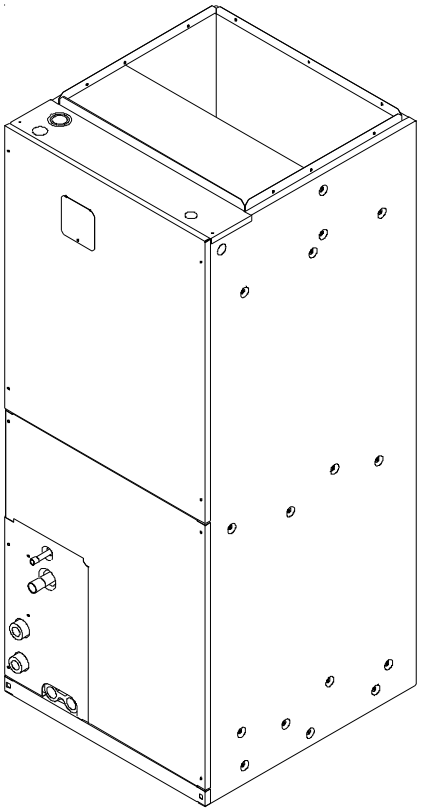
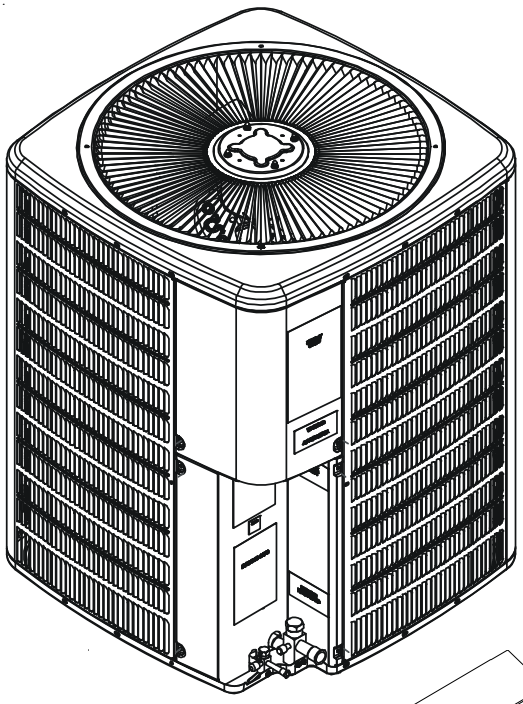
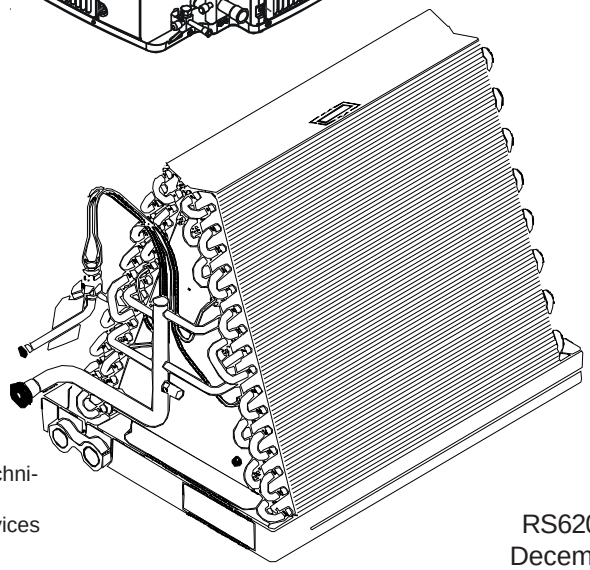
Service Instructions

SSX, ASX, GSX, DSX, ASXC, DSXC Condensing Units, SSZ, ASZ, GSZ DSZ, ASZC, DSZC Split System Heat Pumps with R-410A Refrigerant Blowers, Coils, & Accessories







This manual is to be used by qualified, professionally trained HVAC technicians only. Goodman does not assume any responsibility for property damage or personal injury due to improper service procedures or services performed by an unqualified person.

RS6200006r16
December 2009

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IMPORTANT INFORMATION

IMPORTANT INFORMATION ..... 2 - 3
PRODUCT IDENTIFICATION ..... 4 - 11
ACCESSORIES ..... 13 - 23
PRODUCT DESIGN ..... 25 - 27
SYSTEM OPERATION ..... 28 - 32
TROUBLESHOOTING CHART 33
SERVICE TABLE OF CONTENTS 34
SERVICING ..... 35 - 72
ACCESSORIES WIRING DIAGRAMS ..... 73 - 80

Pride and workmanship go into every product to provide our customers with quality products. It is possible, however, that during its lifetime a product may require service. Products should be serviced only by a qualified service technician who is familiar with the safety procedures required in the repair and who is equipped with the proper tools, parts, testing instruments and the appropriate service manual. **REVIEW ALL SERVICE INFORMATION IN THE APPROPRIATE SERVICE MANUAL BEFORE BEGINNING REPAIRS.**

IMPORTANT NOTICES FOR CONSUMERS AND SERVICERS

RECOGNIZE SAFETY SYMBOLS, WORDS AND LABELS

⚠ WARNING

THIS UNIT SHOULD NOT BE CONNECTED TO, OR USED IN CONJUNCTION WITH, ANY DEVICES THAT ARE NOT DESIGN CERTIFIED FOR USE WITH THIS UNIT OR HAVE NOT BEEN TESTED AND APPROVED BY GOODMAN. SERIOUS PROPERTY DAMAGE OR PERSONAL INJURY, REDUCED UNIT PERFORMANCE AND/OR HAZARDOUS CONDITIONS MAY RESULT FROM THE USE OF DEVICES THAT HAVE NOT BEEN APPROVED OR CERTIFED BY GOODMAN.

⚠ WARNING

INSTALLATION AND REPAIR OF THIS UNIT SHOULD BE PERFORMED ONLY BY INDIVIDUALS MEETING THE REQUIREMENTS OF AN ENTRY LEVEL TECHNICIAN AS SPECIFIED BY THE AIR-CONDITIONING, HEATING, AND REFRIGERATION INSTITUTE (AHRI). ATTEMPTING TO INSTALL OR REPAIR THIS UNIT WITHOUT SUCH BACKGROUND MAY RESULT IN PRODUCT DAMAGE, PERSONAL INJURY, OR DEATH.

⚠ WARNING

TO PREVENT THE RISK OF PROPERTY DAMAGE, PERSONAL INJURY, OR DEATH, DO NOT STORE COMBUSTIBLE MATERIALS OR USE GASOLINE OR OTHER FLAMMABLE LIQUIDS OR VAPORS IN THE VICINITY OF THIS APPLIANCE.

⚠ WARNING

GOODMAN WILL NOT BE RESPONSIBLE FOR ANY INJURY OR PROPERTY DAMAGE ARISING FROM IMPROPER SERVICE OR SERVICE PROCEDURES. IF YOU INSTALL OR PERFORM SERVICE ON THIS UNIT, YOU ASSUME RESPONSIBILITY FOR ANY PERSONAL INJURY OR PROPERTY DAMAGE WHICH MAY RESULT. MANY JURISDICTIONS REQUIRE A LICENSE TO INSTALL OR SERVICE HEATING AND AIR CONDITIONING EQUIPMENT.

⚠ WARNING

HIGH VOLTAGE
DISCONNECT **ALL** POWER BEFORE SERVICING OR INSTALLING THIS UNIT. MULTIPLE POWER SOURCES MAY BE PRESENT. FAILURE TO DO SO MAY CAUSE PROPERTY DAMAGE, PERSONAL INJURY OR DEATH.



To locate an authorized servicer, please consult your telephone book or the dealer from whom you purchased this product. For further assistance, please contact:

CONSUMER INFORMATION LINE

GOODMAN® BRAND PRODUCTS
TOLL FREE
1-877-254-4729 (U.S. only)
email us at: **customerservice@goodmanmfg.com**
fax us at: **(713) 856-1821**
(Not a technical assistance line for dealers.)
Outside the U.S., **call 1-713-861-2500.**
(Not a technical assistance line for dealers.)
Your telephone company will bill you for the call.

AMANA® BRAND PRODUCTS
TOLL FREE
1-877-254-4729 (U.S. only)
email us at: **hac.consumer.affairs@amanahvac.com**
fax us at: **(931) 438- 4362**
(Not a technical assistance line for dealers.)
Outside the U.S., call **1-931-433-6101.**
(Not a technical assistance line for dealers.)
Your telephone company will bill you for the call.

IMPORTANT INFORMATION

SAFE REFRIGERANT HANDLING

While these items will not cover every conceivable situation, they should serve as a useful guide.

⚠ WARNING

REFRIGERANTS ARE HEAVIER THAN AIR. THEY CAN "PUSH OUT" THE OXYGEN IN YOUR LUNGS OR IN ANY ENCLOSED SPACE. TO AVOID POSSIBLE DIFFICULTY IN BREATHING OR DEATH:

- NEVER PURGE REFRIGERANT INTO AN ENCLOSED ROOM OR SPACE. BY LAW, ALL REFRIGERANTS MUST BE RECLAIMED.
- IF AN INDOOR LEAK IS SUSPECTED, THOROUGHLY VENTILATE THE AREA BEFORE BEGINNING WORK.
- LIQUID REFRIGERANT CAN BE VERY COLD. TO AVOID POSSIBLE FROSTBITE OR BLINDNESS, AVOID CONTACT WITH REFRIGERANT AND WEAR GLOVES AND GOGGLES. IF LIQUID REFRIGERANT DOES CONTACT YOUR SKIN OR EYES, SEEK MEDICAL HELP IMMEDIATELY.
- ALWAYS FOLLOW EPA REGULATIONS. NEVER BURN REFRIGERANT, AS POISONOUS GAS WILL BE PRODUCED.

⚠ WARNING

THE UNITED STATES ENVIRONMENTAL PROTECTION AGENCY ("EPA") HAS ISSUED VARIOUS REGULATIONS REGARDING THE INTRODUCTION AND DISPOSAL OF REFRIGERANTS INTRODUCED INTO THIS UNIT. FAILURE TO FOLLOW THESE REGULATIONS MAY HARM THE ENVIRONMENT AND CAN LEAD TO THEH IMPOSITION OF SUBSTANTIAL FINES. THESE REGULATIONS MAY VARY BY JURISDICTION. SHOULD QUESTIONS ARISE, CONTACT YOUR LOCAL EPA OFFICE.

⚠ WARNING

TO AVOID POSSIBLE EXPLOSION:

- NEVER APPLY FLAME OR STEAM TO A REFRIGERANT CYLINDER. IF YOU MUST HEAT A CYLINDER FOR FASTER CHARGING, PARTIALLY IMMERSE IT IN WARM WATER.
- NEVER FILL A CYLINDER MORE THAN 80% FULL OF LIQUID REFRIGERANT.
- NEVER ADD ANYTHING OTHER THAN R-22 TO AN R-22 CYLINDER OR R-410A TO AN R-410A CYLINDER. THE SERVICE EQUIPMENT USED MUST BE LISTED OR CERTIFIED FOR THE TYPE OF REFRIGERANT USED.
- STORE CYLINDERS IN A COOL, DRY PLACE. NEVER USE A CYLINDER AS A PLATFORM OR A ROLLER.

⚠ WARNING

TO AVOID POSSIBLE EXPLOSION, USE ONLY RETURNABLE (NOT DISPOSABLE) SERVICE CYLINDERS WHEN REMOVING REFRIGERANT FROM A SYSTEM.

- ENSURE THE CYLINDER IS FREE OF DAMAGE WHICH COULD LEAD TO A LEAK OR EXPLOSION.
- ENSURE THE HYDROSTATIC TEST DATE DOES NOT EXCEED 5 YEARS.
- ENSURE THE PRESSURE RATING MEETS OR EXCEEDS 400 LBS.

WHEN IN DOUBT, DO NOT USE CYLINDER.

⚠ WARNING

TO AVOID POSSIBLE INJURY, EXPLOSION OR DEATH, PRACTICE SAFE HANDLING OF REFRIGERANTS.

⚠ WARNING

SYSTEM CONTAMINANTS, IMPROPER SERVICE PROCEDURE AND/OR PHYSICAL ABUSE AFFECTING HERMETIC COMPRESSOR ELECTRICAL TERMINALS MAY CAUSE DANGEROUS SYSTEM VENTING.

The successful development of hermetically sealed refrigeration compressors has completely sealed the compressor's moving parts and electric motor inside a common housing, minimizing refrigerant leaks and the hazards sometimes associated with moving belts, pulleys or couplings.

Fundamental to the design of hermetic compressors is a method whereby electrical current is transmitted to the compressor motor through terminal conductors which pass through the compressor housing wall. These terminals are sealed in a dielectric material which insulates them from the housing and maintains the pressure tight integrity of the hermetic compressor. The terminals and their dielectric embedment are strongly constructed, but are vulnerable to careless compressor installation or maintenance procedures and equally vulnerable to internal electrical short circuits caused by excessive system contaminants.

In either of these instances, an electrical short between the terminal and the compressor housing may result in the loss of integrity between the terminal and its dielectric embedment. This loss may cause the terminals to be expelled, thereby venting the vaporous and liquid contents of the compressor housing and system.

A venting compressor terminal normally presents no danger to anyone, providing the terminal protective cover is properly in place.

If, however, the terminal protective cover is not properly in place, a venting terminal may discharge a combination of

(a) hot lubricating oil and refrigerant

(b) flammable mixture (if system is contaminated with air)

in a stream of spray which may be dangerous to anyone in the vicinity. Death or serious bodily injury could occur.

Under no circumstances is a hermetic compressor to be electrically energized and/or operated without having the terminal protective cover properly in place.

See Service Section S-17 for proper servicing.

PRODUCT IDENTIFICATION

Split System Heat Pumps R410A	
Model #	**Description**
GSZ13**1AA	**G**oodman **S**plit **Z** R410A Heat Pump 13 Seer R410A heat pump units. Initial release with Regal Beloit motor.
GSZ13**1AB	**G**oodman **S**plit **Z** R410A Heat Pump 13 Seer R410A heat pump units. Initial release with Broad Ocean motor.
SSZ140**1AA	**S**pecial High Feature **S**plit **Z** R410A heat pump 14 Seer heat pump units. Initial release of Goodman 14 SEER Heat Pump R410A.
SSZ140**1AB	**S**pecial High Feature **S**plit **Z** R410A heat pump 14 Seer heat pump units. Introduces new revisions have screw locations moved in the top panel, base pans, louvers, and control box covers.
SSZ140**1AC	**S**pecial High Feature **S**plit **Z** R410A heat pump 14 Seer heat pump units. Models contain Broad Ocean motors.
SSZ140181AC SSZ140241AF SSZ140301AD	**S**pecial High Feature **S**plit **Z** R410A heat pump 14 Seer heat pump units. Introduces new revisions adding mufflers to the discharge line.
SSZ140361AF SSZ140421AD SSZ140[48-60]1AD	**S**pecial High Feature **S**plit **Z** R410A heat pump 14 Seer heat pump units. New revisions replace TXV & compensator with flowrator & accumulator; adds mufflers on SSZ14036`, 421, 481, 601.
SSZ160**1AA	**S**pecial High Feature **S**plit **Z** R410A heat pump 16 Seer heat pump units. Initial release of Goodman 16 SEER Heat Pump R410A.
SSZ160**1AB	**S**pecial High Feature **S**plit **Z** R410A heat pump 16 Seer heat pump units. Introduces new revisions have screw locations moved in the top panel, base pans, louvers, and control box covers.
SSZ160[24-48]1AC SSZ160601AD	**S**pecial High Feature **S**plit **Z** R410A heat pump 16 Seer heat pump units. Introduces new revisions adding mufflers to the discharge line.
SSZ160**1AC	**S**pecial High Feature **S**plit **Z** R410A heat pump 16 Seer heat pump units.Introduces models containing the Broad Ocean motor and added Muffler and standardized TXV, Compensator using the ASZ18 Seer weldment to the SSZ160601AC.
DSZ160**1AA	**D**eluxe **S**plit **Z** Heat Pump 16 Seer heat pump units. Introduces Goodman 2-stage 16 SEER heat pumps with R-410A.
DSZ180**1AA	**D**eluxe **S**plit **Z** Heat Pump 18 Seer heat pump units. Introduces Goodman 2-stage 18 SEER heat pumps with R-410A.
DSZC16**1AA	**D**eluxe **S**plit ***Z*** **C**ommunicating heat pump, 16 Seer R410A heat pump units. Introduces Goodman 2-stage 16 SEER heat pumps with R-410A, communicating models.
DSZC18**1AA	**D**eluxe **S**plit ***Z*** **C**ommunicating heat pump, 18 Seer R410A heat pump units. Introduces Goodman 2-stage 16 SEER heat pumps with R-410A, communicating models.

PRODUCT IDENTIFICATION

Split System Heat Pumps R410A	
Model #	**Description**
ASZ130**1AA	**A**mana® Brand **S**plit **Z** R410A heat pump 13 Seer heat pump units. Initial release of Amana® Brand 13 SEER Heat Pump R410A.
ASZ140**1AA	**A**mana® Brand **S**plit **Z** R410A heat pump 14 Seer heat pump units. Initial release of Amana® Brand 14 SEER Heat Pump R410A.
ASZ140**1AB	**A**mana® Brand **S**plit **Z** R410A heat pump 14 Seer heat pump units. Introduces new revisions have screw locations moved in the top panel, base pans, louvers, and control box covers.
ASZ140**1AC	**A**mana® Brand **S**plit **Z** R410A heat pump 14 Seer heat pump units. New revisions have horizontal style louvers.
ASZ140181AD ASZ140[24-36]1AE ASZ14[42-48]1AD ASZ140601AE	**A**mana® Brand **S**plit **Z** R410A heat pump 14 Seer heat pump units. Adds new steel muffler, and suction tubes w/shock loop.
ASZ160**1AA	**A**mana® Brand **S**plit **Z** R410A heat pump 16 Seer heat pump units. Initial release of Amana® Brand 16 SEER Heat Pump R410A.
ASZ160**1AB	**A**mana® Brand **S**plit **Z** R410A heat pump 16 Seer heat pump units. Introduces new revisions have screw locations moved in the top panel, base pans, louvers, and control box covers.
ASZ160**1AC	**A**mana® Brand **S**plit **Z** R410A heat pump 16 Seer heat pump units. New revisions have horizontal style louvers.
ASZ160**1AD	**A**mana® Brand **S**plit **Z** R410A heat pump 16 Seer heat pump units. New revisions added Muffler and standardized TXV, Compensator using the ASZ18 Seer weldment.
ASZ160241AD ASZ160[36-60]AE	**A**mana® Brand **S**plit **Z** R410A heat pump 16 Seer heat pump units. Adds new steel muffler, and suction tubes w/shock loop.
ASZ180**1AB	**A**mana® Brand **S**plit **Z** R410A heat pump 18 Seer heat pump units. Initial release of Amana® Brand 18 SEER Heat Pump R410A.
ASZC16**1AA	**A**mana® brand **S**plit ***Z*** **C**ommunicating heat pump, 16 Seer R410A heat pump units. Introduces Goodman 2-stage 16 SEER heat pumps with R-410A, communicating models.
ASZC18**1AA	**A**mana® brand **S**plit ***Z*** **C**ommunicating heat pump, 18 Seer R410A heat pump units. Introduces Goodman 2-stage 16 SEER heat pumps with R-410A, communicating models.

PRODUCT IDENTIFICATION

Split System Air Conditioners R410A	
Model #	**Description**
GSX130**1AA	**G**oodman **S**plit **X** Condenser 13 Seer condensing units. Introduction of Goodman 13 SEER R-410A Condensers with Regal Beloit motors
GSX130**1AB	**G**oodman **S**plit **X** Condenser 13 Seer condensing units. Introduction of Goodman 13 SEER R-410A Condensers with Broad Ocean motors.
GSX130**1BA	**G**oodman **S**plit **X** Condenser 13 Seer condensing units. Introduction of Goodman 13 SEER R-410A Condensers, using Quantum Leap coils. Units will have new louvers because units are smaller. Piston size change. Other components unchanged.
SSX140**1AA	**S**pecial High Feature **S**plit **X** Condenser 14 Seer condensing units. Initial release of Goodman 14 SEER AC 410A.
SSX140**1AB	**S**pecial High Feature **S**plit **X** **C**ondenser 14 Seer condensing units. Revisions have screw locations moved in the top panel, base pans, louvers, and control box covers.
SSX14018,241AC	**S**pecial High Feature **S**plit **X** Condenser 14 Seer condensing units. Revised condenser coils by removing [1] haripin.
SSX140301AC	**S**pecial High Feature **S**plit **X** Condenser 14 Seer condensing units. Model contains the Broad Ocean motor 0131M00060
SSX14036-601AC	**S**pecial High Feature **S**plit **X** Condenser 14 Seer condensing units. Models contain the Broad Ocean motor 0131M00061
SSX14030,361AD	**S**pecial High Feature **S**plit **X** Condenser 14 Seer condensing units. Revised condenser coils by removing [1] haripin.
SSX140421AD	**S**pecial High Feature **S**plit **X** Condenser 14 Seer condensing units. Introduces SSX140421A in 29" base pan
SSX140421BA	**S**pecial High Feature **S**plit **X** Condenser 14 Seer condensing units. Revision for SSZ140421B* in 29 base pan and it will the reduce the unit charge from 180 oz. to 170 oz. and replace the 1/4 hp outdoor unit motor with 1/6 hp motor.
SSX14030-421AE	**S**pecial High Feature **S**plit **X** Condenser 14 Seer condensing units. Revised condenser coils by removing [1] haripin.
SSX140[18-36]1BA SSX140421CA	**S**pecial High Feature **S**plit **X** Condenser 14 Seer condensing units. Introduction of Goodman 14 SEER R-410A Condensers, using Quantum Leap Coils.
SSX160**1AA	**S**pecial High Feature **S**plit **X** Condenser 16 Seer condensing units. Introduces Goodman 16 SEER AC 410A
SSX160**1AB	**S**pecial High Feature **S**plit **X** Condenser 16 Seer condensing units. New revisions have screw locations moved in the top panel, base pans, louvers, and control box covers.
SSX160**1AB	**S**pecial High Feature **S**plit **X** Condenser 16 Seer condensing units. New revisions have screw locations moved in the top panel, base pans, louvers, and control box covers.
SSX160[24 & 36]1BA	**S**pecial High Feature **S**plit **X** Condenser 16 Seer condensing units. Conversion of 2 & 3 ton models to Quantum Leap Coils.

PRODUCT IDENTIFICATION

Split System Air Conditioners R410A	
Model #	**Description**
DSX160**1AA	**D**eluxe **S**plit **X** Condenser 16 Seer condensing units. Introduces Goodman 2-stage, 16 SEER condensing units with R-410A.
DSX160[24 & 36]1BA	**D**eluxe **S**plit **X** Condenser 16 Seer condensing units. Goodman 2-stage, 16 SEER condensing units with R-410A. Conversion of 2 & 3 ton models to Quantum Leap Coils.
DSX180**1AA	**D**eluxe **S**plit **X** Condenser 18 Seer condensing units. Introduces Goodman 2-stage, 18 SEER condensing units with R-410A.
DSXC16**1AA	**D**eluxe **S**plit **X** **C**ommunicating condensing units, 16 Seer R410A heat pump units. Introduces Goodman 2-stage 16 SEER condensing units with R-410A, communicating models.
DSXC18**1AA	**D**eluxe **S**plit **X** **C**ommunicating condensing units, 18 Seer R410A condensing units. Introduces Goodman 2-stage 16 SEER condensing units with R-410A, communicating models.

PRODUCT IDENTIFICATION

Split System Air Conditioners R410A	
Model #	**Description**
ASX130**1AA	**Amana® Brand** **S**plit **X** Condenser 13 Seer condensing units. Initial release new models of Amana® Brand Deluxe 13 SEER AC R410A conditioners.
ASX130**1BA	**Amana® Brand** **S**plit **X** Condenser 13 Seer condensing units. Introduction of Amana® Brand 13 SEER R-410A Condensers, using Quantum Leap Coils. Units will have new louvers since units are smaller. Piston size change; other components unchanged.
ASX140**1AA	**Amana® Brand** **S**plit **X** Condenser 14 Seer condensing units. Initial release new models of Amana® Brand Deluxe 14 SEER AC R410A conditioners.
ASX140**1AB	**Amana® Brand** **S**plit **X** Condenser 14 Seer condensing units. New revisions have screw locations moved in the top panel, base pans, louvers, and control box covers.
ASX140**1AC	**Amana® Brand** **S**plit **X** Condenser 14 Seer condensing units. The new revisions have horizontal style louvers.
ASX14018-361AD	**Amana® Brand** **S**plit **X** Condenser 14 Seer condensing units. Revised condenser coils by removing (1) hairpin.Reduce R410A quantity by 6 ounces
ASX140421AD	**Amana® Brand** **S**plit **X** Condenser 14 Seer condensing units. Introduces ASX140421A in 29" base pan
ASX140421BA	**Amana® Brand** **S**plit **X** Condenser 14 Seer condensing units. Revision for ASX140421 in 29" platform. It will the reduce the unit charge from 180 oz. to 170 oz. and replace the 1/4 hp outdoor unit motor with 1/6 hp motor.
ASX140[18-36]1BA ASX140421CA	**Amana® Brand** **S**plit **X** Condenser 14 Seer condensing units. Introduction of Amana® Brand 14 SEER R-410A Condensers, using Quantum Leap Coils.
ASX160**1AB	**Amana® Brand** **S**plit **X** Condenser 16 Seer condensing units. New revisions have screw locations moved in the top panel, base pans, louvers, and control box covers.
ASX160**1AC	**Amana® Brand** **S**plit **X** Condenser 16 Seer condensing units. The new revisions have horizontal style louvers.
ASX160[24 & 36]1CA	**Amana® Brand** **S**plit **X** Condenser 16 Seer condensing units. Introduction of Amana® Brand 16 SEER R-410A Condensers. Conversion of 2 & 3 ton models to Quantum Leap Coils.
ASX180**1AB	**Amana® Brand** **S**plit **X** Condenser 18 Seer condensing units. Initial release new models of Amana® Brand Deluxe 16 SEER AC R410A conditioners.
ASXC16**1AA	**A**mana® brand **S**plit **X** **C**ommunicating condensing units, 16 Seer R410A. Introduces Goodman 2-stage 16 SEER condensing units with R-410A, communicating models.
ASXC18**1AA	**A**mana® brand **S**plit **X** **C**ommunicating condensing units, 18 Seer R410A heat pump units. Introduces Goodman 2-stage 16 SEER condensing units with R-410A, communicating models.

PRODUCT IDENTIFICATION

Single Piece Air Handlers	
Model #	**Description**
ARUF****16AA	**A** Single Piece **R** Multi-Position PSC Motor **U**npainted **F**lowrater Introducation of new 13 SEER Air Handler Models. All Models will be suitable for use with R-22 and R-410A
ARUF364216AB	**A** Single Piece **R** Multi-Position PSC Motor **U**npainted **F**lowrater.Revision replaces the current spot welded blower housing with the same cinched or crimped design used on the 80% furnace line.
ARUF486016AB	**A** Single Piece **R** Multi-Position PSC Motor **U**npainted **F**lowrater.Revision replaces the current spot welded blower housing with the same cinched or crimped design used on the 80% furnace line.
ARUF364216AC	**A** Single Piece **R** Multi-Position PSC Motor **U**npainted **F**lowrater.Revision replaces the current spot welded blower housing with the same cinched or crimped design used on the 80% furnace line.
ARUF****16BA	**A** Single Piece **R** Multi-Position PSC Motor **U**npainted **F**lowrater. Revision replaces all ARUFcoils using wavy fin with louver enhanced fin.
ARUF****1BA	**A** Single Piece **R** Multi-Position PSC Motor **U**npainted **F**lowrater Introducation of R-22 Only Air Handlers.
ARPF****16AA	**A** Single Piece **R** Multi-Position PSC Motor **P**ainted **F**lowrater Introducation of new 13 SEER Air Handler Models. All Models will be suitable for use with R-22 and R-410A
ARPF364216AB	**A** Single Piece **R** Multi-Position PSC Motor **P**ainted **F**lowrater. Revision replaces the current spot welded blower housing with the same cinched or crimped design used on the 80% furnace line.
ARPF486016AB	**A** Single Piece **R** Multi-Position PSC Motor **P**ainted **F**lowrater. Revision replaces the current spot welded blower housing with the same cinched or crimped design used on the 80% furnace line.
ARPF****16BA	**A** Single Piece **R** Multi-Position PSC Motor **P**ainted **F**lowrater. Revision replaces all ARPFcoils using wavy fin with louver enhanced fin.
ARPF****1BA	**A** Single Piece **R** Multi-Position PSC Motor **P**ainted **F**lowrater. Introducation of R-22 Only Air Handlers.
ADPF****16AA	**A** Single Piece **D**ownflow PSC Motor **U**npainted **F**lowrater. Introducation of new 13 SEER Air Handler Models. All Models will be suitable for use with R-22 and R-410A.
ADPF364216AB	**A** Single Piece **D**ownflow PSC Motor **U**npainted **F**lowrater. Revision replaces the current spot welded blower housing with the same cinched or crimped design used on the 80% furnace line.
ADPF486016AB	**A** Single Piece **D**ownflow PSC Motor **U**npainted **F**lowrater. Revision replaces the current spot welded blower housing with the same cinched or crimped design used on the 80% furnace line.
ADPF304216AC	**A** Single Piece **D**ownflow PSC Motor **U**npainted **F**lowrater. Revision replaces the current spot welded blower housing with the same cinched or crimped design used on the 80% furnace line.
ADPF****1BA	**A** Single Piece **D**ownflow PSC Motor **U**npainted **F**lowrater Revision replaces all ARPFcoils using wavy fin with louver enhanced fin.

PRODUCT IDENTIFICATION

Single Piece Air Handlers	
Model #	**Description**
AEPF****16AA	**A** Single Piece **E** Multi-Position Variable-Speed **P**ainted **F**lowrator. Introducation of new 13 SEER Air Handler Models. All Models will be suitable for use with R-22 and R-410A
AEPF****16BA	**A** Single Piece **E** Multi-Position Variable-Speed **P**ainted **F**lowrator. Revision introduces new models adding lower kw hit kits on the S&R plate
AEPF****16BB	**A** Single Piece **E** Multi-Position Variable-Speed **P**ainted **F**lowrator. Revision replaces the current spot welded blower housing with the same cinched or crimped design used on the 80% furnace line.
AEPF****16CA	**A** Single Piece **E** Multi-Position Variable-Speed **P**ainted **F**lowrator. Revision replaces all ARPFcoils using wavy fin with louver enhanced fin.
AEPF****1BA	**A** Single Piece **E** Multi-Position Variable-Speed **P**ainted **F**lowrator Introduction of R-22 Only Air Handlers.
AEPF313716AA ASPF313716AA	**A** Single Piece **E** Multi-Position Variable-Speed **P**ainted **F**lowrator **(AEPF)** and **A** Single Piece **S** Multi-Position EEM motor **P**ainted **F**lowrator **(ASPF)**. Introduction of 3-Ton Air Handler units with 3-row coil.
ASPF****16AA	**A** Single Piece **S** Multi-Position EEM motor **P**ainted **F**lowrator. Introduces new ASPF Air Handlers
ASPF****16BA	**A** Single Piece **S** Multi-Position EEM motor **P**ainted **F**lowrator. Revision introuces modified ASPF control scheme, to ensure blower operation during and after call for heat on units with heat kits and replacing wavy fin with louver enhanced fin on coil
AWUF****1AA	**A** Single Piece Air Handler **W**all Mount **U**npainted **F**lowrator. Introduces 13 SEER Dayton wall mount air handlers
AWUF****16AA	**A** Single Piece Air Handler **W**all Mount **U**npainted **F**lowrator. Introduces 13 SEER Dayton wall mount air handlers. All Models will be suitable for use with R-22 and R-410A
AWUF3005-101AA	**A** Single Piece Air Handler **W**all Mount **U**npainted **F**lowrator. Introduces 13 SEER Dayton wall mount air handlers using a Burr Oak Louvered Fin coil.
AWUF****1BA	**A** Single Piece Air Handler **W**all Mount **U**npainted **F**lowrator. Revision replaces current wavey fin design with new louvered fin design
AWUF370**16AA	**A** Single Piece Air Handler **W**all Mount **U**npainted Flowrator. Introduction of AWUF37 Air Handlers for use with R-22 and R410A.

PRODUCT IDENTIFICATION

Single Piece Air Handlers	
Model #	**Description**
AWUF****16BA	**A** Single Piece Air Handler **C**eiling Mount **N** Uncased **F**lowrater. Revision has louver fins & replaces copper tube hairpins with aluminum hairpins.
AWUF180316BA AWUF240316BA AWUF300316BA	**A** Single Piece Air Handler **W**all Mount **U**npainted **F**lowrator. AWUF 3KW Heater Introduction. Introduction of 3KW heater in the AWUF air handlers
AWUF310516AA AWUF310816AA AWUF321016AA	**A** Single Piece Air Handler **W**all Mount **U**npainted **F**lowrator. Introduction of higher 14 SEER AWUF series air-handlers
AVPTC183014AA AVPTC313714AA AVPTC426014AA	**A** Single Piece **V** Multi-Position Variable-Speed **P**ainted **T** **F**lowrator **C**ommunicating ready w/4-wires. Introduction of new 13 SEER Air Handler Models with the new communicating control & serial communicating indoor blower motor. All Models will be suitable for
ACNF****1AA	**A** Single Piece Air Handler **C**eiling Mount **N** Uncased **F**lowrater. Revision release all models of 13 SEER Dayton uncased air handlers.
ACNF****16AA	**A** Single Piece Air Handler **C**eiling Mount **N** Uncased **F**lowrater. Revision release all models of 13 SEER Dayton uncased air handlers.All Models will be suitable for use with R-22 and R-410A
ACNF****1BA	**A** Single Piece Air Handler **C**eiling Mount **N** Uncased **F**lowrater. Revision replaces current wavey fin design with new louvered fin design
AH**-1*	**A** Single Piece Air Handler **H**ydronic Air Handler. Revision replaces the time delay relay in the AH air handlers with the UTEC time delay control board.

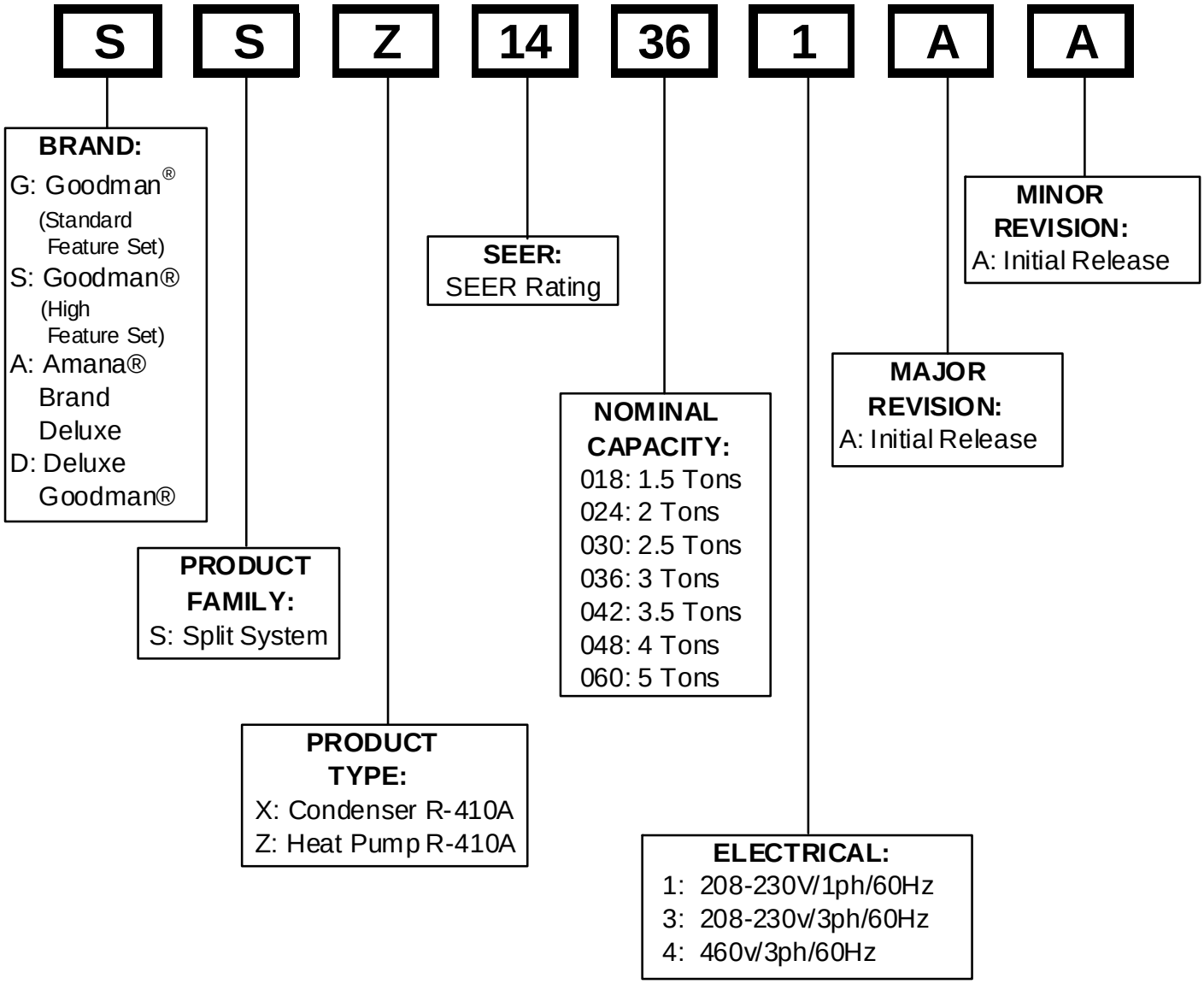
PRODUCT IDENTIFICATION

MBR/MBE/MBVC Air Handlers	
Model #	**Description**
MBR****AA-1AA	**M**odular **B**lower **R** Multi-Position PSC Motor. Introduces module blower with PSC blower motor.
MBE****AA-1AA	**M**odular **B**lower **E** Multi-Position Variable-Speed. Introduces module blower with variable speed blower motor.
MBE****AA-1BA	**M**odular **B**lower **E** Multi-Position Variable-Speed.Revision introduces new models adding lower kw hit kits on the S&R plate
MBVC1200AA-1AA MBVC1600AA-1AA MBVC2000AA-1AA	**M**odular **B**lower **V** Multi-Position Variable-Speed **C**ommunicating ready w/4-wires. Introduction of module blower with variable speed blower motor with the new communicating control & serial communicating indoor blower motor.

PRODUCT IDENTIFICATION

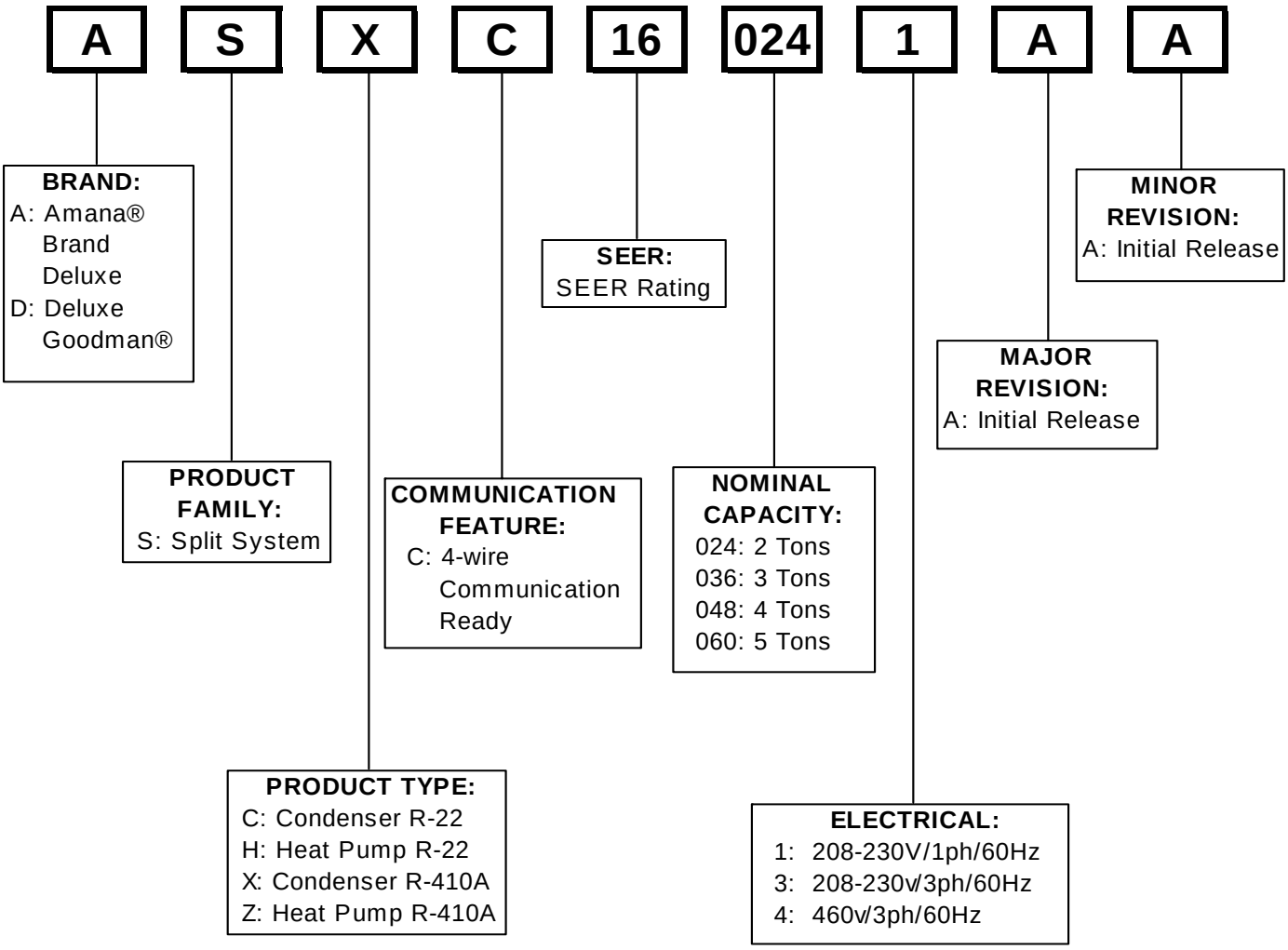
Evaporator Coils	
Model #	**Description**
CAUF*****6AA	**C** Indoor Coil **A** Upflow/Downflow **U**ncased **F**lowrator. Introduces 13 SEER CAUF Dayton Upflow/Downflow coils.
CAUF*****6BA	**C** Indoor Coil **A** Upflow/Downflow **U**ncased **F**lowrator. Revision releases Burr Oak Louvered Fin in place of the Wavy Fin currently in production.
CAPF*****6AA	**C** Indoor Coil **A** Upflow/Downflow **P**ainted **F**lowrator. Introduces 13 SEER CAPF Dayton Upflow/Downflow coils.
CAPF*****6BA	**C** Indoor Coil **A** Upflow/Downflow **P**ainted **F**lowrator. Revision releases Burr Oak Louvered Fin in place of the Wavy Fin currently in production.
CAPF/CAUF36***CA	**C** Indoor Coil **A** Upflow/Downflow [**P**ainted or **U**ncased] **F**lowrator. Revision redesigns for performance improvement from 2 row to 3 row.
CHPF*****6AA	**C** Indoor Coil **H**orizontal A Coil **P**ainted **F**lowrator. Release 13 SEER CHPF horizontal A coil.
CHPF*****6BA	**C** Indoor Coil **H**orizontal A Coil **P**ainted **F**lowrator. Release 13 SEER CHPF horizontal A coil. Revision releases Burr Oak Louvered Fin in place of the Wavy Fin currently in production. The rows change by one, (i.e. 4 row to 3 row; 3 row to 2 row) where applicable.
CHPF1824A6CA CHPF2430B6CA CHPF3636B6CA CHPF3642C6CA CHPF3642D6CA CHPF3743C6BA CHPF3743D6BA CHPF4860D6DA	**C** Indoor Coil **H**orizontal A Coil **P**ainted **F**lowrator. 13 SEER CHPF horizontal A coil, revision has louver fins & replaces copper tube hairpins with aluminum hairpins.
CSCF*****6AA	**C** Indoor Coil **S** Horizontal Slab Coil **C** Upainted **F**lowrator. Release 13 SEER CSCF slab horizontal coil.
CSCF*****6BA	**C** Indoor Coil **S** Horizontal Slab Coil **C** Upainted **F**lowrator. Revision releases Burr Oak Louvered Fin in place of the Wavy Fin currently in production. The rows change by one, (i.e. 4 row to 3 row; 3 row to 2 row) where applicable.

PRODUCT IDENTIFICATION

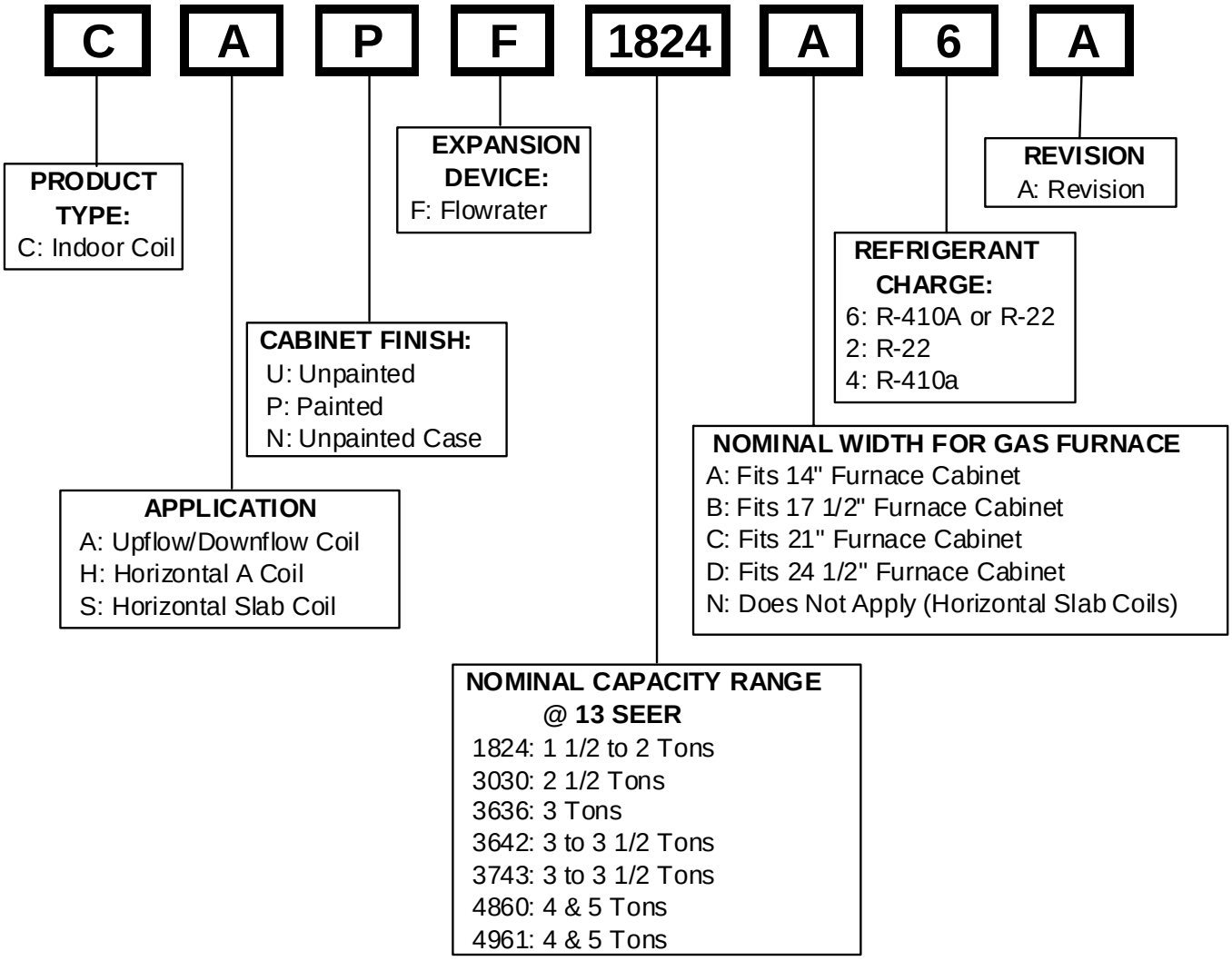


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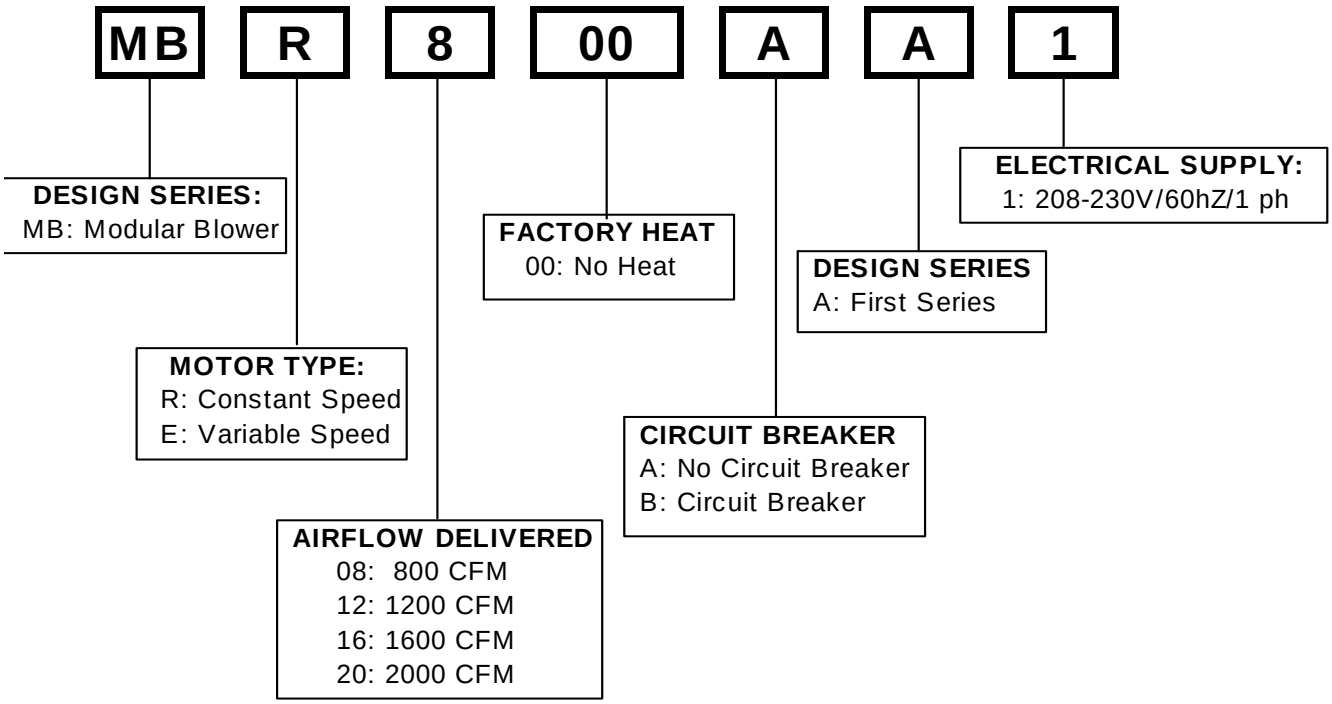
ComfortNet



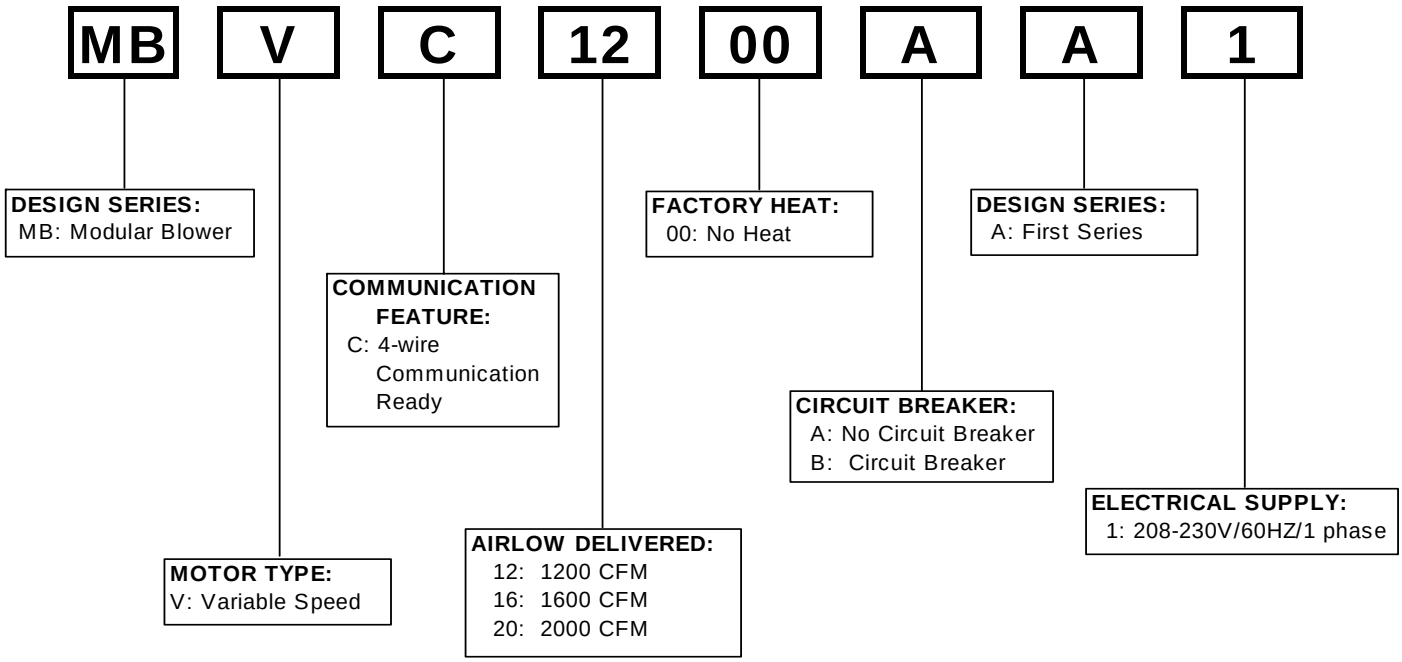
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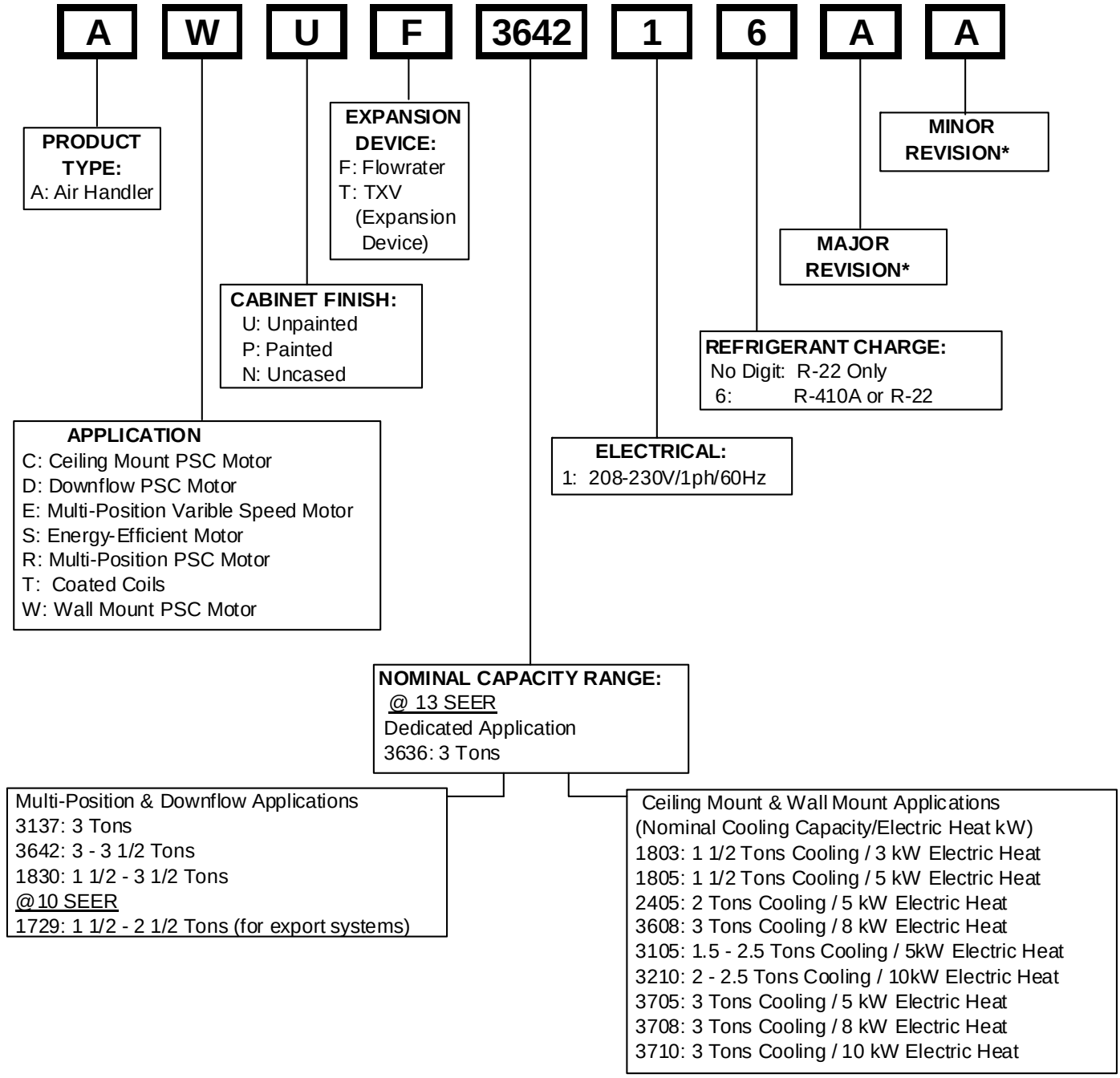
PRODUCT IDENTIFICATION



ComfortNet



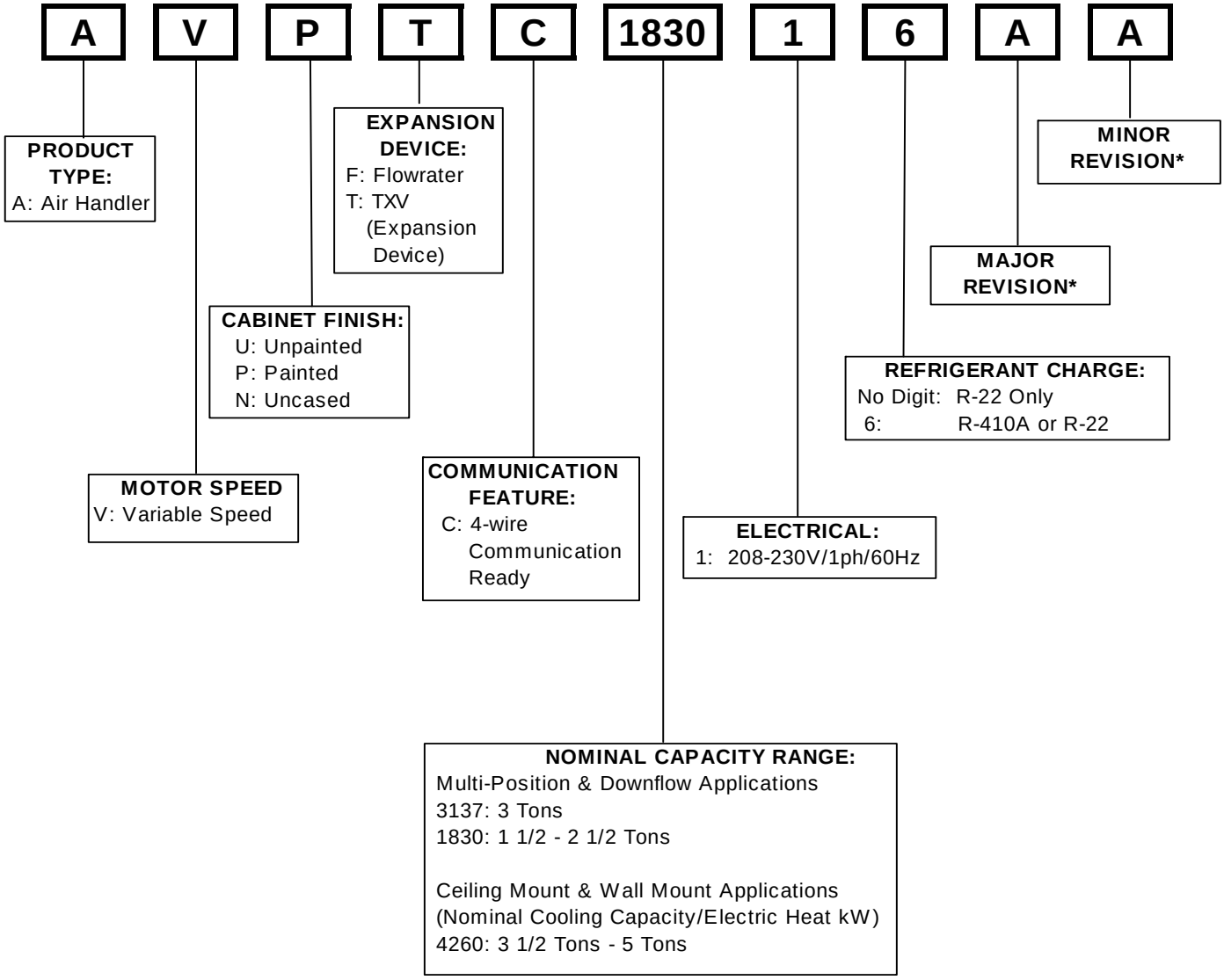
PRODUCT IDENTIFICATION



All Airhandlers use **DIRECT DRIVE MOTORS**. Power supply is AC 208-230v, 60 hz, 1 phase.

PRODUCT IDENTIFICATION

ComfortNet



All Airhandlers use **DIRECT DRIVE MOTORS**. Power supply is AC 208-230v, 60 hz, 1 phase.

ACCESSORIES

ASX13

Model	Description	ASX13 018	ASX13 024	ASX13 030	ASX13 036	ASX13 042	ASX13 0418	ASX13 060
ASC01	Anti-Short Cycle Kit	X	X	X	X	X	X	X
CSR-U-1	Hard-start Kit	X	X	X	X			
CSR-U-2	Hard-start Kit				X	X	X	X
CSR-U-3	Hard-start Kit						X	X
FSK01A[1]	Freeze Protection Kit	X	X	X	X	X	X	X
TX2N4[3]	TXV Kit	X						
TX3N4[2]	TXV Kit		X	X	X			
TX5N4[2]	TXV Kit					X	X	X

GSX13

Model	Description	GSX13 018	GSX13 024	GSX13 030	GSX13 036	GSX13 042	GSX13 0418	GSX13 060
ASC01	Anti-Short Cycle Kit	X	X	X	X	X	X	X
CSR-U-1	Hard-start Kit	X	X	X	X			
CSR-U-2	Hard-start Kit				X	X	X	X
CSR-U-3	Hard-start Kit						X	X
FSK01A[1]	Freeze Protection Kit	X	X	X	X	X	X	X
TX2N4[3]	TXV Kit	X						
TX3N4[2]	TXV Kit		X	X	X			
TX5N4[2]	TXV Kit					X	X	X

SSX14

Model	Description	SSX14 018	SSX14 024	SSX14 030	SSX14 036	SSX14 042	SSX14 048	SSX14 060
ASC01	Anti-Short Cycle Kit	X	X	X	X	X	X	X
CSR-U-1	Hard-start Kit	X	X	X	X			
CSR-U-2	Hard-start Kit				X	X	X	X
CSR-U-3	Hard-start Kit						X	X
FSK01A[1]	Freeze Protection Kit	X	X	X	X	X	X	X
TX2N4[3]	TXV Kit	X						
TX3N4[2]	TXV Kit		X	X	X			
TX5N4[2]	TXV Kit					X	X	X

ASX14

Model	Description	ASX14 018	ASX14 024	ASX14 030	ASX14 036	ASX14 042	ASX14 048	ASX14 060
ASC01	Anti-Short Cycle Kit	X	X	X	X	X	X	X
CSR-U-1	Hard-start Kit	X	X	X	X			
CSR-U-2	Hard-start Kit				X	X	X	X
CSR-U-3	Hard-start Kit						X	X
FSK01A[1]	Freeze Protection Kit	X	X	X	X	X	X	X
TX2N4[3]	TXV Kit	X						
TX3N4[3]	TXV Kit		X	X	X			
TX5N4[3]	TXV Kit					X	X	X

[1] Installed on indoor coil

[2] Required for heat pump applications where ambient temperatures fall below 0°F with 50% or higher relative humidy.

[3] Field-installed, non-bleed, expansion valve kit — Condensing units and heat pumps with reciprocating compressors require the use of

ACCESSORIES

DSX/SSX16

Model	Description	D/SSX16 024	D/SSX16 030	D/SSX16 036	D/SSX16 042	D/SSX16 048	D/SSX16 060
ASC01	Anti-Short Cycle Kit	X	X	X	X	X	X
CSR-U-1	Hard-start Kit	X	X	X			
CSR-U-2	Hard-start Kit			X	X	X	X
CSR-U-3	Hard-start Kit					X	X
FSK01A[1]	Freeze Protection Kit	X	X	X	X	X	X
TX2N4[3]	TXV Kit	X					
TX3N4[3]	TXV Kit		X	X			
TX5N4[3]	TXV Kit				X	X	X

[1] Installed on indoor coil

[2] Required for heat pump applications where ambient temperatures fall below 0°F with 50% or higher relative humidy.

[3] Field-installed, non-bleed, expansion valve kit — Condensing units and heat pumps with reciprocating compressors require the use of start-assist components when used in conjunction with an indoor coil using a non-bleed thermal expansion valve refrigerant metering device.

ASX16

Model	Description	ASX16 024	ASX16 030	ASX16 036	ASX16 042	ASX16 048	ASX16 060
ASC01	Anti-Short Cycle Kit	X	X	X	X	X	X
CSR-U-1	Hard-start Kit	X	X	X			
CSR-U-2	Hard-start Kit			X	X	X	X
CSR-U-3	Hard-start Kit					X	X
FSK01A[1]	Freeze Protection Kit	X	X	X	X	X	X
TX2N4[3]	TXV Kit	X					
TX3N4[3]	TXV Kit		X	X			
TX5N4[3]	TXV Kit				X	X	X

[1] Installed on indoor coil

[2] Required for heat pump applications where ambient temperatures fall below 0°F with 50% or higher relative humidy.

[3] Field-installed, non-bleed, expansion valve kit — Condensing units and heat pumps with reciprocating compressors require the use of start-assist components when used in conjunction with an indoor coil using a non-bleed thermal expansion valve refrigerant metering device.

ACCESSORIES

ASX/DSX18

Model	Description	ASX/DSX18 036	ASX/DSX18 048	ASX/DSX18 060
ASC01	Anti-Short Cycle Kit	X	X	X
CSR-U-1	Hard-start Kit	X		
CSR-U-2	Hard-start Kit	X	X	X
CSR-U-3	Hard-start Kit		X	X
FSK01A[1]	Freeze Protection Kit	X	X	X
TX2N4[3]	TXV Kit			
TX3N4[3]	TXV Kit	X		
TX5N4[3]	TXV Kit		X	X

[1] Installed on indoor coil

[2] Required for heat pump applications where ambient temperatures fall below 0° F with 50% or higher relative humidy.

[3] Field-installed, non-bleed, expansion valve kit — Condensing units and heat pumps with reciprocating compressors require the use of start-assist components when used in conjunction with an indoor coil using a non-bleed thermal expansion valve refrigerant metering device.

ACCESSORIES

ASXC/DSXC16

ASXC/DSXC18

Model	Description	ASXC16024 DSXC16024	ASXC16036 DSXC16036	ASXC16048 DSXC16048	ASXC16060 DSXC16060	ASXC18036 DSXC18036	ASXC18048 DSXC18048	ASXC18060 DSXC18060
TX2N4 [1]	TXV Kit	X						
TX3N4 [1]	TXV Kit		X			X		
TX5N4 [1]	TXV Kit			X	X		X	X
CSR-U-1	Hard-start Kit	*Maximum number installed at the same time is limited. See separate table.*	*Maximum number installed at the same time is limited. See separate table.*			X		
CSR-U-2	Hard-start Kit			X	X	X	X	X
CSR-U-3	Hard-start Kit			X	X		X	X
FSK01A [2]	Freeze Protection Kit			X	X	X	X	X
LSK02A	Liquid Line Solenoid Valve			X	X	X	X	X
OT18-60A [3]	Outdoor Thermostat/ Lockout Thermostat			X	X	X	X	X
B1141643 [4]	24V Transformer			X	X	X	X	X

Maximum Number of Accessory Kits Installed Simultaneously in ASXC/DSXC16024						
Model	**Description**	**ASXC16024 DSXC16024**	**ASXC16024 DSXC16024**	**ASXC16024 DSXC16024**	**ASXC16024 DSXC16024**	**ASXC16024 DSXC16024**
CSR-U-1	Hard-start Kit	X	X	X		
CSR-U-2	Hard-start Kit					
CSR-U-3	Hard-start Kit					
FSK01A [2]	Freeze Protection Kit	X	X	X	X	X
LSK02A	Liquid Line Solenoid Valve	X			X	X
OT18-60A [3]	Outdoor Thermostat/ Lockout Thermostat		X		X	
B1141643 [4]	24V Transformer			X		X

Maximum Number of Accessory Kits Installed Simultaneously in ASXC/DSXC16036					
Model	**Description**	**ASXC16036 DSXC16036**	**ASXC16036 DSXC16036**	**ASXC16036 DSXC16036**	**ASXC16036 DSXC16036**
CSR-U-1	Hard-start Kit	X	X		
CSR-U-2	Hard-start Kit				
CSR-U-3	Hard-start Kit				
FSK01A [2]	Freeze Protection Kit	X	X	X	X
LSK02A	Liquid Line Solenoid Valve	X		X	X
OT18-60A [3]	Outdoor Thermostat/ Lockout Thermostat		X	X	
B1141643 [4]	24V Transformer				X

* * Contains 20 brackets; four brackets needed to anchor unit to pad.

[1] Field-installed, non-bleed, expansion valve kit - Condensing units and heap pumps with reciprocating compressors require the use of start-assist components when used in conjunction with an indoor coil using a non-bleed thermal expansion valve refrigerant metering device.

[2] Installed on the indoor coil.

[3] Available in 24V legacy mode only. This feature is integrated in the communicating mode.

[4] This component is included in the CTK01AA communicating thermostat kit.

ACCESSORIES

ASZ13

Model	Description	ASZ13 018	ASZ13 024	ASZ13 030	ASZ13 036	ASZ13 042	ASZ13 048	ASZ13 060
AFE18-60A	All-Fuel Kit	X	X	X	X	X	X	X
ASC01	Anti-Short Cycle Kit	X	X	X	X	X	X	X
CSR-U-1	Hard-start Kit	X	X	X	X			
CSR-U-2	Hard-start Kit				X	X	X	X
CSR-U-3	Hard-start Kit						X	X
FSK01A[1]	Freeze Protection Kit	X	X	X	X	X	X	X
OT/EHR18-60	Emergency Heat Relay kit	X	X	X	X	X	X	X
OT18-60A[2]	Outdoor Thermostat w/ Lockout Stat	X	X	X	X	X	X	X
TX2N4[3]	TXV Kit	X						
TX3N4[3]	TXV Kit		X	X	X			
TX5N4[3]	TXV Kit					X	X	X

GSZ13

Model	Description	GSZ13 018	GSZ13 024	GSZ13 030	GSZ13 036	GSZ13 042	GSZ13 048	GSZ13 060
AFE18-60A	All-Fuel Kit	X	X	X	X	X	X	X
ASC01	Anti-Short Cycle Kit	X	X	X	X	X	X	X
CSR-U-1	Hard-start Kit	X	X	X	X			
CSR-U-2	Hard-start Kit				X	X	X	X
CSR-U-3	Hard-start Kit						X	X
FSK01A[1]	Freeze Protection Kit	X	X	X	X	X	X	X
OT/EHR18-60	Emergency Heat Relay kit	X	X	X	X	X	X	X
OT18-60A[2]	Outdoor Thermostat w/ Lockout Stat	X	X	X	X	X	X	X
TX2N4[3]	TXV Kit	X						
TX3N4[3]	TXV Kit		X	X	X			
TX5N4[3]	TXV Kit					X	X	X

SSZ14

Model	Description	SSZ14 018	SSZ14 024	SSZ14 030	SSZ14 036	SSZ14 042	SSZ14 048	SSZ14 060
AFE18-60A	All-Fuel Kit	X	X	X	X	X	X	X
ASC01	Anti-Short Cycle Kit	X	X	X	X	X	X	X
CSR-U-1	Hard-start Kit	X	X	X	X			
CSR-U-2	Hard-start Kit				X	X	X	X
CSR-U-3	Hard-start Kit						X	X
FSK01A[1]	Freeze Protection Kit	X	X	X	X	X	X	X
OT18-60A[2]	Outdoor Thermostat	X	X	X	X	X	X	X
OY-EHR18-60	Emergency Heat Relat Kit	X	X	X	X	X	X	X
TX2N4[3]	TXV Kit	X						
TX3N4[3]	TXV Kit		X	X	X			
TX5N4[3]	TXV Kit					X	X	X

ASZ14

Model	Description	ASZ14 018	ASZ14 024	ASZ14 030	ASZ14 036	ASZ14 042	ASZ14 048	ASZ14 060
AFE18-60A	All-Fuel Kit	X	X	X	X	X	X	X
ASC01	Anti-Short Cycle Kit	X	X	X	X	X	X	X
CSR-U-1	Hard-start Kit	X	X	X	X			
CSR-U-2	Hard-start Kit				X	X	X	X
CSR-U-3	Hard-start Kit						X	X
FSK01A[1]	Freeze Protection Kit	X	X	X	X	X	X	X
OT18-60A[2]	Outdoor Thermostat	X	X	X	X	X	X	X
OY-EHR18-60	Emergency Heat Relat Kit	X	X	X	X	X	X	X
TX2N4[3]	TXV Kit	X						
TX3N4[3]	TXV Kit		X	X	X			
TX5N4[3]	TXV Kit					X	X	X

[1] Installed on indoor coil

[2] Required for heat pump applications where ambient temperatures fall below 0°F with 50% or higher relative humidy.

[3] Condensing units and heatp pumps with reciprocating compressors require the use of start-assist components when used in conjunction with an indoor coil using a

ACCESSORIES

DSZ/SSZ16

Model	Description	D/SSZ16 024	D/SSZ16 030	D/SSZ16 036	D/SSZ16 042	D/SSZ16 048	D/SSZ16 060
AFE18-60A	All-Fuel Kit	X	X	X	X	X	X
ASC01	Anti-Short Cycle Kit	X	X	X	X	X	X
CSR-U-1	Hard-start Kit	X	X	X			
CSR-U-2	Hard-start Kit			X	X	X	X
CSR-U-3	Hard-start Kit					X	X
FSK01A[1]	Freeze Protection Kit	X	X	X	X	X	X
OT/EHR18-60	Emergency Heat Relay Kit	X	X	X	X	X	X
OY/EH R18-60	Emergency Heat Relay Kit	X	X	X	X	X	X
OT18-60A[2]	Outdoor Thermostat w/ Lockout Stat	X	X	X	X	X	X
TX2N4[3]	TXV Kit	X					
TX3N4[3]	TXV Kit		X	X			
TX5N4[3]	TXV Kit				X	X	X

[1] Installed on indoor coil

[2] Required for heat pump applications where ambient temperatures fall below 0°F with 50% or higher relative humidy.

[3] Field-installed, non-bleed, expansion valve kit — Condensing units and heat pumps with reciprocating compressors require the use of start-assist components when used in conjunction with an indoor coil using a non-bleed thermal expansion valve refrigerant metering device.

ASZ16

Model	Description	ASZ16 024	ASZ16 030	ASZ16 036	ASZ16 042	ASZ16 048	ASZ16 060
AFE18-60A	All-Fuel Kit	X	X	X	X	X	X
ASC01	Anti-Short Cycle Kit	X	X	X	X	X	X
CSR-U-1	Hard-start Kit	X	X	X			
CSR-U-2	Hard-start Kit			X	X	X	X
CSR-U-3	Hard-start Kit					X	X
FSK01A[1]	Freeze Protection Kit	X	X	X	X	X	X
OT/EHR18-60	Emergency Heat Relay Kit	X	X	X	X	X	X
OY/EH R18-60	Emergency Heat Relay Kit	X	X	X	X	X	X
OT18-60A[2]	Outdoor Thermostat w/ Lockout Stat	X	X	X	X	X	X
TX2N4[3]	TXV Kit	X					
TX3N4[3]	TXV Kit		X	X			
TX5N4[3]	TXV Kit				X	X	X

[1] Installed on indoor coil

[2] Required for heat pump applications where ambient temperatures fall below 0°F with 50% or higher relative humidy.

[3] Field-installed, non-bleed, expansion valve kit — Condensing units and heat pumps with reciprocating compressors require the use of start-assist components when used in conjunction with an indoor coil using a non-bleed thermal expansion valve refrigerant metering device.

ACCESSORIES

ASZ/DSZ18

Model	Description	ASZ/DSZ18 036	ASZ/DSZ18 048	ASZ/DSZ18 060
AFE18-60A	All-Fuel Kit	X	X	X
ASC01	Anti-Short Cycle Kit	X	X	X
CSR-U-1	Hard-start Kit	X		
CSR-U-2	Hard-start Kit	X	X	X
CSR-U-3	Hard-start Kit		X	X
FSK01A[1]	Freeze Protection Kit	X	X	X
OT/EHR18-60	Emergency Heat Relay Kit	X	X	X
OY/EH R18-60	Emergency Heat Relay Kit	X	X	X
OT18-60A[2]	Outdoor Thermostat w/ Lockout Stat	X	X	X
TX2N4[3]	TXV Kit			
TX3N4[3]	TXV Kit	X		
TX5N4[3]	TXV Kit		X	X

[1] Installed on indoor coil

[2] Required for heat pump applications where ambient temperatures fall below 0°F with 50% or higher relative humidy.

[3] Field-installed, non-bleed, expansion valve kit — Condensing units and heat pumps with reciprocating compressors require the use of start-assist components when used in conjunction with an indoor coil using a non-bleed thermal expansion valve refrigerant metering device.

ACCESSORIES

ComfortNet

ASZC/DSZC16

ASZC/DSZC18

Model	Description	ASZC16024 DSZC16024	ASZC16036 DSZC16036	ASZC16048 DSZC16048	ASZC16060 DSZC16060	ASZC18036 DSZC18036	ASZC18048 DSZC18048	ASZC18060 DSZC18060
TX2N4 [1]	TXV Kit	X						
TX3N4 [1]	TXV Kit		X			X		
TX5N4 [1]	TXV Kit			X	X		X	X
CSR-U-1	Hard-start Kit	X	X			X		
CSR-U-2	Hard-start Kit		X	X	X	X	X	X
CSR-U-3	Hard-start Kit			X	X		X	X
FSK01A [2]	Freeze Protection Kit	X	X	X	X	X	X	X
OT18-60A [3]	Outdoor Thermostat/ Lockout Thermostat	X	X	X	X	X	X	X
B1141643 [4]	24V Transformer	X	X	X	X	X	X	X

* Contains 20 brackets; four brackets needed to anchor unit to pad

[1] Field-installed, non-bleed, expansion valve kit - Condensing units and heap pumps with reciprocating compressors require the use of start-assist components when used in conjunction with an indoor coil using a non-bleed thermal expansion valve refrigerant metering device.

[2] Installed on the indoor coil

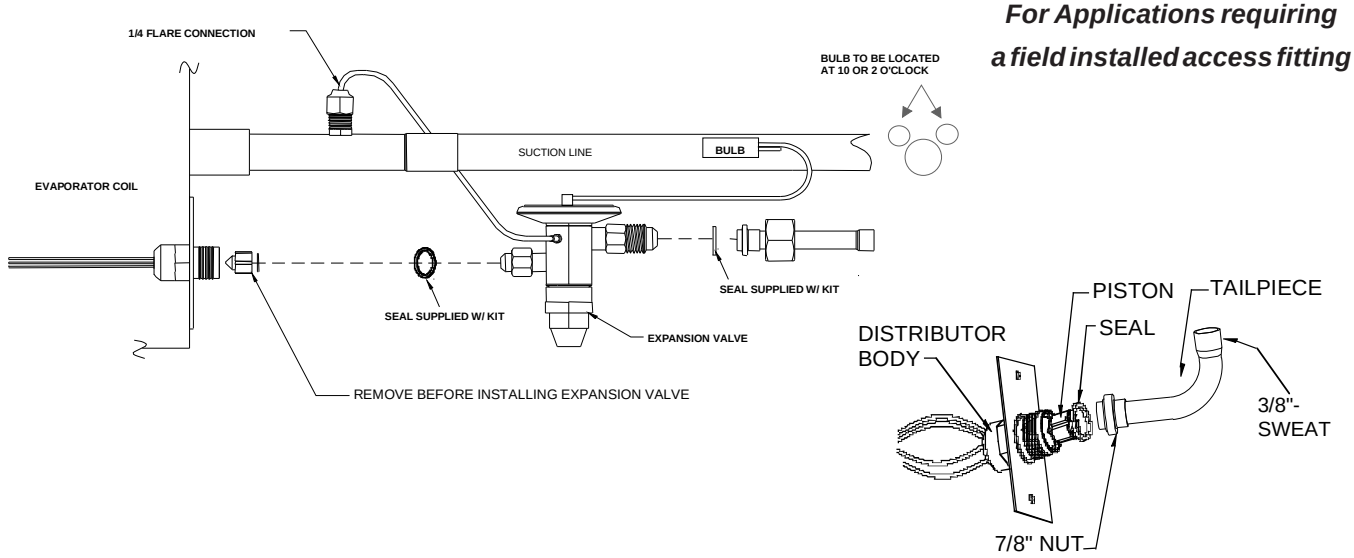
[3] Available in 24V legacy mode only. This feature is integrated in the communicating mode. Required for heat pump applications where ambient temperature fall below 0 °F with 50% or higher relative humidity.

[4] This component is included in the CTK01AA communicating thermostat kit.

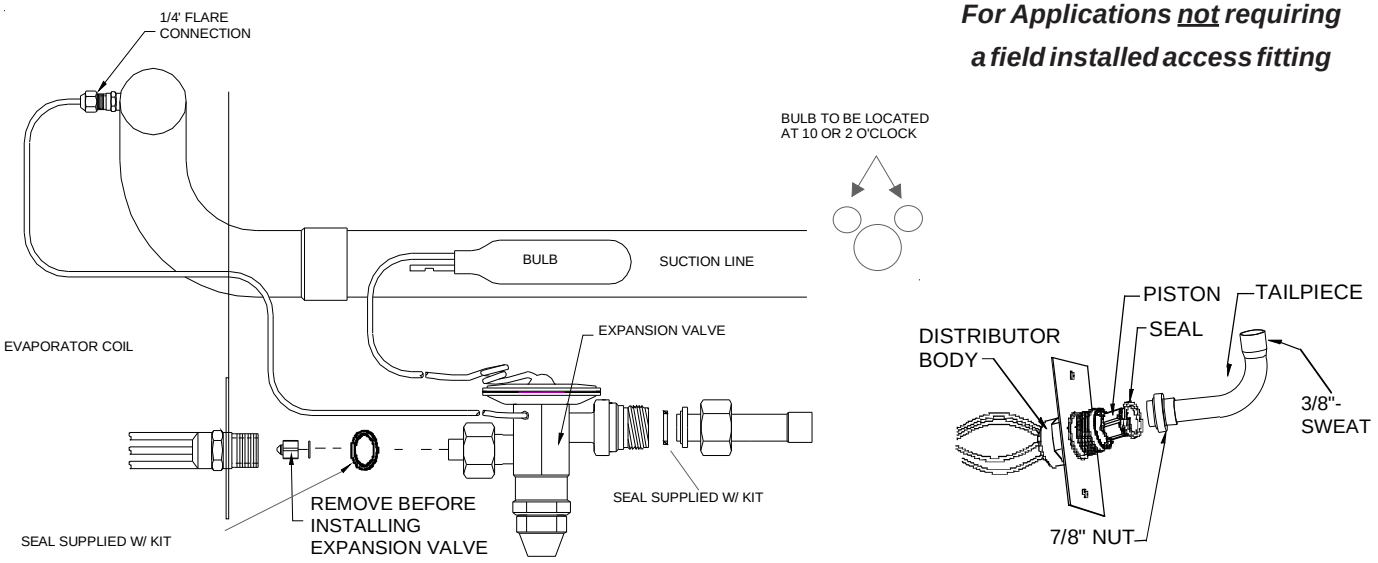
ACCESSORIES

EXPANSION VALVE KITS

For Applications requiring a field installed access fitting

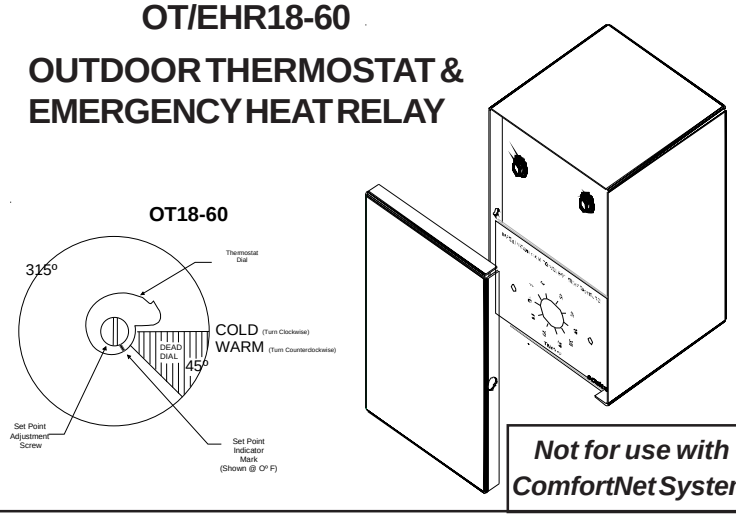


For Applications <u>not</u> requiring a field installed access fitting



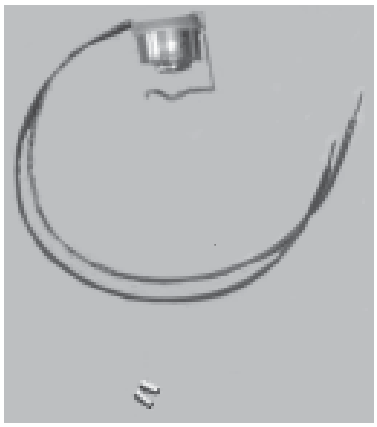
OT/EHR18-60

OUTDOOR THERMOSTAT & EMERGENCY HEAT RELAY

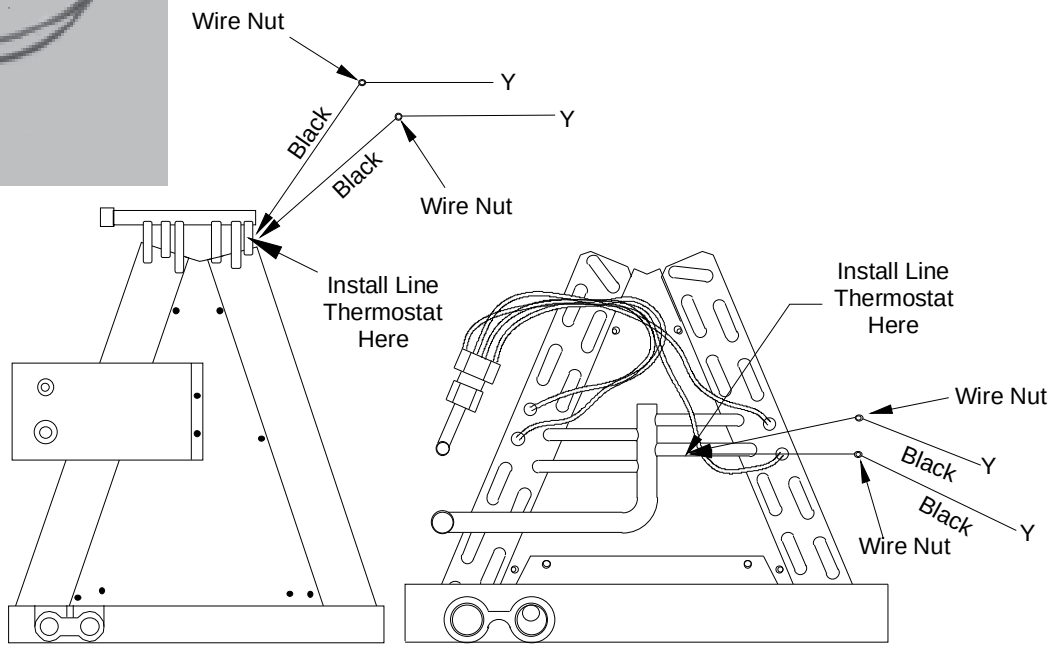


Not for use with ComfortNet System

ACCESSORIES



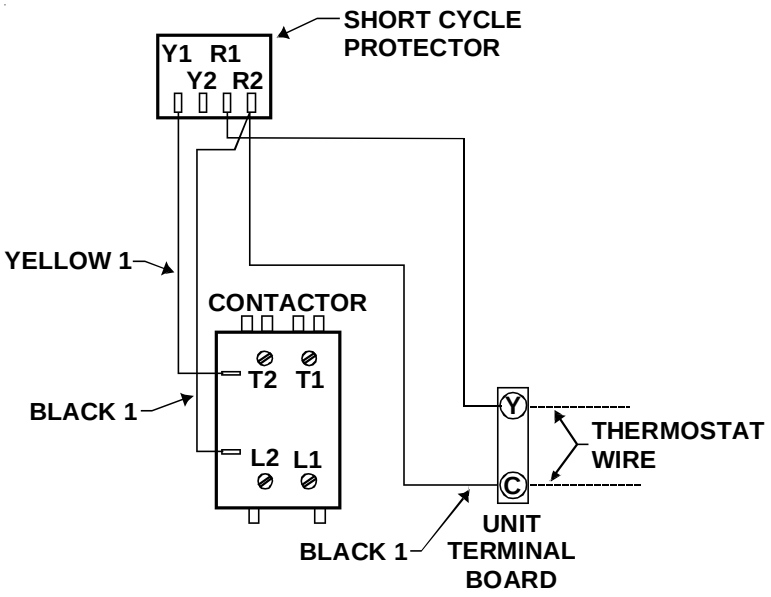
FSK01A
FREEZE THERMOSTAT KIT



ASC01A
ANTI-SHORT-CYCLE CONTROL KIT

Not for use with ComfortNet System

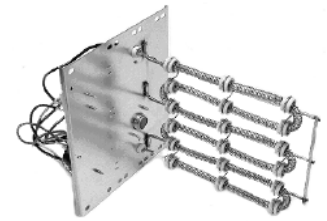




ACCESSORIES

COIL ACCESSORIES

COIL MODEL	TX2N4 TXV KIT	TX3N4 TXV KIT	TX5N4 TXV KIT	FSK01A FREEZE PROTECTION KIT
CA*F18246*	X	X		X
CA*F30306*		X		X
CA*F36426*		X	X	X
CHPF18246*			X	X
CHPF30306*			X	X
CHPF36426*			X	X
CSCF1824N6*	X			X
CSCF303N6*		X		X
CSCF3642N6*		X	X	X



HKR SERIES ELECTRIC HEAT KITS

ELECTRIC HEAT KIT APPLICATIONS - MBR, MBE, MBVC

BLOWER		ELECTRIC HEAT KIT									
	NO HEAT	HKR-03*	HKR05-(C)'	HKR-06*	HKR-08(C)*	HKR-10(C)*	HKR-15(C)*	HKR-20(C)*	HKR-21(C)*	^HKR3-15*	^HKR3-20A
MBR0800AA-1AA	-	X	X	X	X	X					
MBR1200AA-1AA	-	X	X	X	X	X	X	X	X	X	X
MBR1600AA-1AA	-	X	X	X	X	X	X	X	X	X	X
MBR2000AA-1AA	-	X	X	X	X	X	X	X	X	X	X
MBE1200AA-1AA	-	-	-	-	X	X	X	-	-	-	-
MBE1600AA-1AA	-	-	-	-	-	X	X	-	-	-	-
MBE2000AA-1AA	-	-	-	-	-	X	X	X	-	-	-
MBE1200AA-1BA	-	X	X	X	X	X	X	-	-	-	-
MBE1600AA-1BA	-	X	X	X	X	X	X	-	-	-	-
MBE2000AA-1AA	-	X	X	X	X	X	X	X	-	-	-
MBVC1200AA-1AA	-	X	X	X	X	X	X	-	-	-	-
MBVC1600AA-1AA	-	X	X	X	X	X	X	-	-	-	-
MBVC2000AA-1AA	-	X	X	X	X	X	X	X	-	-	-

X = Allowable combinations
- = Restricted combinations

^ = Circuit 1: Single Phase for Air Handler Motor
Circuit 2: 3-Phase for HKR3 Heater Kits

* = Revision level that my or may not be designated
C = Circuit Breaker option

ACCESSORIES

ELECTRIC HEAT KIT APPLICATIONS - ARPF

	ARPF1824 1/16	ARPF1931 1/16	ARPF3030 1/16	ARPF3642 1/16	ARPF3743 1/16	ARPF4860 1/16
HKR-03*	X	X	X	X	X	X
HKR-05*, HKR-05C*	X	X	X	X	X	X
HKR-06*	X	X	X	X	X	X
HKR-08*, HKR-08C*	X[1]	X[1]	X	X	X	X
HKR-10*, HKR-10C*	X[1]	X[1]	X[1]	X	X	X
HKR-15C*	X[2]	X[2]	X[2]	X[3]	X[3]	X
HKR-20C*			X[2]	X[3]	X[3]	X
HKR-21C*			X[2]	X[3]	X[3]	X
^ HKR3-15*			X[2]	X[3]	X[3]	X
^ HKR3-20*			X[2]	X[3]	X[3]	X

* Revision level that may or may not be designated

C Circuit breaker option

^ Heat kit required three-phase power supply

[1] Air handler must either be on medium or high speed

[2] Air handler must be on high speed

[3] For static pressure of 0.6 or higher, air handler must be on medium or high speed.

ACCESSORIES

ELECTRIC HEAT KIT APPLICATIONS - ARUF

	ARUF1729 1/16	ARUF1824 1/16	ARUF1931 1/16	ARUF3030 1/16	ARUF3642 1/16	ARUF3743 1/16	ARUF4860 1/16
HKR-03*	X	X	X	X	X	X	X
HKR-05*, HKR-05C*	X	X	X	X	X	X	X
HKR-06*	X	X	X	X	X	X	X
HKR-08*, HKR-08C*	X[1]	X[1]	X[1]	X	X	X	X
HKR-10*, HKR-10C*	X[1]	X[1]	X[1]	X[1]	X	X	X
HKR-15C*	X[2]	X[2]	X[2]	X[2]	X[3]	X[3]	X
HKR-20C*				X[2]	X[3]	X[3]	X
HKR-21C*				X[2]	X[3]	X[3]	X
^ HKR3-15*				X[2]	X[3]	X[3]	X
^ HKR3-20*				X[2]	X[3]	X[3]	X

* Revision level that may or may not be designated

C Circuit breaker option

^ Heat kit required three-phase power supply

[1] Air handler must either be on medium or high speed

[2] Air handler must be on high speed

[3] For static pressure of 0.6 or higher, air handler must be on medium or high speed.

	ARUF024-00A1A	ARUF032-00A1B	ARUF042-00A1B	ARUF049-00A1B	ARUF061-00A1B
HKR-03*	X	X	X	X	X
HKR-05*, HKR-05C*	X	X	X	X	X
HKR-06*	X	X	X	X	X
HKR-08*, HKR-08C*	X	X[1]	X	X	X
HKR-10*, HKR-10C*	X[1]	X[1]	X[1]	X	X
HKR-15C*		X[2]	X[2]	X[3]	X
HKR-20C*			X[2]	X[3]	X
HKR-21C*			X[2]	X[3]	X
^ HKR3-15*			X[2]	X[3]	X
^ HKR3-20*			X[2]	X[3]	X

* Revision level that may or may not be designated

C Circuit breaker option

^ Heat kit required three-phase power supply

[1] Air handler must either be on medium or high speed

[2] Air handler must be on high speed

[3] For static pressure of 0.6 or higher, air handler must be on medium or high speed.

ACCESSORIES

ELECTRIC HEAT KIT APPLICATIONS - AEPF

	AEPF183016	AEPF303616	AEPF313716	AEPF426016
HKR-05*, HKR-05C*	X		X	
HRK-08*, HKR-08C	X	X	X	
HKR-10*, HKR-10C	X[1]	X	X	X
HKR-15C*		X[1]	X[1]	X
HKR-20C*				X[2]
HKR-21C				X[2]

* Revision level that may or may not be designated

C Circuit Breaker option

[1] This heater kit can be used ONLY for **1000 CFM or higher** applications

[2] This heater kit can be used ONLY for **1200 CFM or higher** applications

ELECTRIC HEAT KIT APPLICATIONS - ASPF

	ASPF183016	ASPF303616	ASPF313716	ASPF426016
HKR-03*	X	X	X	X
HKR-05*, HKR-05C*	X	X	X	X
HKR-06*	X	X	X	X
HRK-08*, HKR-08C*	X[1]	X[1]	X[1]	X
HKR-10*, HKR-10C*	X[1]	X[1]	X[1]	X
HKR-15C*	X[2]	X[2]	X[2]	X[1]
HKR-20C*		X[2]	X[2]	X[1]
HKR-21C*		X[2]	X[2]	X[1]
+HKR3-15*	X[2]	X[2]	X[2]	X[1]
+HKR3-20*		X[2]	X[2]	X[1]

* Revision level that may or may not be designated

C Circuit Breaker option

+ Heat kit requires 3-phase power supply

[1] Air handler must be on speed tap 2, 3, 4 or 5

[2] Air handler must be on speed tap 4 or 5

[3] Air handler must be on speed tap 3, 4 or 5

PRODUCT DESIGN

This section gives a basic description of cooling unit operation, its various components and their basic operation. Ensure your system is properly sized for heat gain and loss according to methods of the Air Conditioning Contractors Association (ACCA) or equivalent.

CONDENSING UNIT

The condenser air is pulled through the condenser coil by a direct drive propeller fan. This condenser air is then discharged out of the top of the cabinet. These units are designed for free air discharge, so no additional resistance, like duct work, shall be attached.

The suction and liquid line connections on present models are of the sweat type for field piping with refrigerant type copper. Front seating valves are factory installed to accept the field run copper. The total refrigerant charge for a normal installation is factory installed in the condensing unit.

GSX, GSZ, ASX, ASZ, SSX, SSZ and DSX, DSZ models are available in 1 1/2 through 5 ton sizes and use R-410A refrigerant. They are designed for 208/230 volt single phase applications.

ASX, ASZ, DSX and DSZ R-410A model units use the Copeland Scroll "Ultratech" Series compressors which are specifically designed for R-410A refrigerant. These units also have Copeland® ComfortAlert diagnostics.

GSX, GSZ, SSX and SSZ R-410A model units use the Copeland Scroll "Ultratech" Series compressors which are specifically designed for R-410A refrigerant.

ASXC, ASZC, DSXC, DSZC models are available in 2 through 5 ton sizes and use R-410A refrigerant. They are designed for 208/230 volt single phase applications.

ASXC, ASZC, DSXC, DSZC R-410A model units use the Copeland Scroll "Ultratech" Series compressors which are specifically designed for R-410A refrigerant. These units also have Copeland® ComfortAlert diagnostics. The Copeland® ComfortAlert diagnostics are integrated into the unitary (UC) control.

There are a number of design characteristics which are different from the traditional reciprocating and/or scroll compressors.

"Ultractech" Series scroll compressors will not have a discharge thermostat. Some of the early model scroll compressors required discharge thermostat.

"Ultratech" Series scroll compressors use "POE" or polyolester oil which is **NOT** compatible with mineral oil based lubricants like 3GS. "POE" oil must be used if additional oil is required.

COILS AND BLOWER COILS - LEGACY MODELS

MBR/MBE/MBVC blower cabinets are designed to be used as a two-piece blower and coil combination. MBR/MBE/MBVC blower sections can be attached to cased evaporator coil. This two-piece arrangement allows for a variety of mix-matching possibilities providing greater flexibility. The MBE/MBVC blower cabinets use a variable speed motor that maintains a constant airflow with a higher duct static.

MBE/MBVC blower cabinests are approved for applications with cooling coils of up to 0.8 inches W.C. external static pressure. The MBE models includes a feature that allows airflow to be changed by +15%. The MBVC models allow airflow trimming of +/-10%.

The MBR blower cabinet uses a PSC motor. It is approved for applications with cooling coils of up to 0.5 inches W.C. external static pressure.

The MBR/MBE/MBVC blower cabinets with proper coil matches can be positioned for upflow, counterflow, horizontal right or horizontal left operation. All units are constructed with R-4.2 insulation. In areas of extreme humidity (greater than 80% consistently), insulate the exterior of the blower with insulation having a vapor barrier equivalent to ductwork insulation, providing local codes permit.

The CAPX/CHPX coils are equipped with a thermostatic expansion valve that has a built-in internal check valve for refrigerant metering. The CACF/CAPF/CHPF coils are equipped with a fixed restrictor orifice.

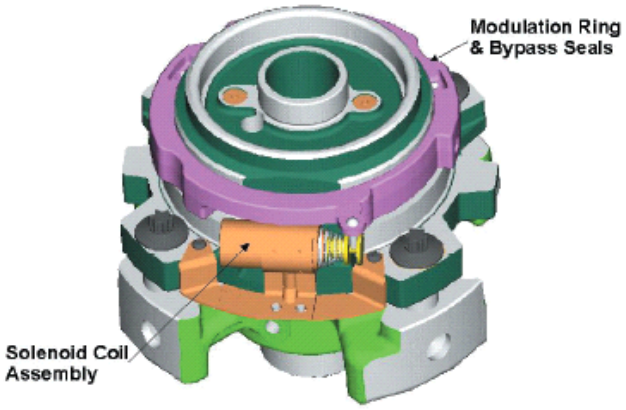
The coils are designed for upflow, counterflow or horizontal application, using two-speed direct drive motors on the CACF/CAPF/CHPX models and BPM (Brushless Permanent Magnet) or ECM motors on the MBE/MBVC models.

Communicating Unitary Control (UC) PCB

The Communicating System Unitary Control PCB is a microprocessor-based control for heat pump and air conditioning condensing units with single-phase compressors up to 5 ton capacity operating on standard residential or Delta and Wye commercial power. The control incorporates the basic functionality of existing defrost controls, outdoor thermostats, contactors, compressor staging controls, short cycle controls, line voltage monitors, Comfort Alert Module, two speed condenser fan relays and the Active Protection component of enabled thermostats. The control is designed to work as part of a fully communicating HVAC system with 4 wires. The control also supports legacy 24VAC thermostat inputs for Y1, Y2, O and 24VAC outputs for RVS, W1, and L for non-communicating systems. Outputs include compressor power, compressor stage select, and outdoor fan high and outdoor fan low speed. System inputs include high/low pressure switches, as well as thermistor inputs for outdoor coil temperature and outdoor air temperature.

PRODUCT DESIGN

The ASX & ASXC [16 & 18], ASZ & ASZC [16 & 18], DSX & DSXC [16 & 18] and DSZ & DSZC [16 & 18] series split system units use a two-stage scroll compressor. The two-step modulator has an internal unloading mechanism that opens a bypass port in the first compression pocket, effectively reducing the displacement of the scroll. The opening and closing of the bypass port is controlled by an internal electrically operated solenoid.



The ZPS/ZRS two-step modulated scroll uses a single step of unloading to go from full capacity to approximately 67% capacity. A single speed, high efficiency motor continues to run while the scroll modulates between the two capacity step

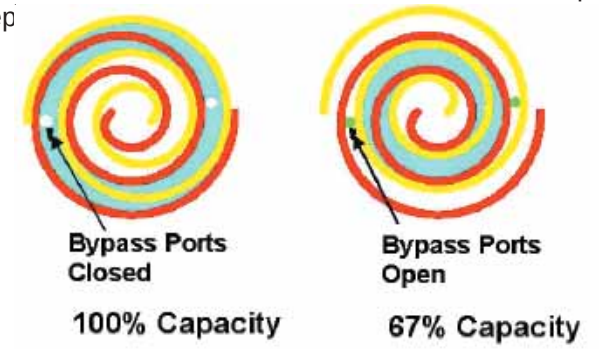


FIGURE A

A scroll is an involute spiral which, when matched with a mating scroll form as shown, generates a series of crescent shaped gas pockets between the two members.

During compression, one scroll remains stationary (fixed scroll) while the other form (orbiting scroll) is allowed to orbit (but not rotate) around the first form.



As this motion occurs, the pockets between the two forms are slowly pushed to the center of the two scrolls while simultaneously being reduced in volume. When the pocket reaches the center of the scroll form, the gas, which is now at a high pressure, is discharged out of a port located at the center.

During compression, several pockets are being compressed simultaneously, resulting in a very smooth process. Both the suction process (outer portion of the scroll members) and the discharge process (inner portion) are continuous.

Some design characteristics of the Compliant Scroll compressor are:

- Compliant Scroll compressors are more tolerant of liquid refrigerant.

  NOTE: Even though the compressor section of a Scroll compressor is more tolerant of liquid refrigerant, continued floodback or flooded start conditions may wash oil from the bearing surfaces causing premature bearing failure.

- Compliant Scroll compressors use white oil which is compatible with 3GS. 3GS oil may be used if additional oil is required.

- Compliant scroll compressors perform "quiet" shutdowns that allow the compressor to restart immediately without the need for a time delay. This compressor will restart even if the system has not equalized.

  NOTE: Operating pressures and amp draws may differ from standard reciprocating compressors. This information can be found in the unit's Technical Information Manual.

PRODUCT DESIGN

CAPACITY CONTROL - LEGACY MODELS

During the compression process, there are several pockets within the scroll that are compressing gas. Modulation is achieved by venting a portion of the gas in the first suction pocket back to the low side of the compressor thereby reducing the effective displacement of the compressor. See Figure A. Full capacity is achieved by blocking these vents, increasing the displacement to 100%. A solenoid in the compressor, controlled by an external 24-volt ac signal, moves the slider ring that covers and uncovers these vents. The vent covers are arranged in such a manner that the compressor operates somewhere around 67% capacity when the solenoid is not energized and 100% capacity when the solenoid is energized. The loading and unloading of the two step scroll is done “on the fly” without shutting off the motor between steps. See Figure B below**.** The unloaded mode default was chosen for two reasons:

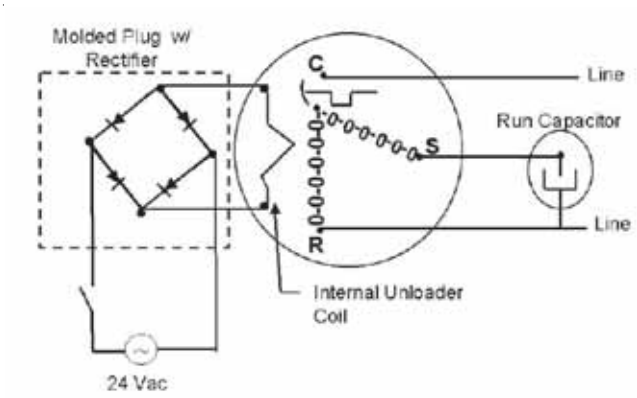


FIGURE B

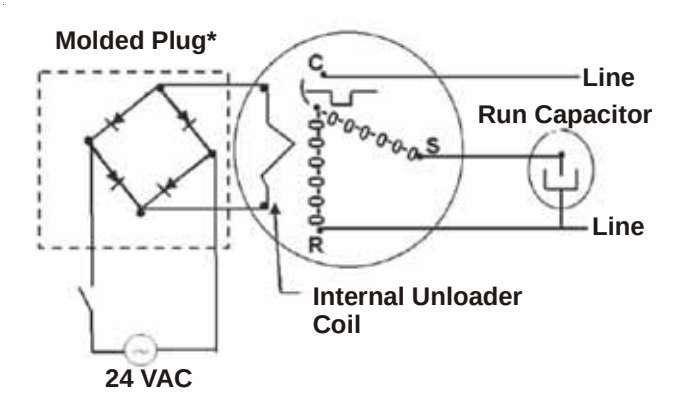
1. It is expected that the majority of run hours will be in the low capacity, unloaded mode.
2. It allows a simple two-stage thermostat to control capacity through the second stage in both cooling and possibly heating if desired.

UNLOADER SOLENOID

A nominal 24-volt direct current coil activates the internal unloader solenoid. The input control circuit voltage must be 18 to 28 volt ac. The coil power requirement is 20 VA. The external electrical connection is made with a molded plug assembly. This plug is connected to the Comfort Alert Module which contains a full wave rectifier to supply direct current to the unloader coil.

CAPACITY CONTROL - COMFORTNET™ MODELS

During the compression process, there are several pockets within the scroll that are compressing gas. Modulation is achieved by venting a portion of the gas in the first suction pocket back to the low side of the compressor thereby reducing the effective displacement of the compressor. See Figure A. Full capacity is achieved by blocking these vents, increasing the displacement to 100%. A solenoid in the compressor, controlled by an external 24-volt ac signal, moves the slider ring that covers and uncovers these vents. The vent covers are arranged in such a manner that the compressor operates somewhere around 67% capacity when the solenoid is not energized and 100% capacity when the solenoid is energized. The loading and unloading of the two step scroll is done “on the fly” without shutting off the motor between steps. See Figure B below**.** The unloaded mode default was chosen for two reasons:



***Rectifier is integrated on the UC PCB**

FIGURE B

1. It is expected that the majority of run hours will be in the low capacity, unloaded mode.
2. It allows a simple two-stage thermostat to control capacity through the second stage in both cooling and possibly heating if desired.

UNLOADER SOLENOID

A nominal 24-volt direct current coil activates the internal unloader solenoid. The input control circuit voltage must be 18 to 28 volt ac. The coil power requirement is 20 VA. The external electrical connection is made with a molded plug assembly. This plug is connected to the Communicating Unitary Control PCB (UC PCB) which contains a full wave rectifier to supply direct current to the unloader coil.

SYSTEM OPERATION

COOLING

The refrigerant used in the system is R-410A. It is a clear, colorless, non-toxic and non-irritating liquid. R-410A is a 50:50 blend of R-32 and R-125. The boiling point at atmospheric pressure is **-62.9°F.**

A few of the important principles that make the refrigeration cycle possible are: heat always flows from a warmer to a cooler body. Under lower pressure, a refrigerant will absorb heat and vaporize at a low temperature. The vapors may be drawn off and condensed at a higher pressure and temperature to be used again.

The indoor evaporator coil functions to cool and dehumidify the air conditioned spaces through the evaporative process taking place within the coil tubes.

NOTE: The pressures and temperatures shown in the refrigerant cycle illustrations on the following pages are for demonstration purposes only. Actual temperatures and pressures are to be obtained from the "Expanded Performance Chart".

Liquid refrigerant at condensing pressure and temperatures, (270 psig and 122°F), leaves the outdoor condensing coil through the drier and is metered into the indoor coil through the metering device. As the cool, low pressure, saturated refrigerant enters the tubes of the indoor coil, a portion of the liquid immediately vaporizes. It continues to soak up heat and vaporizes as it proceeds through the coil, cooling the indoor coil down to about 48°F.

Heat is continually being transferred to the cool fins and tubes of the indoor evaporator coil by the warm system air. This warming process causes the refrigerant to boil. The heat removed from the air is carried off by the vapor.

As the vapor passes through the last tubes of the coil, it becomes superheated. That is, it absorbs more heat than is necessary to vaporize it. This is assurance that only dry gas will reach the compressor. Liquid reaching the compressor can weaken or break compressor valves.

The compressor increases the pressure of the gas, thus adding more heat, and discharges hot, high pressure superheated gas into the outdoor condenser coil.

In the condenser coil, the hot refrigerant gas, being warmer than the outdoor air, first loses its superheat by heat transferred from the gas through the tubes and fins of the coil. The refrigerant now becomes saturated, part liquid, part vapor and then continues to give up heat until it condenses to a liquid alone. Once the vapor is fully liquefied, it continues to give up heat which subcools the liquid, and it is ready to repeat the cycle.

HEATING

The heating portion of the refrigeration cycle is similar to the cooling cycle. By energizing the reversing valve solenoid coil, the flow of the refrigerant is reversed. The indoor coil now becomes the condenser coil, and the outdoor coil becomes the evaporator coil.

The check valve at the indoor coil will open by the flow of refrigerant letting the now condensed liquid refrigerant bypass the indoor expansion device. The check valve at the outdoor coil will be forced closed by the refrigerant flow, thereby utilizing the outdoor expansion device.

The restrictor orifice used with the CA*F, CHPF and CH**FCB coils will be forced onto a seat when running in the cooling cycle, only allowing liquid refrigerant to pass through the orifice opening. In the heating cycle, it will be forced off the seat allowing liquid to flow around the restrictor. A check valve is not required in this circuit.

COOLING CYCLE

For legacy room thermostat: When the room thermostat calls for cool, the contacts of the room thermostat close making terminals R to Y1 & G (if thermostat calls for low stage cool), or R to Y1, Y2 & G (if thermostat calls for high stage cool), the low voltage circuit of the transformer is completed. Current now flows through the magnetic holding coils of the compressor contactor (CC) and fan relay (RFC). If thermostat calls for high stage cool, the microprocessor on the UC board will also energize the compressor high stage solenoid to run the compressor at full capacity.

This draws in the normally open contact CC, starting the compressor and condenser fan motors in either low or high stage depending on the thermostat's demand. At the same time, contacts RFC close, starting the indoor fan motor.

When the thermostat is satisfied, it opens its contacts, breaking the low voltage circuit, causing the compressor contactor and indoor fan relay to open, shutting down the system.

If the room thermostat fan selector switch should be set on the "on" position, then the indoor blower would run continuously rather than cycling with the compressor.

GSZ, ASZ, SSZ and DSZ models energize the reversing valve thorough the "O" circuit in the room thermostat. Therefore, the reversing valve remains energized as long as the thermostat subbase is in the cooling position. The only exception to this is during defrost.

For heat pumps, during cooling cycle the reversing valve is energized as the room thermostat closes "O" terminal to R and the microprocessor on the UC board responds to such a condition by energizing the solenoid coil on the reversing valve.

For communicating room thermostat: When the room thermostat calls for either low stage cool or high stage cool, such a command is sent to the microprocessors on the UC and the indoor communicating PCB via the data lines using Climate Talk protocol. The microprocessors therefore energize the coil of CC and RFC, and compressor high stage solenoid if it is a high stage call.

This draws in the normally open contact CC, starting the compressor and condenser fan motors in either low stage or high stage depending on the thermostat's demand. At the same time, contacts RFC close, starting the indoor fan motor.

SYSTEM OPERATION

When the thermostat is satisfied, it sends such a status to the microprocessors on the UC indoor communicating PCB via the data lines using Climate Talk protocol. Then the microprocessors open the compressor contactor and indoor fan relay, shutting down the system.

If room thermostat fan status is set to be “on”, then indoor blower would run continuously rather than cycling with the compressor.

For heat pumps, during cooling cycle the reversing valve is energized in operation, as the room thermostat sends the call for cool to the microprocessor on the UC board and the microprocessor responds to such a condition by energizing the coil on the reversing valve.

DEFROST CYCLE

The defrosting of the outdoor coil is jointly controlled by the UC PCB and the outdoor coil temperature (OCT) sensor.

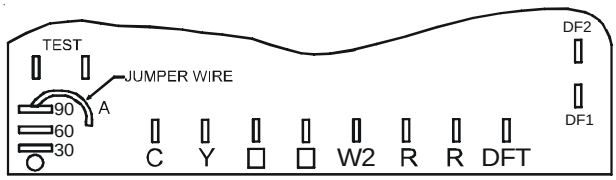
The OCT sensor is clamped to a feeder tube entering the outdoor coil. Defrost timing periods of 30, 60, 90 or 120 minutes may be selected via the dipswitch settings on the UC PCB. In a communicating system, the defrost timing periods can also be selected in the communicating thermostat user menu. During operation the microprocessor on the UC checks coil temperature via the OCT sensor every 30, 60, 90, or 120 minutes when there is a call for heating. If by the time the microprocessor checks the coil temperature, and it's low enough (approximately 31°F), and if there is a call for heat from the thermostat, the PCB will initiate a defrost. When the microprocessor detects the coil temperature to be high enough (approximately 75 ^{0}F), or 10 minutes of maximum defrost cycle time has elapsed, whichever occurs first, the defrost cycle is terminated and the timing period is reset. The field service personnel can also advance a heat pump to the defrost cycle by simultaneously pressing the “TEST” button and the “RECALL” button on the UC board.

DEFROST CYCLE

The defrosting of the outdoor coil is jointly controlled by the defrost control board and the defrost thermostat.

Solid State Defrost Control

During operation the power to the circuit board is controlled by a temperature sensor, which is clamped to a feeder tube entering the outdoor coil. Defrost timing periods of 30, 60, or 90 minutes may be selected by connecting the circuit board jumper to 30, 60, or 90 respectively. Accumulation of time for the timing period selected starts when the sensor closes (approximately 31° F), and when the room thermostat calls for heat. At the end of the timing period, the unit’s defrost cycle will be initiated provided the sensor remains closed. When the sensor opens (approximately 75° F), the defrost cycle is terminated and the timing period is reset. If the defrost cycle is not terminated due to the sensor temperature, a ten minute override interrupts the unit’s defrost period.



HEATING CYCLE

The reversing valve on the GSZ, SSZ, ASZ and DSZ models is energized in the cooling cycle through the "O" terminal on the room thermostat.

These models have a 24 volt reversing valve coil. When the thermostat selector switch is set in the cooling position, the "O" terminal on the thermostat is energized all the time.

Care must be taken when selecting a room thermostat. Refer to the installation instructions shipped with the product for approved thermostats.

HEATING CYCLE

For legacy room thermostat: When the room thermostat calls for heat, the contacts of the room thermostat close making terminals R to Y & G, the low voltage circuit of the transformer is completed. Current now flows through the magnetic holing coils of the compressor contactor (CC) and fan relay (RFC).

This draws in the normally open contact CC, starting the compressor condenser fan motors. At the same time, contacts RFC close, starting the indoor fan motor.

When the thermostat is satisfied, it opens its contacts, breaking the low voltage circuit, causing the compressor contactor and indoor fan relay to open, shutting down the system.

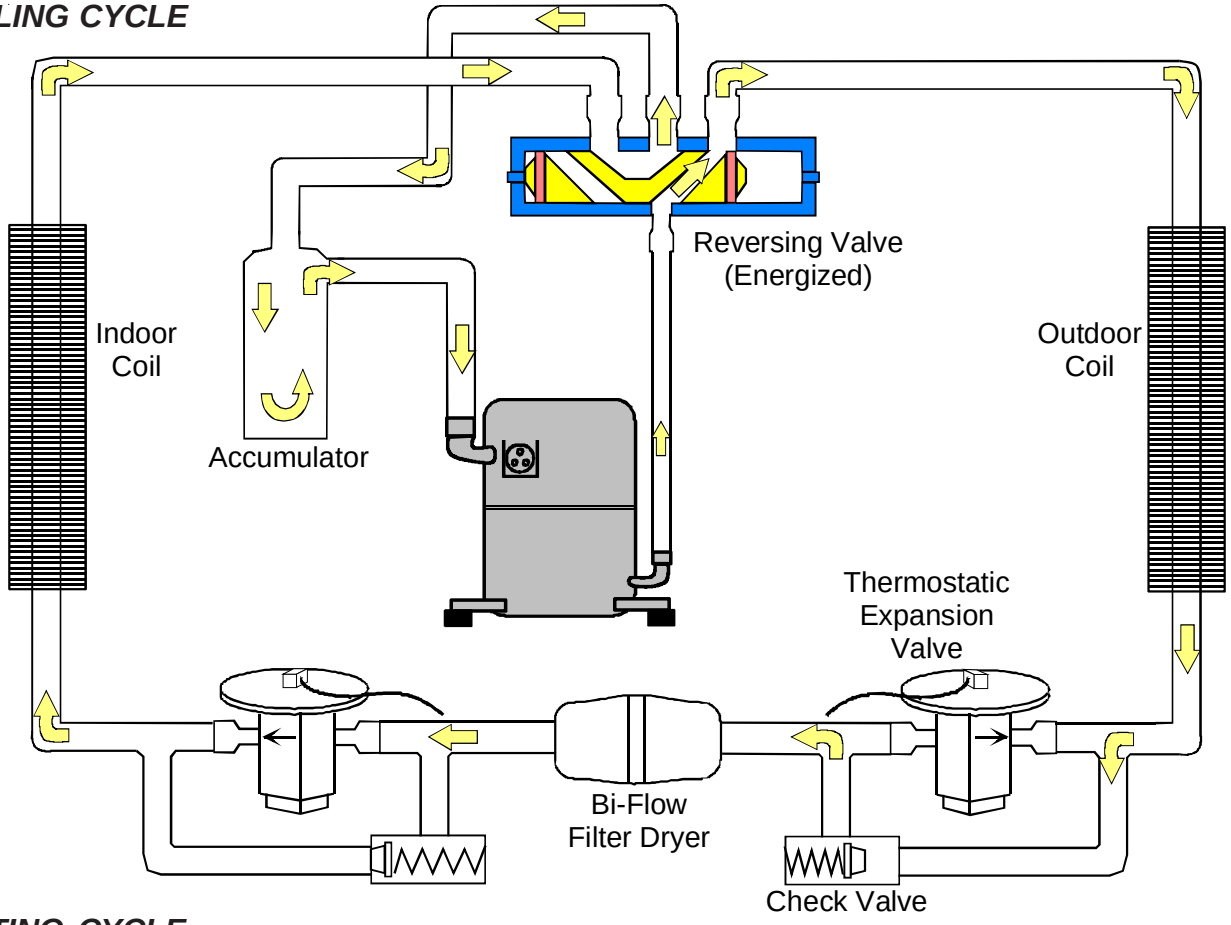
If the room thermostat fan selector switch should be set on the “on” position, then the indoor blower would run continuously rather than cycling with the compressor.

For communicating room thermostat: When the room thermostat calls for cool, the thermostat sends such a command to the microprocessors on the UC and the indoor communicating PCB via the data lines using Climate Talk protocol. The microprocessors therefore energize the coil of CC and RFCThis draws in the normally open contact CC, starting the compressor and condenser fan motors. At the same time, contacts RFC close, starting the indoor fan motor.

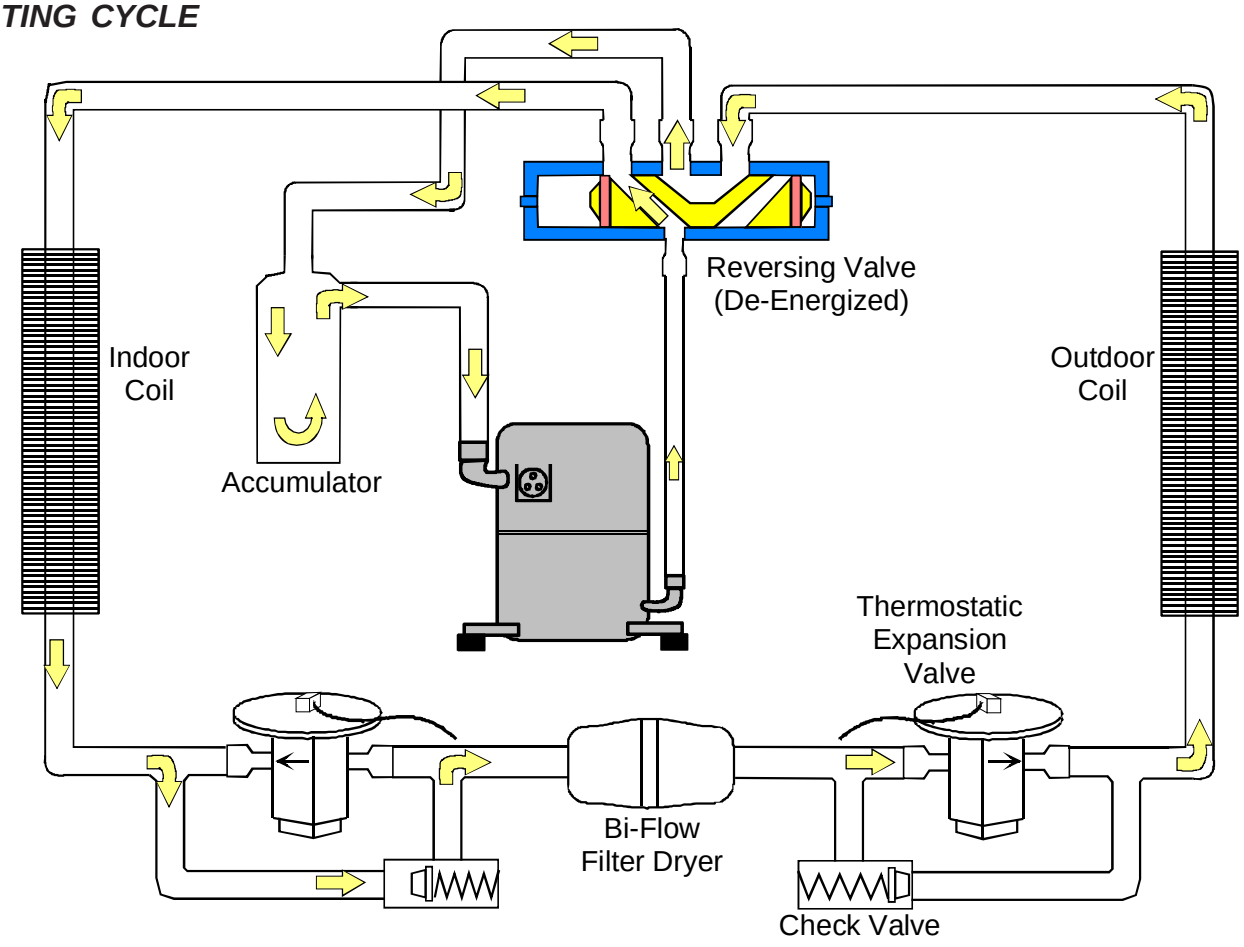
When the thermostat is satisfied, it sends such a status to the microprocessors on the UC indoor communicating PCB via the data lines using Climate Talk protocol. Then the microprocessors open the compressor contactor and indoor fan relay, shutting down the system.

SYSTEM OPERATION

COOLING CYCLE

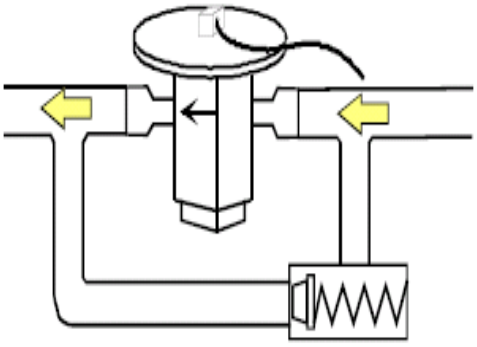


HEATING CYCLE

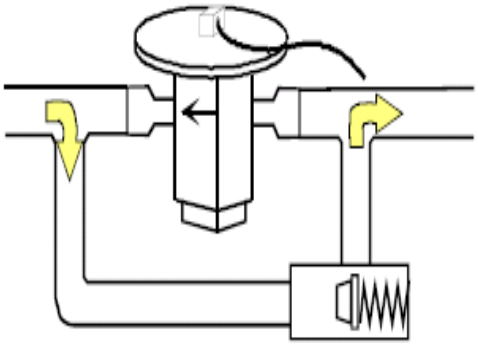


SYSTEM OPERATION

EXPANSION VALVE/CHECK VALVE ASSEMBLY IN COOLING OPERATION

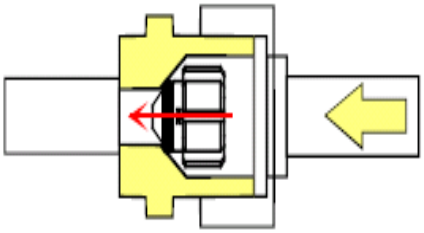


EXPANSION VALVE/CHECK VALVE ASSEMBLY IN HEATING OPERATION



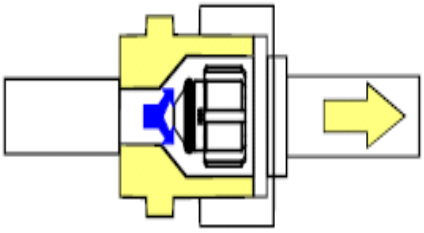
Most expansion valves used in current Amana® Brand Heat Pump products use an internally checked expansion valve.
This type of expansion valve does not require an external check valve as shown above.
However, the principle of operation is the same.

RESTRICTOR ORIFICE ASSEMBLY IN COOLING OPERATION



In the cooling mode, the orifice is pushed into its seat, forcing refrigerant to flow through the metered hole in the center of the orifice.

RESTRICTOR ORIFICE ASSEMBLY IN HEATING OPERATION



In the heating mode, the orifice moves back off its seat, allowing refrigerant to flow unmetered around the outside of the orifice.

SYSTEM OPERATION

AFE18-60A CONTROL BOARD

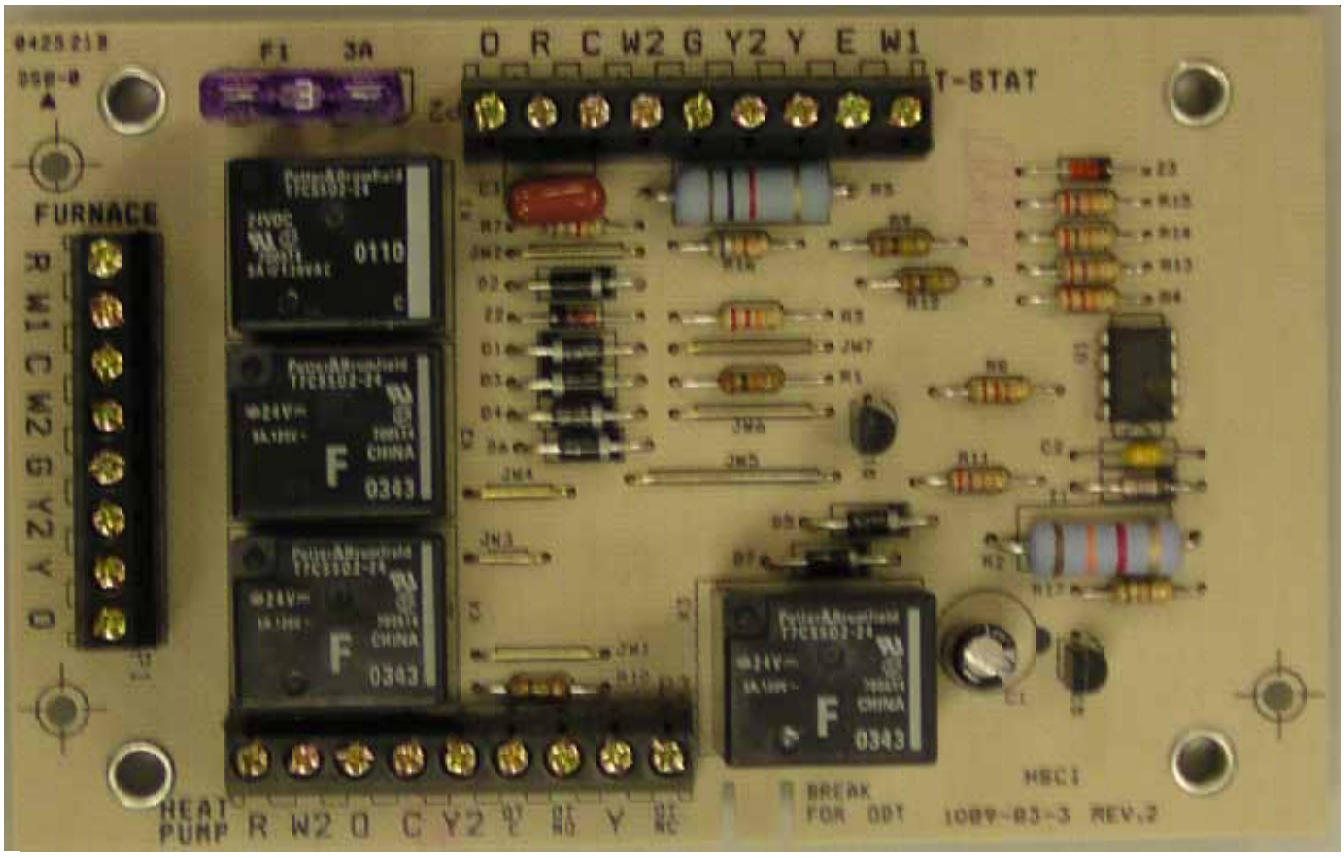
DESCRIPTION

The AFE18 control is designed for use in heat pump applications where the indoor coil is located above/downstream of a gas or fossil fuel furnace. It will operate with single and two stage heat pumps and single and two stage furnaces. The AFE18 control will turn the heat pump unit off when the furnace is turned on. An anti-short cycle feature is also incorporated which initiates a 3 minute timed off delay when the compressor goes off. On initial power up or loss and restoration of power, this 3 minute timed off delay will be initiated. The compressor won't be allowed to restart until the 3 minute off delay has expired. Also included is a 5 second de-bounce feature on the "Y, E, W1 and O" thermostat inputs. These thermostat inputs must be present for 5 seconds before the AFE18 control will respond to it.

An optional outdoor thermostat, OT18-60A, can be used with the AFE18 to switch from heat pump operation to furnace operation below a specific ambient temperature setting, i.e. break even temperature during heating. When used in this manner, the "Y" heat demand is switched to the "W1" input to the furnace by the outdoor thermostat and the furnace is used to satisfy the first stage "Y" heat demand. On some controls, if the outdoor thermostat fails closed in this position during the heating season, it will turn on the furnace during the cooling season on a "Y" cooling demand. In this situation, the furnace produces heat and increases the indoor temperature thereby never satisfying the cooling demand. The furnace will continue to operate and can only be stopped by switching the thermostat to the off position or removing power to the unit and then replacing the outdoor thermostat. **When the AFE18 receives a "Y" and "O" input from the indoor thermostat**, it recognizes this as a cooling demand in the cooling mode. If the outdoor thermostat is stuck in the closed position switching the "Y" demand to the "W1" furnace input during the cooling mode as described above, the AFE18 won't allow the furnace to operate. The outdoor thermostat will have to be replaced to restore the unit to normal operation.

WARNING

HIGH VOLTAGE!
Disconnect ALL power before servicing or installing. Multiple power sources may be present. Failure to do so may cause property damage, personal injury or death.



TROUBLESHOOTING CHART

COOLING/HP ANALYSIS CHART

Complaint	No Cooling							Unsatisfactory Cooling/Heating								System Operating Pressures				Test Method Remedy	See Service Procedure Ref.
POSSIBLE CAUSE DOTS IN ANALYSIS GUIDE INDICATE "POSSIBLE CAUSE" SYMPTOM	System will not start	Compressor will not start - fan runs	Comp. and Cond. Fan will not start	Evaporator fan will not start	Condenser fan will not start	Compressor runs - goes off on overload	Compressor cycles on overload	System runs continuously - little cooling/htg	Too cool and then too warm	Not cool enough on warm days	Certain areas too cool, others too warm	Compressor is noisy	System runs - blows cold air in heating	Unit will not terminate defrost	Unit will not defrost	Low suction pressure	Low head pressure	High suction pressure	High head pressure		
Power Failure	●																			Test Voltage	S-1
Blown Fuse	●		●	●																Inspect Fuse Size & Type	S-1
Unbalanced Power, 3PH		●				●	●													Test Voltage	S-1
Loose Connection	●			●		●														Inspect Connection - Tighten	S-2, S-3
Shorted or Broken Wires	●	●	●	●	●	●														Test Circuits With Ohmmeter	S-2, S-3
Open Fan Overload				●	●															Test Continuity of Overload	S-17A
Faulty Thermostat	●		●	●					●											Test Continuity of Thermostat & Wiring	S-3
Faulty Transformer	●		●																	Check Control Circuit with Voltmeter	S-4
Shorted or Open Capacitor		●		●	●	●	●													Test Capacitor	S-15
Internal Compressor Overload Open		●											♦							Test Continuity of Overload	S-17A
Shorted or Grounded Compressor		●				●														Test Motor Windings	S-17B
Compressor Stuck		●				●	●						♦							Use Test Cord	S-17D
Faulty Compressor Contactor			●		●	●														Test Continuity of Coil & Contacts	S-7, S-8
Faulty Fan Relay				●																Test Continuity of Coil And Contacts	S-7
Open Control Circuit				●																Test Control Circuit with Voltmeter	S-4
Low Voltage		●				●	●													Test Voltage	S-1
Faulty Evap. Fan Motor				●												●			♦	Repair or Replace	S-16
Shorted or Grounded Fan Motor					●														●	Test Motor Windings	S-16
Improper Cooling Anticipator							●		●											Check Resistance of Anticipator	S-3B
Shortage of Refrigerant							●	●					♦			●	●			Test For Leaks, Add Refrigerant	S-101,103
Restricted Liquid Line							●	●								●	●		●	Remove Restriction, Replace Restricted Part	S-112
Open Element or Limit on Elec. Heater								♦					♦							Test Heater Element and Controls	S-26,S-27
Dirty Air Filter								●		●	●					●			♦	Inspect Filter-Clean or Replace	
Dirty Indoor Coil								●		●	●					●			♦	Inspect Coil - Clean	
Not enough air across Indoor Coil								●		●	●					●			♦	Check Blower Speed, Duct Static Press, Filter	S-200
Too much air across Indoor Coil																	♦	●		Reduce Blower Speed	S-200
Overcharge of Refrigerant						●	●					●	♦					●	●	Recover Part of Charge	S-113
Dirty Outdoor Coil						●	●			●						♦			●	Inspect Coil - Clean	
Noncondensibles							●			●			♦						●	Recover Charge, Evacuate, Recharge	S-114
Recirculation of Condensing Air							●			●									●	Remove Obstruction to Air Flow	
Infiltration of Outdoor Air								●		●	●									Check Windows, Doors, Vent Fans, Etc.	
Improperly Located Thermostat						●			●											Relocate Thermostat	
Air Flow Unbalanced									●		●									Readjust Air Volume Dampers	
System Undersized								●		●										Refigure Cooling Load	
Broken Internal Parts												●	♦							Replace Compressor	S-115
Broken Valves								●				●					●	●		Test Compressor Efficiency	S-104
Inefficient Compressor								●					♦				●	●		Test Compressor Efficiency	S-104
Wrong Type Expansion Valve						●	●	●		●						●	●		♦	Replace Valve	S-110
Expansion Device Restricted						●	●	●		●						●	●		●	Remove Restriction or Replace Expansion Device	S-110
Oversized Expansion Valve								●											●	Replace Valve	
Undersized Expansion Valve						●	●	●		●						●				Replace Valve	
Expansion Valve Bulb Loose												●						●		Tighten Bulb Bracket	S-105
Inoperative Expansion Valve						●		●								●				Check Valve Operation	S-110
Loose Hold-down Bolts												●								Tighten Bolts	
Faulty Reversing Valve						●							♦	♦	♦		♦	♦	♦	Replace Valve or Solenoid	S-21, 122
Faulty Defrost Control					●								♦	♦	♦	♦	♦		♦	Test Control	S-24
Faulty Defrost Thermostat													♦	♦	♦	♦	♦	♦	♦	Test Defrost Thermostat	S-25
Flow rator Not Seating Properly								●									●	●		Check Flow rator & Seat or Replace Flow rator	S-111

● Cooling or Heating Cycle (Heat Pump) ♦ Heating Cycle Only (Heat Pump)

SERVICING

S-1 Checking Voltage 44
S-2 Checking Wiring 44
S-3 Checking Thermostat, Wiring & Anticipator .. 44
S-3A Thermostat & Wiring 44
S-3B Cooling Anticipator 45
S-3C Heating Anticipator 45
S-3D Checking Encoded Thermostats 45
S-3E CTK01AA ComfortNet™ Thermostats 46
S-4 Checking Transformer & Control Circuit 51
S-5 Checking Cycle Protector 51
S-6 Checking Time Delay Relay 51
S-7 Checking Contactor and/or Relays 52
S-8 Checking Contactor Contacts 52
S-8A Checking UC Contactor/Relay Contacts 52
S-9 Checking Fan Relay Contact 53
S-10 Copeland Comfort™ Alert Diagnositics 55
S-11 Checking Loss of Charge Protector 62
S-12 Checking High Pressure Control 62
S-13 Checking Low Pressure Control 62
S-15 Checking Capacitor 62
S-15A Resistance Check 63
S-15B Capacitance Check 63
S-16A Checking Fan & Blower Motor Windings (PSC Motors) 64
S-16B Checking Fan & Blower Motor (ECM Motors) 64
S-16C Checking ECM Motor Windings 67
S-16D ECM CFM Adjustments 67
S-16E Blower Performance Data 69
S-16F Checking GE X13™ Motors 69
S-16G Emerson UltraTech™ ECM Motors 70
S-16H AVPTC/MBVC ECM CFM Adjustments 73
S-17 Checking Compressor Windings 70
S-17A Resistance Test 74
S-17B Ground Test 74
S-17C Unloader Test 75
S-17D Operation Test 75
S-18 Testing Crankcase Heater (optional item) 76
S-21 Checking Reversing Valve and Solenoid 76
S-24 Testing Defrost Control 76
S-25 Testing Defrost Themrmostat 77
S-26 Testing Temp Sensors (ComfortNet™ Ready Models Only) 77
S-40 MBR/ARUF Electronic Blower Time Delay with Single Stage Air Conditioners & Heat Pumps 77
S-40A AVPTC and MBVC Electronic Blower and Heater Control 77
S-50 Checking Heater Limit Control(S) 79
S-52 Checking Heater Elements 79
S-60 Electric Heater (optional item) 92
S-61A Checking Heater Limit Control(S) 93
S-61B Checking Heater Fuse Line 93
S-100 Refrigeration Repair Practice 93
S-101 Leak Testing 94
S-102 Evacuation 94
S-103 Charging 95
S-104 Checking Compressor Efficiency 95
S-105A Piston Chart - ASX13, GSX13, SSX14, ASX14, ASZ13, GSZ13 Units 96
S-105B Thermostatic Expansion Valve 96
S-106 Overfeeding 96
S-107 Underfeeding 96
S-108 Superheat 99
S-109 Checking Subcooling 99
S-109A Two Speed Application 100
S-109B Heat Pump Heating Mode 67
S-110 Checking Expansion Valve Operation 100
S-111 Fixed Orifice Restriction Devices 100
S-112 Checking Restricted Liquid Line 100
S-113 Refrigerant Overcharge 101
S-114 Non-condensables 101
S-115 Compressor Burnout 101
S-120 Refrigerant Piping 102
S-202 Duct Static Pressure & Static Pressure Drop Across Coils 104
S-203 Air Handler External Static 104
S-204 Coil Static Pressure Drop 105

⚠ WARNING

HIGH VOLTAGE!
Disconnect ALL power before servicing or installing. Multiple power sources may be present. Failure to do so may cause property damage, personal injury or death.



SERVICING

S-1 CHECKING VOLTAGE

1. Remove outer case, control panel cover, etc., from unit being tested.

With power ON:

WARNING

Line Voltage now present.

2. Using a voltmeter, measure the voltage across terminals L1 and L2 of the contactor for the condensing unit or at the field connections for the air handler or heaters.

   ComfortNet™ Ready Condensing Units: Measure the voltage acrosss the L1 and L2 lugs on the unitary (UC) control.

3. No reading - indicates open wiring, open fuse(s) no power or etc., from unit to fused disconnect service. Repair as needed.
4. With ample voltage at line voltage connectors, energize the unit.
5. Measure the voltage with the unit starting and operating, and determine the unit Locked Rotor Voltage. **NOTE**: If checking heaters, be sure all heating elements are energized.

   Locked Rotor Voltage is the actual voltage available at the compressor during starting, locked rotor, or a stalled condition. Measured voltage should be above minimum listed in chart below.

   To measure Locked Rotor Voltage attach a voltmeter to the run "R" and common "C" terminals of the compressor, or to the T_1 and T_2 terminals of the contactor. Start the unit and allow the compressor to run for several seconds, then shut down the unit. Immediately attempt to restart the unit while measuring the Locked Rotor Voltage.

   ComfortNet™ Ready Condensing Units: To measure the Locked Rotor Voltage, attach a voltmeter to the run "R" and common "C" terminals of the compressor or acrosss the "R" and "C" lugs on the unitary (UC) control. Start the unit and allow the compressor to run for several seconds, then shut down the unit. Immediately attempt to restart the unit while measuring the Locked Rotor Voltage.

6. Lock rotor voltage should read within the voltage tabulation as shown. If the voltage falls below the minimum voltage, check the line wire size. Long runs of undersized wire can cause low voltage. If wire size is adequate, notify the local power company in regard to either low or high voltage.

UNIT SUPPLY VOLTAGE		
VOLTAGE	MIN.	MAX.
460	437	506
208/230	198	253

NOTE: When operating electric heaters on voltages other than 240 volts, refer to the System Operation section on electric heaters to calculate temperature rise and air flow. Low voltage may cause insufficient heating.

S-2 CHECKING WIRING

WARNING

HIGH VOLTAGE!
Disconnect ALL power before servicing or installing. Multiple power sources may be present. Failure to do so may cause property damage, personal injury or death.



1. Check wiring visually for signs of overheating, damaged insulation and loose connections.
2. Use an ohmmeter to check continuity of any suspected open wires.
3. If any wires must be replaced, replace with comparable gauge and insulation thickness.

S-3 CHECKING THERMOSTAT, WIRING, AND ANTICIPATOR

THERMOSTAT WIRE SIZING CHART	
LENGTH OF RUN	MIN. COPPER WIRE GAUGE (AWG)
25 feet	18
50 feet	16
75 feet	14
100 feet	14
125 feet	12
150 feet	12

ComfortNet™ Ready Models

1. Legacy Thermostat Wiring: The maximum wire length for 18 AWG thermostat wire is 100 feet.
2. Communicating Thermostat Wiring: The maximum wire length for 18 AWG thermostat wire is 100 feet.

S-3A THERMOSTAT AND WIRING

WARNING

Line Voltage now present.

With power ON, thermostat calling for cooling

1. Use a voltmeter to check for 24 volts at thermostat wires C and Y in the condensing unit control panel.
2. No voltage indicates trouble in the thermostat, wiring or external transformer source.
3. Check the continuity of the thermostat and wiring. Repair or replace as necessary.

SERVICING

Indoor Blower Motor

With power ON:

WARNING

Line Voltage now present.

1. Set fan selector switch at thermostat to "ON" position.
2. With voltmeter, check for 24 volts at wires C and G.
3. No voltage indicates the trouble is in the thermostat or wiring.
4. Check the continuity of the thermostat and wiring. Repair or replace as necessary.

Resistance Heaters

1. Set room thermostat to a higher setting than room temperature so both stages call for heat.
2. With voltmeter, check for 24 volts at each heater relay. Note: BBA/BBC heater relays are DC voltage.
3. No voltage indicates the trouble is in the thermostat or wiring.
4. Check the continuity of the thermostat and wiring. Repair or replace as necessary.

NOTE: Consideration must be given to how the heaters are wired (O.D.T. and etc.). Also safety devices must be checked for continuity.

S-3B COOLING ANTICIPATOR

The cooling anticipator is a small heater (resistor) in the thermostat. During the "off" cycle, it heats the bimetal element helping the thermostat call for the next cooling cycle. This prevents the room temperature from rising too high before the system is restarted. A properly sized anticipator should maintain room temperature within 1 1/2 to 2 degree range.

The anticipator is supplied in the thermostat and is not to be replaced. If the anticipator should fail for any reason, the thermostat must be changed.

S-3C HEATING ANTICIPATOR

The heating anticipator is a wire wound adjustable heater which is energized during the "ON" cycle to help prevent overheating of the conditioned space.

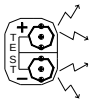
The anticipator is a part of the thermostat and if it should fail for any reason, the thermostat must be replaced. See the following tables for recommended heater anticipator setting in accordance to the number of electric heaters installed.

S-3D TROUBLESHOOTING ENCODED TWO STAGE COOLING THERMOSTATS OPTIONS

TROUBLESHOOTING ENCODED TWO STAGE COOLING THERMOSTATS OPTIONS

The chart below provides troubleshooting for either version of the encoded thermostat option. This provides diagnostic information for the GMC CHET18-60 or a conventional two cool / two stage heat thermostat with IN4005 diodes added as called out in the above section.

A test lead or jumper wire can be added from the test terminal to any terminal on the B13682-74 or B13682-71 variable speed terminal board and provide information through the use of the LED lights on the B13682-71 VSTB control. Using this chart, a technician can determine if the proper input signal is being received by the encoded VSTB control and diagnose any problems that may be relayed to the output response of the B13682-74 VSTM control.



	TEST INDICATION	FUNCTION	SIGNAL OUT	SIGNAL FAN	
INPUT FROM THERMOSTAT	S1 +	LOW SPEED COOL	YCON +	Y1	
	* S1 - *	* LO SPEED COOL *	* YCON - *	* Y / Y2 HI *	* ERROR CONDITION (DIODE ON THERMOSTAT BACKWARDS)
	S1 + -	HI SPEED COOL	YCON + -	Y / Y2	
	S2 +	LO SPEED HEAT	W1 HEATER	W / W1	SEE NOTE 3
	S2 -	O	ED - (FUTURE USE)	O	
	S2 + -	LO SPEED HEAT HI SPEED HEAT	W1 HEATER W2 HEATER	W / W1 EM / W2	SEE NOTE 3
	S3 +	G	NONE	G	
	* S3 - *	N/A	N/A	N/A	* ERROR CONDITION (S3 CAN ONLY READ +)
	* S3 + - *	N/A	N/A	N/A	* ERROR CONDITION (S3 CAN ONLY READ +)
POWER TO THERMOSTAT	R + -	24 VAC	R TO T'STAT	R	
	COM	GND	COM TO T'STAT	C1 , C2	

NOTES:

1.) THE TEST SPADE CAN BE CONNECTED TO ANY OTHER TEST SPADE ON EITHER BOARD.

2.) THE + LED WILL BE RED AND WILL LIGHT TO INDICATE + HALF CYCLES.
THE - LED WILL BE GREEN AND WILL LIGHT TO INDICATE - HALF CYCLES.
BOTH RED AND GREEN ILLUMINATED WILL INDICATE FULL CYCLES DENOTED BY + - .

3.) SIGNAL OUT CONDITION FOR W1 , W2 HEATER WILL BE AFFECTED BY OT1 PJ4 AND OT2 PJ2 JUMPERS AND OUTDOOR THERMOSTATS ATTACHED. THE TABLE ABOVE ASSUMES OT1 PJ4 IS REMOVED AND OT2 PJ2 IS MADE WITH NO OUTDOOR THERMOSTATS ATTACHED.

SERVICING

S-3E CTK01AA COMFORTNET™ THERMOSTAT

Overview

The ComfortNet™ system (or CT™ system) is a system that includes a ComfortNet™ compatible modular blower and air conditioner or heat pump with a CTK01AA thermostat. Any other system configurations are considered invalid ComfortNet™ systems and must be connected as a traditional (or legacy) system. The table below compares the valid CT™ systems.

CT™ compatible Modular Blower	*CT™ compatible Air Conditioner*	*Full CT™ system benefits & features*
CT™ compatible Modular Blower	*CT™ compatible Heat Pump*	*Full CT™ system benefits & features*

A ComfortNet™ heating/air conditioning system differs from a legacy/traditional system in the manner in which the indoor unit, outdoor unit and thermostat interact with one another. In a traditional system, the thermostat sends commands to the indoor and outdoor units via analog 24 VAC signals. It is a one-way communication path in that the indoor and outdoor units typically do not return information to the thermostat.

On the other hand, the indoor unit, outdoor unit, and thermostat comprising a ComfortNet™ system "communicate" digitally with one another. It is now a two-way communications path. The thermostat still sends commands to the indoor and outdoor units. However, the thermostat may also request and receive information from both the indoor and outdoor units. This information may be displayed on the CT™ thermostat. The indoor and outdoor units also interact with one another. The outdoor unit may send commands to or request information from the indoor unit. This two-way digital communications between the thermostat and subsystems (indoor/outdoor unit) and between subsystems is the key to unlocking the benefits and features of the ComfortNet™ system.

Two-way digital communications is accomplished using only two wires. The thermostat and subsystem controls are powered with 24 VAC Thus, a maximum of 4 wires between the equipment and thermostat is all that is required to operate the system.

CTK01AA Wiring

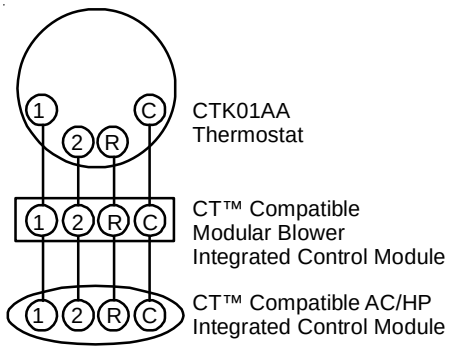
NOTE: Refer to section *Electrical Connections* for 208/230 volt line connections to the modular blower.

NOTE: A removable plug connector is provided with the control to make thermostat wire connections. This plug may be removed, wire connections made to the plug, and replaced. It is **strongly** recommended that multiple wires into a single terminal be twisted together prior to inserting into the plug connector. Failure to do so may result in intermittent operation.

Typical 18 AWG thermostat wire may be used to wire the system components. However, communications reliability may be improved by using a high quality, shielded, twisted pair cable for the data transmission lines. In either case, 100 feet is the maximum length of wire between indoor unit and outdoor unit, or between indoor unit and thermostat.

Four-Wire Indoor and Outdoor Wiring

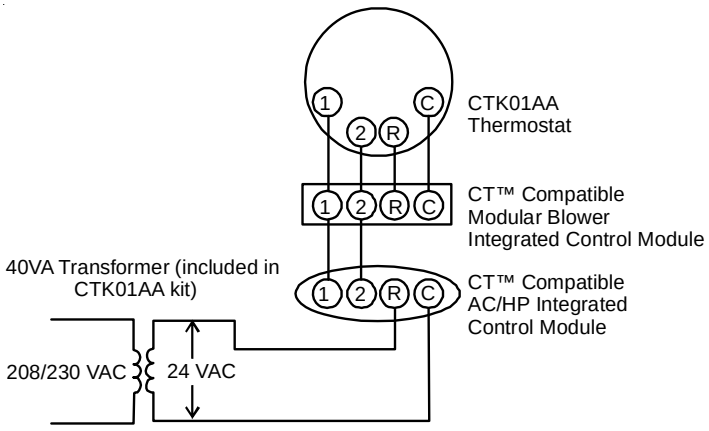
Typical wiring will consist of four wires between the indoor unit and outdoor unit and between the indoor unit and thermostat. The required wires are: (a) data lines, 1 and 2; (b) thermostat "R" (24 VAC hot) and "C" (24 VAC common).



System Wiring Using Four-Wires

Two-Wire Outdoor, Four-Wire Indoor Wiring

Two wires only may be utilized between the indoor and outdoor units. For this wiring scheme, only the data lines, 1 and 2, are required between the indoor and outdoor units. A 40VA, 208/230 VAC to 24 VAC transformer must be installed in the outdoor unit to provide 24 VAC power to the outdoor unit's electronic control. The transformer is included with the CTK01AA kit. See kit instructions for mounting and wiring instructions. Four wires are required between the indoor unit and thermostat.



System Wiring using Two-Wires between Furnace and AC/HP and Four-Wires between Furnace and Thermostat

ComfortNet™ System Advanced Features

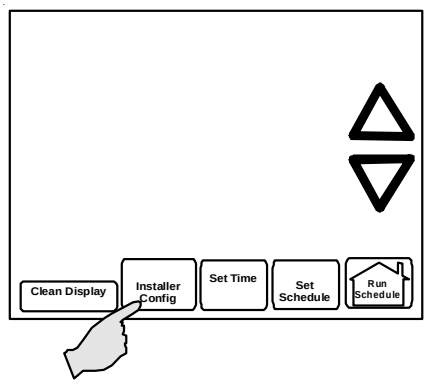
The ComfortNet™ system permits access to additional system information, advanced setup features, and advanced diagnostic/troubleshooting features. These advanced features are organized into a menu structure. The menus are accessed and navigated as described below.

SERVICING

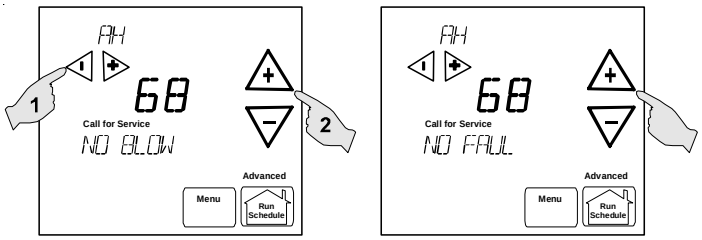
ACCESSING AND NAVIGATING THE ADVANCED FEATURES MENUS

The advanced system features are accessed using the ComfortNet™ thermostat. These advanced features are accessed as follows:

- On the CT™ thermostat Home Screen Display, touch the **Menu** key to display additional key choices.
- Touch and hold the **Installer Config** key for approximately 3 seconds to enter the Thermostat Options Configuration menu.
- Touch and hold the **Installer Config** key again for approximately 3 seconds to enter the Advanced Installer Configuration menu.



Upon entering the advanced menus, the Advanced Fault Menu is displayed. The display will change to the Fault Screen and indicate any faults that may be present in the indoor or outdoor equipment. If a fault is present, the Fault Screen will show the equipment and an error code with a description of the fault. Touch ◁ or ▷ keys to view the fault status of any remaining equipment. The text **"NO FAULTS"** will be scrolled if no errors are present.



Touch the △ or ▽ to step through the list of installed equipment, including the thermostat. Touch the **Installer Config** key to enter the submenus for the equipment displayed. The text **"WORKING"** will be displayed in the scrolling display area while the data is being retrieved. The first sub-menu is then displayed. See tables below for listing of modular blower submenus.

Touch the △ or ▽ to step through the list of submenus and view settings. If a setting can be adjusted, ◁ and ▷ keys will appear. Use the ◁ or ▷ keys to adjust the setting to the desired value. Touch the △ or ▽ to step to the next item. **"WORKING"** will appear as the settings are being updated. **"DONE"** will appear to indicate the change was accepted. If the change is not accepted, the display will show **"FAIL"** then revert to the Fault Screen.

Some parameters being displayed switch between the item name and the item value. Touch the **Hold** key to momentarily stop the display from switching.

To exit an equipment submenu and revert back to the equipment menus, touch the **Menu** key. Touch Menu again to revert back to the Thermostat Options Menu. Touch the **Run Schedule** key to step out of all menus and back to the CT™ thermostat Home Screen Display.

SERVICING

AVPTC and MBVC Advanced User Menus

CONFIGURATION	
Submenu Item	**Indication (for Display Only; not User Modifiable)**
Electric Heat Size (HTR KW)	Displays the size in kW of the selected electric heaters.
Motor HP (1/2, 3/4, or 1 MTR HP)	Displays the modular blower indoor blower motor horsepower.
Heat ON Delay (HT ON)	Displays the electric heat indoor blower ON delay.
Heat OFF Delay (HT OFF)	Displays the electric heat indoor blower OFF delay.

DIAGNOSTICS		
Submenu Item	**Indication/User Modifiable Options**	**Comments**
Fault 1 (FAULT #1)	Most recent fault	For display only
Fault 2 (FAULT #2)	Next most recent fault	For display only
Fault 3 (FAULT #3)	Next most recent fault	For display only
Fault 4 (FAULT #4)	Next most recent fault	For display only
Fault 5 (FAULT #5)	Next most recent fault	For display only
Fault 6 (FAULT #6)	Least recent fault	For display only
Clear Fault History (CLEAR)	NO or YES	Selecting “YES” clears the fault history

NOTE: Consecutively repeated faults are shown a maximum of 3 times

IDENTIFICATION	
Submenu Item	**Indication (for Display Only; not User Modifiable)**
Model Number (MOD NUM)	Displays the modular blower model number
Serial Number (SER NUM)	Displays the modular blower serial number (Optional)
Software (SOFTWARE)	Displays the application software revision

SET-UP		
Submenu Item	**User Modifiable Options**	**Comments**
Heat Airflow Trim (HT TRM)	-10% to +10% in 2% increments, default is 0%	Trims the electric heating airflow by the selected amount.

STATUS	
Submenu Item	**Indication (for Display Only; not User Modifiable)**
Mode (MODE)	Displays the current modular blower operating mode
CFM (CFM)	Displays the airflow for the current operating mode

SERVICING

ASXC/ASZC and DSXC/DSZC Advanced User Menus

CONFIGURATION	
Submenu Item	**Indication (for Display Only; not User Modifiable)**
Number of AC Stages (CL STG)	Displays the number of air conditioning stages; applies to AC and
Number of HP Stages (HT STG)	Displays the number of heat pump stages; applies to HP only.
AC Tonnage (TONS)	Displays the air conditioning tonnage; applies to AC and HP.

DIAGNOSTICS		
Submenu Item	**Indication/User Modifiable Options**	**Comments**
Fault 1 (FAULT #1)	Most recent AC/HP fault	For display only
Fault 2 (FAULT #2)	Next most recent AC/HP fault	For display only
Fault 3 (FAULT #3)	Next most recent AC/HP fault	For display only
Fault 4 (FAULT #4)	Next most recent AC/HP fault	For display only
Fault 5 (FAULT #5)	Next most recent AC/HP fault	For display only
Fault 6 (FAULT #6)	Least recent AC/HP fault	For display only
Clear Fault History (CLEAR)	NO or YES	Selecting “YES” clears the fault history

NOTE: Consecutively repeated faults are shown a maximum of 3 times

IDENTIFICATION	
Submenu Item	**Indication (for Display Only; not User Modifiable)**
Model Number (MOD NUM)	Displays the air conditioner or heat pump model number
Serial Number (SER NUM)	Displays the air conditioner or heat pump serial number (Optional)
Software (SOFTWARE)	Displays the application software revision

SENSORS		
Submenu Item	**User Modifiable Options**	**Comments**
Outdoor Air Temperature (AIR TMP)	Displays the outdoor air temperature	Sensor may or may not be available on an air conditioner. Check air conditioner instructions for details.
Outdoor Coil Temperature (COIL TMP)	Displays the outdoor coil temperature	Required for heat pump operation.

SERVICING

ASXC/ASZC AND DSXC/DSZC ADVANCED USER MENUS, CONT'D

COOL SET-UP		
Submenu Item	**User Modifiable Options**	**Comments**
Cool Airflow Trim (CL TRM)	-10% to +10% in 2% increments, default is 0%	Selects the airflow trim amount; applies to air conditioner only.
Cool Airflow Profile (CL PRFL)	A, B, C, or D, default is A	Selects the airflow profile; applies to air conditioner only.
Cool ON Delay (CL ON)	5, 10, 20, or 30 seconds, default is 5 seconds	Selects the indoor blower ON delay; applies to air conditioner only.
Cool OFF Delay (CL OFF)	30, 60, 90, or 120 seconds, default is 30 seconds	Selects the indoor blower OFF delay; applies to air conditioner only.
Dehumidification Select (DEHUM)	ON or OFF (default is OFF)	Selecting "OFF" disables dehumidification; selecting "ON" enables dehumidification; applies to air conditioner only.

STATUS	
Submenu Item	**Indication (for Display Only; not User Modifiable)**
Mode (MODE)	Displays the current air conditioner operating mode
CFM (CFM)	Displays the airflow for the current operating mode

HEAT SET-UP		
Submenu Item	**User Modifiable Options**	**Comments**
Heat Airflow Trim (HT TRM)	-10% to +10% in 2% increments, default is 0%	Selects the airflow trim amount; applies to heat pump only.
Heat ON Delay (HT ON)	5, 10, or 15 seconds, default is 5 seconds	Selects the indoor blower heat ON delay; applies to heat pump only.
Heat OFF Delay (HT OFF)	30, 50, 70, or 90 seconds, default is 30 seconds	Selects the indoor blower heat OFF delay; applies to heat pump only.
Defrost Interval (DEFROST)	30, 60, 90, or 120 minutes, default is 30 minutes.	Selects the time interval between defrosts; applies to heat pump only.
Compressor Delay (CMP DLY)	0, 5, 15, or 30 seconds, default is 5 seconds	Selects the compressor off time after a reversing valve shift; applies to heat pump only.

SERVICING

S-4 CHECKING TRANSFORMER AND CONTROL CIRCUIT

WARNING

HIGH VOLTAGE!
Disconnect ALL power before servicing or installing. Multiple power sources may be present. Failure to do so may cause property damage, personal injury or death.



A step-down transformer (208/240 volt primary to 24 volt secondary) is provided with each indoor unit. This allows ample capacity for use with resistance heaters. The outdoor sections do not contain a transformer (see note below).

NOTE: ComfortNet™ ready condensing units may have an optional 240VAC to 24VAC transformer installed. This transformer provides 24VAC power to the unitary (UC) control in some communicating system installation scenarios.

WARNING

Disconnect ALL power before servicing.

1. Remove control panel cover, or etc., to gain access to transformer.

With power ON:

WARNING

Line Voltage now present.

2. Using a voltmeter, check voltage across secondary voltage side of transformer (R to C).
3. No voltage indicates faulty transformer, bad wiring, or bad splices.
4. Check transformer primary voltage at incoming line voltage connections and/or splices.
5 If line voltage available at primary voltage side of transformer and wiring and splices good, transformer is inoperative. Replace.

S-5 CHECKING CYCLE PROTECTOR

Some models feature a solid state, delay-on make after break time delay relay installed in the low voltage circuit. This control is used to prevent short cycling of the compressor under certain operating conditions.

The component is normally closed (R_1 to Y_1). A power interruption will break circuit (R_1 to Y_1) for approximately three minutes before resetting.

1. Remove wire from Y_1 terminal.
2. Wait for approximately four (4) minutes if machine was running.

With power ON:

WARNING

Line Voltage now present.

1. Apply 24 VAC to terminals R_1 and R_2.
2. Should read 24 VAC at terminals Y_1 and Y_2.
3. Remove 24 VAC at terminals R_1 and R_2.
4. Should read 0 VAC at Y_1 and Y_2.
5. Reapply 24 VAC to R1 and R2 - within approximately three (3) to four (4) minutes should read 24 VAC at Y_1 and Y_2.

If not as above - replace relay.

S-6 CHECKING TIME DELAY RELAY

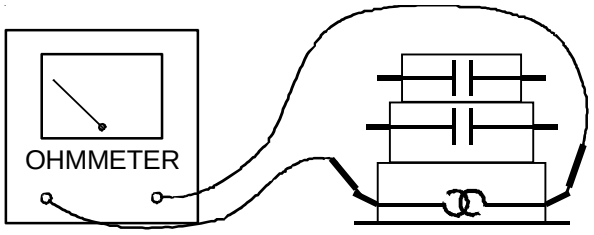
Time delay relays are used in some of the blower cabinets to improve efficiency by delaying the blower off time. Time delays are also used in electric heaters to sequence in multiple electric heaters.

WARNING

Disconnect ALL power before servicing.

1. Tag and disconnect all wires from male spade connections of relay.
2. Using an ohmmeter, measure the resistance across terminals H1 and H2. Should read approximately 150 ohms.
3. Using an ohmmeter, check for continuity across terminals 3 and 1, and 4 and 5.
4. Apply 24 volts to terminals H1 and H2. Check for continuity across other terminals - should test continuous. If not as above - replace.

NOTE: The time delay for the contacts to make will be approximately 20 to 50 seconds and to open after the coil is de-energized is approximately 40 to 90 seconds.



TESTING COIL CIRCUIT

SERVICING

S-7 CHECKING CONTACTOR AND/OR RELAYS

WARNING

HIGH VOLTAGE!
Disconnect ALL power before servicing or installing. Multiple power sources may be present. Failure to do so may cause property damage, personal injury or death.

The compressor contactor and other relay holding coils are wired into the low or line voltage circuits. When the control circuit is energized, the coil pulls in the normally open contacts or opens the normally closed contacts. When the coil is de-energized, springs return the contacts to their normal position.

NOTE*: Most single phase contactors break only one side of the line (L1), leaving 115 volts to ground present at most internal components.*

NOTE: *The compressor contactor/relay in ComfortNet™ ready equipment is fully integrated into the unitary (UC) control. The compressor contactor/relay coil on the UC control is non-serviceable.*

1. Remove the leads from the holding coil.
2. Using an ohmmeter, test across the coil terminals.

If the coil does not test continuous, replace the relay or contactor.

S-8 CHECKING CONTACTOR CONTACTS

WARNING

Disconnect ALL power before servicing.

***SINGLE PHASE*:**

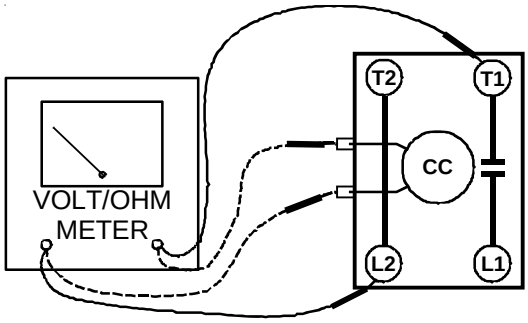
1. Disconnect the wire leads from the terminal (T) side of the contactor.
2. With power ON, energize the contactor.

WARNING

Line Voltage now present.

3. Using a voltmeter, test across terminals.
   A. L2 - T1 - No voltage indicates CC1 contacts open.

If a no voltage reading is obtained - replace the contactor.



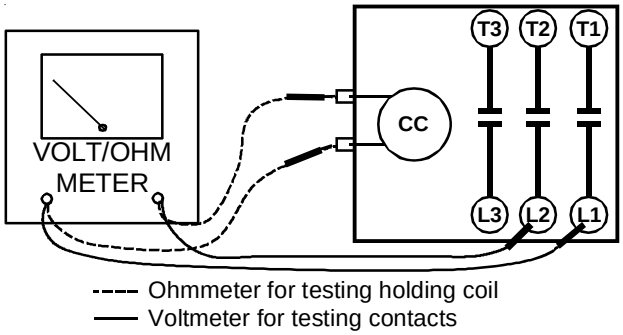
TESTING COMPRESSOR CONTACTOR
(Single Phase)

THREE PHASE

Using a voltmeter, test across terminals:

A. L1-L2, L1-L3, and L2-L3 - If voltage is present, proceed to B. If voltage is not present, check breaker or fuses on main power supply..

B. T1-T2, T1-T3, and T2-T3 - If voltage readings are not the same as in "A", replace contactor.



TESTING COMPRESSOR CONTACTOR
(Three-phase)

S-8A CHECKING UNITARY (UC) CONTROL COMPRESSOR CONTACTOR/RELAY CONTACTS

WARNING

Disconnect ALL power before servicing.

1. Connect voltmeter to lugs (L2) and (C).
2. With power ON, provide a call for cool or heat pump to energize the on-board compressor contactor/relay.

WARNING

Line Voltage now present.

3. Measure voltage across on-board compressor contactor/ relay contacts.

A. No voltage indicates the contacts are closed and the contactor/relay is functioning properly.

B. A reading of approximately half of the supply voltage (example: 115VAC for 230VAC) indicates the relay is open. Replace UC control if relay does not close.

NOTE: The unitary (UC) control has a built-in short cycle delay. Ensure short cycle delay has elapsed before making voltage measurements.

S-9 CHECKING FAN RELAY CONTACTS

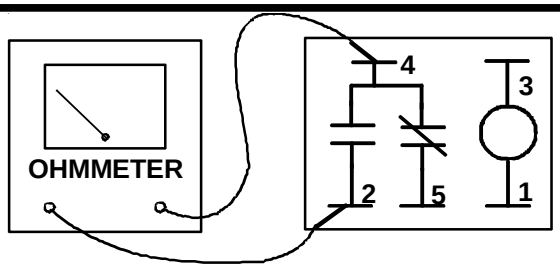
WARNING

HIGH VOLTAGE!
Disconnect ALL power before servicing or installing. Multiple power sources may be present. Failure to do so may cause property damage, personal injury or death.

1. Disconnect wire leads from terminals 2 and 4 of Fan Relay Cooling and 2 and 4, 5 and 6 of Fan Relay Heating.
2. Using an ohmmeter, test between 2 and 4 - should read open. Test between 5 and 6 - should read continuous.
3. With power ON, energize the relays.

WARNING

Line Voltage now present.



TESTING FAN RELAY

4. Using an ohmmeter, test between 2 and 4 - should read continuous . Test between 5 and 6 - should read open.
5. If not as above, replace the relay.

FAN RELAY CONTACTS - UNITARY (UC) CONTROL

Applies to ASXC/ASZC and DSXC/DSZC Models

Condenser fan control for the ASXC/ASZC and DSXC/DSZC models is fully integrated into the UC control. The control supports one- or two-speed PSC condenser fan motors and one- or two-speed ECM condenser fan motors.

The fan motor is controlled by two on-board relays. Connection to the fan motor is via a 6-circuit plug connector. Wiring to the connector is dependant upon the type of condenser fan motor used. See unit wiring diagram for details.

CHECKING RELAY CONTACTS - PSC FAN MOTOR

WARNING

HIGH VOLTAGE!
Disconnect ALL power before servicing or installing. Multiple power sources may be present. Failure to do so may cause property damage, personal injury or death.

1. Disconnect the motor leads from 6-circuit fan motor wire harness.
2. Connect a voltmeter between circuit 3 and circuits 2 (low speed) or 1 (high speed).

NOTE: Circuit 3 is connected directly to L2.

3. Energize the system at low or high stage.

WARNING

Line Voltage now present.

4. The measured voltage between circuit 3 and circuits 2 or 1 should be approximately 0VAC, which indicates the relay contacts are closed. A voltage measurement of approximately 115VAC indicates the relay is open. Replace the control if the relay checks open when it should be closed. See notes and cautions below.

NOTE: Ensure any ON delays have expired before making voltage measurements

CAUTION: Prolonged operation with the condenser fan motor disconnected will the high pressure switch to trip.

CHECKING RELAY CONTACTS - ECM FAN MOTOR

WARNING

HIGH VOLTAGE!
Disconnect ALL power before servicing or installing. Multiple power sources may be present. Failure to do so may cause property damage, personal injury or death.

1. Disconnect the motor leads from 6-circuit fan motor wire harness.
2. Connect a voltmeter between circuit 6 and circuits 3 (low speed) or 1 (high speed).

NOTE: Circuit 6 is connected directly to 24VAC.

3. Energize the system at low or high stage.

SERVICING

DIAGNOSTICS TABLE

Status LED	Status LED Description	Status LED Troubleshooting Information
Green "POWER"	**Module has power**	Supply voltage is present at module terminals
Red "TRIP"	Thermostat demand signal Y1 is present, but the compressor is not running	1. Compressor protector is open 2. Outdoor unit power disconnect is open 3. Compressor circuit breaker or fuse(s) is open 4. Broken wire or connector is not making contact 5. Low pressure switch open if present in system 6. Compressor contactor has failed open
Yellow "ALERT" **Flash Code 1**	**Long Run Time** Compressor is running extremely long run cycles	1. Low refrigerant charge 2. Evaporator blower is not running 3. Evaporator coil is frozen 4. Faulty metering device 5. Condenser coil is dirty 6. Liquid line restriction (filter drier blocked if present in system) 7. Thermostat is malfunctioning
Yellow "ALERT" **Flash Code 2**	**System Pressure Trip** Discharge or suction pressure out of limits or compressor overloaded	1. High head pressure 2. Condenser coil poor air circulation (dirty, blocked, damaged) 3. Condenser fan is not running 4. Return air duct has substantial leakage 5. If low pressure switch present in system, check Flash Code 1 information
Yellow "ALERT" **Flash Code 3**	**Short Cycling** Compressor is running only briefly	1. Thermostat demand signal is intermittent 2. Time delay relay or control board defective 3. If high pressure switch present go to Flash Code 2 information 4. If low pressure switch present go to Flash Code 1 information
Yellow "ALERT" **Flash Code 4**	**Locked Rotor**	1. Run capacitor has failed 2. Low line voltage (contact utility if voltage at disconnect is low) 3. Excessive liquid refrigerant in compressor 4. Compressor bearings are seized
Yellow "ALERT" **Flash Code 5**	**Open Circuit**	1. Outdoor unit power disconnect is open 2. Compressor circuit breaker or fuse(s) is open 3. Compressor contactor has failed open 4. High pressure switch is open and requires manual reset 5. Open circuit in compressor supply wiring or connections 6. Unusually long compressor protector reset time due to extreme ambient temperature 7. Compressor windings are damaged
Yellow "ALERT" **Flash Code 6**	**Open Start Circuit** Current only in run circuit	1. Run capacitor has failed 2. Open circuit in compressor start wiring or connections 3. Compressor start winding is damaged
Yellow "ALERT" **Flash Code 7**	**Open Run Circuit** Current only in start circuit	1. Open circuit in compressor run wiring or connections 2. Compressor run winding is damaged
Yellow "ALERT" **Flash Code 8**	**Welded Contactor** Compressor always runs	1. Compressor contactor has failed closed 2. Thermostat demand signal not connected to module
Yellow "ALERT" **Flash Code 9**	**Low Voltage** Control circuit < 17VAC	1. Control circuit transformer is overloaded 2. Low line voltage (contact utility if voltage at disconnect is low)

- Flash Code number corresponds to a number of LED flashes, followed by a pause and then repeated
- TRIP and ALERT LEDs flashing at same time means control circuit voltage is too low for operation.
- Reset ALERT Flash code by removing 24VAC power from module
- Last ALERT Flash code is displayed for 1 minute after module is powered on.

SERVICING

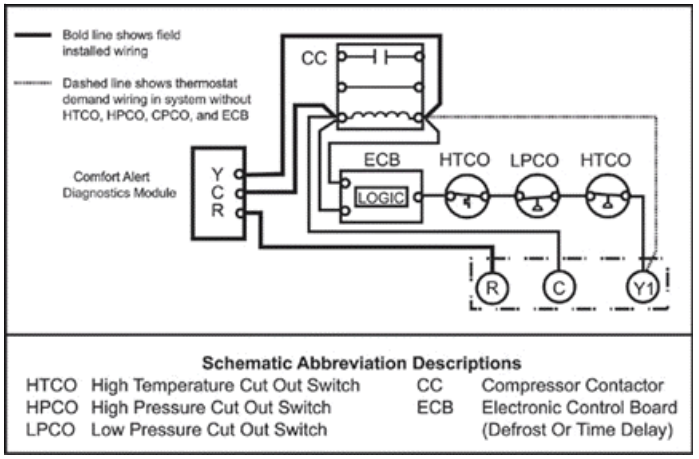
WARNING

Line Voltage now present.

4. The measured voltage between circuit 6 and circuits 3 or 1 should be approximately 0VAC, which indicates the relay contacts are closed. A voltage measurement of approximately 24VAC indicates the relay is open. Replace the control if the relay checks open when it should be closed. See notes and cautions below.
5. Circuit 5 is connected to 24VAC common. The measured voltage between circuits 6 and 5 should be 24VAC.

NOTE: Ensure any ON delays have expired before making voltage measurements

CAUTION: Prolonged operation with the condenser fan motor disconnected will the high pressure switch to trip.



Schematic Abbreviation Descriptions

HTCO	High Temperature Cut Out Switch	CC	Compressor Contactor
HPCO	High Pressure Cut Out Switch	ECB	Electronic Control Board
LPCO	Low Pressure Cut Out Switch		(Defrost Or Time Delay)

S-10 COPELAND COMFORT ALERT™

DIAGNOSTICS

Applies to ASX /ASZ and DSX/DSZ units

WARNING

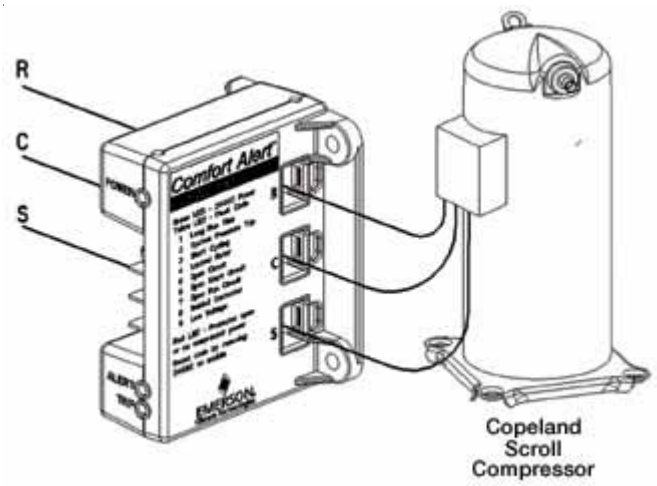
HIGH VOLTAGE
Disconnect ALL power before servicing or installing this unit. Multiple power sources may be present. Failure to do so may cause property damage, personal injury or death.



Comfort Alert™ is self-contained with no required external sensors and is designed to install directly into the electrical box of any residential condensing unit that has a Copeland Scroll™ compressor inside.

Once attached, Comfort Alert™ provides around-the-clock monitoring for common electrical problems, compressor defects and broad system faults. If a glitch is detected, an LED indicator flashes the proper alert codes to help you quickly pinpoint the problem. *See Diagnostic Table on following page.)*





SERVICING

COPELAND COMFORT ALERT™ - UNITARY (UC) CONTROL DIAGNOSTICS

Applies to ASXC, ASZC, DSXC, and DSZC models

WARNING

HIGH VOLTAGE!
Disconnect ALL power before servicing or installing. Multiple power sources may be present. Failure to do so may cause property damage, personal injury or death.



The Copeland Comfort Alert™ diagnostics are fully integrated into the unitary (UC) control. The UC control and integraged Comfort Alert™ diagnostics provide around-the-clock monitoring for common electrical problems, compressor defects and broad system faults. If a problem is detected, LED indicators flash the proper alert codes to help you quickly pinpoint the problem.

The diagnostic tables on following pages provide detailed information regarding the system symptons, indicators (LED and thermostat), potential problem(s), and corrective actions. The diagnostic information applies to systems wired as 24VAC traditional (legacy) systems and systems wired as communicating systems with the CTK01AA communicating thermostat.

Symptoms of Abnormal Operation (Legacy & ComfortNet™ Thermostat)	Diagnostic/Status LED Codes				Fault Description	ComfortNet™ Thermostat Only		Possible Causes	Corrective Actions	Notes & Cautions
	Green	Yellow	Red	Red Y1		Message	Code			
• Very long run time. • Four consecutive compressor protector trips with average run time between trips greater than 3 hours. • Compressor operating at high speed and outdoor fan operating at low speed • Integrated control module diagnostic/status LED's display the indicated code.	OFF	1 Flash	OFF	ON if call present; OFF if no call	• Low Side Fault.	*LOW SIDE FAULT*	*01*	• Low refrigerant charge. • Restriction in liquid line. • Indoor blower motor failure. • Indoor thermostat set extremely low.	• Verify refrigerant charge; adjust as needed. • Check for restricted liquid line; repair/replace as needed. • Check indoor blower motor; repair/replace as needed. • Check indoor thermostat setting.	• Turn power OFF prior to repair. • Fault will clear after 30 consecutive normal cycles. • Fault may be cleared by cycling 24VAC to control. • Replace with correct replacement part(s).
• Compressor and outdoor fan are off. • Thermostat demand is present. • Integrated control module diagnostic/status LED's display the indicated code.	ON	1 Flash	OFF	ON if call present; OFF if no call	• Low Pressure CO Trip.	*LPS OPEN*	*01*	• Low refrigerant charge. • Restriction in liquid line. • Indoor blower motor failure. • Indoor thermostat set extremely low.	• Verify refrigerant charge; adjust as needed. • Check for restricted liquid line; repair/replace as needed. • Check indoor blower motor; repair/replace as needed. • Check low pressure switch; repair/replace as needed. • Check indoor thermostat setting.	• Turn power OFF prior to repair. • Replace with correct replacement part(s).
• Compressor and outdoor fan are off. • Low pressure switch trip 3 times within same thermostat demand. • Thermostat demand is present. • Integrated control module diagnostic/status LED's display the indicated code. • ComfortNet™ thermostat "Call for Service" icon illuminated. • ComfortNet™ thermostat scrolls "Check Air Conditioner" or "Check Heat Pump" message.	ON	1 Flash	ON	ON if call present; OFF if no call	• LPCO Lockout (3 Trips).	*LPS LOCKOUT*	*01*	• Low refrigerant charge. • Restriction in liquid line. • Indoor blower motor failure. • Indoor thermostat set extremely low.	• Verify refrigerant charge; adjust as needed. • Check for restricted liquid line; repair/replace as needed. • Check indoor blower motor; repair/replace as needed. • Check low pressure switch; repair/replace as needed. • Check indoor thermostat setting.	• Turn power OFF prior to repair. • Must clear fault by cycling 24VAC to control. • Replace with correct replacement part(s).

Symptoms of Abnormal Operation (Legacy & ComfortNet™ Thermostat)	Diagnostic/Status LED Codes				Fault Description	ComfortNet™ Thermostat Only		Possible Causes	Corrective Actions	Notes & Cautions
	Green	Yellow	Red	Red Y1		Message	Code			
• Four consecutive compressor protector trips with average run time between trips greater than 1 minute and less than 15 minutes. • Low pressure and high pressure switches are closed. • Integrated control module diagnostic/status LED's display the indicated code.	OFF	2 Flashes	OFF	ON if call present; OFF if no call	• High Side Fault	*HIGH SIDE FAULT*	*02*	• Blocked condenser coil. • Outdoor fan not running.	• Check and clean condenser coil. • Check outdoor fan motor; repair/replace as needed. • Check outdoor fan motor wiring; repair/replace as needed. • Check outdoor fan motor capacitor; replace as needed.	• Turn power OFF prior to repair. • Fault will clear after 4 consecutive normal cycles. • Fault may be cleared by cycling 24VAC to control. • Replace with correct replacement part(s).
• Compressor and outdoor fan are off. • Thermostat demand is present. • Integrated control module diagnostic/status LED's display the indicated code.	ON	2 Flashes	OFF	ON if call present; OFF if no call	• High Pressure CO Trip	*HPS OPEN*	*02*	• Blocked condenser coil. • Outdoor fan not running.	• Check and clean condenser coil. • Check outdoor fan motor; repair/replace as needed. • Check outdoor fan motor wiring; repair/replace as needed. • Check outdoor fan motor capacitor; replace as needed.	• Turn power OFF prior to repair. • Replace with correct replacement part(s).
• Compressor and outdoor fan are off. • Low pressure switch trip 3 times within same thermostat demand. • Thermostat demand is present. • Integrated control module diagnostic/status LED's display the indicated code. • ComfortNet™ thermostat "Call for Service" icon illuminated. • ComfortNet™ thermostat scrolls "Check Air Conditioner" or "Check Heat Pump" message.	ON	2 Flashes	ON	ON if call present; OFF if no call	• HPCO Lockout (3 Trips)	*HPS LOCKOUT*	*02*	• Blocked condenser coil. • Outdoor fan not running.	• Check and clean condenser coil. • Check outdoor fan motor; repair/replace as needed. • Check outdoor fan motor wiring; repair/replace as needed. • Check outdoor fan motor capacitor; replace as needed.	• Turn power OFF prior to repair. • Must clear fault by cycling 24VAC to control. • Replace with correct replacement part(s).
• Run time for last 4 cycles is less than 3 minutes each. • Compressor protector has not tripped. • Low pressure and high pressure switches are closed. • Integrated control module diagnostic/status LED's display the indicated code.	OFF	3 Flashes	OFF	ON if call present; OFF if no call	• Short Cycling	*CMPR SHRT CYCLE*	*03*	• Intermittent thermostat demand. • Faulty compressor relay.	• Check thermostat and thermostat wiring; repair/replace as needed. • Check compressor relay operation; replace control as needed.	• Turn power OFF prior to repair. • Fault will clear after 4 consecutive normal cycles. • Fault may be cleared by cycling 24VAC to control. • Replace with correct replacement part(s).

Symptoms of Abnormal Operation (Legacy & ComfortNet™ Thermostat)	Diagnostic/Status LED Codes				Fault Description	ComfortNet™ Thermostat Only		Possible Causes	Corrective Actions	Notes & Cautions
	Green	Yellow	Red	Red Y1		Message	Code			
• Compressor and outdoor fan are off. • Compressor protector trips four consecutive times. • Average run time between trips is less than 15 seconds. • Integrated control module diagnostic/status LED's display the indicated code. • ComfortNet™ thermostat "Call for Service" icon illuminated. • ComfortNet™ thermostat scrolls "Check Air Conditioner" or "Check Heat Pump" message.	OFF	4 Flashes	ON	ON if call present; OFF if no call	• Locked Rotor	*LOCKED ROTOR*	*04*	• Compressor bearings are seized. • Failed compressor run capacitor. • Faulty run capacitor wiring. • Low line voltage.	• Check compressor operation; repair/replace as needed. • Check run capacitor; replace as needed. • Check wiring; repair/replace as needed. • Verify line voltage is within range on rating plate; contact local utility is out of range.	• Turn power OFF prior to repair. • Must clear fault by cycling 24VAC to control. • Replace with correct replacement part(s).
• Compressor and outdoor fan are off for greater than 4 hours. • Low pressure and high pressure switches are closed. • Integrated control module diagnostic/status LED's display the indicated code. • ComfortNet™ thermostat "Call for Service" icon illuminated. • ComfortNet™ thermostat scrolls "Check Air Conditioner" or "Check Heat Pump" message.	OFF	5 Flashes	OFF	ON if call present; OFF if no call	• Open Circuit	*OPEN CIRCUIT*	*05*	• Power is disconnected. • Failed compressor protector. • Compressor not properly wired to control.	• Check circuit breakers and fuses. • Check wiring to unit; repair/replace as needed. • Check compressor; repair/replace as needed. • Check compressor wiring; repair/replace as needed.	• Turn power OFF prior to repair. • Fault will clear after 1 normal cycle. • Fault may be cleared by cycling 24VAC to control. • Replace with correct replacement part(s).
• Compressor and outdoor fan are off. • Low pressure and high pressure switches are closed. • Integrated control module diagnostic/status LED's display the indicated code. • ComfortNet™ thermostat "Call for Service" icon illuminated. • ComfortNet™ thermostat scrolls "Check Air Conditioner" or "Check Heat Pump" message.	OFF	6 Flashes	OFF	ON if call present; OFF if no call	• Open Start Circuit	*OPEN START*	*06*	• Compressor start winding is open. • Failed compressor run capacitor. • Faulty run capacitor wiring. • Compressor not properly wired to control. • Faulty compressor wiring.	• Check compressor; repair/replace as needed. • Check run capacitor; replace as needed. • Check wiring; repair/replace as needed.	• Turn power OFF prior to repair. • Fault will clear after 1 normal cycle. • Fault may be cleared by cycling 24VAC to control. • Replace with correct replacement part(s).
• Compressor and outdoor fan are off. • Low pressure and high pressure switches are closed. • Open start circuit has been detected 4 times with 5 minute delay between each detection. • Integrated control module diagnostic/status LED's display the indicated code. • ComfortNet™ thermostat "Call for Service" icon illuminated. • ComfortNet™ thermostat scrolls "Check Air Conditioner" or "Check Heat Pump" message.	OFF	6 Flashes	ON	ON if call present; OFF if no call	• Open Start Circuit Lockout	*OPEN START LOCK*	*06*	• Compressor start winding is open. • Failed compressor run capacitor. • Faulty run capacitor wiring. • Compressor not properly wired to control. • Faulty compressor wiring.	• Check compressor; repair/replace as needed. • Check run capacitor; replace as needed. • Check wiring; repair/replace as needed.	• Turn power OFF prior to repair. • Must clear fault by cycling 24VAC to control. • Replace with correct replacement part(s).

Symptoms of Abnormal Operation (Legacy & ComfortNet™ Thermostat)	Diagnostic/Status LED Codes				Fault Description	ComfortNet™ Thermostat Only		Possible Causes	Corrective Actions	Notes & Cautions
	Green	Yellow	Red	Red Y1		Message	Code			
• Compressor and outdoor fan are off. • Low pressure and high pressure switches are closed. • Integrated control module diagnostic/status LED's display the indicated code. • ComfortNet™ thermostat "Call for Service" icon illuminated. • ComfortNet™ thermostat scrolls "Check Air Conditioner" or "Check Heat Pump" message.	OFF	7 Flashes	OFF	ON if call present; OFF if no call	• Open Run Circuit	*OPEN RUN*	*07*	• Compressor run winding is open. • Compressor not properly wired to control. • Faulty compressor wiring.	• Check compressor; repair/replace as needed. • Check wiring; repair/replace as needed.	• Turn power OFF prior to repair. • Fault will clear after 1 normal cycle. • Fault may be cleared by cycling 24VAC to control. • Replace with correct replacement part(s).
• Compressor and outdoor fan are off. • Low pressure and high pressure switches are closed. • Open run circuit has been detected 4 times with 5 minute delay between each detection. • Integrated control module diagnostic/status LED's display the indicated code. • ComfortNet™ thermostat "Call for Service" icon illuminated. • ComfortNet™ thermostat scrolls "Check Air Conditioner" or "Check Heat Pump" message.	OFF	7 Flashes	ON	ON if call present; OFF if no call	• Open Run Circuit Lockout	*OPEN RUN LOCK*	*07*	• Compressor run winding is open. • Compressor not properly wired to control. • Faulty compressor wiring.	• Check compressor; repair/replace as needed. • Check wiring; repair/replace as needed.	• Turn power OFF prior to repair. • Must clear fault by cycling 24VAC to control. • Replace with correct replacement part(s).
• Air conditioner/heat pump may appear to be operating normally. • Compressor protector may be open (compressor and outdoor fan off). • Integrated control module diagnostic/status LED's display the indicated code.	OFF	8 Flashes	OFF	ON if call present; OFF if no call	• Low Line Voltage	*LOW LINE VOLT*	*08*	• Low line voltage.	• Check circuit breakers and fuses. • Verify unit is connected to power supply as specified on rating plate. • Correct low line voltage condition; contact local utility if needed.	• Turn power OFF prior to repair. • Control detects line voltage less than 185 VAC.
• Air conditioner/heat pump may appear to be operating normally. • Compressor protector may be open (compressor and outdoor fan off). • Integrated control module diagnostic/status LED's display the indicated code.	ON	8 Flashes	OFF	ON if call present; OFF if no call	• High Line Voltage	*HIGH LINE VOLT*	*08*	• High line voltage.	• Correct high line voltage condition; contact local utility if needed. • Verify unit is connected to power supply as specified on rating plate. • Correct low line voltage condition; contact local utility if needed.	• Turn power OFF prior to repair. • Control detects line voltage greater than 255 VAC.

