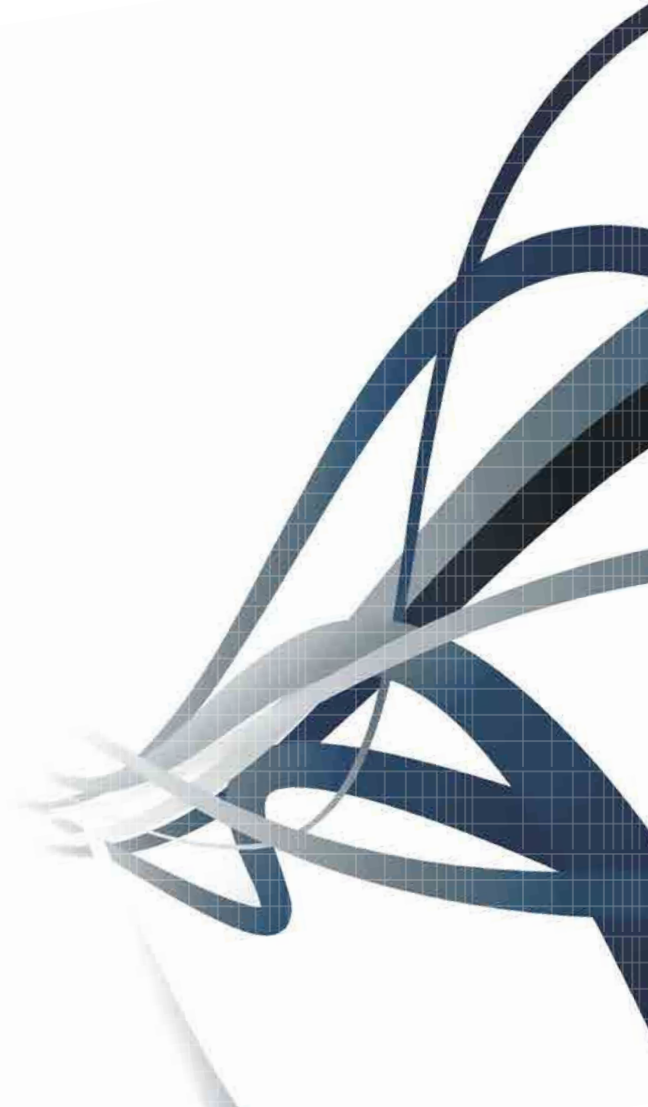


# APx555

AUDIO ANALYZER

Installation Instructions  
and Specifications





# APx555 audio analyzer

## Installation Instructions and Specifications



model APx555

October, 2014

**Audio**  
precision

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## **Documentation and Support**

This booklet contains safety information, installation instructions and full specifications for the Audio Precision APx555 audio analyzer.

### **The APx500 User's Manual**

Detailed information on the operation of the APx555 is available from the embedded Help installed with the APx500 measurement software, and in the APx500 User's Manual, included with the analyzer. The user's manual is also available as a PDF on the APx500 Application Disc and on the Web at [ap.com](http://ap.com); additional copies can be ordered from Audio Precision or your local distributor.

### **Audio Test Discs**

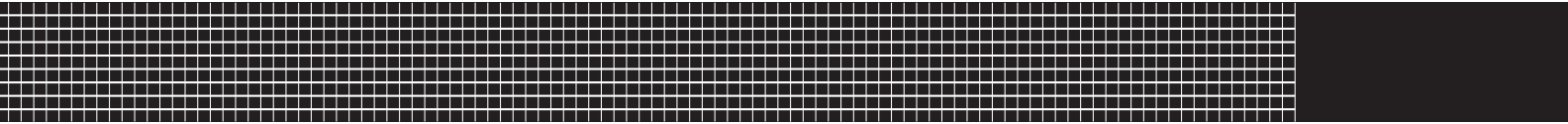
These discs are included with your analyzer system:

- APx-DVD1 is a playable video DVD with menu-driven linear and coded audio test signals for external source use with DVD players.
- APx-CD1 is a playable audio CD with linear audio test signals for external source use with CD players.

### **ap.com**

Visit the Audio Precision Web site at [ap.com](http://ap.com) for APx support information. APx resources are available at [ap.com/downloads/apx](http://ap.com/downloads/apx). You can also contact our Technical Support staff at [techsupport@ap.com](mailto:techsupport@ap.com), or by telephoning 503-627-0832 extension 4, or 800-231-7350 extension 4 (toll free in the U.S.A.).





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# Safety

## Safety Information

Do NOT service or repair this equipment unless properly qualified. Servicing should be performed only by a qualified technician or an authorized Audio Precision distributor.

Do NOT defeat the safety ground connection. This equipment is designed to operate only with an approved three-conductor power cord and safety grounding. Loss of the protective grounding connection can result in electrical shock hazard from the accessible conductive surfaces of this equipment.

Do NOT exceed mains voltage ratings. This equipment is designed to operate only from a 50–60 Hz ac mains power source at 100–240 Vac nominal voltage. The mains supply voltage is not to exceed  $\pm 10\%$  of nominal (90–264 Vac).

For continued fire hazard protection, fuses should be replaced ONLY with the exact value and type indicated on the rear panel of the instrument and discussed on page 4 of this manual.

The International Electrotechnical Commission (IEC 1010-1) requires that measuring circuit terminals used for voltage or current measurement be marked to indicate their Measurement Category. The Measurement Category is based on the amplitude of transient or impulse voltage that can be expected from the AC power distribution network. This product is classified as Measurement Category I, abbreviated “CAT I” on the instrument front panel. This product should not be used within Categories II, III, or IV. The 2-channel input module measurement terminals are rated for a maximum voltage of 230 Vpk to ground, and a signal input of 160 Vrms unbalanced, 300 Vrms balanced; the 8-channel input module measurement terminals are

rated for a maximum input of 160 Vpk to ground, and a signal input of 115 Vrms, balanced or unbalanced. These terminals are intended to be used for the measurement of audio signals only.

Do NOT substitute parts or make any modifications without the written approval of Audio Precision. Doing so may create safety hazards. Using this product in a manner not specified by Audio Precision can result in a safety hazard.

This product is for indoor use—Installation Category II, Measurement Category I, pollution degree 2.

## Safety Symbols

The following symbols may be marked on the panels or covers of equipment or modules, and are used in this manual:



**WARNING!**—This symbol alerts you to a potentially hazardous condition, such as the presence of dangerous voltage that could pose a risk of electrical shock. Refer to the accompanying Warning Label or Tag, and exercise extreme caution.



**ATTENTION!**—This symbol alerts you to important operating considerations or a potential operating condition that

could damage equipment. If you see this marked on equipment, refer to the Operator's Manual or User's Manual for precautionary instructions.



**FUNCTIONAL EARTH TERMINAL**—A terminal marked with this symbol is electrically connected to a reference point of a measuring circuit or output and is intended to be earthed for any functional purpose other than safety.



**PROTECTIVE EARTH TERMINAL**—A terminal marked with this symbol is bonded to conductive parts of the instrument and is intended to be connected to an external protective earthing system.

## Disclaimer

Audio Precision cautions against using their products in a manner not specified by the manufacturer. To do otherwise may void any warranties, damage equipment, or pose a safety risk to personnel.





# Installation

## Software

All APx systems use the same award-winning measurement software, APx500.

### PC system requirements

The APx500 measurement software version 4.0 and later requires a personal computer (PC) with the following features and capabilities:

- Operating system: Microsoft Windows 8, Windows 7 or Windows Vista.
- A multi-core processor (at least dual-core) running at a clock speed of at least 2 GHz. Most current processors from Intel and AMD meet these requirements.

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*Note: the Intel Atom processor does not meet our minimum specification.*

---

- At least 2 GB of RAM.
- At least 300 MB of free hard disk space.
- A CD-ROM optical disc drive.
- A USB 2.0 port; two are required for optional switcher or DCX-127 use.
- A color monitor and a video card with at least VGA capabilities. Video resolution of 1024 x 768 or greater is recommended.

System performance is sensitive to processor speed; faster processors will yield faster results.

APx500 is data intensive and it is recommended that other data-intensive applications not be run concurrently. This includes Audio Precision's AP2700, APWIN or ATS.

## Installation

To install the measurement software, insert the APx500 CD-ROM into the optical drive on the PC and follow the instructions in the installation dialog.

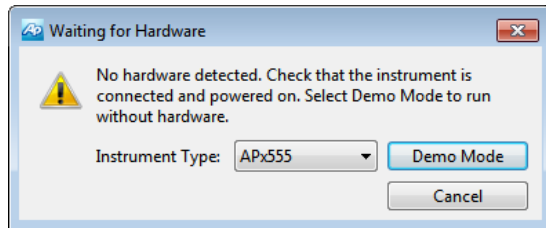
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*NOTE: You must have local administrator rights to install APx500 software. Go to User Accounts in the Windows Control Panel, or check with your network administrator.*

---

## Running the software without instrument hardware attached

You can launch the APx500 software without instrument hardware attached. When no hardware is detected, APx500 will present you with the following dialog box:



Select “Demo Mode.” APx500 will run in demo mode, which allows you to explore the user interface but does not enable any measurement functions. Input data shown in Demo Mode is false data, generated for display only.

From the Instrument Type menu, select an instrument to be emulated in Demo Mode.

## Running the software with instrument hardware attached

---

*NOTE: You must have standard user rights or administrator rights to operate APx500 software. Guest users are not supported.*

---

### Connecting the instrument to your PC

Before connecting your APx instrument to your PC, install the APx500 measurement software as described above. Connecting the instrument prior to software installation may cause Windows to select an incorrect USB driver for the instrument.

### USB driver selection

The measurement software communicates with the instrument using a USB 2.0 interconnection. Once the software is successfully installed, connect one end of the USB cable to a USB 2.0 port on the PC, and the other end to the PC INTERFACE port on the rear of the instrument. We strongly recommend that you use the USB cable included with your instrument (AP order number CAB-APSI). We have tested other USB cables that perform poorly.

---

*Note: Some PCs have optional USB ports on the front of the PC, or on extension brackets on the rear. In many cases these convenience ports have compromised performance due to the extra cable length within the PC. We recommend using USB ports directly connected to the PC motherboard, typically at the rear of the PC.*

---

Connect the instrument mains power cord to the instrument and to a source of ac mains power. See **Setting up the hardware** below for more information about mains connections.

Turn the instrument ON by pressing the pushbutton on the front of the instrument. Microsoft Windows will detect the presence of the instrument on the USB and will open the Hardware Update Wizard to search for the correct software driver. Select “Install the software automatically.” Windows will find the Audio Precision driver software installed with APx500 and connect to the instrument.

Launch APx500 by double-clicking on the installed shortcut. With the instrument connected, you may be asked to update the instrument firmware during the first launch of the measurement software. APx500 will start, and in a short time you will be presented with the opening screen. Refer to the APx500 User’s Manual for more information about making measurements.

*A copy of the APx500 User’s Manual is included with your instrument. The manual is also available as a PDF on the APx500 Application Disc and online at [ap.com](http://ap.com).*

## Setting up the hardware

### Connecting your instrument to the electrical mains supply

The APx500 series instrument must be connected to a 50–60 Hz alternating current (ac) electrical mains supply. The minimum voltage is 90 Vac; maximum voltage is 264 Vac. The instrument is fitted with a universal power supply that does not require voltage configuration or change of fuse type to accept mains voltages within the specified range.

### Removing and installing mains fuses

To remove the mains fuse carrier module, refer to the figures below and proceed as follows:



**Power entry module**



**Fuse carrier removal**

Remove the mains power supply cord from the connector on the power entry module, located on the instrument rear panel. The mains fuse carrier module is part of the power entry module, to the right of the power cord connector.

