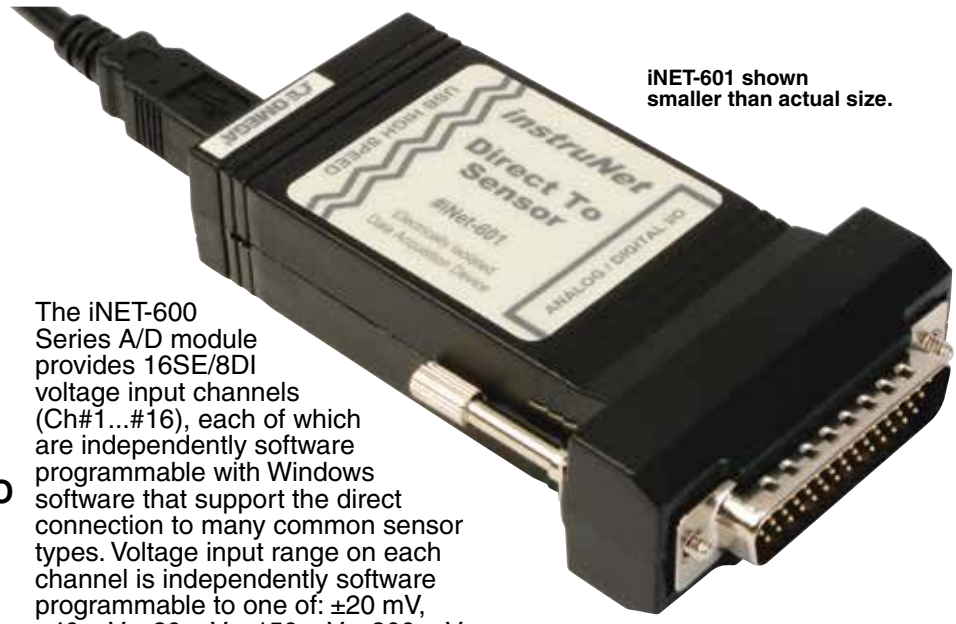
High Accuracy Direct-to-Sensor USB Data Acquisition System

OMEGA™

iNET-600 and iNET-601

1 YEAR WARRANTY

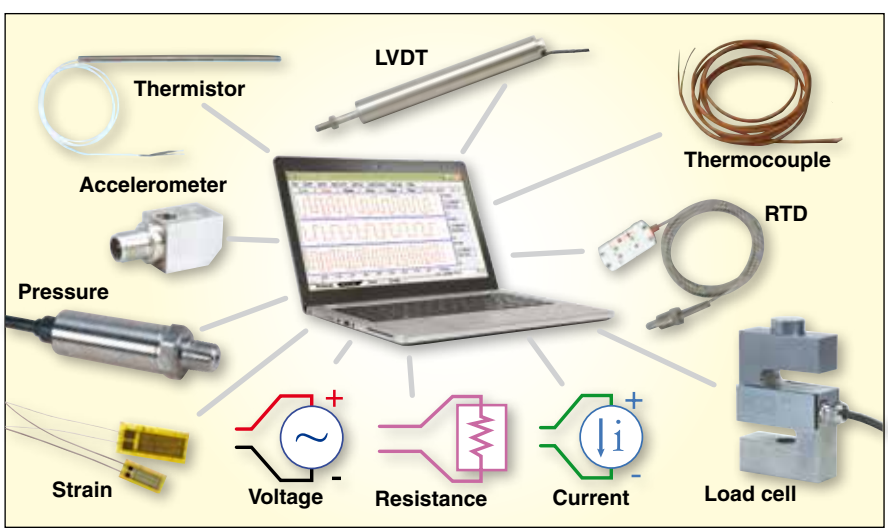


iNET-601 shown smaller than actual size.

- **16SE/8DI Voltage Input Channels with Extremely Accurate 24-Bit A/D Converter that Supports ±20 mV to ±10V Ranges**
- **4 Digital I/O (4 mA Sink/ Source, 0 to 3.3V)**
- **Controls Process via Windows® Software Using Analog Inputs and Digital I/O**
- **iNET-601 Provides ±36V Input Bank to USB Electrical Isolation**
- **iNET-600 Connects I/O Signal Ground to Computer Ground**
- **Receives Power from the USB Bus and Provides Excitation Power (+3.3V, 80 mA) to Sensors**
- **Easily Set-Up Sensors Using the Included instruNet World Software**
- **Connect a Computer Directly to Sensors: Voltage, Thermocouple, Thermistor, RTD, Load Cell, Strain Gage, Potentiometer, Current, Resistance**

The iNET-600 Series A/D module provides 16SE/8DI voltage input channels (Ch#1...#16), each of which are independently software programmable with Windows software that support the direct connection to many common sensor types. Voltage input range on each channel is independently software programmable to one of: ±20 mV, ±40 mV, ±80 mV, ±150 mV, ±300 mV, ±600 mV, ±1.2V, ±2.5V, ±5V, ±10V. Included is a mating Hd44 Female Connector and Cover. Alternatively, you can attach iNET-600 Series to the following optional wiring boxes: iNET-500, iNET-511, iNET-512. If you are working with thermocouples, an iNET-510 wiring box is required due to its internal cold junction compensation.

iNET-600 Series is a stand-alone USB data acquisition system. No additional components, such as external power supply, are required. Included in the box: iNET-600 Series Hardware Device, USB Cable, Software on CD, Mating Hd44 Female Connector and Hd44 Cover.



Digitize at a maximum sample rate of 160K sample/sec for 1 channel, 16Ks/sec/ch for 2 channels, 8Ks/sec/ch for 4 channels, and 4Ks/sec/ch for 8 channels. Maximum sample rate is for ±5V input signal. For accuracy and sample rate details on all supported input signals, see the tables at the end of the spec sheet.

