# How to be successful with the
# ISS PACKET PERSONAL MESSAGING SYSTEM
## ISS PACKET OPERATIONS MANUAL

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**(Layout by Claudio Ariotti, IK1SLD)**

The ISS Packet system is now working as a two-way mailbox (*Personal Message System*).
This mailbox is only designed as a single user mailbox. Because it is a single user mailbox, you must be very careful when attempting to use the mailbox, in order to prevent unintentional interference to other users.
In this memo, I will try to explain some of the important procedures you should know before you try to access the ISS Packet mailbox system. The ARISS team would like to remind you that if you use the mailbox to send a message to the ISS crew, that you should not expect to get a reply back from the ISS crew.
There are over 2 million amateur radio stations world wide, and many have potential access to this single user Personal Message System.
Please be supportive of this proof-of-concept project, which is also a tool for the ISS crew and not necessarily a worldwide resource.

## EDUCATION :

Over the years, the human space flight teams (SAFEX, MIREX, MAREX, SAREX) have run similar Packet projects in space. One of the important things learned was that your success increased with knowledge. In countries where Amateur Radio Stations took the time to learn correct packet procedures, the success rate was very high when using the PMS on Mir.
In other countries, where people did not know the correct packet procedures, the success rate was limited only to station running kilowatts of ERP. Please help us educate the world.

## HARDWARE :

The Space Station ISS is currently using an Ericsson single band 2-meter radio transceiver and a PacComm Terminal Node Controller AX.25 1200-baud packet modem (usually just called a TNC or a Modem).
The radio is currently connected to an externally mounted mono band antenna (two antennas on opposite sides of the Zarya (FGB), co-phased together and tuned for 147 MHz).
The typical power output of this system is 4-5 watts.

To work ISS from your home, you should have at least the following Amateur Radio equipment:

- A 2-meter radio with an output rating of 25 to 50 watts.
- An omni-directional antenna or small beam.
- A short run of good quality coax (RG-213, 100 feet or less).
- A standard 1200-baud AX.25 Packet modem (TNC).

And that is it for radio equipment. I use an inexpensive KPC-3 modem for all of my ISS packet connections and I can even hear ISS with my police scanner.

## TIMING :

You will need access to a computer or web to tell you when ISS is in range of your station.
The timing of your contact is the most important part of a successful contact with ISS.
There are many tracking programs out in the market place today.
The ARISS team does not endorse any specific tracking program. Some programs are share-ware (STSPLUS); others cost a few bucks. I recommend using the DOS InstantTrack, program by AMSAT. www.amsat.org
This program is very easy to use and works very well with older style computers such as 80286 style PC's. The cost of most tracking software applications is approximately $50-100.

## DOPPLER SHIFT :

The ISS Space Station is traveling around the Earth at over 17,500-mph (28,000 kph).

This great speed will make radio signals appear to shift in frequency.

This phenomenon is called **Doppler Shift.**

Many of us have radios that are Channel locked.  This means you cannot make any fine tuning adjustments to your receiver or transmitter's frequency.  Most Mobile and HT radios cannot make any frequency changes less than 5 kHz channel steps (lets hope that radio manufacturers will add 1 or 2 kHz channels steps in the future).

This Doppler shift will cause the ISS transmit frequency (145.800) to look as if it is 3.5 kHz higher in frequency when ISS is approaching your location.

If you listen on 145.805 or 145.795, your reception may actually improve (for a 5 kHz radio).

