

CD-4

Originated by JVC

AN INTRODUCTION

JVC

Message from Mr. K. Suzuki, the Director in charge of JVC's Stereo Division.



This booklet has been specially written to give people concerned with sound an understanding of JVC's CD-4 discrete 4-channel system. It is addressed to dealers in and salesmen of both hardware and software and all audio writers and critics who, in the course of their work, will have to deal with the CD-4 system.

Audio realism is the watchword behind JVC's progress. Ever since JVC emerged as a company in its own right there has been a continuous quest for perfection. The aim has been to give the consumer the wherewithal to recreate in his living room exactly the conditions that existed where the recording was made.

As you may or may not know the 45/45 stereo system was independently developed in Japan by JVC. This was merely a step in the direction of reaching "audio realism". CD-4, compatible discrete 4-channel, is yet another step. I do not claim that it is the ultimate step, but I think I am justified in claiming that it is the most important step to have been taken in audio for many years and will establish the recording standard for many years to come.

This booklet does not set out to be a full technical description of the CD-4 system but it will give people concerned with audio a good understanding of the principles involved.

Ken Suzuki

WHY 4-CHANNEL ?



From Edison to the 1950s played back sound was monaural. The quality of the sound improved over the years but the sound remained monaural. A sound field which originates from one source cannot sound like anything other than it is. And when you're in a live listening environment the sound doesn't appear to come from just one place.

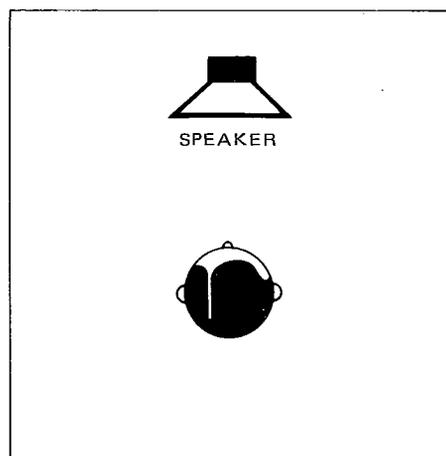
The late 1950s brought 2-channel stereo. This was a big advance over mono; with the sound coming from two speakers instead of one the apparent source could be anywhere between the two speakers. You could actually hear the singer move and the violinists were on the left and the brass was on the right just like in the live performance.

But even though 2-channel was a big improvement over mono something was still missing. At a live performance there's a 3-dimensional sound field; it's made up from sound coming from the orchestra (or rock group) and reflections from the walls, ceiling and floor. It's this that gives the sound its unique quality. But two speakers cannot create a 3-dimensional sound field; to do this accurately you must have four speakers, each producing its own sound.

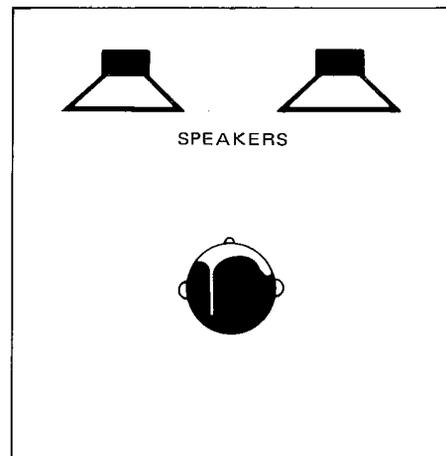
The need for 4-channel sound was admitted by audio experts several years ago but technical obstacles stood in the way of implementing it.

Reel-to-reel tape decks were the first source to be used to produce 4-channel sound. With these tape decks the obstacles were not so great and four fully discrete channels could easily be recorded to and picked up from 1/4" wide magnetic tape. The next program source that was used for discrete 4-channel playback was 8-track cartridge tape. Here again the problems were not so great.

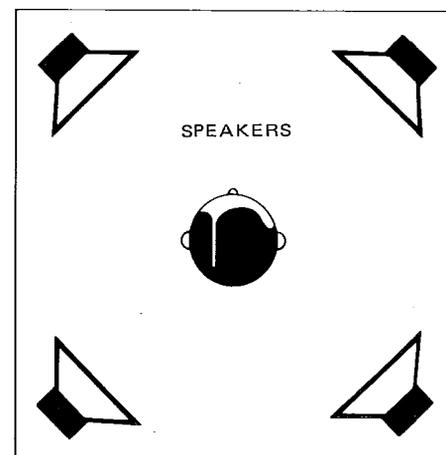
But tape decks are not such a popular program source. Reel-to-reel decks only have a 5% market penetration, and this is confined to real hi-fi enthusiasts.



MONO



2-CHANNEL
STEREO

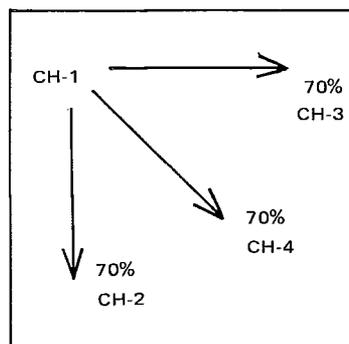
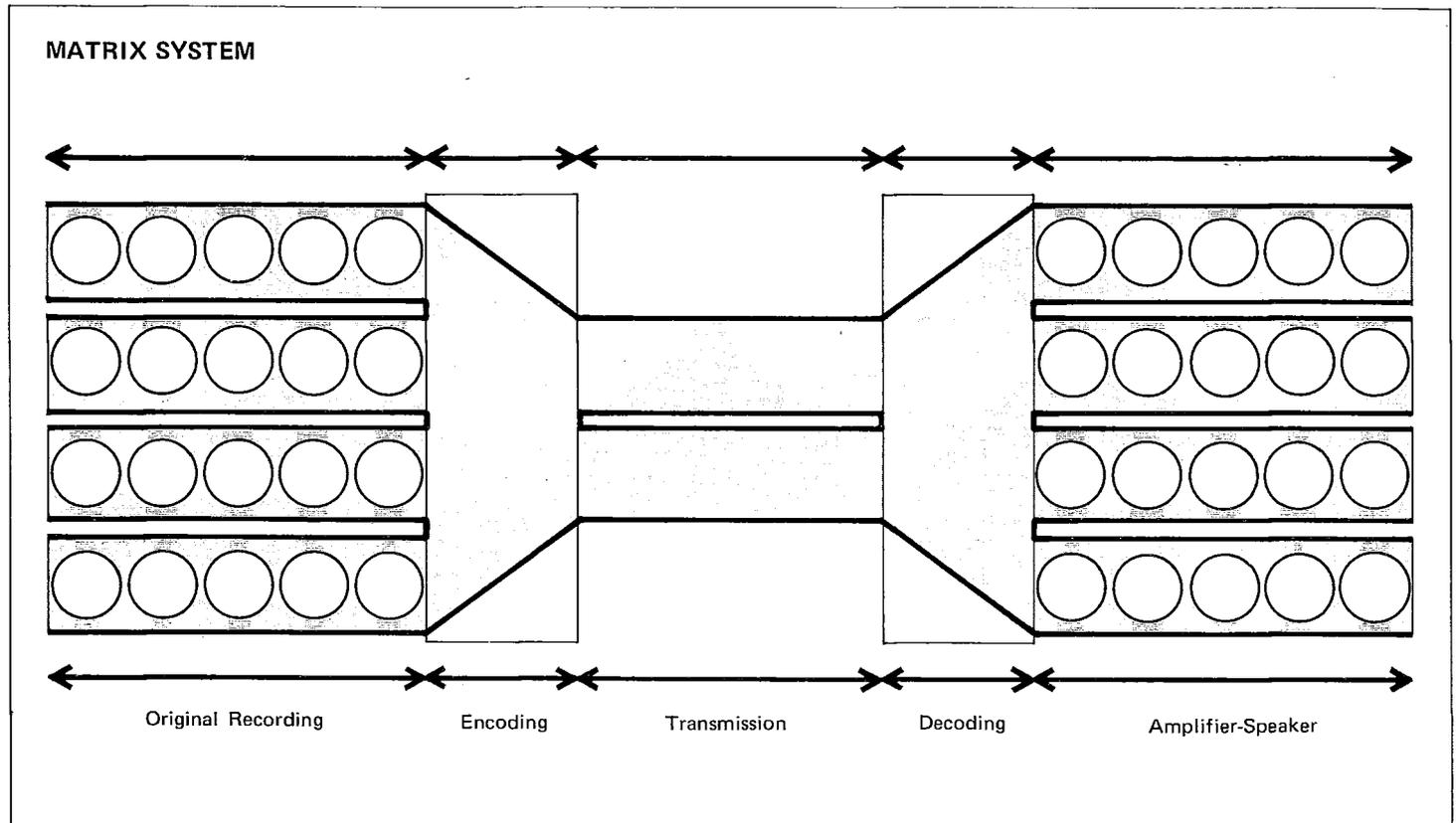


4-CHANNEL
SOUND

To make 4-channel really marketable what was needed was a disc system. So audio engineers throughout the world set about seeking a 4-channel recording and playback technique. When many people set about the same kind of research it's quite natural that many different approaches will be tried. And that's what happened with 4-channel recording systems. But most engineers considered themselves limited by the recording techniques currently in use and so had to restrict themselves to systems which, although they had 4-channel recording and playback, had only a 2-channel transmission system. So, in effect, the four individual or discrete channels which made up the original sound field had to be electronically processed to fit the existing stereo format.

To achieve this it was necessary to include in the recording system an encoder which takes the 4 channels from the master tape and, by mixing them in a carefully predetermined way, arrives at two signals which can then be recorded by the conventional 2-channel system. In playback a decoder performs exactly the opposite function of the encoder used in recording and produces the four channels which should recreate the sound field.

These systems are called matrix — because of the encoder/decoder configuration — or 4-2-4 systems. In the last few years many such systems have been introduced and the fact that so many systems existed created real confusion in the minds of the record buying public.



Interchannel crosstalk with matrix systems
About 70% of one channel's signal goes to the other 3 channels' speakers.

