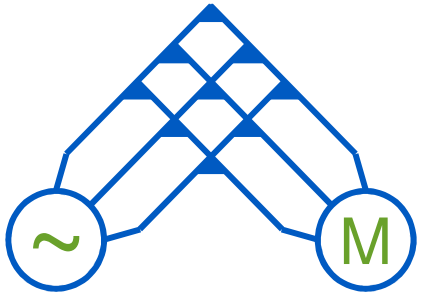
U1000 Matrix Drive

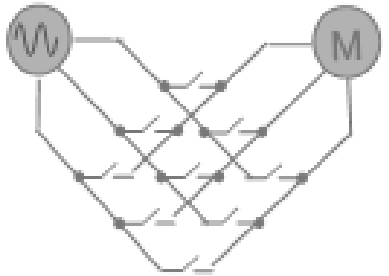
A NEW CHAPTER IN ENERGY SAVING AND POWER QUALITY

- with Direct AC to AC Conversion



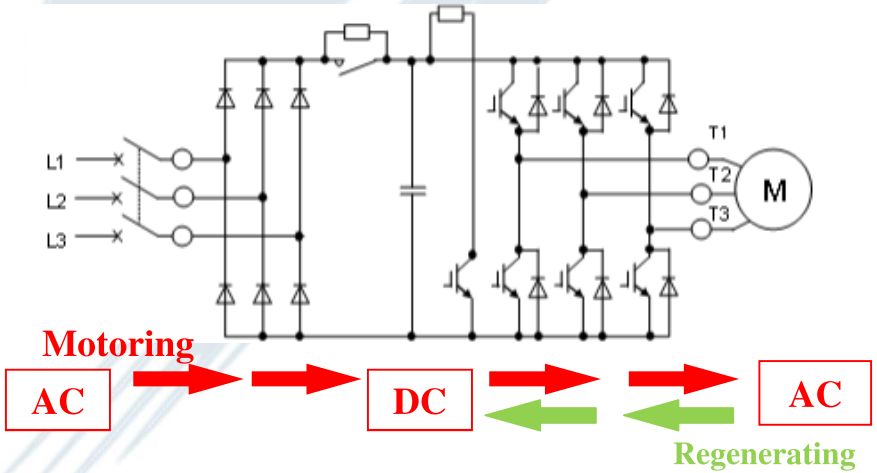
Matrix Theory

- The Matrix Drive creates precise control of voltage and frequency from 3ph AC power by connecting 9 bi-directional switches like a matrix.
- Differing from conventional drives, the Matrix Drive has no DC link circuit with diode and main capacitor, thus resulting higher efficiency.
- Typical harmonics associated with charging and discharging of DC link capacitors is not present with the Matrix drive.
- The Matrix Drive can return power during regeneration which can be re-used by loads connected to the same power source.

