

CASCADE17-0192Y3

R134a

48 V DC

VARIABLE SPEED



Brushless DC Variable Speed Compressor Technical Data Sheet

General Information

Compressor Part Number (Stationary)	CASCADE0005	(140 per pallet)
Compressor Part Number (Mobile)	CASCADE1005	(140 per pallet)
Compressor Drawing	DCMX17	
12-24V Controller Part Number	030F0121	(LBP / MBP only)
12-24V Controller Part Number	030F0182	(LBP / MBP only)
24V Controller Part Number	030F0152	
24V Controller Part Number	030F0189	
48V Controller Part Number	030F0137	
48V Controller Part Number	030F0192	
48V Controller Part Number (LBP only)	030F0175	
Wiring Diagram Drawing	DEMX0028	

Application Information

Application	LBP/MBP/HBP
Refrigerant	R134a
Evaporator Temperature Range	-40° F to 59° F (-40° C to 15° C)
Condenser Temperature Range	80° F to 150° F (26.7° C to 65.6° C)

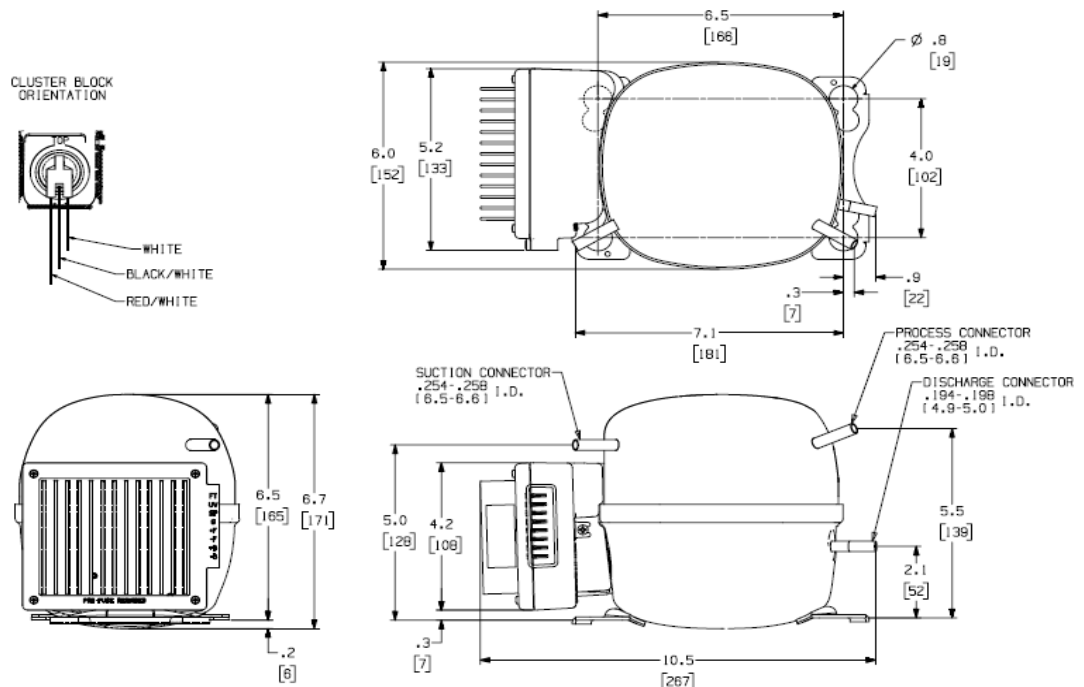
Design

Displacement	3.14 cm ³ (0.192 in ³)
Oil Quantity	270 ml
Oil Type	POE 32cSt
Weight - Compressor/Controller	6.67 kg / 14.7 lb

Battery Protection

	Min.	24V Nominal	Max.	Min.	48V Nominal	Max.
Under Voltage Shutdown	18.0	19.0	20.0	34.0	36.0	37.0
Over Voltage Shutdown	29.0	30.0	31.0	59.0	60.0	61.0

