

## 54F/74F189 64-Bit Random Access Memory with TRI-STATE® Outputs

### General Description

The 'F189 is a high-speed 64-bit RAM organized as a 16-word by 4-bit array. Address inputs are buffered to minimize loading and are fully decoded on-chip. The outputs are TRI-STATE and are in the high impedance state whenever the Chip Select ( $\overline{CS}$ ) input is HIGH. The outputs are active only in the Read mode and the output data is the complement of the stored data.

### Features

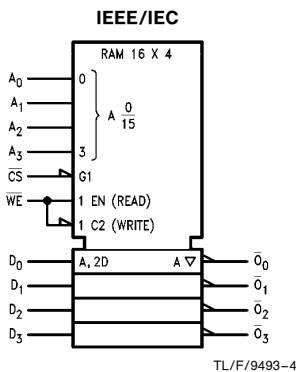
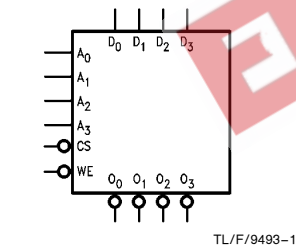
- TRI-STATE outputs for data bus applications
- Buffered inputs minimize loading
- Address decoding on-chip
- Diode clamped inputs minimize ringing
- Available in SOIC, (300 mil only)

Commercial	Military	Package Number	Package Description
74F189PC		N16E	16-Lead (0.300" Wide) Molded Dual-In-Line
	54F189DL (Note 2)	J16A	16-Lead Ceramic Dual-In-Line
74F189SC (Note 1)		M16A	16-Lead (0.150" Wide) Molded Small Outline, JEDEC
74F189SJ (Note 1)		M16D	16-Lead (0.300" Wide) Molded Small Outline, EIAJ
	54F189FL (Note 2)	W16A	16-Lead Cerpack
	54F189LL (Note 2)	E20A	20-Lead Ceramic Leadless Chip Carrier, Type C

**Note 1:** Devices also available in 13" reel. Use suffix = SCX and SJX.

**Note 2:** Military grade device with environmental and burn-in processing. Use suffix = DLQB, FLQB and LLQB.

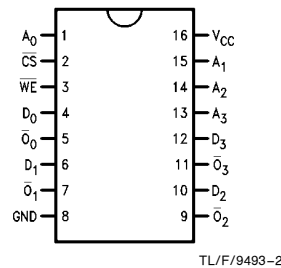
### Logic Symbols



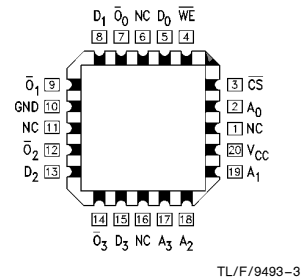
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### Connection Diagrams

Pin Assignment for DIP, SOIC and Flatpak



Pin Assignment for LCC



## Unit Loading/Fan Out

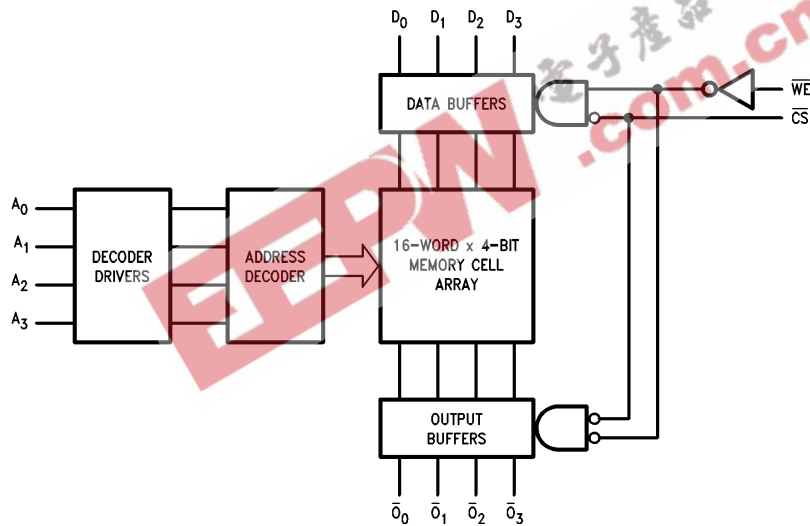
Pin Names	Description	54F/74F	
		U.L. HIGH/LOW	Input $I_{IH}/I_{IL}$ Output $I_{OH}/I_{OL}$
$A_0-A_3$	Address Inputs	1.0/1.0	$20 \mu\text{A} / -0.6 \text{ mA}$
$\overline{CS}$	Chip Select Input (Active LOW)	1.0/1.0	$20 \mu\text{A} / -1.2 \text{ mA}$
$\overline{WE}$	Write Enable Input (Active LOW)	1.0/1.0	$20 \mu\text{A} / -0.6 \text{ mA}$
$D_0-D_3$	Data Inputs	1.0/1.0	$20 \mu\text{A} / -0.6 \text{ mA}$
$\overline{O}_0-\overline{O}_3$	Inverted Data Outputs	150/40 (33.3)	$-3.0 \text{ mA} / 24 \text{ mA} (20 \text{ mA})$

