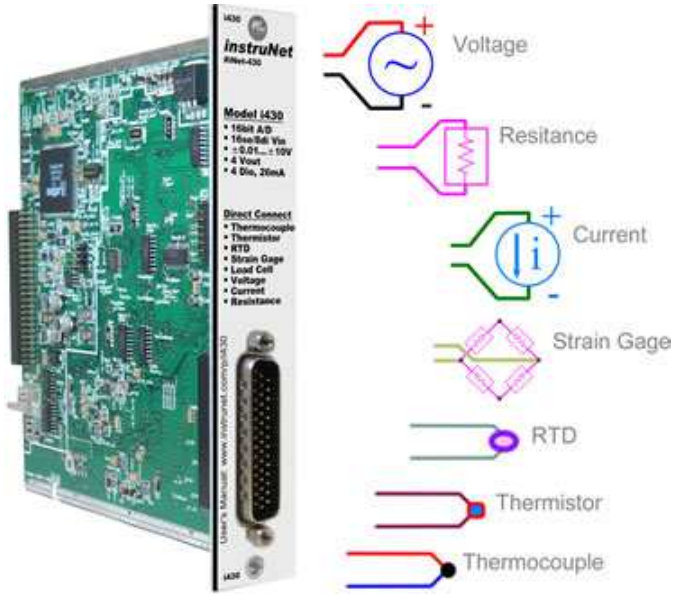
i430 Product Overview

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

Product Summary

- 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
- 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
- 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
- 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
- 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] .
- Excitation power (+3.3V ±.2V, <0.22A, 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.

Photograph



More Info...

Accuracy Specifications
Voltage, Thermocouple, Thermistor, RTD, Load Cell, Strain Gage, Potentiometer, Current, Resistance

Wiring Diagram and Setup
Voltage, Thermocouple, Thermistor, RTD, Load Cell, Strain Gage, Potentiometer, Current, Resistance

Hardware I/O Specifications
Voltage Input, ±10V Output, 0..+10V Output, Universal Digital

Software Interface
Voltage Input, ±10V Output, 0..+10V Output, Universal Digital, I/O Software Channels

Hardware Interface
Hd44 Connector Pins, Power Available to End User, Physical/Environmental Specifications, Compatible Computers and Operating Systems

Getting Started
Installing instruNet Hardware & Software, instruNet World Tutorial, Connecting to Sensors and Controls, Setting Up A Digitization, Working with Voltage Output Channels, Tutorial, Working with Digital I/O Channels, Tutorial, Working With Digital Filters, Calibration Options and Strategies

- This module provides 2 channels (Ch#19...#20) that can output a voltage between -10.1 and +10.1V accurate to ±4mV[41] . An internal 14-bit d/a converter is following by an amplifier that can drive up to ±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
- This module provides 2 channels (Ch#17...#18) that can output a voltage between 0 and +10.1V accurate to ±78mV[42] . An internal 8-bit d/a converter is following by an amplifier that can drive up to ±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
- 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[43] . 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.

Operation

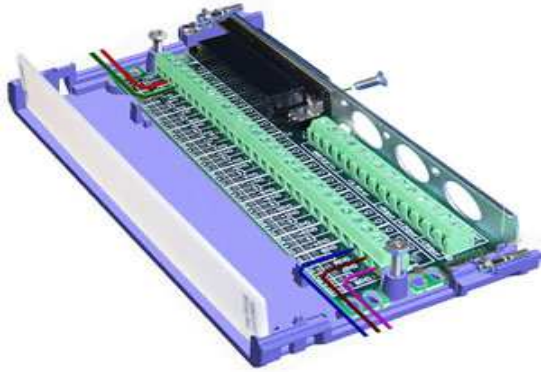
Digitize Performance, Digitize To Ram or File?, Scalar I/O vs. High Speed I/O, Intergration vs. SampleRate vs. Noise, Powering instruNet from +12VDC or Batteries, Upgrading to latest DLL, Troubleshooting Hardware

Front End Schematics

Hd44 Connector, 16x Vin Mux, ±10V Buffer, 0-10V Buffer, 4x Uio_A Bits

Optional Accessories, i430

HD44 Cable (3 meters)



i510 Wiring Box

Shunt Resistors

Analog Voltage Input (A/D), i430

Parameter	Specifications[19]	Notes
Description	16se/8di Voltage Input Channels with 16-bit A/D Converter	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	16-bit	Internal 16-bit A/D Converter resolves voltage input range to 0...65535 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 is programmable between 2 and 32 for bandpass/bandstop; and between 2 and 16 for lowpass/highpass[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 ±.2V, <0.22A, 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, i430

