



Measuring Input Thresholds on an Existing Board

NASA's Jet Propulsion Laboratory, Pasadena, California

A critical PECL (positive emitter-coupled logic) interface to Xilinx interface needed to be changed on an existing flight board. The new Xilinx input interface used a CMOS (complementary metal-oxide semiconductor) type of input, and the driver could meet its thresholds typically, but not in worst-case, according to the data sheet. The previous interface had been based on comparison with an external reference, but the CMOS input is based on comparison with an internal divider from the power supply. A way to measure what the exact input threshold was for this device for 64 inputs on a flight board was needed.

The measurement technique allowed an accurate measurement of the voltage required to switch a Xilinx input from high to low for each of the 64 lines, while only probing two of them. Directly driving an external voltage was consid-

ered too risky, and tests done on any other unit could not be used to qualify the flight board. The two lines directly probed gave an absolute voltage threshold calibration, while data collected on the remaining 62 lines without probing gave relative measurements that could be used to identify any outliers.

The PECL interface was forced to a long-period square wave by driving a saturated square wave into the ADC (analog to digital converter). The active pull-down circuit was turned off, causing each line to rise rapidly and fall slowly according to the input's weak pull-down circuitry. The fall time shows up as a change in the pulse width of the signal ready by the Xilinx. This change in pulse width is a function of capacitance, pull-down current, and input threshold. Capacitance was known from the different trace lengths, plus a gate input capaci-

tance, which is the same for all inputs. The pull-down current is the same for all inputs including the two that are probed directly. The data was combined, and the Excel solver tool was used to find input thresholds for the 62 lines. This was repeated over different supply voltages and temperatures to show that the interface had voltage margin under all worst case conditions.

Gate input thresholds are normally measured at the manufacturer when the device is on a chip tester. A key function of this machine was duplicated on an existing flight board with no modifications to the nets to be tested, with the exception of changes in the FPGA program.

This work was done by Igor Kuperman, Daniel G. Gutrich, and Andrew C. Berkun of Caltech for NASA's Jet Propulsion Laboratory. For more information, contact iaoffice@jpl.nasa.gov. NPO-47705

Scanning and Defocusing Properties of Microstrip Reflectarray Antennas

Microstrip reflectarrays have applications in radar and remote sensing systems.

NASA's Jet Propulsion Laboratory, Pasadena, California

A symmetric reflectarray, consisting of variable-size square patch elements with a commonly used mathematical model for the horn in the form of a cosine function, has been designed using the transmit mode technique for different f/D ratios with -10 dB edge taper. Subsequently, the antennas were analyzed for the radiation pattern and gain. The infinite array model was used to determine the reflection phase of each patch element in the design and analysis codes. By displacing the feed laterally, the scan characteristics were obtained, such as the beam deviation factor, gain loss, and pattern degradation. The properties of reflectarrays were compared to those of the conventional paraboloidal reflectors. The same procedure was used to study the scan properties of offset reflectarrays. There is no cross-polarized radiation in the princi-

pal planes for a symmetric system. Cross-polarized radiation exists in non-principal planes off broadside in symmetric systems, with greater levels for larger values of subtended angles. Such cross-polarized radiation level increases with subtended angle just as cross-polarization level increases with decreasing values of f/D ratios for symmetric paraboloids in non-principal planes. Pattern distortions and gain loss were found to be more severe in the case of a microstrip reflectarray compared to the conventional parabolic reflector. The scan performance of the reflectarrays was found to improve with f/D ratios as is true for paraboloids. In general, scanning by means of displaced feed is limited to a few beamwidths in reflectarrays.

Feed displacement in the axial direction of a symmetric reflectarray was in-

vestigated and compared to that of paraboloids. The gain loss due to the defocused feed of a reflectarray was found to be nearly the same as that of a paraboloid of the same subtended angle for larger values of f/D , and for displacements away from the antenna. The gain loss of an axially defocused reflectarray was found to be greater than that of a paraboloid for displacements closer to the antenna, especially for smaller values of f/D .

In general, the performance of a defocused reflectarray was found to be poorer than that of a comparable paraboloid reflector.

This work was done by Sembiam Rengarajan of Caltech for NASA's Jet Propulsion Laboratory. For more information, contact iaoffice@jpl.nasa.gov. NPO-47550