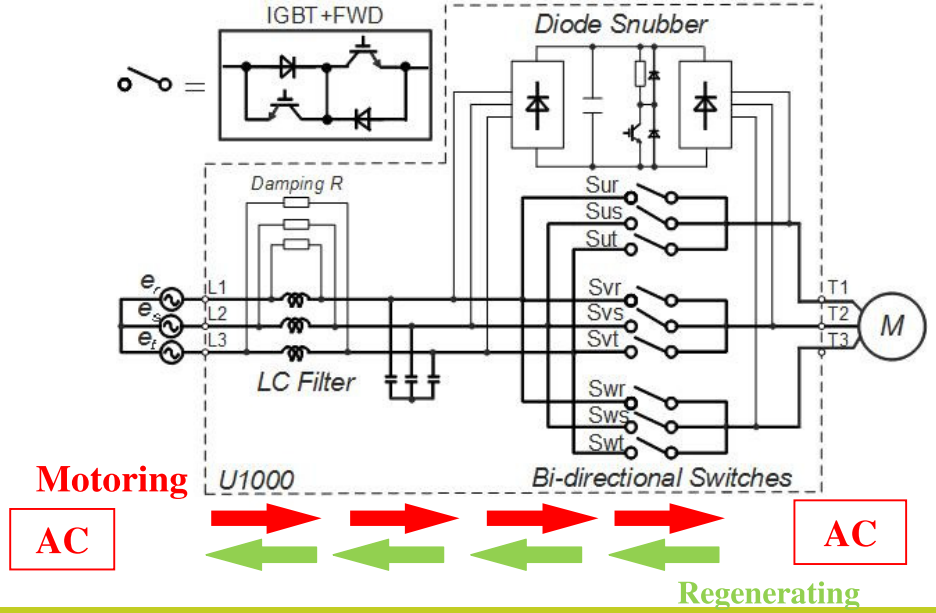


【9 bi-directional switches】

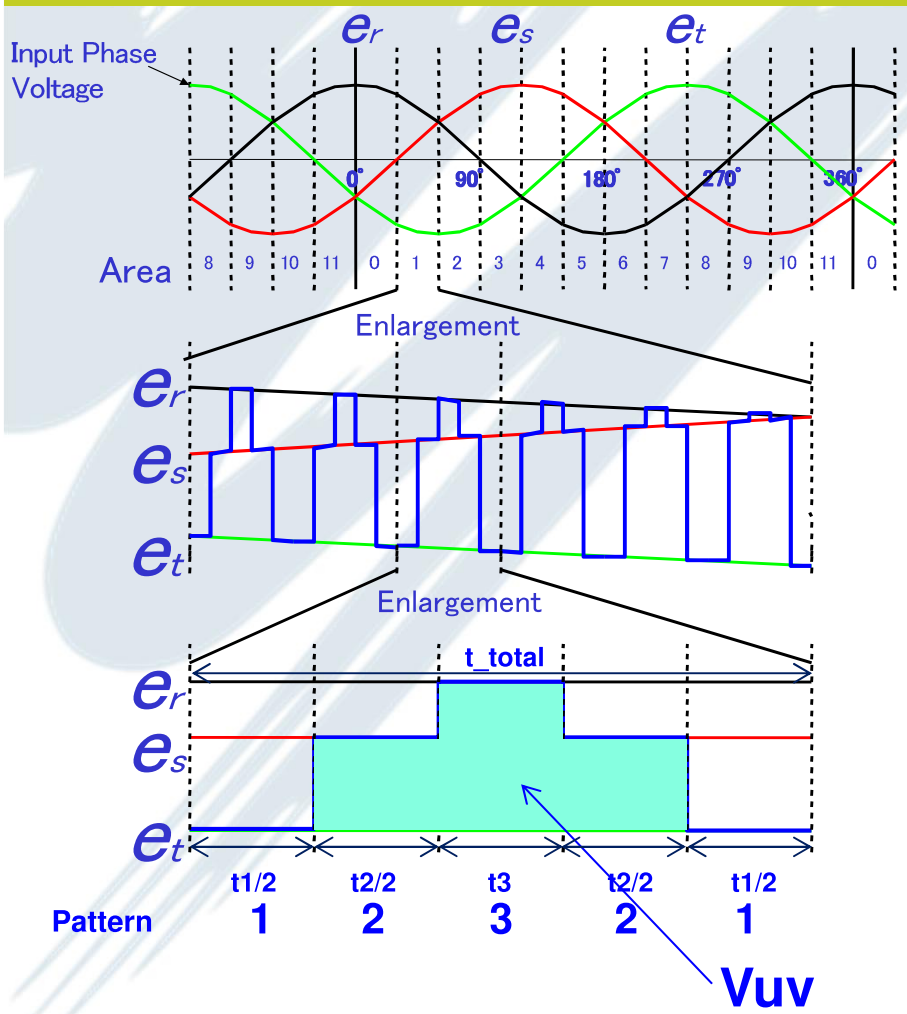
【Circuit configuration - general-purpose drive】



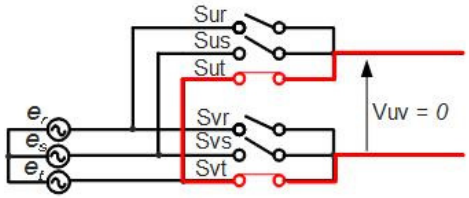
【Circuit configuration – U1000 Matrix】



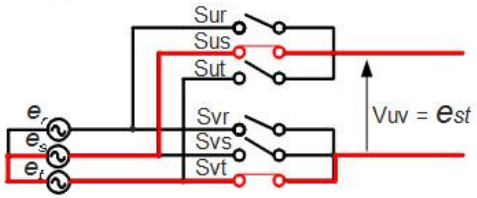
Matrix Theory



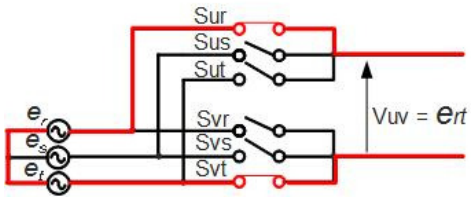
Pattern1



Pattern2



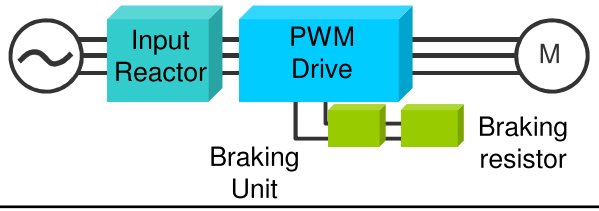
Pattern3



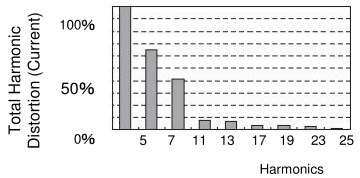
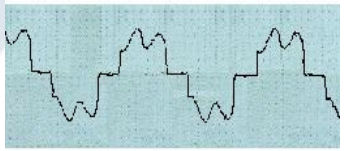
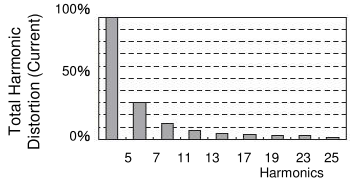
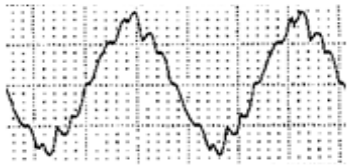
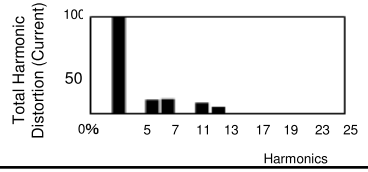
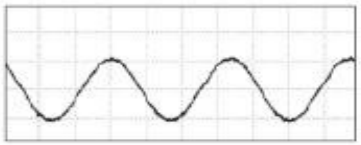
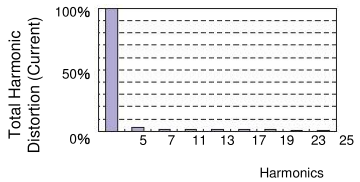
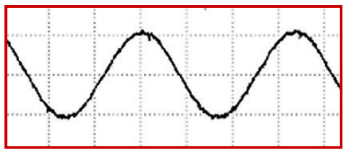
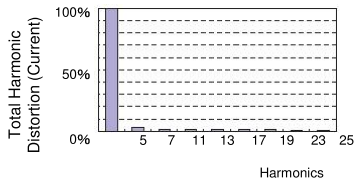
Vuv = (est * t2 + ert * t3) / t_total