Compressor Dimensions



the Cascade

*ALTERNATE MOUNTING: 6.7" [171] L x 2.8" [70] W, Ø.64" [16]

Compressor Rating Data

LBP

<u>Specification</u>	<u>ASHRAE</u>	<u>CECOMAF</u>	<u>SPEER</u>
Voltage (VDC)	48	48	48
RPM	4200	4170	4180
Evap. Temp. (°F/°C)	-10°F / -23.3°C	-13°F / -25.0°C	-10°F / -23.3°C
Cond. Temp. (°F/°C)	130°F / 54.4°C	131°F / 55.0°C	105°F / 40.6°C
Ambient Temp. (°F/°C)	90°F / 32.2°C	90°F / 32.2°C	90°F / 32.2°C
Suction Temp. (°F/°C)	90°F / 32.2°C	90°F / 32.2°C	90°F / 32.2°C
Liquid Temp. (°F/°C)	90°F / 32.2°C	131°F / 55.0°C	90°F / 32.2°C
Cooling Capacity (BTU/watt)	332.07 / 97.3214	249.97 / 73.259	336.32 / 98.5657
Power (watt)	80.79	76.32	78.24
Current (amp)	1.68	1.59	1.63
Efficiency (EER/COP)	4.11 / 1.20	3.28 / 0.96	4.30 / 1.26

MBP

<u>Specification</u>	<u>ASHRAE</u>	<u>ARI</u>
Voltage (VDC)	48	48
RPM	4170	4200
Evap. Temp. (°F/°C)	20°F / -6.7°C	20°F / -6.7°C
Cond. Temp. (°F/°C)	130°F / 54.4°C	120°F / 48.9°C
Ambient Temp. (°F/°C)	95°F / 35.0°C	95°F / 35.0°C
Suction Temp. (°F/°C)	95°F / 35.0°C	40°F / 4.4°C
Liquid Temp. (°F/°C)	115°F / 46.1°C	120°F / 48.9°C
Cooling Capacity (BTU/watt)	750.79 / 220.035	575.50 / 168.662
Power (watt)	129.12	126.72
Current (amp)	2.69	2.64
Efficiency (EER/COP)	5.81 / 1.70	4.54 / 1.33

HBP

<u>Specification</u>	<u>ASHRAE</u>	<u>ARI</u>
Voltage (VDC)	48	48
RPM	4195	4200
Evap. Temp. (°F/°C)	45°F / 7.2°C	45°F / 7.2°C
Cond. Temp. (°F/°C)	130°F / 54.4°C	130°F / 54.4°C
Ambient Temp. (°F/°C)	95°F / 35.0°C	95°F / 35.0°C
Suction Temp. (°F/°C)	95°F / 35.0°C	65°F / 18.3°C
Liquid Temp. (°F/°C)	115°F / 46.1°C	115°F / 46.1°C
Cooling Capacity (BTU/watt)	1570.92 / 460.39	1472.97 / 431.69
Power (watt)	172.80	177.77
Current (amp)	3.60	3.70
Efficiency (EER/COP)	9.09 / 2.66	8.29 / 2.43

Cooling Capacity (24V) - ARI HBP **BTU/hr (Watt)**

RPM	Evaporator Temperature													
	20°F	(-7°C)	30°F	(-1°C)	35°F	(2°C)	40°F	(4°C)	45°F	(7°C)	50°F	(10°C)	55°F	(13°C)
1800	282	(83)	406	(119)	464	(136)	525	(154)	596	(175)	683	(200)	791	(232)
2400	389	(114)	572	(168)	657	(193)	745	(218)	842	(247)	952	(279)	1083	(317)
3000	490	(144)	726	(213)	835	(245)	946	(277)	1065	(312)	1197	(351)	1346	(395)
3600	593	(174)	875	(256)	1005	(295)	1136	(333)	1273	(373)	1422	(417)	1588	(465)
4200	704	(206)	1025	(300)	1173	(344)	1321	(387)	1473	(432)	1636	(479)	1815	(532)

