IBC
Gas-Fired Boilers

IBC Technologies Inc.

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Memorandum 2006-01

High Efficiency Air Handling using a Modulating, Condensing Boiler

Use Coolest Possible Temperature:- To maximize condensing boiler efficiency, it is important to use heat distribution terminals (radiation) that allow the use of the coolest possible circulating water temperature. Clearly the optimal space heating format is in-slab radiant floor – where return water temperatures of 75°F are common, yielding combustion efficiencies of up to 98%.

Typical air handling equipment is generally not as efficient. Most fan coil units were designed for 160°F+ supply water temperatures, with a 20°F drop across the coil and 140°F at the return – to avoid condensation within traditional low performance boilers. This sort of equipment generally offers a single speed air circulator that can deliver air of sufficient warmth to overcome the "wind-chill effect", because to the high temp of the circulating water. It is generally possible to run such air handlers as low as 140° in / 120° out without uncomfortable wind chill. At such levels a condensing boiler should deliver combustion efficiency of approx. 90-92%.

Deep Modulation: to improve on this, it is necessary to dial down the circulating airflow rate in concert with lower circulating temperature. A lower limit can be established at the standard ventilation flow-rate of 400 cfm, which is routinely used without added heat with full comfort. At ventilation level, the minimum heat input is a function of the area of the coil and the minimum firing rate of the boiler. IBC's VFC 15-150 boiler is capable of sustained combustion at 15,000 Btu /hr. (e.g. 14,000 Btu output). A fan coil with sufficiently large heat exchange area can run with a boiler supply temp. of 110°F, sinking this energy without cycling.

Add Reset Heating to the Mix:- To satisfy seasonal heating requirements, it is then necessary to vary heat delivery to match the loads as they fluctuate. This is done by coordinated movement of the circulating water temperature and the air circulation rate, using Reset Heating principles. We couple high water temperature with rapid air movement at the design outdoor temperature – for example 160°F entry (boiler supply to air handler) / 140°F exit and up to 1,200 cfm at the -40° outdoor condition for Edmonton, or the same values at – 8°C for Vancouver. Fences can then be set at levels such as 110°F entry and 400 cfm to ensure adequate circulation without boiler cycling. This will generally provide 95%+ system efficiency for perhaps 75% of the heating season while still allowing full warmth and 90% efficiency at design heating conditions.

IBC / Nutech:- IBC has partnered with Nutech Brands Inc (London ON) to develop customized versions of the Lifebreath™ Clean Air Furnace and its straight air handler sister product (without heat recovery ventilation). This equipment incorporates ECM brushless DC variable speed air circulation, modified to operate with full modulation within settable parameters.

System Control:- the air handler is controlled by the IBC boiler: the process starts with the outdoor temperature signal from a properly located sensor (a tekmar 071 thermister is supplied as standard equipment with boiler, to which it is wired). For any given outdoor condition below the *Summer Shutdown* level, a water temperature is derived from the lookup table as shaped by the installer's input Reset parameters. In parallel, a fan speed value is sent from the boiler to the

air handler to adopt a particular flow rate. The boiler will "see" a resultant heating load, which will be matched through burner rate modulation. At marginal heating weather and ventilation airflow rates, the boiler would typically run at 15 – 25 MBH. At design conditions the boiler would typically see a load above that actually required by the building, due to generally conservative sizing and settings practices in the industry. Using just an outdoor signal, this would lead to occasional cycling, but with an indoor sensor, the airflow and water temp. values will adjust to balance the building heat loss.

Cooling is also contemplated:- the boiler control with switch airflow to high with a cooling call.

Piping / Wiring / Settings:-

Use a Primary / Secondary piping layout; all pumps are to be placed under the control of the boiler, including the Grundfos unit integral to the air handler (IBC disconnects this from the air handler controller). It must be wired to the boiler's green connector block using one of the 3 Load P(ump)/V(alve) contact pairs. Connect the room thermostat to contacts at the air handler. A connection is then made from dry contacts at the air handler (marked BB) to the boiler for call-for-heat. The boiler has command of the air circulating fan (via the boiler's red & white harness lead marked VS Pump) which is connected to the air handler's barrier (or connector) strip at positions M (for positive (boiler Red)) and C (for common (boiler White)). Remove the 2 position Molex connector from the boiler's VS Pump lead and Marrette™ as necessary.

