## Suspensions

# *A modulated NIR calibration system*


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# *Measurement of AC / DC gain ratio*

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- Violin-Mode (VM) transimpedance amplifier has a single Photodiode (PD) input.
- Can measure its *DC* response to a quasi-static shadow displacement, in volts per metre, by scanning a silica suspension test fibre's shadow across the PD.
- Need to know the ratio of the PD + amplifier's *AC* to *DC* gain, at a given frequency (such as 500 Hz, the fundamental VM resonance of a silica fibre).
- ➢ Then will know the VM calibration of the PD + amplifier in terms of output volts (rms) per metre (rms) of VM oscillation at that frequency.

# Passband of prototype VM Amplifier

The ratio of *AC* voltage gain to the *DC* (s = 0) gain of the prototype VM transimpedance amplifier is: -

$$\frac{V_{AC}}{V_{DC}} = \frac{A\,(R_F / R_i)\, s^2\, CRC_2R_2}{(s^2 CRC_FR_F + sCR + R_F / R_i)(sC_2R_2 + 1)(sC_3R_3 + 1)}$$

$A = 100$, $R_F = 1.2\ \mathrm{M\Omega}$, $R_i = 120\ \mathrm{k\Omega}$, $R = 100\ \mathrm{k\Omega}$, $C = 100\ \mathrm{nF}$, $R_2 = 10\ \mathrm{k\Omega}$, $C_2 = 100\ \mathrm{nF}$, $R_3 = 3\ \mathrm{k\Omega}$, $C_3 = 4.7\ \mathrm{nF}$.

- **So expect Gain Ratio mid-band = 1000** (approximately—expect it to be slightly reduced from this value through its narrowly circumscribed passband).

# Control of NIR calibration source

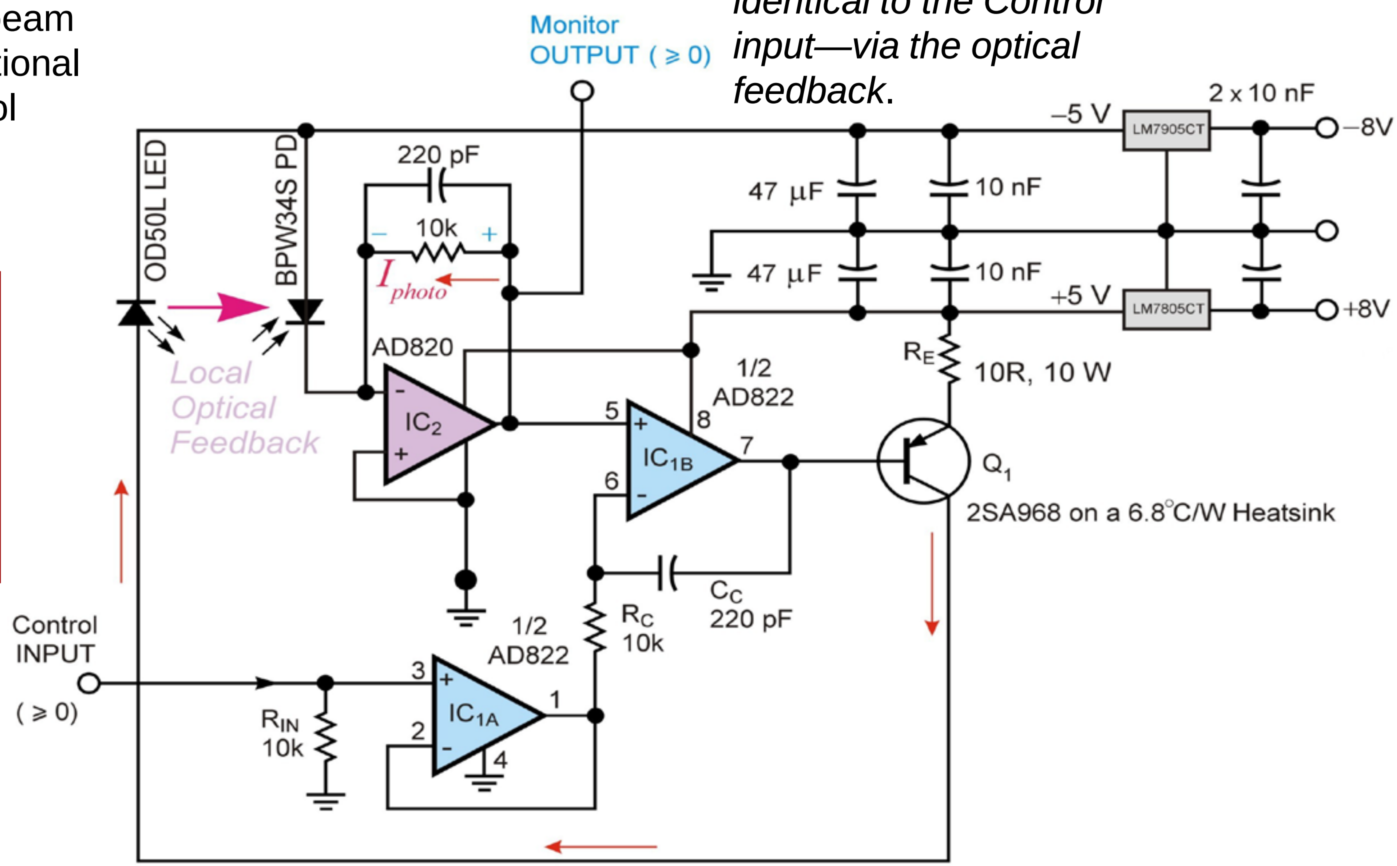
- CW and modulated NIR output beam components forced to be proportional to *AC* modulation and *DC* Control input voltages, respectively.