Power Consumption (24V) - ARI HBP **Watt** **Current (24V) - ARI HBP** **Amp**

RPM	Evaporator Temperature								Evaporator Temperature							
	20°F	30°F	35°F	40°F	45°F	50°F	55°F	20°F	30°F	35°F	40°F	45°F	50°F	55°F		
1800	59	69	74	77	77	75	69	2.47	2.89	3.07	3.19	3.22	3.11	2.86		
2400	75	87	92	97	99	98	94	3.13	3.62	3.85	4.03	4.12	4.09	3.92		
3000	88	103	110	116	121	123	121	3.68	4.29	4.60	4.85	5.04	5.11	5.05		
3600	103	121	131	140	147	152	154	4.28	5.06	5.46	5.83	6.13	6.34	6.41		
4200	122	146	158	171	181	190	196	5.07	6.07	6.60	7.11	7.55	7.91	8.15		

Efficiency (24V) - ARI HBP **BTU/hr/W (W/W)**

RPM	Evaporator Temperature													
	20°F	(-7°C)	30°F	(-1°C)	35°F	(2°C)	40°F	(4°C)	45°F	(7°C)	50°F	(10°C)	55°F	(13°C)
1800	4.77	(1.40)	6.86	(2.01)	6.28	(1.84)	6.85	(2.01)	7.73	(2.26)	9.14	(2.68)	11.53	(3.38)
2400	5.17	(1.52)	7.61	(2.23)	7.11	(2.08)	7.71	(2.26)	8.52	(2.50)	9.70	(2.84)	11.51	(3.37)
3000	5.55	(1.63)	8.21	(2.41)	7.57	(2.22)	8.12	(2.38)	8.81	(2.58)	9.75	(2.86)	11.10	(3.25)
3600	5.78	(1.69)	8.52	(2.50)	7.67	(2.25)	8.12	(2.38)	8.65	(2.54)	9.35	(2.74)	10.32	(3.02)
4200	5.79	(1.70)	8.43	(2.47)	7.40	(2.17)	7.74	(2.27)	8.13	(2.38)	8.61	(2.52)	9.27	(2.72)

* all points are at 35°C (95°F) ambient, 18.33°C (65°F) suction temperature, 8.33°C (15°F) subcooling, 54.4°C (130°F) condenser

Performance Coefficients (24V) - ARI HBP

Coefficient	Capacity (BTU/Hr)	Power (Watts)	Current (Amperes)	Mass Flow (Lbs/Hr)
C1	-3.679444E+03	-4.867675E+02	-2.167131E+01	-4.461791E+01
C2	5.845223E-01	1.496091E-02	1.084824E-03	6.334890E-03
C3	-1.199373E-04	-1.144763E-05	-5.209596E-07	-1.642697E-06
C4	5.042385E-09	2.857283E-09	1.204947E-10	5.906442E-11
C5	-8.177431E+01	-2.699716E+01	-1.119082E+00	-8.254951E-01
C6	1.948400E+00	4.766123E-01	2.025301E-02	2.327494E-02
C7	7.393059E-03	-9.956184E-04	-4.372382E-05	1.139669E-04
C8	1.138050E+02	1.831397E+01	7.897037E-01	1.372716E+00
C9	-9.715160E-01	-1.715265E-01	-7.280854E-03	-1.159750E-02
C10	2.372521E-03	4.297170E-04	1.805009E-05	2.761414E-05
C11	1.063754E-04	-3.838692E-05	-1.514576E-06	2.539709E-06
C12	-2.927039E-08	5.218283E-09	2.133914E-10	-4.587501E-10
C13	9.787587E-06	7.255192E-07	3.083418E-08	1.340220E-07
C14	-2.861350E-06	-1.748781E-07	-7.732676E-09	-4.059919E-08
C15	5.039345E-02	7.105331E-03	2.928178E-04	5.793075E-04
C16	-1.584335E-02	-1.356610E-04	-1.214603E-05	-1.925216E-04
C17	8.072227E-02	1.308253E-01	5.113779E-03	-1.826536E-03
C18	2.874906E-06	-5.038764E-07	-2.040962E-08	4.565069E-08
C19	-1.313822E-03	-8.678778E-05	-3.700978E-06	-1.776029E-05
C20	7.331022E-07	-1.256252E-07	-4.994258E-09	1.070925E-08
C21	8.673954E-05	6.326422E-06	2.873865E-07	1.104408E-06
C22	-1.972921E-02	-3.198176E-03	-1.341445E-04	-2.523549E-04
C23	4.652237E-03	5.993140E-04	2.657248E-05	7.017327E-05

