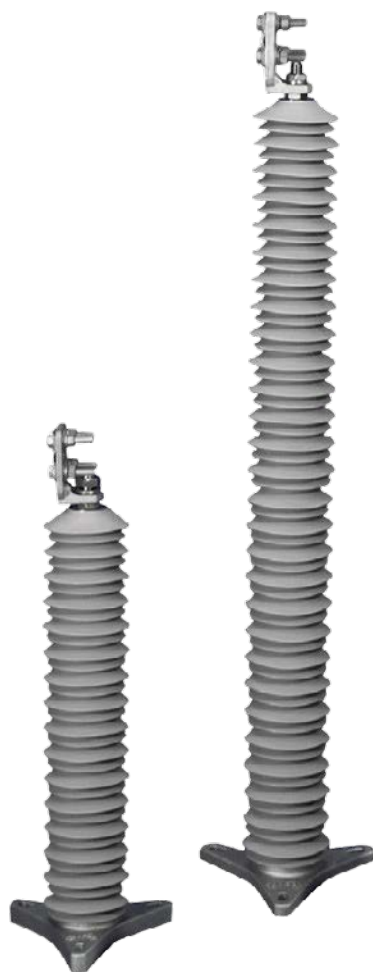


U2AA: UltraSIL polymer-housed VariSTAR IEC station class SL surge arresters



General

Eaton's Cooper Power™ series UltraSIL™ polymer-housed VariSTAR™ Type U2AA station class SL surge arresters for systems up to 132 kV meet or exceed the requirements of IEC 60099-4 for gapless metal oxide varistor (MOV) surge arresters.

Table 1. U2AA arrester ratings and characteristics

Arrester characteristic	Rating
Voltage ratings: U_r (kV)	3–120
Continuous operating voltages: U_c (kV)	2.55–98
Arrester IEC 60099-4 classification	SL
Nominal discharge current: I_n (kA)	10
Switching impulse discharge current (kA)	0.5
Repetitive charge transfer rating: Q_{rs} (C)	1.2
Thermal energy rating: W_{th} (kJ/kV U_r)	4.5
High current impulses (peak current 4/10 μ s kA)	100
Rated short-circuit current: I_s (kA)	40
System frequency (Hz)	50/60
Ambient temperature ($^{\circ}$ C)	–40 to +40
Bending moment	
Specified long-term load: SLL (Nm)	460
Specified short-term load: SSL (Nm)	575

Features and construction

Eaton's full line of IEC certified UltraSIL polymer-house VariSTAR station class arrester products begin with world-class MOV disks produced at our manufacturing facility in Olean, NY.

The quality of Eaton-produced MOV disks is a result of years of continuous improvements in disk formulation and advances in manufacturing technology. From initial raw material inspection to final physical and electrical testing of each disk and finished arrester, Eaton maintains strict quality control over the entire production process resulting in a long history of in-service use with outstanding durability, quality, and protective capability.

Eaton's U2AA UltraSIL polymer-housed arresters are made with the industry-recognized superior silicone rubber, with a unique high-creep alternating shed profile. The housing utilizes an interference fit, which is then bonded to the internal module to form a solid, void-free, high-dielectric strength insulation system that has been verified by long-term environmental testing.

The UltraSIL polymer-housing material provides the primary moisture seal with the composite-matrix arrester module acting as a secondary seal.

The UltraSIL housing material, internal components, and hardware work as a system to withstand years of exposure to environmental extremes.

