

Advanced Harmonic Solutions For Harmonic Current Distortion

Highly Efficient, System-Designed Solutions for Harmonic Distortion

Introducing Danfoss Advanced Harmonic Solutions (AHS)

Danfoss now offers a compact, cost-effective and completely integrated system solution for the growing number of applications in which IEEE 519-1992 guidelines need to be addressed. Advanced Harmonics Solutions seamlessly combine the reliability and performance of Danfoss VLT® Series drives with innovative new technology in a single package. The result is a complete solution that has been perfectly matched for optimal performance.

Advanced Harmonic Solutions can include any of the following VLT Series drives:

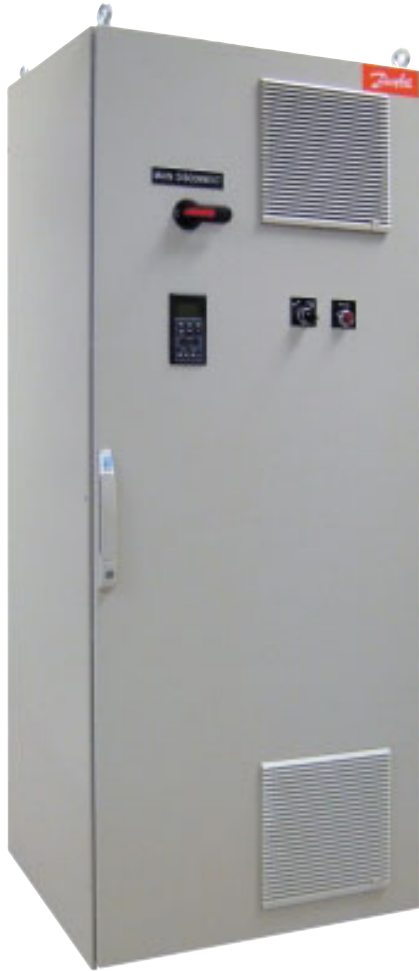
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|------------------------|-----------|-----------|
| • VLT 4000 VT | 40-600 HP | 380-600 V |
| • VLT 5000 / 5000 FLUX | 40-600 HP | 380-600 V |
| • VLT 6000 HVAC | 40-600 HP | 480-575 V |
| • VLT 8000 AQUA | 40-600 HP | 380-600 V |

Danfoss has a long history as a market leader in both the VFD and panel industries:

- In 1968, Danfoss introduced the VLT 5, the first commercial VFD on the market. The VLT Series tradition continues to this day: the VLT 5000 for Industrial Process; VLT 6000 for HVAC; and VLT 8000 for Water/Wastewater.
- Danfoss was also the first to offer an integral panel solution in 1979: a VFD with a contactor bypass. In the quarter-century since, our panel business has expanded into a full spectrum of integrated solutions to meet our customers' widely varying and demanding application requirements.

Danfoss Advanced Harmonic Solutions follow these groundbreaking traditions by providing highly efficient current distortion reduction in a simple and compact system.





Danfoss AHS: A Clear Advantage

Performance Advantages:

- Meets or exceeds IEEE 519-1992 guidelines for current distortion limits for VFD installations
- Equal or superior performance and cost competitive compared to 12- and 18-pulse rectifiers
- Engineered drive, harmonic reduction, bypass, and disconnect in one compact NEMA 1 or 12 enclosure
- Flexible installation configurations with dramatic size and weight advantages over other harmonic filtering solutions

Panel Options and Configurations

- Fused/disconnect panel and bypass panel configurations
- 2- or 3-contactor bypasses
- Common start/stop
- Undervoltage relay
- Dual motor selection
- Variety of fuse and disconnect options
- Control switches
- Indicator lights
- Meters
- System communications
- Auxiliary enclosure for customer-supplied equipment
- Multiple drives in a single enclosure

Compact Enclosure Sizes*

AHS NEMA 1 and NEMA 12 enclosures are among the most compact in the industry:

HP	H x W x D (inches)
30-75	75 x 32 x 20
100-125	75 x 48 x 20
150	75 x 48 x 24
200-300	83 x 48 x 24
350	83 x 80 x 24
450-600	83 x 96 x 24

* Consult factory for exact dimensions.

What is harmonic distortion?

Harmonics are deviations from ideal current and voltage waveforms. In general, harmonic distortion occurs in non-linear loads, where AC voltage is converted to DC voltage. Examples include power supplies, UPS systems, and the rectifiers of VFDs.

Aside from efficiency and heat dissipation issues, there are regulatory guidelines that may or must be addressed. IEEE 519-1992 are widely accepted guidelines used in North America for total harmonic distortion limits. Compliance with these guidelines are required of large consumers and are increasingly being applied to low voltage systems as well.

Harmonic current distortion is an influence on these distortion limits. If not managed properly, harmonic distortions can cause overheating of components, including the supply transformer, switchgear, and cables.

