Torque

$$T_d = \frac{63{,}025 \times P}{N} \times S.F.$$

Where:

T_d =	Dynamic Torque (lb.–in.)
P =	Horsepower, HP
N =	RPM = Shaft Speed
S.F. =	Service Factor
63,025 =	Constant

Reflected Inertia

$$\text{Equivalent } WR_A^2 = WR_B^2 \left(\frac{N_B}{N_A}\right)^2$$

Where:

WR_A^2 =	Inertia of rotating load reflected to the clutch or brake shaft (lb.–in.^{2})
WR_B^2 =	Inertia of rotating load (lb.–in.^{2})
N_B =	Shaft speed at load (RPM)
N_A =	Shaft speed at clutch or brake (RPM)

Linear Inertia

$$\text{Equivalent } WR_A^2 = W\left(\frac{V}{2\pi N_A}\right)$$

Where:

WR_A^2 =	Inertia of linear moving load reflected to the clutch or brake shaft (lb.–in.^{2})
V =	Linear velocity of load (in./min.)
W =	Weight of linear moving load (lb.)
N_A =	Shaft speed at clutch or brake (RPM)
2π =	Constant

Thermal Capacity

$$TC = \frac{WR^2 \times N_A \times n}{4.63 \times 10^8}$$

Where:

TC =	Thermal capacity required for rotational or linear moving loads (hp–sec./min.)
WR^2 =	Total system inertia reflected to the clutch or brake shaft (lb.–in.^{2})
N_A =	Shaft speed at clutch or brake (RPM)
n =	Number of stops or starts per minute, not less than one
4.63×10^8 =	Constant

Linear Velocity

$IPM = PD \times N \times \pi$

Where:

IPM =	Velocity of object (inches per minute)
PD =	Pitch diameter of object (inches)
N =	Speed of shaft at the object (RPM)
π =	Constant

Inertia – (WR^2)

To calculate the inertia for a cylinder, the formula is:

$$WR^2 = \frac{\pi}{32} \times D^4 \times L \times \rho$$

Where:

WR^2 =	Inertia – lb.–in.^{2} (kg–m^2)
D =	Diameter – inches (meters)
L =	Length – inches (meters)
ρ =	Density – lb./in.^{3} (kg/m^3)

Approximate values for ρ are:

Steel –	.284 (7860)
Aluminum –	.098 (2700)
Plastic –	.047 (1300)
Rubber –	.047 (1300)

For steel shafting, refer to the inertia chart, Fig. A.

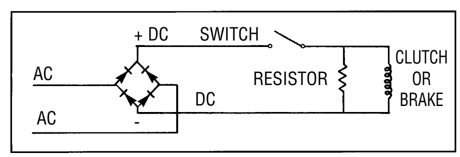
Arc Suppression

When the clutch or brake is deenergized, a reverse voltage is generated in the coil. The reverse voltage can be very high and may cause damage to the coil and switch in the circuit. To protect the coil and switch, the voltage should be suppressed using an arc suppression circuit. Arc suppression does not affect the clutch or brake engagement time.

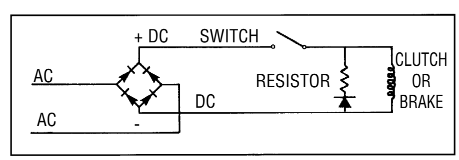
Resistor/Diode/Zener Diode –

Normal Disengagement Time

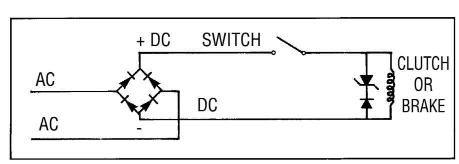
For most applications, a resistor connected in parallel with the clutch/brake coil is adequate. The resistor should be rated at six times the coil resistance and approximately 25% of the coil wattage.



To eliminate the added current draw, a diode may be added as shown below.



For faster release, use a zener diode with a rating two times the coil voltage.