Each channel provides the following software programmable parameters: A/D Signal-Averaging-Per-Point (0 ... 100 mSec), Sample-Rate (samples-per-second-per-channel), Digital IIR Filter (Low Pass, High Pass, Band Pass, or Band Stop), Voltage Measurement Range (±20 mV to ±10V), Sensor Type, and Single-Ended or Differential Wiring.

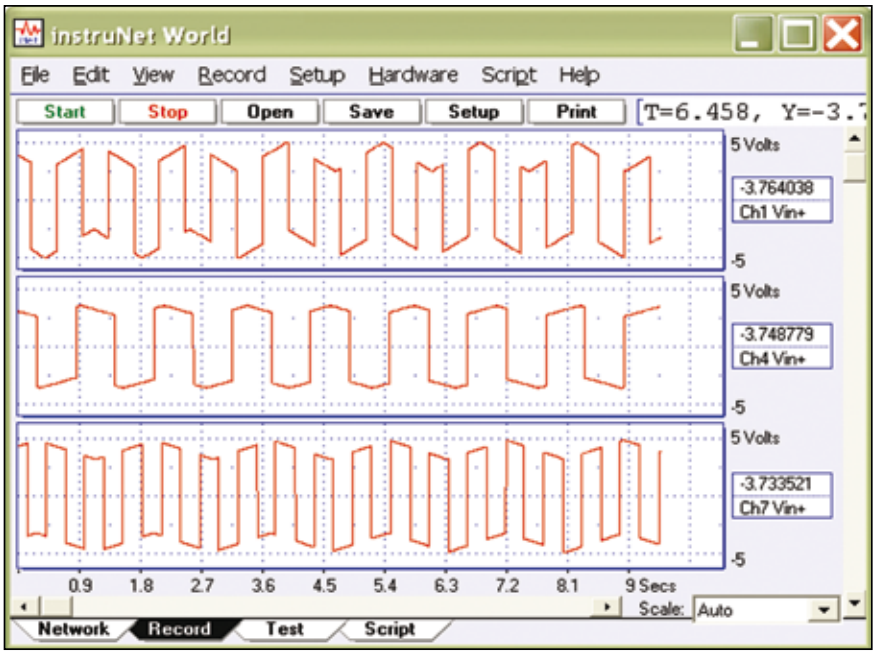
Excitation power (+3.3V ±0.2V, <80 mA, 28 mA per sensor max) is provided for sensors, along with other End User Power voltages. This 3.3V, which is referenced to instruNet Ground, is automatically read back by A/D when calculating sensor values.

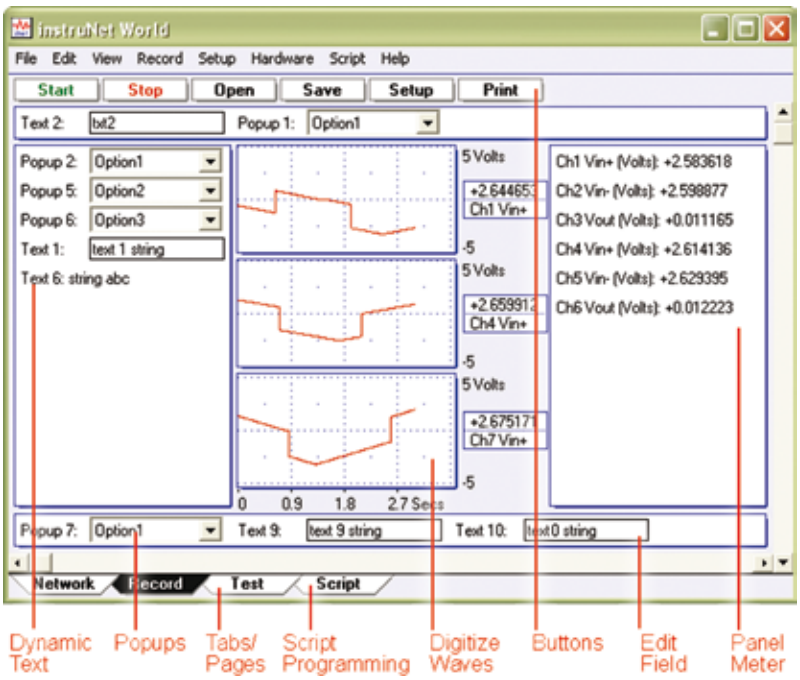
The 4 mA sink/source digital I/O port consists of 4 individual TTL-compatible lines (Ch#25...#28), each of which can be configured as: input or output bit. When configured as an input, a channel can be used to sense a digital high (2 to 5.5V) or digital low (0V to 0.8V). When configured as an output, a channel

can be set high (e.g. >2V) or low (e.g. <0.8V). These I/O pins are short-circuit protected against high voltages up to 6.0V and down to -6.0V.

Digitize and Plot Waveforms in Real-time

Waveforms are recorded in one long continuous stream (strip chart mode); or they are digitized in short segments where each segment begins after a specified trigger event (oscilloscope mode). Any one of the instruNet analog or digital input channels can be used as a trigger. Data is either placed into RAM memory, a file on disk, or is deleted after being plotted. One uses the Setup dialog box to set the sample rate (i.e. points-digitized-per-second-per-channel) and number of points digitized; and uses the Network page to select which channels are digitized. After setting up the system; one can press the Network Save button to save the setup, press the Start button to start digitizing, press the Stop button to stop it, press the Record Save button to save waves in RAM to disk (post-acquisition), and press the Open button to load waves from disk for viewing.





