

Don Tillman's Blog



« [Feynman Lives!](#) | [Main](#) | [Twin pic](#) »

June 10, 2005

Last of the OTA's

There has been a lot of fearmongering from the electronic music crowd for a long time about electronic music parts going out of production. Usually it's just a case of some guys who are naturally kind'a jumpy. However, this one looks serious; [Intersil](#) has recently set the status of the CA3280 Operational Transconductance Amplifier to "To Be Discontinued".

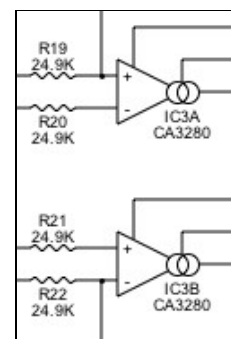
"What you talkin' bout Willis?"

An Operational Transconductance Amplifier ("OTA") is something like an opamp, but is really quite different. It's an amplifier; and like an opamp it has a pair of differential inputs and a single output. But the output is a current source instead of a voltage source. The gain of the amplifier is expressed as a transconductance (current out / voltage in), and that gain is programmable because it is proportional to the current going into a gain programming pin. While opamps are almost always implementing some function by the use of a specific feedback network, the OTA is very often used open loop (or partially open loop).

OTA's are perfect for a multitude of electronic music applications because they can control a parameter, such as amplifier gain or filter frequency, and control it very accurately over a range of at least three decades.

The first OTA chip was the RCA CA3080 introduced around 1969 or so. The current OTA of choice is the CA3280 introduced roughly around 1971. By a complex series of corporate megers and acquisitions, GE bought Intersil and formed GE Semiconductor, GE then bought the entire RCA Corp. and merged the two semiconductor groups, GE sold the combined semiconductor group to Harris, Harris sold all assets to a management buyout group, which reorganized things and chose the name "Intersil" for the new company. Or something like that; I was napping at the time.

So here's my recent email conversation with Intersil support on the matter:



Gentlemen,

I see from the Intersil web site that the CA3280 and CA3280A Tranconductance Amplifiers have been scheduled to be discontinued. I want to suggest that these chips are too important to retire.

1. The RCA/GE/Harris/Intersil line of Operatational Transconductance Amplifiers used to include the following chips:

CA3080 -- basic single OTA, used for most examples of OTA operation and applications

CA3060 -- triple OTA

CA3094 -- OTA with simple output buffer

CA3280 -- dual deluxe OTA

The CA3080 was discontinued recently, the CA3060 and CA3094 were discontinued previously. So right now, the CA3280 is the last of the Intersil OTA's.

The 3280 is clearly the most advanced and flexible. It features a very nice input diode linearization circuit, low noise, low offset voltage, and it comes in matched pairs. None of the other chips comes close in these areas, so if you can only support one OTA chip, that's the one.

The 3280 is also capable of functionally replacing any of the other OTA models, ignoring the obvious pin-compatibility issues.

There are not many alternatives available from other manufacturers. For instance:

LM13600 -- dual OTA with simple diode linearization and simple buffer

LM13700 -- ditto

The LM13600 has been discontinued. Neither the LM13600 nor the LM13700 has the performance of the CA3280.

2. There are many audio electronics applications for the 3280, and while admittedly most audio is digital now, the analog alternatives are where the high-end markets lie. ("Reproduction" is mostly digital, but "production" is mostly analog.)

3. The 3280 is invaluable in electronic music work. It's the preferred chip for voltage controlled oscillators, voltage controlled filters, voltage controlled amplifiers, waveform shaping, modulation, signal processing, routing and control, chaos circuits, simulation of mechanical systems, and so forth. And there is currently a resurgence in modular analog music synthesizers (SynthTech, Synthesizers.com, Buchla, Cyndustries, Blacet, Doepfer, Oakley, etc.).

4. Along those lines, the 3280 is inspirational for new designs. For example, my Quadrature Trapezoid thru-Zero Voltage Control Oscillator, my Interpolating Scanner and my Voltage Controlled Duty Cycle Sawtooth Circuit (<http://www.till.com/articles>) are all innovative designs inspired by the CA3280. And I have a significant number of additional applications in the pipeline.