*This voltage should be identical to the Control input—via the optical feedback.*

Ref. This circuit was derived from that given in an article by Lukasz Sliwczynskia and Marcin Lipinski, Institute of Electronics, Krakow, Poland

EDN,1 September,1998.

*DC* control level + (small) *AC* modulation at frequency of interest.



# *AC Calibration of VM sensor*

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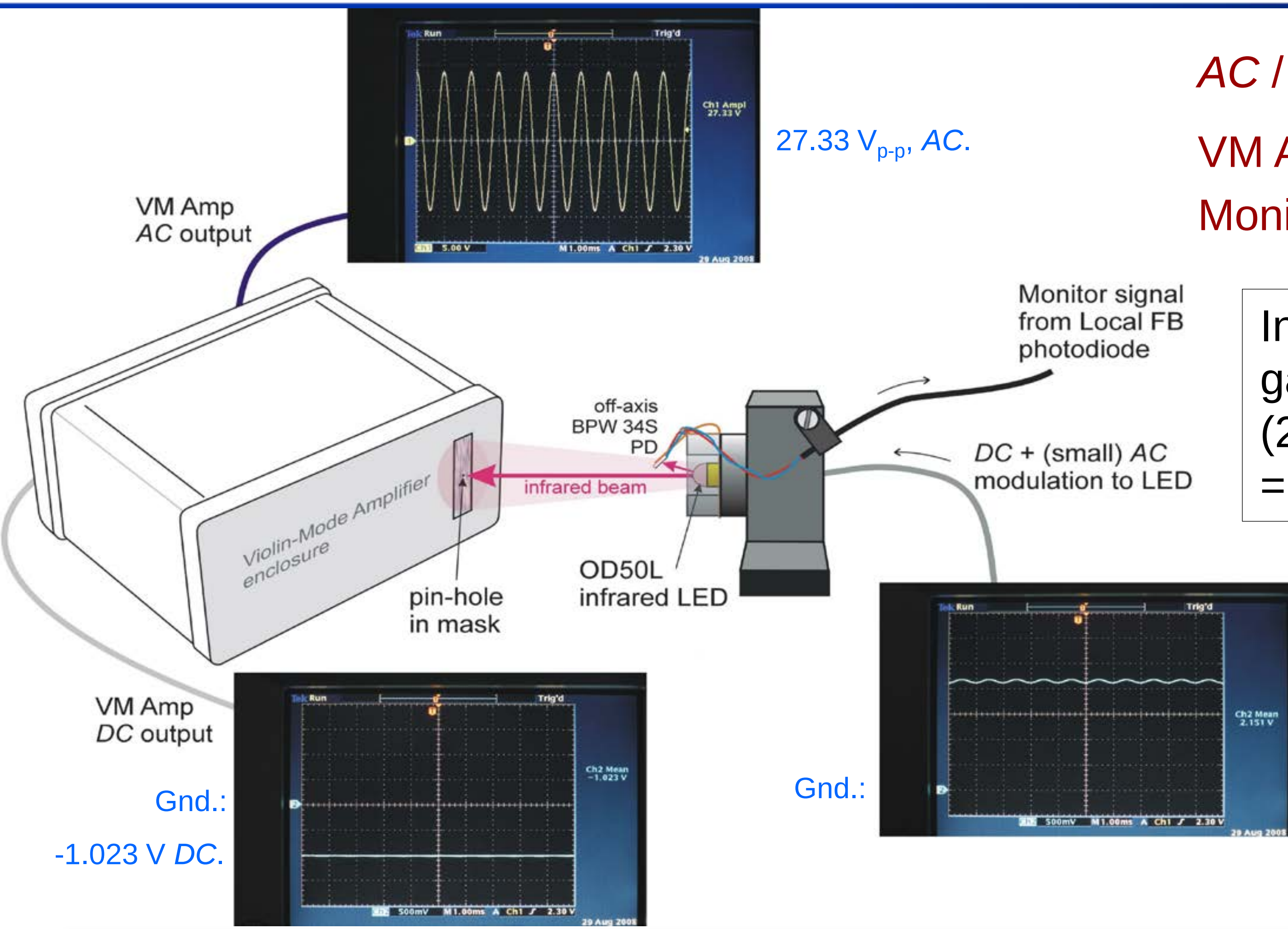


*AC* / *DC* gain ratio =

$$\frac{\text{VM Amp: } (AC \text{ output} / |DC \text{ output}|)}{\text{Monitor: } (AC \text{ input} / DC \text{ input})}$$

In this example, *AC* / *DC* gain ratio = (27.33/1.023)/(0.058/2.151) = 990.8, at 1 kHz.

