



November 1994

54F/74F169 4-Stage Synchronous Bidirectional Counter

General Description

The 'F169 is a fully synchronous 4-stage up/down counter. The 'F169 is a modulo-16 binary counter. Features a preset capability for programmable operation, carry lookahead for easy cascading and a U/D input to control the direction of counting. All state changes, whether in counting or parallel loading, are initiated by the LOW-to-HIGH transition of the clock.

Features

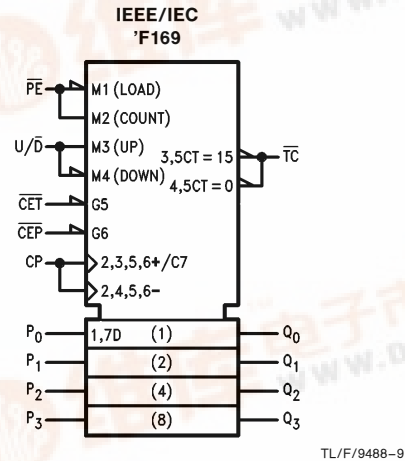
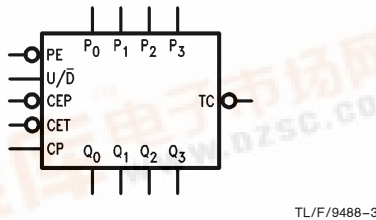
- Asynchronous counting and loading
- Built-in lookahead carry capability
- Presettable for programmable operation

Commercial	Military	Package Number	Package Description
74F169PC		N16E	16-Lead (0.300" Wide) Molded Dual-In-Line
	54F169DM (Note 2)	J16A	16-Lead Ceramic Dual-In-Line
74F169SC (Note 1)		M16A	16-Lead (0.150" Wide) Molded Small Outline, JEDEC
74F169SJ (Note 1)		M16D	16-Lead (0.300" Wide) Molded Small Outline, EIAJ

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 = DMQB.

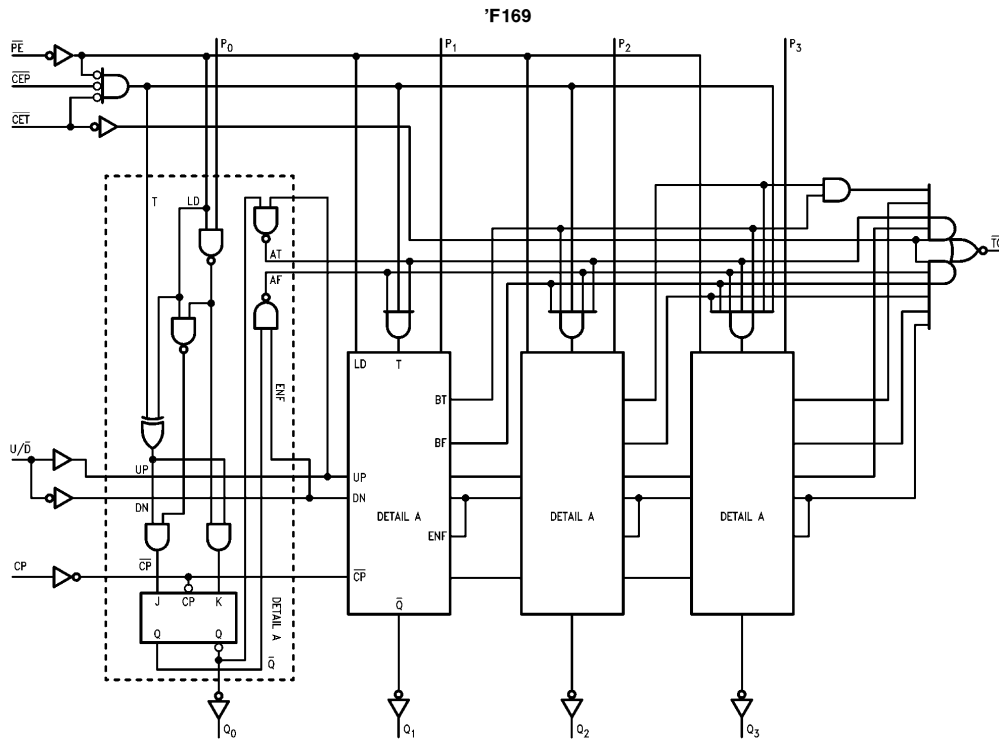
Logic Symbols



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Logic Diagram



TL/F/9488-5

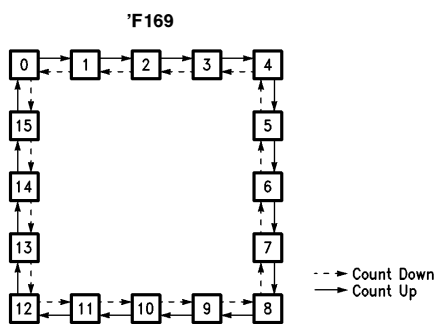
Please note that these diagrams are provided only for the understanding of logic operations and should not be used to estimate propagation delays.

