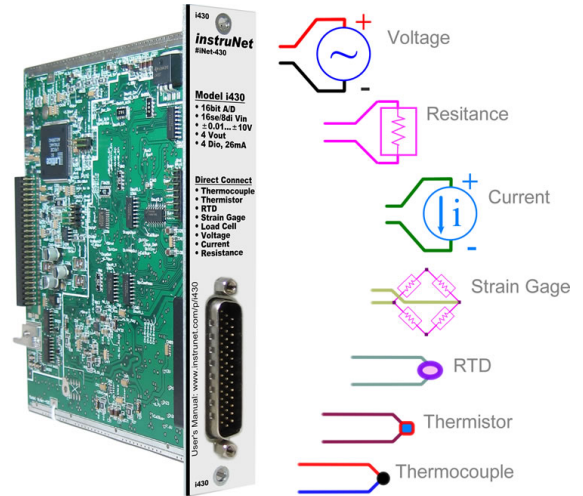


instruNet i430 Datasheet

Measure Volts, Ohms, Amps, RTD, Thermocouple, Strain Gage, Load Cell.

Features

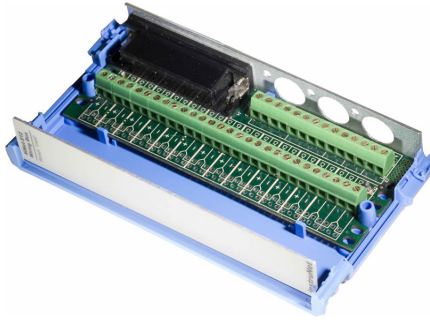
- o The i430 card plugs into a 4 to 16 slot instruNet i4xx Card Cage, which in turn attaches to a Windows computer
- o 16se/8di Voltage Input Channels with extremely accurate 24-bit A/D Converter²⁹
- o 2x Precision Analog Voltage Outputs ($\pm 10V$, 14bit D/A)
- o 2x Analog Voltage Outputs (0..+10V, 8bit D/A)
- o 4x Universal Digital I/O (20mA sink, -10V..30V)
- o Connect Directly To Sensors: Voltage, Thermocouple, Thermistor, RTD, Load Cell, Strain Gage, Potentiometer, Current, Resistance



Summary

- o This A/D module provides 16se/8di voltage input channels (Ch#1...#16)⁴⁰, each of which are independently software programmable with Windows software that support the direct connection to many common sensor types
- o Voltage input range on each channel is independently software programmable to one of: $\pm 10mV$, $\pm 20mV$, $\pm 40mV$, $\pm 80mV$, $\pm 600mV$, $\pm 1.2V$, $\pm 2.5V$, $\pm 5V$, $\pm 10V$ ²⁰, 0 to 1.2V, 0 to 2.5V, 0 to 5V
- o Each channel provides the following software programmable parameters: A/D Signal-Averaging-Per-Point (0 ... 100mSec)³, Sample-Rate (samples-per-second-per-channel)¹⁷, Digital IIR Filter (LowPass, HighPass, BandPass, or BandStop)⁵⁵, Voltage Measurement Range ($\pm 10mV$... $\pm 10V$ ²⁰)¹, Sensor Type¹³, and Single-Ended or Differential Wiring
- o Excitation power ($+3.3V \pm 0.2V$, $<220mA$, 28mA 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 readback by A/D when calculating sensor values.
- o This module provides 2 channels (Ch#19...#20) that can output a voltage between -10.1 and +10.1V accurate to $\pm 4mV$ ⁴¹. An internal 14-bit d/a converter is followed by an amplifier that can drive up to $\pm 4 mA$ of current and drive up to 10K pF of capacitance. Each output is short-circuit protected against -18 to +18V, power on or off, without damage
- o This module provides 2 channels (Ch#17...#18) that can output a voltage between 0 and +10.1V accurate to $\pm 78mV$ ⁴². An internal 8-bit d/a converter is followed by an amplifier that can drive up to $\pm 4 mA$ of current and drive up to 10K pF of capacitance. Each output is short-circuit protected against -18 to +18V, power on or off, without damage
- o The 20mA sink digital I/O port consists of 4 individual TTL-compatible lines (Ch#25...#28), each of which can be configured as: digital input bit, digital output bit, control output, clock output⁴³. When configured as an input, a channel can be used to sense a digital high (2.1 to 30 Volts) or digital low (-10V to .65Volts). 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 32.0V and down to -16.0V.

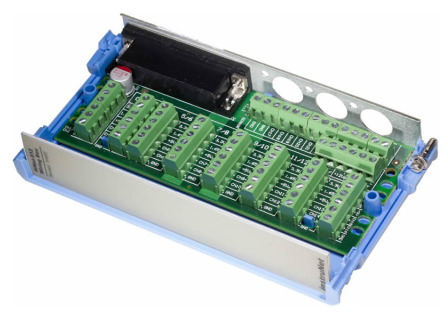
Optional i51x Wiring Box



i510 Low Cost Wiring Box

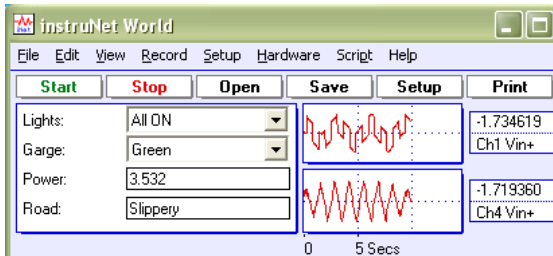


i511 BNC Wiring Box



i512 Wiring Box

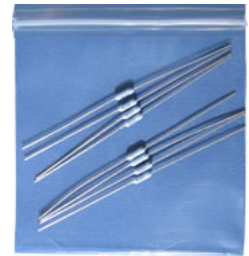
Optional Accessories



instruNet World PLUS Software (iW+)



Application Software



Shunt Resistors

Subjects Discussed in this Datasheet, iNet-430

- [Analog Voltage Input \(A/D\), Electrical Specifications, Software Interface](#)
- [2x Precision Analog Voltage Outputs \(\$\pm 10V\$, 14bit D/A\), Electrical Specifications, Software Interface](#)
- [2x Analog Voltage Outputs \(0..+10V, 8bit D/A\), Electrical Specifications, Software Interface](#)
- [4x Universal Digital I/O \(20mA sink, -10V..30V\), Electrical Specifications, Software Interface](#)
- [I/O Software Channels](#)
- [Hd44 Connector Pins](#)
- [Power Available to End User](#)
- [Physical/Environmental Specifications](#)
- [Voltage Measurement Absolute Accuracy Specifications](#)
- [Voltage Measurement Drift Errors](#)
- [Thermocouple Measurement Absolute Accuracy Specifications](#)
- [Thermistor Measurement Absolute Accuracy Specifications](#)
- [RTD Measurement Absolute Accuracy Specifications](#)
- [Load Cell Measurement Absolute Accuracy Specifications](#)
- [Strain Gage Measurement Absolute Accuracy Specifications](#)
- [Potentiometer Measurement Absolute Accuracy Specifications](#)
- [Current Measurement Absolute Accuracy Specifications](#)
- [Resistance Measurement Absolute Accuracy Specifications](#)

Analog Voltage Input (A/D), iNet-430

Parameter	Specifications ¹⁹	Notes
Description	16se/8di Voltage Input Channels with extremely accurate 24-bit A/D Converter ²⁹	This 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
Absolute Accuracy	Specified	Error components (i.e. INL, DNL, linearity, noise, temperature drift ⁶⁶ , time stability) are summed and specified as "Absolute Accuracy" with the following supported sensors (click for accuracy and maximum sample rate): Voltage , Thermocouple , Thermistor , RTD , Load Cell , Strain Gage , Potentiometer , Current , Resistance . Please see A/D datasheet (AD7685crmz) for details on this very accurate part.
Voltage Ranges	±10mV ... ±5V, 0 to 1.2V ... 0 to 5V, ±10V ²⁰	Voltage input range on each channel is independently software programmable to one of: ±10mV, ±20mV, ±40mV, ±80mV, ±600mV, ±1.2V, ±2.5V, ±5V, ±10V ²⁰ , 0 to 1.2V, 0 to 2.5V, 0 to 5V
Internal A/D	24-bit	Internal 24-bit A/D Converter ²⁹ resolves voltage input range to ±8.4M digital value.
Sensors	Direct Connect	Each of the 8 differential channels support the direct connection to the following sensor types (click for Wiring Diagram and Setup Instructions): Voltage , Thermocouple , Thermistor , RTD , Load Cell , Strain Gage , Potentiometer , Current , Resistance
Channel Amplifiers	Software Programmable	Each channel provides the following software programmable parameters: A/D Signal-Averaging-Per-Point (0 ... 100mSec) ³ , Sample-Rate (samples-per-second-per-channel) ¹⁷ , Digital IIR Filter (LowPass, HighPass, BandPass, or BandStop) ⁵⁵ , Voltage Measurement Range (±10mV...±10V ²⁰) ¹ , Sensor Type ¹³ , and Single-Ended or Differential Wiring
Wiring	Single-Ended or Differential	Single-ended (SE) wiring involves measuring the voltage between the input pin and instruNet Ground; whereas Differential (DI) wiring involves measuring the voltage between two input pins
Protected Voltage	-25 to +25V	Short any combination of voltage input channels to external -25 to +25V power source (i.e. capable of high current), instruNet power on or off, any duration, without damage
Bandwidth	Depends on Voltage Range	See absolute accuracy specification tables below (e.g. Voltage Accuracy) for bandwidth details
RFI Filter	24 KHz RFI filter on ≤ ±80mVrange	RFI filter is a low pass filter that rejects high frequencies that could cause small measurement errors if left unfiltered
Digital Filter	LowPass, HighPass, BandPass, or BandStop	Each channel provides optional digital IIR lowpass, highpass, bandpass and bandstop filters with independent software programmable cut-off frequency, minimum dB stopband attenuation, maximum dB passband attenuation, and filter type (e.g. Elliptic, Chebyshev B, Chebyshev S, and Butterworth). Number of poles/zeros (i.e. "filter order") is programmable between 2 and 32 ⁵⁵ .
Maximum Sample Rate ¹⁷	166Ks/sec/aggregate	Digitize ⁷⁰ at a maximum sample rate of 166K sample/sec for 1 channel on largest voltage input range. More channels at same voltage input range involves slower rates, e.g. 83Ks/sec per channel for 2 channels, 41Ks/sec/ch for 4 channels, and 20Ks/sec/ch for 8 channels. For a details on maximum sample rate and bandwidth with different voltage input ranges, sensor types, and a/d averaging ⁶¹ ; see absolute accuracy specification tables below (e.g. Voltage Accuracy). Things that decrease High Speed I/O sample rate: longer computer to instruNet cable, i330 optical-isolator. Sample rate is set accurate to 50 ppm (e.g. user specifies 20000 s/sec yet system actually digitizes at 20001 s/sec). Minimum sample rate is 0.015 samples/sec/ch. A/D converter resolves one sample in 4uSec.
Sensor Excitation	Included	Excitation power (+3.3V ±0.2V, <220mA, 28mA 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 readback by A/D when calculating sensor values.

