NEW 3 MM-λ RECEIVERS

Two new receivers are to be constructed for line and continuum work in the 80-120 GHz range. Brief descriptions of these receivers are attached, and suggestions, comments, etc. would be appreciated.

A. R. Kerr
June 13, 1972

Distribution:

Scientific Staff
Engineers
Technicians

PROPOSED 85 GHZ DUAL-CHANNEL UNCOOLED CONTINUUM RECEIVER

A dual-channel room-temperature continuum receiver is proposed for Cassegrain operation at 85 GHz on the 36 foot telescope. The two channels are intended to improve the sensitivity of the receiver by receiving both polarizations (either linear or circular), and not for use as a polarimeter.

A lens corrected feed horn is being supplied by TRG. This is considerably shorter than the conventional long horn required to illuminate the subreflector and is being explored in the hope that it can be used in the future cryogenic multi-frequency receiver. A conventional feed horn is also being made by George Behrens at Green Bank.

A novel calibration system will be used: a small plane mirror at the vertex of the subreflector will reflect a noise signal from a horn beside the subreflector into the feed horn. This calibration signal will have a 45° polarization angle to deliver equal powers to both receiver channels. The obscuration of the subreflector by the plane mirror will be ∿1%. To calibrate the calibration signal the outputs of the total power channel will be compared with the feed looking at a room-temperature absorber, a 77° absorber, and the subreflector with the noise source on and off (about 50°K difference). An accurately known attenuator will then be inserted at the noise source to give a suitably small calibration signal. The advantages of such a noise calibration system are: (i) a directional coupler with its associated loss is not required between the feed and mixers; (ii) the system is potentially broadband and may be useable over more than an octave without encountering any strong frequency

dependence of the calibration signal; and (iii) having the calibration source remote from the front-end will simplify the construction of future cryogenic front-ends with cold feeds.

It is hoped to have this receiver completed by the end of October.

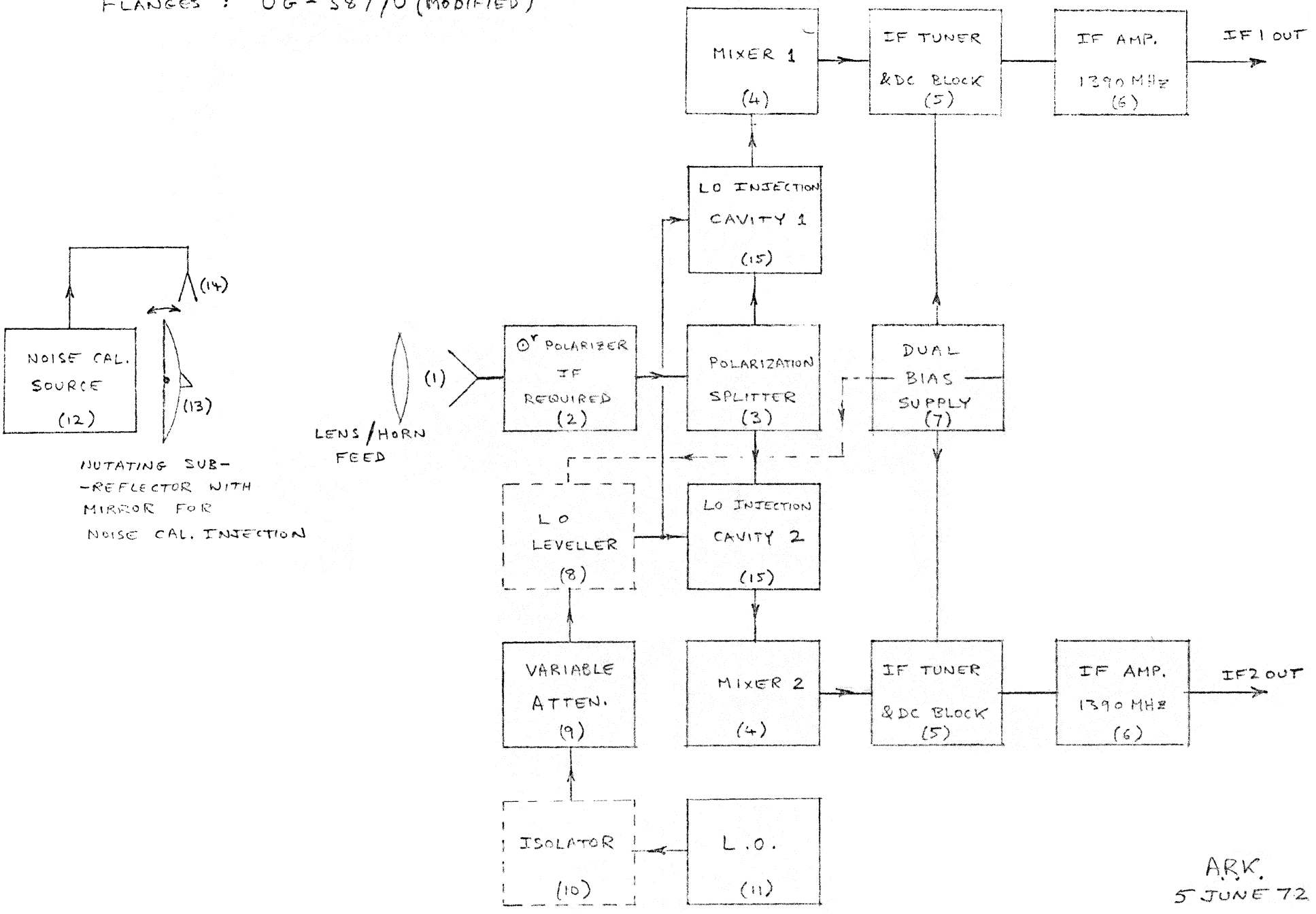
DESCRIPTION OF COMPONENTS - See Block Diagram

