

**digital****pdp11****PROGRAMMING CARD**

FOR FAMILY OF PDP-11 COMPUTERS

**WORD FORMAT:**BINARY-OCTAL  
REPRESENTATION

MODE	R
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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 adrs; (R) + (1 or 2)
3	auto-incr deferred	@(R)+	(R) is adrs of adrs; (R) + 2
4	auto-decrement	-(R)	(R) - (1 or 2); (R) is adrs
5	auto-decr deferred	@-(R)	(R) - 2; (R) is adrs of adrs
6	index	X(R)	(R) + X is adrs
7	index deferred	@X(R)	(R) + X is adrs of adrs

**PROGRAM COUNTER ADDRESSING:** Reg = 7

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

**LEGEND:****Op Codes**

- = 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)

**Operations**

- ( ) = contents of
- s = contents of source
- d = contents of destination
- r = contents of register
- ← = becomes
- X = relative address
- % = register definition

**Boolean**

- Λ = AND
- V = inclusive OR
- ∨ = exclusive OR
- ~ = NOT

**Condition Codes**

- \* = 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

**digital equipment corporation**

MAYNARD, MASSACHUSETTS

July 1975



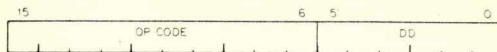
### NUMERICAL OP CODE LIST:

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	↑	
00 00 02	RTI	00 62 DD	ASR	↓	
00 00 03	BPT	00 63 DD	ASL	10 43 77	TRAP
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	MTP1	↓	
00 00 07	(unused)	00 67 DD	SXT	10 47 77	TRAP
00 00 77					
00 01 DD	JMP	00 70 00	(unused)	10 50 DD	CLRB
00 02 OR	RTS	00 77 77		10 51 DD	COMB
00 02 10	(unused)	01 SS DD	MOV	10 52 DD	INCB
00 02 27		02 SS DD	CMP	10 53 DD	DECB
00 02 27	(unused)	03 SS DD	BIT	10 54 DD	NEGB
00 02 3N		SPL	04 SS DD	BIC	10 55 DD
00 02 40	NOP	05 SS DD	BIS	10 56 DD	SBCB
00 02 41	cond codes	06 SS DD	ADD	10 57 DD	TSTB
00 02 77		07 OR SS	MUL	10 60 DD	RORB
00 03 DD	SWAB	07 1R SS	DIV	10 61 DD	ROLB
00 04 XXX	BR	07 2R SS	ASH	10 62 DD	ASRB
00 10 XXX	BNE	07 3R SS	ASHC	10 63 DD	ASLB
00 14 XXX	BEQ	07 4R DD	XOR	10 64 00	(unused)
00 20 XXX	BGE	07 50 OR	FADD	10 64 77	
00 24 XXX	BLT	07 50 1R	FSUB	10 65 SS	MFPD
00 30 XXX	BGT	07 50 2R	FMUL	10 66 DD	MTPD
00 34 XXX	BLE	07 50 3R	FDIV	10 67 00	(unused)
00 4R DD	JSR	07 67 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	BHI	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	↑	
		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: OPR dst



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

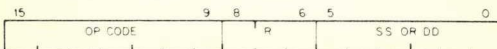
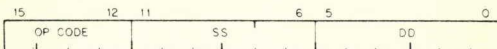
#### Rotate & Shift

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	* * * *
▲SXT	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 ∧ d	* * 0 -
BIC(B)	4SSDD	bit clear	d ← (~s) ∧ d	* * 0 -
BIS(B)	5SSDD	bit set (OR)	d ← s ∨ 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 -



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) 777 160	230	BR4	X	RJP04/ Disk RWP04/ control & status #1 RP04 word count	(RPCS1) 776 700	254*	BR5**	X			
	column count	(CDBC) 777 162					(RPWC) 776 702						
	current address	(CDBA) 777 164					(RPBA) 776 704						
	data	(CDDB) 777 166					(RPDA) 776 706						
CR11	Card Reader status	(CRS) 777 160	230	BR6		RH11 control & status	(RPCS2) 776 710						
	buffer, 12-bit char	(CRB1) 777 162					(RPDS) 776 712						
	buffer, 8-bit char	(CRB2) 777 164					(RPER1) 776 714						
KW11-L	Line Clock	(LKS) 777 546	100	BR6		error register #1	(RPER1) 776 714						
	Programmable Clock control & status	772 540	104	BR6		attention summary	(RPAS) 776 716						
KW11-P	count set buffer	772 542				look ahead	(RPLA) 776 720						
	counter	772 544				data buffer	(RPDB) 776 722						
						maintenance register	(RPMR) 776 724						
						drive type	(RPDT) 776 726						
LA30, LA36, LT33, VT05, VT50	Console Terminal keyboard/reader status	777 560	60	BR4		serial number	(RPSN) 776 730						
	keyboard/reader buffer	777 562				offset	(RPOF) 776 732						
	printer/punch status	777 564	64	BR4		desired cylinder	(RPDC) 776 734						
	printer/punch buffer	777 566				current cylinder	(RPCC) 776 736						
						error #2	(RPER2) 776 740						
LP11, LS11, LV11	Line Printer printer status	777 514	200	BR4		error #3	(RPER3) 776 740						
	printer data	777 516				ECC position	(RPEC1) 776 744						
PC11	Paper Tape reader status	777 550	70	BR4		ECC pattern	(RPEC2) 776 746						
	reader buffer	777 552				bus address ext	(RPBAE) 776 750†						
	punch status	777 554	74	BR4		control & status #3	(RPCS3) 776 752†						
	punch buffer	777 556											
RK11/ RK05	Disk Cartridge drive status	(RKDS) 777 400	220	BR5	X	RJS04/ Disk RWS04/ control & status #1 RS04 word count RJS03, UNIBUS address RWS03 desired disk adrs RS03 RH11 control & status	(RSCS1) 772 040	204*	BR5**	X			
	error	(RKER) 777 402					(RSW) 772 042						
	control & status	(RKCS) 777 404					(RSBA) 772 044						
	word count	(RKWC) 777 406					(RSDA) 772 046						
	current bus adrs	(RKBA) 777 410					(RSCS2) 772 050						
	disk address	(RKDA) 777 412					(RSDS) 772 052						
	data buffer	(RKDB) 777 416					(RSER) 772 054						
							(RSAS) 772 056						
		(RSLA) 772 060											
RF11/ RS11	Disk disk control status	(DCS) 777 460	204	BR5	X	TJU16/ Tape TWU16/ control & status #1 TU16 word count	(MTSC1) 772 440	224*	BR5**	X			
	word count	(WC) 777 462					(MTWC) 772 442						
	current mem adrs	(CMA) 777 464					(MTBA) 772 444						
	disk address	(DAR) 777 466					(MTFC) 772 446						
	disk adrs ext & error	(DAE) 777 470					(MTCS2) 772 450						
	disk data buffer	(DBR) 777 472					(MTDS) 772 452						
	maintenance	(MA) 777 474					(MTER) 772 454						
	adrs of disk segment	(ADS) 777 476					(MTAS) 772 456						
							(MTCK) 772 460						
							(MTDB) 772 462						
RP11-C/Disk RP03, RPR11/ RPR02	device status	(RPDS) 776 710	254	BR5	X	TMA11/ Magnetic Tape TU10, status TS03 command	(MTS) 772 520	224	BR5	X			
	error	(RPER) 776 712					(MTC) 772 522						
	control status	(RPCS) 776 714					(MTBRC) 772 524						
	word count	(RPWC) 776 716					(MTCMA) 772 526						
	bus address	(RPBA) 776 720					(MTD) 772 530						
	cylinder address	(RPCA) 776 722					(MTRD) 772 532						
	disk address	(RPDA) 776 724											
	maintenance 1	(RPM1) 776 726											
	maintenance 2	(RPM2) 776 730											
	maintenance 3	(RPM3) 776 732											
	selected unit	(SUCA) 776 734											
	sil memory	(SILO) 776 736											
RX11/ RX01	Floppy Disk command & status	(RXCS) 777 170	264	BR5		*Jumper Selectable **Plug Selectable † Implemented on PDP-11/70 only							
	data buffer	(RXDB) 777 172											

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

**ABSOLUTE LOADER**

Starting Address: — 500  
Memory Size: —  
4K 017  
8K 037  
12K 057  
16K 077  
20K 117  
24K 137  
28K 157  
(or larger)

**BOOTSTRAP LOADER**

Address	Contents	Address	Contents
— 744	016 701	— 764	000 002
— 746	000 026	— 766	— 400
— 750	012 702	— 770	005 267
— 752	000 352	— 772	177 756
— 754	005 211	— 774	000 765
— 756	105 711	— 776	177 560 (TTY)
— 760	100 376		or 177 550 (PC11)
— 762	116 162		
773 000	Paper Tape Bootstrap		
773 100	Disk/DECTape Bootstrap		
773 200	Card Reader Bootstrap		
773 300	Cassette Bootstrap		
773 400	Floppy Disk Bootstrap		

**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

**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

**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	TJU16
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

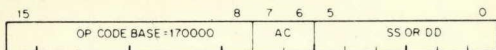
21	8	7	3	2	0
DEVICE TYPE      UNIT #					

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

**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	RS	076	>	136	^	176	~
037	US	077	?	137	_	177	DEL

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



Mnemonic	Op Code	Instruction	Operation
CFCC	170000	copy fl cond codes	
SETF	170001	set floating mode	FD ← 0
SETI	170002	set integer mode	FL ← 0
SETD	170011	set fl 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 fl/dbl	
ABSF, ABSD	1706 fdst	make absolute fl/dbl	fdst ←  fdst
NEGF, NEGD	1707 fdst	negate fl/dbl	fdst ← -fdst
MULF, MULD	171 (AC) fsrc	multiply fl/dbl	AC ← AC x fsrc
MODF, MODD	171 (AC + 4) fsrc	multiply & integerize	
ADDF, ADDD	172 (AC) fsrc	add fl/dbl	AC ← AC + fsrc
LDF, LDD	172 (AC + 4) fsrc	load fl/dbl	AC ← fsrc
SUBF, SUBD	173 (AC) fsrc	subtract fl/dbl	AC ← AC - fsrc
CMPF, CMPD	173 (AC + 4) fsrc	compare fl/dbl (to AC)	
STF, STD	174 (AC) fdst	store fl/dbl	fdst ← AC
DIVF, DIVD	174 (AC + 4) fsrc	divide fl/dbl	AC ← AC / fsrc
STEXP	175 (AC) dst	store exponent	
STCFI, STCFL	175 (AC + 4) dst	{ store & convert fl or dbl to int or long int	
STCDI, STCDL			
STCFD, STCDF	176 (AC) fdst	store & convert (dbl-fl)	
LDEXP	176 (AC + 4) src	load exponent	
LDCIF, LDCID	177 (AC) src	{ load & convert int or long int to fl or dbl	
LDCLF, LDCLD			
LDCDF, LDCFD	177 (AC + 4) fsrc	load & convert (dbl-fl)	

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

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

### POWERS OF 2:

<u>n</u>	<u>2<sup>n</sup></u>	<u>n</u>	<u>2<sup>n</sup></u>
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