APEX MICROTECHNOLOGY
PRECISION • POWER • ANALOG

**Tech Alert**

# *Upgrading From the PA24X to the PA34X*

## Introduction

The semiconductor manufacturing process used to fabricate the PA24x family of monolithic power amplifiers was discontinued in 2011 and end-of-life notifications on the PA24x were sent to customers in June 2011. Apex Microtechnology has introduced the PA34x as a replacement for the PA24x. The package(s) and pin-out of the PA34x are identical to that of the PA24x. Although the PA34x was designed to replace the PA24x, there are some performance differences between the two parts. This Tech Alert is intended to highlight those differences and to provide customer guidance and support for the PA24x to PA34x transition. Complete and more detailed information for the PA34x is in the PA34x data sheet.

**A Comparison of Selected Specifications (Typical Values)**

| Parameter | PA24x | PA34x | Units | Comment |
|---|---|---|---|---|
| Slew Rate | 30 | 32 | V/us | 34x was measured with Cc=4.7pF. 24x was measured with Cc=3.3pF. 34x is (4.7/3.3)(32/30) = 1.52 (50%) faster. |
| Quiescent Current | 2.2 | 2.2 | mA | |
| Input Offset Voltage | 25 | 12 | mV | |
| Open Loop Gain at 15 Hz | 96 | 103 | dB | |
| Input Capacitance | 6 | 3 | pF | |
| Power Bandwidth | 30 | 35 | kHz | 280Vpp |
| Minimum Supply | +/- 50 | +/- 10 | V | |
| Gain Bandwidth Product | 3 | 10 | MHz | |
| Noise Broadband | 50 | 337 | uV rms | |

## Frequency Response

The PA34x was fabricated with a smaller geometry process than the PA24x, and as a result it is a significantly faster part. Consider the following example. Refer to the SMALL SIGNAL RESPONSE and PHASE RESPONSE performance plots in the PA24x and PA34x datasheet. If an existing design with a PA24x has a closed loop gain of 10dB and a 500 kHz BW, a Cc = 15 pF will result in a phase margin of 60°. If you now replace the PA24x with a PA34x you will find that the BW has widened to about 2 MHz, and the phase margin would be slightly better, at 65°. This is a good thing. You have gotten wider BW with your replacement part. We usually don't want to throw away BW, but if for some reason you don't want the higher speed, you would have to use a larger Cc on the PA34x to slow it down. A Cc just under 68 pF would cut the PA34x BW down to about 500 kHz with a phase margin of about 85°. On the other hand, for new designs, bandwidths unobtainable with the PA24x are available with the PA34x. Again, if we wanted a closed loop gain of 10dB but we now wanted a 2 MHz BW, we would use the PA34x and a Cc = 15 pF. With this Cc the phase margin would be about 65°. For the PA24x, the 2 MHz BW design wouldn't be possible because the phase margin would be zero. In summary, replacement of the PA24x with the PA34x will result in wider BW performance. If you don't want the added BW you will have to increase the Cc. Running the PA34x with enough "braking" to give PA24x performance will result in very stable designs (lots of phase margin), but requires a larger Cc component.

## Noise

The new 1.0 um process used to fabricate the PA34x family of power amplifiers has unexpectedly turned out to be noisier than the process used for the PA24x. As a result the noise performance of the PA34x is worse than that of the PA24x. If this noise performance is an issue in your application there are two work-around techniques that we can suggest.

