

FEATURES

- ❑ 25 ns Worst-Case Multiply Time
- ❑ Low Power CMOS Technology
- ❑ Replaces TRW MPY112K
- ❑ Two's Complement or Unsigned Operands
- ❑ Three-State Outputs
- ❑ Available 100% Screened to MIL-STD-883, Class B
- ❑ Package Styles Available:
 - 48-pin Plastic DIP
 - 48-pin Sidebrazed, Hermetic DIP
 - 52-pin Plastic LCC, J-Lead

DESCRIPTION

The LMU112 is a high-speed, low power 12-bit parallel multiplier built using advanced CMOS technology. The LMU112 is pin and functionally compatible with TRW's MPY112K.

The A and B input operands are loaded into their respective registers on the rising edge of the separate clock inputs (CLK A and CLK B). Two's complement or unsigned magnitude operands are accommodated via the operand control bit (TC).

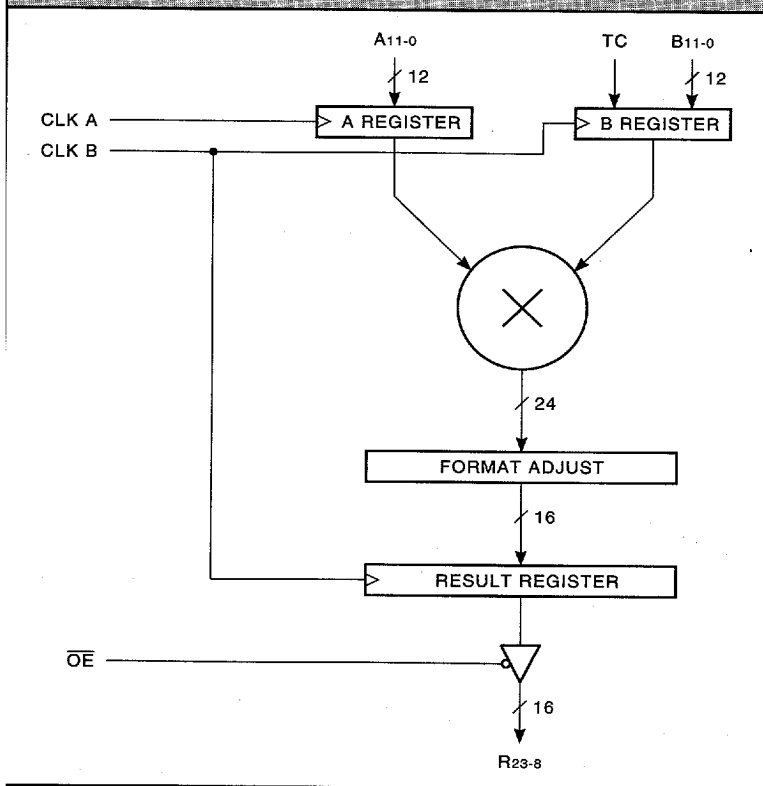
which is loaded along with the B operands. The operands are specified to be in two's complement format when TC is asserted and unsigned magnitude when TC is deasserted. Mixed mode operation is not allowed.

For two's complement operands, the 17 most significant bits at the output of the asynchronous multiplier array are shifted one bit position to the left. This is done to discard the redundant copy of the sign-bit, which is in the most significant bit position, and extend the bit precision by one bit. The result is then truncated to the 16 MSB's and loaded into the output register on the rising edge of CLK B.

The contents of the output register are made available via three-state buffers by asserting \overline{OE} . When \overline{OE} is deasserted, the outputs (R23-8) are in the high impedance state.

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LMU112 BLOCK DIAGRAM



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FIGURE 1A. INPUT FORMATS

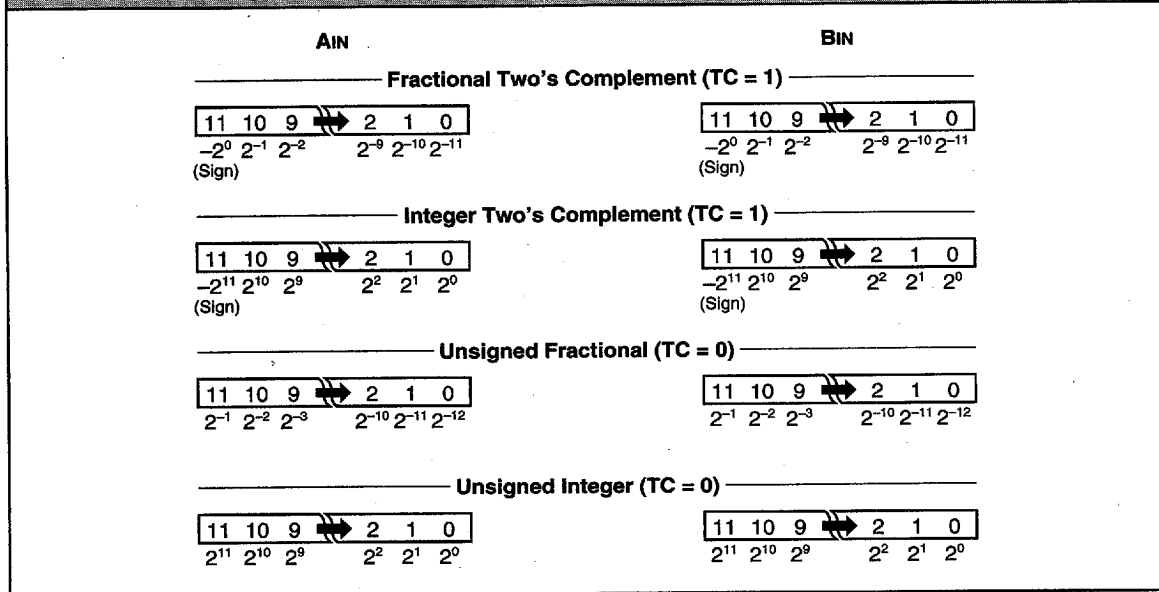
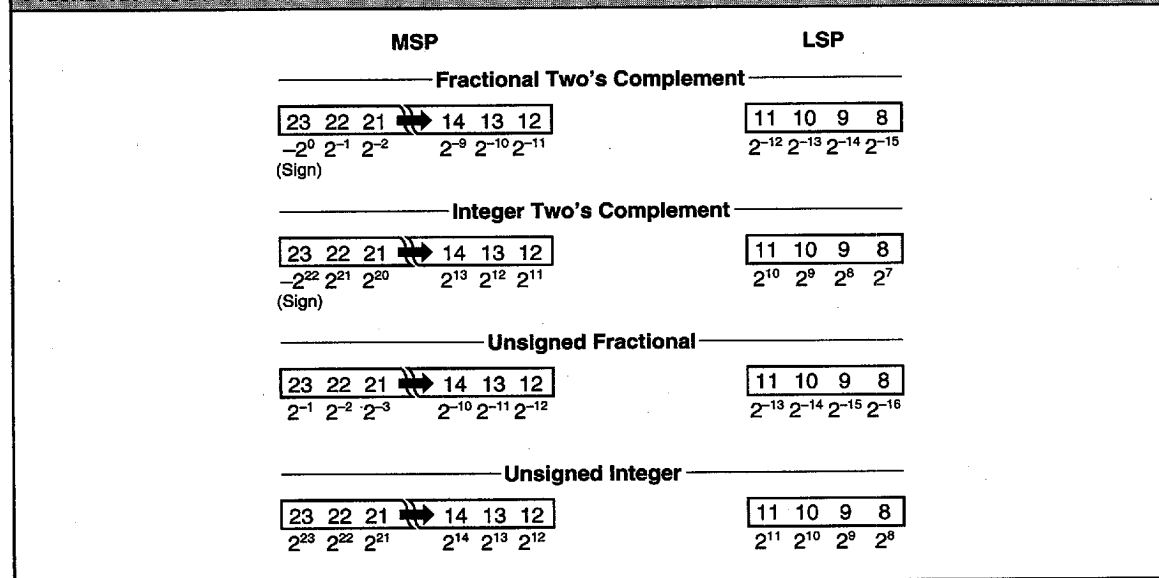


FIGURE 1B. OUTPUT FORMATS



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12 x 12-bit Parallel Multiplier

MAXIMUM RATINGS Above which useful life may be impaired (Notes 1, 2, 3, 8)

Storage temperature	-65°C to +150°C
Operating ambient temperature	-55°C to +125°C
V _{CC} supply voltage with respect to ground	-0.5 V to +7.0 V
Input signal with respect to ground	-3.0 V to +7.0 V
Signal applied to high impedance output	-3.0 V to +7.0 V
Output current into low outputs	25 mA
Latchup current	> 400 mA

OPERATING CONDITIONS To meet specified electrical and switching characteristics

Mode	Temperature Range (Ambient)	Supply Voltage
Active Operation, Commercial	0°C to +70°C	4.75 V ≤ V _{CC} ≤ 5.25 V
Active Operation, Military	-55°C to +125°C	4.50 V ≤ V _{CC} ≤ 5.50 V

ELECTRICAL CHARACTERISTICS Over Operating Conditions (Note 4)

