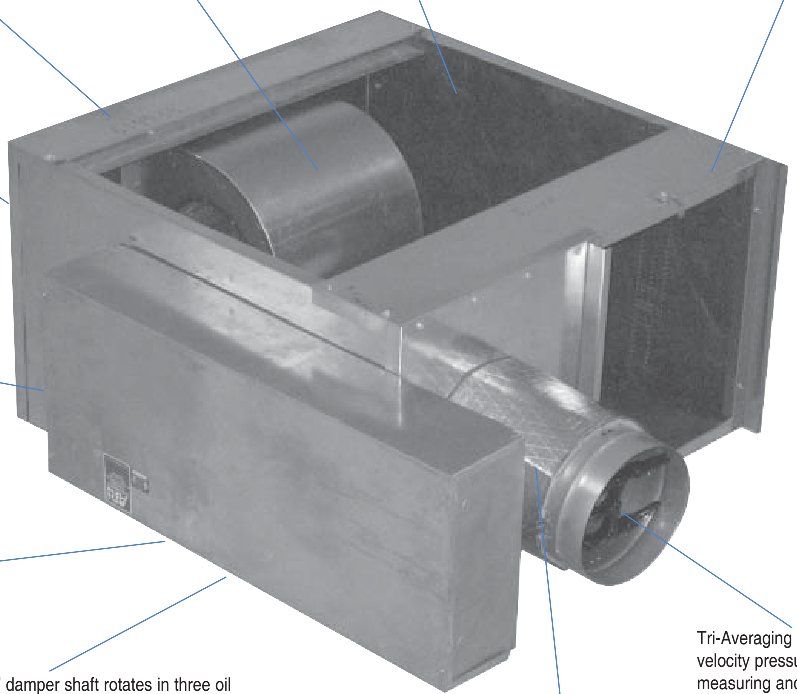

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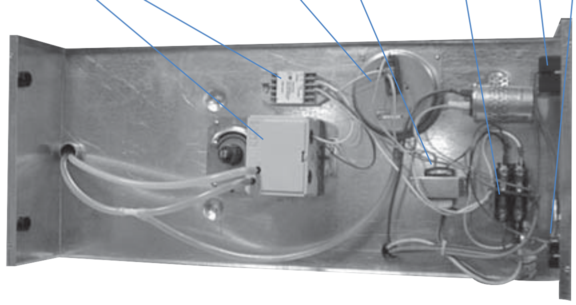
OPTIONAL ETL LISTING



INSIDE CONTROLS ENCLOSURE

CONSTANT VOLUME FAN TERMINALS

- From the job specification or schedule, determine the Maximum and Minimum primary CFM requirement for each zone.
- Refer to the fan curves located under the Performance Data Section of this catalog.
- Select a Fan Size from these curves, making sure that the fan selected can deliver the Maximum Primary CFM at a given downstream external static pressure [ESP]. Downstream ESP consists of ductwork, flex, coils etc. NOTE: For proper operation, it is recommended that the downstream ESP be at least 0.20" WG.
- Units must be selected to operate within the minimum and maximum range of the fan curves. Fan speed controllers [SCR] are provided as standard to allow air flow adjustments and balancing.
- Inlet size is predetermined according to the Fan Size selected for constant volume units. See Quick Selection Table.
- After a Fan Size is selected, refer to the Primary Air Inlet Parameter chart Table. Make sure that the Minimum primary CFM is within the ranges shown for Pneumatic or Electronic controls.
- Sound Level: Refer to the sound section of this catalog to determine if the unit selected meets the required NC or Db levels specified.
- Pressure Drop: Refer to the performance section of this catalog to determine the air differential pressure [∆Ps]. ∆Ps is the static pressure difference from the inlet to discharge and does not include hot water or electric coils. See coil selection for Ps of these devices.
- Heating Coils: For units that require hot water or electric heat refer to the appropriate sections of this catalog for performance data.
- Controls: See Control Section for Terminal Unit Controls and the sequence of operation as specified.

