

**SIEMENS**

Series 81000™ Controller  
with Drawout Vacuum Contactors



# Series 81000™ Drawout Vacuum Contactors

For more than 20 years, Siemens has been at the leading edge of vacuum contactor technology for motor control applications. Today, as a result of its inherent reliability and outstanding performance, the entire line of Siemens Series 81000™ Controllers, from 5 through 7.2kV, exclusively features vacuum contactor technology.

The efficient design of the Series 81000 Controllers is used to maximum advantage by accommodating up to three separate contactors in one vertical section. The value of this design pays off with substantial weight savings, speedy installation and plenty of cabling room.

Every Series 81000 Controller we manufacture represents our commitment to total quality. Simply stated, we at Siemens believe that quality cannot be inspected into a product, it must be *designed* in from the start.

### The Vacuum Contactor Advantage

Available with enclosed ratings of 360A and 720A at 5kV, plus 360A at 7.2kV, the Siemens family of UL listed vacuum contactors forms the very heart of our medium voltage controllers. And to enable you to take maximum advantage of this technology, every Series 81000 Controller features drawout construction design.

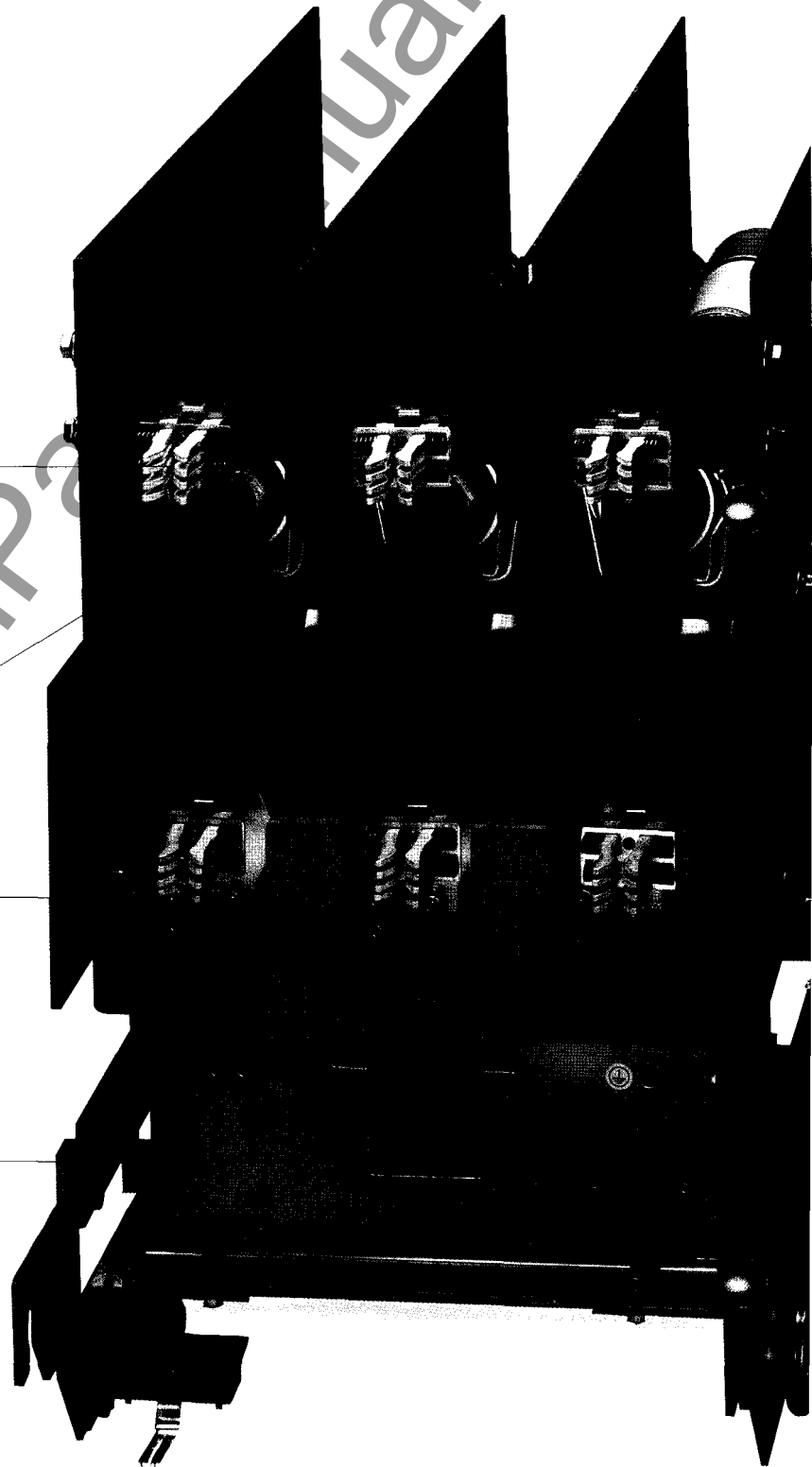
Why drawout construction? Because drawout construction speeds installation and maintenance. Plus it allows for safe access to the vacuum interrupter, coil and fuses. Siemens' 60 years of drawout experience in metalclad switchgear has proven the value of drawout construction for protecting equipment and personnel,

Line Primary  
Disconnects

Current  
Limiting  
Fuses

Load Primary  
Disconnects

Vacuum  
Contactor  
(see inset)

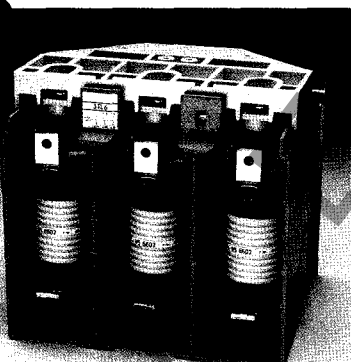




For an extra measure of protection, the contactor can be provided with a blown fuse trip option to cause the contactor to open in the event of a blown fuse and prevent single phase operation of the motor.

Siemens offers the 5kV and the 7.2kV contactors in both fused and unfused models. When those models with primary fuses are subjected to high values of short circuit current, the total fault clearing time will be within one-quarter cycle — minimizing damage to your electrical equipment and loads.

In terms of maintenance, Siemens Vacuum Contactors require only minimal periodic upkeep during their life span of 1,000,000 electrical operations. When you compare that figure with the higher maintenance and the 100,000 operation life span common to air magnetic contactors, it's easy to see how Siemens' vacuum contactors have earned a reputation for outstanding reliability and durability.

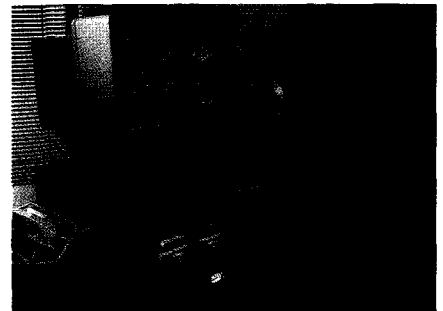


3TL6 Vacuum Contactor

enhancing safety and increasing serviceability for medium voltage equipment.

The latched contactor is an optional feature available on all 81000 Controllers. The latched contactor keeps the vacuum contactor closed even when power to the coil has been removed. A typical installation for a latched contactor is as a transformer feeder where you don't want the controller to open during a momentary loss of power.

*The 81000 Controllers can be made a key part of the ACCESS™ Electrical Distribution Communication System*



## Series 81000 Structural Features

### Built for Versatility and Ease of Operation

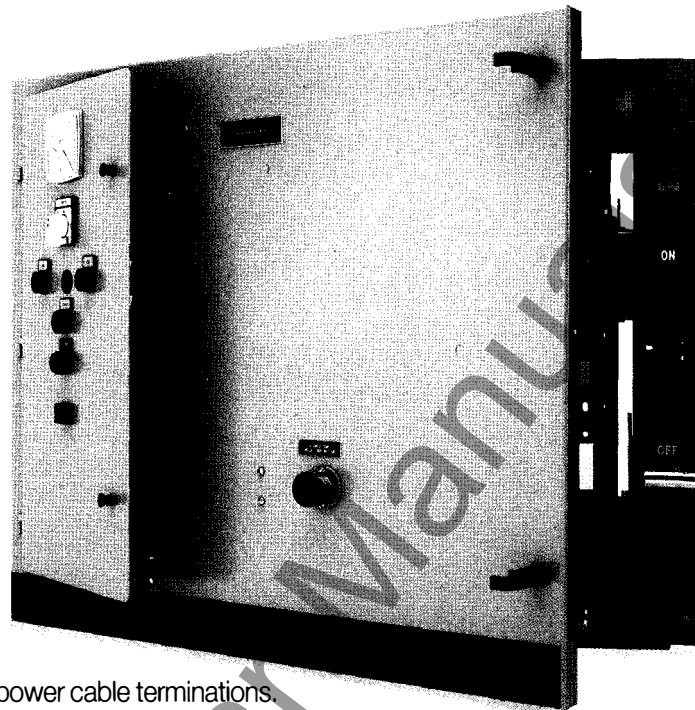
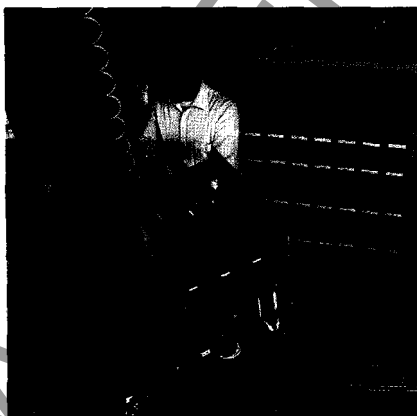
The construction of Siemens Series 81000 Controllers allows you to mount one, two or three controllers in a standard vertical section and gives you maximum control over where and how they are to be used.

Available structure types include:

- NEMA 1 - General purpose, indoor
- NEMA 1 - Gasketed
- NEMA 2 - Drip proof
- NEMA 3R - Outdoor, rain, sleet and snow proof
- NEMA 12 - Industrial type, dust and drip proof

The Siemens door-in-door construction creates sufficient space for most of your low voltage control equipment. This space saving feature puts the controls right at the medium voltage controller.

Within the medium voltage compartments, the contactors themselves are offset to the right to give the user more wiring access to the load terminals of the contactor. There are no barriers in the contactor cell that interfere with access to



power cable terminations. This arrangement also allows easy access to current transformers and optional surge limiters.

In addition, the grounded metal segregation of the main bus, the low voltage compartment and the medium voltage section increases safety throughout the entire controller structure.

For motor protection, the Siemens 3UA thermal overload relay with NEMA class 10 tripping characteristics is standard. This front adjustable relay has a wide range of trip settings and is ambient temperature compensated. The 3UA has directly heated bi-metallic elements that, after tripping, can be reset either by hand or automatically, as desired.

The 3UA relay's internal trip mechanism provides motor single phase protection and phase

*For easy access to low voltage controls, 81000 Controllers feature Door-In-Door Construction*

unbalance protection. In addition to a normally open alarm contact, the relay also has a normally closed contact for control circuit de-energization in case of a thermal trip. This highly accurate and reliable thermal overload relay has a trip indicator, manual test button and removable protective cover. And, in line with Siemens' commitment to quality, the 3UA is completely factory tested, calibrated and sealed.

For those applications which require longer acceleration times, Siemens offers the type 3UB solid-state overload relay. This relay is adjustable from NEMA class 5 up to NEMA class 30 characteristics.

Siemens Series 81000 Controllers have been designed to utilize a wide variety of bus ratings and materials for maximum specification flexibility. Horizontal main bus is available for 600, 1000 and 1200 amperes in tin

*Siemens is Committed to Total Quality in Manufacturing and Engineering*



Grounded Steel Barriers Between Power Bus & Contactors

Low Voltage or Controller Compartment

Shutters

Steel Barriers Between Compartments

Current Transformers

And, if your specifications call for the added flexibility and protection of a main circuit breaker for the controller lineup, Siemens has a bus transition frame that allows you to connect your Series 81000 Controller directly to Siemens GM Switchgear.

With the addition of a Siemens 4700 Power Meter, your Series 81000 Vacuum Controller becomes an integral part of the Siemens ACCESS™ Electrical Distribution Communication System. Contact your local Siemens Sales Office for more information about this exciting new technology.

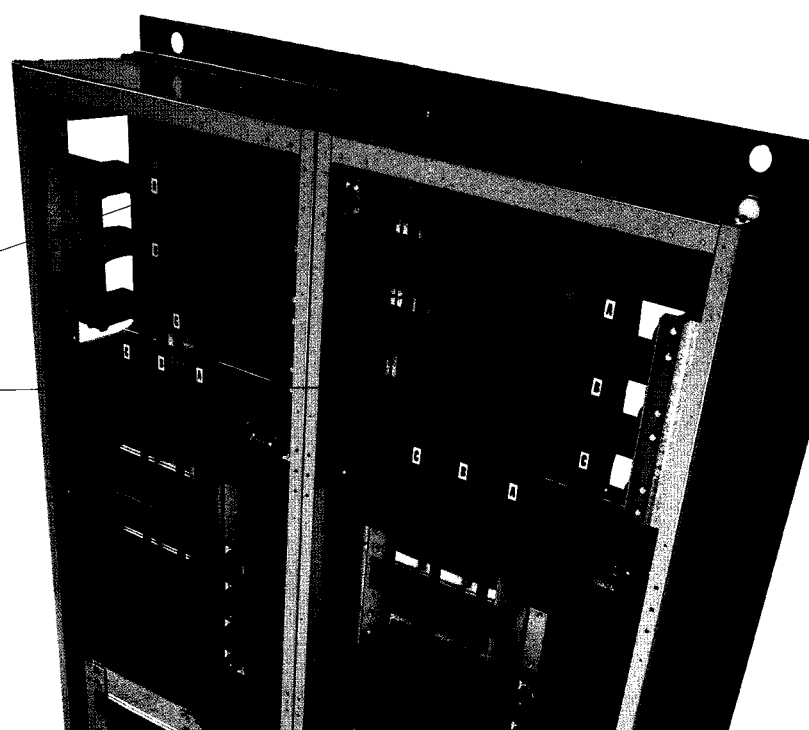
Siemens also offers the 85000 Synchronous Control system for synchronous motor applications. This microprocessor based protection system gives you everything you need for controlled starting and protection of brush-type synchronous machines. The 85000 Control package allows for convenient mounting of all components in one vertical section.

plated aluminum. With copper bus, ratings of 1000, 1200 and 2000 amperes are available, with tin plated or silver plated connections. Vertical bus is available with a 600 ampere rating using copper conductors.

For application flexibility, Siemens offers load interrupter switches in 600 and 1200 ampere ratings, fused or unfused. These switches are often specified for incoming line disconnect purposes or for bus tie applications.

Horizontal Main Bus

Full Height Copper Vertical Bus



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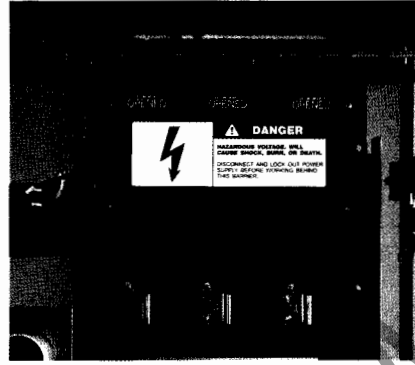
# Racking Description And Drawout Construction Features

## Safe And Easy Racking

Every Series 81000 Controller features a convenient racking mechanism as well as a host of other features that enhance safety and ease maintenance.

