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**Version:** 0.38

# AMSAT PACSAT Ground Station Manual

## 1 Introduction

Thank you for downloading the PACSAT Ground Station software.

PACSATground is experimental. We are sure it can be improved. Please provide feedback and suggestions by email to [g0kla@arrl.net](mailto:g0kla@arrl.net) or by logging an issue at <https://github.com/ac2cz/Falcon/issues>

In theory this ground station will work with any Pacsat, but it was written specifically to support FalconSat-3. In particular the support for telemetry collection is probably bespoke to that spacecraft.

### 1.1 License

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## **3 Getting Started**

### **3.1 A bit about PacSats**

FalconSat-3 and similar spacecraft run software that follows the PacSat protocols. This is a clever set of software routines that provide a delay tolerant network connection to the spacecraft. The protocols are split into two halves. The broadcast protocol is used to receive data from the spacecraft. The files and data available on the spacecraft are broadcast as a directory listing. This means that all ground stations can listen and record the data.

Specific files are requested by transmitting a broadcast request to the spacecraft. The file is then broadcast in chunks of data and again all ground stations can receive it. Each ground station can then request the parts of the file that they missed. This makes it a very efficient way to communicate data to many stations and makes it possible to download the directory and files across fades and different passes of the spacecraft.

To upload files a ground station makes a dedicated connection to the spacecraft by logging in. The spacecraft then confirms space is available and provides the file number to use. The data is then uploaded. Again, this is very delay tolerant and picks up seamlessly across fades or passes.

You may think this is all very old and out of date, and perhaps the speed at 9600bps is, but the protocols form the basis of modern high speed, delay tolerant communications through spacecraft. It is a very robust solution for transmitting data around the world with no dependence on the telecoms infrastructure. I imagine a similar protocol will serve us well when we exchange data with the moon or Mars.

If you want to learn more about the Pacsat Protocols then have a look at the reference documents at the bottom of this page: <https://www.g0kla.com/pacsat/>

A Pacsat like FalconSat-3 produces a decent amount of telemetry. That telemetry is broadcast periodically and also stored in Whole Orbit Data (WOD) files on board. In fact, there is more data stored than a single AMSAT Operations ground station can download. So we are asking for your help collecting telemetry. Any WOD files you collect and any broadcast telemetry you receive can be forwarded to the AMSAT telemetry server. Partial files are just as helpful as complete files because we reassemble them centrally. This means that receive only ground stations can contribute too.

### **3.2 Installing and running**

There is no fancy installer for Pacsat Ground. You just unzip the distribution and put it in the directory of your choice.

Once you have done that, to run on windows double click PacSatGround.exe. To run on Linux or MacOS you may be able to double click on the jar file or you can run the supplied start script, called

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PacSatGround. If that does not work then you can run from the command line. Make sure you are in the same directory as the program, then run with:  
`java -jar PacSatGround.jar`

MacOs makes all of this quite difficult for non-technical users. If you have difficulty on MacOs then reach out and we will help.

When PACSATground starts you should have the Welcome screen shown below (unless you passed the data folder as a command line parameter). We recommend you choose a data folder that is different to the location of the program. This makes upgrades easier and avoids issues if the installation folder is not writable.

You need to put a valid Amateur Radio callsign if you are going to transmit to the spacecraft. If you are a receive only ground station then put something useful and unique as we use this to keep track of who has contributed telemetry.

A screenshot of the "Welcome to the Amsat Pacsat Ground Station" dialog box. The window has a title bar with the AMSAT logo and a close button. The main content area has a light gray background. At the top, it says "AMSAT PacsatGround". Below that, it says "It looks like this is the first time you have run the ground station. Configuration settings will be saved in: C:\Users\chris\PacsatGroundConfig". Then it says "Enter your callsign and a folder below, where the directory and downloaded files will be stored. You will also need to configure the connection to a software or hardware TNC on the File > Settings menu". There are two input fields: "Ground station Callsign" and "Data Folder". The "Data Folder" field has a "Browse" button next to it. At the bottom, there are "Continue" and "Cancel" buttons.

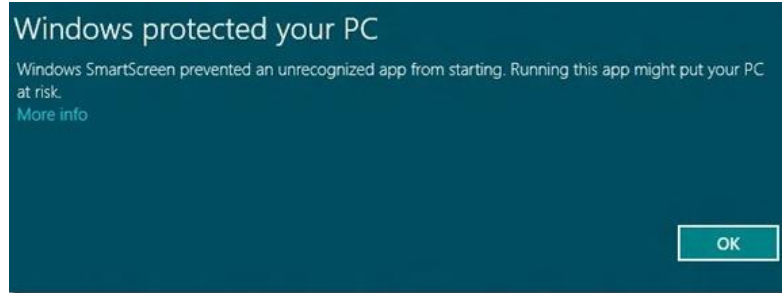
Pacsat Ground will write the configuration file into your home directory. This means it can find the configuration even if you change the data folder or move the installed program. For me on Windows that is c:\users\chris\PacsatGroundConfig\PacSatGround.properties

### 3.3 Troubleshooting Issues running PACSAT ground

Pacsat Ground will not start if you do not have java installed. You will get a message from the launcher telling you to download and install the latest version. Use Java version 8 (also called 1.8) or later. Right now my preferred installation is from AdoptJDK and you can find them here <https://adoptopenjdk.net/>, but any Java 8 or later version should work.

If you get an error message from Windows SmartScreen like the below, then click "More Info" and then "Run Anyway". Windows gives this message for new or little known applications that have not established a reputation.

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MacOS has similar security precautions.

