Amateur Radio Direction-Finding Fox Transmitter

Instruction Manual

Developers:

RF and Enclosure – Les Tocko VA7OM

Controller – Dave Miller VE7HR

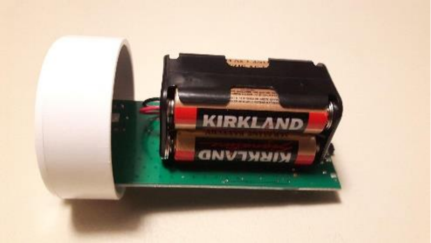
Firmware – Chris Scholefield VE7XH

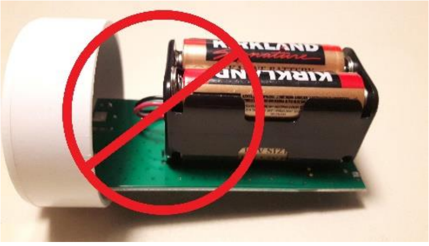
For pricing and availability contact John Brodie VA7XB by email: JohnVA7XB@gmail.com

Quick Start Guide

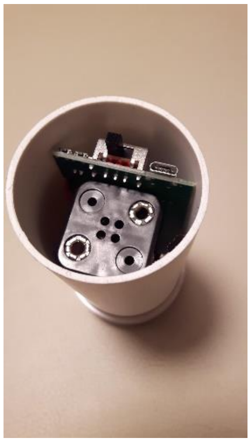
Congratulation on your new amateur radio direction finding fox transmitter. There are a few things you will need to do before using the fox.

- ☐ Open the enclosure and remove the transmitter circuit board and battery holder.
- ☐ Insert four AA batteries in the battery holder.
- ☐ Position the battery holder with the plastic side against the circuit board - not the open side which could cause a short circuit.

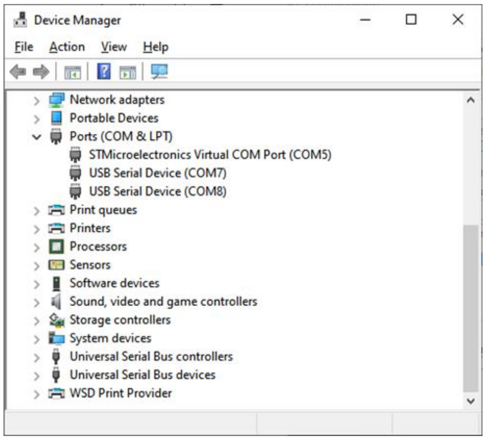




- ☐ Reattach the outer sleave, leaving the base of the transmitter board exposed.
- ☐ Connect the fox to a computer using a micro-USB cable and without switching the fox on (it will be powered via the USB port). The transmission will start, and the LED will flash in time with the CW sequence of sending "MOE" 3 times, followed by "N0CALL" and then the LED will remain steady on.

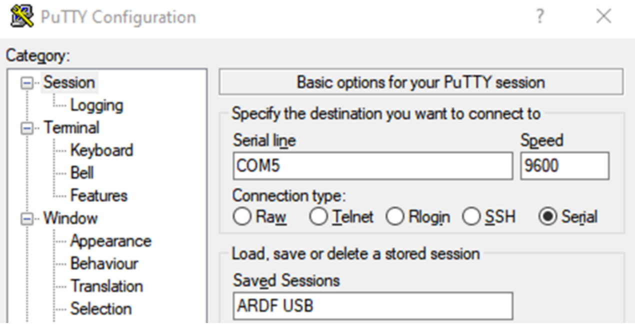


- ☐ Identify the COM port number on the personal computer (see "Connecting to the PC" on page 4).



Network adapters
Portable Devices
Ports (COM & LPT)
STMicroelectronics Virtual COM Port (COM5)
USB Serial Device (COM7)
USB Serial Device (COM8)
Print queues
Printers
Processors
Sensors
Software devices
Sound, video and game controllers
Storage controllers
System devices
Universal Serial Bus controllers
Universal Serial Bus devices
WSD Print Provider

- □ Open a terminal session to the fox using its COM port (see “Terminal Emulation” on page 6).



PuTTY Configuration

Basic options for your PuTTY session

Specify the destination you want to connect to

Serial line: COM5

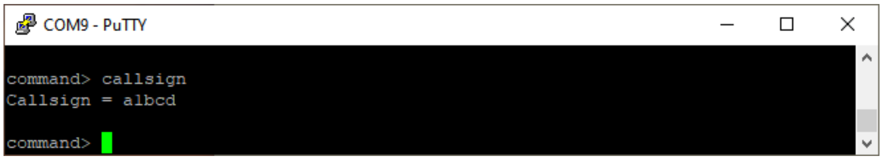
Speed: 9600

Connection type: ○ Raw ○ Telnet ○ Rlogin ○ SSH ● Serial

Load, save or delete a stored session

Saved Sessions: ARDF USB

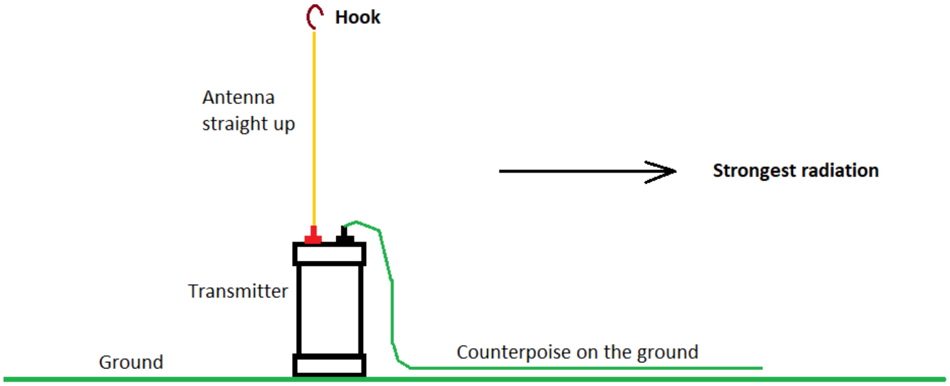
- □ Press the <esc> key to get a command prompt of “command> ”.
- □ Enter your callsign using the command of “callsign ” followed by your callsign and the <return> or <enter> key.



COM9 - PuTTY

```
command> callsign
Callsign = albcd

command>
```

- □ Enter the command “go” followed by the <return> or <enter> key and the transmitter will restart with the CW sequence of “MOE” 3 times, your callsign and then the LED will remain on. (It is necessary to enter “go” to commit the change to non-volatile memory)
- □ Disconnect the micro-USB cable.
- □ Attach the two antenna wires to the top of the fox.
- □ Suspend the fox using the hook at the end of the brown wire and lay the counterpoise wire on the ground.
- □ Switch on the power to the fox and replace the end cap.
- □ Confirm the fox is transmitting a CW sequence of “MOE” 3 times followed by your callsign.



ARDF Fox Transmitter Overview

The new ARDF fox is a highly configurable transmitter with the following features:

- Configurable using a serial terminal through the USB port on a PC
- Configurable call sign identification, CW speed and repetition frequency
- Adjustable fox number from 1 sending “MOE” to 5 sending “MO5”
- Configurable transmission modes
    - Standard (10wpm, on 1 min, off 4 min)
    - Alternate (10wpm, on 1 min, off 1 min)
    - Sprint (10wpm, on 12 s, off 48 s)
    - Fast sprint (15wpm, on 12 s, off 48 s)
- Beacon mode sending “MO” at 10wpm continuously
- Spectator mode sending “S” at 15wpm continuously
- Low battery mode sending MOx once every 5 minutes
- Start of event timer configurable up to 120 minutes
- Start button to synchronize multiple foxes
- Optional short pre-event transmissions one hour before the event start with configurable CW speed
- Flashing LED showing status
    - waiting to begin delayed start – rapid flashing
    - running – on continuously
    - CW transmissions – flashing with CW timing
- Debug mode providing progress reporting via the terminal

Operation

Before the fox will function, it must be configured with a minimum of the call sign. Without this it will do nothing at power on, other than display an error message through the terminal if connected.

