# PDM I/O option for APx

**A complete solution for both MEMS microphones and decimators**

APx525 2-channel analyzer shown with digital I/O, digital serial, PDM and *Bluetooth* options.

## Key Features

- Direct connectivity to any device with a PDM input or output.
- 1.5–3.6 VDC device Vdd supply.
- Support of independent audio channels on rising and falling edges.
- Integral PSR measurement.
- Selectable clock direction for both input and output.
- Undecimated bitstream analysis for diagnostics.
- Multiple I/O interface options available: PDM, analog balanced/unbalanced, AES3 and S/PDIF digital, HDMI, *Bluetooth,* and serial digital.
- A flexible, intuitive UI with over 30 one-click audio measurements.
- Powerful built-in "code-free" automation.
- API for VB.NET, C#.NET, or LabVIEW automation and control.
- Custom reports using Microsoft Word templates or output to CSV for database input.
- Compatible with APx525 and APx585 families.

## The APx PDM option

PDM (pulse density modulation) is a one-bit, high clock rate data stream used with MEMS (Micro-Electro-Mechanical System) digital microphones, used extensively in smartphone design. The APx PDM option allows APx500 series audio analyzers to connect directly to any device with a PDM input or output, enabling comprehensive testing of audio for the fast-moving telecom industry.

In addition to all the standard audio measurements, the APx PDM interface provides a variable DC supply voltage to the MEMS device, variable sample rate, and a PSR (power supply rejection) measurement to test the device's full operating parameters. PDM (mono or stereo) can be selected for both the analyzer inputs and outputs simultaneously; alternatively, PDM as an input or output can be complemented with any of the other available I/O formats. A special PDM bitstream mode permits analysis of the entire spectrum, bypassing the decimator.

APx analyzers are the ideal platform for complete smartphone and tablet audio development, combining PDM with integrated *Bluetooth* wireless technology, low noise analog for testing headphone outputs, digital serial ($I^2S$) for direct chip-level communication, and HDMI for devices with HD video capabilities. No other analyzer combines direct PDM connectivity with APx's best in class speed, ease-of-use, and performance.

## Designed with decimators and MEMS microphones in mind

MEMS microphone designers can connect their device output directly to the PDM option input, taking advantage of both an integral clock and device DC power availability. A special suite of acoustic response measurements makes MEMS transducer testing fast, easy, and efficient, even in non-anechoic environments.

Semiconductor R&D engineers working on new decimators have had no simple solution for a PDM reference signal. Now they can immediately put the APx PDM option to work, generating modulated PDM bitstreams and sending them directly to their decimators with no further conversion or hardware. The APx PDM modulator provides a reference quality signal, embedding pristine audio from the APx generator, across a full set of audio measurements.

Smartphone and tablet manufacturers working on new designs can interface directly with both MEMS microphones and PDM decimators to tune and verify performance.

## An integrated solution

The APx PDM option has all the functionality needed and is embedded in a fully-featured APx audio analyzer, enabling quick connection and sophisticated testing. APx500 measurement software provides over 30 customizable audio measurements, all of which can be easily put under automation control.

## Bitstream analysis

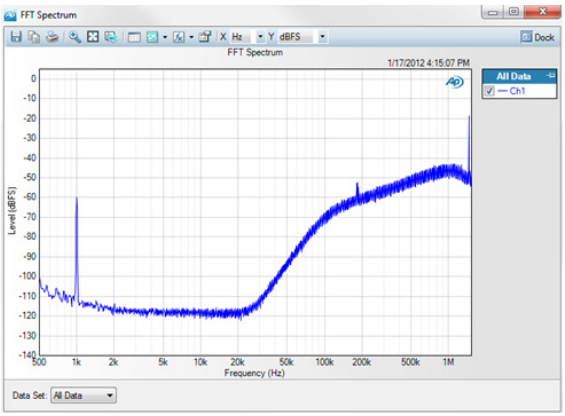
PDM-to-PCM converters can decimate the embedded audio for testing, but the APx PDM option also makes the raw bitstream available for FFT analysis, an invaluable diagnostic tool.