To program, go to Installer Setup and move the cursor down to line 9, "VS Output for…". Select and move the cursor up to "Load 1 Fan" (on software release 2.15, this will initially display "256") if the variable speed air handler is to be placed on load 1. If the air handler is to be located on load 2 – move the cursor one further step up (to select Load 2 Fan, or initially "512" on software release 2.15). Similarly, move up one more step for Load 3 Fan for that load configuration.

Next, set the minimum and maximum air handler fan speed fences; drop down to line 10 in *Installer Setup* for *Min. Variable Speed %* (this will display a default value of 28). The percentage scale pertains to the throttle level of air circulation with 100% reflecting 1,400 cfm; 28% equates to the fixed minimum throttle level of approximately 400 cfm. Note that while it is possible to enter valves down to 10%, there will be no reduction in airflow below the 400 cfm level. Such ventilation level is a good setting for most installations. Use *Installer Setup* line 11 to adjust *Max. Variable Speed %* - this can be used to restrain the upper end of the range to avoid unnecessary circulation in modest sized buildings (e.g. 60% will give 840 cfm).

Finally go to the boiler's load settings for the selected air handler load, and register the appropriate Reset Heating parameters. Define the load as "Space Heating" then configure using "Air Handler" on line 1, the desired indoor target (typically 70-73 °F) at line 2, the local Design or coldest day temp. at line 3. At line 4, leave Design Indoor temp. at 70°F – this anchors the Reset Heating curve at this most common level. At line 5 – *Design Supply Temp*. – enter the level of boiler water wanted at the air handler on the coldest day; typically this would be 160°F. Skip lines 6 (*Design Heat Load*) and 7*(% of Space Heat Load*) – these are fields under development as at January 2006. At line 8 - *Summer Shutdown* - the default value of 65°F should work well unless lots of south facing glass allows significant solar gain (here, use a lower setting). Line 9 – *Max. Supply Temp*. must be at least ½ the *Supply Differential Temp*.(line 11) above the Design Supply Temp. (from line 5) or else the boiler will cycle off its software high

limit while attempting to operate as specified on the coldest day of the year. For the typical 160°F Design Supply discussed for line 5, with a Supply Differ'l of 22°F, the Maximum Supply must be 160 + 11 = 171°F

Air Handler Performance:-

Air Handlers and the Clean Air Furnace(combined air handler & heat recovery ventilation) have similar heating and ventilating capacities – 400 cfm to 1,400 cfm (max). Use with standard A coil for cooling; equates with 3.5 tons capacity.

See attached sheets (extracts from Nutech / Lifebreath documentation) for dimension and further performance data.

Part Number / Description:-

Air handler:

- Up-flow AH-U-L4A-36-E16 / IBC
- Down-flow AH-D-L4A-36-E16 / IBC

Clean Air Furnace

- Up-flow CAF-U-L4A-36-E16 / IBC
- Down-flow CAF-D-L4A-36-E16 / IBC

Note – while these part numbers reflect those of Nutech / Lifebreath, they do not cross directly to that company's general production. IBC labeled units contain proprietary software covering full modulating operation.

January 4, 2006

Specifications

Model AH-U-L4A-36-P16

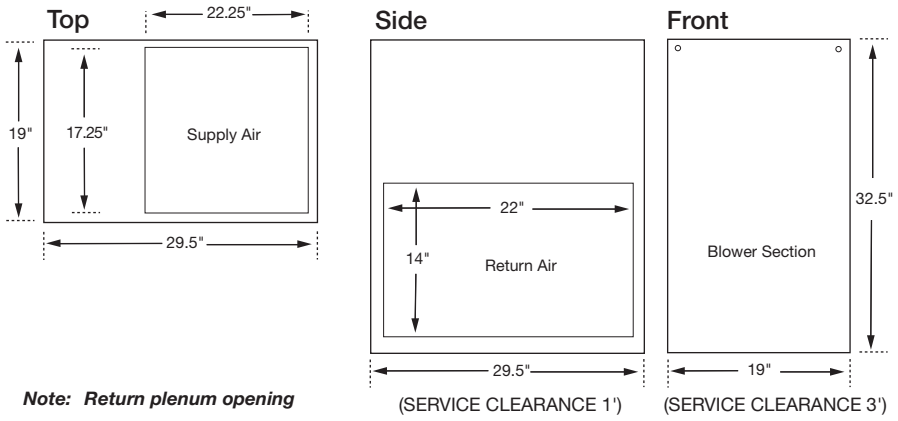
Filters 1" pleated in return plenum side.

Case Prepainted galvanized steel for superior corrosion resistance.

L4A-36 Coil Output Chart (1000's of BTUH)

CFM	Water Temp.	3 GPM						4 GPM						5 GPM					
CFM@.5"WG	1180	51.4	60.2	69.0	77.9	86.8	95.8	56.3	65.9	75.6	85.3	95.0	104.8	59.4	69.5	79.7	89.9	100.1	110.3
	1120	50.0	58.7	67.2	75.9	84.5	93.2	54.5	63.9	73.2	82.6	92.0	101.5	57.4	67.1	76.9	86.8	96.6	106.5
	890	43.9	51.4	60.0	66.5	74.1	81.7	46.9	54.9	62.9	70.9	79.0	87.1	48.7	56.9	65.3	73.5	81.8	90.2
	675	36.6	42.8	49.0	55.3	61.5	67.8	38.2	44.7	51.2	57.7	64.2	70.7	37.3	43.7	50.0	56.4	62.8	69.2
CFM@.25"WG	1350	54.7	64.2	73.6	83.1	92.6	102.1	60.8	71.2	81.7	92.2	102.7	113.3	64.7	75.8	86.8	98.0	109.2	120.4
	1275	53.3	62.5	71.7	80.9	90.2	99.5	58.9	69.0	79.1	89.3	99.5	109.7	62.4	73.1	83.8	94.5	105.3	116.5
	940	45.4	53.2	60.9	68.8	76.6	84.5	48.7	57.0	65.3	73.7	82.1	90.4	50.7	59.3	67.9	76.6	85.3	94.0
	730	38.6	45.2	51.8	58.4	65.0	71.7	40.6	47.5	54.4	61.3	68.3	75.2	41.8	48.8	55.9	63.0	70.1	77.2
		130	140	150	160	170	180	130	140	150	160	170	180	130	140	150	160	170	180

Dimensions & Clearances



Note: Return plenum opening available off either side of cabinet. All units conform to CSA and UL Standards

Model	AH-U-L4A-36-PI6
Voltage	120 VAC 60 Hz
Hp	1/2
Amps (total)	8.7
Water Connections	3/4" Copper Soldered Connection
Airflow (High) .25 in wg .5 in. wg	 1350 CFM 1180 CFM
Net Weight	121 lbs.
Shipping Weight	140 lbs.

Warranty

Units carry a five year replacement parts warranty on all components.

Specifications Model CAF-U-L4A-36-P16

Core Ventilation system has patented aluminum heat recovery core (standard) or an enthalpic energy recovery core (optional) for energy-efficient ventilation. Enthalpic cores are recommended for regions where the temperature does not drop below 25˚F (-4˚C).

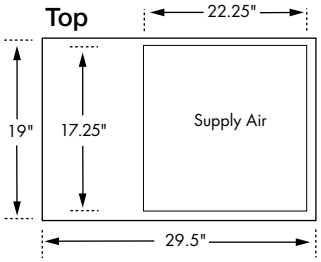
Filters Washable air filters in exhaust and supply air streams of ventilation section, 1" pleated in return plenum side.