ARDF TX Configuration

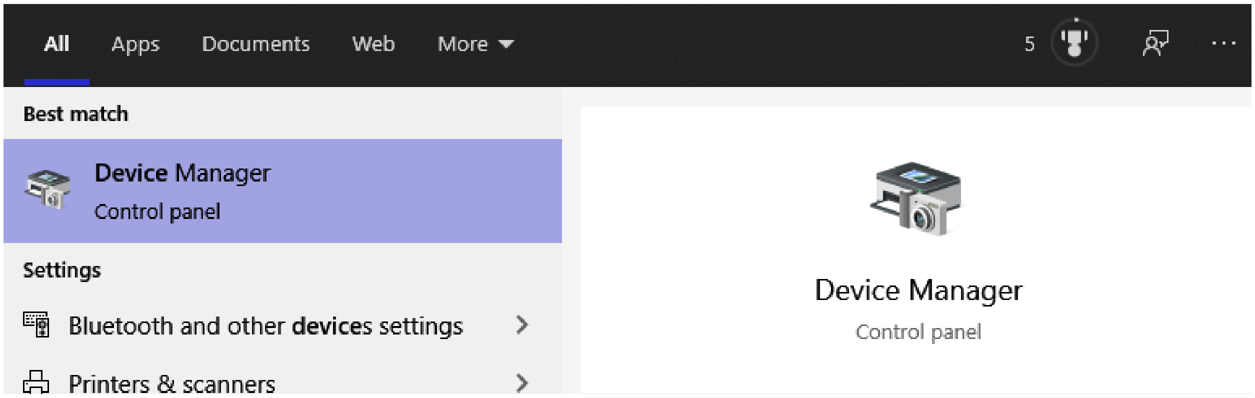
Before operating the ARDF fox transmitter for the first time it needs to be configured. As a minimum, a callsign needs to be added.

Connecting to the PC

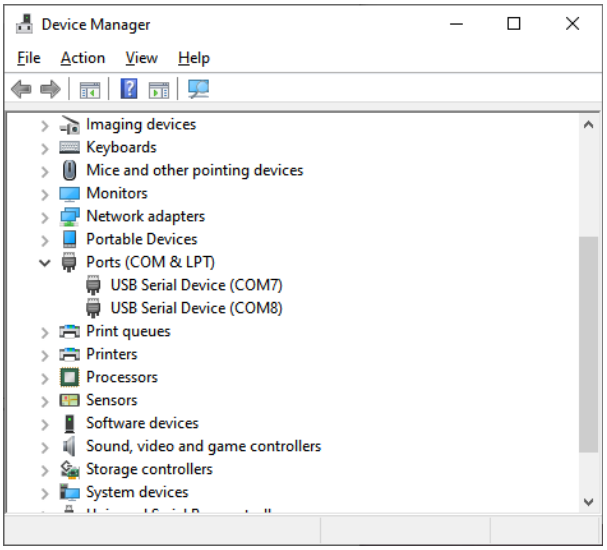
The fox transmitter is configured using commands from a computer using a USB cable. You will need a common USB-A to micro-USB cable. Connect the power to the fox and switch it on, then attach the USB cable to a windows PC. When connected to a PC the USB connection is automatically configured as a COM port.

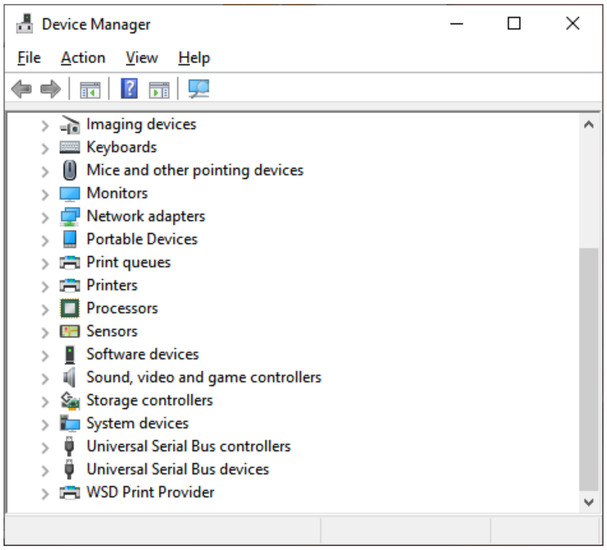
It is necessary to identify the COM port number for entry into a terminal emulator. This is achieved in the device manager and can be tricky if you already have serial ports connected to the PC. To begin, we identify any existing connections.

On Windows 10, type “Device Manager” into the start menu and launch the program.

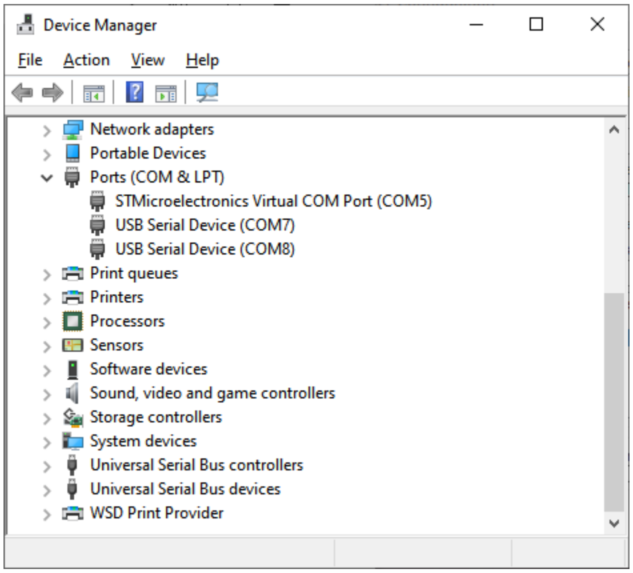


Scroll down to the “Ports (COM & LPT)” and expand the field to reveal the available ports. There may be one or more COM ports (left). It is also possible that there are none (right), in which case the com ports will be absent on the list of devices. Make a note of the COM ports, if any, that are in use before the fox is connected. In the example below, there are two COM ports already in use numbered COM7 and COM8.





Next, connect the fox using a USB type A to micro-USB cable. You should see an additional COM port in use, and this is the one identifying the connection to the fox. In the example below, the additional COM port is COM5. Do not be concerned if it has a different name to the one in the example below, which depends on the driver installation in the PC.



Network adapters
Portable Devices
Ports (COM & LPT)
STMicroelectronics Virtual COM Port (COM5)
USB Serial Device (COM7)
USB Serial Device (COM8)
Print queues
Printers
Processors
Sensors
Software devices
Sound, video and game controllers
Storage controllers
System devices
Universal Serial Bus controllers
Universal Serial Bus devices
WSD Print Provider

Each time the same fox is connected to the PC, the COM port should be the same value. However, when connecting a different fox, it will enumerate with a different COM port value and will need to be identified using the same procedure.

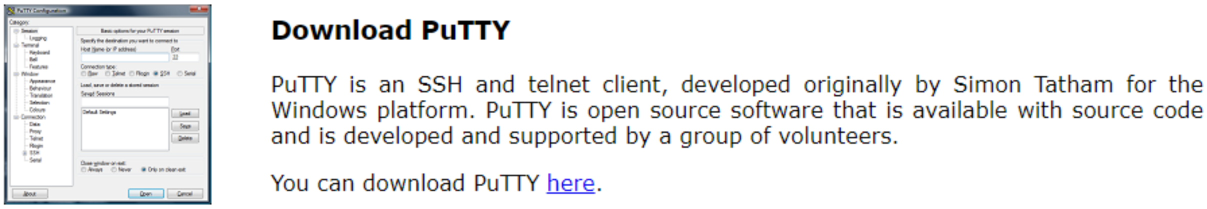
What if the COM Port is Not Found?

When connecting the USB for the first time on the latest Windows 10 PC, the COM port should be automatically configured. This may take a minute or two, so be patient. If it fails to install correctly, then you may see a warning that the USB device is not recognized. If this happens, scroll down the section on “Universal Serial Bus controllers” in the Device Manager where you will find the unrecognized USB device.

