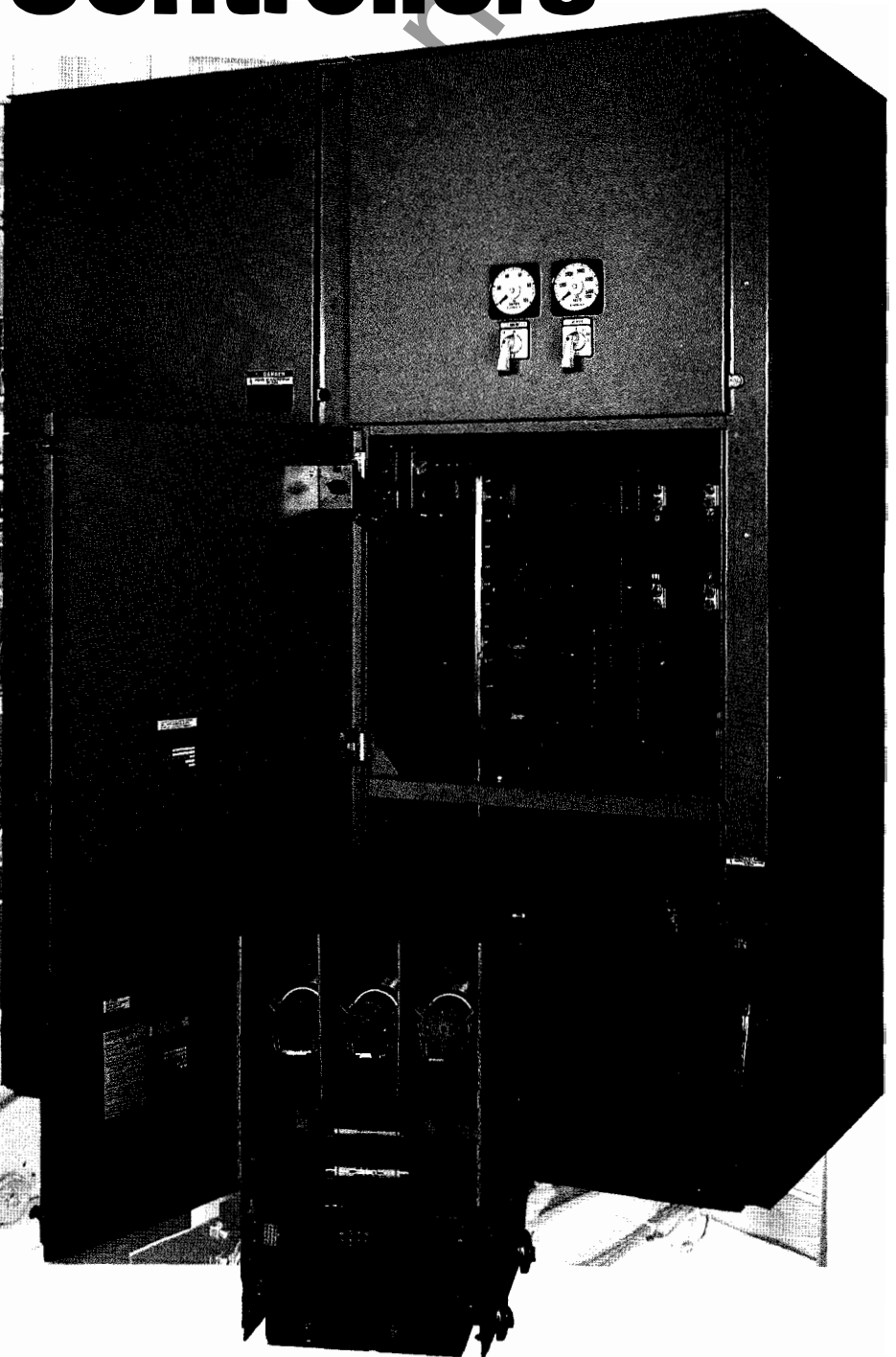
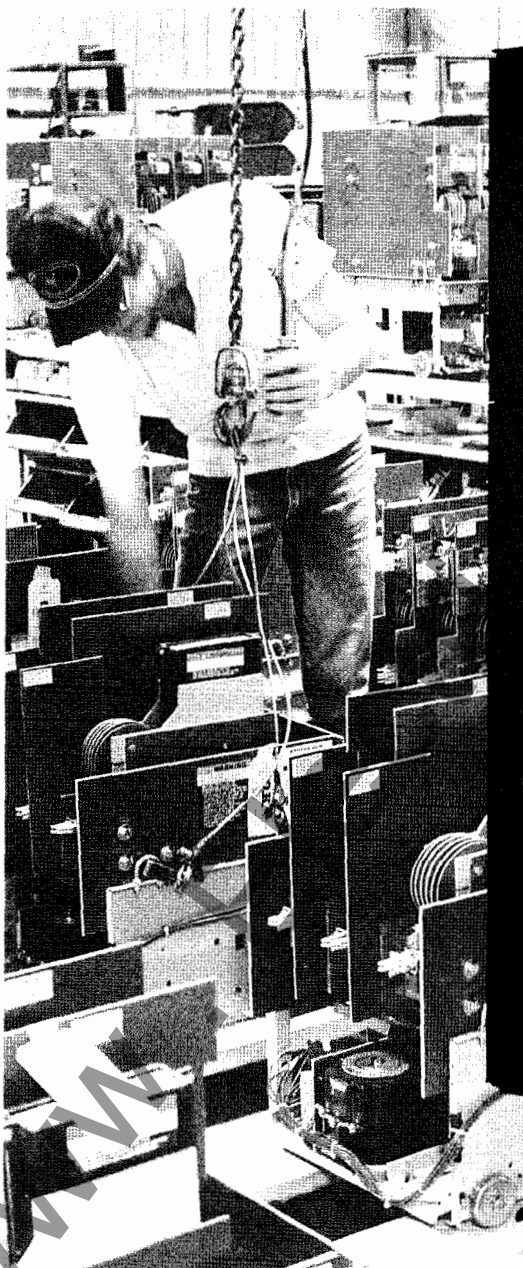


