Introducing the DMT interface

The Kurzweil **DMT interface** (known henceforth as the **DMTi**) is a versatile digital audio sample-rate and format convertor, which can synchronize the sample-rate clocks of up to four independent stereo signals. It can work with digital audio, bidirectionally, from Kurzweil K2500-series instruments, AES/EBU sources, S/PDIF sources using either coaxial or optical cables, and modular digital multitrack recorders such as the Alesis ADAT and TASCAM DA-88. It makes working with multiple digital audio formats simple.

What's In the Box

- The **DMTi** itself
- AC power cord
- 3-meter "KDS" interface cable for connecting the **DMTi** with a K2500. (A longer KDS interface cable—15 meters—is available from Kurzweil.)

*You should save the **DMTi**'s packaging materials, in case you ever have to ship it.*

Why Do I Need It?

Anyone who has tried to combine multiple digital audio signals while keeping them in the digital domain knows that this can be extremely difficult. Clicks, dropouts, speed changes, and other anomalies show up with regularity, often with no consistency, in the result.

The reason for this is that the AES/EBU digital audio standard (and its offshoot, the "consumer" or S/PDIF standard) has no provisions for externally clocking the samples—in other words, every digital audio signal carries its own timing information. This means that two signals from two different sources will have no common timing reference, so when you try to combine them, errors will occur that cause samples to be skipped or dropped, producing various unpleasant audible artifacts.

Since the modern audio studio uses digital audio from a variety of sources, including hard-disk audio systems, samplers, signal processors, mixers, DAT, CD, and digital multitrack tape decks, the problem has become acute. One common solution has been to convert all of the signals to analog before mixing them, and thus avoid the problem of conflicting sample rates altogether. While this is acceptable in some situations, it obviously defeats at least some of the purpose of using digital audio in the first place.

However, if the sample-rate clocks of these sources can be coordinated so that they are in perfect synchronization with each other while staying in the digital domain, these problems can be avoided without resorting to analog solutions.

What Else Do I Need?

To connect your *DMTi* to a K2500 Series instrument, the K2500 will have to be equipped with a KDS Output Option or KDFX Option. These options require the K2500 to be running operating system version 2.3 or higher.

For hooking the *DMTi* up to an ADAT or DA-88, you'll also need the appropriate interface option installed into the *DMTi*. Contact your Young Chang/ Kurzweil dealer if you have any questions.
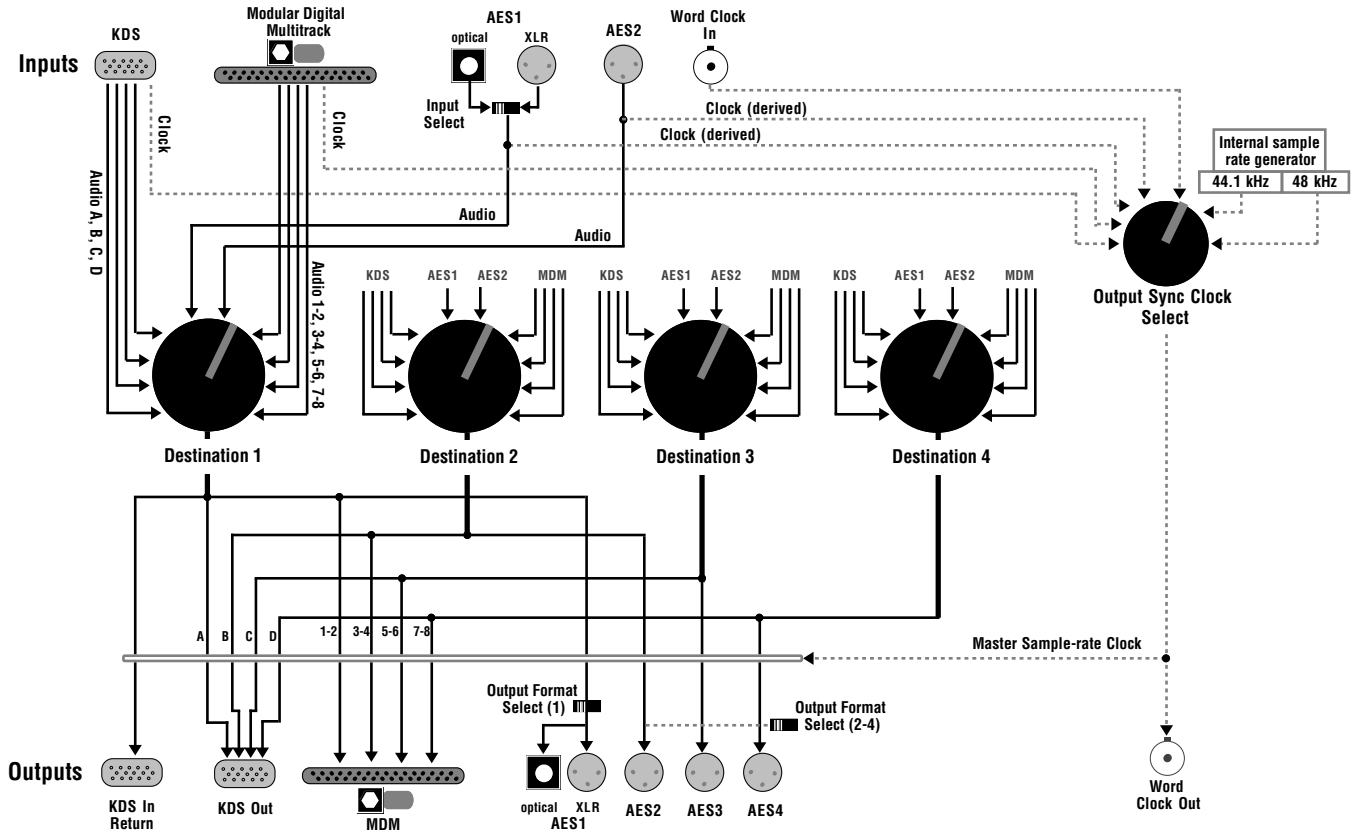
What Does It Do?

The principle behind the *DMTi* is relatively simple, although it is being implemented with some very sophisticated technology. There are four sets of digital inputs, in three different formats, and four sets of digital outputs, also in three formats. Each input and output comprises two channels of audio. The signal on each input is converted, and then routed to any one (or more) of the outputs.

The conversion process can change the sample-rate clock, either to a sample rate determined by one of the *other* incoming audio signals; to the rate set by incoming word clock; or to a rate set by the *DMTi*'s internal clock. Whichever sample-rate clock is chosen serves as the master for the entire unit—therefore, all four of the digital signals appear at the outputs in perfect synchronization with each other.

The conversion process can also change the signal format, for example, from AES/EBU to DA-88 (TDIF-1) or ADAT, or from the K2500's proprietary "KDS" format to S/PDIF, or from any supported format to any other. Although the sample-rate *clocks* are all linked together, the *format* conversions of the various audio streams can be independent of each other, and in fact multiple types of format conversions can take place simultaneously.

The operation of the *DMTi* is very straightforward: there are no menus, hidden functions, factory settings, or other obscure features to worry about. What you see is what you get. However, the uses to which you can put the device are quite varied—you might think of it as the "Swiss Army knife" of digital audio tools.
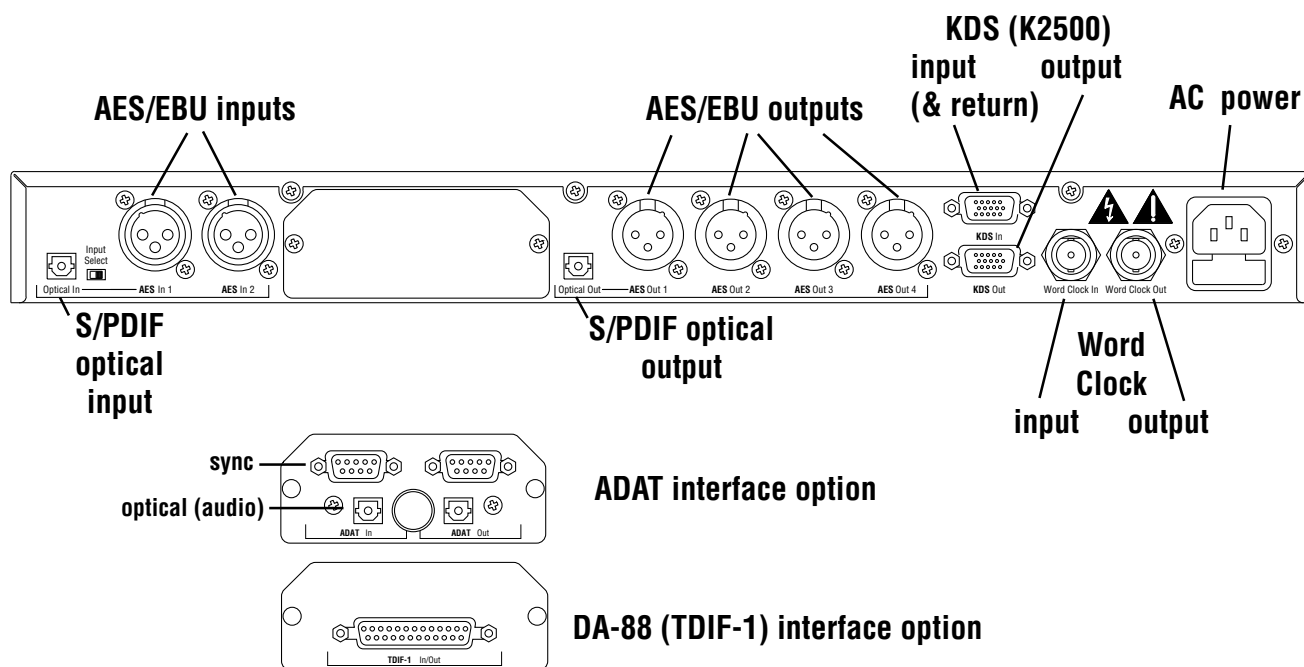
Inputs

KDS

Modular Digital Multitrack

AES1 — optical — XLR

AES2

Word Clock In

Input Select

Clock (derived)

Clock (derived)

Internal sample rate generator — 44.1 kHz — 48 kHz

Audio

Audio

Clock

Clock

Audio A, B, C, D

Audio 1-2, 3-4, 5-6, 7-8

KDS AES1 AES2 MDM   KDS AES1 AES2 MDM   KDS AES1 AES2 MDM

Destination 1   Destination 2   Destination 3   Destination 4

Output Sync Clock Select

A B C D   1-2 3-4 5-6 7-8

Master Sample-rate Clock

Output Format Select (1)

Output Format Select (2-4)

Outputs

KDS In Return   KDS Out   MDM   optical XLR AES1   AES2   AES3   AES4

Word Clock Out

DMTi signal flow

About This Manual

This manual starts with a description of all features and controls. After that, we will discuss specific applications of the *DMTi* in a variety of scenarios. Read the first two scenarios, even if they don't apply to you: they will give you a good overall idea of how to use the *DMTi*, and will make the other scenarios easier to understand.

We don't really expect you to read the entire manual through—each scenario is meant to stand on its own. But besides the first two, it might be helpful to take the time to read over all of the scenarios that *might* be of interest to you; the more you understand about how the *DMTi* can be used, the better you will be able to form your own ideas about how to get the best out of it.

AES/EBU inputs   AES/EBU outputs   KDS (K2500) input   output (& return)   AC power

S/PDIF optical input

S/PDIF optical output

Word Clock input   output

sync

optical (audio)

ADAT interface option

DA-88 (TDIF-1) interface option

DMTi rear panel

Inputs

AES1 and **AES2**. These two AES/EBU inputs each accept a stereo signal. These are the "professional" type of AES/EBU connectors, as described by the AES Type 3 specification, which use XLR connectors. These inputs can also accept "consumer" type AES/EBU or Sony/Philips Digital Interface Format (S/PDIF) signals, but external adapters must be used. These adapters are described on Page 10.

The **AES1** input can alternatively be accessed with an optical connector, for S/PDIF signals in that format. A switch on the rear panel determines which **AES1** input will be active.

KDS In. This is an input for the eight-channel digital output bus (known as the "Kurzweil Digital Stream") from a Kurzweil 2500-series instrument which is equipped with a KDS digital input/output or KDFX digital effects option. It uses a 15-pin connector and a 3-meter custom cable, included with the *DMTi*. (A 15-meter version of the cable is available from Kurzweil dealers.) The sampling rate of the KDS bus is 48 kHz.

The **KDS In** also includes a two-channel *output* to the K2500, called the "Return", which allows signals being processed through the *DMTi* to be sampled by the K2500, if the K2500 is equipped with the Sampling option. (To use this feature, set the following parameters on the K2500's Sample Page: *Input* to "Digital" and *Src* to "Rtn".)

MDM. The *DMTi* can be interfaced with a **M**odular **D**igital **M**ultitrack tape deck using either of two options:

The ADAT option, for use with Alesis, Fostex, and Panasonic decks, uses an optical connnector for audio and a DB-9 connector for synchronization. The pair labelled **In** is for signals from an ADAT. (Be careful not to connect the ADAT option's optical connectors with an AES or S/PDIF optical input or output—you won't damage anything, but the formats are not compatible.)
It is possible to use just the optical cable when connecting an ADAT to the *DMTi*, but it is not advised—using the sync cable is an easy way to avoid potential synchronization problems, and it can't do any harm. Some other devices that use the ADAT interface, such as mixers, do not use the sync cable.