These harmonic current distortions flowing back into the AC line can cause harmonic voltage distortion, which can interfere with and eventually damage equipment connected to the same line. The guidelines for current distortion limits are expressed in Table 10.3 of IEEE 519-1992:

Table 10.3 General System Current Distortion Limits (Maximum % of I_1)

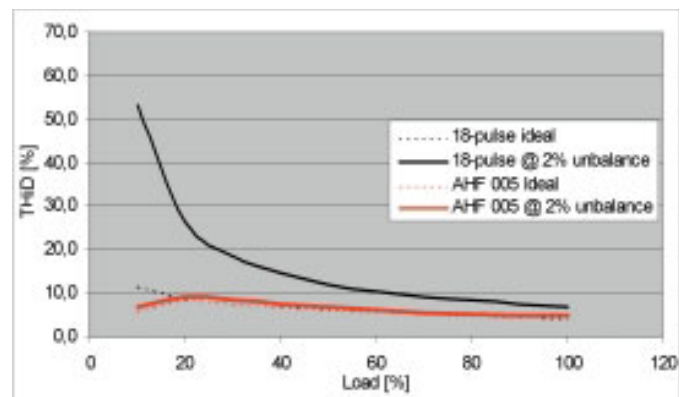
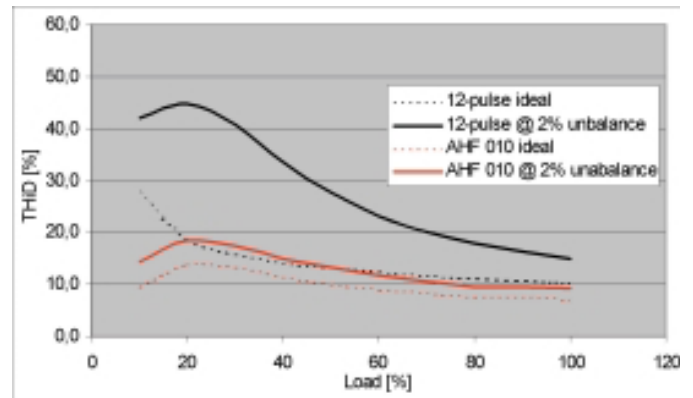
Individual Harmonic Order	Maximum % of I_1					
	$I_{sc} < 20$	<11	11h<17	17 h<23	23 h<35	35 h TDD
$I_{sc} < 20$	4.0	2.0	1.5	0.6	0.3	5.0
20-50	7.0	3.5	2.5	1.0	0.5	8.0
50<100	100.0	4.5	4.0	1.5	0.7	12.0
100<1000	12.0	5.5	5.0	2.0	1.0	15.0
>1000	15.0	7.0	6.0	2.5	1.4	20.0

Where I_{sc} = Maximum short circuit current at PCC (Point of Common Coupling)

I_1 = Maximum demand load current (fundamental frequency component at PCC)

The Best Solution...

With Danfoss Advanced Harmonic Solutions, harmonic current is reduced to less than 5% or 10%, depending on the system selected, and voltage distortion is typically reduced to less than 5%. Furthermore, the Danfoss system is specially designed to match Danfoss VLT Drive characteristics. Compared to other known harmonic reduction techniques, Danfoss AHS systems offer the best performance for the price:



Harmonic Reduction Method	THiD
3Ø 6-pulse rectifier	60% – 100%
3Ø 6-pulse rectifier with AC input line reactor	35% – 45%
Danfoss VLT with standard built-in DC-link reactor	<45%
12-pulse rectifier	10% – 15%
Danfoss AHS 10 Package (VLT with AHF 10)	<10%
18-pulse rectifier	4% – 7%
Active filters	3% - 8%
Danfoss AHS 05 Package (VLT with AHF 05)	<5%

Determining whether harmonics are an issue for your application

Current distortion relates specifically to the individual drive and equipment. Voltage distortion calculations require an understanding of the harmonic currents of the non-linear load and the system short-circuit impedance. It is not possible to predict the voltage distortion knowing only the drive's performance. Voltage distortion is a system performance parameter.

So how do you determine whether harmonics are or will be an issue?

Danfoss has the experience and knowledge to provide you with practical and realistic advice when it comes to your installation. Using the Danfoss MCT-31 Harmonics Calculation Tool, we can quickly, completely and accurately estimate the harmonics in any facility.



The MCT-31 Harmonics Calculation Tool can save you time and money by forecasting how changes in your configuration will impact the overall system. Along with our application engineering staff, MCT-31 will help you specify the right VFD system the first time, and avoid costly mistakes and unnecessary equipment changes.

