

Experiment No - 9

Aim → The objective of the experiment is to fully understand the functionality of 4-bit Arithmetic Logic Units using 74181 which has 4 select inputs and one mode control input.

Theory →

Arithmetic Logic Units → The 4 bit Arithmetic logic units perform 16 different

Arithmetic operation and 16 different logical operation.

This Arithmetic Logic Units controlled by 4 select inputs and one mode control input.

Pin Description description of 74181 (4 bit ALU) →

Pin No.	Symbol	Name and Function
1, 22, 20, 18	\bar{B}_0 to \bar{B}_3	operand inputs (active LOW)
2, 23, 21, 19	\bar{A}_0 to \bar{A}_3	operand inputs (active LOW)
6, 5, 4, 3	S_0 to S_3	select inputs
7	C_n	carry inputs
8	M	mode control input
9, 10, 11, 13	\bar{F}_0 to \bar{F}_3	function outputs (active LOW)
12	GND	ground (0V)
14	$A=B$	comparator output
15	\bar{P}	carry propagate output (active LOW)
16	C_{n+4}	carry output
17	\bar{C}_4	carry generate output (active LOW)
24	V_{CC}	positive supply voltage.

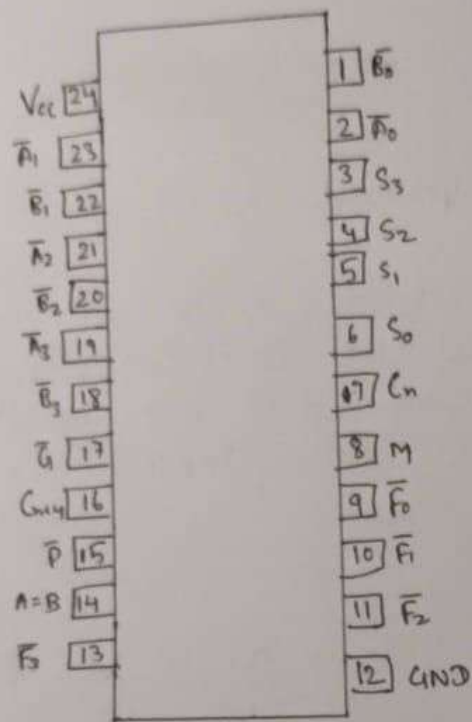


Fig-1→ Pin configuration of 74181 (4 bit Arithmetic Logic Unit)

Functionality → When the mode control input (M) is high, all internal carries are disabled and device performs logical operation on individual bits as listed. When M is low, carries are enabled allowing the device to perform arithmetic operations on two four-bit words. It features full internal lookahead and supports either ripple carry using the Cn+4 output or carry lookahead between packages with signals P (Carry Propagate) and G (Carry Generate), which are unaffected by carry in. For lower speed requirements a high speed operation the device pairs with a 182 carry lookahead circuit requiring one circuit for each group of four 181 devices.

The A=B output goes high when all four outputs are high, indicating logical equivalence in subtract mode. This open collector output can be wired AND with others for multi-bit comparison. The A=B signal, in conjunction with Cn+4, indicates $A < B$ and $A > B$.

The function table outlines arithmetic operation without a carry in; an incoming carry adds one. For example, LHS yields A minus B minus 1 (2's complement) without a carry and A minus B with a carry. A carry out means no underflow, while no carry indicates underflow. The device supports both active low and active high inputs/outputs as detailed in the operation table.

MODE SELECT INPUTS				ACTIVE HIGH INPUTS AND OUTPUTS	
S_3	S_2	S_1	S_0	LOGIC ($M=H$)	ARITHMETIC ($M=L$); ($n=H$)
L	L	L	L	\bar{A}	A
L	L	L	H	$\overline{A+B}$	$A+B$
L	L	H	L	$\bar{A}B$	$A+B$
L	L	H	H	logical 0	minus 1
L	H	L	L	$\overline{A+B}$	
L	H	L	L	$\bar{A}B$	A plus $\bar{A}B$
L	H	L	H	$\overline{A+B}$ \bar{B}	$(A+B)$ plus $\bar{A}B$
L	H	H	L	$\overline{A+B}$	A minus B minus 1
L	H	H	H	$\bar{A}B$	$\bar{A}B$ minus 1
H	L	L	L	$\bar{A} \oplus \bar{B}$	A plus $\bar{A}B$
H	L	L	H	$B \bar{A} \oplus \bar{B}$	A plus B
H	L	H	L	$\bar{A}B$	$(A+\bar{B})$ plus $\bar{A}B$
H	L	H	H	logical 1 $\bar{A}B$	$\bar{A}B$ minus 1
H	H	L	L	$\bar{A}B$ logical 1	A plus $A^{(1)}$
H	H	L	H	$A+\bar{B}$	$(A+B)$ plus A
H	H	H	L	$A+B$	$(A+\bar{B})$ plus A
H	H	H	H	A	A minus 1