Heliosdyne Addendum

Single Transistor FM DX Receiver

VERSION 1 ©2011

*The information below is **not** guaranteed to be free of errors.*

1. INTRODUCTION

This is a companion to the Heliosdyne PDF which describes a single JFET radio for FM DX. This single active device (1AD) radio is adaptable for QRP (low-power) usage on the ham bands. The Heliosdyne is a departure from the ubiquitous common-gate JFET super-regenerative detector. The Heliosdyne is a super-regenerative detector setup as common-drain or *source-follower at RF*.

2. OSCILLATOR TOPOLOGY

The Hartley oscillator was historically used on all broadcast bands including 88 to 108 MHz FM. That said, a Colpitts oscillator is preferred above 50 MHz. With a 47 pF trim capacitor attached from source to ground: a Colpitts oscillator is formed. A capacitative divider is created between the 47 pF air-variable capacitor and the J310's Csg or internal *source-gate capacitance*, about 4.1 pF. The tank's inductor and capacitors will need to be altered (this is beyond the scope of this article).

3. THE TANK

Ideally the tank inductor has an air core. Toroidal FM coils wrapped on iron powder of μi=6 (example Amidon T50-10) are problematic in 1AD designs because RF must be fed into the tank. This can be achieved using a *gimmick* (two covered wires entwined over a length of a few inches). Use of real capacitors is problematic in terms of fine tuning and hand capacitance. With a varactor, combining a 1-turn 10k pot and 1-turn 1k pot, in series, may be used instead of the 10-turn pot.

4. FOLLOWER CIRCUIT

The source circuit must perform several actions, including setting up the DC load, feeding RF back into the tank, and reducing the audio load. I found two unique ways to accomplish these tasks. The principles can undoubtedly be used to boost performance of other hobbyists' receivers.

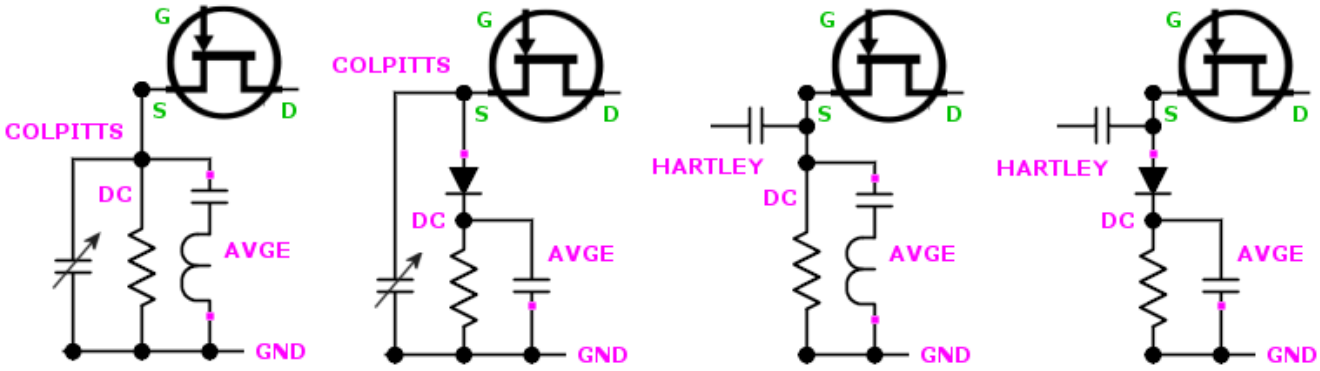
A. DIODE RF CHOKE

A diode will pass half the RF, DC, and audio. This means a diode acts as a perfect RF choke that traps half the RF above itself. A 1N34A diode has 200 ohms of resistance at a forward voltage of 0.50 Volts and 100 ohms at 0.80 Volts. This fact can even be used to control a Colpitts oscillator.

B. AUDIO VOLTAGE GAIN ENHANCER

An AVGE or audio voltage gain enhancer allows low resistance at audio but blocks both the DC and RF energy. The AVGE boosts voltage gains on many 1AD common-collector, common-drain, and common-plate audio amplifiers. This is due to voltage gain being inversely related to this load.

The AVGE is simply an AF capacitor (ex. 0.22 μF) in series with an RF choke. When the DC resistor is high enough, the RF coil itself is not that critical because the RF will "see" the DC load.



Also consider that a 0.22 µF capacitor in series with, say, 250 nH is resonant at ~680 kHz. This means it will not only boost audio but tend to dump medium wave energy out of the system. The AVGE will distort audio somewhat and likely can be omitted when using sound-powered phones.

5. QUENCH WAVEFORM

Add a 500 ohm potentiometer under the *audio voltage gain enhancer* to alter the quench waveform (as per *Charles Kitchin*). This was not fully tested but may be needed for narrowband FM.

6. VOLTAGE STABILITY

The Heliosdyne prototype had one serious design flaw. With usage, as the battery voltage dropped, the varactors could no longer tune the upper end of the band. One solution is the use of a *zener diode*. The power used to drive a super-regenerative detector alters *selectivity* (push less power) and *sensitivity* (push more power). RF chokes with high DC resistance can be problematic.

7. PHONE CIRCUIT

The use of sound powered phones will result in a 18 dB gain over the $16 Koss Sparkplug. The Bogen T725 transformer is advised as it provides 1420 ohms at DC and ~90k ohms at audio.

8. ACTIVE DEVICES

An n-JFET is electrically similar to an n-channel depletion-mode MOSFET. Higher gains may also be possible using JFETs with higher gfs or IDDS. Take into account the device capacitances.

9. MISCELLANEOUS

Ideally the AVGE inductor is at a 90 degree angle with the tank inductor. This will minimize any interaction. Sometimes the placement of the varactors affect the tuning: anything close to the ground line can add capacitance and restrict the upper range. The coil can be compressed (lowers tuning range) or expanded (raises tuning range). The 1000 µF capacitor was added later. Without it the battery's internal resistance is often too high. Also try a pot in place of the 10k source resistor. Adjust the regeneration so that the least amount of voltage is used (5V), this enhances selectivity. Properly setup, the Heliosdyne can hear a new station with every small turn of the tuning resistor.

just_rtfm@<NOSPAM>yahoo.com
http://home.comcast.net/~phils_radio_designs