Insert a small screwdriver into the power cord connector area, reaching into the slot on the mains fuse carrier module. Pry the module out slightly, until you can grasp the module firmly with your fingers. Pull the fuse carrier module out of the power entry module. The two mains fuses are loosely mounted within the fuse carrier module; take care not to let them fall.

Replace the fuses if necessary, using fuses as described below. Carefully reinsert the fuse carrier module into the power entry module, and press it firmly into place.

Connect the power cord from a mains power outlet to the power cord connector on the instrument rear panel.

### **Fuse Information**

APx500 series instruments are fitted with a universal power supply. For all rated voltages, use two mains fuses of type 2A T/SB (5 x20 mm) 250 V.



# Abbreviations, Terms and Symbols

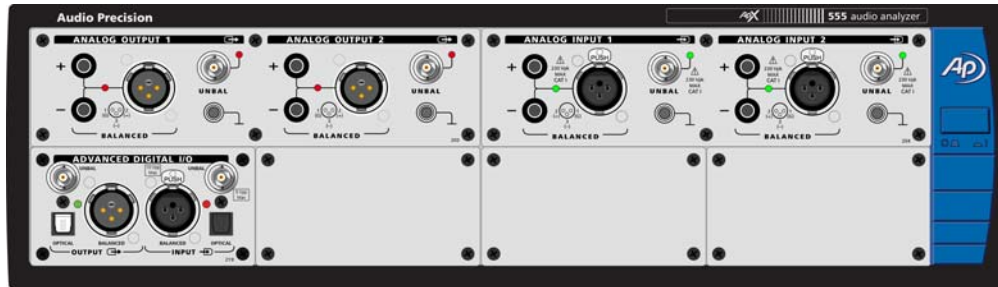
## used in the following specifications

ADC or A/D	.....	Analog to Digital converter or conversion.
BW	.....	Bandwidth or Measurement Bandwidth, nominally at -3 dB; a single number indicates only the upper limit.
DAC or D/A	.....	Digital to Analog converter or conversion.
DSP	.....	Digital Signal Processing or Digital Signal Processor.
DUT	.....	Device Under Test, the device to which the generator or analyzer is connected.
EMC	.....	Electro-Magnetic Compatibility, usually refers to both emissions (radiated and conducted via AC mains) and susceptibility.
ENBW	.....	Equivalent Noise Bandwidth, the frequency of an ideal filter having the same rms response to white noise.
FFT	.....	Fast Fourier Transform, a mathematical process converting a signal in the time domain to the frequency domain.
IMD	.....	Inter-Modulation Distortion, a measure of non-linearity using a test signal with two or more components.
RMS or rms	.....	Root Mean Square, an equivalent-power expression of signal amplitude.
SR	.....	Sample Rate, usually as it applies to the conversion rate of A/D and D/A converters or digital audio formats.
THD	.....	Total Harmonic Distortion, rms summation of d2 to d9 (may be bandwidth limited), usually derived from an FFT.
THD+N	.....	Rms measurement of ALL harmonics, spurious signals, and noise within a specified bandwidth.
Typical or Typ	.....	A characteristic that is not guaranteed, usually due to a practical limitation in testing or metrology.
UI	.....	Unit Interval, a measure of time as it applies to digital audio formats. $1 \text{ UI} = 1/(128 \cdot \text{SR})$
[ ]	.....	Indicates a specification in an equivalent unit, for example: 0.030 dB [0.35%] or 10.61 Vrms [30.00 Vpp].
≈	.....	Indicates an approximate or nominal value, or range of values; not guaranteed.



# Analog I/O specifications APx555 audio analyzer

with APx500 v4.0 or higher measurement software  
September 2014 NP0020.00022 r000



This illustration shows an APx555 in its standard configuration, with an ADIO module installed.

These specifications cover the analog input and output functions of the Audio Precision APx555.

Specifications for the ADIO interface and other available interface modules including DSIO, HDMI, PDM, Bluetooth and AMC, are found in other sections of this document, as are General and Environmental specifications for the entire APx family. Analog specifications begin on the next page.

Characteristic	Specifications	Supplemental Information
----------------	----------------	--------------------------

<b>ANALOG GENERATOR</b>		
<b>Number of Channels</b>	2, independent amplitude control	
<b>Waveforms</b>	Sine, sine split frequency, sine split phase, sine+DC offset, continuously swept-sine, square-wave, noise, IMD signals, multi-tone, wave file playback	<i>DC offset capability applies to all DAC waveforms. Projects created with the Hi-Perf Sine will load as Sine in other APx analyzers.</i>
<b>High Performance Sine</b>		
Generation Technique		<i>Exceptionally stable RC oscillator</i>
Frequency Range (Fs)	5 Hz to 204 kHz	
Frequency Setting Resolution		
5.0 Hz to 205.0 Hz		$\approx 0.025$ Hz
205.0 Hz to 2.050 kHz		$\approx 0.25$ Hz
2.050 kHz to 20.50 kHz		$\approx 2.5$ Hz
20.50 kHz to 204 kHz		$\approx 25$ Hz
Frequency Accuracy		
10 Hz to 100 kHz	$\pm 0.35\%$	<i>Typically &lt;25 ppm/°C</i>
5 Hz to 204 kHz	$\pm 0.5\%$	
Amplitude Range <sup>1</sup>		
10 Hz to 100 kHz	0-26.66 Vrms [75.4 Vpp] bal; 0-13.33 Vrms [37.7 Vpp] unbal & CMT	<i>Will drive 600 <math>\Omega</math> balanced load to at least +30.0 dBm when Rs = 40 <math>\Omega</math></i>
5 Hz to 204 kHz	0-21.22 Vrms [60.0 Vpp] bal; 0-10.61 Vrms [30.0 Vpp] unbal & CMT	
Amplitude Accuracy, 1 kHz		
+15°C to +30°C	$\pm 0.030$ dB [ $\pm 0.35\%$ ]	
0°C to +45°C	$\pm 0.040$ dB [ $\pm 0.46\%$ ]	
Flatness, 1 kHz ref		
5 Hz to 20 kHz	$\pm 0.008$ dB	<i>Typically &lt;0.003 dB</i>
20 kHz to 50 kHz	$\pm 0.015$ dB	
50 kHz to 100 kHz	$\pm 0.060$ dB	
100 kHz to 204 kHz	$\pm 0.15$ dB	
Settling Time		<i>Typically &lt;(40 cycles + 100 ms) to within 0.001 dB of final value</i>

Characteristic	Specifications	Supplemental Information
Residual THD+N <sup>2,3,4</sup>		
10 Hz to 20 kHz, 22 kHz BW	$\leq (-117 \text{ dB} + 1.0 \mu\text{V})$ , $V \leq 9.3 \text{ Vrms}$ ; $\leq -115 \text{ dB}$ , $V > 9.3 \text{ Vrms}$ .	Typically $< -120 \text{ dB}$ at 1 kHz from 2.0–2.3 Vrms, 3.7–4.6 Vrms, and 7.3–9.3 Vrms.
10 Hz to 20 kHz, 80 kHz BW	$\leq (-111 \text{ dB} + 2.0 \mu\text{V})$	
10 Hz to 20 kHz, 100 kHz BW	$\leq (-110 \text{ dB} + 2.3 \mu\text{V})$	
10 Hz to 50 kHz, 250 kHz BW	$\leq (-105 \text{ dB} + 3.8 \mu\text{V})$	
10 Hz to 100 kHz, 500 kHz BW	$\leq (-100 \text{ dB} + 5.5 \mu\text{V})$	
Residual THD only <sup>2,3,4</sup>		
10 Hz to 40 Hz		Typically $< -125 \text{ dB}$
40 Hz to 5 kHz		Typically $< -130 \text{ dB}$
5 kHz to 20 kHz		Typically $< -120 \text{ dB}$
20 kHz to 50 kHz		Typically $< -110 \text{ dB}$
50 kHz to 100 kHz		Typically $< -102 \text{ dB}$
<b>Dual Sine, Continuous Swept Sine</b>		
Generation Technique		24-bit $\Sigma$ - $\Delta$ DACs, SR = 192 kS/s.
Frequency Range (Fs)	0.001 Hz to 80.1 kHz	Setting resolution is typically 45 $\mu\text{Hz}$ [192 kHz / $2^{32}$ ] over full range
Frequency Accuracy <sup>5</sup>	$\pm 0.0003\%$ [3 ppm]	Lockable to external reference
Amplitude Range <sup>1</sup>		
10 Hz to 80 kHz	0-26.66 Vrms [75.4 Vpp] bal; 0-13.33 Vrms [37.7 Vpp] unbal & CMT	Will drive 600 $\Omega$ balanced load to at least +30.0 dBm when $R_s = 40 \Omega$
0.001 Hz to 10 Hz	0-21.22 Vrms [60.0 Vpp] bal; 0-10.61 Vrms [30.0 Vpp] unbal & CMT	
Amplitude Accuracy, 1 kHz		
+15°C to +30°C	$\pm 0.030 \text{ dB}$ [ $\pm 0.35\%$ ]	
0°C to +45°C	$\pm 0.040 \text{ dB}$ [ $\pm 0.46\%$ ]	
Amplitude Setting Resolution		Typically $< 0.001 \text{ dB}$ or 0.05 $\mu\text{Vrms}$

Characteristic	Specifications	Supplemental Information
Flatness (1 kHz ref)		
10 Hz to 20 kHz	$\pm 0.008$ dB	
Fs = 20 kHz to 50 kHz	$\pm 0.030$ dB	
Fs = 50 kHz to 80 kHz	$\pm 0.10$ dB	
Residual THD+N <sup>2, 3, 4</sup>		
10 Hz to 20 kHz, 22 kHz BW	$\leq (-105$ dB + 1.0 $\mu$ V)	
5 Hz to 20 kHz, 80 kHz BW	$\leq (-95$ dB + 2.0 $\mu$ V)	
Spurious Content		
5 Hz to 20 kHz		Typically $< -100$ dB to 500 kHz
20 kHz to 50 kHz		Typically $< -85$ dB at (384 kHz $\pm 2 \cdot F_s$ )
50 kHz to 76 kHz		Typically $< -70$ dB at (384 kHz $\pm 2 \cdot F_s$ )
76 kHz to 80 kHz		Typically $< -55$ dB at (192 kHz - Fs)
Phase Offset Range	$-179.999$ to $+180.000$ deg	
DC Offset Range	$\pm 12.00$ Vdc bal; $\pm 6.00$ Vdc unbal	DC offset limits maximum ac signal and degrades residual THD+N
Residual DC Offset	$\leq 0.25\%$ of Vrms setting + 100 $\mu$ V	
<b>Sine Burst</b>		
Generation Technique		Zero-crossing synchronized analog switching between Low/High states
Frequency Range	10 Hz to 80.1 kHz	
Frequency Accuracy <sup>5</sup>	$\pm 0.0003\%$ [3 ppm]	
Amplitude Range <sup>1</sup>	0–75.4 Vpp bal 0–37.7 Vpp unbal	
Amplitude Accuracy (1 kHz)	$\pm 0.05$ dB [0.58%]	
Low/High Ratio Range	0 to $-80$ dB, and zero	
Ratio Accuracy (1 kHz)	$\pm 0.15$ dB, 0 to $-60$ dB	Unspecified below $-60$ dB.
Amplitude Flatness		
10 Hz to 50 kHz		Typically $< 0.03$ dB
50 kHz to 80 kHz		Typically $< 0.10$ dB
High Cycles (Duration)	1 to 16,777,214	
Total Cycles (Interval)	2 to 16,777,215	$> 4.6$ hours at 1 kHz