Right-click and uninstall the device. Then select in the menu, Action / Scan for hardware changes to try again. Be patient and let the configuration complete.

Terminal Emulation

Run a terminal emulation program on the PC. If you do not have a program already, a common one is Putty which can be downloaded for free from https://www.putty.org/. Download and install the program.

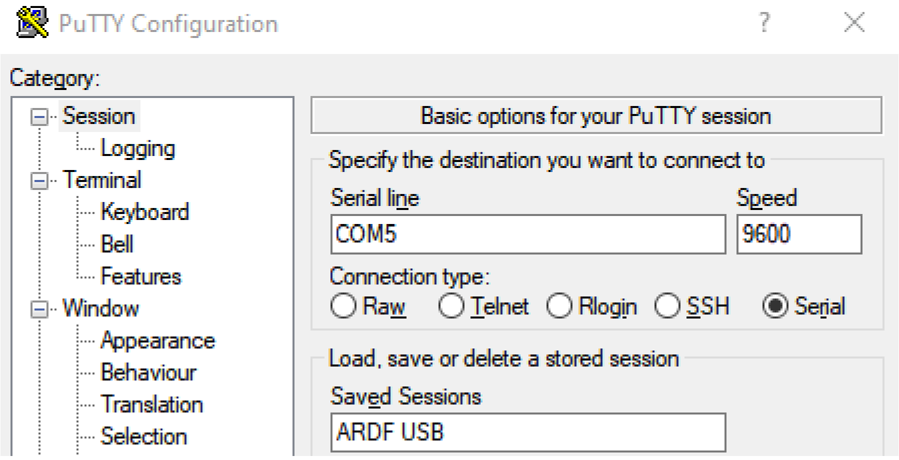


Download PuTTY

PuTTY is an SSH and telnet client, developed originally by Simon Tatham for the Windows platform. PuTTY is open source software that is available with source code and is developed and supported by a group of volunteers.

You can download PuTTY here.

Next, launch the terminal program, select the Connection Type as Serial and configure it to access the COM port identified. The speed is not important since the PC will autodetect the baud rate. While the USB are connected to the fox, press open.


PuTTY Configuration
?
Category:
Session
Logging
Terminal
Keyboard
Bell
Features
Window
Appearance
Behaviour
Translation
Selection
Basic options for your PuTTY session
Specify the destination you want to connect to
Load, save or delete a stored session

Serial line: COM5

Speed: 9600

Connection type: ○ Raw ○ Telnet ○ Rlogin ○ SSH ● Serial

Saved Sessions: ARDF USB

Press the <esc> key to get a command prompt.

First Time Configuration

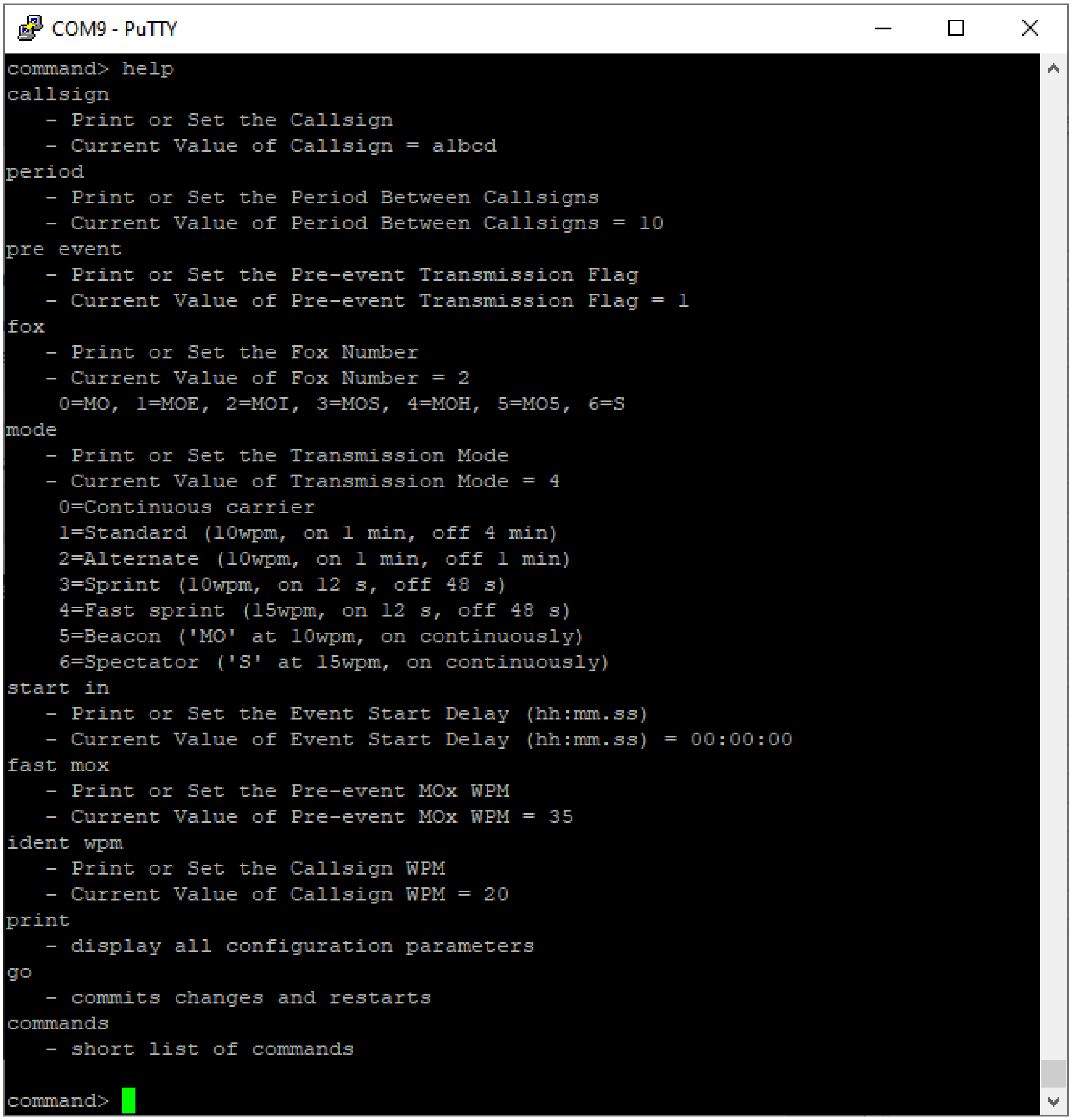
Before the fox can be used, it needs to have a valid callsign configured. Initially it is configured with “N0CALL”.

Enter “callsign” followed by your callsign and press <enter>. You can confirm the setting by entering “callsign” followed by <enter>. Alternatively, view all the configuration parameters by entering “print” followed by <enter>.

Getting Help

To get a list of the commands type “help” or “?” followed by the <return> or <enter> key. This will provide the list of all commands with the syntax in Backus-Naur form (BNF), the descriptions and the current values of the settings.