The UltraSIL silicone rubber housing also provides:

- Inherent water-repellent material
- Weight reduction compared to porcelain-housed arresters
- Resistance to UV degradation and surface tracking
- Chemical inertness
- Temperature stability
- Resistance to biological growth
- Low external power losses under contaminated conditions
- Nonflammable housing material that will not support combustion

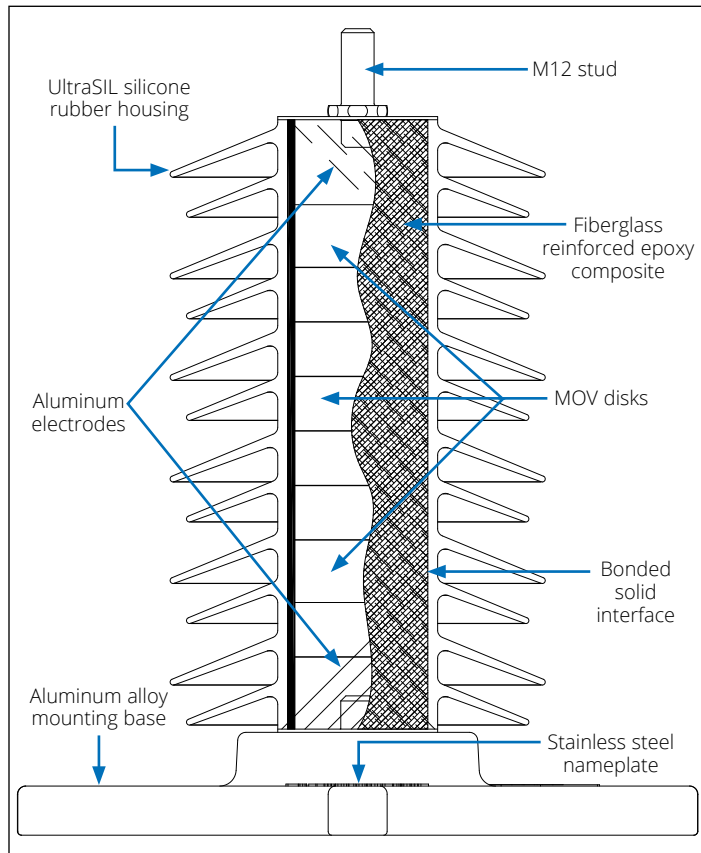


Figure 1. Cutaway illustration of a U2AA arrester

Operation

The U2AA arrester is a gapless MOV surge arrester. During steady-state conditions, line-to-earth voltage is continuously across the arrester terminals. When overvoltages occur, the VariSTAR arrester immediately limits the overvoltage to the required protective level by conducting only the necessary level of surge current to earth. Upon passage of the overvoltage condition, the arrester returns to its initial condition, once again conducting only minimal leakage current.

U2AA arresters are ideal for the protection of critical substation apparatus in areas of moderate lightning incidence and protection against switching surges generated on transmission systems.

Design testing

The components and the assembled arrester meet the relevant IEC 60099-4 requirements. Additional reference documents are listed on page 11.

Quality assurance tests

An extensive and automated production test program ensures a quality product. Each MOV and fully assembled arrester undergo a series of electrical tests. Additional quality validation is achieved by subjecting varistor samples from each production batch to destructive testing.

Listed are the varistor tests performed in accordance with IEC 60099-4:

- Physical inspection
- Switching surge energy rating
- Discharge voltage
- Reference voltage
- Power loss
- Batch high current impulse
- Batch thermal stability
- Batch aging

Each fully assembled UltraSIL arrester must pass the following routine tests per IEC 60099-4:

- Physical inspection
- Reference voltage
- Power loss
- Partial discharge

General application recommendations

Table 2 provides a general guide for determining the proper arrester rating (U_r) for a given system voltage and grounding configuration.

Eaton's application engineers are available to help make specific system application recommendations. The following information is normally required:

1. Maximum system operating voltage
2. System grounding conditions
3. Available fault current
4. Maximum line-to-ground voltage and overvoltage duration during fault conditions

Additional details on arrester selection and application recommendations can be found in IEC 60099-5.

Table 2. Arrester ratings commonly used on three-phase systems

System voltage phase-to-phase (kV, rms)		Arrester rating— U_r (kV, rms)	
Nominal	Maximum	Grounded circuits	High-impedance/ ungrounded circuits
3.3	3.7	3	6
6.6	7.3	6	9
10.0	11.5	9	12–15
11.0	12.0	9–10	12–15
16.4	18.0	15.0	18–21
22.0	24.0	18–21	24–27
33.0	36.3	27–30	36–39
47.0	52.0	39–48	54–60
66.0	72.0	54–60	66–84
91.0	100.0	78–84	90–96
110.0	123.0	96–108	120–135
132.0	145.0	108–120	—

Performance and protective characteristics

The temporary overvoltage (TOV) capability of the U2AA arrester with and without prior duty is shown in **Figure 2**. The curves indicate the arrester's ability to withstand abnormal system power frequency (sinusoidal) overvoltages for various durations.

Table 3 lists the creepage distance and insulation withstand voltages for the standard housing designations, as specified by digits 12 and 13 in the catalog configurator.

Table 4 displays the arrester rating (U_r), continuous operating voltage (U_c), and the protective characteristics.

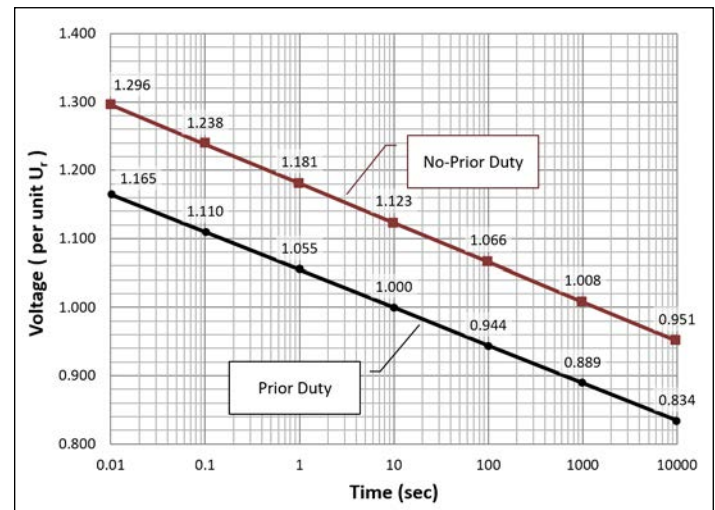


Figure 2. TOV curves of the U2AA station class surge arrester

Note: The TOV curve in **Figure 2** applies to standard electrical build arresters. See **Table 4** for TOV with Prior duty (kV) for 1 and 10 second values.

Table 3. Insulation withstand voltages of the UltraSIL polymer-housed VariSTAR Type U2AA surge arrester

Housing designation	Creepage distance (mm)	Strike (mm)	BIL 1.2/50 impulse (kV, Pk)	Wet 50/60 Hz 60 sec (kV, rms)	Dry 50/60 Hz 60 sec (kV, rms)
06	585	154	86	46	60
08	780	193	115	61	80
10	975	232	134	70	94
12	1170	272	155	82	109
14	1365	311	176	93	123
16	1560	351	201	104	140
18	1755	390	217	118	151
20	1950	430	237	130	164
22	2145	470	252	139	172
24	2340	509	275	154	188
26	2535	549	294	172	201
28	2730	588	316	181	212
34	3315	741	418	222	291
36	3510	780	434	236	302
38	3705	820	454	248	315
40	3900	860	474	260	328
42	4095	900	489	269	336
44	4290	940	504	278	344
46	4485	979	527	293	360
56	5460	1176	632	362	424

Table 4. Protective characteristics of the UltraSIL polymer-housed VariSTAR Type U2AA surge arrester

