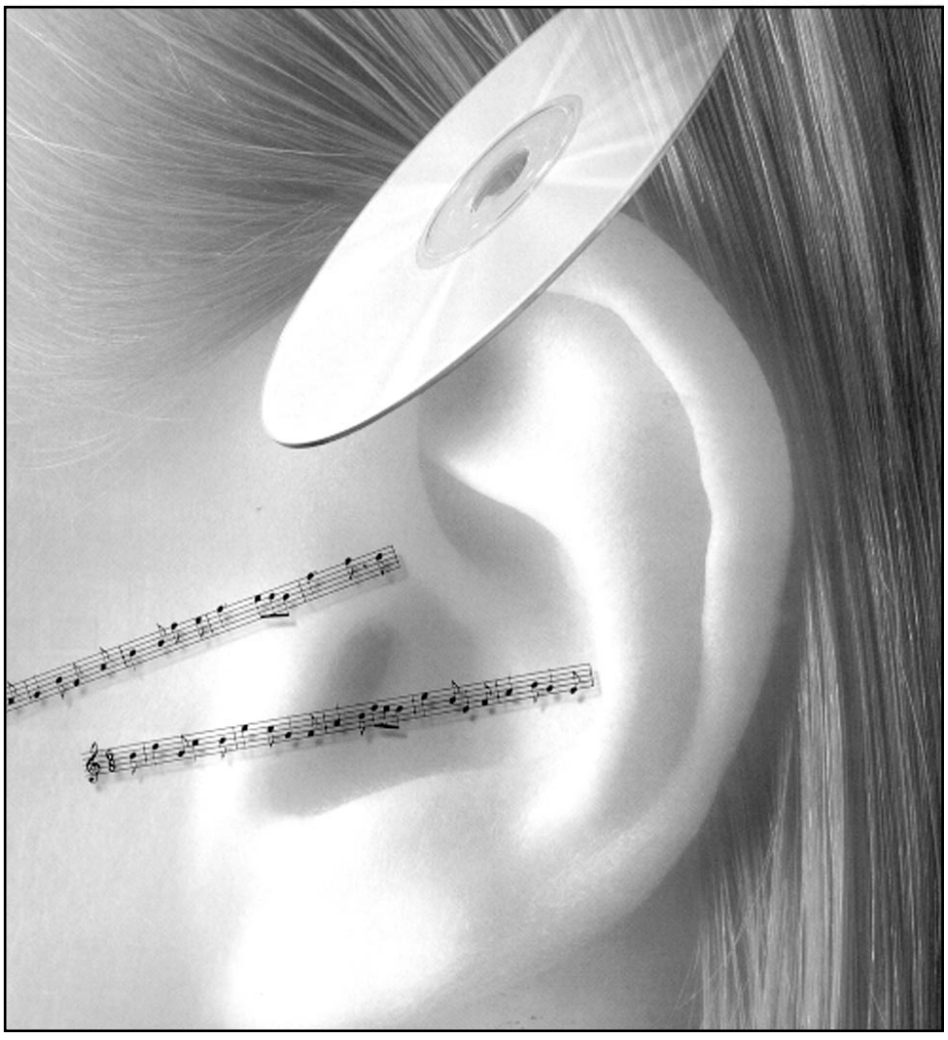
The CD

Compact Disc

Seminar
Working
material



BMW AG
Service Training

Note

The information contained in this training manual is intended solely for the people attending this course, run by BMW Service Training.

Status of information: May 1997

Modifications/additions to the Technical Data can be found by consulting the appropriate information issued by the "Technical After-Sales Service".

VK12; J. Stadler

Contents

Page

1. General points about CD technology

1.1 The history and principle of the CD

The CD began its conquest of the market over 12 years ago. Some years of further development were needed before CD-players for vehicle use came into being. Now it is impossible to imagine a world without portable CD-players.

In terms of use at home, the conventional record has completely lost its pivotal position to the CD once and for all. It is therefore foreseeable that the use of CD-players in cars will also increase.

In this context, we must not overlook the position held by the audio cassette. In the future, the audio cassette, with all its advantages and disadvantages, will also be overtaken by the CD.

Music is recorded on the CD in digital form. The analogue voltage values of the music signal are converted into corresponding numerical combinations. The data is changed back into its original values during a scanning process.

Unlike previous systems, this information is untouched when read and is therefore undamaged.

The scanning process takes place by laser beam reflection. A scanning unit (which will subsequently be referred to as a pickup) transmits an intense infrared laser beam to the CD's surface. This laser beam is reflected by a surface which has been vapour-coated with silver or gold. An optic sensor subsequently receives and analyses it.

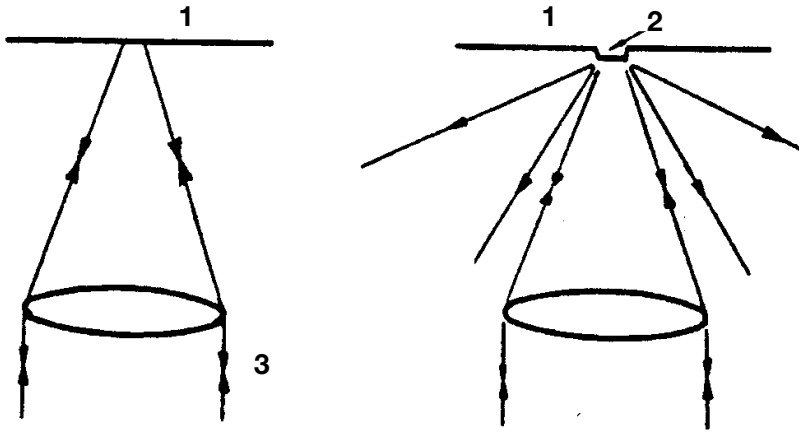


Fig. 1: Scanning by reflection

1 The CD's surface
2 Peak
3 Pickup (which moves up and down in order to focus)

The music (audio data) is presented in the form of binary values (0 and 1) on the CD. In terms of physics, what is present are entities which rise and fall, whose length alters the beam's reflection, thereby creating certain patterns. This means that the values 0 and 1 can be differentiated.

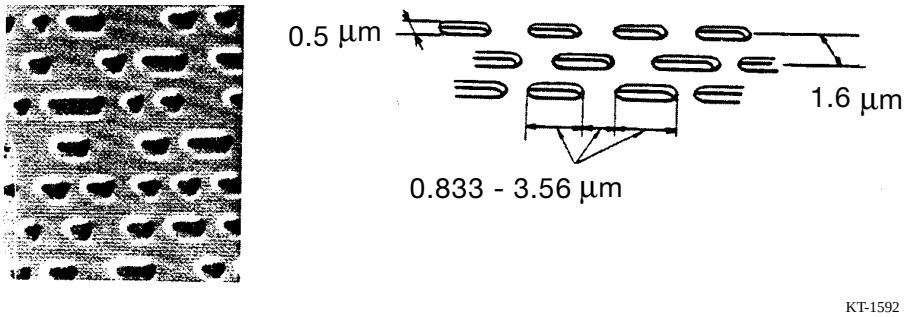
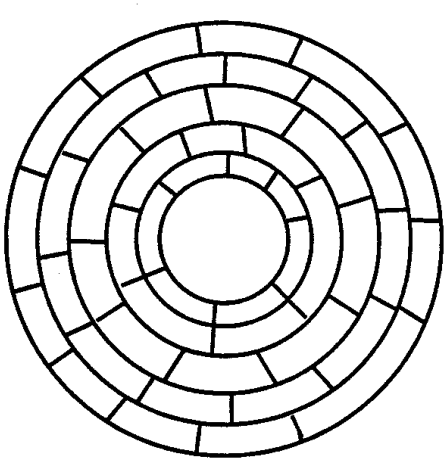


Fig. 2: Microscopic recording of a CD's surface

µm = micron

The CD's audio data is situated in concentric pits, not in a spiral groove, as was the case with a record. Therefore the CD's pits contain information in addition to the music which helps to guide the scanning unit (tracking). This enables you to jump from track to track when the CD is playing.

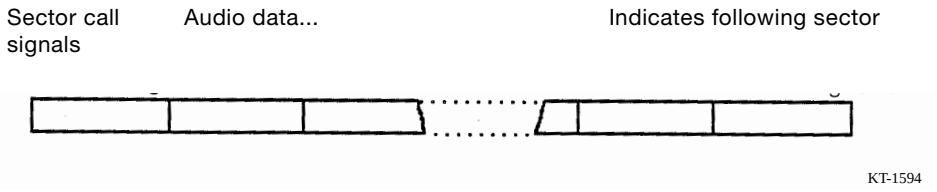


KT-1593

Fig. 3: The CD's pits have a concentric arrangement and are divided into various sectors

30 pits have the same width as a human hair. CD operations therefore take place in microscopic dimensions.

These sizes should be taken into account in the event of scanning problems.



KT-1594

Fig. 4: Extended sectors

The CD-player not only has to track accurately, it must also compensate for any irregularities in the surface of the CD.

To achieve this, the focal sharpness of the reflected infrared laser beam is monitored continuously and is corrected by raising and lowering the pickup lens. This process is known as focusing.

If data is lost during pickup (due to scratches or vibrations), it can be reconstructed to a certain extent.

The value which has been read most recently is compared with the next value which can be read. The fault corrector calculates an average value using both these values. The human ear cannot detect this process.

1.2 CD data - technology

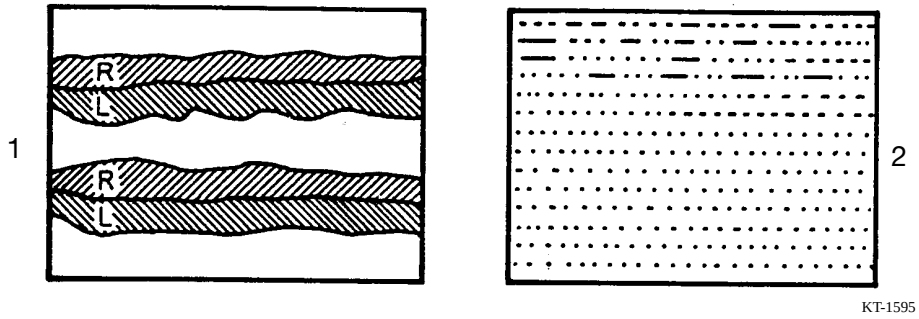


Fig. 5: Enlarged view of grooves on an LP (1) and pits of a CD (2)

