APWIN 1.52 Addendum

APWIN version 1.52 Addendum to System One & System Two version 1.50 User's Manuals

This document describes the changes in maintenance release 1.50a and 1.52 from version 1.50. It is designed to be used in conjunction with and as a supplement to the existing System One & System Two version 1.50 manual sets

October, 1998

Changes Affecting Both System One and System Two

Support for WIN98 & NT4.0 None for WIN3.11

Version 1.52 of APWIN has been tested with Windows 98 and NT version 4.0. Windows 3.11 and earlier versions of Windows are no longer supported and APWIN 1.52 or future versions of APWIN will not operate with them.

Need for updated Windows Common Control

Early versions of Windows 95 do not support certain Windows Common Control features that are required for APWIN version 1.52 (and earlier version 1.50a). If you are using an older version of Windows 95, it is possible that the installation of some other application may have already updated your computer to the newer Common Control Library (comctl32.dll). If your computer does not have the required version of this Windows support program, the installation of APWIN 1.52 will detect this and give you the choice of installing the newer version or aborting the installation.

Tighter APWIN Basic Syntax Checking

Recent changes in Visual Basic have tightened the requirements for correct syntax. This evolution of the Basic language has been tracked by APWIN Basic. This tighter syntax control could mean that APWIN Basic procedures written previously that ran with earlier versions of APWIN might not run with this version 1.52 without minor syntax revisions. Known commands affected include: `AP.Reg.StartNoWait` and `AP.Reg.IsRunning`.

New UTIL Configuration Dialog with Tabs

To simplify operation by reducing the amount of information in any one dialog, the Utilities Configuration dialog has been re-designed. Utilities Configuration now consists of five tabs—General, Hardware, Configure Filters, Log, and Graph.
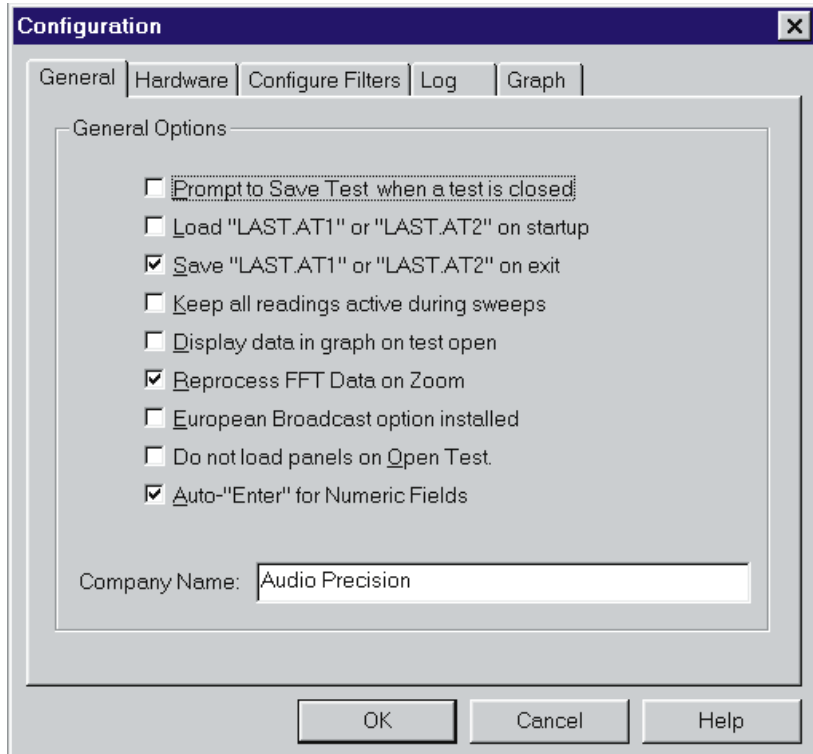
The **General** tab displays a dialog similar to the top part of the old Utilities Configuration, plus the Company Name field previously at the bottom. A new checkbox, "Auto "Enter" for Numeric Fields", was added. It is described below.

The **Hardware** tab carries the choices of hardware platform (System One versus System Two) that APWIN should assume when it is started.

The **Configure Filters** tab is an alternate route to the same analog analyzer plug-in option filter setup utility that can also still be

viewed by the original Utilities Filters menu command. Both operate identically.

The **Log** tab carries all the instructions for logging files that previously occupied most of the lower half of the Utilities Configuration dialog.

The **Graph** tab is completely new. It provides control over several modes of trace color selection and over whether the "Edit Copy Panel to Clipboard" copies a black-background bitmap or a white-background metafile graph to the Windows clipboard. Both these features are described below.

Numeric Field Auto Enter

The new Auto "Enter" for Numeric Fields checkbox on the General tab of Utilities Configuration controls the style of operation on the many numeric data entry fields such as generator Amplitude or Sweep Panel Source 1 Start Frequency. When Auto "Enter" for Numeric Fields is not checked, APWIN operates in its original style that requires the user to follow a numeric entry by pressing the Enter or Tab keys before the entry will take effect. If Auto "Enter" for Numeric Fields is checked, a number can be typed into a field and will automatically take effect when the cursor leaves the field, such as by clicking on another field.

Graph Legend-Data Editor Improvements

A number of improvements have been made in the Data Editor and Graph Legend to make it much easier to identify which data corresponds to which trace when there are multiple traces resulting from nested sweeps or the File Append command.

In the Graph Legend, the first, third, fifth, etc. nested or appended sweeps are indicated by bold type and a gray background. The Legend descriptions of the second, fourth, sixth, etc. sweeps are shown with normal type and a white background.

