Table 10
Ratings for Standard Three-Phase Contactors
For MELP Units up to 6.9KV Assemblies

Contactor Capacitor Switching			
Contactor Amp Rating	**Voltage Ratings**	**Kvar Ratings**	**Capacitor Switching Amps**
160A Contactor	2200-2500V	480	120
	3000-3600V	640	
	3800-4800V	960	
	6000-6900V	1320	
200A Contactor	2200-2500V	600	150
	3000-3600V	800	
	3800-4800V	1200	
	6000-6900V	1650	
360A Contactor	2200-2500V	1000	270
	3000-3600V	1475	
	3800-4800V	2150	
	6000-6900V	2950	
400A Contactor	2200-2500V	1200	295
	3000-3600V	1650	
	3800-4800V	2400	
	6000-6900V	3300	
800A Contactor	2200-2500V	2400	550
	3000-3600V	3200	
	3800-4800V	4000	
	6000-6900V	4800	

Vacuum contactors have the following ratings:
+ Mechanical Operations 2,500,000
+ Electrical Operations 300,000

Table 11
Ratings for Standard Single-Phase Capacitor Switches
(Grouped with junction box to operate as three phase device)

Oil Switches. . . Motor Operated Vacuum switches. . . Motor operated or Solenoid operated	
Switches are 15KV, 200 amps, 150 amp capacitor rated	
Three Phase Voltage	**Three Phase Kvar (Max)**
2400	600
4160	900
4800	1200
6600	1500
7200	1800
12470	3000
13200	3300
13800	3600
14400	3600

Single phase oil and vacuum switches are designed to handle 200 amps of capacitor current. This means that the device will have to handle 135% of nominal capacitor current. This, by standard, includes 10% overvoltage, 10% harmonics and 15% capacitor tolerance. Therefor, the calculated current of the bank should not be greater than 150 amps.

Example:
3000KVAR / (12.47KV*SQRT(3) = 138.9 amps.
138.9 amps times 1.35 = 187.5 amps.

Vacuum switches have the following ratings:
+ Mechanical Operations 50,000
+ Electrical Operations 10,000

Oil switches have the following ratings:
+ Mechanical Operations 10,000
+ Electrical Operations 400

Constructing a Catalog Number

The chart below shows how to construct the catalog number for the series MSC metal-enclosed capacitor assembly with the following requirements:

- 7200/12470 volt 3150Kvar three-phase
- Three stages to develop seven steps of 450 KVAR increments (3150 KVAR total).
- Three phase, four wire system – Grounded-wye connected bank
- Switched with 200 amp vacuum switches
- Main disconnect switch
- Bottom entry
- Control Power Transformer (Connected phase to neutral)
- Lightning arrestors
- Key-interlock scheme
- Ground switch for each step
- Allen Bradley Controller
- ANSI 61 gray
- Standard enclosure

MSC - Basic letters for series MSC metal enclosed **M**ultiple **S**tep **C**apacitor assembly
G- Total installed three -phase Kvar from Table 1.
315 - Voltage rating code Table 2.
7 - Number of steps from Table 3.
450 - Kvar increment from Table 4.
G - Bank connection code; select from Table 5.
130 - Incoming section option code; select from Table 6.
V - Switch code; select from Table 7.
KABGR - Optional equipment codes: select from Table 8.

The complete catalog number would be:
MSC-G-315-7-450-G-130-V-KABGR

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250 Hogan Drive • Conway, AR 72034
Phone (501) 327-6456 • Fax (501) 327-8301 • www.pssamerica.com

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Standard Metal Enclosed Multiple Step Capacitor Assemblies

Power System Solutions (PSS) metal enclosed capacitor assemblies are designed to meet a wide variety of multiple step capacitor applications for utility and industrial customers.

Standard assemblies are available as low as 300 KVAR per stage and as large as 7200 KVAR per stage for 5 to 15 KV applications (25KV and 35 KV assemblies are available as well as higher kvar ratings.)

Multiple **S**tep **C**apacitor Assemblies **(MSC)** offers a well-engineered and efficient way to provide a wide variety of KVAR and options.

PSS-MSC metal enclosed capacitor assemblies can offer cost savings over open-type capacitor and competitive assemblies in several ways:

- More KVAR can be furnished in a smaller area saving in "real-estate" costs.
- The assemblies come pre-assembled and installation site assembly is minimal allowing a substantial savings in labor and equipment costs.
- The enclosure is tamper resistant and meets ANSI standard C57.12.28 enclosure integrity requirement providing safety for operating personnel. Also, reduces operating costs by protecting the equipment from wildlife and mischievous vandalism.
- The tamper resistant feature allows the assembly to be placed in a non-fenced area saving cost and reduces space limitations.
- The enclosure is durable, 11 gauge welded galvanneal sheet steel with positive three point latched doors.
- Application versatility with the addition of many options and controls within the assembly.
- Assemblies can be place indoor as well as outdoor locations.

Available Options Include:

- Bank connections: Grounded wye, ungrounded wye or delta.
- Single-phase capacitors through 8.32KV for 14.4KV three-phase systems are available.
- Vacuum or oil switches (vacuum contactors for 5KV applications).
- Incoming cable arrangements for bottom or top entry.
- Control power transformer.
- Current limiting reactors.
- Surge arresters.
- Ground switches.
- Unbalance detection.
- Key interlocks.
- Pentahead-bolted doors.
- Standard paint Guardian green, finish-paint Munsell 7.0GY3.29/1.5. ANSI gray 61 or 70 are also available. Other colors can be furnished.
- Standard material is 11-gauge Galvanneal steel welded enclosures with ship channel base.
- Aluminum and Stainless Steel units are available.