Arrester rating Ur (kV, rms)	Arrester COV Uc (kV, rms)	Steep current residual voltage (kV crest)	Maximum residual voltage (kV crest) 8/20 μ s current wave							Switching surge protective level (kV crest)				TOV with prior duty	
			1.5 kA	3 kA	5 kA	10 kA	20 kA	40 kA		125 A	250 A	500 A	1000 A	1 sec	10 sec
3	2.55	8.7	6.8	7.2	7.6	8.3	9.1	10.3		5.9	6.0	6.2	6.5	3.46	3.29
6	5.1	17.4	13.6	14.4	15.1	16.6	18.1	20.7		11.7	12.0	12.5	13.0	6.93	6.57
9	7.65	26.2	20.4	21.5	22.7	24.8	27.2	31.0		17.6	18.1	18.7	19.5	10.4	9.86
10	8.4	28.7	22.4	23.7	24.9	27.3	29.9	34.0		19.3	19.8	20.6	21.5	11.4	10.8
12	10.2	34.9	27.1	28.7	30.2	33.1	36.3	41.3		23.5	24.1	25.0	26.0	13.9	13.1
15	12.7	43.4	33.8	35.8	37.6	41.2	45.2	51.5		29.2	30.0	31.1	32.4	17.2	16.4
18	15.3	52.3	40.7	43.1	45.3	49.6	54.4	62.0		35.2	36.1	37.4	39.1	20.8	19.7
21	17	58.1	45.2	47.9	50.4	55.2	60.5	68.9		39.1	40.2	41.6	43.4	23.1	21.9
24	19.5	66.7	51.9	54.9	57.8	63.3	69.4	79.0		44.9	46.1	47.7	49.8	26.5	25.1
27	22	75.2	58.5	62.0	65.2	71.4	78.2	89.2		50.6	52.0	53.8	56.2	29.9	28.4
30	24.4	83.5	64.9	68.7	72.3	79.2	86.8	98.9		56.1	57.6	59.7	62.3	33.1	31.5
33	27.5	94.1	73.2	77.5	81.5	89.2	97.8	111		63.3	65.0	67.3	70.2	37.3	35.4
36	29	99.2	77.2	81.7	85.9	94.1	103	118		66.7	68.5	71.0	74.1	39.4	37.4
39	31.5	108	83.8	88.7	93.3	102	112	128		72.5	74.4	77.1	80.4	42.8	40.6
42	34	116	90.5	95.8	101	110	121	138		78.2	80.3	83.2	86.8	46.2	43.8
45	36.5	125	97.1	103	108	118	130	148		84.0	86.2	89.3	93.2	49.6	47.0
48	39	133	104	110	116	127	139	158		89.7	92.1	95.4	99.6	53.0	50.3
54	42	144	112	118	124	136	149	170		96.6	99.2	103	107	57.0	54.1
60	48	164	128	135	142	156	171	195		110	113	117	123	65.2	61.9
66	53	181	141	149	157	172	188	215		122	125	130	135	72.0	68.3
72	57	195	152	161	169	185	203	231		131	135	139	146	77.4	73.5
78	62	212	165	175	184	201	221	251		143	146	152	158	84.2	79.9
84	68	233	181	192	201	221	242	276		156	161	166	174	92.3	87.7
90	72	246	192	203	213	234	256	292		166	170	176	184	97.8	92.8
96	76	260	202	214	225	247	270	308		175	180	186	194	103	98.0
108	88	301	234	248	261	286	313	357		202	208	215	225	120	113
108	84	287	224	237	249	273	299	340		193	198	206	215	114	108
120	98	335	261	276	290	318	349	397		225	232	240	250	133	126

Dimensions and mounting

Figure 3 illustrates an in-line mounting arrangement. Line and earth terminal details are shown on **page 9** and **page 10**, options 14 and 15 of the standard catalog configurations. **Figure 4** shows an outline drawing of the standard UltraSIL polymer-housed VariSTAR Type U2AA Class SL arrester.