Symptoms of Abnormal Operation (Legacy & ComfortNet™ Thermostat)	Diagnostic/Status LED Codes				Fault Description	ComfortNet™ Thermostat Only		Possible Causes	Corrective Actions	Notes & Cautions
	Green	Yellow	Red	Red Y1		Message	Code			
• Air conditioner/heat pump may appear to be operating normally. • Integrated control module diagnostic/status LED's display the indicated code.	OFF	9 Flashes	OFF	ON if call present; OFF if no call	• Low Pilot Voltage	*LOW SECOND VOLT*	*09*	• Control detects secondary voltage less than 18 VAC. • Transformer overloaded. • Low line voltage.	• Check fuse. • Correct low secondary voltage condition. • Check transformer; replace if needed.	• Turn power OFF prior to repair. • Fault will clear if secondary voltage rises above 21VAC. • Replace with correct replacement part(s).
• Compressor is off. • Integrated control module diagnostic/status LED's display the indicated code.	OFF	ON	ON	ON if call present; OFF if no call	• Comp Protector Open	Not displayed	Not displayed	• No current through run or start windings. • Compressor run winding is open. • Compressor not properly wired to control. • Faulty compressor wiring. • Failed compressor run capacitor. • Faulty run capacitor wiring.	• Check compressor; repair/replace as needed. • Check wiring; repair/replace as needed. • Check run capacitor; replace as needed.	• Turn power OFF prior to repair. • Fault will clear after 1 normal cycle. • Fault may be cleared by cycling 24VAC to control. • Replace with correct replacement part(s).

SERVICING

S-11 CHECKING LOSS OF CHARGE PROTECTOR

(Heat Pump Models)

The loss of charge protector senses the pressure in the liquid line and will open its contacts on a drop in pressure. The low pressure control will automatically reset itself with a rise in pressure.

The low pressure control is designed to cut-out (open) at approximately 21 PSIG. It will automatically cut-in (close) at approximately 50 PSIG. Test for continuity using a VOM and if not as above, replace the control.

S-12 CHECKING HIGH PRESSURE CONTROL

WARNING

HIGH VOLTAGE!
Disconnect ALL power before servicing or installing. Multiple power sources may be present. Failure to do so may cause property damage, personal injury or death.



The high pressure control capillary senses the pressure in the compressor discharge line. If abnormally high condensing pressures develop, the contacts of the control open, breaking the control circuit before the compressor motor overloads. This control is automatically reset.

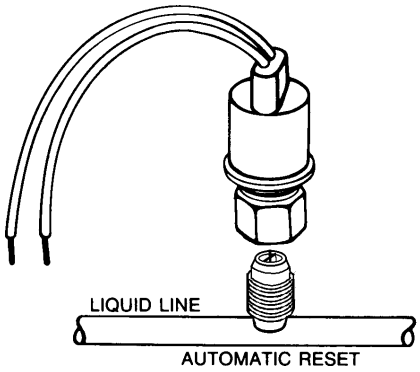
1. Using an ohmmeter, check across terminals of high pressure control, with wire removed. If not continuous, the contacts are open.
3. Attach a gauge to the dill valve port on the base valve.

With power ON:

WARNING

Line Voltage now present.

4. Start the system and place a piece of cardboard in front of the condenser coil, raising the condensing pressure.
5. Check pressure at which the high pressure control cuts-out.



If it cuts-out at 610 PSIG ± 10 PSIG, it is operating normally (See causes for high head pressure in Service Problem Analysis Guide). If it cuts out below this pressure range, replace the control.

S-13 CHECKING LOW PRESSURE CONTROL

The low pressure control senses the pressure in the suction line and will open its contacts on a drop in pressure. The low pressure control will automatically reset itself with a rise in pressure.

The low pressure control is designed to cut-out (open) at approximately 21 PSIG. It will automatically cut-in (close) at approximately 50 PSIG.

Test for continuity using a VOM and if not as above, replace the control.

S-15 CHECKING CAPACITOR

CAPACITOR, RUN

A run capacitor is wired across the auxiliary and main windings of a single phase permanent split capacitor motor. The capacitors primary function is to reduce the line current while greatly improving the torque characteristics of a motor. This is accomplished by using the 90° phase relationship between the capacitor current and voltage in conjunction with the motor windings, so that the motor will give two phase operation when connected to a single phase circuit. The capacitor also reduces the line current to the motor by improving the power factor.

The line side of this capacitor is marked with "COM" and is wired to the line side of the circuit.

CAPACITOR, START

SCROLL COMPRESSOR MODELS

In most cases hard start components are not required on Scroll compressor equipped units due to a non-replaceable check valve located in the discharge line of the compressor. However, in installations that encounter low lock rotor voltage, a hard start kit can improve starting characteristics and reduce light dimming within the home. Only hard start kits approved by Amana® brand or Copeland should be used. "Kick Start" and/or "Super Boost" kits are not approved start assist devices.

The discharge check valve closes off high side pressure to the compressor after shut down allowing equalization through the scroll flanks. Equalization requires only about ½ second.

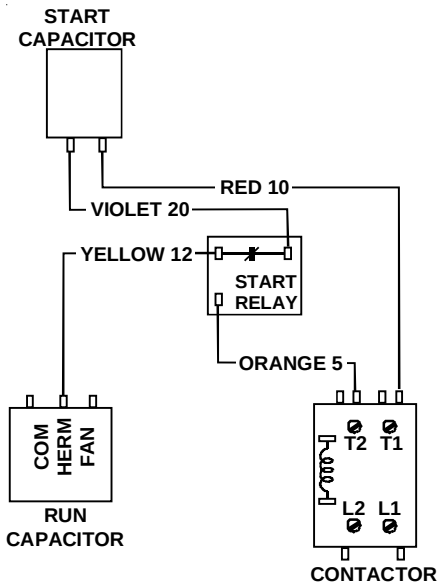
To prevent the compressor from short cycling, a Time Delay Relay (Cycle Protector) has been added to the low voltage circuit.

RELAY, START

A potential or voltage type relay is used to take the start

capacitor out of the circuit once the motor comes up to speed. This type of relay is position sensitive. The normally closed contacts are wired in series with the start capacitor and the relay holding coil is wired parallel with the start winding. As the motor starts and comes up to speed, the increase in voltage across the start winding will energize the start relay holding coil and open the contacts to the start capacitor.

Two quick ways to test a capacitor are a resistance and a capacitance check.



HARD START KIT WIRING

S-15A RESISTANCE CHECK

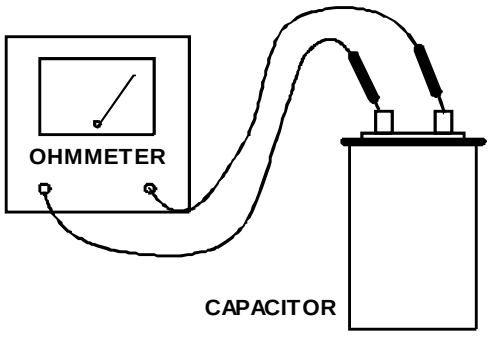
WARNING

HIGH VOLTAGE!
Disconnect ALL power before servicing or installing. Multiple power sources may be present. Failure to do so may cause property damage, personal injury or death.

1. Discharge capacitor and remove wire leads.

WARNING

Discharge capacitor through a 20 to 30 OHM resistor before handling.



TESTING CAPACITOR RESISTANCE

2. Set an ohmmeter on its highest ohm scale and connect the leads to the capacitor -

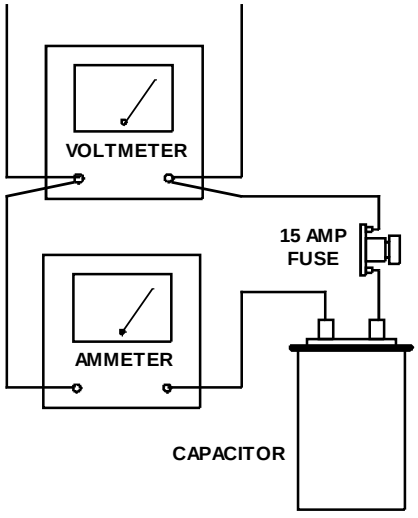
   A. Good Condition - indicator swings to zero and slowly returns to infinity. (Start capacitor with bleed resistor will not return to infinity. It will still read the resistance of the resistor).

   B. Shorted - indicator swings to zero and stops there - replace.

   C. Open - no reading - replace. (Start capacitor would read resistor resistance.)

S-15B CAPACITANCE CHECK

Using a hookup as shown below, take the amperage and voltage readings and use them in the formula:



TESTING CAPACITANCE

WARNING

Discharge capacitor through a 20 to 30 OHM resistor before handling.

$$\textit{Capacitance (MFD)} = \frac{2650 \times \textit{Amperage}}{\text{Voltage}}$$

SERVICING

S-16A CHECKING FAN AND BLOWER MOTOR WINDINGS (PSC MOTORS)

The auto reset fan motor overload is designed to protect the motor against high temperature and high amperage conditions by breaking the common circuit within the motor, similar to the compressor internal overload. However, heat generated within the motor is faster to dissipate than the compressor, allow at least 45 minutes for the overload to reset, then retest.

WARNING

HIGH VOLTAGE!
Disconnect ALL power before servicing or installing. Multiple power sources may be present. Failure to do so may cause property damage, personal injury or death.



1. Remove the motor leads from its respective connection points and capacitor (if applicable).
2. Check the continuity between each of the motor leads.
3. Touch one probe of the ohmmeter to the motor frame (ground) and the other probe in turn to each lead.

If the windings do not test continuous or a reading is obtained from lead to ground, replace the motor.

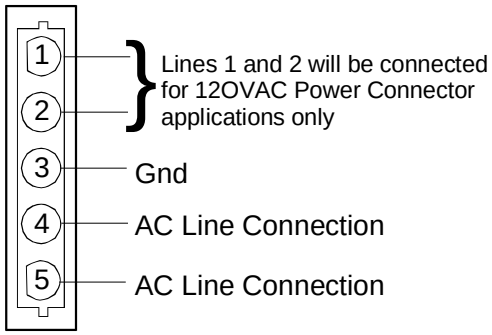
S-16B CHECKING FAN AND BLOWER MOTOR (ECM MOTORS)

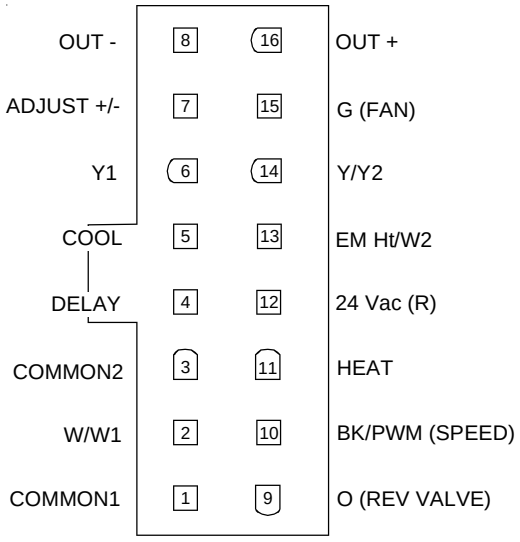
An ECM is an *Electronically Commutated Motor* which offers many significant advantages over PSC motors. The ECM has near zero rotor loss, synchronous machine operation, variable speed, low noise, and programmable air flow. Because of the sophisticated electronics within the ECM motor, some technicians are intimated by the ECM motor; however, these fears are unfounded. GE offers two ECM motor testers, and with a VOM meter, one can easily perform basic troubleshooting on ECM motors. An ECM motor requires power (line voltage) and a signal (24 volts) to operate. The ECM motor stator contains permanent magnet. As a result, the shaft feels "rough" when turned by hand. This is a characteristic of the motor, not an indication of defective bearings.

WARNING

Line Voltage now present.

1. Disconnect the 5-pin connector from the motor.
2. Using a volt meter, check for line voltage at terminals #4 & #5 at the power connector. If no voltage is present:
3. Check the unit for incoming power See section S-1.
4. Check the control board, See section S-40.
5. If line voltage is present, reinsert the 5-pin connector and remove the 16-pin connector.
6. Check for signal (24 volts) at the transformer.
7. Check for signal (24 volts) from the thermostat to the "G" terminal at the 16-pin connector.
8. Using an ohmmeter, check for continuity from the #1 & #3 (common pins) to the transformer neutral or "C" thermostat terminal. If you do not have continuity, the motor may function erratically. Trace the common circuits, locate and repair the open neutral.
9. Set the thermostat to "Fan-On". Using a voltmeter, check for 24 volts between pin # 15 (G) and common.
10. Disconnect power to compressor. Set thermostat to call for cooling. Using a voltmeter, check for 24 volts at pin # 6 and/or #14.
11. Set the thermostat to a call for heating. Using a voltmeter, check for 24 volts at pin #2 and/or #11.





16-PIN ECM HARNESS CONNECTOR

If you do not read voltage and continuity as described, the problem is in the control or interface board, but not the motor. If you register voltage as described , the ECM power head is defective and must be replaced.

Troubleshooting Chart for GE/Regal-Beloit ECM Variable Speed Air Circulator Blower Motors

Symptom	Fault Description(s)	Possible Causes	Corrective Action	Cautions and Notes
- Motor rocks slightly when starting.	- This is normal start-up for variable speed motor.	----	----	----
- Motor won't start.	- No movement.	- Manual disconnect switch off or door switch open. - Blown fuse or circuit breaker. - 24 Vac wires miswired. - Unseated pins in wiring harness connectors. - Bad motor/control module. - Moisture present in motor or control module.	- Check 230 Vac power at motor. - Check low voltage (24 Vac R to C) at motor. - Check low voltage connections (G, Y, W, R, C) at motor. - Check for unseated pins in connectors on motor harness. - Test with a temporary jumper between R - G. -	- Turn power OFF prior to repair. Wait 5 minutes after disconnecting power before opening motor. - Handle electronic motor/control with care.
	- Motor rocks, but won't start.	- Loose motor mount. - Blower wheel not tight on motor shaft. - Bad motor/control module.	- Check for loose motor mount. - Make sure blower wheel is tight on shaft. - Perform motor/control replacement check, ECM motors only.	- Turn power OFF prior to repair. Wait 5 minutes after disconnecting power before opening motor. - Handle electronic motor/control with care.
- Motor oscillates up & down while being tested off of blower.	- It is normal for motor to oscillate with no load on shaft.	----	----	----
- Motor starts, but runs erratically.	- Varies up and down or intermittent.	- Variation in 230 Vac to motor. - Unseated pins in wiring harness connectors. - Erratic CFM command from "BK" terminal. - Improper thermostat connection or setting. - Moisture present in motor/control module.	- Check line voltage for variation or "sag". - Check low voltage connections (G, Y, W, R, C) at motor, unseated pins in motor harness connectors. - Check-out system controls - Thermostat. - Perform Moisture Check.*	- Turn power OFF prior to repair.
	- "Hunts" or "puffs" at high CFM (speed).	- Incorrect or dirty filter(s). - Incorrect supply or return ductwork. - Incorrect blower speed setting.	- Does removing panel or filter reduce "puffing"? - Check/replace filter. - Check/correct duct restrictions. - Adjust to correct blower speed setting.	- Turn power OFF prior to repair.

***Moisture Check**

- Connectors are oriented "down" (or as recommended by equipment manufacturer).
- Is condensate drain plugged?
- Check for undercharged condition.
- Arrange harnesses with "drip loop" under motor.
- Check for low airflow (too much latent capacity).
- Check and plug leaks in return ducts, cabinet.

Note: You must use the correct replacement control/motor module since they are factory programmed for specific operating modes. Even though they look alike, different modules may have completely different functionality. The ECM variable speed motors are c

Important Note: Using the wrong motor/control module voids all product warranties and may produce unexpected results.

CHART CONTINUED ON NEXT PAGE

CHART CONTINUED FROM PREVIOUS PAGE.

Troubleshooting Chart for GE/Regal-Beloit ECM Variable Speed Air Circulator Blower Motors

Symptom	Fault Description(s)	Possible Causes	Corrective Action	Cautions and Notes
- Motor starts, but runs erratically.	- Stays at low CFM despite system call for cool or heat CFM.	- 24 Vac wires miswired or loose. - "R" missing/not connected at motor. - Fan in delay mode.	- Check low voltage (Thermostat) wires and connections. - Verify fan is not in delay mode - wait until delay complete. - Perform motor/control replacement check, ECM motors only.	- Turn power OFF prior to repair. Wait 5 minutes after disconnecting power before opening motor. - Handle electronic motor/control with care.
	- Stays at high CFM.	- "R" missing/not connected at motor. - Fan in delay mode.	- Is fan in delay mode? - wait until delay time complete. - Perform motor/control replacement check, ECM motors only.	- Turn power OFF prior to repair. Wait 5 minutes after disconnecting power before opening motor. - Handle electronic motor/control with care.
	- Blower won't shut off.	- Current leakage from controls into G, Y, or W.	- Check for Triac switched t'stat or solid state relay.	- Turn power OFF prior to repair.
- Excessive noise.	- Air noise.	- High static creating high blower speed. - Incorrect supply or return ductwork. - Incorrect or dirty filter(s). - Incorrect blower speed setting.	- Check/replace filter. - Check/correct duct restrictions. - Adjust to correct blower speed setting.	- Turn power OFF prior to repair.
	- Noisy blower or cabinet.	- Loose blower housing, panels, etc. - High static creating high blower speed. - Air leaks in ductwork, cabinets, or panels.	- Check for loose blower housing, panels, etc. - Check for air whistling thru seams in ducts, cabinets or panels. - Check for cabinet/duct deformation.	- Turn power OFF prior to repair.
	- "Hunts" or "puffs" at high CFM (speed).	- High static creating high blower speed. - Incorrect or dirty filter(s). - Incorrect supply or return ductwork. - Incorrect blower speed setting.	- Does removing panel or filter reduce "puffing"? - Check/replace filter. - Check/correct duct restrictions. - Adjust to correct blower speed setting.	- Turn power OFF prior to repair.
- Evidence of Moisture.	- Motor failure or malfunction has occurred and moisture is present.	- Moisture in motor/control module.	- Replace motor and perform Moisture Check.*	- Turn power OFF prior to repair. Wait 5 minutes after disconnecting power before opening motor. - Handle electronic motor/control with care.

***Moisture Check**

- Connectors are oriented "down" (or as recommended by equipment manufacturer).
- Is condensate drain plugged?
- Check for undercharged condition.
- Arrange harnesses with "drip loop" under motor.
- Check for low airflow (too much latent capacity).
- Check and plug leaks in return ducts, cabinet.

Note: You must use the correct replacement control/motor module since they are factory programmed for specific operating modes. Even though they look alike, different modules may have completely different functionality. The ECM variable speed motors are c

Important Note: Using the wrong motor/control module voids all product warranties and may produce unexpected results.

SERVICING

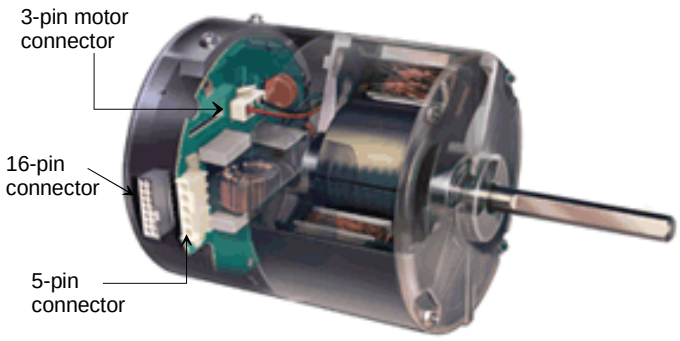
S-16C CHECKING ECM MOTOR WINDINGS

WARNING

HIGH VOLTAGE!
Disconnect ALL power before servicing or installing. Multiple power sources may be present. Failure to do so may cause property damage, personal injury or death.



1. Disconnect the 5-pin and the 16-pin connectors from the ECM power head.
2. Remove the 2 screws securing the ECM power head and separate it from the motor.
3. Disconnect the 3-pin motor connector from the power head and lay it aside.
4. Using an ohmmeter, check the motor windings for continuity to ground (pins to motor shell). If the ohmmeter indicates continuity to ground, the motor is defective and must be replaced.
5. Using an ohmmeter, check the windings for continuity (pin to pin). If no continuity is indicated, the thermal limit (over load) device may be open. Allow motor to cool and retest.



S-16D ECM CFM ADJUSTMENTS MBE / AEPF

MBE MOTOR

This section references the operation characteristics of the MBE/AEPF models motor only. The ECM control board is factory set with the dipswitch #4 in the “ON” position and all other dipswitches are factory set in the “OFF” position. When MBE/AEPF are used with 2-stage cooling units, dipswitch #4 should be in the "OFF" position.

For most applications, the settings are to be changed according to the electric heat size and the outdoor unit selection.

The MBE/AEPF products use a General Electric ECM™ motor. This motor provides many features not available on the traditional PSC motor. These features include:

- Improved Efficiency
- Constant CFM
- Soft Start and Stop
- Improved Humidity Control

MOTOR SPEED ADJUSTMENT

Each ECM™ blower motor has been preprogrammed for operation at 4 distinct airflow levels when operating in Cooling/Heat Pump mode or Electric Heat mode. These 4 distinct levels may also be adjusted slightly lower or higher if desired. The adjustment between levels and the trim adjustments are made by changing the dipswitch(s) either to an "OFF" or "ON" position.

DIPSWITCH FUNCTIONS

The MBE / AEPF air handler motors have an electronic control that contains an eight (8) position dip switch. The function of these dipswitches are shown in **Table 1.**

Dipswitch Number	Function
1	Electric Heat
2	
3	N/A
4	Indoor Thermostat
5	Cooling & Heat Pump CFM
6	
7	CFM Trim Adjust
8	

Table 1

CFM DELIVERY

Tables 2, **3, 5** and **6** show the CFM output for dipswitch combinations 1-2, and 5-6.

Electric Heat Operation

Model	Switch 1	Switch 2	CFM
MBE1200	OFF	OFF	1,200
	ON	OFF	1,000
	OFF	ON	800
	ON	ON	600
MBE1600	OFF	OFF	1,600
	ON	OFF	1,400
	OFF	ON	1,200
	ON	ON	1,000
MBE2000	OFF	OFF	2,000
	ON	OFF	1,800
	OFF	ON	1,600
	ON	ON	1,200

Table 2

SERVICING

Cooling/Heat Pump Operation

Model	Switch 5	Switch 6	CFM
MBE1200	OFF	OFF	1,200
	ON	OFF	1,000
	OFF	ON	800
	ON	ON	600
MBE1600	OFF	OFF	1,600
	ON	OFF	1,400
	OFF	ON	1,200
	ON	ON	1,000
MBE2000	OFF	OFF	2,000
	ON	OFF	1,800
	OFF	ON	1,600
	ON	ON	1,200

Table 3

THERMOSTAT "FAN ONLY" MODE

During Fan Only Operations, the CFM output is 30% of the cooling setting.

CFM TRIM ADJUST

Minor adjustments can be made through the dip switch combination of 7-8. **Table 4** shows the switch position for this feature.

NOTE: The airflow will not make the decreasing adjustment in Electric Heat mode.

CFM	Switch 7	Switch 8
+10%	ON	OFF
-15%	OFF	ON

Table 4

HUMIDITY CONTROL

When using a Humidstat (normally closed), cut jumper PJ6 on the control board. The Humidstat will only affect cooling airflow by adjusting the Airflow to 85%.

TWO STAGE HEATING

When using staged electric heat, cut jumper PJ4 on the control board.

AEPF DIPSWITCH FUNCTIONS

Dipswitch 1/2 & 7/8

AEPF 1830

Heating Element	Switch Position		Switch Position		Emergency Backup	Heat Pump With Backup
(kw)	1	2	7	8		
UP TO 10	OFF	OFF	OFF	OFF	1100	1210
UP TO 10	ON	OFF	OFF	OFF	890	935
5	OFF	ON	OFF	OFF	700	770

AEPF3036 / 3137 / 4260

Heating Element	Switch Position		Switch Position		Emergency Backup	Heat Pump With Backup
(kw)	1	2	7	8		
UP TO 20	OFF	OFF	OFF	OFF	2050	2150
UP TO 20	ON	OFF	OFF	OFF	1750	1835
UP TO 15	OFF	ON	OFF	OFF	1600	1680
UP TO 10	ON	ON	OFF	OFF	1200	1260
UP TO 10	ON	ON	OFF	ON	1020	1070

Dipswitch 5/6 & 7/8

AEPF 1830

Switch Position		Switch Position		Indoor Airflow	
5	6	7	8	Cooling	Heat Pump
OFF	OFF	OFF	OFF	1100	1100
ON	OFF	OFF	OFF	800	800
OFF	ON	OFF	OFF	600	600

AEPF3036 / 3137 / 4260

Switch Position		Switch Position		Indoor Airflow	
5	6	7	8	Cooling	Heat Pump
OFF	OFF	OFF	OFF	1800	1800
ON	OFF	OFF	OFF	1580	1580
OFF	ON	OFF	OFF	1480	1480
ON	ON	OFF	OFF	1200	1200
ON	ON	OFF	ON	1020	1020

SERVICING

S-16E BLOWER PERFORMANCE DATA

SPEED	STATIC	MBR800**-* SCFM	MBR1200**-* SCFM	MBR1600**-* SCFM	MBR2000**-* SCFM
HIGH	0.1	1,240	1,500	1,800	2,160
	0.2	1,170	1,460	1,740	2,080
	0.3	1,120	1,360	1,680	1,990
	0.4	1,060	1,280	1,610	1,890
	0.5	980	1,200	1,520	1,790
	0.6	900	1,110	1,430	1,690
MEDIUM	0.1	900	1,380	1,540	1,730
	0.2	850	1,320	1,490	1,670
	0.3	790	1,270	1,450	1,590
	0.4	740	1,200	1,400	1,520
	0.5	680	1,140	13,560	1,420
	0.6	605	1,040	1,280	1,320
LOW	0.1	650	1,170	1,130	1,520
	0.2	590	1,130	1,100	1,450
	0.3	540	1,080	1,070	1,360
	0.4	500	1,020	1,030	1,290
	0.5	430	950	990	1,200
	0.6	330	830	930	1,090

NOTE: External static is for blower @ 230 Volts. It does not include Coil, Air Filter or Electric Heaters.

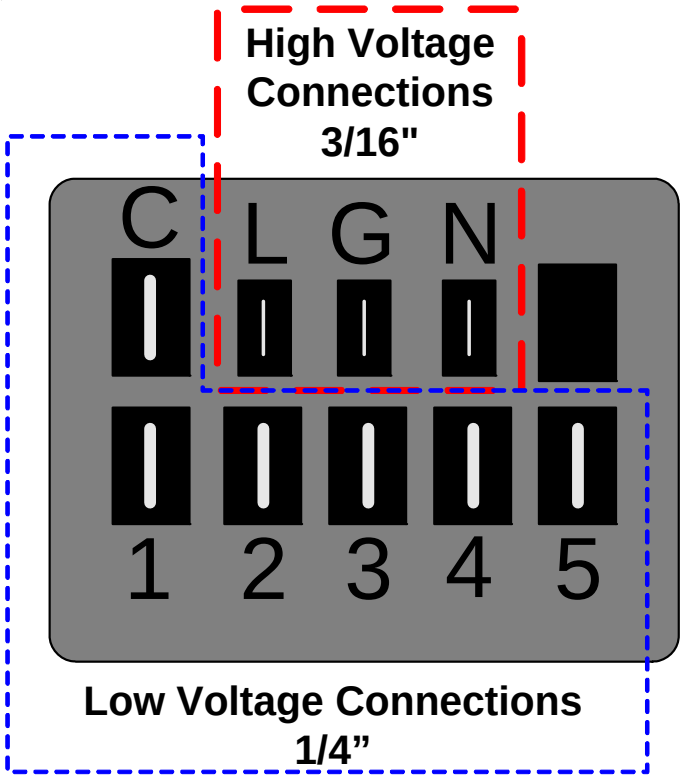
S-16F CHECKING GE X13™ MOTORS

The GE X13™ Motor is a one piece, fully encapsulated, 3 phase brushless DC (single phase AC input) motor with ball bearing construction. Unlike the ECM 2.3/2.5 motors, the GE X13™ features an integral control module.

Note: The GE TECMate will not currently operate the GE X13™ motor.

1. Using a voltmeter, check for 230 volts to the motor connections L and N. If 230 volts is present, proceed to step 2. If 230 volts is not present, check the line voltage circuit to the motor.
2. Using a voltmeter, check for 24 volts from terminal C to either terminal 1, 2, 3, 4, or 5, depending on which tap is being used, at the motor. If voltage present, proceed tostep 3. If no voltage, check 24 volt circuit to motor.
3. If voltage was present in steps 1 and 2, the motor has failed and will need to be replaced.

Note: When replacing motor, ensure the belly band is between the vents on the motor and the wiring has the proper drip loop to prevent condensate from entering the motor.



GE X13™ MOTOR CONNECTIONS

SERVICING

S-16G CHECKING EMERSON ULTRATECH™ ECM MOTORS

DESCRIPTION

The AVPTC and MBVC models utilize an Emerson, 4-wire variable speed ECM blower motor. The ECM blower motor provides constant CFM.

The motor is a serially communicating variable speed motor. Only four wires are required to control the motor: +Vdc, Common, Receive, and Transmit.

The +Vdc and Common wires provide power to the motor's low voltage control circuits. Typical supply voltage is 9-15 volts DC.

GENERAL CHECKS/CONSIDERATIONS

1. Check power supply to the air handler or modular blower. Ensure power supply is within the range specified on rating plate. See section S-1.
2. Check motor power harness. Ensure wires are continuous and make good contact when seated in the connectors. Repair or replace as needed.
3. Check motor control harness. Ensure wires are continuous and make good contact when seated in the connectors. Repair or replace as needed.
4. Check thermostat and thermostat wiring. Ensure thermostat is providing proper cooling/heating/continuous fan demands. Repair or replace as needed.
5. Check blower wheel. Confirm wheel is properly seated on motor shaft. Set screw must be on shaft flat and torqued to 165 in-lbs minimum. Confirm wheel has no broken or loose blades. Repair or replace as needed.
6. Ensure motor and wheel turn freely. Check for interference between wheel and housing or wheel and motor. Repair or replace as needed.
7. Check housing for cracks and/or corrosion. Repair or replace as needed.
8. Check motor mounting bracket. Ensure mouting bracket is tightly secured to the housing. Ensure bracket is not cracked or broken.

Emerson UltraCheck-EZ™ Diagnostic Tool

The Emerson UltraCheck-EZ™ diaganostic tool may be used to diagnose the ECM motor.

⚠ WARNING

HIGH VOLTAGE!
Disconnect ALL power before servicing or installing. Multiple power sources may be present. Failure to do so may cause property damage, personal injury or death.



To use the diagnostic tool, perform the following steps:

1. Disconnect power to the air handler.
2. Disconnect the 4-circuit control harness from the motor.
3. Plug the 4-circuit connector from the diagnostic tool into the motor control connector.
4. Connect one alligator clip from the diagnostic tool to a ground source.
5. Connect the other alligator clip to a 24VAC source.

NOTE: The alligator clips are NOT polarized.

NOTE: The UltraCheck-EZ™ diagnostic tool is equipped with a nonreplaceable fuse. Connecting the tool to a source other than 24VAC could damage the tool and cause the fuse to open. Doing so will render the diagnostic tool inoperable.

6. Turn on power to air handler or modular blower.

⚠ WARNING

Line Voltage now present.

7. Depress the orange power button on the diagnostic tool to send a run signal to the motor. Allow up to 5 seconds for the motor to start.

NOTE: If the orange power button does not illuminate when depressed, the tool either has an open fuse or is not properly connected to a 24VAC source.

8. The green LED on the diagnostic tool will blink indicating communications between the tool and motor. See table below for indications of tool indicators and motor actions. Replace or repair as needed.

Power Button	Green LED	Motor Action	Indication(s)
OFF	OFF	Not Rotating	Confirm 24VAC to UltraCheck-EZ™ tool. If 24VAC is confirmed, diagnostic tool is inoperable.
ON	Blinking	Rotating	Motor and control/end bell are functioning properly.
ON	OFF	Rotating	Replace motor control/end bell.
ON	Blinking	Not Rotating	Check motor (see *Motor Checks* below).
ON	OFF	Not Rotating	Replace motor control/end bell; verify motor (see *Motor Checks* below).

9. Depress the orange power button to turn off motor.
10. Disconnect power. Disconnect diagnostic tool.

11. Reconnect the 4-wire harness from control board to motor.

Electrical Checks - High Voltage Power Circuits

WARNING

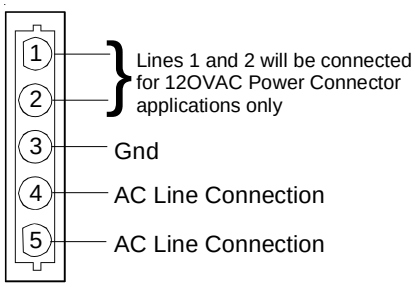
HIGH VOLTAGE!
Disconnect ALL power before servicing or installing. Multiple power sources may be present. Failure to do so may cause property damage, personal injury or death.

1. Disconnect power to air handler or modular blower.
2. Disconnect the 5-circuit power connector to the ECM motor.
3. Turn on power to air handler or modular.

WARNING

Line Voltage now present.

4. Measure voltage between pins 4 and 5 on the 5-circuit connector. Measured voltage should be the same as the supply voltage to the air handler or modular.



5. Measure voltage between pins 4 and 3. Voltage should be approximately half of the voltage measured in step 4.
6. Measure voltage between pins 5 and 3. Voltage should be approximately half of the voltage measured in step 4.
7. If no voltage is present, check supply voltage to air handler or modular blower. See section S-1.
8. Disconnect power to air handler or modular blower. Reconnect the 5-circuit power harness disconnected in step 2.

Electrical Checks - Low Voltage Control Circuits

1. Turn on power to air handler or modular.

WARNING

Line Voltage now present.

2. Check voltage between pins 1 and 4 on the 4-wire motor control harness between the motor and control board. Voltage should be between 9 and 15 VDC.
3. If no voltage is present, check control board. See section S-40A.

Motor Control/End Bell Checks

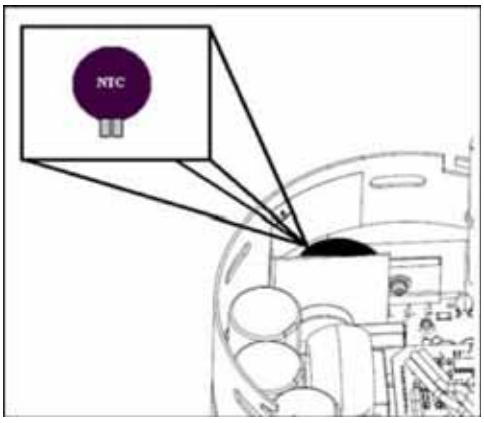
WARNING

HIGH VOLTAGE!
Disconnect ALL power before servicing or installing. Multiple power sources may be present. Failure to do so may cause property damage, personal injury or death.

1. Disconnect power to air handler or modular blower.

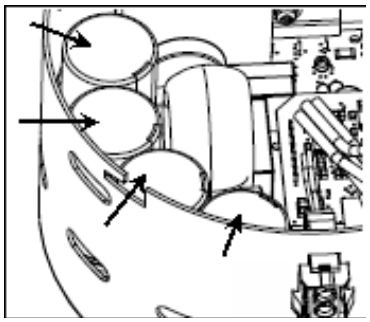
NOTE: Motor contains capacitors that can hold a charge for several minutes after disconnecting power. Wait 5 minutes after removing power to allow capacitors to discharge.

2. Disconnect the motor control harness and motor power harness.
3. Remove the blower assembly from the air handler or modular blower.
4. Remove the (3) screws securing the control/end bell to the motor. Separate the control/end bell. Disconnect the 3-circuit harness from the control/end bell to remove the control/end bell from the motor.
5. Inspect the NTC thermistor inside the control/end bell (see figure below). Replace control/end bell if thermistor is cracked or broken.



6. Inspect the large capacitors inside the control/end bell (see figure below). Replace the control/end bell if any of the capacitors are bulging or swollen.

SERVICING



7. Locate the 3-circuit connector in the control/end bell. Using an ohmmeter, check the resistance between each terminal in the connector. If the resistance is 100kW or greater, the control/end bell is functioning properly. Replace the control/end bell if the resistance is lower than 100kW.
8. Reassemble motor and control/end bell in reverse of disassembly. Replace blower assembly into air handler or modular blower.

Motor Checks

WARNING

HIGH VOLTAGE!
Disconnect ALL power before servicing or installing. Multiple power sources may be present. Failure to do so may cause property damage, personal injury or death.

1. Disconnect power to air handler or modular blower.

NOTE: Motor contains capacitors that can hold a charge for several minutes after disconnecting power. Wait 5 minutes after removing power to allow capacitors to discharge.

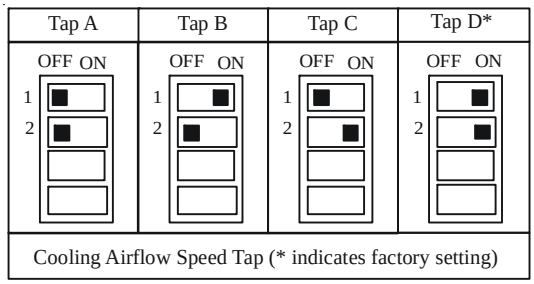
2. Disassemble motor as described in steps 2 through 4 above.
3. Locate the 3-circuit harness from the motor. Using an ohmmeter, measure the resistance between each motor phase winding. The resistance levels should be equal. Replace the motor if the resistance levels are unequal, open circuited or short circuited.
4. Measure the resistance between each motor phase winding and the motor shell. Replace the motor if any phase winding is short circuited to the motor shell.
5. Reassemble motor and control/end bell in reverse of disassembly. Replace blower assembly into air handler or modular blower.

S-16H ECM CFM ADJUSTMENTS AVPTC/MBVC

This section references the operation characteristics of the MBVC models. The MBVC models utilize an integrated air handler control. The air handler control provides ECM blower motor control and includes all dipswitches necessary to set up the cooling, heat pump and electric airflow characteristics.

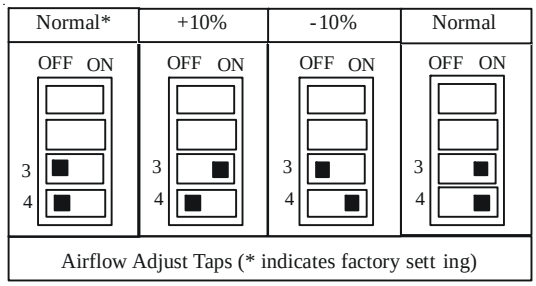
The control has three banks of dipswitches: a bank for cooling airflow and trim adjustment, a bank for selecting one of (4) enhancement profiles and enabling dehumidification, and a bank for selecting the installed electric heater kit size. Adjustments are made by selecting the appropriate ON/OFF combinations of the dipswitches. The dipswitches along with their functions are shown in the figures below.

Cooling Airflow Dipswitches - Used to set the desired cooling airflow



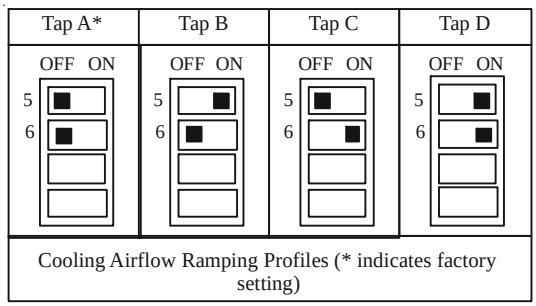
Cooling Airflow Speed Tap (* indicates factory setting)

Airflow Adjust Dipswitches - Used to adjust the airflow +/- 10%



Airflow Adjust Taps (* indicates factory sett ing)

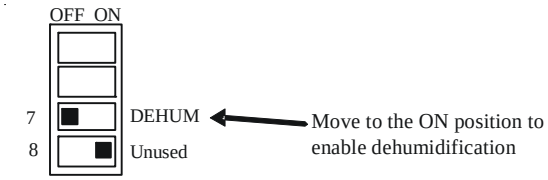
Ramping Profile Dipswitches - Used to select a comfort profile for the cooling mode.



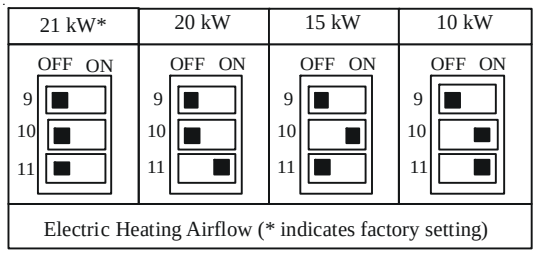
Cooling Airflow Ramping Profiles (* indicates factory setting)

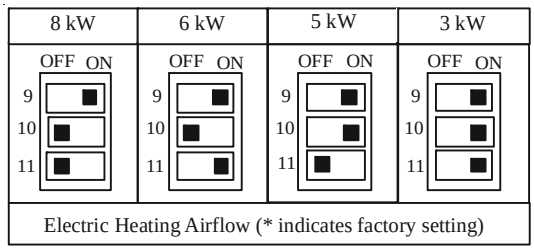
Dehumidification Disable/Enable Dipswitch - Reduces cooling airflow by ~ 15% when enabled AND when used with a humidistat (such as DEHUM1). Airflow is reduced when a call for cooling is present and the humidistat is open.

SERVICING



Electric Heater Airflow - Airflow for installed electric heaters is set by adjusting the dipswitches to the appropriate heater size.





The table below indicates the airflow that corresponds to the available dipswitch settings.

MBVC Airflow Table

Speed Selection Dip Switches								
	Cool Selection Switches		Adjust Selection Switches		Profile Selection Switches			
TAP	1	2	3	4	5	6		
A	OFF	OFF	OFF	OFF	OFF	OFF		
B	ON	OFF	ON	OFF	ON	OFF		
C	OFF	ON	OFF	ON	OFF	ON		
D	ON	ON	ON	ON	ON	ON		

Profiles	Pre-Run	Short-Run	OFF Delay
A	-------	--------	60 sec/100%
B	-------	30 sec/50%	60 sec/100%
C	-------	7.5 min/82%	60 sec/100%
D	30 sec/50%	7.5 min/82%	30 sec/50%

To set airflow: (1) Select model and desired high stage cooling airflow. Determine the cooresponding tap (A, B, C, or D). Set dip switches 1 and 2 to the appropriate ON / OFF positions. (2) Select model and installed electric heater size. Set switches 9, 10, and 11 to the appropriate ON/OFF positions. (3) Select the airflow adjustment factor tap A and D are 0%; Tap B is +10%; Tap C -10%. Set dip switches 3 and 4 to the appropriate ON / OFF positions.

To set Comfort Mode: Select desired Comfort Mode profile [see profiles above]. Set switches 5 and 6 to the approriate ON / OFF positions.

0140A00045

Htr Kw	9	10	11	MBVC1200*	MBVC1600*	MBVC2000*
3	ON	ON	ON	600	800	800
5	ON	ON	OFF	600	800	800
6	ON	OFF	ON	635	800	800
8	ON	OFF	OFF	740	1000	1000
10	OFF	ON	ON	1000	1000	1200
15	OFF	ON	OFF	1400	1500	1500
20	OFF	OFF	ON	NR	NR	2000

Model	Tap	Low Stage Cool	High Stage Cool
MBVC1200 *	A	400	600
	B	540	800
	C	670	1000
	D	800	1200
MBVC1600 *	A	670	1000
	B	800	1200
	C	940	1400
	D	1070	1600
MBVC2000 *	A	800	1200
	B	1070	1600
	C	1200	1800
	D	1340	2000

SERVICING

S-17 CHECKING COMPRESSOR

WARNING

Hermetic compressor electrical terminal venting can be dangerous. When insulating material which supports a hermetic compressor or electrical terminal suddenly disintegrates due to physical abuse or as a result of an electrical short between the terminal and the compressor housing, the terminal may be expelled, venting the vapor and liquid contents of the compressor housing and system.

If the compressor terminal PROTECTIVE COVER and gasket (if required) are not properly in place and secured, there is a remote possibility if a terminal vents, that the vaporous and liquid discharge can be ignited, spouting flames several feet, causing potentially severe or fatal injury to anyone in its path.

This discharge can be ignited external to the compressor if the terminal cover is not properly in place and if the discharge impinges on a sufficient heat source.

Ignition of the discharge can also occur at the venting terminal or inside the compressor, if there is sufficient contaminant air present in the system and an electrical arc occurs as the terminal vents.

Ignition cannot occur at the venting terminal without the presence of contaminant air, and cannot occur externally from the venting terminal without the presence of an external ignition source.

Therefore, proper evacuation of a hermetic system is essential at the time of manufacture and during servicing.

To reduce the possibility of external ignition, all open flame, electrical power, and other heat sources should be extinguished or turned off prior to servicing a system.

If the following test indicates shorted, grounded or open windings, see procedures S-19 for the next steps to be taken.

S-17A RESISTANCE TEST

Each compressor is equipped with an internal overload.

The line break internal overload senses both motor amperage and winding temperature. High motor temperature or amperage heats the disc causing it to open, breaking the common circuit within the compressor on single phase units.

Heat generated within the compressor shell, usually due to recycling of the motor, high amperage or insufficient gas to cool the motor, is slow to dissipate. Allow at least three to four hours for it to cool and reset, then retest.

Fuse, circuit breaker, ground fault protective device, etc. has not tripped -

WARNING

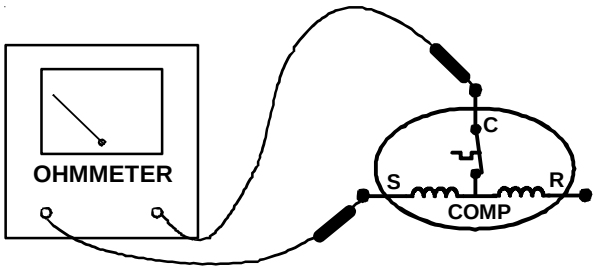
HIGH VOLTAGE!
Disconnect ALL power before servicing or installing. Multiple power sources may be present. Failure to do so may cause property damage, personal injury or death.

1. Remove the leads from the compressor terminals.

WARNING

See warnings S-17 before removing compressor terminal cover.

2. Using an ohmmeter, test continuity between terminals S-R, C-R, and C-S, on single phase units or terminals T2, T2 and T3, on 3 phase units.



TESTING COMPRESSOR WINDINGS

If either winding does not test continuous, replace the compressor.

NOTE: If an open compressor is indicated, allow ample time for the internal overload to reset before replacing compressor.

S-17B GROUND TEST

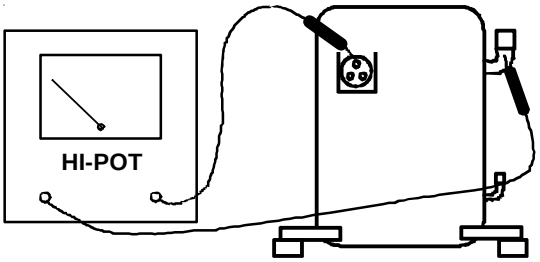
If fuse, circuit breaker, ground fault protective device, etc., has tripped, this is a strong indication that an electrical problem exists and must be found and corrected. The circuit protective device rating must be checked, and its maximum rating should coincide with that marked on the equipment nameplate.

With the terminal protective cover in place, it is acceptable to replace the fuse or reset the circuit breaker ONE TIME ONLY to see if it was just a nuisance opening. If it opens again, DO NOT continue to reset.

Disconnect all power to unit, making sure that **all** power legs are open.

1. DO NOT remove protective terminal cover. Disconnect the three leads going to the compressor terminals at the nearest point to the compressor.
2. Identify the leads and using a Megger, Hi-Potential Ground Tester, or other suitable instrument which puts out a voltage between 300 and 1500 volts, check for a ground separately between each of the three leads and

ground (such as an unpainted tube on the compressor). Do not use a low voltage output instrument such as a volt-ohmmeter.



COMPRESSOR GROUND TEST

3. If a ground is indicated, then carefully remove the compressor terminal protective cover and inspect for loose leads or insulation breaks in the lead wires.
4. If no visual problems indicated, carefully remove the leads at the compressor terminals.

WARNING

Damage can occur to the glass embedded terminals if the leads are not properly removed. This can result in terminal and hot oil discharging.

Carefully retest for ground, directly between compressor terminals and ground.

5. If ground is indicated, replace the compressor.

S-17C UNLOADER TEST PROCEDURE

A nominal 24-volt direct current coil activates the internal unloader solenoid. The input control circuit voltage must be 18 to 28 volt ac. The coil power requirement is 20 VA. The external electrical connection is made with a molded plug assembly. This plug contains a full wave rectifier to supply direct current to the unloader coil.



UNLOADER SOLENOID (Molded Plug)

Unloader Test Procedure

If it is suspected that the unloader is not working, the following methods may be used to verify operation.

1. Operate the system and measure compressor current. Cycle the unloader ON and OFF at 10 second intervals. The compressor amperage should go up or down at least 25 percent.
2. If step one does not give the expected results, shut unit off. Apply 18 to 28 volt ac to the unloader molded plug leads and listen for a click as the solenoid pulls in. Remove power and listen for another click as the unloader returns to its original position.
3. If clicks can't be heard, shut off power and remove the control circuit molded plug from the compressor and measure the unloader coil resistance. The resistance should be 32 to 60 ohms, depending on compressor temperature.
4. Next check the molded plug.
   A. Voltage check: Apply control voltage to the plug wires (18 to 28 volt ac). The measured **dc** voltage at the female connectors in the plug should be around 15 to 27 vdc.
   B. Resistance check: Measure the resistance from the end of one molded plug lead to either of the two female connectors in the plug. One of the connectors should read close to zero ohms while the other should read infinity. Repeat with other wire. The same female connector as before should read zero while the other connector again reads infinity. Reverse polarity on the ohmmeter leads and repeat. The female connector that read infinity previously should now read close to zero ohms.
   C. Replace plug if either of these test methods doesn't show the desired results.

S-17D OPERATION TEST

If the voltage, capacitor, overload and motor winding test fail to show the cause for failure:

WARNING

HIGH VOLTAGE!
Disconnect ALL power before servicing or installing. Multiple power sources may be present. Failure to do so may cause property damage, personal injury or death.



1. Remove unit wiring from disconnect switch and wire a test cord to the disconnect switch.

NOTE: The wire size of the test cord must equal the line wire size and the fuse must be of the proper size and type.

2. With the protective terminal cover in place, use the three leads to the compressor terminals that were disconnected at the nearest point to the compressor and connect the common, start and run clips to the respective leads.

3. Connect good capacitors of the right MFD and voltage rating into the circuit as shown.
4. With power ON, close the switch.

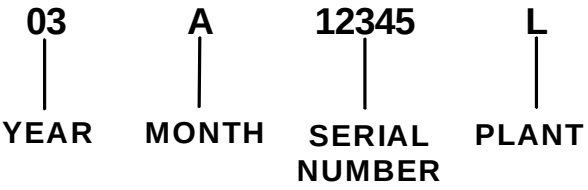
WARNING

Line Voltage now present.

A. If the compressor starts and continues to run, the cause for failure is somewhere else in the system.

B. If the compressor fails to start - replace.

COPELAND COMPRESSOR



S-18 TESTING CRANKCASE HEATER (OPTIONAL ITEM)

The crankcase heater must be energized a minimum of four (4) hours before the condensing unit is operated.

Crankcase heaters are used to prevent migration or accumulation of refrigerant in the compressor crankcase during the off cycles and prevents liquid slugging or oil pumping on start up.

A crankcase heater will not prevent compressor damage due to a floodback or over charge condition.

WARNING

Disconnect ALL power before servicing.

1. Disconnect the heater lead in wires.
2. Using an ohmmeter, check heater continuity - should test continuous. If not, replace.

NOTE: The positive temperature coefficient crankcase heater is a 40 watt 265 voltage heater. The cool resistance of the heater will be approximately 1800 ohms. The resistance will become greater as the temperature of the compressor shell increases.

S-21 CHECKING REVERSING VALVE AND SOLENOID

Occasionally the reversing valve may stick in the heating or cooling position or in the mid-position.

When stuck in the mid-position, part of the discharge gas from the compressor is directed back to the suction side, resulting in excessively high suction pressure. An increase in the suction line temperature through the reversing valve can also be measured. Check operation of the valve by starting the system and switching the operation from COOLING to HEATING cycle.

If the valve fails to change its position, test the voltage (24V) at the valve coil terminals, while the system is on the COOLING cycle.

All heat pumps and ComfortNet™ heat pumps wired in legacy - If no voltage is registered at the coil terminals, check the operation of the thermostat and the continuity of the connecting wiring from the "O" terminal of the thermostat to the unit.

ComfortNet™ heat pumps only - Check voltage (24VAC) at the non-insulated terminal E22 on the UC control board (RVS on silkscreen) and "C" terminal on the 7-pin or 4-pin connector on the UC control

If voltage is registered at the coil, tap the valve body lightly while switching the system from HEATING to COOLING, etc. If this fails to cause the valve to switch positions, remove the coil connector cap and test the continuity of the reversing valve solenoid coil. If the coil does not test continuous - replace it.

If the coil test continuous and 24 volts is present at the coil terminals, the valve is inoperative - replace it.

S-24 TESTING DEFROST CONTROL

LEGACY MODELS:

To check the defrost control for proper sequencing, proceed as follows: With power ON; unit not running.

1. Jumper defrost thermostat by placing a jumper wire across the terminals "DFT" and "R" at defrost control board.
2. Connect jumper across test pins on defrost control board.
3. Set thermostat to call for heating. System should go into defrost within 21 seconds.
4. Immediately remove jumper from test pins.
5. Using VOM check for voltage across terminals "C & O". Meter should read 24 volts.
6. Using VOM check for voltage across fan terminals DF1 and DF2 on the board. You should read line voltage (208-230 VAC) indicating the relay is open in the defrost mode.
7. Using VOM check for voltage across "W2 & C" terminals on the board. You should read 24 volts.
8. If not as above, replace control board.
9. Set thermostat to off position and disconnect power before removing any jumpers or wires.

NOTE: Remove jumper across defrost thermostat before returning system to service.

COMFORTNET™ UNITS:

To check the defrost control for proper sequencing, proceed as follows: With power ON; unit not running.

1. Set thermostat to call for heating.
2. Press **TEST** and **RECALL** buttons simultaneously for approximately 3 seconds, then release them. System

should go into defrost immediately.

3. Using VOM check for voltage across terminals "C & O". Meter should read 24 volts (skip this step if system a fully communicating system)
4. Visually inspect to see that the frost is gradually melting on the coil and the compressor is running.
5. Using VOM check for voltage across "W2 & C" terminals on the board. You should read 24 volts.
6. If not as above, replace control board.
7. Set thermostat to off position and disconnect power before removing any jumpers or wires.

S-25 TESTING DEFROST THERMOSTAT

LEGACY MODELS ONLY:

1. Install a thermocouple type temperature test lead on the tube adjacent to the defrost control. Insulate the lead point of contact.
2. Check the temperature at which the control closes its contacts by lowering the temperature of the control. Part # 0130M00009P which is used on 2 and 2.5 ton units should close at 34°F ± 5°F. Part # 0130M00001P which is used on 3 thru 5 ton units should close at 31°F ± 3°F.
3. Check the temperature at which the control opens its contacts by raising the temperature of the control. Part # 0130M00009P which is used on 2 and 2.5 ton units should open at 60°F ± 5°F. Part # 0130M00001P which is used on 3 thru 5 ton units should open at 75°F ± 6°F.
4. If not as above, replace control.

S-26 TESTING TEMPERATURE SENSORS (COMFORTNET™ READY MODELS ONLY)

The ASXC and DSXC ComfortNet™ ready air conditioner models are factory equipped with an outdoor air temperature (OAT) sensor. The OAT sensor allows the outdoor air temperature to be displayed on the CTK01AA thermostat when used with the ASXC and DSXC models.

The ASZC and DSZC ComfortNet™ ready heat pump models are equipped with both an outdoor air temperature (OAT) sensor and an outdoor coil temperature (OCT) sensor. The OAT provides the balance point temperature in heat pump systems (air handler w/electric heat + heat pump) and dual fuel systems. The OCT sensor is provides the outdoor coil temperature and is used in determining defrost cycles.

To check either the outdoor air or outdoor coil temperature sensors:

⚠ WARNING

HIGH VOLTAGE!
Disconnect ALL power before servicing or installing. Multiple power sources may be present. Failure to do so may cause property damage, personal injury or death.



1. Disconnect power to the air conditioner or heat pump.
2. Disconnect the sensor from the unitary (UC) control.
3. Connect an ohmmeter across the sensor terminals. The ohmmeter should read be 10kΩ, +/-10%, at 75°F. Replace the sensor if the sensor is open, shorted, or outside the valid resistance range.

S-40 MBR/AR*F ELECTRONIC BLOWER TIME DELAY RELAY

The MBR/AR*F contains an Electronic Blower Time Delay Relay board, B1370735. This board provides on/off time delays for the blower motor in cooling and heat pump heating demands when “G” is energized.

During a cooling or heat pump heating demand, 24Vac is supplied to terminal “G” of the EBTDR to turn on the blower motor. The EBTDR initiates a 7 second delay on and then energizes it’s onboard relay. The relay on the EBTDR board closes it’s normally open contacts and supplies power to the blower motor. When the “G” input is removed, the EBTDR initiates a 65 second delay off. When the 65 seconds delay expires the onboard relay is de-energized and it’s contacts open and remove power from the blower motor.

During an electric heat only demand, “W1” is energized but “G” is not. The blower motor is connected to the normally closed contacts of the relay on the EBTDR board. The other side of this set of contacts is connected to the heat sequencer on the heater assembly that provides power to the first heater element. When “W1” is energized, the sequencer will close it’s contacts within 10 to 20 seconds to supply power to the first heater element and to the blower motor through the normally closed contacts on the relay on the EBTDR. When the “W1” demand is removed, the sequencer opens it contacts within 30 to 70 seconds and removes power from the heater element and the blower motor.

The EBTDR also contains a speedup terminal to reduce the delays during troubleshooting of the unit. When this terminal is shorted to the common terminal, “C”, on the EBTDR board, the delay ON time is reduced to 3 seconds and the delay OFF time is reduced to 5 second.

Two additional terminals, M1 and M2, are on the EBTDR board. These terminals are used to connect the unused leads from the blower motor and have no affect on the board’s operation.

S-40A AVPTC/MBVC ELECTRONIC BLOWER/ HEATER CONTROL

Description

The AVPTC and MBVC models utilize an electronic control that provides ECM blower motor control and control of up to two electric heat sequencers. The control has thermostat inputs for up to two stages of cooling, two stages of electric heat, reversing valve, and dehumidification. Control input is 24VAC.

SERVICING

All dipswitches necessary to setup cooling, heat pump, and electric heat airflow are fully integrated into the control. Dehumidification is enabled/disabled via an on-board dipswitch.

Features

The new air handler control includes advanced diagnostic features with fault recall, estimated CFM display via on-board LED, and ComfortNet™ ready. Diagnostics includes heater kit selection diagnostics, open fuse, internal control fault, data errors, and blower motor faults. Data errors are not included in the fault recall list. Diagnostic error codes are displayed on a single red LED.

The estimated CFM is displayed on an on-board green LED. The LED flashes once for each 100 CFM.

The AVPTC/MBVC air handlers may be used in a fully communicating ComfortNet™ system when matched with a compatiable outdoor unit and the CTK01AA thermostat. A fully communicating system offers advanced setup and diagnostic features.

Basic Operation

The air handler control receives thermostat inputs either from a standard 24VAC thermostat or the CTK01AA ComfortNet™ thermostat. For cooling and heat pump operation, the control operates the variable speed blower motor at the demand as determined from the thermostat input(s). If a demand for electric heat is received, the control will provide a 24VAC output for up to two electric heat sequencers.

Troubleshooting

Motor Control Circuits

WARNING

HIGH VOLTAGE!
Disconnect ALL power before servicing or installing. Multiple power sources may be present. Failure to do so may cause property damage, personal injury or death.



1. Turn on power to air handler or modular.

WARNING

Line Voltage now present.

2. Check voltage between pins 1 and 4 at the 4-wire motor connector on the control board. Voltage should be between 9 and 15 VDC. Replace control if voltage is not as specified.

Electric Heat Sequencer Outputs

WARNING

HIGH VOLTAGE!
Disconnect ALL power before servicing or installing. Multiple power sources may be present. Failure to do so may cause property damage, personal injury or death.



1. Turn on power to air handler or modular blower.

WARNING

Line Voltage now present.

2. Disconnect the 4-circuit harness connecting the control to the electric heater kit.
3. Provide a thermostat demand for low stage auxiliary heat (W1). Measure the voltage between circuits 1 and 3 at the on-board electric heat connector. Voltage should measure 24VAC. Replace control if no voltage is present.

NOTE: Allow for any built-in time delays before making voltage measurements. Any electric heater faults that are present may prevent the heater output from energizing. Verify that no heater faults are present before making voltage measurements.

4. Provide a thermostat demand for high stage auxiliary heat (W1 + W2). Measure the voltage between circuits 1 and 3 at the on-board electric heat connector. Measure the voltage between circuits 2 and 3 at the on-board electric heat connector. Voltage should measure 24VAC. Replace control if no voltage is present.

Communications (Applies only to Systems with Compatible ComfortNetTM Outdoor Unit and CTK01AA Thermostat)

The integrated air handler control has some on-board tools that may be used to troubleshoot the network. These tools are: red communications LED, green receive (Rx) LED, and learn button. These are described below

a. Red communications LED – Indicates the status of the network. Refer to the Network Troubleshooting Chart for the LED status and the corresponding potential problem.

b. Green receive LED – Indicates network traffic. Refer to the Network Troubleshooting Chart for the LED status and the corresponding potential problem.

c. Learn button – Used to reset the network. Depress the button for approximately 2 seconds to reset the network.

Voltages between the two data lines and between each data line and common may be used to determine if the network is operating properly.

Do the following to measure the voltages on the communi-

cations data lines.

WARNING

Line Voltage now present.

1. With power on to the unit, measure voltage between terminal "1" and terminal "C" on control board's thermostat connector. Voltage should be as noted in the table below.
2. Measure voltage between terminals "2" and "C".
3. Measure voltage between terminals "1" and "2".
4. If voltages are different than stated in the table below, check thermostat wiring for opens/shorts. Confirm that the BIAS and TERM dipswitches are in the ON position.
5. The network troubleshooting chart on the next page provides additonal communications troubleshooting information.

Terminals	Nonimal dc Voltages
1 to C	> 2.5 Vdc
2 to C	< 2.5 Vdc
1 to 2	> 0.2 Vdc

S-50 CHECKING HEATER LIMIT CONTROL(S) *(OPTIONAL ELECTRIC HEATERS)*

Each individual heater element is protected with an automatic rest limit control connected in series with each element to prevent overheating of components in case of low airflow. This limit control will open its circuit at approximately 150°F. to 160°F and close at approximately 110°F.

WARNING

Disconnect ALL power before servicing.

1. Remove the wiring from the control terminals.
2. Using an ohmmeter test for continuity across the normally closed contacts. No reading indicates the control is open - replace if necessary. Make sure the limits are cool before testing.

IF FOUND OPEN - REPLACE - DO NOT WIRE AROUND.

S-52 CHECKING HEATER ELEMENTS

Optional electric heaters may be added, in the quantities shown in the spec sheet for each model unit, to provide electric resistance heating. Under no condition shall more heaters than the quantity shown be installed.

WARNING

HIGH VOLTAGE!
Disconnect ALL power before servicing or installing. Multiple power sources may be present. Failure to do so may cause property damage, personal injury or death.



1. Disassemble and remove the heating element(s).
2. Visually inspect the heater assembly for any breaks in the wire or broken insulators.
3. Using an ohmmeter, test the element for continuity - no reading indicates the element is open. Replace as necessary.

SEQUENCE OF OPERATION

This document covers the basic sequence of operation for a typical application with a mercury bulb thermostat. When a digital/electronic thermostat is used, the on/off staging of the auxiliary heat will vary. **Refer to the installation instructions and wiring diagrams provided with the MBR/AR*F for specific wiring connections and system configuration.**

MBR/AR*F WITH SINGLE STAGE CONDENSERS

1.0 Cooling Operation

1.1 On a demand for cooling, the room thermostat energizes "G" and "Y" and 24Vac is supplied to "Y" at the condensing unit and the "G" terminal on the EBTDR board.

1.2 The compressor and condenser fan are turned on and after a 7 second on delay, the relay on the EBTDR board is energized and the blower motor starts.

1.3 When the cooling demand "Y" is satisfied, the room thermostat removes the 24Vac from "G" and "Y".

1.4 The compressor and condenser fan are turned off and after a 65 second delay off, the relay on the EBTDR board is de-energized and the blower is turned off.

2.0 Heating Operation

2.1 On a demand for heat, the room thermostat energizes "W1" and 24Vac is supplied to heat sequencer, HR1, on the heater assembly.

2.2 The contacts M1 and M2 will close within 10 to 20 seconds and turn on heater element #1. The normally closed contacts on the EBTDR are also connected to terminal M1. When M1 and M2 close, the blower motor will be energized thru the normally closed contacts on the EBTDR board. At the same time, if the heater assembly contains a second heater element, HR1 will contain a second set of contacts, M3 and M4, which will close to turn on heater element #2.

Note: If more than two heater elements are on the heater assembly, it will contain a second heat sequencer, HR2,

SERVICING

NETWORK TROUBLESHOOTING CHART

LED	LED Status	Indication	Possible Causes	Corrective Action(s)	Notes & Cautions
Red Communications LED	Off	• Normal condition	• None	• None	• None
	1 Flash	• Communication Failure	• Communication Failure	• Depress Learn Button	• Depress once quickly for a power-up reset • Depress and hold for 2 seconds for an out-of-box reset
	2 Flashes	• Out-of-box reset	• Control power up • Learn button depressed	• None	• None
Green Receive LED	Off	• No power • Communication error	• No power to modular blower • Open fuse • Communication error	• Check fuses and circuit breakers; replace /reset • Replace blown fuse • Check for shorts in low voltage wiring in modular blower/system • Reset network by depressing learn button • Check data 1/ data 2 voltages	• Turn power OFF prior to repair
	1 Steady Flash	• No network found	• Broken/ disconnected data wire(s) • Modular blower is installed as a legacy/ traditional system	• Check communications wiring (data 1/ data 2 wires) • Check wire connections at terminal block • Verify modular blower installation type (legacy/ traditional or communicating) • Check data 1/ data 2 voltages	• Turn power OFF prior to repair • Verify wires at terminal blocks are securely twisted together prior to inserting into terminal block
	Rapid Flashing	• Normal network traffic	• Control is "talking" on network as expected	• None	• None
	On Solid	• Data 1/ Data 2 miss-wire	• Data 1 and data 2 wires reversed at modular blower thermostat, or CT™ compatible outdoor AC/HP • Short between data 1 and data 2 wires • Short between data 1 or data 2 wires and R (24 VAC) or C (24 VAC common)	• Check communications wiring (data 1/ data 2 wires) • Check wire connections at terminal block • Check data 1/ data 2 voltages	• Turn power OFF prior to repair • Verify wires at terminal blocks are securely twisted together prior to inserting into terminal block

of operation does not cover those applications.

4.1 On a demand for first stage heat with heat pump units, the room thermostat energizes "G" and "Y" and 24Vac is supplied to "Y" at the heat pump unit and the "G" terminal on the EBTDR board. The heat pump is turned on in the heating mode and the blower motor starts after a 7 second on delay.

4.2 If the first stage heat demand cannot be satisfied by the heat pump, the temperature indoors will continue to drop. The room thermostat will then energize terminal "W2' for second stage heat and 24Vac will be supplied to heat sequencer HR1 on the heater assembly.

4.3 HR1 contacts M1 and M2 will close will close within 10 to 20 seconds and turn on heater element #1. At the same time, if the heater assembly contains a second heater element, HR1 will contain a second set of contacts, M3 and M4, which will close and turn on heater element #2. The blower motor is already on as a result of terminal "G" on the EBTDR board being energized for the first stage heat demand.

Note: If more than two heater elements are on the heater assembly, it will contain a second heat sequencer, HR2, which will control the 3rd and 4th heater elements if available. If the second stage heat demand, "W2" cannot be satisfied by the heat pump, the temperature indoors will continue to drop. The room thermostat will then energize "W3" and 24Vac will be supplied to HR2 on the heater assembly. When the "W3" demand is satisfied, the room thermostat will remove the 24Vac from HR2. The contacts on HR2 will open between 30 to 70 seconds and heater elements #3 and #4 will be turned off. **On most digital/electronic thermostats, "W3" will remain energized until the first stage heat demand "Y" is satisfied and then the "G", "Y", "W2" and "W3" demands will be removed.**

4.4 As the temperature indoors increase, it will reach a point where the second stage heat demand, "W2", is satisfied. When this happens, the room thermostat will remove the 24Vac from the coil of HR1. The contacts on HR1 will open between 30 to 70 seconds and turn off both heater element(s). The heat pump remains on along with the blower motor because the "Y" demand for first stage heat will still be present.

4.5 When the first stage heat demand "Y" is satisfied, the room thermostat will remove the 24Vac from "G" and "Y". The heat pump is turned off and the blower motor turns off after a 65 second off delay.

5.0 Defrost Operation

On heat pump units, when the room thermostat is set to the heating mode, the reversing valve is not energized. As long as the thermostat is set for heating, the reversing valve will be in the de-energized position for heating except during a defrost cycle.

5.1 The heat pump will be on and operating in the heating mode as described the Heating Operation in section 4.

5.2 The defrost control in the heat pump unit checks to see if a defrost is needed every 30, 60 or 90 minutes of heat pump operation depending on the selectable setting by monitoring the state of the defrost thermostat attached to the outdoor coil.

5.3 If the temperature of the outdoor coil is low enough to cause the defrost thermostat to be closed when the defrost board checks it, the board will initiate a defrost cycle.

5.4 When a defrost cycle is initiated, the contacts of the HVDR relay on the defrost board open and turns off the outdoor fan. The contacts of the LVDR relay on the defrost board closes and supplies 24Vac to "O" and "W2". The reversing valve is energized and the contacts on HR1 close and turns on the electric heater(s). The unit will continue to run in this mode until the defrost cycle is completed.

5.5 When the temperature of the outdoor coil rises high enough to causes the defrost thermostat to open, the defrost cycle will be terminated. If at the end of the programmed 10 minute override time the defrost thermostat is still closed, the defrost board will automatically terminate the defrost cycle.

5.6 When the defrost cycle is terminated, the contacts of the HVDR relay will close to start the outdoor fan and the contacts of the LVDR relay will open and turn off the reversing valve and electric heater(s). The unit will now be back in a normal heating mode with a heat pump demand for heating as described in the Heating Operation in section 4.

MBE/AEPF WITH GSX, SSX, ASX, dsx

MBE ELECTRONIC BLOWER TIME DELAY RELAY

AEPF AIR HANDLER

SEQUENCE OF OPERATION

This document covers the basic sequence of operation for a typical application with a mercury bulb thermostat. When a digital/electronic thermostat is used, the on/off staging of the auxiliary heat will vary. **Refer to the installation instructions and wiring diagrams provided with the MBE/AEPF for specific wiring connections, dip switch settings and system configuration.**

MBE/AEPF WITH SINGLE STAGE GSX, ASX AND SSX CONDENSERS

When used with a single stage GSX, SSX and ASX condensers, dip switch #4 must be set to the on position on the VSTB inside the MBE/AEPF. The "Y" output from the indoor thermostat must be connected to the yellow wire labeled "Y/Y2" inside the wire bundle marked "Thermostat" and the yellow wire labeled "Y/Y2" inside the wire bundle marked "Outdoor Unit" must be connected to "Y" at the condenser. **The orange jumper wire from terminal "Y1" to terminal "O" on the VSTB** inside the MBE/AEPF must remain connected.

1.0 Cooling Operation

which will control the 3rd and 4th heater elements if available. If the first stage heat demand, "W1" cannot be satisfied by the heat pump, the temperature indoors will continue to drop. The room thermostat will then energize "W2" and 24Vac will be supplied to HR2 on the heater assembly. When the "W2" demand is satisfied, the room thermostat will remove the 24Vac from HR2. The contacts on HR2 will open between 30 to 70 seconds and heater elements #3 and #4 will be turned off. **On most digital/electronic thermostats, "W2" will remain energized until the first stage demand "W1" is satisfied and then the "W1" and "W2" demands will be removed.**

2.3 When the "W1" heat demand is satisfied, the room thermostat will remove the 24Vac from HR1. Both set of contacts on the relay opens within 30 to 70 seconds and turn off the heater element(s) and the blower motor.

MBR/AR*F WITH SINGLE STAGE HEAT PUMPS

3.0 Cooling Operation

On heat pump units, when the room thermostat set to the cooling mode, 24Vac is supplied to "O" which energizes the reversing valve. As long as the thermostat is set for cooling, the reversing valve will be in the energized position for cooling.

3.1 On a demand for cooling, the room thermostat energizes "G" and "Y" and 24Vac is supplied to "Y" at the heat pump and the "G" terminal on the EBTDR board.

3.2 The heat pump turned on in the cooling mode and after a 7 second on delay, the relay on the EBTDR board is energized and the blower motor starts.

3.3 When the cooling demand is satisfied, the room thermostat removes the 24Vac from "G" and "Y".

3.4 The heat pump is turned off and after a 65 second delay off, the relay on the EBTDR board is de-energized and the blower motor is turned off.

4.0 Heating Operation

On heat pump units, when the room thermostat set to the heating mode, the reversing valve is not energized. As long as the thermostat is set for heating, the reversing valve will be in the de-energized position for heating except during a defrost cycle. Some installations may use one or more outdoor thermostats to restrict the amount of electric heat that is available above a preset ambient temperature. Use of optional controls such as these can change the operation of the electric heaters during the heating mode. This sequence **1.1** On a demand for cooling, the room thermostat energizes "G" and "Y" and 24Vac is supplied to "G" and "Y/Y2" of the MBE/AEPF unit. The VSTB inside the MBE/AEPF will turn on the blower motor and the motor will ramp up to the speed programmed in the motor based on the settings for dip switch 5 and 6. The VSTB will supply 24Vac to "Y" at the condenser and the compressor and condenser are turned on.

1.2 When the cooling demand is satisfied, the room thermostat removes the 24Vac from "G" and "Y". The MBE/AEPF removes the 24Vac from "Y' at the condenser and the compressor and condenser fan are turned off. The blower motor will ramp down to a complete stop based on the time and rate programmed in the motor.

2.0 Heating Operation

2.1 On a demand for heat, the room thermostat energizes "W1" and 24Vac is supplied to terminal "E/W1" of the VSTB inside the MBE/AEPF unit. The VSTB will turn on the blower motor and the motor will ramp up to the speed programmed in the motor based on the settings for dip switch 1 and 2. The VSTB will supply 24Vac to heat sequencer HR1 on the electric heater assembly.

2.2 HR1 contacts M1 and M2 will close within 10 to 20 seconds and turn on heater element #1. At the same time, if the heater assembly contains a second heater element, HR1 will contain a second set of contacts, M3 and M4, which will close and turn on heater element #2.

Note: If more than two heater elements are on the heater assembly, it will contain a second heat sequencer, HR2, which will control the 3rd and 4th heater elements if available. **For the 3rd and 4th heater elements to operate on a second stage heat demand, the PJ4 jumper on the VSTB inside the MBE/AEPF must be cut.** With the PJ4 jumper cut, the VSTB will run the blower motor on low speed on a "W1" only demand. If the first stage heat demand, "W1" cannot be satisfied by the heat pump, the temperature indoors will continue to drop. The room thermostat will then energize "W2" and 24Vac will be supplied to HR2 on the heater assembly and the blower motor will change to high speed. When the "W2" demand is satisfied, the room thermostat will remove the 24Vac from "W2" and the VSTB will remove the 24Vac from HR2. The contacts on HR2 will open between 30 to 70 seconds and heater elements #3 and #4 will be turned off and the blower motor will change to low speed. **On most digital/electronic thermostats, "W2" will remain energized until the first stage demand "W1" is satisfied and then the "W1" and "W2" demands will be removed.**

2.3 When the "W1" heat demand is satisfied, the room thermostat will remove the 24Vac from "E/W1" and the VSTB removes the 24Vac from HR1. The contacts on HR1 will open between 30 to 70 seconds and turn off the heater element(s) and the blower motor ramps down to a complete stop.

MBE/AEPF WITH SINGLE STAGE

GSZ, SSZ, & ASZ HEAT PUMPS

When used with a single stage GSZ, SSZ or ASZ heat pumps, dip switch #4 must be set to the ON position on the VSTB inside the MBE. The "Y" output from the indoor thermostat must be connected to the yellow wire labeled "Y/Y2" inside the wire bundle marked "Thermostat" and the yellow wire labeled "Y/Y2" inside the wire bundle marked "Outdoor Unit" must be connected to "Y" at the heat pump. **The orange jumper wire from terminal "Y1" to terminal "O" on the VSTB inside the MBE/AEPF must be re-**

moved.

3.0 COOLING OPERATION

On heat pump units, when the room thermostat is set to the cooling mode, 24Vac is supplied to terminal "O" of the VSTB inside the MBE/AEPF unit. The VSTB will supply 24Vac to "O" at the heat pump to energize the reversing valve. As long as the thermostat is set for cooling, the reversing valve will be in the energized position for cooling.

3.1 On a demand for cooling, the room thermostat energizes "G" and "Y" and 24Vac is supplied to terminals "G" and "Y/Y2" of the MBE/AEPF unit. The VSTB will turn on the blower motor and the motor will ramp up to the speed programmed in the motor based on the settings of dip switch 5 and 6. The VSTB will supply 24Vac to "Y" at the heat pump.

3.2 The heat pump is turned on in the cooling mode.

3.3 When the cooling demand is satisfied, the room thermostat removes the 24Vac from "G" and "Y/Y2" of the MBE/AEPF and the VSTB removes the 24Vac from "Y" at the heat pump. The heat pump is turned off and the blower motor will ramp down to a complete stop based on the time and rate programmed in the motor.

4.0 HEATING OPERATION

On heat pump units, when the room thermostat is set to the heating mode, the reversing valve is not energized. As long as the thermostat is set for heating, the reversing valve will be in the de-energized position for heating except during a defrost cycle. Some installations may use one or more outdoor thermostats to restrict the amount of electric heat that is available above a preset ambient temperature. Use of optional controls such as these can change the operation of the electric heaters during the heating mode. This sequence of operation does not cover those applications.

4.1 On a demand for first stage heat with heat pump units, the room thermostat energizes "Y" and "G" and 24Vac is supplied to "G" and "Y/Y2" of the MBE/AEPF. The VSTB will turn on the blower motor and the motor will ramp up to the speed programmed in the motor based on the settings of dip switch 1 and 2. The VSTB will supply 24Vac to "Y" at the heat pump and the heat pump is turned on in the heating mode.

4.2 If the first stage heat demand cannot be satisfied by the heat pump, the temperature indoors will continue to drop. The room thermostat will then energize terminal "W2" for second stage heat and 24Vac will be supplied to "E/W1" of the MBE/AEPF. The VSTB will supply 24Vac to heat sequencer, HR1, on the electric heater assembly.

4.3 HR1 contacts M1 and M2 will close within 10 to 20 seconds and turn on heater element #1. At the same time, if the heater assembly contains a second heater element, HR1 will contain a second set of contacts, M3 and M4, which will close to turn on heater element #2.

Note: If more than two heater elements are on the heater assembly, it will contain a second heat sequencer, HR2, which will control the 3rd and 4th heater elements if available. **For the 3rd and 4th heater elements to operate on a third stage heat demand, the PJ4 jumper on the VSTB inside the MBE/AEPF must be cut.** If the second stage heat demand, "W2", cannot be satisfied by the heat pump, the temperature indoors will continue to drop. The room thermostat will then energize "W3" and 24Vac will be supplied to "W/W2" of the MBE/AEPF. The VSTB will supply 24Vac to HR2 on the electric heater assembly. When the "W3" demand is satisfied, the room thermostat will remove the 24Vac from "W/W2" of the MBE/AEPF. The contacts on HR2 will open between 30 to 70 seconds and heater elements #3 and #4 will be turned off. **On most digital/electronic thermostats, "W3" will remain energized until the first stage demand "Y" is satisfied and then the "G", "Y", "W2" and "W3" demands will be removed.**

4.4 As the temperature indoors increase, it will reach a point where the second stage heat demand, "W2", is satisfied. When this happens, the room thermostat will remove the 24Vac from "E/W1" of the MBE/AEPF. The contacts on HR1 will open between 30 to 70 seconds and turn off both heater element(s). The heat pump remains on along with the blower motor because the "Y" demand for first stage heat will still be present.

4.5 When the first stage heat demand "Y" is satisfied, the room thermostat will remove the 24Vac from "G" and "Y/Y2" of the MBE/AEPF. The VSTB removes the 24Vac from "Y" at the heat pump and the heat pump is turned off. The blower motor will ramp down to a complete stop based on the time and rate programmed in the motor control.

5.0 DEFROST OPERATION

On heat pump units, when the room thermostat is set to the heating mode, the reversing valve is not energized. As long as the thermostat is set for heating, the reversing valve will be in the de-energized position for heating except during a defrost cycle.

5.1 The heat pump will be on and operating in the heating mode as described the Heating Operation in section 4.

5.2 The defrost control in the heat pump unit checks to see if a defrost is needed every 30, 60 or 90 minutes of heat pump operation depending on the selectable setting by monitoring the state of the defrost thermostat attached to the outdoor coil.

5.3 If the temperature of the outdoor coil is low enough to cause the defrost thermostat to be closed when the defrost board checks it, the board will initiate a defrost cycle.

5.4 When a defrost cycle is initiated, the contacts of the HVDR relay on the defrost board open and turns off the outdoor fan. The contacts of the LVDR relay on the defrost board closes and supplies 24Vac to "O" and "W2". The reversing valve is energized and the contacts on HR1 close and turns on the electric heater(s). The unit will continue to run in this mode until the defrost cycle is completed.

SERVICING

5.5 When the temperature of the outdoor coil rises high enough to causes the defrost thermostat to open, the defrost cycle will be terminated. If at the end of the programmed 10 minute override time the defrost thermostat is still closed, the defrost board will automatically terminate the defrost cycle.

5.6 When the defrost cycle is terminated, the contacts of the HVDR relay on the defrost board will close to start the outdoor fan and the contacts of the LVDR relay will open and turn off the reversing valve and electric heater(s). The unit will now be back in a normal heating mode with a heat pump demand for heating as described in the Heating Operation in section 4.

SEQUENCE OF OPERATION

This document covers the basic sequence of operation for a typical application with a mercury bulb thermostat. When a digital/electronic thermostat is used, the on/off staging of the outdoor unit and auxiliary heat will vary. Refer to the installation instructions and wiring diagrams provided with the MBE for specific wiring connections, dip switch settings and system configuration.

MBE/AEPF WITH TWO STAGE ASX & DSX CONDENSERS

1.0 COOLING OPERATION

When used with the ASX & DSX two stage condensers, dip switch #4 must be set to the OFF position on the VSTB inside the MBE/AEPF. The "Y1" output from the indoor thermostat must be connected to the purple wire labeled "Ylow/Y1" inside the wire bundle marked "Thermostat" and the purple wire labeled "Ylow/Y1" inside the wire bundle marked "Outdoor Unit" must be connected to "Ylow/Y1" at the condenser. The "Y2" output from the indoor thermostat must be connected to the yellow wire labeled "Y/Y2" inside the wire bundle marked "Thermostat" and the yellow wire labeled "Y/Y2" inside the wire bundle marked "Outdoor Unit" must be connected to "Y/Y2" at the condenser. **The orange jumper wire from terminal "Y1" to terminal "O" on the VSTB inside the MBE/AEPF must remain connected.**

1.1 On a demand for cooling, the room thermostat energizes "G" and "Y1" and 24Vac is supplied to "G" and "Ylow/Y1" of the MBE/AEPF unit. The VSTB inside the MBE/AEPF will turn on the blower motor and the motor will ramp up to 60% of the speed programmed in the motor based on the settings for dip switch 5 and 6. The VSTB will supply 24Vac to "Ylow/Y1" at the condenser and the compressor and condenser fan starts in low speed operation.

1.2 If first stage cooling cannot satisfy the demand, the room thermostat will energize "Y2" and supply 24Vac to the MBE/AEPF unit. The blower motor will change to the cfm for high speed operation and the VSTB will supply 24Vac to "Y/Y2" at the condenser and the compressor and condenser fan will change to high speed operation. When the "Y2" demand is satisfied, the thermostat will remove the "Y2" demand and the VSTB will remove the 24Vac from "Y/Y2" at the condenser. The blower will drop to 60% of the programmed cfm and the compressor and condenser fan will change to low speed. **On most digital/electronic thermostats, "Y2" will remain energized until the first stage cooling demand "Y1" is satisfied and then the "G", "Y1" and "Y2" demands will be removed.**

1.3 When the first stage cooling demand, "Y1", is satisfied, the room thermostat removes the 24Vac from "G" and "Y1". The MBE/AEPF removes the 24Vac from "Ylow/Y1' at the condenser and the compressor and condenser fan are turned off. The blower motor will ramp down to a complete stop based on the time and rate programmed in the motor.

2.0 Heating Operation

2.1 On a demand for heat, the room thermostat energizes "W1" and 24Vac is supplied to terminal "E/W1" of the VSTB inside the MBE/AEPF unit. The VSTB will turn on the blower motor and the motor will ramp up to the speed programmed in the motor based on the settings for dip switch 1 and 2. The VSTB will supply 24Vac to heat sequencer HR1 on the electric heater assembly.

2.2 HR1 contacts M1 and M2 will close within 10 to 20 seconds and turn on heater element #1. At the same time, if the heater assembly contains a second heater element, HR1 will contain a second set of contacts, M3 and M4, which will close and turn on heater element #2.

Note: If more than two heater elements are on the heater assembly, it will contain a second heat sequencer, HR2, which will control the 3rd and 4th heater elements if available. **For the 3rd and 4th heater elements to operate on a second stage heat demand, the PJ4 jumper on the VSTB inside the MBE/AEPF must be cut.** With the PJ4 jumper cut, the VSTB will run the blower motor on low speed on a "W1" only demand. If the first stage heat demand, "W1" cannot be satisfied by the heat pump, the temperature indoors will continue to drop. The room thermostat will then energize "W2" and 24Vac will be supplied to HR2 on the heater assembly and the blower motor will change to high speed. When the "W2" demand is satisfied, the room thermostat will remove the 24Vac from "W2" and the VSTB will remove the 24Vac from HR2. The contacts on HR2 will open between 30 to 70 seconds and heater elements #3 and #4 will be turned off and the blower motor will change to low speed. **On most digital/electronic thermostats, "W2" will remain energized until the first stage demand "W1" is satisfied and then the "W1" and "W2" demands will be removed.**

2.3 When the "W1" heat demand is satisfied, the room thermostat will remove the 24Vac from "E/W1" and the VSTB removes the 24Vac from HR1. The contacts on HR1 will open between 30 to 70 seconds and turn off the heater element(s) and the blower motor ramps down to a complete stop.

MBE/AEPF WITH TWO STAGE ASZ & DSZ HEAT PUMP

SERVICING

UNITS

3.0 Cooling Operation

When used with the ASZ & DSZ two stage heat pumps, dip switch #4 must be set to the OFF position on the VSTB inside the MBE/AEPF. The "Y1" output from the indoor thermostat must be connected to the purple wire labeled "Ylow/Y1" inside the wire bundle marked "Thermostat" and the purple wire labeled "Ylow/Y1" inside the wire bundle marked "Outdoor Unit" must be connected to "Y" at the heat pump. The "Y2" output from the indoor thermostat must be connected to the yellow wire labeled "Y/Y2" inside the wire bundle marked "Thermostat" and the yellow wire labeled "Y/Y2" inside the wire bundle marked "Outdoor Unit" must be connected to "Y/Y2" at the heat pump. **The orange jumper wire from terminal "Y1" to terminal "O" on the VSTB inside the MBE/AEPF must be removed.**

On heat pump units, when the room thermostat is set to the cooling mode, 24Vac is supplied to terminal "O" of the VSTB inside the MBE unit. The VSTB will supply 24Vac to "O" at the heat pump to energize the reversing valve. As long as the thermostat is set for cooling, the reversing valve will be in the energized position for cooling.

3.1 On a demand for cooling, the room thermostat energizes "G" and "Y1" and 24Vac is supplied to "G" and "Ylow/Y1" of the MBE unit. The VSTB inside the MBE will turn on the blower motor and the motor will ramp up to 60% of the speed programmed in the motor based on the settings for dip switch 5 and 6. The VSTB will supply 24Vac to "Y" at the heat pump and the compressor and outdoor fan starts in low speed operation.

3.2 If first stage cooling cannot satisfy the demand, the room thermostat will energize "Y2" and supply 24Vac to "Y/Y2"of the MBE unit. The blower motor will change to the cfm for high speed operation and the VSTB will supply 24Vac to "Y2" at the heat pump. The compressor and outdoor fan will change to high speed operation. When the "Y2" demand is satisfied, the thermostat will remove the "Y2" demand and the VSTB will remove the 24Vac from "Y2" at the heat pump. The blower will drop to 60% of the programmed cfm and the compressor and outdoor fan will change to low speed operation. **On most digital/electronic thermostats, "Y2" will remain energized until the first stage cooling demand "Y1" is satisfied and then the "G", "Y1" and "Y2" demands will be removed.**

3.3 When the first stage cooling demand, "Y1", is satisfied, the room thermostat removes the 24Vac from "G" and "Y1". The VSTB removes the 24Vac from "Y' at the heat pump and the compressor and outdoor fan are turned off. The blower motor will ramp down to a complete stop based on the time and rate programmed in the motor.

4.0 Heating Operation

On heat pump units, when the room thermostat is set to the heating mode, the reversing valve is not energized. As long as the thermostat is set for heating, the reversing valve will be in the de-energized position for heating except during a defrost cycle. Some installations may use one or more outdoor thermostats to restrict the amount of electric heat that is available above a preset ambient temperature. Use of optional controls such as these can change the operation of the electric heaters during the heating mode. This sequence of operation does not cover those applications.

4.1 On a demand for first stage heat with heat pump units, the room thermostat energizes "G" and "Y1" and 24Vac is supplied to "G" and "Ylo/Y1" of the MBE/AEPF. The VSTB will turn on the blower motor and the motor will ramp up to 60% of the speed programmed in the motor based on the settings of dip switch 1 and 2. The VSTB will supply 24Vac to "Y" at the heat pump. **The compressor will start on low stage and outdoor fan will start on low speed on a "Y1" heating demand but the blower motor will deliver only 60% of the programmed cfm for high speed heating operation.**

4.2 If a thermostat that provides a "Y2" demand in heating is used and first stage heating cannot satisfy the demand, the room thermostat will energize "Y2" and supply 24Vac to "Y/Y2" of the MBE unit. The blower motor will change to the cfm for high speed heating operation and the VSTB will supply 24Vac to "Y/Y2" at the heat pump. The outdoor fan will change to high speed operation and compressor will shift to high stage. If the "Y2" demand is present and becomes satisfied, the thermostat will remove the "Y2" demand and the VSTB will remove the 24Vac from "Y/Y2" at the heat pump. The blower will drop to 60% of the programmed cfm and the outdoor fan will change to low speed. On most digital/electronic thermostats, "Y2" will remain energized until the first stage heating demand "Y1" is satisfied and then the "G", "Y1" and "Y2" demands will be removed.

4.3 If the heat pump operation cannot satisfy the demand, the room thermostat energizes "W2/W3" and 24Vac is supplied to terminal "E/W1" of the VSTB inside the MBE/AEPF unit. The VSTB will supply 24Vac to heat sequencer HR1 on the electric heater assembly.

4.4 HR1 contacts M1 and M2 will close within 10 to 20 seconds and turn on heater element #1. At the same time, if the heater assembly contains a second heater element, HR1 will contain a second set of contacts, M3 and M4, which will close and turn on heater element #2.

Note: If more than two heater elements are on the heater assembly, it will contain a second heat sequencer, HR2, which will control the 3rd and 4th heater elements if available. **For the 3rd and 4th heater elements to operate on a second stage auxiliary heat demand, the PJ4 jumper on the VSTB inside the MBE/AEPF must be cut.** If the "W2/W3" demand cannot be satisfied by the heat pump, the temperature indoors will continue to drop. The room thermostat will then energize "W3/W4" and 24Vac will be supplied to "W/W2" of the MBE. The VSTB will supply 24Vac to HR2 on the electric heater assembly. When the "W3/W4" demand is satisfied, the room thermostat will remove the 24Vac from

"W/W2" of the MBE/AEPF. The contacts on HR2 will open between 30 to 70 seconds and heater elements #3 and #4 will be turned off. **On most digital/electronic thermostats, "W3/W4" will remain energized until the first stage demand "Y1" is satisfied and then the "G", "Y1", "Y2" "W2/W3" and "W3/W4" demands will be removed.**

4.5 As the temperature indoors increase, it will reach a point where the "W2/W3" demand is satisfied. When this happens, the room thermostat will remove the 24Vac from "E/W1" of the MBE/AEPF. The contacts on HR1 will open between 30 to 70 seconds and turn off the 1st and 2nd heater elements. If the "Y2" demand is present and becomes satisfied the room thermostat will remove the 24Vac from "Y/Y2" of the MBE and the blower motor will change to 60% of the programmed cfm. The VSTB will remove the 24Vac from "Y/Y2" at the heat pump and the outdoor fan will change to low speed operation. The heat pump remains on along with the blower motor because the "Y1" demand for first stage heat will still be present.

4.6 When the first stage heat demand "Y1" is satisfied, the room thermostat will remove the 24Vac from "G" and "Ylo/Y1" of the MBE/AEPF. The VSTB removes the 24Vac from "Ylo/Y1" at the heat pump and the compressor and outdoor fan are turned off. The blower motor will ramp down to a complete stop based on the time and rate programmed in the motor control.

5.0 Defrost Operation

On heat pump units, when the room thermostat is set to the heating mode, the reversing valve is not energized. As long as the thermostat is set for heating, the reversing valve will be in the de-energized position for heating except during a defrost cycle.

5.1 The heat pump will be on and operating in the heating mode as described the Heating Operation in section 4.

5.2 The defrost control in the heat pump unit checks to see if a defrost is needed every 30, 60 or 90 minutes of heat pump operation depending on the selectable setting by monitoring the state of the defrost thermostat attached to the outdoor coil.

5.3 If the temperature of the outdoor coil is low enough to cause the defrost thermostat to be closed when the defrost board checks it, the board will initiate a defrost cycle.

5.4 When a defrost cycle is initiated, the contacts of the HVDR relay on the defrost board open and turns off the outdoor fan. The contacts of the LVDR relay on the defrost board closes and supplies 24Vac to "O" and "W2". The reversing valve is energized and the contacts on HR1 close and turns on the electric heater(s). The unit will continue to run in this mode until the defrost cycle is completed.

5.5 When the temperature of the outdoor coil rises high enough to causes the defrost thermostat to open, the defrost cycle will be terminated. If at the end of the programmed 10 minute override time the defrost thermostat is still closed, the defrost board will automatically terminate the defrost cycle.

5.6 When the defrost cycle is terminated, the contacts of the HVDR relay on the defrost board will close to start the outdoor fan and the contacts of the LVDR relay will open and turn off the reversing valve and electric heater(s). The unit will now be back in a normal heating mode with a heat pump demand for heating as described in the Heating Operation in section 4.

SEQUENCE OF OPERATION

AVPTC/MBVC with Single Stage Condensers (24VAC Legacy Wired Systems)

1.0 Cooling Operation

1.1 On a demand for single stage cooling operation, the thermostat closes the "G" and "Y" contacts providing 24VAC to the "G", "Y1", and "Y2" terminals at the integrated air handler control. The integrated AH control initiates the selected cooling ramping profile after any blower ON delays have expired. After completing any blower ON delays and ramping profile, the control operates the variavble speed ECM motor at the demanded airflow.

1.2 The compressor and condensor fan motor is energized by the closing of the thermostat "Y" contacts.

1.3 The system operates at single stage cooling.

1.4 Upon satisfying the thermostat, the "G" and "Y" thermostat contacts open, removing 24VAC from the both the outdoor condensor and integrated air handler control. The compressor and condensor fan motor are both de-energized immediately. The integrated AH control continues to operate the ECM blower motor for an OFF delay period, then applies the off portion of the selected ramping profile. The ECM blower motor is then de-energized.

2.0 Heating Operation

2.1 On a demand for auxiliary heat operation, the thermostat closes the "W1" contacts providing 24VAC to the "W1" terminal at the integrated air handler control. The integrated AH control initiates the heating ramping profile after any blower ON delays have expired. After completing any blower ON delays and ramping profile, the control operates the variavble speed ECM motor at the demanded airflow.

2.2 The system operates at low stage auxiliary heat.

2.3 If the thermostat demand cannot be met on low stage auxiliary heat, the thermostat will close the "W2" contacts, providing 24VAC to the "W2" terminal at the integrated AH control. Thermostat "W1" contacts remain closed.

2.4 Upon receiving the high stage auxiliary heat demand, the control operates the ECM blower motor at the demanded airflow.

2.5 The system operates at high stage auxiliary heat as demanded by the thermostat.

2.6 Upon satisfying the thermostat, the "W1" thermostat

contacts (or "W1" and "W2" contacts) open, removing 24VAC from the integrated air handler control. The integrated AH control continues to operate the ECM blower motor for an OFF delay period, then applies the off portion of the heating ramping profile. The ECM blower motor is then de-energized.

3.0 Continuous Fan Operation

3.1 On a demand for continuous fan operation, the thermostat closes the "G" contacts providing 24VAC to the "G" terminal at the integrated air handler control. The control energizes the variavble speed ECM motor at 30% of the air handler's maximum airflow capability.

3.2 Removing the thermostat demand for continuous fan opens the "G" contacts, removing 24VAC from the integrated air handler control. The integrated AH control immediately de-energizes the ECM blower motor.

AVPTC/MBVC with Single Stage Heat Pumps (24VAC Legacy Wired Systems)

1.0 Cooling Operation

1.1 On a demand for single stage cooling operation, the thermostat closes the "G", "O", and "Y" contacts providing 24VAC to the "G", "O", "Y1", and "Y2" terminals at the integrated air handler control. The integrated AH control initiates the selected cooling ramping profile after any blower ON delays have expired. After completing any blower ON delays and ramping profile, the control operates the variavble speed ECM motor at the demanded airflow.

1.2 The compressor and condensor fan motor is energized by the closing of the thermostat "Y" contacts. The reveersing valve is energized by the closing of the thermostat "O" contacts.

1.3 The system operates at single stage cooling.

1.4 Upon satisfying the thermostat, the "G", "O", and "Y" thermostat contacts open, removing 24VAC from the both the outdoor condensor and integrated air handler control. The compressor, condensor fan motor, and reversing valve are de-energized immediately. The integrated AH control continues to operate the ECM blower motor for an OFF delay period, then applies the off portion of the selected ramping profile. The ECM blower motor is then de-energized.

2.0 Heating Operation

2.1 On a demand for heat pump heating, the room thermostat closes the "G" and "Y" contacts, providing 24VAC to the "G" and "Y" terminals at the integrated air handler control. The integrated AH control initiates the heat pump heating ramping profile after any blower ON delays have expired. After completing any blower ON delays and ramping profile, the control operates the variavble speed ECM motor at the demanded airflow.

2.2 The compressor and condensor fan motor are energized by the closing of the thermostat "Y" contacts.

2.3 The system operates at single stage heat pump heat.

2.4 If the thermostat demand cannot be met with heat pump heating, the thermostat will close the "W1/W2" contacts, providing 24VAC to the "W1" or "W1" and "W2" terminals at the integrated AH control. Thermostat "G" and "Y" contacts remain closed.

2.5 Upon receiving a demand for auxiliary heat, the control determines the appropriate airflow demand for heat pump + auxiliary heat operation and operates the ECM blower motor at that airflow demand. The control determines which airflow demand is greatest and applies that demand when operating the ECM blower motor.

2.6 The system operates at single stage heat pump heating plus auxiliary heat.

2.5 Upon satisfying the thermostat, the "G" and "Y" thermostat contacts (or "G", "Y" and "W1/W2" contacts) open, removing 24VAC from the integrated air handler control. The integrated AH control continues to operate the ECM blower motor for an OFF delay period, then applies the off portion of the heat pump heating ramping profile. The ECM blower motor is then de-energized.

3.0 Continuous Fan Operation

3.1 On a demand for continuous fan operation, the thermostat closes the "G" contacts providing 24VAC to the "G" terminal at the integrated air handler control. The control energizes the variavble speed ECM motor at 30% of the air handler's maximum airflow capability.

3.2 Removing the thermostat demand for continuous fan opens the "G" contacts, removing 24VAC from the integrated air handler control. The integrated AH control immediately de-energizes the ECM blower motor.

4.0 Defrost Operation

4.1 The control in the outdoor unit determines when a defrost cycle is needed. Upon determing that a defrost cycle is needed, the outdoor control de-energizes the condensor fan motor and energizes the reversing valve. A "W1" signal is sent from the outdoor unit control to the integrated air handler control.

4.2 The air handler control energizes the eletric heat sequencer output to turn on the electric heaters. The appropriate airflow demand is provided to the motor (greater of heat pump or auxiliary heat).

4.3 At the conclusion of the defrost cycle, the outdoor unit control removes the "W1" output to the integrated air handler control, de-energizes the reversing valve and re-energizes the condensor fan motor.

5.0 Emergency Heat Operation

5.1 On a demand for emergency heat operation, the thermostat closes the "W1/W2" contacts providing 24VAC to the "W1" terminal at the integrated air handler control. The integrated AH control initiates the heating ramping profile after any blower ON delays have expired. After completing any blower ON delays and ramping profile, the control operates the variavble speed ECM motor at the demanded airflow.

5.2 The system operates at emergency heat.

5.3 Upon satisfying the thermostat emergnecy heat demand, the "W1" thermostat contacts open, removing 24VAC from the integrated air handler control. The integrated AH control continues to operate the ECM blower motor for an OFF delay period, then applies the off portion of the heating ramping profile. The ECM blower motor is then de-energized.

AVPTC/MBVC with 2-Stage Condensers (24VAC Legacy Wired Systems)

1.0 Cooling Operation

1.1 On a demand for low stage cooling operation, the thermostat closes the "G" and "Y1" contacts providing 24VAC to the "G" and "Y1" terminals at the integrated air handler control. The integrated AH control initiates the selected cooling ramping profile after any blower ON delays have expired. After completing any blower ON delays and ramping profile, the control operates the variavble speed ECM motor at the demanded airflow.

1.2 The compressor and condensor fan motor are energized by the closing of the thermostat "Y1" contacts.

1.3 The system operates at low stage cooling.

1.4 If the thermostat demand cannot be met with low stage cooling, the thermostat closes the "Y2" contacts, providing 24VAC to the "Y2" terminal at the AH control. The integrated AH control operates the ECM blower motor at the high stage cooling airflow demand. Thermostat "G" and Y1" contacts remain closed.

1.5 The compressor and condensor fan motor high stage speeds are energized by the closing of the thermostat "Y2" contacts.

1.6 The system operates at high stage cooling.

1.7 Upon satisfying the thermostat, the "G", "Y1" and "Y2" thermostat contacts open, removing 24VAC from the both the outdoor condensor and integrated air handler control. The compressor and condensor fan motor are both de-energized immediately. The integrated AH control continues to operate the ECM blower motor for an OFF delay period, then applies the off portion of the selected ramping profile. The ECM blower motor is then de-energized.

2.0 Heating Operation

2.1 On a demand for auxiliary heat operation, the thermostat closes the "W1" contacts providing 24VAC to the "W1" terminal at the integrated air handler control. The integrated AH control initiates the heating ramping profile after any blower ON delays have expired. After completing any blower ON delays and ramping profile, the control operates the variavble speed ECM motor at the demanded airflow.

2.2 The system operates at low stage auxiliary heat.

2.3 If the thermostat demand cannot be met on low stage auxiliary heat, the thermostat will close the "W2" contacts, providing 24VAC to the "W2" terminal at the integrated AH control. Thermostat "W1" contacts remain closed.

2.4 The system operates on high stage auxiliary heat.

2.5 Upon receiving the high stage auxiliary heat demand, the control operates the ECM blower motor at the high stage auxiliary heat airflow.

2.6 Upon satisfying the thermostat, the "W1" thermostat contacts (or "W1" and "W2" contacts) open, removing 24VAC from the integrated air handler control and outdoor unit. The compressor and condensor fan motor are immediately de-enerized. The integrated AH control continues to operate the ECM blower motor for an OFF delay period, then applies the off portion of the heating ramping profile. The ECM blower motor is then de-energized.

3.0 Continuous Fan Operation

3.1 On a demand for continuous fan operation, the thermostat closes the "G" contacts providing 24VAC to the "G" terminal at the integrated air handler control. The control energizes the variavble speed ECM motor at 30% of the air handler's maximum airflow capability.

3.2 Removing the thermostat demand for continuous fan opens the "G" contacts, removing 24VAC from the integrated air handler control. The integrated AH control immediately de-energizes the ECM blower motor.

AVPTC/MBVC with 2-Stage Heat Pumps (24VAC Legacy Wired Systems)

1.0 Cooling Operation

1.1 On a demand for low stage cooling operation, the thermostat closes the "G", "O", and "Y1" contacts providing 24VAC to the "G", "O", and "Y1" terminals at the integrated air handler control. The integrated AH control initiates the selected cooling ramping profile after any blower ON delays have expired. After completing any blower ON delays and ramping profile, the control operates the variavble speed ECM motor at the low stage cooling airflow.

1.2 The low stage compressor and condensor fan motor speeds are energized by the closing of the thermostat "Y1" contacts. The reversing valve is energized with the closing of the thermostat "O" contacts.

1.3 The system operates at low stage cooling.

1.4 If the thermostat demand cannot be met with low stage cooling, the thermostat closes the "Y2" contacts, providing 24VAC to the "Y2" terminal at the AH control. The integrated AH control operates the ECM blower motor at the high stage cooling airflow demand. Thermostat "G", "O", and Y1" contacts remain closed.

1.5 The compressor and condensor fan motor high stage speeds are energized by the closing of the thermostat "Y2" contacts.

1.6 The system operates at high stage cooling.

1.7 Upon satisfying the thermostat, the "G", "O", and "Y1" (or "Y1" and "Y2") thermostat contacts open, removing 24VAC from the both the outdoor condensor and integrated air handler control. The compressor, condensor

fan motor, and reverving valve are all de-energized immediately. The integrated AH control continues to operate the ECM blower motor for an OFF delay period, then applies the off portion of the selected ramping profile. The ECM blower motor is then de-energized.

2.0 Heating Operation

2.1 On a demand for low stage heat pump heating, the room thermostat closes the "G" and "Y1" contacts, providing 24VAC to the"G" and "Y1" terminals at the integrated air handler control. The integrated AH control initiates the heat pump heating ramping profile after any blower ON delays have expired. After completing any blower ON delays and ramping profile, the control operates the variavble speed ECM motor at the low stage heat pump airflow.

2.2 The low stage compressor and condensor fan motor speeds are energized by the closing of the thermostat "Y1" contacts.

2.3 The system operates at low stage heat pump heating.

2.4 If the thermostat demand cannot be met with low stage heat pump heating, the thermostat will close the "Y2" contacts, providing 24VAC to the "Y2" terminals at the integrated AH control and heat pump. Thermostat "G" and "Y1" contacts remain closed. The air handler control operates the ECM blower motor at the high stage heat pump heating airflow.

2.5 The system operates at high stage heat pump heating.

2.6 If the thermostat demand cannot be met with high stage heat pump heating, the thermostat will close the "W1/W2" contacts, providing 24VAC to the "W1" or "W1" and "W2" terminals at the integrated AH control. Thermostat "G", "Y1", and "Y2" contacts remain closed.

2.7 Upon receiving a demand for auxiliary heat, the control determines the appropriate airflow demand for high stage heat pump + auxiliary heat operation and operates the ECM blower motor at that airflow demand. The control determines which airflow demand is greatest and applies that demand when operating the ECM blower motor.

2.8 The system operates at high stage heat pump heating plus auxiliary heat.

2.9 Upon satisfying the thermostat, the "G" and "Y1" thermostat contacts (or "G", "Y1", "Y2" and "W1/W2" contacts) open, removing 24VAC from the integrated air handler control. The compressor and condensor fan motor are de-energized immediately. The integrated AH control continues to operate the ECM blower motor for an OFF delay period, then applies the off portion of the heat pump heating ramping profile. The ECM blower motor is then de-energized.

3.0 Continuous Fan Operation

3.1 On a demand for continuous fan operation, the thermostat closes the "G" contacts providing 24VAC to the "G" terminal at the integrated air handler control. The control energizes the variavble speed ECM motor at 30% of the air handler's maximum airflow capability.

3.2 Removing the thermostat demand for continuous fan opens the "G" contacts, removing 24VAC from the integrated air handler control. The integrated AH control immediately de-energizes the ECM blower motor.

4.0 Defrost Operation

4.1 The control in the outdoor unit determines when a defrost cycle is needed. Upon determing that a defrost cycle is needed, the outdoor control de-energizes the condensor fan motor and energizes the reversing valve. A "W1" signal is sent from the outdoor unit control to the integrated air handler control.

4.2 The air handler control energizes the eletric heat sequencer output to turn on the electric heaters. The appropriate airflow demand is provided to the motor (greater of heat pump or auxiliary heat).

4.3 At the conclusion of the defrost cycle, the outdoor unit control removes the "W1" output to the integrated air handler control, de-energizes the reversing valve and re-energizes the condensor fan motor.

5.0 Emergency Heat Operation

5.1 On a demand for emergency heat operation, the thermostat closes the "W1/W2" contacts providing 24VAC to the "W1" terminal at the integrated air handler control. The integrated AH control initiates the heating ramping profile after any blower ON delays have expired. After completing any blower ON delays and ramping profile, the control operates the variavble speed ECM motor at the emergency heat airflow.

5.2 The system operates at emergency heat.

5.3 Upon satisfying the thermostat emergnecy heat demand, the "W1" thermostat contacts open, removing 24VAC from the integrated air handler control. The integrated AH control continues to operate the ECM blower motor for an OFF delay period, then applies the off portion of the heating ramping profile. The ECM blower motor is then de-energized

AVPTC/MBVC with ASXC/DSXC Condenser and CTK01AA Communicating Themostat

The AVPTC or MBVC air handle/modular blower matched with an ASXC or DSXC condensing unit and CTK01AA communicating thermostat constitute a network. The three components, or subsystems, making up the system communicate with one another with information passed between all three components. This leads to a somewhat non-traditional manner in which the system components receive commands for system operation. All system commands are routed from the component through the network to the appropriate destination component.

NOTE: The individual subsystems will cease operation if the request for operation is NOT refreshed after 5 minutes. This is a built-in safe guard to prevent the possibility of runaway operation.

1.0 Cooling Operation - Low and High Stage Cool

1.1 The CTK01AA thermostat sends a request for low stage cooling through the network to the unitary (UC) control in

the condenser. The UC control receives the command and processes any compressor and fan delays.

1.2 The UC control sends a request for low stage fan speed to the air handler/modular blower. The blower energizes the ECM blower motor at the appropriate speed.

1.3 The condenser energizes the compressor and condenser fan motor at the appropriate low stage speeds.

1.4 The system operates at low stage cooling.

1.5 If the thermostat demand cannot be met on low stage cooling, the CTK01AA thermostat sends a request for high stage cooling to the condenser. The condenser in turn sends a request for high stage fan speed to the air handler/modular blower. The blower increases the blower speed to the high stage cooling speed.

1.6 The condenser's unitary control energizes the high stage compressor solenoid and switches the condenser fan motor to high speed.

1.7 The system operates at high stage cooling.

1.8 Once the thermostat demand is satisfied, the CTK01AA thermostat commands the UC control to end cooling operation. The condenser de-energizes the compressor and condenser fan motor. The UC control continues providing a fan request until any cooling blower OFF delays have expired.

2.0 Heating Operation - Auxiliary/Emergency Heat

2.1 The CTK01AA thermostat sends a request for emergency heat to the air handler/modular blower.

2.2 The air handler control energizes the ECM blower motor at the emergency heat speed. The electric heat sequencer outputs are also energized, thus energizing the electric heaters.

2.3 The system operates at emergency heat.

2.4 Once the thermostat demand is satisfied, the CTK01AA thermostat commands the air handler/modular blower to end emergency heat operation. The air handler control de-energizes the electric heat sequencer outputs. The ECM blower motor remains energized until any blower OFF delay timing has expired.

3.0 Continuous Fan Operation

3.1 With a demand for continuous fan operation, the CTK01AA thermostat sends a fan request to the integrated air handler control along with a fan demand. The control energizes the variavble speed ECM motor at fan demand provided by the thermostat. The fan demand provided by the thermostat will be 30%, 50%,or 70% of the air handler's maximum airflow capability. The continuous fan demand is set from the thermostat as low, medium, or high.

3.2 If the thermostat demand for continuous fan is removed, the CTK01AA thermostat commands the integrated air handler control to end continuous fan operation. The integrated AH control immediately de-energizes the ECM blower motor.

AVPTC/MBVC with ASZC/DSZC Heat Pump and CTK01AA Communicating Themostat

The AVPTC or MBVC air handle/modular blower matched with an ASZC or DSZC condensing unit and CTK01AA communicating thermostat constitute a network. The three components, or subsystems, making up the system communicate with one another with information passed between all three components. This leads to a somewhat non-traditional manner in which the system components receive commands for system operation. All system commands are routed from the component through the network to the appropriate destination component.

NOTE: Communicating heat pump systems are designed to utilize a balance point temperature. The balance point temperature in part controls heat pump operation. If the outdoor temperature is below the balance point, the heat pump is disable and only electric heat is available for heating. The balance point temperature is set via the CTK01AA thermostat in the advanced installer's configuration menu.

The CTK01AA thermostat also allows the user to disable the electric heaters in the air handler/modular blower depending on the outdoor temperature. The electric heaters are disabled If the outdoor temperature is above the set point. All heating is supplied by the heat pump.

The outdoor air temperature is aquired from the outdoor air temperature (OAT) sensor included with the ASZC/DSZC heat pump models. Faults with the sensor will affect heating operation.

NOTE: The individual subsystems will cease operation if the request for operation is NOT refreshed after 5 minutes. This is a built-in safe guard to prevent the possibility of runaway operation.

1.0 Cooling Operation - Low and High Stage Cool

1.1 The CKT01AA thermostat sends a request for low stage cooling through the network to the unitary (UC) control in the heat pump. The UC control receives the command and processes any compressor and fan delays.

1.2 The UC control sends a request for low stage fan speed to the air handler/modular blower. The blower energizes the ECM blower motor at the appropriate speed.

1.3 The heat pump energizes the compressor and condenser fan motor at the appropriate low stage speeds. The reversing valve is also energized.

1.4 The system operates at low stage cooling.

1.5 If the thermostat demand cannot be met on low stage cooling, the CTK01AA thermostat sends a request for high stage cooling to the heat pump. The heat pump in turn sends a request for high stage fan speed to the air handler/modular blower. The AH control increases the blower speed to the high stage cooling speed.

1.6 The heat pump's unitary control energizes the high stage compressor solenoid and switches the condenser fan motor to high speed. The reversing valve remains energized.

1.7 The system operates at high stage cooling.

1.8 Once the thermostat demand is satisfied, the CTK01AA

thermostat commands the UC control to end cooling operation. The heat pump de-energizes the compressor, condenser fan motor, and reversing valve. The UC control continues providing a fan request until any cooling blower OFF delays have expired.

2.0 Heating Operation

Outdoor Temperature Above the Heat Pump Balance Point

2.1 The CTK01AA thermostat sends a request for the outdoor air temperature to the heat pump. The heat pump returns an outdoor air temperature that is above the balance point temperature. Heat pump heating is enabled.

2.2 The CKT01AA thermostat sends a request for low stage heat pump heating to the unitary (UC) control in the heat pump. The UC control receives the command and processes any compressor and fan delays.

2.3 The UC control sends a request for low stage fan speed to the air handler/modular blower. The blower energizes the ECM blower motor at the appropriate speed.

2.4 The condenser energizes the compressor and condenser fan motor at the appropriate low stage speeds.

2.5 The system operates at low stage heat pump heating.

2.6 If the thermostat demand cannot be met on low stage heat pump heating, the CTK01AA thermostat sends a request for high stage heat pump heating to the heat pump. The heat pump in turn sends a request for high stage fan speed to the air handler/modular blower. The AH control increases the blower speed to the high stage heat pump heating speed.

2.7 The heat pump's unitary control energizes the high stage compressor solenoid and switches the condenser fan motor to high speed.

2.8 The system operates at high stage heat pump heating.

2.9 If the thermostat demand cannot be met on high stage heat pump heating, the CTK01AA thermostat sends a request for auxiliary heat to the air handler/modular blower.

2.10 Upon receiving a demand for auxiliary heat, the air handler control determines the appropriate airflow for high stage heat pump + auxiliary heat operation and operates the ECM blower motor at that airflow demand. The air handler control determines which airflow demand is greatest and applies that demand when operating the ECM blower motor.

2.11 The system operates at high stage heat pump heating plus auxiliary heat.

2.12 Once the thermostat demand is satisfied, the CTK01AA thermostat commands the heat pump to end heat pump heating operation. The compressor and outdoor fan motor are de-energized.

The air handler/modular blower is commanded to end auxiliary heat operation. The air handler control de-energizes the electric heat sequencer outputs. The ECM blower motor remains energized until any blower OFF delay timing has expired.

Outdoor Temperature Below the Heat Pump Balance Point

2.1 The CTK01AA thermostat sends a request for the outdoor air temperature to the heat pump. The heat pump returns an outdoor air temperature that is below the balance point temperature. Heat pump heating is disabled.

2.2 The CTK01AA thermostat sends a request for auxiliary heat to the air handler/modular blower.

2.2 The air handler control energizes the ECM blower motor at the auxiliary heat speed. The electric heat sequencer outputs are also energized, thus energizing the electric heaters.

2.3 The system operates at auxiliary heat.

2.4 Once the thermostat demand is satisfied, the CTK01AA thermostat commands the air handler/modular blower to end auxiliary heat operation. The air handler control de-energizes the electric heat sequencer outputs. The ECM blower motor remains energized until any blower OFF delay timing has expired.

3.0 Continuous Fan Operation

3.1 With a demand for continuous fan operation, the CTK01AA thermostat sends a fan request to the integrated air handler control along with a fan demand. The control energizes the variavble speed ECM motor at fan demand provided by the thermostat. The fan demand provided by the thermostat will be 30%, 50%,or 70% of the air handler's maximum airflow capability. The continuous fan demand is set from the thermostat as low, medium, or high.

3.2 If the thermostat demand for continuous fan is removed, the CTK01AA thermostat commands the integrated air handler control to end continuous fan operation. The integrated AH control immediately de-energizes the ECM blower motor.

4.0 Defrost Operation

4.1 While the system is operating in heat pump heating (see **2.0 Heating Operation**), the control in the outdoor unit may determines that a defrost cycle is needed. Upon determing that a defrost cycle is needed, the UC control de-energizes the condensor fan motor and energizes the reversing valve.

4.2 The compressor may be de-energized for a short delay during the reversing valve shift. (The delay period is adjustable via the CTK01AA thermostat. The compressor delay is intended to eliminate compressor noise during the reversing valve shift.) The compressor will energized (or re-energized) at high stage.

4.3 The UC control sends a request for defrost operation to the integrated air handler control. The air handler control energizes the electric heat sequencer outputs and operates the ECM blower model at the electric heat speed.

4.4 Once the defrost cycle is terminated, the heat pump

commands the air handler/modular blower to end defrost operation.

4.5 The system returns to heat pump heating operation that was in effect prior to the defrost cycle.

5.0 Emergency Heat Operation

5.1 The CTK01AA thermostat sends a request for emergency heat to the air handler/modular blower.

5.2 The air handler control energizes the ECM blower motor at the emergency heat speed. The electric heat sequencer outputs are also energized, thus energizing the electric heaters.

5.3 The system operates at emergency heat.

5.4 Once the thermostat demand is satisfied, the CTK01AA thermostat commands the air handler/modular blower to end emergency heat operation. The air handler control de-energizes the electric heat sequencer outputs. The ECM blower motor remains energized until any blower OFF delay timing has expired.

S-60 ELECTRIC HEATER (OPTIONAL ITEM)

Optional electric heaters may be added, in the quantities shown in the specifications section, to provide electric resistance heating. Under no condition shall more heaters than the quantity shown be installed.

The low voltage circuit in the air handler is factory wired and terminates at the location provided for the electric heater(s). A minimum of field wiring is required to complete the installation.

Other components such as a Heating/Cooling Thermostat and Outdoor Thermostats are available to complete the installation.

The system CFM can be determined by measuring the static pressure external to the unit. The installation manual supplied with the blower coil, or the blower performance table in the service manual, shows the CFM for the static measured.

Alternately, the system CFM can be determined by operating the electric heaters and indoor blower WITHOUT having the compressor in operation. Measure the temperature rise as close to the blower inlet and outlet as possible.

If other than a 240V power supply is used, refer to the **BTUH CAPACITY CORRECTION FACTOR** chart below.

BTUH CAPACITY CORRECTION FACTOR				
SUPPLY VOLTAGE	250	230	220	208
MULTIPLICATION FACTOR	1.08	.92	.84	.75

EXAMPLE: Five (5) heaters provide 24.0 KW at the rated 240V. Our actual measured voltage is 220V, and our measured temperature rise is 42°F. Find the actual CFM:

Answer: 24.0KW, 42°F Rise, 240 V = 1800 CFM from the **TEMPERATURE RISE** chart on the right.

Heating output at 220 V = 24.0KW x 3.413 x .84 = 68.8 MBH.

Actual CFM = 1800 x .84 Corr. Factor = 1400 CFM.

NOTE: The temperature rise table is for sea level installations. The temperature rise at a particular KW and CFM will be greater at high altitudes, while the external static pressure at a particular CFM will be less.

TEMPERATURE RISE (°F) @ 240V								
CFM	3.0 kW	4.8 kW	7.2 kW	9.6 kW	14.4 kW	19.2 kW	24.0 kW	28.8 kW
600	16	25	38	51	-	-	-	-
700	14	22	33	43	-	-	-	-
800	12	19	29	38	57	-	-	-
900	11	17	26	34	51	-	-	-
1000	10	15	23	30	46	-	-	-
1100	9	14	21	27	41	55	-	-
1200	8	13	19	25	38	50	-	-
1300	7	12	18	23	35	46	-	-
1400	7	11	16	22	32	43	54	65
1500	6	10	15	20	30	40	50	60
1600	6	9	14	19	28	38	47	57
1700	6	9	14	18	27	36	44	53
1800	5	8	13	17	25	34	42	50
1900	5	8	12	16	24	32	40	48
2000	5	8	12	15	23	30	38	45
2100	5	7	11	14	22	29	36	43
2200	4	7	11	14	21	27	34	41
2300	4	7	10	13	20	26	33	39

ELECTRIC HEATER CAPACITY BTUH								
HTR KW	3.0 KW	4.7 KW	6.0 KW	7.0 KW	9.5 KW	14.2 KW	19.5 KW	21.0 KW
BTUH	10200	16200	20400	23800	32400	48600	66500	71600

FORMULAS:

Heating Output = KW x 3413 x Corr. Factor

Actual CFM = CFM (from table) x Corr. Factor

BTUH = KW x 3413

BTUH = CFM x 1.08 x Temperature Rise (T)

$$CFM = \frac{KW \times 3413}{1.08 \times T}$$

$$T = \frac{BTUH}{CFM \times 1.08}$$

SERVICING

S-61A CHECKING HEATER LIMIT CONTROL(S)

Each individual heater element is protected with a limit control device connected in series with each element to prevent overheating of components in case of low airflow. This limit control will open its circuit at approximately 150°F.

WARNING

HIGH VOLTAGE!
Disconnect ALL power before servicing or installing. Multiple power sources may be present. Failure to do so may cause property damage, personal injury or death.



1. Remove the wiring from the control terminals.
2. Using an ohmmeter, test for continuity across the normally closed contacts. No reading indicates the control is open - replace if necessary.

IF FOUND OPEN - REPLACE - DO NOT WIRE AROUND.

S-61B CHECKING HEATER FUSE LINK (OPTIONAL ELECTRIC HEATERS)

Each individual heater element is protected with a one time fuse link which is connected in series with the element. The fuse link will open at approximately 333°.

WARNING

Disconnect ALL power before servicing.

1. Remove heater element assembly so as to expose fuse link.
2. Using an ohmmeter, test across the fuse link for continuity - no reading indicates the link is open. Replace as necessary.

NOTE: The link is designed to open at approximately 333°F. DO NOT WIRE AROUND - determine reason for failure.

S-62 CHECKING HEATER ELEMENTS

WARNING

Disconnect ALL power before servicing.

1. Disassemble and remove the heating element.
2. Visually inspect the heater assembly for any breaks in the wire or broken insulators.
3. Using an ohmmeter, test the element for continuity - no reading indicates the element is open. Replace as necessary.

S-100 REFRIGERATION REPAIR PRACTICE

DANGER

Always remove the refrigerant charge in a proper manner before applying heat to the system.

When repairing the refrigeration system:

WARNING

HIGH VOLTAGE!
Disconnect ALL power before servicing or installing. Multiple power sources may be present. Failure to do so may cause property damage, personal injury or death.



1. Never open a system that is under vacuum. Air and moisture will be drawn in.
2. Plug or cap all openings.
3. Remove all burrs and clean the brazing surfaces of the tubing with sand cloth or paper. Brazing materials do not flow well on oxidized or oily surfaces.
4. Clean the inside of all new tubing to remove oils and pipe chips.
5. When brazing, sweep the tubing with dry nitrogen to prevent the formation of oxides on the inside surfaces.
6. Complete any repair by replacing the liquid line drier in the system, evacuate and charge.

BRAZING MATERIALS

IMPORTANT NOTE: Torch heat required to braze tubes of various sizes is proportional to the size of the tube. Tubes of smaller size require less heat to bring the tube to brazing temperature before adding brazing alloy. Applying too much heat to any tube can melt the tube. Service personnel must use the appropriate heat level for the size of the tube being brazed.

NOTE: The use of a heat shield when brazing is recommended to avoid burning the serial plate or the finish on the unit. Heat trap or wet rags should be used to protect heat sensitive components such as service valves and TXV valves.

Copper to Copper Joints - Sil-Fos used without flux (alloy of 15% silver, 80% copper, and 5% phosphorous). Recommended heat 1400°F.

Copper to Steel Joints - Silver Solder used without a flux (alloy of 30% silver, 38% copper, 32% zinc). Recommended heat - 1200°F.

SERVICING

S-101 LEAK TESTING (NITROGEN OR NITROGEN-TRACED)

WARNING

To avoid the risk of fire or explosion, never use oxygen, high pressure air or flammable gases for leak testing of a refrigeration system.

WARNING

To avoid possible explosion, the line from the nitrogen cylinder must include a pressure regulator and a pressure relief valve. The pressure relief valve must be set to open at no more than 150 psig.

Pressure test the system using dry nitrogen and soapy water to locate leaks. If you wish to use a leak detector, charge the system to 10 psi using the appropriate refrigerant then use nitrogen to finish charging the system to working pressure, then apply the detector to suspect areas. If leaks are found, repair them. After repair, repeat the pressure test. If no leaks exist, proceed to system evacuation.

S-102 EVACUATION

WARNING

REFRIGERANT UNDER PRESSURE!
Failure to follow proper procedures may cause property damage, personal injury or death.

IMPORTANT NOTE: *Because of the potential damage to compressors, do not allow suction pressure at service valve to drop below 20 PSIG when pumping unit system down for repair. Outdoor section, depending on line set length and amount of charge in system, may not be able to hold the entire system charge.*

This is the most important part of the entire service procedure. The life and efficiency of the equipment is dependent upon the thoroughness exercised by the serviceman when evacuating air (non-condensables) and moisture from the system.

Air in a system causes high condensing temperature and pressure, resulting in increased power input and reduced performance.

Moisture chemically reacts with the refrigerant oil to form corrosive acids. These acids attack motor windings and parts, causing breakdown.

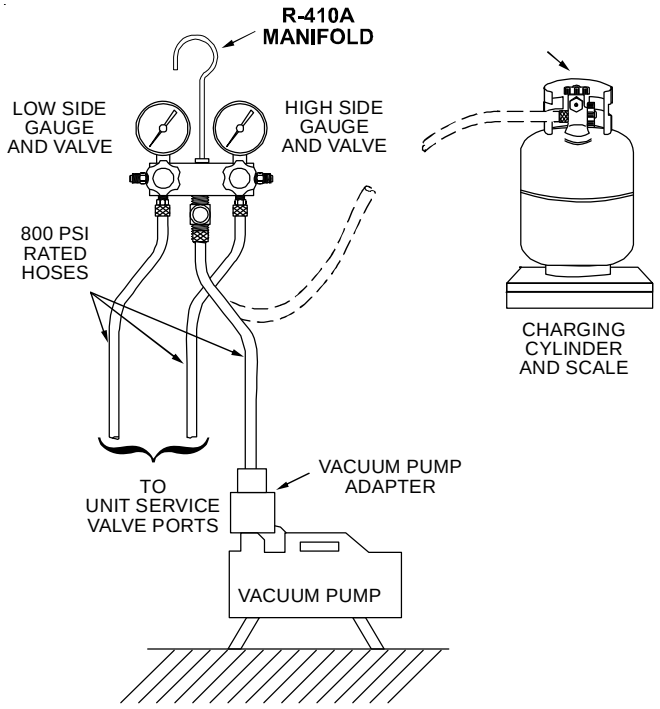
The equipment required to thoroughly evacuate the system is a high vacuum pump, capable of producing a vacuum equivalent to 25 microns absolute and a thermocouple vacuum gauge to give a true reading of the vacuum in the system

NOTE: Never use the system compressor as a vacuum pump or run when under a high vacuum. Motor damage could occur.

WARNING

Do not front seat the service valve(s) with the compressor open, with the suction line of the comprssor closed or severely restricted.

1. Connect the vacuum pump, vacuum tight manifold set with high vacuum hoses, thermocouple vacuum gauge and charging cylinder as shown.
2. Start the vacuum pump and open the shut off valve to the high vacuum gauge manifold only. After the compound gauge (low side) has dropped to approximately 29 inches of vacuum, open the valve to the vacuum thermocouple gauge. See that the vacuum pump will blank-off to a maximum of 25 microns. A high vacuum pump can only produce a good vacuum if its oil is non-contaminated.



EVACUATION

3. If the vacuum pump is working properly, close the valve to the vacuum thermocouple gauge and open the high and low side valves to the high vacuum manifold set. With the valve on the charging cylinder closed, open the manifold valve to the cylinder.
4. Evacuate the system to at least 29 inches gauge before opening valve to thermocouple vacuum gauge.
5. Continue to evacuate to a maximum of 250 microns. Close valve to vacuum pump and watch rate of rise. If vacuum does not rise above 1500 microns in three to five minutes, system can be considered properly evacuated.
6. If thermocouple vacuum gauge continues to rise and levels off at about 5000 microns, moisture and non-condensables are still present. If gauge continues to rise a leak is present. Repair and re-evacuate.

7. Close valve to thermocouple vacuum gauge and vacuum pump. Shut off pump and prepare to charge.

S-103 CHARGING

WARNING

REFRIGERANT UNDER PRESSURE!
*** Do not overcharge system with refrigerant.**
*** Do not operate unit in a vacuum or at negative pressure.**
Failure to follow proper procedures may cause property damage, personal injury or death.

CAUTION

Use refrigerant certified to AHRI standards. Used refrigerant may cause compressor damage and will void the warranty. Most portable machines cannot clean used refrigerant to meet AHRI standards.

CAUTION

Operating the compressor with the suction valve closed will void the warranty and cause serious compressor damage.

Charge the system with the exact amount of refrigerant.

Refer to the specification section or check the unit nameplates for the correct refrigerant charge.

An inaccurately charged system will cause future problems.

1. When using an ambient compensated calibrated charging cylinder, allow liquid refrigerant only to enter the high side.
2. After the system will take all it will take, close the valve on the high side of the charging manifold.
3. Start the system and charge the balance of the refrigerant through the low side.

NOTE: R410A should be drawn out of the storage container or drum in liquid form due to its fractionation properties, but should be "Flashed" to its gas state before entering the system. There are commercially available restriction devices that fit into the system charging hose set to accomplish this. **DO NOT** charge liquid R410A into the compressor.

4. With the system still running, close the valve on the charging cylinder. At this time, you may still have some liquid refrigerant in the charging cylinder hose and will definitely have liquid in the liquid hose. Reseat the liquid line core. Slowly open the high side manifold valve and transfer the liquid refrigerant from the liquid line hose and charging cylinder hose into the suction service valve port. CAREFUL: Watch so that liquid refrigerant does not enter the compressor.

Final Charge Adjustment

The outdoor temperature must be 60°F or higher. Set the room thermostat to COOL, fan switch to AUTO, and set the temperature control well below room temperature.

After system has stabilized per startup instructions, compare the operating pressures and outdoor unit amp draw to the numbers listed on the performance label on the outdoor unit. If pressures and amp draw are too low, add charge. If pressures and amp draw are too high, remove charge. Check subcooling and superheat as detailed in the following section.

5. With the system still running, remove hose and reinstall both valve caps.
6. Check system for leaks.

Do not charge a remote condensing unit with a non-matching evaporator coil, or a system where the charge quantity is unknown. Do not install or charge R410A condensers matched with coils having capillary tubes or flow control restrictors. AHRI rated Coil combinations with thermostatic expansion valves (TEV's) should be charged by subcooling. See "Checking Subcooling and Superheat" sections in this manual. Subcooling values for "Ultron" system are found in the Technical Information manuals for "Ultron" outdoor units.

Due to their design, Scroll compressors are inherently more tolerant of liquid refrigerant.

NOTE*: Even though the compressor section of a Scroll compressor is more tolerant of liquid refrigerant, continued floodback or flooded start conditions may wash oil from the bearing surfaces causing premature bearing failure.*

S-104 CHECKING COMPRESSOR EFFICIENCY

The reason for compressor inefficiency is broken or damaged scroll flanks on Scroll compressors, reducing the ability of the compressor to pump refrigerant vapor.

The condition of the scroll flanks is checked in the following manner.

1. Attach gauges to the high and low side of the system.
2. Start the system and run a "Cooling Performance Test.

If the test shows:

a. Below normal high side pressure.
b. Above normal low side pressure.
c. Low temperature difference across coil.
d. Low amp draw at compressor.

And the charge is correct. The compressor is faulty - replace the compressor.

SERVICING

S-105A PISTON CHART FOR ASX13, GSX13, SSX14, ASX14, ASZ13, GSZ13 units

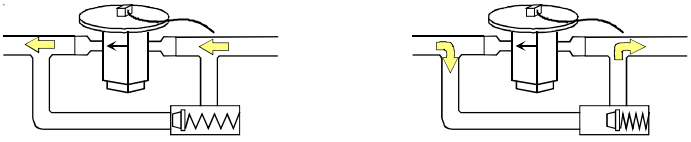
Remote Condenser	Orifice Size
A/GSX130181A	0.049
A/GSX130181B	0.051
A/GSX130241A	0.053
A/GSX130241B	0.057
A/GSX130301	0.059
A/GSX130301B	0.061
A/GSX130361A	0.068
A/GSX130361B	0.070
A/GSX130421A	0.074
A/GSX130421B	0.076
A/GSX130481A	0.080
A/GSX130481B	0.080
A/GSX130601	0.092
SSX140181A	0.049
SSX140241A	0.057
SSX140301A	0.063
SSX140361A	0.067
SSX140421A	0.074
SSX140421B	0.074
SSX140481A	0.079
SSX140601A	0.088
A/SSX140181B	0.052
A/SSX140241B	0.055
A/SSX140301B	0.065
A/SSX140361B	0.068
A/SSX140421C	0.070

Remote Heat Pump	Orifice Size
A/GSZ130181	0.049
A/GSZ130241	0.051
A/GSZ130301	0.053
A/GSZ130361	0.057
A/GSZ130421	0.059
A/GSZ130481	0.061
A/GSZ130601	0.068
SSZ140361A*	0.070
SSZ140421A*	0.074
SSZ140481A*	0.076
SSZ140601A*	0.080

S-105B THERMOSTATIC EXPANSION VALVE

The expansion valve is designed to control the rate of liquid refrigerant flow into an evaporator coil in exact proportion to the rate of evaporation of the refrigerant in the coil. The amount of refrigerant entering the coil is regulated since the valve responds to temperature of the refrigerant gas leaving the coil (feeler bulb contact) and the pressure of the refrigerant in the coil. This regulation of the flow prevents the return of liquid refrigerant to the compressor.

The illustration below shows typical heatpump TXV/check valve operation in the heating and cooling modes.



COOLING HEATING

TXV VALVES

Some TXV valves contain an internal check valve thus eliminating the need for an external check valve and bypass loop. The three forces which govern the operation of the valve are: (1) the pressure created in the power assembly by the feeler bulb, (2) evaporator pressure, and (3) the equivalent pressure of the superheat spring in the valve.

0% bleed type expansion valves are used on indoor and outdoor coils. The 0% bleed valve will not allow the system pressures (High and Low side) to equalize during the shut down period. The valve will shut off completely at approximately 100 PSIG.

30% bleed valves used on some other models will continue to allow some equalization even though the valve has shut-off completely because of the bleed holes within the valve. This type of valve should not be used as a replacement for a 0% bleed valve, due to the resulting drop in performance.

The bulb must be securely fastened with two straps to a clean straight section of the suction line. Application of the bulb to a horizontal run of line is preferred. If a vertical installation cannot be avoided, the bulb must be mounted so that the capillary tubing comes out at the top.

THE VALVES PROVIDED BY GOODMAN ARE DESIGNED TO MEET THE SPECIFICATION REQUIREMENTS FOR OPTIMUM PRODUCT OPERATION. DO NOT USE SUBSTITUTES.

S-106 OVERFEEDING

Overfeeding by the expansion valve results in high suction pressure, cold suction line, and possible liquid slugging of the compressor.

If these symptoms are observed:

1. Check for an overcharged unit by referring to the cooling performance charts in the servicing section.
2. Check the operation of the power element in the valve as explained in S-110 Checking Expansion Valve Operation.
3. Check for restricted or plugged equalizer tube.

S-107 UNDERFEEDING

Underfeeding by the expansion valve results in low system capacity and low suction pressures.

If these symptoms are observed:

1. Check for a restricted liquid line or drier. A restriction will be indicated by a temperature drop across the drier.
2. Check the operation of the power element of the valve as described in S-110 Checking Expansion Valve Operation.

SERVICING

Pressure vs. Temperature Chart

R-410A

PSIG	°F	PSIG	°F	PSIG	°F	PSIG	°F	PSIG	°F	PSIG	°F
12	-37.7	114.0	37.8	216.0	74.3	318.0	100.2	420.0	120.7	522.0	137.6
14	-34.7	116.0	38.7	218.0	74.9	320.0	100.7	422.0	121.0	524.0	137.9
16	-32.0	118.0	39.5	220.0	75.5	322.0	101.1	424.0	121.4	526.0	138.3
18	-29.4	120.0	40.5	222.0	76.1	324.0	101.6	426.0	121.7	528.0	138.6
20	-36.9	122.0	41.3	224.0	76.7	326.0	102.0	428.0	122.1	530.0	138.9
22	-24.5	124.0	42.2	226.0	77.2	328.0	102.4	430.0	122.5	532.0	139.2
24	-22.2	126.0	43.0	228.0	77.8	330.0	102.9	432.0	122.8	534.0	139.5
26	-20.0	128.0	43.8	230.0	78.4	332.0	103.3	434.0	123.2	536.0	139.8
28	-17.9	130.0	44.7	232.0	78.9	334.0	103.7	436.0	123.5	538.0	140.1
30	-15.8	132.0	45.5	234.0	79.5	336.0	104.2	438.0	123.9	540.0	140.4
32	-13.8	134.0	46.3	236.0	80.0	338.0	104.6	440.0	124.2	544.0	141.0
34	-11.9	136.0	47.1	238.0	80.6	340.0	105.1	442.0	124.6	548.0	141.6
36	-10.1	138.0	47.9	240.0	81.1	342.0	105.4	444.0	124.9	552.0	142.1
38	-8.3	140.0	48.7	242.0	81.6	344.0	105.8	446.0	125.3	556.0	142.7
40	-6.5	142.0	49.5	244.0	82.2	346.0	106.3	448.0	125.6	560.0	143.3
42	-4.5	144.0	50.3	246.0	82.7	348.0	106.6	450.0	126.0	564.0	143.9
44	-3.2	146.0	51.1	248.0	83.3	350.0	107.1	452.0	126.3	568.0	144.5
46	-1.6	148.0	51.8	250.0	83.8	352.0	107.5	454.0	126.6	572.0	145.0
48	0.0	150.0	52.5	252.0	84.3	354.0	107.9	456.0	127.0	576.0	145.6
50	1.5	152.0	53.3	254.0	84.8	356.0	108.3	458.0	127.3	580.0	146.2
52	3.0	154.0	54.0	256.0	85.4	358.0	108.8	460.0	127.7	584.0	146.7
54	4.5	156.0	54.8	258.0	85.9	360.0	109.2	462.0	128.0	588.0	147.3
56	5.9	158.0	55.5	260.0	86.4	362.0	109.6	464.0	128.3	592.0	147.9
58	7.3	160.0	56.2	262.0	86.9	364.0	110.0	466.0	128.7	596.0	148.4
60	8.6	162.0	57.0	264.0	87.4	366.0	110.4	468.0	129.0	600.0	149.0
62	10.0	164.0	57.7	266.0	87.9	368.0	110.8	470.0	129.3	604.0	149.5
64	11.3	166.0	58.4	268.0	88.4	370.0	111.2	472.0	129.7	608.0	150.1
66	12.6	168.0	59.0	270.0	88.9	372.0	111.6	474.0	130.0	612.0	150.6
68	13.8	170.0	59.8	272.0	89.4	374.0	112.0	476.0	130.3	616.0	151.2
70	15.1	172.0	60.5	274.0	89.9	376.0	112.4	478.0	130.7	620.0	151.7
72	16.3	174.0	61.1	276.0	90.4	378.0	112.6	480.0	131.0	624.0	152.3
74	17.5	176.0	61.8	278.0	90.9	380.0	113.1	482.0	131.3	628.0	152.8
76	18.7	178.0	62.5	280.0	91.4	382.0	113.5	484.0	131.6	632.0	153.4
78	19.8	180.0	63.1	282.0	91.9	384.0	113.9	486.0	132.0	636.0	153.9
80	21.0	182.0	63.8	284.0	92.4	386.0	114.3	488.0	132.3	640.0	154.5
82	22.1	184.0	64.5	286.0	92.8	388.0	114.7	490.0	132.6	644.0	155.0
84	23.2	186.0	65.1	288.0	93.3	390.0	115.0	492.0	132.9	648.0	155.5
86	24.3	188.0	65.8	290.0	93.8	392.0	115.5	494.0	133.3	652.0	156.1
88	25.4	190.0	66.4	292.0	94.3	394.0	115.8	496.0	133.6	656.0	156.6
90	26.4	192.0	67.0	294.0	94.8	396.0	116.2	498.0	133.9	660.0	157.1
92	27.4	194.0	67.7	296.0	95.2	398.0	116.6	500.0	134.0	664.0	157.7
94	28.5	196.0	68.3	298.0	95.7	400.0	117.0	502.0	134.5	668.0	158.2
96	29.5	198.0	68.9	300.0	96.2	402.0	117.3	504.0	134.8	672.0	158.7
98	30.5	200.0	69.5	302.0	96.6	404.0	117.7	506.0	135.2	676.0	159.2
100	31.2	202.0	70.1	304.0	97.1	406.0	118.1	508.0	135.5	680.0	159.8
102	32.2	204.0	70.7	306.0	97.5	408.0	118.5	510.0	135.8	684.0	160.3
104	33.2	206.0	71.4	308.0	98.0	410.0	118.8	512.0	136.1	688.0	160.8
106	34.1	208.0	72.0	310.0	98.4	412.0	119.2	514.0	136.4	692.0	161.3
108	35.1	210.0	72.6	312.0	98.9	414.0	119.6	516.0	136.7	696.0	161.8
110	35.5	212.0	73.2	314.0	99.3	416.0	119.9	518.0	137.0		
112	36.9	214.0	73.8	316.0	99.7	418.0	120.3	520.0	137.3		

*Based on ALLIED SIGNAL Data

SERVICING

REQUIRED LIQUID LINE TEMPERATURE						
LIQUID PRESSURE AT SERVICE VALVE (PSIG)	REQUIRED SUBCOOLING TEMPERATURE (°F)					
	8	10	12	14	16	18
189	58	56	54	52	50	48
195	60	58	56	54	52	50
202	62	60	58	56	54	52
208	64	62	60	58	56	54
215	66	64	62	60	58	56
222	68	66	64	62	60	58
229	70	68	66	64	62	60
236	72	70	68	66	64	62
243	74	72	70	68	66	64
251	76	74	72	70	68	66
259	78	76	74	72	70	68
266	80	78	76	74	72	70
274	82	80	78	76	74	72
283	84	82	80	78	76	74
291	86	84	82	80	78	76
299	88	86	84	82	80	78
308	90	88	86	84	82	80
317	92	90	88	86	84	82
326	94	92	90	88	86	84
335	96	94	92	90	88	86
345	98	96	94	92	90	88
354	100	98	96	94	92	90
364	102	100	98	96	94	92
374	104	102	100	98	96	94
384	106	104	102	100	98	96
395	108	106	104	102	100	98
406	110	108	106	104	102	100
416	112	110	108	106	104	102
427	114	112	110	108	106	104
439	116	114	112	110	108	106
450	118	116	114	112	110	108
462	120	118	116	114	112	110
474	122	120	118	116	114	112
486	124	122	120	118	116	114
499	126	124	122	120	118	116
511	128	126	124	122	120	118

SERVICING

S-108 SUPERHEAT

The expansion valves are factory adjusted to maintain 8 to 12 degrees superheat of the suction gas. Before checking the superheat or replacing the valve, perform all the procedures outlined under Air Flow, Refrigerant Charge, Expansion Valve - Overfeeding, Underfeeding. These are the most common causes for evaporator malfunction.

