SteppIR Controller Hardware

The SteppIR Antenna Controller serial interface can be used with a wide range of Amateur Radio transceivers to automatically track frequency changes. The controller can also be commanded from a computer via the serial interface. The SteppIR Controller typically connects to a radio on the Data In connector, and can connect to a computer on the Data Out connector.

Serial Cable Connections

The Serial interface is soldered to the driver board inside the SteppIR controller. Externally, it has two 9-pin D-sub connectors labeled **Data In** and **Data Out**. The Serial Interface will only control the SteppIR when it is in the General Frequency Mode.

Data In is the radio connection port. This port has a unique pin-out requiring non-standard cables to connect to particular radio models. This was done so that only a cable change is necessary to support different radio types. The Data In port baud rate can be changed to standard values between 4800 and 57600 baud.

Pin	Purpose
1	**Data out** RXD
2	RXD to RS232 Radio TXD
3	TXD to Radio RXD
4	TTL Kenwood and active high for Radio CTS
5	Signal Ground
6	Optional ICOM TXD
7	TTL version of pin 2
8	NC
9	TTL RXD for Steppir.

Figure 1 -Pinout of the 9-pin D-SUB DATA IN CONNECTOR

Data Out is the Computer or Daisy chain port. This port is wired like a Computer serial port and requires a standard Null Modem cable (pins 2 and 3 crossed) to connect to a computer or the Data In of another SteppIR controller. This port's baud rate ranges from 4800 to 19.2k baud. If the controller baud rate is set higher than 19.2k, this port will remain at 19.2k.

Pin	Purpose
1	Internally connected to pins 4 and 6
2	RXD
3	TXD
4	Internally connected to pins 1 and 6
5	Signal Ground
6	Internally connected to pins 4 and 1
7	Internally connected to pin 8
8	Internally connected to pin 7
9	Radio TTL RXD

Figure 2 - Pinout of the 9-pin D-SUB DATA OUT CONNECTOR

OPERATION

For the SteppIR controller to follow the Radio frequency the baud and radio type must be set and the controller needs to be in the "General Freq" mode. With most configurations with most radios, the controller or logging program will requests radio status every 1 to 7 seconds. It's normal that on startup that there will be a delay before the SteppIR controller frequency changes.

The SteppIR controller behaves differently when used with ICOM radios. Due to the way that ICOM radios communicate, the Controller will only track when the radio frequency is changed. When initially powered on, the controller will not track the radio frequency until the radio front panel knob is moved.

The controller breaks each band up into approximately 50 kHz segments. Small radio frequency changes may not cause a change of antenna lengths until a segment boundary is crossed.

There several operating configurations depending on how the SteppIR is connected to other equipment.

- Stand-alone Radio to SteppIR Controller – This is the most basic configuration and only requires the proper cable, and on some radios a serial adapter, to go between the radio's serial port and the Steppir Serial interface **Data In**.
- Computer Logging program and SteppIR Controller – In this configuration the SteppIR must share the radio's computer port with the Logging program which creates a conflict with the transmit data going to the radio. To address this problem the SteppIR Controller uses a "Y" cable that allows it to passively listen to the data being sent to the computer from the radio. The drawback to this method is that the logging program must request the radio to report the frequency so the SteppIR can see it. Most logging programs, such as TRX Manager and Logic 6, do query the radio for the frequency at periodic intervals. However, a few don't and they will not work with the Steppir. We had originally designed the serial interface to pass through the data so we could hear both sides but quickly learned that many radios were passing huge amounts of data for a simple frequency change that easily overran our microprocessor serial buffer so we had to abandon that approach. ICOM radios will work with any logging program because their "transceive" mode sends out the frequency the radio is on every few hundred milliseconds.
- Computer Control – The Computer typically connects to the Data Out connector and programs like N8LP's Virtual Control Panel (VCP) or YO3DMU's PstRotator use SteppIR serial commands to control the antenna direction and frequency. The Computer can also be connected to the Data In with the Radio type set to SteppIR, this will respond to the same commands as the Data Out but acts like the master controller sending out a request for status every second. It is also possible to have a radio attached to the Data In while the computer is attached to the Data Out.
- Connecting to a SteppIR controller – In this configuration you can use one controller to make several SteppIRs follow each other or just pass the Radio Data through to the next controller down the line. This feature makes controlling a stack of antennas simple.

