

Division

		<u>1001</u> _{ten}	Quotient
Divisor	1000 _{ten}	1001010 _{ten}	Dividend
		<u>-1000</u>	
		10	
		101	
		1010	
		<u>-1000</u>	
		10 _{ten}	Remainder

At every step,

- shift divisor right and compare it with current dividend
- if divisor is larger, shift 0 as the next bit of the quotient
- if divisor is smaller, subtract to get new dividend and shift 1 as the next bit of the quotient

Division

		1001 _{ten}		Quotient
Divisor	1000 _{ten}	1001010 _{ten}		Dividend
	0001001010	0001001010	0000001010	0000001010
	100000000000 →	0001000000 →	0000100000 →	0000001000
Quo: 0		000001	0000010	000001001

At every step,

- shift divisor right and compare it with current dividend
- if divisor is larger, shift 0 as the next bit of the quotient
- if divisor is smaller, subtract to get new dividend and shift 1 as the next bit of the quotient

Divide Example

- Divide 7_{ten} ($0000\ 0111_{\text{two}}$) by 2_{ten} (0010_{two})

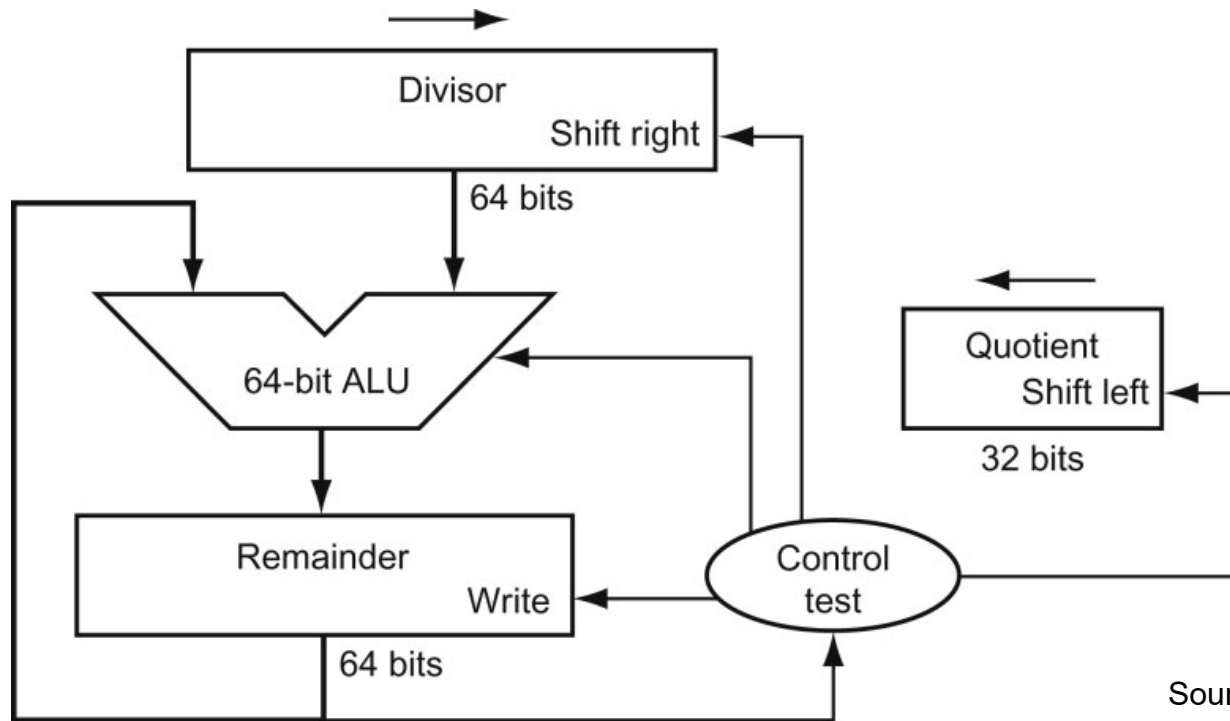
Iter	Step	Quot	Divisor	Remainder
0	Initial values			
1				
2				
3				
4				
5				

Divide Example

- Divide 7_{ten} ($0000\ 0111_{\text{two}}$) by 2_{ten} (0010_{two})

Iter	Step	Quot	Divisor	Remainder
0	Initial values	0000	0010 0000	0000 0111
1	Rem = Rem – Div	0000	0010 0000	1110 0111
	Rem < 0 → +Div, shift 0 into Q	0000	0010 0000	0000 0111
	Shift Div right	0000	0001 0000	0000 0111
2	Same steps as 1	0000	0001 0000	1111 0111
		0000	0001 0000	0000 0111
		0000	0000 1000	0000 0111
3	Same steps as 1	0000	0000 0100	0000 0111
4	Rem = Rem – Div	0000	0000 0100	0000 0011
	Rem ≥ 0 → shift 1 into Q	0001	0000 0100	0000 0011
	Shift Div right	0001	0000 0010	0000 0011
5	Same steps as 4	0011	0000 0001	0000 0001

Hardware for Division

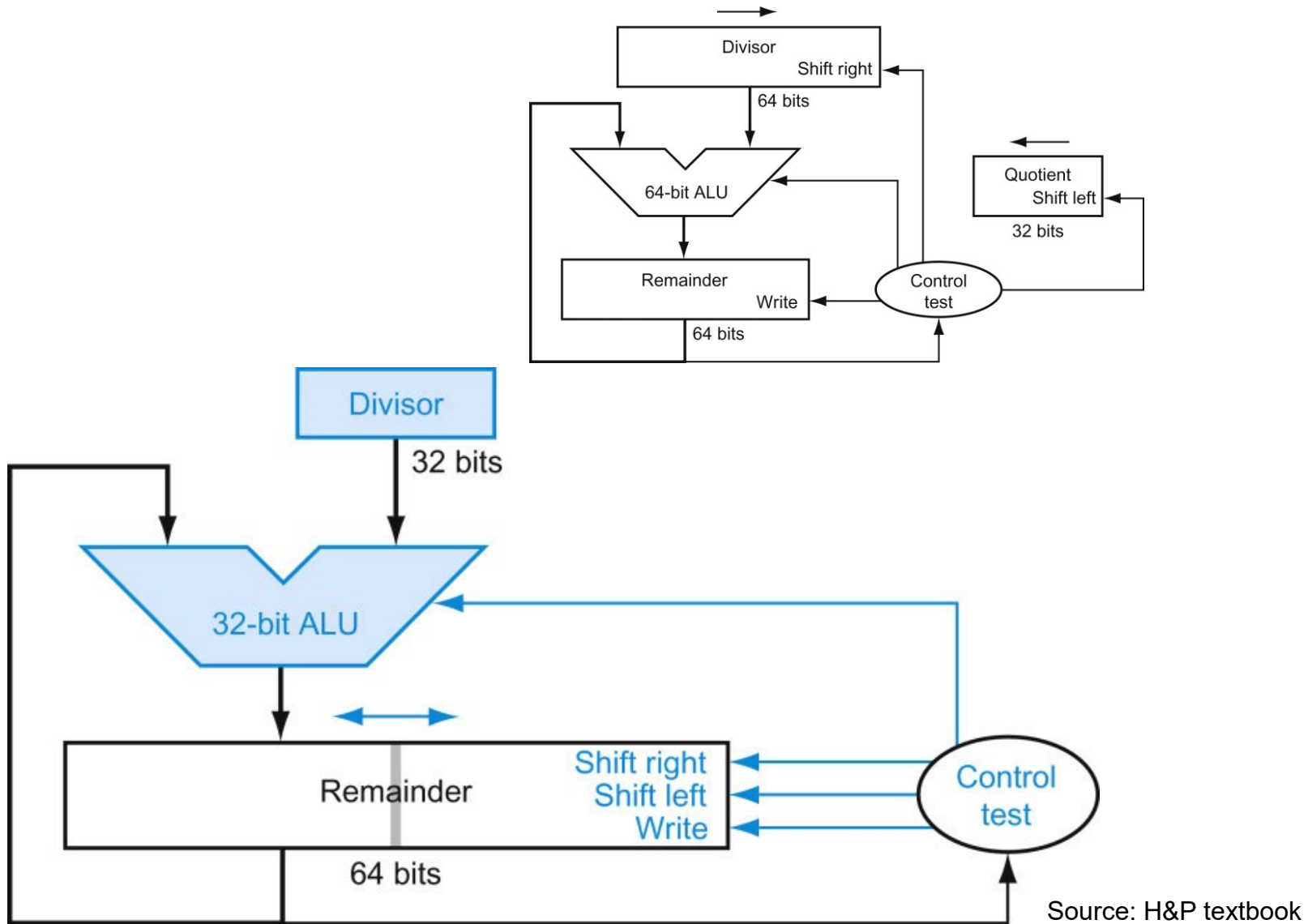


Source: H&P textbook

A comparison requires a subtract; the sign of the result is examined; if the result is negative, the divisor must be added back

Similar to multiply, results are placed in Hi (remainder) and Lo (quotient)

Efficient Division



Divisions involving Negatives

- Simplest solution: convert to positive and adjust sign later
- Note that multiple solutions exist for the equation:

Dividend = Quotient x Divisor + Remainder

+7 div +2 Quo = Rem =

-7 div +2 Quo = Rem =

+7 div -2 Quo = Rem =

-7 div -2 Quo = Rem =

Divisions involving Negatives

- Simplest solution: convert to positive and adjust sign later
- Note that multiple solutions exist for the equation:

$$\text{Dividend} = \text{Quotient} \times \text{Divisor} + \text{Remainder}$$

$$+7 \text{ div } +2 \quad \text{Quo} = +3 \quad \text{Rem} = +1$$

$$-7 \text{ div } +2 \quad \text{Quo} = -3 \quad \text{Rem} = -1$$

$$+7 \text{ div } -2 \quad \text{Quo} = -3 \quad \text{Rem} = +1$$

$$-7 \text{ div } -2 \quad \text{Quo} = +3 \quad \text{Rem} = -1$$

Convention: Dividend and remainder have the same sign

Quotient is negative if signs disagree

These rules fulfil the equation above