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 is connected to instruNet chassis, which is connected to

		Earth ground via instruNet power supply plug 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. -80dB = 20 * log (1 / 10000). For example, one can apply a 10Hz 10Vpp sinewave to Ch1 on the ±5Vrange, apply 0 Volts DC to Ch3 on the ±2.5Vrange, 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	100MΩ	Internal 100MΩ resistor (5% accuracy) between input pin and instruNet ground reduces fluctuating measurments 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 samle rates with low level signals; please see i423 which routes inputs to instrumentation amplifers instead of multiplexors.
Input leakge 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 ±100uV) 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	Multiplexor	Voltage input pin connects directly to internal protected multiplexor IC
Common Mode Rejection Ratio	≥ 74dB	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, i430

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 ≥ 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 2G bytes. 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, ±10mV...±10V[20]

Connector Pins	One pin per bit	Signals are available at Hd44 connector pins: #1...#16[215]
Ground Reference	Hd44 Pins 29/42/43/44	instruNet ground = instruNet chassis = earth ground via power supply 3rd prong

2x Precision Analog Voltage Outputs, i430

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 ±4mV. An internal 14-bit d/a converter is following by an amplifier that can drive up to ±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
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 ~1.3mV per LSB (least-significant-bit) monotonic resolution
Output Absolute Accuracy	±4mV max error	Output is set accurate to ±4mV, 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	±3.2mV for ≥ ±5V ±1.2mV for < ±5V	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. ±3.2mV maximum error for output ≥ ±5V, ±1.2mV for output between 0V and ±5V).
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 > 15mA over-current condition, and automatically closes otherwise

Electrical Specifications, Precision Voltage Out, i430

Parameter	Specifications[19]	Notes
Output Current Drive	±4 mA	Output channel can drive up to ±4 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	±4mV max	Final output voltage after resetting or starting instruNet software

Power On/Off State	±30mV max	Final output voltage after powering instruNet hardware on or off
Update Glitch	±150mV for 30uSec typ	Pulse on output that occurs after updating this vout channel
Digital Feedthru Glitch	±200mV for 1uSec typ	Pulse on output that occurs after updating another vout channel
Reset Glitch	±200mV for 300mSec typ	Pulse on output that occurs after resetting or starting instruNet software
Power On/Off Glitch	±2V for 50mSec typ	Pulse on output that occurs after powering instruNet hardware on or off
Front End Schematics	Published	Schematics: Hd44 Connector, ±10V Buffer

Software Interface, Precision Voltage Out, i430

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 ≥ 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: ±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[215]
Ground Reference	Hd44 Pins 29/42/43/44	instruNet ground = instruNet chassis = earth ground via power supply 3rd prong

2x Analog Voltage Outputs, i430

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 ±78mV. An internal 8-bit d/a converter is following by an amplifier that can drive up to ±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
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 ~39.8mV per LSB (least-significant-bit) monotonic resolution
Output Absolute Accuracy	±78mV max error	Output is set accurate to ±78mV, 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	±3.2mV for ≥ ±5V ±1.2mV for < ±5V	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. ±3.2mV maximum error for output ≥ ±5V, ±1.2mV for output between 0V and ±5V)

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 > 15mA over-current condition, and automatically closes otherwise

Electrical Specifications, 8bit Voltage Out, i430

Parameter	Specifications[19]	Notes
Output Current Drive	±4 mA	Output channel can drive up to ±4 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	±10mV 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	±10mV for 30uSec typ	Pulse on output that occurs after updating this vout channel
Digital Feedthru Glitch	±40mV for 1uSec typ	Pulse on output that occurs after updating another vout channel
Reset Glitch	±20mV for 20mSec typ	Pulse on output that occurs after resetting or starting instruNet software
Power On/Off Glitch	±1V 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, i430

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 ≥ 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[215]

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, i430

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, 93.750008KHz, 23.437502KHz, 10KHz, 5.9KHz, 1.5KHz, 1KHz, 366Hz, 100Hz, 91.552734Hz, 22.888184Hz, 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] 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, 12V), 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, i430

