Application Report
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Differences Between LM4600x/LM4360x A and Non-A Orderable Part Numbers

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ABSTRACT

This application note is written in order to provide our customers with a description of the differences between the A and non-A versions of the LM436xx device family as well as the LM460xx family.

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Trademarks

1 Introduction

The LM4360x and LM4600x regulators are capable of operating in pulse frequency modulation (PFM) mode in order to increase efficiency at no load or light load conditions. The input current is reduced because the device reduces its switching frequency hence reducing the switching losses under light load conditions. During the ramping up of VIN, the device transitions from pulse width modulation (PWM) to PFM mode if there is no load (or light load) at the output. In order to enter the PFM mode, the VIN has to be high enough such that there is enough energy delivered to the output capacitor. Once the output capacitor is charged, the extra energy causes the FB node to slightly rise and trigger the converter to enter PFM mode.

2 "A" vs "non-A" Version

The difference between the A and non-A version of the devices is discussed in this section. This difference also applies to the whole family of parts (automotive Q1 grade) which includes the LM43600, LM43601, LM43602, LM43603, LM46000, LM46001, and LM46002. During the ramping up of VIN, in a non-A version of the device, there is more variation of the point where PFM mode is entered. In order to give a better picture of the statistics, Figure 1 and Figure 2 show the input voltage for PFM entry for a sample of 50 units.

Below is the statistical value of VIN PFM entry point for 50 units of LM43603-Q1 (non-A) operating in 200 kHz and 400 kHz.

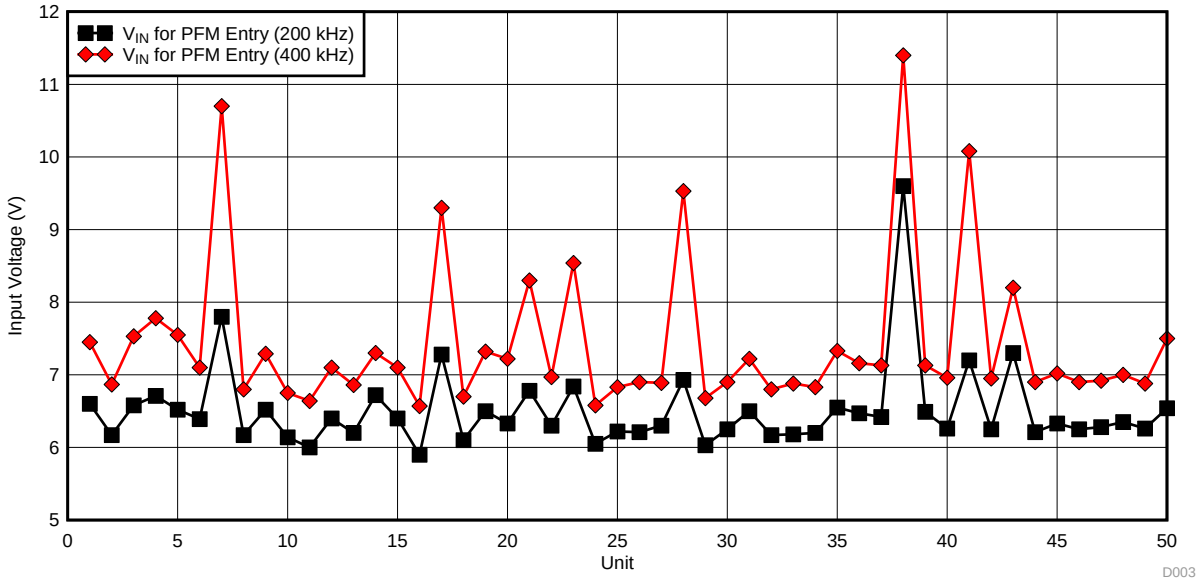

Figure 1. LM43603-Q1 PFM Entry Input Voltage for 5-V Output With 12.2-µH Inductor and 0.5-mA Standby Load

As for comparison, below is the test result for 50 units of the LM43603A-Q1 version

