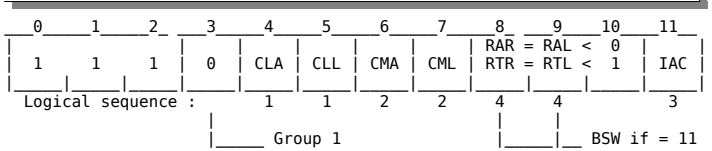
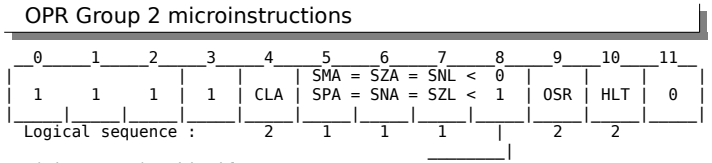
OPR Instruction

OPR group 1 microinstructions



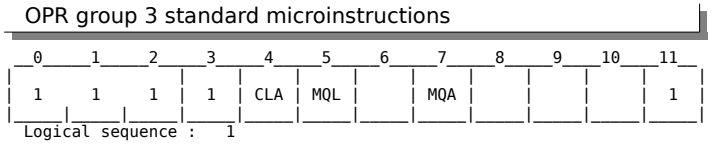
NOP	7000	no operation
CLA	7200	clear AC
CLL	7100	clear link
CMA	7040	complement AC
CML	7020	complement link
RAR	7010	rotate AC & link right 1
RAL	7004	rotate AC & link left 1
RTR	7012	rotate AC & link right 2
RTL	7006	rotate AC & link left 2
SWP	7002	swap bytes in AC
IAC	7001	increment AC

OPR Group 2 microinstructions



SMA	7500	skip on minus AC
SZA	7440	skip on zero AC
SPA	7510	skip on plus AC
SNA	7450	skip on non-zero AC
SNL	7420	skip on non-zero link
SZL	7430	skip on zero link
SKP	7410	skip unconditionally
CLA	7600	clear AC
OSR	7404	or switch register into AC
HLT	7402	halts the program

OPR group 3 standard microinstructions



	NOP	7401	no operation
1	CLA	7601	clear AC
2	MQL	7421	load MQ from AC then clear AC
2	MQA	7501	inclusive OR the MQ with the AC
3	CAM	7621	clear AC and MQ
3	SWP	7521	swap AC and MQ
3	ACL	7701	load MQ into AC
3	CLA,SWP	7721	load AC from MQ then clear MQ

OPR combinations

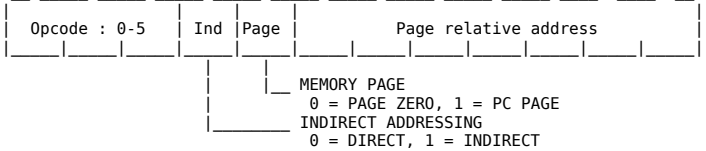
CIA	7041	complement and increment AC	2,3
LAS	7604	load AC with switch register	2,3
STL	7120	set link (to 1)	1,2
GLK	7204	get link (put link in AC bit 11)	1,4
CLA CLL	7300	clear AC and link	1.4
CLL RAR	7110	shift positive number one right	1,4
CLL RAL	7104	shift positive number one left	1,4
CLL RTL	7106	clear link, rotate 2 left	1,4
CLL RTR	7112	clear link, rotate 2 right	1,4
SZA CLA	7640	skip if AC=0, then clear AC	1,2
SZA SNL	7460	skip if AC=0, or link is 1	1.2
SNA CLA	7650	skip if AC/=0, then clear AC	1,2
SMA CLA	7700	skip if AC<0, then clear AC	1,2
SMA SZA	7540	skip if AC<=0	1.2
SMA SNL	7520	skip if AC<0 or line is 1	1.2
SPA SNA	7550	skip if AC>0	1
SPA SZL	7530	skip if AC>=0 and link is 0	1
SPA CLA	7710	skip of AC>=0, then clear AC	1,2
SNA SZL	7470	skip if AC=0 and link=0	1

OPR literal composition

0000	CLA CLL	3777	CLA CLL CMA RAR
0001	CLA CLL IAC	4000	CLA CLL CML RAR
0002	CLA CLL IAC RAL	5777	CLA CLL CMA RTR
0003	CLA CLL CML IAC RAL	6000	CLA CLL CML IAC RTL
0004	CLA CLL IAC RTL	7775	CLA CLL CMA RTL
0006	CLA CLL CML IAC RTL	7776	CLA CLL CMA RAL
0100	CLA IAC BSW	7777	CLA CLL CMA
2000	CLA CLL CML RTR		

Instruction set

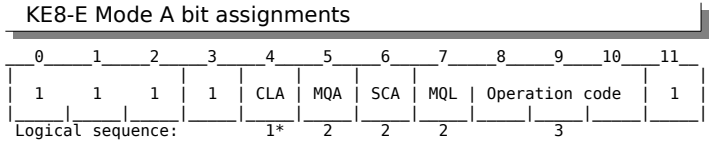
AND	0aaa	logical AND	2.6
TAD	1aaa	2's complement add	2.6
ISZ	2aaa	increment, skip if zero	2.6
DCA	3aaa	deposit and clear AC	2.6
JMS	4aaa	jump to subroutine	2.6
JMP	5aaa	jump	1.2
IOT	6ddf	in-out transfer	---
OPR	7fff	operate	1.2



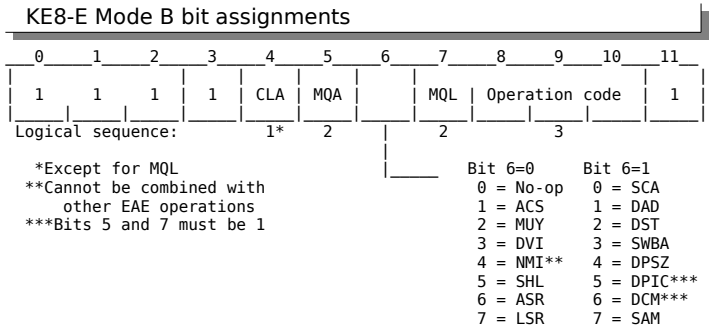
KE8-E : EXTENDED ARITHMETIC ELEMENT

Mode Instructions		
SWAB	7431	switch Mode from A to B
SWBA	7447	switch Mode from B to A
Shift instructions		
SCA	7441	logical OR step counter with AC
SCA CLA	7641	step counter to AC
SCL	7403 (Mode A)	step counter load (from memory)
NMI	7411	normalize
SHL	7413	shift left
ASR	7415	arithmetic shift right
LSR	7417	logical shift right
ASC	7403 (Mode B)	AC to step counter
Arithmetic instructions		
MUY	7405	multiply
DVI	7407	divide
SAM	7457	subtract AC from MQ
Double precision instructions		
DLD	7763	double precision load
DST	7445	double precision store
DAD	7443	double precision add
DPIC	7573	double precision increment
DCM	7575	double precision complement
DPSZ	7451	double precision skip if zero

KE8-E Mode A bit assignments



KE8-E Mode B bit assignments



KE8-E Instruction differences

Instruction	Mode A	Mode B
MUY	The next location holds the multiplier	The next location hold the multiplier address
DVI	The next location holds the division	The next location holds the divisor address
SHL LSR ASR	The next location holds one less than the number of shifts. On right shifts, MQ11 is lost.	The next location holds the shift count. (A shift Of 0 is legal) On right shifts, MQ11 is shifted Into the GT flag.