## PSR and PSR vs. Frequency

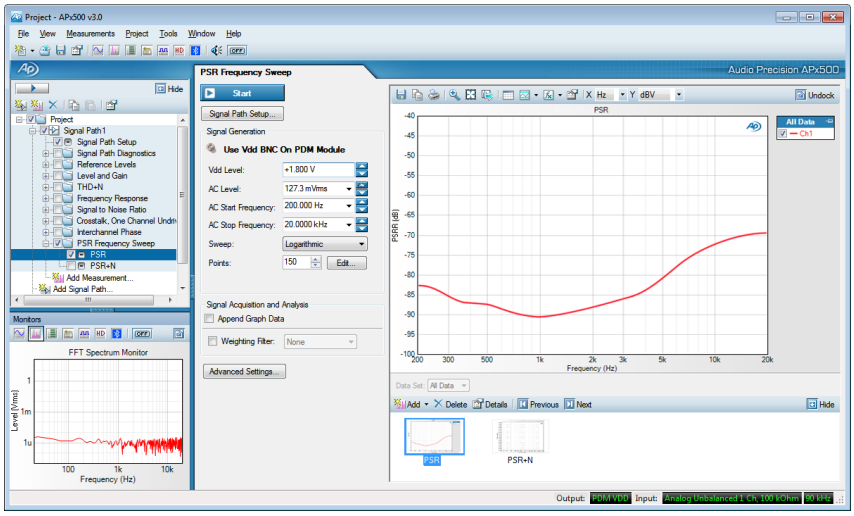
The MEMS device Vdd supply can be modulated with a sine wave or the standard GSM 217 Hz square wave. The APx software includes both PSR and PSR frequency sweep measurements; these can be used with analog MEMS microphones as well. A couple of clicks and you have PSR results.

## Full Sampling Rate and Logic Level ranges

Both the PDM input and output support audio sampling rates across a range of 4 kHz to 192 kHz. The Vdd power supply is variable from 1.5 VDC to 3.6 VDC to test beyond the range of typical devices.




Output of actual MEMS PDM microphone captured by an APx analyzer, showing a 1 kHz test tone and the effects of noise shaping above the passband.




▲ **FAST & INTUITIVE UI**
A test engineer measures the PSR of a MEMS microphone. If desired, the result could be added to a larger automated sequence of measurements and then output to a formatted Word doc or a database.

### PDM Specs

**Sample rate range**
4 kHz to 192 kHz

**Bit clock range**
128 kHz to 24.576 MHz

**Oversampling ratio**
32, 64, 128, 256

**Interface logic levels**
1.8–3.6 VDC

**Edge modes**
Rising edge, 1 channel; Falling edge, 1 channel; Stereo (Both edges), 2 channel

**DC output**
1.5–3.6V, 15 mA max

**Modulator maximum input level**
–0 dBFS

**SNR**
129 dB (1 kHz, 20 kHz BW, unwtd, 256x oversampling, 5th order modulator)

**THD+N**
–129 dB (1 kHz, –9.3 dBFS, 20 kHz BW, unwtd, 256x oversampling, 5th order modulator)

**Dynamic Range**
137 dB (AES17, CCIR-RMS, 256x oversampling, 5th order modulator)

**Flatness**
± 0.001 dB (20 Hz to 20 kHz)

**Connectors**
Output data, output clock, input data, input clock, external power (all via BNC)

### APx500 Series Audio Analyzer Key Specifications

#### SYSTEM PERFORMANCE

**Residual THD+N (20 kHz BW)**
–105 dB + 1.3 µV [APx525 family]
–103 dB + 1.4 µV [APx585 family]

#### GENERATOR PERFORMANCE

**Sine Frequency Range**
0.1 Hz to 80.1 kHz [APx525 family]
5 Hz to 80.1 kHz [APx585 family]

**Frequency Accuracy**
2 ppm [APx525 family]
3 ppm [APx585 family]

**IMD Test Signals**
SMPTE, MOD, DFD

**Maximum Amplitude (balanced)**
21.21 Vrms [APx525 family]
14.4 Vrms [APx585 family]

**Amplitude Accuracy**
±0.05 dB

**Flatness (20 Hz–20 kHz)**
±0.008 dB

**Analog Output Configurations**
unbalanced & balanced

**Digital Output Sampling Rate**
22 kHz–192 kHz

**Dolby / DTS Generator**
Yes

#### ANALYZER PERFORMANCE

**Maximum Rated Input Voltage**
300 Vrms (bal) / 160 Vrms (unbal) [APx525 family]
110 Vrms (bal/unbal) [APx585 family]

**Maximum Bandwidth**
>90 kHz

**IMD Measurement Capability**
SMPTE, MOD, DFD

**Amplitude Accuracy (1 kHz)**
±0.05 dB

**Amplitude Flatness (20 Hz–20 kHz)**
±0.008 dB

**Residual Input Noise (20 kHz BW)**
1.3 µV

**Individual Harmonic Analyzer**
d2–d10

**Max FFT Length**
1.2M points

**DC Voltage Measurement**
Yes

ACCREDITED
Accredited by A2LA under ISO/IEC: 17025 for equipment calibration

Specifications subject to change.

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