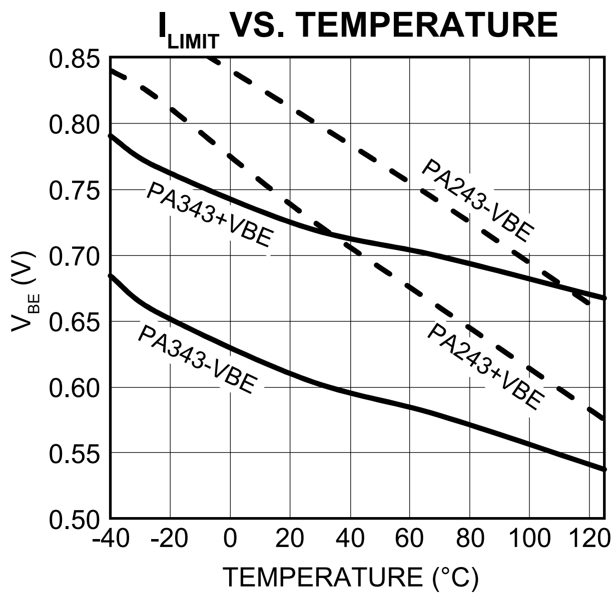
The first technique is to filter the noise by rolling off the gain. This approach is helpful if your signal bandwidth is less than your overall system bandwidth (low frequency applications). By rolling off the gain we are reducing the noise in the output that is coming from unused parts of the available bandwidth. To get this filtering action, simply place a capacitor CF across the feedback resistor RF. A pole at fp = 1/2πRFCF is now created which will attenuate noise at 20 dB/dec beyond the pole frequency.

The next technique applies when the signal bandwidth and system bandwidth are similar and system bandwidth cannot be reduced. In this case it is possible to build a composite amplifier around the PA34x. In the composite amplifier, an inexpensive low noise and low offset part (i.e. the OP07) can be used as a front end small signal amplifier. The output of this small signal amplifier drives the input of the PA34x. In this case, the closed loop gain of the PA34x amplifier can be reduced by the closed loop gain of the front end amplifier. For example, if the PA34x was originally used with a gain of 10, then when it is driven by a front end amplifier with a gain of 5, the PA34x gain can be reduced to a gain of 2. This will reduce the noise from the PA34x at its output by a factor of 5. Feedback from the PA34x output is taken all the way back to the front end amplifier and compensation is more challenging. Contact Apex Microtechnology Applications for design support.

## Current Limit

The PA34x data sheet includes a rewritten Current Limit section. Information and examples have been added to this section for customer support. One note here regarding this topic concerns the plot called "ILIMIT VS. TEMPERATURE." In the PA34x data sheet this plot has been renamed "VBE for ILMIT". More importantly note that the "plus VBE" and "minus VBE" curves have traded places. In the PA34x the "plus VBE" is the one with larger values over temperature. This means that for the PA34x the current limit when the part is sourcing current is larger than the current limit when the part is sinking current. It is the reverse in the PA24x.

The table on the right shows "plus VBE" and "minus VBE" measured data. These VBE values can be used with the information and examples in Current Limit section of the Data Sheet to choose a value of a current limiting resistor.




## Output Voltage Swing

Under typical operating conditions (supplies are +/- 150V), and at a maximum continuous load current of 60 mA, the ability of the PA34x to pull down or drive up the load voltage is slightly less than it is in the PA24x. Please see the plot called "OUTPUT VOLTAGE SWING". For 60 mA of load current, the PA34x load voltage can be brought to within 6 to 11 volts of the supply (depending on which supply and the temperature), while for the PA24x this range is 6 to 8 volts. For those applications at elevated temperatures and with higher pulsed currents (currents above 60 mA and up to 120 mA) the voltage difference from supply to load becomes larger in the PA34x than it is in the PA24x.

## Rejection

Please see the POWER SUPPLY REJECTION and COMMON MODE REJECTION plots.
The corner frequency on the rejection of common mode ac inputs is about a decade higher in the PA34x than it is in the PA24x. This means that you maintain higher rejection over a wider band width with the PA34x. Furthermore, after the corner frequency, the roll-off is not as steep with the PA34x as it is with the PA24x. For both of these reasons, the common mode rejection of the PA34x is better than it was in the PA24x.

Power supply rejection, especially around 60 Hz is significantly greater in the PA34x. Note that the larger rejection in the PA34x is of the positive supply, while in the PA24x it is the negative supply.

## NEED TECHNICAL HELP? CONTACT APEX SUPPORT!

For all Apex Microtechnology product questions and inquiries, call toll free 800-546-2739 in North America.
For inquiries via email, please contact apex.support@apexanalog.com.
International customers can also request support by contacting their local Apex Microtechnology Sales Representative.
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