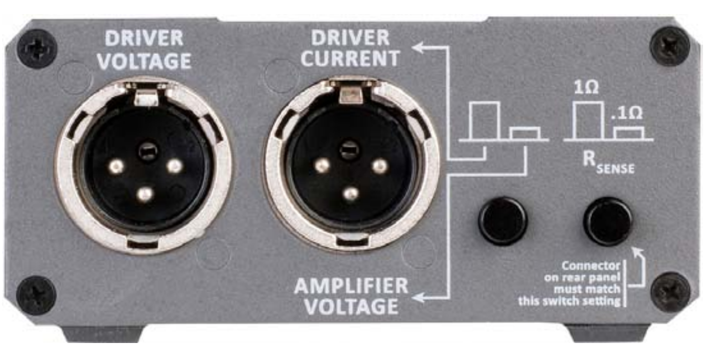
# IMP1 Impedance Fixture User's Guide

The Audio Precision IMP1 Impedance Fixture provides a convenient solution for measuring loudspeaker driver impedance.


## Overview

This document describes the use of the IMP1 impedance fixture with the APx Impedance/Thiele-Small or Loudspeaker Production Test measurements, which can produce a set of impedance curves and the derived Thiele-Small parameters. Unless noted, references made to settings and fields in the APx software refer to either of these measurements.

Driver impedance measurements require simultaneous measurement of the voltage across the driver voice coil and the current through it. The voltage across the coil can be directly measured by an analyzer input; the current in the circuit is calculated from the measured voltage across a precision resistor of known value, called the *sense* resistor.



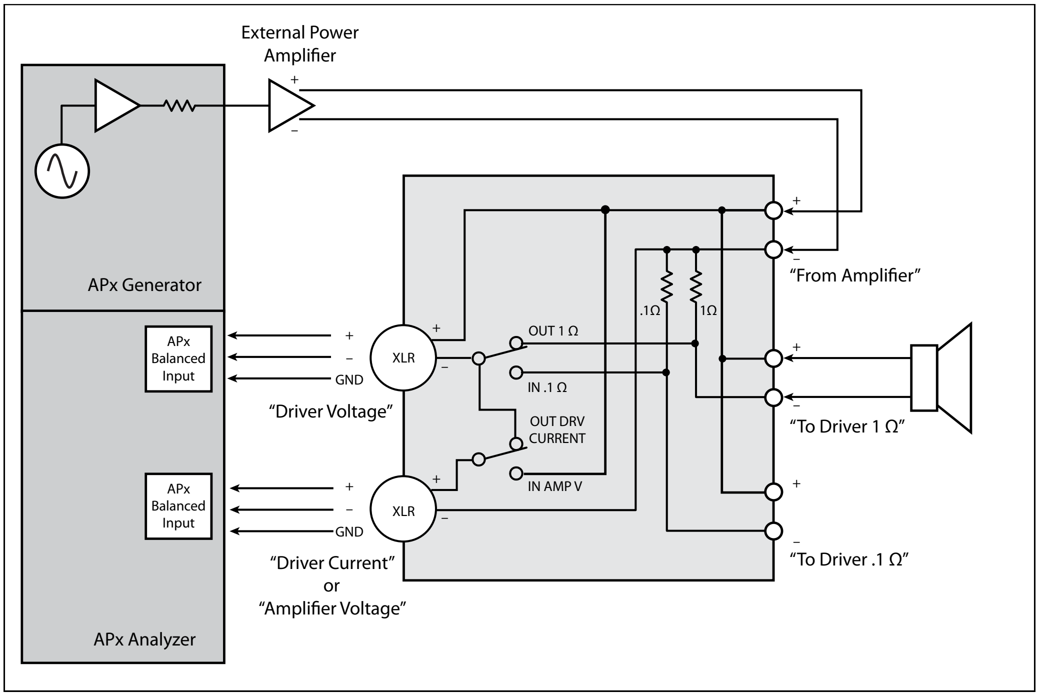

IMP1 front panel

When measuring impedance in one of the external configurations available in the APx500 software, an external power amplifier and sense resistor are required. The IMP1 provides a choice of two sense resistors, with the values of 1.0 Ω and 0.1 Ω. XLR connectors on the front of the IMP1 provide analyzer connections, and double-banana connectors on the rear provide connections for the driver and a power amplifier.


IMP1 rear panel

## Impedance Testing with an APx analyzer

In these tests, we are not measuring conventional audio parameters; we are measuring voltage or current in circuit components and making calculations with the results. Consequently, one or two of the analyzer input




IMP1 schematic

channels must have specific roles assigned, either to measure the voltage across the driver, the voltage across the sense resistor, or the total voltage across the driver and the sense resistor. Please pay close attention to the roles depicted in the illustrations below and identified on the Channel control in the software. Refer to the Impedance/Thiele-Small and Loudspeaker Production Test documentation in the APx500 User's Manual and in the online Help.