# *Calibration results for prototype Violin-Mode transimpedance Amplifier*

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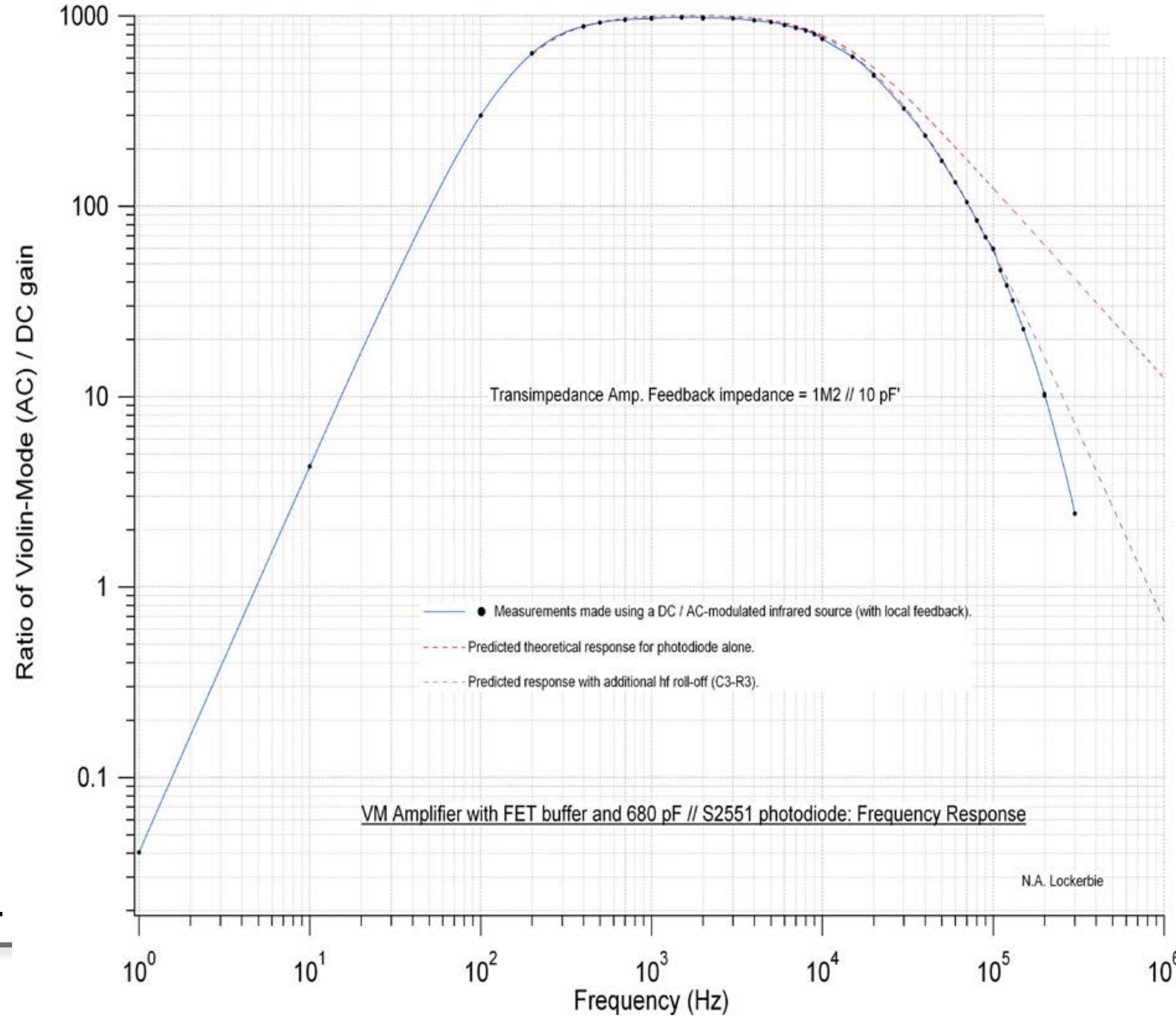
- VM sensors were calibrated *absolutely* in terms of ***AC*** V / m displacement.

- e.g.: ***AC*** shadow displacement *'slope sensitivity'* at 1 kHz ≅ 1000 × ***DC*** value.

// 680pF simulated the cable capacitance.



