Digital Audio Processor

PCM-1610
New Digital Audio Processor
Unexcelled in Every Aspect of Performance, Flexibility, and Reliability.

The Spotlight Is On Performance

The genuine advantage of the PCM-1610 digital audio processor is its enormous potential to deliver drastically improved sound. Whereas analog recorders are saddled with performance limitations of one form or another, unlimited quality improvement is possible using digital technology.

With the PCM-1610, equal amplitude digital pulses are used to represent all audio signal waveforms. This means that every pulse can be recorded at a level well above the residual noise level and well below the saturation level. Thus the system's dynamic range is no longer limited by the parameters of magnetic tape and heads. The PCM-1610 has a remarkably wide 90dB of dynamic range, which is about 30dB better than that of the best analog tape recorders. And the only technology required to achieve this was to incorporate A/D and D/A converters with a 16-bit quantizing capability.

The frequency response is flat within +0.5dB and -1dB from 20Hz out to 20,000Hz. Harmonic distortion is never worse than 0.05%. Wow and flutter are too minute to be measured. This is because, in the PCM-1610, millions of pulses corresponding to the audio signal are first stored in the short-term memory and then released in perfect, uniform sequence determined by a reference clock. Modulation noise is totally absent for the same reason, and this gives a fascinating inner purity to the sound.

Obviously, the PCM-1610 is completely free of any performance limitations, and thus can provide a distinctly audible improvement. Even those, who are accustomed to the best possible analog studio equipment will be astonished to discover how much clarity they have been missing up till now.

The Perfect Studio Master

The PCM-1610 can instantly replace the existing 2-channel analog mastering equipment, giving you substantially better sound as well as increased operational convenience.

First, the PCM-1610 can operate in perfect synchronization with professional videocassette recorders. Sony also offers U-matic digital audio recorders, such as the BVU-800DA and VO-5850DA/5850PDA, designed exclusively for use with digital audio processors for improved operational convenience.

Second, the PCM-1610 lets you record separate takes and edit them at will. Sony has an advanced editor, the DAE-1100, developed to serve the specialized needs of digital audio. With this unit, editing can be performed much more easily and accurately than with any conventional analog system. Electronic editing, as opposed to tape-splice editing, also allows the original recording to be used again and again.

Third, direct digital-to-digital dubbing is possible. In professional recording, it is a common practice to make several dubbings from the original master recording. With an analog system, each dubbing is itself a poorer version of the original, with noise increasing each time a copy is made. With the PCM-1610 and the BVU-800DA or VO-5850DA combination, however, any number of dubbings can be made with absolutely no deterioration of the signal quality. Each copy, regardless of the generation, sounds as if it is a master itself. In addition, digital recording also eliminates problems such as print-through. Digital recording, after all, can maintain the original high quality even after going through various studio operations of mixing down, adding reverberation, repeat dubbing, and so on.

Why Sony Is Your Choice

One aspect of digital audio which seems to make everyone nervous is the problem of dropouts. Tape dropouts can, of course, pose a serious problem in a digital system. In an analog system, a short dropout is often undetectable, since our ears tend to fill in the gaps if they are sufficiently short. In a digital system, however, dropouts mean an absence of pulses, which the system would interpret not as missing music but as a different bit-code altogether. Accordingly, an effective error correction scheme becomes essential.

Sony, as the leader in digital audio technology, has eliminated this problem. When a word consists of 16 bits, as with the PCM-1610, a professional video tape has approximately 50% redundancy for error correction codes. Using this redundancy, "Cross Word Codes", which is original with Sony, are built in to the basic bit stream of the PCM-1610. These codes not only can detect the data code errors but can also actually correct them. In addition, they can cope with extremely extensive burst errors.

By virtue of interleaving, the Cross Word Codes can perfectly correct burst errors as large as 2,240 bits (11.7 horizontal lines) in one interleaved block of 6,720 bits (35 horizontal lines). Errors greater than this but less than 4,480 bits (23.3 horizontal lines) can be compensated for by means of linear interpolation. Probability of errors exceeding this limit is all but nil in practical applications, unless a tape of inferior quality is used. This means that the PCM-1610 is fully capable of offering failsafe reproduction. The effects of code errors by dropouts will never be audible under any conditions.
Main Features

The PCM-1610 has enormous potential benefits in every aspect of quality, operation, and system flexibility. Consider how perfectly and comprehensively it can serve your professional needs.

Instant VTR Interfacing
For the convenience of professional users, the PCM-1610 features the same input/output specifications and connectors as those of professional videocassette recorders. For the interconnections between these units, BNC connectors are used. For analog connections, the PCM-1610 naturally is fitted with balanced type XLR connectors.

