

Magnetic Reduced Voltage Starters

Engineering Notes

Application

Reduced voltage starting is required when there are limitations on inrush current or when the load current cannot stand the mechanical shock of starting. Starting current and starting torque can be reduced by reducing the applied voltage to the motor stator terminals. A change in the voltage applied to the stator results in a change of flux proportional to primary voltage.

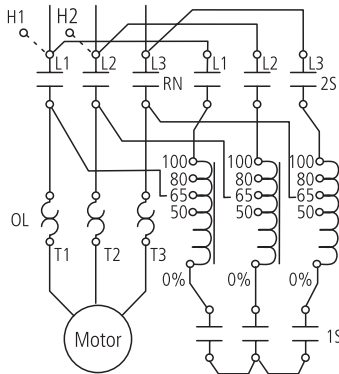
Stator and rotor currents vary in proportion to applied stator voltage. Since motor torque is proportional to the product of flux and rotor current, torque is proportional to the square of the voltage applied to the stator. The commonly used methods of reduced voltage or current starting are autotransformer type, star-delta type and part-winding type.

Comparison chart for reduced voltage starters

Criteria	Autotransformer starter Type AT	Star-delta starter Type SD	Part-winding starter Type PW																								
Motor requirements	Can be used with any standard squirrel-cage motor.	Requires a special motor with 6 leads brought out (delta-wound stator).	Requires a special motor in which the stator windings are divided into two or more equal parts with six leads provided. Also dual-voltage motors can be used in the lower range.																								
Description of operation	The motor is connected to the line through the reduced voltage taps of an autotransformer for the starting interval and then directly across the line for running condition.	This method requires two main or line contactors to connect the motor winding in delta connection for running. A third contactor is used to form the star point on the starting step.	Like the star-delta starter, this starter requires no external equipment. One winding is connected to the line for starting. After a time interval, the second or run contactor connects the other motor winding to the line in parallel with the first winding.																								
Starting characteristics in percent of normal	Autotransformer taps at: <table border="1"> <tr> <td></td> <td>80 -</td> <td>65 -</td> <td>50 %</td> </tr> <tr> <td>current</td> <td>64</td> <td>42</td> <td>25 %</td> </tr> <tr> <td>torque</td> <td>64</td> <td>42</td> <td>25 %</td> </tr> </table>		80 -	65 -	50 %	current	64	42	25 %	torque	64	42	25 %	<table border="1"> <tr> <td>100 %</td> <td>Line voltage</td> <td>100 %</td> </tr> <tr> <td>▲</td> <td></td> <td>▲</td> </tr> <tr> <td>33 %</td> <td></td> <td>60 %</td> </tr> <tr> <td>33 %</td> <td></td> <td>45 %</td> </tr> </table>	100 %	Line voltage	100 %	▲		▲	33 %		60 %	33 %		45 %	
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Advantages	High torque efficiency. All the power taken from the line, except for transformer losses, is transmitted to the motor. The starting current and torque are easily adjusted by changing autotransformer taps. Closed circuit transition.	The star-delta starter provides low inrush current with torque efficiency, without the use of any external equipment. Normally open circuit transition but closed transition can be achieved with the use of resistors.	Part-winding starting provides one-step acceleration at a reduced current. So that the second current inrush is not objectionable. Closed circuit transition.																								
Limitations	Torque remains practically constant for the first step and practically constant at another value for the second step.	Starting characteristics depend on motor design and cannot be adjusted. Requires special delta wound starter.	Requires special motor or dual-voltage motor on low range. Torque efficiency is usually poor for high speed motors.																								
Applications	Applications where there are limitations on starting voltage and current. Most widely used.	Low starting torque applications.	Commercial air conditioning equipment.																								
Approximate price comparison (% of type AT)	100 %	60 %	40 %																								

