SONY.

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 distinctively 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 TV 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.
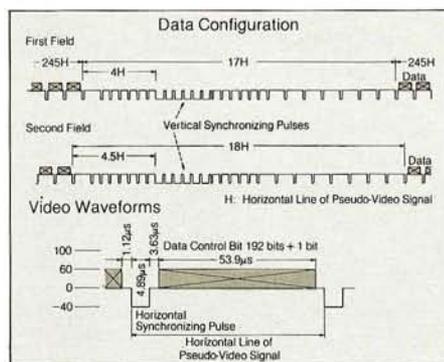
Main Features

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.
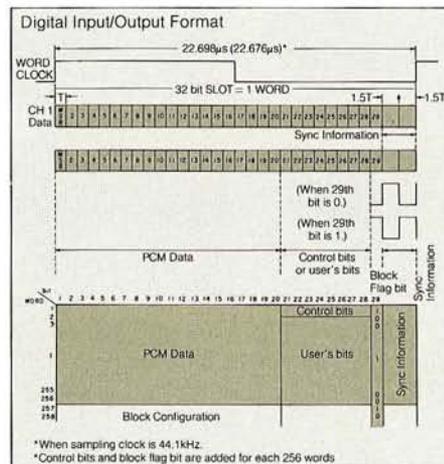
○○○● Instant VTR Interfacing

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

Data Configuration

First Field

Second Field

Vertical Synchronizing Pulses

H: Horizontal Line of Pseudo-Video Signal

Video Waveforms

Data Control Bit 192 bits + 1 bit
53.9μs

Horizontal Synchronizing Pulse

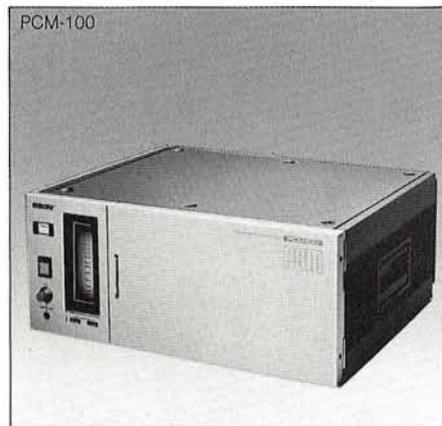Horizontal Line of Pseudo-Video Signal

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.

Digital Input/Output Format

22.698μs (22.676μs)*

WORD CLOCK

32 bit SLOT = 1 WORD

CH 1 Data

Sync Information

(When 29th bit is 0.)

(When 29th bit is 1.)

PCM Data

Control bits or user's bits

Block Flag bit

Control bits

PCM Data

User's bits

Sync Information

Block Configuration

*When sampling clock is 44.1kHz.
*Control bits and block flag bit are added for each 256 words
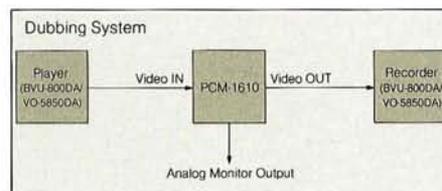
○○○● Wide Interchangeability

The PCM-1610 features two built-in sampling frequencies and a serial format for digital input and output, making it perfectly interchangeable with

PCM-100

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.
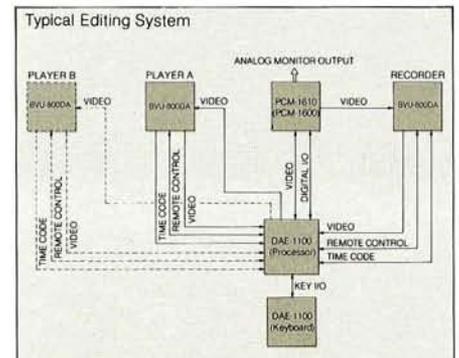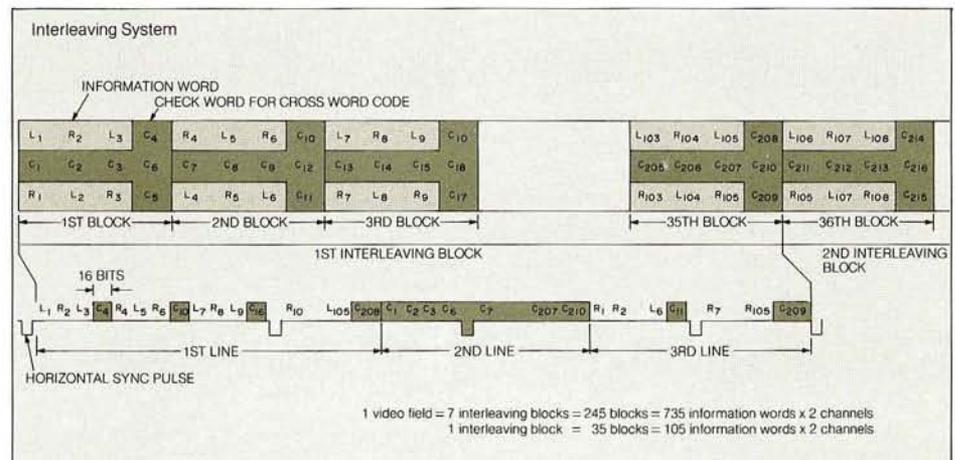
○●○○ Digital-to-Digital Dubbing