INTERMITTENT VOLUME FAN TERMINALS

- From the job specification or schedule, determine the Maximum and Minimum primary CFM requirement for each zone.
- Select a unit size within the Maximum and Minimum primary CFM range. Maximum CFM should not exceed the maximum rating shown. [Maximum rating based on approximately 3000 FPM]. Minimum CFM should be selected within the pneumatic or electronic minimum CFM ranges shown. [A minimum of 0 CFM is also acceptable if specified].
- Evaluate the fan CFM requirement for each unit and refer to the Fan Curves of this catalog. Note: Actual heating CFM = fan CFM + minimum primary CFM.
- Select a Fan Size from these curves, making sure that the fan selected can deliver the desired CFM at a given downstream external static pressure [ESP]. Downstream ESP consists of ductwork, flex, coils, etc. Note: For proper operation, it is recommended that the downstream ESP be at least 0.20" WG.
- Units must be selected to operate within the minimum and maximum range of the fan curves. Fan speed controllers [SCR] are provided as standard to allow air flow adjustments and balancing.
- After the Fan and Inlet Size is determined refer to the Quick Selection Table to make sure that your selection is available. You will notice that there are many Fan and Inlet size combinations shown for intermittent fan terminals [AS units].
- Sound Level: Refer to the sound section of this catalog to determine if the unit selected meets the required NC or dB levels specified.
- Pressure Drop: Refer to the performance section of this catalog to determine the air differential pressure [∆Ps]. ∆Ps is the static pressure difference from the inlet to discharge and does not include hot water or electric coils. See coil selection for ∆Ps of these devices.
- Heating Coils: For units that require hot water or electric heat refer to the appropriate sections of this catalog for performance data. Note: Actual heating CFM = fan CFM + minimum primary CFM.
- Controls: See Control Section for Terminal Unit Controls and the sequence of operation as specified.

Typical Sequence of Operation – Intermittent Volume

Central fan on – Day (occupied) operation.

When the central system fan is "on", the intermittent fan unit operates as a standard throttling control unit for cooling loads. As the cooling load diminishes the control valve throttles to a minimum or closed position, the fan is energized by the P/E switch for pneumatic controls or an electric contactor for electronic controls to draw in warm plenum air. Thermostat is calling for heat.

Central fan off – Night (unoccupied) operation.

When the central system fan is "off", on a call for less cooling, the primary air supply valve closes. The unit fan is then turned on and off by the P/E switch for pneumatic controls or an electric contactor for electronic controls on demands for heat and not heat respectively.

CAUTION: For electronically controlled unit, a minimum CFM value other than zero may cause the damper to drive open when the central system is off.

Typical Sequence of Operation – Constant Volume

Central fan on – Day (occupied) operation.

When the central system fan is "on" and a positive pressure of at least .10 IWC is present at the primary air inlet, the unit air flow switch senses this pressure and keeps the fan on all the time by overriding the unit P/E switch action with pneumatic controls or electric contactor with electronic controls.

Central fan off – Night (unoccupied) operation.

When the central system fan is "off at 0.0 to negative pressure is present at the primary air inlet. The air flow switch senses the negative pressure and is taken out of the circuit. The unit fan is then turned off by the P/E switch with pneumatic controls or electric contactor with electronic controls.

CAUTION: For electronically controlled unit, a minimum CFM value other than zero may cause the damper to drive open when the central system is off.

Fan Powered Units

QUICK SELECTION TABLE

CONSTANT VOLUME FAN TERMINALS WITH PSC MOTORS *(Standard Design)*

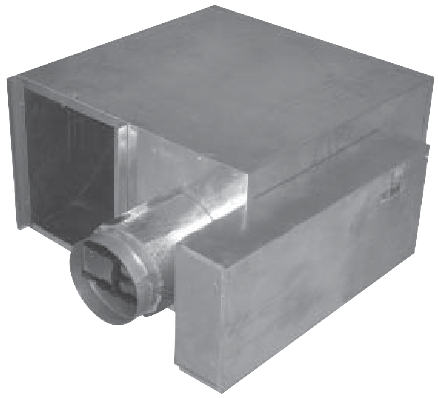
Unit Type	Fan Size	Inlet Size (In.)	Motor HP	Full Load Amps 120 V	Full Load Amps 277V	Maximum Primary Air Flow	Minimum Primary Air Flow (Pneumatic)	Minimum Primary Air Flow (Electronic)	Maximum Fan CFM 0.25"wg
AC_J	B	5	1/6	2.0	1.0	350	0 or 75	0 or 45	550
	B	6	1/6	2.0	1.0	500	0 or 110	0 or 65	550
	C	7	1/6	2.9	1.0	700	0 or 140	0 or 85	750
	D	8	1/4	5.0	1.5	1000	0 or 185	0 or 105	1275
	E	10	1/2	7.2	3.6	1500	0 or 300	0 or 155	1780
	F	12	3/4	11.4	4.7	2300	0 or 430	0 or 225	2430
	G	14	1	—	6.5	3100	0 or 600	0 or 335	3100
	G	16	1	—	6.5	4200	0 or 780	0 or 465	3100
	J	16	(2) 3/4	19.5	7.8	4200	0 or 780	0 or 465	4130

