

UTMC Application Note

UT80CRH196KD Instruction Execution Times (in State Times)

Instructions are listed below by their hexadecimal opcode designator and corresponding mnemonic. The instruction execution times are denoted by their state time equivalent (1 State Time = 2 * XTAL1 period).

- Single number state times denote Direct or Immediate address executions times.
- Dual number state times (SFR/MEM) indicate SFR as the execution time using SFRs and internal memory, and MEM as the execution time using the memory controller.
- Indirect address modes list execution times as Normal:(SFR/MEM) / Auto-Increment: (SFR/MEM).
- Indexed address modes list execution times as Short:(SFR/MEM) / Long: (SFR/MEM).

Additionally, the effects of Program Status Flag settings are listed.

PSW Flag Symbols

- Checkmark (√) indicates that a flag is set or cleared as appropriate.
- Hyphen (-) indicates that the flag is not modified.
- A one or zero, (1)(0) indicates that the flag will be in that state after the instruction.
- An 's' indicates that the instruction may set the flag if it is appropriate, but will not clear the flag.
- A 'c' indicates that the flag can be cleared but not set by the instruction.
- A question mark (?) indicates that the flag will be left in an unknown state after the operation.

Opcode	Mnemonic	Length in bytes	Addressing	PSW Flags						Execution Time	
				Z	N	C	V	VT	ST	UTMC UT80CRH196KD	INTEL
00	SKIP	2		-	-	-	-	-	-	3	3
01	CLR	2	Direct	1	0	0	0	-	-	3	3
02	NOT	2	Direct	√	√	0	0	-	-	3	3
03	NEG	2	Direct	√	√	√	√	s	-	3	3
04	XCH	3	Direct	-	-	-	-	-	-	5	5
05	DEC	2	Direct	√	√	√	√	s	-	3	3
06	EXT	2	Direct	√	√	0	0	-	-	3	4
07	INC	2	Direct	√	√	√	√	s	-	3	3
08	SHR	3	Direct	√	√	√	0	-	√	4+1/shft	6+1/shft
09	SHL	3	Direct	√	√	√	√	s	-	4+1/shft	6+1/shft
0A	SHRA	3	Direct	√	√	√	0	-	√	4+1/shft	6+1/shft
0B	XCH	4/5	Indexed	-	-	-	-	-	-	(8/13)/(8/13)	(8/13)/(9/14)
0C	SHRL	3	Direct	√	√	√	0	-	√	6+1/shft	7+1/shft
0D	SHLL	3	Direct	√	√	√	√	s	-	6+1/shft	7+1/shft
0E	SHRAL	3	Direct	√	√	√	0	-	√	6+1/shft	7+1/shft
0F	NORML	3	Direct	√	√	0	-	-	-	7+1/shft	8+1/shft
10	Unim OpCd	1		-	-	-	-	-	-	16	-
11	CLRB	2	Direct	1	0	0	0	-	-	3	3
12	NOTB	2	Direct	√	√	0	0	-	-	3	3
13	NEGB	2	Direct	√	√	√	√	s	-	3	3