- **Each output phase is generated by switching between all 3 input phases.**
- **3 levels are always being produced, but 1st step (e_s) varies between 50% and 100% magnitude**

Comparison to Conventional Drives

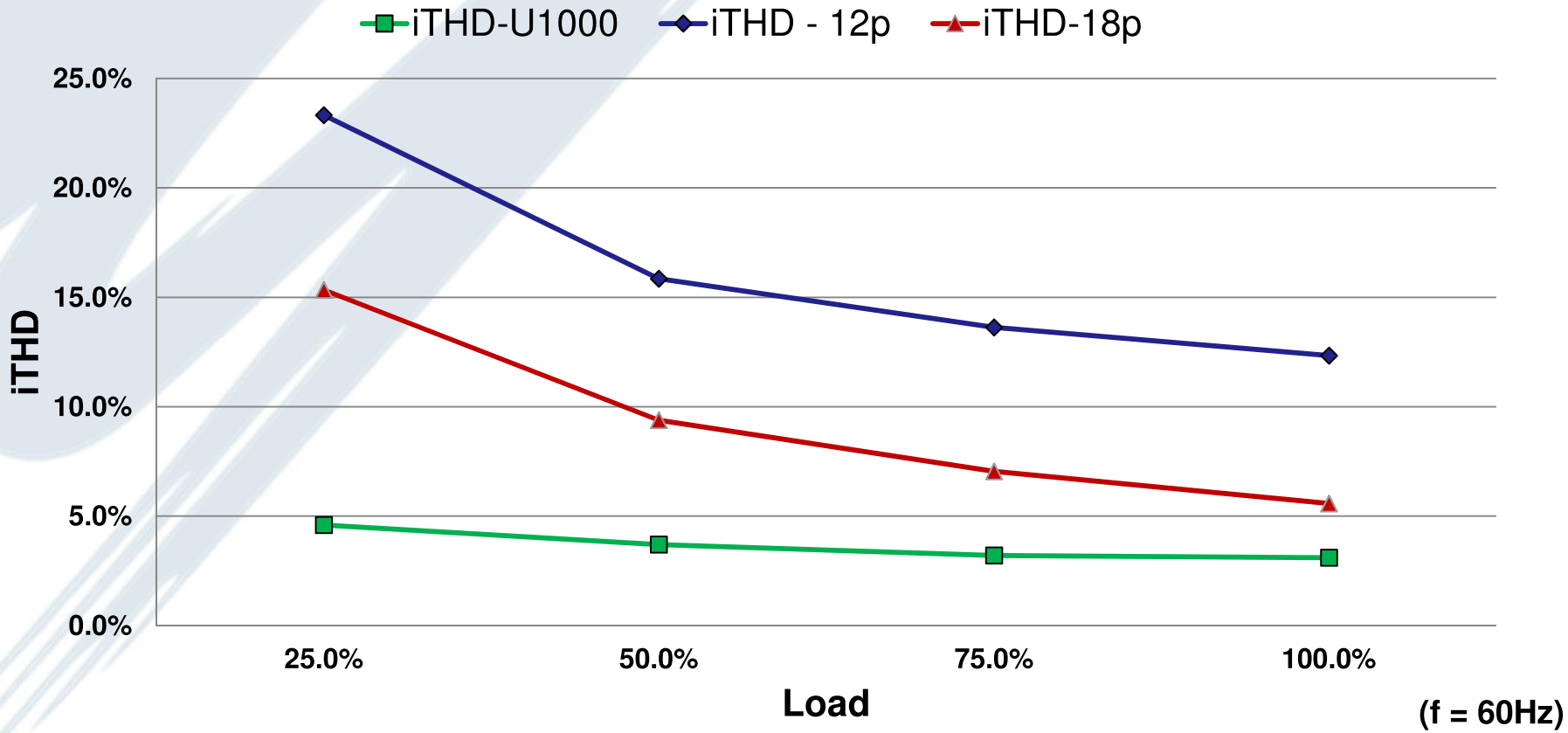
U1000		****	****	****	****	****
Active Front End + General-Purpose Drive		****	****	***	****	**
General-Purpose Drive		**	**	***	*	**