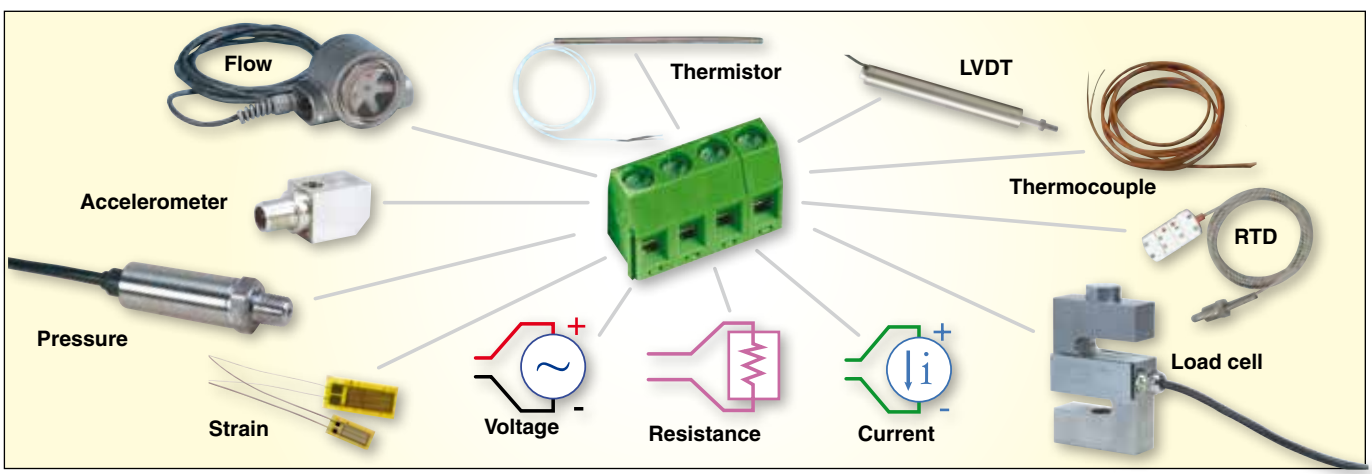
Free instruNet World Software

instruNet World Software is a FREE application program that manages, monitors and operates instruNet data acquisition and control hardware. Additionally, it digitizes long continuous waveforms, spools them to disk, views incoming waveforms in real-time and then allows post acquisition viewing, like an oscilloscope or strip chart recorder.

Download free instruNet Software to Learn More

If you want to learn more about instruNet software, you can download it for free from

instruNet World PLUS software adds valuable features to the FREE instruNet World (not PLUS) software.



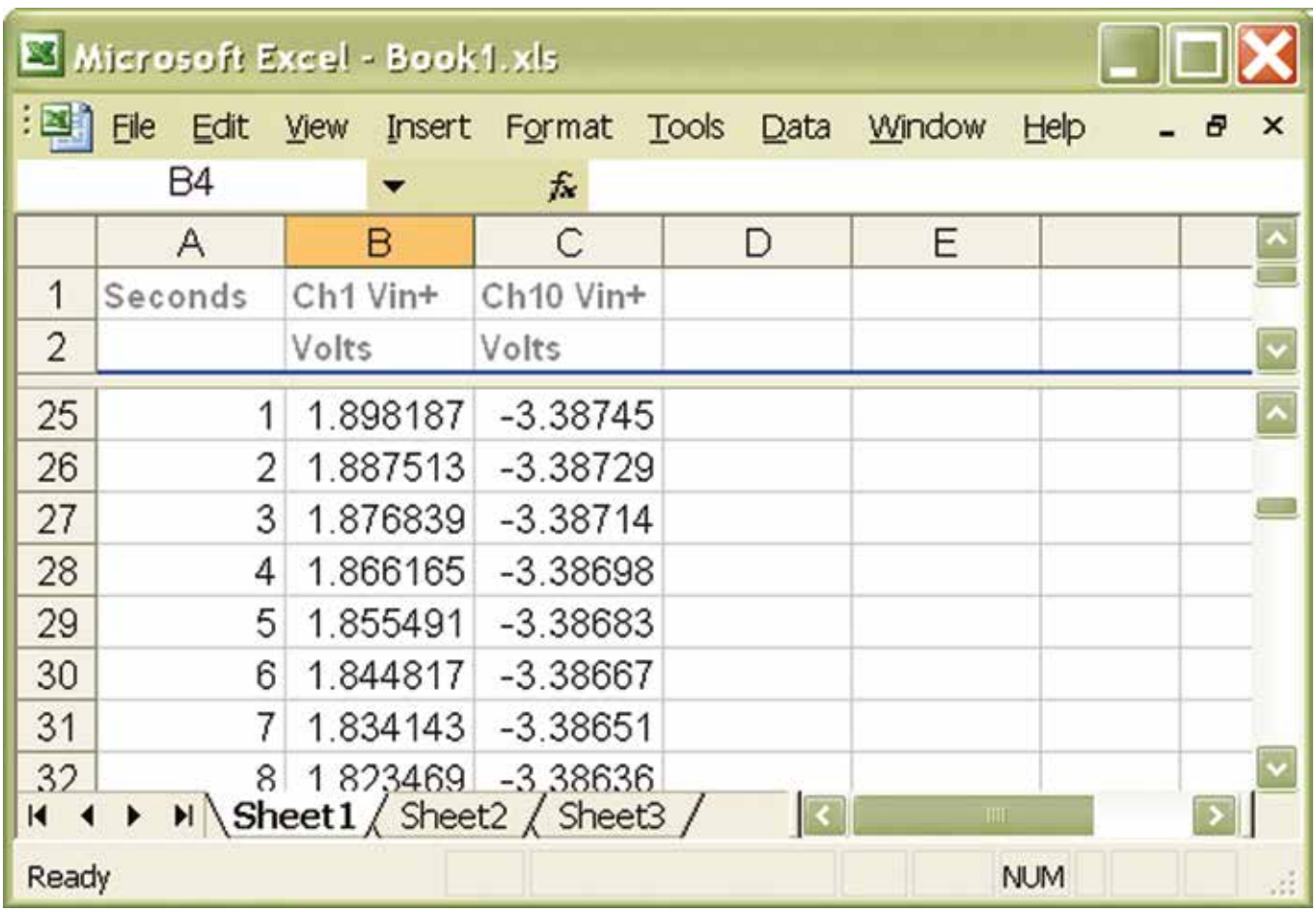
Connect Directly to Thermocouple, RTD, Thermistor, Strain Gage, Load Cell, Voltage, Current, Resistance and Accelerometer Inputs.

