Host Mode Programmer's Guide

Purpose

This document describes Kantronics' host mode as implemented in
Kantronics TNCs beginning with version 5.0. Prior versions of the
host mode are considered obsolete and will not be described or
supported. A complete description of the host mode format is
included, providing software programmers sufficient information
to fully implement support for Kantronics' products.

Scope

This document describes the host mode in all Kantronics TNCs. Some
units are single port units (i.e. one radio connection) and
others are two-port units. In addition, some models are capable
of operating packet radio only, while others add the ability to
operate HF modes such as RTTY, G-TOR, and Pactor.

Assumptions about the reader

This document assumes you are familiar with the operation of the
TNC in the command mode (i.e. from the cmd: prompt). It further
assumes that you are familiar with the purpose of the various
commands within the TNC; it will not attempt to describe the
purpose and/or syntax of the individual commands. Kantronics
provides this document to assist programmers with the required
details to implement host mode support in their programs,
    however, Kantronics will not provide help with coding your program
    or suggestions on how to organize your program.

Conventions

Throughout this document, the following conventions will be used.
    Hex numbers will be shown as 0xNN where NN is the hex code. < >
    is used to indicate that this is a single character over the
    serial port. For example <CTRL-C> indicates the control-c
    character (0x03), and <FEND> indicates a single character (0xC0).
    <FEND> indicates the character used to begin and end all host
    frames. This character is a hex 0xC0 or decimal 192.

Overview of Host Mode

Kantronics host mode provides a standardized method of
communication between a host computer and the TNC. This is
    accomplished through a special setting of the INTFACE command
    which enables host mode. Once the TNC is placed in host mode, all
    communication between the TNC and the computer will occur using
    this host method.

    Entering Host Mode

To enter the host mode of operation, you must first be
communicating with the TNC. This implies that you have
initialized the TNC through its autobaud routine and entered a
callsign. Once this is done, place the TNC in the host mode by
issuing two command: INTFACE HOST and then RESET. These are
standard terminal mode commands and can therefore be sent with
    any communications program. Remember each command ends with a <CR>

character.

Flow Control

In order to provide flow control between the TNC and computer in host
mode, the RTS and CTS lines must be properly connected, and the software
must be written to provide hardware flow control. To do this, the software

must detect and respond to the state of the CTS line (when CTS is
inactive, the software cannot send any data to the TNC), and must also
control the state of the RTS line. The TNC will not send any data to the
computer when the RTS line is inactive.

Host Frame Format

Once the TNC is placed in host mode, the communication between the
computer and TNC occurs in "frames." All frames begin and end with a
special character called a FEND (Frame End). This character is a hex 0xC0
(192 decimal). The FEND character is not permitted to occur anywhere
within a frame, only at the beginning and end of the frame. the basic
format for host frames includes the opening FEND, a one byte "PORT" byte,
one byte "STREAM" byte, optional "DATA" bytes, and a closing FEND. Most
host frames will contain all of these, however some host frames (detailed
later) may not require all of these items.

Data from the host computer to the TNC are considered COMMAND frames,
instructing the TNC to perform a function, or DATA frames which provide
data for transmission to the TNC.
Data Transparency

If it is necessary to send a FEND character as data rather than the
beginning or end of a frame, as special FESC (Frame escape) character must

be sent first, followed by a TFEND (translated FEND) character. The FESC
character is hex 0xDB (219 decimal) and a TFEND character is hex 0xDC (220

decimal). Should it be necessary to send a FESC character in the data
stream, a similar two-character sequence is required. To insert a FESC
into the data, your program must send a FESC character followed by a TFESC

(translated FESC). The TFESC character is hex 0xDD (221 decimal).
In summary, the following special two-character translations must be
implemented as indicated below:

To send as data	Send these codes to the TNC
0xC0	0xDB 0xDC
0xDB	0xDB 0xDD
When you receive	Translate it to
0xDB 0xDC	0xC0
0xDB 0xDD	0xDB

When operating host mode, the computer controls the size of a data frame.
When operating packet, the host computer should insure that no frame
contains more than 256 data characters. The TNC paclen parameter will not
affect the size of data frames, as the TNC will transmit one entire host
frame as a single AX.25 frame. In order to remain compatible with the
existing packet radio network, a frame must contain no more than 256
characters. The above special translations do not affect the transmitted
frame size. For example, if your need to send 256 <FEND> characters in a
single frame, you must translate each <FEND> into a <FESC><TFEND>
combination. This means that you will actually be sending 512 characters
in the data portion of the host frame. This is legal since the TNC will
convert this before transmission over the radio, resulting in only 256
data bytes in the AX.25 frame that is transmitted.
Front Panel LEDs

The front panel CON and STA lights are updated whenever a stream change
occurs. Therefore, a host mode program should send a host frame with a
command byte of C and the new PORT and STREAM bytes whenever a user
changes from one display channel to another. For example, to update the

front panel LEDs to show the status of stream B on port 1, send the host
frame <FEND>C1B<FEND>.