KE8-E Instructions timings

Mode A

	MEM CYCLES	INSTR TIME	LONGEST CYCLE	NOTES
SWAB	1	1.2us	1.2us	
SWBA	1	1.2	1.2	
SCL	2	2.6	1.4	
MUY	2	7.4	6.2	
DVI	2	7.4	6.2	No overflow
NMI	1	1.5+.3N	8.1	
SHL	2	2.6+.3N	8.9*	25-place shift
ASR	2	2.6+.3N	8.9*	25-place shift
LSR	2	2.6+.3N	8.9*	25-place shift
SCA	1	1.2	1.2	

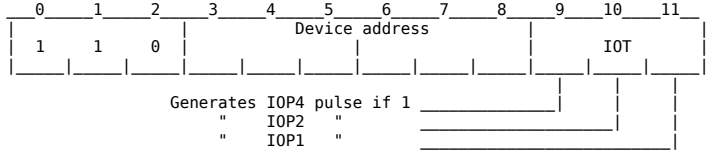
Mode B

	MEM CYCLES	INSTR TIME	LONGEST CYCLE	NOTES
SWAB	1	1.2us	1.2us	
SWBA	1	1.2	1.2	
ACS	1	1.2	1.2	
MUY	3	8.6	6.2	
DVI	3	8.6	6.2	No overflow
NMI	1	1.5+.3N	8.1	
SHL	2	2.9+.3N	9.2**	25-place shift
ASR	2	2.9+.3N	9.2**	25-place shift
LSR	2	2.9+.3N	9.2**	25-place shift
SCA	1	1.2	1.2	
DAD	4	5.2	1.4	
DST	4	5.2	1.4	
DPSZ	1	1.2	1.2	
DPIC	1	1.6	1.6	
DCM	1	1.6	1.6	
SAM	1	1.2	1.2	

*Computed from 1.4+.3N **Computed from 1.7+.3N

IOT Instruction

IOT bit assignments



PROCESSOR IOT MICROINSTRUCTIONS (1.2usec.)

			(usec.)
SKON	6000	skip if interrupt ON, and turn OFF	
ION	6001	turn interrupt ON	
IOF	6002	turn interrupt OFF	
SRQ	6003	skip interrupt request	
GTF	6004	get interrupt flags	
RTF	6005	restore interrupt flags	
SGT	6006	skip on Greater Than flag	
CAF	6007	clear all flags	

MC8E : Extended Memory Controller

			(usec.)
CDF n	62n1	Change data field	1.2
CIF n	62n2	Change instruction field	1.2
CDI n	62n3	Change data & instruction fields	1.2
CINT	6204		1.2
RDF	6214		1.2
RIF	6224		1.2
RIB	6234		1.2
RMF	6244		1.2
SINT	6254		1.2
CUF	6264		1.2
SUF	6274		1.2

KE8 : TELETYPE KEYBOARD/READER

			(usec.)
KCF	6030	Clear Keyboard/Reader Flag, do not start Reader	1.2
KSF	6031	Skip if Keyboard/Reader Flag = 1	1.2
KCC	6032	Clear AC and Keyboard/Reader Flag, Set Reader run	1.2
KRS	6034	Read Keyboard/Reader Buffer Static	1.2
KIE	6035	AC 11 to Keyboard/Reader Interrupt Enable F.F.	1.2
KRB	6036	Clear AC, Read Keyboard Buffer, Clear Keyboard Flags	1.2

KE8 : TELETYPE TELEPRINTER/PUNCH

			Time (usec.)
SPF	6040	Set Teleprinter/Punch Flag	1.2
TSF	6041	Skip if Teleprinter/Punch Flag = 1	1.2
TCF	6042	Clear Teleprinter/Punch Flag	1.2
TPC	6044	Load Teleprinter/Punch Buffer Select and Print	1.2
SPI	6045	Skip if Teletype Interrupt	1.2
TLS	6046	Load Teleprinter/Punch Buffer, Select and Print and Clear Teleprinter/Punch Flag	1.2

PR8-E : HIGH SPEED TAPE READER

			Time (usec.)
RPE	6010	Set Interrupt Enable for Reader and Punch	1.2
RSF	6011	Skip if Reader Flag = 1	1.2
RRB	6012	Read Reader Buffer and Clear Flag	1.2
RCF	6014	Clear Flag and Buffer and Fetch Character	1.2
RCC	6016	Read Reader Buffer, Clear Flag and Buffer, and Fetch Character	1.2
PCE	6020	Clear interrupt Enable for Reader and Punch	1.2

