



## TYPE 4015 RECTIFIED DYNAMIC LOWERING FOR HOIST SERVICE



All the advantages of a dc hoist controller on an ac crane:

- Rugged dc series wound mill motor.
- Reliable dc series wound brake
- Time-proven dc dynamic lowering hoist circuit.
- High-speed hoisting and lowering of empty hook or light loads.
- Slow, stable hook speeds hoisting and lowering with all loads.
- Reliable dc dynamic lowering with motor connected as a generator and loaded with the dynamic braking resistor.
- "Off point" braking because of spring-closed dynamic braking contactor.

The complete hoist control system consists of a power transformer, a silicon bridge rectifier and the hoist controller with accessories.

- The power transformer is a totally enclosed, nonventilated (TENV), three-phase unit with delta connected primary and a three-phase wye-connected secondary.

- The rectifier unit is a three-phase full wave bridge with diodes in parallel for redundancy. Rectifier protection is provided by fuses in each leg and a surge suppressor and snubbing circuit on the dc side. Output of the rectifier is 300V dc.
- The hoist controller is standard dc dynamic lowering controller arranged for operation from 300V dc power. The controller components are all front-mounted, front-removable, and front-wired.

A hoist control system with rectifier output of 360V dc is available as an option. Such a system operates at higher speeds than the 300V dc system, resulting in a reduced duty cycle time of about 15%.

Suitable for all NEMA and CMAA service classes.

Recommended for: NEMA service Class I, CMAA service Classes A1, C, D, E, F

### MATERIAL LIST FOR TYPE 4015 SINGLE MOTOR CONTROLLER WITH PROTECTION

- 1 — Two pole main knife switch.
- 1 — Two pole fused control knife switch.
- 1 — Electronic overload relay with instantaneous and inverse time trip feature.
- 1 — 50mV ammeter shunt.
- 1 — Single pole main line contactor.
- 4 — Single pole directional contactors with mechanical interlocks.
- 1 — Single pole spring-closed contactor for dynamic lowering.
- 4 or 5 — Single pole accelerating contactors.
- 4 or 5 — Solid state "in-line" timers for acceleration.
- 2 — Voltage relays.
- 1 — Undervoltage relay
- 1 — Power transformer with three-phase delta primary and three-phase wye secondary (for separate mounting by customer).
- 1 — Three-phase full wave rectifier bridge with current limiting fuses and surge suppressors.



## APPLICATION DATA

### TRANSFORMER

The power supply transformer is a totally enclosed nonventilated, air-cooled, separately mounted transformer with 480V, three-phase, 60 Hz primary; it has 2—2½% taps above and below the nominal voltage rating. A 3-phase wye secondary connection is used.

### RECTIFIER

A 3-phase full wave connected rectifier circuit is used. Each of the three phases contains two or more silicon diodes, protective fuses and neon fuse failure indicators. A voltage surge suppression network is included on the rectifier.

### RECTIFIER PANEL AND TRANSFORMER RATINGS

The ratings shown are based on a maximum ambient temperature of 40° C with the rectifier panel and transformer supplied in standard, nonventilated enclosures. Higher temperature ratings are attained by either de-rating the equipment or by providing ventilation. For applications involving ambient temperatures above 40°, consult the factory.

### MOTOR HORSEPOWER SELECTION

In addition to the weight of the load being hoisted and the desired hoisting speed, the hoisting cycle also affects the motor horsepower selection.

### COMPARISON OF BASIC CHARACTERISTICS OF DC SERIES MOTOR AND AC WOUND ROTOR MOTORS

DC SERIES MOTOR	AC WOUND ROTOR MOTOR
<ul style="list-style-type: none"> <li>No load speed is approximately 2 or 3 times full load speed.</li> <li>When used with dynamic lowering controller the motor can lower rated load at a speed much greater than the rated load-hoisting speed.</li> </ul>	<ul style="list-style-type: none"> <li>Maximum motor speed limited to near synchronous speed for no load and full load.</li> </ul>
<ul style="list-style-type: none"> <li>Maximum motor speed increases in proportion to increase in line voltage.</li> <li>Increased speeds result in increased horsepower without change in motor size.</li> </ul>	<ul style="list-style-type: none"> <li>Maximum motor speed not affected by increase in line voltage.</li> </ul>

### CRANE PERFORMANCE COMPARISON\*

Control Type	Standard AC	Standard 230V DC	Standard with 300V DC	Optional with 360V DC
Hoist full load	96%	100%	130%	155%
Lower full load	102%	200%	220%	240%
Hoist empty load	99%	212%	250%	252%
Lower empty load	100%	140%	155%	180%
Average	99%	149%	175%	198%

\* 100% speed = ac motor synchronous speed or dc motor rated speed at 230 volts dc.  
90% efficiency is assumed.

### SPECIFIED HOISTING SPEED EXAMPLE

Assume the hoist must lift a 50-ton load at a specific speed of 45 feet per minute, a crane hoist motor is selected on the basis of the following formula:

$$HP = \frac{\text{Payload \& Hook Block Weight in Lbs.} \times \text{Desired Full load Hoisting Speed in fpm}}{33,000 \times \text{Crane Hoist Efficiency}}$$

$$HP = \frac{100,000 \text{ Lbs.} \times 50 \text{ fpm}}{33,000 \times .90} = 168 \text{ hp}$$

Therefore, 200-hp ac motor would be required.

If a dc series motor of equal horsepower is selected and used with the Type 4015 controller, it will hoist full load at 130% of rated motor speed:

$$HP (@ 230 \text{ vdc}) = 168 \text{ hp} / 1.30 = 129 \text{ hp}$$

Therefore, a 135-hp dc motor would be applicable.

### DUTY CYCLE EXAMPLE

Assume that this same hoist must meet the following duty cycle rather than a specific hoisting speed: (1) lower the empty hook; (2) hoist full load or less; (3) lower full load or less; (4) hoist empty hook.

Since the standard Type 4015 hoist control provides an average hook speed of 175% as compared to the ac motor control:

$$HP (@ 230 \text{ vdc}) = 168 \text{ hp} / 1.75 = 96 \text{ hp.}$$

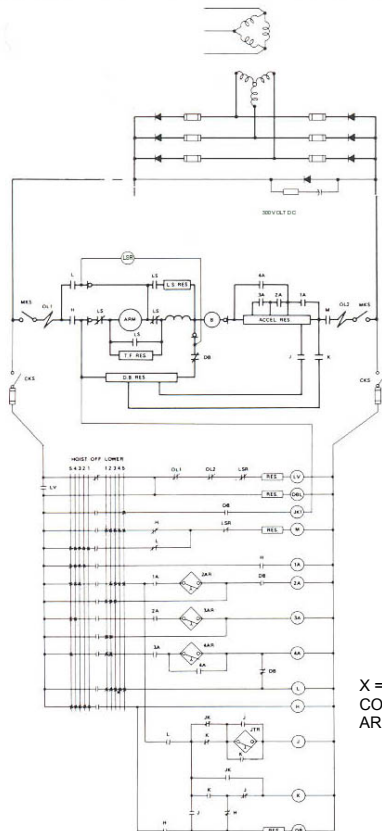
A 100-hp dc motor could be used.

In other words, a dc series motor of equal horsepower as its ac counterpart will complete the hoist cycle in about half the time required by the ac motor.

Even greater performance can be obtained by increasing the voltage to the motor to 360V dc. With the higher voltage, the hoisting cycle described above can be completed 198% faster than it could with an ac motor drive of equal horsepower.

If the Type 4015 hoist control is applied on bucket or magnet cranes, the minimum load consists of the weight of the magnet or empty bucket. Only two (2) operating conditions exist. The hoist cycle consists of hoisting full load and lowering minimum load. When the average speed is determined, the required 230V horsepower rating for the dc series motor will usually vary from 65% to 70% of its ac counter-part, depending on the minimum load conditions.

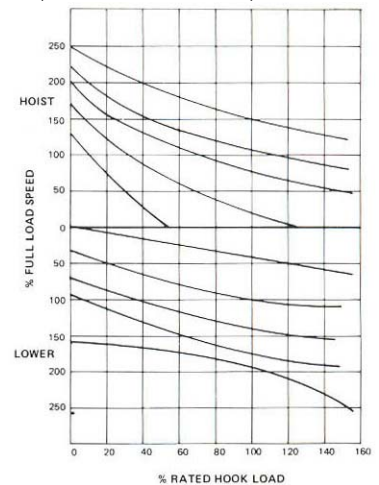
## ELEMENTARY DIAGRAM FOR HOIST CONTROL



X = DENOTES CONTACTS CLOSED  
CONTACTORS 1A AND L, K AND H, H AND J  
ARE MECHANICALLY INTERLOCKED

		CONTACTOR SEQUENCE									
CON- TACTOR	FACTOR	HOIST					LOWER				
		5	4	3	2	1	5	4	3	2	1
M		X	X	X	X	X	X	X	X	X	X
H		X	X	X	X	X	X	X	X	X	X
L							X	X	X	X	X
DB							X	X	X	X	X
J							X	X	X	X	X
K											X
1A		X	X	X	X	X					
2A		X	X	X	X	X					
3A		X	X	X	X	X					
4A		X	X	X	X	X					

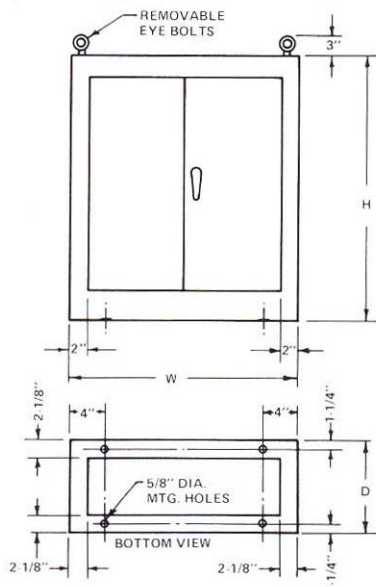
TYPICAL CRANE PERFORMANCE CURVES  
TYPE 4015 DC DYNAMIC LOWERING CONTROL  
(RECTIFIED AC POWER) 300 VOLT DC



CURVES ARE BASED ON AN ASSUMED  
HOIST DRIVE EFFICIENCY OF 80%

### DIMENSION DATA

SINGLE MOTOR CONTROL WITH PROTECTION  
APPROXIMATE DIMENSIONS AND WEIGHTS  
(DO NOT USE FOR CONSTRUCTION PURPOSES)



#### ENCLOSED CONTROL PANEL

Max HP Crane Rating 230 vdc	H	W	D	Net Weight (lbs.)
35	72	45	16	900
55	72	45	16	900
110	80	45	18	1100
225	85	94	24	2000
330	85	94	24	2100

Panel modifications may change controller dimensions.  
Door swing is limited to 20" or less.

#### ENCLOSED RECTIFIER PANEL

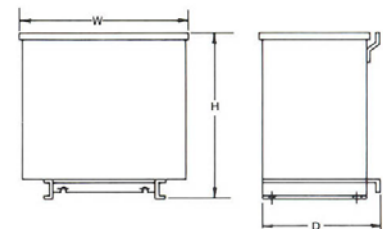
Max HP Crane Rating 230 vdc	H	W	D	Net Weight (lbs.)
35	60	24	22	500
65	60	24	22	500
100	60	24	22	500
135	60	40	22	800
200	60	40	22	800
330	72	50	22	1200

Door swing is limited to 20" or less.

#### TRANSFORMER

Max HP Crane Rating 230 vdc	H	W	D	Net Weight (lbs.)
19	26	26	20	300
35	28	27	20	400
45	30	29	20	500
65	36	35	24	600
100	39	38	28	800
135	48	47	30	1100
200	51	48	30	1300
265	53	50	35	1800

NOTE: Transformer for 100 HP and above are floor  
mounted only.



#### APPROXIMATE NUMBER OF SEPARATELY MOUNTED STANDARD "Z" LENGTH RESISTOR FRAMES (26.5" LONG)

Horsepower	10	13½	19	26	33	45	65	100	135	200	265
NEMA Class 162 DL	5	5	6	8	10	12	17	21	30	43	53
NEMA Class 172 DL	7	7	9	11	14	17	24	30	42	60	74



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