**SIEMENS**

# **Series 81000™ Vacuum Controllers**



**SIEMENS**

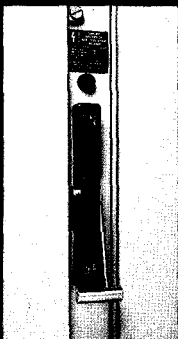
# Thirty years of leadership led to the Series 81000 Controller

The heart of the Series 81000 Controller is the Siemens vacuum contactor. Field proven for high reliability and long service life, it's suitable for heavy duty loads of different types.

High performance comes from containing arc interruption completely within vacuum bottles. Then, backing the seal and integrity of the bottle design with solid engineering. Add to that, a positive-action operator

mechanism to simplify operation. Lighter contactors for easier handling. One, two and three-high construction offering greater flexibility to meet customer requirements. Additional wiring space. Vertical bus. Blown fuse protection. One standard 36" width for all designs, and, a UL recognized contactor.

The Series 81000 medium voltage vacuum controller for high performance reliability.

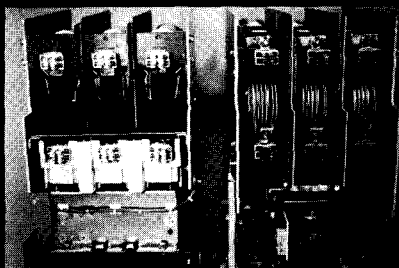


New operator mechanism



# Technological Development

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Vacuum technology has developed rapidly in recent years and is becoming widely accepted for medium voltage motor control applications, replacing the predominant air break technology. (See Figure 1, Comparison Chart).

The development of the vacuum contactor was a major step forward. Although the basic facts of

Extensive and wide-ranging research and development were an essential preliminary to the introduction of high-performance medium voltage vacuum contactors capable of switching their respective currents reliably and with virtually no maintenance. The rated number of switching operations is so high that the limits are hardly reached in actual practice.

FEATURES	VACUUM	AIR
Continuous Current	360 Amperes	180 or 360 Amperes
Voltage Rating	5kV	5kV
Interrupting Rating (Fused)	400mVA	400mVA
Electrical Life	1,000,000 Operations	100,000 Operations
Mounting Configuration	3-High (600A Max.)	3-High (540A Max.)

Figure 1. Series 81000 Vacuum Versus Air Comparison Chart

current interruption in vacuum were known at the turn of the last century, quantity production of vacuum interrupters waited until it became possible in the mid-sixties to use new technologies and manufacturing methods with economic efficiency. Modern manufacturing and testing methods make it possible to keep the vacuum at such a high level that the full switching capacity of the interrupter is assured even after several years storage.

Contactors for medium voltages should invariably be vacuum type. This design has firmly established itself because of the advantages it offers. Siemens has supplied the 3TL Series of vacuum contactors in large quantities since 1972.

## Vacuum Design Criteria

- High Reliability and Long Service Life
- Compact Design and Lighter Weight

2

The distinctive features of the Siemens type 85H3 vacuum contactors are their high reliability, long service life, compact dimensions and ability to deal with most motor switching duties. Even service under severe operating duties or extreme environmental conditions presents no problem thanks to the enclosed contact system. They are suitable for loads of many types; for example, three phase motors, transformers, capacitors and resistive loads.

The Siemens type 85H3 vacuum contactors provide an alternative to

the Type 81H2 and 81H3 air-magnetic contactors for use in the Series 81000 medium voltage controllers. In addition to the advantages of long mechanical and electrical life with low maintenance, the contacts are essentially immune to adverse atmospheric environments. Vacuum contactors are lighter in weight than comparable air-break contactors.

The overall dimensions of the draw-out vacuum contactor are similar to the air-magnetic contactor — 18 inches wide by 27.5 inches high by 23.25 inches deep. The vacuum

contactor with single or double barrel power fuses can be installed in Series 81000 class E2 controllers of either one, two, or three high construction.

