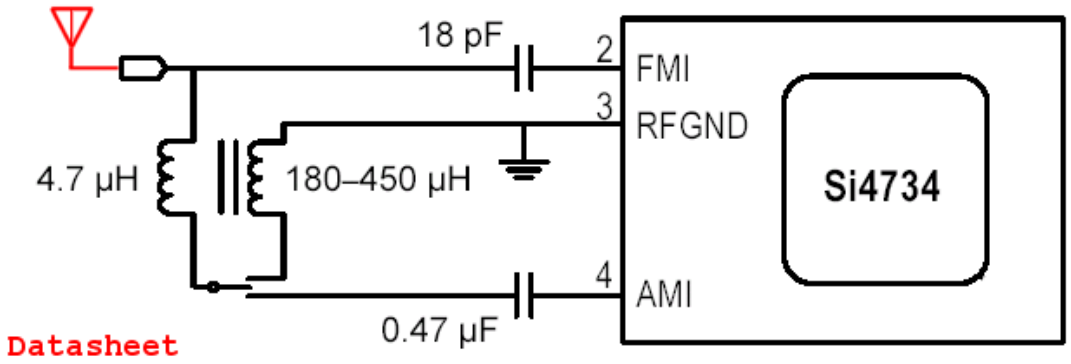
Hacking the Si4734

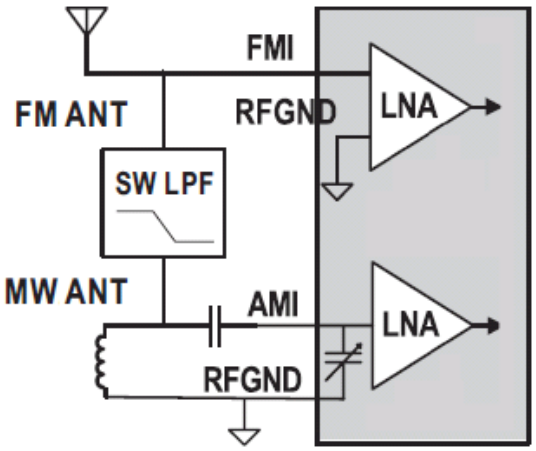
Shortwave Antenna Modification

VERSION 1 ©2010

This information is PRELIMINARY and may contain errors.

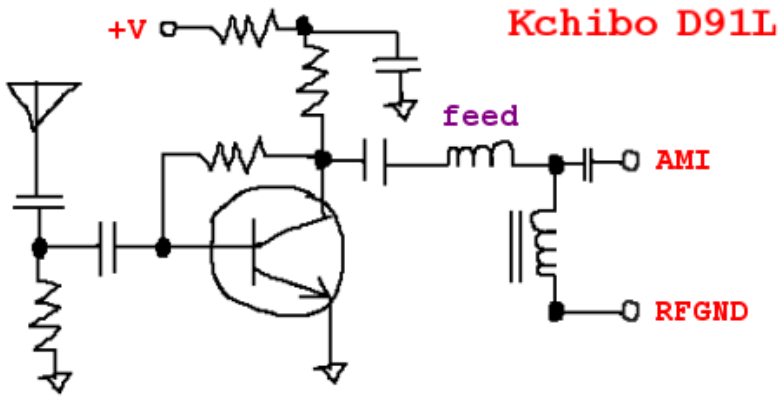


The critical ingredient in any Si4734-based design is the antenna system. The FM IP3 was given as 105 dBµV at 2-MHz spacing. This calculates to only -2.0 dBm at 50-ohms. Unwanted RF energy must be kept out of the LNA to prevent mixer overload. Manufacturers tend to follow the available datasheet designs. Silicon Labs' schematics showcase the need for a minimum amount of external components. However, it is better to use a tuned circuit than a wideband collector of shortwave energy. Note: the 0.47 µF capacitor is for DC isolation (large, as not to affect tuning).



TECSUN PL-310

Above is the block diagram of the Tecsun PL-310, as per their manual. The antenna is not ideal for shortwave: RF energy from the whip is low-pass filtered (perhaps an inductor) and then sent to the MW tank. If the chip's capacitor were set to 590 pF then much of the SW energy would be lost: 3 MHz sees 590 pF as 90 ohms and 23 MHz sees it as 12 ohms. **Speculating**: the Tecsun engineers would be forced to set the capacitor to its minimum value of 7 pF (0x0001) to minimize losses. If MW ferrite inductance is 330 µH then the tank is resonant at 3.3 MHz. Replacing the rod with a small inductor (4 µH) may not aid SW performance: software setting of the capacitance to 0x0001 is untuned and disables automatic tuning. It may be unviable to try SW antenna variations without software hacking. Manufacturers may wish to incorporate both an automatic and a manual capacitance setting, as well as PIN diodes for antenna selection, and a Si4734 computer interface.

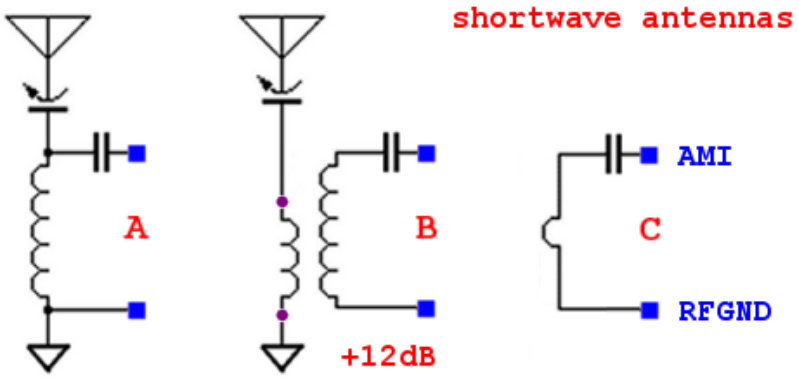


Inspection of the PCB of the Kchibo D48L and D91L revealed common emitter transistor amplified shortwave antennas. SW energy is fed into the MW ferrite tank via an inductor (same topology as the PL-310). Unfortunately, the Kchibo design exposes the LNA/mixers to amplified broadband (MW/HF) RF energy; plus MW energy captured by the ferrite. Local BCB stations are likely to cause overload on the shortwave bands. Feeding amplified RF into the chip's LNA could push it into its non-linear region. The end result may be a sensitive radio with spurious signals.

Antenna Toroid Calculations			
T37-2	32-turns	4.096 µH	3.24-27.80 MHz
T50-2	29-turns	4.121 µH	3.23-27.72 MHz

Note: stray antenna capacitance will hinder tuning the upper range.

A red iron-powder toroidal inductor of type 2 material (1 to 30 MHz frequency range) can be used to form a tank with the chip's internal tuning capacitor. A toroid is compact, cheap, high "Q", and fairly self-shielding. The proposed shortwave antennas below **were not yet tested** but are based on regenerative receiver designs. Although shown with no ferrite rod, **PIN** diodes (ex. HP 5082-3080) or a rotary switch can be used to select between MW and SW. It may be feasible to add an external low-range-enhancing capacitor in parallel to the Si4734's internal capacitance.



The inductors above form a tank with the chip's internal capacitor. Antenna **A** uses a trim capacitor to introduce shortwave energy to the tank; this prevents loading. Antenna **B** increases voltage via the turns ratio on the toroid. A trim capacitor negates the need for taps. Air-coupled, this setup may utilize a tuning cap (purple taps). Antenna **C** is a 30" by 3" single turn metal loop.

REFERENCE

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