To start, a combination of electrical and mechanical interlocks is utilized to prevent a closed contactor from being racked in or out. The interlocking mechanism also prevents the opening of a medium voltage compartment door unless the contactor is racked out. The enhanced safety for your maintenance personnel created by these features is obvious.

Ease of operation is an important benefit of the 81000 drawout design. In fact, drawout operation is the height of simplicity: merely open the 81000 Contactor, move the racking handle to the OFF position, open the door, and the contactor is ready to be rolled out of the compartment. As the contactor is moved to the OFF position, insulated safety shutters



*Insulated Shutters cover the line stabs when the contactor is withdrawn.*

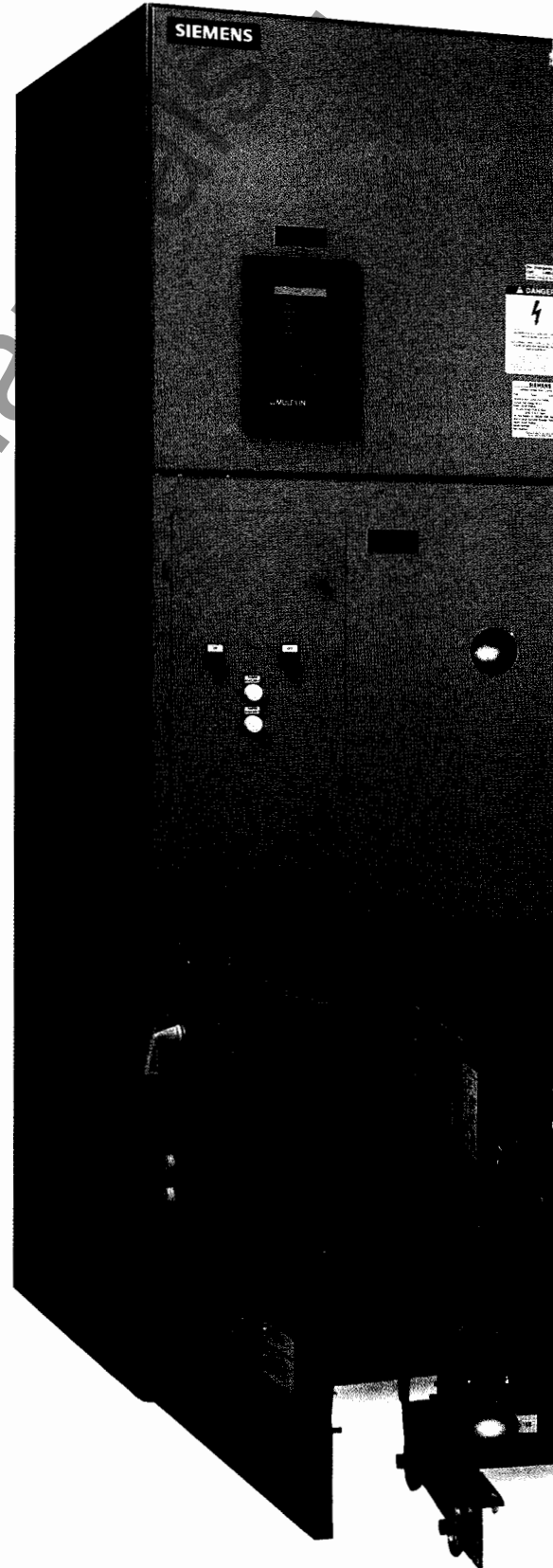
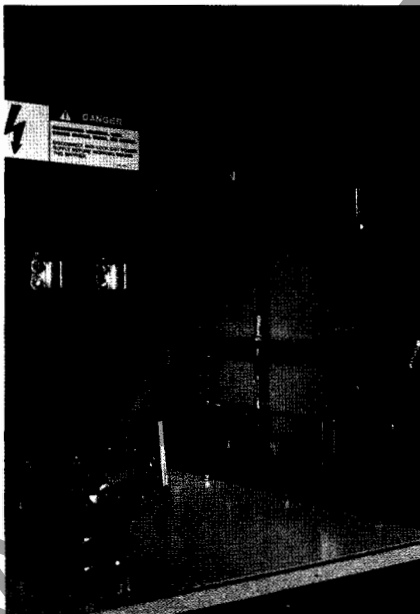
automatically drop down to cover the line stabs.

A compound four-bar mechanism makes the racking of the drawout element a simple one-handed operation. With the drawout element racked out, inspection of vital elements is a snap. All items that may require inspection are either on the drawout element itself or are in plain view when it is racked out.

A test switch is provided in the low voltage compartment that enables you to verify the electrical operation of the contactor while in the racked out position. Use this switch to select either the RUN or TEST mode.

The control circuit disconnect plug, conveniently located on the left side of the contactor, is extremely helpful for maintenance personnel when the contactor is away from the Series 81000 Controller lineup. During bench testing, the control circuit disconnect plug provides complete access to the operating solenoid and the auxiliary contacts.

*Positive Mechanical Interlocking enhances safe drawout operation.*



## Drawout Construction Speeds Maintenance and Improves Safety

When comparing drawout construction to fixed mounted construction, take into consideration the safety aspects of drawout's positive disconnect and the fact that drawout construction has been the safety standard in metal-clad switchgear for over sixty years.

