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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 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 and Mir-Sat-1. In particular the support for telemetry collection is probably bespoke to those spacecraft.

1.1 License

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3 Getting Started

3.1 A bit about PacSats

FalconSat-3, Mir-Sat-1 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 and connected mode.

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You may think this is all very old and out of date, and perhaps using low speeds at 9600bps is, but the protocols form the basis of modern high speed, delay tolerant communications through spacecraft.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 produces a decent amount of telemetry. That telemetry is broadcast periodically and some also store telemetry in Whole Orbit Data (WOD) files on board. In fact, there is more data stored than a single AMSAT Operations ground station can download. We are asking for your help collecting telemetry. Any WOD files you collect and any broadcast telemetry you receive can be forwarded to the telemetry server. Partial files are just as helpful as complete files because we can 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.

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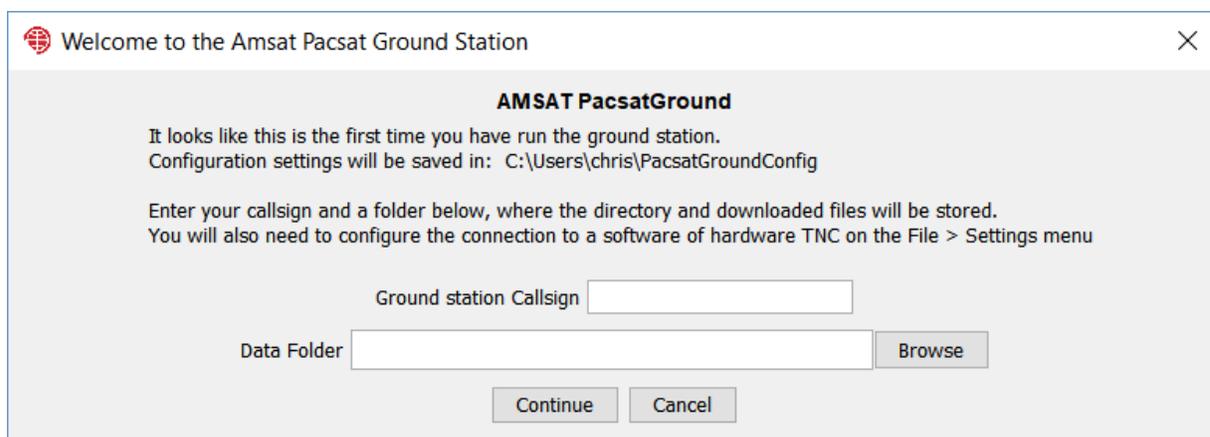


Once you have done that, to run on windows double click PacSatGround.exe. To run on Linux or MacOs you may be able to double click on the jar file or you can run the supplied start script, called PacSatGround. If that does not work then you can run from the command line. Make sure you are in the same directory as the program, then run with:
java -jar PacSatGround.jar

MacOs makes all of this quite difficult for non-technical users. You can run the program with the start script but you must first install the Java Development Kit (JDK). The Java Runtime (JRE) is not sufficient. 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 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 name to keep track of who has contributed telemetry.



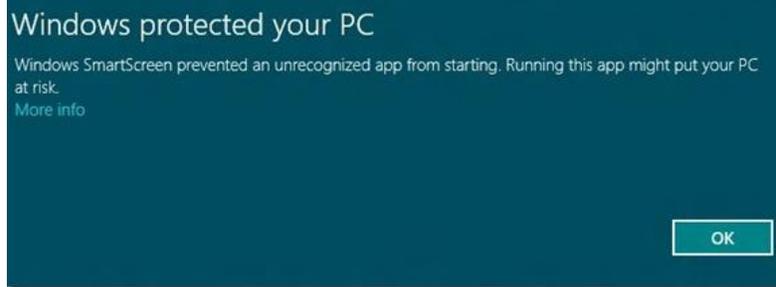
Pacsat Ground will write the configuration file into your home directory. This means it can find the configuration even if you change the data folder or move the installed program. For me on Windows that is c:\users\chris\PacsatGroundConfig\PacSatGround.properties

