Am25LS15

Quad Serial Adder/Subtractor

DISTINCTIVE CHARACTERISTICS

- Four independent adder/subtractors
- Use with two's complement arithmetic
- Magnitude only addition/subtraction
- Second sourced by T.I. as Am54LS/74LS385

GENERAL DESCRIPTION

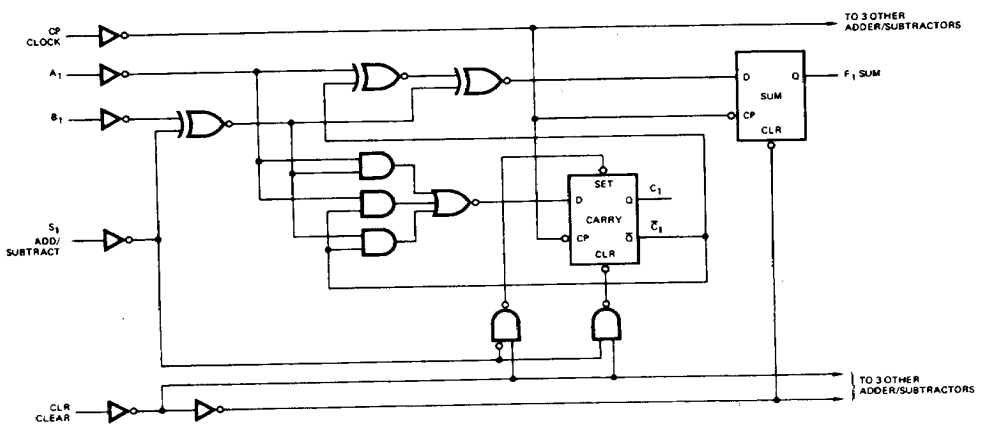
The Am25LS15 is a serial two's complement adder/subtractor designed for use in association with the Am25LS14 serial/parallel two's complement multiplier. This device can also be used for magnitude only or one's complement addition or subtraction.

Four independent adder/subtractors are provided with common clock and clear inputs. The add function is A plus B and the subtract function is A minus B. The clear function sets the internal carry function to logic zero in the add mode and to logic one in subtract mode. This least significant carry is self propagating in the subtract mode as long as zeroes are applied to the A and B inputs at the LSB's. All internal flip-flops change state on the LOW-to-HIGH clock transition.

The Am25LS15 is particularly useful for recursive or non-recursive digital filtering or butterfly networks in Fast Fourier Transforms.

BLOCK DIAGRAM

(One of Four Similar Functions)



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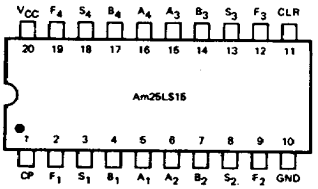
CONNECTION DIAGRAM
Top View



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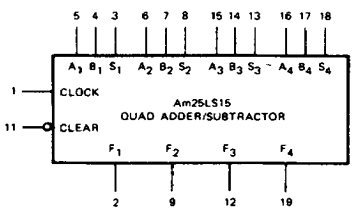
Note: Pin 1 is marked for orientation

LOGIC SYMBOL



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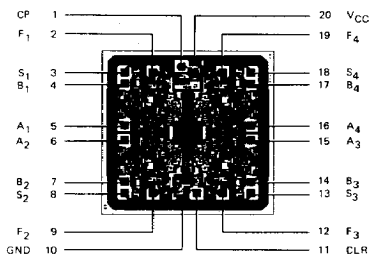
METALLIZATION AND PAD LAYOUT



DIE SIZE 0.095" x 0.095"

ORDERING INFORMATION

AMD products are available in several packages and operating ranges. The order number is formed by a combination of the following: Device number, speed option (if applicable), package type, operating range and screening option (if desired).