In all cases, for best accuracy use short wires of very low resistance and choose a power amplifier with low output impedance.

## Choosing the sense resistor value

The resistance of the sense resistor must be low compared to the nominal driver impedance to avoid affecting the measured Q. The 0.1 Ω resistor is appropriate for drivers of 2 Ω to 8 Ω. For higher impedance drivers (such as headphones), the 1.0 Ω sense resistor is recommended.

Selecting a sense resistor requires two actions:

1. Set the IMP1 front panel switch to the selected resistance, with the button **OUT** for 1.0 Ω, or **IN** for 0.1 Ω.
2. Connect the driver under test to the appropriate set of banana jacks, labeled for 1.0 Ω or 0.1 Ω on the rear panel.

Both of these actions must be taken for correct measurements.

## Choosing a test configuration

IMP1 and the APx impedance measurements support two test configurations (with additional variations), detailed below. Both configurations use a power amplifier and sense resistor external to the analyzer.

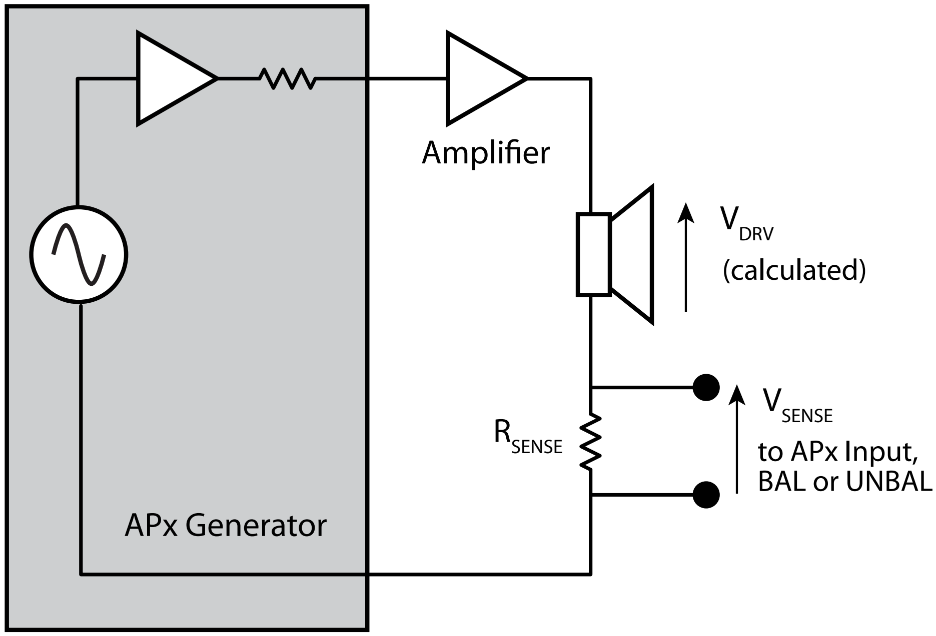
## External/known gain

In the APx software, this configuration is denoted as **Ext./known gain.**

The gain and phase response of the amplifier must be known from a previous measurement to allow correction for amplifier characteristics. We recommend that you perform the amplifier correction procedure available in the Impedance/Thiele-Small and Loudspeaker Production Test measurements in current versions of APx500. See the APx500 user documentation for more information.

Once amplifier correction is in place, the selector switch on the IMP1 front panel must be set to DRIVER CURRENT (**OUT** position). Only one connection is required, from the XLR labeled DRIVER CURRENT to an analyzer input. In the APx software, **Channel (sense)** must be set to the input channel connected to DRIVER CURRENT.

Enter the amplifier gain and the value of the sense resistor into the data entry fields in the APx software. The voltage across the sense resistor is measured. Since the amplifier gain is known, the total voltage across the load (driver plus sense resistor) is known. $V_{DRV}$ is calculated by subtracting $V_{SENSE}$ from the total voltage across the load.



External/known gain test configuration

### Advantage

Only one analyzer input is required for the impedance measurement. Since the Loudspeaker Production Test measurement requires an additional input for the acoustic test, this configuration is important for analyzers with only two inputs.