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>

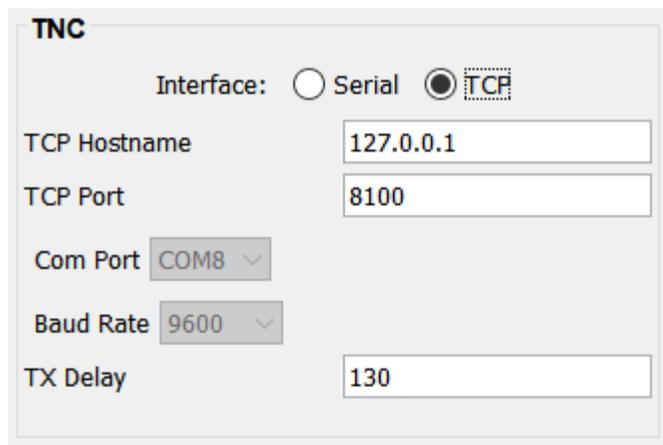
If PacSatGound still won't start, then ask for help on the amsat-bb mailing list: <https://www.amsat.org/amsat-new//tools/maillist/maillist.php> or email gOkla@arrl.net.

3.4 Setup

Pacsat ground is designed to have minimal setup. The parameters needed to connect to FalconSat-3 or Mir-Sat-2 are included in configuration files. 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. You need to download hs_soundmodem (hs for high speed). 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.

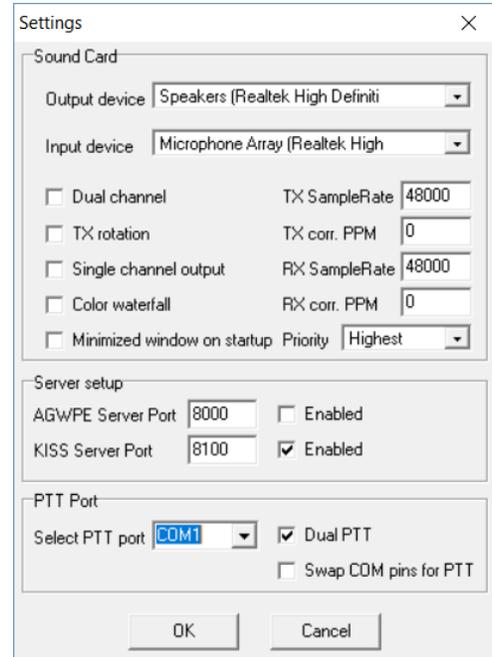
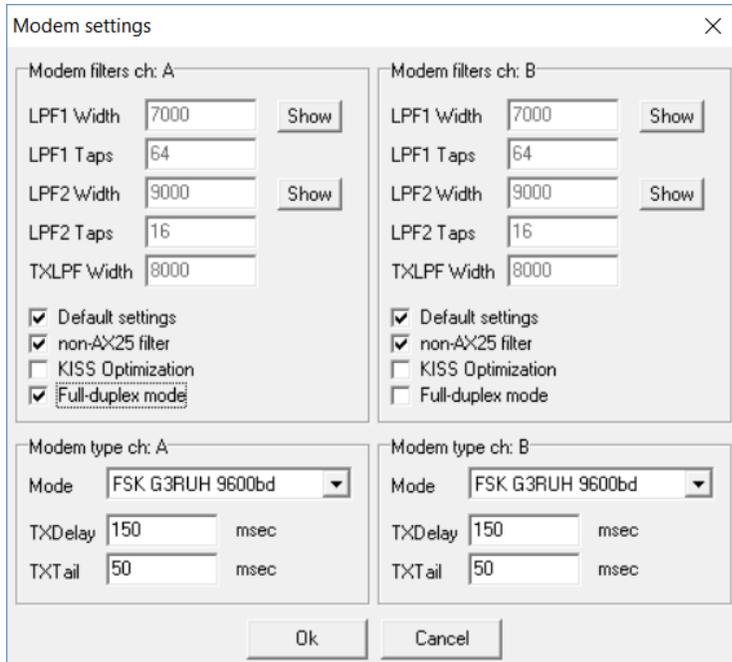


In hs_soundmodem you choose FSK G3RUH 9600bp as the modem type on the Settings > Modems screen (or a different setting if the spacecraft you are using requires it). Configure it to be full duplex.

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. You can not take the radio's audio from the headphone or speaker jack. You must take the audio from a port that preserves the full bandwidth of the audio signal. The headphone and speaker jacks will be filtered to remove low and high frequency noise, so they are not suitable.

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.

