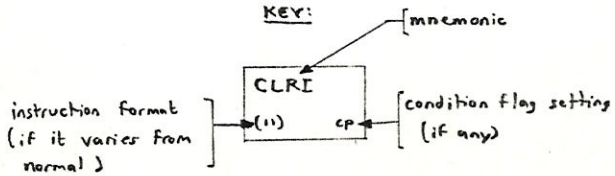
META 4B INSTRUCTION SET

	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F	INST FMT
0		ARR as	SRR as	MRR	DRR ov	CRR cp	RRR	SWRR	ORR	NRR	XRR	CLRR cp	TMRR tm	NOP (5)		(UNARY) (9) *	(1)
1	LSHLI	RSHLI	LSHLDI	RSHLDI	LSHI ov	RSHI	LSHDI ov	RSHDI	LSHLR	RSHLR	LSHLDR	RSHLDR	LSHR ov	RSHR	LSHDR ov	RSHDR	(1)
2	BF																(4)
3	BT																(4)
4	B																(4)
5		ARI as	SRI as	MRI	DRI ov	CRI cp	RRI (11)		ORI	NRI	XRI	CLRI (11) cp	TMRI tm	BCF (7)	RETURN (13)		(6)
6		ARH as	SRH as	MRH	DRH ov	CRH cp	RRH	SWRH	ORH	NRH	XRH	CLRH cp	TMRH tm	CASE (10)		ETC (15)	(8)
7		ARA as	SRA as	MRA	DRA ov	CRA cp	RRA		ORA	NRA	XRA	CLRA cp	TMRA tm			(UNARY) (12) *	(8)
8							RRB	SWRB	ORB	NRB	XRB	CLRB cp	TMRB tm		CLOCK (14)		(8)
9		AHR as	SHR as			CHR cp	RHR	SWHR	OHR	NHR	XHR	CLHR cp	TMHR tm	SEMA (12) sm		(UNARY) (12) *	(9)
A							RBR	SWBR	OBR	NBR	XBR	CLBR cp	TMBR tm				(9)
B		AHI as	SHI as			CHI cp	RHI		OHI	NHI	XHI	CLHI cp	TMHI tm				(16)
C		AHA as	SHA as			CHA cp	RHA		OHA	NHA	XHA	CLHA cp	TMHA tm				(17)
D		AHH as	SHH as			CHH cp	RHH	SWHH	OHH	NHH	XHH	CLHH cp	TMHH tm				(17)
E							RBI		OBI	NBI	XBI	CLBI cp	TMBI tm				(18)
F	SCFEA sc	SCFNA sc	SCBEA sc	SCBNA sc	SCFT st	SCBT st	RCC		OCC	NCC	XCC	CLCC cp		TR	INIT	XFER (20)	(19)

KEY:



CONDITION FLAG REGISTER (CFR) SETTINGS

code	condition	CFR bit set	S flag	applicable branches		side effects
as :	carry out	0	(off)	BC		
	overflow	1		BO		
cp :	=	Ø	1	BE	BE	
	>	1	Ø	BG	BNG	
	<	2	Ø	BL	BNL	
ov :	overflow	1	(off)	BO		
sc :	found	Ø	1	BS		R1→char,
	¬found	1	Ø	BNS		
sm :	bit off	Ø	Ø	BZ	BNZ	
	bit on	1	1	BO	BNO	
st :	found	Ø	1	BS		R1→char, RØ=code
	¬found	1	Ø	BNS		
tm :	zeroes	Ø	Ø	BZ	BNZ	
	ones	1	1	BO	BNO	
	mixed	2	Ø	BM	BNM	
ts :	Ø	Ø	Ø	BZ	BNZ	
	+	1	1	BP	BNP	
	−	2	1	BN	BNN	

MASK BYTES FOR BCF INSTRUCTIONS (x'5D')

opcode	mask	opcode	mask	opcode	mask	opcode	mask
BC	80	BN	20	BNN	C0		
BE	80	BNE	60	BNO	A0	BO	40
BG	40	BNG	A0	BNP	A0	BP	40
BL	20	BNL	C0	BNS	40	BS	80
BM	20	BNM	C0	BNZ	60	BZ	80

