NATIONAL RADIO ASTRONOMY OBSERVATORY

ELECTRONICS DIVISION TECHNICAL NOTE NO. 141

TITLE: Whiskerless Diode Burnout Test

AUTHOR(S): Diane Garfield (UVA)

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DEPARTMENT OF ELECTRICAL ENGINEERING, THORNTON HALL
UNIVERSITY OF VIRGINIA
CHARLOTTESVILLE, VIRGINIA 22901
Correspondent's Telephone: (804)924-6089

MEMORANDUM

To: Dr. S. Weinreb

From: Diane Garfield

Date: June 1, 1987

Re: Whiskerless Diode Burnout Test

Two whiskerless diodes were tested to determine the current-voltage characteristics associated with burnout. One diode was tested in the forward bias mode and the other in reverse bias mode. The device, testing procedure and results are summarized below.

Device Description

Both diodes were whiskerless, surface-channel devices from batch #SC2R1, fabricated at UVA.

Crystal material: substrate = semi-insulating GaAs
buffer layer = 3.5 microns n^+-type > $2 \times 10^{18} cm^{-3}$
active layer = 1000 Å n-type at $2 \times 10^{17} cm^{-3}$

Device dimensions: 5 mils width x 15 mils length x 5 mils thick
anode diameter = 2.5 microns
anode fingers = 4 x 50 microns

Typical DC characteristics: R_s = 5-6 Ohms
C_{jo} = 5-6 fF
ΔV = 71-72 mV (10-100μA)
V_{BR} = 4.5-5.5V

Test Procedure

The forward biased device was affixed to a glass slide using Strong Hold 7036 Adhesive. The reverse biased device was left affixed to a silicon wafer with Apiezon W grease (used for wafer dicing). The assembly was then placed in the diode test station used in the SDL. Contact was made to the anode and ohmic contact pads using two pointed, gold-plated, nickel wires.

Resistance in the test circuit was determined to be less than 0.5 ohms, probe-tip to probe-tip. Current and voltage measurements were made with a NRAO digital bias supply.

Baseline IV characteristics were measured by applying forward currents of 0.1uA, 1.0uA, 10.0uA, 100uA, 1mA, and 10mA, and taking voltage measurements at each value. Subsequently higher current values were progressively applied in the forward or reverse directions. Baseline diode characteristics were re-checked for changes between each successive new current value. In the forward case, progression was made at intervals of 10mA, beginning with 20mA. In the reverse direction, initial measurements were made at 10uA intervals beginning with -1.0uA. However, when no indication of change was evident by 100uA, progression was adjusted to 1mA intervals.

Test Results

Prior to reaching critical current levels, successive IV characteristics varied by values of under 3 mV. In the forward bias case changes in the IV curve were noted at 30mA, and burnout was complete at 40mA. In the reverse bias case, diode-curve changes were seen at -4mA and burnout occurred at -7mA. Results are tabulated for endpoint values below. Since measurements were made on only these two diodes, no inferences can be made regarding variation among devices in this batch.

Forward Bias

I	V (volts)	V (volts)	V (volts)	V (volts)
0.1uA	0.604	0.603	0.606	0.009
1.0uA	0.676	0.675	0.680	0.085
10uA	0.750	0.748	0.753	0.338
100uA	0.825	0.824	0.830	0.604
1mA	0.907	0.906	0.912	0.788
10mA	1.024	1.023	1.027	0.954
⋮				
20mA	1.089	1.088	1.092	1.018
30mA	--	1.146	1.145	1.080
40mA	--	--	1.140	1.135

Reverse Bias

I	V (volts)	V (volts)	V (volts)	V (volts)	V (volts)
0.1uA	0.622	0.626	0.609	0.403	0.020
1.0uA	0.692	0.697	0.681	0.503	0.130
10uA	0.763	0.768	0.755	0.608	0.301
100uA	0.836	0.841	0.830	0.723	0.447
1mA	0.916	0.921	0.921	0.846	0.600
10mA	1.040	1.046	1.030	0.994	0.878
⋮					
-4mA	-6.886	--	--	--	--
-5mA	--	-6.650	--	--	--
-6mA	--	--	-6.400	--	--
-7mA	--	--	--	-3.951	--