AM Stereo Encoding/Decoding Improvements

★ TX/RX - Increase (daytime) audio bandwidth to -3dB@12½kHz where possible and 75µs Pre-Emphasis with an 11kHz pole, about ⅓ octave higher than current NRSC. There are a couple of music samples of C-QUAM® in Japan on YouTube using 12½kHz audio, sounding great, and some from quite a long distance.

★ TX/RX - (Nighttime) audio bandwidth in crowded areas could/should be cut back to at least 7½kHz and continue to use the current 75µs NRSC Pre-Emphasis which has an 8.7kHz pole.

★ TX/RX - An alternative is to use a 50µs Pre-Emphasis with a 35kHz pole. 50µs is 3.183kHz and using an L-C bandpass of ±3.183kHz prior to decoding can be used to preform De-Emphasis and help to reduce the effects of adjacent channel interference caused by non-synchronous envelope detection. Most mono radio bandwidths now days are at least this narrow if not narrower. If -100% modulation is exceeded with the higher frequencies it will not affect synchronous detectors and if the band limited ±3.183kHz filter reduces the higher frequencies enough to limit negative modulation to -100% for envelope detectors no distortion will occur.

★ TX/RX - Using an additional 2.65ms Pre-Emphasis with a 180Hz pole to reduce bass levels that are usually the strongest will add at least 3dB headroom for the mid & high frequencies thus increasing S/N ratios in the needed areas. This can be compensated for upon reception using the bass control for receivers without this De-Emphasis. The equalization curve on a phonograph record has a much greater bass attenuation and this lower S/N ratio is well tolerated allowing more headroom for the upper frequencies.

★ RX - Include 9/10kHz adjacent carrier whistle filters for nighttime reception.

★ RX - Envelope detection is inferior to synchronous detection when interfering noise is present and requires a greater narrowing of the signal bandwidth to improve listenability compared to synchronous detection. This is why the Harris system excelled in receiveability "Showing major strength without distortion" as one writer put it. In C-QUAM having the envelope as the 'Gold Standard' reference for signal reconstruction means that any harmonic distortion generated from the by product of 'Signal × Noise' is modulated into **L**—**R**. If there is a way of detecting the **L**—**R** quadrature signal with all the shortcomings of an envelope detector this is it. When the S/N ratio of a C-QUAM signal drops below 21dB the Secant correction decoding factor for **L**—**R** goes off on a Tangent and starts expanding the noise, **L**—**R** = (1**+L+R**)**×**Tan**θ** . The envelope output during these conditions is a multiplicative product of the 'Signal × Noise' along with the original Signal and Noise information. This 3rd component, which has harmonic characteristics related to both Signal and Noise, makes it difficult for the psycho-acoustics of the human ear to separate the Signal from the Noise. With synchronous detection this 3rd component is not present and it's more like picking out a single conversation in a crowded room. The total sum of the aural energy is all additive and not multiplicative.

★ RX - Decoders should be designed to go into full synchronous detection mode and be capable of receiving a signal with a reduced carrier. More transmitter energy can be put into the sidebands which also reduces transmitter duty cycle thus prolonging transmitter life. This also reduces the need for adjacent carrier whistle filters since the sideband to carrier energy ratio is much greater. Amateur radio operators have determined that a carrier can be reduced to -11dB PEP and still provide good PLL lock and reception during less than optimal reception conditions. Having the envelope detector eventually go the way of the dinosaur would be one of the best things to happen to AM radio. This migration probably would have already happened if it wasn't for the AM Stereo wars. The FCC could have picked the best parts of all the proposed systems and chosen a path of planned obsolescence for envelope detection as older radios were slowly replaced and migrated towards synchronously detected reduced carrier AM. With few AM Stereo radios available and with the only current AM receivers being very narrow-band it is not really advantageous to permanently stay with C-QUAM, a non-linear multiplicative process, but linear quadrature modulation of some form is the direction to take. Pure linear ISB uses linear quadrature modulation with the addition of **P**hase **S**hift **N**etworks and offers better S/N ratio, separation, and signal integrity during adverse reception conditions. In choosing one system to eventually migrate to it would have to be **Reduced Carrier Linear ISB**. This system offers Stereo, two completely independent program channels separated by frequency and not phase during transmission, or one SSB channel, all more transmission efficient when reduced carrier is used. ISB/SSB is also more immune to asymmetrical sideband reception issues and other forms of selective fading.

★ TX - If not broadcasting in Stereo and if a station has a C-QUAM Exciter then using an ISB/SSB **PSN** can create a C-VSB™ (Compatible Vestigial Sideband) signal that is envelope compatible, kind of a C-QUAM version of Kahn PowerSide™. The vestigial sideband could be limited to 2½kHz while the other sideband is limited to 7½kHz occupying only 10kHz broadcast bandwidth and providing 7½kHz audio. A receiver could use the typical ±5kHz IF bandwidth filter with the LO offset tuned by 2½kHz. This could be used for high quality talk radio or if the bandwidth was widened to 12½kHz mono high fidelity music could be transmitted and this would only require a ±7½kHz IF bandwidth filter.