<b>Characteristic</b>	<b>Specifications</b>	<b>Supplemental Information</b>
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<b>IMD Test Signals</b>		
Generation Technique		Analog summation of separately generated test signal components
<b>MOD &amp; SMPTE</b>		
Lower Frequency (LF)	40 Hz to 1 kHz	LF must be $\leq 500$ Hz for SMPTE
Upper Frequency (HF)	2.00 kHz to 60.00 kHz	HF must be $\geq 6 \cdot LF$
Frequency Accuracy <sup>5</sup>	$\pm 0.0003\%$ [3 ppm]	
Mix Ratio (LF:HF)	Selectable 10:1, 4:1 or 1:1	Ratio accuracy typically $< 1\%$
Amplitude Range <sup>1</sup>	0 to 75.4 V <sub>pp</sub> , bal; 0 to 37.7 V <sub>pp</sub> , unbal	
Amplitude Accuracy	$\pm 0.07$ dB [ $\pm 0.81\%$ ]	
Residual IMD <sup>2,3,6</sup>	$\leq -100$ dB [0.0010%], SMPTE $\leq -102$ dB [0.00080%], MOD	60 Hz + 7 kHz, 4:1 mix
<b>DFD</b>		
Difference Frequency ( $F_{diff}$ )	80 Hz to 2.00 kHz	$F_{diff} =  F2 - F1 $
Mean Frequency	250 Hz to 60 kHz	$F_{mean} = (F1 + F2)/2$ ( $F_{mean} / F_{diff}$ ) must be $\geq 6$ {see note 7}
Frequency Accuracy <sup>5</sup>	$\pm 0.0003\%$ [3 ppm]	
Amplitude Range <sup>1</sup>	0 to 75.4 V <sub>pp</sub> , bal; 0 to 37.7 V <sub>pp</sub> , unbal	
Amplitude Accuracy	$\pm 0.07$ dB [ $\pm 0.81\%$ ]	
Residual IMD <sup>2,3,6,7</sup>	$\leq -110$ dB [0.00032%] d2+d3; $\leq -115$ dB [0.00018%] d2 only	
<b>DIM</b>		
Square + Sine Frequencies	3.15 kHz + 15 kHz [DIM-100, DIM-30] 2.96 kHz + 14 kHz [DIM-B], or 2.96 kHz / 8 kHz [DIM-B8]	DIM-100 square-wave BW limited by 100 kHz 1-pole filter ( $t_r \approx 3.5 \mu\text{sec}$ ); other DIM square-waves BW limited by 30 kHz 1-pole filter ( $t_r \approx 11.7 \mu\text{sec}$ )
Frequency Accuracy <sup>5</sup>	$\pm 0.0003\%$ [3 ppm]	
Mix Ratio	4:1 based on V <sub>pp</sub>	Ratio accuracy typically $< 1.5\%$
Amplitude Range <sup>1</sup>	0 to 75.4 V <sub>pp</sub> , bal; 0 to 37.7 V <sub>pp</sub> , unbal	
Amplitude Accuracy	$\pm 0.09$ dB [ $\pm 1.0\%$ ]	
Residual IMD <sup>2,3,6</sup>	$\leq -95$ dB [0.0018%]	DIM-100 or DIM-30

Characteristic	Specifications	Supplemental Information
<b>Square Wave</b>		
Generation Technique		<i>Special circuit, optimized for time domain response and symmetry.</i>
Frequency Range (Fq)	0.1 Hz to 30 kHz	
Frequency Accuracy <sup>5</sup>	±0.0003% [3 ppm]	
Amplitude Range	0 to 60.0 Vpp, balanced; 0 to 30.0 Vpp, unbalanced	
Amplitude Accuracy	±0.09 dB [±1.0%]	
Risetime	≤1.7 μsec	<i>Rs ≤200 Ω (not valid if Rs = 600 Ω); total load C must be ≤800 pF</i>
Aberrations		<i>Typically &lt;1%</i>
Even Harmonic Content		
Fq = 10 Hz to 5 kHz	≤(-100 dB + 0.2 μV) to 80 kHz	
Fq = 5 kHz to 20 kHz	≤(-90 dB + 0.2 μV) to 500 kHz	
Spurious Content		<i>Typically &lt;(-110 dB + 0.2 μV)</i>
<b>Noise Signals</b>		
Generation Technique		<i>DAC based, pseudo-random with IIR filtering and additional processing.</i>
Types	White (5 Hz to >80 kHz), Pink (10 Hz to >80 kHz), IEC 60268-1, or BS EN 50332-1	
Amplitude Range <sup>1</sup>	0 to 60.0 Vpp, balanced; 0 to 30.0 Vpp, unbalanced	<i>Calibration is approximate only</i>
<b>Multitone, Wave File Playback</b>		
Sample Rate Range (SR)	8 kS/s to 108 kS/s, and 175 kS/s to 216 kS/s	<i>Operation from 109 kS/s to 174 kS/s is possible, but with degraded flatness</i>
Maximum File Size	32 MSamples	
Amplitude Range <sup>1</sup>	0 to 60.0 Vpp, bal; 0 to 30.0 Vpp, unbal	<i>“.Wav” file must peak at digital full scale for calibrated amplitude.</i>
Flatness (1 kHz ref)		
SR = 175 kS/s to 216 kS/sec		<i>Typically &lt;0.015 dB to 20 kHz</i>
SR = 8 kS/s to 108 kS/sec		<i>Typically &lt;0.010 dB to 20 kHz or 0.45 • SR, whichever is lower</i>
Spurious Content		<i>Typically &lt;(-100 dB + 0.2 μV)</i>



Characteristic	Specifications	Supplemental Information
<b>Output Equalization</b>	Arbitrary 30-pole output filter, scaled so the maximum gain is -1 dB.	<i>Filter cannot be applied to square and IMD test signals.</i>
<b>Source Resistance (Rs)</b>		
Balanced	Selectable 40 Ω ±1.5%, 100 Ω ±1%, 150 Ω ±1%, 200 Ω ±1%, or 600 Ω ±0.5%.	<i>Grounded, symmetrical</i>
Unbalanced	Selectable 20 Ω ±2%, 50 Ω ±1.5%, 75 Ω ±1.2%, 100 Ω ±1%, or 600 Ω ±0.5%.	<i>BNC shield to ground ≈10 Ω    1 μF; Unbal outputs can float up to 0.6 Vpk to reject DUT ground noise.</i>
Common Mode Test	Same as Balanced selections, or 10 Ω Unbalanced per IEC-60268.	
<b>Output Related Crosstalk</b>	≤ (-130 dB + 0.2 μV) to 20 kHz	
<b>Maximum Output Current</b>		<i>Typically &gt;80 mA peak, 50 mA dc</i>
<b>Peak Reverse Overload</b>		<i>Up to 1A or 30 W, whichever is less. Outputs automatically disconnect if a damaging potential is sensed</i>
<b>ANALOG ANALYZER</b>		
<b>Number of Channels</b>	2, independently auto-ranging	
<b>Maximum Rated Input</b>	230 Vpk, 160 Vrms, dc to 100 kHz; 0.6 Vpk from BNC shields to ground	<i>Up to 300 Vrms differentially may be applied to the Balanced inputs</i>
<b>Input Ranges</b>	310mV, 620mV, 1.25V, 2.5V, 5V, 10V, 20V, 40V, 80V, 160V, and 320V	<i>Auto-ranging thresholds are ≈48-50% and ≈107-111% of range value (Vac)</i>
<b>Input Impedance</b>		
Balanced, each side to ground	100 kΩ ±0.5%    ≈190 pF	<i>200 kΩ    ≈95 pF, differentially</i>
Unbalanced, to BNC shield	100 kΩ ±0.5%    ≈190 pF	<i>BNC shield to ground ≈500 Ω    1 μF</i>
<b>Input Terminations</b>	600 Ω ±0.5%, 1.5 W max 300 Ω ±0.5%, 3.0 W max	<i>Terminations automatically open in the 80 V and higher input ranges</i>
<b>Input Coupling</b>	DC or AC	<i>Input bias current typically &lt;0.35 μA with DC coupling. Coupling is set by high-pass filter selection</i>

Characteristic	Specifications	Supplemental Information
<b>Common Mode Rejection<sup>8,9</sup></b>		<i>The maximum peak input signal, each side to ground, must not exceed:</i>
310 mV to 2.5 V input ranges	≥ 90 dB, 5 Hz to 5 kHz; ≥ 80 dB, 5 kHz to 20 kHz	±6 V
5 V and 10 V input ranges	≥ 65 dB, 5 Hz to 20 kHz	±160% of input range value
20 V to 320 V ranges	≥ 50 dB, 5 Hz to 1 kHz	±160% of input range value or ±230 V <sub>pk</sub> , whichever is less
<b>Input Crosstalk (<math>R_s \leq 600\Omega</math>)</b>		
≤ (-140 dB + 0.1 μV) to 20 kHz		
<b>Level (Amplitude) Measurement</b>		
Range	< 1 μV to 300 Vrms, bal; < 1 μV to 160 Vrms, unbal	
Accuracy (1 kHz)		
+15°C to +30°C	±0.03 dB [±0.35%]	
0°C to +45°C	±0.05 dB [±0.58%]	
Flatness (1 kHz ref, no filters)		
20 Hz to 20 kHz	±0.008 dB; ±0.020 dB above 5 kHz in the 20 V to 320 V input ranges	
10 Hz to 50 kHz	±0.030 dB	
50 kHz to 100 kHz	±0.080 dB	
100 kHz to 300 kHz	±0.20 dB	
<b>Residual Noise (<math>R_s \leq 40 \Omega</math>)</b>		
22 kHz BW	≤ 1.0 μVrms [-117.8 dBu]	<i>Typically &lt;6.2 nV / √Hz at 1 kHz</i>
80 kHz BW	≤ 2.0 μVrms [-111.8 dBu]	
250 kHz BW	≤ 4.2 μVrms [-105.3 dBu]	
500 kHz BW	≤ 6.0 μVrms [-102.2 dBu]	
<b>THD/THD+N/SINAD Measurement</b>		
Fundamental Range ( $F_0$ )	5 Hz to 200 kHz	
Tuning Control	Generator tracking, Input tracking, or Fixed (directly entered value)	<i>Signal must be ≥100 μVrms for input tracking; <math>F_0</math> must be within ±0.5% of the entered value for fixed tuning.</i>
Measurement Range	0 to 100% [0 dB]	

Characteristic	Specifications	Supplemental Information
Measurement Technique		
High Perf Sine Analyzer ON	Signals are passed through analog notch filters to minimize the distortion contribution from the A/D converters.	<i>If distortion exceeds about 5-6%, the analog notch filters are automatically bypassed.</i>
High Perf Sine Analyzer OFF	Signals are passed directly to the A/D converters with no analog filtering.	<i>Projects created using other APx analyzers will load with the HPSA OFF.</i>
Accuracy ( $F_o \leq 100$ kHz)		
Harmonics to 100 kHz	$\pm 0.3$ dB	
Harmonics to 300 kHz	$\pm 0.5$ dB	
Residual THD+N <sup>2,3,4</sup>		
10 Hz to 20 kHz, 22 kHz BW	$\leq (-117$ dB + $1.0$ $\mu$ V), $V \leq 9.3$ Vrms; $\leq -115$ dB, $V > 9.3$ Vrms.	<i>Typically <math>&lt; (-105</math> dB + <math>1.0</math> <math>\mu</math>V) with the High Performance Sine Analyzer OFF</i>
10 Hz to 20 kHz, 80 kHz BW	$\leq (-111$ dB + $2.0$ $\mu$ V)	<i>Typically <math>&lt; (-92</math> dB + <math>2.0</math> <math>\mu</math>V) with the High Performance Sine Analyzer OFF</i>
10 Hz to 20 kHz, 100 kHz BW	$\leq (-110$ dB + $2.3$ $\mu$ V)	
10 Hz to 50 kHz, 250 kHz BW	$\leq (-105$ dB + $3.8$ $\mu$ V)	
20 Hz to 100 kHz, 500 kHz BW	$\leq (-100$ dB + $5.5$ $\mu$ V)	<i>Only one channel can be measured at a time when BW <math>&gt; 250</math> kHz and the High Perf Sine Analyzer is ON.</i>
Residual THD only <sup>2,3,4</sup>		
10 Hz to 40 Hz		<i>Typically <math>&lt; -125</math> dB</i>
40 Hz to 5 kHz		<i>Typically <math>&lt; -130</math> dB</i>
5 kHz to 20 kHz		<i>Typically <math>&lt; -120</math> dB</i>
20 kHz to 50 kHz		<i>Typically <math>&lt; -110</math> dB</i>
50 kHz to 100 kHz		<i>Typically <math>&lt; -102</math> dB</i>
<b>Bandwidth Limiting Filters</b>		
High-Pass		
DC	DC Coupling	
AC ( $< 10$ Hz)	AC coupling	<i>Response is 2-pole via a combination of analog and digital filters, and is typically <math>-3</math> dB at <math>\approx 4</math> Hz</i>
Butterworth	$F_{HP}$ ( $-3$ dB) = 10 Hz to 1.0 kHz, 4-pole	

