



A2 Application Hint

INTRODUCTION

This document describes how to calculate the unweighted *physical* Sound Pressure Level (SPL) out of a microphone level measured with an A1 or A2.

NOTE The physical SPL does not exactly correspond to the standardized *weighted* SPL that is measured by SPL meters etc.

- The physical SPL reflects the *instantaneous* RMS level.
- The standard SPL is a *time-weighted* measurement function.

ASSUMPTIONS

Given Sensitivity of the microphone: **S** expressed in mV/Pa
 Microphone output level: **ML** expressed in dBu, dBV or V

Wanted Physical sound pressure level: **SPL** expressed in dB

CONVERSION FORMULAS

The following formulas convert the measured microphone level **ML** - expressed dBu, dBV or V - in into the physical sound pressure level **SPL**, expressed in dB.

$$SPL [dB] = 151.8 - 20 * \log_{10}(S) + ML [dBu]$$

$$SPL [dB] = 154.0 - 20 * \log_{10}(S) + ML [dBV]$$

$$SPL [dB] = 151.8 - 20 * \log_{10}(S) + 20 * \log_{10}\left(\frac{ML [V]}{0.7746 V}\right)$$

DERIVATION

The formulas listed above are derived in the following way: First, the measured sound pressure **p** [Pa] must be calculated by using **S** [mV/Pa] and **ML**.

$$p [Pa] = \frac{ML [V] * 1000}{S [mV / Pa]} = 774.6mV * \frac{10^{\left(\frac{ML [dBu]}{20}\right)}}{S [mV / Pa]}$$

Next, the linear SPL_{LIN} value must be calculated, which is the ratio between the measured sound pressure p and the reference pressure $p_0 = 20 \cdot 10^{-6}$ [Pa].

$$SPL_{LIN} = \frac{p [Pa]}{p_0 [Pa]} = \frac{774.6mV}{20 \cdot 10^{-6} Pa * S [mV / Pa]} * 10^{\left(\frac{ML[dBu]}{20}\right)}$$

The physical SPL , expressed in dB, is calculated according to

$$SPL [dB] = 20 * \log_{10}(SPL_{LIN}) = 20 * \log_{10}\left(\frac{774.6mV}{20 \cdot 10^{-6} Pa * S [mV / Pa]} + 10^{\left(\frac{ML[dBu]}{20}\right)}\right)$$

This formula may be reduced as follows

$$\begin{aligned} SPL [dB] &= 20 * \left[\log_{10}\left(\frac{774.6mV}{20 \cdot 10^{-6} Pa * S [mV / Pa]}\right) + \log_{10}\left(10^{\frac{ML[dBu]}{20}}\right) \right] \\ &= 20 * \left[\log_{10}\left(\frac{774.6}{20 \cdot 10^{-6} * S}\right) + \frac{ML [dBu]}{20} \right] \\ &= 20 * \log_{10}\left(\frac{774.6}{20 \cdot 10^{-6} * S}\right) + ML [dBu] \\ &= 20 * \left[\log_{10}\left(\frac{774.6}{20 \cdot 10^{-6}}\right) - \log_{10}(S) \right] + ML [dBu] \\ &= 20 * (7.588 - \log_{10}(S)) + ML [dBu] \\ &= 151.8 - 20 * \log_{10}(S) + ML [dBu] \end{aligned}$$

which is the formula for the conversion of a microphone level, expressed in dBu, into the physical SPL , expressed in dB (see **p. 1**).