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 quot;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	3.9KΩ ±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 uSec	Schmitt trigger circuit adds < 0.7uSec delay between voltage at I/O pin, and internal version of digital input
Output Fall Time	0.02 uSec @ 100 pF typ, < 1.3 uSec @ 1K pF	Output transitions from 2V to 0.8V in approximately 0.02uSec with 100 pF of capacitive load
Output Rise Time	1.3 uSec @ 100 pF typ, < 4.9 uSec @ 1K pF	Output transitions from 0.8V to 2V in approximately 1.3uSec 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, i430

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 ≥ 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 2G bytes. Data consumes 4 bytes per point.
Scalar I/O Benchmark	50 to 300uSec typ	Scalar I/O[60] typically requires 50 to 300uSec 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[215]
Ground Reference	Hd44 Pins 29/42/43/44	instruNet ground = instruNet chassis = earth ground via power supply 3rd prong

I/O Software Channels, i430

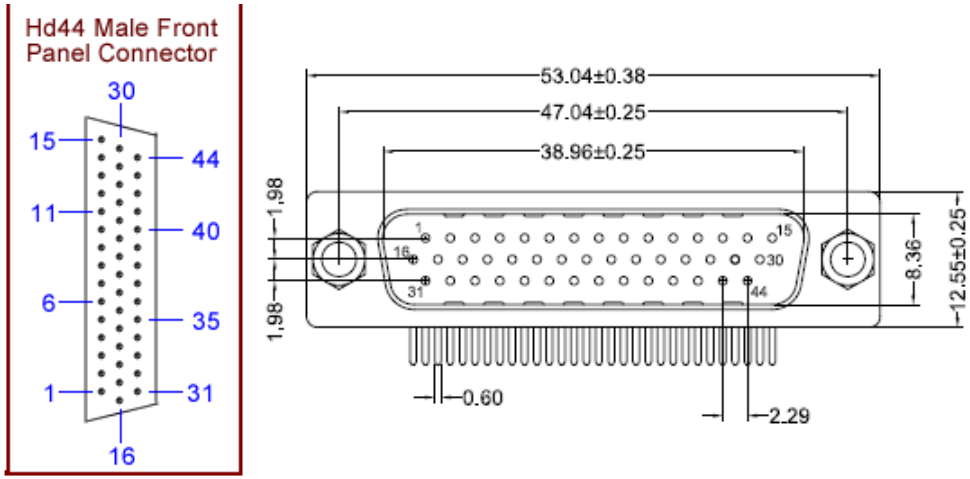
ChNum	Name	Channel Type	Hd44 Pin(s)	Description	Scalar I/O Support	High Speed Digitize Support
#1	Ch1 Vin+	SE/DI Voltage Input	1, 2	±10mV...±10V[20]	input	input
#2	Ch2 Vin-	SE Voltage Input	2	"	"	"
#3	Ch3 Vin+	SE/DI Voltage Input	3, 4	"	"	"
#4	Ch4 Vin-	SE Voltage Input	4	"	"	"
#5	Ch5 Vin+	SE/DI Voltage 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	Voltage Out, 0-10V	17	0V...10V	input/output	output
#18	Ch18 Vout	"	18	"	"	"
#19	Ch19 Vout	Voltage Out, ±10V	19	±10V	"	no high speed i/o
#20	Ch20 Vout	"	20	"	"	"
#25	Ch25 Uio	One Uio Bit	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, i430

Hd44 Pin#	Pin Name	Pin Type	Description
#1	Ch1 Vin+	SE/DI+ Voltage In	Supported Sensors: Voltage, Thermocouple, Thermistor, RTD, Load Cell, Strain Gage, Potentiometer, Current, Resistance
#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	Voltage Out, 0-10V	0V...10V, 8 bits, 4 mA, scalar input/output, high speed output
#18	Ch18 Vout	"	"
#19	Ch19 Vout	Voltage Out, ±10V	±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	One Uio Bit	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 ±.2V, <0.22A	Power Available to End User
#35	"	"	"
#36	5Vpwr	+5V ±0.5V, <0.22A	Power Available to End User
#37	"	"	"
#38	12Vpwr	+12V ±1.2V, <0.22A	Power Available to End User
#39	"	"	"
#40	-12Vpwr	-12V ±1.2V, <0.22A	Power Available to End User
#41	"	"	"
#42	Gnd	instruNet Ground	instruNet ground = instruNet chassis = earth ground via power supply 3rd prong
#43	"	"	"
#44	"	"	"



