RTTY LOOP

Amateur Radio Teletype

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One-Chip AFSK Generator

You all are certainly a vocal crew. It may take me until Labor Day to sift through all the responses to the First Annual Decade survey published here. But, try I must, and I promise to let you all know the sense of the readership. . . just as soon as I figure out what it is!

In the meantime, here is the second in the series of one-evening kitchen table projects that you are all asking for. This month, I have a one-chip AFSK generator. With its reasonable purity of emission, it should be useful for putting many of you onto RTTY.

It's based on a versatile chip billed as a "function generator." I picked up my last few on the bargain clearance table at my local Radio Shack. While the XR-2206 may not be in the latest Radio Shack catalog, it certainly remains available from them on order, or on the Jim Paks wall of many distributors, for about six bucks, list price.

Figure 1 shows the schematic of the AFSK generator, which is easily assembled on a perf board just by following the diagram. Take special note of the chip's +Vcc—it is +10 volts DC, rather than the +5 volts DC common to other TTL chips.

The RTTY keying input is basically TTL level voltage, with a swing from less than one volt to more than two volts for the mark/space transition. Most keying circuits should supply this level without much trouble. If you would like to key this circuit off of a 60 mA teleprinter loop, you will need some form of isolation, such as an optoisolator or reed relay.

Meanwhile, the output frequency of this device is as stable as the frequency determining components used, particularly the capacitor connected between pins 5 and 6. Nominally a 0.01 µF capacitor, this should be a high quality, stable capacitor, rather than the common disc variety. The latter has too wide a manufacturing tolerance, and too much drift in value, to be used in this critical area.

A high level signal on pin 9 generates an output frequency determined by the combination of the capacitor between pins 5 and 6, and the resistor going to ground from pin 7. A low level signal on pin 9 similarly generates a signal dependent on the resistance of the potentiometer on pin 8. The formula is:

$$\text{freq} = \frac{1}{R \times C}$$

where *freq* is the output frequency, *R* is the resistance presented to either pin 7 or 8 to ground in ohms, and *C* is the capacitance in farads between pins 5 and 6.

With a 0.01 µF (0.00000001 F) capacitor and a 45kΩ (45000 Ω) resistor, a frequency of about 2222 Hz would be generated. This is well within the common AFSK range. Therefore, the use of a 50k potentiometer allows frequencies as low as 2000 Hz to be generated, with no real upper limit. If you like, for finer control, a 30k resistor in series with a 20k potentiometer would allow coverage of the 2000 Hz to 3000 Hz range, with much better accuracy.

The perceptive among you may have noticed that I have not really labeled one or the other signals "mark" or "space." That is because such labels are, after all, relative. If you are keying this circuit with a positive voltage for mark, and a zero or negative voltage for space, then the mark frequency will be determined by the resistor on pin 7, and the space frequency on pin 8.

However, if you are using a computer to key this circuit, and you are using the common RS-232 standard interface, then you may have a surprise coming. Mark voltage in the RS-232 standard is a negative voltage; space is positive. This is just the reverse of what we were talking about. But, no problem. Just use the potentiometer on pin 8 to set up the mark frequency, and pin 7 for the space.

You could put in a reversing switch if it were important to you to swap mark and space frequencies.

Now, for those of you who are VHF bound, the standard mark frequency is 2125 Hz. There are two standard shifts in use, the old 850 Hz, so-called "wide shift," and the newer 170 Hz, or "narrow shift." To save you trouble with higher math, that yields a space frequency of 2975 Hz (2125 + 850) for wide shift, and 2290 Hz (2125 + 170) for narrow shift.

VHF and SSB

But these are for VHF AFSK, you see. If you will be feeding this AFSK into a single sideband transmitter to produce FSK, you don't need those frequencies at all. Most transmitters will not pass a signal upwards of 2000 Hz that well, as the audio stage is peaked for voice transmissions. Therefore, feel free to use a lower set of frequencies. There are two precautions you should take, though.

First, choose a pair of frequencies, not harmonically related, that fits in the passband of your transmitter. If you are using wide shift, for example, *don't* choose 850 Hz and 1700 Hz. I know that they are 850 Hz apart, and reasonably low, but the higher is the first harmonic of the lower. Bad news! Better to choose 1000 Hz and 1850 Hz, or a similar combination for a 170 Hz shift.

Second, remember that FSK convention places the space on the lower frequency. That is, the frequency shifts downward from the mark frequency. When transmitting on lower sideband, the audio tone used for space is the higher frequency, reversed from FSK convention. This goes along with AFSK practice, though, so there is some consistency. Once again, generate an AFSK pair with a low mark and high space, and use lower sideband to convert this into an FSK signal with high mark and low space.

Transmitting

Now that you've selected your transmit frequencies, you will want to couple the signal to your transmitter. The potentiometer on pin 3 controls the amplitude of the output signal. According to the specs of the chip, about 60 mV of signal are available per kilohm of resistance, so a 50k resistance should generate about 3 volts peak to peak.

The adventurous among you might chose to combine the previous demodulator project and this month's modulator into a box, with a common power supply, and make a small RTTY modem. Keep all that data flowing this way, to the above address, or electronically. Either CompuServe (ppn 75036,2501) or Delphi (username: MARCWA3AJR) are fine. Let's hear from you! 73

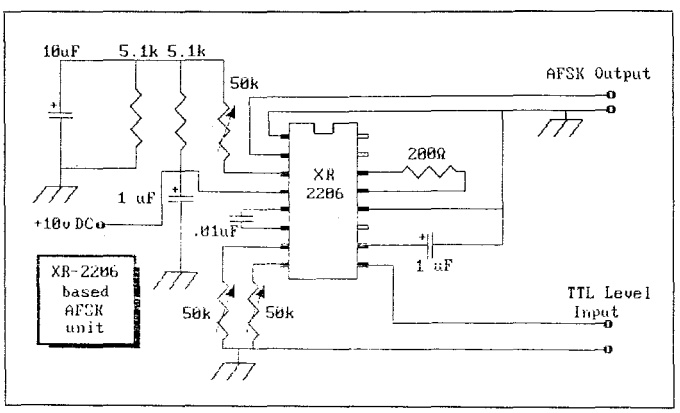

Figure 1. Simple one-chip AFSK generator.

AFSK Generator Parts List

Integrated Circuit	XR-2206	Jim-Paks or mail order	
Resistors	5100Ω	RS 271-13305*	$0.39
(¼ or ½ W)	220Ω	RS 271-13135	$0.39
Potentiometer	50000Ω	RS 271-219	$0.69
	Miniature PC mount		
Capacitors	0.01 µF	RS 272-10652	$0.59
	1.0 µF	RS 272-1434	$0.59
	10.0 µF	RS 272-1436	$0.79
Perf board	0.1 inch grid	RS 276-1394	$1.99

*Radio Shack parts are nearest whole values. Resistor values are nominally within 10%. For all practical purposes, the available Radio Shack values are close enough for this project to the specified values. If you can get exact values, fine. If not, don't lose any sleep over it.