

КАРТА ПРОГРАММИСТА СМ ЭВМ

Device	Registers	Address	Int Vec-tor	Prior-ity	MPR
TA11	Cassette command & status data buffer	(TACS) 777 500 (TADB) 777 502	260	RA6	
TC11/ TU56	DECtape control & status command word count bus address data	(TCST) 777 340 (TCCM) 777 342 (TCWC) 777 344 (TCBA) 777 346 (TCD1) 777 350	214	BR6	X

BM873-YA BOOTSTRAP LOADER:

Starting Address	Device
773 000	RF11
773 010	RK11
773 020	Transfer to address contained in Switch Register
773 030	TC11
773 050	TM11
773 100	RP11
773 144	RC11
773 210	ASR paper tape reader
773 230	TA11
773 312	PC11

BM873-YB BOOTSTRAP LOADER:

Starting Address	Device
773 000	RJS03/RJS04 Disk Unit 0
773 002	RJS03/RJS04 Unit specified in console switch register
773 030	RK11 Disk Unit 0
773 032	RK11 Unit specified in console switch register
773 070	TC11
773 110	TM11
773 136	RF11
773 150	TU16
773 212	RC11
773 320	RJP04 Disk Unit 0
773 322	RJP04 Unit specified in console switch register
773 344	Transfer to address in console switch register
773 350	RP11 Disk Unit 0
773 352	RP11 Unit specified in console switch register
773 510	KL11/DL11 Console TTY Reader
773 524	TA11 Cassette Unit 0
773 526	TA11 Unit specified in console switch register
773 620	PC11

PDP-11/70 BOOTSTRAP LOADER:

Starting Address	17	765	000
Device Type:	1	TM11	6
	2	TC11	7
	3	RK11	10
	4	RP11	11
			TWU16
			RWP04
			RWS03/4
			RX11

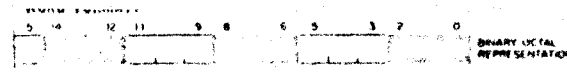
ABSOLUTE LOADER		BOOTSTRAP LOADER	
Address	Contents	Address	Contents
Starting Address: --- 500	--- 744 016 701	--- 764 000 002	--- 766 --- 300
Memory Size ---	--- 746 000 026	--- 766 005 267	--- 770 177 786
4K 017	--- 750 012 702	--- 772 177 786	--- 774 000 765
8K 017	--- 752 000 352	--- 776 177 560 (TTY)	or 177 550 (PC11)
12K 057	--- 754 005 211		
16K 077	--- 756 105 711		
20K 117	--- 760 100 376		
24K 137	--- 762 116 162		
28K 157			
(or larger)			
	773 000 Paper Tape Bootstrap		
	773 100 Disk/DECtape Bootstrap		
	773 200 Card Reader Bootstrap		
	773 300 Cassette Bootstrap		
	773 400 Floppy Disk Bootstrap		

MR11-DB BOOTSTRAP LOADER:

Starting Address	Device
773 100	RF11
773 110	RK11
773 120	TC11
773 136	TM11
773 154	RP11
773 220	RC11

7-BIT ASCII CODE:

Octal Code	Char	Octal Code	Char	Octal Code	Char	Octal Code	Char
000	NUL	040	SP	100	@	140	\
001	SOH	041	!	101	A	141	a
002	STX	042	"	102	B	142	b
003	ETX	043	#	103	C	143	c
004	EOT	044	\$	104	D	144	d
005	ENQ	045	%	105	E	145	e
006	ACK	046	&	106	F	146	f
007	BEL	047	'	107	G	147	g
010	BS	050	(	110	H	150	h
011	HT	051	)	111	I	151	i
012	LF	052	*	112	J	152	j
013	VT	053	+	113	K	153	k
014	FF	054	,	114	L	154	l
015	CR	055	-	115	M	155	m
016	SO	056	.	116	N	156	n
017	SI	057	/	117	O	157	o
020	DLE	060	0	120	P	160	p
021	DC1	061	1	121	Q	161	q
022	DC2	062	2	122	R	162	r
023	DC3	063	3	123	S	163	s
024	DC4	064	4	124	T	164	t
025	NAK	065	5	125	U	165	u
026	SYN	066	6	126	V	166	v
027	ETB	067	7	127	W	167	w
030	CAN	070	8	130	X	170	x
031	EM	071	9	131	Y	171	y
032	SUB	072	:	132	Z	172	z
033	ESC	073	;	133	[	173	{
034	FS	074	<	134	\	174	|
035	GS	075	=	135	]	175	}
036	NS	076	>	136	^	176	~
037	US	077	?	137	_	177	DEL



Mode	Name	Symbolic	Description
0	register	R	(R) is operand (ex. R2=%2)
1	register deferred	(R)	(R) is address
2	auto increment	(R)+	(R) is addr; (R) + (1 or 2)
3	auto-incr deferred	@(R)+	(R) is addr of addr; (R) + 2
4	auto-decrement	-(R)	(R) - (1 or 2); (R) is addr
5	auto-decr deferred	@-(R)	(R) - 2; (R) is addr of addr
6	index	X(R)	(R) + X is addr
7	index deferred	@X(R)	(R) + X is addr of addr

PROGRAM COUNTER ADDRESSING: Reg = 7

2	immediate	#n	operand n follows instr
3	absolute	@#A	address A follows instr
5	relative	A	instr addr + 4 + X is addr
7	relative deferred	@A	instr addr + 4 + X is addr of addr

LEGEND:

Op Codes	Operations
n	= 0 for word/1 for byte
SS	= source field (6 bits)
DD	= destination field (6 bits)
R	= gen register (3 bits; 0 to 7)
XXX	= offset (8 bits); +127 to -128
N	= number (3 bits)
NN	= number (6 bits)

Boolean	Condition Codes
A	= AND
V	= inclusive OR
^	= exclusive OR
~	= NOT
*	= conditionally set/cleared
-	= not affected
0	= cleared
1	= set

NOTE:

- ▲ = Applies to the 11/35, 11/40, 11/45 & 11/70 computers
- = Applies to the 11/45 & 11/70 computers

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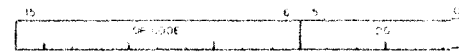
NUMERICAL OP CODE LIST:

OP Code	Mnemonic	OP Code	Mnemonic	OP Code	Mnemonic	
00 00 00	HALT	00 60 DD	ROR	10 40 00	EMT	
00 00 01	WAIT	00 61 DD	ROL	10 41 00		
00 00 02	RTI	00 62 DD	ASR	10 43 77		
00 00 03	BPT	00 63 DD	ASL	10 43 77		
00 00 04	IOT	00 64 NN	MARK			
00 00 05	RESET	00 65 SS	MFPI	10 44 00	TRAP	
00 00 06	RTT	00 66 DD	MTPI	10 44 00		
00 00 07	(unused)	00 67 DD	SXT	10 47 77		
00 00 77	(unused)					
00 01 DD	JMP	00 70 00	(unused)	10 50 DD	CLRB	
00 02 OR	RTS	00 77 77	(unused)	10 51 DD	COMB	
00 02 10	(unused)	01 SS DD	MOV	10 52 DD	INCB	
00 02 27	(unused)	02 SS DD	CMP	10 53 DD	DECR	
00 02 3N	SPL	03 SS DD	EIT	10 54 DD	NEGB	
00 02 40	NOP	04 SS DD	BIC	10 55 DD	ADCR	
00 02 41	cond codes	05 SS DD	BIS	10 56 DD	SBCB	
00 02 77		06 SS DD	ADD	10 57 DD	ISTB	
07 OR SS		MUL	10 60 DD	RORB	10 62 DD	ASRB
07 1R SS		DIV	10 61 DD	ROLB	10 63 DD	ASLB
00 02 77	(unused)	07 2R SS	ASH	10 64 00	(unused)	
00 03 DD	SWAB	07 3R SS	ASHC	10 64 77		
00 04 XXX	BR	07 4R DD	XOR	10 64 77		
00 10 XXX	BNE	07 50 OR	FADD	10 64 77		
00 20 XXX	BGE	07 50 1R	FSLB	10 65 SS	MFPD	
00 24 XXX	BGT	07 50 2R	FMUL	10 66 DD	MTPD	
00 30 XXX	BGT	07 50 3R	FDIV	10 67 00	(unused)	
00 34 XXX	BLE	07 50 40	(unused)	10 67 77		
00 4R DD	JSR	07 77 77	(unused)	10 77 77		
00 50 DD	CLR	07 7R NN	SOB	11 SS DD		MOVB
00 51 DD	COM	10 00 XXX	BPL	12 SS DD	CMPB	
00 52 DD	INC	10 04 XXX	BMI	13 SS DD	BITB	
00 53 DD	DEC	10 10 XXX	PLI	14 SS DD	BICB	
00 54 DD	NEG	10 14 XXX	BLOS	15 SS DD	BISB	
00 55 DD	ADC	10 20 XXX	BVC	16 SS DD	SUB	
00 56 DD	SBC	10 24 XXX	BVS	17 00 00	floating point	
00 57 DD	TST	10 30 XXX	BCC, BHIS	17 77 77		
		10 34 XXX	BCS, BLO			