Synchronized Operation
The PCM-1610 can be locked to an external sync, such as the NTSC composite sync signal from a video signal source or the sampling clock from another digital audio processor. This means that it can be operated in perfect synchronization with video equipment and other digital audio units, giving you the flexibility you need to set up any studio recording arrangement.

Wide Interchangeability
The PCM-1610 features two built-in sampling frequencies and a serial format for digital input and output, making it perfectly interchangeable with the PCM-100, another of Sony’s professional digital audio processors. The PCM-1610 is also capable of reproducing the tape programs recorded with the PCM-1600.

Digital-to-Digital Dubbing
Using the PCM-1610 and a pair of BVU-800DA or VO-5850DA digital audio recorders, direct digital-to-digital dubbing can be performed with no degradation in signal quality. Even after repeated dubbing, the high quality of the original recording remains true.

Digital Editing
Adding the DAE-1100 digital audio editor to a combination of the PCM-1610 and a pair of digital audio recorders makes a fully electronic digital editing system. The edit accuracy of this system is an amazing 363 microseconds, which is equivalent to 16 words with the PCM-1610. The ordinary video editing console, the BVE-800, can also be used in place of the DAE-1100 if the requirements are not so demanding.

Extraordinary Specifications
Because of its operating principle, the PCM-1610 can offer a host of impressive specification figures. Outstanding among them are a dynamic range that is greater than 90dB, undetectable wow and flutter, unusual frequency response flatness from 20Hz to 20,000Hz, and vanishingly low distortion over this entire audio frequency spectrum.

16-bit Linear Quantization
To realize true high fidelity recording and reproduction, the PCM-1610 employs A/D and D/A converters with 16-bit quantizing capability for each channel. The PCM-1610 also uses a high-performance low-pass filter which steeply cuts the audio frequencies at just below half the sampling frequency to eliminate aliasing noise.
Although the chances of dropouts are minimal when combined with Sony's advanced digital audio recorder and high quality videocassette tape, the PCM-1610 employs the Cross Word Codes to prevent code errors from affecting the reproduced sound quality.

**Built-in SMPTE Time Code Generator**

The PCM-1610 incorporates an SMPTE time code generator. With this new function, it is now possible to address the program contents precisely on the tape. Besides the time code track of the videocassette tape, this code can be recorded on either of the audio tracks. For this reason, the PCM-1610 has two different connectors, BNC and Cannon XLR, for feeding out the SMPTE time code.

**Additional Emphasis Switch**

The PCM-1610 is equipped with a manual emphasis switch to put pre-emphasis on recording. The basic curve incorporates a 50μs boost, that is, an approximate 10dB lift at around 20kHz in recording.

A code that indicates whether a signal has pre-emphasis or alternatively is digitalized as flat is imprinted in the data codes so that it can be extracted in playback and can automatically activate the de-emphasis switching circuitry when appropriate. Emphasis/de-emphasis has the effect of further improving the signal-to-noise ratio in high frequencies.

**Superb Analog Circuit**

The analog circuit of the PCM-1610 consists of high quality components and devices including specially selected IC operational amplifiers and line transformers. The PCM-1610 also has an internal switch which can make the signal bypass the input and output transformers for improved sound quality.

**Muting Facility**

The "REC MUTE" switch can be effectively used to provide appropriate no-signal intervals between programs. On the PCM-1610, there is another muting switch with "NORMAL" and "HOLD" indications. This can be used in playback to mute dropout errors beyond the correction capability of the PCM-1610. With this switch set to the "HOLD" position, the associated LED lamp will stay lit once such an error has occurred. This is especially convenient because it informs you of the existence of dropouts, even if they occurred while you were not present. In addition, any of nine muting durations can be preset with a switch on the printed circuit board.

**LED Peak Level Meters**

The PCM-1610 incorporates one of the finest meters for high visibility and accuracy. The scale being vertical and employing as many as 24 LED segments per channel, the levels can be noted with amazing accuracy. For each channel, just below the normal level calibrations, there is also an extra expanded scale designed to facilitate 0dB setting. This scale consists of five segments in 0.2dB steps with the 0dB mark in the center.

