NATIONAL RADIO ASTRONOMY OBSERVATORY

ELECTRONICS DIVISION TECHNICAL NOTE NO. 98

TITLE: NOISE MEASUREMENTS ON REFURBISHED 18 cm RECEIVER

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NATIONAL RADIO ASTRONOMY OBSERVATORY

MEMORANDUM September 10, 1981

To: M. Balister
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From: R. Norrod *RDN*

Subj: Noise Measurements on Refurbished 18 cm Receiver

Attached are results from recent measurements made on the cooled FET 18 cm receiver. The noise temperature was measured using Sandy's liquid nitorgen load and the 9825 calculator program written by J. Coe. IF bandwidth was 40 MHz for all measurements. System temperature measurements made on the 140-ft are also attached.

I cannot explain the variation in noise temperature measured at the dewar input flange. Water does condense about the connector center conductor when it is not connected to an external line as a heatsink, but the noise measurements were repeatable and the input return loss was reasonable (12-16 dB across 1560-1760 MHz; this is about 5 dB worse than measured at CV but identical with earlier measurements by A. Wu). Return loss of the coaxial line connecting the feed to the dewar is greater than 25 dB (with a termination in place of the feed), but I did notice a change in measured gain at the two points. This change in gain was about 0.3 dB in the center of the band but almost zero at the band edges. Measured insertion loss in the Channel A coaxial line was 0.14 dB. The line consists of:

Component	Mechanical Length
7/8" Elbow	6"
7/8" Rigid Airline	8.75"
7/8" - 30 dB Coupler	6.5"
7/8" - 7 mm Adapter	3"
3/8" Aluminum Jacket Foam Coax	12.25"

Theoretical loss of these lines is 0.015 dB/ft for the 7/8 airline and 0.055 dB/ft for the 3/8 coax. Channel B is similar except slightly longer lengths.

From the data measured on the telescope, it appears that the contribution of the antenna is about 6°K higher on Channel A. The antenna contribution plus ohmic feed losses, T_{AF}, can be estimated:

$$\left.\begin{aligned} T_{AF} &= T_{sys} - T_{background} - T_{atmosphere} - \frac{T_{NT}}{2} - T_{rx} \\ &= 57 - 4 - 2 - 1.7 - 34 \\ &= 15.3°K \end{aligned}\right\} \text{CH A at 1666 MHz}$$

$$T_{AF} = 52 - 4 - 2 - 1.4 - 35.5 = 9.1°K$$ CH B at 1666 MHz

Recommendations

It seems that the 18 cm box could become the basis for the new 1-2 GHz receiver since the control circuitry and IF system are basically identical with that needed on the new receiver.

To significantly improve the existing receiver temperature, it will be necessary to radically rearrange the feed/FET amp connection system, both inside and outside the dewar. Two possible approaches are:

(1) Redesign the dewar using short coaxial input lines, and design it mechanically for interface with the existing feed and OMJ. The dewar should be moved forward in the box and the cal couplers moved to the 15° station. Remaining circuitry modules in the box would have to be rearranged, requiring a great deal of rewiring and recabling. It should be possible to eliminate half to two-thirds of the contribution due to the input lines or 8-12°K. It also should improve reliability since the old input lines have had a problem with vacuum leaks. At a later time the cooled orthomode and new feed could be incorporated, but this would probably require a second rearrangement of the dewar.

