Data Acquisition Unit II Guide

Revision 3
August 2005

IMPORTANT
Please read this entire document before
attempting to operate
the ODAU II Unit.

Revision Status

Revision Number	Date (DD MM YY)	Description
2.8	08 12 04	Synchronization of multiple ODAU II units is essential. (Section 1.1.)
3	20 08 05	Removed Toolbench references

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Read Me First!

Read this section before continuing with the rest of the guide.

Warnings

In all NDI documentation, warnings are marked by this symbol. Follow the information in the accompanying paragraph to avoid personal injury.

1. Explosion hazard: Do not use in the presence of flammable materials such as anaesthetics, solvents, cleaning agents and endogenous gases.
2. Use of this device may create disturbances that interfere with the operation of other equipment. Likewise, use of other equipment may create emissions which interfere with the operation of this device. In the event that either of these cases are suspected, use of this device should be suspended and the appropriate technical personnel consulted.
3. Electrical shock hazard: No user-serviceable parts. All servicing to be carried out by trained technicians or referred to Northern Digital.
4. This equipment has been investigated with regard to safety from electrical shock and fire hazard. The inspection authority has not investigated other physiological effects.
5. Do not immerse any part of the Optotrak System in water nor allow water or other fluid to enter the equipment in any way. Spillage may damage it and may present a fire or shock hazard.
6. Do not autoclave any part of the system.
7. Do not attempt to bypass the grounding prong on the Position Sensor, System Control Unit, or the Power Supply Unit by using a three-prong to two-prong adapter. The unit must be properly grounded to ensure safe operation.
8. **For warnings specific to the devices in your measurement system please refer to all the manuals accompanying your system.**

Cautions

Caution! In all NDI documentation, cautions are marked with the word "Caution!". Follow the information in the accompanying paragraph to avoid damage to equipment.

1. To move or ship the Optotrak System, repack it in its original containers together with all protective packaging to prevent damage.
2. Crimping the cable and 50-pin male connector must be done by a trained technician. If the crimping is done incorrectly, electrical shorts could occur and may damage the ODAU II.
3. Ensure that all system components are powered OFF before connecting/disconnecting any equipment.

4. The steps to attaching the Power Supply Unit to the ODAU II must be done in the order that they are specified. Improper connections could result in damage to both the ODAU II and/or the Power Supply unit.

Disclaimers

1. All Northern Digital Inc. tracking systems are designed to exclusively use NDI specific components (i.e. Position Sensors are manufactured to track NDI markers). NDI is not responsible for any outcome that should arise from using non-NDI components.

Contact Information

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Updates

NDI is committed to continuous improvements in the quality and versatility of its software and hardware. To obtain the best results with your NDI system, check the NDI Partner Site regularly for update information:

http://support.ndigital.com

1 Introduction and Overview

The Optotrak Analog Data Acquisition Unit II (ODAU II) unit is an optional component of the Optotrak System. The ODAU II includes all the ODAU I unit functions but supports higher data rates, and has additional functions.

The ODAU II is capable of analog and digital input and outputs.

The most common end user application of the ODAU II is to convert an analog signal from sources such as a forceplate or an EMG (electromyogram) to a digital signal for processing by the System Control Unit (SCU).

The ODAU II automatically synchronizes the collection of incoming data from external sources to incoming Optotrak position data. Sample applications would be a gait analysis lab or a study monitoring muscular electrical activity.

Note The term “Optotrak” in this guide applies to both the Optotrak 3020 and the Optotrak Certus systems.

Note The ODAU II is designed for use with the Optotrak 3020 System. The ODAU II is not compatible with the Optotrak 3010/2010 System. The ODAU II cannot be used in conjunction with ODAU I units.

The ODAU II option includes:

- an ODAU II
- a Power Supply unit
- a communication cable with circular metal connectors
- a synchronization cable with BNC connectors
- a 50-pin male connector

This document contains hardware and software information about the ODAU II.

