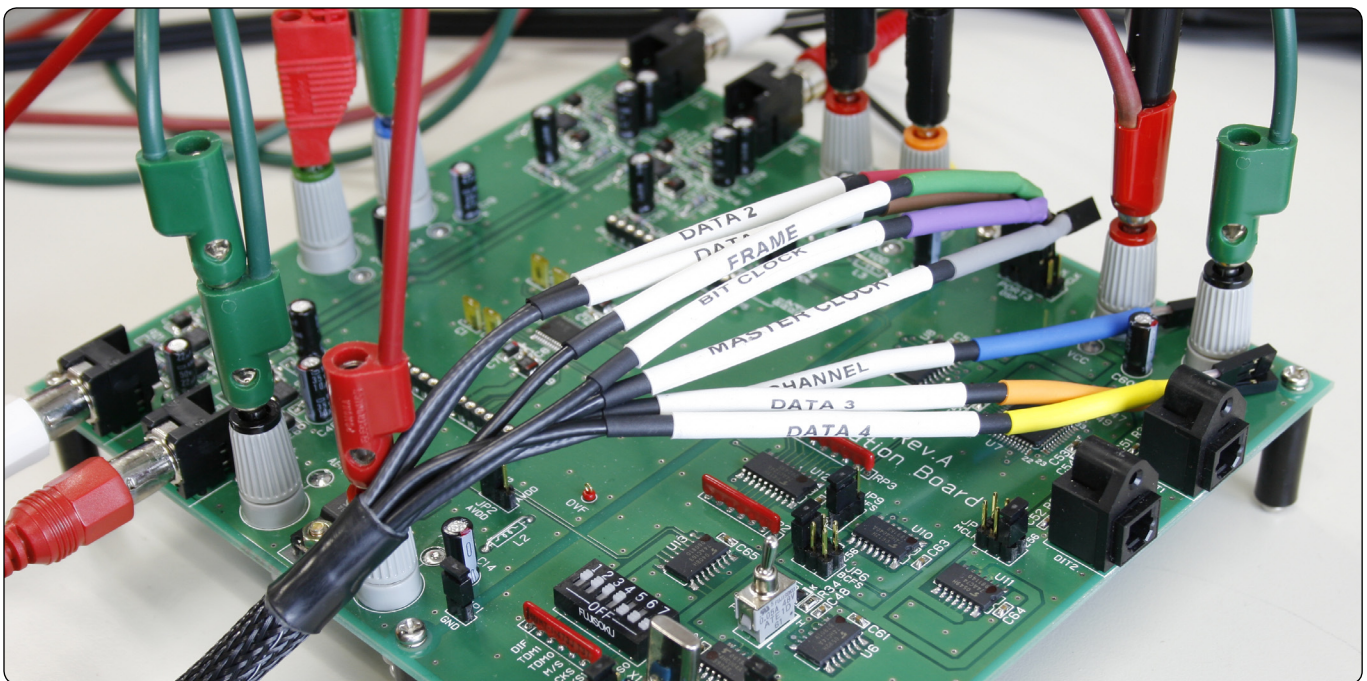




Serial Digital Measurements with APx



Serial digital signal analysis is essential in research and development for evaluating audio circuit designs at the chip and at the board level. Devices like A/D and D/A converters, CODECs, DSPs, and sample rate converters all require a serial interface for testing, since they use serial protocols for their audio connections to other circuit board devices, rather than the familiar AES and S/PDIF formats used on the outside to connect one piece of audio gear to another.

The Audio Precision Digital Serial I/O (DSIO) option for the APx Series analyzers, as well as the outboard PSIA-2722 for the 2700 Series analyzers, provide advanced serial interface capabilities. In this AP Applied, we'll talk about the connectivity options that a good serial interface should have, ways to monitor the serial clock and data streams, and how to use presets to simplify making settings. Then, we'll quickly go through the steps needed to test an A/D converter.

Hardware Connectivity

Connectivity options are important in serial testing to ensure that the audio analyzer can connect to the widest variety of chip and board level devices, and test them in all their various modes of operation.



Figure 1 APx Digital I/O and Digital Serial I/O front panel

Typically, either separate cables or a single cable with break-outs will connect all the clock and data lines to the DUT (device under test). A full compliment of clock lines includes the master, frame, and bit clocks.



Figure 2 APx DSIO Clock and data lines.

Then come the data lines (Figure 2). Ideally, the analyzer should handle up to eight channels on one data line (TDM), and up to eight channels in pairs spread across up to four data lines.

Data format and logic voltage level flexibility is also very important. Formats commonly encountered include left justified, right justified, I²S, and DSP. Having a visual “active timing diagram” (Figure 3) makes it easier

to select the proper settings and helps eliminate errors. CMOS logic voltage levels of 1.8, 2.5, and 3.3 Volts should be selectable.

