

BRK (00)		Cycles: 7	Size: 2*
Implied			
Cycle	R/W	Desc	
-X.2	Read PC	Store as OpCode.	
1.1		Inc. PC unless PC writes are disabled.	
1.2	Read PC	To be discarded.	
2.1		Inc. PC unless PC writes are disabled.	
2.2	** Write S \$0100	Push PC.H onto stack.	
3.1			
3.2	** Write (S -1) \$0100	Push PC.L onto stack.	
4.1		Use Interrupt flags to decide which vector to use. RESET=\$FFFC NMI=\$FFFA IRQ/BRK=\$FFFE	
4.2	** Write (S -2) \$0100	Push P onto stack, with B flag if software BRK.	
5.1		Decrease S by 3.	
5.2	Read Vector Low	Store to Address.L.	
6.1		Set I , unset B (required by Tom Harte tests).	
6.2	Read Vector High	Store to Address.H.	
7.1		Enable writes to PC (disabled by NMI/IRQ). Copy Address to PC .	
7.2	Read PC	Store as OpCode.	
+X.1			

* Concerning the BRK instruction, you should also note that although its second byte is basically a “don’t care” byte – that is, it can have any value - the BRK (and COP instruction as well) is a two-byte instruction, the second byte sometimes is used as a signature byte to determine the nature of the BRK being executed. When an RTI instruction is executed, control always returns to the second byte past the BRK opcode. — assembly-programming-manual-for-w65c816.pdf

cycle	ab	db	rw	Fetch	pc	a	x	y	s	p	Execute	State
2	0001	00	1	BRK	0001	aa	00	00	fd	nv-BdiZc	CLI	T1
2	0001	00	1	BRK	0001	aa	00	00	fd	nv-BdiZc	CLI	T1
3	0002	20	1		0002	aa	00	00	fd	nv-BdiZc	BRK	T2
3	0002	20	1		0002	aa	00	00	fd	nv-BdiZc	BRK	T2
4	01fd	20	0		0003	aa	00	00	fd	nv-BdiZc	BRK	T3
4	01fd	00	0		0003	aa	00	00	fd	nv-BdiZc	BRK	T3
5	01fc	20	0		0003	aa	00	00	fd	nv-BdiZc	BRK	T4
5	01fc	03	0		0003	aa	00	00	fd	nv-BdiZc	BRK	T4
6	01fb	20	0		0003	aa	00	00	fd	nv-BdiZc	BRK	T5
6	01fb	32	0		0003	aa	00	00	fd	nv-BdiZc	BRK	T5
7	fffe	00	1		0003	aa	00	00	fa	nv-BdiZc	BRK	
7	fffe	00	1		0003	aa	00	00	fa	nv-BdiZc	BRK	
8	ffff	00	1		0003	aa	00	00	fa	nv-BdIZc	BRK	T0
8	ffff	00	1		0003	aa	00	00	fa	nv-BdIZc	BRK	T0
9	0000	58	1	CLI	0000	aa	00	00	fa	nv-BdIZc	BRK	T1
9	0000	58	1	CLI	0000	aa	00	00	fa	nv-BdIZc	BRK	T1

** If handling a RESET, the writes turn into reads. The databus is populated but ignored.

ORA (01)	Cycles: 6	Size: 2
Indirect, X (Read)		
Cycle	R/W	Desc
-X.2	Read PC	Store as OpCode.
1.1		Inc. PC .
1.2	Read PC	Store as Operand.
2.1		Inc. PC .
2.2	Read Operand	
3.1		Set Pointer to (Operand+X) & \$FF.
3.2	Read Pointer	Store to Address.L.
4.1		
4.2	Read (Pointer+1) & \$FF	Store to Address.H.
5.1		
5.2	Read Address	Store as Operand.
6.1		* Perform A=A Operand , set N and Z accordingly.
6.2	Read PC	Store as OpCode.
+X.1		A and N, Z applied.

* Setting of A/flags is delayed by 1 cycle until the start of the following instruction.

cycle	ab	db	rw	Fetch	pc	a	x	y	s	p	Execute	State
2	0001	01	1	ORA (zp,X)	0001	aa	00	00	fd	nv-BdiZc	CLI	T1
2	0001	01	1	ORA (zp,X)	0001	aa	00	00	fd	nv-BdiZc	CLI	T1
3	0002	20	1		0002	aa	00	00	fd	nv-BdiZc	ORA (zp,X)	T2
3	0002	20	1		0002	aa	00	00	fd	nv-BdiZc	ORA (zp,X)	T2
4	0020	22	1		0003	aa	00	00	fd	nv-BdiZc	ORA (zp,X)	T3
4	0020	22	1		0003	aa	00	00	fd	nv-BdiZc	ORA (zp,X)	T3
5	0020	22	1		0003	aa	00	00	fd	nv-BdiZc	ORA (zp,X)	T4
5	0020	22	1		0003	aa	00	00	fd	nv-BdiZc	ORA (zp,X)	T4
6	0021	00	1		0003	aa	00	00	fd	nv-BdiZc	ORA (zp,X)	T5
6	0021	00	1		0003	aa	00	00	fd	nv-BdiZc	ORA (zp,X)	T5
7	0022	ff	1		0003	aa	00	00	fd	nv-BdiZc	ORA (zp,X)	T0
7	0022	ff	1		0003	aa	00	00	fd	nv-BdiZc	ORA (zp,X)	T0
8	0003	10	1	BPL	0003	aa	00	00	fd	nv-BdiZc	ORA (zp,X)	T1
8	0003	10	1	BPL	0003	aa	00	00	fd	nv-BdiZc	ORA (zp,X)	T1
9	0004	00	1		0004	ff	00	00	fd	Nv-Bdizc	BPL	T2
9	0004	00	1		0004	ff	00	00	fd	Nv-Bdizc	BPL	T2

JAM (02)	Cycles: ∞	Size: 1
Implied		
Cycle	R/W	Desc
-X.2	Read PC	Store as OpCode.
1.1		Inc. PC .
1.2	Read PC	
2.1		
2.2	Read \$FFFF	
3.1		
3.2	Read \$FFFE	
4.1		
4.2	Read \$FFFE	
5.1		Repeat 5.1 and 5.2 forever.
5.2	Read \$FFFF	

cycle	ab	db	rw	Fetch	pc	a	x	y	s	p	Execute	State
2	0002	02	1	unknown	0002	00	00	00	fd	nv-BdIZc	LDA #	T1
2	0002	02	1	unknown	0002	00	00	00	fd	nv-BdIZc	LDA #	T1
3	0003	10	1		0003	00	00	00	fd	nv-BdIZc	unknown	T2
3	0003	10	1		0003	00	00	00	fd	nv-BdIZc	unknown	T2
4	ffff	00	1		0004	00	00	00	fd	nv-BdIZc	unknown	T3
4	ffff	00	1		0004	00	00	00	fd	nv-BdIZc	unknown	T3
5	fffe	00	1		0004	00	00	00	fd	nv-BdIZc	unknown	T4
5	fffe	00	1		0004	00	00	00	fd	nv-BdIZc	unknown	T4
6	fffe	00	1		0004	00	00	00	fd	nv-BdIZc	unknown	T5
6	fffe	00	1		0004	00	00	00	fd	nv-BdIZc	unknown	T5
7	ffff	00	1		0004	00	00	00	fd	nv-BdIZc	unknown	
7	ffff	00	1		0004	00	00	00	fd	nv-BdIZc	unknown	
8	ffff	00	1		0004	00	00	00	fd	nv-BdIZc	unknown	
8	ffff	00	1		0004	00	00	00	fd	nv-BdIZc	unknown	
9	ffff	00	1		0004	00	00	00	fd	nv-BdIZc	unknown	
9	ffff	00	1		0004	00	00	00	fd	nv-BdIZc	unknown	
10	ffff	00	1		0004	00	00	00	fd	nv-BdIZc	unknown	
10	ffff	00	1		0004	00	00	00	fd	nv-BdIZc	unknown	
11	ffff	00	1		0004	00	00	00	fd	nv-BdIZc	unknown	
11	ffff	00	1		0004	00	00	00	fd	nv-BdIZc	unknown	

SLO (03)	Cycles: 8	Size: 2
Indirect, X (Read/Modify/Write)		
Cycle	R/W	Desc
-X.2	Read PC	Store as OpCode.
1.1		Inc. PC .
1.2	Read PC	Store as Operand.
2.1		Inc. PC .
2.2	Read Operand	
3.1		Set Pointer to (Operand+X) & \$FF.
3.2	Read Pointer	Store to Address.L.
4.1		
4.2	Read (Pointer+1) & \$FF	Store to Address.H.
5.1		
5.1	Read Address	Store as Operand.
6.1		
6.2	Write Address	Write unmodified Operand.
7.1		* Set C if high bit of Operand is set. Perform Operand=Operand << 1, A=A Operand, set N and Z based off A .
7.2	Write Address	Write modified Operand.
8.1		
8.2	Read PC	Store as OpCode.
+X.1		A applied.

* Setting of A is delayed by 2 cycles until the start of the following instruction.

cycle	ab	db	rw	Fetch	pc	a	x	y	s	p	Execute	State
2	0001	03	1	unknown	0001	aa	00	00	fd	nv-BdiZc	CLI	T1
2	0001	03	1	unknown	0001	aa	00	00	fd	nv-BdiZc	CLI	T1
3	0002	20	1		0002	aa	00	00	fd	nv-BdiZc	unknown	T2
3	0002	20	1		0002	aa	00	00	fd	nv-BdiZc	unknown	T2
4	0020	22	1		0003	aa	00	00	fd	nv-BdiZc	unknown	T3
4	0020	22	1		0003	aa	00	00	fd	nv-BdiZc	unknown	T3
5	0020	22	1		0003	aa	00	00	fd	nv-BdiZc	unknown	T4
5	0020	22	1		0003	aa	00	00	fd	nv-BdiZc	unknown	T4
6	0021	00	1		0003	aa	00	00	fd	nv-BdiZc	unknown	T5
6	0021	00	1		0003	aa	00	00	fd	nv-BdiZc	unknown	T5
7	0022	ff	1		0003	aa	00	00	fd	nv-BdiZc	unknown	
7	0022	ff	1		0003	aa	00	00	fd	nv-BdiZc	unknown	
8	0022	ff	0		0003	aa	00	00	fd	nv-BdiZc	unknown	
8	0022	ff	0		0003	aa	00	00	fd	nv-BdiZc	unknown	
9	0022	ff	0		0003	aa	00	00	fd	Nv-BdizC	unknown	T0
9	0022	fe	0		0003	aa	00	00	fd	Nv-BdizC	unknown	T0
10	0003	10	1	BPL	0003	aa	00	00	fd	Nv-BdizC	unknown	T1
10	0003	10	1	BPL	0003	aa	00	00	fd	Nv-BdizC	unknown	T1
11	0004	00	1		0004	fe	00	00	fd	Nv-BdizC	BPL	T2
11	0004	00	1		0004	fe	00	00	fd	Nv-BdizC	BPL	T2

NOP (04)		Cycles: 3	Size: 2
Zero Page (Read)			
Cycle	R/W		Desc
-X.2	Read PC		Store as OpCode.
1.1	Read PC		Inc. PC .
1.2			Store as Address.
2.1			Inc. PC .
2.2			Store as Operand.
3.1			
3.2	Read PC		Store as OpCode.
+X.1			

cycle	ab	db	rw	Fetch	pc	a	x	y	s	p	Execute	State
2	0001	04	1	unknown	0001	aa	00	00	fd	nv-BdiZc	CLI	T1
2	0001	04	1	unknown	0001	aa	00	00	fd	nv-BdiZc	CLI	T1
3	0002	20	1		0002	aa	00	00	fd	nv-BdiZc	unknown	T2
3	0002	20	1		0002	aa	00	00	fd	nv-BdiZc	unknown	T2
4	0020	22	1		0003	aa	00	00	fd	nv-BdiZc	unknown	T0
4	0020	22	1		0003	aa	00	00	fd	nv-BdiZc	unknown	T0
5	0003	10	1	BPL	0003	aa	00	00	fd	nv-BdiZc	unknown	T1
5	0003	10	1	BPL	0003	aa	00	00	fd	nv-BdiZc	unknown	T1
6	0004	00	1		0004	aa	00	00	fd	nv-BdiZc	BPL	T2
6	0004	00	1		0004	aa	00	00	fd	nv-BdiZc	BPL	T2

ORA (05)		Cycles: 3	Size: 2
Zero Page (Read)			
Cycle	R/W	Desc	
-X.2	Read PC	Store as OpCode.	
1.1	Read PC	Inc. PC .	
1.2		Store as Address.	
2.1		Inc. PC .	
2.2		Store as Operand.	
3.1		* Perform A=A Operand, set N and Z accordingly.	
3.2	Read PC	Store as OpCode.	
+X.1		A and N, Z applied.	

* Setting of A/flags is delayed by 1 cycle until the start of the following instruction.

cycle	ab	db	rw	Fetch	pc	a	x	y	s	p	Execute	State
2	0001	05	1	ORA zp	0001	aa	00	00	fd	nv-BdiZc	CLI	T1
2	0001	05	1	ORA zp	0001	aa	00	00	fd	nv-BdiZc	CLI	T1
3	0002	20	1		0002	aa	00	00	fd	nv-BdiZc	ORA zp	T2
3	0002	20	1		0002	aa	00	00	fd	nv-BdiZc	ORA zp	T2
4	0020	44	1		0003	aa	00	00	fd	nv-BdiZc	ORA zp	T0
4	0020	44	1		0003	aa	00	00	fd	nv-BdiZc	ORA zp	T0
5	0003	10	1	BPL	0003	aa	00	00	fd	nv-BdiZc	ORA zp	T1
5	0003	10	1	BPL	0003	aa	00	00	fd	nv-BdiZc	ORA zp	T1
6	0004	00	1		0004	ee	00	00	fd	Nv-Bdizc	BPL	T2
6	0004	00	1		0004	ee	00	00	fd	Nv-Bdizc	BPL	T2

ASL (06)	Cycles: 5	Size: 2
Zero Page (Read/Modify/Write)		
Cycle	R/W	Desc
-X.2	Read PC	Store as OpCode.
1.1		Inc. PC .
1.2	Read PC	Store as Address.
2.1		Inc. PC .
2.2	Read Address	Store as Operand.
3.1		
3.2	Write Address	Write unmodified Operand.
4.1		Set C if high bit of Operand is set. Perform Operand=Operand << 1, set N and Z accordingly.
4.2	Write Address	Write modified Operand.
5.1		
5.2	Read PC	Store as OpCode.
+X.1		

cycle	ab	db	rw	Fetch	pc	a	x	y	s	p	Execute	State
2	0001	06	1	ASL zp	0001	aa	00	00	fd	nv-BdiZc	CLI	T1
2	0001	06	1	ASL zp	0001	aa	00	00	fd	nv-BdiZc	CLI	T1
3	0002	20	1		0002	aa	00	00	fd	nv-BdiZc	ASL zp	T2
3	0002	20	1		0002	aa	00	00	fd	nv-BdiZc	ASL zp	T2
4	0020	44	1		0003	aa	00	00	fd	nv-BdiZc	ASL zp	T3
4	0020	44	1		0003	aa	00	00	fd	nv-BdiZc	ASL zp	T3
5	0020	44	0		0003	aa	00	00	fd	nv-BdiZc	ASL zp	T4
5	0020	44	0		0003	aa	00	00	fd	nv-BdiZc	ASL zp	T4
6	0020	44	0		0003	aa	00	00	fd	Nv-Bdizc	ASL zp	T0
6	0020	88	0		0003	aa	00	00	fd	Nv-Bdizc	ASL zp	T0
7	0003	10	1	BPL	0003	aa	00	00	fd	Nv-Bdizc	ASL zp	T1
7	0003	10	1	BPL	0003	aa	00	00	fd	Nv-Bdizc	ASL zp	T1
8	0004	00	1		0004	aa	00	00	fd	Nv-Bdizc	BPL	T2
8	0004	00	1		0004	aa	00	00	fd	Nv-Bdizc	BPL	T2

SLO (07)	Cycles: 5	Size: 2
Zero Page (Read/Modify/Write)		
Cycle	R/W	Desc
-X.2	Read PC	Store as OpCode.
1.1		Inc. PC .
1.2	Read PC	Store as Address.
2.1		Inc. PC .
2.2	Read Address	Store as Operand.
3.1		
3.2	Write Address	Write unmodified Operand.
4.1		Set C if high bit of Operand is set. * Perform Operand=Operand << 1, A = A Operand, set N and Z based off A .
4.2	Write Address	Write modified Operand.
5.1		
5.2	Read PC	Store as OpCode.
+X.1		A and N , Z applied.

* Setting of A/flags is delayed by 1 cycle until the start of the following instruction.

cycle	ab	db	rw	Fetch	pc	a	x	y	s	p	Execute	State
2	0001	07	1	unknown	0001	aa	00	00	fd	nv-BdiZc	CLI	T1
2	0001	07	1	unknown	0001	aa	00	00	fd	nv-BdiZc	CLI	T1
3	0002	20	1		0002	aa	00	00	fd	nv-BdiZc	unknown	T2
3	0002	20	1		0002	aa	00	00	fd	nv-BdiZc	unknown	T2
4	0020	88	1		0003	aa	00	00	fd	nv-BdiZc	unknown	T3
4	0020	88	1		0003	aa	00	00	fd	nv-BdiZc	unknown	T3
5	0020	88	0		0003	aa	00	00	fd	nv-BdiZc	unknown	T4
5	0020	88	0		0003	aa	00	00	fd	nv-BdiZc	unknown	T4
6	0020	88	0		0003	aa	00	00	fd	nv-BdiZc	unknown	T0
6	0020	10	0		0003	aa	00	00	fd	nv-BdiZc	unknown	T0
7	0003	10	1	BPL	0003	aa	00	00	fd	nv-BdiZc	unknown	T1
7	0003	10	1	BPL	0003	aa	00	00	fd	nv-BdiZc	unknown	T1
8	0004	00	1		0004	ba	00	00	fd	Nv-BdiZc	BPL	T2
8	0004	00	1		0004	ba	00	00	fd	Nv-BdiZc	BPL	T2

PHP (08)		Cycles: 3	Size: 1
Implied			
Cycle	R/W	Desc	
-X.2	Read PC	Store as OpCode.	
1.1	Read PC	Inc. PC .	
1.2		To be discarded.	
2.1			
2.2		Push the status register with B and M set.	
3.1		Dec. S .	
3.2	Read PC	Store as OpCode.	
+X.1			

cycle	ab	db	rw	Fetch	pc	a	x	y	s	p	Execute	State
2	0001	08	1	PHP	0001	aa	00	00	fd	nv-BdiZc	CLI	T1
2	0001	08	1	PHP	0001	aa	00	00	fd	nv-BdiZc	CLI	T1
3	0002	20	1		0002	aa	00	00	fd	nv-BdiZc	PHP	T2
3	0002	20	1		0002	aa	00	00	fd	nv-BdiZc	PHP	T2
4	01fd	20	0		0002	aa	00	00	fd	nv-BdiZc	PHP	T0
4	01fd	32	0		0002	aa	00	00	fd	nv-BdiZc	PHP	T0
5	0002	20	1	JSR Abs	0002	aa	00	00	fc	nv-BdiZc	PHP	T1
5	0002	20	1	JSR Abs	0002	aa	00	00	fc	nv-BdiZc	PHP	T1
6	0003	10	1		0003	aa	00	00	fc	nv-BdiZc	JSR Abs	T2
6	0003	10	1		0003	aa	00	00	fc	nv-BdiZc	JSR Abs	T2

ORA (09)	Cycles: 2	Size: 2
Immediate (Read)		
Cycle	R/W	Desc
-X.2	Read PC	Store as OpCode.
1.1	Read PC	Inc. PC .
1.2		Store as Operand.
2.1		Inc. PC . * Perform A=A Operand, set N and Z accordingly.
2.2		Store as OpCode.
+X.1		A and N, Z applied.

* Setting of A/flags is delayed by 1 cycle until the start of the following instruction.

cycle	ab	db	rw	Fetch	pc	a	x	y	s	p	Execute	State
2	0001	09	1	ORA #	0001	aa	00	00	fd	nv-BdiZc	CLI	T1
2	0001	09	1	ORA #	0001	aa	00	00	fd	nv-BdiZc	CLI	T1
3	0002	ff	1		0002	aa	00	00	fd	nv-BdiZc	ORA #	T0+T2
3	0002	ff	1		0002	aa	00	00	fd	nv-BdiZc	ORA #	T0+T2
4	0003	10	1	BPL	0003	aa	00	00	fd	nv-BdiZc	ORA #	T1
4	0003	10	1	BPL	0003	aa	00	00	fd	nv-BdiZc	ORA #	T1
5	0004	00	1		0004	ff	00	00	fd	Nv-Bdizc	BPL	T2
5	0004	00	1		0004	ff	00	00	fd	Nv-Bdizc	BPL	T2

ASL (0A)	Cycles: 2	Size: 1
Implied		
Cycle	R/W	Desc
-X.2	Read PC	Store as OpCode.
1.1	Read PC	Inc. PC .
1.2		To be discarded.
2.1		Set C if high bit of Operand is set. Perform A=A << 1 , set N and Z accordingly.
2.2		Store as OpCode.
+X.1		A and C , N , Z applied.

* Setting of A/flags is delayed by 1 cycle until the start of the following instruction.

cycle	ab	db	rw	Fetch	pc	a	x	y	s	p	Execute	State
2	0001	0a	1	ASL	0001	aa	00	00	fd	nv-BdiZc	CLI	T1
2	0001	0a	1	ASL	0001	aa	00	00	fd	nv-BdiZc	CLI	T1
3	0002	98	1		0002	aa	00	00	fd	nv-BdiZc	ASL	T0+T2
3	0002	98	1		0002	aa	00	00	fd	nv-BdiZc	ASL	T0+T2
4	0002	98	1	TYA	0002	aa	00	00	fd	nv-BdiZc	ASL	T1
4	0002	98	1	TYA	0002	aa	00	00	fd	nv-BdiZc	ASL	T1
5	0003	10	1		0003	54	00	00	fd	nv-BdiZc	TYA	T0+T2
5	0003	10	1		0003	54	00	00	fd	nv-BdiZc	TYA	T0+T2

ANC (0B)		Cycles: 2	Size: 2
Immediate (Read)			
Cycle	R/W	Desc	
-X.2	Read PC	Store as OpCode.	
1.1	Read PC	Inc. PC .	
1.2		Store as Operand.	
2.1		Inc. PC . * Perform A=A & Operand , set C , N , and Z accordingly (C is set using logic for N).	
2.2		Store as OpCode.	
+X.1		** A and C , N , Z applied.	

* Setting of A/flags is delayed by 1 cycle until the start of the following instruction.

** Visual6502 incorrectly omits the update of A; flags are updated based off the incorrect A value.

cycle	ab	db	rw	Fetch	pc	a	x	y	s	p	Execute	State
2	0001	0b	1	unknown	0001	aa	00	00	fd	nv-BdiZc	CLI	T1
2	0001	0b	1	unknown	0001	aa	00	00	fd	nv-BdiZc	CLI	T1
3	0002	0f	1		0002	aa	00	00	fd	nv-BdiZc	unknown	T0+T2
3	0002	0f	1		0002	aa	00	00	fd	nv-BdiZc	unknown	T0+T2
4	0003	10	1	BPL	0003	aa	00	00	fd	nv-BdiZc	unknown	T1
4	0003	10	1	BPL	0003	aa	00	00	fd	nv-BdiZc	unknown	T1
5	0004	00	1		0004	aa	00	00	fd	Nv-BdiZc	BPL	T2
5	0004	00	1		0004	aa	00	00	fd	Nv-BdiZc	BPL	T2

ANC (ANC2, ANA, ANB)

Type: Combination of an immediate and an implied command (Sub-instructions: AND, ASL/ROL)

Op.	Mnemonic	Function	Size	Cycles	N	V	-	B	D	I	Z	C
\$0B	ANC #imm	A = A & #{imm}	2	2	0						0	0
\$2B	ANC #imm	A = A & #{imm}	2	2	0						0	0

Operation: ANDs the contents of the A register with an immediate value and then moves bit 7 of A into the Carry flag.

- This opcode works basically identically to AND #imm. except that the Carry flag is set to the same state that the Negative flag is set to. (bit 7 is put into the carry, as if the ASL/ROL would have been executed)

— NoMoreSecrets-NMOS6510UnintendedOpcodes-20232412.pdf

NOP (0C)		Cycles: 4	Size: 3
Absolute (Read)			
Cycle	R/W	Desc	
-X.2	Read PC	Store as OpCode.	
1.1	Read PC	Inc. PC .	
1.2		Store as Address.L.	
2.1		Inc. PC .	
2.2		Store as Address.H.	
3.1		Inc. PC .	
3.2		Store as Operand.	
4.1		Store as OpCode.	
4.2			
+X.1			

cycle	ab	db	rw	Fetch	pc	a	x	y	s	p	Execute	State
2	0001	0c	1	unknown	0001	aa	00	00	fd	nv-BdiZc	CLI	T1
2	0001	0c	1	unknown	0001	aa	00	00	fd	nv-BdiZc	CLI	T1
3	0002	0f	1		0002	aa	00	00	fd	nv-BdiZc	unknown	T2
3	0002	0f	1		0002	aa	00	00	fd	nv-BdiZc	unknown	T2
4	0003	10	1		0003	aa	00	00	fd	nv-BdiZc	unknown	T3
4	0003	10	1		0003	aa	00	00	fd	nv-BdiZc	unknown	T3
5	100f	00	1		0004	aa	00	00	fd	nv-BdiZc	unknown	T0
5	100f	00	1		0004	aa	00	00	fd	nv-BdiZc	unknown	T0
6	0004	00	1	BRK	0004	aa	00	00	fd	nv-BdiZc	unknown	T1
6	0004	00	1	BRK	0004	aa	00	00	fd	nv-BdiZc	unknown	T1
7	0005	4c	1		0005	aa	00	00	fd	nv-BdiZc	BRK	T2
7	0005	4c	1		0005	aa	00	00	fd	nv-BdiZc	BRK	T2

ORA (0D)		Cycles: 4	Size: 3
Absolute (Read)			
Cycle	R/W	Desc	
-X.2	Read PC	Store as OpCode.	
1.1	Read PC	Inc. PC .	
1.2		Store as Address.L.	
2.1		Inc. PC .	
2.2		Store as Address.H.	
3.1		Inc. PC .	
3.2		Store as Operand.	
4.1		* Perform A=A Operand , set N and Z accordingly.	
4.2		Store as OpCode.	
+X.1		A and N, Z applied.	

* Setting of A/flags is delayed by 1 cycle until the start of the following instruction.

cycle	ab	db	rw	Fetch	pc	a	x	y	s	p	Execute	State
2	0001	0d	1	ORA Abs	0001	aa	00	00	fd	nv-BdiZc	CLI	T1
2	0001	0d	1	ORA Abs	0001	aa	00	00	fd	nv-BdiZc	CLI	T1
3	0002	1f	1		0002	aa	00	00	fd	nv-BdiZc	ORA Abs	T2
3	0002	1f	1		0002	aa	00	00	fd	nv-BdiZc	ORA Abs	T2
4	0003	01	1		0003	aa	00	00	fd	nv-BdiZc	ORA Abs	T3
4	0003	01	1		0003	aa	00	00	fd	nv-BdiZc	ORA Abs	T3
5	011f	0f	1		0004	aa	00	00	fd	nv-BdiZc	ORA Abs	T0
5	011f	0f	1		0004	aa	00	00	fd	nv-BdiZc	ORA Abs	T0
6	0004	a9	1	LDA #	0004	aa	00	00	fd	nv-BdiZc	ORA Abs	T1
6	0004	a9	1	LDA #	0004	aa	00	00	fd	nv-BdiZc	ORA Abs	T1
7	0005	4c	1		0005	af	00	00	fd	Nv-Bdizc	LDA #	T0+T2
7	0005	4c	1		0005	af	00	00	fd	Nv-Bdizc	LDA #	T0+T2

ASL (0E)	Cycles: 6	Size: 3
Absolute (Read/Modify/Write)		
Cycle	R/W	Desc
-X.2	Read PC	Store as OpCode.
1.1		Inc. PC .
1.2	Read PC	Store as Address.L.
2.1		Inc. PC .
2.2	Read PC	Store as Address.H.
3.1		Inc. PC .
3.2	Read Address	Store as Operand.
4.1		
4.2	Write Address	Write unmodified Operand.
5.1		Set C if high bit of Operand is set. Perform Operand=Operand << 1, set N and Z accordingly.
5.2	Write Address	Write modified Operand.
6.1		
6.2	Read PC	Store as OpCode.
+X.1		

cycle	ab	db	rw	Fetch	pc	a	x	y	s	p	Execute	State
2	0001	0e	1	ASL Abs	0001	aa	00	00	fd	nv-BdiZc	CLI	T1
2	0001	0e	1	ASL Abs	0001	aa	00	00	fd	nv-BdiZc	CLI	T1
3	0002	1f	1		0002	aa	00	00	fd	nv-BdiZc	ASL Abs	T2
3	0002	1f	1		0002	aa	00	00	fd	nv-BdiZc	ASL Abs	T2
4	0003	01	1		0003	aa	00	00	fd	nv-BdiZc	ASL Abs	T3
4	0003	01	1		0003	aa	00	00	fd	nv-BdiZc	ASL Abs	T3
5	011f	0f	1		0004	aa	00	00	fd	nv-BdiZc	ASL Abs	T4
5	011f	0f	1		0004	aa	00	00	fd	nv-BdiZc	ASL Abs	T4
6	011f	0f	0		0004	aa	00	00	fd	nv-BdiZc	ASL Abs	T5
6	011f	0f	0		0004	aa	00	00	fd	nv-BdiZc	ASL Abs	T5
7	011f	0f	0		0004	aa	00	00	fd	nv-BdiZc	ASL Abs	T0
7	011f	1e	0		0004	aa	00	00	fd	nv-BdiZc	ASL Abs	T0
8	0004	a9	1	LDA #	0004	aa	00	00	fd	nv-BdiZc	ASL Abs	T1
8	0004	a9	1	LDA #	0004	aa	00	00	fd	nv-BdiZc	ASL Abs	T1
9	0005	4c	1		0005	aa	00	00	fd	nv-BdiZc	LDA #	T0+T2
9	0005	4c	1		0005	aa	00	00	fd	nv-BdiZc	LDA #	T0+T2

SLO (0F)	Cycles: 6	Size: 3
Absolute (Read/Modify/Write)		
Cycle	R/W	Desc
-X.2	Read PC	Store as OpCode.
1.1	Read PC	Inc. PC .
1.2		Store as Address.L.
2.1		Inc. PC .
2.2		Store as Address.H.
3.1		Inc. PC .
3.2		Store as Operand.
4.1		Write unmodified Operand.
4.2		
5.1		
5.2		Set C if high bit of Operand is set. * Perform Operand=Operand << 1, A=A Operand, set N and Z based off A .
6.1	Write Address	Write modified Operand.
6.2	Read PC	Store as OpCode.
+X.1		A and N, Z applied.