Function Table

Inputs		Operation	Condition of Outputs
$\overline{CS}$	$\overline{WE}$		
L	L	Write	High Impedance
L	H	Read	Complement of Stored Data
H	X	Inhibit	High Impedance

H = HIGH Voltage Level  
L = LOW Voltage Level  
X = Immaterial

## Block Diagram



TL/F/9493-5

## Absolute Maximum Ratings (Note 1)

If Military/Aerospace specified devices are required, please contact the National Semiconductor Sales Office/Distributors for availability and specifications.

Storage Temperature	-65°C to +150°C
Ambient Temperature under Bias	-55°C to +125°C
Junction Temperature under Bias	-55°C to +175°C
Plastic	-55°C to +150°C
V <sub>CC</sub> Pin Potential to Ground Pin	-0.5V to +7.0V
Input Voltage (Note 2)	-0.5V to +7.0V
Input Current (Note 2)	-30 mA to +5.0 mA
Voltage Applied to Output in HIGH State (with V <sub>CC</sub> = 0V)	
Standard Output	-0.5V to V <sub>CC</sub>
TRI-STATE Output	-0.5V to +5.5V
Current Applied to Output in LOW State (Max)	twice the rated I <sub>OL</sub> (mA)

**Note 1:** Absolute maximum ratings are values beyond which the device may be damaged or have its useful life impaired. Functional operation under these conditions is not implied.

**Note 2:** Either voltage limit or current limit is sufficient to protect inputs.

## Recommended Operating Conditions

Free Air Ambient Temperature	
Military	-55°C to +125°C
Commercial	0°C to +70°C
Supply Voltage	
Military	+4.5V to +5.5V
Commercial	+4.5V to +5.5V

## DC Electrical Characteristics

Symbol	Parameter	54F/74F			Units	V <sub>CC</sub>	Conditions
		Min	Typ	Max			
V <sub>IH</sub>	Input HIGH Voltage	2.0			V		Recognized as a HIGH Signal
V <sub>IL</sub>	Input LOW Voltage			0.8	V		Recognized as a LOW Signal
V <sub>CD</sub>	Input Clamp Diode Voltage			-1.2	V	Min	I <sub>IN</sub> = -18 mA
V <sub>OH</sub>	Output HIGH Voltage	54F 10% V <sub>CC</sub> 54F 10% V <sub>CC</sub> 74F 10% V <sub>CC</sub> 74F 10% V <sub>CC</sub> 74F 5% V <sub>CC</sub> 74F 5% V <sub>CC</sub>	2.5 2.4 2.5 2.4 2.7 2.7		V	Min	I <sub>OH</sub> = -1 mA I <sub>OH</sub> = -3 mA I <sub>OH</sub> = -1 mA I <sub>OH</sub> = -3 mA I <sub>OH</sub> = -1 mA I <sub>OH</sub> = -3 mA
V <sub>OL</sub>	Output LOW Voltage	54F 10% V <sub>CC</sub> 74F 10% V <sub>CC</sub>		0.5 0.5	V	Min	I <sub>OL</sub> = 20 mA I <sub>OL</sub> = 24 mA
I <sub>IH</sub>	Input HIGH Current	54F 74F		20.0 5.0	μA	Max	V <sub>IN</sub> = 2.7V
I <sub>BVI</sub>	Input HIGH Current Breakdown Test	54F 74F		100 7.0	μA	Max	V <sub>IN</sub> = 7.0V
I <sub>CEX</sub>	Output HIGH Leakage Current	54F 74F		250 50	μA	Max	V <sub>OUT</sub> = V <sub>CC</sub>
V <sub>ID</sub>	Input Leakage Test	74F	4.75		V	0.0	I <sub>ID</sub> = 1.9 μA All Other Pins Grounded
I <sub>OD</sub>	Output Leakage Circuit Current	74F		3.75	μA	0.0	V <sub>IOD</sub> = 150 mV All Other Pins Grounded
I <sub>IL</sub>	Input LOW Current			-0.6 -1.2	mA	Max	V <sub>IN</sub> = 0.5V (except $\overline{CS}$ ) V <sub>IN</sub> = 0.5V ( $\overline{CS}$ )
I <sub>OZH</sub>	Output Leakage Current			50	μA	Max	V <sub>OUT</sub> = 2.7V
I <sub>OZL</sub>	Output Leakage Current			-50	μA	Max	V <sub>OUT</sub> = 0.5V
I <sub>OS</sub>	Output Short-Circuit Current			-60 -150	mA	Max	V <sub>OUT</sub> = 0V
I <sub>ZZ</sub>	Bus Drainage Test			500	μA	0.0V	V <sub>OUT</sub> = 5.25V
I <sub>CCZ</sub>	Power Supply Current		37 55		mA	Max	V <sub>O</sub> = HIGH Z