★ RX - To sum it all up a decoder having envelope and full synchronous (reduced carrier) detection with **PSN** for ISB/VSB/SSB would make a very versatile receiver offering the following modes: Mono Envelope, C-QUAM, C-ISB™, C-VSB, C-SSB™, Mono Synchronous, QuAM, ISB, VSB, SSB and possibly others. The 'C-' in some of the modes implies Cosine Correction used in transmission and/or reception. While the MC13028 has greatly improved detection integrity and reduced platform motion its hackability is very limited. The MC13020 is very hackable and all the modes just listed can be realized with external components. Any future encoder/decoder designed should be multi-system like this, envelope/synchronous with audio **PSN** for sideband.

The AM Stereo Tech Zone™

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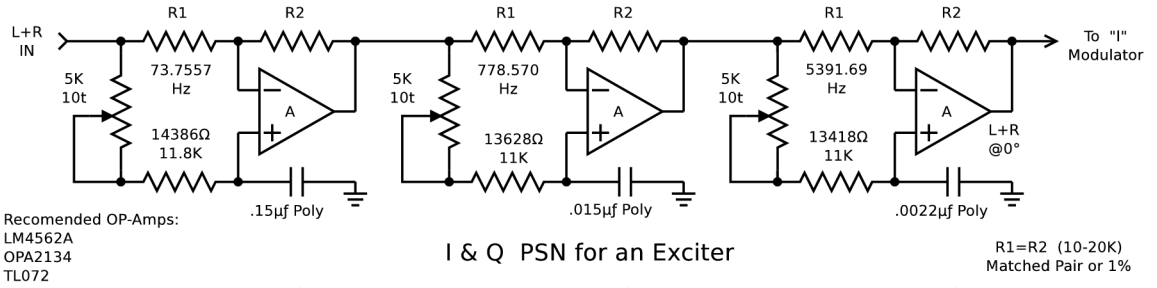
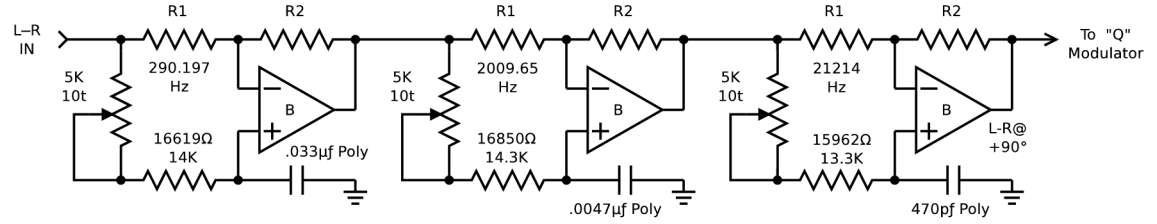
3 Stage Phase Shift Networks



Recomended OP-Amps:
LM4562A
OPA2134
TL072

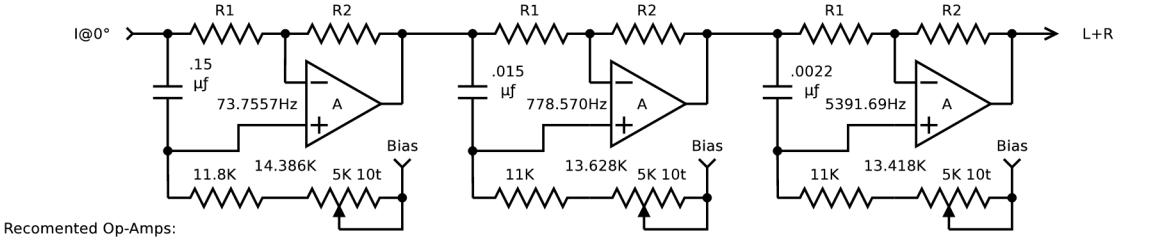
I & Q PSN for an Exciter

R1=R2 (10-20K)
Matched Pair or 1%



153Hz to 10¼kHz –40db/±1.15° --- (–28db/4½° at 125Hz & 12½kHz)
(For ISB only. C-ISB will be less from Cosine Modulation)