In the Data Editor, bold type corresponds to bold rows in the Graph Legend and normal type to normal rows. Furthermore, clicking in any row in the Graph Legend causes the Data Editor to automatically scroll vertically such that the first row displayed in the Data Editor is the first point of the sweep data just clicked in the Graph Legend.
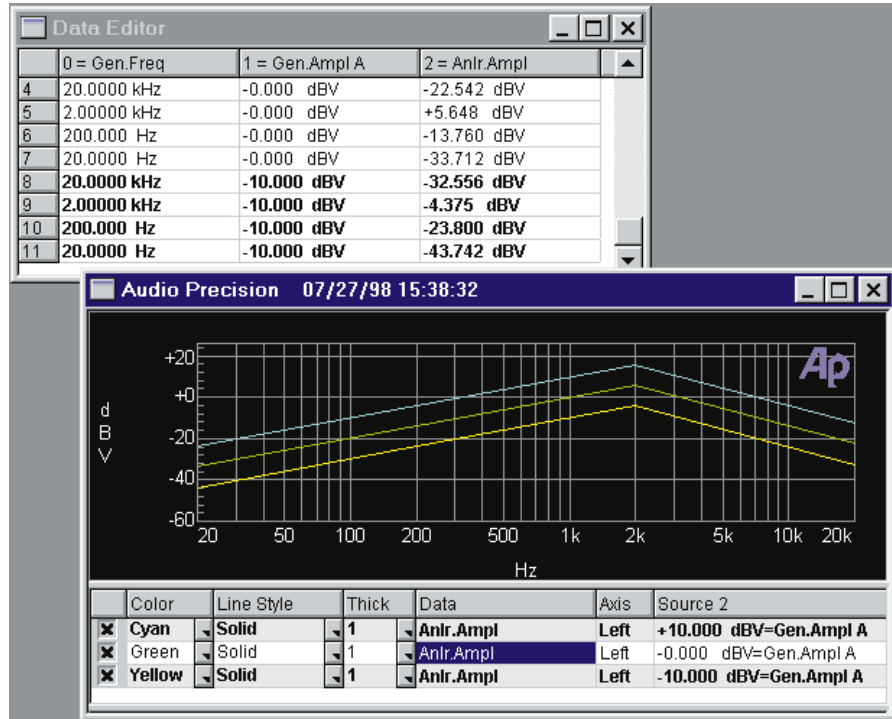
Tabular Printout from Data Editor

The File Print menu command has been modified to permit a tabular printout of the contents of the Data Editor (including any comments typed into the Comments Editor below the Graph Legend) as an alternative to a graph printout. For a tabular printout, be sure the Data Editor is displayed on some page. Select
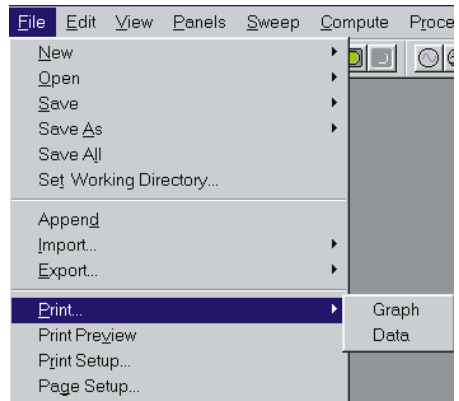
the File Print command and the two subsidiary choices of Graph or Data will appear. Click Graph for a graph printout or Data for a tabular printout. Clicking the Print icon on the toolbar will always cause a graph printout.

```
Audio Precision            08/04/98 09:37:26          File Name: Untitled1

        Gen              Anlr             Anlr
        Freq             Level A          Ampl

   0    20.0000 kHz      +0.000  dBV      -9.300   dBV
   1    6.32500 kHz      +0.002  dBV      -0.108   dBV
   2    2.00000 kHz      +0.001  dBV      +1.207   dBV
   3    632.500  Hz      +0.001  dBV      -1.901   dBV
   4    200.000  Hz      +0.001  dBV      -10.819  dBV
   5    63.2500  Hz      +0.002  dBV      -26.075  dBV
   6    20.0000  Hz      +0.002  dBV      -49.515  dBV

COMMENTS:
```

New External Single-Point Sweep Function

Single-point sweeps may now be made with either a Setting parameter at Source 1 (such as Generator Frequency) or a Reading parameter (such as Analyzer Level or Analyzer Frequency). When a Reading parameter is selected, the Spacing field and the Min Lvl (minimum level) source and value fields appear, as they do for other sweeps with Source 1 selected as a Reading parameter ("External sweeps"). When GO is clicked or F9 is pressed, data will not be taken until the actual measurement of the Source 1 parameter is within the "Spacing" percentage of the Source 1 Start field value, and the Min Lvl parameter satisfies the Min Lvl value. These features may be used to extract a single reading, or permit a procedure to continue, only when a measured parameter reaches a particular value. For example, a test tape or disc or distant-origination signal may include a stepped or swept frequency track following a track with a 1 kHz reference signal. The first test in a measurement procedure may be a Single Point External test with Analyzer Frequency selected as Source 1, 1 kHz entered into the Start field, and the default 5% Spacing retained. The procedure may be started but data will not be taken, regardless of the time delay, until the external signal frequency comes within 5% of

1 kHz. The measured level may then be retained and the next test setup of the procedure loaded to capture the frequency sweep data.

The external single-point feature could also be used to capture the frequency value when the measured amplitude reaches -3.0 dB relative to a mid-band value, thus automatically finding the -3.0 dB point of a filter.

Since an X-Y graph cannot be drawn for a single point measurement, the Data Editor should be displayed by selecting the Data Editor icon or expanding the Sweep panel to full size, checking the "Create Table" box, and un-checking the "Create Graph" box.