**PCM-1610 Block Diagram**

The PCM-1610 is basically designed as a signal processor that converts analog signals into digital, then into pseudo-video signals including vertical and horizontal syncs. In brief, this is how it operates to provide unmatched performance. In recording, the analog signal first goes into the audio amplifier where 50μs pre-emphasis is given. Next, unnecessary high frequencies above half the sampling frequency are cut off by an anti-aliasing filter. Frequencies passing through this filter are sampled and then quantized in the A/D converter, resulting in digital codes with 16 bits per word. In the next encoder circuit, error check bits are added and then the whole series of codes is compressed on the time axis. Then, after going through the memory circuit, the sync signals are added in order to be recorded on the recorder. For reproduction, exactly the same operations are performed in reverse. The playback signal from the recorder is passed through the video amplifier and the following sync separator circuit so that the sync signals can be separated. Jitters are absorbed in the memory circuit. In the digital decoder circuit, the codes are de-interleaved and expanded. Dropout error correction and compensation are all carried out. Then, the signals go through the D/A converter, the low-pass filter, and are finally de-emphasized, restoring the original analog waveforms.
Digital audio has come a long way in a very short time, with Sony leading the way. And now, Sony presents the PCM-1610, a highly developed, practical digital audio processor for the broadcast and professional recording industries. When combined with a professional videocassette recorder, the PCM-1610 is capable of recording and reproducing sound with quality that is nothing short of extraordinary. Backed up by Sony's years of research and meticulous engineering, it offers a wide variety of functions and utmost reliability. In fact, the PCM-1610 represents the state of the advancement of the top digital audio manufacturer in the world. It is the real key that will open your studio to the incredible advantages of digital audio technology.
## Specifications

- **Number of channels:** Two channels
- **Modulation system:** PCM system using NTSC standard TV signals
- **Sampling frequencies:** 44.056kHz or 44.1kHz
- **Recording density:** 3.5795Mbits/second (44.056kHz)
- **Timing code:** 3.5831Mbits/second (44.1kHz)
- **Code configuration:** 6 words in 1 TVH
- **Quantization:** 16-bit linear quantization
- **Harmonic distortion:** Less than 0.05%
- **Wow and flutter:** Beneath measurable limits
- **Frequency response:** 20—20,000Hz +0.5,—1.0dB
- **Inputs:**
  - ANALOG (Cannon XLR-3-31) 2
  - Reference input level +4dB (0dB = 0.775V)
  - Max. input level +24dB (0dB = 0.775V)
  - 25k ohms, balanced, or 4.7k ohms, unbalanced
  - VIDEO (BNC-R) 1
  - 75 ohms, unbalanced, 0.714Vp-p (Data level 60 IRE)
  - COMPOSITE SYNC (BNC-R) 1
  - TTL level, 32-slot serial format
  - WORDSYNC (BNC-R) 1

- **Outputs:**
  - ANALOG (Cannon XLR-3-32) 2
  - Reference output level +4dB (0dB = 0.775V)
  - Max. output level +24dB (0dB = 0.775V)
  - Balanced, or unbalanced, 600-ohm load permissible
  - VIDEO (BNC-R) 1
  - 75 ohms, unbalanced, 0.714Vp-p (Data level 60 IRE)

- **TIME CODE**
  - Balanced (XLR-3-33), or unbalanced (BNC-R), 600-ohm load permissible
  - 2.2Vp-p, SMPTE time code
  - Composite sync (negative), 4Vp-p, 75 ohms, unbalanced
  - TTL level, 32-slot serial format
  - WORDSYNC (BNC-R) 1

- **Power consumption:** Approx. 125W
- **Dimensions:** 430 (W) x 280 (H) x 510 (D) mm (16.92 x 11.02 x 20.07”)
- **Weight:** Approx. 38 kg (83 lb 12 oz)
- **Supplied accessories:**
  - Connecting cable with BNC connectors (2 pcs)
  - Connecting cable with BNC and phono connectors (1 pc)
  - Rack mounting adaptor (1 set)
  - Extension board (1 pc)
  - AC power cord (1 pc)

- **Usable recorders:**
  - BVU-800DA, VO-5850DA/5850PDA U-matic digital audio recorders
  - BVU-100/110, BVU-200A/200B U-matic videocassette recorders
  - BVH-500A/500A, BVH-1000/1100/1100A 1” video tape recorders

- **Recommended editing systems:**
  - Regular system: BVU-800DA (x2) + BVE-800
  - Advanced system: BVU-800DA (x2) + DAE-1100

Design and specifications subject to change without notice.

## Related Equipment

- **DAE-1100**
  - Digital Audio Editor
- **BVU-800DA**
  - U-matic Digital Audio Recorder
- **VO-5850DA/VO-5850PDA**
  - U-matic Digital Audio Recorder
- **BVG-1500**
  - SMPTE Time Code Reader
- **KCA-60/KCA-30**
  - U-matic Videocassette Tapes (60 min./30 min.)
- **BVG-1600**
  - SMPTE Time Code Generator

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