Drawout construction also allows you to quickly insert a spare contactor as a replacement for any unit undergoing routine inspection, maintenance or repair. This minimized downtime is not possible with outdated fixed contactor construction, which could require you to shut down the entire lineup of controllers and physically unbolt the contactors and other equipment from the bus.

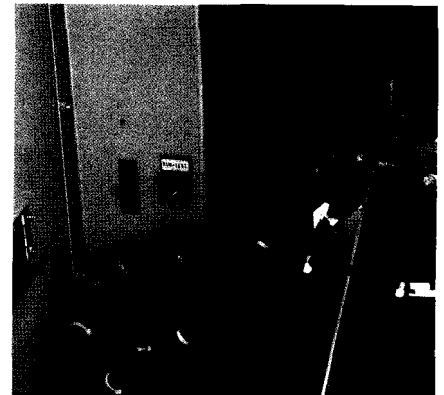
When you consider the long list of features (and benefits) that Siemens Series 81000 Controllers possess — drawout construction design, racking interlocks, safety shutters, one-handed racking, vacuum contactors, safer maintenance and inspection, as well as weight savings compared to air contactors — it's easy to see why the Series 81000 is the logical choice for state-of-the-art medium voltage controllers.

*Positive One-Step Drawout Handle*

*Contactor is Opened Behind Closed Steel Door*

*The Test Switch allows electrical operation of the contactor in the racked out position.*

*The Withdrawn Contactor Can Be Serviced Away From 81000 MVC*



# Typical Layouts For Series 81000

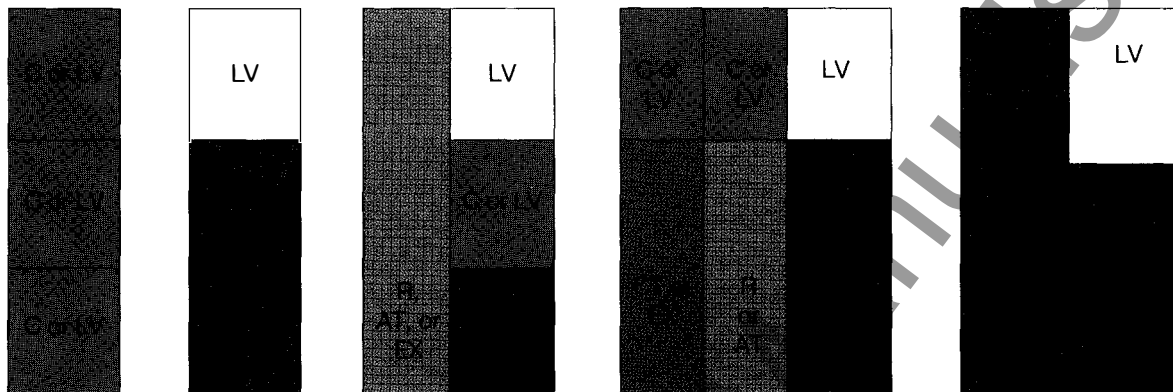


Fig A

Fig B

Fig C

Fig D

Fig E

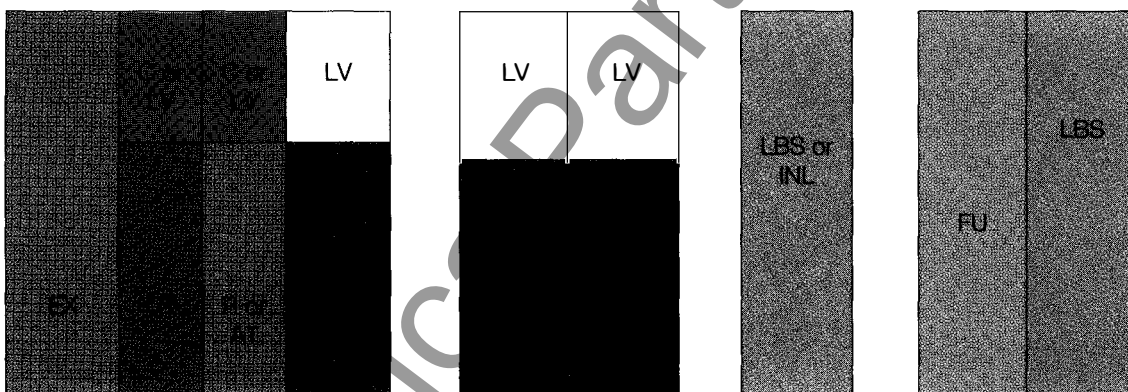


Fig F

Fig G

Fig H

Fig I

## Key:

- AT - Auto-transformer
- C - Medium Voltage Contactor
- CT - Cable Terminations
- EX - Space for Field Excitation Equipment
- FU - Fuses
- INL - Incoming Line
- LBS - Load Break Switch
- LV - Low Voltage (Control)
- R - Reactor

## Notes:

1. When upper cell is used for a drawout contactor, horizontal main bus (if required) is mounted on top of unit. This adds 10" to height of indoor structure.
2. Weights and dimensions for auto-transformer and reactor controllers vary as motor size varies.
3. For static exciter with any brush-type synchronous controller, using Series 85000 Synchronizing and Protection Module, add one 24" wide auxiliary structure.
4. Metering and protective device space requirements may warrant addition of a 24" wide auxiliary structure.
5. Power Factor Correction capacitors, when required with a FVNR controller, take

the same space as an additional controller (1/3 of a vertical structure).