Daisy chaining Controllers

- There are several ways to get multiple controllers to track the radio frequency. It will depend on your preferences and the Radio type. With ICOM radios you have the ability of connecting 5 devices directly to the Radio using a CT-17 or similar device. If you have a RS-232 radio you would need a

"Y" cable to do the same thing with the first controller being the only controller connected to the Radio RXD pin.

- Alternately you can Daisy chain controllers having one controller be the master and the rest slaves. This has the advantage of allowing you to select the direction or the frequency of all the controllers connected together from the Master.

Remote Control Considerations With latest software versions

In some cases you may want to control the SteppIR from the computer.

- The SteppIR will remember the state of the power switch, but the state is written approximately 3 minutes after the last change. After this delay you can remove power from the controller and it will turn on when power is restored.
- You should use the Retract (HOME) elements command before removing power.
- If the Controller loses power while it is tuning, it will get out of sync with the SteppIR Antenna Element location. A recalibration command can be used to bring the controller and antenna elements into sync.

Radio Considerations

ALL Radios

The baud rate must be set to the same value on both the radio and the SteppIR. The SteppIR is not compatible with any auto baud rate feature that some radios have.

ICOM Radios

NOTE: Please be aware the new serial interface software will not operate at 1200 baud, which is the default for older ICOM radios. Simply choose a baud rate of 4800 or higher.

- The Radio must have the CI-V transceive mode enabled. This mode is used to make more than one radio follow the master radio.
- When using more than one CI-V device (a computer and a SteppIR) the SteppIR should be connected directly to the CI-V port through a "Y" connector or an ICOM CT-17. If connected to a "Y" cable through a RS-232 Converter (CT-17) the SteppIR will only track if the logging program polls the radio.
- Using a logging program with an ICOM radio is quite transparent with the SteppIR connected directly to CI-V port. It will follow the frequency of the logging program or the radio.
- There are a few logging programs that want the transceive mode disabled, in this configuration the SteppIR will only follow the frequency when the logging program requests status.

Kenwood Radios and the **Elecraft K2, K3, KX3**

- The Kenwood uses several different port and interface configurations, requiring different cables for different models check table at end of the document.
- The newer RS-232 Kenwood radios like the TS-2000 and TS-570 are sensitive to RS-232 levels and require a different cable than the radios using the Kenwood IF10.

- To use a logging program and the SteppIR requires a "Y" cable that connects the radio transmit pin to the SteppIR receive pin. This allows the SteppIR to monitor the data coming from the radio for the frequency information. The limitation of the "Y" cable is that the SteppIR will only track when the logging program is loaded and active.

YAESU Radios

- Only radios that are part of the families listed will work (i.e. FT1000MP, FT1000MP-V, FT1000MP-Field) this has do to each one having a unique response to the status command.
- To use a logging program will require a "Y" cable that connects the radio transmit pin to the SteppIR Receive pin. This allows the SteppIR to monitor the data coming from the radio for the frequency information. The limitation of the "Y" cable is that the SteppIR will only track when the logging program is loaded and active. It should be further noted that when using a "Y" cable that it is possible to get the incorrect frequency information. This only happens with some logging programs and can be caused by polling frequency and configuration. This is because Yaesu does not mark which radio command requested the data, or the start of the data stream, or the end of data so the SteppIR only knows that there was new data. Our current software does a better job than earlier versions did at handling the Yaesu communications. You may want to consider using a separate PC serial port rather than the Y cable with Yaesu radios.

Ten-Tec ORION

- This radio only operates at 57.6k baud so you should remember that when the Radio (Data IN) is set higher than 19.2k baud that the Data OUT port will default to 19.2k. It is important to remember to set the slave controllers to 19.2k if you are daisy chaining SteppIRs.
- To use a logging program requires a "Y" cable that connects the radio transmit pin to the SteppIR receive pin. This allows the Steppir to monitor the data coming from the radio for the frequency information. The limitation of the "Y" cable is that the SteppIR will only track when the logging program is loaded and active.

