

# NASA TECH BRIEF



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## Improved Phase Locked Loop Receiver

An improved phase locked loop receiver has been designed to track and demodulate a signal whose signal-to-noise ratio may be very low and whose information sidebands are close to each other in frequency. When the sideband frequency approximates 10 percent or less of the carrier frequency, conventional methods for recovering the carrier would result in the loss of the information in the sideband.

In the improved receiver, a phase locked loop recovers the carrier from the received input signals and applies it together with these input signals to a demodulator which recovers the sidebands. The phase locked loop contains a variable frequency oscillator (VFO) and associated circuits for generating a signal that is of the same frequency as the carrier. The loop also contains a phase detector that generates an error signal for controlling the frequency and phase of the VFO signal so that it is coherent with the received carrier signal. The loop includes circuitry for applying control and reference signals to the phase detector on the basis of which the error signals can be generated. A frequency standard provides the reference signals. The control circuitry includes first and second mixers and first and second bandpass filters, each having a passband sufficient to pass the expected (Doppler) frequency shift and matched phase response characteristics. The recovered carrier and the reference signals are applied to the second mixer and passed through the second filter to the first mixer. The input signals are passed through the first filter to the first mixer. The output of the first mixer, at the

same frequency as the reference signal, is applied as the control signal to the phase detector. By generating the control signals in this manner, the loop excludes noise and does not interfere with the sidebands while tracking the (Doppler) variation in carrier frequency. The carrier is recovered, even though its amplitude may be well below the ambient noise level.

### Notes:

1. Although the circuitry was especially designed for tracking rf signals transmitted from spacecraft, it should be useful in systems requiring signals that are phase coherent with an input carrier, as in signal analyzers.
2. Inquiries concerning this receiver may be directed to:

Technology Utilization Officer  
Goddard Space Flight Center  
Greenbelt, Maryland 20771  
Reference: B68-10008

### Patent status:

Title to this invention has been waived under the provisions of the National Aeronautics and Space Act [42 U.S.C. 2457 (f)] to General Dynamics/Electronics, 1400 North Goodman Street, Post Office Box 226, Rochester, New York 14601.

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