Power Available to End User, i430

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[215] pins.
+3.3V Reference Pwr	+3.3V ±.2V, <0.22A	+3.3Vdc power available to end user at Hd44 connector pins 34 and 35
+5V End User Pwr	+5V ±0.5V, <0.22A	+5Vdc power available to end user at Hd44 connector pins 36 and 37
+12V End User Pwr	+12V ±1.2V, <0.22A	+12Vdc power available to end user at Hd44 connector pins 38 and 39

-12V End User Pwr	-12V ±1.2V, <0.22A	-12Vdc power available to end user at Hd44 connector pins 40 and 41
Fuse	Auto-Reset, > .35Amp	Internal fuse on each power pin opens during >.35A over-current condition, and automatically closes otherwise

Physical/Environmental Specifications, i430

Parameter	Specifications[19]	Notes
I/O Connector	HD44 male	High density 44 pin male connector[215] (e.g. Astron #HD6C-44-AMAN-1G[213] , click footnote for datasheet, outer shell is same size as DB25)
Wiring Box	Compatible	Easy to install wiring box: i510
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	≤ 90%	Operate in humidity less than 90%, no condensation
Hot Plug & Play	Yes	One can insert i4xx module 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 ±0.4V, ~184mA	Power required to operate module (not for sensors or end user power)
+12Vdc Requirement	+12V ±0.8V, ~91mA	"
-12Vdc Requirement	-12V ±0.8V, ~74mA	"

Voltage Measurement
Absolute Accuracy Specifications, i430

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)	1.85K	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)	1.81K	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)	1.74K	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)	1.70K	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, i430

- The i430 module supports quantity 8 Voltage devices wired Differential or 16 wired Single-Ended.
- **Absolute Accuracy** 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, 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 drift.
- 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]

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

- 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]
- 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, i430

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% + 0.0µV)/°C	±(0.0035% + 0.0µV)/yr	±(0.0013% + 241.3µV)/°C
±5V	±(0.010% + 332.7µV)	±(0.0005% + 0.0µV)/°C	±(0.0025% + 0.0µV)/yr	±(0.0010% + 118.8µV)/°C
±2.5V	±(0.010% + 178.9µV)	±(0.0005% + 0.0µV)/°C	±(0.0025% + 0.0µV)/yr	±(0.0010% + 63.8µV)/°C
±1.2V	±(0.010% + 141.9µV)	±(0.0005% + 0.0µV)/°C	±(0.0025% + 0.0µV)/yr	±(0.0010% + 36.3µV)/°C
±600mV	±(0.010% + 94.6µV)	±(0.0005% + 0.0µV)/°C	±(0.0025% + 0.0µV)/yr	±(0.0010% + 22.5µV)/°C
±80mV	±(0.015% + 10.1µV)	±(0.0005% + 0.0µV)/°C	±(0.0025% + 0.0µV)/yr	±(0.0048% + 2.4µV)/°C
±40mV	±(0.015% + 7.7µV)	±(0.0005% + 0.0µV)/°C	±(0.0025% + 0.0µV)/yr	±(0.0048% + 1.5µV)/°C
±20mV	±(0.015% + 7.2µV)	±(0.0005% + 0.0µV)/°C	±(0.0025% + 0.0µV)/yr	±(0.0048% + 1.1µV)/°C
±10mV	±(0.015% + 6.5µV)	±(0.0005% + 0.0µV)/°C	±(0.0025% + 0.0µV)/yr	±(0.0048% + 0.9µV)/°C
0 to 5V	±(0.010% + 178.9µV)	±(0.0005% + 0.0µV)/°C	±(0.0025% + 0.0µV)/yr	±(0.0010% + 63.8µV)/°C
0 to 2.5V	±(0.010% + 141.9µV)	±(0.0005% + 0.0µV)/°C	±(0.0025% + 0.0µV)/yr	±(0.0010% + 36.3µV)/°C
0 to 1.2V	±(0.010% + 94.6µV)	±(0.0005% + 0.0µV)/°C	±(0.0025% + 0.0µV)/yr	±(0.0010% + 22.5µV)/°C