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14	XCHB	3	Direct	-	-	-	-	-	-	5	5
15	DECB	2	Direct	√	√	√	√	s	-	3	3
16	EXTB	2	Direct	√	√	0	0	-	-	3	4
17	INCB	2	Direct	√	√	√	√	s	-	3	3
18	SHRB	3	Direct	√	√	√	0	-	√	4+1/shft	6+1/shft
19	SHLB	3	Direct	√	√	√	√	s	-	4+1/shft	6+1/shft
1A	SHRAB	3	Direct	√	√	√	0	-	√	4+1/shft	6+1/shft
1B	XCHB	4/5	Indexed	-	-	-	-	-	-	(8/13)/(8/13)	(8/13)/(9/14)
1C-1F	Unim OpCd	1		-	-	-	-	-	-	16	-
20-27	SJMP	2		-	-	-	-	-	-	7	7
28-2F	SCALL	2		-	-	-	-	-	-	9/12	11/13
30-37	JBC	3		-	-	-	-	-	-	5/9	5/9
38-3F	JBS	3		-	-	-	-	-	-	5/9	5/9
40	AND (3 op)	4	Direct	√	√	0	0	-	-	4	5
41	AND (3 op)	5	Immediate	√	√	0	0	-	-	4	6
42	AND (3 op)	4	Indirect	√	√	0	0	-	-	(6/8)/(7/9)	(7/10)/(8/11)
43	AND (3 op)	5/6	Indexed	√	√	0	0	-	-	(6/8)/(6/8)	(7/10)/(8/11)
44	ADD (3 op)	4	Direct	√	√	√	√	s	-	4	4
45	ADD (3 op)	5	Immediate	√	√	√	√	s	-	4	5
46	ADD (3 op)	4	Indirect	√	√	√	√	s	-	(6/8)/(7/9)	(7/10)/(8/11)
47	ADD (3 op)	5/6	Indexed	√	√	√	√	s	-	(6/8)/(6/8)	(7/10)/(8/11)
48	SUB (3 op)	4	Direct	√	√	√	√	s	-	4	4
49	SUB (3 op)	5	Immediate	√	√	√	√	s	-	4	5
4A	SUB (3 op)	4	Indirect	√	√	√	√	s	-	(6/8)/(7/9)	(7/10)/(8/11)
4B	SUB (3 op)	5/6	Indexed	√	√	√	√	s	-	(6/8)/(6/8)	(7/10)/(8/11)
4C	MULU (3 op)	4	Direct	-	-	-	-	-	-	6	14
4D	MULU (3 op)	5	Immediate	-	-	-	-	-	-	6	15
4E	MULU (3 op)	4	Indirect	-	-	-	-	-	-	(8/10)/(9/11)	(16/19)/(17/19)
4F	MULU (3 op)	5/6	Indexed	-	-	-	-	-	-	(8/10)/(8/10)	(17/20)/(18/21)
50	ANDB (3 op)	4	Direct	√	√	0	0	-	-	4	5
51	ANDB (3 op)	4	Immediate	√	√	0	0	-	-	4	6
52	ANDB (3 op)	4	Indirect	√	√	0	0	-	-	(6/8)/(7/9)	(7/10)/(8/11)
53	ANDB (3 op)	5/6	Indexed	√	√	0	0	-	-	(6/8)/(6/8)	(7/10)/(8/11)
54	ADDDB (3 op)	4	Direct	√	√	√	√	s	-	4	5
55	ADDDB (3 op)	4	Immediate	√	√	√	√	s	-	4	6
56	ADDDB (3 op)	4	Indirect	√	√	√	√	s	-	(6/8)/(7/9)	(7/10)/(8/11)
57	ADDDB (3 op)	5/6	Indexed	√	√	√	√	s	-	(6/8)/(6/8)	(7/10)/(8/11)
58	SUBB (3 op)	4	Direct	√	√	√	√	s	-	4	5
59	SUBB (3 op)	4	Immediate	√	√	√	√	s	-	4	6
5A	SUBB (3 op)	4	Indirect	√	√	√	√	s	-	(6/8)/(7/9)	(7/10)/(8/11)
5B	SUBB (3 op)	5/6	Indexed	√	√	√	√	s	-	(6/8)/(6/8)	(7/10)/(8/11)
5C	MULUB (3 op)	4	Direct	-	-	-	-	-	-	5	10
5D	MULUB (3 op)	4	Immediate	-	-	-	-	-	-	5	10
5E	MULUB (3 op)	4	Indirect	-	-	-	-	-	-	(7/9)/(8/10)	(12/15)/(13/15)

