XIRGO TECHNOLOGIES

XT3630F Series User Guide

Model: XT3630F

FCC ID: GKM- XT3630F

IC: 10281A- XT3630F

Version 1

XIRGO TECHNOLOGIES

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Document Change History

Revision	Date	Author	Changes
1.0	6/15/2017	Johnny Chen	Initial Release

1 Introduction

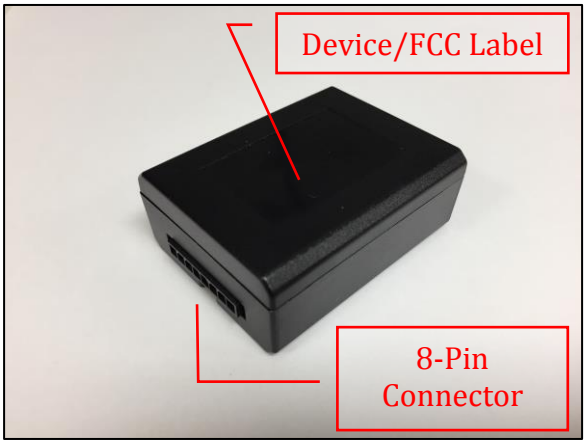
XT3630F is a self-contained Narrowband LPWAN radio with integrated GPS engine and patch antenna, accelerometer, motion detector, and 1040 mAh internal rechargeable battery. With a low power 16-bit microprocessor and unique power management algorithm, XT3630F consumes less than 10 µA in sleep mode and yet capable of periodic reporting of health, status and location of remote assets. With multiple input and output ports, along with proven embedded application, XT3630F is an ideal solution for monitoring and control of remote M2M assets where input power availability is of concern.

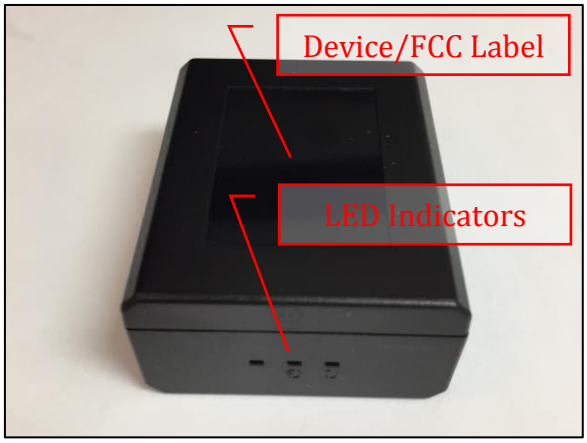
1.1 Feature Matrix

Feature Description	Base Unit	Optional
Sigfox Transmitter	✓	✓
GPS Receiver for Tracking Applications		✓
Location Polling		✓
Periodic Reporting	✓	✓
Sleep/Wake Configuration Settings	✓	✓
Nearby Wi-Fi Hotspot Address Reporting		✓
Device Diagnostics (Battery voltage, connectivity, etc.)	✓	

2 Hardware Description

Below is a depiction of key interfaces of the XT4970D:





The Associated Cable Harness that interfaces with the unit is shown below:

2.1 Hardware Specifications

Communication Technology	
Sigfox	▪ Operates Sigfox Protocol over 915 ISM Band
GPS Specification	
Receiver 50 channels	▪ 72 channels
Receiver tracking Sensitivity	▪ -167 dBm
Accuracy	▪ +/- 2.0 m CEP (50% , -130 dBm, > 6 Satellites)
Cold Start	▪ 26 sec
Hot Start	▪ 1 sec
Power Requirements	
D.C. Power	▪ 8-24V, 12 V nominal
Current Consumption (4V Supply internal Battery)	▪ 80 µA in sleep state ▪ 60 mA in idle state ▪ 385mA in transmit/receive state
Internal Battery (Optional)	▪ Internal 1040 mAh rechargeable Li-Ion
Physical Connection	
Interface Connector	▪ 8-pin Micro-fit
Sigfox/GPS Antenna	▪ Internal
Programming	▪ Serial (RS232 3V logic level)
Mechanical	
Case Material	▪ PC and PBT composite
Dimension	▪ 2.325” X 1.8” X 0.91”
Weight	▪ 4 oz.
Operating Temperature	▪ -30°C to +70°C
Certifications	
Regulatory	▪ FCC
Operator	▪ Sigfox P1

2.2 Cable Harness Description

Pin #	Wire Color	Pin Name	Functional Description	Port Characteristic
1	White	IN1	Wake up pin	8V to 24V, Internally pulled low
2	Yellow	N/A	N/A	N/A
3	Black	Ground	Ground	
4	Green	N/A	N/A	N/A
5	Blue	UART-Rx		3.3V Logic Interface Com Port Settings: Baud rate: 115200 bps; Flow control: None; 8N1
6	Brown	UART-Tx		3.3V Logic Interface Com Port Settings: Baud rate: 115200 bps; Flow control: None;8N1
7	Red	VBATT	Main battery voltage, DC	8V-24 V
8	Orange	N/A	N/A	N/A

2.3 LED Description

LED	Description	Status
Sigfox (Auburn)	Idle or Sleep Mode	OFF
	Transmitting	ON

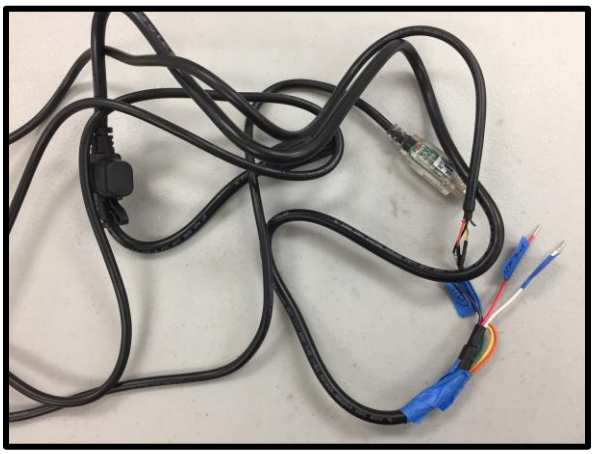
3 Quick Start Guide

3.1 Introduction

This guide will help you get started with the devices and show you the various commands you may need to use in demonstrating the functionality of the XT3630.

Each XT3630 is provided and labeled to show the product #, serial #, SIGFOX Identification 3 (SFID). For the purposes of viewing the data on the SIGFOX portal, the SFID is the most important identifier for the end user. The information pairing the devices with the SIGFOX ID is shown below:

The USB/Charging cable harness is shown below with the wire descriptions in the table to the right. The red wire is the power input wire (8V-24V), the white wire "IN1" wakes the device with an 8-24V input, and the black wire is ground.



3.2 Initial Configuration Example

The XT3630 needs to be can be configured to report based on a timer. The 9V wake cable will be the easiest method to activate the devices. Simply attach a 9V battery to the connector cable and mate the 8-pin connector with each XT3630 for 1-2 seconds to wake. When the device transmits, it will light up the orange LED on the device which will confirm that the device is awake and operational. You can also check on which device is awake by seeing if the unit reported in at the expected time. The device will send a ping to the server every time upon wake.

The XT3630 Commands Description section will explain each of the commands and explain how to interface with the device with the USB cable. Below is an example configuration:

+XT:4001,1,5,3

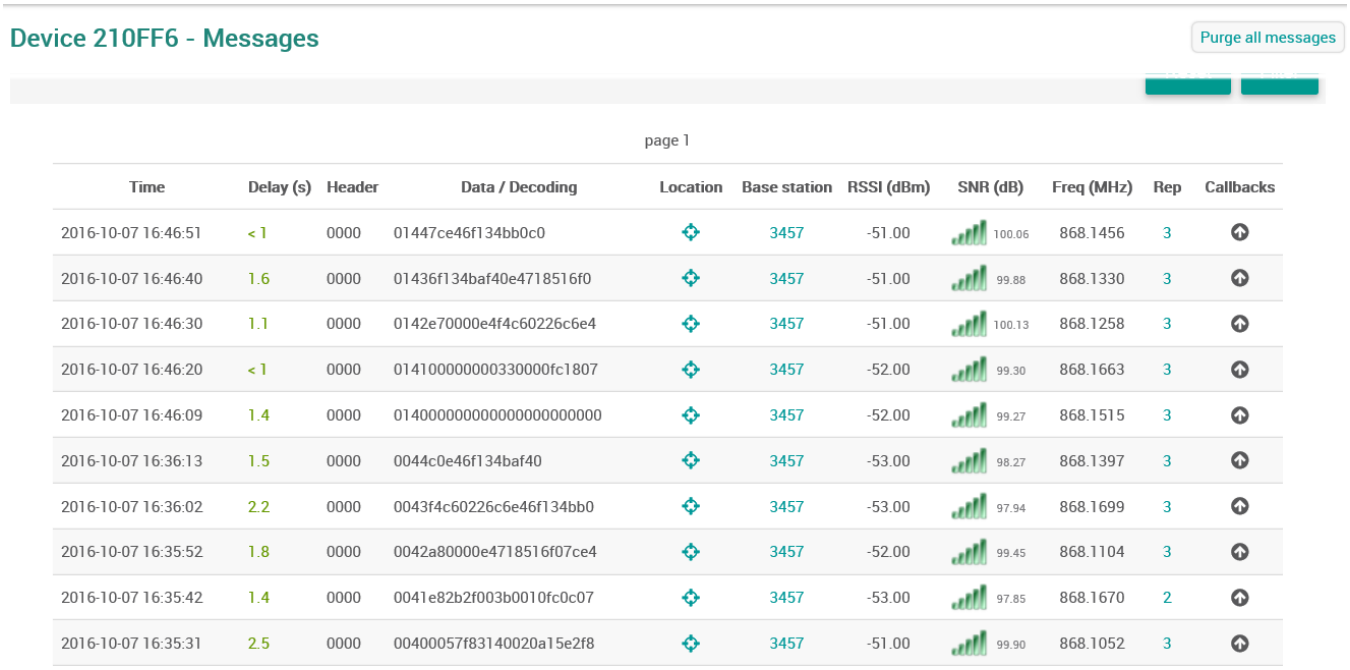
+XT:4002,1,50

+XT:4003,0,0,0,0,0

+XT:5401,8

+XT:3017,90,30,0,1

These configurations mean that the device will report the data packet per the established protocol to the SIGFOX backend every 10 minutes. The GPS data is configured to be **a minimum** 50m accuracy to allow locking at challenging locations. If the device is successfully awake. You will get data packets in the portal as shown below:



Device 210FF6 - Messages

Purge all messages

page 1

Time	Delay (s)	Header	Data / Decoding	Location	Base station	RSSI (dBm)	SNR (dB)	Freq (MHz)	Rep	Callbacks
2016-10-07 16:46:51	< 1	0000	01447ce46f134bb0c0		3457	-51.00	100.06	868.1456	3	
2016-10-07 16:46:40	1.6	0000	01436f134baf40e4718516f0		3457	-51.00	99.88	868.1330	3	
2016-10-07 16:46:30	1.1	0000	0142e70000e4f4c60226c6e4		3457	-51.00	100.13	868.1258	3	
2016-10-07 16:46:20	< 1	0000	014100000000330000fc1807		3457	-52.00	99.30	868.1663	3	
2016-10-07 16:46:09	1.4	0000	01400000000000000000000		3457	-52.00	99.27	868.1515	3	
2016-10-07 16:36:13	1.5	0000	0044c0e46f134baf40		3457	-53.00	98.27	868.1397	3	
2016-10-07 16:36:02	2.2	0000	0043f4c60226c6e46f134bb0		3457	-53.00	97.94	868.1699	3	
2016-10-07 16:35:52	1.8	0000	0042a80000e4718516f07ce4		3457	-52.00	99.45	868.1104	3	
2016-10-07 16:35:42	1.4	0000	0041e82b2f003b0010fc0c07		3457	-53.00	97.85	868.1670	2	
2016-10-07 16:35:31	2.5	0000	00400057f83140020a15e2f8		3457	-51.00	99.90	868.1052	3	

The devices will begin to report once every 10 minutes.

3.3 USB Serial Cable Connection

To interface with the device for serial communication you must set up the RS-232 to USB adapter cable. Connect USB cable from the cable harness to a PC. Install the drivers for the corresponding operating system on the computer. The driver can be downloaded from the URL below:

- http://www.ftdichip.com/Drivers/VCP.htm

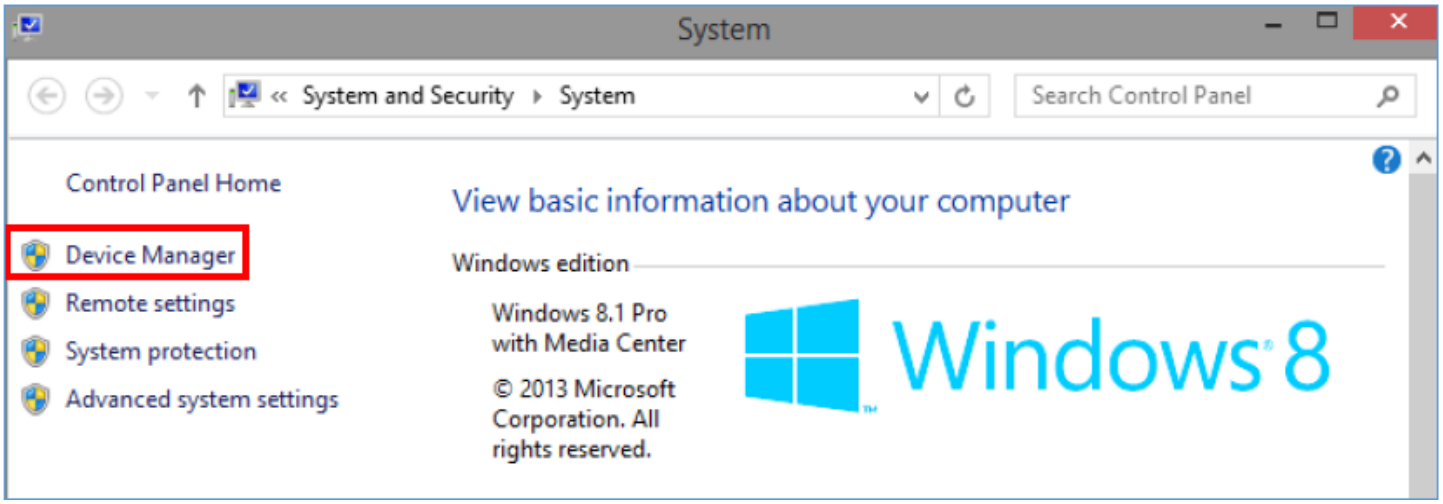
When the drivers are successfully installed, you should be able to see a USB COM port for the XT3630. Pick the correct COM port for the XT3630 by looking for USB COM port under the 'Ports' section within Windows Device Manager. Use the following terminal application settings:

1) Bits per second: 115200
2) Data bits: 8
3) Parity: None
4) Stop bits: 1
5) Flow control: None

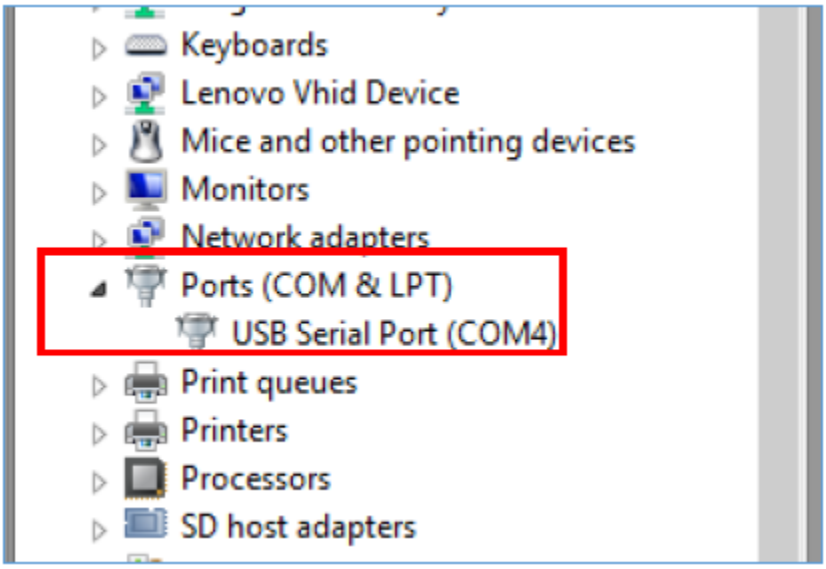
See the next section for setting up a recommend terminal program, ZOC Terminal.