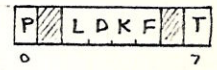
UNARY INSTRUCTIONS

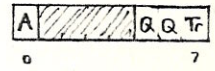
CFR setting	*	ØF*	9F*	7F*
	Ø	SZR	SZH	
	1	SOR	SOH	
	2	IR	IH	
	3	IIR	IIH	
ts	4	DTSR	DTSH	
ts	5	DDTSR	DDTSH	
	6	ABSR	ABSH	
	7	NEGR	NEGH	
ts	8	TSR	TSH	TSA
	9	EXSR		
	A	SQRTR	SQRTH	
	B			
	C	BR	BH	
	D	CALLR	CALLH	CALLA
	E	SINTR	SINTH	SINTA
	F	INTAR	INTAH	INTAA

CONTROL REGISTERS

hex no	function
10	PBR
11	PDR
12	CFR
13	ICMR
14	SP
18	VGIR/VGOR
19	VGPIOR/VGPIOW

ICMR FORMAT

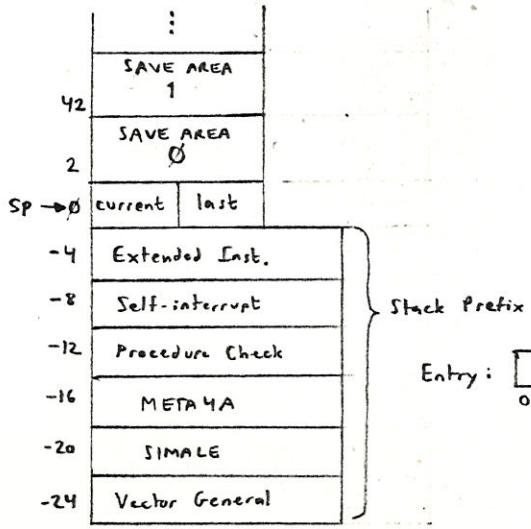


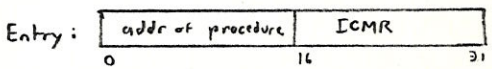


P = P-bit
D = Data tablet
K = Keyboard
F = Function Keys
A = METAYA
QQTr : Don't touch!

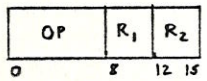
L T
0 x = LP int remains pending
1 0 = LP int occurs
1 1 = LP int discarded

STACK FORMAT



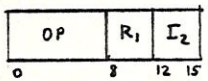


R_1, R_2



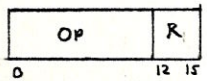
(1)

R_1, I_2



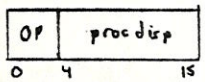
(2)

R



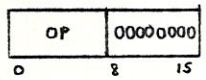
(3)

label



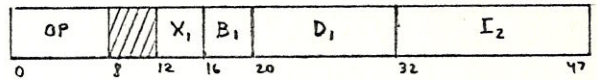
(4)

Ø



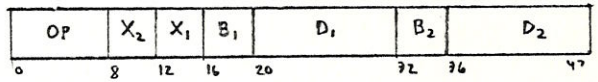
(5)

$D_1(X_1, B_1), I_2$



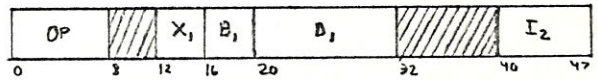
(16)

$D_1(X_1, B_1), D_2(X_2, B_2)$



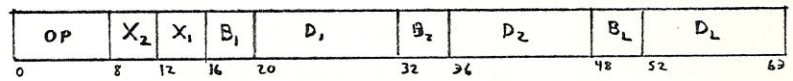
(17)

$D_1(X_1, B_1), I_2$



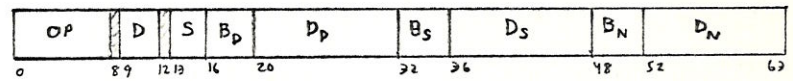
(18)

$D_1(X_1, B_1), D_2(X_2, B_2), D_L(B_L)$



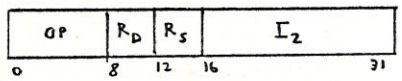
(19)