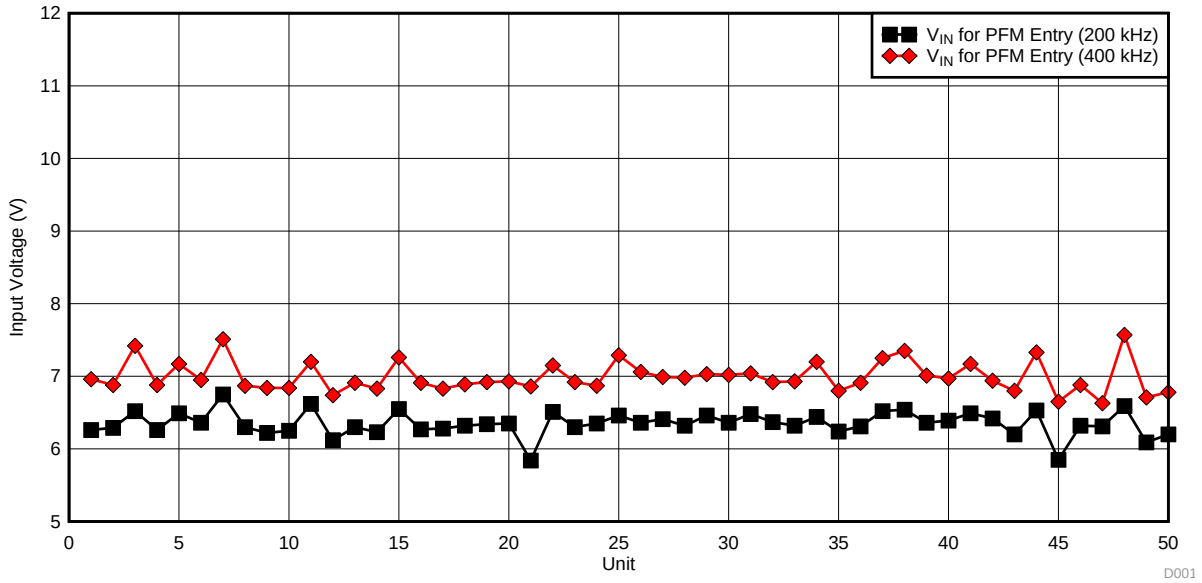

Figure 2. LM43603A-Q1 PFM Entry Input Voltage for 5V Output With 12.2-µH Inductor and 0.5-mA Standby Load

The tests above were done with 2 different RT resistor frequency settings (200 kHz and 400 kHz) with the same output voltage, inductor, and the same output capacitor. From Figure 1 and Figure 2 there are 2 important points to be noted. First, the device that operates at lower set switching frequency has a VIN PFM entry point lower compared with the same device that operates at a higher set frequency. Second, regardless of switching frequency, there are some units that have a VIN PFM entry point that is quite a bit higher compared to the rest of the other units.

The above points also hold true for the A version. However, the variation in the VIN PFM entry point is less with the A version than with the non-A version. All units in this case entered PFM at an input voltage below 8 V. Therefore, given the same BOM between the A and non-A version of the device, the A version has less variability of the VIN PFM entry point.

3 Application Information

For customers that require a low operating input current at light or no load, and low input voltages, the A version is the best choice. If these considerations are not a concern in a given application, then the non-A version is adequate.

Figure 3 and Figure 4 show a comparison of the input current for the A and non-A version of the device. The operating condition are as follows:

- Input voltage = 8.5 V
- Output voltage = 5 V
- Output standby load = 0.5 mA
- Switching frequency setting = 200 kHz
- Same BOM for both versions

