



## Calibration Test Set for a Phase-Comparison Digital Tracker

Four equal-amplitude signals are generated at selectable phase increments of  $0.1^\circ$ .

NASA's Jet Propulsion Laboratory, Pasadena, California

An apparatus that generates four signals at a frequency of 7.1 GHz having precisely controlled relative phases and equal amplitudes has been designed and built. This apparatus is intended mainly for use in computer-controlled automated calibration and testing of a phase-comparison digital tracker (PCDT) that measures the relative phases of replicas of the same X-band signal received by four antenna elements in an array. (The relative direction

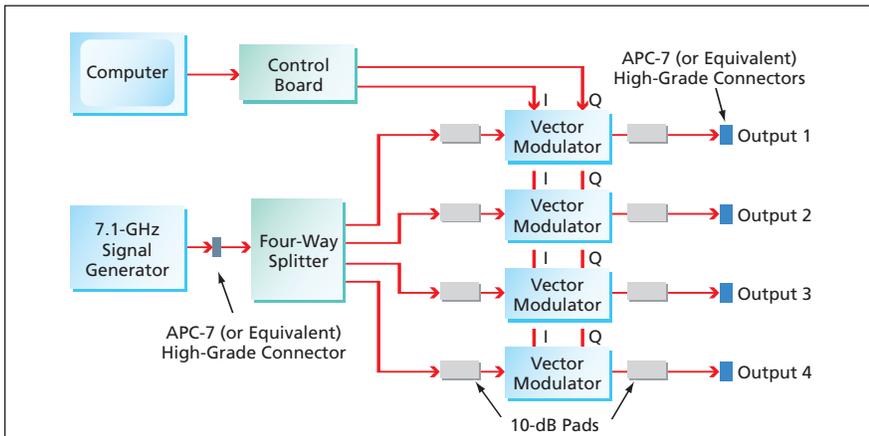
of incidence of the signal on the array is then computed from the relative phases.) The present apparatus can also be used to generate precisely phased signals for steering a beam transmitted from a phased antenna array.

The apparatus (see figure) includes a 7.1-GHz signal generator, the output of which is fed to a four-way splitter. Each of the four splitter outputs is attenuated by 10 dB and fed as input to a vector modu-

lator, wherein DC bias voltages are used to control the in-phase (I) and quadrature (Q) signal components. The bias voltages are generated by digital-to-analog-converter circuits on a control board that receives its digital control input from a computer running a LabVIEW program. The outputs of the vector modulators are further attenuated by 10 dB, then presented at high-grade radio-frequency connectors. The attenuation reduces the effects of changing mismatch and reflections.

The apparatus was calibrated in a process in which the bias voltages were first stepped through all possible IQ settings. Then in a reverse interpolation performed by use of MATLAB software, a lookup table containing 3,600 IQ settings, representing equal amplitude and phase increments of  $0.1^\circ$ , was created for each vector modulator. During operation of the apparatus, these lookup tables are used in calibrating the PCDT.

*This work was done by Amy Boas, Samuel Li, and Robert McMaster of Caltech for NASA's Jet Propulsion Laboratory. Further information is contained in a TSP (see page 1). NPO-42813*



The PCDT Calibration Test Set contains four computer-controlled vector modulators that produced selectively phased replicas of a 7.1-GHz input signal.

## Wireless Acoustic Measurement System

This system supplants older, less-capable, cable-connected systems.

Stennis Space Center, Mississippi

A prototype wireless acoustic measurement system (WAMS) is one of two main subsystems of the Acoustic Prediction/ Measurement Tool, which comprises software, acoustic instrumentation, and electronic hardware combined to afford integrated capabilities for predicting and measuring noise emitted by rocket and jet engines. The other main subsystem is described in the article on page 8.

The WAMS includes analog acoustic measurement instrumentation and analog and digital electronic circuitry combined with computer wireless local-area

networking to enable (1) measurement of sound-pressure levels at multiple locations in the sound field of an engine under test and (2) recording and processing of the measurement data. At each field location, the measurements are taken by a portable unit, denoted a field station. There are ten field stations, each of which can take two channels of measurements.

Each field station is equipped with two instrumentation microphones, a micro-ATX computer, a wireless network adapter, an environmental enclosure, a directional radio antenna, and a battery

power supply. The environmental enclosure shields the computer from weather and from extreme acoustically induced vibrations. The power supply is based on a marine-service lead-acid storage battery that has enough capacity to support operation for as long as 10 hours.

A desktop computer serves as a control server for the WAMS. The server is connected to a wireless router for communication with the field stations via a wireless local-area network that complies with wireless-network standard 802.11b of the Institute of Electrical and Electronics Engineers. The router and the