APx52x/58x

FAMILIES OF AUDIO ANALYZERS

Installation Instructions and Specifications

Audio precision

APx52x and 58x families of audio analyzers

Installation Instructions and Specifications

Audio precision

model APx525 with DIO, DSIO, HDMI and Bluetooth options

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Documentation and Support

This booklet contains safety information, installation instructions and full specifications for the Audio Precision APx52x and 58x families of audio analyzers.

The APx500 User's Manual

Detailed information on the operation of the APx52x and 58x families of analyzers 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; 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 for APx support information. APx resources are available at ap.com/downloads/apx. You can also contact our Technical Support staff at 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 ±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 3 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.

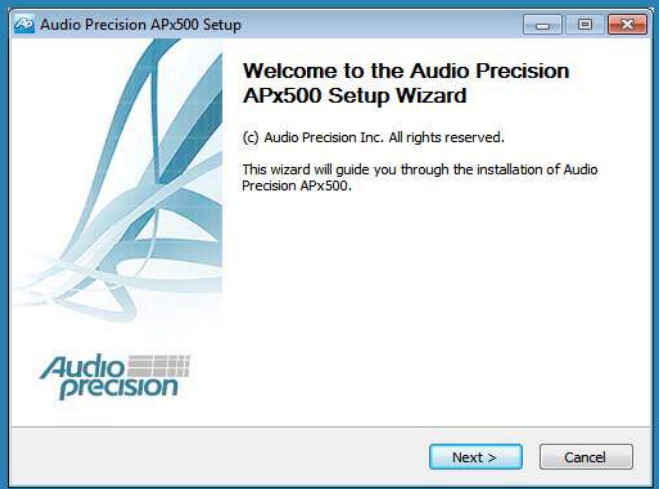
ATTENTION!—This symbol alerts you to important operating considerations or a potential operating condition that could damage equipment. If you see this marked on equipment, refer to the Operator's Manual or User's Manual for precautionary instructions.

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.


Audio Precision APx500 Setup
Welcome to the Audio Precision APx500 Setup Wizard
(c) Audio Precision Inc. All rights reserved.
This wizard will guide you through the installation of Audio Precision APx500.
Audio precision
Next >
Cancel

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Installation

Software

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

PC system requirements

The APx500 measurement software version 4.1 and later can be very demanding of the personal computer (PC) running the APx software.

Moderate measurement demands

Moderate measurement demands (measurement bandwidths under 90 kHz, channel counts of 2 or 1) will perform adequately using a PC with these minimum specifications:

- 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.

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.

High measurement demands

High measurement demands (measurement bandwidths above 90 kHz, channel counts over 2) will perform much better with a superior PC; in some cases, very high measurement demands can slow or stop measurements.

Please view the current APx PC Minimum System Solutions document on our Web site at www.ap.com/display/file/764. This information will help you to determine the adequacy of a particular PC for high-bandwidth, high-channel count measurement.

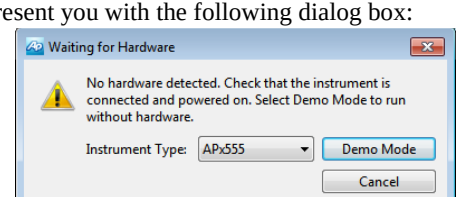
Installation

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.

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 **Connecting your instrument to the electrical mains supply** 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.

Connecting your instrument to the electrical mains supply

APx52x/58x instruments 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. These instruments are 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. For all rated voltages, use two mains fuses of type 2A T/SB (5 x20 mm) 250 V.

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.

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 is it applies to digital audio formats.
1 UI= 1/(128 • 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
APx525 family of audio analyzers

with APx500 v4.2 or higher measurement software
October 2015 NP0020.00010 r012

This illustration shows an APx525 in its standard configuration, with a DIO module installed.

These specifications cover the analog input and output functions of the Audio Precision APx525 and APx526 analyzers, as well as Audio Precision analyzers branded APx520 and APx521.

The APx525 has 2 analog output channels and 2 analog input channels.
The APx526 has 2 analog output channels and 4 analog input channels.

The performance of AG52 analog generator option and the BW52 analog analyzer option are also specified in this section.

Specifications for the DIO interface and other available interface modules including ADIO, DSIO, HDMI, PDM, AMC and Bluetooth, are found in other sections of this document, as are General and Environmental specifications for the entire APx 52x/58x family.

Analog specifications begin on the next page.

Characteristic	Specifications	Supplemental Information
ANALOG GENERATOR		
Number of Channels	2, independent amplitude control	
Waveforms	Sine, sine split frequency, sine split phase, sine+DC offset, continuously swept-sine, square-wave, noise, IMD signals, multi-tone, wave file playback	*Option AG52 required for square waves and DIM test signals*
Sine Characteristics		
Frequency Range (Fs)	0.1 Hz to 80.1 kHz	*Setting resolution is typically 45 µHz*
Frequency Accuracy	±(0.0002% + 100 µHz)	
Amplitude Range	0 to 21.21 Vrms [60.0 Vpp], bal; 0 to 10.61 Vrms [30.0 Vpp], unbal	*Option AG52 increases max output to 26.66 Vrms bal, 13.33 Vrms unbal*
Amplitude Accuracy, 1 kHz		
+15C to +30C	±0.03 dB [±0.35%]	
0C to +45C	±0.05 dB [±0.58%]	
Flatness (1 kHz ref)		
Fs = 5 Hz to 20 kHz	±0.008 dB	*Typically <0.003 dB*
Fs = 20 kHz to 50 kHz	±0.030 dB	
Fs = 50 kHz to 80 kHz	±0.10 dB	
Residual THD+N[1,2]		
Fs = 20 Hz–20 kHz	≤ (–105 dB + 1.3 µV), 20 kHz BW; ≤ (–100 dB + 1.8 µV), 40 kHz BW; ≤ (–92 dB + 2.6 µV), 80 kHz BW; ≤ (–85 dB + 6 µV), 250 kHz BW; ≤ (–82 dB + 9 µV), 500 kHz BW	*Typically <–110 dB at 1 kHz, 2.5 V with option AG52; typically <–108 dB in standard units*
Non-Harmonic Content		*Typically <–110 dB when Fs ≤75 kHz, increasing to ≈ –55 dB at Fs =80 kHz*
Phase offset range (split phase).	–179.999 to +180.000 deg	
DC Offset Range	±12.00 Vdc balanced; ±6.00 Vdc unbalanced	*DC offset limits maximum ac signal*
Residual DC Offset	≤0.25% of Vrms setting [≤0.09% of Vpp setting] + 100 µV	
Square Characteristics (requires option AG52)		
Frequency Range (Fq)	0.1 Hz to 30 kHz	*Same accuracy as sine wave*

Characteristic	Specifications	Supplemental Information
Amplitude Range	0 to 60.0 Vpp, balanced; 0 to 30.0 Vpp, unbalanced	
Amplitude Accuracy	±0.10 dB [±1.2%]	
Risetime	≤2.0 µsec	*Typically <1.7 µsec when Rs ≤200 Ω*
Even Harmonic Content		
Fq = 10 Hz to 5 kHz	≤–100 dB to at least 80 kHz	
Fq = 5 kHz to 20 kHz	≤–90 dB to at least 80 kHz	
Non-Harmonic Content		*Typically <–110 dB*
Noise Characteristics		
Shape	White (<5 Hz to >80 kHz), Pink (<10 Hz to >80 kHz), IEC 60268-1 or BS EN 50332-1	
Amplitude Range	0 to 60.0 Vpp, balanced; 0 to 30.0 Vpp, unbalanced	*Amplitude calibration is approximate*
IMD Test Signals		
SMPTE & MOD		
Lower Frequency (LF)	40 Hz to 1.00 kHz	
Upper Frequency (HF)	2.00 kHz to 60.00 kHz	*HF tone must be ≥ 6 • LF tone.*
Mix Ratio (LF:HF)	10:1, 4:1 or 1:1	
Amplitude Range	0 to 60.0 Vpp, balanced; 0 to 30.0 Vpp, unbalanced.	*Option AG52 increases maximum to 75.4 Vpp bal, 37.7 Vpp unbal.*
Amplitude Accuracy	±0.06 dB [±0.70%]	
Residual IMD[1,2,3]	≤ –95 dB [0.0018%], 4:1 mix ratio	
DFD		
Difference Frequency (Fdiff)	80 Hz to 2.00 kHz	$F_{mean} = (F1 + F2)/2.$
Mean Frequency (Fmean)	250 Hz to 60.00 kHz	$F_{diff} = \|F2 - F1\|$ F_{mean} *must be* $\geq 6 \bullet F_{diff}$
Amplitude Range	0 to 60.0 Vpp, balanced; 0 to 30.0 Vpp, unbalanced.	*Option AG52 increases maximum to 75.4 Vpp bal, 37.7 Vpp unbal.*
Amplitude Accuracy	±0.06 dB [±0.70%]	
Residual IMD[1,2,3]	≤ –106 dB [0.0005%]	

Characteristic	Specifications	Supplemental Information
DIM (requires option AG52)		
Square / Sine Frequencies	3.15 kHz / 15.0 kHz, 2.96 kHz / 14.0 kHz, or 2.96 kHz / 8.0 kHz.	*"DIM100" or "DIM30"* *"DIM-B"* *"DIM-B8"*
Mix Ratio	4:1, square to sine, peak-peak	
Amplitude Range	<60 µV to 75.4 Vpp, balanced; <30 µV to 37.7 Vpp, unbalanced.	
Amplitude Accuracy	±0.10 dB [±1.2%]	
Residual IMD[1,2,3]	≤ –95 dB [0.0018%]	
Multitone, Wave File Playback		
Sample Rate Range (SR)	8 kS/s to 108 kS/s, and 175 kS/s to 192 kS/s	*Operation from 109 kS/s to 175 kS/s is possible, but with degraded flatness*
Maximum File Size	32M Sample	
Amplitude Range	0 to 45.2 Vpp, balanced; 0 to 22.6 Vpp, unbalanced.	*".Wav" file must peak at digital full scale to obtain selected amplitude.*
Flatness (1 kHz ref)		
SR = 175 kS/s to 192 kS/sec		*Typically <0.012 dB to 20 kHz*
SR = 8 kS/s to 108 kS/sec		*Typically <0.04 dB to 20 kHz;* *max frequency limited to ≈0.45*SR*
Spurious Content		*Typically <–110 dB*
Output Equalization	Arbitrary 30-pole output filter	*Filter cannot be applied to AG52 special waveforms square and DIM.*
Source Resistance (Rs)		
Balanced	Selectable 40 Ω ±1.5%, 100 Ω ±1%, 150 Ω ±1%, 200 Ω ±1%, or 600 Ω ±1%.	*Grounded, symmetrical*
Unbalanced	Selectable 20 Ω ±2%, 50 Ω ±1.5%, 75 Ω ±1.2%, 100 Ω ±1%, or 600 Ω ±1%.	*Electronically floating, 0.3 Vpk max;* *bnc shield to ground ≈10-17Ω || 22nF*
Common Mode Test	Same as Balanced selections, or 10 Ω Unbalanced per IEC-60268.	
Max Output Current		*Typically >80 mA peak, 50 mA dc*
Reverse Overload Protection		*Up to 1A or 30 W, whichever is less*