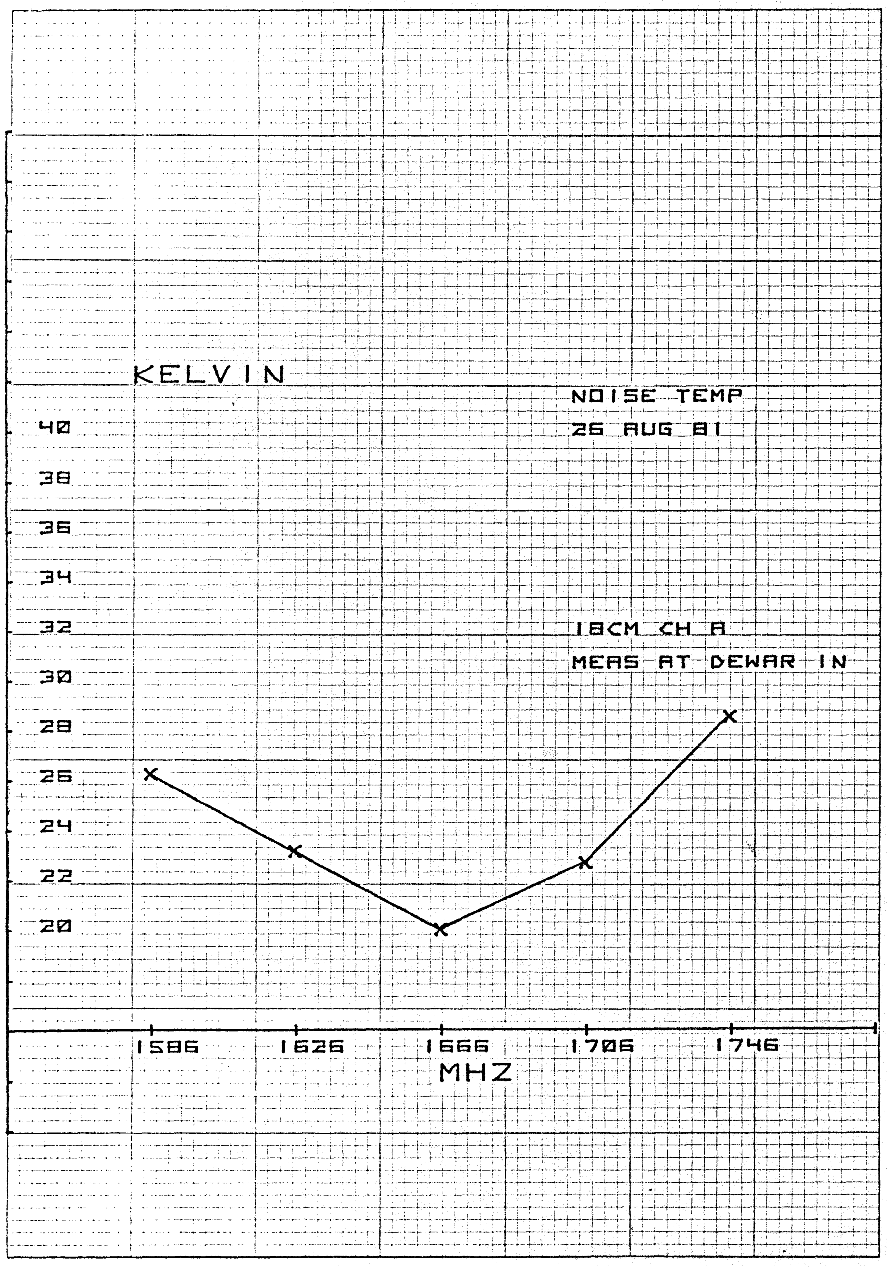
(2) Skip most of (1) and go directly to the cooled OMJ configuration.