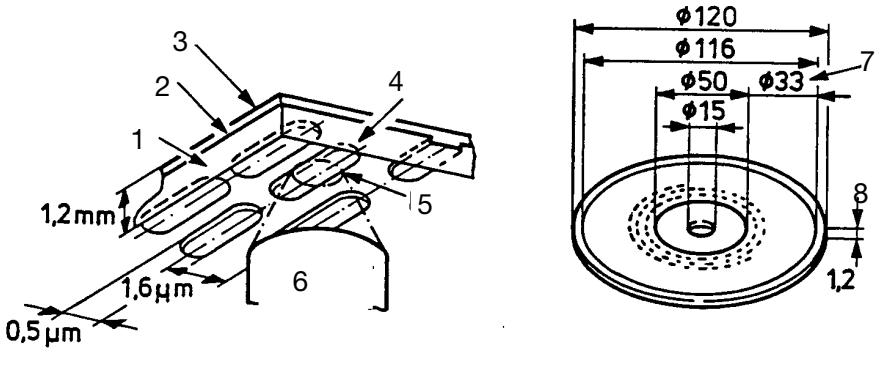


Fig. 6: Technical Data of a CD

1 Plastic (transparent)
2 Aluminium vapour coating
3 Plastic protective coating
4 Hole track
5 Laser
6 Objective lens
7 Receiving area
8 One-sided disk

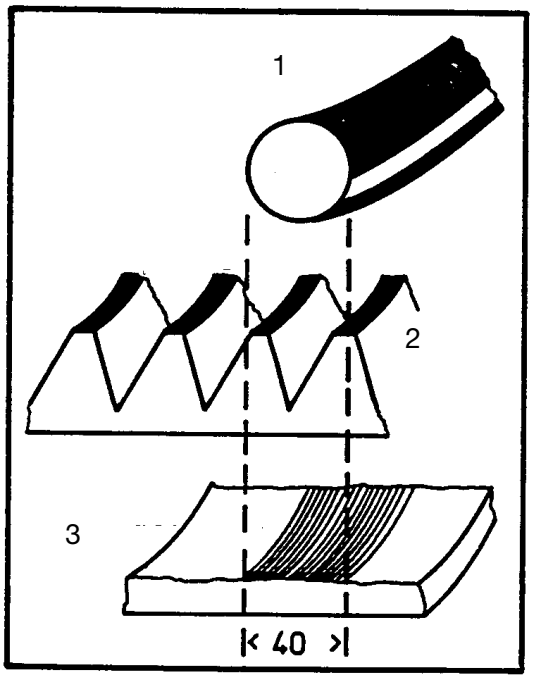


Fig. 7: Comparison of a human hair (1), the grooves of an LP (2) and the pits of a CD (3)

2. Obtaining a signal

2.1 Optical scanning

Principle of optical CD scanning

The CD is scanned by a laser beam with a wavelength of 720 nanometers. This light is made up of visible and invisible components of the electromagnetic spectrum generated by a laser diode with a performance rating of 0.4 milliwatts.

Scanning process:

- Laser emits beam (wavelength 780 nanometers/0.4 milliwatts)
- Beam passes through prism (glass/mirror)
- Lens converts beam into parallel light
- Lens unit focuses beam into a tiny spot with a diameter of 1 micron
- Separate coils handle the focusing and tracking functions
- The beam hits the opaque underside of the CD which reflects it
- Reflected beam passes through lens
- Beam hits prism and emerges at a different angle
- PE cell converts beam into high frequency electrical voltage

Caution!

A laser produces a highly concentrated beam of light and this should be duly marked on the CD-players. To prevent possible injury, do not look at the laser beam when in its proximity.

Only trained service staff should open up the CD-player and operate it.

Optical scanner

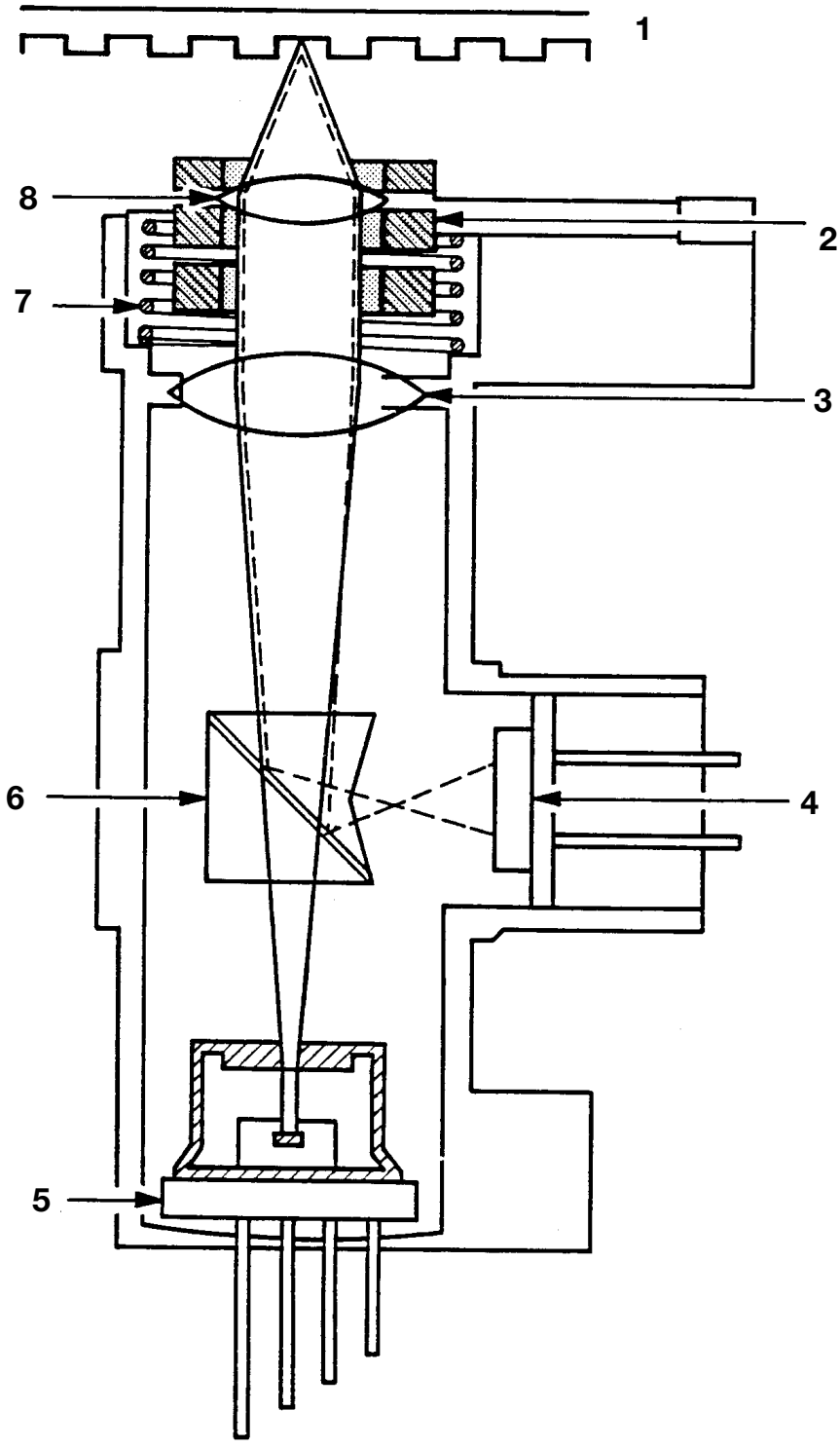


Fig. 8: Cross section, CD scanning

1	CD	5	Laser
2	Magnet	6	Prism
3	Lens	7	Focus coil
4	PE cell	8	Lens

2.2 From a digital signal to an analogue signal

The CD (Compact Disc) is a plastic disc (made from polycarbonate) with a diameter of 12 cm and a thickness of approx. 1.2 mm.

The information on the CD corresponds to the binary sequences of the digitized audio signal.

By pressing or burning the CD, an indented structure is produced, comprising valleys (pits) and peaks. It is then sealed with a very thin aluminium layer. After this sealing process is completed, the surface is given a protective coating and is pressed with a label. Only the CD's side which does not have a label can be scanned.

The information is stored on the CD using a known mathematical formula in order to compensate for any production defects which might arise. After the laser has scanned the CD, a computer decodes the data using the same formula. Thanks to this process, the CD-player can easily compensate for any defects on the CD.

Every CD has its own code. This code consists of the 8-bit subcode data (with the CD's playing time and the number of tracks) and is read before playback.

Each CD is scanned from centre to edge at a frequency of 44.1 kHz. A scanning period contains 16-bit information for the left music channel and 16-bit information for the right music channel.

A pivot-mounted arm laser head keeps time delays to a minimum whenever a new track is requested, while ensuring scanning stability and that the information contained in each pit can be read accurately.

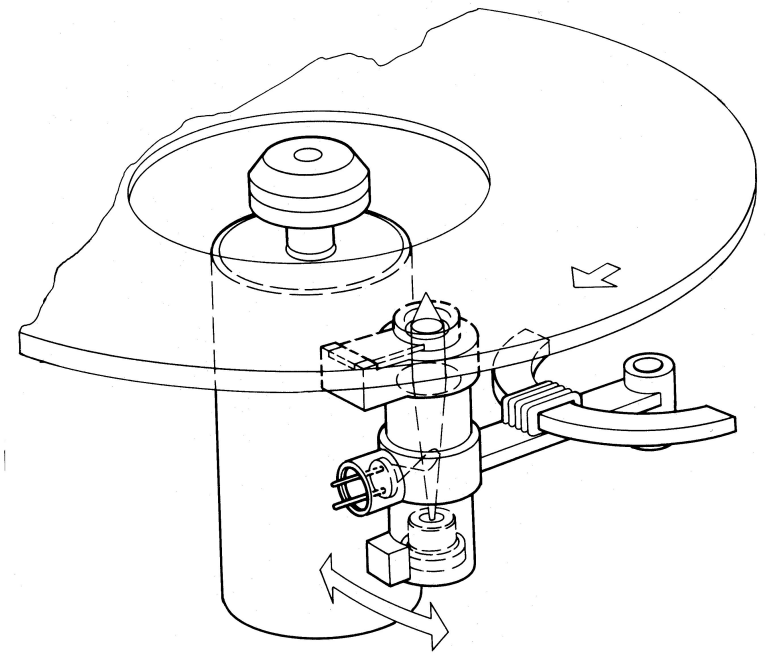
The high frequency signal is converted into 16-bit data and is transmitted to the D/A (digital/analogue) converter with a frequency of 44.1 kHz. A wide-ranging correction program is in operation in this program.

The D/A converter changes each 16-bit block of data into a serial 1-bit data stream and feeds this into a network of condensers (e.g. at a 256-fold oversampling rate across a frequency of 11.2896 MHz/256 x 44.1 kHz). The digital information is thereby converted into an analogue signal whose resolution has been enhanced by 256 times.

Since BMW CD-players operate with a 1-bit and 8-fold over-sampling rate, they have a 1-bit data stream and a frequency of 8 x 44,1 kHz = 352.8 kHz.

In order to obtain an audible music signal, the digital signal is converted into an analogue signal and is transmitted to the internal car radio amplifiers.

The clarity and fidelity of audio-playback depend not only on the CD-player, but also on the recording itself (date of recording and whether or not it was analogue), and on the mixing (digital or analogue) when being mastered for CD production.