Harmonic Performance Comparison

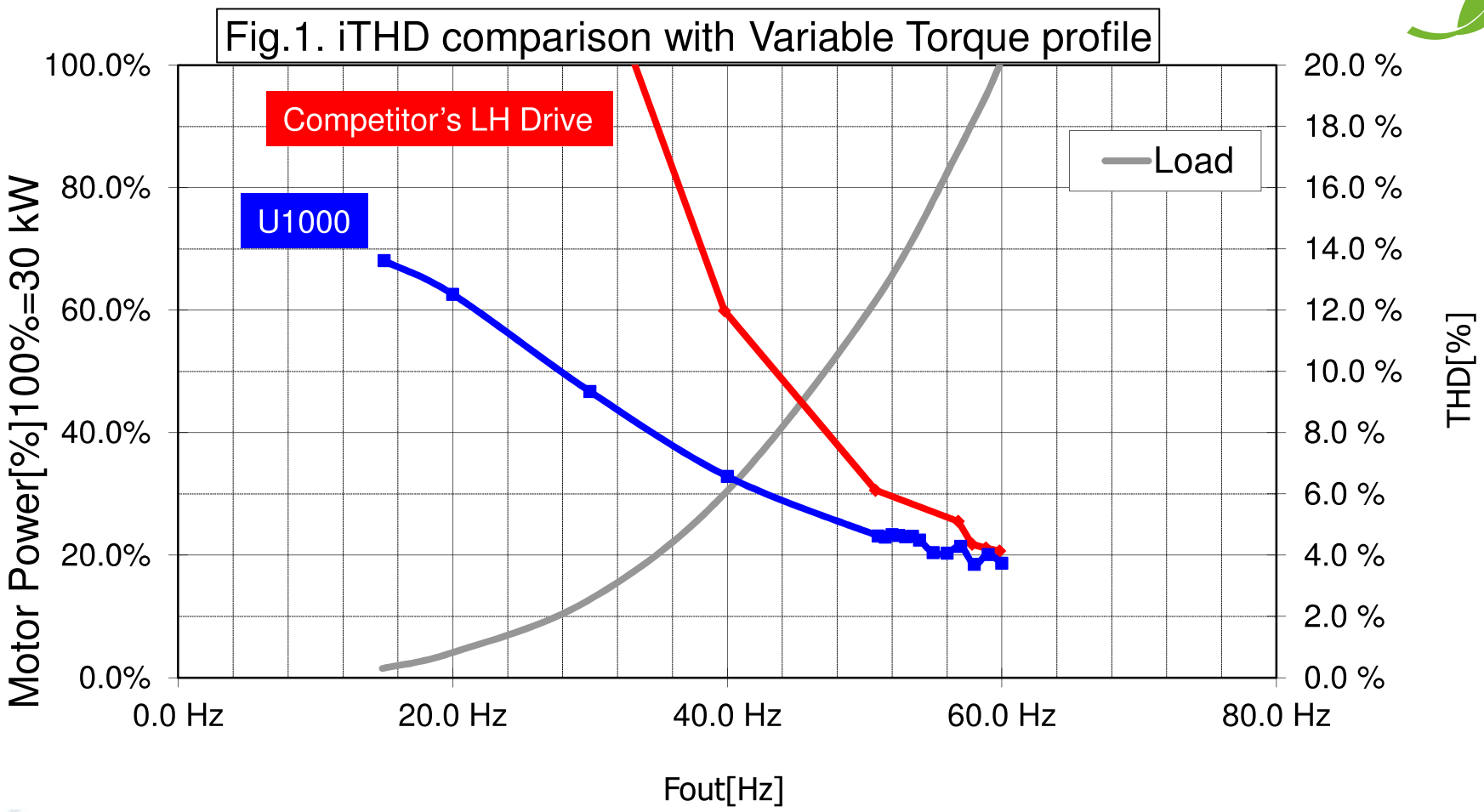
	Current Waveform	Current Spectrum	iTHD
AC drive without reactor			~ 80%
AC drive with DC reactor			~ 40%
AC drive with multi-pulse			6 - 12%
AC drive with AFE			≤ 5%
U1000 Matrix			≤ 5%

Harmonic Performance Comparison (U1000 vs. Multi-Pulse)

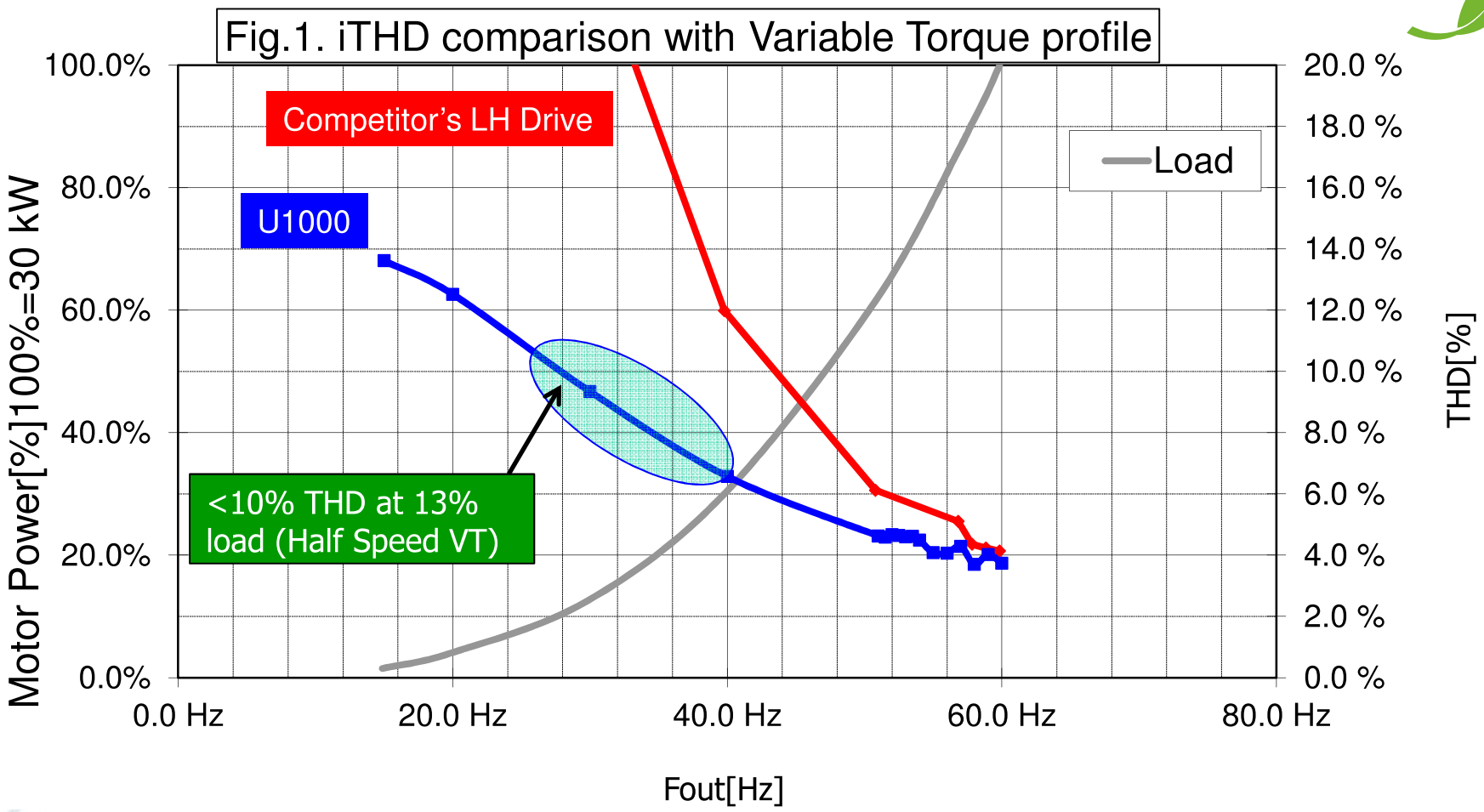
Excellent low harmonic performance is possible over a wider load range compared to Multi-pulse configurations.