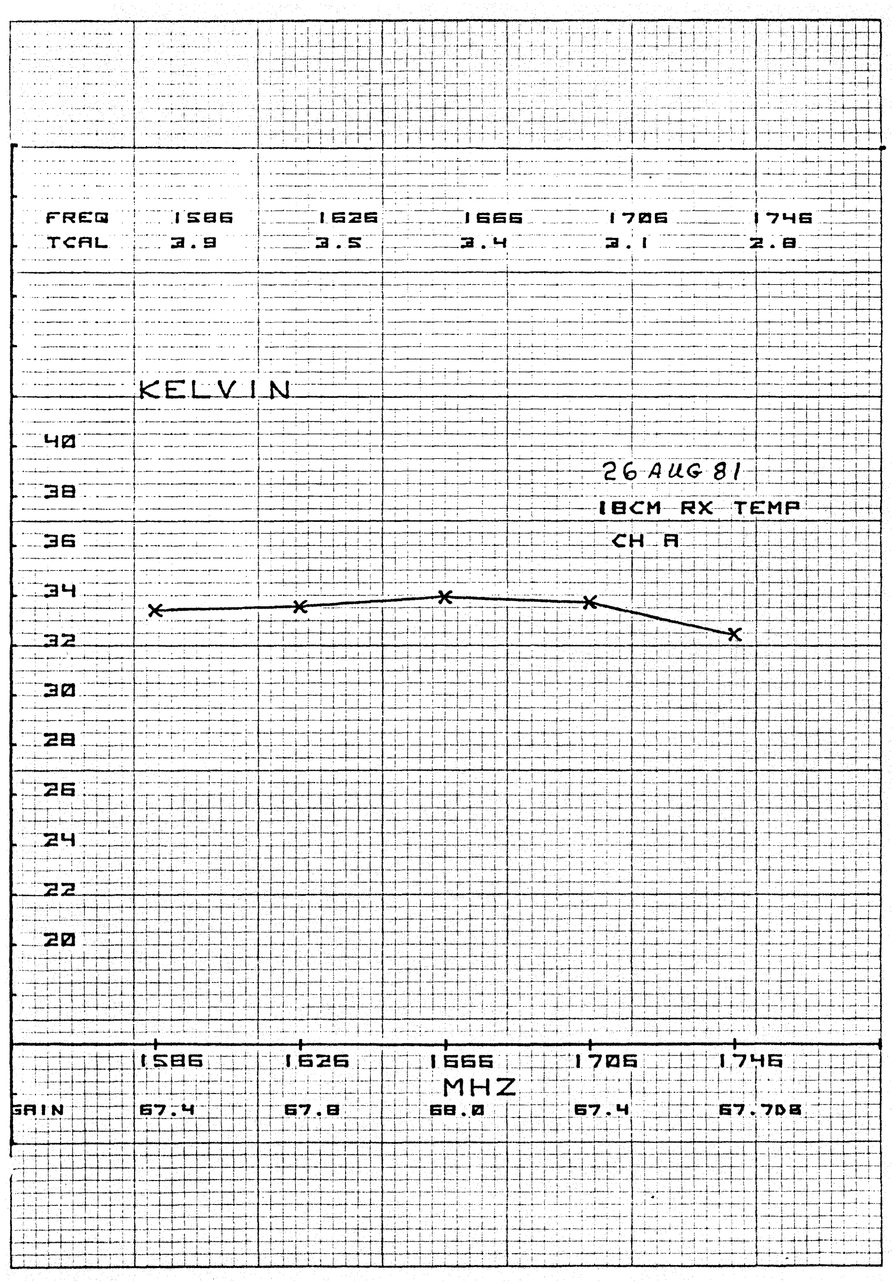
Doing (1) would probably result in an improved receiver sooner but would require some duplication of effort.