Characteristic	Specifications	Supplemental Information
Low-Pass <sup>10</sup>		
Butterworth	$F_{LP}$ (-3 dB) = 1 kHz to 500 kHz, 8-pole	$ENBW \approx 1.006 \cdot F_{LP}$
Elliptic	$F_{LP}$ (-0.01 dB) = 1 kHz to 500 kHz, 8-pole; 0.01 dB pass-band ripple; ≤-60 dB stop-band	$ENBW \approx (1.012-1.062) \cdot F_{LP}$ (varies due to warping)
20k (AES17), 40k (AES17) ADC Bandpass (Maximum)	Special filters conforming with AES17 No filter is implemented, bandwidth and response are limited by the A/D and sample rate (SR)	-3 dB at $\approx 0.490 \cdot SR$ , $SR \leq 216$ kS/s -3 dB at $\approx 260$ kHz for 624 kS/s -3 dB at $\approx 520$ kHz for 1.248 MS/s -3 dB at $\approx 1$ MHz for 2.496 MS/s
Weighting	A-wt, B-wt, C-wt, CCIR-1k, CCIR-2k, CCITT, C-message, 50 $\mu$ s or 75 $\mu$ s de-emph (with and without A-wt), or None	Weighting filter is cascaded with both high-pass and low-pass filters
<b>IMD Measurement</b>		
Test Signal Compatibility		
SMPTE & MOD	Any combination of 40 Hz-1 kHz (LF) and 1 kHz-60 kHz (HF) tones, mixed in any ratio from 1:1 to 10:1 (LF:HF)	HF tone must be $\geq 6 \cdot LF$ ; LF must be $\leq 500$ Hz for SMPTE
DFD & CCIF <sup>7</sup>	Any two-tone combination with mean frequency of 250 Hz-60 kHz and a dif- ference frequency of 80 Hz-2.0 kHz	$F_{diff} =  F2 - F1 $ $F_{mean} = (F1 + F2)/2$ . ( $F_{mean} / F_{diff}$ ) must be $\geq 6$ [see note 7]
DIM	DIM100, DIM30, DIM-B, or DIM-B8	
IMD Products Measured		
SMPTE	Amplitude modulation of HF tone	Demodulator BW is $\approx 40-750$ Hz
MOD	d2, d3, d2+d3, or d2...d5	Use "d2+d3" for IEC60268
DFD	d2, d3, d2+d3, or d2...d5	Use "d2+d3" for IEC60268
CCIF	d2 only	"CCIF" is an archaic form of DFD that measures only the d2 product. It uses a different 0 dB reference than DFD causing 2x higher readings
DIM	U1...U9 or "Emulation"	Use "U1...U9" for IEC-60268; "Emula- tion" matches the response of earlier AP analyzers
Measurement Range	0 to 20%	

**Characteristic                      Specifications                      Supplemental Information**

	Accuracy	±0.5 dB	
	Residual IMD <sup>2,3,6,7</sup>		
	SMPTE	≤ -100 dB [0.0010%]	60 Hz + 7 kHz, 4:1 mix
	MOD	≤ -102 dB [0.00080%], d2+d3	60 Hz + 7 kHz, 4:1 mix
	DFD	≤ -110 dB [0.00032%], d2+d3 ≤ -115 dB [0.00018%], d2 only	19 kHz + 20 kHz [F <sub>mean</sub> = 19.5 kHz, F <sub>diff</sub> = 1 kHz]
	CCIF	≤ -109 dB [0.00036%]	12 kHz + 13 kHz [F <sub>mean</sub> = 12.5 kHz, F <sub>diff</sub> = 1 kHz]
	DIM	≤ -95 dB [0.0018%]	DIM-100 or DIM-30
<b>Frequency Measurement</b>			
	Range	<5 Hz to 1.0 MHz	Maximum frequency is limited to ≈0.45 • SR of the analyzer A/Ds.
	Accuracy <sup>5</sup>	±(0.0003% [3 ppm] + 100 μHz)	
	Minimum Input	3 mV	Usable down to 100 μV
<b>Phase Measurement</b>			
	Ranges	-90 to +270, ±180, or 0 to 360 deg	
	Accuracy <sup>9</sup>		
	5 Hz to 5 kHz	±0.15 deg	
	5 kHz to 20 kHz	±0.6 deg	
	20 kHz to 50 kHz	±1.5 deg	
	Minimum Input	3 mV	
<b>DC Voltage Measurement</b>			
	Maximum Rated Input	±160 Vdc, 230 Vpk (dc + peak ac)	
	Input Ranges	310mV, 620mV, 1.25V, 2.5V, 5V, 10V, 20V, 40V, 80V, 160V, and 320V	Auto-ranging thresholds are ≈66-70% and ≈150-158% of range value (Vpk)
	Accuracy		
	315 mV & 630 mV input range	±(0.7% reading + 800 μV)	
	All other input ranges	±(0.7% reading + 0.1% range)	
	Normal Mode Rejection		Typically > 90 dB, 20 Hz to 20 kHz.

NOTES to SPECIFICATIONS:	
1	Generator performance is not guaranteed for amplitude settings below 100 $\mu\text{V}/\text{rms}$ [283 $\mu\text{V}/\text{pp}$ ].
2	System specification including contributions from both generator and analyzer.
3	Generator load must be $\geq 600\Omega$ balanced or $\geq 300\Omega$ unbalanced.
4	The "+" symbol in "THD+N" indicates rms summation of the two components. "THD" is the rms summation of H2 to H9. Specified residual THD+N and THD assumes the High Performance Sine Analyzer (HPSA) is ON.
5	Drift of the internal reference is typically 0.3 to 1 ppm / year, however it is lockable to an external reference.
6	Signal must be $\geq 200$ mV for specified residual IMD; analyzer must be set to "d2+d3" for MOD and DFD, or "U1...U9" for DIM.
7	The ratio (Fmean / Fdiff) can be as low as 2.6 when measuring d2+d3 or d2 only. Avoid ratios near 3.5, 4.5, or 5.5.
8	Valid only for the balanced input configuration within the common range shown.
9	Valid only with DC coupling, both channels. High-pass filters may significantly degrade performance at low frequencies.
10	DSP warping may significantly increase roll-off rate and lower ENBW.

## ADIO Advanced Digital Input/Output module specifications

with APx500 v4.0 or higher measurement software  
as fitted in APx52x, 555, and 58x audio analyzers  
NP0020.00021 rev 000  
October 2014



This illustration shows a stand-alone APx ADIO module, model 219.

These specifications cover the digital input and output functions of the Audio Precision Advanced Digital Input/Output (ADIO). The ADIO is available as a stand-alone module (model 219).

The APx ADIO provides balanced digital input and output compatible with AES3, AES/EBU and IEC60958-4, on XLR connectors; unbalanced digital input and output compatible with S/PDIF and IEC60958-3 and also AES3id and SMPTE 276 M, on BNC connectors; and optical digital input and output compatible with Toslink interfaces.

ADIO also enables certain carrier and metadata impairments, and it supports the imposition of jitter on the transmitted carrier, and jitter measurement, when used with the Advanced Master Clock (AMC).

ADIO specifications begin on the next page.

## Characteristic

## Specifications

## Supplemental Information

<b><u>ADVANCED DIGITAL I/O</u></b>		
<i>DIGITAL OUTPUT RELATED:</i>		
<b>Formats</b>		
Electrical, unbalanced	SPDIF-EIAJ per IEC60958	
Electrical, balanced	AES-EBU per AES3-1992	
Optical	Toslink® or equivalent	
<b>Sample Rate (SR) Range</b>		
Electrical	27 kS/s to 200 kS/s	<i>Usable over the extended range of 16 kS/s to 216 kS/s with degraded waveform fidelity, accuracy, and jitter</i>
Optical	27 kS/s to 108 kS/s	
<b>Sample Rate (SR) Accuracy</b>		
	±0.0003% [3 PPM]	
<b>Output Amplitude</b>		
Unbalanced		
Range	0.0 Vpp to 2.50 Vpp into 75 Ω	<i>1 mV resolution</i>
Accuracy	±(8 % + 20 mV)	
Source Impedance		<i>Typically 75 Ω</i>
Balanced		
Range	0.0 Vpp to 8.00 Vpp into 110 Ω	<i>1 mV resolution</i>
Accuracy	±(10 % + 80 mV)	
Source Impedance		<i>Typically 110 Ω</i>
Optical	Fixed, determined by transducer.	
<b>Channel Status Bits</b>		
	Full implementation per IEC-60958 (consumer) and AES3 (professional)	<i>Automatically set or manual override, hex or plain English, CRC override and auto-increment local address and time of day</i>
<b>User Bits and Validity Flag</b>		
	Fully settable	<i>Hex</i>



**Characteristic                      Specifications                      Supplemental Information**

<b>Residual Jitter<sup>1</sup></b>			
	Unbalanced, Balanced		
	700 Hz-100 kHz BW	≤600 ps	<i>Peak detection</i>
	50 Hz-100 kHz BW	≤1.0 ns	<i>Peak detection</i>
	Optical		<i>Typically &lt;2.5 ns, SR ≤96 kS/s</i>
<i>INTERFACE SIGNAL IMPAIRMENTS</i>			
<b>Variable Rise/Fall Time</b>			
	Range	12 ns to 100 ns	<i>1 ns typical resolution</i>
	Accuracy	±(10% + 2 ns)	
<b>Cable Simulation</b>			<i>Approximates the signal degradation of 100 meters of Belden 1696A.</i>
<b>Induced Jitter</b>			
	Waveforms	Sine, Square, Noise	
	Sine Wave Jitter		<i>Above 200 Hz, maximum allowable jitter decreases in a "1/f" fashion to 0.20 UI at F<sub>J</sub> = 10 kHz and higher.</i>
	Frequency Range (F <sub>J</sub> )	2 Hz to 200 kHz	
	Amplitude Range	0-1.591 μs for F <sub>J</sub> ≤20 Hz and derating linearly to 0.1591 μs at 200 kHz	<i>Equivalent to 0-9.775 UI at 48 kHz sample rate, derating to 0.9775 UI</i>
	Amplitude Resolution	100 ps	
	Accuracy (1 kHz)	±(0.01%)	
	Flatness	±0.01 dB	
	Jitter Spectrum <sup>1</sup>		<i>Spurious products are typically -40 dBc (below jitter signal) or -60 dBUI, whichever is larger.</i>
<b>Normal Mode Noise</b>			
	Waveform	Pseudo-random pulse train	
	Unbalanced	0 to 635 mVpp, 2.5 mV steps ±(10% + 25 mV)	
	Balanced	0 to 2.55 Vpp, 10 mV steps ±(10% + 100mV)	