Am25LS15 **D** **C** **B**

- **B** — Screening Option
  - Blank – Standard processing
  - B – Burn-in
- **C** — Temperature (See Operating Range)
  - C – Commercial (0°C to +70°C)
  - M – Military (–55°C to +125°C)
- **D** — Package
  - D – 20-pin CERDIP
  - F – 20-pin flatpak
  - P – 20-pin plastic DIP
  - X – Dice
- **Am25LS15** — Device type
  - Quad Serial Adder/Subtractor

Valid Combinations	
Am25LS15	PC DC, DM FM XC, XM

Valid Combinations

Consult the AMD sales office in your area to determine if a device is currently available in the combination you wish.

PIN DESCRIPTION

Pin No.	Name	I/O	Description
5,6,15,16	A_1, A_2, A_3, A_4	I	The "A" input into each adder/subtractor.
4,7,14,17	B_1, B_2, B_3, B_4	I	The "B" input into each adder/subtractor.
3,8,13,18	S_1, S_2, S_3, S_4	I	The add subtract control for each adder/subtractor. When S is LOW, the F function is A + B. When S is HIGH, the F function is A – B.
2,9,12,19	F_1, F_2, F_3, F_4	O	The four independent serial outputs of the adder/subtractor.
1	CP Clock	I	The clock input for the device. All internal flip-flops change state on the LOW-to-HIGH transition.
11	CLR Clear	I	When the clear input is LOW, the four independent adder/subtractors are asynchronously reset. The sum flip-flop is always set to logic "0". The carry flip-flop is set to logic "0" in the add mode and logic "1" in the subtract mode.

FUNCTION TABLE

External Inputs					Internal Point		Output	
CP	CLR	S	A	B	C	C_1	F	Function
X	L	L	X	X	L	L	L	Clear
X	L	H	X	X	H	H	L	
L	H	X	X	X	NC	NC	NC	
H	H	X	X	X	NC	NC	NC	
↑	H	L	L	L	L	L	L	Add
↑	H	L	L	L	H	L	H	
↑	H	L	L	H	L	L	H	
↑	H	L	L	H	H	H	L	
↑	H	L	H	L	L	L	H	
↑	H	L	H	L	H	H	L	
↑	H	L	H	H	L	H	L	
↑	H	L	H	H	H	H	H	
↑	H	H	L	L	L	L	H	Subtract
↑	H	H	L	L	H	H	L	
↑	H	H	L	H	L	L	L	
↑	H	H	L	H	H	L	H	
↑	H	H	H	L	L	H	L	
↑	H	H	H	L	H	H	H	
↑	H	H	H	H	L	L	H	
↑	H	H	H	H	H	H	L	

C = Data in the Carry Flip-Flop Before the Clock Transition
C_l = Data in the Carry Flip-Flop After the Clock
X = Don't Care
NC = No Change
H = HIGH
L = LOW
↑ = LOW-to-HIGH Transition

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Refer to Page 13-1 for Essential Information on Military Devices

APPLICATIONS

The normal butterfly network associated with the Cooley-Tukey Fast Fourier Transform (FFT) algorithm is shown below. Here we assume A, B, C, D and W are all complex numbers such that:

$A = A_R + jA_I$

$B = B_R + jB_I$

$W = W_R + jW_I$

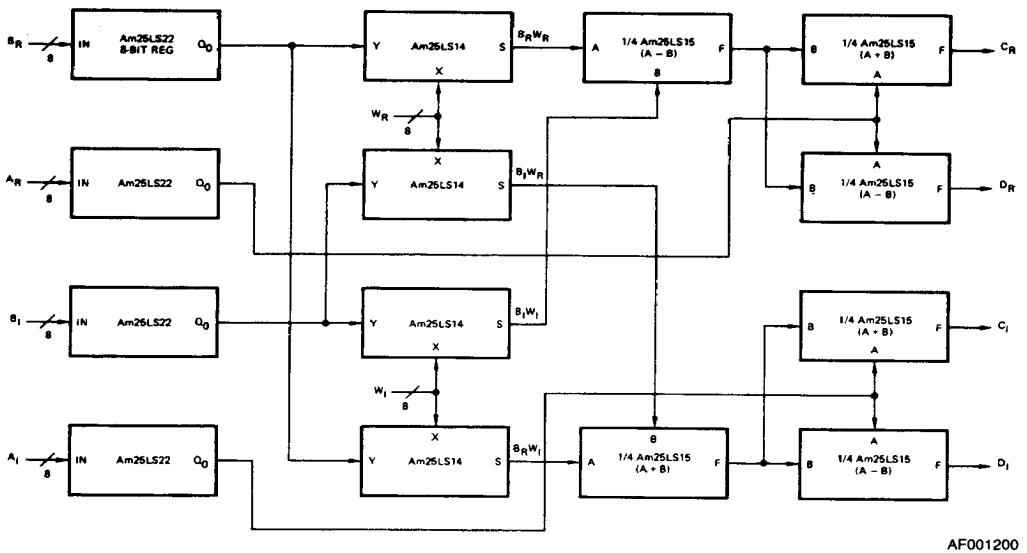
The outputs C and D are also complex numbers and are evaluated as:

$C = C_R + jC_I = (A_R + B_RW_R - B_IW_I) + j(A_I + B_RW_I + B_IW_R)$

$D = C_R + jD_I = (A_R - B_RW_R + B_IW_I) + j(A_I - B_RW_I - B_IW_R)$

The four multiplications can be implemented using four Am25LS14 serial-parallel multipliers (the appropriate number of bits must, of course, be used). The additions and the subtractions are implemented using the Am25LS15 quad serial adder/subtractors. This diagram depicts only the basic data flow; binary weighting of the numbers, rounding, truncation, etc. must be handled as required by the individual design parameters.

FAST FOURIER TRANSFORM (FFT) BUTTERFLY



An FFT butterfly connection for complex arithmetic inputs and outputs.

ABSOLUTE MAXIMUM RATINGS

Storage Temperature ..... −65°C to +150°C
(Ambient) Temperature Under Bias ..... −55°C to +125°C
Supply Voltage to Ground Potential
Continuous ..... −0.5V to +7.0V
DC Voltage Applied to Outputs For
HIGH Output State ..... −0.5V to +V_{CC} max
DC Input Voltage ..... −0.5V to +7.0V
DC Output Current, Into Outputs 30mA
DC Input Current ..... −30mA to +5.0mA

Stresses above those listed under ABSOLUTE MAXIMUM RATINGS may cause permanent device failure. Functionality at or above these limits is not implied. Exposure to absolute maximum ratings for extended periods may affect device reliability.

OPERATING RANGES

Commercial (C) Devices
Temperature ..... 0°C to +70°C
Supply Voltage ..... +4.75V to +5.25V

Military (M) Devices
Temperature ..... −55°C to +125°C
Supply Voltage ..... +4.5V to +5.5V

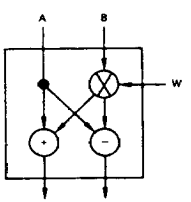
Operating ranges define those limits over which the functionality of the device is guaranteed.

