PROPOSALS FOR A PRELIMINARY VLA SPECTRAL LINE SYSTEM Arthur M. Shalloway

Specification goals for a preliminary spectral line system are as follows: 10 Antennas: Polarizations per antenna: 1 Maximum Bandwidth: 5 MHz (could be higher with less channels, to a maximum of 40 MHz, however, this increases the cost of the delay portion of the system). Sampling level: 3 levels by 3 levels Number of channels at 5 MHz BW: 128 delay channels 64 frequency channels Integration period between dumps to computer: <10 sec Efficiency (observation time - non-integration time): >95% observation time

With the experience gained, on the VLA delay-multiplier prototype system, the above line system could be built in a straightforward manner using similar circuits at an 80 MHz clock rate. It would occupy two racks and would exactly meet the above specifications. Because of the shortage of engineering time to do investigations for this report, and because the above system is not expected to present any problems, an investigation of an alternative 300 MHz method has been made. The cost of the standard 80 MHz system and the alternative 300 MHz system are in the same "ballpark" for the preliminary system; however, the alternative 300 MHz system presents some important advantages, some slight disadvantage and could possibly be cheaper in the final system. The final system price could only be determined after experience has been gained with such high frequency circuits.

The 300 MHz system is at the state of the art. In order to provide a higher possibility of success, certain conservative measures have been taken which result in a new set of specifications:

2

Antennas: 10 Polarizations per antenna: Maximum Bandwidth: 4 to 5

4 to 5 MHz (same note applies as in 80 MHz system above). NOTE: Maximum clock rate determines BW and this is to be determined by experience with the circuits. A reasonable value at present seems to be between 256 MHz (4 MHz BW) and 320 MHz (5 MHz BW). Sampling level resolution: See number of channels specification Number of Channels at 4 to 5 MHz BW: 2 level by 3 level - 256 delay channels 128 frequency channels Channels can be split 50-50% between polarizations 3 level by 3 level - 128 delay channels 64 frequency channels Integration period between dump to computer: <10 sec Efficiency (observation time - non-integration time): >95% observation time

As can be seen above, the advantages of the 300 MHz system are the greater flexibility in number of channels and their use. For example, if polarization is not important, observation can be made with two two-level by three-level correlators - one on left and one on right polarization - and add them together to obtain a higher sensitivity than is possible with a 3 level by 3 level correlator. Or if the receivers are available, two different one-bit observations could be made simultaneously. It should be made clear that either the 80 MHz or 300 MHz system can be made to provide any number of channels in any type of flexible system within reason. The comparison here is between systems of approximately the same cost. Experience is required on the 300 MHz system before absolute comparison can be made, but one important feature that appears probable with the 300 MHz system is a reduction in the number of components and a corresponding improvement in reliability.

In both systems, oversampling can be provided with the proper choice of bandwidth and number of channels - particularly at the low bandwidths - to provide greater sensitivity. Also, in both systems, the number of channels can be doubled each time the bandwidth is halved to the point where the computer can no longer handle the data.

Table 1 lists some of the bandwidths, number of channels, sensitivities and etc. for the systems. Table 2 is a cost breakdown of the 300 MHz system. This is a very rough conservative figure based on the following:

Prices are as listed in catalogs - not bargains obtained for the 6 antenna delay-multiplier system.

-2-

Prices include all components, labor, testing, non-recurring charges, etc. Prices include the complete system: delay line, correlator, system controller computer, CRT terminal, power supplies and hardware.

Figure 1 is a logic diagram of one cross correlator - 4 channels at 300 Hz - and the necessary drive circuits. Figure 2 is a possible rack layout. Table 3 is a listing of the layout - i.e., grouping of antenna correlators on cards. COST ESTIMATE TABLE 2 6-30-75 A.M. SHALLOWAY VLA SPECTRAL LINE SYSTEM-300 MHZ, - 128 DELAY CHANNELS