Copy to Clipboard Changes

Previous versions of APWIN could copy the graph (if the graph has the Windows focus) to the Windows clipboard as a bitmap image. From the clipboard, the graph can be pasted into almost any Windows program supporting graphics.
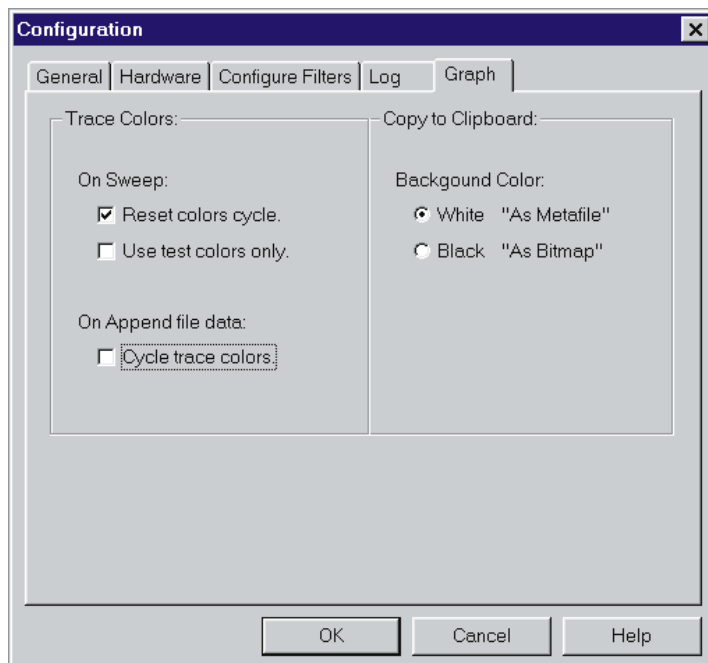
The bitmap, as an exact pixel-for-pixel copy of the graph on screen, has a black background. With version 1.52, it is now also possible to copy a white-background metafile to the clipboard and then paste it into another application. A metafile is a vector rendition of the graph. It will print at the resolution of the output device, unrelated to the graph size, shape, and resolution on screen at the time of capture.

The new Graph tab of the Utilities Configuration dialog controls which type of copy will be made. Under "Copy to Clipboard, Background Color", click the Black "As Bitmap" button if you wish a black-background bitmap to be copied to the clipboard. Click the White "As Metafile" button for a white-background Windows Metafile. The text content of the metafile (in addition to the graph itself) is determined by the File Page Setup dialog. This permits the Title, Legend, Comments, etc. to be individually turned on and off. The margins, centering, and Fill Page controls of Page Setup have no effect on the metafile.

Graph Trace Color Changes

Controls on the new Utilities Configuration Graph tab provide some improved functions on how colors are assigned to traces on the graph. Six colors (plus gray) are available for graph trace colors. There is a defined sequence of these six trace colors: cyan, green, yellow, red, magenta, and blue. This is the order in which the colors appear in the drop-down list in the Color column of the Graph Legend

Nested and Appended Sweeps

When appended or nested sweeps are made, each trace cycles down through this color sequence, starting with whatever color the trace was on the previous sweep. An appended or nested sweep following a green trace thus always produces yellow, appending to a red trace always produces magenta, appending to a blue trace always goes "around the corner" to cyan, etc.

Reset Colors Cycle Checkbox

If the "**Reset colors cycle**" box on the Graph tab of Utilities Configuration is checked and a normal sweep is made (not appended or nested), each trace color is directly associated with the Sweep panel Data parameter number that produces the trace. The color of the Data-1 trace is always cyan, the Data-2 trace is always green, Data-3 is always yellow, Data-4 is always red, Data-5 is always magenta, and Data-6 is always blue. If the user should manually change the color of any trace to another color following a sweep, then makes another sweep, the trace color will revert to the defined color per this paragraph. Appending and nesting sweeps will cause each trace color to cycle down through the sequence defined at the beginning of this section.

If the "**Reset colors cycle**" box is not checked, the user can manually change trace colors using the Legend and those user-selected colors will then be used for each successive normal (not appended or nested) sweep. These user-selected colors will also serve as the starting point for the automatic color cycling of appended or nested sweeps, with the cycling for any trace always being in the defined sequence described above. This mode of operation can allow three dual-trace sweeps or two triple-trace sweeps to be made with no duplication of colors. For example, a sweep is made using Data 1 and Data 2. The default colors assigned will be cyan for Data 1 and green for Data 2. If the "**Reset colors cycle**" box is not checked, the green Data 2 trace can be manually changed to red (the fourth color in the sequence). Now three sweeps can be made via Append or nested sweep. Colors for the first sweep will be cyan and red (1st and 4th colors), for the second sweep green and magenta (2nd and 5th colors), and for the third sweep yellow and blue (3rd and 6th colors), as each trace progresses through the color sequence list.

Use Test Colors Only Checkbox

If a test is loaded, the Append box checked, and additional sweeps are made (F9 or Go), the colors of the newly measured and appended traces depend on the "**Use test colors only**" box. If this box is checked, each newly appended set of traces will be the same color as the traces in the test that was loaded. If this box is not checked, the

newly appended trace colors will cycle through the defined sequence, starting with the color of each trace in the test loaded.

Cycle Trace Colors Checkbox

When the File Append command is used, the color of the appended traces depends on the status of the "**Cycle trace colors**" box. If this box is not checked, the trace colors of the appended file will come in exactly as they were in the file on disk being appended. If this box is checked, the colors of the traces appended from disk file will cycle through the defined sequence, using as the starting point the last set of traces currently in memory.

Page Setup Dialog Modified

The File Page Setup dialog has been modified to a new structure with three tabs: Display, Layout, and Trace. The functions of the various controls have not changed, only their location.

