STUDER
professional audio equipment

Studer D424
2-Channel MO Disk Recorder
Software Version 1.6

Operating Instructions

A   Safety Information

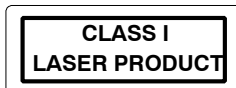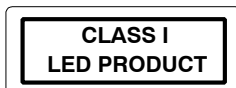|	
CAUTION RISK OF ELECTRIC SHOCK DO NOT OPEN **ATTENTION** RISQUE DE CHOC ELECTRIQUE NE PAS OUVRIR **ACHTUNG** GEFAHR: ELEKTRISCHER SCHLAG NICHT ÖFFNEN	To reduce the risk of electric shock, do not remove covers (or back). No user-serviceable parts inside. Refer servicing to qualified service personnel.
⚡	This symbol is intended to alert the user to presence of un-insulated *dangerous voltage* within the equipment that may be of sufficient magnitude to constitute a risk of electric shock to a person.
⚠	This symbol is intended to alert the user to the presence of *important instructions* for operating and maintenance in the enclosed documentation.
CLASS I **LED PRODUCT** **CLASS I** **LASER PRODUCT**	Assemblies or sub-assemblies of this product can contain opto-electronic devices. As long as these devices comply with Class I of laser or LED products according to EN 60825-1:1994, they will not be expressly marked on the product. If a special design should be covered by a higher class of this standard, the device concerned will be marked directly on the assembly or sub-assembly in accordance with the above standard.

A1   First Aid

In Case of Electric Shock: Separate the person as quickly as possible from the electric power source:
- By switching off the equipment,
- By unplugging or disconnecting the mains cable, or
- By pushing the person away from the power source, using dry insulating material (such as wood or plastic).
- After having sustained an electric shock, *always* consult a doctor.

⚡ *Warning!*   ***Do not touch the person or his clothing before the power is turned off, otherwise you stand the risk of sustaining an electric shock as well!***

If the Person is Unconscious:
- Check the pulse,
- Reanimate the person if respiration is poor,
- Lay the body down, turn it to one side, call for a doctor immediately.

B General Installation Hints

Please consider besides these general hints also any product-specific hints in the "Installation" chapter of this manual.

B1 Unpacking

Check the equipment for any transport damage. A unit that is mechanically damaged or that has been penetrated by liquids or foreign objects must not be connected to the AC power outlet or must be immediately disconnected by unplugging the power cable. Repairs must only be performed by trained personnel in accordance with the applicable regulations.

B2 Installation Site

Install the unit in a place where the following conditions are met:
- The temperature and the relative humidity of the environment must be within the specified limits during operation of the unit. Relevant air values are the ones at the air inlets of the unit.
- Condensation must be avoided. If the unit is installed in a location with large variation of ambient temperature (e.g. in an OB-van), feasible measures must be taken before and after operation (for details on this subject, refer to Appendix 1).
- Unobstructed air flow is essential for proper operation. Air vents of the unit are a functional part of the design and must not be blocked in any way during operation (e.g. by objects placed upon them or placement of the unit on a soft support).
- The unit must not be heated up by external sources of heat radiation (sunlight, spot lights).

B3 Earthing and Power Supply

Earthing of units with mains supply (class I equipment) is performed via the protective earth (PE) conductor integrated in the mains cable. Units with battery operation (< 60 V, class III equipment) must be earthed separately.

Earthing the unit is one of the measures for protection against electrical shock hazard (dangerous body currents). Hazardous voltage may not only be caused by a defective power supply insulation, but may also be introduced by the connected audio or control cables.

If the unit is installed with one or several external connections, its earthing must be provided during operation as well as while the unit is inoperative. If the earthing could be interrupted via the power supply (e.g. by pulling the mains plug), an additional, permanent earthing must be installed using the provided earth terminal.

Avoid ground loops (hum loops) by keeping the loop surface as small as possible (by consequently guiding the earth conductors in a narrow, parallel way), and reduce the noise current flowing through the loop by inserting an additional impedance (common-mode choke).
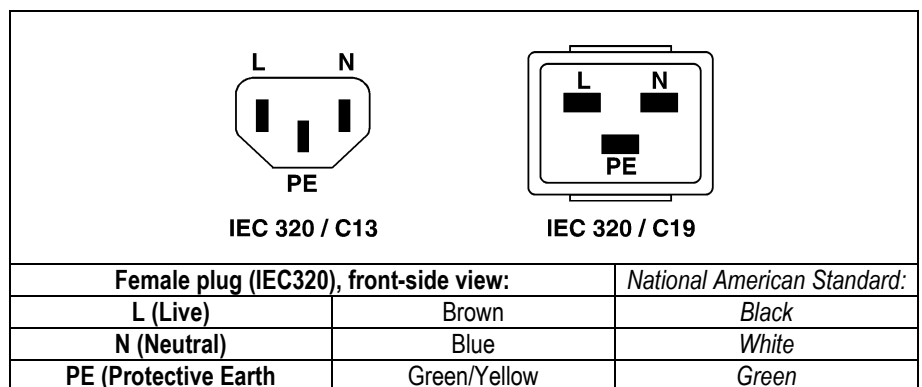
Class I Equipment (Mains Operation)

Should the equipment be delivered without a matching mains cable, the latter has to be prepared by a trained person using the attached female plug (IEC320/C13 or IEC320/C19) with respect to the applicable regulations in your country.

Before connecting the equipment to the AC power outlet, check that the local line voltage matches the equipment rating (voltage, frequency) within the admissible tolerance. The equipment fuses must be rated in accordance with the specifications on the equipment.

Equipment supplied with a 3-pole appliance inlet (protection conforming to class I equipment) *must* be connected to a 3-pole AC power outlet so that the equipment cabinet is connected to the protective earth.

For information on mains cable strain relief please refer to Appendix 2.

IEC 320 / C13   **IEC 320 / C19**

Female plug (IEC320), front-side view:		*National American Standard:*
L (Live)	Brown	*Black*
N (Neutral)	Blue	*White*
PE (Protective Earth	Green/Yellow	*Green*

Class III Equipment (Battery Operation up to 60 V$_{DC}$)

Equipment of this protection class must be earthed using the provided earth terminal, if one or more external signals are connected to the unit (see explanation at the beginning of this paragraph).

B4   Electromagnetic Compatibility (EMC)

The unit conforms to the protection requirements relevant to electromagnetic phenomena that are listed in the guidelines 89/336/EC and FCC, part 15.

- The electromagnetic interference generated by the unit is limited in such a way that other equipment and systems can be operated normally.
- The unit is adequately protected against electromagnetic interference so that it can operate properly.

The unit has been tested and conforms to the EMC standards of the specified electromagnetic environment, as listed in the following declaration. The limits of these standards ensure protection of the environment and corresponding noise immunity of the equipment with appropriate probability. However, a professional installation and integration within the system are imperative prerequisites for operation without EMC problems.

For this purpose, the following measures must be followed:

- Install the equipment in accordance with the operating instructions. Use the supplied accessories.
- In the system and in the vicinity where the equipment is installed, use only components (systems, equipment) that also fulfill the EMC standards for the given environment.
- Use a system grounding concept that satisfies the safety requirements (class I equipment must be connected with a protective ground conduc-

tor) and that also takes into consideration the EMC requirements. When deciding between radial, surface, or combined grounding, the advantages and disadvantages should be carefully evaluated in each case.

- Use shielded cables where shielding is specified. The connection of the shield to the corresponding connector terminal or housing should have a large surface and be corrosion-proof. Please note that a cable shield connected only single-ended can act as a transmitting or receiving antenna within the corresponding frequency range.

- Avoid ground loops or reduce their adverse effects by keeping the loop surface as small as possible, and reduce the noise current flowing through the loop by inserting an additional impedance (e.g. common-mode choke).

- Reduce electrostatic discharge (ESD) of persons by installing an appropriate floor covering (e.g. a carpet with permanent electrostatic filaments) and by keeping the relative humidity above 30%. Further measures (e.g. conducting floor) are usually unnecessary and only suitable if used together with corresponding personal equipment.

- When using equipment with touch-sensitive operator controls, please take care that the surrounding building structure allows for sufficient capacitive coupling of the operator. This coupling can be improved by an additional, conducting surface in the operator's area, connected to the equipment housing (e.g. metal foil underneath the floor covering, carpet with conductive backing).

C   Maintenance

All air vents and openings for operating elements (faders, rotary knobs) must be checked on a regular basis, and cleaned in case of dust accumulation. For cleaning, a soft paint-brush or a vacuum cleaner is recommended.

Cleaning the surfaces of the unit is performed with a soft, dry cloth or a soft brush.

Persistent contamination can be treated with a cloth that is slightly humidified with a mild cleaning solution (soap-suds).

For cleaning display windows, commercially available computer/TV screen cleaners are suited. Use only a slightly damp (never wet) cloth.

Never use any solvents for cleaning the exterior of the unit! Liquids must never be sprayed or poured on directly!

For equipment-specific maintenance information please refer to the corresponding chapter in the Operating and Service Instructions manuals.

D   Electrostatic Discharge during Maintenance and Repair

Caution:

Observe the precautions for handling devices sensitive to electrostatic discharge!

Many semiconductor components are sensitive to electrostatic discharge (ESD). The life-span of assemblies containing such components can be drastically reduced by improper handling during maintenance and repair work. Please observe the following rules when handling ESD sensitive components:

- ESD sensitive components should only be stored and transported in the packing material specifically provided for this purpose.

- *When performing a repair by replacing complete assemblies, the removed assembly must be sent back to the supplier in the same packing*

material in which the replacement assembly was shipped. If this should not be the case, any claim for a possible refund will be null and void.

- Unpacked ESD sensitive components should only be handled in ESD protected areas (EPA, e.g. area for field service, repair or service bench) and only be touched by persons who wear a wristlet that is connected to the ground potential of the repair or service bench by a series resistor. The equipment to be repaired or serviced as well as all tools and electrically semi-conducting work, storage, and floor mats should also be connected to this ground potential.
- The terminals of ESD sensitive components must not come in uncontrolled contact with electrostatically chargeable (voltage puncture) or metallic surfaces (discharge shock hazard).
- To prevent undefined transient stress of the components and possible damage due to inadmissible voltages or compensation currents, electrical connections should only be established or separated when the equipment is switched off and after any capacitor charges have decayed.

E   Repair

Removal of housing parts, shields, etc. exposes energized parts. For this reason the following precautions must be observed:
- Maintenance may only be performed by trained personnel in accordance with the applicable regulations.
- The equipment must be switched off and disconnected from the AC power outlet before any housing parts are removed.
- Even if the equipment is disconnected from the power outlet, parts with hazardous charges (e.g. capacitors, picture tubes) must not be touched until they have been properly discharged. Do not touch hot components (power semiconductors, heat sinks, etc.) before they have cooled off.
- If maintenance is performed on a unit that is opened and switched on, no un-insulated circuit components and metallic semiconductor housings must be touched, neither with your bare hands nor with un-insulated tools.

Certain components pose additional hazards:
- *Explosion hazard* from lithium batteries, electrolytic capacitors and power semiconductors (watch the component's polarity. Do not short battery terminals. Replace batteries only by the same type).
- *Implosion hazard* from evacuated display units.
- *Radiation hazard* from laser units (non-ionizing), picture tubes (ionizing).
- *Caustic effect* of display units (LCD) and components containing liquid electrolyte.

Such components should only be handled by trained personnel who are properly protected (e.g. safety goggles, gloves).

E1 SMD Components

Studer does not keep any commercially available SMD components in stock. For repair the corresponding devices should be purchased locally. The specifications of special components can be found in the service manual.

SMD components should only be replaced by skilled specialists using appropriate tools. No warranty claims will be accepted for circuit boards that have been damaged. Proper and improper SMD soldering joints are illustrated below.
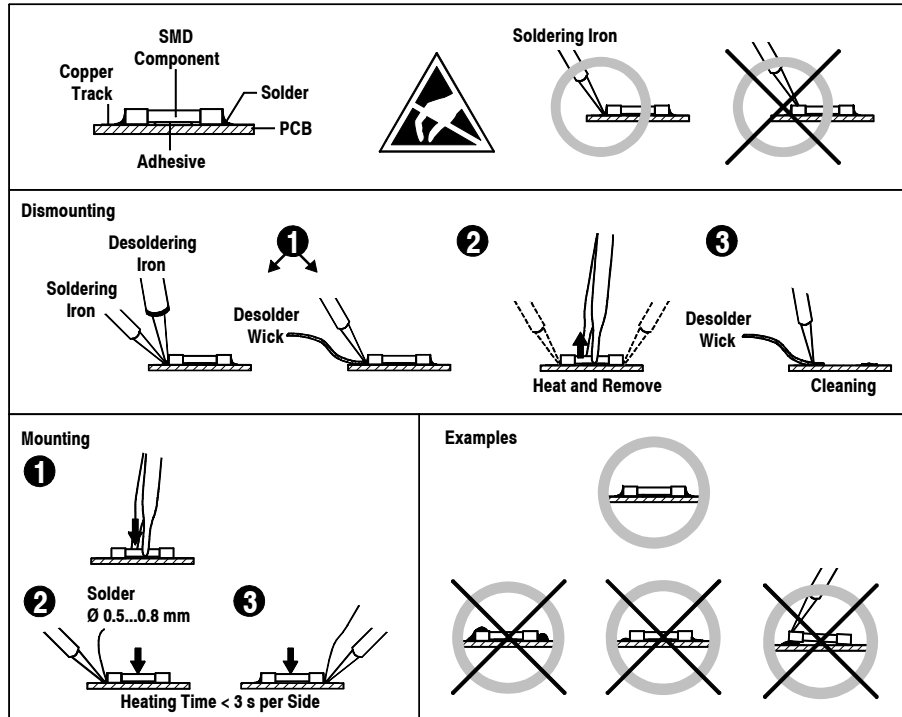
F Disposal

Disposal of Packing Materials

The packing materials have been selected with environmental and disposal issues in mind. All packing material can be recycled. Recycling packing saves raw materials and reduces the volume of waste.

If you need to dispose of the transport packing materials, please try to use recyclable means.

Disposal of Used Equipment

Used equipment contains valuable raw materials as well as materials that must be disposed of professionally. Please return your used equipment via an authorized specialist dealer or via the public waste disposal system, ensuring any material that can be recycled is.

Please take care that your used equipment cannot be abused. To avoid abuse, delete sensitive data from any data storage media. After having disconnected your used equipment from the mains supply, make sure that the mains connector and the mains cable are made useless.

G   Declarations of Conformity

G1   Class A Equipment - FCC Notice

This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide a reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference, in which case the user will be required to correct the interference at his own expense.

Caution: *Any changes or modifications not expressly approved by the manufacturer could void the user's authority to operate the equipment. Also refer to relevant information in this manual.*

G2   CE Declaration of Conformity

We,
Studer Professional Audio GmbH,
CH-8105 Regensdorf,
declare under our sole responsibility that the product
Studer D424, Professional 2-Channel MO Disk Recorder
(starting with serial no. 101)
to which this declaration relates, according to following regulations of EU directives and amendments
- Low Voltage (LVD):
  73/23/EEC + 93/68/EEC
- Electromagnetic Compatibility (EMC):
  89/336/EEC + 92/31/EEC + 93/68/EEC
is in conformity with the following standards or normative documents:
- Safety:
  EN 60950:1992 + A1/A2:1993 (Class I equipment)
- EMC:
  EN 50081-1:1992, EN 50082-1:1992

Regensdorf, July 18, 1996

B. Hochstrasser, President   P. Fiala, Manager QA

Appendix 1: Air Temperature and Humidity

General

Normal operation of the unit or system is warranted under the following ambient conditions defined by *EN 60721-3-3, set IE32, value 3K3*.

This standard consists of an extensive catalogue of parameters, the most important of which are: ambient temperature +5...+40 °C, relative humidity 5...85% (i.e., no formation of condensation or ice); absolute humidity 1...25 g/m³; rate of temperature change < 0.5 °C/min. These parameters are dealt with in the following paragraphs.

Under these conditions the unit or system starts and works without any problem. Beyond these specifications, possible problems are described in the following paragraphs.

Ambient Temperature

Units and systems by Studer are generally designed for an ambient temperature range (i.e. temperature of the incoming air) of +5...+40 °C. When rack mounting the units, the intended air flow and herewith adequate cooling must be provided. The following facts must be considered:

- The admissible ambient temperature range for operation of the semiconductor components is 0 °C to +70 °C (commercial temperature range for operation).
- The air flow through the installation must provide that the outgoing air is always cooler than 70 °C.
- Average heat increase of the cooling air shall be 20 K, allowing for an additional maximum 10 K increase at the hot components.
- In order to dissipate 1 kW with this admissible average heat increase, an air flow of 2.65 m³/min is required.

Example: A rack dissipating *P = 800 W* requires an air flow of *0.8 * 2.65 m³/min* which corresponds to *2.12 m³/min*.

- If the cooling function of the installation must be monitored (e.g. for fan failure or illumination with spot lamps), the outgoing air temperature must be measured directly above the modules at several places within the rack. The trigger temperature of the sensors should be 65 to 70 °C.

Frost and Dew

The unsealed system parts (connector areas and semiconductor pins) allow for a minute formation of ice or frost. However, formation of dew visible with the naked eye will already lead to malfunctions. In practice, reliable operation can be expected in a temperature range above –15 °C, if the following general rule is considered for putting the cold system into operation:

If the air within the system is cooled down, the relative humidity rises. If it reaches 100%, condensation will arise, usually in the boundary layer between the air and a cooler surface, together with formation of ice or dew at sensitive areas of the system (contacts, IC pins, etc.). Once internal condensation occurs, trouble-free operation cannot be guaranteed, independent of temperature.

Before putting into operation, the system must be checked for internal formation of condensation or ice. Only with a minute formation of ice, direct evaporation (sublimation) may be expected; otherwise the system must be heated and dried while switched off.

A system without visible internal formation of ice or condensation should be heated up with its own heat dissipation, as homogeneously (and subsequently as slow) as possible; the ambient temperature should then always be lower than the one of the outgoing air.

If it is absolutely necessary to operate the cold system immediately within warm ambient air, this air must be dehydrated. In such a case, the absolute humidity must be so low that the relative humidity, related to the coldest system surface, always remains below 100%.

Ensure that the enclosed air is as dry as possible when powering off (i.e. before switching off in winter, aerate the room with cold, dry air, and remove humid objects as clothes from the room).

These relationships are visible from the following climatogram. For a controlled procedure, thermometer and hygrometer as well as a thermometer within the system will be required.

Example 1: An OB-van having an internal temperature of 20 °C and relative humidity of 40% is switched off in the evening. If temperature falls below +5 °C, dew or ice will be forming.

Example 2: An OB-van is heated up in the morning with air of 20 °C and a relative humidity of 40%. On all parts being cooler than +5 °C, dew or ice will be forming.
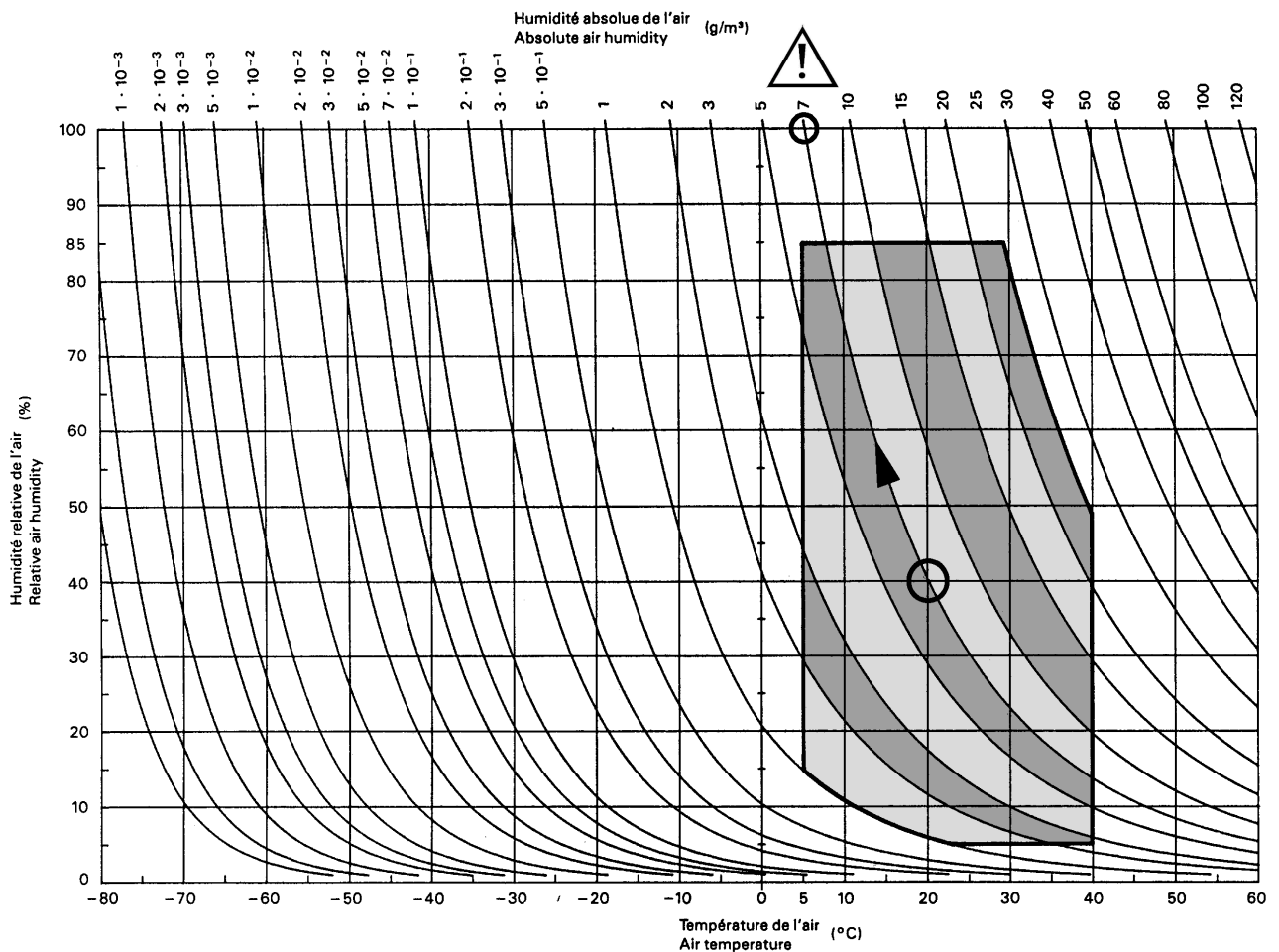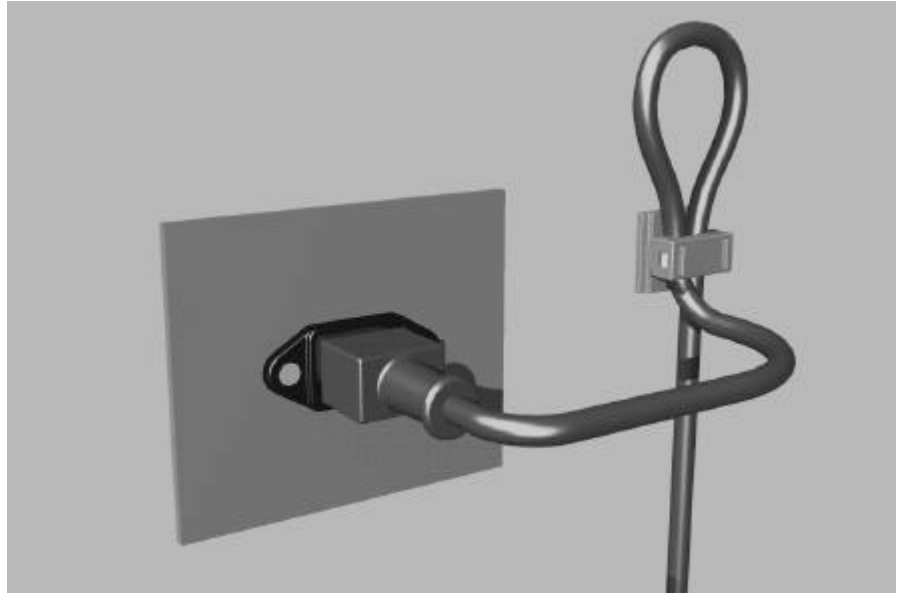

Figure B.3 – Climatogramme pour catégorie 3K3
Climatogram for class 3K3

721-3-3 © CEI:1994

Appendix 2: Mains Connector Strain Relief

For anchoring connectors without a mechanical lock (e.g. IEC mains connectors), we recommend the following arrangement:

Procedure: The cable clamp shipped with your unit is auto-adhesive. For mounting please follow the rules below:
- The surface to be adhered to must be clean, dry, and free from grease, oil, or other contaminants. Recommended application temperature range is 20...40 °C.
- Remove the plastic protective backing from the rear side of the clamp and apply it firmly to the surface at the desired position. Allow as much time as possible for curing. The bond continues to develop for as long as 24 hours.
- For improved stability, the clamp should be fixed with a screw. For this purpose, a self-tapping screw and an M4 bolt and nut are included.
- Place the cable into the clamp as shown in the illustration above and firmly press down the internal top cover until the cable is fixed.

