
TANGO²⁴

User's Guide

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≡ Introduction ≡

Tango24™ is a high-resolution, multichannel A/D and D/A converter for computer-based systems. Its features include:

- ADAT™ optical digital interface (in/thru/out) and an external power supply, which provide isolation from electrically-induced computer noise
- 8 analog inputs and 8 analog outputs with 24-bit resolution
- balanced TRS connectors which can be individually set to +4dBu or -10dBV levels (factory setting is +4dBu)
- LED meters indicating signal level, -3dB, and clipping on either the inputs or the outputs
- word clock I/O for synchronizing to other digital audio gear
- rugged 1U rackmount enclosure



About the Company

Frontier Design Group develops, manufactures and sells digital audio hardware and software. Our goal is to provide high-quality, high-value tools to help our customers be more creative and productive.

We're always interested in receiving your feedback on our products, as well as your ideas for improvements and new products. You can send e-mail to feedback@FrontierDesign.com or write to us at 199 Heater Road, Lebanon, NH 03766.

Technical Support

If you have any problems or questions that aren't addressed in this Guide, there are three ways to get more help:

- Refer to our web site (<http://www.FrontierDesign.com>) for information on current revisions, answers to frequently asked questions, troubleshooting procedures, and additional documentation. The web site is available every day, 24 hours a day.
- Send specific questions via e-mail to support@FrontierDesign.com. We'll respond promptly (usually within one business day).
- For time-critical questions, you can call Frontier Design Group at 1-800-928-3236 (outside the USA, call 603-448-6283). Phone support is normally provided weekdays from 9:30 am to 5:30 pm EST.

Setting Up

In addition to this Guide, your Tango24 package should contain:

- Tango24 multichannel converter box
- AC power adapter

WARNING! Before you connect the AC power adapter, verify that its prong style and input voltage rating are appropriate for your local AC power source.

1. You can install Tango24 in a standard 19" rack.
2. Attach analog cables to the appropriate inputs and outputs on Tango24's back panel. Since inputs and outputs use the same type of connectors, be careful to always connect from an output on one device to an input on another device.
3. Connect optical cables from the ADAT ports of another device (such as our WaveCenter ISA card or Dakota PCI card) to Tango24's ADAT input and output, making sure that you connect from an output to an input.

Note: The direction of an optical signal is easy to verify because optical outputs emit red light. The outputs use light-emitting diodes (LEDs), not laser light, so their light is not dangerous.

4. Connect the barrel plug of the AC power adapter to the Power input on Tango24's back panel, and connect the AC adapter to an acceptable power outlet. If the power outlet is active, all the indicators on Tango24's front panel should blink, and then the Power indicator should remain on.
5. Set the clock source switches on Tango24's front panel to the appropriate settings for your system. For details and illustrations, see "Clock Source Selection" later in this Guide.

Note: At the factory, Tango24 is set for +4dBu input and output levels. If you want to change any of the levels to -10dBV, see "Changing Input and Output Levels" later in this Guide.

≡ Front Panel ≡



Power Indicator — Lights green when Tango24's power is on.

Clock Source Switches

48kHz	If the adjacent switch is set to "Internal," the converters are clocked from Tango24's crystal-controlled 48kHz oscillator.
44.1kHz	If the adjacent switch is set to "Internal," the converters are clocked from Tango24's crystal-controlled 44.1kHz oscillator.

Word Clock	Tango24's clock system follows the Word Clock input.
Optical	Tango24's clock system follows the ADAT optical input.
Internal	Tango24 uses an internal crystal clock source whose frequency is selected by the adjacent (48/44.1) switch.

Clock Status Indicator

Shows the status of the currently selected clock source.

on	The clock is stable.
blinking	An external clock source is selected, but either its sample rate is outside of Tango24's lock range or it has other errors such as incorrect formatting.
off	An external clock source is selected, but there is no signal at that input.



Optical Input Indicator

Shows the status of the ADAT optical input signal.

on	The optical input is valid and locked to the clock system.
slow blinking	The optical input is valid, but is not locked to the Tango24 clock system (Tango24's optical input is based on a different clock source and is "slipping").
fast blinking	The optical input has errors (either the data stream contains errors or it is not ADAT optical format data – see note).
off	There is no active optical input.

Note: Although TOSLINK connections from DAT machines, CD players and other devices fit into the ADAT optical connectors physically, their 2-channel SPDIF format is logically incompatible with the 8-channel ADAT optical format used by Tango24.

Meters Switch — Selects whether the meter indicators show signal levels for input channels or output channels.

Meter Indicators

red	Clip – the signal is within 0.002dB of full scale. (When metering outputs, clip indicators remain on for about half a second. When metering inputs, clip indicators remain on until you reset them by toggling the Meters Switch to Output and then back to Input.)
yellow	-3dB – the signal is within 3dB of full scale. (This indicator remains on for about half a second.)
green	Signal – the intensity of this indicator varies in proportion to signal strength.

≡ Back Panel ≡



Analog I/O

The Tango24 converter box has 8 analog inputs and 8 analog outputs. Each can accept balanced 1/4" TRS (tip/ring/sleeve) plugs which have three metal bands for the three wires (hot/cold/ground) in a balanced audio connection, and are physically identical to 1/4" stereo plugs. Tango24 can also be used with 1/4" mono plugs which have only two metal bands, but this is an unbalanced connection which can pick up more noise than a balanced connection.

Individual jumpers inside Tango24 let you set the reference level to either +4dBu or -10dBV for each input and output independently. For more details, see "Changing Input and Output Levels" later in this Guide.

Word Clock I/O

The Word Clock Input can be used as Tango24's clock source when selected by the clock source switches on Tango24's front panel.



The Word Clock Output is always driven by Tango24's clock system at a frequency equal to the sample rate. For word clock I/O, be sure to use coaxial 75-ohm video cables with BNC connectors.

Optical I/O

The Optical Input receives audio data in ADAT optical format which is converted to 8 channels of analog output.



The Optical Thru port simply transmits a copy of the optical input data. By connecting the Optical Thru port to an ADAT machine, you can archive 8 tracks of audio to ADAT tape without recabling. Since the Optical Thru port acts as a repeater, you can also use it to send digital audio data twice as far as a single optical cable can reach.

The Optical Output transmits audio data from Tango24's A/D converters.

Note: If the optical ports or the ends of your optical cables have protective plastic covers, you'll need to remove the covers before connecting the cables.

Power

The Power jack is a barrel connector that receives power from Tango24's external AC power adapter.

WARNING! Use only a power adapter approved for Tango24 by Frontier Design Group. Using an unapproved power adapter will void all warranties and may harm Tango24's

≡ Theory of Operation ≡

Tango24 has 8 channels of analog-to-digital (A/D) conversion and 8 channels of digital-to-analog (D/A) conversion. The reference level for each analog input and output channel can be individually set to either +4dBu or -10dBV. For instructions, see “Changing Input and Output Levels” later in this Guide.

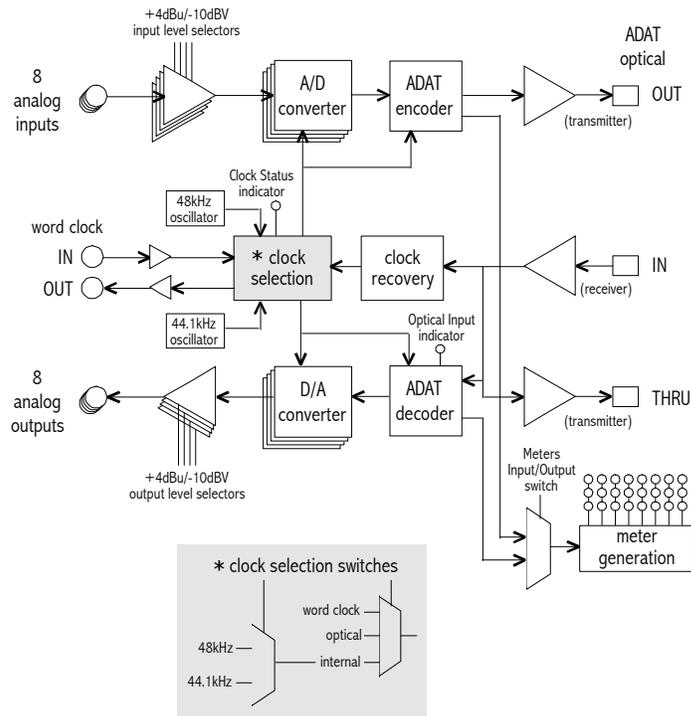
All the converters share a common sample clock along with the ADAT encoder, ADAT decoder, and word clock transmitter. This sample clock can come from internal crystal oscillators (44.1 or 48 kHz), from the word clock input, or from the ADAT optical input.

Digital audio data from the A/D converters is combined and encoded into ADAT format and is sent to the ADAT optical output.