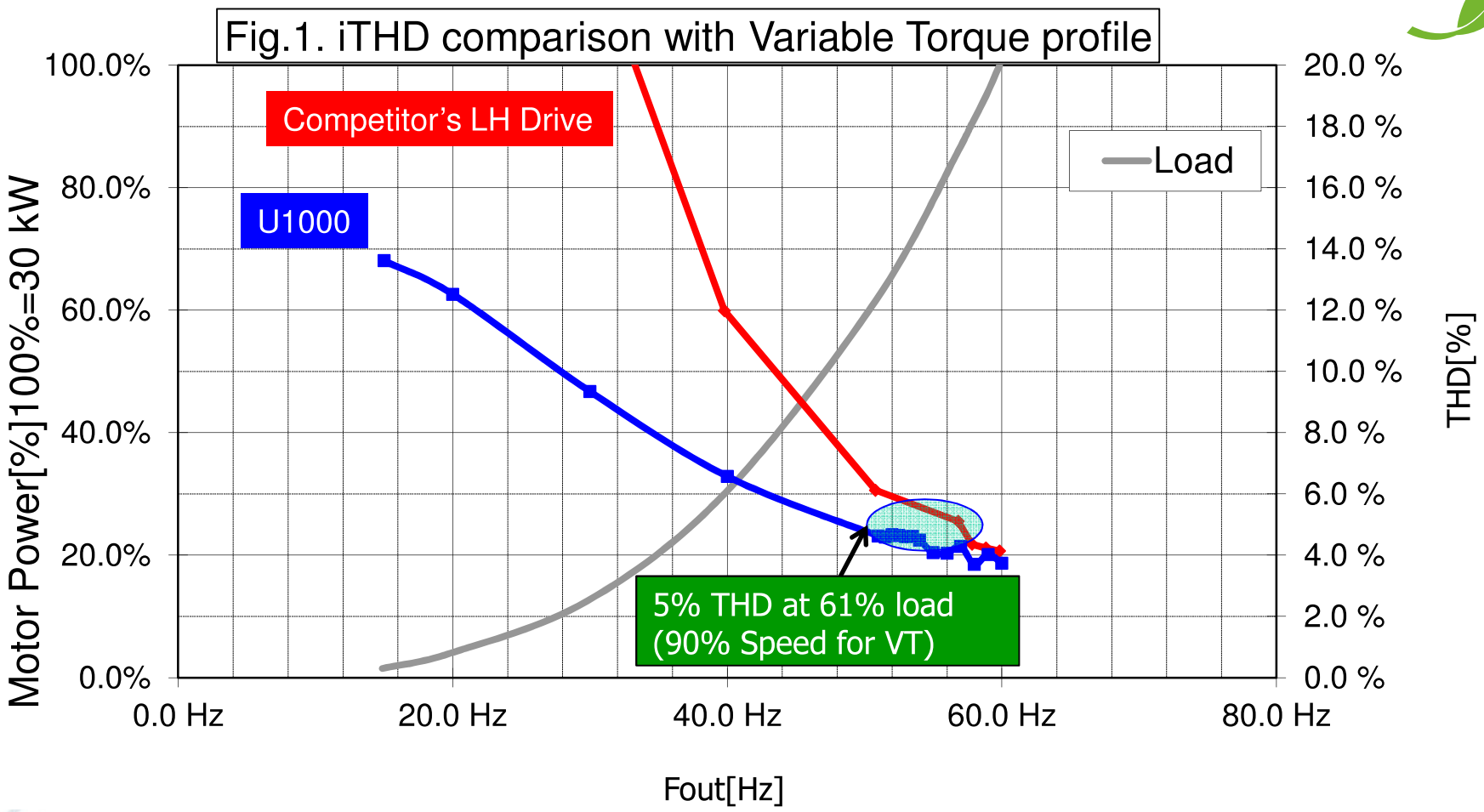
Harmonic Performance Comparison (U1000 vs. Competitor)



