



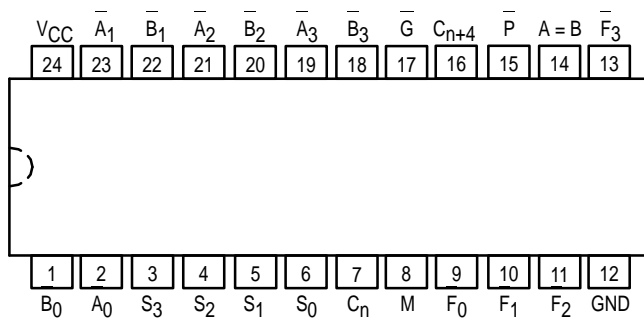
MOTOROLA

4-BIT ARITHMETIC LOGIC UNIT

The MC54/74F181 is a 4-bit Arithmetic Logic Unit (ALU) which can perform all the possible 16 logic operations on two variables and a variety of arithmetic operations. It is 40% faster than the Schottky ALU and only consumes 30% as much power.

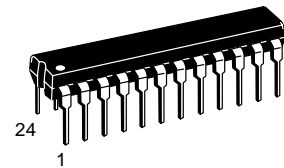
- Provides 16 Arithmetic Operations, ie, Add, Subtract, Compare, Double, Plus Twelve Other Arithmetic Operations
- Provides all 16 Logic Operations of Two Variables, ie, Exclusive-OR, Compare, AND, NAND, OR, NOR, Plus Ten Other Logic Operations
- Full Lookahead for High-Speed Arithmetic Operation on Long Words

CONNECTION DIAGRAM



MC54/74F181

4-BIT ARITHMETIC LOGIC UNIT
FAST™ SCHOTTKY TTL



N SUFFIX
PLASTIC
CASE 724-03

ORDERING INFORMATION

MC54/74FXXXN Plastic

GUARANTEED OPERATING RANGES

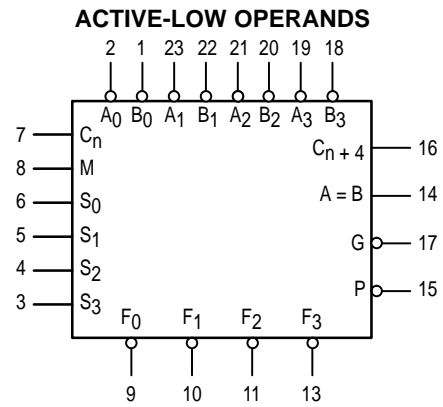
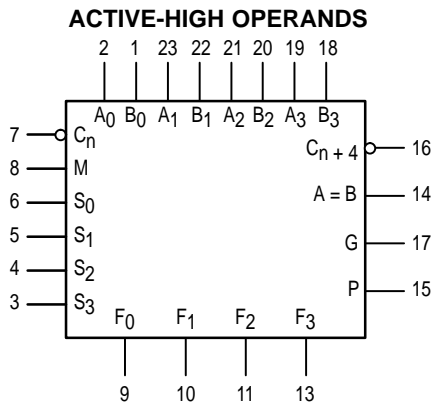
Symbol	Parameter		Min	Typ	Max	Unit
VCC	Supply Voltage	54, 74	4.5	5.0	5.5	V
TA	Operating Ambient Temperature Range	54	-55	25	125	°C
		74	0	25	70	
IOH	Output Current — High	54, 74			-1.0	mA
VOH	Output Voltage — High A = B output	54, 74			5.5	V
IOL	Output Current — Low	54, 74			20	mA

