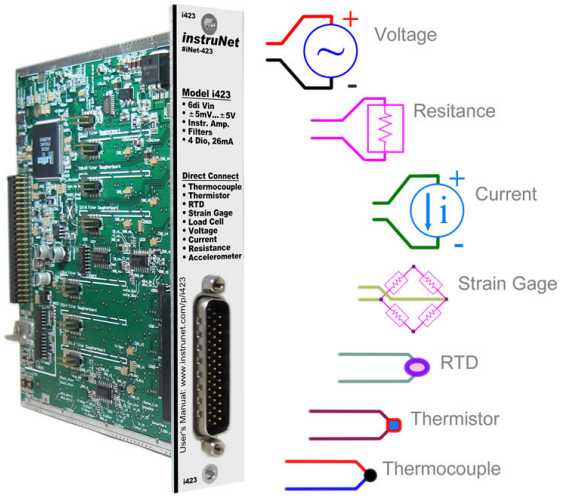
instruNet i423 Datasheet

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

Features

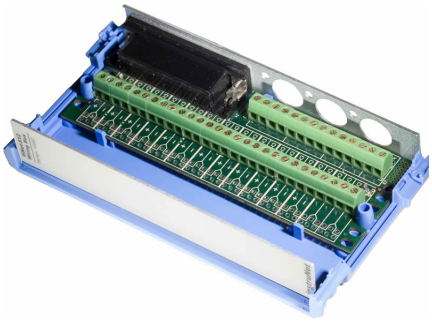
- The i423 card plugs into a 4 to 16 slot instruNet i4xx Card Cage, which in turn attaches to a Windows computer
- 6di Voltage Input Channels
- 4x Universal Digital I/O (20mA sink, -10V..30V)
- Connect Directly To Sensors: Voltage, Thermocouple, Thermistor, RTD, Load Cell, Strain Gage, Potentiometer, Current, Resistance, Accelerometer
- Additional i43x A/D module required to measure voltages[21]
- Amplifier/Filter outputs made available at Hd44 connector for end user monitoring[25]



Summary

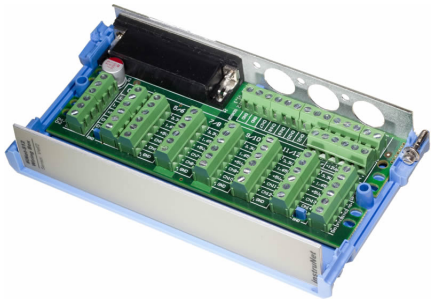
- This Amplifier (not A/D) module provides 6 differential voltage input channels (Ch#1/2...#11/12)[40] , each of which are independently software programmable with Windows software that support the direct connection to many common sensor types
- This module does not contain an A/D converter, and therefore internally routes measured voltage to an i43x A/D module anywhere in card cage. At least one i43x must be installed in order to measure a voltage with this module.
- Each channel provides several independent analog low pass filter options: 0.006KHz / 2poles, 4KHz / 2poles, or FullBandwidth
- Voltage input range on each channel is independently software programmable to one of: ±5mV, ±10mV, ±20mV, ±40mV, ±80mV, ±300mV, ±600mV, ±1.2V, ±2.5V, ±5V, 0 to 40mV, 0 to 80mV, 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] , Analog Low Pass Filter (0.006KHz / 2poles, 4KHz / 2poles, or FullBandwidth)[2] , Digital IIR Filter (LowPass, HighPass, BandPass, or BandStop)[55] , Voltage Measurement Range (±5mV...±5V)[1] , and Sensor Type[13]
- Each input channel passes through it's own amplifier with a software selectable voltage gain of 1 or 64, and optional analog low pass filter. After this treatment, these are made available at Hd44 connector pins #17..#22 for purposes of end user monitoring, in addition to possible internal digitizing by A/D[25].
- Excitation power (+3.3V ±0.2V, <220mA, 37mA 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.
- 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.

Optional i51x Wiring Box



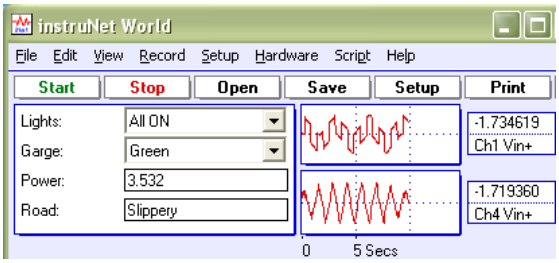
i510 Low Cost Wiring Box

i511 BNC Wiring Box



i512 Wiring Box

Optional Accessories



instruNet World PLUS Software (iW+)

Application Software

Shunt Resistors

Subjects Discussed in this Datasheet, iNet-423

Analog Voltage Input, iNet-423

Parameter	Specifications[19]	Notes
Description	6di Voltage Input Channels	This Amplifier (not A/D) module provides 6 differential voltage input channels (Ch#1/2...#11/12), 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, Accelerometer
Voltage Ranges	±5mV ... ±5V, 0 to 40mV ... 0 to 5V	Voltage input range on each channel is independently software programmable to one of: ±5mV, ±10mV, ±20mV, ±40mV, ±80mV, ±300mV, ±600mV, ±1.2V, ±2.5V, ±5V, 0 to 40mV, 0 to 80mV, 0 to 2.5V, 0 to 5V
Internal A/D	(none)	This module does not contain an A/D converter, and therefore internally routes measured voltage to an i43x A/D module anywhere in card cage. At least one i43x must be installed in order to measure a voltage with this module.
Sensors	Direct Connect	Each of the 6 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, Accelerometer
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] , Analog Low Pass Filter (0.006KHz / 2poles, 4KHz / 2poles, or FullBandwidth)[2] , Digital IIR Filter (LowPass, HighPass, BandPass, or BandStop)[55] , Voltage Measurement Range (±5mV...±5V)[1] , and Sensor Type[13]
Wiring	Differential Only	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	-18 to +18V	Short any combination of voltage input channels to external -18 to +18V power source (i.e. capable of high current), instruNet power on or off, any duration, without damage
Analog Low Pass Filter	0.006KHz / 2poles, 4KHz / 2poles, or FullBandwidth	Each channel provides several independent analog low pass filter options. "FullBandwidth" refers to no filter, which involves running the channel at it's full bandwidth as notes in the Voltage Accuracy table
RFI Filter	124 KHz RFI filter	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.
Sensor Excitation	Included	Excitation power (+3.3V ±0.2V, <220mA, 37mA 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-423