Characteristic	Specifications	Supplemental Information
Output Related Crosstalk[1]	≤ (–130 dB + 0.3 µV) to 20 kHz	
ANALOG ANALYZER		
Number of Channels		
APx525 (and APx520)	2, independently auto-ranging.	
APx526 (and APx521)	4, independently auto-ranging.	*With option BW52: only Channels 1 and 2 are active if BW setting = 250 kHz, 500 kHz or 1 MHz*
Maximum Rated Input	230 Vpk, 160 Vdc, any input to ground; 0.5 Vpk for unbalanced bnc shields	
Input Impedance		
Balanced	100 kΩ || ≈220 pF, each side to ground	
Unbalanced	100 kΩ || ≈220 pF to bnc shield	*Electronically floating, 0.5 Vpk max; bnc shield to ground ≈500Ω || 22nF*
Input Terminations	Selectable 600 Ω ±1% (1.5 W max), or 300 Ω ±1% (3 W max).	*Terminations automatically open in the 100 V and 300 V ranges.*
Input Coupling	Selectable DC or AC	*Typically <0.5 µA bias current with DC coupling, typically <0.03 dB roll-off at 20 Hz with AC coupling*
Input Ranges	320 mV to 300 V, 10 dB steps	*Maximum ac signal is ≈160 Vac unbal, 300 Vac bal, in the 300V range*
Common Mode Rejection[4]		*Max common mode signal range:*
320 mV, 1 V, 3.2 V ranges	≥ 80 dB, 5 Hz to 5 kHz; ≥ 72 dB, 5 kHz to 20 kHz	*±6 Vpk*
10 V range	≥ 50 dB, 5 Hz to 20 kHz	*±16 Vpk*
32 V range	≥ 50 dB, 5 Hz to 20 kHz	*±60 Vpk*
100 V and 300 V ranges	≥ 45 dB, 5 Hz to 20 kHz	*±230 Vpk*
Input Related Crosstalk	≤ (–140 dB + 0.1 µV) to 20 kHz	*R_s ≤ 600 Ω*

Characteristic	Specifications	Supplemental Information
Level (Amplitude) Measurement		
Range		
Balanced or bridging input	< 1 µV to 300 Vrms	
Unbalanced input	< 1 µV to 160 Vrms	
Accuracy (1 kHz)		
+15C to +30C	±0.03 dB [±0.35%]	
0C to +45C	±0.05 dB [±0.58%]	
Flatness (1 kHz ref, DC coupling)		
10 Hz to 20 kHz	±0.008 dB	*Typically < 0.003 dB*
20 kHz to 50 kHz	±0.030 dB	
50 kHz to 80 kHz	±0.10 dB	
80 kHz to 250 kHz (requires option BW52)	±0.20 dB	*Roll-off is typically <–3 dB at the selected input BW setting, 1 MHz max*
Residual Noise (inputs shorted)		
20–20 kHz BW[5]	≤ 1.3 µVrms	*Typically <8.0 nV / √Hz at 1 kHz.*
20–500 kHz, with option BW52	≤ 8.0 µVrms	
THD+N Measurement		
Fundamental Range	5 Hz to 90 kHz	
Measurement Range	0 to 100%	
Accuracy	±0.5 dB	*Q=2.6 typically*
Residual THD+N[1,2]		
20 Hz–20 kHz fundamentals	≤ (–105 dB + 1.3 µV, 20 kHz BW); ≤ (–100 dB + 1.8 µV, 40 kHz BW); ≤ (–92 dB + 2.6 µV, 80 kHz BW); ≤(–85 dB + 6 µV), 250 kHz BW; ≤(–82 dB + 9 µV), 500 kHz BW	*Typically <–110 dB at 1 kHz, 2.5 V with option AG52; typically <–108 dB in standard units.*

Characteristic	Specifications	Supplemental Information
Bandwidth Limiting Filters		
High-Pass[6]		
DC	DC coupling	
AC (< 10 Hz)	AC coupling	*Response is 2-pole via a combination of analog and digital filters, and is typically –3 dB at 4.1 Hz*
Butterworth	F_{HP} (–3 dB) = 10 Hz to 90 kHz, 4-pole; 10 Hz to 1 MHz (BW52)	
Elliptic	F_{HP} (–0.01 dB) = 10 Hz to 90 kHz, 5-pole; 10 Hz to 1 MHz (BW52); 0.01 dB pass-band ripple; ≤–60 dB stop-band	
Low-Pass [5, 6]		
ADC Passband	No filter is implemented, bandwidth and response are limited by the A/D and sample rate (SR)	*–3 dB at ≈ 0.490 • SR, SR ≤ 216 kS/s; for BW52, add: –3 dB at ≈ 260 kHz for 624 kS/s –3 dB at ≈ 520 kHz for 1.248 MS/s –3 dB at ≈ 1 MHz for 2.496 MS/s*
20k (AES17), 40k (AES17)	Special filters conforming with AES17	
Butterworth	F_{LP} (–3 dB) = 10 Hz to 90 kHz, 8-pole; 10 Hz to 1 MHz (BW52)	*ENBW ≈ 1.006 • F_{LP}*
Elliptic	F_{LP} (–0.01 dB) = 10 Hz to 90 kHz, 8-pole; 10 Hz to 1 MHz (BW52); 0.01 dB pass-band ripple; ≤–60 dB stop-band	*ENBW ≈ (1.012–1.062) • F_{LP} (varies due to warping)*
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 both high-pass and low-pass filters*
Input Equalization	Arbitrary 30-pole input filter	*The EQ operates on any selected analyzer input channels.*

Characteristic	Specifications	Supplemental Information
IMD Measurement		
Test Signal Compatibility		
SMPTE & MOD	Any combination of 40 Hz–1 kHz (LF) and 1 kHz–60 kHz (HF), mixed in any ratio from 1:1 to 10:1 (LF:HF)	*HF tone must be ≥ 6 • LF tone*
DFD	Any two-tone combination with mean frequency of 250 kHz–60 kHz and a difference frequency of 80 Hz–2.0 kHz	$F_{mean} = (F1 + F2)/2.$ $F_{diff} = \|F2 - F1\|$ F_{mean} *must be* ≥6 • F_{diff}
DIM	DIM100, DIM30, DIM-B, or DIM-B8	
IMD Measured		
SMPTE	Amplitude modulation of HF tone	*Measurement BW is typ. 40–750 Hz*
MOD	d2, d3, d2+d3, or d2+d3+d4+d5	*Use "d2+d3" for measurements per IEC60268*
DFD	d2, d3, d2+d3, or d2+d3+d4+d5	*Use "d2+d3" for measurements per IEC60268*
DIM	u1 to u9 per IEC-60286	
Measurement Range	0 to 20%	
Accuracy	±0.5 dB	
Residual IMD[1,2,3]		
SMPTE & MOD	≤ –95 dB [0.0018%], 4:1 mix ratio	
DFD	≤ –106 dB [0.0005%]	
DIM	≤ –95 dB [0.0018%]	
Frequency Measurement		
Range	<5 Hz to 90 kHz, standard; <5 Hz to 1 MHz with option BW52.	
Accuracy	±(0.0002% + 100 µHz)	V_{in} *must be ≥ 5 mV.*
Resolution	6 digits	
Phase Measurement		
Ranges	–90 to +270, ±180, or 0 to 360 deg	
Accuracy	±0.2 deg, 5 Hz to 5 kHz; ±0.8 deg, 5 kHz to 20 kHz; ±2.0 deg, 20 kHz to 50 kHz	V_{in} *must be ≥ 5 mV with DC coupling, both channels. Accuracy degrades below 50 Hz with AC coupling.*
Resolution	0.001 deg	

Characteristic	Specifications	Supplemental Information
DC Voltage Measurement		*Valid only for input bandwidths ≤90k*
Input Ranges	0.32V to 300V, 10 dB steps	*±160 Vdc maximum in 300V range*
Accuracy		
0.32 V range	±(0.7% reading + 800 µV)	
1 V–300 V ranges	±(0.7% reading + 0.1% range)	
Normal Mode Rejection		*Typically > 90 dB, 20 Hz to 20 kHz.*

NOTES to SPECIFICATIONS:

1. System specification including contributions from both generator and analyzer. Generator-only and/or analyzer-only contributions are typically less.
2. Generator load must be ≥600Ω balanced or ≥300Ω unbalanced for specified performance. Generator dc offset must be off or set to ≤10 mV.
3. Input must be ≥150 mV for specified performance. Analyzer must be set to measure "d2+d3" for MOD and DFD, and "U1…U9" for DIM per IEC-60268.
4. Valid for the balanced input configuration with DC coupling only. With AC coupling, specified performance is invalid below 50 Hz.
5. Maximum low-pass filter frequency is limited by analyzer input bandwidth setting.
6. Filter response is relative to “no filter” selection; overall system performance will also include analog flatness imperfections. DSP warping may significantly increase roll-off rate and lower ENBW.

Characteristic	Specifications	Supplemental Information

Analog I/O specifications
APx582 audio analyzer

with APx500 v4.2 or higher measurement software
October 2015 NP0020.00019 r003

This illustration shows an APx582 in its standard configuration, with a DIO module installed.

These specifications cover the analog input and output functions of the Audio Precision APx582 audio analyzer. The APx582 has 2 analog output channels and 8 analog input channels. The APx582 is fitted with the AG52 analog generator option as a standard feature. The performance of the AG52 when fitted in an APx582 is also specified in this section.

Specifications for the DIO interface and other available interface modules including DSIO, HDMI, PDM and Bluetooth, 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
ANALOG GENERATOR		
Number of Channels	2, independent amplitude control	
Waveforms	Sine, sine split frequency, sine split phase, sine+DC offset, continuously swept-sine, square-wave, noise, IMD signals, multi-tone, wave file playback	
Sine Characteristics		
Frequency Range (Fs)	0.1 Hz to 80.1 kHz	*Setting resolution is typically 45 µHz*
Frequency Accuracy	±(0.0003% + 100 µHz)	
Amplitude Range	0 to 26.66 Vrms [75.4 Vpp], bal; 0 to 13.33 Vrms [37.7 Vpp], unbal	
Amplitude Accuracy, 1 kHz		
+15C to +30C	±0.03 dB [±0.35%]	
0C to +45C	±0.05 dB [±0.58%]	
Flatness (1 kHz ref)		
Fs = 5 Hz to 20 kHz	±0.008 dB	*Typically <0.003 dB*
Fs = 20 kHz to 50 kHz	±0.030 dB	
Fs = 50 kHz to 80 kHz	±0.10 dB	
Residual THD+N[1,2]		
Fs = 20 Hz–20 kHz	≤ (–105 dB + 1.3 µV), 20 kHz BW; ≤ (–100 dB + 1.8 µV), 40 kHz BW; ≤ (–92 dB + 2.6 µV), 80 kHz BW; ≤ (–85 dB + 6 µV), 250 kHz BW; ≤ (–82 dB + 9 µV), 500 kHz BW	*Typically <–110 dB at 1 kHz, 2.5 V*
Non-Harmonic Content		*Typically <–110 dB when Fs ≤75 kHz, increasing to ≈ –55 dB at Fs =80 kHz*
Phase offset range (split phase).	–179.999 to +180.000 deg	
DC Offset Range	±12.00 Vdc balanced; ±6.00 Vdc unbalanced	*DC offset limits maximum ac signal*
Residual DC Offset	≤0.25% of Vrms setting [≤0.09% of Vpp setting] + 100 µV	