The **Display** tab carries the basic Landscape-Portrait orientation selection field, controls for whether each group of text prints (Title, Comments, Legend, axis Labels, etc.), and controls for line style of the graph graticule (solid, dash, dot, etc.)

The **Layout** tab carries controls for the graph margin and size, centering the graph, and filling the page. The Save As Defaults, Restore Defaults, Load from Test, and Load from Display buttons are visible on both the Display and Layout tabs.

The **Trace** tab carries the controls for printing or not printing individual traces, for trace color, thickness, and line style, identification (instrument and parameter) of each trace, and the Track Display Changes checkbox.

New User Interface for MAKEWAVE

System One and System Two DSP-equipped models can generate multitone signals at both their analog and digital outputs. A multitone signal consists of a number of sinewaves, all generated simultaneously. These signals and the appropriate DSP analyzer program (*FAST*TEST

with System Two and System One, plus *FAST*TRIG and CODEC with System One) can test audio devices and systems with a number of benefits. Primary advantages include minimized testing duration, comprehensive testing (response, distortion, noise, phase, separation), and more realistic signals than the single sinewave normally used. A number of multitone signal files (.AGM and .AGS file types) are furnished with APWIN for use in multitone testing. These furnished waveform files are located in the C:\APWIN\WAVEFORM folder. For applications needing custom multitone signals, the DOS utility program MAKEWAV2.EXE has been furnished since the beginning of APWIN. This v1.52 release of APWIN now incorporates a much easier-to-use Windows interface for MAKEWAV2, eliminating the need to deal with DOS command-line options. The new interface also provides capabilities previously not available or available only with difficulty (stereo waveforms of matched amplitude, Microsoft .WAV file output in addition to Audio Precision waveform files, automatic creation of sweep tables, simple randomization of phase values). Note that the original DOS interface to MAKEWAV2 is still available via the Audio Precision program group.

Main Menu, Multitone Waveform Creation

The new interface is reached via the Utilities Multitone Creation menu item. When this command is selected, the Main Menu for this utility is displayed, as illustrated. A unique waveform name (DOS-limited to eight characters maximum) should be typed into the Waveform Name field. The new waveform, carrying this name, will be stored in the current working directory as established by the File Set Working Directory command. The Sample Rate at which the waveform will be used should be typed into the Sample Rate field. The desired Waveform length should be selected in the Multitone Waveform Length field. Longer waveforms provide higher frequency resolution but require greater time for generation, acquisition, and processing. Frequency resolution (the lowest possible frequency, also the minimum spacing between frequencies) is (Sample Rate) / (Multi-tone Waveform Length). Thus, with a 48000 Hz Sample Rate, a Waveform Length of 8192 samples produces a frequency resolution of about 5.86 Hz and a Waveform Length of 2048 samples produces a resolution of about 23.44 Hz. The Record Length field is normally set to the same value as the Multitone Waveform Length except for some

specialized applications with the *FAST*TEST program of System One. The Margin Headroom field is normally left at the default 1.0 dB value, but may be decreased to nearly zero in order to obtain maximum signal-to-noise ratio for the waveform or may be increased in order to produce digital domain signal amplitudes of a specific absolute value.
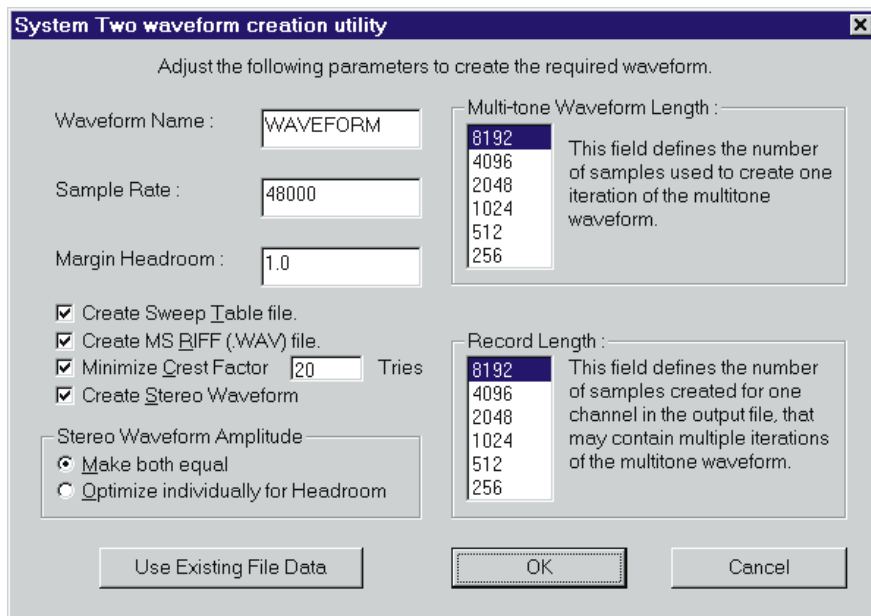
The four checkboxes at the lower left of the panel control additional actions beyond basic creation of the multitone waveform file. The Create Sweep Table checkbox causes creation of a sweep table (.ADS file) typically used for response, distortion, and phase measurements. The Create MS RIFF (.WAV) checkbox creates a Microsoft-compatible .WAV file in addition to the Audio Precision format file. This .WAV file can be played by Microsoft's Media Player utility and all sound card software. The Minimize Crest Factor checkbox and numeric entry field labeled "Tries" will cause a phase randomization process to take place for the number of attempts specified, with the results retained that produce the lowest crest factor (peak-to-RMS ratio). The Create Stereo Waveform checkbox causes the process to create a stereo (.AGS) waveform containing independent signals for the left and right channels. When this box is checked, a subsidiary choice appears that gives the choice of making

the tone amplitudes of the two channels equal or optimizing each independently for maximum headroom. If the stereo waveform is to be used for stereo balance (differential gain) measurements, the "**Make both equal**" choice must be selected.