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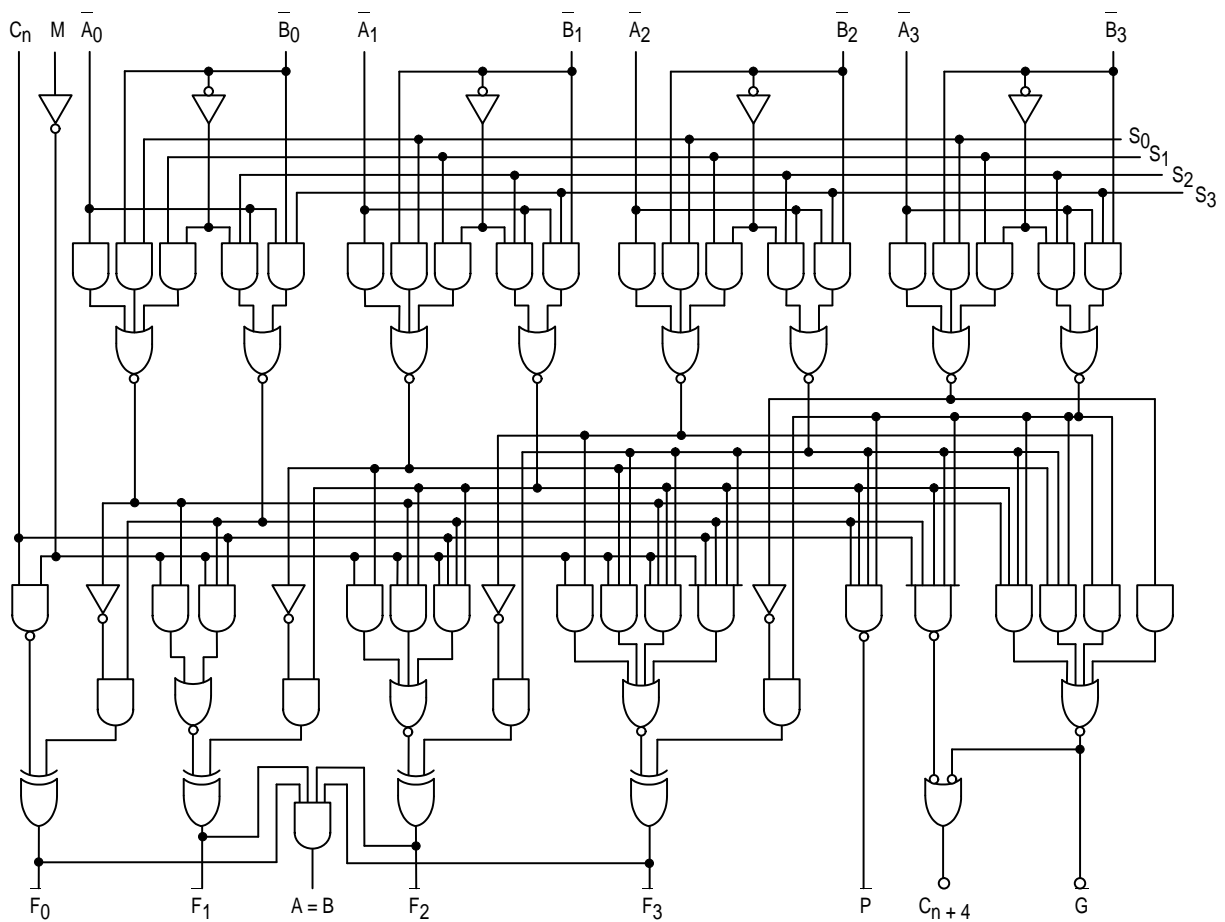
MC54/74F181

LOGIC SYMBOLS



VCC = PIN 24
GND = PIN 12

LOGIC DIAGRAM



MC54/74F181

DC CHARACTERISTICS OVER OPERATING TEMPERATURE RANGE (unless otherwise specified)

Symbol	Parameter	Limits			Unit	Test Conditions	
		Min	Typ	Max			
V _{IH}	Input HIGH Voltage	2.0			V	Guaranteed Input HIGH Voltage	
V _{IL}	Input LOW Voltage			0.8	V	Guaranteed Input LOW Voltage	
V _{IK}	Input Clamp Diode Voltage			-1.2	V	I _{IN} = -18 mA	V _{CC} = MIN
I _{OH}	Output Current — HIGH			250	μA	V _{OH} = 5.5 V	V _{CC} = MIN, A = B
V _{OH}	Output HIGH Voltage	54, 74	2.5	3.4	V	I _{OH} = -1.0 mA	V _{CC} = 4.5 V
		74	2.7	3.4	V	I _{OH} = -1.0 mA	V _{CC} = 4.75 V
V _{OL}	Output LOW Voltage		0.35	0.5	V	I _{OL} = 20 mA	V _{CC} = MIN
I _{IH}	Input HIGH Current			20	μA	V _{IN} = 2.7 V	V _{CC} = MAX
				100	μA	V _{IN} = 7.0 V	
I _{IL}	Input LOW Current	M Input		-0.6	mA	V _{IN} = 0.5 V	V _{CC} = MAX
		A and B Inputs		-1.8	mA		
		S ₀₋₃ Inputs		-2.4	mA		
		C _n Input		-3.0	mA		
I _{OS}	Output Short Circuit Current (Note 2)	-60		-150	mA	V _{OUT} = 0 V	V _{CC} = MAX
I _{CC}	Power Supply Current		43	65	mA	V _{CC} = MAX	

