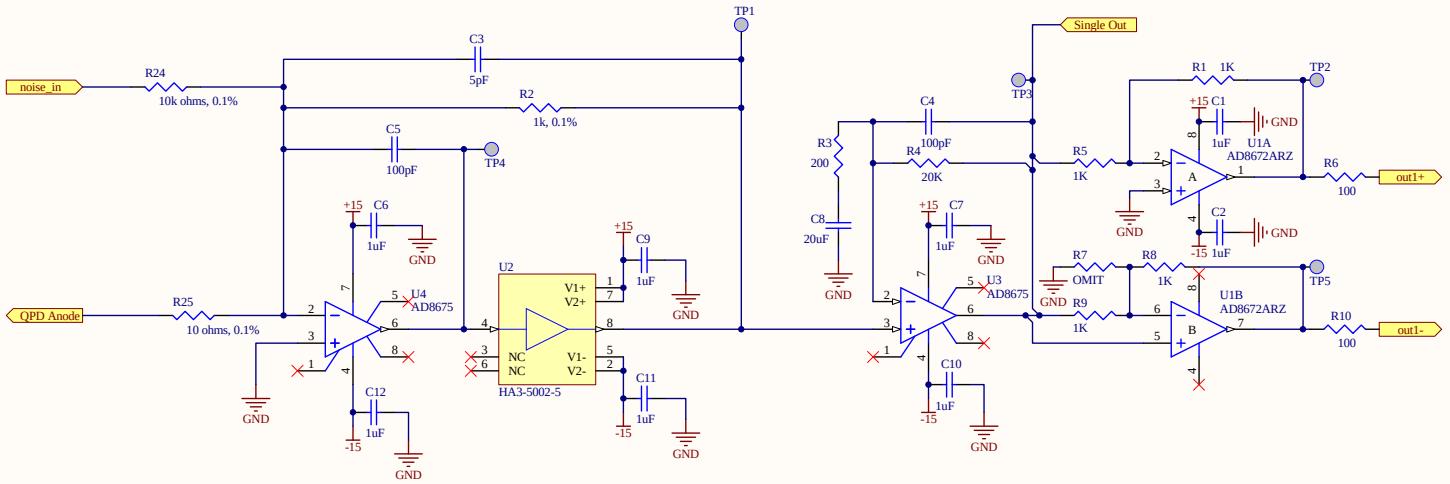
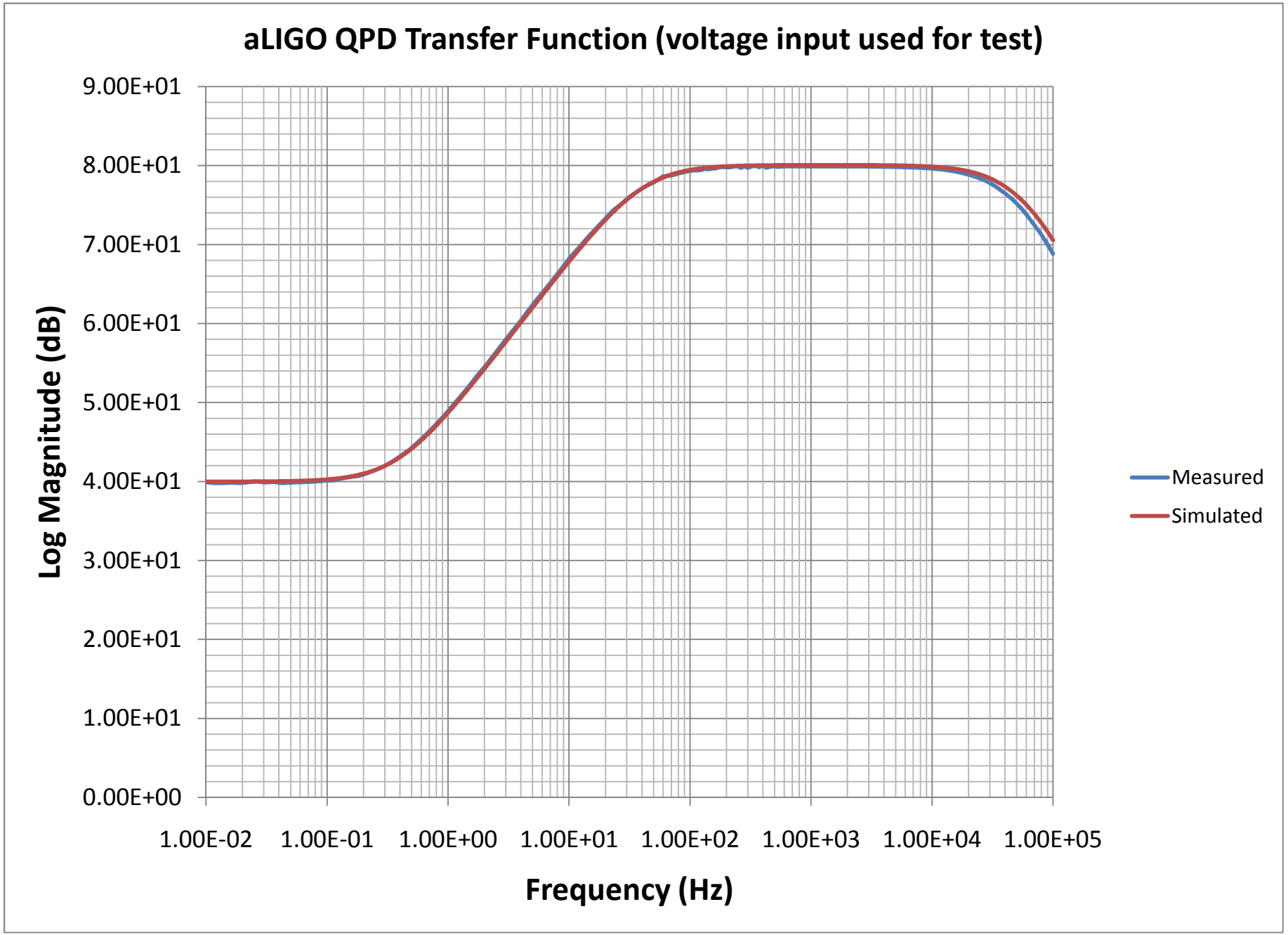
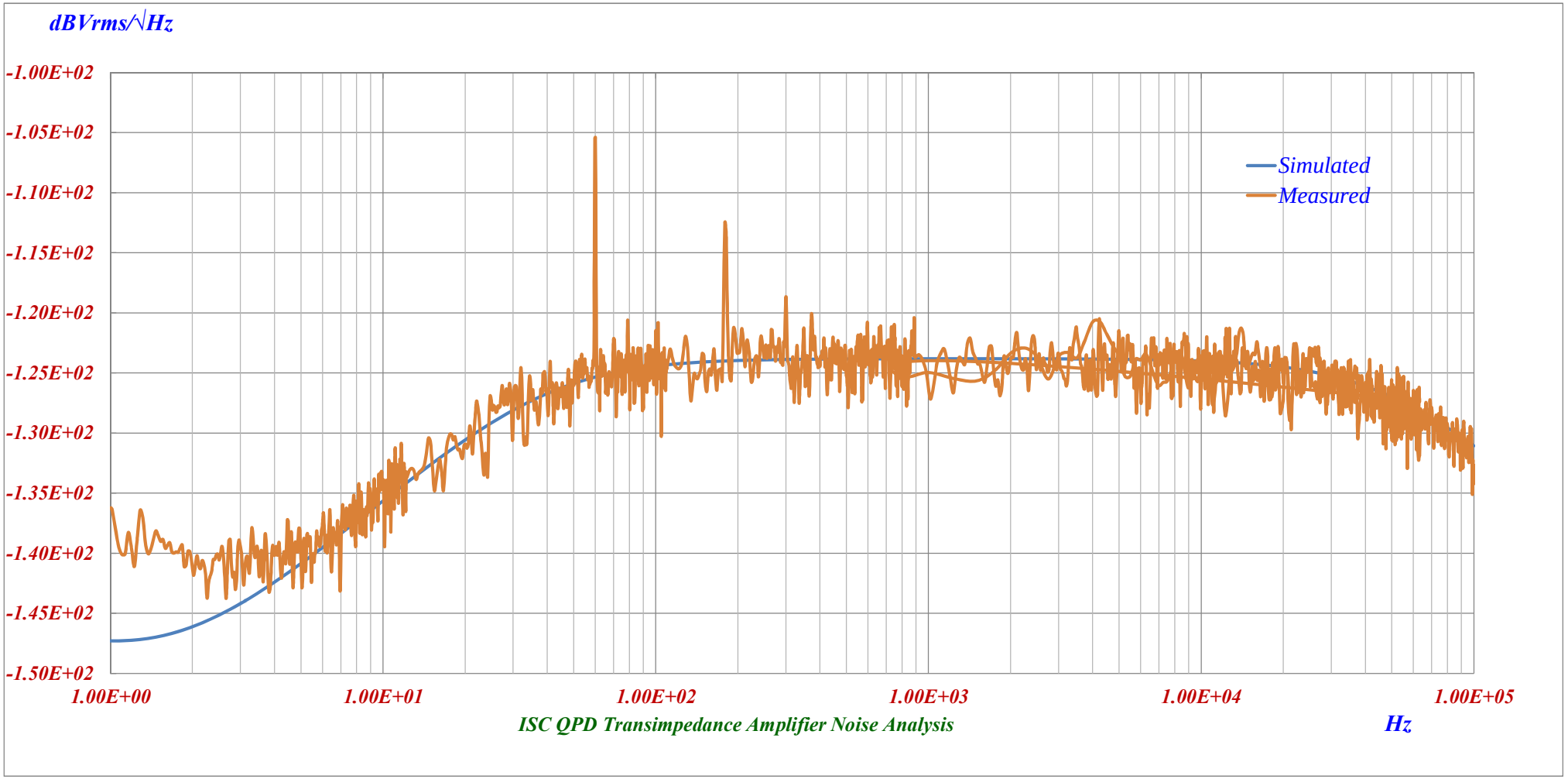