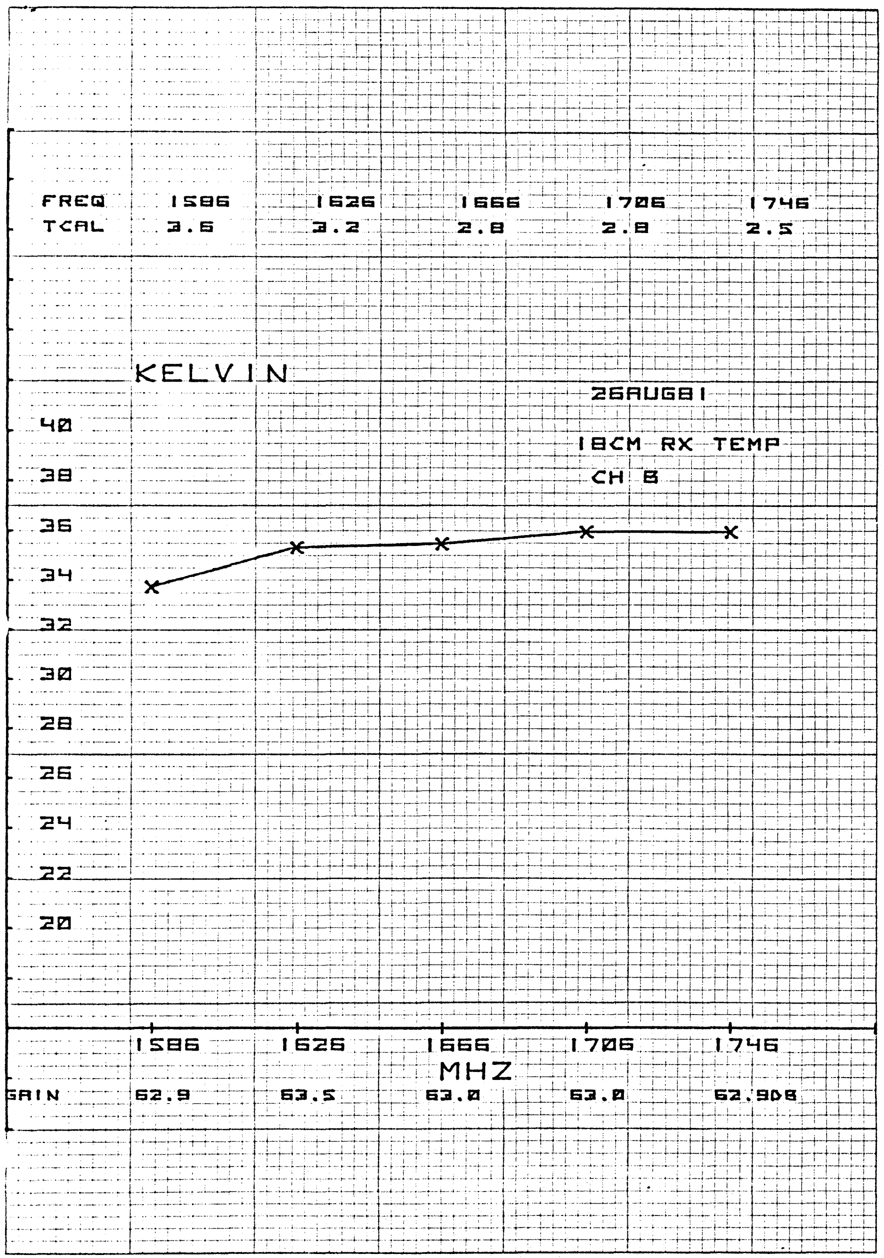
Also, I would like to request that the CV group either build or provide GB with the information needed to build and calibrate a hot/cold load similar to that recently loaned to us. Capability to electronically switch from hot to cold temperatures would be extremely helpful since we could then include that feature in the 9825 system. Such a load would find a great deal of use for receiver systems under 5 GHz.

RDN/cjd

Enclosures


KELVIN
NOISE TEMP
26 AUG 81
18CM CH A
MEAS AT DEWAR IN
40
38
36
34
32
30
28
26
24
22
20
1586
1626
1666
1706
1746
MHZ


FREQ 1586 1626 1666 1706 1746
TCAL 3.9 3.5 3.4 3.1 2.8
KELVIN
26 AUG 81
18CM RX TEMP
CH A
40
38
36
34
32
30
28
26
24
22
20
1586
1626
1666
1706
1746
MHZ
GAIN 67.4 67.8 68.0 67.4 67.708



1Sept81
RON

18cm Rx System Temp
Measured on 140' Aug 3-5, 1981
per Phil Bowers

	CHA	CHB
1612 MHz		
BW = 0.625 MHz	56°	52°
BW = 1.25 MHz	60°	55°
1666 MHz		
BW = 0.625 MHz	56°	50°
BW = 1.25 MHz	58°	54°