Thermocouple Measurement
Absolute Accuracy Specifications, i430

TC Type [13]	Measurement Range [11]	Voltage Range [1]	Absolute Accuracy (±Max Error) [38w]	Max Multi-Channel Aggregate Sample Rate (s/sec/agg) [18]
J	-210 to 150°C	±10mV	-10 to 150°C: ±0.72°C -210 to -10°C: ±1.00°C	1.70K i423 is faster
	-210 to 1200°C	±80mV	10 to 1200°C: ±0.94°C -210 to 1200°C: ±1.20°C	1.85K
K	-200 to 200°C	±10mV	-10 to 120°C: ±0.78°C ±200°C: ±1.12°C	1.70K
	-200 to 1360°C	±80mV	10 to 1360°C: ±1.17°C -200 to 1360°C: ±1.36°C	1.85K
B	251 to 1300°C	±10mV	251 to 600°C: ±3.43°C 600 to 1300°C: ±1.87°C	1.70K
	251 to 1820°C	±20mV	251 to 1300°C: ±3.70°C 1300 to 1820°C: ±1.47°C	1.70K
C	0 to 1K°C	±20mV	±1.63°C	1.74K
	0 to 2315°C	±40mV	±2.59°C	1.81K
D	0 to 1K°C	±20mV	±1.85°C	1.74K
	0 to 2315°C	±40mV	±2.62°C	1.81K
E	-200 to 125°C	±10mV	-90 to 80°C: ±0.73°C -200 to 125°C: ±0.90°C	1.70K
	-200 to 1K°C	±80mV	10 to 1K°C: ±0.85°C -200 to 1K°C: ±1.05°C	1.85K
G	0 to 500°C	±10mV	0 to 500°C: ±4.65°C 100 to 500°C: ±2.57°C	1.70K
	0 to 2315°C	±40mV	0 to 300°C: ±5.26°C 300 to 2315°C: ±1.96°C	1.70K
N	-200 to 170°C	±10mV	-200 to 0°C: ±1.35°C 0 to 170°C: ±0.87°C	1.70K
	-10 to 570°C	±20mV	±0.90°C	1.74K
	-200 to 1300°C	±80mV	10 to 1300°C: ±1.07°C -200 to 1300°C: ±1.72°C	1.85K
R	-50 to 800°C	±10mV	-50 to 10°C: ±2.53°C 10 to 800°C: ±1.86°C	1.70K
	-50 to 1768°C	±40mV	10 to 1768°C: ±2.10°C -50 to 1768°C: ±2.85°C	1.81K
S	-50 to 860°C	±10mV	-50 to -10°C: ±2.34°C	1.70K

			-10 to 860°C: ±1.98°C	
	-50 to 1768°C	±20mV	-50 to -10°C: ±2.51°C -10 to 1768°C: ±2.12°C	1.70K
T	-200 to 175°C	±10mV	-200 to -10°C: ±1.08°C -10 to 175°C: ±0.76°C	1.70K
	-200 to 400°C	±40mV	10 to 400°C: ±0.78°C -200 to 400°C: ±1.17°C	1.81K

Thermocouple Specification Conditions, i430

- The i430 module supports quantity 8 Thermocouple devices wired Differential (not SE).
- **Absolute Accuracy** 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 1.0 mSec for all rows[3] .
- 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 thermcouple 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 °C [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 (±10mV ... ±80mV) [1]
- Sensor Type [13]
- Min/Max °C Range [11]

More Information

- Thermocouple Wiring Diagram and Setup
- instruNet i430 Product Description
- Model i430 Thermocouple Measurement Error Components
- Electrical Specifications

Thermistor Measurement
Absolute Accuracy Specifications, i430

Thermistor Type (Ω @ 25°C) [23]	Measurement Range [11]	Voltage Range [1]	Absolute Accuracy (±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 i423 has more range	0 to 1.2V	10 to 30°C: ±0.25°C 30 to 70°C: ±0.17°C 70 to 130°C: ±0.29°C	6.41K i423 is faster	10K Ω	0.05%, 5ppm/C	#iNet-R-10K
	0 to 70°C	0 to 2.5V	±0.30°C	6.41K	10K Ω	0.05%, 5ppm/C	#iNet-R-10K

	90 to 250°C	±80mV	±1.03°C	1.52K	10K Ω	0.05%, 5ppm/C	#iNet-R-10K
	30 to 250°C	±600mV	30 to 170°C: ±0.87°C 170 to 250°C: ±4.38°C	6.41K	10K Ω	0.05%, 5ppm/C	#iNet-R-10K
	30 to 70°C	0 to 1.2V	±0.16°C	6.41K	10K Ω	0.01%, 5ppm/C	contact disti

