Lineator AUHF Filter Sizing Considerations and Methodology

Preface: There are many considerations within a Drive circuit that the engineer considers within the specification of a VFD/ASD/Drive, including motor sizing and losses, motor speed and configuration, load variables, cable length and losses, output inductor and filter losses and others. The full circuit considerations are quite involved. But sizing the Mirus Lineator AUHF and AUHF-HP filter to the application is reasonably simple once the VFD has been selected or proposed.

Since the drive secondary circuit is used to size the VFD/ASD device, the specification of the drive itself is your primary consideration; but not all drives are Horsepower (HP) rated. Some drive manufacturers have decided to specify their product via kW, kVA, and/or current versus the more traditional HP designation. The goal of this discussion is to help with size selection of the harmonic filter based on varying VFD/ASD rating methods.

Variable Torque Drives versus Constant Torque Drives: The Mirus AUHF is a constant torque rated device and is appropriate for use on both Variable Torque or Constant Torque Drive applications. Many other harmonic filters are variable torque rated only with derating required for Constant Torque applications, which may not be obvious from their specification sheets. Since many industrial applications are constant torque, specifying a Mirus AUHF or AUHF-HP filter, will eliminate concern regarding torque requirements and derating factors.

When ratings were initially established for the Mirus Lineator, the filters were given motor HP/kW ratings that corresponded to the motor shaft power (HP/kW) they are to be applied to. This logical approach is also commonly used by VFDs/ASDs in order to simplify selection. This approach may lead to some confusion though, since the full power rating of the filter is actually higher than its motor shaft rating. In order to supply a motor's full shaft power rating, the Lineator must also be capable of supplying the typical load losses, including those of the VFD/ASD. In an effort to eliminate this confusion, Mirus Technical Data Sheets include Input and Output current ratings as well as Output kVA and kW ratings.

Sizing Methodology: Below is a summary sheet with examples of how to select the appropriately sized Mirus Lineator filter based on varying VFD size specifications.

VFD/ASD Rating	Sizing Protocol	Spec Sheet Detail
Motor HP/kW	This is the easiest selection method. A straight motor HP/kW to motor HP/kW sizing can assure you of proper coordination in most applications. Match the motor shaft HP rating of the filter directly to the VFD HP rating which is typically also based on motor shaft HP. This selection method should not be used when there is additional equipment downstream of the VFD, such as a step-up transformer, as those additional losses should be considered.	A
Full kW	For some VFDs, a full kW rating is provided which includes motor losses. In this case, selection should be based on the output kW rating of the filter as provided in the most up-to-date Lineator AUHF Technical Data sheet (AUHF-S001). Find the output kW rating that matches or is just above the VFD rating, then read across to choose the filter by HP size.	B
kVA	Use the same criteria for selection as with kW above, but instead use the kVA Output column and again select the correct HP by reading across.	C
Output Current	VFD/ASD output current is not an appropriate method for matching an input filter. The output current rating of a VFD/ASD may be larger than the input rating since power factor is typically lower at the VFD output due to the motor inductive reactance that it must provide. For proper filter selection, HP, kW, kVA or input current rating of the drive should be used if possible.	N/A
Input Current	The input current rating of the VFD should be matched to the output current rating of the filter from the AUHF Technical Data sheet. This will ensure that the filter can handle the VFD full load current but may result in a slight oversizing of the filter. This is because the VFD input current rating includes the harmonic currents drawn by the input rectifier which will always be higher than the filter will see when connected in the circuit. If this is a concern, use one of the other criteria for filter selection.	D
Other	If the associated drive is using a method of specification different from the above, consult factory for proper sizing. For example, if the application includes long cable runs and step-up transformers or other equipment downstream of the VFD, the losses associated with this equipment must be included in both VFD and filter selection. If VFD/ASD input amps, kVA or full kW ratings are available, they can be used for sizing as above.	Consult Factory

Note: When selecting from the Technical Data sheet, make sure to select from the proper schedule based on the drive nominal voltage. If there is any concern over the proper selection, contact the factory.

Detail A – By Motor Shaft HP/kW Rating

Motor Size		Lineator Rating (3-Phase)							
		Current Rating (Amps)							
HP	kW	460/480V 60Hz		575/600V 60Hz		660/690V 50/60Hz		Output	
		Input	Output	Input	Output	Input	Output	kVA	kW
5	4	7	7	5	5	5	5	6	4.5
7.5	5.5	9	10	7	7	6	6	8	6.3
10	7.5	12	13	10	11	8	8	10	8.5
15	11	17	18	14	15	12	13	14	13
20	15	23	24	18	19	16	17	19	17
25	18.5	29	31	23	24	20	21	25	21
30	22	34	36	28	30	24	25	29	25
40	30	46	49	37	39	32	34	39	34
50	37.5	57	60	45	48	40	42	48	42
60	45	69	73	55	58	48	51	58	51
75	55	85	90	68	72	59	63	72	63
100	75	113	120	90	95	79	84	96	84
125	90	141	149	112	119	98	104	119	104
150	110	169	179	135	143	118	125	143	125
200	150	226	240	180	191	158	167	191	168

For sizing based on motor shaft HP rating, select the filter based on the published motor HP rating. This should match the HP rating for the VFD/ASD. This will properly size the filter for motor and VFD losses in addition to the motor shaft HP in typical applications.