6. Surge Protection, consisting of 3-phase station class surge arrestors and surge capacitors, requires a 24" wide auxiliary section.
7. Type 3EF1 surge limiters can be provided with any controller with no effect on layout or dimensions.
8. Special metering and relaying can be provided. A wide variety of current and voltage sensing relays, metering devices, ACCESS™ system components, and similar equipment is available. Normally, the top 1/3 of the structure will be devoted to a low voltage section, and the middle and lower cells will each house a FVNR starter.



Type of Contactor	Control Rating	Number of Contactors	Approx. Shipping Weight (lb) With Contactors		Approximate Enclosure Dimensions (inches)					Layout Arrangement Figure
			NEMA 1 or 12 Enclosure	NEMA 3R Enclosure	NEMA 1, 1A or 12 Enclosure			NEMA 3R Enclosure		
					Height	Width	Depth	Walk-in Width	Non-Walk-in Width	
Induction Full Voltage Non-Reversing	5kV 360A 5kV 720A 7kV 310A	1 1 1	1400 1600 1500	1600 1800 1700	30 90 90	36 36 36	36 36 36	42 42 42	42 42 42	A B B
Induction Reduced Voltage-Reactor Non-Reversing	5kV 360A 5kV 720A 7kV 310A	2 2 2	4000/6800 7400/8800 4600/7400	4400/7200 7800/9200 5000/7800	90 90 90	60/72 96/108 96/108	36 36 36	78 114 114	78 120 120	C D D
Induction Reduced Voltage-Autotransformer Non-Reversing	5kV 360A 5kV 720A 7kV 310A	3 3 3	4200/7000 7600/9000 4800/7600	4600/7400 8200/9600 5400/8200	90 90 90	60/72 96/108 96/108	36 36 36	78 114 114	78 120 120	C D D
Induction Full Voltage Reversing	5kV 360A 5kV 720A 7kV 310A	3 3 3	1800 3200 2000	2000 3600 2200	90 90 90	36 72 36	36 36 36	42 78 42	42 78 42	A E B
Synchronous Full Voltage Non-Reversing	5kV 360A 5kV 720A 7kV 310A	1 1 1	2000 2200 2100	2400 2600 2500	90 90 90	60/72 72/84 72/84	36 36 36	78 78/114 78/114	78 78/120 78/120	C C C
Synchronous Reduced Voltage-Autotransformer Non-Reversing	5kV 360A 5kV 720A 7kV 310A	3 3 3	5100/7900 8500/9900 5700/8500	5700/8500 9300/10700 6500/9300	90 90 90	84/108 132/144 132/144	36 36 36	114 150 150	120 156 156	D F F
Induction Full Voltage 2-Speed, 2-Winding	5kV 360A 5kV 720A 7kV 310A	2 2 2	1800 3200 3000	2000 3600 3400	90 90 90	36 72 72	36 36 36	42 78 78	42 78 78	A G G
Induction Full Voltage 2-Speed, 1-Winding	5kV 360A 5kV 720A 7kV 310A	3 3 3	2000 Note 1 3300	2200 Note 1 3700	90 Note 1 90	36 Note 1 72	36 Note 1 36	42 Note 1 78	42 Note 1 78	A Note 1 G
Latched Contactor	5kV 360A 5kV 720A 7kV 310A	1 1 1	1400 1600 1500	1600 1800 1700	90 90 90	36 36 36	36 36 36	42 42 42	42 42 42	A B B
LBS-unfused 600A or 1200A LBS-600A fused (to 480E)	5kV 7kV	— —	1400 1400	1600 1600	90 90	36 36	36 36	42 42	42 42	H H
LBS-1200A fused (to 1100E)	5kV 7kV	— —	2200 2200	2600 2600	90 90	72 72	36 36	78 78	78 78	I I
Incoming Line Main Lugs Only	5kV 7kV	— —	600 600	800 800	90 90	18/24/36 18/24/36	36 36	42 42	42 42	H H

Note 1: Consult Factory

**All dimensions and weights are for estimating purposes only—not for construction!**

NEMA 3R Walk-in Enclosures are 107" H x 101" D

NEMA 3R Non Walk-in Enclosures are 100" H x 47" D

Rough approximation for weights:  
 1200# per vertical structure, indoor  
 600# per incoming line structure, indoor  
 1200 – 4100# per reactor, up to 360A  
 1400 – 4300# per autotransformer, up to 360A

add 200# per contactor, 5kV 360A  
 add 400# per contactor, 5kV 720A  
 add 300# per contactor, 7kV 310A  
 add 200# per structure, outdoor

# Overvoltage Protection

## Proven Vacuum Interrupter Technology

Over the years, vacuum interrupters have proven to be the best circuit protection and disconnect devices available. With very little arcing and no arc products emitted to foul either the contacts or the controller, the Series 81000 Contactor has a life span of up to 1,000,000 electrical operations.

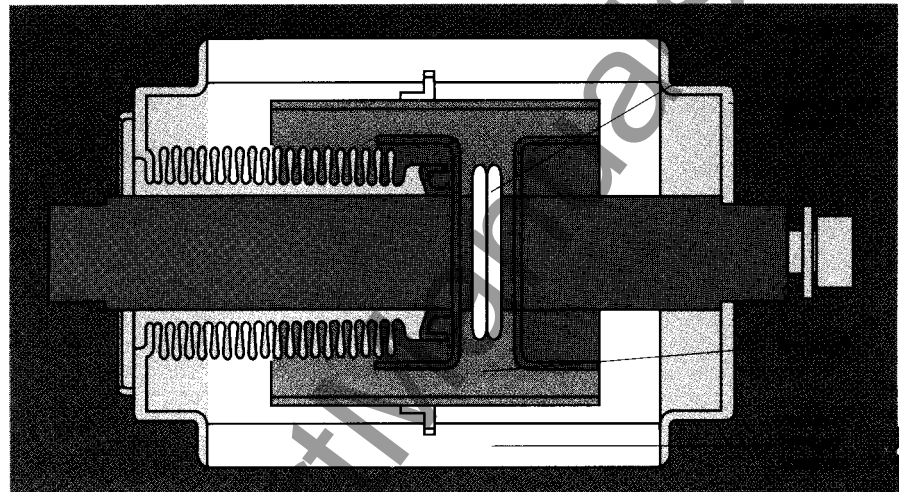
Series 81000 Controllers feature modern contact materials that minimize current chopping and the associated overvoltage produced. For those applications where surges may be of concern, Siemens Type 3EF1 surge limiters are available as optional equipment.

When surge limiters are specified, they are connected to the load terminals of the controller. As a result of the controller compartment's efficient design, no special space allowance is required for the 3EF1. Voltage ratings of the Type 3EF1 Surge Limiters are shown in the table below.

Voltage Ratings of Surge Limiters		Application		
System Voltage	Limiter Voltage	Delta	Effectively Grounded Wye	Resistance Grounded Wye
2.3kV	3.6kV	2.4kV	4.16kV	2.4kV
4.0kV	6.0kV	4.16kV	6.9kV	4.16kV
4.6kV	6.0kV	4.8kV	—	4.16kV
6.6kV	7.5kV	6.9kV	—	6.9kV

For more information on overvoltage protection, contact your local Siemens Sales Office.

**Siemens Energy and Automation**  
Technology that serves the customer.



## Guide Form Specifications CSI Section

### 16920 - Medium Voltage Control Specifications

#### 1.0 General Conditions

- 1.1 This specification covers the design, manufacture, assembly and testing of 5kV and 7.2kV Medium Voltage Controllers, Class E2.
- 1.2 Controllers shall be Siemens 81000 or Engineer approved equal.
- 1.3 This equipment will be designed and constructed in accordance with applicable sections of NEMA, ANSI and the National Electrical Code.
- 1.4 The controllers will comply with the requirements of UL 347 and shall bear the UL label whenever possible.
- 1.5 See attached drawings for equipment one line diagram.

#### 2.0 Structural, Construction, and Finish Requirements

- 2.1 The controller line-up shall consist of free standing vertical sections which are designed to allow additional sections, or individual starters, to be added in the field.
- 2.2 Individual vertical sections shall be capable of mounting up to three (3) drawout controller assemblies.
- 2.3 The frames shall be fabricated from 11 gauge steel.
- 2.4 Doors shall be fabricated from 12 gauge steel minimum.
- 2.5 Typical dimensions of the vertical sections shall be 90" high, 36" wide and 36" deep.
- 2.6 All external controller parts shall be provided with an electrostatically applied ANSI-61 light gray thermosetting polyester finish.
- 2.7 Interior sheet steel shall be provided with an electrostatically applied ANSI-61 light gray thermosetting polyester finish or be provided as heavy galvanized construction for corrosion protection.
- 2.8 All units shall be dead front construction and will utilize sheet steel barriers for isolation of the power bus compartments from the drawout controller area.
- 2.9 An insulating shutter mechanism shall act automatically to cover the line side stab connections when the controller is racked off the bus.
- 2.10 The back of each section shall be provided with a two-piece removable barrier for ease of access.
- 2.11 Enclosures shall be provided as one of the following NEMA types: □ 1 (general purpose indoor), □ 1 (gasketed), □ 2 (drip proof), □ 3R (outdoor), or □ 12 (dust proof).
- 2.12 Outdoor enclosure construction shall be □ Walk-in, or □ Non walk-in.

- 2.13 Within the door of each controller compartment, a low voltage section will be provided. This low voltage compartment must have a separate door, and must totally isolate all low voltage control circuitry from the high voltage cubicle. The low voltage compartment door shall be provided with an externally operable overload reset button.

- 2.14 The low voltage section shall contain terminal blocks for termination of purchaser's low voltage control circuits, as well as the overload relay and any other low voltage devices.

- 2.15 Provision shall be made for □ top, or □ bottom entry of power cables.

