COMPACT disc DIGITAL AUDIO

SONY®

North American Philips Corporation

THE RECORD OF TOMORROW — a 4.7-inch disc that delivers one hour of music with concert-hall fidelity in the Compact Disc Digital Audio System of Sony (left) and North American Philips (right). Market introduction will begin in the fall of 1982.

COMPACT disc DIGITAL AUDIO

North American Philips Corporation

SONY

Contact: **Albert Ruttner** (212) 697-3600 **William E. Baker** (212) 371-5800

The Phonograph Record of the Future...This is the Compact Digital Audio Disc, jointly developed by Sony Corporation and N.V. Philips of Holland. The digital disc contains up to one hour of music on a single side compared to the conventional L.P. capacity of 30 minutes per side. The sound is reproduced exactly as recorded by means of a miniature, low-power solid-state laser. Market introduction is scheduled for Autumn 1982.

COMPACT disc DIGITAL AUDIO

North American Philips Corporation

SONY

Contact:

Albert Ruttner
(212) 697-3600

William E. Baker
(212) 371-5800

This is the Compact Digital Audio Disc, the phonograph record of the future. Impervious to dust, dirt and wear, the Compact Disc contains up to one hour of music on one side of the 4.7 in. diameter disc. Sound of incredible fidelity is reproduced by means of a low-power, solid state laser. The Compact Disc Digital Audio system was jointly developed by Sony Corp. and N.V. Philips of Holland. Market introduction is scheduled for Autumn 1982.

COMPACT disc DIGITAL AUDIO

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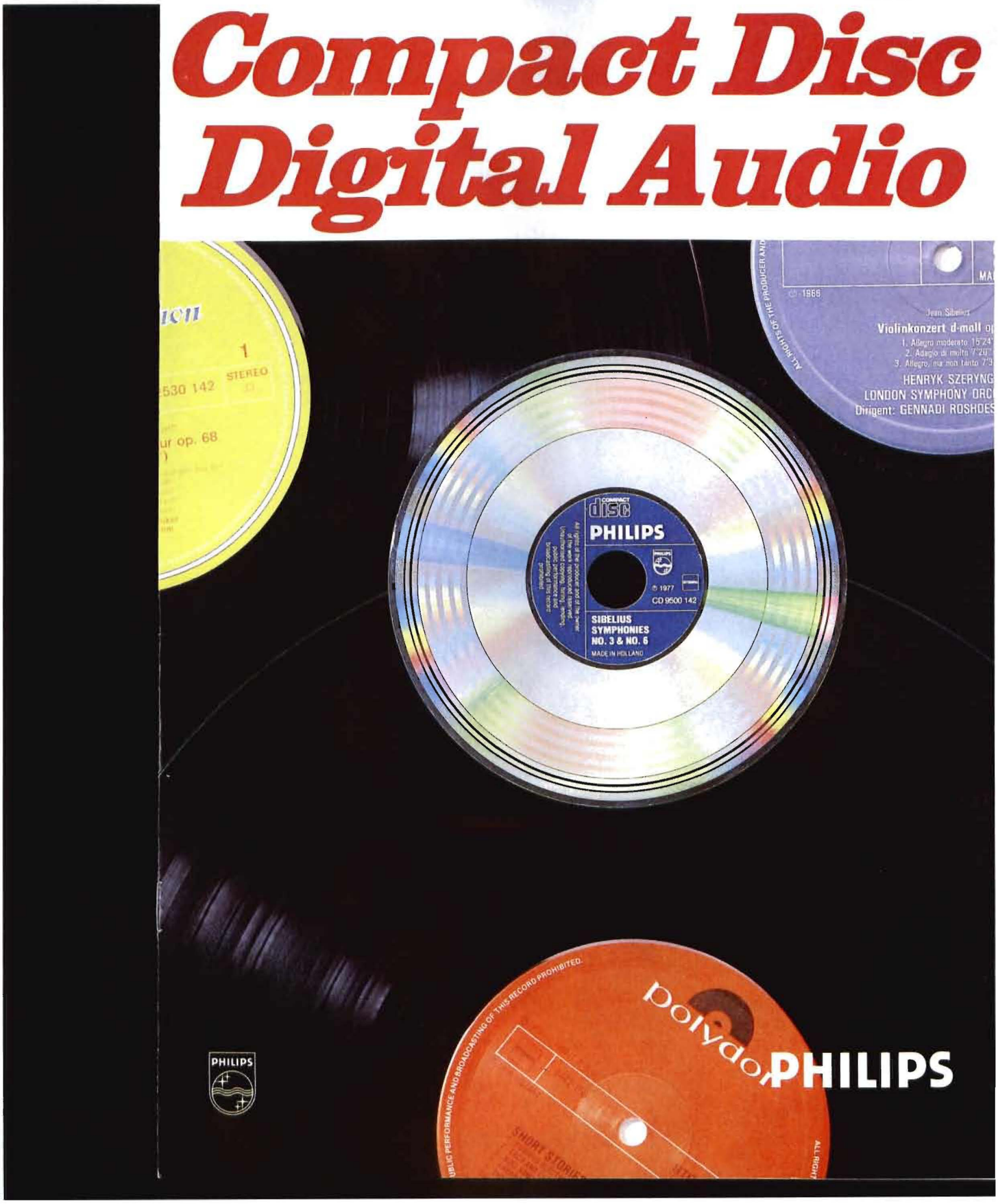
Compact Disc Digital Audio



PHILIPS

PHILIPS

LP and CD – actual size.
Playing time for single sided CD is equal to both sides of LP.

Compact Disc
The new world standard for Digital Audio disc

Compact Disc Digital Audio – CD for short – is a totally new concept in sound reproduction from the Philips High Fidelity laboratories. With its digital recording system and laser-beam optical pick-up, CD represents the biggest single step forward ever taken in sound reproduction from disc – bigger even than the advance from the old '78' to the microgroove LP of today.

Consider these performance figures. Dynamic range, signal-to-noise ratio and channel separation all approaching infinity at over 90 dB. Frequency response completely flat from 20 Hz to 20,000 Hz. Harmonic distortion less than 0.05%. No rumble. No wow or flutter. No microphony.

The single sided Compact Disc is only 120 mm in diameter and 1.2 mm thick, yet it will give the same playing time as both sides of a conventional LP. And the digital recording is sealed inside the disc, safe from dust, scratches and fingermarks.

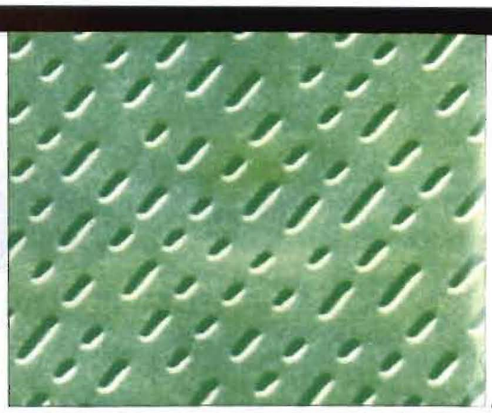
With such a small disc, the player can be small, too. The chassis is about the size of a compact cassette recorder mechanism. With laser beam scanning, there is no wear on either disc or pick-up. The player can be programmed to play tracks in any sequence, and even to display titles and supporting information for tracks as they are played.

These powerful advantages make Compact Disc Digital Audio the system of the future – a fact already recognised by the Sony Corporation and Matsushita Electric Industrial Co Ltd of Japan – both of which have adopted CD. Several companies in Europe have also joined the CD system and others will follow.

) is equal to both sides of LP.

COMPACT
disc
DIGITAL AUDIO

10 Solid reasons why Compact Disc will be the new world standard for Digital Audio discs



Better Sound Reproduction
The CD digital audio system, with its 16-bit word configuration, can translate sound information far more accurately, and over a wider range, than any existing disc reproduction system. With digital recordings, made expressly for CD, the system exhibits its total superiority. But any existing analogue recording can be converted to CD digital format, with considerably improved reproduction quality.

60-Minutes UNINTERRUPTED Stereo Playing Time
A 120 mm diameter disc will give up to 60 minutes of stereo playing time without interruption (equal to an LP).

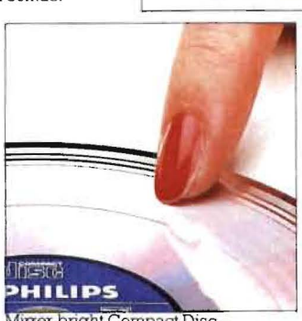
Two-way Protection Against the Effects of Scratches and Dirt
With CD, the recorded information does not lie naked and exposed on the surface of the disc. It is encapsulated in a transparent protective coating, but still fully accessible to the laser beam which is focussed upon it. Dirt, dust and scratches can only appear on the surface, where they are out of focal range, and have no influence on sound quality. In addition, the digital reproduction circuitry has its own built-in error detection and correction system to take out dropouts or bursts if they should appear. This means that no particular care is needed in Compact Disc handling or storage. It is not even necessary to keep the discs in sleeves, and they can be cleaned by simply wiping with a damp cloth!

CD visual display unit.

Prototype CD Player

No Wear on Disc or Pick-up
With a laser beam 'stylus', there is no mechanical contact between pick-up and disc. The ultra-sharp beam can never be blunted, and it causes no more wear on the disc than you are causing by reading this sheet of paper. Even continuous use produces no deterioration in performance.

Mini-sized Player, Pocket-sized Disc
The small dimensions of the CD player (the chassis is much the same size as a compact cassette mechanism) make it fully compatible with mini HiFi and car audio components, as well as the highest specification rack systems. It can also be integrated into combination equipment, pointing towards the mini HiFi music centre. The discs themselves slip conveniently into pocket or handbag, and a complete library occupies only one-sixth of the space required for the equivalent number of LPs. Durability and compactness make Compact Discs easy to send by post – a big stimulus to mail order and gift business. For the trade, there will be new opportunities in packaging and display (with reductions in cost). Self-service units can offer very wide choice in a small space, yet still with completely adequate safeguards against shoplifting.



Mirror-bright Compact Disc – impervious to scratches...

... and fingermarks (pocket-sized, too)

Laser-beam 'stylus'

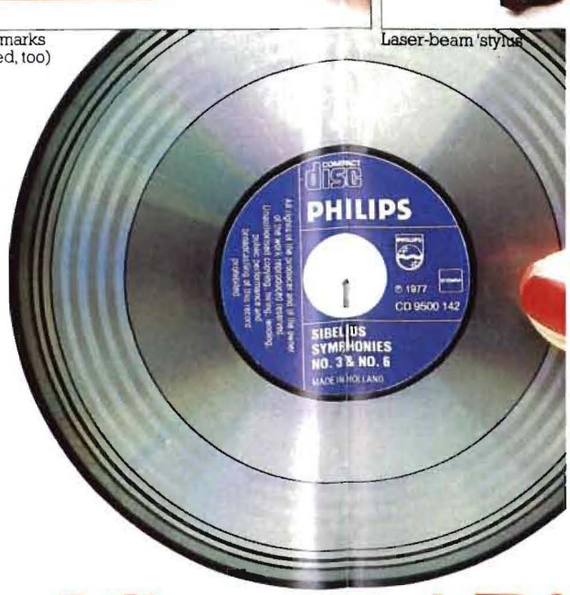
Compact Discs at LP Prices
With sales of sufficient volume, Compact Discs will be directly comparable in price with existing LPs. Compact Discs can contain a lot more recorded information, but they are much smaller and more robust, bringing substantial cost savings in raw materials, packaging, storage and transport.

The CD Player - Far Higher Performance, No Higher Price
A CD player will cost much the same as a high quality LP record player. But with its spectacular sound quality and unique features, the CD player is going to be fiercely competitive against even the very finest existing HiFi record players.

Superb Quadraphony
The CD system is designed to accommodate 4-channel recordings, with unprecedented realism because of the high-quality reproduction and virtually total channel separation. Playing time is reduced, but the sound quality may well be just the stimulus needed to awaken a big new interest in quadraphony.

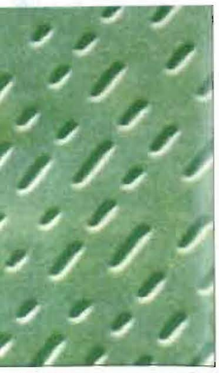
Simple To Use - Yet So Versatile
Basically, a CD player is even easier to use than a cassette player - just pop in the disc, close the lid – and the music starts. But it is easy to include programming information in the digitally recorded discs – so that the player can select tracks, play them in any desired sequence, and even show titles and supporting information on an integral visual display unit.

