



599 Menlo Drive, Suite 100
Rocklin, California 95765, USA
Office: (916) 624-8333
Fax: (916) 624-8003

General: info@parallax.com
Technical: support@parallax.com
Web Site: www.parallax.com
EFX Products: www.parallaxefx.com

AP-8 Audio Player (#31308)

Solid-State Audio Player

General Description

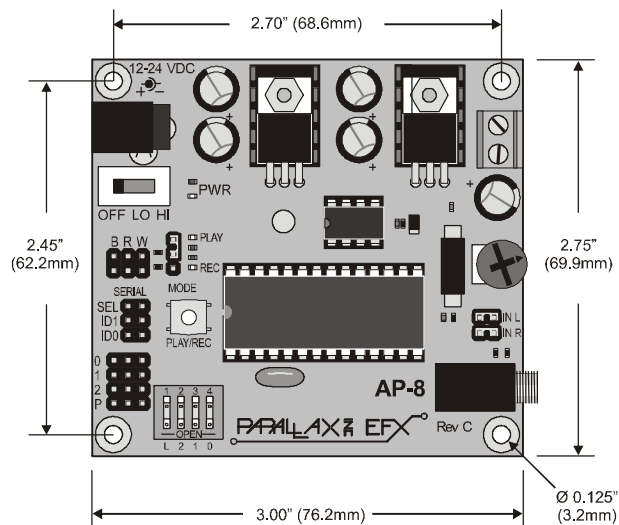
Professional prop builders know a secret: audio is more than half of the experience of a high-quality prop. Until now, consumer-level audio boards lacked some professional features – things like quality amplification, as well as the ability to mix a stereo signal (to mono) right on the board. The AP-8 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.

Applications

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

Features

- 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"



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 most applications the AP-8 will be connected to a host microcontroller like the Prop-1 or a BASIC Stamp® 2 model in a Board of Education® (BoE). To make the connection between the host controller and the AP-8 use a 3-wire servo extender cable (e.g., Parallax #805-00001 or #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.

Baud Rate Selection

The AP-8 supports two baud rates: 2400 baud for the Prop-1 (BS1 family) and 38.4k baud for the BS2-family and other microcontrollers. Baud rate is set with a jumper on the **SEL** header.

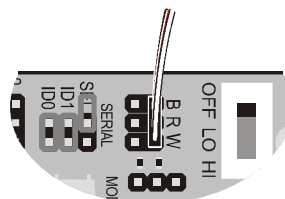
Jumper	Baud Rate
Out	2400 (Prop-1, BS1, and compatible controllers)
In	38.4k (BS2 and compatible controllers)

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 – 5v) 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., RC-4, DC-16), *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	<i>Reserved</i>	<i>Reserved</i>
5	Single-shot play	Loop play
4	Record mode selected	Play mode selected
3	<i>Reserved</i>	<i>Reserved</i>
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”)
```

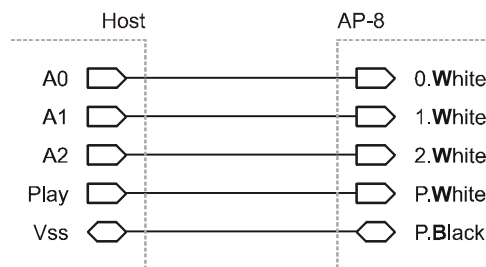
In this example the AP-8 at address %11 is stopped.



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

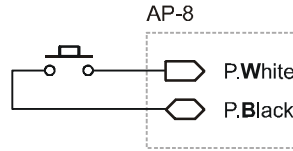
In applications where the host microcontroller is not capable of generating the proper serial communications stream the AP-8 may be controlled through the parallel interface headers 0..2 (segment selection), and P (Play). These signal inputs are active-low and should be allowed to float to a Hi-Z (open) 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.



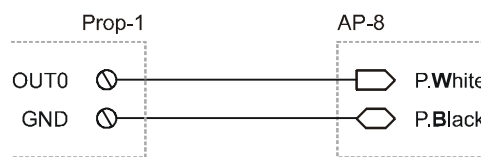
When using parallel input control the segment select dip switches 0..2 should be left in the Open position.

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.



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:

```
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.

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 (the EFX team 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 your 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 through 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 open) 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 your 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 (BS1) controller. When using the Prop-1 the serial baud rate is set to 2400 (Baud jumper removed).

```
' =====
'
' File..... AP8_Test.BS1
' Purpose.... AP-8 Interface Example
' Author..... Team EFX -- Copyright (C) 2005 Parallax, Inc.
' E-mail..... teamefx@parallax.com
' Started....
' Updated.... 14 OCT 2005
'
' {$STAMP BS1}
' {$PBASIC 1.0}
'
```

```

' =====
' -----[ Program Description ]-----
'
' Demonstration program for the AP-8 Audio Player Board.  All commands are
' send to the AP-8 through a serial link at 2400 baud (OT2400 baudmode).
' The use of the open baudmode allows boards to be daisy-chained for up to
' 32 sounds from one I/O pin.
'
' Command syntax: "!AP8", address, cmd {, data}
' -- where 'address' is %00 to %11
' -- 'cmd' is a single character
' -- optional 'data' is a byte
'
' Valid commands:
'
'   "!AP8", address, "V"
'     -- requests version string from AP-8
'     -- should be followed by SERIN to receive three-byte string
'
'   "!AP8", address, "G"
'     -- retrieves current AP-8 status
'     -- should be followed by SERIN to receive one-byte status
'     -- status byte is bit-mapped:
'     * BIT7 : 1 = playing, 0 = idle
'     * BIT6 : reserved
'     * BIT5 : 1 = single-shot play, 0 = loop play
'     * BIT4 : 1 = Record mode, 0 = Play mode
'     * BIT3 : reserved
'     * BIT2 : Segment switch 2
'     * BIT1 : Segment switch 1
'     * BIT0 : Segment switch 0
'
'   "!AP8", address, "P", segment
'     -- plays selected segment (0 - 7)
'     -- returns status (same as "G" command) -- may be ignored
'
'   "!AP8", address, "X"
'     -- stops AP-8 (if playing) at selected address
'
' -----[ I/O Definitions ]-----
SYMBOL  Sio                = 0
'
' -----[ 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

```

Additional Applications

For additional ideas and application notes for the AP-8 audio board, be sure to visit our web site and user forums at the following URLs:

*www.parallax.com
www.parallaxefx.com
forums.parallax.com*

Errata

On AP-8 boards marked "Rev B" the baud rate selection header (SEL) is marked as ID2; this does not affect proper operation of the AP-8.