CONSTANT VOLUME FAN TERMINALS WITH ECM MOTORS *(Standard Design)*

Unit Type	Fan Size	Inlet Size (In.)	Motor HP	Full Load Amps 120 V	Full Load Amps 277V	Maximum Primary Air Flow	Minimum Primary Air Flow (Pneumatic)	Minimum Primary Air Flow (Electronic)	Maximum Fan CFM 0.25"wg
AC_J	B	6	1/4	4.25	2.5	550	0 or 110	0 or 65	550
	C	7	1/3	5	2.6	800	0 or 140	0 or 85	800
	D	8	1/2	7.7	4.1	1200	0 or 185	0 or 105	1200
	E	10	3/4	9.6	5.5	1800	0 or 300	0 or 155	1800
	F	12	1	12.8	6.9	2350	0 or 430	0 or 225	2350
	H	14	(2) 3/4	19.2	11	3200	0 or 600	0 or 335	3200
	J	16	(2) 1	25.6	13.8	4200	0 or 780	0 or 465	4200

NOTES: *AC Units = Constant Volume Terminals (Series)*

Models ACF w/o Coil
ACW w/Hot Water Coil
ACE w/Electric Coil



The Carnes constant volume fan terminal unit provides constant air volume to the space while retaining the advantages of a variable air volume system.

The primary air control assembly operates in the same manner as a standard throttling control valve when cooling loads are high. As cooling loads diminish the integral blower(s) induces warm ceiling plenum air to maintain constant air volume.

Features Include:

- Air flow capacities to 4130 CFM.
- Durable 22 gauge galvanized steel casing construction.
- Bottom access panel for internal components.
- Flange or slip and drive discharge connections.
- Forward curved centrifugal type fan assemblies with thermally protected, Permanent Split Capacitor or ECM type, fractional horsepower motors. Multiple voltages available.
- Adjustable SCR fan speed control.
- Fan/motor assemblies are isolated from the casing using rubber isolators to minimize vibration transmission.
- Low leakage primary air damper design.
- Secondary air filter rack.
- Performance data based on tests conducted in accordance with AHRI Standard 880-2008.
- Air flow switch.
- All units are equipped with pressure independent pneumatic or electronic controls.
- Field adjustable P/E switch with pneumatic controls.
- Tri-Averaging type velocity sensor and calibration chart for measuring air flow through the primary air damper.
- Insulation is 1” thick, 1-1/2 lb. dual density fiberglass with surface treated to prevent air erosion, UL listed and meets NFPA 90A requirements.
- Damper controls and fan controls are located in one enclosure.
- AHRI listed.
- Optional ETL listing.
- Optional secondary air sound baffle. Sound baffle is factory attached to secondary air inlet.
- Optional one to four row hot water coils (Model ACW). Coil is factory attached to the unit discharge.
- Optional one or two stage electric reheat coils (Model ACE). Coil is factory attached to unit discharge.
- Optional secondary air filters, Class I (re-usable) or Class II (throw away).
- Optional non-fused or fused fan disconnect switch.
- Optional foil coated insulation.
- Optional fiber-free liner.
- Optional dual wall.

Available Modules:

- Basic control unit — **Model ACF**.
- Basic control unit with hot water coil — **Model ACW**.
- Basic control unit with electric coil — **Model ACE**.