Finally, the decision must be made between use of an existing file containing a set of frequency-vs-amplitude points as the model for the multitone, or creating and editing a new set of frequency-amplitude points. To use an existing file containing this data, click the "**Use Existing File Data**" button. To create a new set of frequency-amplitude points, click the "OK" button. In either case, the Main Menu will disappear and a message will indicate that the present setup panel conditions are being saved under a standard test name (MAKEWAVE.TMP).

New Frequency List Creation

If "OK" was clicked rather than using existing data, the Frequencies Menu dialog will appear, as illustrated. This permits entry of the highest and lowest tone frequencies desired in the Start Frequency and Stop Frequency fields, selection of the total number of tones (including Start and Stop) in the "**Number of frequencies**" field, and selection of a logarithmic or linear relationship between those frequencies. If some arbitrary set of frequencies is desired rather than either

equal log or linear spacing, you will be able to edit to the desired values in a following step. Press the OK button to continue.

Use of Existing File for Frequency List

If the "**Use Existing File Data**" button is clicked, a dialog will appear prompting you to use the File Open menu command to Open an existing test, data, equalization, or sweep table file or to Import an

ASCII data file containing a list of frequencies and amplitudes that will define the multitone.

Modification of Data

With either a newly-generated frequency list or an existing file loaded, the Data Editor will appear after a few moments of processing. Three columns may be occupied—frequency, amplitude, and (if present in the loaded file) phase. The values in the frequency column (Gen Freq) will be the nearest synchronous frequencies to those specified by loading an existing file or by your entries in the Start, Stop, Log/Lin, and Number of Frequencies fields if you used the Frequencies Menu dialog. A synchronous frequency is one that will contain an exact integer number of complete cycles in a buffer of the selected Multitone Waveform Length at the selected Sample Rate.
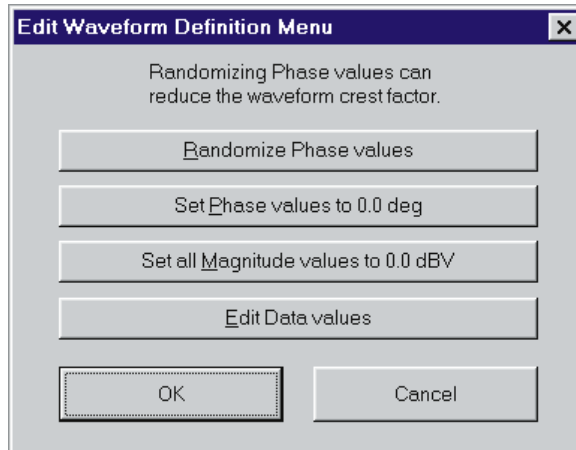
The Edit Waveform Definition dialog illustrated will appear on top of the Data Editor. If you are not satisfied with the frequency values and/or magnitude values, click the "**Edit Data Values**" button. A message will appear indicating that you can then click in any Data Editor cell and change to the desired values. After editing, click on "**Continue Procedure**" to return to the Edit Waveform Definition dialog. Note that any frequency values that you changed will be automatically changed to the nearest synchronous frequency (if required) at this point. To produce a multitone waveform with exactly equal amplitudes at each frequency, click on the "**Set all Magnitude values to 0.0 dBV**" button. All phase values may be set to random

values by the "**Randomize Phase values**" button, or all set to zero (every tone's waveform starting from zero signal level at the beginning of the record) by the "**Set Phase values to 0.0 deg**" button. Note that the individual waveforms that make up a Stereo waveform should not be individually randomized if they are to be used for the measurement of interchannel phase. When you are satisfied with the multitone definition shown in the Data Editor, click on the OK button. The specified waveform will be generated by MAKEWAV2.EXE and saved under the name you specified at the beginning. The test setup you had at the beginning of the process (saved as MAKEWAVE.TMP) will be re-loaded. You will be prompted as to whether you wish the new waveform to be loaded into the arbitrary waveform generator memory.

Sweep Table Definition

If the Create Sweep Table checkbox on the Main Menu was checked, a Sweep Table Definition dialog will appear as illustrated. Check Fundamental Frequencies to create a table to be used for frequency response, phase, or total distortion measurements. Check Harmonics and enter the range of harmonic orders to obtain a table to be used for measurement of harmonic distortion only. Check IM products and enter the desired upper limit of IMD product order to obtain a table for measurement of intermodulation distortion products.
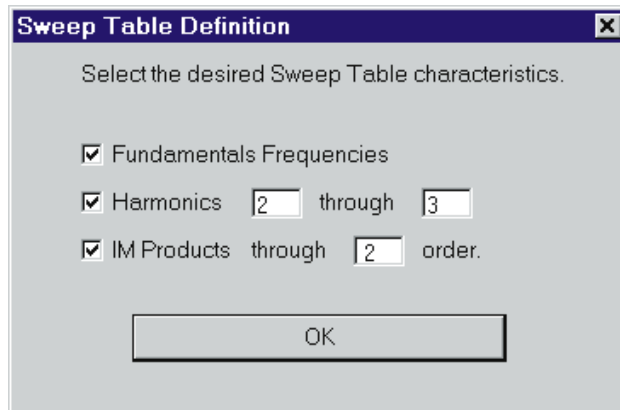
After creation of a sweep table, the user will be asked whether it should be automatically loaded.

