DESCRIPTION

Professional prop builders know a secret: audio is more than half of the experience of a high-quality prop. Until now, consumer-level audio boards lacked some professional features – things like quality amplification, as well as the ability to mix a stereo signal (to mono) right on the board. The AP-8 solves this problem, providing quality audio and amplification in a small format; a format perfect for amateur and professional prop builders alike. Need more than eight sounds? No problem – the AP-8 is addressable allowing up to four units to be attached to the same host (serial) connection.

PRODUCT APPLICATIONS

- Props and holiday displays
- Sophisticated audio annunciation for small-scale industrial control

FEATURES & BENEFITS

- Plays up to 60 seconds of audio (8 kHz sample rate)
- Audio memory may be divided into one to eight discrete segments
- Loop switch for continuous play of selected segment
- Onboard two-level amplifier directly drives 8-ohm speaker
- Serial control for connection to host microcontroller
- User-configured baud rate (2400 or 38.4k) for serial control
- User-configured address allows up to four AP-8 boards on one serial connection
- Direct control with simple N.O. switch and button input (segment, loop mode, play/record)
- Compact size: 2.75" x 3" (76.2 mm x 69.9 mm)

MECHANICAL
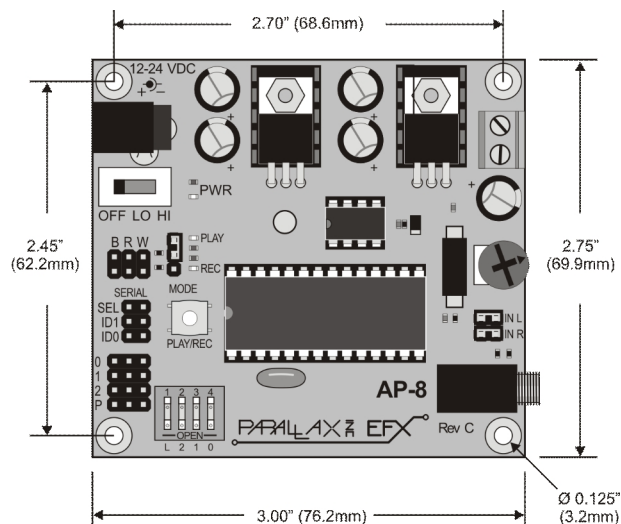
Mounting the AP-8

Mount the AP-8 on a non-conductive surface using ½" (not included) stand-offs and appropriate hardware. Mounting the AP-8 (or any other circuit board) above a conductive (metal) surface could lead to the possibility of a hazardous condition that might damage the AP-8 or the host controller.

Connections – Power and Speaker

Connect a 12-24 volt, 1 amp DC power supply to the AP-8. Power to the AP-8 is input through a 2.1 mm, center-positive barrel connector.

Connect a suitable 8-ohm speaker (non-amplified) to the green screw terminals.

Connections – Serial Control

For many applications the AP-8 will be connected to a host microcontroller like the Prop-1. To make the connection between the host and the AP-8 use a 3-wire servo extender cable (#805-00002). When making the connection it is important to note the color-coded polarity of the extender cable (W = white, R = red, B = black) and match it to the output header on the Prop-1 or other host.

Baud Rate Selection

The AP-8 supports two baud rates: 2400 baud for the Prop-1, and 38.4k baud for other microcontrollers. Baud rate is set with a jumper on the **SEL** header.

Jumper	Baud Rate
Out	2400 (Prop-1)
In	38.4k (Other controllers)

Address Selection

Using a serial connection allows the host controller to connect to up to four AP-8 boards; to do this, however, each must have a unique address. The AP-8 board address is set with jumpers on the **ID0** and **ID1** headers.

ID1	ID0	Address
Out	Out	0 (%00)
Out	In	1 (%01)
In	Out	2 (%10)
In	In	3 (%11)

The illustration below shows the AP-8 configured for 2400 baud, set to address 3 (%11).
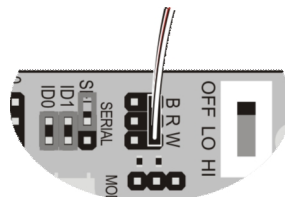
AP-8 Serial Protocol

The AP-8 serial connection conforms to the Parallax AppMod bi-directional communications protocol, which operates at TTL (0 to 5 VDC) using "open-true" baud mode to enable daisy-chaining devices. All exchanges are initiated by the host controller. The format of host communications to the AP-8 is as follows:

"!AP8", *address, command { , data }*

… where "!AP8" is the preamble that allows the AP-8 to exist on the same communications line as other devices (e.g., DC-16, RC-4), *address* is the board address set with jumpers on ID0 and ID1, *command* is a single character command designator, and *data* is any value that may be required by command. The following section details valid commands ("V", "G", "P", and "X") for the AP-8.

"V" – Get AP-8 Version number

Syntax: "!AP8", *address*, "V"
Reply: 3-byte (ASCII) version string

Prop-1 Example:

```
SEROUT Sio, OT2400, ("!AP8", %11, "V")
SERIN  Sio, OT2400, id0, id1, id2
DEBUG "AP-8 Version ", #@id0, #@id1, #@id2, CR
```

"G" – Get AP-8 Status

Syntax: "!AP8", *address*, "G"
Reply: Single byte that indicates the AP-8 status and switch settings. See below.

Bit	When 1	When 0
7	AP-8 is Playing	AP-8 is Idle
6	*Reserved*	*Reserved*
5	Single-shot play	Loop play
4	Record mode selected	Play mode selected
3	*Reserved*	*Reserved*
2	Segment switch 2 is Open	Segment switch 2 is Closed
1	Segment switch 1 is Open	Segment switch 1 is Closed
0	Segment switch 0 is Open	Segment switch 0 is Closed

Prop-1 Example:

```
Main:
  SEROUT Sio, OT2400, ("!AP8", %11, "G")
  SERIN  Sio, OT2400, ap8Status
```

In this example, *ap8Status* will hold the current state of the AP-8. See the example program for reading and decoding the status bits.

"P" – Play Specified Audio Segment

Syntax: "!AP8", *address*, "P", *segment*
                  – *segment* is the audio segment to play (0 – 7)
Reply: AP-8 status (same as "G" command) – may be ignored

Prop-1 Example:

```
SEROUT Sio, OT2400, ("!AP8", %11, "P", 7)
```

In this example, the AP-8 at address %11 will play audio segment seven.

"X" – Stop Play

Syntax: "!AP8", *address*, "X"
Reply: none

Prop-1 Example:

```
SEROUT Sio, OT2400, ("!AP8", %11, "X")
```

In this example the AP-8 at address %11 is stopped.

☞ | **NOTE**: The AP-8 "P" and "X" commands have "all call" capability. When the address byte for these commands is set to 255, any AP-8 on the communications line will respond to the command, but no status byte(s) will be returned. |
|---|---|

Connections – Parallel Input Control

In applications where the host microcontroller is not capable of generating the proper serial communications stream the AP-8 may be controlled through the parallel interface headers 0..2 (segment selection), and P (Play). These signal inputs are active-low and should be allowed to float to a Hi-Z (open) state when not selected. A short-duration (~50 ms) low-going pulse on the P connection will start the selected segment. A segment cannot be stopped when using parallel input control.
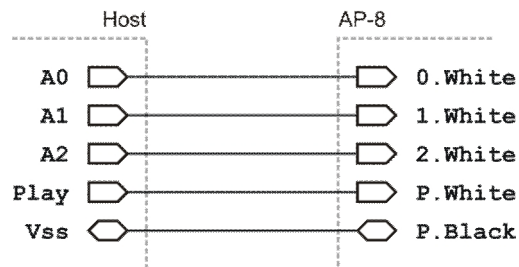
When using parallel input control the segment select dip switches 0..2 must be left in the Open position.

Connections – Direct Input Control

In applications where the goal is to manually play a segment, a normally-open switch (e.g., push-button, mat switch, etc.) may be connected to the P control header as shown below. This connection emulates pressing the AP-8 PLAY/REC button – the segment selected by switches 0..2 will be played.
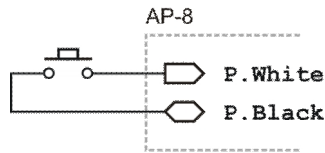
While the serial connection provides the greatest flexibility, beginning prop-builders can use this connection between the Prop-1 and the AP-8.
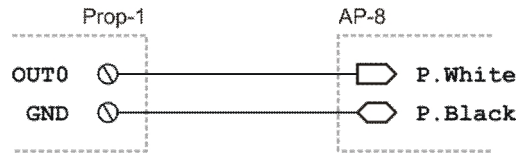
To start the AP-8 from the Prop-1 using the connection, you could use the following code segment:

```
Play_Sound:
  HIGH 0
  PAUSE 50
  LOW 0
```

☞ **NOTE**: If the Loop switch is set to the closed position the selected segment will continuously play until the AP-8 is powered-down or receives the "X" command message on the serial input.

Transferring Sounds to the AP-8

The AP-8 uses WinBond's ISD2560 ChipCorder® as its recording and playback element, so transferring audio segments to the AP-8 is accomplished through an audio connection between a PC (or similar audio source, e.g., a CD player) and the AP-8. For most applications, the following process is used to record one or more audio segments:

1. Connect your PC sound card output to the AP-8 with a stereo 1/8" cable (male-to-male).
2. Move the AP-8 power switch to the LO position.
3. Select the track(s) to record (left, right, or both) with the IN L and IN R jumpers.
   (Default setting is both in which mixes the left and right channels to a mono track)
4. Move the PLAY/REC jumper to the REC position.
   (The red REC LED will illuminate)
5. Select the segment for recording with switches 0..2; set the loop (L) switch to Open.
   (Refer to the segment table below)
6. Start the audio on your computer and press the PLAY/REC button on the AP-8.
7. Hold the PLAY/REC button until the sound is finished playing, then release.
8. Repeat steps 3 through 7 as required for all segments.
9. Move the PLAY/REC jumper to the PLAY position.

Note that every sound card and PC is different, so you will probably have to experiment to get the best possible sound. When possible, use an audio editing tool (Team EFX likes a neat freeware program called Audacity, see *audacity.sourceforge.net* for details) to "normalize" all of your audio files to a consistent level. This will allow you to set you PC volume level to a known position to get good recordings. Once you find a setting that works, make note of it for future use. In general, if you can listen to the sound from your PC comfortably though a set of headphones then it should record well. If the volume is too high the sound will become scratchy and distorted; too low and you may hear unwanted hiss.

The ISD2560 addressing scheme causes the AP-8 to break the audio segments as shown in the table that follows. Note the position of the segment select switches for each of the AP-8 audio segments.

#	2	1	0	Start	Length
0	X	X	X	0.0	6.4
1	X	X	O	6.4	6.4
2	X	O	X	12.8	6.4
3	X	O	O	19.2	6.4
4	O	X	X	25.6	6.4
5	O	X	O	32.0	6.4
6	O	O	X	38.4	6.4
7	O	O	O	44.8	15.2

O = Open, X = Closed

Start and *Length* are in Seconds

It is okay to have sounds longer than the segments shown; if you record a sound longer than the target segment then the next segment will be merged to extend the segment length (this does not apply to segment 7) – just remember that if the sound requires the use of two (or more) segments then you reduce the number of sounds you can play with the AP-8. If, for example, you have a sound effect that is 10 seconds long and you want to place it into segment 0, this is no problem. Set the segment switches to XXX (all closed) and record the sound. The next available segment is now #2, so set the segment switches to XOX and record the next sound. If your second sound was 20 seconds long then segments 2, 3, 4, and 5 would be merged to hold that sound.

Once the sounds are recorded you have two options for volume: power switch position LO provides low volume output (suitable for quiet environments) and position HI provides a 20x amplification boost that can be used for noisy environments. Note that the volume in position HI can be quite loud; set the volume level potentiometer accordingly.

Example Program

The following program demonstrates the AP-8 features under serial control using the Prop-1 controller. When using the Prop-1 the serial baud rate is set to 2400 (Baud jumper removed).

```
' ============================================================================
'
'   File....... AP-8_Test.BS1
'   Purpose.... AP-8 Features Test
'   Author..... EFX-TEK
'   E-mail..... teamefx@efx-tek.com
'   Started....
'   Updated.... 01 JUN 2006
'
'   {$STAMP BS1}
'   {$PBASIC 1.0}
'
' ============================================================================


' -----[ Program Description ]-------------------------------------------
'
' Demonstration program for the AP-8 Audio Player Board

' -----[ I/O Definitions ]-------------------------------------------

SYMBOL  Sio           = 7

' -----[ Constants ]-------------------------------------------
```

```
SYMBOL   Baud            = OT2400
SYMBOL   Addr            = %11

' -----[ Variables ]---------------------------------------------------

SYMBOL   id0             = B0                   ' also used to status
SYMBOL   id1             = B1
SYMBOL   id2             = B2
SYMBOL   segment         = B3                   ' loop control
SYMBOL   switches        = B4                   ' board switch settings
SYMBOL   ctrlChar        = B5                   ' used for Debug Home

' -----[ Initialization ]----------------------------------------------

Reset:
  DEBUG CLS
  ctrlChar = 1                                  ' home

' -----[ Program Code ]------------------------------------------------

Main:
  SEROUT Sio, Baud, ("!AP8", Addr, "V")         ' get version
  SERIN  Sio, Baud, id0, id1, id2               ' receive ID string
  DEBUG "AP-8 Version ", #@id0, #@id1, #@id2    ' display it
  PAUSE 2000
  DEBUG CLS

  FOR segment = 0 TO 7
    SEROUT Sio, Baud, ("!AP8", Addr, "P", segment)
    SERIN  Sio, Baud, id0                       ' clear auto status byte

Get_Status:
    SEROUT Sio, Baud, ("!AP8", Addr, "G")       ' get status
    SERIN  Sio, Baud, id0

    IF BIT4 = 1 THEN Mode_Error                 ' AP-8 in record mode

    switches = id0 & %00000111                  ' isolate switch bits
    IF switches <> %111 THEN Switch_Error       ' error if any closed

Show_Status:
    DEBUG #@ctrlChar                            ' home cursor
    DEBUG "Segment #", #segment, CR             ' show board status
    DEBUG CR
    DEBUG "Playing / Idle... ", #BIT7, CR
    DEBUG "Single / Loop.... ", #BIT5, CR
    DEBUG "Record / Play.... ", #BIT4, CR
    DEBUG "Segment Sw2...... ", #BIT2, CR
    DEBUG "Segment Sw1...... ", #BIT1, CR
    DEBUG "Segment Sw0...... ", #BIT0, CR

    IF BIT7 = 1 THEN Get_Status                 ' allow to finish
    PAUSE 1000
  NEXT

  DEBUG CLS, "Demo complete."
  END

Switch_Error:
  DEBUG CLS
```

```
  DEBUG "Please set AP-8 segment select", CR
  DEBUG "switches to OPEN, then restart", CR
  DEBUG "the program."
  END

Mode_Error:
  DEBUG CLS
  DEBUG "AP-8 is set to Record mode; please", CR
  DEBUG "move PLAY/REC jumper to PLAY."
  END
```

Accessories

750-00007   12 VDC, 1 Amp power supply; *provides ample power for the AP-8*
805-00002   14-inch, 3-pin extension cable; *used to connect the AP-8 to the Prop-1 controller*

Additional Applications

For additional ideas and application notes for the AP-8, be sure to visit our web site at the following link:

www.efx-tek.com

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