### Disadvantage

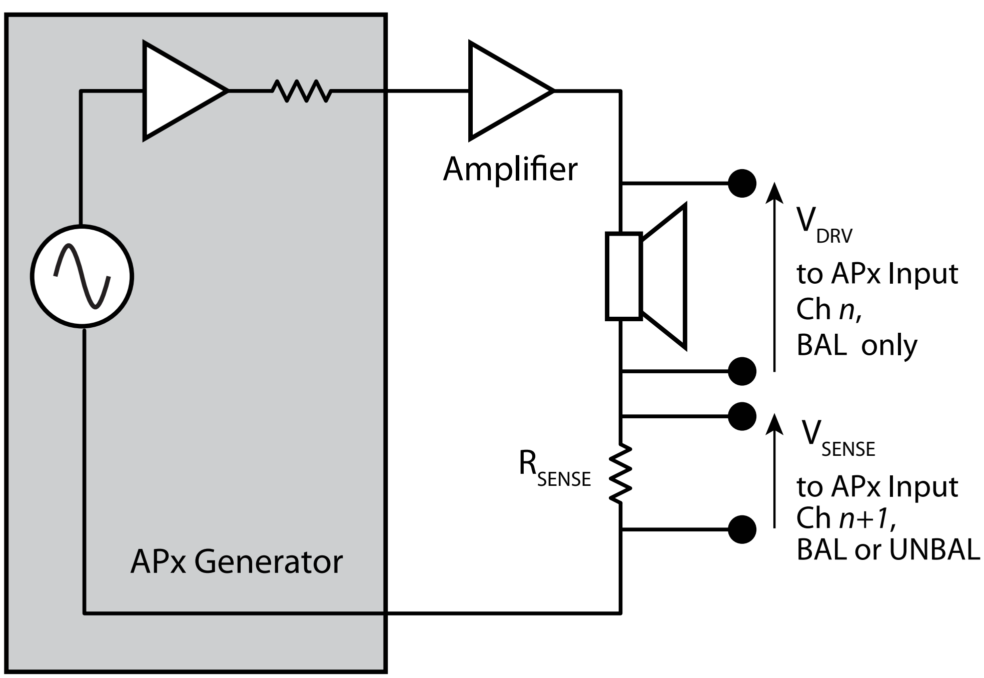
Amplifier gain and phase response must be carefully measured and remain stable through out the testing period. For amplifiers with level controls, there is the risk that the gain may be accidentally changed.

## External/unknown gain

In the APx software, this configuration is denoted as **Ext./unknown gain.**

For this configuration, the resistance of the sense resistor must be precisely known, but the amplifier gain is irrelevant. The analyzer inputs must be balanced.

The selector switch on the IMP1 front panel must be set to DRIVER CURRENT (**OUT** position). Two connections are required. For this configuration, the APx software assigns the roles of **drvr** (driver voltage) and **sense** (driver current) to adjacent channel pairs. Be sure to connect DRIVER VOLTAGE to the analyzer balanced input as-



External/unknown gain test configuration signed the **drvr** role, and connect DRIVER CURRENT to the analyzer input assigned the **sense** role.

Enter the value of the sense resistor into the data entry fields in the APx software. The amplifier gain is measured, and the voltages across the driver and the sense resistor are measured.

### Advantage

This is our recommended configuration if your analyzer has more than two inputs. Because $V_{DRV}$ and $V_{SENS}$E are measured simultaneously, no assumptions are made regarding the amplifier response. Impedance results are reported correctly across the frequency range.

### Disadvantage

Requires two analog inputs for the impedance measurement. Since the Loudspeaker Production Test measurement also requires an input for the acoustic test, analyzers with only two inputs cannot use Loudspeaker Production Test in this configuration.

## Four-wire configurations

There are unavoidable resistances in connections, switch contacts and lengths of wire that will affect the overall accuracy of measurements made with impedance fixtures. In a *four-wire* configuration, use two additional wires to connect the analyzer **drvr** connection directly across the driver voice coil to improve overall accuracy.

## Power Dissipation

The IMP1 has a maximum continuous power dissipation of 10 watts. The IMP1 will typically become warm to the touch with continuous testing at 10 watts.

The table in the next column lists examples of the amplifier output voltages that will attain 10 watts dissipation in the sense resistor, for a range of driver impedances and for both sense resistance values. Do not exceed the recommended Amplifier Output Voltage for a given combination of Driver Impedance and sense resistor value.

Caution: Continuous power dissipation of more than 10 watts in the IMP1 sense resistors can result in high case temperatures and damage to the IMP1.

| Nominal Driver Impedance, ohms | Maximum Amplifier Output Voltage, Vrms (1 Ω sense resistor) | Maximum Amplifier Output Voltage, Vrms (0.1 Ω sense resistor) |
|---|---|---|
| 0 | 3.16 | 1.00 |
| 1 | 6.32 | 11.00 |
| 2 | 9.49 | 21.00 |
| 3 | 12.65 | 31.00 |
| 4 | 15.81 | 41.00 |
| 5 | 18.97 | 51.00 |
| 6 | 22.14 | 61.00 |
| 7 | 25.30 | 71.00 |
| 8 | 28.46 | 80.00 |
| 16 | 53.17 | 80.00 |

## Specifications

**Sense Resistors**

1.0 Ω, 1 %

0.1 Ω, 1 %

**Power dissipation, continuous**

10 W

**Typical overall accuracy**

Known gain, two wire: typically ±3 %

Unknown gain, two wire: typically ±2 %

Unknown gain, four wire: typically ±1 %

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