

NATIONAL RADIO ASTRONOMY OBSERVATORY  
Charlottesville, Virginia

June 17, 1975

VLA COMPUTER MEMORANDUM #124

SYSTEM CONTROL BLOCKS FOR SYNCHRONOUS COMPUTERS

Revised Preliminary Specifications

B. Clark

This memo replaces VLA Computer Memo #108. The additions and changes to Memo #108 have grown to the extent that it now seems appropriate to place the revised version in general circulation. However, it is even now clear that these control blocks are not the final version. After the system is in initial operation it will be necessary to make a major revision of the control block structure in order to eliminate inconveniences, unclear conventions, and undue inefficiencies. The revisions made in this Memo are, for the most part, of technical details only, and are of concern only to the programmers of the Modcomp computers.

One change in philosophy has occurred since the writing of Memo #108. In that memo, it was contemplated that only an abbreviated version of the control blocks would be kept in Monty. We now send, every ten seconds, the entire set of control blocks, except the monitor system control blocks, from Boss to Monty, where they are located at the same addresses, so that the pointers apply without offset. If we eventually end up with a shared memory system, we may simply eliminate this data transmission step.

LOC CONTENTS

	BIT SIGNIFICANCE	
0	WARNING	+
1	ERROR	+
2	SEVERE ERROR	+
3	DANGER	+
4	WARNING	+
5	ERROR	+
6	SEVERE ERROR	+
7	DANGER	+
8	WARNING	+
9	ERROR	+
10	SEVERE ERROR	+
11	DANGER	+

SET DURING NORMAL ARRAY OPERATION

SET DURING CALIBRATOR OBSERVATIONS ONLY

SET DURING SPECIAL TEST OPERATIONS ONLY

LOC	CONTENTS			
0	MODIFIED JULIAN ATOMIC DATE	S+31	CLOCKB	DAYS
1	"			
2	TIME, INTERRUPT COUNTS SINCE 0 HOURS THIS DAY	S+31		
3	"			
4	TIME, INTERRUPT COUNTS SINCE LAST 10 SEC INTERRUPT LEFT BYTE USED DURING COLD START	B+15		
5	CONTROL PROGRAM ID (NOT IMPLEMENTED)		CDA	
6	RESERVED TO IDENTIFY REDUNDANT SYSTEM		---	
7	TIMING COORDINATION BITS			
8	TIME, IAT, FRACTION OF A DAY, AT LAST 10 SEC INTERRUPT	D	G10	RADIANS=2* $\pi$ *DAYS
9	"			
10	"			
11	TIME, LST, FRACTION OF A DAY, AT LAST 10 SEC INTERRUPT	D		RADIANS
12	"			
13	"			
14	ARRAY STATUS WORD		CHECK	
15	REDUNDANT ITEMS STATUS			
16	POINTER TO FIRST ARM CONTROL BLOCK		CDA	
17	RESERVED FOR MONITOR SYSTEM POINTERS			
18	"			
19	POINTER TO FIRST SUBARRAY CONTROL BLOCK			
20	RESERVED FOR MONITOR SYSTEM POINTERS			
21	"			
22	POINTER TO FIRST IF GROUP CONTROL BLOCK			
23	RESERVED FOR MONITOR SYSTEM POINTERS			
24	"			
25	POINTER TO FIRST ANTENNA CONTROL BLOCK			
26	RESERVED FOR MONITOR SYSTEM POINTERS			
27	"			
28	POINTER TO FIRST FRONTEND CONTROL BLOCK			
29	RESERVED FOR MONITOR SYSTEM POINTERS			
30	"			
31	POINTER TO FIRST PREAMP CONTROL BLOCK			
32	RESERVED FOR MONITOR SYSTEM POINTERS			
33	"			
34	POINTER TO FIRST IF CONTROL BLOCK			
35	RESERVED FOR MONITOR SYSTEM POINTERS			
36	"			
37	POINTER TO FIRST FAULTY CORRELATOR CONTROL BLOCK			
38	RESERVED FOR MONITOR SYSTEM POINTERS			
39	"			
40	COSINE SIDEREAL TIME LAST 10 SEC INTERRUPT	D	G10	
41	"			
42	"			
43	SINE SIDEREAL TIME, LAST 10 SEC INTERRUPT			
44	"			
45	"			
46	TIME, IAT, AT NEXT 10 SEC INTERRUPT	D		RADIANS
47	"			
48	"			
49	TIME, LST, AT NEXT 10 SEC INTERRUPT			

