TV/VCR Tuner Applications

The first of a three-part series.

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With the increased availability of used TV/VCR tuners, electronic projects abound for the ham experimenter. Numerous receiver and test equipment projects can be developed around TV/VCR tuners, which are the RF front ends of TV receivers and VCRs. Modern tuners are electronically tuned, which makes them mechanically stable and relatively easy to use. "Cable ready" tuners have a typical frequency range from about 45 to 900 MHz, which covers most of the desired VHF and UHF spectrum.

A list of projects supported by TV/VCR tuners could be quite extensive. A few of them are: wideband frequency converter; wideband receiver; wideband signal generator; sweep generator; standard deviation signal source; spectrum analyzer; and tracking generator. Here's a little more insight into each project.

Wideband frequency converter and receiver

These two projects are closely related in that the tuner performs the same function for each, but a different receiver is used after the tuner. Not all tuners are alike, nor do they cover exactly the same band of frequencies, but they do provide the capability of receiving a band of frequencies ranging from about 45 to 900 MHz. This band of frequencies is the typical frequency range covered by TV channels 2 through 83. Although the upper three channels have been transferred to cellular phone and other business applications, some tuners may still approach 900 MHz. There will be little loss in tuner desirability due to the band change, however.

"If you don't plan to save your tuners for* your *projects, give them to me—I'll find a use for them!"

The basic difference between the converter and receiver applications deals with the receiver used following the tuner. A converter is a stand-alone box which outputs a single frequency (47-63 MHz) to a receiver where the rest of the receiver functions are supported. The 47-63 MHz output is referred to as the intermediate frequency (IF) of the tuner. The tuner and receiver functions are contained within one box to provide a complete wideband receiver.

Signal generator

Within every TV/VCR tuner is a local oscillator which is intended to mix with a received signal to produce an IF. The oscillator operates typically on the high side of the received signal and is offset in frequency by the value of the IF. Normally, the oscillator signal can be accessed and used as a signal source with the support of tuning control and power. Thus a signal generator is born capable of covering the band from 90 to 915 MHz.

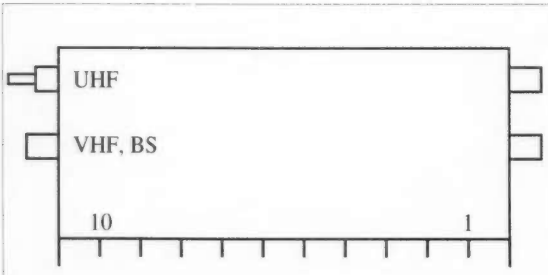
Sweep generator

A sweep generator is used to sweep a frequency across a resonant device or circuit with the objective of observing the profile of the circuit's response as a function of frequency.

With the oscillator in a tuner being used as a signal generator, a sawtooth voltage waveform is applied to the tuning voltage line, causing the oscillator to sweep across a band of frequencies. The frequency spread is controlled by the amplitude of the sawtooth, while the sweep rate is controlled by the repetition frequency of the sawtooth.

Standard deviation signal source

When a signal is frequency modulated with a sine wave audio signal, the produced carrier from the generator will



PIN	FUNCTION
1	IF
2	PLL +5 V
3	BM +12 V MIXER
4	N/C
5	BH VHF HIGH
6	BL VHF LOW
7	AGC 0 - 7 V
8	BS SUPER BAND
9	VT TUNING VOLTAGE 0 - 29 V
10	BU UHF BAND