Performance Equation

$$Y = C_1 + C_2 X_1 + C_3 X_1^2 + C_4 X_1^3 + C_5 X_2 + C_6 X_2^2 + C_7 X_2^3 + C_8 X_3 + C_9 X_3^2 + C_{10} X_3^3 + C_{11} X_1 X_2 X_3 + C_{12} X_1^2 X_2 X_3 + C_{13} X_1 X_2^2 X_3 + C_{14} X_1 X_2 X_3^2 + C_{15} X_1 X_2^2 + C_{16} X_1 X_3 + C_{17} X_2 X_3 + C_{18} X_1^2 X_2 + C_{19} X_1 X_2^2 + C_{20} X_1^2 X_3 + C_{21} X_1 X_3^2 + C_{22} X_2^2 X_3 + C_{23} X_2 X_3^2$$

X₁ = RPM

X₂ = E_t (°F)

X₃ = C_t (°F)

Cooling Capacity (48V) - ARI HBP **BTU/hr (Watt)**

RPM	Evaporator Temperature													
	20°F	(-7°C)	30°F	(-1°C)	35°F	(2°C)	40°F	(4°C)	45°F	(7°C)	50°F	(10°C)	55°F	(13°C)
1800	282	(83)	406	(119)	464	(136)	525	(154)	596	(175)	683	(200)	791	(232)
2400	389	(114)	572	(168)	657	(193)	745	(218)	842	(247)	952	(279)	1083	(317)
3000	490	(144)	726	(213)	835	(245)	946	(277)	1065	(312)	1197	(351)	1346	(395)
3600	593	(174)	875	(256)	1005	(295)	1136	(333)	1273	(373)	1422	(417)	1588	(465)
4200	704	(206)	1025	(300)	1173	(344)	1321	(387)	1473	(432)	1636	(479)	1815	(532)

Power Consumption (48V) - ARI HBP **Watt** **Current (48V) - ARI HBP** **Amp**

RPM	Evaporator Temperature								Evaporator Temperature							
	20°F	30°F	35°F	40°F	45°F	50°F	55°F	20°F	30°F	35°F	40°F	45°F	50°F	55°F		
1800	58	68	72	75	76	73	67	1.21	1.42	1.51	1.57	1.58	1.53	1.40		
2400	74	85	91	95	97	96	92	1.54	1.78	1.89	1.97	2.02	2.01	1.92		
3000	87	101	108	114	119	120	119	1.81	2.11	2.25	2.38	2.47	2.51	2.48		
3600	101	119	129	137	144	149	151	2.10	2.48	2.68	2.86	3.01	3.11	3.14		
4200	119	143	155	167	178	186	192	2.48	2.98	3.24	3.48	3.70	3.88	4.00		

Efficiency (48V) - ARI HBP **BTU/hr/W (W/W)**

RPM	Evaporator Temperature													
	20°F	(-7°C)	30°F	(-1°C)	35°F	(2°C)	40°F	(4°C)	45°F	(7°C)	50°F	(10°C)	55°F	(13°C)
1800	4.86	(1.42)	6.99	(2.05)	6.41	(1.88)	6.99	(2.05)	7.88	(2.31)	9.32	(2.73)	11.76	(3.45)
2400	5.28	(1.55)	7.76	(2.27)	7.25	(2.12)	7.86	(2.30)	8.69	(2.55)	9.89	(2.90)	11.74	(3.44)
3000	5.65	(1.66)	8.38	(2.45)	7.72	(2.26)	8.28	(2.43)	8.98	(2.63)	9.94	(2.91)	11.32	(3.32)
3600	5.89	(1.73)	8.69	(2.55)	7.82	(2.29)	8.28	(2.43)	8.82	(2.59)	9.54	(2.79)	10.52	(3.08)
4200	5.90	(1.73)	8.59	(2.52)	7.55	(2.21)	7.90	(2.31)	8.29	(2.43)	8.78	(2.57)	9.45	(2.77)