Parameter	Specifications[19]	Notes

Common Mode Voltage	-5 to +5V	All voltage input pins must be driven with a voltage between -5 and +5V, 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. -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 measurements when input pin is left unconnected
Current Pump	None	Input pin connects to internal amplifier IC (not multiplexor), and therefore does not pump current when switching between channels
Input leakage current	1.0 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 1.0 nA at 37°C, and 0.5 nA at 25°C.
Input Circuit	RFI filter + Instrumentation Amplifier	Voltage input pins connect directly to internal instrumentation amplifier IC (AD8221ar), after passing through an RFI filter
Common Mode Rejection Ratio	≥ 110dB on ≤ ±80mV range ≥ 80dB on > ±80mV range	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

Software Interface, Analog Voltage Input, iNet-423

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 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_2 Vin ... Ch11_12 Vin	Channels #1/2...#11/12: DI voltage inputs, ±5mV...±5V
Connector Pins	One pin per bit	Signals are available at Hd44 connector pins: #1/2...#11/12[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-423

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 rd/wr to Uio 25..28 port, pulse low when read from Uio 25..28 port, 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.
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-423

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, iNet-423

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 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 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

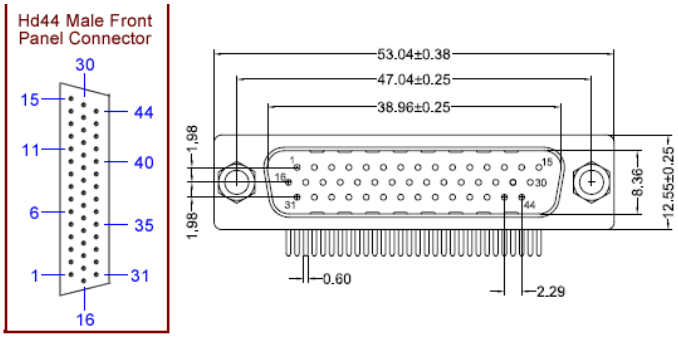
I/O Software Channels, iNet-423

ChNum	Name	Channel Type	Hd44 Pin(s)	Description	Scalar I/O Support	High Speed Digitize Support
#1	Ch1_2 Vin	DI Voltage Input	1, 2	±5mV...±5V	input	input
#3	Ch3_4 Vin	"	3, 4	"	"	"
#5	Ch5_6 Vin	"	5, 6	"	"	"
#7	Ch7_8 Vin	"	7, 8	"	"	"
#9	Ch9_10 Vin	"	9, 10	"	"	"
#11	Ch11_12 Vin	"	11, 12	"	"	"
#17	Ch17 Out1_2	Channel Amplifier Out[25]	17	On/Off	input/output	no high speed i/o
#18	Ch18 Out3_4	"	18	"	"	"
#19	Ch19 Out5_6	"	19	"	"	"
#20	Ch20 Out7_8	"	20	"	"	"
#21	Ch21 Out9_10	"	21	"	"	"
#22	Ch22 Out11_12	"	22	"	"	"
#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, iNet-423

Hd44 Pin#	Pin Name	Pin Type	Description
#1	Ch1 Vin+	DI+ Voltage In	Supported Sensors: Voltage, Thermocouple, Thermistor, RTD, Load Cell, Strain Gage, Potentiometer, Current, Resistance, Accelerometer
#2	Ch2 Vin-	DI- Voltage In	"
#3	Ch3 Vin+	DI+ Voltage In	"
#4	Ch4 Vin-	DI- Voltage In	"
#5	Ch5 Vin+	DI+ Voltage In	"
#6	Ch6 Vin-	DI- Voltage In	"
#7	Ch7 Vin+	DI+ Voltage In	"
#8	Ch8 Vin-	DI- Voltage In	"
#9	Ch9 Vin+	DI+ Voltage In	"
#10	Ch10 Vin-	DI- Voltage In	"
#11	Ch11 Vin+	DI+ Voltage In	"
#12	Ch12 Vin-	DI- Voltage In	"
#13	Not Used	Not Used	
#14	"	"	"
#15	"	"	"
#16	"	"	"
#17	Ch17 Out1_2	Channel Amplifier Out	Each input channel passes through it's own amplifier with a software selectable voltage gain of 1 or 64, and optional analog low pass filter. This pin provides access to the output of that amplifier & filter[25].
#18	Ch18 Out3_4	"	"
#19	Ch19 Out5_6	"	"
#20	Ch20 Out7_8	"	"
#21	Ch21 Out9_10	"	"
#22	Ch22 Out11_12	"	"
#23	Not Used	Not Used	
#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 ±0.2V, <220mA	Power Available to End User
#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
30
15
44
11
40
6
35
1
31
16
53.04±0.38
47.04±0.25
38.96±0.25
1,98
1,98
8.36
12.55±0.25
0.60
2.29

Power Available to End User, iNet-423

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 ±0.2V, <220mA	+3.3Vdc power available to end user at Hd44 connector pins 34 and 35
+5V End User Pwr	+5V ±0.5V, <220mA	+5Vdc power available to end user at Hd44 connector pins 36 and 37
+12V End User Pwr	+12V ±1.2V, <220mA	+12Vdc power available to end user at Hd44 connector pins 38 and 39
-12V End User Pwr	-12V ±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-423

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	≤ 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 ±0.4V, ~129mA	Power required to operate module (not for sensors or end user power)
+12Vdc Requirement	+12V ±0.8V, ~71mA	"
-12Vdc Requirement	-12V ±0.8V, ~42mA	"