If you are on Windows and the program complains that it is missing MSVCR100.dll or something similar to that, then you need to install the Microsoft Visual C++ redistributable. This is usually included by default in Windows, but sometimes it is not there:

For 32 bit Windows: <http://www.microsoft.com/download/en/details.aspx?id=5555>

For 64 bit Windows: <http://www.microsoft.com/download/en/details.aspx?id=14632>

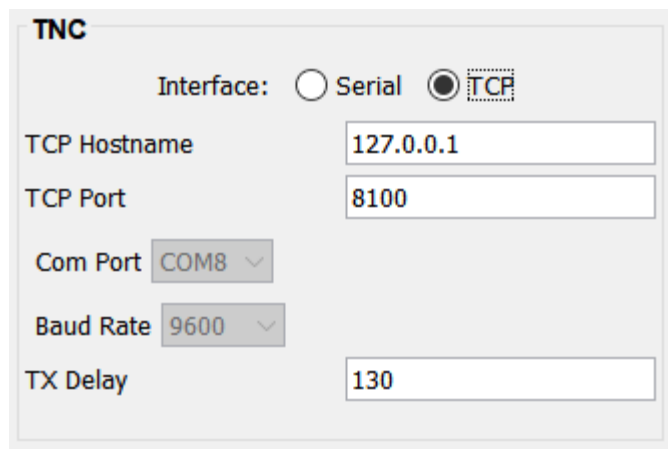
If PacSatGound still won't start, then ask for help on the amsat-bb mailing list or email [g0kla@arrl.net](mailto:g0kla@arrl.net).

### 3.4 Setup

Pacsat ground is designed to have minimal setup. The parameters needed to connect to FalconSat-3 are included in a configuration file. You do not need to setup callsigns for the spacecraft. You do need to decide how you are connecting the computer to your radio and configure the connection. You have two options, a software TNC or a traditional hardware TNC.

#### 3.4.1 Using a Software TNC

A software TNC such as `hs_soundmodem` is a good choice for most people. Instead of a serial cable data is passed to the Pacsat Groundstation through a TCP port. On the File > Settings screen make sure that TCP is selected in the TNC settings. The hostname should be 127.0.0.1 if you are running `hs_soundmodem` on the same machine. The default port is 8100, though you can change it in `soundmodem`.



You need to download `hs_soundmodem` (hs for high speed). In `soundmodem` you choose FSK G3RUH 9600bp as the modem type on the Settings > Modems screen. Configure it to be full duplex.

On the Settings > Devices screen select the sound card or cards that you will connect to your radio. Make sure the radio is in 9600bps packet mode.

Under Server Setup, also on the Devices screen, make sure that KISS Server Port is enabled and has the same port number as the one you used in Pacsat Ground.

You will also need to arrange a way to key your radio using a COM port. Select the COM port that you have used on the Devices screen.

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The 'Modem settings' dialog box is divided into two main sections for 'Modem filters ch: A' and 'Modem filters ch: B'. Each section contains input fields for 'LPF1 Width' (7000), 'LPF1 Taps' (64), 'LPF2 Width' (9000), 'LPF2 Taps' (16), and 'TXLPF Width' (8000), each with a 'Show' button. Below these are checkboxes for 'Default settings' (checked), 'non-AX25 filter' (checked), 'KISS Optimization' (unchecked), and 'Full-duplex mode' (checked). The 'Modem type ch: A' and 'Modem type ch: B' sections have a 'Mode' dropdown set to 'FSK G3RUH 9600bd', and input fields for 'TXDelay' (150 msec) and 'TXTail' (50 msec). 'Ok' and 'Cancel' buttons are at the bottom.

The 'Settings' dialog box has three main sections. The 'Sound Card' section includes 'Output device' (Speakers (Realtek High Definiti...)) and 'Input device' (Microphone Array (Realtek High...)). It has checkboxes for 'Dual channel', 'TX rotation', 'Single channel output', and 'Color waterfall', along with 'TX SampleRate' (48000), 'TX corr. PPM' (0), 'RX SampleRate' (48000), and 'RX corr. PPM' (0). There is also a 'Minimized window on startup' checkbox and a 'Priority' dropdown (Highest). The 'Server setup' section has 'AGWPE Server Port' (8000) and 'KISS Server Port' (8100), each with an 'Enabled' checkbox. The 'PTT Port' section has a 'Select PTT port' dropdown (COM1) and checkboxes for 'Dual PTT' (checked) and 'Swap COM pins for PTT' (unchecked). 'OK' and 'Cancel' buttons are at the bottom.

### 3.4.2 Using a Hardware TNC

If you have a hardware Terminal Node Controller (TNC) then you can use that instead of `hs_soundmodem`. On the File > Settings screen make sure that Serial is selected in the TNC section. Select the serial Com port that you are using to connect to the TNC. The baud rate here is the connection speed to the TNC and not the speed that the data is transmitted to the spacecraft.

You need to restart PacsatGround to connect to the TNC. PacsatGround tries to put the TNC into KISS mode and you should see the typical light sequence specified in your TNCs manual.

The 'TNC' settings dialog box has an 'Interface' section with 'Serial' selected (radio button) and 'TCP' (radio button). Below are 'Com Port' (COM8) and 'Baud Rate' (9600) dropdown menus. There are checkboxes for 'Toggle TNC in/out of KISS Mode' (checked) and 'Send TNC custom bytes at startup' (unchecked). At the bottom is a 'TX Delay' input field set to 130.

If the TNC does not go into KISS mode then it means it is not TNC2 compatible. Meaning sending the Sequence “KISS ON” followed by “RESTART” does not put it into KISS mode. You have two choices to address this.

Option 1 is to uncheck the setting “Toggle TNC in/out of KISS Mode”. Then exit the program. Connect to your TNC with a separate terminal program and issue the required incantation to put it into

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KISS mode. Then just leave it there. When you start the Pacsat ground station it will not try to put the TNC into KISS mode. It will send the KISS commands for Full Duplex and the TX Delay. At exit it will leave the TNC in KISS Mode.

If leaving the TNC in KISS mode is a pain, then Option 2 is to check the setting “Send TNC Custom bytes at startup”. This shows additional fields to setup custom bytes. If they are not all visible then stretch the window.

The screenshot shows the 'TNC' configuration window. At the top, the title is 'TNC'. Below it, the 'Interface' is set to 'Serial' (selected with a radio button) and 'TCP' is unselected. The 'Com Port' is set to 'COM8' and the 'Baud Rate' is set to '9600'. There are two checked checkboxes: 'Toggle TNC in/out of KISS Mode' and 'Send TNC custom bytes at startup'. Below these, the 'Edit' options are 'Text' (unselected) and 'Bytes' (selected). The section 'Send these bytes to TNC at startup' contains two rows: 'KISS ON' with hex values '4B 49 53 53 20 4F 4E 0D 52 45 53' and 'RESTART' with hex values '54 41 52 54 0D'. The section 'Send these bytes to TNC at exit' contains one row: 'ÀÿÀ' with hex values 'C0 FF C0'. At the bottom, the 'TX Delay' is set to '130'.