Appendix 3: Software License

Use of the software is subject to the Studer Professional Audio Software License Agreement set forth below. Using the software indicates your acceptance of this license agreement. If you do not accept these license terms, you are not authorized to use this software.

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Under no circumstance are third parties entitled to have access to the installation software on the original data media. The Customer shall safeguard the original data media accordingly.

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Warranty, Disclaimer, and Liability

For all issues not covered herewithin, please refer to the "General Terms and Conditions of Sale and Delivery" that are part of the sales contract.

CONTENTS

1   GENERAL

1.1   MO Recording

For a long time, analog tape recording has been the standard recording technology in the professional audio industry. The step into the digital audio era has been done a few years ago with the introduction of digital tape recorders, such as DASH and R-DAT machines. Another important evolution was pushed by the computer industry: Hard disk-based workstations record on fast, direct-access media, which are also capable for later editing without destroying the original information.

Beginning with the consumer format CD, a removable medium with excellent price and archiving characteristics, the optical disk became in the meantime a reliable recording media standard, in audio and computer industry.

Taking the advantages of the above approaches:
• Well accepted and easy-to-understand surface of a dedicated audio recorder,
• Versatile and future-proof technology, based on standard data storage devices (SCSI-2),
• Removable medium with very good archiving characteristics and the capability for direct access editing,
the Studer D424-2 MO recorder has been designed to be integrated into today's and future environments, combined with analog and digital audio processing and automation. It is ready to follow the rapid evolution of recording technology, without neglecting the needs of the professional user.

1.2 The Medium – Magneto-Optical Disks

1.2.1 Disk Standards

The D424 MO recorder with ISO drive is equipped with a 5.25" MO drive capable of reading and writing to the standard double-sided 5.25" disk types listed below. Only high-quality disks should be used for the D424 application. Please contact your Studer representative for information on the recommended suppliers.

1.2 GB (512 bytes/sector)	available on request
2.3 GB (512 bytes/sector)	available on request
1.3 GB (1024 bytes/sector)	available on request
2.6 GB (1024 bytes/sector)	Order No. 15.622.260.13
4.8 GB (1024 bytes/sector)	available on request
5.2 GB (2048 bytes/sector)	available on request

The D424 will automatically recognize the type of the disk being inserted. Direct-overwrite (LIM-DOW) type disks are only supported when the D424 is equipped with a F-541-DW drive.

1.2.2 Disk Formatting

New disks are preformatted from the manufacturer. This process is called "low-level formatting". It is only useful after having cleaned a disk which had numerous defective blocks. Low-level formatting will then re-check every bit on the disk for validity, which can take up to 40 minutes.

In order to start recording, the D424 only has to add the basic system files. Building up a DOS system and installing the basic D424 files is called "high-level formatting", or simply "formatting". This process takes only a few seconds.

After inserting a new, empty disk for the first time, the D424 will automatically ask for formatting. Any prerecorded disk may be re-formatted at any time. This is a fast and direct way to delete the whole contents of a disk.

1.2.3   Disk Capacities

Depending on disk type, sampling rate, and recording format, the recording capacity will vary. The following table shows some examples of the recording capacities (stereo, per side):

Disk type	44.1 kHz / 16 bit	48 kHz / 16 bit	48 kHz / 24 bit
1.2 GB ISO	55 min	50 min	34 min
1.3 GB ISO	60 min	55 min	37 min
2.3 GB ISO	1 h 45 min	1 h 37 min	1 h 5 min
2.6 GB ISO	2 h	1 h 50 min	1 h 15 min
4.8 / 5.2 GB ISO	3 h 15 min	3 h	2 h

Notes: All 5.25" disks are double-sided. Each side provides the stereo capacity listed above.

Because of the DOS operating system, a maximum of 2 GB can be used; 4.8 and 5.2 GB disks are automatically formatted with a maximum partition.

With 1.2 and 1.3 GB disks, the insert recording modes are limited to 16 and 20 bit resolution. For assemble recording and editing there is no such limitation.

1.2.4   Disk Handling

Disks can be write-protected by sliding the appropriate tab to the "data protect" position (see manufacturer's information).
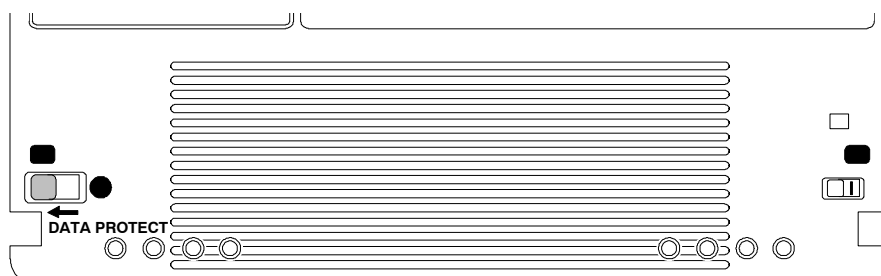
The magneto-optical medium is very reliable. Nevertheless, there are some recommendations for disk storage and handling:

*   Always store a disk in its case.
*   Keep the disk cartridges away from sources of heat, excessive dust, or moisture.
    Please, follow also the information of the disk manufacturer.

After being exposed to a dusty environment, some blocks may be marked as defective during recording. The MO drive will automatically assign spare blocks for storing the affected audio information.

The D424 will check a disk when set to RECORD READY. A warning message will be displayed if more than 60 grown defective sectors were found.

When starting with a new production, empty disks should not report any defective blocks. It is therefore recommended to clean empty disks with appropriate tools when encountering such warning messages. After a subsequent low-level formatting process, the disk will again be in perfect shape for further recordings.

If the number of reported defective blocks is increasing notably, any further recording and editing should be avoided. Backup your data before resuming your session.

Please contact your disk supplier or Studer for detailed information on accessories as disk cleaning kits.

1.3   File Systems, File Formats, Audio Files

The D424 MO-recorder is based on a SCSI-controlled magneto-optical drive, and standard ISO disks as storage medium. The same drives and disks are used in computer applications for storing and archiving.

By using the same file system and formats as MS-DOS based computer platforms, disks which were recorded with a D424 can be played by all DOS based systems – from simple multimedia computers to fully professional audio workstations.

The D424 is storing all audio information to sound files in standard Microsoft Wave format (*.WAV), including all relevant recording parameters, as sampling rate, word length, and number of channels.

All further information on the structure of a session as well as all editing information are kept in separate sequence files (*.seq), also known under the name Edit Decision List (EDL).

1.3.1   Takes, Indices, and Sequences

When working with the D424, you don't have to care for sound files, directories, or disk structures and the like; the following definitions, however, are important for your recording, editing, and playback work.

The recorded material is subdivided into takes and indices.
* Every time you start recording, a new take is created.
* Place additional take markers during a long recording session. In a concert you may mark the begin of a new song. This will save time for creating the definitive markers when editing later.
* Store additional index markers at positions which have to be edited. Later, you will be able to address them directly, without the need for searching.
* During the subsequent editing session, all markers having been previously set can be deleted or moved. New ones can be set in order to prepare your project for transferring to a CD, with all desired take and index markers.

When you start working with a new project, all settings and editing information will be stored to the currently selected sequence. Only one sequence can be active at a time, which is called the "Current Sequence".
* When you start recording on a new disk, a first sequence will be created. You will stay with this first sequence until you switch to a new one.
* Create a new, empty sequence for a different project. Start recording and do your editing session in a separate environment. It is very easy to switch between different sequences.
* You can have several sequences for a single project – do your basic editing first, copy the current sequence to a new one, and continue with your session. You will have access to the basic version at any time.
* Make different versions of an original recording. You can decide at the end of your projects, which one you would like to keep – or keep all of them. Sequences do not require much storage capacity.

Takes, Indices: Insert a new, empty disk, set the channels ready, and press REC+PLAY. The first take in the initial sequence 1 will be recorded. Each time you start recording, a new take is created, which is given a numbered take marker at its beginning automatically.
After having recorded three audio takes, the contents of the disk will look like this:

1	**2**	**3**
take 1	take 2	take 3

The current sequence now consists of three takes. Simply record one more take, and you will end up with:

1	**2**	**3**	**4**
take 1	take 2	take 3	take 4

Whenever there is a need for marking certain points within a take, or to subdivide a single take into smaller parts, you can create indices by freely placing index or take markers anywhere within your sequence, either on-line during recording, or later when editing.

Take 2 can be divided into two separate takes by placing an additional marker. The new take marker gets number 5, which is the next free number in the current sequence. In addition, a certain position in take 4 is marked with an index.

1	**2**	**5**	**3**	**4.1**	**4.2**
take 1	take 2	take 5	take 3		take 4

After having placed these markers, you can not only skip from one original take to the next one, like with a CD player, but also skip to the new markers.
In the example above, the skip sequence is: 1 – 2 – 5 – 3 – 4.1 – 4.2

All the markers can simply be deleted if they are not required anymore. In case of deleting the take markers 3 and 5 in the above example, the takes 2, 5, and 3 would be joined to a new take. The result would be like this:

1	**2**	**4.1**	**4.2**
take 1	take 2		take 4

Finally, markers can be moved, to adjust the take structure of the existing source material, e.g. to define the position of the tracks and indices of a CD, or to prepare precise start positions for on-air broadcasting.

After moving the begin of take 2, the above sequence will look like this:

1	**2**	**4.1**	**4.2**
take 1	take 2		take 4

Sequences: If it is necessary to make another production with the same recorded material, a new sequence is defined. In the following example, only the takes 2, 3, and 4 should be edited, but in reverse order.

1	2	3	4
take 1	take 2	take 3	take 4

For this purpose, create a new sequence with the Sequence Editing feature, insert the required takes in their new order (takes 4, 3, and 2), and the new sequence will be:

4	3	2
take 4	take 3	take 2

You can now start with further editing, like changing markers, renumbering, cutting or re-arranging audio information, or adjusting levels.
With a few keystrokes you can switch to another available sequence on the disk, and start playing, recording, or editing.

Note: Creating new sequences does not need additional audio file capacity on a disk. There is only a new small EDL file, describing how to play the same audio data in a different way.

1.3.2   Non-Destructive Editing

The D424 is providing non-destructive editing. Because all editing processes are simply instructions on how to play the original sound files, the original audio data remain untouched during the whole editing process.

The following processes therefore only modify the sequence data, not the original audio data:
- Creating, deleting or moving markers.
- Deleting, erasing and inserting audio elements.
- Changing the order of takes.
- Adjusting output levels.

It is possible to have several sequences on the same disk, which represent different variations of the same basic audio material. Each sequence stores the editing data into its own sequence file, but will make use of the same audio files.
Without explicitly deleting sound files, which has to be done with a separate menu utility, the original data can be re-used at any time. It is hardly possible to delete audio data by accident.

1.4   Utilization for the Purpose Intended

The Studer D424 is a Disk recorder intended for professional use. It is designed for recording on MO disks.

It is presumed that the unit is operated only by trained personnel. Servicing is reserved to skilled technicians.

The electrical connections may be connected only to the voltages and signals designed in this manual.

1.5   Copyright

Copies of pre-recorded Material:

Please consider that copying pre-recorded information is only allowed with the approval of the authorized copyright holders of the original material.

1.6   First Steps

1.6.1   Unpacking and Inspection

Your new MO recorder is shipped in a special packing which protects the unit against mechanical shock during transit. Care should be exercised when unpacking so that its surfaces do not get marred.

Verify that the content of the packing agrees with the items listed on the enclosed shipping list.

Check the condition of the equipment for signs of shipping damage. If there should be any complaints you should immediately notify the forwarding agent and your nearest Studer distributor.

Please retain the original packing material because it offers the best protection in case your equipment ever needs to be transported.

1.6.2   Installation

Power Connection: The attached female IEC 320/C 13 mains cable socket has to be connected to an appropriate mains cable by a trained technician with respect to your local regulations. Refer to the "Installation, Operation, and Waste Disposal" section at the beginning of this manual.

Maintenance work inside the unit must be performed by a trained technician.

Humidity: Do not use the unit near any source of moisture or in excessively humid environments.

Ventilation: When installing the unit in a rack or any other location, be sure that there is adequate ventilation. The recorder should be situated so that its location or position does not interfere with its proper ventilation.

The ambient temperature of the D424 must not exceed 35 °C, otherwise the longevity of the mechanism and of the disk drive might be drastically reduced.

1.6.3 Adjustments, Repair

Danger: *All internal adjustments as well as repair work on this product are to be performed by skilled technicians!*
During service work dangerous laser radiation can occur, so the appropriate precautions must be taken.

Primary Fuse: The primary fuse (F 4 A H 250 V, 5×20 mm) is located inside the unit. *Therefore only skilled technicians are authorized to replace the fuse.*

1.6.4 Accessories, Options

Accessories Shipped with the D424:	1 Operating manual (English)	Order No. 10.27.3803
	1 Female mains connector (IEC 320/C 13)	Order No. 54.42.1050
	1 MO Disk	
	1 Hexagon pin spanner 2.5 mm	Order No. 98.00.2023
	2 Fuses F 4 A, 250 V	Order No. 51.01.0156
D424 Options:	Desktop Controller	Order No. 20.866.500.00
Recording Media:	MO Disk 2.6 GB ISO	Order No. 15.622.260.13
	(Other capacities available on request)	
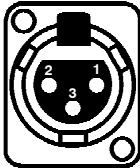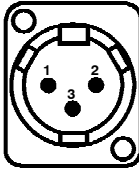
1.6.5   Connector Field
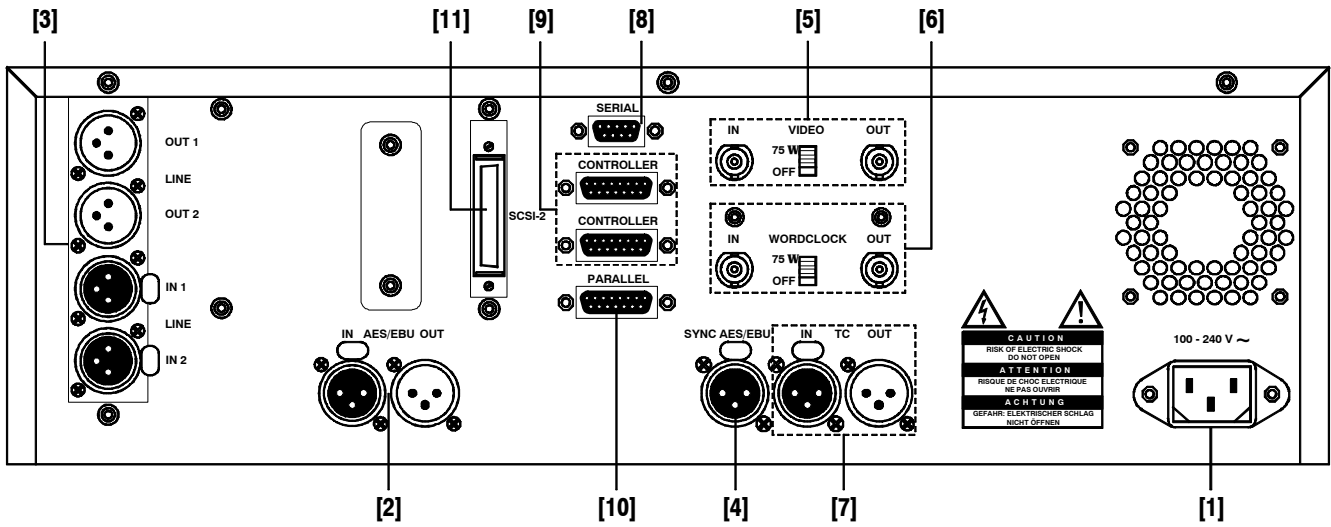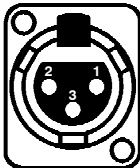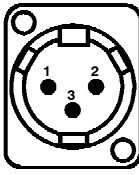
[1]	**AC PLUG**	AC power connector IEC 320/C 14 for mains supply 100...240 V, 50...60 Hz
[2]	**AES/EBU IN/OUT**	AES/EBU digital audio I/O Input (XLR-3, female) and output (XLR-3, male)
[3]	**ANALOG IN/OUT** (optional)	Analog audio I/O Input CH1/CH2 (XLR-3 female) and output CH1/CH2 (XLR-3 male)
[4]	**SYNC AES/EBU**	AES-11 digital audio reference Input (XLR-3, female)
[5]	**VIDEO REFERENCE**	Composite Video Reference, 75 Ω termination selectable Input and output (loop through), BNC connectors
[6]	**WORD CLOCK**	Digital word clock, 75 Ω termination selectable Input and output, BNC connectors
[7]	**TIME CODE**	SMPTE/EBU longitudinal timecode Input (XLR-3 female), and output (XLR-3 male)
[8]	**SERIAL**	Serial remote RS-422, Input (SONY 9-pin compatible)
[9]	**CONTROLLER**	Desktop Controller, input and output (loop through) For Desktop Controller operation and multi-machine configurations
[10]	**PARALLEL**	Parallel GPI port, input/output
[11]	**SCSI-2**	SCSI-2 port For external drive configurations and SCSI data transfer

1.6.6 Connector Pin Assignments
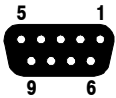
INPUT/OUTPUT LEFT/RIGHT

IN	OUT	Pin	Signal
		1	Ground
		2	Line A ("hot")
		3	Line B ("cold")
XLR-3f	XLR-3m		
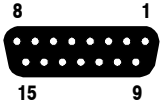
AES/EBU DIGITAL IN/OUT

IN	OUT	Pin	Signal
		1	Ground
		2	Line A ("hot")
		3	Line B ("cold")
XLR-3f	XLR-3m		
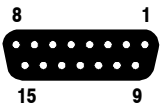
SERIAL **9 pin D-type, female**

	Pin	Signal	Function
	1	FGND	Frame ground
	2	TXA	Transmit A (inverted)
	3	RXB	Receive B
	4	RXC	Receive common
5 1	5	VCC	Supply voltage +24 V, switchable
9 6	6	TXC	Transmit common
	7	TXB	Transmit B
	8	RXA	Receive A (inverted)
	9	FGND	Frame ground

CONTROLLER **15 pin D-type, female**

	Pin	Signal	Function
	1	PHL–	Phones left, inverted
	2	PHR–	Phones right, inverted
	3	AGND	Analog ground
	4	REMT	Rem bus transmit
	5	REMR	Rem bus receive
8 1	6	STSTR	Start signal
	7	SYNCBUS	Sync bus
15 9	8	DGND	Digital ground
	9	PHL+	Phones left
	10	PHR+	Phones right
	11	+24 V	Supply voltage
	12	IREMT	Rem bus transmit, inverted
	13	IREMR	Rem bus receive, inverted
	14	ISTSTR	Start signal, inverted
	15	ISYNCBUS	Sync bus, inverted

PARALLEL   **15 pin D-type, female**

Pin	Signal	Function
1	B_TAKE	Take pulse
2	B_INDEX	Index pulse
3	B_PLAY	Play tally
4	S_STOP	Stop command
5	S_PLAY	Play command
6	S_PLOC	Ploc command
7	FADER1	Fader start input 1
8	GND	Ground
9	B_STOP	Stop tally
10	B_READY	D424 ready
11	VCC	Supply voltage, switchable 5/24 V
12	S_PREV	Previous command
13	S_NEXT	Next command
14	FADER2	Fader start input 2
15	KEY	Key

1.7   Technical Specifications (Subject to change as technological progress may warrant)

1.7.1   Drive System

The D424 is equipped with an ISO standard 2.6 or 5.2 GB drive supporting the following 5¼" disk standards:

2 × WO	1.2 / 1.3 GB	512/1024 bytes/sector
4 × WO/DW	2.3 / 2.6 GB	512/1024 bytes/sector
8 × WO	4.1 / 4.8 / 5.2 GB	512/1024/2048 bytes/sector

(WO = Write Once; DW = Direct Overwrite)

The D424 also supports SCSI CD writers.

1.7.2   Recording Formats

- Linear recording mode with 16, 20 or 24 bit resolution
- Standard file system and audio files (MS-DOS and WAVE)
- Session data supports major manufacturer standard

1.7.3   Audio Processing

Switchable Word Length	16/20/24 bits
Sampling Rates	44.056, 44.1, 47.952, 48 kHz
Varispeed Operation	±12.5%
Digital Scrub Range	0...±2 V_{nom}
Real-time Output Gain Control	(−∞...12 dB)

1.7.4   Audio Input/Output

Digital I/O   AES-3, balanced, transformer coupled, XLR connector

Monitor Output   (headphone connector)
- Unbalanced, 6.3 mm Jack connector
- 16 bit D/A converter

Impedance	100 Ω
Level	Max. 7 V, with potentiometer volume control

Analog In   (measured with line level of +15 dBu for 0 dB_{FS})
- Balanced, transformer coupled, XLR connector
- 20 bit delta-sigma converter (64 times oversampling)

Impedance	>10 kΩ
Level	10...24 dBu (for 0 dB_{FS}), electronically adjustable in steps of 0.5 dB
Frequency Response	20 Hz...20 kHz ±0.1 dB
THD + N	< −87 dB_{FS} (20 Hz...20 kHz, 0 dB_{FS})
	< −103 dB_{FS} (1 kHz, −20 dB_{FS})
Channel Crosstalk	> 110 dB (1 kHz)

Analog Out	(measured with line level of +15 dBu for 0 dB$_{FS}$)
	• Electronically balanced, XLR connector
	• 20 bit delta-sigma converter (128 times oversampling)
Impedance	$< 30\ \Omega$
Level	4 digitally selectable levels between 10...24 dBu (for 0 dB$_{FS}$), adjustable with trimmer potentiometer (default +10, 15, 20, 24 dBu)
Frequency Response	20 Hz...20 kHz $\pm$0.1 dB
THD + N	< -90 dB$_{FS}$ (20 Hz...20 kHz, -1 dB$_{FS}$)
	< -98 dB$_{FS}$ (1 kHz, -20 dB$_{FS}$)
Channel Crosstalk	> 110 dB (1 kHz)
De-Emphasis	50 ms/15 ms

1.7.5 Synchronization

AES-11 Input	XLR connector
Word Clock Input	BNC connector, with termination selector. Minimum level: 1 Vpp
Composite Video Input	2 BNC connectors, with termination selector
Word Clock Output	BNC connector, TTL Level

1.7.6 Timecode

Accepts and generates all available formats:
24, 25, 29.97D and 30, 29.97 and 30D
(D = drop frame mode for NTSC compensation)

Reader	For timecode recording and chase mode, balanced, transformer coupled, XLR connector
Input Level	0.5...5 V
Speed Range	0.1...2 times nominal speed

| **Generator** | For providing LTC of current position, balanced, transformer coupled, XLR connector |
| **Nom. Output Level** | 2 V (peak to peak) |

1.7.7 Control Interfaces

- Desktop Controller interface
  For multi-machine configurations, providing sample-accurate synchronization between up to three D424 units (RS422, 15 pin D-type)
- System remote interface
  With proprietary or SONY 9 pin protocol (RS422, 9 pin D-type)
- Parallel port
  With basic commands, fader start and tallies (15 pin D-Type)
- SCSI-2 for external drives and data transfer

1.7.8   Power Supply

Power Requirements   100...240 VAC ±10%, 50...60 Hz, 1.4...0.6 A

1.7.9   Operating Conditions

Ambient Temperature: +5...+35 °C
Rel. Humidity: 10...80%, non-condensing
Operating Position: horizontal ±10°

1.7.10   Standards

Safety Standard: Protection class 1, EN 60950; 1992 + A1/A2; 1993
                                          Class 1 laser product, EN 60825-1; 1994
EMC Standard: EN 50081-1; 1992, EN 50082-1; 1992

1.7.11   Physical Dimensions

Size   438 × 142 × 392 mm (W × H × D); 19" rack-mount size, 3 HU
Weight   9.5 kg

1.8   Syntax Used in this Manual

[COMMAND]	Keyboard entries are indicated in **bold** printing and within **[ ]** brackets.
[PLAY]	"PLAY" key.
[REC+PLAY]	Double key combination: **[REC]** is pressed first and, as long as **[REC]** is pressed, **[PLAY]** is pressed additionally.
[1...9]	One of the keys **[1]** to **[9]**.
[ENT or PLAY]	*Either* the **[ENT]** *or* the **[PLAY]** key.

[SETUP] [3] [1] [6] [0] [ENT] [▶] [6] [0] [ENT] [SETUP]

Sequence of keys pressed one after the other.