Voltage Measurement
Absolute Accuracy Specifications, iNet-423

Voltage Range [1]	Analog Low Pass Filter (KHz Fc) [2]	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]
±5V	0.006 or 4 KHz	0 mSec	±(0.015% + 713.7µV)	113.48K	8.8
	74 KHz		±(0.015% + 798.0µV)	113.48K	8.8
	0.006 or 4 KHz	0.1 mSec	±(0.015% + 436.8µV)	6.41K	8.8
	74 KHz		±(0.015% + 462.2µV)	6.41K	8.8
	0.006 or 4 KHz	1.0 mSec	±(0.015% + 347.9µV)	0.79K	8.8
	74 KHz		±(0.015% + 354.5µV)	0.79K	8.8
±2.5V	0.006 or 4 KHz	0 mSec	±(0.015% + 433.6µV)	104.23K	9.6
	75 KHz		±(0.015% + 554.1µV)	104.23K	9.6
	0.006 or 4 KHz	0.1 mSec	±(0.015% + 256.2µV)	6.41K	9.6
	75 KHz		±(0.015% + 294.3µV)	6.41K	9.6
	0.006 or 4 KHz	1.0 mSec	±(0.015% + 194.2µV)	0.79K	9.6
	75 KHz		±(0.015% + 203.5µV)	0.79K	9.6
±1.2V	0.006 or 4 KHz	0 mSec	±(0.016% + 230.8µV)	98.92K	10.1
	70 KHz		±(0.016% + 389.2µV)	98.92K	10.1
	0.006 or 4 KHz	0.1 mSec	±(0.016% + 156.0µV)	6.41K	10.1
	70 KHz		±(0.016% + 206.0µV)	6.41K	10.1
	0.006 or 4 KHz	1.0 mSec	±(0.016% + 129.8µV)	0.79K	10.1
	70 KHz		±(0.016% + 142.1µV)	0.79K	10.1
±600mV	0.006 or 4 KHz	0 mSec	±(0.016% + 165.7µV)	90.01K	11.1
	71 KHz		±(0.016% + 346.7µV)	90.01K	11.1
	0.006 or 4 KHz	0.1 mSec	±(0.016% + 112.3µV)	6.41K	11.1
	71 KHz		±(0.016% + 172.6µV)	6.41K	11.1
	0.006 or 4 KHz	1.0 mSec	±(0.016% + 91.8µV)	0.78K	11.1
	71 KHz		±(0.016% + 105.8µV)	0.78K	11.1
±300mV	0.006 or 4 KHz	0 mSec	±(0.016% + 145.0µV)	82.26K	12.2
	71 KHz		±(0.016% + 339.4µV)	82.26K	12.2
	0.006 or 4 KHz	0.1 mSec	±(0.016% + 101.5µV)	6.41K	12.2
	71 KHz		±(0.016% + 170.2µV)	6.41K	12.2
	0.006 or 4 KHz	1.0 mSec	±(0.016% + 82.9µV)	0.78K	12.2
	71 KHz		±(0.016% + 97.9µV)	0.78K	12.2
±80mV	0.006 or 4 KHz	0 mSec	±(0.018% + 16.3µV)	90.65K	11.0
	49 KHz		±(0.018% + 27.5µV)	90.65K	11.0
	0.006 or 4 KHz	0.1 mSec	±(0.018% + 11.6µV)	6.41K	11.0
	49 KHz		±(0.018% + 15.3µV)	6.41K	11.0
	0.006 or 4 KHz	1.0 mSec	±(0.018% + 9.8µV)	0.78K	11.0
	49 KHz		±(0.018% + 10.7µV)	0.78K	11.0
±40mV	0.006 or 4 KHz	0 mSec	±(0.018% + 12.3µV)	82.58K	12.1
	49 KHz		±(0.018% + 24.8µV)	82.58K	12.1
	0.006 or 4 KHz	0.1 mSec	±(0.018% + 8.9µV)	6.41K	12.1
	49 KHz		±(0.018% + 13.3µV)	6.41K	12.1
	0.006 or 4 KHz	1.0 mSec	±(0.018% + 7.4µV)	0.78K	12.1

	49 KHz		±(0.018% + 8.4µV)	0.78K	12.1
±20mV	0.006 or 4 KHz	0 mSec	±(0.019% + 10.0µV)	79.01K	12.7
	47 KHz		±(0.019% + 22.9µV)	79.01K	12.7
	0.006 or 4 KHz	0.1 mSec	±(0.019% + 7.5µV)	5.95K	12.7
	47 KHz		±(0.019% + 12.1µV)	5.95K	12.7
	0.006 or 4 KHz	1.0 mSec	±(0.019% + 6.5µV)	0.78K	12.7
	47 KHz		±(0.019% + 7.5µV)	0.78K	12.7
±10mV	0.006 or 4 KHz	0 mSec	±(0.019% + 9.2µV)	72.40K	13.8
	48 KHz		±(0.019% + 22.4µV)	72.40K	13.8
	0.006 or 4 KHz	0.1 mSec	±(0.019% + 7.0µV)	5.95K	13.8
	48 KHz		±(0.019% + 12.0µV)	5.95K	13.8
	0.006 or 4 KHz	1.0 mSec	±(0.019% + 5.9µV)	0.78K	13.8
	48 KHz		±(0.019% + 6.9µV)	0.78K	13.8
±5mV	0.006 or 4 KHz	0 mSec	±(0.019% + 9.0µV)	68.67K	14.6
	48 KHz		±(0.019% + 22.3µV)	68.67K	14.6
	0.006 or 4 KHz	0.1 mSec	±(0.019% + 6.8µV)	5.95K	14.6
	48 KHz		±(0.019% + 11.9µV)	5.95K	14.6
	0.006 or 4 KHz	1.0 mSec	±(0.019% + 5.8µV)	0.78K	14.6
	48 KHz		±(0.019% + 6.8µV)	0.78K	14.6
0 to 5V	0.006 or 4 KHz	0 mSec	±(0.015% + 433.6µV)	107.38K	9.3
	75 KHz		±(0.015% + 554.1µV)	107.38K	9.3
	0.006 or 4 KHz	0.1 mSec	±(0.015% + 252.4µV)	6.41K	9.3
	75 KHz		±(0.015% + 288.7µV)	6.41K	9.3
	0.006 or 4 KHz	1.0 mSec	±(0.015% + 194.2µV)	0.79K	9.3
	75 KHz		±(0.015% + 203.5µV)	0.79K	9.3
0 to 2.5V	0.006 or 4 KHz	0 mSec	±(0.015% + 332.9µV)	98.92K	10.1
	75 KHz		±(0.015% + 484.1µV)	98.92K	10.1
	0.006 or 4 KHz	0.1 mSec	±(0.015% + 202.7µV)	6.41K	10.1
	75 KHz		±(0.015% + 250.5µV)	6.41K	10.1
	0.006 or 4 KHz	1.0 mSec	±(0.015% + 157.3µV)	0.79K	10.1
	75 KHz		±(0.015% + 169.0µV)	0.79K	10.1
0 to 80mV	0.006 or 4 KHz	0 mSec	±(0.018% + 12.3µV)	85.56K	11.7
	49 KHz		±(0.018% + 24.8µV)	85.56K	11.7
	0.006 or 4 KHz	0.1 mSec	±(0.018% + 8.8µV)	6.41K	11.7
	49 KHz		±(0.018% + 12.9µV)	6.41K	11.7
	0.006 or 4 KHz	1.0 mSec	±(0.018% + 7.4µV)	0.78K	11.7
	49 KHz		±(0.018% + 8.4µV)	0.78K	11.7
0 to 40mV	0.006 or 4 KHz	0 mSec	±(0.018% + 11.0µV)	78.14K	12.8
	50 KHz		±(0.018% + 24.2µV)	78.14K	12.8
	0.006 or 4 KHz	0.1 mSec	±(0.018% + 8.1µV)	5.95K	12.8
	50 KHz		±(0.018% + 12.8µV)	5.95K	12.8
	0.006 or 4 KHz	1.0 mSec	±(0.018% + 6.9µV)	0.78K	12.8
	50 KHz		±(0.018% + 7.9µV)	0.78K	12.8