Compatible with Existing HiFi Equipment
Although CD is a digital audio system, it has an analogue output interface, so that it will connect directly to any normal HiFi installation.



The benefits of Compact Di

10 Sound reasons why Compact Disc Digital Audio achieves far superior sound reproduction



Prototype CD Player

No Rumble
No Wow and Flutter

The laser pick-up scans the digital track at a constant linear velocity, tightly synchronised with information encoded in the track itself. As a result, the disc rotation speed varies inversely with the scanning radius, from 500 rpm at the inside (start) to 200 rpm at the outside (end) of the track. At these high and accurately maintained speeds, there is no sign of rumble or wow and flutter.

True Frequency Range
True Dynamic Range

With optical scanning of digitally-encoded sound signals, there are absolutely no mechanical or electromagnetic limitations on either frequency response or dynamic range, and exceptionally high specification figures are obtained.

Negligible Noise
Negligible Distortion

In digital audio, signal-to-noise ratio depends on the number of bits in a word, i.e. the accuracy with which the audio signal is expressed. In the CD system, each bit contributes approximately 6 dB to a remarkable signal-to-noise ratio of over 90 dB. Compare that with 50 - 60 dB for an LP (and 30 dB for an old 78).

Harmonic and intermodulation distortion are fixed by the relation between the highest audio frequency and the sampling rate. The CD parameters ensure extremely low distortion figures.

Complete Channel Separation
No Sound Coloration

In a CD digital recording, left and right channel sound signals appear alternately, in completely separate words. Since they cannot mix in the player, channel separation is over 90 dB (as against 30 dB for a good record player).

The laser beam always reads the track exactly, and the digital circuitry of the player continuously checks that the reading is correct. So the CD system neither leaves out any sound information, nor adds any of its own.

No Groove-sticking or Jumping
No Mechanically-induced Noises

Tracking error is eliminated because scanning is controlled by information in the track itself. The laser beam cannot skate, it offers no microphony link and is completely uninfluenced by static electricity.

Dust, dirt and scratches are sealed out of the digital track (and the focal range of the laser beam). Clicks, crackles and hisses are completely eliminated.

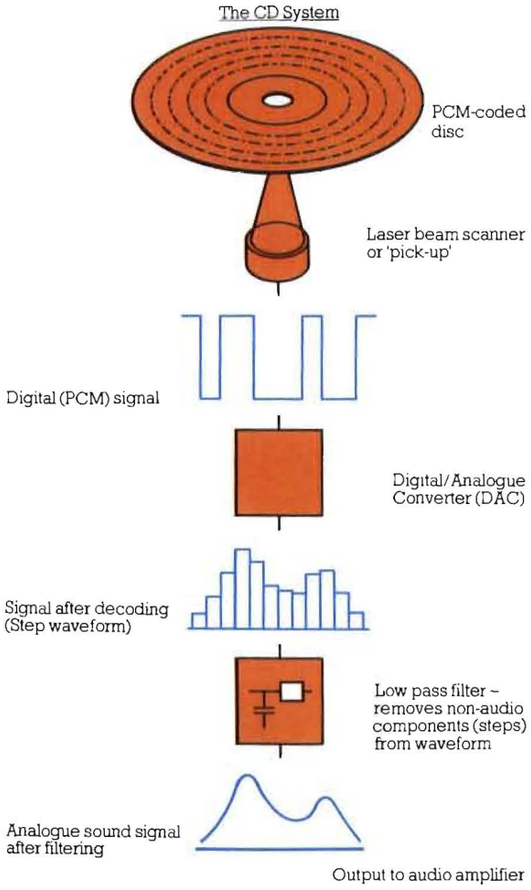
Laser-beam 'stylus'

Solid-state laser

Compact Disc Digital Audio

The shape of Sound to Come: Compact Disc Digital Audio in typical applications.

The CD System



CD – Digital sound reproduction with laser beam scanning

A 120 mm diameter disc that plays for an hour without turning over clearly contains ultra-concentrated sound information. In fact, a Compact Disc contains over 5 billion digital sound signal bits. And that does not include all the extra bits (used for such tasks as speed control, error correction and visual display) which contribute so much to CD's unique audio performance.

Each bit is either a flat surface, representing 1, or a microscopic pit, representing 0. They are laid out in a helical track, and one unit of sound information consists of 16 bits. This is known technically as a word, but it has no connection with the spoken word. It is a word in a special code known as PCM – Pulse Code Modulation.

As the disc rotates, it is scanned (from behind, and from the centre outwards) by a concentrated light-spot several times thinner than a human hair. This beam detects the sequence of pits and flats at a rate of approximately 4.3 million bits per second. Response is at the speed of light – immeasurably faster than the conventional stylus in the groove. Each PCM word is read in under 10 microseconds at a constant rate. The speed of the disc is controlled by coded information on the disc itself.

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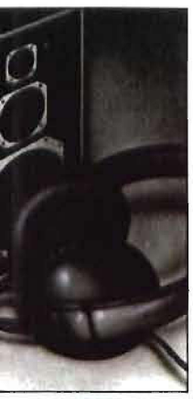
output of an electr
technique used –
deflecting a stylus

Achievable audio
Number of channels
Frequency range
Dynamic range
S/N ratio
Channel separation
Harmonic distortion
Wow and flutter

Signal format
Sampling frequency
Quantization
Encoding
Error correction sys
Modulation system
Bit rate

Frame Format
12 data words of 16 b
4 error correction pa of 16 bits
Control and display
Frame before modu
Frame after modulat (33 symbols of 14 bit
Symbols for multiple LF suppression (3 bits per symbol of
Synchronisation patt 3 bits for multiplexin LF suppression
Total frame

Error correction
Maximum correctab length
Maximum acceptabl length (by combinec correction and interp



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The output from the laser pick-up is a stream of electrical pulses in 16-bit PCM code. In the Digital/Analogue converter this stream is decoded, word by word, and synthesised into the conventional form of stereo audio signal. But this signal is more exact and more powerful than the output of an electromagnetic pick-up, because of the digital technique used – a much more accurate procedure than deflecting a stylus in the groove of a conventional record.

The decoder, in fact, checks each word to see that it is correctly formed and avoids errors by correcting any that are not. By reconstructing the decoded sound-values the words synthesise an audio signal which exactly represents the information on the disc. And this signal, unlike that of the electromagnetic pick-up, can be set at an optimal amplitude for subsequent amplification. It then only remains to feed it through the audio amplifier to the loudspeakers.

CD – Technical data

Achievable audio performance	
Number of channels	2 or 4[1])
Frequency range	20 Hz - 20 kHz
Dynamic range	> 90 dB
S/N ratio	> 90 dB
Channel separation	> 90 dB
Harmonic distortion	< 0.05%
Wow and flutter	Quartz crystal precision

Signal format	
Sampling frequency	44.1 kHz
Quantization	16 bits linear/channel
Encoding	2's complement
Error correction system	Cross Interleave Reed Solomon Code (CIRC)[2])
Modulation system	Eight to Fourteen Modulation (EFM)[3])
Bit rate	4.3218 Mbits/sec.

Frame Format	
12 data words of 16 bits	: 24 symbols of 8 bits
4 error correction parity words of 16 bits	: 8 symbols of 8 bits
Control and display symbol	: 1 symbol of 8 bits
Frame before modulation	: 33 symbols of 8 bits
Frame after modulation (EFM) (33 symbols of 14 bits)	: 462 channel bits
Symbols for multiplexing and LF suppression (3 bits per symbol of 14 bits)	: 99 channel bits
Synchronisation pattern incl. 3 bits for multiplexing and LF suppression	: 27 channel bits
Total frame	: 588 channel bits

Error correction	
Maximum correctable burst length	4000 bits (≈ 2.5 mm)
Maximum acceptable burst length (by combined error correction and interpolation	14000 bits (≈ 8.4 mm)

Disc	
Diameter	120 mm
Thickness	1.2 mm[4])
Diameter of centre hole	15 mm
Programme area start diameter	50 mm
Programme area maximum diameter	116 mm
Sense of rotation (seen from reading side)	anti-clockwise
Scanning velocity	1.2 - 1.4 m/sec
Rotation speed	500 - 200 rpm (approx.)
Maximum recording time	60 min. stereo[4])
Track pitch	1.6 µm
Material	Transparent plastic, with aluminiumised reflective coating, sealed with protective lacquer

Optical stylus (laser)	
Wave length of AlGaAs laser	0.78µm
Numerical aperture	0.45
Focus depth	Approx. 2µm
Beam diameter at disc surface	Approx. 1.0 mm

[1]) 4 channels with reduced recording time.

[2]) CIRC: new error correction code for protection against scratches, with high error correction capability for random errors and low probability of undetectable errors.

[3]) EFM: new modulation method for increasing packing density and meeting requirements of optical servo systems.

[4]) Single sided disc (double sided disc optional).

COMPACT
disc
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Compact Disc – The optimised digital audio system

CD uses a light beam similar to VLP Laservision – the video long play disc system now coming into use with television.
An immediate and obvious question arises: Why should CD and VLP Laservision not use the same parameters? The answer is quite simple: the applications are totally different. Each system has its own specific requirements and objectives. The basic difference between the two systems lies in the considerably higher information content required for a combined picture and sound signal as compared with a sound signal only. The VLP disc is the same size as an LP, the player is relatively large and the system is expensive by audio standards. To use VLP Laservision, even in simplified form, for HiFi sound reproduction is no logical solution. Moreover, a world standard is not feasable because of the various non-compatible TV-systems. It is doubtful whether such a system could ever replace the conventional LP and record player.

With these factors in mind, CD has been developed specifically for sound. It displays the full advantages of the light beam/PCM technique as applied to HiFi reproduction; extended technical performance; attractively compact dimensions; prices in the same bracket as present-day LPs and record players. The size of the CD disc, coupled with its protection against influence from dirt and damage, even makes it suitable for mobile or in-car use.

CD, designed for the purpose, is without doubt the finest system ever developed for sound reproduction.

PHILIPS

VLP Laservision player

CD player, early development demonstration model

VLP disc

Compact disc

Into the opto-electronic age with PHILIPS

Printed in the Netherlands

3122.115.82691 - 5/81

Optical Disc Mastering

Compact Disc Digital Audio

COMPACT disc DIGITAL AUDIO

PHILIPS

PHILIPS

DIGITAL AUDIO

contribution to sound reproduction can be seen in its performance figures. Dynamic range, signal-to-noise ratio and channel separation, all aproach infinity at over 90 dB. Between 20 Hz and 20.000 Hz, frequency response is completely flat. Harmonic distortion is less than 0,05%, and rumble, wow-and-flutter and microphony are eliminated.

The Compact Disc is single-sided – only 120 mm in diameter and 1,2 mm thick – yet it gives the same playing time as both sides of a conventional LP. And as the digital recording is sealed within the disc, its performance is unaffected by dust, scratches, and fingermarks.

The small size of the Compact Disc also enables the size of the player to be reduced to around that of a compact cassette recorder. In addition, laser beam scanning eliminates problems of wear on either the disc or pick-up.

of the necessary control information (subware).

Existing analogue recordings can also be used in the production of a Compact Disc, by first transferring them to a two-channel PCM-master tape. Whilst the use of analogue material will not enable the exceptional performance characteristics of a digital original, it still gives a markedly better result than that found on normal LP records.

Compact Disc Mastering

The mastering process for LP records requires a simple process of machine cutting a lacquer disc. Compact Discs on the other hand, require a complex set-up of differing processes, as can be seen in the flow diagram. There is considerable similarity between Compact Disc mastering and that of LaserVision Discs. The PCM signals from the master tape

recording, substrate development, and final optical and electrical inspection. From this master, galvanic copies are made (similar to normal LP production), and they are used as stampers in the subsequent replication process.