Symbol	Parameter	Test Condition	Min	Typ	Max	Unit
V _{OH}	Output High Voltage	V _{CC} = Min., I _{OH} = -2.0 mA	2.4			V
V _{OL}	Output Low Voltage	V _{CC} = Min., I _{OL} = 8.0 mA			0.5	V
V _{IH}	Input High Voltage		2.0		V _{CC}	V
V _{IL}	Input Low Voltage	(Note 3)	0.0		0.8	V
I _{Ix}	Input Current	Ground ≤ V _{IN} ≤ V _{CC} (Note 12)			±20	μA
I _{OZ}	Output Leakage Current	Ground ≤ V _{OUT} ≤ V _{CC} (Note 12)			±20	μA
I _{CC1}	V _{CC} Current, Dynamic	(Notes 5, 6)		10	20	mA
I _{CC2}	V _{CC} Current, Quiescent	(Note 7)			1.0	mA

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SWITCHING CHARACTERISTICS

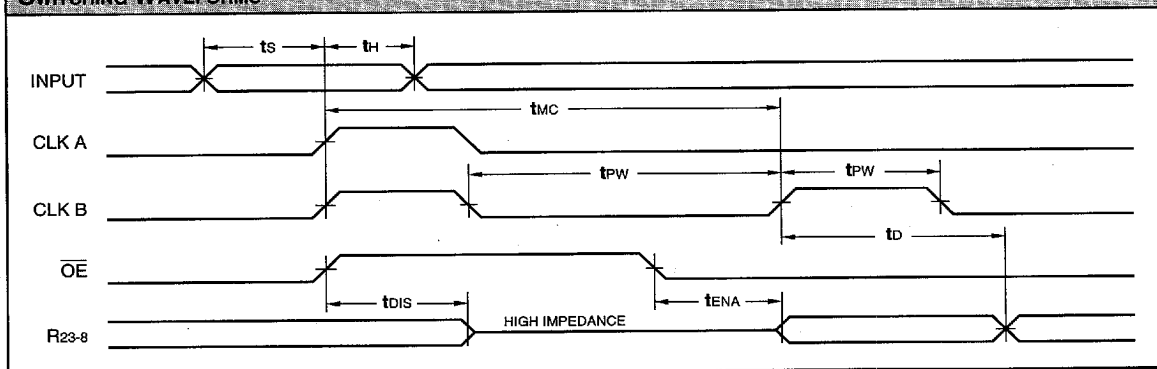
COMMERCIAL OPERATING RANGE (0°C to +70°C) Notes 9, 10 (ns)

Symbol Parameter		LMU112-					
		60		50		25	
		Min	Max	Min	Max	Min	Max
t _{MC}	Clocked Multiply Time		60		50		25
t _{PW}	Clock Pulse Width	15		15		10	
t _S	Input Register Setup Time	15		15		10	
t _H	Input Register Hold Time	3		3		1	
t _D	Output Delay		25		25		20
t _{ENA}	Three-State Output Enable Delay (Note 11)		25		25		20
t _{DIS}	Three-State Output Disable Delay (Note 11)		25		25		20

MILITARY OPERATING RANGE (-55°C to +125°C) Notes 9, 10 (ns)

Symbol Parameter		LMU112-					
		65		55		30	
		Min	Max	Min	Max	Min	Max
t _{MC}	Clocked Multiply Time		65		55		30
t _{PW}	Clock Pulse Width	20		20		12	
t _S	Input Register Setup Time	15		15		12	
t _H	Input Register Hold Time	3		3		3	
t _D	Output Delay		30		30		25
t _{ENA}	Three-State Output Enable Delay (Note 11)		30		30		25
t _{DIS}	Three-State Output Disable Delay (Note 11)		30		30		25

SWITCHING WAVEFORMS



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NOTES

1. Maximum Ratings indicate stress specifications only. Functional operation of these products at values beyond those indicated in the Operating Conditions table is not implied. Exposure to maximum rating conditions for extended periods may affect reliability.

2. The products described by this specification include internal circuitry designed to protect the chip from damaging substrate injection currents and accumulations of static charge. Nevertheless, conventional precautions should be observed during storage, handling, and use of these circuits in order to avoid exposure to excessive electrical stress values.

3. This device provides hard clamping of transient undershoot and overshoot. Input levels below ground or above VCC will be clamped beginning at -0.6 V and VCC + 0.6 V. The device can withstand indefinite operation with inputs in the range of -0.5 V to +7.0 V. Device operation will not be adversely affected, however, input current levels will be well in excess of 100 mA.