The default bytes are shown above. You can either edit the bytes directly or edit the text. If you edit the bytes, then they are in hex and should have a space between each of them. Note that I have used 0D as the line termination in the default, which is a Carriage Return (CR). Some systems use 0A, which is a line feed (LF) and some use both. You will need to check in your TNC manual to see what bytes are required. If you hit Enter when in the Text section it will insert a Line Feed (0A). That may or may not be what you want.

Note that the ground station will still send the KISS commands for Full Duplex and for the TX Delay after the TNC is in KISS mode, so you do not need to enter bytes for those commands.

### 3.4.3 Initial Test

Is the TNC connected? If you press the “DIR” button at the top of the main window it will request a directory, even if the spacecraft has not been heard. You should see lights operate on your TNC and the radio should be keyed. RF should be transmitted. So make sure the antenna or a dummy load is connected! In a software TNC you will see the KISS bytes printed on the display.

Note that the Ground station may refuse the request and print this in the log area:



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Ignored DIR REQ: Wait until your current PB session has completed before requesting another directory

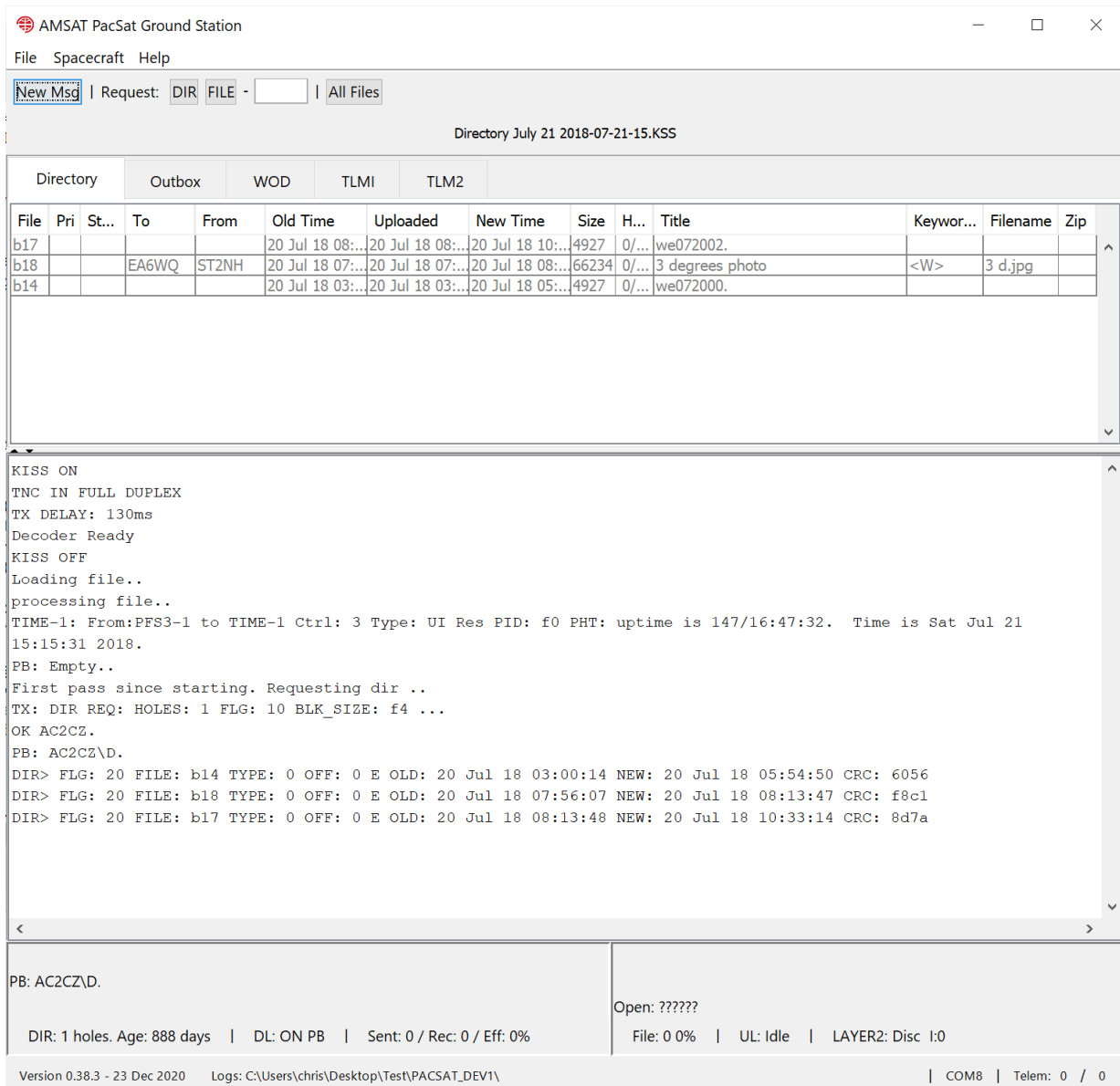
That means that you have already been heard by the spacecraft and you should wait before sending another directory request. If you wait for a minute then the Downlink Wait timer will expire and you will be able to request again.

## 4 Live operation

### 4.1 First pass

The spacecraft is constantly transmitting, so an initial test just listens for the spacecraft. 9600bps packet radio sounds like white noise, so it can be hard to tell if you are receiving the signal. The S meter may well move and the DCD light will come on when data is being heard. Like all spacecraft you will need to compensate for doppler by retuning the radio. I have my FT736R connected to SatPC32 for that purpose.

Let's look at a pass and talk about the display in the ground station:



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File Spacecraft Help

New Msg | Request: DIR FILE - | All Files

Directory July 21 2018-07-21-15.KSS

Directory	Outbox	WOD	TLMI	TLM2									
File	Pri	St...	To	From	Old Time	Uploaded	New Time	Size	H...	Title	Keywor...	Filename	Zip
b17					20 Jul 18 08:...	20 Jul 18 08:...	20 Jul 18 10:...	4927	0/...	we072002.			
b18			EA6WQ	ST2NH	20 Jul 18 07:...	20 Jul 18 07:...	20 Jul 18 08:...	66234	0/...	3 degrees photo	<W>	3 d.jpg	
b14					20 Jul 18 03:...	20 Jul 18 03:...	20 Jul 18 05:...	4927	0/...	we072000.			

```

KISS ON
TNC IN FULL DUPLEX
TX DELAY: 130ms
Decoder Ready
KISS OFF
Loading file..
processing file..
TIME-1: From:PFS3-1 to TIME-1 Ctrl: 3 Type: UI Res PID: f0 PHT: uptime is 147/16:47:32. Time is Sat Jul 21
15:15:31 2018.
PB: Empty..
First pass since starting. Requesting dir ..
TX: DIR REQ: HOLES: 1 FLG: 10 BLK_SIZE: f4 ...
OK AC2CZ.
PB: AC2CZ\D.
DIR> FLG: 20 FILE: b14 TYPE: 0 OFF: 0 E OLD: 20 Jul 18 03:00:14 NEW: 20 Jul 18 05:54:50 CRC: 6056
DIR> FLG: 20 FILE: b18 TYPE: 0 OFF: 0 E OLD: 20 Jul 18 07:56:07 NEW: 20 Jul 18 08:13:47 CRC: f8c1
DIR> FLG: 20 FILE: b17 TYPE: 0 OFF: 0 E OLD: 20 Jul 18 08:13:48 NEW: 20 Jul 18 10:33:14 CRC: 8d7a
  
```

PB: AC2CZ\D.

DIR: 1 holes. Age: 888 days | DL: ON PB | Sent: 0 / Rec: 0 / Eff: 0%

Open: ??????

File: 0 0% | UL: Idle | LAYER2: Disc I:0

Version 0.38.3 - 23 Dec 2020 Logs: C:\Users\chris\Desktop\Test\PACSAT\_DEV1\ COM8 | Telem: 0 / 0

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When we start the ground station it prints KISS ON, TNC IN FULL DUPLEX and TX DELAY: XXXms. It sends those KISS commands to the TNC. You can see these printed in the log area of the screen shot above. Ignore the words “Loading file..” and “processing file..” which show I replayed a KISS file to show this data.

In the absence of any requests the spacecraft transmits several things. First, we see the time on the spacecraft. The next message is the status of the “PB”. The PB is a queue indicating who has requested Pacsat data to be Broadcast. If no one has requested anything you will see:

PB Empty ..

This indicates that no one is on the PB but that the PB is available for use.

Pacsat Ground then notes that this is the “First pass since starting..” and requests the directory. If you don’t want PacsatGround to transmit (perhaps no transmitter is even connected) then you can disable it on the File > Settings screen by selecting “Inhibit Transmitter”.

If the transmitter is enabled then the message transmitted to the spacecraft is shown, which in the screen shot above is a directory request for 1 hole:

TX: DIR REQ: HOLES: 1 FLG: 10 BLK\_SIZE: f4 ...

(for an explanation of directory holes, see the Pacsat protocol reference documents here <https://www.g0kla.com/pacsat/index.php>, especially this document which explains how they work <https://www.g0kla.com/pacsat/bdcastu2.txt>):

We then get two responses:

OK AC2CZ.

PB: AC2CZ\D.

This shows that our transmission was heard and that we are now on the PB with a directory request. Note that the status of the PB is also shown in the bottom left of the window, together with the number of holes in the directory and its age, meaning the oldest file header that Pacsat Ground will request. You can adjust this age on the Spacecraft > FalconSat-3 screen.

While we are requesting the directory the spacecraft will transmit telemetry and other status messages, including the status of the uplink. For example, if we see a message like:

Open ABCD:

This means that the uplink to the spacecraft is open and available for use. There are 4 possible uplinks (A-D) but I think only A is available on FalconSat-3. Notice that the status of the uplink is shown in the bottom right of the window together with details of the uplink state machine and the layer 2 state machine. These are mostly to help me debug things, but if you are curious I can explain what it all means.

If the uplink is available and you have a file to upload, then Pacsat Ground will attempt to login. See the section on uploading files below.

## 4.2 All about the directory

The spacecraft has an onboard file system which stores Pacsat headers for each file. The files are split into two types: System files and User files. By default the system files are hidden. You can change which files are shown by pressing the button labeled “User Files” near the top of the screen. It will then say “All Files” and the System files will be shown mixed in with the user files. If you press it again then only the user files are shown.

We see a typical directory listing for user files below. If we have received the Pacsat file header for a file, but no other data, then it is in light grey. Once we receive some data the file is in black. You can see in the “Holes” column the number of holes that the specific file has and the percentage of bytes downloaded for that file. File holes can be of any size, so the number is not that meaningful and can rise and fall as different parts of the file are received. Eventually the holes will reach zero and the percentage downloaded reaches 100. The file will then be colored blue unless it is directly to you, then it is red.

Unread files are in bold. Read files are no longer in bold.