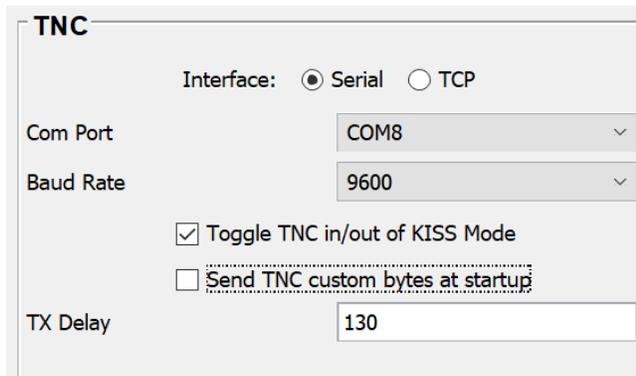
You will also need to arrange a way to key your radio to transmit. This is best achieved using a COM port. Select the COM port that you have used on the Devices screen.



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 PacsatGround 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.



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.

A screenshot of the 'TNC' configuration window. At the top, it says 'TNC'. Below that, 'Interface:' has two radio buttons: 'Serial' (selected) and 'TCP'. 'Com Port' is a dropdown menu showing 'COM8'. 'Baud Rate' is a dropdown menu showing '9600'. There are two checked checkboxes: 'Toggle TNC in/out of KISS Mode' and 'Send TNC custom bytes at startup'. Below these, 'Edit:' has two radio buttons: 'Text' and 'Bytes' (selected). There are two sections for custom bytes: 'Send these bytes to TNC at startup' and 'Send these bytes to TNC at exit'. The first section has two rows: 'KISS ON' with bytes '4B 49 53 53 20 4F 4E 0D 52 45 53' and 'RESTART' with bytes '54 41 52 54 0D'. The second section has one row: 'ÀÿÀ' with bytes 'C0 FF C0'. At the bottom, 'TX Delay' is a text box containing '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), because that is what many TNCs expect. 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

When in Pacsat mode, the spacecraft is constantly transmitting, so as 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:

The screenshot shows the AMSAT PacSat Ground Station software interface. At the top, there is a menu bar with 'File', 'Spacecraft', and 'Help'. Below the menu bar, there is a 'New Msg' button and a 'Request:' dropdown menu with options 'DIR', 'FILE', and 'All Files'. The main window displays a directory listing for 'July 21 2018-07-21-15.KSS'. The directory listing has columns for 'File', 'Pri', 'St...', 'To', 'From', 'Old Time', 'Uploaded', 'New Time', 'Size', 'H...', 'Title', 'Keywor...', 'Filename', and 'Zip'. The directory listing shows three files: b17, b18, and b14. Below the directory listing, there is a terminal window showing the following text:

```

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
    
```

At the bottom of the terminal window, there is a status bar showing 'PB: AC2CZ\D.', 'DIR: 1 holes. Age: 888 days | DL: ON PB | Sent: 0 / Rec: 0 / Eff: 0%', 'Open: ??????', 'File: 0% | UL: Idle | LAYER2: Disc I:0', and '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, if it has one. For example, if we see a message like:

Open ABCD:

This means that the uplink to the spacecraft is open and available for use. Currently FalconSat-3 allows uploads but Mir-Sat-1 does not.

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. Send me an email.

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 on the system files are hidden for FalconSat-3 as most people are interested in the user files. For Mir-Sat-1 only system files are available, so they are displayed by default. 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.

But you do not have to wait for a file to be fully downloaded before you try to read it. Often partial files can be opened and understood. Partial images will be displayed whenever that is possible. Large images from Mir-Sat-1 will be incrementally downloaded and the file window can be left open to monitor the progress.



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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:...	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:...	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:...	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			PY4ZBZ	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: ??????