The major drawback which exists in these matrix systems is that interchannel crosstalk cannot be eliminated. This is inherent in the system. And as crosstalk increases, channel separation deteriorates. With conventional stereo a channel separation of around 20dB can easily be achieved but with matrix 4-channel manufacturers are asking the public to be satisfied with 3dB. Very few people can distinguish sound with such a low channel separation from monaural sound.

There have been improvements in matrix systems but they all add to the cost of the decoder needed to play the records back. Phase shift circuits and logic components have added to channel separation but generally it seems that, as one problem has been eliminated, another has arisen, especially the loss of original sound material due to phase shifts.

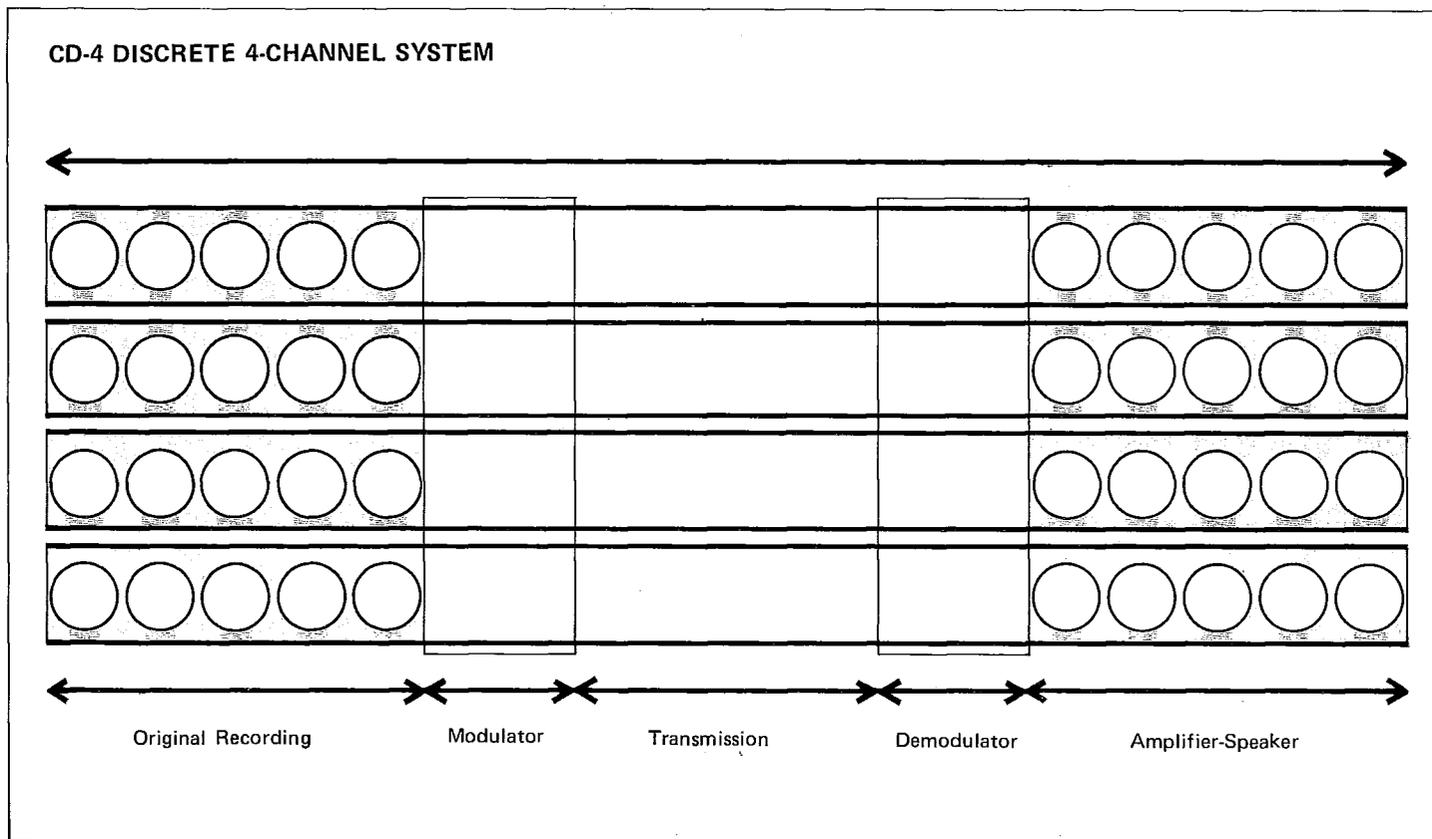
The approach that JVC engineers decided on was completely different. They did not consider themselves to be restricted by current recording techniques and set about their research along another path entirely. Their initial experiments showed them that matrix systems had inherent weaknesses and that the only system which could satisfactorily reproduce the 3-dimensional sound field of a recording studio was a fully discrete system.

Their system requires a more accurate record cutting system than was previously available and a stylus/cartridge with a wider range. The only constraints that they imposed on themselves was that it should be compatible with existing playback equipment and be fully discrete 4-channel. These two principles — Compatibility and Discreteness — give the system its name — the CD-4 system.

CD-4 - AN INTRODUCTION

JVC's CD-4 is a revolutionary record system. It keeps the four channels separate all the way from recording to playback. This gives it its unique discreteness. And it can be played back on existing 2-channel or even mono record players without any loss of musical information. This is because it is fully compatible.

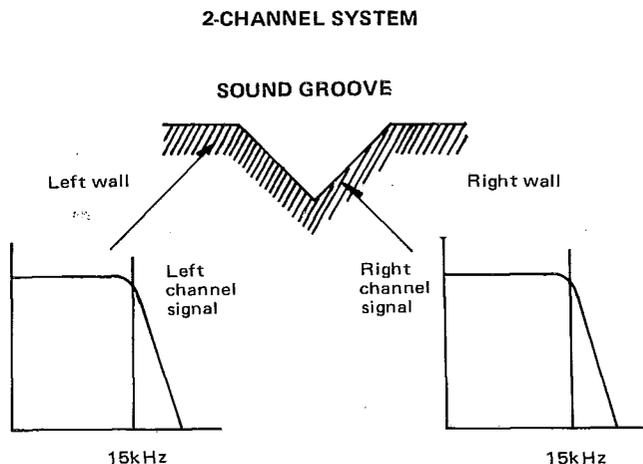
Matrix systems are not discrete. And, if you've listened to matrix recordings on a conventional 2-channel or mono record player, you'll realize that they're not compatible. There are certain combinations of sound which will disappear in playback even if you use the correct decoder.



The Recorded Signals in Regular Stereo

You understand the 2-channel 45/45 system which is the standard used in regular stereo. The left wall of the groove holds the left channel signal and the right wall holds the right channel signal.

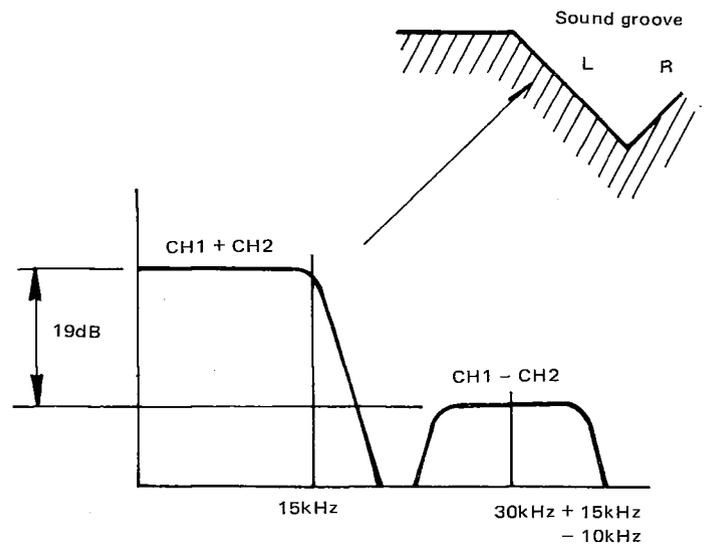
Both these signals are held as amplitude-modulated audio signals.



Two Signals on One Wall

Now the breakthrough occurred when it was realized that each wall could carry two signals if the latest technological advances were used. One signal can be held as a regular audio signal and the other as a frequency modulated signal — like in FM radio — with a base frequency so high that the FM signal doesn't interfere with the audio signal at all.

So that the groove can be tracked by a conventional stylus and to minimize any chance of interference by the FM signal with the audio signal — the FM signal will have to be treated specially anyway — the FM signal's level can be reduced below that of the audio signal. A level difference of 19dB was decided on as an optimum.

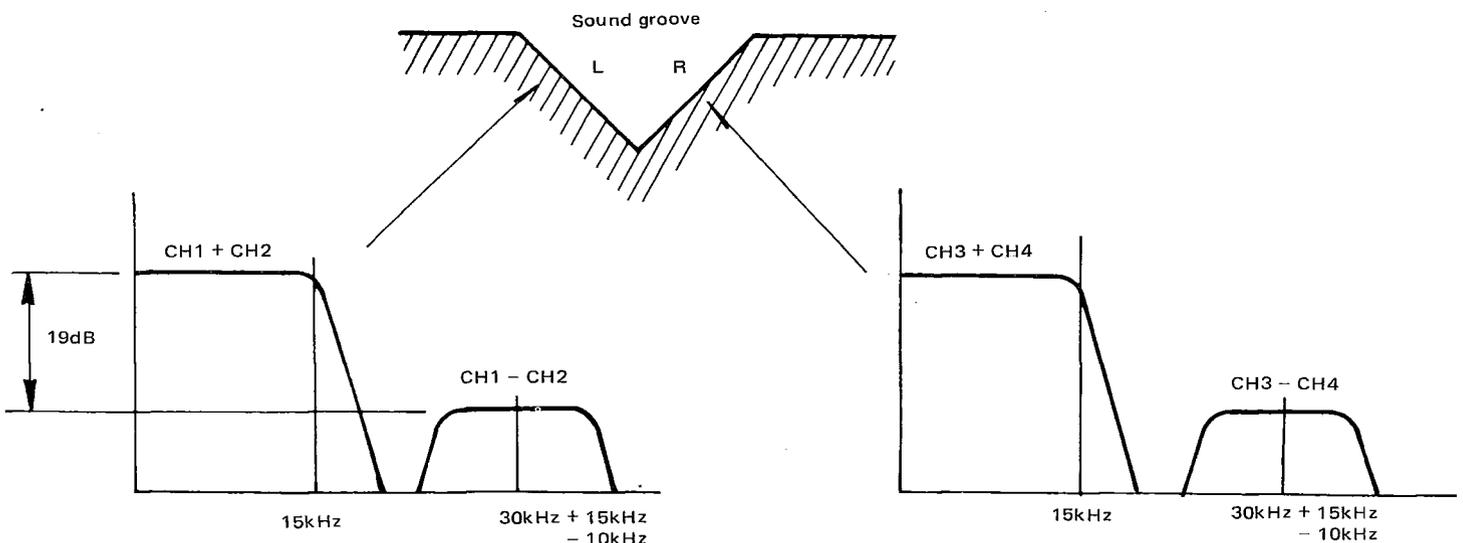


Four Signal in One Groove

These advances give us the ability to record four separate signals in one groove, but this doesn't solve the problem completely. If each of the signals was music from one channel and if the record was played back on conventional 2-channel stereo equipment, then only the two channels recorded as audio signals would be heard. This would result in the loss of half the musical information on the record and would not satisfy the original concept of "compatibility"

But a system exists which satisfies the "compatibility" requirement. To understand it you need only a very basic knowledge of algebra.