Voltage Specification Conditions, iNet-423

- The iNet-423 module supports quantity 6 Voltage 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): Intergal Nonlinearity (INL), Differential Nonlinearity (DNL), system noise (ground input, digitize, and see noise), gain/offset temperature drift,

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

gain/offset time stability drift, gain/offset initial offset error, 1.0nA 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 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.
- 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].

- Analog Low Pass Filter (0.006KHz / 2poles, 4KHz / 2poles, or FullBandwidth) [2]
- Digital IIR Filter (LowPass, HighPass, BandPass, or BandStop) [55]
- Voltage Measurement Range (±5mV...±5V) [1]
- Sensor Type [13]

More Information

- Voltage Wiring Diagram and Setup
- instruNet i423 Product Description
- Model i423 Voltage Measurement Error Components
- Electrical Specifications
- I/O Software Channels
- Hd44 Connector Pins

Voltage Measurement
Drift Errors, iNet-423

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]
±5V	±(0.015% + 354.5µV)	±0.0005%/°C	±0.0025%/yr	±(0.0015% + 125.3µV)/°C
±2.5V	±(0.015% + 203.5µV)	±0.0005%/°C	±0.0025%/yr	±(0.0015% + 70.3µV)/°C
±1.2V	±(0.016% + 142.1µV)	±0.0005%/°C	±0.0025%/yr	±(0.0040% + 39.7µV)/°C
±600mV	±(0.016% + 105.8µV)	±0.0005%/°C	±0.0025%/yr	±(0.0040% + 26.0µV)/°C
±300mV	±(0.016% + 97.9µV)	±0.0005%/°C	±0.0025%/yr	±(0.0040% + 19.1µV)/°C
±80mV	±(0.018% + 10.7µV)	±0.0005%/°C	±0.0025%/yr	±(0.0048% + 2.4µV)/°C
±40mV	±(0.018% + 8.4µV)	±0.0005%/°C	±0.0025%/yr	±(0.0048% + 1.5µV)/°C
±20mV	±(0.019% + 7.5µV)	±0.0005%/°C	±0.0025%/yr	±(0.0073% + 1.1µV)/°C
±10mV	±(0.019% + 6.9µV)	±0.0005%/°C	±0.0025%/yr	±(0.0073% + 0.9µV)/°C
±5mV	±(0.019% + 6.8µV)	±0.0005%/°C	±0.0025%/yr	±(0.0073% + 0.7µV)/°C
0 to 5V	±(0.015% + 203.5µV)	±0.0005%/°C	±0.0025%/yr	±(0.0015% + 70.3µV)/°C
0 to 2.5V	±(0.015% + 169.0µV)	±0.0005%/°C	±0.0025%/yr	±(0.0015% + 42.7µV)/°C
0 to 80mV	±(0.018% + 8.4µV)	±0.0005%/°C	±0.0025%/yr	±(0.0048% + 1.5µV)/°C
0 to 40mV	±(0.018% + 7.9µV)	±0.0005%/°C	±0.0025%/yr	±(0.0048% + 1.1µV)/°C

Thermocouple Measurement
Absolute Accuracy Specifications, iNet-423

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: ±0.75°C -210 to -10°C: ±1.10°C	72.40K
	10 to 1200°C	0 to 80mV	±0.98°C	85.56K
	-210 to 1200°C	±80mV	±1.44°C	90.65K
K	-10 to 120°C	±5mV	±0.81°C	68.67K
	±200°C	±10mV	±1.23°C	72.40K
	10 to 1360°C	0 to 80mV	±1.24°C	85.56K
	-200 to 1360°C	±80mV	±1.66°C	90.65K
B	251 to 1300°C	±10mV	251 to 600°C: ±3.99°C 600 to 1300°C: ±2.14°C	68.67K
	251 to 1820°C	±20mV	251 to 1300°C: ±4.27°C 1300 to 1820°C: ±1.65°C	72.40K
C	0 to 1K°C	±20mV	±1.74°C	79.01K
	0 to 2315°C	0 to 40mV	±2.90°C	78.14K
D	0 to 1K°C	±20mV	±2.00°C	79.01K
	0 to 2315°C	0 to 40mV	±2.94°C	78.14K
E	-90 to 80°C	±5mV	±0.76°C	68.67K
	-200 to 125°C	±10mV	±0.97°C	72.40K
	10 to 1K°C	0 to 80mV	±0.88°C	85.56K
	-200 to 1K°C	±80mV	±1.24°C	90.65K
G	0 to 500°C	±5mV	0 to 500°C: ±5.26°C 100 to 500°C: ±2.82°C	68.67K
	0 to 2315°C	0 to 40mV	0 to 300°C: ±6.16°C 300 to 2315°C: ±2.19°C	68.67K
N	-200 to 170°C	±5mV	-200 to 0°C: ±1.50°C 0 to 170°C: ±0.92°C	68.67K
	-10 to 570°C	±20mV	±0.96°C	79.01K
	10 to 1300°C	0 to 80mV	±1.13°C	85.56K
	-200 to 1300°C	±80mV	±2.18°C	90.65K
R	-50 to 800°C	±10mV	-50 to 10°C: ±2.90°C 10 to 800°C: ±2.13°C	68.67K
	10 to 1768°C	0 to 40mV	±2.44°C	78.14K
	-50 to 1768°C	±40mV	±3.64°C	82.58K
S	-50 to 860°C	±10mV	-50 to -10°C: ±2.69°C -10 to 860°C: ±2.27°C	68.67K
	-50 to 1768°C	±20mV	-50 to -10°C: ±2.87°C -10 to 1768°C: ±2.40°C	68.67K
T	-200 to 175°C	±10mV	-200 to -10°C: ±1.19°C -10 to 175°C: ±0.80°C	72.40K
	10 to 400°C	0 to 40mV	±0.83°C	78.14K
	-200 to 400°C	±40mV	±1.37°C	82.58K