Philips in optical disc mastering

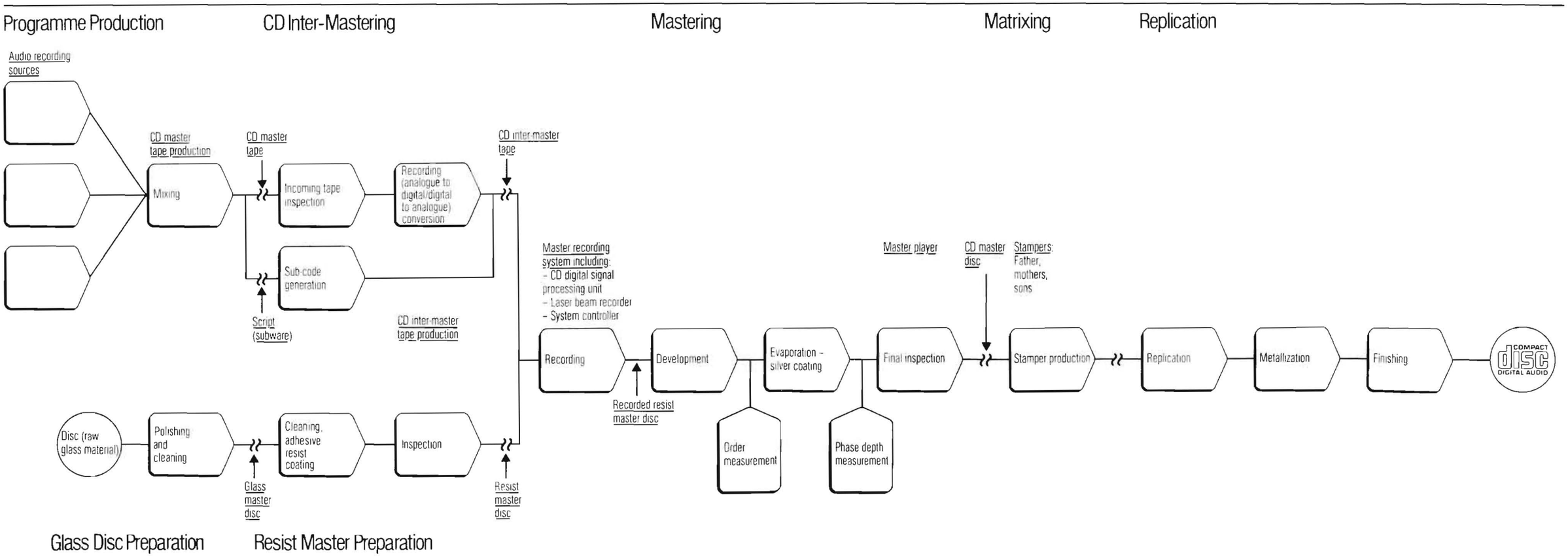
The development of mastering techniques for the Compact Disc has been greatly assisted by Philips' knowledge and experience with the LaserVision system. As with LaserVision mastering equipment, Philips can also supply and install mastering processing equipment for Compact Discs. But it is more than just equipment. With Philips, it is a total service, which includes:

- consultancy regarding clean room specifications and layout, together with purchasing requirements for equipment and materials

The complexity of the new concept, technologies and equipment, together with the allied costs involved in the production of Compact Discs, naturally precludes the installation of mastering equipment in every recording studio. For these reasons, initially, customized mastering and replication operations will be carried out in specifically designed replication facilities, thus providing an economic solution to customer requirements. Philips can also provide full services for customized mastering.

For further information on Philips Compact Disc mastering systems, please contact:

N.V. Philips' Gloeilampenfabrieken,
Electro-Acoustics Division,
Optical Disc Mastering Group,
Building DBC,
Eindhoven, The Netherlands.



COMPACT
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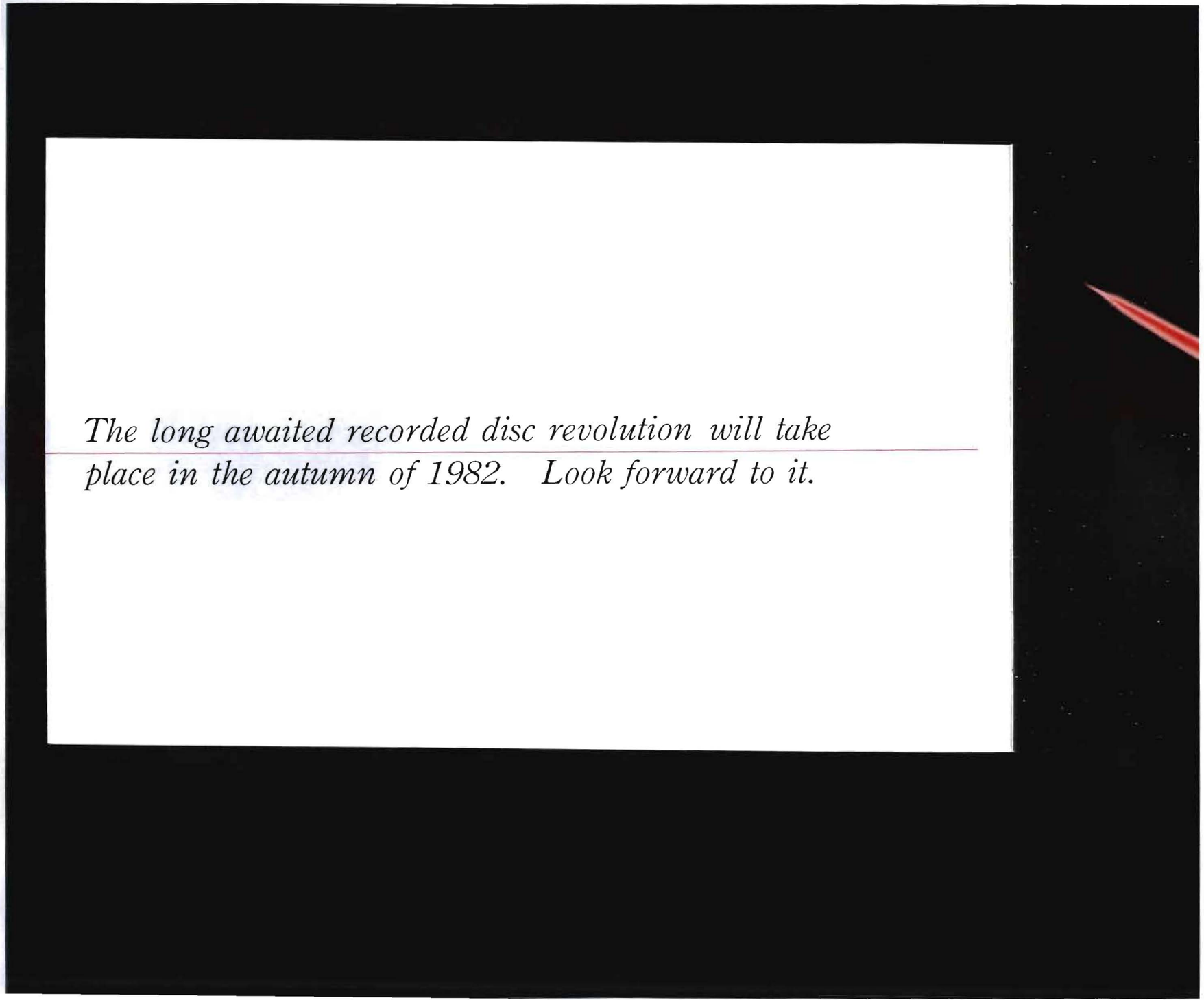
Compact Disc Digital Audio System

SONY


The long awaited recorded disc revolution will take place in the autumn of 1982. Look forward to it.

Audio improves because people keep seeki

It all started with a cylinder of tin foil.

In the year 1877, Thomas Alva Edison recorded and played back "Mary had a Little Lamb" on a foil covered cylinder. With that small feat, the Wizard of Menlo Park invented more than the phonograph, he also invented audio, the means to listen to music at one's leisure. In the more than 100 years since then, audio has made great progress: The foil covered cylinder became wax, only to be superceded by the shellac 78, then the LP and, most recently, the stereo disc. Today improvement continues because music lovers seek still better sound quality.

se people keep seeking better sound quality.

Into a new age with the Compact Disc Digital Audio.

The recorded disc is about to be transformed from an analog medium into a digital one. In its new form it will be called the "Compact Disc". But far more important than its compact size is the fact that the Compact Disc delivers ,much better sound quality than has ever been, or could ever be, achieved with analog technology. Also, the Compact Disc is the starting point for completely digital audio reproduction systems. Such systems can be designed to avoid most of the distortion and noise added to the signal by analog devices. At last we will be able to enjoy reproduced music that is truly faithful to the original. The Compact Disc makes it possible.

The superiority of digi
recording.

Both in theory and practice
gital techniques have inhe
advantages over analog for
cording, transmission and re
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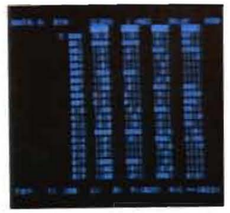
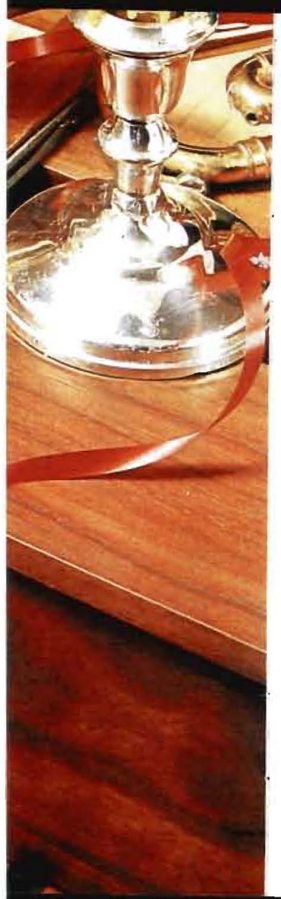
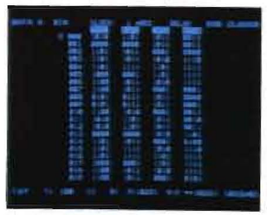




The superiority of digital recording.

Both in theory and practice, digital techniques have inherent advantages over analog for recording, transmission and reproduction. Whether called PCM (pulse code modulation) or digital, the technology is the same. Simply speaking, it involves breaking up the complex, continuously changing audio signal into discrete bits which are handled as a binary (ones or zeros) code represented by the presence or absence of pulses. Recording accuracy therefore depends on how finely the audio signal is divided and how many digits are used in the pulse code. In contrast, analog systems record the audio signal as fluctuations in waveform or magnetism. Therefore, the only way to obtain better quality is to improve the recording medium itself. However, it seems that we have already reached the limit when it comes to better analog disc or tape quality.



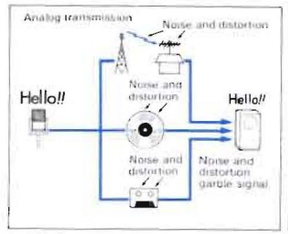
Digital recording is not limited by the medium because only a series of pulses needs to be handled. The only requirement is high recording density which is already available with present day video tapes and the new Compact Disc.

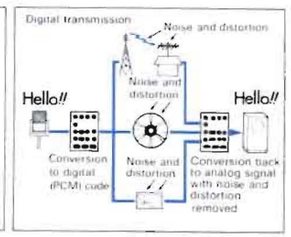
Fidelity unaffeced by transmission conditions.

To understand how digital recording assures higher fidelity, compare the telephone with the telegraph. The telegraph is digital; it uses a code consisting of dots and dashes. Even if there is noise or distortion, the person receiving the signal need only tell the difference between a dot and a dash to be able to understand the original message. The telephone is different: since it is analog, the message can easily become garbled by noise and distortion at any point.

Like the dots and dashes in Morse code, digital audio's pulse code is not affected by noise and distortion. Only the presence or absence of pulses needs to be deteced to retrieve the original music. Besides that, digital audio is recorded along with a sync signal which allows any wow & flutter to be cancelled before the music is reproduced. With all this going for it, it's no wonder that digital audio sounds so much better than analog.

In fact the sound quality is so good that it makes an audiophile out of the average listener.





Compact Disc Digital Audio System

Tie-up with Philips brings faster result

Serious work on devel digital disc began at years ago. The best minc business have particip this task, coming up wit unique ideas and origina ment.

From the beginning, S has invested vast re time, and effort in this di Naturally, the results ha impressive, ranging fr perimental playback for actual video disc pro equipment. In March Sony entered into a sharing agreement with By working together, we rapid acceleration of pr In June 1980, our effor rewarded. The Compa was born as the first n viable music source suit taking audio into the 2 tury.

Tie-up with Philips brings faster results.

Serious work on developing a digital disc began about 10 years ago. The best minds in the business have participated in this task, coming up with many unique ideas and original equipment.