2 OPERATING ELEMENTS
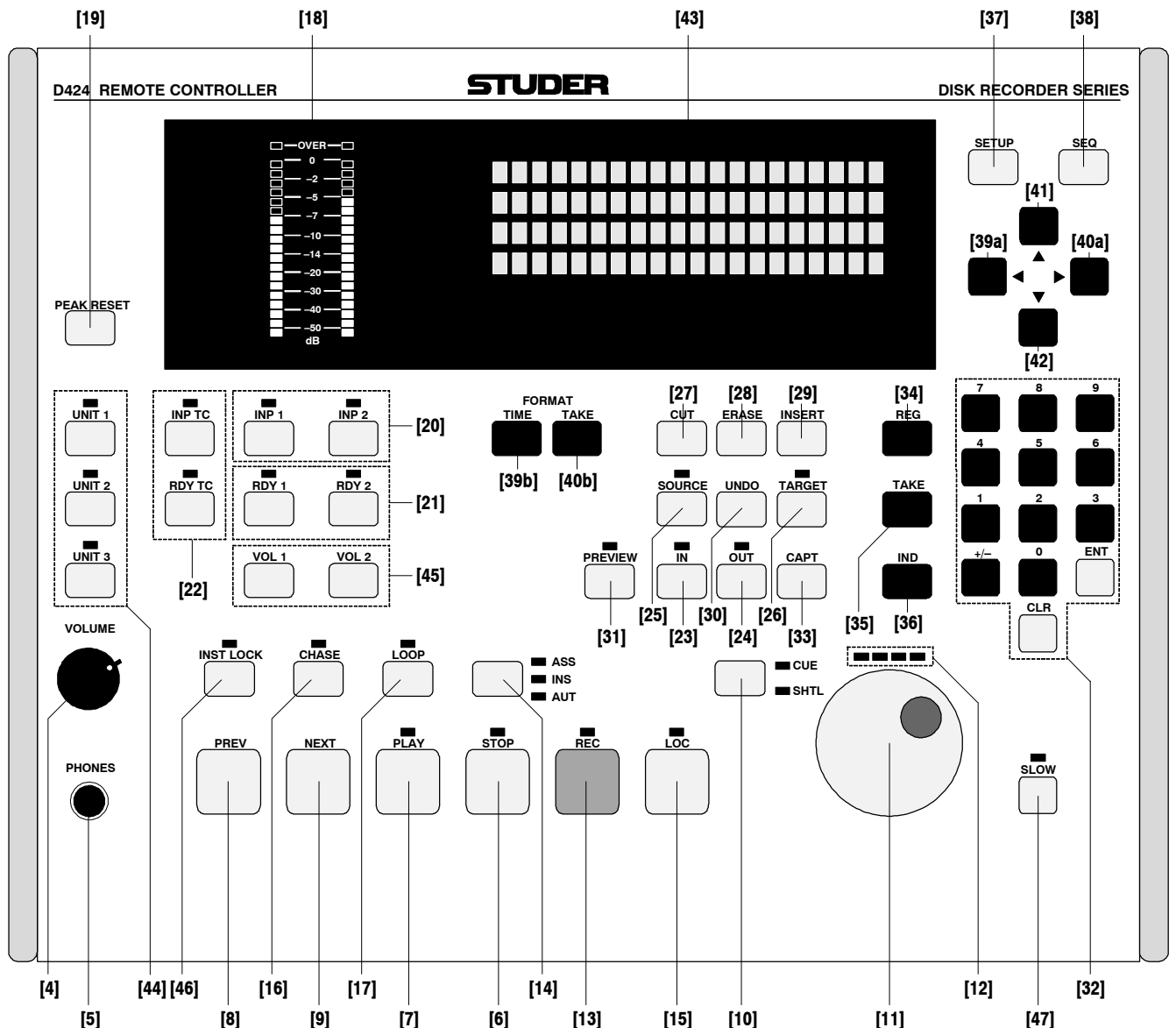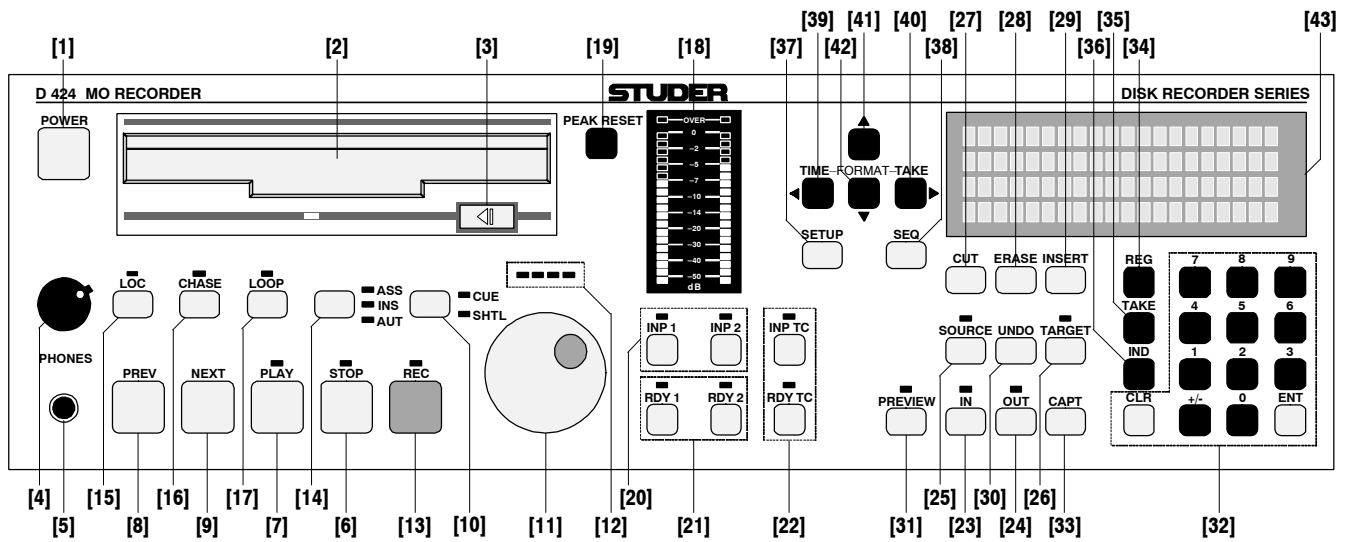
2.1   General (* = not available on Desktop Controller)

*[1]	**POWER**	Switches the D424 on or off.
*[2]	**Disk**	A disk is inserted by gently pushing it in until the loading mechanism engages.
*[3]	◀ I **(Eject)**	A disk is ejected by pressing this button in stop mode.
[4] [5]	**VOLUME** **PHONES**	A stereo headphone may be connected to the 6.3 mm jack socket [5], the volume is adjusted with potentiometer [4].

2.2   Transport Section

[6]	**STOP**	Stops the recorder at the current position. During recording, a stop command terminates the session.
[7]	**PLAY**	Starts playing from the current position. During insert recording, a play command performs a punch-out.
[8]	**PREV**	Skips to the previous take or index marker.
[9]	**NEXT**	Skips to the next take or index marker.
[10] [11] [12]	**CUE/SHTL** **Control Wheel** **Speed Indication LEDs**	The control wheel key [10] switches to CUE or SHTL (shuttle mode, starting with the one which was used last. Each subsequent keystroke toggles between speed control (SHTL) and position control (CUE). The currently selected mode is indicated with the LEDs next to the CUE/SHTL key. The control wheel allows to modify speed or position, the current speed is indicated with the speed indication LEDs.
[13]	**REC**	Recording is started by pressing **[REC+PLAY]** simultaneously; a record-pause status is entered with the key combination **[REC+STOP]**.
[14]	**ASS/INS/AUT (Rec. Mode)**	One of the available recording modes (ASSemble/INSert/AUTo) is pre-selected by pressing the key [14] until the desired mode is indicated.
[15]	**LOC**	With this key and a subsequent destination (register, take/index number, or a shortcut) the D424 can be set to a new position.
[16]	**CHASE**	In chase mode, the D424 is following the external timecode.
[17]	**LOOP**	In loop mode the D424 plays the element between the IN and OUT point repeatedly.
[18]	**LED Level Meter**	Displays input or disk level, either in peak or in peak hold mode.
[19]	**PEAK RESET**	For resetting the meter display when in peak hold mode.
[20]	**INP 1, INP 2**	Output source selection. Either the input signal (LED is on) or the information from the disk (LED is off) is provided at the output channels.

[21]	RDY 1, RDY 2	Record ready switch. The LED is flashing when the channel is set ready for recording; it is on during recording.
[22]	RDY TC, INP TC	Timecode channel selectors.

2.3 Editing Section

[23]	IN,	IN and OUT are the edit registers. A source element is defined with the IN
[24]	OUT	and OUT registers, and the target point with the IN register (when in target mode).
		A register is selected with the corresponding keys **[IN]** or **[OUT]**, modifications are possible either with **[CAPT]**, the control wheel, or the numeric keypad.
[25]	SOURCE	After selecting **[SOURCE]**, all edit operations related to a source element are enabled (cut, erase).
[26]	TARGET	After selecting **[TARGET]**, the source element may be inserted at the target point with **[INSERT]**.
[27]	CUT	Cuts out the source element.
[28]	ERASE	Erases the contents of the source element.
[29]	INSERT	Inserts the source element at the position defined with the target IN point.
[30]	UNDO	The D424 reverts to the status before the last editing process.
[31]	PREVIEW	In editing modes (source or target LED on), **[PREVIEW]** followed by a second key allows to preview either the edit points (with **[IN]** or **[OUT]**), the selected element (with **[SOURCE]**), or an edit process (with **[CUT]**, **[ERASE]**, or **[INSERT]**).
		When not in edit mode, the **[PREVIEW]** key is used as rehearse mode selector and indication for insert recording.

2.4 Keyboard and Register Section

[32]	0...9, CLR, +/–, ENT	Register and menu parameters can be set with the numeric keypad. Values which were entered in the display buffer are stored to the register with the **[ENT]** key. With **[CLR]** the display buffer is cleared.
[33]	CAPT	Copies the current position to the register selected with the numeric keypad.
[34]	REG	With this key and a subsequent register number (0...9), one of the available registers is selected. It can be set and used for locating or editing.
[35]	TAKE	This key is used for directly addressing takes for locating, or for setting and clearing take markers (in combination with **[INSERT]** and **[ERASE]**).

[36]	**IND**	This key is used for directly addressing index positions within takes when locating, or for setting and clearing index markers (in combination with **[INSERT]** and **[ERASE]**).

2.5   Display and Menu Section

[37]	**SETUP**	Pressing **[SETUP]** toggles between standard and SETUP mode, which is a menu-structured display mode for setting the D424's configuration and parameters, and performing system utilities.
		Submenus and items are selected with the cursor keys [39]...[42], the control wheel with **[ENT]**, or directly with the numeric keys **[1]**...**[8]**.

[38]	**SEQ**	With **[SEQ]** the sequence editing mode is entered. It allows defining and editing sequences and deleting sound files (also refer to the Sequence editing section).

[39]	**TIME** FORMAT / ◀	In standard mode, the current position may be switched between absolute, relative, or timecode formats.
		In setup and sequence editing modes the key is used as cursor key.
	Note:	On the Desktop Controller, these two functions have dedicated keys.

[40]	**TAKE** FORMAT / ▶	In standard mode, the current take number can be shown with or without index markers. If index markers are indicated as well, all skip functions are referring to both markers instead of take markers only.
		In setup and sequence editing modes the key is used as cursor key.
	Note:	On the Desktop Controller, these two functions have dedicated keys.

[41]	**▲**, **[42]** **▼**	Cursor keys, used in setup and sequence editing modes.

[43]	**Display**	The display section consists of 4 lines with 20 digits each. Depending on the selected mode, there are different configurations. The standard configuration is:
	Line 1:	Graphical indication of the current position within the sequence
	Line 2:	Current take (and index) number, current position
	Line 3:	Sequence number, remaining time, or register entry field
	Line 4:	D424 configuration (sampling frequency, word length, input, clock source, recording mode, emphasis).

2.6   Additional Functions (Desktop Controller only)

[44]	**UNIT 1...3**	For assigning one of up to three D424 units to the Desktop Controller.

[45]	**VOL1, VOL2**	For modifying the analog input attenuation for the two channels together with the control wheel.

[46]	**INST LOCK**	Locks the unit immediately to a master timecode at the current position; the current offset is stored to the nominal offset register. Chase mode is selected automatically.

[47]	**SLOW**	Reduces the cue speed to one third of the standard cue speed.

3   GETTING STARTED QUICKLY

3.1   Recording New Takes From an Analog Source

3.1.1   Installation and Settings

1.   Connect the analog outputs of the source unit to the analog input connectors of the D424 (LINE IN 1/2) with XLR cables.

2.   Insert a write-enabled disk with sufficient free recording space (see step 7).

3.   Check the status of the D424 in the fourth display line. There, sampling rate, recording format, clock reference, audio input, and recording mode are indicated.

The standard setting is: 441, 16, INT, ANA, ST.

If necessary, change the settings for sampling rate, recording format, and recording mode. The clock reference may also be external.

Note: There is only one sampling rate allowed per disk side. Changing the frequency is only possible with an empty disk.

4.   Recording mode should be set to ASS (LED above the REC button), which is the default setting after switching on the D424.

5.   Check the input levels by switching the D424 to input with **[INP1]** and **[INP2]**.

Apply the input signals and check that there is no overload (red LED) at the loudest position. The input signal attenuation may be adjusted in the setup menu 31.

Example: Set the input attenuation of both channels to –6 dB:
[SETUP] [3] [1] [6] [0] [ENT] [▶] [6] [0] [ENT] [SETUP]

3.1.2   Start Recording

6.   Set the recording channels to READY by pressing **[RDY1]** and **[RDY2]** (both corresponding LEDs will be on).

7.   Check the remaining recording time with **[REC+STOP]**. The remaining time is indicated in the display.

8.   Start recording with **[REC+PLAY]**.

9.   It is possible to set the take and the index markers on-the-fly with **[TAKE+INSERT]** or **[IND+INSERT]**.

10.   Stop the recording session with **[STOP]**.

3.2 Recording New Takes From a Digital Source

3.2.1 Installation and Settings

1. Connect the AES/EBU output of the source unit to the AES/EBU input connector of the D424 (AES/EBU IN) with an XLR cable.

2. Insert a write-enabled disk with sufficient free recording space (see step 6).

3. Check the status of the D424 in the forth line of the display. It indicates sampling rate, recording format, clock reference, audio input and recording mode.
The standard setting is: 441, 16, INT, ANA, ST.
If necessary, change the settings for sampling rate, recording format, and recording mode.
Switch the input to AES/EBU with:
[SETUP] [2] [1],
select "dig" with: **[▶] [ENT] [▲] [▶] [▼]**,
select "audio" with: **[▶] [ENT] [SETUP]**.

Notes: There is only one sampling rate allowed per disk side. Changing the frequency is only possible with an empty disk.
An error message will appear when the D424 settings do not match with the source signals.

4. The recording mode should be set to ASS (LED above the REC button), which is the default setting after switching on the D424.

3.2.2 Start Recording

5. Set the recording channels to READY by pressing **[RDY1]** and **[RDY2]** (both corresponding LEDs will be on).

6. It is now possible to check the remaining time with **[REC+STOP]**. The remaining recording time is indicated in the display.

7. Start recording with **[REC+PLAY]**.

8. It is possible to set the take and the index markers on-the-fly with **[TAKE+INSERT]** or **[IND+INSERT]**.

9. Stop the recording session with **[STOP]**.

3.3   Playing Pre-Recorded Disks

3.3.1   Installation and Settings

- Check that the D424 is either set to internal reference, or the corresponding external reference clock has to be provided. With an external clock, the DIG indication in the bottom line of the display must not flash:
  441, 16, INT, <u>DIG</u>, ST.
- Be sure that the INP switches are not activated.
- Insert a disk and wait until the sequence data have been loaded from disk.

3.3.2   Position

Take and index numbers as well as the current position are shown in the display. The position indication may be adapted with the following keys:

[TIME]   switches between absolute time (a: sequence time, starting with 0), relative time (r: take time, time within take) or timecode position (t). If no timecode was recorded, the timecode display is identical with the absolute time indication, the "t" mark is flashing.

[TAKE]   switches between take display, or take *and* index display.

3.3.3   PLAY and STOP

Start playing with **[PLAY]**, stop at the current position with **[STOP]**.

3.3.4   Skip to Take and Index Markers

With **[PREV]** and **[NEXT]**, the D424 will locate or continue playing at the next or previous marker. Depending on the selected TAKE mode, only take markers or take and index markers are considered.

Example: When playing take 5 and pressing **[NEXT]** twice, the D424 will continue playing at the beginning of take 7.
Use the LOCATE function to access markers directly.

3.3.5   CUE and SHUTTLE

With **[CUE]**, either the CUE or SHUTTLE mode is selected. Subsequent keystrokes toggle between the two modes.
In CUE mode, the D424 follows the control wheel position with a speed up to 2 times nominal speed. In SHUTTLE mode, the D424 moves with a constant speed, which is set with the control wheel.

3.3.6   LOCATE

Find a particular position in a sequence with the locate function. Locating is available to sequence, take, and index positions as well as to register locations having been set in advance.

Examples:

[LOC] [PREV] – locate to begin of sequence
[LOC] [NEXT] – locate to end of sequence
[LOC] [2] [STOP] – stop at take 2
[LOC] [2] [PLAY] – play from take 2
[LOC] [2] [ENT] – locate to take 2
[LOC] [2] [IND] [3] [PLAY] – play from take 2 index 3
[LOC] [IN] – locate to IN register
[LOC] [REG] [3] – locate to register 3.

When not terminated with **[STOP]** or **[PLAY]**, the recorder will continue in the same status as it was before (stop or play).

3.3.7   Setting Markers

Set and remove markers with the following keystrokes:
[TAKE+INSERT] – inserts a new take marker
[INDEX+INSERT] – inserts a new index marker
[TAKE+ERASE] – removes the take marker which is currently displayed
[INDEX+ERASE] – removes the index marker which is currently displayed.
Moving a marker is achieved by removing it at the old position and inserting it at the new place.

Notes: Newly inserted take markers will get the first available free number, and will keep it during further editing.
When moving a take marker with **[ERASE]** followed by **[INSERT]**, it will keep its number.
Index numbers are always contiguous within a take. After inserting or removing index markers, they will be renumbered automatically.

3.4   Editing

3.4.1   Before You Start Editing

- Verify that there is a write-enabled disk inserted.
- The sequence currently selected will be modified. If you have already edited a part of the sequence and you would like to keep the current version, start editing with a copy of the sequence.
- The current setting of the cross-fade time (setup menu item 34) will be used by all editing processes. Change them if necessary.

3.4.2   Cut Out or Erase an Element – Cut/Erase Editing

For cutting out or erasing an element of the current sequence:
- Define a source element by setting the edit registers **[IN]** and **[OUT]**, and perform an **[INSERT]** command.

With larger productions, it is helpful to mark the points to be edited in advance. For this purpose, set index markers either during the recording or when pre-listening the material.

1. Switch on the source editing mode with **[SOURCE]**.
2. Find the element to be removed and copy the start point of the element to the IN register, the end point to the OUT register. There are different ways:
   - Listen to the sequence and mark begin and end of the element with **[IN] [CAPT] [OUT] [CAPT],** *or*
   - locate to the points when there are already markers and change to CUE for precise positioning. Transfer the current address to the register with **[IN] [CAPT]**, or **[OUT] [CAPT]**, *or*
   - search the point with the control wheel in SHTL mode (adjust the maximum wind speed in the setup menu 41, if necessary), slow down and change to CUE for precise positioning. Transfer the current address to the register with **[IN] [CAPT]** or **[OUT] [CAPT]**.
3. Check the settings with the REHEARSE feature. De-select the edit registers and choose one of the following rehearse commands:
   [PREVIEW] [IN] – listen to the section before the IN point
   [PREVIEW] [OUT] – listen to the section after the OUT point
   [PREVIEW] [SOURCE] – listen to the selected element between IN and OUT
   [PREVIEW] [CUT] – rehearse the cut command
   [PREVIEW] [ERASE] – rehearse the erase command.
4. Modify the edit points if necessary and check again (item 3).
   You can either locate to the edit point and adjust it:
   [LOC] [IN] [CUE]...[IN] [CAPT], or
   Trim the edit register directly with the cursor keys: **[IN] [▼] [▲]**.
   Use the **[SOURCE]** and **[TARGET]** keys for accessing either the source registers IN and OUT, or the target register IN.
5. If the settings are correct, the final cut or erase command is **[CUT]** or **[ERASE]**.

   If the result of the command is not what you expected it to be, or if a wrong edit command was executed by accident, it can be made undone with **[UNDO]**.

3.4.3 Move or Duplicate an Element – Insert Editing

For moving or duplicating an element of the current sequence:
- define a source element which should be moved or duplicated, by setting the edit registers SOURCE IN and OUT,
- set the target location (i.e., where the source element should be inserted) by setting the edit register TARGET IN,
- and perform an INSERT command.

With larger productions, it is helpful to mark the points to be edited in advance. For this purpose, set index markers either during the recording or when pre-listening the material.

1. Activate the source editing mode with **[SOURCE]**.
2. Find the element to be removed, copy the start point of the element to the source IN register, and the end point to the source OUT register. There are different ways:
   - Listen to the sequence and mark begin and end of the element with **[IN] [CAPT] [OUT] [CAPT]**, *or*
   - locate to the points if there are already markers, and change to CUE for precise positioning. Transfer the current address to the register with **[IN] [CAPT]** or **[OUT] [CAPT]**, *or*
   - search the point with SHUTTLE (adjust the maximum wind speed in the setup menu 41, if necessary), slow down, and change to CUE for precise positioning. Transfer the current address to the register with **[IN] [CAPT]** or **[OUT] [CAPT]**.
3. Activate the target editing mode with **[TARGET]**.
4. Find the location to insert the source element defined above. Use one of the methods described in item 2, and copy the position to the TARGET IN point with **[IN] [CAPT]**.
5. Check the settings with the REHEARSE feature. De-select the edit registers and choose one of the following rehearse commands:
   [PREVIEW] [IN] – listen to the section before the insert point,
   [PREVIEW] [OUT] – listen to the section after the insert point,
   [PREVIEW] [INSERT] – rehearse the insert command.
   For adjusting the source element, simply switch to source editing mode with **[SOURCE]** and use the corresponding preview commands (**[IN] [OUT] [SOURCE]**).
6. Modify the edit points if necessary and check again (item 3).
   You can either locate to the edit point and adjust it:
   [LOC] [IN] [CUE]...[IN] [CAPT],
   or
   trim the edit register directly with the cursor keys: **[IN] [▼] [▲]**.
   Use the **[SOURCE]** and **[TARGET]** keys for accessing either the source registers IN and OUT, or the target register IN.
7. If the settings are correct, the final insert command is **[INSERT]**.

Repeat from step 3 if you like to insert the source element to different locations.

Moving an element is achieved by copying it to the destination first and then cutting out the original source element. Simply press **[CUT]** after the last **[INSERT]** command.

If the result of the command is not what you expected it to be, or if a wrong edit command was executed by accident, the *last command* can be made undone with **[UNDO]** (single level undo).

3.5 Insert Recording

Use insert recording for directly replacing a part of the current sequence in a "destructive way". A typical example is dialog replacement.

3.5.1 Before You Start Recording

- Check your system configuration (refer to the analog or digital recording sections).
- With a correct setup, no LEDs should be flashing. After switching to input with the INP keys, you can monitor your source signal.
- You can check the free space available for recording with **[RDY]** **[REC+STOP]**. Press **[STOP]** again to revert to standby.

3.5.2 Manual Insert Recording

1. Select the INSERT recording mode with the recording mode key (above the STOP key). The "INS" LED will be on.
2. Set the recording channels to READY by pressing **[RDY1]** **[RDY2]** (the corresponding LEDs will be on).
3. Start playing ahead of the section to be replaced, wait until the correct position is reached, and then make record punch-in with a **[REC+PLAY]** command, *or*

   park the D424 at the punch-in location and start recording with **[REC+PLAY]**.
4. Perform a punch-out with **[PLAY]** or **[STOP]**.

Note: After having tried replacing a section for several times, all these attempts will be stored on the disk. They can be made accessible when creating a new sequence from the complete table of contents.

3.5.3 Auto Insert Recording

1. Select the AUTO recording mode with the recording mode key (above the STOP key). The "AUT" LED will be on.
2. Store the beginning and the end of the section to be replaced to the edit registers; IN: punch-in point, OUT: punch-out point.
3. Set the recording channels to READY by pressing **[RDY1]** and **[RDY2]** (the corresponding LEDs will be on).
4. Use the **[PREVIEW]** key to either perform a rehearsal (PREVIEW LED is on) or a recording (PREVIEW LED is off).
5. Start with **[REC+PLAY]**.
   The D424 will start at IN-PREROLL, automatically perform a punch-in at the IN point and a punch-out at the OUT point. It will stop at OUT+POSTROLL.
   During the process, the current mode as well as a countdown to the following event are indicated.

3.6   Working with Sequences

There may be several sequences on a disk. Only one of them can be selected as the current sequence.

All modifications resulting from editing or sequence processing only change the sequence data, which are kept with each sequence. They do not modify or delete the audio information.

The **[SEQ]** key gives access to a number of features, which allow to:
- switch between the available sequences on a disk,
- create new, empty sequences,
- modify sequences by inserting or deleting single takes,
- delete complete sequences, or
- copy existing sequences.

3.6.1   Change the Current Sequence

If there is a sequence no. 2 available on the disk, it is selected with **[SEQ] [2] [ENT]**.

3.6.2   Create a New Sequence

A new, empty sequence is created with **[SEQ] [ENT]**.

If it is necessary to assign a specific number to the new sequence, the new number is added to the command. If there are 3 sequences on a disk, and the following numbers should be reserved for additional revisions, a new sequence no. 10 is created with **[SEQ] [10] [ENT]**.