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.

Dubbing System

| Player (BVU-800DA/ VO-5850DA) | → Video IN | PCM-1610 | Video OUT → | Recorder (BVU-800DA/ VO-5850DA) |

Analog Monitor Output

○○○● 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.

Typical Editing System

DAE-1100

○○○● 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.

Interleaving System

INFORMATION WORD
CHECK WORD FOR CROSS WORD CODE

L_1	R_2	L_3	C_4	R_4	L_5	R_6	C_{10}	L_7	R_8	L_9	C_{10}	L_{103}	R_{104}	L_{105}	C_{208}	L_{106}	R_{107}	L_{108}	C_{214}
C_1	C_2	C_3	C_6	C_7	C_8	C_9	C_{12}	C_{13}	C_{14}	C_{15}	C_{18}	C_{205}	C_{206}	C_{207}	C_{210}	C_{211}	C_{212}	C_{213}	C_{216}
R_1	L_2	R_3	C_5	L_4	R_5	L_6	C_{11}	R_7	L_8	R_9	C_{17}	R_{103}	L_{104}	R_{105}	C_{209}	R_{105}	L_{107}	R_{108}	C_{215}

1ST BLOCK | 2ND BLOCK | 3RD BLOCK | 35TH BLOCK | 36TH BLOCK

1ST INTERLEAVING BLOCK | 2ND INTERLEAVING BLOCK

16 BITS

| L_1 | R_2 | L_3 | C_4 | R_4 | L_5 | R_6 | C_{10} | L_7 | R_8 | L_9 | C_{10} | R_{10} | L_{105} | C_{208} | C_1 | C_2 | C_3 | C_6 | C_7 | C_{207} | C_{210} | R_1 | R_2 | L_6 | C_{11} | R_7 | R_{105} | C_{209} |

1ST LINE | 2ND LINE | 3RD LINE

HORIZONTAL SYNC PULSE

1 video field = 7 interleaving blocks = 245 blocks = 735 information words x 2 channels
1 interleaving block = 35 blocks = 105 information words x 2 channels
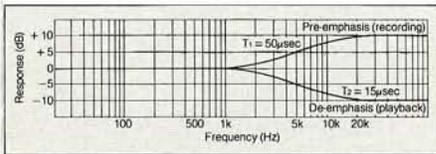
●○○○ Effective Error Correction

Though 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

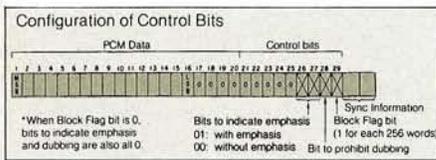## ●●○○ Built-in SMPTE Time Code Generator

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 track. 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.
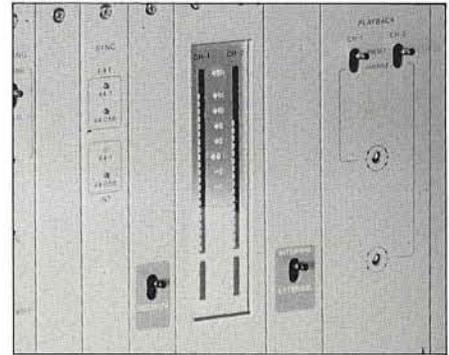
●●○○ Muting Facility

