ISC QPD test status

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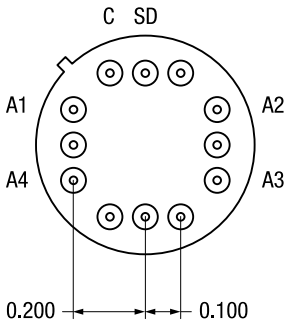
G1100950-v1

Testing ~80 OSI FCI-InGaAs-Q3000 (with Chris Mueller of UF)

- Found too high dark current (~uA) instead of nA spec. level.
- What's wrong?

Pinout / Spec. of OSI FCI-InGaAs-Q3000



Bottom View

Pinout

PIN	Description
A1	ANODE QUADRANT 1
A2	ANODE QUADRANT 2
A3	ANODE QUADRANT 3
A4	ANODE QUADRANT 4
C	COMMON CATHODE
SD	SUCTION DIODE

Absolute Maximum Ratings

PARAMETERS	SYMBOL	MIN	MAX	UNITS
Storage Temperature	T_{stg}	-55	+125	°C
Operating Temperature	T_{op}	-40	+75	°C
Soldering Temperature	T_{sld}	---	+260	°C

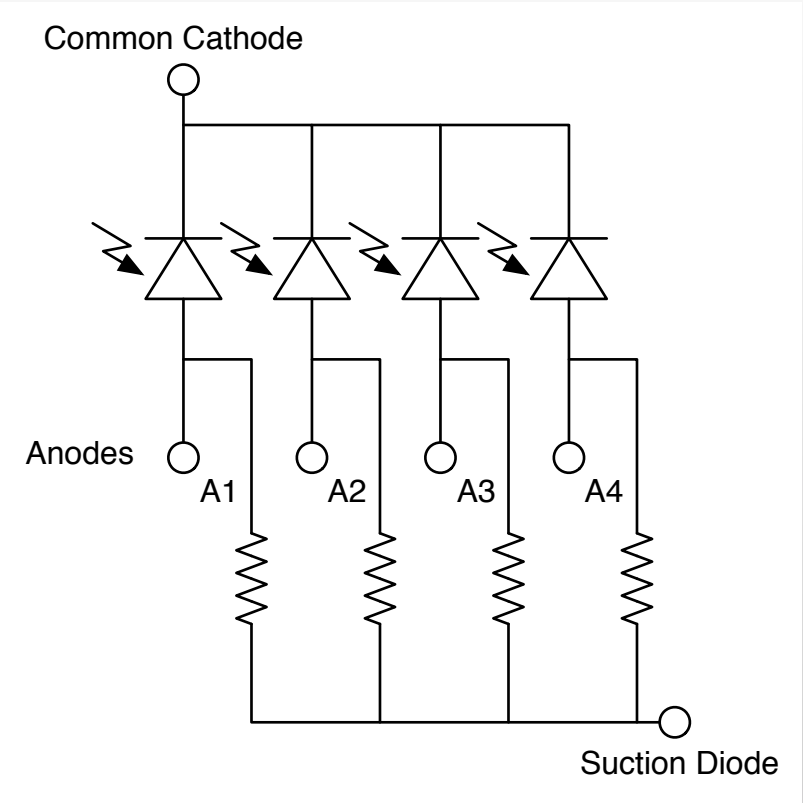
Electro-Optical Characteristics (per 1 element) T_A=23°C