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5F	MULUB (3 op)	5/6	Indexed	-	-	-	-	-	-	(7/9)/(7/9)	(12/16)/(14/17)
60	AND (2 op)	3	Direct	√	√	0	0	-	-	4	4
61	AND (2 op)	4	Immediate	√	√	0	0	-	-	4	5
62	AND (2 op)	3	Indirect	√	√	0	0	-	-	(6/8)/(7/9)	(6/8)/(7/9)
63	AND (2 op)	4/5	Indexed	√	√	0	0	-	-	(6/8)/(6/8)	(6/8)/(7/9)
64	ADD (2 op)	3	Direct	√	√	√	√	s	-	4	4
65	ADD (2 op)	4	Immediate	√	√	√	√	s	-	4	5
66	ADD (2 op)	3	Indirect	√	√	√	√	s	-	(6/8)/(7/9)	(6/8)/(7/9)
67	ADD (2 op)	4/5	Indexed	√	√	√	√	s	-	(6/8)/(6/8)	(6/8)/(7/9)
68	SUB (2 op)	3	Direct	√	√	√	√	s	-	4	4
69	SUB (2 op)	4	Immediate	√	√	√	√	s	-	4	5
6A	SUB (2 op)	3	Indirect	√	√	√	√	s	-	(6/8)/(7/9)	(6/8)/(7/9)
6B	SUB (2 op)	4/5	Indexed	√	√	√	√	s	-	(6/8)/(6/8)	(6/8)/(7/9)
6C	MULU (2 op)	3	Direct	-	-	-	-	-	-	6	14
6D	MULU (2 op)	4	Immediate	-	-	-	-	-	-	6	15
6E	MULU (2 op)	3	Indirect	-	-	-	-	-	-	(8/10)/(9/11)	(16/19)/(17/19)
6F	MULU (2 op)	4/5	Indexed	-	-	-	-	-	-	(8/10)/(8/10)	(17/20)/(18/21)
70	ANDB (2 op)	3	Direct	√	√	0	0	-	-	4	4
71	ANDB (2 op)	3	Immediate	√	√	0	0	-	-	4	5
72	ANDB (2 op)	3	Indirect	√	√	0	0	-	-	(6/8)/(7/9)	(6/8)/(7/9)
73	ANDB (2 op)	4/5	Indexed	√	√	0	0	-	-	(6/8)/(6/8)	(6/8)/(7/9)
74	ADDB (2 op)	3	Direct	√	√	√	√	s	-	4	4
75	ADDB (2 op)	3	Immediate	√	√	√	√	s	-	4	5
76	ADDB (2 op)	3	Indirect	√	√	√	√	s	-	(6/8)/(7/9)	(6/8)/(7/9)
77	ADDB (2 op)	4/5	Indexed	√	√	√	√	s	-	(6/8)/(6/8)	(6/8)/(7/9)
78	SUBB (2 op)	3	Direct	√	√	√	√	s	-	4	4
79	SUBB (2 op)	3	Immediate	√	√	√	√	s	-	4	5
7A	SUBB (2 op)	3	Indirect	√	√	√	√	s	-	(6/8)/(7/9)	(6/8)/(7/9)
7B	SUBB (2 op)	4/5	Indexed	√	√	√	√	s	-	(6/8)/(6/8)	(6/8)/(7/9)
7C	MULUB (2 op)	3	Direct	-	-	-	-	-	-	5	10
7D	MULUB (2 op)	3	Immediate	-	-	-	-	-	-	5	10
7E	MULUB (2 op)	3	Indirect	-	-	-	-	-	-	(7/9)/(8/10)	(12/15)/(13/15)
7F	MULUB (2 op)	4/5	Indexed	-	-	-	-	-	-	(7/9)/(7/9)	(12/16)/(14/17)
80	OR	3	Direct	√	√	0	0	-	-	4	4
81	OR	4	Immediate	√	√	0	0	-	-	4	5
82	OR	3	Indirect	√	√	0	0	-	-	(6/8)/(7/9)	(6/8)/(7/9)
83	OR	4/5	Indexed	√	√	0	0	-	-	(6/8)/(6/8)	(6/8)/(7/9)
84	XOR	3	Direct	√	√	0	0	-	-	4	4
85	XOR	4	Immediate	√	√	0	0	-	-	4	5
86	XOR	3	Indirect	√	√	0	0	-	-	(6/8)/(7/9)	(6/8)/(7/9)
87	XOR	4/5	Indexed	√	√	0	0	-	-	(6/8)/(6/8)	(6/8)/(7/9)
88	CMP	3	Direct	√	√	√	√	s	-	4	4
89	CMP	4	Immediate	√	√	√	√	s	-	4	5
8A	CMP	3	Indirect	√	√	√	√	s	-	(6/8)/(7/9)	(6/8)/(7/9)