* Setting of A/flags is delayed by 1 cycle until the start of the following instruction.

cycle	ab	db	rw	Fetch	pc	a	x	y	s	p	Execute	State
2	0001	0f	1	unknown	0001	aa	00	00	fd	nv-BdiZc	CLI	T1
2	0001	0f	1	unknown	0001	aa	00	00	fd	nv-BdiZc	CLI	T1
3	0002	1f	1		0002	aa	00	00	fd	nv-BdiZc	unknown	T2
3	0002	1f	1		0002	aa	00	00	fd	nv-BdiZc	unknown	T2
4	0003	01	1		0003	aa	00	00	fd	nv-BdiZc	unknown	T3
4	0003	01	1		0003	aa	00	00	fd	nv-BdiZc	unknown	T3
5	011f	1e	1		0004	aa	00	00	fd	nv-BdiZc	unknown	T4
5	011f	1e	1		0004	aa	00	00	fd	nv-BdiZc	unknown	T4
6	011f	1e	0		0004	aa	00	00	fd	nv-BdiZc	unknown	T5
6	011f	1e	0		0004	aa	00	00	fd	nv-BdiZc	unknown	T5
7	011f	1e	0		0004	aa	00	00	fd	nv-Bdizc	unknown	T0
7	011f	3c	0		0004	aa	00	00	fd	nv-Bdizc	unknown	T0
8	0004	a9	1	LDA #	0004	aa	00	00	fd	nv-Bdizc	unknown	T1
8	0004	a9	1	LDA #	0004	aa	00	00	fd	nv-Bdizc	unknown	T1
9	0005	4c	1		0005	be	00	00	fd	Nv-Bdizc	LDA #	T0+T2
9	0005	4c	1		0005	be	00	00	fd	Nv-Bdizc	LDA #	T0+T2

BPL (10)	Cycles: 2-4	Size: 2
Branch Relative		
Cycle	R/W	Desc
-X.2	Read PC	Store as OpCode.
1.1	Read PC	Inc. PC . Check condition (N == 0).
1.2		Store as Operand. Treat as signed 16-bit (Op16=i16(i8(Operand))).
2.1		Inc. PC . If not jumping, end (next half-cycle is 4.2)
2.2		If (PC +Op16).H != PC .H, end after PC .L fix (next half-cycle is 4.2). PC .L= PC .L+Operand.
3.1		
3.2	Read PC	
4.1	Read PC	PC .H=previous “(PC +Op16).H” value.
4.2		Store as OpCode.
+X.1		

cycle	ab	db	rw	Fetch	pc	a	x	y	s	p	Execute	State
2	0002	10	1	BPL	0002	80	00	00	fd	Nv-BdIZc	LDA #	T1
2	0002	10	1	BPL	0002	80	00	00	fd	Nv-BdIZc	LDA #	T1
3	0003	fc	1		0003	80	00	00	fd	Nv-BdIZc	BPL	T2
3	0003	fc	1		0003	80	00	00	fd	Nv-BdIZc	BPL	T2
4	0004	00	1	BRK	0004	80	00	00	fd	Nv-BdIZc	BPL	
4	0004	00	1	BRK	0004	80	00	00	fd	Nv-BdIZc	BPL	
5	0005	4c	1		0005	80	00	00	fd	Nv-BdIZc	BRK	T2
5	0005	4c	1		0005	80	00	00	fd	Nv-BdIZc	BRK	T2

cycle	ab	db	rw	Fetch	pc	a	x	y	s	p	Execute	State
2	0002	10	1	BPL	0002	00	00	00	fd	nv-BdIZc	LDA #	T1
2	0002	10	1	BPL	0002	00	00	00	fd	nv-BdIZc	LDA #	T1
3	0003	fc	1		0003	00	00	00	fd	nv-BdIZc	BPL	T2
3	0003	fc	1		0003	00	00	00	fd	nv-BdIZc	BPL	T2
4	0004	00	1		0004	00	00	00	fd	nv-BdIZc	BPL	T3
4	0004	00	1		0004	00	00	00	fd	nv-BdIZc	BPL	T3
5	0000	a9	1	LDA #	0000	00	00	00	fd	nv-BdIZc	BPL	
5	0000	a9	1	LDA #	0000	00	00	00	fd	nv-BdIZc	BPL	
6	0001	00	1		0001	00	00	00	fd	nv-BdIZc	LDA #	T0+T2
6	0001	00	1		0001	00	00	00	fd	nv-BdIZc	LDA #	T0+T2

cycle	ab	db	rw	Fetch	pc	a	x	y	s	p	Execute	State
5	00fc	10	1	BPL	00fc	00	00	00	fd	nv-BdIZc	JMP Abs	T1
5	00fc	10	1	BPL	00fc	00	00	00	fd	nv-BdIZc	JMP Abs	T1
6	00fd	1c	1		00fd	00	00	00	fd	nv-BdIZc	BPL	T2
6	00fd	1c	1		00fd	00	00	00	fd	nv-BdIZc	BPL	T2
7	00fe	22	1		00fe	00	00	00	fd	nv-BdIZc	BPL	T3
7	00fe	22	1		00fe	00	00	00	fd	nv-BdIZc	BPL	T3
8	001a	00	1		001a	00	00	00	fd	nv-BdIZc	BPL	T0
8	001a	00	1		001a	00	00	00	fd	nv-BdIZc	BPL	T0
9	011a	00	1	BRK	011a	00	00	00	fd	nv-BdIZc	BPL	T1
9	011a	00	1	BRK	011a	00	00	00	fd	nv-BdIZc	BPL	T1
10	011b	00	1		011b	00	00	00	fd	nv-BdIZc	BRK	T2
10	011b	00	1		011b	00	00	00	fd	nv-BdIZc	BRK	T2

ORA (11)		Cycles: 5-6	Size: 2
Indirect, Y (Read)			
Cycle	R/W	Desc	
-X.2	Read PC	Store as OpCode.	
1.1	Read PC	Inc. PC .	
1.2		Store as Pointer.	
2.1		Inc. PC .	
2.2		Store to Address.L.	
3.1	Read Pointer	Store to Address.H.	
3.2			
4.1			
4.2	Read Address	Final=Address+Y. Address.L = Final.L.	
5.1	Read Address	Store as Operand. If Address.H == Final.H, skip the next cycle (next half-cycle is 6.1).	
5.2		Address.H = Final.H (fixes high byte of address).	
6.1	Read PC	Store as Operand.	
6.2		* Perform A=A Operand , set N and Z accordingly.	
+X.1		Store as OpCode.	
		A and N, Z applied.	

* Setting of A/flags is delayed by 1 cycle until the start of the following instruction.

cycle	ab	db	rw	Fetch	pc	a	x	y	s	p	Execute	State
5	00fc	11	1	ORA (zp),Y	00fc	aa	00	4c	fd	nv-BdIzc	JMP Abs	T1
5	00fc	11	1	ORA (zp),Y	00fc	aa	00	4c	fd	nv-BdIzc	JMP Abs	T1
6	00fd	ee	1		00fd	aa	00	4c	fd	nv-BdIzc	ORA (zp),Y	T2
6	00fd	ee	1		00fd	aa	00	4c	fd	nv-BdIzc	ORA (zp),Y	T2
7	00ee	22	1		00fe	aa	00	4c	fd	nv-BdIzc	ORA (zp),Y	T3
7	00ee	22	1		00fe	aa	00	4c	fd	nv-BdIzc	ORA (zp),Y	T3
8	00ef	01	1		00fe	aa	00	4c	fd	nv-BdIzc	ORA (zp),Y	T4
8	00ef	01	1		00fe	aa	00	4c	fd	nv-BdIzc	ORA (zp),Y	T4
9	016e	ff	1		00fe	aa	00	4c	fd	nv-BdIzc	ORA (zp),Y	T0
9	016e	ff	1		00fe	aa	00	4c	fd	nv-BdIzc	ORA (zp),Y	T0
10	00fe	4a	1	LSR	00fe	aa	00	4c	fd	nv-BdIzc	ORA (zp),Y	T1
10	00fe	4a	1	LSR	00fe	aa	00	4c	fd	nv-BdIzc	ORA (zp),Y	T1
11	00ff	01	1		00ff	ff	00	4c	fd	Nv-BdIzc	LSR	T0+T2
11	00ff	01	1		00ff	ff	00	4c	fd	Nv-BdIzc	LSR	T0+T2

JAM (12)	Cycles: ∞	Size: 1
Implied		
Cycle	R/W	Desc
-X.2	Read PC	Store as OpCode.
1.1		Inc. PC .
1.2	Read PC	
2.1		
2.2	Read \$FFFF	
3.1		
3.2	Read \$FFFE	
4.1		
4.2	Read \$FFFE	
5.1		Repeat 5.1 and 5.2 forever.
5.2	Read \$FFFF	

cycle	ab	db	rw	Fetch	pc	a	x	y	s	p	Execute	State
2	0002	02	1	unknown	0002	00	00	00	fd	nv-BdIZc	LDA #	T1
2	0002	02	1	unknown	0002	00	00	00	fd	nv-BdIZc	LDA #	T1
3	0003	10	1		0003	00	00	00	fd	nv-BdIZc	unknown	T2
3	0003	10	1		0003	00	00	00	fd	nv-BdIZc	unknown	T2
4	ffff	00	1		0004	00	00	00	fd	nv-BdIZc	unknown	T3
4	ffff	00	1		0004	00	00	00	fd	nv-BdIZc	unknown	T3
5	fffe	00	1		0004	00	00	00	fd	nv-BdIZc	unknown	T4
5	fffe	00	1		0004	00	00	00	fd	nv-BdIZc	unknown	T4
6	fffe	00	1		0004	00	00	00	fd	nv-BdIZc	unknown	T5
6	fffe	00	1		0004	00	00	00	fd	nv-BdIZc	unknown	T5
7	ffff	00	1		0004	00	00	00	fd	nv-BdIZc	unknown	
7	ffff	00	1		0004	00	00	00	fd	nv-BdIZc	unknown	
8	ffff	00	1		0004	00	00	00	fd	nv-BdIZc	unknown	
8	ffff	00	1		0004	00	00	00	fd	nv-BdIZc	unknown	
9	ffff	00	1		0004	00	00	00	fd	nv-BdIZc	unknown	
9	ffff	00	1		0004	00	00	00	fd	nv-BdIZc	unknown	
10	ffff	00	1		0004	00	00	00	fd	nv-BdIZc	unknown	
10	ffff	00	1		0004	00	00	00	fd	nv-BdIZc	unknown	
11	ffff	00	1		0004	00	00	00	fd	nv-BdIZc	unknown	
11	ffff	00	1		0004	00	00	00	fd	nv-BdIZc	unknown	

SLO (13)	Cycles: 8	Size: 2
Indirect, Y (Read/Modify/Write)		
Cycle	R/W	Desc
-X.2	Read PC	Store as OpCode.
1.1		Inc. PC .
1.2	Read PC	Store as Pointer.
2.1		Inc. PC .
2.2	Read Pointer	Store to Address.L.
3.1		
3.2	Read (Pointer+1) & \$FF	Store to Address.H.
4.1		Final=Address+Y. Address.L = Final.L.
4.2	Read Address	Store as Operand.
5.1		Address.H = Final.H (fixes high byte of address).
5.2	Read Address	Store as Operand.
6.1		
6.2	Write Address	Write unmodified Operand.
7.1		* Set C if high bit of Operand is set. Perform Operand=Operand << 1, A=A Operand, set N and Z based off A .
7.2	Write Address	Write modified Operand.
8.1		
8.2	Read PC	Store as OpCode.
+X.1		A applied.

* Setting of A is delayed by 2 cycles until the start of the following instruction.

cycle	ab	db	rw	Fetch	pc	a	x	y	s	p	Execute	State
5	00fc	13	1	unknown	00fc	aa	00	4c	fd	nv-BdIzc	JMP Abs	T1
5	00fc	13	1	unknown	00fc	aa	00	4c	fd	nv-BdIzc	JMP Abs	T1
6	00fd	ee	1		00fd	aa	00	4c	fd	nv-BdIzc	unknown	T2
6	00fd	ee	1		00fd	aa	00	4c	fd	nv-BdIzc	unknown	T2
7	00ee	22	1		00fe	aa	00	4c	fd	nv-BdIzc	unknown	T3
7	00ee	22	1		00fe	aa	00	4c	fd	nv-BdIzc	unknown	T3
8	00ef	01	1		00fe	aa	00	4c	fd	nv-BdIzc	unknown	T4
8	00ef	01	1		00fe	aa	00	4c	fd	nv-BdIzc	unknown	T4
9	016e	ff	1		00fe	aa	00	4c	fd	nv-BdIzc	unknown	T5
9	016e	ff	1		00fe	aa	00	4c	fd	nv-BdIzc	unknown	T5
10	016e	ff	1		00fe	aa	00	4c	fd	nv-BdIzc	unknown	
10	016e	ff	1		00fe	aa	00	4c	fd	nv-BdIzc	unknown	
11	016e	ff	0		00fe	aa	00	4c	fd	nv-BdIzc	unknown	
11	016e	ff	0		00fe	aa	00	4c	fd	nv-BdIzc	unknown	
12	016e	ff	0		00fe	aa	00	4c	fd	Nv-BdIzC	unknown	T0
12	016e	fe	0		00fe	aa	00	4c	fd	Nv-BdIzC	unknown	T0
13	00fe	4a	1	LSR	00fe	aa	00	4c	fd	Nv-BdIzC	unknown	T1
13	00fe	4a	1	LSR	00fe	aa	00	4c	fd	Nv-BdIzC	unknown	T1
14	00ff	01	1		00ff	fe	00	4c	fd	Nv-BdIzC	LSR	T0+T2
14	00ff	01	1		00ff	fe	00	4c	fd	Nv-BdIzC	LSR	T0+T2

NOP (14)		Cycles: 4	Size: 2
Zero Page, X (Read)			
Cycle	R/W	Desc	
-X.2	Read PC	Store as OpCode.	
1.1	Read PC	Inc. PC .	
1.2		Store as Pointer.	
2.1		Inc. PC .	
2.2		Store as Operand.	
3.1		Set Address to (Pointer+ X) & \$FF.	
3.2		Store as Operand.	
4.1			
4.2		Store as OpCode.	
+X.1			

cycle	ab	db	rw	Fetch	pc	a	x	y	s	p	Execute	State
3	0002	14	1	unknown	0002	aa	00	00	fd	NV-BdIzc	BIT zp	T1
3	0002	14	1	unknown	0002	aa	00	00	fd	NV-BdIzc	BIT zp	T1
4	0003	fb	1		0003	aa	00	00	fd	NV-BdIzc	unknown	T2
4	0003	fb	1		0003	aa	00	00	fd	NV-BdIzc	unknown	T2
5	00fb	80	1		0004	aa	00	00	fd	NV-BdIzc	unknown	T3
5	00fb	80	1		0004	aa	00	00	fd	NV-BdIzc	unknown	T3
6	00fb	80	1		0004	aa	00	00	fd	NV-BdIzc	unknown	T0
6	00fb	80	1		0004	aa	00	00	fd	NV-BdIzc	unknown	T0
7	0004	01	1	ORA (zp,X)	0004	aa	00	00	fd	NV-BdIzc	unknown	T1
7	0004	01	1	ORA (zp,X)	0004	aa	00	00	fd	NV-BdIzc	unknown	T1
8	0005	50	1		0005	aa	00	00	fd	NV-BdIzc	ORA (zp,X)	T2
8	0005	50	1		0005	aa	00	00	fd	NV-BdIzc	ORA (zp,X)	T2

ORA (15)	Cycles: 4	Size: 2
Zero Page, X (Read)		
Cycle	R/W	Desc
-X.2	Read PC	Store as OpCode.
1.1		Inc. PC .
1.2	Read PC	Store as Pointer.
2.1		Inc. PC .
2.2	Read Pointer	Store as Operand.
3.1		Set Address to (Pointer+ X) & \$FF.
3.2	Read Address	Store as Operand.
4.1		* Perform A=A Operand , set N and Z accordingly.
4.2	Read PC	Store as OpCode.
+X.1		A and N, Z applied.

* Setting of A/flags is delayed by 1 cycle until the start of the following instruction.

cycle	ab	db	rw	Fetch	pc	a	x	y	s	p	Execute	State
5	00fc	15	1	ORA zp,X	00fc	aa	00	01	fd	nv-BdIzc	JMP Abs	T1
5	00fc	15	1	ORA zp,X	00fc	aa	00	01	fd	nv-BdIzc	JMP Abs	T1
6	00fd	ee	1		00fd	aa	00	01	fd	nv-BdIzc	ORA zp,X	T2
6	00fd	ee	1		00fd	aa	00	01	fd	nv-BdIzc	ORA zp,X	T2
7	00ee	2f	1		00fe	aa	00	01	fd	nv-BdIzc	ORA zp,X	T3
7	00ee	2f	1		00fe	aa	00	01	fd	nv-BdIzc	ORA zp,X	T3
8	00ee	2f	1		00fe	aa	00	01	fd	nv-BdIzc	ORA zp,X	T0
8	00ee	2f	1		00fe	aa	00	01	fd	nv-BdIzc	ORA zp,X	T0
9	00fe	4a	1	LSR	00fe	aa	00	01	fd	nv-BdIzc	ORA zp,X	T1
9	00fe	4a	1	LSR	00fe	aa	00	01	fd	nv-BdIzc	ORA zp,X	T1
10	00ff	01	1		00ff	af	00	01	fd	Nv-BdIzc	LSR	T0+T2
10	00ff	01	1		00ff	af	00	01	fd	Nv-BdIzc	LSR	T0+T2

ASL (16)	Cycles: 6	Size: 2
Zero Page, X (Read/Modify/Write)		
Cycle	R/W	Desc
-X.2	Read PC	Store as OpCode.
1.1		Inc. PC .
1.2	Read PC	Store as Pointer.
2.1		Inc. PC .
2.2	Read Pointer	Store as Operand.
3.1		Set Address to (Pointer+ X) & \$FF.
3.2	Read Address	Store as Operand.
4.1		
4.2	Write Address	Write unmodified Operand.
5.1		Set C if high bit of Operand is set. Perform Operand=Operand << 1, set N and Z accordingly.
5.2	Write Address	Write modified Operand.
6.1		
6.2	Read PC	Store as OpCode.
+X.1		

cycle	ab	db	rw	Fetch	pc	a	x	y	s	p	Execute	State
5	00fc	16	1	ASL zp,X	00fc	aa	00	01	fd	nv-BdIzc	JMP Abs	T1
5	00fc	16	1	ASL zp,X	00fc	aa	00	01	fd	nv-BdIzc	JMP Abs	T1
6	00fd	ee	1		00fd	aa	00	01	fd	nv-BdIzc	ASL zp,X	T2
6	00fd	ee	1		00fd	aa	00	01	fd	nv-BdIzc	ASL zp,X	T2
7	00ee	2f	1		00fe	aa	00	01	fd	nv-BdIzc	ASL zp,X	T3
7	00ee	2f	1		00fe	aa	00	01	fd	nv-BdIzc	ASL zp,X	T3
8	00ee	2f	1		00fe	aa	00	01	fd	nv-BdIzc	ASL zp,X	T4
8	00ee	2f	1		00fe	aa	00	01	fd	nv-BdIzc	ASL zp,X	T4
9	00ee	2f	0		00fe	aa	00	01	fd	nv-BdIzc	ASL zp,X	T5
9	00ee	2f	0		00fe	aa	00	01	fd	nv-BdIzc	ASL zp,X	T5
10	00ee	2f	0		00fe	aa	00	01	fd	nv-BdIzc	ASL zp,X	T0
10	00ee	5e	0		00fe	aa	00	01	fd	nv-BdIzc	ASL zp,X	T0
11	00fe	4a	1	LSR	00fe	aa	00	01	fd	nv-BdIzc	ASL zp,X	T1
11	00fe	4a	1	LSR	00fe	aa	00	01	fd	nv-BdIzc	ASL zp,X	T1
12	00ff	01	1		00ff	aa	00	01	fd	nv-BdIzc	LSR	T0+T2
12	00ff	01	1		00ff	aa	00	01	fd	nv-BdIzc	LSR	T0+T2

SLO (17)	Cycles: 6	Size: 2
Zero Page, X (Read/Modify/Write)		
Cycle	R/W	Desc
-X.2	Read PC	Store as OpCode.
1.1		Inc. PC .
1.2	Read PC	Store as Pointer.
2.1		Inc. PC .
2.2	Read Pointer	Store as Operand.
3.1		Set Address to (Pointer+ X) & \$FF.
3.2	Read Address	Store as Operand.
4.1		
4.2	Write Address	Write unmodified Operand.
5.1		* Set C if high bit of Operand is set. Perform Operand=Operand << 1, A=A Operand, set N and Z based off A .
5.2	Write Address	Write modified Operand.
6.1		
6.2	Read PC	Store as OpCode.
+X.1		A applied.

* Setting of A is delayed by 2 cycles until the start of the following instruction.

cycle	ab	db	rw	Fetch	pc	a	x	y	s	p	Execute	State
5	00fc	17	1	unknown	00fc	aa	00	01	fd	nv-BdIzc	JMP Abs	T1
5	00fc	17	1	unknown	00fc	aa	00	01	fd	nv-BdIzc	JMP Abs	T1
6	00fd	ee	1		00fd	aa	00	01	fd	nv-BdIzc	unknown	T2
6	00fd	ee	1		00fd	aa	00	01	fd	nv-BdIzc	unknown	T2
7	00ee	5e	1		00fe	aa	00	01	fd	nv-BdIzc	unknown	T3
7	00ee	5e	1		00fe	aa	00	01	fd	nv-BdIzc	unknown	T3
8	00ee	5e	1		00fe	aa	00	01	fd	nv-BdIzc	unknown	T4
8	00ee	5e	1		00fe	aa	00	01	fd	nv-BdIzc	unknown	T4
9	00ee	5e	0		00fe	aa	00	01	fd	nv-BdIzc	unknown	T5
9	00ee	5e	0		00fe	aa	00	01	fd	nv-BdIzc	unknown	T5
10	00ee	5e	0		00fe	aa	00	01	fd	Nv-BdIzc	unknown	T0
10	00ee	bc	0		00fe	aa	00	01	fd	Nv-BdIzc	unknown	T0
11	00fe	4a	1	LSR	00fe	aa	00	01	fd	Nv-BdIzc	unknown	T1
11	00fe	4a	1	LSR	00fe	aa	00	01	fd	Nv-BdIzc	unknown	T1
12	00ff	01	1		00ff	be	00	01	fd	Nv-BdIzc	LSR	T0+T2
12	00ff	01	1		00ff	be	00	01	fd	Nv-BdIzc	LSR	T0+T2

CLC (18)	Cycles: 2	Size: 1
Implied		
Cycle	R/W	Desc
-X.2	Read PC	Store as OpCode.
1.1	Read PC	Inc. PC .
1.2		To be discarded.
2.1		Clear the C status bit.
2.2		Store as OpCode.
+X.1		

cycle	ab	db	rw	Fetch	pc	a	x	y	s	p	Execute	State
7	00fc	18	1	CLC	00fc	aa	00	00	fd	nv-BdIZC	JMP Abs	T1
7	00fc	18	1	CLC	00fc	aa	00	00	fd	nv-BdIZC	JMP Abs	T1
8	00fd	ee	1		00fd	aa	00	00	fd	nv-BdIZC	CLC	T0+T2
8	00fd	ee	1		00fd	aa	00	00	fd	nv-BdIZC	CLC	T0+T2
9	00fd	ee	1	INC Abs	00fd	aa	00	00	fd	nv-BdIZc	CLC	T1
9	00fd	ee	1	INC Abs	00fd	aa	00	00	fd	nv-BdIZc	CLC	T1
10	00fe	4a	1		00fe	aa	00	00	fd	nv-BdIZc	INC Abs	T2
10	00fe	4a	1		00fe	aa	00	00	fd	nv-BdIZc	INC Abs	T2

ORA (19)	Cycles: 4-5	Size: 3
Absolute, Y (Read)		
Cycle	R/W	Desc
-X.2	Read PC	Store as OpCode.
1.1		Inc. PC .
1.2	Read PC	Store as Address.L.
2.1		Inc. PC .
2.2	Read PC	Store as Address.H.
3.1		Inc. PC . Final=Address+Y. Address.L = Final.L.
3.2	Read Address	Store as Operand. If Address.H == Final.H, skip the next cycle (next half-cycle is 5.1).
4.1		Address.H = Final.H (fixes high byte of address).
4.2	Read Address	Store as Operand.
5.1		* Perform A=A Operand , set N and Z accordingly.
5.2	Read PC	Store as OpCode.
+X.1		A and N, Z applied.

* Setting of A/flags is delayed by 1 cycle until the start of the following instruction.

cycle	ab	db	rw	Fetch	pc	a	x	y	s	p	Execute	State
5	00fc	19	1	ORA Abs,Y	00fc	aa	00	38	fd	nv-BdIzc	JMP Abs	T1
5	00fc	19	1	ORA Abs,Y	00fc	aa	00	38	fd	nv-BdIzc	JMP Abs	T1
6	00fd	ff	1		00fd	aa	00	38	fd	nv-BdIzc	ORA Abs,Y	T2
6	00fd	ff	1		00fd	aa	00	38	fd	nv-BdIzc	ORA Abs,Y	T2
7	00fe	00	1		00fe	aa	00	38	fd	nv-BdIzc	ORA Abs,Y	T3
7	00fe	00	1		00fe	aa	00	38	fd	nv-BdIzc	ORA Abs,Y	T3
8	0037	00	1		00ff	aa	00	38	fd	nv-BdIzc	ORA Abs,Y	T4
8	0037	00	1		00ff	aa	00	38	fd	nv-BdIzc	ORA Abs,Y	T4
9	0137	0f	1		00ff	aa	00	38	fd	nv-BdIzc	ORA Abs,Y	T0
9	0137	0f	1		00ff	aa	00	38	fd	nv-BdIzc	ORA Abs,Y	T0
10	00ff	18	1	CLC	00ff	aa	00	38	fd	nv-BdIzc	ORA Abs,Y	T1
10	00ff	18	1	CLC	00ff	aa	00	38	fd	nv-BdIzc	ORA Abs,Y	T1
11	0100	00	1		0100	af	00	38	fd	Nv-BdIzc	CLC	T0+T2
11	0100	00	1		0100	af	00	38	fd	Nv-BdIzc	CLC	T0+T2

NOP (1A)		Cycles: 2	Size: 1
Implied			
Cycle	R/W		Desc
-X.2	Read PC		Store as OpCode.
1.1	Read PC		Inc. PC .
1.2			To be discarded.
2.1			
2.2			Store as OpCode.
+X.1			

cycle	ab	db	rw	Fetch	pc	a	x	y	s	p	Execute	State
5	00fc	1a	1	unknown	00fc	aa	00	38	fd	nv-BdIzc	JMP Abs	T1
5	00fc	1a	1	unknown	00fc	aa	00	38	fd	nv-BdIzc	JMP Abs	T1
6	00fd	18	1		00fd	aa	00	38	fd	nv-BdIzc	unknown	T0+T2
6	00fd	18	1		00fd	aa	00	38	fd	nv-BdIzc	unknown	T0+T2
7	00fd	18	1	CLC	00fd	aa	00	38	fd	nv-BdIzc	unknown	T1
7	00fd	18	1	CLC	00fd	aa	00	38	fd	nv-BdIzc	unknown	T1
8	00fe	00	1		00fe	aa	00	38	fd	nv-BdIzc	CLC	T0+T2
8	00fe	00	1		00fe	aa	00	38	fd	nv-BdIzc	CLC	T0+T2

SLO (1B)	Cycles: 7	Size: 3
Absolute, Y (Read/Modify/Write)		
Cycle	R/W	Desc
-X.2	Read PC	Store as OpCode.
1.1		Inc. PC .
1.2	Read PC	Store as Address.L.
2.1		Inc. PC .
2.2	Read PC	Store as Address.H.
3.1		Inc. PC . Final=Address+ Y . Address.L = Final.L.
3.2	Read Address	Store as Operand.
4.1		Address.H = Final.H (fixes high byte of address).
4.2	Read Address	Store as Operand.
5.1		
5.2	Write Address	Write unmodified Operand.
6.1		Set C if high bit of Operand is set. * Perform Operand=Operand << 1, A = A Operand, set N and Z based off A .
6.2	Write Address	Write modified Operand.
7.1		
7.2	Read PC	Store as OpCode.
+X.1		A and N , Z applied.