Characteristic	Specifications	Supplemental Information
Square Characteristics		
Frequency Range (Fq)	0.1 Hz to 30 kHz	*Same accuracy as sine wave*
Amplitude Range	0 to 60.0 Vpp, balanced; 0 to 30.0 Vpp, unbalanced	
Amplitude Accuracy	±0.10 dB [±1.2%]	
Risetime	≤2.0 µsec	*Typically <1.7 µsec when Rs ≤200 Ω*
Even Harmonic Content		
Fq = 10 Hz to 5 kHz	≤–100 dB to at least 80 kHz	
Fq = 5 kHz to 20 kHz	≤–90 dB to at least 80 kHz	
Non-Harmonic Content		*Typically <–110 dB*
Noise Characteristics		
Shape	White (<5 Hz to >80 kHz), Pink (<10 Hz to >80 kHz), IEC 60268-1 or BS EN 50332-1	
Amplitude Range	0 to 60.0 Vpp, balanced; 0 to 30.0 Vpp, unbalanced	*Amplitude calibration is approximate*
IMD Test Signals		
SMPTE & MOD		
Lower Frequency (LF)	40 Hz to 1.00 kHz	
Upper Frequency (HF)	2.00 kHz to 60.00 kHz	*HF tone must be ≥ 6 • LF tone.*
Mix Ratio (LF:HF)	10:1, 4:1 or 1:1	*4:1 maximum with SMPTE signal*
Amplitude Range	0 to 75.4 Vpp, balanced; 0 to 37.7 Vpp, unbalanced.	
Amplitude Accuracy	±0.06 dB [±0.70%]	
Residual IMD[1,2,3]	≤–95 dB [0.0018%], 4:1 mix ratio	
DFD		
Difference Frequency (Fdiff)	80 Hz to 2.00 kHz	$F_{mean} = (F1 + F2)/2.$
Mean Frequency (Fmean)	250 Hz to 60.00 kHz	$F_{diff} = \|F2 - F1\|$ F_{mean} *must be* $\geq 6 \cdot F_{diff}$
Amplitude Range	0 to 75.4 Vpp, balanced; 0 to 37.7 Vpp, unbalanced.	
Amplitude Accuracy	±0.06 dB [±0.70%]	
Residual IMD[1,2,3]	≤–106 dB [0.0005%]	

Characteristic	Specifications	Supplemental Information
DIM		
Square / Sine Frequencies	3.15 kHz / 15.0 kHz, 2.96 kHz / 14.0 kHz, or 2.96 kHz / 8.0 kHz.	*"DIM100" or "DIM30"* *"DIM-B"* *"DIM-B8"*
Mix Ratio	4:1, square to sine, peak-peak	
Amplitude Range	<60 µV to 75.4 Vpp, balanced; <30 µV to 37.7 Vpp, unbalanced.	
Amplitude Accuracy	±0.10 dB [±1.2%]	
Residual IMD[1,2,3]	≤–95 dB [0.0018%]	
Multitone, Wave File Playback		
Sample Rate Range (SR)	8 kS/s to 108 kS/s, and 175 kS/s to 192 kS/s	*Operation from 109 kS/s to 175 kS/s is possible, but with degraded flatness*
Maximum File Size	32M Sample	
Amplitude Range	0 to 45.2 Vpp, balanced; 0 to 22.6 Vpp, unbalanced.	*".Wav" file must peak at digital full scale to obtain selected amplitude.*
Flatness (1 kHz ref)		
SR = 175 kS/s to 192 kS/sec		*Typically <0.012 dB to 20 kHz*
SR = 8 kS/s to 108 kS/sec		*Typically <0.04 dB to 20 kHz;* *max frequency limited to ≈0.45*SR*
Spurious Content		*Typically <–110 dB*
Output Equalization	Arbitrary 30-pole output filter	*Filter cannot be applied to special waveforms square and DIM.*
Source Resistance (Rs)		
Balanced	Selectable 40 Ω ±1.5%, 100 Ω ±1%, 150 Ω ±1%, 200 Ω ±1%, or 600 Ω ±1%.	*Grounded, symmetrical*
Unbalanced	Selectable 20 Ω ±2%, 50 Ω ±1.5%, 75 Ω ±1.2%, 100 Ω ±1%, or 600 Ω ±1%.	*Electronically floating, 0.3 Vpk max;* *bnc shield to ground ≈10-17Ω || 22nF*
Common Mode Test	Same as Balanced selections, or 10 Ω Unbalanced per IEC-60268.	
Max Output Current		*Typically >80 mA peak, 50 mA dc*
Reverse Overload Protection		*Up to 1A or 30 W, whichever is less*

Characteristic	Specifications	Supplemental Information
Output Related Crosstalk[1]	≤(–130 dB+0.3 µV) to 20 kHz	
ANALOG ANALYZER		
Number of Channels	8, independently auto-ranging	
Maximum Rated Input	160 Vpk, 120 Vdc any input to ground; 0.5 Vpk bnc shields to ground	
Input Impedance		
Balanced	100 kΩ || ≈230 pF, each side to ground	
Unbalanced	100 kΩ || ≈230 pF to bnc shield	*Electronically floating, 0.5 Vpk max; bnc shield to ground ≈500Ω || 22nF*
Input Coupling	DC	*Typically <0.5 µA bias current*
Input Ranges	320 mV to 100 V, 10 dB steps	*Maximum ac signal ≈115 Vac, unbal or bal, in the 100 V range*
Common Mode Rejection[4]		*Max common mode signal range:*
320 mV, 1 V, 3.2 V ranges	≥ 70 dB, 5 kHz to 20 kHz	*±6 Vpk*
10 V range	≥ 50 dB, 5 Hz to 20 kHz	*±16 Vpk*
32 V range	≥ 50 dB, 5 Hz to 20 kHz	*±60 Vpk*
100 V range	≥ 45 dB, 5 Hz to 20 kHz	*±160 Vpk*
Input Related Crosstalk		*Typically <100 dB to 20 kHz between any two channels*
Level (Amplitude) Measurement		
Range	< 1 µV to 115 Vrms	
Accuracy (1 kHz)		
+15C to +30C	±0.03 dB [±0.35%]	
0C to +45C	±0.05 dB [±0.58%]	
Flatness (1 kHz ref, DC coupling)		
10 Hz to 20 kHz	±0.008 dB	*Typically < 0.003 dB*
20 kHz to 50 kHz	±0.030 dB	
50 kHz to 80 kHz	±0.10 dB	

Characteristic	Specifications	Supplemental Information
Residual Noise (inputs shorted)	≤ 1.3 µVrms, 20 kHz BW	*Typically <8.0 nV / √Hz at 1 kHz*
THD+N Measurement		
Fundamental Range	5 Hz to 90 kHz	
Measurement Range	0 to 100%	
Accuracy	±0.5 dB	
Residual THD+N[1,2]		
20 Hz–20 kHz fundamentals	≤ (–103 dB + 1.3 µV, 20 kHz BW); ≤ (–95 dB + 2.5 µV, 80 kHz BW)	*Typically <-108 dB at 1 kHz, 2.5V*
Bandwidth Limiting Filters		
High-Pass[6]		
DC	DC coupling	
AC (< 10 Hz)	AC coupling	*Response is 2-pole via a combination of analog and digital filters, and is typically –3 dB at 4.1 Hz*
Butterworth	F_{HP} (–3 dB) = 10 Hz to 90 kHz, 4-pole	
Elliptic	F_{HP} (–0.01 dB) = 10 Hz to 90 kHz; 5-pole; 0.01 dB pass-band ripple; ≤–60 dB stop-band	
Low-Pass[5, 6]		
ADC Passband	No filter is implemented, bandwidth and response are limited by the A/D and sample rate (SR)	*–3 dB at ≈ 0.490 • SR, SR ≤ 216 kS/s*
20k (AES17), 40k (AES17)	Special filters conforming with AES17	
Butterworth	F_{LP} (–3 dB) = 10 Hz to 90 kHz, 8-pole	*ENBW ≈ 1.006 • F_{LP}*
Elliptic	F_{LP} (–0.01 dB) = 10 Hz to 90 kHz, 8-pole; 0.01 dB pass-band ripple; ≤–60 dB stop-band	*ENBW ≈ (1.012–1.062) • F_{LP} (varies due to warping)*
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 both high-pass and low-pass filters*

Characteristic	Specifications	Supplemental Information
Input Equalization	Arbitrary 30-pole input filter	*The EQ operates on any selected analyzer input channels.*
IMD Measurement		
Test Signal Compatibility		
SMPTE & MOD	Any combination of 40 Hz–1 kHz (LF) and 1 kHz–60 kHz (HF), mixed in any ratio from 1:1 to 10:1 (LF:HF)	*HF tone must be ≥ 6 • LF tone*
DFD	Any two-tone combination with mean frequency of 250 kHz–60 kHz and a difference frequency of 80 Hz–2.0 kHz	F_{mean} *= (F1 + F2)/2.* F_{diff} *= |F2 - F1|* F_{mean} *must be ≥6 •* F_{diff}
DIM	DIM100, DIM30, DIM-B, or DIM-B8	
IMD Measured		
SMPTE	Amplitude modulation of HF tone	*Measurement BW is typ. 40–750 Hz*
MOD	d2, d3, d2+d3, or d2+d3+d4+d5	*Use "d2+d3" for measurements per IEC60268*
DFD	d2, d3, d2+d3, or d2+d3+d4+d5	*Use "d2+d3" for measurements per IEC60268*
DIM	u1 to u9 per IEC-60286	
Measurement Range	0 to 20%	
Accuracy	±0.5 dB	
Residual IMD[1,2,3]		
SMPTE & MOD	≤ –95 dB [0.0018%], 4:1 mix ratio	
DFD	≤ –106 dB [0.0005%]	
DIM	≤ –95 dB [0.0018%]	
Frequency Measurement		
Range	<5 Hz to 90 kHz	
Accuracy	±(0.0003% + 100 µHz)	V_{in} *must be ≥ 5 mV*
Resolution	6 digits	
Phase Measurement		
Ranges	–90 to +270, ±180, or 0 to 360 deg	
Accuracy	±0.25 deg, 5 Hz to 5 kHz; ±1.0 deg, 5 kHz to 20 kHz; ±2.5 deg, 20 kHz to 50 kHz	*Vin must be ≥5 mV, all channels*
Resolution	0.001 deg	

DC Voltage Measurement				*Valid only for input bandwidths ≤90k*
	Input Ranges		0.32 V to 100 V, 10 dB steps	*±120 Vdc maximum in 100 V range*
	Accuracy			
		0.32 V range	±(0.7% reading + 800 µV)	
		1 V–100 V ranges	±(0.7% reading + 0.1% range)	
	Normal Mode Rejection			*Typically > 90 dB, 20 Hz to 20 kHz.*

NOTES to SPECIFICATIONS:

1	System specification including contributions from both generator and analyzer. Generator-only and/or analyzer-only contributions are typically less.
2	Generator load must be ≥600Ω balanced or ≥300Ω unbalanced for specified performance. Generator dc offset must be off or set to ≤10 mV.
3	Input must be ≥150 mV for specified performance. Analyzer must be set to measure "d2+d3" for MOD and DFD, and "U1…U9" for DIM per IEC-60268.
4	Valid for the balanced input configuration with DC coupling only. With AC coupling, specified performance is invalid below 50 Hz.
5	Maximum low-pass filter frequency is limited by analyzer input bandwidth setting.
6	Filter response is relative to “no filter” selection; overall system performance will also include analog flatness imperfections. DSP warping may significantly increase roll-off rate and lower ENBW.