You will need to review the owner's manual for your radio to learn how to program 'Odd-Splits' channel combinations and program the following consecutive frequencies into your radios' memories.

| For 5 kHz channel step radios do not try to adjust for Doppler | | | | | |
|---|---|---|---|---|---|
| **Channel 1** | 145.800.0 RX | 144.490.0 TX | **Voice** | **Region 2** **Region 3** | North & South America Asia, Australia |
| **Channel 2** | 145.800.0 RX | 145.990.0 TX | **Packet** | **Worldwide** | |
| **Channel 3** | 145.800.0 RX | 145.200.0 TX | **Voice** | **Region 1** | Europe, Africa |

| For VOICE - 2.5 kHz channel step radios | | | | |
|---|---|---|---|---|
| **Channel 1** | 145.802.5 RX | 144.487.5 TX | **Region 2** **Region 3** | North & South America Asia, Australia |
| **Channel 2** | 145.800.0 RX | 144.490.0 TX | | |
| **Channel 3** | 145.797.5 RX | 144.492.5 TX | | |

| For PACKET - 2.5 kHz channel step radios | | | |
|---|---|---|---|
| **Channel 4** | 145.802.5 RX | 145.987.5 TX | **Worldwide** |
| **Channel 5** | 145.800.0 RX | 145.990.0 TX | |
| **Channel 6** | 145.797.5 RX | 145.992.5 TX | |

| For VOICE - 2.5 kHz channel step radios | | | |
|---|---|---|---|
| **Channel 7** | 145.802.5 RX | 145.197.5 TX | **Region 1** Europe, Africa |
| **Channel 8** | 145.800.0 RX | 145.200.0 TX | |
| **Channel 9** | 145.797.5 RX | 145.202.5 TX | |

Let's assume ISS is approaching your location (QTH) and the packet system is active.

Use channel #4 at the beginning of the pass, then when ISS is over head, use channel #5 and when ISS passes your QTH use channel #6.

For best results, use an updated tracking program, which displays the current Doppler shift.

A program such as InstantTrack will display the Doppler shift in real-time.  This will assist you in determining when it is best to change channels.

As you may have noticed, it is not recommended for you to adjust your uplink frequency on 5 kHz radios. You will have better results if you leave your receiver on 145.800 and your transmitter on 145.990 (for packet).

The Doppler shift is only at the +3.5 kHz setting for a few seconds, then it will slowly begin to approach zero. After 5 minutes or less, the Doppler shift will be 0 for a few seconds, and then it will begin to swing towards -3.5 kHz.


## TNC CONFIGURATION :

To operate the ISS PMS, you will need to modify some of the settings on your TNC.  Most of the parameter changes required for ISS will be compatible with terrestrial BBS operations.  Using these suggested parameters will improve you're connection rate and at the same time help reduce Interference (QRM).

This is a portion of the TNC parameters in my KPC-3; your actual parameters may vary:

| | |
|---|---|
| **AUTOCR** | **OFF** |
| **LFADD** | **OFF** |
| **MAXFRAME** | **4** |
| **MCON** | **ON** |
| **MCOM** | **ON** |
| **MONITOR** | **ON** |
| **PACLEN** | **72** |
| **RETRY** | **8-10** |
| **TIME STAMP** | **ON** |

**LFADD:** This value seems to interfere with normal ISS BBS operations.  Make sure LFADD is turned **OFF**.

**MCOM:** Set this value **ON** if you want to see the details of every single packet. This is very useful while monitoring space packets.

**MCON:** This value is normally turned OFF for terrestrial BBS connections, and ON for connections to the ISS PMS.  This value will allow you to see packets going to other stations, while you are Connected or Attempting to Connect.  All courteous operators using ISS will keep this value **ON**.

**MONITOR:** An **ON** value allows monitoring of packets while not connected.

**PACLEN:** Lots of short packet lengths are less likely to be clobbered than a few very long packets.

**RETRY:** You do not want to set this value too high because you may cause QRM during your initial connect.  Also, if 'RETRY' is too short, you may time-out during the one of the 4 deep RF signal fades.  During a 10-minute pass, there will be 4 RF polarity shifts in the signal coming from ISS. This shift is caused by the apparent change in orientation of the ISS antennas in relation to your antenna.

**TIME STAMP:** With Time Stamp turned **ON**, you will be able to log data to your disk while you are away and track the time and duration's of the passes.


