REFTEK SYSTEMS INC.

Xi-202 User Manual

MINIATURE GLOBAL REMOTE MONITORING

Version 6.1
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Shipped From

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Specifics

This manual version is written with respect to Xi-202 firmware build 8351. If you wish to acquire the latest firmware for your device, contact support@reftek.com

Version History

Version No.	Date	Description
1.0	Jan 2014	Original Xi-202 Integrator Manual
1.2	Feb 2014	Updated format and technical specification
2.0	Feb 2015	Update to Xi-202 Q330 information
3.0	Aug 2016	Complete re-write for Xi-202 multi
3.1	Sept 2016	Added additional details on Charge Controller
3.2	Nov 2017	Document Overhaul
4.0	Sept 2018	Centaur integration, Net-R9 integration, Data relay integration, Vaisala information, color-coding
4.1	Jan 2019	Added REF TEK Setup section
4.2	Feb 2021	Formatting, modified Q330 pass-through command section
5.0	Apr 2021	Overhaul of Vaisala section
6.0	Jun 2022	Transfer to REF TEK; added Wrangler, Pegasus, Vaisala Support
6.1	Jul 2023	Added IP-Self to Q330 Setup, tips for Settings readout

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General Description

The Xi-202 Iridium Data Relay provides a robust and rugged transmission platform for sensor data from a supported data acquisition system (DAS), instantly providing worldwide communication capabilities. With an integrated Iridium transceiver, the Xi-202 can transmit to multiple emails or servers.

The Xi-202 can communicate with external devices over Serial (RS-232) or Ethernet. Through XeosOnline™, a user can easily send pass-through commands and remotely configure connected devices, retrieve system statuses and data messages.

Setting up an Iridium Account

The Xi-202 makes use of the Iridium Satellite Systems' Short Burst Data (SBD) service via the 9602 transceiver. This service is a global (including the Polar Regions), two-way, real-time and email-based data delivery service with a maximum outbound (from beacon) message size of 340 bytes and a maximum inbound (to beacon) message size of 270 bytes.

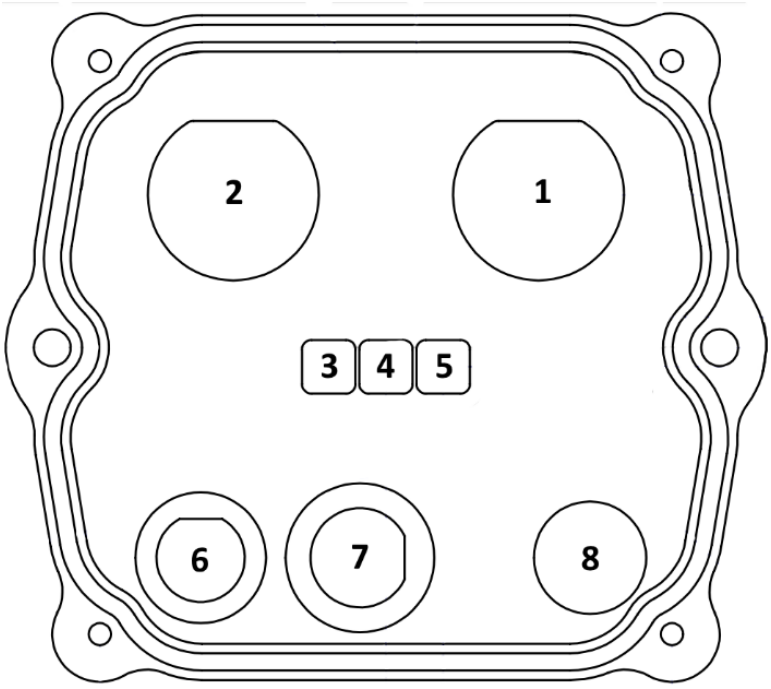
Xi-202 end users must set up an approved data delivery account with their preferred service provider. This can only be done once Xeos has provided the user with an International Mobile Equipment Identity **(IMEI)** number. For a list of service providers in your area please contact Iridium for recommendations. Xeos Technologies is also able to provide Iridium SBD data service and accounts. Please contact activations@xeostech.com for more information.

Each IMEI number is capable of being associated with up to five (5) unique destinations (IP addresses or Emails).

Xi-202 makes use of a simple and robust binary email protocol as the default outgoing message format. Any email application can be used to send and receive messages to or from the Xi-202, however, some messages from the device in this format are not human-readable. XeosOnline is a web-based monitoring system which allows users to view and manage readable information from the Xi-202.

Sending messages and changing configuration can be completed through XeosOnline. See www.reftek.com or contact REF TEK for more information.

Connections



N°	Name	Function
1	Port 1/Ethernet	Connection to peripheral device via Ethernet or Serial (14-Pin Female)
2	Port 2/Power	Connection to power supply, secondary serial connection and power switches (12-Pin Female)
3	PWR LED	Indicates power status during button test
4	DAS LED	Indicates status of connection to peripheral device during button test
5	SAT LED	Indicates status of Iridium ability during button test
6	USB-Mini	Low-level powering for configuration of device for deployment via PC
7	SAT TNC	Modem's connection to Iridium antenna via TNC connector
8	Test Button	Used to initiate self-test of the device's connection to peripheral devices and Iridium transmission capability

Ethernet/Serial Connector

Port 1/ENET on the Xi-202 is the Communication port used with a peripheral device. The type of device the Xi-202 expects to be connected depends on the settings internal to the Xi-202 (the **$Mqrc** setting).

The connection on the peripheral end of the cable (Serial, Ethernet) depends on the device to be connected.

A listing of the cables offered for this port with their drawings are at the end of this document.

Power/External Sensor Connector

Port 2 connects Power to the Xi-202, and contains a secondary serial port. A voltage of 7 to 32V is required to power the Xi-202 and connect to the Iridium network.

Depending on the use-case, Port 2 cables can have both power leads and a DB9 connector for secondary serial or Vaisala WXT520 weather station communication.

A listing of the cables offered for this port with their drawings are at the end of this document.

Satellite Antenna Connector

For Iridium communication, an Iridium antenna must be connected to Xi-202. The antenna connector is a threaded TNC connector, which connects directly to the 9602 modem via the SAT connection on the front panel of the device.

USB Mini Connector

Configuration of the Xi-202 and firmware updates can be done via the USB Mini connector. Connecting to a PC will provide enough power to do these tasks, but will not allow Iridium transmissions.

Note: A normal USB mini connector will not properly connect to this port as the USB on the Xi-202 is recessed.

Test Button

The test button allows you to check the Xi-202's connection to the DAS and Iridium transmission. Data relay functionality has a separate DAS LED behavior (see below).

LED	PWR	DAS	SAT
Green	Powered	Successful data acquisition	Successful Iridium registration
Red	n/a	Failure to connect	Failure to register
Flashing Yellow	n/a	Attempting data acquisition	Active registration attempt
Unlit	Unpowered	Inactive	Inactive

Data Relay LED behavior - DAS	
Red/Yellow repeating	No data being transferred
Flashing Green	Data currently being transferred for transmission

Note: The DAS LED will go inactive between attempts. The test can take up to 2.5 minutes. LEDs will time out after 15 minutes.

Commanding the Xi-202

There are 4 ways to communicate with the Nemo-V:

1. Locally via its USB Port
2. Locally via its RS-232 secondary serial port
3. Over-the-air with XeosOnline
4. Over-the-air with Email SBD messages

To receive commands from the Iridium network, the device in use must have a clear view of the sky. If the device is unable to communicate with the Iridium network, commands will remain queued for five days before they are automatically deleted.

Sending Commands Using USB

The Xi-202 can be directly interfaced with for configuration through its USB connection. The USB connection has the following requirements for proper communication:

Baud Rate	57600
Parity	None
Data Bits	8
Stop Bits	1

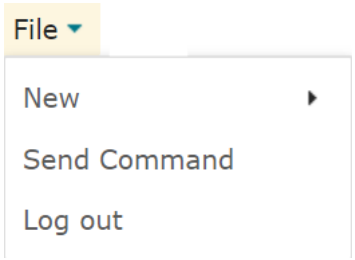
Commands to the Xi-202 all must begin with a dollar sign (**$**).

Sending Commands Using RS-232

If secondary serial is enabled using the **$cfg Ms2** command, USB is disabled and diagnostics are enabled through the Port 2 connector with the same port settings as USB.

Sending Commands Using XeosOnline

Before using XeosOnline make sure that your account has been set up and your device added to your organization. Contact support@reftek.com for more information.



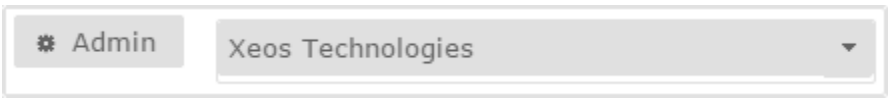
- Navigate to the Send Command window.
- From the Home Tab, choose **File > Send Command**
- Select the units you wish to target with commands and move them over to the right-hand target list using the **->** button.
- Type your command(s) into the command box and press send.

Remember to include the dollar sign (**$**) ahead of each command, and enter each command on a separate line.

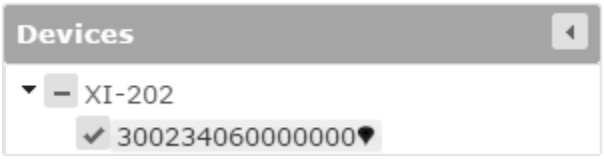
Outgoing messages will appear in the Message Log for the commanded device.

Tracking the Xi-202's Messages

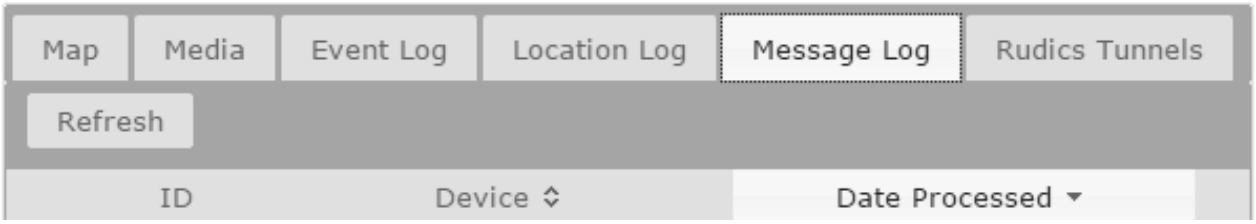
Now that the Xi-202 has been added to XeosOnline, the user can send commands and track location an event data. First, make sure you have the right organization selected from the menu at the top-right of the screen.



Click the **Home** button at the top of the screen to get back to the main page of XeosOnline. Select your device from the right-hand device area. Multiple devices may be selected.



Messages can be viewed in the **Message Log** tab. File uploads can be downloaded from the **Media** tab.



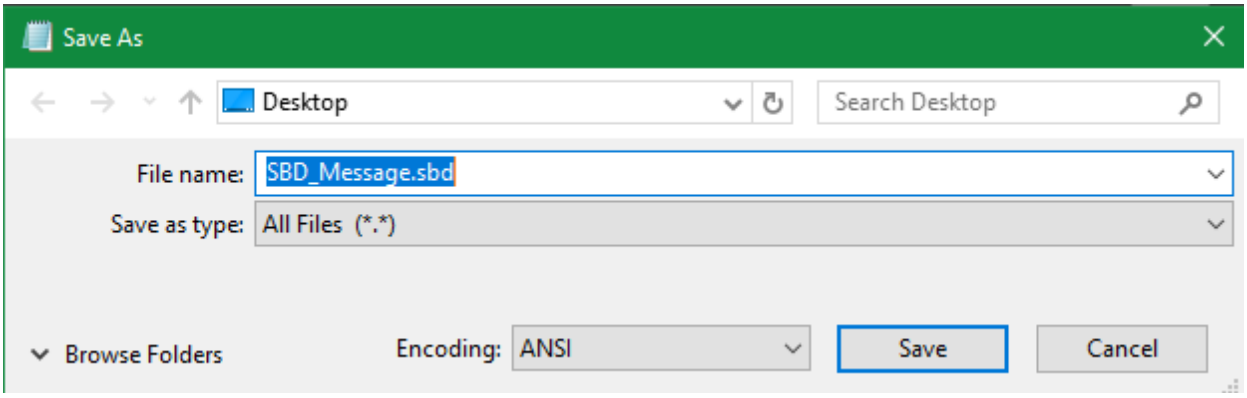
Sending Commands via Email

Xi-202 commands can be sent to the unit as an email attachment, or through XeosOnline. With an email setup, users can create an .sbd file that includes the commands for configuration.

To send and receive information through the Iridium network, the device's antenna must have a clear view of the sky. If the device is unable to communicate with the Iridium network, Mobile-Terminating (to device) commands will remain queued for five days.

Command Format

To create an SBD command, open a new file in a text editor (ex. Notepad) and save it using the **.sbd** extension. Make sure the **Save as type** option is set to **All Files** to achieve this.



