The over-pressure ***difference*** signal is input to an ***integrating*** op-amp, which electronically carries out the above integral operation. The voltage signal output from the integrating op-amp is thus ***proportional*** to the 1-D particle velocity $\tilde{u}_r(\vec{r},t) = \tilde{u}_r\left(\tfrac{1}{2}(\vec{r}_1+\vec{r}_2),t\right)$ ! Using 3 such microphone pairs (in orthogonal *x*-*y*-*z* orientation) thus yields the full 3-D particle velocity $\vec{\tilde{u}}(\vec{r},t)$ !

The use of matched pairs of omni-directional pressure microphones separated by a small distance $\Delta z \ll \lambda$ to measure the local pressure gradient $\Delta_z \tilde{p}(\vec{r},t)/\Delta z$ and thereby infer (*i.e.* compute) the local 1-D particle velocity $\partial\tilde{u}_z(\vec{r},t)/\partial t$ is known as the so-called ***p-p method***.

If the diaphragm of the pressure microphone is ***fully-open*** (*i.e.* not enclosed), such a microphone {of characteristic longitudinal/*z*-dimension *d*} measures the local over-pressure ***difference*** $\Delta\tilde{p}_{dia}(\vec{r},t) = \tilde{p}_{dia}^{front}(\vec{r},t) - \tilde{p}_{dia}^{rear}(\vec{r},t)$ for $d \ll \lambda$ – *i.e.* it becomes a ***differential-pressure*** microphone. Furthermore, it is obvious that differential pressure microphones have a vectorial-type directional response, since the voltage signal output from this microphone will reverse its sign if the differential microphone is rotated about its symmetry axis by 180°. The angular response of a differential pressure microphone is therefore vectorially described by $\Delta\tilde{p}_{dia}(\vec{r},t)\hat{n}$ where $\hat{n}$ is defined as the ***outward*** pointing unit vector from the front surface of the microphone diaphragm. For a sound wave with vector wavenumber $\vec{k} = |\vec{k}|\hat{k} = k\hat{k}$ ( $\hat{k}$ || to the propagation direction), the ***angular*** response of the differential pressure microphone is $\Delta\tilde{p}_{dia}(\vec{r},t)\hat{n}\bullet\hat{k} = \Delta\tilde{p}_{dia}(\vec{r},t)\cos\Theta$ where $\Theta$ is the 3-D opening angle between $\hat{n}$ and $\hat{k}$.

Thus when: $\Theta = 0^o$, $\hat{n}\bullet\hat{k} = \cos\Theta = +1$ and: $\Delta\tilde{p}_{dia}(\vec{r},t)\hat{n}\bullet\hat{k} = +\Delta\tilde{p}_{dia}(\vec{r},t)$.

When: $\Theta = 90^o$, $\hat{n}\bullet\hat{k} = \cos\Theta = 0$ and: $\Delta\tilde{p}_{dia}(\vec{r},t)\hat{n}\bullet\hat{k} = 0$.

When: $\Theta = 180^o$, $\hat{n}\bullet\hat{k} = \cos\Theta = -1$ and: $\Delta\tilde{p}_{dia}(\vec{r},t)\hat{n}\bullet\hat{k} = -\Delta\tilde{p}_{dia}(\vec{r},t)$.

The polar response of a ***differential*** pressure microphone is a ***figure-8 pattern***, as shown below: