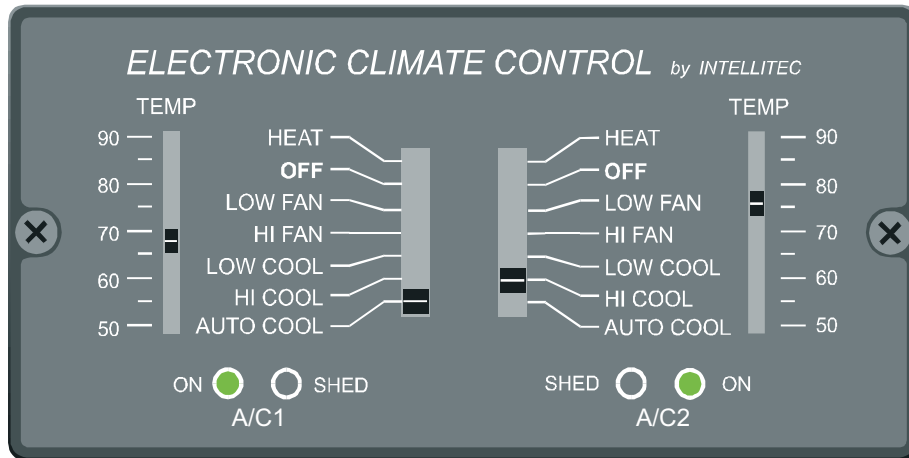


ELECTRONIC CLIMATE CONTROL

SERVICE MANUAL



PRODUCT DESCRIPTION

The **ELECTRONIC CLIMATE CONTROL** (ECC) System offers automatic and manual control of the A/C1 and A/C2 roof-top air conditioners and furnace/s in the motoR home. The system includes an energy management system that shuts off the air conditioners, when necessary, to prevent electrical over-load. It also includes a number of features that provide the owner with the most comfortable temperature controlled environment possible.

In the **HEAT** mode, the system offers automatic control of the furnace/s in a manner identical to standard wall mount thermostats.

In either the **LOW COOL** or **HIGH COOL** modes, the air conditioner fans run continuously at the selected speed and the compressors are controlled to maintain the set point temperature. When in the **AUTO** mode, the unit automatically controls the compressors and selects the appropriate air conditioner fan speed based on the difference between the set point temperature and the ambient temperature in the motoR home.

In addition to controlling the temperature within the coach, the system constantly monitors the current being drawn by all of the 120 VAC electrical appliances, including the air conditioners, and will control the operation of the air conditioners to prevent them from over-loading the circuit breakers. Once the system turns the air conditioners off, it will keep them off until there is enough power available to restore normal operation.

The system has been designed to operate from 120 VAC, 30 Amp service **only**. *Connecting the coach to any other power source will cause the system to operate improperly.* If only 20 Amp service is available, "load management" must be done manually by the owner, and only **one** air conditioner can be operated at a time, unless the auxiliary generator is utilized

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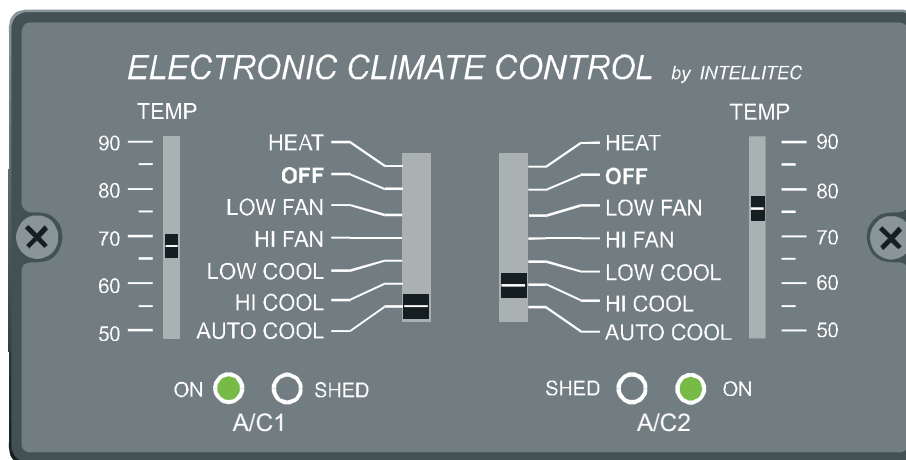
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HOW IT WORKS

The System contains two major components, the ECC Thermostat and the ECC Control Module, along with additional external sensors which are connected to these modules.

THE ECC THERMOSTAT:

The Thermostat allows the owner to set the A/C1 and A/C2 air conditioning and heating systems' modes and temperatures. The electronics in this panel measure ambient temperatures via two external temperature probes (front and rear). Based on the mode and set point temperature settings, the probes send appropriate control signals to the ECC Control Module. These signals are sent via a two wire multiplexed communication link labeled IPX SIG and IPX GND.