If, before the signals are recorded, the front and rear signals are added together and recorded as the audio signal and subtracted before being recorded as the FM signal, then in playback through a regular stereo system the sum of the front and rear would be heard and no musical information would be lost. This would make it a completely compatible system.



The four signals which are recorded are:

- (CH1 + CH2) Left wall, audio signal
- (CH1 - CH2) Left wall, frequency modulated signal
- (CH3 + CH4) Right wall, audio signal
- (CH3 - CH4) Right wall, frequency modulated signal

By providing circuitry which can perform a simple algebraic operation on these signals, the four independent signals can be obtained.

$$\frac{1}{2} [(CH1 + CH2) + (CH1 - CH2)] = CH1$$

$$\frac{1}{2} [(CH1 + CH2) - (CH1 - CH2)] = CH2$$

$$\frac{1}{2} [(CH3 + CH4) + (CH3 - CH4)] = CH3$$

$$\frac{1}{2} [(CH3 + CH4) - (CH3 - CH4)] = CH4$$

This is the principle of the CD-4 system. Not so difficult to understand but it presented problems of an entirely new kind which were sufficiently difficult to make some manufacturers who investigated this kind of system discontinue their research. JVC persevered, and in the course of their research, as well as developing the demodulator necessary to treat the FM component of the signal, was forced to develop a Noise Reduction System (ANRS), a new cartridge and stylus and an improved record material and cutting system.

PLL Demodulation

The most critical element of the system is the demodulation of the frequency and phase modulated carrier which holds the difference signals. There are several ways in which this demodulation can be done but the Phase Locked Loop (PLL) IC used in the CD-4 demodulator is most appropriate in this application.

The theory of PLL was discovered in the 1930s and has been used for detecting cosmic rays, measuring signals masked by noise and in other fields of telecommunication measurement. Its uses, however, were limited because of its size and complexity and it wasn't till the 1960s that the PLL was perfected and compacted by NASA for use in space telecommunications.

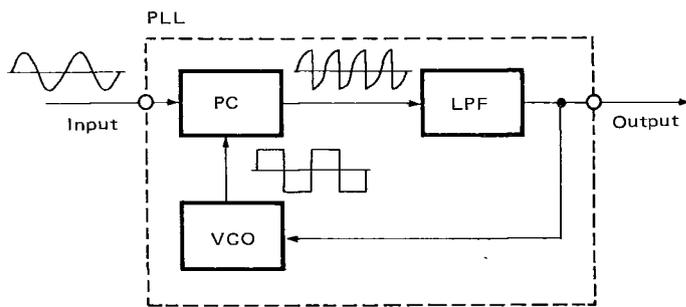
The Phase Locked Loop is a feedback system consisting of a phase comparator (PC), a low pass filter (LPF) and a voltage controlled oscillator (VCO). The frequency of the VCO is synchronized with the incoming signal. When the phase comparator detects a phase difference indicating a change in the frequency of the input signal, its output increases or decreases just enough to keep the VCO's frequency the same as the incoming frequency. This means that the voltage applied to the VCO is a function of the incoming frequency.

If the VCO has a linear voltage to frequency relationship, and if the input to the PLL is a frequency modulated signal, then the voltage which must be applied to the VCO to correct its output to the phase comparator is the demodulated output required.

Modulation

Throughout this discussion, for the sake of simplicity, the modulated carrier which holds the difference signal is referred to as "frequency modulated". This is not entirely true; it is actually a combination of frequency modulated signals and phase modulated signals. Below 800Hz frequency modulation is used, from 800Hz to 6,000Hz phase modulation is used and then above 6,000Hz frequency modulation is again used. This takes full advantage of the nature of both these systems of modulation. There is reduced crosstalk and an improvement in the S/N in the mid, phase-modulated range and more linearity in the low and high frequency, frequency modulated, ranges.

When there is no input signal to the PLL the VCO operates at 30kHz and there is no demodulator output. When an input signal with a frequency close to 30kHz is applied to the PLL, the VCO's frequency will follow the input signal and the signal which controls the VCO will be the demodulated signal.



BLOCK DIAGRAM OF PHASE LOCKED LOOP

The benefits of PLL demodulation are independent center frequency adjustment, independent bandwidth adjustment, high noise immunity, high selectivity and high frequency operation. Perhaps the most important in its application to CD-4 demodulation is the bandwidth adjustment which enables the carrier based difference signal to be detected without shattering distortion when the CD-4 record has been played back many times.

ANRS(Automatic Noise Reduction System)

To avoid interference between the audio signal and the FM difference signal, the FM signal is recorded 19dB lower than the audio signal. But this, in turn, means that parts of the difference signal will themselves be severely interfered with by noise originating from the mechanical parts of the system; the cutter, record and pick-up. The system developed to solve this problem by JVC's engineers is called ANRS (Automatic Noise Reduction System) and requires two circuits; one in recording and the other in playback.

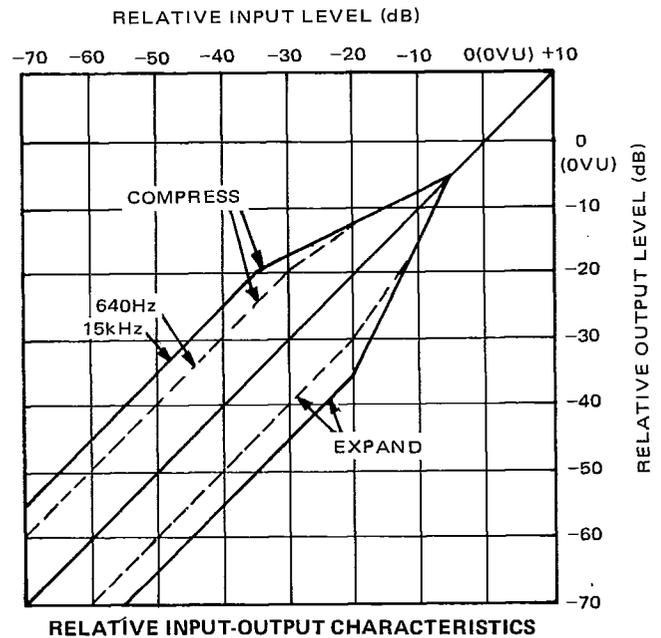
The principle behind ANRS is the masking ability of the human ear. When two sounds occur at the same time and one is quiet and the other is loud, only the louder sound will be heard.

The way this is applied is that, in recording, the music signal is boosted before the noise is added to it. In playback the whole of the signal is reduced by exactly the same amount as it was boosted in recording; this makes the music signal the same as the original, but, because the noise was a smaller part of the recorded signal, it is also a smaller part of the played back signal.

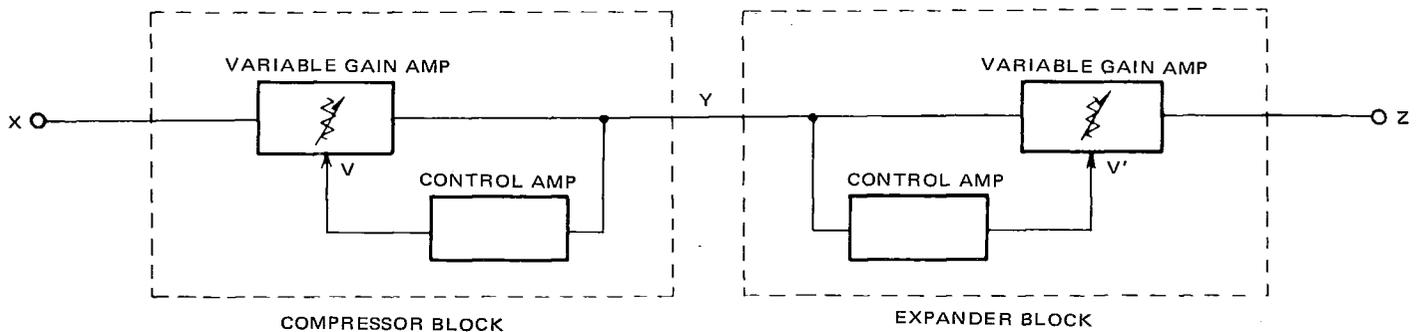
As noise is most apparent in the middle and high frequencies with low level signals it is only these parts of the signal which need to be treated in this way.

The recording system uses a variable gain amplifier, the gain of which is controlled by its own output signal and the playback system again uses a variable gain amplifier but this time its gain is controlled by its input signal. To achieve the exact

correspondence necessary so that the input and output signals should be the same, all that is necessary is that the characteristics of the two variable gain amplifiers be exactly complementary at all frequencies and levels.

