

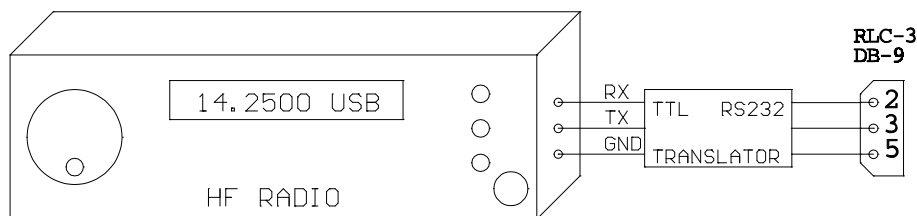
Chapter 15: Serial Controlled (HF) Radio Support

This section describes the controller's interface for serial controlled radios. Most such radios are for the HF bands, but some such as the FT-736 handle the VHF and UHF bands. The controller's software will handle frequencies through the 1.2GHz band for radios that support them. When "HF radios" are referred to in this chapter, other serial controlled radios are also included.

HF Radio Interfacing

The audio in, audio out and PTT connections to the serial controlled radio should be made just like for a repeater or any other radio, as described in Chapter 1 (they go to the bottom DB-9 connector on a radio card). If the serial controlled radio has a COR output (from an all-mode squelch), it can be connected normally as well. If the radio does not have a COR output, set the COR polarity for that radio port to active high, so the internal pullup will make it always active (or leave it active low and tie the COR input to ground). This is necessary because the controller normally mutes incoming audio unless the COR line is active (see command 005 for more information). Note that having the COR line always active will make the HF receiver timer out, so you might want to disable the time out timer for that radio port by setting it to zero (with command 020). If it does time out, you can reset the time out timer by resetting the controller with command 035 (you will have to exit HF mode to do that).

In addition to the audio in, audio out, COR and PTT signals, you will need to connect the controller to the radio's serial port, so you can control the frequency and other settings. Before doing this, execute command 195 so the controller will know not to echo serial characters to the radio (which can cause then to get into an endless loop). Most serial controlled radios use TTL level signals, rather than the RS-232 signals that computers, mice, modems, and the controller's main serial port all use. RS-232 signals switch between +12 and -12 volts, while TTL signals change from 0 to 5 volts. A few radios use RS-232 level signals. **Do not connect an RS-232 serial port to a TTL serial port without an adapter!** Adapters to convert TTL signals to RS-232 signals can be purchased from the radio manufacturers or built from scratch (for less than \$10). Some of these adapters may invert the data (the Kenwood TS-870 for example), just to make it more confusing. We have schematics for the level converters for some radios; check our web page or call us for more information. Once you have connected an adapter to the radio, you can simply connect the RS-232 serial port on the adapter to the top DB-9 connector on the same radio card that you have the audio connections to. **You must then install a Dallas DS1275 IC into the socket labeled U8 and make sure that there are no jumper blocks on header J5 on that radio card (both are underneath the level adjustment pots).** The Dallas DS1275 does not come standard with the RLC-3, but it is available from Link Communications and electronics supply sources.



If your radio's serial port uses TTL level signals, it may also be possible to connect it to the controller without using a serial level translator on the radio or the DS1275 IC on the controller. If you install two jumper blocks on header J5 on the controller (shorting pins 1 and 2 together and 3 and 4 together - do not do this while a DS1275 is installed in U8), it connects the controller's TTL level signals to the serial port connector (the top DB-9). These signals come directly from the HC11 processor on the radio card, so if you short them out or hit them with static, it may take out the HC11 processor. If these lines on the processor are damaged but the rest of the processor works, you can just switch and use a different radio card (with a different HC11), or you can get a new HC11 from Link Communications or another electronics supply source. Do not try to remove the HC11 from its socket with small screwdrivers - use a PLCC chip puller. If you replace the HC11, cycle the power a couple of times before resuming testing, to give the processor a chance to set up its config register. If you have jumper blocks on J5, you can then connect the TTL level signals from the controller to the TTL serial port of the radio. Kenwood radios may require that this data be inverted (both ways); a 74HC04 IC will do this. If you don't want to hassle with the TTL levels, just use the DS1275 IC on the controller and the RS-232 level translator on the radio.