Analog I/O specifications
APx585 and 586 audio analyzers

with APx500 v4.2 or higher measurement software
October 2015 NP0020.00008 r010

This illustration shows an APx585 in its standard configuration, with a DIO module installed.

These specifications cover the analog input and output functions of the Audio Precision APx585 and APx586 audio analyzers. The APx585 has 8 analog output channels and 8 analog input channels; the APx586 has 8 analog output channels and 16 analog input channels.

Specifications for the DIO interface and other available interface modules including DSIO, HDMI, PDM and Bluetooth, 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
ANALOG GENERATOR		
Number of Channels	8, independent amplitude control	
Waveforms	Sine, sine split frequency, sine split phase, sine+DC offset, continuously swept-sine, square-wave, noise, IMD signals, multi-tone, wave file playback	
Sine Characteristics		
Frequency Range (Fs)	5 Hz to 80.1 kHz	*Setting resolution is typically 45 µHz*
Frequency Accuracy	±(0.0003 % + 100 µHz)	
Amplitude Range	0 to 14.40 Vrms [40.72 Vpp], bal; 0 to 7.20 Vrms [20.36 Vpp], unbal	
Amplitude Accuracy, 1 kHz		
+15C to +30C	±0.03 dB [±0.35%]	
0C to +45C	±0.05 dB [±0.58%]	*+40C max with APx586*
Flatness (1 kHz ref)		
10 Hz to 20 kHz	±0.008 dB	*Typically <0.003 dB.*
20 kHz to 50 kHz	±0.030 dB	
50 kHz to 80 kHz	±0.10 dB	
Residual THD+N[1,2]		
20 Hz–20 kHz fundamentals	≤ (–103 dB + 1.4 µV)	
Non-Harmonic Content		Typically <-110 dB when Fs ≤75 kHz, increasing to ≈-55 dB at Fs =80 kHz
Phase offset range (split phase)	–179.999 to +180.000 deg	
DC Offset Range	±12.00 Vdc balanced; ±6.00 Vdc unbalanced	*DC offset limits maximum ac signal*
Residual DC Offset	≤0.25% of Vrms setting [≤0.09% of Vpp setting] + 100 µV	

Characteristic	Specifications	Supplemental Information
Noise Characteristics		
Shape	White (<5 Hz to >80 kHz), Pink (<10 Hz to >80 kHz), IEC 60268-1 or BS EN 50332-1	
Amplitude Range	0 to 40.72 Vpp, balanced; 0 to 20.36 Vpp, unbalanced	*Amplitude calibration is approximate*
IMD Test Signals		
SMPTE & MOD		
Lower Frequency (LF)	40 Hz to 1.00 kHz	
Upper Frequency (HF)	2.00 kHz to 60.00 kHz	*HF tone must be ≥ 6 • LF tone.*
Mix Ratio (LF:HF)	10:1, 4:1 or 1:1	*4:1 maximum with SMPTE signal*
Amplitude Range	0 to 40.72 Vpp, balanced; 0 to 20.36 Vpp, unbalanced	
Amplitude Accuracy	±0.06 dB [±0.70%]	
Residual IMD[1,2,3]	≤ 0.0025% [–92 dB], 4:1 mix ratio	
DFD		
Difference Frequency (Fdiff)	80 Hz to 2.00 kHz	F_{mean} = *(F1 + F2)/2.*
Mean Frequency (Fmean)	250 Hz to 60.00 kHz	F_{diff} = *|F2 - F1|* F_{mean} *must be ≥6 •* F_{diff}
Amplitude Range	0 to 40.72 Vpp, balanced; 0 to 20.36 Vpp, unbalanced.	
Amplitude Accuracy	±0.06 dB [±0.70%]	
Residual IMD[1,2,3]	≤ 0.0010% [–100 dB]	
Multitone, Wave File Playback		
Sample Rate Range (SR)	8 kS/s to 108 kS/s, and 175 kS/s to 192 kS/s	*Operation from 109 kS/s to 175 kS/s is possible, but with degraded flatness*
Maximum File Size	32M Sample	
Amplitude Range	0 to 45.2 Vpp, balanced; 0 to 22.6 Vpp, unbalanced.	*".Wav" file must peak at digital full scale to obtain selected amplitude.*
Flatness (1 kHz ref)		
SR = 175 kS/s to 192 kS/sec		*Typically <0.012 dB to 20 kHz*
SR = 8 kS/s to 108 kS/s		*Typically <0.04 dB to 20 kHz;* *max frequency limited to ≈0.45*SR*
Spurious Content		*Typically <–100 dB*

Characteristic	Specifications	Supplemental Information
Output Equalization	Arbitrary 30-pole output filter	*The EQ operates on the first two internal generator channels, and is disabled for >2 output channels.*
Source Resistance (Rs)		
Balanced	100 Ω, ±1 %	*Grounded, symmetrical*
Unbalanced	50 Ω, ±2 %	*Electronically floating, 0.3 Vpk max; bnc shield to ground ≈10-17Ω || 22nF*
Maximum Output Current		*Typically >30 mA peak, 10 mA dc; sum of all outputs ≤180 mA peak*
Reverse Overload Protection		*Up to 30 W*
Output Related Crosstalk[1]		
Balanced	≤ (–100 dB + 1 µV) to 20 kHz	*With AP cable PN 4150.0001.*
Unbalanced	≤ (–115 dB + 1 µV) to 20 kHz	
ANALOG ANALYZER		
Number of Channels		
APx585	8, independently auto-ranging	
APx586	16, independently auto-ranging	
Maximum Rated Input	160 Vpk, 120 Vdc any input to ground; 0.5 Vpk bnc shields to ground	
Input Impedance		
Balanced	100 kΩ || ≈230 pF, each side to ground	
Unbalanced	100 kΩ || ≈230 pF to bnc shield	*Electronically floating, 0.5 Vpk max; bnc shield to ground ≈500Ω || 22nF*
Input Coupling	DC	*Typically <0.5 µA bias current*
Input Ranges	320 mV to 100 V, 10 dB steps	*Maximum ac signal ≈115 Vac, unbal or bal, in the 100 V range*

Characteristic	Specifications	Supplemental Information
Common Mode Rejection[4]		*Max common mode signal range:*
320 mV, 1 V, 3.2 V ranges	≥ 70 dB, 5 kHz to 20 kHz	*±6 Vpk*
10 V range	≥ 50 dB, 5 Hz to 20 kHz	*±16 Vpk*
32 V range	≥ 50 dB, 5 Hz to 20 kHz	*±60 Vpk*
100 V range	≥ 45 dB, 5 Hz to 20 kHz	*±160 Vpk*
Input Related Crosstalk		*Typically <100 dB to 20 kHz between any two channels*
Level (Amplitude) Measurement		
Range	< 1 µV to 115 Vrms	
Accuracy (1 kHz)		
+15C to +30C	±0.03 dB [±0.35%]	
0C to +45C	±0.05 dB [±0.58%]	
Flatness (1 kHz ref, DC coupling)		
10 Hz to 20 kHz	±0.008 dB	*Typically < 0.003 dB*
20 kHz to 50 kHz	±0.030 dB	
50 kHz to 80 kHz	±0.10 dB	
Residual Noise (inputs shorted)	≤ 1.3 µVrms, 20 kHz BW	*Typically <8.0 nV / √Hz at 1 kHz*
THD+N Measurement		
Fundamental Range	5 Hz to 90 kHz	
Measurement Range	0 to 100%	
Accuracy	±0.5 dB	
Residual THD+N[1,2]		
20 Hz–20 kHz fundamentals	≤ (–103 dB + 1.3 µV, 20 kHz BW); ≤ (–95 dB + 2.5 µV, 80 kHz BW)	*Typically <-108 dB at 1 kHz, 2.5V*

Characteristic	Specifications	Supplemental Information
Bandwidth Limiting Filters		
High-Pass[6]		
DC	DC coupling	
AC (< 10 Hz)	AC coupling	*Response is 2-pole via a combination of analog and digital filters, and is typically –3 dB at 4.1 Hz*
Butterworth	F_{HP} (–3 dB) = 10 Hz to 90 kHz, 4-pole	
Elliptic	F_{HP} (–0.01 dB) = 10 Hz to 90 kHz; 5-pole; 0.01 dB pass-band ripple; ≤–60 dB stop-band	
Low-Pass [5, 6]		
ADC Passband	No filter is implemented, bandwidth and response are limited by the A/D and sample rate (SR)	*–3 dB at ≈ 0.490 • SR, SR ≤ 216 kS/s*
20k (AES17), 40k (AES17)	Special filters conforming with AES17	
Butterworth	F_{LP} (–3 dB) = 10 Hz to 90 kHz, 8-pole	*ENBW ≈ 1.006 • F_{LP}*
Elliptic	F_{LP} (–0.01 dB) = 10 Hz to 90 kHz, 8-pole; 0.01 dB pass-band ripple; ≤–60 dB stop-band	*ENBW ≈ (1.012–1.062) • F_{LP} (varies due to warping)*
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 both high-pass and low-pass filters*
Input Equalization	Arbitrary 30-pole input filter	*The EQ operates on any selected analyzer input channels.*
IMD Measurement		
Test Signal Compatibility		
SMPTE & MOD	Any combination of 40 Hz–1 kHz (LF) and 1 kHz–60 kHz (HF), mixed in any ratio from 1:1 to 10:1 (LF:HF)	*HF tone must be ≥ 6 • LF tone*
DFD	Any two-tone combination with mean frequency of 250 Hz–60 kHz and a difference frequency of 80 Hz–2.0 kHz	*F_{mean} = (F1 + F2)/2.* *F_{diff} = |F2 - F1|* *F_{mean} must be ≥6 • F_{diff}*
DIM	DIM100, DIM30, DIM-B, or DIM-B8	

Characteristic	Specifications	Supplemental Information
IMD Measured		
SMPTE	Amplitude modulation of HF tone	*Measurement BW is typ. 40–500 Hz*
MOD	d2, d3, d2+d3, or d2+d3+d4+d5	*Use "d2+d3" for measurements per IEC60268*
DFD	d2, d3, d2+d3, or d2+d3+d4+d5	*Use "d2+d3" for measurements per IEC60268*
DIM	u1 to u9 per IEC-60286	
Measurement Range	0 to 20%	
Accuracy	±0.5 dB	
Residual IMD[1,2,3]		
SMPTE & MOD	≤ –95 dB [0.0018%], 4:1 mix ratio	
DFD	≤ –106 dB [0.0005%]	
DIM	≤ –95 dB [0.0018%]	
Frequency Measurement		
Range	<5 Hz to 90 kHz	
Accuracy	±(0.0003% + 100 µHz)	*V_{in} must be ≥ 5 mV*
Resolution	6 digits	
Phase Measurement		
Ranges	–90 to +270, ±180, or 0 to 360 deg	
Accuracy	±0.2 deg, 5 Hz to 5 kHz; ±0.8 deg, 5 kHz to 20 kHz; ±2.0 deg, 20 kHz to 50 kHz	*Vin must be ≥5 mV, all channels*
Resolution	0.001 deg	

DC Voltage Measurement				*Valid only for input bandwidths ≤90k*
	Input Ranges		0.32 V to 100 V, 10 dB steps	*±120 Vdc maximum in 100 V range*
	Accuracy			
		0.32 V range	±(0.7% reading + 800 µV)	
		1 V–100 V ranges	±(0.7% reading + 0.1% range)	
	Normal Mode Rejection			*Typically > 90 dB, 20 Hz to 20 kHz.*

NOTES to SPECIFICATIONS:

1	System specification including contributions from both generator and analyzer. Generator-only and/or analyzer-only contributions are typically less.
2	Generator load must be ≥600Ω balanced or ≥300Ω unbalanced for specified performance. Generator dc offset must be off or set to ≤10 mV.
3	Input must be ≥150 mV for specified performance. Analyzer must be set to measure "d2+d3" for MOD and DFD.
4	Valid for the balanced input configuration only.
5	Maximum low-pass filter frequency is limited by analyzer input bandwidth setting.
6	Filter response is relative to “no filter” selection; overall system performance will also include analog flatness imperfections. DSP warping may significantly increase roll-off rate and lower ENBW.