KT-1749

Fig. 9: Positioning the scanner

2.3 Oversampling

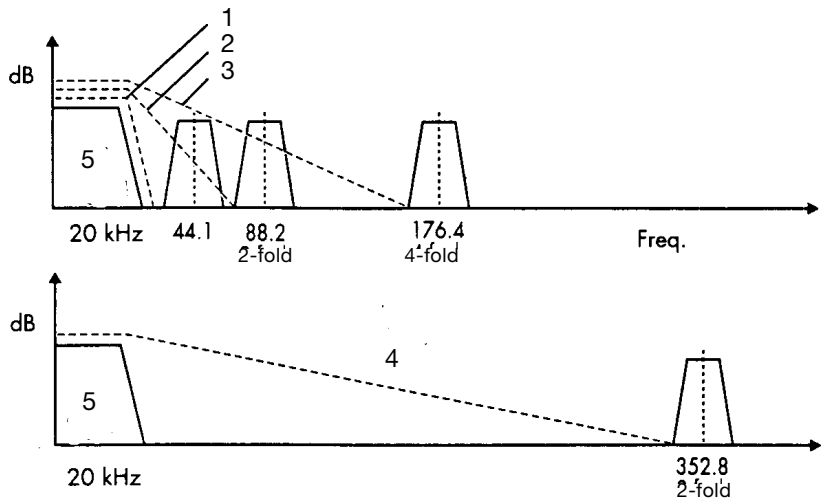
The CD's music signal is scanned in the oversampling process.

Oversampling means: more rapid digital/analogue conversion than was the case with CDs which were recorded with 44.1 kHz.

During the conversion process, interference can result as a by-product of the frequency (44.1 kHz) at which the music signal is sampled. This has to be suppressed by suitably high quality filters. For this reason, a multiple of the basic sampling frequency is chosen:

e.g. 88.2 kHz when multiplied by 2
176.4 kHz when multiplied by 4
352.8 kHz when multiplied by 8
1.2896 MHz when multiplied by 256

This creates the greatest possible distance between the music signal desired and the interference by-products. The result is a signal which is almost completely free from distortion.



KT-1599

Fig. 10: Signal behaviour with analogue filter and different oversampling frequencies

1 Analogue filter without oversampling
2 Analogue filter with 2-fold oversampling
3 Analogue filter with 4-fold oversampling
4 Analogue filter with 8-fold oversampling
5 Audible signal

Digitizing the sound signal

Pits and obtaining of a signal have been explained on the previous pages.

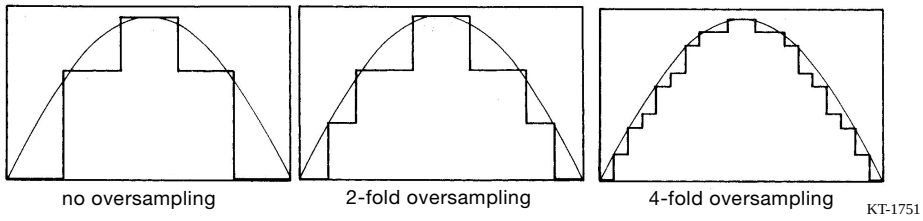


Fig. 11: Comparison of scanning without oversampling and scanning with oversampling

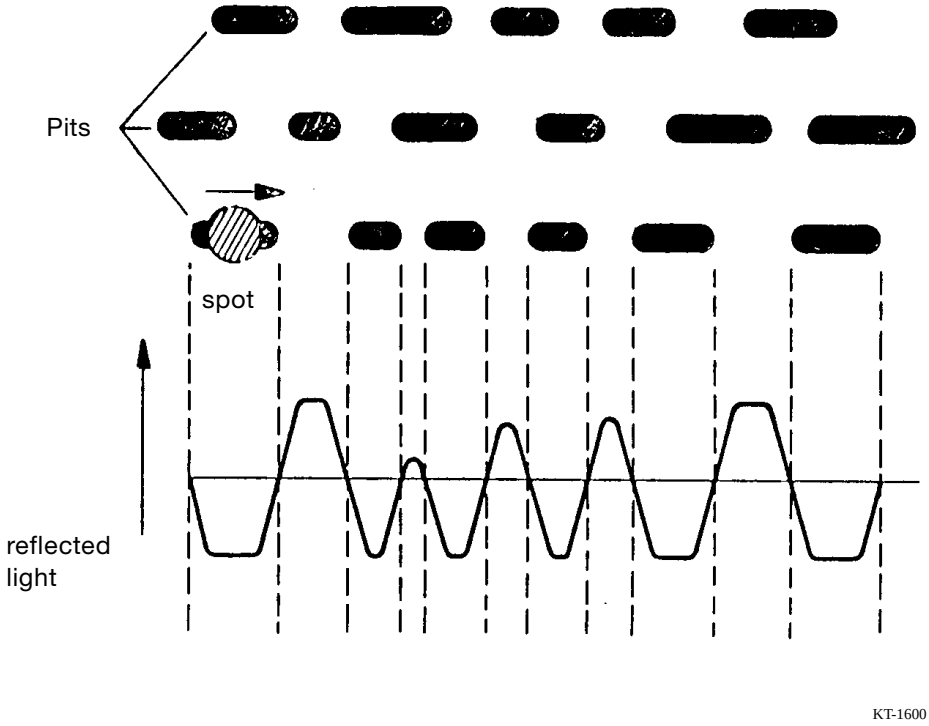


Fig. 12: Scanning and obtaining a signal

Obtaining a signal

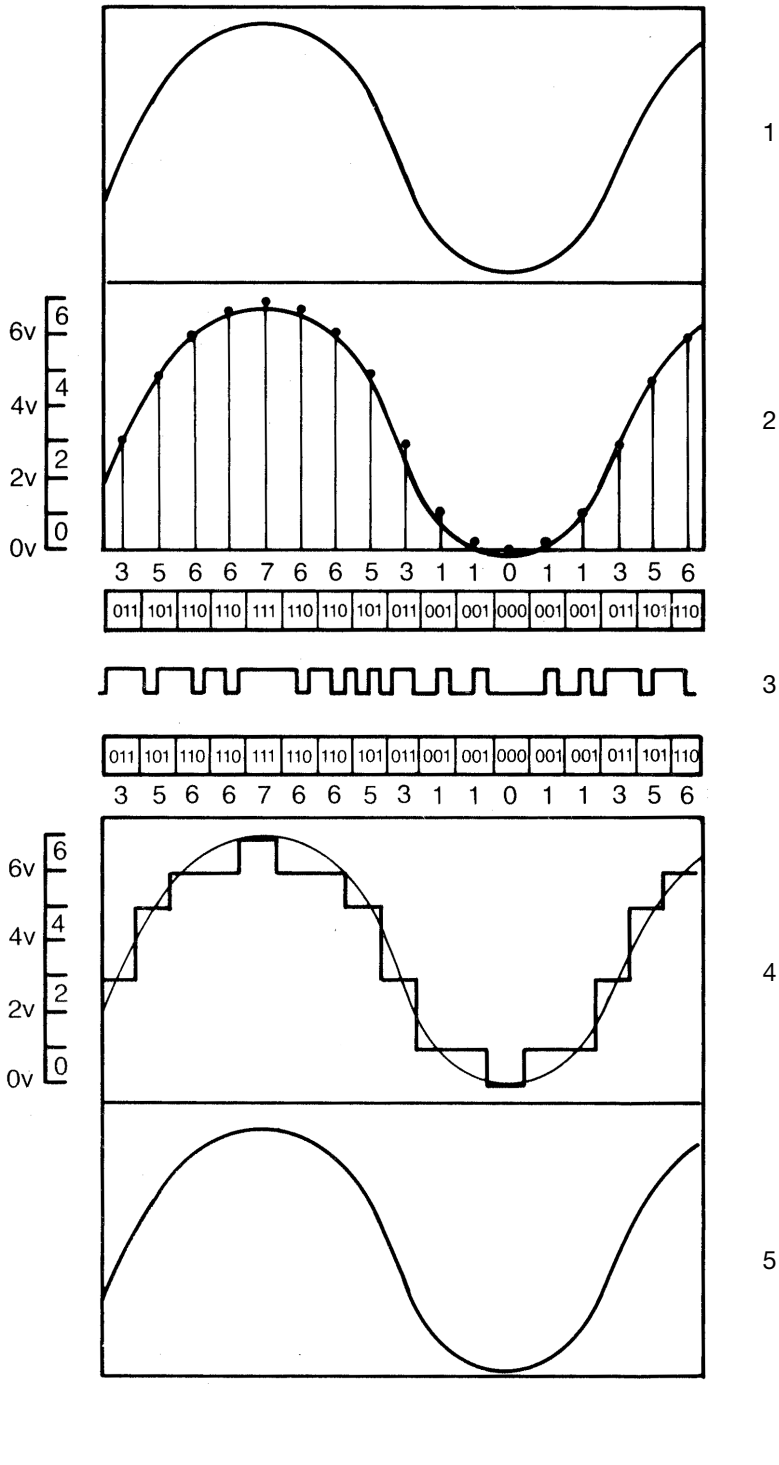


Fig. 13: Scanning and obtaining a signal

1 Origin of the CD's data
2 Scanning the CD
3 Digitizing and encoding of data
4 Oversampling
5 Filtered signal, final signal

3. The basic functions of a CD player

3.1 Principle

The information on a CD is retrieved by a beam of laser light. The laser system is mounted on a support arm.

The CD is driven directly off the drive shaft of the electric motor. To evaluate the information on the CD, very precise feedback control circuits are required:

- Focus control of the laser
- Tracking control
- CD speed control

The control circuits for focus and tracking operate indepedently of the information contents. The CD speed control function depends on the information on the disc. All these functions are computer-controlled.

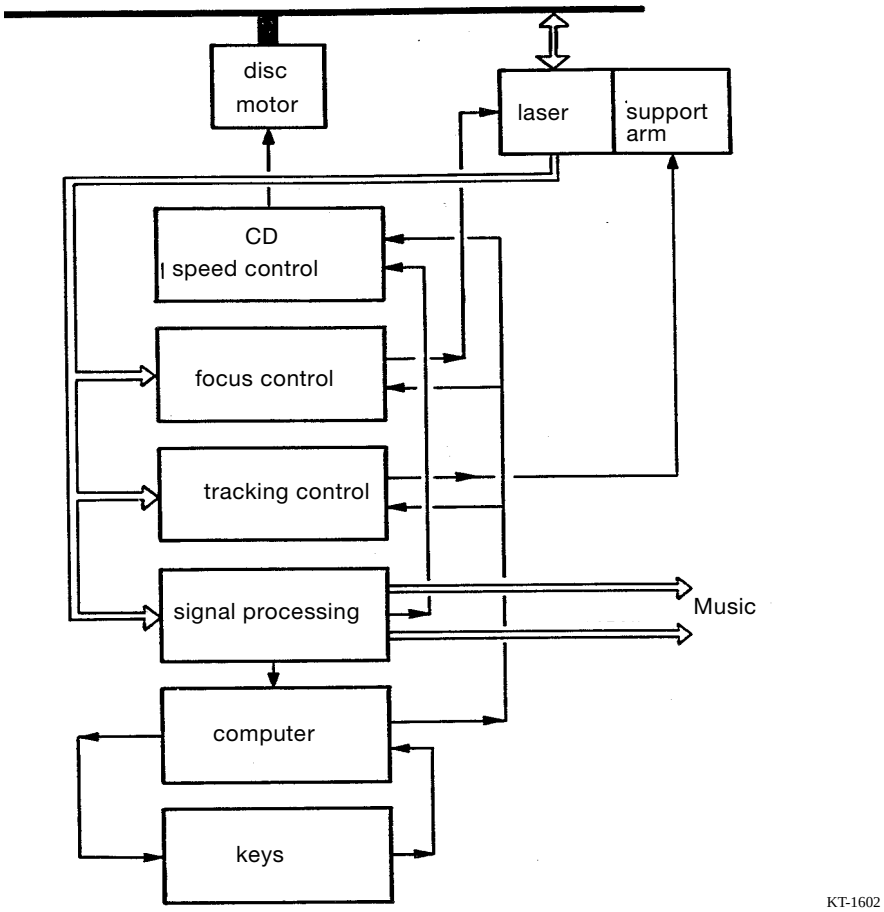


Fig. 14: Principle of a CD-player

3.2 Player units

Operation

To play CDs, radios with a CD option are used in conjunction with various makes of CD-changers (also known as "autostacks") with 6-CD and 10-CD magazines.