PC03 : HIGH SPEED TAPE PUNCH

			Time (usec.)
RPE	6010	Set Interrupt Enable for Reader and Punch	1.2
PCE	6020	Clear interrupt Enable for Reader and Punch	1.2
PSF	6021	Skip If Punch Flag = 1	1.2
PCF	6022	Clear Flag and Buffer	1.2
PPC	6024	Load Buffer and Punch Character	1.2
PLS	6026	Clear Flag and Buffer, Load Buffer and Punch Character	1.2

TU56/TC08 : DECTAPE AND CONTROL

			Time (usec.)
DTRA	6761	read status register A	2.6
DTCA	6762	clear status register A	2.6
DTXA	6764	load status register A	2.6
DTSF	6771	skip on flags	2.6
DTRB	6772	read status register B	2.6
DTLB	6774	load status register B	2.6

Notes

DF32D : RANDOM ACCESS DISC FILE

			Time (usec.)
DCMA	6601	clear disk memory address register, & disk flags	2.6
DMAR	6603	load disk memory address register & read	3.6
DMAW	6605	load disk memory address register and write	3.6
DCEA	6611	clear disk extended address register and address memory extension	2.6
DSAC	6612	skip on address confirmed flag	2.6
DEAL	6615	load disk extended address and memory address extension	3.6
DEAC	6616	read disk extended addr register	3.6
DFSE	6621	skip on zero error flag	2.6
DFSC	6622	skip on data completion flag	2.6
DMAC	6626	read disk memory address register	3.6

RK8E : RANDOM ACCESS DISC FILE

			(usec.)
DSKP	6741	skip on DONE or ERR	2.6
DCLR	6742	clear based on AC10 and AC11	2.6
DLAG	6743	set disk address and start	2.6
DLCA	6744	set memory address	2.6
DRST	6745	read status register	2.6
DLCD	6746	load command register	2.6
DMAN	6747	maintenance operation	2.6

Status register

0	1	2	3	4	5	6	7	8	9	10	11
Done	Rdy		Seek Fail	Not rdy	Busy	Time out	Write Lock	CRC err	Data late	Drv err	Cyl err

Command register

0	1	2	3	4	5	6	7	8	9	10	11
Operation code			Int on	Done seek		Memory field			Drive		MA bit 0

000 Read data
001 Read all
010 Write protect drive
011 Start seek
100 Write data
101 Write all

CONTROL CHARACTERS

8-bit ASCII CODE	Character Name	Remarks
000	null	Ignored in ASCII input.
200	leader/trailer	Leader/trailer code precedes and follows the data portion of binary files.
203	CTRL/C	OS/8 break character, forces return to Keyboard Monitor, echoed as ^C.
207	BELL	CTRL/G.
211	TAB	CTRL/I, horizontal tabulation.
213	VT	CTRL/K, vertical tabulation.
214	FORM	CTRL/L, form feed.
215	RETURN	Carriage return, generally echoed as carriage return followed by a line feed.
217	CTRL/O	Break Character, used conventionally to suppress teletype output, echoed as ^O.
225	CTRL/U	Delete current input line, echoed as ^U.
232	CTRL/Z	End-of-File character for all ASCII and binary files (in relocatable binary files CTRL/Z is not a terminator if it occurs before the trailer code).
233	ESC	Escape replaces ALTMODE on some terminals. Considered equivalent to ALTMODE.
375	ALTMODE	Special break character for Teletype input.
376	PREFIX	PREFIX replaces ALTMODE on some terminals. Considered equivalent to to ALTMODE.
377	RUBOUT	Key is labeled DELETE on some terminals. Deletes the previous character typed.