Command Structure

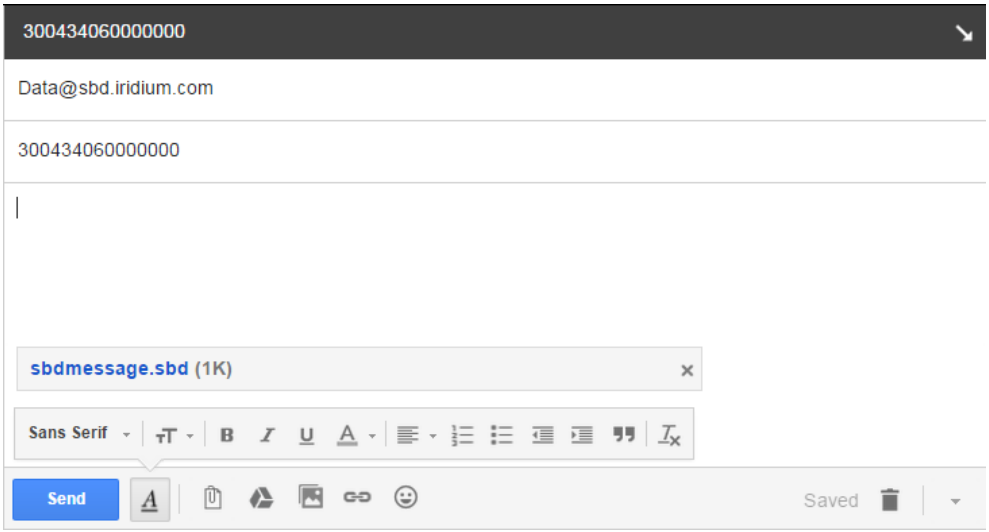
Commands must be structured in the following way:

1. Each command **MUST** have a dollar sign (**$**) before each command.
2. A list of commands, one command per line.

Sending the Command

To send the .sbd command, create a new email message with the following fields:

To	data@sbd.Iridium.com
Subject	Your device's IMEI; always a 15 digit number
Body	Empty
Attachments	Your .sbd file



A confirmation will immediately be returned from the Iridium Gateway from the address **sbdservice@sbd.Iridium.com** indicating that your message is now in the message queue. The command will be delivered to the device during the device's next Iridium check.

Commands can be sent from any email address, but responses will be returned **only** to email addresses on the unit's forwarding list.

Commands

Commands can be sent to the Xi-202 in two ways: over Iridium by way of SBD or over a serial connection. Some commands are not available over Iridium and must be issued locally.

Basic Commands

Command	Iridium	Description
$ver	yes	Show hardware and firmware versions
$settings	yes	Show settings
$cfg	yes	Set configuration item, see below
$resetnow	yes	Reset the unit immediately, settings are retained
$factorydefaults	yes	Change all settings to default and reset
$timers	yes	Show all timers
$h	no	Show all commands
$htrtemp	yes	Set the modem heater's shutoff temperature. 30°c to -30°c
$vstart	yes	Start Vaisala sensor data acquisition
$vdata	yes	Send Vaisala sensor data by SBD.
$rly	yes	Set/Show relay state, see below
$rv	no	Read battery voltage
$rt	yes	Read internal temperature
$ip X	no	Initiate or stop a single Iridium session, (X = 1 or 0)
$sendSBD	no	Send data out of peripheral device to Iridium Gateway via the Xi-202 (Coupled with the **$finished** command, see Data Relay)
$outport X	yes	Send data through specified Xi serial port to peripheral device (X = Serial Port)

Configuration Command ($cfg)

The **$cfg** command is used to set all configuration values of the Xi-202. Command format is as follows:

$cfg Xitem Value

$cfg Mii 1d

$cfg Nis 192.168.1.2

$cfg	The base command for the configuration change.
X	Category of the configured item (ex. Q for Q330) **Case sensitive**
Item	Command name of the item to be changed. Item names are displayed with the **$settings** command. Each item is detailed in the settings sections below.
Value	New value to be set.

Show Current Timers

The **$timers** command shows all currently active timers in the following format:

Timer	Time Until	Rate
M...ii	00:21:56	1h
M...si	00:21:06	1h
M...ri	23:21:06	1d
Q...qi	00:10:21	20m

The first column shows the timer label, the second column is the time until the next occurrence, and the third column is the timers' current rate of occurrence.

For easier readability, only the timers for the enabled mode are displayed. For instance, if the Xi-202 is configured to operate with a Q330 and the Genasun Charge Controller, only those timers will be displayed, along with the always present Xi-202 Main timers.

Navigating Settings

- Locally, sending **$settings 2** prints all settings in a table, displaying categories, setting command identifier, current value, as well as the minimum, maximum and default value.
- In addition, adding a category letter to the above prints the table format for that particular section of settings. For example, sending **$settings 2 Q** prints out all the values above, for the Q330 only.

Switched Power Output

The Xi-202 comes equipped with two pins on the Power Port that allow the user to supply power to a peripheral device. There are three ways to control this feature:

1) A one-time commanded session to power a relay switch for a set duration (**$rly**)
2) A commanded session where the switch remains on until commanded, or the device is reset (**$pwrSwtch**)
3) Durations set for both on-time and interval for repeated automatic power-on sessions (Mri/Mro or Mr2i/Mr2o timers)

One-Time Switched Power

The **$rly** command is used to set/show the current status of the Xi-202's power switches if there are no parameters. The $rly command also allows the Xi-202 to supply power to attached devices for a set amount of time and is a **1-time activation** of the relay. The **$rly** command follows this format:

$rly switch# on/off duration

The first parameter (valid values 1 or 2) selects the power switch being turned on and are the same switches referred to in the $pwrSwtch command section below.

The second parameter (1 or 0) enables or disables relay functionality.

The third parameter is the relay duration, between 1 second and 31 days. The format for the second parameter is **Nx**, where **N** is an integer and **x** is a unit of time (s)econds, (m)inutes, (h)ours, or (d)ays. This parameter is only required when turning the switch on.

$rly 2 1 4h
$rly 2 0

Switched Power Output

The Xi-202 has the ability to power peripheral devices with 12VDC through Port 2 using the following pins:

Switch Number	Positive Pin (Port 2)	Command
1	H	$pwrSwtch 1
2	J	$pwrSwtch 2
Power Switch Ground is on Pin K of Port 2		

Both power switches have the ability to be turned on and off, using the following command:

Command	**$pwrSwtch switch on/off**
switch	Which switch is to be commanded, 1 or 2
on/off	The power state to use, on (1) or off (0)

Repeating Timed Switched Power

Power switches can also be set to toggle on and off on set intervals.

To enable the toggling feature for a power switch, complete the following:

1. Enable the timers for relay interval and relay duration by sending the corresponding command.

Switch Number	Command
1	$cfg Mre 1
2	$cfg Mr2e 1

2. Command the corresponding switch to be on using the $pwrSwtch command.
3. Change the relay-on interval for the corresponding switch using:

Switch Number	Command	Example
1	$cfg Mri (Interval)	$cfg Mri 1d
2	$cfg Mr2i (Interval)	$cfg Mr2i 12h

4. Change the relay-on duration for the corresponding switch using:

Switch Number	Command	Example
1	$cfg Mro (Duration)	$cfg Mro 20m
2	$cfg Mr2o (Duration)	$cfg Mr2o 3h

Q330

The following commands are specific to the acquiring and display of Q330 data. Automatic acquisition and configuration of settings related to the Q330 are covered later in this document.

Command	Iridium	Description
$qqv	yes	Initiate a Quanterra Quickview session
$qstat	yes	Initiate a Quanterra Status session
$qss X	yes	Initiate a Quanterra Special Status session, see additional notes
$Qucmd	yes	Send a Quanterra command, see additional notes

$qss X

The **$qss X** initiates a special status session, there are two additional parameters. The first parameter **X** (a, b, or c) specifies which status to use. The second parameter: (0 or 1) indicates whether to send the response by SBD.

$Qucmd

The **$Qucmd** command sends a Quanterra command and hex payload to the Q330. The response is sent over SBD. See later in the document for more details.

REF TEK 130

The following commands are specific to the acquiring and display of RT 130 data. Automatic acquisition and configuration of settings related to the RT 130 are covered later in this document.

The data monitor response contains both a Data Stream and Channel setting. These must be set to the appropriate values with the following commands:

Command	Parameters	Description
$cfg Rsd	1 - 12	REF TEK 130 Data Stream
$cfg Rcd	1 - 12	REF TEK 130 Data Channel

Command	Iridium	Description
$rtStat X Y	yes	Get RT 130 Status (X = Command group; 1 = sc1, 2 = sc2, 3 = sc3) (Y = Send via SBD; 1 = Yes, 0 = No)
$rtData X	yes	Get Data (X = Send via SBD; 1 = Yes, 0 = No)
$rtCmd qResp Payload	yes	Send a REF TEK command, qResp = 1 to return via SBD, see additional notes

REF TEK 130 Commands

Individual commands can also be sent to the REF TEK 130 by the Xi-202. The message uses the following format:

$rtCmd X PAYLOAD

Command	Parameter 1	Parameter 2
$rtCmd	Send response over SBD (1 = Yes, 0 = No)	ASCII Message Payload

See example below.

Example:
To acquire **Disk information** from the Status command, the following data would be included (highlighted in blue):

Offset	Description	No. Bytes	Type and Range
0	Attention	1	0x84
1	Reserved	1	0x00
2	Unit ID	4	ASCII hex representation of the unit ID of the unit to receive the command (0 addresses any/all units)
6	Length	4	ASCII integer
10	Command code	2	ASCII characters: SS
12	Status Type	2	ASCII characters: see table
14	Status Parameters	14	
28	Command code	2	ASCII characters: SS
30	CRC	4	ASCII hexadecimal
34	Delimiter	2	ASCII carriage return and line feed characters: <CR><LF>

$rtCmd 1 "SSDK SS"

The above table is for status messages (SS), but this general format applies to most messages. Blank bytes are filled with spaces (0x20).

For more information on REF TEK status codes see the **REF TEK 130 Command Reference Document,** revision 3.3.0

Nanometrics

The following commands are specific to the acquiring and display of Nanometrics data. Automatic acquisition and configuration of settings related to this type of instrument are covered later in this document.

Command	Iridium	Description
$nGetS X Y	yes	Get status from Nanometrics Instrument X = Sent via SBD (0/1) Y = Save to SRAM (0/1)
$nGetD X Y	yes	Get data from Nanometrics Instrument X = Sent via SBD (0/1) Y = Save to SRAM (0/1)
$nBuff	yes	Show data received from instrument
$nSts	yes	Show channel status
$nSOH	no	Show SOH data received from instrument

Data Relay

The following commands are specific to the acquiring and display of data relayed to and from Iridium. Automatic acquisition and configuration of settings related to data relay are covered later in this document.

Command	Iridium	Description
$outport X	yes	Send data through specified Xi serial port to peripheral device (Serial Port = X, 1/2)
$sendSBD	no	Send data out of peripheral device to Iridium Gateway via the Xi-202 (Full package is sent once command **$finished** is received)

Charge Controller

The following commands are specific to the acquiring and display of charge controller data. Automatic acquisition and configuration of settings related to the charge controller are covered later in this document.

Command	Iridium	Description
$ccget	yes	Initiate a charge controller data acquisition
$ccshow	no	Show unsent charge controller data

Settings Commands

Settings are subset of commands set using **$cfg**. All Xi-202 settings are changed in this way. Settings are broken up into eight categories, the letter of which **must immediately precede the item to be changed and are case sensitive** (See Configuration Command ($cfg) above).

Name	Symbol
Iridium	I
Main	M
Data Relay	d*
RT 130	R
Wrangler	w
Store Forward	S

Name	Symbol
Q330	Q
Centaur	N
Charge Controller	B
Pegasus	P
Vaisala	v
PUI	U

I – Iridium

Setting	Description	Default	Min/Max value
mxl	Maximum byte-length for SBD messages	340	50/340
mnr	Maximum Iridium session without registration	50	20/300 seconds
try	Maximum SBD message tries per session	5	1/15
t	Minimum temperature for Iridium session	-30	-50/-5 °C

M – Main

Setting	Description	Default	Min/Max value
qrc	Switch mode between devices, **see below**	1	1/4
cc	Enable or disable charge controller functionality (this change resets device)	0	0/1
ii	Iridium message check interval	4h	5m/1d
si	XI status message interval	4h	5m/31d
us	Enable or disable XI status interval	1	0/1
vi	Vaisala data interval	1h	5m/1d
ve	Enable or disable Vaisala data collection	0	0/1
ht	Heater shutoff threshold	-30	-30/30 °C
he	Enable or disable the modem heater	1	0/1
s2	Enable or disable secondary serial mode, **see below**	0	0/1
re	Power Relay 1 enable/disable	0	0/1
ru	Power Relay 1 use UTC	0	0/1
rbt	Power Relay 1 offset time	0s	0s/23h
ri	Power Relay 1 interval (Power Switch 1)	1d	1m/2d
ro	Power Relay 1 On duration (Power Switch 1)	1h	1m/2d
r2e	Power Relay 2 enable/disable	0	0/1

r2u	Power Relay 2 use UTC	0	0/1
r2bt	Power Relay 2 offset time	0s	0s/23h
r2i	Power Relay 2 interval (Power Switch 2)	1d	1m/2d
r20	Power Relay 2 interval (Power Switch 2)	1h	1m/2d

Notes:

- The **$cfg Mqrc X** setting switches between **Q330 (1)**, **REF TEK 130 (2)**, **Nanometrics (3)**, **Data Relay (4)** **REF TEK Wrangler (5)** or **Pegasus (6)** device functionality. Changing this setting causes the Xi-202 to reset immediately to load in the corresponding configuration.
- Be aware that switching to secondary serial will immediately disable input and output from USB diagnostics. Communication to and from the Xi-202 will be routed through the RS-232 pins of the PWR/PORT2 connector. The Xi-202 can still be powered over USB in this state. Secondary serial uses a baud rate of 57.6k.

d – Serial Relay

Setting	Description	Default	Min/Max value
mb	Maximum data backlog in bytes	4000	500/12000
ml	Maximum relay message length	340	30/340
mq	Maximum backlog message quantity	10	5/10
to	Serial relay timeout (seconds * 16)	96	4/240
sn	Sequence number rollover limit	0	0/4294967295
ma	Maximum data age	ma	1m/70d

S – Store Forward

Setting	Description	Default	Min/Max value
to	Message timeout (seconds)	16	4/240
serPort	Serial Port used for relay	1	1/2
baud	Baud rate of serial port	19200	4800/115200