Thermistor Specification Conditions, i430

- The i430 module supports quantity 8 Thermistor devices wired Differential or 16 wired Single-Ended.
- **Absolute Accuracy** 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.
- These specifications assume signal averaging per point is 1.0 mSec for all rows[3] .
- instruNet connects directly to all types of Thermistor's.
- The end user must supply one external shunt resistor per channel (i.e. this resistor is not included with i4xx or i51x products).
- The end user must supply Steinhart a/b/c coefficients, unless working with YSI/Omega 4xx or 4xxxx series thermistors [23] .
- 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 °C.
- 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.
- 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 (±10mV ... ±5V) [1]
- Sensor Type [23]
- Min/Max °C Range [11]
- Single-Ended or Differential Wiring
- External End-User-Supplied Shunt Resistor resistance (Ω) [15]
- Device Steinhart-Hart a/b/c coefficients

More Information

- Thermistor Wiring Diagram and Setup
- instruNet i430 Product Description
- Model i430 Thermistor Measurement Error Components
- Electrical Specifications

RTD Measurement
Absolute Accuracy Specifications, i430

RTD Type (Ω @ 0°C) [13]	Measurement Range [11]	Voltage Range [1]	Absolute Accuracy (±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	±50°C	±40mV	±0.44°C	1.49K	10K Ω	0.05%, 5ppm/C	#iNet-R-10K
	-100 to 300°C	±80mV	-100 to 150°C: ±0.57°C 150 to 300°C: ±0.73°C	1.52K i423 is faster	10K Ω	0.05%, 5ppm/C	#iNet-R-10K
	-238 to 850°C	±600mV	-238 to 0°C: ±1.27°C 0 to 100°C: ±1.40°C	1.49K	10K Ω	0.05%, 5ppm/C	#iNet-R-10K

			100 to 850°C: ±2.57°C				
500 Ω	-100 to 300°C	±600mV	±0.84°C	6.41K	10K Ω	0.05%, 5ppm/C	#iNet-R-10K
1K Ω	-100 to 300°C	±600mV	±0.81°C	6.41K	10K Ω	0.05%, 5ppm/C	#iNet-R-10K
100 Ω	-100 to 150°C	±80mV	±0.40°C	1.52K	10K Ω	0.01%, 5ppm/C	contact disti

RTD Specification Conditions, i430

- The i430 module supports quantity 8 RTD devices wired Differential or 16 wired Single-Ended.
- **Absolute Accuracy** 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.
- These specifications assume signal averaging per point is 1.0 mSec for all rows[3] .
- instruNet connects directly to all types of RTD's.
- 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 °C.
- 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.
- 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 (±10mV ... ±5V) [1]
- Sensor Type [13]
- Min/Max °C Range [11]
- Single-Ended or Differential Wiring
- External End-User-Supplied Shunt Resistor resistance (Ω) [15]
- RTD alpha (e.g. 0.0038) and delta (e.g. 1.492) coefficients
- RTD beta (e.g. 0.11) coefficient when working with temperatures < 0°C

More Information

- RTD Wiring Diagram and Setup
- instruNet i430 Product Description
- Model i430 RTD Measurement Error Components
- Electrical Specifications

Load Cell Measurement
Absolute Accuracy Specifications, i430

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	1.39K, i423 is faster	±10mV
25 Kg, 350Ω, 2mV/V @ MaxKg	0 to 25 Kg	±0.017 Kg	1.39K	±10mV
100 Kg, 350Ω, 2mV/V @ MaxKg	0 to 100 Kg	±0.066 Kg	1.39K	±10mV
250 Kg, 350Ω, 2mV/V @ MaxKg	0 to 250 Kg	±0.166 Kg	1.39K	±10mV

1000 Kg, 350Ω, 2mV/V @ MaxKg	0 to 1K Kg	±0.662 Kg	1.39K	±10mV
5000 Kg, 350Ω, 2mV/V @ MaxKg	0 to 5K Kg	±3.312 Kg	1.39K	±10mV
100 Kg, 500Ω, 2mV/V @ MaxKg	0 to 100 Kg	±0.069 Kg	1.37K	±10mV
100 Kg, 1000Ω, 2mV/V @ MaxKg	0 to 100 Kg	±0.080 Kg	1.34K	±10mV

Load Cell Specification Conditions, i430

- The i430 module supports quantity 8 Load Cell devices wired Differential (not SE).
- **Absolute Accuracy** 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.
- These specifications assume signal averaging per point is 1.0 mSec for all rows[3] .
- instruNet connects directly to all types of Load Cell's.
- These specifications assume the device has been calibrated at the 0 point. This "balancing" involves appling 0 force and then telling instruNet to "balance bridges" via a software command. Subsequently, instruNet automatically subtracts this voltage from future measurements.
- 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).
- 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 Kg.
- 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.
- 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 (±10mV ... ±80mV) 1
- Sensor Type 13
- Min/Max Kg Range 11
- Device maximum-Kg-force and mV/V-sensitivity-at-max-force coefficients