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File Spacecraft Help

New Msg | Request: DIR FILE - | User Files

Directory		Outbox	WOD	TLMI	TLM2							
File	Pri	State	To	From	Uploaded	Size	Holes	Title	Type	Keywords	Zip	
365			JA0CAW,J...	JA6PL	28 Mar 18 09:43...	392	0/ 0%	HELLO	ASCII-0	<W>		
35f			EA1JM	ST2NH	28 Mar 18 00:44...	405	0/ 0%	Re: Hello Nader	ASCII-0	<W>		
35a			ST2NH	EA1JM	27 Mar 18 22:55...	367	0/ 0%	Hello Nader	ASCII-0	<W>		
357			ALL	PY4ZBZ	27 Mar 18 17:43...	20615	0/ 0%	PicSat last RX :-(	JPG-16	PY4ZBZ		
352		PART	ALL	PY4ZBZ	27 Mar 18 09:23...	20682	2/ 7%	Toucans from Brazil	JPG-16	PY4ZBZ		
34e			G8T2J	AC2CZ	27 Mar 18 04:11...	1355	0/ 0%	RE: Recover from BB Resets	ASCII-0			
34f			PY4ZBZ	K4KDR	27 Mar 18 04:10...	414	1/ 0%	Re: My antennas	ASCII-0	<W> PY4ZBZ		
34c			ST2NH	KE0LX	27 Mar 18 02:30...	452	1/ 0%	Re: NO BODY HERE?	ASCII-0			
347		NEW	ALL	ST2NH	26 Mar 18 23:39...	81374	0/10...	MY SHACK AND ANT	JPG-16	<W>		
346			PY4ZBZ	ST2NH	26 Mar 18 23:39...	368	1/ 0%	Re: QSL from Athenoxat-1	ASCII-0	<W>		
344		NEW	AC2CZ KO...	G8T2J	26 Mar 18 21:51...	1348	0/10...	RE: Recover from BB Resets	ASCII-0			
343			EB2AT	G8T2J	26 Mar 18 21:51...	465	1/ 0%	Re: Hi	ASCII-0			
33e			PY4ZBZ	ST2NH	26 Mar 18 15:22...	449	1/ 0%	Re: Hello from Brazil	ASCII-0	<W>		
32f			ALL	PY4ZBZ	26 Mar 18 09:57...	25687	1/ 0%	QSL from Athenoxat-1	JPG-16	PY4ZBZ		
32e		PART	EA6WQ	ST2NH	25 Mar 18 17:35...	362	2/67%	Re: One alive here !!	ASCII-0	<W>		
32d			PY4ZBZ	ST2NH	25 Mar 18 17:34...	520	1/ 0%	hello and thanks	ASCII-0	<W>		
32c		NEW	EA6WQ	ST2NH	25 Mar 18 17:34...	363	0/10...	Re: One alive here !!	ASCII-0	<W>		
327		PART	ALL	PY4ZBZ	25 Mar 18 10:33...	15523	6/31%	My antennas	JPG-16	PY4ZBZ		
31e			PY4ZB	EA6WQ	25 Mar 18 00:41...	359	1/ 0%	Hello	ASCII-0	all		
31f			G8T2J	EB2AT	24 Mar 18 23:04...	350	1/ 0%	Hi	ASCII-0			
31d			EA6WQ	EB2AT	24 Mar 18 23:01...	360	1/ 0%	Re: Saludos	ASCII-0			

KISS ONRESTART  
TNC IN FULL DUPLEX  
TX DELAY: 130ms  
Decoder Ready

PB: ??????

DIR: 0 holes. Age: 10 days | DL: Listening | Sent: 0 / Rec: 0 / Eff: 0%

Open: ??????  
File: 0 0% | UL: Idle | LAYER2: Disc I:0

Version 0.37a - 11 Nov 2020 | Logs: C:\Users\chris\Desktop\Test\IPACSAT

DATA | COM8 | Telem: 136 / 0

To mark a file for download, select it with the mouse or the arrow keys and then press one of the numeric keys from 1-4. This will give it a download priority, with 1 being the highest priority. You can also select 0 to clear the priority or N to prevent the file from being downloaded automatically, as discussed below in the section on Directory Selection Equations.

If you double click on a file then it opens in another window, as I did with the message “MY SHACK AND ANT” from Nader, ST2NH. You see the result below, a really nice image he uploaded.

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A screenshot of the AMSAT Message Editor window. The window has a title bar "Message Editor" with standard minimize, maximize, and close buttons. Below the title bar is a menu bar with "File" and "Edit". Under "File", there are buttons for "Reply", "Reply Inc", "Export", and "Exit". The "Reply" button is highlighted with a blue border. Below the menu bar are input fields for "To:" (set to "ALL"), "From:" (set to "ST2NH"), and "Title:" (set to "MY SHACK AND ANT"). There is a "Keywords:" field with "<W>" entered. To the right of the "To:" field is a "Compressed" checkbox (unchecked) and a "JPG" dropdown menu. Below these fields is a "Date:" field showing "26 Mar 18 23:07:51 UTC". The main content area of the window displays two images: the top one is a photo of a man with grey hair and a beard, wearing a blue shirt, sitting at a desk with a computer monitor and various electronic equipment; the bottom one is a photo of a large, complex antenna structure made of many thin metal rods.

From here you can reply to the message. If it is a text-based message you can press “Reply Inc” to include the original message in your response.

## 4.3 Telemetry

We would like your help downloading telemetry from the spacecraft and then uploading it to the telemetry server. All you need to do is go to the File > Settings screen and complete some of the details. Fill in your locator or lat/long and make sure “Send AMSAT Telemetry” is selected. Then any downloaded telemetry is forwarded to the server.

This will automatically forward broadcast telemetry and any full or partial Whole Orbit Data Files received. If you are able to transmit to the spacecraft you may want to ask for WOD files to be downloaded automatically using a Directory Selection Equation, as described below. Even if you don’t manage to download complete files, any partial fragments are very helpful.

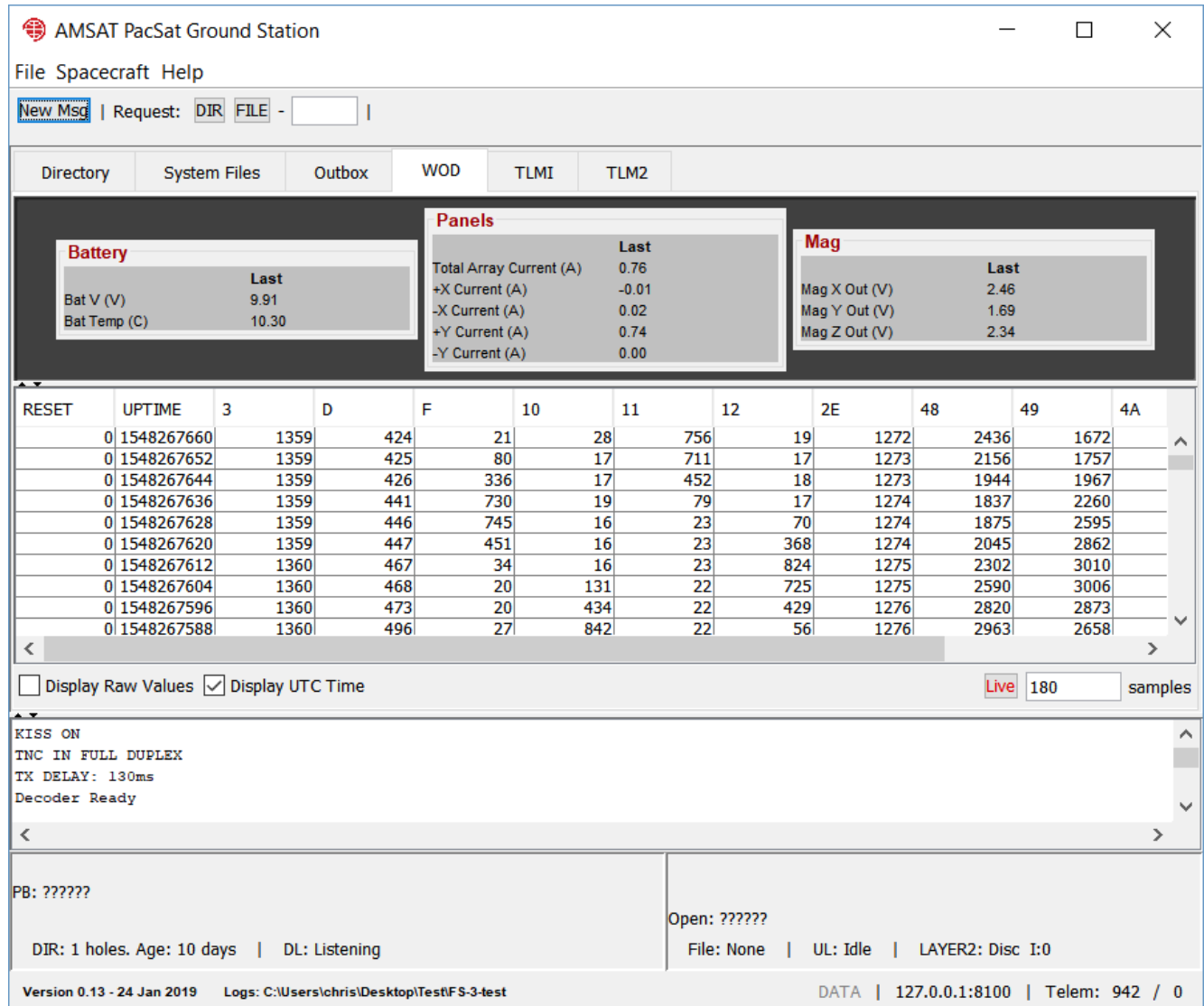
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A screenshot of the "Settings" window for PACSAT Ground Station. The window is titled "Settings" and has a close button (X) in the top right corner. It is divided into several sections: "Files and Directories", "Ground Station Params", "Options", and "TNC".  
**Files and Directories:**  
Home directory: C:\Users\chris\PacsatGroundConfig  
Server Data URL: http://tlm.amsatfox.org/tlm  
Log files directory: C:\Users\chris\Desktop\Test\PACSAT\_DEV1\ (with a "Browse" button)  
Archive directory: C:\Users\chris\Desktop\Test\PACSAT\_ARCHIVE\ (with a "Browse" button)  
**Ground Station Params:**  
Groundstation Name: N8MH  
Telem Server: tlm.amsatfox.org  
Lat (S is -ve): 51.64583  
Long (W is -ve): -0.375  
Lat Long gives Locator: io91tp  
Altitude (m): 0  
RF-Receiver Description: NONE  
**Options:**  
☒ Send AMSAT Telemetry  
☐ Enable Logging  
☐ Log KISS  
☐ Inhibit Transmitter  
☐ Debug Layer 2  
☐ Debug Uplink  
☐ Debug Downlink  
☐ Debug Tx  
☐ Show System Files on Dir Tab  
☒ Force Log window to scroll to end  
**TNC:**  
Interface: ☒ Serial ☐ TCP  
Com Port: COM8 (dropdown menu)  
Baud Rate: 9600 (dropdown menu)  
☒ Toggle TNC in/out of KISS Mode  
☐ Send TNC custom bytes at startup  
TX Delay: 130  
At the bottom of the window are "Save" and "Cancel" buttons.

Downloaded telemetry is shown on the WOD, TLMI and TLM2 tabs. If you are familiar with FoxTelem then you will recognize these screens. Like FoxTelem, if you click on a value a graph opens up and plots the data that you have collected.

You can download the telemetry that everyone else has uploaded. Select File > Fetch Server Data. But be careful. You will get a warning that your existing log file data will be overwritten. This will only overwrite telemetry logs and won't impact your directory, your downloaded System Files or your uploads. If you don't want to overwrite, then switch to a new directory using File > Settings or create shortcuts to start PacsatGround with different directories passed in as a parameter. I have a shortcut called FS-3 Server that starts PacsatGround in a directory that only contains server data.

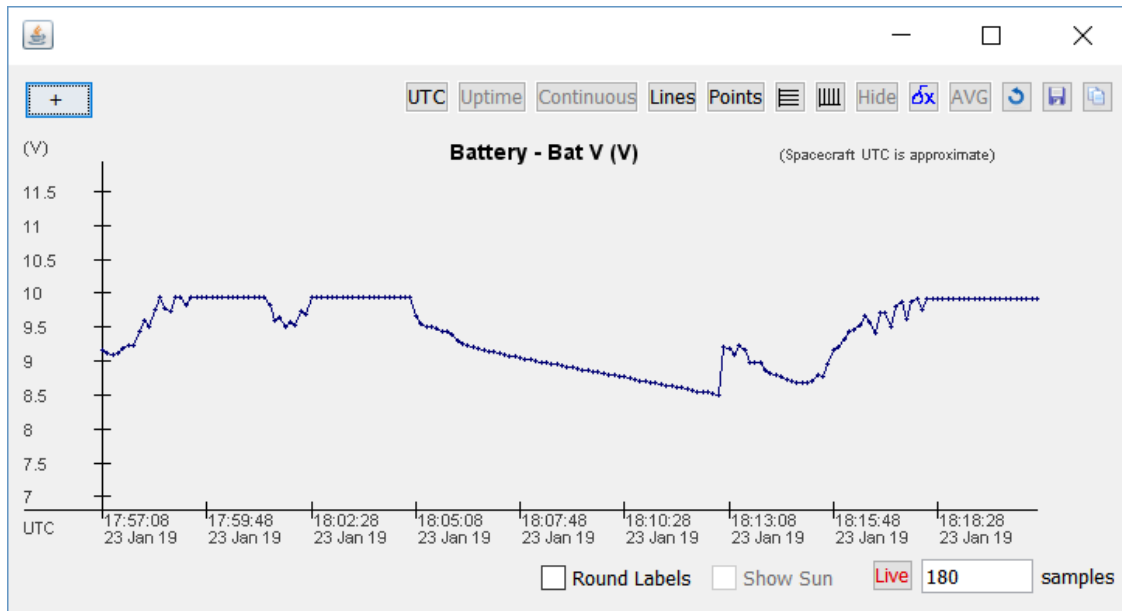
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Below is a graph of Bat V from the Whole Orbit Data, showing the last 180 values. By default this is plotted against UTC. Unlike the Fox spacecraft, “Uptime” just shows the number of seconds since the Unix date epoch and not the uptime of the spacecraft.

You can use the “+” button in the top left to add other traces from the same data set. Saving to a file as CSV values is not yet working. Let me know if you need it.

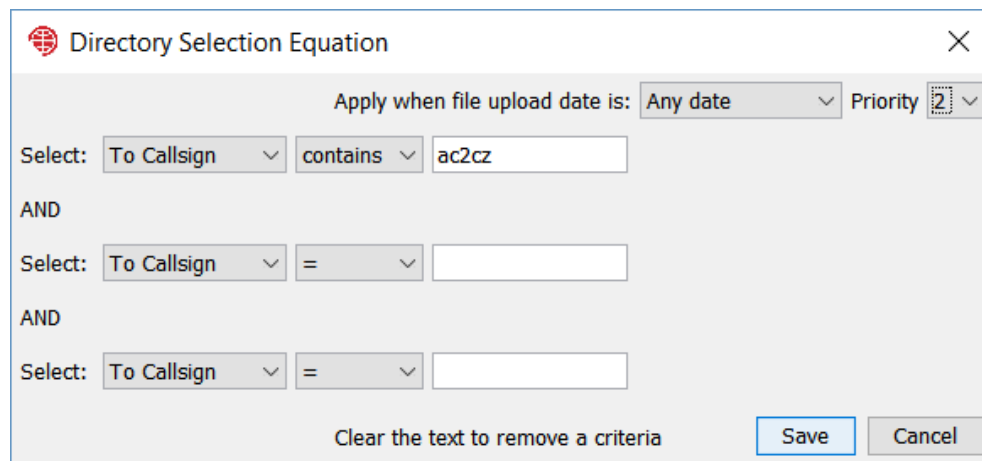




#### 4.4 Directory Selection Equations

It is fun to watch a Pacsat pass and see the files appear. You can select them for download and compose a response in real time. If you are lucky it gets uploaded before the pass is done. But you can not always be in front of the computer. If someone sends a message directly to you, then it would be nice if it was automatically downloaded without you having to give it a priority. To do this you setup a directory selection equation. It's called an equation for historical reasons.

On the Spacecraft > FalconSat-3 screen you can see a section of the window for Equations. It is initially empty. Click "Add" to enter an equation, which gives you the screen below:



The screenshot shows the "Directory Selection Equation" dialog box. It has a title bar with a globe icon and a close button. The main area contains three criteria separated by "AND" labels. The first criterion is "Select: To Callsign" with a dropdown menu, followed by "contains" with a dropdown menu, and then a text input field containing "ac2cz". The second and third criteria are identical but empty. At the top right, there are dropdowns for "Apply when file upload date is:" (set to "Any date") and "Priority" (set to "2"). At the bottom, there is a "Clear the text to remove a criteria" button, a "Save" button, and a "Cancel" button.

On this screen I have specified that if "To Callsign" in the Pacsat Header contains the string AC2CZ then set the priority to 2. This applies to a file with any upload date.

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A screenshot of the "Directory Selection Equation" dialog box. At the top, it says "Apply when file upload date is:" followed by a dropdown menu set to "Any date" and "Priority" followed by a dropdown menu set to "3". Below this, there are three criteria separated by "AND". The first criterion is "Select: To Callsign" followed by a dropdown menu set to "contains" and a text box containing "ALL". The second criterion is "Select: File Size" followed by a dropdown menu set to "<" and a text box containing "20000". The third criterion is "Select: To Callsign" followed by a dropdown menu set to "=" and an empty text box. At the bottom, there is a link "Clear the text to remove a criteria", a "Save" button, and a "Cancel" button.

In the example above I have specified that the message needs to be to ALL and the size of the file should be less than 20k. This will exclude large images. Priority is 3.

A screenshot of the "Directory Selection Equation" dialog box. At the top, it says "Apply when file upload date is:" followed by a dropdown menu set to "Current Day" and "Priority" followed by a dropdown menu set to "4". Below this, there are three criteria separated by "AND". The first criterion is "Select: File Type" followed by a dropdown menu set to "=" and a text box containing "3". The second criterion is "Select: To Callsign" followed by a dropdown menu set to "=" and an empty text box. The third criterion is "Select: To Callsign" followed by a dropdown menu set to "=" and an empty text box. At the bottom, there is a link "Clear the text to remove a criteria", a "Save" button, and a "Cancel" button.

And then in the example above I have specified the File Type to be "3" which is a Whole Orbit Data (WOD) file. If you are willing to help collect telemetry, set this rule up. Note that it will flag today's file's only, but it does not automatically switch the rule off. You can setup another rule to set File Type 3 to Priority N after 2 or 3 days. This prevents you from getting back logged with older telemetry files.

See the appendix for File Types.

### 4.5 Uploading Files

If you press "New Msg" on the main screen you get an editor window, ready to create a new message.

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A screenshot of a software window titled "New Message". The window has a standard Windows-style title bar with a minimize button, a maximize button, and a close button. Below the title bar is a menu bar with "File" and "Edit". Under "File", there are three buttons: "Export", "Send", and "Exit". The main area of the window contains several input fields: a "To:" field, a "From:" field with the text "G0KLA", a "Keywords:" field, and a "Title:" field. To the right of the "To:" field is a dropdown menu labeled "Select Type". Below these fields is a large text area containing the text ".... select document type to edit".