3.6.3   Modify a Sequence

Entering sequence editing mode:

When modifying a sequence, single takes can be added or deleted.

For entering the sequence editing mode, the following parameters are necessary:
- a source sequence number (i.e. the number of the sequence where the takes are to be copied from).
- a target sequence number (i.e. the sequence to be modified), and
  [SEQ] [n] [SOURCE] – modify sequence "n"; the default source sequence is the table of contents of the disk.
  [SEQ] [n] [▶] [s] [SOURCE] – modify sequence "n", with source sequence "s".

In editing mode, both source and target sequences are displayed. After having selected one of them with the **[SOURCE]** or the **[TARGET]** key, the take positions can be entered for executing the functions "add additional takes", and "delete takes" described below.

Adding additional takes: Select the take to be copied from the source sequence, and the insert position in the target sequence:
[3] [TARGET] [5] [INSERT] – Insert take 3 from the source sequence, after take 5;
[INSERT] [INSERT], ... – further INSERT commands will copy takes 4, 5, and so on.

Deleting takes: Specify the target take to be deleted:
[TARGET] [4] [CUT] – delete take 4 from the target sequence;
[CUT] [CUT], ... – further CUT commands will delete take 3, 2, and so on.

3.6.4 Copy a Sequence

For copying an existing sequence, enter editing mode and perform a TARGET+INSERT command:
[SEQ] [▶] [2] [SOURCE] [TARGET+INSERT] – create a new sequence as a copy of sequence 2.

Note: If the **[TARGET+INSERT]** command is applied to a non-empty sequence, the current data are overwritten by the copied sequence data.

3.6.5 Delete a Sequence

For deleting a sequence, enter the editing mode and perform a **[TARGET+CUT]** command:
[SEQ] [2] [SOURCE] [TARGET+CUT] – delete sequence 2.

3.7   CD Transfer and Disk Copies

For making transfers and backup copies between the D424 and external drives such as further MO disk drives or CD writers, establish a SCSI connection between the two devices.

3.7.1   Before You Start the Transfer

- Switch the two units *off* and connect the SCSI cable.
- Make sure that the two units have not the same SCSI address. The default address of a D424 is "1", the one of the Studer D741 is "2". Refer to the corresponding section in the operating manual of the device for changing SCSI addresses.
- Switch on the peripheral device first, and switch it to SCSI mode (Studer D741: SCSI ON, D424: SCSI offline mode).
- Switch on the D424.

3.7.2   Creating a CD with an External SCSI CD Writer (e.g. Studer D741)

When making a master copy of the current D424 sequence to an external CD writer, the audio information including all track and index markers will be transferred to the CD. Furthermore, PQ information like ISRC and UPC codes can be added.

Note: Only sequences recorded with 44.1 kHz sampling rate can be directly transferred to the CD recorder.

- Insert a CD-R. Use an empty disc if you intend to burn a CD in a disc-at-once operation.

Entering UPC and ISRC Codes   Select the UPC menu 642, enter the UPC code, and confirm with **[ENT]**. An UPC code will be accepted only if no UPC code has been programmed yet.

Select the ISRC menu 643 and enter a code for each track. Set the sequence to the first track and enter the code for track 1. For skipping the track number, use the **[NEXT]** key, and update the display with **[▲] [▼]**.

Note: The first group of the ISRC code requires alphanumeric entries. Start with the **[▼]** key, select the digit with the control wheel and go on to the next digit with the **[▶]** key.

Set the CD Transfer Parameters   Use the standard setting for transferring a 16 bit sequence to a new, empty CD. No additional processing is done (no noise shaping, no additional pauses will be inserted). Refer to "Operation", section 4, for details.

Start the Transfer   Select the master copy menu 62. If the "CD mounted" message is not visible, the CD writer has to be selected as target drive first:

- Select the "target" submenu and select the CD drive as target drive (use the **[◀]** or **[▶]** keys to locate one of the items, the **[▼]** key to select items or to enter submenus, or the **[▲]** key to return to the previous menu).
- Start the transfer process by moving to the "start" item and confirming with **[ENT]**.

During the whole process, a progress bar is revealed. After a successful transfer, the disc will be finalized. Usually, the CD writer (e.g. Studer D741) will open its disc tray.

3.7.3   Copying a CD to the D424

The contents of a CD can be copied to a new sequence on the D424 disk, including all track and index markers.

- Check the inserted disk: it should not be write protected, have sufficient free capacity for adding the CD information, and the format must be CD compatible (44.1 kHz sampling rate).
- Select the CD writer as the current source drive. Use the setup menu 51 for this purpose; the CD drive usually has the SCSI address 2.
- If the copy mode in menu 644 is set to "toc", the complete CD will be transferred; if it is set to "add", only the currently selected track will be copied.
  Use the D424 transport keys for pre-listening and selecting CD tracks.
- Select the master copy menu 62 and enter the "target" submenu to select the MO disk as target drive, the internal SCSI address is usually 1 (use the **[◄]** or **[▶]** keys to locate one of the items, the **[▼]** key to select items or to enter submenus, or the **[▲]** key to return to the previous menu).
- Start the transfer process by moving to the "start" item and confirming with **[ENT]**.
  During the whole process, a progress bar is revealed. After a successful transfer, the display reverts to standard mode.

3.7.4   Copying to/from Other MO Disks

Sequences and complete disks can be copied from the internal drive to additional external drives. There are 3 possible choices:

DISK COPY   will copy the complete disk. The target disk has to be empty. Reformat it before, if necessary (setup utility 53).

MASTER COPY   will create a new sequence on the target disk as an exact copy of the source sequence, including track and index information. The audio information will be merged into a new single sound file.

WORK COPY   will create a new sequence on the target disk. It is identical with the source, and includes all sequence information. All sound files used by the sequence will be transferred as well.

- Check the target disk. It must not be write protected, have enough free capacity for adding the source information, and the sampling rate of both disks must be identical.
- Use the setup menu 51 to check if:
  the internal drive is currently selected as the active one, and
  the external drive appears on the drive list.
- Go to one of the copy menus (Work Copy 61, Master Copy 62, Disk Copy 63) and check the indicated transfer information "copying sequence/track i to drive m")
- Modify the target address if necessary (submenu target).
- Start the transfer process by moving to the "start" item and confirming with **[ENT]**.
  During the whole process, a progress bar is revealed. After a successful transfer, the display reverts to standard mode.

3.8   Working with Timecode

The D424 provides an LTC timecode input, which allows to record LTC timecode. When playing back a sequence consisting of takes with different timecode positions, the D424 will provide a contiguous timecode defined by the first take.

3.8.1   Recording Timecode

- Check for correct timecode wiring by selecting **[INP TC]**. The incoming code should be displayed.
- When recording timecode, be sure that the timecode source and the D424 are running synchronously. The usual way is to provide a common video reference signal.
- Enable timecode recording with **[TC RDY]**. When the corresponding LED is on, the timecode position will be added to the audio information of all subsequent recording sessions.

Notes: The timecode information will be recorded as a single TC stamp at the beginning of an audio file. Timecode jumps during recording will not be considered.
Timecode can be recorded only together with audio channel(s) set to ready.

3.8.2   Playing Back Timecode

The D424 always provides the current position at the TC output connector. If no timecode was recorded, the absolute position is present. During STOP or CUE, a stationary code is generated.

3.8.3   Chasing to Timecode

In chase mode, the recorder is following an external timecode.
- When chasing to a master timecode, make sure that the master and the D424 are running with the same reference clock. Both master and D424 must be configured to the same timecode format.
- Start/stop the chase mode with **[CHASE]**.

Chase LED is On: Chase mode is on, D424 runs synchronously in PLAY mode.
Chase LED is Flashing: Chase mode is on, but D424 waits because the master is not in PLAY mode (STOP or fast forward/rewind).

- An offset can be applied by storing a value (±12 hours) into the nominal offset register. It is accessed with **[REG] [0]**.
- An "instant lock" command will lock the D424 at the current position by storing the current offset to the nominal offset register and launching the chase mode. The command is performed with **[LOC+CHASE]** or with the **[INST LOCK]** key of the desktop controller.

3.9   The Desktop Controller

The Desktop Controller may be used to control up to 3 recorders with an ergonomic user interface.

3.9.1   Installation and Settings

1. Use the controller cable to connect the desktop controller to one of the two controller ports at the rear side of the D424. Connect further units with separate sync cables. The second connector of the last recorder must be terminated (termination plug).

```
                              ┌──────┐   ┌──────┐   ┌──────┐
                              │ D424 │   │ D424 │   │ D424 │
                              └──────┘   └──────┘   └──────┘
 ┌──────────┐                                              ▪ Termination
 │ Desktop  │                                                plug
 │Controller│──────────────────────────────────────────────
 └──────────┘  Controller cable   Sync cable   Sync cable
```
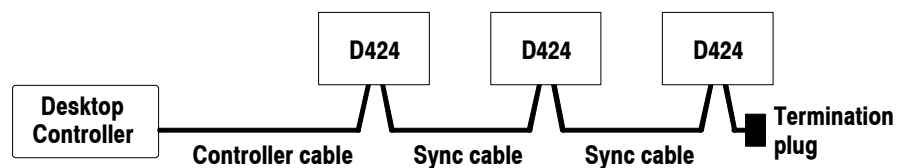
2. Check the addresses of the connected units in setup menu 15. *Each D424 should have a unique address*.

3.9.2   Operation Enhancements

Desktop controller operation of a D424 is the same as front panel operation, except for the following enhancements:

1. The controller is activated by selecting one of the connected units, using the keys **[UNIT1]**, **[UNIT2]**, or **[UNIT 3]**. The D424 will indicate remote operation by a message in its local display. Press an other **[UNIT ...]** key (or the active one again) for de-selecting the recorder being active.

2. Setting the input attenuation of the analog input signal is easier. Instead of selecting the menu item 31, simply hold down the **[VOL1]** or **[VOL2]** key and modify the level with the control wheel.

3. There are two different resolutions for the CUE mode. With the **[SLOW]** key, the CUE speed is one third of the standard speed for more precise locating.

4. The mode keys for switching the take/index format and the time format are now separated (**[◄]** and **[►]** at the front panel).

5. The **[LOC]** key is closer to the destination keys (**[IN] [OUT] [0...9]**) and it has the same size as the other main transport keys.

6. To the left of the **[CHASE]** key, there is a separate key for the **[INSTANT LOCK]** function.

3.10 The Parallel Port with Fader Start Operation

A parallel remote port is provided for basic transport control and status indication, a fader start circuit, and supply voltages for external circuits.

3.10.1 Signal List

Inputs		
4	S_STOP	Generates a Stop command
5	S_PLAY	Generates a Play command
6	S_PLOC	Generates a Locate command to the last Play position (PlayLoc)
12	S_PREV	Generates a Previous command, skip to the previous take/index
13	S_NEXT	Generates a Next command, skip to the next take/index
7	FADER1	Fader start contacts
14	FADER2	
Outputs		
1	B_TAKE	Take pulse, when passing a take marker in Play
2	B_INDEX	Index pulse, when passing an index marker in Play
9	B–STOP	Stop tally
3	B_PLAY	Play tally
10	B–READY	Ready for fader start operation
Others		
8	GND	Signal ground
11	VCC	Supply voltage (5 or 24 V_{DC})
15	KEY	

3.10.2 Fader Start

The D424 provides an opto-coupler input (with internal bridge rectifier and 20 mA current sink) for fader start operation. Use either an external voltage source of 5...24 VDC, or use the internal supply voltage. The polarity of the external supply voltage is of no importance.
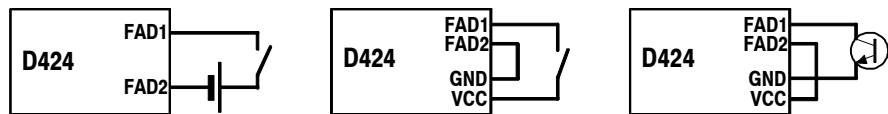
- Enable fader start operation with setup menu 45.
- When applying a control voltage at the fader input pins, the D424 will start, releasing the control signal will result in a STOP.

Note: During fader play operation, the local keyboard is disabled.

3.11 The Setup Menu

The **[SETUP]** command is used for entering the setup mode, in order to change parameters and to perform a number of utilities.

Navigation within a menu is done numerically or with the cursor keys:

[SETUP] [3] [1] – opens setup menu 31;

[◄] and **[►]** – move to an item within a setup level (or control wheel);

[▲] and **[▼]** – go to the previous/next level or activate an item. **[ENT]** is an alternative to **[▼]**.

For more detailed information on the setup menu see chapter 4.10 .

Menu Item			Display	Meaning	Parameters
1			**CONFIG**	**System configuration**	
	11		S.FREQ	Sampling frequency	44.056, 44.1, 47.952, 48 kHz
	12		S.WORD	Sample resolution	16, 20, 24, 24L bits
	13		TC	Timecode format	24, 25, 29.97DF, 30, NONSTD
	14		RECMODE	Record mode	stereo, mono
	15		UNIT	Unit selection	unit1, unit2, unit3
	16		DEFAULT	Configuration	
		161	RECALL	Recall	User, PowerOn, Factory
		162	STORE	Save curr. config to user setting	cancel, yes
	17		REMOTE	Remote	local, remote
2			**REF & INP**	**Reference & input parameters**	
	21		CLK SRC	Ref. clock source	int, dig, video
	22		DIG REF	Digital reference	sync, wclock, audio
	23		INPUT	Audio input	dig, analog, option
3			**AUDIO**	**Audio parameters**	
	31		INP LEV	Analog input attenuator	inp1, inp2 (0...–14 dB)
	32		OUT LEV	Analog output level	level (0...3)
	33		DIG LEV	Digital playback level	channel1, channel2, (–12..+6 dB)
	34		XFADE	Crossfade time	(0...2000) ms
	35		METER	Meter mode	peak, peak hold
4			**TRANSPORT**	**Transport & display parameters**	
	41		MAXSPD	Maximum wind speed	(2...30) × nominal speed
	42		VARISPD	Play varispeed	off, on (±12.5%)
	43		AUTO	Auto stop	off, on
	44		PRE/POST	Preroll/postroll	(2...40) s
	45		FADER	Fader start1	disabled, enabled
	46		REMAIN	Remaining time mode	auto, ind, take, seq
	47		DISP RES	Display resolution	frames, ms
5			**DISK**	**Disk & sequence utilities**	
	51		SELECT	Select disk drive	(1...6)
	52		SCSI	SCSI offline	yes, no
	53		FORMAT	Format disk # ?	cancel, yes
	54		CLEANUP	Cleanup disk # ?	cancel, yes
	55		REN-SEQ	Renumber sequence ##)	cancel, yes
	56		CLR-IND	Clear all indices of sequence	cancel, yes
	57		DEL-FILE	Delete sound file DESTRUCTIVE	Seq #, take #; cancel, yes
6			**COPY**	**Copy utilities**	
	61		WORK	Work copy seq ## to drv #	target, start
	62		MASTER	Master copy seq ## to drv #	target, start
	63		DISK	Copy disk # to drv #	target, start
	64		XFER PAR	Transfer parameters	
		641	SHAPING	Noise shaping	off, on
		642	UPC/EAN	UPC/EAN code	1234 1234 12345
		643	ISRC	ISRC code, track ##	abcde 1234567
		644	CD MODE	CD copy mode	toc, multi, add, fix
		645	DELAY	CD track delay	off, on
		646	INDEX 0	Index 0 duration	off, on (2...5) s
	65		FIXUP	Fixup disk # ? (for SADiE exchg.)	cancel, yes
7			**SERVICE**	**Service utilities**	
	71		FORMAT	Format disk # ? (up to 40 min!)	cancel, yes
	72		DATE	Date & time	day.month year hours:min

4   OPERATION

4.1   System Configuration

There is a number of configuration parameters in the D424 that are stored either in a battery-buffered RAM or on the disk. The default values of the D424 have been chosen for easy and safe operation.
After switching on the D424 for the first time, or after restoring the factory default values, the D424 is ready to be operated and to record from analog sources.

4.1.1   Recording Formats

Before starting a new recording session, check the current status in the display.

```
--------------⊕--------------
1.1    a    12:54.120
1    rem     1:08.987
44D 20 AES DIG ST E
```

— **Emphasis**
— **Recording mode**
— **Sample word length [bit]**
— **Sampling rate [kHz]**
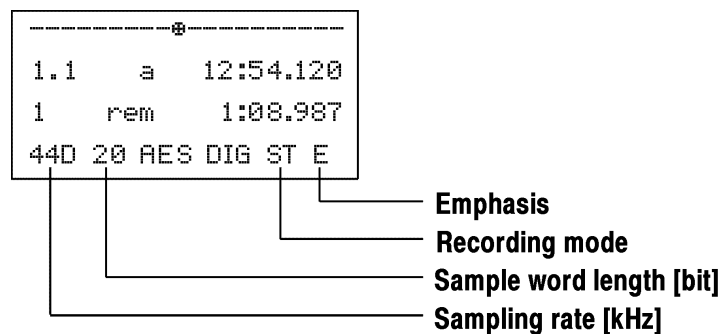
The parameters can be modified in the following setup menus:
- Menu 11: Sampling rate
- Menu 12: Sample word length
- Menu 14: Recording mode

Notes: It is possible to have different recording modes and sample word lengths in a single sequence. There are no restrictions in editing and transferring.
However, only one sampling frequency is allowed per disk side. An error message will appear if the sampling frequency does not match with the format already existing on the disk.
The emphasis status a digital recording is stored to the disk together with the audio information. The status of the first take determines the status of a sequence. A warning will be displayed if subsequent recordings do not match with the emphasis status of the current sequence.

4.1.2 Audio Input

```
------------⊛------------
1.1    a    12:54.120

1    rem     1:08.987

44D 20 AES DIG ST E
```
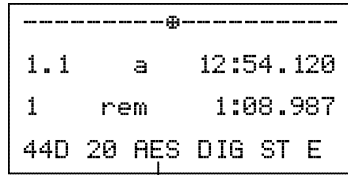
Audio input

The input source is selected with the setup menu 23. Select "dig" for recording digital signals connected to the AES/EBU input, or "analog" for recording analog line signals at the LINE IN connectors.

Notes: The D424 has to be equipped with the analog I/O option for analog recording and playback.
Check the correct synchronization of digital sources and the D424 if recording digital audio. Both the source machine and the D424 have to be locked to the same reference (see the following section).

4.1.3 Reference Clock Source

The currently selected clock source is also shown in the display status line. In case of an external reference, the presence of a correct signal is indicated by a non-flashing clock source indication (INT, VID or DIG).

```
------------⊛------------
1.1    a    12:54.120

1    rem     1:08.987

44D 20 AES INT ST E
```

Clock source

Selecting the Correct Reference   There are the following settings for the D424 clock synchronization:

Mode	Setup menu 21	Setup menu 22	Reference input
Internal	int	-	-
Video	video	-	VIDEO
Digital, AES-11 ref.	dig	sync	AES/EBU SYNC
Digital, AES-3 audio input	dig	audio	AES/EBU IN
Digital, word clock	dig	wclock	WORDCKLOCK IN

- If the D424 is used in a analog environment, select the Internal Mode.
- If one or few digital machines are connected for playback or recording, and the peripherals can be locked to one of the D424's sync signals (Word Clock or Digital Audio) select the Internal Mode.
- If the other machines do not accept the D424's sync signals, connect one of the peripheral's sync signal to the D424, and select the corresponding Digital Mode.

Note: Be sure that the master machine is always switched on when operating the D424, and that it provides the reference signal in all conditions.

- If the D424 is integrated into a system with video and digital audio equipment, use a stable composite video reference as master for all machines. Switch the D424 to Video Mode.
- If a common high quality reference is available in a digital environment, use the corresponding Digital Mode. AES-11 and Word Clock are preferred.

4.1.4   Other Parameters

There is a number of general parameters for
- remote operation
- storing user defaults
- timecode and display formats
- audio levels and editing parameters
- transport parameters.

They are accessible in the setup menu. Refer to the corresponding manual section for more details, or find a complete list of parameters and utilities in the setup menu section.

4.2 Display and Register Functions

4.2.1 Display Information and Formats

The standard display shows various information on 4 lines.

```
-----------⊕-----------    Line 1: Position indication
1.1    a    12:54.120      Line 2: Current position (take, time)
1    rem    1:08.987        Line 3: Current sequence and
44D 20 AES DIG ST E                   remaining time
                           Emphasis
                           Recording config. (stereo/mono)
                           Audio input
                           Clock source
                           Sample word length [bit]
                           Sampling rate [kHz]
```
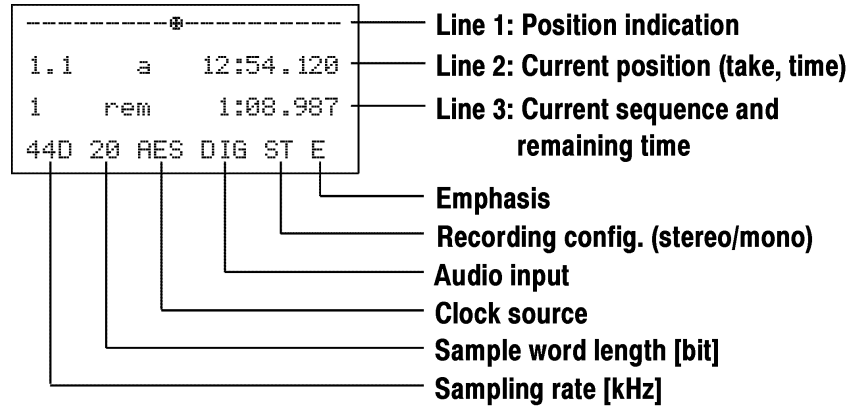
Line 1
- The position indicator at the top of the display is indicating the current position, relative to the selected sequence. It allows to see roughly where the recorder is, when controlling it with the transport commands.

Line 2
- The current take and index.
  Use the **[TAKE]** key to display either the take only, or take and indices.
- The selected time mode.
  Use the **[TIME]** key to display the current time in one of the following formats:
  - **"a"** Absolute time
  - **"r"** Relative time to take begin or last index marker
  - **"t"** Timecode.
- The current time.
  The time field is showing the current position in hours, minutes, seconds and frames or milliseconds. Select either frames or milliseconds as display resolution with setup menu 47.

Line 3
- The currently selected sequence
- Following the "rem" indication, the field at the right shows the remaining time to one of the following points. Use setup item 46 to select:
  - the next take or index marker, depending on the take format
  - the next index marker
  - the next take marker
  - the end of the sequence.
  The third line is also used for displaying alternative information. Depending on the current mode, the following information may appear instead of the remaining time:
  - **"free"** free recording time (during recording modes)
  - **"to in", "to out"** countdown to IN or OUT point (during preview, auto record)
  - **"var"** current play varispeed (during varispeed operation)
  - **"reg0"..."reg9"** entry field for general purpose register (register editing)
  - **"in", "out"** entry field for edit registers IN, OUT (register editing)

Line 4   The bottom line indicates the status of the main configuration and the current take parameters:

Sampling Rate   44D 441 48D 48

Sampling frequencies include 44.1 kHz (441), 48 kHz (48) as well as the drop-frame formats 44.056 kHz (44D) and 47.952 kHz (48D).

Word Length   16 20 24

Word length allows 16, 20, and 24 bit recording.

Audio Input   AES ANA (OPT)

Audio inputs are AES/EBU (AES), Analog (ANA) or further optional I/Os (OPT). With an appropriate adapter, the AES input will also accept SPDIF signals.

Clock Source   INT VID DIG

The following clock sources may be selected: Internal (INT), video (VID), and digital input (DIG). For detailed information see the System Configuration section.

Channel Configuration   ST MON

Files are either recorded in stereo (ST) or mono (MON) mode.

Emphasis   E

Digital signals with emphasis will result in a E status indication.

Time Format   There are several sources for the current position within the sequence. With **[TIME FORMAT]** one of the following choices can be selected by toggling through the menu.

TC   Timecode mode: The position is displayed referring to the recorded timecode. When a sequence consists of several takes with different timecode positions, the sequence timecode is derived from the first take's address.

                               If no timecode was recorded at all, the absolute position is displayed instead, and the TC sign flashes.

ABS   Absolute time mode: The absolute time position is displayed. It starts with 0 at the first recorded take and increases contiguously within the current sequence.

REL   Relative time mode: The relative position to the beginning of the current take or the last index mark is displayed.

Take Format   For displaying and accessing takes and indices, there are two different modes, selected with **[TAKE FORMAT]**:

TAKE   Only takes are displayed; all operations are performed in units of complete takes or relative to take markers.

TAKE/INDEX   Takes and indices are displayed, all operations are referring to take and index markers (e.g. skip to next index marker with **[NEXT]**).

4.2.2 Using General Purpose Registers

There are several memory and editing registers which can be selected and modified. After being selected, a register may be modified or cleared with the numeric keypad, any changes are confirmed with the **[ENT]** key.

Selecting/Modifying a Register: The contents of any register appear in the display entry field if it has been selected.

```
————————————⊕————————————
2      a   1:12:54:10
1   reg1 23:59:59:24
441 16 AES VID ST
```

The edit registers (IN, OUT) may be addressed directly be pressing the respective key; all others (0...9) are selected with the key sequence **[REG] [n]**, where n is one of the following registers:

reg0   Nominal offset register in chase mode,
reg1...9 General purpose registers, for use with the locator,
IN   Edit IN register,
OUT   Edit OUT register.