* Setting of A/flags is delayed by 2 cycles until the start of the following instruction.

cycle	ab	db	rw	Fetch	pc	a	x	y	s	p	Execute	State
5	00fc	1b	1	unknown	00fc	aa	00	38	fd	nv-BdIzc	JMP Abs	T1
5	00fc	1b	1	unknown	00fc	aa	00	38	fd	nv-BdIzc	JMP Abs	T1
6	00fd	18	1		00fd	aa	00	38	fd	nv-BdIzc	unknown	T2
6	00fd	18	1		00fd	aa	00	38	fd	nv-BdIzc	unknown	T2
7	00fe	00	1		00fe	aa	00	38	fd	nv-BdIzc	unknown	T3
7	00fe	00	1		00fe	aa	00	38	fd	nv-BdIzc	unknown	T3
8	0050	0f	1		00ff	aa	00	38	fd	nv-BdIzc	unknown	T4
8	0050	0f	1		00ff	aa	00	38	fd	nv-BdIzc	unknown	T4
9	0050	0f	1		00ff	aa	00	38	fd	nv-BdIzc	unknown	T5
9	0050	0f	1		00ff	aa	00	38	fd	nv-BdIzc	unknown	T5
10	0050	0f	0		00ff	aa	00	38	fd	nv-BdIzc	unknown	
10	0050	0f	0		00ff	aa	00	38	fd	nv-BdIzc	unknown	
11	0050	0f	0		00ff	aa	00	38	fd	nv-BdIzc	unknown	T0
11	0050	1e	0		00ff	aa	00	38	fd	nv-BdIzc	unknown	T0
12	00ff	18	1	CLC	00ff	aa	00	38	fd	nv-BdIzc	unknown	T1
12	00ff	18	1	CLC	00ff	aa	00	38	fd	nv-BdIzc	unknown	T1
13	0100	00	1		0100	be	00	38	fd	Nv-BdIzc	CLC	T0+T2
13	0100	00	1		0100	be	00	38	fd	Nv-BdIzc	CLC	T0+T2

NOP (1C) Cycles: 4-5		Size: 3
Absolute, X (Read)		
Cycle	R/W	Desc
-X.2	Read PC	Store as OpCode.
1.1	Read PC	Inc. PC .
1.2		Store as Address.L.
2.1		Inc. PC .
2.2		Store as Address.H.
3.1		Inc. PC . Final=Address+X. Address.L = Final.L.
3.2	Read Address	Store as Operand. If Address.H == Final.H, skip the next cycle (next half-cycle is 5.1).
4.1	Read Address	Address.H = Final.H (fixes high byte of address).
4.2		Store as Operand.
5.1		
5.2	Read PC	Store as OpCode.
+X.1		

cycle	ab	db	rw	Fetch	pc	a	x	y	s	p	Execute	State
5	00fc	1c	1	unknown	00fc	aa	00	38	fd	nv-BdIzc	JMP Abs	T1
5	00fc	1c	1	unknown	00fc	aa	00	38	fd	nv-BdIzc	JMP Abs	T1
6	00fd	18	1		00fd	aa	00	38	fd	nv-BdIzc	unknown	T2
6	00fd	18	1		00fd	aa	00	38	fd	nv-BdIzc	unknown	T2
7	00fe	00	1		00fe	aa	00	38	fd	nv-BdIzc	unknown	T3
7	00fe	00	1		00fe	aa	00	38	fd	nv-BdIzc	unknown	T3
8	0018	00	1		00ff	aa	00	38	fd	nv-BdIzc	unknown	T0
8	0018	00	1		00ff	aa	00	38	fd	nv-BdIzc	unknown	T0
9	00ff	18	1	CLC	00ff	aa	00	38	fd	nv-BdIzc	unknown	T1
9	00ff	18	1	CLC	00ff	aa	00	38	fd	nv-BdIzc	unknown	T1
10	0100	00	1		0100	aa	00	38	fd	nv-BdIzc	CLC	T0+T2
10	0100	00	1		0100	aa	00	38	fd	nv-BdIzc	CLC	T0+T2

ORA (1D)		Cycles: 4-5	Size: 3
Absolute, X (Read)			
Cycle	R/W	Desc	
-X.2	Read PC	Store as OpCode.	
1.1	Read PC	Inc. PC .	
1.2		Store as Address.L.	
2.1		Inc. PC .	
2.2		Store as Address.H.	
3.1		Inc. PC . Final=Address+X. Address.L = Final.L.	
3.2	Read Address	Store as Operand. If Address.H == Final.H, skip the next cycle (next half-cycle is 5.1).	
4.1	Read Address	Address.H = Final.H (fixes high byte of address).	
4.2		Store as Operand.	
5.1		* Perform A=A Operand , set N and Z accordingly.	
5.2		Store as OpCode.	
+X.1		A and N, Z applied.	

* Setting of A/flags is delayed by 1 cycle until the start of the following instruction.

cycle	ab	db	rw	Fetch	pc	a	x	y	s	p	Execute	State
5	00fc	1d	1	ORA Abs,X	00fc	aa	1f	00	fd	nv-BdIzc	JMP Abs	T1
5	00fc	1d	1	ORA Abs,X	00fc	aa	1f	00	fd	nv-BdIzc	JMP Abs	T1
6	00fd	ff	1		00fd	aa	1f	00	fd	nv-BdIzc	ORA Abs,X	T2
6	00fd	ff	1		00fd	aa	1f	00	fd	nv-BdIzc	ORA Abs,X	T2
7	00fe	00	1		00fe	aa	1f	00	fd	nv-BdIzc	ORA Abs,X	T3
7	00fe	00	1		00fe	aa	1f	00	fd	nv-BdIzc	ORA Abs,X	T3
8	001e	00	1		00ff	aa	1f	00	fd	nv-BdIzc	ORA Abs,X	T4
8	001e	00	1		00ff	aa	1f	00	fd	nv-BdIzc	ORA Abs,X	T4
9	011e	00	1		00ff	aa	1f	00	fd	nv-BdIzc	ORA Abs,X	T0
9	011e	00	1		00ff	aa	1f	00	fd	nv-BdIzc	ORA Abs,X	T0
10	00ff	18	1	CLC	00ff	aa	1f	00	fd	nv-BdIzc	ORA Abs,X	T1
10	00ff	18	1	CLC	00ff	aa	1f	00	fd	nv-BdIzc	ORA Abs,X	T1
11	0100	00	1		0100	aa	1f	00	fd	Nv-BdIzc	CLC	T0+T2
11	0100	00	1		0100	aa	1f	00	fd	Nv-BdIzc	CLC	T0+T2

ASL (1E)	Cycles: 7	Size: 3
Absolute, X (Read/Modify/Write)		
Cycle	R/W	Desc
-X.2	Read PC	Store as OpCode.
1.1		Inc. PC .
1.2	Read PC	Store as Address.L.
2.1		Inc. PC .
2.2	Read PC	Store as Address.H.
3.1		Inc. PC . Final=Address+ X . Address.L = Final.L.
3.2	Read Address	Store as Operand.
4.1		Address.H = Final.H (fixes high byte of address).
4.2	Read Address	Store as Operand.
5.1		
5.2	Write Address	Write unmodified Operand.
6.1		Set C if high bit of Operand is set. Perform Operand=Operand << 1, set N and Z accordingly.
6.2	Write Address	Write modified Operand.
7.1		
7.2	Read PC	Store as OpCode.
+X.1		

cycle	ab	db	rw	Fetch	pc	a	x	y	s	p	Execute	State
5	00fc	1e	1	ASL Abs,X	00fc	aa	1f	00	fd	nv-BdIzc	JMP Abs	T1
5	00fc	1e	1	ASL Abs,X	00fc	aa	1f	00	fd	nv-BdIzc	JMP Abs	T1
6	00fd	ff	1		00fd	aa	1f	00	fd	nv-BdIzc	ASL Abs,X	T2
6	00fd	ff	1		00fd	aa	1f	00	fd	nv-BdIzc	ASL Abs,X	T2
7	00fe	00	1		00fe	aa	1f	00	fd	nv-BdIzc	ASL Abs,X	T3
7	00fe	00	1		00fe	aa	1f	00	fd	nv-BdIzc	ASL Abs,X	T3
8	001e	00	1		00ff	aa	1f	00	fd	nv-BdIzc	ASL Abs,X	T4
8	001e	00	1		00ff	aa	1f	00	fd	nv-BdIzc	ASL Abs,X	T4
9	011e	7f	1		00ff	aa	1f	00	fd	nv-BdIzc	ASL Abs,X	T5
9	011e	7f	1		00ff	aa	1f	00	fd	nv-BdIzc	ASL Abs,X	T5
10	011e	7f	0		00ff	aa	1f	00	fd	nv-BdIzc	ASL Abs,X	
10	011e	7f	0		00ff	aa	1f	00	fd	nv-BdIzc	ASL Abs,X	
11	011e	7f	0		00ff	aa	1f	00	fd	Nv-BdIzc	ASL Abs,X	T0
11	011e	fe	0		00ff	aa	1f	00	fd	Nv-BdIzc	ASL Abs,X	T0
12	00ff	18	1	CLC	00ff	aa	1f	00	fd	Nv-BdIzc	ASL Abs,X	T1
12	00ff	18	1	CLC	00ff	aa	1f	00	fd	Nv-BdIzc	ASL Abs,X	T1
13	0100	00	1		0100	aa	1f	00	fd	Nv-BdIzc	CLC	T0+T2
13	0100	00	1		0100	aa	1f	00	fd	Nv-BdIzc	CLC	T0+T2

SLO (1F)	Cycles: 7	Size: 3
Absolute, X (Read/Modify/Write)		
Cycle	R/W	Desc
-X.2	Read PC	Store as OpCode.
1.1		Inc. PC .
1.2	Read PC	Store as Address.L.
2.1		Inc. PC .
2.2	Read PC	Store as Address.H.
3.1		Inc. PC . Final=Address+ X . Address.L = Final.L.
3.2	Read Address	Store as Operand.
4.1		Address.H = Final.H (fixes high byte of address).
4.2	Read Address	Store as Operand.
5.1		
5.2	Write Address	Write unmodified Operand.
6.1		* Set C if high bit of Operand is set. Perform Operand=Operand << 1, A = A Operand, set N and Z based off A .
6.2	Write Address	Write modified Operand.
7.1		
7.2	Read PC	Store as OpCode.
+X.1		A applied.

* Setting of A is delayed by 2 cycles until the start of the following instruction.

cycle	ab	db	rw	Fetch	pc	a	x	y	s	p	Execute	State
7	00fc	1f	1	unknown	00fc	00	1f	00	fd	nv-BdIZc	LDA #	T1
7	00fc	1f	1	unknown	00fc	00	1f	00	fd	nv-BdIZc	LDA #	T1
8	00fd	ff	1		00fd	00	1f	00	fd	nv-BdIZc	unknown	T2
8	00fd	ff	1		00fd	00	1f	00	fd	nv-BdIZc	unknown	T2
9	00fe	00	1		00fe	00	1f	00	fd	nv-BdIZc	unknown	T3
9	00fe	00	1		00fe	00	1f	00	fd	nv-BdIZc	unknown	T3
10	001e	00	1		00ff	00	1f	00	fd	nv-BdIZc	unknown	T4
10	001e	00	1		00ff	00	1f	00	fd	nv-BdIZc	unknown	T4
11	011e	fe	1		00ff	00	1f	00	fd	nv-BdIZc	unknown	T5
11	011e	fe	1		00ff	00	1f	00	fd	nv-BdIZc	unknown	T5
12	011e	fe	0		00ff	00	1f	00	fd	nv-BdIZc	unknown	
12	011e	fe	0		00ff	00	1f	00	fd	nv-BdIZc	unknown	
13	011e	fe	0		00ff	00	1f	00	fd	Nv-BdIzC	unknown	T0
13	011e	fc	0		00ff	00	1f	00	fd	Nv-BdIzC	unknown	T0
14	00ff	18	1	CLC	00ff	00	1f	00	fd	Nv-BdIzC	unknown	T1
14	00ff	18	1	CLC	00ff	00	1f	00	fd	Nv-BdIzC	unknown	T1
15	0100	00	1		0100	fc	1f	00	fd	Nv-BdIzC	CLC	T0+T2
15	0100	00	1		0100	fc	1f	00	fd	Nv-BdIzC	CLC	T0+T2

JSR (20)	Cycles: 6	Size: 3
Absolute		
Cycle	R/W	Desc
-X.2	Read PC	Store as OpCode.
1.1		Inc. PC .
1.2	Read PC	Store as Address.L.
2.1		Inc. PC .
2.2	Read S \$0100	
3.1		
3.2	Write S \$0100	Push PC .H onto stack.
4.1		
4.2	Write (S -1) \$0100	Push PC .L onto stack.
5.1		
5.2	Read PC	Store as Address.H.
6.1		PC =Address. Decrease S by 2.
6.2	Read PC	Store as OpCode.
+X.1		

cycle	ab	db	rw	Fetch	pc	a	x	y	s	p	Execute	State
2	0002	20	1	JSR Abs	0002	aa	1f	00	fd	nv-BdIzc	LDX #	T1
2	0002	20	1	JSR Abs	0002	aa	1f	00	fd	nv-BdIzc	LDX #	T1
3	0003	fa	1		0003	aa	1f	00	fd	nv-BdIzc	JSR Abs	T2
3	0003	fa	1		0003	aa	1f	00	fd	nv-BdIzc	JSR Abs	T2
4	01fd	00	1		0004	aa	1f	00	fa	nv-BdIzc	JSR Abs	T3
4	01fd	00	1		0004	aa	1f	00	fa	nv-BdIzc	JSR Abs	T3
5	01fd	00	0		0004	aa	1f	00	fa	nv-BdIzc	JSR Abs	T4
5	01fd	00	0		0004	aa	1f	00	fa	nv-BdIzc	JSR Abs	T4
6	01fc	00	0		0004	aa	1f	00	fa	nv-BdIzc	JSR Abs	T5
6	01fc	04	0		0004	aa	1f	00	fa	nv-BdIzc	JSR Abs	T5
7	0004	00	1		0004	aa	1f	00	fa	nv-BdIzc	JSR Abs	T0
7	0004	00	1		0004	aa	1f	00	fa	nv-BdIzc	JSR Abs	T0
8	00fa	a9	1	LDA #	00fa	aa	1f	00	fb	nv-BdIzc	JSR Abs	T1
8	00fa	a9	1	LDA #	00fa	aa	1f	00	fb	nv-BdIzc	JSR Abs	T1
9	00fb	00	1		00fb	aa	1f	00	fb	nv-BdIzc	LDA #	T0+T2
9	00fb	00	1		00fb	aa	1f	00	fb	nv-BdIzc	LDA #	T0+T2

AND (21)		Cycles: 6	Size: 2
Indirect, X (Read)			
Cycle	R/W	Desc	
-X.2	Read PC	Store as OpCode.	
1.1	Read PC	Inc. PC .	
1.2		Store as Operand.	
2.1		Inc. PC .	
2.2		Read Operand	
3.1		Set Pointer to (Operand+X) & \$FF.	
3.2		Read Pointer	
4.1		Store to Address.L.	
4.2		Read (Pointer+1) & \$FF	
5.1		Store to Address.H.	
5.2		Read Address	
6.1	Read PC	Store as Operand.	
6.2		* Perform A=A & Operand, set N and Z accordingly.	
+X.1		Store as OpCode.	
		A and N, Z applied.	

* Setting of A/flags is delayed by 1 cycle until the start of the following instruction.

cycle	ab	db	rw	Fetch	pc	a	x	y	s	p	Execute	State
4	0004	21	1	AND (zp,X)	0004	7f	0f	00	fd	nv-BdIzc	LDX #	T1
4	0004	21	1	AND (zp,X)	0004	7f	0f	00	fd	nv-BdIzc	LDX #	T1
5	0005	0e	1		0005	7f	0f	00	fd	nv-BdIzc	AND (zp,X)	T2
5	0005	0e	1		0005	7f	0f	00	fd	nv-BdIzc	AND (zp,X)	T2
6	000e	00	1		0006	7f	0f	00	fd	nv-BdIzc	AND (zp,X)	T3
6	000e	00	1		0006	7f	0f	00	fd	nv-BdIzc	AND (zp,X)	T3
7	001d	80	1		0006	7f	0f	00	fd	nv-BdIzc	AND (zp,X)	T4
7	001d	80	1		0006	7f	0f	00	fd	nv-BdIzc	AND (zp,X)	T4
8	001e	00	1		0006	7f	0f	00	fd	nv-BdIzc	AND (zp,X)	T5
8	001e	00	1		0006	7f	0f	00	fd	nv-BdIzc	AND (zp,X)	T5
9	0080	88	1		0006	7f	0f	00	fd	nv-BdIzc	AND (zp,X)	T0
9	0080	88	1		0006	7f	0f	00	fd	nv-BdIzc	AND (zp,X)	T0
10	0006	4c	1	JMP Abs	0006	7f	0f	00	fd	Nv-BdIzc	AND (zp,X)	T1
10	0006	4c	1	JMP Abs	0006	7f	0f	00	fd	Nv-BdIzc	AND (zp,X)	T1
11	0007	00	1		0007	08	0f	00	fd	nv-BdIzc	JMP Abs	T2
11	0007	00	1		0007	08	0f	00	fd	nv-BdIzc	JMP Abs	T2

JAM (22)	Cycles: ∞	Size: 1
Implied		
Cycle	R/W	Desc
-X.2	Read PC	Store as OpCode.
1.1		Inc. PC .
1.2	Read PC	
2.1		
2.2	Read \$FFFF	
3.1		
3.2	Read \$FFFE	
4.1		
4.2	Read \$FFFE	
5.1		Repeat 5.1 and 5.2 forever.
5.2	Read \$FFFF	

cycle	ab	db	rw	Fetch	pc	a	x	y	s	p	Execute	State
2	0002	02	1	unknown	0002	00	00	00	fd	nv-BdIZc	LDA #	T1
2	0002	02	1	unknown	0002	00	00	00	fd	nv-BdIZc	LDA #	T1
3	0003	10	1		0003	00	00	00	fd	nv-BdIZc	unknown	T2
3	0003	10	1		0003	00	00	00	fd	nv-BdIZc	unknown	T2
4	ffff	00	1		0004	00	00	00	fd	nv-BdIZc	unknown	T3
4	ffff	00	1		0004	00	00	00	fd	nv-BdIZc	unknown	T3
5	fffe	00	1		0004	00	00	00	fd	nv-BdIZc	unknown	T4
5	fffe	00	1		0004	00	00	00	fd	nv-BdIZc	unknown	T4
6	fffe	00	1		0004	00	00	00	fd	nv-BdIZc	unknown	T5
6	fffe	00	1		0004	00	00	00	fd	nv-BdIZc	unknown	T5
7	ffff	00	1		0004	00	00	00	fd	nv-BdIZc	unknown	
7	ffff	00	1		0004	00	00	00	fd	nv-BdIZc	unknown	
8	ffff	00	1		0004	00	00	00	fd	nv-BdIZc	unknown	
8	ffff	00	1		0004	00	00	00	fd	nv-BdIZc	unknown	
9	ffff	00	1		0004	00	00	00	fd	nv-BdIZc	unknown	
9	ffff	00	1		0004	00	00	00	fd	nv-BdIZc	unknown	
10	ffff	00	1		0004	00	00	00	fd	nv-BdIZc	unknown	
10	ffff	00	1		0004	00	00	00	fd	nv-BdIZc	unknown	
11	ffff	00	1		0004	00	00	00	fd	nv-BdIZc	unknown	
11	ffff	00	1		0004	00	00	00	fd	nv-BdIZc	unknown	

RLA (23)	Cycles: 8	Size: 2
Indirect, X (Read/Modify/Write)		
Cycle	R/W	Desc
-X.2	Read PC	Store as OpCode.
1.1		Inc. PC .
1.2	Read PC	Store as Operand.
2.1		Inc. PC .
2.2	Read Operand	
3.1		Set Pointer to (Operand+X) & \$FF.
3.2	Read Pointer	Store to Address.L.
4.1		
4.2	Read (Pointer+1) & \$FF	Store to Address.H.
5.1		
5.2	Read Address	Store as Operand.
6.1		
6.2	Write Address	Write unmodified Operand.
7.1		* Perform Operand=(Operand << 1) C , A = A & Operand, set N and Z based off A . Set C if high bit of Operand was set before the shift operation.
7.2	Write Address	Write modified Operand.
8.1		
8.2	Read PC	Store as OpCode.
+X.1		A applied.

* Setting of A is delayed by 2 cycles until the start of the following instruction.

cycle	ab	db	rw	Fetch	pc	a	x	y	s	p	Execute	State
4	0004	23	1	unknown	0004	7f	0f	00	fd	nv-BdIzc	LDX #	T1
4	0004	23	1	unknown	0004	7f	0f	00	fd	nv-BdIzc	LDX #	T1
5	0005	0e	1		0005	7f	0f	00	fd	nv-BdIzc	unknown	T2
5	0005	0e	1		0005	7f	0f	00	fd	nv-BdIzc	unknown	T2
6	000e	00	1		0006	7f	0f	00	fd	nv-BdIzc	unknown	T3
6	000e	00	1		0006	7f	0f	00	fd	nv-BdIzc	unknown	T3
7	001d	80	1		0006	7f	0f	00	fd	nv-BdIzc	unknown	T4
7	001d	80	1		0006	7f	0f	00	fd	nv-BdIzc	unknown	T4
8	001e	00	1		0006	7f	0f	00	fd	nv-BdIzc	unknown	T5
8	001e	00	1		0006	7f	0f	00	fd	nv-BdIzc	unknown	T5
9	0080	88	1		0006	7f	0f	00	fd	nv-BdIzc	unknown	
9	0080	88	1		0006	7f	0f	00	fd	nv-BdIzc	unknown	
10	0080	88	0		0006	7f	0f	00	fd	nv-BdIzc	unknown	
10	0080	88	0		0006	7f	0f	00	fd	nv-BdIzc	unknown	
11	0080	88	0		0006	7f	0f	00	fd	nv-BdIzc	unknown	T0
11	0080	10	0		0006	7f	0f	00	fd	nv-BdIzc	unknown	T0
12	0006	4c	1	JMP Abs	0006	7f	0f	00	fd	nv-BdIzc	unknown	T1
12	0006	4c	1	JMP Abs	0006	7f	0f	00	fd	nv-BdIzc	unknown	T1
13	0007	00	1		0007	10	0f	00	fd	nv-BdIzc	JMP Abs	T2
13	0007	00	1		0007	10	0f	00	fd	nv-BdIzc	JMP Abs	T2

BIT (24)	Cycles: 3	Size: 2
Zero Page (Read)		
Cycle	R/W	Desc
-X.2	Read PC	Store as OpCode.
1.1		Inc. PC .
1.2	Read PC	Store as Address.
2.1		Inc. PC .
2.2	Read Address	Store as Operand.
3.1		V =(Operand & (1 << 6)) != 0. N =(Operand & (1 << 7)) != 0. Z =(Operand & A) == 0.
3.2	Read PC	Store as OpCode.
+X.1		

cycle	ab	db	rw	Fetch	pc	a	x	y	s	p	Execute	State
2	0002	24	1	BIT zp	0002	00	00	00	fd	nv-BdIZc	LDA #	T1
2	0002	24	1	BIT zp	0002	00	00	00	fd	nv-BdIZc	LDA #	T1
3	0003	10	1		0003	00	00	00	fd	nv-BdIZc	BIT zp	T2
3	0003	10	1		0003	00	00	00	fd	nv-BdIZc	BIT zp	T2
4	0010	e8	1		0004	00	00	00	fd	nv-BdIZc	BIT zp	T0
4	0010	e8	1		0004	00	00	00	fd	nv-BdIZc	BIT zp	T0
5	0004	a9	1	LDA #	0004	00	00	00	fd	NV-BdIZc	BIT zp	T1
5	0004	a9	1	LDA #	0004	00	00	00	fd	NV-BdIZc	BIT zp	T1
6	0005	4c	1		0005	00	00	00	fd	NV-BdIZc	LDA #	T0+T2
6	0005	4c	1		0005	00	00	00	fd	NV-BdIZc	LDA #	T0+T2

AND (25)		Cycles: 3	Size: 2
Zero Page (Read)			
Cycle	R/W	Desc	
-X.2	Read PC	Store as OpCode.	
1.1	Read PC	Inc. PC .	
1.2		Store as Address.	
2.1		Inc. PC .	
2.2		Store as Operand.	
3.1		* Perform A=A & Operand, set N and Z accordingly.	
3.2	Read PC	Store as OpCode.	
+X.1		A and N, Z applied.	

* Setting of A/flags is delayed by 1 cycle until the start of the following instruction.

cycle	ab	db	rw	Fetch	pc	a	x	y	s	p	Execute	State
2	0002	25	1	AND zp	0002	01	00	00	fd	nv-BdIzc	LDA #	T1
2	0002	25	1	AND zp	0002	01	00	00	fd	nv-BdIzc	LDA #	T1
3	0003	10	1		0003	01	00	00	fd	nv-BdIzc	AND zp	T2
3	0003	10	1		0003	01	00	00	fd	nv-BdIzc	AND zp	T2
4	0010	e8	1		0004	01	00	00	fd	nv-BdIzc	AND zp	T0
4	0010	e8	1		0004	01	00	00	fd	nv-BdIzc	AND zp	T0
5	0004	a9	1	LDA #	0004	01	00	00	fd	Nv-BdIzc	AND zp	T1
5	0004	a9	1	LDA #	0004	01	00	00	fd	Nv-BdIzc	AND zp	T1
6	0005	4c	1		0005	00	00	00	fd	nv-BdIzc	LDA #	T0+T2
6	0005	4c	1		0005	00	00	00	fd	nv-BdIzc	LDA #	T0+T2

ROL (26)		Cycles: 5	Size: 2
Zero Page (Read/Modify/Write)			
Cycle	R/W	Desc	
-X.2	Read PC	Store as OpCode.	
1.1	Read PC	Inc. PC .	
1.2		Store as Address.	
2.1		Inc. PC .	
2.2		Store as Operand.	
3.1			
3.2	Write Address	Write unmodified Operand.	
4.1	Write Address	Perform Operand=(Operand << 1) C , set N and Z accordingly.	
4.2		Set C if high bit of Operand was set before the shift operation.	
5.1		Write modified Operand.	
5.2	Read PC	Store as OpCode.	
+X.1			

cycle	ab	db	rw	Fetch	pc	a	x	y	s	p	Execute	State
6	0004	26	1	ROL zp	0004	aa	01	00	fd	Nv-BdIZc	AND zp	T1
6	0004	26	1	ROL zp	0004	aa	01	00	fd	Nv-BdIZc	AND zp	T1
7	0005	4c	1		0005	a8	01	00	fd	Nv-BdIZc	ROL zp	T2
7	0005	4c	1		0005	a8	01	00	fd	Nv-BdIZc	ROL zp	T2
8	004c	00	1		0006	a8	01	00	fd	Nv-BdIZc	ROL zp	T3
8	004c	00	1		0006	a8	01	00	fd	Nv-BdIZc	ROL zp	T3
9	004c	00	0		0006	a8	01	00	fd	Nv-BdIZc	ROL zp	T4
9	004c	00	0		0006	a8	01	00	fd	Nv-BdIZc	ROL zp	T4
10	004c	00	0		0006	a8	01	00	fd	nv-BdIZc	ROL zp	T0
10	004c	00	0		0006	a8	01	00	fd	nv-BdIZc	ROL zp	T0
11	0006	45	1	EOR zp	0006	a8	01	00	fd	nv-BdIZc	ROL zp	T1
11	0006	45	1	EOR zp	0006	a8	01	00	fd	nv-BdIZc	ROL zp	T1
12	0007	00	1		0007	a8	01	00	fd	nv-BdIZc	EOR zp	T2
12	0007	00	1		0007	a8	01	00	fd	nv-BdIZc	EOR zp	T2

RLA (27)	Cycles: 5	Size: 2
Zero Page (Read/Modify/Write)		
Cycle	R/W	Desc
-X.2	Read PC	Store as OpCode.
1.1		Inc. PC .
1.2	Read PC	Store as Address.
2.1		Inc. PC .
2.2	Read Address	Store as Operand.
3.1		
3.2	Write Address	Write unmodified Operand.
4.1		* Perform Operand=(Operand << 1) C , A = A & Operand, set N and Z based off A . Set C if high bit of Operand was set before the shift operation.
4.2	Write Address	Write modified Operand.
5.1		
5.2	Read PC	Store as OpCode.
+X.1		A applied.

* Setting of A is delayed by 2 cycles until the start of the following instruction.

cycle	ab	db	rw	Fetch	pc	a	x	y	s	p	Execute	State
6	0004	27	1	unknown	0004	aa	01	00	fd	Nv-BdIZc	AND zp	T1
6	0004	27	1	unknown	0004	aa	01	00	fd	Nv-BdIZc	AND zp	T1
7	0005	4c	1		0005	a8	01	00	fd	Nv-BdIZc	unknown	T2
7	0005	4c	1		0005	a8	01	00	fd	Nv-BdIZc	unknown	T2
8	004c	00	1		0006	a8	01	00	fd	Nv-BdIZc	unknown	T3
8	004c	00	1		0006	a8	01	00	fd	Nv-BdIZc	unknown	T3
9	004c	00	0		0006	a8	01	00	fd	Nv-BdIZc	unknown	T4
9	004c	00	0		0006	a8	01	00	fd	Nv-BdIZc	unknown	T4
10	004c	00	0		0006	a8	01	00	fd	nv-BdIZc	unknown	T0
10	004c	00	0		0006	a8	01	00	fd	nv-BdIZc	unknown	T0
11	0006	45	1	EOR zp	0006	a8	01	00	fd	nv-BdIZc	unknown	T1
11	0006	45	1	EOR zp	0006	a8	01	00	fd	nv-BdIZc	unknown	T1
12	0007	00	1		0007	00	01	00	fd	nv-BdIZc	EOR zp	T2
12	0007	00	1		0007	00	01	00	fd	nv-BdIZc	EOR zp	T2

PLP (28)	Cycles: 4	Size: 1
Implied		
Cycle	R/W	Desc
-X.2	Read PC	Store as OpCode.
1.1		Inc. PC .
1.2	Read PC	To be discarded.
2.1		
2.2	Read S \$0100	
3.1		Inc. S .
3.2	Read S \$0100	Store as Operand.
4.1		P =(Operand & ~ B) M (the reserved bit).
4.2	Read PC	Store as OpCode.
+X.1		

cycle	ab	db	rw	Fetch	pc	a	x	y	s	p	Execute	State
3	0002	28	1	PLP	0002	aa	a6	00	fd	Nv-BdIzc	LDX zp	T1
3	0002	28	1	PLP	0002	aa	a6	00	fd	Nv-BdIzc	LDX zp	T1
4	0003	10	1		0003	aa	a6	00	fd	Nv-BdIzc	PLP	T2
4	0003	10	1		0003	aa	a6	00	fd	Nv-BdIzc	PLP	T2
5	01fd	00	1		0003	aa	a6	00	fd	Nv-BdIzc	PLP	T3
5	01fd	00	1		0003	aa	a6	00	fd	Nv-BdIzc	PLP	T3
6	01fe	01	1		0003	aa	a6	00	fe	Nv-BdIzc	PLP	T0
6	01fe	01	1		0003	aa	a6	00	fe	Nv-BdIzc	PLP	T0
7	0003	10	1	BPL	0003	aa	a6	00	fe	nv-BdizC	PLP	T1
7	0003	10	1	BPL	0003	aa	a6	00	fe	nv-BdizC	PLP	T1
8	0004	27	1		0004	aa	a6	00	fe	nv-BdizC	BPL	T2
8	0004	27	1		0004	aa	a6	00	fe	nv-BdizC	BPL	T2

AND (29)		Cycles: 2	Size: 2
Immediate (Read)			
Cycle	R/W	Desc	
-X.2	Read PC	Store as OpCode.	
1.1	Read PC	Inc. PC .	
1.2		Store as Operand.	
2.1		Inc. PC . * Perform A=A & Operand , set N and Z accordingly.	
2.2		Store as OpCode.	
+X.1		A and N, Z applied.	

