

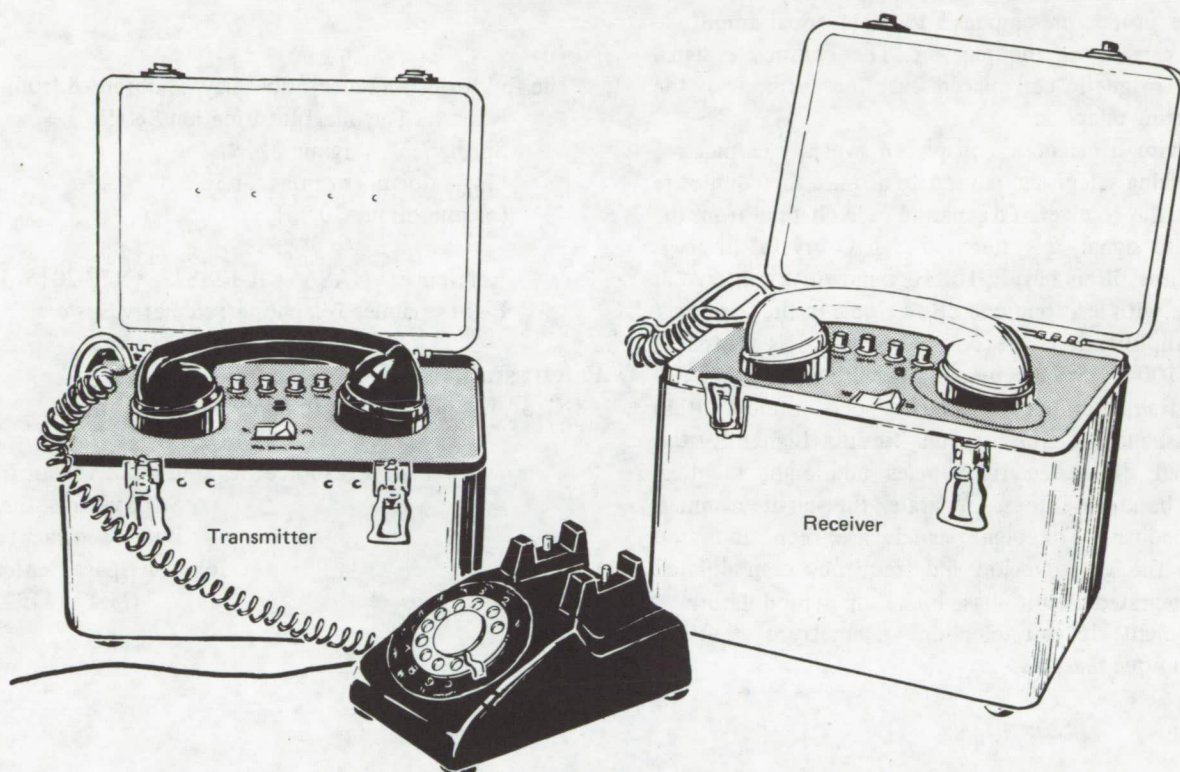
# NASA TECH BRIEF

## *Lyndon B. Johnson Space Center*



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### Eight-Channel Telephone Telemetry System



Eight-Channel Telephone Telemetry System

#### The problem:

Electroencephalograms (EEG), the recordings of human brain waves, are very difficult to interpret without extensive training and practice. The normal procedure is for a physician or medical assistant to record the patient's EEG and then to send it to a trained analyst for interpretation. The method is unnecessarily long and may take several days to be completed.

#### The solution:

A portable, eight-channel telephone telemetry system uses a conventional telephone link which eliminates the

mailing or messenger service between the physician and analyst.

#### How it's done:

The system utilizes two units: one, a transmitter, is used by the physician, the other, a receiver, is used by the analyst. Both the receiver and transmitter are designed to accept a conventional telephone hand set (see figure). Each unit is inductively coupled to its respective telephone set, the transmitter converting the EEG into audio frequency and the receiver converting this frequency back to EEG.

(continued overleaf)

The transmitter utilizes frequency division multiplexing with eight constant-bandwidth channels each of which is frequency modulated. The total frequency of operation is less than one octave to reduce interchannel crosstalk generated by harmonics of the lower channels. For maximum separation between channels, the high end of the telephone bandwidth (400 to 2700 Hz) is used. However, the region above 2500 Hz contains much telephone company in-band signaling and hence is not usable. The most suitable region is 1250 to 2400 Hz. The center frequencies of the eight channels are spaced 144 Hz apart, channel one being at 1322 Hz and channel eight at 2330 Hz.

The carriers are generated by integrated-circuit, voltage-controlled oscillators (VCO's) and linearly added with the proper pre-emphasis to yield equal amplitude of the carriers at the receiver. The composite signal drives a magnetic coil placed over the earpiece of the transmitting telephone.

Likewise, a magnetic coil placed over the earpiece of the receiving telephone is used to acquire the composite signal at the receiver. To separate each channel from the composite signal, a system of high Q crystal filters is used. These filters have a 100-Hz bandwidth centered at 100 kHz, with less than one dB of ripple in the passband. After amplification, the composite signal is translated to the 100-kHz range by mixing with the proper difference frequency to place the channel of interest within the passband of the crystal filters. Eight crystal-controlled difference frequencies and eight identical crystal bandpass filters separate the eight channels simultaneously. The eight signals are then translated back to the audio region and frequency demodulated using integrated circuit phase-lock-loop demodulators.

The eight channel telephone telemetry system has several unique features:

1. It does not require electrical connection to the telephone.
2. Frequency translation is used to allow the use of high Q crystal bandpass filters to filter low frequency data.
3. All eight carrier frequencies are located within a single octave to reduce the interchannel crosstalk.

This system provides several advantages. First, it allows small medical facilities without analysts to diagnose EEG records rapidly. Second, consultations and confirmations between doctors separated by long distances are feasible with the use of voice-grade telephone lines. Finally, because the system is portable, emergency cases can be screened rapidly at any location where telephones are available.

**Note:**

The following documentation may be obtained from:  
National Technical Information Service  
Springfield, Virginia 22151  
Single document price \$4.50  
(or microfiche \$0.95)

Reference: NASA CR-128877 (N73-20186),  
Eight-Channel Telephone Telemetry System.

**Patent status:**

NASA has decided not to apply for a patent.

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