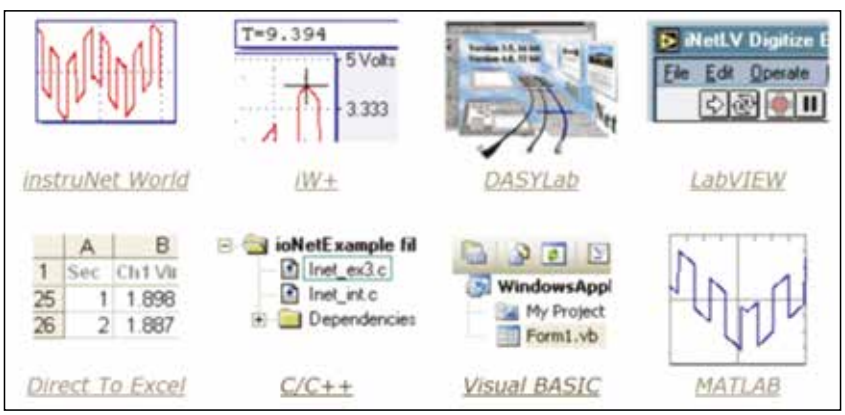
the OMEGA website and do the tutorial with “instruNet World Demo. exe”. This program is the same as “instruNet World.exe”, except it generates a random number instead of reading the A/D.

Optional instruNet World PLUS (iNET-IWPLUS) Software

instruNet World PLUS (iNET-IWPLUS) is a reasonably priced yet powerful and easy-to-use data acquisition software program for Windows. It enables you to digitize, plot, control, analyze, and save to disk A/D, and digital I/O data from instruNet hardware. Additionally, it enables you to define your own instrument front panel with buttons, popup menus, edit fields, dynamic text, text editor regions, and waveform graphs; as illustrated on the right. instruNet World PLUS is programmed with a simple script language that can define tasks such as control loops. For example, one can type “Dio1 = OnOff (Ain1, 3)” to define Dio #1 as a function of A/D #1.

Digitize Directly into Excel® Spreadsheet

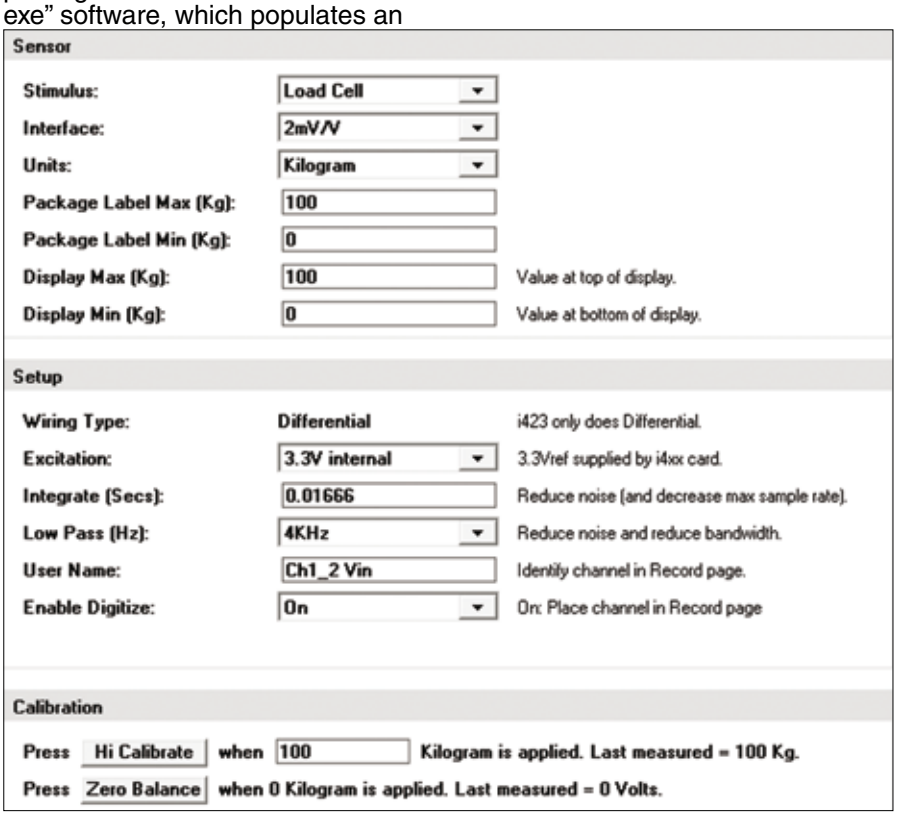




Application Software

instruNet is compatible with Excel, LabVIEW®, DASYLab®, MATLAB, Origin, C & Visual BASIC software. Application software is used to configure all I/O channels, store your settings, view digitized data in real-time, analyze, stream data to disk, and scroll through your waveform post-acquisition.