More Information

- Load Cell Wiring Diagram and Setup
- instruNet i430 Product Description
- Model i430 Load Cell Measurement Error Components
- Electrical Specifications

Strain Gage Measurement
Absolute Accuracy Specifications, i430

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, ¼ Bridge	±5931 µS	±10.0 µS	1.39K, i423 is faster	350 Ω, 5ppm/C	#iNet-R-350	±10mV
	±11934 µS	±11.9 µS	1.41K	350 Ω, 5ppm/C	#iNet-R-350	±20mV
	±24157 µS	±15.9 µS	1.46K	350 Ω, 5ppm/C	#iNet-R-350	±40mV
	±49509 µS	±24.5 µS	1.49K	350 Ω, 5ppm/C	#iNet-R-350	±80mV
350 Ω, ½ Bridge Bend	±2948 µS	±3.9 µS	1.39K	350 Ω, 5ppm/C	#iNet-R-350	±10mV

350 Ω, ½ Bridge Axial	±4480 µS	±5.9 µS	1.39K	350 Ω, 5ppm/C	#iNet-R-350	±10mV
350 Ω, Full Br Bend	±1474 µS	±0.8 µS	1.39K	(no ext Ro)		±10mV
350 Ω, Full Br Axial I	±2233 µS	±1.2 µS	1.39K	(no ext Ro)		±10mV
350 Ω, Full Br Axial II	±2237 µS	±1.2 µS	1.39K	(no ext Ro)		±10mV
1K Ω, ¼ Bridge	±5931 µS	±6.2 µS	1.34K	1K Ω, 5ppm/C	#iNet-R-1K	±10mV

Strain Gage Specification Conditions, i430

- The i430 module supports quantity 8 Strain Gage devices wired Differential (not SE).
- **Absolute Accuracy** 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.
- These specifications assume signal averaging per point is 1.0 mSec for all rows[3] .
- instruNet connects directly to all types of Strain Gage's.
- 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).
- These specifications assume the device has been calibrated at the 0 point. This "balancing" involves appling 0 force and then telling instruNet to "balance bridges" via a software command. Subsequently, instruNet automatically subtracts this voltage from future measurements.
- 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).
- 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 µS.
- 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.
- 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 (±10mV ... ±80mV) 1
- Sensor Type 13
- Min/Max µS Range 11
- External End-User-Supplied Shunt Resistor resistance (Ω) 15
- Device GF (e.g. 2) and Poisson (e.g. 0.32) coefficients
- Device to instruNet lead resistance (Ω)

More Information

- Strain Gage Wiring Diagram and Setup
- instruNet i430 Product Description
- Model i430 Strain Gage Measurement Error Components
- Electrical Specifications

Potentiometer Measurement
Absolute Accuracy Specifications, i430

POT Type (ohms) 13	Measurement Range 11	Signal Averaging Per Point (mSec) 3	Absolute Accuracy (±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	±0.000332Eu	2.60K, i423 is faster	0 to 5V
50K Ω	0 to 1.0Eu	0.1 mSec	±0.000485Eu	0.74K	0 to 5V

Potentiometer Specification Conditions, i430

- The i430 module supports quantity 8 Potentiometer devices wired Differential (not SE).
- **Absolute Accuracy** 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.
- instruNet connects directly to all types of Potentiometer's.
- 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 Eu.
- 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.
- 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 (±10mV ... ±5V) 1
- Sensor Type 13

More Information

- Potentiometer Wiring Diagram and Setup
- instruNet i430 Product Description
- Model i430 Potentiometer Measurement Error Components
- Electrical Specifications