[Electrical Specifications, Analog Voltage Input, iNet-430](#)

Parameter	Specifications ¹⁹	Notes

Common Mode Voltage	-10 to +10V	All voltage input pins must be driven with a voltage between -10 and +10V, with respect to instruNet ground. instruNet ground = instruNet chassis = earth ground via power supply 3rd prong
Crosstalk	< -80dB typ	Crosstalk from one channel to another depends on sample rate and frequency of applied signal, and is typically < -80dB; i.e. $-80\text{dB} = 20 * \log(1 / 10000)$. For example, one can apply a 10Hz 10Vpp sinewave to Ch1 on the $\pm 5\text{V}$ range, apply 0 Volts DC to Ch3 on the $\pm 2.5\text{V}$ range, digitize both at the maximum sample rate, and see < 1mVpp sinewave on Ch3, in a typical case. The amplitude of this sinewave would decrease with slower sample rates, and increase with higher sinewave frequencies.
Input Coupling	DC	Measure constant DC voltage or dynamic AC waveform with absolute voltage accuracy
Input Impedance	100M Ω	Internal 100M Ω resistor (5% accuracy) between input pin and instruNet ground reduces fluctuating measurements when input pin is left unconnected
Current Pump	60 pC max	Internal multiplexors pump a small amount of current out voltage measurement pin and into the end user circuit when channels switch. This is normal for multiplexors (they all do this), and is automatically mitigated when doing sensor measurements by waiting for current to dissipate before taking the measurement. If you don't like multiplexors, or need fast sample rates with low level signals; please see i423 which routes inputs to instrumentation amplifiers instead of multiplexors.
Input leakage current	2.8 nA max at 37°C	This is a small current that flows out the voltage input pin and into the end user circuit. It has little effect unless measuring small voltages (e.g. expecting accuracy better than $\pm 100\mu\text{V}$) with a high source impedance (e.g. > 2K Ω). Maximum leakage is 2.8 nA at 37°C, and 1.4 nA at 25°C.
Input Circuit	Multiplexer	Voltage input pin connects directly to internal protected multiplexer IC
Common Mode Rejection Ratio	$\geq 74\text{dB}$	CMRR is the amount of rejection of a common signal that is present on both inputs of a differential measurement. Theoretically, it should not be measured because the differential measurement looks at the voltage between two pins; however small internal imbalances cause a small error, which is specified here with a DC to 60Hz common mode signal.
Calibration	Software Control	instruNet hardware is calibrated ⁶⁶ when the system is reset (i.e. press RESET button, load .prf configuration file, or start instruNet software), and when the system is software calibrated (i.e. press CALIBRATE button, issue software calibrate command, or set up software to calibrate every X minutes ⁵⁹).
Front End Schematics	Published	Schematics: Hd44 Connector, 16x Vin Mux

[Software Interface, Analog Voltage Input, iNet-430](#)

Parameter	Specifications ¹⁹	Notes
Software Interface	Windows Compatible	instruNet Scalar I/O and High Speed I/O ⁶⁰ interface subroutines execute on Windows Computer via instruNet World, Visual Basic, C, Labview, or DasyLab software. Scalar I/O reads or writes 1 value at a time; whereas High Speed I/O reads or writes multiple values (i.e. a waveform) at a fixed rate (i.e. sample rate).
Maximum # of Channels	Up to 256	instruNet system (iNet32/64.dll \geq v3.0) supports simultaneous high speed I/O to/from computer with 1 to 256 I/O channels ⁷⁰
Maximum Waveform Size	Limited by Computer	Continuously digitize into Windows computer RAM or into file on Windows computer hard disk ⁶² . Maximum file size is limited by available space on hard disk. Data consumes 4 bytes per point.
Scalar I/O Benchmark	50 to 300uSec typ	Scalar I/O ⁶⁰ typically requires 50 to 300uSec to read 1 value from 1 voltage input channel with 0 mSec of a/d averaging. This increases by the amount of a/d averaging (e.g. 1050 to 1300uSec for 1mSec of a/d averaging)
Software Channels	Ch1 Vin+ ... Ch16 Vin-	Channels #1...#16: SE/DI voltage inputs, $\pm 10\text{mV} \dots \pm 10\text{V}$ ²⁰
Connector Pins	One pin per bit	Signals are available at Hd44 connector pins: #1...#16 ²¹⁷
Ground Reference	Hd44 Pins 29/42/43/44	instruNet ground = instruNet chassis = earth ground via power supply 3rd prong

2x Precision Analog Voltage Outputs, iNet-430

Parameter	Specifications ¹⁹	Notes
Description	2x 14-bit Voltage Outputs	This module provides 2 channels (Ch#19...#20) that can output a voltage between -10.1 and +10.1V accurate to $\pm 4\text{mV}$. An internal 14-bit d/a converter is followed by an amplifier that can drive up to $\pm 4\text{ mA}$ of current and drive up to 10K pF of capacitance. Each output is short-circuit protected against -18 to +18V, power on or off, without damage
Output Voltage Range	-10.1 to +10.1V	Each channel is set independently to a voltage between -10.1 and +10.1V via software running on a Windows computer
D/A Resolution	14-bit	Internal 14-bit digital-to-analog converter resolves 0...16383 digital value to -10.1 to +10.1V analog voltage with $\sim 1.3\text{mV}$ per LSB (least-significant-bit) monotonic resolution
Output Absolute Accuracy	$\pm 4\text{mV}$ max error	Output is set accurate to $\pm 4\text{mV}$, which is the sum of all maximum error components (i.e. INL, DNL, linearity)
Output Voltage Noise	1.4mVrms typ	Approximately 1.4mVrms of random noise is present on the output signal at all times, independent of output voltage and load
Readback Accuracy	$\pm 3.2\text{mV}$ for $\geq \pm 5\text{V}$ $\pm 1.2\text{mV}$ for $< \pm 5\text{V}$	A Scalar I/O subroutine writes to this channel to set the output voltage, and reads from this channel to have the A/D readback the output voltage. The readback voltage measurement accuracy is the same as that for the voltage measurement channels (e.g. $\pm 3.2\text{mV}$ maximum error for output $\geq \pm 5\text{V}$, $\pm 1.2\text{mV}$ for output between 0V and $\pm 5\text{V}$).
Protected Voltage	-18 to +18V	Short any combination of voltage output channels to external -18 to +18V power source (i.e. capable of high current), instruNet power on or off, any duration, without damage
Fuse	Auto-Reset, 15 Milliamp	Internal fuse on each vout pin opens during $> 15\text{mA}$ over-current condition, and automatically closes otherwise

[Electrical Specifications, Precision Voltage Out, iNet-430](#)

Parameter	Specifications ¹⁹	Notes
Output Current Drive	$\pm 4\text{ mA}$	Output channel can drive up to $\pm 4\text{ mA}$ of current, independent of output voltage
Output Capacitance Drive	10K pF	Output channel can drive capacitive load up to 10K pF, without oscillation or accuracy degradation
Output Coupling	DC	Output constant DC voltage or dynamic waveform with absolute voltage accuracy
Output Impedance	0.4 Ω typ	Output voltage accuracy degrades 0.4mV for each 1 mA of load
Calibration	Each Update	Output channel uses A/D converter at each update to calibrate the D/A (i.e. it outputs, reads with a/d, and then outputs again; in approx 700uSec per update)
Output Settling Time	700uSec max	Time required to settle to specified accuracy, after changing from minimum voltage to maximum voltage
Output Slew Rate	2V/uSec typ	Rate at which output voltage changes after update
Post-Reset State	$\pm 4\text{mV}$ max	Final output voltage after resetting or starting instruNet software
Power On/Off State	$\pm 30\text{mV}$ max	Final output voltage after powering instruNet hardware on or off
Update Glitch	$\pm 150\text{mV}$ for 30uSec typ	Pulse on output that occurs after updating this vout channel
Digital Feedthru Glitch	$\pm 200\text{mV}$ for 1uSec typ	Pulse on output that occurs after updating another vout channel
Reset Glitch	$\pm 200\text{mV}$ for 300mSec typ	Pulse on output that occurs after resetting or starting instruNet software
Power On/Off Glitch	$\pm 2\text{V}$ for 50mSec typ	Pulse on output that occurs after powering instruNet hardware on or off
Front End Schematics	Published	Schematics: Hd44 Connector , $\pm 10\text{V}$ Buffer

[Software Interface, Precision Voltage Out, iNet-430](#)

Parameter	Specifications ¹⁹	Notes
Software Interface	Windows Compatible	instruNet Scalar I/O and High Speed I/O ⁶⁰ interface subroutines execute on Windows Computer via instruNet World, Visual Basic, C, Labview, or DasyLab software. Scalar I/O reads or writes 1 value at a time; whereas High Speed I/O reads or writes multiple values (i.e. a waveform) at a fixed rate (i.e. sample rate).

Maximum # of Channels	Up to 256	instruNet system (iNet32/64.dll \geq v3.0) supports simultaneous high speed I/O to/from computer with 1 to 256 I/O channels ⁷⁰
Scalar I/O Benchmark	600 to 900uSec typ	Scalar I/O ⁶⁰ typically requires 600 to 900uSec to write 1 value to 1 output channel
Readback Scalar I/O	50 to 300uSec typ	Readback 1 voltage on 1 output pin with A/D in 50 to 300uSec
Software Channels	Ch19 Vout ... Ch20 Vout	Channels #19...#20: $\pm 10V$, 14 bits, 4 mA, scalar input/output, no high speed i/o
Connector Pins	One pin per bit	Signals are available at Hd44 connector pins: #19...#20 ²¹⁷
Ground Reference	Hd44 Pins 29/42/43/44	instruNet ground = instruNet chassis = earth ground via power supply 3rd prong