#### 3.0 Power Bus Requirements

- 3.1 A continuous 3 phase horizontal bus shall extend the length of the line-up.
  - 3.1.1 Horizontal bus shall be rated at □ 600 (aluminum only), □ 1000, □ 1200, or □ 2000 Amperes (copper only).
  - 3.1.2 Horizontal bus material shall be □ tin plated aluminum, □ tin plated copper, or □ silver plated copper.
- 3.2 Each vertical section housing drawout controllers shall be provided with a 600A rated copper vertical bus with the same plating as specified in 3.1.2.
- 3.3 An optional continuous horizontal ground bus shall be copper with a 600A rating.
- 3.4 All power buses will be readily accessible from the top, sides or rear of the structure by simple removal of the external cover plates.

#### 4.0 Incoming Power Requirements

- 4.1 Metalclad Switchgear (optional) - Metalclad Switchgear, used for incoming line equipment, shall be Siemens Type GM. (see CSI specification section 16320)
- 4.2 Load Interrupter Switchgear (optional) - Load Interrupter Switchgear used for incoming line, feeder or bus tie equipment shall be Siemens Type 81000 □ Fused, □ Non Fused, □ 600A, or □ 1200A.
- 4.3 Incoming Line Section (optional) - An incoming line section shall be provided for the following conditions □ Top entry cables, □ Bottom entry cables, □ Top entry bus duct (see attached drawings), □ Bus transition to transformer (see attached drawings), or □ Bus transition to switchgear (see attached drawings).

#### 5.0 Drawout Controller Assembly Requirements

- 5.1 Each 360A drawout controller shall consist of a magnetically held contactor, primary fuses for short circuit protection and an overload relay for motor overload protection.
- 5.2 Each 720A controller shall consist of a drawout primary fuse assembly for short circuit protection, an overload relay for motor overload protection and fixed contactor.
- 5.3 Overload relays shall provide running single-phase protection and an isolated N.O. alarm contact and shall be Siemens Type 3UA.

- 5.4 The drawout assembly shall include both line and load side stab fingers, allowing for complete removal of the drawout unit without disconnecting any power cabling.

- 5.5 All contactors shall utilize a vacuum interrupter main contact design to ensure extended operating life. Minimum electrical life of main contacts shall be 1,000,000 operations for 360A contactors.

- 5.6 The racking mechanism for each controller shall be designed such that it is impossible to rack the contactor or fuse assembly on or off the bus without first opening the contactor. Likewise, the mechanism must prevent opening of the compartment door unless the carriage is racked out.

- 5.7 The racking handle must clearly indicate the "ON" and "OFF" positions of the controller, and must be capable of being padlocked in the "OFF" position.

- 5.8 As an added safety feature, each controller will be provided with an externally visible red indicator light which is illuminated whenever the contactor is racked onto the bus.

- 5.9 The minimum short circuit rating of the fused assembly will be □ 350 MVA at 4kV, or □ 570 MVA at 6.6kV. The primary protective fuses should be ANSI class "R" for motor starting duty, and class "E" for transformer or capacitor feeder duty. All fuses shall be rated a minimum of 4800 volts and should have an interrupting rating of at least 80,000 amps asymmetrical. Fuses should be Siemens □ Type FM (2400-4800 volts), or □ Type A720R (7200 volts).

#### 6.0 Control Power Requirements

- 6.1 A control power transformer shall be provided with each controller to provide single-phase power for the contactor holding coil and other auxiliary devices as specified.
- 6.2 The CPT secondary will be rated □ 115 VAC, or □ 230 VAC.
- 6.3 Minimum transformer size shall be 750 VA and each CPT will be provided with two primary current-limiting fuses.
- 6.4 An electrical interlock shall be provided to automatically open the CPT secondary whenever the contactor is racked out.

## Ratings Table

SERIES 81000 CONTROLLER RATINGS										
Circuit Voltage	Enclosure Dimensions NEMA Rating	Controller Type	Interrupting Capacity		Motor Horsepower Rating - Phases		Inrush Current	Maximum Motor Load (%)	Maximum 3-Phase kVA	Maximum Fuses Rating
			1-Phase Fault Cr.	3-Phase Fault Cr.	1-Phase	3-Phase				
250	150	90H35	5kA	20kMVA	100	175	100	50%	1500	450E
250	150	90H6	10kA	20kMVA	200	350	100	57%	3000	600E
480	150	90H37	5kA	35kMVA	200	350	200	50%	2000	450E
480	150	90H6	10kA	35kMVA	400	700	200	57%	3500	600E
480	150	90H37	5kA	40kMVA	250	400	250	50%	2500	450E
480	150	90H6	10kA	40kMVA	500	900	250	57%	4000	600E
600	150	90H37	5kA	50kMVA	350	450	350	125%	1500	200E

\*Nominal Motor Voltage 660V.

## Operating Table

Operating Data	90H35 or 90H37 Contactor				90H6 Contactor			
	115V	250V	125V	250V	115V	250V	125V	250V
Rated Control Voltage	115	250	125	250	115	250	125	250
Pickup Voltage	36	135	100	175	31	117	80	175
Dropout Voltage	42	64	44	77	45	62	50	100
Pickup Time	60-100ms				120ms			
Dropout Time	200-250ms				<30ms			
Inrush Current	4.7A	2.3A	4.0A	2.0A	10A	5A	10A	5A
Steady Holding Current	1.05A	0.27A	0.56A	0.34A	1.3A	0.65A	1.3A	0.65A

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