### AC Electrical Characteristics

Symbol	Parameter	74F			54F		74F		Units
		T <sub>A</sub> = +25°C V <sub>CC</sub> = +5.0V C <sub>L</sub> = 50 pF			*T <sub>A</sub> , V <sub>CC</sub> = Mil C <sub>L</sub> = 50 pF		T <sub>A</sub> , V <sub>CC</sub> = Com C <sub>L</sub> = 50 pF		
		Min	Typ	Max	Min	Max	Min	Max	
t <sub>PLH</sub> t <sub>PHL</sub>	Access Time, HIGH or LOW A <sub>n</sub> to $\overline{O}_n$	10.0 8.0	18.5 13.5	26.0 19.0	9.0 8.0	32.0 23.0	10.0 8.0	27.0 20.0	ns
t <sub>PZH</sub> t <sub>PZL</sub>	Access Time, HIGH or LOW $\overline{CS}$ to $\overline{O}_n$	3.5 5.0	6.0 9.0	8.5 13.0	3.5 5.0	10.5 15.0	3.5 5.0	9.5 14.0	ns
t <sub>PHZ</sub> t <sub>PLZ</sub>	Disable Time, HIGH or LOW $\overline{CS}$ to $\overline{O}_n$	2.0 3.0	4.0 5.5	6.0 8.0	2.0 2.5	8.0 10.0	2.0 3.0	7.0 9.0	ns
t <sub>PZH</sub> t <sub>PZL</sub>	Write Recovery Time, HIGH or LOW $\overline{WE}$ to $\overline{O}_n$	6.5 6.5	15.0 11.0	28.0 15.5	6.5 6.5	37.5 17.5	6.5 6.5	29.0 16.5	ns
t <sub>PHZ</sub> t <sub>PLZ</sub>	Disable Time, HIGH or LOW $\overline{WE}$ to $\overline{O}_n$	4.0 5.0	7.0 9.0	10.0 13.0	3.5 5.0	12.0 15.0	4.0 5.0	11.0 14.0	ns