From the beginning, Sony too has invested vast resources, time, and effort in this direction. Naturally, the results have been impressive, ranging from experimental playback formats to actual video disc production equipment. In March of 1979 Sony entered into a patent sharing agreement with Philips. By working together, we assured rapid acceleration of progress. In June 1980, our efforts were rewarded. The Compact Disc was born as the first new and viable music source suitable for taking audio into the 21st century.

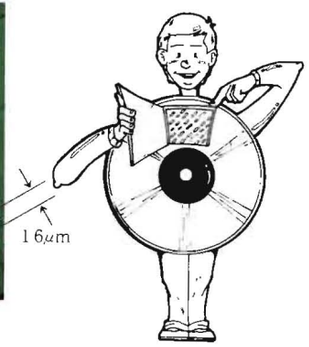
Small size; high density.

The Compact Disc is 12cm in diameter and 1.2mm thick. Within this truly "compact" space, it holds an incredible 60 minutes of stereo sound using only one side.

Ultra high fidelity

Hi-fi this good deserves the name "ultra". And of course it is this amazing sound quality which is the foremost benefit of the Compact Disc. Frequency response is completely flat from 20Hz to 20kHz. Dynamic range is at least 90dB; S/N ratio is also at least 90dB. Distortion is 0.05% or better. The result is captiviating, intriguing sound that totally involves the listener. This is the kind of sound that is possible with a properly designed digital system.

Convenience is another great advantage of the Digital Disc. No longer will the user have to worry about phono cartridge compliance, stylus wear, equalization and so forth. Anyone will be able to enjoy this ultra high fidelity without any technical knowledge of the finer points of disc reproduction. Hopefully this will serve to introduce more and more people to the pleasures of music listening.



Both are Greig's Op.16 piano concerto.
The difference in
recording
density is
amazing.


CBS SONY
MASTERWORKS
GRIEG
PIANO CONCERTO IN A MINOR,
Op. 16

The new audio source we've been waiting for.

Closer to the ideal in every respect

Why the Compact Disc? The simple answer is that it is the closest mankind has ever come to the ideal audio source. However, we should be quick to point out that it is the result of a multitude of hard decisions and painstaking steps. We did not start with such a specific goal. Choices had to be made about the pickup system, the size of the disc itself and whether we would aim for video compatibility or audio alone.

On the other hand, our conditions were quite clearly defined. The new system had to (1) provide clearly improved fidelity, (2) have the features, functions and performance needed to make music listening more a part of our daily lives, and (3) have physical characteristics that would make it appealing to the greatest number of people. It was in trying to best fulfill these conditions that we decided on a laser optical pickup system, a disc diameter of 12cm and an audio-only 2-channel, 60-minute playing time.

Why an optical pickup?

• Eliminates stylus and disc wear.

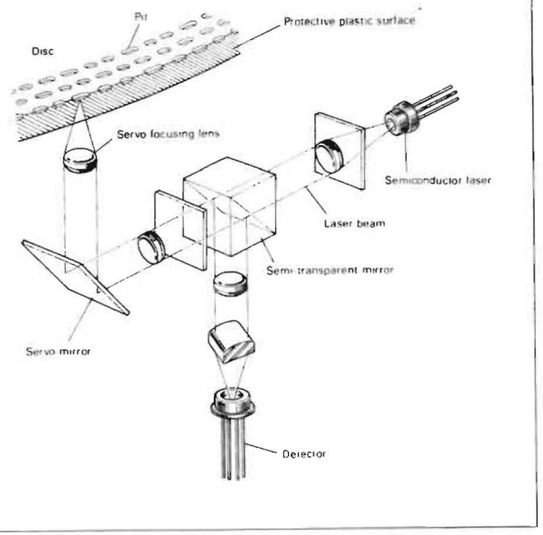
Since a laser is used to read the encoded signal on the disc, there is no physical contact, no wear, and therefore no degradation of sound quality over time. Of course, there is also no groove skipping.

• Stands up to dirt, dust and abuse.

The encoded signal is below the disc surface, protected by a transparent plastic coating. Should the disc become dirty, it can be wiped clean to restore it to its original condition.

This is also an advantage for portable and in-car use.

Optical pickup system



Why a 12cm diameter

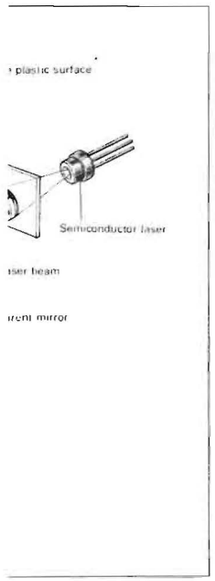
• Broader applications.

While the conventional LI limited to home use, the Compact Disc will allow p back in car audio systems pocket-size players which ar the developmental stage.

• Space saving size and ea handling.

The new Compact Disc take

for.



Why a 12cm diameter?

• **Broader applications.**
While the conventional LP is limited to home use, the new Compact Disc will allow playback in car audio systems and pocket-size players which are in the developmental stage.

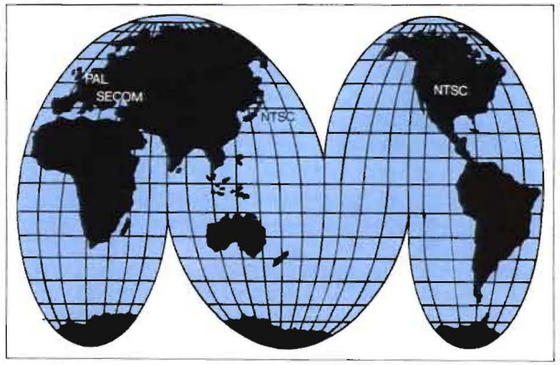
• **Space saving size and easier handling.**
The new Compact Disc takes up only about one sixth the space of an LP. Storage and handling are also easier.

Why audio only?

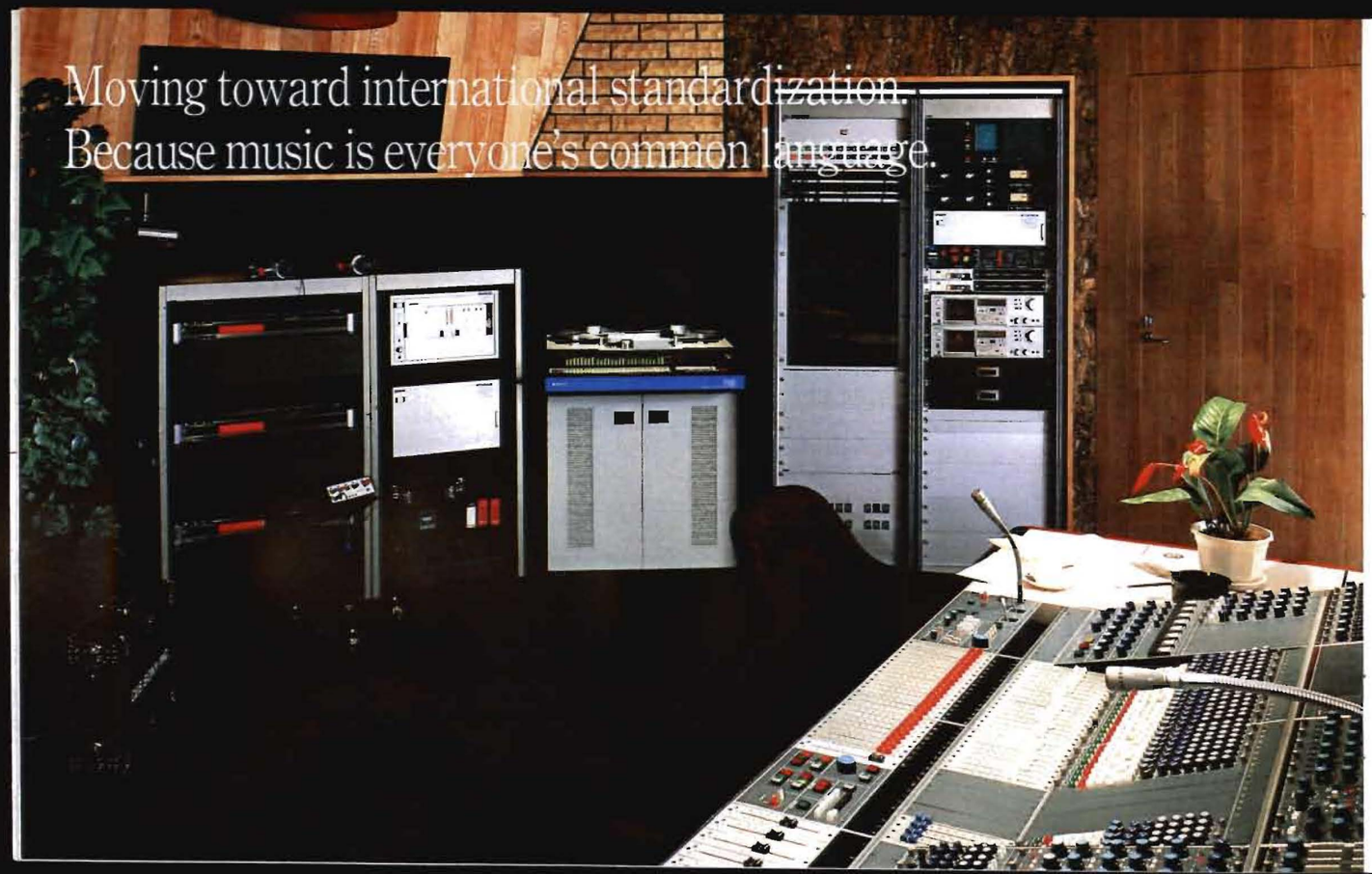
• **A video compatible system cannot achieve world standardization.**
Since digital audio requires the use of a very high frequency signal, it is possible to borrow video techniques and employ them as is. While this is very tempting, we were forced to abandon audio/video compatibility because it would be impossible to achieve a standard system worldwide. Different countries use different TV broadcast signal systems so an American disc player would not be able to play a European disc.

Simple connection to any existing audio system.

By simply connecting the Compact Disc player to an existing audio system, anyone can enjoy this revolution in audio sound quality and convenience. The player connects directly to amp or receiver jacks for reproduction through an ordinary speaker system.

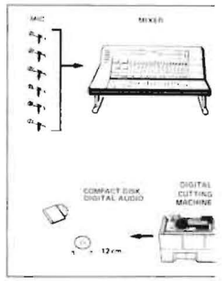


Although the ideal would be to have a completely digital audio system, the difference in fidelity will still be quite apparent using today's better quality amps and speakers. After all, the Compact Disc doesn't require the extra gain applied to an ordinary phono signal, so it avoids the noisiest part of the amplification process.



When will the Compa Disc Become Availab

As all audiophiles are aware, digital recording signal processing techn. are already in use by the re ing industry. Unfortunate do not hear the full benef this change because the re we listen to are still analog only thing keeping a truly tal audio source from rea the consumer's hands is la



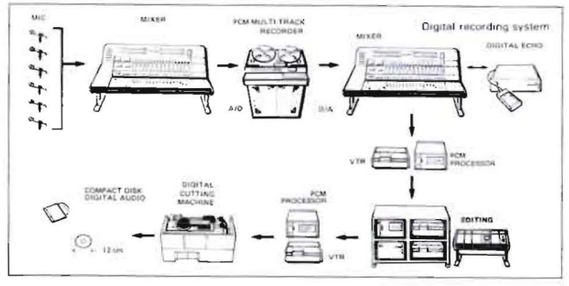
When will the Compact Disc Become Available?

As all audiophiles are well aware, digital recording and signal processing techniques are already in use by the recording industry. Unfortunately we do not hear the full benefits of this change because the records we listen to are still analog. The only thing keeping a truly digital audio source from reaching the consumer's hands is lack of world standardization. Sony and Philips are in the process of negotiating with the world's audio hardware and software (record) companies on this subject. Every day brings another step toward agreement and cooperation. Have patience, the Compact Disc will be here soon.

The completely digital recording system.

The obvious next step is the adoption of completely digital recording systems. All the equipment has already been developed. This includes a multi-track digital recorder, digital processor, digital reverberation, digital audio editor, laser cutting machine and Compact Disc pressing machine.

Once complete standardization has been reached, the world's record companies will be able to use this equipment to begin full scale Compact Disc production. Since all the equipment is digital, the recorded signal should be just as it sounded in the studio, without any noise and distortion.