2x Analog Voltage Outputs, iNet-430

Parameter	Specifications ¹⁹	Notes
Description	2x 8-bit Voltage Outputs	This module provides 2 channels (Ch#17...#18) that can output a voltage between 0 and +10.1V accurate to $\pm 78\text{mV}$. An internal 8-bit d/a converter is followed by an amplifier that can drive up to $\pm 4\text{ mA}$ of current and drive up to 10K pF of capacitance. Each output is short-circuit protected against -18 to +18V, power on or off, without damage
Output Voltage Range	0 to +10.1V	Each channel is set independently to a voltage between 0 and +10.1V via software running on a Windows computer
D/A Resolution	8-bit	Internal 8-bit digital-to-analog converter resolves 0...255 digital value to 0 to +10.1V analog voltage with $\sim 39.8\text{mV}$ per LSB (least-significant-bit) monotonic resolution
Output Absolute Accuracy	$\pm 78\text{mV}$ max error	Output is set accurate to $\pm 78\text{mV}$, which is the sum of all maximum error components (i.e. INL, DNL, linearity)
Output Voltage Noise	0.8mVrms typ	Approximately 0.8mVrms of random noise is present on the output signal at all times, independent of output voltage and load
Readback Accuracy	$\pm 3.2\text{mV}$ for $\geq \pm 5\text{V}$ $\pm 1.2\text{mV}$ for $< \pm 5\text{V}$	A Scalar I/O subroutine writes to this channel to set the output voltage, and reads from this channel to have the A/D readback the output voltage. The readback voltage measurement accuracy is the same as that for the voltage measurement channels (e.g. $\pm 3.2\text{mV}$ maximum error for output $\geq \pm 5\text{V}$, $\pm 1.2\text{mV}$ for output between 0V and $\pm 5\text{V}$).
Protected Voltage	-18 to +18V	Short any combination of voltage output channels to external -18 to +18V power source (i.e. capable of high current), instruNet power on or off, any duration, without damage
Fuse	Auto-Reset, 15 Milliamp	Internal fuse on each vout pin opens during $> 15\text{mA}$ over-current condition, and automatically closes otherwise

[Electrical Specifications, 8bit Voltage Out, iNet-430](#)

Parameter	Specifications ¹⁹	Notes
Output Current Drive	$\pm 4\text{ mA}$	Output channel can drive up to $\pm 4\text{ mA}$ of current, independent of output voltage
Output Capacitance Drive	10K pF	Output channel can drive capacitive load up to 10K pF, without oscillation or accuracy degradation
Output Coupling	DC	Output constant DC voltage or dynamic waveform with absolute voltage accuracy
Output Impedance	0.4 Ω typ	Output voltage accuracy degrades 0.4mV for each 1 mA of load
Calibration	At Factory	Output channel is calibrated at factory, not during software calibration (i.e. output voltage is stable during that time)
Output Settling Time	15uSec max	Time required to settle to specified accuracy, after changing from minimum voltage to maximum voltage
Output Slew Rate	1V/uSec typ	Rate at which output voltage changes after update
Post-Reset State	$\pm 10\text{mV}$ max	Final output voltage after resetting or starting instruNet software
Power On/Off State	"	Final output voltage after powering instruNet hardware on or off
Update Glitch	$\pm 10\text{mV}$ for 30uSec typ	Pulse on output that occurs after updating this vout channel
Digital Feedthru Glitch	$\pm 40\text{mV}$ for 1uSec typ	Pulse on output that occurs after updating another vout channel
Reset Glitch	$\pm 20\text{mV}$ for 20mSec typ	Pulse on output that occurs after resetting or starting instruNet software
Power On/Off Glitch	$\pm 1\text{V}$ for 20mSec typ	Pulse on output that occurs after powering instruNet hardware on or off
Maximum Update Rate	41Ks/sec for 1ch	Update 1 output channel at 41K sample/sec. More channels involve slower rates, e.g. 27K sample/sec per channel for 2 output channels
Front End Schematics	Published	Schematics: Hd44 Connector , 0-10V Buffer

[Software Interface, 8bit Voltage Out, iNet-430](#)

Parameter	Specifications ¹⁹	Notes
Software Interface	Windows Compatible	instruNet Scalar I/O and High Speed I/O ⁶⁰ interface subroutines execute on Windows Computer via instruNet World, Visual Basic, C, Labview, or DasyLab software. Scalar

		I/O reads or writes 1 value at a time; whereas High Speed I/O reads or writes multiple values (i.e. a waveform) at a fixed rate (i.e. sample rate).
Maximum # of Channels	Up to 256	instruNet system (iNet32/64.dll \geq v3.0) supports simultaneous high speed I/O to/from computer with 1 to 256 I/O channels ⁷⁰
Scalar I/O Benchmark	50 to 300uSec typ	Scalar I/O ⁶⁰ typically requires 50 to 300uSec to write 1 value to 1 output channel
Readback Scalar I/O	"	Readback 1 voltage on 1 output pin with A/D in 50 to 300uSec
Software Channels	Ch17 Vout ... Ch18 Vout	Channels #17...#18: 0V...10V, 8 bits, 4 mA, scalar input/output, high speed output
Connector Pins	One pin per bit	Signals are available at Hd44 connector pins: #17...#18 ²¹⁷
Ground Reference	Hd44 Pins 29/42/43/44	instruNet ground = instruNet chassis = earth ground via power supply 3rd prong

4x Universal Digital I/O, 20mA sink, iNet-430

Parameter	Specifications ¹⁹	Notes
Description	4 Bidirectional Digital I/O	The 20mA sink digital I/O port consists of 4 individual TTL-compatible lines (Ch#25...#28), each of which can be configured as: digital input bit, digital output bit, control output, clock output. When configured as an input, a channel can be used to sense a digital high (2.1 to 30 Volts) or digital low (-10V to .65Volts). 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 32.0V and down to -16.0V.
Function	Multiple Options	Software programmed to one of: digital input bit, digital output bit, control output, clock output. Clock output options are: 24MHz, 12MHz ²⁴ , 6MHz, 1.5MHz, 1MHz, 375KHz, 100KHz, 94KHz, 23KHz, 10KHz, 5.9KHz, 1.5KHz, 1KHz, 366Hz, 100Hz, 92Hz, 23Hz, 10Hz, 5.7Hz, 1.4Hz, 1Hz, 0.358Hz, 0.0894Hz. Control output options are: pulse low when write to d/a ic (Cs1), pulse low when rd/wr to Uio 25..28 port, pulse low when read from Uio 25..28 port, pulse low when read from a/d ic, pulse low when in software reset or power is off.
Maximum Sample Rate ¹⁷	166Ks/sec/aggregate	Input ⁷⁰ digital data at a maximum sample rate of 166K sample/sec for 1 channel. More channels involve slower rates, e.g. 83Ks/sec per channel for 2 channels, 41Ks/sec/ch for 4 channels, and 20Ks/sec/ch for 8 channels. Things that decrease High Speed I/O sample rate: longer computer to instruNet cable, i330 optical-isolator. Sample rate is set accurate to 50 ppm (e.g. user specifies 20000 s/sec yet system actually digitizes at 20001 s/sec). Minimum sample rate is 0.015 samples/sec/ch. A/D converter resolves one sample in 4uSec.
Maximum Update Rate	41Ks/sec for 1ch	Update 1 output channel at 41K sample/sec. More channels involve slower rates, e.g. 27K sample/sec per channel for 2 output channels
TTL Compatible	Yes	Supports 0.8V for logic 0 and 2V for logic 1, which is typical for TTL
3.3V CMOS Compatible	"	Supports 1.1V (3.3V*.35) for logic 0 and 2.3V (3.3V*.7) for logic 1, which is typical for digital Cmos powered by 3.3V
5V CMOS Compatible	"	Supports 1.75V (5V*.35) for logic 0 and 3.5V (5V*.7) for logic 1, which is typical for digital Cmos powered by 5V
Drive Relay Directly	"	Wire one side of external relay coil to power supply (e.g. 5V), wire other side to I/O pin, and output logic 0 to turn on relay
Detect Switch Closure	"	Wire one side of external switch to gnd, wire other side to I/O pin, input logic 0 when switch is closed, and input logic 1 when switch is open

Electrical Specifications, Universal Digital I/O, iNet-430

Parameter	Specifications ¹⁹	Notes
Working Voltage	-10 to +30V	Functions properly when working with -10 to +30V between the I/O pin and instruNet gnd, where each bit is set up as an input or output
Protected Voltage	-16 to +32V	Short any combination of I/O pins to external -16 to +32V power source (i.e. capable of high current), set up as input or output (0 or 1), instruNet power on or off, without damage
Fuse	Auto-Reset, 30 Milliamp	Internal fuse on each I/O pin opens during > 30mA over-current condition, and automatically closes otherwise
"0" Input Voltage	-10 to +0.65V	Applying -10 to +0.65V is read as logic 0 when I/O pin is configured as input
"0" Input Current	Amps = (4.5V - Vin) / 3900	External signal must sink internal 3.9K resistor to < 0.65V to input logic "0". 3.9KΩ pull-up resistor is internally attached to 5V via diode
"1" Input Voltage	+2.1 to +30V	Applying +2.1 to +30V is read as logic 1 when I/O pin is configured as input. If left unconnected this pin floats to 4.5V.
"1" Input Current	< 1.4mA	Vin < 4.5V: Amps = (4.5V - Vin) / 3900 Vin > 4.5V: Amps = (Vin - 3.3V) / 22000
"0" Output Voltage	< 0.8V @ <5mA, < 2V @ < 20mA	I/O pin configured as an output sinks current low to 0.3V...0.8V with 0 to 5mA load; or sinks low to 0.3V...2V with 5 to 20mA load
"1" Output Voltage	3.9V...4.5V	I/O pin floats to 3.9V...4.5V via internal 3.9K pull-up resistor connected to internal 5V via diode
"1" Output Current	See "1" Input Current	Outputting a 1 is the same as configuring the bit as an input; see "1" Input Current,

		above, for details
Pull-Up Resistor	3.9K Ω \pm 10%	Internal 3.9K resistor pulls pin up to 4.5V via diode (little current flows if pin voltage > 4.5V)
Current Sink IC	ULN2003	See www.ti.com for details on this npn transistor that sinks current low to gnd
Schmitt Trigger Input	Yes	Insures that a slow moving input signal with noise is not seen as vibrating between 0 and 1 when transitioning between the two
Input Delay	< 0.7 μ Sec	Schmitt trigger circuit adds < 0.7 μ Sec delay between voltage at I/O pin, and internal version of digital input
Output Fall Time	0.02 μ Sec @ 100 pF typ, < 1.3 μ Sec @ 1K pF	Output transitions from 2V to 0.8V in approximately 0.02 μ Sec with 100 pF of capacitive load
Output Rise Time	1.3 μ Sec @ 100 pF typ, < 4.9 μ Sec @ 1K pF	Output transitions from 0.8V to 2V in approximately 1.3 μ Sec with 100 pF of capacitive load. To reduce this time significantly, attach a resistor (e.g. 1K Ω) between I/O pin and +5Vpwr pin ²⁴
Output Oscillation	None	Output will not oscillate with any capacitive load
Front End Schematics	Published	Schematics: Hd44 Connector, 4x Uio_A Bits

[Software Interface, Universal Digital I/O, iNet-430](#)