Block

1. Lens Corrected Horn Feed. Being made by TRG.
2. Circular Polarizer. May be replaced by circular waveguide for dual linear polarization.
3. Polarization Splitter. Rectangular waveguide outputs.
4. Mixer. Presently being developed at NRAO.
5. IF Tuner & DC Block. To match mixer.
6. IF Ampflier. Either broadband transistor amplifiers or Colgate paramps. The optimum choice will depend on the mixer performance obtained.
7. Dual Bias Supply. Including LO levelling circuits.
8. LO Leveller. Ferrite attenuator or modulator.
9. Variable attenuator.
10. LO Isolator.
11. LO Klystron.
12. Noise Source. Remotely switched.
13. Nutating Subreflector. A small inclined mirror is mounted at the vertex to reflect the noise calibration signal into the feed.
14. Noise Calibration Horn.

85 GHz CONTINUUM RECEIVER

WAVEGUIDE : WR-10 75-110 GHz
FLANGES : UG-387/U (MODIFIED)



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5 JUNE 72

PROPOSED NEW 80-120 GHZ UNCOOLED LINE RECEIVER

It is proposed to construct a new 80-120 GHz room temperature front-end for spectral line work. This will be mounted at the prime focus of the 36-foot telescope and will be compatible with the existing LO phase-lock and IF systems. In most respects the new front-end will resemble the 30-50 GHz line front-end completed in May 1972; the differences presently envisaged being:

(i) A local oscillator power levelling loop sensing the DC mixer current. This should reduce instabilities due to LO power variations.

(ii) Remote control of all tuning parameters. The remote tuning range will be limited by the range of the individual LO klystrons.

Initially LO klystrons will be available at the following frequencies:

75-85 GHz
85-95 GHz
95-101 GHz
108-116 GHz

These cover the majority of present observing requests. The gaps at 101-108 and 116-120 GHz can be covered if required, but the cost of these klystrons will be $4000-$5000 each.

It is hoped to have this receiver operating early in October. The receiver noise temperature will depend on mixer and diode developments in the next few months, but we hope it will be under 1500°K single-sideband.

A. R. Kerr
June 4, 1972

DESCRIPTION OF COMPONENTS - see block diagram

Block No.

1 Chopper Drive. Same as Jesse's system on 30-50 GHz receiver.

2 Feed Horn. Conical horn - must determine best throat design to minimize VSWR, and whether one horn can cover the whole band adequately

3 LO Injection Cavity and Servo. Same as Jesse's system on 30-50
4 GHz receiver; this has very low signal loss, high rejection of LO noise at signal and image frequencies, and wide tuning range. May need more than one to cover the frequency range without higher order mode problems.

5 Mixer. To be based on the present laboratory model using a U. Va. 5 μ diode. It may be necessary to use a smaller diode (3.5 μ) to cover the whole frequency range with reasonable conversion loss.

6 IF tuner DC Block. Matched to Mixer.

7 Bias Supply. This should be able to operate in constant voltage or constant current mode, or with finite source resistance. If the LO levelling loop is incorporated its mixer current sensor and LO attenuator driver should be in this unit.

8 LO Leveller. A ferrite attenuator or modulator. Rapid response of the levelling loop is required to handle chopper wheel, and frequency switching effects. Only a small amount of attenuation is required in the leveller.

