# APPLICATION NOTE

AN-127

# TOUGH TESTING CHALLENGE – LOW CURRENT MEASUREMENTS OF PHOTODIODE ARRAYS

## Overview

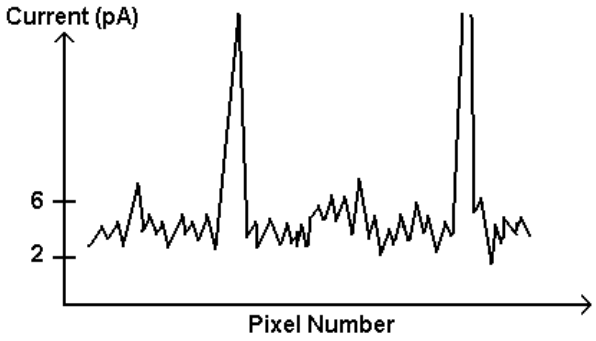
Some GaAs fabs produce optical devices in the form of photodiode arrays. Wafers can have tens of thousands to hundreds of thousands of diodes, which means lots and lots of pixels have to be electrically tested, typically in the pA range. This makes it both a production and engineering challenge to make lots of low current measurements in the shortest possible time-span.

Rack and stack systems used for this application often prove to be a production bottleneck. As shown here, significantly higher throughputs are possible with standard Reedholm test systems configured with a few key items:

**A)** Testing Speed: 4x Speed Gain with Reedholm Low current measurements with the PAM-16 >1pA take ~50msec inclusive of integrating over one ac line cycle. So, seven pixels per PAM require 350msec, and 21 pixels can be measured in that time.

● With one reading/pixel, a delay of 350msec for pixel settling, and 600msec for a prober move, average time was 65msec/pixel, or 1.8 hours for 100k pixels.

● With three readings/pixel, average time was 100msec, so measuring 100k pixels took 2.8 hours. For the customer achieving the above times, their rack and stack systems took ~ 8 hours per wafer. Actual elapsed times inclusive of prober moves were longer at 12 hours, but visually bad portions of wafers were not tested. Thus, the Reedholm test time of 1.8 hours for 100k diodes was more than a 4x speed gain.




**B)** Low Leakage Rectangular Probe Cards Reedholm low leakage probe cards meet the low current requirements for pixel measurements. Blades minimize leakage currents. These are described here.

### 1) Light Shielding

The prober needs to be light tight, i.e. completely dark, inside the wafer probing chamber. Also, means of mounting LED's is needed. These details are worked out directly with the prober vendor.

### 2) Settling Time

Reedholm cards have leakage specifications of 50fA/V within one second, but the Reedholm definition is far more exacting. Instead of biasing a single pin, Reedholm places 100V on all

surrounding probe card pins, top and bottom, then measures current for eight seconds. The resultant curve must indicate that the dominant feature is polarization current that dies to <5pA after one second, and <2pA after eight seconds. 3) Self Testing LL cards are designed with one end containing loopback connections so that the card used for probing can be removed and then used to automatically check cable integrity.

**C)** 24-Pin Picoammeter (PAM) Matrix = 3 Amplifiers Each PAM has eight pins and a single picoammeter amplifier. So, three PAM's permits simultaneous probing of up to 23 pixels as well as having one pin assigned to D.C. chuck bias or A.C. chuck excitation for capacitance measurements. Pixels not being measured would be grounded so it would not be necessary to increase settling time when pins are switched. More matrix cards could be added to access more diodes. Three amplifiers permit launching three measurements simultaneously. Then the amplifiers were switched to the next three pixels and another three measurements launched. Thus, there are seven measurement times after the settling time delay. The PAM-16N datasheet is here.

**D)** 100kHz CMM A 100kHz capacitance meter takes data within 50msec and allows ±600V D.C. bias limited by the system resources. The CMM datasheet is here.