## LEARN TO READ PACKET :

There are only a half dozen actual packet headers.  If you take the time to learn the different headers, you will be more successful in connecting to the ISS packet system.  If you set your TNC to the correct parameters, you will be able to monitor all of the data coming from the ISS PMS.  The packet data you see will typically fall into one of the 6 categories listed below.

**C** - Connect request
**D** - Disconnect request
**DM** - Disconnect mode
**UA** - Unnumbered Acknowledge
**UI** - Unconnected Information frame
**I(n)** - Information frame or Index packet (n=0-7).

## ISS PACKET COMMAND LISTING :

It takes a long time to down load the HELP file from ISS.  I have included an actual copy of the ISS help file.  The commands are similar to most terrestrial TNC's.  You should review these commands and compare them to your TNC owner's manual.

| | | |
|---|---|---|
| **B(ye)** | **B** [CR] | disconnects you from PMS. |
| **H(elp)** | **H** [CR] or **?** [CR] | displays this help file. |
| **J(log)** | **J** [CR] | displays a list of callsigns heard (optional date/time) |
| **K(ill)** | **K n** [CR] | deletes message number **n**  (only to/from your callsign). |
| **KM(ine)** | **KM**[CR] | deletes all READ messages addressed to your call sign. |
| **L(ist)** | **L** [CR] | lists the 10 latest messages. |
| **M(ine)** | **M** [CR] | lists the 10 latest messages to/from your callsign. |
| **R(ead)** | **R n** [CR] | reads message number **n**. |
| **S(end)** | **S** (callsign) [CR] | begins a message addressed  to (callsign). |
| | **SB** Sends Bulletin | |
| | **SP** Sends Personal | |
| | **ST** Sends Traffic | |
| | **Subject**: | ending with [CR]. |
| | **Text:** | End each line with [CR]. End message by typing **/ex** [CR]  or **CTRL-Z** [CR] at the beginning of a new line. |
| **SR(eply)** | **SR n**[CR] | Sends a reply to message **n** prompting only for text. |
| **V(ersion)** | **V** [CR] | displays the software version of the PMS system. |

The only commands the Public should be using are:

- **Bye**, to disconnect.
- **Kill** and **KM**, to delete your old mail.
- **List** and **Mine** to see a message list.
- **Read**, **Send** and **SR**, for mail

The rest of the commands are for the system operator usage.

### Software Version of the Packet System:

```
International Space Station
(c) Copyright 1985-2001
PacComm Packet Radio Systems, Inc.

AX.25 Level 2 Version 2.0
Features:
  KISS
  SMR TRUNKING
  1024K EXTENDED PMS MEMORY
  Expanded NMEA 183 (GPS) SUPPORT

Release 5.0.2 May 07, 2001
```

## PRACTICE  PRACTICE  PRACTICE :

If you want to be successful in sending and receiving packet mail from ISS you must be fully proficient in using packet mail on Earth first, before you make any attempt to use the packet mail system on ISS.

### Your Goals:

To send and/or receive a message from ISS, as efficiently as possible.
To help teach others to do the same.
Make sure your 2-meter station is fully functional and your TNC, Computer and Radio connections are 100% reliable.  Practice on Earth before you reach for space.
Find a local terrestrial packet BBS to use for your practicing.

## *Upload:*

Log into your local BBS and try sending a series of packet messages to your self.

Each message should be less than approximately 500 bytes long. (The sample message listed below was approximately 500 bytes long)

Learn all of the fast upload features of your TNC program and learn how to upload a 500-byte file from disk into a terrestrial BBS quickly.  Never send a file larger than 500 bytes (that is bytes NOT kilobytes).  Remember there are less than 64,000 bytes of memory for the active mailbox.

## *Download:*

You will also need to know how to down load all data from a BBS session to disk, so you can save and read the data later.  You do not want to waste time reading the messages on your screen while you are connected to the ISS PMS.

Read all messages and listing AFTER you have logged out and disconnected.