LOC	CONTENTS			
50	"			
51	"			
52	COSINE TIME, NEXT 10 SEC INTERRUPT	D		
53	"			
54	"			
55	SINE TIME, NEXT 10 SEC INTERRUPT	D		
56	"			
57	"			
58	DERIVATIVE OF UT1 WRT IAT	E	EPH	DAYS/DAY - 1
59	"			
60	DERIVATIVE OF EQUATION OF THE EQUINOX	E		URNS/DAY
61	"			
62	APPARENT LST OF MIDNIGHT IAT	D		RADIANS
63	"			
64	"			
65	REFRACTION CONSTANT FOR POINTING	B-12		URNS
66	CURRENT SURFACE REFRACTIVITY	E		N-1
67	"			
68	ESTIMATED ATMOSPHERIC PHASE PATH	E		NANOSECONDS
69	"			
70	POINTER TO NEXT FREE FAULTY CORRELATOR BLOCK			
71	POINTER TO MONITOR SYSTEM CONTROL BLOCK			
72	TASK SYNCHRONIZATION CONTROL FOR MONTY			
73	TASK SYNCHRONIZATION CONTROL FOR MONTY			
74	TASK SYNCHRONIZATION CONTROL FOR CORA			
75	TASK SYNCHRONIZATION CONTROL FOR CORBIN			

LOC	CONTENTS	
0	ARM ID	CDA
1	ARM STATUS WORD	CHECK
2	POINTER TO NEXT ARM CONTROL BLOCK	CDA

LOC	CONTENTS				
0	SUBARRAY ID				
1	SOURCE NAME (8 CHARACTERS MAX)		ASCII	CDA	SNE
2	"				
3	"				
4	"				
5	SOURCE NAME NUMERIC QUALIFIER		B+15		
6	OBSERVER AND PROGRAM ID		ASCII		
7	"				
8	"		B+15		
9	OBSERVATION MODE DESCRIPTORS				
10	"				
11	DATA SURPRESSION CONTROL			INIT	
12	RA +		D	SNE	RADIANS
13	" +				
14	" +				
15	DEC + SOURCE POSITION (1950 OR OTHER REFERENCE EQUINOX)				
16	" +				
17	" +				
18	COS DEC +		D	G10	
19	" +				
20	" +				
21	SIN DEC +				
22	" +				
23	" +				
24	COS RA +				
25	" + TRIG FUNCTIONS OF SOURCE COORDINATES,				
26	" + LAST 10 SEC INTERUPT				
27	SIN RA +				
28	" +				
29	" +				
30	COS HA +				
31	" +				
32	" +				
33	SIN HA +				
34	" +				
35	" +				
36	POINTER TO FIRST IF GROUP CONTROL BLOCK			CONNEC	
	CORA RR				
37	POINTER TO SECOND IF GROUP CONTROL BLOCK				
	CORA LL				
38	POINTER TO THIRD IF GROUP CONTROL BLOCK				
	CORB RR				
39	POINTER TO FOURTH IF GROUP CONTROL BLOCK				
	CORB LL				
40	POINTER TO NEXT SUBARRAY CONTROL BLOCK				
41	LO FREQ #1 CORA RR		D	SNE OR G10	GIGAHERTZ
42	"				
43	"				
44	LO FREQ #2 CORA LL				
45	"				
46	"				
47	LO FREQ #3 CORB RR				