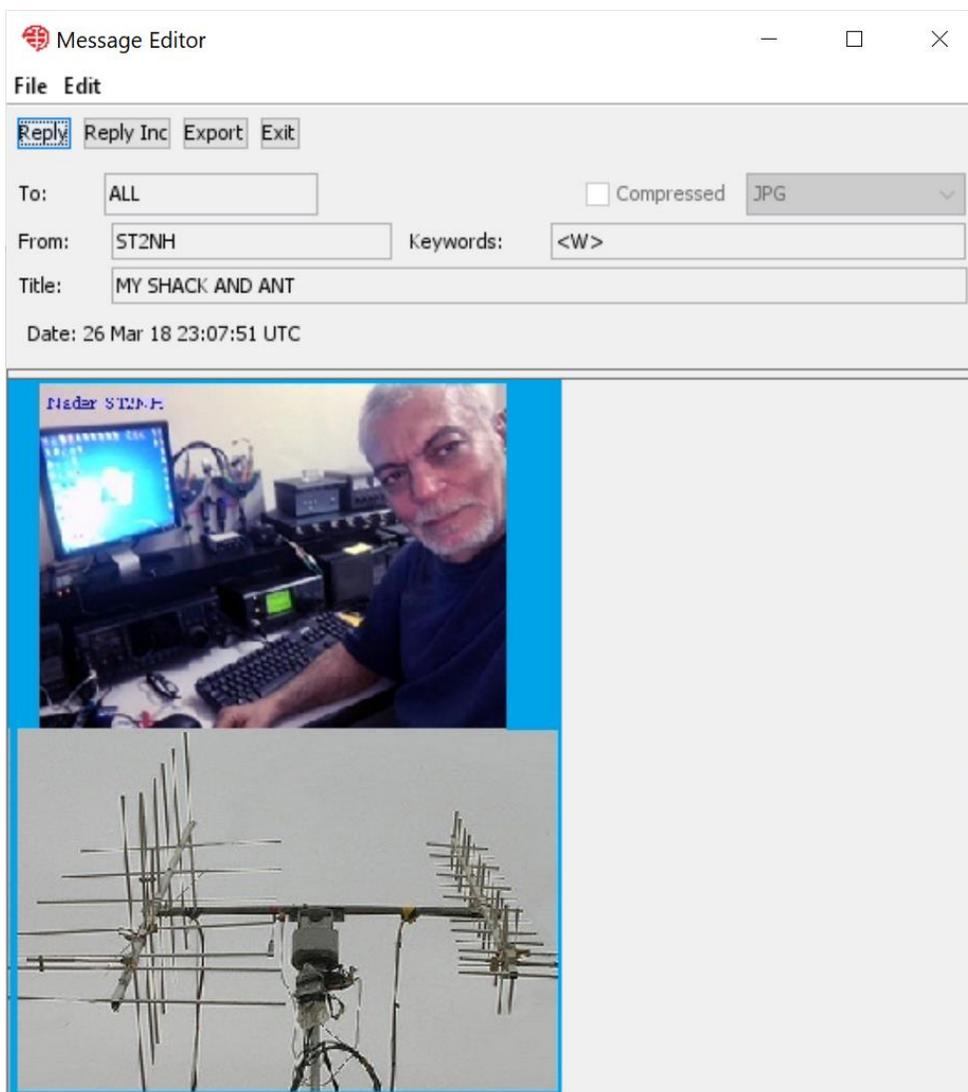
File: 0 0% | UL: Idle | LAYER2: Disc I:0

Version 0.37a - 11 Nov 2020 Log: C:\Users\chris\Desktop\Test\PACSAT 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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From here you can reply to the message if the spacecraft supports uploads. 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 Server Telemetry” is selected. Then any downloaded telemetry is forwarded to the server. Telemetry for FalconSat-3 is sent to AMSAT-NA and telemetry for Mir-Sat-1 will be warehoused at SatNogs.

This setting will automatically forward broadcast telemetry and any full or partial Whole Orbit Data Files received. If you are able to transmit to a spacecraft like FalconSat-3 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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The screenshot shows the "Settings" dialog box for PacsatGround. 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)
Baud Rate: 9600 (dropdown)
 Toggle TNC in/out of KISS Mode
 Send TNC custom bytes at startup
TX Delay: 130
At the bottom, there are "Save" and "Cancel" buttons.

Downloaded telemetry is shown on the WOD, TLM 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.

For FalconSat-3 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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— □ ×

File Spacecraft Help

New Msg | Request: DIR FILE - |

Directory
System Files
Outbox
WOD
TLMI
TLM2

Battery

	Last
Bat V (V)	9.91
Bat Temp (C)	10.30

Panels

	Last
Total Array Current (A)	0.76
+X Current (A)	-0.01
-X Current (A)	0.02
+Y Current (A)	0.74
-Y Current (A)	0.00