Q – Q330

Setting	Description	Default	Min/Max value
e	Enable or disable Q330 intervals	1	0/1
eth	Enable Ethernet, or disable to use Serial	1	0/1
qi	Q330 Quickview interval	1h	5m/31d
si	Q330 Status interval	1h	5m/31d
uv	Enable or disable Quickview	1	0/1
us	Enable or disable Status interval	1	0/1
ch	Q330 channel bitmap	7	1/63
sn	Q330 Serial number	none	none
ac	Q330 authorization code	00	none
ac0-7	Alternative Q330 authorization codes	none	none
sAu	Enable or disable Q330 special status A	1	0/1

sAi	Q330 special status A interval	6h	5m/31d
sAd	Q330 special status A data	See Q330	none
sBu	Enable or disable Q330 special status B	1	0/1
sBi	Q330 special status B interval	84h	5m/31d
sBd	Q330 special status B data	See Q330	none
sCu	Enable or disable Q330 special status C	0	0/1
sCi	Q330 special status C interval	6h	5m/31d
sCd	Q330 special status C data	See Q330	none
is	Xi-202 IP address (dot-decimal notation)	192.168.0.10	0 - 255
ig	IP gateway (dot-decimal notation)	192.168.0.3	0 - 255
im	IP Netmask (dot-decimal notation)	255.255.255.0	0 - 255
id	Q330 IP address	192.168.0.3	0 - 255
p	Q330 network port (UDP)	6332	1/65535
uu	Use UDP	1	0/1
mi	Maximum idle time (Seconds)	20	3/200
lw	Maximum timeout for network connection (Seconds)	120	5/200

R – REF TEK RT 130

Setting	Description	Default	Min/Max value
sd	Data stream for sensor data interval	1	0/9
cd	Channel for sensor data interval	1	1/12
di	REF TEK data acquisition interval	1h	5m/31d
du	Enable or disable data acquisition interval	1	0/1
si1	REF TEK status interval 1	1h	5m/31d
si2	REF TEK status interval 2	1h	5m/31d
si3	REF TEK status interval 3	1h	5m/31d
su1	Enable or disable status interval 1	1	0/1
su2	Enable or disable status interval 2	1	0/1
su3	Enable or disable status interval 3	0	0/1
sc1	REF TEK status interval 1 included status codes, see notes	AQ/DK/US/XC	none
sc2	REF TEK status interval 2 included status codes, see notes	NT/SI	none
sc3	REF TEK status interval 3 included status codes, see notes	RT1	none
is	Xi-202 IP address (dot-decimal notation)	10.200.100.10	0 - 255
ig	IP gateway (dot-decimal notation)	10.200.100.59	0 - 255
in	IP Netmask (dot-decimal notation)	255.255.255.0	0 - 255
id	REF TEK IP address	10.200.100.59	0 - 255
p	REF TEK network port (TCP)	5000	1/65535

uu	Use UDP	0	0/1
mi	Maximum idle time in seconds	20	3/200
lw	Maximum timeout for network connection in seconds	80	5/200

N – Nanometrics Centaur, Trimble Net-R9

Setting	Description	Default	Min/Max value
si	Centaur status interval	1h	5m/1d
di	Centaur data interval	1h	5m/1d
dx	Centaur data exclusions	none	none
nn	Centaur Network Name	NS	none
sn	Centaur Station Name	SVAL	none
mn	Maximum message number before rollover	1	1/255
ds	Centaur data acquisition length in seconds	10	1/15
is	Xi-202 IP address (dot-decimal notation)	169.254.35.10	0 - 255
ig	IP gateway (dot-decimal notation)	169.254.35.35	0 - 255
im	IP Netmask (dot-decimal notation)	255.255.255.0	0 - 255
id	Centaur IP address	169.254.35.35	0 - 255
p	Centaur network port (TCP)	80	1/65535
uu	Use UDP	0	0/1
mi	Maximum idle time in seconds	20	3/200
lw	Maximum timeout for network connection in seconds	10	5/200

p – Pegasus

Setting	Description	Default	Min/Max value
shi	Status of Health Interval	1h	5m/31d
sii	Station Information Interval	1h	5m/31d
cri	Config Req Interval	1h	5m/31d
uci	User Command Interval	1h	5m/31d
ush	Use Status of Health	1	0/1
usi	Use Station Information	1	0/1
ucr	Use Configuration Req	0	0/1
uuc	Use User Command	0	0/1
ucn	User Command Number	12	24
ucd	User Command Data	N/A	N/A

w –REF TEK Wrangler

Setting	Description	Default	Min/Max value
si1	REF TEK status interval 1	1h	5m/31d
si2	REF TEK status interval 2	1h	5m/31d
si3	REF TEK status interval 3	1h	5m/31d
su1	Enable or disable status interval 1	1	0/1
su2	Enable or disable status interval 2	1	0/1
su3	Enable or disable status interval 3	0	0/1
sc1	REF TEK status interval 1 included status codes	SSAQ/SSCK/SSDK/SSTM/SSUS	N/A
sc2	REF TEK status interval 2 included status codes	SSAD/SSEN/SSKT/SSLV/SSR1-4/SSS	N/A
sc3	REF TEK status interval 3 included status codes	ID/SSV1-3	N/A
is	Xi-202 IP address (dot-decimal notation)	10.100.100.99	N/A
ig	IP gateway (dot-decimal notation)	10.100.100.141	none
in	IP Netmask (dot-decimal notation)	255.255.255.0	none
id	REF TEK IP address	10.100.100.141	none
p	REF TEK network port (TCP)	5000	1/65535
uu	Use UDP	0	0/1
mi	Maximum idle time in seconds	20	3/200
lw	Maximum timeout for network connection in seconds	80	5/200

v – Vaisala

Note: The intervals below control the sampling rates of the Vaisala itself; how often the Xi-202 queries the weather sensor for data is controlled by the **Mv**i setting.

Setting	Description	Default	Min/Max value
t	Pressure/Temp/Humidity options	11111111	All 0/1
ti	tu interval	10	1/3600
w	Wind Sensor options	11111111	All 0/1
wi	wu interval	10	1/3600
wa	wu averaging	10	1/16
wg	wu gust	1	1/3
wo	wu offset	0	0/180
wf	wu frequency	1	1/4
r	Precipitation options	11111111	All 0/1
ri	ru interval	10	1/3600

s	Supervisor options	11111111	All 0/1
si	su interval	10	1/3600
sh	su heating	0	0/1
uct	user command response time	5	1/600
uc	vaisala user command	None	N/A
mi	send vaisala immediately	0	0/1

B – Charge Controller

Note: When Charge Controller functionality is enabled or disabled with the **cfg Mcc X** command, the device immediately resets.

Setting	Description	Default	Min/Max value
ai	Charge controller acquisition interval	1h	1m/7d
spr	Seconds per acquisition interval	20	1/250
sbdi	Charge controller acquisition report interval	1h	10m/7d
mpr	Maximum reports per SBD message	8	1/30
mblg	Maximum reports backlog	20	1/250

U – PUI

Setting	Description	Default	Min/Max value
s1	Turn on/off switch 1	0	0/1
s2	Turn on/off switch 2	0	0/1
s3	Turn on/off switch 3	0	0/1

Xi-202 Iridium Messages

Xi-Status

The Xi-Status messages have a one-hour interval at default settings. This message gives a brief overview of the Xi-202's timers and sensors.

```
Data Source: SBD, Message Type: XI-Status, Timestamp: 2022-05-06T22:41:17.000Z, IRDInterval: 60, Q330 Status interval: 0, Q330 Quickview Interval: 0, XI Sensor Interval: 0, BatteryV: 12.27, Operation Mode: 5, Heater Enabled: Yes, Heater Threshold: -30, RSSI: 5, Start Temperature: 22, Preheat End Temperature: 22, CREG Temperature: 49, High Temperature: 22, Preheat Seconds: 0, CREG Seconds: 8, Modem Power Cycle Count: 147, Firmware Version: 1.14.8350, Hardware Revision: 4.0.0
```

The Xi-Status contains the following:

Parameter	Description
Timestamp	Time in UTC of message
IrdInterval (mins)	Iridium message check interval
Q330 Status Interval (mins)	Interval for Q330 Status messages; if using another datalogger, this value is equal to the Status Interval for that peripheral
Q330 Quickview Interval (mins)	Interval for Q330 Quickview sessions; if using another datalogger, this value is equal to the Data Interval for that peripheral
Xi-Sensor Interval (mins)	Interval for using connected Vaisala sensor events
BatteryV	Battery Voltage read before transmission
Peripheral Device	Displays numerical value of device the Xi-202 is connected to, determined by the Mqrc setting
Heater Enabled	0 if heater is not used, 1 if heater is used
Heater Threshold	Temperature at which the modem heater will be turned off
RSSI	Last observed modem RSSI (signal) value
Start Temperature	Temperature at the beginning of the last Iridium session
12	Temperature at the end of the last preheat period
CREG Temperature	Temperature at the point in time when the modem registered with the network
High Temperature	The last measured temperature value
Preheat Seconds	Number of seconds that preheat was used on the last session
CREG Seconds	Number of seconds from initial modem power on until registration was obtained
Modem Power Cycle Count	Quantity of modem power cycles done during the last power-on session of device (rolls over at 255)
Firmware Version	Firmware version of device
Hardware Revision	Hardware revision of device

Settings

Over Iridium, the response to the **$settings** command is transmitted in ASCII. In this form, only the enabled settings are transmitted.

```
Ascii: [cfg]
I:mxl=340;mnr=50;try=5;t=30;epThrs=71000000;epchLT=987654321;epchGT=45
3133434;
M:qrc=1;cc=Y;ii=1h;si=1h;us=n;vi=10m;vr=10m;ve=n;ht=30;he=Y;s2=n;re=n;
ru=n;rbt=0s;ri=1d;ro=1h;r2e=n;r2u=n;r2bt=0s;r2i=1d;r2o=1h;
Q:e=Y;eth=Y;qi=1h;si=30m;uv=Y;us=Y;ch=7;sn=0100000B699B970C;ac=00;sAu=
Y;sAi=12h;sAd=0,2,8/3,9,10,11,12/11,1,2;sBu=n;sBi=84h;sBd=1,5,8,9,10/3
,1,2,3/16,2/20,11,24,25,26,27;sCu=n;sCi=6h;sCd=unused;is=10.100.100.3;
ig=10.100.100.2;im=255.255.255.0;id=10.100.100.2;p=5330;mi=20;lw=120;
B:ai=1h;spr=20;sbdi=1h;mpr=8;mblg=20;
```

Adding arguments to the **$settings** command over diagnostics will print the list in different ways.

- **$settings 1** will print the list in a column, showing only the current values of each setting.
- **$settings 2** will print the settings in a table form, showing all minimums, maximums, default values, and current values.
- Adding a settings category **letter** as an additional argument (case-sensitive) will do the above, but **just for that category**.
    - Example: **$settings 2 M** will print a table of all of the possible settings of the **Main** category.

Configuring the Q330

Overview

To configure the Xi-202 for use with the Q330, the following steps are required:

1. Update the Xi-202 with firmware compatible with Q330-over-ethernet (Build 2951 or later)
2. Check your unit's firmware using the command **$ver** over USB or XeosOnline.
3. Connect and power the two devices
4. Update the Xi-202's Ethernet settings to match the Q330 (Q330 parameters can be acquired by using Quanterra's Willard program)
5. For Iridium use, the Xi-202's modem must be provisioned and added to XeosOnline

Q330 Network Setup

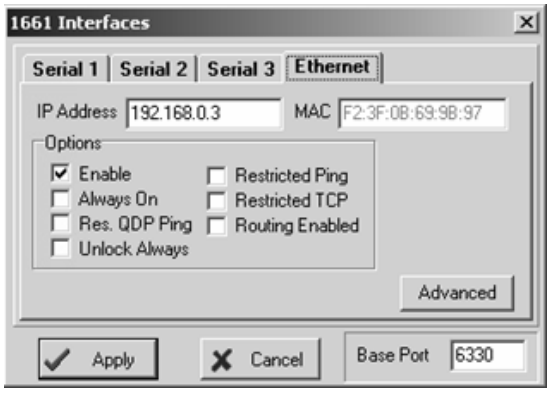
Once the Xi-202's firmware has been updated and an Ethernet connection has been confirmed, the Xi-202's settings must be changed to match the Q330. The Xi-202 must know the Q330's serial number and network settings must match the Q330.

Ethernet Setup

For Ethernet relay of Q330 data, make sure to configure the following settings:

Settings Name	Parameter Default	Description
Qeth	1	Enable Ethernet
Qis	192.168.0.10	The Xi-202's IP must be on the same sub-domain as the Q330
Qig	192.168.0.3	Should match the Ethernet IP from Willard
Qim	255.255.255.0	Network Mask
Qid	192.168.0.3	Should match the Ethernet IP from Willard
Qp	6330	Match the Base Port from Willard
Quu	1	Enable UDP packets

The serial number and IP information can be found in the following dialogs:



The Q330 should also be set to have announcements sent to the Xi-202's IP address. This can also be done from the Willard announcements menu option.

Testing the Network Settings

Once you have finished configuring the Xi-202's network settings you can test the connection by pressing the TEST button on the front of the Xi-202. The DAS button will go solid green if the connection is successful.

For more detailed information, connect to the Xi-202 over serial and issue a **$Qstat** command. If everything is set properly, you should see the Xi-202 register with the Q330, send a status command, receive the command and then un-register. The following should be seen from the Xi-202's diagnostics:

```
Q-Reg...
2,Send QtrCmd:x10 len=20
QRx:  open:udpOK
QRx done:xA1 28
2,Send QtrCmd:x11 len=60
QRx: QRx done:xA0 12
2,Send QtrCmd:x1F len=16
QRx: QRx done:xA9 68
2,Send QtrCmd:x1F len=16
QRx: QRx done:xA9 68
2,Q-Reg OK
QStat fixValueReq
2,Send QtrCmd:x1C len=12
 QRx: QRx done:xA7 200
QStat done
Q330 DataSize: 200
Q-Unregister...
3,Send QtrCmd:x12 len=20
QRx: QRx done:xA0 12
3,Q-Unregister OK
```

- If the QStat is successful, your Xi-202 is properly configured.
- The Q330 QStat and Quickview messages are not compressed (passed through unchanged) so they are decoded by referencing the Q330 protocol document.