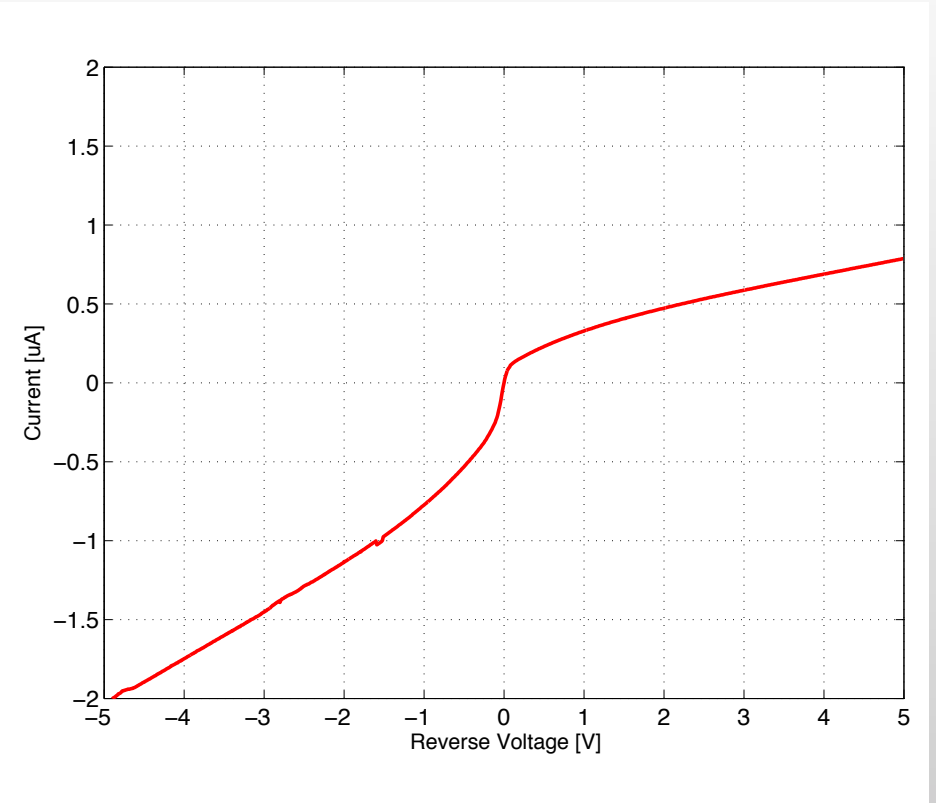
PARAMETERS	SYMBOL	CONDITIONS	FCI-InGaAs-Q1000			FCI-InGaAs-Q3000			UNITS
			MIN	TYP	MAX	MIN	TYP	MAX	
Active Area Diameter	AA_ϕ	---	---	1000	---	---	3000	---	μm
Responsivity	R_λ	λ=1310nm	0.85	0.90	---	0.85	0.90	---	A/W
		λ=1550nm	0.90	0.95	---	0.90	0.95	---	
Element Gap	---	---	---	0.045	---	---	0.045	---	mm
Capacitance	C_j	V_R = 5.0V	---	---	25	---	---	225	pF
Dark Current	I_d	V_R = 5.0V	---	0.5	15	---	2.0	100	nA
Rise Time/ Fall Time	t_r/t_f	V_R = 5.0V, 50Ω 10% to 90%	---	3	---	---	24	---	ns
Crosstalk	---	λ=1550nm, V_R = 5.0V	---	---	1	---	---	1	%
Max. Revervse Voltage	---	---	---	---	15	---	---	10	V
NEP	---	λ=1550nm	---	1.20E-14	---	---	2.50E-14	---	W/√Hz

"suction diode" pin?

Spec.: 2nA typ, 100nA max, for VR=5V

Cathode / Anodes / Suction Diode



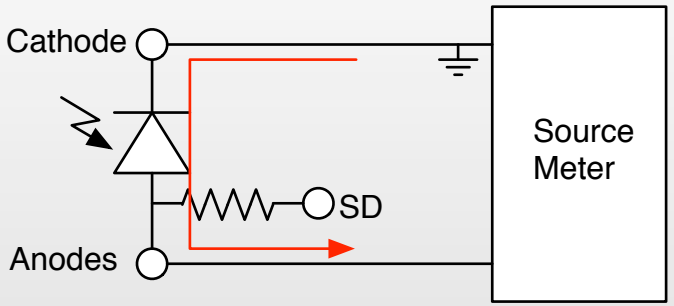


The "suction diode" pin works as the "fifth" diode to enhance the isolation between the segments. (OSI told to Rich)

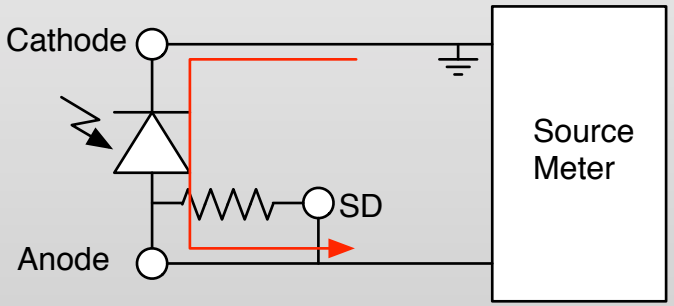
Phenomenologically, the connections between the anode pins and the SD pin are approximately (but not exactly) **resistive with R<1MOhm,** according to the static responses (c.f. right figure).

How should the SD pin connected?

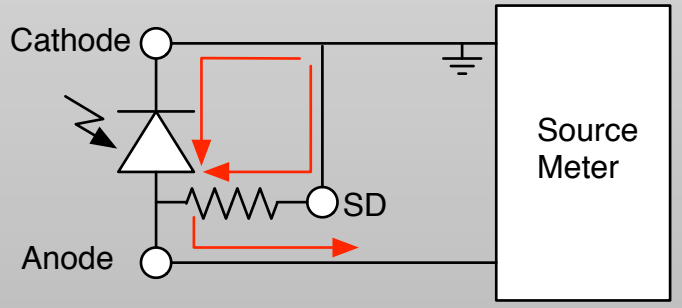
TEST1: Isolate SD



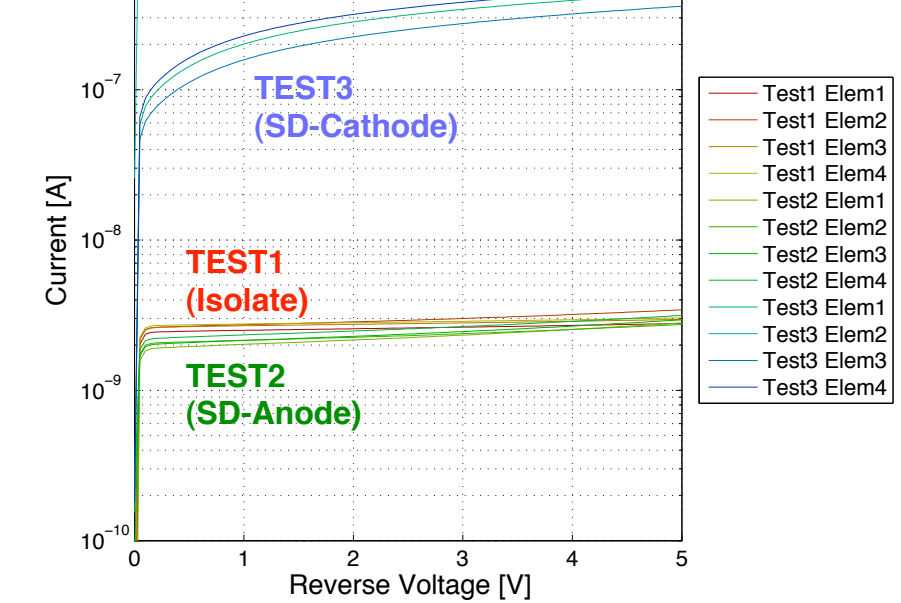
TEST2: Connect SD and Anode

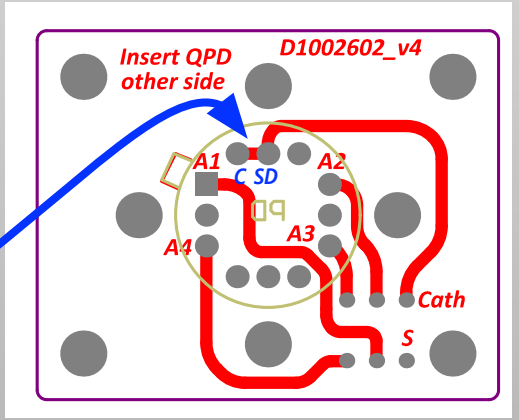


TEST3: Connect SD and Cathode



This is the topology used in the flexible circuit D1002602-v4





Resistances of the SD pin depends on the device and also can be quite small (~12k for element #2 in the above example)

What to do?

- The solution is to be decided

- The best: to connect SD pin to the ground potential

The dark current through the SD pin will be suppressed as the anodes are virtually connected to the ground by the transimpedance amp.

==> Needs replacement of the cable and the flexible board

The current design has no ground potential supplied on the QPD board

- The 2nd best: to isolate SD pin

The dark current will be suppressed. Isolation between segments may be degraded.

==> May needs optical test?

==> Needs replacement of the flexible board

==> Needs cutting the SD pin for LHO TRANSMON QPDs and LLO QPDs that is to be assembled within a month

QPD test (with SD pin isolated)

Chris has finished all the measurements
Example shot of the QPD test result

QPD #45

Measurement Date:
Sept. 1, 2011

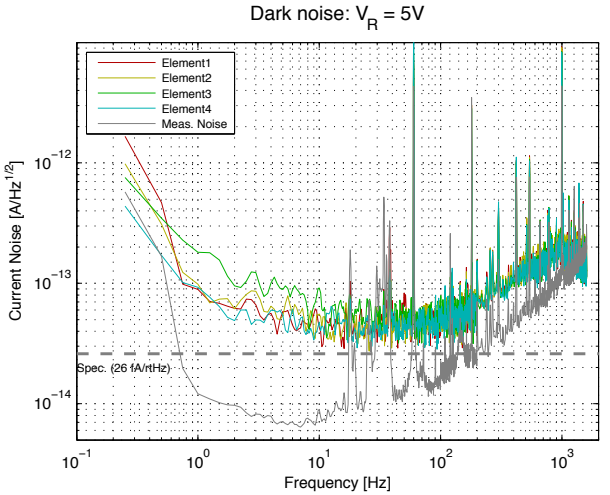
Shunt Resistance (R_{SH}):
Elem1: 6.093 MOhm
Elem2: 5.956 MOhm
Elem3: 5.955 MOhm
Elem4: 5.916 MOhm

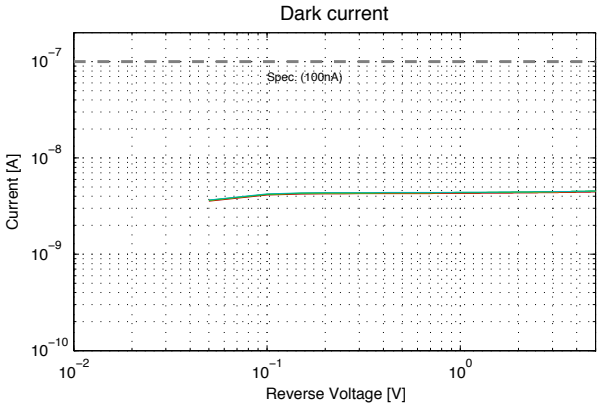
Series Resistance: (R_s):
Elem1: 15.5 Ohm
Elem2: 16.2 Ohm
Elem3: 16.8 Ohm
Elem4: 16.6 Ohm

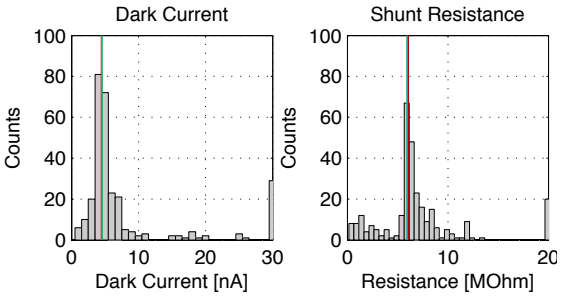
Junction Capacitance: (C_{pd}):
Elem1: 137.9 pF
Elem2: 139.3 pF
Elem3: 136.0 pF
Elem4: 137.8 pF

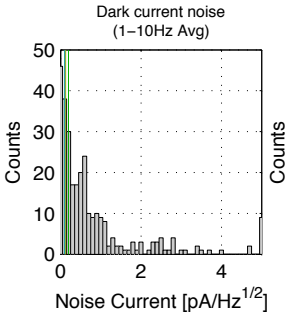
Dark Current [nA]:
Elem1: 4.43 nA
Elem2: 4.51 nA
Elem3: 4.55 nA
Elem4: 4.54 nA

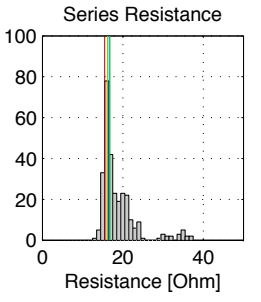
Dark Noise:
1~10Hz avg
Elem1: 0.111 pA/rtHz
Elem2: 0.126 pA/rtHz
Elem3: 0.196 pA/rtHz
Elem4: 0.103 pA/rtHz
200~290Hz avg
Elem1: 0.099 pA/rtHz
Elem2: 0.099 pA/rtHz
Elem3: 0.096 pA/rtHz
Elem4: 0.096 pA/rtHz

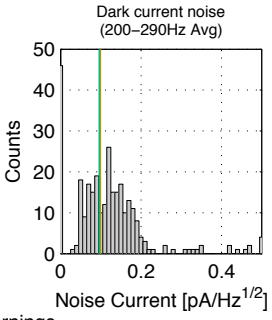


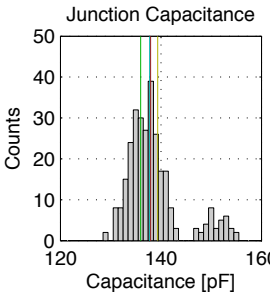












Errors / Warnings

Elem3: i_{noise}(LF) > 180fA/rtHz (100nA shot)