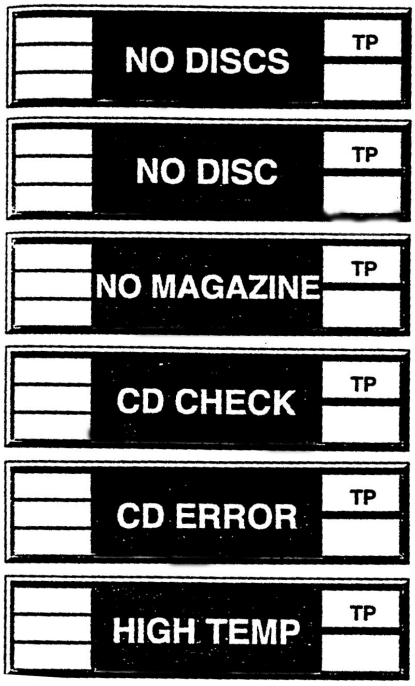
In a CD-changer unit, the radio acts as the control unit. The changer is controlled by an external connection.

Commands are issued by pressing appropriate keys in the CD sub-menu on the radio. This applies to both versions of this equipment.

Operating functions: SCAN, Random, Track,
Single CD forwards/backwards.

The operating manual for the radio or on-board monitor describes the various options available for operating the system.

The following illustration shows fault patterns in the display of the on-board monitor or CD-radio unit.



KT-1752

Fig. 15: Possible ways of presenting fault patterns on the CD display

Faults on CDs and CD devices, cleaning, care and handling are illustrated on the following pages.

Radio-CD devices can be affected by special conditions which can arise in the passenger cell, some of which can be due to the actions of the driver and passengers. For example, smoke and dust can result in dirt collecting on the lens system in the sensing unit. This means that the CD can no longer be read correctly, potentially giving rise to inaccurate sound reproduction.

Mute mode when the telephone is in use:

Whenever the telephone is in use, the audio system goes into mute mode. This feature is therefore referred to as telephone mute. This is a standard feature on all BMW cars equipped with telephones, or to which telephones are retrofitted.

During any telephone conversation, the tuner, cassette and CD-NF function have their volume turned right down ("muted") automatically by the telephone mute input linking the telephone to the radio. The MD and CD drives are stopped.

This mute mode is not interrupted, even by traffic messages.

Conditions for CD equipment in cars:

CD equipment in cars is exposed to difficult conditions. For example:

- Installation position: CD equipment must be placed in locations which allow them to operate in their correct position.
- CDs and CD-players are subjected to vibrations of up to 60 Hz.
- Temperatures can range from -15 to +80°C.
- Humidity in the surrounding area or on the CD can rise as high as 95%.
- All in all, a mechanically challenging environment.

4. Using CD-changers in a vehicle

4.1 Basis

Defects have often been noted in CD-changers when they are used in vehicles. These defects are caused by external influences. Many of these defects are due to the system and cannot be remedied. Therefore, there will now be a short introduction to CD technology since it is the basis of the BMW CD-changers.

The mechanism must be spring mounted without, however, being allowed to swing. It must be able to cushion bumps. This negates the effects of uneven terrain. This is achieved by 8 rubber dampers with an air reservoir, or with oil dampers on a 4-point mounting. These dampers are supported by 2 springs.
The spring mounting position should be altered to suit the assembly position of each spring (refer to chapter 5.10).

If the damper's components are defective, the CD will skip during play if the vehicle is being driven on uneven terrain.

When the unit is being shipped, the damper components must be firmly secured. To do this, tighten down the transport retaining screws and insert the retaining pin. The CD-changer might otherwise be damaged.

The CDs are kept ready for use in a magazine holding 6 CDs. Only the CD currently being played is situated entirely within the mechanism.

2 rubber rollers grip the CD in the magazine and pull it into the mechanism. This places the CD in play position.

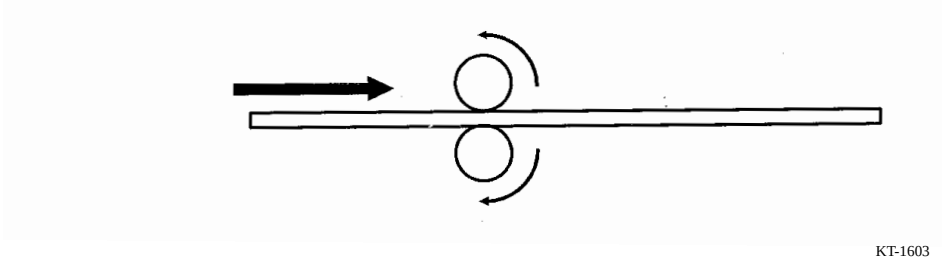


Fig. 16: Rubber rollers changing a CD

Once the CD is in play position, it is lowered into the centre holes and placed securely on a taper (clamping).

Playback can now begin. The reverse process takes place to return the CD to its original position after play.

To locate the CD inside the mechanism, 3 PE cells have been added to the CD-changer. The disc's exact location is determined by the order in which these PE cells are interrupted.

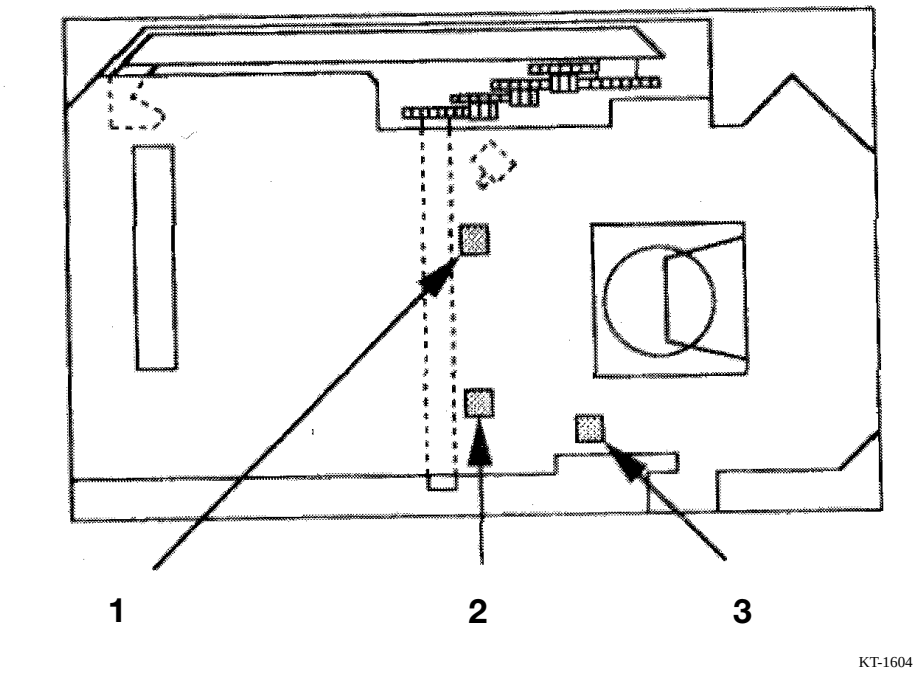


Fig. 17: Determining CD's position

1 - 3 PE cells

The CD-changer can only change and correctly position 12 cm standard CDs.

The CD-charger cannot position CDs which have been altered or have an unusual shape. These CDs are not played. The fault message "no disc" is displayed.

Note:

Conventional CD-changers cannot be used in the BMW car CD system. Consequently, even standard commodities produced by the same manufacturer cannot be modified for use with the BMW CD-changer.

4.2 Faults caused by the CD

When used in vehicles, CD-changers can lead to problems in relatively fragile CDs. Of course, the car's CD-player itself has similar problems.

CDs whose edges have not been deburred sufficiently:

These CDs can have several undesirable effects.

- Transport rollers cannot hold the CD because it is too thick.
- Plastic burrs could come loose and remain stuck to the CD's surface when it is being transported by the rollers. The same can happen with a deburred centre hole. Plastic burrs are pressed out when the CD is being securely positioned on the taper (known as clamping). They then get into the mechanism, thereby contaminating both the CDs and their magazines.

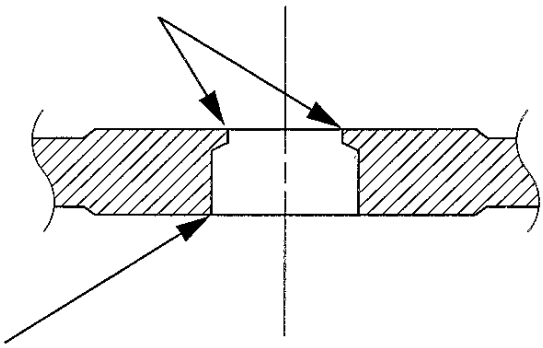
Negative effects caused by plastic chips:

- They can leave fine scratches on the CD's surface if they get into the magazine.
- In unfortunate circumstances, larger chips (5 - 7 mm) can cause scanning faults (skipping) or result in the CD player being unable to read the CD's contents (TOC). If this happens, the CD cannot be played.

CDs which are too thick:

If the magazine contains several CDs which are too thick, the mechanism has difficulties in returning a CD back to the magazine after play. One result is that more power is needed to return the CD back into the magazine. Another is that the separators holding the individual CDs could be shifted out of place, making it impossible to return a CD to its original position.

Remedy: Before using them for the first time, deburr new CDs. Only use a very thick CD if it is the only one in the CD magazine.



KT-1605

Fig. 18: Burr on the centre hole

For 8 cm CDs, there are the following accessories: single adapter, protective foil and varnish, stabilizing rings etc.

KT-1754

Fig. 19: 8 cm CD

These features which enhance stability and safety are suited to home use. However, they can lead to irregularities when used in a car CD-player:

- The CDs become thicker than normal
- When the CD is being removed or replaced, singles could be pressed out of the adapter, which would block the mechanism. The stabilizing rings could get caught in the transport rollers.

Remedy: Do not use these accessories in the vehicle. 8 cm CDs cannot be played in a car radio CD-player and CD-changer!

CDs with an unusual shape:

CDs which do not have the standard 12 cm diameter and/or which, for instance, are not round but square should not be played here.

KT-1849

Fig. 20: Off-centre 8 cm CD

Transparent CDs:

Unfortunately, it is frequently the case that the protective vaporized coating of the CDs is insufficient. These CDs are, partially or completely, more transparent than normal CDs. Although these CDs can still be played, their position cannot be monitored using photoelectric light beams. The CD is not recognized as being a CD.

Light from outside:

Leaving the magazine flap open can lead to faults. Any light that enters from outside as a result of an open flap disturbs the opto-electronics. Sunlight contains light in its spectrum that shares the same wavelength as the light analysed by the photoelectric light beams. This is also particularly true for fluorescent tubes. Therefore, the magazine flap must always be closed when the machines are monitored in the workshop.

Defects in CD manufacturing:

In individual cases, the production of some CDs has been faulty. The faults generally affect the layer containing the musical information. These CDs can sometimes be played at home. They cannot, however, be played in the vehicle. This is not a failing on the part of the CD-changer but is an unavoidable part of vehicle use of CDs, since the fault correction process in a vehicle presents different requirements than in stationary use.

A CD-player designed for home use is extremely sensitive to movement. This is offset by the fact that laser tracking can cope with surface faults in an optimum manner. To use a CD player in a vehicle, a compromise must be found. To counteract any distortion caused by vibrations, the tracking distance (here, the capacity to compensate for surface defects) must be restricted. It is only then that use in a vehicle is possible.

Sometimes CDs are not completely flat. Consequently, they have a top runout, as was often the case in vinyl records. Since the CD is scanned from centre to edge, the fault correction process might, in rare cases, not be able to cope when the last track is played. A CD-changer is extremely sensitive to movement during playback of the last track.

If the CD skips, its data can no longer be read correctly and the CD is changed.

External influences:

Other external factors in the passenger car can lead to further irregularities. Cleaning fluid for plastic, and even nicotine can have an adverse effect on the principal components of this type of machine:

The pickup's lens receives a coating. The CD-player becomes more sensitive to vibrations, changing tracks takes longer and, in extreme cases of lack of cleanliness, CDs cannot be played.

The transport rollers can lose their malleability and/or their adhesiveness. As a result, the CDs cannot be taken from the play position and returned to the magazine.

It is for this reason that clients should always be advised against treating the CD-changer's housing with cockpit spray. Otherwise, the flap might no longer close completely or open due to vibrations. Light could also get into the mechanism from outside, which would adversely affect the function determining the disc's position when the disc is being changed.

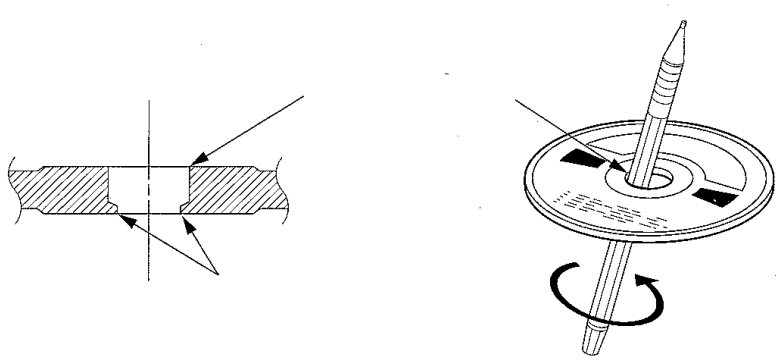
5. Useful information about CDs

5.1 New CDs

If a newly-bought CD is placed in the CD-changer's magazine or in the CD-player itself, it is possible that it will not be played the first time.

This is due to areas around the centre hole and the outer edges of the CD being slightly uneven. They prevent the CD from being positioned correctly. We therefore recommend that you take care when using new CDs.

In order to remove these uneven spots, rub the CD's inner and outer edges with a pencil or similar object. Then try playing the CD again.



KT-1606

Fig. 21: Deburring centre hole

5.2 Correct CD maintenance

Hold the CD as demonstrated in the illustration. If the surface/scanning surface (underside) is scratched, the CD might skip several passages.

Take care that there are no fingerprints on the surface.

Do not stick adhesive tape, paper or stickers to the CD.

Do not write on the scanning surface of the CD. The CD may only be labeled with suitable waterproof, non-acidic felt pens.

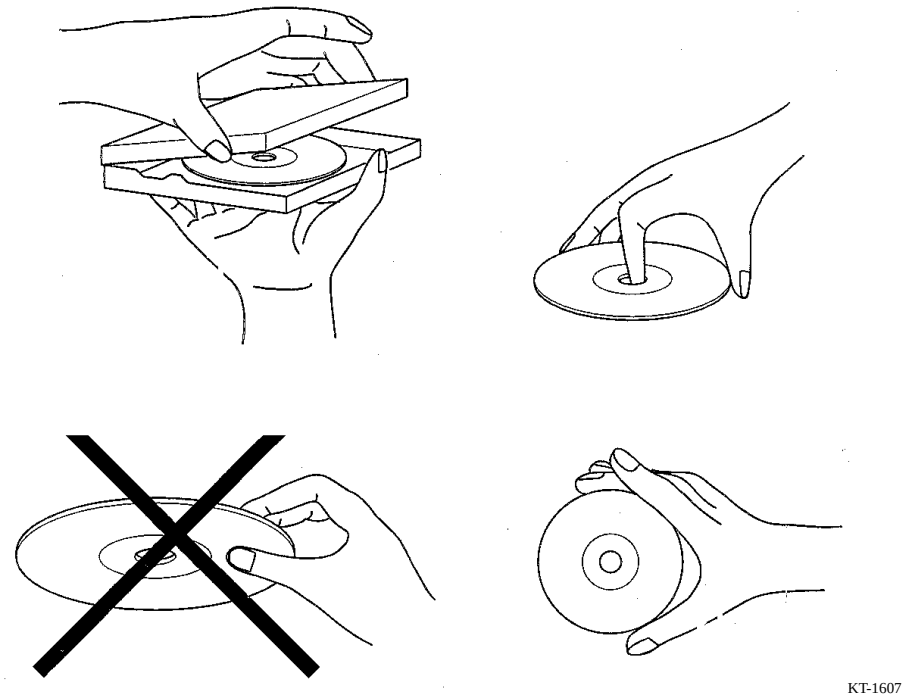


Fig. 22: Correct maintenance of the CD

5.3 Damaged CDs

Playing damaged, spoiled or cracked CDs can damage the CD-player drive.

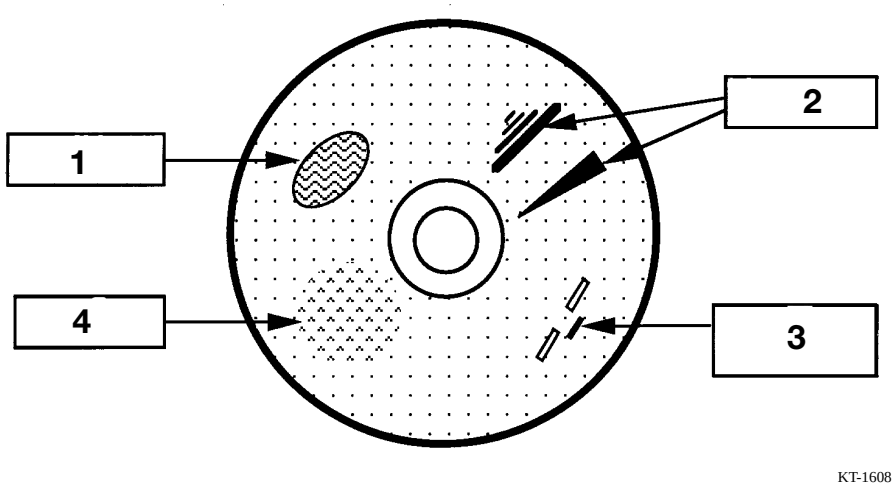


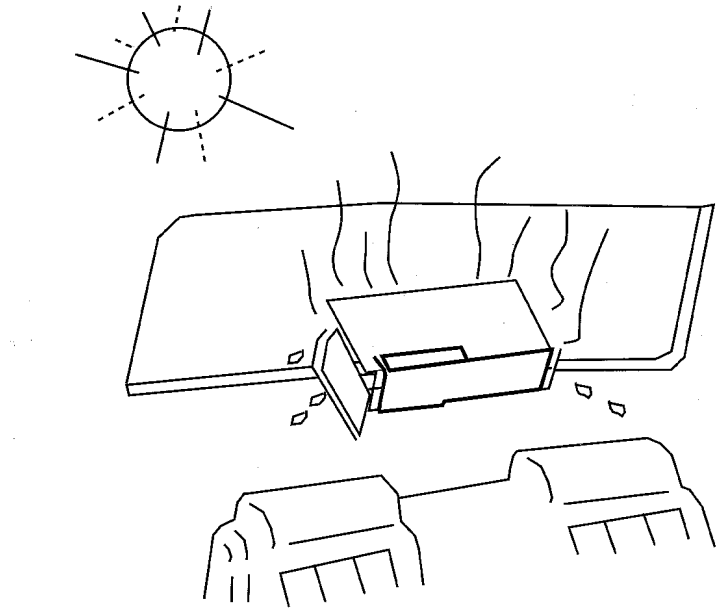
Fig. 23: Damaged and faulty CDs

1 Fingerprint
2 Scratch
3 Dust
4 Residue from processing

5.4 How CDs should be kept when not in use

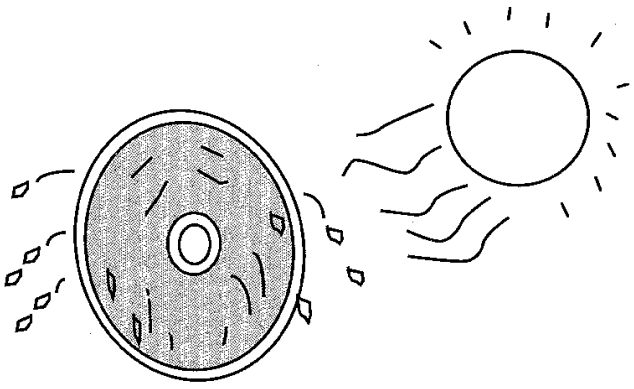
When not in use, CDs should always be kept in their cases in a cool place to protect them from direct sunlight, heat and dust.

CDs and machines should be kept out of the sunlight as much as possible.



KT-1609

Fig. 24: CD-changer when fitted to the back shelf



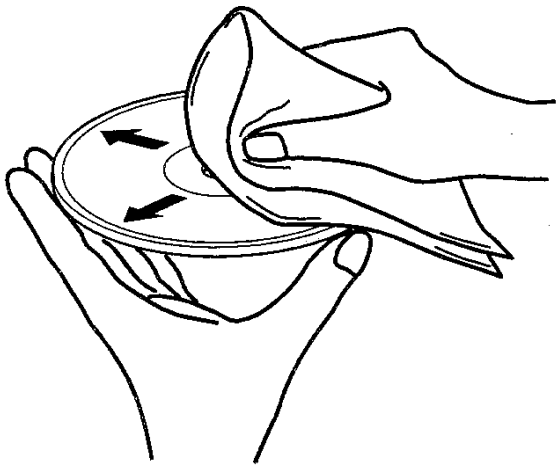
KT-1609

Fig. 25: Keep CD out of sunlight

5.5 Cleaning CDs

The CD must be kept clean. Fingerprints, dust and other impurities can make the CD-player skip and cause momentary sound loss. The underside of the CD can be cleaned from centre to edge using a clean soft cloth.

CDs which are very dirty should be wiped clean with a cloth and mild pH neutral cleaning fluid.



KT-1610

Fig. 26: Cleaning a CD

CDs which are not clean (e.g. due to fingerprints) can prolong interruptions caused by vibrations.

Reason: After a vibration, the pickup must be retracked or refocused (or sometimes both).

It is difficult to find a track which is not clean, so it takes longer to remedy the results of vibration.

5.6 CD accessories

There is a wide range of accessories on the market designed to protect the CD's surface and to improve sound quality. However, use of these accessories can increase a CD's thickness and/or diameter.

These accessories could mean that the CD's threshold values for the CD's format are exceeded, which would prevent the CD-changer from functioning correctly.

Due to the high precision electronics of the CD-changer and the extreme stability of the mechanism, these accessories are not necessary. We therefore recommend that you do not employ them with CDs which you intend to use in the CD-changer or the vehicle's CD player.

Examples of accessories

- Stabilizers
- Transparent stickers
- Stickers used to make your own label for the CD
- Brackets for 8 cm CDs

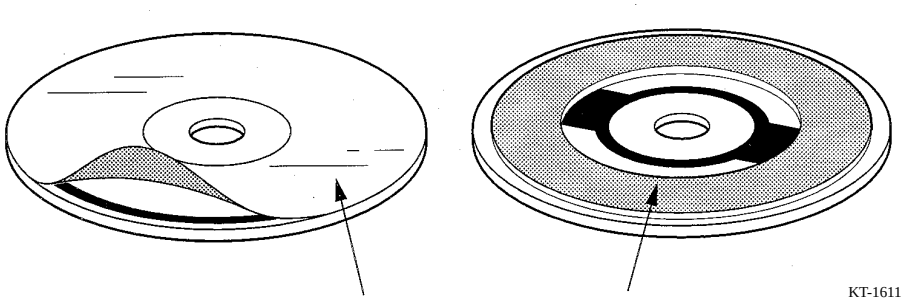


Fig. 27: Examples of accessories

Loose adapters designed for horizontal use (i.e. for the standard CD-player used at home) might slip out of position in a vertically mounted CD-changer when a CD is being changed. In some cases, the adapter might then get jammed.

This might cause the CD to fall out completely and thereby destroy the CD-changer.

Fig. 28: Bracket for 8 cm CD

For 8 cm CD playback, these CDs can be placed inside a bracket or an adapter ring which secures them in three places. These accessories are suitable for domestic use only, **not** for use in a car CD-player/CD-changer.

5.7 Marking on a CD

A CD or its cover might have a various markings or indications.

Certain markings are indicative of the audio data:

Stereo/Mono: This indicates what form playback will take.

AAD/ADD/DDD: This indicates the recording type, mixing and mastering on the CD.

"A" stands for analogue
"D" stands for digital

The sound produced by the amplifiers and loudspeakers depends on which of these markings has been given to the CD in order to indicate its origin (analogue/digital recording). This should be taken into account if clients complain.

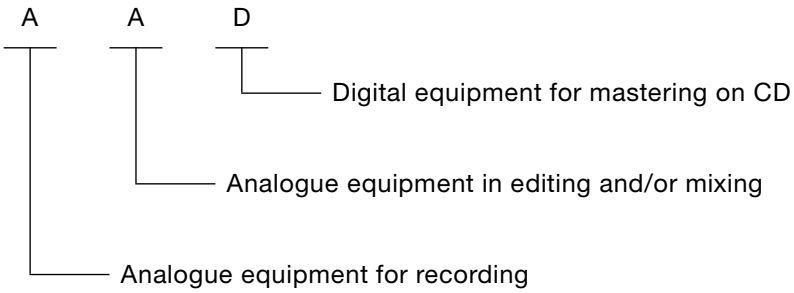
Note:

- CDs vary in quality and price.
- The sound quality produced by the various systems (Stereo/HiFi/DSP) is very much dependent on the quality of the CD itself (refer to marking).

Fig. 29: marking on CD cover

Fig. 30: CD markings

Example:



DDD = Digital equipment for recording, editing and/or mixing and mastering on CD

ADD = Analogue equipment for recording, digital equipment for editing and/or mixing and for mastering on CD

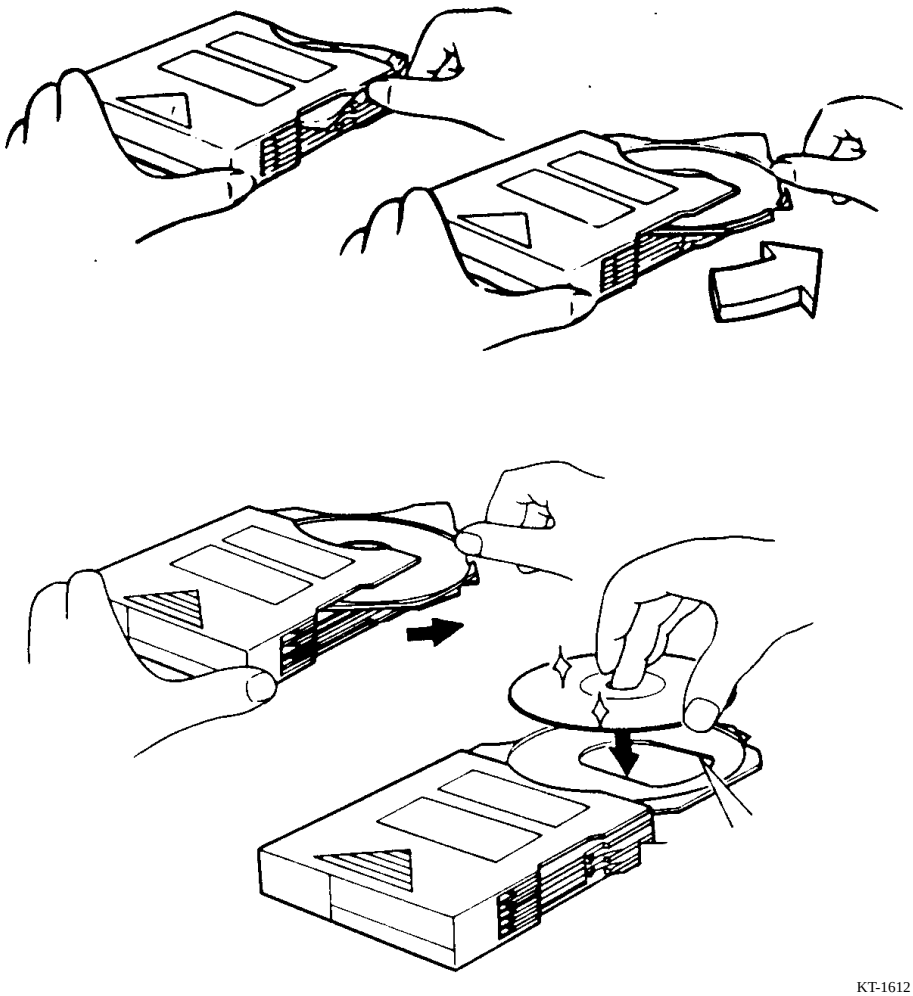
AAD = Analogue equipment for recording and editing and/or mixing, digital equipment for mastering on CD

5.8 Maintenance of CD with magazine

The numbers given to the CD compartments correspond to the control buttons.

Only one CD compartment can be pulled out at a time. The compartments are locked in place by with spherical stoppers and are damaged when several compartments are forced open at the same time. There is no longer any guarantee for CDs being changed properly. The changer is damaged and, in some cases, unusable.

The CD should be placed in the changer the correct way up (see written instructions).



KT-1612

Fig. 31: Maintenance of the CD

Important points:

- Only use magazine designed for CD-changers.
- Do not use a magazine of other BMW changers.
- Do not force magazine into changer.

5.9 BMW CD-changers-systems

CD-changers are designed for a variety of systems and are therefore different:

- Changers coming from different suppliers: Becker, Alpine, Pioneer
- Changers with different magazines which can hold different amounts of CDs: 6 CDs, 10 CDs
- Connected directly to amplifier or radio equipment
- Type of assembly: horizontal or vertical
- marking: changer A = Alpine; P = Pioneer.

Examples of audio system configurations (BMW E36):

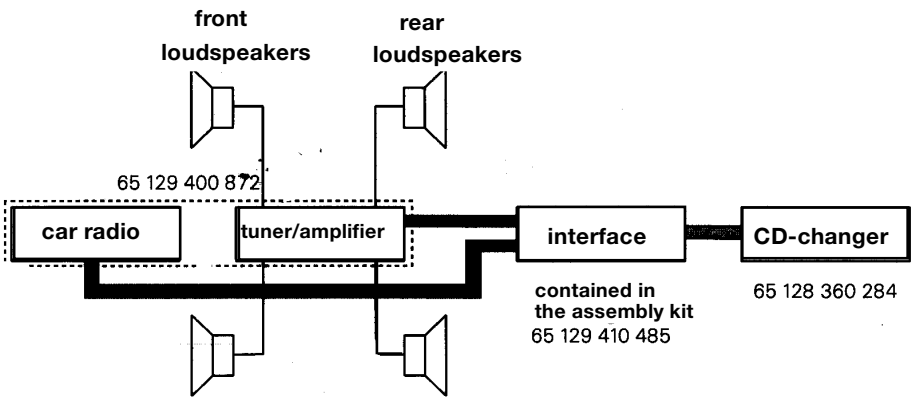


Fig. 32: Bavaria C Professional RDS (2 unit system)

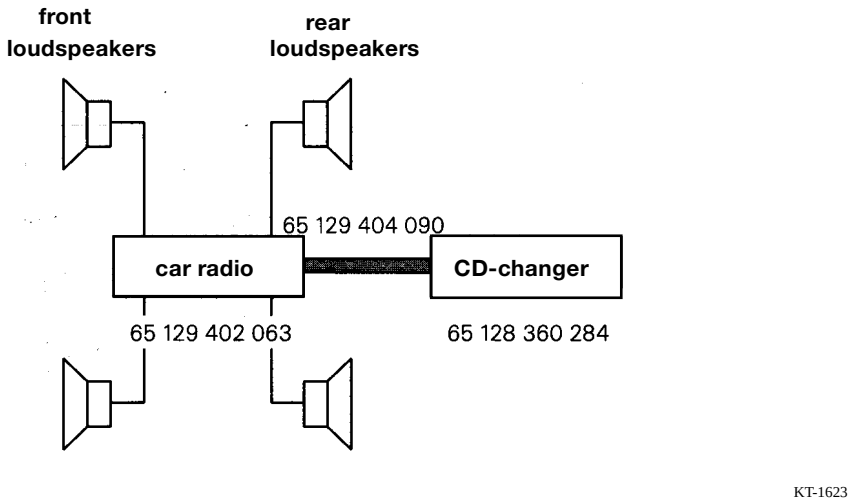


Fig. 33: Business RDS

5.10 Mounting/ securing of CD-changer

This section deals with how to adjust spring mounts since CD-changers occasionally need to be replaced.