Q330 Special Status Message

The Xi-202 has two separate Q330 status message types:

- The **QStat** Message is a set of status requests sent by the Xi-202, the Q330's responses are sent back by SBD message in their entirety.
- The **Special Status Message** consists of three separate **QStat** messages on independent timers. These messages can target specific responses for specific status bits of the **C1_RQSTAT** ($1F) message. The chosen responses will be filtered out of the Q330 response and sent over SBD without any further changes.

With one special status message, you can request information from multiple status responses. For example, status message **A** could specify **Power on Time in Seconds** from **Global Status** (p23) and **Battery Temperature** and **Depth of Discharge** from **Power Supply (SMU) Status** (p25).

> Page numbers refer to the **Q330 Communications Protocol Rev 22** document (Q330com-v22.pdf)

To create the message, you need to know the bitmap number, followed by which response you want from that number. **Global Status is bitmap 0**, of which **Power on Time in Seconds is part 8. SMU Status is bitmap 2**, of which **Battery Temperature is part 2** and **Depth of Discharge is part 4.**

Usage

To set Special Status Message **A** for the above responses, you would send the following command to the Xi-202 over serial or Iridium:

$cfg QsAd "0,8/2,2,4"

Once set, the Special Status A message will be sent according to its set interval.

You can specify any number of responses, but there are two limits:

- The Config string can only be 60 characters long,
- The response data (what's sent over Iridium) will not exceed 600 bytes. If the responses specified in the configuration string exceed 600 bytes, only the first 600 bytes will be sent.

Related Commands

The Special Status message has a number of commands to control their timings and use.

Command	Description	Parameters
$cfg QsAd "0,2/3,2"	Specify the special status messages string	Bit number followed by parts, **status bits are separated by a slash '/'**
$cfg QsAu 1	Turn the Special Status on or off	1 for on, 0 for off
$cfg QsAi 5h	Set the message's timing interval	Timings can span from 5 minutes to 1 month. Uses (m)inutes, (h)ours or (d)ays

There are three separate special status messages available: A, B and C. The above examples are for Special Status A.

Special Status Letter	Default values for Request
A	0,2,8/3,9,10,11,12/11,1,2
B	1,5,8,9,10/3,1,2,3/16,2/20,11,24,25,26,27
C	none

Special Status Message Example

```
24 1C 00 00 28 AA 01 00 00 06 9A 40 74 BB 00 07 10 00 45 8B 20 EA 13
03 08 48 56 50 2A 58 4B 60 00 0B 04 08 00 10 00 AA
```

Color	Name	Description
	SBD Header	0x24 header format
	Message Type	Xi-202 message type 0x1C (28)
	Q330 SN	Q330 SN from Xi-202 settings, all 0's if not available
	Status Byte	Status message 0 (Global Status)
	Message Length	Length of status 0 data (7 Bytes)
	Data	Protocol buffer data
	Status Byte	Status message 3 (Boom Positions)
	Message Length	Length of status 3 data (8 Bytes)
	Data	Protocol buffer data
	Status Byte	Status message 11 (Data Port 4 Status)
	Message Length	Length of status 11 (4 Bytes)
	Data	Protocol buffer data
	SBD Footer	SBD footer (16-bit checksum)

Note: Prior to build 4268, only fields 10, 13 and 14 were set to zigzag encoding, therefore all values were encoded as though the memory location represented either a 4 byte unsigned (for fields 10, 13 and 14) or a 2 byte unsigned. For negative values, only the lower 16 bits should be decoded as 2's compliment.

From 4268 onward, all values should be decoded as sint16.

Important Notes

- The strings in the A9 responses, such as from GPS Status have their length and terminator characters removed to match the byte size in the **Q330 Communications Protocol Rev 22** document.

Q330 Pass-through Command

The Xi-202's **$Qucmd** allows any Q330 command to be sent by the Xi-202 when commanded over serial or Iridium. If there is any response from the Q330, it will be sent back over Iridium as an SBD. The format of the response is below.

It must be noted that, currently, **ANY** command can be sent by the Xi-202. This includes commands that can disable your Q330 or prevent remote access. Make sure that extreme care is taken when sending these commands.

The format for the command to the Xi-202 over a local connection or Iridium is as follows:

$Qucmd seq cmd payload

Command	Description
$Qucmd	Base command
seq	Sequence number; value is in hex. Min 0x0000, Max 0xFFFF The Xi-202 does not pass this value to the Q330; the user can utilize this value to pair commands to the Q330 with the responses to these commands. If the user does not wish to utilize this feature, this value can be constant. Values that have missing characters add zeroes to fill out the balance of two bytes. Example: 87 = 0x0087
cmd	The Q330 command being forwarded through the Xi-202. This is represented in hex, as does direct commanding of the Q330. Ex. C1_POLLSN is command 0x14, therefore the command will also use a value of 14.
payload	If the command has a payload, this is represented as all hex characters, no spaces. If there is no payload, this value can be omitted.

For more information on Quanterra commands, see the **Q330 Communications Protocol** document, rev 22.

Multiple commands can be sent to the Xi-202 for use with the Q330 in a single message, provided they are all on separate lines:

$Qucmd 1 19 0010
$Qucmd 2 16
$Qucmd 3 1C

The Xi-202 will retrieve the commands during its next Iridium session, after which it will attempt to:

- Register with the Q330
- Send each command sequentially
- Deregister from the Q330
- Package each response into an SBD
- Send each command response as an SBD to the Iridium gateway

SBD Response

Each command's response gets its own SBD message (up to 315 bytes) and are sent as-is. To understand these responses, the user should be familiar with Q330 commands.

Multiple messages can be sent to the Xi-202 between Iridium checks. Each separate SBD message containing $Qucmd will cause registration with the Q330.

Responses are wrapped in a 7-byte header, followed by the response to the command.

Responses are limited to a single SBD and will be truncated if too large.

Notes

- The acknowledge ($A0) and error ($0A) response codes are easy to mix up when looking through SBD responses
- If a command's bitmap is too short, the Xi-202 will append additional 0 bytes to the right (LSB)
- If a command's bitmap is too long, the Xi-202 will wrap it in the QDP and IP headers and send it.

Example: Turn off GPS

The Q330's C1_CTRL ($19) command (p16) can be used to power on the Q330 and its GPS. The command takes 2 bytes, using only the lowest 8 bits. The Turn GPS Off flag is bit 4. The command would be as follows:

$Qucmd seq cmd payload

$Qucmd 87 19 0008

Command

$Qucmd 87 19 0008

Response

```
24 1B 00 00 0D AA 19 A0 00 87 00 00 AA
```

Color	Name	Description
	SBD Header	Message type 1B header
	User Command	The Q330 command issued by the user
	Q330 Response	The Q330 Message response code
	Sequence Number	The 2-byte sequence number included by the user
	Data Length	The Q330 response length in bytes
	SBD Footer	SBD footer

In this case the Q330 command does not return any payload data, which would be loaded between **Data Length** and the **SBD footer**.

Configuring the RT 130

To configure the Xi-202 for use with a REF TEK RT 130, the following steps are required:

1. Update the Xi-202 with compatible firmware (Build 2951 or later)
2. Check your unit's firmware using the command **$ver** over USB or XeosOnline.
3. Connect and power the two devices
4. Update the Xi-202's settings to match the appropriate settings for the RT 130

RT 130 Network Setup

Once the Xi-202's firmware has been updated and an Ethernet connection has been confirmed, the Xi-202's settings must be changed to match the RT 130 where applicable.

For Ethernet relay of RT 130 data, make sure to configure the following settings:

Settings Name	Default	Description
Mqrc - Device	1	For the RT 130 this value must be set to 2.
Ris – IP-Self	10.200.100.10	The Xi-202's IP must be on the same sub-domain as the RT 130
Rig – Gateway IP	10.200.100.59	Must match the RT 130's IP Address
Rin – Netmask	255.255.255.0	Network Mask
Rid – Destination IP	10.200.100.59	Must match the RT 130's Static IP address
Ruu – UDP On/Off	0	UDP packets must be disabled
Rp – Port Number	5000	The RT 130's TCP Command port

Testing the Network Settings

Once configuration of the Xi-202's network settings is complete, you can test the connection by pressing the TEST button on the front of the Xi-202. The DAS button will go solid green if the connection is successful.

REF TEK Mode Timers

REF TEK Timers differ from other modes in that the status message is split into three separate messages.

Command	Parameters	Description
$cfg Rsi1	5m – 31d	REF TEK 130 Acquisition, Disk, Unit, and External Clock status
$cfg Rsi2	5m – 31d	REF TEK 130 Network and Sensor information status
$cfg Rsi3	5m – 31d	REF TEK 130 RTP status
$cfg Rdi	5m – 31d	REF TEK 130 Data Monitor Response

The REF TEK 130's status message is actually 3 separate messages, each having a separate interval. REF TEK messages are not compressed into binary, instead the Xi-202 relays the exact response from the REF TEK 130.

The Xi-202 will also relay the REF TEK 130's Data monitor response as-is; the format is not mSEED and contains 160 data points.

Configuring the NMX Instrument

Overview

To configure the Xi-202 for use with a Nanometrics Centaur, the following steps are required:

5. Update the Xi-202 with compatible firmware (Build 2951 or later)
6. Check your unit's firmware using the command **$ver** over USB or XeosOnline.
7. Connect and power the two devices
8. Update the Xi-202's settings to match the appropriate settings for the Centaur
9. For Iridium use, the Xi-202's modem must be provisioned and added to XeosOnline

NMX Network Setup

Once the Xi-202's firmware has been updated and an Ethernet connection has been confirmed, the Xi-202's settings must be changed to match the Centaur where applicable.

For Ethernet relay of Centaur data, make sure to configure the following settings:

Settings Name	Default	Description
Mqrc - Device	1	For NMX instruments this value must be set to 3.
Nis – IP-Self	169.254.35.10	The Xi-202's IP must be on the same sub-domain as the NMX instrument
Nig – Gateway IP	169.254.35.35	Must match the NMX's Link Local IP address
Nim – Netmask	255.255.255.0	Network Mask
Nid – Destination IP	169.254.35.35	Must match the NMX's Link Local IP address
Nuu – UDP On/Off	0	UDP packets must be disabled
Np – Port Number	80	The NMX's HTTP port
Nnn – Network Name	NS	The Network Name of the Centaur
Nsn – Station Name	SVAL	The Station Name of the Centaur

Testing the Network Settings

Once configuration of the Xi-202's network settings is complete, you can test the connection by pressing the TEST button on the front of the Xi-202. The DAS button will go solid green if the connection is successful.

NMX Mode Timers

There are two separate timers for NMX instruments:

- **Status (Nsi)** – Requests and transmits a Status of Health message from the NMX instrument. This message uses a bitmap of values parsed from the NMX's status API.
- **Quickview (Ndi)** – Requests and transmits a 10 second data capture (configurable time length) in mSEED format. If the data is larger than 338 bytes, it will be split into multiple messages and re-assembled for download in the Media Tab of XeosOnline.

Status of Health

Determined by the Nsi timer, the Xi-202 will request a Status of Health message from the NMX instrument, which will then be transmitted via Iridium as a Type 19 (0x13) message. This message is parsed by XeosOnline and appears in the Message Log.

Quickview Data

Determined by the Ndi timer, the NMX Quickview message will send data from every channel currently recording sensor information. If the channel has no sensor, recorded noise will be sent as data. Sending this noise as though it is legitimate information can use excessive amounts of Iridium data.

The Xi-202 allows for channels to be excluded from the Quickview message using the **Data Exclude (Ndx)** command. All channels listed with this command are excluded:

$cfg Ndx HNZ;HNY;HNX;HHY;HHX

Channel names can be acquired from either the Instrument's webserver or the Xi-202. To restore all channels, use the command **$cfg Ndx 0**

The size of messages is also determined by the length of time of data being requested. The length of data that is requested during timed and prompted Data Acquisition is determined by the **Data Seconds (Nds)** command. The length of time can be between 1 and 15 seconds. Ten seconds of Data Acquisition is typically 1.5kb of data.

Raw Data messages that are not re-assembled are sent out as message type 20 (0x14).

Channel Status

To query the Xi-202 for Quickview channels, use the command **$nSTS.** The Xi-202 will display a list of channels:

```
Channel Status:
HNZ 2015-10-22 17:47:50 0/0 (Excluded)
HNY 2015-10-22 17:47:50 0/0 (Excluded)
HNX 2015-10-22 17:47:50 0/0 (Excluded)
HHZ 2015-10-22 17:47:50 4/1804
HHY 2015-10-22 17:47:50 0/0 (Excluded)
HHX 2015-10-22 17:47:50 0/0 (Excluded)
USR 2000-00-00 00:00:00 0/0
```

Quickview files are available for download from the Media tab of XeosOnline once all pieces are re-assembled into one file.

Configuring a Trimble NetR9

The Xi-202 has the ability to send data from a connected Trimble NetR9 via Ethernet to the Iridium network. This process is not automated for the NetR9; data is returned in response to NetR9 programmatic commands prepended by the **$nUsr 1** Xi-202 command via serial (local) or Iridium (remote). Since all communication with the NetR9 is through commands, automated timers for use with the Nanometrics Centaur in this mode (**Nsi** and **Ndi**) can be ignored and set to their maximum intervals for the lowest possible power consumption.

To configure the Xi-202 for use with a Trimble NetR9, the following steps are required:

1. Update the Xi-202 with compatible firmware (Build 2951 or later)
2. Check your unit's firmware using the command **$ver** over USB or XeosOnline.
3. Connect and power the two devices
4. Update the Xi-202's settings to match the appropriate settings for the NetR9
5. For Iridium use, the Xi-202's modem must be provisioned and added to XeosOnline

To configure the NetR9 for use with the Xi-202, the following steps are required:

1. The NetR9's DHCP setting must be disabled.
2. The following information must be acquired from the NetR9:
    a. IP Address
    b. Gateway IP

Trimble Network Setup

Once the Xi-202's firmware has been updated and an Ethernet connection has been confirmed, the Xi-202's settings must be changed to match the NetR9 where applicable.