$D, D_D(B_D), S, D_S(B_S), D_N(B_N)$



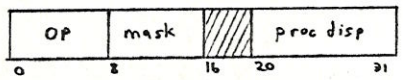
(20)

$R_D[, R_S], I_2$



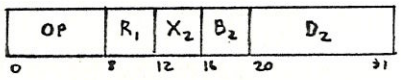
(6)

mask, label



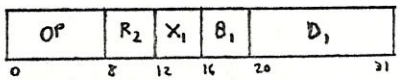
(7)

$R_1, D_2(X_2, B_2)$



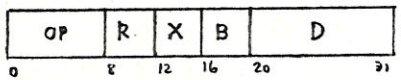
(8)

$D_1(X_1, B_1), R_2$



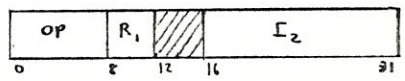
(9)

R, D(X, B)



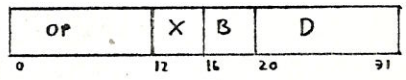
(10)

R_1, I_2



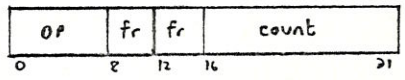
(11)

D(X, B)



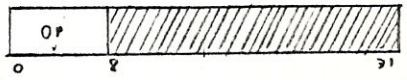
(12)

fr, count



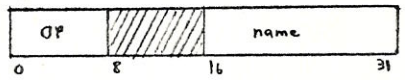
(13)

Ø



(14)

name



(15)

META 4B INSTRUCTION FORMATS

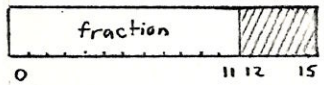
XFER S/D codes :
- 0 R - Register file
- 1 LS - Local Store
- 2 MS - Main Store
- 3 VGR - Vector General Register
- 4-7 (unused — given zeroes when source)

VG REGISTER NAMES

hex no.	name	format
00	VGFKL0	(8)
01	VGFKL8	"
02	VGTABX	(TABX)
03	VGTABY	(12)
05	VGMCR	(MCR)
08	VGXCOORD	(12)
09	VGYCOORD	"
0A	VGZCOORD	"
0D	VGISR	"
11	VGXSCALE	"
13	VGYSCALE	"
14	VGXDISP	"
15	VGYDISP	"
34	VGFKL16	(8)
35	VGFKL24	"
43	VGJOYX	(12)
44	VGJOYY	"
45	VGJOYZ	"
46	VGDIAL1	"
47	VGDIAL2	"
48	VGDIAL3	"
49	VGDIAL4	"
4A	VGDIAL5	"
4B	VGDIAL6	"
4C	VGDIAL7	"
4D	VGDIAL8	"
4E	VGDIAL9	"
4F	VGDIAL10	"

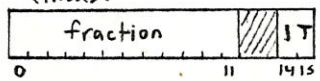
VG REGISTER FORMATS

(12):



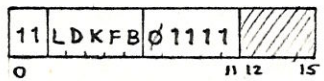
(8):

(TABX):



I: near bit
T: touch bit

(MCR):

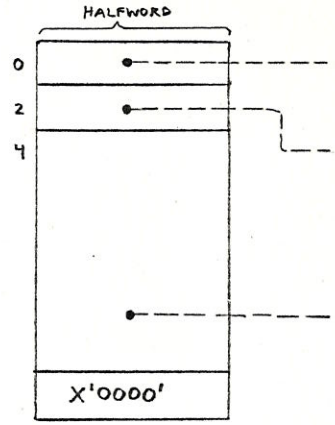


L: light pen
D: data tablet
K: keyboard
F: function keys
B: blink

ETC REGISTERS

hex no.	name	abs/rel.	
20	DBR	abs	setup before ETC
21	BP	rel	
22	SBP	rel	
28	FDBR	abs	
29	FBP	rel	
2A	FSBP	rel	
2B	FDP	rel	
2F	ETCNAME		

BLOCK FORMAT

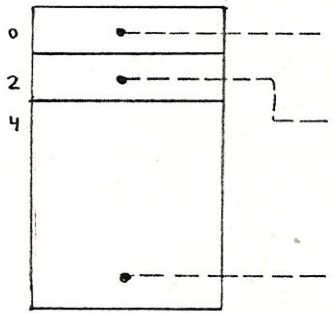


Pointer to next block, relative to start of DATA area (pointed to DBR).

