ASI8914

QUAD HD RADIO™ TUNER PCI ADAPTER

1 DESCRIPTION

The ASI8914 is a professional PCI tuner adapter designed for use in HD Radio broadcast audio monitoring and auditing.

Four different channels of digital HD Radio or analog AM/FM signals can be received and recorded simultaneously from a single antenna input.

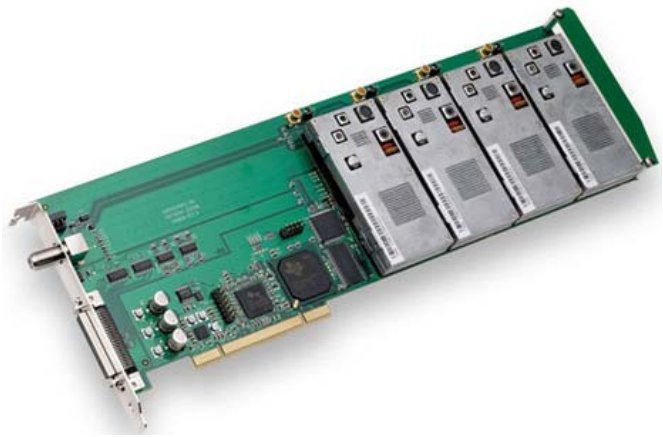
Recording formats include PCM, MPEG-1 Layer 2 and MPEG-1 Layer 3 (MP3). Using MRX technology, each stream can be recorded at any sample rate between 8 and 48kHz

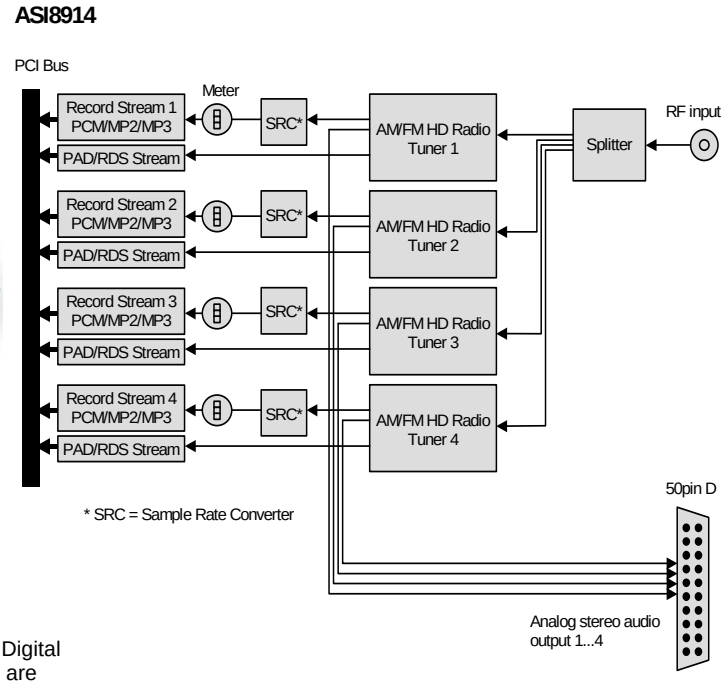
Each tuner can also decode and stream the HD Radio Program Service Data (PSD).

HD Radio multi-cast is supported, allowing the audio and PAD stream to be switched between the Main Program Service (MPS) and Supplemental Program Service (SPS) under software control.

2 FEATURES

- Up to 4 channels of HD Radio or analog AM/FM signal capture
- HD Radio Multicast capable
- Up to 4 channels of HD Radio PSD data capture
- Tuners can be fed from individual external antennas
- Audio monitoring of all tuners simultaneously
- MRX technology allows each stream to have an independent sample rate of between 8 and 48kHz.
- PCM, MPEG-1 Layer 2 and MPEG-1 Layer 3 (MP3) recording formats
- Full-length PCI card
- Up to 8 cards in one system
- Windows XP/Server 2003/Vista and Linux software drivers available





3 SPECIFICATIONS

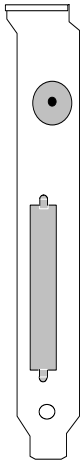
RF INPUT	
Connector	F type 75 ohms, on card bracket MCX connector (per tuner, jumper selectable
Input Level	100 dBuV Maximum (F connector) 100 dBuV Maximum (External antenna connector)
FM TUNER	
HD Radio FM	
Frequency range	87.9MHz – 107.9MHz, 200kHz resolution
Sensitivity	**<TBD>**dBuV for <TBD>dB S/N (NOTE 1)
THD+N	60dB @ 60dBuV RF Level, 1kHz sinewave, mono, 75kHz deviation, A-weighting
De-emphasis	75us (not user configurable)
Audio bandwidth	20Hz-**<TBD>**kHz (+/-3dB)
PAD	<TBD>
Analog FM	
Frequency range	87.9MHz - 107.9MHz, 200kHz resolution
Sensitivity	**<TBD>**dBuV for <TBD>dB S/N
THD+N	**<TBD>** @ 60dBuV RF Level, 1kHz sinewave, mono, 75kHz deviation, A-weighting
De-emphasis	75us (not user configurable)
Audio bandwidth	20Hz-15kHz (+/-3dB)
AM TUNER	
HD Radio AM	
Frequency range	520kHz-1720kHz, 10kHz resolution
Sensitivity	**<TBD>**dBuV for 20dB S/N
THD+N	**<TBD>** @ 60dBuV RF Level, 1kHz sinewave, 75% modulation, A-weighting, 2kHz bandwidth
Audio bandwidth	**<TBD>**
Analog AM	
Frequency range	520kHz-1720kHz, 10kHz resolution
Sensitivity	**<TBD>**dBuV for 20dB S/N
THD+N	**<TBD>** @ 60dBuV RF Level, 1kHz sinewave, 75% modulation, A-weighting, 2kHz bandwidth
Audio bandwidth	**<TBD>**
LINE OUTPUT	
Connector	Mini 50pin on card bracket
Breakout Cable	CBL3004 – Mini 50pin to 24 RCA jacks (Included)
Audio	4Vpp max into 10Kohms
Video	CVBS, 1Vpp into 75ohms
SIGNAL PROCESSING	
DSP	Texas Instruments TMS320C6713@300MHz
Memory	8MB
Sample rates	8, 11.025, 12, 16, 22.05, 24, 32, 44.1, 48kHz
Audio Formats	8 bit unsigned PCM, 16bit signed PCM , 32bit IEEE floating point PCM MPEG-1 Layer 2, MPEG-1 Layer 3 (MP3)
GENERAL	
Bus	Universal 32bit PCI (3.3V or 5V signaling)
Dimensions	PCI form factor - 13" x 4.5" x 0.8" (330mm x 115mm x 20mm) (excluding edge connector
Weight	**<TBD>** max
Operating Temperature	0°C to 60°C
Power Requirements	**<TBD>**
NOTES: 1 – 92.1MHz, Fmod=1kHz, deltaF=22.5kHz, 75us de-emphasize, mono	

4 REVISIONS

Date	Description
07November2008	Updated information/formatting

5 CONTENTS

6 CONNECTORS



6.1 F-Type

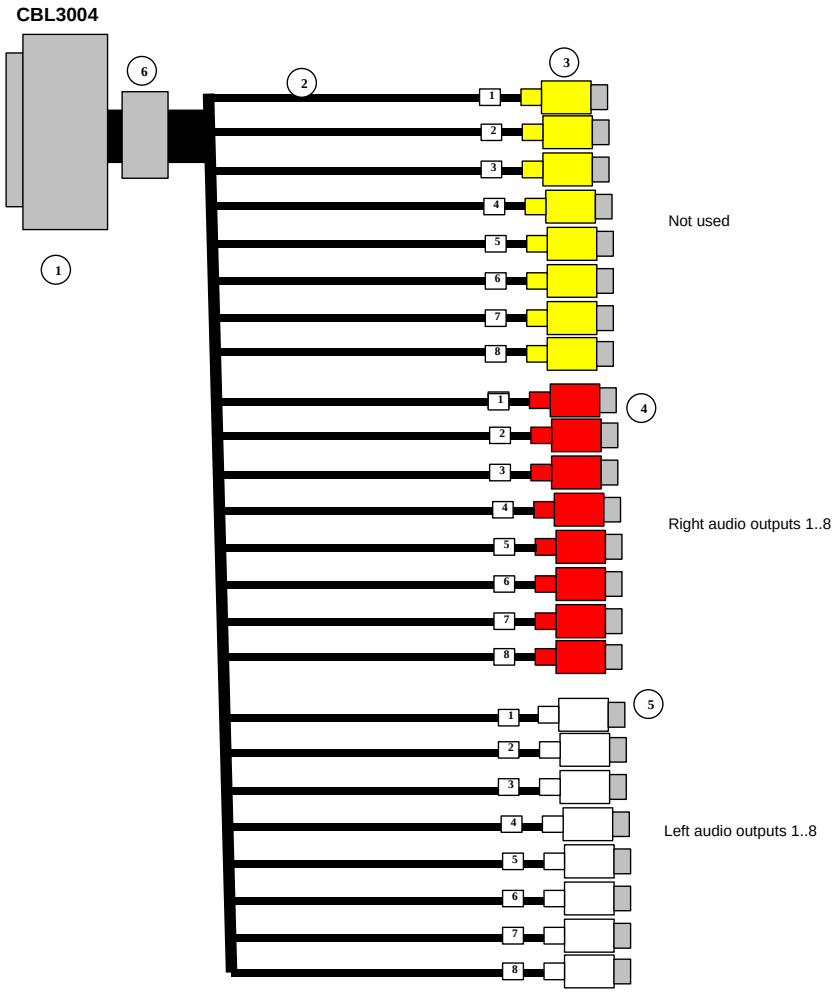
The F connector feeds the RF signal from an external antenna to all tuners on the ASI8914.

6.2 HD50

The HD50 connector makes available the mono or stereo audio of each tuner output. Ch1 is sourced from a software-controlled mux and may be programmed to output Ch1...8. The output level is 2Vpp into 10Kohms.

7 CABLES

Breakout cable CBL3004 is supplied with the ASI8914. This supplies the 8 stereo audio outputs on RCA (phono) jacks.



7.1 HARDWARE INSTALLATION

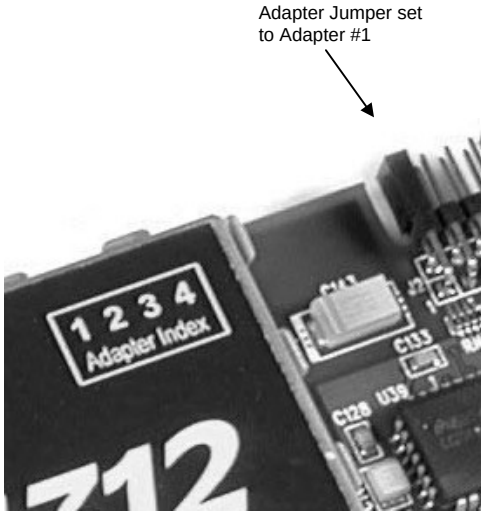
This section explains how to install one or more AudioScience adapters in a computer.

1. Make sure your computer is turned off.

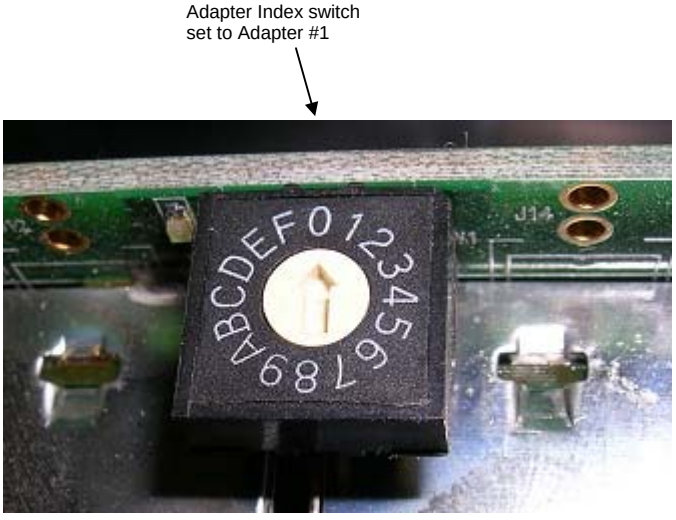
2.PCI adapters should be installed in any empty PCI slot and PCIe adapters should be installed in any x1 (or greater) PCIe slot.

3. Make sure the adapter jumper is set to adapter index #1 (factory default). Depending on the adapter family, there are different ways of setting the adapter index.

For ASI4000, ASI5000, ASI6000 families, there is an adapter jumper that must be set. The left most position represents adapter index #1.



For ASI8700 and ASI8900 families, there is a rotary switch. NOTE Position 0 (zero) represents adapter #1, position 1 is adapter #2, etc



4. When installing two or more adapters in the same computer, make sure they have the adapter jumper/rotary switch position set to unique numbers. For example if you are installing two adapters, the first one would be set to adapter index #1 and the second to adapter index #2.

Different adapter types can coexist in the same computer; for example, an ASI6416 and ASI8702 will work correctly if installed in the same PC. Different adapter types still require unique adapter index numbers.

5. Turn on the computer and let it boot. Under Windows 2000/XP a dialog box will pop up informing you that the computer has detected a new Multimedia Audio card. Cancel out of this dialog box and proceed to the software installation section of this datasheet.

8 SOFTWARE INSTALLATION

AudioScience makes audio adapters and drivers for various operating systems. Enhancements to an adapter's utility come from the integrators software that uses the audio driver to implement sophisticated audio playback and recording functions.

8.1 Drivers for Windows 2000/XP/Server 2003/Vista

The first step is what type of driver is needed for the adapter. There are two types of drivers for Windows: The WAVE driver and the WDM driver. Typically this will be decided by the application used with the AudioScience adapter. For any application that uses DirectSound, use the WDM driver.

Driver 3.10 and later present the user with three install options during installation:

- Install Standard PCI/PCIe Driver.
- Install Standard + Network Audio Driver.
- Remove all driver components

Traditional installs should select the first of these options. Users of AudioScience CobraNet products should select the second option with the "+Network Audio Driver." in the text.

8.1.1 WAVE Driver

Download the file named ASIWAVE_xxxxxx.EXE from www.audioscience.com and run it (_xxxxxx is the version number). After the EXE has run, reboot the computer and the audio adapter will be operational. If the cover is off the computer, one can see one or two blinking LEDs on top of the card indicating its DSP is running and communicating with the driver.

Verify that the adapter is running using ASIControl (see ASIControl section in this document).

8.1.2 WDM Driver

Download the file named ASIWDM_xxxxxx.EXE from www.audioscience.com and run it (_xxxxxx is the version number). After the EXE has run, reboot the computer and the audio adapter will be operational. If the cover is off the computer, one can see one or two blinking LEDs on top of the card indicating its DSP is running and communicating with the driver.

Verify that the adapter is running using ASIControl (see ASIControl section in this document).

8.1.3 Combo Driver

The Combo driver presents both Wave and WDM devices to the user. Download the file named ASICOMBOV_xxxxxx.EXE from www.audioscience.com and run it (_xxxxxx is the version number). After the EXE has run, reboot your computer and the audio adapter will be operational. If the cover is off the computer, one can see one or two blinking LEDs on top of the card indicating its DSP is running and communicating with the driver.

Verify that the adapter is running using ASIControl (see ASIControl section in this document).

8.1.4 ASIO

The AudioScience drivers listed above also install an ASIO driver interface. It is installed by default.

8.1.5 Driver Failure

In the event that an adapter's driver fails to load correctly, the OS's event viewer should be checked. The event log is viewed as follows:

XP: The system event log is accessed from \Start\Control Panel\Administrative Tools\Event Viewer. The System view should be selected.

Vista: The system event log is accessed from \Start\Control Panel\System and Maintenance\Administrative Tools\Event Viewer. The Windows Logs\System view should be selected.

If two or more adapters are installed in the same system, the first thing to check is that the adapters were assigned unique adapter numbers. If issues persist, please email support@audioscience.com.

8.2 Drivers for Linux

The latest Linux driver can be downloaded from the AudioScience website – www.audioscience.com

8.3 Applications for Windows

AudioScience provides two application for adapter set-up and configuration: ASIControl and ASIMixer.

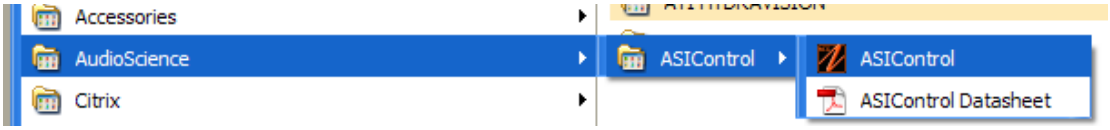
8.3.1 ASIControl

All Windows drivers install an AudioScience application called ASIControl that can be used to setup and verify functionality of adapters. ASIControl provides a common interface for users across all driver types.

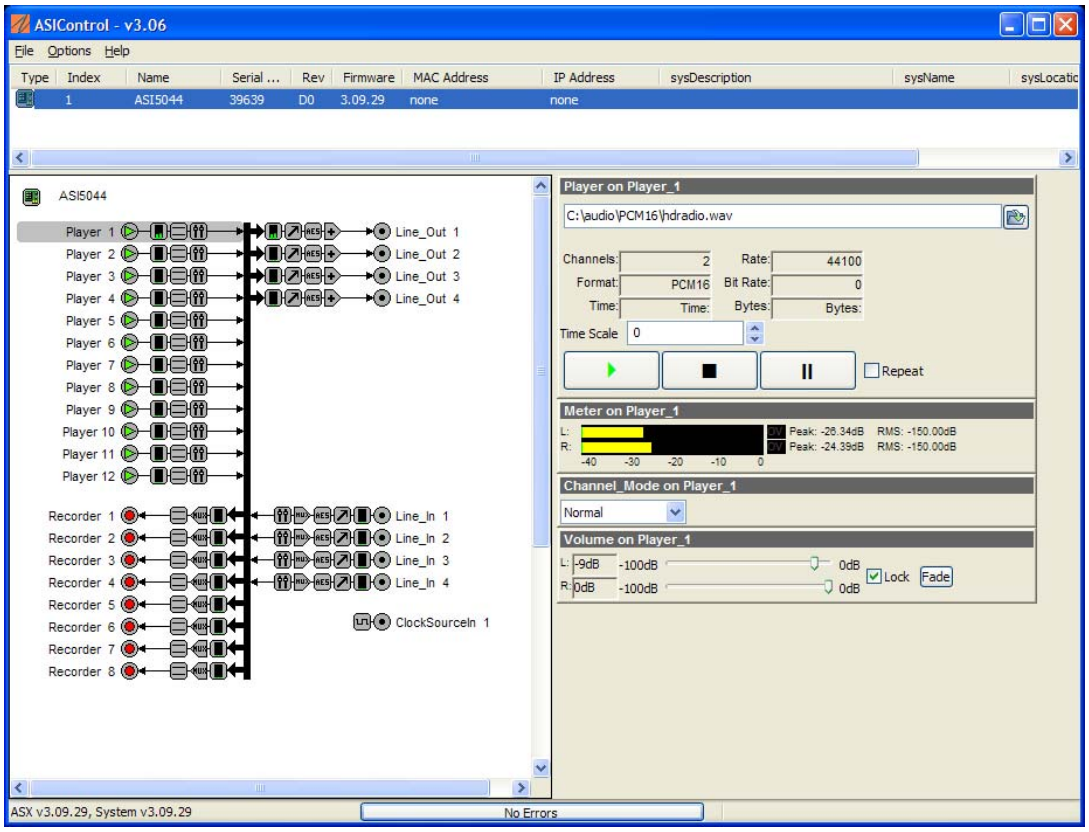
The following list of controls are uniquely supported in ASIControl (as opposed to ASIMixer):

- ASI8700 tuner pre-emphasis
- ASI8900 tuner RDS
- ASI8900 tuner FM stereo indication
- ASI8914 HD Radio PAD field
- ASI8914 HD Radio Digital status field
- ASI8914 HD Radio Digital program number selection

From the Windows Start menu, navigate to Start→Programs→AudioScience and run the ASIControl program.



When started, ASIControl will look something like the following:



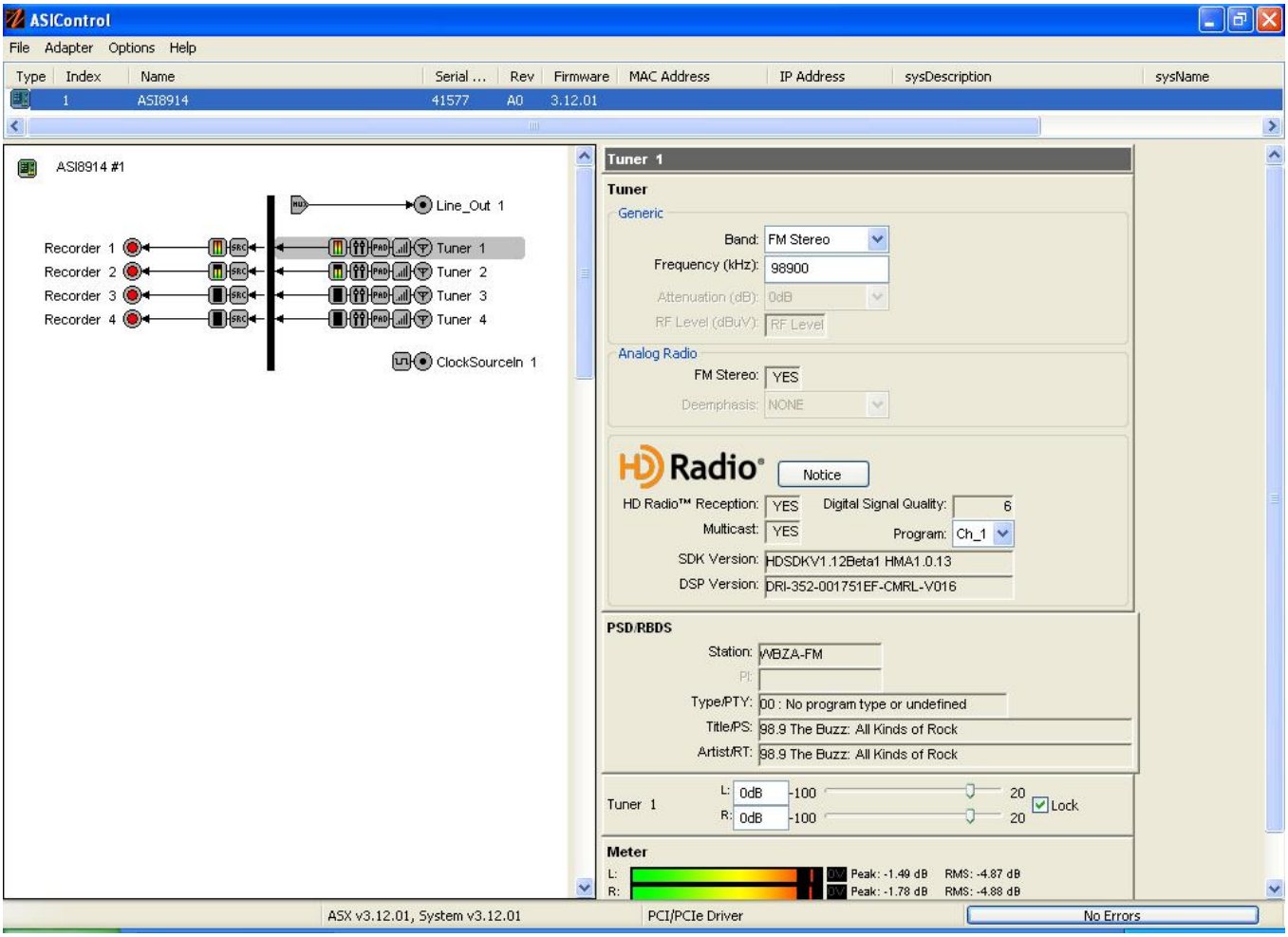
8.3.2 ASIMixer

ASIMixer is specific to the Wave and Combo drivers and is available from the AudioScience website. It uses the Wave/Mixer interface to control AudioScience adapters. Users of driver version 3.10 and later are encouraged to use ASIControl for manipulating adapter controls.

See the list of controls in the previous section that that are only available in ASIControl.

9 OPERATION USING ASICONTROL

Using ASIControl, the ASI8914 will look like so:



For more information on how to operate ASIControl, please see the ASIControl datasheet, available from www.audioscience.com and also installed by the driver.

9.1 Tuner Node

9.2 Tuner

The Tuner control is used to tune radio or TV channels on the ASI8700 and ASI8900 series tuner adapters. There are four sections to the tuner control: **Generic**, **Analog Radio**, **HD Radio**, and **Analog TV**.

Note: Not all tuner adapters support all four sections.

9.2.1 Generic

Figure 1. Generic section of Tuner controls.

Band:
Selects which type of demodulation the tuner will perform. Depending on the adapter type, the following Bands may be available:

Band	Description	Supported adapters
AM	Mono AM radio	ASI87XX, ASI8921, ASI8914
FM Mono	Mono FM radio	ASI87XX, ASI8921, ASI8914
FM Stereo	Stereo FM radio	ASI87XX, ASI8921, ASI8914
TV NTSC	Analog NTSC TV	ASI8723
TV PAL-B/G	Analog PAL-B/G TV	ASI8733
TV PAL-I	Analog PAL-I TV	ASI8733
TV PAL-D/K	Analog PAL-D/K TV	ASI8733
TV SECAM-L	Analog SECAM-L TV	ASI8733
Aux	Auxiliary input on ASI87XX (50pin header)	ASI87XX

Frequency:
Sets the frequency of the channel to be tuned. It is specified in kilohertz (kHz). For example, an FM radio frequency of 88.1MHz is specified as 88100 and NTSC-TV Ch2 is specified as 55250.

Attenuation:
Only available on the ASI8700 series of tuner adapters. Allows a 0db or 20dB attenuation of the incoming RF signal.

RF Level:
If available, shows the RF signal strength of the incoming RF signal in dBuV.

9.2.2 Analog Radio

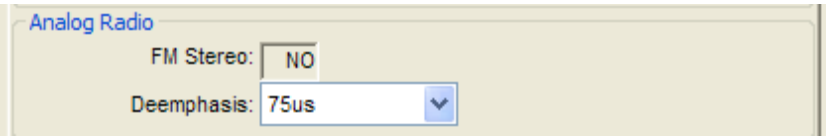


Figure 2. Analog Radio section of Tuner controls for ASI87XX and ASI8921.

Figure 3. Analog Radio section of Tuner controls for ASI8914.

If an analog AM/FM tuner is present on the adapter then the following items are available.
Supported adapters: ASI87XX, ASI8914, and ASI8921.

FM Stereo:
For analog FM, shows whether the signal is being received as stereo.

De-emphasis:
Sets the de-emphasis for analog radio. Available choices are:
AM: none, 50us
FM: 50 or 75us

NOTE: The ASI8914 is set at 75us and is not user configurable.

9.2.3 HD Radio Interface

Figure 4. HD Radio information section of Tuner controls.

If an HD Radio tuner is present on the adapter then the following items are available.
Supported adapters: ASI8914.

Notice:
Displays IP information for HD Radio logo.

HD Radio:
Shows whether an HD Radio signal is being received or not.

Digital Signal Quality:
Displays quality level of received HD Radio signal.
Ranges between 0 (poor) and 6 (excellent).

Multicast:
Shows whether multiple programs are available on this HD Radio station.

Program:
If multi-programs are available, allows you to select which one to receive.

SDK Version:
Displays the version of the SDK firmware running on the HD Radio tuner.

DSP Version:
Displays the version of the DSP firmware running on the HD Radio tuner.

9.2.4 Analog TV

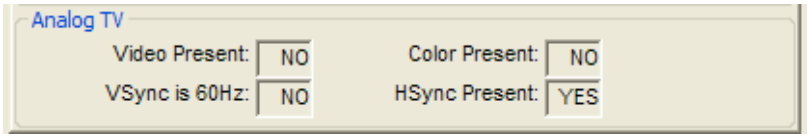


Figure 5. Analog TV section of Tuner controls.

If an analog TV tuner is present on the adapter then the following items are available.
Supported adapters: ASI8723, ASI8733

Video Present:
Shows whether video is present in the TV signal being received.

Color Present:
Shows whether color information is present in the TV signal being received.

Vsync is 60Hz:
Shows whether the vertical sync is 60Hz. This will be YES for NTSC and NO for PAL signals.

Hsync Present:
Shows whether the horizontal sync is present.

9.3 RDS/RBDS and PSD

This control shows metadata that is contained in an analog FM or AM/FM HD Radio broadcast.

9.3.1 Analog FM - RDS/RBDS

Figure 6. FM PSD/RBDS information as seen in ASIControl.

When an analog FM signal is being received that has RDS (Europe) or RBDS (United States) data, the following fields are available:

PI:
Short for Program Identification. A unique code that identifies the station. 5B2D is shown above.

PTY:
Short for Program Type. A code representing up to 31 different radio program types. RDS and RBDS definitions are different. In the above example the PTY code is 06, which represents in RBDS coding, Classic Rock type.

PS:
Short for Program Service. It is an eight-character string that represents the call letters or station identity. In this example WCMF is shown.

RT:
Short for Radio Text. This is a string up to 64 characters long. In the example shown, the current artist (ERIC CLAPTON) and song (I CAN'T STAND IT), as well as frequency (96.5) are shown.

HD Radio Broadcast – PSD

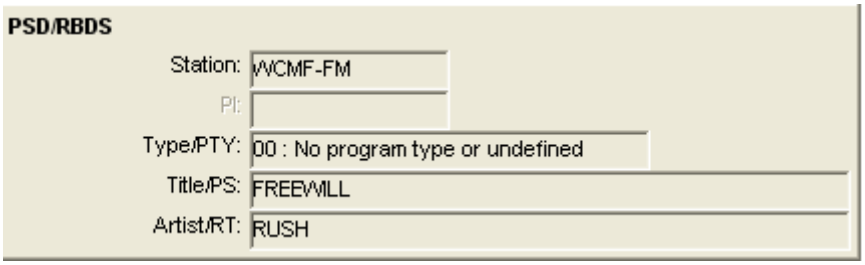


Figure 7. HD Radio Broadcast PSD information as seen in ASIControl

Station:
Displays the station string. The ASI8914 limits the station string to 8 characters. Longer station names are not supported. The example above shows WCMF.

Type:
The station genre or type is listed here. In the case above, it is not defined.

Title:
The current song title is displayed here (FREEWILL). The display supports up to 40 characters of title information.

Artist:
The artist of the current song is listed here (RUSH). The display supports up to 40 characters of title information.

9.4 Recorder

The Recorder control supports recording of an audio file.

9.4.1 Interface

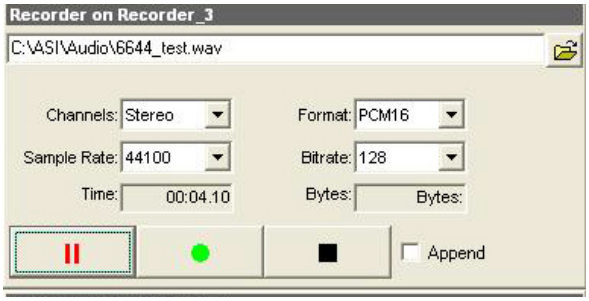


Figure 8. A recorder in ASIControl.

The first line of text contains the name given to the recorded file along with the location where it is to be saved. Below the filename is the file information: record time and record bytes, the recorder control buttons and the file Append option.

9.4.2 How To Record a File

The first step in recording a file is to have audio coming into the adapter. This can be from a line-in or from one of the players in ASIControl. See appropriate sections in this datasheet to accomplish this. Next, the new file needs a name and place to be saved, or an existing audio file can be selected to be overwritten or appended to. Use the **file icon button** to navigate to the location to create the file and to give it a name, or to open a previously recorded file to overwrite or append to it. Next, from the dropdown arrows, select the number of "**Channels"**, the "**Sample Rate"**, the "**Format"**, and the "**Bitrate"** that the file should be recorded in.

Check the **Append** checkbox to save the audio to the end of an already existing file.

The file is now ready to be recorded. To start recording, press the **record button**. At this point the "**Time'** and "**Bytes'** fields report record time and the number of bytes of the file that have been recorded.

Once recording has started, the **stop** and **pause buttons** can be used to stop or pause the playback.