The Type 85H3 vacuum contactor consists of: (1) a low voltage section which contains the magnetic drive and auxiliary contacts; (2) a medium voltage section which houses the vacuum interrupter bottles; and (3) a super-structure which provides mounting for the power fuses, control transformer and primary fuses, and drawout finger assemblies.

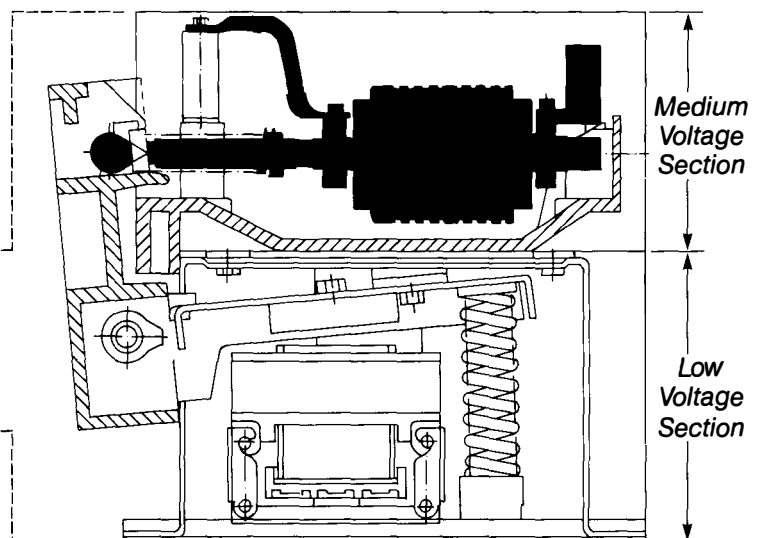
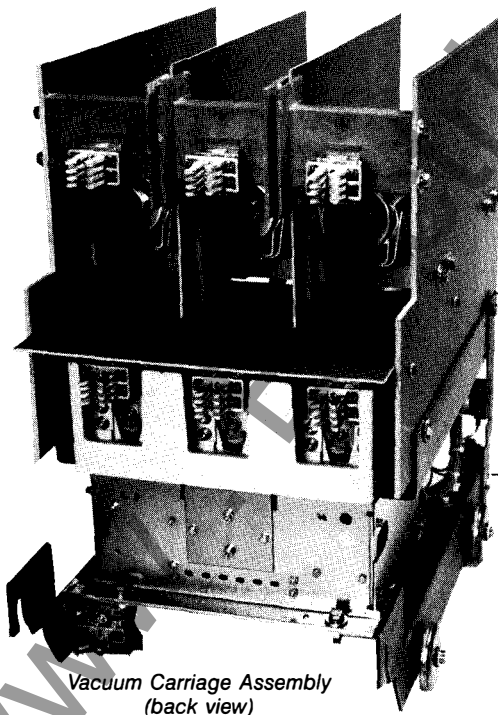


Figure 2. Cutaway of Vacuum Contactor from Carriage Assembly (side view)

# Operation and Ratings Data

- 5000 Volt Insulation Level
- Ratings for Both AC and DC Supply

## Operation

Since arc interruption is accomplished completely within vacuum bottles, arc chutes, blowout coils and pole plates are not required. Stationary and movable power contacts are located inside the vacuum bottles with corrugated steel spring bellows attached to the movable contacts to insure a complete seal and integrity of the vacuum bottle. Because the contacts are sealed in the interrupter and have only a short travel, it is possible to construct vacuum contactors of a compact size.

Series 81000 class E2 controllers designed for use with vacuum contactors are very similar to those which are used with our air-magnetic contactors. The handle mechanism, line and load power disconnects and line switch interlock (LSI) are identical in both cases. Features unique to our vacuum controllers are a racking mechanism mechanically interlocked by means of a solenoid actuated plunger and, whenever needed surge arrestors furnished to limit transient over-voltages caused by multiple reignitions.

Siemens medium voltage vacuum contactors are built in accordance with the latest applicable provisions of the National Electrical Code (NEC), Underwriters' Laboratories Standards and Procedures, specifically UL 347, NEMA ICS2-324, VDE and IEC standards, and the National Electrical Safety Code.

## Operating Data

The coil ratings are shown in Figure 3 for both AC or DC supply. When individual control power transformers are supplied, the standard size is 0.75kVA with 115 or 230V AC secondary. Note the extreme low seal-in current and low energy consumption of the coil.

Figure 3.

OPERATING DATA				
DESCRIPTION	230 VOLT AC SUPPLY*	115 VOLT AC SUPPLY*	250 VOLT DC SUPPLY	125 VOLT DC SUPPLY
Rated Control Voltage	240 Volts	120 Volts	250 Volts	125 Volts
Pick-Up Voltage	190 Volts	95 Volts	200 Volts	100 Volts
Drop-Out Voltage	24 Volts	12 Volts	20 Volts	10 Volts
Pick-Up Time (to contact touch)	5-7 cycles	5-7 cycles	5-7 cycles	5-7 cycles
Drop-Out Time (to contact break)	5-7 cycles	5-7 cycles	5-7 cycles	5-7 cycles
Inrush Current**	4.2 Amps	8.6 Amps	3.1 Amps	6.0 Amps
Sealing Current**	0.43 Amps	0.87 Amps	0.35 Amps	0.65 Amps

\*Denotes Utilization Voltage.

