Anniversary Time:

Looking Back To Beginnings.

This month's column date marks a couple of milestones in my publishing history. First of all, it is the first anniversary of this column's startup. Over the last year, we've seen 13 serial columns, composed of both short monthly types as well as two more lengthy ones within the Analog Special issues. January 1998 also marks another key date for me, as back in January of 1968, I had my very first ever article published, an "Idea for Design" piece within ELECTRONIC DESIGN.[1] So, this present column looks back at these two ELECTRONIC DESIGN beginnings with some considerations for the future.

Topics for Tools and Tips: Regular columns such as this one become rather unique vehicles of communication, for several good reasons. First, a column confines one to a narrow form of presentation, mostly due to finite space budget. Given that, it also forces the author to write more concisely and clearly just to get the point across. These factors, of course, hone down the list of eligible topics, as many analog design areas just can't be adequately covered in the slim format of a regular monthly column.

Planning ahead for such a column can be almost an exercise in futility. You may have very good intentions in doing so, but in the end, what really matters most is whether readers react to it. If they do, maybe it was your great planning and topic choice. But, if they just don't react, does that mean your planning was bad? Not necessarily so—maybe you just didn't manage to hit their hot button that month. But then, don't persist in missing those hot buttons, as that could mean you are uniformly bland!

Looking back over 1997, it has been a learning experience. Going in, I had imagined that readers would be most interested in topics related purely to analog design, such as the Analog Special issue circuits presented, the book reviews, and so on. But, while there were some good responses on these, by far the most numerous and lively replies resulted from the two "Computer Tech Support" columns, followed closely by the July 7 column on "EEs and the Audio Hobby."

Searching for what's behind the meaning of these spikes in reader response leads me to suspect that analog oriented readers aren't always thirsting solely for new design tricks. Maybe some things *do* supersede when they hit a hot button. If a topic comes by that touches on an everyday problem, particularly one that transcends regular duties, then this message can attract many more people. And, if the problem under discussion is sufficiently serious and widespread, then you just might see a veritable flood of responses.

I suspect that the "Computer Tech Support" columns fit this description, simply because more and more of us use PCs routinely, and have seen the dark underside of the PC world first hand. The PC support problems we all have aren't getting better, they are getting worse! I anticipate more discussions of these support issues in coming months, based on continuing feedback received since the November 3, 1997 column.

WALT JUNG

On the other hand, understanding hot/cold interests on audio-related topics is nowhere so clear cut. In fact, with the just-published audio-oriented topic in the November 17 Analog Special issue, the response has been far less than that of the July 7, 1997 column. It could be that this is simply due to the focus of the particular audio topic for the November 17 column, specifically slanted toward professional audio. I know that there is a great deal of audio interest out there. But, I also know that audio is an extremely broad topic, and pro-audio issues wouldn't necessarily be appealing to those involved on a hobby or entertainment basis. Perhaps you readers can tell me what the difference is.

Looking Back to Beginnings: Hopefully, our readers can forgive my immodesty in discussing an old circuit of mine which is now exactly 30 years young. When I realized that this column wasn't just marking a 1-year **Tools and Tips** anniversary, but it was also a 30-year anniversary of my first ever publication, this changed the perspective. I decided to look more closely at that old circuit, to see what it might still hold as worthy of current discussion.

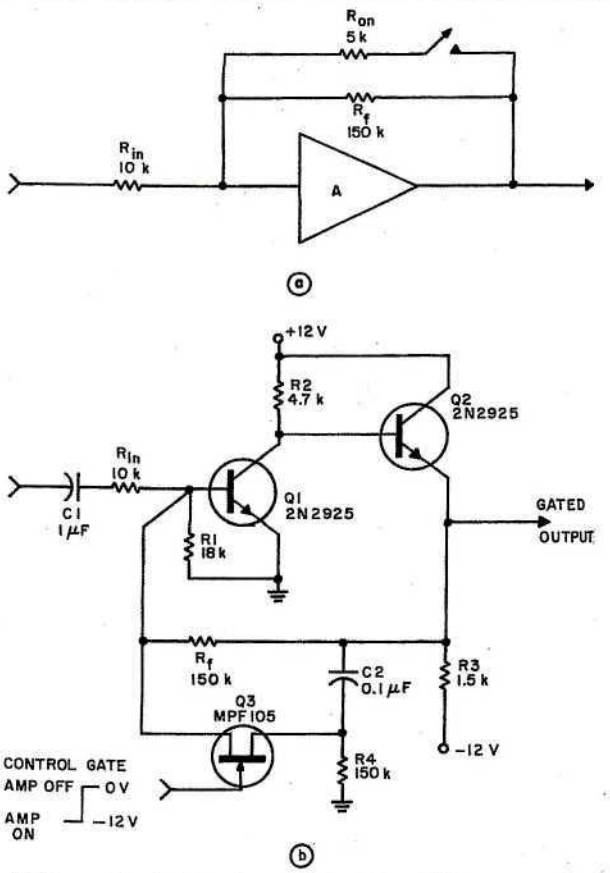
The circuit in question has been excised from the ELECTRONIC DESIGN archives, and is reprised here in the Figure, just as in the original. I'm not going to repeat all that was said about it, but I will point out some fascinating points that actually make the technique described just as viable even today, using either today's parts, or alternately, original equivalents. **Question:** How many circuits designed 30 years ago can still be considered viable today?