5. I predict that if the CA3280 is not discontinued, sales will pick up as the supplies of the other OTA chips drop off and the choice of which OTA to use narrows, with the resurgence of audio and electronic music applications, and with new applications being developed.

In summary, I think it would be a big win to keep the CA3280 in production, for all the standard business reasons, but also because the chip is culturally and educationally important, and it would give Intersil a great reputation.

Thanks for listening.

-- Don Tillman
Engineer, consultant, writer, musician
Palo Alto, CA
don@till.com
<http://www.till.com>

I received a response the next morning:

Dear Don,

I will pass on your concerns but please understand, these CA family of products were developed by RCA on a very old and obsolete fab process that is long since been discontinued and the fab plant was shut down and sold off. We have been living on wafer stock. Today the wafer stock has been depleted to the point we have to withdraw the product. We need to insure we have enough product remaining to support the life time buys that are now incoming.

So, we reluctantly must withdraw these CA parts as our stock is depleted and in good faith, notify our customer base in time for last time buys.

Sorry
Intersil corp.

I tried for a few more details:

Thanks for passing my comments on.

The CA series parts are certainly old; I think most of them were introduced before the Nixon administration (!!!).

Do you know if another company (like the one that purchased the old fab equipment) is considering carrying on production when the current stock depletes?

Or would Intersil consider introducing an improved 21st century version of the the CA3280, made in a modern fab?

-- Don Tillman

And received this the next morning:

Don,

We are sorry but what FAB equipment we did not move to Florida, we sold with the building. The CA process was based on an old 7 micron specialized process. So, the process is gone and is not worth the time and 10's of millions to rebuild when today we are working with sub micron processes. The market size for the CA part just will not return a profit for the cost.

As for other sources, I would start with our obsolete distributor, [Rochester Electronics](#). You might consider looking at [Analog Devices](#), [Linear Technology](#) or [Maxim](#) for alternatives.

Hokay, well... I don't blame Intersil. The process used to make those chips is very old and has been handed down through a number of corporate buyouts. And I'm sure the CA3280 hasn't been their top seller. Still, this sucks.

Also, this appears to affect the entire CA line which, besides the four OTA's, includes transistor arrays, opamps, video amps, amps with unusual circuit configurations and taps, special purpose radio and television circuits, and so forth. Most of these are somewhat antiquated designs and have few practical uses today. The transistor arrays are certainly nice, but given how easy it is to hand-match transistors, I don't see an array of less-than-great transistors on a chip as an especially compelling story. But the OTA's are a serious loss.

What to do? Well, several things:

- For one, there are a lot of CA3280's still available, maybe hundreds of thousands, and that should meet demand for a while. Concerned electronic music folks could make "lifetime buys" and do fine.
- I have a number of projects and articles in the pipeline that use CA3280's, and I'll keep on course with those. (Although, admittedly, one project uses dozens of CA3280's; we'll have to see how that one goes.)
- Use the LM13700; it's not as good, but it's still in production and second sourced. (It might actually work for my dozens-of-OTA's project.)
- The guys who the fab was sold to? Oh, never mind...
- Try to get other foundries to manufacture OTA chips. OTA's are general purpose devices, not specific to electronic music applications, so the demand should be enough to support at least one good one.
- Build discrete OTA's. OTA's are not complex devices, although a substantial amount of hand matching of transistor will be required, but that's not difficult. Heck, the original Moog modulars were all discrete.
- This is also an opportunity to build a better discrete OTA. I might do that; it could have a lower noise input stage, built in exponential conversion for the programming current, a better linearization circuit, better current mirrors, that sort of thing.

And... this is a wonderful opportunity for another semiconductor manufacturer to build a 21st century version of the CA3280. Are you listening [Analog Devices National](#), [On Semiconductor](#), [THAT Corp.](#), [Linear Technology](#)? Or even [Intersil](#). I'll be happy to consult on such a project.