The DA-88 (or "TDIF-1") option, for use with TASCAM and Sony decks, uses a single 25-pin connector which handles both input and output signals.

Word clock. This input accepts sample-rate or word clock from an external source such as a digital audio system (with separate word clock signal) or a synchronizer. The word clock signal is a square wave, with a frequency of between 38 kHz and 53 kHz, at a nominal level of 5 volts peak-to-peak (minimum 200 mV). The signal is carried on 75Ω unbalanced coaxial cable, terminated with a BNC connector.

Outputs

AES1, AES2, AES3, and **AES4.** These four outputs each carry a stereo signal. Like the **AES** inputs, these are the "professional" type of AES/EBU connectors, using XLR connectors, and they can also be used to drive "Consumer"-type AES/EBU or Sony/Philips Digital Interface Format (S/PDIF) inputs on other devices, with proper external adapters (see Page 10).

The **AES1** output is also sent to an optical connector, for use with compatible AES or S/PDIF devices.

Output switches on the front panel determine whether the output signals are in "Pro" or "Consumer" format. The difference involves certain channel status information. (There are also differences in level and impedance, but this switch does not deal with them.) One switch controls output **1**, while the other controls outputs **2**, **3**, and **4**.

KDS Out. This output is designed for linking two *DMTi*s together, or linking the *DMTi* with other KDS-compatible equipment, including any K2500 Series instrument equipped with a KDFX board. Without the KDFX board, those instruments have only a single return input pair, and that pair is accessed, as described on Page 4, on the **KDS In** jack. The **KDS Out** jack, unlike the **KDS In**, is unidirectional, and carries only the eight output channels being generated by the *DMTi*.

KDS In. As described on Page 4, the **KDS In** includes a two-channel *output* to the K2500, known as the "Return", which allows signals being processed through the *DMTi* to be sampled with the K2500.

MDM. If you have the ADAT option, a pair of jacks, one optical and one DB-9, labelled **Out** serves as the output to an ADAT-format digital multitrack recorder or mixer. (Do not confuse the ADAT optical connector with the AES optical connectors.) On the DA-88 (TDIF-1) option, the DB-25 connector serves as both input and output.

Note: All of the audio outputs are in parallel, and all are "live" all the time. Therefore, a signal that is routed to the **AES1** output will also appear at the first two channels of the **MDM** output ("**1-2**"), the first pair of the **KDS Out** jack ("**A**"), *and* the "return" to the K2500 located on the **KDS In** jack. You can monitor signals as they go through the *DMTi* by listening to one of the unused outputs through an appropriate device such as a DAT.

The **Word Clock Out**put carries a word clock signal, the source of which is determined by the **Output Sync Clock Select** switch. This signal is either derived from an incoming digital audio signal; is generated by the *DMTi*; or is an echo of the signal appearing at the **Word Clock In**put. If the switch is set to an input at which there is no signal, then either no signal or an unstable, unpredictable signal will appear at this output. Like the input, this output uses a 75Ω unbalanced coaxial cable with a BNC connector.
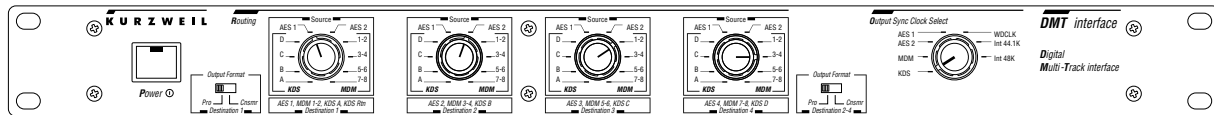
DMTi front panel

Controls and switches

The **Power** switch has an integral green pilot light.

The **Routing** section consists of the four **Destination** knobs, which set up the routing of the signals. Each knob is associated with a particular *output* pair—it determines which input pair will be routed to the knob's assigned output.

The first knob selects the input source for the first pair of outputs: **AES1** (both XLR and optical), **MDM "1-2"**, **KDS Out "A"**, and the "return" pair on the **KDS In**. Since the various outputs are in parallel, the setting for this knob affects all of its associated outputs simultaneously.

The second knob sets the input source for the second pair of outputs:
AES2, **MDM** "**3-4**", and **KDS** "**B**".

The third knob sets the input source for the third pair of outputs:
AES3, **MDM** "**5-6**", and **KDS** "**C**".

The fourth knob sets the input source for the fourth pair of outputs:
AES4, **MDM** "**7-8**", and **KDS** "**D**".

The choices of inputs for all of the knobs are the same:
AES1
AES2
MDM "**1-2**", "**3-4**", "**5-6**", and "**7-8**"
and **KDS** "**A**", "**B**", "**C**", and "**D**".

The **Output Sync Clock Select** control (which we'll refer to as "**Clock Select**") determines the source of sample-rate synchronization for all of the digital outputs. Whichever source is selected will be the master clock for all of the signals at all of the outputs. You can select from one of the audio inputs (**AES1**, **AES2**, **MDM**, or **KDS**), or the **Word Clock** ("**WDCLK**") input, or you can use the *DMTi*'s highly-stable internal ("**Int**") clock source, which can operate at either **44.1K** or **48K** Hz. The setting of this switch is extremely important: if you select an input at which there is no signal present, the outputs will produce unstable or unusable signals, or shut off completely.

There is a special way to use this switch when the *DMTi* is part of a system that contains multiple ADAT-compatible tape decks. See Appendix A for details.

The **Input Format** switch on the rear panel determines which of the two **AES1** inputs will be active: the XLR input or the optical input. The switch does not change the *signal format* of the input: the XLR input can be used either with "Professional" or "Consumer" (S/PDIF) sources, while the optical input expects a "Consumer" signal.

The **Output Format** switches on the front panel determine whether the signals leaving the AES/EBU outputs are in "**Pro**" or "**Cnsmr**" format. The difference has to do with certain channel status information. One switch controls output **1** and the other controls outputs **2**, **3**, and **4**. These switches do *not* turn on and off the outputs: all outputs are always active. There are also differences in level and impedance between the different digital formats, and it is possible that an S/PDIF input could be damaged if it is fed with an AES/EBU signal. This switch does not deal with those differences—use the attenuating adapter described on Page 10 if this is an issue.

As a general rule, if the device you are sending audio to has an XLR digital input, the corresponding **Output Format** switch should be set to "**Pro**". If the input is an optical or RCA connector, set the **Output Format** switch to "**Cnsmr**".
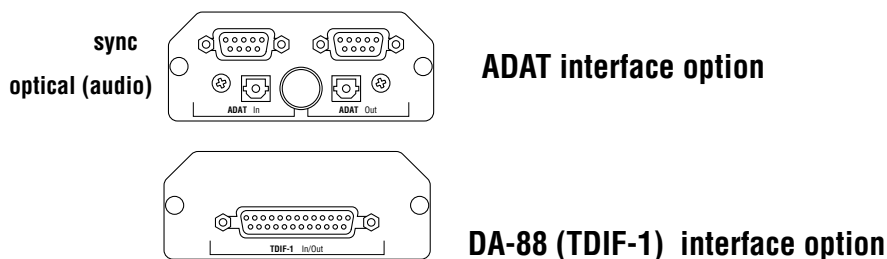
Cables and adapters

KDS

The *DMTi* ships with a three-meter cable for connecting it to the Kurzweil Digital Stream (KDS). This cable is used to link the *DMTi* with a Kurzweil K2500-series instrument (equipped with the KDS or KDFX option), and/or to link two *DMTi*s together. It is a proprietary 15-pin format. A 15-meter KDS cable is available from your Kurzweil dealer.

MDM

An interface for a modular digital multitrack tape recorder is available as an option for the *DMTi*. There are two models: one for use with ADAT-type decks, made by Alesis, Fostex, and Panasonic; and the other for use with DA-88 (or "TDIF") type decks made by TASCAM and Sony. Whichever option you choose comes with connectors that are the same as on the deck itself, so that connecting the *DMTi* to the deck is just like connecting a second deck to the tape deck. Consequently, the cable that is supplied with the deck for this purpose can be used with the *DMTi*: a 25-pin connector for the DA-88, and two optical connectors and two DB-9 sync connectors for ADATs. Note that although an ADAT optical cable is physically the same as an AES or S/PDIF optical cable, the two formats are not compatible: you won't do any damage if you connect one to the other, but you won't get any signal.


sync

optical (audio)

ADAT In   ADAT Out

ADAT interface option

TDIF-1   In/Out

DA-88 (TDIF-1) interface option

S/PDIF

The AES/EBU inputs and outputs can be used with S/PDIF digital audio signals (also known as "CP-340 Type II" and "AES Consumer" formats). S/PDIF signals use single-conductor shielded video cable, terminated in RCA (phono-type) jacks. (They can also use optical fibre cables.) There are differences between AES/EBU and S/PDIF involving signal level, line impedance, and channel status data. The circuits used at the *DMTi*'s digital inputs are sensitive and tolerant enough to accept either kind of signal.

You can easily make an adaptor to bring S/PDIF signals into the **DMTi**'s AES/EBU inputs. The shield of the RCA connector is wired to pins 1 and 3 of the XLR connector, and the center (hot) conductor of the RCA connector is wired to pin 2 of the XLR. Here's a diagram of such an adaptor:

From S/PDIF Out   **To AES In**
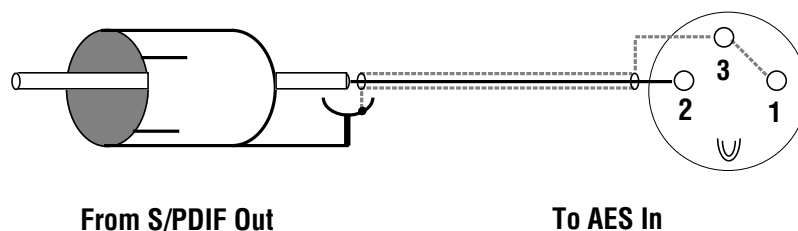
A similar adapter can be used to send AES/EBU signals from the **DMTi** to an S/PDIF device:

From AES Out

To S/PDIF In
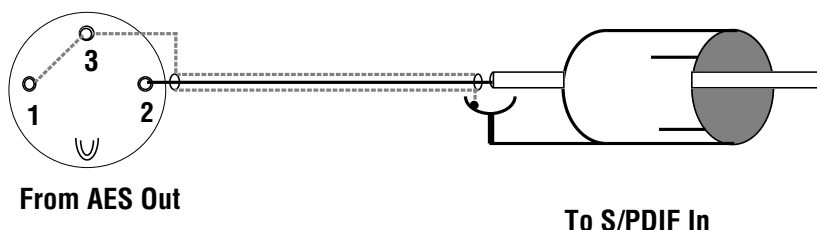
The signal at the AES/EBU outputs, however, is at the higher level required by AES/EBU devices, and it is possible, although unlikely, that the input on an S/PDIF device could be damaged if it is connected directly to one of these outputs. An attenuating adapter can avoid this problem. If you are in doubt, check with the manufacturer of the S/PDIF equipment to see if it can handle the elevated signal level. To make an attenuating adapter, insert an 82.5Ω resistor between pin 2 of the XLR connector and the center conductor of the coaxial cable, and connect a 750Ω resistor from pin 3 of the XLR connector to the center conductor of the coaxial cable:

750Ω
82.5Ω

From AES Out   **To S/PDIF In**
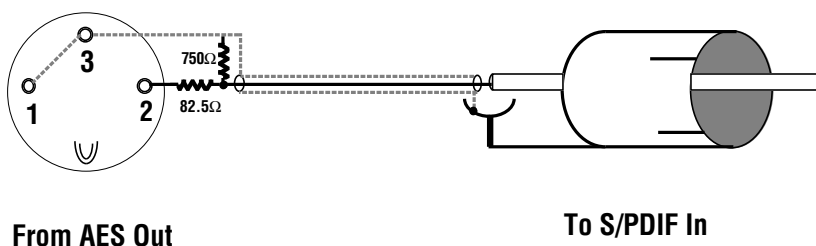
Generally speaking, when sending a digital audio signal to an S/PDIF device, the **Output Format** switch for that signal should be set to "**Cnsmr**". Also note that S/PDIF signals sometimes have trouble travelling long distances. Using high-quality video-compatible coaxial cable and making cable runs as short as possible will keep problems to a minimum.

Using the *DMTi*: Scenarios

The next 22 pages will deal with specific scenarios for using the *DMTi*. We have tried to cover as many applications as possible, but you may find others. Chances are, however, that you will find information relevant to your application in one or more of the scenarios presented here. Please read the first two scenarios even if their situation doesn't apply to you: you will find them useful in understanding how the *DMTi* works.

K2500 to Modular Digital Multitrack (DA-88/ADAT)

Application

This is one of the most useful applications of the *DMTi*. You can record from two to eight channels simultaneously from a Kurzweil K2500-series instrument directly to a modular digital multitrack recorder ("MDM") such as an Alesis ADAT or TASCAM DA-88, without leaving the digital domain. The *DMTi* provides the proper signal conversions and also provides proper sync for recording on the digital multitrack.

What you need

- The K2500 must be equipped with a KDS digital input/output or KDFX digital effects option.
- The *DMTi* must have an ADAT or DA-88 (TDIF-1) option, depending on which type of modular digital multitrack you are using.