Note: The green monitor button, used to test functionality, acts as a record button but does not create a recorded audio file.

9.4.3 Developer

9.4.3.1 Windows APIs

Wave – use waveInOpen(), waveInStart() etc.
HPI – use HPI_InStreamxxx() functions.
ASX – use ASX_Recorder_xxx() functions.
DirectSound – TBD.

9.4.3.2 Linux APIs

HPI – use HPI_InStreamxxx() functions.
ASX – use ASX_Recorder_xxx() functions.
ALSA – TBD

9.5 Meter

Meters in ASIControl are located on audio nodes and display the audio level as the audio signal passes through the node. Most AudioScience devices return both RMS and peak level readings and ASIControl displays both simultaneously.

9.5.1 Interface

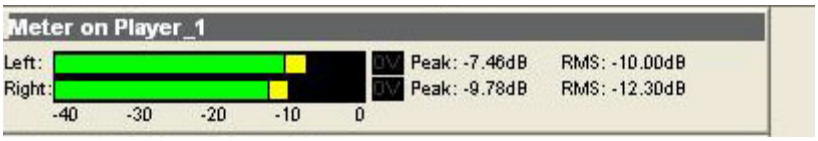


Figure 9. A stereo peak meter display. The RMS is the green bar and the peak is the yellow bar.

To the right of the peak meter is the absolute readings in dBFS. These can be useful when testing input tones of a specific known level.

The ASI2416 has mono (single channel) peak meter, so only a single bar is displayed in that instance.

9.5.2 Developer

9.5.2.1 Windows APIs

Wave/Mixer – Meters are read using mixerGetControlDetails() on a control of type signed and with type “Peak” the name “Peak Meter”. A minimum value is 0 and maximum is 32767. The interface returns the peak readings only, not the RSM level. It confirms to expected Windows functionality.
HPI – Meters are read using the HPI_Meterxxx() API.
ASX – Meters are read using the ASX_Meter_xxx() API.
DirestSound – TBD.

9.5.2.2 Linux APIs

HPI – Meters are read using the HPI_Meterxxx() API.
ASX – Meters are read using the ASX_Meter_xxx() API.
ALSA – TBD.

10 AUDIO FORMATS

The ASI8914 supports the following audio recording formats:

Format	HPI format	Windows format
8 bit unsigned PCM	HPI_FORMAT_PCM8_UNSIGNED	WAVE_FORMAT_PCM, wBitsPerSample=8
16 bit signed PCM	HPI_FORMAT_PCM16_SIGNED	WAVE_FORMAT_PCM, wBitsPerSample=16
32 bit floating point PCM (+/-1.0)	HPI_FORMAT_PCM32_FLOAT	WAVE_FORMAT_IEEE_FLOAT
MPEG-1 Layer 2	HPI_FORMAT_MPEG_L2	WAVE_FORMAT_MPEG -fwHeadLayer=ACM_MPEG_LAYER2 -fwHeadMode=ACM_MPEG_SINGLECHANNEL, ACM_MPEG_DUALCHANNEL, ACM_MPEG_STEREO
MPEG-1 Layer 3 (MP3)	HPI_FORMAT_MPEG_L3	WAVE_FORMAT_MPEG - fwHeadLayer=ACM_MPEG_LAYER3 -fwHeadMode=ACM_MPEG_SINGLECHANNEL, ACM_MPEG_DUALCHANNEL, ACM_MPEG_STEREO OR WAVE_FORMAT_MPEGLAYER3

Not all combinations of channels, samplerates and bitrates are allowed for MP3. The following table shows the supported variations, assuming all eight recording streams are being used:

Sample Rate (kHz)	Channels	Bitrates (kbs)
8, 11.025, 12	Mono/Stereo	16,32,40,48,56
16, 22.05, 24	Mono/Stereo	16,32,40,48,56,64,96,112,128
32	Mono only	32,40,48,56,64,80,96,112,128

NOTE – for maximum efficiency, you must use one sample rate for all streams and set the global sample rate of the ASI8914 to this rate.

11 ANTENNAS

AudioScience has tested and can recommend the following antenna configuration for use with the ASI8700 and ASI8900 series adapters.

The configuration is made up of an omni-directional FM whip antenna, plus multiple ferrite stick antennas, each oriented and tuned to pick up a particular AM station. The antenna's signals are mixed using a common 75-ohm cable TV splitter, which we have found has the necessary low end bandwidth to pass AM signals.

The FM antenna is made by Fanfare (http://www.fanfarefm.com) and is part number FM-2G. Besides FM stations, this antenna will also pickup strong AM stations.

The AM antenna is made by C.Crane (http://www.ccrane.com) and is part number TCA. This antenna has a tuning control that allows you to tune into a particular station using a dial on the front of the control.

The following diagram shows how three AM and the one FM antennas would be wired.