Parameter	Specifications ¹⁹	Notes
Software Interface	Windows Compatible	instruNet Scalar I/O and High Speed I/O ⁶⁰ interface subroutines execute on Windows Computer via instruNet World, Visual Basic, C, Labview, or DasyLab software. Scalar I/O reads or writes 1 value at a time; whereas High Speed I/O reads or writes multiple values (i.e. a waveform) at a fixed rate (i.e. sample rate).
Maximum # of Channels	Up to 256	instruNet system (iNet32/64.dll \geq v3.0) supports simultaneous high speed I/O to/from computer with 1 to 256 I/O channels ⁷⁰
Maximum Waveform Size	Limited by Computer	Continuously input into Windows computer RAM or into file on Windows computer hard disk ⁶² . Maximum file size is limited by available space on hard disk. Data consumes 4 bytes per point.
Scalar I/O Benchmark	50 to 300 μ Sec typ	Scalar I/O ⁶⁰ typically requires 50 to 300 μ Sec to R/W 1 value to/from 1 bit or a bank of multiple I/O bits
Bit or Bank Control	Yes	Either R/W one bit (0 or 1 value) at a time, or R/W multiple bits within one bank (e.g. 0...255 value with one 8bit bank)
Latching I/O	"	Internal register reads all input bits within one bank at same time, and updates all output bits within one bank at same time
Bit Software Channels	Ch25 Uio ... Ch28 Uio	Channels #25...#28: universal I/O bits, 0 or 1 value, scalar input/output, no high speed i/o, 20mA sink
Bank Software Channels	Uio25_28 In Uio25_28 Out	Channel #29: bank of 4 bits, 0...15 value, scalar input/output, high speed input Channel #30: bank of 4 bits, 0...15 value, scalar input/output, high speed output
Connector Pins	One pin per bit	Signals are available at Hd44 connector pins: #25...#28 ²¹⁷
Ground Reference	Hd44 Pins 29/42/43/44	instruNet ground = instruNet chassis = earth ground via power supply 3rd prong

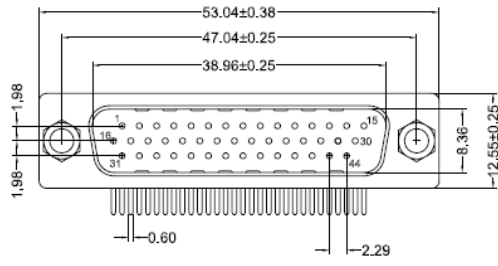
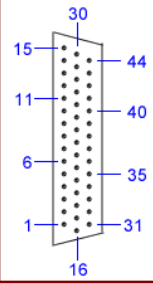
I/O Software Channels, iNet-430

ChNum	Name	Channel Type	Hd44 Pin(s)	Description	Scalar I/O Support	High Speed Digitize Support
#1	Ch1 Vin+	<u>SE/DI Voltage Input</u>	1, 2	$\pm 10\text{mV} \dots \pm 10\text{V}^{20}$	input	input
#2	Ch2 Vin-	SE Voltage Input	2	"	"	"
#3	Ch3 Vin+	SE/DI Voltage Input	3, 4	"	"	"
#4	Ch4 Vin-	SE Voltage Input	4	"	"	"
#5	Ch5 Vin+	SE/DI Voltage Input	5, 6	"	"	"
#6	Ch6 Vin-	SE Voltage Input	6	"	"	"
#7	Ch7 Vin+	SE/DI Voltage Input	7, 8	"	"	"
#8	Ch8 Vin-	SE Voltage Input	8	"	"	"
#9	Ch9 Vin+	SE/DI Voltage Input	9, 10	"	"	"
#10	Ch10 Vin-	SE Voltage Input	10	"	"	"
#11	Ch11 Vin+	SE/DI Voltage Input	11, 12	"	"	"
#12	Ch12 Vin-	SE Voltage Input	12	"	"	"
#13	Ch13 Vin+	SE/DI Voltage Input	13, 14	"	"	"
#14	Ch14 Vin-	SE Voltage Input	14	"	"	"
#15	Ch15 Vin+	SE/DI Voltage Input	15, 16	"	"	"
#16	Ch16 Vin-	SE Voltage Input	16	"	"	"
#17	Ch17 Vout	<u>Voltage Out, 0-10V</u>	17	0V...10V	input/output	output
#18	Ch18 Vout	"	18	"	"	"
#19	Ch19 Vout	<u>Voltage Out, $\pm 10\text{V}$</u>	19	$\pm 10\text{V}$	"	no high speed i/o
#20	Ch20 Vout	"	20	"	"	"
#25	Ch25 Uio	<u>One Uio Bit</u>	25	0 or 1, 20mA sink	"	"
#26	Ch26 Uio	"	26	"	"	"
#27	Ch27 Uio	"	27	"	"	"
#28	Ch28 Uio	"	28	"	"	"
#29	Uio25_28 In	Group of Uio Bits	25...28	0...15	"	input
#30	Uio25_28 Out	"	"	"	"	output

Hd44 Connector Pins, iNet-430

Hd44 Pin#	Pin Name	Pin Type	Description
#1	Ch1 Vin+	<u>SE/DI+ Voltage In</u>	Supported Sensors: Voltage, Thermocouple, <u>Thermistor</u> , <u>RTD</u> , <u>Load Cell</u> , <u>Strain Gage</u> , <u>Potentiometer</u> , <u>Current</u> , <u>Resistance</u>
#2	Ch2 Vin-	SE/DI- Voltage In	"
#3	Ch3 Vin+	SE/DI+ Voltage In	"
#4	Ch4 Vin-	SE/DI- Voltage In	"
#5	Ch5 Vin+	SE/DI+ Voltage In	"
#6	Ch6 Vin-	SE/DI- Voltage In	"
#7	Ch7 Vin+	SE/DI+ Voltage In	"
#8	Ch8 Vin-	SE/DI- Voltage In	"
#9	Ch9 Vin+	SE/DI+ Voltage In	"
#10	Ch10 Vin-	SE/DI- Voltage In	"
#11	Ch11 Vin+	SE/DI+ Voltage In	"
#12	Ch12 Vin-	SE/DI- Voltage In	"
#13	Ch13 Vin+	SE/DI+ Voltage In	"
#14	Ch14 Vin-	SE/DI- Voltage In	"
#15	Ch15 Vin+	SE/DI+ Voltage In	"
#16	Ch16 Vin-	SE/DI- Voltage In	"
#17	Ch17 Vout	<u>Voltage Out, 0-10V</u>	0V...10V, 8 bits, 4 mA, scalar input/output, high speed output
#18	Ch18 Vout	"	"
#19	Ch19 Vout	<u>Voltage Out, ±10V</u>	±10V, 14 bits, 4 mA, scalar input/output, no high speed i/o
#20	Ch20 Vout	"	"
#21	Internal_21	Internal Use Only	Pin is used by manufacturer for product testing, please do not touch
#22	Internal_22	"	"
#23	Internal_23	"	"
#24	Internal_24	"	"
#25	Ch25 Uio	<u>One Uio Bit</u>	universal I/O bits, 0 or 1 value, scalar input/output, no high speed i/o, 20mA sink, -10V..30V
#26	Ch26 Uio	"	"
#27	Ch27 Uio	"	"
#28	Ch28 Uio	"	"
#29	Gnd	instruNet Ground	instruNet ground = instruNet chassis = earth ground via power supply 3rd prong
#30	Internal_30	Internal Use Only	Pin is used by manufacturer for product testing, please do not touch
#31	Internal_31	"	"
#32	Internal_32	"	"
#33	Internal_33	"	"
#34	3.3Vref	+3.3V ±0.2V, <220mA	<u>Power Available to End User</u>
#35	"	"	"
#36	5Vpwr	+5V ±0.5V, <220mA	Power Available to End User
#37	"	"	"
#38	12Vpwr	+12V ±1.2V, <220mA	Power Available to End User
#39	"	"	"
#40	-12Vpwr	-12V ±1.2V, <220mA	Power Available to End User
#41	"	"	"
#42	Gnd	instruNet Ground	instruNet ground = instruNet chassis = earth ground via power supply 3rd prong
#43	"	"	"
#44	"	"	"

Hd44 Male Front Panel Connector



Power Available to End User, iNet-430

Parameter	Specifications ¹⁹	Notes
Description	External Power	+3.3V, +5V, +12V, and -12V power (< 300mA) is available to the end user at several Hd44 Connector ²¹⁷ pins.
+3.3V Reference Pwr	+3.3V \pm 0.2V, <220mA	+3.3Vdc power available to end user at Hd44 connector pins 34 and 35
+5V End User Pwr	+5V \pm 0.5V, <220mA	+5Vdc power available to end user at Hd44 connector pins 36 and 37
+12V End User Pwr	+12V \pm 1.2V, <220mA	+12Vdc power available to end user at Hd44 connector pins 38 and 39
-12V End User Pwr	-12V \pm 1.2V, <220mA	-12Vdc power available to end user at Hd44 connector pins 40 and 41
Fuse	Auto-Reset, > .35Amp	Internal fuse on each power voltage opens during >.35A over-current condition, and automatically closes otherwise

Physical/Environmental Specifications, iNet-430

Parameter	Specifications ¹⁹	Notes
I/O Connector	HD44 male	High density 44 pin male connector ²¹⁷ (e.g. Astron #HD6C-44-AMAN-1G ²¹³ , click footnote for datasheet, outer shell is same size as DB25)
Wiring Box	Compatible	Compatible with the following optional wiring boxes: i510 , i511 , i512
Physical Dimensions	5.3" x 5.13" x 1"	Standard instruNet i4xx card, 134.6mm x 130.3mm x 25.4mm
Operating Temp.	1 to 45°C	Operate in temperature between 1°C and 45°C, no condensation
Storage Temperature	-20 to 70°C	Store in ambient temperature between -20°C and +70°C
Relative Humidity	\leq 90%	Operate in humidity less than 90%, no condensation
Hot Plug & Play	Yes	One can attach device with power on or off, without damage
Safety	IEC, EN, UL, CSA	Designed to meet IEC 61010-1, EN 61010-1, UL 61010-1, CSA 61010-1
Emissions	EN, CE, FCC	Designed to meet EN 61326 EMC Min Immunity, EN 55011 Emissions Group 1 Class A, CE, C-tick, ICES, and FCC Part 15 Emissions Class A
CE Compliance	Yes	Meets 73/23/EEC low-voltage safety, and 89/336/EEC electromagnetic compatibility
Specifications	Subject to change	All specifications are subject to change without notice
+5Vdc Requirement	+5V \pm 0.4V, ~184mA	Power required to operate module (not for sensors or end user power)
+12Vdc Requirement	+12V \pm 0.8V, ~91mA	"
-12Vdc Requirement	-12V \pm 0.8V, ~74mA	"