Thermocouple Specification Conditions, iNet-423

- The iNet-423 module supports quantity 6 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. 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 No Integ for all rows[3] .
- These specifications assume analog low pass filter is set to 0.006 or 4 KHz for all rows[2] .
- 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]
- Analog Low Pass Filter (0.006KHz / 2poles, 4KHz / 2poles, or FullBandwidth) [2]
- Digital IIR Filter (LowPass, HighPass, BandPass, or BandStop) [55]
- Voltage Measurement Range (±5mV ... ±80mV) [1]
- Sensor Type [13]
- Min/Max °C Range [11]

More Information

- Thermocouple Wiring Diagram and Setup
- instruNet i423 Product Description
- Model i423 Thermocouple Measurement Error Components
- Electrical Specifications

Thermistor Measurement
Absolute Accuracy Specifications, iNet-423

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	Signal Averaging Per Point (mSec) 3
2252 Ω eg #44004	10 to 130°C	±1.2V	10 to 30°C: ±0.26°C 30 to 70°C: ±0.18°C 70 to 130°C: ±0.47°C	98.92K	10K Ω	0.05%, 5ppm/C	#iNet-R-10K	0 mSec
	0 to 70°C	0 to 2.5V	±0.31°C	98.92K	10K Ω	0.05%, 5ppm/C	#iNet-R-10K	
	-80 to 110°C	0 to 5V	-80 to 0°C: ±0.45°C 0 to 40°C: ±0.14°C 40 to 110°C: ±1.47°C	107.38K	33K Ω	0.05%, 5ppm/C	#iNet-R-33K	
			±0.74°C	0.78K				1.0 mSec
	90 to 250°C	0 to 80mV	±0.78°C	85.56K	10K Ω	0.05%, 5ppm/C	#iNet-R-10K	0 mSec
	30 to 250°C	±600mV	30 to 170°C: ±1.05°C 170 to 250°C: ±5.33°C	90.01K	10K Ω	0.05%, 5ppm/C	#iNet-R-10K	
10K Ω eg #44006	-80 to 80°C	0 to 5V	-80 to 10°C: ±1.52°C 10 to 80°C: ±0.16°C	107.38K	33K Ω	0.05%, 5ppm/C	#iNet-R-33K	
	10 to 130°C	±1.2V	±0.34°C	98.92K	33K Ω	0.05%, 5ppm/C	#iNet-R-33K	
	110 to 250°C	0 to 80mV	110 to 150°C: ±0.10°C 150 to 210°C: ±0.31°C 210 to 250°C: ±0.60°C	85.56K	33K Ω	0.05%, 5ppm/C	#iNet-R-33K	
2252 Ω eg #44004	30 to 70°C	±1.2V	±0.17°C	90.01K	10K Ω	0.01%, 5ppm/C	contact disti	

Thermistor Specification Conditions, iNet-423

- The iNet-423 module supports quantity 6 Thermistor 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, 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, 1.0nA max leakage current (at 37°C) times user source impedance error, polynomial linearization 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 analog low pass filter is set to 0.006 or 4 KHz for all rows[2] .
- 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] .
- 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
- 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]
- Analog Low Pass Filter (0.006KHz / 2poles, 4KHz / 2poles, or FullBandwidth) [2]
- Digital IIR Filter (LowPass, HighPass, BandPass, or BandStop) [55]
- Voltage Measurement Range (±5mV ... ±5V) [1]
- Sensor Type [23]
- Min/Max °C Range [11]
- External End-User-Supplied Shunt Resistor resistance (Ω) [15]
- Device Steinhart-Hart a/b/c coefficients

More Information

- Thermistor Wiring Diagram and Setup

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.

- instruNet i423 Product Description
- Model i423 Thermistor Measurement Error Components
- Electrical Specifications

RTD Measurement
Absolute Accuracy Specifications, iNet-423

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	0 to 40mV	±0.40°C	78.14K	10K Ω	0.05%, 5ppm/C	#iNet-R-10K
	-100 to 300°C	0 to 80mV	-100 to 150°C: ±0.52°C 150 to 300°C: ±0.69°C	85.56K	10K Ω	0.05%, 5ppm/C	#iNet-R-10K
	-238 to 850°C	±300mV	-238 to 0°C: ±1.39°C 0 to 100°C: ±1.54°C 100 to 850°C: ±2.83°C	78.14K	10K Ω	0.05%, 5ppm/C	#iNet-R-10K
500 Ω	-100 to 300°C	±600mV	±0.97°C	90.01K	10K Ω	0.05%, 5ppm/C	#iNet-R-10K
1K Ω	-100 to 300°C	±600mV	±0.91°C	90.01K	10K Ω	0.05%, 5ppm/C	#iNet-R-10K
100 Ω	-100 to 150°C	0 to 80mV	±0.35°C	85.56K	10K Ω	0.01%, 5ppm/C	contact disti

RTD Specification Conditions, iNet-423

- The iNet-423 module supports quantity 6 RTD 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, 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, 1.0nA max leakage current (at 37°C) times user source impedance 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 No Integ for all rows[3] .
- These specifications assume analog low pass filter is set to 0.006 or 4 KHz for all rows[2] .
- 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).
- 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
- Analog Low Pass Filter (0.006KHz / 2poles, 4KHz / 2poles, or FullBandwidth) 2
- Digital IIR Filter (LowPass, HighPass, BandPass, or BandStop) 55
- Voltage Measurement Range (±5mV ... ±5V) 1
- Sensor Type 13
- Min/Max °C Range 11
- 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 i423 Product Description
- Model i423 RTD Measurement Error Components
- Electrical Specifications