1.1 Connections

The ODAU II must be connected to the System Control Unit (SCU). If more than one ODAU II is used, they are connected in series to each other. A maximum of four (4) ODAU IIs may be connected in one setup. Communication cables equipped with circular metal connectors allow communication between units. Multiple ODAU II’s must be synchronized. To synchronize the ODAU II’s with each other, separate coaxial cables equipped with BNC connectors are used. The BNC clock out signal can also be sent to an external device.

1.2 Inputs

In the default configuration, the ODAU II allows you to collect 16 single-ended or 8 differential analog channels of input data in addition to 8 digital input channels. The number of input channels collected using the ODAU II'ODAU IIs can be increased in two ways:

1. Up to 4 ODAU II's can be connected in the same system, each allowing the collection of up to 16 analog and 8 digital channels of input.
2. A National Instruments AMUX-64T multiplexer board may be connected to an ODAU II to increase the number of analog input channels to either 64 single-ended or 32 differential channels. In this case, the number of digital input channels is reduced to 4 (per ODAU II). Contact National Instruments (*www.ni.com*) for more information about the multiplexer board.

1.3 Software Control

ODAU II settings can be set using NDI application software or the Application Programmer's Interface (API). Digital and analog outputs may be controlled from user-written programs using the API.

Analog and/or digital input data may be collected using NDI application software or the API.

1.4 Using the ODAU II

The ODAU II is controlled via application software. Refer to the documentation that accompanied your application software for details on data collection. In general the process for data collection using the ODAU II is as follows:

1. Attach the forceplate (or other analog input device) to the appropriate analog input channels (ACH 3-18 see Table 2-2 on page 6). As appropriate, use the 50-pin male connector (with attached ribbon cable) to facilitate this connection.
2. Power up the ODAU II.
3. On the host computer start the data collection application software.
4. Follow the procedure in the application software to ensure that:
    a) The ODAU II is connected in the setup
    b) The number of ODAU IIs is correct
    c) The ODAU hardware revision is set to 2
5. Follow the procedure in the application software to collect data.

2 Parts and Functions

2.1 The ODAU II

Front View

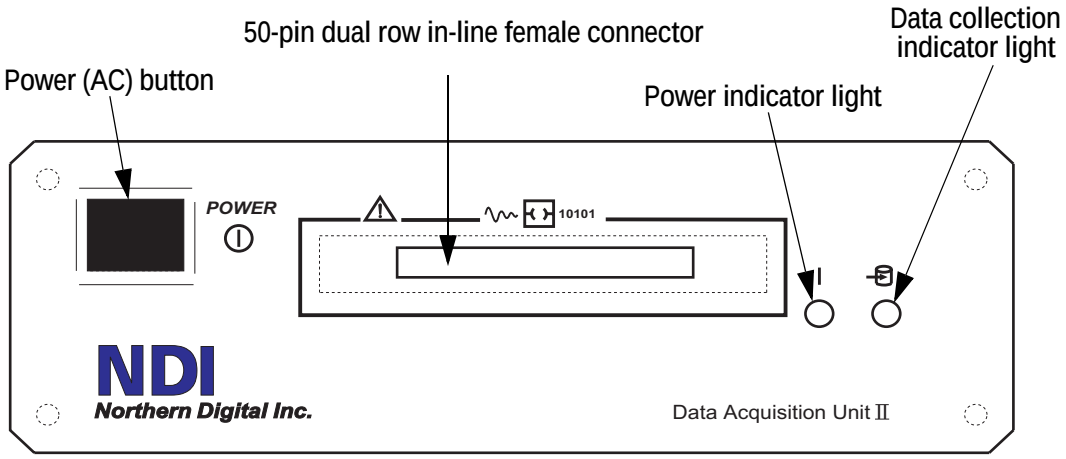


Figure 2-1 ODAU II - Front View

Power (AC) button Depress this button to power the ODAU II on and off.