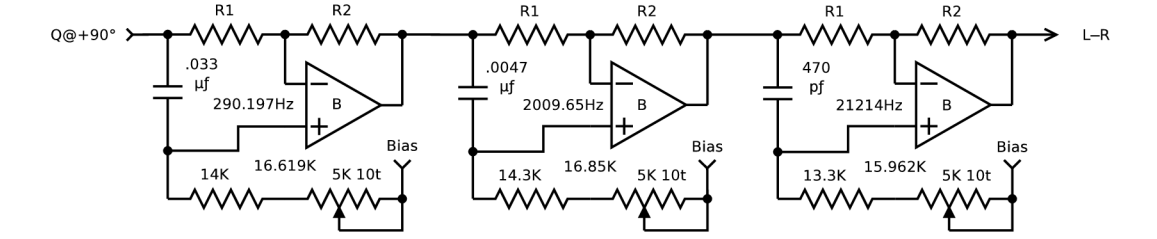
All Capacitors are Hi-Q
Temperature Stable
C0G or NP0 Type
for Best Performance

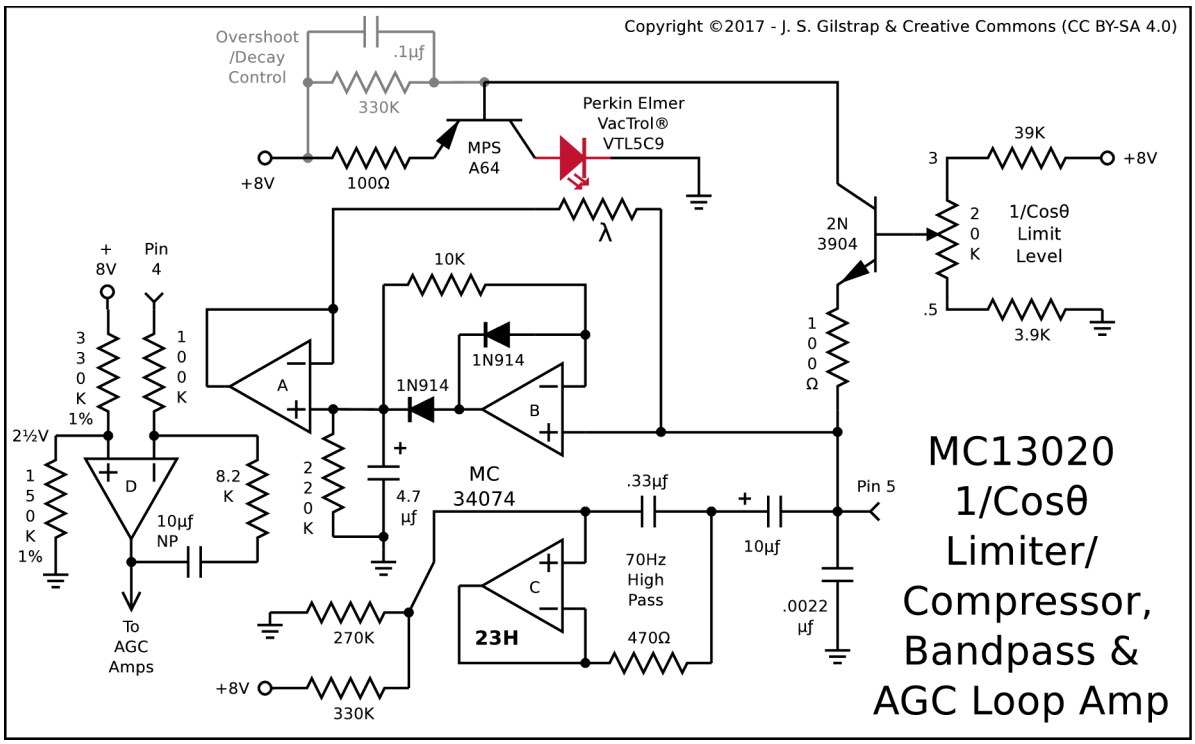


Recomented Op-Amps:
TL072 (J-FET High Performance)
MC34072 (Low Voltage High Performance)
MC33172 (Low Voltage Low Power)

I & Q PSN for a Receiver

R1=R2 (10-20K)
Matched Pair or 1%





You may access these links only after you have fully read this document.

Links: C-QUAM AM Stereo Made in Japan

For C-QUAM these sound great as they have little if any interference even from great distances. This is evident of a well managed band plan, unlike the U.S. C-QUAM's signal quality degrades as interference increases causing distortion as described above. A synchronously detected system would sound this good with interference as background noise, minus the distortion though. C-QUAM's reception quality can be improved during interference when detected as synchronous QuAM with some loss of separation and a little non-objectionable distortion as this WBAP air check demonstrates.

YouTube Flash Ogg 1242 Tokyo – Stan Getz & Astrud Giberto – The Girl From Ipanema
YouTube Flash Ogg 1242 Tokyo – The Beatles – Oh! Darling
YouTube Flash Ogg 1242 Tokyo – Boston – More Than A Feeling

YouTube Flash Ogg 1287HBC Sapporo – The Police – Every Breath You Take
Received 830km/516mi away in Tokyo.

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