There may be times during program operation that you would like to issue a

command to determine additional status information about a specific
stream. One example would be to check the number of tries that have
occurred in trying to send a connected packet. To do this, your program
will need to use the TRIES command, however this command does not use the
PORT or STREAM byte. You can still perform this function by using the
following technique. First, send a host frame to switch to the desired
channel (e.g. <FEND>C1D<FEND>). Next send a host frame with the tries
command, and a STREAM byte of 0 (i.e. <FEND>C10TRIES<FEND>). This will
return the tries count for the last stream that was addressed. Your
program should then update the front panel LEDs to the current stream
status as discussed above.

Data Restrictions

Using a terminal mode, some characters are assigned special meaning.
<CTRL-C>, for example, returns the TNC to the cmd: prompt from the
converse mode. This results in many characters that cannot be easily
transmitted from standard terminal programs. A list of these characters
can be shown by issuing the DISPLAY C command to your TNC.

Using Kantronics host mode, however, makes sending and receiving any data
possible. Since all transmitted data is contained in a host frame, the TNC

will simply pass the data through for transmission, even if it one of the
spacial characters (i.e. <CTRL-C>). The only exceptions are the two
special characters <FEND> and <FESC> noted above.

Buffer usage in the TNC

Proper implementation of flow control between the computer and the TNC
requires that you understand the operation of certain buffers within the
TNC. A simplified diagram of the buffers in the TNC is shown below. Note
that data from the computer are first placed in the TTY input buffer. This

buffer is then transferred to a second buffer, depending on the type of
data.

                                        Packet buffer
              TTY Input   Command buffer
                                        HF buffer

Commands are transferred to a command buffer for processing by the
firmware. Data which are to be transmitted on packet are transferred to a
packet buffer, and data intended for an HF mode (e.g. RTTY) are placed in
the HF buffer.

Those TNCs which do not support HF modes will not have the HF buffer
indicated above, but will have the Packet buffer and Command buffer.
The size of the buffers can be determined by using the STATUS command.
When operating from the command mode (cmd: prompt), giving the status
command will return a line indicating FREE BYTES. This indicates the
number of free bytes available in the Packet buffer.

As data are moved into the packet buffer (from the TTY Input buffer), the
data is queued for transmission over the radio. Since the radio speed is
generally much slower than the computer-to-TNC speed, it is likely that
new data queued for packet transmission will eventually fill the Packet
buffer. When this happens, the data backs up into the TTY Input buffer.
When the TTY Input buffer is nearly full, the TNC will cause the CTS line
to go inactive, providing hardware flow control and stopping data from the

computer.

An important point here is that the TTY Input buffer is a FIFO (First In,

First Out) buffer. Since commands to the TNC must pass through this buffer

in order to reach the command buffer, any data already in the TTY Input
buffer must be processed before a command can be processed. A well-written

program will, therefore, check the status command periodically and never
permit the FREE BYTES number to reach zero.

When operating with a TNC that supports HF modes as well as packet, the
STATUS command reports two numbers in the FREE BYTES section. A typical
response might indicate "FREE BYTES 1520/3040", indicating 1520 bytes free

in the packet buffer and 3040 bytes free in the HF buffer. As long as your

program never allows free bytes to reach 0, you will be able to issue
commands to the TNC. Note that the status command will only show two
numbers if the TNC is currently operating in the packet mode and
simultaneously operating an HF mode. This is only possible in host mode.

Host-to-TNC frame format

This diagram shows the basic construction of a host frame sent to the TNC
from a computer.

Byte 1 | Byte 2 | Byte 3 | Byte 4 | Variable Length | Last Byte
FEND | Command | Port | Stream | Data | FEND

Communication from the host to the TNC must occur in blocks. The block of
data is delimited with a FEND character at the beginning and end of the
block.

Following the opening FEND, the next byte is the command byte. This byte
indicates the type of data contained in this host frame. Valid command
byte characters for all TNCs are C, D, or Q. For those TNCs that support
HF modes, there are additional command byte characters which perform
special functions within an HF mode. These are described in detail in the
Special Command Bytes section of this document.
Following the command byte is the PORT byte. When operating with a single
port (i.e. one radio port) TNC, the PORT byte must be set to an ASCII 1
(0x31). For dual port (i.e. two radio ports) the command byte will be an
ASCII 1 for radio port 1 and an ASCII 2 for radio port 2. Note that the
KAM uses port 1 for VHF operation and port 2 for HF operation (including
HF modes).

The next byte in a host frame is the STREAM byte. This indicates which
data stream (i.e. connected packet stream) is to be affected by the
command. Streams are identified by a letter, and either upper or lower
case may be used. The number of streams available (and therefore the
available stream letters) is determined by the setting of the MAXUSERS
command. For instance, if MAXUSERS is set to 10 (the default), the
available streams are A through J. Some commands do not specifically refer

to a stream, and in these cases the stream byte should be set to an ASCII
0 (0x30).

Following the STREAM byte your program inserts the actual data associated
with this frame. This may be a command, data to be transmitted, or simply
no data at all. Remember that if you need to include the FEND or FESC
characters as part of your data, you must apply the translations discussed

earlier. When entering a command to the TNC, the data portion of a host
frame contains the exact same syntax as entering the command from the cmd:

prompt.

After the data, the frame must be closed with a FEND character.

Host Command Bytes

When the host (computer) sends a frame to the TNC, the command byte is used to indicate the type of frame being sent. The following command bytes

are supported:

C
This indicates that the frame contains a TNC command. The data portion of this frame contains the command name and the arguments to the command. The

data portion does not contain a carriage return at the end. When sending commands to the TNC, we recommend you send the full command name instead of an abbreviation. Kantronics reserves the right to enhance our firmware which could cause abbreviated commands to fail.

D
This indicates that the frame contains data to be transmitted over the radio. The PORT byte and STREAM byte must be used to select the radio port

and associated stream for the data. This command can also be used to transmit "UNPROTO" packets by addressing the appropriate PORT, and setting

the STREAM byte to ASCII 0.

For transmission of the HF modes (not packet), the PORT byte will be an ASCII 2 and the STREAM byte will be ASCII 0.

Q
This indicates that the TNC is to exit the host mode and return to the command mode of operation. This command byte does not require a PORT byte or a STREAM byte, so the full command is simply <FEND>Q<FEND>.
TNC-to-Host frame format

This diagram shows the basic construction of a host frame sent to the computer from the TNC.

Byte 1 | Byte 2 | Byte 3 | Byte 4 | Variable Length | Last Byte
FEND | Command | Port | Stream | Data | FEND

Communication from the TNC to the host occurs in blocks. The block of data

is delimited with a FEND character at the beginning and end of the block.

Following the opening FEND, the next byte is the command byte. This byte indicates the type of data contained in this frame.

Following the command byte is the PORT byte. When operating with a single port (i.e. one radio port) TNC, the PORT byte will be set to an ASCII 1 (0x31) for frames containing data, and to an ASCII 0 for command responses. For dual port TNCs (i.e. two radio ports) the command byte will

be an ASCII 1 for radio port 1 and an ASCII 2 for radio port 2. Note that the KAM uses port 1 for VHF operation and port 2 for HF operation (including HF modes).

The next byte in a host frame is the STREAM byte. This indicates which data stream (i.e. connected packet stream) received the information in this frame.

Following the STREAM byte is the data associated with this frame. This may

be a command response, data that has been received, other informational messages from the TNC, or simply no data at all. Remember that if the data

includes the FEND or FESC characters, it will be sent to the computer as a

two-character translation as discussed earlier.

After the data, the frame is closed with a FEND character.

TNC Command Bytes

When the Tnc sends a frame to the host, the command byte is used to indicate the type of frame being sent. The following command bytes are supported:

C
This indicates that the frame contains a response to a TNC command or information generated by the TNC. The data portion of this frame may contain a response to the command, an error message, or other information generated by the TNC.

D
This indicates that the frame contains data which was received from the radio. The PORT byte and STREAM byte indicate which radio port and associated stream received the data. When operating packet, only data received from a station you are connected to will have a D for the command

byte.

If the TNC is operating in an HF mode, the STREAM byte will be 0 for all received data.

M
This indicates that the data in the frame was received as monitored data (i.e. from a station you are not connected to). If the command byte is M, the PORT byte will indicate which radio port received the data, and the STREAM byte will be set to ASCII 0.

S
This indicates a status message from the TNC caused by a change in the link state. Such messages include *** CONNECTED TO, *** DISCONNECTED, and FRMR messages.