\*\*Maximum, Warm Coil

Figure 4.

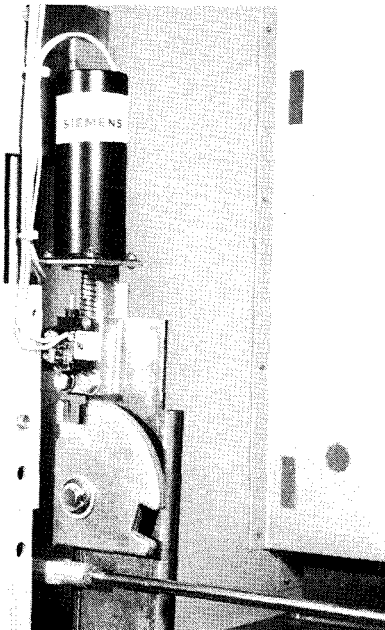
CONTACTOR RATING									
Enclosed Continuous Ampere Rating	Interrupting Capacity		Horsepower Rating at Utilization Voltage						KV Impulse Level (BIL)
			2300V, 3 Phase			4000 & 4600V, 3 Phase			
	Unfused 2300- 5000V	Fused Class E2 Controllers (MVA)	Synchronous Motors		Induction Motors	Synchronous Motors		Induction Motors	
			0.8 PF	1.0 PF		0.8 PF	1.0 PF		
360	4.5KA	200 @ 2300V  350 @ 4000V  400 @ 4600V	1500	1750	1500	2500	3000	2500	60

Auxiliary Contacts: On drawout contactors, 2 N.O. and 2 N.C. contacts are available for customers use. These contacts are rated 600V, 10A (NEMA Class A600).

# Isolation Disconnect and Interlocking

- Electrical and Mechanical Interlocks
- Overvoltage Transients

4



*Mechanical and electrical interlocks — view from inside cubicle (side sheet removed)*

## Isolation Disconnect

The Series 81000 controllers use the complete contactor drawout assembly as the high voltage isolation switch. Horizontal forward and back movement of the drawout assembly simultaneously opens and closes the line and load contacts. Because both line and load terminals are disconnected there is no need for grounding the load side terminals in the open position. Non-conducting glass polyester barriers completely isolate the stationary line terminals. The shutter mechanism is positively driven by the same linkage mechanism which moves the contactor from the connected to the disconnected position.

## Interlocking

A combination of mechanical and electrical interlocks are included to:

- (a) Prevent the forward and back movement of the drawout contactor assembly (isolation switch) unless the contactor is de-energized or open.
- (b) Prevent the opening of the high voltage compartment door unless the contactor assembly (isolation switch) is de-energized or open.
- (c) Prevent the forward movement of the drawout contactor assembly (isolation switch) to the closed position unless the high voltage compartment door is closed.