* all points are at 35°C (95°F) ambient, 18.33°C (65°F) suction temperature, 8.33°C (15°F) subcooling, 54.4°C (130°F) condenser

Performance Coefficients (48V) - ARI HBP

Coefficient	Capacity (BTU/Hr)	Power (Watts)	Current (Amperes)	Mass Flow (Lbs/Hr)
C1	-3.679444E+03	-4.773614E+02	-1.062627E+01	-4.461791E+01
C2	5.845223E-01	1.467181E-02	5.319307E-04	6.334890E-03
C3	-1.199373E-04	-1.122642E-05	-2.554464E-07	-1.642697E-06
C4	5.042385E-09	2.802070E-09	5.908315E-11	5.906442E-11
C5	-8.177431E+01	-2.647547E+01	-5.487287E-01	-8.254951E-01
C6	1.948400E+00	4.674024E-01	9.930824E-03	2.327494E-02
C7	7.393059E-03	-9.763794E-04	-2.143946E-05	1.139669E-04
C8	1.138050E+02	1.796008E+01	3.872219E-01	1.372716E+00
C9	-9.715160E-01	-1.682120E-01	-3.570081E-03	-1.159750E-02
C10	2.372521E-03	4.214133E-04	8.850650E-06	2.761414E-05
C11	1.063754E-04	-3.764514E-05	-7.426543E-07	2.539709E-06
C12	-2.927039E-08	5.117446E-09	1.046340E-10	-4.587501E-10
C13	9.787587E-06	7.114995E-07	1.511918E-08	1.340220E-07
C14	-2.861350E-06	-1.714988E-07	-3.791626E-09	-4.059919E-08
C15	5.039345E-02	6.968030E-03	1.435797E-04	5.793075E-04
C16	-1.584335E-02	-1.330395E-04	-5.955662E-06	-1.925216E-04
C17	8.072227E-02	1.282973E-01	2.507481E-03	-1.826536E-03
C18	2.874906E-06	-4.941396E-07	-1.000762E-08	4.565069E-08
C19	-1.313822E-03	-8.511073E-05	-1.814731E-06	-1.776029E-05
C20	7.331022E-07	-1.231977E-07	-2.448875E-09	1.070925E-08
C21	8.673954E-05	6.204173E-06	1.409166E-07	1.104408E-06
C22	-1.972921E-02	-3.136376E-03	-6.577617E-05	-2.523549E-04
C23	4.652237E-03	5.877330E-04	1.302950E-05	7.017327E-05

Performance Equation

$$Y = C_1 + C_2 X_1 + C_3 X_1^2 + C_4 X_1^3 + C_5 X_2 + C_6 X_2^2 + C_7 X_2^3 + C_8 X_3 + C_9 X_3^2 + C_{10} X_3^3 + C_{11} X_1 X_2 X_3 + C_{12} X_1^2 X_2 X_3 + C_{13} X_1 X_2^2 X_3 + C_{14} X_1 X_2 X_3^2 + C_{15} X_1 X_2^2 + C_{16} X_1 X_3 + C_{17} X_2 X_3 + C_{18} X_1^2 X_2 + C_{19} X_1 X_2^2 + C_{20} X_1^2 X_3 + C_{21} X_1 X_3^2 + C_{22} X_2^2 X_3 + C_{23} X_2 X_3^2$$

X₁ = RPM

X₂ = E_t (°F)