Mag

	Last
Mag X Out (V)	2.46
Mag Y Out (V)	1.69
Mag Z Out (V)	2.34

RESET	UPTIME	3	D	F	10	11	12	2E	48	49	4A
0	1548267660	1359	424	21	28	756	19	1272	2436	1672	
0	1548267652	1359	425	80	17	711	17	1273	2156	1757	
0	1548267644	1359	426	336	17	452	18	1273	1944	1967	
0	1548267636	1359	441	730	19	79	17	1274	1837	2260	
0	1548267628	1359	446	745	16	23	70	1274	1875	2595	
0	1548267620	1359	447	451	16	23	368	1274	2045	2862	
0	1548267612	1360	467	34	16	23	824	1275	2302	3010	
0	1548267604	1360	468	20	131	22	725	1275	2590	3006	
0	1548267596	1360	473	20	434	22	429	1276	2820	2873	
0	1548267588	1360	496	27	842	22	56	1276	2963	2658	

Display Raw Values Display UTC Time Live samples

```

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

PB: ??????

DIR: 1 holes. Age: 10 days | DL: Listening

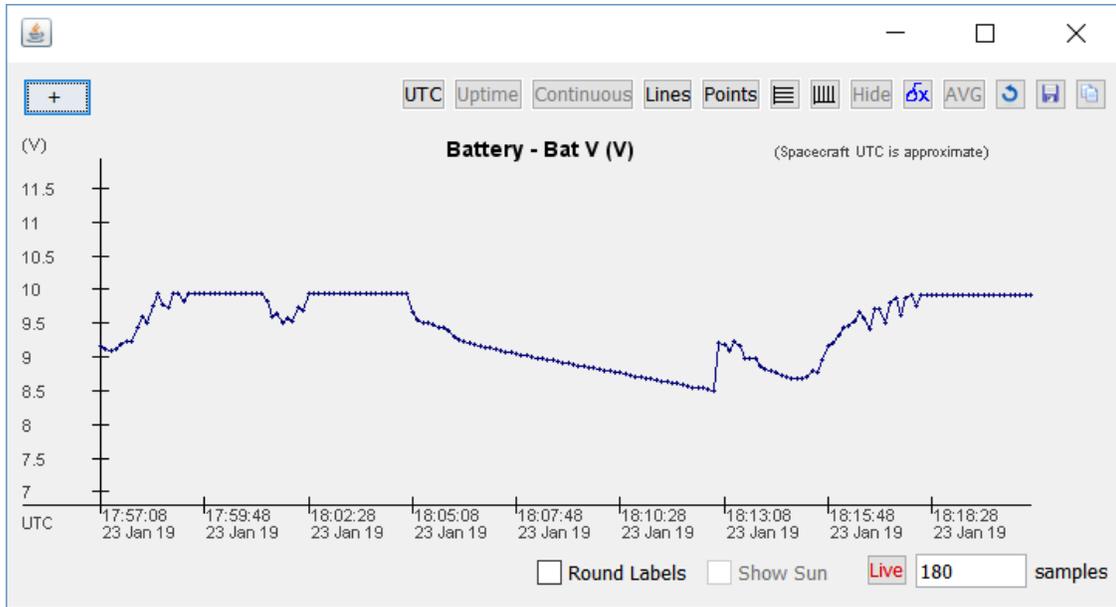
Open: ??????

File: None | UL: Idle | LAYER2: Disc I:0

Version 0.13 - 24 Jan 2019
Logs: C:\Users\chris\Desktop\Test\F3-3-test
DATA | 127.0.0.1:8100 | Telem: 942 / 0

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.

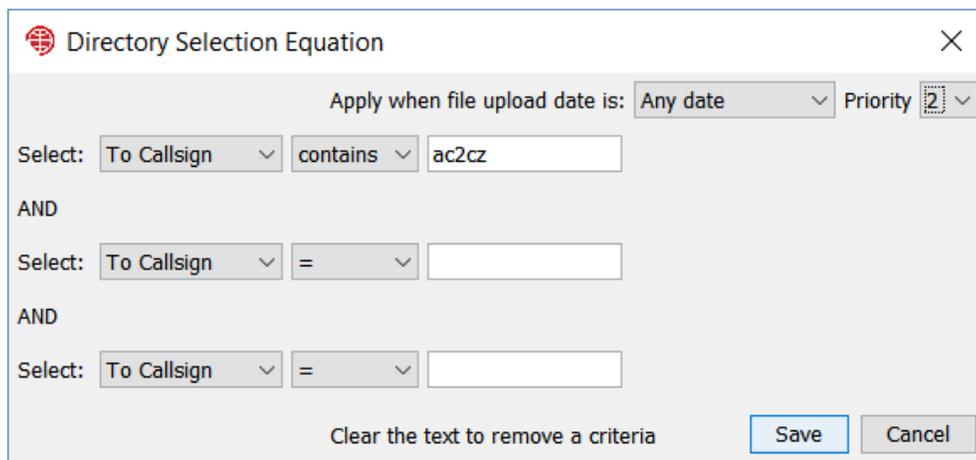
You can use the “+” button in the top left to add other traces from the same data set. Saving to a file as CSV values is not yet working. Let me know if you need it.



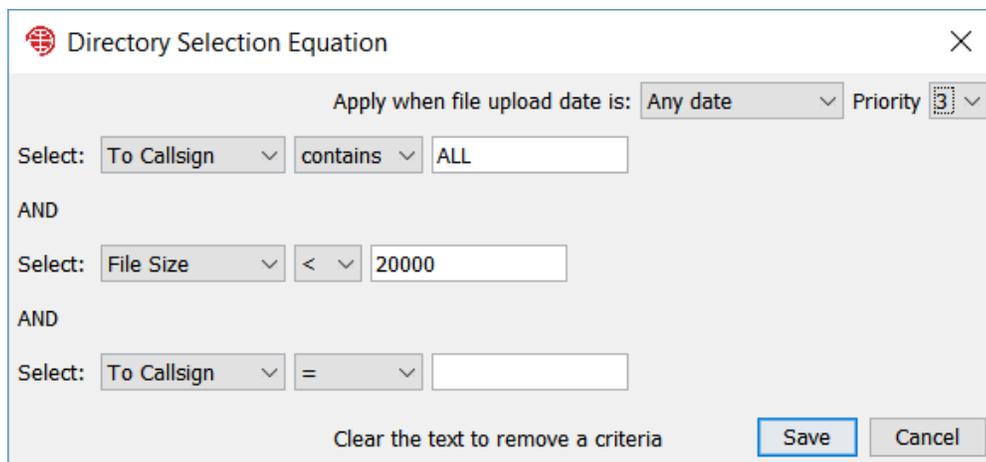
4.4 Directory Selection Equations

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 but you can think of it as a download rule.

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:

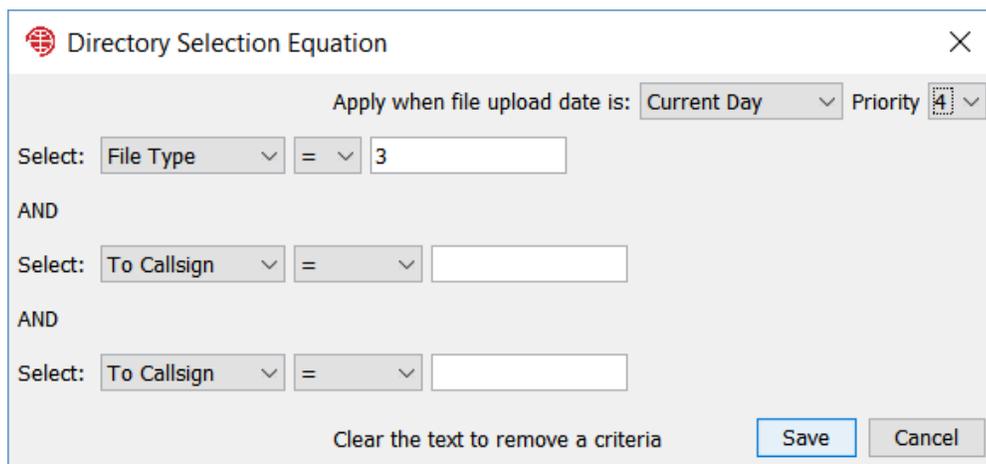


On this screen I have specified that if "To Callsign" in the Pacsat Header contains the string AC2CZ then set the priority to 2. This applies to a file with any upload date.



The screenshot shows a dialog box titled "Directory Selection Equation". At the top right is a close button (X). Below the title bar, there are two dropdown menus: "Apply when file upload date is:" set to "Any date" and "Priority" set to "3". The main area contains three criteria separated by "AND" labels. The first criterion is "Select: To Callsign" with a dropdown arrow, followed by "contains" with a dropdown arrow, and a text input field containing "ALL". The second criterion is "Select: File Size" with a dropdown arrow, followed by "<" with a dropdown arrow, and a text input field containing "20000". The third criterion is "Select: To Callsign" with a dropdown arrow, followed by "=" with a dropdown arrow, and an empty text input field. 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.