There are two identical sets of controls on the panel, one for each of the front (A/C1) and rear (A/C2) systems. The potentiometers allow the user to select a desired temperature for each system in the range of 50 to 90 degrees Fahrenheit. Moving the controls down, lowers the set point temperature. The two, seven-position function switches are used to select the furnace's and air conditioners' operating modes.

A brief description of each mode is as follows:

HEAT - The Thermostat controls the furnace/s to maintain the desired temperature in the coach. The furnace/s will be energized at an ambient temperature 2 degrees below the set point temperature and shut off when the ambient temperature is at the set point temperature. Load shedding is not active in this mode.

OFF - All control settings are disabled and the Thermostat is placed in a low-current "sleep" mode in order to minimize battery drain. (35-45 mA)

LOW FAN - The air conditioner fan is energized on low speed. Load shedding is active.

HIGH FAN - The air conditioner fan is energized on high speed. Load shedding is active.

LOW COOL - The air conditioner fan is energized on low speed. The air conditioner compressor is turned on when the ambient temperature goes 2 degrees above the set point temperature and shuts off when the ambient temperature reaches the set point temperature. Load shedding is active.

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HIGH COOL - The air conditioner fan is energized on high speed. The air conditioner compressor is turned on when the ambient temperature is 2 degrees above the set point temperature and shuts off when the ambient temperature reaches the set point temperature. Load shedding is active.

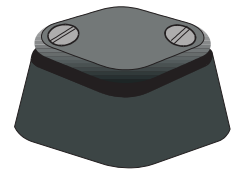
AUTO COOL - Both the air conditioner compressor and high fan are on when the ambient temperature goes 5 degrees above the set point temperature. When the ambient temperature drops to within 2 degrees of the set point, the fan switches to low speed. When the temperature drops to the set point, the compressor turns off. When the ambient temperature drops 2 degrees below the set point, the fan turns off. As the ambient temperature rises, the reverse procedure happens. Load shedding is active.

INDICATOR LIGHTS:

There are two indicator lights on the control panel for each of the front (A/C1) and rear (A/C2) systems. The green **ON** indicator will be lit when the associated function switch is in *any* mode, except the **"OFF"** mode and the system has not shed the associated air conditioner compressor, or fan. The red **"SHED"** indicator will be lit when the associated function switch is in *any* mode, except the **"OFF"** mode and the system *has* shed the associated air conditioner compressor, or fan. The **"ON"** and **"SHED"** indicators will blink alternately when the system is holding off operation of the air conditioner compressor during the 2 minute "short-cycle" protection cycle. (see *ECC Control Module*)

THE ECC TEMPERATURE PROBES:

These Temperature Probes are thermistors mounted in protective plastic housings so they can sense the temperature of the air without being influenced by the mounting surface temperature. Thermistors vary their electrical resistance *inversely* with temperature; which means, the higher the temperature, the lower the thermistors' resistance. The thermistors utilized in this system have a resistance of about 10,000 Ohms at 77 degrees.



**TEMPERATURE
PROBE**

There are two temperature probes, one for each of the front (A/C1) and rear (A/C2) systems. They are located remotely from the thermostat panel to sense temperatures in the front and rear. The connections to the ECC Thermostat are via small 2 pin connectors labelled J1 (A/C1) and J4 (A/C2). Since the devices are not polarity sensitive, the two wires leading to them can be reversed without harm. However, it is necessary to connect the A/C1 and A/C2 TEMPERATURE PROBE to the correct connector to ensure the ECC Thermostat interprets the correct ambient temperatures associated with the front (A/C1) and rear (A/C2) of the coach.

THE ECC CONTROL MODULE:

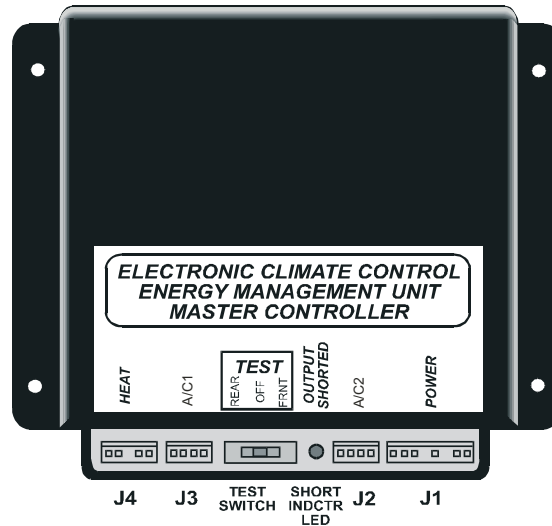
The Control Module performs the timing, sequencing, switching, and load shedding functions for the furnace/s, air conditioner fans and compressors. It is often located under the refrigerator. The circuitry in this module decodes the control signals sent to it via the multiplexed communication link from the ECC Thermostat.

The Control Module operates the furnace/s by closing a set of relay contacts. The relay contacts for the front furnace are connected to pins 1 and 2 of connector J4, and the contacts for the rear furnace are connected to pins 4 and 5 of the same connector.

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The relay contacts are electrically isolated from all other circuitry on the Control Module. The contacts are functionally equivalent to the contacts on a wall mounted thermostat and are wired to the blue and black thermostat leads from each furnace. The coach may be equipped with one, or two furnaces. On coaches equipped with one furnace, the furnace should be wired to pins 1 and 2 of connector J4.



The pigtail connector supplied with the system (PC4) utilizes the following color codes:

PC4 /J4 pin	FUNCTION	COLOR
1	FRONT FURNACE THERMOSTAT (BLUE)	WHT/BLUE
2	FRONT FURNACE THERMOSTAT (BLACK)	WHT/BLK
3	KEYED - NOT CONNECTED	
4	REAR FURNACE THERMOSTAT (BLACK)	BLK
5	REAR FURNACE THERMOSTAT (BLUE)	BLU

The Control Module operates the air conditioner compressors and fans via three relays with 12 VDC coils supplied by the A/C manufacturer and mounted in their equipment. The contacts on these relays are internally wired by the A/C manufacturer to the 120 VAC supply line for each unit and connect the compressor with the low, or high speed taps on the fan motor to that supply line when operated. The wiring between the Control Module and these relays is low voltage (12 VDC) wiring. The Control Module uses *high-side switching* to operate the corresponding relays. One side of each of the relay coils is connected together. This "common" lead is connected to ground through the Control Module and *should not* be grounded anywhere else. The other side of each of the coils is brought out to one of three separate leads. These leads are connected to the Control Module via a four-pin connector: J2 for the A/C1 unit, and J3 for the A/C2 unit. The corresponding pigtail connectors, PC2 and PC3, are supplied with the system. PC3, the A/C2 (rear) connector, is marked in red in order to differentiate it from PC2.

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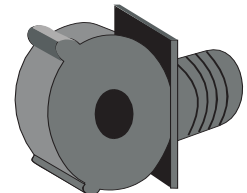
The following table indicates the connection and control states:

MODULE CONN PIN	PIGTAIL WIRE COLOR	FUNCTION	"ON" VOLTAGE	"OFF" VOLTAGE
J2-1	BLU	COMMON	<1 VDC	<1 VDC
J2-1	GRY	LOW FAN	+12 VDC	<1 VDC
J2-3	GRN	HIGH FAN	+12 VDC	<1 VDC
J2-4	YEL	COMPRESSOR	+12 VDC	<1 VDC
J3-1	BLU	COMMON	<1 VDC	<1 VDC
J3-2	GRY	LOW FAN	+12 VDC	<1 VDC
J3-3	GRN	HIGH FAN	+12 VDC	<1 VDC
J3-4	YEL	COMPRESSOR	+12 VDC	<1 VDC

NOTE: The PC2 and PC3 pigtail wire colors are included *for reference only* to identify the function of the wires emanating from the Control Module. The wire colors emanating from the A/C1 and A/C2 units may, or may not agree with these colors. *Always refer to the installation manual supplied with the A/C unit, or see "Identifying control lead functions on the A/C unit", in order to match the wire color/functions with those on the Control Module.*

TEST SWITCH:

The Control Module incorporates a three-position test switch located between J2 and J3 to verify proper wiring to each A/C unit relay. Sliding the test switch towards the J2 operates A/C1 and high fan by connecting J2-3 and J2-4 to +12V. Sliding the test switch towards the J3 operates A/C2 and high fan by connecting J2-3 and J2-4 to +12V. The test switch must be placed in the **CENTER**, or **OFF** position for normal operation.



SHORT INDICATOR:

The 12 volt wires feeding the air conditioners are protected from short circuits. If any of these wires are shorted to ground, the **"SHORT"** indicator will be lit, indicating the short. To help locate the short, the plugs feeding the air conditioners should be unplugged, one at a time, to see which cable is at fault. When the shorted cable is unplugged, the **"SHORT"** indicator will go out and the other air conditioner will operate normally. The individual wires of the shorted plug can be tested for shorts to find which one is at fault.

The **"SHORT"** indicator operates in the **"OFF"** and **"TEST"** modes of the **TEST SWITCH**.

The Control Module also includes protection circuitry to eliminate the possibility of "short-cycling" the A/C compressors. Short-cycling causes undue stress on the compressor motor when refrigerant pressures are not allowed to stabilize prior to restarting the compressor. A two-minute timer is incorporated in each of the control systems for the front (A/C1) and rear (A/C2) compressors.

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The timer is started each time one of three conditions is encountered:

- 1) If the Control Module shuts down the associated A/C compressor during a the shedding sequence, or if the ambient temperature has reached the set point.
- 2) If the 120 VAC line current sensed by the Current Sensor goes below 1 Amp. *This will occur during an interruption of power, if the generator is not running, or if the shore power cord is not plugged in.*
- 3) If +12 VDC power is not applied to the Control Module. The Control Module does not allow the compressor to be re-energized until the two-minute period has elapsed. If during this period, the coach requires cooling, or if the unit is recovering from load-shedding, the Control Module will signal the ECC Thermostat to alternately flash the **"ON"** and **"SHED"** indicators on the control panel until the period has elapsed. After the two minute period has elapsed the system will return to normal operation.

An important feature included in the Control Module circuitry is the Automatic Load Shedding function. This circuitry measures the total current being drawn by all of the 120 VAC operated equipment in the coach being fed through the main panel. The Current Sensor is mounted in the main panel and supplies an input signal to the Control Module. When enough 120 volt appliances are operated so that the current exceeds 30 Amps for more than approximately 3 seconds, the Control Module begins to shed (shut off) the A/C compressors and fans to bring the current back below the 30 Amp limit. This prevents nuisance tripping of the main 30 Amp breaker.

The shedding sequence occurs in the following order:

1. Rear (A/C2) compressor (if running)
2. Front (A/C1) compressor (if running)
3. Rear (A/C2) fan (if running)
4. Front (A/C1) fan

When the Control Module sheds any of the loads, it returns a signal to the ECC Thermostat to light the corresponding front, or rear **"SHED"** indicator. Based on the shedding sequence, the rear **"SHED"** indicator will always be the first to light. If enough appliances are operated to generate a load current of 30 Amps, the Control Module will proceed through the entire shedding sequence and essentially shut down both A/C compressors and fans. *(It is important to note that if the Control Module has shed all four loads and the line current continues to exceed the 30 Amp limit, it is likely that the 30 Amp line breaker will open.)*

ALTERNATING OPERATION:

If the total current being drawn is such that only one A/C can operate, and the ECC Thermostat continues to demand that both A/C compressors operate, the Control Module will alternate operation of A/C1 and A/C2 compressors every 30 minutes. When the line current is low enough to allow operation of both air conditioners, the Control Module will restore their operation in a reverse order to the shedding sequence. The front (A/C1), or rear (A/C2) **"SHED"** indicators on the ECC Thermostat will remain lit until the corresponding A/C compressor and fan are restored to normal operation.

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SYSTEM INTERCONNECTS:

12 VDC power is supplied to the Control Module via connector J1. This connector also provides the signal connections between the Control Module and ECC Thermostat, and the Current Sensor. Connector PC1B is part of the Current Sensor assembly.

The pigtail connector, PC1A, is supplied with the system and is wired per the following table:

J1 PIN	PC1B PIN	FUNCTION	COLOR
1	1	CURRENT SENSOR IN	WHT
2	2	CURRENT SENSOR GND	WHT

J1 PIN	PC1B PIN	FUNCTION	COLOR
3	1	KEYED - NOT CONNECTED	N/C
4	2	+12 VDC POWER	RED
5	3	KEYED - NOT CONNECTED	N/C
6	4	POWER GROUND	BLK
7	5	IPX GND	BRN
8	6	IPX SIG	YEL

THE ECC CURRENT SENSOR:

The Current Sensor is a transformer which converts the AC current passing through its core into a corresponding voltage. A functional Current Sensor has a resistance of approximately 40 Ohms and produces an AC voltage of 0.1 VAC per Amp of current passing through the core (10 Amps = 1.0 VAC). The Current Sensor should be mounted in one of the knockouts in the 120 VAC box so that the donut shaped head is inside the box. The black wire feeding the 30 Amp main breaker in the 120 VAC panel should pass through the hole in the Current Sensor.

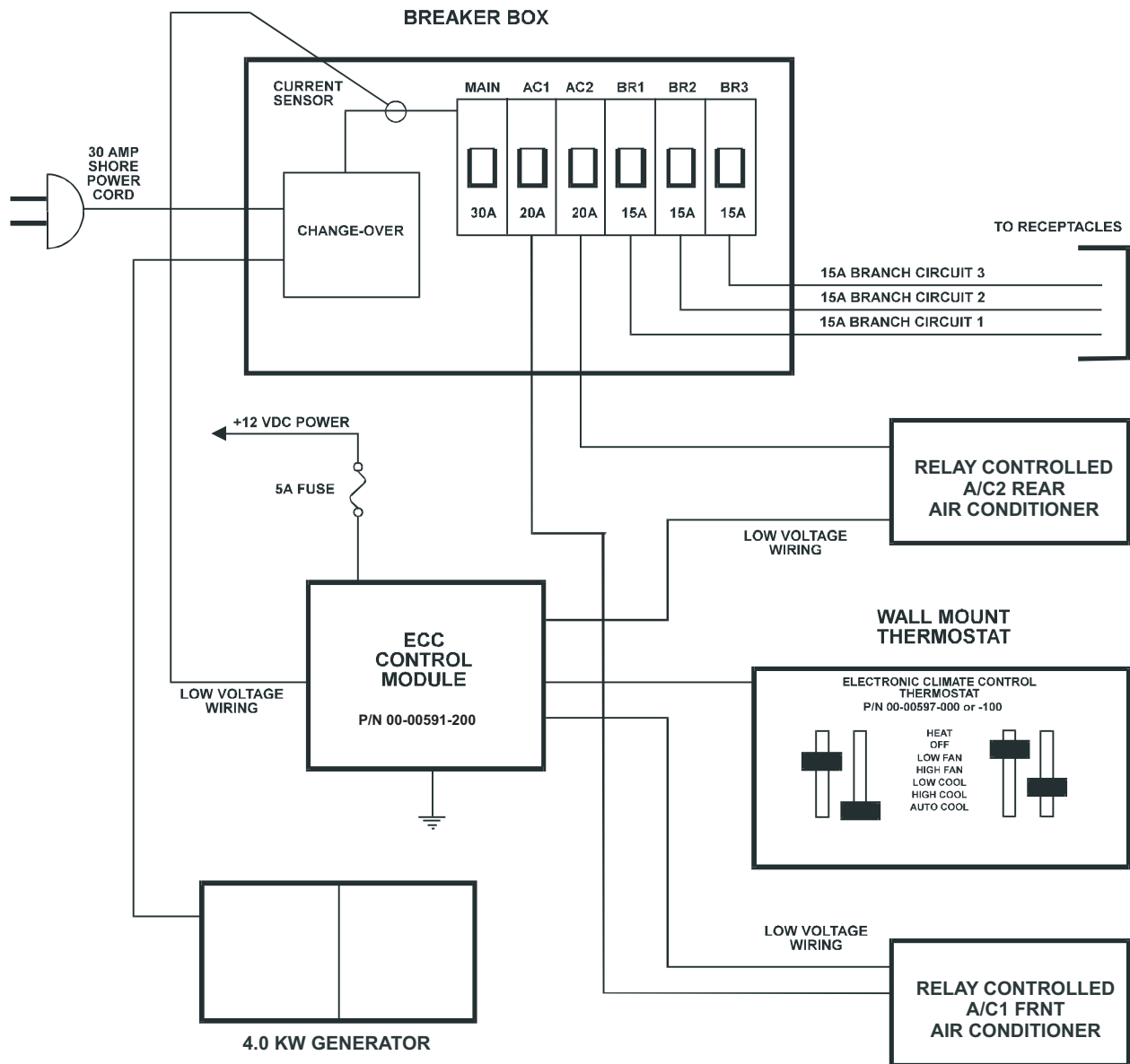
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USE OF THE ECC WITH AUXILIARY GENERATOR SETS

USE WITH 4KW GENERATOR

In systems using 4KW generator sets, the main system includes a manual, or automatic change-over which selects the 30 Amp power feed from either the shore power, or generator. In this situation, all ECC load shedding features will remain unchanged.