Voltage Measurement

Absolute Accuracy Specifications, iNet-430

Voltage Range ¹	Signal Averaging Per Point (mSec) ³	Absolute Accuracy (Max Gain + Offset Error) ^{38a}	Max Multi-Channel Aggregate Sample Rate (s/sec/agg) ¹⁸	Channel Switching Acquisition Time (uSec) ⁴	Analog Amplifier Bandwidth (KHz) ⁵
±10V ²⁰	0 mSec	±(0.017% + 1412.9µV)	166.67K	5.9	377
	0.1 mSec	±(0.017% + 802.5µV)	6.41K	5.9	377
	1.0 mSec	±(0.017% + 669.4µV)	0.79K	5.9	377
±5V	0 mSec	±(0.010% + 697.1µV)	166.67K	5.9	464
	0.1 mSec	±(0.010% + 397.9µV)	6.41K	5.9	464
	1.0 mSec	±(0.010% + 332.7µV)	0.79K	5.9	464
±2.5V	0 mSec	±(0.010% + 416.2µV)	166.67K	5.9	493
	0.1 mSec	±(0.010% + 221.3µV)	6.41K	5.9	493
	1.0 mSec	±(0.010% + 178.9µV)	0.79K	5.9	493
±1.2V	0 mSec	±(0.010% + 314.6µV)	129.03K	7.7	525
	0.1 mSec	±(0.010% + 179.3µV)	6.41K	7.7	525
	1.0 mSec	±(0.010% + 141.9µV)	0.79K	7.7	525
±600mV	0 mSec	±(0.010% + 250.0µV)	115.73K	8.6	564
	0.1 mSec	±(0.010% + 130.2µV)	6.41K	8.6	564
	1.0 mSec	±(0.010% + 94.6µV)	0.79K	8.6	564
±80mV	0 mSec	±(0.015% + 18.8µV)	2.31K	366.9	12
	0.1 mSec	±(0.015% + 11.6µV)	1.81K	366.9	12
	1.0 mSec	±(0.015% + 10.1µV)	0.60K	366.9	12
±40mV	0 mSec	±(0.015% + 15.3µV)	2.25K	383.5	12
	0.1 mSec	±(0.015% + 9.1µV)	1.77K	383.5	12
	1.0 mSec	±(0.015% + 7.7µV)	0.59K	383.5	12
±20mV	0 mSec	±(0.015% + 14.4µV)	2.14K	400.1	12
	0.1 mSec	±(0.015% + 8.5µV)	1.70K	400.1	12
	1.0 mSec	±(0.015% + 7.2µV)	0.58K	400.1	12
±10mV	0 mSec	±(0.015% + 13.5µV)	2.08K	416.3	12
	0.1 mSec	±(0.015% + 7.7µV)	1.67K	416.3	12
	1.0 mSec	±(0.015% + 6.5µV)	0.58K	416.3	12
0 to 5V	0 mSec	±(0.010% + 416.2µV)	166.67K	5.9	493
	0.1 mSec	±(0.010% + 221.3µV)	6.41K	5.9	493
	1.0 mSec	±(0.010% + 178.9µV)	0.79K	5.9	493
0 to 2.5V	0 mSec	±(0.010% + 314.6µV)	166.67K	5.9	525
	0.1 mSec	±(0.010% + 172.8µV)	6.41K	5.9	525
	1.0 mSec	±(0.010% + 141.9µV)	0.79K	5.9	525
0 to 1.2V	0 mSec	±(0.010% + 250.0µV)	120.30K	8.3	564
	0.1 mSec	±(0.010% + 130.2µV)	6.41K	8.3	564
	1.0 mSec	±(0.010% + 94.6µV)	0.79K	8.3	564

Voltage Specification Conditions, iNet-430

- o The iNet-430 module supports quantity 8 Voltage devices wired Differential or 16 wired Single-Ended.
- o **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 (we are conservative): Intergal Nonlinearity (INL), Differential Nonlinearity (DNL), system noise (ground input, digitize, and see noise), gain/offset temperature drift,
- o Calibration: These specifications assume 1 year since Factory Calibration, instruNet hardware ambient temperature is between 13 and 33 °C, and instruNet hardware temperature changed 1°C since its last self-calibration ⁵⁹.

Software Programmable Parameters

Each channel provides the following independently programmable parameters:

gain/offset time stability drift, gain/offset initial offset error, 2.8nA max leakage current (at 37°C) times 50Ω user source impedance error, and voltage reference temperature/time drift ⁶⁶. 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.

- 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 the input. For example, if one measures 2Volts and the absolute accuracy specification is $\pm(1\% + 3\text{mV})$, then one could expect $\pm(1\% * 2\text{V} + 3\text{mV}) = \pm 23\text{mV}$ accuracy.
- These specifications assume the external end user source resistance is $<50\ \Omega$ (op amp source); and the external end user source capacitance to GND is $< 1000\ \text{pF}$.

- [A/D Signal-Averaging-Per-Point \(0 ... 100mSec\)](#) ³
- [Sample-Rate \(samples-per-second-per-channel\)](#) ¹⁷
- [Digital IIR Filter \(LowPass, HighPass, BandPass, or BandStop\)](#) ⁵⁵
- [Voltage Measurement Range \(\$\pm 10\text{mV} \dots \pm 10\text{V}\$ \)](#) ¹
- [Sensor Type](#) ¹³
- [Single-Ended or Differential Wiring](#)

More Information

- [Voltage Wiring Diagram and Setup](#)
- [instruNet i430 Product Description](#)
- [Model i430 Voltage Measurement Error Components](#)
- [Electrical Specifications](#)
- [I/O Software Channels](#)
- [Hd44 Connector Pins](#)

Voltage Measurement

Drift Errors, iNet-430

Voltage Range ¹	Absolute Accuracy (Max Gain + Offset Error) _{38a}	Additional Error Per °C If Operate Hardware at >33°C or <13°C ⁷	Additional Error Per Year if Not Factory Calibrate Hardware After 1Yr ⁹	Additional Error per °C if not AutoCal after 1°C Hardware Change Since last AutoCal ⁸
±10V ²⁰	±(0.017% + 669.4µV)	±0.0008%/°C	±0.0035%/yr	±(0.0013% + 241.3µV)/°C
±5V	±(0.010% + 332.7µV)	±0.0005%/°C	±0.0025%/yr	±(0.0010% + 118.8µV)/°C
±2.5V	±(0.010% + 178.9µV)	±0.0005%/°C	±0.0025%/yr	±(0.0010% + 63.8µV)/°C
±1.2V	±(0.010% + 141.9µV)	±0.0005%/°C	±0.0025%/yr	±(0.0010% + 36.3µV)/°C
±600mV	±(0.010% + 94.6µV)	±0.0005%/°C	±0.0025%/yr	±(0.0010% + 22.5µV)/°C
±80mV	±(0.015% + 10.1µV)	±0.0005%/°C	±0.0025%/yr	±(0.0048% + 2.4µV)/°C
±40mV	±(0.015% + 7.7µV)	±0.0005%/°C	±0.0025%/yr	±(0.0048% + 1.5µV)/°C
±20mV	±(0.015% + 7.2µV)	±0.0005%/°C	±0.0025%/yr	±(0.0048% + 1.1µV)/°C
±10mV	±(0.015% + 6.5µV)	±0.0005%/°C	±0.0025%/yr	±(0.0048% + 0.9µV)/°C
0 to 5V	±(0.010% + 178.9µV)	±0.0005%/°C	±0.0025%/yr	±(0.0010% + 63.8µV)/°C
0 to 2.5V	±(0.010% + 141.9µV)	±0.0005%/°C	±0.0025%/yr	±(0.0010% + 36.3µV)/°C
0 to 1.2V	±(0.010% + 94.6µV)	±0.0005%/°C	±0.0025%/yr	±(0.0010% + 22.5µV)/°C

Thermocouple Measurement

Absolute Accuracy Specifications, iNet-430

TC Type ¹³	Measurement Range ¹¹	Voltage Range ¹	Absolute Accuracy (\pm Max Error) ^{38w}	Max Multi-Channel Aggregate Sample Rate (s/sec/agg) ¹⁸
J	-210 to 150°C	\pm 10mV	-10 to 150°C: \pm 0.72°C -210 to -10°C: \pm 1.00°C	1.67K i423 is faster
	-210 to 1200°C	\pm 80mV	10 to 1200°C: \pm 0.94°C -210 to 1200°C: \pm 1.20°C	1.81K
K	-200 to 200°C	\pm 10mV	-10 to 120°C: \pm 0.78°C \pm 200°C: \pm 1.12°C	1.67K
	-200 to 1360°C	\pm 80mV	10 to 1360°C: \pm 1.17°C -200 to 1360°C: \pm 1.36°C	1.81K
B	251 to 1300°C	\pm 10mV	251 to 600°C: \pm 3.43°C 600 to 1300°C: \pm 1.87°C	1.67K
	251 to 1820°C	\pm 20mV	251 to 1300°C: \pm 3.70°C 1300 to 1820°C: \pm 1.47°C	1.67K
C	0 to 1K°C	\pm 20mV	\pm 1.63°C	1.70K
	0 to 2315°C	\pm 40mV	\pm 2.59°C	1.77K
D	0 to 1K°C	\pm 20mV	\pm 1.85°C	1.70K
	0 to 2315°C	\pm 40mV	\pm 2.62°C	1.77K
E	-200 to 125°C	\pm 10mV	-90 to 80°C: \pm 0.73°C -200 to 125°C: \pm 0.90°C	1.67K
	-200 to 1K°C	\pm 80mV	10 to 1K°C: \pm 0.85°C -200 to 1K°C: \pm 1.05°C	1.81K
G	0 to 500°C	\pm 10mV	0 to 500°C: \pm 4.65°C 100 to 500°C: \pm 2.57°C	1.67K
	0 to 2315°C	\pm 40mV	0 to 300°C: \pm 5.26°C 300 to 2315°C: \pm 1.96°C	1.67K
N	-200 to 170°C	\pm 10mV	-200 to 0°C: \pm 1.35°C 0 to 170°C: \pm 0.87°C	1.67K
	-10 to 570°C	\pm 20mV	\pm 0.90°C	1.70K
	-200 to 1300°C	\pm 80mV	10 to 1300°C: \pm 1.07°C -200 to 1300°C: \pm 1.72°C	1.81K
R	-50 to 800°C	\pm 10mV	-50 to 10°C: \pm 2.53°C 10 to 800°C: \pm 1.86°C	1.67K
	-50 to 1768°C	\pm 40mV	10 to 1768°C: \pm 2.10°C -50 to 1768°C: \pm 2.85°C	1.77K
S	-50 to 860°C	\pm 10mV	-50 to -10°C: \pm 2.34°C -10 to 860°C: \pm 1.98°C	1.67K
	-50 to 1768°C	\pm 20mV	-50 to -10°C: \pm 2.51°C -10 to 1768°C: \pm 2.12°C	1.67K
T	-200 to 175°C	\pm 10mV	-200 to -10°C: \pm 1.08°C -10 to 175°C: \pm 0.76°C	1.67K
	-200 to 400°C	\pm 40mV	10 to 400°C: \pm 0.78°C -200 to 400°C: \pm 1.17°C	1.77K

- The iNet-430 module supports quantity 8 Thermocouple devices wired Differential (not SE).
- **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 (we are conservative): voltage measurement errors as described above, cold junction compensation (supplied automatically by instrunet) error, polynomial linearization error, 0.2°C instrunet screw terminal temperature change since last autocalibration, multiplexor current pump error. Absolute Accuracy does Not include errors from the actual Thermocouple device. Absolute Accuracy is the same as Maximum Worst Case error. For Typical error, divide maximum by 2.
- These specifications assume signal averaging per point is 0.1mSec Integ for all rows³.
- Measurement of thermocouples Requires that an i51x Wiring Box be attached to the i4xx Module, and that the thermocouple leads are attached directly to the i51x screw terminals (for automatic Cold Junction Compensation).
- The measured thermocouple temperature is a function of the instrunet hardware screw terminal temperature and the voltage measured across the thermocouple. Therefore, an additional temperature measurement error of 1°C occurs for each 1°C change of the instrunet screw terminal temperature since the last instrunet auto-calibration (where it measures screw terminal temperature)⁵⁹. For example, if the instrunet hardware auto-calibrates when it's screw terminals are at 23°C, and they then heat up 3°C before another auto-calibration, then all thermocouple measurements will return a temperature that is 3°C higher than expected. One can program the instrunet to auto-calibrate once every 1 to 1000 minutes.

- These specifications assume the thermocouple device is grounded at the instrunet (e.g. the end user connects an external wire between the i51x Vin Minus (Vin-) and GND screw terminals).
- Calibration: These specifications assume 1 year since Factory Calibration, instrunet hardware ambient temperature is between 13 and 33 °C⁵⁹.

Software Programmable Parameters

Each channel provides the following independently programmable parameters:

- A/D Signal-Averaging-Per-Point (0 ... 100mSec)³
- Sample-Rate (samples-per-second-per-channel)¹⁷
- Digital IIR Filter (LowPass, HighPass, BandPass, or BandStop)⁵⁵
- Voltage Measurement Range ($\pm 10\text{mV}$... $\pm 80\text{mV}$)¹
- Sensor Type¹³
- Min/Max °C Range¹¹

More Information

- [Thermocouple Wiring Diagram and Setup](#)
- [instrunet i430 Product Description](#)
- [Model i430 Thermocouple Measurement Error Components](#)
- [Electrical Specifications](#)

Thermistor Measurement

Absolute Accuracy Specifications, iNet-430

Thermistor Type (Ω @ 25°C) ²³	Measurement Range ¹¹	Voltage Range ¹	Absolute Accuracy (\pm Max Error) ³⁸ⁿ	Max Multi-Channel Aggregate Sample Rate (s/sec/agg) ¹⁸	External Shunt Resistor (Ω) ¹⁵	Shunt Resistor Initial Accuracy (%) and Temp Drift (ppm/C) ¹⁶	Example Shunt Resistor Product ¹⁰⁰
2252 Ω eg #44004	10 to 130°C <i>i423 has more range</i>	0 to 1.2V	10 to 30°C: $\pm 0.25^\circ\text{C}$ 30 to 70°C: $\pm 0.17^\circ\text{C}$ 70 to 130°C: $\pm 0.29^\circ\text{C}$	6.41K <i>i423 is faster</i>	10K Ω	0.05%, 5ppm/C	#iNet-R-10K
	0 to 70°C	0 to 2.5V	$\pm 0.30^\circ\text{C}$	6.41K	10K Ω	0.05%, 5ppm/C	#iNet-R-10K
	90 to 250°C	$\pm 80\text{mV}$	$\pm 1.04^\circ\text{C}$	1.49K	10K Ω	0.05%, 5ppm/C	#iNet-R-10K
	30 to 250°C	$\pm 600\text{mV}$	30 to 170°C: $\pm 0.87^\circ\text{C}$ 170 to 250°C: $\pm 4.38^\circ\text{C}$	6.41K	10K Ω	0.05%, 5ppm/C	#iNet-R-10K
	30 to 70°C	0 to 1.2V	$\pm 0.16^\circ\text{C}$	6.41K	10K Ω	0.01%, 5ppm/C	contact disti

Thermistor Specification Conditions, iNet-430

- o The iNet-430 module supports quantity 8 Thermistor devices wired Differential or 16 wired Single-Ended.
- o **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 (we are conservative): voltage measurement errors as described above, readback of excitation voltage error, sensor self heating error, external shunt resistor self heating error, external shunt resistor initial accuracy error, instruNet input impedance variation error, 2.8nA max leakage current (at 37°C) times user source impedance error, polynomial linearization error, multiplexor current pump error. Absolute Accuracy does Not include errors from the actual Thermistor device. Absolute Accuracy is the same as Maximum Worst Case error. For Typical error, divide maximum by 2.
- o These specifications assume signal averaging per point is 0.1mSec Integ for all rows³.
- o instruNet connects directly to all types of Thermistor's.
- o The end user must supply one external shunt resistor per channel (i.e. this resistor is not included with i4xx or i51x products).
- o The end user must supply Steinhart a/b/c coefficients, unless working with YSI/Omega 4xx or 4xxxx series thermistors ²³.
- o These specifications assume that less than 1000 pF of external capacitance is between the end user source and GND.
- o instruNet provides a fixed 3.3V excitation voltage which is accurately readback in order to calculate °C.
- o These specifications assume an i51x Wiring Box is attached to the i4xx Module, and that the device leads are attached to the i51x screw terminals (for accurate readback of 3.3Vref). The i51x can be attached directly to the i4xx front panel; or a cable can be placed between the i4xx and i51x wiring box (e.g. $\leq 5\text{meters}$, 44 wire, point-to-point) without degradation of accuracy.

- o Calibration: These specifications assume 1 year since Factory Calibration, instruNet hardware ambient temperature is between 13 and 33 °C, and instruNet hardware temperature changed 1°C since its last self-calibration ⁵⁹.

Software Programmable Parameters

Each channel provides the following independently programmable parameters:

- o A/D Signal-Averaging-Per-Point (0 ... 100mSec) ³
- o Sample-Rate (samples-per-second-per-channel) ¹⁷
- o Digital IIR Filter (LowPass, HighPass, BandPass, or BandStop) ⁵⁵
- o Voltage Measurement Range ($\pm 10\text{mV}$... $\pm 5\text{V}$) ¹
- o Sensor Type ²³
- o Min/Max °C Range ¹¹
- o Single-Ended or Differential Wiring
- o External End-User-Supplied Shunt Resistor resistance (Ω) ¹⁵
- o Device Steinhart-Hart a/b/c coefficients

More Information

- o [Thermistor Wiring Diagram and Setup](#)
- o [instruNet i430 Product Description](#)
- o [Model i430 Thermistor Measurement Error Components](#)
- o [Electrical Specifications](#)

RTD Measurement

Absolute Accuracy Specifications, iNet-430

RTD Type (Ω @ 0°C) ¹³	Measurement Range ¹¹	Voltage Range ¹	Absolute Accuracy (\pm Max Error) ^{38e}	Max Multi-Channel Aggregate Sample Rate (s/sec/agg) ¹⁸	External Shunt Resistor (Ω) ¹⁵	Shunt Resistor Initial Accuracy (%) and Temp Drift (ppm/C) ¹⁶	Example Shunt Resistor Product ¹⁰⁰
100 Ω	$\pm 50^\circ\text{C}$	$\pm 40\text{mV}$	$\pm 0.44^\circ\text{C}$	1.46K	10K Ω	0.05%, 5ppm/C	#iNet-R-10K
	-100 to 300°C	$\pm 80\text{mV}$	-100 to 150°C: $\pm 0.57^\circ\text{C}$ 150 to 300°C: $\pm 0.73^\circ\text{C}$	1.49K i423 is faster	10K Ω	0.05%, 5ppm/C	#iNet-R-10K
	-238 to 850°C	$\pm 600\text{mV}$	-238 to 0°C: $\pm 1.27^\circ\text{C}$ 0 to 100°C: $\pm 1.40^\circ\text{C}$ 100 to 850°C: $\pm 2.57^\circ\text{C}$	1.46K	10K Ω	0.05%, 5ppm/C	#iNet-R-10K
500 Ω	-100 to 300°C	$\pm 600\text{mV}$	$\pm 0.84^\circ\text{C}$	6.41K	10K Ω	0.05%, 5ppm/C	#iNet-R-10K
1K Ω	-100 to 300°C	$\pm 600\text{mV}$	$\pm 0.81^\circ\text{C}$	6.41K	10K Ω	0.05%, 5ppm/C	#iNet-R-10K
100 Ω	-100 to 150°C	$\pm 80\text{mV}$	$\pm 0.40^\circ\text{C}$	1.49K	10K Ω	0.01%, 5ppm/C	contact disti

RTD Specification Conditions, iNet-430

- o The iNet-430 module supports quantity 8 RTD devices wired Differential or 16 wired Single-Ended.
- o **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 (we are conservative): voltage measurement errors as described above, readback of excitation voltage error, sensor self heating error, external shunt resistor self heating error, external shunt resistor initial accuracy error, instruNet input impedance variation error, 2.8nA max leakage current (at 37°C) times user source impedance error, multiplexor current pump error. Absolute Accuracy does Not include errors from the actual RTD device. Absolute Accuracy is the same as Maximum Worst Case error. For Typical error, divide maximum by 2.
- o These specifications assume signal averaging per point is 0.1mSec Integ for all rows³.
- o instruNet connects directly to all types of RTD's.
- o The end user must supply one external shunt resistor per channel (i.e. this resistor is not included with i4xx or i51x products).
- o These specifications assume that less than 1000 pF of external capacitance is between the end user source and GND.
- o instruNet provides a fixed 3.3V excitation voltage which is accurately readback in order to calculate °C.
- o These specifications assume an i51x Wiring Box is attached to the i4xx Module, and that the device leads are attached to the i51x screw terminals (for accurate readback of 3.3Vref). The i51x can be attached directly to the i4xx front panel; or a cable can be placed between the i4xx and i51x wiring box (e.g. ≤ 5 meters, 44 wire, point-to-point) without degradation of accuracy.

- o Calibration: These specifications assume 1 year since Factory Calibration, instruNet hardware ambient temperature is between 13 and 33 °C, and instruNet hardware temperature changed 1°C since its last self-calibration⁵⁹.

Software Programmable Parameters

Each channel provides the following independently programmable parameters:

- o A/D Signal-Averaging-Per-Point (0 ... 100mSec)³
- o Sample-Rate (samples-per-second-per-channel)¹⁷
- o Digital IIR Filter (LowPass, HighPass, BandPass, or BandStop)⁵⁵
- o Voltage Measurement Range ($\pm 10\text{mV}$... $\pm 5\text{V}$)¹
- o Sensor Type¹³
- o Min/Max °C Range¹¹
- o Single-Ended or Differential Wiring
- o External End-User-Supplied Shunt Resistor resistance (Ω)¹⁵
- o RTD alpha (e.g. 0.0038) and delta (e.g. 1.492) coefficients
- o RTD beta (e.g. 0.11) coefficient when working with temperatures $< 0^\circ\text{C}$

More Information

- o [RTD Wiring Diagram and Setup](#)
- o [instruNet i430 Product Description](#)
- o [Model i430 RTD Measurement Error Components](#)
- o [Electrical Specifications](#)

Load Cell Measurement

Absolute Accuracy Specifications, iNet-430

Load Cell (Max Kg) ¹³	Measurement Range ¹¹	Absolute Accuracy (±Max Error) ^{38p}	Max Multi-Channel Aggregate Sample Rate (s/sec/agg) ¹⁸	Voltage Range ¹
10 Kg, 350Ω, 2mV/V @ MaxKg	0 to 10 Kg	±0.007 Kg	1.37K, i423 is faster	±10mV
25 Kg, 350Ω, 2mV/V @ MaxKg	0 to 25 Kg	±0.017 Kg	1.37K	±10mV
100 Kg, 350Ω, 2mV/V @ MaxKg	0 to 100 Kg	±0.066 Kg	1.37K	±10mV
250 Kg, 350Ω, 2mV/V @ MaxKg	0 to 250 Kg	±0.166 Kg	1.37K	±10mV
1000 Kg, 350Ω, 2mV/V @ MaxKg	0 to 1K Kg	±0.663 Kg	1.37K	±10mV
5000 Kg, 350Ω, 2mV/V @ MaxKg	0 to 5K Kg	±3.316 Kg	1.37K	±10mV
100 Kg, 500Ω, 2mV/V @ MaxKg	0 to 100 Kg	±0.070 Kg	1.34K	±10mV
100 Kg, 1000Ω, 2mV/V @ MaxKg	0 to 100 Kg	±0.080 Kg	1.32K	±10mV

Load Cell Specification Conditions, iNet-430

- o The iNet-430 module supports quantity 8 Load Cell devices wired Differential (not SE).
- o **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 (we are conservative): voltage measurement errors as described above, readback of excitation voltage error, 2.8nA max leakage current (at 37°C) times user source impedance error, multiplexor current pump error. Absolute Accuracy does Not include errors from the actual Load Cell device. Absolute Accuracy is the same as Maximum Worst Case error. For Typical error, divide maximum by 2.
- o These specifications assume signal averaging per point is 0.1mSec Integ for all rows³.
- o instruNet connects directly to all types of Load Cell's.
- o These specifications assume the device has been calibrated at the 0 point. This "balancing" involves applying 0 force and then telling instruNet to "balance bridges" via a software command. Subsequently, instruNet automatically subtracts this voltage from future measurements.
- o 120Ω devices are typically not used due to excess heating at the device (3.3V / 120Ω = 27mA, 90 mWatts). ≥ 350Ω devices are preferred (3.3V / 350Ω = 9mA, 31 mWatts).
- o These specifications assume that less than 1000 pF of external capacitance is between the end user source and GND.
- o instruNet provides a fixed 3.3V excitation voltage which is accurately readback in order to calculate Kg.
- o These specifications assume an i51x Wiring Box is attached to the i4xx Module, and that the device leads are attached to the i51x screw terminals (for accurate readback of 3.3Vref). The i51x can be attached directly to the i4xx front panel; or a cable can be placed between the i4xx and i51x wiring box (e.g. ≤ 5meters, 44 wire, point-to-point) without degradation of accuracy.
- o Calibration: These specifications assume 1 year since Factory Calibration, instruNet hardware ambient temperature is between 13 and 33 °C, and instruNet hardware temperature changed 1°C since its last self-calibration⁵⁹.

Software Programmable Parameters

Each channel provides the following independently programmable parameters:

- o A/D Signal-Averaging-Per-Point (0 ... 100mSec) ³
- o Sample-Rate (samples-per-second-per-channel) ¹⁷
- o Digital IIR Filter (LowPass, HighPass, BandPass, or BandStop) ⁵⁵
- o Voltage Measurement Range (±10mV ... ±80mV) ¹
- o Sensor Type ¹³
- o Min/Max Kg Range ¹¹
- o Device maximum-Kg-force and mV/V-sensitivity-at-max-force coefficients

More Information

- o [Load Cell Wiring Diagram and Setup](#)
- o [instruNet i430 Product Description](#)
- o [Model i430 Load Cell Measurement Error Components](#)
- o [Electrical Specifications](#)

Strain Gage Measurement

Absolute Accuracy Specifications, iNet-430

Strain Gage (ohms) ¹³	Measurement Range ¹¹	Absolute Accuracy (±Max Error) ^{38d}	Max Multi-Channel Aggregate Sample Rate (s/sec/agg) ¹⁸	External Ro Resistor (Ω, temp drift) ¹⁵	Example Shunt Resistor Product ¹⁰⁰	Voltage Range ¹
350 Ω, ½ Bridge	±5943 μS	±10.0 μS	1.39K, i423 is faster	350 Ω, 5ppm/C	#iNet-R-350	±10mV
	±11958 μS	±11.9 μS	1.44K	350 Ω, 5ppm/C	#iNet-R-350	±20mV
	±24206 μS	±15.9 μS	1.46K	350 Ω, 5ppm/C	#iNet-R-350	±40mV
	±49612 μS	±24.5 μS	5.95K	350 Ω, 5ppm/C	#iNet-R-350	±80mV
350 Ω, ½ Bridge Bend	±2954 μS	±3.9 μS	1.39K	350 Ω, 5ppm/C	#iNet-R-350	±10mV
350 Ω, ½ Bridge Axial	±4489 μS	±5.8 μS	1.39K	350 Ω, 5ppm/C	#iNet-R-350	±10mV
350 Ω, Full Br Bend	±1477 μS	±0.8 μS	1.39K	(no ext Ro)		±10mV
350 Ω, Full Br Axial I	±2238 μS	±1.2 μS	1.39K	(no ext Ro)		±10mV
350 Ω, Full Br Axial II	±2241 μS	±1.2 μS	1.39K	(no ext Ro)		±10mV
1K Ω, ½ Bridge	±5943 μS	±6.2 μS	1.34K	1K Ω, 5ppm/C	#iNet-R-1K	±10mV

Strain Gage Specification Conditions, iNet-430

- o The iNet-430 module supports quantity 8 Strain Gage devices wired Differential (not SE).
- o **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 (we are conservative): voltage measurement errors as described above, readback of excitation voltage error, external shunt resistor self heating error, 2.8nA max leakage current (at 37°C) times user source impedance error, multiplexor current pump error. Absolute Accuracy does Not include errors from the actual Strain Gage device. Absolute Accuracy is the same as Maximum Worst Case error. For Typical error, divide maximum by 2.
- o These specifications assume signal averaging per point is 0.1mSec Integ for all rows³.
- o instruNet connects directly to all types of Strain Gage's.
- o The end user must supply 2 external shunt resistors if working with a half bridge and 3 external resistors if working with a quarter bridge (i.e. these resistors are not included with i4xx or products).
- o These specifications assume the device has been calibrated at the 0 point. This "balancing" involves applying 0 force and then telling instruNet to "balance bridges" via a software command. Subsequently, instruNet automatically subtracts this voltage from future measurements.
- o 120Ω devices are typically not used due to excess heating at the device (3.3V / 120Ω = 27mA, 90 mWatts). ≥ 350Ω devices are preferred (3.3V / 350Ω = 9mA, 31 mWatts).
- o These specifications assume that less than 1000 pF of external capacitance is between the end user source and GND.
- o instruNet provides a fixed 3.3V excitation voltage which is accurately readback in order to calculate μS.
- o These specifications assume an i51x Wiring Box is attached to the i4xx Module, and that the device leads are attached to the i51x screw terminals (for accurate readback of 3.3Vref). The i51x can be attached directly to the i4xx front panel; or a cable can be placed between the i4xx and i51x wiring box (e.g. ≤ 5meters, 44 wire, point-to-point) without degradation of accuracy.
- o Calibration: These specifications assume 1 year since Factory Calibration, instruNet hardware ambient temperature is between 13 and 33 °C, and instruNet hardware temperature changed 1°C since its last self-calibration⁵⁹.

Software Programmable Parameters

Each channel provides the following independently programmable parameters:

- o A/D Signal-Averaging-Per-Point (0 ... 100mSec)³
- o Sample-Rate (samples-per-second-per-channel)¹⁷
- o Digital IIR Filter (LowPass, HighPass, BandPass, or BandStop)⁵⁵
- o Voltage Measurement Range (±10mV ... ±80mV)¹
- o Sensor Type¹³
- o Min/Max μS Range¹¹
- o External End-User-Supplied Shunt Resistor resistance (Ω)¹⁵
- o Device GF (e.g. 2) and Poisson (e.g. 0.32) coefficients
- o Device to instruNet lead resistance (Ω)

More Information

- o [Strain Gage Wiring Diagram and Setup](#)
- o [instruNet i430 Product Description](#)
- o [Model i430 Strain Gage Measurement Error Components](#)
- o [Electrical Specifications](#)

Potentiometer Measurement

Absolute Accuracy Specifications, iNet-430

POT Type (ohms) ¹³	Measurement Range ¹¹	Signal Averaging Per Point (mSec) ³	Absolute Accuracy (\pm Max Error) ^{38q}	Max Multi-Channel Aggregate Sample Rate (s/sec/agg) ¹⁸	Voltage Range ¹
10K Ω	0 to 1.0Eu	0.1 mSec	± 0.000332 Eu	2.53K, i423 is faster	0 to 5V
50K Ω	0 to 1.0Eu		± 0.000349 Eu	0.74K	0 to 5V

Potentiometer Specification Conditions, iNet-430

- o The iNet-430 module supports quantity 8 Potentiometer devices wired Differential (not SE).
- o **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 (we are conservative): voltage measurement errors as described above, readback of excitation voltage error, instruNet input impedance variation error, 2.8nA max leakage current (at 37°C) times user source impedance error, multiplexor current pump error. Absolute Accuracy does Not include errors from the actual Potentiometer device. Absolute Accuracy is the same as Maximum Worst Case error. For Typical error, divide maximum by 2.
- o instruNet connects directly to all types of Potentiometer's.
- o These specifications assume that less than 1000 pF of external capacitance is between the end user source and GND.
- o instruNet provides a fixed 3.3V excitation voltage which is accurately readback in order to calculate Eu.
- o These specifications assume an i51x Wiring Box is attached to the i4xx Module, and that the device leads are attached to the i51x screw terminals (for accurate readback of 3.3Vref). The i51x can be attached directly to the i4xx front panel; or a cable can be placed between the i4xx and i51x wiring box (e.g. \leq 5meters, 44 wire, point-to-point) without degradation of accuracy.

- o Calibration: These specifications assume 1 year since Factory Calibration, instruNet hardware ambient temperature is between 13 and 33 °C, and instruNet hardware temperature changed 1°C since its last self-calibration ⁵⁹.