DIO digital input/output module specifications

with APx500 v4.2 or higher measurement software
as fitted in APx52x, and 58x audio analyzers
NP0020.00017 rev 004
October, 2015

This illustration shows an APx DIO module, model 210.

These specifications cover the digital input and output functions of the Audio Precision DIO. The DIO is available as a stand-alone module (models 110 or 210), and in several combination modules, combined with DSIO (models 111 or 211), Bluetooth I/O (model 217) or PDM I/O (model 218). The same hardware is also used in the APx515.

The APx DIO 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.

Note: Earlier APx585/586 analyzers may be fitted with a model 109 DIO module, which does not support balanced digital I/O, and is not described by these specifications.

DIO specifications begin on the next page.

Characteristic	Specifications	Supplemental Information
DIGITAL I/O		
DIGITAL OUTPUT RELATED:		
Formats		
Electrical, unbalanced	SPDIF-EIAJ per IEC60958	
Electrical, balanced	AES-EBU per AES3-1992	
Optical	Toslink® or equivalent	
Sample Rate (SR) **Range**		
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	
Sample Rate (SR) **Accuracy**	±0.0003% [3 PPM]	
Channel Status Bits	Full implementation per IEC-60958, automatically set, all channels same	
User Bits and Validity Flag	Fully settable	
Residual Jitter[1]		
Electrical		*Typically <1.5 ns*
Optical		*Typically <2.5 ns, SR ≤96 kS/s*
EMBEDDED OUTPUT SIGNAL RELATED:		
Waveforms	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*

Characteristic	Specifications	Supplemental Information
Sine Characteristics		
Frequency Range	5 Hz to 0.499 • SR	
Flatness[1]		*Typically < 0.001 dB*
Offset Range	To maximum digital code [±1D]	*Offset limits maximum ac signal*
Harmonics & Spurious[1]		*Typically < –140 dBFS*
Square Characteristics		
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 < –140 dBFS*
Noise Characteristics		
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.
IMD Test Signals		
SMPTE & MOD		
Lower Frequency (LF)	40 Hz to 1.00 kHz	
Upper Frequency (HF)	2 kHz to (0.499 • SR) or 60 kHz, whichever is lower	*HF tone must be ≥ 6 • LF tone*
Mix Ratio (LF:HF)	10:1, 4:1 or 1:1	
Residual IMD[1]		*Typically < –140 dBFS*
DFD		
Difference Frequency (Fdiff)	80 Hz to 2.0 kHz	$F_{mean} = (F1 + F2)/2$
Mean Frequency (Fmean)	2.5 kHz to (0.499 • SR – F_{diff} / 2) or 60 kHz, whichever is lower	$F_{diff} = \|F2-F1\|$; F_{mean} *must be* ≥ 6 • *Fdiff*
Residual IMD[1]		*Typically < –150 dBFS*
Multitone, Wave File Playback		
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*SR*
Spurious Content		*Typically <–140 dBFS*

Characteristic	Specifications	Supplemental Information
DIGITAL INPUT RELATED:		
Formats		
Unbalanced	SPDIF-EIAJ per IEC 60958, ≤5 Vpp	*Input typically 75 Ω or ≈8.3 kΩ*
Balanced	AES-EBU per AES3-2003, ≤10 Vpp	*Input typically 110 Ω or ≈2.5 kΩ*
Optical	Toslink® or equivalent	
Sample Rate (SR) **Range**		
Electrical	27 kS/s to 216 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	±0.0003% [±3 ppm]	
EMBEDDED INPUT SIGNAL RELATED:		
Level (Amplitude) Measurement		
Measurement Range	< –120 dBFS to +3 dBFS	
Accuracy (1 kHz)		*Typically < 0.001 dB*
Flatness		*Typically < 0.001 dB*
Residual Noise		*Typically < –140 dBFS*
THD+N Measurement		
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^2		*Typically < –140 dBFS*

Characteristic	Specifications	Supplemental Information
Bandwidth Limiting Filters (audio signals)		
High-Pass[4]		
DC	DC coupling	
AC (<10 Hz)	AC coupling	*–3 dB at 4.1 Hz*
Butterworth	F_{HP} (–3 dB) = 10 Hz to 100 kHz, 4-pole	
Elliptic	F_{HP} (–0.01 dB) = 10 Hz to 100 kHz, 5-pole; 0.01 dB pass-band ripple; ≤–60 dB stop-band	
Low-Pass[4]		
FS/2	No filter is implemented, bandwidth and response are limited by the SR	
Butterworth	F_{LP} (–3 dB) = 10 Hz to 100 kHz, 8-pole	*ENBW ≈ 1.006* • F_{LP}
Elliptic	F_{LP} (–0.01 dB) = 10 Hz to 100 kHz, 8-pole; 0.01 dB pass-band ripple; ≤ –60 dB stop-band.	*ENBW ≈ (1.012–1.062)* • F_{LP} *(varies due to warping)*
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.*
Input Equalization	Arbitrary 30-pole input filter	*The EQ operates on any selected analyzer input channels.*
IMD Measurement		
Test Signal Compatibility		
SMPTE & MOD	Any combination of 40 Hz–1 kHz (LF) and 2 kHz–60 kHz (HF), mixed in any ratio from 1:1 to 10:1 (LF:HF)	*HF tone must be ≥ 6 • LF tone*
DFD	Any two-tone combination with mean frequency of 250 kHz–60 kHz and a difference frequency of 80 Hz–2.0 kHz	$F_{mean} = (F1 + F2)/2$ $F_{diff} = \|F2 - F1\|$ F_{mean} *must be ≥ 6 •* F_{diff}

IMD Measured		
SMPTE	Amplitude modulation of HF tone	*Measurement BW is typ. 40–750 Hz*
MOD	d2, d3, d2+d3, or d2+d3+d4+d5	*Use "d2+d3" for measurements per IEC-60268*
DFD	d2, d3, d2+d3, or d2+d3+d4+d5	*Use "d2+d3" for measurements per IEC-60268*
CCIF	d2 only	*CCIF"" is an archaic form of DFD that measures only the d2 product using a different 0 dB reference*
Measurement Range	0 to 20%	
Accuracy	±0.5 dB	
Residual IMD[2]		
SMPTE & MOD		*Typically < –140 dBFS*
DFD		*Typically < –150 dBFS*
Frequency Measurement		
Range	< 5 Hz to 0.499 • SR	
Accuracy	±(0.0003% + 100 µHz)	
Phase Measurement		
Ranges	–90 to +270, ±180, or 0 to 360 deg	
Accuracy		*Typically < 0.001 deg*

NOTES to SPECIFICATIONS:

1. Sample rate (SR) must be ≥27 kS/s for specified performance. Jitter analyzer set for 700 Hz high-pass response per AES3-1992.
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).
4. DSP warping may significantly increase roll-off rate and lower ENBW.

ADIO
Advanced Digital Input/Output module specifications

with APx500 v4.2 or higher measurement software
as fitted in APx52x, 555, and 58x audio analyzers
NP0020.00021 rev 003
January, 2016

This illustration shows an 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
ADVANCED DIGITAL I/O		
DIGITAL OUTPUT RELATED:		
Formats		
Electrical, unbalanced	SPDIF-EIAJ per IEC60958	
Electrical, balanced	AES-EBU per AES3-1992	
Optical	Toslink® or equivalent	
Sample Rate (SR) **Range**		
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	
Sample Rate (SR) **Accuracy**	±0.0003% [3 PPM]	
Output Amplitude		
Unbalanced		
Range	0.0 Vpp to 2.50 Vpp into 75 Ω	*1 mV resolution*
Accuracy	±(8 % + 20 mV)	
Source Impedance		*Typically 75* Ω
Balanced		
Range	0.0 Vpp to 8.00 Vpp into 110 Ω	*1 mV resolution*
Accuracy	±(10 % + 80 mV)	
Source Impedance		*Typically 110* Ω
Optical	Fixed, determined by transducer.	
Channel Status Bits	Full implementation per IEC-60958 (consumer) and AES3 (professional)	*Automatically set or manual override, hex or plain English, CRC override and auto-increment local address and time of day*
User Bits and Validity Flag	Fully settable	*Hex*

Characteristic	Specifications	Supplemental Information
Residual Jitter[1]		
Unbalanced, Balanced		
700 Hz-100 kHz BW	≤600 ps	*Peak detection*
50 Hz-100 kHz BW	≤1.0 ns	*Peak detection*
Optical		*Typically <2.5 ns, SR ≤96 kS/s*
INTERFACE SIGNAL IMPAIRMENTS		
Variable Rise/Fall Time		
Range	12 ns to 100 ns	*1 ns typical resolution*
Accuracy	±(10% + 2 ns)	
Cable Simulation		*Approximates the signal degradation of 100 meters of Belden 1696A.*
Induced Jitter		
Waveforms	Sine, Square, Noise	
Sine Wave Jitter		*Above 200 Hz, maximum allowable jitter decreases in a "1/f" fashion to 0.20 UI at F_J =10 kHz and higher.*
Frequency Range (F_J)	2 Hz to 200 kHz	
Amplitude Range	0-1.591 µs for F_J ≤20 Hz and derating linearly to 0.1591 µs at 200 kHz	*Equivalent to 0-9.775 UI at 48 kHz sample rate, derating to 0.9775 UI*
Amplitude Resolution	100 ps	
Accuracy (500 Hz)	±(0.5% + 0.1 ns)	
Flatness[1]	±0.5 dB, 100 Hz to 50 kHz	
Jitter Spectrum[1]		*Spurious products are typically –40 dBc (below jitter signal) or –60 dBUI, whichever is larger.*
Square Wave and Noise Waveform Jitter		*Jitter amplitude limited to 40 ns maximum.*
Normal Mode Noise		
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
Common Mode Signal (Bal only)		
Waveform	Sine	
Frequency Range	20 Hz to 100 kHz	
Amplitude Range	0 to 20.0 Vpp, 20 mV steps: ±(10% + 50 mV)	
EMBEDDED OUTPUT SIGNAL RELATED:		
Waveforms	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*
Sine Characteristics		
Frequency Range	0.001 Hz to 0.499 • SR	
Flatness[1]		*Typically < 0.001 dB*
Offset Range	To maximum digital code [±1D]	*Offset limits maximum ac signal*
Harmonics & Spurious[1]		*Typically < –190 dBFS*
Square Characteristics		
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*
Noise Characteristics		
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.
IMD Test Signals		
SMPTE & MOD		
Lower Frequency (LF)	40 Hz to 1.00 kHz	
Upper Frequency (HF)	2 kHz to (0.499 • SR) or 60 kHz, whichever is lower	*HF tone must be ≥ 6 • LF tone*
Mix Ratio (LF:HF)	10:1, 4:1 or 1:1	
Residual IMD[1,2]		*Typically < –140 dBFS*