IAQ

IAQ Insulation Available

Fan powered constant volume terminal units are designed to deliver a constant volume of air to a given space. Currently a PSC motor with an SCR is used to turn a blower wheel at a constant rate. As primary air from the air handler is increased the amount of air induced from the conditioned space is decreased. Because there are multiple variable air volume units in a system, the duct static pressure may increase or decrease depending on the total load. As the static pressure in the duct system changes the typical PSC motor blower combination can not adjust itself and therefore the CFM delivered to an area will vary. This makes initial balancing difficult and provides a less than ideal flow of air to the conditioned space.

ECM

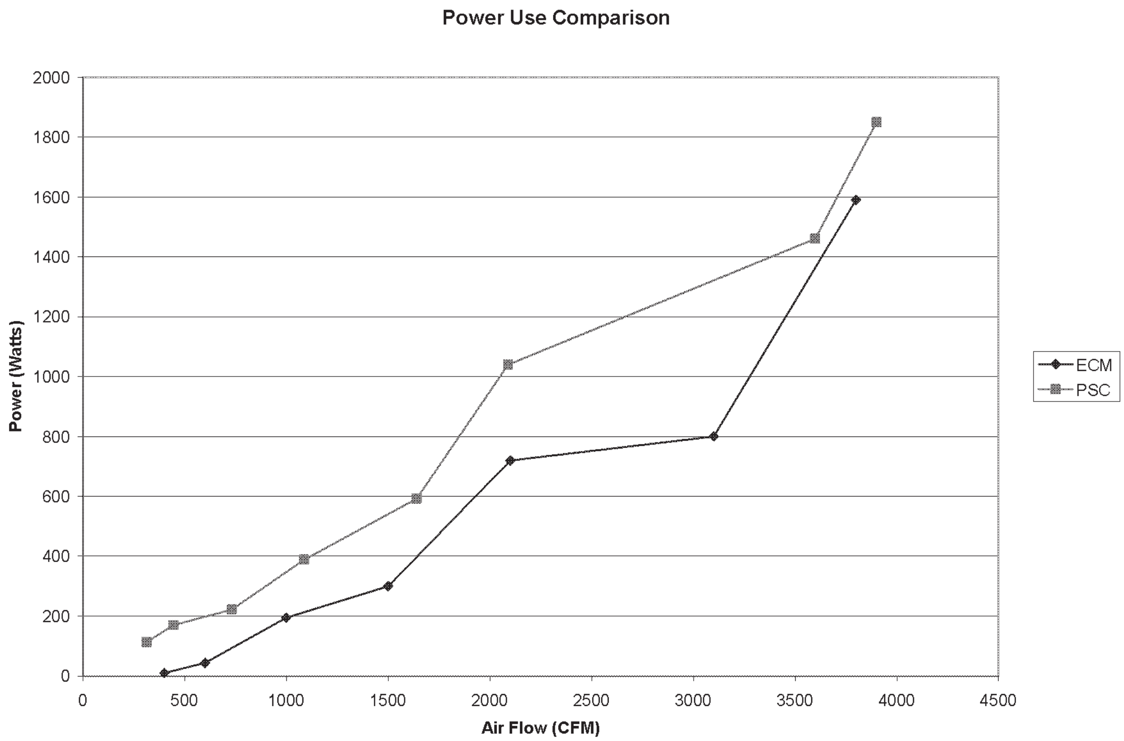
The ideal speed at which an induction motor can turn is fixed by the frequency of the voltage applied and the number of poles it contains. The motor's speed can be reduced by altering the voltage applied across its windings. This can be done with resistors, inductors, transformers or solid state speed controls. Decreasing the voltage reduces the starting and full-load torque, increases the rotors slip and decreases the motors efficiency. The further the motor operates from its ideal speed, the greater the energy loss and running temperature of the motor. The lack of torque control prevents precise air flow control and the low frequency noise may increase.

Front of VCU

In response to the need for a high efficiency motor in which speed can be set and maintained, GE developed an Electronically Commutated Motor or ECM. It is an ultra high efficiency brushless DC motor with a built in inverter. The electronics package, included with the GE ECM motor serves two purposes. One, it switches the DC magnetic fields which allow the motor to operate. Two, it controls torque and speed so that the air flow is maintained despite the pressure seen by the fan. The ECM can be programmed in the factory to set maximum and minimum values which can then be adjusted in the field to the desired CFM. Once set, the motor will maintain constant air flow within + or – 5%.