NOTES:

1. For conditions such as MIN or MAX, use the appropriate value specified under guaranteed operating ranges.
2. Not more than one output should be shorted at a time, nor for more than 1 second.

FUNCTIONAL DESCRIPTION

The F181 is a 4-bit high-speed parallel Arithmetic Logic Unit (ALU). Controlled by the four Function Select inputs (S₀–S₃) and the Mode Control input (M), it can perform all the 16 possible logic operations or 16 different arithmetic operations on active-HIGH or active-LOW operands. The Function Table lists these operations.

When the Mode Control input (M) is HIGH, all internal carries are inhibited and the device performs logic operations on the individual bits as listed. When the Mode Control input is LOW, the carries are enabled and the device performs arithmetic operations on the two 4-bit words. The device incorporates full internal carry lookahead and provides for either ripple carry between devices using the C_{n+4} output, or for carry lookahead between packages using the signals P (Carry Propagate) and G (Carry Generate). In the Add mode, P indicates that F is 15 or more, while G indicates that F is 16 or more. In the Subtract mode, P indicates that F is zero or less, while G indicates that F is less than zero. P and G are not affected by carry in. When speed requirements are not stringent, it can be used in a simple Ripple Carry mode by connecting the Carry output (C_{n+4}) signal to the Carry input (C_n) of the next unit. For high-speed operation the device is used in conjunction with a carry lookahead circuit. One carry lookahead package is re-

quired for each group of four F181 devices. Carry lookahead can be provided at various levels and offers high-speed capability over extremely long word lengths.

The A = B output from the device goes HIGH when all four F outputs are HIGH and can be used to indicate logic equivalence over four bits when the unit is in the Subtract mode. The A = B output is open collector and can be wired-AND with other A = B outputs to give a comparison for more than four bits. The A = B signal can be used with the C_{n+4} signal to indicate A > B and A < B.

The Function Table lists the arithmetic operations that are performed without a carry in. An incoming carry adds a one to each operation. Thus, select code LHHL generates A minus B minus 1 (2s complement notation) without a carry in and generates A minus B when a carry is applied. Because subtraction is actually performed by complementary addition (1s complement), a carry out means borrow; thus a carry is generated when there is no underflow and no carry is generated when there is underflow. As indicated, this device can be used with either active-LOW inputs producing active-LOW outputs or with active-HIGH inputs producing active-HIGH outputs. For either case the table lists the operations that are performed to the operands labeled inside the logic symbol.