* Setting of A/flags is delayed by 1 cycle until the start of the following instruction.

cycle	ab	db	rw	Fetch	pc	a	x	y	s	p	Execute	State
2	0002	29	1	AND #	0002	ff	00	00	fd	Nv-BdIzc	LDA #	T1
2	0002	29	1	AND #	0002	ff	00	00	fd	Nv-BdIzc	LDA #	T1
3	0003	33	1		0003	ff	00	00	fd	Nv-BdIzc	AND #	T0+T2
3	0003	33	1		0003	ff	00	00	fd	Nv-BdIzc	AND #	T0+T2
4	0004	a6	1	LDX zp	0004	ff	00	00	fd	nv-BdIzc	AND #	T1
4	0004	a6	1	LDX zp	0004	ff	00	00	fd	nv-BdIzc	AND #	T1
5	0005	4c	1		0005	33	00	00	fd	nv-BdIzc	LDX zp	T2
5	0005	4c	1		0005	33	00	00	fd	nv-BdIzc	LDX zp	T2

ROL (2A)		Cycles: 2	Size: 1
Implied (Read)			
Cycle	R/W	Desc	
-X.2	Read PC	Store as OpCode.	
1.1	Read PC	Inc. PC .	
1.2			
2.1		Perform Operand=(Operand << 1) C , set N and Z accordingly.	
2.2		Set C if high bit of Operand was set before the shift operation.	
+X.1	Read PC	Store as OpCode.	

cycle	ab	db	rw	Fetch	pc	a	x	y	s	p	Execute	State
3	0002	2a	1	ROL	0002	aa	00	00	fd	NV-BdIzc	BIT zp	T1
3	0002	2a	1	ROL	0002	aa	00	00	fd	NV-BdIzc	BIT zp	T1
4	0003	56	1		0003	aa	00	00	fd	NV-BdIzc	ROL	T0+T2
4	0003	56	1		0003	aa	00	00	fd	NV-BdIzc	ROL	T0+T2
5	0003	56	1	LSR zp,X	0003	aa	00	00	fd	NV-BdIzc	ROL	T1
5	0003	56	1	LSR zp,X	0003	aa	00	00	fd	NV-BdIzc	ROL	T1
6	0004	01	1		0004	54	00	00	fd	nV-BdIzc	LSR zp,X	T2
6	0004	01	1		0004	54	00	00	fd	nV-BdIzc	LSR zp,X	T2

ANC (2B)		Cycles: 2	Size: 2
Immediate (Read)			
Cycle	R/W	Desc	
-X.2	Read PC	Store as OpCode.	
1.1	Read PC	Inc. PC .	
1.2		Store as Operand.	
2.1		Inc. PC . * Perform A=A & Operand , set C , N , and Z accordingly (C is set using logic for N).	
2.2		Store as OpCode.	
+X.1		** A and C , N , Z applied.	

* Setting of A/flags is delayed by 1 cycle until the start of the following instruction.

** Visual6502 incorrectly omits the update of A; flags are updated based on the incorrect A value.

cycle	ab	db	rw	Fetch	pc	a	x	y	s	p	Execute	State
2	0002	2b	1	unknown	0002	0f	00	00	fd	nv-BdIzc	LDA #	T1
2	0002	2b	1	unknown	0002	0f	00	00	fd	nv-BdIzc	LDA #	T1
3	0003	33	1		0003	0f	00	00	fd	nv-BdIzc	unknown	T0+T2
3	0003	33	1		0003	0f	00	00	fd	nv-BdIzc	unknown	T0+T2
4	0004	a6	1	LDX zp	0004	0f	00	00	fd	nv-BdIzc	unknown	T1
4	0004	a6	1	LDX zp	0004	0f	00	00	fd	nv-BdIzc	unknown	T1
5	0005	4c	1		0005	0f	00	00	fd	nv-BdIzc	LDX zp	T2
5	0005	4c	1		0005	0f	00	00	fd	nv-BdIzc	LDX zp	T2

ANC (ANC2, ANA, ANB)

Type: Combination of an immediate and an implied command (Sub-instructions: AND, ASL/ROL)

Op.	Mnemonic	Function	Size	Cycles	N	V	-	B	D	I	Z	C
\$0B	ANC #imm	A = A & #{imm}	2	2	o						o	o
\$2B	ANC #imm	A = A & #{imm}	2	2	o						o	o

Operation: ANDs the contents of the A register with an immediate value and then moves bit 7 of A into the Carry flag.

- This opcode works basically identically to AND #imm. except that the Carry flag is set to the same state that the Negative flag is set to. (bit 7 is put into the carry, as if the ASL/ROL would have been executed)

— NoMoreSecrets-NMOS6510UnintendedOpcodes-20232412.pdf

BIT (2C)	Cycles: 4	Size: 3
Absolute (Read)		
Cycle	R/W	Desc
-X.2	Read PC	Store as OpCode.
1.1		Inc. PC .
1.2	Read PC	Store as Address.L.
2.1		Inc. PC .
2.2	Read PC	Store as Address.H.
3.1		Inc. PC .
3.2	Read Address	Store as Operand.
4.1		V =(Operand & (1 << 6)) != 0. N =(Operand & (1 << 7)) != 0. Z =(Operand & A) == 0.
4.2	Read PC	Store as OpCode.
+X.1		

cycle	ab	db	rw	Fetch	pc	a	x	y	s	p	Execute	State
2	0002	2c	1	BIT Abs	0002	0f	00	00	fd	nv-BdIzc	LDA #	T1
2	0002	2c	1	BIT Abs	0002	0f	00	00	fd	nv-BdIzc	LDA #	T1
3	0003	10	1		0003	0f	00	00	fd	nv-BdIzc	BIT Abs	T2
3	0003	10	1		0003	0f	00	00	fd	nv-BdIzc	BIT Abs	T2
4	0004	00	1		0004	0f	00	00	fd	nv-BdIzc	BIT Abs	T3
4	0004	00	1		0004	0f	00	00	fd	nv-BdIzc	BIT Abs	T3
5	0010	e8	1		0005	0f	00	00	fd	nv-BdIzc	BIT Abs	T0
5	0010	e8	1		0005	0f	00	00	fd	nv-BdIzc	BIT Abs	T0
6	0005	4c	1	JMP Abs	0005	0f	00	00	fd	NV-BdIzc	BIT Abs	T1
6	0005	4c	1	JMP Abs	0005	0f	00	00	fd	NV-BdIzc	BIT Abs	T1
7	0006	45	1		0006	0f	00	00	fd	NV-BdIzc	JMP Abs	T2
7	0006	45	1		0006	0f	00	00	fd	NV-BdIzc	JMP Abs	T2

AND (2D)		Cycles: 4	Size: 3
Absolute (Read)			
Cycle	R/W	Desc	
-X.2	Read PC	Store as OpCode.	
1.1	Read PC	Inc. PC .	
1.2		Store as Address.L.	
2.1		Inc. PC .	
2.2		Store as Address.H.	
3.1		Inc. PC .	
3.2		Store as Operand.	
4.1		* Perform A=A & Operand , set N and Z accordingly.	
4.2		Store as OpCode.	
+X.1		A and N, Z applied.	

* Setting of A/flags is delayed by 1 cycle until the start of the following instruction.

cycle	ab	db	rw	Fetch	pc	a	x	y	s	p	Execute	State
2	0002	2d	1	AND Abs	0002	0f	00	00	fd	nv-BdIzc	LDA #	T1
2	0002	2d	1	AND Abs	0002	0f	00	00	fd	nv-BdIzc	LDA #	T1
3	0003	10	1		0003	0f	00	00	fd	nv-BdIzc	AND Abs	T2
3	0003	10	1		0003	0f	00	00	fd	nv-BdIzc	AND Abs	T2
4	0004	00	1		0004	0f	00	00	fd	nv-BdIzc	AND Abs	T3
4	0004	00	1		0004	0f	00	00	fd	nv-BdIzc	AND Abs	T3
5	0010	88	1		0005	0f	00	00	fd	nv-BdIzc	AND Abs	T0
5	0010	88	1		0005	0f	00	00	fd	nv-BdIzc	AND Abs	T0
6	0005	4c	1	JMP Abs	0005	0f	00	00	fd	Nv-BdIzc	AND Abs	T1
6	0005	4c	1	JMP Abs	0005	0f	00	00	fd	Nv-BdIzc	AND Abs	T1
7	0006	45	1		0006	08	00	00	fd	nv-BdIzc	JMP Abs	T2
7	0006	45	1		0006	08	00	00	fd	nv-BdIzc	JMP Abs	T2

ROL (2E)	Cycles: 6	Size: 3
Absolute (Read/Modify/Write)		
Cycle	R/W	Desc
-X.2	Read PC	Store as OpCode.
1.1		Inc. PC .
1.2	Read PC	Store as Address.L.
2.1		Inc. PC .
2.2	Read PC	Store as Address.H.
3.1		Inc. PC .
3.2	Read Address	Store as Operand.
4.1		
4.2	Write Address	Write unmodified Operand.
5.1		Perform Operand=(Operand << 1) C , set N and Z accordingly. Set C if high bit of Operand was set before the shift operation.
5.2	Write Address	Write modified Operand.
6.1		
6.2	Read PC	Store as OpCode.
+X.1		

cycle	ab	db	rw	Fetch	pc	a	x	y	s	p	Execute	State
3	0002	2e	1	ROL Abs	0002	aa	00	00	fd	NV-BdIzc	BIT zp	T1
3	0002	2e	1	ROL Abs	0002	aa	00	00	fd	NV-BdIzc	BIT zp	T1
4	0003	fb	1		0003	aa	00	00	fd	NV-BdIzc	ROL Abs	T2
4	0003	fb	1		0003	aa	00	00	fd	NV-BdIzc	ROL Abs	T2
5	0004	01	1		0004	aa	00	00	fd	NV-BdIzc	ROL Abs	T3
5	0004	01	1		0004	aa	00	00	fd	NV-BdIzc	ROL Abs	T3
6	01fb	8f	1		0005	aa	00	00	fd	NV-BdIzc	ROL Abs	T4
6	01fb	8f	1		0005	aa	00	00	fd	NV-BdIzc	ROL Abs	T4
7	01fb	8f	0		0005	aa	00	00	fd	NV-BdIzc	ROL Abs	T5
7	01fb	8f	0		0005	aa	00	00	fd	NV-BdIzc	ROL Abs	T5
8	01fb	8f	0		0005	aa	00	00	fd	nV-BdIzC	ROL Abs	T0
8	01fb	1e	0		0005	aa	00	00	fd	nV-BdIzC	ROL Abs	T0
9	0005	50	1	BVC	0005	aa	00	00	fd	nV-BdIzC	ROL Abs	T1
9	0005	50	1	BVC	0005	aa	00	00	fd	nV-BdIzC	ROL Abs	T1
10	0006	2e	1		0006	aa	00	00	fd	nV-BdIzC	BVC	T2
10	0006	2e	1		0006	aa	00	00	fd	nV-BdIzC	BVC	T2

RLA (2F)	Cycles: 6	Size: 3
Absolute (Read/Modify/Write)		
Cycle	R/W	Desc
-X.2	Read PC	Store as OpCode.
1.1		Inc. PC .
1.2	Read PC	Store as Address.L.
2.1		Inc. PC .
2.2	Read PC	Store as Address.H.
3.1		Inc. PC .
3.2	Read Address	Store as Operand.
4.1		
4.2	Write Address	Write unmodified Operand.
5.1		* Perform Operand=(Operand << 1) C , A=A & Operand, set N and Z based off A . Set C if high bit of Operand was set before the shift operation.
5.2	Write Address	Write modified Operand.
6.1		
6.2	Read PC	Store as OpCode.
+X.1		A applied.

* Setting of A is delayed by 2 cycles until the start of the following instruction.

cycle	ab	db	rw	Fetch	pc	a	x	y	s	p	Execute	State
4	0003	2f	1	unknown	0003	0f	00	00	fd	nv-BdIzC	SEC	T1
4	0003	2f	1	unknown	0003	0f	00	00	fd	nv-BdIzC	SEC	T1
5	0004	2e	1		0004	0f	00	00	fd	nv-BdIzC	unknown	T2
5	0004	2e	1		0004	0f	00	00	fd	nv-BdIzC	unknown	T2
6	0005	00	1		0005	0f	00	00	fd	nv-BdIzC	unknown	T3
6	0005	00	1		0005	0f	00	00	fd	nv-BdIzC	unknown	T3
7	002e	7f	1		0006	0f	00	00	fd	nv-BdIzC	unknown	T4
7	002e	7f	1		0006	0f	00	00	fd	nv-BdIzC	unknown	T4
8	002e	7f	0		0006	0f	00	00	fd	nv-BdIzC	unknown	T5
8	002e	7f	0		0006	0f	00	00	fd	nv-BdIzC	unknown	T5
9	002e	7f	0		0006	0f	00	00	fd	Nv-BdIzc	unknown	T0
9	002e	ff	0		0006	0f	00	00	fd	Nv-BdIzc	unknown	T0
10	0006	00	1	BRK	0006	0f	00	00	fd	Nv-BdIzc	unknown	T1
10	0006	00	1	BRK	0006	0f	00	00	fd	Nv-BdIzc	unknown	T1
11	0007	00	1		0007	0f	00	00	fd	nv-BdIzc	BRK	T2
11	0007	00	1		0007	0f	00	00	fd	nv-BdIzc	BRK	T2

BMI (30)	Cycles: 2-4	Size: 2
Branch Relative		
Cycle	R/W	Desc
-X.2	Read PC	Store as OpCode.
1.1	Read PC	Inc. PC . Check condition (N == 1).
1.2		Store as Operand. Treat as signed 16-bit (Op16=i16(i8(Operand))).
2.1		Inc. PC . If not jumping, end (next half-cycle is 4.2)
2.2		If (PC +Op16).H != PC .H, end after PC .L fix (next half-cycle is 4.2). PC .L= PC .L+Operand.
3.1		
3.2	Read PC	
4.1	Read PC	PC .H=previous “(PC +Op16).H” value.
4.2		Store as OpCode.
+X.1		

cycle	ab	db	rw	Fetch	pc	a	x	y	s	p	Execute	State
4	0003	30	1	BMI	0003	0f	00	00	fd	nv-BdIzC	SEC	T1
4	0003	30	1	BMI	0003	0f	00	00	fd	nv-BdIzC	SEC	T1
5	0004	2e	1		0004	0f	00	00	fd	nv-BdIzC	BMI	T2
5	0004	2e	1		0004	0f	00	00	fd	nv-BdIzC	BMI	T2
6	0005	00	1	BRK	0005	0f	00	00	fd	nv-BdIzC	BMI	
6	0005	00	1	BRK	0005	0f	00	00	fd	nv-BdIzC	BMI	
7	0006	00	1		0006	0f	00	00	fd	nv-BdIzC	BRK	T2
7	0006	00	1		0006	0f	00	00	fd	nv-BdIzC	BRK	T2

cycle	ab	db	rw	Fetch	pc	a	x	y	s	p	Execute	State
4	0003	30	1	BMI	0003	ff	00	00	fd	Nv-BdIzC	SEC	T1
4	0003	30	1	BMI	0003	ff	00	00	fd	Nv-BdIzC	SEC	T1
5	0004	2e	1		0004	ff	00	00	fd	Nv-BdIzC	BMI	T2
5	0004	2e	1		0004	ff	00	00	fd	Nv-BdIzC	BMI	T2
6	0005	00	1		0005	ff	00	00	fd	Nv-BdIzC	BMI	T3
6	0005	00	1		0005	ff	00	00	fd	Nv-BdIzC	BMI	T3
7	0033	00	1	BRK	0033	ff	00	00	fd	Nv-BdIzC	BMI	
7	0033	00	1	BRK	0033	ff	00	00	fd	Nv-BdIzC	BMI	
8	0034	00	1		0034	ff	00	00	fd	Nv-BdIzC	BRK	T2
8	0034	00	1		0034	ff	00	00	fd	Nv-BdIzC	BRK	T2

cycle	ab	db	rw	Fetch	pc	a	x	y	s	p	Execute	State
7	00fc	30	1	BMI	00fc	ff	00	00	fd	Nv-BdIzC	JMP Abs	T1
7	00fc	30	1	BMI	00fc	ff	00	00	fd	Nv-BdIzC	JMP Abs	T1
8	00fd	2e	1		00fd	ff	00	00	fd	Nv-BdIzC	BMI	T2
8	00fd	2e	1		00fd	ff	00	00	fd	Nv-BdIzC	BMI	T2
9	00fe	00	1		00fe	ff	00	00	fd	Nv-BdIzC	BMI	T3
9	00fe	00	1		00fe	ff	00	00	fd	Nv-BdIzC	BMI	T3
10	002c	00	1		002c	ff	00	00	fd	Nv-BdIzC	BMI	T0
10	002c	00	1		002c	ff	00	00	fd	Nv-BdIzC	BMI	T0
11	012c	00	1	BRK	012c	ff	00	00	fd	Nv-BdIzC	BMI	T1
11	012c	00	1	BRK	012c	ff	00	00	fd	Nv-BdIzC	BMI	T1
12	012d	00	1		012d	ff	00	00	fd	Nv-BdIzC	BRK	T2
12	012d	00	1		012d	ff	00	00	fd	Nv-BdIzC	BRK	T2

AND (31)		Cycles: 5-6	Size: 2
Indirect, Y (Read)			
Cycle	R/W	Desc	
-X.2	Read PC	Store as OpCode.	
1.1	Read PC	Inc. PC .	
1.2		Store as Pointer.	
2.1		Inc. PC .	
2.2		Store to Address.L.	
3.1	Read Pointer		
3.2		Store to Address.H.	
4.1		Final=Address+Y. Address.L = Final.L.	
4.2		Store as Operand. If Address.H == Final.H, skip the next cycle (next half-cycle is 6.1).	
5.1	Read Address	Address.H = Final.H (fixes high byte of address).	
5.2		Store as Operand.	
6.1		* Perform A=A & Operand , set N and Z accordingly.	
6.2		Store as OpCode.	
+X.1		A and N, Z applied.	

* Setting of A/flags is delayed by 1 cycle until the start of the following instruction.

cycle	ab	db	rw	Fetch	pc	a	x	y	s	p	Execute	State
4	0003	31	1	AND (zp),Y	0003	aa	00	ff	fd	Nv-BdIzC	SEC	T1
4	0003	31	1	AND (zp),Y	0003	aa	00	ff	fd	Nv-BdIzC	SEC	T1
5	0004	fc	1		0004	aa	00	ff	fd	Nv-BdIzC	AND (zp),Y	T2
5	0004	fc	1		0004	aa	00	ff	fd	Nv-BdIzC	AND (zp),Y	T2
6	00fc	30	1		0005	aa	00	ff	fd	Nv-BdIzC	AND (zp),Y	T3
6	00fc	30	1		0005	aa	00	ff	fd	Nv-BdIzC	AND (zp),Y	T3
7	00fd	2e	1		0005	aa	00	ff	fd	Nv-BdIzC	AND (zp),Y	T4
7	00fd	2e	1		0005	aa	00	ff	fd	Nv-BdIzC	AND (zp),Y	T4
8	2e2f	00	1		0005	aa	00	ff	fd	Nv-BdIzC	AND (zp),Y	T5
8	2e2f	00	1		0005	aa	00	ff	fd	Nv-BdIzC	AND (zp),Y	T5
9	2f2f	00	1		0005	aa	00	ff	fd	Nv-BdIzC	AND (zp),Y	T0
9	2f2f	00	1		0005	aa	00	ff	fd	Nv-BdIzC	AND (zp),Y	T0
10	0005	00	1	BRK	0005	aa	00	ff	fd	nv-BdIZC	AND (zp),Y	T1
10	0005	00	1	BRK	0005	aa	00	ff	fd	nv-BdIZC	AND (zp),Y	T1
11	0006	00	1		0006	00	00	ff	fd	nv-BdIZC	BRK	T2
11	0006	00	1		0006	00	00	ff	fd	nv-BdIZC	BRK	T2

JAM (32)	Cycles: ∞	Size: 1
Implied		
Cycle	R/W	Desc
-X.2	Read PC	Store as OpCode.
1.1		Inc. PC .
1.2	Read PC	
2.1		
2.2	Read \$FFFF	
3.1		
3.2	Read \$FFFE	
4.1		
4.2	Read \$FFFE	
5.1		Repeat 5.1 and 5.2 forever.
5.2	Read \$FFFF	

cycle	ab	db	rw	Fetch	pc	a	x	y	s	p	Execute	State
2	0002	02	1	unknown	0002	00	00	00	fd	nv-BdIZc	LDA #	T1
2	0002	02	1	unknown	0002	00	00	00	fd	nv-BdIZc	LDA #	T1
3	0003	10	1		0003	00	00	00	fd	nv-BdIZc	unknown	T2
3	0003	10	1		0003	00	00	00	fd	nv-BdIZc	unknown	T2
4	ffff	00	1		0004	00	00	00	fd	nv-BdIZc	unknown	T3
4	ffff	00	1		0004	00	00	00	fd	nv-BdIZc	unknown	T3
5	fffe	00	1		0004	00	00	00	fd	nv-BdIZc	unknown	T4
5	fffe	00	1		0004	00	00	00	fd	nv-BdIZc	unknown	T4
6	fffe	00	1		0004	00	00	00	fd	nv-BdIZc	unknown	T5
6	fffe	00	1		0004	00	00	00	fd	nv-BdIZc	unknown	T5
7	ffff	00	1		0004	00	00	00	fd	nv-BdIZc	unknown	
7	ffff	00	1		0004	00	00	00	fd	nv-BdIZc	unknown	
8	ffff	00	1		0004	00	00	00	fd	nv-BdIZc	unknown	
8	ffff	00	1		0004	00	00	00	fd	nv-BdIZc	unknown	
9	ffff	00	1		0004	00	00	00	fd	nv-BdIZc	unknown	
9	ffff	00	1		0004	00	00	00	fd	nv-BdIZc	unknown	
10	ffff	00	1		0004	00	00	00	fd	nv-BdIZc	unknown	
10	ffff	00	1		0004	00	00	00	fd	nv-BdIZc	unknown	
11	ffff	00	1		0004	00	00	00	fd	nv-BdIZc	unknown	
11	ffff	00	1		0004	00	00	00	fd	nv-BdIZc	unknown	

RLA (33)	Cycles: 8	Size: 2
Indirect, Y (Read/Modify/Write)		
Cycle	R/W	Desc
-X.2	Read PC	Store as OpCode.
1.1		Inc. PC .
1.2	Read PC	Store as Pointer.
2.1		Inc. PC .
2.2	Read Pointer	Store to Address.L.
3.1		
3.2	Read (Pointer+1) & \$FF	Store to Address.H.
4.1		Final=Address+Y. Address.L = Final.L.
4.2	Read Address	Store as Operand.
5.1		Address.H = Final.H (fixes high byte of address).
5.2	Read Address	Store as Operand.
6.1		
6.2	Write Address	Write unmodified Operand.
7.1		* Perform Operand=(Operand << 1) C , A = A & Operand, set N and Z based off A . Set C if high bit of Operand was set before the shift operation.
7.2	Write Address	Write modified Operand.
8.1		
8.2	Read PC	Store as OpCode.
+X.1		A applied.

* Setting of A is delayed by 2 cycles until the start of the following instruction.

cycle	ab	db	rw	Fetch	pc	a	x	y	s	p	Execute	State
4	0003	33	1	unknown	0003	aa	00	ff	fd	Nv-BdIzC	SEC	T1
4	0003	33	1	unknown	0003	aa	00	ff	fd	Nv-BdIzC	SEC	T1
5	0004	fc	1		0004	aa	00	ff	fd	Nv-BdIzC	unknown	T2
5	0004	fc	1		0004	aa	00	ff	fd	Nv-BdIzC	unknown	T2
6	00fc	30	1		0005	aa	00	ff	fd	Nv-BdIzC	unknown	T3
6	00fc	30	1		0005	aa	00	ff	fd	Nv-BdIzC	unknown	T3
7	00fd	2e	1		0005	aa	00	ff	fd	Nv-BdIzC	unknown	T4
7	00fd	2e	1		0005	aa	00	ff	fd	Nv-BdIzC	unknown	T4
8	2e2f	00	1		0005	aa	00	ff	fd	Nv-BdIzC	unknown	T5
8	2e2f	00	1		0005	aa	00	ff	fd	Nv-BdIzC	unknown	T5
9	2f2f	00	1		0005	aa	00	ff	fd	Nv-BdIzC	unknown	
9	2f2f	00	1		0005	aa	00	ff	fd	Nv-BdIzC	unknown	
10	2f2f	00	0		0005	aa	00	ff	fd	Nv-BdIzC	unknown	
10	2f2f	00	0		0005	aa	00	ff	fd	Nv-BdIzC	unknown	
11	2f2f	00	0		0005	aa	00	ff	fd	nv-BdIzc	unknown	T0
11	2f2f	01	0		0005	aa	00	ff	fd	nv-BdIzc	unknown	T0
12	0005	00	1	BRK	0005	aa	00	ff	fd	nv-BdIzc	unknown	T1
12	0005	00	1	BRK	0005	aa	00	ff	fd	nv-BdIzc	unknown	T1
13	0006	00	1		0006	00	00	ff	fd	nv-BdIzc	BRK	T2
13	0006	00	1		0006	00	00	ff	fd	nv-BdIzc	BRK	T2

NOP (34)		Cycles: 4	Size: 2
Zero Page, X (Read)			
Cycle	R/W	Desc	
-X.2	Read PC	Store as OpCode.	
1.1	Read PC Read PC Read Pointer Read Address Read PC	Inc. PC .	
1.2		Store as Pointer.	
2.1		Inc. PC .	
2.2		Store as Operand.	
3.1		Set Address to (Pointer+ X) & \$FF.	
3.2		Store as Operand.	
4.1		Store as OpCode.	
4.2			
+X.1			

cycle	ab	db	rw	Fetch	pc	a	x	y	s	p	Execute	State
4	0003	34	1	unknown	0003	aa	00	ff	fd	Nv-BdIzC	SEC	T1
4	0003	34	1	unknown	0003	aa	00	ff	fd	Nv-BdIzC	SEC	T1
5	0004	fc	1		0004	aa	00	ff	fd	Nv-BdIzC	unknown	T2
5	0004	fc	1		0004	aa	00	ff	fd	Nv-BdIzC	unknown	T2
6	00fc	30	1		0005	aa	00	ff	fd	Nv-BdIzC	unknown	T3
6	00fc	30	1		0005	aa	00	ff	fd	Nv-BdIzC	unknown	T3
7	00fc	30	1		0005	aa	00	ff	fd	Nv-BdIzC	unknown	T0
7	00fc	30	1		0005	aa	00	ff	fd	Nv-BdIzC	unknown	T0
8	0005	00	1	BRK	0005	aa	00	ff	fd	Nv-BdIzC	unknown	T1
8	0005	00	1	BRK	0005	aa	00	ff	fd	Nv-BdIzC	unknown	T1
9	0006	00	1		0006	aa	00	ff	fd	Nv-BdIzC	BRK	T2
9	0006	00	1		0006	aa	00	ff	fd	Nv-BdIzC	BRK	T2

AND (35)		Cycles: 4	Size: 2
Zero Page, X (Read)			
Cycle	R/W	Desc	
-X.2	Read PC	Store as OpCode.	
1.1	Read PC	Inc. PC .	
1.2		Store as Pointer.	
2.1		Inc. PC .	
2.2		Store as Operand.	
3.1	Read Pointer	Set Address to (Pointer+ X) & \$FF.	
3.2	Read Address	Store as Operand.	
4.1	Read PC	* Perform A=A & Operand, set N and Z accordingly.	
4.2		Store as OpCode.	
+X.1		A and N, Z applied.	