In 1974 the first fan powered variable air volume boxes were introduced to the market. They provided significant energy savings compared to standard systems at that time because of their ability to recapture plenum heat. With increasing energy costs, the demand for higher efficiency motors has increased. Through testing, the Carnes Company has shown that the ECM has proven true to its reputation for using less energy. The following chart shows the wattage used at various air flows over the range of units provided by Carnes.

Energy Savings



The energy savings for the ECM motor can be quite significant. Depending on energy cost for a given area, the payback for the ECM motor can be seen in as little as two years.

One of the unique features of the ECM motor is that it can be controlled by a 0-10V dc signal from the building automation system. The fan speed can now be increased in cooling mode and decreased for heating mode. This allows the design engineer to further optimize performance.

▼ ECM Motor Control

ECM Motor Taps

The ECM motor was originally designed for the residential HVAC market. Because of the need to provide a different air flow rate for heating versus cooling, two different tap positions were provided. In addition two more tap wires are provided. One is to adjust the flow rate, for example in an application where humidity control was a concern. The other provided a way to delay the start of the fan according to a desired delay profile. The ECM motor tap connections are provided via the ECM control connection. Additional taps are provided as a way for the thermostat to send a control signal to the ECM motor. All of these tap positions are available when the ECM motor is programmed for the TSTAT mode. (See figure 1, table 1)

Variable Speed Control

When applying the ECM to use with a Variable air volume box it is more desirable to be able to provide a variable speed control. This allows the ECM to operate over a range of CFM values. The maximum and minimum air flow rates are programmed into the motor at the factory. The speed of the motor is then set by Pulse width modulated (PWM) signal sent to the ECM motor via a special controller provided by Carnes. The ECM tap positions are all given below. The positions used by Carnes for the Variable air volume application are out lined in blue.

Table 1

PIN	DESCRIPTION
1	C1
2	W/W1
3	C2 (GREEN WIRE) COMMON
4	DELAY
5	COOL
6	Y1
7	ADJUST
8	OUT – (GREEN WIRE)
9	O
10	PK/PWM (RED) CONTROLS SPEED OF MOTOR
11	HEAT
12	R
13	EM/W2
14	Y/Y2
15	G (WHITE WIRE) MOTOR ON/ OFF – GROUND
16	OUT+ (BLACK) - TACHOMETER

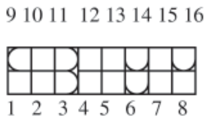


Figure 1

The GE ECM motor is unique in that it is turned off and on via a 24 V control signal. Power should not be disrupted to the motor as a means to control the motor. In fact doing so will reduce the life span of the motor.

Carnes Control Options

Carnes is working together with Evolution Controls to provide three control options with the ECM motor. The standard electronic control is the VCU. It has a digital number readout which allows the user to see the RPM output of the motor as well as the flow index. The flow index is a range of flow from 0-100. A flow index of zero marks the minimum flow of the VAV box. A flow index of 100 is the maximum air flow of the VAV box. Refer to table 2 which is a listing of the expected CFM (within + or – 10%) for the various size units. Once a flow rate is set on the VAV unit, the ECM will maintain the air flow within + or – 5% of the set value.