Steppir Slave Mode

This mode allows you to gang multiple controllers together under the control of one master controller. The master controller will control the slaves either manually or from a radio. The master is controlled via Data In port (the upper 9-pin DB connector) by the radio and the first slave is then connected to the master Data Out port (the lower 9-pin DB connector). Use a 9-pin to 9-pin null modem cable to connect each controller's Data Out to the next-in-line's Data In port.

- This mode is provided to make the radio port (Data In) so it can read data from the Data Out port of the SteppIR.
- In this master slave mode the controllers with the widest frequency range (i.e. 40m to 6m) should be first in the chain so the frequency gets passed along.

DATA OUT PORT (Computer Control)

- The SteppIR can be controlled by a computer using this port (lower 9-pin DB).
- This port is always active thus allowing control of the antenna by both the computer and radio simultaneously.
- The Data Out port is a standard RS-232 port with a baud rate range of 2400 to 19.2k baud. Setting the baud rate higher than 19.2k on the SteppIR controller will set this port to 19.2k.

- The Data Out port supports two commands: Status request (?,A,CR) and Set (@,A,z,Fh,Fm,Fl,ac,dir,0,0,CR).
- The Status command is three ASCII characters. The controller will return an 11 byte string indicating frequency, motor active/stopped status, and direction (3/4 wave in vertical case)

  Request for status:

  ASCII string: 1 2 3

  ? A "CR" (0x0D)

The response to request for status:

ASCII **8 bit** byte number: 1 2 3 4 5 6 7 8 9 10 11

ASCII values @ A z Fh Fm Fl ac dir 0 v "CR" (0x0D)

Translation:

z = the Zero (00H, this byte contains no info, it's always zero)

v = Firmware version, 30H or 0 for older versions and 35H or 5 for this version.

A = the ASCII A (41H, this byte contains no info, it's always an A)

Fh, **Fm**, **Fl** = 24 bit Hex value representing the frequency divided by 10 (i.e. 14.2MHz = 1,420,000 = 15AAE0 hex)

ac = active motor flags, a 8 bit value with any of the following bits 2,3,4,5,6,7 being set if a motor is active. 2= DVR, 3= DIR1, 4=Refl, 5=DIR2

dir = direction, an 8 bit value defined as follows;

	01234567
Normal direction	xxxxx000 B
180 direction	xxxxx010 B
Bi-directional	xxxxx001 B
3⁄4 wave	xxxxx100 B (Vertical only)
Setup mode	xxx1xxxx B (active with the home and calibrate commands)
Frequency update	xx1xxxxx B (active when ENA command is set)

cmd = ASCII command that is passed to the controller

Valid commands =

1 = Default set frequency and Direction, Must be present if only valid direction update is requested

R = Turn on Serial frequency update, Required after a home command to re-enable

S = Home antenna

U = Turn off Serial frequency update

V = Calibrate antenna.

To send a command to the controller you use the 11 byte format as shown below;

ASCII **8 bit** byte number: 1 2 3 4 5 6 7 8 9 10 11

ASCII values @ A z Fh Fm Fl ac dir cmd 0 "CR" (0x0D)

Example: to set the antenna to 21.347 MHz, 180 degree send the following command.

1 2 3 4 5 6 7 8 9 10 11

40h 41h 00h 20h 92h ACh 00h 40h 31h 30h 0Dh

There are several considerations when sending Commands to the SteppIR controller.
"1" = When this command byte is set **both** the frequency and direction are updated in the controller. If the Frequency update is disabled this command will still change the direction of the controller. While the antenna is tuning to the new frequency the status can be checked (?A "CR") and the ac (Motor) flags will be set until the motors stop.

"R" = This command re-enables the frequency update after the Home or "U" commands are sent. It is recommended that the frequency bytes be set to 0000 to prevent odd frequencies being set before the command takes effect. If a valid frequency is sent with this command the controller frequency will change to that frequency. Bit 2 of the **dir** byte in the status reflects the state of this command 1= enabled.

"S" = Home the antenna elements has a specific sequence of events and should be sent with frequency bytes set to 0000. What will happen first is the frequency will be set to zero, the **dir** bit 3 will be set and bit 2 the Frequency update will be cleared. Next the Motor activity flags will be set until the elements are home. When the elements are home (motor flags all clear) the **dir** flag will be cleared and the frequency will remain at zero. You can use the zero frequency to tell if the antenna is at home.