Multi-track digital recorder

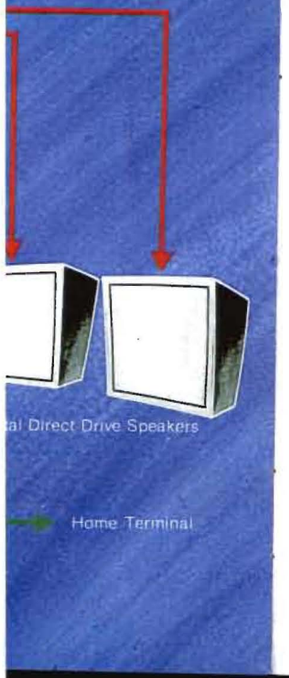

Digital audio editor


Digital processor


Digital reverberation

First, the source.

Digital audio will inev
change the entire reprod
system, but the change
begin with the source, i
case the Compact Disc.
audiophiles have already
this step by using the Son
tal audio processor hooke
a video cassette record
both recording and pla
The cost is still high, bu
micro-processors should
this system more easily
able in the near future.
Digital broadcasting is a
innovation now under de
ment. Using a stationary
lite, a PCM broadcast co
picked up directly and re
on a home video casse
corder with digital audi
cessor. This would eli
multipath and other
ference to provide pre
unattainable reception
with wider frequency re
and dynamic range.



First, the source.

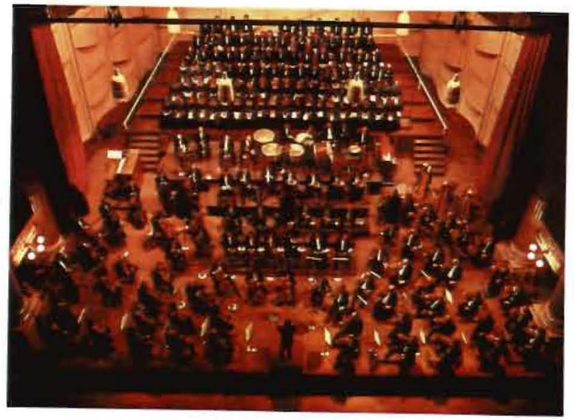
Digital audio will inevitably change the entire reproduction system, but the change must begin with the source, in this case the Compact Disc. Some audiophiles have already taken this step by using the Sony digital audio processor hooked up to a video cassette recorder for both recording and playback. The cost is still high, but new micro-processors should make this system more easily available in the near future.

Digital broadcasting is another innovation now under development. Using a stationary satellite, a PCM broadcast could be picked up directly and recorded on a home video cassette recorder with digital audio processor. This would eliminate multipath and other interference to provide previously unattainable reception quality with wider frequency response and dynamic range.

Digital audio components.

With a digital source, other components in the audio system will start changing too. First will come amplifiers capable of handling digital audio signals. This technology is already available. Further away is a digital direct drive speaker system. With that development, digital signal quality will be protected from the beginning to the end of the audio chain. Not only will such a system eliminate weak analog links, it will also make it easier to process the signal (in digital form) to provide ambience enhancement as well as compensation for listening room acoustics.

Digital components will be more compact, more reliable, and easier to use than analog components. Needless to say, digital amps and speakers will also be able to handle conventional source material converted to digital form.



We can also look forward to an effect on musical composition and performance. No longer will the composer, musician or recording engineer need to feel constricted by the limitations of the home reproduction system. With digital audio, musical details and pianissimo subtleties will be clearly audible, as will fortissimo peaks that cause distortion in analog systems.

SONY's Digital Audio Developments.

• October 1974
X-12DTC Professional stationary head digital audio recorder.
• September 1976
FM video-format digital audio disc system (1800 rpm 30-minute single-side play, optical laser pickup.)
• September 1976
FM video-format PCM audio disc. (1800 rpm 30-minute single-side play, optical laser pickup.)
• October 1976
Digital audio processor for recording and playback on VTR. (12-bit, 2-channel)
• June 1977
PAU-1602 digital audio processor, jointly developed with NHK for use with U-matic VTR for recording and playback. System adopted by NHK.
• September 1977
PCM-1 digital audio processor designed to be used with home VCR for recording and playback. (13-bit, 2-channel)
• September 1977
Digital disc system using direct PCM encoded signal. (900 rpm, 60-minute single-side play, optical laser pickup.)
• March 1978
PCM 1600 2-channel digital audio processor designed to be used with professional VTR for broadcast applications.
• May 1978
X-22DTC 1/4-inch, stationary head, digital audio recorder. (38 cm/s, 12-bit, 2-channel)
• May 1978
Experimental FM network broadcast (FM Tokyo, FM Osaka, FM Aichi, FM Fukuoka) using a digital recording/playback system for complete program production.
• October 1978
Long playing PCM disc. (450 rpm, single-side playing time 2-hours and 30-minutes, optical laser pickup.)
• October 1978
PCM 3224 stationary head professional 24-channel PCM recorder. (1-inch tape)
• October 1978
DMX-800 Professional 8-channel digital audio mixer.
• October 1978
DRX-1000 Professional digital reverberator.
• May 1979
Production begun (on order basis) of PCM-10 home-use digital audio processor and PCM-100 professional digital audio processor based on EIAJ standards format for home digital adaptors.
• May 1979
DEC-1000 digital audio editor for use with the PCM-1600 or PCM-100 audio processors.
• October 1979
PCM-3324 Professional stationary-head 24-channel audio recorder. (1/2-inch tape)
PCM-3204 stationary-head 4-channel audio recorder. (1/4-inch tape)
• May 1980
Technical agreement with Studer of Switzerland concerning stationary-head digital audio recorders. Agreement reached on cooperation for standard format.
• June 1980
Philips of Holland and Sony embark on joint development of Compact Disc system. Standard specifications suggested: 12cm diameter, single-side 60-minute play.
• October 1980
Sony-Philips Compact D tem revealed at Japan Fair.
• February 1981
Production begun (on basis) of Compact Disc ing system:
PCM-1610 Professional audio processor: DA digital audio editor DR digital reverberator.
• February 1981
Toshiba, Sanyo, and Son lop three LSIs for use in & decoder of digital au cesser based on EIAJ st format.

essor based on EIAJ stand-
format for home digital
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-1000 digital audio editor
use with the PCM-1600 or
1-100 audio processors.

tober 1979

1-3324 Professional station-
head 24-channel audio re-
er. (1/2-inch tape)

1-3204 stationary-head 4-
nel audio recorder. (1/4-
tape)

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pact Disc system. Standard
ifications suggested: 12cm
neter, single-side 60-minute

• October 1980
Sony-Philips Compact Disc system revealed at Japan Audio Fair.

• February 1981
Production begun (on order basis) of Compact Disc mastering system:
PCM-1610 Professional digital audio processor; DAE-1100 digital audio editor DRE-2000 digital reverberator.

• February 1981
Toshiba, Sanyo, and Sony develop three LSIs for use in encoder & decoder of digital audio processer based on EIAJ standard format.

Produced by Sony
Sony Corporation
6-7-35, Kita-Shinagawa, Shinagawa-ku,
Tokyo 141, Japan
Showrooms Tokyo, Sony Building, Sukiyabashi, Ginza, Tokyo
Osaka Sony Tower, Shinsaibashi, Minami-ku, Osaka
Information Center Tokyo (03) 448-3311, Osaka (06) 251-5111

May 1981

SONY

News and Information

Sony Corporation of America

Corporate Communications Department
9 West 57th Street, New York, N.Y. 10019
(212) 371-5800 or (212) 355-7747 (Night)

For Release: April 29, 1981

Contact: Fred Wahlstrom - Sony
Alec Shapiro
(212) 575-1976

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SONY DEVELOPS "HIGH DEFINITION VIDEO SYSTEM"
TO MEET THE NEEDS OF THE COMING ERA
OF HIGH-STANDARD VISUAL INFORMATION

TOKYO -- Sony Corporation announced today that it has developed a new, high-standard video recording and playback system called "Sony High Definition Video System" to expand the uses of video and television toward the new image requirements of the 21st century. Sony became the first company in the world to demonstrate a high-definition television system that incorporates video recording capabilities. This high-definition video system is a result of Sony's research and development work in future-oriented visual information technology.

The prototype HDVS being demonstrated today features 1,125 scanning lines and 60 fields per second with a frequency band width of about 30 MHz, which can contain five to six times more information than the present NTSC standard color TV system. The NTSC system used in Japan, the United States and some other countries uses 525 scanning lines and 60 fields per second with a maximum band width of 4.2 MHz.

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Based on the recording and processing of wide-band video signals, this is a total video system to meet the requirements of high-definition images, including a new video camera, videotape recorder, display unit and other video-related equipment.

With the standard TV system, which uses 525 scanning lines, it is impossible to obtain pictures of very high resolution approaching the quality of 35mm film. However, supported by the rapid advances in video technology in recent years, there has been a growing interest in high-definition pictures among the TV broadcasting, cinema and other image-handling industries of the world. This global interest in high-definition images has already stimulated the reassessment of the present broadcasting systems.

In the meantime, Japan Broadcasting Corporation (NHK) conducted research and development in this field for the first time in the world back in 1968. The NHK system, which also uses 1,125 lines, was demonstrated at the SMPTE conference in San Francisco in February of this year. NHK showed its high-definition TV system at an FCC gathering in Washington also. With remarkable features, the NHK system is attracting the keen interest of the world's broadcasting industry as an initial step toward the coming era of high-definition visual information.

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Based on NHK's HDTV technology, Sony has developed this high-definition video system by adding video recording, time base correction and other capabilities. Sony expects to play a significant role in promoting and enhancing the high-definition technology as proposed by NHK and providing a direction for the new image industry of the coming era.

Sony has demonstrated this HDVS prototype so as to substantiate its feasibility as a highly potential video system in the coming age of high-definition pictures. The new system is expected to improve the economical efficiency and expand the production techniques of motion-picture production drastically with its electronic shooting and editing capabilities. Of course, Sony's High Definition Video System ensures that the picture resolution is the same as the present 35mm film, which boasts about a million picture elements.

The 1,125-line Sony High Definition Video System mainly consists of the following equipment:

1. High-definition 3-tube TV camera, which incorporates a newly developed 1-inch Saticon^{R}* high-resolution pickup tube.

2. 1-inch wide-band RGB VTR, which employs a new high-density recording format.

3. Wide-band digital time base corrector, which features a new wide-band AD converter.

-more-

4. 20-inch and 32-inch high-definition Trinitron monitors with a fine-pitch Trinitron picture tube.

5. 100-inch high-definition TV projector with a wide-band picture tube for projection use.

The HDVS incorporates a three-channel component signal system, which processes three different color signals (red, green and blue) separately, from the input to the output of video signals. This new signal system accommodates a very wide band width of about 30 MHz for each of the three color channels.

*Saticon^{R} is a trade mark registered by NHK.

Main Specifications of the Sony High Definition Video System

Signal system:	RGB component 3-channel system
Horizontal scanning lines:	1,125 lines
Number of fields:	60 fields per second
Interlace:	1:2
Aspect ratio:	1:1.33 (Standard) or 1:1.85 (Vista) 1:2.35 (CinemaScope)
Band width:	About 30 MHz per channel

Numerous Possibilities of the Sony High Definintion Video System

Sony's U-matic video system has been used in news gathering by TV stations over the past nine years, steadily replacing 16mm film, because of its economy, efficiency in program production and convenience in editing. Video is used not only in news events, which is called Electronic News Gathering (ENG), but also in production and editing of programs. Now, the Type-C one-inch VTR developed by Sony is widely used for producing, editing and broadcasting of TV programs.

However, the present standard TV system, which uses 525 lines and 60 fields per second, cannot provide a picture resolution as high as that of 35mm film because of its technical limitations. At present, therefore, 35mm films (occasionally 16mm films) are used for shooting and producing TV movies and motion pictures for theater projection. 35mm film provides about one million picture elements.

Sony's High Definition Video System, however, equals the 35mm film capabilities in definition and color fidelity, as it uses 1,125 lines (with 60 fields per second) and the RGB three-channel signal system. The HDVS, therefore, is expected to change the production and distribution methods of motion pictures dramatically in the future, challenging the dominance of 35mm film.

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Advantages of using video in movie making:

1. Economy and production efficiency

The use of video in motion-picture production will lead to drastic reductions in raw film consumption, film developing, editing and other related costs.