Microsoft WAV File Creation

If the Create MS RIFF (.WAV) file box was checked on the main menu, the MS RIFF Waveform Creation dialog will appear as illustrated. Here you may specify the duration of the .WAV file and whether dither will be added (and the type of dither) during generation of the file. Dither, if added, is based on 16-bit resolution.

```
┌─────────────────────────────────────────────┐
│ MS RIFF Waveform Creation              [×]  │
│                                              │
│   Waveform Length:   [5        ]    Sec      │
│                                              │
│          Dither:   ┌──────────────┐          │
│                    │ None         │          │
│                    │ Triangular   │          │
│                    │ Rectangular  │          │
│                    └──────────────┘          │
│                                              │
│       ┌──────────┐        ┌──────────┐       │
│       │    OK    │        │  Cancel  │       │
│       └──────────┘        └──────────┘       │
└─────────────────────────────────────────────┘
```
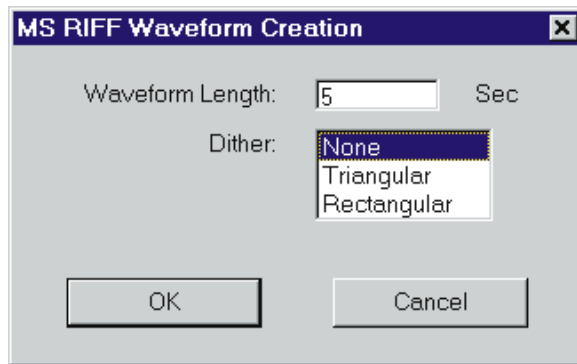
Statistics

When MAKEWAV2.EXE operates, it generates a detailed report including exact frequencies, number of complete cycles of each frequency in the file, relative amplitude of each tone, peak and rms amplitudes of the composite signal and the computed crest factor, and the absolute digital domain amplitude corresponding to 1 Volt or 0 dB input file specification. Similarly, a summary report of the contents of a sweep table is generated if the sweep table option is chosen. Dialogs will appear asking you whether you wish to view Waveform Statistics and (if relevant) Sweep Table Statistics. The Waveform Statistics file will be created with a .WFS extension and the Sweep Table Statistics file with a .STS extension. If a stereo waveform file is generated, two .WFS reports are generated, with the final character of the channel A filename replaced with "A" and the channel B filename with "B". These .WFS and .STS reports are automatically loaded into the Microsoft Notepad text editor and minimized. Click on the desired button on the Win95 Taskbar across the bottom of the screen to view (and print, if desired) the statistical reports.

Changes Affecting System Two Only

Jitter Calibration Changed to PEAK

To conform with the latest revision of the AES3 recommendation on digital audio interface, the jitter measurement calibration of System Two has been changed to peak, rather than p-p. This change pertains to jitter measured either with the DIO panel jitter meter (Average or Peak detection) or to the INTERVU Digital Analyzer program. The numeric value of jitter displayed by v1.52 APWIN will thus be exactly half what was displayed by v1.50 and earlier. This calibration change means that current Audio Precision specifications must be re-interpreted. For example, the range of measurable jitter amplitude presently published as "Peak Mode 0-6 UI ±(10% + 0.08 UI)" is for a peak-to-peak calibration of the instrument. With the new peak calibration, the specification must be interpreted as "Peak Mode 0-3 UI ±(10% + 0.04 UI).

INTERVU FFT Jitter Calibration Now RMS

To conform with normal practice when displaying FFT spectrum analyses of analog signals, the jitter amplitude calibration of the INTERVU program is RMS when Source 1 is selected as Intervu Freq for frequency domain views. For example, if a sinewave jitter signal of 100 nanoseconds peak amplitude is viewed in the frequency domain with INTERVU, the spectral peak will be approximately 71 nanoseconds (0.707 * peak).

BITTEST for System Two

Digital Data Analyzer (BITTEST)

The Digital Data Analyzer program (BITTEST), long a capability of System One Dual Domain, has now been added to System Two. In conjunction with certain specific signals created by the digital generator, this program measures the returned digital audio signals for

bit errors. The audio test signal may be a pseudo-random noise sequence, constant valued samples ("digital dc"), a sinewave of selectable amplitude and frequency, or walking bit patterns. Generated word width must generally be equal to or greater than measurement word width, both controlled from the Digital I/O panel. The measurement displays both real-time received data and errors in the received data sequence. Any amount of delay between transmitted and received signals is permissible, allowing testing of devices and transmission links with large amounts of delay or even recorder-reproducers. Dither cannot be used during BITTEST analysis except with sine waveforms.
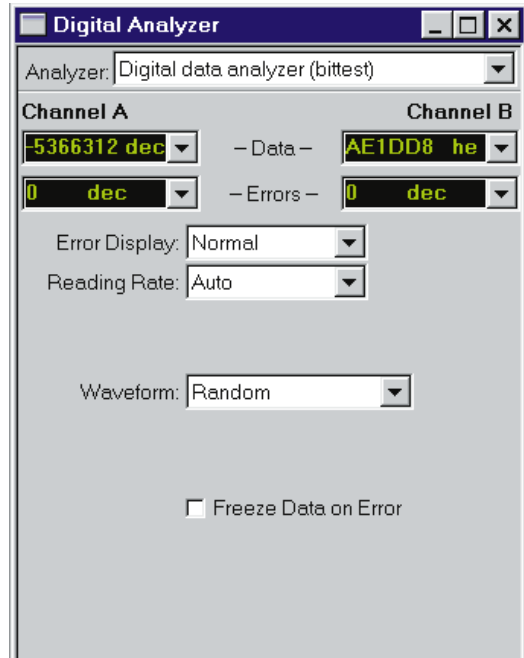
BITTEST is useful for investigating the integrity of digital audio data links, recorders, etc. It is also invaluable for design test of digital interfaces. Each waveform measured by the program has a specific testing application. BITTEST operates only with digital domain input and output.