## *Time it:*

Keep practicing until you can successfully perform all of the following commands in less than 60 seconds.

- **Log in** to a BBS
- **Upload** a mail message from disk to the BBS
- **Kill** a sample message
- **Log off** the BBS

After you have mastered the above tasks, it is now on to the next step.

Find a distant terrestrial weak signal BBS that you can connect to (signal level S3 - 4).

Weak signal BBS will be harder to work when the channel is busy with lots of activity.

You should test with the weak signal terrestrial BBS first during off hours, and then repeat the test during prime time, when the channel is full of other packet traffic.

Sending data to a weak signal BBS during peak traffic hours will be similar to working the ISS PMS, however the ISS PMS is a little harder.

Now repeat the same practice session as before. Keep practicing on the weak signal terrestrial BBS until you can successfully perform all of the following commands in less that 60 seconds.

- **Log in** to a BBS
- **Upload** a mail message from disk to the BBS
- **Kill** a sample message
- **Log off** the BBS

Now try for ISS and please be courteous.

## PICKING A PASS :

Use your computer program to select a good pass with high elevation angles.

When ISS first appears on the horizon, the satellite will be 1500 miles (2400 km) away.

When ISS is directly over your house, it is only 240 miles (384 km) away.

Using your tracking program, pick a pass with a maximum elevation of over 40 degrees.  These are typically the best passes because ISS will be closer to your QTH.  If you were to try to call ISS when it is low on the Horizon, you will probably not be successful.

For low elevation angles, your radio signal will have to travel along the ground, where it will be affected by trees, buildings and hills.

When ISS is high above the trees, you will have a clear line-of-site shot to the ISS antenna.

A 1000-mile contact on 2-meters is easy, that is if there is nothing between you and the other station. A good pass is only 10 minutes long.  Since ISS is low on the Horizon during the beginning and end of each pass, you will want to avoid calling during the first two and last two minutes of each pass.  This will still leave you with a 6-minute window of opportunity.

## CALLING ISS :

Before you begin calling ISS on packet, make sure you are familiar with the operations of your packet system. Try experimenting with a local terrestrial PBBS or connecting to a friends TNC. Practice uploading short files from your disk to another station. See if you can Login, upload and logout in less than a minute. Once you have mastered this technique on a busy PBBS frequency, you will be ready for ISS. Most TNC programs will allow you to save packet files you have read to your disk. You can learn a lot from perusing your old data files of previous ISS passes.

When ISS first comes over your Horizon, it will usually be already connected to another Amateur Radio Station. Before you transmit, monitor the data coming down from ISS.
If you read the data carefully, you will be able to determine if another station is logged into the ISS PMS. If you see any 'Index' packets going from ISS to any other station, then ISS is connected a station. An Index packet is any packet from ISS with the tag <<I0, I1, I2, I3, I4, I5, I6, - I7>>

### *Example:*

In this example, the ISS PMS is connected to WF1F and is in the process of transferring a Packet Mail message.
Each line contains the call sign of the sender (RS0ISS-1).
The call of the receiving station (WF1F).
The Index packet or Information Frame and number sequence 0 - 7.

```
RS0ISS-1>WF1F <<I0>>:Stat   : PR
RS0ISS-1>WF1F <<I1>>:Posted : 00/00/00 00:33
RS0ISS-1>WF1F <<I2>>:To     : WF1F
RS0ISS-1>WF1F <<I3>>:From   : RS0ISS
RS0ISS-1>WF1F <<I4>>:@ BBS  :
RS0ISS-1>WF1F <<I5>>:xID    :
RS0ISS-1>WF1F <<I6>>:Subject: HAM- FUN
RS0ISS-1>WF1F <<I7>>:
```

You will only see Index packets if the Mailbox is being used.
If you attempt a connection to ISS while it is busy, you will receive the message:

**RS0ISS-1>yourcall <<DM>>: "RS0ISS Busy"**

When you receive a 'Busy' from ISS, then you must STOP calling the ISS PMS.
Do not attempt to call ISS until you see the currently connected station 'Log-off':