LOC	CONTENTS			
48	"			
49	"			
50	LO FREQ #4 CORB LL			
51	"			
52	"			
53	SIN H +	E	G10	
54	" +			
55	COS H +			
56	" +			
57	SIN H +	B+0		
58	COS H +			
59	COS A +			ALTAZ COORDINATES LAST 10 SECOND INTERRUPT
60	SIN A +			
61	COS ETA +			
62	SIN ETA +			
63	UNUSED +			
64	" +			
65	H +	S+1		TURNS
66	" +			
67	A +			
68	" +			
69	CHANGE IN AZIMUTH SINCE LAST 10 SEC INTERUPT	B-6	GEOMA	TURNS
70	CHANGE IN ZENITH ANGLE SINCE LAST 10 SEC INTERUPT			
71	COS DEC +	D	EPH	
72	" +			
73	" +			
74	SIN DEC +			
75	" +			
76	" +			TRIG FUNCTIONS OF SOURCE COORDINATES
77	COS RA +			REFERRED TO MIDNIGHT TODAY
78	" +			
79	" +			
80	SIN RA +			
81	" +			
82	" +			
83	D RA/DT +	E	EPH	TURNS/DAY
84	" +			
85	D DEC/DT +			DERIVITIVES OF SOURCE POSITION
86	" +			
87	D V/DT +	E		LIGHTS/DAY
88	" +			
89	COS DEC +	S+0		TURNS
90	" +			
91	GAIN CODE			
92	COS DEC +	D		
93	" +			
94	" +			
95	SIN DEC +			
96	" +			
97	" +			
98	COS RA +			
99	" +			TRIG FUNCTIONS OF SOURCE COORDINATES,
100	" +			NEXT 10 SEC INTERRUPT

LOC	CONTENTS			
101	SIN RA	+		
102	"	+		
103	"	+		
104	COS HA	+		
105	"	+		
106	"	+		
107	SIN HA	+		
108	"	+		
109	"	+		
110	SIN H	+	E	
111	"	+		
112	COS H	+		
113	"	+		
114	SIN H	+	B+0	
115	COS H	+		
116	COS A	+		
117	SIN A	+		ALTAZ COORDINATES NEXT 10 SEC INTERRUPT
118	COS ETA	+		
119	SIN ETA	+		
120	UNUSED	+		
121	"	+		
122	H	+	S+1	URNS
123	"	+		
124	A	+		
125	"	+		
126	POINTER TO THE FIRST IF CONNECTED TO THIS SUBARRAY		B+1	CONNEC
127	+			EPH
128	+			
129	+			
130	+			
131	PRECESSION MATRIX			
132	+			
133	+			
134	+			
135	+			
136	STOP TIME		E	SNE RADIANS
137	"			
138	POINTER TO NEXT SOURCE CARD ON DISK			
139	START TIME			
140	"			
141	TIME UNTIL STOP		B+15	G10 TENS OF SECOND
142	BANDS		ASCII	SNE HUNDREDS OF MH
143	FIRST LO FREQUENCY			
144	+			
145	+		B+15	SNE TENS OF MHZ
146	+			
147	+			
148	TUNING DIGITS			



LOC	CONTENTS				
0	IF GROUP ID				CDA
1	IF GROUP STATUS FLAGS				CHECK
2	POINTER TO SUBARRAY CONTROL BLOCK				CONNEC
3	POINTER TO NEXT IF GROUP CONTROL BLOCK				CDA
4	SYNTHESIZER SETTING NJW	+	DOPPLER DATA FOR LINE OBSERVATIONS	S+31	G10 HZ
5	"	+			
6	LINE REST FREQUENCY	+		0	INIT GHZ
7	"	+			
8	"	+			
9	SYNTHESIZER SETTING FOR 0 H TODAY	+		S+31	HZ
10	"	+			