Current Measurement
Absolute Accuracy Specifications, i430

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	±(0.061% + 7.6uA)	92.49K	33 Ω	0.05%, 5ppm/C	#iNet-R-33	0 to 1.2V
	0.1 mSec	±(0.061% + 4.2uA)	6.41K				
±24mA	0 mSec	±(0.061% + 9.5uA)	97.56K	33 Ω	0.05%, 5ppm/C	#iNet-R-33	±1.2V
	0.1 mSec	±(0.061% + 5.7uA)	6.41K				
±12mA	0 mSec	±(0.061% + 3.5uA)	89.51K	120 Ω	0.05%, 5ppm/C	#iNet-R-120	±2.5V
	0.1 mSec	±(0.061% + 1.8uA)	6.41K				
±2.5mA	0 mSec	±(0.061% + 0.4uA)	34.92K	1K Ω	0.05%, 5ppm/C	#iNet-R-1K	±2.5V
	0.1 mSec	±(0.061% + 0.2uA)	4.90K				
±1.2mA	0 mSec	±(0.060% + 0.31uA)	33.95K	1K Ω	0.05%, 5ppm/C	#iNet-R-1K	±1.2V
	0.1 mSec	±(0.060% + 0.17uA)	4.90K				
±500uA		±(0.061% + 0.04uA)	2.60K	10K Ω	0.05%, 5ppm/C	#iNet-R-10K	±5V
±600uA	0 mSec	±(0.060% + 0.25uA)	32.96K	1K Ω	0.05%, 5ppm/C	#iNet-R-1K	±600mV
	0.1 mSec	±(0.060% + 0.12uA)	4.90K				

±800uA	0 mSec	±(0.060% + 2.08uA)	77.67K	120 Ω	0.05%, 5ppm/C	#iNet-R-120	±600mV
	0.1 mSec	±(0.060% + 1.02uA)	6.41K				
±120uA		±(0.062% + 0.017uA)	2.60K	10K Ω	0.05%, 5ppm/C	#iNet-R-10K	±1.2V
±80uA		±(0.067% + 0.012uA)	1.44K	1K Ω	0.05%, 5ppm/C	#iNet-R-1K	±80mV
0 to 24mA	0 mSec	±(0.021% + 7.6uA)	92.49K	33 Ω	0.01%, 5ppm/C	contact disti	0 to 1.2V
	0.1 mSec	±(0.021% + 4.2uA)	6.41K				

Current Specification Conditions, i430

- The i430 module supports quantity 8 Current devices wired Differential or 16 wired Single-Ended.
- **Absolute Accuracy** 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 porportional to the the input. For example, if one measures 2Volts and the absolute accuracy specification is ±(1% + 3mV), then one could expect ±(1% * 2V + 3mV) = ±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 (±10mV ... ±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, i430

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	±(0.093% + 0.076 Ω)	87.07K	1K Ω	0.05%, 5ppm/C	#iNet-R-1K	±600mV
	0.1 mSec	±(0.085% + 0.038 Ω)	6.41K				
0 to 100 Ω	0 mSec	±(0.095% + 0.076 Ω)	87.07K	1K Ω	0.05%, 5ppm/C	#iNet-R-1K	±600mV
	0.1 mSec	±(0.087% + 0.038 Ω)	6.41K				

0 to 330 Ω	0 mSec	±(0.102% + 0.08 Ω)	89.64K	1K Ω	0.05%, 5ppm/C	#iNet-R-1K	0 to 1.2V
	0.1 mSec	±(0.093% + 0.04 Ω)	6.41K				
0 to 1K Ω	0 mSec	±(0.130% + 0.10 Ω)	97.12K	1K Ω	0.05%, 5ppm/C	#iNet-R-1K	0 to 2.5V
	1.0 mSec	±(0.115% + 0.04 Ω)	0.79K				
0 to 3300 Ω	0 mSec	±(0.131% + 0.3 Ω)	97.12K	3.3K Ω	0.05%, 5ppm/C	#iNet-R-3300	0 to 2.5V
	0.1 mSec	±(0.118% + 0.2 Ω)	6.41K				
0 to 10K Ω		±(0.183% + 0.2 Ω)	6.41K	3.3K Ω	0.05%, 5ppm/C	#iNet-R-3300	0 to 2.5V
0 to 100 Ω	0 mSec	±(0.055% + 0.076 Ω)	87.07K	1K Ω	0.01%, 5ppm/C	contact disti	±600mV
	0.1 mSec	±(0.047% + 0.038 Ω)	6.41K				

Resistance Specification Conditions, i430

- The i430 module supports quantity 8 Resistance devices wired Differential or 16 wired Single-Ended.
- **Absolute Accuracy** 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 porportional to the the input. For example, if one measures 2Volts and the absolute accuracy specification is ±(1% + 3mV), then one could expect ±(1% * 2V + 3mV) = ±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).
- 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. ≤ 5meters, 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 (±10mV ... ±5V) 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

Subjects Discussed on this Page, i430

- Analog Voltage Input (A/D), Electrical Specifications, Software Interface
- 2x Precision Analog Voltage Outputs (±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