VLB ARRAY MEMO No. 442

VLBA Electronics Memo No. 41

NATIONAL RADIO ASTRONOMY OBSERVATORY
Charlottesville, Virginia

April 10, 1985

TO: VLBA Electronics Group

FROM: Dick Thompson

SUBJECT: VLBA Electronics Meeting, April 4, 1985 - Discussion of the Front-End Monitor and Control System

Attendees: Balister, Bradley, Brundage, Campbell, D'Addario, Dill, Koski, Lillie, Mauzy, Moffet, Napier, Norrod, Rogers, Schlecht, Simon, Thompson, Weber, Weinreb.

The entire meeting was devoted to a discussion of the monitor and control interface for the front ends. There is a rather wide divergence of opinion upon the approach that should be taken. A monitor and control unit for the prototype 8.4 GHz front ends has been developed by Sandy Weinreb, but since this was required at a time when the monitor and control philosophy for the VLBA was largely undeveloped, it is appropriate to review its function at this time. This memorandum will not be confined to the meeting on April 4 but will include results of some subsequent discussions.

The Rack-Mounted Interface

The existing system developed for the 8.4 GHz front ends is described in VLBA Technical Report No. 1 by S. Weinreb. All of the monitor and control voltages are brought out from the front end to a separate module using a 25 conductor cable. This system could be adapted for the VLBA by including a monitor and control interface card within a module of this general type. One module would be required for each front end. If double-width modules are used, a DVM readout could be included in the front of each one, and two bins would be required to accommodate up to 12 front ends. With single-width modules one bin would suffice. A single-width front panel layout proposed by Sandy is attached. A principal feature of this system is that it provides an independent analog monitor system in parallel with the computer-based system. This would be available at a rack in the antenna vertex room. Some expense in time and effort would be required to provide all of the switches and readouts required for this parallel capability.

There is general agreement that the 25 conductor cable used to connect the prototype 8.4 GHz front ends to their modules is too restrictive. Sandy proposed summing the bias voltages of the second and later stages of the FET amplifiers, but this would release only four conductors. At this early stage in the VLBA development one would like to have at least, say, ten spare lines so that such things as feed pressure can be included if required. Ways of increasing the number of monitor points are as follows:

(a) Include an analog multiplexer in the front end. There is some concern that if this is mounted in the card cage there could be digital pickup from the address lines.

(b) Use a 37 or 50 conductor cable. The present 25 conductor cable uses the widely-available D-type connectors. Two cables of the present type between each front end and module is another possibility. One male and one female connector would be used at each end. One cable would carry only monitor voltages and could be unplugged from the front end without disturbing its operation to allow a local monitor box to be installed.

The Front-End-Mounted Interface

The alternate approach is based on the proposition that monitor and control through the computer should be preferable for most situations once the appropriate software is developed. For example, many different voltages can be displayed simultaneously, and the computer offers a high degree of sophistication in presentation. In fact, the computer system will have to be developed to a considerable level of adequacy to enable faults at antennas to be diagnosed at the Control Center. Thus the interface components could be mounted directly on the front-end unit, thereby saving the cable and the bin hardware. This arrangement would avoid the limitation imposed by the cable on the number of points that can be monitored. However, it is generally felt that some additional analog facility should be available on the front end to allow continuous display of voltages on an oscilloscope, and to provide a backup capability during the installation period when the computer is being installed. This would take the form of a small box with meters and switches that could be plugged into a front end to provide local manual monitor and control. Larry D'Addario points out that a manual control system available to a person working on a front end could operate in several ways: through direct analog connection, or through the bus using the station computer or a special microprocessor unit. The direct analog system can be used to provide an independent check of the digital system, and should be available during the installation period when the software may not be fully developed.

To avoid digital pickup on (possibly) sensitive points such as the FET bias lines of the front ends, the interface circuitry should be in a shielded box with some filtering on input and output lines. This box should not, however, be mounted permanently to the front end assembly but should be demountable. This would allow maintenance of the interface circuitry without removal of the front end. The interface unit would connect to the front end through a connector carrying analog voltages or single-bit command lines.

Choice Between the Two Schemes

The two schemes outlined above could both be made to work well. They differ mainly in the location of the interface circuitry, which may seem to be a relatively small point, but at the meeting both had staunch advocates of their relative merits. Basically, the rack-mounted module scheme is intended to provide a rather elaborate parallel monitoring arrangement that would be available for all front ends at all times. The front-end-mounted scheme is based on the philosophy that the monitor and control interface should be close to the circuits that is monitors and controls, and long cables should be avoided.

Both schemes satisfy almost equally well three points that were raised at the meeting. First, the same front-end assembly should be usable with the VLA or the VLBA. This requires only that the front-end-mounted interface be demountable so that it can be replaced by an interface designed for the VLA monitor and control system. Second, it is desirable that a front end be tested on the bench with the same monitor and control unit with which it will work on the antenna. Third, it should be possible to operate the front end from a simple, non-digital monitor and control unit when assembling front ends during construction.

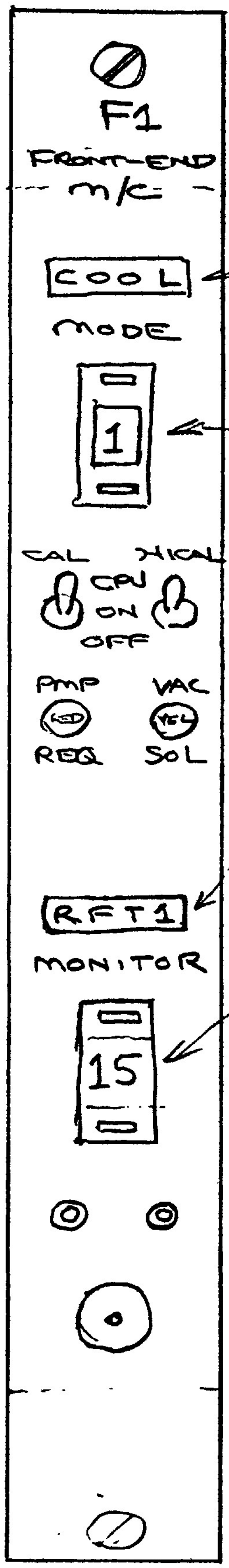
The advantages of the rack-based interface system were carefully described at the electronics meeting, but subsequent conversations indicate that the case did not prove convincing. In making this judgement I give heavy weight to the opinions of those engineers who have spent a lot of time maintaining front ends in the field, particularly at the VLA. Although none of the NRAO facilities closely resemble the VLBA in operating conditions, the VLA comes closest. A number of people in this category felt that the rack-mounted analog system would not be much used in the long term. One important aspect in which it fails is that it cannot be seen by a person working at a front end (in most cases), and a further cable from the rack to the work location would be cumbersome. A small unit that plugs directly into a front end or into a front-end-mounted monitor and control unit would be preferable. Thus the present conclusion is that the second of the two possibilities is the better choice, and a detailed study of the front-end-mounted interface unit will therefore be initiated.

Further Miscellaneous Details

Three further functions should be added to those listed in VLBA Technical Report No. 1 for the 8.4 GHz front end. These are a pump command, an on/off control command for the front end amplifiers, and monitoring of the voltage applied to the LED light sources required in HEMT amplifiers.

Readback of the frequency band, serial number, and modification status of any front end is required. This can be coded as three analog voltages, or about 12 digital bits. We should allow for at least 12 frequency bands, 12 serial numbered units for each band and, say, eight levels of modification.

A method of distinguishing between a failure in the cooled stages of a front end and a failure in the ambient-temperature, post-amplifier stages, through remote monitoring, would be very useful. The ambient temperature stages are field-replacable but the cooled stages are not.



RED ALPHA-NUMERIC DISPLAY
HP HDSP-2300, SHOWS MODE
BLINKING OF MANUALLY SELECTED,
STEADY IF CPU CONTROLLED

DIGIT-SWITCH MODE SELECT

0 - CPU	4 - PUMP
1 - COOL	5 - HEAT
2 - STRS	
3 - OFF	

← TOGGLE-SWITCH CAL CONTROL

← LED INDICATORS

GREEN ALPHA-NUMERIC DISPLAY
HP HDSP-2303, SHOW MONITOR
POINT. BLINKS IF CALS NOT
UNDER CPU CONTROL

SELECTS MONITOR POINT

0 - 15K	6 - LFT1
1 - 45K	7 - LFT2
2 - 300K	8 - RFT1
3 - DWRV	9 - RFT2
4 - PMPV	10 - LED
5 - ID	

TIP JACKS
BNC

} FOR SELECTED MONITOR POINT WHICH IS ALSO WIRED TO ONE DVM MODULE

VLBA
FRONT-END CONTROL MODULE

S. WEINREB
4/2/86