Not used by hardware; can be specified at assembly time as a relative pointer (PREV = label) or absolute value (SECOND = value).

Zero or more consecutive sub-blocks.

SUB-BLOCK FORMAT



Length of sub-block, in bytes. Must include 4 bytes for header.

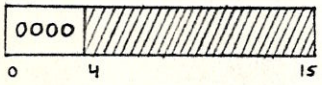
If bit 0 is on, then it is a VG sub-block (bits 1-15 ignored). Otherwise, bits 1-15 contain SIMALE initialization info.

Data within sub-block.

MACROS

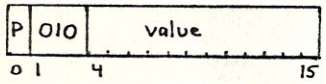
```
[label0]   DATA
 [label1]    BLK    next_blk [,PREV=label | SECOND=value ]
  [label2]     SUBLK  VG | simale_info
  [label3]     ENDSUBLK
 [label4]    ENDBLK
[label5]   ENDDATA
```

VGNOP

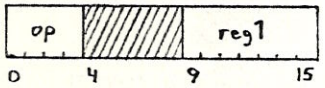


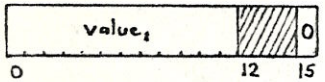
VGSPEC [DATA=value][,PBIT=N|Y]

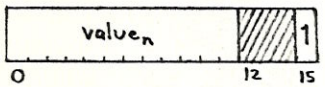
Default ↑



VGLOAD reg1, value1, ..., valuen
VGOR
VGAND
VGADD

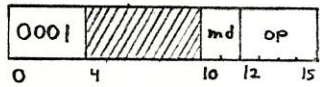






op bits	command
0100	VGLOAD
0101	VGOR
0110	VGAND
0111	VGADD

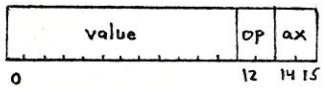
VGABS [MODE=<md>]
VGREL



op bits	command
0000	VGREL
0100	VGABS

md bits	<md>
00	LINE (default)
01	DASHED
10	DOTTED
11	POINT

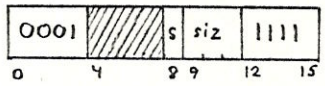
VGC value, op, axis



bits	op	axis
00	L	AI
01	LD	X
10	LM	Y
11	LDT	Z

last hex digit in VGC	axis → AI	X	Y	Z
op ↓ L	0	1	2	3
op ↓ LD	4	5	6	7
op ↓ LM	8	9	A	B
op ↓ LDT	C	D	E	F

VGCHAR [SIZE=<siz>][,SLANT=<s>]



s bit	<s>
0	HORIZONTAL (default)
1	VERTICAL

siz bits	<siz>	width		height	
000	PREVIOUS	-	-	-	-
100	60X120	.0167	(34)	.0333	(68)
101	40X80	.0250	(51)	.0500	(102)
110	30X60	.0333	(68)	.0667	(136)
111	16X32	.0625	(128)	.1250	(256)

Notes: the <siz> figures are the number of characters, in rows x columns per screen. The width and height are the character spacings, in coordinate fractions and (raster units).

ASCII CODE CHART

	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
0	NUL								BS		LF			CR		
1			DEC-SZ	INC-SZ	TERM											
2	□	!	"	#	$	%	&	'	(	)	*	+	,	-	.	/
3	Ø	1	2	3	4	5	6	7	8	9	:	;	<	=	>	?
4	@	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
5	P	Q	R	S	T	U	V	W	X	Y	Z	[	\	]	↑	_
6	`	a	b	c	d	e	f	g	h	i	j	k	l	m	n	o
7	p	q	r	s	t	u	v	w	x	y	z	{	¦	}	~	