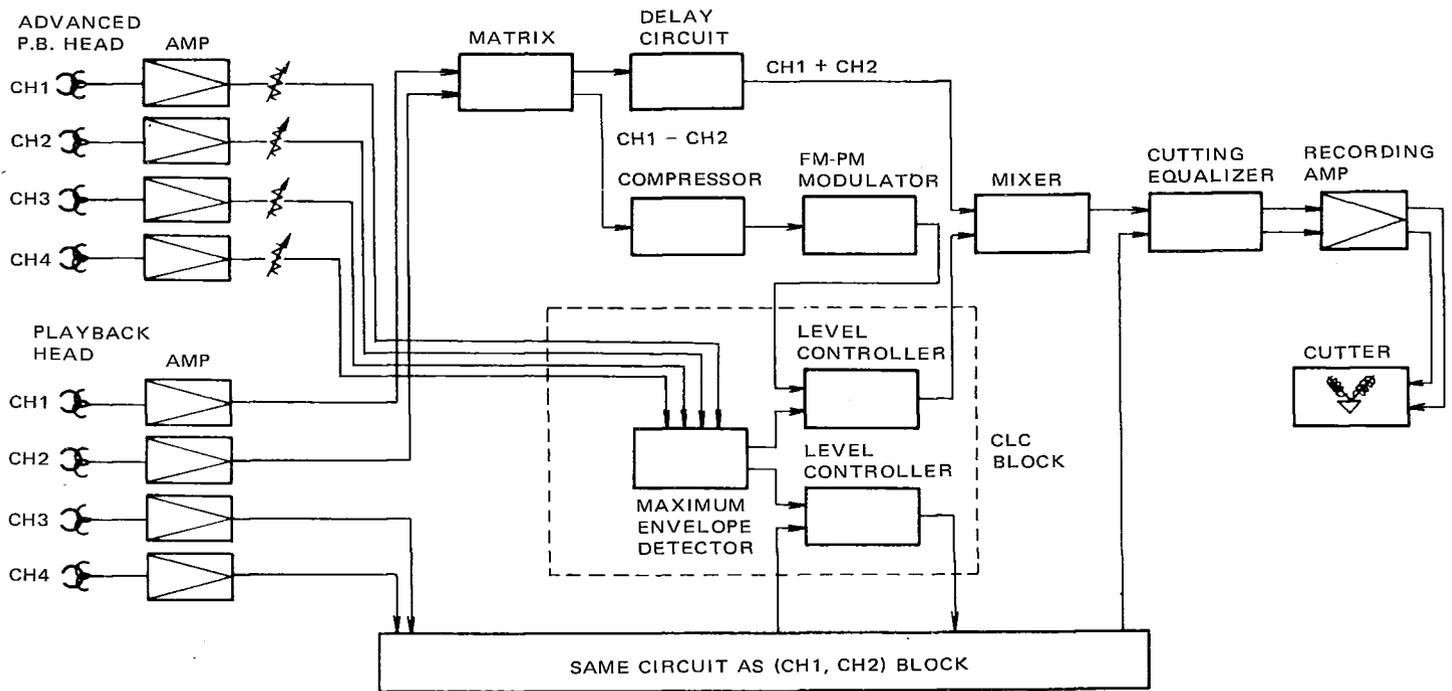


PROCESS OF AUTOMATIC NOISE REDUCTION SYSTEM



$$\begin{aligned}
 Y &= X \times V \\
 Z &= Y \times V' = X \times V \times V' \\
 V \times V' &= 1 \\
 \text{Now } Z &\equiv X
 \end{aligned}$$

CD-4 RECORD CUTTING



BLOCK DIAGRAM OF CARRIER LEVEL CONTROLLER

Several new techniques have been introduced into the record cutting process, all of them intended to facilitate playback and reduce the cost and complexity of playback equipment.

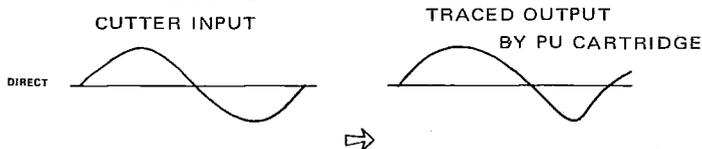
Cutting Equipment

The cutting equipment used at present is not able to cut the wide range of frequencies needed in the CD-4 system. Initially cutting was done at 1/2.7 of the normal cutting speed and this introduced a great number of complications; now cutting is done at 1/2 the normal cutting speed and this is a considerable simplification as the record cutters used throughout the audio industry have a 1/2 speed cutting mode. An additional complication that low speed cutting introduces is that the various time constants needed in the CD-4 system must be scaled down accordingly.

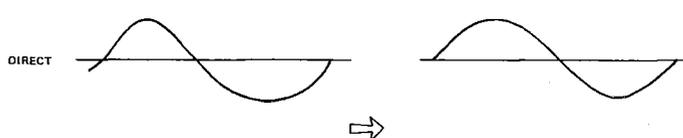
Delay Circuit

In playback, the modulated signals must be picked up 40 μ sec earlier than the corresponding sum signals. This is so that the demodulation process can be performed without altering the phase relationship between the sum and difference signals in playback. It is done by using a delay circuit in the sum signal's path; the length of this delay must be doubled to 80 μ sec if 1/2 speed cutting is being used.

1. ORDINARY CUTTING



2. CUTTING CONTROLLED BY NEUTREX



Carrier Base Oscillator

A single master oscillator is used to provide the base for the carrier on the two walls of the groove. This eliminates beats between the two signals, reduces crosstalk and minimizes distortion. Again the frequency of this oscillator must be scaled down when low speed cutting is being performed.

Carrier Level Controller

For their optimum detection the level of the modulated signals must be different for different levels of the sum signal. The Carrier Level Controller compensates for this. The record cutter tape deck has two heads; as well as the main heads there are also heads reading the tape slightly in advance. The signals from these heads are fed into a maximum envelope detector and from there into a level controller which adjusts the level of the modulated difference signals before they are mixed with the sum signals.

Neutrex

The groove in the CD-4 system is complex and this presents a serious obstacle to the accurate tracing of the groove by the stylus as it must track both the audio and modulated signals. If there was no kind of compensation the stylus would tend to skate along the groove, tracking the imaginary waveform resulting from the mixture of audio and modulated signals, tracking neither accurately. The system developed by JVC is called Neutrex. It modifies both the cutter waveform and the modulated signals so that the correct signals are picked up in playback.

The effect of Neutrex is to improve channel separation by reducing interference between the sum and difference signals and the resultant distortion of the sum signals by minimizing fluctuations in the carrier level.

A NEW KIND OF CARTRIDGE AND STYLUS

The CD-4 system needed a cartridge/stylus assembly with a wider frequency response than was available from those currently being produced. Conventional styluses were capable of a reasonably flat response up to a frequency of about 20kHz, and this is satisfactory in a conventional stereo system because the upper audible limit is 18kHz. But, because the CD-4 uses a carrier based FM signal which can hold necessary musical information up to 45,000Hz research had to be undertaken to develop a new stylus.

Currently available styluses are classified as spherical or elliptical depending on the shape of the tip which comes into contact with the record groove: spherical styluses are most common. But the weakness of spherical styluses is that they cannot follow the record groove accurately. As can be seen from the diagram, when the groove changes in direction it has a narrower effective width and the spherical stylus tip is forced up so that it no longer traces the groove. To overcome this problem an elliptical stylus was developed that could trace the groove more accurately even when there were lateral oscillations.

But elliptical styluses have one serious drawback: the area of contact between the stylus and the groove is very much reduced. This means that for a given stylus pressure the force on the record is much greater and this accelerates record and stylus wear.

These were the conditions then: the new stylus had to have a larger contact area with the record groove than the conventional elliptical stylus and yet had to follow the groove more accurately.

The result was the SHIBATA stylus called after the engineer who led the development team. As can be seen from diagram it has an entirely new shape which results in 4 times greater contact area than was possible before. This effectively doubles the mechanical resonance frequency which in turn increases the frequency range.

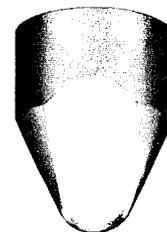
The increase in the contact area by four times means that for a given stylus pressure the force on the record is reduced by the same amount; this increases record and stylus life by four times. And because the stylus has the ideal dimensions and shape it follows the groove more accurately, decreasing waveform and phase distortion and increasing fidelity. This increase does not apply to CD-4 records alone; when played back with a SHIBATA stylus conventional 2-channel records have greater fidelity.



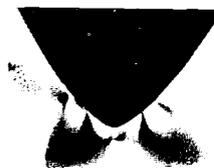
THE TRACING ACTION OF STYLUSES



SHIBATA STYLUS



CONVENTIONAL ELLIPTICAL STYLUS



TENSION UPON THE DISC SURFACE BY SHIBATA STYLUS (2g)



TENSION UPON THE DISC SURFACE BY ELLIPTICAL STYLUS (2g)

CD-4—A CHRONOLOGY

JVC's research into recording systems using a supersonic modulated carrier started in 1963. Since then there has been intensive research which has resulted in the CD-4 discrete 4-channel record system. Major milestones in its recent development are:

- | | | | | | |
|------------|---|------------|---|-----------|--|
| 1970 Sept. | JVC announced the CD-4 system in Japan and demonstrated it. | 1971 March | At the 1st Central European AES Meeting JVC read a report "The 4-Channel Disc, CD-4" and demonstrated the CD-4 system. | 1971 Oct. | At the 41st AES Convention in New York JVC gave a report on "Further Improvements of the Discrete 4-Channel Disc System" |
| 1970 Oct. | At the 39th AES Convention in New York JVC gave a report "A Discrete 4-Channel Disc and its Reproducing System" and demonstrated the CD-4 system. | 1971 April | At the 40th AES Convention in Los Angeles JVC reported on a number of engineering improvements in the CD-4 system. | 1971 Nov. | An announcement was made in New York by JVC, Panasonic and RCA that RCA Records would adopt the CD-4 system. |
| | | 1971 June | The Shibata stylus, specially designed for the CD-4 system, was announced. | 1971 Dec. | The Engineering Committee of the Japan Phonograph Record Association issued standards for the manufacture of CD-4 records. |
| | | 1971 June | CD-4 records and playback equipment were released on the Japanese market. | 1972 Feb. | A demodulator was developed with a better performance and improved compatibility because of its use of a PLL (Phase Locked Loop) IC. |
| | | 1971 July | JVC submitted a technical report "A Discrete 4-Channel Disc and its Reproducing System (CD-4)" to the Journal of the AES. | | |

MARKETING IN JAPAN

AND WORLD-WIDE

CD-4 was first sold in Japan in the middle of 1971 and has had unrivalled success since then. Over 60% of the 4-channel records sold are CD-4. This is because CD-4 is the only system which satisfies all the conditions necessary to be really marketable. JVC's prediction which was made early in the development of the CD-4 system, that CD-4 would be the industry-wide standard in the years to come, is coming true. Several record companies have already released CD-4 records and several more have stated their intention to do so in the months to come.

