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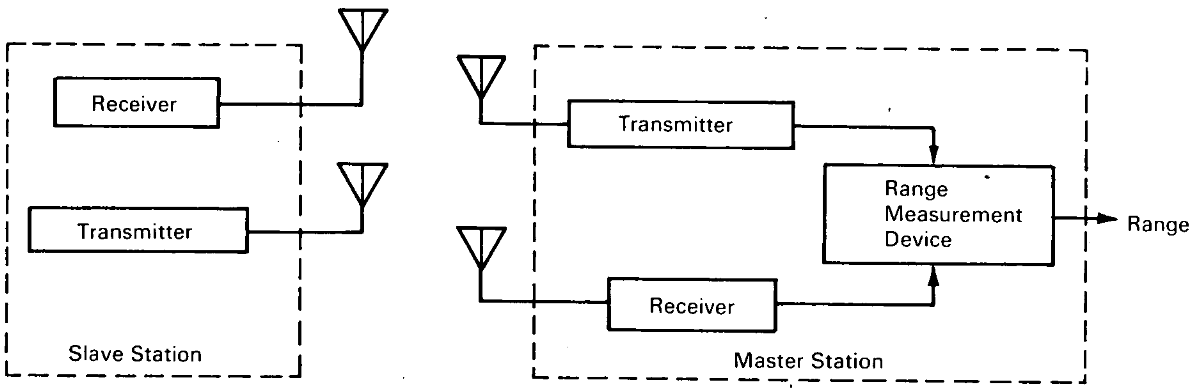
NASA TECH BRIEF

Communication System Features Dual Mode Range Acquisition Plus Time Delay Measurement



A communication system has been designed to overcome two very troublesome problems involved in following and measuring the movements of high velocity airborne or space probing vehicles.

The first involves target acquisition and breaks down to (1) providing a sufficient accuracy which requires a high bit rate resulting in a high doppler shift necessitating a small range cell per bit; and (2) adequate unambiguous range indications requiring a low word rate. This system automatically switches between a coarse range measurement or slow code acquisition mode and a tracking mode using combined low word rate signal and a high bit rate signal.

The range acquisition system uses a pseudonoise (PN) code to determine range. In range acquisition, the master station receiver first centers on a coarse quanta from the slave station transponder while simultaneously seeking to center on a fine quanta. Following coarse range acquisition, a dual mode is initiated using half-added coarse and fine quanta signals. The receiver then tracks range using the dual signals with a frequency-controlled oscillator to adjust fine range with detected coarse range. The coarse quanta is chosen so that doppler shift in the system is avoided. When synchronized, PN code generators are used to define the quanta in terms of elapsed time with selected units of the high speed signals being half-added with coarse quanta bits.

The second involves a time measurement system that reduces uncontrolled phase variations in the demodulated signal, usually attributable to temperature and other environmental fluctuations. The master station transmitter emits signals modulated by a PN code and the slave station transponder returns it to the master station receiver. A frequency controlled oscillator in this receiver is automatically adjusted to determine the time lag or delay, introduced into the modulation components, caused by the propagation time between the two stations, thereby indicating range or distance between the two stations. Typically, the master station transmitter supplies a reference signal to a range measurement device. The master station

(continued overleaf)

receiver in turn sends its frequency-controlled oscillator signal as adjusted by the slave station transponder output signal to the same range measurement device. Here, the two signals are compared, the time difference between the reference signal and the frequency-controlled oscillator signal representing the time delay. In addition to propagation time, the total time delay includes delays introduced by the electronics, which, when known, are compensated for.

Notes:

1. The technique described may be found useful in police and other civil communications systems and by designers of avionics and commercial communications equipment.
2. Inquiries concerning this invention may be directed to:

   Technology Utilization Officer
   Marshall Space Flight Center
   Huntsville, Alabama 35812
   Reference: B68-10306

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 Motorola, Inc., Scottsville, Arizona.

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under contract to
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