Magnetic Reduced Voltage Starters Autotransformer Type

UL/CSA max. Hp rating 50/60Hz 3 phase				Standard auxiliary contacts		Type Specify coil voltage and frequency → pages 03/065, 066 Specify overload relay suffix code → page 03/023	Price includes 3 phase, bimetallic overload relay Enclosed			
200 V HP	230 V HP	460 V HP	575 V HP	N.O.	N.C.	...	(...)	General purpose Type 1 Replace <input type="checkbox"/> with suffix /S	Industrial use Type 12 dusttight Replace <input type="checkbox"/> with suffix /SD	Type 3R weatherproof Replace <input type="checkbox"/> with suffix /DW
Closed transition										
-	-	-	15	2	2	AT0M/22/Z00-... <input type="checkbox"/> (...)				
-	-	15	20	2	2	AT0AM/22/Z00-... <input type="checkbox"/> (...)				
-	10	-	-	2	2	AT0AM/22/Z1-... <input type="checkbox"/> (...)				
-	-	20	25	2	2	AT1M/22/Z1-40 <input type="checkbox"/> (...)				
-	15	25	30	2	2	AT1AM/22/Z1-... <input type="checkbox"/> (...)				
15	20	40	40	2	2	AT2M/22/Z1-57 <input type="checkbox"/> (...)				
20	-	-	50	2	2	AT2AM/22/Z1-... <input type="checkbox"/> (...)				
-	25	50	-	2	2	AT2AM/22/Z1-75 <input type="checkbox"/> (...)				
25	30	60	75	2	2	AT3M80/22/Z5-... <input type="checkbox"/> (...)				
40	50	100	125	2	2	AT4M115/22/Z5-... <input type="checkbox"/> (...)				
50	60	125	150	2	2	ATM185/22/Z5-160 <input type="checkbox"/> (...)				
60	75	150	200	2	2	ATM225/22/Z5-220 <input type="checkbox"/> (...)				
75	100	200	250	2	2	ATM250/22/Z5-250 <input type="checkbox"/> (...)				
100	125	250	300	2	2	ATM300/22/ZW7-... <input type="checkbox"/> (...)				
125	150	300	350	2	2	ATM400/22/ZW7-... <input type="checkbox"/> (...)				



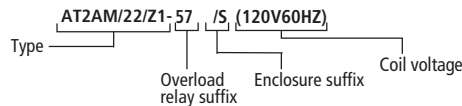
Autotransformer with thermal protection

Standard Features:

- 3-phase overload protection
- Reset button in cover
- Auxiliary contacts are standard in all starters
- Closed transition, by 3 core dry type autotransformer duty cycle of one 15 second period out of each 4 minutes for one hour followed by a rest period of 2 hours.
- 65% and 80% voltage taps available on all sizes
Additional 50% tap for 60HP and larger starters
- All starters are normally connected to the 65% tap at the factory
- Autotransformer supplied with thermal protection

To order specify:

- Type number
- Overload relay suffix
- Enclosure suffix
- Coil voltage
- Accessories

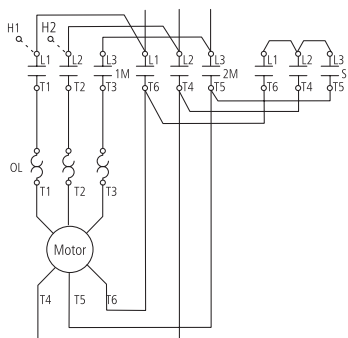


Additional information

Additional information	Page
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Factory modifications	03/050
Weights	14/020