For Ethernet relay of NetR9 data, make sure to configure the following settings:

Settings Name	Default	Description
Mqrc - Device	1	For NetR9, this value must be set to **3**.
Nis – IP-Self	169.254.35.10	The Xi-202's IP must be on the same sub-domain as the NetR9's IP address
Nig – Gateway IP	169.254.35.35	Must match the NetR9's Gateway IP
Nim – Netmask	255.255.255.0	Network Mask
Nid – Destination IP	169.254.35.35	Must match the NetR9's IP address
Nuu – UDP On/Off	0	UDP packets must be disabled
Np – Port Number	80	The NetR9's HTTP port

Testing Network Setup

Once all settings are configured, connection can be confirmed using the $nUsr command. Various commands for the NetR9 will prompt responses from the NetR9, provided they are sent to the Xi-202 in the following format:

$nUsr X COMMAND

$nUsr 1 /prog/Show?Voltages

$nUsr	Base command for the Xi-202; required to send COMMAND through Ethernet to NetR9
X	Send response to command over SBD (1 = Yes, 0 = No)
COMMAND	NetR9 command, as it would normally be sent directly to the NetR9. Ex. /prog/Show?Temperature

An example of a serial response to the $nUsr 1 /prog/Show?Voltages command:

```
...REST GET: /prog/Show?Voltages
 open: tcp: 22E1
Connected
TCP out,bytes=57
<SentOK>
Rx:348/348
Null pbuf rx'd.
Channel Status:
       2000-00-00 00:00:00 0/0
       2000-00-00 00:00:00 0/0
       2000-00-00 00:00:00 0/0
       2000-00-00 00:00:00 0/0
       2000-00-00 00:00:00 0/0
       2000-00-00 00:00:00 0/0
   USR 2012-08-24 22:22:22 0/348
```

The above example shows a request of 57 bytes, and a response from the NetR9 of 348 bytes. For programmatic commands that return a response, messages will be sent via SBD in a series of packets, if the response is larger than the maximum size of an allowable SBD message. If using XeosOnline, the response will be reassembled into a readable message, which is then downloadable via the Media Tab. The downloaded file can then be examined.

Below is an example of a response to a Show Voltages query.

```
HTTP/1.1 200 OK
Server: TRMB/1.2
Date: Thu, 22 Feb 2018 15:14:07 GMT
Cache-Control: no-cache, must-revalidate
Pragma: no-cache
Expires: Fri, 30 Oct 1998 14:19:41 GMT
Connection: close
Content-Type: text/plain

<Show Voltages>
port=0 B1 volts=8.27 cap=100%
port=1 ETH volts=0.00 cap=0%
port=2 P2 volts=17.68 cap=100%
<end of Show Voltages>
```

Note: When using the Xi-202 with the NetR9, it is imperative that only one programmatic command be sent per Iridium session to avoid data from hanging in the buffer. If the device no longer returns data from programmatic commands, issue a reset to the Xi-202 to flush the buffer.

Data Relay Setup and Usage

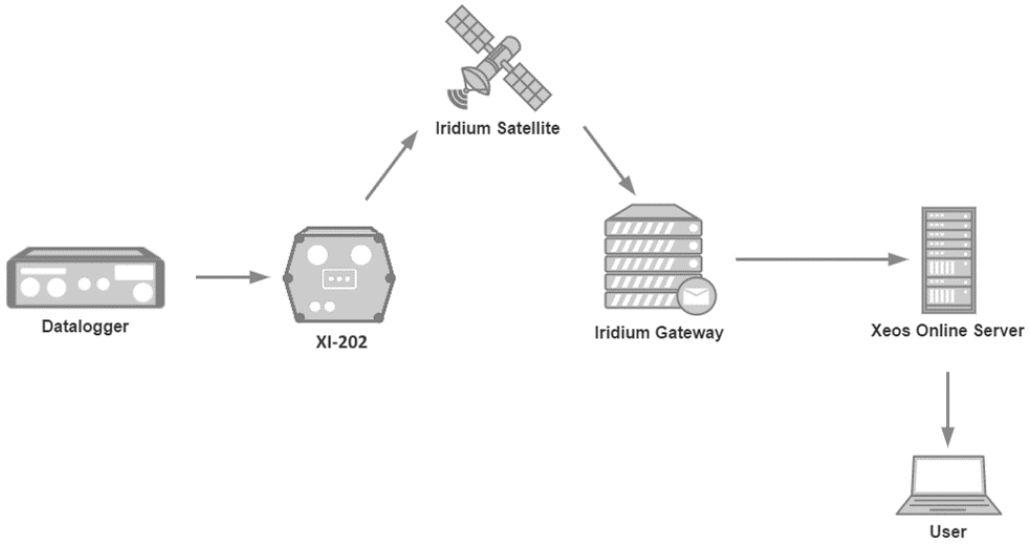
The Xi-202 has the ability to allow for serial relay functionality as of build 4736. Xi-202s with the proper firmware can send data to and from a connected serial device over the Iridium Satellite network.

Configuration

Several items require configuration before using the Serial Relay functionality. Remember that configuration for Store Forward items begin with a capital **S**.

Setting	Description	Default	Min/Max value
Sto	Message timeout (seconds)	16	4/240
SserPort	Serial Port used for Relay	1	1/2
Sbaud	Baud rate of serial port	19200	4800/115200

Mobile Originated SBD (From Device)



To send a payload of data from your connected serial device via the Xi-202 to the user, the device will send the payload in the following format:

$sendSBD
payload line 1
payload line 2
payload line 3
$finished

All lines are terminated with either a carriage return, line feed, or both.

The command $sendSBD is case-sensitive.

For example, using a carriage return as the line terminator for the same content as the previous example (represented with "\R"):

$sendSBD\R payload line 1\R payload line 2\R payload line 3\R $finished\R

$sendSBD\R The payload of the message can be single-lined as well\R $finished\R

The **$sendSBD** and **$finished** commands **must** be immediately preceded and followed by a line terminator character. The payload can be data of any type and is not limited to ASCII characters.

Any data that exceeds the 330 byte SBD message limit will be split into several chunks and sent according to the Iridium device's SBD interval. Each Iridium transmission can send up to 8 SBD messages of 330 bytes each.

Mobile-originated messages will be transmitted over the Iridium satellite network from the Iridium device and arrive as an e-mail attachment. The first line in the e-mail attachment will have the following format:

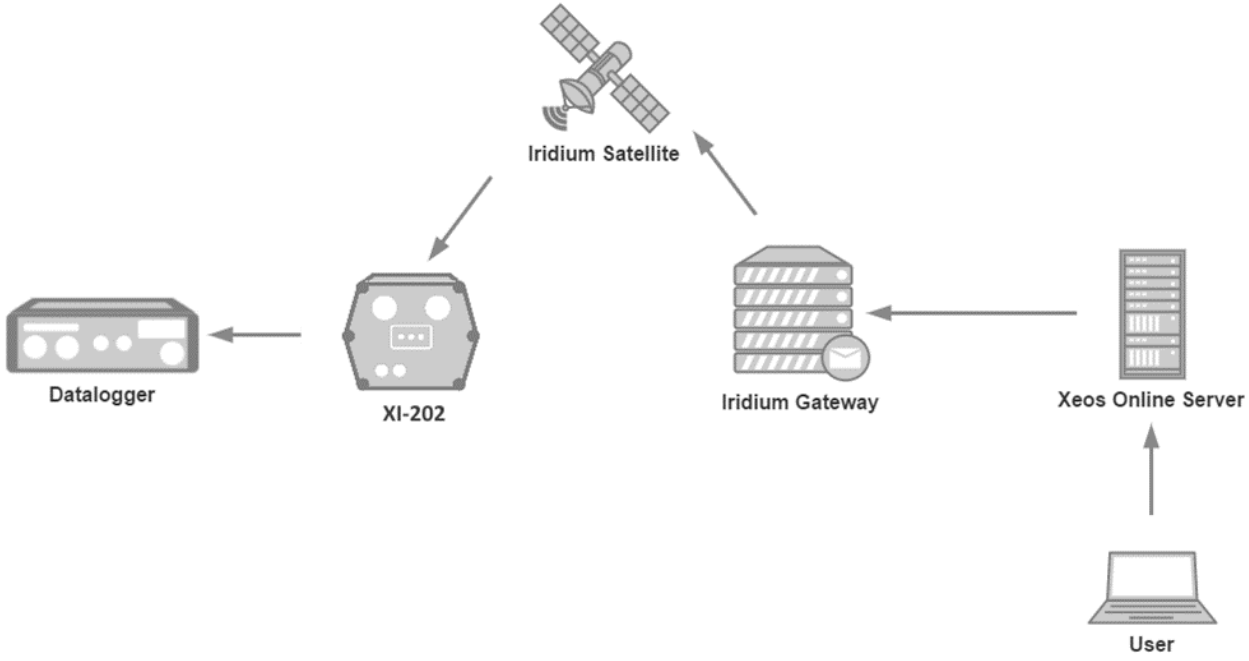
devData X,S,Y,Z PAYLOAD

devData a,1,1,1 The payload of the message can be single-lined as well

X	The alphabetic representation of the port the device is connected to
S	The sequence number of the incremented with each new $sendSBD command
Y	The message part number
Z	The total number of parts to the complete message

Following the "devData" line will be all or part of the payload, depending on the size of the payload.

Mobile Terminated SBD (To Device)



To send a payload of data to your connected serial device via the Xi-202, create a file with the extension ".sbd" with its contents adhering to the following format:

$outPort X (where 'X' is the alphabetic port number of the connected device)
payload line 1
payload line 2
payload line 3

Again, all lines are terminated with either a carriage return, line feed, or both.

When the data to be sent is compiled, normal methods of sending commands to Iridium devices can be implemented, either through email or a web service such as XeosOnline.

All lines after the **"$outPort"** line will be delivered to the connected serial device the next time the Xi-202 is scheduled to contact the Iridium network. The total message cannot exceed 270 bytes. Upon reception of the **$outPort** command, the device would output the following data to the connected serial device, according to the above example:

payload line 1
payload line 2
payload line 3

Configuring the REF TEK Wrangler

To configure the Xi-202 for use with a REF TEK Wrangler, the following steps are required:

1. Update the Xi-202 with compatible firmware (Build 8350 or later)
2. Check your unit's firmware using the command **$ver** over USB or XeosOnline.
3. Connect and power the two devices
4. Update the Xi-202's settings to match the appropriate settings for the Wrangler.

Wrangler Network Setup

Once the Xi-202's firmware has been updated and an Ethernet connection has been confirmed, the Xi-202's settings must be changed to match the Wrangler where applicable.

For Ethernet relay of Wrangler data, make sure to configure the following settings:

Settings Name	Default	Description
Mqrc - Device	1	For the Wrangler this value must be set to **5**.
wis – IP-Self	10.100.100.99	The Xi-202's IP must be on the same sub-domain as the Wrangler
wig – Gateway IP	10.100.100.141	Must match the Wrangler's IP Address
win – Netmask	255.255.255.0	Network Mask
wid – Destination IP	10.100.100.141	Must match the Wrangler's Static IP address
wuu – UDP On/Off	0	UDP packets must be disabled
wp – Port Number	5000	The Wrangler's TCP Command port

Wrangler Mode Timers

Command	Parameters	Description
$cfg wsi1	5m – 31d	REF TEK 130 Acquisition, Disk, Unit, and External Clock status
$cfg wsi2	5m – 31d	REF TEK 130 Network and Sensor information status
$cfg wsi3	5m – 31d	REF TEK 130 RTP status

The Wrangler status message is actually 3 separate messages, each having a separate interval.

Configuring the Pegasus

To configure the Xi-202 for use with a Pegasus, the following steps are required:

1. Update the Xi-202 with compatible firmware (Build 8350 or later)
2. Check your unit's firmware using the command **$ver** over USB or XeosOnline.
3. Connect and power the two devices
4. Update the Xi-202's settings to match the appropriate settings for the Pegasus.

Pegasus Network Setup

Once the Xi-202's firmware has been updated and an Ethernet connection has been confirmed, the Xi-202's settings must be changed to match the Pegasus where applicable.

For Ethernet relay of Wrangler data, make sure to configure the following settings:

Settings Name	Default	Description
Mqrc - Device	1	For the Pegasus this value must be set to **6**.

Pegasus Mode Timers

Command	Parameters	Description
$cfg pshi	5m – 31d	Pegasus Status of Health Interval
$cfg psii	5m – 31d	Pegasus Station Information Interval
$cfg pcri	5m – 31d	Pegasus Config Req Interval
$cfg puci	5m – 31d	Pegasus User Command Interval

Vaisala Setup and Usage

As of build number 7173, Vaisala interfacing has been overhauled for greater control of Vaisala remote configuration and custom data messages. Vaisala must be enabled using the **$cfg Mve** command. The Xi-202 uses its Serial Port 2 to communicate over RS-232 to the Vaisala instrument, and automatically powers Pin H (Switch 1) to supply power to the instrument before the query.

The Vaisala feature communicates with the connected instrument using a baud rate of 19.2k.

Configuration

Xi-202 configuration relating to the Vaisala is almost entirely related to what data is requested from the weather station. This consists of several specific settings (for example, enabling heating with the **vsh** setting) along with several bitmaps which determine individual datapoints to transmit over Iridium. The **vsi** setting finally sets whether received data from the Vaisala is transmitted immediately, or if data is stored until the next scheduled Iridium session. All saved records are transmitted at that time.

Operation

When the Vaisala timer expires (determined by the **Mvi** setting) the Xi-202 sends Vaisala-compatible commands out its serial 2 port. The arguments of all these commands are those in the Xi-202's settings. For weather data, only the data that is specified as "Enabled" in the bitmaps is received by the Xi-202.