Hookup

- Using the 3-meter KDS cable supplied with the *DMTi* (or the optional 15-meter KDS cable), connect the KDS Output on the K2500 to the KDS input on the *DMTi*.
- Connect the modular digital multitrack to the *DMTi* using the cable(s) provided with the recorder for connecting two decks together. DA-88-format decks use a single 25-pin "D" connector, while ADAT-format decks use one optical and one sync cable for input and a similar pair for output.
- If you want to use an external source of word clock as the sync master, connect that source to the *DMTi*'s **Word Clock In**put — however…
- You *must* use the multitrack recorder as the sync master if you are overdubbing tracks (see next page).
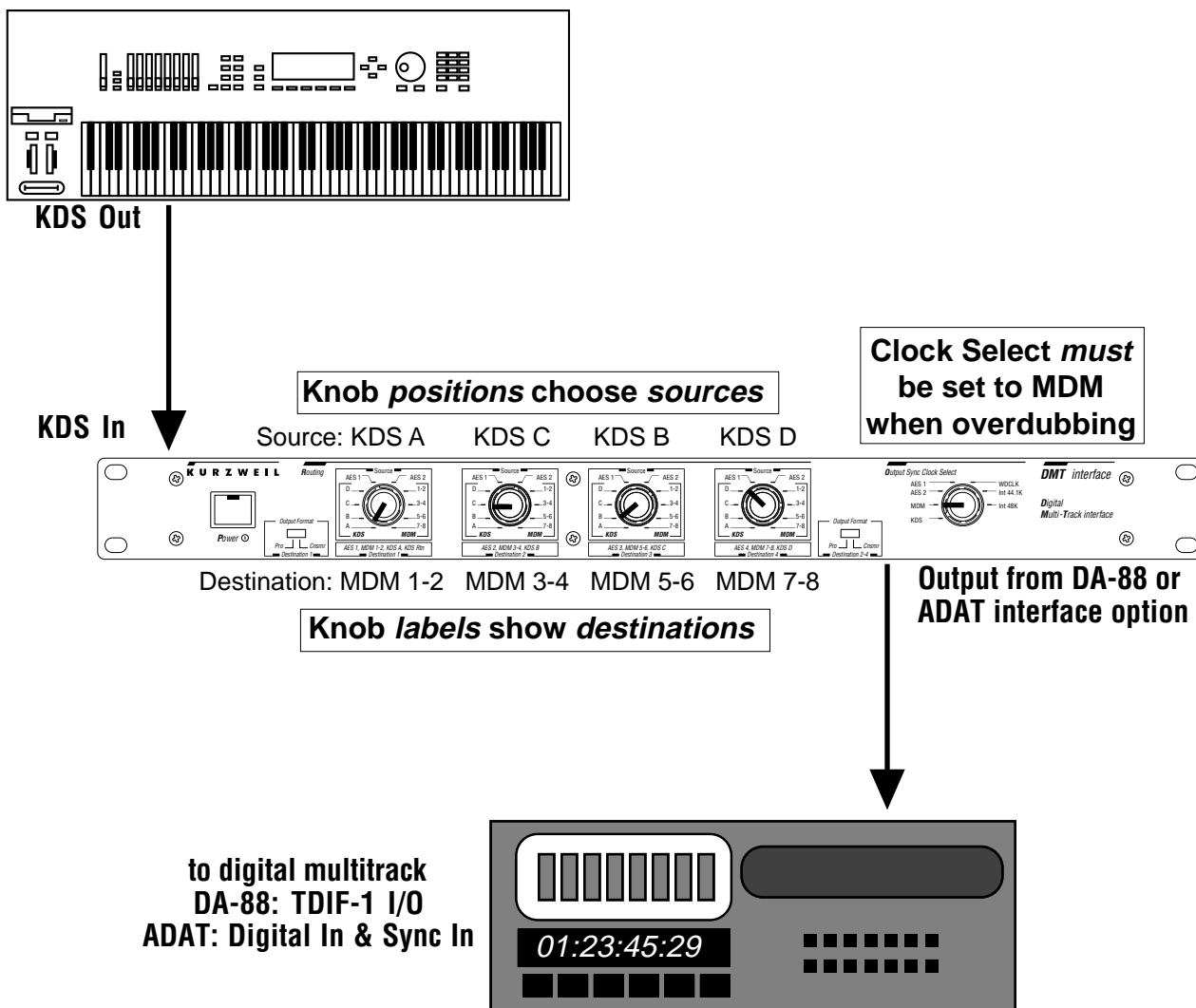
Settings

- Determine which MDM tracks you want to record to, and choose a source pair from the K2500 for each pair of MDM tracks. Set the **Destination** knob that is assigned to each output pair (going to the MDM) so that its input is the desired pair coming from the KDS. For example, if you want to record KDS pair A onto MDM tracks 1 and 2, set **Destination 1** (which selects the source for MDM tracks 1 and 2) to **KDS A**. If you want to record KDS pair B onto MDM tracks 5 and 6, set **Destination 3** (which selects the source for MDM tracks 5 and 6) to **KDS B**. Set the other **Destination** knobs accordingly.
- For your initial tracks, it is usually easiest to use the MDM as the sync master: set **Clock Select** to **MDM**. You may, however, set it to **KDS** (provided you are recording at 48 kHz—remember, the KDS bus always runs at 48 kHz), or one of the **Int** settings. Alternatively, if you are using an external clock master, you can set **Clock Select** to **WDCLK**. Note that any time you are not using the MDM as the clock master, you must make sure the multitrack tape deck is set to sync to an external clock signal.

When overdubbing to the MDM…

Modular Digital Multitrack decks cannot use different clock sources for recording and playback at the same time. Therefore, if you are recording tracks to a multitrack digital tape that *already* has one or more tracks recorded on it, then the MDM must be the sync master: set **Clock Select** to **MDM**. There is an exception to this rule: if you are using an external clock source, then *both* the *DMTi* and the MDM must be set up to slave to that source.

Special note for ADAT users:

If you are using multiple ADAT units, then one ADAT must act as sync master for all of the others, as well as for any *DMTi* that is feeding signals to any of the decks. The sync signal is carried through the system on the Alesis Sync cable. The *DMTi* can access that signal, provided a jumper on the ADAT option's circuit board is set correctly. See Appendix A for details.

KDS Out

KDS In

**Clock Select *must*
be set to MDM
when overdubbing**

Knob *positions* choose *sources*

Source: KDS A   KDS C   KDS B   KDS D

Destination: MDM 1-2   MDM 3-4   MDM 5-6   MDM 7-8

**Output from DA-88 or
ADAT interface option**

Knob *labels* show *destinations*

**to digital multitrack
DA-88: TDIF-1 I/O
ADAT: Digital In & Sync In**

01:23:45:29

Variation: Sending to a DA-88- or ADAT-compatible mixer

The *DMTi* can be used to bring a K2500 signal directly into a digital mixer with a DA-88- or ADAT-compatible input. The procedure is the same as when working with a digital multitrack recorder. The mixer must be set up to sync to external sample-rate clock.

Modular Digital Multitrack to K2500

Application

This is the reverse of the preceding scenario: you have a track on a modular digital multitrack tape which you want to load (sample) into the K2500 for manipulation and/or MIDI-triggered playback.

What you need

• The K2500 must be equipped with the Sampling option *and* either the KDS digital input/output option or the KDFX digital effects option.
• The **DMTi** must have an ADAT or DA-88 (TDIF-1) option, depending on which type of modular digital multitrack you are using.

Hookup

• Using the 3-meter KDS cable supplied with the **DMTi (**or the optional 15-meter KDS cable), connect the KDS Output on the K2500 to the KDS input on the **DMTi**. (If this sounds backwards, remember the KDS interface has a Return path—that's what we'll be using.)
• Connect the modular digital multitrack to the **DMTi** using the cable(s) provided with the recorder for connecting two decks together. DA-88-format decks use a single 25-pin "D" connector, while ADAT-format decks use one optical and one sync cable for input and a similar pair for output.
• If you want to use an external source of word clock as the sync master, connect that source to the **DMTi**'s **Word Clock In**put.

Settings

• Determine which pair of MDM tracks you want to sample. Select that pair with the **Destination 1** knob, by setting it to one of the **MDM** positions. The **Destination 1** knob routes the signal to the **KDS Rtn** bus.
• In most cases, **Clock Select** should be set to **KDS**. It can also be set to **Int 48K** or **MDM**, if the source tape was recorded at 48 kHz (the KDS bus runs at 48 kHz). Alternatively, if you are using an external 48 kHz clock master, you can set **Clock Select** to **WDCLK**.
• Set the following parameters on the K2500's Sample Page: *Input* to "Digital" and *Src* to "Rtn".

Note: if you want to sample from the MDM at a rate other than 48 kHz, you can go from one of the **DMTi**'s AES/EBU outputs into the K2500's digital input. See Page 22.
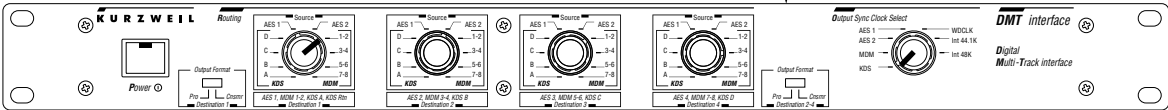
**from digital multitrack
DA-88: TDIF-1 I/O
ADAT: Digital In & Sync In**

01:23:45:29
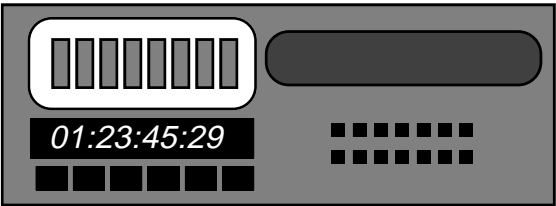
**to DMTi's DA-88 or
ADAT interface option**

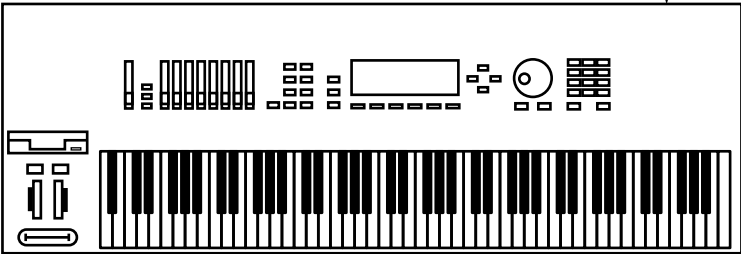**Knob *position* chooses *source***

Source: MDM 1-2

Destination: KDS Rtn

Knob *label* shows *destination*

**KDS In
(*Return*)**

**KDS Out
(*Return*)**

K2500 to AES/EBU

Applications

Sending the output of a K2500-series instrument's 8-channel KDS bus to one or
   more AES/EBU devices. Examples:
- Mastering to a DAT from the K2500
- Recording two or more channels from the K2500 to a hard-disk audio system
- Tracking from the K2500 to a multitrack tape deck with AES/EBU inputs
- Mixing the outputs of the K2500 on a digital mixer
- Sending an output of the K2500 to an external signal processor

What you need

- The K2500 must be equipped with a KDS digital input/output or KDFX
   digital effects option.
- Use a KDS cable (included with the **DMTi**) to connect the K2500 to the **DMTi**.
- AES/EBU cable(s).

Hookup

- Connect the KDS cable between the K2500 and the **DMTi**'s **KDS In** connector.
- Connect AES/EBU cables from the **DMTi**'s outputs to the inputs you want to
   use.

Settings

- Set the **Destination** knobs for all of the pairs that you are using to one of the
   KDS pairs.
- Set the **Clock Select** to **KDS**, unless you want to record at a different sample
   rate than the KDS's 48 kHz rate, in which case you can use the **Int 44.1K** Hz
   clock.

- **Variation 1: using the AES/EBU receiver as the clock
   master**

In some situations, such as when using an AES/EBU device that won't lock to
   incoming digital signals, you will want to use that device as the synchroni-
   zation master.