Characteristic	Specifications	Supplemental Information
<b>Common Mode Signal (Bal only)</b>		
Waveform	Sine	
Frequency Range	20 Hz to 100 kHz	
Amplitude Range	0 to 20.0 V <sub>pp</sub> , 20 mV steps: ±(10% + 50 mV)	
<b>EMBEDDED OUTPUT SIGNAL RELATED:</b>		
<b>Waveforms</b>	Sine, sine split frequency, sine split phase, sine+DC offset, continuously swept-sine, square-wave, noise, IMD signals, multi-tone, constant value, walking ones/zeros, bittest random, wave file playback	8–24 bit word width, triangular PDF dither
<b>Sine Characteristics</b>		
Frequency Range	0.001 Hz to 0.499 • SR	
Flatness <sup>1</sup>		Typically < 0.001 dB
Offset Range	To maximum digital code [±1D]	Offset limits maximum ac signal
Harmonics & Spurious <sup>1</sup>		Typically < -190 dBFS
<b>Square Characteristics</b>		
Frequency Range (Fq)	10 Hz to SR / 6	Fq must equal SR / N where N is an even integer ≥6.
Even Harmonic, Spurious Content		Typically < -190 dBFS
<b>Noise Characteristics</b>		
Shape	White (<5 Hz to 0.499 • SR), Pink (<10 Hz to 0.45 • SR), IEC 60268-1 or BS EN 50332-1	IEC 60268-1 is shaped pink noise. BS EN 50332-1 is similar, but with soft clipping to limit crest factor to ≈2.
<b>IMD Test Signals</b>		
<b>SMPTE &amp; MOD</b>		
LF Tone Range	40 Hz to 1 kHz	
HF Tone Range	2 kHz to (0.499 • SR) or 20 kHz, whichever is lower	HF tone must be ≥ 6 • LF tone
Mix Ratio (LF:HF)	10:1, 4:1 or 1:1	
Residual IMD <sup>1,2</sup>		Typically < -140 dBFS

Characteristic	Specifications	Supplemental Information
<b>DFD</b>		
Tone Pair Mean Range	2.5 kHz to $(0.499 \cdot SR - F_{diff} / 2)$ or 20 kHz, whichever is lower	$F_{mean} = (F1 + F2)/2$
Tone Pair Difference Range	80 Hz to 2.0 kHz	$F_{diff} =  F2 - F1 $ ; $F_{mean}$ must be $\geq 6 \cdot F_{diff}$
Residual IMD <sup>1,2</sup>		Typically $< -150$ dBFS
<b>Multitone, Wave File Playback</b>		
Sample Rate (SR)	8 kS/s to 216 kS/s	
Maximum File Size	32 MSample	
Flatness (1 kHz ref)		Typically $< 0.001$ dB to $0.499 \cdot SR$
Spurious Content		Typically $< -140$ dBFS
<b>DIGITAL INPUT RELATED:</b>		
<b>Formats</b>		
Unbalanced	SPDIF-EIAJ per IEC 60958, $\leq 5$ Vpp	Input typically 75 $\Omega$ or $\approx 8.3$ k $\Omega$
Balanced	AES-EBU per AES3-2003, $\leq 10$ Vpp	Input typically 110 $\Omega$ or $\approx 2.5$ k $\Omega$
Optical	Toslink® or equivalent	
<b>Sample Rate (SR) Range</b>		
Electrical	27 kS/s to 200 kS/s	Usable over the extended range of 16 kS/s to 216 kS/s with degraded waveform fidelity, accuracy, and jitter
Optical	27 kS/s to 108 kS/s	
SR Measurement Accuracy	$\pm 0.0003\%$ [ $\pm 3$ ppm]	
<b>Input Amplitude Measurement</b>		
Unbalanced	0 to 2.50 Vpp, $\pm(5\% + 6$ mV)	
Balanced	0 to 8.0 Vpp, $\pm(5\% + 25$ mV)	

Characteristic	Specifications	Supplemental Information
<b>Jitter Measurement</b>		
Range	0-4.0 UI at $F_J \leq 500$ Hz	
Detection	Peak, RMS, or Average	<i>"Peak" detection must be used for residual measurements per AES3. "Average" detection is recommended for jitter response measurements.</i>
Bandwidth		
Low Limit	50 Hz or 700 Hz (AES3)	
High Limit	Variable from 1 kHz to 150 kHz in 0.1 kHz steps, Butterworth or Elliptic response.	
Accuracy (1 kHz)	$\pm(10\% + 1.0$ ns)	
Flatness <sup>1</sup>	$\pm 0.5$ dB, 100 Hz to 80 kHz	
Residual Jitter <sup>1</sup>		
700 Hz - 100 kHz BW	$\leq 600$ ps	
50 Hz - 100 kHz BW	$\leq 1.0$ ns	
Jitter Spectrum <sup>1</sup>		<i>Spurious products are typically -40 dBc (below jitter signal) or -60 dBUI, whichever is larger.</i>
<b>Channel Status Bits</b>		
	Full implementation per IEC-60958 (consumer) and AES3 (professional)	
<b>User Bits</b>		
	Displayed in hex	
<b>Validity Flag</b>		
	Displayed for each channel	
<b>Receiver Lock</b>		
	Displayed, both channels combined	
<b>EMBEDDED INPUT SIGNAL RELATED:</b>		
<b>Level (Amplitude) Measurement</b>		
Measurement Range	$< -120$ dBFS to $+3$ dBFS	
Accuracy (1 kHz)		<i>Typically <math>&lt; 0.001</math> dB</i>
Flatness <sup>1</sup>		<i>Typically <math>&lt; 0.001</math> dB</i>
<b>Residual Noise</b>		
		<i>Typically <math>&lt; -140</math> dBFS</i>

**Characteristic                      Specifications                      Supplemental Information**

<b>THD+N Measurement</b>		
Fundamental Range	5 Hz to $0.49 \cdot SR$ or 50 kHz, whichever is lower	<i>Tuning can be set to track measured frequency, generator setting or fixed</i>
Measurement Range	0 to 100%	
Accuracy	$\pm 0.5$ dB	
Residual THD+N <sup>1,2</sup>		<i>Typically &lt; -140 dBFS</i>
<b>Level &amp; THD+N Filters</b>		
High-Pass		
DC	DC coupling	
AC(<10 Hz)	AC coupling, 1-pole	<i>-3 dB at <math>\approx 1.6</math> Hz</i>
Butterworth	$F_{HP}$ (-3 dB) = 10 Hz to 1.0 kHz, 6-pole	<i>Combined with AC coupling</i>
Low-Pass <sup>3</sup>		
Butterworth	$F_{LP}$ (-3 dB) = 1 kHz to 150 kHz, 8-pole	<i><math>ENBW \approx 1.006 \cdot FLP</math></i>
Elliptic	$F_{LP}$ (-0.01 dB) = 1 kHz to 150 kHz, 8-pole; 0.01 dB pass-band ripple; $\leq -60$ dB stop-band.	<i><math>ENBW \approx (1.012-1.062) \cdot FLP</math></i>
SR / 2 (Maximum)	No filter is implemented, bandwidth and response are limited by the A/D	<i>-3 dB at <math>\approx 0.490 \cdot SR</math></i>
Weighting	A-wt, B-wt, C-wt, CCIR-1k, CCIR-2k, CCITT, C-message, 50 $\mu$ s or 75 $\mu$ s de-emph (with and without A-wt), or None	<i>Weighting filter is cascaded with the high-pass and low-pass bandwidth limiting filters.</i>

Characteristic	Specifications	Supplemental Information
<b>IMD Measurement</b>		
Test Signal Compatibility		
SMPTE & MOD	Any combination of 40 Hz–1 kHz (LF) and 2 kHz–20 kHz (HF), mixed in any ratio from 1:1 to 10:1 (LF:HF)	<i>HF tone must be <math>\geq 6 \cdot LF</math> tone</i>
DFD	Any two-tone combination with mean frequency of 2.5 kHz–50 kHz and a difference frequency of 80 Hz–2.0 kHz	$F_{mean} = (F1 + F2)/2$ $F_{diff} =  F2 - F1 $ <i><math>F_{mean}</math> must be <math>\geq 6 \cdot F_{diff}</math></i>
<b>IMD Measured</b>		
SMPTE	Amplitude modulation of HF tone	<i>Measurement BW is typ. 40–500 Hz xxx</i>
MOD	d2, d3, d2+d3, or d2+d3+d4+d5	<i>Use “d2+d3” for measurements per IEC-60268</i>
DFD	d2, d3, d2+d3, or d2+d3+d4+d5	<i>Use “d2+d3” for measurements per IEC-60268</i>
CCIF	d2 only	<i>CCIF<sup>™</sup> is an archaic form of DFD that measures only the d2 product using a different 0 dB reference</i>
Measurement Range	0 to 20%	
Accuracy	$\pm 0.5$ dB	
<b>Residual IMD<sup>2</sup></b>		
SMPTE & MOD		<i>Typically <math>&lt; -140</math> dBFS</i>
DFD		<i>Typically <math>&lt; -150</math> dBFS</i>
<b>Frequency Measurement</b>		
Range	$< 5$ Hz to $0.499 \cdot SR$	
Accuracy	$\pm(0.0003\% + 100 \mu\text{Hz})$	
<b>Phase Measurement</b>		
Ranges	$-90$ to $+270$ , $\pm 180$ , or 0 to 360 deg	
Accuracy		<i>Typically <math>&lt; 0.001</math> deg</i>

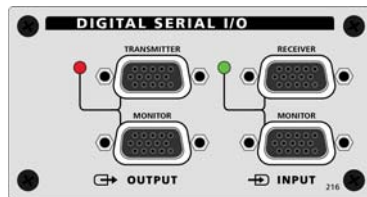
<b>NOTES to SPECIFICATIONS:</b>	
1	System specification including contributions from both generator and analyzer subject to the following conditions: (A) SR = 27 kS/s to 200 kS/s, (B) interface signal $\geq 1.5$ Vpp Bal or $\geq 300$ mVpp Unbal, (C) rise-time $\leq 20$ nsec, and (D) no impairments. Optical interface is unspecified for residual jitter.
2	Digital generator word width must be set to 24 bits for specified performance; shorter word widths may degrade performance.
3	Maximum low-pass filter frequency is limited by input sample rate (SR).





## **DSIO digital serial input/output module specifications**

**with APx500 v4.0 or higher measurement software  
as fitted in APx52x, 555, and 58x audio analyzers  
NP0020.00013 rev 005  
October 2014**



**This illustration shows a stand-alone APx DSIO module, model 216.**

These specifications cover the digital serial input and output functions of the Audio Precision DSIO. The DSIO is available as a stand-alone module (model 216), and in a combination module, combined with DIO (models 111 or 211).

The Digital Serial Input/Output (or DSIO) option provides a flexible chip- or board-level serial input and output interface. With separate Master Clock, Bit Clock, Frame Clock, Channel Clock and four Data lines, variable signal formats, variable word width, bit depth and synchronization options, the DSIO can address almost any serial interface need.

Formats include TDM, I<sup>2</sup>S, DSP (bit-wide pulse) and custom formats. Up to 16 channels can be transmitted and received using the TDM format.

DSIO specifications begin on the next page.

