Build a 3-Band Shortwave Converter for Your Car

Wouldn't it be nice if you could take your shortwave radio with you in your car? Imagine tooling down the highway on your way to work, listening to the latest world news on the BBC. Or maybe tuning in a spot of upbeat Latin music to get your day started on the right foot.

You could put an inexpensive portable on the dashboard and watch it slide from one side to the other every time you make a turn. The heat of the sun, magnified through the windshield, even in winter, might ruin that radio and chances are that if it survives that, someone might steal it. Too much of a headache? There is an easier way.

We're going to show you how to build a converter for your car radio that will allow you to tune in the 49 (5950 to 6200 kHz), 31 (9500 to 10000 kHz) and 19 (15100 to 15490 kHz) meter bands without all of those hassles. We chose these bands because the probability of finding one or more of them open during any time of the day or night is good. Also, the time signals from WWV on 10000 kHz are tuneable on the 31 meter band. So we have a talking clock in our car to tell us how late we are!

How it Works

There are two controls on the converter; the bandswitch S1, and the on/off switch S2. T1 matches the car antenna's impedance to the input impedance of Q1, a dual gate mosfet. Capacitors are placed in parallel with T1's secondary by S1A. These capacitors are chosen to resonate T1 to the band we wish to tune on the car radio.

Q1 is the mixer. Shortwave band frequencies are present on gate #1, while a fixed H.F. frequency from oscillator Q2 is present on gate #2. At the drain of the mixer are 4 signals: the 2 original ones on gates 1 and 2, their sum, and their difference. The difference frequency will fall in the tuning range of the AM car radio.

Q2 is a Pierce crystal oscillator. Two capacitors (designated Cfb) provide feedback to sustain oscillation. S1B selects a crystal to correspond to the band selected by S1A. The oscillator is a fundamental type, meaning it's output is the same frequency as the crystal.

S2 is a DPDT slide switch. One pole switches 12v DC to the converter during use, the other pole switches the converter out of the antenna line when not in use.

Choosing Crystals

The builder is given wide latitude in choosing crystals for this converter, with the hopeful result that he will be able to scrounge them up for free in the junkbox or for cheap at a swapmeet or hamfest. It makes no difference if the crystal frequency is above or below the shortwave frequency we want to receive, so long as the difference falls in the tuning range of the AM car radio.

If the crystal frequency is below the shortwave frequency, then the car radio will tune the shortwave band in the conventional manner (lowest frequency on the left, highest on the right of the slide rule scale). If the crystal frequency is above the shortwave frequency, then the car radio will tune "backwards" (highest frequency left, lowest on the right).

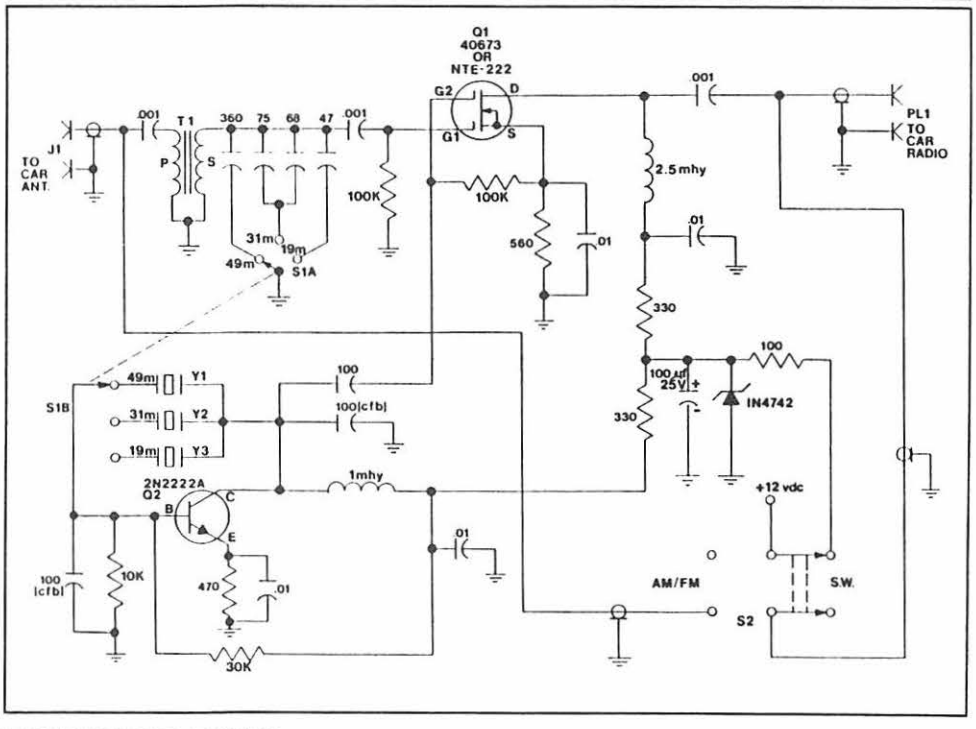
Listening enjoyment will not be affected if you choose a crystal which causes "backward" tuning. So start scrounging for crystals that will fall in the frequency ranges given in the chart below, and see how cheaply you can get by!

Construction Tips

The manner of construction is not too critical. Perfboard is recommended for the first time builder. An ambitious builder could make up a single or double sided PCB. T1 must be wound by hand; the secondary windings must use the gauge of wire specified and must be "closewound" in order for the transformer to resonate properly with the values of fixed capacitors specified in the schematic. A sketch of how the transformer should look is included with the semiconductor base diagrams.