* Setting of A/flags is delayed by 1 cycle until the start of the following instruction.

cycle	ab	db	rw	Fetch	pc	a	x	y	s	p	Execute	State
4	0003	35	1	AND zp,X	0003	aa	00	ff	fd	Nv-BdIzC	SEC	T1
4	0003	35	1	AND zp,X	0003	aa	00	ff	fd	Nv-BdIzC	SEC	T1
5	0004	fc	1		0004	aa	00	ff	fd	Nv-BdIzC	AND zp,X	T2
5	0004	fc	1		0004	aa	00	ff	fd	Nv-BdIzC	AND zp,X	T2
6	00fc	30	1		0005	aa	00	ff	fd	Nv-BdIzC	AND zp,X	T3
6	00fc	30	1		0005	aa	00	ff	fd	Nv-BdIzC	AND zp,X	T3
7	00fc	30	1		0005	aa	00	ff	fd	Nv-BdIzC	AND zp,X	T0
7	00fc	30	1		0005	aa	00	ff	fd	Nv-BdIzC	AND zp,X	T0
8	0005	00	1	BRK	0005	aa	00	ff	fd	nv-BdIzC	AND zp,X	T1
8	0005	00	1	BRK	0005	aa	00	ff	fd	nv-BdIzC	AND zp,X	T1
9	0006	00	1		0006	20	00	ff	fd	nv-BdIzC	BRK	T2
9	0006	00	1		0006	20	00	ff	fd	nv-BdIzC	BRK	T2

ROL (36)	Cycles: 6	Size: 2
Zero Page, X (Read/Modify/Write)		
Cycle	R/W	Desc
-X.2	Read PC	Store as OpCode.
1.1		Inc. PC .
1.2	Read PC	Store as Pointer.
2.1		Inc. PC .
2.2	Read Pointer	Store as Operand.
3.1		Set Address to (Pointer+ X) & \$FF.
3.2	Read Address	Store as Operand.
4.1		
4.2	Write Address	Write unmodified Operand.
5.1		Perform Operand=(Operand << 1) C , set N and Z accordingly. Set C if high bit of Operand was set before the shift operation.
5.2	Write Address	Write modified Operand.
6.1		
6.2	Read PC	Store as OpCode.
+X.1		

cycle	ab	db	rw	Fetch	pc	a	x	y	s	p	Execute	State
4	0003	36	1	ROL zp,X	0003	aa	00	ff	fd	Nv-BdIzC	SEC	T1
4	0003	36	1	ROL zp,X	0003	aa	00	ff	fd	Nv-BdIzC	SEC	T1
5	0004	fc	1		0004	aa	00	ff	fd	Nv-BdIzC	ROL zp,X	T2
5	0004	fc	1		0004	aa	00	ff	fd	Nv-BdIzC	ROL zp,X	T2
6	00fc	30	1		0005	aa	00	ff	fd	Nv-BdIzC	ROL zp,X	T3
6	00fc	30	1		0005	aa	00	ff	fd	Nv-BdIzC	ROL zp,X	T3
7	00fc	30	1		0005	aa	00	ff	fd	Nv-BdIzC	ROL zp,X	T4
7	00fc	30	1		0005	aa	00	ff	fd	Nv-BdIzC	ROL zp,X	T4
8	00fc	30	0		0005	aa	00	ff	fd	Nv-BdIzC	ROL zp,X	T5
8	00fc	30	0		0005	aa	00	ff	fd	Nv-BdIzC	ROL zp,X	T5
9	00fc	30	0		0005	aa	00	ff	fd	nv-BdIzc	ROL zp,X	T0
9	00fc	61	0		0005	aa	00	ff	fd	nv-BdIzc	ROL zp,X	T0
10	0005	00	1	BRK	0005	aa	00	ff	fd	nv-BdIzc	ROL zp,X	T1
10	0005	00	1	BRK	0005	aa	00	ff	fd	nv-BdIzc	ROL zp,X	T1
11	0006	00	1		0006	aa	00	ff	fd	nv-BdIzc	BRK	T2
11	0006	00	1		0006	aa	00	ff	fd	nv-BdIzc	BRK	T2

RLA (37)	Cycles: 6	Size: 2
Zero Page, X (Read/Modify/Write)		
Cycle	R/W	Desc
-X.2	Read PC	Store as OpCode.
1.1		Inc. PC .
1.2	Read PC	Store as Pointer.
2.1		Inc. PC .
2.2	Read Pointer	Store as Operand.
3.1		Set Address to (Pointer+ X) & \$FF.
3.2	Read Address	Store as Operand.
4.1		
4.2	Write Address	Write unmodified Operand.
5.1		* Perform Operand=(Operand << 1) C , A = A & Operand, set N and Z based off A . Set C if high bit of Operand was set before the shift operation.
5.2	Write Address	Write modified Operand.
6.1		
6.2	Read PC	Store as OpCode.
+X.1		A applied.

* Setting of A is delayed by 2 cycles until the start of the following instruction.

cycle	ab	db	rw	Fetch	pc	a	x	y	s	p	Execute	State
4	0003	37	1	unknown	0003	aa	00	ff	fd	Nv-BdIzC	SEC	T1
4	0003	37	1	unknown	0003	aa	00	ff	fd	Nv-BdIzC	SEC	T1
5	0004	fc	1		0004	aa	00	ff	fd	Nv-BdIzC	unknown	T2
5	0004	fc	1		0004	aa	00	ff	fd	Nv-BdIzC	unknown	T2
6	00fc	61	1		0005	aa	00	ff	fd	Nv-BdIzC	unknown	T3
6	00fc	61	1		0005	aa	00	ff	fd	Nv-BdIzC	unknown	T3
7	00fc	61	1		0005	aa	00	ff	fd	Nv-BdIzC	unknown	T4
7	00fc	61	1		0005	aa	00	ff	fd	Nv-BdIzC	unknown	T4
8	00fc	61	0		0005	aa	00	ff	fd	Nv-BdIzC	unknown	T5
8	00fc	61	0		0005	aa	00	ff	fd	Nv-BdIzC	unknown	T5
9	00fc	61	0		0005	aa	00	ff	fd	Nv-BdIzc	unknown	T0
9	00fc	c3	0		0005	aa	00	ff	fd	Nv-BdIzc	unknown	T0
10	0005	00	1	BRK	0005	aa	00	ff	fd	Nv-BdIzc	unknown	T1
10	0005	00	1	BRK	0005	aa	00	ff	fd	Nv-BdIzc	unknown	T1
11	0006	00	1		0006	82	00	ff	fd	Nv-BdIzc	BRK	T2
11	0006	00	1		0006	82	00	ff	fd	Nv-BdIzc	BRK	T2

SEC (38)	Cycles: 2	Size: 1
Implied		
Cycle	R/W	Desc
-X.2	Read PC	Store as OpCode.
1.1		Inc. PC .
1.2	Read PC	To be discarded.
2.1		Set the C status bit.
2.2	Read PC	Store as OpCode.
+X.1		

cycle	ab	db	rw	Fetch	pc	a	x	y	s	p	Execute	State
2	0002	38	1	SEC	0002	aa	00	ff	fd	Nv-BdIzc	LDY #	T1
2	0002	38	1	SEC	0002	aa	00	ff	fd	Nv-BdIzc	LDY #	T1
3	0003	39	1		0003	aa	00	ff	fd	Nv-BdIzc	SEC	T0+T2
3	0003	39	1		0003	aa	00	ff	fd	Nv-BdIzc	SEC	T0+T2
4	0003	39	1	AND Abs,Y	0003	aa	00	ff	fd	Nv-BdIzC	SEC	T1
4	0003	39	1	AND Abs,Y	0003	aa	00	ff	fd	Nv-BdIzC	SEC	T1
5	0004	fc	1		0004	aa	00	ff	fd	Nv-BdIzC	AND Abs,Y	T2
5	0004	fc	1		0004	aa	00	ff	fd	Nv-BdIzC	AND Abs,Y	T2

AND (39)		Cycles: 4-5	Size: 3
Absolute, Y (Read)			
Cycle	R/W	Desc	
-X.2	Read PC	Store as OpCode.	
1.1	Read PC	Inc. PC .	
1.2		Store as Address.L.	
2.1		Inc. PC .	
2.2		Store as Address.H.	
3.1		Inc. PC . Final=Address+Y. Address.L = Final.L.	
3.2	Read Address	Store as Operand. If Address.H == Final.H, skip the next cycle (next half-cycle is 5.1).	
4.1	Read Address	Address.H = Final.H (fixes high byte of address).	
4.2		Store as Operand.	
5.1		* Perform A=A & Operand , set N and Z accordingly.	
5.2	Read PC	Store as OpCode.	
+X.1		A and N, Z applied.	

* Setting of A/flags is delayed by 1 cycle until the start of the following instruction.

cycle	ab	db	rw	Fetch	pc	a	x	y	s	p	Execute	State
4	0003	39	1	AND Abs,Y	0003	aa	00	ff	fd	Nv-BdIzC	SEC	T1
4	0003	39	1	AND Abs,Y	0003	aa	00	ff	fd	Nv-BdIzC	SEC	T1
5	0004	fc	1		0004	aa	00	ff	fd	Nv-BdIzC	AND Abs,Y	T2
5	0004	fc	1		0004	aa	00	ff	fd	Nv-BdIzC	AND Abs,Y	T2
6	0005	00	1		0005	aa	00	ff	fd	Nv-BdIzC	AND Abs,Y	T3
6	0005	00	1		0005	aa	00	ff	fd	Nv-BdIzC	AND Abs,Y	T3
7	00fb	00	1		0006	aa	00	ff	fd	Nv-BdIzC	AND Abs,Y	T4
7	00fb	00	1		0006	aa	00	ff	fd	Nv-BdIzC	AND Abs,Y	T4
8	01fb	00	1		0006	aa	00	ff	fd	Nv-BdIzC	AND Abs,Y	T0
8	01fb	00	1		0006	aa	00	ff	fd	Nv-BdIzC	AND Abs,Y	T0
9	0006	00	1	BRK	0006	aa	00	ff	fd	nv-BdIzC	AND Abs,Y	T1
9	0006	00	1	BRK	0006	aa	00	ff	fd	nv-BdIzC	AND Abs,Y	T1
10	0007	00	1		0007	00	00	ff	fd	nv-BdIzC	BRK	T2
10	0007	00	1		0007	00	00	ff	fd	nv-BdIzC	BRK	T2

NOP (3A)		Cycles: 2	Size: 1
Implied			
Cycle	R/W	Desc	
-X.2	Read PC	Store as OpCode.	
1.1	Read PC	Inc. PC .	
1.2		To be discarded.	
2.1			
2.2		Store as OpCode.	
+X.1			

cycle	ab	db	rw	Fetch	pc	a	x	y	s	p	Execute	State
4	0003	3a	1	unknown	0003	aa	00	ff	fd	Nv-BdIzC	SEC	T1
4	0003	3a	1	unknown	0003	aa	00	ff	fd	Nv-BdIzC	SEC	T1
5	0004	a9	1		0004	aa	00	ff	fd	Nv-BdIzC	unknown	T0+T2
5	0004	a9	1		0004	aa	00	ff	fd	Nv-BdIzC	unknown	T0+T2
6	0004	a9	1	LDA #	0004	aa	00	ff	fd	Nv-BdIzC	unknown	T1
6	0004	a9	1	LDA #	0004	aa	00	ff	fd	Nv-BdIzC	unknown	T1
7	0005	00	1		0005	aa	00	ff	fd	Nv-BdIzC	LDA #	T0+T2
7	0005	00	1		0005	aa	00	ff	fd	Nv-BdIzC	LDA #	T0+T2

RLA (3B)	Cycles: 7	Size: 3
Absolute, Y (Read/Modify/Write)		
Cycle	R/W	Desc
-X.2	Read PC	Store as OpCode.
1.1		Inc. PC .
1.2	Read PC	Store as Address.L.
2.1		Inc. PC .
2.2	Read PC	Store as Address.H.
3.1		Inc. PC . Final=Address+ Y . Address.L = Final.L.
3.2	Read Address	Store as Operand.
4.1		Address.H = Final.H (fixes high byte of address).
4.2	Read Address	Store as Operand.
5.1		
5.2	Write Address	Write unmodified Operand.
6.1		* Perform Operand=(Operand << 1) C , A = A & Operand, set N and Z based off A . Set C if high bit of Operand was set before the shift operation.
6.2	Write Address	Write modified Operand.
7.1		
7.2	Read PC	Store as OpCode.
+X.1		A applied.

* Setting of A is delayed by 2 cycles until the start of the following instruction.

cycle	ab	db	rw	Fetch	pc	a	x	y	s	p	Execute	State
4	0003	3b	1	unknown	0003	aa	00	ff	fd	Nv-BdIzC	SEC	T1
4	0003	3b	1	unknown	0003	aa	00	ff	fd	Nv-BdIzC	SEC	T1
5	0004	a9	1		0004	aa	00	ff	fd	Nv-BdIzC	unknown	T2
5	0004	a9	1		0004	aa	00	ff	fd	Nv-BdIzC	unknown	T2
6	0005	00	1		0005	aa	00	ff	fd	Nv-BdIzC	unknown	T3
6	0005	00	1		0005	aa	00	ff	fd	Nv-BdIzC	unknown	T3
7	00a8	00	1		0006	aa	00	ff	fd	Nv-BdIzC	unknown	T4
7	00a8	00	1		0006	aa	00	ff	fd	Nv-BdIzC	unknown	T4
8	01a8	00	1		0006	aa	00	ff	fd	Nv-BdIzC	unknown	T5
8	01a8	00	1		0006	aa	00	ff	fd	Nv-BdIzC	unknown	T5
9	01a8	00	0		0006	aa	00	ff	fd	Nv-BdIzC	unknown	
9	01a8	00	0		0006	aa	00	ff	fd	Nv-BdIzC	unknown	
10	01a8	00	0		0006	aa	00	ff	fd	nv-BdIzc	unknown	T0
10	01a8	01	0		0006	aa	00	ff	fd	nv-BdIzc	unknown	T0
11	0006	00	1	BRK	0006	aa	00	ff	fd	nv-BdIzc	unknown	T1
11	0006	00	1	BRK	0006	aa	00	ff	fd	nv-BdIzc	unknown	T1
12	0007	00	1		0007	00	00	ff	fd	nv-BdIzc	BRK	T2
12	0007	00	1		0007	00	00	ff	fd	nv-BdIzc	BRK	T2

NOP (3C)		Cycles: 4-5	Size: 3
Absolute, X (Read)			
Cycle	R/W	Desc	
-X.2	Read PC	Store as OpCode.	
1.1	Read PC	Inc. PC .	
1.2		Store as Address.L.	
2.1		Inc. PC .	
2.2		Store as Address.H.	
3.1		Inc. PC . Final=Address+X. Address.L = Final.L.	
3.2	Read Address	Store as Operand. If Address.H == Final.H, skip the next cycle (next half-cycle is 5.1).	
4.1	Read Address	Address.H = Final.H (fixes high byte of address).	
4.2		Store as Operand.	
5.1			
5.2	Read PC	Store as OpCode.	
+X.1			

cycle	ab	db	rw	Fetch	pc	a	x	y	s	p	Execute	State
4	0003	3c	1	unknown	0003	aa	00	ff	fd	Nv-BdIzC	SEC	T1
4	0003	3c	1	unknown	0003	aa	00	ff	fd	Nv-BdIzC	SEC	T1
5	0004	a9	1		0004	aa	00	ff	fd	Nv-BdIzC	unknown	T2
5	0004	a9	1		0004	aa	00	ff	fd	Nv-BdIzC	unknown	T2
6	0005	00	1		0005	aa	00	ff	fd	Nv-BdIzC	unknown	T3
6	0005	00	1		0005	aa	00	ff	fd	Nv-BdIzC	unknown	T3
7	00a9	00	1		0006	aa	00	ff	fd	Nv-BdIzC	unknown	T0
7	00a9	00	1		0006	aa	00	ff	fd	Nv-BdIzC	unknown	T0
8	0006	00	1	BRK	0006	aa	00	ff	fd	Nv-BdIzC	unknown	T1
8	0006	00	1	BRK	0006	aa	00	ff	fd	Nv-BdIzC	unknown	T1
9	0007	00	1		0007	aa	00	ff	fd	Nv-BdIzC	BRK	T2
9	0007	00	1		0007	aa	00	ff	fd	Nv-BdIzC	BRK	T2

AND (3D) Cycles: 4-5		Size: 3
Absolute, X (Read)		
Cycle	R/W	Desc
-X.2	Read PC	Store as OpCode.
1.1	Read PC	Inc. PC .
1.2		Store as Address.L.
2.1		Inc. PC .
2.2		Store as Address.H.
3.1		Inc. PC . Final=Address+ X . Address.L = Final.L.
3.2	Read Address	Store as Operand. If Address.H == Final.H, skip the next cycle (next half-cycle is 5.1).
4.1	Read Address	Address.H = Final.H (fixes high byte of address).
4.2		Store as Operand.
5.1		* Perform A=A & Operand , set N and Z accordingly.
5.2	Read PC	Store as OpCode.
+X.1		A and N, Z applied.

* Setting of A/flags is delayed by 1 cycle until the start of the following instruction.

cycle	ab	db	rw	Fetch	pc	a	x	y	s	p	Execute	State
5	0003	3d	1	AND Abs,X	0003	aa	33	00	fd	nv-BdIzC	SEC	T1
5	0003	3d	1	AND Abs,X	0003	aa	33	00	fd	nv-BdIzC	SEC	T1
6	0004	a9	1		0004	aa	33	00	fd	nv-BdIzC	AND Abs,X	T2
6	0004	a9	1		0004	aa	33	00	fd	nv-BdIzC	AND Abs,X	T2
7	0005	00	1		0005	aa	33	00	fd	nv-BdIzC	AND Abs,X	T3
7	0005	00	1		0005	aa	33	00	fd	nv-BdIzC	AND Abs,X	T3
8	00dc	f0	1		0006	aa	33	00	fd	nv-BdIzC	AND Abs,X	T0
8	00dc	f0	1		0006	aa	33	00	fd	nv-BdIzC	AND Abs,X	T0
9	0006	00	1	BRK	0006	aa	33	00	fd	Nv-BdIzC	AND Abs,X	T1
9	0006	00	1	BRK	0006	aa	33	00	fd	Nv-BdIzC	AND Abs,X	T1
10	0007	00	1		0007	a0	33	00	fd	Nv-BdIzC	BRK	T2
10	0007	00	1		0007	a0	33	00	fd	Nv-BdIzC	BRK	T2

ROL (3E)		Cycles: 7	Size: 3
Absolute, X (Read/Modify/Write)			
Cycle	R/W	Desc	
-X.2	Read PC	Store as OpCode.	
1.1	Read PC	Inc. PC .	
1.2		Store as Address.L.	
2.1	Read PC	Inc. PC .	
2.2		Store as Address.H.	
3.1	Read Address	Inc. PC . Final=Address+ X . Address.L = Final.L.	
3.2		Store as Operand.	
4.1	Read Address	Address.H = Final.H (fixes high byte of address).	
4.2		Store as Operand.	
5.1	Write Address	Write unmodified Operand.	
5.2		Perform Operand=(Operand << 1) C , set N and Z accordingly.	
6.1	Write Address	Set C if high bit of Operand was set before the shift operation.	
6.2		Write modified Operand.	
7.1	Read PC		
7.2		Store as OpCode.	
+X.1			

cycle	ab	db	rw	Fetch	pc	a	x	y	s	p	Execute	State
5	0003	3e	1	ROL Abs,X	0003	aa	33	00	fd	nv-BdIzC	SEC	T1
5	0003	3e	1	ROL Abs,X	0003	aa	33	00	fd	nv-BdIzC	SEC	T1
6	0004	a9	1		0004	aa	33	00	fd	nv-BdIzC	ROL Abs,X	T2
6	0004	a9	1		0004	aa	33	00	fd	nv-BdIzC	ROL Abs,X	T2
7	0005	00	1		0005	aa	33	00	fd	nv-BdIzC	ROL Abs,X	T3
7	0005	00	1		0005	aa	33	00	fd	nv-BdIzC	ROL Abs,X	T3
8	00dc	f0	1		0006	aa	33	00	fd	nv-BdIzC	ROL Abs,X	T4
8	00dc	f0	1		0006	aa	33	00	fd	nv-BdIzC	ROL Abs,X	T4
9	00dc	f0	1		0006	aa	33	00	fd	nv-BdIzC	ROL Abs,X	T5
9	00dc	f0	1		0006	aa	33	00	fd	nv-BdIzC	ROL Abs,X	T5
10	00dc	f0	0		0006	aa	33	00	fd	nv-BdIzC	ROL Abs,X	
10	00dc	f0	0		0006	aa	33	00	fd	nv-BdIzC	ROL Abs,X	
11	00dc	f0	0		0006	aa	33	00	fd	Nv-BdIzC	ROL Abs,X	T0
11	00dc	e1	0		0006	aa	33	00	fd	Nv-BdIzC	ROL Abs,X	T0
12	0006	00	1	BRK	0006	aa	33	00	fd	Nv-BdIzC	ROL Abs,X	T1
12	0006	00	1	BRK	0006	aa	33	00	fd	Nv-BdIzC	ROL Abs,X	T1
13	0007	00	1		0007	aa	33	00	fd	Nv-BdIzC	BRK	T2
13	0007	00	1		0007	aa	33	00	fd	Nv-BdIzC	BRK	T2

RLA (3F)	Cycles: 7	Size: 3
Absolute, X (Read/Modify/Write)		
Cycle	R/W	Desc
-X.2	Read PC	Store as OpCode.
1.1		Inc. PC .
1.2	Read PC	Store as Address.L.
2.1		Inc. PC .
2.2	Read PC	Store as Address.H.
3.1		Inc. PC . Final=Address+ X . Address.L = Final.L.
3.2	Read Address	Store as Operand.
4.1		Address.H = Final.H (fixes high byte of address).
4.2	Read Address	Store as Operand.
5.1		
5.2	Write Address	Write unmodified Operand.
6.1		* Perform Operand=(Operand << 1) C , A = A & Operand, set N and Z based off A . Set C if high bit of Operand was set before the shift operation.
6.2	Write Address	Write modified Operand.
7.1		
7.2	Read PC	Store as OpCode.
+X.1		A applied.

* Setting of A is delayed by 2 cycles until the start of the following instruction.

cycle	ab	db	rw	Fetch	pc	a	x	y	s	p	Execute	State
5	0003	3f	1	unknown	0003	aa	33	00	fd	nv-BdIzC	SEC	T1
5	0003	3f	1	unknown	0003	aa	33	00	fd	nv-BdIzC	SEC	T1
6	0004	a9	1		0004	aa	33	00	fd	nv-BdIzC	unknown	T2
6	0004	a9	1		0004	aa	33	00	fd	nv-BdIzC	unknown	T2
7	0005	00	1		0005	aa	33	00	fd	nv-BdIzC	unknown	T3
7	0005	00	1		0005	aa	33	00	fd	nv-BdIzC	unknown	T3
8	00dc	e1	1		0006	aa	33	00	fd	nv-BdIzC	unknown	T4
8	00dc	e1	1		0006	aa	33	00	fd	nv-BdIzC	unknown	T4
9	00dc	e1	1		0006	aa	33	00	fd	nv-BdIzC	unknown	T5
9	00dc	e1	1		0006	aa	33	00	fd	nv-BdIzC	unknown	T5
10	00dc	e1	0		0006	aa	33	00	fd	nv-BdIzC	unknown	
10	00dc	e1	0		0006	aa	33	00	fd	nv-BdIzC	unknown	
11	00dc	e1	0		0006	aa	33	00	fd	Nv-BdIzC	unknown	T0
11	00dc	c3	0		0006	aa	33	00	fd	Nv-BdIzC	unknown	T0
12	0006	00	1	BRK	0006	aa	33	00	fd	Nv-BdIzC	unknown	T1
12	0006	00	1	BRK	0006	aa	33	00	fd	Nv-BdIzC	unknown	T1
13	0007	00	1		0007	82	33	00	fd	Nv-BdIzC	BRK	T2
13	0007	00	1		0007	82	33	00	fd	Nv-BdIzC	BRK	T2

RTI (40)	Cycles: 6	Size: 1
Implied		
Cycle	R/W	Desc
-X.2	Read PC	Store as OpCode.
1.1		Inc. PC .
1.2	Read PC	Store as Address.L.
2.1		Inc. PC .
2.2	Read S \$0100	
3.1		
3.2	Read (S +1) \$0100	Store as Tmp.
4.1		Copy all but the M and B flags from Tmp to P (M and B remain unchanged on P).
4.2	Read (S +2) \$0100	Store as Address.L.
5.1		Increase S by 3.
5.2	Read S \$0100	Store as Address.H.
6.1		PC =Address.
6.2	Read PC	Store as OpCode.
+X.1		

cycle	ab	db	rw	Fetch	pc	a	x	y	s	p	Execute	State
2	0002	40	1	RTI	0002	00	00	00	fd	nv-BdIZc	LDA #	T1
2	0002	40	1	RTI	0002	00	00	00	fd	nv-BdIZc	LDA #	T1
3	0003	10	1		0003	00	00	00	fd	nv-BdIZc	RTI	T2
3	0003	10	1		0003	00	00	00	fd	nv-BdIZc	RTI	T2
4	01fd	ff	1		0004	00	00	00	fd	nv-BdIZc	RTI	T3
4	01fd	ff	1		0004	00	00	00	fd	nv-BdIZc	RTI	T3
5	01fe	88	1		0004	00	00	00	fd	nv-BdIZc	RTI	T4
5	01fe	88	1		0004	00	00	00	fd	nv-BdIZc	RTI	T4
6	01ff	12	1		0004	00	00	00	fd	Nv-BDizc	RTI	T5
6	01ff	12	1		0004	00	00	00	fd	Nv-BDizc	RTI	T5
7	0100	00	1		0004	00	00	00	00	Nv-BDizc	RTI	T0
7	0100	00	1		0004	00	00	00	00	Nv-BDizc	RTI	T0
8	0012	e6	1	INC zp	0012	00	00	00	00	Nv-BDizc	RTI	T1
8	0012	e6	1	INC zp	0012	00	00	00	00	Nv-BDizc	RTI	T1
9	0013	0f	1		0013	00	00	00	00	Nv-BDizc	INC zp	T2
9	0013	0f	1		0013	00	00	00	00	Nv-BDizc	INC zp	T2

EOR (41)	Cycles: 6	Size: 2
Indirect, X (Read)		
Cycle	R/W	Desc
-X.2	Read PC	Store as OpCode.
1.1		Inc. PC .
1.2	Read PC	Store as Operand.
2.1		Inc. PC .
2.2	Read Operand	
3.1		Set Pointer to (Operand+X) & \$FF.
3.2	Read Pointer	Store to Address.L.
4.1		
4.2	Read (Pointer+1) & \$FF	Store to Address.H.
5.1		
5.2	Read Address	Store as Operand.
6.1		* Perform A=A ^ Operand , set N and Z accordingly.
6.2	Read PC	Store as OpCode.
+X.1		A and N, Z applied.

* Setting of A/flags is delayed by 1 cycle until the start of the following instruction.

cycle	ab	db	rw	Fetch	pc	a	x	y	s	p	Execute	State
4	0003	41	1	EOR (zp,X)	0003	1f	00	00	fd	nv-BdIzC	SEC	T1
4	0003	41	1	EOR (zp,X)	0003	1f	00	00	fd	nv-BdIzC	SEC	T1
5	0004	a9	1		0004	1f	00	00	fd	nv-BdIzC	EOR (zp,X)	T2
5	0004	a9	1		0004	1f	00	00	fd	nv-BdIzC	EOR (zp,X)	T2
6	00a9	55	1		0005	1f	00	00	fd	nv-BdIzC	EOR (zp,X)	T3
6	00a9	55	1		0005	1f	00	00	fd	nv-BdIzC	EOR (zp,X)	T3
7	00a9	55	1		0005	1f	00	00	fd	nv-BdIzC	EOR (zp,X)	T4
7	00a9	55	1		0005	1f	00	00	fd	nv-BdIzC	EOR (zp,X)	T4
8	00aa	00	1		0005	1f	00	00	fd	nv-BdIzC	EOR (zp,X)	T5
8	00aa	00	1		0005	1f	00	00	fd	nv-BdIzC	EOR (zp,X)	T5
9	0055	f8	1		0005	1f	00	00	fd	nv-BdIzC	EOR (zp,X)	T0
9	0055	f8	1		0005	1f	00	00	fd	nv-BdIzC	EOR (zp,X)	T0
10	0005	00	1	BRK	0005	1f	00	00	fd	nv-BdIzC	EOR (zp,X)	T1
10	0005	00	1	BRK	0005	1f	00	00	fd	nv-BdIzC	EOR (zp,X)	T1
11	0006	00	1		0006	e7	00	00	fd	Nv-BdIzC	BRK	T2
11	0006	00	1		0006	e7	00	00	fd	Nv-BdIzC	BRK	T2

JAM (42)	Cycles: ∞	Size: 1
Implied		
Cycle	R/W	Desc
-X.2	Read PC	Store as OpCode.
1.1		Inc. PC .
1.2	Read PC	
2.1		
2.2	Read \$FFFF	
3.1		
3.2	Read \$FFFE	
4.1		
4.2	Read \$FFFE	
5.1		Repeat 5.1 and 5.2 forever.
5.2	Read \$FFFF	

cycle	ab	db	rw	Fetch	pc	a	x	y	s	p	Execute	State
2	0002	02	1	unknown	0002	00	00	00	fd	nv-BdIZc	LDA #	T1
2	0002	02	1	unknown	0002	00	00	00	fd	nv-BdIZc	LDA #	T1
3	0003	10	1		0003	00	00	00	fd	nv-BdIZc	unknown	T2
3	0003	10	1		0003	00	00	00	fd	nv-BdIZc	unknown	T2
4	ffff	00	1		0004	00	00	00	fd	nv-BdIZc	unknown	T3
4	ffff	00	1		0004	00	00	00	fd	nv-BdIZc	unknown	T3
5	fffe	00	1		0004	00	00	00	fd	nv-BdIZc	unknown	T4
5	fffe	00	1		0004	00	00	00	fd	nv-BdIZc	unknown	T4
6	fffe	00	1		0004	00	00	00	fd	nv-BdIZc	unknown	T5
6	fffe	00	1		0004	00	00	00	fd	nv-BdIZc	unknown	T5
7	ffff	00	1		0004	00	00	00	fd	nv-BdIZc	unknown	
7	ffff	00	1		0004	00	00	00	fd	nv-BdIZc	unknown	
8	ffff	00	1		0004	00	00	00	fd	nv-BdIZc	unknown	
8	ffff	00	1		0004	00	00	00	fd	nv-BdIZc	unknown	
9	ffff	00	1		0004	00	00	00	fd	nv-BdIZc	unknown	
9	ffff	00	1		0004	00	00	00	fd	nv-BdIZc	unknown	
10	ffff	00	1		0004	00	00	00	fd	nv-BdIZc	unknown	
10	ffff	00	1		0004	00	00	00	fd	nv-BdIZc	unknown	
11	ffff	00	1		0004	00	00	00	fd	nv-BdIZc	unknown	
11	ffff	00	1		0004	00	00	00	fd	nv-BdIZc	unknown	

SRE (43)	Cycles: 8	Size: 2
Indirect, X (Read/Modify/Write)		
Cycle	R/W	Desc
-X.2	Read PC	Store as OpCode.
1.1		Inc. PC .
1.2	Read PC	Store as Operand.
2.1		Inc. PC .
2.2	Read Operand	
3.1		Set Pointer to (Operand+X) & \$FF.
3.2	Read Pointer	Store to Address.L.
4.1		
4.2	Read (Pointer+1) & \$FF	Store to Address.H.
5.1		
5.1	Read Address	Store as Operand.
6.1		Set C if lowest bit of Operand is set.
6.2	Write Address	Write unmodified Operand.
7.1		* Perform Operand=Operand >> 1, A = A ^ Operand, set N and Z based off A .
7.2	Write Address	Write modified Operand.
8.1		
8.2	Read PC	Store as OpCode.
+X.1		A applied.