Connect an AES/EBU cable from the *output* of the AES/EBU device to one of
   the **DMTi**'s AES inputs. Set the **Clock Select** to that AES input. Make sure
   the AES/EBU device's clock is set to "internal". Now the sample-rate clock
   generated by the AES/EBU device (which typically is present at all times)
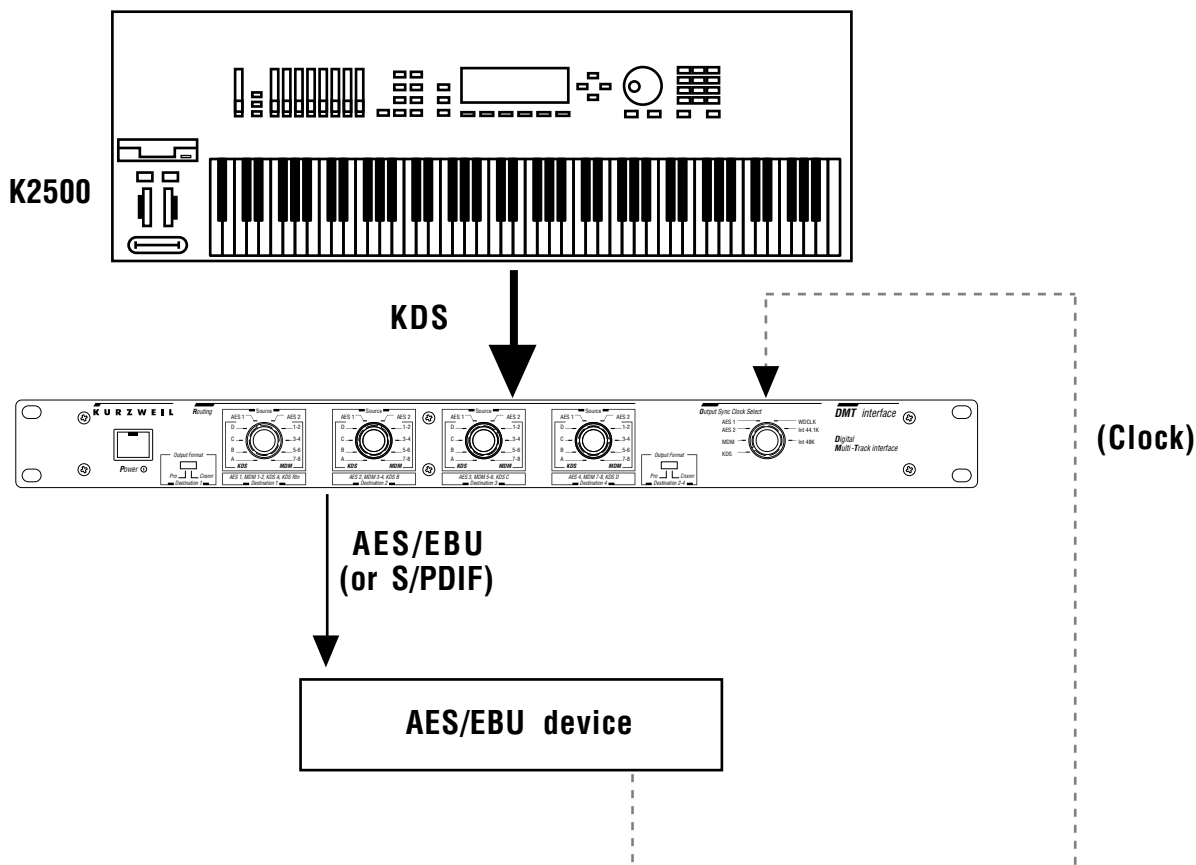
will be the master. Be careful that you don't route the audio signal from the AES/EBU device back to its own input, or you will create a feedback loop.

• Variation 2: K2500 to S/PDIF

Common S/PDIF devices include DAT decks, computer sound cards, and signal processors. They may have optical or coaxial (RCA) connectors.

Decide which AES/EBU output(s) you want to use, and set the appropriate output format switch(es) to "**Cnsmr**". For devices with optical inputs, connect an optical cable between the *DMTi* and the S/PDIF input. For co-axial inputs, use AES/EBU-to-S/PDIF adapters at the *DMTI*'s outputs (see Page 10).

Set the S/PDIF device's clock to "external". If there's no way to do this—the S/PDIF device cannot be locked to an incoming digital signal—then you must use its clock as the master by routing its output back to the *DMTi*, as detailed above, and setting the *DMTi*'s **Clock Select** switch accordingly.

AES/EBU to K2500

Application

Sending a channel pair from an AES/EBU device to a K2500-series
instrument's KDS bus input. Examples:
• Sampling from a DAT deck, CD player, or digital mixer
• Transferring a stereo pair from a multitrack deck or disk system to the K2500
• Returning a signal to the K2500 from a signal processor
(Note: Since a Sampling-option-equipped K2500 has AES/EBU and S/PDIF
optical inputs, you can sample directly from a digital source without the *DMTi*.
However, using the *DMTi* gives you the option of changing the sample rate of
the digital signal. Also, if you already have the K2500 and *DMTi* hooked to-
gether for another purpose, this will save the hassles of rewiring.

What you need

• The K2500 must be equipped with the Sampling option *and* the KDS digital
input/output option or KDFX digital effects option.
• Use a KDS cable (included with the *DMTi*) to connect the K2500 to the *DMTi*.
• AES/EBU cable(s).

Hookup

• Connect the KDS cable between the K2500 and the *DMTi*'s **KDS In** connector
(not the **KDS Out**).
• Connect AES/EBU cables from the output on the AES/EBU device to one of
the *DMTi*'s two AES inputs.

Settings

• **Destination 1** controls the input to the K2500 (using the "return" pair on the
KDS In bus). Set it to **AES1** or **AES2**, depending on which input you are
using.
• Set the **Clock Select** to **KDS** to make sure the outgoing signal is compatible
with the KDS bus. Alternatively, you can use the **Int 48K** setting, or you can
use one of the **AES** settings, provided the signal at the corresponding **AES**
input is at 48 kHz.
• Set the following parameters on the K2500's Sample Page: *Input* to "Digital"
and *Src* to "Rtn".

AES/EBU device

**AES/EBU
(or
S/PDIF)**

**KDS In
("return")**
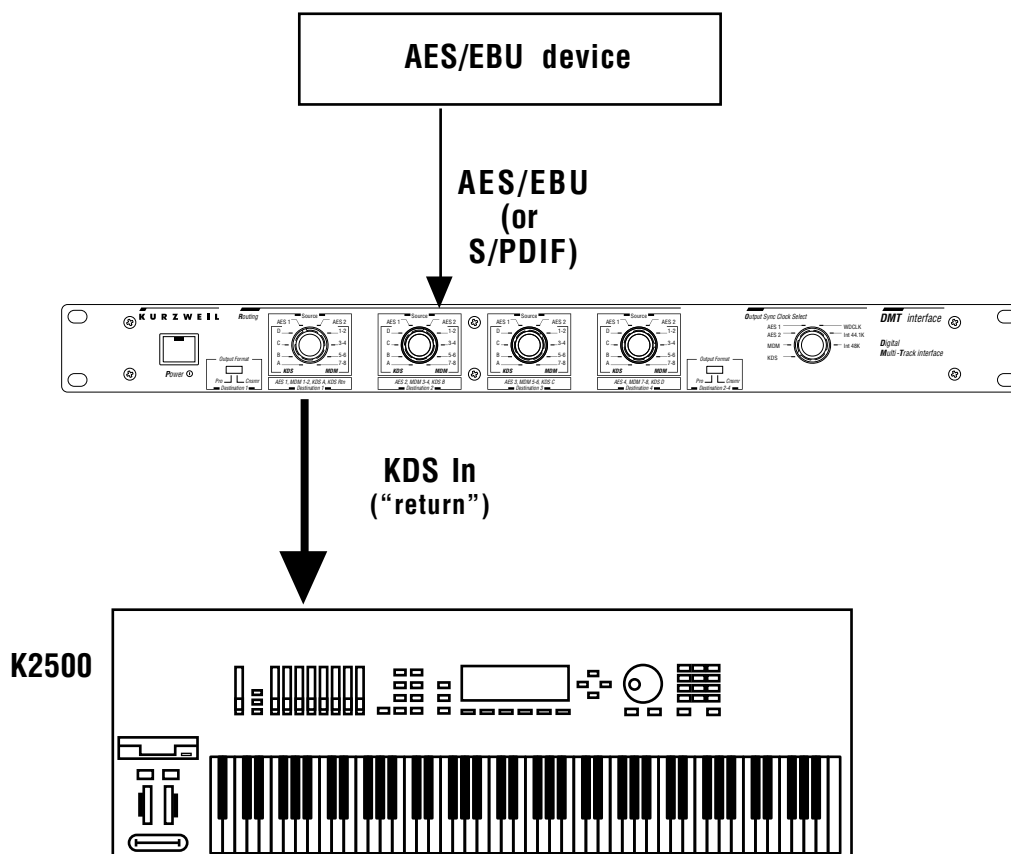
K2500

• Variation: S/PDIF to K2500

Common S/PDIF sources include DAT decks, computer sound cards, signal processors, and CD players with digital outputs.

For optical sources, connect an optical cable between the S/PDIF device and the *DMTi*'s optical input. Set the selector switch for the **AES1** input to "**Optical**". Coaxial sources can be connected to either of the *DMTi*'s **AES** inputs, using an S/PDIF-to-AES/EBU adapter at the input (see Page 10).

K2500 to Pro Tools or other hard-disk system

Application

Recording two or more channels from a K2500-series instrument to a hard-disk audio system, such as Digidesign's Pro Tools.

What you need

- The K2500 must be equipped with a KDS digital input/output or KDFX digital effects option.
- Use a KDS cable (included with the *DMTi*) to connect the K2500 to the *DMTi*.
- AES/EBU XLR-to-XLR cable(s), or AES/EBU-to-S/PDIF adapters, depending on which types of inputs the Pro Tools system has.

Hookup

- Connect the KDS cable between the K2500 and the *DMTi*.
- Connect AES/EBU (or S/PDIF) cables from the *DMTi*'s outputs to the Pro Tools inputs that you want to use.
- You may want to record using Pro Tools' sample-rate clock as the master, in which case you have two options:

    1) connect a BNC-to-BNC coaxial cable from Pro Tools' word clock output to the *DMTi*'s **Word Clock In**, or

    2) connect an AES/EBU (or S/PDIF) cable from one of Pro Tools' digital *outputs* to one of the **AES** inputs on the *DMTi*.

Settings

- Set the **Destination** knobs for all of the pairs that you are using to one of the **KDS** pairs.
- If you *are not* using Pro Tools as the clock master, set **Clock Select** to **KDS**, or one of the **Int** settings. Also, you must set the "Sync" switch in the Pro Tools setup software to "Digital".
- If you *are* using Pro Tools as the clock master, set **Clock Select** accordingly: either to **WDCLK**, if you are using that option, or to **AES1** or **AES2** if you are using that option. Set the "Sync" switch in the Pro Tools setup software to "Internal".

K2500

KDS

AES/EBU

**(Clock:
from AES/EBU output
or Word Clock)**

Hard-disk audio
system
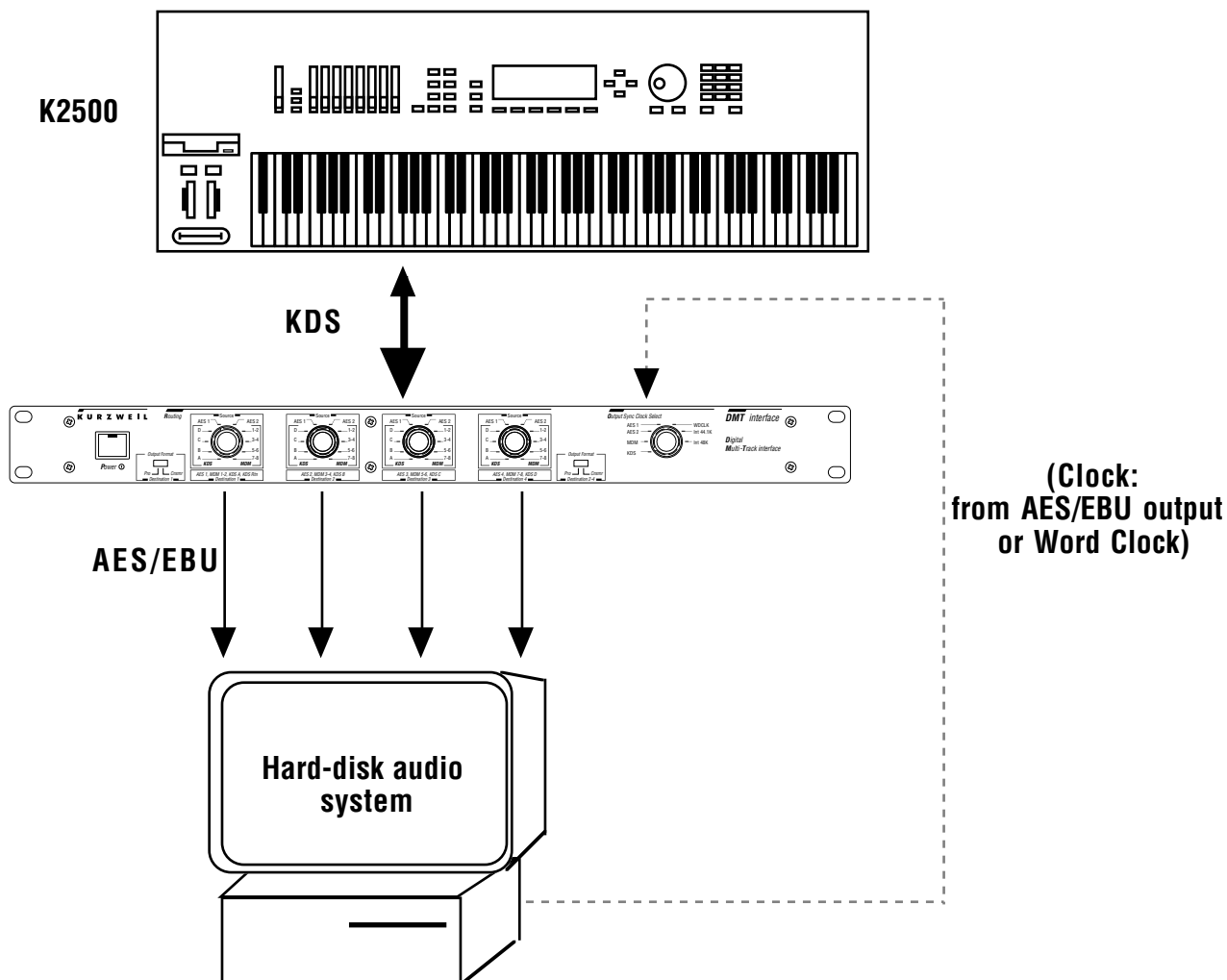
Returning signals from Pro Tools to the K2500

You can also route signals from Pro Tools back into the K2500 for sampling or processing purposes. Use the setup for AES/EBU or S/PDIF to K2500 on Pages 18 and 19. For best results, set **Clock Select** to **KDS** when recording to the K2500.