Fan Powered Units

J-Series ECM Motor Flow Index Table

	AC_J06	AC_J07	AC_J08	AC_J10	AC_J12	AC_J14	AC_J16
Min. CFM	200	450	700	1100	1800	2200	3100
Max. CFM	550	800	1200	1800	2500	3200	4200
Flow Index	Fan CFM	Fan CFM	Fan CFM	Fan CFM	Fan CFM	Fan CFM	Fan CFM
1	200	450	700	1100	1800	2200	3100
2	204	454	705	1107	1807	2210	3111
3	207	457	710	114	1814	2220	3122
4	211	461	715	1121	1821	2230	3133
5	214	464	720	1128	1828	2240	3144
6	218	468	725	1135	1835	2251	3156
7	221	471	730	1142	1842	2261	3167
8	225	475	735	1149	1849	2271	3178
9	228	478	740	1157	1857	2281	3189
10	232	482	745	1164	1864	2291	3200
11	235	485	751	1171	1871	2301	3211
12	239	489	756	1178	1878	2311	3222
13	242	492	761	1185	1885	2321	3233
14	246	496	766	1192	1892	2331	3244
15	249	499	771	1199	1899	2341	3256
16	253	503	776	1206	1906	2352	3267
17	257	507	781	1213	1913	2362	3278
18	260	510	786	1220	1920	2372	3289
19	264	514	791	1227	1927	2382	3300
20	267	517	796	1234	1934	2392	3311
21	271	521	801	1241	1941	2402	3322
22	274	524	806	1248	1948	2412	3333
23	278	528	811	1256	1956	2422	3344
24	281	531	816	1263	1963	2432	3356
25	285	535	821	1270	1970	2442	3367
26	288	538	826	1277	1977	2453	3378
27	292	542	831	1284	1984	2463	3389
28	295	545	836	1291	1991	2473	3400
29	299	549	841	1298	1998	2483	3411
30	303	553	846	1305	2005	2493	3422
31	306	556	852	1312	2012	2503	3433
32	310	560	857	1319	2019	2513	3444
33	313	563	862	1326	2026	2523	3456
34	317	567	867	1333	2033	2533	3467
35	320	570	872	1340	2040	2543	3478
36	324	574	877	1347	2047	2554	3489
37	327	577	882	1355	2055	2564	3500
38	331	581	887	1362	2062	2574	3511
39	334	584	892	1369	2069	2584	3522
40	338	588	897	1376	2076	2594	3533
41	341	591	902	1383	2083	2604	3544
42	345	595	907	1390	2090	2614	3556
43	348	598	912	1397	2097	2624	3567
44	352	602	917	1404	2104	2634	3578
45	356	606	922	1411	2111	2644	3589
46	359	609	927	1418	2118	2655	3600
47	363	613	932	1425	2125	2665	3611
48	366	616	937	1432	2132	2675	3622

J-Series ECM Motor Flow Index Table

49	370	620	942	1439	2139	2685	3633
50	373	623	947	1446	2146	2695	3644
51	377	627	953	1454	2154	2705	3656
52	380	630	958	1461	2161	2715	3667
53	384	634	963	1468	2168	2725	3678
54	387	637	968	1475	2175	2735	3689
55	391	641	973	1482	2182	2745	3700
56	394	644	978	1489	2189	2756	3711
57	398	648	983	1496	2196	2766	3722
58	402	652	988	1503	2203	2776	3733
59	405	655	993	1510	2210	2786	3744
60	409	659	998	1517	2217	2796	3756
61	412	662	1003	1524	2224	2806	3767
62	416	666	1008	1531	2231	2816	3778
63	419	669	1013	1538	2238	2826	3789
64	423	673	1018	1545	2245	2836	3800
65	426	676	1023	1553	2253	2846	3811
66	430	680	1028	1560	2260	2857	3822
67	433	683	1033	1567	2267	2867	3833
68	437	687	1038	1574	2274	2877	3844
69	440	690	1043	1581	2281	2887	3856
70	444	694	1048	1588	2288	2897	3867
71	447	697	1054	1595	2295	2907	3878
72	451	701	1059	1602	2302	2917	3889
73	455	705	1064	1609	2309	2927	3900
74	458	708	1069	1616	2316	2937	3911
75	462	712	1074	1623	2323	2947	3922
76	465	715	1079	1630	2330	2958	3933
77	469	719	1084	1637	2337	2968	3944
78	472	722	1089	1644	2344	2978	3956
79	476	726	1094	1652	2352	2988	3967
80	479	729	1099	1659	2359	2998	3978
81	483	733	1104	1666	2366	3008	3989
82	486	736	1109	1673	2373	3018	4000
83	490	740	1114	1680	2380	3028	4011
84	493	743	1119	1687	2387	3038	4022
85	497	747	1124	1694	2394	3048	4033
86	501	751	1129	1701	2401	3059	4044
87	504	754	1134	1708	2408	3069	4056
88	508	758	1139	1715	2415	3079	4067
89	511	761	1144	1722	2422	3089	4078
90	515	765	1149	1729	2429	3099	4089
91	518	768	1155	1736	2436	3109	4100
92	522	772	1160	1743	2443	3119	4111
93	525	775	1165	1751	2451	3129	4122
94	529	779	1170	1758	2458	3139	4133
95	532	782	1175	1765	2465	3149	4144
96	536	786	1180	1772	2472	3160	4156
97	539	789	1185	1779	2479	3170	4167
98	543	793	1190	1786	2486	3180	4178
99	546	796	1195	1793	2493	3190	4189
100	550	800	1200	1800	2500	3200	4200

Visual Control Unit (VCU)

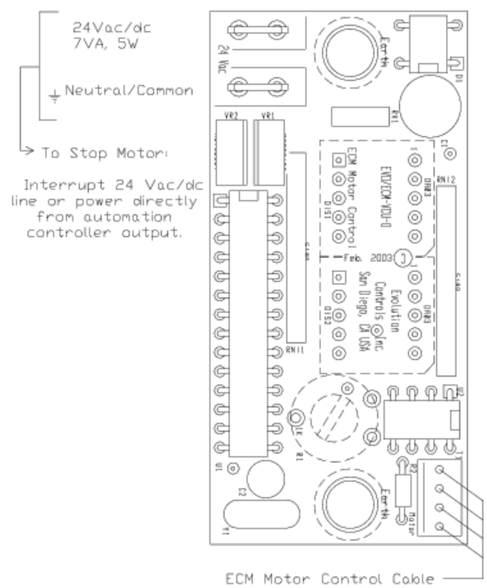
The EVO/ECM-VCU control allows accurate manual adjustment and monitor of fans using General Electric's ECM Motor. (See Figure 2)

The EVO/ECM-VCU features a 4 digit LED numerical display to allow easy reading in dark spaces. Watch the display and set the flow index with a screwdriver to adjust. Twenty seconds later, the display shows the motor RPM. Then, the display periodically alternates between the flow index and motor RPM.

The EVO/ECM-VCU may also be used where automation systems only turn the fan on or off.

Figure 2

Front of VCU



Back of VCU control unit

Specifications:

Power	NEC Class II Only 24 Vac ± 20% 50/60 Hz 4 W, 6 VA
Flow Index	
Adjustment	270° rotation F Off-0-100
RPM	0-2000 RPM ± 2%
Outputs	
Go & Vspd	24 Vdc @ 20 mA
ECM 2.3	Set for Vspd Operation Set Status Flag (7) to RPM Thermal
Stability	>0.01 %/°F
Operating	0°F to 130°F (-18°C to 55°C) Environment 10-80% rh
Connections	1/4 Tabs

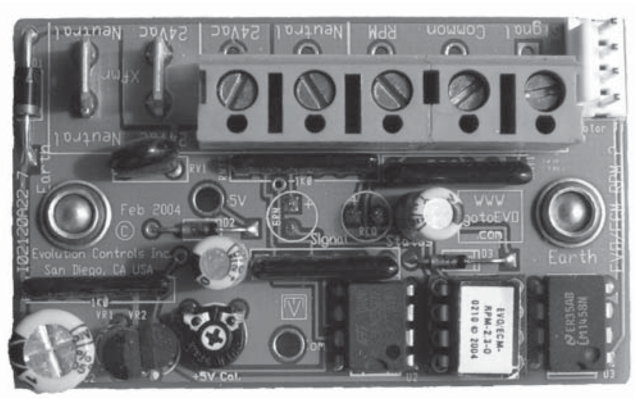
Automatic Control Unit (ACU+)

If digital controls are being used on the project it is possible to control the speed of the ECM motor with a 0-10V control signal using the EVO ACU+ unit. (See figure 3) The on/off signal is provided at a 24V input. Another option is to turn the motor on/off with a 0-1V signal and to use the 2-10V for speed control.

The EVO/ECM-ACU+ allows remote adjustment of the output from 0% to 100% of the programmed control range. A LED on the control continuously flashes out the flow index (percent of the programmed control range), so instruments are not required to read the value.

The "P" version provides ON/OFF control by switching the motor's "GO" control when the input signal drops below the 2 volt (4 mA) operating point.

Figure 3



The green LED continuously indicates the flow index. After a pause, the LED flashes out the tens digit, then the units digit of a number (percent) between 1 and 99. Two extra long flashes indicate a flow index of 0%. Long flashes represent the tens digit, and short flashes represent the units digit. A flow index of 23%, flashes two longs and three shorts.