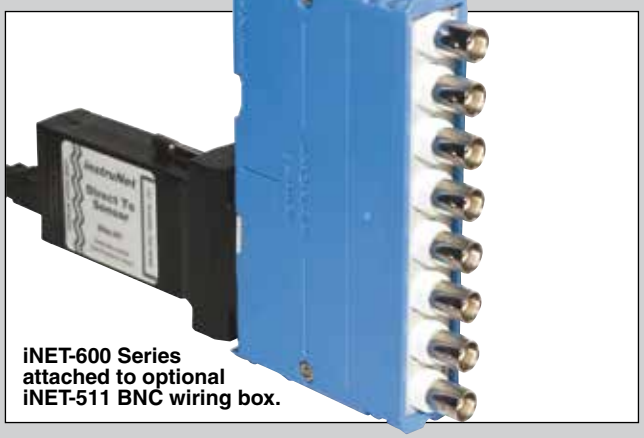
As illustrated on the right, the instruNet World PLUS software package includes “Direct To Excel. exe” software, which populates an



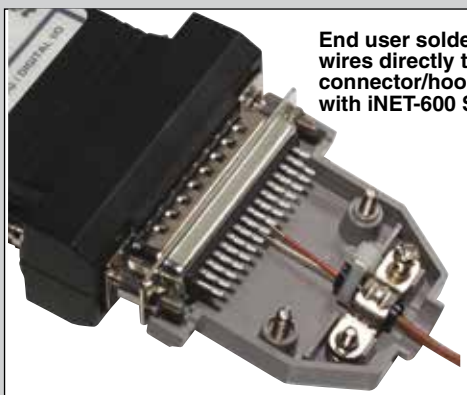
Wiring to Sensors

The following photos show several methods for attaching to sensors:

iNET-600 Series attached to optional iNET-512 wiring box.



iNET-600 Series attached to optional iNET-511 BNC wiring box.



End user solders sensor wires directly to mating Hd44 connector/hood included with iNET-600 Series.

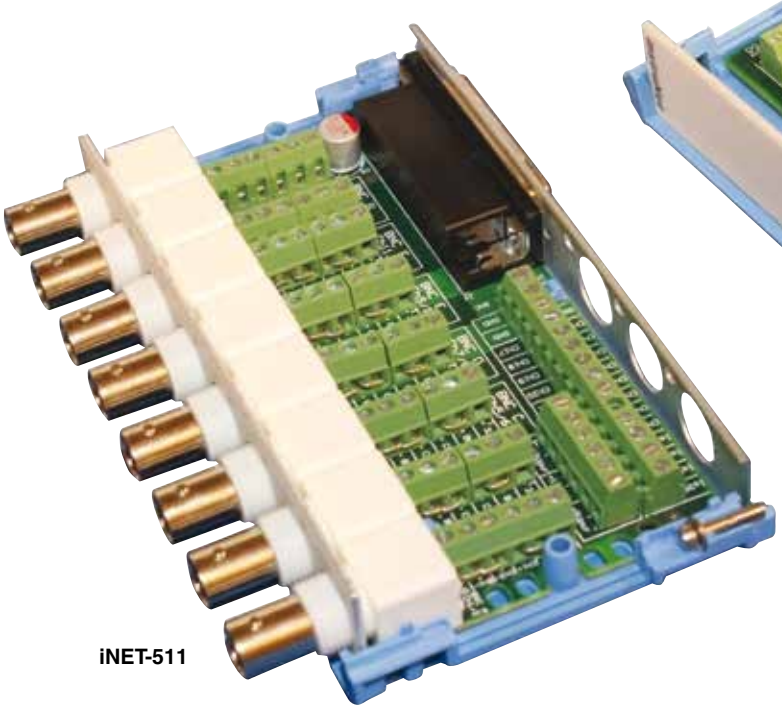
Mating Hd44 female connector, Hd44 cover and hardware assembly kit included with iNET-600 Series.

Optional Wiring Boxes

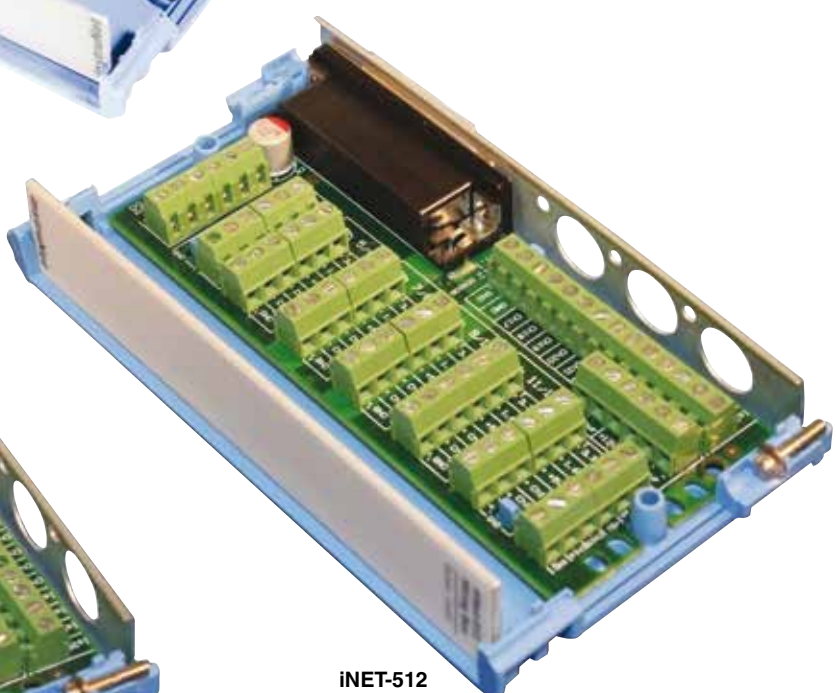
iNET-510, iNET-511, iNET-512 wiring boxes easily bolt to iNET-600 Series devices. The iNET-510 is the simplest, is the lowest cost, and supports thermocouples. The iNET-511 includes 8 BNC connectors. The iNET-512 has a vRef/2 source that is used to help complete ¼ bridge and ½ bridge strain gage circuits. If you are measuring thermocouples, then the iNET-510 is the only wiring box that will work, since it contains an internal temperature sensor that measures the temperature of the iNET-510 screw terminals.