There are several ways to change the displayed value in the entry field (or the register contents):

1. Typing in a new value with the numeric keys **[0...9]**. With the first keystroke, the display is automatically cleared.
2. Resetting the field to 0 with **[CLR]**.
3. Modifying the displayed value with the control wheel.

All these modifications do not directly affect the register contents. The modified value is flashing, indicating that the entry field is different from the register contents, until it is stored with **[ENT]**.

4. The current position is transferred to the selected register with **[CAPT]**.
5. A register value can be incremented or decremented with the **[▶]** or **[◀]** keys by one display unit (ms or frame)

These two actions directly modify the register contents. Therefore, the field will not be flashing, and no termination with **[ENT]** is necessary.

The register programming mode can be cancelled anytime by pressing the initial select key **[REG] [IN]** or **[OUT]** once more. When terminating an entry with the **[ENT]** key, the display also reverts to standard mode.

Transferring Registers and Locations

The contents of any other register may be transferred to a destination register by placing the machine to the desired position, and then transferring the location to any other register:
[LOC] [REG] [2] [REG] [0] [CAPT] – stores the value in register 2 to the nominal offset register.

4.3   Basic Transport Operation

The following basic transport commands allow to navigate the D424 to any point within the current sequence, and to playback audio files:

[PLAY]   starts playback at the current position
[STOP]   stops recorder at the current position
[PREV]   moves to the previous take begin (or index marker)
[NEXT]   moves to the next take begin (or index marker)
[LOC]   moves to a predefined position
[SHTL]   moves recorder forward or backward with a variable speed
[CUE]   moves recorder forward or backward according to the control wheel position.
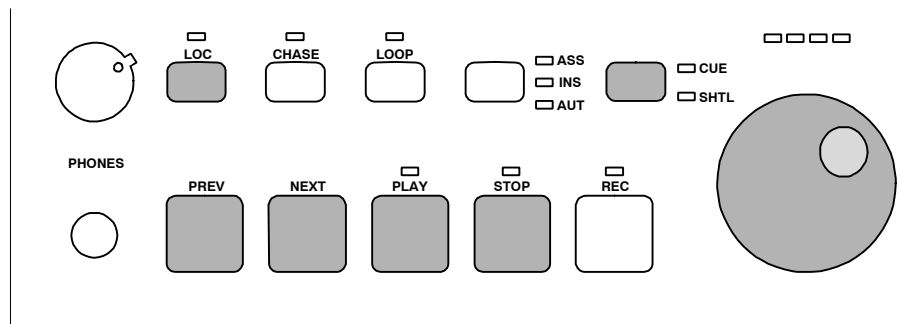
For easy access to random positions, index and take markers can be placed, moved, and erased. Two edit registers as well as nine general-purpose registers support efficient processing of editing and playback tasks.

4.3.1   The Current Position

When playing back pre-recorded material, the operation is similar to a CD player or an R-DAT recorder. There is a current position within the sequence, defined in absolute time or timecode, from which the recorder can immediately reproduce audio.
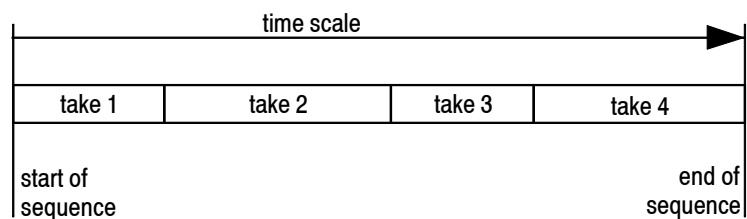
The current position within the sequence is indicated by a running indicator sign in the first line of the display. The far left position corresponds to the sequence start, the far right to the sequence end.

Current sequence
Take/index position
Time mode
Position indicator

```
––––––––––––––––––⊕––––––––––––––
1.1     a      12:54.120
1      rem      1:08.987
441 16 AES INT ST
```

Position (time)
Remaining time
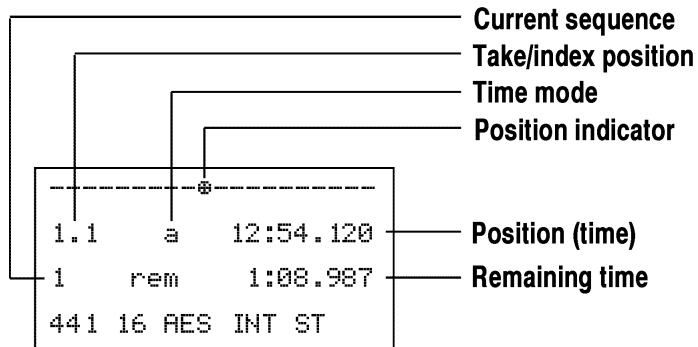
The second line displays the current take (and index) with the position in hours, minutes, seconds, and subdivisions.
The third line includes the current sequence number and the remaining time.
There are various display formats which can be adapted to the user's needs with a mode key or in the setup menu.

Take/Index Format:	**[TAKE]**	Selects between displaying only take numbers, or take and index numbers.
Time Mode:	**[TIME]**	Either the absolute, relative, or timecode position is displayed in line 2.
Remaining Time Mode:	**Menu 46**	The remaining time is showing the time until the next "take" or "index" marker, until the end of the current "sequence" (in "auto" position, either the next take or index marker is referenced, depending on the take/index mode).
Display Resolution:	**Menu 47**	ms (milliseconds) or frames.
Timecode Format:	**Menu 13**	24, 25, 29.97 and 30 frames/second.
Time Display Modes:	**"a"**	is the absolute time. The contiguous time scale starts at the beginning of the sequence.
	"r"	means relative time. It indicates the position within a take.
	"t"	is the timecode position. If no timecode was recorded, the absolute position will be displayed with a flashing "t".

Time scales within a sequence:

Take: 1   2   3   4
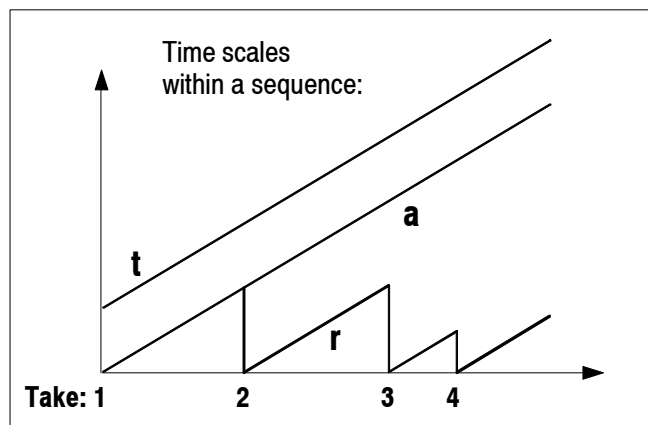
4.3.2   Playback and Stop

With **[PLAY]** the recorder starts to reproduce audio from the current posi-
tion. At the end of the last take, the D424 stops automatically.
[STOP] causes the D424 to stop at the current position.

4.3.3   Skipping to Take and Index Markers

Similar to CD players, locating to the previous or to the next take beginning
(take marker) is possible with **[PREV]** and **[NEXT]**. At the new destina-
tion, the D424 starts playing if it was in playback before the skip command.
Multiple commands are cumulated.
If track/index mode is selected, skipping refers to index markers instead of
take markers.
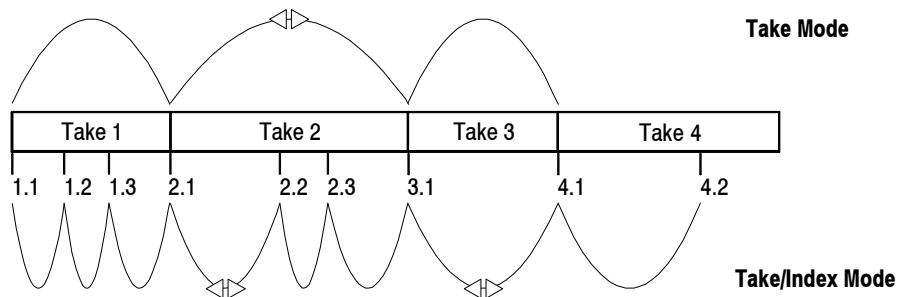
4.3.4   The CUE and SHUTTLE Modes

With the **[CUE/SHTL]** key, the mode which was used last is entered. Each
subsequent keystroke toggles between CUE and SHTL mode.

CUE Mode   **SHUTTLE Mode**
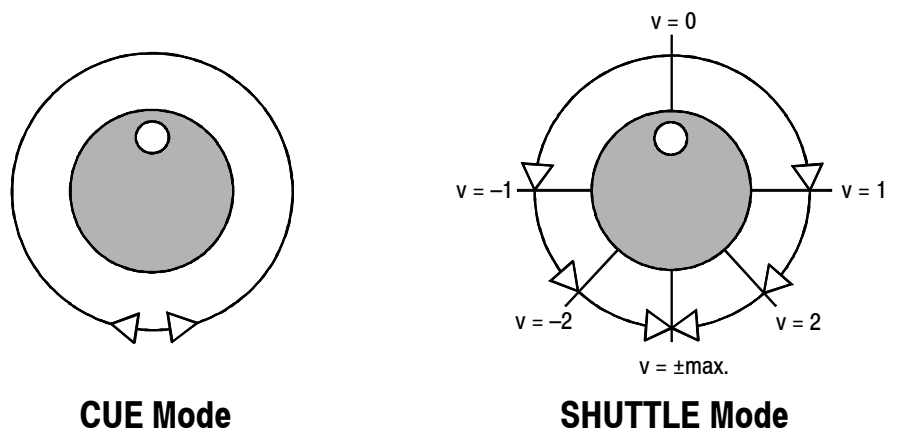
In the CUE mode, the position of the D424 is directly coupled with the con-
trol wheel. As with the reel of a tape recorder, a direct and precise tool for
audible positioning is provided. It allows to search for a particular position
by moving the D424 with the control wheel.
The SHTL mode allows to search for a particular position audibly by mov-
ing the D424's position at a speed in the range of $0...\pm2$ times nominal
speed. The speed is defined by the control wheel, the initial speed after se-
lecting the mode is 0.

LED Speed Indication:

☐☐☐■   fast wind forward
☐☐■■ $1...2 \times v_{nom}$
☐☐■☐ $0...1 \times v_{nom}$
☐■■☐   still
☐■☐☐ $0...1 \times v_{nom}$
■■☐☐ $1...2 \times v_{nom}$
■☐☐☐   fast wind reverse

At the upper and lower limits of the control wheel range, a maximum speed is applied (without audio output). This allows to "wind" the recorder to a target position, slowing down at the end, and positioning with low speed SHTL or CUE.

The present speed is shown in the display area, the LEDs above the control wheel indicate a rough speed overview.

As an alternative, full-speed shuttle mode is achieved with the following wind key combinations:

[**PLAY+NEXT**]   Fast forward mode,
[**PLAY+PREV**]   Fast rewind mode.
Use [**STOP**] or [**PLAY**] key to leave the CUE/SHTL mode.

4.3.5   Locating to a Random Position

Locating to Take/Index Markers

Any take or index position in e sequence can be addressed in a simple way with the [**LOC**] key. The following keyboard entry is terminated either with [**ENT**], with [**STOP**], or with [**PLAY**].

[**LOC**] [**2**] [**PLAY**] – will start playing at take no. 2
[**LOC**] [**5**] [**ENT**] – will park the D424 at the beginning of take no. 5

For accessing indices, simply add the index number:

[**LOC**] [**7**] [**IND**] [**2**] [**PLAY**] – will start playing at index no. 2 in take no. 7
[**LOC**] [**IND**] [**3**] [**PLAY**] – will start playing at index no. 3 in the current take.

Locating to Memory Positions

The D424 can be located to any position of the current sequence, if it has previously been stored in one of the memory registers.

To perform a memory locate, the [**LOC**] key is pressed, followed by one of the destinations indicated below:

[**IN**]   Edit IN register
[**OUT**]   Edit OUT register
[**PREV**]   Start of sequence
[**NEXT**]   End of sequence
[**REG**] [**1...9**]   General-purpose register 1...9

Examples: [**LOC**] [**IN**]   Locate to edit IN point
[**LOC**] [**PREV**]   Locate to start of sequence
[**LOC**] [**REG**] [**3**] [**ENT**]   Locate to REG 3

4.4   Recording

The D424 has been designed to offer the well-known recording techniques from a tape recorder. But with a non-linear recording medium, new features in recording and editing become available. The D424 offers different recording modes, each offering certain advantages and flexibility.

```
┌──────────┐    ▭ ASS
│          │    ▭ INS
└──────────┘    ▭ AUT
```
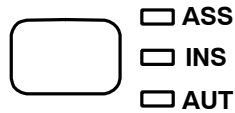
With the **[ASS/INS/AUT]** recording mode key, one of three recording modes is selected (see below). The corresponding LED will indicate the currently selected mode.

4.4.1   The D424 Recording Modes

Assemble Mode The assemble mode is similar to recording with a CD recorder. Every new recorded take is simply added at the end of the sequence. The identification number is increased by one, the absolute time continues at the end of the last take.

In the following example, there is a sequence with 3 takes, with the current position in take 2.

take 1	take 2	take 3

▲
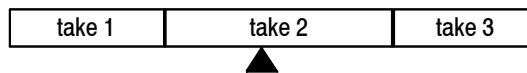
No matter where the current position is, recording one more take is simply done with **[REC+PLAY]**. The sequence will then look as follows:

take 1	take 2	take 3	take 4

▲
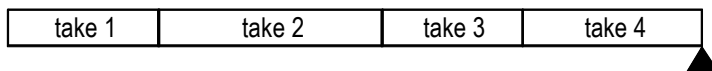
Insert Mode In insert mode, a destructive punch-in/-out is performed. The current data will be overwritten. The insert mode is therefore similar to the recording mode of a tape recorder.

take 1	take 2

▲

When performing a recording in the example above at the indicated position, take 1 would be overwritten until the punch-out command. Index markers are automatically placed at the punch-in and punch-out positions:

take 1		take 2

▲
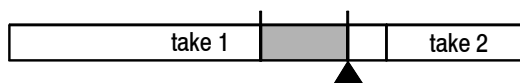
Take and index markers will be overwritten by new recorded elements.

take 1		

▲
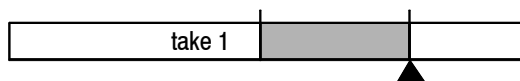
The sequence length is automatically adjusted, if necessary:

Auto Insert Mode   The auto insert mode is similar to the insert mode. But instead of manually performing punch-in and punch-out commands, the record commands will be precisely executed when passing the IN our OUT points. Both edit registers are preset in advance.
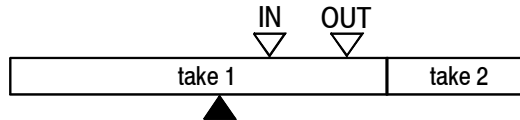
If at least one channel is set to READY, and a **[REC]** command is given, the D424 will start ahead of the IN point. It will show a countdown to the IN point, and a precise insert up to the OUT point is then performed automatically.

4.4.2   Channel Assignments

[RDY1] and **[RDY2]** are the record enable keys. The ready condition is indicated by a flashing LED; during the recording process, this LED is continuously on.
If recording in STEREO mode, the **[RDY1]** and **[RDY2]** keys are linked, i.e. selecting one of them automatically activates both channels. In MONO mode, either **[RDY1]** or **[RDY2]** is selectable.

	RDY 1	RDY 2	
STEREO	ON	ON	Stereo recording (both channels linked)
MONO	ON	OFF	Mono recording from input channel 1
MONO	OFF	ON	Mono recording from input channel 2

Note: When playing mono recordings, the mono disk channel will be routed to both output channels.

[INP1] and **[INP2]** are assigning the source of the two audio outputs, which can be the disk (INPUT LED off) or the selected input source (INPUT LED on). During a recording process, the enabled channels are automatically switched to INP for monitoring purposes, the INP LEDs are then also switched on.

4.4.3   Rehearse Mode

In both INSERT and AUTO INSERT modes, a rehearsal mode is available. It is activated with the **[PREVIEW]** key.
With the rehearse mode switched on, an insert recording process behaves exactly the same as a real recording, i.e. the monitor switches from disk to input during the recording period, but no data will be stored to disk.

4.4.4 Meters

The meters either display in standard peak mode or in peak hold mode. In the latter case, the peak value can be reset with **[PEAK RESET]** or **[STOP]**.

If the red overflow LED is on, a full scale digital value has been detected. The highest green LED indicates a level between –1 and 0 dB.

4.4.5 Adjusting the Analog Input Level

For recording from an analog source, the input sensitivity can be adjusted. For this purpose, the meters are switched to input either manually with the **[INP1]** and **[INP2]** keys, or by pressing **[REC+STOP]** (record pause mode).
The levels may then be modified in the setup menu 31.
With the Desktop Controller, there are separate keys for direct access to the level setting menu. Simply keep **[VOL1]** or **[VOL2]** pressed, and set the level with the control wheel.

Attenuation in setup menu [dB]	0.0	–0.5	–1.0	...	–13.0	–13.5	–14.0
Input sensitivity [dBu full scale]	10.0	10.5	11.0	...	23.0	23.5	24.0

4.4.6 Before You Start Recording...

• Make sure that your system configuration is correct. All relevant data are shown in the status line of the display.
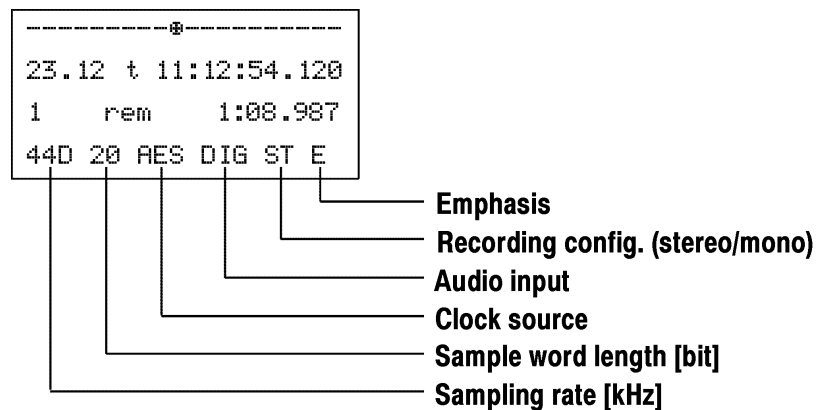
• Once set, it should not be necessary to modify the general parameters, because the remain stored when the D424 is switched off. In case of configuration errors, which are indicated with a flashing status or an error message, please refer to the system configuration or the troubleshooting sections.
• Insert a disk with the write-protect tab in "write" position.
• Set the D424 to Record Ready. The disk will then be asked for the number of defective blocks, and a warning will appear if it is not in a safe range.

```
▓▓▓▓▓▓▓▓▓
2      a   1:23:54:10
1  free      25:46:23
441 16 AES VID ST
```

- You can see the available space for recording with a **[REC+STOP]** command. The top bar is an indication of the total recorded space, and the third line shows the time available for recording.
- Please note that the free recording time depends on the selected format: There is more recording time available with 16 bit resolution or with 44.1 kHz sampling rate, than with 24 bit resolution and/or 48 kHz sampling rate.
- Check the input level. The sensitivity of the analog input can be aligned to match your standard studio levels.

4.4.7   Assemble Recording

Recording is simply started with **[REC+PLAY]** and stopped again with **[STOP]**.

```
▓▓▓▓▓▓▓▓▓
3      a   1:25:12:24
1  free      23:12:01
441 16 AES VID ST
```

During the recording process, the available recording space is displayed. If no disk space is available anymore, the D424 automatically stops.
The new take number appears in the position line (i.e. the 2nd display line).
Every new recording session is pasted to the end of the current session, regardless of the position before starting. A new take number is automatically assigned.

4.4.8   Insert Recording

Insert recording allows to overdub existing recordings. It corresponds to the destructive recording mode of a tape recorder.
- Place the D424 to the beginning of the section to be replaced, and start with **[REC+PLAY]**,
  or
- listen to the previously recorded material and punch-in on-the-fly with a **[REC+PLAY]** command.
- For a record punch-out, press either **[PLAY]** or **[STOP]**.

After performing an insert record, index markers are placed at the punch-in and punch-out positions, and the two points are automatically transferred to the IN and OUT edit registers for later editing.

4.4.9   Auto Insert Recording

In the auto insert mode, an auto-triggered destructive record punch-in/-out is performed at the current IN and OUT positions.

The mode is started like a normal recording by pressing **[REC+PLAY]**. The D424 then automatically starts at (IN minus PRE-ROLL). As soon as it is passing the edit points at nominal speed with at least one channel set to READY, a precise punch-in at the IN point and a punch-out at the OUT point are performed. The auto record process is stopped at (OUT plus POST-ROLL).

The auto insert can be previewed by activating the rehearse mode with the **[PREVIEW]** key before starting the process.

```
⊕·─·──·──·──·──·──·──·──·──·──·──·──
2.1   a          4:10
           to IN     3:12
auto RECORD
```

```
■■■■■■■▷
2.1   a          5:15
           to OUT    0:12
auto RECORD
```

```
⊕·─·──·──·──·──·──·──·──·──·──·──·──
2.1   a          7:22
       from OUT    1:07
auto RECORD
```

The auto insert process is indicated in the display, a countdown to the next edit event replaces the remaining time display.

Note: When using several attempts to replace a part of the session with Auto Insert, all versions are stored on disk. As a result of the non-destructive editing, they are not deleted automatically and can be accessed in Sequence Editing later. Use the CLEAN-UP tool in the Setup menu to delete all unused files, when the production is fixed.

4.5 Editing

In addition to the standard recording modes, non-destructive editing is provided. It is possible to cut out or delete a part of a sequence, and to move or copy a source element to any destination.

For all editing processes there is a source element which has to be specified. It is identified with a register pair IN and OUT. For some of the editing features, an additional insert position is required which is marked by a target point.

Source Element   Target Point
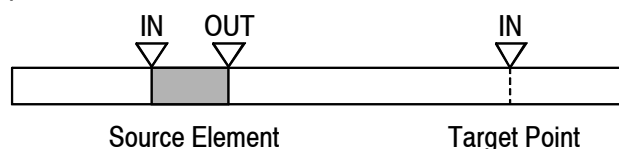
All source operations are performed in the source editing mode which is selected with **[SOURCE]**. For target-related functions, the target mode is switched on with **[TARGET]**.

There are three main editing functions which can be combined for more complex processes:

CUT   A source audio element is cut out of a sequence. It has the same effect as cutting out a piece of tape and splicing the two ends.

ERASE   A source element is erased, i.e. the audio element is filled with silence.

INSERT A marked source element is inserted at the target position.

Editing usually consists of the following steps:

- The source element is defined by setting the IN and OUT points
- The settings for the source element can be audibly checked with PREVIEW functions. If necessary, the edit points are adjusted.
- In case of an INSERT the target point is set in the same way.
- The process is executed with **[CUT]**, **[ERASE]**, or **[INSERT]**.
- If an edit process has been executed by mistake, it may be cancelled afterwards with **[UNDO]**.

4.5.1 Setting IN and OUT Points

The SOURCE IN, SOURCE OUT, and TARGET IN edit points can be edited in different ways. In general, the positions can be searched for with the transport commands, or they can be set and trimmed off-line with the numeric keypad and the control wheel.

The source points are selected with the **[IN]** and **[OUT]** keys, either in source mode, or with source and target mode switched off.

The target point is selected with the **[IN]** key when in target mode.

Setting a Point "On-the-Fly"   An edit point can be set by listening to the material and simply storing the current position with a keystroke. For this reason, the **[CAPT]** key copies the sequence time to the selected edit register.

Example: *Defining the source element:*
[PLAY] – Start listening to the source
[IN] – Select SOURCE IN point
... [CAPT] – Copy the current position to the IN point
[OUT] – Select SOURCE OUT point
... [CAPT] – Copy the current position to the OUT point.

Searching for a Point Audibly
By means of the transport commands – especially with the control wheel – the correct edit position is first searched for. If it has been found, the position is transferred to the edit register again with the **[CAPT]** key.

When working with the control wheel, the sequence may look like this:

[TARGET] **[IN]** – select TARGET IN point

[CUE/SHTL] + **control wheel** – search for insert point with CUE/SHTL

[CAPT] – copy the position to the edit register

Trimming a Register Setting
For minor modifications of a setting, points can easily be trimmed with the cursor keys or the control wheel.

[OUT] – select source OUT point

[▼] and [▲] – trim OUT register

[IN] – select source IN point

Control wheel – modify the current value

[ENT] – and save it to IN

Entering New Values
If the correct position is known by position from an existing list, or if points should be roughly defined before accurate tuning, the position can be entered like any other register.

[IN] – select source IN point

[0...9] or [CLR] – enter a new value with the numerical keyboard

[ENT] – and store the entry to IN

Note: Trimming with the cursor keys automatically stores the modified values to the register. Keyboard entries and modifications by the control wheel are stored with a subsequent **[ENT]** command.

4.5.2 The CUT Function

For cutting out an element within the sequence, first the source element is defined by setting the IN and OUT registers. When the source editing mode is selected with **[SOURCE]**, the currently selected element is indicated in the display.