9 Variable attenuator.

10 Directional Coupler.

11 Isolator. 8% bandwidth seems to be the broadest commercially available. Possibly keep one with each LO klystron.

12 LO Klystron.

13 Klystron Servo. Same as 30-50 GHz receiver. Will need modifying if Varian klystrons are used.

14 Variable Attenuator.

15 Harmonic Mixer

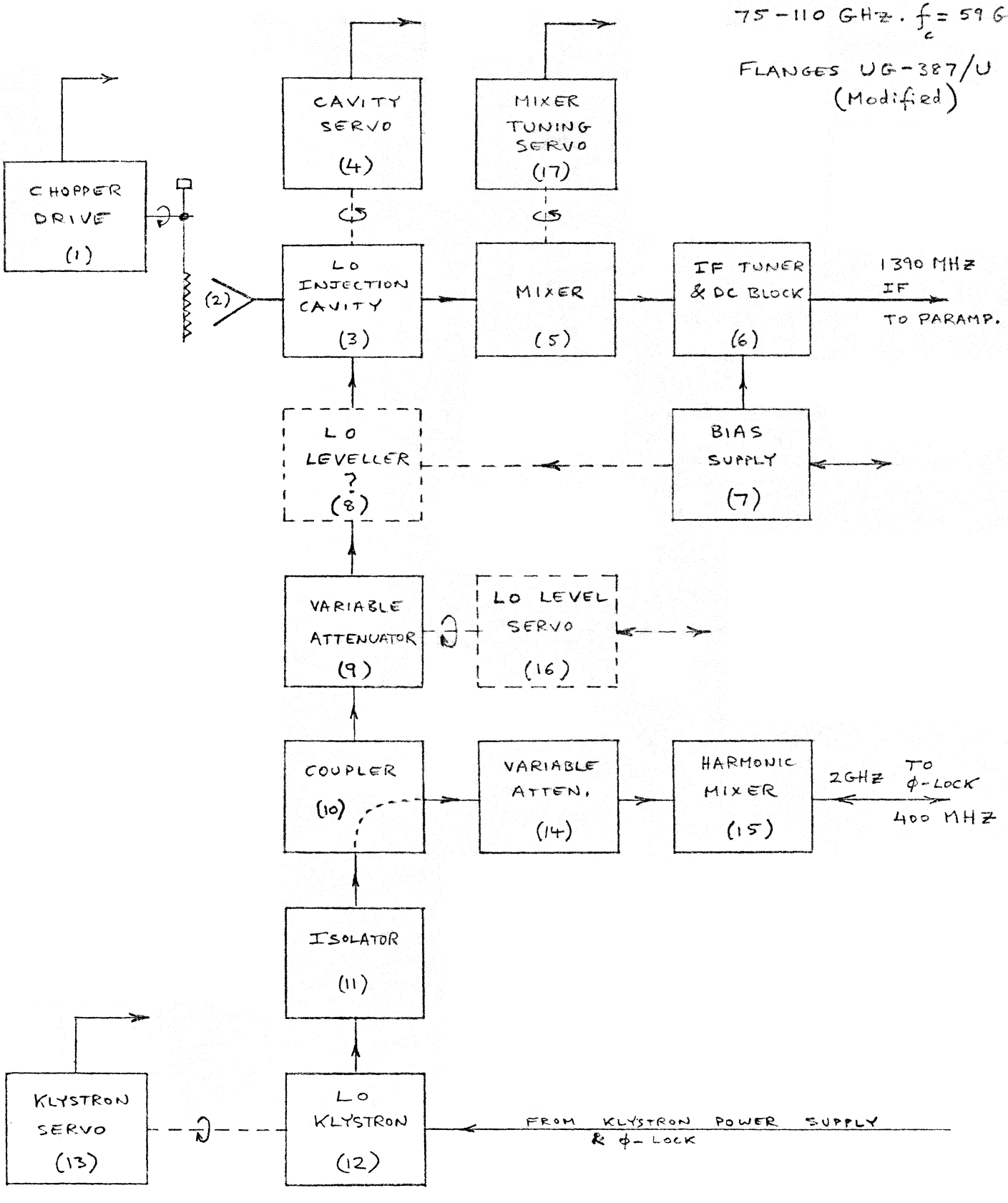
16 LO Level Servo. Not necessary if closed loop levelling is used.

17 Mixer Tuning Servo. Drives mixer back-short.

80 — 120 GHZ FRONT-END

WAVEGUIDE WR10
75 - 110 GHz. f_c = 59 GHz

FLANGES UG-387/U
(Modified)



A.R.K.
4 JUN 72