Characteristic	Specifications	Supplemental Information
DFD		
Difference Frequency (Fdiff)	80 Hz to 2.0 kHz	*F_{diff} = |F2-F1|; F_{mean} must be ≥ 6 • Fdiff*
Mean Frequency (Fmean)	2.5 kHz to (0.499 • SR – F_{diff} / 2) or 60 kHz, whichever is lower	*F_{mean} = (F1 + F2)/2*
Residual IMD[1,2]		*Typically < –150 dBFS*
Multitone, Wave File Playback		
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 • SR*
Spurious Content		*Typically <–140 dBFS*
DIGITAL INPUT RELATED:		
Formats		
Unbalanced	SPDIF-EIAJ per IEC 60958, ≤5 Vpp	*Input typically 75 Ω or ≈8.3 kΩ*
Balanced	AES-EBU per AES3-2003, ≤10 Vpp	*Input typically 110 Ω or ≈2.5 kΩ*
Optical	Toslink® or equivalent	
Sample Rate (SR) **Range**		
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	±0.0003% [±3 ppm]	
Input Amplitude Measurement		
Unbalanced	0 to 2.50 Vpp, ±(5% + 6 mV)	
Balanced	0 to 8.0 Vpp, ±(5% + 25 mV)	
Jitter Measurement		
Range	0-4.0 UI at F_J ≤500 Hz	
Detection	Peak, RMS, or Average	*"Peak" detection must be used for residual measurements per AES3. "Average" detection is recommended for jitter response measurements.*

Characteristic	Specifications	Supplemental Information
Bandwidth Limiting Filters (jitter signals)		
High-pass[4]		
700 Hz (AES3)	Special filter conforming with AES3	
Butterworth	F_{HP} (–3 dB) = 50 Hz to 150 kHz, 4-pole	
Elliptic	F_{HP} (–0.01 dB) = 50 Hz to 150 kHz, 5-pole; 0.01 dB pass-band ripple; ≤–60 dB stop-band	
Low-pass[4]		
Butterworth	F_{LP} (–3 dB) = 50 Hz to 150 kHz, 8-pole	ENBW ≈ 1.006 • F_{LP}
Elliptic	F_{LP} (–0.01 dB) = 50 Hz to 150 kHz, 8-pole; 0.01 dB pass-band ripple; ≤–60 dB stop-band	*ENBW ≈ (1.012–1.062)* • F_{LP} *(varies due to warping)*
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 both high-pass and low-pass bandwidth limiting
Accuracy (500 Hz)	±(10% + 1.0 ns)	
Flatness[1]	±0.5 dB, 100 Hz to 50 kHz	
Residual Jitter[1]		
700 Hz - 100 kHz BW	≤600 ps	
50 Hz - 100 kHz BW	≤1.0 ns	
Jitter Spectrum[1]		*Spurious products are typically –40 dBc (below jitter signal) or –60 dBUI, whichever is larger.*
Input Equalization	Arbitrary 30-pole input filter	*The EQ operates on any selected analyzer input channels.*
Channel Status Bits	Full implementation per IEC-60958 (consumer) and AES3 (professional)	
User Bits	Displayed in hex	
Validity Flag	Displayed for each channel	
Receiver Lock	Displayed, both channels combined	

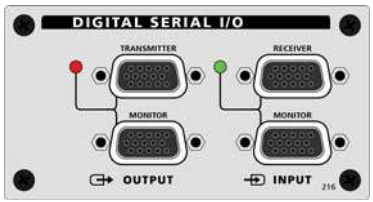
Characteristic	Specifications	Supplemental Information
EMBEDDED INPUT SIGNAL RELATED:		
Level (Amplitude) Measurement		
Measurement Range	< –120 dBFS to +3 dBFS	
Accuracy (1 kHz)		*Typically < 0.001 dB*
Flatness[1]		*Typically < 0.001 dB*
Residual Noise		*Typically < –140 dBFS*
THD+N Measurement		
Fundamental Range	5 Hz to 0.49 • SR	*Tuning can be set to track measured frequency, generator setting or fixed*
Measurement Range	0 to 100%	
Accuracy	±0.5 dB	
Residual THD+N[1,2]		*Typically < –140 dBFS*
Bandwidth Limiting Filters (audio signals)		
High-Pass[4]		
DC	DC coupling	
AC (<10 Hz)	AC coupling	*–3 dB at 4.1 Hz*
Butterworth	F_{HP} (–3 dB) = 10 Hz to 100 kHz, 4-pole	
Elliptic	F_{HP} (–0.01 dB) = 10 Hz to 100 kHz, 5-pole; 0.01 dB pass-band ripple; ≤–60 dB stop-band	
Low-Pass[4]		
FS/2	No filter is implemented, bandwidth and response are limited by the SR	
Butterworth	F_{LP} (–3 dB) = 10 Hz to 100 kHz, 8-pole	*ENBW ≈ 1.006* • F_{LP}
Elliptic	F_{LP} (–0.01 dB) = 10 Hz to 100 kHz, 8-pole; 0.01 dB pass-band ripple; ≤ –60 dB stop-band.	*ENBW ≈ (1.012–1.062)* • F_{LP} *(varies due to warping)*
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.*

Characteristic	Specifications	Supplemental Information
IMD Measurement		
Test Signal Compatibility		
SMPTE & MOD	Any combination of 40 Hz–1 kHz (LF) and 1 kHz–60 kHz (HF), mixed in any ratio from 1:1 to 10:1 (LF:HF)	*HF tone must be ≥ 6 • LF tone*
DFD	Any two-tone combination with mean frequency of 250 kHz–60 kHz and a difference frequency of 80 Hz–2.0 kHz	$F_{mean} = (F1 + F2)/2$ $F_{diff} = \|F2 - F1\|$ F_{mean} *must be* ≥ 6 • F_{diff}
IMD Measured		
SMPTE	Amplitude modulation of HF tone	*Measurement BW is typ. 40–500 Hz xxx*
MOD	d2, d3, d2+d3, or d2+d3+d4+d5	*Use "d2+d3" for measurements per IEC-60268*
DFD	d2, d3, d2+d3, or d2+d3+d4+d5	*Use "d2+d3" for measurements per IEC-60268*
CCIF	d2 only	*"CCIF" is an archaic form of DFD that measures only the d2 product using a different 0 dB reference*
Measurement Range	0 to 20%	
Accuracy	±0.5 dB	
Residual IMD[2]		
SMPTE & MOD		*Typically < –140 dBFS*
DFD		*Typically < –150 dBFS*
Frequency Measurement		
Range	< 5 Hz to 0.499 • SR	
Accuracy	±(0.0003% + 100 µHz)	
Phase Measurement		
Ranges	–90 to +270, ±180, or 0 to 360 deg	
Accuracy		*Typically < 0.001 deg*

NOTES to SPECIFICATIONS:	
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 ≥1.5 Vpp Bal or ≥300 mVpp Unbal, (C) rise-time ≤20 ns, 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).
4	DSP warping may significantly increase roll-off rate and lower ENBW.

DSIO digital serial input/output module specifications

with APx500 v4.2 or higher measurement software
as fitted in APx52x, 555, and 58x audio analyzers
NP0020.00013 rev 007
October 2015



This illustration shows an 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^2S, 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
Functional characteristics		
Channels		
1 data line, TDM	1, 2, 4, 6, 8 or 16	*Time division multiplexing (TDM)*
Multiple data lines	1, 2, 4, 6 or 8	*up to 4 data lines; 2 channels on each line by TDM*
Data formats	I^2S, 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	
Word width	8–128 bits	*cannot be less than bit depth*
Bit depth (data length)	8–32 bits	
Sample rate (frame rate)	4 kS/s–432 kS/s	*1, 2, 4, 6 or 8 channels*[2]
	4 kS/s–216 kS/s	*16 channels*[2]
Master Clock range	4 kHz–56 MHz	*Actual clock rate is dependent upon bit clock, word width, and sample rate settings.*
Logic voltage levels	1.8 V, 2.5 V, 3.3 V	

Characteristic	Specifications	Supplemental Information
DC characteristics, no load		
1.8 volt setting		
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	
2.5 volt setting		
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	

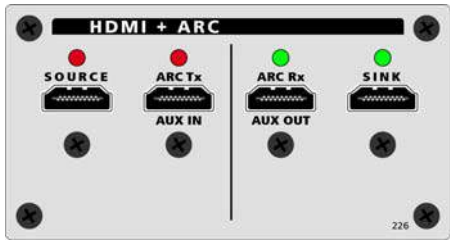
Characteristic	Specifications	Supplemental Information
3.3 volt setting		
High level input		
Minimum	1.8 V	
Low level input		
Maximum	1.5 V	
High level output		
Minimum	3.0 V	
Low level output		
Maximum	0.1 V	
Absolute range		
Minimum	–0.5 V	
Maximum	5.5 V	
Input/Output impedance		
All Outputs	50 Ω, nominal	
All Inputs	10 kΩ, nominal	
AC characteristics		
Clock frequencies, input or output		
Master clock	4 kHz–56 MHz	*Actual clock rate is dependent upon bit clock, word width, and sample rate settings.*
Bit clock	4 kHz–56 MHz maximum	*Actual clock rate is dependent upon word width and sample rate settings.*
Frame	432 kHz maximum	
Output latency		
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*
Input setup and hold requirements		
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
Clock Jitter (Advanced Master Clock required)		
Jitter Measurement		
Range	0 to 650 ns	
Detection	Peak, RMS, or Average	*"Average" detection is recommended for jitter response measurements.*
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)	*"Average" detection*
Flatness[1]	±0.2 dB, 100 Hz to 100 kHz	
Residual Jitter[1]		
50 Hz to 100 kHz BW	≤1.0 ns	
Jitter Spectrum[1]		*Spurious products are typically –40 dBc (below jitter signal) or –60 dBUI, whichever is larger.*[3]
Induced Jitter		
Waveforms	Sine, Square, Noise	
Signals Affected	Master Clk, Bit Clk, Frame Clock and Data	
Sine Wave Jitter		
Frequency Range (F_J)	2 Hz to 200 kHz	
Amplitude Range	0 to 1591 ns for $F_J \leq 20$ kHz, derating linearly with frequency to 159.1 ns at 200 kHz	*Equivalent to 0 to 9.775 UI at 48 kHz sample rate, derating to 0.9775 UI.*[3]
Amplitude Resolution	100 ps	
Accuracy (1 kHz)	±0.01%	
Flatness	±0.01%	
Jitter Spectrum[1]		*Spurious products are typically –40 dBc (below jitter signal) or –60 dBUI, whichever is larger.*[3]
Square Wave and Noise Waveform Jitter		*Jitter amplitude limited to 40 ns maximum.*

NOTES to SPECIFICATIONS		
	1	System specification including contributions from both generator and analyzer subject to the following condition: Bit Clock ≥ 192 kHz.
	2	In TDM, channel count can limit the bit clock rate.
	3	For Digital Serial (DSIO), the Unit Interval (UI) is defined as 1/fb, where fb is the bitclock rate in hertz.