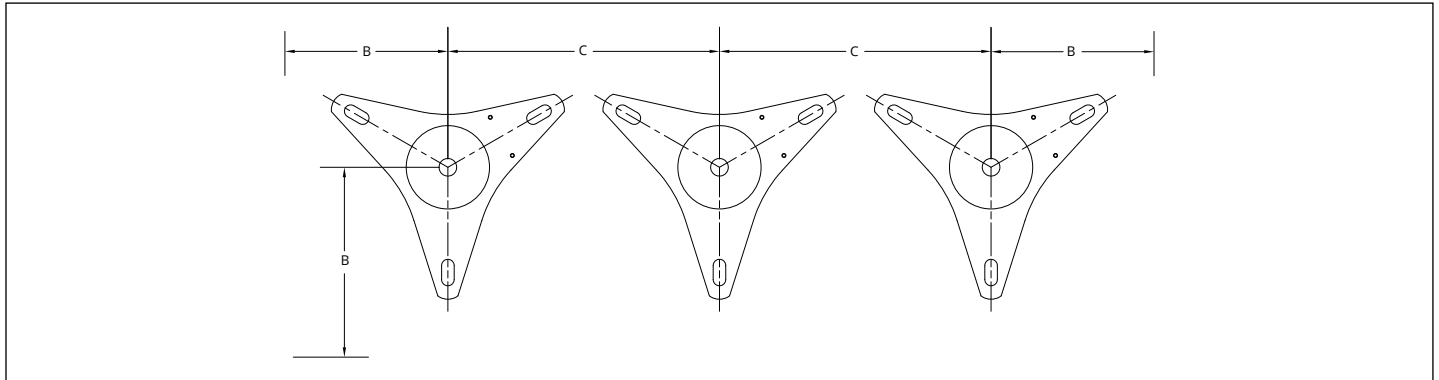


Figure 3. Three-phase in-line mounting

Note: Refer to **Table 5** for dimensions B and C.

Table 5. Catalog numbers, dimensional information, and weights for VariSTAR U2AA surge arresters

Arrester rating U_r (kV, rms)	Arrester COV U_c (kV, rms)	Standard arrester catalog number	Dimension A (mm) (Figure 4)	Dimension D (mm) (Figure 4)	Dimension B minimum phase-to-earth clearance ^① (mm) (Figure 3)	Dimension C minimum phase-to-phase clearance ^① (mm) (Figure 3)	Housing creepage distance (mm)	Arrester mass (kg)
3	2.55	U2AA003002A0645AAA	160	130	140	254	585	2.0
6	5.1	U2AA006005A0645AAA	160	130	140	254	585	2.1
9	7.65	U2AA009007A0845AAA	200	130	149	263	780	2.5
10	8.4	U2AA010008A0845AAA	200	130	154	268	780	2.5
12	10.2	U2AA012010A0845AAA	200	130	168	282	780	2.6
15	12.7	U2AA015012A1045AAA	239	130	191	305	975	2.9
18	15.3	U2AA018015A1045AAA	239	130	218	332	975	3.1
21	17	U2AA021017A1045AAA	239	130	236	351	975	3.1
24	19.5	U2AA024019A1245AAA	279	130	242	356	1170	3.6
27	22	U2AA027022A1445AAA	318	130	267	381	1365	3.9
30	24.4	U2AA030024A1445AAA	318	130	291	405	1365	4.0
33	27.5	U2AA033027A1645AAA	358	130	322	436	1560	4.4
36	29	U2AA036029A1645AAA	358	130	337	451	1560	4.4
39	31.5	U2AA039031A18A5AAA	397	130	362	476	1755	4.9
42	34	U2AA042034A2045AAA	436	130	387	501	1950	5.1
45	36.5	U2AA045036A2045AAA	436	130	412	527	1950	5.3
48	39	U2AA048039A2245AAA	476	130	437	552	2145	5.7
54	42	U2AA054042A2245AAA	476	130	467	582	2145	5.7
60	48	U2AA060048A2645AAA	555	130	528	642	2535	6.5
66	53	U2AA066053A2645AAA	555	130	578	692	2535	6.6
72	57	U2AA072057A2845AAA	594	130	618	732	2730	7.1
78	62	U2AA078062A3445AAA	715	130	668	782	3315	8.2
84	68	U2AA084068A3645AAA	754	130	728	842	3510	8.7
90	72	U2AA090072A3845AAA	793	130	768	883	3705	9.1
96	76	U2AA096076A4045AAA	832	130	808	923	3900	9.5
108	88	U2AA108088A4645AAA	951	130	929	1043	4485	10.7
108	84	U2AA108084A4445AAA	912	130	889	1003	4290	10.3
120	98	U2AA120098A5645AAA	1148	130	1029	1143	5460	12.7

^① Phase-to-phase clearances are expressed as minimum arrester center-to-center distances. Phase-to-earth clearances are expressed as minimum arrester centerline-to-ground distances.