## Characteristic

## Specifications

## Supplemental Information

<b>Functional characteristics</b>		
<b>Channels</b>		
1 data line, TDM	1, 2, 4, 8 or 16	<i>Time division multiplexing (TDM)</i>
Multiple data lines	1, 2, 4 or 8	<i>up to 4 data lines; 2 channels on each line by TDM</i>
<b>Data formats</b>	I <sup>2</sup> S, DSP, custom (left/right justified, one bit/one subframe/50% duty cycle frame, inverted or normal frame, optionally 1-bit left-shifted frame). All modes LSB or MSB first	
<b>Word width</b>	8–128 bits	<i>cannot be less than bit depth</i>
<b>Bit depth (data length)</b>	8–32 bits	
<b>Sample rate (frame rate)</b>	4 kS/s–216 kS/s	<i>1, 2 or 4 channels</i>
	4 kS/s–192 kS/s	<i>8 or 16 channels</i>
<b>Master Clock range</b>	4 kHz–55.296 MHz	<i>1, 2, or 4 channels. Actual clock rate is dependent upon channel count, word width, and sample rate settings.</i>
	4 kHz–49.152 MHz	<i>8 or 16 channels. Actual clock rate is dependent upon channel count, word width, and sample rate settings.</i>
<b>Logic voltage levels</b>	1.8 V, 2.5 V, 3.3 V	

Characteristic	Specifications	Supplemental Information
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<b>DC characteristics, no load</b>		
<b>1.8 volt setting</b>		
High level input		
Minimum	1.0 V	
Low level input		
Maximum	0.8 V	
High level output		
Minimum	1.6 V	
Low level output		
Maximum	0.1 V	
Absolute range		
Minimum	-0.5 V	
Maximum	5.5 V	
<b>2.5 volt setting</b>		
High level input		
Minimum	1.4 V	
Low level input		
Maximum	1.1 V	
High level output		
Minimum	2.2 V	
Low level output		
Maximum	0.1 V	
Absolute range		
Minimum	-0.5 V	
Maximum	5.5 V	

Characteristic	Specifications	Supplemental Information
<b>3.3 volt setting</b>		
High level input		
Minimum	1.8 V	
Low level input		
Maximum	1.5 V	
High level output		
Minimum	3.0 V	
Low level output		
Maximum	0.1 V	
Absolute range		
Minimum	-0.5 V	
Maximum	5.5 V	
<b>Input/Output impedance</b>		
<b>All Outputs</b>	50 $\Omega$ , nominal	
<b>All Inputs</b>	10 k $\Omega$ , nominal	
<b>AC characteristics</b>		
<b>Clock frequencies, input or output</b>		
Master clock	4 kHz–55.296 MHz	1, 2, or 4 channels. Actual clock rate is dependent upon channel count, word width, and sample rate settings.
	4 kHz–49.152 MHz	8 or 16 channels. Actual clock rate is dependent upon channel count, word width, and sample rate settings.
Bit clock	49.152 MHz maximum	
Frame	216 kHz maximum	
<b>Output latency</b>		
Frame		typ 3 ns referenced to Bit clock
Data 1–4		typ 3 ns referenced to Bit clock
Monitor ports		typ 10 ns referenced to Signal pin
<b>Input setup and hold requirements</b>		
Frame, setup		6 ns referenced to Bit clock
Frame, hold		2 ns referenced to Bit clock
Data 1–4, setup		6 ns referenced to Bit clock
Data 1–4, hold		2 ns referenced to Bit clock

**Characteristic                      Specifications                      Supplemental Information**

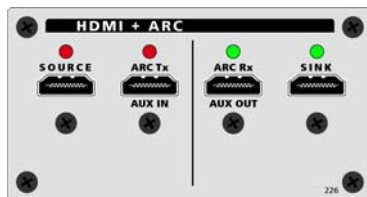
<u><b>Clock Jitter (Advanced Master Clock required)</b></u>		
<b>Jitter Measurement</b>		
Range	0 to 650 ns	
Detection	Peak, RMS, or Average	<i>"Average" detection is recommended for jitter response measurements.</i>
Bandwidth		
Low Limit	50 Hz or 700 Hz	
High Limit	Variable from 1 kHz to 150 kHz in 0.1 kHz steps, Butterworth or Elliptic response	
Accuracy (1 kHz)	±(1% + 300 ps)	<i>"Average" detection</i>
Flatness <sup>1</sup>	±0.2 dB, 100 Hz to 100 kHz	
Residual Jitter <sup>1</sup>		
50 Hz to 100 kHz BW	≤1.0 ns	
Jitter Spectrum <sup>1</sup>		<i>Spurious products are typically -40 dBc (below jitter signal) or -60 dBUI, whichever is larger</i>
<b>Induced Jitter</b>		
Waveforms	Sine, Square, Noise	
Signals Affected	Master Clk, Bit Clk, Frame Clock and Data	
<b>Sine Wave Jitter</b>		
Frequency Range (F <sub>J</sub> )	2 Hz to 200 kHz	
Amplitude Range	0 to 1591 ns for F <sub>J</sub> ≤ 20 kHz, derating linearly with frequency to 159.1 ns at 200 kHz	<i>Equivalent to 0 to 9.775 UI at 48 kHz sample rate, derating to 0.9775 UI</i>
Amplitude Resolution	100 ps	
Accuracy (1 kHz)	±0.01%	
Flatness	±0.01%	
Jitter Spectrum <sup>1</sup>		<i>Spurious products are typically -40 dBc (below jitter signal) or -60 dBUI, whichever is larger</i>

**Characteristic****Specifications****Supplemental Information****NOTE to SPECIFICATIONS**

1	System specification including contributions from both generator and analyzer subject to the following condition: Bit Clock $\geq$ 192 kHz.
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# HDMI+ARC input/output module specifications

with APx500 v3.4 or higher measurement software  
 as fitted in APx52x, 555 and 58x audio analyzers  
 NP0020.00011 rev 003  
 October 2013



This illustration shows the HDMI+ARC module, model 214.

These specifications cover the input and output functions of the Audio Precision HDMI+ARC (High Definition Multimedia Interface plus Audio Return Channel) I/O module. HDMI+ARC is available as a stand-alone module (models 114 or 214).

The model HDMI+ARC module is fully compatible with HDMI 1.3a; additionally, it supports a subset of HDMI 1.4a, the ARC (Audio Return Channel) feature. With APx500 v3.1, HDMI EDID 1.4 is supported. HDMI+ARC modules manufactured after October, 2013 will support CEC communications on the Source and Sink connectors. Go to Help > About in APx500 to check feature availability.

HDMI is designed to carry high-bandwidth digital streams providing an audio/video interface that includes content protection and a bi-directional channel for interaction with connected electronic devices. ARC (Audio Return Channel) provides an additional digital audio channel, which can simplify interface cabling in certain applications, for user convenience.

NOTE: Earlier APx585 instruments may be fitted with a Model 112 HDMI module, which does not include ARC support. The HDMI specifications are the same.

HDMI+ARC specifications begin on the next page.

## Characteristic

## Specifications

## Supplemental Information

<b>Revision</b>	1.3a + ARC.	<i>ARC (Audio Return Channel) implemented per HDMI 1.4a</i>
<b>Device Connections</b>		
SOURCE	Typically connects to the sink input of a DUT.	<i>The video is an internally generated single color screen or the signal applied to the AUX IN connector. The audio is internally generated: see "Embedded Output Signal Related" under "DIGITAL I/O" for typical waveforms and parameters.</i>
ARC Tx / AUX IN	<p>HDMI ARC Tx configuration: Typically connects to an HDMI source that accepts ARC audio.</p> <p>HDMI Source configuration: typically connects to an external source of video to be included in the Source output signal.</p>	<p><i>Generates and transmits audio across ARC, per HDMI 1.4a. HDMI source should not transmit video.</i></p> <p><i>Incoming audio is ignored. Incoming video is passed to HDMI Source in "pass through" mode.</i></p>
ARC Rx / AUX OUT	<p>HDMI ARC Rx configuration: Typically connects to an HDMI sink that produces ARC audio.</p> <p>HDMI Sink configuration: Typically connects to an independent monitoring device.</p>	<p><i>HDMI ARC Rx configuration: Receives and analyzes audio across ARC, per HDMI 1.4a. No video is transmitted.</i></p> <p><i>HDMI Sink configuration: Contains video and audio sent to Sink input.</i></p>
SINK	Typically connects to the source output of a DUT.	<i>The embedded and encoded audio signal components are recovered for analysis.</i>
<b>Hardware Interface</b>	HDMI Type A	
<b>EDID</b>	256-byte EEPROM on both Sink and ARC TX / AUX IN connectors.	



Characteristic	Specifications	Supplemental Information
<b>CEC (ARC connectors)</b>	HDMI ARC Tx configuration: ARC CEC implementation per HDMI 1.4a.  HDMI ARC Rx configuration: ARC CEC implementation per HDMI 1.4a.	<i>ARC link can be negotiated or forced on.</i>  <i>User can manually send a CEC ping or arbitrary CEC message to any of the standard logical addresses. An indicator confirms the receipt of an ACK (acknowledged) message from the messaged device.</i>
<b>CEC (HDMI Sink, Source Connectors)</b>	HDMI Source configuration: CEC implementation per HDMI 1.4a. Also, user-selectable CEC pass-through from AUX IN to Source.  HDMI Sink configuration: CEC implementation per HDMI 1.4a. Also, user-selectable CEC pass through from Sink to AUX OUT.	<i>User can manually send a CEC ping or arbitrary CEC message to any of the standard logical addresses. An indicator confirms the receipt of an ACK (acknowledged) message from the messaged device.</i>
<b>Color Support</b>	24-bit, 30-bit, 36-bit (Deep Color)	
<b>Max Video Rate</b>	1080p	
<b>ARC DIGITAL I/O</b>		
<i>ARC DIGITAL OUTPUT RELATED:</i>		
<b>Formats</b>		
Signal level, single mode	0.5 Vpp typical	<i>Output R is 55 Ω typical.</i>
Signal level, common mode	0.4 Vpp typical	<i>Output R is 30 Ω typical.</i>
<b>Sample Rate (SR) Range</b>	8 kS/s–216 kS/s	
<b>Sample Rate (SR) Accuracy</b>	±0.0003% [3 PPM]	
<b>Channel Status Bits</b>	Full implementation per IEC60958	<i>Automatically set or manual override, hex or plain English.</i>
<b>User Bits</b>	Fully settable	<i>Hex.</i>
<b>Validity Flag</b>	Set to 0, all channels	
<b>Residual Jitter</b> <sup>1,2</sup>		<i>&lt;1.0 ns typical</i>

Characteristic	Specifications	Supplemental Information
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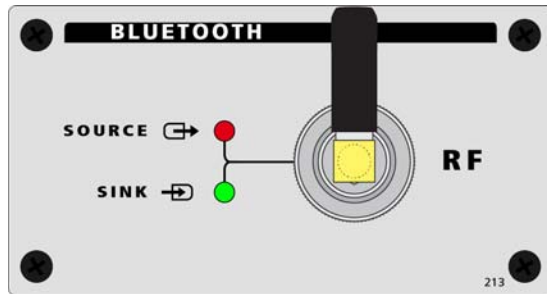
<i>EMBEDDED OUTPUT SIGNAL RELATED:</i>		
<b>Waveforms</b>	Sine, sine split frequency, sine split phase, sine+DC offset, continuously swept-sine, square-wave, noise, IMD signals, multi-tone, constant value, walking ones/zeros, bittest random, wave file playback.	8–24 bit word width, triangular PDF dither.
<b>Sine Characteristics</b>		
Frequency Range	5 Hz to $0.499 \cdot SR$	
Flatness <sup>1</sup>		Typically < 0.001 dB
Harmonics & Spurious Products <sup>1,3</sup>		Typically < -140 dBFS
<b>Square Characteristics</b>		
Frequency Range (Fq)	10 Hz to $SR / 6$	Only specific values are allowed: $Fq = SR / N$ where N is an even integer $\geq 6$
Even Harmonic, Spurious Content		Typically < -140 dBFS
<b>Noise Characteristics</b>		
Shape	White (<5 Hz to $0.499 \cdot SR$ ), Pink (<10 Hz to $0.45 \cdot SR$ ), IEC 60268-1 or BS EN 50332-1	
<b>IMD Test Signals</b>		
<b>SMPTE &amp; MOD</b>		
LF Tone Range	40 Hz to 1 kHz	
HF Tone Range	2 kHz to ( $0.499 \cdot SR$ ) or 20 kHz, whichever is lower	HF tone must be $\geq 6 \cdot LF$ tone.
Mix Ratio (LF:HF)	10:1, 4:1 or 1:1	4:1 maximum with SMPTE signal
Residual IMD <sup>1,3</sup>		Typically < -140 dBFS
<b>DFD</b>		
Tone Pair Mean Range	2.5 kHz to ( $0.499 \cdot SR - F_{diff} / 2$ ) or 20 kHz, whichever is lower	$F_{mean} = (F1 + F2)/2$ .
Tone Pair Difference Range	80 Hz to 2.0 kHz	$F_{diff} =  F2-F1 $ ; $F_{mean}$ must be $\geq 6 \cdot F_{diff}$ .