Fig.1. *Typical connector configuration.*

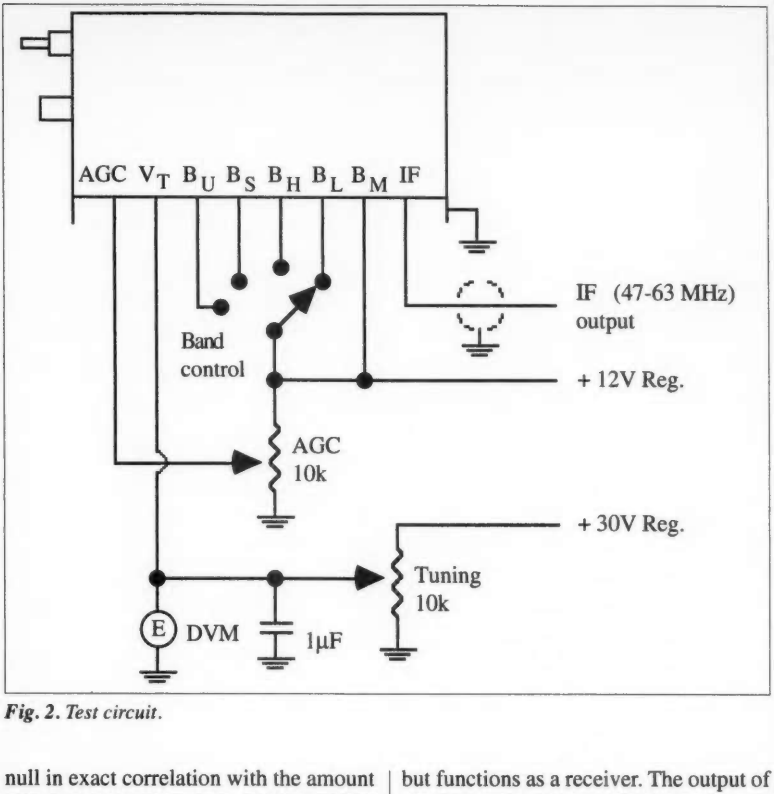


Fig. 2. Test circuit.

null in exact correlation with the amount of frequency deviation. The audio signal as modulation is applied to the tuning voltage line FMing the carrier. The amount of deviation is controlled by the amplitude of the sine wave modulation. With the use of a Bessel Function chart or a carrier null equation, the carrier null can be predicted for accurate frequency deviation measurements or as a standard deviated signal source.

Spectrum analyzer

A spectrum analyzer utilizes the sweep function of the sweep generator, but functions as a receiver. The output of the spectrum analyzer is displayed on an oscilloscope. Adjusting the sweep width allows viewing of a selected portion of frequency spectrum. One of the many uses of the spectrum analyzer is to allow the examination for purity of a transmitted signal. If the transmitted signal is "dirty," numerous spurious signals will be observed within the transmitted spectrum and centered on the signal.

VT	BL	BH	BS	BU
0	45	82	156	406
5	71	139	214	539
10	92	160	269	646
15	106	180	320	762
20	114	200	357	850
25	118	205	370	899
28	119	207	376	915

Table 1. Typical frequencies vs. voltage table.

Tracking generator

A tracking generator utilizes the sweep generator function and is used in conjunction with the spectrum analyzer to profile the frequency response of a resonant circuit. In operation, the tracking generator operates precisely on the received center frequency of the spectrum analyzer and remains in sync as it is swept across any selected portion of spectrum.

ID your tuner

Building a receiver is generally a pretty complex project, but with TV/VCR tuners available from junked equipment, the complexity is cut to less than half—making the building of a receiver feasible. Let me make you a

proposition: If you don't plan to save your tuners for *your* projects, please give them to me so that I can find a use for them. I'll even test them for you, should you desire.

The electronically-tuned TV/VCR tuners cover a wide band of frequencies, typically from 45-900 MHz, broken into 3-4 tuning bands depending on whether the tuner is "cable ready." This indicates that a super band is included. If the tuner is marked, the band indications will be BL (low VHF), BH (high VHF), BS (super band), and BU (UHF). Within the 45-900 MHz range are four ham bands, aircraft (both civilian and military), public service, hospitals, weather, taxicabs, phone systems, all TV channels, and many others.