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8B	CMP	4/5	Indexed	√	√	√	√	s	-	(6/8)/(6/8)	(6/8)/(7/9)
8C	DIVU	3	Direct	-	-	-	√	s	-	22	24
8D	DIVU	4	Immediate	-	-	-	√	s	-	22	25
8E	DIVU	3	Indirect	-	-	-	√	s	-	(24/26)/(25/27)	(26/29)/(27/30)
8F	DIVU	4/5	Indexed	-	-	-	√	s	-	(24/26)/(24/26)	(27/30)/(28/30)
90	ORB	3	Direct	√	√	0	0	-	-	4	4
91	ORB	3	Immediate	√	√	0	0	-	-	4	5
92	ORB	3	Indirect	√	√	0	0	-	-	(6/8)/(7/9)	(6/8)/(7/9)
93	ORB	4/5	Indexed	√	√	0	0	-	-	(6/8)/(6/8)	(6/8)/(7/9)
94	XORB	3	Direct	√	√	0	0	-	-	4	4
95	XORB	3	Immediate	√	√	0	0	-	-	4	5
96	XORB	3	Indirect	√	√	0	0	-	-	(6/8)/(7/9)	(6/8)/(7/9)
97	XORB	4/5	Indexed	√	√	0	0	-	-	(6/8)/(6/8)	(6/8)/(7/9)
98	CMPB	3	Direct	√	√	√	√	s	-	4	4
99	CMPB	3	Immediate	√	√	√	√	s	-	4	5
9A	CMPB	3	Indirect	√	√	√	√	s	-	(6/8)/(7/9)	(6/8)/(7/9)
9B	CMPB	4/5	Indexed	√	√	√	√	s	-	(6/8)/(6/8)	(6/8)/(7/9)
9C	DIVUB	3	Direct	-	-	-	√	s	-	10	16
9D	DIVUB	3	Immediate	-	-	-	√	s	-	10	16
9E	DIVUB	3	Indirect	-	-	-	√	s	-	(12/14)/(13/15)	(18/21)/(19/22)
9F	DIVUB	4/5	Indexed	-	-	-	√	s	-	(12/14)/(12/14)	(19/22)/(20/23)
A0	LD	3	Direct	-	-	-	-	-	-	4	4
A1	LD	4	Immediate	-	-	-	-	-	-	4	5
A2	LD	3	Indirect	-	-	-	-	-	-	(6/8)/(7/9)	(5/8)/(6/8)
A3	LD	4/5	Indexed	-	-	-	-	-	-	(6/8)/(6/8)	(6/9)/(7/10)
A4	ADDC	3	Direct	c	√	√	√	s	-	4	4
A5	ADDC	4	Immediate	c	√	√	√	s	-	4	5
A6	ADDC	3	Indirect	c	√	√	√	s	-	(6/8)/(7/9)	(6/8)/(7/9)
A7	ADDC	4/5	Indexed	c	√	√	√	s	-	(6/8)/(6/8)	(6/8)/(7/9)
A8	SUBC	3	Direct	c	√	√	√	s	-	4	4
A9	SUBC	4	Immediate	c	√	√	√	s	-	4	5
AA	SUBC	3	Indirect	c	√	√	√	s	-	(6/8)/(7/9)	(6/8)/(7/9)
AB	SUBC	4/5	Indexed	c	√	√	√	s	-	(6/8)/(6/8)	(6/8)/(7/9)
AC	LDBZE	3	Direct	-	-	-	-	-	-	4	4
AD	LDBZE	3	Immediate	-	-	-	-	-	-	4	4
AE	LDBZE	3	Indirect	-	-	-	-	-	-	(6/8)/(7/9)	(5/8)/(6/8)
AF	LDBZE	4/5	Indexed	-	-	-	-	-	-	(6/8)/(6/8)	(6/9)/(7/10)
B0	LDB	3	Direct	-	-	-	-	-	-	4	4
B1	LDB	3	Immediate	-	-	-	-	-	-	4	5
B2	LDB	3	Indirect	-	-	-	-	-	-	(6/8)/(7/9)	(6/8)/(7/9)
B3	LDB	4/5	Indexed	-	-	-	-	-	-	(6/8)/(6/8)	(6/8)/(7/9)
B4	ADDCB	3	Direct	c	√	√	√	s	-	4	4
B5	ADDCB	3	Immediate	c	√	√	√	s	-	4	5
B6	ADDCB	3	Indirect	c	√	√	√	s	-	(6/8)/(7/9)	(6/8)/(7/9)