Load Cell Measurement
Absolute Accuracy Specifications, iNet-423

Load Cell (Max Kg) [13]	Measurement Range [11]	Analog Low Pass Filter (KHz Fc) [2]	Absolute Accuracy (±Max Error) [38p]	Max Multi-Channel Aggregate Sample Rate (s/sec/agg) [18]	Voltage Range [1]	Signal Averaging Per Point (mSec) [3]
10 Kg, 350Ω, 2mV/V	0 to 10 Kg	0.006 or 4 KHz	±0.009 Kg	72.40K	±10mV	0 mSec
		48 KHz	±0.029 Kg	72.40K		
		0.006 or 4 KHz	±0.004 Kg	0.78K		1.0 mSec
25 Kg, 350Ω, 2mV/V	0 to 25 Kg	0.006 or 4 KHz	±0.024 Kg	72.40K	±10mV	0 mSec
		48 KHz	±0.073 Kg	72.40K		
		0.006 or 4 KHz	±0.011 Kg	0.78K		1.0 mSec
100 Kg, 350Ω, 2mV/V	0 to 100 Kg	0.006 or 4 KHz	±0.094 Kg	72.40K	±10mV	0 mSec
		48 KHz	±0.293 Kg	72.40K		
		0.006 or 4 KHz	±0.045 Kg	0.78K		1.0 mSec
250 Kg, 350Ω, 2mV/V	0 to 250 Kg	0.006 or 4 KHz	±0.236 Kg	72.40K	±10mV	0 mSec
		48 KHz	±0.734 Kg	72.40K		
		0.006 or 4 KHz	±0.111 Kg	0.78K		1.0 mSec
1000 Kg, 350Ω, 2mV/V	0 to 1K Kg	0.006 or 4 KHz	±0.945 Kg	72.40K	±10mV	0 mSec
		48 KHz	±2.935 Kg	72.40K		
		0.006 or 4 KHz	±0.446 Kg	0.78K		1.0 mSec
5000 Kg, 350Ω, 2mV/V	0 to 5K Kg	0.006 or 4 KHz	±4.724 Kg	72.40K	±10mV	0 mSec
		48 KHz	±14.674 Kg	72.40K		
		0.006 or 4 KHz	±2.229 Kg	0.78K		1.0 mSec
100 Kg, 500Ω, 2mV/V	0 to 100 Kg	0.006 or 4 KHz	±0.096 Kg	72.40K	±10mV	0 mSec
		48 KHz	±0.295 Kg	72.40K		
		0.006 or 4 KHz	±0.046 Kg	0.78K		1.0 mSec
100 Kg, 1000Ω, 2mV/V	0 to 100 Kg	0.006 or 4 KHz	±0.099 Kg	72.40K	±10mV	0 mSec
		48 KHz	±0.298 Kg	72.40K		
		0.006 or 4 KHz	±0.050 Kg	0.78K		1.0 mSec

Load Cell Specification Conditions, iNet-423

- The iNet-423 module supports quantity 6 Load Cell 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, readback of excitation voltage error, 1.0nA max leakage current (at 37°C) times user source impedance 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.
- 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).
- 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]
- Analog Low Pass Filter (0.006KHz / 2poles, 4KHz / 2poles, or FullBandwidth) [2]
- Digital IIR Filter (LowPass, HighPass, BandPass, or BandStop) [55]
- Voltage Measurement Range (±5mV ... ±80mV) [1]
- Sensor Type [13]
- Min/Max Kg Range [11]
- Device maximum-Kg-force and mV/V-sensitivity-at-max-force coefficients

- 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.

More Information

- Load Cell Wiring Diagram and Setup
- instruNet i423 Product Description
- Model i423 Load Cell Measurement Error Components
- Electrical Specifications

Strain Gage Measurement
Absolute Accuracy Specifications, iNet-423

Strain Gage (ohms) [13]	Measurement Range [11]	Analog Low Pass Filter (KHz Fc) [2]	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]	Signal Averaging Per Point (mSec) [3]
350 Ω, ¼ Bridge	±2948 µS	0.006 or 4 KHz	±10.1 µS	72.40K	350 Ω, 5ppm/C	#iNet-R-350	±5mV	0 mSec
		48 KHz	±18.2 µS	72.40K				
	±5914 µS	0.006 or 4 KHz	±11.3 µS	79.01K	350 Ω, 5ppm/C	#iNet-R-350	±10mV	
		48 KHz	±19.4 µS	79.01K				
	±11899 µS	0.006 or 4 KHz	±13.7 µS	82.58K	350 Ω, 5ppm/C	#iNet-R-350	±20mV	
		47 KHz	±21.7 µS	82.58K				
	±24085 µS	0.006 or 4 KHz	±19.1 µS	90.65K	350 Ω, 5ppm/C	#iNet-R-350	±40mV	
		49 KHz	±27.0 µS	90.65K				
	±49359 µS	0.006 or 4 KHz	±30.1 µS	82.26K	350 Ω, 5ppm/C	#iNet-R-350	±80mV	
		49 KHz	±37.6 µS	82.26K				
350 Ω, ½ Bridge Bend	±2939 µS	0.006 or 4 KHz	±4.5 µS	79.01K	350 Ω, 5ppm/C	#iNet-R-350	±10mV	
		48 KHz	±8.5 µS	79.01K				
350 Ω, ½ Bridge Axial	±4467 µS	0.006 or 4 KHz	±6.8 µS	79.01K	350 Ω, 5ppm/C	#iNet-R-350	±10mV	
		48 KHz	±12.9 µS	79.01K				
350 Ω, Full Br Bend	±1469 µS	0.006 or 4 KHz	±1.1 µS	79.01K	(no ext Ro)		±10mV	
		48 KHz	±3.1 µS	79.01K				
		0.006 or 4 KHz	±0.6 µS	0.78K				1.0 mSec
350 Ω, Full Br Axial I	±2227 µS	0.006 or 4 KHz	±1.7 µS	79.01K	(no ext Ro)		±10mV	0 mSec
		48 KHz	±4.7 µS	79.01K				
		0.006 or 4 KHz	±0.9 µS	0.78K				1.0 mSec
350 Ω, Full Br Axial II	±2230 µS	0.006 or 4 KHz	±1.7 µS	79.01K	(no ext Ro)		±10mV	0 mSec
		48 KHz	±4.7 µS	79.01K				
		0.006 or 4 KHz	±0.9 µS	0.78K				1.0 mSec
1K Ω, ¼ Bridge	±5914 µS	0.006 or 4 KHz	±7.1 µS	79.01K	1K Ω, 5ppm/C	#iNet-R-1K	±10mV	0 mSec
		48 KHz	±15.2 µS	79.01K				

