

QL01 Quantum-Limited Nanowatt Photoreceiver

The QL01E-A/B are part of a family of advanced photoreceivers from Hobbs ElectroOptics. Offering a previously unattainable combination of low noise and high speed, they allow measurements at the quantum (shot noise) sensitivity limit in a full 1 MHz bandwidth at light levels from as low as 35 nanowatts up to a few microwatts. The QL01s are all-new designs based on expertise gained through our own research and from designing dozens of advanced instruments for our consulting clients. We also do specials and other OEM products, so if you have an unusual requirement, give us a call or send an email.

Description

With a quantum-limited photoreceiver, the signal-to-noise ratio of the measurement is just that of the light itself—all the information present in your optical signal is preserved for the measurement. Typically we're working pretty hard to get that signal, so it's a shame to let a poor photoreceiver degrade it. That's where the QL01 comes in.

Competing products may reach this level near DC, but none beyond 10 kHz, a full factor of 100 slower than the QL01. Why should you care about speed? First of all, with 100 times the bandwidth and the same noise level, you get 100 times more data. More subtly, you can do your measurement further from DC, where many sources of noise and interference are much less troublesome. The cost of a photoreceiver is generally a small part of the total system cost, so why not choose the best?



Figure 1: The QL01 family delivers shot-noise limited performance from 7 nA to 1 uA photocurrent.

The QL01 achieves its outstanding performance through a proprietary bootstrap topology that reduces the effect of photodiode capacitance by a factor of over 1000, with sub-nanovolt noise densities. This advanced design gives the Model B shot-noise-limited detection performance at 25 nA out to its full 1 MHz bandwidth, and at 7 nA in 100 kHz.

The Model A trades off a bit of low-light performance to gain a 7× increase in detector area for more light collection and ease of alignment: it is quantum limited above 45 nA in 1 MHz and above 8 nA in 100 kHz.

Low-light applications in solid state physics, spectroscopy, chemistry, biology, and other fields will see an immediate improvement in their measurements when they switch to the QL01. The QL01 is also available in an OEM version, ready to bring improved sensitivity to commercial instruments.

Construction

These instruments are solidly built to enable high performance. The nearly featureless, machined from solid, brass Faraday cage allows high fidelity measurements be made even in electrically noisy environments. The compact size and modular design allows for swapping mechanical components and connectors to fit into constrained systems.

QL01 Typical Specifications

	QL01-A/B
Bandwidth:	DC - 1 MHz
Rise/Fall Time:	400 ns
Transimpedance:	10 M Ω
Slew Rate:	No slew limiting with full scale step input
Output Voltage:	0 - 10 V
Dark Current (20°C):	≤ 2 nA
Dimensions:	110 × 55 × 30mm

Noise

Noise Equivalent Power (NEP) is the signal level required to reach a SNR of 1.0 in a 1-Hz bandwidth, and so considers only the dark noise.

NEP @ 840 nm	Model A	Model B
DC - 20 kHz:	70 fW	70 fW
DC - 100 kHz:	80 fW	70 fW
DC - 1 MHz:	170 fW	125 fW

Integrated Noise (RMS)

DC - 20 kHz:	70 μ V	63 μ V
DC - 100 kHz:	160 μ V	145 μ V
DC - 1 MHz:	1.1 mV	0.8 mV

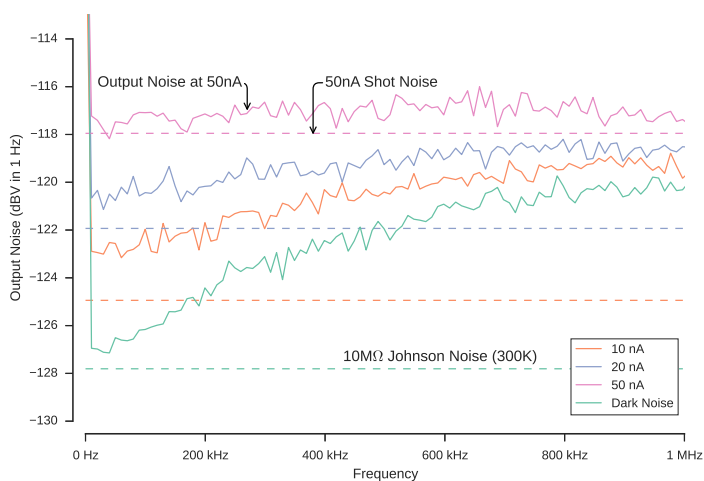


Figure 2: Noise spectra of the QL01-B. It is shot-noise limited at ≥ 7 nA (DC-100 kHz) and ≥ 25 nA (DC-1 MHz).

Linearity

The QL01 is highly linear through its operating range of 0-10V output. Output ranges much above 11.5V or short pulses with high peak power and very low duty cycles may cause linearity to suffer. See the user's manual for more.

Spectral Response

	Model A	Model B
Spectral Response:	See Figure 3	See Figure 3
Peak Response:	0.62 A/W	0.65 A/W
Peak Wavelength:	850 nm	870 nm

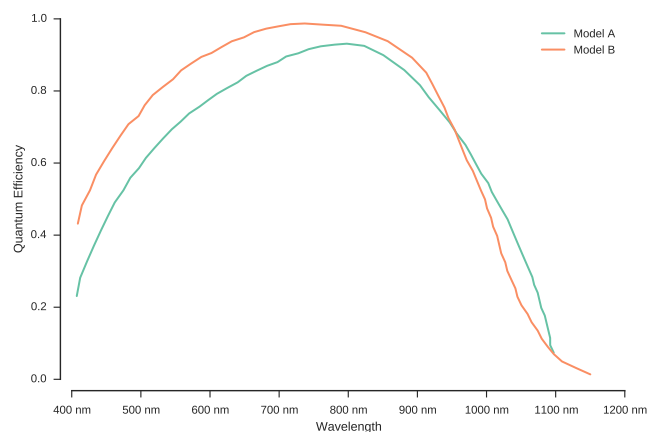


Figure 3: Quantum efficiency of the QL01-A/B vs wavelength, showing $> 90\%$ peak QE.

Resources

- Product Page:** <http://hobbs-eo.com/ql01>
- User Manual:** <http://hobbs-eo.com/ql01manual>
- Order Form:** <http://hobbs-eo.com/order-form>

Company Information

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