Modular Digital Multitrack to AES/EBU (including Pro Tools)

Application

Moving tracks back and forth between a modular digital multitrack tape recorder and one or more AES/EBU devices. Examples:
- Dumping tracks from MDM to DAT, and perhaps changing the sample rate in the process.
- Bouncing tracks through a digital signal processor and re-recording them in real time.
- Transferring tracks from digital multitrack tape to a hard-disk audio system for on-disk processing, and then transferring them back to tape.
- Sampling tracks from a modular digital multitrack into a K2500 at a rate other than the KDS bus's 48 kHz.

What you need

- The *DMTi* must have an ADAT or DA-88 (TDIF-1) option.
- AES/EBU (XLR, AES/EBU-to-S/PDIF, or optical) cable(s).

Hookup

- Connect the modular digital multitrack recorder to the *DMTi* using the cable(s) provided with the recorder for connecting two decks together: one 25-pin "D" cable for a DA-88; one optical and one sync cable for an ADAT's input and a similar pair for output.
- Connect AES/EBU cables from the *DMTi*'s **AES** outputs to the AES/EBU inputs you want to use.
- If you want to route signals back to the modular digital multitrack for bouncing or re-recording, connect cables from the AES/EBU device's output(s) to the **AES1** and/or **AES2** inputs on the *DMTi*. Note that you can only connect two pairs of channels at a time this way.
- If you want to use an external source of word clock as the sync master, connect that source to the *DMTi*'s **Word Clock In**put. Also connect the clock source to the modular digital multitrack's word clock input.
- You *must* use the modular digital multitrack as the sync master if you are overdubbing tracks onto it (see below).

Settings

- Set the **Destination** knobs to **MDM**, **AES1**, or **AES2**, depending on how you want the signals to be routed.

- If you are recording to the modular digital multitrack, and there are any tracks already recorded on the tape, you must set **Clock Select** to **MDM**, with one exception: if you are slaving the recorder to external word clock, then set the *DMTi* 's **Clock Select** to **WDCLK** and set the tape deck to slave to external word sync as well. Also make sure the other AES/EBU device(s) is set up to lock to external sync.
- If you are not overdubbing onto the digital multitrack, you have more choices. Set the **Clock Select** to **MDM**, **WDCLK** (if external word clock is present), one of the **AES** inputs if they are in use, or one of the **Int** settings.
- Alternatively, if you are using an AES/EBU device that does *not* lock to external sync, you can have the *DMTi* lock to it, by making sure there is a cable from the *output* of the AES/EBU device to one of the **AES** inputs, and setting the **Clock Select** to that **AES** input.
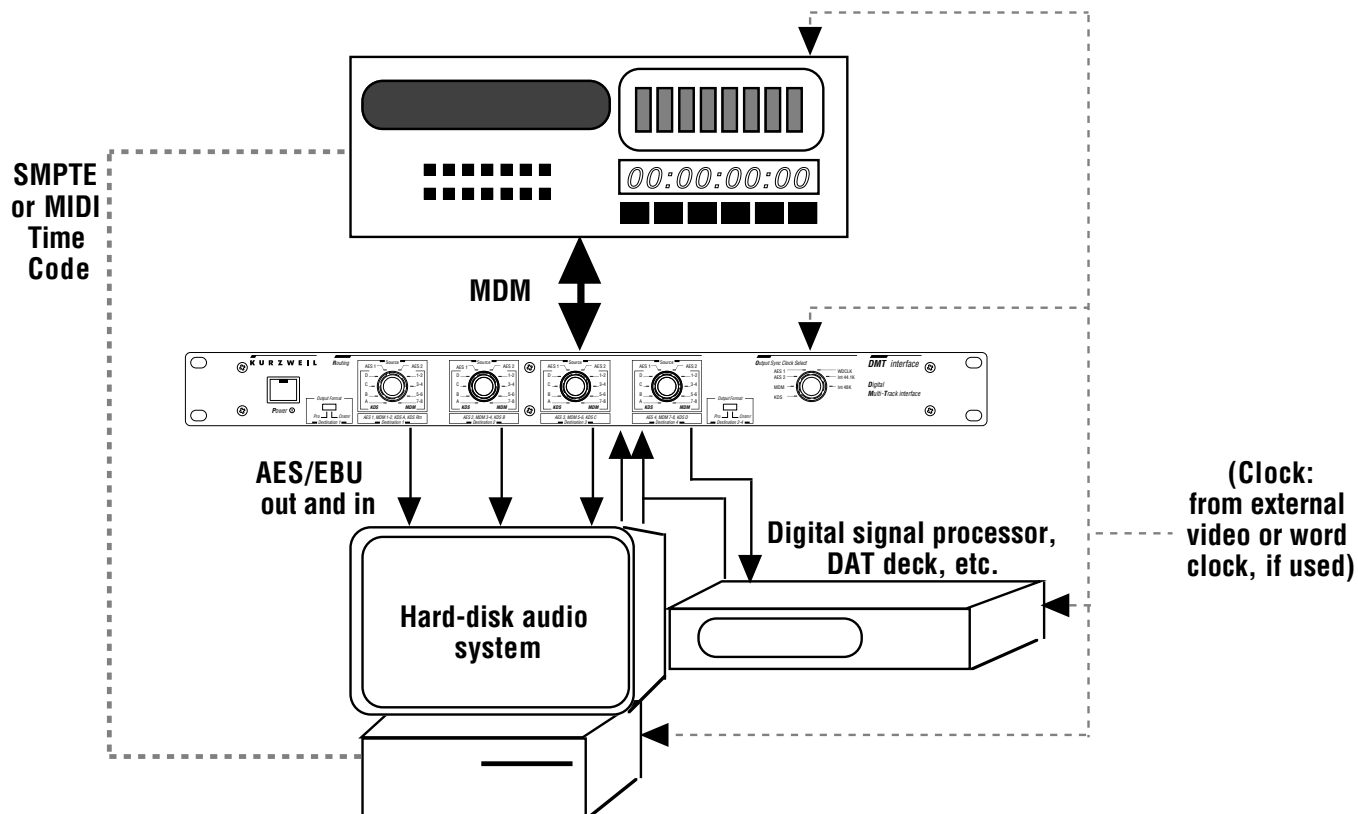
Special note for ADAT users:

If you are using multiple ADAT units, then one ADAT must act as sync master for all of the others, as well as for any *DMTi* that is feeding signals to any of the decks. The sync signal is carried through the system on the Alesis Sync cable. The *DMTi* can access that signal, provided a jumper on the ADAT option's circuit board is set correctly. See Appendix A for details.

Timecode issues

SMPTE timecode is not carried along with the audio and clock data in any of the standard digital formats, and therefore the *DMTi* does not pass SMPTE timecode between devices. If you need to synchronize two devices' SMPTE times, for example to transfer tracks from a modular digital multitrack to a hard-disk audio system while keeping everything locked to video, you will need to set up a specific connection between them for that purpose. Decide which device is the timecode master and which is the slave (there can be more than one slave), and then use standard audio cables to connect the "timecode out" jack of the master device to the "timecode in" jack(s) of the slave(s); or if the devices use MIDI Time Code, use a MIDI cable from the master to the slave(s).

Note that in a larger studio such as a video post-production suite, the master timecode device does not necessarily have to be *either* the MDM or the AES/EBU device; a videotape or SMPTE generator can act as the master, with both audio devices slaved to it.

Keep in mind that the *timecode* master/slave relationship is independent of the *sample-rate* or *word clock* master/slave relationship: a device can be the SMPTE master at the same time it is following an external sample-rate clock, or vice versa.

AES to AES with resampling

Application

Converting an AES/EBU signal into a different AES or S/PDIF format and/or
at a different sampling rate. Examples:
- Making a dub of a 48-kHz DAT onto another DAT at 44.1 kHz.
- Recording a CD (from a player with an S/PDIF output) onto a DAT or digital videotape at 48 kHz.
- Copying an old PCM-F1 digital recording (which used a 44.056-kHz sampling rate) to DAT at 44.1-kHz, without changing the speed. Normally there would be a speed shift of 0.1% (3.6 seconds per hour) when the DAT is played back.
- Correcting the speed and/or sample rate of other digital recordings using pull-down (video-based) sample rates.

What you need

- AES/EBU (XLR, AES/EBU-to-S/PDIF, or optical) cable(s).
- Word clock cables if you are planning to lock to an external sync source.

Hookup

- Connect the source to either **AES** input; connect the recording deck to any **AES** output.
- If locking the output to an external source of sample-rate clock, connect that signal to the **Word Clock** input.

Settings

- Set the **Destination** knobs to route the signal appropriately.
- If the sample rate of the dub is to match that of the original, set **Clock Select** to **AES1** or **AES2** depending on where the source is connected.
- If the sample rate is to be changed, set **Clock Select** to one of the **Int** clock rates.
- If the sample rate is being determined by an external sync source, set **Clock Select** to **WDCLK**.
- Set the recording device to lock to external digital sync. Alternatively, if the recording device *cannot* lock to external sync, you can have the *DMTi* lock to it, by making sure there is a cable from the *output* of the recording device to the *DMTi*'s unused **AES** input, and setting **Clock Select** to that **AES** input.

Note: the *DMTi* does not pass the Serial Copy Management System (SCMS) flag in the digital audio signal, so if that flag is set in your source recording, it will not be set in the copy.

Multimedia sources (samplers, CD, sound cards) to Modular Digital Multitrack

Application

Modular digital multitracks allow recording on 8 tracks simultaneously, but if those tracks are coming from different digital sources, they will not record properly. A modular digital multitrack can only sync to one incoming digital source at a time, and so any other incoming signals will be out of sync, with resultant signal degradation.

The *DMTi* synchronizes the signals before they get to the modular digital multi-track. Up to four channels of AES/EBU or S/PDIF audio from digital samplers, signal processors, computer audio cards, DAT decks, and/or CD players can be combined this way, along with two or more channels from a Kurzweil K2500-series instrument.

Note that this same setup can also be used with a digital mixer that has a DA-88- or ADAT-compatible interface, as described on Page 13. The mixer should be set up to lock to external sample-rate clock.

What you need

- The *DMTi* must have an ADAT or DA-88 (TDIF-1) option.
- AES/EBU (XLR, AES/EBU-to-S/PDIF, or optical) cables.
- Word clock cables if you are planning to lock to an external sync source.
- If you are using a K2500-series instrument as one of the sources, it must be equipped with a KDS digital input/output or KDFX digital effects option.

Hookup

- Connect the AES/EBU or S/PDIF sources to the **AES1** and **AES2** inputs.
- Connect the K2500 (if you are using one) to the *DMTi*'s **KDS In** connector using the KDS cable included with the *DMTi*.
- Connect the modular digital multitrack to the *DMTi* using the cable(s) provided with the recorder for connecting two decks together. The DA-88 uses a single 25-pin "D" connector, while the ADAT uses one optical and one sync cable for input, and a similar pair for the output.
- If you want to use an external source of word clock as the sync master, connect that source to the *DMTi*'s **Word Clock In**put — however…
- You *must* use the multitrack recorder as the sync master if you are overdubbing tracks (see next page).

Settings

- Set the **Destination** knobs for all of the pairs that you are using to either one of the **AES** inputs or one of the **KDS** pairs, as appropriate.
- For your initial tracks, it is often easiest to use the MDM as the sync master: set **Clock Select** to **MDM**. If you want to use one of the other sources as the sync master, you can, or you can use one of the **Int** settings or **WDCLK**. If you are using anything other than the MDM as the master, however, you must make sure the modular digital multitrack deck is set to sync to an external clock signal. (Multiple ADAT users see the "Special Note" on Page 23.)