Strain Gage Specification Conditions, iNet-423

- The iNet-423 module supports quantity 6 Strain Gage 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, readback of excitation voltage error, external shunt resistor self heating error, 1.0nA max leakage current (at 37°C) times user source impedance 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.
- 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"
- 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]
- Analog Low Pass Filter (0.006KHz / 2poles, 4KHz / 2poles, or FullBandwidth) [2]
- Digital IIR Filter (LowPass, HighPass, BandPass, or BandStop) [55]
- Voltage Measurement Range (±5mV ... ±80mV) [1]
- Sensor Type [13]
- Min/Max µS Range [11]

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).
- 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.
- 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 i423 Product Description
- Model i423 Strain Gage Measurement Error Components
- Electrical Specifications

Potentiometer Measurement
Absolute Accuracy Specifications, iNet-423

POT Type (ohms) [13]	Measurement Range [11]	Analog Low Pass Filter (KHz Fc) [2]	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	0.006 or 4 KHz	0 mSec	±0.000469Eu	113.48K	0 to 5V
		75 KHz		±0.000506Eu	113.48K	
50K Ω	0 to 1.0Eu	0.006 or 4 KHz		±0.000475Eu	113.48K	0 to 5V
		75 KHz		±0.000512Eu	113.48K	

Potentiometer Specification Conditions, iNet-423

- The iNet-423 module supports quantity 6 Potentiometer 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, readback of excitation voltage error, instruNet input impedance variation error, 1.0nA max leakage current (at 37°C) times user source impedance 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.
- 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]
- Analog Low Pass Filter (0.006KHz / 2poles, 4KHz / 2poles, or FullBandwidth) [2]
- Digital IIR Filter (LowPass, HighPass, BandPass, or BandStop) [55]
- Voltage Measurement Range (±5mV ... ±5V) [1]
- Sensor Type [13]

More Information

- Potentiometer Wiring Diagram and Setup
- instruNet i423 Product Description
- Model i423 Potentiometer Measurement Error Components
- Electrical Specifications

Current Measurement

Absolute Accuracy Specifications, iNet-423

Measurement Range [11]	Analog Low Pass Filter (KHz Fc) [2]	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	0.006 or 4 KHz	0 mSec	±(0.067% + 7.0uA)	98.92K	33 Ω	0.05%, 5ppm/C	#iNet-R-33	±1.2V
	70 KHz		±(0.067% + 11.8uA)	98.92K				
	0.006 or 4 KHz	1.0 mSec	±(0.067% + 3.9uA)	0.79K				
±24mA	0.006 or 4 KHz	0 mSec	±(0.067% + 7.0uA)	98.92K				
	70 KHz		±(0.067% + 11.8uA)	98.92K				
	0.006 or 4 KHz	1.0 mSec	±(0.067% + 3.9uA)	0.79K				
±12mA	0.006 or 4 KHz	0 mSec	±(0.066% + 3.6uA)	104.23K	120 Ω	0.05%, 5ppm/C	#iNet-R-120	±2.5V
	75 KHz		±(0.066% + 4.6uA)	104.23K				
	0.006 or 4 KHz	1.0 mSec	±(0.066% + 1.6uA)	0.79K				
±2.5mA	0.006 or 4 KHz	0 mSec	±(0.065% + 0.4uA)	104.23K	1K Ω	0.05%, 5ppm/C	#iNet-R-1K	±2.5V
	75 KHz		±(0.065% + 0.6uA)	104.23K				
	0.006 or 4 KHz	1.0 mSec	±(0.065% + 0.2uA)	0.79K				
±1.2mA	0.006 or 4 KHz	0 mSec	±(0.066% + 0.23uA)	98.92K	1K Ω	0.05%, 5ppm/C	#iNet-R-1K	±1.2V
	70 KHz		±(0.066% + 0.39uA)	98.92K				
	0.006 or 4 KHz	1.0 mSec	±(0.066% + 0.13uA)	0.79K				
±500uA	0.006 or 4 KHz	0 mSec	±(0.065% + 0.07uA)	113.48K	10K Ω	0.05%, 5ppm/C	#iNet-R-10K	±5V
	74 KHz		±(0.065% + 0.08uA)	113.48K				
	0.006 or 4 KHz	1.0 mSec	±(0.065% + 0.03uA)	0.79K				
±600uA	0.006 or 4 KHz	0 mSec	±(0.066% + 0.17uA)	90.01K	1K Ω	0.05%, 5ppm/C	#iNet-R-1K	±600mV
	71 KHz		±(0.066% + 0.35uA)	90.01K				
	0.006 or 4 KHz	1.0 mSec	±(0.066% + 0.09uA)	0.78K				
±800uA	0.006 or 4 KHz	0 mSec	±(0.066% + 1.21uA)	82.26K	120 Ω	0.05%, 5ppm/C	#iNet-R-120	±300mV
	71 KHz		±(0.066% + 2.83uA)	82.26K				
	0.006 or 4 KHz	1.0 mSec	±(0.066% + 0.69uA)	0.78K				
±120uA	0.006 or 4 KHz	0 mSec	±(0.067% + 0.023uA)	98.92K	10K Ω	0.05%, 5ppm/C	#iNet-R-10K	±1.2V
	70 KHz		±(0.067% + 0.039uA)	98.92K				
	0.006 or 4	1.0 mSec	±(0.067% + 0.013uA)	0.79K				

	KHz							
±80uA	0.006 or 4 KHz	0 mSec	±(0.068% + 0.016uA)	90.65K	1K Ω	0.05%, 5ppm/C	#iNet-R-1K	±80mV
	49 KHz		±(0.068% + 0.027uA)	90.65K				
0 to 24mA	0.006 or 4 KHz		±(0.027% + 7.0uA)	98.92K	33 Ω	0.01%, 5ppm/C	contact disti	±1.2V
	70 KHz		±(0.027% + 11.8uA)	98.92K				
	0.006 or 4 KHz	1.0 mSec	±(0.027% + 3.9uA)	0.79K				