A **[CUT]** command then removes the source element; the audio information before and after the element is joined directly.
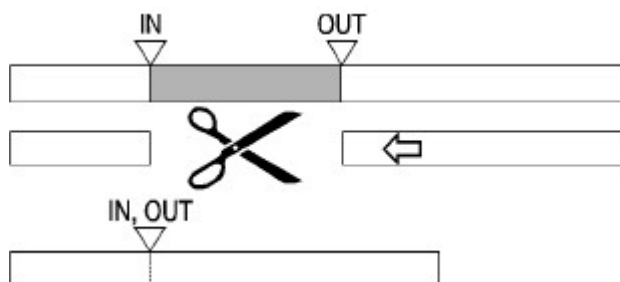
All markers located within the source element will also be removed. A new index marker is placed at the removed source element's position.

4.5.3   The ERASE Function

For erasing an element, first the source element is defined by setting the IN and OUT registers. An **[ERASE]** command then deletes all audio information between the IN and OUT points.
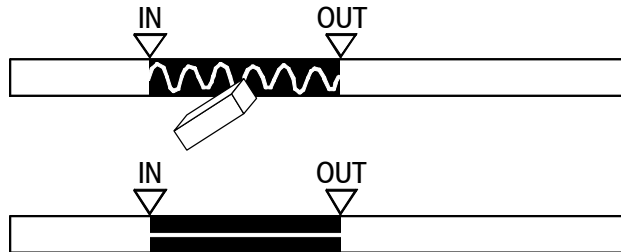
Neither the length of the sequence nor the take and index markers between the IN and OUT points are affected.

4.5.4   The INSERT Function

For the INSERT function, an additional point is required: the TARGET IN point. When selecting the target edit mode with **[TARGET]**, the SOURCE IN point and the insert position (TARGET IN) are displayed.

The **[INSERT]** command simply copies the source element to the target position.
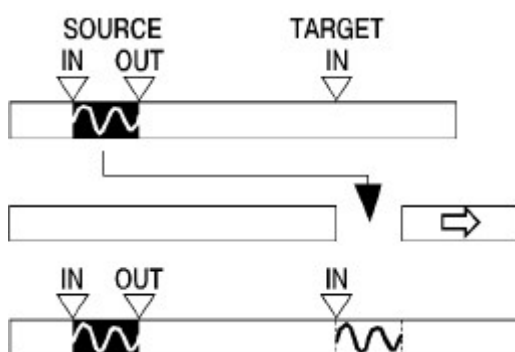
4.5.5 Combined Editing Processes

Taking the above basic functions, various combinations allow moving and copying elements in a sequence. The source and target modes are mutually exclusive; switching between them is possible at any time with the **[SOURCE]** and **[TARGET]** keys. Leaving the editing mode is possible by pressing the active edit key again.

All insert functions refer to the currently selected source element.

Copying an Element

1. A source element is selected in source editing mode.
2. After changing to the target mode, the selected element may be inserted once or at several addresses.

Moving an Element

1. A source element is selected in source editing mode.
2. After changing to the target mode, the selected element is inserted at the new position.
3. The source element is then removed in source mode with **[SOURCE] [CUT]**.

4.5.6 The PREVIEW Function

During adjusting the edit points, or as a final check before performing a CUT, ERASE, or INSERT, all settings can be previewed in advance. Rehearsing is started with the **[PREVIEW]** key while being in the edit mode.

```
----------⊕------------
2.1    a  1:12:54:10
       to IN    3:12
preview CUT
```
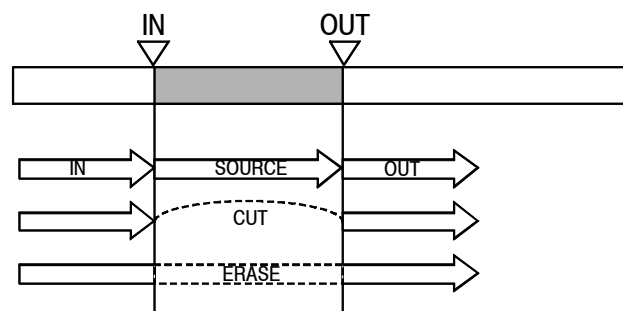

The following functions are provided for CUT and ERASE in the source mode:

[PREVIEW] [IN] – The pre-roll element before the IN point is played.

[PREVIEW] [OUT] – The post-roll element following the OUT point is played.

[PREVIEW] [SOURCE] – The complete source element (between IN and OUT) is played

[PREVIEW] [CUT] – The cut process is rehearsed by playing the preview IN and OUT elements in sequence.

[PREVIEW] [ERASE] – The erase process is rehearsed by playing the preview IN element, the muted source element, and the preview OUT element in sequence.
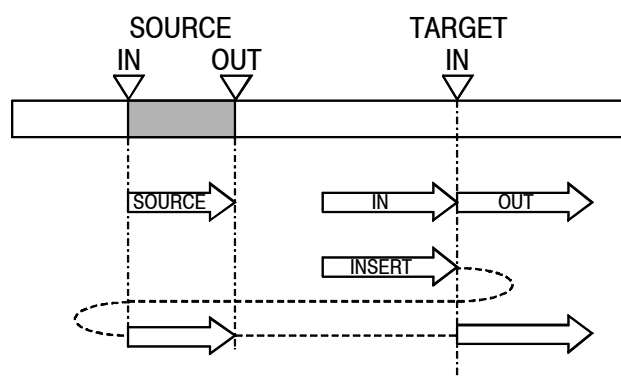
The following functions are provided for INSERT in the target mode:

[PREVIEW] **[IN]** – The pre-roll element before the TARGET IN point is played in target mode.

[PREVIEW] **[OUT]** – The post-roll element following the TARGET IN point is played in target mode.

[PREVIEW] **[SOURCE]** – The complete source element which will be inserted is played

[PREVIEW] **[INSERT]** – The insert process is rehearsed by playing the preview IN element, the insert element, and the preview OUT element in sequence.

The preview process can be stopped at any time by pressing **[PREVIEW]** again, or with a **[STOP]** command.

4.6   Sequence Editing

The sequence editing mode allows to select, create, and edit user sequences. It is selected with the **[SEQ]** key.

The display changes to the sequence select mode, first waiting for a sequence number. The ones available on the inserted disk are listed at the top. If there are too many takes, they will be displayed as a running sequence.

```
available sequences:
1 2 3


seq  _
```

4.6.1   Selecting a Sequence

An already existing sequence number can be typed in. After confirmation with **[ENT]**, the selection is made, and the display reverts to the standard mode.

```
⊕────────────────────

1     a        0.000
3   rem    53:08.987
441 16 ANA  INT ST
```

Quitting the selection mode without changing the current sequence is achieved with a further **[SEQ]** command.

4.6.2   Creating a New Sequence

If a new number is entered which is not listed in the available sequence list yet, a new sequence will be created with the corresponding number: **[SEQ]** **[4]** **[ENT]**

If no number is entered at all, a new sequence with the lowest available number will be created: **[SEQ]** **[ENT].**

When confirmed with **[ENT]**, the new empty sequence is selected as the current one, and the display reverts to standard mode.

```
⊕────────────────────

1     a        0.000
3   rem        0.000
441 16 ANA  INT ST
```

4.6.3   Deleting a Sequence

A sequence may be deleted by selecting it, and by performing a "Cut All" command with the key combination **[TARGET+CUT]**.

4.6.4   Editing a Sequence

The sequence to be edited – either an existing one, or a new, empty one – is selected by typing in the corresponding number (or nothing) followed by **[SOURCE]** or **[TARGET]**.

As default, the source sequence from where takes can be copied will be the table of contents of the current disk (sequence 0). Each source take corresponds to a sound file.

When takes from any other sequence should be copied, they have to be assigned before entering the editing mode. With the **[▶]** key the source sequence field (from...) is selected, and any sequence number may be entered.

```
available sequences:
1 2 3 4 5


seq 6          from 2
```

The sequence editing mode is entered with a **[SOURCE]** or **[TARGET]** command: **[SEQ] [3] [▶] [2] [SOURCE].**

The following display will appear:

```
1-2-3-4-5-6
source 02  take 01
target 03  take 03
1-2-3
```

The source sequence (from where takes are copied) and the target sequence (the sequence which is edited) are listed in the first or last line, respectively.

Lines 2 and 3 show the currently selected sequences with a source take and a target take position.

Now, the take in the source sequence which should be copied can be entered. The destination insert point is defined by switching to the target line with **[TARGET]**, and typing in the corresponding take number before the insert point.

If there is not enough space in the line to display all takes, a page with the currently entered take in the center of the line is automatically shown. Arrow signs indicate that there are more takes at the left or at the right of the current page.

It is possible to switch between source and target definition with the keys **[SOURCE]** and **[TARGET]** before performing an edit process. The active half of the display is indicated with brighter digits, the entry field with flashing digits.

With **[INSERT]** the source take is inserted after the target take.
With **[CUT]** the target take is deleted from the selected sequence.

Examples: *Insert take 3 from sequence 2 after take 4 in sequence 3:*
[SEQ] [3] [▶] [2] [SOURCE] – define sequences and enter editing mode
[3] [TARGET] [4] [INSERT] – define takes and insert.

Delete take 5 from sequence 1:
[SEQ] [1] [TARGET] [5] [CUT] – define sequence and enter editing mode, select target take and delete it.

With **[TARGET+CUT]** the current sequence file with all takes will be deleted.

With **[TARGET+INSERT]** the complete source sequence will be copied to the target sequence. Existing takes in the target sequence will be overwritten.

Leaving the sequence editing mode is possible in any state with a **[SEQ]** command.

Notes: When entering the sequence editing mode, the source take is set to the first take of the source sequence, the target take to the last take of the edited sequence.

After an INSERT command, the source take is incremented to the next take of the source sequence, the target position is after the take just inserted. This will allow to copy a sequence by simply pressing **[INSERT]** several times.

After a **[CUT]** command, the indicated take will be the take before the removed one. Performing several **[CUT]** commands in sequence will result in deleting a sequence take by take (in reverse direction).

All take selections can also be done with the **[▶]** and **[◀]** cursor keys or with the CUE/SHUTTLE wheel.

Examples: *Switch to sequence 2:*
[SEQ] [2] [ENT]

Create a new sequence with all files from toc
[SEQ] [▶]
[SOURCE] [TARGET+INSERT]
[SEQ]

Insert take 3 and 4 (sequence 2) after take 4 in sequence 3:
[SEQ] [3] [▶] [2]
[SOURCE] [3] [TARGET] [4] [INSERT] [INSERT]
[SEQ]

Delete takes 5, 6 and 7 from sequence 1:
[SEQ] [1]
[TARGET] [7] [CUT] [CUT] [CUT]
[SEQ]

Create a new sequence 3 as a copy of sequence 1:
[SEQ] [3] [▶] [1]
[SOURCE] [TARGET+INSERT]
[SEQ]

Delete sequence 3:
[SEQ] [3]
[TARGET+CUT]

4.7   CD Transfer and Disk Copies

The D424 MO recorder is equipped with a SCSI port. Additional external MO drives and/or CD writers may be connected to perform fast data transfers.

4.7.1   Configuration

For making copies between the D424 and external drives, a SCSI connection between the two devices has to be established.

Please follow the instructions below for correct operation:

- Switch off the two units and connect the SCSI cable.
- Make sure that the two units do not have the same SCSI address. The default address of a D424 is "1", the one of the Studer D741 is "2". See the corresponding manual section of the device for changing SCSI addresses.
- Switch on the peripheral device first. If it is not a single peripheral drive (disk drive only), switch it to SCSI slave mode (Studer D741: SCSI ON, D424: SCSI offline mode).
- Switch on the D424.

4.7.2   Transfer to a CD Writer

The CD transfer option is the solution for small CD mastering applications. It allows to copy sessions having been edited in a D424 sequence to a CD writer.

The copy utility not only transfers audio data, but also additional PQ information. The transfer is performed with double speed.

What will be Transferred?   The audio data are transferred in one of the following modes:

TOC   A complete sequence is transferred to a new, empty disc, including all defined PQ information (disc-at-once mode). The CD is finalized and ready for use on any CD player.

MULTI   Same as TOC, but the CD is multi-session expandable (for use on PC systems).

ADD   The current sequence is added to the CD-R contents. The table of contents of the disc will not be finalized, it will be therefore ready for further subsequent transfers.

FIX   No data are transferred. A CD-R which has been recorded in "add" mode will be finalized.

The D424 supports editing of the PQ data listed below, which are copied to the CD in addition to the audio data of the currently selected sequence. They can be set in the TRANSFER PARAMETER menu 64.

Take and Index Markers   The take and index markers which were set in the D424's current sequence will appear in the CD-R at the same position.
The take markers of the D424 correspond to CD tracks.

ISRC and UPC/EAN Codes   There is a separate menu item in the COPY menu for defining the CD's catalog number – the UPC/EAN code – and the ISRC code of each track.

Control Data   The emphasis flag of the current sequence is copied to the CD writer as well, all other control data are set to 0.

Further parameters are considered for a data transfer to a CD recorder:

Noise Shaping   For improved audio quality when transferring 20 bit or 24 bit data to a 16 bit CD.

Track Delay   For inserting a delay of 100 ms between track begin and audio, to improve readability of CDs on consumer players.

Index 0 Pause   When transferring in "toc" mode, an additional pause (index 0) of 2...5 s can automatically be inserted between tracks. In "add" transfer mode, the Studer D741 always generates pauses of 2 seconds.

Starting the Transfer

- The transfer process is initiated in the SETUP menu. After having edited the current sequence and checked the parameters, select MASTER COPY menu 62: **[SETUP] [6] [2]**

```
    Master Copy
  seq 01   to Drv 2
      cd mounted
  target     start
```

- The indication "cd mounted" will confirm that the communication between D424 and the CD writer is working properly.
- Start the process by moving to the "start" item with the cursor keys, and confirm with **[ENT]**.
- During the entire transfer process, the indication "processing" and a progress bar with "#" signs will inform you on the transfer status.
- As soon as the transfer is finished, the display will revert to standard mode. If a "toc" transfer has been made, the CD writer will open its disc tray.

Notes: Do not interrupt a SCSI transfer by disconnecting or switching off one of the two units. The current session on the CD-R might be damaged.

The D424 will check if the CD-R has sufficient capacity for doing a disk-at-once transfer of the current disk. An ERROR message will appear if the sequence is too long.

In ADD mode, the capacity check is made "take by take". The transfer process is stopped automatically when the CD-R is full.

The D424 does not accept more than 99 indices for a single disk-at-once transfer. If the required number is higher, multiple ADD transfers have to be used.

Finalizing a CD will take 2...3 minutes. Do not interrupt the process. The display will revert to standard mode as soon as the process is finished.

4.7.3   Copying a CD to the D424

The contents of a CD can be copied to a new sequence on the D424 disk, including the track information.

What will be Transferred?   The following transfer modes are available:

TOC   The complete CD will be copied into a new sequence on the target disk. Every track is stored as a separate sound file. The take markers in the new sequence correspond to the CD tracks.

ADD   The CD track currently selected is transferred. A new sequence is created on the target disk with the single CD track.
No further transfer parameters are considered.

Starting the Transfer

- Check that the inserted MO disk is ready for recording the CD tracks – it should not be write-protected, have enough free capacity for adding the information, and the format should be CD compatible (44.1 kHz).
- Select the CD drive as active drive (setup menu 51). Select the desired transfer mode in menu 644. If transferring a single track, locate the CD to the corresponding track by using the D424 transport keys.
- The transfer process is then initiated in the SETUP menu. Select the MASTER COPY menu 62: **[SETUP] [6] [2]**

```
     Master Copy
  seq 01   to Drv 2
      cd mounted
  target     start
```

- The indication "cd mounted" will confirm that the communication between the D424 and the CD writer is working properly.
- Start the process by moving to the "start" item with the cursor key and confirming with [ENT].
- During the entire transfer process, the indication "processing" and a progress bar with "#" signs will inform you on the transfer status. After a successful transfer, the display reverts to standard mode.
- Reselect the internal MO drive as current drive (setup menu 51); you will find a new sequence with the audio information just transferred from the CD.

4.7.4   Copying to/from Other Disks

Sequences and complete disks can be copied from the internal drive to additional, external drives.

What will be Transferred?   The following transfer modes are available:

DISK COPY   Will copy the complete disk. The target disk has to be empty; reformat it first, if necessary (setup utility 53).

MASTER COPY   Will create a new sequence on the target disk. The audio information will be merged into a new, single sound file.

WORK COPY   will create a new sequence on the target disk which is identical with the source and includes all sequence information. All sound files which are used by the sequence will be transferred as well.

The following additional parameters will be considered for the MASTER COPY mode:

Noise Shaping   (in TRANSFER PARAMETER menu 641); for improving data quality when transferring 20 bit or 24 bit data to a 16 bit sequence.

Recording Parameters   With MASTER COPY a new audio file is generated. Some of the basic recording parameters are considered.

Digital Playback Level   The transfer process considers the digital playback level setting in setup menu 33.

Starting the Transfer
- Check that the target MO disk is ready for recording – it should not be write-protected and should have sufficient free capacity for adding the prepared audio.
- The transfer process is initiated in the SETUP menu. After having edited the current sequence and checked the parameters, select one of the COPY menus 61...63, e.g. **[SETUP] [6] [3]**

```
┌─────────────────────────────┐
│      Copy Disk  1           │
│           to Drv 4          │
│                             │
│                             │
│   target      start         │
└─────────────────────────────┘
```

- The current source and target information is displayed. The target disk can be changed by selecting the "target" item.
- Start the process by moving to the "start" item with the cursor key and confirm with [ENT].
- During the entire transfer process, the indication "processing" and a progress bar with "#" signs will inform you on the transfer status. After a successful transfer, the display reverts to standard mode.

4.7.5   Transfer Parameters

There is a number of transfer parameters which can be modified to meet the requirements of different applications. All settings can be accessed in the TRANSFER PARAMETER menu 64.

Noise Shaping (Menu 641)   For making best use of high quality recordings in 20 or even 24 bit resolution, it is possible to apply the noise shaping algorithm to audio information which is transferred to16 bit media.
If set to OFF, audio data will be truncated to 16 bits.

UPC/EAN (Menu 642)   The UPC/EAN code is a catalogue number for CDs (13 digits). The indicated number is read from the inserted CD, modifications are possible only as long as no code was programmed yet (code is 0).

ISRC (Menu 643)   International Standard Recording Code (5 alphanumeric and 7 numeric digits), including country and owner identification, recording year, and serial number.
There is one ISRC code for each take. If cleared, no UPC/EAN is recorded.

CD MODE (Menu 644)   One of the following modes can be selected:
TOC   Disc-at-once transfer, including table of contents
MULTI   Same as TOC, but multi-session expandable
ADD   Add the current sequence without table of contents
FIX   The CD is finalized (table of contents, no data transfer)

CD TRACK DELAY (Menu 645)   When starting a consumer CD player, it usually takes some time before the circuit is stable and the output is unmuted. For being sure that the complete audio information is played when starting from a cue position, the waiting position has to be a certain time before the audio start position.
For that purpose, the CD track delay feature can be used. When it is enabled, the begin of index 1 of each track is placed 100 ms ahead of the previous position (audio start position).
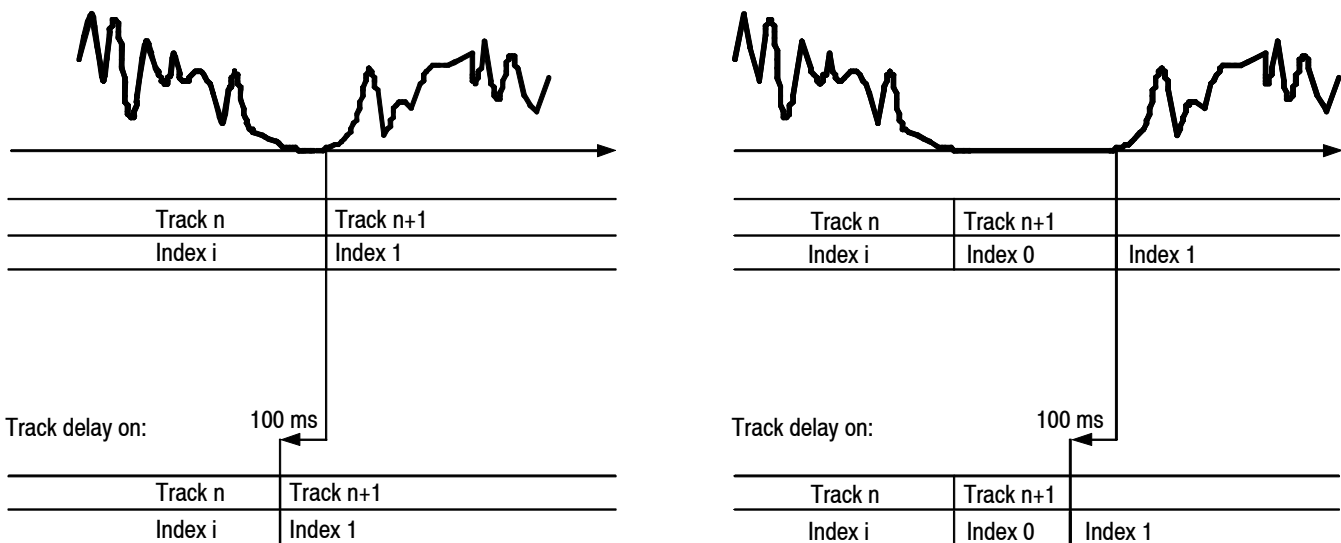
If there is no pause (index 0), moving index 1 is identical to moving the track begin.

INDEX 0 DURATION (Menu 646)   Commercial CDs often have an invisible "index 0" part between two tracks. It allows to have a pause when playing the 2 tracks in sequence, but also to indicate the end of a track with the track signal and to start immediately when paused at the begin of the following one.

When transferring sequences from the D424 to the CD writer, a pause of 2...5 seconds may be inserted between the tracks. This is useful when constant pause periods with index 0 are required.

If individual pause times are required, they have to be inserted when editing the sequence. Transferring is then performed with no additional "index 0 pause" (parameter = 0). The CD will then be recorded without index 0.

When inserting a pause between two tracks, cross-fades are usually applied similar to insert recording. No additional cross-fades will be added, when there already is a cross-fade section at the take begin (e.g. take has been defined by a new record start, or a pause has been inserted manually).

Note: In ADD mode, the Studer D741 will generate pauses of 2 seconds regardless of the D424 settings. Use the "toc" mode for transferring sequences with continuous transitions from one take to the other (e.g. live concerts).

4.7.6   SCSI Addresses

The addresses of SCSI peripherals have to be unique. The SCSI host of the D424 core board is on address "7", the default address of the internal MO drive is "1". The default address of the Studer D741 CD recorder is "2".

The address of an additional external drive may be set to any address between 1 and 6, except the address of the D424's internal drive.

If connecting several D424 MO recorders with a SCSI cable, the address of the additional recorders has to be adapted. See the troubleshooting section for the modification of the D424's internal drive.

The address of the Studer D741 may be changed at the DIP switch near the SCSI connectors on its rear panel (for details see Studer D741 Operating Instructions).

For changing the SCSI address of other CD writers, please consult the corresponding manual.

4.8   Backup Copies

When working on projects for several days, backup copies of the current projects may be made either on the same disk or on a separate, external disk. We recommend, as with any other computer-based data processing program, to perform backups on a regular basis.
There are two backup methods with the D424.

4.8.1   Sequence Backup

With a sequence backup, the sequence file with all the editing information is simply copied onto the same disk.

Example: Copy the current sequence 1 into a new sequence 2
[SEQ] [2] [▶] [1] – Create a new sequence from sequence 1
[TARGET+INSERT] – Copy all takes.

It is very easy to switch between different versions of the same production by selecting one of the available sequences as the active one.

Example: Select sequence 4 as the active sequence
[SEQ] [4] [ENT] – Select sequence 4 and return to main mode.

The disk contents may look like this:
Sequence 1   Original recording session, without any modifications
Sequence 2   Final pre-edited version after the first day
Sequence 3   1st version based on sequence 2
Sequence 4   2nd version based on sequence 2
Sequence 5   Special mix for customer A.

Notes: With a sequence backup, the sequence file with all the editing information is simply copied onto the same disk. The audio data remain unchanged and are referred to by all the different sequences

For more information on sequence editing, see the corresponding section above.

4.8.2   Disk Backup

When there is additional disk drive available (or a second D424 recorder), the contents of the current sequence with audio and editing data may be copied onto a separate backup disk.

For setting up the system, the following steps are required:
- Switch off both units and install the SCSI cable between both units. The termination of the destination drive must be on. In case of the D424, termination is provided automatically.
- Switch on the destination drive. In case of the D424, switch it to SCSI off-line mode in menu item 52.
- Switch on the D424. It will automatically recognize the connected SCSI destination.

After having started your system, the following steps are necessary for transferring the current sequence onto the destination disk:
- Be sure to be in the sequence which you would like to copy.
- Select the "work copy" mode with **[SETUP] [6] [1]**.
- The target drive is listed in the menu page. If it is not yet correct, select the "target" item, select the desired target drive and confirm with **[ENT]**.
- Start the transfer by selecting the "start" item.