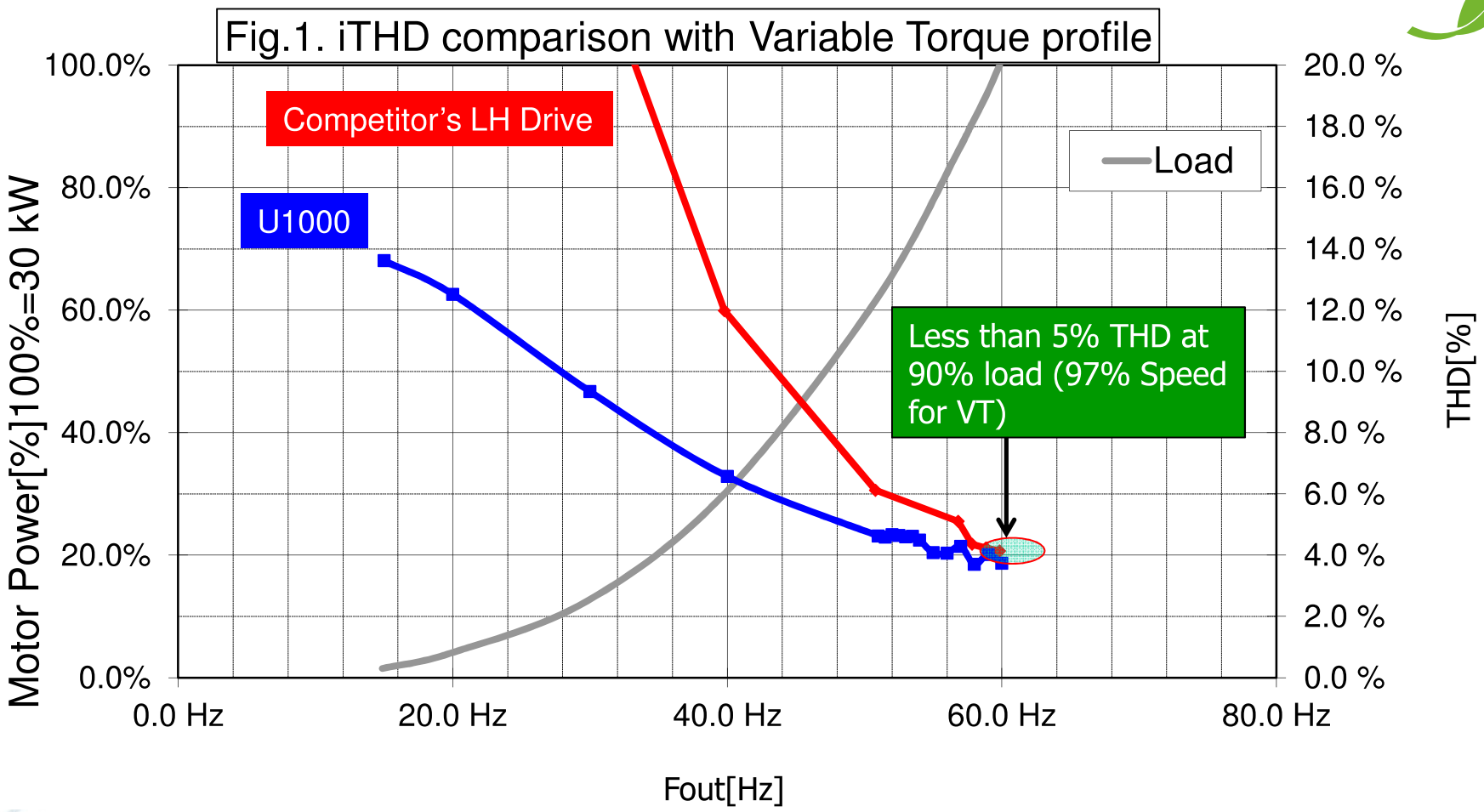
Harmonic Performance Comparison (U1000 vs. Competitor)



Harmonic Performance Comparison (U1000 vs. Competitor)