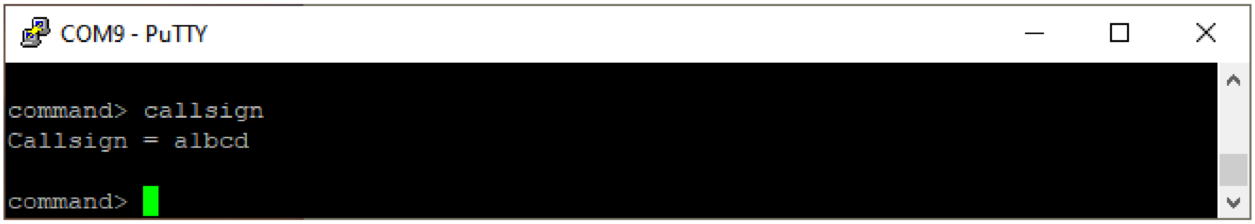
Items in square brackets [] are optional and items in triangular brackets <> are substituted for the named parameters. For example, entering the command **callsign** will return the current value of the callsign identification field, while **callsign A1BCD** will set the callsign to “A1BCD”.



```
command> help
callsign
   - Print or Set the Callsign
   - Current Value of Callsign = a1bcd
period
   - Print or Set the Period Between Callsigns
   - Current Value of Period Between Callsigns = 10
pre event
   - Print or Set the Pre-event Transmission Flag
   - Current Value of Pre-event Transmission Flag = 1
fox
   - Print or Set the Fox Number
   - Current Value of Fox Number = 2
    0=MO, 1=MOE, 2=MOI, 3=MOS, 4=MOH, 5=MO5, 6=S
mode
   - Print or Set the Transmission Mode
   - Current Value of Transmission Mode = 4
    0=Continuous carrier
    1=Standard (10wpm, on 1 min, off 4 min)
    2=Alternate (10wpm, on 1 min, off 1 min)
    3=Sprint (10wpm, on 12 s, off 48 s)
    4=Fast sprint (15wpm, on 12 s, off 48 s)
    5=Beacon ('MO' at 10wpm, on continuously)
    6=Spectator ('S' at 15wpm, on continuously)
start in
   - Print or Set the Event Start Delay (hh:mm.ss)
   - Current Value of Event Start Delay (hh:mm.ss) = 00:00:00
fast mox
   - Print or Set the Pre-event MOx WPM
   - Current Value of Pre-event MOx WPM = 35
ident wpm
   - Print or Set the Callsign WPM
   - Current Value of Callsign WPM = 20
print
   - display all configuration parameters
go
   - commits changes and restarts
commands
   - short list of commands

command>
```

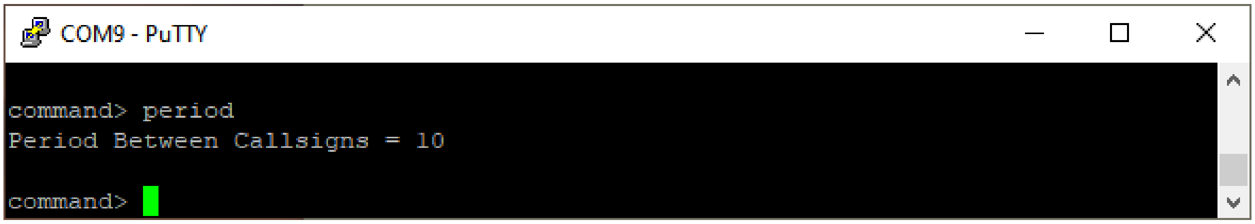
Command Description

callsign displays and sets the callsign identification which is sent periodically (see **period** and **ident wpm** below).



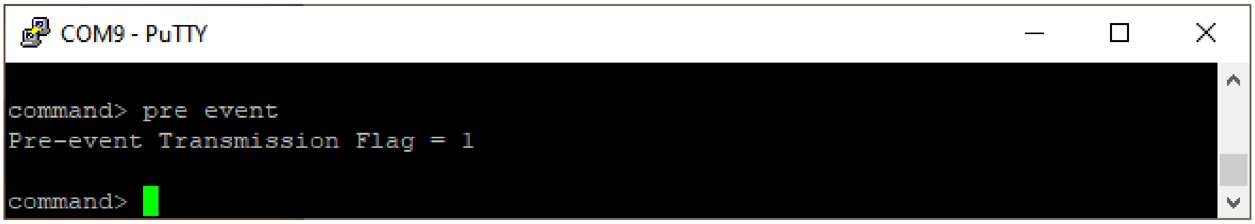
```

command> callsign
Callsign = a1bcd

command>
```

period displays and sets the time between callsign identification transmissions, typically 30 minutes in Canada or 10 minutes in the US.



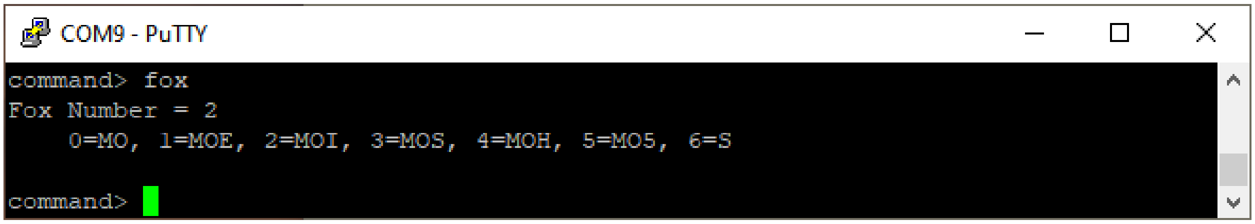
```
command> period
Period Between Callsigns = 10

command>
```

pre event displays and sets whether MO(x) is sent before the event start time as a pre-event warning transmission (TX) to provide an opportunity to confirm the foxes are working correctly. 1 sets the pre flag and 0 disables it. The pre-event transmission is sent at high speed (see **fast mox** below). The pre-event TX lasts only a second, so does not allow time for contestants to obtain a fix.



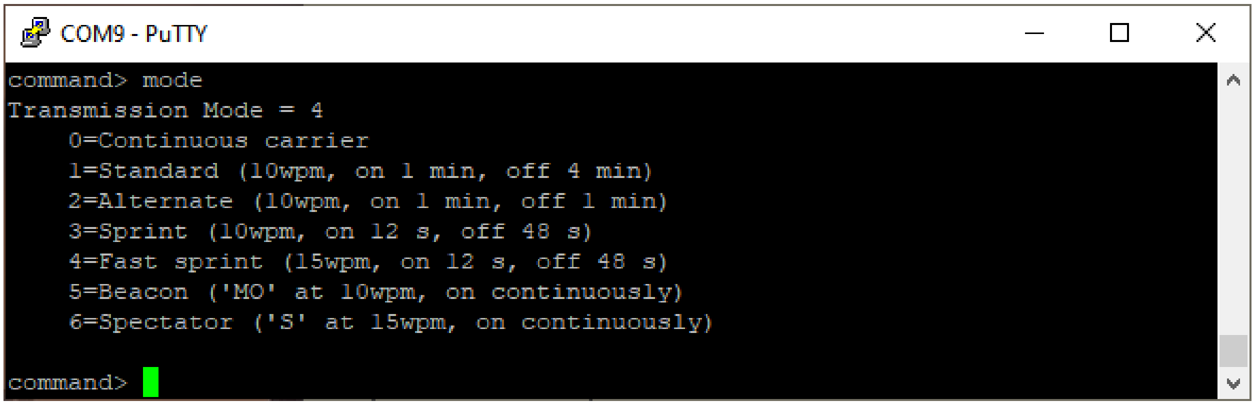
```
command> pre event
Pre-event Transmission Flag = 1

command>
```

fox displays and sets the fox number representing the number of dits sent in the MO(x) sequence.



```
command> fox
Fox Number = 2
    0=MO, 1=MOE, 2=MOI, 3=MOS, 4=MOH, 5=MO5, 6=S

command>
```

mode displays and sets the TX pattern.

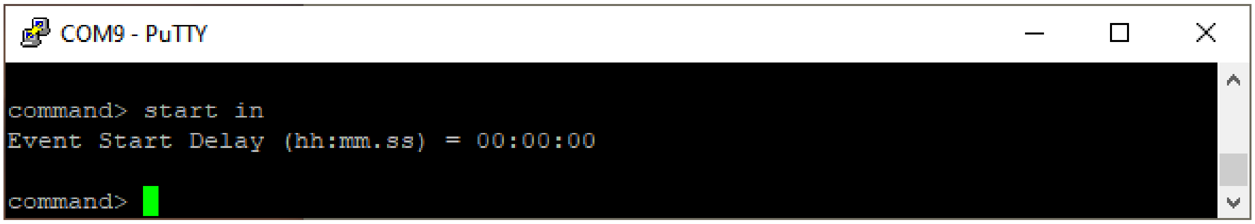


```
command> mode
Transmission Mode = 4
    0=Continuous carrier
    1=Standard (10wpm, on 1 min, off 4 min)
    2=Alternate (10wpm, on 1 min, off 1 min)
    3=Sprint (10wpm, on 12 s, off 48 s)
    4=Fast sprint (15wpm, on 12 s, off 48 s)
    5=Beacon ('MO' at 10wpm, on continuously)
    6=Spectator ('S' at 15wpm, on continuously)

command>
```

- 1 is the standard sequence of TX for 1 minute then off for 4 minutes and repeating every 5 minutes with the CW sequence at 10 wpm.
- 2 is a sequence of TX for 1 minute then off for 1 minute and repeating every 2 minutes with the CW sequence at 10 wpm.