"U" = Disable frequency update works in conjunction with the "R" command and has the same concerns with the frequency. The direction update is still active after this command is issued.

"V" = Calibrate the antenna is much the same as the Home command except it does not disable frequency update and it will return to the last frequency after the calibrate process is complete. Once the elements are home the antenna will return to the previous frequency or if there was a valid frequency in the command it will return to that frequency, at this point it will give the same feedback as changing frequency with the '1' command. The calibrate command should be used if power is lost in a storm with the elements out, or if power is lost while the antenna is tuning, to re-sync the antenna and controller.

Radio type table:

Tested and working Logging programs: TRX manager, DX4win, Logger, Logic7, Logger32, MixW, TRLog, WIN-EQF, WriteLog, LogWindows, N1MM, CT

Cable part numbers are 21-60XX-0x, where XX = the 2 digit number below

Radio	Cable Required	Interface	Notes
ICOM all	**"S01", 3.5mm Phono,**	**CI-V**	**Transieve mode enabled, 781 user settings**
Kenwood	----------	----------	----------
TS850S	**"S15", 6 pin din,**	**ACC1**	**Tested .....**
TS940S	**"S15", 6 pin din,**	**ACC1**	**Requires Optional IF-10B**
TS950S	**"S15", 6 pin din,**	**ACC1**	
TS680S	**"S15", 6 pin din,**	**ACC1-**	**Requires Optional IF-10C**
TS690S	**"S15", 6 pin din,**	**ACC1**	
TS440S	**"S15", 6 pin din,**	**ACC1-**	**Requires Optional IC-10**
TS450S	**"S15", 6 pin din,**	**ACC1**	
TS140S	**"S15", 6 pin din,**	**ACC1-**	**Requires Optional IF-10C**

TS711A	**"S15", 6 pin din,**	**ACC1-**	**Requires Optional IF-10A**
TS790A	**"S15", 6 pin din,**	**ACC1**	
TS811A	**"S15", 6 pin din,**	**ACC1-**	**Requires Optional IF-10A**
R5000	**"S15", 6 pin din,**	**ACC1-**	**Requires Optional IC-10**
TS570	**"S18", 9 pin male RTS.**		
TS870	**"S18", 9 pin male RTS.**	**-**	**Requires kenwood cable**
TS2000	**"S18", 9 pin male RTS.**		
TS50S	**"S12", 9 pin male Cross**	**- -**	**Requires Optional IF-10D**
TS480D	**"S18", 9 pin male RTS.**		
Yaesu----------			
FT847	**"S12", 9 pin male Cross**	**CAT -**	**Tested.**
FT857	**"S13", 9 pin M to F**	**CAT -**	**Requires CT-62 interface– Tested**
FT897	**"S13", 9 pin M to F**	**CAT -**	**Requires CT-62 interface– Tested**
FT840	**????**	**- -**	**Looks like 1000D ?**
FT920	**"S00" or "S18", 9 pin**	**CAT -**	
FT990	**9 Pin (S13) or 25 pin (S19) M to F.**		**Requires IFF232 RS-232 interface. ROM of ver –04 or later only.**
FT1000D	**9 Pin (S13) or 25 pin (S19) M to F.**		**Requires FIF-232 interface.**
FT1000MP	**"S00" or "S18" 9 pin.**	**CAT --**	
FT1000MP-field	**"S00" or "S18" 9 pin.**	**CAT - - -**	
9000DX	**"S18" 9 pin male RTS**	**CAT - - -**	
TenTec----------			
Omni 5	**Does not work - - -**		**Tentek IF**
Omni 6	**"S01" 3.5 mm or "S13" 9 pin**		**Has ICOM interface**
Orion	**"S13", 9 pin M to F**		**-Requires 57.6K baud, new Xtal.**
Pegasus	**????**		**Similar to Orion**
Jupiter	**"S01" 3.5 mm or "S13" 9 pin**		**ICOM port.**
Other----------			
K2, K3	**"S13", 9 pin M to F**		**K2 Needs Serial kit**
JS245	**"S19"**		**Needs special software**
SteppIR	**"S16", 9 pin fm Cross, one back shell.**		**Used for Slaving controllers or computer.**