Mode Select Table

PE	CEP	CET	U/D	Action on Rising Clock Edge
L	X	X	X	Load ($P_n \rightarrow Q_n$)
H	L	L	H	Count Up (Increment)
H	L	L	L	Count Down (Decrement)
H	H	X	X	No Change (Hold)
H	X	H	X	No Change (Hold)

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

State Diagram



TL/F/9488-7

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 _{CC} 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 _{CC} = 0V)	
Standard Output	–0.5V to V _{CC}
TRI-STATE® Output	–0.5V to +5.5V

Current Applied to Output in LOW State (Max) twice the rated I_{OL} (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 _{CC}	Conditions
		Min	Typ	Max			
V _{IH}	Input HIGH Voltage	2.0			V		Recognized as a HIGH Signal
V _{IL}	Input LOW Voltage			0.8	V		Recognized as a LOW Signal
V _{CD}	Input Clamp Diode Voltage			–1.2	V	Min	I _{IN} = –18 mA
V _{OH}	Output HIGH Voltage	54F 10% V _{CC} 74F 10% V _{CC} 74F 5% V _{CC}	2.5 2.5 2.7		V	Min	I _{OH} = –1 mA I _{OH} = –1 mA I _{OH} = –1 mA
V _{OL}	Output LOW Voltage	54F 10% V _{CC} 74F 10% V _{CC}		0.5 0.5	V	Min	I _{OL} = 20 mA I _{OL} = 20 mA
I _{IH}	Input HIGH Current	54F 74F		20.0 5.0	μA	Max	V _{IN} = 2.7V
I _{BVI}	Input HIGH Breakdown Test	54F 74F		100 7.0	μA	Max	V _{IN} = 7.0V
I _{CEX}	Output HIGH Leakage Current	54F 74F		250 50	μA	Max	V _{OUT} = V _{CC}
V _{ID}	Input Leakage Test	74F	4.75		V	0.0	I _{ID} = 1.9 μA All Other Pins Grounded
I _{OD}	Output Leakage Circuit Current	74F		3.75	μA	0.0	V _{IOD} = 150 mV All Other Pins Grounded
I _{IL}	Input LOW Current			–0.6 –1.2	mA	Max	V _{IN} = 0.5V (except C _{ET}) V _{IN} = 0.5V (C _{ET})
I _{OS}	Output Short-Circuit Current		–60	–150	mA	Max	V _{OUT} = 0V
I _{CCL}	Power Supply Current		35	52	mA	Max	V _O = LOW

'F169

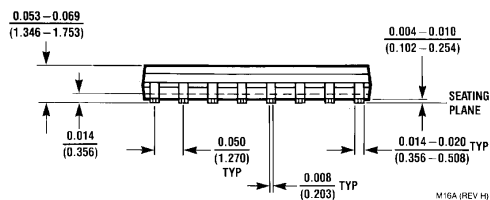
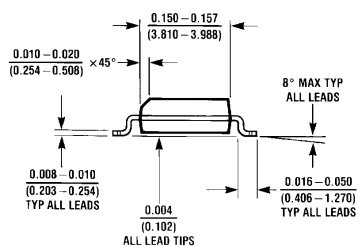
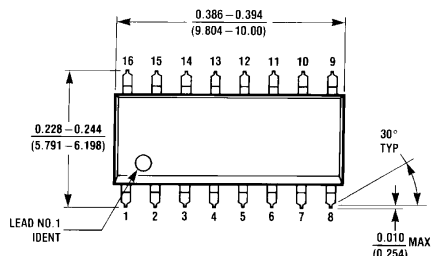
AC Electrical Characteristics