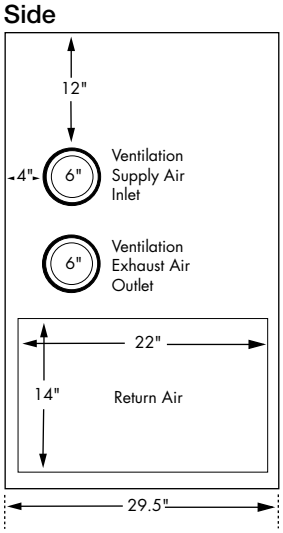
Case Prepainted galvanized steel for superior corrosion resistance.

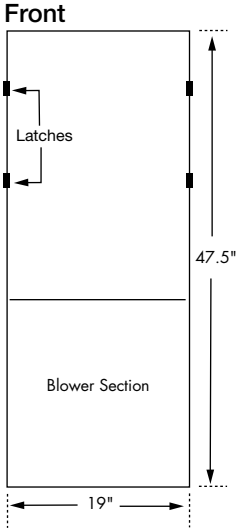
L4A-36 Coil Output Chart (1000's of BTUH)

		3 GPM						4 GPM						5 GPM					
CFM @ .5"WG	1180	51.4	60.2	69.0	77.9	86.8	95.8	56.3	65.9	75.6	85.3	95.0	104.8	59.4	69.5	79.7	89.9	100.1	110.3
	1120	50.0	58.7	67.2	75.9	84.5	93.2	54.5	63.9	73.2	82.6	92.0	101.5	57.4	67.1	76.9	86.8	96.6	106.5
	890	43.9	51.4	60.0	66.5	74.1	81.7	46.9	54.9	62.9	70.9	79.0	87.1	48.7	56.9	65.3	73.5	81.8	90.2
	675	36.6	42.8	49.0	55.3	61.5	67.8	38.2	44.7	51.2	57.7	64.2	70.7	37.3	43.7	50.0	56.4	62.8	69.2
CFM @ .25"WG	1350	54.7	64.2	73.6	83.1	92.6	102.1	60.8	71.2	81.7	92.2	102.7	113.3	64.7	75.8	86.8	98.0	109.2	120.4
	1275	53.3	62.5	71.7	80.9	90.2	99.5	58.9	69.0	79.1	89.3	99.5	109.7	62.4	73.1	83.8	94.5	105.3	116.5
	940	45.4	53.2	60.9	68.8	76.6	84.5	48.7	57.0	65.3	73.7	82.1	90.4	50.7	59.3	67.9	76.6	85.3	94.0
	730	38.6	45.2	51.8	58.4	65.0	71.7	40.6	47.5	54.4	61.3	68.3	75.2	41.8	48.8	55.9	63.0	70.1	77.2
	Water Temp.	130	140	150	160	170	180	130	140	150	160	170	180	130	140	150	160	170	180

Dimensions & Clearances







Note: Ventilation ports and return plenum opening available off either side of cabinet. All units conform to CSA and UL Standards.

Model	CAF-U-L4A-36-P16
Voltage	120 VAC 60 Hz
Hp	1/2
Amps (total)	8.7
Water Connections	3/4" Copper Soldered Connection
Airflow (High) .25 in wg .5 in. wg	 1350 CFM 1180 CFM
Ventilation Airflow	100 - 140 CFM
Effectiveness (Aluminum Core)	70%
Total Efficiency (Enthalpic Core)	50%
Net Weight	150 lbs.
Shipping Weight	165 lbs.

Options

99-186 Weatherhoods, Two - 6" c/w 1/4" mesh screen

99-130W Remote Wall Mount Dehumidistat Control 24 VAC only

99-RSK6 6” back draft damper

99-104 DET - Digital Electronic Timer

Warranty

Units carry a lifetime warranty on the heat recovery (aluminum) core, a five year warranty on the energy recovery (enthalpic) core and a five year replacement parts warranty on all other components.