50-pin dual row in-line female connector This low density connector enables the relay of input and output signals to and from the ODAU II. Pin 1 of the connector is in the upper left corner when you are looking at the front of the ODAU II. Pin 2 is underneath Pin 1. All odd numbered pins are in the same row as pin 1 and all even numbered pins are in the same row as pin 2. See Front Panel Connector Pins on page 4. Depending on how the ODAU II will be connected in your setup, a 50-conductor ribbon cable (which may be purchased from a local electronics store) can be crimped onto the 50-pin male connector included with the ODAU II, and then attached to the female connector here.

Caution! Crimping the cable and 50-pin male connector must be done by a trained technician. If the crimping is done incorrectly, electrical shorts could occur and may damage the ODAU II.

Data collection indicator light (green) Lights when a data collection is in progress.

Power indicator light (green) Lights when the ODAU II is powered ON.

Back View

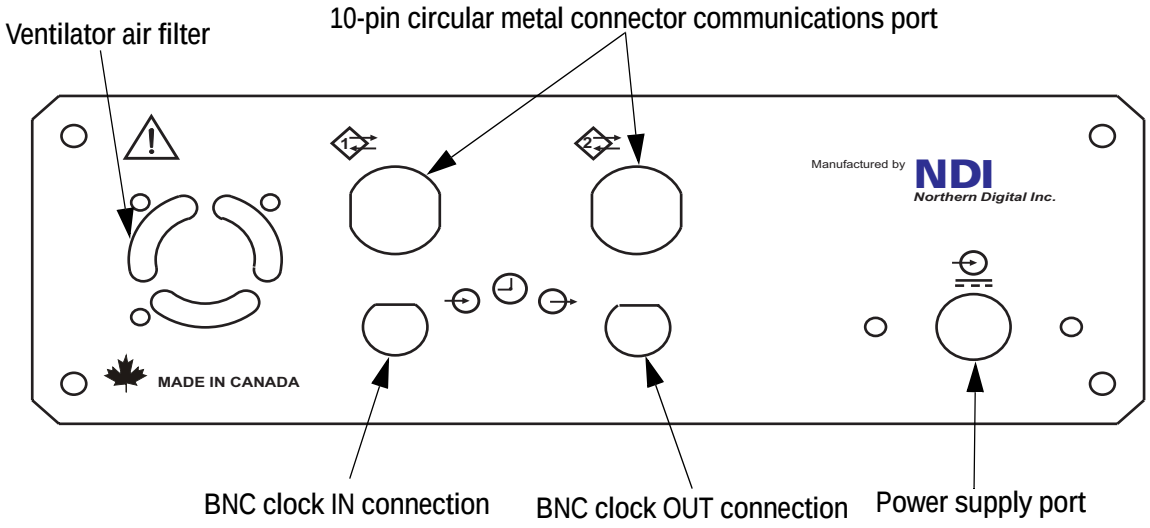


Figure 2-2 ODAU II - Back View

10-pin circular metal connector communications port Either communication port can be used for connecting the ODAU II to the System Control unit or for connecting the next ODAU II in a chain.

Ventilator air filter

BNC clock IN connection This connection provides synchronization between multiple ODAU II's in a single system.

BNC clock OUT connection This connection provides synchronization between multiple ODAU II's in a single system.

Power supply port An 8-pin connector that links the ODAU II to the Power Supply unit.

Front Panel Connector Pins

The 50-pin connector found on the ODAU II is a low-density connector that enables the relay of input and output signals to and from the ODAU II. The signal on each pin is indicated in Table 2-1 on page 5. The 50 pins on the connector are numbered as follows:

- Pin 1 is in the upper left corner when you are looking at the front of the ODAU II.
- Pin 2 is underneath pin 1.
- All odd numbered pins are in the same row as pin 1.
- All even numbered pins are in the same row as pin 2.

