

CRAY RESEARCH, INC.

IOS Model C Hardware Reference Card

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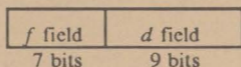
CMQ11090A0

NOTATION

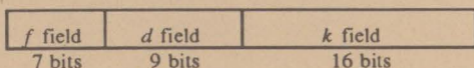
A	Accumulator
B	Operand register, index register (B register)
(B)	Contents of the operand register addressed by B
C	Carry Flag. 2^{16} of accumulator
E	Exit Stack pointer, 4 bits
(E)	Exit Stack storage location pointed to by E
I	Interrupt Enable flag
P	Program address register
R	Return jump program address
R!sym	Operand register with index=sym, sym is any positive symbol <512
dl	Operand register with value of dd, dd is <512
[dd]	Value of symbol dd
(dd)	Memory parcel addressed by contents of operand register dd
k	Unsigned 16 bit value <65536
d	Unsigned numeric value <512
(k)	Memory parcel addressed by the value of k
(dd + k)	Memory parcel addressed by sum of operand register dd contents and contents of k
iod	3-character channel mnemonic, Ex. IOR, MOS...
&	Logical Product (perform AND function)
>	Shift right end off. Carry will shift with accum.
<	Shift left end off. Carry will shift with accum.
>>	Shift right circular through carry
<<	Shift left circular through carry
#	APML symbol for not equal, (\neq)
†	Requires Maintenance Switch on
BZ	Busy
DN	Done
M.C.	Master Clear (MC)
L.M.	Local Memory

INSTRUCTION FORMAT

1-parcel instruction



2-parcel instruction



CRAY PROPRIETARY

CHANNEL NOTES

CONSOLES

TIA : 3 Set baud rate.

With accumulator set to 1, baud rate = 300

With accumulator set to 3, baud rate = 1200

With accumulator set to 4, baud rate = 2400

With accumulator set to 5, baud rate = 4800

With accumulator set to 6, baud rate = 9600 (default)

With accumulator set to 7, baud rate = 19200

LOSP Channel (20-27-DMA 1) (30-37-DMA 2)

CIA : 11

2²- Parity Error flag

2¹⁴-Sequence Error

2¹⁵-Ready Data waiting

COA : 4

2⁸- Write Disconnect

2⁹- Hold Disconnect

2¹¹-Dead Dump (ch.21 only)

2¹²-RTC Interrupt (ch.21 only)

2¹⁴-I/O Master Clear

2¹⁵-CPU Master Clear (ch.21 only)

COA : 11

2¹⁵-sequence error

Maint. LOSP Channel (50/51-DMA 3)

LIA : 11

2⁰- Parity Error flag for bits 2⁰ - 2³

2¹- Parity Error flag for bits 2⁴ - 2⁷

2²- Parity Error flag for bits 2⁸ - 2¹¹

2³- Parity Error flag for bits 2¹² - 2¹⁵

2¹⁵- Ready waiting flag

LOA : 4

2⁸- Write Disconnect

2⁹- Hold Disconnect

2¹⁴- Master Clear

LOA : 11

2¹ - 2⁰ IOP number

2¹⁵- Sequence error

HISP Channel

HIA : 10 , HOA : 10 can be used on HISP Channel 14/15 - DMA 4 only. Remaining functions apply to both 14/15 and HISP Channel 16/17. See HR-0081 for function and status codes.

DIAGNOSTIC MODES

<u>Channel</u>	<u>M.C.</u>	<u>Description</u>
140403		Clear History Log address
140404		Log all jumps/incrementing read
140405	On	Log return jumps/decrementing read
140406		Turn History Log-off
140407	On	Turn History Log-on
140410 †		Instruction Stack parity mode
140411 †		Clear Error flags
140412 †		Disable check bits and error correct
140413 †		Sample into B reg. SECDDED errors
140416 †		Read SECDDED upper and parity flag
140417 †	On	Disable modes 410 through 416

† = Maintenance switch on the deadstart panel must be on.

M.C. column shows state after Master Clear.