Spring Applied Friction Brakes

Technical Data & Formulas Metric

Torque

$$T_d = \frac{9{,}550 \times kW}{N} \times S.F.$$

Where:

T_d =	Dynamic Torque (N-m)
kW =	Power, kW
N =	RPM = Shaft Speed
S.F. =	Service Factor
9,550 =	Constant

Reflected Inertia

$$\text{Equivalent } WR_A^2 = WR_B^2 \left(\frac{N_B}{N_A}\right)^2$$

Where:

WR_A^2 =	Inertia of rotating load reflected to the clutch or brake shaft (kg-m²)
WR_B^2 =	Inertia of rotating load (kg-m²)
N_B =	Shaft speed at load (RPM)
N_A =	Shaft speed at clutch or brake (RPM)

Linear Inertia

$$\text{Equivalent } WR_A^2 = W\left(\frac{V}{2\pi N_A}\right)$$

Where:

WR_A^2 =	Inertia of linear moving load reflected to the clutch or brake shaft (lb.–in.²)
V =	Linear velocity of load (in./min.)
W =	Weight of linear moving load (lb.)
N_A =	Shaft speed at clutch or brake (RPM)
2π =	Constant

Thermal Capacity

$$TC = \frac{WR^2 \times N_A \times n}{4.63 \times 10^8}$$

Where:

TC =	Thermal capacity required for rotational or linear moving loads (hp–sec./min.)
WR^2 =	Total system inertia reflected to the clutch or brake shaft (lb.–in.²)
N_A =	Shaft speed at clutch or brake (RPM)
n =	Number of stops or starts per minute, not less than one
4.63×10^8 =	Constant

Linear Velocity

$$IPM = PD \times N \times \pi$$

Where:

IPM =	Velocity of object (inches per minute)
PD =	Pitch diameter of object (inches)
N =	Speed of shaft at the object (RPM)
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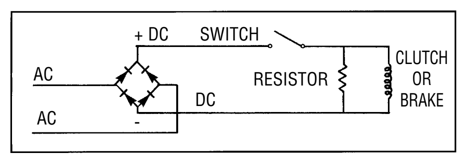
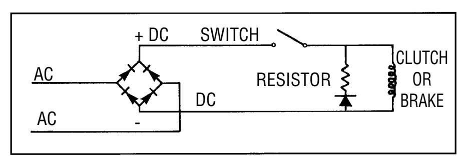
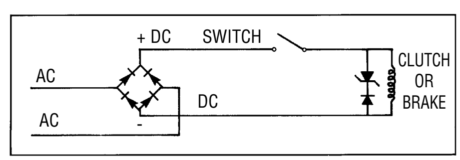


To eliminate the added current draw, a diode may be added as shown below.



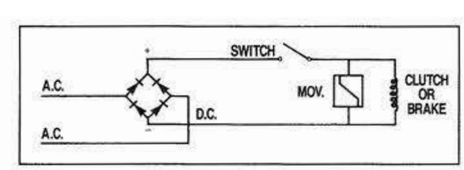
For faster release, use a zener diode with a rating two times the coil voltage.



Metal Oxide Varistor (MOV) –

Fast Disengagement Time

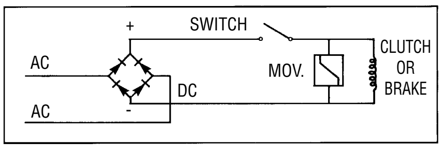
For applications requiring fast clutch or brake disengagement a capacitor or MOV connected in parallel with the clutch/brake coil should be used.



Metal Oxide Varistor (MOV) –

Fast Disengagement Time

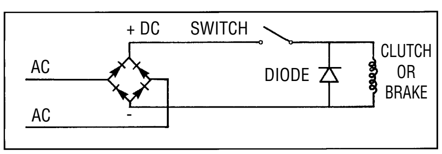
For applications requiring fast clutch or brake disengagement, an MOV connected in parallel with the clutch/brake coil should be used.



Diode

Slow Disengagement Time

For applications where a delayed disengagement is desired, a diode should be used in parallel with the clutch/brake coil or switch the AC side of the circuit.



Inertia Conversion Chart

To determine the inertia of a rotating member of a material other than steel, multiply the inertia of the steel diameter from Fig. A at right by:

MATERIAL	MULTIPLIER
Bronze	1.05
Steel	1.00
Iron	.92
Powdered Bronze	.79
Powdered Metal Iron	.88
Aluminum	.35
Nylon	.17

Fig. A
Inertia Chart
I = WR^2 of Steel
(per inch of length)

DIA. (IN.)	WR2 (LB. - IN.^{2})
1/4	.00011
5/16	.00027
3/8	.00055
7/16	.00102
1/2	.00173
9/16	.00279
5/8	.00425
11/16	.00623
3/4	.00864
13/16	.01215
7/8	.01634
15/16	.02154
1	.0288
1 1/4	.0720
1 1/2	.144
1 3/4	.288
2	.432
2 1/4	.720
2 1/2	1.152
2 3/4	1.584
3	2.304
3 1/2	4.176
3 3/4	5.472
4	7.056
4 1/4	9.072
4 1/2	11.376
5	17.280
5 1/2	25.488
6	36.000
6 1/4	42.624
6 1/2	49.680
6 3/4	57.888
7	66.816

Note:

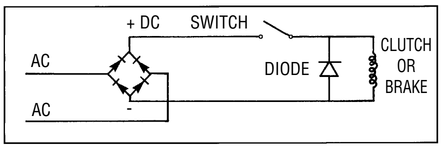
1. To determine WR^2 of a given shaft, multiply the WR^2 given above by the length of the shaft or the thickness of the disc in inches.
2. For hollow shafts, subtract WR^2 of I.D. from WR^2 of O.D. and multiply by length.