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AC CHARACTERISTICS

Symbol	Path	Parameter	Mode	54/74F		54F		74F		Unit
				$T_A = +25^\circ\text{C}$ $V_{CC} = +5.0\text{ V}$ $C_L = 50\text{ pF}$		$T_A = -55\text{ to }+125^\circ\text{C}$ $V_{CC} = 5.0\text{ V } \pm 10\%$ $C_L = 50\text{ pF}$		$T_A = 0\text{ to }+70^\circ\text{C}$ $V_{CC} = 5.0\text{ V } \pm 10\%$ $C_L = 50\text{ pF}$		
				Min	Max	Min	Max	Min	Max	
t_{PLH} t_{PHL}	C_n to C_{n+4}			3.0 3.0	8.5 8.0	3.0 3.0	10.5 10	3.0 3.0	9.5 9.0	ns
t_{PLH} t_{PHL}	A or B to C_{n+4}		Sum	5.0 5.0	13 12	5.0 5.0	15 14	5.0 5.0	14 13	ns
t_{PLH} t_{PHL}	A or B to C_{n+4}		Dif	5.0 5.0	14 13	5.0 5.0	16 15	5.0 5.0	15 14	ns
t_{PLH} t_{PHL}	C_n to F		Any	3.0 3.0	8.5 8.5	3.0 3.0	10.5 10.5	3.0 3.0	9.5 9.5	ns
t_{PLH} t_{PHL}	A or B to G		Sum	3.0 3.0	7.5 7.5	3.0 3.0	9.5 9.5	3.0 3.0	8.5 8.5	ns
t_{PLH} t_{PHL}	A or B to G		Dif	3.0 3.0	8.5 9.5	3.0 3.0	10.5 11.5	3.0 3.0	9.5 10.5	ns
t_{PLH} t_{PHL}	A or B to P		Sum	3.0 3.0	7.0 7.5	3.0 3.0	9.0 9.5	3.0 3.0	8.0 8.5	ns
t_{PLH} t_{PHL}	A or B to P		Dif	4.0 3.5	7.5 8.5	4.0 3.5	9.5 10.5	4.0 3.5	8.5 9.5	ns
t_{PLH} t_{PHL}	A_i or B_i to F_i		Sum	3.0 3.0	9.0 10	3.0 3.0	11 11	3.0 3.0	10 10	ns
t_{PLH} t_{PHL}	A_i or B_i to F_i		Dif	3.0 3.0	11 11	3.0 3.0	13 13	3.0 3.0	12 12	ns
t_{PLH} t_{PHL}	Any A or B to Any F		Sum	4.0 4.0	10.5 10	4.0 4.0	12.5 12	4.0 4.0	11.5 11	ns
t_{PLH} t_{PHL}	Any A or B to Any F		Dif	4.5 4.5	12 12	4.5 4.5	14 14	4.5 4.5	13 13	ns
t_{PLH} t_{PHL}	A or B to F		Logic	4.0 4.0	9.0 10	4.0 4.0	11 12	4.0 4.0	10 11	ns
t_{PLH} t_{PHL}	A or B to A = B		Dif	11 7.0	27 12.5	11 7.0	31 14.5	11 7.0	29 13.5	ns

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FUNCTION TABLE

Mode Select Inputs				Active-LOW Operands & F _n Outputs		Active-HIGH Operands & F _n Outputs	
S ₃	S ₂	S ₁	S ₀	Logic (M = H)	Arithmetic** (M = L) (C _n = L)	Logic (M = H)	Arithmetic** (M = L) (C _n = H)
L	L	L	L	\overline{A}	A minus 1	\overline{A}	A
L	L	L	H	\overline{AB}	\overline{AB} minus 1	$\overline{A + B}$	A + \overline{B}
L	L	H	L	A + B	AB minus 1	AB	A + B
L	L	H	H	Logic 1	minus 1	Logic 0	minus 1
L	H	L	L	$\overline{A + B}$	A plus (A + \overline{B})	\overline{AB}	A plus \overline{AB}
L	H	L	H	\overline{B}	AB plus (A + B)	\overline{B}	(A + B) plus \overline{AB}
L	H	H	L	$A \oplus \overline{B}$	A minus B minus 1	$A \oplus B$	A minus B minus 1
L	H	H	H	A + B	A + B	AB	AB minus 1
H	L	L	L	\overline{AB}	A plus (A + B)	$\overline{A + B}$	A plus AB
H	L	L	H	$A \oplus B$	A plus B	$A \oplus B$	A plus \overline{B}
H	L	H	L	B	AB plus (A + B)	B	(A + B) plus AB
H	L	H	H	A + B	A + B	AB	AB minus 1
H	H	L	L	Logic 0	A plus A*	Logic 1	A plus A*
H	H	L	H	AB	\overline{AB} plus A	A + B	(A + B) plus A
H	H	H	L	AB	AB minus A	A + B	(A + B) plus A
H	H	H	H	A	A	A	A minus 1

*Each bit is shifted to the next more significant position.

H = HIGH Voltage Level

**Arithmetic operations expressed in 2s complement notation.

L = LOW Voltage Level


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