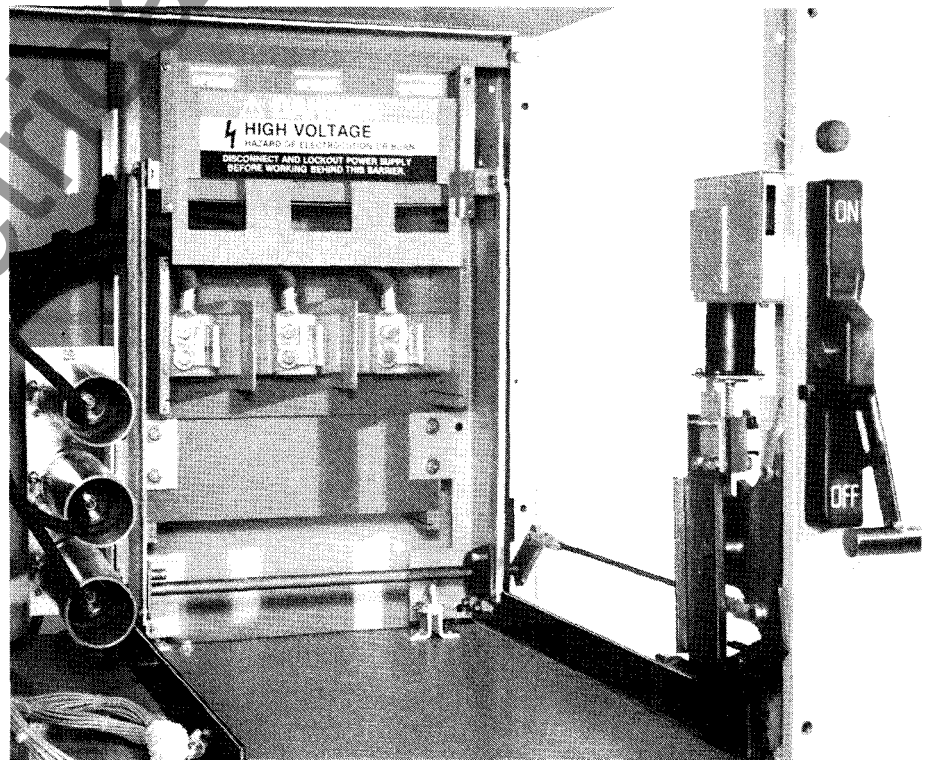
## Overvoltages

### Due to Current

### Interruption in Vacuum

Of the three major reasons of overvoltage transients due to switching current in vacuum, multiple reignition is the most serious problem. The use of modern contact materials has reduced the chopping current values to a range of 0.5 to 5 amps, hence, overvoltage from current chopping in vacuum is no longer a serious problem as it was once thought to be.

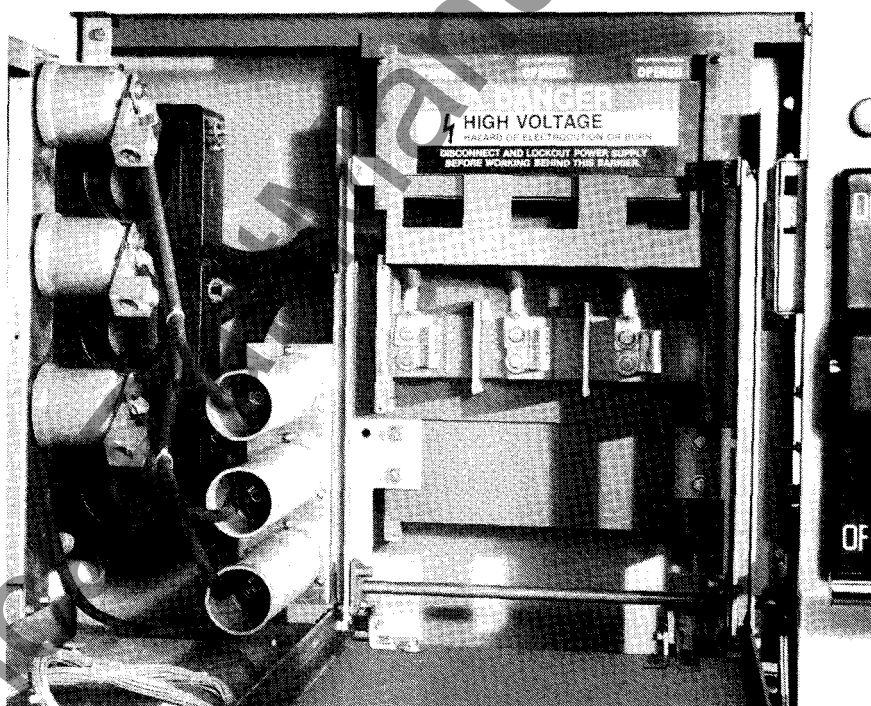
The second area of concern is overvoltage due to virtual current chopping. Protection against over-



*Typical isolation disconnect on power module*

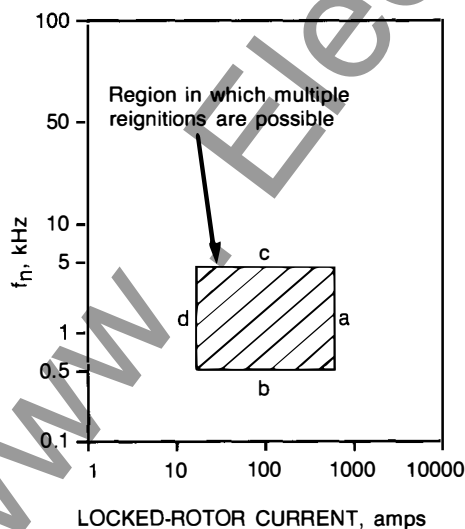
voltages caused by multiple reignition will also provide protection from virtual current chopping. Hence, the major area of concern is multiple reignition which is possible under the following conditions, regardless of the chopping current rating of the vacuum interrupter:

- a) motor with locked rotor current of 500A or less is switched off under locked rotor condition, that is, while the motor is not fully up to speed yet, such as during startup or jogging conditions.
- b) the main contacts of the vacuum interrupter parted at an instant of time less than 0.5 milliseconds from the natural sinusoidal zero of current. This condition is possible 18% of the time for a three phase system.
- c) the natural frequency on the load side of the interrupter is between 0.5 and 5.0 kHz.



Surge arrestors mounted within the controller.

Figure 5. Multiple Reignitions



If we examine Figure 5, and the prerequisite conditions for multiple reignition, it can be said that the first condition is a function of the motor size, while the second condition is a probability function, and the third condition is a function of the system, namely the motor inductance and the load cable capacitance. Siemens has developed four tables to determine the maximum length of load cables that will not allow reignition to occur.