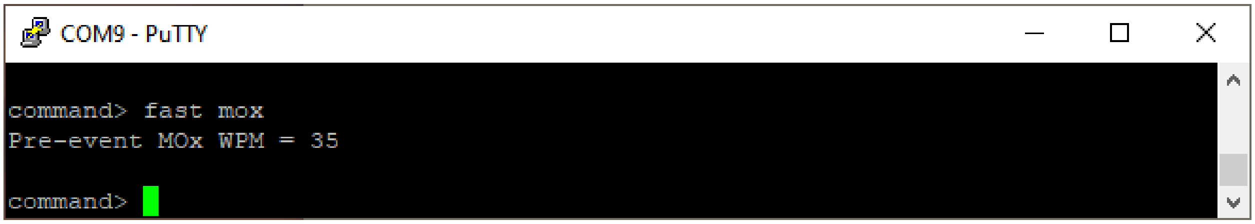
- 3 is the sprint sequence of TX for 12 seconds then off for 48 seconds and repeating every 1 minutes with the CW sequence at 10 wpm.
- 4 is the fast-sprint sequence of TX for 12 seconds then off for 48 seconds and repeating every 1 minutes, but with the CW sequence at 15 wpm.
- 5 is the beacon sequence of TX continuously with the "MO" sequence at 10 wpm.
- 6 is the spectator sequence of TX continuously with the "S" sequence at 15 wpm.

start in displays and sets the delay before the event start time. This is the time when the TX scheduling begins. The actual MO(x) transmission time depends on the mode and fox number configured. In standard mode (1), fox 1 starts TX in the 1st minute, continuing for 60 seconds, then fox 2 starts in the 2nd minute. Similarly, in sprint mode (3), fox 1 starts TX in the immediately at the event start time, continuing for 12 seconds, then fox 2 starts at the 12-second mark.



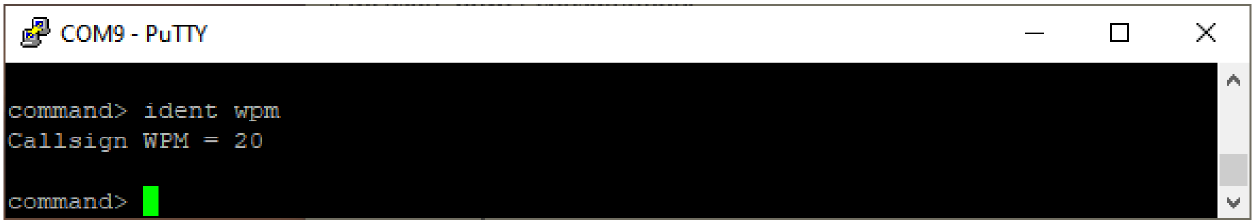
```
command> start in
Event Start Delay (hh:mm.ss) = 00:00:00

command>
```

fast mox displays and sets the speed of the pre-event warning TX in words per minute.



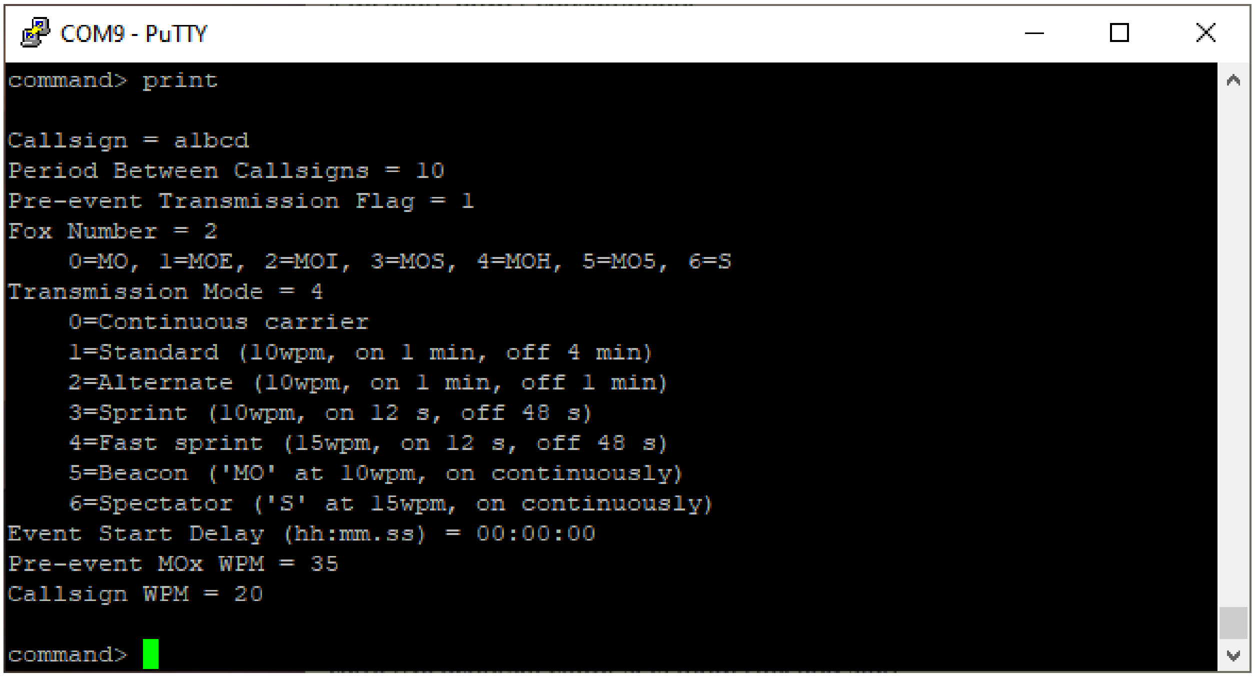
```
command> fast mox
Pre-event MOx WPM = 35

command>
```

ident wpm displays and sets the speed of the callsign identification TX in words per minute.



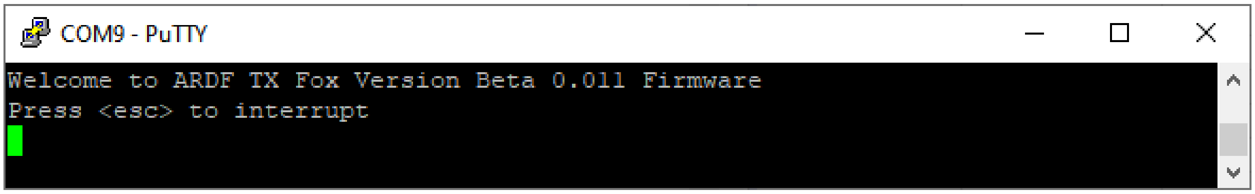
```
command> ident wpm
Callsign WPM = 20

command>
```

print displays a list all the configurable settings with their values.