* Setting of A is delayed by 2 cycles until the start of the following instruction.

cycle	ab	db	rw	Fetch	pc	a	x	y	s	p	Execute	State
4	0003	43	1	unknown	0003	1f	00	00	fd	nv-BdIzC	SEC	T1
4	0003	43	1	unknown	0003	1f	00	00	fd	nv-BdIzC	SEC	T1
5	0004	a9	1		0004	1f	00	00	fd	nv-BdIzC	unknown	T2
5	0004	a9	1		0004	1f	00	00	fd	nv-BdIzC	unknown	T2
6	00a9	55	1		0005	1f	00	00	fd	nv-BdIzC	unknown	T3
6	00a9	55	1		0005	1f	00	00	fd	nv-BdIzC	unknown	T3
7	00a9	55	1		0005	1f	00	00	fd	nv-BdIzC	unknown	T4
7	00a9	55	1		0005	1f	00	00	fd	nv-BdIzC	unknown	T4
8	00aa	00	1		0005	1f	00	00	fd	nv-BdIzC	unknown	T5
8	00aa	00	1		0005	1f	00	00	fd	nv-BdIzC	unknown	T5
9	0055	f8	1		0005	1f	00	00	fd	nv-BdIzC	unknown	
9	0055	f8	1		0005	1f	00	00	fd	nv-BdIzC	unknown	
10	0055	f8	0		0005	1f	00	00	fd	nv-BdIzC	unknown	
10	0055	f8	0		0005	1f	00	00	fd	nv-BdIzC	unknown	
11	0055	f8	0		0005	1f	00	00	fd	nv-BdIzC	unknown	T0
11	0055	7c	0		0005	1f	00	00	fd	nv-BdIzC	unknown	T0
12	0005	00	1	BRK	0005	1f	00	00	fd	nv-BdIzC	unknown	T1
12	0005	00	1	BRK	0005	1f	00	00	fd	nv-BdIzC	unknown	T1
13	0006	00	1		0006	63	00	00	fd	nv-BdIzC	BRK	T2
13	0006	00	1		0006	63	00	00	fd	nv-BdIzC	BRK	T2

NOP (44)		Cycles: 3	Size: 2
Zero Page (Read)			
Cycle	R/W	Desc	
-X.2	Read PC	Store as OpCode.	
1.1	Read PC	Inc. PC .	
1.2		Store as Address.	
2.1		Inc. PC .	
2.2		Store as Operand.	
3.1		Store as OpCode.	
3.2	Read PC		
+X.1			

cycle	ab	db	rw	Fetch	pc	a	x	y	s	p	Execute	State
4	0003	44	1	unknown	0003	1f	00	00	fd	nv-BdIzC	SEC	T1
4	0003	44	1	unknown	0003	1f	00	00	fd	nv-BdIzC	SEC	T1
5	0004	a9	1		0004	1f	00	00	fd	nv-BdIzC	unknown	T2
5	0004	a9	1		0004	1f	00	00	fd	nv-BdIzC	unknown	T2
6	00a9	55	1		0005	1f	00	00	fd	nv-BdIzC	unknown	T0
6	00a9	55	1		0005	1f	00	00	fd	nv-BdIzC	unknown	T0
7	0005	00	1	BRK	0005	1f	00	00	fd	nv-BdIzC	unknown	T1
7	0005	00	1	BRK	0005	1f	00	00	fd	nv-BdIzC	unknown	T1
8	0006	00	1		0006	1f	00	00	fd	nv-BdIzC	BRK	T2
8	0006	00	1		0006	1f	00	00	fd	nv-BdIzC	BRK	T2

EOR (45)		Cycles: 3	Size: 2
Zero Page (Read)			
Cycle	R/W	Desc	
-X.2	Read PC	Store as OpCode.	
1.1	Read PC	Inc. PC .	
1.2		Store as Address.	
2.1		Inc. PC .	
2.2		Store as Operand.	
3.1		* Perform A=A ^ Operand , set N and Z accordingly.	
3.2	Read PC	Store as OpCode.	
+X.1		A and N, Z applied.	

* Setting of A/flags is delayed by 1 cycle until the start of the following instruction.

cycle	ab	db	rw	Fetch	pc	a	x	y	s	p	Execute	State
4	0003	45	1	EOR zp	0003	1f	00	00	fd	nv-BdIzC	SEC	T1
4	0003	45	1	EOR zp	0003	1f	00	00	fd	nv-BdIzC	SEC	T1
5	0004	9f	1		0004	1f	00	00	fd	nv-BdIzC	EOR zp	T2
5	0004	9f	1		0004	1f	00	00	fd	nv-BdIzC	EOR zp	T2
6	009f	f8	1		0005	1f	00	00	fd	nv-BdIzC	EOR zp	T0
6	009f	f8	1		0005	1f	00	00	fd	nv-BdIzC	EOR zp	T0
7	0005	f8	1	SED	0005	1f	00	00	fd	nv-BdIzC	EOR zp	T1
7	0005	f8	1	SED	0005	1f	00	00	fd	nv-BdIzC	EOR zp	T1
8	0006	00	1		0006	e7	00	00	fd	Nv-BdIzC	SED	T0+T2
8	0006	00	1		0006	e7	00	00	fd	Nv-BdIzC	SED	T0+T2

LSR (46)	Cycles: 5	Size: 2
Zero Page (Read/Modify/Write)		
Cycle	R/W	Desc
-X.2	Read PC	Store as OpCode.
1.1		Inc. PC .
1.2	Read PC	Store as Address.
2.1		Inc. PC .
2.2	Read Address	Store as Operand.
3.1		Set C if lowest bit of Operand is set.
3.2	Write Address	Write unmodified Operand.
4.1		Perform Operand=Operand << 1, set N and Z accordingly.
4.2	Write Address	
5.1		
5.2	Read PC	Store as OpCode.
+X.1		

cycle	ab	db	rw	Fetch	pc	a	x	y	s	p	Execute	State
4	0003	46	1	LSR zp	0003	1f	00	00	fd	nv-BdIzC	SEC	T1
4	0003	46	1	LSR zp	0003	1f	00	00	fd	nv-BdIzC	SEC	T1
5	0004	9f	1		0004	1f	00	00	fd	nv-BdIzC	LSR zp	T2
5	0004	9f	1		0004	1f	00	00	fd	nv-BdIzC	LSR zp	T2
6	009f	f8	1		0005	1f	00	00	fd	nv-BdIzC	LSR zp	T3
6	009f	f8	1		0005	1f	00	00	fd	nv-BdIzC	LSR zp	T3
7	009f	f8	0		0005	1f	00	00	fd	nv-BdIzc	LSR zp	T4
7	009f	f8	0		0005	1f	00	00	fd	nv-BdIzc	LSR zp	T4
8	009f	f8	0		0005	1f	00	00	fd	nv-BdIzc	LSR zp	T0
8	009f	7c	0		0005	1f	00	00	fd	nv-BdIzc	LSR zp	T0
9	0005	a0	1	LDY #	0005	1f	00	00	fd	nv-BdIzc	LSR zp	T1
9	0005	a0	1	LDY #	0005	1f	00	00	fd	nv-BdIzc	LSR zp	T1
10	0006	00	1		0006	1f	00	00	fd	nv-BdIzc	LDY #	T0+T2
10	0006	00	1		0006	1f	00	00	fd	nv-BdIzc	LDY #	T0+T2

SRE (47)	Cycles: 5	Size: 2
Zero Page (Read/Modify/Write)		
Cycle	R/W	Desc
-X.2	Read PC	Store as OpCode.
1.1		Inc. PC .
1.2	Read PC	Store as Address.
2.1		Inc. PC .
2.2	Read Address	Store as Operand.
3.1		Set C if lowest bit of Operand is set.
3.2	Write Address	Write unmodified Operand.
4.1		* Perform $\text{Operand} = \text{Operand} \gg 1$, $\text{A} = \text{A} \wedge \text{Operand}$, set N and Z based off A .
4.2	Write Address	Write modified Operand.
5.1		
5.2	Read PC	Store as OpCode.
+X.1		A applied.

* Setting of A is delayed by 2 cycles until the start of the following instruction.

cycle	ab	db	rw	Fetch	pc	a	x	y	s	p	Execute	State
4	0003	47	1	unknown	0003	1f	00	00	fd	nv-BdIzC	SEC	T1
4	0003	47	1	unknown	0003	1f	00	00	fd	nv-BdIzC	SEC	T1
5	0004	9f	1		0004	1f	00	00	fd	nv-BdIzC	unknown	T2
5	0004	9f	1		0004	1f	00	00	fd	nv-BdIzC	unknown	T2
6	009f	7e	1		0005	1f	00	00	fd	nv-BdIzC	unknown	T3
6	009f	7e	1		0005	1f	00	00	fd	nv-BdIzC	unknown	T3
7	009f	7e	0		0005	1f	00	00	fd	nv-BdIzc	unknown	T4
7	009f	7e	0		0005	1f	00	00	fd	nv-BdIzc	unknown	T4
8	009f	7e	0		0005	1f	00	00	fd	nv-BdIzc	unknown	T0
8	009f	3f	0		0005	1f	00	00	fd	nv-BdIzc	unknown	T0
9	0005	a0	1	LDY #	0005	1f	00	00	fd	nv-BdIzc	unknown	T1
9	0005	a0	1	LDY #	0005	1f	00	00	fd	nv-BdIzc	unknown	T1
10	0006	00	1		0006	20	00	00	fd	nv-BdIzc	LDY #	T0+T2
10	0006	00	1		0006	20	00	00	fd	nv-BdIzc	LDY #	T0+T2

PHA (48)		Cycles: 3	Size: 1
Implied			
Cycle	R/W		Desc
-X.2	Read PC		Store as OpCode.
1.1	Read PC		Inc. PC .
1.2			To be discarded.
2.1			
2.2			Write A .
3.1			
3.2	Read PC		Store as OpCode.
+X.1			

cycle	ab	db	rw	Fetch	pc	a	x	y	s	p	Execute	State
2	0002	48	1	PHA	0002	fe	00	00	fd	Nv-BdIzc	LDA #	T1
2	0002	48	1	PHA	0002	fe	00	00	fd	Nv-BdIzc	LDA #	T1
3	0003	10	1		0003	fe	00	00	fd	Nv-BdIzc	PHA	T2
3	0003	10	1		0003	fe	00	00	fd	Nv-BdIzc	PHA	T2
4	01fd	10	0		0003	fe	00	00	fd	Nv-BdIzc	PHA	T0
4	01fd	fe	0		0003	fe	00	00	fd	Nv-BdIzc	PHA	T0
5	0003	10	1	BPL	0003	fe	00	00	fc	Nv-BdIzc	PHA	T1
5	0003	10	1	BPL	0003	fe	00	00	fc	Nv-BdIzc	PHA	T1
6	0004	00	1		0004	fe	00	00	fc	Nv-BdIzc	BPL	T2
6	0004	00	1		0004	fe	00	00	fc	Nv-BdIzc	BPL	T2

EOR (49)		Cycles: 2	Size: 2
Immediate			
Cycle	R/W	Desc	
-X.2	Read PC	Store as OpCode.	
1.1	Read PC	Inc. PC .	
1.2		Store as Operand.	
2.1		Inc. PC . * Perform A=A ^ Operand , set N and Z accordingly.	
2.2		Store as OpCode.	
+X.1		A and N, Z applied.	

* Setting of A/flags is delayed by 1 cycle until the start of the following instruction.

cycle	ab	db	rw	Fetch	pc	a	x	y	s	p	Execute	State
2	0002	49	1	EOR #	0002	80	00	00	fd	Nv-BdIzc	LDA #	T1
2	0002	49	1	EOR #	0002	80	00	00	fd	Nv-BdIzc	LDA #	T1
3	0003	80	1		0003	80	00	00	fd	Nv-BdIzc	EOR #	T0+T2
3	0003	80	1		0003	80	00	00	fd	Nv-BdIzc	EOR #	T0+T2
4	0004	35	1	AND zp,X	0004	80	00	00	fd	Nv-BdIzc	EOR #	T1
4	0004	35	1	AND zp,X	0004	80	00	00	fd	Nv-BdIzc	EOR #	T1
5	0005	4c	1		0005	00	00	00	fd	nv-BdIZc	AND zp,X	T2
5	0005	4c	1		0005	00	00	00	fd	nv-BdIZc	AND zp,X	T2

LSR (4A)	Cycles: 2	Size: 1
Implied		
Cycle	R/W	Desc
-X.2	Read PC	Store as OpCode.
1.1	Read PC	Inc. PC .
1.2		To be discarded.
2.1		Set C if low bit of A is set. Perform A=A >> 1 , unset N and set Z accordingly.
2.2		Store as OpCode.
+X.1		A and N, Z applied.

* Setting of A/flags is delayed by 1 cycle until the start of the following instruction.

cycle	ab	db	rw	Fetch	pc	a	x	y	s	p	Execute	State
2	0002	4a	1	LSR	0002	80	00	00	fd	Nv-BdIzc	LDA #	T1
2	0002	4a	1	LSR	0002	80	00	00	fd	Nv-BdIzc	LDA #	T1
3	0003	35	1		0003	80	00	00	fd	Nv-BdIzc	LSR	T0+T2
3	0003	35	1		0003	80	00	00	fd	Nv-BdIzc	LSR	T0+T2
4	0003	35	1	AND zp,X	0003	80	00	00	fd	Nv-BdIzc	LSR	T1
4	0003	35	1	AND zp,X	0003	80	00	00	fd	Nv-BdIzc	LSR	T1
5	0004	00	1		0004	40	00	00	fd	nv-BdIzc	AND zp,X	T2
5	0004	00	1		0004	40	00	00	fd	nv-BdIzc	AND zp,X	T2

ASR (4B)	Cycles: 2	Size: 2
Immediate		
Cycle	R/W	Desc
-X.2	Read PC	Store as OpCode.
1.1	Read PC	Inc. PC .
1.2		Store as Operand.
2.1		Inc. PC . * Perform A=A & Operand , A=A >> 1 , set C , N and Z accordingly. C is set if (A & 1) before the shift.
2.2		Store as OpCode.
+X.1		

cycle	ab	db	rw	Fetch	pc	a	x	y	s	p	Execute	State
2	0002	4b	1	unknown	0002	ff	00	00	fd	Nv-BdIzc	LDA #	T1
2	0002	4b	1	unknown	0002	ff	00	00	fd	Nv-BdIzc	LDA #	T1
3	0003	0f	1		0003	ff	00	00	fd	Nv-BdIzc	unknown	T0+T2
3	0003	0f	1		0003	ff	00	00	fd	Nv-BdIzc	unknown	T0+T2
4	0004	30	1	BMI	0004	ff	00	00	fd	Nv-BdIzc	unknown	T1
4	0004	30	1	BMI	0004	ff	00	00	fd	Nv-BdIzc	unknown	T1
5	0005	4c	1		0005	7f	00	00	fd	nv-BdIzc	BMI	T2
5	0005	4c	1		0005	7f	00	00	fd	nv-BdIzc	BMI	T2

JMP (4C)		Cycles: 3	Size: 3
Absolute			
Cycle	R/W	Desc	
-X.2	Read PC	Store as OpCode.	
1.1	Read PC	Inc. PC .	
1.2		Store as Address.L.	
2.1		Inc. PC .	
2.2		Store as Address.H.	
3.1		Copy Address to PC .	
3.2		Store as OpCode.	
+X.1			

cycle	ab	db	rw	Fetch	pc	a	x	y	s	p	Execute	State
2	0002	4c	1	JMP Abs	0002	ff	00	00	fd	Nv-BdIzc	LDA #	T1
2	0002	4c	1	JMP Abs	0002	ff	00	00	fd	Nv-BdIzc	LDA #	T1
3	0003	20	1		0003	ff	00	00	fd	Nv-BdIzc	JMP Abs	T2
3	0003	20	1		0003	ff	00	00	fd	Nv-BdIzc	JMP Abs	T2
4	0004	01	1		0004	ff	00	00	fd	Nv-BdIzc	JMP Abs	T0
4	0004	01	1		0004	ff	00	00	fd	Nv-BdIzc	JMP Abs	T0
5	0120	35	1	AND zp,X	0120	ff	00	00	fd	Nv-BdIzc	JMP Abs	T1
5	0120	35	1	AND zp,X	0120	ff	00	00	fd	Nv-BdIzc	JMP Abs	T1
6	0121	00	1		0121	ff	00	00	fd	Nv-BdIzc	AND zp,X	T2
6	0121	00	1		0121	ff	00	00	fd	Nv-BdIzc	AND zp,X	T2

EOR (4D)		Cycles: 4	Size: 3
Absolute (Read)			
Cycle	R/W	Desc	
-X.2	Read PC	Store as OpCode.	
1.1	Read PC	Inc. PC .	
1.2		Store as Address.L.	
2.1		Inc. PC .	
2.2		Store as Address.H.	
3.1		Inc. PC .	
3.2	Read Address	Store as Operand.	
4.1	Read PC	* Perform A=A ^ Operand , set N and Z accordingly.	
4.2		Store as OpCode.	
+X.1		A and N, Z applied.	

* Setting of A/flags is delayed by 1 cycle until the start of the following instruction.

cycle	ab	db	rw	Fetch	pc	a	x	y	s	p	Execute	State
2	0002	4d	1	EOR Abs	0002	ff	00	00	fd	Nv-BdIzc	LDA #	T1
2	0002	4d	1	EOR Abs	0002	ff	00	00	fd	Nv-BdIzc	LDA #	T1
3	0003	20	1		0003	ff	00	00	fd	Nv-BdIzc	EOR Abs	T2
3	0003	20	1		0003	ff	00	00	fd	Nv-BdIzc	EOR Abs	T2
4	0004	01	1		0004	ff	00	00	fd	Nv-BdIzc	EOR Abs	T3
4	0004	01	1		0004	ff	00	00	fd	Nv-BdIzc	EOR Abs	T3
5	0120	35	1		0005	ff	00	00	fd	Nv-BdIzc	EOR Abs	T0
5	0120	35	1		0005	ff	00	00	fd	Nv-BdIzc	EOR Abs	T0
6	0005	20	1	JSR Abs	0005	ff	00	00	fd	Nv-BdIzc	EOR Abs	T1
6	0005	20	1	JSR Abs	0005	ff	00	00	fd	Nv-BdIzc	EOR Abs	T1
7	0006	02	1		0006	ca	00	00	fd	Nv-BdIzc	JSR Abs	T2
7	0006	02	1		0006	ca	00	00	fd	Nv-BdIzc	JSR Abs	T2

LSR (4E)	Cycles: 6	Size: 3
Absolute (Read/Modify/Write)		
Cycle	R/W	Desc
-X.2	Read PC	Store as OpCode.
1.1		Inc. PC .
1.2	Read PC	Store as Address.L.
2.1		Inc. PC .
2.2	Read PC	Store as Address.H.
3.1		Inc. PC .
3.2	Read Address	Store as Operand.
4.1		Set C if lowest bit of Operand is set.
4.2	Write Address	Write unmodified Operand.
5.1		Perform Operand=Operand << 1, set N and Z accordingly.
5.2	Write Address	Write modified Operand.
6.1		
6.2	Read PC	Store as OpCode.
+X.1		

cycle	ab	db	rw	Fetch	pc	a	x	y	s	p	Execute	State
3	0002	4e	1	LSR Abs	0002	aa	00	00	fd	NV-BdIzc	BIT zp	T1
3	0002	4e	1	LSR Abs	0002	aa	00	00	fd	NV-BdIzc	BIT zp	T1
4	0003	fb	1		0003	aa	00	00	fd	NV-BdIzc	LSR Abs	T2
4	0003	fb	1		0003	aa	00	00	fd	NV-BdIzc	LSR Abs	T2
5	0004	01	1		0004	aa	00	00	fd	NV-BdIzc	LSR Abs	T3
5	0004	01	1		0004	aa	00	00	fd	NV-BdIzc	LSR Abs	T3
6	01fb	3f	1		0005	aa	00	00	fd	NV-BdIzc	LSR Abs	T4
6	01fb	3f	1		0005	aa	00	00	fd	NV-BdIzc	LSR Abs	T4
7	01fb	3f	0		0005	aa	00	00	fd	NV-BdIzc	LSR Abs	T5
7	01fb	3f	0		0005	aa	00	00	fd	NV-BdIzc	LSR Abs	T5
8	01fb	3f	0		0005	aa	00	00	fd	nV-BdIzc	LSR Abs	T0
8	01fb	1f	0		0005	aa	00	00	fd	nV-BdIzc	LSR Abs	T0
9	0005	50	1	BVC	0005	aa	00	00	fd	nV-BdIzc	LSR Abs	T1
9	0005	50	1	BVC	0005	aa	00	00	fd	nV-BdIzc	LSR Abs	T1
10	0006	2e	1		0006	aa	00	00	fd	nV-BdIzc	BVC	T2
10	0006	2e	1		0006	aa	00	00	fd	nV-BdIzc	BVC	T2

SRE (4F)	Cycles: 6	Size: 3
Absolute (Read/Modify/Write)		
Cycle	R/W	Desc
-X.2	Read PC	Store as OpCode.
1.1		Inc. PC .
1.2	Read PC	Store as Address.L.
2.1		Inc. PC .
2.2	Read PC	Store as Address.H.
3.1		Inc. PC .
3.2	Read Address	Store as Operand.
4.1		Set C if lowest bit of Operand is set.
4.2	Write Address	Write unmodified Operand.
5.1		* Perform Operand=Operand >> 1, A = A ^ Operand, set N and Z based off A .
5.2	Write Address	Write modified Operand.
6.1		
6.2	Read PC	Store as OpCode.
+X.1		A applied.

* Setting of A is delayed by 2 cycles until the start of the following instruction.

cycle	ab	db	rw	Fetch	pc	a	x	y	s	p	Execute	State
2	0002	4f	1	unknown	0002	ff	00	00	fd	Nv-BdIzc	LDA #	T1
2	0002	4f	1	unknown	0002	ff	00	00	fd	Nv-BdIzc	LDA #	T1
3	0003	20	1		0003	ff	00	00	fd	Nv-BdIzc	unknown	T2
3	0003	20	1		0003	ff	00	00	fd	Nv-BdIzc	unknown	T2
4	0004	01	1		0004	ff	00	00	fd	Nv-BdIzc	unknown	T3
4	0004	01	1		0004	ff	00	00	fd	Nv-BdIzc	unknown	T3
5	0120	ff	1		0005	ff	00	00	fd	Nv-BdIzc	unknown	T4
5	0120	ff	1		0005	ff	00	00	fd	Nv-BdIzc	unknown	T4
6	0120	ff	0		0005	ff	00	00	fd	Nv-BdIzC	unknown	T5
6	0120	ff	0		0005	ff	00	00	fd	Nv-BdIzC	unknown	T5
7	0120	ff	0		0005	ff	00	00	fd	nv-BdIzC	unknown	T0
7	0120	7f	0		0005	ff	00	00	fd	nv-BdIzC	unknown	T0
8	0005	20	1	JSR Abs	0005	ff	00	00	fd	nv-BdIzC	unknown	T1
8	0005	20	1	JSR Abs	0005	ff	00	00	fd	nv-BdIzC	unknown	T1
9	0006	02	1		0006	80	00	00	fd	Nv-BdIzC	JSR Abs	T2
9	0006	02	1		0006	80	00	00	fd	Nv-BdIzC	JSR Abs	T2

BVC (50)	Cycles: 2-4	Size: 2
Branch Relative		
Cycle	R/W	Desc
-X.2	Read PC	Store as OpCode.
1.1	Read PC	Inc. PC . Check condition (V == 0).
1.2		Store as Operand. Treat as signed 16-bit (Op16=i16(i8(Operand))).
2.1		Inc. PC . If not jumping, end (next half-cycle is 4.2)
2.2		If (PC +Op16).H != PC .H, end after PC .L fix (next half-cycle is 4.2). PC .L= PC .L+Operand.
3.1		
3.2		
4.1		PC .H=previous “(PC +Op16).H” value.
4.2		Store as OpCode.
+X.1		

cycle	ab	db	rw	Fetch	pc	a	x	y	s	p	Execute	State
3	0002	50	1	BVC	0002	aa	00	00	fd	nV-BdIzc	BIT zp	T1
3	0002	50	1	BVC	0002	aa	00	00	fd	nV-BdIzc	BIT zp	T1
4	0003	20	1		0003	aa	00	00	fd	nV-BdIzc	BVC	T2
4	0003	20	1		0003	aa	00	00	fd	nV-BdIzc	BVC	T2
5	0004	01	1	ORA (zp,X)	0004	aa	00	00	fd	nV-BdIzc	BVC	
5	0004	01	1	ORA (zp,X)	0004	aa	00	00	fd	nV-BdIzc	BVC	
6	0005	50	1		0005	aa	00	00	fd	nV-BdIzc	ORA (zp,X)	T2
6	0005	50	1		0005	aa	00	00	fd	nV-BdIzc	ORA (zp,X)	T2

cycle	ab	db	rw	Fetch	pc	a	x	y	s	p	Execute	State
2	0002	50	1	BVC	0002	ff	00	00	fd	Nv-BdIzc	LDA #	T1
2	0002	50	1	BVC	0002	ff	00	00	fd	Nv-BdIzc	LDA #	T1
3	0003	20	1		0003	ff	00	00	fd	Nv-BdIzc	BVC	T2
3	0003	20	1		0003	ff	00	00	fd	Nv-BdIzc	BVC	T2
4	0004	01	1		0004	ff	00	00	fd	Nv-BdIzc	BVC	T3
4	0004	01	1		0004	ff	00	00	fd	Nv-BdIzc	BVC	T3
5	0024	16	1	ASL zp,X	0024	ff	00	00	fd	Nv-BdIzc	BVC	
5	0024	16	1	ASL zp,X	0024	ff	00	00	fd	Nv-BdIzc	BVC	
6	0025	32	1		0025	ff	00	00	fd	Nv-BdIzc	ASL zp,X	T2
6	0025	32	1		0025	ff	00	00	fd	Nv-BdIzc	ASL zp,X	T2

cycle	ab	db	rw	Fetch	pc	a	x	y	s	p	Execute	State
6	01fb	50	1	BVC	01fb	aa	00	00	fd	nv-BdIzc	JMP Abs	T1
6	01fb	50	1	BVC	01fb	aa	00	00	fd	nv-BdIzc	JMP Abs	T1
7	01fc	7f	1		01fc	aa	00	00	fd	nv-BdIzc	BVC	T2
7	01fc	7f	1		01fc	aa	00	00	fd	nv-BdIzc	BVC	T2
8	01fd	00	1		01fd	aa	00	00	fd	nv-BdIzc	BVC	T3
8	01fd	00	1		01fd	aa	00	00	fd	nv-BdIzc	BVC	T3
9	017c	00	1		017c	aa	00	00	fd	nv-BdIzc	BVC	T0
9	017c	00	1		017c	aa	00	00	fd	nv-BdIzc	BVC	T0
10	027c	00	1	BRK	027c	aa	00	00	fd	nv-BdIzc	BVC	T1
10	027c	00	1	BRK	027c	aa	00	00	fd	nv-BdIzc	BVC	T1
11	027d	00	1		027d	aa	00	00	fd	nv-BdIzc	BRK	T2
11	027d	00	1		027d	aa	00	00	fd	nv-BdIzc	BRK	T2

EOR (51)	Cycles: 5-6	Size: 2
Indirect, Y (Read)		
Cycle	R/W	Desc
-X.2	Read PC	Store as OpCode.
1.1		Inc. PC .
1.2	Read PC	Store as Pointer.
2.1		Inc. PC .
2.2	Read Pointer	Store to Address.L.
3.1		
3.2	Read (Pointer+1) & \$FF	Store to Address.H.
4.1		Final=Address+Y. Address.L = Final.L.
4.2	Read Address	Store as Operand. If Address.H == Final.H, skip the next cycle (next half-cycle is 6.1).
5.1		Address.H = Final.H (fixes high byte of address).
5.2	Read Address	Store as Operand.
6.1		* Perform A=A ^ Operand , set N and Z accordingly.
6.2	Read PC	Store as OpCode.
+X.1		A and N, Z applied.