3.4 Initial ZOC Console Setup

1. Install ZOC: http://download.cnet.com/ZOC-Terminal/3000-7240_4-10125963.html
2. Connect the USB cable to your PC and the 8-pin connector to the XT-3630
3. Connect a 9V battery to the black wire (GND) and the white wire (IN1) to wake the device. You can also connect to a DC regulated power supply to wake the device from ship mode.
4. Navigate to Device Manager to locate the COM port associated with the XT-4970.
    a. Windows Key Shortcut: Start+Pause: This will bring up your system overview and Device Manager should be in within this new window. The Windows icon button is called, Start.
    b. Windows 8.1:

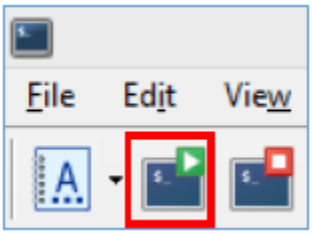


5. Within Device Manager, navigate to Ports and make note of the COM port associated with the XT-4970:

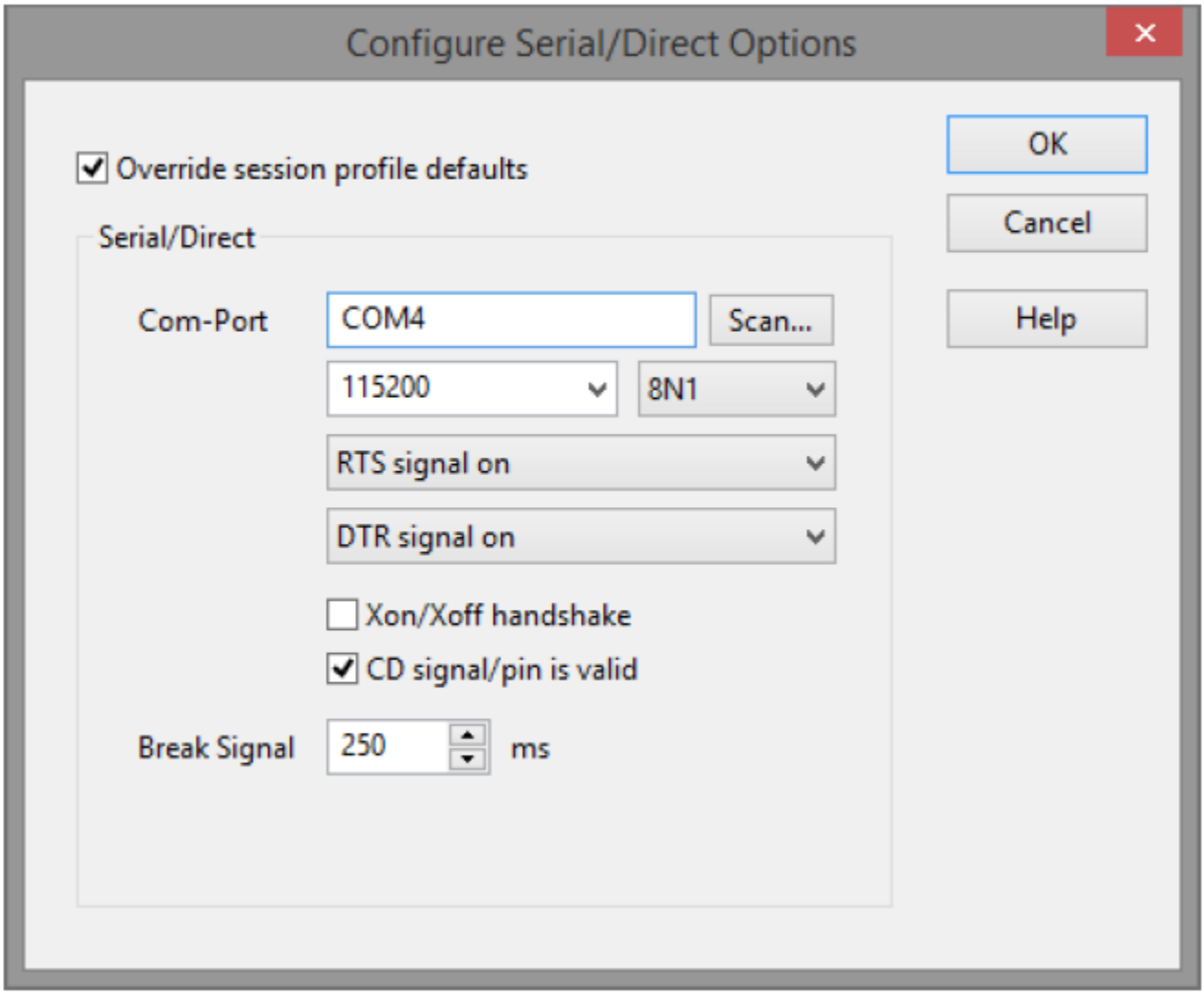


6. Now, open ZOC.

7. If the Connection setup window does not open by default, you can open or re-open the connection settings using the green button at the top left side near the File menu:

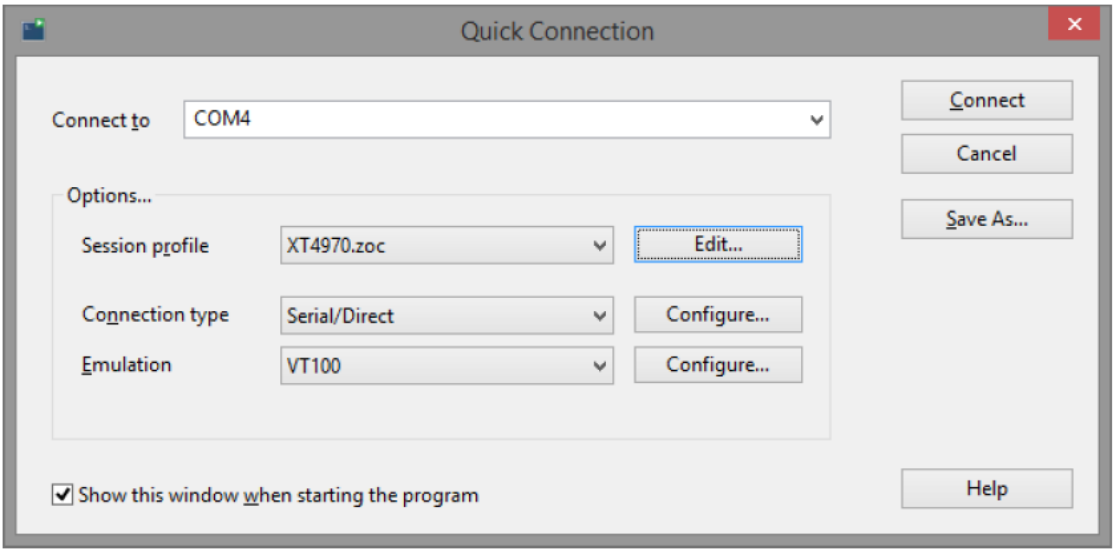


8. You can select your COM port using the drop down menu in the middle and edit your connection settings for Connection type and Emulation using the 'Configure…' buttons and the drop down menus.
    a. Connection type: Serial/Direct (from the drop down menu)



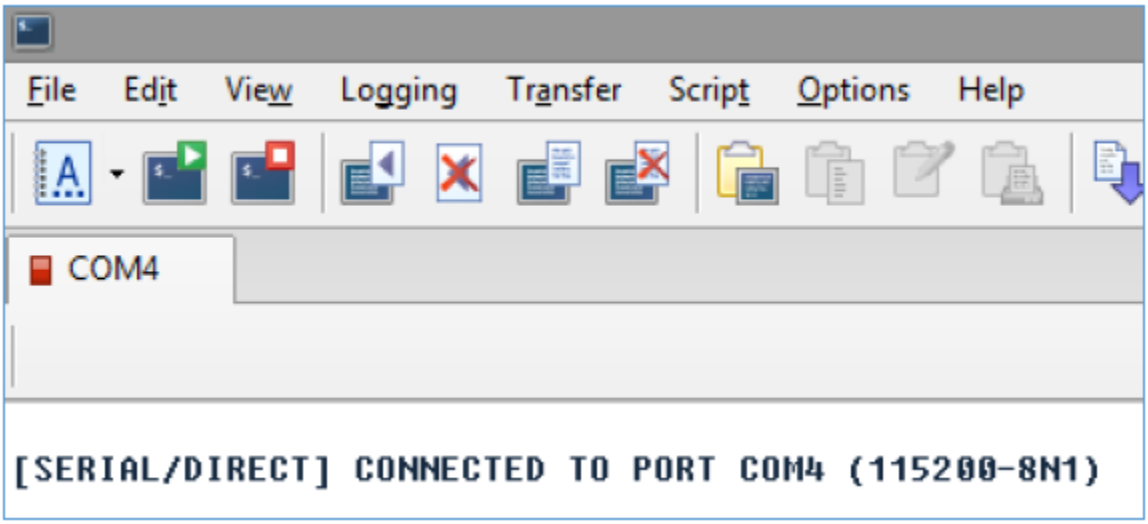
    b. Emulation: VT100 (from the drop down menu)
        i. No 'Configure…' button setting changes.

c. Main page for connection settings should look like this:

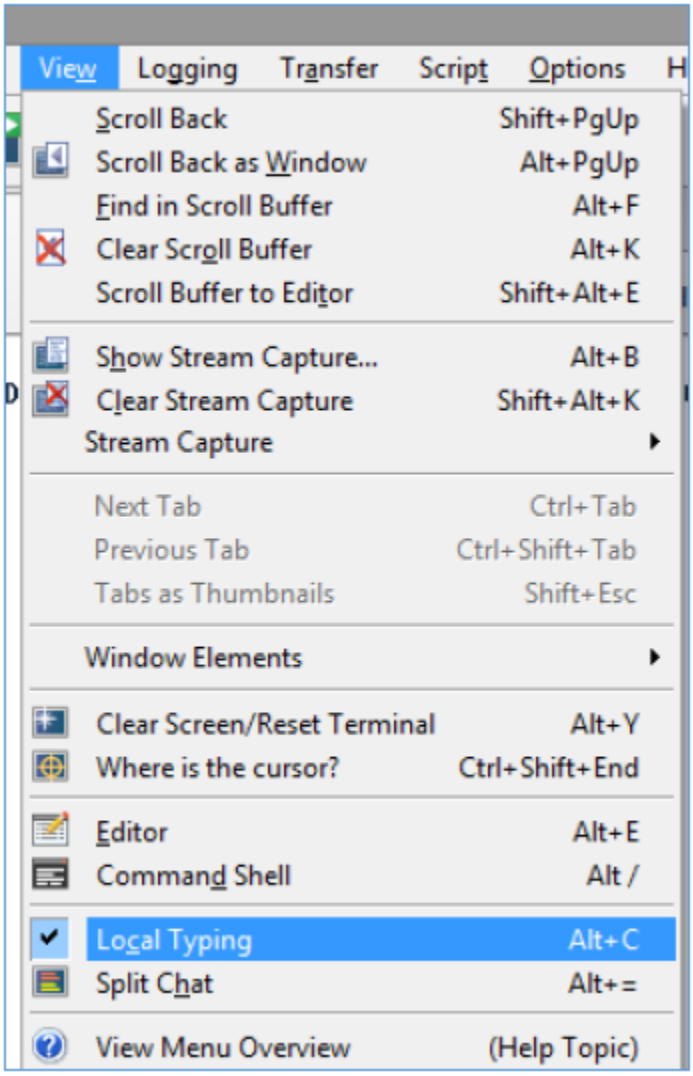


d. These connection settings can be saved in a .zoc file, by clicking the 'Edit…' button, verifying your connection settings and clicking 'Save As'.

9. Clock 'Connect' to begin the ZOC terminal session.
10. ZOC should report the connection as successful:

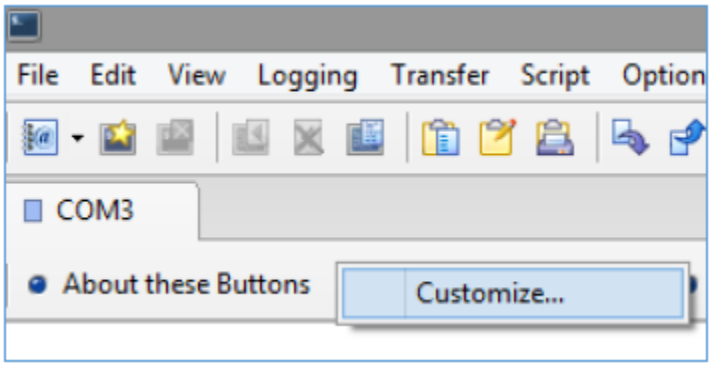


11. To enable the local typing field, navigate to View->Local Typing:

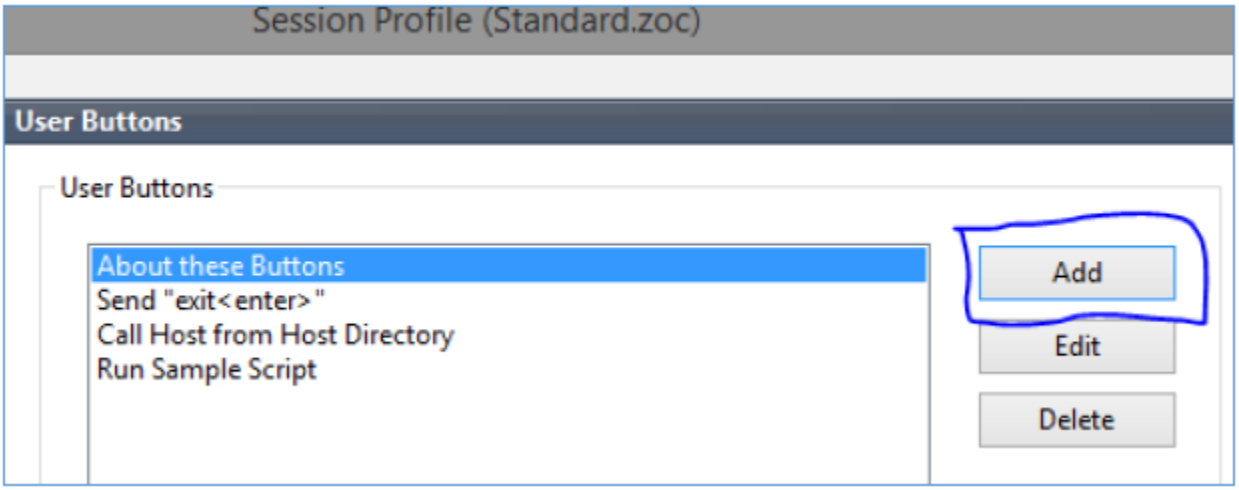


3.5 Automated AES Login

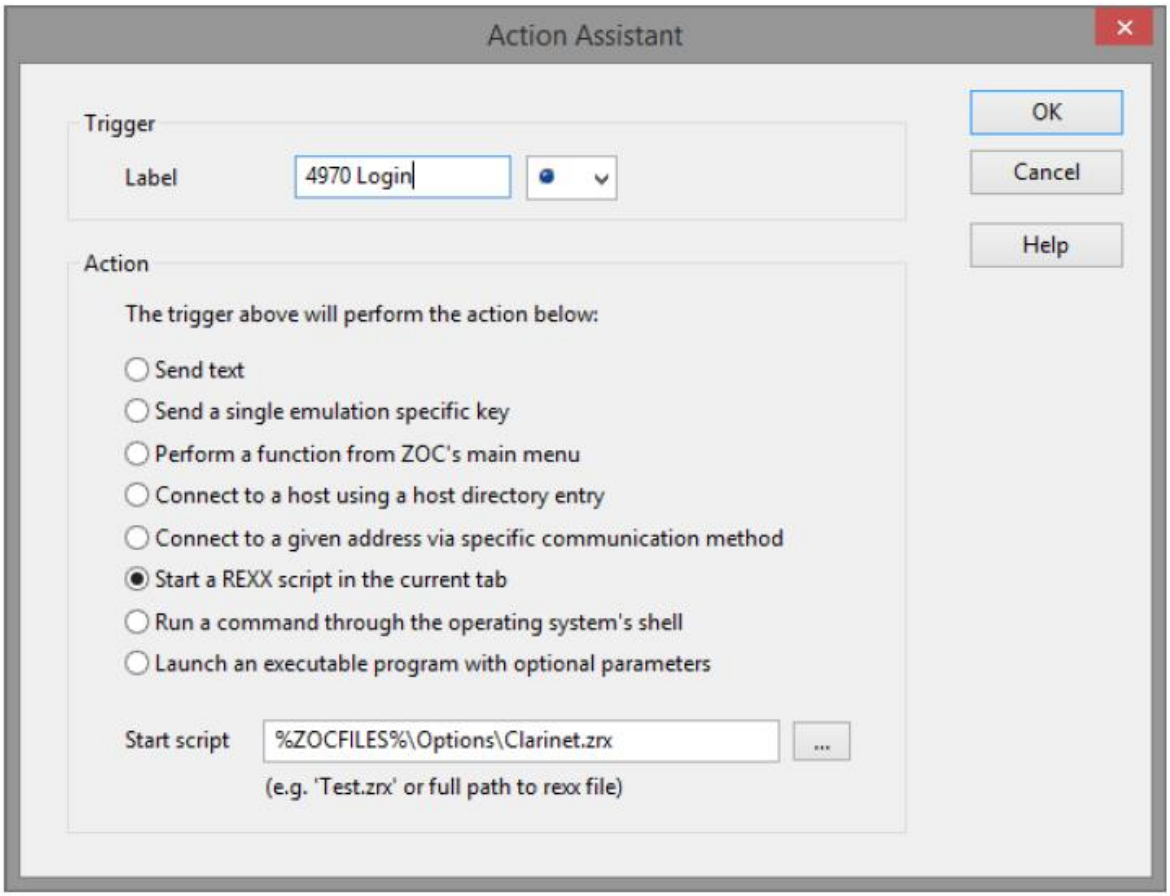
1. After connecting to the COM port, right click on the user button menu and click ‘Customize’



2. Select ‘Add’:



3. Give the button a ‘Label’ name:

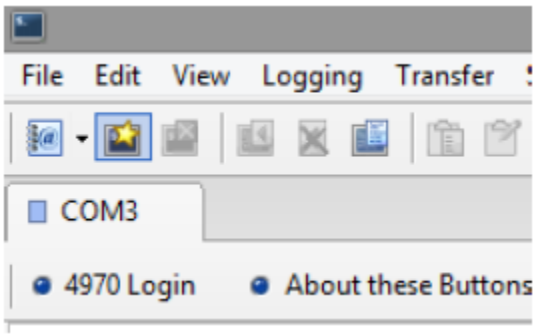


a. Select from the ‘Action’ menu, ‘Start a REXX script in the current tab’

b. Copy and paste the following into the ‘Start script’ field:

i. %ZOCFILES%\Options\Clarinet.zrx

c. Click ‘OK’ and ‘Save’

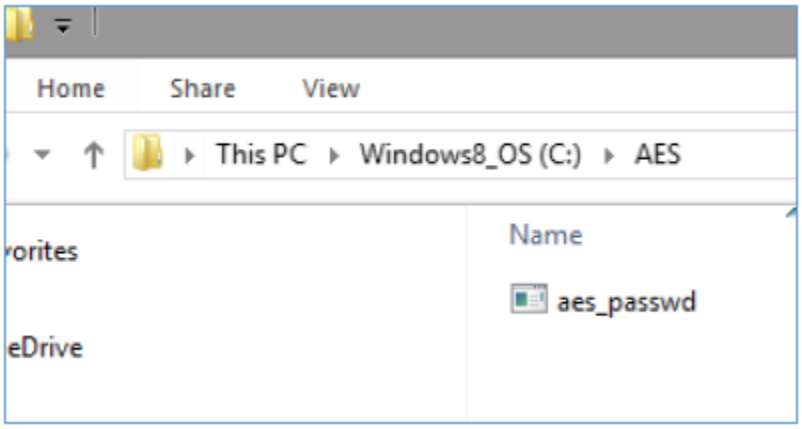


4. Create the following folder directory:

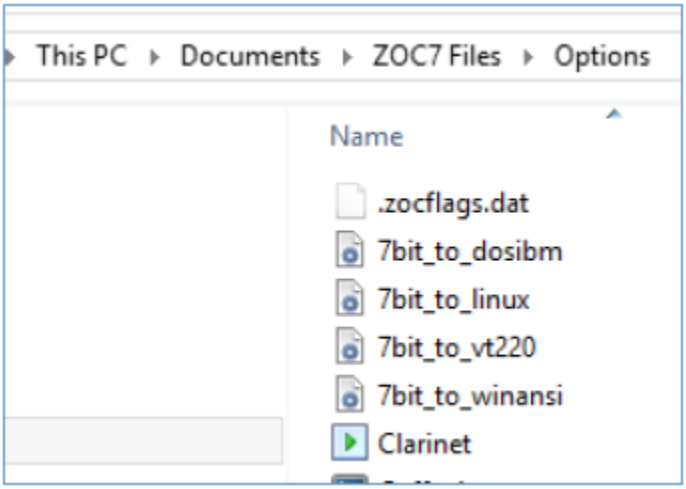
a. C:\AES

i. If a different directory path is needed (root directory is not C: for instance) the Clarinet.zrx file will need to be modified in a text editor, such as notepad, to navigate to a different path for the .exe file to execute.

b. Store the aes_passwd.exe file here

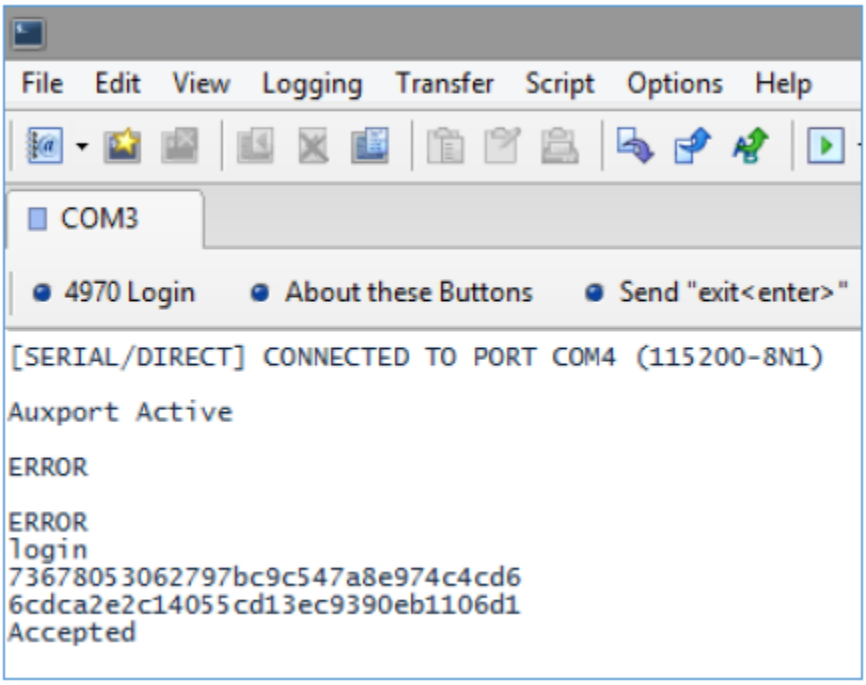


5. Navigate to the ZOC directory and store the Clarinet.zrx file in the 'Options' directory:



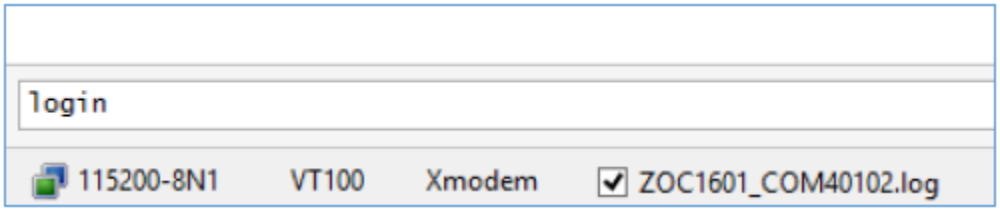
6. Now, in ZOC if you are already connected to the device over the COM port, you can click the login in button that you just created, '4970 Login' as noted here.

a. You may have to press the 'Enter' key a few times to wake the serial port before using the login in button.



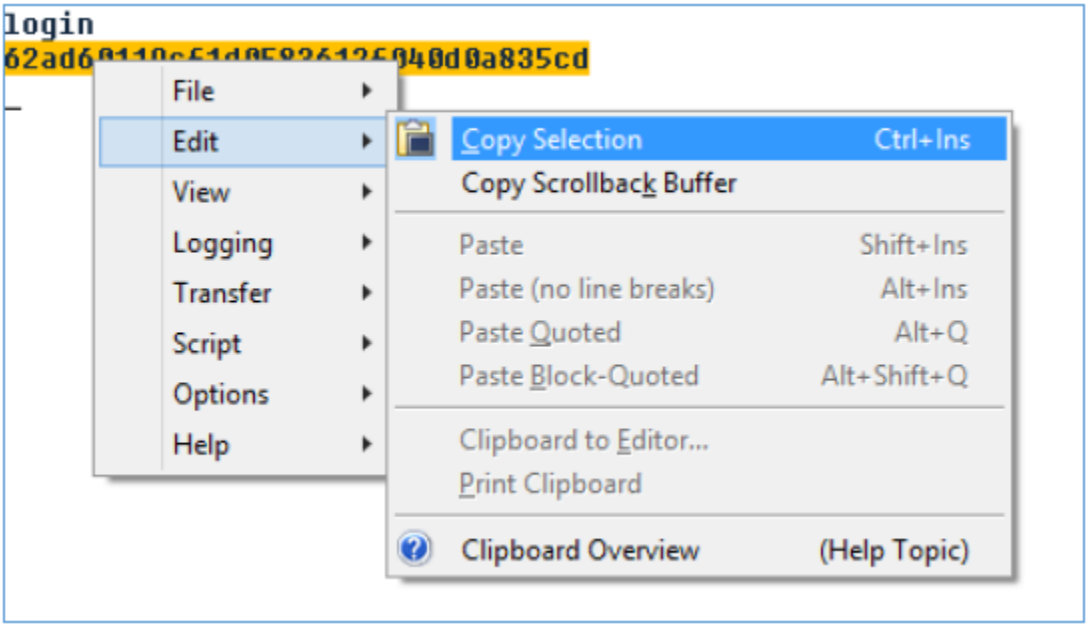
3.6 Manual AES Login

1. In the text field at the bottom of the window type, ‘login’



2. The device will respond with a ‘Challenge’ value to be provided to the AES utility. Highlight the challenge by left clicking and dragging the mouse.

b. Copy the challenge by right clicking on the highlighted text, then navigate the pop-up menu to 'Edit'->'Copy Selection'



c. As a tip to check for spaces, you can open Start->run and paste your selection and make changes before pasting into command prompt.

3. Now open command prompt, Start->Run then type 'cmd' and change the directory to the location of the AES encryption utility location. For example:

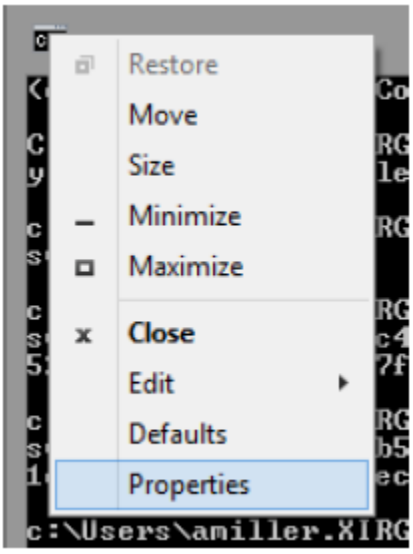
```
C:\Users\amiller.XIRGOTECH>cd c:\users\amiller.xirgotech\appdata\roaming\skype\m
y skype received files

c:\Users\amiller.XIRGOTECH\AppData\Roaming\Skype\My Skype Received Files>
```

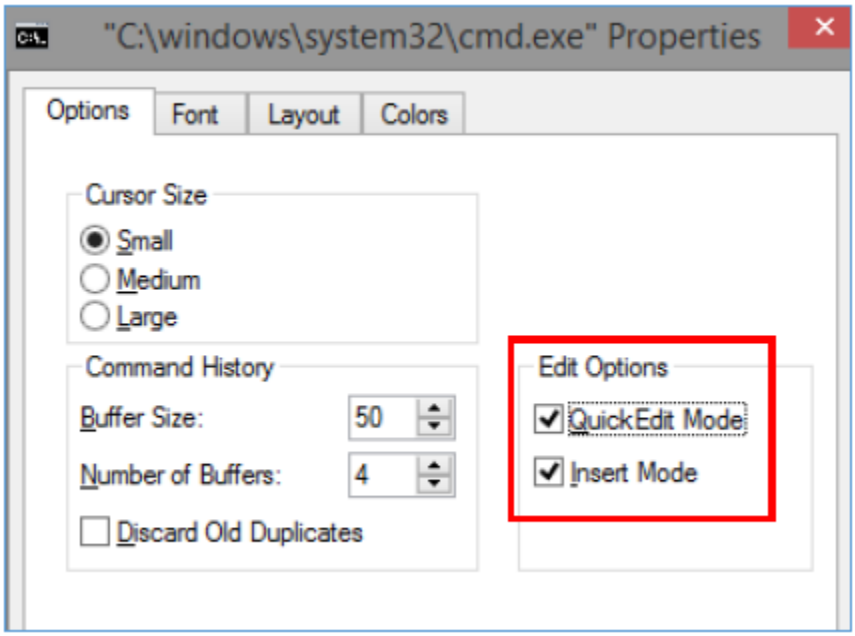
4. Once you have entered the correct directory path, type the following:

a. 'aes_passwd_dynkey <challenge> <key>

i. As a tip for pasting into command prompt, navigate to the properties menu by right clicking on the command prompt icon at the top of the window and select Properties:



ii. On the 'Options' tab select 'Quick Edit mode' and 'Insert Mode'. This will allow copying and pasting by right clicking to past and highlighting followed by right clicking to copy.



Example text of the AES utility command, challenge and key.

```
c:\Users\amiller.XIRGOTECH\AppData\Roaming\Skype\My Skype Received Files>aes_pas
swd_dynkey 62ad60119cf1d0583612f040d0a835cd 584952474F5445434844454641554C54
```

b. Hit enter and the utility will send a response to provide to ZOC.

5. Highlight the response and right click the highlighted text.

```
c:\Users\amiller.XIRGOTECH\AppData\Roaming\Skype\My Skype Received Files>aes_pas
swd_dynkey 62ad60119cf1d0583612f040d0a835cd 584952474F5445434844454641554C54
93badefa3dcfa325a2df7bbda0e91f64

c:\Users\amiller.XIRGOTECH\AppData\Roaming\Skype\My Skype Received Files>
```

6. As mentioned before you can check that your copy was copied correctly by using Start->Run or the local typing field in ZOC before entering.

7. Right click in the local typing field to enter the response and hit 'Enter'

a. If the Aux port has gone inactive hit 'Enter' until the port becomes active again and proceed with sending the AES utility response:

```
login
62ad60119cf1d0583612f040d0a835cd
Auxport Going Inactive
Auxport Active
93badefa3dcfa325a2df7bbda0e91f64
Accepted
```

8. The ZOC terminal should respond with 'Accepted'.

```
login
62ad60119cf1d0583612f040d0a835cd
Auxport Going Inactive
Auxport Active
93badefa3dcfa325a2df7bbda0e91f64
Accepted
```

3.7 XT3630 Commands Description

When you connect successfully you will be able to send console commands to the device. The console commands are case sensitive and must be entered with the return key. The list of applicable commands shown in the table below:

USB Console Commands	
sSHDN5	Sets the device into ship mode (low power sleep mode)
mV	Prints the version of the FW
Xpd	Prints various ADC values (helpful for checking battery voltage)
deM	Firmware Update Command using Xmodem transfer
+XT:4001,<WFE>,<WSI>,<WSD>	Enables/Disables Wi-Fi Scanning and sets scan interval and duration.
+XT:4002,<GE>,<GA>	Enables/Disables GPS and sets minimum fix accuracy
+XT:4003,<BE>,<BM>,<BAM>,<BAI>,<BAN>	Enables/Disables BLE and sets status, data mask, interval, and name
+XT:5401,<ST>	Configures Sleep Timer
+XT:3017,<WT1>,<WT2>,<WNM>,<MWM>	Configures wait times and sleep mask
Rpi	Displays Wi-Fi APs and RSSI
Sxx	Reset the device. This will allow the devices to be secured after logging into the device via serial cable.

Please remember to place the device into ship mode ('sSHDN5') if the device is going to be charging or non-operational for a period of time. This will keep the battery from draining during expected non-operational periods of times. The 4001, 4002, 4003, 5401, and 3017 commands syntax are the explained in Appendix A.

3.8 XT3630 Firmware Update

Within ZOC Terminal Issue the following command

deM

When prompted by the ZOC console with:

Preparing firmware download (.evf)

Erasing FLASH memory

Waiting for Xmodem Start ("dE" to abort)

Now navigate to the 'Transfer' drop down menu and select 'Upload'. Browse to the directory where the .evf file is located, select the file and click Ok.

The firmware update process will begin and the console will report when the update is complete.

Once completed, type 'mV' into the ZOC console to view the updated firmware version.

3.9 Example Device Behavior

This section describes XT3630 device behavior based on the following configurations:

+XT:4001,1,5,3

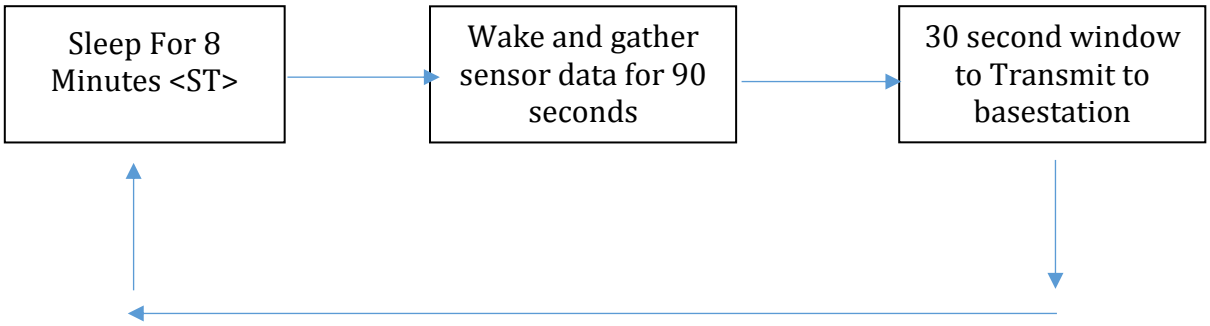
+XT:4002,1,50

+XT:4003,0,0,0,0,0

+XT:5401,8

+XT:3017,90,30,0,1

The sleep/wake configuration and the sleep timer are the most important commands to set correctly to set the expected reporting behavior of the XT3630. The units have been configured with a sleep timer of 8 minutes. This means that after the wait times defined in the 3017, the unit will enter low power mode for 8 minutes until it wakes again to report per the 3017 configured timings. The flow chart below will show the expected periodic behavior of this configured XT3630.



The 4001, 4002, and 4003 command configure how the device will gather sensor data during the 90 Second <WT1> period. Xirgo recommends using only the default WT1 and WT2 at this time. This can be further tuned if necessary at a later time. The 4002 is set at a minimum of 50-meter accuracy, but that can be increased or decreased as necessary.

Bluetooth is disabled by default, but can be tested if desired. The recommended test command for Bluetooth advertising is:

+XT:4003,1,2,15,10,BLETEST

Any BLE scanning device should be able to detect the 'BLETEST' name and view the available advertising data from the device.

4 SIGFOX Payload Structure

4.1 Xirgo Simple Fragmentation Protocol Specification (XSFPS)

T	H	I	S		I	S		A	N		E	N	C	A	P	S	U	L	A	T	E	D		P	A	Y	L	O	A	D	!

In order to transmit the data efficiently we need to create an encapsulation protocol which can support message fragmentation.

To support this, we use a Group Index and a Message Index. Each Group contains some number of Messages. Every Message indicates the Group, the Message Index and the total number of Messages in the Group. The Message Index indicates ordering for payload concatenation.

The message above "THIS IS AN ENCAPSULATED PAYLOAD!" requires 4 SigFox messages to be transmitted assuming 2 Bytes of framing information in the fragmentation protocol.

One Byte is reserved for the Group which is a logical 8-bit integer that will roll over at 256 (0-255). The second Byte is reserved for the Message Index and the total Message Count. The Lower nibble of the 2nd Byte is the Message Index within the Group and the upper nibble of the 2nd Byte indicates total number of messages in the Group. ((Byte & 0x0f) + 1) == Message Index. (((Byte & 0xf0) >> 4) + 1) == Message Count. The (+1) assumption being that there is at least one Message per Group allowing us a maximum of 16 messages per Group and a maximum of 160 payload bytes per Group.

0	0x30	T	H	I	S		I	S		A	N

0	0x31	E	N	C	A	P	S	U	L	A

0	0x32	T	E	D		P	A	Y	L	O	A

0	0x33	D	!

The payload can contain any data. ASCII strings as shown above, or formatted binary data.

The data to be presented for this project:

1. Protocol Version, 1 Byte
2. Timestamp, 4 Bytes, Must be epoch as an absolute cannot fit in 4 Bytes. UNIX Epoch.
3. GPS Latitude, 4 Bytes
4. GPS Longitude, 4 Bytes
5. Accelerometer X, Y, Z, 6 Bytes
6. Temperature, Degrees F? C?, 2 Bytes
7. Light, Lux, 2 Bytes
8. Wi-Fi APs visible, 4 Max.

4.2 Payload Data Description

Offset	Size (Bytes)	Description
0	1	Payload Protocol Version
1	4	Timestamp; UNIX Epoch Offset
5	4	GPS Latitude
9	4	GPS Longitude
13	2	Accelerometer X acceleration vector
15	2	Accelerometer Y acceleration vector
17	2	Accelerometer Z acceleration vector
19	2	Temperature; tenths degrees F,C? (multiplied by 10)
21	2	Light, Lux
23	6	Highest RSSI Wi-Fi AP BSSID
29	6	2nd Highest RSSI Wi-Fi AP BSSID
35	6	3rd Highest RSSI Wi-Fi AP BSSID
41	6	4th Highest RSSI Wi-Fi AP BSSID

Highlighted fields are optional. When all of the Message Fragments are collected by the server and assembled in order the server will have the total Message Size. 23 Bytes for no APs, 29 Bytes for 1 AP, 35 Bytes for 2 APs, 41 Bytes for 3 APs and 47 Bytes for 4 APs. Additional APs if required can be concatenated and determined server-side based on ((Message Size – 23 Bytes) / 6 Bytes) == Number of APs at the end of the payload.

Any additional changes to the defined payload (Bytes 0 – 22) will cause an increment of the Payload Protocol Version.

4.3 Sample Payload Parsing Guide

Messages:

1F 40 00 58 04 C6 EF 02 0A 16 03 F8
1F 41 E8 2B F4 FF F8 00 23 FC 18 08
1F 42 40 00 00 4C 09 D4 87 0D 13 5C
1F 43 DC 96 74 07 BD A8 D3 F7 31 0A
1F 44 08

Parsing:

Group Number: 1F
Message Count (Index + 1): 5
Note: Index is the lower nibble of the second byte of each SIGFOX message 40 -> Index 0, 41 -> Index 1, 42 -> Index 2, etc.
Protocol Version: 00
Time Stamp: 58 04 C6 EF

1. Convert from hex to decimal: 0x5804C6EF = 1476708079
2. Open http://www.epochconverter.com/
3. Enter the seconds since epoch (Jan 1. 1970)
4. 58 04 C6 EF -> Mon, 17 Oct 2016 12:41:19 GMT

Latitude: 02 0A 16 03

1. Convert from hex to binary to check for negative value (2's compliment format)
2. 0x020A1603 = 00100000101000010110000000011b (leading bit is zero -> positive value)
3. Convert from hex to decimal
4. 0x020A1603 = 34215427
5. Move decimal 6 places
6. 34.215427° N

Longitude: F8 E8 2B F4

1. Always check the binary conversion for a negative number (2's compliment format)
2. 0xF8E82BF4 = 11111000111010000010101111110100b (leading bit is 1 -> negative value)
3. Convert from binary to decimal using 2's compliment:
    a. http://www.exploringbinary.com/twos-complement-converter/
4. 11111111110001011100100000101110b <-(2's compliment) -> --119002124
5. Move 6 decimal places: -119.002124 ° W

Accel X: FF F8 = 0xFFF8 = 1111111111111000b (leading bit is 1, 2's compliment for negative value) = -8mG
Accel Y: 00 23 = 0x23 = 00100011b (leading bit is 0, positive value) = 35mG
Accel Z: FC 18 = 0xFC18 = 1111110000011000b (leading bit is 1, 2's compliment, negative value) = -1000mG
Temperature: 08 40 = 0x840 = 2,112, reference the table below for approximate temperature value
Ambient Light: 00 00 (should always read 00 00 because of enclosure 0x0000 = 0 lux
Wi-Fi BSSID 1: 4C 09 D4 87 0D 13
Wi-Fi BSSID 2: 5C DC 96 74 07 BD
Wi-Fi BSSID 3: A8 D3 F7 31 0A 08

4.4 Xirgo Byte Packed Protocol (XBPP)

4.4.1 SIGFOX Payload Overview

In order to create a robust transport protocol, a standard header within the 12 Byte payload will include information regarding the message which will provide the Alizent backend with information regarding each message. This will allow the detection of a failed transmission if some SIGFOX message transmissions fail which carry additional AP data. A standard message header including message type, version, index and count (total number of messages), will be included in every message along with battery and AP information.

4.4.2 Payload Data Structure

Field	Size (bits)	Description	Value/Sample
MessageType	5	Type of Message	'00100' (4)
MessageVersion	3	Version of this message	'0'
Message Index	8	Increments with each transmission attempt	“0000000”
Message Count	8	High nibble: number of messages Low nibble: current message count	“01010001” (3,1)
MacAddress	48	BSSID of the detected access point	48:2C:6A:1E:59:3D
SignalStrength	8	Received Signal Strength Intensity (RSSI) associated with the previous BSSID.	‘01010001’ (-81 dBm)
BatteryStatus	16	Battery voltage ADC value	
TOTAL	96		

4.4.3 SIGFOX Example Payload

For: Message type = 00001b, Message Version = 000b, Battery Status = 1200

A device wakes up and, after scouting, it finds 3 access points (addresses “02:01:01:01:01:01”, “03:02:02:02:02:02”, “04:03:03:03:03:03”) with RSSIs (-85, -90, -110).

The following SIGFOX messages are sent:

SIGFOX Message 0

Field	Size (bits)	Value/Sample
MessageType	5	'00001' (1)
MessageVersion	3	'000'
Message Index	8	‘0000000’ (next time the device wakes up it will be ‘00000001’ …)
Message Count	8	‘00110000’ (3,0) (high nibble number of messages, low nibble current message count)
MacAddress	48	00000010, 00000001, 00000001, 00000001, 00000001, 00000001 (MSB First)
SignalStrength	8	‘01010101’ (-85, we assume the RSSI is always lower than 0)
BatteryStatus	16	‘00000100’,’10110000’ (MSB first)
TOTAL	96	

SIGFOX Message 1

Field	Size (bits)	Value/Sample
MessageType	5	'00001' (1)
MessageVersion	3	'000'
Message Index	8	'0000000' (next time the device awakes it will be '00000001' …)
Message Count	8	'00110001' (3,1) (high nibble number of messages, low nibble current message count)
MacAddress	48	00000011, 00000010, 00000010, 00000010, 00000010, 00000010 (MSB First)
SignalStrength	8	'01011010' (-90, we assume the RSSI is always lower than 0)
BatteryStatus	16	'00000100','10110000' (MSB first)
TOTAL	96	

SIGFOX Message 2

Field	Size (bits)	Value/Sample
MessageType	5	'00001' (1)
MessageVersion	3	'000'
Message Index	8	'0000000' (next time the device awakes it will be '00000001' …)
Message Count	8	'00110010' (3,2) (high nibble number of messages, low nibble current message count)
MacAddress	48	0000100, 00000011, 00000011, 00000011, 00000011, 00000011 (MSB First)
SignalStrength	8	'01101110' (-110, we assume the RSSI is always lower than 0)
BatteryStatus	16	'00000100','10110000' (MSB first)
TOTAL	96	

4.5 Bluetooth Payload Structure

Data	Description
0xFF	Ad packet type (0xFF = mfg-specific data)
0xEF	Placeholder for a two-byte company ID number
0xBE	Placeholder for a two-byte company ID number
0x00	Accel data next
	Two bytes, little-endian, signed integer, X-axis acceleration
	Two bytes, little-endian, signed integer, Y-axis acceleration
	Two bytes, little-endian, signed integer, Z-axis acceleration
	Two bytes, little-endian, unsigned integer, acceleration magnitude
0x01	Lux data next
	Two bytes, little-endian, unsigned integer, lux ADC count
0x02	Temp data next
	Two bytes, little-endian, unsigned integer, temp ADC count
0x03	GPS data next
	Four bytes, little-endian, signed integer, GPS latitude * 1e6
	Four bytes, little-endian, signed integer, GPS longitude * 1e6

4.6 Battery Voltage and Temperature Conversion Tables

4.6.1 Battery Voltage vs. Count Value

Battery (V)	ADC (Counts)
4.2	283.3
4.1	276.4
4	269.7
3.9	263
3.8	256.1
3.7	249.5
3.6	242.7
3.5	236
3.4	229.4
3.3	225
3.2	225
3.1	226
3	227.4

Battery voltage can be observed with HyperTerminal, SecureCRT or ZOC command ‘Xpd’:

Xpd
SensorIgnition: Clear (39)
SensorAccelerometer: {-23131,8,-5216}, 1mg
SensorVibration: {0}
SensorMainVoltage: 0.3 (0.8)
SensorBatteryVoltage: 281.2 (0.0)
SensorTmp20: 2550,134.5 (274.1)
SensorAmbientLight: 305.6 (0.0)
SensorExt1Voltage: 0.0 (0.0)
SensorSigfoxVoltage: 409.5 (0.0)

4.6.2 Temperature in Celsius or Fahrenheit vs. Count Value

Chamber Temp (Celsius)	Unit 1 Temp Data	Unit 1 Raw Count	Unit 1 Celsius count	Unit 1 Fahrenheit Count
-35	3036,131.5 (268.7)	3036	131.5	268.7
-25	2873,132.5 (270.5)	2873	132.5	270.5
-15	2713,133.5 (272.3)	2713	133.5	272.3
-5	2548,134.5 (274.1)	2548	134.5	274.1
5	2388,135.5 (275.9)	2388	135.5	275.9
15	2226,136.5 (277.7)	2226	136.5	277.7
25	2072,137.4 (279.4)	2072	137.4	279.4
35	1911,138.4 (281.2)	1911	138.4	281.2
45	1766,139.3 (282.8)	1766	139.3	282.8
55	1605,140.3 (284.6)	1605	140.3	284.6
65	1448,141.3 (286.3)	1448	141.3	286.3
75	1287,142.3 (288.1)	1287	142.3	288.1
85	1130,143.2 (289.8)	1130	143.2	289.8

Chamber Temp (Celsius)	Unit 2 Temp Data	Unit 2 Raw Count	Unit 2 Celsius Count	Unit 2 Fahrenheit Count
-35	3098,131.1 (268.0)	3098	131.1	268.0
-25	2929,132.2 (269.9)	2929	132.2	269.9
-15	2766,133.2 (271.7)	2766	133.2	271.7
-5	2598,134.2 (273.6)	2598	134.2	273.6
5	2431,135.2 (275.4)	2431	135.2	275.4
15	2264,136.2 (277.2)	2264	136.2	277.2
25	2100,137.3 (279.1)	2100	137.3	279.1
35	1931,138.3 (280.9)	1931	138.3	280.9
45	1791,139.2 (282.5)	1791	139.2	282.5
55	1628,140.2 (284.3)	1628	140.2	284.3
65	1466,141.2 (286.1)	1466	141.2	286.1
75	1304,142.2 (287.9)	1304	142.2	287.9
85	1145,143.1 (289.7)	1145	143.1	289.7

5 RS232 Based Configuration Command Protocol

5.1 Wi-Fi Configuration

Type	Syntax	Response	ASCII
Set	+XT:4001,<WE>,<WSI>,<WSD>	$$<UID>,4001,<WE>,<WSI>,<WSD>##	
Read	+XT:4001?	$$<UID>4001,<WE>,<WSI>,<WSD>##	
Parameter	**Type**	**Description**	
<WE>	Numeric	Wi-Fi Enable • 1: Enabled • 0: Disabled • Default is 0 (Disabled)	
<WSI>	Numeric	Wi-Fi Scanning Interval • Valid Range is 0 – 86400 (seconds) • 0: Disabled Default is 0 (Disabled)	
<WSD>		Wi-Fi Scanning Duration • Valid Range is 0 – 86400 (seconds) • 0: Disabled Default is 0 (Disabled)	

NOTE: If Scanning duration is larger than scanning interval, then the Wi-Fi module will be permanently scanning.

5.2 GPS Configuration

Type	Syntax	Response	ASCII
Set	+XT:4002,<GE>,<GI>	$$<UID>,4002,<GE>,<GA>##	
Read	+XT:4002?	$$<UID>,4002,<GE>,<GA>##	
Parameter	**Type**	**Description**	
<GE>	Numeric	GPS Enable • 1: Enabled • 0: Disabled • Default is 0 (Disabled)	
<GA>	Numeric	GPS minimum accuracy • Valid Range is 0 – 255 (meters) • 0: Disabled Default is 0 (Disabled)	

5.3 Bluetooth Configuration

Type	Syntax	Response ASCII
Set	+XT:4003, <BE>,<BM>,<BAM>,<BAI>,<BAN>	$$<UID>,4003, <BE>,<BM>,<BAM>,<BAI>,<BAN>##
Read	+XT:4003?	$$<UID>,4003, <BE>,<BM>,<BAM>,<BAI>,<BAN>##

Parameter	Type	Description
<BE>	Numeric	Bluetooth Enable • 1: Enabled • 0: Disabled • Default is 0 (Disabled)
<BM>	Numeric	Bluetooth Mode • 0: Idle • 1: Scanner • 2: Advertise
<BAM>	Numeric	Bluetooth Advertising Data Mask • 0: Disabled • 1: Accelerometer • 2: Lux • 4: Temp • 8: GPS • 16: Serial#
<BAI>	Numeric	Bluetooth Advertising Interval • Valid Range is 0 – 86400 (seconds) • 0: Disabled Default is 0 (Disabled)
<BAN>	Numeric	APN Username • Maximum 12 characters accepted • Default value is “”

5.4 Low Power Sleep/Wake Configuration

Type	Syntax	Response	ASCII
Set	+XT:3017,<WT1>,<WT2>,<WMN>,<MWM>	$$<UID>,3017,<WT1>,<WT2>,<WMN>,<MWM>##	
Read	+XT:3017?	$$<UID>,3017,<WT1>,<WT2>,<WNM>,<MWM>##	

Parameter	Type	Description
<WT1>	Numeric	Pre-Alert Maximum Wait Time • Valid Range is 0 – 32767 (seconds) • Default Value is 1
<WT2>	Numeric	Post-Alert Wait Time • Valid Range is 0 – 32767 (seconds) • Default Value is 1
<WNM>	Numeric	Shutdown/Sleep Notification Time • Default Value is 0 (Disabled)
<MWM>	Numeric	Wake Mask • 0: Disabled • 1: Sleep Time • 2: Motion Wake • 4: Motion/No-Motion Periods & Thresholds • 8: Daily Wake • 16: Wake-Pin (Input1/Ignition) • 32: External Power • 64: Battery Good

5.5 Sleep Alarm

Type	Syntax	Response	ASCII
Set	+XT:5401,<ST>	$$<UID>,5401,<ST>##	
Read	+XT:5401?	$$<UID>,5401,<ST>##	

Parameter	Type	Description
<ST>	Numeric	Sleep Alarm Timer • Valid Range is 1 – 32767 (minutes) • 1 Minute Increments • Default Value is 0 (Disabled)

6. FCC/IC REGULATORY COMPLIANCE INFORMATION

This equipment with FCC-ID: GKM-XT3630F and IC-ID: 10281A- XT3630F, Model: XT3630F

is subject to the Federal Communications Commission (FCC) and Industry Canada (IC) rules.

NOTICE:
Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) this device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

This device complies with radiation exposure limits set forth for an uncontrolled environment and meets radio frequency (RF) Exposure Guidelines. This equipment should be installed and operated by keeping the device at least 20cm from a person's body.

Antenna Statement

Under Industry Canada regulations, this radio transmitter may only operate using an antenna of a type and maximum (or lesser) gain approved for the transmitter by Industry Canada. To reduce potential radio interference to other users, the antenna type and its gain should be so chosen that the equivalent isotropically radiated power (e.i.r.p.) is not more than that necessary for successful communication.

Conformément à la réglementation d'Industrie Canada, le présent émetteur radio peut

fonctionner avec une antenne d'un type et d'un gain maximal (ou inférieur) approuvé pour

l'émetteur par Industrie Canada. Dans le but de réduire les risques de brouillage radioélectrique à l'intention des autres utilisateurs, il faut choisir le type d'antenne et son gain de sorte que la puissance isotrope rayonnée équivalente (p.i.r.e.) ne dépasse pas l'intensité nécessaire à l'établissement d'une communication satisfaisante.

Licence exempt

This device complies with Industry Canada licence-exempt RSS standard(s). Operation is subject to the following two conditions:

(1) this device may not cause interference, and

(2) this device must accept any interference, including interference that may cause undesired operation of the device.

Le présent appareil est conforme aux CNR d'Industrie Canada applicables aux appareils radio

exempts de licence. L'exploitation est autorisée aux deux conditions suivantes :

(1) l'appareil ne doit pas produire de brouillage, et

(2) l'utilisateur de l'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement.