Understanding the DA795 Bit Stream "Status" Analyzer

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Analog audio problems were quickly remedied with a test tone generator and viewing the audio on an oscilloscope. Digital audio however is much different as problems can be mysterious and can't be diagnosed with old conventional methods.

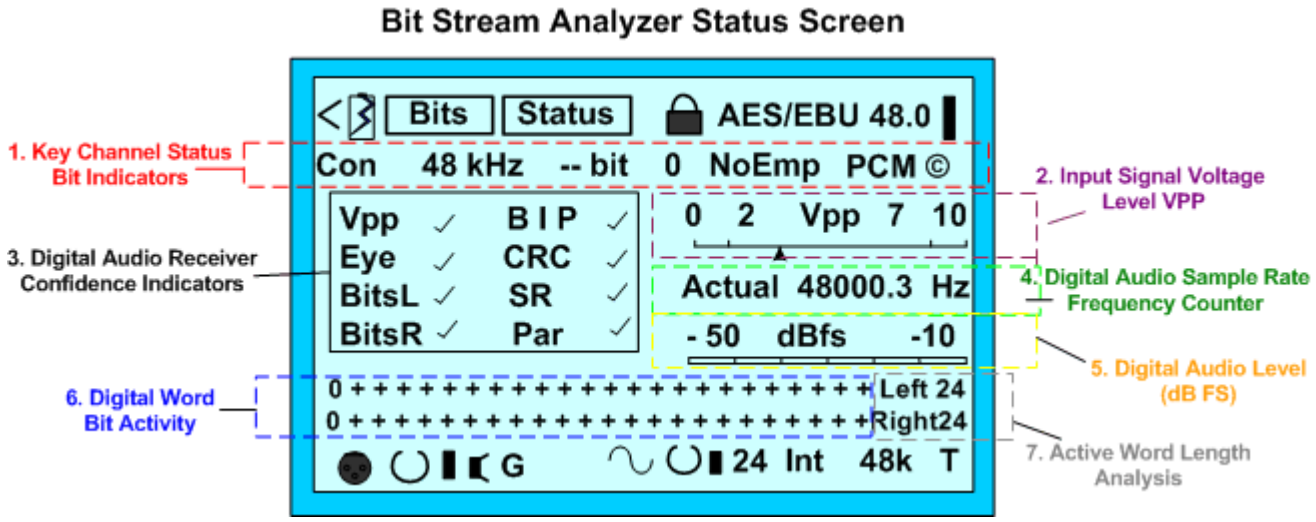
When the digital audio feed develops problems you can quickly remedy the cause using the DA795. The DA795 Bit Stream Analyzer function displays a complete analysis of a digital audio signal. This Technical Article explains how the DA795 Bit Stream Analyzer examines the status of a digital audio signal.

The DA795 Bit Stream "Status" Analyzer

To understand the "Status" screen of the DA795's Bit Stream Analyzer function, it can be divided into 7 sections as shown in the nearby figure. Each of the following sections is explained in the remainder of this article. The sections include:

1. Key Channel Status Bit Indicators
2. Input Signal Voltage Level VPP
3. Digital Audio Receiver Confidence Indicators
4. Digital Audio Sample Rate Frequency Counter
5. Digital Audio Level dB FS
6. Digital Word Bit Activity
7. Active Word Length Analysis

To analyze a digital audio signal with the DA795's Bit Stream Analyzer function, connect the digital audio signal to the INPUT 1 AES/EBU Balanced input or S/PDIF input. Select the input with the Input Select field in the top tool bar (2nd field from the top right corner of the DA795). A pad lock indicator in the top center of the DA795 indicates the presence of a digital audio signal in which the DA795's receiver can obtain a lock. Failure to achieve a lock indicates a missing or severely degraded digital audio input signal.



1. Key Channel Status Bit Indicators

The second line of the "Status" screen indicates key information carried by the digital audio signal in the channel status bits. The device that creates or processes the digital audio encodes information into the channel status bits. In some cases, discrepancies between this information and the actual digital audio result in receive, decode or processing problems. These problems can be quickly identified when channel status bit information shown in line 2 disagrees with actual information detected by the DA795's digital audio receiver.