There is one special form of the S command byte, which consists of two <FEND> characters with the command byte S, PORT byte 0, and STREAM byte 0,

and a closing FEND. This frame indicates that the TNC has performed a reset, and any connections that may have existed have been lost. This frame also occurs when the TNC is powered up if it is in host mode.

R
This indicates that the TNC has received a connect request from another station, but is unable to accept the connect at this time. This is analogous to the "*** connect request" message when operating in terminal mode.

E
This command byte only occurs when operating an HF mode and contains the data being transmitted. This frame occurs at the time the data is actually

transmitted over the radio, allowing the operator to observe the progress of data over the radio. XMITECHO must be ON for this frame to occur, and since it applies only to HF modes, the PORT byte will be ASCII 2 and the STREAM byte will be ASCII 0.

T
This indicates the frame contains TRACE data. This frame was discontinued with version 6.0 of the firmware and is no longer supported. The data in this frame is RAW received data, and includes the AX.25 callsigns in the bit-shifted format. No processing is done by the TNC on this data. To disable this frame turn TRACE OFF.

I
This special TNC-to-host command byte is used only in AMTOR, PACTOR, and
G-TOR to indicate whether your station is currently the sending station or

the receiving station. The frame <FEND>I20<FEND> indicates that you are
the Information Receiving Station (IRS), and the frame <FEND>I21<FEND>
indicates you are the Information Sending Station (ISS).

?
This special command byte indicates that this frame is the response to a
host inquiry command. This frame does not contain a PORT or STREAM byte,
and was added to the host mode starting with version 6.1 for those TNCs
supporting HF mode operation. For more details, see the Special Command
Bytes section below.

Commands and Responses

Special Command Bytes

When operating HF modes with a Kantronics TNC, a few special host frames
are required. These frames consist of the standard host <FEND> character
at the beginning and end, but only contain a COMMAND byte. The PORT byte
and STREAM byte are not present since the HF modes can only be operated
through one of the radio ports and only support one conversation at time.
The special COMMAND bytes are listed below, along with a description of
the function for each.

T
This command byte places the TNC in transmit mode.

E
This command byte is used to indicate that the TNC should continue to
transmit all data that may be in the transmit buffer, and then allow the
other station to send data to you. The exact action differs depending on
the mode your are operating as follows:

RTTY/ASCII/CW/AMTOR FEC/PSK31 - In these modes, the TNC will
transmit all remaining data and then return to the receive
mode, unkeying your transmitter.

PACTOR/G-TOR - In these modes, the TNC will transmit all remaining data
and then perform a changeover. This allows the other station to become the

ISS and your station becomes the IRS.

AMTOR ARQ - This command byte was not implemented until version 7.1 for
the KAM and KAM Plus TNCs. Prior to these versions, the E command byte
will have no effect. Starting with version 7.1, the E command byte will
cause the TNC to finish sending any data and then insert the changeover
sequence (+?).

R
This command byte indicates that the TNC should allow the other station to

transmit. The difference between this command byte and the E command byte
(above) is that the TNC returns to the receive mode (or performs the
changeover) immediately. Any data remaining to be transmitted is retained
in the transmit buffer and will be sent when the TNC again enters the
transmit mode. In AMTOR ARQ, this command byte was implemented beginning
with version 7.1

X
This command byte causes the TNC to exit the current HF operating mode and

return to packet operation. If your station is currently linked to another

station in an ARQ mode (AMTOR/PACTOR/G-TOR), the TNC will attempt to gracefully disconnect the link before exiting the mode.

A
This command byte was implemented beginning with version 6.0 for those TNCs supporting HF modes. It instructs the TNC to abort the current link (or link attempt). If already linked, the TNC will attempt to perform a proper disconnect. It will abort the link on the first incorrect signal from the other station.

<CTRL-X>
This command byte will dump the transmit buffer for the HF mode. Any data which has not yet been transmitted will be discarded.

L
This command byte applies only to the CW mode of operation. It causes the TNC to lock the CW transmit speed to the speed of the CW signal being received. This also locks the receive speed, defeating the auto-track feature when receiving CW. For this reason, you should immediately send the unlock command byte (see below) after sending the lock.

U
This command byte applies only to the CW mode of operation. It causes the TNC to unlock the CW receive speed, allowing the TNC to automatically adjust the receive speed as the other station varies transmitting speed.

<CTRL-Q>
    When in PSK31 mode, this command selects the QPSK mode of
    transmission and reception.

    P
    When in PSK31 mode, this command selects the BPSK mode of
    transmission and reception.

    Z
    When in PSK31 mode, this command causes the bar graph to zoom out.