Crystal Frequency Ranges

Xtal	Band	Band Frequency	Xtal Frequency Range
Y1	49M	5.95-6.2 MHz	4.6-5.41 MHz or 6.74-7.55 MHz
Y2	31M	9.5-10.0 MHz	8.4-8.96 MHz or 10.54-11.1 MHz
Y3	19M	15.1-15.49 MHz	13.895-14.56 MHz or 16.035-16.7



Keep all leads to S1 as short as possible. One way to do this is to mount S1 on the front panel of the box you are going to use, then mount your board directly behind S1 using screws, spacers, and nuts. (see diagram). J1 and PL1 are simply a 2 foot long car antenna coax extension cable available from Radio Shack, which is cut in half. Drill two holes in the back of the box and fit the holes with grommets, then put the two pieces of coax through the holes. The +12v power lead can also pass through one of the holes with the coax.

Be sure and use a metal box for the enclosure, as a plastic one will allow the strong local mediumwave stations to "bleed" past the mixer and you'll never hear any shortwave stations. The fixed capacitors on S1A could be replaced by small trimmer capacitors of a slightly higher value if desired. This will increase the costs but will allow you to more exactly resonate T1 to the center of each shortwave band.

Using the Converter

First of all be advised that this project will work best with a conventional slide-rule tuned (analog) car radio. Most digital radios are pre-programmed to tune in 10 khz increments, where as shortwave stations are in 5 khz increments or on "weird" frequencies like 99770 kHz. So a digital car radio which is programmed in 10 khz increments will only allow you to hear half of what is available.

Next you need to know where on your dial you can expect to find the shortwave. To do this, subtract the frequency of each crystal you've found from the band limits of it's corresponding band. For example, say you found a crystal marked 8.65 MHz for the 31 meter band. 9.5 - 8.65 = .85, and 10.0 - 8.65 = 1.35. So you will tune the 31 meter band between 850 and 1350 on your car radio, with WWV falling on 1350.

This circuit is sensitive enough to get all the major broadcasters loud and clear with your engine on. And if you are out camping in a quiet location with your engine off, you can actually do some real DXing on your car radio using only the car's antenna!

Good luck! Any questions from constructors regarding this project will be answered if a Self-addressed, stamped envelope is enclosed.

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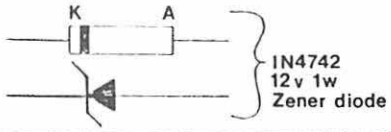
SEMICONDUCTORS

DEVICE	BOTTOM VIEW	TOP VIEW
40673 OR NTE-222 N-CHANNEL dual gate MOSFET	G2, G1, D, S	G2, G2, S, D
2N2222 NPN Bipolar Transistor	C, B, E	C, B, E

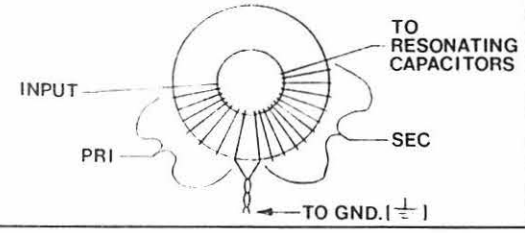


TOROIDAL TRANSFORMER T1

AMIDON T-68-2 core (red color, one size.)

PRI: 8 Turns, #21 enamel coated wire.

SEC: 12 Turns, #21 enamel coated wire.

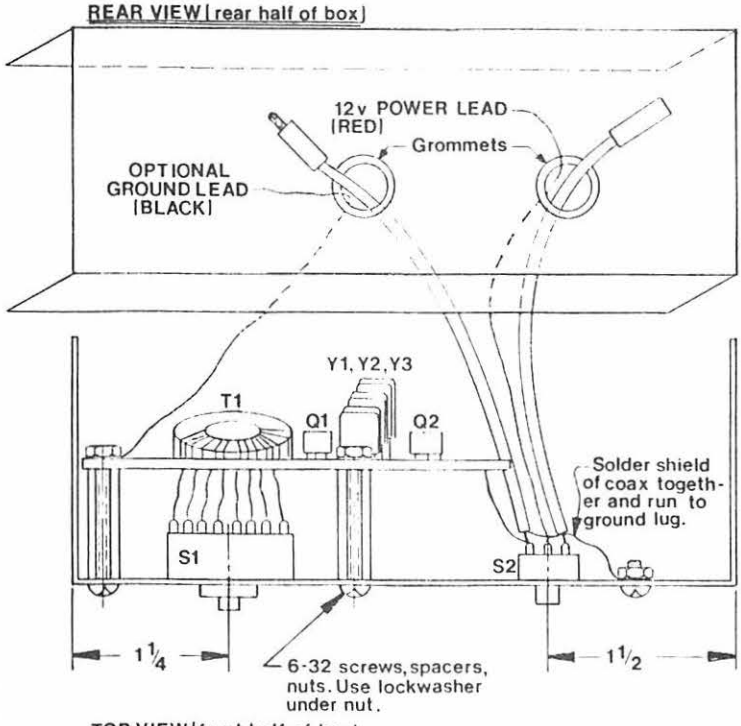


GENERALIZED PHYSICAL LAYOUT

1.) Use metal box 5 1/4" W x 2 1/4" H x 2" D; larger if you feel confined working in so small a box. Box consists of two U shaped pieces held together by screws.

2.) Mount back half of box to frame of car with screws. If mounted to plastic, provide ground wire as shown, connect to car chassis.

REAR VIEW (rear half of box)



TOP VIEW (front half of box)

* Hook power lead to "radio" side of fuse, or use an in-line fuse holder with a 1/4 A fuse inside.