HF Radio Control:

There are several commands that are used to set up the HF radio interface. They tell the controller what radio is installed and a few other things. After the radio is set up and you are ready to change frequencies, scan, etc., you can go into a special "HF control mode". When you are in this mode, all of the normal commands are disabled and a separate set of HF control commands are used instead. This makes it possible to control the HF radio with short command codes without having to worry about what other commands might get executed accidentally. These commands are organized by mapping the DTMF keypad in a logical way that makes the various commands easy to remember. When you are done using the HF radio, there is a command code that takes you back to the normal mode where you can execute the normal commands. It is possible to execute HF commands from normal mode using command ??? (not finished yet). This is usually used in a macro. There is also a way to execute normal commands while you are in HF mode (see keypad code ??? - not finished yet). And finally, there are event triggers (see command 157) that are called when the different HF commands are entered that can be used to customize how the HF commands work (not finished yet).

Virtual Radio Features:

Although the RLC-3's HF remote base interface is loaded with features, it uses only the most basic features on the HF radio itself: receive frequency, transmit frequency, vfo, split, and mode. The rest

of the features are provided by the RLC-3 itself. This allows the RLC-3 to provide all of those features even on radios that don't have built-in support for them. Scanning is performed by sending a change of frequency several times a second, so the controller always knows what frequency the radio is on and so it can handle scan edges even if the radio doesn't support them directly. Memories are stored on the controller, so radios without built-in memories can support them with the RLC-3. Even VFO A and VFO B are simulated by the controller; they work like you would expect but both use VFO A on the radio (the radio's VFO B is used to handle offsets with some radios). You could call all of these features that are handled by the controller "virtual" features, since they may or may not exist on the radio but the controller makes it work like they do. The only reason you need to know about which features are virtual and which ones actually use the features of the radio is so you can understand why the display on the radio doesn't always reflect the commands you enter. Watching the display on the radio may be more confusing than just using the frequency recall command (keypad command '8') while you are in HF mode.

Default Values:

The first time the HF remote is turned on (or after it has been reinitialized), it will go to 14.25 Mhz, USB. All of the virtual memories also default to 14.25 Mhz, USB. Of course you can change them to any other frequency you may choose.

Example:

I want to control a Kenwood TS-870S. I want my command prefix digit to be '1', so I enter "195 11". I then enter "196 2 2 0" to set the radio type and tell the controller that it will be connected to port.two. The audio cable is built just like the one for my repeater was. Since the TS-870S already has a RS-232 serial port, I don't need a level converter, but I do need a null modem adapter in the serial cable between it and the controller to connect the data out line on each end to the data in line on the other. At least for now, I don't care about transmit or scan band edges, so I am going to skip command 197. Entering "198" from the repeater on port 1 turns on HF mode and sets the frequency to 14.25 Mhz. "179" starts it scanning up fast. Kerchunking it stops the scan. "13" will turn of HF mode.

195: Configure HF Mode

This command configures the HF control mode and assigns the HF command prefix digit.

<195> 0	Disable HF
<195> 1 p	Enable HF and set HF prefix digit to 'p'
<195> 2	Turn HF off without enabling or disabling
<195> 3	Recall HF mode settings

Parameters:

p = the HF command prefix digit. This is the digit that must be pressed before any command is entered in HF mode. It is commonly set to '1'. If you prefer not to use a prefix digit, just enter "195 1".

Notes:

- When you disable HF with "195 0", the HF remote will be turned off if it is in use and it will be disabled so it cannot be turned back on until it is enabled with this command.
- Normally the HF remote will be turned off from the port that is using it, by entering the HF command prefix digit followed by a '3' (the exit command - see the HF commands on the following pages). If you need to turn the HF remote off from another port (one that is not currently controlling the HF remote), you can enter "195 2".

Voice Response:

"HF on/off, key x" where "on/off" indicates whether HF is enabled or disabled (not whether HF mode is turned on or not) and "x" is the HF command prefix digit. "x" will be "clear" if no prefix digit is used.