**RS0ISS-1>someonescall/V :<<I1>>: - Logged off**

# Remember
## *ONLY ONE STATION CAN CONNECT TO THE ISS PMS AT A TIME*

If you continue your attempt at connecting to the ISS PMS while it is busy, the following will happen:

1. You will be causing intentional interference (QRM)
2. The station currently connected may not be able to log off, because of the QRM generated by your station. This will cause ISS to go into a 'time-out loop' and prevent anyone from logging into ISS for 1-2 Minutes.
3. Anyone within 3000 miles of your stations will be able to see ISS sending DM messages to your station. If you do not follow the correct procedures, everyone within 3000 miles will know who is causing the interference (QRM).

### *When is it appropriate to call the ISS Packet PMS:*

Set your terminal program to save all data to disk. This will help you look ack and see a lot of good data. If you are unable to connect to ISS, you can read what other people were sending.
This is a sample of a station logging off from ISS:

```
RS0ISS-1>WF1F/V [12/30/02 04:20:57]: <<I1>>:  - Logged off
RS0ISS-1>WF1F/V [12/30/02 04:20:58]: <<D>>:
*** DISCONNECTED [12/30/02 04:20:58]
RS0ISS-1>CQ/V [12/30/02 04:20:59]: <<UI>>:  - Logged off
```

## <span style="color:red">NOW YOU MAY BEGIN CALLING ISS</span>
### C RS0ISS-1

This is the only time you can log into the ISS PMS port.  You need to look for the:

**RS0ISS-1>CQ/V - Logged off**     packet coming from ISS.

Another packet flag you should be aware of is the  **<<D>>**  Disconnect Request message.
This packet message means that ISS is trying to disconnect from the station currently connected to this port.  This is different from the  **<<DM>>**  Disconnect Busy message.
If the station connected to ISS goes out of range, then an '***Idle-timer***' will force a log out after 1-2 minutes.  The ISS PMS will send several **<<D>>** messages to the connected station.  Then ISS resets and sends out the desired  **CQ, <<UI>>**  packet (UI = Unconnected Information frame).


### ISS CALL SIGN :
The call sign of the Packet station has changed several times.
Currently the Mailbox address is **RS0ISS-1**.  The address may change from time to time between RS0ISS and RS0ISS-1.

### *I have connected, now what?*
Before you connect, you should have a plan of what you want to accomplish. Try to keep your connection time limited to 60 seconds or less.  With this goal in mind, you will be limited to what you can do during one pass.  Here are a few examples:

1. Login, Send a short message (**S RS0ISS or just S**) and then Logout.
2. Login, List the last 10 messages (**L command**), read a message addressed to ALL (**R n**) and Logout.
3. Login, Read mail to your station **(R n**), Kill your mail (**K n**) and Logout

After you have connected, keep your mail messages short  (2 or 3 lines). The TNC on ISS has a very limited amount of memory for mail messages (the TNC has a 1 Meg RAM, however only 64k is allocated for mail storage in each mailbox).
If someone sent mail to you via ISS, then make sure you delete the message before you upload any more mail.  The reason you want to delete first before you upload, is to make room for your new message.

### *Actual Message from ISS.*
Here is an actual message sent from ISS commander Valery Korzun to Dave Larsen N6CO, on June 28, 2002.  It is mandatory that you have your terminal program configured to save all data to your disk drive.  This will allow you to read the information after the pass and not tie-up the TNC by slowly reading the information as it is displayed.  There will be plenty of time after the pass to review the details of your messages. In this message, I will point out a few important items in [   ].

```
30-Jun-02  09:03:43
CONNECTED to RS0ISS-1
Logged on to RS0ISS's Personal Message System
on board the International Space Station

You have mail waiting.
```