The ADAT decoder reads 8 channels of audio and a sample clock from the ADAT optical input. As this data is sent to the D/A converters, it will be muted if —

- the ADAT decoder detects errors
- the ADAT optical input is not sample-locked to the Tango24 clock system
- the clock source is an inactive or out-of-range word clock input

Tango24 Block Diagram



≡ Tango24 Options ≡

Tango24's front panel includes clock source switches that let you specify the sample rate of your digital audio system. Tango24 also has internal jumpers that let you set the analog input/output levels to +4dBu or -10dBV.

Clock Source Selection

Every digital audio system operates at a particular sample rate, such as 44,100 samples per second (44.1kHz) for CDs. Tango24 has internal crystal oscillators that support the standard sample rates of 44.1kHz and 48kHz.

When two or more digital audio devices transfer data, one and only one of them should be used to set the sample rate. This device is called the sync source or the sample clock master, and it uses an internal oscillator to set the sample rate. All other devices must be synchronized (slaved) to the sample clock master. (Note: This discussion is referring to sample rate synchronization, not timecode synchronization.)

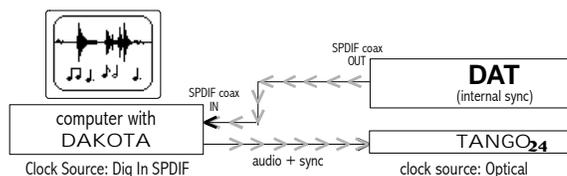
No two oscillators run at exactly the same rate, even if they're both 44.1kHz oscillators (for example). Therefore, if two devices in one system are both using their own internal oscillators, one is inevitably faster than the other. As a result, samples are lost or duplicated during the transfer. When multiple sample rates are detected, some devices mute, some generate clicks and pops, and some exhibit completely erratic behavior.

REMEMBER! Any digital audio system must always have one and only one sync source, which should determine the sample rate for all devices in that system.

For example, consider a DAT machine connected via SPDIF to a Dakota digital audio soundcard that's connected to Tango24.

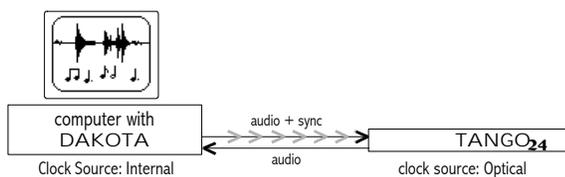
Most DAT machines must be the sync source when they're playing. Therefore, if you want to play from a DAT tape through Dakota and listen to the audio in real time through Tango24 —

- the DAT machine's sync (or clock) is set to "Internal" by default
- set the Dakota clock source to "Dig In SPDIF" (so it is slaved to the DAT's sample rate)
- set Tango24's clock source switch to "Optical" (so it is slaved to Dakota's sample rate which is in turn slaved to the DAT)

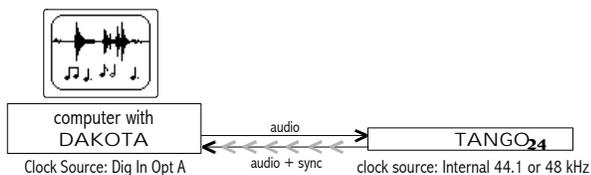


The following illustrations show some synchronization settings that work well, and two examples that don't work. In each usable system, exactly one device is set to "Internal" sync, and all other devices receive sync signals from that device.

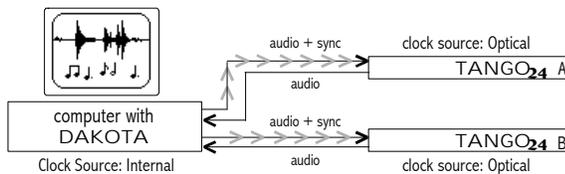
Example 1: Dakota is the master; Tango24 is slaved to Dakota.



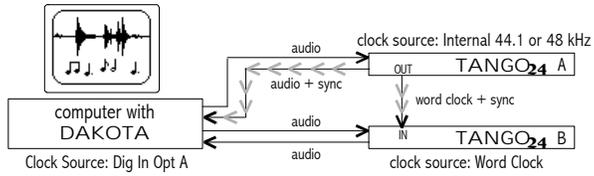
Example 2: Tango24 is the master; Dakota is slaved to Tango24.



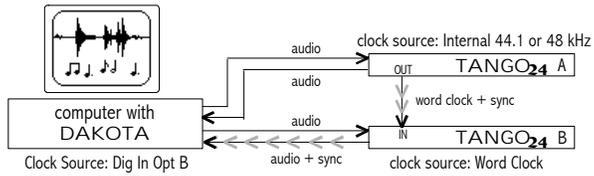
Example 3: Dakota is the master;
Tango24 A and Tango24 B are slaved to Dakota.