Characteristic	Specifications	Supplemental Information
	Residual IMD <sup>1, 3</sup>	Typically < -150 dBFS
<b>DIGITAL INPUT RELATED:</b>		
<b>Formats</b>		
	Single mode	≤1.5 Vpp Input R is nominally 55 Ω
	Dual mode	≤1.5 Vpp Input R is nominally 30 Ω
	<b>Sample Rate Range</b>	22 kS/s–216 kS/s Typically locks down to 16 kS/s
<b>EMBEDDED INPUT SIGNAL RELATED:</b>		
<b>Level (Amplitude) Measurement</b>		
	Measurement Range	< -120 dBFS to +3 dBFS
	Accuracy (1 kHz)	Typically < 0.001 dB
	Flatness <sup>1</sup>	Typically < 0.001 dB
	<b>Residual Noise</b>	Typically < -140 dBFS
<b>THD+N Measurement</b>		
	Fundamental Range	5 Hz to 0.49 • SR or 50 kHz, whichever is lower Tuning can be set to track measured frequency, generator setting or fixed
	Measurement Range	0 to 100%
	Accuracy	±0.5 dB
	Residual THD+N <sup>1, 3</sup>	Typically < -140 dBFS
<b>Level &amp; THD+N Filters</b>		
	High-Pass Filter	5 Hz to 500 Hz, or None 1 Hz steps
	Low-Pass Filter <sup>3</sup>	1 kHz to 97.2 kHz, or None 100 Hz steps; very sharp roll-off characteristic exceeds AES-17
	Weighting	A-wt, B-wt, C-wt, CCIR-1k, CCIR-2k, CCITT, C-message, 50 μs or 75 μs de-emph (with and without A-wt), or None Weighting filter is cascaded with the high-pass and low-pass bandwidth limiting filters
<b>IMD Measurement</b>		
	Test Signal Compatibility	
	SMPTE & MOD	Any combination of 40 Hz–1 kHz (LF) and 2 kHz–20 kHz (HF), mixed in any ratio from 1:1 to 10:1 (LF:HF) HF tone must be ≥ 6 • LF tone.

Characteristic		Specifications	Supplemental Information
	DFD	Any two-tone combination with mean frequency of 2.5 kHz–50 kHz and a difference frequency of 80 Hz–2.0 kHz	$F_{mean} = (F1 + F2)/2$ $F_{diff} =  F2 - F1 $ $F_{mean} \text{ must be } \geq 6 \cdot F_{diff}$ .
	IMD Measured		
	SMPTE	Amplitude modulation of HF tone.	<i>Measurement BW is typ. 40–500 Hz.</i>
	MOD & DFD	d2, d3, d2+d3, or d2+d3+d4+d5	<i>Use “d2+d3” for measurements per IEC-60268.</i>
	Measurement Range	0 to 20%	
	Accuracy	±0.5 dB	
	Residual IMD <sup>1,3</sup>		
	SMPTE & MOD		<i>Typically &lt; –140 dBFS</i>
	DFD		<i>Typically &lt; –150 dBFS</i>
<b>Frequency Measurement</b>			
	Range	< 5 Hz to 0.499 • SR	
	Accuracy	±(0.0003% + 100 µHz)	
	Resolution	6 digits	
<b>Phase Measurement</b>			
	Ranges	–90 to +270, ±180, or 0 to 360 deg	
	Accuracy <sup>1</sup>		<i>Typically &lt; 0.001 deg</i>
	Resolution	0.001 deg	
<b>Notes to Specifications</b>			
1.	System specification including contributions from both generator and analyzer. Generator-only and analyzer-only contributions are typically less.		
2.	Sample rate (SR) must be ≥ 27 kHz for specified performance. Jitter analyzer set for 700 Hz highpass response per AES3-1992.		
3.	Digital generator word width must be set to 24 bits for specified performance; shorter word widths may degrade performance.		

## Bluetooth input/output module specifications

with APx500 v3.2 or higher measurement software  
as fitted in APx52x, 555 and 58x audio analyzers  
NP0020.00015 rev 003  
November 2012



This illustration shows the stand-alone Bluetooth module, model 213.

These specifications cover the digital input and output functions of the Audio Precision Bluetooth interface. Bluetooth is available as a stand-alone module (model 213), and in a combination module, combined with DIO (model 217).

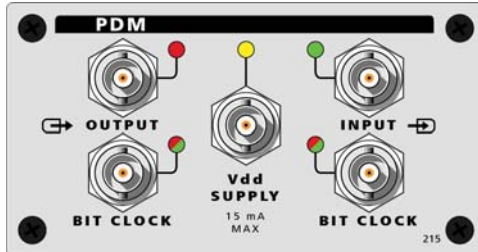
Bluetooth is a short-distance (a few meters) control, data, and audio communications wireless technology. Bluetooth uses low power, frequency-hopping radio in the 2.4 GHz band. Communication is two-way (for handshaking, metadata, etc); some profiles (HFP, for example) support duplex audio (both directions simultaneously); some profiles (A2DP) support only simplex audio (one direction per connection). Audio Precision supports several audio-specific Bluetooth profiles for audio test.

Bluetooth specifications begin on the next page.

Characteristic	Specifications	Supplemental Information
<b>Bluetooth Core Version</b>		
	2.1+EDR	
<b>Profiles/Roles Supported</b>		
	A2DP Source	<i>With APx-BT-WB hardware module, there is a potential +/- 1 sample inter-channel phase error in A2DP Source or Sink operation.</i>
	A2DP Sink	<i>See note above.</i>
	HFP Audio Gateway	
	HFP Hands-Free	
	HSP Audio Gateway	
	HSP Headset	
	AVRCP Controller	
<b>Codecs Supported</b>		
	SBC	
	APT-X	
	CVSD	
	mSBC	<i>Requires APx-BT-WB hardware module.</i>
<b>RF Connection</b>		
	Type N, Female	
	Antenna	
<b>RF Input Impedance</b>		<i>Typically 50 Ω</i>
<b>RF Output Impedance</b>		<i>Typically 50 Ω</i>
<b>RF Power</b>		<i>Typically 0 dBm</i>
		<i>Typical maximum +4 dBm</i>
<b>RF Sensitivity (0.1% BER)</b>		<i>Typically -81 dBm</i>

# PDM input/output module specifications

with APx500 v3.2 or higher measurement software  
 as fitted in APx52x, 555 and 58x audio analyzers  
 NP0020.00016 rev 001  
 October 2013



This illustration shows the stand-alone PDM module, model 215.

These specifications cover the digital input and output functions of the Audio Precision PDM interface. PDM is available as a stand-alone module (model 215), and in a combination module, combined with DIO (model 218).

The PDM option provides a complete solution for addressing circuits or devices with a PDM input or output.

The PDM signal output consists of an APx generator audio signal, interpolated by a broad choice of oversampling ratios, and modulated into a 1-bit PDM bitstream. A 4th-order modulator is the default; a 5th-order modulator can be selected. The PDM Option also provides a signal input with its associated clock connection. The input accepts a 1-bit PDM bitstream, which is then decimated by one of a wide range of decimation ratios and filtered into baseband audio at the Decimated Rate. The input bitstream can also be analyzed directly (before decimation) in the Signal Analyzer to view out-of-band components.

PDM specifications begin on the next page.

## Technical Specifications

Parameter	Symbol	Test Conditions	Min	Typ	Max	Unit
<b>TRANSMITTER</b>						
Decimated Rate	$F_S$		4		216	kHz
Bit Clock Rate	$F_B$	Master or slave mode	0.128		24.576	MHz
<b>INTERPOLATION FILTER</b>						
Interpolation Ratio ( $F_B/F_S$ )	INTR	16, 16.67, 21.33, 24, 25, 32, 33.33, 37.5, 42.67, 48, 50, 64, 66.67, 75, 85.33, 96, 100, 128, 150, 192, 200, 256, 300, 384, 400, 512, 500, 768, 800	16		800	
Passband Frequency Range						
Passband Gain		INTR = 32, 64, 128, 256, 512 All other INTR	-0.0001 -0.0063		+0.0001 +0.0001	dB dB
Stopband Frequency Range			0.55		INTR / 2	$F_S$
Stopband Attenuation		INTR = 32, 64, 128, 256, 512 All other INTR	115 100			dB dB
<b>MODULATOR: GENERAL</b>						
Passband Frequency Range			0		0.45	$F_S$
Passband Gain			-0.0001		+0.0001	dB
Maximum Input Level	MIL				0	dBFS
Linearity		-100 dBFS to MIL (order 4, 5) MIL to 0 dBFS (order 4) MIL to 0 dBFS (order 5)	-0.010 -0.010 -0.010		+0.001 +0.002 +0.001	dB dB dB
Ones Density at Full Scale			99.94	100		%
<b>MODULATOR: ORDER 4, 64x OSR</b>						
Overload Point	OLP	1 kHz			-7.8	dBFS
Total Harm. Dist. + Noise		@OLP; BW = 0.45 $F_S$			-105	dB
Signal-to-Noise Ratio	SNR	@OLP; BW = 0.45 $F_S$	106			dB



Parameter	Symbol	Test Conditions	Min	Typ	Max	Unit
Dynamic Range	DNR	@MIL; $F_S = 48$ kHz; per AES17	115			dB
<b>MODULATOR: ORDER 5, 64x OSR</b>						
Overload Point	OLP	1 kHz			-9.4	dBFS
Total Harm. Dist. + Noise		@OLP; $BW = 0.45 F_S$			-116	dB
Signal-to-Noise Ratio	SNR	@OLP; $BW = 0.45 F_S$	116			dB
Dynamic Range	DNR	@MIL; $F_S = 48$ kHz; per AES17	125			dB
<b>MODULATOR: ORDER 4, 128x OSR</b>						
Overload Point	OLP	1 kHz			-7.9	dBFS
Total Harm. Dist. + Noise		@OLP; $BW = 0.45 F_S$			-127	dB
Signal-to-Noise Ratio	SNR	@OLP; $BW = 0.45 F_S$	127			dB
Dynamic Range	DNR	@MIL; $F_S = 48$ kHz; per AES17	135			dB
<b>MODULATOR: ORDER 5, 128x OSR</b>						
Overload Point	OLP	1 kHz			-9.6	dBFS
Total Harm. Dist. + Noise		@OLP; $BW = 0.45 F_S$			-127	dB
Signal-to-Noise Ratio	SNR	@OLP; $BW = 0.45 F_S$	127			dB
Dynamic Range	DNR	@MIL; $F_S = 48$ kHz; per AES17	135			dB
<b>MODULATOR: ORDER 4, 256x OSR</b>						
Overload Point	OLP	1 kHz			-8.0	dBFS
Total Harm. Dist. + Noise		@OLP; $BW = 0.45 F_S$			-130	dB
Signal-to-Noise Ratio	SNR	@OLP; $BW = 0.45 F_S$	129			dB
Dynamic Range	DNR	@MIL; $F_S = 48$ kHz; per AES17	137			dB
<b>MODULATOR: ORDER 5, 256x OSR</b>						
Overload Point	OLP	1 kHz			-9.8	dBFS
Total Harm. Dist. + Noise		@OLP; $BW = 0.45 F_S$			-128	dB
Signal-to-Noise Ratio	SNR	@OLP; $BW = 0.45 F_S$	127			dB
Dynamic Range	DNR	@MIL; $F_S = 48$ kHz; per AES17	137			dB