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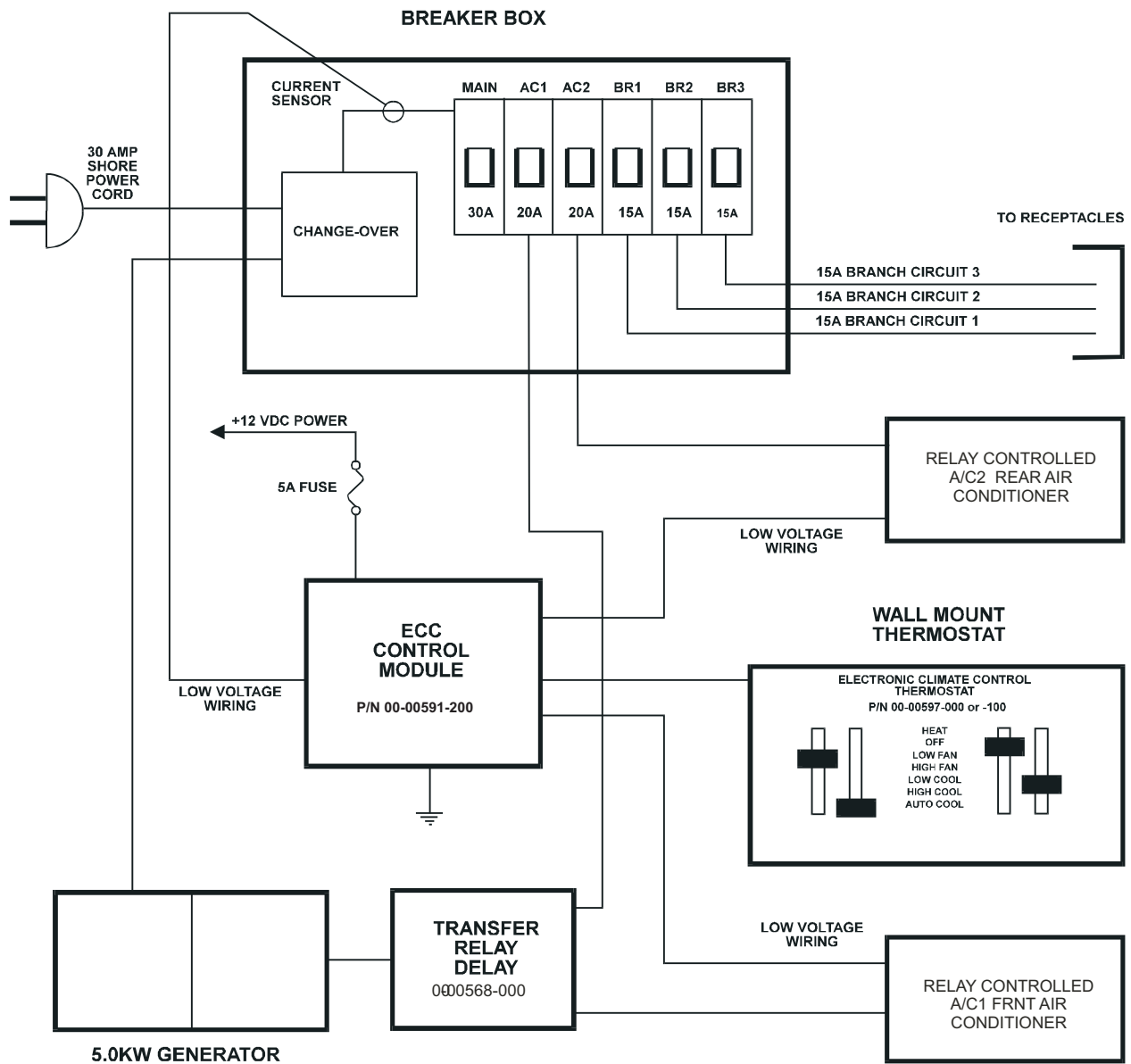
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USE WITH 5 KW GENERATOR

In systems using 5 KW generator sets, an additional change-over, or transfer relay is used to transfer the load of the larger A/C system (usually the front, A/C1 system) to the generator's second output to utilize generator's full output capability. In this situation, the ECC load shedding features will remain unchanged, but the Current Sensor will not measure the load current going to the larger, A/C1 (front) system when the generator is running. If the measured load currents through the current sensor continue to exceed 30 Amps with the smaller, A/C2 (rear) system shed, the ECC Control Module will shed the larger, A/C1 (front) system to prevent over load of the generator.



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Trouble Shooting

If the following problems occur, proceed with their analysis using the steps below ***in the order in which they are listed.***

I. No green "ON" indicator lit, Thermostat in any functional position.

- A. Slide the test switch on the Control Module towards J2. A/C1 compressor and high fan should turn on.

If **NOT**:

1. Make sure that the power connector (PC1A) is plugged into J1 on the control module. Make sure that the pigtail keying matches connector keying.
2. Check the 5A fuse in the distribution panel for Control Module power.
3. Check for +12VDC at pin 4 of J1 on control module and ground at pin 6.

- B. Check the IPX SIG and IPX GND connections to the ECC Thermostat.

If **OK**:

1. Measure the DC voltage between the IPX SIG and IPX GND lugs and measure the voltage between pins 7 and 8 of J1 on the Control Module. The voltage should read greater than 4 VDC and be the same at both locations. If the voltage is **OK** at both locations replace the Thermostat.

If **NOT**:

- (a) Check the wiring.
- (b) Replace the Control.

II. "ON" indicator is lit, but the position of the set point temperature controls on the ECC Thermostat have no effect on heat and cool functions on either A/C1 or A/C2 systems. In the HEAT mode, the furnace stays on all the time. In the COOL modes the fan comes on, but the A/C compressor never comes on.

- A. Check the installation of the Temperature probes. The front probe should be connected to J1 and the rear probe to J4 on the Thermostat. If **OK**, measure the resistance of the Temp Probe at the connector. Resistance should be 7,500 to 15,000 Ohms.

If **NOT**:

1. Replace Temp Probe.
2. Replace ECC Thermostat.

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III. "ON" indicator is lit, but the A/C compressor never comes on in either the LOW COOL, HIGH COOL, or AUTO COOL mode, even when the set point control is set to its lowest (cool) position. In the HEAT mode, the furnace works properly in conjunction with the set point control.

A. Slide the test switch on the Control Module towards J2. Front compressor and high fan should turn on.

If NOT:

1. Check to make sure that the leads on PC2 are connected to their corresponding function at the A/C1 unit. The wire colors may, or may not match. It is likely that the "common" and "high fan" leads are reversed.
2. Check the continuity of the "Comp Relay" lead between the Control Module and the front A/C unit.

B. Slide the test switch on the Control Module towards J3. Rear compressor and high fan should turn on.

If NOT:

1. Check to make sure that the leads on PC3 are connected to their corresponding function at the A/C2 unit. The wire colors may, or may not match. It is likely that the "common" and "high fan" leads are reversed.
2. Check the continuity of the "Comp Relay" lead between the Control Module and the A/C2 unit.

C. Check to make sure that the connector, PC1B, from the Current Sensor is plugged into J1, pins 1 and 2 and that the 120 VAC supply lead to the 30 Amp breaker in the distribution panel passes through the hole in the Current Sensor.

If OK then:

1. Unplug the Current Sensor from the Control Module and measure the resistance across the leads to the Current Sensor. The resistance should be approximately 40 Ohms.

If NOT:

- (a) Replace the Current Sensor.

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IV. "ON" indicator is lit, but fans do not operate in LOW FAN, or HIGH FAN modes.

- A. Make sure that the coach is plugged in to a "live" shore power outlet.
- B. Check the 120 VAC circuit breakers in the distribution panel.
- C. Slide test switch on Control Module towards J2. A/C1 compressor and high fan should turn on. If **OK** replace Control Module.

If NOT:

- 1. Check wiring between PC2 and A/C1 unit.
- D. Slide test switch on Control Module towards J3. Rear compressor and high fan should turn on. If **OK**, replace Control Module. If not:

- 1. Check wiring between PC3 and rear A/C unit.

V. "ON" indicator is lit, but the furnace does not operate in HEAT mode at any thermostat setting.

- A. Check the fuse, or circuit breaker feeding the furnace.
- B. Move the set point control up to the highest and down to the lowest temperature settings. Somewhere in between these settings an audible click should be heard from the relay in the control module.

If NOT:

- 1. Replace the Control Module.
- C. Disconnect plug PC4 from the Control Module. Placing a shorting jumper between PC4 pins 1 and 2 should cause the front furnace to energize. Placing a shorting jumper between PC4 pins 4 and 5 should cause the rear furnace to energize.

If NOT:

- 1. Check the wiring between PC4 and the furnace.

VI. "SHED" indicator is on in the HEAT mode.

- A. This occurs normally within 20 seconds of system power-up. If the shed indicator stays lit and a test of the rest of the system functions checks OK, replace the Thermostat.

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VII. "SHED" indicator is lit when in the FAN, or COOL modes.

- A. Current draw is above 30 Amps. Remove 120 VAC appliance loads from the line by turning off all of the breakers in the distribution panel other than the 30 Amp main and A/C breakers. If the "SHED" indicator still stays on replace the Control Module.