Technical Data & Formulas Metric

Diode

Slow Disengagement Time

For applications where a delayed disengagement is desired, a diode should be used in parallel with the clutch/brake coil or switch the AC side of the circuit.



Full Load Running Torque of Motors N-m

kW	3450 RPM	1750 RPM	1150 RPM	870 RPM
.015	0.041	.081	0.124	0.164
.037	0.103	.203	0.309	0.409
.062	0.172	.339	0.516	0.682
.093	0.258	.508	0.774	1.023
.12	0.344	.678	1.034	1.366
.19	0.516	1.017	1.548	2.045
.25	0.687	1.356	2.061	2.724
.37	1.032	2.034	3.095	4.091
.56	1.548	3.051	4.643	6.136
.75	2.063	4067	6.189	8.181
1.1	3.095	6.101	9.284	12.27
1.5	4.126	8.135	12.38	16.36
2.2	6.189	12.20	18.56	24.54
3.7	10.32	20.34	30.95	40.90
5.6	15.48	30.51	46.41	61.36

and Standards

All Inertia Dynamics standard clutches, brakes, and spring applied brakes are recognized by Underwriters Laboratories and the Canadian Standards Association. Products built to meet their construction requirements are labeled with the UL and CSA recognized symbol. All products meet UL Class B requirements.

Fig. A
Inertia Chart
I = WR^2 of Steel (per cm of length)

DIA. cm	kg-cm^2	DIA. cm	DIA. kg-cm^2	cm	kg-cm^2
1.91	.0253	26.67	990.3	81.28	85038.7
2.54	.0843	27.31	1087.2	83.83	961163.7
3.18	.2107	27.94	1192.6	86.36	108384.4
3.81	.4214	28.58	1302. 1	88.90	121700.6
4.45	.9428	29.21	1424.3	91.44	136196.8
5.08	1.264	29.85	17351.	93.98	151999.4
5.72	2.107	30.48	1685.6	96.52	1691083
6.35	3.371	31.12	1832.2	99.06	18764.99
6.99	4.635	31.75	1989.0	101.6	207666.5
7.62	6.742	32.39	2153.4	104.1	229200.1
8.89	12.221	33.02	2351.4	106.7	252335.0
9.53	16.013	33.66	2511.6	109.2	277324.1
10.16	20.649	34.29	2705.4	111.8	303998.8
10.80	26.548	34.93	2911.9	114.3	332611.9
11.43	33.291	35.56	3126.8	116.8	363163.5
12.70	50.568	36.20	3358.6	119.4	395822.1
13.97	74.588	36.83	3598.8	121.9	430587.6
15.24	105.350	37.47	3855.8	124.5	467586.7
15.88	124.735	38.10	4108.7	127.0	506987 .7
16.51	145.383	40.64	5313.9	129.5	548748 .5
17.15	169.403	43.18	6771.9	132.1	593079 .9
17.78	195.530	45.72	8516.5	134.6	640024.0
18.42	225.450	48.26	10568.7	137.1	689707.2
19.05	257.476	50.80	12974 .9	139.7	742255.9
19.69	294.559	53.34	15773.0	142.2	797754.4
20.32	333.328	55.88	19001.0	144.8	856244.9
20.96	377.154	58.42	22700.9	147.3	917937.4
21.59	421.401	60.96	26910.7	149.9	982918.1
22.23	476.183	63.50	316851.	152.4	1051269.3
22.86	535.179	66.04	37066.4	167.6	1539167.5
23.50	594.176	68.58	43109.3	182.9	2179486.5
24.13	682.436	71.12	49856.0	198.1	3002482.8
24.77	737.452	73.66	57327.4	213.4	4038708.2
25.40	813.304	76.20	65704.9	228.6	532187.54
26.04	897.584	78.74	74912.5	243.8	6889486.6
				259.1	8780313.3

Note:

1. To determine WR^2 of a given shaft, multiply the WR^2 given above by the length of the shaft or the thickness of the disc in centimeters.
2. For hollow shafts, subtract WR^2 of I.D. from WR^2 of O.D. and multiply by length.