BITTEST.AZ2 is a real time program. Measurements can be continuously observed in panel or bargraph modes. This is particularly useful for making adjustments on devices under test. The Data values and/or Error values may also be graphed versus time in chart recorder fashion, or against Digital Generator Amplitude (Special Constant "waveform").

Signal Compatibility for BITTEST

Signal generation must be coordinated with BITTEST analysis. BITTEST can analyze five different digital-domain waveforms: Random, Constant, Walking-1, Walking-0, and Sine. When testing

real-time devices and using System Two's digital generator, the same waveform must be selected on both the Digital Generator panel and the BITTEST analyzer. When analyzing a previously-recorded or distantly-generated signal, the Waveform field on the BITTEST analyzer panel must correspond to the waveform being analyzed. In some cases the System Two Digital Generator panel must also be properly set, since the BITTEST analyzer looks to the Digital Generator panel for certain signal parameter information even though the output of the generator may not be currently used.

Constant

The Constant waveform analysis mode expects a continuous stream of data samples at the same fixed value. This is the digital equivalent of a DC voltage source. The "Special Constant" waveform of System Two's digital generator and the "Constant" waveform of System One's BITTEST generator are both compatible with System Two's BITTEST analysis. On the System Two Digital Generator panel, the data word to be generated is determined by the Amplitude field on the Digital Generator panel. ***NOTE: generator dither must be turned off (None) for BITTEST analysis to function with the Constant waveform.*** Constant mode aids in the investigation of data-dependent errors in digital systems. If a Constant waveform is digitally recorded and then reproduced, or is transmitted from a distant System, the local System Two Digital Generator Waveform must be set to Special Constant and the Amplitude field must be exactly the same as was recorded or is being transmitted even though the locally-generated waveform is not being used. The Output Resolution (word width) on the Digital I/O panel must at least equal the Input Resolution for BITTEST analysis to function properly.

Random

The Random waveform analysis mode expects a specific, predictable pseudo-random waveform uniformly distributed between plus and minus full scale. The System Two Digital Generator Waveform "Special—Bittest Random", System One's BITTEST Random waveform, and the RAND waveform of Portable One Dual Domain are all compatible. This signal is intended for error rate testing of communications links, AES/EBU interfaces, and digital recorders. It

provides the most thorough error testing of any of the waveforms. Digital generator dither is automatically turned off in this waveform, so the Dither panel field setting of the generator used is not important. The Output Resolution on the Digital I/O panel must at least equal the Input Resolution for BITTEST analysis to function properly.

Walking Bit

There are two walking bit modes. The Walking-1 mode sets all bits to 0 except one bit which is set to 1. This single high bit is continuously incremented from lower to upper bits. When it reaches the MSB it wraps around to the LSB of the selected word width (Output Resolution field, Digital I/O panel). The Walking-0 mode sets all bits to 1 except one bit which is set to 0. This single low bit is continuously incremented from lower to upper bits. When it reaches the MSB it wraps around to the LSB of the selected word width. System Two's and System One's Walking-1 and Walking-0 waveforms are compatible with BITTEST analysis. Digital generator dither is automatically turned off in this waveform, so the generator Dither panel field setting is not important. The Output Resolution on the Digital I/O panel must exactly equal the Input Resolution for BITTEST analysis to function properly.

Sinewave

The Sine waveform is the only waveform of BITTEST that allows error checking of digital audio devices with gain or equalization. It is difficult to test such devices with bit-pattern-based test signals. The sinewave retains its shape passing through any linear digital device. Good quality digital domain sinewaves from a wide variety of sources are compatible with BITTEST analysis—System Two, System One, Portable One Dual Domain, and even sinewaves recorded on test CDs. The sinewave analysis technique used by BITTEST will automatically adapt to normal dither levels, so Dither may be turned on or off.

Signal Analysis (BITTEST)

Data Displays

Received data is displayed on the Ch 1 and Ch 2 Data fields at the top of the panel, truncated to the word length set in the Input Resolution field of the Digital I/O panel. Ch 1 refers to digital Channel 1 (subframe A) and Ch 2 refers to digital Channel 2 (subframe B). BITTEST cannot be used with analog signals. The Data may be displayed in decimal or hexadecimal units. The Data (and Errors) readings are updated at the rate selected in the Reading Rate field (Auto-4/sec-8/sec-16/sec) until an error occurs. When an error occurs (see below), the data display function depends upon the setting of the "**Freeze Data on Error**" checkbox. If the "**Freeze**" checkbox is checked, the Data fields will display the value that was received when the first error occurred. If the "**Freeze**" checkbox is not checked, the Data fields will continue updating, independently of any errors detected.

Error Displays

Received data is measured to determine if it matches the data transmitted. Only the number of bits selected in the Input Resolution (bits) field of the Digital I/O panel will be analyzed. This comparison is done with algorithms which are not sensitive to delay between the send and receive sections. The number of errors in the received data per measurement interval are counted independently for each channel. The Error Display field selects the type of analysis to be performed. In the Normal mode, the number of errors detected during the last measurement interval (1/4 second, 1/8 second, 1/16 second) are displayed directly in the Ch 1 and Ch 2 Errors fields of the panel. If Error Display is selected as Maximum, the largest error count during any one measurement interval will be held in the display. A running total of all errors may be accumulated by using the Totalize mode of the Error Display field. To reset the Totalize or Maximum error displays, press Enter while the Error Display field is selected.