Example:

I want the remote base turned on and I want my HF command prefix digit to be a '1'.

195 1 1

196: Configure HF Radio

This command tells the controller which radio port the HF radio is interfaced to and which type of radio it is. The controller uses this information to automatically set the baud rate (4800 for Kenwood or Yaesu, 1200 for Icom) and to send the proper command codes for your radio.

<196> 0	Recall HF Radio Configuration
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<196> p 2 0	Kenwood TS-450, TS-690, TS-850, TS-870 and other recent radios
<196> p 2 1	Kenwood TS-940
<196> p 2 2	Kenwood TS-50, TS-140S, TS-440, TS-440S, TS-680, TS-711, TS-790A, TS-811, TS-850?, TS-940, TS-950?, R-5000 and other early radios

<196> p 3 0	Yaesu FT-736
<196> p 3 1	Yaesu FT-757 (no control of modes), FT757GXII
<196> p 3 2	Yaesu FT-767
<196> p 3 3	Yaesu FT-747GX, FT-890, FT-900, FT-990, FT-1000
Not Supported	FT-727R, FRG-8800

<196> p 1 xx	Icom. See table on next page or check your radio manual to find 'xx' (the address) for your radio
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Parameters:

p = the radio port that the HF radio is connected to.
xx = radio address (Icom only)

Voice Response:

"HF on <port>, <I/K/Y><type>" where <port> is the radio port on the controller that the HF radio is connected to, <I/K/Y> signifies the brand of the radio (Icom, Kenwood or Yaesu, respectively), and <type> signifies the radio type.

Icom Notes:

- Because the Icom radios can co-exist on a common serial bus (CI-V), a radio address is needed to select what radio gets the serial data. The list below shows the addresses of some Icom radios. If you don't find your radio listed, check your radio's owner's manual.

- Some Icom radios will let you change their addresses. This should not cause any problems as long as you don't change the address of an IC-735 to anything but 04 and you don't change the address of any other radio to 04. The IC-735 uses a slightly different format to set the frequency and the controller software uses this format whenever the radio address is set to 04.

Icom Radio Addresses

Radio Address	Radio Type	Radio Address	Radio Type
04	IC-735	34	IC-471 A/E/H
08	IC-R7000	36	IC-1271 A/E
16	IC-275 A/E/H	38	IC-781
18	IC-375 A	40	IC-725
20	IC-475 A/E/H	42	IC-R9000
22	IC-575 A/H	44	IC-765
24	IC-1275 A/E	46	IC-970 A/E/H
26	IC-R71 A/E/D	48	IC-726
28	IC-751 A	50	IC-R72
30	IC-761	52	IC-R7100
32	IC-271 A/E/H	Other ...

Example 1:

I want to tell the controller that there is an Icom IC-725 on radio port 2.

195 2 1 16

Example 2:

I have a Kenwood TS-440 radio on port 2.

195 2 2 2

197: Set/Recall Transmit/Scan Band Edges

This command allows you to set and recall the edges of the frequency ranges that you are allowed to transmit in and within which the scanning function will loop. These two features are completely separate: they are stored separately and they operate independently, although the frequency ranges for both are set with this command.

Transmit Edges: The controller will let you receive on any frequency, but only transmit within the transmit edges that you set up with this command. This protects you from accidentally transmitting on a frequency you shouldn't.

Scan Edges: The controller will let you start scanning from any frequency. Since you will often want to focus on a small frequency range, it will also allow you set a more limited range to scan within. This is the purpose of the scan band edges. Even if you started scanning from a frequency that was not within any of the scan bands, if you are scanning up and reach the top edge of a scan band, it will automatically loop to the bottom edge and continue scanning. If it reaches the bottom edge of a scan band, it will automatically loop to the top edge. It will speak the current frequency immediately before and after looping.

197 e	Recall Edges for all Bands
197 e c	Set Edges for all Bands for a Class (novice..amateur extra)
197 e bb	Recall Edges for one Band
197 e bb c	Set Edges for one Band for a Class
197 e bb u f..f*f.f	Set Upper or Lower Edge for one Band to a Specific Frequency

Parameters:

e = 0 to set a transmit band edge(s), 1 for a scan band edge(s)

c = Class to set edge(s) to. You can find out what the edges are for each class by setting them then recalling them with this command.

