GE Energy

Harmonic Control Drive Solutions

imagination at work

Harmonic Control Drive Solutions




What are harmonic currents and what effects do they have?
In electrical distribution systems, harmonic currents are enlarged distortions of the fundamental frequency (i.e., 60Hz). They are created by non-linear loads – such as adjustable speed drives, battery chargers or other power electronics – that draw current in pulses instead of continuous levels. Because of the additional current levels, harmonics can cause problems like overheated conductors, breakers or transformers, and they reduce system efficiencies. The distribution system's characteristics (i.e., I_{SC} / I_I) and other loads on the grid will affect the quality of power and adds greater complexity to the problem.

What is the standard for harmonic levels in distribution systems?
IEEE 519-1992 provides guidelines for recommended harmonic levels in electrical distribution systems. It suggests maximum voltage and current distortions based on the distribution systems level of impedance (i.e., I_{SC} / I_I). While it does not state how these levels are to be obtained, this standard has set recommended levels that contractors, owners and manufacturers should meet with installed equipment.

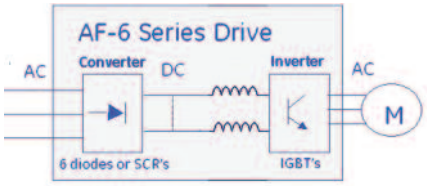
What's the right solution for me, and where can I find it?
Every electrical system is different so there is no one solution for all installations. To make it easier to comply, GE offers multiple solutions that are simple, reliable and compliant to the requirements. Each builds on our AF-6 Series family of drives, so programming, maintenance and performance are consistent. Based on your specific system requirements, GE can help you meet the IEEE 519-1992 standard in a way that matches your needs and budget.



Harmonic mitigation solutions

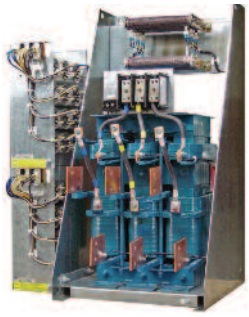
Drives with DC link reactors and/or AC line reactors

Impedance can be added to the line side of a drive using either an AC line reactor or a DC link reactor/choke. This smooths out current pulses and reduces harmonic content. Reactors are small and inexpensive and may limit harmonic THID (Total Harmonic Current Distortion) to 35–44%. This solution is appropriate for systems with low concerns about harmonics for low horsepower drives, when the harmonic content is a small portion of the system's load, or when used in conjunction with other solutions (e.g., a harmonic filter).

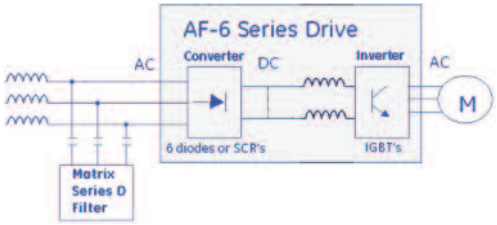


All GE AF-6 series drives come standard with a DC link reactor and can have additional line impedance added for further mitigation. They are available in NEMA 1, 12 and 3R enclosures and with ratings up to 300 horsepower. For more details and product selection, see the Control Catalog (GEP-1260P) or Standard Drives Buyers Guide (GEP-S1000E).

Drives with Matrix harmonic filters



Low pass multi-stage filters are a simple and effective way to control harmonics. The matrix filter's design typically achieves 5% THID at full load and 8% THID or less at any load between 0% and 100%. Unlike single-stage, passive devices and other broadband filters, GE's filter design delivers this performance without causing power system resonance. Whether applied to a single unit or multiple drives, Matrix filter drives are typically smaller and less expensive than 18 pulse solutions and provide better results over the operating range.



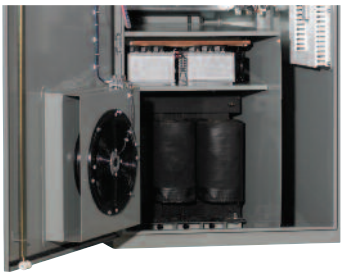
GE Matrix Series D filter drives:

- Meet IEEE 519-1992 5% THID
- Come in NEMA Type 1 enclosures
- Are rated up to 100hp as an integrated solution
- Can be configured with other standard options
- Only filter during drive run conditions to optimize power factor

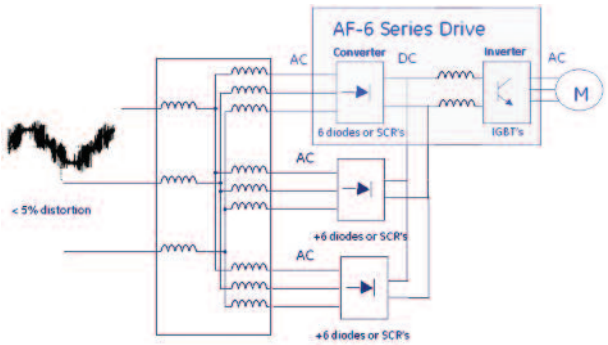
Horsepower Rating @ 460V	Dimensions (H x W x D) (in.)*		
1 – 20	71.24	25.15	17.57
25 – 60	71.84	39.10	23.09
75 – 100	94.48	48.00	26.09