Parameter	Symbol	Test Conditions	Min	Typ	Max	Unit
<b>MODULATOR: ORDER 4, 512x OSR</b>						
Overload Point	OLP	1 kHz			-8.2	dBFS
Total Harm. Dist. + Noise		@OLP; BW = 0.45 F <sub>S</sub>			-130	dB
Signal-to-Noise Ratio	SNR	@OLP; BW = 0.45 F <sub>S</sub>	129			dB
Dynamic Range	DNR	@MIL; F <sub>S</sub> = 48 kHz; per AES17	137			dB
<b>MODULATOR: ORDER 5, 512x OSR</b>						
Overload Point	OLP	1 kHz			-10	dBFS
Total Harm. Dist. + Noise		@OLP; BW = 0.45 F <sub>S</sub>			-128	dB
Signal-to-Noise Ratio	SNR	@OLP; BW = 0.45 F <sub>S</sub>	127			dB
Dynamic Range	DNR	@MIL; F <sub>S</sub> = 48 kHz; per AES17	137			dB
<b>RECEIVER</b>						
Decimated Rate	F <sub>S</sub>		0.160		768	kHz
Bit Clock Rate	F <sub>B</sub>	Master or slave mode	0.128		24.576	MHz
<b>DECIMATION FILTER</b>						
Decimation Ratio (FB/FS)	DECR	1, 3, 12.5, 4, 6, 25, 8, 8, 33, 10, 67, 12, 5, 16, 16, 67, 18, 75, 21, 33, 24, 25, 32, 33, 33, 37, 5, 42, 67, 48, 50, 64, 66, 67, 75, 85, 33, 96, 100, 128, 150, 192, 200, 256, 300, 384, 400, 512, 500, 768, 800	1		800	
Passband Frequency Range		All DECR except DECR = 1	0		0.45	F <sub>S</sub>
		DECR = 1	0		0.5	F <sub>B</sub>
Passband Gain		DECR = 1, 4, 8, 16, 32, 64, 128, 256, 512	-0.0001		+0.0001	dB
		All other DECR	-0.001		+0.001	dB
Stopband Frequency Range		All DECR except DECR = 1	0.55		DECR/2	F <sub>S</sub>
Stopband Attenuation		All DECR except DECR = 1	120			dB

Parameter	Symbol	Test Conditions	Min	Typ	Max	Unit
<b>LOGIC LEVEL</b>						
Interface Voltage	$V_{INT}$		1.80		3.30	V
Resolution					0.01	V
Accuracy				±0.05		V
<b>OUTPUT CHARACTERISTICS</b>						
Output Voltage High	$V_{OH}$	$I_{LOAD} = 0.5 \text{ mA}$	$0.7 \cdot V_{INT}$			V
Output Voltage Low	$V_{OL}$	$I_{LOAD} = 0.5 \text{ mA}$			$0.3 \cdot V_{INT}$	V
<b>VDD OUTPUT</b>						
DC Voltage	$V_{DD}$		0.80		3.60	V
Resolution					0.01	V
Accuracy				±0.05		V
Maximum Current	$I_{MAX}$				15	mA
<b>VDD MODULATION</b>						
AC output level		All waveforms	0.01		$V_{DD} / 5$	$V_{pp}$
Square/Pulse Frequency		Per GSM standard		216.667		Hz
Sine Frequency			10		22000	Hz
Frequency Accuracy				3		ppm

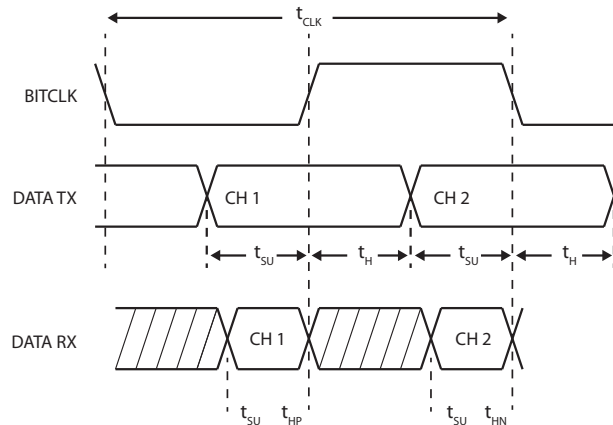
## Timing Characteristics

### PDM TRANSMITTER

$t_{CLKTX}$	Clock period (master or slave mode)	41	7813	ns
$t_H$	Data hold time	20		ns
$t_{SU}$	Data setup time		$t_{CLKTX} / 2-30$	ns

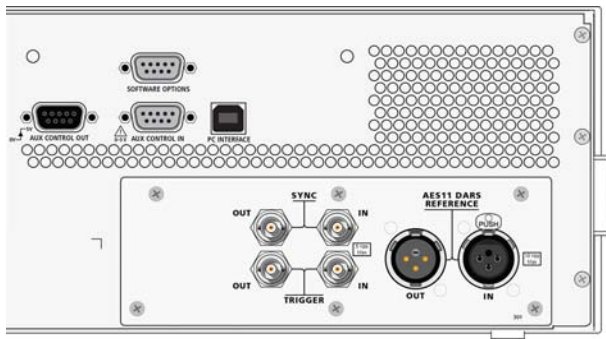
### PDM RECEIVER

$t_{CLKRX}$	Clock period (master or slave mode)	41	7813	ns
$t_{HP}$	Data hold time, rising edge	5		ns
$t_{HN}$	Data hold time, falling edge	10		ns
$t_{SU}$	Data setup time		5	ns



# AMC Advanced Master Clock Rear Panel Sync, Trigger and Ref I/O specifications

with APx500 v4.0 or higher measurement software  
as fitted in APx52x, 555, and 58x audio analyzers  
NP0020.00023 rev 000  
October 2014



**This illustration shows a section of the APx rear panel, focusing on the Auxiliary I/O and the Sync, Trigger and DARS reference connections for the AMC.**

These specifications cover rear panel Sync, Trigger and DARS Reference I/O functions for APx analyzers fitted with the Advanced Master Clock (AMC).

The Auxiliary I/O (GPIO) function is also described here. The Auxiliary I/O function is not part of the AMC option, but is fitted on all APx analyzers.

Characteristic

Specifications

Supplemental Information

<b>REAR PANEL I/O</b>		
<b>Auxiliary Digital Control</b>		
Output	8 bits	<i>Typically 0-5V, 9-pin male D-sub</i>
Input	8 bits	<i>Internal pull-up, 9-pin female D-sub</i>
<b>Sync Input</b>		
Signal Compatibility	Square or Sine	
Voltage Range	0.8 Vpp to 5.0 Vpp	$R_{IN} > 10\text{ k}\Omega$ , AC coupled
Frequency Range	4 kHz to 50 MHz, square; 1 MHz to 50 MHz, sine	
Lock Range		<i>Typically 100 ppm</i>
<b>Sync Output</b>		
Signal	Square	
Amplitude (VH)	+0.8 V to +3.6 V, 0.1 V steps	$V_L \approx 0$ to 0.1 V
Frequency Range	8 kHz to 50 MHz	<i>Maximum recommended frequency when interfacing to low voltage logic: 50 MHz for VH = 1.5–2.0 V; 30 MHz for VH = 1.0–1.4 V; 10 MHz for VH = 0.8–0.9 V</i>
<b>Reference Input (AES11 / DARS)</b>		
Voltage Range	2.0 Vpp to 6.0 Vpp	$R_{IN}$ selectable: $>5\text{ k}\Omega$ or $\approx 110\ \Omega$
Sample Rate Range	27 kS/s to 216 kS/s	
Lock Range		<i>Typically 100 ppm</i>
<b>Reference Output (AES11 / DARS)</b>		
Amplitude	5.0 Vpp into $110\ \Omega$ , balanced	
Sample Rate Range	8 kS/s to 216 kS/s	<i>Usable below 27 kS/s with some loss in waveform fidelity</i>



Characteristic	Specifications	Supplemental Information
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Characteristic	Specifications	Supplemental Information
<b>Trigger Input</b>		
Voltage Range	-0.5 V to +5.5 V	
Threshold Level	+0.8 to +3.6 V, 0.1 V steps	$R_{IN} \approx 10\text{ k}\Omega$ , DC coupled, + or - edge selectable
Minimum Pulse Width		Typically 20 ns
<b>Trigger Output</b>		
Trigger Sources	Analog Sine Generator, Audio Generator, and Jitter Generator	
Amplitude (VH)	+0.8 V to +3.6 V, 0.1 V steps	$V_L \approx 0$ to 0.1 V





# General and Environmental Specifications

for APx555 audio analyzers  
 NP0020.00024 rev 000  
 September 2014

Characteristic	Specifications	Supplemental Information
<b>GENERAL/ENVIRONMENTAL</b>		
<b>Power Requirements</b>	100–240 Vac $\pm$ 10% (90–264 Vac), 50–60 Hz, with safety ground via approved power cord, 160 VA max	<i>No range switching or fuse changes required over the full operating range of 90–264 Vac</i>
<b>Temperature</b>	0°C to +45°C operating, –40°C to +75°C storage	
<b>Humidity</b>	10% to 80%, non-condensing	
<b>Max Operating Altitude</b>	3,000 m [9,840 feet]	
<b>Stabilization Time</b>	20 minutes	<i>Allow up to 1 hour per 10°C if unit has been exposed to a significant change in temperature. Allow 24–48 hours to recover if condensation has occurred.</i>

Characteristic	Specifications	Supplemental Information
<b>EMC</b>	Complies with Directive 2004/108/EC, IEC 61326-1:2005, EN 61326-1:2006. Radiated and conducted emissions are within Class B limits of CISPR 11. Complies with Directive 1995/5/EC if option "BT" (Bluetooth) is installed. IEC 61326-2-1:2005 Section 5.2.401 is applied (controlled EM environment) for options "DSIO" and "PDM".	<i>Emissions and immunity levels are influenced by the quality of interface and signal cables attached to the unit. Compliance was demonstrated using Audio Precision cables.</i>
<b>Safety</b>	Complies with Directive 2006/95/EC, IEC 61010-1:2001, EN 61010-1:2001, CAN/CSA-C22.2 No. 61010-1-04, and UL Std No. 61010-1 (2nd Edition).	<i>Equipment Class I, Installation Category II, Pollution Degree 2, Measurement Category I</i>
<b>Dimensions (W, H, D)</b>	432 mm, 129 mm, 475 mm 17.0 in, 5.08 in, 18.7 in	<i>3U rack mount kit available</i>
<b>Weight</b>	10.8 kg [23.8 lbs] with no digital interface options installed	<i>Add <math>\approx</math> 0.2 kg [0.4 lbs] for each digital interface option installed.</i>





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