0	Novice
1	Technician / Tech Plus
2	General
3	Advanced
4	Amateur Extra

bb = 0..15 which band. See table on the following page. You don't have to leave the bands as they default if you want to re-assign them some other way. If two bands overlap, the first one found that contains the current frequency will be used.

u = 0 for lower edge, 1 for upper edge. If you try to set the upper edge to a lower frequency than the lower edge, the lower edge will be set to match it. If you try to set the lower edge to a higher frequency than the upper edge, the upper edge will be set to match it.

f.f*f.f = the new frequency. The '*' should go between the 1MHz digit and the 100KHz digit of the frequency. Example "14*25" for 14.25MHz. Frequencies over 2GHz have not been tested.

Defaults:

The following table shows the defaults for both the transmit and scan edges (they can be set separately). These are the edges of the voice bands for the amateur extra class. Note that voice is not allowed on 30 meters. There is also a user defined band at the end that you can set for any other frequency range.

Band	bb	Lower Edge	Upper Edge
160 meters	0	1.8 Mhz	2.0 Mhz
80 meters	1	3.75 Mhz	4.0 Mhz
40 meters	2	7.15 Mhz	7.3 Mhz
30 meters	3	0.0 Mhz	0.0 Mhz
20 meters	4	14.15 Mhz	14.35 Mhz
17 meters	5	18.11 Mhz	18.168 Mhz
15 meters	6	21.2 Mhz	21.45 Mhz
12 meters	7	24.93 Mhz	24.99 Mhz
10 meters	8	28.3 Mhz	29.7 Mhz
6 meters	9	50.1 Mhz	54.0 Mhz
2 meters	10	144.1 Mhz	148 Mhz
1.25 meters	11	222.0 Mhz	225.0 Mhz
70 cm	12	420.0 Mhz	450.0 Mhz
33 cm	13	902.0 Mhz	928.0 Mhz
23 cm	14	1240.0 Mhz	1300.0 Mhz
user defined	15	0.0 Mhz	0.0 Mhz

198: HF Mode Enable

This command enables the HF remote base mode. This mode re-defines the DTMF keyboard into a quick HF remote access pad. When this mode is enabled, only HF commands can be entered (see the following pages). In order to execute any system wide commands the user must get out of the HF mode.

<198>

Parameters:

There are no parameters for this command

Defaults:

HF mode is disabled

Response:

- "HF Remote On <frequency>" if successful.
- "HF is off" if need to enable HF control with command 195.
- "HF busy X" if another port is in HF control mode. X is the number of the port this is currently using the HF remote (9 is the main controller serial port). If they just forgot to exit HF mode, you can turn them off with "195 2", then enter "198" again to enable control from the port you are using.
- "Error 217" if you are already in HF mode.

HF Prefix:

The HF prefix is a single digit that is configured with Command 195. This digit is always the first digit entered when executing a command while in HF mode. The reason for the prefix digit is to keep single digit entries from accidentally being entered.

Example: I am in HF mode and need to start the scan function for fast up scanning

Enter: 1 79 unkey or '#' Response: "Scan up fast"

Example: I am in HF mode and need to enter a frequency

Enter: 1 29*600 unkey or '#' Response: '2 9 point 6 0 0 0 0'

Example: I am in HF mode and need to recall memory 15

Enter: 1 515 unkey or '#' Response: <frequency>

In all these examples the format for data entry was:

<HF Prefix> <Command> <Additional Data if Needed> <unkey or '#>

HF Remote Base Keypad Definition:

1 Remote in receive only mode or Select HF Mode #	2 Remote in receive and transmit on mode	3 Receive and transmit off. Cancels HF mode	A Bump Up Remote 20HZ
4 Bump Down Remote 100HZ	5 Select VFO A or Recall Memory Channel xx 00..99	6 Bump Up Remote 100HZ	B Bump Down Remote 20HZ
7 Bump Down Remote 500 HZ or Start Scan #	8 Recall Frequency of current VFO or Select Offset	9 Bump Up Remote 500HZ	C Not Defined
* Frequency <Point> Key .	0 Select VFO B or Write Memory Channel xx	# Force-Execution Digit Enter	D Not Defined

Explanation of Keypad Commands:

Remember that before pressing the digit shown on the keypad map above, you must enter the HF prefix digit you set with command 195. The prefix digit is shown as a 'p' in the descriptions below; it defaults to '1'.

Digit 1:

- "p 1": Selects receive only mode. Keying the repeater will not cause the HF radio to transmit while in receive only mode. You can also go to any frequency the radio supports while in this mode, while the allowed frequency ranges may be restricted when transmit is enabled. Voice response: "HF Receive". This does the same thing as command 001 does when you are not in HF mode.

- **"p 1 x"**: Select radio mode. "x" is from the table below. If your radio supports wide and narrow versions of a mode, the wide version will be used.

"x"	Definition
1	Selects USB Mode
2	Selects LSB Mode
3	Selects AM Mode
4	Selects FM Mode
5	Selects CW Mode

Digit 2:

- **"p 2"**: Select transceive mode. Keying the repeater will cause the HF radio to transmit while in this mode. You can only go to frequencies that are within the transmit band edges while in this mode. If you try to go to a disallowed frequency, or if you try to enable this mode while on a disallowed frequency, the controller will generate the HF error (the default is for it to speak "error 217) and will not do it. If this command is successful, you should hear the voice response: "HF Transmit". This does the same thing as command 000 does when you are not in HF mode.

Digit 3:

- **"p 3"**: Exit HF mode and return to normal command mode. Voice response is "HF Off".

Digit 4:

- **"p 4"**: Bump down 100 Hz. If you are in transceive mode, you may get an error if the new frequency would be disallowed by the transmit edges. Voice response is "Down 100".

Digit 5:

- **"p 5"**: Selects virtual VFO A. Has no effect if you are already using virtual VFO A. Restores the receive frequency, transmit frequency offset and mode to whatever they were when you last used virtual VFO A.
- **"p 5 x"** or **"p 5 xx"**: Recalls the contents of virtual memory "xx" into the current virtual VFO. This includes the receive frequency, transmit frequency offset and mode. Once a memory has been recalled, you can bump up or down, scan, or do anything else you would do with a frequency you entered directly into the VFO. Since the memories are virtual, that is they are stored in the controller's memory rather than in the radio, all 100 memories will work regardless of whether your HF radio has built-in memories or not.

Digit 6:

- **"p 6"**: Bump up 100 Hz. If you are in transceive mode, you may get an error if the new frequency would be disallowed by the transmit edges. Voice response is "Up 100".

Digit 7:

- **"p 7"**: Bump down 500 Hz. If you are in transceive mode, you may get an error if the new frequency would be disallowed by the transmit edges. Voice response is "Down 500".

- "p 7 x": Start scan type "x" (see table below).

"x"	Definition
1	Scan Down Slow
3	Scan Up Slow
4	Scan Down Medium
6	Scan Up Medium
7	Scan Down Fast
9	Scan Up Fast

Digit 8:

- "p 8": Recalls the current frequency, offset (if not zero) and virtual VFO (if it is VFO B).
- "p 8 0": Turn transmitter frequency offset off (set it to 0). Voice response is "Off".
- "p 8 1": Turn transmitter frequency offset on (set it to whatever offset was last used on this band). Voice response is "<offset frequency> Mhz". The controller will not bother to tell the radio to go into split mode unless you have transmit enabled (keypad command 2).
- "p 8 1 x": Turn offset on and make it negative if "x" is 1, positive if x is 0 or 2.
- "p 8 1 x y": Turn offset on and make it negative if "x" is 1, positive if x is 0 or 2. Set offset size "y" from the table below.

Offset Code	Offset size
0	0
1	100 Khz
2	500 Khz
3	600 Khz
4	1 Mhz
5	1.6 Mhz
6	1.7 Mhz
7	5 Mhz
8	12 Mhz
9	20 Mhz

Digit 9:

- **"p 9"**: Bump up 500 Hz. If you are in transceive mode, you may get an error if the new frequency would be disallowed by the transmit edges. Voice response is "Up 500".

