CTM Magnetics
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Subject: High Frequency Filtering
Application: HighSine™ Sine Wave Filters
Case Study: Upgrading to PM Motors

STOP SAYING, "WE MADE IT WORK". BETTER SOLUTIONS EXIST.

Solving The Distortion Problem:

High frequency PM motor applications lead to higher harmonic distortion for the entire motor drive system. To account for this you can either reduce the harmonics by derating your VFD, increasing the drive cost and size, or derate your PM motor so that it can absorb the elevated harmonics while maintaining the desired HP rating. Either way, the CAPEX of your system will increase substantially, figure 1 below.

Conventional sine wave filters can take 15% THID from the VFD and filter it to 5% THID. The problem with adding a contemporary sine wave filter is that the cost of the filter is often greater than the cost to derate the PM motor.

CTM sine wave filters are different. Due to superior filtering capabilities, **CTM FlexSine® and HighSine™ filters are able to reduce drive harmonics from 35% THID to 5% THID**. The 35% to 5% relationship of the VFD/SWF/Motor will Lower CAPEX (investment), OPEX, and reduce the system's overall size and weight without introducing additional common mode noise (figure 2 below). Optimize your motor drive system today by adding a CTM FlexSine® or HighSine™ filter.
The following 3 pages compare field data from our HighSine 350 (350Hz) filter to competitor field data.

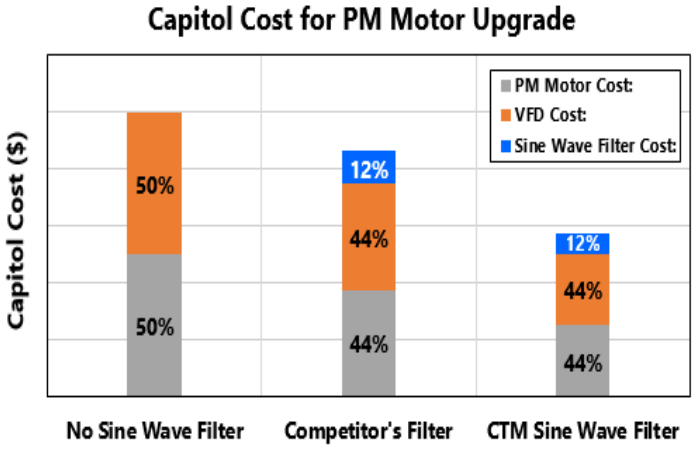

Figure 1. Cost Breakdown for PM Motor Upgrade

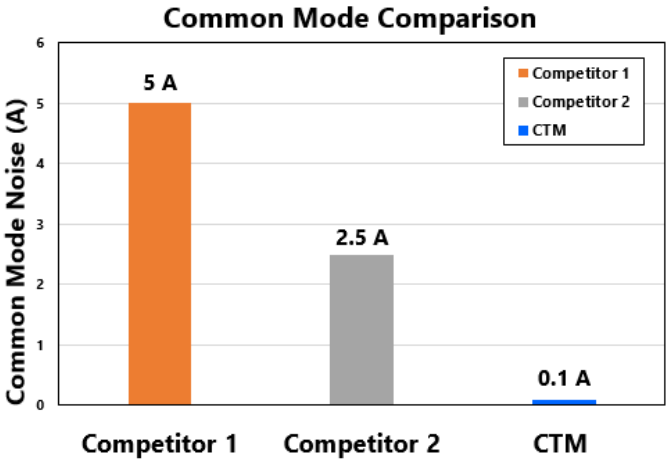

Figure 2. CTM vs. Competitors' Common Mode Noise

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HIGHSINE™ FIELD DATA

Performance Results:

Figure 3 shows the data from one of our 420 A HighSine™ 350 Hz sine wave filters. The switching frequency of the drive was 5 kHz, and the motor was running at 90% load. The total harmonic distortion coming out of the drive was measured at 28.5% THID. The total harmonic distortion going to the motor was measured at 2.3% THID.

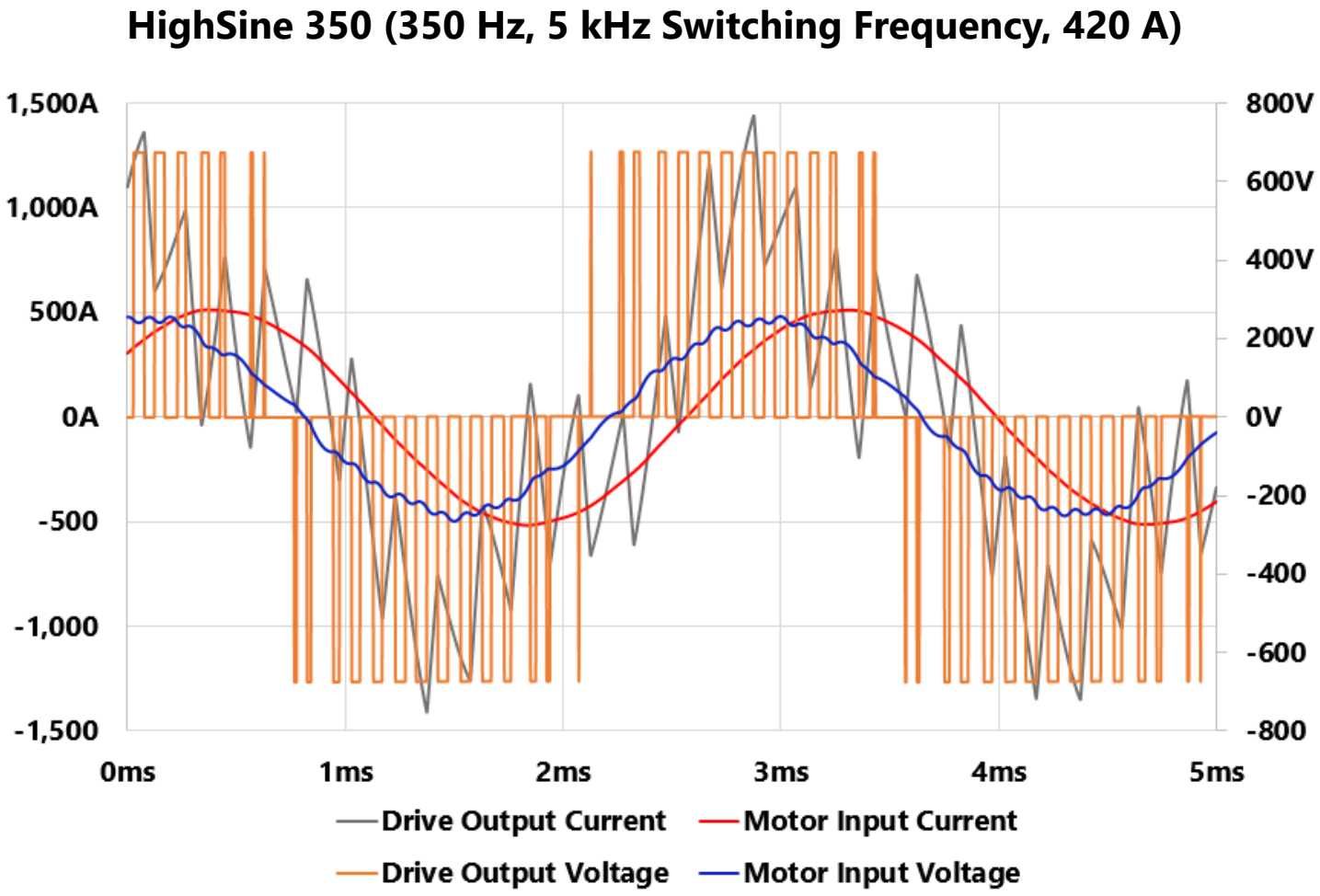

Figure 3. CTM HighSine 350 (420 A) Filter Performance

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HIGHSINE™ FIELD DATA

Harmonic Filter Reduction:

Figures 4 through 6 compare the filter performance of CTM's HighSine 350 filter against 2 other market standard high frequency sine wave filters. The data was provided by a customer who ran an identical test against all three sine wave filters. Without a derate, the THID coming out of the drive typically sits around ~30%. Note that the THID of both competitor filters was measured to be higher than the THID produced by the drive. This was due to the filters resonating and amplifying the harmonics. Competitor 2's load, figure 6, was significantly lower than the others due to the amount of additional harmonics created by the filter. It is important to note that lower amperage applications, and partial load conditions, can elevate the THD of the motor drive system.

After reviewing the test results, CTM identified the root cause of the harmonics shown encircled by the red bubble, on figure 4. The harmonics at that location were caused by the cable lengths connecting the inductor to the capacitor portion of the filter. It is for this reason CTM recommends our customers purchase an integrated panel package type as it reduces the length of the inductor to capacitor connection cables. This, in turn, increases the filter's performance. Additionally, CTM is able to reduce the harmonics even further by adding dampening resistors. This, however, is not always beneficial as there is increased power loss and capitol cost when you add resistors to your filter.

CTM HighSine filters are able to filter out more harmonics than any of our competitors. If your are looking at upgrading your existing induction motor to a high frequency or permanent magnet motor, CTM's HighSine product line is the best choice to meet all your filtering needs.

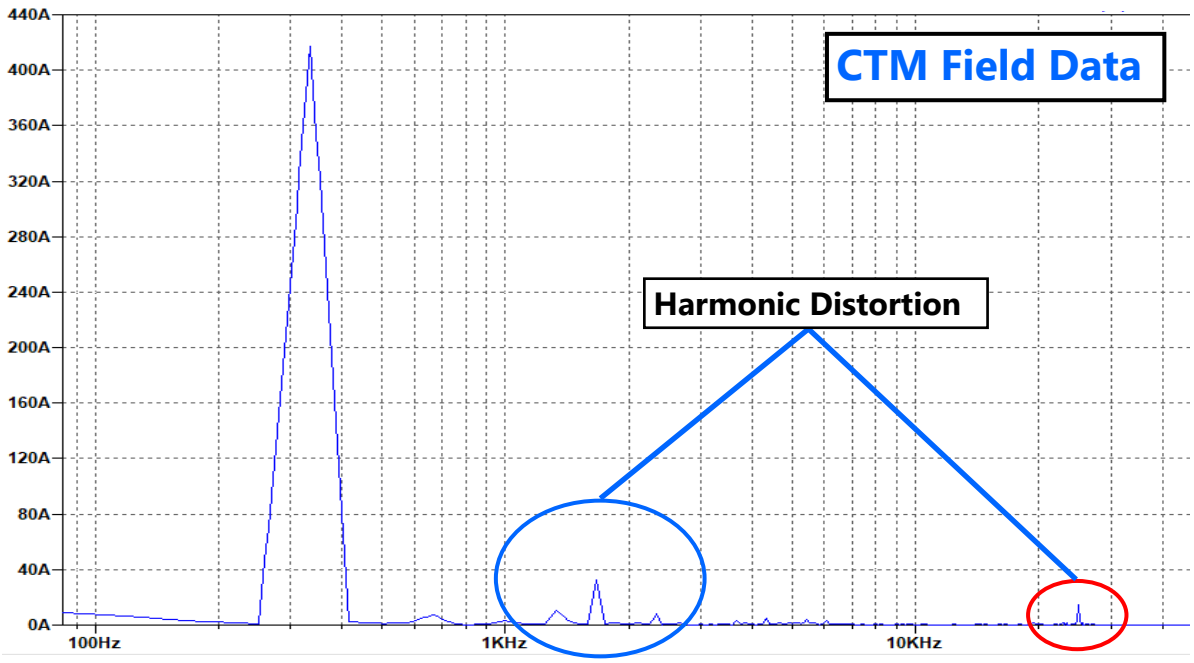

Figure 4. CTM HighSine 350 (420 A) Filter Output To Motor **(11% THID) @ 71% Load**