More important, other hardware manufacturers who were or, in some cases, still are involved with matrix pseudo 4-channel systems are incorporating CD-4 demodulators into their latest, top quality amplifiers and receivers. Almost every high quality amplifier being sold in Japan has a built-in CD-4 demodulator. As well as increasing the number of CD-4 users this indicates that CD-4 has really been accepted.

Stereo and hi-fi have maximum market penetration in the United States. At the moment CD-4 4-channel has had its maximum impact in Japan but this situation is likely to change.

From the start CD-4 has been accepted by RCA as the only wholly satisfactory 4-channel record system. Their "QUADRADISC" records are in the CD-4 format. These records are being released every month in increasing numbers and it is RCA's intention to change their entire production to "QUADRADISC" records in the near future. The WEA group, the biggest popular record producer in the U.S., has also signed a licensing agreement with JVC to manufacture CD-4 records. JVC has established a wholly owned subsidiary in Los Angeles, JVC Records Inc. to cut CD-4 masters for U.S. record manufacturers. These developments, together with the sales and publicity campaign planned by JVC, should make the U.S. audio buying public fully aware of the CD-4 system during 1973.

In Europe the situation is slightly different because 4-channel records and CD-4 are relatively unknown. At the end of 1972 JVC entertained a party of American and European audio writers. Their comments, combined with the publicity campaign in 1973, should change this situation.

JVC's CD-4 equipment will be demonstrated throughout Western Europe in 1973 and JVC's CD-4 records will be available. Very soon RCA "QUADRADISC" records will be released in Europe, first imported from the U.S.A. and then later cut in Europe.

| | | | | | |
|------------|---|------------|--|-----------|--|
| 1972 March | At the 2nd Central European AES Meeting JVC reported on "Further Improvements in the Discrete 4-Channel System (CD-4)". | 1972 July | The Engineering Committee of the Electronic Industries Association of Japan issued a set of standards for CD-4 hardware. | 1972 Nov. | Teichiku Records and Nippon Phonogram Records released CD-4 records. |
| 1972 March | The 4DD-10 Demodulator was put on sale in export markets. | 1972 July | The number of CD-4 albums released in Japan exceeded 100. | 1972 Dec. | The number of CD-4 albums released in Japan exceeded 150. |
| 1972 May | RCA Records released CD-4 records in the U.S.A. | 1972 July | CD-4 record cutting started at RCA's New York studio. | 1973 Feb. | The WEA Group of companies signed a licensing agreement to produce CD-4 records. |
| 1972 May | At the 42nd AES Convention in Los Angeles JVC reported "On the Reproduction of Discrete 4-Channel Disc, CD-4" | 1972 Aug. | A CD-4 patent was issued in the U.S.A. | | |
| 1972 June | The 4DD-5 fully compatible Demodulator was put on sale in the Japanese and export markets. | 1972 Sept. | At the 43rd AES Convention in New York, JVC gave a paper on "The Technical Requirements of Phono Cartridges for Proper Playback of CD-4 Discrete 4-Channel Records". | | |
| 1972 June | JVC submitted a report on "Further Improvements in CD-4" to the Journal of the AES. | 1972 Nov. | A 4-channel receiver 4VR-1006 with a built-in CD-4 demodulator was put on sale. | | As of March 1973, the hardware companies other than JVC which are committed to the CD-4 system are: Panasonic, Pioneer, Hitachi, Mitsubishi, Sanyo, Onkyo, Sharp, Trio Kenwood, Akai and Sansui. |

CD-4 PLAYBACK EQUIPMENT

If a buyer was setting up a CD-4 system as his first venture into the world of audio he would be able to buy a complete range of components which have been specially designed to play CD-4 records and get the best out of them. And if an enthusiast with an unlimited budget wanted to set up a CD-4 system he could do the same. But this is seldom the case. Usually people upgrade their audio systems by adding components to an existing system.

WHAT DO I NEED TO PLAY CD-4 RECORDS?

Your record player will probably be completely satisfactory. The main consideration is that the signal cords which connect it to the demodulator should have a sufficiently low capacitance. JVC makes low capacitance signal cords (LSC-1) and these are available from your JVC dealer.

Your cartridge and stylus assembly, unless it is very modern, will almost certainly have to be replaced by one with the wide range frequency response necessary to play CD-4 records to their best advantage. If a cartridge/stylus with a less wide frequency response is used, although the difference (frequency modulated) signal will be detected, it will not be strong enough to produce the optimum channel separation between the front and rear.

The next component in the system is the only truly essential new component. JVC's newly developed demodulator is necessary for playing CD-4 records. You can buy it as a separate component or built-in with a record player, receiver, amplifier or console.



Fully discrete 4-channel amplification is, of course, necessary. Some audiophiles will already have an integrated 4-channel amplifier. Others may choose to buy an add-on amplifier such as JVC's model VN-5101; these can be used to give an existing 2-channel amplifier a 4-channel ability. And still others will choose to buy a 4-channel amplifier or receiver.

Four identical speakers are the ideal but many people will prefer initially to buy only one pair of new speakers. To get the best possible sound from a CD-4 system it is better to buy omni-directional speakers for the rear pair of speakers.



SRP-473E — precision-built 2-speed turntable with "Sure-Tracking" tonearm

The SRP-473E is specially designed to be ready for the age of discrete 4-channel sound. It comes fitted with a 4-channel cartridge and has the low capacitance signal cords necessary in the CD-4 system. To upgrade this record player to full CD-4 specification, all that is needed is a Shibata stylus. JVC's 4DT-10X from your dealer.

The 4-pole synchronous motor ensures precise speeds and reduced vibration and noise. It uses a belt to drive the high inertia aluminum die-cast platter; this further improves the system, getting the wow and flutter down to less than 0.1% WRMS. The universal tonearm is specially designed to provide stable tracking at low stylus pressures.

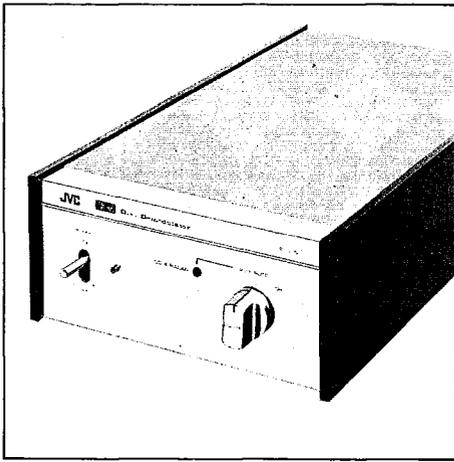
7-1/4"(H)x18-3/16"(W)x14-9/16"(D), 22 lbs.

VL-8 — a very special record player

A top performance precision 2-speed turntable and a high class tonearm put the VL-8 in a class by itself. The high inertia turntable is driven by a brushless DC servo motor which reduces wow and flutter to less than 0.05% WRMS. A built-in stroboscope provides an additional check that the speed is exactly correct and fine adjustment controls allow precise setting. The universal tonearm is statically balanced for stable tracking at light stylus pressures and is provided with an anti-skating bias adjustment device.

The record player is ideal for every hi-fi system and, fitted with a CD-4 compatible cartridge, gives the best quality possible of discrete 4-channel sound.

7-1/2"(H)x19-3/8"(W)x16-1/4"(D), 22 lbs.



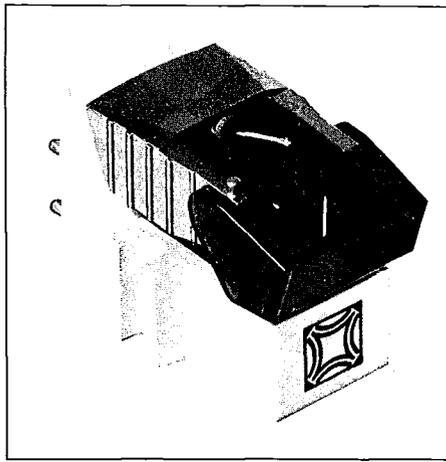
4DD-5 Demodulator *kr. 1450,-*

This is the unique component that makes CD-4 discrete 4-channel sound possible. Although it's possible to buy demodulators built-in to many stereo components, many audiophiles will prefer to buy a separate component demodulator.

The 4DD-5 makes your stereo system completely 4-channel/2-channel compatible: you can switch it to 2CH and the signals from the record player by-pass the demodulator completely. Or you can switch it to 4CH AUTO: in this mode a logic circuit examines the signal from the record player and only demodulates it if it is a CD-4 signal.

The 4DD-5 was designed by highly professional engineers and uses top quality components. 6 ICs, 6 FETs, 27 transistors and 23 semiconductor diodes are used in its construction. It will give years of service and satisfaction.

3-3/8" (H) x 6-7/8" (W) x 12-3/4" (D), 5 lbs.

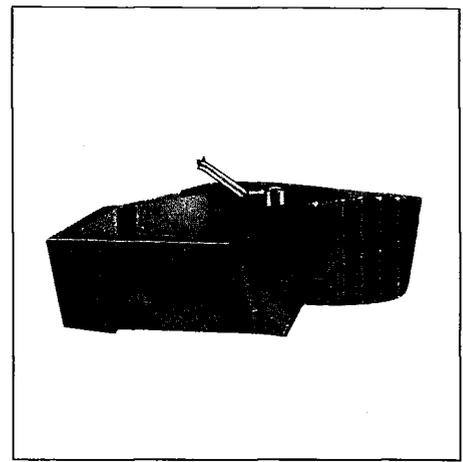


4MD-20X Unique 4-Channel/2-Channel Cartridge *kr. 570,-*

This cartridge was specially developed for use with CD-4 records but its improved characteristics give it advantages over other cartridges when used in a conventional 2-channel stereo system.

It uses a V-shaped moving magnet attached to a SHIBATA stylus. The magnet moves between highly precise coils. The frequency response is from 20 to 60,000Hz; this is a much wider range than ever before but is necessary in the CD-4 system.

Its output is 2.0mV at 1kHz and 50mm/s. The channel separation is better than 30dB at 1kHz and 20dB at 30kHz. It tracks at a stylus pressure of between 1.5 and 2.0 grams and its compliance is 35×10^{-6} cm/dyne.



4DT-20X The SHIBATA Stylus *kr. 220,-*

This is the stylus used in JVC's CD-4 cartridges and was specially developed for the CD-4 system. Its new shape enables it to trace the record groove much more exactly than any conventional stylus with the advantage, since the area of contact with the groove is four times greater, less wear on the record or stylus and longer life for both.

The larger area of contact with the record groove means that the record is "stiffer" than was before possible. This increases the mechanical resonance frequency which in turn increases the electrical resonance frequency and extends the frequency range by 40 to 50%.

The greater accuracy of groove tracing improves the S/N ratio and produces less waveform and phase distortion.

Although the SHIBATA stylus was designed specially for use in the CD-4 system its improved characteristics are apparent when playing 2-channel stereo records.

RECORD CHANGER WITH BUILT-IN CD-4 DEMODULATOR



4VC-5244 — a unique component.

A quality record changer with a built-in CD-4 demodulator.

Operation of the 4VC-5244 is in every way the same as a regular stereo record changer. The difference is the four signal cords which come from the rear panel. These signal cords carry the separate signals of the four discrete channels to a 4-channel amplifier.

The high quality record changer uses a 4-pole outer rotor induction motor driving a high inertia 11" die-cast platter at accurate speeds. The cartridge was specially developed for the 4VC-5244 and uses the CD-4 Shibata stylus 4DT-35X giving a frequency response from 20 to 50,000Hz.

Perhaps this is the most convenient way to give your system 4-channel capability.

7-3/4" (H) x 16-3/8" (W) x 15" (D), 18 lbs.

4-CHANNEL RECEIVERS WITH BUILT-IN CD-4 DEMODULATORS

This family of receivers have several high value similarities. The most important is that they all have a built-in CD-4 demodulator. This means that in addition to one of these receivers all that's necessary to play CD-4 records is a modern record player with 4-channel capabilities and 4 speakers. Two matrix decoder circuits are incorporated so that all matrix pseudo 4-channel records can be played. The S.E.A. tone control system breaks the sonic spectrum into 5 bands.

With $\pm 12\text{dB}$ control in each of these bands you can tailor the sound to suit your own taste. A BTL (Balanced Transformer-Less) circuit can rearrange the connection of the pre-amps and power amps to give double power for 2-channel stereo playback. Easy and accurate tuning, with two tuning meters, one showing the signal strength and the other the center frequency of FM broadcasts.

All these receivers use pure complementary OCL power amplifiers and this ensures that the amplification is free from distortion throughout the frequency range.



4VR-5456 kr. 5950,-

Two sets of speakers can be connected so you can have CD-4's unique 4-channel sound field in two rooms of your house.

Two 4-channel tape recorders can be connected giving you additional recording, playback and dubbing capability.

A newly developed protection circuit guards against power surges and protects the speakers and expensive electronic components.

Two independent sets of S.E.A. controls give separate adjustment of front and rear tone.

The additional controls which give the 4VR-5456 greater power and flexibility are hidden by a front panel which can be swung down when you want to use them. Additional facilities include an FM Stereo Only switch to assist in FM Stereo reception and an Audio Muting switch which instantaneously reduces the output by 20dB.

7-1/8"(H)x20"(W)x15-7/8"(D), 44 lbs.

4VR-5446

The middle model of this family, with the CD-4 demodulator as its main feature, but with other features that make it an excellent choice as centerpiece of a CD-4 discrete 4-channel system. Output terminals allow the connection of a full range of 4-channel and 2-channel program sources, including two 4-channel tape recorders.

The program source selected is illuminated above the tuning scale on the elegant black-out dial.

The same new protection circuit as used in the 4VR-5456 protects the expensive components against damage.

6-3/8"(H)x20"(W)x15-3/8"(D), 34.8 lbs.

4VR-5436 kr. 4980,-

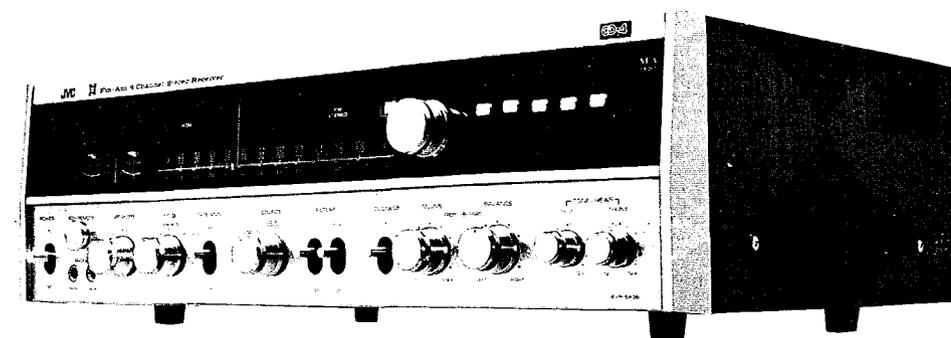
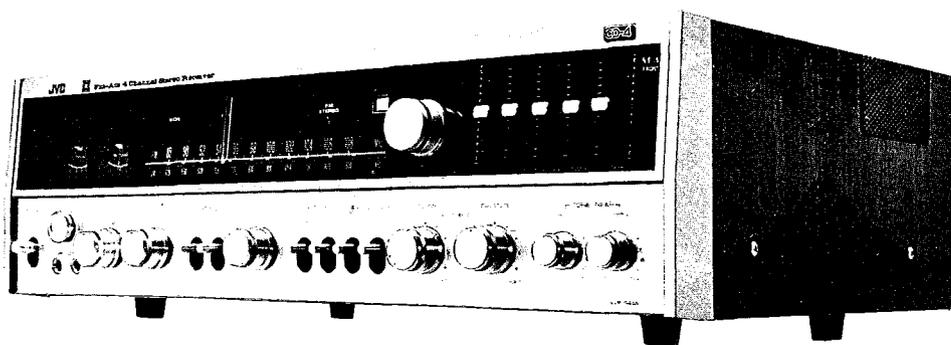
Even though this is the least powerful member of this group of receivers, it still packs enough power to fill your living room with a 4-channel sound field and packs enough flexibility to make it the central component of a high fidelity discrete 4-channel system.

Its tuner sections contain the latest electronic circuitry, with ICs in the IF and MPX stages of the FM tuner. The FM DET OUT socket on the rear panel makes it ready for the 4-channel FM broadcasts of the future.

Another socket is provided for the connection of an optional Remote Control (JVC Model 5911) which lets you control the volume and 4-channel balance from the comfort of your listening position.

The functional control panel, the black-out dial and the elegant walnut cabinet combine to make the 4VR-5436 a handsome addition to your stereo set and living room.

6-3/8"(H)x20"(W)x15-3/8"(D), 31.5 lbs.



AND WITH PIN-POINT BALANCE CONTROL

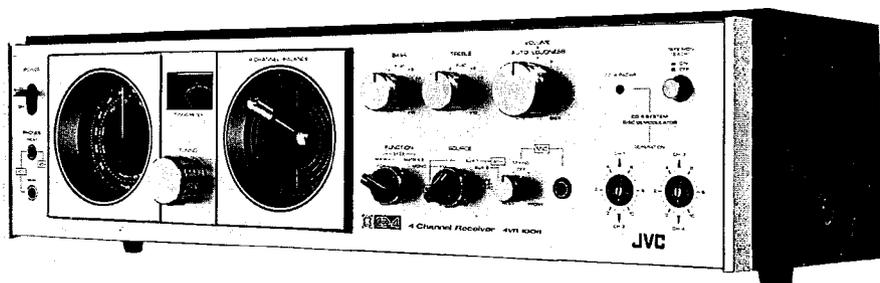


4VR-5406

As with all the receivers shown here, the CD-4 demodulator built into the 4VR-5406 is its most important feature. Another distinctive feature is the PPC control which gives one touch control over the 4-channel sound field. The styling makes the 4VR-5406 an outstanding CD-4 discrete 4-channel component, with its black-out front panel, linear FM tuning dial, PPC with illuminated sound field indicator and conveniently placed controls.

And nothing has been ignored in efforts to optimize its performance. The FM Stereo and AM tuner sections both contain the highest quality electronic components. Two matrix circuits decode any matrix pseudo 4-channel records to give a 4-channel effect.

5-5/8"(H)x19"(W)x13-5/8"(D), 18.7 lbs.



4VR-1006

Another receiver which has a built-in CD-4 demodulator and Pin-Point balance control is the 4VR-1006. Designed and built to JVC's high standards, it incorporates the latest and best electronic components. As well as all the features and facilities that you would expect in a quality model from one of the world's leading audio manufacturers, you have the mic mixing facility. You can make sound-on-sound and sound-with-sound mixed recordings and can make announcements while a program is being played.

5-7/8"(H)x21-3/8"(W)x18"(D), 26.9 lbs.

4-CHANNEL ACCESSORIES



5911 Balance Remote Control Unit *kr. 350,-*

This unit can be connected to all JVC 4-channel amplifiers and receivers. It has one joy-stick like lever. Move it in the direction you want the sound to move and, simultaneously, the level of every channel changes to change the sound field exactly to your requirements. A master volume control allows you to set the precise level you wish. With the 5911 you can do all these operations with one finger without moving from your listening position — where it really matters.

2"(H)x3-1/2"(W)x4-3/4"(D), 1.0 lbs.

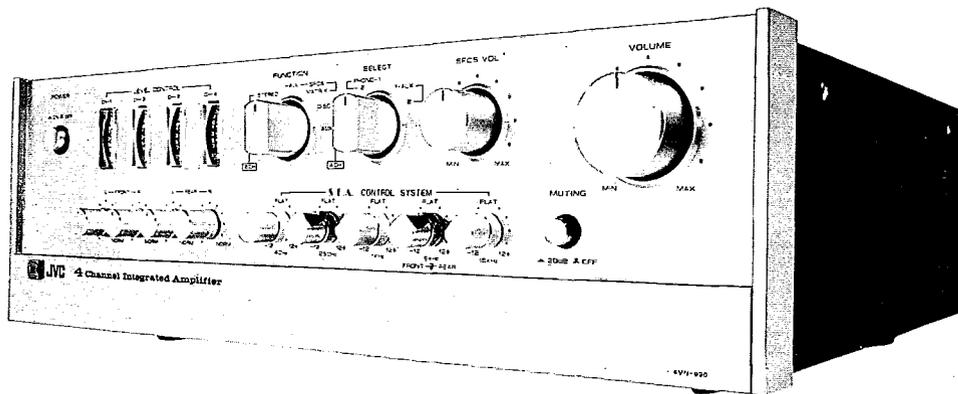
5944 4-Channel/2-Channel Stereo Headphones *kr. 450,-*

The first ever headphones which reproduce sound from four separate units. Fully 2-channel compatible, they deliver sound from 20 to 20,000Hz with complete channel separation and a distortion of less than 0.5%. The built-in phase change-over circuit gives them the ability to add a final touch to the sound that your audio system is playing back. Professionally designed with an adjustable headband and exceptionally soft ear pads, they give hours of comfortable listening enjoyment.

Weight: 1.3 lbs.

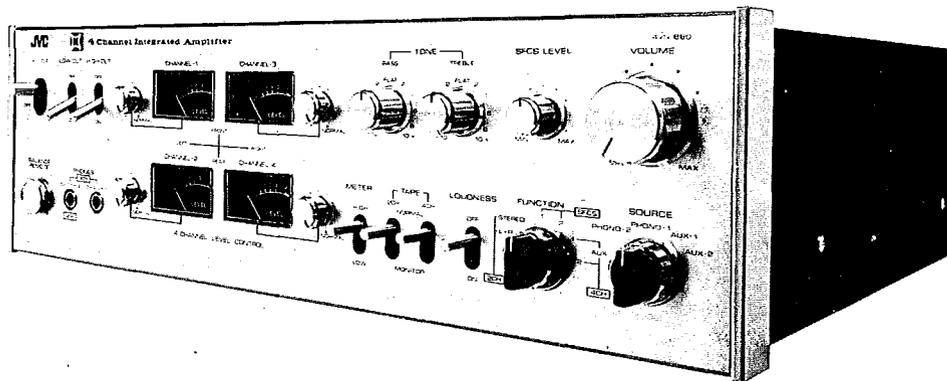
4-CHANNEL INTEGRATED AMPLIFIERS

JVC manufactures a comprehensive range of discrete 4-channel integrated amplifiers which, connected to a demodulator, give CD-4 4-channel sound.



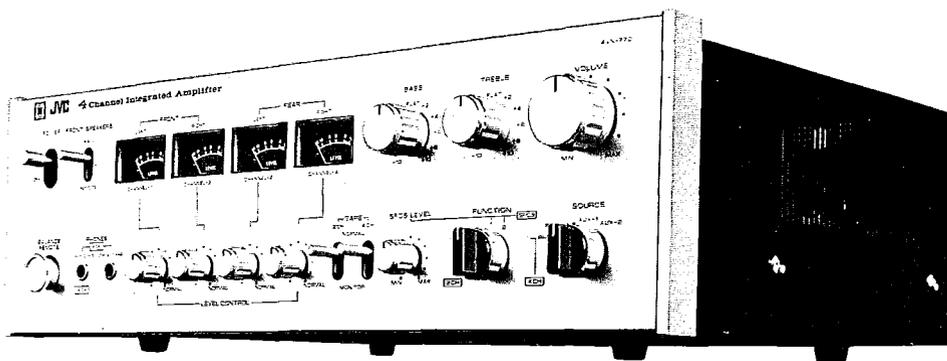
4VN-990

The 4VN-990's rear panel connection jacks provide for two 4-channel speaker systems, a 4-channel tape recorder — both record and playback, a CD-4 demodulator and a further 4-channel source. Then there are jacks for a 2-channel tape recorder, two 2-channel stereo phonographs and two further 2-channel sources. A 5-element S.E.A. unit gives better than ever control over the tone of your 4-channel sound field and lets you compensate for the acoustics of your room in a way no other system can do. 5-3/8"(H)x16-5/8"(W)x15-3/8"(D), 35.2 lbs.



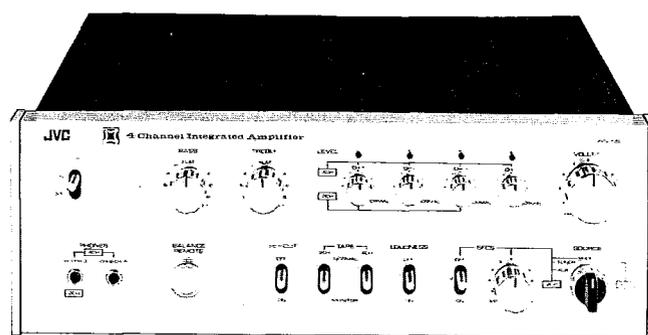
4VN-880 *kr. 3700,-*

This powerful 4-channel amplifier gives 240 watt, room filling, output. And everything is separate from input to output. The 4 pre-amps with their level controls and level meters drive 4 separate power amplifiers. JVC's unique SFCS is a matrix circuit which decodes matrix records and can be used to produce a 4-channel effect from 2-channel sources. Selectable phono input impedance, protection circuits which protect the speakers and electronic components separately and a 18Hz subsonic filter are further features which make the 4VN-880 attractive and marketable. 5-3/8"(H)x16-1/2"(W)x14-1/4"(D), 26.4 lbs.



4VN-770

A room filling 100 watts of 4-channel sound. Or, with the BTL (Balanced Transformer-Less) connection — super-powerful 100 watt 2-channel sound. The 4VN-770 has a full range of rear panel connections, both 4-channel and 2-channel. The separable pre-amps and power amps can be used in a multi-channel system. All this and JVC's SFCS matrix circuit which decodes matrix records and produces a 4-channel effect from regular 2-channel sources. 5-1/2"(H)x16-1/2"(W)x12"(D), 21.4 lbs.



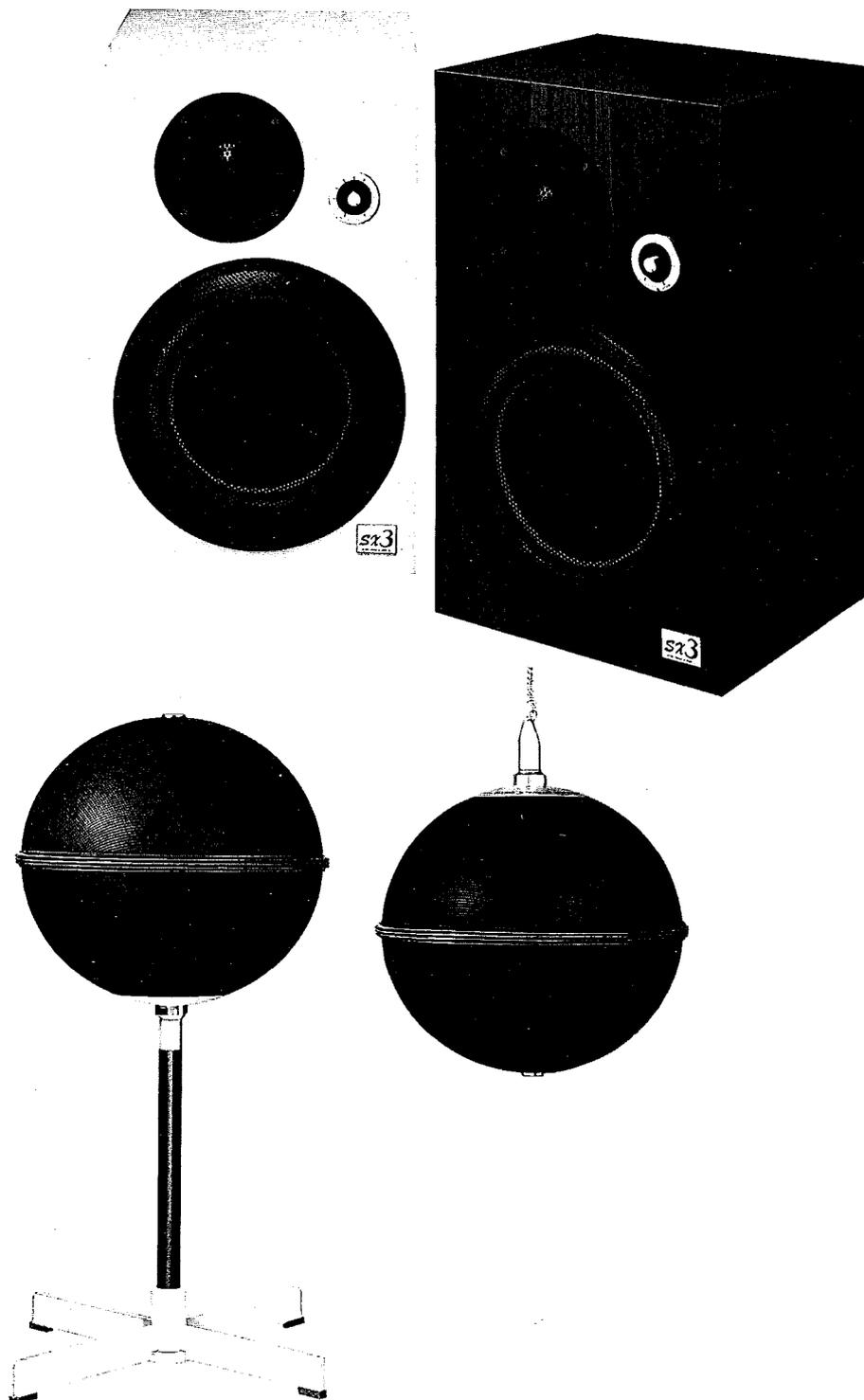
4VN-550

This is a flexible 4-channel integrated amplifier with power enough for most applications, and flexibility that will enhance any stereo system. BTL doubles the power when it's used for 2-channel operation. And JVC's SFCS gives it matrix capability. Features like the loudness circuit which improves the tone at low volumes, the high cut filter which eliminates unpleasant tape hiss, the 4-channel headphone jacks and the socket for the connection of JVC's 5911 Balance Remote Control are all points which make the 4VN-550 a winner. 5-3/8"(H)x15-1/2"(W)x12"(D), 18.5 lbs.