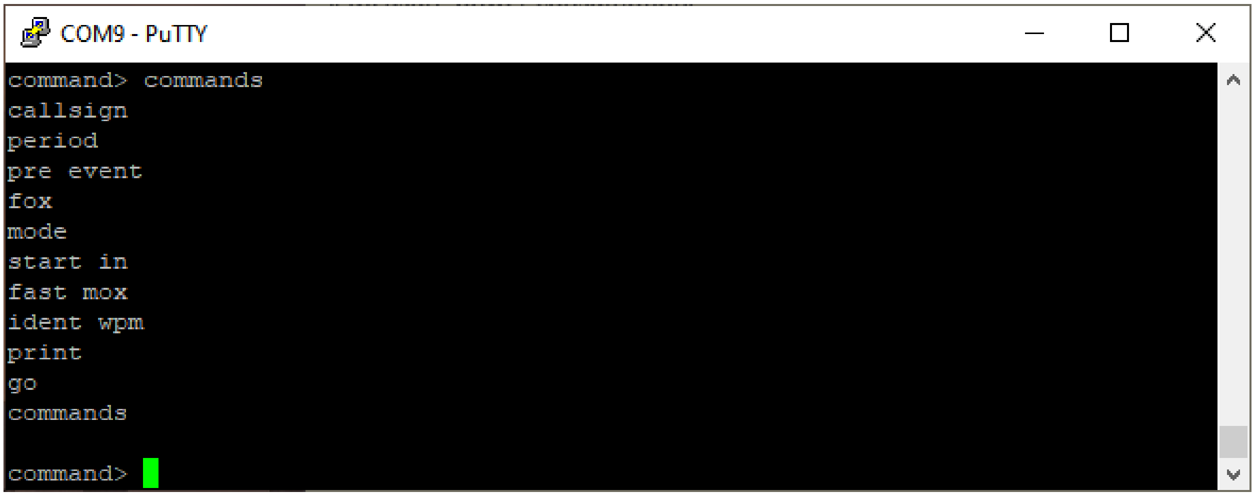
```
command> print

Callsign = albcd
Period Between Callsigns = 10
Pre-event Transmission Flag = 1
Fox Number = 2
    0=MO, 1=MOE, 2=MOI, 3=MOS, 4=MOH, 5=MO5, 6=S
Transmission Mode = 4
    0=Continuous carrier
    1=Standard (10wpm, on 1 min, off 4 min)
    2=Alternate (10wpm, on 1 min, off 1 min)
    3=Sprint (10wpm, on 12 s, off 48 s)
    4=Fast sprint (15wpm, on 12 s, off 48 s)
    5=Beacon ('MO' at 10wpm, on continuously)
    6=Spectator ('S' at 15wpm, on continuously)
Event Start Delay (hh:mm.ss) = 00:00:00
Pre-event MOx WPM = 35
Callsign WPM = 20

command>
```

go must be entered following any changes to commit the results to non-volatile memory and reinitialize the device. If this is not done, then at power on the fox will operate using the previously stored values.



```
Welcome to ARDF TX Fox Version Beta 0.011 Firmware
Press <esc> to interrupt
```

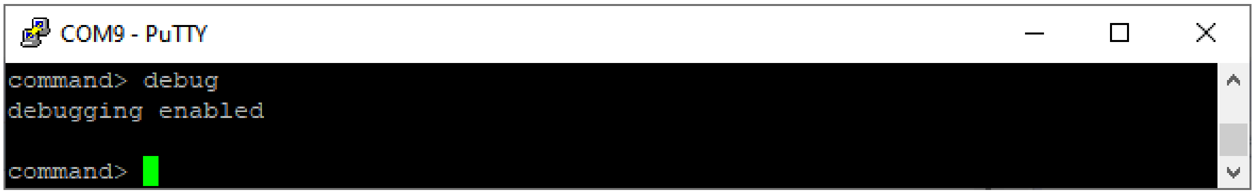
commands will display a list of available commands without the detailed help information.



```
command> commands
callsign
period
pre event
fox
mode
start in
fast mox
ident wpm
print
go
commands

command>
```

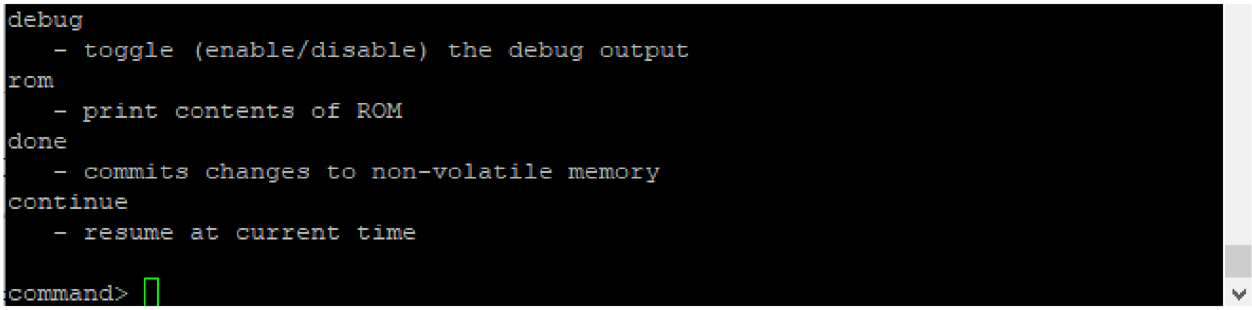
Advanced Debug Commands

There are several additional commands that may be used to provide additional information and control.



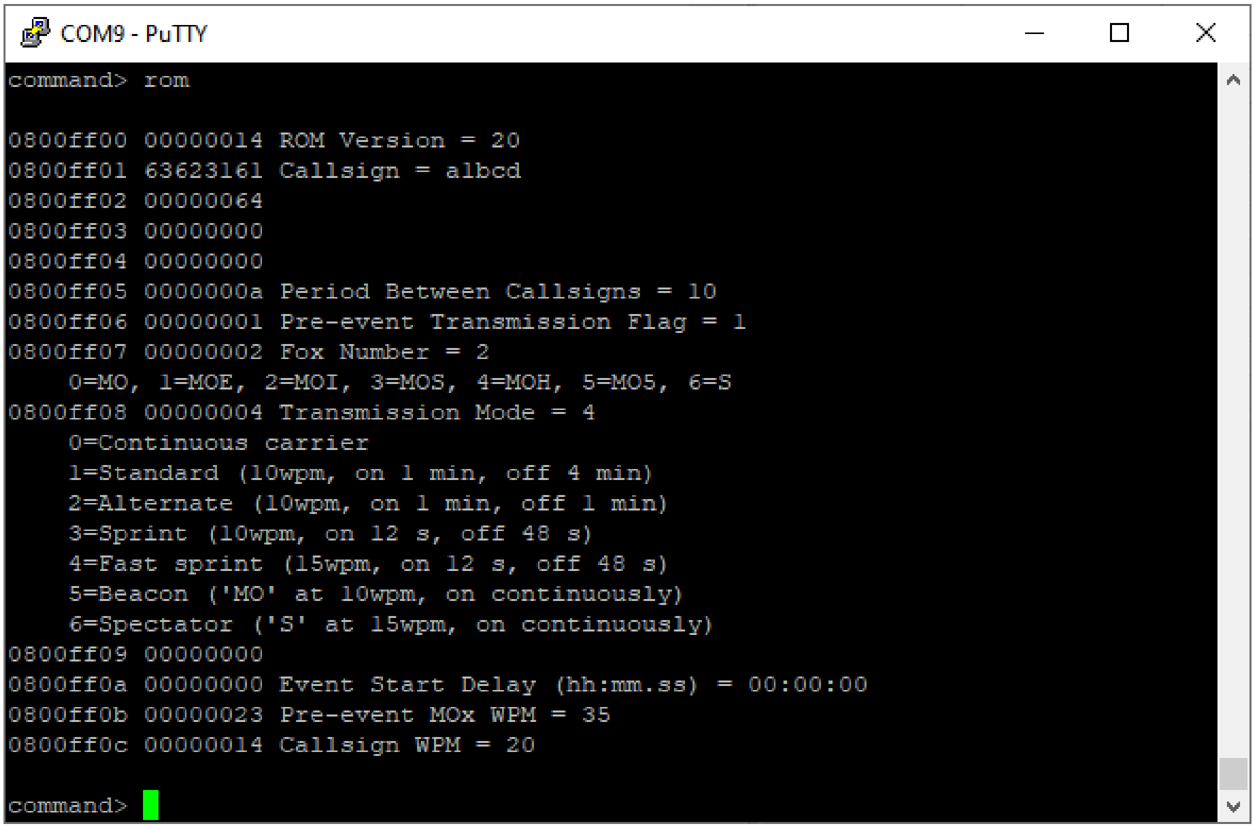
```
command> debug
debugging enabled

command>
```

debug enables or disables (toggles) the debug mode. In debug mode, the help command includes the full list of commands including the debug commands. Many of the debug commands are inhibited under normal operation. Also, while running in debug mode, the fox displays operations on the PC via the terminal emulator.



```
debug
   - toggle (enable/disable) the debug output
rom
   - print contents of ROM
done
   - commits changes to non-volatile memory
continue
   - resume at current time

command>
```