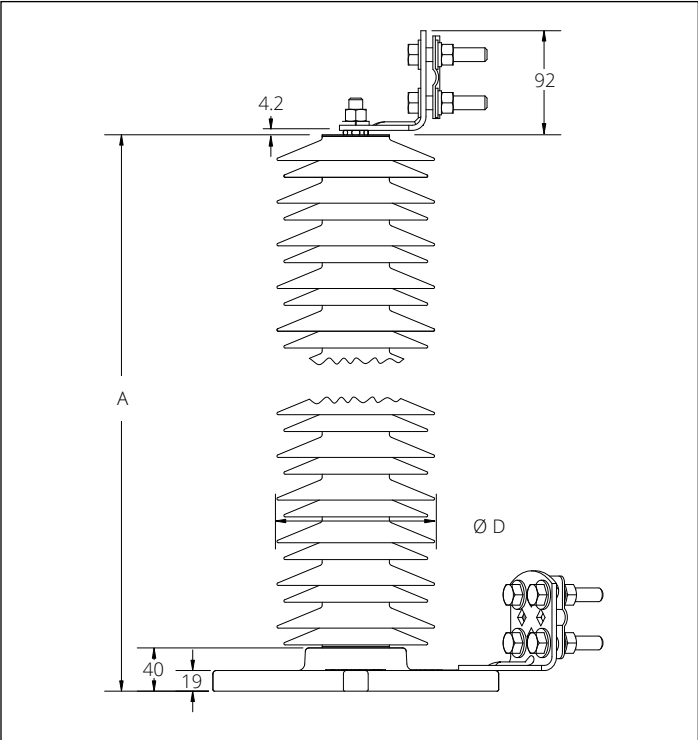


Figure 4. Outline drawing of standard U2AA arrester—dimensions in mm

Notes: Refer to **Table 5** for dimension A and D. Arresters shown with standard line and earth terminals. Outlines in **Figure 4** and data from **Table 5** represent standard arrester catalog numbers. Outline dimensions will vary when optional housing codes are selected.

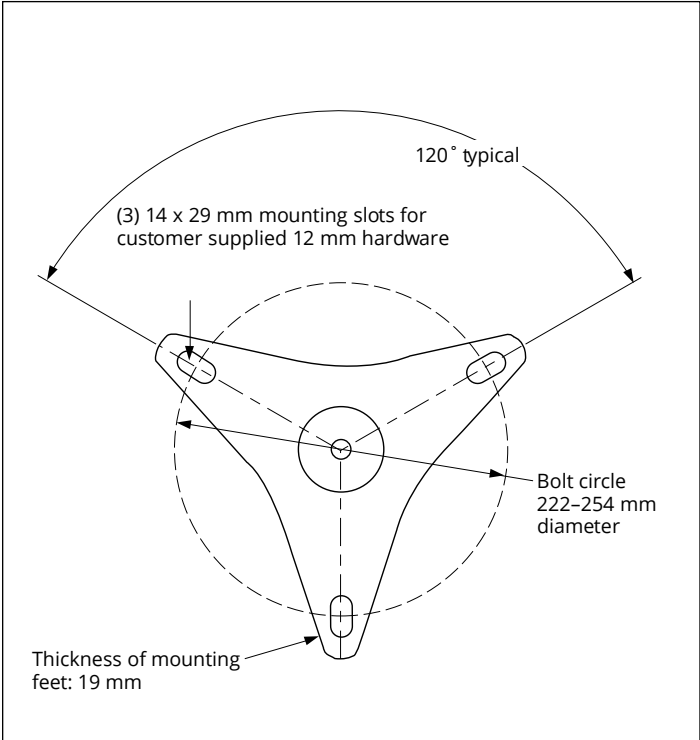


Figure 5. Base mounting

Isolation bases and surge counters

Table 6. Bases and counters

Catalog number	Description of counters
AM22A1	Counter without leakage current meter
AM22A2	Counter with leakage current meter (0–30 mA)
AM22A3	Counter with leakage current meter (0–50 mA)
AM22A12	AM22A2 with auxiliary contact
Description of bases	
AM23A1	Polyfiber molded insulator base set and hardware

Note: See the insulating bases and surge counter instructions manual, MN235003EN for additional details.

