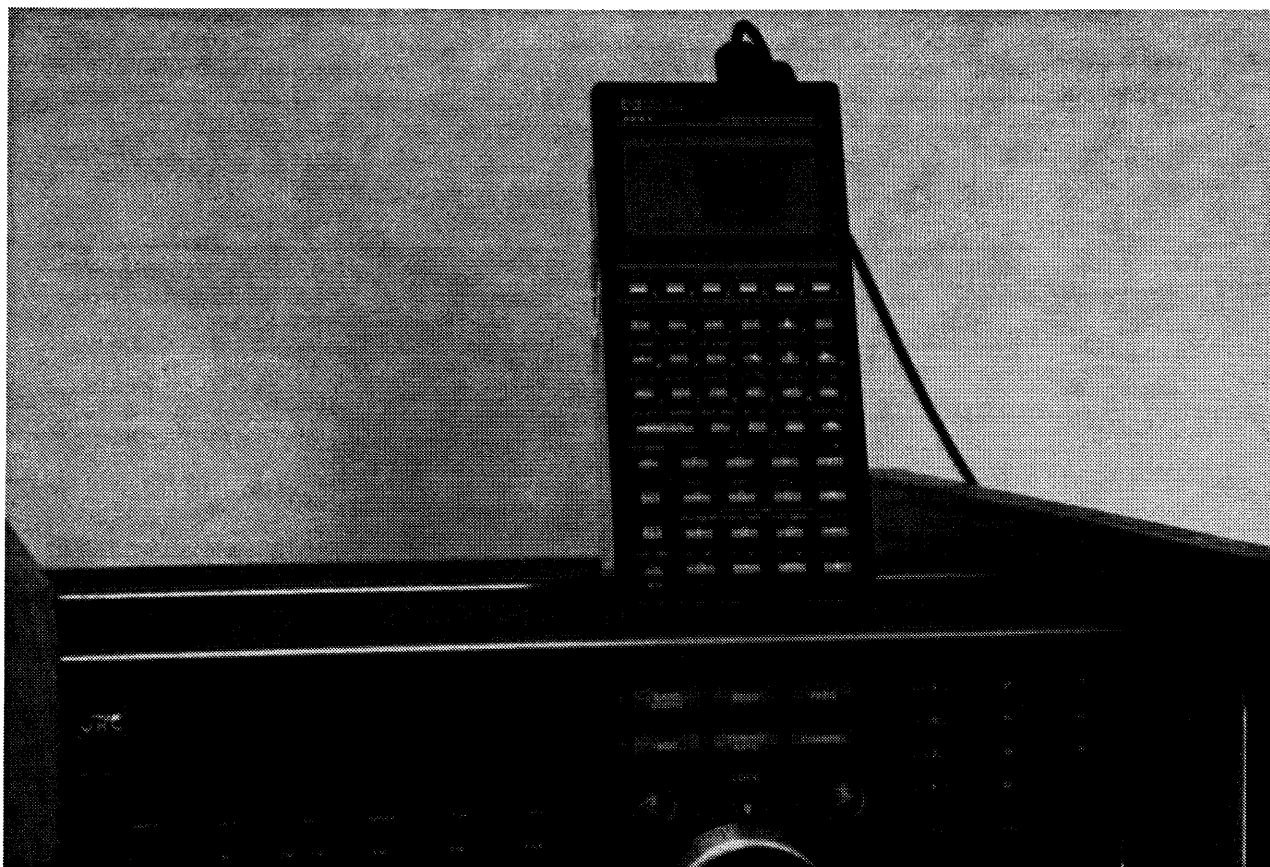


# RECEIVER CONTROL USING A HANDHELD CALCULATOR

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## FORWARD AND BACKGROUND

As much as the venerable hollow state receivers of times past are still up to the demands of today's DX listening, when it comes time to purchase a modern receiver, it is difficult to ignore the common characteristic of all high end receivers today; all of them can be modified to add computer control in some form. The computer software market has responded with many fine programs for most computers, and allow us to take advantage of the new receivers. Two kinds of programs exist. Some are designed to provide remote control of virtually every receiver function from the console of the computer. Others are more like data base managers that keep files of frequencies, times and receiver settings and are extensions of the receiver's internal memories. Along with this function, the computer can be used to log stations and frequencies for future reference.

## TRADITIONAL COMPUTER CONTROL

Some DXers are unimpressed with the mating digital microprocessors to analog radio receivers. I'm not here to sell the concept of computer control but will say that everyone I know who has tried it has grown to appreciate what computers can do for their listening and DXing pleasure. An alternative to computer use is to use one of the modern handheld calculators such as the HP48 series from Hewlett-Packard as the receiver controller. It is less expensive and avoids many problems with computers.