HDMI+ARC input/output module specifications

with APx500 v4.2 or higher measurement software
as fitted in APx52x, 555 and 58x audio analyzers
NP0020.00011 rev 005
October, 2015



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
Revision	1.3a + ARC.	*ARC (Audio Return Channel) implemented per HDMI 1.4a*
Device Connections		
SOURCE	Typically connects to the sink input of a DUT.	*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.*
ARC Tx / AUX IN	HDMI ARC Tx configuration: Typically connects to an HDMI source that accepts ARC audio. HDMI Source configuration: typically connects to an external source of video to be included in the Source output signal.	*Generates and transmits audio across ARC, per HDMI 1.4a. HDMI source should not transmit video.* *Incoming audio is ignored. Incoming video is passed to HDMI Source in "pass through" mode.*
ARC Rx / AUX OUT	HDMI ARC Rx configuration: Typically connects to an HDMI sink that produces ARC audio. HDMI Sink configuration: Typically connects to an independent monitoring device.	*HDMI ARC Rx configuration: Receives and analyzes audio across ARC, per HDMI 1.4a. No video is transmitted.* *HDMI Sink configuration: Contains video and audio sent to Sink input.*
SINK	Typically connects to the source output of a DUT.	*The embedded and encoded audio signal components are recovered for analysis.*
Hardware Interface	HDMI Type A	
EDID	256-byte EEPROM on both Sink and ARC TX / AUX IN connectors.	

Characteristic	Specifications	Supplemental Information
CEC (ARC connectors)	HDMI ARC Tx configuration: ARC CEC implementation per HDMI 1.4a. HDMI ARC Rx configuration: ARC CEC implementation per HDMI 1.4a.	*ARC link can be negotiated or forced on.* *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.*
CEC (HDMI Sink, Source Connectors)	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.	*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.*
Color Support	24-bit, 30-bit, 36-bit (Deep Color)	
Max Video Rate	1080p	
ARC DIGITAL I/O		
ARC DIGITAL OUTPUT RELATED:		
Formats		
Signal level, single mode	0.5 Vpp typical	*Output R is 55 Ω typical.*
Signal level, common mode	0.4 Vpp typical	*Output R is 30 Ω typical.*
Sample Rate (SR) **Range**	27 kS/s–200 kS/s	*Usable over the extended range of 16 kS/s to 216 kS/s with degraded waveform fidelity, accuracy, and jitter*
Sample Rate (SR) **Accuracy**	±0.0003% [3 PPM]	
Channel Status Bits	Full implementation per IEC60958	*Automatically set or manual override, hex or plain English.*
User Bits	Fully settable	*Hex.*
Validity Flag	Set to 0, all channels	
Residual Jitter[1,2]		*<1.0 ns typical*

Characteristic	Specifications	Supplemental Information
EMBEDDED OUTPUT SIGNAL RELATED:		
Waveforms	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.*
Sine Characteristics		
Frequency Range	5 Hz to 0.499 • SR	
Flatness[1]		*Typically < 0.001 dB*
Harmonics & Spurious Products[1, 3]		*Typically < –140 dBFS*
Square Characteristics		
Frequency Range (Fq)	10 Hz to SR / 6	*Only specific values are allowed: Fq = SR / N where N is an even integer ≥6*
Even Harmonic, Spurious Content		*Typically < –140 dBFS*
Noise Characteristics		
Shape	White (<5 Hz to 0.499 • SR), Pink (<10 Hz to 0.45 • SR), IEC 60268-1 or BS EN 50332-1	
IMD Test Signals		
SMPTE & MOD		
Lower Frequency (LF)	40 Hz to 1.00 kHz	
Upper Frequency (HF)	2 kHz to (0.499 • SR) or 60 kHz, whichever is lower	*HF tone must be ≥ 6 • LF tone*
Mix Ratio (LF:HF)	10:1, 4:1 or 1:1	
Residual IMD[1]		*Typically < –140 dBFS*
DFD		
Difference Frequency (Fdiff)	80 Hz to 2.0 kHz	$F_{mean} = (F1 + F2)/2$
Mean Frequency (Fmean)	2.5 kHz to (0.499 • SR – F_{diff} / 2) or 60 kHz, whichever is lower	$F_{diff} = \|F2\text{-}F1\|$; F_{mean} *must be* ≥ *6 • Fdiff*
Residual IMD[1, 3]		*Typically < –150 dBFS*

Characteristic	Specifications	Supplemental Information
DIGITAL INPUT RELATED:		
Formats		
Single mode	≤1.5 Vpp	*Input R is nominally 55 Ω*
Dual mode	≤1.5 Vpp	*Input R is nominally 30 Ω*
Sample Rate Range	22 kS/s–216 kS/s	*Typically locks down to 16 kS/s*
EMBEDDED INPUT SIGNAL RELATED:		
Level (Amplitude) Measurement		
Measurement Range	< –120 dBFS to +3 dBFS	
Accuracy (1 kHz)		*Typically < 0.001 dB*
Flatness[1]		*Typically < 0.001 dB*
Residual Noise		*Typically < –140 dBFS*
THD+N Measurement		
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[1, 3]		*Typically < –140 dBFS*
Bandwidth Limiting Filters		
High-Pass[4]		
DC	DC coupling	
AC (<10 Hz)	AC coupling	*–3 dB at 4.1 Hz*
Butterworth	F_{HP} (–3 dB) = 10 Hz to 100 kHz, 4-pole	
Elliptic	F_{HP} (–0.01 dB) = 10 Hz to 100 kHz, 5-pole; 0.01 dB pass-band ripple; ≤–60 dB stop-band	
Low-Pass[4]		
FS/2	No filter is implemented, bandwidth and response are limited by the SR	
Butterworth	F_{LP} (–3 dB) = 10 Hz to 100 kHz, 8-pole	*ENBW ≈ 1.006* • F_{LP}

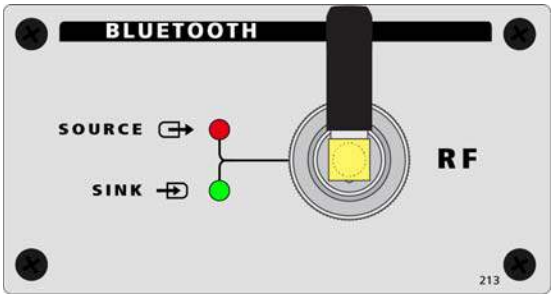
Characteristic	Specifications	Supplemental Information
Elliptic	F_{LP} (–0.01 dB) = 10 Hz to 100 kHz, 8-pole; 0.01 dB pass-band ripple; ≤ –60 dB stop-band.	*ENBW ≈ (1.012–1.062) • F_{LP} (varies due to warping)*
Weighting	A-wt, B-wt, C-wt, CCIR-1k, CCIR-2k, CCITT, C-message, 50 µs or 75 µs de-emph (with and without A-wt), or None	*Weighting filter is cascaded with the high-pass and low-pass bandwidth limiting filters.*
Input Equalization	Arbitrary 30-pole input filter	*The EQ operates on any selected analyzer input channels.*
IMD Measurement		
Test Signal Compatibility		
SMPTE & MOD	Any combination of 40 Hz–1 kHz (LF) and 2 kHz–60 kHz (HF), mixed in any ratio from 1:1 to 10:1 (LF:HF)	*HF tone must be ≥ 6 • LF tone.*
DFD	Any two-tone combination with mean frequency of 250 kHz–60 kHz and a difference frequency of 80 Hz–2.0 kHz	*F_{mean} = (F1 + F2)/2* *F_{diff} = |F2 - F1|* *F_{mean} must be ≥ 6 • F_{diff} .*
IMD Measured		
SMPTE	Amplitude modulation of HF tone.	*Measurement BW is typ. 40–750 Hz.*
MOD & DFD	d2, d3, d2+d3, or d2+d3+d4+d5	*Use "d2+d3" for measurements per IEC-60268.*
Measurement Range	0 to 20%	
Accuracy	±0.5 dB	
Residual IMD[1, 3]		
SMPTE & MOD		*Typically < –140 dBFS*
DFD		*Typically < –150 dBFS*
Frequency Measurement		
Range	< 5 Hz to 0.499 • SR	
Accuracy	±(0.0003% + 100 µHz)	
Resolution	6 digits	

Characteristic	Specifications	Supplemental Information
Phase Measurement		
Ranges	–90 to +270, ±180, or 0 to 360 deg	
Accuracy[1]		*Typically < 0.001 deg*
Resolution	0.001 deg	
Notes to Specifications		
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.	
4.	DSP warping may significantly increase roll-off rate and lower ENBW.	

Characteristic	Specifications	Supplemental Information

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 Bluetooth module, model 213.

These specifications cover the digital input and output functions of the Audio Precision Bluetooth interface.

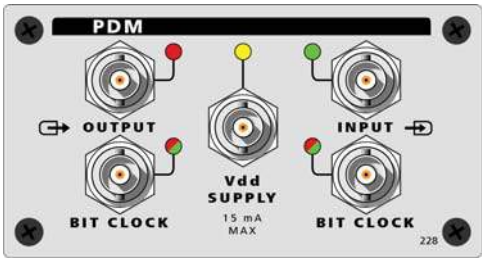
Bluetooth is a short-distance (a few meters) control, data, and audio communications wireless technology. Bluetooth uses low power, frequency-hopping radio in the 2.4 GHz band. Communication is two-way (for handshaking, metadata, etc); some profiles (HFP, for example) support duplex audio (both directions 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
Bluetooth Core Version		
	2.1+EDR	
Profiles/Roles Supported		
	A2DP Source	*With APx-BT-WB hardware module, there is a potential +/- 1 sample inter-channel phase error in A2DP Source or Sink operation.*
	A2DP Sink	*See note above.*
	HFP Audio Gateway	
	HFP Hands-Free	
	HSP Audio Gateway	
	HSP Headset	
	AVRCP Controller	
Codecs Supported		
	SBC	
	APT-X	
	CVSD	
	mSBC	*Requires APx-BT-WB hardware module.*
RF Connection		
	Type N, Female	
	Antenna	
RF Input Impedance		*Typically 50 Ω*
RF Output Impedance		*Typically 50 Ω*
RF Power		*Typically 0 dBm*
		Typical maximum +4 dBm
RF Sensitivity (0.1% BER)		*Typically –81 dBm*

PDM input/output module specifications

with APx500 v4.2 or higher measurement software
as fitted in APx52x, 555 and 58x audio analyzers
NP0020.00016 rev 002
October 2015



This illustration shows the PDM module, model 228.

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 bit-stream, 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.

These specifications cover the digital input and output functions of the Audio Precision PDM interface for the current version, model 228. The PDM module hardware and firmware in model 228 has been changed to provide jitter capabilities and lower logic family voltages. For the earlier PDM module model 215, refer to specifications document NP0020.00016 rev 000, published with previous APx releases.

PDM specifications begin on the next page.

Technical Specifications

Parameter	Symbol	Test Conditions	Min	Typ	Max	Unit
TRANSMITTER						
Decimated Rate	F_S		4		216	kHz
Bit Clock Rate	F_B	Master or slave mode	0.128		24.576	MHz
INTERPOLATION FILTER						
Interpolation Ratio (F_B/F_S)	INTR	16, 16.67, 21.33, 24, 25, 32, 33.33, 37.5, 42.67, 48, 50, 62.5, 64, 66.67, 75, 85.33, 96, 100, 125, 128, 150, 192, 200, 250, 256, 300, 384, 400, 500, 512, 600, 768, 800	16		800	
Passband Frequency Range						
Passband Gain		INTR = 32, 64, 128, 256, 512	–0.0001		+0.0001	dB
		All other INTR	–0.0063		+0.0001	dB
Stopband Frequency Range			0.55		INTR / 2	F_S
Stopband Attenuation		INTR = 32, 64, 128, 256, 512	115			dB
		All other INTR	100			dB
MODULATOR: GENERAL						
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)	–0.010		+0.001	dB
		MIL to 0 dBFS (order 4)	–0.010		+0.002	dB
		MIL to 0 dBFS (order 5)	–0.010		+0.001	dB
Ones Density at Full Scale			99.94	100		%
MODULATOR: ORDER 4, 64x OSR						
Overload Point	OLP	1 kHz			–7.8	dBFS
Total Harm. Dist. + Noise		@OLP; BW = 0.45 F_S			–105	dB

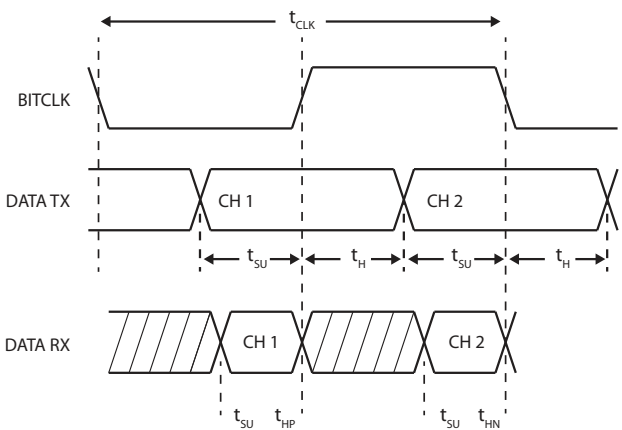
Parameter	Symbol	Test Conditions	Min	Typ	Max	Unit
Signal-to-Noise Ratio	SNR	@OLP; BW = 0.45 F_S	106			dB
Dynamic Range	DNR	@MIL; F_S = 48 kHz; per AES17	115			dB
MODULATOR: ORDER 5, 64x OSR						
Overload Point	OLP	1 kHz			–9.4	dBFS
Total Harm. Dist. + Noise		@OLP; BW = 0.45 F_S			–116	dB
Signal-to-Noise Ratio	SNR	@OLP; BW = 0.45 F_S	116			dB
Dynamic Range	DNR	@MIL; F_S = 48 kHz; per AES17	125			dB
MODULATOR: ORDER 4, 128x OSR						
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
MODULATOR: ORDER 5, 128x OSR						
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
MODULATOR: ORDER 4, 256x OSR						
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
MODULATOR: ORDER 5, 256x OSR						
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
MODULATOR: ORDER 4, 512x OSR						
Overload Point	OLP	1 kHz			–8.2	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
MODULATOR: ORDER 5, 512x OSR						
Overload Point	OLP	1 kHz			–10	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
RECEIVER						
Decimated Rate	F_S		0.160		768	kHz
Bit Clock Rate	F_B	Master or slave mode	0.128		24.576	MHz
DECIMATION FILTER						
Decimation Ratio (FB/FS)	DECR	1, 3.125, 4, 6.25, 8.00, 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_S
		DECR = 1	0		0.5	F_B
Passband Gain		DECR = 1, 4, 8, 16, 32, 64, 128, 256, 512	–0.001		+0.001	dB
		All other DECR	–0.005		+0.005	dB
Stopband Frequency Range		All DECR except DECR = 1	0.55		DECR/2	F_S
Stopband Attenuation		All DECR except DECR = 1	120			dB

Parameter	Symbol	Test Conditions	Min	Typ	Max	Unit
LOGIC LEVEL						
Interface Voltage	V_{INT}		0.80		3.30	V
Resolution					0.01	V
Accuracy				±0.05		V
OUTPUT CHARACTERISTICS						
Output Voltage High	V_{OH}	I_{LOAD} = 0.5 mA	0.7 • V_{INT}			V
Output Voltage Low	V_{OL}	I_{LOAD} = 0.5 mA			0.3 • V_{INT}	V
VDD OUTPUT						
DC Voltage	V_{DD}		0.80		3.60	V
Resolution					0.01	V
Accuracy				±0.05		V
Maximum Current	I_{MAX}				15	mA
VDD MODULATION						
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

Parameter	Symbol	Test Conditions	Min	Typ	Max	Unit
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
Logic Level = 0.8 V						
	t_{CO}	Clock to out		58		ns
	t_R	Rise Time		18		ns
	t_F	Fall Time		16		ns
	r_{OUT}	Output Impedance		450		ohms
	f_{CLK} max	Maximum Clock Frequency		3.072		MHz
Logic Level = 1.0 V						
	t_{CO}	Clock to out		32		ns
	t_R	Rise Time		10		ns
	t_F	Fall Time		7.7		ns
	r_{OUT}	Output Impedance		225		ohms
	f_{CLK} max	Maximum Clock Frequency		6.144		MHz
Logic Level = 1.5 V						
	t_{CO}	Clock to out		18		ns
	t_R	Rise Time		5.2		ns
	t_F	Fall Time		3.8		ns
	r_{OUT}	Output Impedance		85		ohms
	f_{CLK} max	Maximum Clock Frequency		12.28		MHz

Parameter	Symbol	Test Conditions	Min	Typ	Max	Unit
Logic Level ≥ 2.0 V						
	t_{CO}	Clock to out		15		ns
	t_R	Rise Time		3.9		ns
	t_F	Fall Time		2.9		ns
	r_{OUT}	Output Impedance		40		ohms
	f_{CLK} max	Maximum Clock Frequency		24.576		MHz
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		5		ns
	t_{SU}	Data setup time			5	ns



Parameter	Symbol	Test Conditions	Min	Typ	Max	Unit
Clock Jitter (Advanced Master Clock required)						
Jitter Measurement						
Range				0 to 650 ns		
Detection		Peak, RMS or Average				
Bandwidth						
Low Limit				50 Hz or 700 Hz		
High Limit		Variable in 0.1 kHz steps, Butterworth or Elliptic response	1 kHz		150 kHz	
Accuracy (1 kHz)		"Average" detection		±(1% + 300 ps)		
Flatness[1]		100 Hz to 100 kHz			±0.2 dB	
Residual Jitter[1]		50 Hz to 100 kHz BW			≤1.0 ns	
Jitter Spectrum[1]				Spurious products are typically –40 dBc (below jitter signal) or –60 dBUI, whichever is larger.[2]		
PDM Input Jitter Tolerance		Sine wave jitter, bit clock rates from 128kHz to 24.576 MHz.	3.5 UI, (subject to 1591 ns max jitter limit)			
Induced Jitter						
Waveforms		Sine, Square, Noise				
Signals Affected		Bit Clk and Data				

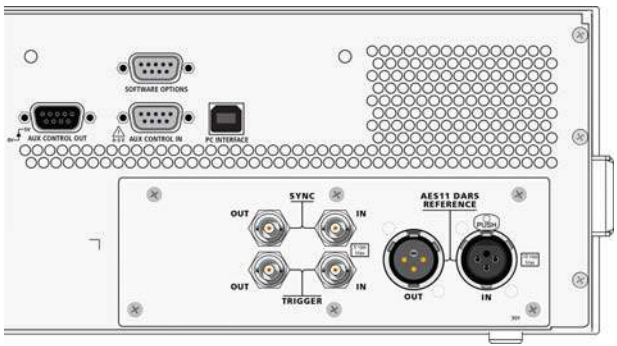
Parameter	Symbol	Test Conditions	Min	Typ	Max	Unit
Sine Wave Jitter						
Frequency Range (f_J)			2 Hz		200 kHz	
Amplitude Range		Referenced to bit clock rate, subject to linear derating at jitter frequencies >20kHz		3.5 UI or 1591 ns which ever is less		
Amplitude Resolution			100 ps			
Accuracy (1 kHz)			±0.01%			
Flatness			±0.01%			
Jitter Spectrum[1]				Spurious products are typically –40 dBc (below jitter signal) or –60 dBUI, whichever is larger.[2]		
Square Wave and Noise Waveform Jitter				Jitter amplitude limited to 40 ns maximum.		
PDM Output Jitter Tolerance		Sine wave jitter, bit clock rates from 128kHz to 24.576 MHz		3.5 UI (subject to 1591ns max jitter limit)		

Notes to Specifications

1. System specification including contributions from both generator and analyzer subject to the following condition: Bit Clock ≥ 192 kHz.
2. For PDM, the Unit Interval (UI) is defined as 1/fb, where fb is the bitclock rate in hertz.

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

with APx500 v4.1 or higher measurement software
as fitted in APx52x, 555, and 58x audio analyzers
NP0020.00023 rev 001
January 2015



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

Characteristic	Specifications	Supplemental Information
Trigger Input		
Voltage Range	–0.5 V to +5.5 V	
Threshold Level	+0.8 to +3.6 V, 0.1 V steps	*R_{IN} ≈10 kΩ, DC coupled, + or – edge selectable*
Minimum Pulse Width		*Typically 20 ns*
Trigger Output		
Trigger Sources	Analog Sine Generator, Audio Generator, and Jitter Generator	
Amplitude (V_H)	+0.8 V to +3.6 V, 0.1 V steps	*R_S = 50 Ω; V_L ≈ 0 to 0.1 V*

General and Environmental Specifications

for APx52x, and 58x audio analyzers
NP0020.00018 rev 004
October 2015

Characteristic	Specifications	Supplemental Information
GENERAL/ENVIRONMENTAL		
Power Requirements	100–240 Vac ±10% (90–264 Vac), 50–60 Hz, with safety ground via approved power cord, 160 VA max	*No range switching or fuse changes required over the full operating range of 90–264 Vac*
Temperature Range		
Operating	0° C to +45° C 0° C to +40° C for APx586 only	
Storage	–40° C to +75° C	
Humidity	10 % to 80 %, non-condensing	
Max Operating Altitude	3,000 m [9,840 feet]	
Stabilization Time	20 minutes	*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.*

Characteristic	Specifications	Supplemental Information
EMC	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. IEC 61326-2-1:2005 Section 5.2.401 is applied (controlled EM environment) for options “DSIO” and “PDM”. Complies with Directive 1995/5/EC if option “BT” (Bluetooth) is installed.	*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*
Safety	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).	*Equipment Class I, Installation Category II, Pollution Degree 2, Measurement Category I*
Dimensions (W x H x D)	432 x 129 x 467 mm [17.0 x 5.1 x 18.4 in]	*3U rack mount kit available. D is 475 mm [18.7 in] if rear panel option keys or Option AMC is installed.*
Weight	Ranges from 10.7 kg [23.5 lbs] to 11.8 kg [26 lbs]	*Weight depends upon model and installed options*

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