Proper testing of sample rate converters requires that the serial transmitter and receiver have independent clocks, so this is an important requirement for a serial analyzer interface.

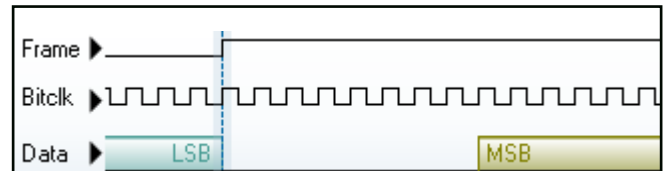


Figure 3 APx DSIO Active Timing Diagram

The APx DSIO option includes all the features mentioned above and more, making it an excellent choice for all kinds of serial audio test applications.

External Oscilloscope Monitoring

Oscilloscope monitoring of both the transmit and receive signals is essential for evaluating the quality of the clock and data lines. A buffered output on the serial interface is a big plus, as it provides convenient connections to the scope and also isolates the scope leads from the DUT.

Another useful feature to look for is a channel output line. This allows you to easily connect an oscilloscope and identify channel transitions on TDM format signals. On the APx DSIO module (Figure 1), the two DB-15 connectors on the bottom part of the panel are the buffered scope outputs.

Digital Serial with the 2700 Series—PSIA-2722

Unlike the optional built-in DSIO module for the APx Series, the 2700 Series uses the outboard PSIA-2722 accessory for digital serial connections to virtually any board-level device. Transmitter and receiver panels within the AP2700 control software give access to all the necessary settings, and PSIA setups are saved in the analyzer’s test files for reuse later. Although the DSIO and the PSIA are essentially



similar, there’s some differences. For example, while PSIA can support up to 256 multiplexed (TDM) channels, DSIO supports 8. The DSIO module, on the other hand, has 4 data lines vs. 1 on the PSIA, and can support different transmit and receive rates to test sample rate converters. And like the rest of the APx interface, the DSIO configuration panel is designed for ease of use.

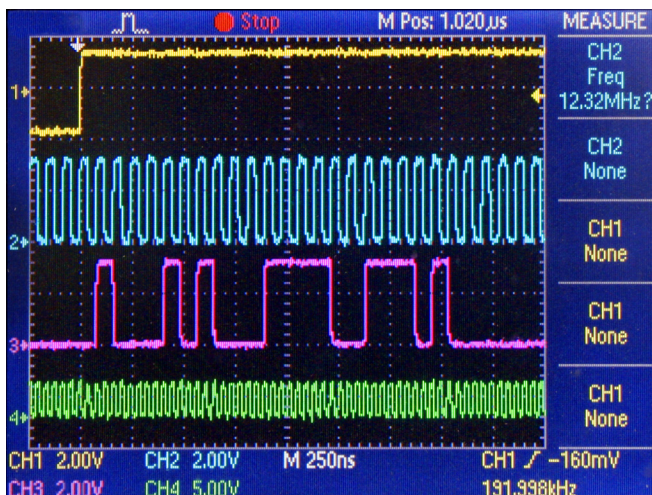


Figure 4 Monitoring the clock and data lines with an external scope

Configuration Files

Preset configuration files to store all the analyzer's serial interface settings, as well as all the jumper, switch, and header positions on the evaluation boards, are a great time saver.

In the APx500 measurement software, configuration files can be easily loaded inside the DSIO output and input settings boxes (Figure 5).

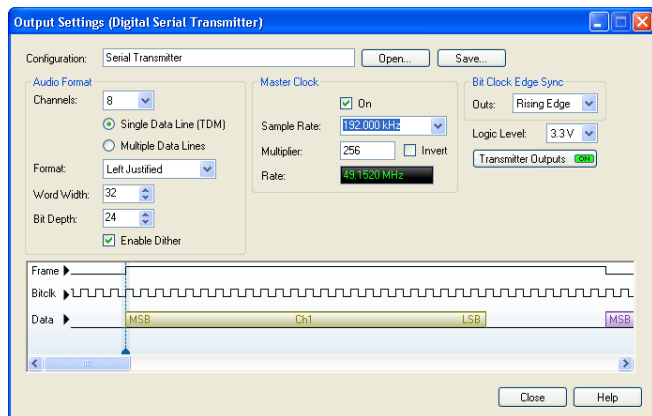


Figure 5 Sample rate converter input and output clock rates

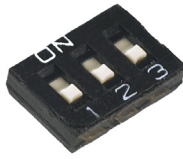
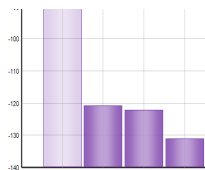
Configuration files for many of the latest A/D, D/A, and sample rate converters from companies like AKM, Analog Devices, Cirrus Logic, and Texas Instruments, are available from Audio Precision.