Posted by DonTillman at June 10, 2005 11:10 PM

Comments

There is a replacement for CA3080 made by NTE, the NTE996. See their cross reference:
[http://nte01.nteinc.com/nte/NTERefSemiProd.nsf/\\$\\$Search?OpenForm](http://nte01.nteinc.com/nte/NTERefSemiProd.nsf/$$Search?OpenForm)

Posted by: drsync at July 15, 2005 05:05 PM

Hey Dr. Sync,

Yeah, I know about that... the CA3080 isn't the interesting OTA though;

it's not a low noise device (it doesn't have a noise spec), it doesn't have input linearization and the offset voltage isn't very good. What I really want is a replacement for the high end CA3280.

Or better yet, an even higher quality OTA!

-- Don

Posted by: [Don Tillman](#) at July 16, 2005 02:00 AM

I tried, too, to persuade Intersil to keep at least the CA3080, which I use often. (Note that you can achieve very respectable dynamic range with this part, and that it will operate on just a few volts and with very little current.) Too late; the plant somewhere in Ohio is gone, Intersil told me. Then I corresponded with NJR, a second-source manufacturer of the LM13700. (This is essentially a dual version of the CA3080 plus linearization diodes and output Darlingtons.) NJR wanted to know my annual usage of the '3080. Knowing full-well that anything less than 500,000 would not interest them, I didn't pursue my case. But NJR obviously has a fab line capable of this "archaic" linear process. So, my fellow analog enthusiasts, I suggest that you petition NJR for the '3080, '3280, and their like, if your quantity requirements are large enough to make it worth their while. Note that in desperate repair situations, some of the LM13700's pins can be wired into a '3080 PCB pattern and provide identical results. Also note that Phillips and second-source ON Semiconductor still (as of this writing) makes the NE5517, which is similar to the LM13600 that National discontinued. I am trying to recall if there is a Phillips part that emulates the '3280, but I can't think of the number. One other thought: If the demand for the NTE996 persists, maybe NTE will have enough influence to get an off-shore manufacturer to produce them regularly. I bought a few hundred NTE996s around April, 2005, when NTE's stock was about 1100 pieces, and Mouser is still showing availability. Perhaps NTE is ahead of the game, and indeed has a new source for these parts. NTE must know that Intersil ran out of CA3080s, though, because the price has gone up about three-fold since I bought them.

Posted by: [Art Harrison](#) at September 23, 2005 02:31 PM

I wanted to mention the BA6110-types as for instance used in a previous Oakley-VCA but I just read these are discontinued as well... Hmm, it'll be unlikely, but perhaps other Japanes/Rohm-types exist ? (I didn't look yet)

Posted by: Peter Vermeeren at October 20, 2005 05:54 AM

CA3080' s for sale in batches of 50 on ebay, from Hong Kong just snatched up a bunch myself
http://cgi.ebay.com/PACK-OF-50-PIECES-CA3080-CHIPS-ICS_W0QQitemZ7363262505QQcategoryZ41415QQssPageNameZWD1VQQrdZ1QQcmdZViewItem-james

Posted by: [James Gideon](#) at November 9, 2005 11:56 AM

I have a question. I am designing a high order analog filter for the audio range. Higher order Imitation of SSM 2040 OTA VCF used for analog synths. What about using higher frequency BW OTA's like the Burr Brown OPA660. It has an OTA and a buffer so seems perfect for filters. Used more for RF with a BW at 850MHz and a slew rate of 3000V/us. Would this be equivalent or better then 3280AE for audio range?

Of course I see that Texas Instruments is discontinuing it (Is this a conspiracy). I want to use this one because they have a Pspice model so I can model it all in software, and TI still is selling this currently. (how long?) (By the way does anyone know if there are pspice models for CA3280 or 3080??, I have searched) Somebody should pick up the 3280. NTE seems the best hope.

Thanks for any input/comments
james@siliconbreakdown.com

Posted by: James Gideon at November 10, 2005 09:18 AM

James,

The OPA660 is very different approach to OTA's, and it's absolutely nothing like the CA3280, the SSM2040, or any of the other OTA's used for electronic music. It's a very different internal design, with very different characteristics, and it is used in a different way. Not that the OPA660 isn't an interesting chip...

