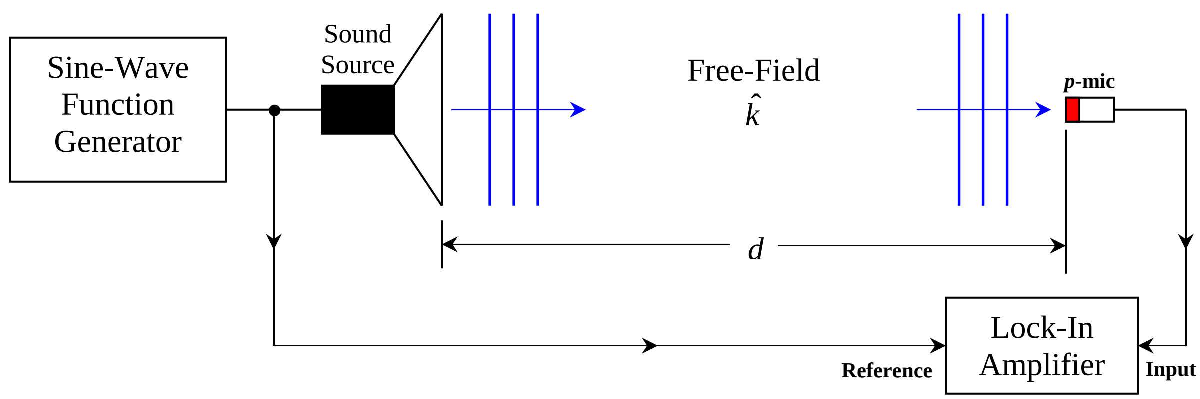
The use of a dual-channel *LIA* for phase-sensitive measurements of periodic complex pressure $\tilde{p}(\vec{r},t)$ and/or particle velocity $\vec{\tilde{u}}(\vec{r},t)$ signals associated with a complex sound field $\tilde{S}(\vec{r},t;\omega)$ has associated with it one other detail which is not immediately apparent in the above formulae.

Consider the use of a dual-channel *LIA* in a typical ***phase-sensitive*** acoustical physics experiment, such as the typical one shown in the figure below, in which a sound source is excited by a pure-tone/single-frequency sine-wave signal output from a function generator, whose instantaneous output voltage is of the form $V^{FG}(\omega,t) = V_o^{FG}\cos(\omega t)$. The sine-wave signal is also used as the ***reference*** for the dual-channel *LIA*.

For simplicity's sake, let us imagine that we have an ***ideal*** sound source, in that it does *not* introduce a phase shift of any kind in the process of generating a monochromatic traveling plane wave, which propagates as a ***free-field***. The ***time-domain*** representation of the complex over-pressure amplitude associated with the ***free-field*** monochromatic traveling plane wave propagating in the +*ve* $\hat{x}$-direction is of the form $\tilde{p}(x,t;\omega) = p_o e^{i(\omega t - kx)} = p_o e^{-ikx}\cdot e^{i\omega t} = \tilde{p}(x,\omega)\cdot e^{i\omega t}$, where $\tilde{p}(x,\omega)$ is the ***frequency-domain*** representation of the complex over-pressure amplitude associated with the monochromatic traveling plane wave.



If the pressure mic is located at *x* = 0, then: $\tilde{p}(x=0,t) = p_o \cdot e^{i\omega t}$. The ***real/in-phase*** and ***imaginary/90º-out-of-phase/quadrature*** *RMS* voltage amplitude components output from the *LIA* will be $V_{o_{RMS}}^{Sig}$ and 0, respectively – *i.e.* the phase $\varphi_S\big|_{x=0} = 0$.

If the *p*-mic sensitivity is $S_{p\text{-}mic}\,(mV/Pascal)$, then the ***frequency-domain real/in-phase*** and ***imaginary/90º-out-of-phase/quadrature*** *RMS* components of the complex pressure amplitude $\tilde{p}(x=0,\omega)$ at *x* = 0 are: $p_o = V_{o_{RMS}}^{Sig}/S_{p\text{-}mic}\,(RMS\ Pascals)$ and: $0\,(RMS\ Pascals)$, respectively.

If the pressure mic is instead moved to *x* = *d*, the complex over-pressure amplitude associated with the a ***free-field*** monochromatic traveling plane wave at $x = d$ is:

$$\tilde{p}(x=d,t;\omega) = p_o e^{i(\omega t - kd)} = p_o e^{-ikd}\cdot e^{i\omega t} = p_o\left[\cos kd - i\sin kd\right]\cdot e^{i\omega t} = \tilde{p}(x=d,\omega)\cdot e^{i\omega t}$$