Field 1: The key channel status bit information in the second line of the status screen differs depending on if the first channel status bit (frame 1) is a logic low or logic high. A logic low (0) indicates a consumer digital audio format which a logic high (1) indicates a professional digital audio format. The status of this important bit is shown in the first field on the left side of the display (Field 1) and abbreviated as "Con" or "Pro." The nearby figure summaries the key channel status information for a professional AES/EBU input.

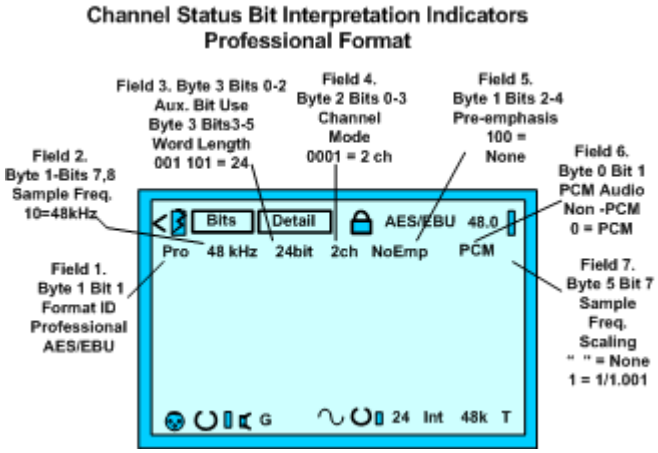
Field 2: The 2nd field (field 2) from the left indicates the audio sample rate as encoded into the channel status bits for either a professional or consumer format. A professional format carries the information in bits 7 & 8 of the channel status bits while a consumer format uses byte 3 bits 24 -27. (See the Sencore Tech Article on Understanding Channel Status Bits)

Field 3: The next field (field 3 – 3rd from left) indicates the number of bits used to carry the audio data as encoded into the channel status bits. This is commonly referred to as the audio word length. This

field provides the word length for both a professional and consumer format although different channel status bits are used.

Field 4: The 4th field from the left (field 4) carries different information depending on if the audio is a professional or consumer format. For a professional format, this field carries a channel mode indication. Examples include: " - - " (mode not indicated), "2 ch" (two channel), "1 ch" (one channel), "str" (stereo), "p/s" (primary/secondary), "x2R", "x2L" or "x2M". When a consumer format is identified, this field indicates a category code identifying the equipment type.

Field 5: The 5th field from the left indicates if any pre-emphasis was used on the digital audio. This field is the same for professional and consumer formats. Pre-emphasis information is used by the receiver to apply appropriate de-emphasis. Indicators include " - - " (emphasis not indicated), "Noemp" (no emphasis), "50/15" (CD type) and "CCITJ17".



Field 6: The 6th field from the left or 2nd field from the right indicates the validity of the digital audio as a linear PCM type "PCM" or non PCM type "NoP" for both a professional or consumer format. A non PCM indication likely means the digital audio signal has been compressed according to an algorithm such as AC-3 or MPEG.

Field 7: The 7th field from the left or 1st field on the right indicates differently for professional or consumer formats. In a professional format, it indicates if down scaling (Fs) has been applied or if the sample rate has been scaled by a ratio of 1/1.001. When scaling is applied a "+" is shown indicating scaling should be applied by the receiver. In a consumer format, this field indicates if the copy-write bit is asserted by showing a copyright symbol or "(©)".

Note: Additional information on the channel status bits can be found in the Sencore technical document "Understanding/Reading Digital Audio Channel Status Bits".