TRAP VECTORS:

000	(reserved)	114	Memory Parity
004	Time Out & other errors	240	PIRQ, prog int req
010	illegal & reserved instr	244	Floating Point
014	BPT instruction	250	Memory Management
020	IOT instruction		
024	Power Fail		
030	EMT instruction		
034	TRAP instruction		

SINGLE OPERAND: OPCode



Mnemonic Op Code Instruction dst Result N Z V C

General

CLR(B)	050DD	clear	0	0 1 0 0
COM(B)	051DD	complement (1's)	d	* * 0 1
INC(B)	052DD	increment	d + 1	* * * *
DEC(B)	053DD	decrement	d - 1	* * * *
NEG(B)	054DD	negate (2's compl)	-d	* * * *
TST(B)	057DD	test	d	* * 0 0

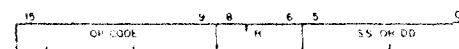
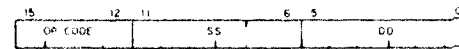
Rotate & Shift

ROR(B)	060DD	rotate right	-> C, d	* * * *
ROL(B)	061DD	rotate left	C, d -	* * * *
ASR(B)	062DD	arith shift right	d/2	* * * *
ASL(B)	063DD	arith shift left	2d	* * * *
SWAB	0003DD	swap bytes		* * * 0

Multiple Precision

ADC(B)	055DD	add carry	d + C	* * * *
SBC(B)	056DD	subtract carry	d - C	* * * *
ASXT	0067DD	sign extend	0 or -1	* * 0 -

DOUBLE OPERAND: OPR src, dst OPR src, R or OPR R, dst



Mnemonic Op Code Instruction Operation N Z V C

General

MOV(B)	1SSDD	move	d ← s	* * 0 -
CMP(B)	2SSDD	compare	s - d	* * * *
ADD	06SSDD	add	d ← s + d	* * * *
SUB	16SSDD	subtract	d ← d - s	* * * *

Logical

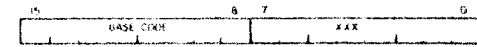
BIT(B)	3SSDD	bit test (AND)	s AND d	* * 0 -
BIC(B)	4SSDD	bit clear	d ← (~s) AND d	* * 0 -
BIS(B)	5SSDD	bit set (OR)	d ← s OR d	* * 0 -

Register

MUL	070RSS	multiply	r ← r x s	* * 0 *
DIV	071RSS	divide	r ← r / s	* * * *
ASH	072RSS	shift arithmetically		* * * *
ASHC	073RSS	arith shift combined		* * * *
XOR	074RDD	exclusive OR	d ← r + d	* * 0 -