A story can be perfected progressively and efficiently, because video enables repetitive recording and playback of any segment of the story for on-the-spot preview and trail editing at the time of collative reading (of a dialogue script) or rehearsing. Thus, the HDVS will reduce production time greatly by simplifying the work involved, including automation.

Moreover, the new system can expand the range and scope of special effects, by producing special effects through electronic processing, with accompanying cost reduction.

As such, the use of video technology will reduce the total cost of motion-picture production. Called "Electronic Cinematography" and enthusiastically promoted by CBS Vice President Joseph Flaherty, Hollywood film directors Francis Coppola, George Lucas and other leaders, this kind of movie production is expected to change the conventional film-making techniques dramatically.

2. Picture quality

The Sony HDVS ensures as high picture resolution as 35mm film even on a VistaVision-size screen (aspect ratio 1:1.85), as it provides a very wide band width of about 30 MHz for each of the three color (red, green and blue) channels. Also, because of its high definition, the new system ensures a wide range of color reproduction and fidelity characteristics unique to video.

3. Distribution

Electronic cinematography is expected to change the conventional method of film distribution as well.

What is produced in video can be transferred onto 35mm film by an electron beam recorder or by means of laser recording, and then distributed in U-matic cassettes to so-called mini-theaters which are becoming popular in the United States and Europe, after converting it to an interim signal system (using, for example, 800 lines) between the HDVS and the NTSC standard system.

Uses of the HDVS can be further expanded through satellite broadcasting, cable TV or optic fiber transmission in the future.

In addition to the expansion of motion picture production techniques through video, the HDVS is expected to enhance the techniques of TV program production and broadcasting by the present NTSC system.

1. Such special effects as electronic zooming and trimming can be easily provided in the post-production process, without degrading the picture quality.

2. Image enhancing, noise reduction, conversion to PAL or SECAM, besides NTSC, and other operations can be done easily through digital image processing prior to broadcasting of programs which are produced by the HDVS.

The above are the key points of the prototype High Definition Video System Sony has developed. With this technological base, Sony will continue its research and development in the field for the coming era of high-standard visual information.

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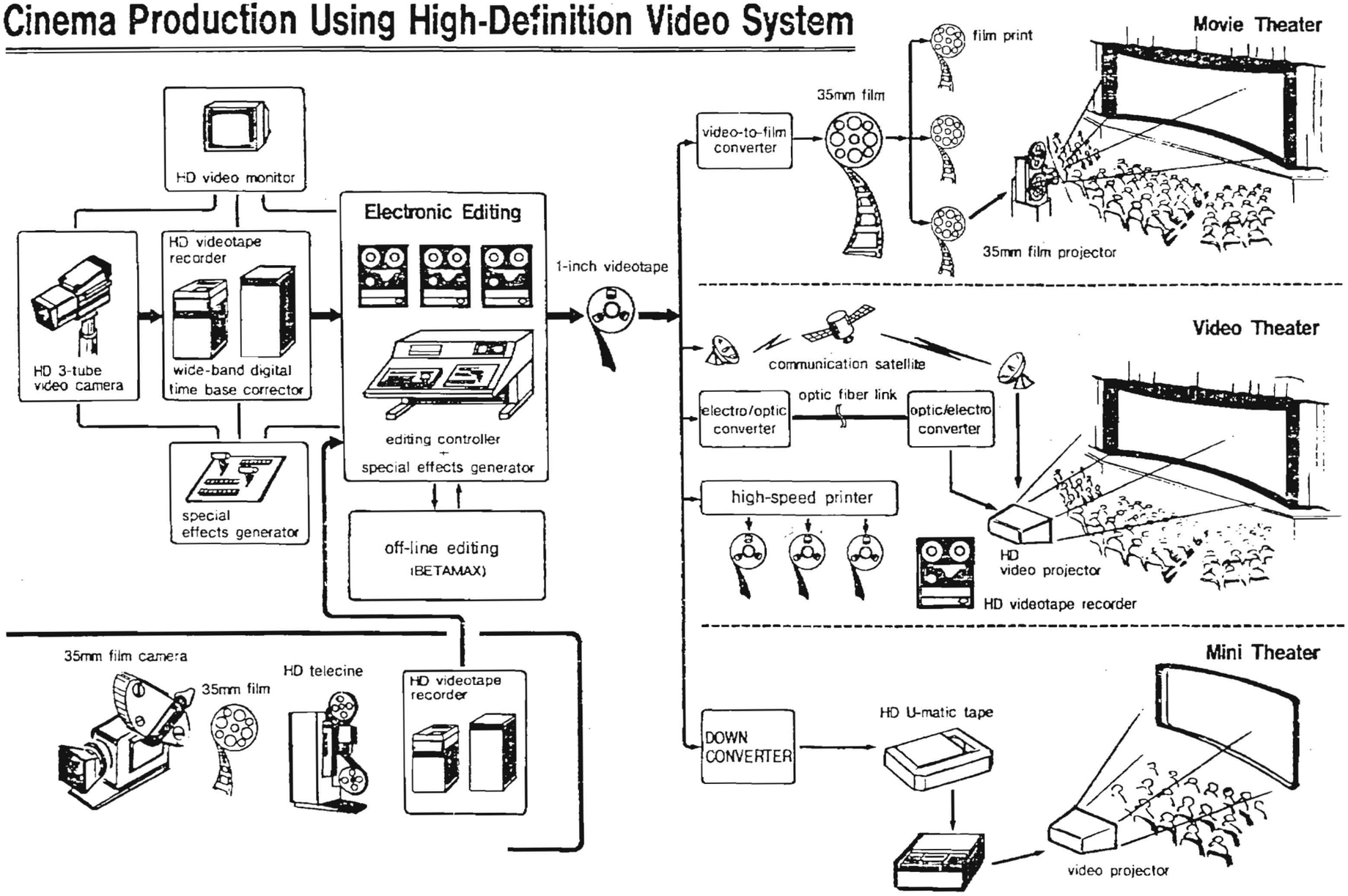
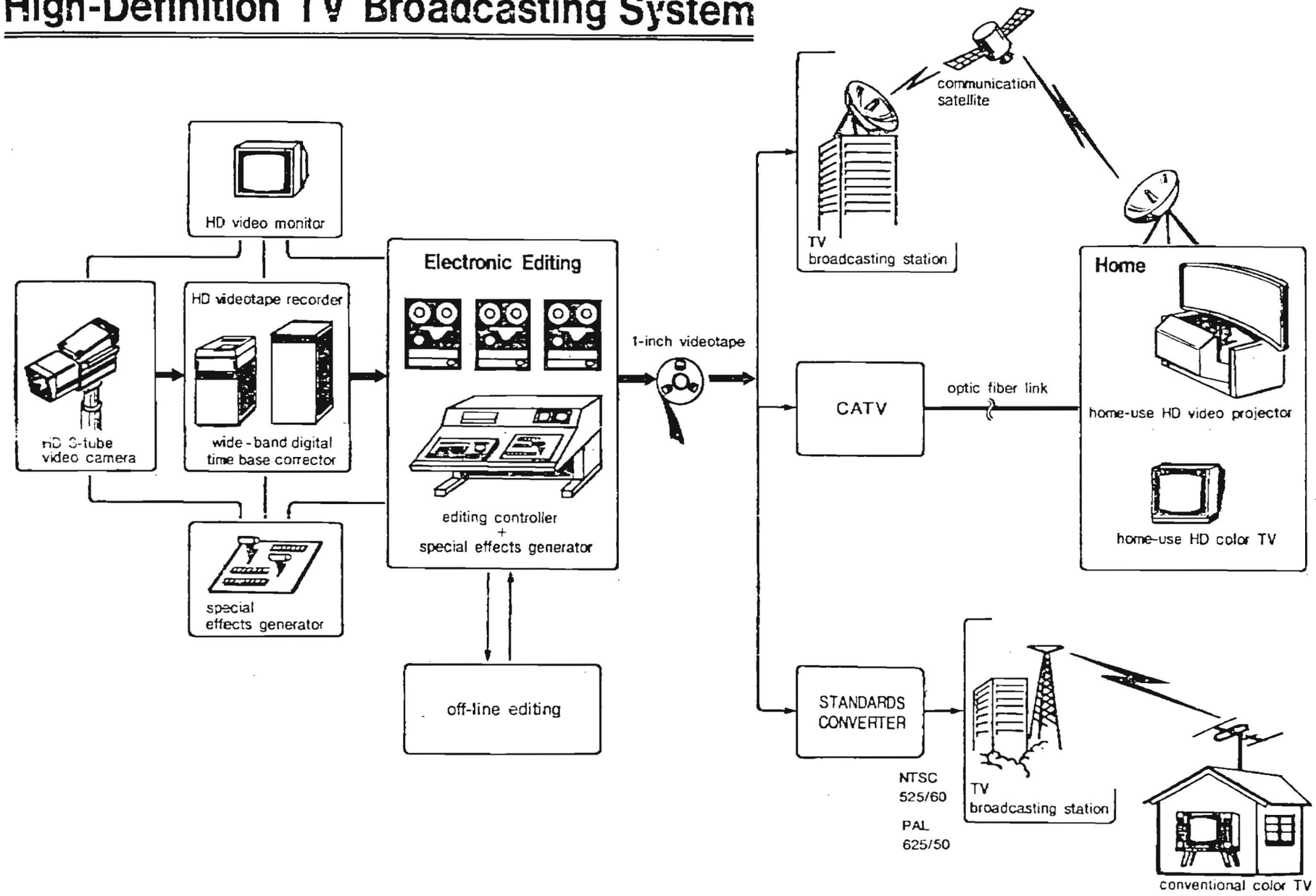
Cinema Production Using High-Definition Video System



High-Definition TV Broadcasting System



COMPACT disc DIGITAL AUDIO

North American Philips Corporation

SONY®

Contact: **Albert Ruttner** (212) 697-3600 **William E. Baker** (212) 371-5800

1982 MARKETING IS PLANNED FOR COMPACT DISC DIGITAL AUDIO SYSTEM

CD Format Gaining As World Standard

NEW YORK, NY, May 27, 1981 -- Sony Corporation and North American Philips Corporation today demonstrated prototypes of the Compact Disc (CD) Digital Audio System. Akio Morita, co-founder and chairman of Sony, and Frank Randall, vice chairman of North American Philips jointly announced that the market introduction of the revolutionary sound reproduction system will begin in the fall of 1982.

The announcement of the marketing plans reflects growing endorsement of the Compact Disc system as the preferred digital audio format by equipment manufacturers and software producers around the world. Movement toward that broad acceptance was given impetus in June 1980, when Sony and Philips agreed to take full advantage of the technological capabilities of both companies and to co-develop the CD system.

Most recently, the worldwide Polygram Group, one of the leading international record manufacturers, and CBS/Sony Inc., the largest record company in Japan, announced plans to produce music programs in the CD format. In 1982, for example, CBS/Sony will release more than 100 Compact Disc albums in Japan simultaneously with the introduction of the CD players.

Philips and Sony jointly submitted the CD format to the Digital Audio Disc Standardization Conference and, in April 1981, the

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final report of its study of three major systems was presented. The study recommended the CD format as the standard for audio disc recording and reproduction. The system continues to gain international acceptance.

"Live" Fidelity

The Compact Disc Digital Audio System delivers concert-hall fidelity, eliminates distortion, preserves the original "live" sound quality, and can be played through any home stereo system. Its unparalleled musical realism results in listener enjoyment which previously could be fully experienced only at a live performance. It is said to demolish the "distance" and the difference between the sound produced in the recording studio and the sound heard in the listener's living room.

In a complete break with all earlier recording-playback techniques, the Compact Disc Digital Audio System employes a record that has no grooves, which rotates faster than conventional LP or 45 discs, and is smaller than either. Only 4.7 inches (12cm) in diameter, the smooth-surfaced Compact Disc carries up to a full hour of digitally-encoded stereo music on one side compared to the LP's maximum of 30 minutes per side. The sound is recaptured, exactly as recorded, by means of a miniature, low-power, solid state laser pick-up unit within the CD player.

Since the invention of the phonograph in 1877, the recording and playback of sound has been based on an analog principle in which the physical energy of a sound wave is converted to variations in the grooves on the record.

- more -

The most noticeable problem in conventional records is that, as the stylus responds to the physical variations within the wavy groove, it also picks up the presence of dust, dirt and groove imperfections as additional -- but unwanted -- sounds. The stylus also is the link through which turntable rumble and tonearm resonance are transmitted to the system's amplifier.