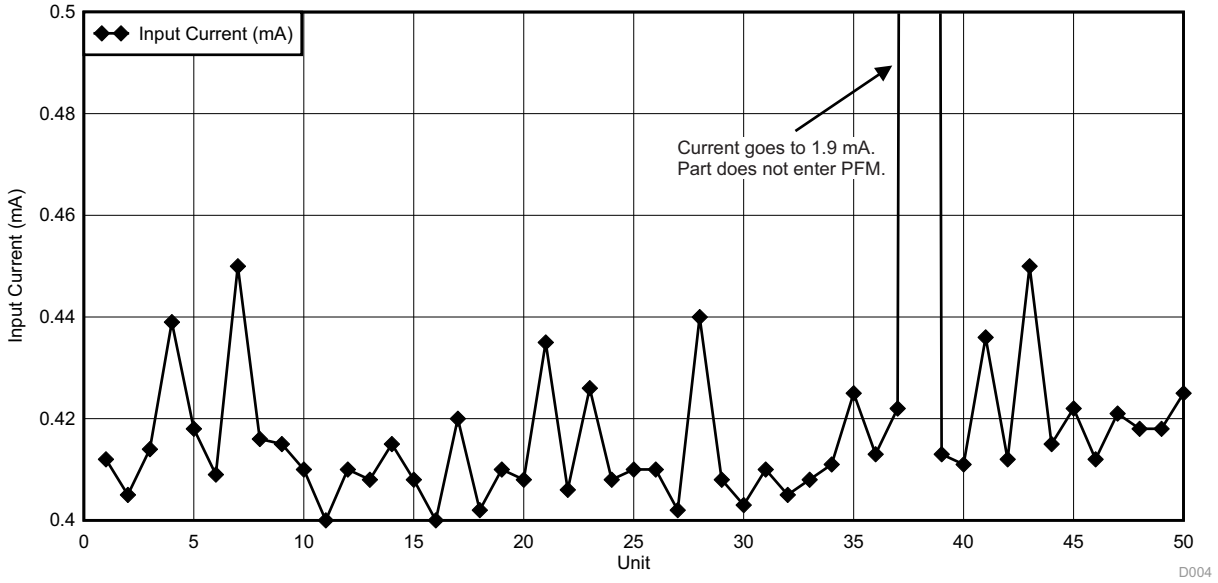

Figure 3. LM43603-Q1 Input Current at 8.5 V^{IN} and 5 V_{OUT} With 0.5-mA Standby Load

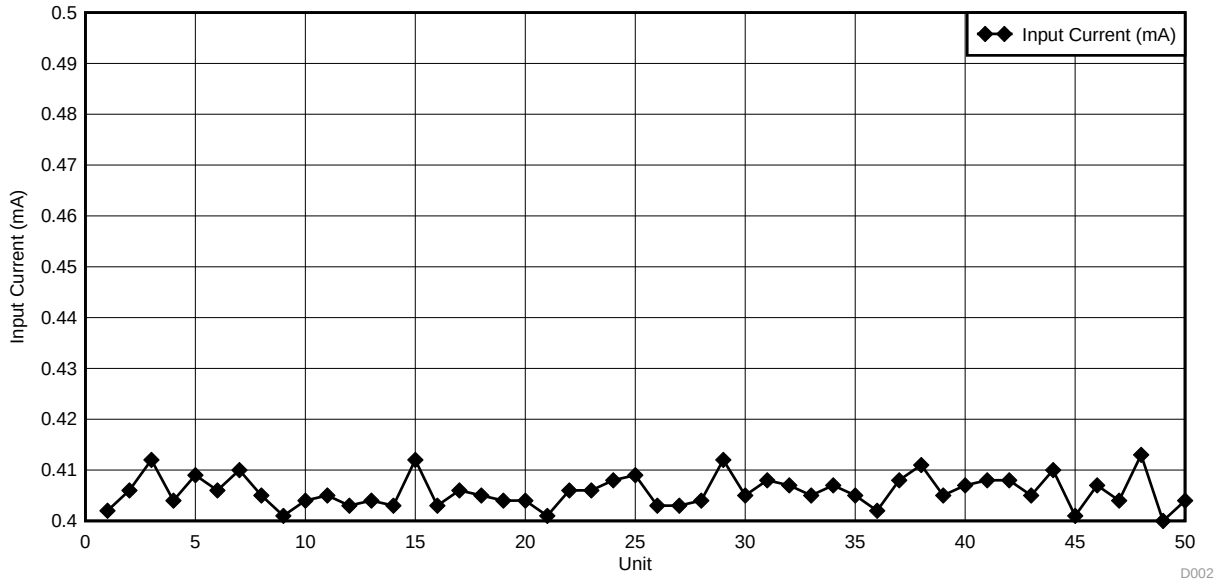

Figure 4. LM43603A-Q1 Input current at 8.5 V_{IN} and 5 V_{OUT} with 0.5-mA Standby load

Thus, as seen from Figure 4 the input current for the A version of the device stays below 0.5 mA, maintains high efficiency at light load condition.

4 Summary

Based on the test results above, there are some conclusions that can be deduced:

- Whether it's an A or non-A version, the VIN PFM entry point is lower when the device is set at lower switching frequency (200 kHz compared to 400 kHz).
- All the devices eventually enter PFM mode at light load.
- The A version of the devices minimize the variation of PFM entry point compared to the non-A version.

Some factors that affects the VIN PFM entry point:

- Output Loading. A higher output load makes it harder to enter PFM because the output load will navigate the current away from the output capacitor, hence there is no excess energy to cause the FB node to slightly rise and trigger PFM mode.
- Switching Frequency. As also shown on the test results above, operating the part at a lower frequency shifts the PFM entry point lower.

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