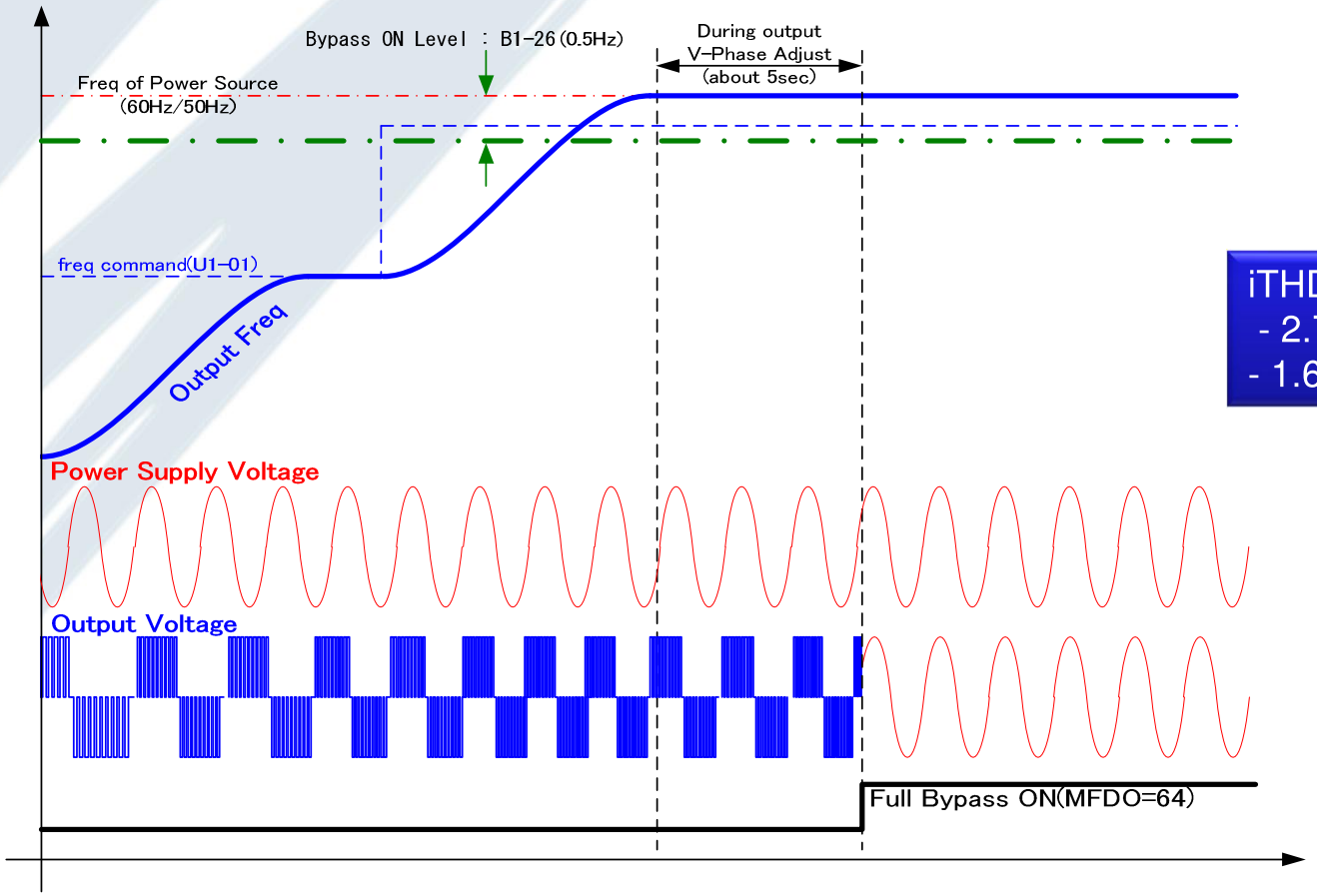


Harmonic Performance Comparison (U1000 vs. Competitor)



ECO Mode – Transfer to Power Supply

The output frequency approaches the frequency of the power supply, the drive device is switched to full bypass mode.



iTHD:
- 2.7% (15HP)
- 1.6% (60HP)

ECO Mode– Transfer to Power Supply

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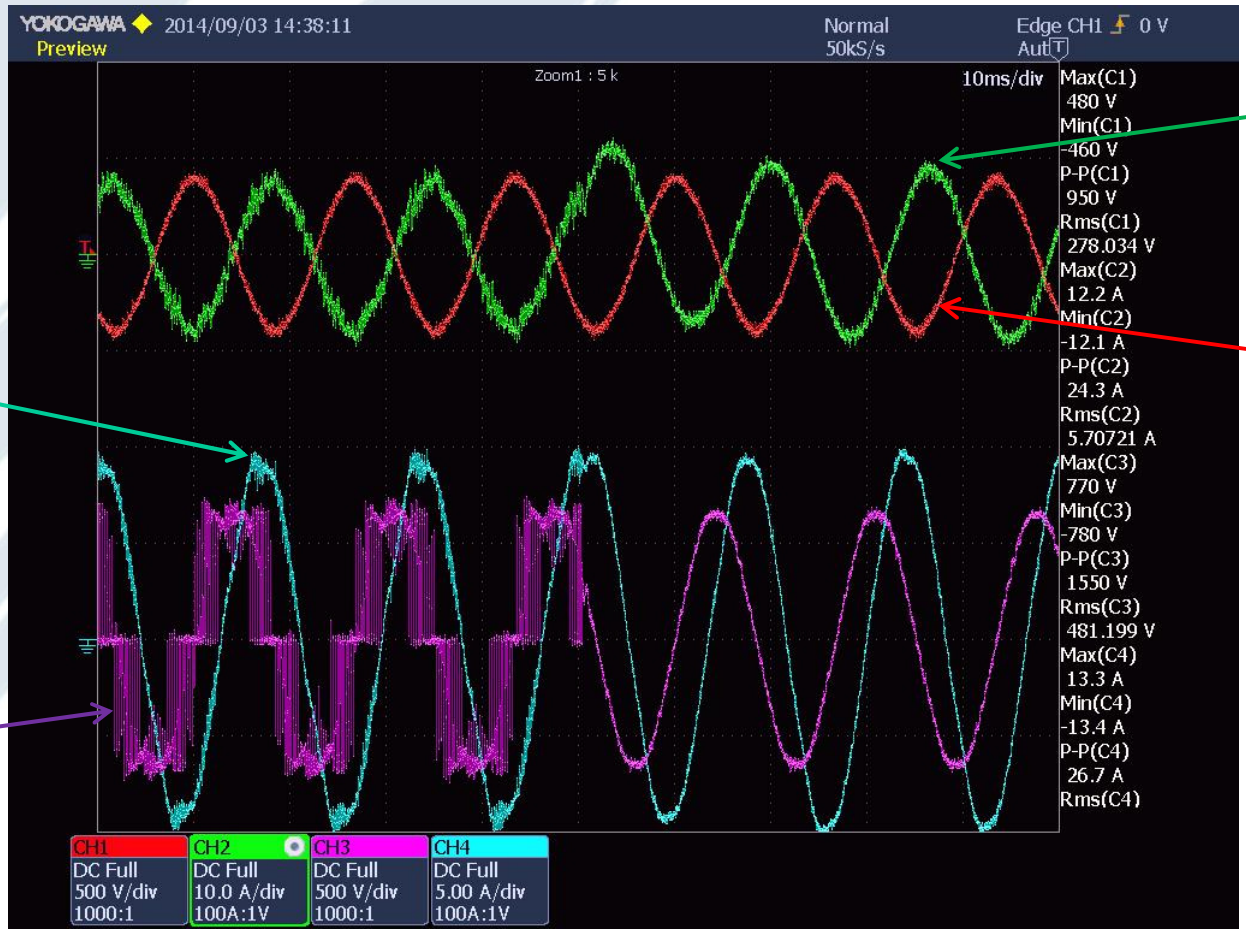


