

Steve's Scanner Shop

The Secrets Of Paging Discover How They Work

By Steve Donnell

One of the more commonplace type of radio equipment around today are pagers, also simply referred to as "beepers". These tiny wonders have evolved from receivers that relayed voice messages into sophisticated digital (numeric and text) display providing information to anyone on to go. But just how do they work? Older generation pagers were FM voice receivers that selectively activated (addressed) by way of a sequence of either 2 or 5 specific audio tones. Besides slow speed, one major limitation to these formats was that they could only support several thousand different pagers for a given system.

Over the past ten to fifteen years, most pagers become digital in both how they receive information and how they display messages. They make use of one or three digital formats for addressing and message data. One format known as Golay was used in many early digital pagers, however it only operated at 600 baud. Another is POCSAG, which originally operated at 512 baud, and more typically at 1,200 baud, and even 2,400 baud. POCSAG has been the most common format of digital paging here in North America for the past ten years or so, and it can support about two million different address codes.

An even newer digital paging protocol, developed by Motorola is called Flex. Flex offers many advantages over older digital formats. For one, it can support over two hundred million addresses for a given system. Because of how a Flex pager synchronizes with the transmissions on a given channel, it is able to "know" when to properly wake up in order to check for incoming pages. This is much more efficient than with older POCSAG pagers that are constantly cycling on/off, checking at the start of every transmission. Flex also provides very robust error correction to help ensure message delivery.

Flex operates at either 1,600 or 3,200 baud. While older

digital formats utilize only "2 level" FSK (frequency shift keying), where the transmitted signal is shifted from either minus 4.5 kHz or plus 4.5 kHz of the center frequency, Flex can also make use of "4 level" FSK; plus/minus 4.5 kHz and plus/minus 2 kHz. This increases the effective transmission speed to over 9,600 baud. You see, paging is an increasingly competitive business, particularly over the past couple of years. The more subscribers that a given paging company can place on a given system, and the quicker and more efficiently messages can be delivered, the easier a paging company can make a profit.

With an older format such as 5tone voice, for the maximum number of subscriber addresses that could be used, along with the amount of "air time" it would take to deliver just one message, there is no way that a paging company would survive. Where as with even a slow digital format such as 1,200 baud POCSAG, which as we noted, can support about two million subscribers on a given channel. In the space of 6 to 8 seconds, the amount of time it would take to deliver just one voice page, you can send about 3 to 5 dozen text/numeric messages using POCSAG.

Way back when paging first began, most all systems were in the VHF bands. Typically either at 35 or 43 MHz. Nearly all of these systems are now gone, however paging does remain active in the VHF High band at 152, 157 and 158 MHz. As well as on UHF at 454 and 462 MHz. However, over the past ten years or so, the bulk of paging systems have moved to 900 MHz, either 929 or 931 MHz. You can also find a few private paging systems operating on different commercial frequencies; one company, called Tekk, offers a 2 or 5 watt transmitter and controller which transmits in 512 baud POCSAG format which any business can use for short range, "on site" paging.

The standard frequencies used for this product are:

464.600 and 467.800 MHz. Many hospitals make use of a special paging frequency of 152.0075 MHz.

In some ways, digital pagers aren't much different from their earlier(voice) counter parts; they consist of an FM receiver and a controller that selectively activates the unit when a message is received. While some have the receiver and control unit integrated onto one board, many have separate boards, where the receiver plugs in to the control/display portion. While most pagers are set on their operating frequency by way of a crystal, it may come as a surprise that some newer generation pagers are frequency synthesized. This adds very little to the circuit complexity and makes the pager much easier/cheaper to setup and move around to different channels.

Most POCSAG pagers are capable of at least four separate addresses or "cap codes" that consists of a seven digit number. But there is also an extra digit known as a "function code"(1,2, 3, or 4). Originally this seems to have been intended to help indicate to a pager as what to do with different types of messages(numeric, tone, or alpha text). However in more practical terms the function code seems to be used to create entire extra groups of useable cap codes, to be able to support a greater numbers of users for a given paging system.

Most pagers require a PC using software provided by a pager manufacturer, along with a special interface in order to connect the pager to the PC's serial port so as to program the pager for it's various address "cap codes", operating frequency(if synthesized) along with all of the various alert and display options. The PC to pager interfaces are often little more than RS232 to TTL "level shifters", such as one designed around a MAX232 IC.

But even more surprisingly, are a few new generation pagers that can have some or all of their functions programmed directly by simply pressing the buttons on the front of them. This is often the case with many low cost pagers manufactured in the Far East. Part of the intent here is to make the pager easier and quicker to program, particularly in areas of the world where PCS may not be as readily available. A few pagers that can be "hand programmed" are those marketed by Digital paging Corp, which include those carrying the names: Apollo, Vortec, and Jetpage.

Pagers can be used in many ways. Twenty years ago, pagers were limited to mostly folks like doctors and photocopier repair technicians. These days, pagers are used by people for all sorts of purposes, not just business messages. Anyone who is on the go a lot, yet needs to be able to receive information in "real time", can be helped by using a pager. Some messages can be things such as news reports, either breaking headlines, sports scores, or stock market stats. Other messages can be such things as emergency notification alerts(similar to what you might listen to on a scanner)(either local or national incidents), or highway traffic

reports. One Taiwan paging service even offers alerts on police traffic enforcement operations.

Years ago, the usual way that most alpha text messages were sent to pagers was to have somebody place a phone call to access number for a given system and use a special keyboard. While they can still be found in daily use, most text messages today are originated by either "voice dispatch" where a person places a call to a regular voice mail number, and a human operator actually listens to the message and transcribes it into text for it to be transmitted.

More and more however, messages to text pagers are originated as a regular email. Not only does this permit a person to receive most any type of message as though it were intended to be read on a PC, no matter where a person may be at any given time, and it allows a person with a text capable pager to receive a message from any source or service that can send messages as a standard email. This also allows a person to receive personal messages much easier than was previously the case, and without the added cost of going through a dispatch service.

The only limitation is the size of the message that can only be about 200 characters(or whatever max message size the paging provider sets), and the messages can only be text format as current generation pagers cannot receive messages

that contain html or other graphic generating codes. Over the past couple of years, competition in the paging business has increased greatly as the technology surrounding cellular phones has continued to mature, resulting in smaller and smaller phones, and offering more "pager like" text message services.

Although illegal here in the United States(though not elsewhere?), traffic on digital paging networks can be monitored by way of several freeware PC programs; one

that's been available for the past several years is called Winflex. It requires a Pentium PC running Windows 95 or later. A more recent arrival is something called "PDW". PDW can also decode more open formats such as ACARS. There are also decoding programs available for older DOS PCS. These include PD203, POCFLEX, and an improved version of POCFLEX that's called POCSAG. All of these programs require the use of a "data slicer" to convert the raw signal from a receiver's discriminator into the serial port of a PC.

POCSAG format data can also be decoded from using the Kantronics KP9612 Amateur packet radio TNC. A few Ham radio groups have started recycling older POCSAG pagers for use on Amateur radio frequencies, both here in the US and parts of Europe. Recently we even came across a simple program called POP for the Palm PDA that can decode POCSAG. Although it lacks many of the refinements of more sophisticated programs, it also requires a special modification to the Palm's "hot sync" cradle. Be sure and check with local law enforcement authorities before using any of these programs for any non amateur purposes.