When overdubbing to the MDM…

Modular Digital Multitrack decks cannot use different clock sources for recording and playback at the same time. Therefore, if you are recording tracks to a multitrack digital tape that *already* has one or more tracks recorded on it, then the MDM must be the sync master: set **Clock Select** to **MDM**. There is an exception to this rule: if you are using an external clock source, then *both* the *DMTi* and the MDM must be set up to slave to that source.
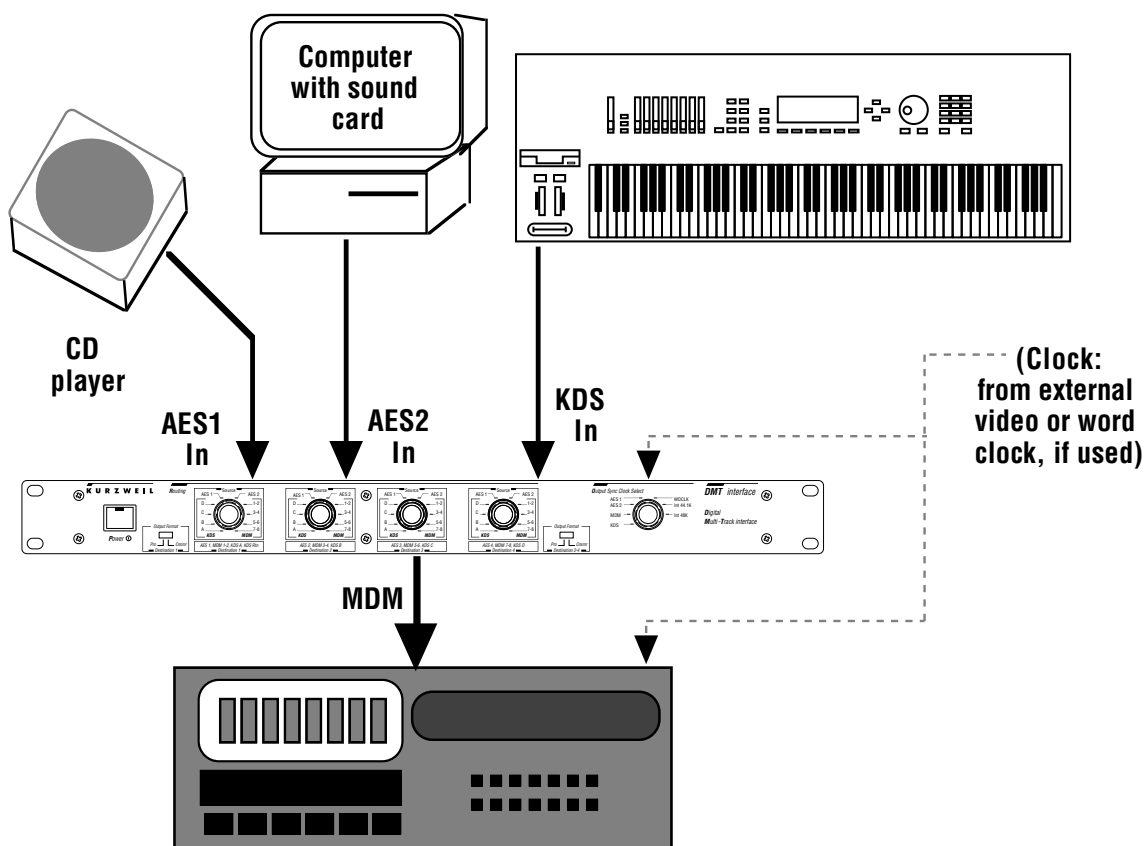
Multimedia sources to digital mixer

Application

With the advent of true digital mixers, it becomes crucial for there to be a way to synchronize digital streams, so that multiple digital signal sources can be used with these mixers. A digital mixer with AES/EBU inputs can only sync to one incoming digital source—generally, it is the signal appearing at the first input. If signals at the other inputs are not synchronized to the first signal, audible errors will occur.

The *DMTi* synchronizes the signals before they get to the mixer. Up to four channels of AES/EBU or S/PDIF audio from digital samplers, signal processors, computer audio cards, DAT decks, and/or CD players can be combined this way, along with two or more channels from a Kurzweil K2500-series instrument.

Note: if the mixer has DA-88- or ADAT-compatible inputs, you can treat it exactly as if it were a multitrack digital recorder (see Page 13).

What you need

- AES/EBU (XLR, AES/EBU-to-S/PDIF, or optical) cables.
- If you are using a K2500-series instrument as one of the sources, it must be equipped with a KDS digital input/output or KDFX digital effects option.
- Word clock cables if you are planning to lock to an external sync source.
- If the mixer uses ADAT- or DA-88-format digital inputs, then the *DMTi* must have the appropriate option.

Hookup

- Connect the AES/EBU or S/PDIF sources to the **AES1** and **AES2** inputs.
- Connect the K2500 (if you are using one) to the *DMTi*'s **KDS In** connector using the KDS cable included with the *DMTi*.
- Connect the digital mixer using either AES/EBU cables, S/PDIF cables and adapters, or MDM cable(s), depending on the mixer's input format. (Some mixers with ADAT inputs do not have a Sync input, and only require the optical cable to be connected.)
- If you want to use an external source of word clock as the sync master, connect that source to the *DMTi*'s **Word Clock In**put.
- If the mixer also accepts external sample-rate sync, and you want to use it, then connect it to the mixer's word clock input.

Settings

- Set the **Destination** knobs for all of the pairs that you are using to either one of the **AES** inputs or one of the **KDS** pairs, as appropriate.
- Set **Clock Select** to one of the **Int** settings or **WDCLK**, as appropriate.

• Variation: Multimedia sources to Pro Tools

Setting up multiple sources for simultaneous recording into Pro Tools is similar to setting them up for digital mixing: the Pro Tools system must have one and only one sync reference, which can come from the *DMTi*'s internal clock, from one of the sources, or from an external word clock signal which is connected both to the *DMTi* and the Pro Tools interface.

Normally, Pro Tools must be set up to accept external digital sync from the *DMTi* —this is done in software—or else it will try to convert incoming signals "on the fly", and this can create errors. If for some reason Pro Tools _must_ be the master clock, the solution is simple: run a BNC-to-BNC cable from Pro Tools' word clock output to the *DMTi*'s **Word Clock In**put, and set **Clock Select** to **WDCLK**.
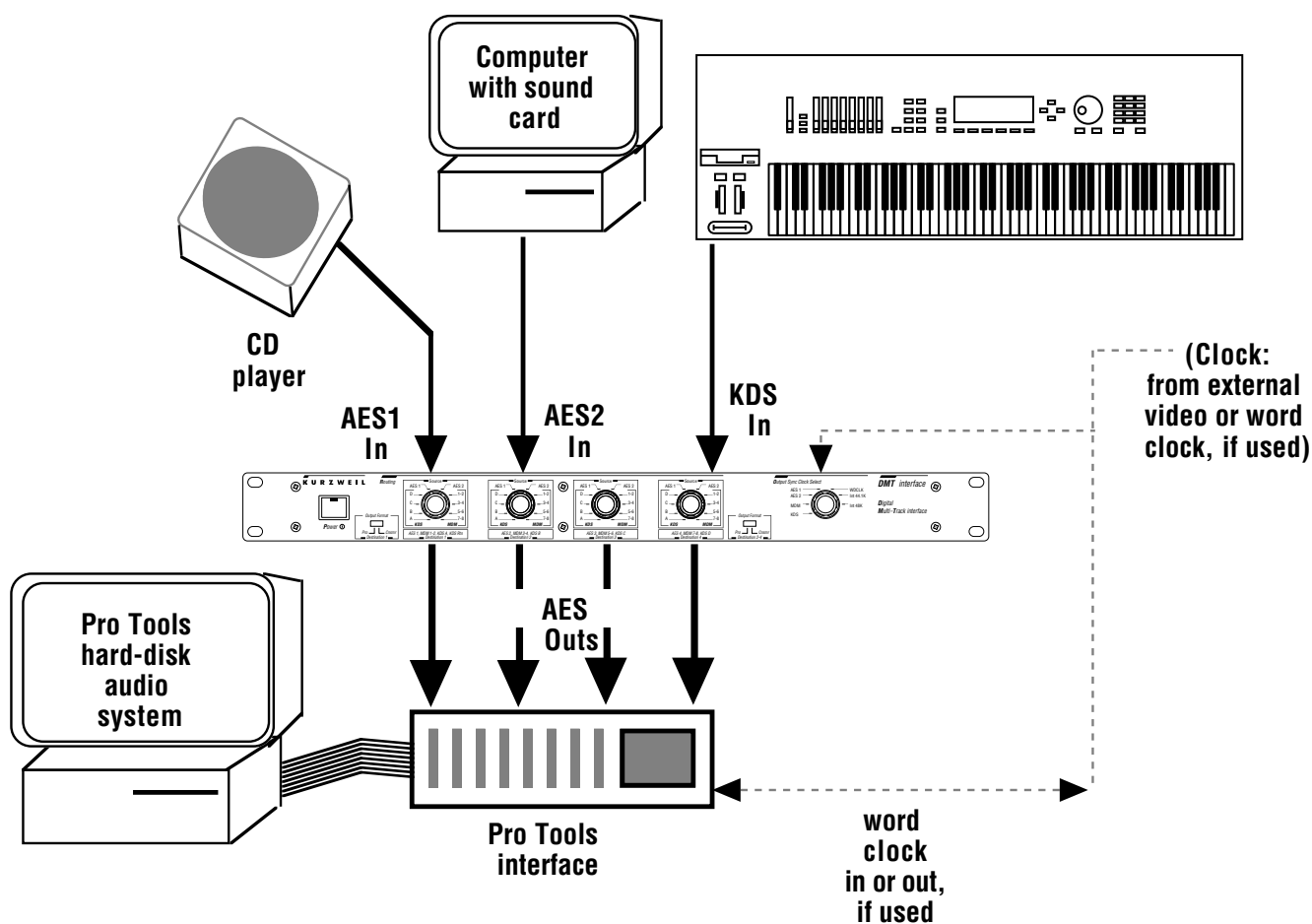
Converting from one Modular Digital Multitrack
to another (DA-88 to ADAT or vice versa)

Application

Transferring tracks in the digital domain from one type of modular digital multitrack to another in a single pass.

What you need

Since the *DMTi* can only interface with one type of modular digital multitrack at a time, to do this conversion requires two *DMTi* s, one equipped with the DA-88 (TDIF-1) option and the other with the ADAT option, linked together using the Kurzweil Digital Stream.

Hookup

• Connect the ADAT-format modular digital multitrack to the **MDM** jack of the ADAT option-equipped *DMTi*, using the cables provided with the recorder for connecting two decks together: two optical cables and two sync cables.

• Connect the DA-88-format digital multitrack recorder to the DA-88 option-equipped *DMTi*'s **MDM** jack, using the 25-conductor cable provided with the recorder for connecting two decks together.

• Determine which deck is the source deck (playback) and which is the destination deck (record). Connect a KDS cable (included with the *DMTi*) from the **KDS Out** of the *DMTi* associated with the source deck, to the **KDS In** of the *DMTi* associated with the destination deck. If you want to transfer bi-directionally between decks, use two KDS cables.

• You may want to use an external source of word clock as the sync master. You can use external word clock for either or both of the decks, but you must make sure that the word clock feeds both the deck and its associated *DMTi*. Connect the source of word clock to the *DMTi*'s **Word Clock In**put, and to the modular digital multitrack's word clock input.

• If you want to preserve SMPTE timecode numbers on the tape, connect an appropriate cable from the source deck's SMPTE or MIDI Time Code output to the corresponding input on the destination deck. (See Page 32 for more on timecode.)

Settings

On the source *DMTi*, set **Destination 1** through **4** to **MDM 1-2**, **MDM 3-4**, **MDM 5-6**, and **MDM 7-8**, respectively. Set **Clock Select** to **MDM**, unless you are using external word clock to control the source deck, in which case set it to **WDCLK**. (Multiple ADAT users see the "Special Note" on Page 12.)

On the destination *DMTi*, set **Destination 1** through **4** to **KDS A**, **KDS B**, **KDS C**, and **KDS D**, respectively. Set **Clock Select** to **MDM**, unless you are using external word clock to control the destination deck, in which case set it to **WDCLK**.
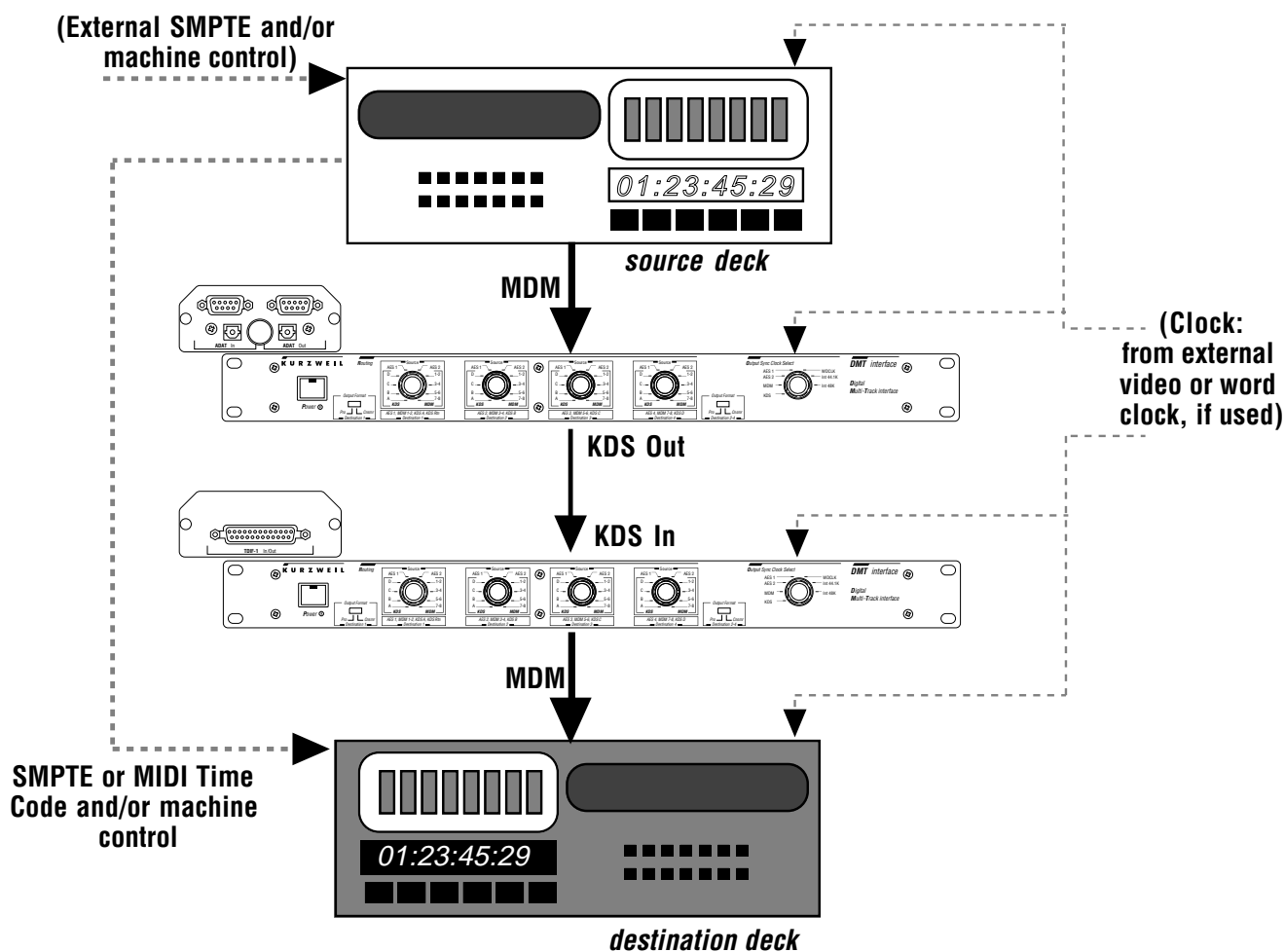
Timecode and machine control issues

SMPTE timecode is not carried along with the audio and clock data on the DA-88 or ADAT buses, and therefore in this setup the *DMTi* will not pass SMPTE timecode between the two tape recorders. If you want to preserve SMPTE numbers over the tape transfer, you will need to set up a specific connection between the two decks for that purpose. Use standard audio cables to connect the "timecode out" jack of the source deck to the "timecode in" jack of the destination deck. Alternatively, if the devices use MIDI Time Code, use a MIDI cable from the source to the destination.