VIII. "ON" and "SHED" indicators flash alternately in any of the COOL modes.

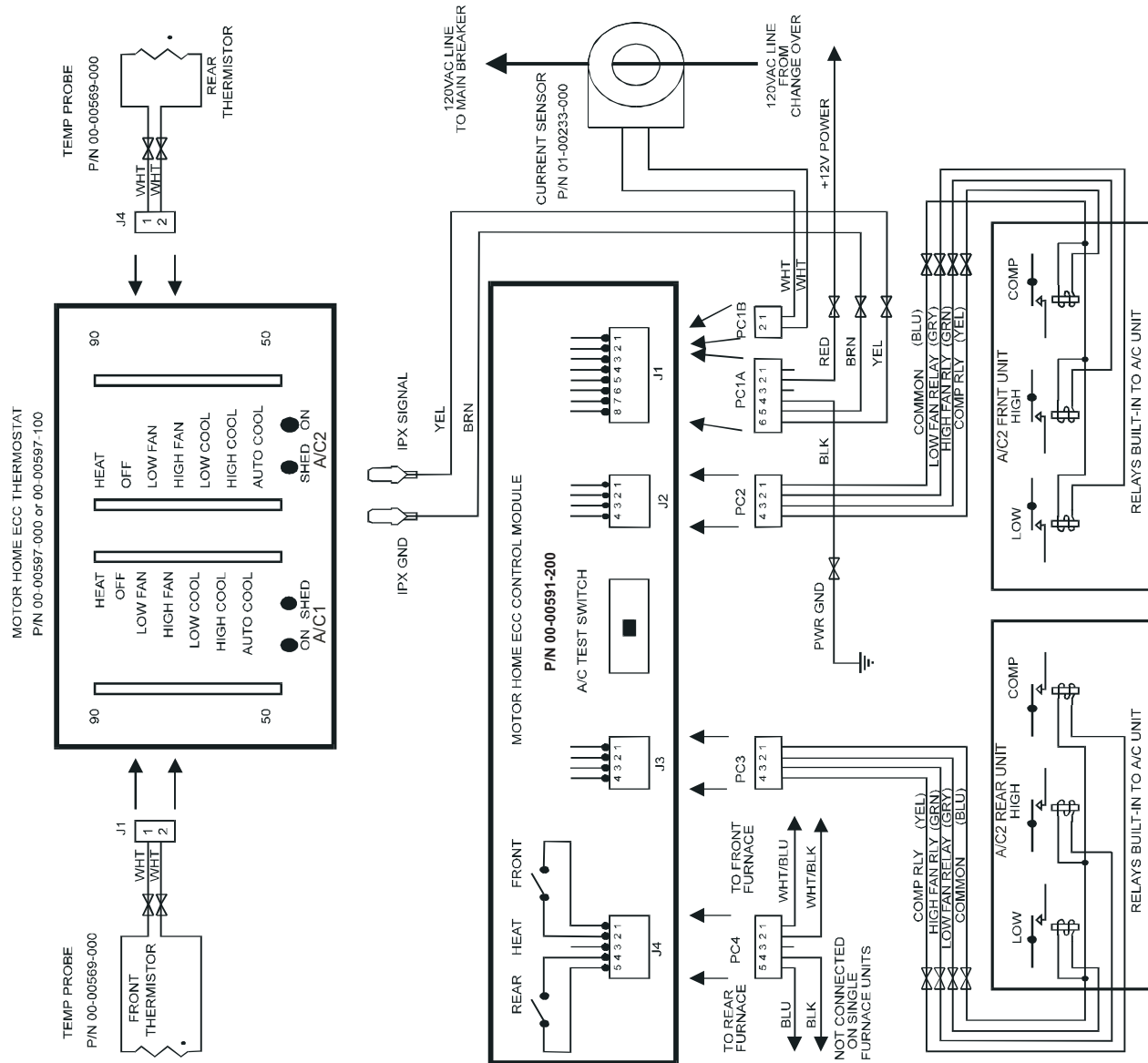
- A. This occurs normally within a two minute period after the following situations:
 - 1. Shore power is plugged in.
 - 2. Generator is started and shore power is not plugged in.
 - 3. The +12 volt power to the control module is first applied.
 - 4. The Control Module has shed an A/C compressor because line current has exceeded 30 Amps. If the indicators continue to flash after the two-minute period, replace the Control Module.

IX. "ON" indicator is lit, air conditioners won't function properly, "SHORT" indicator is lit Control Module is "ON".

- A. One or more of the wires to the air conditioner/s are shorted to ground.
 - 1. Unplug either air conditioner connector (J2 or J3) from the Control Module to see if the "SHORT" indicator goes out. The other air conditioner should operate normally.
 - 2. Check individual wires of suspect connector, for short to ground.
 - 3. Repair short in wires.

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PART DESCRIPTION	INTELLITEC PART NUMBER	INTELLITEC PART NUMBER
Single Furnace Thermostat	00-00597-100	F80-0026
Dual Furnace Thermostat	00-00597-000	F80-0025
Control Module (11k/13.5K BTU air conditioner)	00-00591-200	F97-0053
Current Sensor	01-00233-000	F93-2000
Temp Sensors (2)	00-00569-000	F93-2021
Temp Probe Cables (2) 10 ft.	11-00417-010	F07-9713
Temp Probe Cables (2) 31 ft.	11-00417-031	F07-9711
Temp Probe Cables (2) 50 ft.	11-00417-050	F07-9712
Temp Probe Cables (2) 65 ft.	11-00417-065	F07-9714
Transfer Relay Delay	00-00568-000	F97-0060
Wiring Harness Kit	11-00375-000	F07-0150

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