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

●●●○ 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, interleaving is done, and the whole series of codes is compressed on
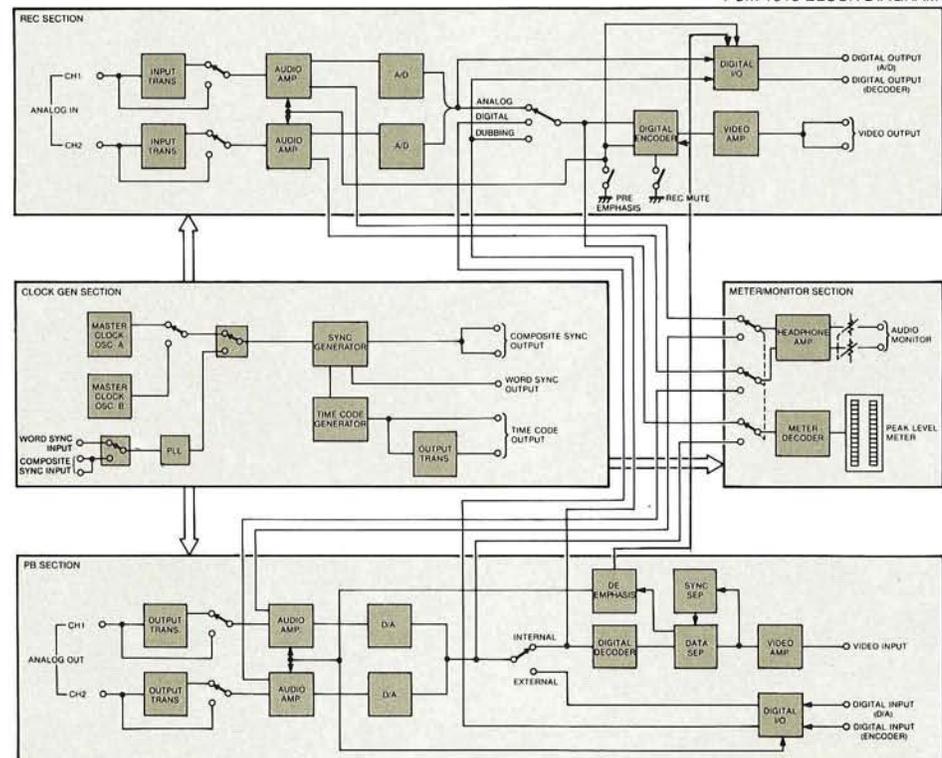
below the normal level calibrations, there is also an extra expanded scale designed to facilitate 0dB setting. This scale consists of five segments in 0.2dB steps with the 0dB mark in the center.

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 decorder circuit, the codes are de-interleaved and expanded. Dropout error correction and compensation are also 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.

PCM-1610 BLOCK DIAGRAM

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)
3.5831Mbits/second (44.1kHz)
Code configuration: 6 words in 1 TVH
Quantization: 16-bit linear quantization
Dynamic range: More than 90dB
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
    Composite sync (negative), 4Vp-p, 75 ohms, unbalanced
DIGITAL (BNC-R)......................................4
    TTL level, 32-slot serial format
WORD SYNC (BNC-R).................................1
    TTL level
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)...2
    75 ohms, unbalanced, 0.714Vp-p (Data level 60 IRE)

TIME CODE...2
    Balanced (XLR-3-32), or unbalanced (BNC-R),
    600-ohm load permissible
    2.2Vp-p, SMPTE time code
COMPOSITE SYNC (BNC-R)..........................2
    Composite sync (negative), 4Vp-p, 75 ohms, unbalanced
DIGITAL (BNC-R)......................................4
    TTL level, 32-slot serial format
WORD SYNC (BNC-R).................................1
    TTL level
HEADPHONES (Stereophone)............................1
    8-ohm load permissible
Power consumption: Approx. 125W
Dimensions: 430 (W) × 280 (H) × 510 (D) mm (16.92 × 11.02 × 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-200/200A/200B U-matic videocassette recorders
BVH-500/500A, BVH-1000/1100/1100A 1" video tape recorders
Redommended editing systems:
    Regular system: BVU-800DA (×2) + BVE-800
    Advanced system: BVU-800DA (×2) + 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

BVG-1500
SMPTE Time Code Reader

BVG-1600
SMPTE Time Code Generator

KCA-60/KCA-30
U-matic Videocassette Tapes
(60 min./30 min.)

Sony Corporation