Waveform

See the Signal Compatibility section above. All modes make error measurements based on the Waveform selection. The random, sine, and walking bit modes compare each successively received sample with the algorithm used to generate the signal. Two samples are required before the error analysis synchronizes with the signal, so errors may be indicated during the initial measurement interval even though no error actually exists. Constant mode requires that dither be turned off at the digital generator.

The Input Resolution (bits) field on the Digital I/O panel sets the number of input bits to be analyzed in all modes. It affects both data and error displays. If the transmitted signal does not have a resolution (word width) at least as great as the input resolution, errors will be displayed.

Error Detection Flag

Whenever an error is detected the DSP will pulse the AUXILIARY OUTPUT (pin 11) on the rear panel 15-pin D-sub serial interface connector. This allows triggering an oscilloscope to observe received data errors. Since the error indication does not occur until after the end of the data word containing the error, a digital storage oscilloscope or logic analyzer is recommended. That instrument should be set in pre-trigger mode to acquire data before the trigger event.

New dBGA, B, W Units for DSP Audio ANLR

Three amplitude measurement units—dBG A, dBG B, and W—have been added to the Level and Function Reading Meter of DSP Audio Analyzer when set for analog input. These same units have been available on the Analog (hardware) Analyzer in earlier versions of APWIN. The dBG A and dBG B units express an amplitude measurement in decibels relative to the present Analog Generator Channel A and Channel B amplitudes, respectively. The W (Watts) unit computes power level from the formula:

$$P = \frac{V^2}{R}$$

using the resistance value in the Analog Analyzer References Watts field near the bottom of the large version of the Analog Analyzer panel.

EQ SINE Available on SINE A/D Generator

The second "Wfm" field on the Analog Generator panel, when "**Sine (D/A)**" has been selected in the first "**Wfm**" field, now includes the selection "**EQ Sine**". This selection produces a DSP-generated D/A converted sinewave from the Analog Generator output terminals. The amplitude of this sinewave will be controlled as a function of frequency according to an equalization file (.ADQ) used as a lookup table. For details on selection of the .ADQ file, Post-EQ amplitude fields, and other aspects of generator equalization, see pages 4-9 through 4-12 of the System Two User's Manual version 1.5.

INTERVU Can Measure Jitter on Squarewave

In addition to measuring jitter on an AES/EBU or SPDIF/EIAJ serial digital input signal, INTERVU can now also measure jitter on any 28 kHz to 13 MHz squarewave connected to the BNC digital input connector. This new feature permits measurement of jitter directly on the clock signal of A/D and D/A converters. The waveform of the jitter may be displayed (time domain view) or a spectrum analysis of the jitter may be performed (frequency domain view).

The "**Jitter Detection**" field on the INTERVU panel must be set to either "**Squarewave Rising**" or "**Squarewave Falling**" to activate this feature. The "**Rising**" selection measures jitter on rising edges of the signal and the "**Falling**" selection measures on falling edges. The first four selections of the "**Trigger**" field (Ch. A and Ch. B Receive and Transmit) and the "**Receive Block**" selection all are essentially "**free run**" selections, acquiring signal as soon as Go is clicked or F9 is pressed. The "**Receive Error**" selection is not useful when measuring squarewave jitter. The External Pre-Trigger and External Post-Trigger selections operate in conjunction with pin 3 of the 15-pin D-sub connector on the rear of the DSP module. When pin 3 is high (or open circuit, in which case it is pulled high by an internal pull-up resistor), triggering occurs at the next digital sample after F9 is pressed or Go is clicked. Pulling pin 3 low from an external device

holds off triggering when F9 is pressed or Go is clicked, with acquisition being triggered on the next sample after pin 3 is pulled high. The External Pre-Trigger selection results in retaining the approximately 3.9 milliseconds of signal immediately preceding this sample, while the External Post-Trigger selection retains the 3.9 milliseconds of signal immediately following this sample. The Jitter Generator trigger selection works only when System Two's Jitter Generator (large form of DIO panel) is turned on. This trigger mode can be useful when looking at jitter on a squarewave clock that is derived from an AES/EBU signal fed from System Two's digital generator output.

Jitter measures time deviation of zero crossings of a waveform compared to a perfect clock of the same average frequency. For AES/EBU waveforms, System Two determines the average clock frequency by measuring the frame rate of the digital input signal. This frame frequency extraction circuitry is not functional for a squarewave signal, so the DIO panel Sample Rate field is not useful with squarewave input. INTERVU determines average clock frequency to the best of its ability from its acquired signal. Since the acquired signal duration is approximately four milliseconds, the resulting frequency measurement is limited in resolution. The result is that a graph of the jitter waveform of a squarewave input clock, plotted across the four millisecond record, may appear as a ramp. The desired jitter signal is the deviation from this ramp. The Compute Linearity function is used to extract variations from an underlying systematic linear variation such as this ramp.

Two standard test setups, one for time domain (waveform) views and one for frequency domain views (spectrum analysis) are furnished in the C:\Apwin\S2\Dig_I-O directory. The time domain test is named CLOCK JITTER.AT2. The test is stored with Squarewave Rising as the Jitter Detection choice and can be changed to Squarewave Falling. The test acquires signal from the Digital Input BNC connector, extracts the jitter signal, automatically applies the Compute Linearity function to eliminate the ramp discussed above, and graphs the jitter waveform. The test is set up as a repeating sweep.

The frequency domain test is named CLOCK JITTER FFT.AT2. It is similar to the time domain test but does not use the Compute

Linearity function. It graphs the spectrum of the jitter signal from low frequencies to 1/2 sample rate (24 kHz, presuming a 48 kHz squarewave input signal). At other signal frequencies (clock rates), the Source 1 Stop frequency must be changed to 1/2 the signal frequency.