MOS 6502 / MOS 6510

Deep Dive Bit Manipulation

LSR ROR ADC

LSR Shift One Bit Right (Memory or Accumulator)

```
0 -> ←76543210→ -> C              N Z C I D V
      >>>>>>>>                    - + + - - -
```

addressing	assembler	opc	bytes	cycls
accumulator	LSR A	4A	1	2
zeropage	LSR oper	46	2	5
zeropage,X	LSR oper,X	56	2	6
absolute	LSR oper	4E	3	6
absolute,X	LSR oper,X	5E	3	7

* add 1 to cycles if page boundary is crossed

** add 1 to cycles if branch occurs on same page
   add 2 to cycles if branch occurs to different page

Legend to Flags: + ... modified
                  - .... not modified
                  1 .... set
                  0 .... cleared
                 M6 .... memory bit 6
                 M7 .... memory bit 7

ROR Rotate One Bit Right (Memory or Accumulator)

```
C -> ←76543210→ -> C              N Z C I D V
      >>>>>>>>                    + + + - - -
```

addressing	assembler	opc	bytes	cyles
accumulator	ROR A	6A	1	2
zeropage	ROR oper	66	2	5
zeropage,X	ROR oper,X	76	2	6
absolute	ROR oper	6E	3	6
absolute,X	ROR oper,X	7E	3	7

* add 1 to cycles if page boundary is crossed

** add 1 to cycles if branch occurs on same page
   add 2 to cycles if branch occurs to different page

Legend to Flags: + ... modified
                  - .... not modified
                  1 .... set
                  0 .... cleared
                 M6 .... memory bit 6
                 M7 .... memory bit 7

ADC Add Memory to Accumulator with Carry

A + M + C -> A, C

N	Z	C	I	D	V
+	+	+	-	-	+

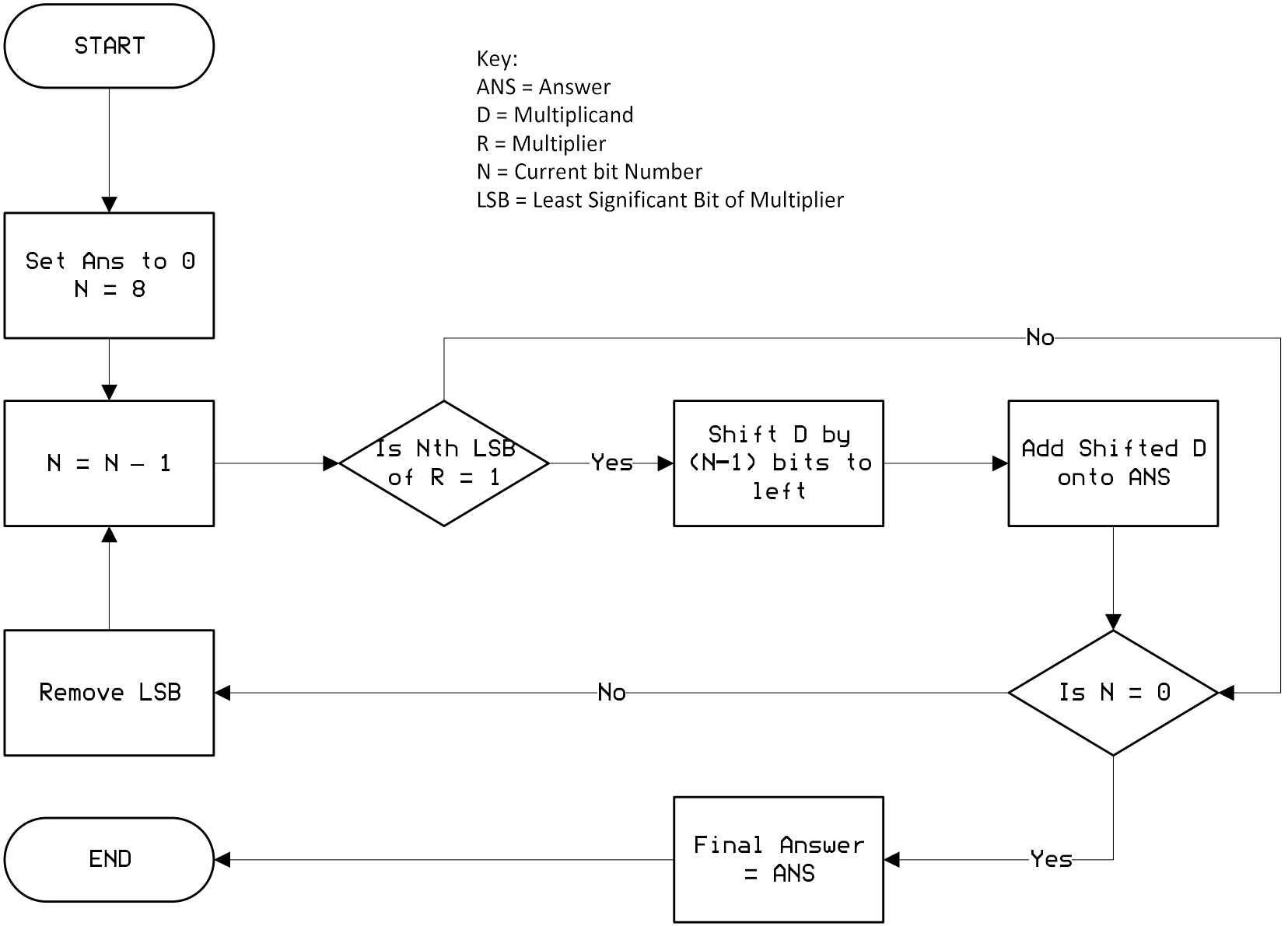
addressing	assembler	opc	bytes	cycls
immediate	ADC #oper	69	2	2
zeropage	ADC oper	65	2	3
zeropage,X	ADC oper,X	75	2	4
absolute	ADC oper	6D	3	4
absolute,X	ADC oper,X	7D	3	4*
absolute,Y	ADC oper,Y	79	3	4*
(indirect,X)	ADC (oper,X)	61	2	6
(indirect),Y	ADC (oper),Y	71	2	5*

* add 1 to cycles if page boundary is crossed

** add 1 to cycles if branch occurs on same page
   add 2 to cycles if branch occurs to different page

Legend to Flags: + ... modified
                  - .... not modified
                  1 .... set
                  0 .... cleared
                 M6 .... memory bit 6
                 M7 .... memory bit 7

Decimal	Binary
13	1101
X14	X1110
52	0000+
130+	11010+
182	110100+
	1101000+
	10110110


START
Key:
ANS = Answer
D = Multiplicand
R = Multiplier
N = Current bit Number
LSB = Least Significant Bit of Multiplier
Set Ans to 0
N = 8
N = N – 1
Is Nth LSB of R = 1
Yes
No
Shift D by (N-1) bits to left
Add Shifted D onto ANS
Is N = 0
No
Yes
Remove LSB
Final Answer = ANS
END