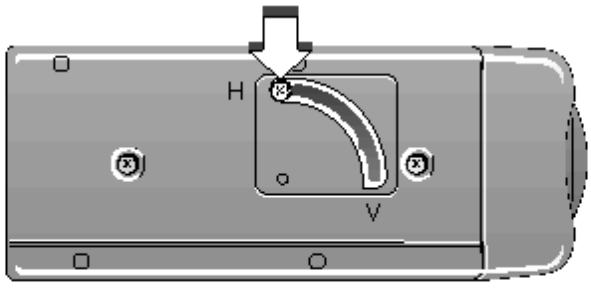
When new machines are delivered, the two covers on the side are often missing. The upper spring mounts of the spring can be adjusted with a pencil (in CD-changer "A") or screwdriver (in CD-changer "P").

The transport retaining screws should be removed before CD-changer is installed. Otherwise, there is no spring/ damper effect. Replacement machines should be set to the installation position and corrected accordingly.

For vertical use, loosen covers and adjust spring mounts.

The spring mounts for horizontal (H) and vertical (V) operation are marked accordingly. Any other position is irrelevant for operation since CD-changers cannot be fitted at an angle in BMW vehicles.

After both sides have been adjusted to the same position, carefully add side covers immediately (to protect inside from dust).



KT-1747

Fig. 34: CD-changer "A" installation position (horizontal adjustment)

KT-1748

Fig. 35: CD-changer "P" mounted for adjustment of installation position

6. Troubleshooting

6.1 System trouble-shooting

System faults can be divided into four categories:

- Faults caused by the CD
- Faults caused by the machine
- Faults caused by the magazine
- Faults in connection or controls

Faults caused by the CD

Damaged CDs

Do not play damaged, spoiled or cracked CDs since this could damage the CD-player's operation.

Scanning faults

In a stationary vehicle:

Check CDs for impurities or scratches.

If CDs are free from defects and can also function properly in other machines, the changer should be sent to the workshop for inspection.
Keep a list of faults with the CDs, briefly describing when the fault appears. For example: "Loss of sound after track 1:34 minutes".

When driving:

Dirty CDs can be more sensitive to vibration.

Additionally, check:

- Have the transport retaining screws been removed?
- Are the mounting springs in the correct position?
- Are the springs in the same position on either side?

- There are, of course, limits in cars with extremely hard suspension, or when driving at very high speeds. If not beforehand, vibrations which cause the mechanism to touch the housing can prevent the electronic error correction from functioning effectively, and the pickup guide is no longer able to realign itself automatically since it then no longer receives any correction data.

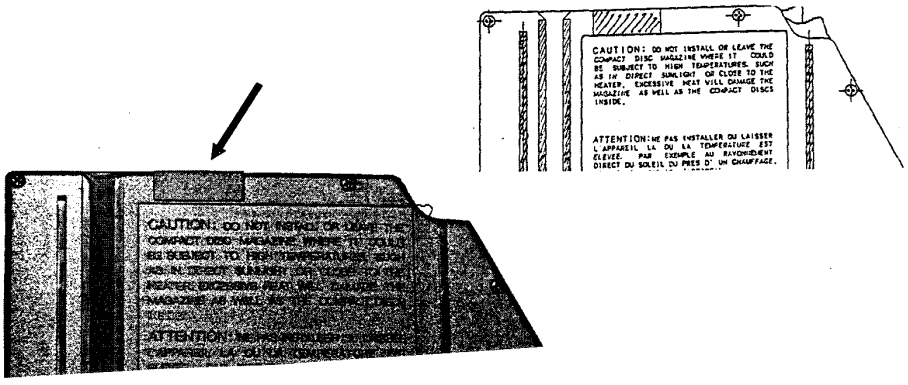
If none of the above applies, problem equipment should be returned to the factory for inspection.

Mechanical faults in CD or magazine

The magazine is not being ejected from the autostack: it is instead lying at an angle in its holder.

In cases like this, the magazine can be slid out using the ejector lever. The equipment must be returned to the factory for repair. This fault can occur while in the vertical assembly position if the magazine is inserted with slightly too much force. To prevent this from happening, the magazine has been modified.

The more recent design of magazine is not subject to this fault. Do not attempt to remove the magazine. The device can only be dismantled in Technical Service. The CDs contained in the magazine will be returned to the dealer.



KT-1613

Fig. 36: Magazine: only the more recent design of magazine is reinforced at the areas subject to the greatest strain (arrow)

Manually removing of magazine:

If the magazine is not ejected, but is lying straight in its holder (only possible with autostack "A"), it must be removed manually (emergency release).

Insert identity card or a similarly narrow object underneath the middle of the magazine.

You will encounter resistance after approx. 4 cm. After this has been overcome, the magazine is ejected.

Check how many CDs there are. If a CD is missing, reinsert empty magazine.

Pressing the eject button will transport the missing CD back into the magazine. The CD will then be ejected. A frequent cause of this is a CD which is too thick or badly processed.

A different procedure is used if there are 2 missing CDs. Since 2 CDs will not fit into 1 magazine compartment at the same time, a different method of removing CDs should be attempted. A flat ruler is required for this. After magazine has been removed manually, press eject button again. Wait until CD-changer stops moving. Now use ruler to push ejector lever back.

The CDs are ejected completely and can be removed.

Ensure that the ruler is lying flat on the black metal plate. As soon as the ejector lever is in its rear position, the CDs start to move out. Hold lever in this position until CDs are completely ejected and lie on the ruler. Move the CD-changer slightly forwards so that the CDs fall out.

If the magazine cannot be removed manually, do not apply force, since it can be assumed that only half of the CD has been pushed out of the magazine. An attempt to lever CD out would damage both the CD and the device.

Always check that the previously mentioned modifications have been made to the magazine. If this proves not to be the case, replace it. Otherwise, faults like those already mentioned might increase.

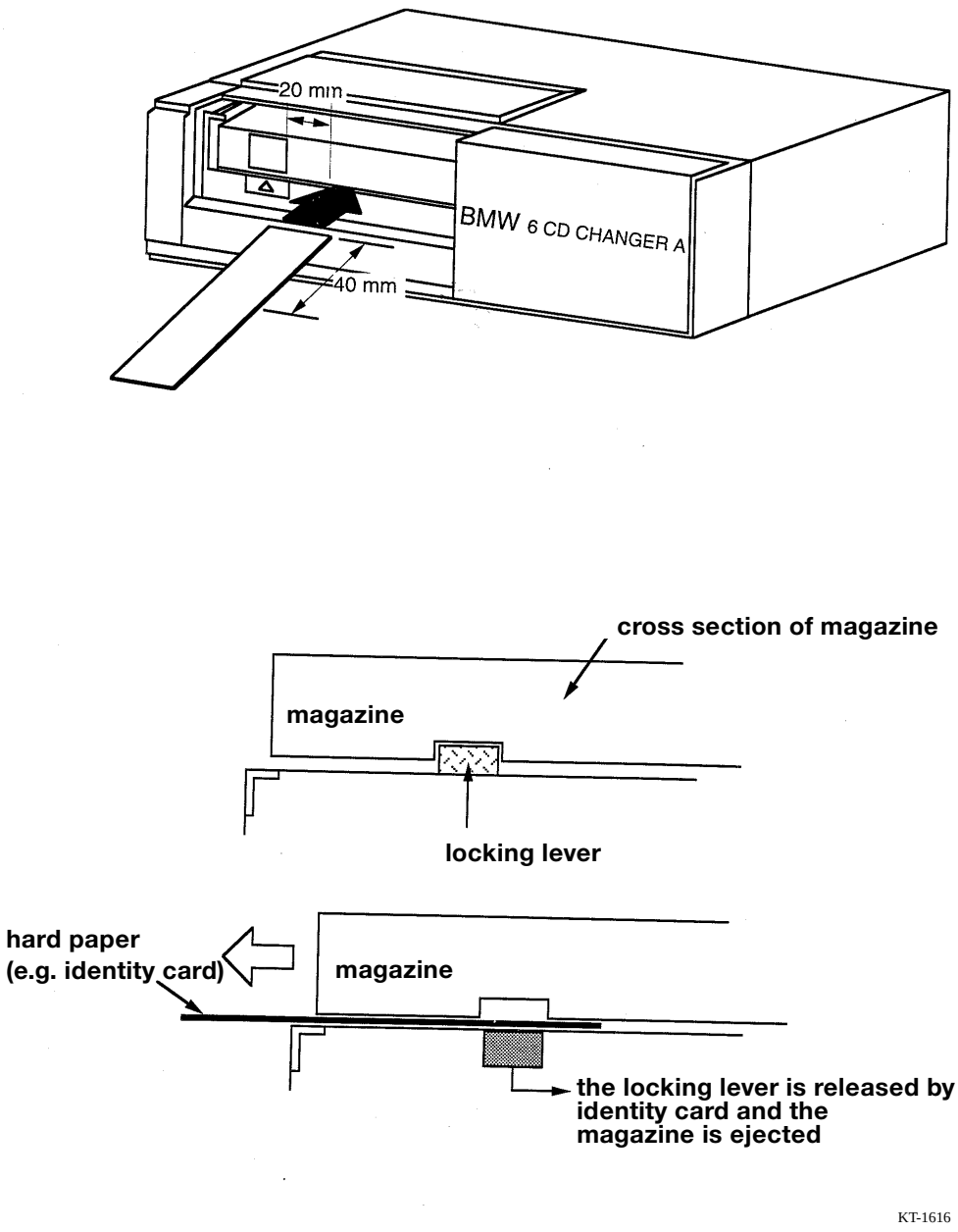


Fig. 37: Emergency removal of magazine in autostack "A"

If autostack "P" is faulty, it must be sent to the workshop with magazine and CD. The CDs are returned (to limit damage).

Jammed magazine or CDs which cannot be returned to changer:

Only tighten transport retaining screws in CD-changer. Do **not** insert transport retaining pin. The transport pin in the assembly would exert pressure on the CD and destroy it.

6.2 General faults

No function/temporary loss of sound/noise interference:

- Are the fuses functioning properly?
- Do the connecting wires follow the diagram?
- Are all wires firmly in their sockets?
- Disconnect DIN wire and voltage supply cable. Wait 1 Minute, then reconnect; voltage supply first, then DIN wire.

  If the CD-changer is operational after this procedure is completed, this indicates that the data communication between the control unit and the CD-changer was faulty, possibly due to external factors. Disconnecting then re-connecting CD-changer initiates a reset process.