During the transfer, the display indicates "processing". When the transfer is completed, the display reverts to the standard mode again.

Note: The information on the destination drive is not overwritten. The new sequence is simply added to the contents of the disk. A warning will appear if there is not enough space on the destination drive.

4.9 Data Exchange with SADiE® Workstations

The audio data files (*.WAV) which were recorded on a D424 can be read by almost every DOS-based workstation. With SADiE® digital audio workstations, a further compatibility level is provided. The EDL files with all the editing and disk structure information can be shared between the two products.

It is therefore possible to record and edit on a D424, do some more sophisticated editing on the DAW, and play the final product again on a D424 without loosing the editing information.

4.9.1 DAW Configuration

SADiE® software version 1.3, equipped with ISO MO drive 2.6 GB.

SETUP Sampling rate according to recording session on disk, 16 bit resolution
MIXER1 Stereo stream
PLAYLIST Two streams

4.9.2 Importing D424 Disks to the DAW

The D424 sequence files including all information for playing sequences are converted into the common SADiE® interchange format. Because the large audio files do not have to be translated, the conversion process only takes a short time.

Use the FIXUP utility in setup menu 65 to start the translation. If the process is finished, remove the disk from the D424.

Insert the disk into SADiE's MO drive and import the D424 data in the following way:

- Select the Disk Manager in the file menu, press the right mouse button and select "Log Disk"
- Select "SCSI DOS transfer" in the file menu.
  The D424 MO disk will be listed.
- Copy the EDL file (filex.EDL) to your project directory on the PC's harddisk.
- Select the menu item "File – Convert".
- Select input file "filex.EDL" (the D424 EDL file), select output file "to playlist".
- Continue working with the DAW, and save your session as usual.

What You Will See (and What You Won't):

You will see all takes and editing effects made on the D424 with 16 bit files; the DAW does *not* consider any 20 bit and 24 bit files.

4.9.3 Importing SADiE® Disks to the D424

Create the EDL file with SADiE® interchange format, and copy the file to the MO disk.

- Convert from "Playlist" into the EDL file (filex.EDL)
- Select "Copy DOS to SCSI" in the file menu – select filex.EDL to MO disk; always copy the EDL file to the main level, do not use any subdirectories.

Close the SADiE® project and remove the disk.

- Select the Disk Manager in the file menu, press the right mouse button and select "unlog disk".
- The disk can now be inserted to the D424. It will automatically detect the interchange file and reconvert it to a standard sequence file. You can switch to the new sequence by typing **[SEQ]** and selecting the new sequence file.
- Continue working with the D424as usual.

What You Will See (and What You Won't):

You will see all markers and edits done by the SADiE® workstation; you will not have access to files which were located on the DAW's harddisk.

4.10 Setup Menu

4.10.1 Accessing and Modifying Menu Items

With **[SETUP]** the display changes to the setup mode, where different types of parameters and functions are available. The same key is used to leave the setup mode again.

All parameters and utilities are identified with a unique number. The setup menu has a hierarchical structure. It allows to directly access an item with its number, or to be guided through the necessary menu levels.

Direct Access The fastest way to access menu items is by specifying their number directly after the setup command.

[SETUP] [3] [1] – opens menu 31 (analog input attenuation).

Cursor Access A menu structure allows to find particular items by navigating through the multiple levels with the cursor keys. After the SETUP command, the main menu is opened. Any item of the menu structure can be accessed with a number of cursor commands.

[◀] and **[▶]** move to an item within a setup level. The control wheel can be used as an alternative to the cursor keys.

The currently selected item is highlighted, its number is flashing.

[▲] and **[▼]** go to the previous or the next menu level.

When several parameters have to be modified, it is usually faster to use the cursor keys to change from one item to the next one.

Modifying and Executing Items Each menu page lists up to 8 items. There are several types:

- Submenu items lead to the next menu level when selected with the **[▼]** cursor or the **[ENT]** key.
- Utilities will be executed when selecting the corresponding "yes" or "start" item with the **[▼]** cursor or the **[ENT]** key.
- Numerical parameters items are selected with the **[▼]** cursor or the **[ENT]** key.
- After the selection, the current value starts flashing. A new entry can now be made by means of the numeric keypad and CLR, or by trimming the current setting with the control wheel or the **[◀]** and **[▶]** cursor keys. The entry is terminated with **[ENT]**.

```
       Crossfade Time


           0 msec

```

- If a parameter page contains a list of presets to select from, each position has a position sign (▢).

```
    Sampling Frequency


    44D   441   48D   48

     o     ⊕     o     o
```

- Move the cursor to the corresponding item with the **[◀]** and **[▶]** keys or the control wheel, and confirm with [ENT] or **[▼]**.

The cursor position is indicated with a flashing position sign (▢), the one currently selected with a cross-marked sign (⊕.

4.10.2   Overview

Menu Item	Display	Meaning	Parameters
1	**CONFIG**	**System configuration**	
11	S.FREQ	Sampling frequency	44.056, 44.1, 47.952, 48 kHz
12	S.WORD	Sample resolution	16, 20, 24, 24L bits
13	TC	Timecode format	24, 25, 29.97DF, 30, NONSTD
14	RECMODE	Record mode	stereo, mono
15	UNIT	Unit selection	unit1, unit2, unit3
16	DEFAULT	Configuration	
161	RECALL	Recall	User, Power on, Factory
162	STORE	Store current config to user setting	cancel, yes
17	REMOTE	Remote	local, remote
2	**REF & INP**	**Reference & input parameters**	
21	CLK SRC	Ref. clock source	int, dig, video
22	DIG REF	Digital reference	sync, wclock, audio
23	INPUT	Audio input	dig, analog, option
3	**AUDIO**	**Audio parameters**	
31	INP LEV	Analog input attenuator	inp1, inp2 (0...–14 dB)
32	OUT LEV	Analog output level	level (0...3)
33	DIG LEV	Digital playback level	channel1, channel2, (–12...+6 dB)
34	XFADE	Cross-fade time	(0...2000) ms
35	METER	Meter mode	peak, peak hold
4	**TRANSPORT**	**Transport & display parameters**	
41	MAXSPD	Maximum wind speed	(2...30) × nominal speed
42	VARISPD	Play varispeed	off, on (±12.5%)
43	AUTO	Auto stop	off, on
44	PRE/POST	Pre-roll/post-roll	(2...40) s
45	FADER	Fader start1	disabled, enabled
46	REMAIN	Remaining time mode	auto, ind, take, seq
47	DISP RES	Display resolution	frames, ms
5	**DISK**	**Disk & sequence utilities**	
51	SELECT	Select disk drive	(1...6)
52	SCSI	SCSI offline	yes, no
53	FORMAT	Format disk # ?	cancel, yes
54	CLEANUP	Cleanup disk # ?	cancel, yes
55	REN-SEQ	Renumber sequence ##)	cancel, yes
56	CLR-IND	Clear all indices of sequence	cancel, yes
57	DEL-FILE	Delete sound file --DESTRUCTIVE--	Seq #, take #; cancel, yes
6	**COPY**	**Copy utilities**	
61	WORK	Work copy seq ## to drv #	target, start
62	MASTER	Master copy seq ## to drv #	target, start
63	DISK	Copy disk # to drv #	target, start
64	XFER PAR	Transfer parameters	
641	SHAPING	Noise shaping	off, on
642	UPC/EAN	UPC/EAN code	1234 1234 12345
643	ISRC	ISRC code, track ##	abcde 1234567
644	CD MODE	CD copy mode	toc, multi, add, fix
645	DELAY	CD track delay	off, on
646	INDEX 0	Index 0 duration	off, on (2...5) s
65	FIXUP	Fixup disk # ? (for SADiE® exchange)	cancel, yes
7	**SERVICE**	**Service utilities**	
71	FORMAT	Format disk # ? (takes up to 40 min!)	cancel, yes
72	DATE	Date & time	day.month year hours:min

4.10.3   Menu 1, CONFIG (System Configuration)

11   S. FREQ

Sampling Frequency

The sampling rates listed below may be selected for recording and playback. Please note that only one format is accepted per disk side. If another format is applied, an error message will appear.

44d	44.056 kHz
441	44.1 kHz
48d	47.952 kHz
48	48 kHz.

The 44d and 48d formats are provided for video drop-frame applications.

12   S. WORD

Sample Resolution

Any of the following resolutions for an audio sample can be selected. It is valid for all subsequent recording sessions. Multiple formats within a sequence are allowed.

16	16 bit
20	20 bit
24	24 bit
24L	24 bit long.

For compatibility reasons, there are two different settings for 24 bit recording. Samples in standard 16, 20 and 24 bit format are packed (2, 2.5 and 3 bytes/sample) for maximum capacity. The 24L format stores a sample in 2 words (4 bytes/sample) for compatibility with third-party applications.

13   TC

Timecode Format

The D424 provides SMPTE/EBU timecode at its TC OUT connector. The provided format can be changed at any time, it does not depend on the recorded information.

Once selected, the TC format is used for providing timecode and as display format.

24	24 fps
25	25 fps
29d	29.97 fps, drop-frame format
30	30 fps.

In addition to these standard formats, a special submenu provides two additional formats, which can be used for non-standard configurations.

29	29.97 fps, non-drop format
30d	30 fps, drop-frame format.

14   RECMODE

Channel configuration ("Record Mode")

The following configurations are available:

stereo   New takes will be recorded in interleaved stereo mode. Both channels are stored in a single file. A single **[RDY]** command will enable both channels.

mono   New takes will be recorded in mono mode. The channel which was selected with the corresponding **[RDY]** key will be stored into a mono file.

When played back, a mono file will be routed to both output channels.

Stereo and mono recordings can be combined in a sequence. Full editing functionality is provided.

15	**UNIT**		Unit Selection

The D424 Desktop Controller can drive up to 3 recorders. Each recorder must have its own unique address which is defined in this menu.
Select the address among unit1...unit3 (front panel only).

16	**DEFAULT**		Configuration settings

The D424 configuration settings can be stored into a user memory. If the settings were changed, they can be restored with a few keystrokes.
[SETUP] [1] [6] [2] – Store the current settings (confirm with "yes").
[SETUP] [1] [6] [1] – Recall one of the following settings:

User	Restore user settings
Power On	Restore settings which were present when switching on the D424
Factory	Restore factory defaults.

17	**REMOTE**		Remote Mode

The remote mode menu allows switching between:

local	Local operation enabled (front panel or Desktop Controller)
remote	Remote operation (serial remote port).

During remote operation, all local functions except SETUP are disabled.

4.10.4   Menu 2, REF & INP (Reference & Input Parameters)

21	**CLK SRC**		Ref Clock Source

Menu 21 provides the main clock references for the D424:

int	Internal reference (quartz)
dig	External digital reference (see menu 22)
video	Composite video reference

22	**DIG REF**		Digital Reference

Menu 22 specifies the external digital reference signal:

sync	AES-11 input
wclock	Word clock input
audio	Digital audio input

Mode	Status line indication	Setup menu 21	Setup menu 22	Reference input
Internal	INT	int	-	-
Video	VID	video	-	VIDEO
Digital, AES-11 ref.	DIG	dig	sync	AES/EBU SYNC
Digital, AES-3 audio input	DIG	dig	audio	AES/EBU IN
Digital, word clock	DIG	dig	wclock	WORDCKLOCK IN

If the currently selected reference is not available, the status line indication will flash.

23	**INPUT**		Audio Input

The D424 either records digital signals at the AES/EBU input, or analog signals at the line input (optional). With an appropriate adapter, the AES input will also accept SPDIF signals.

dig	AES/EBU (or SPDIF) at AES IN
analog	Analog at LINE IN (optional)
option	Reserved for further I/O options

4.10.5   Menu 3, AUDIO (Audio Parameters)

31   INP LEV

Analog Input Attenuation
The level of the analog inputs can be adjusted separately in 0.5 dB steps. The attenuation range is 0...–14 dB; with the standard I/O board configuration, the following sensitivities are achieved:

Attenuation in setup menu [dB]	0.0	–0.5	–1.0	...	–13.0	–13.5	–14.0
Input sensitivity [dBu full scale]	10.0	10.5	11.0	...	23.0	23.5	24.0

32   OUT LEV

Analog Output Level
The level of the analog outputs can be set to one of 4 preset values. There is a common setting for both channels, the following levels are provided with the standard I/O board configuration.

Output level in setup menu	level 0	level 1	level 2	level 3
Output level [dBu full scale]	10	15	20	24

33   DIG LEV

Digital Playback Level
When transferring digital audio signals to external devices, it might be necessary to adjust the overall playback level. The D424 provides a function to modify the playback level in the digital domain. There is a separate setting for each channel.
Range: –12...+6 dB, in 0.1 dB steps

34   XFADE

Cross-fade Time
A cross-fade time can be specified. It will be applied to all subsequent recording and editing processes. Cross-fades are used in insert and auto recording modes as well as in cut, erase, and insert editing.
The cross-fade time is also applied to fade-in and fade-out processes in assemble recording and sequence editing.
It is possible to change the cross-fade parameter during the editing process. Please note that no further editing is allowed in fade or cross-fade areas.
When the cross-fade time is set to 0 ms, all corresponding processes will be performed without fade or cross-fade times.
Range: 0...2000 ms, in 1 ms steps

35   METER

Meter Mode
The meters either display in standard peak or in peak hold mode.
peak   standard peak mode
peak hold   peak hold mode; the peak value is reset with the **[PEAK RESET]** key, or with **[STOP]**.

4.10.6   Menu 4, TRANSPORT (Transport & Display Parameters)

41   MAXSPD

Maximum Wind Speed
In SHTL mode, the end position of the control wheel refers to a variable maximum speed. The same speed is applied to the shortcut wind command **[PLAY+NEXT]** or **[PLAY+PREV]**.
Range: 2...30 × nominal speed, in multiples of the nominal speed.

42   VARISPD

Play Varispeed
If varispeed mode is switched on, playback with internal reference is performed with the corresponding varispeed. An indication with the currently selected speed will appear in the third line of the standard display.

off   Varispeed mode is switched off
on   Playback is performed with varispeed
Range: ±12.5 %, in 0.5 % steps.

43   AUTO

Auto Stop
When activated, the D424 will automatically stop at each new take begin.

44   PRE/POST

Pre-roll/Post-roll
When previewing edit processes or performing auto records, pre-roll and post-roll times are used. The D424 allows to specify these editing parameters separately.
Range: 2...40 s, in 1 s steps.

45   FADER

Fader Start
When the fader start operation is enabled, external fader start signals will generate the specified PLAY and STOP commands.

off   Fader start mode is switched off
on   Fader start mode is switched on.

46   REMAIN

Remaining Time Mode
The remaining time displayed in the 3rd line of the standard display refers to one of the following points:

auto   depends on the take format, see **[TAKE FORMAT]** key:
TAKE – remaining time to end of take
TAKE/INDEX – remaining time to next index or take

ind   remaining time to next index or to end of current take
take   remaining time to end of current take
seq   remaining time to end of sequence.

47   DISP RES

Display Resolution
All time information in the standard mode can be displayed either with ms or frame resolution. The frame format corresponds with the selected timecode format.

msec   time information in hours, minutes, seconds and milliseconds
frames   time information in hours, minutes, seconds and frames.

4.10.7 Menu 5, DISK (Disk & Sequence Utilities)

51 SELECT

Select Disk Drive

In the standard configuration, the D424 is working with its internal MO drive. Because the drive runs on a SCSI bus, the system can be expanded by connecting further devices. The D424 currently supports the 2.6 GB MO drive and the CD writers.

In multiple drive configurations, a "current device" is selected. All system operations are performed with this current device.

```
Select Disk Drive


MO CD -  -  -  -

 ⊕  o  o  o  o  o
```
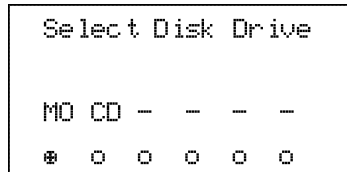
All available disk drives will be listed with the type (MO or CD) in the order of the SCSI address (1...6). The one currently selected is cross-marked.
Default addresses: 1 for internal drive, and 2 for D741 CD recorder.
For changing the current disk, move to the new drive with the cursor keys, and confirm the new selection.

52 SCSI

SCSI Offline

In SCSI offline mode, a D424 is configured as a single MO drive; all internal functions are disabled. As a slave, it can be connected to any SCSI-based controller which supports the 2.6 GB ISO drive, like a master D424 or a suitable digital audio workstation.

yes   Select SCSI offline mode. D424 is operated from an external controller.

no   Select standard online operation.

53 FORMAT

Format Disk

The inserted disk will be high-level formatted. All data will be lost, the necessary DOS file structure is stored onto the disk. The process takes a few seconds.

The FORMAT DISK utility is used for initializing a disk and to make it ready for recording. After inserting a new, unformatted disk, the D424 automatically switches to this menu.

High-level formatting is also the fastest way to "clean" a recorded disk and create a new, empty disk.

cancel   return to the previous menu page

yes   starts the formatting process. A "processing" message will be shown during the formatting process, which takes only a few seconds.

54 CLEANUP

Cleanup Disk

The CLEANUP process removes all sound files which are not used by any of the sequences. It is performed to remove all temporary sound files which were created during a session. All sequences and the required audio files remain unchanged.

cancel   Return to the previous menu page

yes   Start the CLEANUP process. A "processing" message will be shown during the process.

The CLEANUP process can reassign space for recording. If a sequence has been recorded with a single recording session, a CLEANUP cannot have any effect – only complete sound files will be deleted.

55	**REN-SEQ**		Renumber Sequence

During editing, take numbers stay with the corresponding audio information, whereas indices always are renumbered to have an ascending order. At the end of a production, it might be helpful to reassign take numbers to the current sequence.

The utility renumbers the takes in ascending and contiguous order, beginning with "1" and according to the current sequence list.

	cancel	Return to the previous menu page
	yes	Start the RENUMBER process. A "processing" message will be shown during the process.

The take and index markers as well as the absolute time and timecode marks remain unchanged with respect to their audio position.

56	**CLR-IND**		Clear All Indices of sequence

If indices were used for editing purposes only, they can be removed at the end of a production. CLEAR INDICES removes all index markers of the current sequence.

	cancel	Return to the previous menu page
	yes	Start the CLEAR INDICES process. A "processing" message will be shown during the process.

57	**DEL-FILE**		Delete Sound file

Instead of CLEANUP (which removes all sound files which are no more in use), the DELETE SOUND FILE utility allows to delete single sound files.

Because of the non-destructive editing technique, it is the only way to delete single sound files; all other operations only affect the edit decision lists, i.e. sequence files.

Sound files are addressed by means of their take number in the sequence 0, which is a "table of contents" of the currently inserted disk.

seq-0; take ##	Enter the take number to be deleted from the "table of contents"
cancel	Return to the previous menu page
yes	Delete the selected sound file.

For a correct identification, create a new temporary sequence, insert all takes from sequence 0 with **[SEQ] [▶] [TARGET+INSERT] [SEQ]**, and look for the take to be deleted. Then select the DEL-FILE utility and delete the corresponding take of sequence 0.

4.10.8   Menu 6, COPY (Copy Utilities)

All COPY utilities will transfer information from the currently inserted disk to a destination drive connected to the SCSI bus.

target   Select the target drive to which the data will be copied.

start   Start the copy process.

```
      Work Copy

  seq 04   to Drv 1



  target    start
```

```
########

    processing ∕
```

The copy menu page lists the currently selected source data and the target drive

During the copy process, a bar in the top line reports on the progress

61   WORK

Work Copy

will make a copy of the current sequence onto the target MO disk. A new, identical sequence will be created, which includes all sequence information like take and index markers. All sound files used by the sequence will be transferred as well.

Work copy is helpful for making backup copies. The new sequence not only contains the currently used audio information, but also the complete audio sound files.

62   MASTER

Master Copy

will make a copy of the current sequence to the target MO disk, as an exact copy of the source sequence, including track and index information. The audio information will be merged into a new single sound file.

With MASTER COPY a new file is recorded. Some of the general recording parameters are considered. Please check for the correct format (e.g. word length)

When performing a MASTER COPY to or from a CD writer, some special rules apply:

Writing CDs   In addition to the audio files, the essential PQ data will be transferred as well. This includes take and index markers, UPC/EAN and ISRC codes. See menu 64 for more details.

Copying CDs to the D424   When selecting the CD writer as source drive and the D424 as target, single tracks (add mode) or complete CDs (toc mode) can be transferred in a new sequence on the MO disk. Each track is copied to a separate sound file, the sequence also includes the track numbers.

63   DISK

Disk Copy

will copy the complete disk. The target disk has to be empty. Reformat it if necessary (with setup utility 53).

64   XFER PAR   Transfer Parameters
                                     The following parameters (641...646) apply to MASTER COPY transfers.

641   SHAPING   Noise Shaping

```
┌─────────────────────────────┐
│      Noise Shaping          │
│                             │
│                             │
│    off          on          │
│     ⊕           ○           │
└─────────────────────────────┘
```

For making best use of high quality recordings in 20 or 24 bit resolution, it is possible to apply the noise shaping algorithm on audio information which is transferred to 16 bit media.
If set to OFF, audio data will be truncated to 16 bits.

642   UPC/EAN   UPC/EAN Code (CD transfer only)

```
┌─────────────────────────────┐
│      UPC/EAN Code           │
│                             │
│                             │
│    —————                    │
│                             │
└─────────────────────────────┘
```

Catalogue number for CDs (13 digits).
The indicated number is read from the inserted CD, modifications are only possible as long as no code was programmed yet (code is 0).

643   ISRC   ISR Code (CD transfer only)

```
┌─────────────────────────────┐
│        ISR Code             │
│  track                      │
│   03    —————               │
│                             │
└─────────────────────────────┘
```

International Standard Recording Code (5 alphanumeric and 7 numeric digits) including country and owner identification, recording year, and serial number.
There is one ISRC code for each take. If cleared, no ISRC code is recorded.

644   CD MODE   CD Copy Mode (CD transfer only)

```
┌─────────────────────────────┐
│       CD Copy Mode          │
│                             │
│                             │
│  toc   multi  add   fix     │
│   ○      ○     ⊕     ○       │
└─────────────────────────────┘
```

TOC   disc-at-once transfer
MULTI like TOC, multi-session expandable
ADD   adding current sequence without table of contents
FIX   CD finalizing process only (no data)

645 DELAY	CD Track Delay (CD transfer only)	

```
┌─────────────────────────┐
│    CD Track Delay       │
│                         │
│                         │
│   off        on         │
│    ○          ⊕         │
└─────────────────────────┘
```

If the CD track delay is switched on, the audio information of a new track is delayed 100 ms after the start of a new index 1. This allows consumer CD players to start up and de-mute in time.

646 INDEX 0   Index 0 Duration (CD transfer only)

```
┌─────────────────────────┐
│   Index 0 Duration      │
│                         │
│                         │
│  off      on            │
│   ⊕        ○   2 sec    │
└─────────────────────────┘
```

At the beginning of a new track, a pause with index 0 may be inserted, by defining a duration between 2...5 seconds.
When the duration is set to OFF, no pause is inserted.

65 FIXUP   Fixup Disk
The FIXUP utility creates the necessary files required for SADiE® compatibility. The D424 sequence file is replaced by an interchange file which can be interpreted by SADiE®. Remove the disk after the fix-up process.
If a SADiE® compatible disk is reinserted to the D424, all found interchange files will again be replaced by new, corresponding D424 sequence files.

4.10.9   Menu 7, SERVICE (Service Utilities)

71 FORMAT   Format Disk
New disks are preformatted from the manufacturer. This process is called "low-level formatting" and is usually not necessary anymore. It is only useful after having cleaned a disk which had numerous defective blocks. Low-level formatting will then recheck every bit on the disk on validity, which takes up to 40 minutes.

72 DATE   Date & Time
The entered date and time will be stored to a battery-buffered clock circuit. All recorded files will be marked with their origin or modification dates.
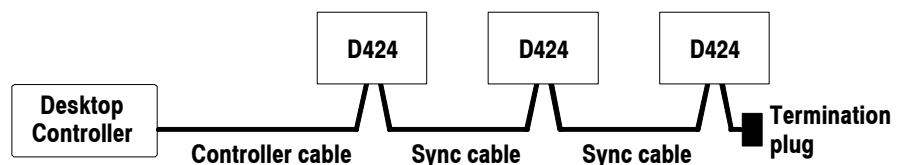
4.11 Desktop Controller

The Desktop Controller is an ergonomic alternative to the D424's standard front panel. It can be placed on a desk or a mixing console, and has a standard size to be built into a console. See fold-out page, section 2. In addition to the new design and the full front panel functionality, it provides some operation enhancements and is capable of controlling up to three recorders.

4.11.1   Configuration

The controller is connected to the master unit with a single controller cable, which includes the power supply as well as an audio monitoring signal for the headphones output (both hard-wired to the master unit) as well as the communication lines.

Note: The headphones output can monitor the audio signal of the first unit only.

Two additional units can be connected in a daisy-chain configuration with two additional sync cables; the last one must be equipped with a termination connector.

Each recorder connected to the Desktop Controller has its own unique address, which can be assigned with setup menu 15.

4.11.2   Operation

Selecting a Recorder:

As long as no recorder is selected, the controller is in idle mode, showing a "not assigned" message. All connected recorders run locally.

