From: http://users.netonecom.net/~swordman/Radio/ShortWaveRadio.htm

Synchronous Detectors

Synchronous detectors seem fascinating. Nearly everyone who writes about using one claims they're great. I've never heard one but have wanted to try building one. I haven't actually started building or even finding parts yet, though. So far it's hard to pick out which one to start with. Here's the information I've been able to find about them.

The sync det plan in recent ARRL handbooks looks very promising, and I got that complete article QST from QST, July 1993, page 28 from the library microfiche too. It uses an NE-602 and an NE-604. The article, by OH2GF, is about six pages long. In a sidebar, WJ1Z describes his testing the project with a Drake SW-4A and an IC-729 transceiver and said that it worked out very well. The original project added the sync detector to a Sangean ATS-808 portable receiver.

FAR Circuits has a $5.25 board for the Sync Det in the Fall, 1994 Communications Quarterly 13-page article by Scott Prather, KB9Y entitled "A Unique Approach to AM Synchronous Detection." It uses the Motorola MC13022 AM Stereo Decoder chip, a 4066 I.C., 2 transistors and an LM311 Audio Amp I.C to drive the speaker. He says that the receiver must be very stable. I hope I won't get in trouble for scanning and posting this article as a 184KB DjVu file. It's a very good article!

I found the MC13022 spec sheet online as a PDF file at http://roadrunner-esng.dibe.unige.it/EESS.Kit/Software%20e%20documentazione/Data%20sheets%20componenti%20elettronici/IC%20Analogici/mc13022arev1f.pdf

An 8-page article called "Synchronous Detection of AM Signals: What is it and how does it work?" appeared in the September, 1992 QEX magazine. It has several pages of the theory of amplitude modulation and then goes into the demodulation. The circuit uses the Sony CX-857 stereo decoder and PSN phasing amplifier chips that are used in the "famous" Sony ICF-2010 synchronous detector. The author of the article, Mike Gruber WA1SVF, an ARRL Laboratory EMC/RFI Engineer, reports that Steve Johnston, WD8DAS sells a kit for building it and has more information on his web site at http://www.qsl.net/wd8das/syncinfo.txt. WD8DAS also has a copy of a 2-page review from the October, 1994 issue of Electric Radio magazine. I have received permission from the ARRL to post a scanned copy of the article.

Reprinted with permission from September 1992 QEX; copyright ARRL. Here's the link QEX 09/1992. (99k)

ARRL does provide reprint service. Cost for reprints is $3 per article for ARRL members, $5 per article for non-members. Requests should be sent to reprints@arrl.org or addressed to the Technical Secretary, ARRL, 225 Main St, Newington, CT 06111.

While looking for other info about the Sony CX-857, I found a web page in another language with a GIF of a stereo decoder circuit using the MC13020 at http://www.jimcom.net/elehobby/syncdet/amsync.gif

And someone who had asked earlier (a year ago) for MC13020 specs sent me a link to the "archived" version (800KB), which is at http://merchant.hibbertco.com/servlet/mtrlext.MtrlExtServlet?tp=archdoc&partnum=MC13020P%2FD&prodstat=A

The web page synch det bibliography (which was) at http://www.primenet.com/~ctrask/syncdet.html says that there's a Popular Electronics article by Dave Hershberger entitled "Build a Synchronous Detector for AM Radio" on pages 61-71 of the April, 1982 issue.

That Popular Electronics article is very informative. It explains a lot about the principles of AM and detection, and what causes the problems with fading and distortion. It explains very well the theory of how this synchronous detector works, how to build it and how to set it up and align it. It works with a fairly wide range of signal levels and includes the phasing circuitry for selectable sideband operation as well. In fact, selectable sideband circuitry is optional and can be left out. The primary active parts of the circuit are an MV2115 Varactor diode, three 2N3904 transistors, an LM318N op amp, 3 TL074CN quad op amps, a TL072 dual op amp, and two CD4053BCN multiplexers. The phase detector itself is a 74C932 but that is described as possibly hard to find and instructions show how to substitute a CD4046 PLL. There's also a zero-center tuning meter. A switch selects two different loop time constants, to make it easier to tune in the signal and then to keep the detector locked even when the signal fades very deeply. All in all, I thought it was a pretty impressive article, and very comprehensive. Especially for a mass-market hobby magazine.