* Setting of A/flags is delayed by 1 cycle until the start of the following instruction.

cycle	ab	db	rw	Fetch	pc	a	x	y	s	p	Execute	State
3	0002	51	1	EOR (zp),Y	0002	aa	00	00	fd	NV-BdIzc	BIT zp	T1
3	0002	51	1	EOR (zp),Y	0002	aa	00	00	fd	NV-BdIzc	BIT zp	T1
4	0003	fb	1		0003	aa	00	00	fd	NV-BdIzc	EOR (zp),Y	T2
4	0003	fb	1		0003	aa	00	00	fd	NV-BdIzc	EOR (zp),Y	T2
5	00fb	80	1		0004	aa	00	00	fd	NV-BdIzc	EOR (zp),Y	T3
5	00fb	80	1		0004	aa	00	00	fd	NV-BdIzc	EOR (zp),Y	T3
6	00fc	00	1		0004	aa	00	00	fd	NV-BdIzc	EOR (zp),Y	T4
6	00fc	00	1		0004	aa	00	00	fd	NV-BdIzc	EOR (zp),Y	T4
7	0080	7f	1		0004	aa	00	00	fd	NV-BdIzc	EOR (zp),Y	T0
7	0080	7f	1		0004	aa	00	00	fd	NV-BdIzc	EOR (zp),Y	T0
8	0004	01	1	ORA (zp,X)	0004	aa	00	00	fd	NV-BdIzc	EOR (zp),Y	T1
8	0004	01	1	ORA (zp,X)	0004	aa	00	00	fd	NV-BdIzc	EOR (zp),Y	T1
9	0005	50	1		0005	d5	00	00	fd	NV-BdIzc	ORA (zp,X)	T2
9	0005	50	1		0005	d5	00	00	fd	NV-BdIzc	ORA (zp,X)	T2

JAM (52)	Cycles: ∞	Size: 1
Implied		
Cycle	R/W	Desc
-X.2	Read PC	Store as OpCode.
1.1		Inc. PC .
1.2	Read PC	
2.1		
2.2	Read \$FFFF	
3.1		
3.2	Read \$FFFE	
4.1		
4.2	Read \$FFFE	
5.1		Repeat 5.1 and 5.2 forever.
5.2	Read \$FFFF	

cycle	ab	db	rw	Fetch	pc	a	x	y	s	p	Execute	State
2	0002	02	1	unknown	0002	00	00	00	fd	nv-BdIZc	LDA #	T1
2	0002	02	1	unknown	0002	00	00	00	fd	nv-BdIZc	LDA #	T1
3	0003	10	1		0003	00	00	00	fd	nv-BdIZc	unknown	T2
3	0003	10	1		0003	00	00	00	fd	nv-BdIZc	unknown	T2
4	ffff	00	1		0004	00	00	00	fd	nv-BdIZc	unknown	T3
4	ffff	00	1		0004	00	00	00	fd	nv-BdIZc	unknown	T3
5	fffe	00	1		0004	00	00	00	fd	nv-BdIZc	unknown	T4
5	fffe	00	1		0004	00	00	00	fd	nv-BdIZc	unknown	T4
6	fffe	00	1		0004	00	00	00	fd	nv-BdIZc	unknown	T5
6	fffe	00	1		0004	00	00	00	fd	nv-BdIZc	unknown	T5
7	ffff	00	1		0004	00	00	00	fd	nv-BdIZc	unknown	
7	ffff	00	1		0004	00	00	00	fd	nv-BdIZc	unknown	
8	ffff	00	1		0004	00	00	00	fd	nv-BdIZc	unknown	
8	ffff	00	1		0004	00	00	00	fd	nv-BdIZc	unknown	
9	ffff	00	1		0004	00	00	00	fd	nv-BdIZc	unknown	
9	ffff	00	1		0004	00	00	00	fd	nv-BdIZc	unknown	
10	ffff	00	1		0004	00	00	00	fd	nv-BdIZc	unknown	
10	ffff	00	1		0004	00	00	00	fd	nv-BdIZc	unknown	
11	ffff	00	1		0004	00	00	00	fd	nv-BdIZc	unknown	
11	ffff	00	1		0004	00	00	00	fd	nv-BdIZc	unknown	

SRE (53)	Cycles: 8	Size: 2
Indirect, Y (Read/Modify/Write)		
Cycle	R/W	Desc
-X.2	Read PC	Store as OpCode.
1.1		Inc. PC .
1.2	Read PC	Store as Pointer.
2.1		Inc. PC .
2.2	Read Pointer	Store to Address.L.
3.1		
3.2	Read (Pointer+1) & \$FF	Store to Address.H.
4.1		Final=Address+Y. Address.L = Final.L.
4.2	Read Address	Store as Operand.
5.1		Address.H = Final.H (fixes high byte of address).
5.2	Read Address	Store as Operand.
6.1		Set C if lowest bit of Operand is set.
6.2	Write Address	Write unmodified Operand.
7.1		* Perform Operand=Operand >> 1, A = A ^ Operand, set N and Z based off A .
7.2	Write Address	Write modified Operand.
8.1		
8.2	Read PC	Store as OpCode.
+X.1		A applied.

* Setting of A is delayed by 2 cycles until the start of the following instruction.

cycle	ab	db	rw	Fetch	pc	a	x	y	s	p	Execute	State
3	0002	53	1	unknown	0002	aa	00	00	fd	NV-BdIzc	BIT zp	T1
3	0002	53	1	unknown	0002	aa	00	00	fd	NV-BdIzc	BIT zp	T1
4	0003	fb	1		0003	aa	00	00	fd	NV-BdIzc	unknown	T2
4	0003	fb	1		0003	aa	00	00	fd	NV-BdIzc	unknown	T2
5	00fb	27	1		0004	aa	00	00	fd	NV-BdIzc	unknown	T3
5	00fb	27	1		0004	aa	00	00	fd	NV-BdIzc	unknown	T3
6	00fc	00	1		0004	aa	00	00	fd	NV-BdIzc	unknown	T4
6	00fc	00	1		0004	aa	00	00	fd	NV-BdIzc	unknown	T4
7	0027	00	1		0004	aa	00	00	fd	NV-BdIzc	unknown	T5
7	0027	00	1		0004	aa	00	00	fd	NV-BdIzc	unknown	T5
8	0027	00	1		0004	aa	00	00	fd	NV-BdIzc	unknown	
8	0027	00	1		0004	aa	00	00	fd	NV-BdIzc	unknown	
9	0027	00	0		0004	aa	00	00	fd	NV-BdIzc	unknown	
9	0027	00	0		0004	aa	00	00	fd	NV-BdIzc	unknown	
10	0027	00	0		0004	aa	00	00	fd	nV-BdIzc	unknown	T0
10	0027	00	0		0004	aa	00	00	fd	nV-BdIzc	unknown	T0
11	0004	01	1	ORA (zp,X)	0004	aa	00	00	fd	nV-BdIzc	unknown	T1
11	0004	01	1	ORA (zp,X)	0004	aa	00	00	fd	nV-BdIzc	unknown	T1
12	0005	50	1		0005	aa	00	00	fd	NV-BdIzc	ORA (zp,X)	T2
12	0005	50	1		0005	aa	00	00	fd	NV-BdIzc	ORA (zp,X)	T2

NOP (54)		Cycles: 4	Size: 2
Zero Page, X (Read)			
Cycle	R/W	Desc	
-X.2	Read PC	Store as OpCode.	
1.1	Read PC	Inc. PC .	
1.2		Store as Pointer.	
2.1		Inc. PC .	
2.2		Store as Operand.	
3.1		Set Address to (Pointer+ X) & \$FF.	
3.2		Store as Operand.	
4.1		Store as OpCode.	
4.2			
+X.1			

cycle	ab	db	rw	Fetch	pc	a	x	y	s	p	Execute	State
3	0002	54	1	unknown	0002	aa	00	00	fd	NV-BdIzc	BIT zp	T1
3	0002	54	1	unknown	0002	aa	00	00	fd	NV-BdIzc	BIT zp	T1
4	0003	fb	1		0003	aa	00	00	fd	NV-BdIzc	unknown	T2
4	0003	fb	1		0003	aa	00	00	fd	NV-BdIzc	unknown	T2
5	00fb	80	1		0004	aa	00	00	fd	NV-BdIzc	unknown	T3
5	00fb	80	1		0004	aa	00	00	fd	NV-BdIzc	unknown	T3
6	00fb	80	1		0004	aa	00	00	fd	NV-BdIzc	unknown	T0
6	00fb	80	1		0004	aa	00	00	fd	NV-BdIzc	unknown	T0
7	0004	01	1	ORA (zp,X)	0004	aa	00	00	fd	NV-BdIzc	unknown	T1
7	0004	01	1	ORA (zp,X)	0004	aa	00	00	fd	NV-BdIzc	unknown	T1
8	0005	50	1		0005	aa	00	00	fd	NV-BdIzc	ORA (zp,X)	T2
8	0005	50	1		0005	aa	00	00	fd	NV-BdIzc	ORA (zp,X)	T2

EOR (55)		Cycles: 4	Size: 2
Zero Page, X (Read)			
Cycle	R/W	Desc	
-X.2	Read PC	Store as OpCode.	
1.1	Read PC	Inc. PC .	
1.2		Store as Pointer.	
2.1		Inc. PC .	
2.2		Store as Operand.	
3.1	Read Pointer	Set Address to (Pointer+ X) & \$FF.	
3.2	Read Address	Store as Operand.	
4.1	Read PC	* Perform A=A ^ Operand, set N and Z accordingly.	
4.2		Store as OpCode.	
+X.1		A and N, Z applied.	

* Setting of A/flags is delayed by 1 cycle until the start of the following instruction.

cycle	ab	db	rw	Fetch	pc	a	x	y	s	p	Execute	State
3	0002	55	1	EOR zp,X	0002	aa	00	00	fd	NV-BdIzc	BIT zp	T1
3	0002	55	1	EOR zp,X	0002	aa	00	00	fd	NV-BdIzc	BIT zp	T1
4	0003	fb	1		0003	aa	00	00	fd	NV-BdIzc	EOR zp,X	T2
4	0003	fb	1		0003	aa	00	00	fd	NV-BdIzc	EOR zp,X	T2
5	00fb	80	1		0004	aa	00	00	fd	NV-BdIzc	EOR zp,X	T3
5	00fb	80	1		0004	aa	00	00	fd	NV-BdIzc	EOR zp,X	T3
6	00fb	80	1		0004	aa	00	00	fd	NV-BdIzc	EOR zp,X	T0
6	00fb	80	1		0004	aa	00	00	fd	NV-BdIzc	EOR zp,X	T0
7	0004	01	1	ORA (zp,X)	0004	aa	00	00	fd	NV-BdIzc	EOR zp,X	T1
7	0004	01	1	ORA (zp,X)	0004	aa	00	00	fd	NV-BdIzc	EOR zp,X	T1
8	0005	50	1		0005	2a	00	00	fd	nV-BdIzc	ORA (zp,X)	T2
8	0005	50	1		0005	2a	00	00	fd	nV-BdIzc	ORA (zp,X)	T2

LSR (56)	Cycles: 6	Size: 2
Zero Page, X (Read/Modify/Write)		
Cycle	R/W	Desc
-X.2	Read PC	Store as OpCode.
1.1		Inc. PC .
1.2	Read PC	Store as Pointer.
2.1		Inc. PC .
2.2	Read Pointer	Store as Operand.
3.1		Set Address to (Pointer+ X) & \$FF.
3.2	Read Address	Store as Operand.
4.1		Set C if lowest bit of Operand is set.
4.2	Write Address	Write unmodified Operand.
5.1		Perform Operand=Operand << 1, set N and Z accordingly.
5.2	Write Address	Write modified Operand.
6.1		
6.2	Read PC	Store as OpCode.
+X.1		

cycle	ab	db	rw	Fetch	pc	a	x	y	s	p	Execute	State
3	0002	56	1	LSR zp,X	0002	aa	00	00	fd	NV-BdIzc	BIT zp	T1
3	0002	56	1	LSR zp,X	0002	aa	00	00	fd	NV-BdIzc	BIT zp	T1
4	0003	fb	1		0003	aa	00	00	fd	NV-BdIzc	LSR zp,X	T2
4	0003	fb	1		0003	aa	00	00	fd	NV-BdIzc	LSR zp,X	T2
5	00fb	4f	1		0004	aa	00	00	fd	NV-BdIzc	LSR zp,X	T3
5	00fb	4f	1		0004	aa	00	00	fd	NV-BdIzc	LSR zp,X	T3
6	00fb	4f	1		0004	aa	00	00	fd	NV-BdIzc	LSR zp,X	T4
6	00fb	4f	1		0004	aa	00	00	fd	NV-BdIzc	LSR zp,X	T4
7	00fb	4f	0		0004	aa	00	00	fd	NV-BdIzC	LSR zp,X	T5
7	00fb	4f	0		0004	aa	00	00	fd	NV-BdIzC	LSR zp,X	T5
8	00fb	4f	0		0004	aa	00	00	fd	nV-BdIzC	LSR zp,X	T0
8	00fb	27	0		0004	aa	00	00	fd	nV-BdIzC	LSR zp,X	T0
9	0004	01	1	ORA (zp,X)	0004	aa	00	00	fd	nV-BdIzC	LSR zp,X	T1
9	0004	01	1	ORA (zp,X)	0004	aa	00	00	fd	nV-BdIzC	LSR zp,X	T1
10	0005	50	1		0005	aa	00	00	fd	nV-BdIzC	ORA (zp,X)	T2
10	0005	50	1		0005	aa	00	00	fd	nV-BdIzC	ORA (zp,X)	T2

SRE (57)	Cycles: 6	Size: 2
Zero Page, X (Read/Modify/Write)		
Cycle	R/W	Desc
-X.2	Read PC	Store as OpCode.
1.1		Inc. PC .
1.2	Read PC	Store as Pointer.
2.1		Inc. PC .
2.2	Read Pointer	Store as Operand.
3.1		Set Address to (Pointer+ X) & \$FF.
3.2	Read Address	Store as Operand.
4.1		Set C if lowest bit of Operand is set.
4.2	Write Address	Write unmodified Operand.
5.1		* Perform Operand=Operand >> 1, A = A ^ Operand, set N and Z based off A .
5.2	Write Address	Write modified Operand.
6.1		
6.2	Read PC	Store as OpCode.
+X.1		A applied.

* Setting of A is delayed by 2 cycles until the start of the following instruction.

cycle	ab	db	rw	Fetch	pc	a	x	y	s	p	Execute	State
2	0002	57	1	unknown	0002	00	00	00	fd	nv-BdIZc	LDA #	T1
2	0002	57	1	unknown	0002	00	00	00	fd	nv-BdIZc	LDA #	T1
3	0003	ff	1		0003	00	00	00	fd	nv-BdIZc	unknown	T2
3	0003	ff	1		0003	00	00	00	fd	nv-BdIZc	unknown	T2
4	00ff	7f	1		0004	00	00	00	fd	nv-BdIZc	unknown	T3
4	00ff	7f	1		0004	00	00	00	fd	nv-BdIZc	unknown	T3
5	00ff	7f	1		0004	00	00	00	fd	nv-BdIZc	unknown	T4
5	00ff	7f	1		0004	00	00	00	fd	nv-BdIZc	unknown	T4
6	00ff	7f	0		0004	00	00	00	fd	nv-BdIZC	unknown	T5
6	00ff	7f	0		0004	00	00	00	fd	nv-BdIZC	unknown	T5
7	00ff	7f	0		0004	00	00	00	fd	nv-BdIzC	unknown	T0
7	00ff	3f	0		0004	00	00	00	fd	nv-BdIzC	unknown	T0
8	0004	20	1	JSR Abs	0004	00	00	00	fd	nv-BdIzC	unknown	T1
8	0004	20	1	JSR Abs	0004	00	00	00	fd	nv-BdIzC	unknown	T1
9	0005	4c	1		0005	3f	00	00	fd	nv-BdIzC	JSR Abs	T2
9	0005	4c	1		0005	3f	00	00	fd	nv-BdIzC	JSR Abs	T2

CLI (58)	Cycles: 2	Size: 1
Implied		
Cycle	R/W	Desc
-X.2	Read PC	Store as OpCode.
1.1		Inc. PC .
1.2	Read PC	To be discarded.
2.1		Clear the I status bit.
2.2	Read PC	Store as OpCode.
+X.1		

cycle	ab	db	rw	Fetch	pc	a	x	y	s	p	Execute	State
2	0002	58	1	CLI	0002	00	00	00	fd	nv-BdIZc	LDA #	T1
2	0002	58	1	CLI	0002	00	00	00	fd	nv-BdIZc	LDA #	T1
3	0003	21	1		0003	00	00	00	fd	nv-BdIZc	CLI	T0+T2
3	0003	21	1		0003	00	00	00	fd	nv-BdIZc	CLI	T0+T2
4	0003	21	1	AND (zp,X)	0003	00	00	00	fd	nv-BdiZc	CLI	T1
4	0003	21	1	AND (zp,X)	0003	00	00	00	fd	nv-BdiZc	CLI	T1
5	0004	20	1		0004	00	00	00	fd	nv-BdiZc	AND (zp,X)	T2
5	0004	20	1		0004	00	00	00	fd	nv-BdiZc	AND (zp,X)	T2

EOR (59)	Cycles: 4-5	Size: 3
Absolute, Y (Read)		
Cycle	R/W	Desc
-X.2	Read PC	Store as OpCode.
1.1	Read PC	Inc. PC .
1.2		Store as Address.L.
2.1		Inc. PC .
2.2		Store as Address.H.
3.1		Inc. PC . Final=Address+Y. Address.L = Final.L.
3.2	Read Address	Store as Operand. If Address.H == Final.H, skip the next cycle (next half-cycle is 5.1).
4.1	Read Address	Address.H = Final.H (fixes high byte of address).
4.2		Store as Operand.
5.1		* Perform A=A ^ Operand , set N and Z accordingly.
5.2	Read PC	Store as OpCode.
+X.1		A and N, Z applied.

* Setting of A/flags is delayed by 1 cycle until the start of the following instruction.

cycle	ab	db	rw	Fetch	pc	a	x	y	s	p	Execute	State
2	0002	59	1	EOR Abs,Y	0002	ff	00	00	fd	Nv-BdIzc	LDA #	T1
2	0002	59	1	EOR Abs,Y	0002	ff	00	00	fd	Nv-BdIzc	LDA #	T1
3	0003	21	1		0003	ff	00	00	fd	Nv-BdIzc	EOR Abs,Y	T2
3	0003	21	1		0003	ff	00	00	fd	Nv-BdIzc	EOR Abs,Y	T2
4	0004	01	1		0004	ff	00	00	fd	Nv-BdIzc	EOR Abs,Y	T3
4	0004	01	1		0004	ff	00	00	fd	Nv-BdIzc	EOR Abs,Y	T3
5	0121	7f	1		0005	ff	00	00	fd	Nv-BdIzc	EOR Abs,Y	T0
5	0121	7f	1		0005	ff	00	00	fd	Nv-BdIzc	EOR Abs,Y	T0
6	0005	4c	1	JMP Abs	0005	ff	00	00	fd	Nv-BdIzc	EOR Abs,Y	T1
6	0005	4c	1	JMP Abs	0005	ff	00	00	fd	Nv-BdIzc	EOR Abs,Y	T1
7	0006	02	1		0006	80	00	00	fd	Nv-BdIzc	JMP Abs	T2
7	0006	02	1		0006	80	00	00	fd	Nv-BdIzc	JMP Abs	T2

NOP (5A)		Cycles: 2	Size: 1
Implied			
Cycle	R/W	Desc	
-X.2	Read PC	Store as OpCode.	
1.1	Read PC	Inc. PC .	
1.2		To be discarded.	
2.1			
2.2		Store as OpCode.	
+X.1			

cycle	ab	db	rw	Fetch	pc	a	x	y	s	p	Execute	State
2	0002	5a	1	unknown	0002	ff	00	00	fd	Nv-BdIzc	LDA #	T1
2	0002	5a	1	unknown	0002	ff	00	00	fd	Nv-BdIzc	LDA #	T1
3	0003	21	1		0003	ff	00	00	fd	Nv-BdIzc	unknown	T0+T2
3	0003	21	1		0003	ff	00	00	fd	Nv-BdIzc	unknown	T0+T2
4	0003	21	1	AND (zp,X)	0003	ff	00	00	fd	Nv-BdIzc	unknown	T1
4	0003	21	1	AND (zp,X)	0003	ff	00	00	fd	Nv-BdIzc	unknown	T1
5	0004	01	1		0004	ff	00	00	fd	Nv-BdIzc	AND (zp,X)	T2
5	0004	01	1		0004	ff	00	00	fd	Nv-BdIzc	AND (zp,X)	T2

SRE (5B)	Cycles: 7	Size: 3
Absolute, Y (Read/Modify/Write)		
Cycle	R/W	Desc
-X.2	Read PC	Store as OpCode.
1.1		Inc. PC .
1.2	Read PC	Store as Address.L.
2.1		Inc. PC .
2.2	Read PC	Store as Address.H.
3.1		Inc. PC . Final=Address+ Y . Address.L = Final.L.
3.2	Read Address	Store as Operand.
4.1		Address.H = Final.H (fixes high byte of address).
4.2	Read Address	Store as Operand.
5.1		Set C if lowest bit of Operand is set.
5.2	Write Address	Write unmodified Operand.
6.1		* Perform Operand=Operand >> 1, A = A ^ Operand, set N and Z based off A .
6.2	Write Address	Write modified Operand.
7.1		
7.2	Read PC	Store as OpCode.
+X.1		A applied.

* Setting of A is delayed by 2 cycles until the start of the following instruction.

cycle	ab	db	rw	Fetch	pc	a	x	y	s	p	Execute	State
2	0002	5b	1	unknown	0002	ff	00	00	fd	Nv-BdIzc	LDA #	T1
2	0002	5b	1	unknown	0002	ff	00	00	fd	Nv-BdIzc	LDA #	T1
3	0003	21	1		0003	ff	00	00	fd	Nv-BdIzc	unknown	T2
3	0003	21	1		0003	ff	00	00	fd	Nv-BdIzc	unknown	T2
4	0004	01	1		0004	ff	00	00	fd	Nv-BdIzc	unknown	T3
4	0004	01	1		0004	ff	00	00	fd	Nv-BdIzc	unknown	T3
5	0121	ff	1		0005	ff	00	00	fd	Nv-BdIzc	unknown	T4
5	0121	ff	1		0005	ff	00	00	fd	Nv-BdIzc	unknown	T4
6	0121	ff	1		0005	ff	00	00	fd	Nv-BdIzc	unknown	T5
6	0121	ff	1		0005	ff	00	00	fd	Nv-BdIzc	unknown	T5
7	0121	ff	0		0005	ff	00	00	fd	Nv-BdIzc	unknown	
7	0121	ff	0		0005	ff	00	00	fd	Nv-BdIzc	unknown	
8	0121	ff	0		0005	ff	00	00	fd	nv-BdIzc	unknown	T0
8	0121	7f	0		0005	ff	00	00	fd	nv-BdIzc	unknown	T0
9	0005	4c	1	JMP Abs	0005	ff	00	00	fd	nv-BdIzc	unknown	T1
9	0005	4c	1	JMP Abs	0005	ff	00	00	fd	nv-BdIzc	unknown	T1
10	0006	02	1		0006	80	00	00	fd	Nv-BdIzc	JMP Abs	T2
10	0006	02	1		0006	80	00	00	fd	Nv-BdIzc	JMP Abs	T2

NOP (5C) Cycles: 4-5		Size: 3
Absolute, X (Read)		
Cycle	R/W	Desc
-X.2	Read PC	Store as OpCode.
1.1	Read PC	Inc. PC .
1.2		Store as Address.L.
2.1		Inc. PC .
2.2		Store as Address.H.
3.1		Inc. PC . Final=Address+X. Address.L = Final.L.
3.2	Read Address	Store as Operand. If Address.H == Final.H, skip the next cycle (next half-cycle is 5.1).
4.1	Read Address	Address.H = Final.H (fixes high byte of address).
4.2		Store as Operand.
5.1		
5.2	Read PC	Store as OpCode.
+X.1		

cycle	ab	db	rw	Fetch	pc	a	x	y	s	p	Execute	State
2	0002	5c	1	unknown	0002	aa	ff	00	fd	Nv-BdIzc	LDX #	T1
2	0002	5c	1	unknown	0002	aa	ff	00	fd	Nv-BdIzc	LDX #	T1
3	0003	21	1		0003	aa	ff	00	fd	Nv-BdIzc	unknown	T2
3	0003	21	1		0003	aa	ff	00	fd	Nv-BdIzc	unknown	T2
4	0004	01	1		0004	aa	ff	00	fd	Nv-BdIzc	unknown	T3
4	0004	01	1		0004	aa	ff	00	fd	Nv-BdIzc	unknown	T3
5	0120	00	1		0005	aa	ff	00	fd	Nv-BdIzc	unknown	T4
5	0120	00	1		0005	aa	ff	00	fd	Nv-BdIzc	unknown	T4
6	0220	00	1		0005	aa	ff	00	fd	Nv-BdIzc	unknown	T0
6	0220	00	1		0005	aa	ff	00	fd	Nv-BdIzc	unknown	T0
7	0005	4c	1	JMP Abs	0005	aa	ff	00	fd	Nv-BdIzc	unknown	T1
7	0005	4c	1	JMP Abs	0005	aa	ff	00	fd	Nv-BdIzc	unknown	T1
8	0006	02	1		0006	aa	ff	00	fd	Nv-BdIzc	JMP Abs	T2
8	0006	02	1		0006	aa	ff	00	fd	Nv-BdIzc	JMP Abs	T2

EOR (5D)		Cycles: 4-5	Size: 3
Absolute, X (Read)			
Cycle	R/W	Desc	
-X.2	Read PC	Store as OpCode.	
1.1	Read PC	Inc. PC .	
1.2		Store as Address.L.	
2.1		Inc. PC .	
2.2		Store as Address.H.	
3.1		Inc. PC . Final=Address+X. Address.L = Final.L.	
3.2	Read Address	Store as Operand. If Address.H == Final.H, skip the next cycle (next half-cycle is 5.1).	
4.1	Read Address	Address.H = Final.H (fixes high byte of address).	
4.2		Store as Operand.	
5.1		* Perform A=A ^ Operand , set N and Z accordingly.	
5.2		Store as OpCode.	
+X.1		A and N, Z applied.	

* Setting of A/flags is delayed by 1 cycle until the start of the following instruction.

cycle	ab	db	rw	Fetch	pc	a	x	y	s	p	Execute	State
2	0002	5d	1	EOR Abs,X	0002	aa	ff	00	fd	Nv-BdIzc	LDX #	T1
2	0002	5d	1	EOR Abs,X	0002	aa	ff	00	fd	Nv-BdIzc	LDX #	T1
3	0003	21	1		0003	aa	ff	00	fd	Nv-BdIzc	EOR Abs,X	T2
3	0003	21	1		0003	aa	ff	00	fd	Nv-BdIzc	EOR Abs,X	T2
4	0004	01	1		0004	aa	ff	00	fd	Nv-BdIzc	EOR Abs,X	T3
4	0004	01	1		0004	aa	ff	00	fd	Nv-BdIzc	EOR Abs,X	T3
5	0120	00	1		0005	aa	ff	00	fd	Nv-BdIzc	EOR Abs,X	T4
5	0120	00	1		0005	aa	ff	00	fd	Nv-BdIzc	EOR Abs,X	T4
6	0220	00	1		0005	aa	ff	00	fd	Nv-BdIzc	EOR Abs,X	T0
6	0220	00	1		0005	aa	ff	00	fd	Nv-BdIzc	EOR Abs,X	T0
7	0005	4c	1	JMP Abs	0005	aa	ff	00	fd	Nv-BdIzc	EOR Abs,X	T1
7	0005	4c	1	JMP Abs	0005	aa	ff	00	fd	Nv-BdIzc	EOR Abs,X	T1
8	0006	02	1		0006	aa	ff	00	fd	Nv-BdIzc	JMP Abs	T2
8	0006	02	1		0006	aa	ff	00	fd	Nv-BdIzc	JMP Abs	T2

LSR (5E)	Cycles: 7	Size: 3
Absolute, X (Read/Modify/Write)		
Cycle	R/W	Desc
-X.2	Read PC	Store as OpCode.
1.1		Inc. PC .
1.2	Read PC	Store as Address.L.
2.1		Inc. PC .
2.2	Read PC	Store as Address.H.
3.1		Inc. PC . Final=Address+ X . Address.L = Final.L.
3.2	Read Address	Store as Operand.
4.1		Address.H = Final.H (fixes high byte of address).
4.2	Read Address	Store as Operand.
5.1		Set C if lowest bit of Operand is set.
5.2	Write Address	Write unmodified Operand.
6.1		Perform Operand=Operand << 1, set N and Z accordingly.
6.2	Write Address	Write modified Operand.
7.1		
7.2	Read PC	Store as OpCode.
+X.1		

cycle	ab	db	rw	Fetch	pc	a	x	y	s	p	Execute	State
2	0002	5e	1	LSR Abs,X	0002	aa	ff	00	fd	Nv-BdIzc	LDX #	T1
2	0002	5e	1	LSR Abs,X	0002	aa	ff	00	fd	Nv-BdIzc	LDX #	T1
3	0003	21	1		0003	aa	ff	00	fd	Nv-BdIzc	LSR Abs,X	T2
3	0003	21	1		0003	aa	ff	00	fd	Nv-BdIzc	LSR Abs,X	T2
4	0004	00	1		0004	aa	ff	00	fd	Nv-BdIzc	LSR Abs,X	T3
4	0004	00	1		0004	aa	ff	00	fd	Nv-BdIzc	LSR Abs,X	T3
5	0020	7f	1		0005	aa	ff	00	fd	Nv-BdIzc	LSR Abs,X	T4
5	0020	7f	1		0005	aa	ff	00	fd	Nv-BdIzc	LSR Abs,X	T4
6	0120	7f	1		0005	aa	ff	00	fd	Nv-BdIzc	LSR Abs,X	T5
6	0120	7f	1		0005	aa	ff	00	fd	Nv-BdIzc	LSR Abs,X	T5
7	0120	7f	0		0005	aa	ff	00	fd	Nv-BdIzc	LSR Abs,X	
7	0120	7f	0		0005	aa	ff	00	fd	Nv-BdIzc	LSR Abs,X	
8	0120	7f	0		0005	aa	ff	00	fd	nv-BdIzc	LSR Abs,X	T0
8	0120	3f	0		0005	aa	ff	00	fd	nv-BdIzc	LSR Abs,X	T0
9	0005	4c	1	JMP Abs	0005	aa	ff	00	fd	nv-BdIzc	LSR Abs,X	T1
9	0005	4c	1	JMP Abs	0005	aa	ff	00	fd	nv-BdIzc	LSR Abs,X	T1
10	0006	02	1		0006	aa	ff	00	fd	nv-BdIzc	JMP Abs	T2
10	0006	02	1		0006	aa	ff	00	fd	nv-BdIzc	JMP Abs	T2

SRE (5F)	Cycles: 7	Size: 3
Absolute, X (Read/Modify/Write)		
Cycle	R/W	Desc
-X.2	Read PC	Store as OpCode.
1.1		Inc. PC .
1.2	Read PC	Store as Address.L.
2.1		Inc. PC .
2.2	Read PC	Store as Address.H.
3.1		Inc. PC . Final=Address+ X . Address.L = Final.L.
3.2	Read Address	Store as Operand.
4.1		Address.H = Final.H (fixes high byte of address).
4.2	Read Address	Store as Operand.
5.1		Set C if lowest bit of Operand is set.
5.2	Write Address	Write unmodified Operand.
6.1		* Perform Operand=Operand >> 1, A = A ^ Operand, set N and Z based off A .
6.2	Write Address	Write modified Operand.
7.1		
7.2	Read PC	Store as OpCode.
+X.1		A applied.