Input Current

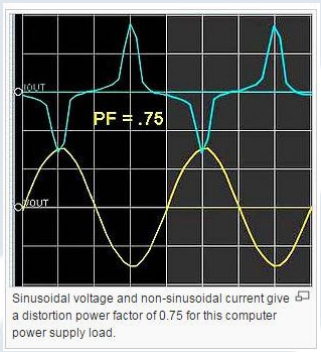
Input Voltage

Output Current

Output Voltage

True Power Factor – Definition

The distortion power factor describes how the harmonic distortion of a load current decreases the average power transferred to the load.



Sinusoidal voltage and non-sinusoidal current give a distortion power factor of 0.75 for this computer power supply load.

$$\text{distortion power factor} = \frac{1}{\sqrt{1+\text{THD}_i^2}} = \frac{I_{1,\,\text{rms}}}{I_{\text{rms}}}$$

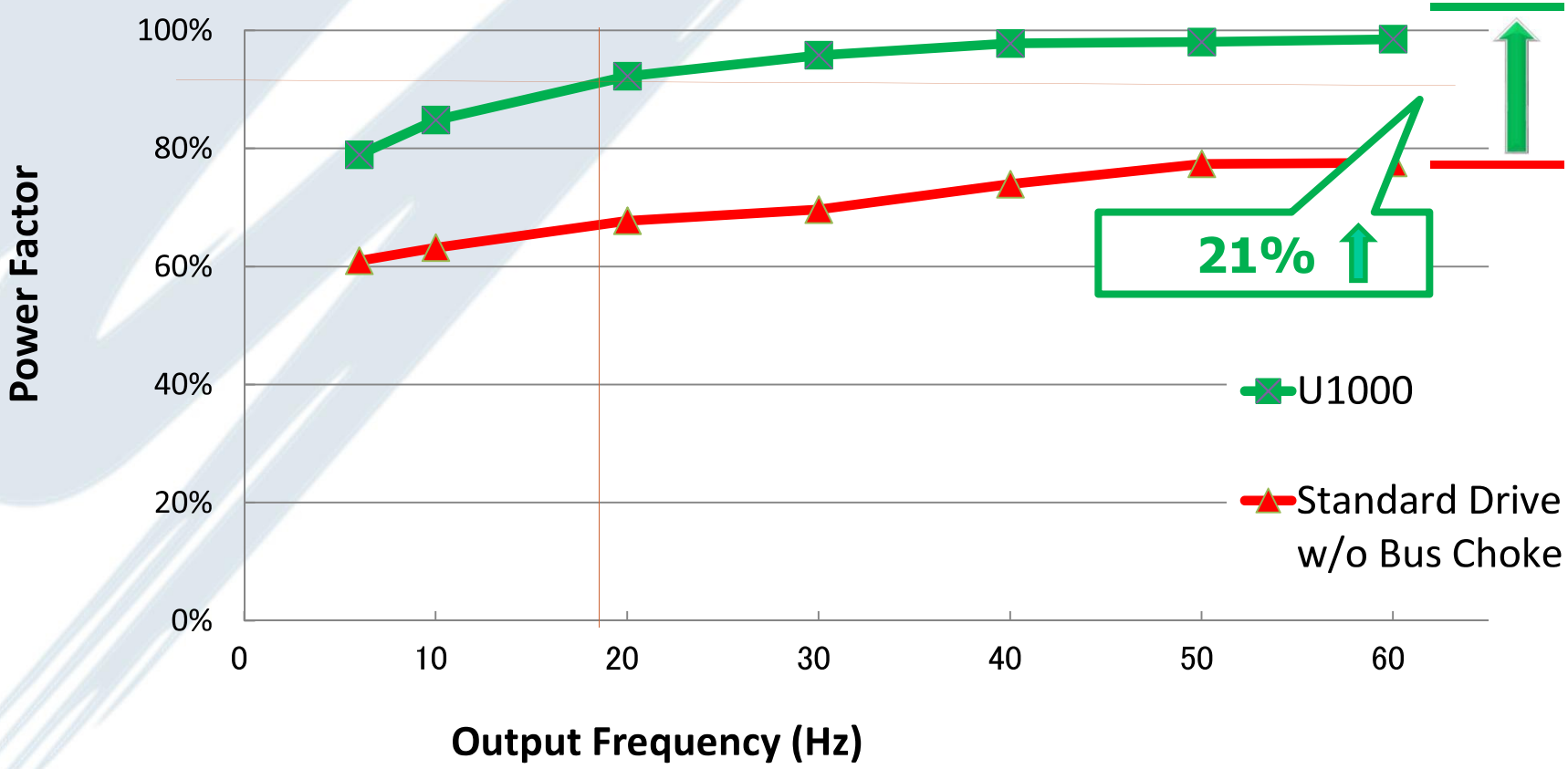
THD_i is the total harmonic distortion of the load current. I_1rms is the fundamental component of the current and I rms is the total current

The result when multiplied with the displacement power factor (DPF) is the overall, true power factor or just power factor (PF):

$$\text{PF} = \text{DPF}\frac{I_{1,\,\text{rms}}}{I_{\text{rms}}}$$

True Power Factor – U1000 vs. Standard Drive

Power Factor is improved by approximately 21% over a standard 6-pulse drive.



Efficiency Comparison – Matrix versus Conventional AFE