X₃ = C_t (°F)

Cooling Capacity (48V) - ASHRAE LBP **BTU/hr (Watt)**

RPM	Evaporator Temperature												
	-40°F (-40°C)	-30°F (-34.4°C)	-20°F (-28.9°C)	-10°F (-23.3°C)	0°F (-17.8°C)	5°F (-15°C)	10°F (-12.2°C)						
1800					167 (49)	226 (66)	254 (74)	281 (82)					
2400			123 (36)	204 (60)	284 (83)	326 (96)	372 (109)						
3000			165 (48)	252 (74)	351 (103)	408 (120)	470 (138)						
3600		132 (39)	207 (61)	299 (88)	416 (122)	485 (142)	564 (165)						
4200	127 (37)	171 (50)	237 (70)	332 (97)	463 (136)	545 (160)	639 (187)						

Power Consumption (48V) - ASHRAE LBP **Watt** **Current (48V) - ASHRAE LBP** **Amp**

RPM	Evaporator Temperature							Evaporator Temperature						
	-40°F	-30°F	-20°F	-10°F	0°F	5°F	10°F	-40°F	-30°F	-20°F	-10°F	0°F	5°F	10°F
1800				34	43	47	50				0.71	0.90	0.98	1.03
2400			36	46	57	62	65			0.75	0.97	1.19	1.29	1.36
3000			45	58	70	75	79			0.95	1.20	1.46	1.57	1.66
3600		44	55	69	83	89	93		0.92	1.14	1.43	1.72	1.84	1.94
4200	48	53	66	81	96	102	107	0.99	1.11	1.37	1.68	2.00	2.13	2.24

Efficiency (48V) - ASHRAE LBP **BTU/hr/W (W/W)**

RPM	Evaporator Temperature												
	-40°F (-40°C)	-30°F (-34.4°C)	-20°F (-28.9°C)	-10°F (-23.3°C)	0°F (-17.8°C)	5°F (-15°C)	10°F (-12.2°C)						
1800					4.87 (1.43)	5.24 (1.54)	5.42 (1.59)	5.68 (1.66)					
2400				3.42 (1.00)	4.38 (1.28)	4.96 (1.45)	5.28 (1.55)	5.70 (1.67)					
3000				3.64 (1.07)	4.38 (1.28)	5.01 (1.47)	5.41 (1.59)	5.92 (1.73)					
3600		3.28 (0.96)	3.78 (1.11)	4.36 (1.28)	5.03 (1.47)	5.48 (1.61)	6.05 (1.77)						
4200	2.66 (0.78)	3.59 (1.05)	3.62 (1.06)	4.11 (1.20)	4.84 (1.42)	5.33 (1.56)	5.95 (1.74)						

* all points are at 32.2°C (90°F) ambient, 32.2°C (90°F) suction temperature, 22.2°C (40°F) subcooling, 54.4°C (130°F) condenser