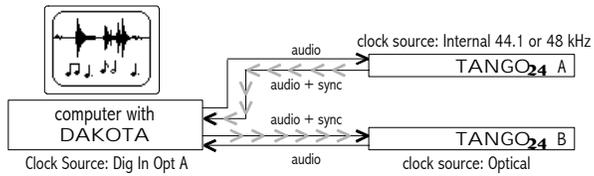
Example 4: Tango24 A is the master;
Dakota and Tango24 B are slaved to Tango24 A.



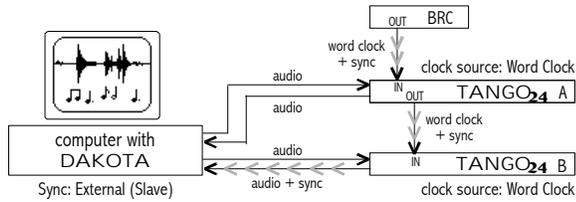
Example 5: Tango24 A is the master;
Tango24 B is slaved to Tango24 A, and Dakota is slaved to Tango24 B.



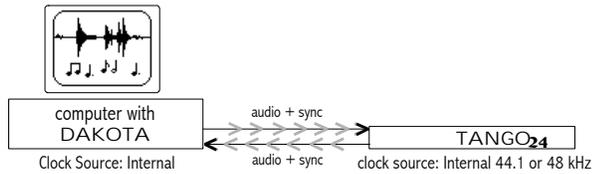
Example 6: Tango24 A is the master;
Dakota is slaved to Tango24 A, and Tango24 B is slaved to Dakota.



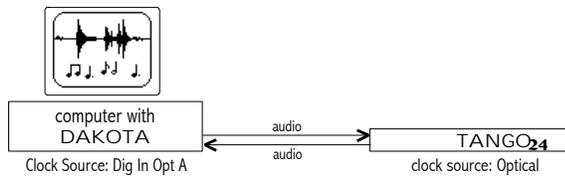
Example 7: The BRC is the master; Tango24 A is slaved to the BRC, Tango24 B is slaved to Tango24 A, and Dakota is slaved to Tango24 B.



Example 8: This example does NOT work because both devices are set to “Internal” (there are too many masters).



Example 9: This example does NOT work because each device expects sync signals from the other device (there is no master).



Changing Input and Output Levels

You can select a +4dBu or -10dBV reference level for each of Tango24's analog inputs and outputs. The factory setting is +4dBu. Most "professional" balanced I/O gear uses +4dBu levels; most unbalanced I/O gear uses -10dBV levels.

To adjust the reference level for any input or output, you change a jumper inside the Tango24 box. You'll need a small crosshead screwdriver (Phillips or Pozi-drive) and a clean, smooth work surface.

WARNING! Before opening the Tango24 box, disconnect all of its cables — especially the power cable. To protect Tango24's electronic components, always touch the metal chassis before touching the jumper or circuit boards.

1. Place Tango24 on a clean, smooth work surface and disconnect the power supply.
2. Remove the 9 screws from the top cover, and remove the screw at the top middle of Tango24's front panel.
3. Remove the top cover, and set it aside.
4. Locate the 3-pin header near the appropriate analog input or output jack(s). Each header should have a black plastic jumper covering two of the header pins. Labels on the circuit board indicate the channel numbers and reference level positions.
5. For a -10dBV level, lift the jumper and place it over the two header pins nearest Tango24's back panel. For a +4dBu level, lift the jumper and place it over the two header pins nearest Tango24's front panel.
6. Replace Tango24's cover and all 10 screws before reconnecting the power supply.

≡Troubleshooting ≡

This section describes some possible problems, and some suggestions for resolving them. It also includes a “Quick Global Test” that lets you quickly test almost all of Tango24’s functions.

Problems	Make sure the answer to each question is “yes”
Power light is off	Is the AC adapter properly connected to an AC power source and to Tango24’s power input? If the AC adapter is connected to a power strip, is the strip on?
Optical Input light is off	Is Tango24’s Power indicator on? Is there an optical cable plugged into Tango24’s optical input? If you unplug the optical cable from Tango24’s optical input, do you see red light emitting from the cable? Is the source device currently sending audio data through the optical cable?
Optical Input light is blinking rapidly (several times a second)	Is the optical cable coming from a device that is transmitting optical data in the 8-channel ADAT format rather than the 2-channel SPDIF (TOSLINK) format generated by a CD player or DAT machine?
Optical Input light is blinking slowly (less than two times a second)	Is the optical input derived from the same sample clock source as Tango24? If not, either set Tango24’s Clock Source switch to “Optical” or change the clock source at the other end of the optical input cable. Refer to “Clock Source Selection” earlier in this Guide to see settings that work well.
Analog outputs are clipping	Is the analog destination device expecting -10dBV levels? If so, are Tango24’s analog outputs set to -10dBV reference levels rather than +4dBu reference levels?
Analog outputs are weak	Is the analog destination device expecting +4dBu levels? If so, are Tango24’s analog outputs set to +4dBu reference levels rather than -10dBV reference levels?

Problems	Make sure the answer to each question is “yes”
Analog outputs are silent	<p>Are Tango24’s analog outputs routed to a mixer–amplifier–speaker system that is powered and has appropriate level settings?</p> <p>Is Tango24’s Optical Input indicator on, and not blinking?</p> <p>Are there active audio tracks playing from the computer (or other source device) on the correct ADAT optical output channels?</p> <p>With the Meters switch on Tango24’s front panel set to “Output,” do the appropriate Analog Output indicators light up in response to amplitude levels of the source audio?</p>
Analog inputs are clipping	<p>Is the analog source device sending +4dBu levels? If so, are Tango24’s analog inputs set to +4dBu reference levels rather than -10dBV reference levels?</p>
Analog inputs are weak	<p>Is the analog source device sending -10dBV levels? If so, are Tango24’s analog inputs set to -10dBV reference levels rather than +4dBu reference levels?</p>
Can’t record through Tango24’s analog inputs	<p>Is Tango24’s Power indicator on?</p> <p>Are there active analog signals routed to the appropriate Tango24 inputs?</p> <p>Is an optical cable properly connected to Tango24’s optical output?</p> <p>If Tango24 is set to an external clock source, is the Clock Source indicator on and not blinking?</p> <p>With the Meters switch on Tango24’s front panel set to “Input,” do the appropriate Analog Input indicators light up in response to amplitude levels of the source audio?</p> <p>Is the computer (or other destination device) set up to record the appropriate ADAT input channels?</p>

Quick Global Test

This loopback procedure tests almost all of Tango24's functions, and can be useful if you have doubts about whether Tango24 is working properly.

1. Connect an active analog source to Tango24's analog input 1.
2. Connect an optical cable from Tango24's optical output to its optical input.
3. Set Tango24's clock source switch to "Internal"
—OR—
If you want to verify a word clock input, connect the appropriate cable from a word clock source and set Tango24's clock source switch to "Word Clock."
4. Make sure the power is on, and monitor Tango24's analog output 1. It should sound the same as analog input 1.

You can repeat this loopback test using other input/output pairs. The output you're monitoring should sound the same as the input, and Tango24's Optical Input indicator should be on and not blinking.

To test the Optical Thru port—

1. Set Tango24's clock source switch to "Internal."
2. Connect an optical cable from the Optical Thru port to the Optical In port, and verify that the Optical Input indicator is on and not blinking.

≡ Tango24 Specifications ≡

These specifications are typical measurements and are subject to revision without notice.

A/D

Resolution	24 bits
Frequency Response	±0.05dB, 20Hz–20kHz
THD+N (EIAJ)	0.002% A-weighted
S/N ratio (EIAJ)	105dB
Connector	balanced ¼" TRS phone jack
Reference Level	+4dBu or -10dBV, selectable per channel
Headroom	15dB (maximum level 5dBV at -10dBV reference level, or 19dBu at +4dBu reference level)
Impedance	>15kΩ

D/A

Resolution	24 bits
Frequency Response	±0.05dB, 20Hz–20kHz
THD+N (EIAJ)	0.002% A-weighted
S/N ratio (EIAJ)	105dB
Connector	differentially balanced ¼" TRS phone jack
Reference Level	+4dBu or -10dBV, selectable per channel
Headroom	15dB (maximum level 5dBV at -10dBV reference level, or 19dBu at +4dBu reference level)

Other

Sample Rates	39–51kHz from optical or word clock input
Clock Sources	Internal (44.1 or 48 kHz), Word Clock, Optical Input
ADAT Optical Ports	In, Thru, Out
Word Clock Ports	In, Out
Power Supply	10–12VAC with 2.1mm x 5mm barrel jack connector
Dissipation	20W
Dimensions	19" x 8.5" x 1.75" (1U rackmount enclosure) 485mm x 215mm x 45mm
Weight	7.5 lbs (3.5 kg), including AC adapter