DC CHARACTERISTICS over operating range unless otherwise specified

Parameters	Description	Test Conditions (Note 2)		Min	Typ (Note 1)	Max	Units
V_{OH}	Output HIGH Voltage	V_{CC} = MIN., I_{OH} = −440μA, V_{IN} = V_{IH} or V_{IL}	MIL	2.5			Volts
			COM'L	2.7			
V_{OL}	Output LOW Voltage	V_{CC}=MIN., V_{IN} = V_{IH} or V_{IL}	I_{OL} = 4.0mA			0.4	Volts
			I_{OL} = 8.0mA			0.45	
V_{IH}	Input HIGH Level	Guaranteed input logical HIGH voltage for all inputs		2.0			Volts
V_{IL}	Input LOW Level	Guaranteed input logical LOW voltage for all inputs	MIL			0.7	Volts
			COM'L			0.8	
V_I	Input Clamp Voltage	V_{CC} = MIN., I_{IN} = −18mA				−1.5	Volts
I_{IL}	Input LOW Current	V_{CC} = MAX., V_{IN} = 0.4V				−0.36	mA
I_{IH}	Input HIGH Current	V_{CC} = MAX., V_{IN} = 2.7V				20	μA
I_I	Input HIGH Current	V_{CC} = MAX., V_{IN} = 7.0V				0.1	mA
I_{SC}	Output Short Circuit Current (Note 3)	V_{CC} = MAX.		−15		−85	mA
I_{CC}	Power Supply Current (Note 4)	V_{CC} = MAX.			48	75	mA

Notes: 1. Typical limits are at V_{CC} = 5.0V, 25°C ambient and maximum loading.
2. For conditions shown as MIN or MAX, use the appropriate value specified under Operating Ranges for the applicable device type.
3. Not more than one output should be shorted at a time. Duration of the short circuit test should not exceed one second.
4. All inputs HIGH, measured after a LOW-to-HIGH clock transmission.

Functional Diagram for FFT Butterfly Connection



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SWITCHING CHARACTERISTICS (T_A = +25°C, V_{CC} = 5.0V)

Parameters	Description		Test Conditions	Min	Typ	Max	Units
t_{PLH}	Clock to Output		C_L = 15pF, R_L = 2.0kΩ		14	22	ns
t_{PHL}					14	22	
t_{PHL}	Clear to Output				20	30	ns
t_s	A, B, S			10			ns
t_h				0			
t_s	Clear Recovery			25			ns
t_h	Clear Hold Time			0			ns
t_{pw}	Clock	HIGH		17			ns
		LOW		17			
t_{pw}	Clear LOW			20			ns
f_{max} (Note 1)	Maximum Clock Frequency			30	40		MHz

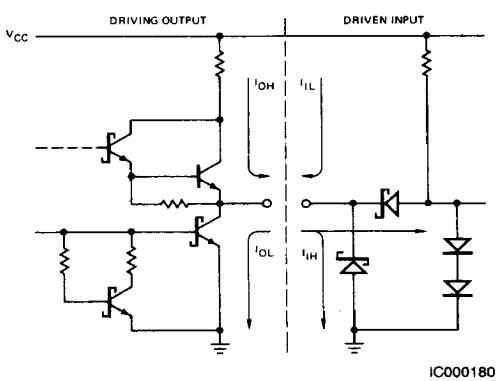
Note 1. Per industry convention, f_{max} is the worst case value of the maximum device operating frequency with no constraints on the t_r, t_f, pulse width or duty cycle.

SWITCHING CHARACTERISTICS over operating range unless otherwise specified*

Parameters	Description		Test Conditions	COMMERCIAL Am25LS		MILITARY Am25LS		Units
				Min	Max	Min	Max	
t_{PLH}	Clock to Output		C_L = 50pF, R_L = 2.0kΩ		33		38	ns
t_{PHL}					33		38	
t_{PHL}	Clear to Output				43		50	ns
t_s	A, B, S			17		20		ns
t_h				4		5		
t_s	Clear Recovery			37		42		ns
t_h	Clear Hold Time			4		5		ns
t_{pw}	Clock	HIGH		26		30		ns
		LOW		26		30		
t_{pw}	Clear LOW			30		35		ns
f_{max} (Note 1)	Maximum Clock Frequency			23		20		MHz

*AC performance over the operating temperature range is guaranteed by testing defined in Group A, Subgroup 9.

Am25LS • Am54LS/74LS
LOW-POWER SCHOTTKY INPUT/OUTPUT CURRENT INTERFACE CONDITIONS



Note: Actual current flow direction shown.

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Refer to Page 13-1 for Essential Information on Military Devices