Current Specification Conditions, iNet-423

- The iNet-423 module supports quantity 6 Current 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, readback of excitation voltage error, external shunt resistor self heating error, external shunt resistor initial accuracy error, instruNet input impedance variation error, 1.0nA max leakage current (at 37°C) times user source impedance 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.
- 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]
- Analog Low Pass Filter (0.006KHz / 2poles, 4KHz / 2poles, or FullBandwidth) [2]
- Digital IIR Filter (LowPass, HighPass, BandPass, or BandStop) [55]
- Voltage Measurement Range (±5mV ... ±5V) [1]
- Sensor Type [13]
- Min/Max uA Range [11]
- External End-User-Supplied Shunt Resistor resistance (Ω) [15]

More Information

- Current Wiring Diagram and Setup
- instruNet i423 Product Description
- Model i423 Current Measurement Error Components
- Electrical Specifications

Resistance Measurement

Absolute Accuracy Specifications, iNet-423

Measurement Range [11]	Analog Low Pass Filter (KHz Fc) [2]	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	0.006 or 4 KHz	0 mSec	±(0.095% + 0.044 Ω)	82.26K	1K Ω	0.05%, 5ppm/C	#iNet-R-1K	±300mV
	71 KHz		±(0.108% + 0.103 Ω)	82.26K				
	0.006 or 4 KHz	1.0 mSec	±(0.092% + 0.025 Ω)	0.78K				
0 to 100 Ω	0.006 or 4 KHz	0 mSec	±(0.098% + 0.044 Ω)	82.26K	1K Ω	0.05%, 5ppm/C	#iNet-R-1K	±300mV
	71 KHz		±(0.111% + 0.103 Ω)	82.26K				
	0.006 or 4 KHz	1.0 mSec	±(0.094% + 0.025 Ω)	0.78K				
0 to 330 Ω	0.006 or 4 KHz	0 mSec	±(0.113% + 0.07 Ω)	98.92K	1K Ω	0.05%, 5ppm/C	#iNet-R-1K	±1.2V
	70 KHz		±(0.124% + 0.12 Ω)	98.92K				
	0.006 or 4 KHz	1.0 mSec	±(0.106% + 0.04 Ω)	0.79K				
0 to 1K Ω	0.006 or 4 KHz	0 mSec	±(0.147% + 0.10 Ω)	98.92K	1K Ω	0.05%, 5ppm/C	#iNet-R-1K	0 to 2.5V
	75 KHz		±(0.161% + 0.15 Ω)	98.92K				
	0.006 or 4 KHz	1.0 mSec	±(0.131% + 0.05 Ω)	0.79K				
0 to 3300 Ω	0.006 or 4 KHz	0 mSec	±(0.147% + 0.3 Ω)	98.92K	3.3K Ω	0.05%, 5ppm/C	#iNet-R-3300	0 to 2.5V
	75 KHz		±(0.161% + 0.5 Ω)	98.92K				
	0.006 or 4 KHz	1.0 mSec	±(0.131% + 0.2 Ω)	0.79K				
0 to 10K Ω	0.006 or 4 KHz	0 mSec	±(0.235% + 0.3 Ω)	98.92K	3.3K Ω	0.05%, 5ppm/C	#iNet-R-3300	0 to 2.5V
	75 KHz		±(0.259% + 0.5 Ω)	98.92K				
	0.006 or 4 KHz	1.0 mSec	±(0.209% + 0.2 Ω)	0.79K				
0 to 33K Ω	0.006 or 4 KHz	0 mSec	±(0.266% + 1.3 Ω)	107.38K	10K Ω	0.05%, 5ppm/C	#iNet-R-10K	0 to 5V
	75 KHz		±(0.286% + 1.7 Ω)	107.38K				
	0.006 or 4 KHz	1.0 mSec	±(0.228% + 0.6 Ω)	0.79K				
0 to 100K Ω	0.006 or 4 KHz	0 mSec	±(0.247% + 3.5 Ω)	98.92K	33K Ω	0.05%, 5ppm/C	#iNet-R-33K	0 to 2.5V
	75 KHz		±(0.270% + 5.0 Ω)	98.92K				
	0.006 or 4 KHz	1.0 mSec	±(0.220% + 1.7 Ω)	0.79K				
0 to 1M Ω	0.006 or 4 KHz	0 mSec	±(1.201% + 252.4 Ω)	98.92K	1M Ω	1%, 100ppm/C	contact disti	0 to 2.5V
	75 KHz		±(1.215% + 298.3 Ω)	98.92K				
0 to 10M Ω	0.006 or 4		±(2.198% + 16187.9 Ω)	98.92K	10M Ω	1%, 100ppm/C	contact disti	0 to 2.5V

	KHz							
	75 KHz		±(2.214% + 16646.4 Ω)	98.92K				
0 to 100 Ω	0.006 or 4 KHz		±(0.058% + 0.044 Ω)	82.26K	1K Ω	0.01%, 5ppm/C	contact disti	±300mV
	71 KHz		±(0.071% + 0.103 Ω)	82.26K				
	0.006 or 4 KHz	1.0 mSec	±(0.054% + 0.025 Ω)	0.78K				

Resistance Specification Conditions, iNet-423

- The iNet-423 module supports quantity 6 Resistance 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, readback of excitation voltage error, external shunt resistor self heating error, external shunt resistor initial accuracy error, instruNet input impedance variation error, 1.0nA max leakage current (at 37°C) times user source impedance 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 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
- Analog Low Pass Filter (0.006KHz / 2poles, 4KHz / 2poles, or FullBandwidth) 2
- Digital IIR Filter (LowPass, HighPass, BandPass, or BandStop) 55
- Voltage Measurement Range (±5mV ... ±5V) 1
- Sensor Type 13
- Min/Max Ω Range 11
- External End-User-Supplied Shunt Resistor resistance (Ω) 15

More Information

- Resistance Wiring Diagram and Setup
- instruNet i423 Product Description
- Model i423 Resistance Measurement Error Components
- Electrical Specifications