Digit 0:

- **"p 0"**: Selects virtual VFO B. Has no effect if you are already using virtual VFO B. Restores the receive frequency, transmit frequency offset and mode to whatever they were when you last used virtual VFO B. VFO B is called a "virtual VFO" because the controller keeps track of it separately from virtual VFO A so it will work as you would expect, but both will usually use VFO A on the radio. In other words, if you look at the radio, it will probably show VFO A even when you select virtual VFO B.
- **"p 0 x" or "p 0 xx"**: Writes the contents of the current virtual VFO into virtual memory "xx". This includes the receive frequency, transmit frequency offset and mode. Since the memories are virtual, that is they are stored in the controller's memory rather than in the radio, all 100 memories will work regardless of whether your HF radio has built-in memories or not. Voice response is "Write xx".

Digit A:

- **"p A"**: Bump up 20 Hz. If you are in transceive mode, you may get an error if the new before the 100 Khz digit. Voice response is "Up 20".

Digit B:

- **"p B"**: Bump down 20 Hz. If you are in transceive mode, you may get an error if the new before the 100 Khz digit. Voice response is "Down 20".

Digit C: Not used.

Digit D: Not used.

Digit *: Used only when entering frequencies. See the instructions for "HF Frequency Entry:" below.

Digit #: Used to make a command execute right away, without waiting for you to unkey. Similar to the forced execution digit of 'D' that is used when not in HF mode. If you press '#' after entering a command, you may not be able to hear part of the voice response to that command. Simply unkeying will avoid this problem.

Scanning:

Although your HF radio may have a scan feature built in, it is not used when scanning with the controller (see the "Virtual Radio Features" section at the beginning of this chapter). Instead, the controller sends a new frequency to the radio several times a second. Each time a new frequency is sent, it is 20, 100 or 500Hz different than the previous frequency, depending on whether you have selected slow, medium or fast scanning. A new frequency is sent just as often when scanning slowly as when scanning fast, but because the frequency is changed by a different amount, the resulting scan rate is different. You can change how often a new frequency is sent to the radio by adjusting a timer. Changing that timer will affect all three scan rates. See command 020 in Chapter 4 for information about changing the HF scan timer value.

When the controller reaches the top or bottom of a scan band (see command 197), it will speak the current frequency, wrap around to the other edge of that band, speak the frequency again, and continue scanning. It will also speak the frequency every 10 Khz when scanning slow or medium or every 25 Khz when scanning fast.

HF Frequency Entry:

To enter a new frequency, press the HF prefix digit (default is '1') followed by the frequency. Put a '*' after the 1 Mhz digit. For example, to go to 14.25 Mhz, enter "1 14*25" and unkey or press '#'. Leading and trailing zeros are optional. The '*' must be entered, as that is the only thing the controller uses to tell whether you are entering a frequency or another command. On the RLC-3, when controlling the HF radio from the controller's serial port, you can use a '.' rather than a '*' if you wish.

Automatic Mode Selection:

When frequencies below 10 Mhz are entered, LSB mode is automatically selected. When frequencies between 10 Mhz and 29 Mhz are entered, USB mode is automatically selected. When frequencies above 29 Mhz are entered, FM mode is automatically selected. Of course you can always override the default mode (using keypad command 1). When memories are recalled, they retain the mode they were stored with, rather than using the automatic mode selection feature.

Typical HF remote base session:

- HF Prefix is '1'
- 1) 106 D or unkey ; Enable HF remote mode
 - 2) 1 29*68 # or unkey ; Move the HF remote to 29.680 mhz, VFO 'A'
 - 3) 1 0 # or unkey ; Select VFO 'B'
 - 4) 1 29*58 # or unkey ; Move the HF remote to 29.580 mhz, VFO 'B'
 - 5) 1 5 # or unkey ; Select VFO 'A'
 - 6) 1 8 1 # or unkey ; Select Split (Repeater Mode)
 - 7) 1 2 # or unkey ; Go into transmit and receive mode
 - ...
 - 1 3 # or unkey ; Cancel HF mode after communications are complete