rom displays the settings stored in non-volatile memory as opposed to the current working settings displayed using the print command. The output shows the memory address (hex), the value (hex) followed by the parameter description and current setting (in RAM). After issuing **go** or **done** (see below) commands, the current settings (in RAM) are written to non-volatile memory (ROM).



```
command> rom

0800ff00 00000014 ROM Version = 20
0800ff01 63623161 Callsign = a1bcd
0800ff02 00000064
0800ff03 00000000
0800ff04 00000000
0800ff05 0000000a Period Between Callsigns = 10
0800ff06 00000001 Pre-event Transmission Flag = 1
0800ff07 00000002 Fox Number = 2
    0=MO, 1=MOE, 2=MOI, 3=MOS, 4=MOH, 5=MO5, 6=S
0800ff08 00000004 Transmission Mode = 4
    0=Continuous carrier
    1=Standard (10wpm, on 1 min, off 4 min)
    2=Alternate (10wpm, on 1 min, off 1 min)
    3=Sprint (10wpm, on 12 s, off 48 s)
    4=Fast sprint (15wpm, on 12 s, off 48 s)
    5=Beacon ('MO' at 10wpm, on continuously)
    6=Spectator ('S' at 15wpm, on continuously)
0800ff09 00000000
0800ff0a 00000000 Event Start Delay (hh:mm.ss) = 00:00:00
0800ff0b 00000023 Pre-event MOx WPM = 35
0800ff0c 00000014 Callsign WPM = 20

command>
```

done copies the configuration settings to non-volatile memory. It may be checked by comparing the output of the **rom** and **print** commands.

continue resumes operation following a pause without resetting the real-time clock or further reinitialization. Once paused, the fox may not operate until the next scheduled transmission time.

sentinel is used to display the non-volatile memory version which is set during the very first initialization and rechecked during subsequent initializations.

sentinel 0 is used to reset all configuration settings back to the factory defaults. The next time the fox initializes it will reset all the values in non-volatile memory. The callsign will once again need to be entered before the fox can be used.

mode 0 is used to TX a continuous carrier which may be necessary when testing the fox. The carrier is sent for 59 seconds with a one second gap which is used to determine whether a callsign identification is needed.

mode 7 is used to enter low battery mode. When in low-battery mode the fox TX for 12s at 10 wpm and then rests for the remainder of a 5-minute period. Mode 7 cannot be written to ROM, so after restarting (the go command) the previous values are restored.

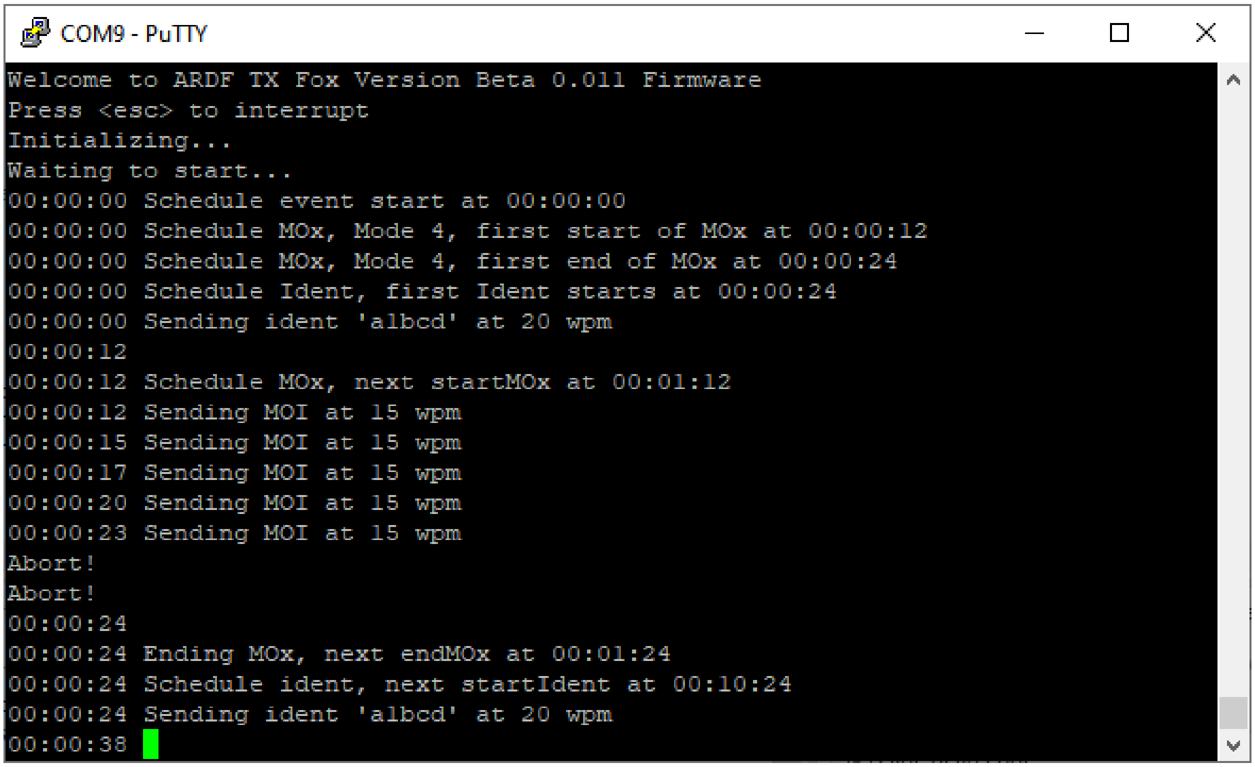
After making the changes, **it is important to commit** the changes to non-volatile memory and restart the fox **by entering "go"** followed by <enter>. The fox will begin operating and terminal will display the normal banner.

Running Operation

When running, the transmissions are scheduled according to the settings. With the default factory settings, the fox will send "MOI" (fox 2) in fast-sprint mode (4) starting immediately after the initialization.

The fox may be reset by either typing "go" at the command prompt or powering on the fox. When power cycling, it is necessary to disconnect the USB which also supplies power to the fox. In addition, the LED indicated the operating state (see below). The LED is normally on continuously while running but will blink in time with the CW TX to indicate this operation.

Using the debug mode, we can display the operations.



```
Welcome to ARDF TX Fox Version Beta 0.011 Firmware
Press <esc> to interrupt
Initializing...
Waiting to start...
00:00:00 Schedule event start at 00:00:00
00:00:00 Schedule MOx, Mode 4, first start of MOx at 00:00:12
00:00:00 Schedule MOx, Mode 4, first end of MOx at 00:00:24
00:00:00 Schedule Ident, first Ident starts at 00:00:24
00:00:00 Sending ident 'albcd' at 20 wpm
00:00:12
00:00:12 Schedule MOx, next startMOx at 00:01:12
00:00:12 Sending MOI at 15 wpm
00:00:15 Sending MOI at 15 wpm
00:00:17 Sending MOI at 15 wpm
00:00:20 Sending MOI at 15 wpm
00:00:23 Sending MOI at 15 wpm
Abort!
Abort!
00:00:24
00:00:24 Ending MOx, next endMOx at 00:01:24
00:00:24 Schedule ident, next startIdent at 00:10:24
00:00:24 Sending ident 'albcd' at 20 wpm
00:00:38
```

The fox can be interrupted by pressing <esc> in the terminal emulator at any time to make configuration changes. Once the changes are complete, **enter "go" again to commit the changes and restart the fox**.