* Setting of A is delayed by 2 cycles until the start of the following instruction.

cycle	ab	db	rw	Fetch	pc	a	x	y	s	p	Execute	State
2	0002	5f	1	unknown	0002	aa	ff	00	fd	Nv-BdIzc	LDX #	T1
2	0002	5f	1	unknown	0002	aa	ff	00	fd	Nv-BdIzc	LDX #	T1
3	0003	21	1		0003	aa	ff	00	fd	Nv-BdIzc	unknown	T2
3	0003	21	1		0003	aa	ff	00	fd	Nv-BdIzc	unknown	T2
4	0004	00	1		0004	aa	ff	00	fd	Nv-BdIzc	unknown	T3
4	0004	00	1		0004	aa	ff	00	fd	Nv-BdIzc	unknown	T3
5	0020	7f	1		0005	aa	ff	00	fd	Nv-BdIzc	unknown	T4
5	0020	7f	1		0005	aa	ff	00	fd	Nv-BdIzc	unknown	T4
6	0120	3f	1		0005	aa	ff	00	fd	Nv-BdIzc	unknown	T5
6	0120	3f	1		0005	aa	ff	00	fd	Nv-BdIzc	unknown	T5
7	0120	3f	0		0005	aa	ff	00	fd	Nv-BdIzc	unknown	
7	0120	3f	0		0005	aa	ff	00	fd	Nv-BdIzc	unknown	
8	0120	3f	0		0005	aa	ff	00	fd	nv-BdIzc	unknown	T0
8	0120	1f	0		0005	aa	ff	00	fd	nv-BdIzc	unknown	T0
9	0005	4c	1	JMP Abs	0005	aa	ff	00	fd	nv-BdIzc	unknown	T1
9	0005	4c	1	JMP Abs	0005	aa	ff	00	fd	nv-BdIzc	unknown	T1
10	0006	02	1		0006	b5	ff	00	fd	Nv-BdIzc	JMP Abs	T2
10	0006	02	1		0006	b5	ff	00	fd	Nv-BdIzc	JMP Abs	T2

RTS (60)	Cycles: 6	Size: 1
Implied		
Cycle	R/W	Desc
-X.2	Read PC	Store as OpCode.
1.1		Inc. PC .
1.2	Read PC	
2.1		Inc. PC .
2.2	Read S \$0100	
3.1		
3.2	Read (S +1) \$0100	Store as Address.L.
4.1		Increase S by 2.
4.2	Read S \$0100	Store as Address.H.
5.1		Copy Address to PC .
5.2	Read PC	
6.1		Inc. PC.
6.2	Read PC	Store as OpCode.
+X.1		

cycle	ab	db	rw	Fetch	pc	a	x	y	s	p	Execute	State
8	0021	60	1	RTS	0021	aa	ff	00	fb	Nv-BdIzc	JSR Abs	T1
8	0021	60	1	RTS	0021	aa	ff	00	fb	Nv-BdIzc	JSR Abs	T1
9	0022	00	1		0022	aa	ff	00	fb	Nv-BdIzc	RTS	T2
9	0022	00	1		0022	aa	ff	00	fb	Nv-BdIzc	RTS	T2
10	01fb	60	1		0023	aa	ff	00	fb	Nv-BdIzc	RTS	T3
10	01fb	60	1		0023	aa	ff	00	fb	Nv-BdIzc	RTS	T3
11	01fc	04	1		0023	aa	ff	00	fb	Nv-BdIzc	RTS	T4
11	01fc	04	1		0023	aa	ff	00	fb	Nv-BdIzc	RTS	T4
12	01fd	00	1		0023	aa	ff	00	fd	Nv-BdIzc	RTS	T5
12	01fd	00	1		0023	aa	ff	00	fd	Nv-BdIzc	RTS	T5
13	0004	00	1		0004	aa	ff	00	fd	Nv-BdIzc	RTS	T0
13	0004	00	1		0004	aa	ff	00	fd	Nv-BdIzc	RTS	T0
14	0005	4c	1	JMP Abs	0005	aa	ff	00	fd	Nv-BdIzc	RTS	T1
14	0005	4c	1	JMP Abs	0005	aa	ff	00	fd	Nv-BdIzc	RTS	T1
15	0006	02	1		0006	aa	ff	00	fd	Nv-BdIzc	JMP Abs	T2
15	0006	02	1		0006	aa	ff	00	fd	Nv-BdIzc	JMP Abs	T2

ADC (61)	Cycles: 6	Size: 2
Indirect, X (Read)		
Cycle	R/W	Desc
-X.2	Read PC	Store as OpCode.
1.1		Inc. PC .
1.2	Read PC	Store as Operand.
2.1		Inc. PC .
2.2	Read Operand	
3.1		Set Pointer to (Operand+X) & \$FF.
3.2	Read Pointer	Store to Address.L.
4.1		
4.2	Read (Pointer+1) & \$FF	Store to Address.H.
5.1		
5.2	Read Address	Store as Operand.
6.1		* u16 Tmp = A + Operand + (C flag). $V = (\sim(u16(A) \wedge u16(Operand)) \& (u16(A) \wedge Tmp) \& \$0080) \neq 0.$ $A = u8(Tmp).$ $C = Tmp > \$FF.$ $Z = A == \$00.$ $N = (A \& \$80) \neq 0.$
6.2	Read PC	Store as OpCode.
+X.1		A and C, N, V, Z applied.

* Setting of A/flags is delayed by 1 cycle until the start of the following instruction.

cycle	ab	db	rw	Fetch	pc	a	x	y	s	p	Execute	State
2	0002	61	1	ADC (zp,X)	0002	aa	ff	00	fd	Nv-BdIzc	LDX #	T1
2	0002	61	1	ADC (zp,X)	0002	aa	ff	00	fd	Nv-BdIzc	LDX #	T1
3	0003	21	1		0003	aa	ff	00	fd	Nv-BdIzc	ADC (zp,X)	T2
3	0003	21	1		0003	aa	ff	00	fd	Nv-BdIzc	ADC (zp,X)	T2
4	0021	01	1		0004	aa	ff	00	fd	Nv-BdIzc	ADC (zp,X)	T3
4	0021	01	1		0004	aa	ff	00	fd	Nv-BdIzc	ADC (zp,X)	T3
5	0020	23	1		0004	aa	ff	00	fd	Nv-BdIzc	ADC (zp,X)	T4
5	0020	23	1		0004	aa	ff	00	fd	Nv-BdIzc	ADC (zp,X)	T4
6	0021	01	1		0004	aa	ff	00	fd	Nv-BdIzc	ADC (zp,X)	T5
6	0021	01	1		0004	aa	ff	00	fd	Nv-BdIzc	ADC (zp,X)	T5
7	0123	6c	1		0004	aa	ff	00	fd	Nv-BdIzc	ADC (zp,X)	T0
7	0123	6c	1		0004	aa	ff	00	fd	Nv-BdIzc	ADC (zp,X)	T0
8	0004	20	1	JSR Abs	0004	aa	ff	00	fd	Nv-BdIzc	ADC (zp,X)	T1
8	0004	20	1	JSR Abs	0004	aa	ff	00	fd	Nv-BdIzc	ADC (zp,X)	T1
9	0005	4c	1		0005	16	ff	00	fd	nv-BdIzC	JSR Abs	T2
9	0005	4c	1		0005	16	ff	00	fd	nv-BdIzC	JSR Abs	T2

JAM (62)	Cycles: ∞	Size: 1
Implied		
Cycle	R/W	Desc
-X.2	Read PC	Store as OpCode.
1.1		Inc. PC .
1.2	Read PC	
2.1		
2.2	Read \$FFFF	
3.1		
3.2	Read \$FFFE	
4.1		
4.2	Read \$FFFE	
5.1		Repeat 5.1 and 5.2 forever.
5.2	Read \$FFFF	

cycle	ab	db	rw	Fetch	pc	a	x	y	s	p	Execute	State
2	0002	02	1	unknown	0002	00	00	00	fd	nv-BdIZc	LDA #	T1
2	0002	02	1	unknown	0002	00	00	00	fd	nv-BdIZc	LDA #	T1
3	0003	10	1		0003	00	00	00	fd	nv-BdIZc	unknown	T2
3	0003	10	1		0003	00	00	00	fd	nv-BdIZc	unknown	T2
4	ffff	00	1		0004	00	00	00	fd	nv-BdIZc	unknown	T3
4	ffff	00	1		0004	00	00	00	fd	nv-BdIZc	unknown	T3
5	fffe	00	1		0004	00	00	00	fd	nv-BdIZc	unknown	T4
5	fffe	00	1		0004	00	00	00	fd	nv-BdIZc	unknown	T4
6	fffe	00	1		0004	00	00	00	fd	nv-BdIZc	unknown	T5
6	fffe	00	1		0004	00	00	00	fd	nv-BdIZc	unknown	T5
7	ffff	00	1		0004	00	00	00	fd	nv-BdIZc	unknown	
7	ffff	00	1		0004	00	00	00	fd	nv-BdIZc	unknown	
8	ffff	00	1		0004	00	00	00	fd	nv-BdIZc	unknown	
8	ffff	00	1		0004	00	00	00	fd	nv-BdIZc	unknown	
9	ffff	00	1		0004	00	00	00	fd	nv-BdIZc	unknown	
9	ffff	00	1		0004	00	00	00	fd	nv-BdIZc	unknown	
10	ffff	00	1		0004	00	00	00	fd	nv-BdIZc	unknown	
10	ffff	00	1		0004	00	00	00	fd	nv-BdIZc	unknown	
11	ffff	00	1		0004	00	00	00	fd	nv-BdIZc	unknown	
11	ffff	00	1		0004	00	00	00	fd	nv-BdIZc	unknown	

RRA (63)	Cycles: 8	Size: 2
Indirect, X (Read/Modify/Write)		
Cycle	R/W	Desc
-X.2	Read PC	Store as OpCode.
1.1		Inc. PC .
1.2	Read PC	Store as Operand.
2.1		Inc. PC .
2.2	Read Operand	
3.1		Set Pointer to (Operand+X) & \$FF.
3.2	Read Pointer	Store to Address.L.
4.1		
4.2	Read (Pointer+1) & \$FF	Store to Address.H.
5.1		
5.1	Read Address	Store as Operand.
6.1		
6.2	Write Address	Write unmodified Operand.
7.1		* Tmp = (C << 7). Set C if low bit of P is set. Operand=(Operand >> 1) Tmp. A =(A ADC Operand), set C , N , V , and Z based off A .
7.2	Write Address	Write modified Operand.
8.1		
8.2	Read PC	Store as OpCode.
+X.1		A and C , N , V , Z applied.

* Setting of A/flags is delayed by 1 cycle until the start of the following instruction.

cycle	ab	db	rw	Fetch	pc	a	x	y	s	p	Execute	State
2	0002	63	1	unknown	0002	f0	00	00	fd	Nv-BdIzc	LDA #	T1
2	0002	63	1	unknown	0002	f0	00	00	fd	Nv-BdIzc	LDA #	T1
3	0003	10	1		0003	f0	00	00	fd	Nv-BdIzc	unknown	T2
3	0003	10	1		0003	f0	00	00	fd	Nv-BdIzc	unknown	T2
4	0010	19	1		0004	f0	00	00	fd	Nv-BdIzc	unknown	T3
4	0010	19	1		0004	f0	00	00	fd	Nv-BdIzc	unknown	T3
5	0010	19	1		0004	f0	00	00	fd	Nv-BdIzc	unknown	T4
5	0010	19	1		0004	f0	00	00	fd	Nv-BdIzc	unknown	T4
6	0011	00	1		0004	f0	00	00	fd	Nv-BdIzc	unknown	T5
6	0011	00	1		0004	f0	00	00	fd	Nv-BdIzc	unknown	T5
7	0019	ff	1		0004	f0	00	00	fd	Nv-BdIzc	unknown	
7	0019	ff	1		0004	f0	00	00	fd	Nv-BdIzc	unknown	
8	0019	ff	0		0004	f0	00	00	fd	Nv-BdIzc	unknown	
8	0019	ff	0		0004	f0	00	00	fd	Nv-BdIzc	unknown	
9	0019	ff	0		0004	f0	00	00	fd	nv-BdIzc	unknown	T0
9	0019	7f	0		0004	f0	00	00	fd	nv-BdIzc	unknown	T0
10	0004	00	1	BRK	0004	f0	00	00	fd	nv-BdIzc	unknown	T1
10	0004	00	1	BRK	0004	f0	00	00	fd	nv-BdIzc	unknown	T1
11	0005	4c	1		0005	70	00	00	fd	nv-BdIzc	BRK	T2
11	0005	4c	1		0005	70	00	00	fd	nv-BdIzc	BRK	T2

NOP (64)		Cycles: 3	Size: 2
Zero Page (Read)			
Cycle	R/W	Desc	
-X.2	Read PC	Store as OpCode.	
1.1	Read PC	Inc. PC .	
1.2		Store as Address.	
2.1		Inc. PC .	
2.2		Store as Operand.	
3.1			
3.2	Read PC	Store as OpCode.	
+X.1			

cycle	ab	db	rw	Fetch	pc	a	x	y	s	p	Execute	State
2	0002	64	1	unknown	0002	f0	00	00	fd	Nv-BdIzc	LDA #	T1
2	0002	64	1	unknown	0002	f0	00	00	fd	Nv-BdIzc	LDA #	T1
3	0003	10	1		0003	f0	00	00	fd	Nv-BdIzc	unknown	T2
3	0003	10	1		0003	f0	00	00	fd	Nv-BdIzc	unknown	T2
4	0010	19	1		0004	f0	00	00	fd	Nv-BdIzc	unknown	T0
4	0010	19	1		0004	f0	00	00	fd	Nv-BdIzc	unknown	T0
5	0004	a4	1	LDY zp	0004	f0	00	00	fd	Nv-BdIzc	unknown	T1
5	0004	a4	1	LDY zp	0004	f0	00	00	fd	Nv-BdIzc	unknown	T1
6	0005	4c	1		0005	f0	00	00	fd	Nv-BdIzc	LDY zp	T2
6	0005	4c	1		0005	f0	00	00	fd	Nv-BdIzc	LDY zp	T2

ADC (65)		Cycles: 3	Size: 2
Zero Page (Read)			
Cycle	R/W	Desc	
-X.2	Read PC	Store as OpCode.	
1.1	Read PC	Inc. PC .	
1.2		Store as Address.	
2.1		Inc. PC .	
2.2		Store as Operand.	
3.1		* u16 Tmp = A + Operand + (C flag). $V = (\sim(u16(A) \wedge u16(Operand)) \& (u16(A) \wedge Tmp) \& \$0080) \neq 0.$ $A = u8(Tmp).$ $C = Tmp > \$FF.$ $Z = A == \$00.$ $N = (A \& \$80) \neq 0.$	
3.2	Read PC	Store as OpCode.	
+X.1		A and C , N , V , Z applied.	

* Setting of A/flags is delayed by 1 cycle until the start of the following instruction.

cycle	ab	db	rw	Fetch	pc	a	x	y	s	p	Execute	State
2	0002	65	1	ADC zp	0002	f0	00	00	fd	Nv-BdIzc	LDA #	T1
2	0002	65	1	ADC zp	0002	f0	00	00	fd	Nv-BdIzc	LDA #	T1
3	0003	10	1		0003	f0	00	00	fd	Nv-BdIzc	ADC zp	T2
3	0003	10	1		0003	f0	00	00	fd	Nv-BdIzc	ADC zp	T2
4	0010	19	1		0004	f0	00	00	fd	Nv-BdIzc	ADC zp	T0
4	0010	19	1		0004	f0	00	00	fd	Nv-BdIzc	ADC zp	T0
5	0004	a4	1	LDY zp	0004	f0	00	00	fd	Nv-BdIzc	ADC zp	T1
5	0004	a4	1	LDY zp	0004	f0	00	00	fd	Nv-BdIzc	ADC zp	T1
6	0005	4c	1		0005	09	00	00	fd	nv-BdIzC	LDY zp	T2
6	0005	4c	1		0005	09	00	00	fd	nv-BdIzC	LDY zp	T2

ROR (66)	Cycles: 5	Size: 2
Zero Page (Read/Modify/Write)		
Cycle	R/W	Desc
-X.2	Read PC	Store as OpCode.
1.1		Inc. PC .
1.2	Read PC	Store as Address.
2.1		Inc. PC .
2.2	Read Address	Store as Operand.
3.1		
3.2	Write Address	Write unmodified Operand.
4.1		* Tmp = (C << 7). Set C if low bit of Operand is set. Operand=(Operand >> 1) Tmp. Set N , and Z based off Operand.
4.2	Write Address	Write modified Operand.
5.1		
5.2	Read PC	Store as OpCode.
+X.1		

cycle	ab	db	rw	Fetch	pc	a	x	y	s	p	Execute	State
4	0002	66	1	ROR zp	0002	aa	00	00	fd	nv-BdIZC	SEC	T1
4	0002	66	1	ROR zp	0002	aa	00	00	fd	nv-BdIZC	SEC	T1
5	0003	10	1		0003	aa	00	00	fd	nv-BdIZC	ROR zp	T2
5	0003	10	1		0003	aa	00	00	fd	nv-BdIZC	ROR zp	T2
6	0010	7f	1		0004	aa	00	00	fd	nv-BdIZC	ROR zp	T3
6	0010	7f	1		0004	aa	00	00	fd	nv-BdIZC	ROR zp	T3
7	0010	7f	0		0004	aa	00	00	fd	nv-BdIZC	ROR zp	T4
7	0010	7f	0		0004	aa	00	00	fd	nv-BdIZC	ROR zp	T4
8	0010	7f	0		0004	aa	00	00	fd	Nv-BdIzC	ROR zp	T0
8	0010	bf	0		0004	aa	00	00	fd	Nv-BdIzC	ROR zp	T0
9	0004	a4	1	LDY zp	0004	aa	00	00	fd	Nv-BdIzC	ROR zp	T1
9	0004	a4	1	LDY zp	0004	aa	00	00	fd	Nv-BdIzC	ROR zp	T1
10	0005	4c	1		0005	aa	00	00	fd	Nv-BdIzC	LDY zp	T2
10	0005	4c	1		0005	aa	00	00	fd	Nv-BdIzC	LDY zp	T2

RRA (67)	Cycles: 5	Size: 2	
Zero Page (Read/Modify/Write)			
Cycle	R/W	Desc	
-X.2	Read PC	Store as OpCode.	
1.1		Inc. PC .	
1.2		Store as Address.	
2.1		Inc. PC .	
2.2		Store as Operand.	
3.1		Write unmodified Operand. * Tmp = (C << 7). Set C if low bit of P is set. Operand=(Operand >> 1) Tmp. A =(A ADC Operand), set C , N , V , and Z based off A .	
3.2			
4.1			
4.2			Write modified Operand.
5.1			
5.2		Store as OpCode.	
+X.1	A and C , N , V , Z applied.		

* Setting of A/flags is delayed by 1 cycle until the start of the following instruction.

cycle	ab	db	rw	Fetch	pc	a	x	y	s	p	Execute	State
2	0002	67	1	unknown	0002	38	00	00	fd	nv-BdIzc	LDA #	T1
2	0002	67	1	unknown	0002	38	00	00	fd	nv-BdIzc	LDA #	T1
3	0003	10	1		0003	38	00	00	fd	nv-BdIzc	unknown	T2
3	0003	10	1		0003	38	00	00	fd	nv-BdIzc	unknown	T2
4	0010	2f	1		0004	38	00	00	fd	nv-BdIzc	unknown	T3
4	0010	2f	1		0004	38	00	00	fd	nv-BdIzc	unknown	T3
5	0010	2f	0		0004	38	00	00	fd	nv-BdIzc	unknown	T4
5	0010	2f	0		0004	38	00	00	fd	nv-BdIzc	unknown	T4
6	0010	2f	0		0004	38	00	00	fd	nv-BdIzc	unknown	T0
6	0010	17	0		0004	38	00	00	fd	nv-BdIzc	unknown	T0
7	0004	a4	1	LDY zp	0004	38	00	00	fd	nv-BdIzc	unknown	T1
7	0004	a4	1	LDY zp	0004	38	00	00	fd	nv-BdIzc	unknown	T1
8	0005	4c	1		0005	50	00	00	fd	nv-BdIzc	LDY zp	T2
8	0005	4c	1		0005	50	00	00	fd	nv-BdIzc	LDY zp	T2

PLA (68)	Cycles: 4	Size: 1
Implied		
Cycle	R/W	Desc
-X.2	Read PC	Store as OpCode.
1.1		Inc. PC .
1.2	Read PC	To be discarded.
2.1		
2.2	Read S \$0100	Tom Harte tests require this to be stored to A .
3.1		Inc. S .
3.2	Read S \$0100	Store as Operand.
4.1		A =Operand, set N and Z based off A .
4.2	Read PC	Store as OpCode.
+X.1		

cycle	ab	db	rw	Fetch	pc	a	x	y	s	p	Execute	State
2	0002	68	1	PLA	0002	80	00	00	fd	Nv-BdIzc	LDA #	T1
2	0002	68	1	PLA	0002	80	00	00	fd	Nv-BdIzc	LDA #	T1
3	0003	10	1		0003	80	00	00	fd	Nv-BdIzc	PLA	T2
3	0003	10	1		0003	80	00	00	fd	Nv-BdIzc	PLA	T2
4	01fd	00	1		0003	80	00	00	fd	Nv-BdIzc	PLA	T3
4	01fd	00	1		0003	80	00	00	fd	Nv-BdIzc	PLA	T3
5	01fe	00	1		0003	80	00	00	fe	Nv-BdIzc	PLA	T0
5	01fe	00	1		0003	80	00	00	fe	Nv-BdIzc	PLA	T0
6	0003	10	1	BPL	0003	00	00	00	fe	nv-BdIZc	PLA	T1
6	0003	10	1	BPL	0003	00	00	00	fe	nv-BdIZc	PLA	T1
7	0004	00	1		0004	00	00	00	fe	nv-BdIZc	BPL	T2
7	0004	00	1		0004	00	00	00	fe	nv-BdIZc	BPL	T2

ADC (69)	Cycles: 2	Size: 2
Immediate (Read)		
Cycle	R/W	Desc
-X.2	Read PC	Store as OpCode.
1.1	Read PC	Inc. PC .
1.2		Store as Operand.
2.1		* u16 Tmp = A + Operand + (C flag). V =(~(u16(A) ^ u16(Operand)) & (u16(A) ^ Tmp) & \$0080) != 0. A =u8(Tmp). C =Tmp > \$FF. Z = A == \$00. N =(A & \$80) != 0.
2.2		Store as OpCode.
+X.1		A and C , N , V , Z applied.

* Setting of A/flags is delayed by 1 cycle until the start of the following instruction.

cycle	ab	db	rw	Fetch	pc	a	x	y	s	p	Execute	State
2	0002	69	1	ADC #	0002	f0	00	00	fd	Nv-BdIzc	LDA #	T1
2	0002	69	1	ADC #	0002	f0	00	00	fd	Nv-BdIzc	LDA #	T1
3	0003	10	1		0003	f0	00	00	fd	Nv-BdIzc	ADC #	T0+T2
3	0003	10	1		0003	f0	00	00	fd	Nv-BdIzc	ADC #	T0+T2
4	0004	a4	1	LDY zp	0004	f0	00	00	fd	Nv-BdIzc	ADC #	T1
4	0004	a4	1	LDY zp	0004	f0	00	00	fd	Nv-BdIzc	ADC #	T1
5	0005	4c	1		0005	00	00	00	fd	nv-BdIZC	LDY zp	T2
5	0005	4c	1		0005	00	00	00	fd	nv-BdIZC	LDY zp	T2

ROR (6A)		Cycles: 2	Size: 1
Implied			
Cycle	R/W	Desc	
-X.2	Read PC	Store as OpCode.	
1.1	Read PC	Inc. PC .	
1.2		To be discarded.	
2.1		* Tmp = (C << 7).	
		Set C if low bit of A is set.	
		A =(A >> 1) Tmp.	
		Set N , and Z based off A .	
2.2	Read PC	Store as OpCode.	
+X.1		A and C , N , Z applied.	

* Setting of A/flags is delayed by 1 cycle until the start of the following instruction.

cycle	ab	db	rw	Fetch	pc	a	x	y	s	p	Execute	State
4	0003	6a	1	ROR	0003	08	00	00	fd	nv-BdIzC	SEC	T1
4	0003	6a	1	ROR	0003	08	00	00	fd	nv-BdIzC	SEC	T1
5	0004	a4	1		0004	08	00	00	fd	nv-BdIzC	ROR	T0+T2
5	0004	a4	1		0004	08	00	00	fd	nv-BdIzC	ROR	T0+T2
6	0004	a4	1	LDY zp	0004	08	00	00	fd	nv-BdIzc	ROR	T1
6	0004	a4	1	LDY zp	0004	08	00	00	fd	nv-BdIzc	ROR	T1
7	0005	4c	1		0005	84	00	00	fd	Nv-BdIzc	LDY zp	T2
7	0005	4c	1		0005	84	00	00	fd	Nv-BdIzc	LDY zp	T2

ARR (6B)	Cycles: 2	Size: 2
Immediate (Read)		
Cycle	R/W	Desc
-X.2	Read PC	Store as OpCode.
1.1	Read PC	Inc. PC .
1.2		Store as Operand.
2.1		Inc. PC . * Perform A=A & Operand. Tmp = (C << 7). Set C if highest bit of A is set. A = (A >> 1) Tmp. Set Z and N based off A . Set V as (C ^ ((A >> 5) & 1)) != 0.
2.2		Store as OpCode.
+X.1		A and C , N , V , Z applied.

* Setting of A/flags is delayed by 1 cycle until the start of the following instruction.

cycle	ab	db	rw	Fetch	pc	a	x	y	s	p	Execute	State
4	0003	6b	1	unknown	0003	02	00	00	fd	nv-BdIzC	SEC	T1
4	0003	6b	1	unknown	0003	02	00	00	fd	nv-BdIzC	SEC	T1
5	0004	01	1		0004	02	00	00	fd	nv-BdIzC	unknown	T0+T2
5	0004	01	1		0004	02	00	00	fd	nv-BdIzC	unknown	T0+T2
6	0005	4c	1	JMP Abs	0005	02	00	00	fd	nv-BdIzc	unknown	T1
6	0005	4c	1	JMP Abs	0005	02	00	00	fd	nv-BdIzc	unknown	T1
7	0006	02	1		0006	81	00	00	fd	Nv-BdIzc	JMP Abs	T2
7	0006	02	1		0006	81	00	00	fd	Nv-BdIzc	JMP Abs	T2

JMP (6C)		Cycles: 5	Size: 3
Indirect			
Cycle	R/W	Desc	
-X.2	Read PC	Store as OpCode.	
1.1	Read PC	Inc. PC .	
1.2		Store as Pointer.L.	
2.1		Inc. PC .	
2.2		Store as Pointer.H.	
3.1		Inc. PC .	
3.2	Read Pointer	Store as Address.L.	
4.1			
4.2	* Read (Pointer.H<<8) u8(Pointer.L+1)	Store as Address.H.	
5.1	Read PC	PC =Address.	
5.2		Store as OpCode.	
+X.1			

cycle	ab	db	rw	Fetch	pc	a	x	y	s	p	Execute	State
2	0002	6c	1	JMP (Abs)	0002	00	00	00	fd	nv-BdIZc	LDA #	T1
2	0002	6c	1	JMP (Abs)	0002	00	00	00	fd	nv-BdIZc	LDA #	T1
3	0003	10	1		0003	00	00	00	fd	nv-BdIZc	JMP (Abs)	T2
3	0003	10	1		0003	00	00	00	fd	nv-BdIZc	JMP (Abs)	T2
4	0004	00	1		0004	00	00	00	fd	nv-BdIZc	JMP (Abs)	T3
4	0004	00	1		0004	00	00	00	fd	nv-BdIZc	JMP (Abs)	T3
5	0010	e8	1		0005	00	00	00	fd	nv-BdIZc	JMP (Abs)	T4
5	0010	e8	1		0005	00	00	00	fd	nv-BdIZc	JMP (Abs)	T4
6	0011	01	1		0005	00	00	00	fd	nv-BdIZc	JMP (Abs)	T0
6	0011	01	1		0005	00	00	00	fd	nv-BdIZc	JMP (Abs)	T0
7	01e8	79	1	ADC Abs,Y	01e8	00	00	00	fd	nv-BdIZc	JMP (Abs)	T1
7	01e8	79	1	ADC Abs,Y	01e8	00	00	00	fd	nv-BdIZc	JMP (Abs)	T1
8	01e9	00	1		01e9	00	00	00	fd	nv-BdIZc	ADC Abs,Y	T2
8	01e9	00	1		01e9	00	00	00	fd	nv-BdIZc	ADC Abs,Y	T2

* Read operation does not cross into a new page if (Pointer+1) causes overflow, hence the high byte of Pointer is retained while "+ 1" is applied only to the low byte.

ADC (6D)		Cycles: 4	Size: 3
Absolute (Read)			
Cycle	R/W	Desc	
-X.2	Read PC	Store as OpCode.	
1.1	Read PC	Inc. PC .	
1.2		Store as Address.L.	
2.1		Inc. PC .	
2.2		Store as Address.H.	
3.1		Inc. PC .	
3.2	Read Address	Store as Operand.	
4.1		* u16 Tmp = A + Operand + (C flag). $V = (\sim(u16(A) \wedge u16(Operand)) \& (u16(A) \wedge Tmp) \& \$0080) \neq 0.$ A = u8(Tmp). C = Tmp > \$FF. Z = A == \$00. $N = (A \& \$80) \neq 0.$	
4.2		Store as OpCode.	
+X.1		A and C , N , V , Z applied.	

* Setting of A/flags is delayed by 1 cycle until the start of the following instruction.

cycle	ab	db	rw	Fetch	pc	a	x	y	s	p	Execute	State
2	0002	6d	1	ADC Abs	0002	00	00	00	fd	nv-BdIZc	LDA #	T1
2	0002	6d	1	ADC Abs	0002	00	00	00	fd	nv-BdIZc	LDA #	T1
3	0003	10	1		0003	00	00	00	fd	nv-BdIZc	ADC Abs	T2
3	0003	10	1		0003	00	00	00	fd	nv-BdIZc	ADC Abs	T2
4	0004	01	1		0004	00	00	00	fd	nv-BdIZc	ADC Abs	T3
4	0004	01	1		0004	00	00	00	fd	nv-BdIZc	ADC Abs	T3
5	0110	e8	1		0005	00	00	00	fd	nv-BdIZc	ADC Abs	T0
5	0110	e8	1		0005	00	00	00	fd	nv-BdIZc	ADC Abs	T0
6	0005	4c	1	JMP Abs	0005	00	00	00	fd	nv-BdIZc	ADC Abs	T1
6	0005	4c	1	JMP Abs	0005	00	00	00	fd	nv-BdIZc	ADC Abs	T1
7	0006	02	1		0006	e8	00	00	fd	Nv-BdIzc	JMP Abs	T2
7	0006	02	1		0006	e8	00	00	fd	Nv-BdIzc	JMP Abs	T2