Detail B – By VFD full kW Rating

Motor Size		Lineator Rating (3-Phase)							
		Current Rating (Amps)							
HP	kW	460/480V 60Hz		575/600V 60Hz		660/690V 50/60Hz		Output	
		Input	Output	Input	Output	Input	Output	kVA	kW
5	4	7	7	5	5	5	5	6	4.5
7.5	5.5	9	10	7	7	6	6	8	6.3
10	7.5	12	13	10	11	8	8	10	8.5
15	11	17	18	14	15	12	13	14	13
20	15	23	24	18	19	16	17	19	17
25	18.5	29	31	23	24	20	21	25	21
30	22	34	36	28	30	24	25	29	25
40	30	46	49	37	39	32	34	39	34
50	37.5	57	60	45	48	40	42	48	42
60	45	69	73	55	58	48	51	58	51
75	55	85	90	68	72	59	63	72	63
100	75	113	120	90	95	79	84	96	84
125	90	141	149	112	119	98	104	119	104
150	110	169	179	135	143	118	125	143	125
200	150	226	240	180	191	158	167	191	168

Match the VFD kW rating to the output kW rating in the table. The filter kW rating should be the same as or larger than the VFD rating. Once found, read over to the filter HP/kW rating for sizing. The example shows selection for a Drive rated at 42 kW matching it with a 50 HP filter.

Detail C – By VFD full kVA Rating

Motor Size		Lineator Rating (3-Phase)							
		Current Rating (Amps)							
HP	kW	460/480V 60Hz		575/600V 60Hz		660/690V 50/60Hz		Output	
		Input	Output	Input	Output	Input	Output	kVA	kW
5	4	7	7	5	5	5	5	6	4.5
7.5	5.5	9	10	7	7	6	6	8	6.3
10	7.5	12	13	10	11	8	8	10	8.5
15	11	17	18	14	15	12	13	14	13
20	15	23	24	18	19	16	17	19	17
25	18.5	29	31	23	24	20	21	25	21
30	22	34	36	28	30	24	25	29	25
40	30	46	49	37	39	32	34	39	34
50	37.5	57	60	45	48	40	42	48	42
60	45	69	73	55	58	48	51	58	51
75	55	85	90	68	72	59	63	72	63
100	75	113	120	90	95	79	84	96	84
125	90	141	149	112	119	98	104	119	104
150	110	169	179	135	143	118	125	143	125
200	150	226	240	180	191	158	167	191	168

Match the VFD kVA rating to the output kVA rating in the table. The filter kVA rating should be the same as or larger than the VFD rating. Once found, read over to the filter HP/kW rating for sizing. The example shows selection for a Drive rated at 48 kVA matching it with a 50 HP filter.

Detail D – By VFD Input Current Rating

Motor Size		Lineator Rating (3-Phase)							
		Current Rating (Amps)							
HP	kW	460/480V 60Hz		575/600V 60Hz		660/690V 50/60Hz		Output	
		Input	Output	Input	Output	Input	Output	kVA	kW
5	4	7	7	5	5	5	5	6	4.5
7.5	5.5	9	10	7	7	6	6	8	6.3
10	7.5	12	13	10	11	8	8	10	8.5
15	11	17	18	14	15	12	13	14	13
20	15	23	24	18	19	16	17	19	17
25	18.5	29	31	23	24	20	21	25	21
30	22	34	36	28	30	24	25	29	25
40	30	46	49	37	39	32	34	39	34
50	37.5	57	60	45	48	40	42	48	42
60	45	69	73	55	58	48	51	58	51
75	55	85	90	68	72	59	63	72	63
100	75	113	120	90	95	79	84	96	84
125	90	141	149	112	119	98	104	119	104
150	110	169	179	135	143	118	125	143	125
200	150	226	240	180	191	158	167	191	168

The VFD input current rating is compared to the output current rating of the filter. The example shows the proper filter rating of 50 HP should be selected when VFD input current is between 50A to 60A. You will note that the filter has a higher output current rating than input current rating. This is due to the fact that the current on the output has to account for harmonic currents being drawn by the VFD. The input current rating can be used for upstream protection device coordination and upstream cable sizing.

Conclusion: In the vast majority of cases, filter selection will be a simple matter of matching Motor HP to VFD HP to Filter HP. But on occasion when these HP ratings are not available or are not matched or other equipment exists downstream of the VFD, alternative selection methods can be used as detailed above. It is important to note that filter design assumes typical losses for the motor and the VFD. If for some reason, these losses exceed those of typical VFDs and motors or there is additional equipment and excessively long cable runs downstream of the VFD, sizing by Output kW or kVA should be used. Of course, if you are having difficulty selecting a filter size, factory support is always available. Application information will be needed so please have VFD specification sheets available when contacting the factory.