> NOTE: The article has a published correction in the July '82 issue of
> "Popular Electronics" on P. 6
in Fig. 4, pin3 of IC8 should be connected to pin 11 of IC2
not pin10.
and an unpublished correction where the "ENV"
> (i.e. Envelope Detector) position of switch S1B should be ground (GND) not
> N.C. as shown

I posted the PE article here: PE_sync.djvu

More information on the **theory** of synchronous detection from the July 1982 issue.
In the something different department: some notes from another person interested in synchronous detectors.

There was a synch det project online at http://members.localnet.com/~wa1sov/technical/sync_det.html too. It uses only an LM311 op amp and an AD607 product detector. It looks pretty simple. The schematic is on the site, but it prints out too wide for my printer so I haven't seen the whole thing yet. Check and see if it's on line now. I did see it on November 10, 2002. There is an architecture description of the AD607 at http://www.analog.com/library/analogDialogue/archives/29-2/ad607_art.html

I don't know if it's still available, but Plessey (also known later as GEC and then Mitel) made a chip for multimode reception that has been used as a synch det, too. It's the SL1624. A circuit for it was shown in their Radio Communications Handbook, published in 1977. I have a scanned copy of the page from the book.

There is a small, simple, basic example circuit for a synch det using a CA3006 on page 375 of Ulrich Rohde's book on receivers, too.

In August, 2002 I received a scan of a synchronous detection article from Chris in the U.K. He said:

"Found a good article in "Electronics World" (formerly Wireless World)
on Homodyne and Synchrodyne AM receivers
"Synchrodyne/Homodyne Receiver"
Micheal Slifkin and Noam Dori
Electonics World November 1988 Volume 104 No. 1751 pp947-953

Electronics World article in pdf format is now attached (500k). Covers design of complete homodyne and synchrodyne receivers. Some of the Motorola chips are now difficult to find but I guess substitutes could be found.
Here is the article: Synchr~1.pdf (516KB).

A pictorial or graphic of an AM Receiver Synchronous Detector is/was on line at http://www.shu.ac.uk/ocr/teaching/ppp/AMnoise/sld007.htm and part two of it is at http://www.shu.ac.uk/ocr/teaching/ppp/AMnoise/sld009.htm . There's as much math as graphics in the two slides.

An article entitled "Synchronous demodulation - What is it and why is it used?" by Ian Poole is posted on line at http://www.radio-electronics.com/info/receivers/sync_det.htm No circuit examples, but it does give a basic description of the theory and operation, with a block diagram.

*"**The Ultimate Homebrew Receiver? Not Quite! by Nick Hall-Patch** "* which appears at http://www.carcanada.net/dx/homerecvr.html uses an Exar XR2228 analog multiplier IC for its synchronous detector. The article has a block diagram of the receiver, but no actual schematic. He says "This type of detector is easier to build and to use than a PLL synchronous detector and deals better with weak signals than some PLL designs. " It may give project developers some ideas, if we're lucky.

There's an ATV page at http://www.ussc.com/~uarc/utah_atv/if_filt.html
Which says

> Nowdays, the vast majority of analog televisions use a *synchronous* detector. This is a big improvement over the envelope detector for several reasons: An envelope detector needs a good video carrier to work properly. One problem is that, as the entire video signal gets weak, the video carrier gets weaker (and noisier) as well. With the video carrier getting noisy, it *adds* to the noise that is already in the video from the rest of the signal being weak, making the video appear noisier than it really is. A *synchronous* detector, on the other hand, takes the received video carrier and *reconstructs* it. It can do this because, as it turns out, the video carrier can be received even though it may be very weak because the circuit that recovers it has a narrower bandwidth than the video detector itself. This is the same sort of situation where you *know* that there is a video signal on frequency, but you cannot see it on your TV, even though you can hear it on your FM receiver just fine. This happens because your FM rig has only about 15 KHz bandwidth as compared to the 6000 KHz (or thereabouts) bandwidth of the video receiver.
>
> With the video carrier "regenerated" within the detector, we now have a "pristine" copy of the carrier that we may used to demodulate the video. As it turns out, synchronous demodulators produce pictures that are 6db less-noisy for a given signal than an envelope detector. This would be equivalent to the transmitter increasing its power by a factor of 4!

And there is a 2-page spec sheet PDF file for the **NTE843 Integrated Circuit TV Video IF Phase Locked Loop (PLL) Synchronous Detector** at http://www.nteinc.com/specs/800to899/pdf/nte843.pdf
(But no circuit diagrams or applications information.)

Now, does that give anyone an idea about other synch det sources of parts, theory or information?
In addition, there was a *Toshiba TA8124* AM STEREO IC decoder, which Google shows listed on
http://www.angelfire.com/biz/techsonic/page6.html