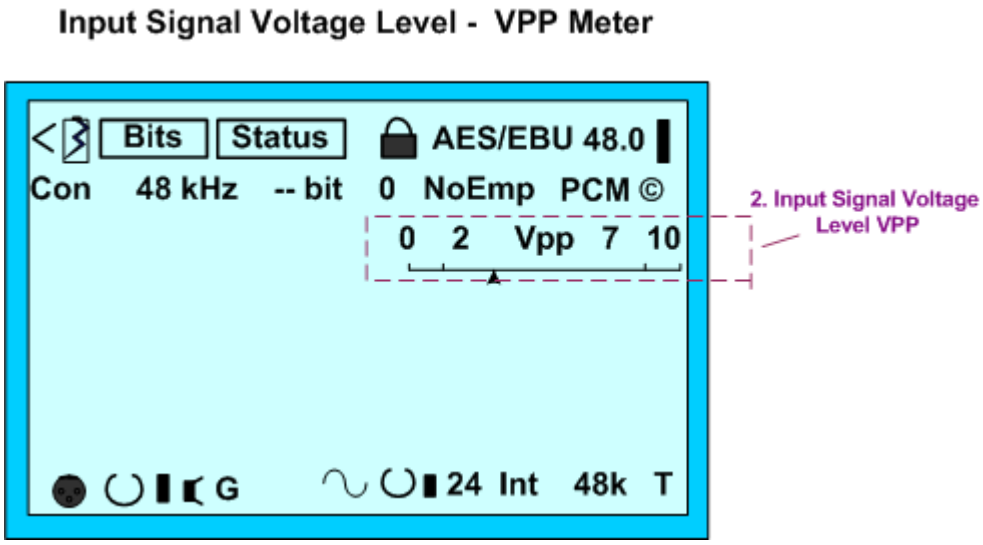
2. Input Signal Voltage Level VPP

The input digital signal voltage amplitude is measured by the Digital Bit Stream Analyzer and indicated by the VPP meter scale. The meter is independent of the DA795's digital audio receiver. When unable to lock to a digital audio input, check for normal peak-to-peak voltage by checking the VPP indicator.

The professional digital audio interface format via the balanced AES/EBU input ranges in level between 2V and 7V peak-to-peak. A marginal level of 2 VPP or lower suggests a transmitter circuit

defect, excessively long cable or cable defect which may cause loss or intermittent digital audio operation. Levels above 7 VPP suggest an impedance mismatch or improper transmitter output.

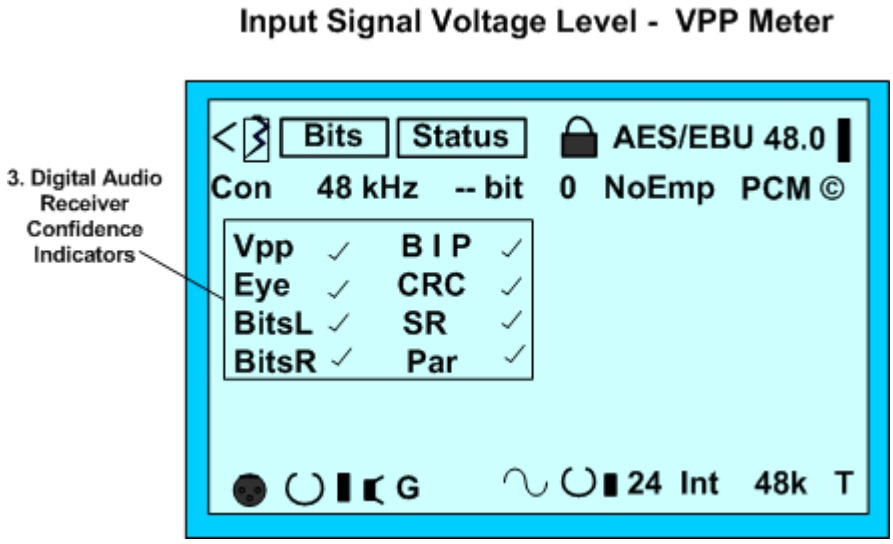
The S/PDIF or consumer interface format via the RCA phono connector has normal levels of .5 VPP. When the S/PDIF input is selected for the Bit Stream Analyzer, the scale is automatically changed from 0 to 1VPP. A normal range of input level is between .2 and .7VPP. This is 1/10 the level of the professional AES/EBU balanced input.



3. Digital Audio Receiver Confidence Indicators

The digital audio receiver of the DA795 includes analyzing functionality. Checks are performed to indicate proper or improper digital audio signal conditions. The indicators are termed "confidence indicators." The confidence indicator readouts are contained in a box to the left center of the status screen. Proper signal conditions are indicated with a check mark to the side of the abbreviated check function.

The confidence indicators of the Digital Bit Stream Analyzer include:
Vpp (Volts peak-to-peak check)
Eye (Eye Pattern check)
Bits L (Bits Left Channel Check)
BitsR (Bits Right Channel) Check)
BIP (Bi-phase Mark Coding Check)
CRC (Cyclic Redundancy Check)
SR (Sample Rate Check)
Par (Parity Check)



Here is a brief description of the Confidence Indicator checks.

Vpp (Volts peak-to-peak): This check indicates if sufficient input line signal voltage is being input to the DA795. This confidence indicator works with the VPP meter described earlier. Levels measured below the normal range place an X beside the VPP confidence indicator.

Eye (Eye Pattern Analysis): This check looks for a minimum eye pattern performance of the input digital audio signal. Eye pattern reflects the slowing of logic transitions between logic states in combination with decreasing amplitudes. Eye patterns commonly deteriorate with poor cable quality (high capacitance) or excessive cable length. If minimum requirements for eye pattern performance are not met, an X is placed beside the Eye confidence indicator.

Bits L (Bits Left Channel): This check confirms bit activity in the digital audio word bits in the left channel sub-frame. An X indicates there is no activity or that the number of digital bits used in the digital audio word does not agree with the word length specified by the channel status bit information for the left channel.

Bits R (Bits Right Channel): This check confirms bit activity in the digital audio word bits in the right channel sub-frame. An X indicates there is no activity or that the number of digital bits used in the digital audio word does not agree with the word length specified by the channel status bit information for the right channel.

BIP (Bi-phase mark coding check): This check analyzes the final bits of each sub-frame, excluding sync bits, for proper bi-phase mark coding. Improper coding indicates errors or coding faults exist and are indicated by an X in the confidence indicator.

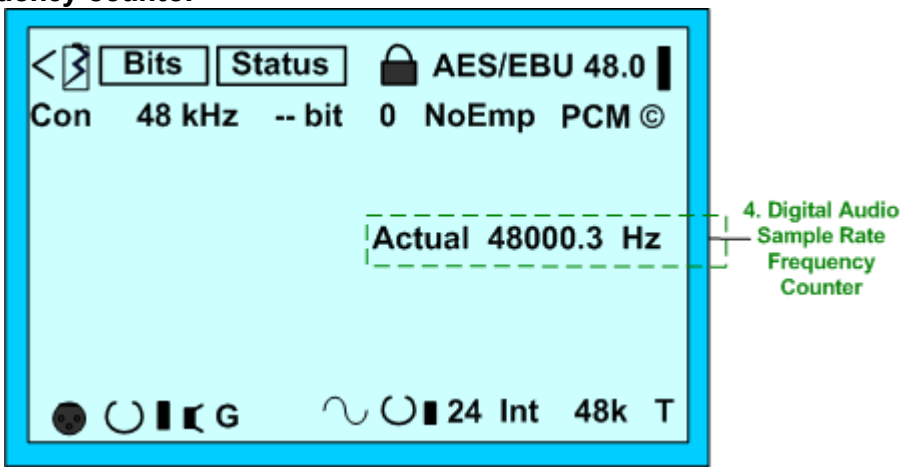
CRC (Cyclic Redundancy Check): This check confirms the validity of the channel status bits by doing a redundancy analysis and comparing results to the CRC values in the channel status bits. An X indicates a problem.

SR (Sample Rate Check): This check compares the digital audio sample rate frequency measured by the DA795 with the sample rate frequency indicated by the channel status bits of the incoming digital audio signal. A check mark indicates the audio sample rate or frequency is within proper limits. An X indicates the sample rate of the incoming digital audio does not agree with the channel status bit's indicated sample rate frequency or an excessive frequency error exists. *Note: The DA795 frequency measurement takes a few seconds as observed in the frequency counter section of the Bit Steam Analyzer function, so there is always a delay before a check mark is displayed.*

Par (Parity Check): This check confirms the proper parity of the digital audio sub-frames. The last 28 bits of every sub-frame should contain an even parity. This confidence indicator shows when the parity is not correct by showing an X in the confidence bar.

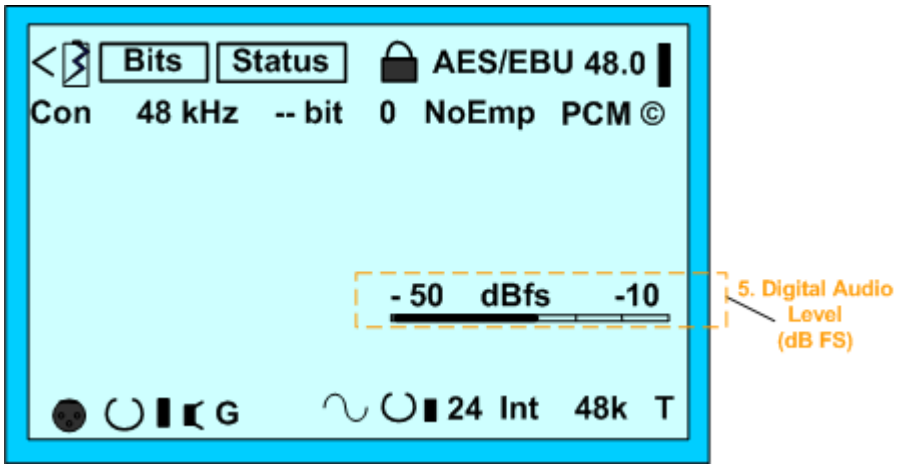
4. Digital Audio Sample Rate Frequency Counter

A digital sample rate measurement is part of the Digital Bit Stream Analyzer. The sample rate frequency counter determines the precise running sampling frequency of the incoming digital audio frames.



5. Digital Audio Level dB FS

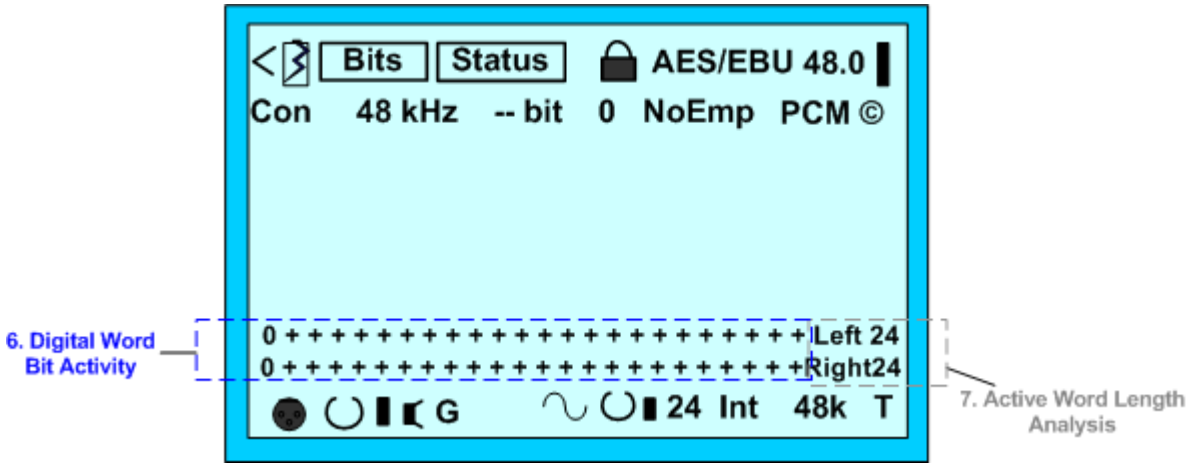
This field indicates the audio level of the digital input signal. This level is contained in the value of the audio digital word. 0 dB FS is the highest audio level (digital number) that the employed word length is capable of representing.



6. Digital Word Bit Activity

The Digital Word Bit Activity field visually shows or indicates if the bits in the digital audio word are changing values or are stuck at logic 0 or 1. Twenty four positions are shown representing each possible audio bit in the audio data word for both the left and right audio channels. The 24 positions are arranged from left MSB to the right LSB. Bits that are changing logic states are illustrated by a bit changes of "+" to "-". Non-changing or stuck bits are shown as their actual value 0 or 1.

It is normal for some of the MSB bits to not show activity depending on the audio data word length and the audio loudness. Keep in mind that the audio level when digitally sampled to binary determines if a bit changes logic states. An audio level must peak to 0 dB FS to get the MSB bit to change logic states. Also, audio word lengths of 20 or 16 bits do not use all of the indicated bit positions. Word Lengths of less than 24, cause bits to be inactive at the right side of the available 24 bit segments. For example a 16 bit word length, causes 8 bits at the right side to be inactive or read 0.



7. Active Word Length Analysis

The Active Word Length field indicates the word length of the incoming digital audio for both the right and left audio channels. The word length is determined by the DA795 receiver and indicates correctly no matter if the bits are active or not.

Summary

The DA795's Bit Stream Analyzer function displays a complete analysis of a digital audio signal, so in just seconds, you can determine the status of an incoming digital audio signal on either a balance XLR input, coaxial, or optical interface. Call 1-800-Sencore or visit http://www.sencore.com for more information or a free trial evaluation.