Magnetic Reduced Voltage Starters Automatic Star-Delta Starters

UL/CSA max. Hp rating 50/60Hz 3 phase		Standard auxiliary contacts		Type		Price includes 3 phase, bimetallic overload relay				
				Specify coil voltage and frequency → pages 03/065, 066		Enclosed				
				Specify overload relay ¹⁾ suffix code → page 03/023		General purpose Type 1 Replace <input type="checkbox"/> with suffix /S	Industrial use Type 12 dusttight Replace <input type="checkbox"/> with suffix /SD	Type 3R weatherproof Replace <input type="checkbox"/> with suffix /DW		
200 V HP	230 V HP	460 V HP	575 V HP	N.O.	N.C.	...	(...)	see price list	see price list	see price list
Open Transition										
-	-	15	20	2	2	SD0M/22Z00-... <input type="checkbox"/> (...)				
-	-	25	30	2	2	SD0AM/22/Z00-... <input type="checkbox"/> (...)				
-	15	30	40	2	2	SD1M/22/Z1-... <input type="checkbox"/> (...)				
-	25	40	50	2	2	SD1AM/22/Z1-... <input type="checkbox"/> (...)				
25	30	50	60	2	2	SD2M/22/Z1-... <input type="checkbox"/> (...)				
30	40	75	75	2	2	SD2AM/22/Z1-... <input type="checkbox"/> (...)				
40	50	100	125	2	2	SD3M80/22/Z1-... <input type="checkbox"/> (...)				
-	50	-	-	2	2	SD3M80/22/Z5-... <input type="checkbox"/> (...)				
60	75	150	200	2	2	SD4M115/22/Z5-... <input type="checkbox"/> (...)				
75	100	200	225	2	2	SDM185/22/Z5-... <input type="checkbox"/> (...)				
100	125	250	300	2	2	SDM225/22/Z5-... <input type="checkbox"/> (...)				
125	150	300	400	2	2	SDM250/22/Z5-... <input type="checkbox"/> (...)				
150	-	350	-	2	2	SDM300/22/Z5-... <input type="checkbox"/> (...)				
-	200	400	500	2	2	SDM300/22/ZW7-... <input type="checkbox"/> (...)				
200	250	500	-	2	2	SDM400/22/ZW7-... <input type="checkbox"/> (...)				



Open transition starter

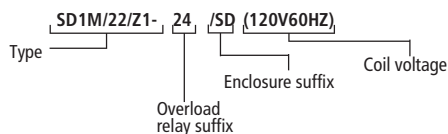
Standard Features:

- 3-phase overload protection
- Reset button in cover
- Auxiliary contacts are standard in all starters

¹⁾ Select and set overload relay for 58% of motor FLC.

To order specify:

- Type number
- Overload relay suffix
- Enclosure suffix
- Coil voltage
- Accessories



Additional information	Page
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Magnetic Reduced Voltage Starters Factory Modifications

Order by description

The standard modifications shown on this page are those available for factory installation. Prices for these modifications are shown in the alpha-numeric price book, under "Starters - Reduced Voltage - Factory Modifications".

The enclosure may or may not change with the addition of any of these items. When accurate dimensions of the enclosure are required, please contact your nearest Moeller Electric branch.

Description	Enclosure type	Price Adder all sizes see price list
Pilot devices in cover		
Pushbuttons		
"START-STOP" or "ON-OFF" Double pushbutton	1, 12, 12K, 3R 13, 3R, 4, 4X	
"START-STOP" or "ON-OFF" Double pushbutton with indicating light	1, 12, 12K, 3R 13, 3R, 4, 4X	
Standard 1-unit pushbutton	all types	
Standard 2-unit pushbutton	all types	
Standard 3-unit pushbutton	all types	
Selector switches		
"MAN-AUTO"	1 12, 13, 3R, 4X	
"HAND-0-AUTO"	1 12, 13, 3R, 4X	
Indicating lights		
Indicating light - specify color	1 12, 13, 3R, 4X	
Push-to-test light or illuminated pushbutton	all types	

Description	Price Adder all sizes see price list
Added devices	
Overload relays	
Overload relay, automatic/manual reset and alarm contacts supplied as standard	no charge
P.T.C. thermistor tripping unit,	type EMT6
Control circuit	
Separate control circuit	no charge
Fused control circuit	250V, 1 or 2 fuses 600V, 2 fuses
Auxiliary relays	
Control relay, max. of 4 poles	unwired wired
Timing relay	
Terminal block, wired	per pole
Meters	
Ammeter, max. 3½" panel type	
Current transformer	
Voltmeter, max. 3½" panel type direct reading up to 600V	
3-phase ammeter or voltmeter switch	
Elapsed time meter	
Nameplates	
Special nameplates	3" x 1"

Description	Price Adder to main contactor size					
	(E)EM 00M 00AM	0M 0AM 1M 1AM	2M 2AM	3M80 4M115	M185 M225 M250	M300 M400 M500
	see price list	see price list	see price list	see price list	see price list	see price list
Control circuit transformers						
Transformer 60 Hz with fused primary						
Transformer with additional capacity up to 100VA, 60 Hz with fused primary						
Mechanical interlock for contactors						
Disconnect device (multi-speed starters only)						
Disconnect switch	non-fusible					
	fusible					
Circuit breaker						
Reversing starter to change non-reversing to reversing						