BRANCH: B -- location

If condition is satisfied:
Branch to location,
New PC ← Updated PC + (2 x offset)
addr of br instr + 2



Op Code = Base Code + XXX

Mnemonic Base Code Instruction Branch Condition

Branches

BR	000400	branch (unconditional)	(always)
BNE	001000	br if not equal (to 0)	≠ 0 Z = 0
BEQ	001400	br if equal (to 0)	= 0 Z = 1
BPL	100000	branch if plus	+ N = 0
BMI	100400	branch if minus	- N = 1
BVC	102000	br if overflow is clear	V = 0
BVS	102400	br if overflow is set	V = 1
BCC	103000	br if carry is clear	C = 0
BCS	103400	br if carry is set	C = 1

Signed Conditional Branches

BGE	002000	br if greater or eq (to 0)	≥ 0 N + V = 0
BLT	002400	br if less than (0)	< 0 N + V = 1
BGT	003000	br if greater than (0)	> 0 Z v (N + V) = 0
BLE	003400	br if less or equal (to 0)	≤ 0 Z v (N + V) = 1

Unsigned Conditional Branches

BHI	101000	branch if higher	> V	C v Z = 0
BLOS	101400	branch if lower or same	≤ V	C v Z = 1
BHIS	103000	branch if higher or same	> V	C = 0
BLO	103400	branch if lower	≤ V	C = 1

JUMP & SUBROUTINE:

Mnemonic	Op Code	Instruction	Notes
JMP	0001DD	jump	PC ← dst
JSR	004RDD	jump to subroutine	use same R
RTS	0002OR	return from subroutine	
MARK	0064NN	mark	aid in subr return
SUB	077RNN	subtract 1 & br (if ≠ 0)	(R) - 1, then if (R) ≠ 0: PC ← Updated PC - (2 x NN)

TRAP & INTERRUPTS:

Mnemonic	Op Code	Instruction	Notes
EMT	104000 to 104377	emulator trap (not for general use)	PC at 50, PS at 32
TRAP	104400 to 104777	trap	PC at 34, PS at 38
BPT	000003	breakpoint trap	PC at 14, PS at 16
IOT	000004	input/output trap	PC at 20, PS at 22
RTI	000002	return from interrupt	
RTT	000006	return from interrupt	inhibit T bit trap

DEVICE REGISTER ADDRESSES:

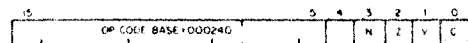
Device	Registers	Address	Int Vec- tor	Prior- ity	NPR	Device	Registers	Address	Int Vec- tor	Prior- ity	NPR
CD11	Card Reader, high speed status & control (CDST) column count (CDCC) current address (CDGA) data (CDDB)	777 160 777 162 777 164 777 166	230	BR4	X	RJP04/ RWP04/ RPO4	Disk control & status #1 (RPCS1) word count (RPWC) UNIBUS address (RPBA) desired sector/track address (RPDA) RH11 control & status (RPCS2) drive status (RPDS) error register #1 (RPER1) attention summary (RPAS) look ahead (RPLA) data buffer (RPDB) maintenance register (RPMR) drive type (RPDT) serial number (RPSN) offset (RPOF) desired cylinder (RPDC) current cylinder (RPCC) error #2 (RPER2) error #3 (RPER3) ECC position (RPEC1) ECC pattern (RPEC2) bus address ext (RPBAE) control & status #3 (RPCS3)	776 700 776 702 776 704 776 706 776 710 776 712 776 714 776 716 776 720 776 724 776 726 776 730 776 732 776 734 776 736 776 740 776 740 776 744 776 746 776 750† 776 752†	254*	BR5**	X
CR11	Card Reader status (CRS) buffer, 12-bit char (CRB1) buffer, 8-bit char (CRB2)	777 160 777 162 777 164	230	BR6		RJS04/ RWS04/ RJS03/ RWS03/ RS03	Disk control & status #1 (RSCS1) word count (RSWC) UNIBUS address (RSBA) desired disk adrs (RSDA) RH11 control & status (RSCS2) drive status (RSDS) error (RSER) attention summary (RSAS) look ahead (RSLA) data buffer (RSDB) maintenance (RSMR) drive type (RSDT) bus address ext (RSBAE) control & status #3 (RSCS3)	772 040 772 042 772 044 772 046 772 050 772 052 772 054 772 056 772 060 772 062 772 064 772 066 772 070† 772 072†	204*	BR5**	X
KW11-L	Line Clock (LKS)	777 546	100	BR6		TJU16/ TJU16/ TU16	Tape control & status #1 (MTSC1) word count (MTWC) UNIBUS address (MTBA) frame count (MTFC) RH11 control & status (MTCS2) drive status (MTDS) error (MTER) attention summary (MTAS) check character (MTCK) data buffer (MTDB) maintenance (MTMR) drive type (MTDT) serial number (MTSN) tape control (MTTC) bus address ext (MTBAE) control & status #3 (MTCS3)	772 440 772 442 772 444 772 446 772 450 772 452 772 454 772 456 772 460 772 462 772 464 772 466 772 470 772 472 772 474† 772 476†	224*	BR5**	X
KW11-P	Programmable Clock control & status count set buffer counter	772 540 772 542 772 544	104	BR6		TMA11/ TU10, TS03	Magnetic Tape status (MYS) command (MIC) byte record cntr (MTBRC) current main adrs (MTCMA) data buffer (MID) read lines (MTRD)	772 520 772 522 772 524 772 526 772 530 772 532	224	BR5	X
LA30, LA36, LF33, VI05, VI50	Console Terminal keyboard/reader status keyboard/reader buffer printer/punch status printer/punch buffer	777 560 777 562 777 564 777 566	60 64	BR4		RX11/ RX01	Floppy Disk command & status data buffer	777 170 777 172	264	BR5	
LP11, LS11, LV11	Line Printer printer status printer data	777 514 777 516	200	BR4							
PC11	Paper Tape reader status (PRS) reader buffer (PRB) punch status (PPS) punch buffer (PPB)	777 550 777 552 777 554 777 556	70 74	BR4							
RK11/ RK05	Disk Cartridge drive status (RKDS) error (RKER) control & status (RKCS) word count (RKWC) current bus adrs (RKBA) disk address (RKDA) data buffer (RKDB)	777 400 777 402 777 404 777 406 777 410 777 412 777 416	270	BR5	X						
RF11/ RS11	Disk disk control status (DCS) word count (WC) current mem adrs (CMA) disk address (DAR) disk adrs ext & error (DAE) disk data buffer (DBR) maintenance (MA) adrs of disk segment (ADS)	777 460 777 462 777 464 777 466 777 470 777 472 777 474 777 476	204	BR5	X						
RP11-C/ RPO3, RPR11/ RPR02	Disk device status (RPDS) error (RPER) control status (RPCS) word count (RPWC) bus address (RPBA) cylinder address (RPCA) disk address (RPDA) maintenance 1 (RPM1) maintenance 2 (RPM2) maintenance 3 (RPM3) selected unit (SUCA) cyl adrs (SIL0) silo memory (SIL0)	776 710 776 712 776 714 776 716 776 720 776 722 776 724 776 726 776 730 776 732 776 734 776 736	254	BR5	X						

*Jumper Selectable
**Plug Selectable
† Implemented on PDP-11/70 only

MISCELLANEOUS:

Mnemonic	Op Code	Instruction
HAIT	000000	halt
WAIT	000001	wait for interrupt
RESET	000005	reset external bus
NOP	000240	(no operation)
● SPL	00023N	set priority level (to N)
▲ MTP1	0065SS	move from previous instr space
▲ MTP1	0065DD	move to previous instr space
● MTPD	1065SS	move from previous data space
● MTPD	1066DD	move to previous data space

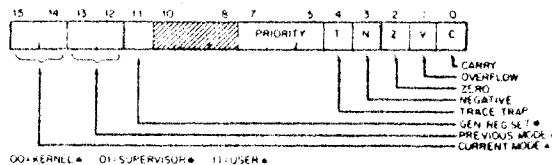
CONDITION CODE OPERATORS:



Mnemonic	Op Code	Instruction	N	Z	V	C
CLC	000241	clear C	-	-	-	0
CLV	000242	clear V	-	-	0	-
CLZ	000244	clear Z	-	0	-	-
CLN	000250	clear N	0	-	-	-
CCR	000257	clear all cc bits	0	0	0	0
SEC	000261	set C	-	-	-	1
SEV	000262	set V	-	-	1	-
SEZ	000264	set Z	-	1	-	-
SEN	000270	set N	1	-	-	-
SCC	000277	set all cc bits	1	1	1	1

PROCESSOR REGISTER ADDRESSES:

Processor Status Word
P3 - 777 776



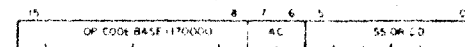
▲ Stack Limit Register — 777 774

● Program Interrupt Request — 777 772

General Registers	R0 — 777 700	R4 — 777 704
(console use only)	R1 — 777 701	R5 — 777 705
	R2 — 777 702	R6 — 777 706
(not for 11/45)	R3 — 777 703	R7 — 777 707

Console Switches & Display Register — 777 570

PDP-11/45, 11/70 FLOATING POINT PROCESSOR:



Mnemonic	Op Code	Instruction	Operation
CFCC	170000	copy fl cond codes	
SEFL	170001	set floating mode	FD ← 0
SEFI	170002	set integer mode	FI ← 0
SEID	170011	set fi/dbl mode	FD ← 1
SETL	170012	set long integer mode	FL ← 1
LDFPS	1701 src	load FPP prog status	
STFPS	1702 dst	store FPP prog status	
STST	1703 dst	store (exc codes & adrs)	
CLRF, CLRD	1704 fdst	clear floating/double	fdst ← 0
TSTF, TSTD	1705 fdst	test fi/dbl	
ABSF, ABSD	1706 fdst	make absolute fi/dbl	fdst ← -fdst
NEGF, NEGSD	1707 fdst	negate fi/dbl	fdst ← -fdst
MULF, MUOLD	171 (AC) fsrc	multiply fi/dbl	AC ← AC x fsrc
MDOF, MUODD	171 (AC + 4) fsrc	multiply & integerize	
ADDF, ADDD	172 (AC) fsrc	add fi/dbl	AC ← AC + fsrc
LDF, LOD	172 (AC + 4) fsrc	load fi/dbl	AC ← fsrc
SUBF, SUBD	173 (AC) fsrc	subtract fi/dbl	AC ← AC - fsrc
CMPE, CMPD	173 (AC + 4) fsrc	compare fi/dbl (to AC)	
STF, STD	174 (AC) fdst	store fi/dbl	fdst ← AC
DIVF, DIVD	174 (AC + 4) fsrc	divide fi/dbl	AC ← AC / fsrc
STEXP	175 (AC) dst	store exponent	
STCFI, STCFDI	175 (AC + 4) dst	store & convert fi or dbi to int or long int	
STCFD, STCFDI	176 (AC) fdst	store & convert (dbi-fi)	
LDEXP	176 (AC + 4) src	load exponent	
LDCF, LDCDI	177 (AC) src	load & convert int or long int to fi or dbi	
LDCF, LDCFD	177 (AC + 4) fsrc	load & convert (dbi-fi)	

PDP-11/35, 11/40 FLOATING POINT UNIT:

			N	Z	V	C
FADD	07500R	floating add	*	*	0	0
FSUB	07501R	floating subtract	*	*	0	0
FML	07502R	floating multiply	*	*	0	0
FINT	07503R	floating divide	*	*	0	0

POWERS OF 2:

n	2 ⁿ	n	2 ⁿ
0	1	10	1,024
1	2	11	2,048
2	4	12	4,096
3	8	13	8,192
4	16	14	16,384
5	32	15	32,768
6	64	16	65,536
7	128	17	131,072
8	256	18	262,144
9	512	19	524,288