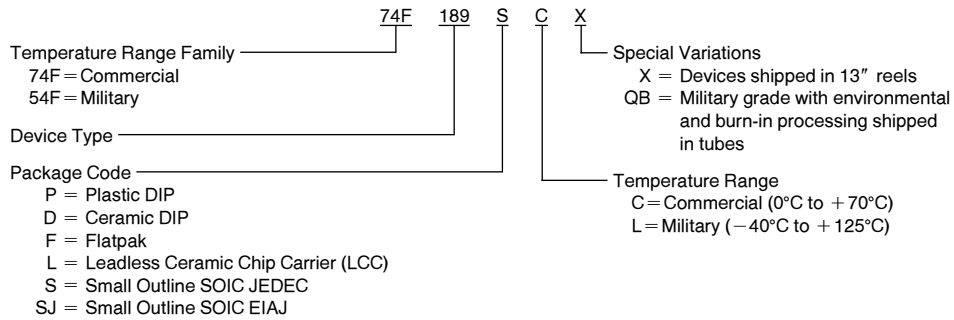
### AC Operating Requirements

Symbol	Parameter	74F		54F		74F		Units
		T <sub>A</sub> = +25°C V <sub>CC</sub> = +5.0V		*T <sub>A</sub> , V <sub>CC</sub> = Mil		T <sub>A</sub> , V <sub>CC</sub> = Com		
		Min	Max	Min	Max	Min	Max	
t <sub>s</sub> (H) t <sub>s</sub> (L)	Setup Time, HIGH or LOW A <sub>n</sub> to $\overline{WE}$	0 0		0 0		0 0		ns
t <sub>h</sub> (H) t <sub>h</sub> (L)	Hold Time, HIGH or LOW A <sub>n</sub> to $\overline{WE}$	2.0 2.0		2.0 2.0		2.0 2.0		ns
t <sub>s</sub> (H) t <sub>s</sub> (L)	Setup Time, HIGH or LOW D <sub>n</sub> to $\overline{WE}$	10.0 10.0		11.0 11.0		10.0 10.0		ns
t <sub>h</sub> (H) t <sub>h</sub> (L)	Hold Time, HIGH or LOW D <sub>n</sub> to $\overline{WE}$	0 0		2.0 2.0		0 0		ns
t <sub>s</sub> (L)	Setup Time, LOW $\overline{CS}$ to $\overline{WE}$	0		0		0		ns
t <sub>h</sub> (L)	Hold Time, LOW $\overline{CS}$ to $\overline{WE}$	6.0		7.5		6.0		ns
t <sub>w</sub> (L)	$\overline{WE}$ Pulse Width, LOW	6.0		15.0		6.0		ns

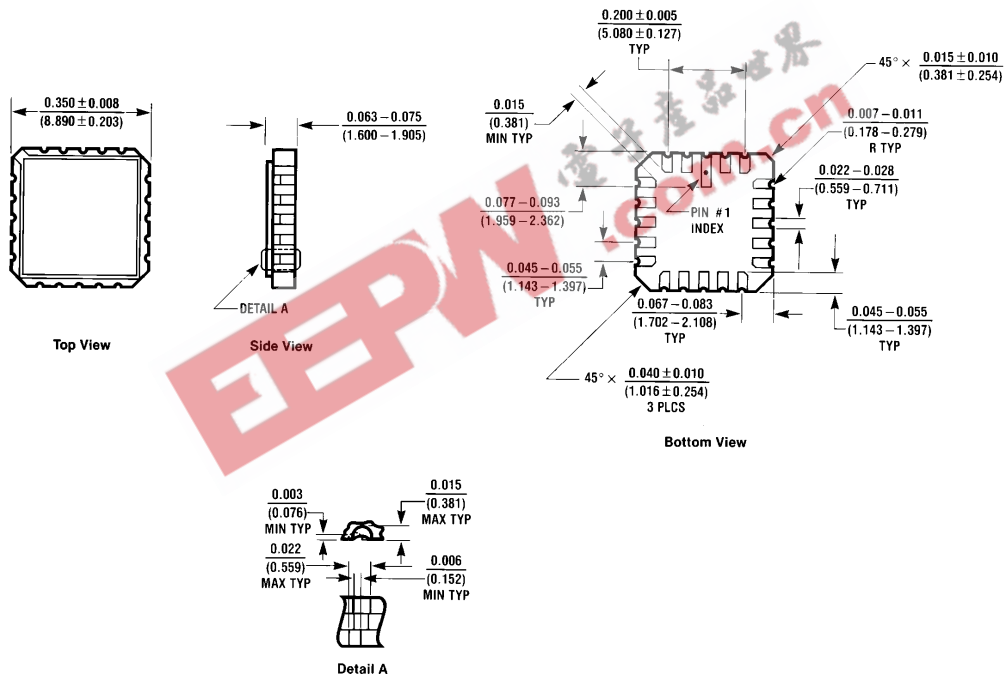
\*T<sub>A</sub> = -55°C to +125°C

## Ordering Information

The device number is used to form part of a simplified purchasing code where the package type and temperature range are defined as follows:



## Physical Dimensions inches (millimeters)

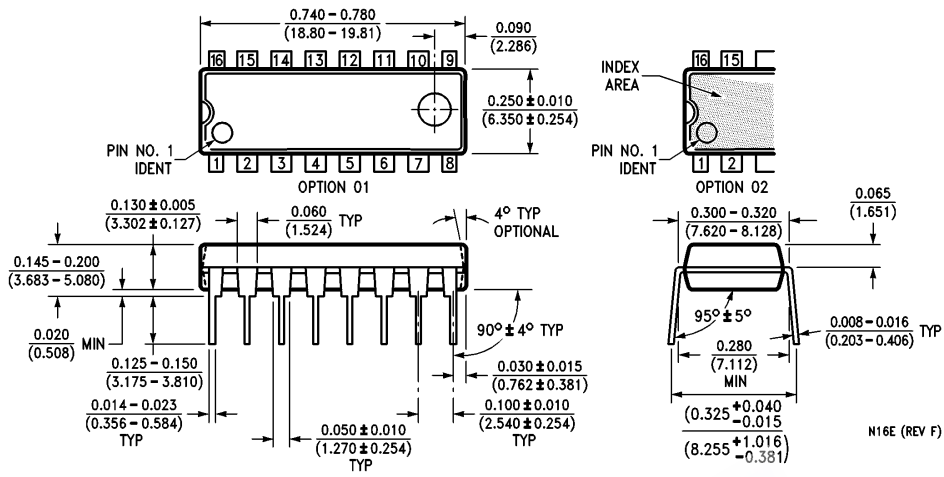


20-Lead Ceramic Leadless Chip Carrier (L)  
NS Package Number E20A

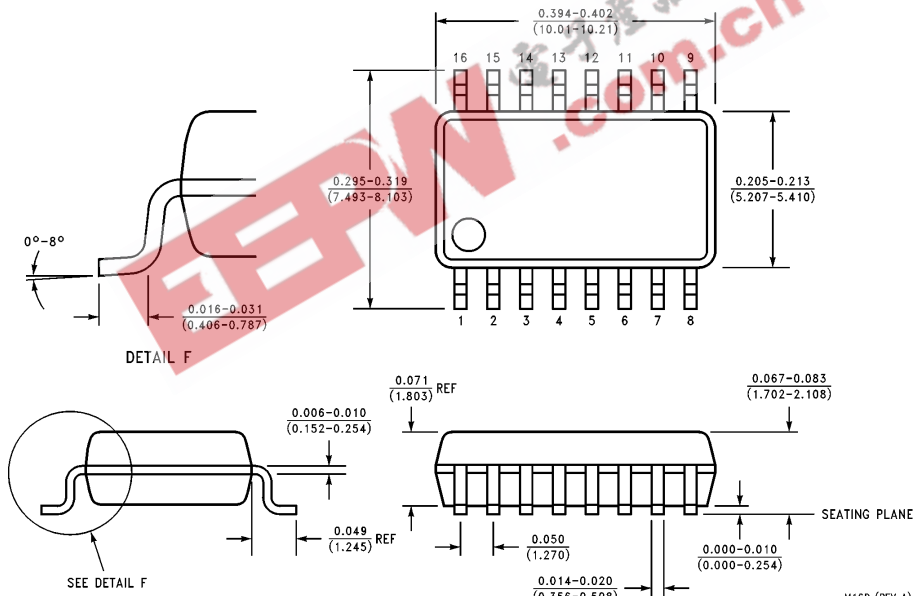
E20A (REV 01)



**Physical Dimensions** inches (millimeters) (Continued)

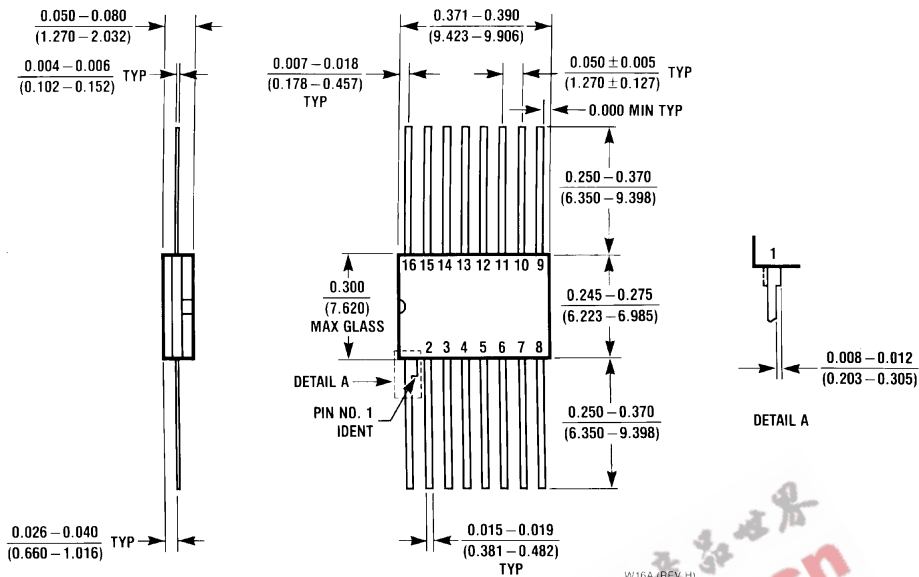


**16-Lead (0.300" Wide) Molded Dual-In-Line Package (P)**  
NS Package Number N16E



**16-Lead (0.300" Wide) Molded Small Outline Package, EIAJ (SJ)**  
NS Package Number M16D

**Physical Dimensions** inches (millimeters) (Continued)



**16 Lead Ceramic Flatpak (F)  
NS Package Number W16A**

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