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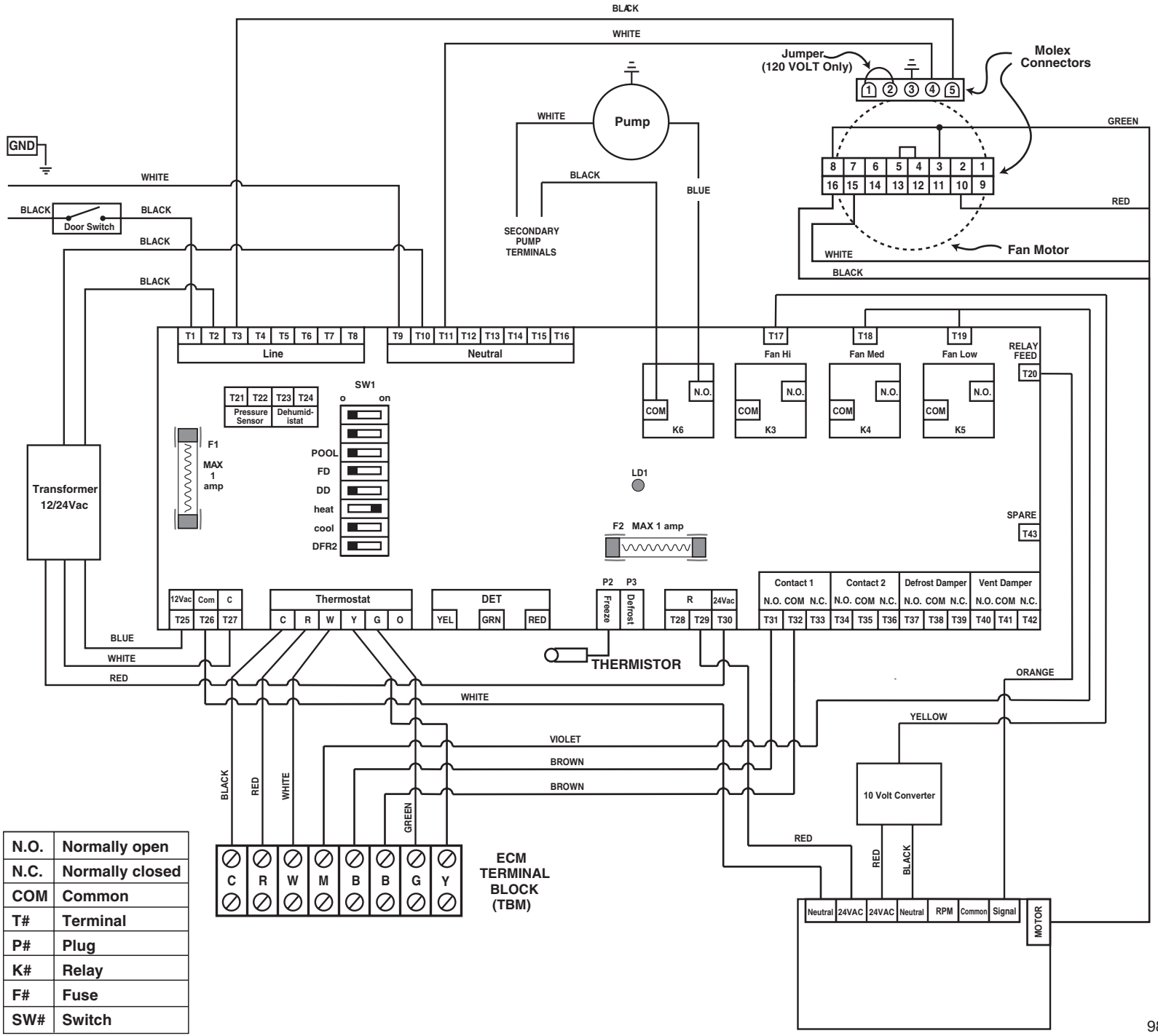
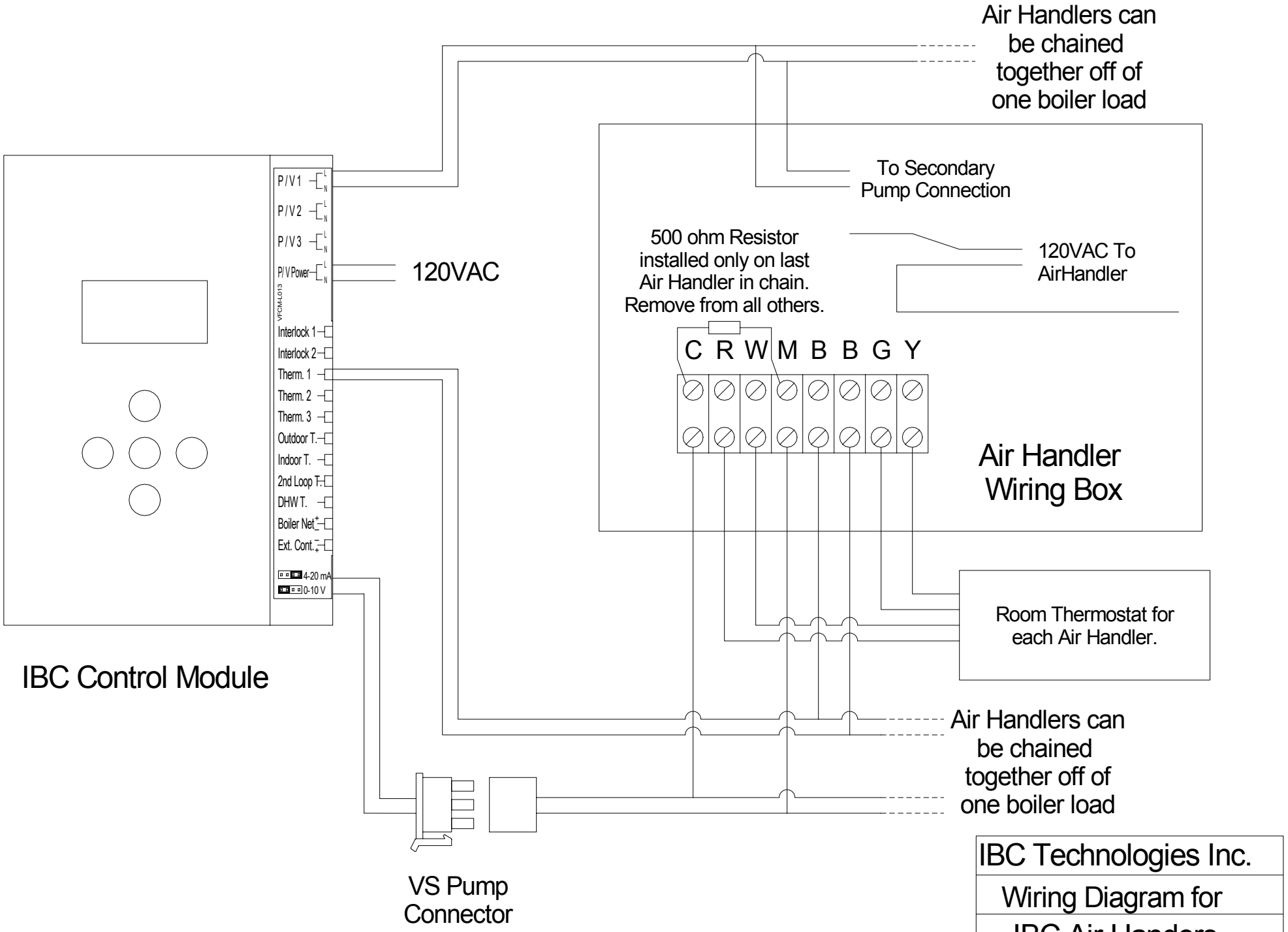
ECM - CAF/Air Handler Wiring Diagram -- IBC Technologies Inc.



N.O.	Normally open
N.C.	Normally closed
COM	Common
T#	Terminal
P#	Plug
K#	Relay
F#	Fuse
SW#	Switch

98-CAF-ECMIBC-01
0601AH R3



IBC Technologies Inc.	
Wiring Diagram for	
IBC Air Handers	
Date: Sept. 28, 2008	Scale: N/A
Drwn by: Allan Teron	File: Air Handler Wiring 2.CAD