Symbol	Parameter	74F			54F		74F		Units
		T _A = +25°C V _{CC} = +5.0V C _L = 50 pF			T _A , V _{CC} = Mil C _L = 50 pF		T _A , V _{CC} = Com C _L = 50 pF		
		Min	Typ	Max	Min	Max	Min	Max	
f _{max}	Maximum Count Frequency	90			60		70		MHz
t _{PLH} t _{PHL}	Propagation Delay CP to Q _n (\overline{PE} HIGH or LOW)	3.0 4.0	6.5 9.0	8.5 11.5	3.0 4.0	12.0 16.0	3.0 4.0	9.5 13.0	ns
t _{PLH} t _{PHL}	Propagation Delay CP to \overline{TC}	5.5 4.0	12.0 8.5	15.5 12.5	5.5 4.0	20.0 15.0	5.5 4.0	17.5 13.0	ns
t _{PLH} t _{PHL}	Propagation Delay CET to \overline{TC}	2.5 2.5	4.5 8.5	6.5 11.0	2.5 2.5	9.0 12.0	2.5 2.5	7.0 12.0	ns
t _{PLH} t _{PHL}	Propagation Delay U/ \overline{D} to \overline{TC}	3.5 4.0	8.5 8.0	11.5 12.0	3.5 4.0	16.0 14.0	3.5 4.0	12.5 13.0	ns

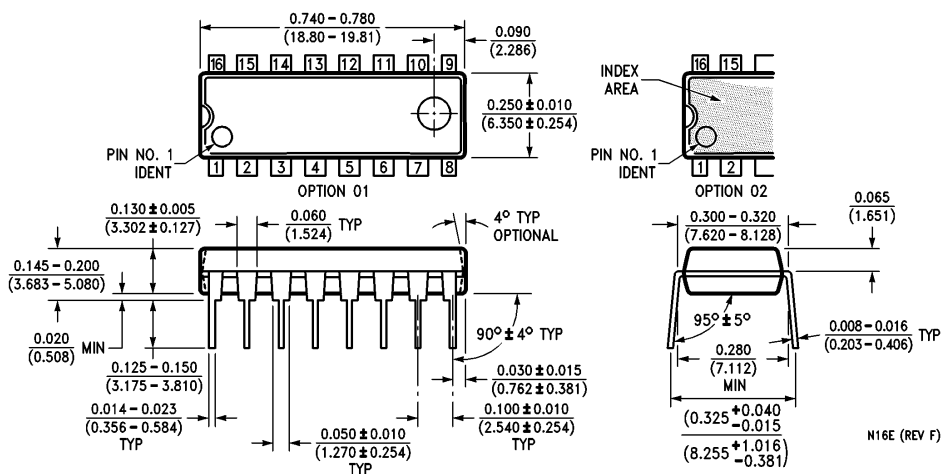
AC Operating Requirements

Symbol	Parameter	74F		54F		74F		Units
		T _A = +25°C V _{CC} = +5.0V		T _A , V _{CC} = Mil		T _A , V _{CC} = Com		
		Min	Max	Min	Max	Min	Max	
t _s (H) t _s (L)	Setup Time, HIGH or LOW P _n to CP	4.0 4.0		4.5 4.5		4.5 4.5		ns
t _h (H) t _h (L)	Hold Time, HIGH or LOW P _n to CP	3.0 3.0		3.5 3.5		3.5 3.5		ns
t _s (H) t _s (L)	Setup Time, HIGH or LOW CEP or CET to CP	7.0 5.0		8.0 8.0		8.0 6.5		ns
t _h (H) t _h (L)	Hold Time, HIGH or LOW \overline{CEP} or \overline{CET} to CP	0 0.5		0 1.0		0 0.5		ns
t _s (H) t _s (L)	Setup Time, HIGH or LOW \overline{PE} to CP	8.0 8.0		10.0 10.0		9.0 9.0		ns
t _h (H) t _h (L)	Hold Time, HIGH or LOW \overline{PE} to CP	1.0 0		1.0 0		1.0 0		ns
t _s (H) t _s (L)	Setup Time, HIGH or LOW U/ \overline{D} to CP	11.0 7.0		14.0 12.0		12.5 8.5		ns
t _h (H) t _h (L)	Hold Time, HIGH or LOW U/ \overline{D} to CP	0 0		0 0		0 0		ns
t _w (H) t _w (L)	CP Pulse Width HIGH or LOW	4.0 7.0		6.0 9.0		4.5 8.0		ns

Physical Dimensions inches (millimeters) (Continued)



16-Lead (0.150" Wide) Molded Small Outline Package, JEDEC (S)
NS Package Number M16A



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

