Maintaining Stability During a Conducted-Ripple EMC Test

Ripple is now injected via amplifier-controlled FETs instead of a transformer.

NASA's Jet Propulsion Laboratory, Pasadena, California

An improved technique, and electronic circuitry to implement the technique, have been developed for a military-standard electromagnetic-compatibility (EMC) test in which one analyzes susceptibility to low-frequency ripple conducted into the equipment under test via a DC power line. In the traditional technique for performing the particular test, the ripple is coupled onto the DC power line via a transformer. Depending upon some design details of the equipment under test, the inductance of the transformer can contribute a degree of instability that results in an oscillation of amplitude large enough to destroy the equipment.

It is usually possible to suppress the oscillation by connecting a damping resistor to the primary terminals of the ripple-injection transformer. However, it is important to emphasize the "usually" in the preceding sentence: sometimes, the resistive damping becomes insufficient to suppress destructive oscillation. In addition, undesirably, the resistor contributes to power dissipation and power demand, and thereby also necessitates the use of a larger ripple-voltage amplifier. Yet another disadvantage of the transformer-coupling technique is that the transformer introduces low-frequency distortion of the injected ripple voltage.

The improved technique makes it possible to inject ripple with very low distortion at low frequency, without inducing oscillation. In this technique, a transformer is not used: Instead, power is fed to the equipment under test via series power field-effect transistors (FETs) controlled by a summing operational amplifier. One of the inputs to the amplifier controls the DC component of the power-line voltage; the other input, generated by an external oscillator, controls the ripple component. The circuitry for implementing this technique includes panel displays, an internal power supply for the operational amplifier and panel displays, and amplitude controls for the DC and ripple power-line voltage components.

This work was done by Vatche Vorperian of Caltech for NASA's Jet Propulsion Laboratory. Further information is contained in a TSP (see page 1). NPO-30652

Photodiode Preamplifier for Laser Ranging With Weak Signals

This circuit suppresses noise without sacrificing timing accuracy.

NASA's Jet Propulsion Laboratory, Pasadena, California

An improved preamplifier circuit has been designed for processing the output of an avalanche photodiode (APD) that is used in a high-resolution laser ranging system to detect laser pulses returning from a target. The improved circuit stands in contrast to prior such circuits in which the APD output current pulses are made to pass, variously, through wide-band or narrow-band load networks before preamplification. A major disadvantage of the prior wide-band load networks is that they are highly susceptible to noise, which degrades timing resolution. A major disadvantage of the prior narrow-band load networks is that they make it difficult to sample the amplitudes of the narrow laser pulses ordinarily used in ranging.

In the improved circuit, a load resistor is connected to the APD output and its value is chosen so that the time constant defined by this resistance and the APD capacitance is large, relative to the duration of a laser pulse. The APD capacitance becomes initially charged by the pulse of current generated by a return laser pulse, so that the rise time of the load-network output is comparable to the duration of the return pulse. Thus, the load-network output is characterized by a fast-rising leading edge, which is necessary for accurate pulse timing.

On the other hand, the resistance-capacitance combination constitutes a low-pass filter, which helps to suppress noise. The long time constant causes the load-network output pulse to have a long shallow-sloping trailing edge, which makes it easy to sample the amplitude of the return pulse. The output of the load network is fed to a low-noise, wide-band amplifier. The amplifier must be a wide-band one in order to preserve the sharp pulse rise for timing. The suppression of noise and the use of a low-noise amplifier enable the ranging system to detect relatively weak return pulses.

This work was done by Alexander Abramovici and Jacob Chapsky of Caltech for NASA's Jet Propulsion Laboratory. Further information is contained in a TSP (see page 1).
NPO-30598

Advanced High-Definition Video Cameras

Marshall Space Flight Center, Alabama

A product line of high-definition color video cameras, now under development, offers a superior combination of desirable characteristics, including high frame rates, high resolutions, low power consumption, and compactness. Several of the cameras feature a 3,840 × 2,160-pixel format with progressive scanning at 30 frames per second. The power consumption of one of these cameras is about 25 W. The size of the camera, excluding the lens assembly, is 2 by 5 by 7 in. (about 5.1 by 12.7 by 17.8 cm).

The aforementioned desirable characteristics are attained at relatively low