MCT-31 is available on our website: www.namc.danfoss.com

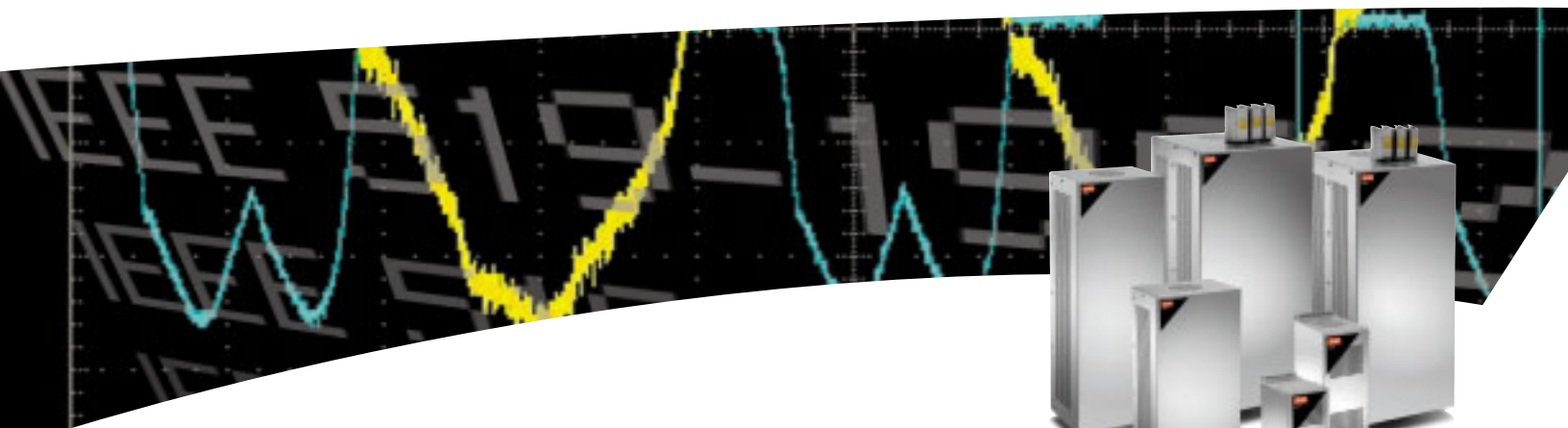
Danfoss



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AHF Series

Advanced Harmonic Filters

Danfoss AHF Series Advanced Harmonic Filters are available for our many drive product families:

- VLT® 4000 VT
- VLT® 5000 Process
- VLT® 5000 FLUX
- VLT® 6000 HVAC
- VLT® 8000 AQUA

As a cost-effective total solution, Danfoss Advanced Harmonic Solutions (AHS) packages combine the reliability and performance of VLT® Series drives with the innovative technology of AHF Series Filters.

AHF Advantages:

- Designed for matched performance with Danfoss VLT® Series drives
- User-friendly startup; no adjustment necessary
- Requires no routine maintenance
- Protects multiple drives with one filter
- Designed to address the current distortion limit guidelines of IEEE 519-1992
- AHF 10 has THiD < 10%; equal or superior performance and cost competitive compared to 12-pulse rectifiers
- AHF 05 has THiD < 5%; equal or superior performance and cost competitive compared to 18-pulse rectifiers
- Compact housing can be fit into a panel

Product Range

Line Voltage: 440-480 VAC (60 Hz)

Filter Current: 10A – 370A (for higher ratings, modules can be paralleled)

Enclosure: Chassis

Technical Specification

Line Voltage: $\pm 10\%$

Frequency: $\pm 5\%$

Overload Current: 160% for 60 seconds

Efficiency: > 0.98

True Power Factor: 0.85 @ 50% load; 0.99 @ 100% load

Ambient Temperature: 5°C - 40°C without derating



AHF Series Advanced Harmonic Filters

AHF Selection (440 - 480V, 60Hz)

HP	Typical Danfoss VLT*				Output Amps	AHF Filter Ordering Number	
	VLT 4000 VT	VLT 5000	VLT 6000	VLT 8000		AHF 005	AHF 010
10 - 15	4011, 4016	5011, 5016	6011, 6016	8011, 8016	19	175G6612	175G6634
20	4022	5022	6022	8022	26	175G6613	175G663
25 - 30	4027, 4032	5027, 5032	6027, 6032	8027, 8032	35	175G6614	175G6636
40	4042	5042	6042	8042	43	175G6615	175G6637
50 - 60	4052, 4062	5052, 5062	6052, 6062	8052, 8062	72	175G6616	175G6638
75	4072	5072	6072	8072	101	175G6617	175G6639
100 - 125	4102, 4122	5102, 5122	6102, 6122	8102, 8122	144	175G6618	175G6640
150	4152	5152	6152	8152	180	175G6619	175G6641
200	4202	5202	6172	8202	217	175G6620	175G6642
250	4252	5252	6222	8252	289	175G6621	175G6643
300	4302	5302	6272	8302	324	175G6689	175G6692
350	4352	5350	6352	8352	370	175G6690	175G6693
450	4450	5450	6400	8450	506	217 A and 289 A unit	
500	4500	5500	6500	8500	578	Two 289 A units	
600	4600	5500**	6600	8600	648	Two 324 A units	

* Note: Matching of the typical Danfoss VFD and filter is pre-calculated based on 440V and assuming typical motor load (4 pole). VLT 5000 series is based on a 160 % torque application, while VLT 6000 and 8000 series are based on a 110% torque application. The pre-calculated filter currents above may be different than input current rating of the VLT Series drive.

** When operating in Normal Overload (110%)

North America Motion Controls

www.namc.danfoss.com

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