Proper current limiting reactors are required and provided, in the stages to protect the equipment from back to back switching transients.

Capacitor Units

PSS type **MSC** capacitor assemblies are furnished with field-proven highly reliable all-film capacitors. The capacitors are designed with low operating temperature, reduced tank rupture hazard and are properly fused.

Quoting and Ordering Information

- Table1. Specifies the code describing the system voltage.
- Table2. Specifies the code describing the total three phase KVAR.
- Table 3. Specifies the code describing the number of switching steps desired.
- Table 4. Specifies the code describing the KVAR increments per step.
- Table 5. Specifies the code describing the required bank connection.
- Table 6. Specifies the code describing the incoming section.
- Table 7. Specifies the code describing the switch options.
- Table 8. Specifies the code describing the optional equipment available.

To request a quotation or order PSS type MSC capacitor assembly, use the tables below to construct a catalog number.

Table 1
System Voltage

Capacitor Line-to-Line Voltage*	Code
2400	A
2770	B
4160	C
4800	D
7200	E
8320	F
12470	G
13200	H
13800	I
14400	J

* Contact us for other voltage ratings.

Table 2
Total Bank Kvar

Total 3-Phase Kvar Rating	Code		Total 3-Phase Kvar Rating	Code
300	030		3750	375
450	045		3900	390
600	060		4050	405
750	075		4200	420
900	090		4350	435
1050	105		4500	450
1200	120		4650	465
1350	135		4800	480
1500	150		4950	495
1650	165		5100	510
1800	180		5250	525
1950	195		5400	540
2100	210		5550	555
2250	225		5700	570
2400	240		5850	585
2550	255		6000	600
2700	270		6150	615
2850	285		6300	630
3000	300		6450	645
3150	315		6600	660
3300	330		6750	675
3450	345		6900	690
3600	360		7050	705
*	*		7200	720

*Contact us for other kvar ratings.

Table 3
Number of Steps

Specify a number from 2 through 12.

Table 4
Kvar per Step

Specify the kvar increment per step.

Note: Add the appropriate step number and KVAR

Table 5
Connection Code

Description	Code
Ungrounded Wye (3-phase-3-wire, or 3-phase, 4-wire systems)	U
Grounded Wye (3-phase, 4-wire multi-grounded systems only)	G
Delta (3-phase, 3wire, or 3-phase, 4-wire systems)	D

Table 6
Incoming Section Arrangement (A)

Incoming Arrangement (Select One Code)		Incoming Options (Select One Code)		Incoming Entry (Select One Code)	
Description	Code	Description	Code	Description	Code
Bus Termination Only	0	None	0	Bottom Entry (Standard)	0
Main 3-Pole Disconnect Switch	1	Control Power Transformer (CPT)	1	Top Entry	1
Main Fuses	2	Distribution Surge Arrester	2	Top Entry via Roof Bushings	2
Main 3-Pole Disconnect Switch & Main Fuses	3	Control Power Transformer (CPT) and Distribution Surge Arrestors	3		

Table 7
Switch Options

Description	Code
Switched with 3 single-phase 200 amp Oil Switches	S
Switched with 3 single-phase 200 amp Vacuum Switches	V
Switched with 1 three-phase Vacuum contactor (For use on systems up to 5 KV only)	C

Table 8
Optional Equipment

Description	Code
Key interlock scheme	K
Penta-head bolt doors	P
Unbalance detection	
Unbalance scheme for each step: Placing a detection scheme on each individual step will trip the affected step only and allow the remaining steps to function without hindrance. The affected step will be locked out until maintenance is performed and the step is reset.	1
A main unbalance detection scheme: This method monitors the main capacitor bus feeding all the steps. All steps will drop and lock out if any step has an unbalance. The relay will have to be set for the smallest capacitor in a step.	2
Ground Switch:	
Ground switch for each step: Placing a ground switch on each individual step will allow the affected step to be grounded, capacitors to discharge and be separated from the rest of the capacitor assembly. This will allow the remaining steps to function without hindrance.	3
A main ground switch scheme: This method requires more circuitry and less ground switches. All steps will have the capacitor step switch opened. The main disconnect switch will have to be opened separating the bank from the incoming line. Then the capacitor switches will have to be reclosed to allow all capacitors to discharge.	4
Controller (select one):	
Allen-Bradley PLC	A
Voltage	E
Current	C
Power Factor	P
Var	R
Multifunctional	L
Manual	M
None (supplied by others)	N
Paint (select one):	
Guardian Green, Munsell No. 7.0GY3.2/1.5 (standard)	5
Gray ANSI 61	6
Light Gray ANSI 70	7
Enclosure (select one):	
Standard 11 ga. Galvanneal Steel	S
Aluminum	U
Stainless Steel	T

Table 9
Standard Ratings of Capacitors for MSC Banks
Single Phase Capacitors - Wye Connected

Kvar Rating	Standard Voltage Ratings								
50	2400	2770	4160	4800	6640	7200	7620	7960	8320
100	2400	2770	4160	4800	6640	7200	7620	7960	8320
150	2400	2770	4160	4800	6640	7200	7620	7960	8320
200	2400	2770	4160	4800	6640	7200	7620	7960	8320
300			4160	4800	6640	7200	7620	7960	8320
400				4800	6640	7200	7620	7960	8320
500					6640	7200	7620	7960	8320

+ Units available with single or, double bushings
+ Units with voltage ratings from 2400 to 4800 volts are 75KVBIL units
+ Units with voltage ratings from 6640 to 8320 volts are 95KVBIL units