Model	BNC connectors	Thermocouple support	¼ and ½ bridge strain gage vRef/2 support	Individual banks of screw terminals for each sensor
iNET-510	0	yes	no	no
iNET-511	8	no	no	yes
iNET-512	0	no	yes	yes

iNET-510



iNET-511



iNET-512

Specifications

ANALOG INPUTS

Number of Channels: 16 single-ended (SE)/8 differential (DI)

A/D Converter: 24-bit when averaging each point for ≥1m sec; and 16 bits when not averaging

Voltage: See voltage accuracy/range charts

Voltage Ranges: ±20 mV, ±40 mV, ±80 mV, ±150 mV, ±300 mV, ±600 mV, ±1.2V, ±2.5V, ±5V, ±10V

Electrical Isolation (iNET-601 Only): ±36 Vdc bank isolation

Protected Voltage: ±30 Vdc with power on or off

RFI Filter: 13 KHz RFI filter on ≤ ±150 mV range

Digital Filter: Low Pass, High Pass, Band Pass, or Band Stop

Digital Filter Type: Elliptic, Chebyshev B, Chebyshev S, or Butterworth

Common Mode Voltage: ±10 Vdc

Common Mode Rejection Ratio: ≥110dB (0 to 60 Hz)

Input Impedance: 100 MΩ

SENSOR MEASUREMENT

Thermocouple: J/K/T/E/R/S/B/N/C/G/D

Thermistor: 2252 Ω (OMEGA 44000 Series), custom

RTD: 100 Ω, 500 Ω, 1 kΩ platinum

Load Cell: 10 kg, 25 kg, 100 kg, 250 kg, 1000 kg, 5000 kg, custom

Strain: 120 Ω or 350 Ω. ¼ bridge, half bridge or full bridge; internal i60x voltage reference supports a maximum of three 120 Ω bridges; and eight 350 Ω bridges

Potentiometer: 1 to 50 kΩ

Current: ±80 uA, ±120 uA, ±500 uA, ±600 uA, ±800 uA, ±1.2 mA, ±2.5 mA, ±12 mA, ±24 mA, 0 to 24 mA, custom

Resistance: 0 to 33 Ω, 0 to 100 Ω, 0 to 330 Ω, 0 to 1 kΩ, 0 to 3300 Ω, 0 to 10 kΩ, custom

LVDT/Flow/Pressure: Current, voltage, mV/V

DIGITAL I/O

Number of Channels: 4 digital I/O (4 mA sink/source, 0 to 3.3V)

"0" Input Voltage: 0 to 0.8 Vdc

"1" Input Voltage: 2 to 5.5 Vdc

"1" Input Current: Amps = V_{in} / 50 kΩ ("1" must drive internal 50 kΩ pull-down resistor)

"0" Output Voltage: <0.7 Vdc @ <2 mA; < 0.9 Vdc @ 4 mA

"1" Output Voltage: 2.2 to 3.3 Vdc @ 4 mA

Pull-Down Resistor: 50 kΩ ±1%

ENVIRONMENTAL

Operating Environment: 1 to 70°C (34 to 158°F), <90% RH, no condensation

Storage Temperature: -20 to 70°C (-4 to 158°F)

POWER

Power Consumed From USB Cable: +5 Vdc 255 mA typical (433 mA max)

Voltage Reference At Hd44 Connector: 3.30 Vdc (80 mA)

Unregulated Power Available to User At Hd44 Connector: 5 Vdc (8 mA), ±15 Vdc (4 mA)

MECHANICAL

Material: Plastic enclosure

Dimensions: 58 H x 96 W x 24 mm D (3.784 x 0.924 x 2.286")

Weight: 454 g (1 lb)

Mounting: Place on desktop, attach to wall, or place inside another enclosure (OEM)

Voltage Range/Accuracy[1]

Voltage Range	Signal Averaging Per Point	Absolute Accuracy (Max Gain + Offset Error)	Max Multi-Channel Aggregate Sample Rate (s/sec/agg)
±10V	0 mSec	±(0.005% + 1569.9 µV)	33.40K
	1.0 mSec	±(0.005% + 271.8 µV)	0.77K
±5V	0 mSec	±(0.005% + 709.4 µV)	33.40K
	1.0 mSec	±(0.005% + 131.6 µV)	0.77K
±2.5V	0 mSec	±(0.005% + 374.2 µV)	25.49K
	1.0 mSec	±(0.005% + 69.2 µV)	0.76K
±1.2V	0 mSec	±(0.005% + 197.3 µV)	25.26K
	1.0 mSec	±(0.005% + 37.2 µV)	0.76K
±600 mV	0 mSec	±(0.005% + 123.9 µV)	20.86K
	1.0 mSec	±(0.005% + 22.4 µV)	0.75K
±300 mV	0 mSec	±(0.005% + 90.9 µV)	20.71K
	1.0 mSec	±(0.005% + 15.3 µV)	0.75K
±150 mV	0 mSec	±(0.005% + 70.4 µV)	3.75K
	1.0 mSec	±(0.005% + 11.4 µV)	0.69K
±80 mV	0 mSec	±(0.005% + 49.3 µV)	3.75K
	1.0 mSec	±(0.005% + 8.6 µV)	0.68K
±40 mV	0 mSec	±(0.005% + 32.8 µV)	3.58K
	1.0 mSec	±(0.005% + 6.7 µV)	0.68K
±20 mV	0 mSec	±(0.006% + 32.1 µV)	3.58K
	1.0 mSec	±(0.006% + 6.5 µV)	0.68K

Thermocouple (Requires iNET-510 Wiring Box)[1,2]

