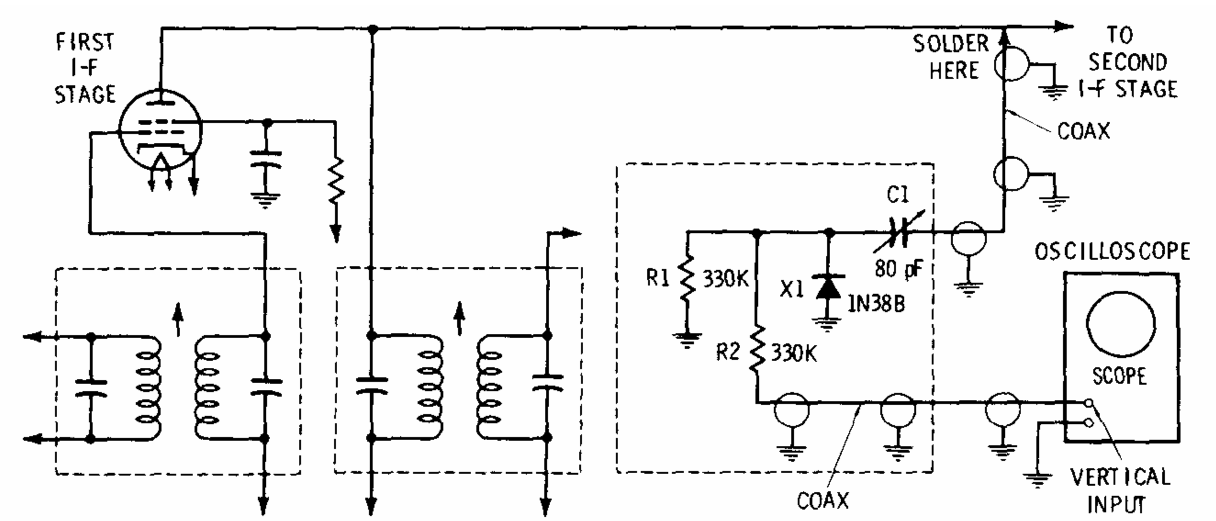
OSCILLOSCOPE-TO-PANADAPTER CONVERTER

Before constructing this design please see the comments at the end of the article

A connection and a couple of parts will tell you what is going on 50 kHz above and below the frequency to which your receiver is tuned, on any band that you choose. The project requires no internal modification of the oscilloscope, just the normal vertical external input connection.

A bright, vertical “blip” on the screen in relation to the frequency that the receiver is tuned shows you that there is someone transmitting, where that station is with respect to the frequency you are tuned to, and the relative signal strength at that location on the band.



Panadapter schematic.

Parts List for Oscilloscope-To-Panadapter Converter

Item No.	Description
C1	80 pF variable capacitor.
R1, R2	330K resistors.
X1	1N38B diode.

The project consists of a variable capacitor, two resistors and a diode. Even better, it is applicable to any kind of receiver.

Tap into your receiver right after the first IF stage, as shown in the schematic. This lead must be carefully shielded;

coaxial cable is a must here. A small metallic box will serve to house the few components in the circuit. *C1* is all that needs to be exposed. Also, use a coax lead from the box to the oscilloscope. You will probably have to realign the IF stage that is connected to the panadapter.

Connection to the “vertical” input on the scope will complete the conversion to the “panoramic adapter”. If you see a very strong blip on the screen, you may want to hop over to see what’s going on.

Adjust the scope to give you a 100 kHz display centered so that the display will present the signals of large amplitude as well as the weaker ones.

Comments from members of the Glowbugs List

From Jim N2EY

From looking at the schematic, all that circuit does is to sample the IF signals, rectify them, and send them to the oscilloscope. There is no spectrum-analyzer/panadapter function at all.

The way a true panadapter works is this:

Signals from the IF of your receiver are sampled and sent to a second IF chain. This chain is at a different frequency than the main IF in the receiver, so there's a mixer to change frequencies.

The mixer is fed by a sweep oscillator - an oscillator whose frequency is constantly sweeping across a certain range. That sweeping is synchronized with the horizontal sweep on the oscilloscope, and the detected signal voltage is displayed on the vertical axis.

The following explanation uses numbers chosen to make the math easy, and is not necessarily something anyone would actually build. It just illustrates the panadapter principle.

For example, suppose I had a receiver with a 2 MHz IF and the local oscillator on the low side. When I tune to 7.1 MHz., the LO is at 5.1 MHz.

Signals at 7 MHz. are heterodyned to 1.9 MHz
Signals at 7.1 MHz. are heterodyned to 2.0 MHz
Signals at 7.2 MHz. are heterodyned to 2.1 MHz, etc.

