

<b><u>Mirus Lineator Advanced Universal Harmonic Filter (AUHF)</u></b>	<b><u>Other Passive Harmonic Filters</u></b>
Filter power range extends from 3HP(2.2kW) to 3500HP (2600kW).	All have limited filter power (HP/kW) ranges. Some that offer higher ratings use paralleled units, which can have overloading/current sharing issues.
Excellent performance even with background voltage distortion, VTHD. Guaranteed performance with up to 5% background VTHD.	Others lose performance when any background voltage distortion is present and performance guarantee is often nullified with even zero background distortion.
Mirus includes additional safety margin in the capacitors to ensure that high levels of harmonics do not negatively affect the capacitor lifespan. Mirus filters are known to have the longest field life expectancy and MTBF before requiring replacement.	High harmonic peaks present in the filter tuned branch do not seem to be considered and can cause premature capacitor failures.
Capacitors and reactors are protected with separate fusing in addition to built-in capacitor overpressure safety disconnect.	Most do not provide fusing of the capacitor bank. The built-in capacitor overpressure safety disconnect is not an overcurrent protection device, so does not guarantee protection of the filter reactor against overcurrent should capacitor degradation occur.
With a low capacitance kVAR design, Mirus filters do not require capacitor switching contactors in most applications.	Most must add capacitor switching contactors because of high kVAR filter design, capacitor failure rate and lack of fusing of the capacitor bank.
No-load over-voltage boost of < 2.5% is, by far, the lowest in the industry.	Introduce much higher no-load over-voltage boost which can cause nuisance tripping of VFD's.
Guaranteed maximum of 15% capacitive reactive power to ensure compatibility with generators.	Most have 30% to 40% capacitive reactive current at light load which can cause failures with diesel generator Automatic Voltage Regulators (AVR) and other generator issues.
Includes a 'real world' performance guarantee. <ul style="list-style-type: none"> <li>Lineator: Less than 8% TDD(I) with background THD(V) up to 5%, and unbalanced line voltage up to 3%.</li> <li>Lineator-HP: Less than 5% TDD(I) with background THD(V) up to 2%, and unbalanced line voltage up to 2%.</li> </ul>	Do not have a 'real world' performance guarantee. Other competitors void their performance guarantees when background VTHD is present and typically any line imbalance greater than 1%.
No minimum or maximum source impedance restrictions.	All have source impedance restrictions, meaning that on some systems the filters may not be recommended, or they will not fulfill any performance guarantee. <sup>1</sup>
No derating required for constant torque loads.	Most require derating for constant torque loads (e.g. conveyors, extruders).
No derating required with up to 8% background voltage distortion, VTHD. In addition, only Mirus offers an Extreme Duty (ED) model that allows for: <ul style="list-style-type: none"> <li>Up to 12% background VTHD without derating.</li> <li>Up to 55deg C ambient without forced air cooling.</li> </ul>	All require derating with background VTHD, operate with reduced performance and no guarantee.
Freely available simulation software, SOLV, to analyze power systems based on discrete components, allowing for accurate simulations under any load and source condition. SOLV is the only software which allows for the inclusion of background voltage distortion and voltage imbalance in the simulation.	Those companies that have simulation software often use 'look-up tables' or test lab measurements rather than discrete component models and none allow inclusion of 'real world conditions' such as background voltage distortion or voltage imbalance.
Highest efficiency in the industry, at greater than 99%.	Inferior efficiency compared to Mirus filters.
Only natural convection cooling required.	Many require forced-air convection cooling (i.e. fans).

Mirus filters are cULus certified, are ABS type-approved for marine applications, and are approved for DNV GL and Lloyd's Register installations.

<sup>1</sup> Source Impedance Restriction Examples:

- Maximum limit example: A maximum limit of 6% source impedance means that when a filter is being used on a system with 18% impedance generator source, the filter load can only be 33% of the generator rating. Mirus filters have no maximum source impedance restrictions, and have no issue being loaded at 100% of a generator's capacity. Generators do not require oversizing.
- Minimum limit example: A minimum limit of 1.5% source impedance means that when a filter is being used on a system with 6% impedance transformer/source, the individual filter size cannot be less than 25% of the supply rating without voiding the performance guarantee. Mirus filters have no minimum source impedance restrictions, and therefore any size filter can be put on any size power system with a full performance guarantee. --

Competitive Analysis of Passive Harmonic Filters: Review of Their Published Performance Limitation Factors

The Difference is in the Detail of the Performance Warranty!

	Mirus Std Lineator: AUHF	Mirus High Performance Lineator: AUHF-HP	[Competitor 1]	[Competitor 2 - Product A]	[Competitor 2 - Product B]
Performance Guarantee	Reduce Current Total Demand Distortion (Itdd) measured at the Lineator input terminals to <8% input terminals to <8%	Reduce Current Total Demand Distortion (Itdd) measured at the Lineator input terminals to <5%	Input current distortion will be less than or equal to 5% THID for [Competitor 1] filters at full load, and less than 8% at 30% load.	[Product A] will deliver typical results of 5 - 6% TDD (Total Demand Distortion), but not more than 8%, at the filter input terminals at full load	"The input VFD current waveform shall be consistent with that of a VFD with 3% line reactance at full load". Then the "input current harmonic will be less than or equal to 5% THID for Standard Series filters at full load, and less than 8% at 30% load.
Line Voltage Imbalance and Source Impedance Restrictions	Less than 3% Imbalance. No Source Impedance Restrictions	Less than 2% Imbalance. No Source Impedance Restrictions. Less than 3% for similar performance as standard Lineator.	Within 1%. System Impedance must be greater than 1.5% and less than 6%. Also it is required to consult the factory for Gen-Set applications.	Line Voltage must be balanced to within +/- 1% at the filter input terminals, and is 100% (+/- 5%) of filter rating.	Nominal System Voltage (Line to line) +/- 10%, with no more than 1.5% Source impedance. Balanced Line Voltage within 0.5%.
Background Voltage Distortion Restrictions	Less than 5% for standard model. ED model allows for up to 14% Vthd	Less than 2%. Less than 5% for similar performance as standard Lineator	0% Vthd Background	[Competitor 2] cannot guarantee individual results when harmonic distortion exists on the system prior to [Product A] installation	< 0.5% Vthd Background Distortion. Note: The presence of background voltage distortion will cause motors and other linear loads to draw harmonic current. Additional harmonic currents may flow into the [Product B] filter if there is any harmonic voltage distortion already on the system.
Comments	Most Flexible System Parameters for IEEE 519 Compliance. Real World Compliant	This level of harmonic mitigation matches Active Front end Drives (AFE'S) and Active Filter (AF) performance without the high frequency harmonics introduced by these more expensive and complex solutions.	0% THVD Background Distortion does not exist within real world applications. Line imbalances within 1% is very tight, and can be found on only very few installations.	The background voltage distortion note for the [Product A] means 0% Vd background within the system which does not exist within real world applications.	The limits on upstream source impedance coupled with the very tight 0.5% Background Voltage Distortion and requirement of an already harmonically mitigated VFD topology, i.e. 3% line reactor current harmonic output renders the [Product B] 5% filter ineffectual for Real World applications.
The performance warranty notes and limitation on background voltage distortion, source impedance, and voltage imbalance are taken from the website of each manufacturer and their published data sheets and literature.					