These tables (pages 6-7) are published for both shielded and nonshielded cable. If the length of cable from the controller to the motor exceeds the distance shown

on these charts, then surge arrestors should be applied either in the controller or at the motor to prevent the possibility of multiple reignition.

Most medium voltage controllers will not require surge arrestors due to the short length of cable and the size of the motor. However, in applications where reignition is possible, the condition should not be ignored. Zinc oxide varistors can be supplied within the high voltage compartment at a nominal cost without requiring extra space. These arrestors limit the magnitude of the surge to a level generally found in interrupters other than vacuum.

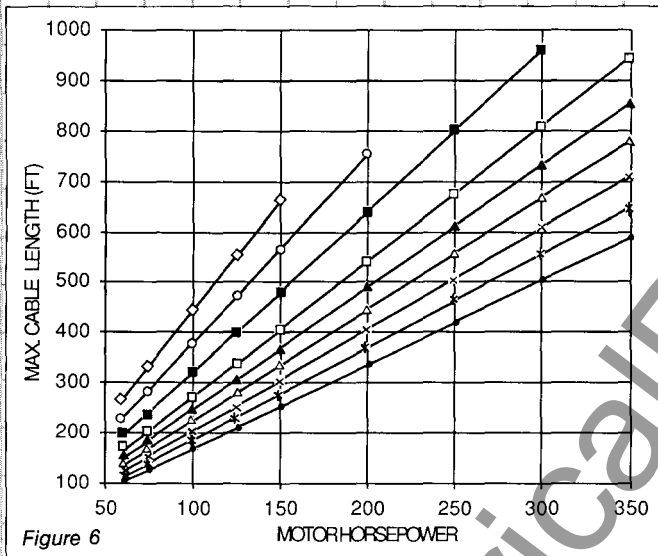
# Surge Arrestors Applications

- Shielded Cable

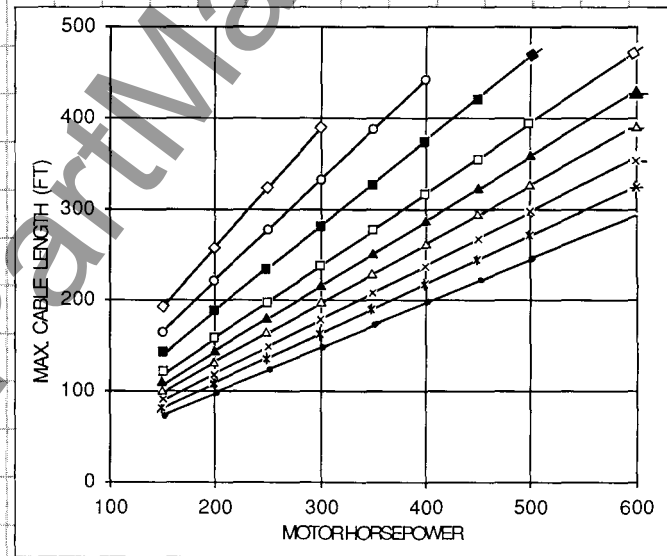
## Maximum Length of Load Cables

6

2300V



4160V



CABLE SIZES		
◇ #8	□ #2	× 2/0
○ #6	▲ #1	* 3/0
■ #4	△ 1/0	→ 4/0

### EXAMPLE (Shielded)

A 350 hp, 4160 volt motor in a pump station will be located approximately 300 ft. from the controller, using 1/0 shielded cable. Figure 7 shows maximum length at 350 hp to be approximately 230 ft. Therefore, surge arrestors should be applied.

