Military/883C Class B, Fully Compliant (-55°C to 125°C)
			5962-87514 22 XX	28D6	
			5962-87514 22 YX	32L	
200	45	0.1	5962-87514 21 UX	32K	Military/883C Class B, Fully Compliant (-55°C to 125°C)
			5962-87514 21 XX	28D6	
			5962-87514 21 YX	32L	
250	45	0.1	5962-87514 20 UX	32K	Military/883C Class B, Fully Compliant (-55°C to 125°C)
			5962-87514 20 XX	28D6	
			5962-87514 20 YX	32L	
			5962-87514 20 ZX	28F	
300	45	0.1	5962-87514 19 UX	32K	Military/883C Class B, Fully Compliant (-55°C to 125°C)
			5962-87514 19 XX	28D6	
			5962-87514 19 YX	32L	
350	45	0.1	5962-87514 18 UX	32K	Military/883C Class B, Fully Compliant (-55°C to 125°C)
			5962-87514 18 XX	28D6	
			5962-87514 18 YX	32L	

Package Type

28D6	28 Lead, 0.600" Wide, Non-Windowed, Ceramic Dual Inline Package (Cerdip)
28F	28 Lead, Non-Windowed, Ceramic Bottom-Brazed Flat Package (Flatpack)
32J	32 Lead, Plastic J-Leaded Chip Carrier (PLCC)
32K	32 Lead, Non-Windowed, Ceramic J-Leaded Chip Carrier (JLCC)
32L	32 Pad, Non-Windowed, Ceramic Leadless Chip Carrier (LCC)
28P6	28 Lead, 0.600" Wide Plastic Dual Inline Package (PDIP)
28S	28 Lead, 0.300" Wide, Plastic Gull Wing Small Outline (SOIC)