The Controller can address one recorder at a time by selecting the corresponding key **[UNIT1]**, **[UNIT2]**, or **[UNIT3]**. The selected recorder will switch to remote mode and show "** serial remote **", the Controller will load the current device data and be ready for operation

A remote connection is cancelled by deselecting the active unit (pressing the same **[UNITx]** key again) or by selecting another one.

Operation Enhancements:

Direct Access to Input Level

The setup menu for the calibration of the analog input attenuation can be accessed directly. Simply press and hold one of the new volume keys **[VOL1]** or **[VOL2]** and modify the parameters with the control wheel or with the numerical keyboard.

Set Cue Mode Sensitivity

With the **[SLOW]** key near the control wheel, the sensitivity of the cue operation can be adapted. In SLOW mode, the same wheel movement causes only a third of the standard distance.

Improved Key Assignment

The INSTANT LOCK function is assigned to a separate key.

The **[LOC]** key is part of the main transport section with large pushbuttons. It is closer to the main destination keys (**[IN]**, **[OUT]**, **[0...9]**).

The **[TAKE FORMAT]** and **[TIME FORMAT]** keys are now separate and no longer shared with the cursor functions.
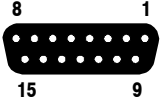
4.12 Parallel Port and Fader Start Operation

A parallel remote port is provided for basic transport control and status indication, a fader start circuit, and power supply voltages for external circuits.

The port is always active. Therefore, a parallel controller may be operated simultaneously with the front panel or a serial controller.

4.12.1 Specifications

Connector: D-type, 15 pin female

Pin Assignment:

Pin	Signal	Function
1	B_TAKE	Take pulse
2	B_INDEX	Index pulse
3	B_PLAY	Play tally
4	S_STOP	Stop command
5	S_PLAY	Play command
6	S_PLOC	Ploc command
7	FADER1	Fader start input 1
8	GND	Ground
9	B_STOP	Stop tally
10	B_READY	D424 ready
11	VCC	Supply voltage, switchable 5/24 V
12	S_PREV	Previous command
13	S_NEXT	Next command
14	FADER2	Fader start input 2
15	KEY	Key

(Connector diagram: pins 8–1 top row, 15–9 bottom row)

4.12.2 Signal Description

Signal	Description
VCC	Supply voltage (5 V_{DC}, may be switched to 24 V_{DC})
GND	Signal ground
S_STOP	Stop command
S_PLAY	Play command
S_PLOC	PlayLoc command (locate to the last play position)
S_PREV	Previous command (skip to the previous take or index marker)
S_NEXT	Next command (skip to the next take or index marker)
B_INDEX	Indicates new index marker. A pulse signal is generated when an index marker is passed in play mode.
B_TAKE	Indicates new take marker. A pulse signal is generated when a take marker is passed in play mode.
B_STOP	Stop tally, active when D424 is in Stop mode
B_PLAY	Play tally, active when D424 is in Play mode
B_READY	Fader Ready status, D424 is ready for fader start
FADER1, FADER2	Fader start contact, see following paragraph
All inputs are opto-coupler inputs, negative-edge triggered. Use a switch or an open collector to signal ground as a driver.	
All outputs are open-collector outputs. A static signal is active low, a pulse signal is a negative pulse with active leading edge.	

4.12.3 Fader Start

The D424 provides an opto-coupler input (with internal bridge rectifier and 20 mA current sink) for fader start operation.
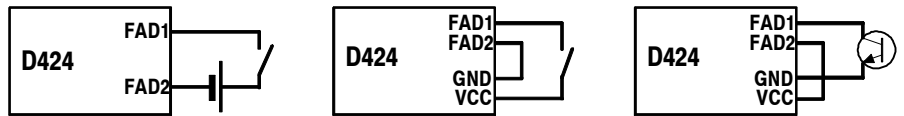
Fader Start Contact The fader start input is activated by applying a voltage of 5...24 VDC. Connect either an external voltage source (left), use the internal supply voltage (center), or pull to ground with a switch or an open collector (right).

Fader Operation The following conditions are necessary to trigger a fader start:
- Fader start operation is enabled with setup menu 45.
- The D424 is ready for playback, i.e. a disk with a playable sequence is inserted.
  If the above conditions are met, the fader ready signal (GPI pin10) is active, indicating that fader start signals will be accepted.

Every transition of the fader start signal from inactive to active (applying a voltage or closing the contact) will generate a PLAY command; each transition from active to inactive (release the contact or removing the voltage) will cause a STOP.

During fader play operation, the local keyboard is disabled. The D424 will stop at the end of a sequence, or at the end of a take with activated AutoStop function.

4.13 Serial Remote Operation

The serial remote control specification for the D424 is intended for applications where the D424 is controlled by equipment using the SONY RS-422 standard. The D424 provides a basic subset of the complete functionality.
In addition to the standard commands, an extension was made to allow addressing of takes and indices instead of timecode and tape counter parameters only.

4.13.1 Command List

Please refer to the appendix (chapter 6) for more details.

5 TROUBLESHOOTING

5.1 Error Messages

Operation and configuration errors:	Problem:	Solution:
"CD not suitable"	Inserted disc cannot be used for selected transfer	Insert empty CD-R for TOC transfer, or not yet finalized CD-R for ADD transfer
"Check take distance"	CD transfer tried with at least 1 take below 4 s audio	Modify corresponding take to more than 4 s
"Clk.RefDk DiskH" "Clk.RefDk DiskHD" "Clk.RefHk DiskD" "Clk.RefHk DiskDD"	Format of external reference signal (Clk.Ref) does not correspond to sampling rate (Disk) H = 48, HD = 48drop, D = 44.1, DD = 44.056	Select correct configuration
"Cmd not allowed"	Command could not be accepted temporarily	Some system utilities and configuration settings disabled in play and recording modes, stop D424 first
"Disk not empty"	When trying to do DISK COPY, target disk was found not empty	Reformat target disk before doing a DISK COPY
"Disk performance"	1.2/1.3 GB disk not capable of performing insert recording with 29/24 bit resolution	Select 16 bit resolution or use 2.3/2.6 GB Disk
"Disk write protected"	Disk protected with "write protect" tab	Move tab to "rec enable" position
"Drive is busy"	SCSI operation failed because corresponding device is in use	Stop D424 before switching SCSI devices
"Drive not mounted"	D741 CD drive not ready for transfer	• Insert appropriate CD-R • Check for correct SCSI wiring
"Drive not supported"	SCSI drive has been connected to a D424 currently not supported	Remove SCSI device
"Editing in fade area"	Editing in fade area not allowed	Move edit points, or modify previously made edit that generates particular fade area
"Emphasis mismatch"	Attempt to add a take with an emphasis status different from the previously recorded sequence	All takes of a sequence should be recorded with the same emphasis status.
"Invalid edit points"	Edit points IN and OUT beyond the sequence limits, or IN > OUT	Set correct edit points
"Invalid rec points"	Edit points IN and OUT for AutoRecord mode beyond the sequence limits, or IN > OUT	Set correct edit points
"ISRC error"	ISRC entry not complete, or corresponding take information corrupted	Check data
"Last rec nr reached"	Attempt to record more than 99 sound files	Try to remove unused audio files with a Cleanup
"Low diskcopy space"	Current sequence (TOC mode) or take (ADD) longer than available space on CD-R	Adjust sequence length to disc, or use new disc
"Max tk/Ix nr reached"	Attempt to create take or index number greater than maximum (99)	Remove old unnecessary markers and renumber sequence
"Mismatch TC format"	Timecode format at TC input not corresponding to internal TC format	Select correct TC format
"No record space left"	No space left for new recording session	Try to remove unused audio files with CLEANUP
"Nothing to UNDO"	Last edit process cannot be undone, because of: • Sequence processes since the last edit • Not in edit mode	• - • Switch to edit mode with SOURCE/TARGET
"One Smplrate on disk"	Attempt to switch sampling rate within recorded disk	Only one sampling rate allowed per disk side – reformat disk to change sampling rate
"Reg val out of range"	Locate was tried with corresponding register contents beyond current sequence range	Modify register
"Smplrate not 44.1kHz"	CD transfer was tried, but source sequence has not 44.1 kHz sampling rate	CD transfers only possible with 44.1 kHz sampling rate
"UPC error"	UPC entry invalid, or inserted CD-R already has valid UPC code	Check data or replace disc
"Wrong copy params"	Copy parameter is not valid for current copy configuration	Check copy target and parameters
"Wrong SCSI id select"	Copy process cannot be performed with currently selected target drive (e.g. work copy to CD-R)	Check copy target and parameters

Operation and configuration errors (cont.):	Problem:	Solution:
"XFadetime too long"	Two fade areas overlapping	Reduce cross-fade time
"Sample slip"	Digital audio input not synchronous with system clock	Check synchronization of external source with D424

Hardware errors:	Problem:	Solution:
"0A: Restart device" "0D: Restart device" "6E: Restart device" "7F: Restart device"	Fatal internal errors	Switch off system and retry Contact dealer
"BD: Restart system"	Currently selected drive reporting fatal HW error	Switch off system and retry Replace drive if necessary
"C5: Restart device"	General SCSI error encountered	Switch off system Check SCSI cabling and retry
"D0: Restart device"	CD transfer failed due to D741 initialization error	Switch off system and retry
"D1: Restart device"	D741 timeout occurred after data transfer or after CD finalizing process	Switch off system and restart; D741 should then be able to read CD
"RTC battery is low"	Battery voltage of parameter RAM low, default parameters loaded	Check parameters; if error occurs again, contact dealer for battery replacement

Medium errors:	Problem:	Solution:
"78: Restart device"	CD transfer failed (write error or manual interrupt)	Restart system, try with new CD-R
"8A: Restart device" "Out of realtime"	Disk-related SCSI error encountered during transfer	• Check disk for defective blocks • Save data to external device as soon as possible, clean and low-level format the disk
"BC: Low format disk"	MO drive reports medium error	Switch off system, retry; save data to external device ASAP, clean and low-level format the disk; if errors remain after formatting, replace disk
"BE: Critical medium"	Information on current disk incorrect, had to be repaired, or SCSI bus is not connected or not correctly terminated	see above
"Corrupt record pool"	Incorrect system files found	Switch off system, retry; save data to external device ASAP, clean and low-level format the disk
"Disk corrupted"	Incorrect application files found	see above
"Last record failed"	Temporary record file found to be incorrect when trying to create corresponding system entries	Contact dealer for trying to repair the disk on system level
Warning: Defect blocks"	Inserted disk already has a considerable number of defective blocks	Do not start new, important sessions with such disks; if the number is increasing rapidly, clean the disk and try to safe the data as soon as possible; refer to chapter 1.2.4 for more details

5.2   Modifying the D424 SCSI Address

If connecting several D424 MO recorders with a SCSI cable, the address of additional units has to be adapted.

SCSI address	Pin 1	Pin 2	Pin 3
0	n.a.	n.a.	n.a.
1			•
2		•	
3		•	•
4	•		
5	•		•
6	•	•	
SCSI address setting for 2.6 GB ISO drive; • = jumper inserted			

For connecting two units, change the address of the second unit from the default value 1 to 4. For that purpose, simply move the address jumper at the rear of the drive from position 3 to position 1, as shown below.
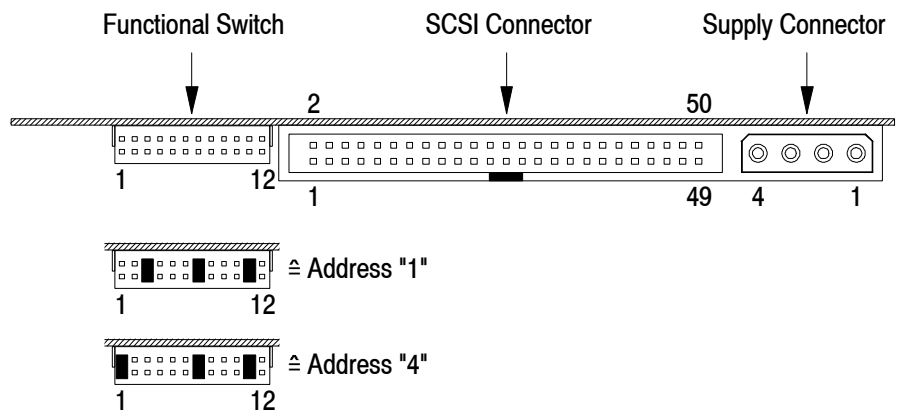
This modification may be performed by qualified personnel only. Please consider the safety and EMC section at the beginning of the operation manual.

1. Disconnect the unit from the mains supply, remove the top cover.
2. Set the address with the jumper(s) on the "functional switch" at the rear side of the drive.
3. Re-install the cover and reconnect the unit to the mains supply.

6   APPENDIX

6.1   Serial Remote Protocol

6.1.1   RS422 9-pin Protocol (Sony-Compatible)

The following remote control specification for the D424 is intended for applications where basic functions compatible with the "Sony 9-pin standard" are required. It provides a subset of the complete D424 functionality.

In addition to the standard commands, an extension was made to allow addressing of takes and indices instead of timecode and tape counter parameters only.

6.1.2   Communication Format

Communication between a controlling device (controller) and the D424 is established by following these rules:

All communication is initiated by the controller sending a command message. The D424 will respond with a message containing the requested data or an acknowledgement.

- The D424 responds within 9 ms after having received the last byte.
- The interval between two command bytes within a message should not exceed 10 ms.
- If no data were requested, the D424 simply gives an ACK (acknowledged) reply message.
- A data reply message is sent after receiving a data request command.
- If a transmission error is detected, or if an unknown command is received, the D424 will respond with a "not acknowledged" message (NAK + ERROR DATA)
- If a NAK command (indicating a transmission error) is received during sending a message, the command transmission should be resumed after a pause of 10 ms.
- If no response is detected within 10 ms after sending a complete command message, the communication is considered to be faulty.
- The controller should not send new messages before having received a response from the D424.

6.1.3   Hardware Layer

- EIA RS422A
- Data rate 38.4 kBaud
- Full duplex communication
- Bit-serial asynchronous data transmission
- Data format:
  1 start bit (logic "0" = SPACE)
  8 data bits
  1 parity bit (odd, number of "1" in D0...D7 and parity is odd)
  1 stop bit (logic "1" = MARK)

	LSB							MSB		
start bit	D0	D1	D2	D3	D4	D5	D6	D7	parity	stop bit

Connector: D-type, 9 pin female

D424	Pin	Controlling device
Frame ground	1	Frame ground
Transmit A	2	Receive A
Receive B	3	Transmit B
Receive common	4	Transmit common
+24 V	5	-
Transmit common	6	Receive common
Transmit B	7	Receive B
Receive A	8	Transmit A
Frame ground	9	Frame ground
Logic "0" (SPACE) if signal B < A, logic "1" (MARK) if signal B > A		

6.1.4   Messages

The structure of a command or a response message is as follows:

Byte 1		Byte 2	Byte 3	...	Byte n+2	Byte n+3
CMD1	N	CMD2	DATA 1	...	DATA n	CHKS

Byte 1   **Command byte 1 (CMD 1)**
The upper 4 bits of byte 1 indicate the command group and the communication direction.

From controller to D424:
- 0: System control command
- 2: Transport command
- 4: Preset/select command
- 6: Data request

From D424 to controller:
- 1: System control response (for type 0/2/4 commands)
- 7: Data response

Data count (N)
The lower 4 bits of byte 1 is the number of data bytes between CMD 2 and CHKS (0...15).

Byte 2   **Command byte 2 (CMD 2)**
The second command byte specifies a particular command (see command list)

Byte 3...   **Data bytes (DATA 1...DATA n)**
Up to 15 data bytes may be added to a command, indicated by the data count in byte 1.

Byte n+3   **Checksum byte (CHKS)**
The checksum byte is calculated by summing up all bytes before the checksum byte (max. 17 bytes) and taking the least significant byte of the result.

6.1.5   Command List

Command from controller			Comment	Response D424		
	CMD 1/2				CMD 1/2	Data
		Data				
			NAK response	11	12	error
STOP	20	00	--		10	01	--
PLAY	20	01	--		10	01	--
RECORD	20	02	--		10	01	--
FFWD	20	10	--	shuttle at max. speed	10	01	--
REW	20	20	--	shuttle at max. speed	10	01	--
SHTL FWD	21	13	speed		10	01	--
SHTL REW	21	23	speed		10	01	--
CUE UP WITH DATA	24	31	time	locate	10	01	--
CHASE	21	37	00	timecode chase	10	01	--
SELECT EE ON	20	63	--	select input	10	01	--
EDIT ON	20	64	--	record punch-in	10	01	--
EDIT OFF	20	65	--	record punch-out	10	01	--
EDIT PRESET	41	30	emode	rec mode & channels	10	01	--
TIMER MODE SELECT	41	36	tmode	set timer mode	10	01	--
CHASE OFFSET PRESET	41	78	time	set chase offset	10	01	--
TIMER MODE SENSE	60	36	--	read current timer position	71	36	tmode
CURRENT TIME SENSE	61	0C	tsource	read current position	74	0x	time
STATUS SENSE	61	20	status address	read current status	7x	20	status

Formats:

speed   1-byte speed format, with speed $= 10^{(N/32 - 2)}$; e.g.:

data (hex)	0	20	2A	36	40	46	4A
speed	0	0.1	0.2	0.5	1.0	1.5	2.0

time   Time parameter according to selected timer mode or requested format. 4 bytes, BCD coded (byte 1 = LSB ... byte 4 = MSB):

data 1		data 2		data 3		data 4	
frame 10	frame 1	sec 10	sec 1	min 10	min 1	hour 10	hour 1

Timecode or absolute time: frames, seconds, minutes, hours.
Timer 2 (track, indices): index, track, don't care, don't care.

emode   Recording mode and channel ready select (see EDIT PRESET).

tmode   Timer mode: TC, absolute or track/index (see TIMER MODE SELECT).

tsource   Time source: TC, absolute or track/index (see CURRENT TIME SENSE).

error   Error type, returned with NAK message.

bit 7							bit 0
timeout	framing	overrun	parity	-	check-sum	-	undefined command

6.1.6   Command Messages

STOP	STOP command
PLAY	PLAY command
RECORD	REC command, corresponds to **[PLAY+REC]** key combination
FFWD	Fast forward, corresponds to shuttle forward with pre-selected speed (**[PLAY+NEXT]**)
REW	Fast rewind, corresponds to shuttle reverse with pre-selected speed (**[PLAY+PREV]**)
SHTL FWD	SHUTTLE FORWARD command
SHTL REV	SHUTTLE REVERSE command
CUE UP WITH DATA	LOC command, parameter format is pre-selected with TIMER MODE SELECT
CHASE	CHASE command
SELECT EE ON	All channels which were set to READY with an EDIT PRESET command will be switched to input. A subsequent EDIT OFF will switch them back.
EDIT ON	Corresponds to a RECORD punch-in command (**[REC+PLAY]**)
EDIT OFF	Corresponds to a RECORD punch-out command (**[PLAY]**)
EDIT PRESET	Presets the recording mode and the channel READY status.

bit 7   bit 0

-	insert	assemble	-	-	TC	A2	A1

insert, assemble: correspond to D424 recording mode
TC, A2, A1: are the D424 recording channels

TIMER MODE SELECT
TIMER MODE SENSE
	For setting and reading the timer mode. The selected format is used for the CUE UP command and other time position-related commands.
	timer mode: 0: timecode
	                      1: timer 1 (absolute time)
	                      2: timer 2 (track, markers)

CHASE OFFSET PRESET	Sets the nominal chase offset. Negative offsets can be defined with parameters >12 hours.
CURRENT TIME SENSE	The position may be reported as timecode value, either as absolute time, or in tracks-and-marker notation.

	Controller command	Device response
timecode	61 0C 01	74 04 time
timer 1 (abs.)	61 0C 04	74 00 time
timer 2 (tracks)	61 0C 08	74 01 time

STATUS SENSE   The device status is listed in an 8-byte field, each bit representing a status information. A status sense command requests a number of bytes from the field, starting at a specified offset.

Controller command: 61 20 xy

Device response: 7n 20 xy data i...data j

x (bit 4...7): First byte to report

y (bit 0...3): Number of bytes to be reported

Data	Bit
	7	6	5	4	3	2	1	0
0			no disk					local
1	standby		stop		rew	ff	rec	play
2	locked		shtl		var	dir	still	cued up
3								
4	sel EE			edit				cueing up
5	insert	assmbl					A2	A1
6								
7				chase				

no disk   "1" when disk is fully ejected

local   "1" when D424 is operated locally

standby   Set when D424 enters standby on mode

stop   Set when D424 enters stop mode

rew   Set when D424 enters rewind mode

ff   Set when D424 enters fast forward mode

rec   Set when D424 enters recording mode (ass/ins)

play   Set when D424 enters play mode

locked   "1" when D424 is correctly locked to sync source

shtl   Set when D424 enters shuttle mode

var   Set when D424 enters varispeed play mode

dir   Transport direction, "0" = forward, "1" = reverse. During STOP or STILL mode the direction before D424 stopped is indicated.

still   Is set in shuttle mode when the speed is 0.

cued up   Is set when a CUE UP command has been completed and reset when the position is changed again.

sel EE   Is set when one or more channel is switched to input (with EDIT PRESET and SELECT EE ON).

edit   Is set when the D424 enters an assemble or insert recording mode with the EDIT ON command.

cueing up   "1" during CUE UP mode

insert   "1" when recording mode is set to INSERT

assmbl   "1" when recording mode is set to ASSEMBLE

A2   "1" when channel 2 is set to READY

A1   "1" when channel 1 is set to READY

chase   Is set during chase mode

6.2 Drive Installation Instructions

6.2.1 MO Drive Kit 2.6 GB (ISO)

6.2.1.1 Settings

The following settings at the functional switch have to be checked at the rear of the drive:
Jumper 3 inserted (SCSI address 1; refer to section 5.2)
Jumper 7 inserted (force verify after write)
Jumper 11 inserted (termination on)

6.2.1.2 Installation

1. Disconnect the unit from the mains supply and remove the cover.
2. Remove the power cable and the SCSI ribbon cable from the rear side of the currently installed drive.
3. Disconnect the old drive by removing the fixing screws (2 at each side).
   On units with serial number below "1001" which were shipped with the 2.2 GB Pioneer drive, the two drive mounting brackets have to be replaced. The new brackets are part of the upgrade kit and allow the installation of a wide variety of drives.
4. The new ISO drive is mounted from the front of the D424, by sliding it through the front panel opening and attaching it with the 4 corresponding screws at the brackets.
5. Reconnect both power supply and SCSI ribbon cables to the ISO drive and reinstall the cover.
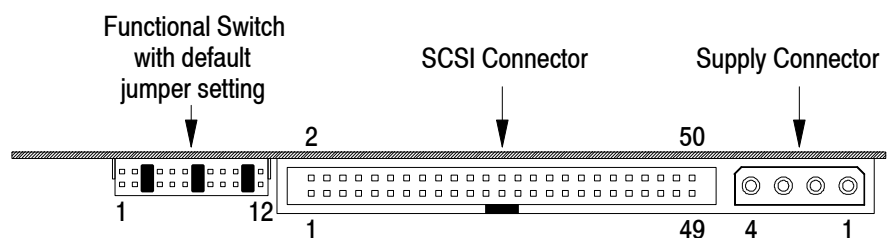
6.2.1.3 Accessories

The 2.6 GB ISO drive is capable of recording to and playback from the following ISO compatible disks (all disks available on request):

1.2 GB	512 bytes/sector
1.3 GB	1024 bytes/sector
2.3 GB	512 bytes/sector
2.6 GB	1024 bytes/sector

6.3 Hardware Configuration (Jumper and DIP Switch Settings)

6.3.1 Motherboard

1. Supply voltage on the parallel remote connector (pin11):		
24 V / max. 300 mA, if JP1 and JP 2 are linked; 5 V / max. 700 mA, if JP2 and JP3 are linked.		
2. Supply voltage on the Serial remote connector (pin9):		
24 V if JP4 and JP5 are linked n.c. if JP5 and JP6 are linked		
3. DIP switch (DS1)		
1	OFF	Spare
2	OFF	Spare
3	OFF	Spare
4	ON	Baud rate (off position used for factory tests only)

6.3.2 Core

The address for the Desktop Controller is normally set in the Setup menu. On units without a front panel operating surface this has to be done with DS1 (on from SW version 1.2).

The controller interface can be selected for operation with the Studer Desktop Controller or with a customer-specific remote control; for this purpose DIP switch No. 1 of DS1 is provided.

DS1:				
1	2	3	4	
				Controller port operation mode:
OFF	x	x	x	Operation w. Studer controller/31.25 kBaud
ON	x	x	x	Operation w. spec. controller/38.4 kBaud
				Controller address:
x	x	OFF	OFF	Selectable on front panel
x	x	OFF	ON	Address 1
x	x	ON	OFF	Address 2
x	x	ON	ON	Address 3

J401 and J403 are always inserted.

All remaining jumpers remain open. They are used for matching to the DP RAM size (J405 and J407), as programming connectors for IC 601/701 (P601...P610 and P701...P710), as a Debug connector for the DSP (IC302) (P301...310) and the processor (IC102) (P111...120), or as a monitoring interface (P101...P103).