# Surge Arrestors Applications

- Nonshielded Cable

## Maximum Length of Load Cables

**2300V**

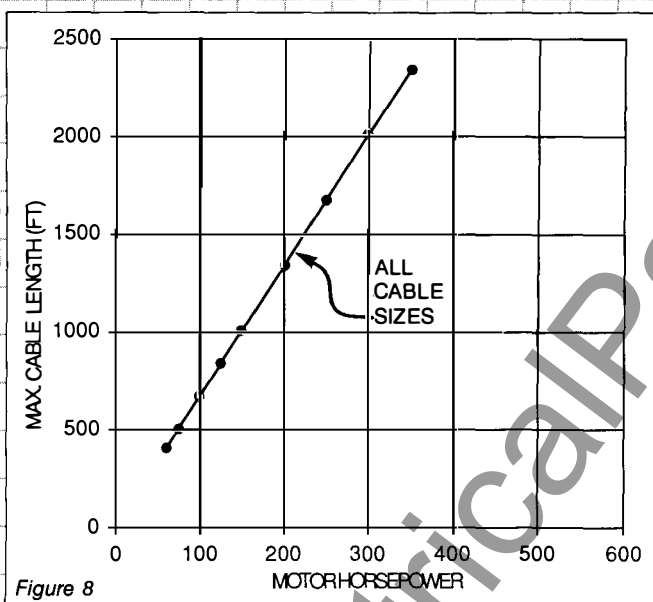


Figure 8

**4160V**

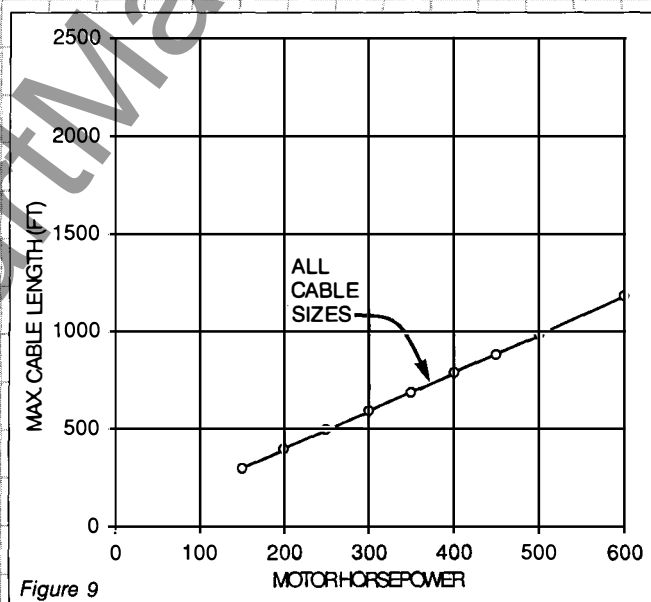


Figure 9

### EXAMPLE (Non-Shielded)

A 300 hp, 2300 volt motor in a chemical plant will be located approximately 1000 ft. from the controller using 3/0 non-shielded cable. Figure 8 shows maximum length at 300 hp to be approximately 2000 ft. Therefore, surge arrestors are not required.

## Contactor Options

- Control Power Transformers
- Blown Fuse Trip Bar
- Auxiliary Contacts
- ANSI "R" Rated Fuses

8

### Control Power Transformers

The basic controller includes a 0.75kVA control power transformer as standard mounted on the drawout carriage. Oversize ratings are available up to 3.25kVA. When dual voltage (230/115V) is required, a separate 230-115 volt transformer can be supplied in the low voltage compartment.

### Blown Fuse Trip Bar

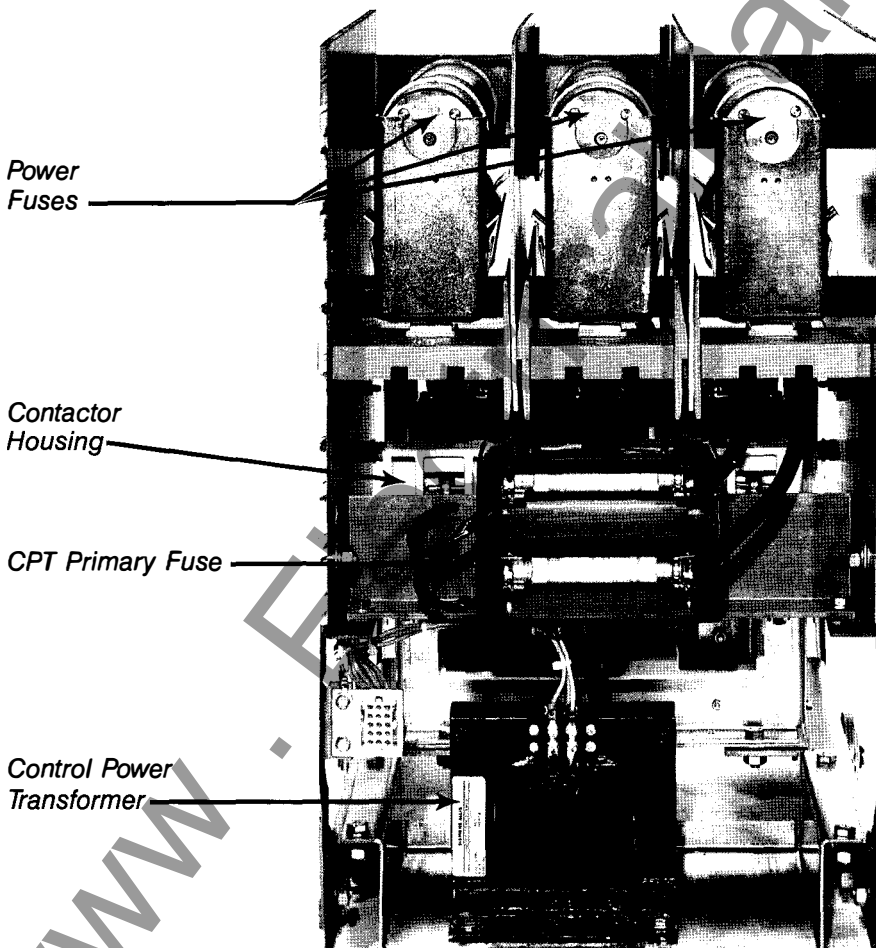
A blown fuse trip bar can be supplied to open the contactor in the event of a blown fuse. The b contact (NC) will always be in the DC side of the control circuit.