The screenshot shows a dialog box titled "Directory Selection Equation". At the top right is a close button (X). Below the title bar, there are two dropdown menus: "Apply when file upload date is:" set to "Current Day" and "Priority" set to "4". The main area contains three criteria separated by "AND" labels. The first criterion is "Select: File Type" with a dropdown arrow, followed by "=" with a dropdown arrow, and a text input field containing "3". The second criterion is "Select: To Callsign" with a dropdown arrow, followed by "=" with a dropdown arrow, and an empty text input field. The third criterion is "Select: To Callsign" with a dropdown arrow, followed by "=" with a dropdown arrow, and an empty text input field. 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 the spacecraft supports uploads and 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 title bar with a minimize button, a maximize button, and a close button. Below the title bar, there is a menu bar with "File" and "Edit" options. Underneath the menu bar, there is a toolbar with three buttons: "Export", "Send", and "Exit". The main area of the window contains several input fields: a "To:" field with an empty text box and a "Select Type" dropdown menu; a "From:" field with the text "GOKLA" and a "Keywords:" field with an empty text box; and a "Title:" field with an empty text box. Below these fields, there 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 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.

The screenshot shows the AMSAT PacSat Ground Station application window. At the top, there's a title bar with the application name and standard window controls. Below that is a menu bar with "File", "Spacecraft", and "Help". A toolbar contains a "New Msg" button and a "Request:" dropdown menu currently set to "DIR", with a "FILE" button and a text input field containing "35f". The main area is titled "TEST1 2018-03-25-13.KSS" and features a tabbed interface with "Directory", "System Files", "Outbox", "WOD", "TLM1", and "TLM2". The "Outbox" tab is active, displaying a table with columns: File, Pri, State, To, From, Uploaded, Size, Title, Type, Keywods, and Filename. A single entry is visible: File "0", State "QUE", To "AC2CZ", From "G0KLA", Uploaded "01 Jan 70 00:...", Size "267", Title "What a fine morning in Brooklyn", Type "ASCII", Keywods "HELLO", and Filename "G0KLA2.tx...". Below the table is a log area showing "TX: DIR REQ: HOLES: 1 FLG: 10 BLK_SIZE: f4 ..." and "Nothing heard from spacecraft ...". At the bottom, there's a status bar with "PB: Empty..", "DIR: 1 holes. Age: 10 days | DL: Listening", "File: None | UL: Idle | LAYER2: Disc I:0", and "Version 0.13 - 24 Jan 2019 | Logs: C:\Users\chris\Desktop\TestIFS-3-test | DATA | 127.0.0.1:8100 | Telem: 942 / 0".

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.

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- 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. If you have spaces in your directory names then the directory path needs to be in quotes.
- 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:

C:\Users\chris\Desktop\Test\PACSAT_DEV1

then make a folder like:

C:\Users\chris\Desktop\Test\PACSAT_ARCHIVE

On the Spacecraft > FalconSat-3 screen (or the screen for Mir-Sat-1), 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)	<input type="text" value="990"/>
Archive limit (headers)	<input type="text" value="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	<input type="text" value="http://tlm.amsatfox.org/tlm"/>
Log files directory	C:\Users\chris\Desktop\Test\PACSAT_DEV1\ <input type="button" value="Browse"/>
Archive directory	C:\Users\chris\Desktop\Test\PACSAT_ARCHIVE\ <input type="button" value="Browse"/>

Then run the archive with File > Archive The Directory

This will prompt to confirm. If you only want to archive one of the spacecraft then just say yes to that one. It 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

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5.4 Troubleshooting

<p>The TNC seems to be receiving data but nothing is shown in Pacsat Ground</p>	<p>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.</p> <p>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)</p>
<p>I never transmit any data from the TNC even though PacsatGround sends data to it</p>	<p>Are you really in Full Duplex mode?</p>
<p>It crashed, what do I do?</p>	<p>Log an issue on github.com/ac2cz/Falcon/issues or send an email to the author g0kla@arrl.net</p>
<p>I connect to my computer using a Remote Desktop Connection (RDP) and Pacsat Ground is always not running.</p>	<p>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.</p>
<p>Everything has got really slow and I no longer seem to be able to upload files</p>	<p>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</p>