    1,2,3,4,5,6,7,8,9, or 0
    When in PSK31 mode, this command causes the bar graph to zoom in,
    centered at LED #n.

0
In PACTOR and G-TOR modes of operation, when you are linked to another station and you are the IRS, this command byte causes the speed to be set to automatic mode. In this mode, the receiving station's TNC (IRS) will request speed changes based on data throughput and errors received. NOTE: When a link is first established, the TNC is in

automatic speed mode, and will always return to automatic mode whenever a changeover occurs.

1
In PACTOR and G-TOR modes, when you are linked to another station and you are the IRS, this command byte causes the speed to be set to 100 baud. The TNC will not request a change in speed, even if the number of errors and data being received indicate that the system would benefit by increased speed. The TNC will return to automatic speed mode when a changeover occurs, or when the 0 command byte frame (described

above) is received from the computer. When your station is the ISS, this command byte is ignored.

2
In PACTOR and G-TOR modes, when you are linked to another station and you are the IRS, this command byte causes the speed to be set to 200 baud. The TNC will not request a change in speed, even if

the number of errors and data being received indicate that the system
would benefit by increased speed, or that the speed should be decreased
due to excessive errors. The TNC will return to automatic speed mode when
a changeover occurs, or when the 0 command byte frame (described above) is

received from the computer. When you station is the ISS, this command byte

is ignored.

NOTE: This command will cause the TNC to attempt to change to 200 baud,
however if the change is not successful, the TNC reverts to its previous
state.

3
In G-TOR modem, when you are linked to another station and
you are the IRS, this command byte causes the speed to be set
to 300 baud. The TNC will not request a change in speed, even if the
number of errors and data being received indicate that the speed should be

decreased due to excessive errors. The TNC will return to automatic speed
mode when a changeover occurs, or when the 0 command byte frame (described

above) is received from the computer. When your station is the ISS, this
command byte is ignored.

NOTE: This command will cause the TNC to attempt to change to 300 baud,
however if the change is not successful, the TNC reverts to its previous
state.

?
This command byte was implemented beginning with version 7.0 for the
Enhancement Board and for the KAM Plus. It causes the TNC to respond with
a status report, mainly concerning the HF mode status. The response from
the TNC will be a host frame with the command byte set to "?", one byte
set to an ASCII 0, and several bytes of status information. Current
versions report 4 bytes of status, however, future implementation may
expand this.

The response frame from the TNC will be:
      <FEND>?0MSXY<FEND> - where MSXY are coded as follows:
      M   One byte indicating the current mode of operation.
            A=Packet
            B=RTTY
            C=ASCII
            D=AMTOR
            E=FEC
            F=SELFEC
            G=LAMTOR
            H=PACTOR
            I=PTLISTEN
            J=GTOR
            K=NAVTEX
            L=CW
            M=TOR Standby
                              N=GMON
                              O=PSK31
      S   One byte indicating a sub-mode of operation. The byte
            contains an ASCII character as follows:
            0=Standby
            1=Phasing
            2=Connected
            3=Disconnecting
            4=FEC
            5=SELFEC
            6=PTFEC
      X   One byte (called status byte X). This byte is bit-
            encoded to indicate specific conditions as follows:
            Bit 0 =   (IDLE) set to 1 when receiving IDLE

characters in a frame.

Bit 1 =   (ERR) set to 1 to indicate the received frame
failed CRC check, or was not a valid CS
response frame.

Bit 2 =   (Combined receive) set to 1 to indicate that
the data was constructed through the use of
error correction (i.e. Golay error correction
for G-TOR or Memory ARQ for Pactor).

Bit 3 =   (RQ) set to 1 to indicate an RQ frame. If you
are the ISS, it indicates that the receiving
station has asked for a repeat of the last
data due to received errors. When you are the
IRS, it indicates that the transmitting
station has sent the same data that you have
already received. This means that the sending
station did not properly copy your
acknowledgement (CS code).

Bit 4 =   (Huffman) set to 1 to indicate that this
frame contains data which uses Huffman
compression.

Bit 5 =   (ISS) set to 1 to indicate that your station
is currently the ISS.

Bit 6&7 = (Speed) these two bits indicate the current
speed of an ARQ link or the PSK31 mode. The
coding of the bits is:
00 = 100 baud or BPSK31
01 = 200 baud or QPSK31
10 = 300 baud

Y   One byte (called status byte Y). This byte is bit-
encoded to indicate specific conditions as follows:
Bit 0 =   reserved (set to 0).
Bit 1 =   (PTT) PTT is active.
Bit 2 =   (Changeover) changeover in progress
Bits 3-7 = reserved (set to 0).