If you really want an SSM2040 filter, check out Jürgen Haible's [SSM2040 Style 4-pole Filter](#), or the [Synthesis Technology MOTM-440 module](#).

A conspiracy? Nah; more like a very weird chip that didn't sell. And then after acquiring buying Burr Brown, Texas Instruments has to figure out what to do with all that stuff they got.

Somebody picking up the 3280? No... somebody needs to introduce a chip that's even better than the CA3280. Let's raise the bar a little, shall we? It's been thirty years, man; surely we can make some improvements.

Posted by: [Don Tillman](#) at November 10, 2005 01:46 PM

Maybe this is why the chip industry is going to china! What's next, the 741?

These chips are commonly used in audio compression / dynamic range systems. The stupidity of the IC industry is that they neglect to understand that the VCA is one function that does not work well in digital. You can't dynamically compress or expand in digital without generation of rounding noise....not to mention the fact that even 24 bit has a limited dynamic range.

The industry likes to PUSH its super-small surface mount multi-function digital ICs for cell phones....while neglecting the rest of the industry. They're shooting themselves in the foot! The US is the largest exporter of industrial controls - which use lots of linear ICs. Small and compact means unreliable and unserviceable. Surface mount does not belong on an airplane or in a car! Ceramic DIP does.


Ok, enough ranting and raving. I have had a problem with this chip for almost 11 years. In 1997, I designed an audio compressor based on the Motorola MC3340P, as part of a broadcast audio processor. The MC3340P is an inverse-coefficient voltage controlled attenuator, which made compression circuits real easy to build. (positive voltage reduces level!)

It was discontinued the year I designed the boards, and by the time I had made my first prototype built, I had to re-design again. This time I used the Matsushita AN829P, a dual direct-coefficient VCA. I think that the AN829P was originally designed for television sets, which needed volume to be remote-controlled. This time I had to use an LM324 and a resistor current circuit to make the inversion for the compressor. This was not a big deal.

Then, they discontinued the AN829P. I almost went to using the CA3280, but had problems with its manufacturer, Harris, who was a "competitor" in the broadcast industry at the time. Out of frustration, I designed my own fill-in replacement for the AN829P. My first prototype failed, because I negelected to cancel the DC offset from my 3 transistor VCA. Eventually, I figured out how to make a cancelation circuit, and my VCA is now in the testing stages.

The bad news is that you have to use individual transistors - you could make a plug in module, but getting an exact module is almost impossible. If you're making a 1970's based synthesizer, you can use many different VCA circuits. For audio applications, the SSM2164 works well. I'll stick to my own circuit, due to the costant discontinuation of fixed ICs.

PS. If you want, the MC3340P has a well drawn internal circuit. I am going to try to build it, and see if it works!

Posted by: [Neil Schubert](#)  at February 23, 2007 05:44 PM

Hello Don,

Is the "Blackmer VCA Devices" from thatcorp (<http://www.thatcorp.com/vcas.html>) the much awaited replacements for the CA3280 likes??

see also: <http://www.thatcorp.com/vcahist.html>

Also Have you found any other replacements?
thanks

Posted by: [ajitcs](#)  at March 27, 2007 02:21 PM

Hello Don,


We have problem to buy CA3080M96. As your suggestion above that NTE996 can be replaced but NTE996 has DIP-8 package according to the datasheet but we need SOIC-8 package. Have you ever buy NTE996 in SOIC-8 package?

Posted by: [Pond](#)  at May 20, 2007 11:00 PM

Hi Don: Thanks for the GREAT blog about the OTAs. We are now reviving and old product that used the 3080, and have found some surplus supplies.

Do you know of any date codes to avoid with the Harris or Intersil parts?

Thanks - JON

Posted by: [sanserino](#)  at June 12, 2007 02:25 PM

Post a comment

You are not signed in. You need to be registered to comment on this site. [Sign in](#)