Digital Advantages

In digital recording, the original sound wave is sampled thousands of times per second and converted into binary computer language. At about one-sixth the size, the Compact Disc offers many advantages over the conventional analog LP record. It provides wider frequency response (20-20,000Hz) and less high frequency distortion (0.05%). The system provides a signal-to-noise ratio and dynamic range of more than 90dB for each. There is no contact between the laser pickup and the disc, resulting in an extremely long record life.

The digitally-encoded sound, in the form of microscopic pits and flat areas along a 2½-mile-long spiral track, is sealed with a transparent plastic that protects against dust, dirt, scratches and other damage.

The right and left sound channels are encoded as separate bits of information that cannot be mixed in the record. Channel separation is greater than in conventional LPs for a stereo effect that significantly increases realism in playback.

Significant Advances

Recognizing the sound advantages of digital systems, more and more manufacturers have been recording their artists in digital master tape for release as improved LPs. Although these recordings have been acclaimed as clear advances over conventional LPs, they do not completely close the distance between studio and living room and they force the LP record to its design limits.

"The Compact Disc Digital Audio System," notes Sony's Akio Morita, "achieves a genuine technology breakthrough that establishes a direct, trouble-free link between the musician and the listener."

Frank Randall of North American Philips called the new system "the most significant advance in consumer sound reproduction in more than 25 years."

Sony and Philips will both demonstrate the Compact Disc Digital Audio System at the Consumer Electronics Show in Chicago, May 31 through June 4.

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COMPACT disc DIGITAL AUDIO

North American Philips Corporation

SONY

Contact: **Albert Ruttner** (212) 697-3600 **William E. Baker** (212) 371-5800

Compact Disc Digital Audio --
The Record of Tomorrow

Welcome to the future of recorded sound.

The innovative combination of digital technology and laser-optics, developed by N.V. Philips and Sony Corporation, has resulted in an unprecedented improvement in sound reproduction that rivals the invention of the phonograph record itself.

Compact Disc solves the problems of recorded sound fidelity by capturing concert-hall realism, eliminating distortion and banishing record wear. The new system converts the original sound into high density pulse code modulation and replaces the standard playback stylus with a low-power solid-state laser scanner.

The unparalleled quality in sound reproduction provided by Compact Disc Digital Audio is the modern culmination of the invention of recorded sound that began with Thomas A. Edison's cylinder phonograph in 1877 and Emil Berliner's "gramophone" in 1887. The "gramophone" used a rotating flat disc, on which sound information was engraved in lateral recording.

Berliner's "gramophone", initially powered by a manual crank, was the direct predecessor of the modern record player.

Since its inception, improvements in disc recordings have been substantial. Mechanical recording via acoustic horn microphone was replaced by more sophisticated techniques using electrical microphones and amplifiers. Electro-magnetic pick-up systems were developed. Vinyl replaced "shellac" in record production, micro-groove was adopted, and monophonic recordings gave way to stereo versions.

Despite the many improvements in reproduction quality over the years, today's long-playing phonograph record remains vulnerable to dust and scratches and must be handled with extreme care. The record size has prevented the design of smaller turntables that could be adapted to the miniaturized versions of other hifi components.

Sound reproduction from records has long been the focal point of criticism by discriminating audio system enthusiasts. Sound system technology has now reached the point at which present day record players are no longer able to fully utilize the potential of the other components in high quality hifi systems.

By introducing Compact Disc, Philips and Sony have closed the technological gap between record turntables and the more sophisticated sound equipment.

FIVE ADVANTAGES OF COMPACT DISC DIGITAL AUDIO

1. The laser pick-up in the CD system functions without any mechanical contact with the disc itself.
2. The 2-1/2-mile-long track of microscopic pits and flat areas containing the sound information is protected from dust and scratches by the transparent disc.
3. With a diameter of only 4.7 inches (12 cm), the Compact Disc takes up approximately one-sixth of the storage space required by normal long-playing records.
4. The CD player can be substantially miniaturized compared with conventional record players, opening up potentially new usages in areas with limited space, for example, "Car-CD."
5. The Compact Disc system offers unparalleled concert-hall fidelity including the dramatic improvement of dynamic music passages that previously could only be experienced at a live performance.

Unique Handling Characteristics

The Compact Disc, no larger than the palm of your hand, contains one entire hour of playing time, and offers the handling convenience of a tape cassette.

Just pop in the Compact Disc, close the lid and the record player is ready to go. The data storage capacity of the disc is much greater than is needed to record an hour of music per side. This additional capacity allows the Compact Disc system to offer many hitherto unknown programming possibilities. Number, length, titles and even texts of songs could be encoded for print-out via luminescent display or on TV monitoring screens. It will be possible to play individual selections in any desired sequence, to skip certain songs, or repeat others at the touch of a button. Compact Disc provides enormous latitude and flexibility for imaginative hifi designers in the future.

Prices and Software

Although it employs ultra modern digital technology for recording and storage of musical information, Compact Disc players are adaptable to any hifi system in use today. The transformation of digital signals into conventional analog signals occurs in the player itself. The miniaturized, integrated circuits were developed exclusively by Philips and Sony, enabling them to offer CD players at prices comparable to the highest quality conventional hifi record players.

To insure success of the new system, ready availability of an extensive selection of recordings on compact discs will be required. The Polygram Group, a subsidiary of Philips, and CBS/Sony, Japan, have decided to commence production in the CD format, and other record companies are expected to offer their own lines of Compact Disc recordings.

The New World Standard

N.V. Philips introduced the first Compact Disc recording system in the spring of 1979, and was subsequently joined in development by The Sony Corporation, Japan. The following firms have adopted the CD format: Bang & Olufsen, CBS/Sony, Crown, Dual, Matsushita, Nakamichi, Nippon Columbia, Onkyo, Polygram, Sony, Studer/Revox, Thomson, Trio Kenwood. For all intents and purposes, these actions establish the Compact Disc as the new international standard in digital audio disc recording systems.

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North American Philips Corporation
SONY®

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The Digital Revolution

Compact Disc Digital Audio represents a revolution in consumer electronics equipment. Now the unique advantages of digital data processing will be available to a broad spectrum of audio enthusiasts.

Superior sound quality is one of the most important benefits of the Compact Disc. Consider some of its important specifications:

- Signal-to-noise ratio is more than 90 dB.
- Dynamic range is greater than 90 dB.
- Flat frequency response is 20-20,000 Hz.
- Stereo channel separation is greater than 90 dB.
- Harmonic distortion is less than 0.05%.
- No rumble.
- No wow or flutter.
- No intermodulation.

Two-Way Protection Against Normal Audio Disturbances

The Compact Disc, which has a diameter of 4.7 inches (12 cm), consists of metalized plastic encapsulated in a transparent

protective coating. The disc is immune to external influences such as dust, scratches, or improper handling. This precludes the need for special care in use or storage of the discs.

The Compact Disc has enormous storage capacity and the digital reproduction circuitry has a built-in error detection and correction system. This automatically adapts to deviations and prevents wow and flutter or drop-outs associated with conventional recordings.

60 Minutes Uninterrupted Playing Time

One side of a Compact Disc contains enough stereo sound information for a full hour of uninterrupted playing time, and the system is designed to accommodate 4-channel recordings at reduced playing time. Compact Discs rotate counterclockwise and are played from the center outwards. Disc rotation speed is variable and is controlled by the information bits encoded on the disc itself. Theoretically, the Compact Disc may be recorded on both sides.

Digital-Sound Pulse Taker

In digital recording, the original sound wave-form is sampled thousands of times per second and each of the samples is

assigned a numeric value. The 44.33kHz sampling frequency is derived from a 4.433Mhz crystal, assuring maximum accuracy.

These samples are then quantized and converted into binary 16-bit "words" through a technique called Pulse Code Modulation (PCM). The bits -- or smallest possible segments -- permit extremely precise description of each sound sample.

The hour-long CD recording is made up of six billion bits, linearly encoded along the helical track of pits (which are about 0.6 micron in width and about 0.2 micron deep) and flats. These represent "ones" and "zeros" in binary computer language, and the extraordinarily high density of information assures an exact reproduction of the original sound.

The solid state laser pick-up scans this sequence of pits and flats from below in the form of a concentrated light spot several times thinner than a human hair. Scanning rate is approximately 4.3 million bits per second. Response is at the speed of light. With no contact between laser pick-up and disc, record wear is eliminated.

Totally New Handling Characteristics

Storage capacity of the Compact Disc - over 8 billion bits per side - is far greater than necessary to contain the sound information for 60 minutes of playing time. This provides infinite possibilities for hifi designers, in devising new concepts in handling ease and versatility for CD players. There are already plans to make it possible to indicate number, length, sequence, title and even the texts of songs recorded on the disc via luminescent display or TV monitor.

Owners of Compact Disc players will be able to make use of sophisticated programming circuitry, enabling them to determine which songs they desire to hear in any sequence. Handling of CD players will be easier - and at the same time more versatile than current cassette players.

CD is Compatible

The Compact Disc system developed by Philips and Sony utilizes the same 16-bit PCM code now in use for professional digital audio purposes. Therefore, CD recordings can be made with existing PCM equipment. It is also possible to adapt existing analog recordings through PCM processors to the CD standard.

This is an important consideration in view of the enormous number of recordings - many of historic value - already available in conventional phonograph record versions. CD players will connect directly to any conventional hifi system. The necessary analog output interface electronics are an integral part of the player. The development of semiconductor chip integrated circuits by Philips and Sony were prerequisite to economic mass production of CD players.

Superior Specifications

The specifications for the Compact Disc system surpass those of conventional record players by far - a direct result of digital technology superiority.

No Wow and Flutter

To maintain a constant linear velocity as a low-power, solid-state laser pick-up scans the digital track, the rotation speed of the disc continuously varies (from 500 rpm at the inside to 200 rpm at the outside end). Tracking, decoding and rotation speeds are precisely synchonized with a central clock generator, which itself is governed by information encoded in the track on the disc. As a result, wow and flutter are no longer measurable.

True Dynamic Range

With optical scanning via solid-state laser there are absolutely no mechanic or electromagnetic limitations on either frequency response or dynamic range. It is therefore possible to reproduce the full dynamic range of 90 dB experienced.

Widest Channel Separation

The CD laser pick-up reads both stereo channel signals alternately instead of simultaneously as in conventional record players. Together with the error correction circuits mentioned above, cross talk is no longer possible in the CD system. Channel separation specifications exceed 90 dB compared to a maximum of 35 dB for very good conventional record player cartridges.

Negligible Noise

In digital audio, signal-to-noise ratio depends on the number of bits per "word". In the CD system each bit contributes about 6dB to the accuracy of signal reproduction. Thus, a remarkable s/n ratio of over 90dB is attained. Any noise heard while listening to a CD record either stems from the original recording or from some other component in the hifi system.

Compact Disc Digital Audio System (CD)

General Specifications:

	CD	LP Record
Frequency Response	2o to 2o ooo Hz	3o to 2o ooo HZ
S/N Ratio	More than 9o dB	More than 6o dB
Dynamic Range	More than 9o dB	max. 55 dB (1 KHZ)
Channel Separation	More than 9o dB	25 - 35 dB
High Frequency Distortion Rate	Less than o.o5 %	o.2 %
Wow Flutter	o %	o.o3 % (W.RMS)
Playing Time	6o Min.	3o Min.
Disc Diameter	4.7 in.	12 in.

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DIGITAL TECHNOLOGY IN THE STUDIO

The digital revolution is already underway, gradually changing recording techniques and adding a new measure to the public's enjoyment of recorded sound. To a large extent, the transition to digital from analog has been implemented in the recording of master tapes in studios around the world. With the introduction of Compact Disc, the benefits of digital technology are extended to include playback in the home, revealing for listeners a degree of realism that has been long sought but never before attained.

Conventional Analog Recording (Diagram 1)

In conventional analog recordings, as the musicians play, the sound signals are picked up by microphones (where they are converted to varying electrical energy) and transmitted to a mixing console and thence to a multi-channel tape recorder. At the console, the engineer regulates and controls the signals from individual instruments or groups of instruments to achieve the desired sound balance for live

-more-

presence and realism. These separate tracks, often as many as 16 or 32, later are mixed-down -- usually with further manipulation -- to obtain two tracks in left-and right-channel stereo. The resulting "master tape" is then used to produce the wavy groove in the "master disc" on a lacquer-cutting machine and from this master many stampers are made.