You can not enter any text until you select the type. For a text message pick ASCII. If you want to upload an image then pick JPG. I need to add some more image types. You can actually pick PNG or some other image formats and it will create the message and upload it. It will probably work with PacsatGround but it may confuse legacy software like WISP. If you test it, let me know what happens.

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In the “To” Field you put one or more callsigns and/or ALL. Keep the title short and pick some keywords if you want.

Once you hit “Send” the message is added to the Outbox and can be seen on the Outbox tab. Here we can see if the spacecraft has assigned it a file number yet. We also see the State, which is QUE and which becomes SENT or FAIL depending on the result of the upload. If the upload fails then an error message is printed in the log area. I’d like the message to go here in a future release.

## 5 Appendix

### 5.1 Starting in Different Directories

You can pass the data directory in at startup, so that you can use scripts or short cuts to run PacsatGround with different data sets. This is most useful to keep a separate copy of server data.

On Linux or MacOS create a shell script with something like the following:

```
cd <directory where Pacsat Ground is installed>
java -jar PacSatGround.jar /home/chris/radio/fs-3-data
```

If java is not in your path you will need the full path to java.

On windows go to the folder where PacsatGround is installed.

- Right click on PacSatGround.exe and drag the icon to the place you want a shortcut. When you release the button you get a menu. Pick “Create Shortcut Here”.
- Right click on the new icon and select Properties. In the field “Target” add the Data folder directory after the target as the first parameter passed to the program when it is launched. In fact you can cut and paste the directory from Explorer if you click in the path at the top of the window.
- Now when you double click the icon it runs PacsatGround using the passed directory as the data folder. It uses a unique set of settings which are stored in the data folder.

## 5.2 Archiving the directory

If there are thousands of files in the directory you have downloaded then eventually things slow down and the ground station may not be responsive enough. It may not be able to respond to the spacecraft quickly enough so that transmissions and replies get out of sync. It may seem that you are unable to upload files.

In this case you can archive the directory as follows.

First make a new folder for the archive data. e.g. if your downloaded data is in /home/g0kla/amsat/pacsat then make a folder like /home/g0kla/amsat/pacsat\_archive\_2020

On the Spacecraft > FalconSat-3 screen, decide how many headers you want to keep by specifying the Archive Limit. This will be the number of headers and files that are kept after you archive.

Directory Settings	
Oldest Files (days)	990
Archive limit (headers)	200

On the File > Settings screen, select the archive folder. For example, I have picked the PACSAT\_ARCHIVE folder below:

Files and Directories		
Home directory	C:\Users\chris\PacsatGroundConfig	
Server Data URL	http://tlm.amsatfox.org/tlm	
Log files directory	C:\Users\chris\Desktop\Test\PACSAT_DEV1\	Browse
Archive directory	C:\Users\chris\Desktop\Test\PACSAT_ARCHIVE\	Browse

Then run the archive with File > Archive The Directory

This will move all of the headers and their associated files into the archive folder. It will keep the most recent files.

Archiving should be an infrequent operation, You do not need to archive every day, week or even month. You can't archive into the same folder (because I did not write that code) so next time you archive you will need to pick a new empty folder.

You can open an archive folder whenever you want. Go to File > Settings and change the Log Files Directory to the archive folder. Then you are looking at the archived files. Change it back for live operation. Or use the approach described in the previous section to setup a script or icon to open an archive folder.

### **5.3 File Types**

This is the list of Pacsat File types I have.

- 0 ASCII Text message.
- 2 Bulletin Board Satellite Gateway Files
- 3 UOSAT whole orbit data
- 6 MSDOS EXE file
- 7 MSDOS COM file
- 8 Keplerian elements - NASA format
- 9 Keplerian elements - AMSAT format
- 12 Binary file(s).
- 13 Multiple files, all ASCII text
- 14 Picture file - GIF format
- 15 Picture file - PCX format
- 16 Picture file - JPG format
- 17 Confirmation Message
- 18 Multiple destination SatGate files
- 19 Internet forward files
- 200 Config. files U/L from command stations
- 201 AL FTL0/PB activity logs
- 202 BL Broadcast logs
- 203 WD whole data logs
- 204 ADCS logs
- 205 TDE data
- 206 SCTE data
- 207 Transputer logs (including EISLOG)
- 208 SEU logs (ELTLOG)
- 209 CPE files (UO3)
- 210 Battery charge logs
- 211 Image files
- 212 PL\* (SPL Logs)
- 213 CU\* (PCT Log Files)
- 214 PC\* (PCT Command Logs)
- 215 Quick look image files
- 221 CCD Image files (KO23)
- 222 CPE Result files (KO23)
- 255 All others not fitting in the above

## 5.4 Troubleshooting

The TNC seems to be receiving data but nothing is shown in Pacsat Ground	Make sure you are in KISS mode. Try connecting to the TNC from a normal terminal and putting it manually into KISS mode. If there is a special way to put your TNC into KISS let me know. Right now it uses the TNC2 compatible method, sending the string KISS ON followed by RESTART. Also note that it takes the TNC out of KISS when it exits by sending a KISS frame with one byte ff. (The whole frame is c0,ff,c0)
I never transmit any data from the TNC even though PacsatGround sends data to it	Are you really in Full Duplex mode?
It crashed, what do I do?	Log an issue on <a href="https://github.com/ac2cz/Falcon/issues">github.com/ac2cz/Falcon/issues</a> or send an email to the author <a href="mailto:g0kla@arrl.net">g0kla@arrl.net</a>
I connect to my computer using a Remote Desktop Connection (RDP) and Pacsat Ground is always not running.	This seems to be a Windows “feature”. When you connect the RDP connection kills something in the audio subsystem that upsets Java. This is outside the Pacsat Ground code base and I don’t have a fix. I recommend using AnyDesk for remote connections.
Everything has got really slow and I no longer seem to be able to upload files	The directory may be too large and your transmissions are out of sync with the replies from the spacecraft. Reset or archive the directory. See the Appendix 5.2