SPEAKERS

In 4-channel sound, the speakers are very, very important. Omni-directivity means that the sound radiated from the speakers should be the same in every direction and all audio manufacturers strive to achieve this ideal. When selecting speakers for use in 4-channel systems omni-directivity is more important than it is in conventional 2-channel stereo systems.

When playing back classical music the component of the sound which comes from the rear channels is mostly reflections which add to the ambience. This sounds more natural if it is produced by omni-directional speakers. And because most audio enthusiasts who invest in CD-4 4-channel equipment will be adding to an already existing stereo system, their selection of speakers for the rear channels is most important.



kr. 1650,-

SX-3 — A Revolution in Speaker Design

The SX-3 was designed for acoustic excellence. If you think its appearance is sharp, well and good, but that's purely incidental. It incorporates a Soft Dome Speaker. These speakers are used by several manufacturers to give wide frequency range, omni-directional sound, but JVC's engineers have developed them to a peak of excellence that other manufacturers have not reached.

The soft dome speaker radiates sound from a pulsating hemi-sphere. The materials used in the construction of this speaker and its design are the result of a great deal of research. One speaker covers a range of frequencies which other manufacturers use 2, 3 or 4 speakers to cover. The advantage of this is that it avoids introducing the unevenness inherent in a system with a complicated crossover network.

As well as its soft dome speaker the SX-3 has many other high value features. The edgeless cabinet was designed to prevent the chamber effect, that is, interference with high frequency sounds by reflections from the front edge. The materials used, white spruce and walnut were selected because of their superior acoustic properties. The 10" free-edge woofer is made from DU cone paper imported from West Germany. And ester wool, with double the absorptivity of glass wool, is used as the sound absorbing material.

20-1/2"(H)x12-3/8"(W)x11-7/16"(D), 29.3 lbs.

VS-5313 (GB-1E) — Omni-directional Speaker

kr. 2200,-

Another new concept in speaker design. Either standing on the floor or hanging from the ceiling, the VS-5313 (GB-1E) looks dazzling. But it doesn't just look good, it sounds good, too. The VS-5313 (GB-1E) has four free edge woofers and four horn tweeters in its spherical baffle. This unique arrangement reproduces sound with fullness and clarity, the same in every direction. Wherever the speaker is or wherever you sit you get the same natural sound. It's got a 20 to 20,000Hz frequency range in every direction and has a peak power handling capacity of 80 watts.

13-1/2" dia., 26.4 lbs.

As well as these speaker systems JVC manufactures a full range of speakers to suit any budget and fit into any audio system.

CD-4 SOFTWARE

By March 1973 JVC had released more than 160 CD-4 albums in Japan; some of these are illustrated below. In Japan some other record manufacturing companies have already started to release CD-4 albums and more intend to do so in the near future.

The situation outside Japan is that RCA has started to make monthly releases of CD-4 format "Quadradisc" records in the U.S.A. and will extend this to Europe and another large international group, the WEA group, has signed a licensing agreement for the production of CD-4 format records.

A selection of albums available world-wide



CD4W-7001E - THE JEWELS OF THE MADONNA
Nini Rosso (trumpet)



CD4W-7002E - MY SHAWL
Xavier Cugat and His Orchestra



CD4W-7003E - THE WORLD OF FRANCIS LAI
The Film Studio Orchestra



CD4W-7005E - MARCHES OF THE WORLD
Paul Yeador and His Brass Orchestra



CD4W-7006E - ART BLAKEY AND THE JAZZ MESSENGERS
Jan Arnet (tr.); Curtis Cramlet (tr.); Joanne Brackeen (p.);
Jan Arnet (b.); Art Blakey (dr.)



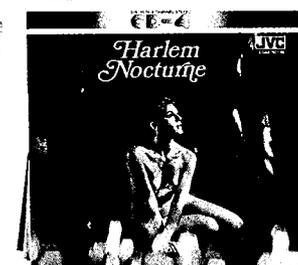
CD4W-7007E - MAMBO JUMBO
Perez Prado and His Orchestra



CD4W-7008E - THE WORLD OF MICHEL LEGRAND
The Film Studio Orchestra



CD4W-7010E - GODFATHER/SOUNDS OF CINE ACTION
The Film Studio Orchestra



CD4B-5014E - HARLEM NOCTURNE FASCINATING TENOR-SAX
Y. Matsura and Victor Orchestra



CD4B-5003E - THE APRIL FOOL/THE LATEST FILM THEMES
Hachidai Nakamura and His Grand Orchestra



CD4B-5005E - LOVE STORY AND OTHER GREAT MOVIE THEMES
Victor Orchestra



CD4K-7501E - CARMEN SUITE (Bizet)
Yomiuri Nippon Symphony Orchestra conducted by Serge Baudo



CD4K-7503E - DEUTSCHE BACHSOLISTEN
Deutsche Bachsolisten
Mehner Witschmann (conductor, Oboe)
Rainer Kutzmaul (violin)



CD4K-7504E - Khechaturian VIOLIN CONCERTO in D Major
Tsugio Tokunaga (violin)
The Tokyo Symphony Orchestra conducted by Kazuyuki Akiyama



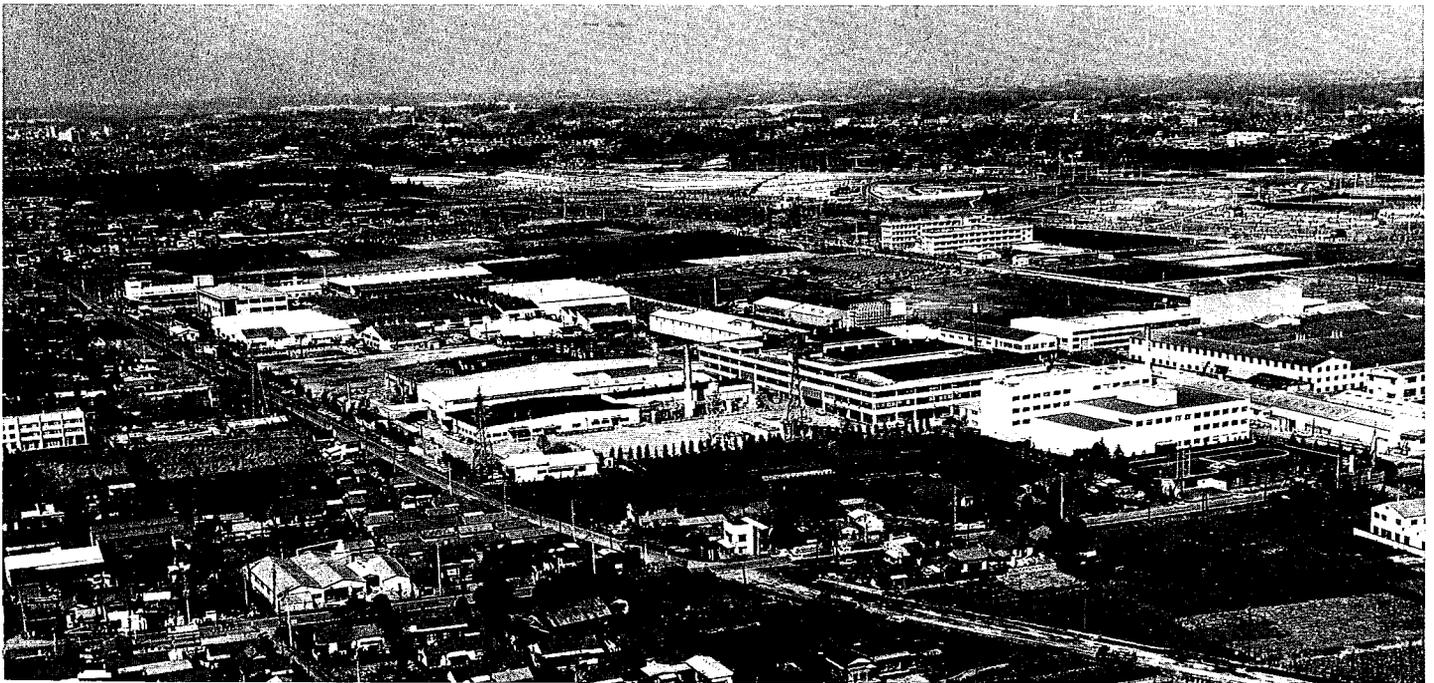
CD4K-7507E - J.S. Bach FAMOUS ORGAN WORKS
A. Webersinke (organ)

THE CD-4 FUTURE

CD-4 records and playback equipment are now being marketed world-wide. Other manufacturers as well as JVC are involved in both these facets of production. And JVC is continuing in its development. These are three very important facts.

The evidence is that JVC has developed a 4-channel recording system which will be used as the world standard for many years to come. The CD-4 system is sufficiently flexible to allow further research to improve many aspects of record production and reproduction techniques without making the playback equipment and records now being marketed obsolete. This is a most powerful recommendation for audio enthusiasts to invest in the CD-4 system.

The home of JVC's Stereo Division — the birthplace of CD-4



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