GLINT NO. 191
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LOCAL OSCILLATOR DISTRIBUTION

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General Description

See Fig. 1 for block diagram of distribution system.

Local oscillator. Varian klystron VA 297Z puts out 1 watt at 10,690 MHz, RG 67 flange. With 33 db of attenuation we have the 0.5 milliwatts required by the mixer.

Phase monitor. In this subsystem, which remains to be designed, the echo from the modulated reflector is compared in phase with the local oscillator. Precision should be high enough to observe phase changes equal to the working tolerance of 1 mm adopted for differential phase error between antenna pairs. This means repeatability to 0.2 mm and imposes strict requirements on the phase monitor phase shifting device, echo coupler, signal-to-noise ratio of the phase monitor meter, connectors, and all other components of the phase monitor system.

Slotted waveguide, SWR meter, slide-screw tuner. Use X810B + 809 B, 415E, X870A.

Five-way divider. Use H-plane bends and magic tees with internal loads.

Local oscillator attenuator. These are required to compensate for the different attenuations in the five transmission lines and also to reduce the local oscillator level to that desired. They then also act to isolate the five lines from each other and to stabilize the impedance into which the phase-monitor system works.

Local oscillator phase trimmer. These are required to bring the phase monitor system into approximately the same state of adjustment for all five lines.

Pressure seal. Five gaskets separate the foregoing items in the room air from the nitrogen-filled transmission line.

Nitrogen manifold and bleed valve. Gas is let into the transmission system at 15 lb/sq.in. through a manifold and its pressure can be finely adjusted down to the standard value by a bleed valve. Effects of pressure changes will be negligible if the pressure is kept to 15 $\pm$ 0.1 lb/sq.in. (see Glint No. 192) but if leakage occurs with a time constant less than a month then there will be significant changes in the pressure during long observing runs. The pressure effect is expected to be regular and calibratable.

Underground transmission system. The waveguide consists of alclad aluminum drawn tube of 1.25 inches outside diameter and .049 inches wall thickness, as follows:

RG 67 flange.
Taper from oval to round
Straight run into pit, 5 feet
Vertical bend
Straight run in trunk trench, 125 feet
Horizontal bend
Straight run in trench (112, 187, 262, 2@ 337 feet)
Vertical bend
Vertical run, 4 feet
Taper round to oval

Ground to focus system
RG 67 flange pair
Spiroguide to bottom bearing embedded in 4" polyfoam insulation (Glint No. 190), 13 feet
RG 67 flange, nitrogen bypass and pressure seal
RG 67 waveguide to coax adapter (hp-X281A)
Coaxial rotating joint such as SAGE 344
Spiroline run to east declination bearing, pressure seal and nitrogen bypass at both ends, 12 feet

Coaxial rotating joint
Coax to waveguide adapter (hp-X281A)
RG 67 flange, nitrogen bypass and pressure seal
Spiroguide to focus, insulated, 30 feet
RG 67 flange and pressure seal
Waveguide to coax adapter (hp-X281A)
(Enter feedbox via LO minitor complex and modulated reflector to mixer.)

Attenuation

Coupler, slotted line, slide-screw tuner, 2 bends, phase trimmer, 9 flanges		3 db
Five-way divider	9 to	6 db
L.O. attenuator	8.7 to	7.7 db
Pipe (5 + 125 + 112 to 337, + 4) = 246 to 471 feet @ 2.0 db/100 ft.	5 to	9.4 db
Spiroguide, 43 feet @ 1.7 db/100 ft.		0.7 db
Spiroline, 12 feet @ 10 db/100 ft.		1.2 db
3 pipe bends (estimated)		1.0 db
3 adapters, 2 rotating joints, 5 flanges, 5 connectors		3.0 db
Items within feedbox		1.0 db
Total	33	33 db

L.O. tolerances

Each mixer requires 0.5 milliwatts at 10,690 MHz in the same phase.

Power stability. A change of 1 db in L.O. level may produce negligible change in IF output level.

Frequency stability. A change of one part in 10^6 shifts the most sensitive fringe (at 75° ex-meridian distance) by one second of arc. The fringe width is 16.9637 sec 75° = 65 seconds of arc.

Phase stability. A differential error of 18° (1.4 mm) produces a loss of 0.1 db in one two-element channel. A differential error of 8° between two antennas produces a phase shift of the Fourier component from those antennas that is "equivalent" to a change of 0.1 db in the strength of that component. The damage done depends on the Fourier spectrum of the source under study. Adopt 1 mm as a working tolerance for differential phase error between antenna pairs.

Phase stability of system

Underground run. From Glint No. 189 we expect 7 mm change in path difference between Septimo (the closest antenna) and Primo or Decimo (the farthest) due to the 16°F annual range in air temperature. A temperature increase makes its effect by expanding the waveguide, reducing the guide wavelength, and thus increasing the phase length. In addition, a rise in temperature increases the pressure which also tends to expand the waveguide, but the effect on guide wavelength is negligible (see Glint No. 192). The increase of dielectric constant with pressure discussed in Glint No. 192 does not occur when the pressure rise is caused by temperature.

The diurnal change in path difference associated with a 50°F peak-to-peak sinusoidal variation is expected to be about 0.2 mm (due to guide wavelength variation, Glint No. 189).

Ground-to-focus run. As these runs will be nominally identical, variations should cancel. Assuming a diurnal temperature variation of 50°F we expect about 6 mm increase due to reduction in guide wavelength in 43 feet of guide (more if the guide is smaller than 1" I.D.), 0.2 mm increase due to linear expansion of 60 feet of guide and coax, and a negligible additional effect due to dielectric effects in the 12 feet of coax (Glint No. 159). Cancellation to better than 1 mm should be expected on most days. Short term weather effects are countered by the insulation (Glint No. 190).

Attenuation stability of system

Underground run. The temperature coefficient of electrical resistivity of aluminum is 0.0045 per degree C (Kaye and Laby, p. 87), and as the attenuation constant in waveguide is proportional to the square root of the resistivity, the temperature coefficient of attenuation must be 0.0022 per degree C. If the waveguide temperature changes 11°F (the underground annual range from Glint No. 189) then the attenuation in 471 feet of 1.25" O.D. pipe will change from 9.4 to 9.5 db.

Ground-to-focus run. In the 60 feet of guide and coax between ground and focus, we estimate 6.9 db of loss. Allowing 50°F for the diurnal range, the attenuation would change from 6.9 to 7.3 db. But only part of the 6.9 db, perhaps half, is subject to temperature dependence -- the rest is due to mismatch.

The variability with temperature may be expected to be within the tolerance of the mixer.

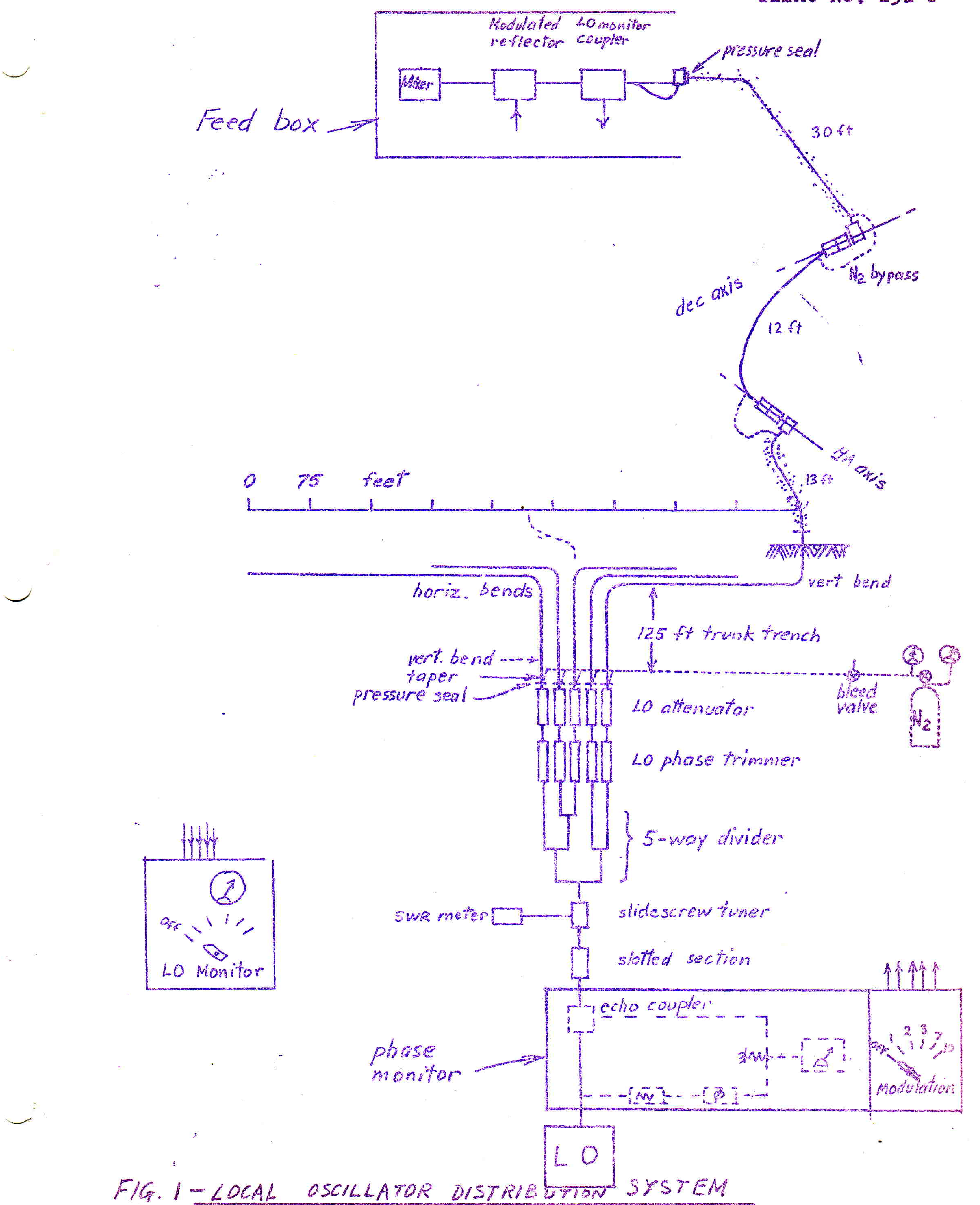

FIG. 1 — LOCAL OSCILLATOR DISTRIBUTION SYSTEM