# ‘Combined image’ dual PD detector

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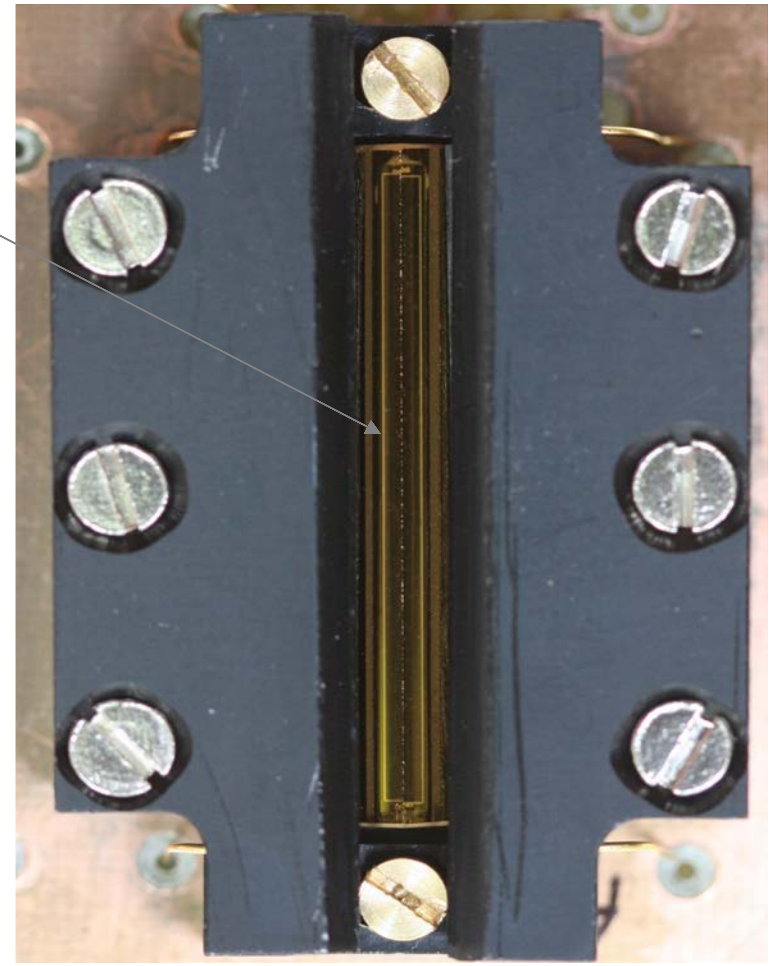
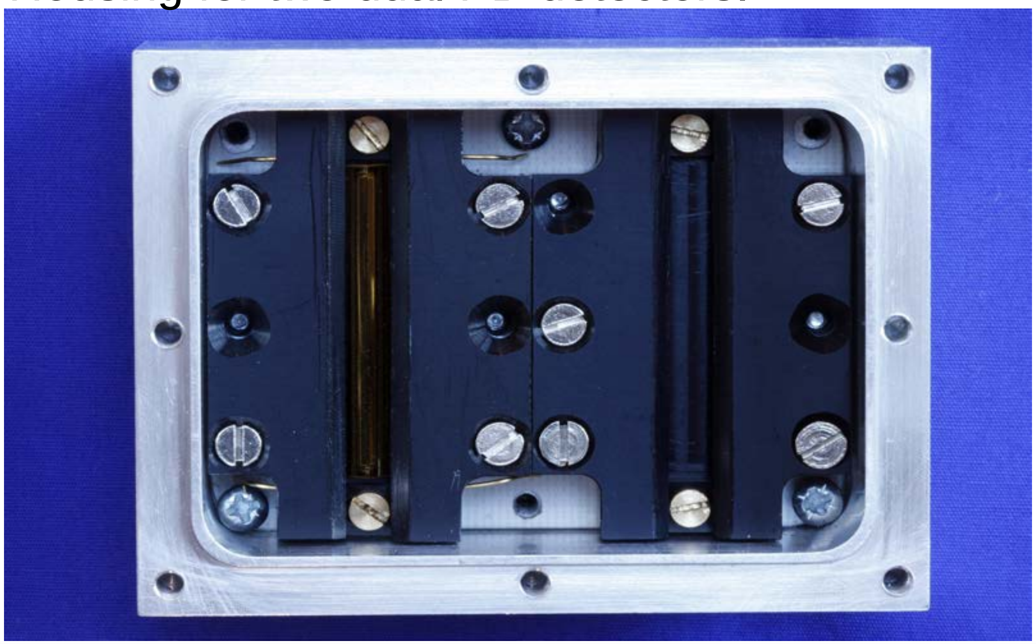
Image of dual-PD detectors (2 × Hamamatsu S2551: each measuring 1.2 mm × 29.1 mm)



Housing for two dual PD detectors.



# *Detector housing for 2 × dual-PD shadow detectors, one per silica fibre*

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