Table 7. UltraQUIK™ catalog numbering system for UltraSIL polymer-housed VariSTAR Type U2AA Class SL arresters

1 U	2 2	3 A	4 A	5	6	7	8	9	10	11	12	13	14	15	16	17	18
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Catalog number digits:

1 = "U" (UltraSIL housed arrester)

2 = "2" (IEC Class SL arrester)

3 = "A" Standard electrical build

4 = "A" Standard cantilever strength design

5 through 10 = Arrester rating U_r (U_c)

003002 = 3 kV (2.55 kV)	042034 = 42 kV (34.0 kV)
006005 = 6 kV (5.10 kV)	045036 = 45 kV (36.5 kV)
009007 = 9 kV (7.65 kV)	048039 = 48 kV (39.0 kV)
010008 = 10 kV (8.4 kV)	054042 = 54 kV (42.0 kV)
012010 = 12 kV (10.2 kV)	060048 = 60 kV (48.0 kV)
015012 = 15 kV (12.7 kV)	066053 = 66 kV (53.0 kV)
018015 = 18 kV (15.3 kV)	072057 = 72 kV (57.0 kV)
021017 = 21 kV (17.0 kV)	078062 = 78 kV (62.0 kV)
024019 = 24 kV (19.5 kV)	084068 = 84 kV (68.0 kV)
027022 = 27 kV (22.0 kV)	090070 = 90 kV (70.0 kV)
030024 = 30 kV (24.4 kV)	096076 = 96 kV (76.0 kV)
033027 = 33 kV (27.0 kV)	108088 = 108 kV (88.0 kV)
036029 = 36 kV (29.0 kV)	108084 = 108 kV (84.0 kV)
039031 = 39 kV (31.5 kV)	120098 = 120 kV (98.0 kV)

11 = "A" High creep UltraSIL polymer housing

Table 7. UltraQUIK catalog numbering system for UltraSIL polymer-housed VariSTAR Type U2AA Class SL arresters (continued)

1 U	2 2	3 A	4 A	5	6	7	8	9	10	11	12	13	14	15	16	17	18
---------------	---------------	---------------	---------------	---	---	---	---	---	----	----	----	----	----	----	----	----	----

12 and 13 = Housing code (select from table below):

O = Standard housing

Note: If additional creepage distance is required, please contact your Eaton representative for customized options.

Creepage distance (mm) U, arrester rating (kV, rms)	06	08	10	12	14	16	18	20	22	26	28	34	36	38	40	44	46	48	56
	585	780	975	1170	1365	1560	1755	1950	2145	2535	2730	3315	3510	3705	3900	4290	4485	4680	5460
3	O																		
6	O																		
9		O																	
10		O																	
12		O																	
15			O																
18			O																
21			O																
24				O															
27					O														
30					O														
33						O													
36						O													
39							O												
42								O											
45								O											
48									O										
54									O										
60										O									
66										O									
72											O								
78												O							
84													O						
90														O					
96															O				
108																O	O		
120																			O

Table 7. UltraQUIK catalog numbering system for UltraSIL polymer-housed VariSTAR Type U2AA Class SL arresters (continued)