Thermocouple	Measurement Range	Absolute Accuracy (≥100 µSec Averaging Per Point)
J	-210 to 150°C	-10 to 150°C: ±0.79°C -210 to -10°C: ±1.15°C
	-210 to 1200°C	10 to 1200°C: ±0.90°C -210 to 1200°C: ±1.40°C
K	-200 to 200°C	-10 to 120°C: ±0.87°C ±200°C: ±1.31°C
	-200 to 1360°C	10 to 1360°C: ±1.16°C -200 to 1360°C: ±1.62°C
B	251 to 1820°C	251 to 600°C: ±4.75°C 600 to 1300°C: ±2.45°C 251 to 1300°C: ±4.75°C 1300 to 1820°C: ±1.63°C
C	0 to 1K°C	±1.84°C
	0 to 2315°C	±2.48°C
D	0 to 1K°C	±2.14°C
	0 to 2315°C	±2.48°C
E	-200 to 125°C	-90 to 80°C: ±0.80°C -200 to 125°C: ±1.01°C
	-200 to 1K°C	10 to 1K°C: ±0.81°C -200 to 1K°C: ±1.20°C
G	0 to 500°C	0 to 500°C: ±6.30°C 100 to 500°C: ±3.23°C
	0 to 2315°C	0 to 300°C: ±6.44°C 300 to 2315°C: ±1.86°C
N	-200 to 570°C	-200 to 0°C: ±1.66°C 0 to 170°C: ±1.01°C -10 to 570°C: ±1.01°C
	-200 to 1300°C	10 to 1300°C: ±1.17°C -200 to 1300°C: ±2.14°C
R	-50 to 800°C	-50 to 10°C: ±3.41°C 10 to 800°C: ±2.49°C
	-50 to 1768°C	10 to 1768°C: ±2.55°C -50 to 1768°C: ±3.48°C
S	-50 to 1768°C	-50 to -10°C: ±3.17°C -10 to 860°C: ±2.66°C -50 to -10°C: ±3.17°C -10 to 1768°C: ±2.66°C
T	-200 to 175°C	-200 to -10°C: ±1.27°C -10 to 175°C: ±0.86°C
	-200 to 400°C	10 to 400°C: ±0.84°C -200 to 400°C: ±1.29°C

RTD (Requires 10 kΩ Shunt Resistor iNET-R-10K) [1, 3]

RTD (Ω @ 0°C)	Measurement Range	Absolute Accuracy (≥100 µSec Averaging Per Point)
100 Ω	±50°C	±0.48°C
	-100 to 300°C	-100 to 150°C: ±0.61°C 150 to 300°C: ±0.74°C
	-238 to 850°C	-238 to 0°C: ±0.52°C 0 to 100°C: ±0.61°C 100 to 850°C: ±1.40°C
500 Ω	-100 to 300°C	±0.62°C
1 kΩ	-100 to 300°C	±0.64°C
100 Ω	-100 to 150°C	±0.44°C

Thermistor (Requires 10 kΩ shunt resistor iNET-R-10K) [1, 3]

Thermistor (Ω @ 25°C)	Measurement Range	Absolute Accuracy (≥100 µSec Averaging Per Point)
2252 Ω e.g. #44004	10 to 130°C	10 to 30°C: ±0.25°C 30 to 70°C: ±0.17°C 70 to 130°C: ±0.21°C
	0 to 70°C	±0.30°C
	90 to 250°C	±1.43°C
	30 to 250°C	30 to 170°C: ±0.48°C 170 to 250°C: ±2.24°C
	30 to 70°C	±0.16°C

Resistance (Requires iNET-R-x Shunt Resistor) [1, 3]

Measurement Range	Signal Averaging Per Point	Absolute Accuracy	Channel Max Aggregate Sample Rate (s/sec/agg)	Shunt Resistor
0 to 33 Ω	0.1 mSec	±(0.067% + 0.008 Ω)	2.08K	iNet-R-1K
	1.0 mSec	±(0.066% + 0.004 Ω)	0.63K	
0 to 100 Ω	0 mSec	±(0.072% + 0.028 Ω)	20.20K	iNet-R-1K
	1.0 mSec	±(0.067% + 0.005 Ω)	0.75K	
0 to 330 Ω	0 mSec	±(0.083% + 0.06 Ω)	24.51K	iNet-R-1K
	1.0 mSec	±(0.072% + 0.01 Ω)	0.76K	
0 to 1 kΩ	0 mSec	±(0.113% + 0.11 Ω)	24.74K	iNet-R-1K
	1.0 mSec	±(0.085% + 0.02 Ω)	0.76K	
0 to 3300 Ω	0 mSec	±(0.114% + 0.40 Ω)	24.74K	iNet-R-3300
	1.0 mSec	±(0.091% + 0.10 Ω)	0.76K	
0 to 10 kΩ	0.1 mSec	±(0.131% + 0.10 Ω)	4.27K	iNet-R-3300
	1.0 mSec	±(0.122% + 0.10 Ω)	0.76K	

Current (Requires iNET-R-x Shunt Resistor) [1, 3]

Measurement Range	Signal Averaging Per Point	Absolute Accuracy	Channel Max Aggregate Sample Rate (s/sec/agg)	Shunt Resistor
0 to 24 mA	0 mSec	±(0.056% + 6.0 uA)	24.70K	iNet-R-33
	1.0 mSec	±(0.056% + 1.1 uA)	0.76K	
±24 mA	0 mSec	±(0.056% + 6.0 uA)	24.70K	
	1.0 mSec	±(0.056% + 1.1 uA)	0.76K	
±12 mA	0 mSec	±(0.056% + 3.1 uA)	23.98K	iNet-R-120
	1.0 mSec	±(0.056% + 0.6 uA)	0.75K	
±2.5 mA	0 mSec	±(0.056% + 0.4 uA)	17.28K	iNet-R-1K
	1.0 mSec	±(0.056% + 0.1 uA)	0.74K	
±1.2 mA	0 mSec	±(0.055% + 0.20 uA)	17.17K	iNet-R-1K
	1.0 mSec	±(0.055% + 0.04 uA)	0.74K	
±500 uA	0.1 mSec	±(0.056% + 0.02 uA)	2.48K	iNet-R-10K
	1.0 mSec	±(0.056% + 0.01 uA)	0.67K	
±600 uA	0 mSec	±(0.056% + 0.12 uA)	15.02K	iNet-R-1K
	1.0 mSec	±(0.056% + 0.02 uA)	0.73K	
±800 uA	0.1 mSec	±(0.055% + 0.19 uA)	2.08K	iNet-R-120
	1.0 mSec	±(0.055% + 0.09 uA)	0.63K	
±120 uA	0.1 mSec	±(0.058% + 0.007 uA)	2.40K	iNet-R-10K
	1.0 mSec	±(0.058% + 0.004 uA)	0.67K	
±80 uA	0.1 mSec	±(0.058% + 0.016 uA)	1.92K	iNet-R-1K
	1.0 mSec	±(0.058% + 0.008 uA)	0.61K	