*[ After you login, if there is mail waiting for you, you will get the 'mail waiting' message and an automatic listing of all mail to and from your call sign ]*

```
Msg #  Stat   Date       Time    To      From    @ BBS    Subject
 844   P      00/00/00 00:07 N6CO    RS0ISS          HELLO
 824   BR     00/00/00 00:19 ALL     N6CO            2 Line ISS Keps 6-28
 795   PR     00/00/00 00:40 RS0ISS N6CO            DLYA Valery [RZ3FK]
CMD(B/H/J/K/KM/L/M/R/S/SB/SP/ST/SR/V/?)>
r 844
```

*[ Here, Dave reads his message with the 'r 844' command, which is R for read, and the message number. In this example, there looks like there is a problem with the time clock in the TNC ]*

```
Stat   : PR
Posted : 00/00/00 00:07
To     : N6CO
From   : RS0ISS
@ BBS  :
xID    :
Subject: HELLO

Dave, I'm glad to receive mess from you and thanks for your biography. Very
nice to meet you again, brave pilot. I'm ex-fighter-Mig- 21,Mig-29.I
served as pilot 12 years, then I was student air force academy, then
Gagarin cosmonaut training center from1987 to June 2002.Married.One son.
Your Russian is very good. Thanks for support and help. Hope hear you
soon.73.Valery.

CMD(B/H/J/K/KM/L/M/R/S/SB/SP/ST/SR/V/?)>
```

*[ As soon as Dave has downloaded the message, he immediately deletes the old message from the ISS mailbox. This is very important because the selected mailbox only has approximately 64k bytes of memory available for mailbox storage ]*

```
k 844
Message erased
CMD(B/H/J/K/KM/L/M/R/S/SB/SP/ST/SR/V/?)>
30-Jun-02  09:04:31
DISCONNECTED: RS0ISS-1
```

*[ Dave has now logged out of the ISS mailbox. Start time was 09:03:43 - End time was 09:04:31 Total time: 48 seconds ]*

I used Dave's message for a few reasons.

- First, it was an interesting memo. It gives us some insight to Commander Valery Korzun's background.
- It shows us that, the commander has a good understanding of the English language, not all ISS crewmembers are fluent in multiple languages. It does help to send email in the native language of the recipient.
- Since Dave is a very experienced ham (Mir amateur radio system operator for 10+ years and ISS packet system operator), it shows you a good example of how to Login and Logout fast, so that the next person can get in. Dave took 48 seconds, this is a little longer than usual because the channel was very busy and there were many 'RETRY' collisions. His hardware for this message consisted of a Zero 'dBd' antenna and 150 watts of power. When you take into account the coax loss and you convert this over to an ERP value, it gave him an ERP value of 75 watts.

## PMS USAGE :
The PMS can also be used to meet people in other parts of the world. If you do send a message looking for a foreign Packet Pen Pal, make sure you include your return terrestrial packet address or Email address.

Once you have made friends around the world, you should then keep in touch via Terrestrial packet/Email methods and do not use the PMS.  One of the few exceptions may be if you are in a boat in the South Pacific or you are out of range of all other Terrestrial PBBS systems.
Trying to Work All States or DXCC via ISS is strictly taboo.

The PMS is NOT a Public Bulletin Board System (PBBS).  You should never post following types of messages on the ISS PMS:
*For Sale, Equipment Wanted, Special Event Stations, etc.*

The ISS PMS station also supports the Digital Repeater option called digi-peating.
This feature should only be used, when no one is using the PMS mail ports.
The one station actively using the Mailbox has top priority.  Read in your TNC manual the section on using the UNPROTO option.
Please practice using the option on a Terrestrial packet station first before going on to ISS.  With Unproto, you can bounce messages off the ISS PMS and chat with people thousands of miles away.
Two-way full connects using the ISS digital-repeater are possible, but extensive testing has proven this feature is not as reliable as Unproto.  The Sysops do not want anyone to use the digital-repeater for two-way-ack connects.

## Layout by Claudio Ariotti,  IK1SLD

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