Title: *QPD Whitening Preamplifier*			*LIGO Laboratory* *California Institute of Technology* *Massachusetts Institute of Technology*	LIGO
Size: B	DCC Number: D0902158	Revision: A	Engineer: *R. Abbott, C. Osthelder*	Last Edited: Date: 11/5/2010 Time: 11:01:03 AM
File: C:\Rich's Files\Mycadfiles\ISC\aLIGO Quadpd amp\aLIGO_quad.SchDoc				Sheet 0 of 0

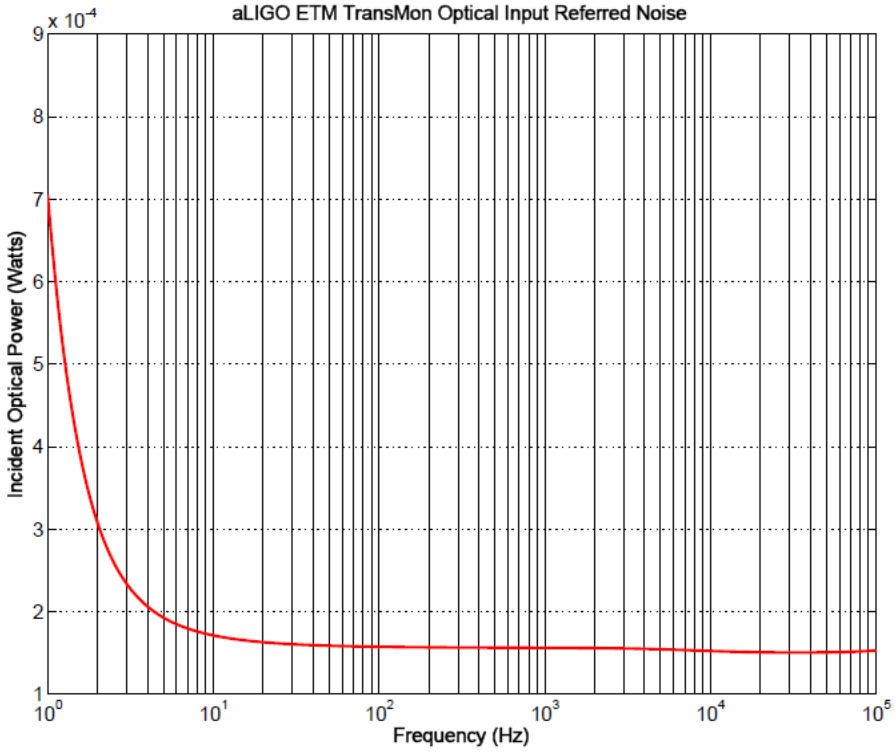

aLIGO QPD Transfer Function (voltage input used for test)
9.00E+01
8.00E+01
7.00E+01
6.00E+01
5.00E+01
4.00E+01
3.00E+01
2.00E+01
1.00E+01
0.00E+00
Log Magnitude (dB)
1.00E-02
1.00E-01
1.00E+00
1.00E+01
1.00E+02
1.00E+03
1.00E+04
1.00E+05
Frequency (Hz)
Measured
Simulated


dBVrms/√Hz
-1.00E+02
-1.05E+02
-1.10E+02
-1.15E+02
-1.20E+02
-1.25E+02
-1.30E+02
-1.35E+02
-1.40E+02
-1.45E+02
-1.50E+02
Simulated
Measured
1.00E+00
1.00E+01
1.00E+02
1.00E+03
1.00E+04
1.00E+05
ISC QPD Transimpedance Amplifier Noise Analysis
Hz

4.7 Input Referred Optical Noise

Trusting the results of the output noise plot in figure 5, a plot is shown in figure 6 depicting the input referred optical power for 1064nm light incident on a single segment of a four-segment photodiode of 95% quantum efficiency. This curve represents a unity ratio of electronics noise to shot noise for the photodetector circuit. It answers the question; what is the minimum optical power for which a single segment of the QPD is shot noise limited?

Figure 6



To go from an electrical input referred noise in units of A/√Hz to watts as shown in this plot, the following transformations are applied:

$P = i_n^2/(2*e*0.81)$, where:

P = the incident optical power shown in the plot

i_n = the input referred current noise spectral density

e = electron charge

0.81 = A/W response at 1064nm, 95%QE conversion factor for the photodiode