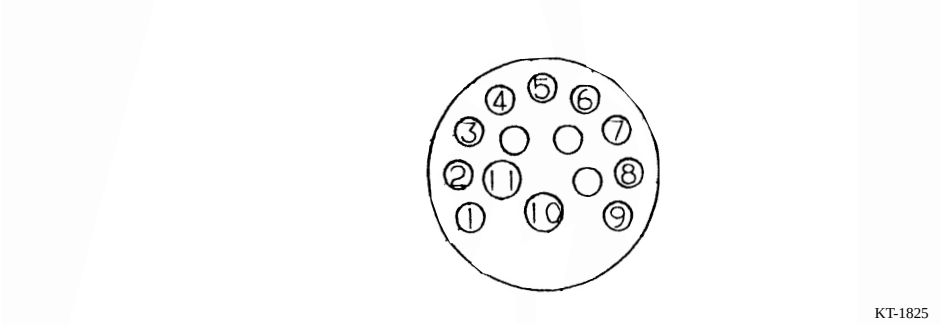


Fig. 38: View of 12-terminal connector

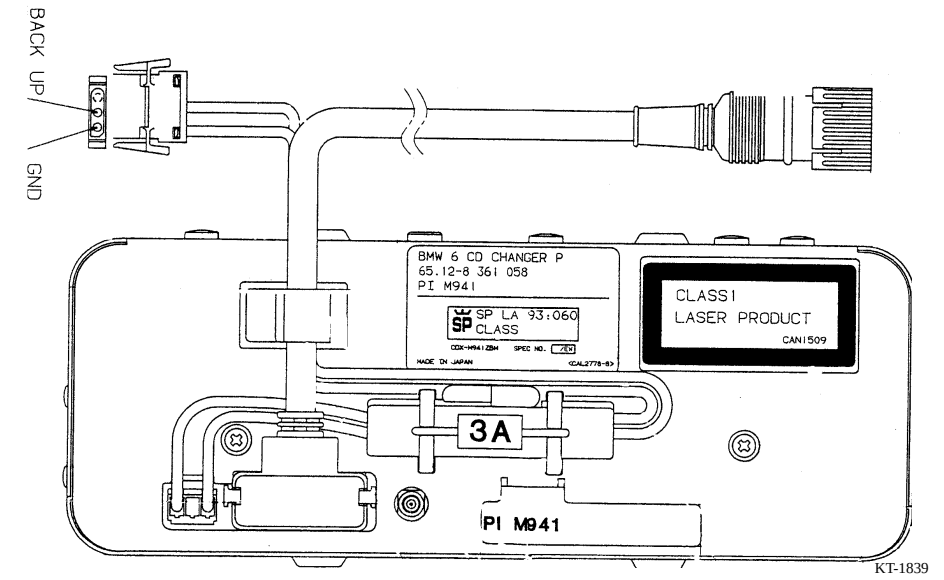


Fig. 39: CD-changer "P" - rear view

Resetting (returning device to its original state) deletes all internal fault messages and all adjustments for internal CD operation. Then all of the sensors are checked to determine the device's current status. If the fault causing the temporary fault function is no longer present, the device can continue to operate normally.

Press reset button with a pen or similar object to reset the CD-changer P. All programmed functions in this autostack can also be reset. If the same fault is repeated, the cause must be detected and removed.

The fault's origin can sometimes be found in the interface which converts the control signals of the Professional radio into the code understood by the CD-changer (this only applies to professional 2-unit machines in the E32/E34 vehicles). Replace interface 65 129 410 485 with another one.

If the fault is still not remedied, try replacing the CD-changer. If CD-mode is now available, the fault's source was in the old CD-changer. Otherwise check control unit. Occasionally, there is an interruption in one of the wires.

If CD-mode is still not available, carry out a counter control procedure with another device. If everything is now properly functional, the defect is in the replaced CD-changer. If not, the fault is in the control unit of the connecting wires.

All functions can be reset following procedure below:

- With a CD-changer P, use a pen or similar object to press cancel button on eject key.
- With all other CD-changers or CD radios, briefly disconnect the system and then reconnect it.

KT-1746

Fig. 40: CD-changer "P" cancel button

6.3 Procedure with defective machines

If a replacement is necessary, please note following guidelines when returning machine:

Tighten transport screws. Pack each CD-changer individually in plastic bags so that no packaging material can get into the mechanism. This also prevents the housing from being scratched accidentally. Do not put any packaging material into magazine holder.

If you cannot remove any CDs which are trapped in the machine, they will be returned to you.

Technical service staff appreciate the importance of a precise description of the problem. Indications such as "defective" or "skipping" are too imprecise.
The following are descriptions which can easily be understood and provide an aid to successful repair work e.g.
"The CDs are removed from the magazine but are not played",
"Playback is temporarily interrupted after 30 minutes".

Please use blue machine complaint card when checking machine. Complete it carefully. Please be as precise as possible when giving information required on complaint and replacement forms.

Note machine's serial number. Failure to do so will cause delays when machine is sent on.

Prevent foreign bodies (navigations CD, hotel key cards, wire clips etc.) from getting into CD-changer. Tighten transport retaining screws before gently shaking or turning CD-changer when trying to locate foreign bodies.

Many customer complaints can be traced back to other causes than the CD-changer itself e.g. poor quality CDs, external factors or, quite simply, unrealistic expectations.

There is a variety of possible reasons for complaint. Of course, not all possibilities can be covered here. Understanding the technology and typical features of CD-changers can help you find the causes of possible defects independently.

6.4 Troubleshooting

CD is not played properly:

Faulty CDs are often the cause of the problems encountered during playback.

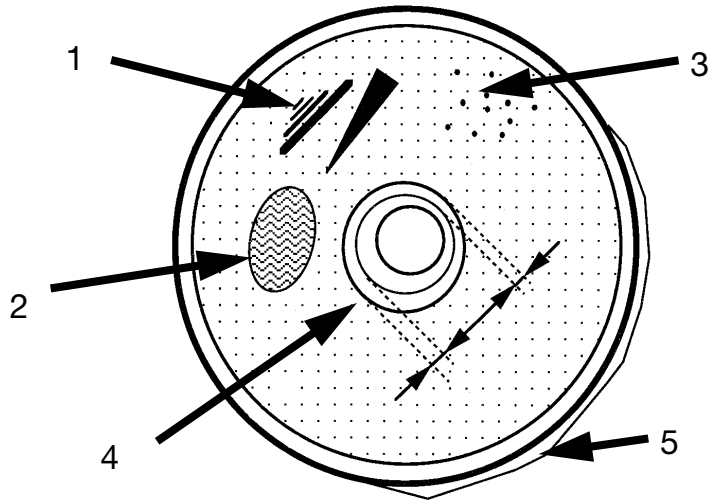


Fig. 41: Summary of problems in CDs

1 Scratches
2 Dirt caused by dust and finger prints
3 Defective material
4 Defective central hole/not concentric
5 Track faults (pressing and write errors)

Scratches/dirt caused by dust/fingerprints

Problem:

- Certain tracks constantly repeated
- Sound interrupted
- CD suddenly ejected during playback

Remedy:

- Clean CD with cleaning set (sold in specialist retail outlets)
- Place CD in protective sleeve when not in use
- Only pick up CD by its edges and centre hole

Defective material

Problem:

- Certain tracks constantly repeated
- Sound interrupted
- CD suddenly ejected during playback

Remedy:

Hold CD to the light and try to look through it. If you can see tiny holes in the CD, then the CD is made of defective material. The CD itself is defective and should be replaced.

Defective centre hole/not concentric

Problem:

CD cannot be played.

Remedy:

- CD is defective → it should be replaced
- CD's contents (TOC) cannot be read by the laser. The CD-player diagnoses a fault and ejects CD.
- Even if the hole is in the centre, problems in playback arise. CD is ejected if the hole is too large.

Track faults (defects in pressing or labeling)

Problem:

- CD cannot be played
- Selected track on CD finishes too early
- CD jammed in magazine

Remedy:

- CD is defective → it should be replaced
- If edge is rough or misshapen, the CD's diameter is too wide and the CD gets jammed in the system→ CD should be replaced

7. The future of the CD - prospects

In addition to the 12 cm CD, the mini-CD will soon come onto the CD scene.

Various manufacturers such as Sony, Panasonic etc. have the mini-CD, called the MD, on offer in addition to hardware machines.

The MD is a small disc covered by a plastic sleeve (cartridge) to protect it from being damaged by the machine.

Playing time lasts either 60 or 74 minutes, depending on the MD. Like its larger counterpart, the MD can boast superior digital sound quality.

MDs can be recorded or played on suitable machines. Tracks of your choice can be inserted and deleted and the entire track order on the MD can be altered.

The MD is currently used in portable mini CD-players, portable Walkman models, and HiFi-MD decks for the audiophile.

MD-changers are also being produced for vehicle use. MD-changers can hold either 4 or 6 MDs in the magazine depending on the type of MD-changer.

Both the (Sony) MD-changer and the Walkman models have special technological features: Shock Resistant Memory and ESP (Electronic Shock Protection).

All Sony Walkmans and Minidisc-players have these features. Shock Resistant Memory is a digital form of mezzanine memory which compensates for vibrations caused by driving on uneven terrain. If the vehicle drives over a pothole on the road, thereby jolting the laser out of the pit it is scanning, the data saved on the memory is used for playback until the pickup is guided back into position. This is possible because the MD rotates considerably more than the CD so there is a larger quantity of data stream available. The data stream first flows into a small, 3 second memory and can only then be transmitted to the Digital/Analogue converter. The memory capacity is approx. 2 Mbytes.

MDs are played on the BMW system from the MD Walkman by means of an adapter cassette. The adapter cassette is connected to the Walkman using the headphone connection. The cassette is operated in the radio system as a standard cassette by using the usual audio settings.

8. Index of specialist terminology/glossary

Oversampling

A music signal is picked up off the CD using the oversampling process. (refer to chapter 2.3, p. 11).

Eight-fold oversampling delivers the best sound without interference components. The 1-bit modulation of the D/A converter guarantees high-precision operation, free of any distortion. The use of separate converters for the right and left channels also excludes the possibility of run-time delays.

Random Play

A short press on the Random/RND button (refer to Operating Manual) is all it takes to have the CD-player select and play tracks in a random sequence (randomizer - also known as the "shuffler").

SCAN

This function plays the first 10 seconds of each track on a disc to enable you to find the track of your choice quickly.

Repeat

A track or the entire disc can be repeated as many times as you wish.

Track

This is the term used to describe a piece of music or individual song on a CD.

TOC

= Table of contents on the CD.

Track selection: forwards/reverse

Using the arrow key on radios, MID or MFL scroll key, you can jump from one track to another.

Pit

The term pit describes the holes burned into the CD which contain the data.

Playing time

The playing time of an audio CD is usually 74 minutes, although 63 minutes are also possible.

A key to CD abbreviations

CD-ROM:	compact disc read only memory
CDR:	compact disc recordable (blank CD which can have data burned on to it)
CD-WO:	compact disc write once