INSTRUCTIONS

<u>IOP APLM</u>	<u>Description</u>
000 PASS	No operation
001 EXTT	Exit from subroutine
002 I = 0	Disable system interrupts
003 I = 1	Enable system interrupts
004 A=A>d	Right shift C and A by <i>d</i> places, end off
005 A=A<d	Left shift C and A by <i>d</i> places, end off
006 A=A>>d	Right shift C and A by <i>d</i> places, circular
007 A=A<<d	Left shift C and A by <i>d</i> places, circular
010 A=d	Transmit <i>d</i> to A
011 A=A&d	Logical product of A and <i>d</i> to A
012 A=A+d	Add <i>d</i> to A
013 A=A-d	Subtract <i>d</i> from A
014 A=k	Transmit <i>k</i> to A
015 A=A&k	Logical product of A and <i>k</i> to A
016 A=A+k	Add <i>k</i> to A
017 A=A-k	Subtract <i>k</i> from A
020 A=dd	Transmit operand register <i>d</i> to A
021 A=A&dd	Logical product of A and operand register <i>d</i> to A
022 A=A+dd	Add operand register <i>d</i> to A
023 A=A-dd	Subtract operand register <i>d</i> from A
024 dd=A	Transmit A to operand register <i>d</i>
025 dd=A+dd	Add operand register <i>d</i> to A, result to operand register <i>d</i>
026 dd=dd+1	Transmit operand register <i>d</i> to A, add 1, result to operand register <i>d</i>
027 dd=dd-1	Transmit operand register <i>d</i> to A, subtract 1, result to operand register <i>d</i>
030 A=(dd)	Transmit contents of memory addressed by operand register <i>d</i> to A
031 A=A&(dd)	Logical product of A and contents of memory addressed by operand register <i>d</i> , result to A
032 A=A+(dd)	Add contents of memory addressed by operand register <i>d</i> to A
033 A=A-(dd)	Subtract contents of memory addressed by operand register <i>d</i> from A
034 (dd)=A	Transmit A to memory addressed by operand register <i>d</i>
035 (dd)=A+(dd)	Add memory addressed by operand register <i>d</i> to A, result to same memory location
036 (dd)=(dd)+1	Transmit memory addressed by operand register <i>d</i> to A, add 1, result to same memory location
037 (dd)=(dd)-1	Transmit memory addressed by operand register <i>d</i> to A, subtract 1, result to same memory location
040 C=1 iod=DN	Set carry equal to 1 if channel <i>d</i> done
041 C=1, iod=BZ	Set carry equal to 1 if channel <i>d</i> busy
042 C=1, IOB-DN	Set carry equal to 1 if channel B done
043 C=1, IOB-BZ	Set carry equal to 1 if channel B busy
044 A=A>B	Right shift C and A by B places, end off
045 A=A<B	Left shift C and A by B places, end off
046 A=A>>B	Right shift C and A by B places, circular
047 A=A<<B	Left shift C and A by B places, circular
050 A=B	Transmit B to A
051 A=A&B	Logical product of A and B to A
052 A=A+B	Add B to A
053 A=A-B	Subtract B from A
054 B=A	Transmit A to B
055 B=A+B	Add B to A, result to B
056 B=B+1	Transmit B to A, add 1, result to B
057 B=B-1	Transmit B to A, subtract 1, result to B
060 A=(B)	Transmit operand register B to A
061 A=A&(B)	Logical product of A and operand register B to A
062 A=A+(B)	Add operand register B to A
063 A=A-(B)	Subtract operand register B from A

<u>Device</u>	<u>APML</u>	<u>Function</u>
INPUT FROM LOSP (CIA,CIB,LIA) 20 30 50 22 32 24 34 26 36	CIA : 0 CIA : 1 CIA : 2 CIA : 3 CIA : 4 CIA : 6 CIA : 7 CIA : 10 CIA : 11	Clear Channel Busy/Done Enter L.M. address, start input Enter parcel count Clear Channel error flags Clear Ready Waiting flag Disable channel interrupts Enable channel interrupts Read L.M. address Read errors/status
• See channel notes		
OUTPUT TO LOSP (COA,COB,LOA) 21 31 51 23 33 25 35 27 37	COA : 0 COA : 1 COA : 2 COA : 3 COA : 4 COA : 6 COA : 7 COA : 10 COA : 11	Clear Channel Busy/Done Enter L.M. address, start output Enter parcel count Clear Sequence Error flag Set/clear external controls Disable channel interrupts Enable channel interrupts Read L.M. address Read error flag
• See channel notes		
INPUT FROM MEMORY HISP CHANNEL (HIA). • See channel notes	HIA : 0 HIA : 1 HIA : 2 HIA : 3 HIA : 4 HIA : 6 HIA : 7 † HIA : 10 † HIA : 14	Clear Channel Busy/Done Enter L.M. address Enter upper Cray Memory address ($2^9 - 2^{23}$) Enter lower Cray Memory address ($2^0 - 2^8$) Read Cray Memory, enter block length Disable channel interrupts Enable channel interrupts Return Error information Enter diagnostic mode
OUTPUT TO MEMORY HISP CHANNEL (HOA). • See channel notes	HOA : 0 HOA : 1 HOA : 2 HOA : 3 HOA : 5 HOA : 6 HOA : 7 † HOA : 10 † HOA : 14	Clear Channel Busy/Done Enter L.M. address Enter upper Cray Memory address ($2^9 - 2^{23}$) Enter lower Cray Memory address ($2^0 - 2^8$) Write Cray Memory, enter block length Disable channel interrupts Enable channel interrupts Return Error information Enter diagnostic mode
CONSOLE KEYBOARD (TIA,TIB,TIC...) CHANNELS 40, 42, 44, 46 • See channel notes	TIA : 0 TIA : 3 TIA : 6 TIA : 7 TIA : 10	Clear Channel Done flag Set baud rate Disable channel interrupts Enable channel interrupts Read data and clear Done flag
CONSOLE DISPLAY (TOA,TOB,TOC...) CHANNELS 41, 43, 45, 47	TOA : 0 TOA : 6 TOA : 7 TOA : 14	Clear Channel Busy/Done Disable channel interrupts Enable channel interrupts Send accumulator data to display