Download the latest APx DSIO Configuration Files at <http://ap.com/display/file/358>

Step by Step:

Testing an A/D Converter

Let's look at the steps required to connect to a new A/D converter for evaluating its use in a microphone preamp.

- 1 Launch APx and open the APx Input Configuration Settings box under Signal Path Setup. Load the DSIO configuration file from the APx DSIO Configuration Files download that matches the converter chip and the sample rate, format, and mode that you want. This automatically configures all the DSIO settings on the analyzer.
- 2 If you don't find a configuration file for your setup, load and edit an existing one as needed. For example, if you want a 96 kHz sample rate and the closest configuration file is set to 192 kHz, load the 192 kHz configuration file and change the sample rate. Then save the configuration file under a new name for later use.
- 3 Connect the power supply and signal wires. Refer to the connection instructions spreadsheet included with AP's DSIO config files download to quickly connect the cables and set the jumpers and DIP switches. 
- 4 Turn on the board power supplies, and run any of the multitude of audio measurements included in the APx500 software, like frequency response, THD+N, phase, and signal-to-noise ratio. 

Common Challenges

- Sometimes demo boards or their instructions contain errors. Make sure you have the latest versions.
- The unmarked side of double-row pin headers is often ground, but don't assume that, as sometimes it isn't.

Tips for Optimum Testing

- Observe static protection measures to prevent failures.
- Don't use excessively long test cables, or extend the cables provided in the CAB-DSIO cable kit.
- Test at all the sample rates and modes that may be utilized in the end product.



Digital Serial Specifications

- Pulse voltage**
1.8V, 2.5V, 3.3V
 - Formats**
Left Justified, Right Justified, I²S, DSP
 - Master Clock rates**
22 kHz to 49.152 MHz
 - Sample rates**
22 kHz to 192 kHz
 - Master Clock inversion**
Yes
 - Bit clock edge synchronization**
Rising or Falling
 - Word length**
8 to 32 bits
 - Data length**
8 to 24 bits
 - Dither**
Selectable ON or OFF
 - Master Clock Direction**
Selectable IN, OUT or OFF
 - Bit/Frame Clock Direction**
Selectable IN or OUT
 - Multichannel configurations**
TDM: 2, 4 or 8 channels
Multiple datalines: 4 or 8 channels
- Compatible with any APx instrument that has the 192k Digital I/O (APx525,526,585,586)

Additional Resources @ AP.com

APx DSIO Datasheet
<http://ap.com/display/file/167>

APx DSIO Configuration Files
<http://ap.com/display/file/358>

APx500 User Manual
<http://ap.com/display/file/25>

PSIA-2722 User Manual
<http://ap.com/display/file/227>

APx500 Series Audio Analyzer Key Specifications

SYSTEM PERFORMANCE

- Residual THD+N (20 kHz BW)**
-105 dB + 1.3 μ V [APx520-26]
-103 dB + 1.4 μ V [APx585/6]

GENERATOR PERFORMANCE

- Sine Frequency Range**
0.1 Hz to 80.1 kHz [APx520-26]
5 Hz to 80.1 kHz [APx585/6]
- Frequency Accuracy**
2 ppm [APx520-26]
3 ppm [APx585/6]
- IMD Test Signals**
SMPTE, MOD, DFD
- Maximum Amplitude (balanced)**
21.21 Vrms [APx520-26]
14.4 Vrms [APx585/6]
- Amplitude Accuracy**
 \pm 0.05 dB
- Flatness (20 Hz-20 kHz)**
 \pm 0.008 dB
- Analog Output Configurations**
Unbalanced & Balanced
- Digital Output Sampling Rate**
22 kHz-192 kHz
- Dolby / dts Generator**
Yes

ANALYZER PERFORMANCE

- Maximum Rated Input Voltage**
300 Vrms (bal) / 160 Vrms (unbal) [APx520-26]
110 Vrms (bal/unbal) [APx585/6]
- Maximum Bandwidth**
>90 kHz
- IMD Measurement Capability**
SMPTE, MOD, DFD
- Amplitude Accuracy (1 kHz)**
 \pm 0.05 dB
- Amplitude Flatness (20 Hz-20 kHz)**
 \pm 0.008 dB
- Residual Input Noise (20 kHz BW)**
1.3 μ V
- Individual Harmonic Analyzer**
d2-d10
- Max FFT Length**
1024K points
- DC Voltage Measurement**
Yes



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

For more information or a demonstration, please contact your local AP sales partner <http://ap.com/contact>.