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
U	2	A	A														

14 = Line terminal options

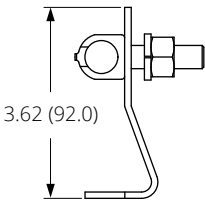
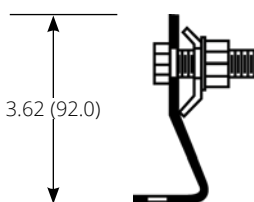
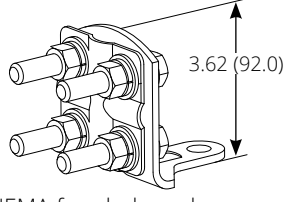
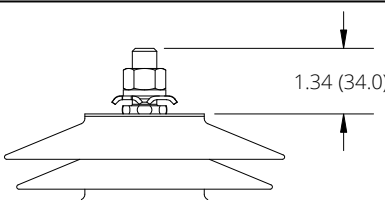
 1 = Eyebolt connector Accepts copper or aluminum conductors from 0.16 inch dia. (#6) to 0.575 inch dia. (250 kcmil)	 3 = Clamp style connector Accepts copper or aluminum conductors from 0.16 inch dia. (#6) to 0.82 inch dia. (500 kcmil)	 4 = NEMA four-hole pad Accepts copper or aluminum conductors from 0.16 inch dia. (#6) to 0.82 inch dia. (500 kcmil) (Standard option)
 5 = Wire clamp Accepts copper or aluminum conductors from 0.16 inch dia. (#6) to 0.575 inch dia. (250 kcmil) (Cubicle mount)		

Table 7. UltraQUIK catalog numbering system for UltraSIL polymer-housed VariSTAR Type U2AA Class SL arresters (continued)

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
U	2	A	A														

15 = Earth terminal options

1 = Clamp style connector
Accepts copper or aluminum conductors from 0.16 inch dia. (#6) to 0.575 inch dia. (250 kcmil)

5 = NEMA four-hole pad
Accepts copper or aluminum conductors from 0.16 inch dia. (#6) to 0.82 inch dia. (500 kcmil)
(Standard option)

B = Wire clamp
Accepts copper or aluminum conductors from 0.16 inch dia. (#6) to 0.575 inch dia. (250 kcmil)
(Cubicle mount)

9 = Eyebolt connector
Accepts copper or aluminum conductors from 0.16 inch dia. (#6) to 0.575 inch dia. (250 kcmil)

16 = Mounting arrangement

A = Mounting base located on bottom
(Standard option)

B = No mounting base
(Cubicle mount)
Available only if Digits 12 and 13 are housing options 16 or less (3–36 kV U_r).

C = Mounting base located on top
(Suspension mount)

Table 7. UltraQUIK catalog numbering system for UltraSIL polymer-housed VariSTAR Type U2AA Class SL arresters (continued)

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
U	2	A	A														

17 = Nameplate information, see Figure 6

Nameplate information is per IEC 60099-4 and is available in the following languages.

Specify:

A = English **B** = Spanish **C** = Portuguese

18 = Packaging

A = Export packing, cardboard

2 = Export packing, wood crating

Nameplate information

A stainless steel nameplate is attached to the base of every UltraSIL polymer-housed Type U2AA arrester. The arrester catalog number, serial number, year of manufacture, U_r , U_c , and pressure relief rating are among the details provided on the nameplate. See **Figure 6** for an example of a base nameplate.

Additional information

MN235010EN	UltraSIL Polymer-Housed VariSTAR Type U2AA Surge Arrester Installation and Maintenance Instructions
CT235015EN	IEC 60099 Certified test report—UltraSIL Polymer-Housed VariSTAR Type U2AA Class SL Station Class Surge Arrester

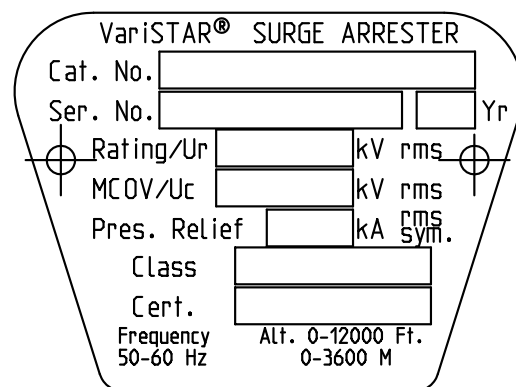


Figure 6. Arrester base nameplate (English version)

Eaton
1000 Eaton Boulevard
Cleveland, OH 44122
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Eaton's Power Systems Division
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Waukesha, WI 53188
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