You can have the destination deck record the incoming timecode at the same time that it records the audio, or you can pre-stripe the tape in the destination deck with SMPTE, making sure the numbers are compatible with the timecode on the source tape. With either method, you slave the destination deck to the source deck, or slave *both* decks to a common source of timecode.

Keep in mind that the *timecode* master/slave relationship is independent of the *sample-rate clock* master/slave relationship: a device can be the SMPTE master at the same time it is following an external sample-rate clock, or vice versa.

Various methods are in use to remotely-control the transports of modular digital multitrack recorders, including Sony 9-pin and MIDI Machine Control. By taking advantage of these protocols, the destination deck can be controlled by the source deck, or both decks operated by a common controller. Consult the manuals of the tape decks for details.

Troubleshooting

The great majority of errors in any digital audio system are caused by problems with digital synchronization, or clocks. The *DMTi* is designed to solve these problems, but as in any complex system, a thorough understanding of how these problems occur is necessary for you to get the *DMTi* to perform correctly.

No sound at all

Besides the obvious problem of missing or defective cables, this may be caused by a lack of proper clock signal to the *DMTi*. Make sure the **Clock Select** switch is set to an input at which there is an actual signal: for example, if it is set to **WDCLK** and there is no signal present at the **Word Clock In**put, there may be no audio output. Similarly, there must be signal present at the AES, MDM, or KDS inputs if any of those are to be the sync master. To determine whether this is the problem, set **Clock Select** to one of the **Int** settings and make sure that clock is getting to the device connected to the *DMTi*'s output.

If there is no sound coming from the **AES1** input, make sure the **Input Select** switch is set correctly.

Intermittent audio

This can be caused by clock problems (as above) or by a weak digital signal. Cables that are too long or are of poor quality can cause the signal to deteriorate or suffer interference. Keep cables as short as possible, especially if you are using single-conductor coaxial S/PDIF cable. Coaxial cables designed for analog audio are not very good for carrying digital signals—instead, use cables designed for video.

If you are using an **AES** output to feed an AES/EBU device, make sure its format switch is set to **Pro**, to ensure that the correct signal format is being transmitted. Similarly, if you are feeding an S/PDIF device, make sure the switch is set to **Cnsmr**. You may also need to use an attenuating adapter to bring the signal level down (see Page 10).

Can't record output

Some recording devices, such as certain DAT decks, may have trouble receiving or locking to the *DMTi*'s output. They may not recognize the digital audio signal, or not go into record at all.

This is caused by the way the *DMTi* handles certain data in the digital audio stream. In the AES/EBU digital word is a set of bits known as the "channel status field" which contains, among other information, a flag denoting the sample rate of the signal being transmitted. This can be set to "44.1", "48", or "unknown". When the *DMTi*'s **Clock Select** switch is set to **Int 44.1K**, this flag in the output signal is set to "44.1". When **Clock Select** is set to **Int 48K** or to **KDS**, this flag is set to "48". With any other settings—**AES1**, **AES2**, **MDM**, or **WDCLK**—this flag is set to "unknown". Some receiving devices may not accept a digital input with an "unknown" flag, and will not record or lock to it. Alternatively, some devices, when they receive a signal with an "unknown" flag, assume that the sample rate is at a particular value (say 48 kHz) and if the incoming signal is at the wrong value (say 44.1 kHz), it will not record it.

If this situation occurs, use one of the "known" settings for **Clock Select**: **Int 44.1K** or **Int 48K**. If that is not possible, contact the manufacturer of the unit in question for assistance.

Clicks and Pops

These occur when trying to combine two digital streams that are out of sync, or when trying to convert a digital stream on the fly. The *DMTi* deals with out-of-sync streams, but if you are sending data from the *DMTi* to a device that has trouble with external synchronization (or doesn't allow it at all), you can experience problems of the latter kind. First of all, make sure that the receiving device is set up to lock to incoming digital data, if possible. Then, check that the *DMTi*'s output sample rate matches the input sample rate of the device in question—often you will find that the device has no trouble working with an external 44.1-kHz clock, but will have a very difficult time if it expects 44.1 kHz and the incoming signal is 48 kHz!

If you are still having trouble, you may have to lock the *DMTi* to the receiving device. Many AES/EBU devices generate a valid signal at their outputs even when there is no audio playing, and this signal can be used as the *DMTi*'s clock master. For example, the output of a DAT deck that you are recording to can be looped back to the *DMTi* through one of the **AES** inputs (as long as you're not using that input for anything else), and the **Clock Select** switch can be set to follow it. Be sure not to route the audio signal from the device's output back to its own input, or you will get a feedback loop.

Another alternative is to use a common source of word clock for both the *DMTi* and the receiving device, assuming that the receiving device has an input for it. Make sure that the receiving device is explicitly set up to sync to word clock—this may be a hardware or software setting, depending on the design.

Make sure that whatever you are using as the master sync device is set to its *own* internal clock. If every device in the chain is looking elsewhere for sync, they will "hunt" each other, with the result that the system will be unstable, creating noise or even failing completely.

Garbage

If the signal deteriorates into a harsh buzz, roar, or "hash" sound, it usually means that clock sync has been lost. Check to see that the clock source you are using is generating a valid signal. For example, you may have the *DMTi*'s clock following the digital output of a DAT deck, as described above; when you turn the deck off, the clock will go off, but the *DMTi* will continue trying to convert incoming signals, with unfortunate results.

Pitch changes

These can occur when the wrong sample rate is chosen for a device. Examples:

• A sound file in Pro Tools or a tape on an MDM recorded at 48 kHz is played back locked to an incoming sample rate of 44.1 kHz. The sound will play approximately 8.8% slow (about $1^1\!/_2$ semitones flat).

• A recording on a DAT made at "low speed" (32 kHz sampling rate) is played back using with a deck locked to an external 44.1 kHz signal. The recording will play back approximately 37.8% fast (about $4^1\!/_2$ semitones sharp).

• A recording made on a video-based digital system using "pulldown" (i.e., a frame rate of 29.97 fps) and a sample rate of 44.056 kHz, is dubbed to another system nominally running at 44.1 kHz, using the source as the sync master. When the dub is played back, it will be 0.1% fast (3.6 seconds per hour).

Most of these problems can be avoided by using the *DMTi*'s internal sample-rate generator (i.e., setting **Clock Select** to **Int 44.1K** or **Int 48K**), and letting the sources "free run"—that is, use their own internal clocks.

Appendix A:

Setting the ADAT Option for Multiple-Machine Synchronization

In a system with multiple ADAT-format tape decks, one and only one of the decks must act as sync master for all of the others. It must also act as sync master for any device providing digital audio to any of the decks, and that includes the **DMTi**.

The signal that provides this sync (which is a form of word clock) is carried in the ADAT's Sync cable. (The optical cable also carries sync information, but it is not enough to provide full machine synchronization). Setting the **Clock Select** switch on the **DMTi** to **MDM** does _not_ access this sync signal—it merely selects the sync from the optical cable. Therefore, a special way to get the **DMTi** to recognize this signal is required.

This is provided by a jumper on the ADAT option board itself. If this jumper is in one position, then when the **Clock Select** switch is set to **WDCLK**, the **DMTi** syncs to the signal coming into the **Word Clock In**put on the back panel—in other words, normal operation. If the jumper is in the other position, and **Clock Select** is set to **WDCLK**, the **DMTi** will sync to *the master sync signal coming in from the ADAT Sync cable*—which is what you want if you are using multiple ADAT decks.

After turning off the power to the **DMTi**, remove the two screws from the rear panel securing the ADAT option board, and slide the board out. Locate the jumper holder, labelled "**JP1**", and the rectangular jumper installed on it. To have the **DMTi** sync to ADAT sync, set the jumper so that it is connecting pins 2 and 3. To return it to normal operation (syncing to Word Clock), set the jumper so it connects pins 1 and 2.

After you set the jumper, replace the ADAT option board inside the **DMTi** and replace the screws on the back panel. You can change this jumper as often as you wish. (Just be sure the power is off!)

Appendix B:

The Kurzweil Digital Stream (KDS) Interface

Overview

The KDS interface transmits eight channels of 26-bit or 32-bit audio data per channel unidirectionally. The 26-bit version is called "KDS26" and the 32-bit version is called "KDS32". The sample rate of KDS audio data is 32K–48K per second ± 12.5% (28K–54K S/s) and is otherwise limited by the sample rates of the devices producing and receiving the data.

The eight channels are arranged as follows. There are four stereo outputs: A, B, C, and D. The outputs are produced/received in the order A Left (Chan 0), B Left (Chan 1), C Left (Chan 2), D Left (Chan 3), A Right (Chan 4), B Right (Chan 5), C Right (Chan 6), D Right (Chan 7). Each output pair (e.g., A Left and A Right) may alternately be assigned as separate mono outputs. The KDS interface is designed to optionally receive 2 channels of up to 24-bit audio data in differential AES3-1992 Pro format. When this document refers to KDS signals it excludes optional AES signals. For a description of the AES3-1992 interface see the *Journal of the Audio Engineering Society*, Volume 40, No. 3, 1992 March, or request a copy of AES3-1992 (ANSI S4.40-1992) from the Audio Engineering Society.

KDS Block Diagram
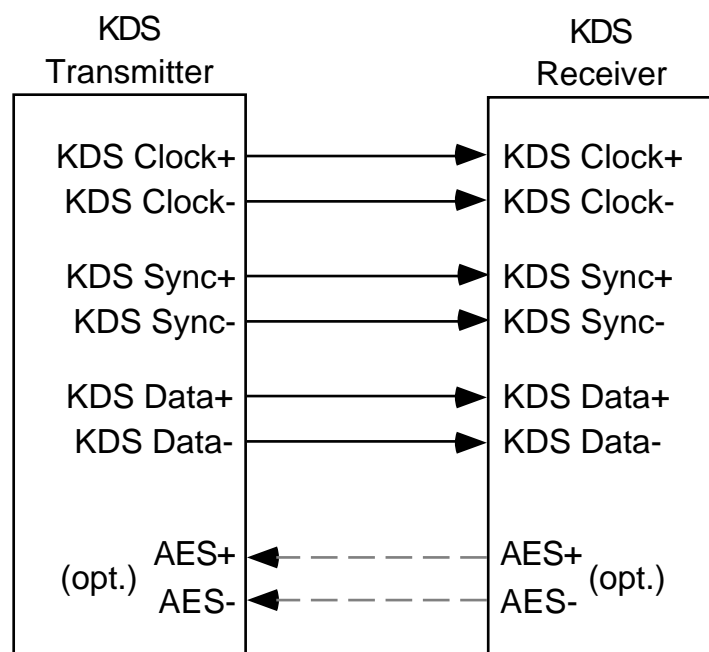
KDS Interface Timing

The KDS physical layer interface consists of three signals; KDS Clock, KDS Sync, and KDS Data. The KDS Clock is a clock signal whose frequency equals 208x or 256x the sample rate, for 26 or 32 bits per channel, respectively. The KDS Sync pulse is valid for one clock cycle each sample frame, such that the Most Significant Bit (MSB) of the first audio channel is valid in the first clock cycle following the valid KDS Sync pulse. Audio data is represented as a 2's complement number where the MSB is the sign bit. Unused Least Significant Bits (LSBs) are usually represented as zeros. One can build a KDS input interface that supports both 26- and 32-bit versions by counting the clock transitions between KDS Sync pulses. There are 208 clock transitions for every KDS Sync pulse for KDS26, and 256 clock transitions for every KDS Sync pulse for KDS32. The KDS Clock, Sync, and Data are produced as follows:
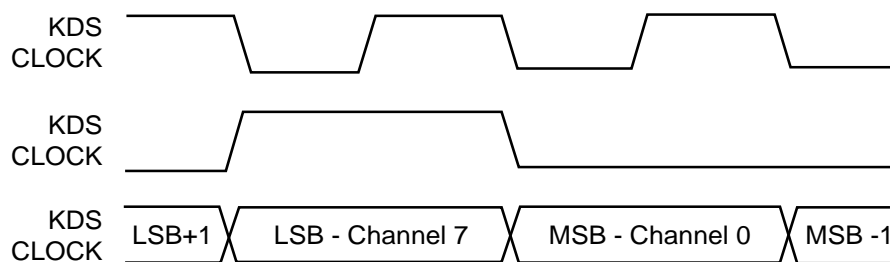
All three signals, Clock, Sync, and Data are typically produced by flip-flops within the same device to minimize skew. The same can be said for the differential transmitters and receivers used at each end of the cable. KDS Sync and KDS Data change at the same time that the KDS Clock transitions from High to Low. At the receiving end of the cable the rising edge of the KDS Clock is used to detect KDS Sync and latch KDS Data.