NOTE---LINE PROGRAMS ARE NOT IMPLEMENTED IN 1975

LOC	CONTENTS			
0	ANTENNA ADDRESS ON COMMUNICATION SYSTEM		BLD	
1	ANTENNA ID		COA	
2	STATION ID			
3	ANTENNA CONTROL STATUS, INCLUDING RECEIVER SELECT		SNE	
4	ANTENNA STATUS WORD		CHECK	
5	POINTER TO SUBARRAY CONTROL BLOCK		CONNEC	
6	POINTER TO ARM CONTROL BLOCK			
7	POINTER TO NEXT ANTENNA CONTROL BLOCK		COA	
8	A + CURRENT ANTENNA COORDINATES	S+1	GEOMA	URNS
9	" +			
10	Z +			
11	" +			
12	FOCUS		SNE	
13	A +	S+1	G10	URNS
14	" + ANTENNA COORDINATES LAST 10 SEC INTERRUPT			
15	Z +			
16	" +			
17	WAVE DELAY, LAST 10 SEC INTERRUPT	0	G10	NANOSECS
18	"			
19	"			
20	WAVE DELAY, LAST 10 SEC INTERRUPT	S+16		10'S OF NANOSECS
21	"			
22	BX +	0	BLD (E&EPH)	NANOSECONDS
23	" +			
24	" +			
25	BY +			
26	" +			
27	" + ANTENNA LOCATION, NANOSECONDS,			
28	BZ +			
29	" +			
30	" +			
31	BA +	E		NANOSECONDS
32	" (K TERM) +			
33	DELAY +			
34	" +			
35	" +			
36	ANTENNA HEIGHT (RELATIVE TO ARRAY CENTER)	E	BLD	NANOSECONDS
37	"			
38	DIFFERENTIAL PHASE PATH DUE TO REFRACTION	E	G10	NANOSEC
39	"			
40	A +	S+1		URNS
41	" + ANTENNA COORDINATES, NEXT 10 SEC INTERRUPT			
42	Z +			
43	" +			
44	U +	B+19	G10	NS
45	V + ANTENNA MOTION DERIVATIVES, LAST 10 SEC INTERRUPT			
46	W +			
47	U +	B+19	G10	NS
48	V + ANTENNA MOTION DERIVATIVES, NEXT 10 SEC INTERRUPT			
49	W +			
50	U +	0		NANOSECS
51	" +			

LOC	CONTENTS			
52	"	+		
53	U°	+	E	
54	"	+		
55	WAVE DELAY, NEXT 10 SEC INTERUPT		D	G10 NANOSECS
56	"			
57	"			
58	WAVE DELAY, NEXT 10 SEC INTERUPT		S+16	
59	"			
60	CHANGE OF DELAY SINCE LAST 10 SEC INTERUPT		8+9	GEOMDL 10'S OF NANOSECOND
61	+	*COS(A)*TAN(H)	8-8	INIT TURNS
62	+	*SIN(A)*TAN(H)		
63	+	*COS(A)		
64	+	*SIN(A)		
65	+	*TAN(H)		
66	+	*SEC(H)		
67	+	ANTENNA POINTING CONSTANTS *1	S+1	TURNS
68	+			
69	+	*SIN(A)	8-8	TURNS
70	+	*COS(A)		
71	+	*COS(H)		
72	+	*SIN(H)		
73	+	*1.	S+1	TURNS
74	+			

LOC CONTENTS

0 FRONT END ID  
1 POINTER TO ANTENNA CONTROL BLOCK  
2 FRONT END STATUS FLAGS  
3 FIRST LO FREQUENCY  
4 POINTER TO NEXT FRONT END CONTROL BLOCK

COA  
CONNEC  
CHECK  
SNE  
COA

100'S OF MHZ

PREAMP CONTROL BLOCK

LOC CONTENTS

0	PREAMP ID
1	POINTER TO FRONTEND CONTROL BLOCK
2	PREAMP STATUS FLAGS
3	POINTER TO NEXT PREAMP CONTROL BLOCK
4	POINTER TO ANTENNA CONTROL BLOCK

CDA  
SNE  
CHECK  
CDA

LOC	CONTENTS			
0	IF ID		COA	
1	IF PECULIAR PHASE	B+0	INIT	TURNS
2	IF PECULIAR DELAY	B+11		10'S OF NANQSECS
3	PHASE + CURRENT OUTPUT	BCD	GEOMLR	TURNS
4	RATE +	S+0		KHZ
5	" +			
6	DELAY +	S+24	GEOMDL	
7	" +			
8	PHASE +	B+0	G10	TURNS
9	RATE + LAST 10 SEC INTERRUPT	S+0		KHZ
10	" +			
11	QUAD TERM +	B-12		KHZ/SEC
12	IF STATUS WORD		CHECK	
13	POINTER TO FRONT END CONTROL BLOCK		SNE	
14	POINTER TO ANTENNA CONTROL BLOCK		COA	
15	POINTER TO IF GROUP CONTROL BLOCK			
16	POINTER TO THE NEXT IF CONNECTED TO THIS SUBARRAY			
17	POINTER TO NEXT IF CONTROL BLOCK			
18	PHASE +		G10	
19	RATE + NEXT 10 SEC INTERRUPT			
20	" +			
21	QUAD TERM +	B-12		KHZ/SEC
22	IF NOMINAL SENSITIVITY	?	?	?
23	NOISE TUBE SYNCHRONOUS DETECTOR NOTE--GAIN = SQRT(NOM.SENS.*SYNC.DET) FLUX (IN JY) = GAIN(1)*GAIN(2)*CORR.COEFF (IN THEORY, ANYWAY)			
24	IF PECULIAR DELAY	E		
25	(SAME AS 2)			
26	POINTER TO PREAMP CONTROL BLOCK			
27	IF ADDRESS IN DELAY CONTROLLER			