Strain Gage[1]

Strain Gage	Measurement Range	Signal Per Point	Absolute Accuracy	Channel Max Aggregate Sample Rate (s/sec/agg)
350 Ω (¼ Bridge)	±11875 µS	0.1 mSec	±13.5 µS	1.97K
	±24035 µS		±15.5 µS	1.97K
	±49258 µS		±22.3 µS	2.02K
350 Ω (½ Bridge Bend)	±5868 µS		±5.6 µS	1.97K
350 Ω (½ Bridge Axial)	±8945 µS		±8.5 µS	1.97K
350 Ω (Full Br Bend)	±2934 µS		±1.6 µS	1.97K
		1.0 mSec	±0.9 µS	0.62K
350 Ω (Full Br Axial I)	±4445 µS	0.1 mSec	±2.5 µS	1.97K
		1.0 mSec	±1.4 µS	0.62K
350 Ω (Full Br Axial II)	±4459 µS	0.1 mSec	±2.5 µS	1.97K
		1.0 mSec	±1.4 µS	0.62K
1 kΩ (¼ Bridge)	±11876 µS	0.1 mSec	±10.0 µS	1.88K

Load Cell[1]

Load Cell	Measurement Range	Absolute Accuracy (≥1 mSec Averaging Per Point)
10 Kg (350Ω, 2 mV/V @ MaxKg)	0 to 10 Kg	±0.006 Kg
25 Kg (350Ω, 2 mV/V @ MaxKg)	0 to 25 Kg	±0.015 Kg
100 Kg (350Ω, 2 mV/V @ MaxKg)	0 to 100 Kg	±0.061 Kg
250 Kg (350Ω, 2 mV/V @ MaxKg)	0 to 250 Kg	±0.152 Kg
1000 Kg (350Ω, 2 mV/V @ MaxKg)	0 to 1K Kg	±0.607 Kg
5000 Kg (350Ω, 2 mV/V @ MaxKg)	0 to 5K Kg	±3.037 Kg
100 Kg (500Ω, 2 mV/V @ MaxKg)	0 to 100 Kg	±0.066 Kg
100 Kg (1000Ω, 2 mV/V @ MaxKg)	0 to 100 Kg	±0.083 Kg

1 *Absolute Accuracy is specified as a percentage of measured value PLUS a fixed offset. It is the sum of the following errors components, each in their worst case: Integral Nonlinearity (INL), Differential Nonlinearity (DNL), system noise (ground input, digitize, and see noise), gain/offset temperature drift, gain/offset time stability drift, gain/offset initial offset error, 4.5nA max leakage current (at 37°C) times user source impedance error, multiplexor current pump error, and voltage reference temperature/time drift. Noise offset error is modeled as 3 times the Noise RMS value (99.7%). Absolute Accuracy is the same as Maximum Worst Case error. For Typical error, divide maximum by 2.*

These specifications assume 1 year since Factory Calibration and instruNet hardware ambient temperature is between 13 and 33 °C.

*Absolute accuracy is shown with both a gain and offset component, where the offset error is independent of the input voltage, and the gain error is proportional to the input. For example, if you measure 2 Volts and the absolute accuracy specification is ± (1% + 3 mV), then you could expect ± (1% * 2V + 3 mV) = ±23 mV accuracy.*

2 *Thermocouple absolute accuracy also includes error from cold junction compensation and 0.2°C iNET-510 screw terminal temperature change since last auto-calibration.*

3 *Absolute accuracy also includes error from INET-R-x external shunt resistor self-heating and initial inaccuracy*

To Order

Model No.	Description
iNET-600	Standalone direct-to-sensor USB data acquisition system, 16SE/8DI voltage inputs, 4 digital I/O
iNET-601	Standalone direct-to-sensor USB data acquisition system, 16SE/8DI voltage inputs, 4 digital I/O, with electrical isolation

iNET-600 and iNET-601 USB data acquisition modules come complete with USB interface cable, instruNet World software on CD, mating Hd44 female connector, Hd44 cover and hardware assembly kit.

Ordering Example: iNET-601 *standalone direct-to-sensor USB data acquisition system, 16SE/8DI voltage inputs, 4 digital I/O, with electrical isolation.*

Accessories

Model No.	Description
iNET-510	Wiring box with screw terminals
iNET-511	Wiring box with BNC connectors
iNET-512	Strain gage/sensor wiring box with screw terminals (not for thermocouples - use iNET-510 for thermocouple)
iNET-iWPLUS	InstruNet World Plus software (IW+)
iNET-380	LabVIEW drivers (LabVIEW version ≥4 currently supported on Windows ≥XP)
iNET-R-33	33 Ω, 8-pack, 0.05%, 5 ppm/°C drift
iNET-R-120	120 Ω, 8-pack, 0.05%, 5 ppm/°C drift
iNET-R-350	350 Ω, 8-pack, 0.05%, 5 ppm/°C drift
iNET-R-1K	1000 Ω, 8-pack, 0.05%, 5 ppm/°C drift
iNET-R-3300	3300 Ω, 8-pack, 0.05%, 5 ppm/°C drift
iNET-R-10K	10 kΩ, 8-pack, 0.05%, 5 ppm/°C drift
iNET-R-33K	33 kΩ, 8-pack, 0.05%, 5 ppm/°C drift