Software Programmable Parameters

Each channel provides the following independently programmable parameters:

- o A/D Signal-Averaging-Per-Point (0 ... 100mSec) ³
- o Sample-Rate (samples-per-second-per-channel) ¹⁷
- o Digital IIR Filter (LowPass, HighPass, BandPass, or BandStop) ⁵⁵
- o Voltage Measurement Range (± 10 mV ... ± 5 V) ¹
- o Sensor Type ¹³

More Information

- o [Potentiometer Wiring Diagram and Setup](#)
- o [instruNet i430 Product Description](#)
- o [Model i430 Potentiometer Measurement Error Components](#)
- o [Electrical Specifications](#)

Current Measurement

Absolute Accuracy Specifications, iNet-430

Measurement Range ¹¹	Signal Averaging Per Point (mSec) ³	Absolute Accuracy (Max Gain + Offset Error) ^{38b}	Max Multi-Channel Aggregate Sample Rate (s/sec/agg) ¹⁸	External Shunt Resistor (Ω) ¹⁵	Shunt Resistor Initial Accuracy (%) and Temp Drift (ppm/C) ¹⁶	Example Shunt Resistor Product ¹⁰⁰	Voltage Range ¹
0 to 24mA	0 mSec	$\pm(0.061\% + 7.6\mu A)$	92.49K	33 Ω	0.05%, 5ppm/C	#iNet-R-33	0 to 1.2V
	0.1 mSec	$\pm(0.061\% + 4.2\mu A)$	6.41K				
±24mA	0 mSec	$\pm(0.061\% + 9.5\mu A)$	97.56K	33 Ω	0.05%, 5ppm/C	#iNet-R-33	±1.2V
	0.1 mSec	$\pm(0.061\% + 5.7\mu A)$	6.41K				
±12mA	0 mSec	$\pm(0.061\% + 3.5\mu A)$	89.51K	120 Ω	0.05%, 5ppm/C	#iNet-R-120	±2.5V
	0.1 mSec	$\pm(0.061\% + 1.8\mu A)$	6.41K				
±2.5mA	0 mSec	$\pm(0.061\% + 0.4\mu A)$	34.92K	1K Ω	0.05%, 5ppm/C	#iNet-R-1K	±2.5V
	0.1 mSec	$\pm(0.061\% + 0.2\mu A)$	4.63K				
±1.2mA	0 mSec	$\pm(0.060\% + 0.31\mu A)$	33.95K	1K Ω	0.05%, 5ppm/C	#iNet-R-1K	±1.2V
	0.1 mSec	$\pm(0.060\% + 0.17\mu A)$	4.63K				
±500uA		$\pm(0.061\% + 0.04\mu A)$	2.53K	10K Ω	0.05%, 5ppm/C	#iNet-R-10K	±5V
±600uA	0 mSec	$\pm(0.060\% + 0.25\mu A)$	32.96K	1K Ω	0.05%, 5ppm/C	#iNet-R-1K	±600mV
	0.1 mSec	$\pm(0.060\% + 0.12\mu A)$	4.63K				
±800uA	0 mSec	$\pm(0.060\% + 2.08\mu A)$	77.67K	120 Ω	0.05%, 5ppm/C	#iNet-R-120	±600mV
	0.1 mSec	$\pm(0.060\% + 1.02\mu A)$	5.95K				
±120uA		$\pm(0.062\% + 0.017\mu A)$	2.53K	10K Ω	0.05%, 5ppm/C	#iNet-R-10K	±1.2V
±80uA		$\pm(0.067\% + 0.012\mu A)$	1.41K	1K Ω	0.05%, 5ppm/C	#iNet-R-1K	±80mV
0 to 24mA	0 mSec	$\pm(0.021\% + 7.6\mu A)$	92.49K	33 Ω	0.01%, 5ppm/C	contact disti	0 to 1.2V
	0.1 mSec	$\pm(0.021\% + 4.2\mu A)$	6.41K				

Current Specification Conditions, iNet-430

- The iNet-430 module supports quantity 8 Current devices wired Differential or 16 wired Single-Ended.
- 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 (we are conservative): voltage measurement errors as described above, readback of excitation voltage error, external shunt resistor self heating error, external shunt resistor initial accuracy error, instruNet input impedance variation error, 2.8nA max leakage current (at 37°C) times user source impedance error, multiplexer current pump error. Absolute Accuracy is the same as Maximum Worst Case error. For Typical error, divide maximum by 2.
- 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 the input. For example, if one measures 2Volts and the absolute accuracy specification is $\pm(1\% + 3mV)$, then one could expect $\pm(1\% * 2V + 3mV) = \pm 23mV$ accuracy.
- The end user must supply one external shunt resistor per channel (i.e. this resistor is not included with i4xx or i51x products).
- instruNet hardware measures the voltage across an external current shunt resistor. Both sides of this resistor must be within ± 5 Volts of instruNet GND at all times.
- These specifications assume that less than 1000 pF of external capacitance is between the end user source and GND.
- Calibration: These specifications assume 1 year since Factory Calibration, instruNet hardware ambient temperature is between 13 and 33 °C, and instruNet hardware temperature changed 1°C since its last self-calibration ⁵⁹.

Software Programmable Parameters

Each channel provides the following independently programmable parameters:

- A/D Signal-Averaging-Per-Point (0 ... 100mSec) ³
- Sample-Rate (samples-per-second-per-channel) ¹⁷
- Digital IIR Filter (LowPass, HighPass, BandPass, or BandStop) ⁵⁵
- Voltage Measurement Range ($\pm 10mV$... $\pm 5V$) ¹
- Sensor Type ¹³
- Min/Max uA Range ¹¹
- Single-Ended or Differential Wiring
- External End-User-Supplied Shunt Resistor resistance (Ω) ¹⁵

More Information

- [Current Wiring Diagram and Setup](#)
- [instruNet i430 Product Description](#)

- Model i430 Current Measurement Error Components

- Electrical Specifications

Resistance Measurement

Absolute Accuracy Specifications, iNet-430

Measurement Range ¹¹	Signal Averaging Per Point (mSec) ³	Absolute Accuracy (Max Gain + Offset Error) ^{38c}	Max Multi-Channel Aggregate Sample Rate (s/sec/agg) ¹⁸	External Shunt Resistor (Ω) ¹⁵	Shunt Resistor Initial Accuracy (%) and Temp Drift (ppm/C) ¹⁶	Example Shunt Resistor Product ¹⁰⁰	Voltage Range ¹
0 to 33 Ω	0 mSec	$\pm(0.093\% + 0.077 \Omega)$	87.07K	1K Ω	0.05%, 5ppm/C	#iNet-R-1K	$\pm 600\text{mV}$
	0.1 mSec	$\pm(0.085\% + 0.038 \Omega)$	6.41K				
0 to 100 Ω	0 mSec	$\pm(0.095\% + 0.077 \Omega)$	87.07K	1K Ω	0.05%, 5ppm/C	#iNet-R-1K	$\pm 600\text{mV}$
	0.1 mSec	$\pm(0.087\% + 0.038 \Omega)$	6.41K				
0 to 330 Ω	0 mSec	$\pm(0.102\% + 0.08 \Omega)$	89.64K	1K Ω	0.05%, 5ppm/C	#iNet-R-1K	0 to 1.2V
	0.1 mSec	$\pm(0.093\% + 0.04 \Omega)$	6.41K				
0 to 1K Ω	0 mSec	$\pm(0.130\% + 0.10 \Omega)$	97.12K	1K Ω	0.05%, 5ppm/C	#iNet-R-1K	0 to 2.5V
	1.0 mSec	$\pm(0.115\% + 0.04 \Omega)$	0.79K				
0 to 3300 Ω	0 mSec	$\pm(0.131\% + 0.3 \Omega)$	97.12K	3.3K Ω	0.05%, 5ppm/C	#iNet-R-3300	0 to 2.5V
	0.1 mSec	$\pm(0.118\% + 0.2 \Omega)$	6.41K				
0 to 10K Ω		$\pm(0.183\% + 0.2 \Omega)$	6.41K	3.3K Ω	0.05%, 5ppm/C	#iNet-R-3300	0 to 2.5V
0 to 100 Ω	0 mSec	$\pm(0.055\% + 0.077 \Omega)$	87.07K	1K Ω	0.01%, 5ppm/C	contact disti	$\pm 600\text{mV}$
	0.1 mSec	$\pm(0.047\% + 0.038 \Omega)$	6.41K				

Resistance Specification Conditions, iNet-430

- The iNet-430 module supports quantity 8 Resistance devices wired Differential or 16 wired Single-Ended.
- 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 (we are conservative): voltage measurement errors as described above, readback of excitation voltage error, external shunt resistor self heating error, external shunt resistor initial accuracy error, instruNet input impedance variation error, 2.8nA max leakage current (at 37°C) times user source impedance error, multiplexor current pump error. Absolute Accuracy is the same as Maximum Worst Case error. For Typical error, divide maximum by 2.
- 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 the input. For example, if one measures 2Volts and the absolute accuracy specification is $\pm(1\% + 3\text{mV})$, then one could expect $\pm(1\% * 2\text{V} + 3\text{mV}) = \pm 23\text{mV}$ accuracy.
- The end user must supply one external shunt resistor per channel (i.e. this resistor is not included with i4xx or i51x products).
- These specifications assume that less than 1000 pF of external capacitance is between the end user source and GND.
- instruNet provides a fixed 3.3V excitation voltage which is accurately readback in order to calculate Ω .
- These specifications assume an i51x Wiring Box is attached to the i4xx Module, and that the device leads are attached to the i51x screw terminals (for accurate readback of 3.3Vref). The i51x can be attached directly to the i4xx front panel; or a cable can be placed between the i4xx and i51x wiring box (e.g. $\leq 5\text{meters}$, 44 wire, point-to-point) without degradation of accuracy.

- Calibration: These specifications assume 1 year since Factory Calibration, instruNet hardware ambient temperature is between 13 and 33 °C, and instruNet hardware temperature changed 1°C since its last self-calibration ⁵⁹.

Software Programmable Parameters

Each channel provides the following independently programmable parameters:

- A/D Signal-Averaging-Per-Point (0 ... 100mSec) ³
- Sample-Rate (samples-per-second-per-channel) ¹⁷
- Digital IIR Filter (LowPass, HighPass, BandPass, or BandStop) ⁵⁵
- Voltage Measurement Range ($\pm 10\text{mV}$... $\pm 5\text{V}$) ¹
- Sensor Type ¹³
- Min/Max Ω Range ¹¹
- Single-Ended or Differential Wiring
- External End-User-Supplied Shunt Resistor resistance (Ω) ¹⁵

More Information

- [Resistance Wiring Diagram and Setup](#)
- [instruNet i430 Product Description](#)
- [Model i430 Resistance Measurement Error Components](#)
- [Electrical Specifications](#)