@ 2 BITS, 3 LEVELS - 256 CH. @ | BIT, 2 LEVELS. - 10 ANTENNA INTERIM SYSTEM

	-							
(.			DUDNITTI	COST DED	TC COST	Radiana	care tr	COST DED
<u> </u>		TC TYPE	EUNC TO	TC TC	DED RAAAD	ETC COST	COS/-IC RANAN ETC	LOST PER
uni, en des	1	E-llooldi	110NS 1 2 0 3	- 1500	FLA DOTAD	H\$ 00	15000	150092
	2	5 100107	36 5	750	6000	0,00	12/00	12000
	3	SE- 100102	72 1	7 500	8500	8500	17000	177000
	4	t- 100112	20	450	3750	3250	6500	65000
in na nainafa	5	3- FE 100131	36 1	2 1500	18000	18022	36000	360000
	6	FOIT 10178	36 3	6 100	14400	144.00	288 22	288000
	7	IQ FACH MUL	TI PLIER CHA	15-9 CORAEL	ATORS DEA CAL	0-4 CHAMME	S EACH-TOTA	1-115300
	8							
	9							10 BASEDS
207	10	256 2606-1B	64 6	4 400	258.00	128 -	38400	1536000
HF 45.	11	SUPPORT	32 3	2 4.22	128.00	64.00	19200	768000
.EASE 20.8U	12	40 EACH BUFF	ED CARDS-12	OF ONE ANT, OU	TPUT STORAGE	DER CARD -	TOTAL	- 23040.00
28 111, 1	13	DELAY STORAG THROW AWAY 4	E= 2 Bits, 2 S BITS, INTEGR	ECTIONS OF 32,00 TE FOR 2 MS. A.B.A.	0 BITS EACH, He.			
	14							5 BOARDS
1	15	255× 2606-18	64 6	4 4.∞	256,00	128.00	38400	1920,00
	15	ELECTRONICS	36 3	6 500	180.00	90 -00	27000	1350,00
(17	3 EACH DELA	TY CARDS-	2 ANT, +2 POL. +	2 BIT PER CI	ARD. INCLUDES	CONTROL TOTH	1- 3270,00
	18							
	19							10 BOARDS
	29	# 8259/	54 5	4 2.85	153,90	153,20	307.80	3078 00
	21	ELECTRONICS.	16 14	5 285	45,69	4569	9120	9/200
	22	10 EACH INTER	RATOR BOARD	5-18 INTERNA	TOKS (12 BITS	EACH) PER BOAR	D- TOTAL	- 3990.00
	23							
م نوب مرد می د	24							
	25	SYSTEM Q	DNTROLLEN	-Mini-or-M	TICRO COMPUT	ER-		1000000
	26							
	27							
	28	TERMINAL	- QRT-					3000-00
	29							
	30							
	31	HARDWARE	-POWER SUP	PLIES-ETC,-				3000==
	32							
	33	Alphi Art						120000
n y nguye da	34	MON-RECOR	RING CHA	RGES -				100-
مىلىدىنىدە 1	35							
1	 							181000
Ŋ.		UEVELOPM	FMT-DAP	EIY-SPARE	x			10/14-
	38							010000
	39						IOTAL	
ي. 1996 مېږې مورم م	્ર-૧) 							
	1.000			(1) (1) (1) (1) (1) (1) (1) (1) (1) (1)	THE REPORT OF THE PARTY OF THE	白白 法国际工作的 医上颌下的	ほんし しんほうおうれつむ 手上したい	

			TABLE	1	na ter angli a si sakan kanan kan	rento no su con a porte o terror e controla en una porte de la controla de	۵۰۰ ۵۵۰٬۰۰۵ ۵۰۰ ۵۰۰ ۵۰۰ ۵۰۰ ۵۰۰ ۵۰۰ ۵۰۰
SENSITIVITY & OBSERVATION TIME							
	ALL FIGURE	ES ARE RE	LATIVE TO	INFINITE LE	VEL CORRELA	TOR	
							<u> </u>
C -	CORRELATOR R	RELATIVE	RELATIVE	MULTIPLICATIO	N FACTOR FOR		
	TYPES	ENSITIVITY	SENSITIVITY	INCREASED OBSL	RVATION TIME		·····
	TONE	VY DUASTI	2 X NYauit	NYAWIST	2X NY BUILT	<u> </u>	
1	POLARIZATIONS	AMPLE RATE	SAMPLE RATE	SAMPLE RATE	SAMPLE RATE		1
2	2 X Z	.636	• [4]	2.412	1.821		2
3		• 118	8/3	1.740	1.0/3		3
	e Tuo	.010	.00/	1.044	1.41		4
6	2 X 2	899	1018	1.237	910		
1	$\frac{2}{2} \times 3$	1015	1150	971	756		7
8	3 * 3	1.146	1.252	741	638		8
9							9
200 10							10
11 F 45							11
12 120 PL		CORRELA	TOR STRU	CTURE			12
- R. 13	THE FOLLOS	WING ARE	EXAMPLES	OF BW, CHA	NNEL & OVER	SAMPLING AVAI	LARE. 13
14	MANY VARIA	ATIONS ARE	= passible: d	SQ. INCREASE	OVERSAMA	LING AT ANY C	3W AT 14
IF 15	THE SACRA	FICE OF C	tannels.				15
15				NUMBER OF	OVERSAMPLE		15
1 1	ORGANIZA	TION	BW IN MHZ.	CHANNELS	FACTOR		17
18	2-LEVEL BY 3	3+45154	10	64			18
19	ONE POLARIZ	ATION		148			19
20			6.3	256			20
			625	256	2		21
			2125	200	6		77
					- F		23
	2-1 FILE RY	3-1 EKEL	10	32			25
25	TINO DOLAD	izations	5	64			25
27	OR		2.5	128			27
28	3-LEVEL BY.	3-LEVEL	1.25	256			28
29	ONE POLARI	IZATION	625	256	1		29
30			.3125	256	2		30
31					-		31
32							32.
33							33
34						A.M. SHALLOWAY	34
35						6-8-73	35
36							36
37							37
38							38
39							39
40							40
							1 1 1 1 1 1

300 MHZ CROSS CORRELATOR



		[]
		CONTROL COMPUTER
INTEGRATORS		
12	←ANTENNA NUMBERS	CRT & KEYBOARD
LEFT DELAY ARRAY ARRAY RIGHT DELAY & BUFFER #1 #2 & BUFFER		
POWER SUPPLY	RACK LAYOUT 10 ANTENNA SPECTRAL LINE	
POWER SUPPLY	SYSTEM FIGURE 2	

A.M.S. 6-24-75

TABLE 3

	A	ELATED AN	TENNAS B
ARRAY # 1	RS	X OR	RS
	LS	X	LS
ARRAY #2	RS	X	RS
	LS	UK	LS
PC CARD NUMBER			
1	1 2	X X	2-6 3-6
2	3 4	X X	4-8 5-8
3	5 6	X X	6-10 7-10
4	7 8	X X	8-10, 1-2 9-10, 1-2
5	9 10	X X	10, 1-4 1-4