Of course I don't hear any signals except those near 7.1 MHz. because the IF selectivity at 2 MHz filters them out.

Now suppose I build a receiver that converts 2 MHz to 500 KHz, and has a detector that can feed an oscilloscope vertical input instead of making audio. Also suppose that this 2 MHz. receiver can tune from 1.9 to 2.1 MHz by varying a control voltage from 0 to 2 volts, because it's LO frequency varies from 1.4 to 1.6 MHz as the control voltage sweeps from 0 to 2 volts.

A saw tooth-wave oscillator is then used to make a control voltage that sweeps from 0 to 2 volts in a linear fashion, then jumps back to 0 volts fast and sweeps again, etc. The oscilloscope horizontal amp is tied into that saw tooth-wave oscillator too, so the horizontal sweep follows the receiver frequency.

So with the whole thing working, when the main receiver is tuned to 7.1 MHz, its LO is tuned to 5.1 MHz and the signals are converted to the 2 MHz main IF. Meanwhile the panadapter LO is constantly tuning/sweeping from 1.4 to 1.6 MHz. so that signals in the 2 MHz. IF are converted to 500 KHz, filtered, detected, and displayed on the screen.

Sound complicated? It is! That's why you don't see a lot of panadapters in GB stations.

If it were as easy as that "Projects" book says, everyone would do it.

From Bob W9RAN

I agree, this circuit doesn't do what the author claims. But, fresh from having refurbished a couple of Heath HO-13 and SB-620 panadaptors, I would say it *almost* looks like a part of a circuit that might have actually worked - but has big chunks missing.

If you read and ponder Jim's explanation of how a spectrum analyzer or panadaptor works - in a nutshell it's a receiver where the IF voltage drives the vertical deflection of a CRT, and where the local oscillator is swept in frequency in synch with the horizontal deflection circuitry. If you already have a receiver and an oscilloscope, you have most of what it takes to make a spectrum analyzer.

An oscilloscope already contains the deflection circuitry and power supplies, along with a vertical amplifier - so the notion of a simple "adapter" isn't all that far-fetched. The "101 Projects" one shows a connection to the vertical input coming from the first IF, but what you really want is to tap the plate of the first Mixer, before any IF filtering is done. So that's the first thing that's wrong. And the connection should only be a small value capacitor - 5 to 20 pf for example. So far, pretty simple....

An oscilloscope also contains a horizontal oscillator and the necessary circuitry to "paint" a horizontal line across the CRT in the absence of vertical deflection. What is missing is a method of using this deflection voltage to cause the local oscillator of the panadaptor to sweep across the desired range of frequencies. In the Heath units, a varactor diode (aka varicap aka tuning diode) is used for this purpose, where the capacitance of the diode is proportional to the applied voltage. (See http://en.wikipedia.org/wiki/Varactor and other resources for more info on varactors). Heathkit picks off the deflection voltage right at one of the CRT horizontal plates through a 1 mF capacitor and then uses voltage dividers to scale this sawtooth ramp down to create the desired voltage at the varicap, and thus the desired frequency sweep of the oscillator.

What caught my eye is that the handful of parts shown in this so-called "adapter" looks like it might have been intended for this function. Common diodes can be used in place of a specially-designed tuning diode, but they exhibit a smaller capacitance change (certainly not enough to create a 100 KHz sweep as claimed). For some rather interesting data on re-purposing diodes and even LEDs for this application, take a look at http://www.hanssummers.com/radio/varicap/index.htm. But assuming the circuit was intended as a sweep generator, it should have been connected between the horizontal deflection voltage in the scope and the local oscillator of the receiver, not to the IF as shown.
To sum up - one could marry a receiver and an oscilloscope with a *properly designed* adaptor to create a rudimentary panadaptor. But - it would be impossible to both listen and scan the spectrum at the same time! My first spectrum analyzer was built using the Science Workshop design based on a TV tuner, and I had a switch to kill the sweep so I could tune signals manually and listen to them, but it was a real thrill to play with. And it would take a lot of fiddling, not that that's a bad thing!

There's another way: The Heathkit "Scanalyzer" is typically available reasonably as many don't work due to HV power supply failures. (Allied sells a fine replacement cap for under $2, and a pair of 1N4007s in series easily replaces the HV diodes). The

HO-13 and SB-620 incorporate a separate 350 KHz IF so they operate completely independently of your receiver and are adaptable to a range of IFs from 455 KHz thru 5 MHz (good luck finding coils!) Moreover the SB-620 can be used with an external signal generator for use as a more general-purpose spectrum analysis tool. Properly restored (read: be prepared to replace resistors!) they work surprisingly well and are certainly one of Heath's more interesting designs.

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