*For estimating purposes only

MultiPulse drives



Long considered the cornerstone for meeting IEEE 519-1992 requirements, MultiPulse drives include a special transformer and additional line rectifiers to cancel harmonics reflected back to the line. Though large in size, 18 pulse drives, and variations like 12 or 24 pulse units, provide great performance at rated load and with close to balance line voltages. GE's AF-600 FP and AF-650 GP drives are both available in MultiPulse configurations.



GE MultiPulse drives:

- Meet IEEE 519-1992 5% THID
- Come in NEMA Type 1, 12, 3R or 4X Enclosures
- Are rated from 25 to 1000hp
- Meet UL 508A
- Offer electromechanical and solid state bypass schemes
- Have fully rated rectifiers in an internal and external bridge design (standard) or full external bridge (optional)
- Are available with a wide range of options

Horsepower Rating @ 460V	Dimensions (H x W x D) (in.)*		
40	90.00	24.00	20.00
50 – 60	90.00	24.00	20.00
75 – 100	90.00	30.00	20.00
125 – 150	90.00	36.00	30.00
200 – 300	90.00	42.00	36.00
350 – 600	90.00	72.00	32.00

*For estimating purposes only

Maximum Harmonic Distortion in Percent of I_L

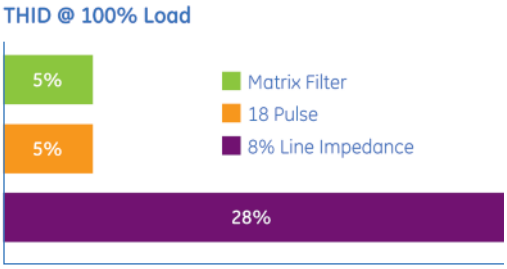
Table 10.3 in IEEE Std 519-1992. *Reprinted with permission.*

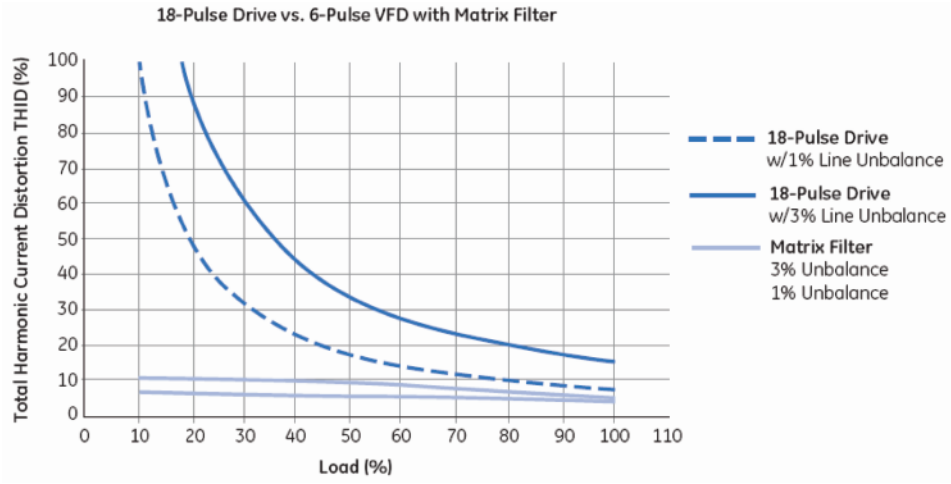
Individual Harmonic Order (Odd Harmonics)						
I_{SC} / I_L	<11	11≤*h*<17	17≤*h*<23	23≤*h*<35	35≤*h*	TDD
<20*	4.0	2.0	1.5	0.6	0.3	5.0
20<50	7.0	3.5	2.5	1.0	0.5	8.0
50<100	10.0	4.5	4.0	1.5	0.7	12.0
100<1000	12.0	5.5	5.0	2.0	1.0	15.0
>1000	15.0	7.0	6.0	2.5	1.4	20.0

Even harmonics are limited to 25% of the odd harmonic limits above.
Current distortions that result in a dc offset, e.g., half-wave converters, are not allowed.
*All power generation equipment is limited to these values of current distortion, regardless of actual I_{SC} / I_L.

where
I_{SC} = maximum short-circuit current at PCC.
I_L = maximum demand load current (fundamental frequency component) at PCC.

Comparison of harmonic mitigation solutions





Addtional reference material

HarmCalc Harmonic Estimating Software	TBD
Variable Frequency Drives and Harmonic Abatement Techniques	DEE-500
Standard Drives Buyers Guide	GEP-S1000

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