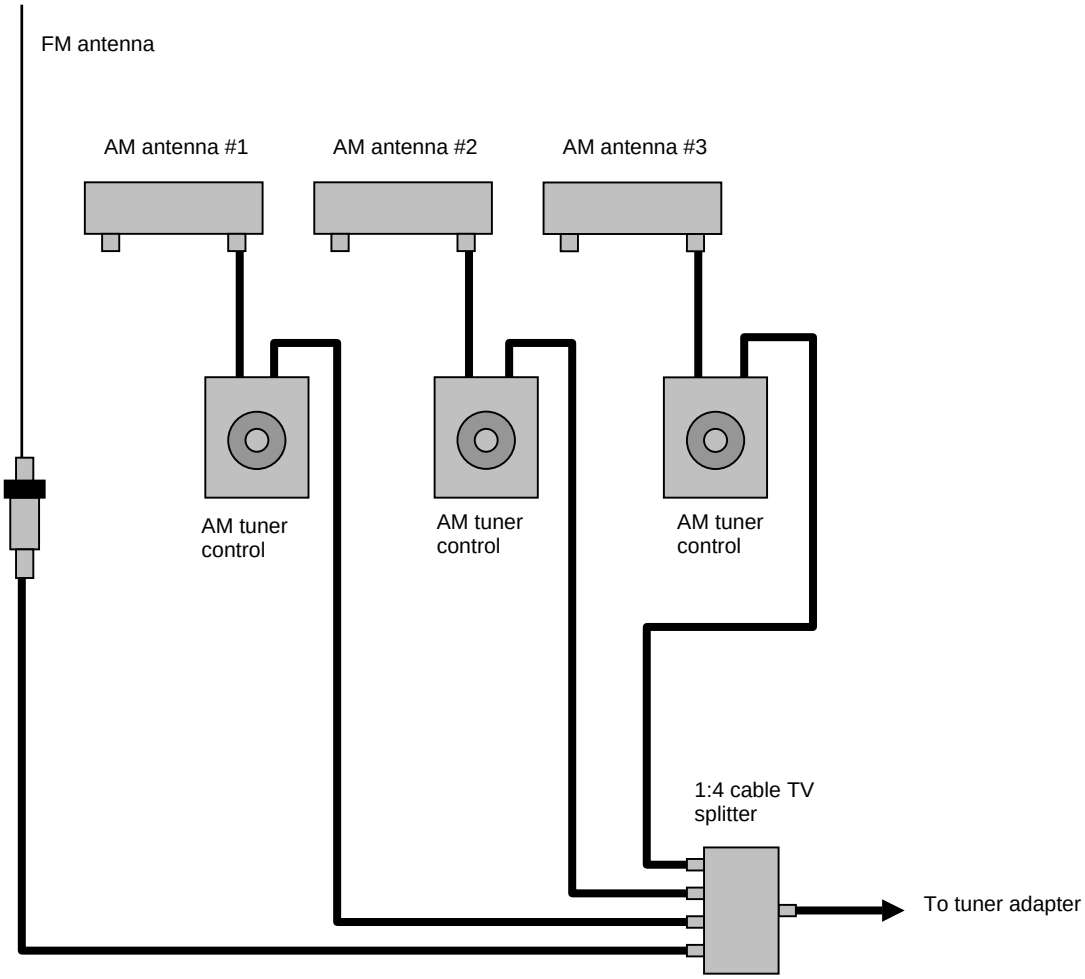


Figure 10. Four antennas, three AM and one FM, wired together.

12 ERRATA

This section lists know issues for specific hardware revisions.

Rev A0/Driver 3.12.xx

- analog FM RDS does not work
- Analog radio PTY is unconfirmed

13 REFERENCES

13.1 RDS

Wright, Scott, 1997, "The broadcaster's guide to RDS", ISBN 0-240-80278-0

13.2 PROGRAMMING APIs

AudioScience provides a number of APIs for interfacing to its audio adapters. This section briefly describes the interfaces and where to locate further documentation on them.

13.2.1 HPI

The HPI interface is an AudioScience specific interface that is support on all AudioScience products, including the ASI2416. It is the low level interface on which all AudioScience drivers across all operating system are built (including Linux).

Under Windows, HPI calls are surfaced to a client application via a DLL. All Windows drivers support the HPI calling interface.

An SDK and online documentation is available on the AudioScience website:

http://www.audioscience.com/internet/download/sdk/sdk.htm

13.2.2 ASX

The ASX interface is supported on all operating systems, including Linux. It is an AudioScience specific interface that supports file level record and playback. The client application does not have to provide and buffer management routines, or create threads to feed audio to /from the audio adapter.

ASIControl is built on top of the ASX interface. It provides interfaces to all features of AudioScience adapters.

An SDK and online documentation is available on the AudioScience website:

http://www.audioscience.com/internet/download/sdk/sdk.htm

13.2.3 Wave

The Wave interface is only implemented under Microsoft Windows. It uses standard Microsoft compatible waveOutXXX(), waveInXXX() and mixerXXXX() calls to play, record and mix audio. Where possible AudioScience's implementation is 100% compatible with other multimedia cards running under Windows.

See the references section below for a link to spcwavx.pdf that details multimedia extensions that AudioScience has implemented to provide access to advanced audio features.

AudioScience has implemented some extensions to the standard wave API to provide access to advanced audio features. Documentation on these APIs may be found here:

SPCWAVX.PDF - WavX - AudioScience Windows Multimedia Extensions

13.2.4 DirectSound

The WDM driver provides a native DirectSound interface to AudioScience sound cards. Use the standard DirectSound APIs provided by Microsoft.

13.2.5 ASIO

All AudioScience Windows drivers support the ASIO programming interface. The ASIO driver is installed by default, but is only activated by an ASIO client application.

13.2.6 ALSA

Under Linux, the ALSA sound programming API is supported. From version 1.0.7, snd-asihpi is part of the standard ALSA driver source. PCM and Mixer APIs are supported.

For more details, see the Linux download page on the AudioScience website:

http://www.audioscience.com/internet/download/linux_drivers.htm

13.3 References

HPI User Manual - Hardware Programming Interface (HPI) Reference Manual

SPCWAVX.PDF - WavX - AudioScience Windows Multimedia Extensions

These documents are available from www.audioscience.com in the Documentation section.

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