There are advantages to using a full size personal computer; larger disk drives for unlimited storage space, high speed operation and dozens of software systems. They are available everywhere new and used. On the other hand, a common complaint with personal computers is that the internal clocks that drive them are also radio frequency genera-

tors. Video monitors also generate interference from their internal circuits and from interface cables. Shielding, rf chokes and just plain good design helps to varying degrees, but the most effective rf eliminator is still the power switch. The HP48 on the other hand can sit directly on top of the NRD535 without interfering with the receiver.

Full size computers work well as long as a source of AC mains current is available. Even the latest crop of portables are not able to run for the duration of a weekend DXpedition without need of a recharge. The three AAA cells of the HP48 last for weeks of heavy use. It is the perfect computer for settling into a log cabin or tent. If only they could make it work on butane.

## TYPICAL USAGE

It is possible for the HP48 to control any of the current top-of-the-line receivers. Indeed, it could conceivably be used to control any intelligent device having a low speed serial data interface. What follows is based on my experience mating it to the NRD525/535. The HP48 connected to the RS232 port of the NRD525/535, behaves much as a hand held remote control of consumer appliance fame, albeit with a cable attached. There are 49 buttons on the calculator, each of which may be redefined to perform any single function or to execute any previously entered program. The HP48 series of calculators is capable of addressing enough memory to maintain a large data base of frequencies, as well as the time schedules for all the stations of interest. Larger data files can be maintained and manipulated on a standard personal computer or even a minicomputer or mainframe computer. Hence, you should never run out of storage space. Data can be transferred between the HP48 and any computer that supports the HP48 data transfer protocol, which includes almost every computer ever made.

## PROGRAMMING EXAMPLE

The Hewlett-Packard line of Hand held calculators, which began in 1972 with the HP35 scientific calculator, uses logic known as RPL or Reverse Polish LISP. The HP48gx is fully programmable in RPL with 2300 functions available in its 500k read only memory (ROM). There is a graphical Liquid Crystal Display which can be used for alphanumeric or pictorial readout. Each dot or picture element on the screen is addressable under program control. This feature in itself is useful, but the additional feature that makes receiver control possible is the standard serial port available through a four pin connector on the back. HP has thoughtfully provided several functions internally to assist in controlling what passes through the bidirectional serial port.

Control functions are implemented on the Japan Radio Company series of receivers through the sending and receiving of plain ASCII text strings. This makes programming them through the HP handhelds almost trivial. As an example, consider the problem that many of the buttons on the NRD535 are multifunction in the sense that a single button selects a series of options in a "carousel" fashion by repeated key presses. To select any of four filters may require from one to three key presses. However if you find yourself, changing from AM to LSB to USB and back again, while simultaneously changing filters to fit the reception mode, it makes sense to assign single function buttons on the HP48 to AM, USB and LSB. Each function will take care of switching in your favorite filter to simultaneously match the mode. Here is what the program looks like for the AM function.

```
<< 4800 BAUD OPENIO "H1D4B0H0" XMIT DROP CLOSEIO 9600 BAUD >>
```

Notice several things about RPL programs that are quite different from other higher level languages. RPL is very much similar to the language "Forth". Compared to other high level languages, it is very compact. The above program would take up several lines as an equivalent BASIC program. Also, notice that the language is "stack" oriented in that the arguments are entered into the calculator in the order they are keyed in. Functions, as they are called, operate on whatever parameters they find that have been last entered on top the stack. For example, to add two numbers, you enter the first, then enter the second. Pressing the "+" key removes the last two entries, adds them and leaves the result as the last entry. The above program first sets the serial bit rate to 4800 bps, opens the input/output port, transmits a string of ASCII to the receiver, closes the port and finally resets the bit rate to 9600. Those of you who have programmed the NRD525/535 may recognize the string as setting the mode to "AM" and the filter to "Wide".

## DATA BASE MANAGEMENT

One unfortunate feature of all receivers with memory is that there is never enough. With the price of semiconductor memory these days, it is surprising that JRC included only 200 storage locations in the NRD535. You can consider the HP handheld as an expansion of the receiver's internal memories and use it both as a controller and a data base manager.

Some useful functions I've implemented include routines to download a list of frequencies to the NRD535, log the current receiver settings into the HP48 for future reference, change modes and filter settings simultaneously and in general, control all the receiver functions that the rich set of commands provided by JRC will allow. Whenever I change one of the dozens of user settable options, I run a program to copy these for restoring later in the event of loss of internal receiver memory. An additional set of commands is available to manage the data files within the calculator, such as to extract lists of frequencies by time and to sort these lists. Thus I can download all known frequencies for a country or limit the search to specified frequencies at specified times. While it is possible to enter and maintain data on the HP48, I've found it easier to build lists of target frequencies on a larger computer and later download the lists to the handheld calculator. I use such data sources as magazines, *Fine Tuning* newsletters and the Internet for keeping current on scheduled frequencies and times.

The accurate internal clock of the HP48 allows setting an almost unlimited number of alarms. When an alarm comes due, you can have a tone sound, or even execute a prepared program. Add the ability to, within a program, turn on the receiver, set a frequency and mode and turn on the tape recorder and you have the ultimate in remote tape recorder control.

## AMATEUR PROGRAMMERS

The HP48 is easily programmed by the individual user, so features can be added in the form of custom menu keys that appear on the display. To write a program, no special knowledge of computers is required. A program consists of entering the same keystrokes as are used to perform the functions manually. Thus the computer "language" used by the HP48 is written on the face of the keypad. To someone who has little understanding of the inner workings of a calculator, the ability to create small programs that reduce the need for repetitive keystrokes is somewhat like magic. You may find yourself taking the machine with you when you anticipate periods of spare time, much as you do with a novel or other light reading. Short programs can be entered directly as ideas occur and without the encumbrance of paper and pencil. Later they can be printed either on the HP48's own optional printer or by sending your program to a larger computer with a printer. This should be done anyway as insurance against the loss of memory on the HP48.

A key area needing further exploration by the programmer community is the use of computing devices by the visually impaired. Coupling the radio's feedback to the calculator's sound capabilities would allow any radio with a two way RS232 port to output its status as Morse code. Unfortunately, programs are written by professionals only if there is a sufficient market for them. By making the calculator easy to program, it is possible for part time programmers to adapt it to specialized situations and some of the smaller markets may be filled.

By programming the HP48, you can customize it to your own style of DXing. Here's how I use my system to fill my needs and changing style. For armchair listening I have a file of times and frequencies for broadcasts directed to North America, collected over the years as personal favorites. I let a program select the frequencies active at a given time and step through them looking for clear signals. I can hold the HP48 in one hand and still adjust the manual controls with the other. For DXing the tropical bands I have a list of Southeast Asian and Pacific frequencies that load into the NRD535's internal memories. As these change, it takes about a minute to completely clear the frequencies and reload a current list. The ability to hold more than 200 receiver settings is especially useful when listening to weather FAX and aircraft transmissions. It is possible to step through or scan hundreds of frequencies very quickly while listening for sometimes sporadic activity.

## OTHER PROGRAMS AVAILABLE

As in most disciplines, we build upon the works of others. Since the HP48 has been around for over five years, it has built up a following, primarily among engineering and mathematics college students. As you would expect, most programs are the result of students programming around their class work. The Internet has a news group dedicated to this little machine. You can find coming over the wires and airwaves all sorts of home crafted software useful in solving differential equations, designing electrical circuits and handling statistics. In addition, you will find several personal data organizers, calendars, phone books, which are useful to those of us in the real world. There are pocket observatories, and programs to calculate sunrise and sunset, moonrise and set, planetary location, as well as a graphical grayline terminator program similar to that you find on the larger machines. If you travel, or listen to business oriented programming, you will want the currency conversion program that allows you to convert between any two world currencies at a touch. Several Morse code practice programs are available that exploit the sound capabilities of the HP48.

All of these programs are available on what are known as "Goodies Disks." They are available on computer bulletin boards throughout the world, on the Internet via file transfer, on commercial systems such as CompuServe and by mail order. The cost is nominal for the disks or is only the cost of transferring the files by telephone.

## AVAILABILITY AND COST

The HP48 is available in several models. The current incarnation is the HP48gx which comes with 128 kilobytes of random access memory (RAM) and would be capable of storing all of the programs I normally use for listening. The predecessor of the "gx" was the HP48sx. It was standard with 32k of RAM and had a few hundred fewer built in functions than the "gx". Both the "gx" and the "sx" can be expanded with another 128k using expansion cards. The HP48sx can accept two 128k RAM modules, and if you really need it, the "gx" can accept an additional 4 megabytes of RAM. Both models are available as the HP48s and HP48g, but since these are not expandable, data and programs would quickly overflow their meager 32k memories. The HP48gx sells for about \$275 in appliance stores and college book stores. You may find the HP48sx used for around \$125, sometimes with other goodies thrown in. 128k expansion cards are \$85 to \$125 new. You will also need an RS232 cable for connection to the receiver and to a larger computer for download. The Hewlett-Packard cable package is \$50 including software, or you can build your own for about \$16 and use your own software. The HP48 uses the "kermit" data transfer protocol which is available in many of the popular communications programs.

The HP48sx comes with a large manual sufficiently detailed for all but the most dedicated users. It is written for both basic users and for those who wish to actually write their own programs. The HP48gx on the other hand has the barest minimum of documentation. Additional help is available in the form of an advanced manual written mainly for programmers. There are other books available that go into much greater depth on many of the features of the HP48 series. Popular among these is a two volume set of "HP48 Insights" Written by Dr. William Wickes, a member of the HP48 development team. These books were originally written for the HP48sx but are excellent discussions of the calculator's applications and inner workings and were not made obsolete by the introduction of the HPgx.