This specification assumes the use of AM26LS31 differential transmitters for driving the KDS bus and AM26LS32B differential receivers for receiving the bus. KDS transmission lines are terminated by a single 110-ohm resistor across the + and - inputs of the receiver.

KDS DC Specifications

KDS interface DC specifications are determined by the differential transmitter and receiver specified, assuming a 4.75V to 5.25V interface supply voltage. The output voltage swing is typically 3 Volts. Typical cable attenuation for 15 meters of Belden 9806 results in a swing of approximately 2 Volts at the receiver. Ground potential difference between the KDS transmitter and receiver should not exceed 1V.

KDS AC Specifications

*All timings specified below are measured at 2.5 Volts*

Output. Measured at the KDS Output connector, the minimum duration of KDS Clock Low or High is 32ns. The total time difference from any KDS Clock output transition to KDS Sync output transition, or from any KDS Clock output transition to KDS Data output transition, is 12ns maximum. This figure is the sum of output-to-output skew, plus jitter introduced by the device that generates the three signals which contributes 2ns (max.), the AM26LS31 which contributes 6ns (max.), the EMI common mode choke and capacitors which contribute 1ns (max.), and the combined circuit Low-to-High and High-to-Low asymmetry which is 3ns (max.).

Cable. Jitter and skew contributed by the cable consisting of cable reflections, nonlinearity, and delay mismatch for up to 15 meters of Belden 9806 cable is estimated to be 3ns, maximum.
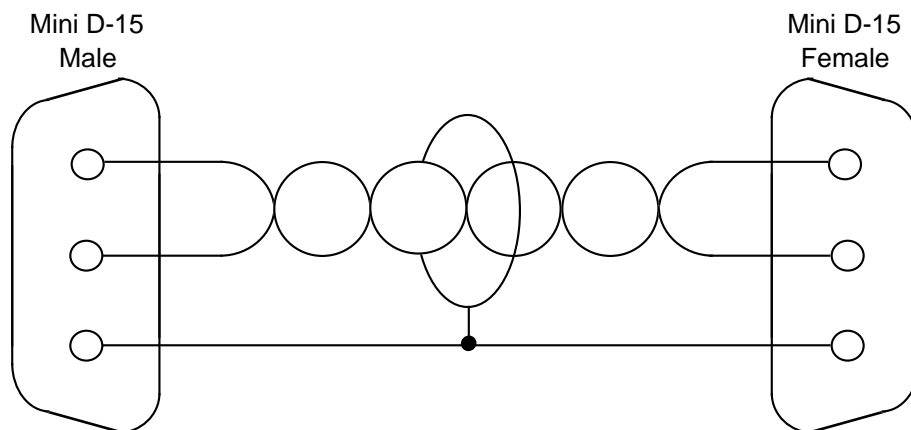
Input. A single AM26LS32B is used to receive the three signals. The AM26LS32B is an improved version of the 26LS32 that features guaranteed minimum hysteresis and skew, plus a much improved output driver. Measured at the output of the receiver, the time difference between any KDS signal transition to any other signal transition should be no more than 22ns, maximum. This figure is the sum of output to output skew, plus jitter introduced by the output circuit which is 12ns (max.), the cable which is 3ns (max.), the receiver which is 4ns (max.), the EMI common mode choke and capacitors which contribute 1ns (max.), and the asymmetry of the receiving circuit which is 2ns (max.).

Receiving Logic. The rising edge of KDS Clock is used to detect KDS Sync and latch KDS Data. With 22ns of total interface skew, jitter, and asymmetry at the output of the receiver and a 32ns minimum KDS Clock input High and Low time, the resulting KDS Sync and KDS Data setup and hold time with respect to the rising edge of KDS Clock is 10ns, minimum. Typical interface skew, jitter, and asymmetry measured at the output of the DMTi KDS receiver is 3ns, much lower than the maximum calculated value. If one pays close attention to minimizing skew in the design, PC board layout, and cable of the KDS inter-face, the result will be more setup and hold margin at the receiver.
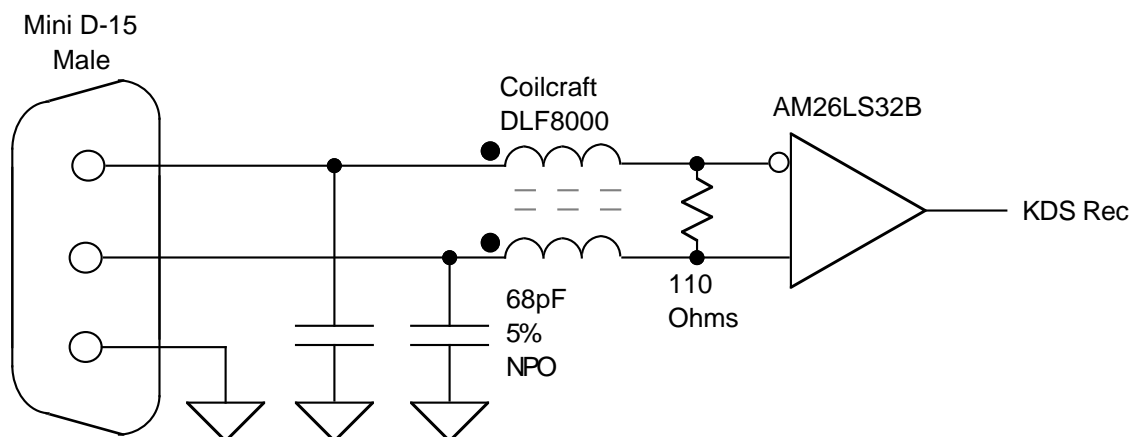
Here is a simplified schematic showing one KDS output signal pair:

Mini D-15
Female

Coilcraft
DLF8000

AM26LS31

KDS Xmit

68pF
5%
NPO
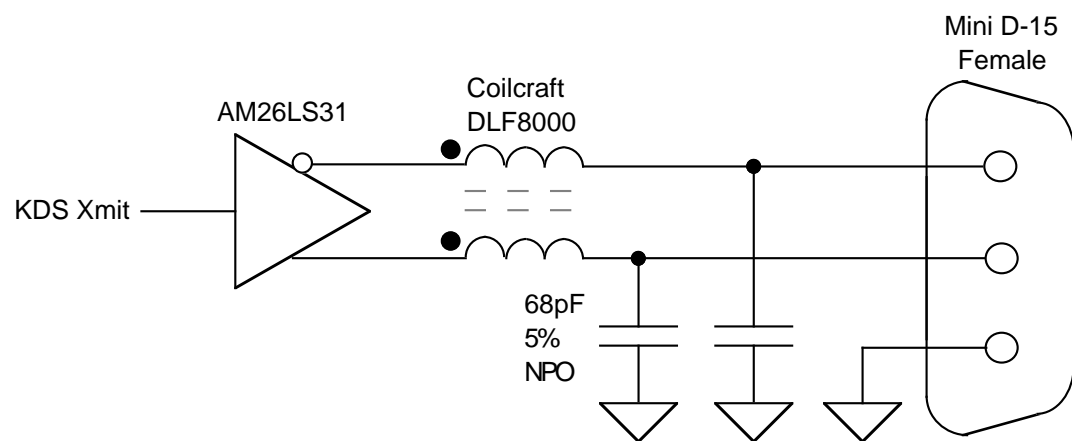
Here is a simplified schematic showing one KDS cable signal pair:

Mini D-15
Male

Mini D-15
Female

Here is a simplified schematic showing one KDS input signal pair:

Mini D-15
Male

Coilcraft
DLF8000

AM26LS32B

KDS Rec

68pF
5%
NPO

110
Ohms

KDS Interface Cabling and Connectors

The connectors to be used are 15-pin "Mini-D" style as used in IBM-PC VGA interconnect. The KDS output connector is a receptacle, the KDS input connector is a plug.

The AMP Part Numbers are as follows:

PC Mount Plug   749767-1
PC Mount Receptacle   748390-6
Cable Mount Plug   748364-1
        with 748333-2 (Strip) or 748333-4 (Loose) crimp-on pins
Cable Mount Receptacle   748565-1
        with 748610-2 (Strip) or 748610-4 (Loose) crimp-on sockets.

Output drivers are AMD, Philips, Motorola, TI, or National AM26LS31. Input receivers are AMD or Philips AM26LS32B. Coilcraft DLF8000 common mode chokes are placed in series with each input or output signal as close as possible to the KDS output and input connectors. Depending on the system, Tokin DL03 common mode chokes may be necessary to meet EMI emissions requirements. The Tokin chokes have separate cores for each twisted pair as opposed to the Coilcraft part that uses one core for all four pairs. Each output signal should have a 68pF NPO 5% capacitor tied to chassis ground. These capacitors should be placed as close to the connector pins as possible with lead lengths as short as possible. PC board traces for KDS output and input differential pairs should be kept short and routed parallel to one another.

The KDS connector pinout is as follows:

Pin	Name	Pin	Name	Pin	Name	Pin	Name	Pin	Name
1	Data+	2	Sync+	3	Clk+	4	n/c	5	AES+
11	Data-	12	Sync-	13	Clk-	14	n/c	15	AES-
6	Gnd	7	Gnd	8	Gnd	9	Gnd	10	Gnd

KDS pins 4 and 14 are not connected. KDS pins 6-10 must be connected to Chassis Ground via the shortest, lowest impedance path possible. It is assumed that Logic Ground has a low-impedance connection to Chassis Ground at some point(s) in the system. The mounting clips for KDS connectors must also be connected to Chassis Ground via the shortest, lowest-impedance path possible.

Note: The standard KDS cable uses only one KDS connector ground pin. KDS pin 6 is used for the shield drain wire ground on both ends of the cable. The other ground pins 7-10 are not used with this cable, but must be connected to ground on both ends. To reduce crosstalk, a cable that uses individually shielded pairs can be used. Ground pins 6, 7, 8, and 10 are used to connect the four shields to ground on both ends and pin 9 is connected on both ends with a larger-gauge wire. This wire is used to reduce ground potential difference between the transmitter and receiver chassis, reducing common-mode voltage at the receiver.

The standard KDS interface cables are fabricated with "four-pair" low capacitance cable, Belden 9806 or equivalent, consisting of four unshielded twisted pairs with a overall braid shield. The connectors are wrapped 360 degrees with copper foil connected to the cable shield and connector shell at each end. The cable length must not exceed 15 meters. Kurzweil offers these cables in both 3- and 15-meter lengths.

KDS Implementation Chart for Kurzweil Products

Product	KDS Output Rate	KDS Output Bits/Channel	AES Input	KDS Input Rate	KDS Input Bits/Channel	AES Output
K2500 KDFX Option	48 KHz x 208	26	Yes	N/A	N/A	N/A
K2500 KDS Out Option	48 KHz x 208	26	Yes	N/A	N/A	N/A
DMTi	28 KHz x 256 – 54 KHz x 256	32	No	28 KHz x 208 – 54 KHz x 256	26 or 32	Yes

Appendix C: Specifications

Physical

- Width   19 in.   (48 cm.)   [plus rack ears]
- Depth   10.9 in.   (27.7 cm.)
- Height   1.75 in.   (4.4 cm.)   [1U]
- Weight   10.5 lb.   (4.8 kg.)

Electrical

	100V	120V	220V	240V
• Voltage Settings	100V	120V	220V	240V
• Safe Voltage Range	85-107	95-125	180-232	190-250
• Frequency Range	48-65 Hz			
• Power Consumption	1.0 amp @120V nominal			
• Fuse	0.25 amp fast-blow			

Environmental

- Temperature (Operating)   41° to 104°F   (5° to 40° C)
- Temperature (Storage)   -13° to 186°F   (25° to 85° C)
- Relative Humidity (Operating and Storage)   5-95%, non-condensing

Audio

- Input Sample Rate   38 kHz-53kHz
- Formats (input and output)
    - AES/EBU (XLR)
    - S/PDIF (optical)
    - ADAT (with option)
    - TDIF-1 (with option)

Word Clock

- Input   200 mVp-p minimum, 75Ω impedance, 38 kHz-53kHz
- Output   5V unbalanced, 75Ω impedance

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Credits

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