Table 2-1 Pin Signals

Signal	Pin Number	Pin Number	Signal
AI GND	1	2	AI GND
ACH0	3	4	ACH8
ACH1	5	6	ACH9
ACH2	7	8	ACH10
ACH3	9	10	ACH11
ACH4	11	12	ACH12
ACH5	13	14	ACH13
ACH6	15	16	ACH14
ACH7	17	18	ACH 15
AI SENSE	19	20	DAC0 OUT
DAC1 OUT	21	22	EXT REF
AO GND	23	24	DIG GND
ADIO0	25	26	BDIO0
ADIO1	27	28	BDIO1
ADIO2	29	30	BDIO2
ADIO3	31	32	BDIO3
DIG GND	33	34	+5 V
+5 V	35	36	!SCANCLK
!EXT STROBE	37	38	!STARTTRIG
!STOP TRIG	39	40	!EXTCONV
TIMER CLK 2	41	42	TIMER GATE 2
TIMER OUT 2	43	44	N/C
N/C	45	46	!FRAME CLK
N/C	47	48	N/C
N/C	49	50	FOUT

Table 2-2 Pin Signal Descriptions

Pin Number	Pin Signal	Signal Description
1 - 2	AI GND	Ground for analog input signals
3 - 18	ACH0 - ACH15	Analog input channels - in differential mode the channels are paired ACH0 with ACH8, ACH1 with ACH9, etc.
19	AI SENSE	**Single-ended mode**: same as AI GND **Differential mode**: same as whichever of the ACH8 - ACH15 that is being scanned (i.e. varies during collection)
20 - 21	DAC0 OUT and DAC1 OUT	Analog output channels, +/-5 volt @ 20mA max
22	EXT REF	External reference to scale the analog output channel(s) - when enabled in hardware, application of a signal V_{REF} in the range 0V - +5V (e.g. sine wave) will give an analog output channel value of (V_{REF} /5) times the value set for the output channel using COLLECT or API software. **Note**: Use of this feature is not supported in the default configuration of the ODAU II. If you require this functionality, please contact Northern Digital Technical Support for assistance.
23	AO GND	Ground for the analog output signals.
24, 33	DIG GND	Ground for digital input/output signals.
25/27/29/31	ADIO0-3	Digital input/output channels, or control signals for a multiplexer board (if used).
26/28/30/32	BDIO0-3	Digital input/output channels.
34-35	+5V	Reference voltage. Also used to power user circuits up to 500mA.
36	!SCANCLK	Is normally high, and pulses low at the beginning of sampling each channel. There will also be a single pulse for sampling the digital channels if digital collection is enabled. **Note:** The "!" signifies that when active, this pin signal pulses low.
37	!EXT STROBE	Is used by the AMUX-64T Multiplexer Board (latches output pins of port A).
38	!START TRIG	Not currently implemented.
39	!STOP TRIG	Not currently implemented.
40	!EXTCONV	Tied to the Clock IN connector on the back panel (i.e. if a signal is applied to the back panel Clock IN, it appears on this pin; if a signal is applied to this pin, it also appears on the Clock IN connector on the back panel).
41 - 43	TIMER CLK 2/ TIMER GATE 2/ TIMER OUT2	Provides a user-accessible divide-by-n clock, controlled through the ODAU II. Set Timer function of the Optotrak API.
44/45/47/48/ 49	N/C	Not connected.

46	!FRAME CLK	Normally high and pulses low for approximately 50 ns at the beginning of each ODAU frame - this pulse coincides with the first SCANCLK pulse of the frame.
50	FOUT	Optotrak frame clock for the first ODAU II in a chain.

2.2 The Power Supply Unit

Top View

Figure 2-3 Power Supply Unit - Top View

Mini-DIN connector cable Connects the Power Supply unit to the ODAU II.

3-pin receptacle Provides a connection to the mains power supply. The power cable must be plugged into a grounded AC receptacle.

