

# IR GRENOUILLES

THE WORLD'S MOST POWERFUL AND EASIEST TO USE ULTRASHORT- LASER- PULSE MEASUREMENT DEVICE NOW MEASURES IR PULSES!

Several IR GRENOUILLES measure pulses with wavelengths from 900 to 1100 nm and 1320 to 1620 nm.

As **FROG** devices, GRENOUILLES yield the pulse intensity and phase vs. time and the spectrum and spectral phase with great accuracy and reliability, making no assumptions about the pulse or its shape.

Both devices also yield the **pulse-front tilt** and **spatial chirp**, and the Model 10-100 yields the **beam spatial profile**.

And, with accompanying QuickFROG pulse-retrieval software, it does all this in **real time!**

GRENOUILLE tells you more about your pulse with less effort than ever imagined!

Remarkably, it **needs no alignment—ever!** Even placing it in the beam is amazingly easy.

Free-space coupling is standard (in all models), but the Models 15-40 and 15-100 also include (as standard) fiber coupling for simple integration with fiber-optic systems.

And weighing only about 1 kg, they're light and compact, with a footprint smaller than a foot!



## GRENOUILLE AT A GLANCE

- The pulse intensity and phase vs. time
- The pulse spectrum and spectral phase vs. wavelength
- The beam spatial profile (1- $\mu$ m models)
- The spatial chirp
- The pulse-front tilt
- The autocorrelation
- No assumptions
- No alignment
- Very easy to use
- High sensitivity
- Real-time intensity and phase retrieval
- Minimal weight and size
- Laptop and USB compatibility
- Low cost

A single GRENOUILLE can measure pulses from a wide variety of sources, from the lowest-power oscillator to the highest-intensity amplifier.

Voted one of the year's 100 most technologically significant inventions in 2003 and one of the top 25 new optics products of 2004, GRENOUILLE represents a huge leap forward in ultrashort-pulse-measurement technology.



## IR GRENOUILLE SPECIFICATIONS

FROG/GRENOUILLE model:	10-100-USB	15-40-USB	15-100-USB
Wavelength range:	0.9 – 1.1 $\mu\text{m}$	1.22 – 1.62 $\mu\text{m}$	1.32 – 1.62 $\mu\text{m}$
Pulse-length range:	$\sim 0.1$ – $\sim 1$ ps	$\sim 40$ – $\sim 400$ fs	$\sim 0.1$ – $\sim 1$ ps
Delay increment <sup>1</sup> (resolution):	1.145 fs/pixel	2.25 fs/pixel	5.41 fs/pixel
Temporal range <sup>2</sup> :	1.9 ps	1.9 ps	3.8 ps
Spectral resolution <sup>3</sup> :	0.4 nm	3 nm	0.6 nm
Spectral range <sup>2</sup> :	35 nm	150 nm	60 nm
Pulse complexity:	Time-bandwidth product < 10		
Intensity accuracy:	2%		
Phase accuracy:	0.01 rad (intensity-weighted phase error)		
Single-shot operation?	Yes (free-running mode and triggered single shot are standard)		
Sensitivity (single-shot)	1 $\mu\text{J}$		
Sensitivity (at $10^3$ pps):	100 $\mu\text{W}$ (100 nJ)		
Sensitivity (at $10^8$ pps):	10 mW (100 pJ)		
Sensitivity (at $10^{10}$ pps):	100 mW (10 pJ)		
Spatial-profile accuracy:	< 0.2 % (8 bits; 480 x 640 pixels)	na	
Spatial chirp accuracy (dx/d $\lambda$ ):	1 $\mu\text{m}/\text{nm}$		
Pulse-front tilt accuracy (dt/dx):	0.05 fs/mm		
Required input polarization:	Any (Just rotate GRENOUILLE!)		
Fiber-coupling available?	No	Yes	
Desired input-beam diameter:	2 – 4 mm (collimated)	2 – 4 mm (if not fiber coupled)	
Input-beam lateral-displacement tolerance:	1 mm (if not fiber-coupled)		
Number of alignment knobs:	Zero		
Time to set up:	$\sim 10$ minutes		
Dimensions (L x W x H):	33 cm x 4.5 cm x 11.5 cm	26 cm x 4.5 cm x 11.5 cm	26 cm x 4.5 cm x 11.5 cm
Weight:	1.2 kg	1.2 kg	1.2 kg

1. At full camera resolution.

2. Temporal and spectral "ranges" are the full-scale ranges, not the pulse FWHM (which is typically a factor of 3 smaller).

3. Achieving optimal spectral resolution involves spectral deconvolution, which improves spectral resolution by a factor of  $\sim 3$ .

## ADDITIONAL NOTES

- Absolute wavelength is determined to a few nm by the calibrated crystal-angle dial.
- GRENOUILLE is a second-harmonic-generation (SHG) FROG and hence has an ambiguity in the direction of time, but this one-bit ambiguity can be removed easily. (In contrast, autocorrelation has infinitely many non-removable ambiguities.)
- Feedback on measurement quality is obtained from comparison with the retrieved trace.
- Input-beam mode quality should be good (but single transverse mode is not required).
- Free-running operation and triggered single-shot mode are both standard on all models. Just connect the USB cable; no power supply needed.



R&D 100  
Award Winner 2003



Circle of Excellence  
Award Winner 2004