When Vaisala data is transported over Iridium, XeosOnline is able to parse any message, no matter the parameters that are enabled or disabled in the original bitmaps. In doing this, Iridium data usage is significantly reduced.

Charge Controller Setup and Usage

Configuration

The Xi-202 can record and report Genasun charge controller output on a scheduled interval when connected to the PORT2 serial pins.

This functionality can be enabled/disabled with the **$cfg Mcc** command over Iridium or serial.

Change to the Mcc setting resets the device immediately to load in the relevant configuration.

Genasun output is recorded according to the **Acquire Interval (Bai)** for a preset number of seconds, set with the **Seconds Per Report (Bspr)** configuration setting.

Once finished listening, the recorded values are averaged and stored in the **Charge Controller Message backlog.** If the Message backlog is full, the oldest report is removed. The number of messages allowed in the backlog is configured using the **Bmblg** setting.

Stored reports are queued for Iridium delivery according to the **Bsbdi** interval. When the **Bsbdi** timer is triggered, all stored reports in the backlog are queued as Type 29 messages and transmitted.

Users can limit the number of charge controller reports sent with each relevant SBD message with the **Bmpr** setting. Each individual charge controller report in a Type 29 message is always 18 bytes in size.

Message Breakdown

Charge Controller Overview

```
EE 1D FF 00 00 2C 36 00 00 00 00 00 00 00 00 45 07 CA 1F 16 09 78 34 11
00 00 00 4A 00 09 09 01 00 8C 08 CA 1F 16 09 78 34 11 00 00 00 4A 00 09
09 01 00 07 90
```

Color	Name	Description
	SBD Header	0xEE header format
	Message Type	Xi-202 message type 0x1D (29)
	Q330 SN	Q330 SN from Xi-202 settings, all 0's if not available
	Genasun Report 1	First Genasun report
	Genasun Report 2	Second Genasun Report
	SBD Footer	SBD footer (16-bit checksum)

Genasun Report Breakdown

All data of a Genasun Report is Little-Endian, therefore the least significant byte is first.

A7 16 47 1F 16 09 10 2F 0B 2F 00 00 56 2F 00 00 04 00

Color	Name	Raw	Parsed
	Start Time	1F 47 16 A7	Wed, 17 Aug 2016 12:35:51 UTC
	Sample Time	16	22 seconds
	Sample Quantity	09	9 samples
	Avg. Battery Voltage 1 (mV)	2F 10	12048 mV
	Avg. Battery Voltage 2 (mV)	2F 0B	12043 mV
	Avg. Current Change (mA)	00 00	0 mA
	Avg. Panel Voltage (mV)	2F 56	12118 mV
	Load1 Quantity	00	0 load1
	Load2 Quantity	00	0 load2
	Last State Value	04	State 4
	CAN Reset Quantity	00	0 resets

Note: Time stamps are calculated as seconds since 00:00:00 January 1, 2000. The full calculation sums this value with epoch time, therefore 524752551 (1F 47 16 A7) + 946684800 gives the full Unix Epoch Time of 1471437351, or August 17, 2016 12:35:51 GMT.

Vaisala Setup and Usage

The Xi-202 has the ability to query and send data from a connected Vaisala weather station using either prompted commands or automatic timers. This data is always in response to the Vaisala 0R0 command. It should be noted that the Xi-202 is only capable of connecting to the Vaisala using Serial Port 2, and automatically powers Pin H (Switch 1) to supply power to the instrument before the query.

Configuration

To use automatic query of the Vaisala, the feature must me enabled:

$cfg Mve 1

How often the Xi-202 powers and queries the Vaisala is determined by the Vaisala interval timer and is adjusted like other parameters and timers:

$cfg Mvi 2h

Once the Vaisala sends back a response to the 0R0 command, the data is sent over Iridium as an ASCII text message.

Other commands can be sent to the Xi-202 relating to the Vaisala connection:

Command	Iridium	Description
$vstart	yes	Start Vaisala sensor data acquisition
$vdata	yes	Send Vaisala sensor data by SBD.

The Vaisala feature communicates with the connected instrument using a baud rate of 19.2k.

Appendix A: Firmware Update Procedure

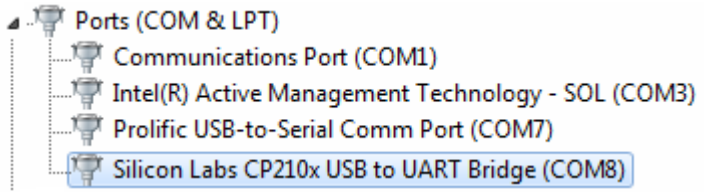
If you have been notified that the firmware in your Xi-202 needs to be updated, please use the instructions below. Please note, the Xi-202 must be removed from the field.

Requirements

- Use of a computer running some version of Windows OS
- Xi-202 diagnostic USB cable
- Device driver for the USB port (Download Here)
- Xi-202 firmware package

Loading Firmware into the Xi-202

1. Disconnect the Xi-202's power
2. Plug the Mini-USB diagnostic connector into the connector on the Xi-202.
3. Then connect the other end of the USB programmer to your computer. Take note of the COM Port number that your computer assigns to the programmer after it is plugged in.
4. Connect the Xi-202 to your PC via the USB-Micro cable.
5. Take note of the COM port number in Control Panel → Device Manager



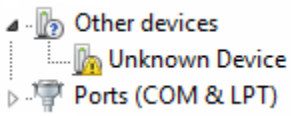
In this case: COM8

6. If the Silicon Labs CP210x does not appear in the device manager under Ports, see Installing the Serial to USB Driver
7. Extract the zipped firmware folder to the desktop.
8. Double click the .cmd file and type the COM port previously noted, in our case **8** and press **Enter**.
9. The firmware will begin updating right away. Firmware update should take approximately 90 seconds. If the window closes immediately upon executing the file, the firmware update has failed.

10. The Xi-202 update progress will be shown in the command prompt window. When it has completed successfully it will say: **"avr dude done. Thank You."**

Installing the Serial to USB Driver

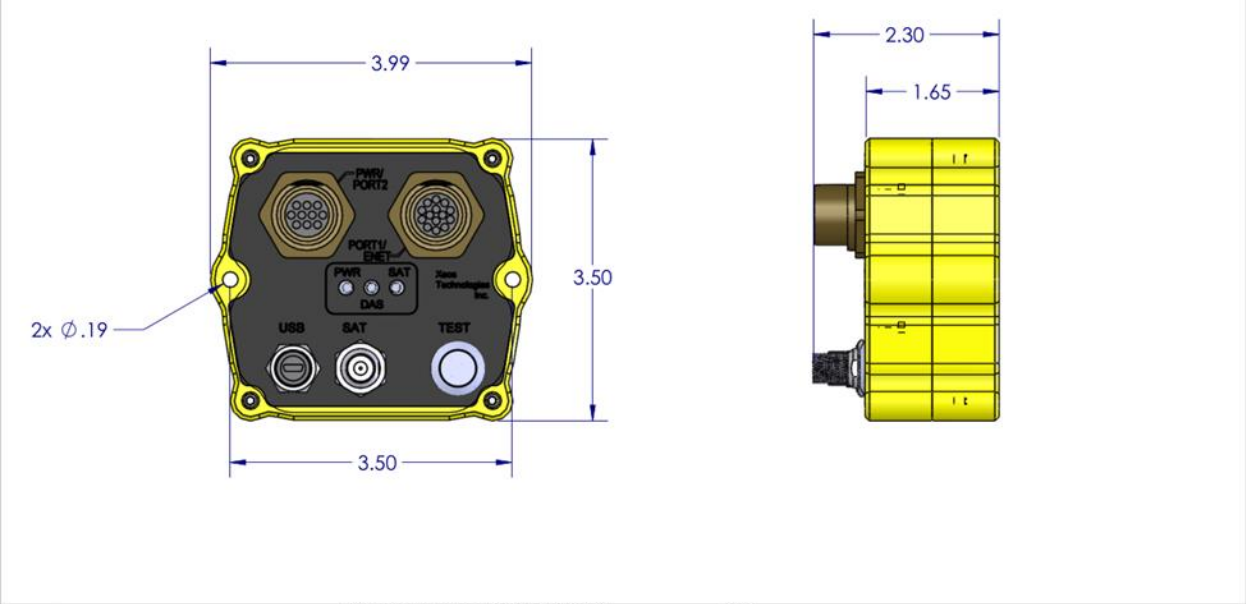
1. Navigate to: **Control Panel** → **Device Manager**
2. The Serial to USB device should be present as an unknown device:



3. Right click the **Unknown Device**, select **Update Driver Software**.
4. In the new window, click **Browse my computer for driver software**.
5. Click on the **Browse** button and navigate to folder containing the Silicon Labs device driver.
6. Click **Next** and the driver should install.

Appendix B: Mechanical Drawings

Hardware



Mechanical	
Material	6063 Aluminum Extrusion
Size	4” x 3.5” x 1.37”
Mass	441g
Iridium Connection	Standard TNC Jack
USB Connection	USB-Mini
Power Connection	10-Pin Mil, Size 12
DAS Interface Connection	14-Pin Mil, Size 12

Electrical (Ratings @ 12VDC)	
Input Voltage	7V – 32VDC
Idle Current	100 µA
Transmission Current	~50mA (30s avg)
Switched Output Current	Max 1.5A

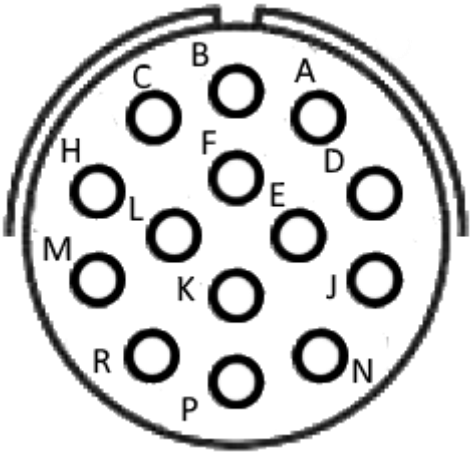
Electronics	
Iridium Hardware	9602 Iridium Transceiver
Digital Controller	Xeos IRDC3
Interfaces	Serial (2), Ethernet (1), USB (1)

Environmental	
Operational Temperature	-50° C to +60° C

Pinouts

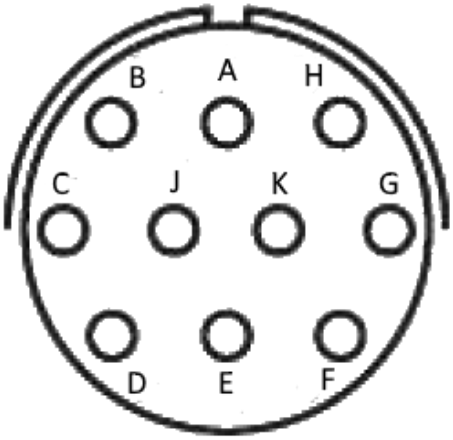
Pinout: Port1/ENET (14-Pin), Size 12

A	RS-232-RTS-1
B	RS-232-DSR-1
C	RS-232-DTR-1
D	Ethernet RX+
E	Ethernet RX-
F	RS-232-CTS-1
H	GND-Signal
J	Ethernet TX-
K	Analog-Input 2
L	RS-232-TX-1
M	RS-232-RX-1
N	Ethernet TX+
P	Analog-Input 1
R	GND-Signal

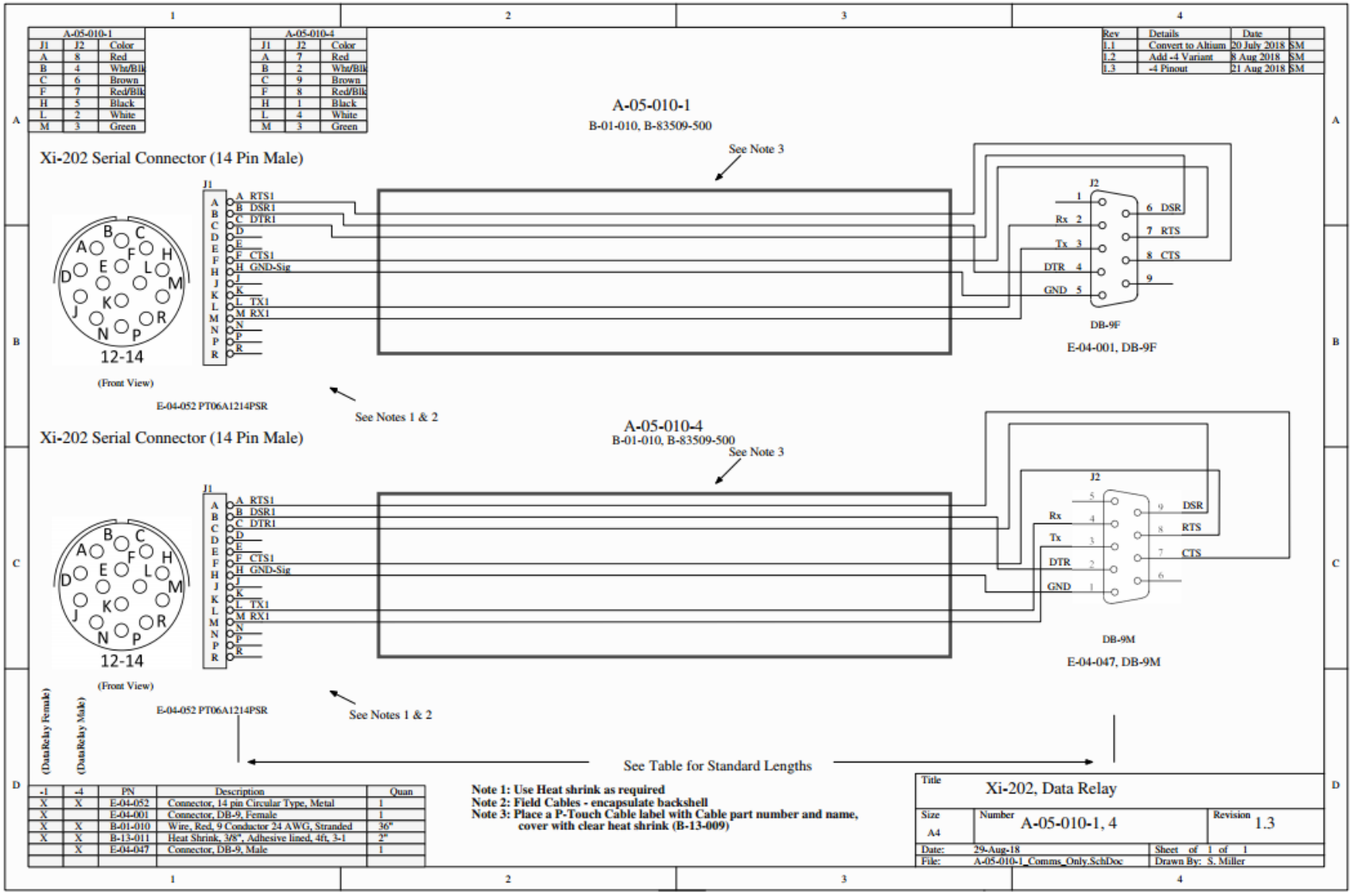


Pinout: Port2/Power (10-Pin), Size 12

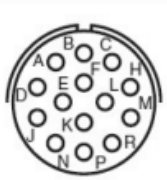
A	V+ (7 – 32VDC)
B	V-
C	RS-232-TX-2
D	RS-232-RX-2
E	RS-232-RTS-2
F	RS-232-CTS-2
G	GND-Sig
H	Power Switch 1 V+
J	Power Switch 2 V+
K	GND-Switch