Immediate start

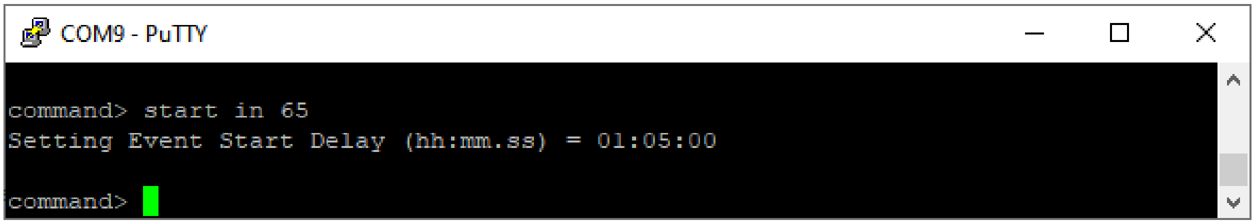
If the fox has been configured with no event start delay and any of the normal transmission modes (standard, alternate, sprint or fast sprint), it will start running immediately at power on. When operating multiple foxes, they must be synchronized by powering on simultaneously.

The transmit timing is dependent on the transmission mode and fox number. Each fox number is offset so that they cycle through the sequence. Fox 1 begins first at power on then fox 2 begins once the first fox completes and so on. After fox 5 completes, fox 1 starts again.

In Alternate mode, only two foxes are used so fox 1 and fox 2 alternate transmissions.

Delayed Event Start

A delayed event start time can be set to provide an opportunity to synchronize multiple foxes, confirm they are working correctly and hide them. The delayed start time is entered in minutes, up to 240 minutes. **Remember to commit the change by typing go!**



```

command> start in 65
Setting Event Start Delay (hh:mm.ss) = 01:05:00

command>
```

Operating in beacon or spectator modes does not allow a delayed start. If you find entering a delayed event start time returns the value of 00:00:00, then check that the fox number is not set to 0 (MO) or 6 (S) or the mode is not set to 5 (beacon) or 6 (spectator).

When powering on the fox after it has been configured, it will wait for synchronization. While waiting, the LED will flash rapidly. All foxes need to be synchronized by pressing and releasing the start button. Pressing the button for 1s stops the LED flashing and then releasing it begins the event start timer. During the delayed start time the LED will flash slowly to indicate the fox is running and counting down to the event start.

If the pre-event warning has been enabled, it will send a short CW sequence every 5 minutes for the last hour before the event starts. The warning transmissions are sequenced using the fox number with each one a minute apart so that over the 5-minute period all foxes can be confirmed operational.

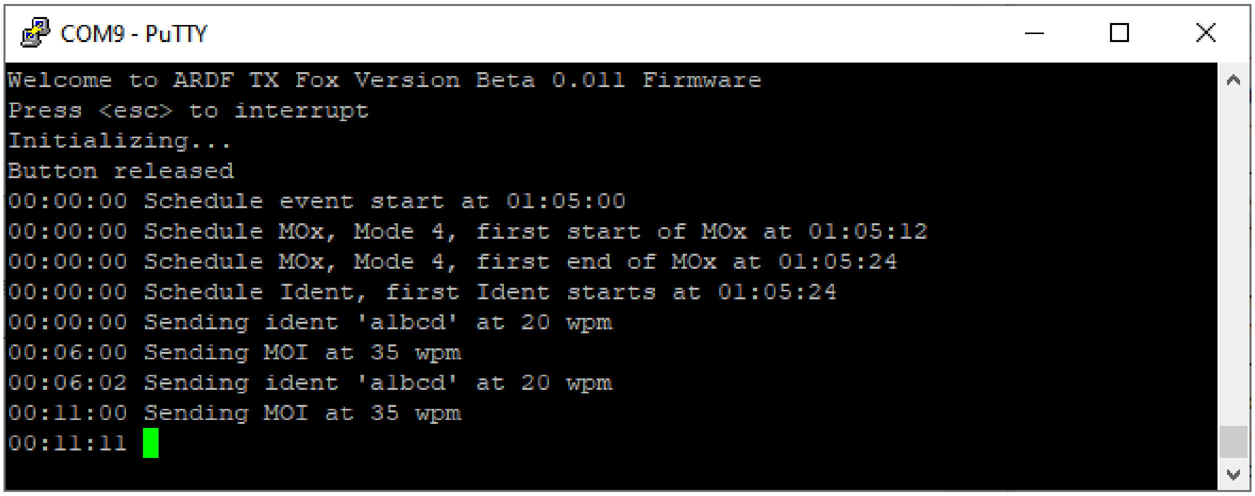
Synchronizing

If there is no delayed event start time set the fox will start immediately. However, if a delayed event start time has been set, it will wait to be started. Several foxes may need to be synchronized to the event start time.

When the fox is first powered on, it will remain in an idle state indicated by a rapid flashing LED. When ready to begin, press and hold the start button for 1s until the LED goes out. The timer is triggered once the start button is released.

During the period before the event start time, the LED will flash slowly. In addition, during the last hour before the event start time, the fox will TX a pre-event MO(x) warning at high speed. This is repeated every 5 minutes and each fox in a group TX in a pattern with one-minute intervals. For example, if the event start delay is 90 minutes, the first fox will send the MOE pre-event warning at 00:30:00, 00:35:00, 00:40:00, etc. The second fox sends the MOI pre-event warning at 00:31:00, 00:36:00, 00:41:00, etc. Then the third fox sends the MOI pre-event warning at 00:32:00, 00:37:00, 00:42:00, etc. and so on. When listening to a receiver tuned to the fox frequency during the hour before the event start time, you will hear each fox transmit a single MO(x) CW pattern at 1-minute intervals in the sequence: MOE, MOI, MOS, MOH and MO5.

With the default fox 2 (MOI) and an event start delay of 01:05:00, MOI is sent at 00:06:00, 00:11:00, etc. following pressing the start button.



```
Welcome to ARDF TX Fox Version Beta 0.011 Firmware
Press <esc> to interrupt
Initializing...
Button released
00:00:00 Schedule event start at 01:05:00
00:00:00 Schedule MOx, Mode 4, first start of MOx at 01:05:12
00:00:00 Schedule MOx, Mode 4, first end of MOx at 01:05:24
00:00:00 Schedule Ident, first Ident starts at 01:05:24
00:00:00 Sending ident 'albcd' at 20 wpm
00:06:00 Sending MOI at 35 wpm
00:06:02 Sending ident 'albcd' at 20 wpm
00:11:00 Sending MOI at 35 wpm
00:11:11
```

Low Battery Mode

If the supply voltage drops below 4.4V, the fox enters low-battery mode. In this mode a single MOx transmission is sent every 5 minutes followed by “LB”.

LED status

The LED indicates the operating status of the fox. The following list can be used to identify the current operation.

- **Off for an expended period** – the fox does not have power.
- **Rapid flashing** – the fox is waiting for a delayed start synchronization by pressing the start button.
- **Slow flashing** – the fox is counting down to the event start time.
- **On continuously** – the fox is running and waiting for the next scheduled transmission.
- **Flashing CW** – the fox is TX and the blinking indicates the CW code being sent.

Beacon and Spectator Modes

Beacon and spectator modes have special predefined sequences which override the normal configuration settings.

Beacon mode can be set either by selecting fox 0 (MO) or mode 5 (beacon). Once either of these are selected the configuration is automatically set to:

- fox 0 (MO)
- mode 5 (beacon)
- start in 00:00:00 (immediately)

Spectator mode can be set either by selecting fox 6 (S) of mode 6 (spectator). Once either of these are selected the configuration is automatically set to:

- fox 6 (S)
- mode 6 (spectator)
- start in 00:00:00 (immediately)

Alternating Modes

Alternating mode restricts the fox number to be either 1 (MOE) or 2 (MOI). Attempting another fox number will report an error.

Acronyms and Abbreviations

ARDF – Amateur Radio Direction Finding

BNF – Backus-Naur form, a notation used to describe the syntax of a command

COM – a communication port

CW – Carrier Wave, an abbreviation used to describe Morse code

<esc> - Escape, a key used to interrupt operations

LED – Light Emitting Diode

LPT – Line Printer

MO(x)/MOI – The transmitted sequence in Morse code of dh dah, pause, dah dah dah, pause followed by several dits representing the fox number. e.g. fox 2 is sent as "I" on Morse which is dit dit.

PC – Personal Computer

PuTTY – The name of a program used for terminal emulation amongst other uses

TX – transmit or transmission

US – United States

USB – Universal Serial Bus

V - Version

WPM – Word per Minute