Up to the tape mastering stage, digital technology is generally thought to provide only marginal improvements in the quality of the sound. In fact, many experts feel that in the recording, mixing and mastering stages digital technology has no discernable effect on sound quality.

The digital influence, however, becomes clearly evident during such further processing steps as copying, multitrack re-mixing and editing -- all of which take place long after the original recording session. At these steps, digital technology provides noticeable improvements in sound quality through complete elimination of noise, distortion, echo, wow and flutter. Digital technology also prevents progressive losses in succeeding sound generations when copying and re-mixing. When digital audio is employed in recording and processing, the sound quality attained in the resulting analog records then depends solely on the degree of sophistication in manufacture of the disc.

The First Step: Digital Recording and Processing (Diagram 2)

At the present state of the art in recording technology, digitalization for the production of Compact Disc has been implemented from the digital multi-channel recorder to the digital cutting machine with the only gaps at present being at the mixing consoles. This almost unbroken chain of digital apparatus is in regular use on the professional level. This, with the development of opto-digital recording machinery for the production of masters, paved the way for the CD system.

Tomorrow -- Complete Digitalization (Diagram 3)

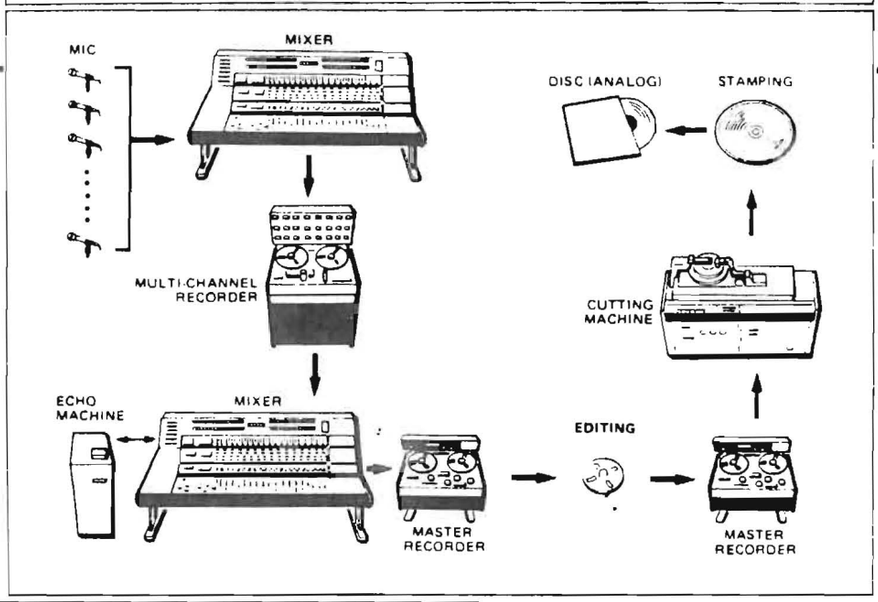
By 1986, it is expected that all stages in the recording and processing of the CD masters will have been digitalized. The only remaining analog stages will be the conversion of physical sound energy to electrical at the microphone and the reconversion of electrical to physical energy at the loudspeakers. As a result, the listener at home will hear an exact and unblemished duplicate of what the artists originally recorded at the studio -- just as if listener and musicians were in the same room.

One further benefit: Even existing analog recordings, long stored in the archives, can be processed digitally to deliver the clarity and realism of the original.

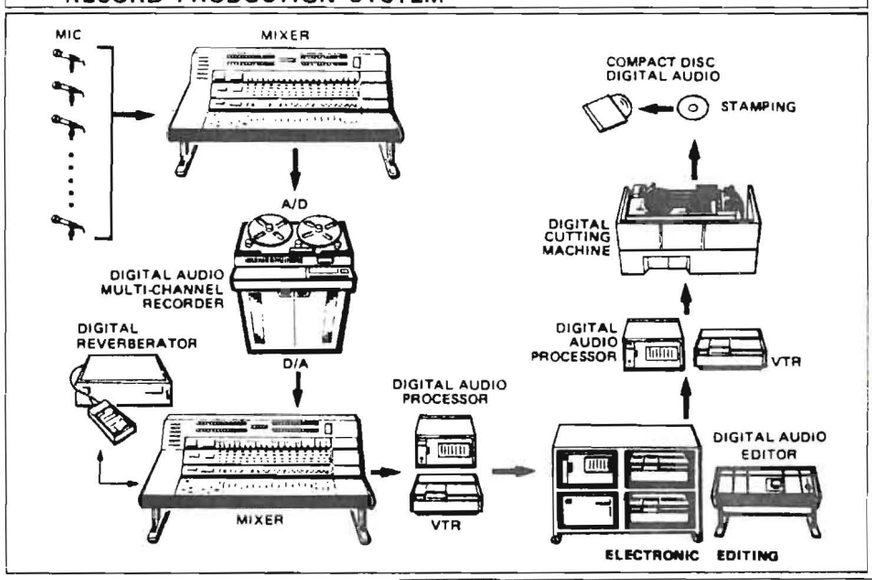
# # #

THE DEVELOPMENT OF AUDIO RECORD PRODUCTION SYSTEMS

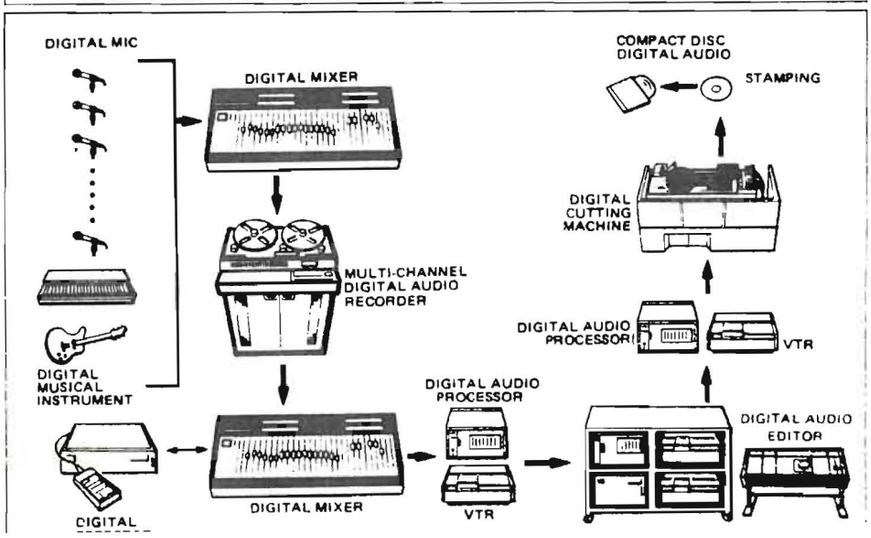
1. THE CONVENTIONAL ANALOG RECORD PRODUCTION SYSTEM



2. THE STATE-OF-THE-ART DIGITAL AUDIO EDITING AND RECORD PRODUCTION SYSTEM



3. THE SONY ALL-DIGITAL AUDIO RECORD PRODUCTION SYSTEM SCHEDULED TO BE AVAILABLE BY 1986



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NORTH AMERICAN PHILIPS CORPORATION

North American Philips Corporation, a multi-market manufacturing organization with more than 52,000 employees in the U.S. and abroad, had sales of $2.7 billion in 1980, ranking it among the 150 largest industrial companies in the United States. (1980 sales do not reflect those of the TV set and components business acquired from GTE in January 1981.) North American Philips stock is traded principally on the New York Stock Exchange under the trading symbol NPH.

North American Philips concentrates its efforts in the fields of consumer products and services; electrical and electronic components; professional equipment and chemical products. Many North American Philips brand names are among the best known in their respective markets. A partial list includes Norelco electric razors and coffee makers, Magnavox, Sylvania and Philco consumer video and audio products, Genie garage door openers, Baker furniture, Selmer musical instruments, Ohmite resistors, Dialight indicators, Plumbicon TV camera tubes and Philips medical systems and electronic instruments.

Approximately 62% of the common stock of North American Philips Corporation is owned by Hartford National Bank and Trust Company as Trustee of the United States Philips Trust. Shareholders of Philips of The Netherlands are beneficiaries of The United States Philips Trust.

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North American Philips places great value on its relationship with N.V. Philips, one of the largest industrial organizations in the world. The Netherlands firm is a supplier to North American Philips of many innovative products, and provides the Corporation with access to a worldwide research and development capability, as well as to advanced manufacturing and process know-how and technology.

# # #

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SONY CORPORATION, TOKYO

Sony Corporation of Tokyo, Japan is celebrating its 35th anniversary in 1981. Since its early beginnings in a bombed out Tokyo department store in 1945, Sony has grown to become a worldwide leader in transistor and integrated circuit technology. From an initial capitalization of $500, Sony now employs over 33,000 people worldwide, with sales during 1980 of over $4.2 billion.

Sony manufactures products that cover the entire range of consumer and professional electronics--from color television receivers to office equipment to state-of-the-art broadcast equipment. The company has manufacturing facilities in eleven countries including two factories in the United States that employ over 3,000 people.

In the course of its relatively short history, Sony has repeatedly caught the attention of consumers and industry experts the world over by introducing spectacular new products of great innovation. Some of these include: the first tape recorder made in Japan (1950), the first Japanese transistor radio (1954), the world's first fully transistorized television set (1959), the world's first home video tape recorder (1964), the first portable VTR (1966), and the first PCM audio unit for home use (1977). The Trinitron color television tube was awarded an Emmy by the American Academy of Television Arts and Sciences in 1973.

- more -

Sony's Betamax system made a substantial impact on the world-wide popularity of home video recording.

The co-founders of Sony, Masaru Ibuka and Akio Morita, still direct executive policy decisions for the entire Sony group. Mr. Ibuka is Honorary Chairman and Mr. Morita is Chairman and Chief Executive Officer. Mr. Kazuo Iwama, President, joined the company during its earliest days and is responsible for the overall operations of Sony.

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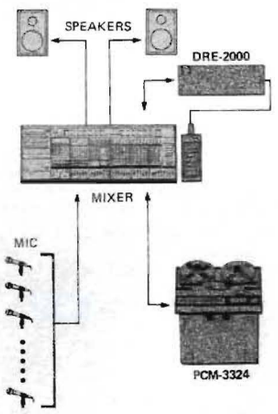
THE COMPACT DISC PRODUCTION SYSTEM

COMPACT disc DIGITAL AUDIO

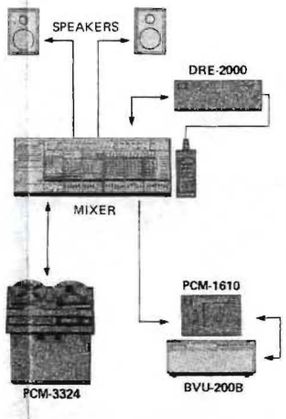
SONY

PHOTO: PRESENTED BY CBS/SONY

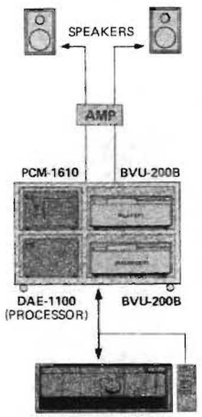
RECORDING



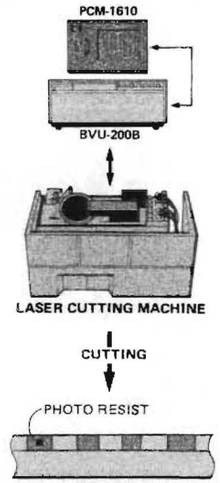
TRACK DOWN



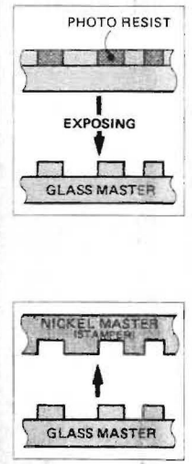
MASTERING



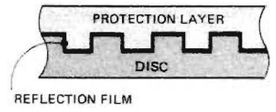
LASER CUTTING



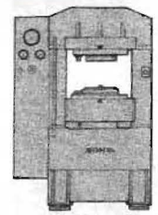
TO MAKE STAMPER



COATING & LAYERING



PRESS SYSTEM



PRESS MACHINE