LOC	CONTENTS	CHECK
0	CORRELATOR ID	
1	BASELINE ID	
2	CORRELATOR STATUS WORD	
3	POINTER TO NEXT FAULTY CORRELATOR CONTROL BLOCK	

LGC CONTENTS

LOCATIONS 0-31  
COMMAND GENERATOR CONTROL WORDS  
LOCATIONS 32-63  
LEFT HALF WORD--DATASET RESPONDING TO Q0  
RIGHT HALFWORD--MONITOR WORD 2 IN SELECT MODE  
LOCATIONS 64-71  
POINTERS TO ANTENNA DEMULTIPLEX TABLES--DIGITAL WORDS  
LOCATIONS 72-79  
POINTERS TO ANTENNA DEMULTIPLEX TABLES--ANALOG WORDS



## Supplement to VLA Computer Memo 124

CHANGES TO GLOBAL COMMON

B. G. Clark

1. Word 17 of ARACB is a pointer to the end of the monitor data demultiplex area.

Word 18 of ARACB is a pointer to the address/ID conversion table. This table is 32 words, in which the  $n^{\text{th}}$  word is the pointer to the antenna control block of the antenna with address  $n$ . (0 for non-existent antennas, -1 for non-antenna devices.)

2. Word 7 of ARACB is control bits

bit	on significance
0	de-icers on
1	weather station off

3. Word 26 of ARACB is the number of antennas. Word 27 is the length of the antenna control block. Word 35 of ARACB = Length of IFCB.

4. Word 11 of SCB is status bits

bit	
15	subarray not in use
14	new source initialization requested
13	new source initialization in progress
11	test programs in progress
7	all antennas in motion
6	some antenna not on source

5. Additional words in SCB

Word 149 is a pointer to source list - beginning of list relative to beginning of partition.

Words 150-152 LO composition =  $m$  = Multiplication factor of 600 MHz.

Words 154-157 =  $n$  = multiplication factor of 5 MHz, except that bit 0 indicates high/low lock on synthesizer. If the 600 MHz is in error at the antenna by  $\theta$  radians and the 5 MHz is conceptually in error by  $\theta$  ( $=\theta/120$  radians) the LO phase will be adjusted by  $-(m\theta+n\theta)$ .

Words 158, 159 Bandwidth selection. One byte per correlator quadrant.

Code:

0 = 50 MHz	}	existing filters
1 = 25 MHz		
2 = 12 MHz		
3 = 6 MHz	}	new filters
4 = 3 MHz		
5 = 1.5 MHz		
6 = 0.8 MHz		
7 = 0.4 MHz		
8 = 0.2 MHz	}	existing filters
9 = 0.1 MHz		
#83 = 4 MHz	}	existing filters
#84 = 1.5 MHz		
#85 = 0.5 MHz		

6. Word 3 of ACB

bit	on meaning
0	reference antenna
1	transfer switch
2	Noise tube modulation on
3,4	Paramp attenuators in
5,6	Paramps off
7	Observing over the zenith
10	Subreflector information uninitialized
11	Antenna information uninitialized
12-15	Front end auxiliary switches

7. Added words in ACB

75	Subreflector rotation
76	Pointer to first IFCB
77	600 MHz round trip $\theta$
78	5 MHz round trip $\theta$

8. Added requirement:

IFCB's for a given antenna are contiguous, and immediately follow the ACB.

9. Added word in IFCB - word 28-controls.

bit	on meaning
0	Synchronous detector low gain
1	Alternate Input
2	IF information uninitialized