Front View

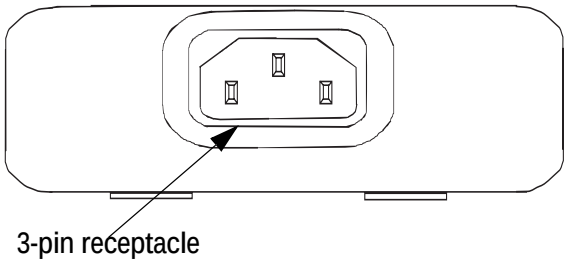


Figure 2-4 Power Supply Unit - Front View

3-pin receptacle Provides a connection to the mains power supply. The power cable must be plugged into a grounded AC receptacle.

Back View

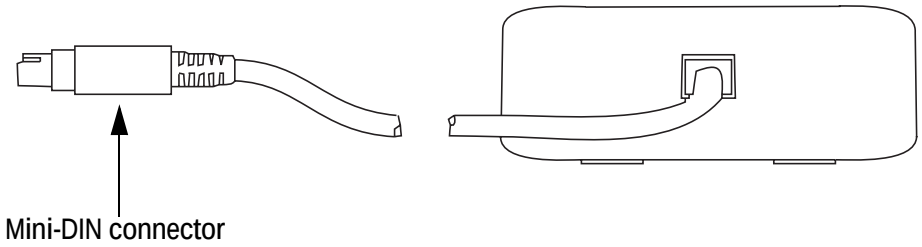


Figure 2-5 Power Supply Unit - Back View

Mini-DIN connector Connects the Power Supply Unit to the ODAU II.

3 Connecting the ODAU II

3.1 Connecting the ODAU II to the Power Supply Unit

To use the ODAU II with your system, you must first connect the ODAU II to the Power Supply Unit (PSU).

Note Please read carefully all instructions before attempting to connect the ODAU II to the Power Supply Unit.

Caution! The steps to attaching the Power Supply Unit to the ODAU II must be done in the order that they are specified above. Improper connections could result in damage to both the ODAU II and/or the Power Supply Unit.

To connect the ODAU II to the PSU, follow these steps:

1. Ensure that all components within the system are powered OFF.
2. Locate the 8-pin power supply port found on the ODAU II. See Figure 2-2 on page 4.
3. Insert the PSU mini-DIN connector (See Figure 2-5 on page 8) into the 8-pin power supply port on the ODAU II.
4. Attach one end of the power line cord, provided with the ODAU II, to the 3-pin receptacle located on the front of the PSU. See Figure 2-4 on page 7.
5. Plug the other end of the power line cord into the mains power supply.

3.2 Connecting a Single ODAU II to the System Control Unit

Caution! Ensure that all system components are powered OFF before connecting/disconnecting any equipment.

To connect the ODAU II to the System Control Unit (SCU):

1. Ensure that all components within the system are powered OFF.
2. Plug one end of the communication cable, included with the ODAU II, into one of the 10-pin circular metal connector communication ports found on the back of the ODAU II. See Figure 2-2 on page 4.
3. Plug the other end of the communication cable into one of the available 10-pin circular metal connector communication ports found on the back of the System Control Unit.
4. Power on the SCU and the ODAU II.

Note When the unit is initially powered on, you should hear a single chirp tone and the power indicator light on the front panel should light up.

3.3 Connecting Multiple ODAU II's to the System

Caution! Ensure that all system components are powered OFF before connecting/disconnecting any equipment.

To connect multiple ODAU II's:

Note Each ODAU II requires its own Power Supply Unit.