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B7	ADDCB	4/5	Indexed	c	√	√	√	s	-	(6/8)/(6/8)	(6/8)/(7/9)
B8	SUBCB	3	Direct	c	√	√	√	s	-	4	4
B9	SUBCB	3	Immediate	c	√	√	√	s	-	4	5
BA	SUBCB	3	Indirect	c	√	√	√	s	-	(6/8)/(7/9)	(6/8)/(7/9)
BB	SUBCB	4/5	Indexed	c	√	√	√	s	-	(6/8)/(6/8)	(6/8)/(7/9)
BC	LDBSE	3	Direct	-	-	-	-	-	-	4	4
BD	LDBSE	3	Immediate	-	-	-	-	-	-	4	4
BE	LDBSE	3	Indirect	-	-	-	-	-	-	(6/8)/(7/9)	(5/8)/(6/8)
BF	LDBSE	4/5	Indexed	-	-	-	-	-	-	(6/8)/(6/8)	(6/9)/(7/10)
C0	ST	3	Direct	-	-	-	-	-	-	4	4
C1	BMOV	3	Direct	-	-	-	-	-	-	6+4/wd+2/ext	6+8/wd
C2	ST	3	Indirect	-	-	-	-	-	-	(6/8)/(7/9)	(5/8)/(6/9)
C3	ST	4/5	Indexed	-	-	-	-	-	-	(6/8)/(6/8)	(6/9)/(7/10)
C4	STB	3	Direct	-	-	-	-	-	-	4	4
C5	CMPL	3	Direct	-	-	-	-	-	-	7	7
C6	STB	3	Indirect	-	-	-	-	-	-	(6/8)/(7/9)	(5/8)/(6/8)
C7	STB	4/5	Indexed	-	-	-	-	-	-	(6/8)/(6/8)	(6/9)/(7/10)
C8	PUSH	2	Direct	-	-	-	-	-	-	5/8	8
C9	PUSH	3	Immediate	-	-	-	-	-	-	5/8	9
CA	PUSH	2	Indirect	-	-	-	-	-	-	{{(7/9)/(8/10)}/{(10/12)/(11/13)}}	(11/14)/(12/15)
CB	PUSH	3/4	Indexed	-	-	-	-	-	-	{{(7/9)/(7/9)}/{(10/12)/(10/12)}}	(12/15)/(13/16)
CC	POP	2	Direct	-	-	-	-	-	-	5/7	8
CD	BMOV _i	3	Direct	-	-	-	-	-	-	7+4/wd+2/ext	7+8/wd+14/ext
CE	POP	2	Indirect	-	-	-	-	-	-	{{(7/9)/(8/10)}/{(10/12)/(11/13)}}	(10/12)/(11/13)
CF	POP	3/4	Indexed	-	-	-	-	-	-	{{(7/9)/(7/9)}/{(10/12)/(10/12)}}	(11/13)/(12/14)
D0	JNST	2		-	-	-	-	-	-	4/7 (no jump/jump)	4/8 (no jump/jump)
D1	JNH	2		-	-	-	-	-	-	4/7 (no jump/jump)	4/8 (no jump/jump)
D2	JGT	2		-	-	-	-	-	-	4/7 (no jump/jump)	4/8 (no jump/jump)
D3	JNC	2		-	-	-	-	-	-	4/7 (no jump/jump)	4/8 (no jump/jump)
D4	JNVT	2		-	-	-	-	0	-	4/7 (no jump/jump)	4/8 (no jump/jump)
D5	JNV	2		-	-	-	-	-	-	4/7 (no jump/jump)	4/8 (no jump/jump)
D6	JGE	2		-	-	-	-	-	-	4/7 (no jump/jump)	4/8 (no jump/jump)
D7	JNE	2		-	-	-	-	-	-	4/7 (no jump/jump)	4/8 (no jump/jump)
D8	JST	2		-	-	-	-	-	-	4/7 (no	4/8 (no