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COMPETITOR FIELD DATA

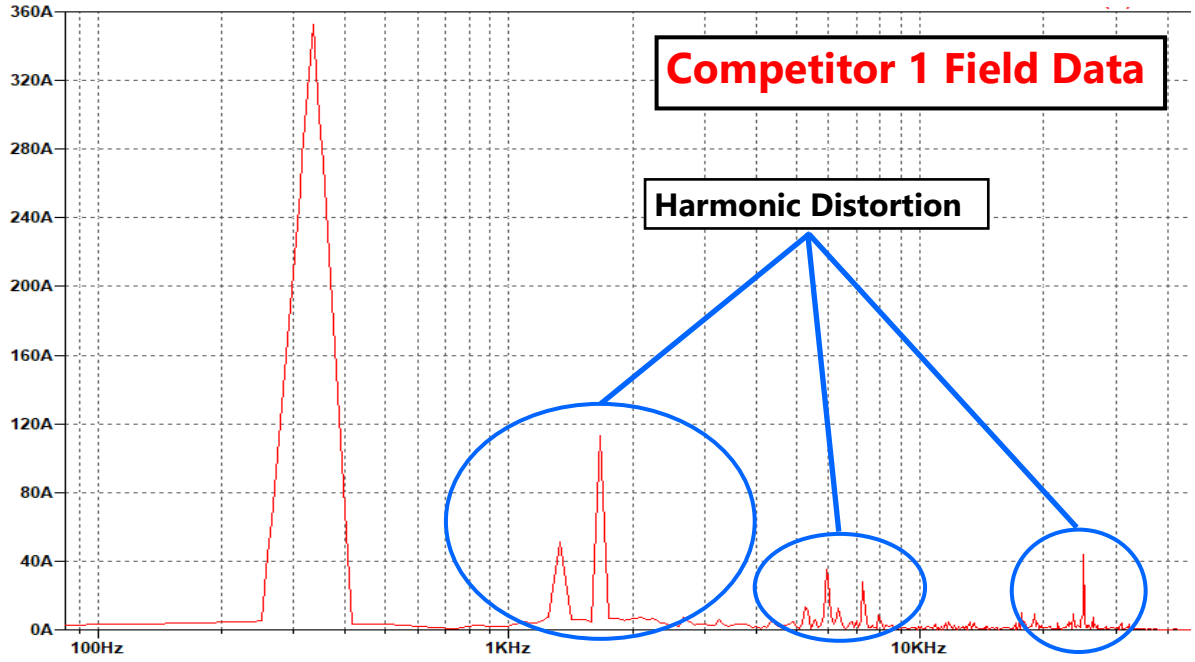

Figure 5. Competitor #1 (333 Hz - 420 A) Filter Output To Motor **(40% THID) @ 65% Load**

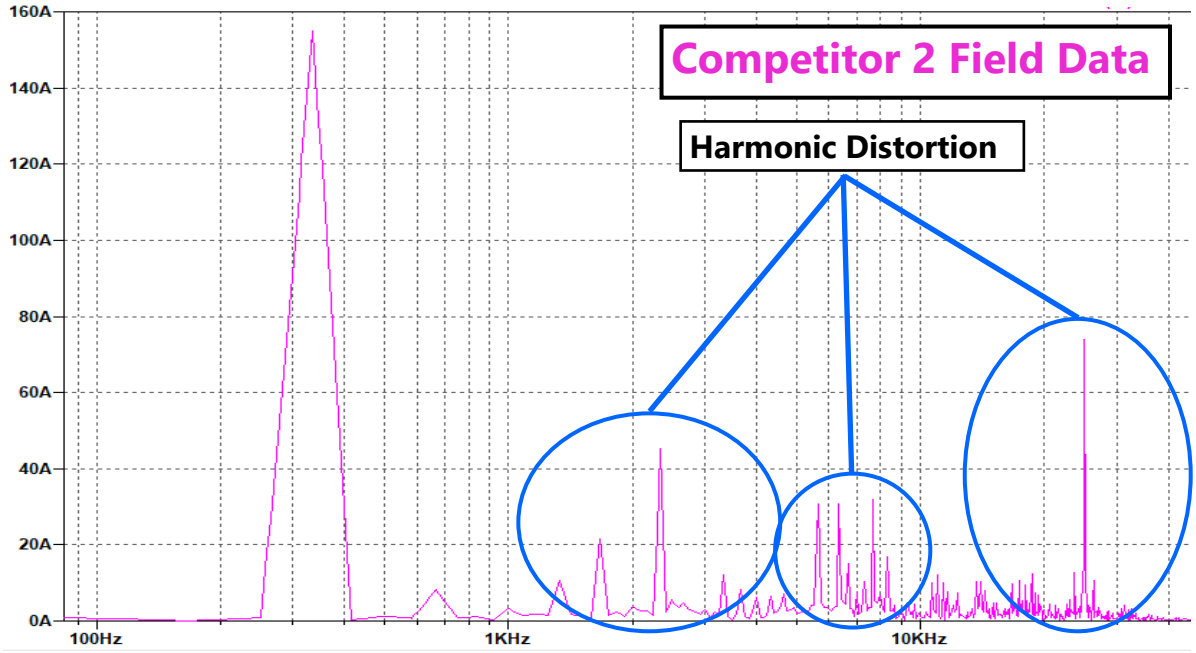

Figure 6. Competitor #2 (333 Hz - 420 A) Filter Output To Motor **(75% THID) @ 32% Load**