1. Ensure that all components within the system are powered OFF.
2. Plug one end of the communication cable into one of the 10-pin circular metal connector communication ports found on the back of the **first ODAU II**. See Figure 2-2 on page 4.
3. Plug the other end of the communication cable into one of the 10-pin circular metal connector communication ports found on the back of the **System Control Unit.**
4. Plug one end of a **second** communication cable into one of the 10-pin circular metal connector communication ports found on the back of the **second** ODAU II.
5. Plug the other end of the **second** communication cable into the other circular metal connector communication port on the back of the **first** ODAU II.
6. Connect one end of the coaxial cable (BNC connector) into the clock OUT connector on the back panel of the **first** ODAU II. See Figure 2-2 on page 4.
7. Connect the other end of the coaxial cable into the clock IN connector, located to the left of the clock OUT connector, on the back panel of the **second** ODAU II. See Figure 2-2 on page 4.
8. Repeat steps 4 to 7 for each additional ODAU II.

4 Technical Specifications

4.1 ODAU II Technical Specifications

Dimensions	270 mm x 175 mm x 65 mm
Weight	2 kg
Mains Power **AC Input Requirements**	90 to 264 VAC @ 47 Hz to 63 Hz

Operating Environmental Conditions

Atmospheric Pressure	70 to 106 kPa
Relative Humidity	30 to 75%
Temperature	+10 to $+40^{0}$C
Input Capacitance	42 pF
Impedance	$\frac{1}{2\pi F \times 42pF}$ where F is the frequency

4.2 Power Supply Technical Specifications

Approvals	UL 544/2601.1/1950 CSA C22.2 #125/234/601.1/950 TUV EN 60601.1/60950 Meets requirements of European EMC directive and EMC requirements from EN60601-1-2 Meets level B requirements of FCC part 15 and CISPR11(EN55011), CISPR22(EN55022) and EN50081-1
Dimensions	160 mm x 85 mm x 38 mm
Weight	450 g

Note These approvals only apply to the Jerome Industries WSL series power supply with the part number WSL-206M.

Operating Environmental Conditions

Atmospheric Pressure	50 to 106 kPa
Relative Humidity	20 to 95%
Temperature	0 to $+40^{0}$C

5 ODAU II Device Specifications

Number of Channels

Input	With 1 Multiplexer[a]	Without Multiplexer
Single-ended analog	64	16
Differential analog	32	8
Digital	4	8

a. Up to four (4) multiplexer boards can be used.

Analog Gain

Gain	Voltage Range (V)	Maximum Recommended Scan Rates (Hz)
1	–10 to +10	90,000
5	–2 to +2	90,000
10	–1 to +1	70,000
100	–0.1 to +0.1	20,000

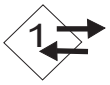
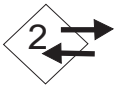
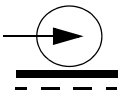
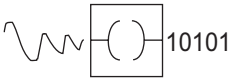
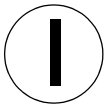
Frame Frequency

1 to 100,000 Hz

6 Abbreviations and Acronyms

Abbreviation or Acronym	Definition
AC	Alternating Current
API	Application Programmer’s Interface
BNC	Bayonet Neill-Concelman (connector)
CSA	Canadian Standards Association
DIN	Deutsches Institut fur Normung (German Standardization Institute)
EMC	ElectroMagnetic Compatibility
MUX	MUltipleXer
EMG	ElectroMyoGram
FCC	Federal Communications Commission
ODAU II	Optotrak Analog Data Acquisition Unit II
PSU	Power Supply Unit
SCU	System Control Unit
TUV	Technischer Überwachungs-Verein (Technical Watch-Over Association)
UL	Underwriter’s Laboratories
VAC	Volts Alternating Current

7 Equipment Symbols

Symbol	Meaning
	Follow the information in this paragraph to avoid personal injury and/ or property damage.
	Circular Metal Connector Communications Port #1
	Circular Metal Connector Communications Port #2
	ODAU II BNC Clock Connections In (at left) and Out (at right)
	Data Collection Indicator Light
	Power Supply Port
	Analog and Digital 50-pin Input Connector
	Power Indicator Light
	Power (AC) Button