

**PREAMPLIFIERS FOR EMFIT SENSORS**

There are two basic operational amplifier circuits for Emfit sensors, charge amplifier (Fig. 1) and voltage amplifier (Fig. 2).

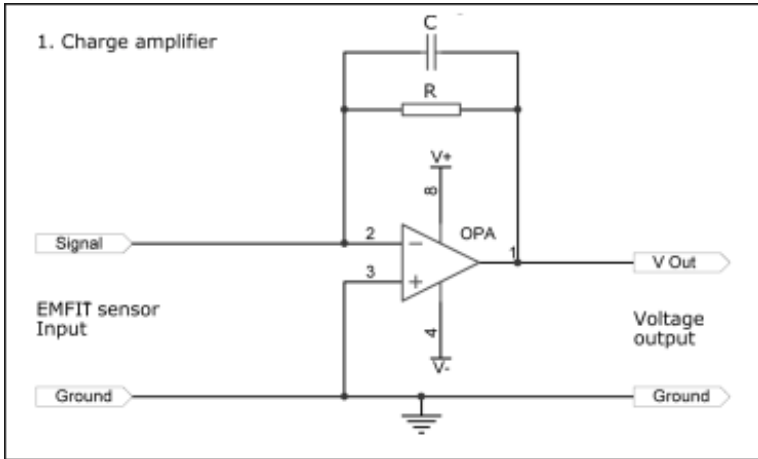


Fig. 1

Time Constant = RC

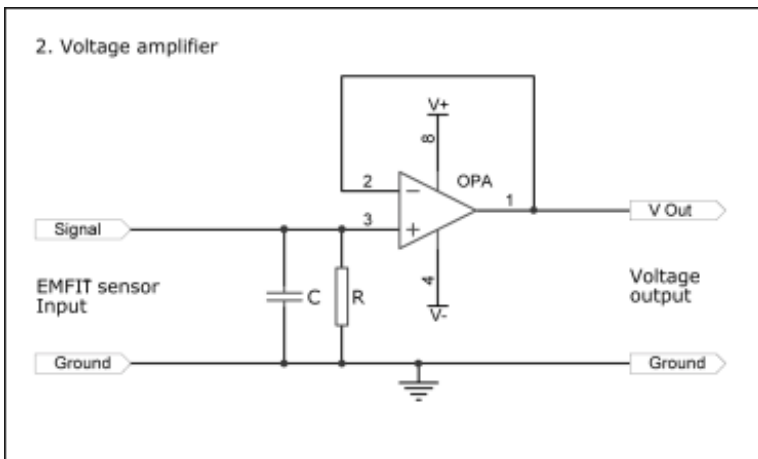


Fig. 2

Time Constant = RC  
(Sensor capacitance must be included)

In both circuits the voltage output is determined by the sensitivity  $S_q$  [pC/N] of the Emfit sensor and the capacitance  $C$  [pF]. The low frequency cut-off is determined by the time constant  $R \times C$ . In the voltage amplifier,  $C$  includes also the capacitance of the Emfit sensor. Both circuits can be modified in several ways to add for example gain and/or filtering

For frequencies  $\gg (1/2\pi) \times R \times C$ , the voltage signal amplitude  $V_p$  [V] in both circuits will then be:

$$V_p = (1/C) \times S_q \times F_p$$

Where  $F_p$  [N] is the amplitude of the force.

In case of a force impact, the time constant  $R \times C$  must be much higher than the duration of the impact ( $T$ ) in order to measure the amplitude of the force accurately. This can be seen in figure 3.

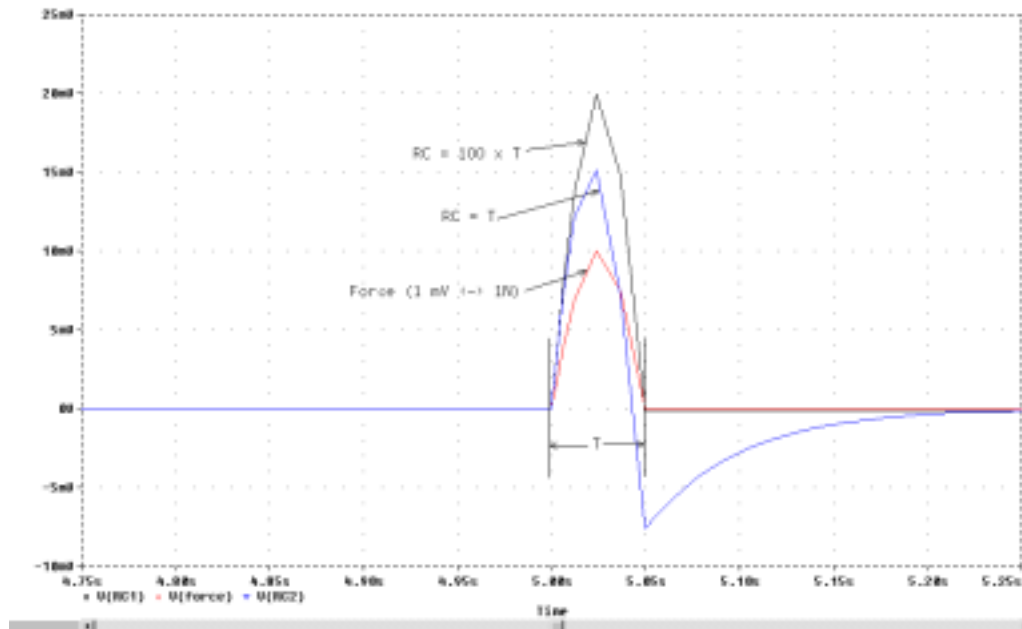


Fig. 3. Effect of the RC time constant to the output voltage.

In most cases we have used 100 M $\Omega$  resistors for R and 100 pF ... 100 nF for C depending on the sensor's size and the requirements for sensitivity and frequency response. AD820 (Analog Devices) is a good operational amplifier. We have also used some operational amplifiers made by Texas Instruments (for example TLC 2274, TLV 2254). In some cases we have preferred the charge amplifier because then the capacitance (size) of the Emfit sensor has no effect on the output signal amplitude.

### ADDITIONAL INFORMATION

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