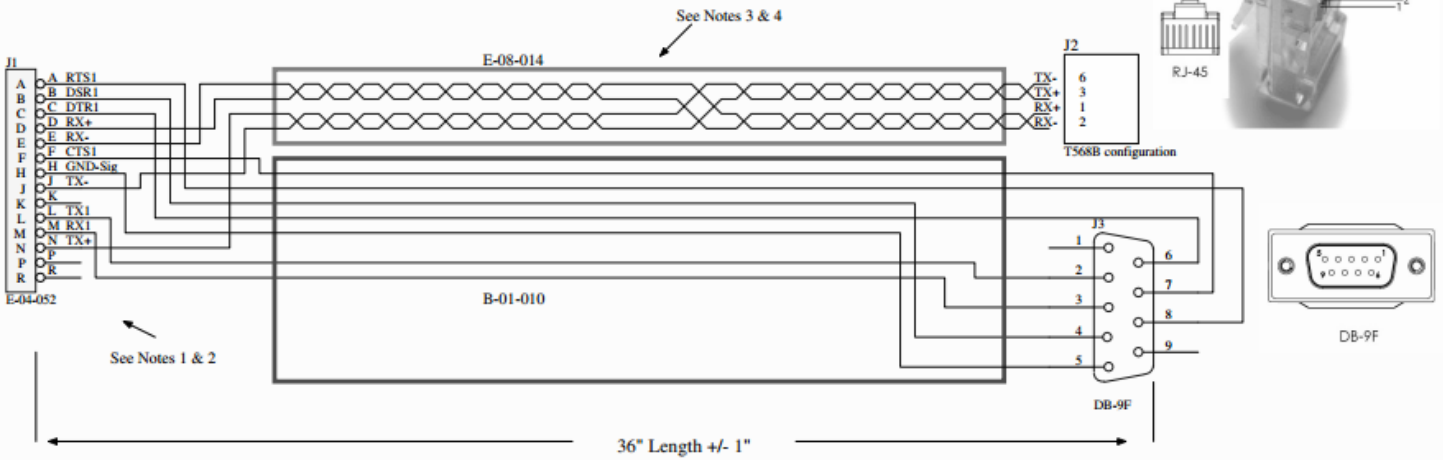


Cables


A-05-010-1
J1 J2 Color
A 8 Red
B 4 Wht/Blk
C 6 Brown
F 7 Red/Blk
H 5 Black
L 2 White
M 3 Green
A-05-010-4
J1 J2 Color
A 7 Red
B 2 Wht/Blk
C 9 Brown
F 8 Red/Blk
H 1 Black
L 4 White
M 3 Green
Rev Details Date
1.1 Convert to Altium 20 July 2018 SM
1.2 Add -4 Variant 8 Aug 2018 SM
1.3 -4 Pinout 21 Aug 2018 SM
A-05-010-1
B-01-010, B-83509-500
Xi-202 Serial Connector (14 Pin Male)
See Note 3
J1
A RTS1
B DSR1
C DTR1
D
E
F CTS1
H GND-Sig
J
K
L TX1
M RX1
N
P
R
12-14
(Front View)
E-04-052 PT06A1214PSR
See Notes 1 & 2
J2
1
Rx 2
Tx 3
DTR 4
GND 5
6 DSR
7 RTS
8 CTS
9
DB-9F
E-04-001, DB-9F
A-05-010-4
B-01-010, B-83509-500
Xi-202 Serial Connector (14 Pin Male)
See Note 3
Rx
Tx
DTR
GND
DSR
RTS
CTS
DB-9M
E-04-047, DB-9M
(DataRelay Female)
(DataRelay Male)
See Table for Standard Lengths
-1 -4 PN Description Quan
X X E-04-052 Connector, 14 pin Circular Type, Metal 1
X E-04-001 Connector, DB-9, Female 1
X X B-01-010 Wire, Red, 9 Conductor 24 AWG, Stranded 36"
X X B-13-011 Heat Shrink, 3/8", Adhesive lined, 4ft, 3-1 2"
X E-04-047 Connector, DB-9, Male 1
Note 1: Use Heat shrink as required
Note 2: Field Cables - encapsulate backshell
Note 3: Place a P-Touch Cable label with Cable part number and name, cover with clear heat shrink (B-13-009)
Title
Xi-202, Data Relay
Size
A4
Number
A-05-010-1, 4
Revision
1.3
Date: 29-Aug-18
Sheet of 1 of 1
File: A-05-010-1_Comms_Only.SchDoc
Drawn By: S. Miller

Rev	Details	Date	
1.0	Initial Release	14-01-15	CDJ
1.1	Convert to Altium	20 May 2015	CDJ
1.2	Fixed Conn Part #	30 May 2018	SM

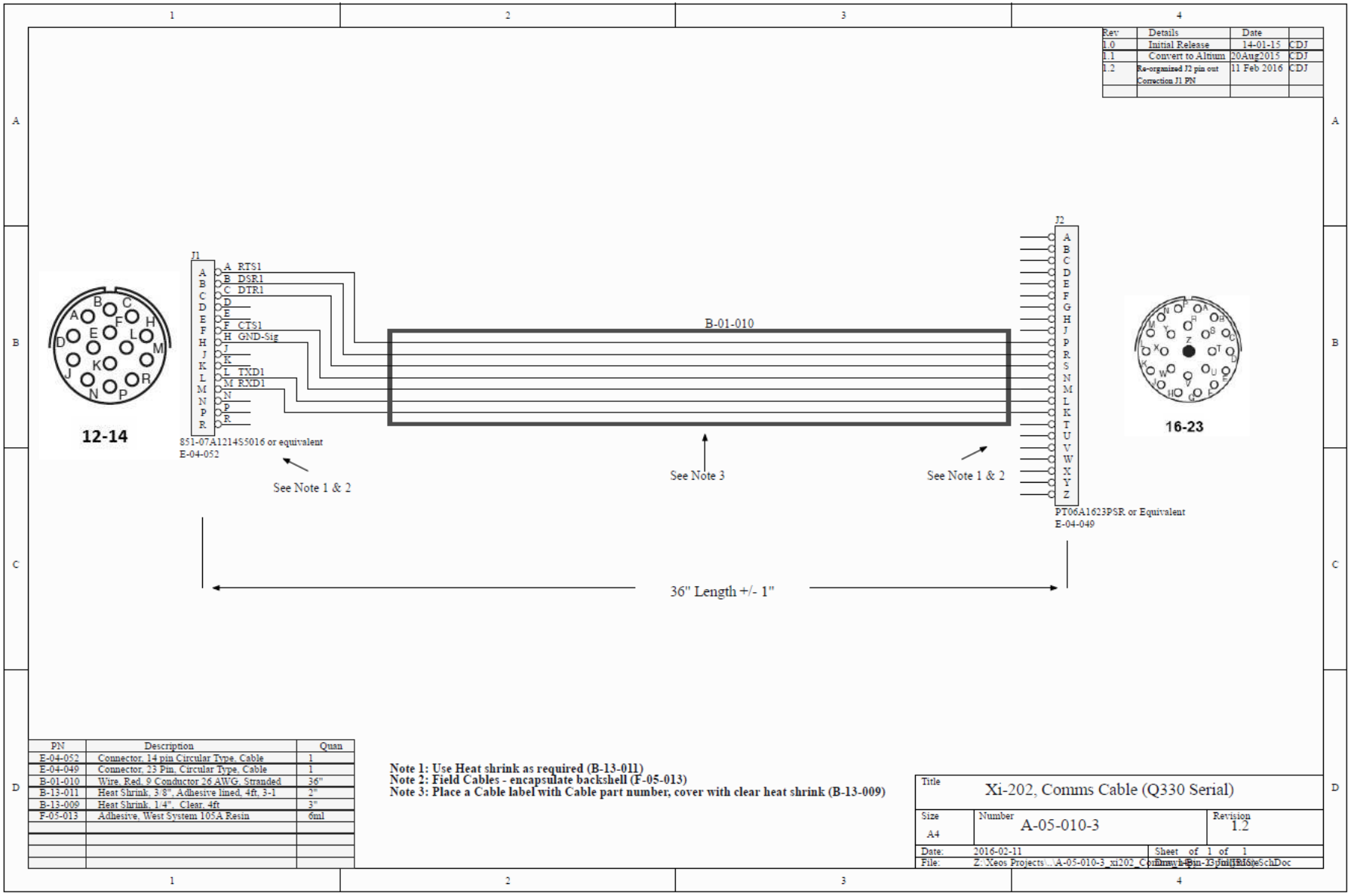




PN	Description	Quan
E-04-052	Connector, 14 pin Circular Type, Cable	1
E-04-001	Connector, DE-9, Female	1
E-08-014	Cable, OEM, Ethernet	0.5
B-01-010	Wire, Red, 9 Conductor 26 AWG, Stranded	36"
B-13-011	Heat Shrink, 3/8", Adhesive lined, 4ft, 3-1	2"

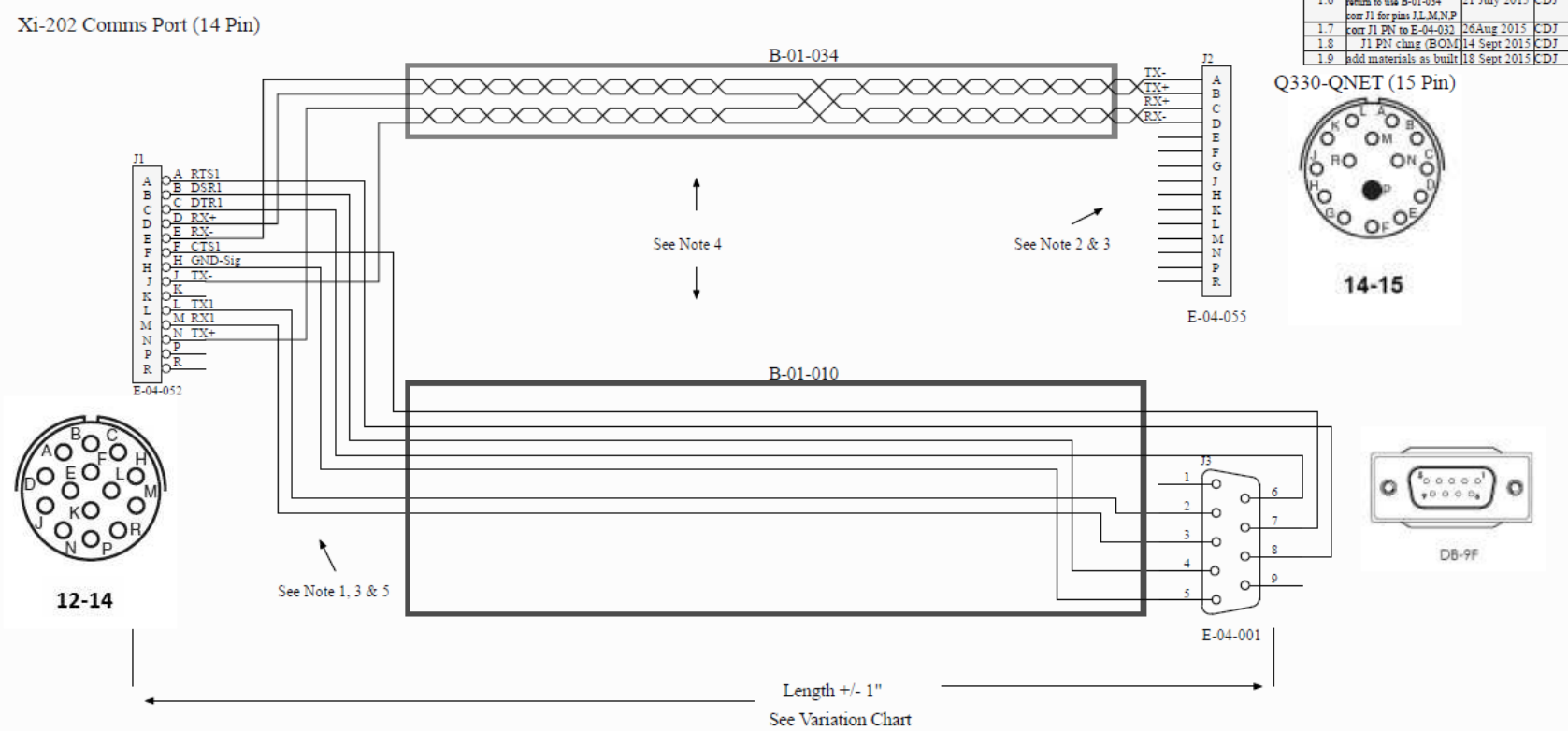
Note 1: Use Heat shrink as required
Note 2: Field Cables - encapsulate backshell
Note 3: Use Black Tie wraps as required
Note 4: Place a P-Touch Cable label with Cable part number, cover with clear heat shrink