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										jump/jump)	jump/jump)
D9	JH	2		-	-	-	-	-	-	4/7 (no jump/jump)	4/8 (no jump/jump)
DA	JLE	2		-	-	-	-	-	-	4/7 (no jump/jump)	4/8 (no jump/jump)
DB	JC	2		-	-	-	-	-	-	4/7 (no jump/jump)	4/8 (no jump/jump)
DC	JVT	2		-	-	-	-	0	-	4/7 (no jump/jump)	4/8 (no jump/jump)
DD	JV	2		-	-	-	-	-	-	4/7 (no jump/jump)	4/8 (no jump/jump)
DE	JLT	2		-	-	-	-	-	-	4/7 (no jump/jump)	4/8 (no jump/jump)
DF	JE	2		-	-	-	-	-	-	4/7 (no jump/jump)	4/8 (no jump/jump)
E0	DJNZ	3		-	-	-	-	0	-	5/9	5/9
E1	DJNZW	3		-	-	-	-	-	-	5/9	6/10
E2	TIJMP	4		-	-	-	-	-	-	14/16/18	15/18/21
E3	BR	2		-	-	-	-	-	-	9	7
E4-E6	Unim OpCd	1		-	-	-	-	0	-	16	-
E7	LJMP	3		-	-	-	-	-	-	7	7
E8-EB	Unim OpCd	1		-	-	-	-	-	-	16	-
EC	DPTS	1		-	-	-	-	-	-	2	2
ED	EPTS	1		-	-	-	-	0	-	2	2
EE	Unim OpCd	1		-	-	-	-	-	-	16	-
EF	LCALL	3		-	-	-	-	-	-	9/12	13
F0	RET	1		-	-	-	-	-	-	9/11	14
F1	Unim OpCd			-	-	-	-	-	-	16	-
F2	PUSHF	1		0	0	0	0	0	0	5/7	8
F3	POPF	1		√	√	√	√	√	√	5/7	10
F4	PUSHA	1		0	0	0	0	0	0	8/12	18
F5	POPA	1		√	√	√	√	√	√	8/12	18
F6	IDLDP	2		-	-	-	-	-	-	8/25	8/25
F7	TRAP	1		-	-	-	-	-	-	16	16
F8	CLRC	1		-	-	0	-	-	-	2	2
F9	SETC	1		-	-	1	-	-	-	2	2
FA	DI	1		-	-	-	-	-	-	2	2
FB	EI	1		-	-	-	-	-	-	2	2
FC	CLRVT	1		-	-	-	-	0	-	2	2
FD	NOP	1		-	-	-	-	-	-	2	2
FE	SGND	1		-	-	-	-	-	-	2	-
FF	RST	1		0	0	0	0	0	0	22	20