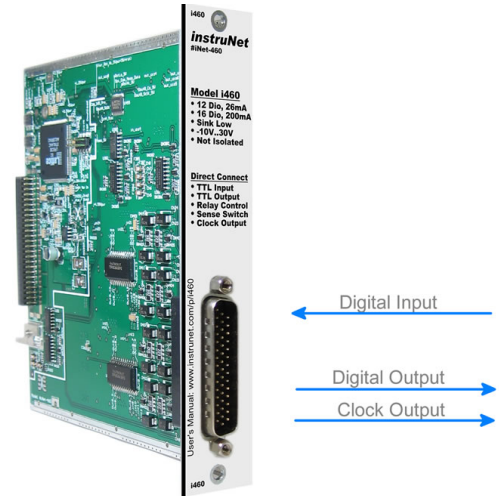# instruNet i460 Datasheet

Easy to Use Digital I/O Channels

Features

- The i460 card plugs into a 4 to 16 slot instruNet i4xx Card Cage, which in turn attaches to a Windows computer

- 12x Universal Digital I/O (20mA sink, -10V..30V)
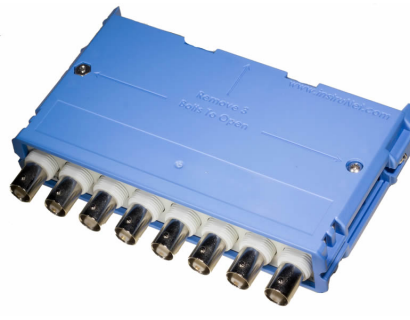
- 16x Digital I/O (200mA sink, -10V..30V)

Summary

- The 20mA sink digital I/O port consists of 12 individual TTL-compatible lines (Ch, #1...#8), 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.

- The 200mA sink digital I/O port consists of 16 individual TTL-compatible lines (Ch#9...#24), each of which can be configured as: input or output bit[44] . 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
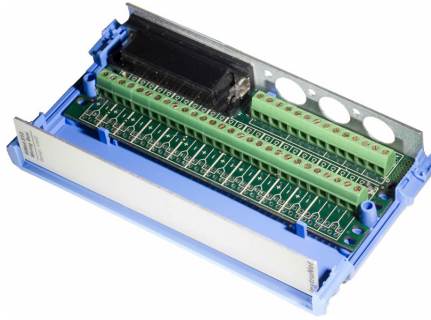
i510 Low Cost Wiring Box

i511 BNC Wiring Box
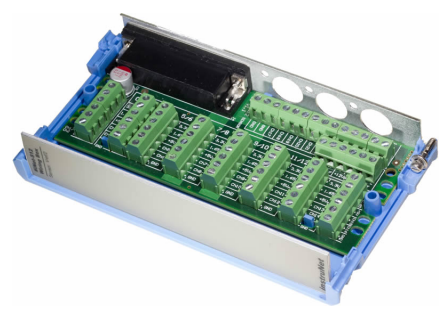
i512 Wiring Box

Optional Accessories
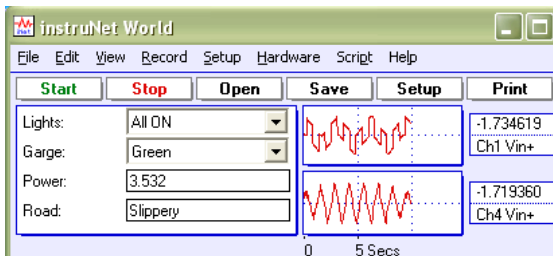
instruNet World PLUS Software (iW+)

Application Software

Shunt Resistors

Subjects Discussed in this Datasheet, iNet-460

○ 12x Universal Digital I/O (20mA sink, -10V..30V),   Electrical Specifications,   Software Interface

○ 16x Digital I/O (200mA sink, -10V..30V),   Electrical Specifications,   Software Interface

○ I/O Software Channels

○ Hd44 Connector Pins

○ Power Available to End User

○ Physical/Environmental Specifications

12x Universal Digital I/O, 20mA sink, iNet-460

| Parameter	Specifications[19]	Notes
Description	12 Bidirectional Digital I/O	The 20mA sink digital I/O port consists of 12 individual TTL-compatible lines (Ch, #1...#8), 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 from Dio Ch9..24 port (Cs2), pulse low when read from Dio Ch9..24 port (Cs3), 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.
"	input or output bit	Each bit is independently software programmed as an input or output
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-460

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*,

Parameter		Notes
		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, 4x Uio_B Bits, 4x Uio_C Bits

Software Interface, Universal Digital I/O, iNet-460

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 Ch1 Uio ... Ch8 Uio	Channels #25...#28: universal I/O bits, 0 or 1 value, scalar input/output, no high speed i/o, 20mA sink Channels #1...#8: 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 Uio1_8 In Uio1_8 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 Channel #31: bank of 8 bits, 0...255 value, scalar input/output, high speed input Channel #32: bank of 8 bits, 0...255 value, scalar input/output, high speed output
Connector Pins	One pin per bit	Signals are available at Hd44 connector pins: , #1...#8[217]
Ground Reference	Hd44 Pins 29/42/43/44	instruNet ground = instruNet chassis = earth ground via power supply 3rd prong

16x Digital I/O, 200mA sink, iNet-460

Parameter	Specifications[19]	Notes
Description	16 Bidirectional Digital I/O	The 200mA sink digital I/O port consists of 16 individual TTL-compatible lines (Ch#9...#24), each of which can be configured as: input or output bit. When configured as an input, a channel can be used to sense a digital high (2.1 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	input or output bit	Each bit is independently software programmed as an input or output
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, Digital I/O, iNet-460

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
Current Limiting	200mA to 1100mA	Internal current limiter (applies to bank of 8 bits) opens at > 200mA, 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) / 3300	External signal must sink internal 3.3K resistor to < 0.65V to input logic quot;0". 3.3KΩ 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) / 3300 *Vin > 4.5V*: Amps = (Vin - 3.3V) / 22000
"0" Output Voltage	< 0.65V @ 50mA, < 1.1V @ 200mA	I/O pin configured as an output sinks current low to 0.3V...0.65V with 0 to 50mA load; or sinks low to 0.3V...1.1V with 50 to 200mA load
"1" Output Voltage	3.9V...4.5V	I/O pin floats to 3.9V...4.5V via internal 3.3K 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	3.3KΩ ±10%	Internal 3.3K resistor pulls pin up to 4.5V via diode (little current flows if pin voltage > 4.5V)
Current Sink IC	TPIC6A595DW	See www.ti.com for details on this mosfet that sinks current low to gnd via series diode
Schmitt Trigger Input	Yes	Insures that a slow moving input signal with noise is not seen as vibrating between 0

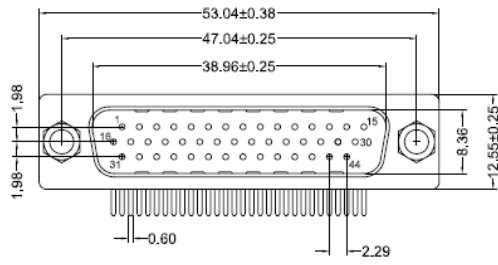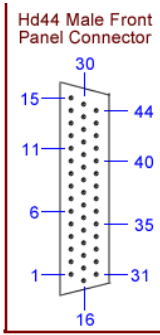|		and 1 when transitioning between the two
Input Delay	< 0.7 uSec	Schmitt trigger circuit adds < 0.7uSec delay between voltage at I/O pin, and internal version of digital input
Output Fall Time	0.02 uSec @ 100 pF typ, < 1.3 uSec @ 1K pF	Output transitions from 2V to 0.8V in approximately 0.02uSec with 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, 16 Din_A Bits, 8x Din_A Bits, 8x Din_B Bits, 16x Dout_A Bits, 16x Dout_A Mosfet

Software Interface, Digital I/O, iNet-460

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	Ch9 Dio ... Ch24 Dio	Channels #9...#24: digital I/O bits, 0 or 1 value, scalar input/output, no high speed i/o, 200mA sink
Bank Software Channels	Dio9_24 In Dio9_24 Out	Channel #33: bank of 16 bits, 0...65535 value, scalar input/output, high speed input Channel #34: bank of 16 bits, 0...65535 value, scalar input/output, high speed output
Connector Pins	One pin per bit	Signals are available at Hd44 connector pins: #9...#24[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-460

ChNum	Name	Channel Type	Hd44 Pin(s)	Description	Scalar I/O Support	High Speed Digitize Support
#1	Ch1 Uio	One Uio Bit	1	0 or 1, 20mA sink	input/output	no high speed i/o
#2	Ch2 Uio	"	2	"	"	"
#3	Ch3 Uio	"	3	"	"	"
#4	Ch4 Uio	"	4	"	"	"
#5	Ch5 Uio	"	5	"	"	"
#6	Ch6 Uio	"	6	"	"	"
#7	Ch7 Uio	"	7	"	"	"
#8	Ch8 Uio	"	8	"	"	"
#9	Ch9 Dio	One Dio Bit	9	0 or 1, 200mA sink	"	"
#10	Ch10 Dio	"	10	"	"	"
#11	Ch11 Dio	"	11	"	"	"
#12	Ch12 Dio	"	12	"	"	"
#13	Ch13 Dio	"	13	"	"	"
#14	Ch14 Dio	"	14	"	"	"
#15	Ch15 Dio	"	15	"	"	"
#16	Ch16 Dio	"	16	"	"	"
#17	Ch17 Dio	"	17	"	"	"
#18	Ch18 Dio	"	18	"	"	"
#19	Ch19 Dio	"	19	"	"	"
#20	Ch20 Dio	"	20	"	"	"
#21	Ch21 Dio	"	21	"	"	"
#22	Ch22 Dio	"	22	"	"	"
#23	Ch23 Dio	"	23	"	"	"
#24	Ch24 Dio	"	24	"	"	"
#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
#31	Uio1_8 In	"	1...8	0...255	"	input
#32	Uio1_8 Out	"	"	"	"	output
#33	Dio9_24 In	Group of Dio Bits	9...24	0...65535	"	input
#34	Dio9_24 Out	"	"	"	"	output

Hd44 Connector Pins, iNet-460

Hd44 Pin#	Pin Name	Pin Type	Description
#1	Ch1 Uio	One Uio Bit	universal I/O bits, 0 or 1 value, scalar input/output, no high speed i/o, 20mA sink, -10V..30V
#2	Ch2 Uio	"	"
#3	Ch3 Uio	"	"
#4	Ch4 Uio	"	"
#5	Ch5 Uio	"	"
#6	Ch6 Uio	"	"
#7	Ch7 Uio	"	"
#8	Ch8 Uio	"	"
#9	Ch9 Dio	One Dio Bit	digital I/O bits, 0 or 1 value, scalar input/output, no high speed i/o, 200mA sink, -10V..30V
#10	Ch10 Dio	"	"
#11	Ch11 Dio	"	"
#12	Ch12 Dio	"	"
#13	Ch13 Dio	"	"
#14	Ch14 Dio	"	"
#15	Ch15 Dio	"	"
#16	Ch16 Dio	"	"
#17	Ch17 Dio	"	"
#18	Ch18 Dio	"	"
#19	Ch19 Dio	"	"
#20	Ch20 Dio	"	"
#21	Ch21 Dio	"	"
#22	Ch22 Dio	"	"
#23	Ch23 Dio	"	"
#24	Ch24 Dio	"	"
#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

1
16
31
15
30
44

0.60

2.29

Power Available to End User, iNet-460

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-460

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, ~146mA	Power required to operate module (not for sensors or end user power)
+12Vdc Requirement	+12V ±0.8V, ~8mA	"
-12Vdc Requirement	-12V ±0.8V, ~0mA	"