To salvage a tuner from its resident equipment, you should observe and transfer any pin markings on the PC board to the tuner to make pin identification easier. But even without available markings, it is reasonably easy to identify the function of each pin. The specific difference between a TV and VCR tuner is the output (IF) frequency. For VCRs, the output is 63 MHz; for TV tuners, the output is 47 MHz. But even with the frequency difference, the tuners can be used alternately if need be. The supporting circuit design remains the same regardless of the IF used by the tuner.

It is best to test the tuner on the workbench prior to building it into a project. The more you know about the tuner, the easier it is to develop the supporting circuitry. All electronically-tuned tuners have pretty much the same voltage requirements, which are as follows: mixer/oscillator, 12V; tuning, 0-28V; AGC, 0-7V; band selection, 0V off and 12V enable; PLL, 5V; and AFT, ±1V.

During the visual examination the various connectors need to be identified. For a VHF/UHF tuner, there will be two antenna connectors. The UHF connector will be two parallel pins and the VHF/super band will be a phono connector. Both antenna connectors will be on the same end of the tuner. On the opposite end of the tuner, one or two more phono connectors may be present. These are arranged close to the local oscillator and provide I/O access between the oscillator and the PLL circuit.

The multiple connector pins along one edge of the tuner provide access to the various tuner control circuits as shown in **Fig. 1**. It must be clearly understood that the pin configuration will be unique for each available tuner. Starting from the oscillator end of the tuner, the pins are typically as follows: IF output; PLL; mixer/oscillator; blank pin; band control; band control; AGC; band control; tuning voltage; and band control. Some tuners have an AFT terminal which is normally used for fine tuning.

Testing a tuner is straightforward in nature, but does require a receiver covering the tuner IF; two regulated power supplies; two 10k pots; a DVM; a VHF and/or UHF antenna; and a couple of short-length clip leads having small-size clips. For UHF, two wires, each about three feet long, can form a rabbit-ear-style antenna; a 146 MHz antenna will work well for VHF.

Fig. 2 shows a typical circuit for testing a tuner. The procedure for tuner setup is as follows: Set the receiver to 47 MHz (or 63 if a VCR tuner is used). Connect the antennas to their respective connectors. Set one power supply to +12V and connect the voltage directly to the mixer/oscillator pin. The negative voltage side connects to the tuner case. Connect one 10k pot across the 12V supply and adjust the output to 5-6 volts. Connect the wiper to the AGC pin. Connect the second pot across the second power supply and set the supply to +30V output. Adjust the pot (tuning voltage control) to 0V. Connect the pot wiper and a DVM to the tuning voltage pin. Connect a clip lead from the +12V output and temporarily attach it to one of the band control pins. During testing, the AFT terminal, if present, may be grounded.

Open the receiver squelch and very slowly adjust the tuning voltage from 0V to maximum, and back again. If you hear a station, stop to record the tuning voltage value and the band control pin number. If the station can be identified by a service, then it should also be noted. Critically adjust the AGC voltage for maximum sensitivity upon hearing the first station. Measure and record the AGC voltage and leave it set for all remaining tests. Repeat the tuning procedure for each band control pin.

F (MHz)	SERVICE
46	phone
49	phone / baby monitor
50	6 meter ham
88	FM BC
108	FM BC
116	aircraft
136	aircraft
146	2 meter ham
150	public service / taxi
162	weather
222	1-1/4 ham
230	mil. aircraft
445	70 cm ham
800	public service
886	phone
902	commercial / ham

Table 2. Frequency spectrum.

When checking the bands, use the chart shown in **Table 1** as a guide. For the UHF band, the only signals heard on the top of the band will be cell phone, and the tuning voltage will be in the range of 20-28 volts.

From the band control and tuning voltage information, a tuning voltage vs. frequency chart can be developed in a manner similar to that shown in **Table 1**. After the tuner has been tested and the voltage requirements noted, select and build a project around the tuner. Tune the spectrum as shown in **Table 2**. Again, if you aren't going to use the tuner, give it to me.

Next time: frequency converter, mobile power. 73