### Auxiliary Contacts

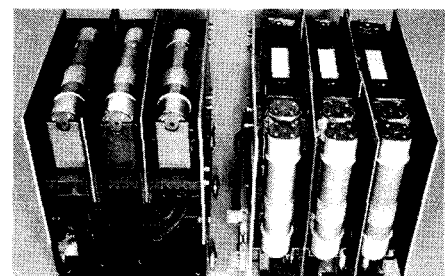
All contactors are supplied with two NO and two NC extra auxiliary contacts available for customer use. Extra contacts are available through the use of the MR relay or extra control relays.

### Power Fuses

ANSI "R" rated fuses are furnished for motor starting duty. ANSI "E" rated fuses are used for most other applications. When subjected to high values of fault currents, the total clearing time of these fuses will be within the first one-half cycle, and the maximum instantaneous peak current permitted by the largest fuse is 52KA (kiloamperes). Fuses 2R through 12R are single barrel; 18R and 24R are double barrel.



Vacuum Carriage Assembly  
(front view)



Location of Power Fuses (Air and Vacuum)

### Latched Contactors

A latched version of the air-break contactors is available for feeder applications. For information or questions on the latched vacuum contactor, refer to the factory.

## Construction Features

- Wide Variety of Grouped Assemblies
- Power Module for Conversions

### Grouped Assemblies

Two or more controllers can be grouped into one or more structures 36 inches wide by 36 inches deep by 90 inches high. Typical groups could include Full-Voltage Non-Reversing (FVNR) Induction Starters, Full-Voltage Non-Reversing Synchronous Starters, Reduced Voltage Reactor or Auto-transformer Type Starters, and Transformer Feeders.

Standard vertical structures consist of three 30-inch high cubicles. One, two, or three controllers may be included in one structure. When three controllers are required, the horizontal bus with ground bus, is mounted in a top mounted 10-inch by 36-inch compartment. An option using two 45-inch compartments with top mounted bus is also available.

Tin plated aluminum horizontal power bus is available in 600, 1000, and 1200 ampere ratings. Tin plated or silver plated copper is also available in 1000 to 2000 ampere ratings. The vertical bus is copper only.

When mounting two or three controllers in one vertical structure, the sum of the full load current of the motors should not exceed 600 amperes.

### Original Equipment Manufacturer (OEM) Units

The power module consists of stabs, shutter, handle, and racking mechanism, and the drawout connector. The module shown in Figure 10 shows the racking mechanism (encircled) for the air break contactors; those modules for vacuum contactor include the racking mechanism mechanically interlocked by a solenoid actuated plunger shown on page 4 of this brochure. These power modules are available to OEMs for mounting in cubicles of their design.

### Conversion Kits

A power module similar to the OEM kit is also available to convert existing Spacemaker II and Series 81000 air-break starters to vacuum starters.

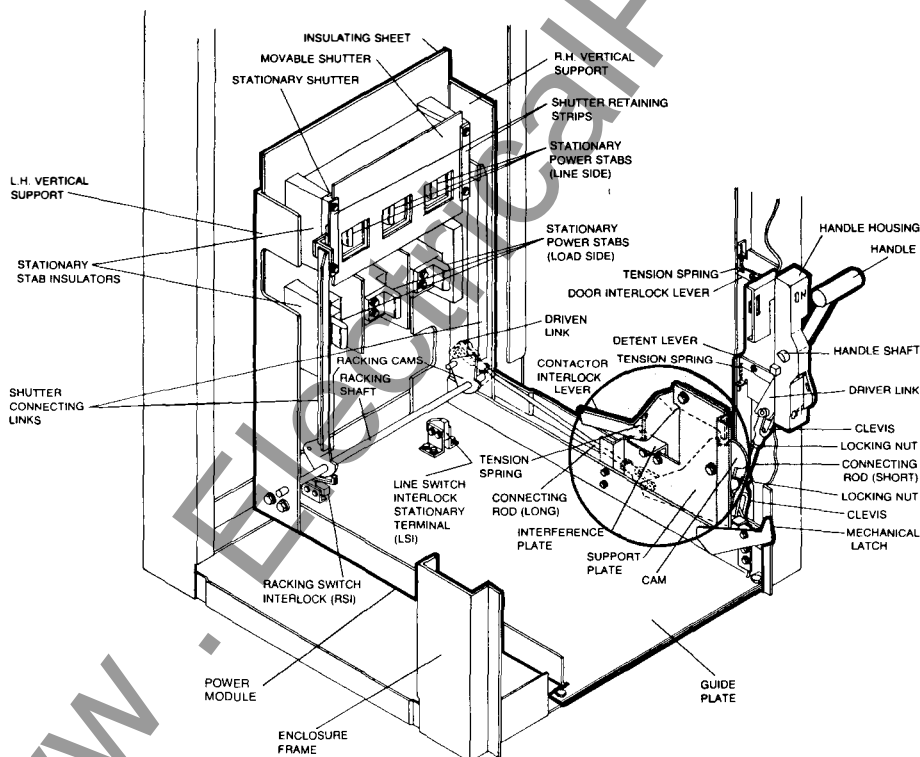


Figure 10.  
Power Module for OEM Units

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