Title	Xi-202, Comms Cable /w Ethernet		
Size A4	Number A-05-010-2		Revision 1.2
Date:	30-May-18	Sheet of 1 of 1	
File:	A-05-010-2_Comms_Ethernet.SchDoc	Drawn By: S. Miller	



A-05-032: Xi-202 Port1 – Q330 Q-NET/DB9

Rev	Details	Date	
1.4	corr E-04-055 descrip	07 July 2015	CDJ
1.5	change B-01-034 to to B-01-037, add B-13-011	09 July 2015	CDJ
1.6	return to use B-01-034 corr J1 for pins J,L,M,N,P	21 July 2015	CDJ
1.7	corr J1 PN to E-04-032	26Aug 2015	CDJ
1.8	J1 PN chng (BOM)	14 Sept 2015	CDJ
1.9	add materials as built	18 Sept 2015	CDJ



Variant		PN	Description	Quan
-1	-2			
X	X	E-04-052	Connector, 14 pin Circular Type, Cable	1
X	X	E-04-001	Connector, DE-9, Female	1
X	X	E-04-055	Connector, 15 Pin, Circular Type, Cable	1
X		B-01-034	Wire, Ethernet, 4 Conductor, 2 Twisted Pair	36"
X		B-01-010	Wire, Red, 9 Conductor 26 AWG, Stranded	36"
X	X	F-05-013	Adhesive, West System 105A Resin, 946ml (qua	3ml
	X	B-01-034	Wire, Ethernet, 4 Conductor, 2 Twisted Pair	48"
	X	B-01-010	Wire, Red, 9 Conductor 26 AWG, Stranded	48"
X	X	B-13-011	Heat Shrink, 3/8", Adhesive lined, 4ft, 3-1	3.5"
X	X	B-13-017	Heat Shrink, 1/2",Clear, 2-1	2.5"
X	X	B-13-007	Heat Shrink, 1/4", 3-1 Ratio, Adhesive Lined	1.5"

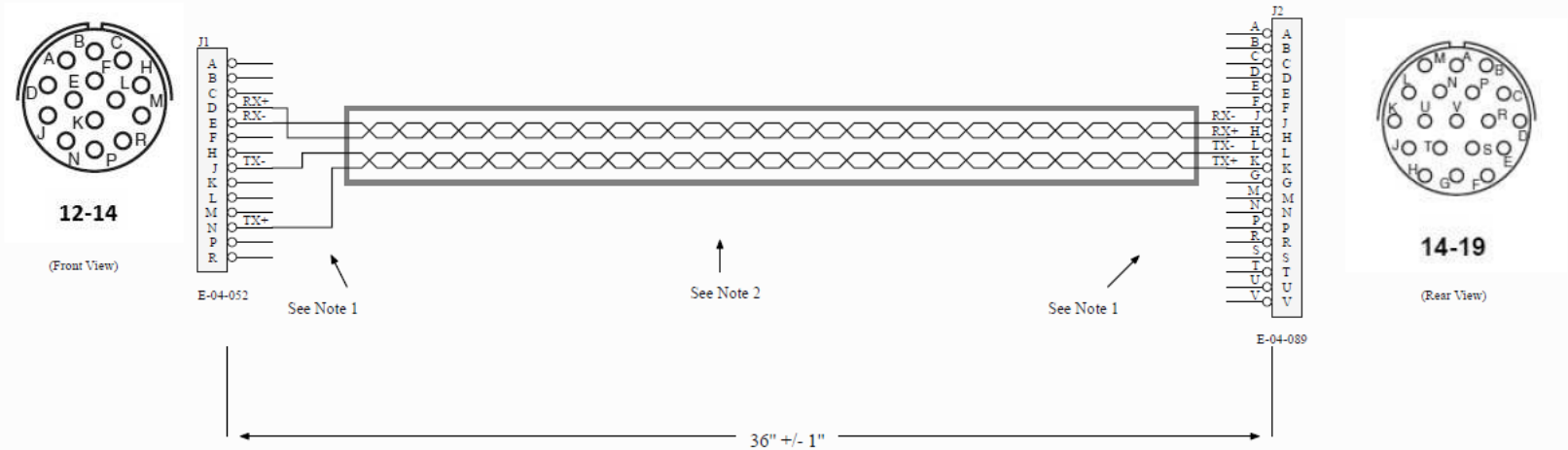
Note 1: Use B-13-011 adhesive lined heat shrink
Note 2: Use B-13-007 adhesive lined heat shrink
Note 3: Field Cables - encapsulate backshell
Note 4: Use Black Tie wraps as required
Note 5: Place a P-Touch Cable label with Cable part number, cover with clear heat shrink (B-13-017)

Title	Cable, Xi-202, Comms /w QNET (15 pin)	
Size A4	Number A-05-032	Revision 1.9
Date: 2015-09-18		Sheet of 1 of 1
File: Z:\Xeos Projects\...\A-05-032_Xi202Comm	Drawn By: C Jollymore	

Rev	Details	Date	
1.0	Initial Release	11 Feb 2016	CDJ
1.1	Corr J2 PN in BOM	16 Feb 2016	CDJ
1.2	Corr J2 Pin out	22 Mar 2016	CDJ

Xi-202 Comms Port (14 Pin Male)

RT130-NET (19 Socket)



PN	Description	Quan
E-04-052	Connector, 14 pin Circular Type, Cable	1
E-04-089	Connector, Circular, 19 Pos, Female	1
B-01-034	Wire, Ethernet, Grey, 2 Twisted Pair	36"
F-05-013	Adhesive, West System 105A Resin, 946ml (qua	3ml
B-13-017	Heat Shrink, 1/2",Clear, 2-1	2.5"

Note 1: Field Cables - encapsulate backshell
Note 2: Place a P-Touch Cable label with Cable part number, cover with clear heat shrink (B-13-017)

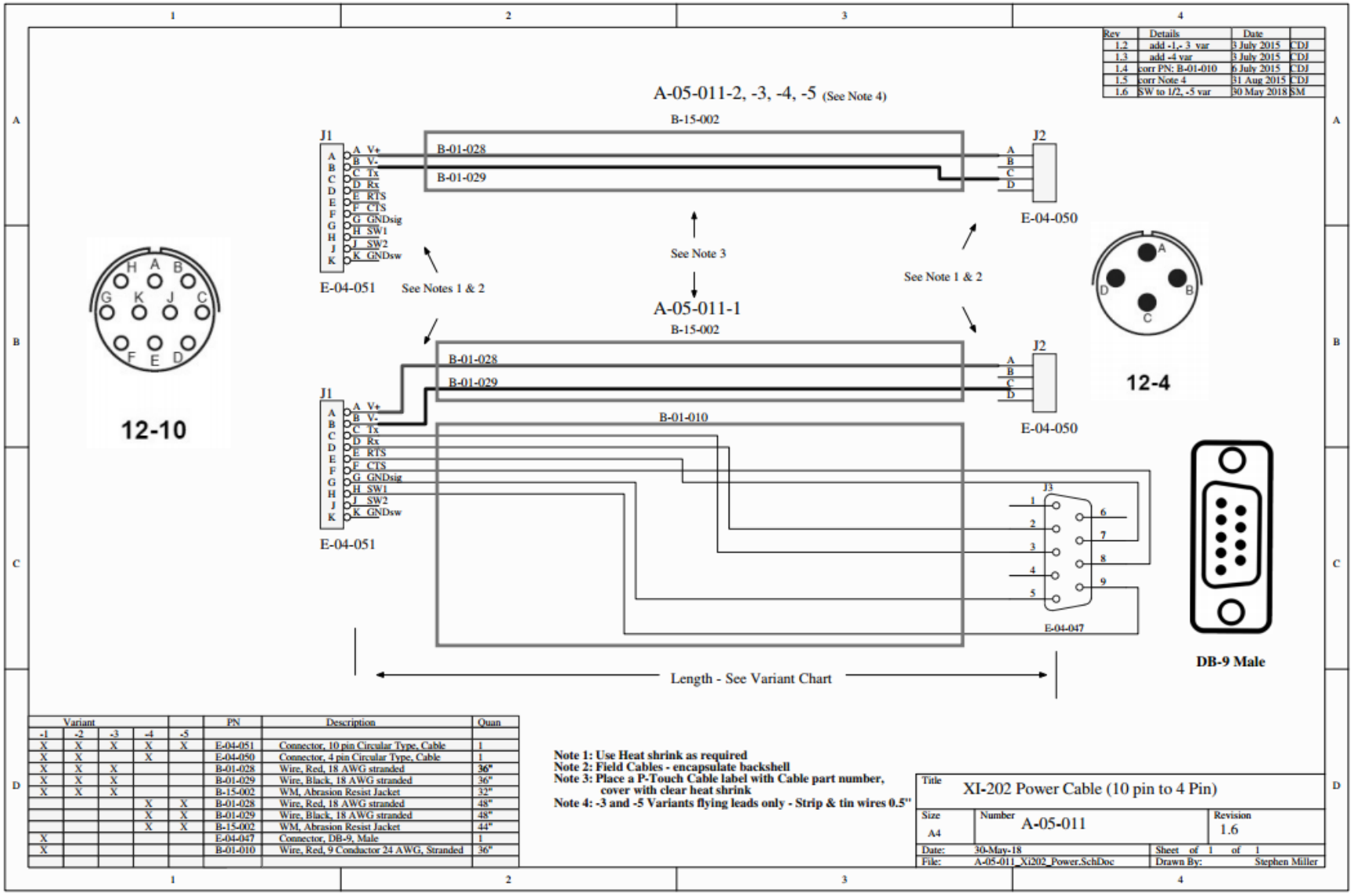
Title: Cable, Xi-202, Comms (14 Pin) - RT130 Net (19 Socket)

Size	Number	Revision
A4	A-05-044	1.2

Date: 2016-03-22 Sheet of 1 of 1

File: Z:\Xeos Projects\...\A-05-044_Xi202Comm...

Rev	Details	Date	
1.2	add -1,- 3 var	3 July 2015	CDJ
1.3	add -4 var	3 July 2015	CDJ
1.4	corr PN: B-01-010	6 July 2015	CDJ
1.5	corr Note 4	31 Aug 2015	CDJ
1.6	SW to 1/2, -5 var	30 May 2018	SM



Variant					PN	Description	Quan
-1	-2	-3	-4	-5			
X	X	X	X	X	E-04-051	Connector, 10 pin Circular Type, Cable	1
X	X		X		E-04-050	Connector, 4 pin Circular Type, Cable	1
X	X	X			B-01-028	Wire, Red, 18 AWG stranded	36"
X	X	X			B-01-029	Wire, Black, 18 AWG stranded	36"
X	X	X			B-15-002	WM, Abrasion Resist Jacket	32"
			X	X	B-01-028	Wire, Red, 18 AWG stranded	48"
			X	X	B-01-029	Wire, Black, 18 AWG stranded	48"
			X	X	B-15-002	WM, Abrasion Resist Jacket	44"
X					E-04-047	Connector, DB-9, Male	1
X					B-01-010	Wire, Red, 9 Conductor 24 AWG, Stranded	36"

Note 1: Use Heat shrink as required
Note 2: Field Cables - encapsulate backshell
Note 3: Place a P-Touch Cable label with Cable part number, cover with clear heat shrink
Note 4: -3 and -5 Variants flying leads only - Strip & tin wires 0.5"

Title	XI-202 Power Cable (10 pin to 4 Pin)		
Size A4	Number A-05-011	Revision 1.6	
Date:	30-May-18	Sheet of 1 of 1	
File:	A-05-011_Xi202_Power.SchDoc	Drawn By:	Stephen Miller

Warranty, Support and Limited Liability

REF TEK Systems Inc. warranties the Xi-202 to be free of defects in material or manufacturing for a period of one year following delivery. Liability is limited to repair or replacement of the defective part and will be done free of charge.

LIMITED WARRANTY: REF TEK Systems Inc. warrants that the product will perform substantially in accordance with the accompanying written materials for a period of one year from the date of receipt.

CUSTOMER REMEDIES: REF TEK Systems Inc. entire liability and your exclusive remedy shall be at REF TEK Systems Inc. option, either (a) return of the price paid or (b) repair or replacement of the product that does not meet REF TEK Systems Inc. Limited Warranty and that is returned to REF TEK Systems Inc. with a copy of your receipt. This Limited Warranty is void if failure of the product has resulted from accident, abuse, or misapplication. Any replacement product will be warranted for the remainder of the original warranty period or ninety (90) days, whichever is longer.

NO OTHER WARRANTIES: REF TEK Systems Inc. disclaims all other warranties, either express or implied, including but not limited to implied warranties of merchantability and fitness for a purpose, with respect to the product or the accompanying written materials. This limited warranty gives you specific legal rights. You may have others, which vary from state to state.

NO LIABILITY FOR CONSEQUENTIAL DAMAGES: In no event shall REF TEK Systems Inc. or its suppliers be liable for any damages whatsoever (including, without limitation, damages for loss of equipment, for loss of business profits, business interruption, loss of business information, or other pecuniary loss) arising out of the use of or inability to use this REF TEK Systems Inc. product, even REF TEK Systems Inc. has been advised of the possibility of such damages.