4. Actual test conditions may vary from those designated but operation is guaranteed as specified.

5. Supply current for a given application can be accurately approximated by:

$$NCV2F$$

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where

N = total number of device outputs

C = capacitive load per output

V = supply voltage

F = clock frequency

6. Tested with all outputs changing every cycle and no load, at a 5 MHz clock rate.

7. Tested with all inputs within 0.1 V of VCC or Ground, no load.

8. These parameters are guaranteed but not 100% tested.

9. AC specifications are tested with input transition times less than 3 ns, output reference levels of 1.5 V (except tDIS test), and input levels of nominally 0 to 3.0 V. Output loading may be a resistive divider which provides for specified IOH and IOL at an output voltage of VOH min and VOL max respectively. Alternatively, a diode bridge with upper and lower current sources of IOH and IOL respectively, and a balancing voltage of 1.5 V may be used. Parasitic capacitance is 30 pF minimum, and may be distributed.

This device has high-speed outputs capable of large instantaneous current pulses and fast turn-on/turn-off times. As a result, care must be exercised in the testing of this device. The following measures are recommended:

a. A 0.1 μ F ceramic capacitor should be installed between VCC and Ground leads as close to the Device Under Test (DUT) as possible. Similar capacitors should be installed between device VCC and the tester common, and device ground and tester common.

b. Ground and VCC supply planes must be brought directly to the DUT socket or contactor fingers.

c. Input voltages should be adjusted to compensate for inductive ground and VCC noise to maintain required DUT input levels relative to the DUT ground pin.

10. Each parameter is shown as a minimum or maximum value. Input requirements are specified from the point of view of the external system driving the chip. Setup time, for example, is specified as a minimum since the external system must supply at least that much time to meet the worst-case requirements of all parts. Responses from the internal circuitry are specified from the point of view of the device. Output delay, for example, is specified as a maximum since worst-case operation of any device always provides data within that time.

11. For the tENA test, the transition is measured to the 1.5 V crossing point with datasheet loads. For the tDIS test, the transition is measured to the ± 200 mV level from the measured steady-state output voltage with ± 10 mA loads. The balancing voltage, VTH, is set at 3.5 V for Z-to-0 and 0-to-Z tests, and set at 0 V for Z-to-1 and 1-to-Z tests.

12. These parameters are only tested at the high temperature extreme, which is the worst case for leakage current.

FIGURE A. OUTPUT LOADING CIRCUIT

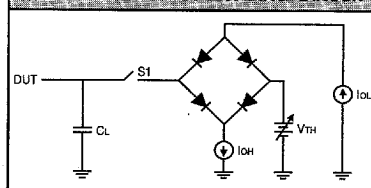
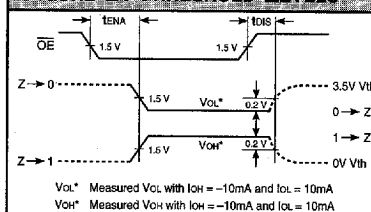


FIGURE B. THRESHOLD LEVELS



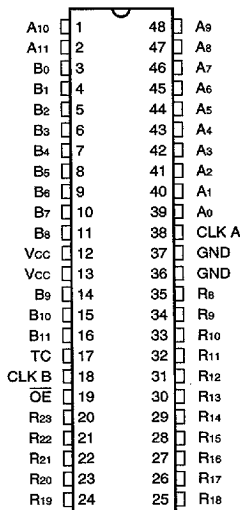
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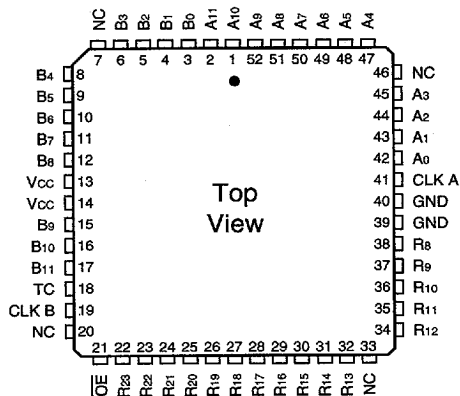
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ORDERING INFORMATION

48-pin



52-pin



Speed	Plastic DIP (P5)	Sidebrazed Hermetic DIP (D5)	Plastic J-Lead Chip Carrier (J5)
0°C to +70°C — COMMERCIAL SCREENING			
60 ns	LMU112PC60	LMU112DC60	LMU112JC60
50 ns	LMU112PC50	LMU112DC50	LMU112JC50
25 ns	LMU112PC25	LMU112DC25	LMU112JC25
-55°C to +125°C — COMMERCIAL SCREENING			
65 ns		LMU112DM65	
55 ns		LMU112DM55	
30 ns		LMU112DM30	
-55°C to +125°C — MIL-STD-883 COMPLIANT			
65 ns		LMU112DMB65	
55 ns		LMU112DMB55	
30 ns		LMU112DMB30	

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