CHARACTER CODES

8-bit ASCII Code	6-bit Code	DEC 029 Card Code	DEC 026 Card Code	Character Graphic	Remarks
240	40	blank	blank		space
241	41	11-8-2	12-8-7	!	exclamation point
242	42	8-7	0-8-5	"	quotation marks
243	43	8-3	0-8-6	#	number sign (10)
244	44	11-8-3	11-8-3	$	dollar sign
245	45	0-8-4	0-8-7	%	percent
246	46	12	11-8-7	&	ampersand
247	47	8-5	8-6	'	apostrophe or acute accent
250	50	12-8-5	0-8-4	(	opening parenthesis
251	51	11-8-5	12-8-4(1)	)	closing parenthesis
252	52	11-8-4	11-8-4	*	asterisk
253	53	12-8-6	12	+	plus
254	54	0-8-3	0-8-3	,	comma
255	55	11	11	-	minus sign or hyphen
256	56	12-8-3	12-8-3	.	period or decimal point
257	57	0-1	0-1	/	slash
260	60	0	0	0	
261	61	1	1	1	
262	62	2	2	2	
263	63	3	3	3	
264	64	4	4	4	
265	65	5	5	5	
266	66	6	6	6	
267	67	7	7	7	
270	70	8	8	8	
271	71	9	9	9	
272	72	8-2	11-8-2	:	colon
273	73	11-8-2	0-8-2	;	semicolon
274	74	12-8-4	12-8-6	<	less than
275	75	8-6	8-3	=	equals
276	76	0-8-6	11-8-6	>	greater than
277	77	0-8-7	12-8-2	?	question mark

CHARACTER CODES

8-bit ASCII Code	6-bit Code	DEC 029 Card Code	DEC 026 Card Code	Character Graphic	Remarks
300	00	8-4	8-4	@	at sign
301	01	12-1	12-1	A	
302	02	12-2	12-2	B	
303	03	12-3	12-3	C	
304	04	12-4	12-4	D	
305	05	12-5	12-5	E	
306	06	12-6	12-6	F	
307	07	12-7	12-7	G	
310	10	12-8	12-8	H	
311	11	12-9	12-9	I	
312	12	11-1	11-1	J	
313	13	11-2	11-2	K	
314	14	11-3	11-3	L	
315	15	11-4	11-4	M	
316	16	11-5	11-5	N	
317	17	11-6	11-6	O	
320	20	11-7	11-7	P	
321	21	11-8	11-8	Q	
322	22	11-9	11-9	R	
323	23	0-2	0-2	S	
324	24	0-3	0-3	T	
325	25	0-4	0-4	U	
326	26	0-5	0-5	V	
327	27	0-6	0-6	W	
330	30	0-7	0-7	X	
331	31	0-8	0-7	Y	
332	32	0-9	0-7	Z	
333	33	12-8-2(5)	11-8-5	[	opening bracket, SHIFT/K
334	34	11-8-7(6)	8-7	/	backslash, SHIFT/L (8)
335	35	0-8-2	12-8-5	]	closing bracket, SHIFT/M
336	36	12-8-7(7)	8-5	^	circumflex (2)
337	37	0-8-5(3)	8-2(3)	_	underline (4)(9)

Footnotes:

(1) On some DEC 026 Keyboards, this character is graphically represented as [].
(2) On most DEC Teletypes circumflex is replaced by up-arrow (^).
(3) A card containing this code in column 1 with all remaining columns blank is an end-of-file card.
(4) On most DEC teletypes underline is replaced by backarrow (<-).
(5) On some 029 keyboards this character is graphically represented as cent sign (c/)
(6) On some 029 keyboards this character is graphically represented as logical not (-).
(7) On some 029 keyboards this character is graphically represented as vertical bar (|).
(8) On some LP8 line printers, the character diamond ( ) is printed instead of backslash.
(9) On some LP8 line printers, the character heart ( ) is printed instead of underline.
(10) The number sign on some terminals is replaced by pound sign (L)

digital

POCKET REFERENCE CARD

pdp8

Paper Tape RIM Loader

TTY (Low Speed)		PTR (High Speed)	
7756/	6032	7756/	6014
7757/	6031	7757/	6011
7760/	5357	7760/	5357
7761/	6036	7761/	6016
7762/	7106	7762/	7106
7763/	7006	7763/	7006
7764/	7510	7764/	7510
7765/	5357	7765/	5374
7766/	7006	7766/	7006
7767/	6031	7767/	6011
7770/	5367	7770/	5367
7771/	6034	7771/	6016
7772/	7420	7772/	7420
7773/	3776	7773/	3776
7774/	3376	7774/	3376
7775/	5356	7775/	5357