The premise of the original article was that standard junction FET devices, because of their moderately high "on" resistance (R_{on}), don't make very good video-switching elements used just by themselves. Generally, that's still true today. But, if the FET switch is configured to operate in the feedback path of an amplifier so that it effectively shunts a much higher resistance, then a moderate R_{on} in the FET won't necessarily be a problem. Further, the amplifier can provide a buffering effect at the input and output.

This concept is shown in functional form in the Figure (a), where the amplifier is shown generically. Note the absence of a (+) input reference terminal for this amp—it is inverting only, with the ground reference understood (its actually Q1's emitter, in the Figure (b).

But (Ahem!) I must confess to an unfortunate rookie mistake at this point. As you can see, the FET R_{on} shown is 5 kΩ. In general the R_{on} will be 1/gm, and for the device under discussion, the gm is specified as 2000 μmhos (for the still-available 2N5459, the JEDEC successor to the original MPF105). This works out for R_{on} to be 500 Ω, not 5 kΩ, so this FET is a much better switch than originally given

WALT JUNG



High-speed switching is possible with a FET connected as shown (b). Simplified schematic is in (a).

Since this circuit functions as an op-amp type inverting gain circuit, the ideal gain is R_f/R_{in}, where R_f and R_{in} are the amplifier's effective feedback and input resistances, respectively. Of course, overall performance is subject to the limitations of the rather modest amplifier, where the main virtue is low cost. R_f is dynamically switched by the FET, via the CONTROL GATE input.

The change is from 150 kΩ in the high gain, or amplifier ON state with the control input low, to the low gain or OFF state with the control input high, where R_f becomes 150 kΩ || R_{on}, or ~498 Ω.

Thus, the inverting gain is either about 15 times with the amplifier gated ON, or about 1/20 when OFF. This equates to a calculated dynamic gain reduction of about 50 dB. It is worth noting to anyone trying this type of circuit that there may be some variation in the FET R_{on}, since the FET channel is dc biased at one V_{BE}, and the control signal positive excursion is ~0V. This uncertainty can be eliminated, if desired, by use of a simple diode level shifter to the FET gate.

To quote from the original article, here are two of the key performance attributes of the circuit:

There's a low output impedance from Q3's emitter under all signal conditions—an advantage that is not possessed by conventional series or shunt choppers.

In addition, a constant input impedance, R_{in}, under all signal conditions—also not characteristic of series or shunt choppers.

TIP: So, what we have in this circuit is an old technique, but one basically just as viable today as it was 30 years ago. The circuit was originally designed when I worked for a small Maryland company, Maryland Telecommunications Inc. (MTI—no longer in business). As best I can establish, the use we then had for it was a gating circuit for a video-processing system, where the (b) circuit, driven by suitable horizontal and vertical sync derived timing signals, opened a controllable active video window over one central portion of the screen.

So yes, we were doing windows all the way back in 1968! And we had a lot of fun with video circuits back in those days. In digging out the history of this circuit, I appreciated helpful comments from a couple of MTI co-workers and good friends from back then, Dick Groom and Al Levin.

My January 1968 article was the first of a long series of "Ideas for Design" published in ELECTRONIC DESIGN. Later on, they were supplemented with many feature articles, and I'd venture the total list has grown to more than 60 by now.

Over these past 30 years, I have been fortunate to work with many different ELECTRONIC DESIGN editors, and with each the experience has been both pleasurable as well as professional. Let's hope we can keep it up!

Next month, we plan to get back onto a more conventional column schedule. As I hope will be clear from remarks above, your comments on future directions will be helpful. Here at the close of 1997, I'd like to take the opportunity to thank all of those readers who took the time to write within the past year, and hope that they (and more of you) will continue to do so in 1998. May you all have a prosperous new year, with fully successful analog designs, and be totally devoid of PC crashes and support problems!

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References:

1. Walter G. Jung, "Gated amplifier uses FET in feedback loop", ELECTRONIC DESIGN, January 4, 1968.

credit (note — the R_{on} error was corrected in a subsequent 1968 follow-up in ELECTRONIC DESIGN).

Despite the quoted R_{on} error, the complete circuit as shown in (b) worked quite well indeed, as you might expect. The original amplifier used 2N2925 general purpose NPN transistors for Q1-Q2, which were popular at the time. I don't know if they are even still available, as neither Newark and Allied now list them. But despite that, I'm also sure that 2N3904's in the same circuit would just work fine and do the job.

So, you could actually build this same circuit today for an active parts cost of a buck or less (much less if you find a inexpensive FET). Or, you could also spif it up by using a video op amp for the gain stage, making the new form of the circuit look a lot more like (a). This would allow for full dc coupling at both input and output, whereas the (b) form must be ac coupled. And it also would allow driving lower-impedance loads.