Performance Coefficients (48V) - ASHRAE LBP

Coefficient	Capacity (BTU/Hr)	Power (Watts)	Current (Amperes)	Mass Flow (Lbs/Hr)
C1	-3.295790E+03	1.038204E+02	-2.254681E+00	-2.190019E+01
C2	1.770597E-01	1.402985E-01	2.813257E-03	2.950640E-03
C3	4.321981E-05	-1.765151E-05	-4.286838E-07	-1.209960E-07
C4	-1.014192E-08	7.595085E-10	2.236787E-11	-3.946378E-11
C5	6.850654E+01	7.451158E+00	3.420705E-02	1.069298E+00
C6	7.807074E-01	-3.844825E-02	-2.348148E-03	7.475581E-03
C7	1.242501E-03	-5.479839E-04	-1.085482E-05	1.721774E-05
C8	8.814758E+01	-5.206222E+00	4.714461E-03	5.656520E-01
C9	-7.637765E-01	5.641091E-02	1.700715E-04	-5.001172E-03
C10	2.270749E-03	-1.806596E-04	-7.593056E-07	1.535818E-05
C11	1.603645E-04	2.170894E-05	3.309449E-08	3.816627E-06
C12	-1.181648E-08	1.967954E-09	3.064124E-12	2.649927E-11
C13	2.155762E-06	1.479896E-08	-3.996940E-09	2.315451E-08
C14	-5.031049E-07	-1.421408E-07	-5.746102E-10	-1.721172E-08
C15	-6.781572E-03	1.097906E-05	1.866478E-05	-1.425872E-04
C16	-6.094824E-04	-1.143837E-03	-1.857540E-05	2.306018E-06
C17	-1.130725E+00	-1.630161E-01	-1.248862E-03	-1.925717E-02
C18	1.275677E-06	-2.885353E-07	-1.830246E-09	-5.635953E-09
C19	-1.786801E-04	-3.611592E-06	4.249993E-07	-1.853742E-06
C20	3.347367E-07	8.006872E-08	1.765311E-09	3.090127E-09
C21	-1.367314E-05	3.087159E-06	3.696640E-08	-1.506971E-07
C22	-7.598152E-03	2.164823E-04	1.821740E-05	-7.323543E-05
C23	4.433028E-03	8.219117E-04	7.438060E-06	8.298551E-05

Performance Equation

$$Y = C_1 + C_2 X_1 + C_3 X_1^2 + C_4 X_1^3 + C_5 X_2 + C_6 X_2^2 + C_7 X_2^3 + C_8 X_3 + C_9 X_3^2 + C_{10} X_3^3 + C_{11} X_1 X_2 X_3 + C_{12} X_1^2 X_2 X_3 + C_{13} X_1 X_2^2 X_3 + C_{14} X_1 X_2 X_3^2 + C_{15} X_1 X_2^2 + C_{16} X_1 X_3 + C_{17} X_2 X_3 + C_{18} X_1^2 X_2 + C_{19} X_1 X_2^2 + C_{20} X_1^2 X_3 + C_{21} X_1 X_3^2 + C_{22} X_2^2 X_3 + C_{23} X_2 X_3^2$$

X₁ = RPM

X₂ = E_t (°F)

X₃ = C_t (°F)

Controller Features

- 4 pole sensor-less variable speed BLDC motor controller
- 420W maximum output power
- 030F0137 & 030F0175: 39 - 60 VDC input range, 030F0152: 19 - 30 VDC input range
- 1800 – 4200 rpm speed
- 1.0 - 4.75V analog speed set input (resistor programmable for fixed speed)
- 030F0137 & 030F0152: 0°C to 45°C operating temperature
- 030F0175: 0°C to 55°C operating temperature (min. fan cooling / airflow across heatsink is 1.5 m/s)
- Under/Over voltage shutdown (resistor programmable under voltage thresholds)
- Locked rotor detection
- Thermal shutdown – for power devices
- Over current shutdown – for power devices
- Low speed shutdown
- TTL Fault output
- Pulsed Fault output (030F0182, 030F0189, & 030F0192 only)
- LED fault indicator
- Fan output, +12VDC @ 0.5A with voltage detection
- Reverse polarity protection

Optional Fixed Resistor Speed Chart

Resistor Value	Motor Speed	
OHMS	[RPM]	
0	3000	48V ONLY
200	1800	
242	1900	
287	2000	
388	2200	
510	2400	
659	2600	
847	2800	
1090	3000	
1.4k	3200	
1.88k	3400	
2.58k	3600	
3.8k	3800	
6.36k	4000	
15.3k	4200	

LED Fault Indicator Output

Motor Fault	1 Flash
Under Voltage	2 Flashes
Over Voltage	3 Flashes
Over Temperature	4 Flashes
Over Current/Power	5 Flashes
Fan Voltage Error	6 Flashes
General Hardware Error	7 Flashes
System Integrity Fault	8 Flashes

Use the formula below to find the resistor value needed to achieve a specific speed for the controller.

$$934960 - 806 * \text{Speed Desired} \\ \text{Speed Desired} - 4360$$