CHECKING SUPERHEAT

Refrigerant gas is considered superheated when its temperature is higher than the saturation temperature corresponding to its pressure. The degree of superheat equals the degrees of temperature increase above the saturation temperature at existing pressure. See Temperature - Pressure Chart on following pages.

⚠ CAUTION

To prevent personal injury, carefully connect and disconnect manifold gauge hoses. Escaping liquid refrigerant can cause burns. Do not vent refrigerant to atmosphere. Recover during system repair or final unit disposal.

1. Run system at least 10 minutes to allow pressure to stabilize.
2. Temporarily install thermometer on suction (large) line near suction line service valve with adequate contact and insulate for best possible reading.
3. Refer to the superheat table provided for proper system superheat. Add charge to lower superheat or recover charge to raise superheat.

Superheat Formula = Suct. Line Temp. - Sat. Suct. Temp.

EXAMPLE:

a. Suction Pressure = 143
b. Corresponding Temp. °F. = 50
c. Thermometer on Suction Line = 61°F.

To obtain the degrees temperature of superheat, subtract 50.0 from 61.0°F.

The difference is 11° Superheat. The 11° Superheat would fall in the ± range of allowable superheat.

SUPERHEAT AND SUBCOOLING ADJUSTMENT ON TXV APPLICATIONS

1. Run system at least 10 minutes to allow pressure to stabilize.
2. Temporarily install thermometer on liquid (small) line near liquid line service valve with adequate contact and insulate for best possible reading.
3. Check subcooling and superheat. Systems with TXV application should have a subcooling and superheat of 7 ± 2ºF.
   a. If subcooling and superheat are low, **adjust** TXV to 7 - 9ºF then check subcooling.
   b. If subcooling is low and superheat is high, **add** charge to raise subcooling to 7 ± 2ºF then check superheat.
   c. If subcooling and superheat are high, **adjust** TXV valve to 7 ± 9ºF then check subcooling.
   d. If subcooling is high and superheat is low, **adjust** TXV valve to 7 to 9ºF superheat and **remove** charge to lower the subcooling to 7 ± 2ºF.

   The TXV should **NOT** be adjusted at light load conditions 55º to 60ºF, under such conditions only the subcooling can be evaluated. This is because suction pressure is dependent on the indoor coil match, indoor airflow, and wet bulb temperature. **NOTE:** Do **NOT** adjust charge based on suction pressure unless there is a gross undercharge.
4. Disconnect manifold set. Installation is complete.

S-109 CHECKING SUBCOOLING

Refrigerant liquid is considered subcooled when its temperature is lower than the saturation temperature corresponding to its pressure. The degree of subcooling equals the degrees of temperature decrease below the saturation temperature at the existing pressure.

1. Attach an accurate thermometer or preferably a thermocouple type temperature tester to the liquid line as it leaves the condensing unit.
2. Install a high side pressure gauge on the high side (liquid) service valve at the front of the unit.
3. Record the gauge pressure and the temperature of the line.
4. Review the technical information manual or specification sheet for the model being serviced to obtain the design subcooling.
5. Compare the hi-pressure reading to the "Required Liquid Line Temperature" chart (page 43). Find the hi-pressure value on the left column. Follow that line right to the column under the design subcooling value. Where the two intersect is the required liquid line temperature.

   Alternately you can convert the liquid line pressure gauge reading to temperature by finding the gauge reading in Temperature - Pressure Chart and reading to the left, find the temperature in the °F. Column.
6. The difference between the thermometer reading and pressure to temperature conversion is the amount of subcooling.

Add charge to raise subcooling. Recover charge to lower subcooling.

Subcooling Formula = Sat. Liquid Temp. - Liquid Line Temp.

EXAMPLE:

a. Liquid Line Pressure = 417
b. Corresponding Temp. °F. = 120°

c. Thermometer on Liquid line = 109°F.

To obtain the amount of subcooling subtract 109°F from 120°F.

The difference is 11° subcooling. See the specification sheet or technical information manual for the design subcooling range for your unit.

S-109A TWO SPEED APPLICATION

Run the remote on low stage cooling for 10 minutes until refrigerant pressures stabilize. Follow the guidelines and methods below to check unit operation and ensure that the refrigerant charge is within limits. Charge the unit on low stage.

1. Purge gauge lines. Connect service gauge manifold to base-valve service ports. Run system at least 10 minutes to allow pressure to stabilize.
2. Temporarily install thermometer on liquid (small) line near liquid line service valve with adequate contact and insulate for best possible reading.
3. Check subcooling and superheat. Systems with TXV application should have a subcooling of 5 to 7 ºF and superheat of 7 to 9 ºF.
   a. If subcooling and superheat are low, **adjust** TXV to 7 to 9 ºF superheat, then check subcooling.

      NOTE: To adjust superheat, turn the valve stem clockwise to increase and counter clockwise to decrease.
   b. If subcooling is low and superheat is high, **add** charge to raise subcooling to 5 to 7 ºF then check superheat.
   c. If subcooling and superheat are high, **adjust** TXV valve to 7 to 9 ºF superheat, then check subcooling.
   d. If subcooling is high and superheat is low, **adjust** TXV valve to 7 to 9 ºF superheat and **remove** charge to lower the subcooling to 5 to 7 ºF.

   NOTE: Do **NOT** adjust the charge based on suction pressure unless there is a gross undercharge.
4. Disconnect manifold set, installation is complete.

Subcooling Formula = Sat. Liquid Temp. - Liquid Line Temp.

S-110 CHECKING EXPANSION VALVE OPERATION

1. Remove the remote bulb of the expansion valve from the suction line.
2. Start the system and cool the bulb in a container of ice water, closing the valve. As you cool the bulb, the suction pressure should fall and the suction temperature will rise.
3. Next warm the bulb in your hand. As you warm the bulb, the suction pressure should rise and the suction temperature will fall.
4. If a temperature or pressure change is noticed, the expansion valve is operating. If no change is noticed, the valve is restricted, the power element is faulty, or the equalizer tube is plugged.
5. Capture the charge, replace the valve and drier, evacuate and recharge.

S-111 FIXED ORIFICE RESTRICTOR DEVICES

The fixed orifice restrictor device (flowrator) used in conjunction with the indoor coil is a predetermined bore (I.D.).

It is designed to control the rate of liquid refrigerant flow into an evaporator coil.

The amount of refrigerant that flows through the fixed orifice restrictor device is regulated by the pressure difference between the high and low sides of the system.

In the cooling cycle when the outdoor air temperature rises, the high side condensing pressure rises. At the same time, the cooling load on the indoor coil increases, causing the low side pressure to rise, but at a slower rate.

Since the high side pressure rises faster when the temperature increases, more refrigerant flows to the evaporator, increasing the cooling capacity of the system.

When the outdoor temperature falls, the reverse takes place. The condensing pressure falls, and the cooling loads on the indoor coil decreases, causing less refrigerant flow.

A strainer is placed on the entering side of the tube to prevent any foreign material from becoming lodged inside the fixed orifice restriction device.

If a restriction should become evident, proceed as follows:

1. Recover refrigerant charge.
2. Remove the orifice or tube strainer assembly and replace.
3. Replace liquid line drier, evacuate and recharge.

CHECKING EQUALIZATION TIME

During the "OFF" cycle, the high side pressure bleeds to the low side through the fixed orifice restriction device. Check equalization time as follows:

1. Attach a gauge manifold to the suction and liquid line dill valves.
2. Start the system and allow the pressures to stabilize.
3. Stop the system and check the time it takes for the high and low pressure gauge readings to equalize.

If it takes more than seven (7) minutes to equalize, the restrictor device is inoperative. Replace, install a liquid line drier, evacuate and recharge.

S-112 CHECKING RESTRICTED LIQUID LINE

When the system is operating, the liquid line is warm to the touch. If the liquid line is restricted, a definite temperature drop will be noticed at the point of restriction. In severe cases, frost will form at the restriction and extend down the

line in the direction of the flow.

Discharge and suction pressures will be low, giving the appearance of an undercharged unit. However, the unit will have normal to high subcooling.

Locate the restriction, replace the restricted part, replace drier, evacuate and recharge.

S-113 OVERCHARGE OF REFRIGERANT

An overcharge of refrigerant is normally indicated by an excessively high head pressure.

An evaporator coil, using an expansion valve metering device, will basically modulate and control a flooded evaporator and prevent liquid return to the compressor.

An evaporator coil, using a capillary tube metering device, could allow refrigerant to return to the compressor under extreme overcharge conditions. Also with a capillary tube metering device, extreme cases of insufficient indoor air can cause icing of the indoor coil and liquid return to the compressor, but the head pressure would be lower.

There are other causes for high head pressure which may be found in the "Service Problem Analysis Guide."

If other causes check out normal, an overcharge or a system containing non-condensables would be indicated.

If this system is observed:

1. Start the system.
2. Remove and capture small quantities of gas from the suction line dill valve until the head pressure is reduced to normal.
3. Observe the system while running a cooling performance test. If a shortage of refrigerant is indicated, then the system contains non-condensables.

S-114 NON-CONDENSABLES

If non-condensables are suspected, shut down the system and allow the pressures to equalize. Wait at least 15 minutes. Compare the pressure to the temperature of the coldest coil since this is where most of the refrigerant will be. If the pressure indicates a higher temperature than that of the coil temperature, non-condensables are present.

Non-condensables are removed from the system by first removing the refrigerant charge, replacing and/or installing liquid line drier, evacuating and recharging.

S-115 COMPRESSOR BURNOUT

When a compressor burns out, high temperature develops causing the refrigerant, oil and motor insulation to decompose forming acids and sludge.

If a compressor is suspected of being burned-out, attach a refrigerant hose to the liquid line dill valve and properly remove and dispose of the refrigerant.

NOTICE

Violation of EPA regulations may result in fines or other penalties.

Now determine if a burn out has actually occurred. Confirm by analyzing an oil sample using a Sporlan Acid Test Kit, AK-3 or its equivalent.

Remove the compressor and obtain an oil sample from the suction stub. If the oil is not acidic, either a burnout has not occurred or the burnout is so mild that a complete clean-up is not necessary.

If acid level is unacceptable, the system must be cleaned by using the clean-up drier method.

CAUTION

Do not allow the sludge or oil to contact the skin. Severe burns may result.

NOTE: The Flushing Method using R-11 refrigerant is no longer approved by Amana® Brand Heating-Cooling.

Suction Line Drier Clean-Up Method

The POE oils used with R410A refrigerant is an excellent solvent. In the case of a burnout, the POE oils will remove any burnout residue left in the system. If not captured by the refrigerant filter, they will collect in the compressor or other system components, causing a failure of the replacement compressor and/or spread contaminants throughout the system, damaging additional components.

Use AMANA® brand part number RF000127 suction line filter drier kit. This drier should be installed as close to the compressor suction fitting as possible. The filter must be accessible and be rechecked for a pressure drop after the system has operated for a time. It may be necessary to use new tubing and form as required.

NOTE: At least twelve (12) inches of the suction line immediately out of the compressor stub must be discarded due to burned residue and contaminates.

1. Remove compressor discharge line strainer.
2. Remove the liquid line drier and expansion valve.
3 Purge all remaining components with dry nitrogen or carbon dioxide until clean.
4. Install new components **including** liquid line drier.
5. Braze all joints, leak test, evacuate, and recharge system.
6. Start up the unit and record the pressure drop across the drier.
7. Continue to run the system for a minimum of twelve (12) hours and recheck the pressure drop across the drier. Pressure drop should not exceed 6 PSIG.
8. Continue to run the system for several days, repeatedly checking pressure drop across the suction line drier. If the pressure drop never exceeds the 6 PSIG, the drier has

trapped the contaminants. Remove the suction line drier from the system.

9. If the pressure drop becomes greater, then it must be replaced and steps 5 through 9 repeated until it does not exceed 6 PSIG.

NOTICE: Regardless, the cause for burnout must be determined and corrected before the new compressor is started.

S-120 REFRIGERANT PIPING

The piping of a refrigeration system is very important in relation to system capacity, proper oil return to compressor, pumping rate of compressor and cooling performance of the evaporator.

POE oils maintain a consistent viscosity over a large temperature range which aids in the oil return to the compressor; however, there will be some installations which require oil return traps. These installations should be avoided whenever possible, as adding oil traps to the refrigerant lines also increases the opportunity for debris and moisture to be introduced into the system. Avoid long running traps in horizontal suction line.

LONG LINE SET APPLICATION R-410A

This long line set application guideline applies to all AHRI listed R-410A air conditioner and heat pump split system matches of nominal capacity 18,000 to 60,000 Btuh. This guideline will cover installation requirements and additional accessories needed for split system installations where the line set exceeds 80 feet in actual length.

Accessories for lines greater than 80 feet:

1. **Crankcase Heater**- a long line set application can critically increase the charge level needed for a system. As a result, the system is very prone to refrigerant migration during its off-cycle and a crankcase heater will help minimize this risk. A crankcase heater is required for any long line application (50 watt minimum).
2. For all line set applications over 80 feet a TXV is recommended. The subcooling should be 6º ± 2º.
3. **Hard Start Assist**- increased charge level in long line applications can require extra work from the compressor at start-up. A hard start assist device may be required to overcome this.
4. **Liquid Line Solenoid** - a long line set application can critically increase the charge level needed for a system. As a result, the system is very prone to refrigerant migration during its off-cycle and a liquid line solenoid will help minimize this. A liquid line solenoid is recommended for any long line application on straight cooling units.

Tube Sizing:

1. In long line applications, the "equivalent line length" is the sum of the straight length portions of the suction line plus losses (in equivalent length) from 45 and 90 degree bends. **Select the proper suction tube size based on equivalent length of the suction line (see Tables 4 & 5) and recalculated system capacity.**

   Equivalent length =

   Length $_{horizontal}$

   + Length $_{vertical}$

   + Losses from bends (see Tables 4 & 5)

   Example using ¾" elbow:

   150 feet of straight tubing + (four short radius elbows x 1.7) + (2 long radius elbows x 1.5) = 150 + 3.4 +3 = 156.4 equivalent feet.

2. **For any residential split system installed with a long line set, 3/8" liquid line size must be used.** Limiting the liquid line size to 3/8" is critical since an increased refrigerant charge level from having a larger liquid line could possibly shorten a compressor's life-span.
3. **Single Stage Condensing Unit:** The maximum length of tubing must not exceed 150 feet.
   - **80 feet** is the maximum recommended vertical difference between the condenser and evaporator when the evaporator is above the condenser. Equivalent length is not to exceed 150 feet.
   - The vertical difference between the condenser and evaporator when the evaporator is below the condenser can approach 150 feet, as long as the equivalent length does not exceed 150 feet.
   - The distance between the condenser and evaporator in a completely horizontal installation in which the indoor and outdoor unit do not differ more than 10 feet in vertical distance from each other can approach 150 feet, as long as the equivalent length does **not exceed 150 feet.**
4. **Two-Stage Condensing Unit:** The maximum length of tubing must not exceed 80 feet where indoor coil is located above the outdoor unit.

NOTE: When the outdoor unit is located above the indoor coil, the maximum vertical rise must not exceed 25 feet. If the maximum vertical rise exceeds 25 feet, premature compressor failure will occur due to inadequate oil return.

5. **Most refrigerant tubing kits are supplied with 3/8"-thick insulation on the vapor line. For long line installations over 80 feet that pass through a high ambient temperature, ½"-thick suction line insulation is recommended to reduce loss of capacity. Insulate the liquid line if it passes through an area of 120°F or greater. Do not attach the liquid line to any non-insulated portion of the suction line.**
6. **Vibration and Noise:** In long line applications, refrigerant tubing is highly prone to transmit noise and vibration to the structure it is fastened to. Use adequate vibration-

isolating hardware when mounting line set to adjacent structure.

Table 4 lists multiplier values to recalculate system-cooling capacity as a function of a system's equivalent line length (as calculated from the suction line) and the selected suction tube size. Table 5 lists the equivalent length gained from adding bends to the suction line. **Properly size the suction line to minimize capacity loss.**

TABLE 4. CAPACITY MULTIPLIERS AS A FUNCTION OF SUCTION LINE SIZE & EQUIVALENT LENGTH

Unit	Suction Dia (in)	Capacity Length (ft)					
		25	50	75	100	125	150
18000	1/2	0.99	0.97	0.96	0.94	0.94	0.93
	5/8	1.00	0.99	0.99	0.99	0.98	0.98
	3/4	**1.00**	1.00	1.00	1.00	0.99	0.99
24000	5/8	0.99	0.99	0.98	0.98	0.97	0.97
	3/4	**1.00**	1.00	0.99	0.99	0.99	0.99
	7/8	1.00	1.00	1.00	1.00	0.99	0.99
30000	5/8	0.99	0.99	0.98	0.97	0.96	0.96
	3/4	**1.00**	1.00	0.99	0.99	0.99	0.98
	7/8	1.00	1.00	1.00	1.00	1.00	0.99
36000	5/8	0.99	0.98	0.96	0.95	0.94	0.93
	3/4	1.00	1.00	0.99	0.99	0.98	0.98
	7/8	**1.00**	1.00	1.00	1.00	0.99	0.99
	1 1/8	1.00	1.00	1.00	1.00	1.00	1.00
42000	3/4	1.00	0.99	0.99	0.98	0.97	0.97
	7/8	1.00	1.00	0.99	0.99	0.99	0.99
	1 1/8	**1.00**	1.00	1.00	1.00	1.00	1.00
48000	3/4	0.99	0.99	0.98	0.97	0.96	0.96
	7/8	1.00	0.99	0.99	0.99	0.98	0.98
	1 1/8	**1.00**	1.00	1.00	1.00	1.00	1.00
60000	3/4	0.99	0.98	0.97	0.96	0.94	0.93
	7/8	1.00	0.99	0.98	0.98	0.97	0.97
	1 1/8	**1.00**	1.00	1.00	0.99	0.99	0.99

NOTE: For a condenser with a liquid valve tube connection less than 3/8" diameter, use 3/8" liquid line tubing for a line set greater than 25 feet.

TABLE 5. LOSSES FROM SUCTION LINE ELBOWS (EQUIVALENT LENGTH, FT.)

Type of elbow fitting	I.D. (in.)		
	3/4	7/8	1-1/8
90° short radius	1.7	2	2.3
90° long radius	1.5	1.7	1.6
45°	0.7	0.8	1

Installation Requirements

1. In a completely horizontal installation with a long line set where the evaporator is at the same altitude as (or slightly below) the condenser, the line set should be sloped towards the evaporator. This helps reduce refrigerant migration to the condenser during a system's off-cycle.

2. For a system installation where the evaporator is above the condenser, an inverted vapor line trap should be installed on the suction line just before the inlet to the evaporator (see Fig 6). The top of the inverted loop must be slightly above the top of the evaporator coil and can be created simply by brazing two 90° long radius elbows together, if a bending tool is unavailable. Properly support and secure the inverted loop to the nearest point on the indoor unit or adjacent structure.

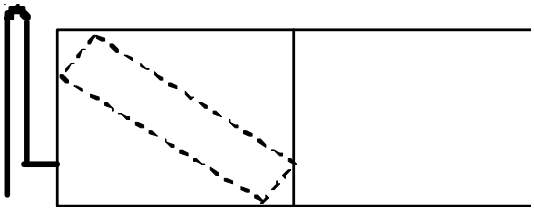


Fig 6. Evaporator unit with inverted vapor loop

3. **An oil trap is required at the evaporator if the condenser is above the evaporator.** Depending on the vertical rise of the line set, oil traps are required in the suction line. Oil traps should be installed at evaporator, in the suction line. Install one oil trap for a height difference of more than 15 feet between indoor and outdoor units. Preformed oil traps are available at most HVAC supply houses, or oil traps may be created by brazing tubing elbows together (see diagram below). Remember to add the equivalent length from oil traps to the equivalent length calculation of the suction line. For example, if you construct an oil trap using two 45° elbows, one short and one long 90° elbow in a ¾" diameter suction line, the additional equivalent length would be 0.7+ 0.7+1.7+1.5, which equals 4.6 feet (refer to Table 5).

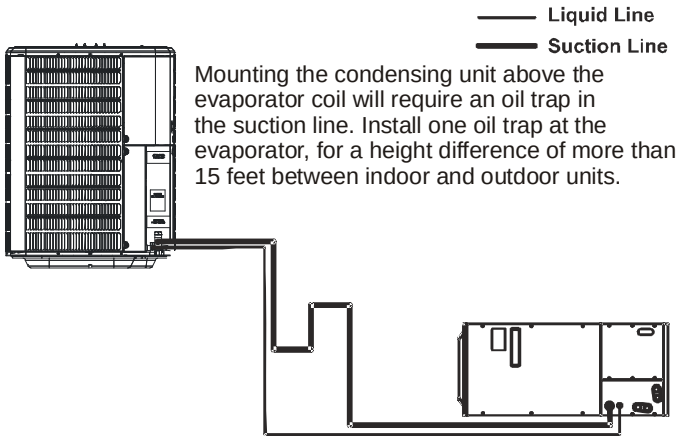


Fig 7. Oil Trap Placement

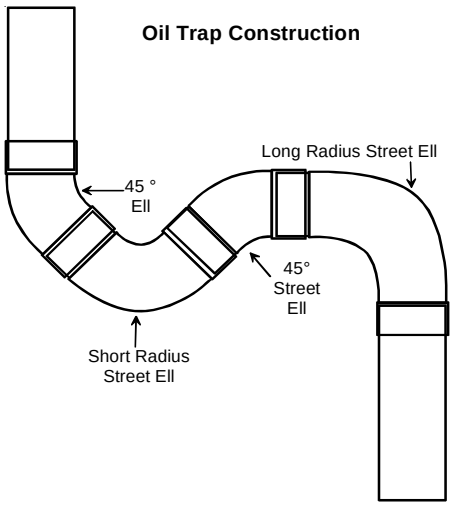


Fig 8. Oil Trap

4. **Low voltage wiring**. Verify low voltage wiring size is adequate for the length used since it will be increased in a long line application.

Initial System Charging

R-410A condensers are factory charged for 15 feet of line set. To calculate the amount of extra refrigerant (in ounces) needed for a line set over 15 feet, multiply the additional length of line set by 0.6 ounces. Note for the formula below, the linear feet of line set is the actual length of liquid line (or suction line, since both should be equal) used, not the equivalent length calculated for the suction line.

Use subcooling as the primary method for final system charging of long line set system application.

Extra refrigerant needed =

(Linear feet of line set – 15 ft.) x **X** oz./ft.

Where **X** = **0.6** for 3/8" liquid tubing

Remember, 3/8" liquid tubing is required for all long line set applications.

Heat pumps should be checked in both heating and cooling mode for proper charge level. This guideline is meant to provide installation instructions based on most common long line set applications. Installation variables may affect system operation.

Follow the charging procedures in the outdoor unit I/O manual to ensure proper superheat and sub-cooling levels, especially on a system with a TXV installed in the indoor unit. Heat pumps should be checked in both heating and cooling mode for proper charge level. This guideline is meant to provide installation instructions based on most common long line set applications. Installation variables may affect system operation.

NO ADDITIONAL COMPRESSOR OIL IS NEEDED FOR LONG LINE SET APPLICATIONS ON RESIDENTIAL SPLIT SYSTEMS.

S-202 DUCT STATIC PRESSURES AND/OR STATIC PRESSURE DROP ACROSS COILS

This minimum and maximum allowable duct static pressure for the indoor sections are found in the specifications section.

Tables are also provided for each coil, listing quantity of air (CFM) versus static pressure drop across the coil.

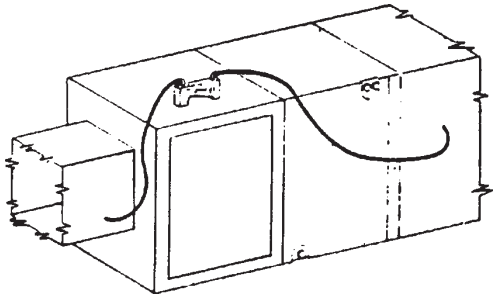
Too great an external static pressure will result in insufficient air that can cause icing of the coil. Too much air can cause poor humidity control and condensate to be pulled off the evaporator coil causing condensate leakage. Too much air can also cause motor overloading and in many cases this constitutes a poorly designed system.

S-203 AIR HANDLER EXTERNAL STATIC

To determine proper air movement, proceed as follows:

1. Using a draft gauge (inclined manometer), measure the static pressure of the return duct at the inlet of the unit, (Negative Pressure).
2. Measure the static pressure of the supply duct, (Positive Pressure).

3. Add the two readings together.

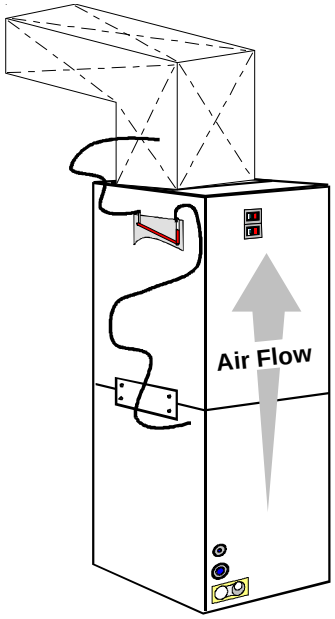


TOTAL EXTERNAL STATIC

NOTE: Both readings may be taken simultaneously and read directly on the manometer if so desired.

4. Consult proper table for quantity of air.

If external static pressure is being measured on a furnace to determine airflow, supply static must be taken between the "A" coil and the furnace.



TOTAL EXTERNAL STATIC

S-204 COIL STATIC PRESSURE DROP

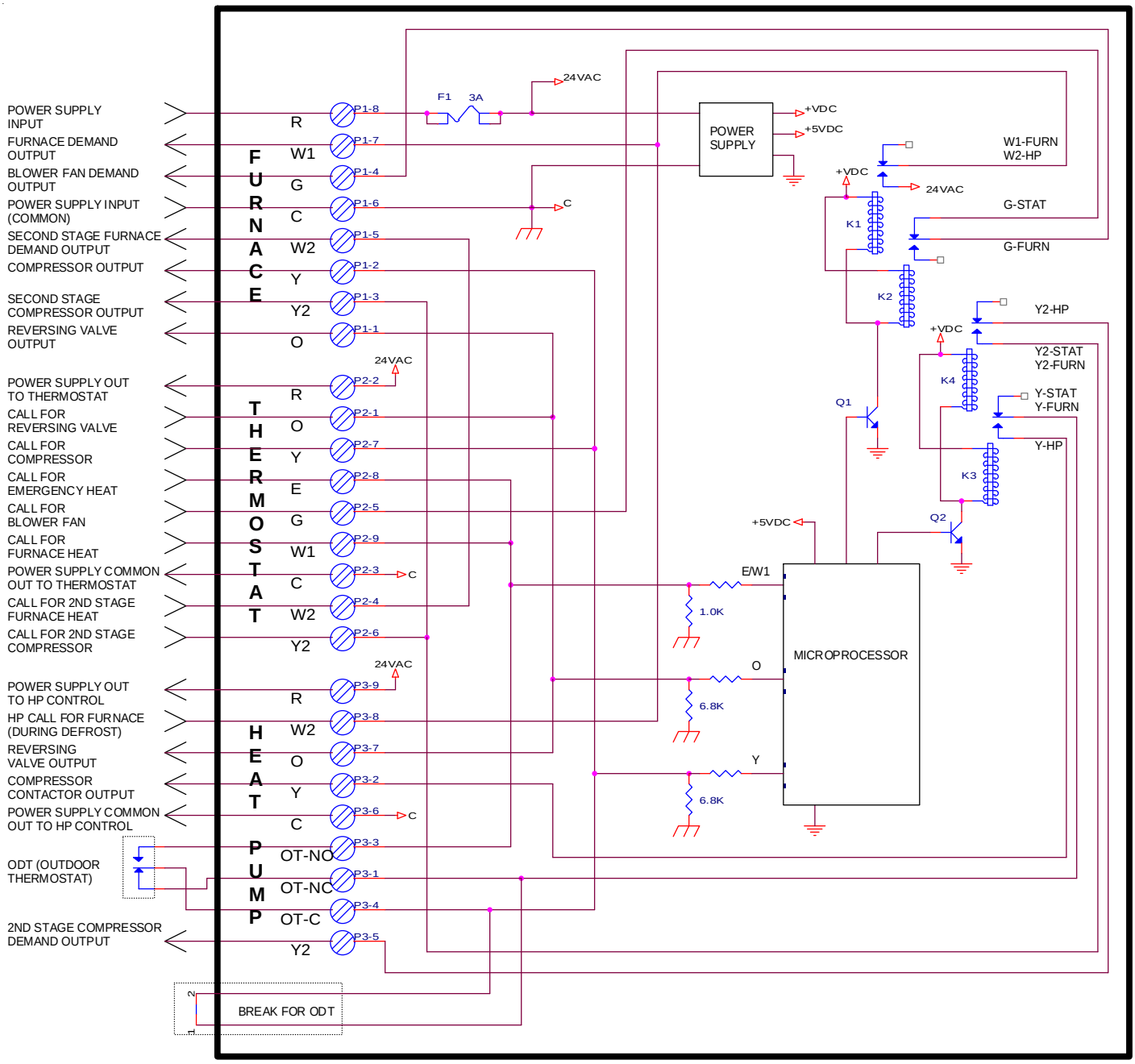
1. Using a draft gauge (inclined manometer), connect the positive probe underneath the coil and the negative probe above the coil.
2. A direct reading can be taken of the static pressure drop across the coil.
3. Consult proper table for quantity of air.

ACCESSORIES WIRING DIAGRAMS

WARNING

HIGH VOLTAGE!
DISCONNECT ALL POWER BEFORE SERVICING OR INSTALLING THIS UNIT. MULTIPLE POWER SOURCES MAY BE PRESENT. FAILURE TO DO SO MAY CAUSE PROPERTY DAMAGE, PERSONAL INJURY OR DEATH.

ALL FUEL SYSTEM AFE18-60A CONTROL BOARD



ALL FUEL CONTROL BOARD - AFE18-60A

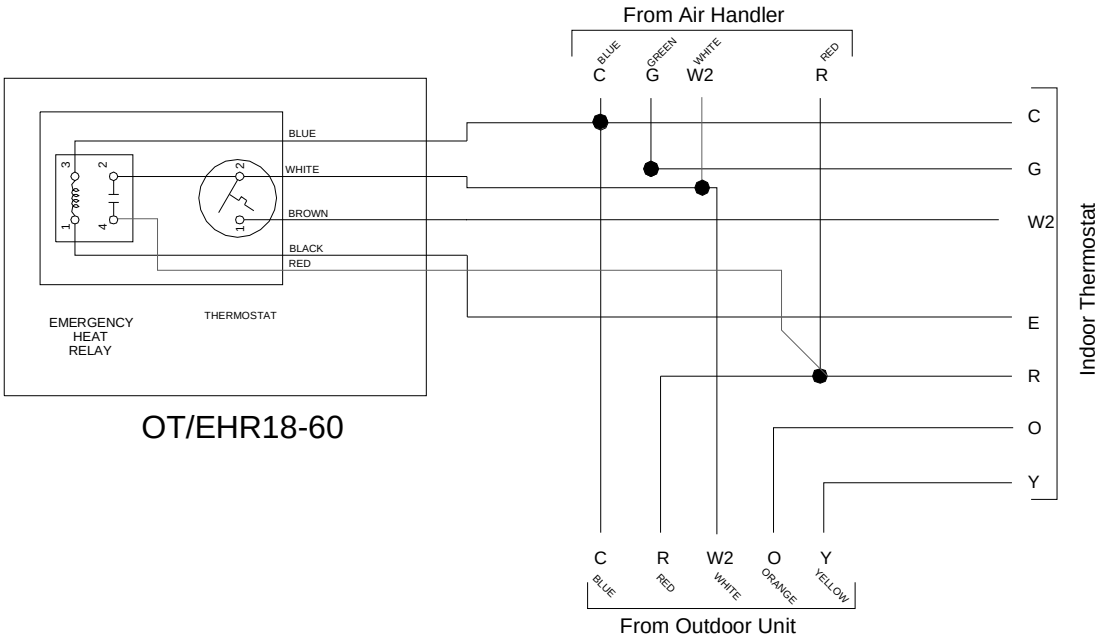
This wiring diagram is for reference only. Not all wiring is as shown above.
Refer to the appropriate wiring diagram for the unit being serviced.
(For use with Heat Pumps in conjunction with 80% or 90% Single-Stage or Two-Stage Furnaces)

ACCESSORIES WIRING DIAGRAMS

WARNING

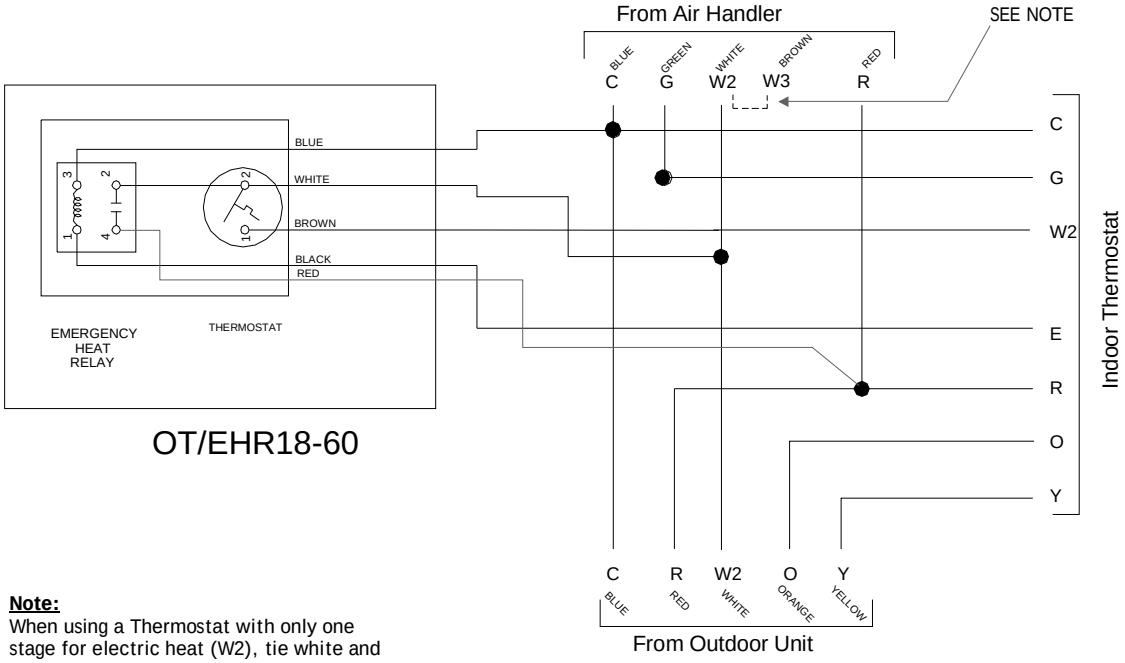
HIGH VOLTAGE!
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10kw and Below, One Stage Electric Heat



OT/EHR18-60

15kw and Above, Two Stage Electric Heat



OT/EHR18-60

Note:
When using a Thermostat with only one stage for electric heat (W2), tie white and brown wires from air handler together.

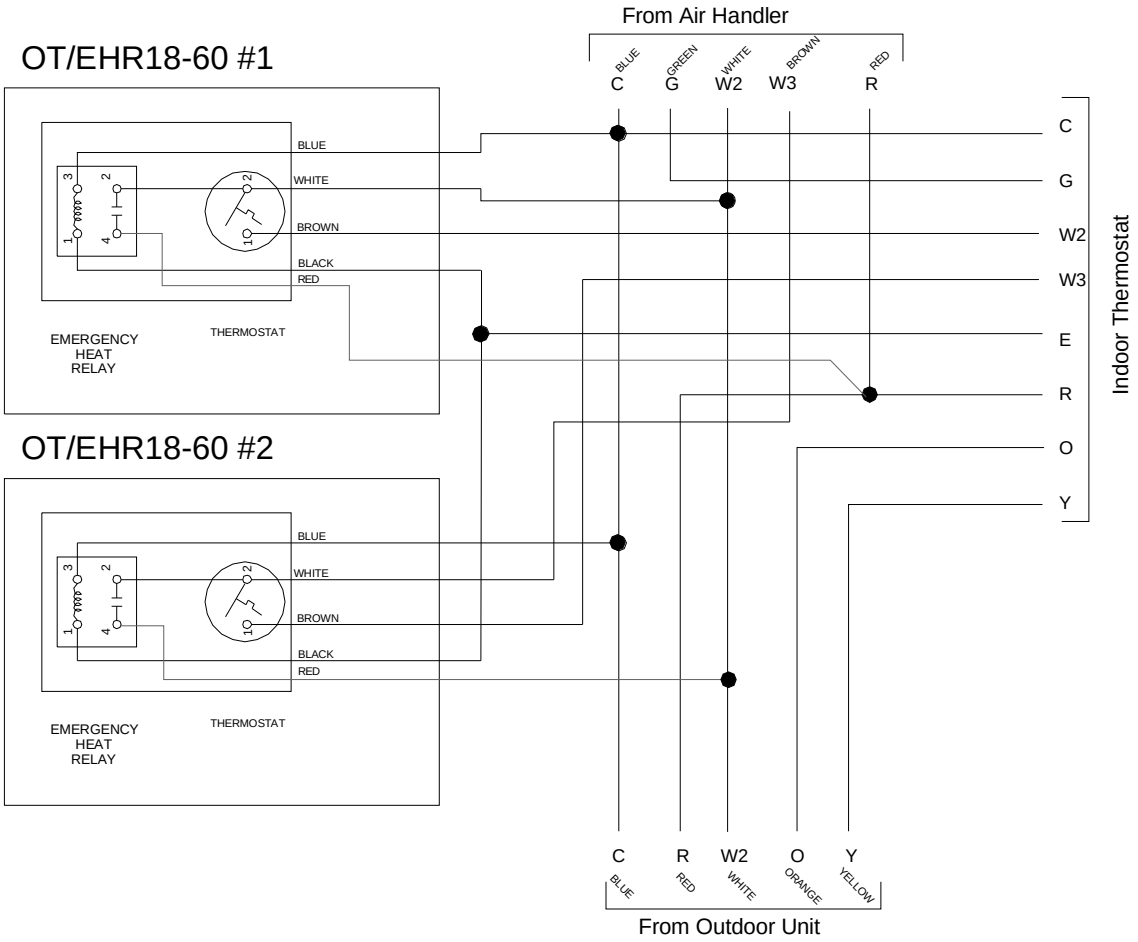
Typical Wiring Schematics for OT/EHR18-60 (Outdoor Thermostat & Emergency Heat Relay).
This wiring diagram is for reference only. Not all wiring is as shown above.
Refer to the appropriate wiring diagram for the unit being serviced.

ACCESSORIES WIRING DIAGRAMS

WARNING

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15kw and Above with Two OT/EHR18-60's, Two Stage Electric Heat and Two Stage Thermostat

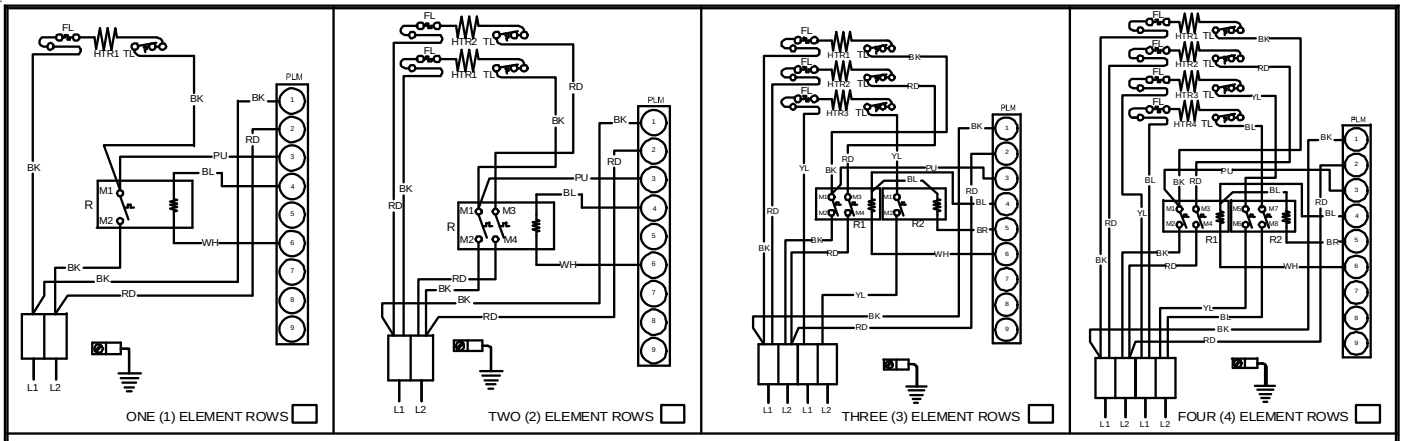


Typical Wiring Schematics for OT/EHR18-60 (Outdoor Thermostat & Emergency Heat Relay).
This wiring diagram is for reference only. Not all wiring is as shown above.
Refer to the appropriate wiring diagram for the unit being serviced.

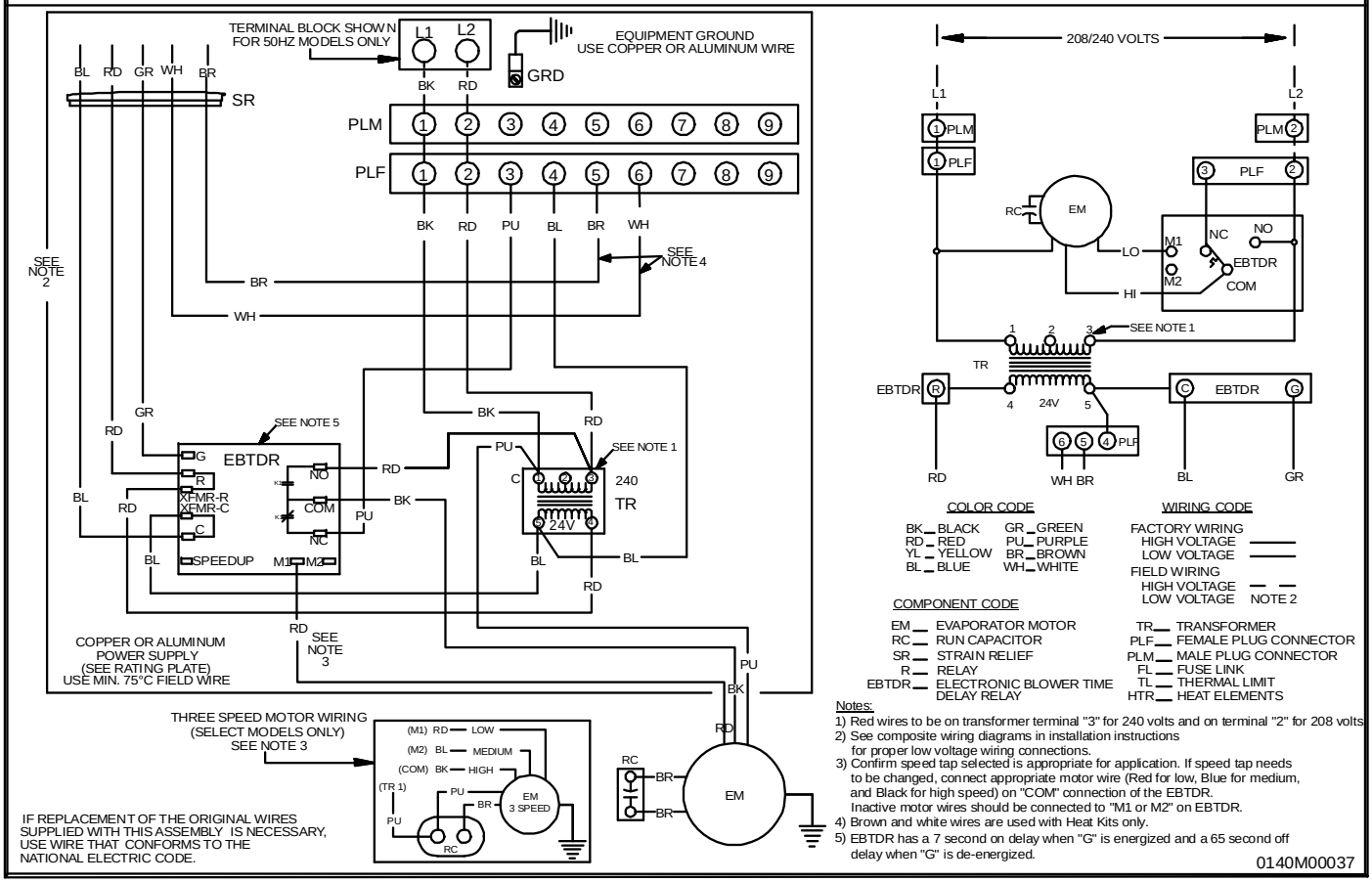
ACCESSORIES WIRING DIAGRAMS

WARNING

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NOTE: WHEN INSTALLING HEATER KIT, ENSURE SPEED TAP DOES NOT EXCEED MINIMUM BLOWER SPEED (MBS) SPECIFIED FOR THE AIRHANDLER/HEAT ER KIT COMBINATION ON THIS UNIT'S S&R PLATE. AFTER INSTALLING OPTIONAL HEAT KIT, MARK AN "X" IN THE ☐ PROVIDED ABOVE. MARK ACCORDING TO NUMBER OF HEATER ELEMENT ROWS INSTALLED. NO MARK INDICATES NO HEAT KIT INSTALLED.



COLOR CODE

BK	BLACK	GR	GREEN
RD	RED	PU	PURPLE
YL	YELLOW	BR	BROWN
BL	BLUE	WH	WHITE

WIRING CODE

FACTORY WIRING
HIGH VOLTAGE ——
LOW VOLTAGE ——
FIELD WIRING
HIGH VOLTAGE — —
LOW VOLTAGE NOTE 2

COMPONENT CODE

EM	EVAPORATOR MOTOR	TR	TRANSFORMER
RC	RUN CAPACITOR	PLF	FEMALE PLUG CONNECTOR
SR	STRAIN RELIEF	PLM	MALE PLUG CONNECTOR
R	RELAY	FL	FUSE LINK
EBTDR	ELECTRONIC BLOWER TIME DELAY RELAY	TL	THERMAL LIMIT
		HTR	HEAT ELEMENTS

Notes:
1) Red wires to be on transformer terminal "3" for 240 volts and on terminal "2" for 208 volts
2) See composite wiring diagrams in installation instructions for proper low voltage wiring connections.
3) Confirm speed tap selected is appropriate for application. If speed tap needs to be changed, connect appropriate motor wire (Red for low, Blue for medium, and Black for high speed) on "COM" connection of the EBTDR. Inactive motor wires should be connected to "M1 or M2" on EBTDR.
4) Brown and white wires are used with Heat Kits only.
5) EBTDR has a 7 second on delay when "G" is energized and a 65 second off delay when "G" is de-energized.

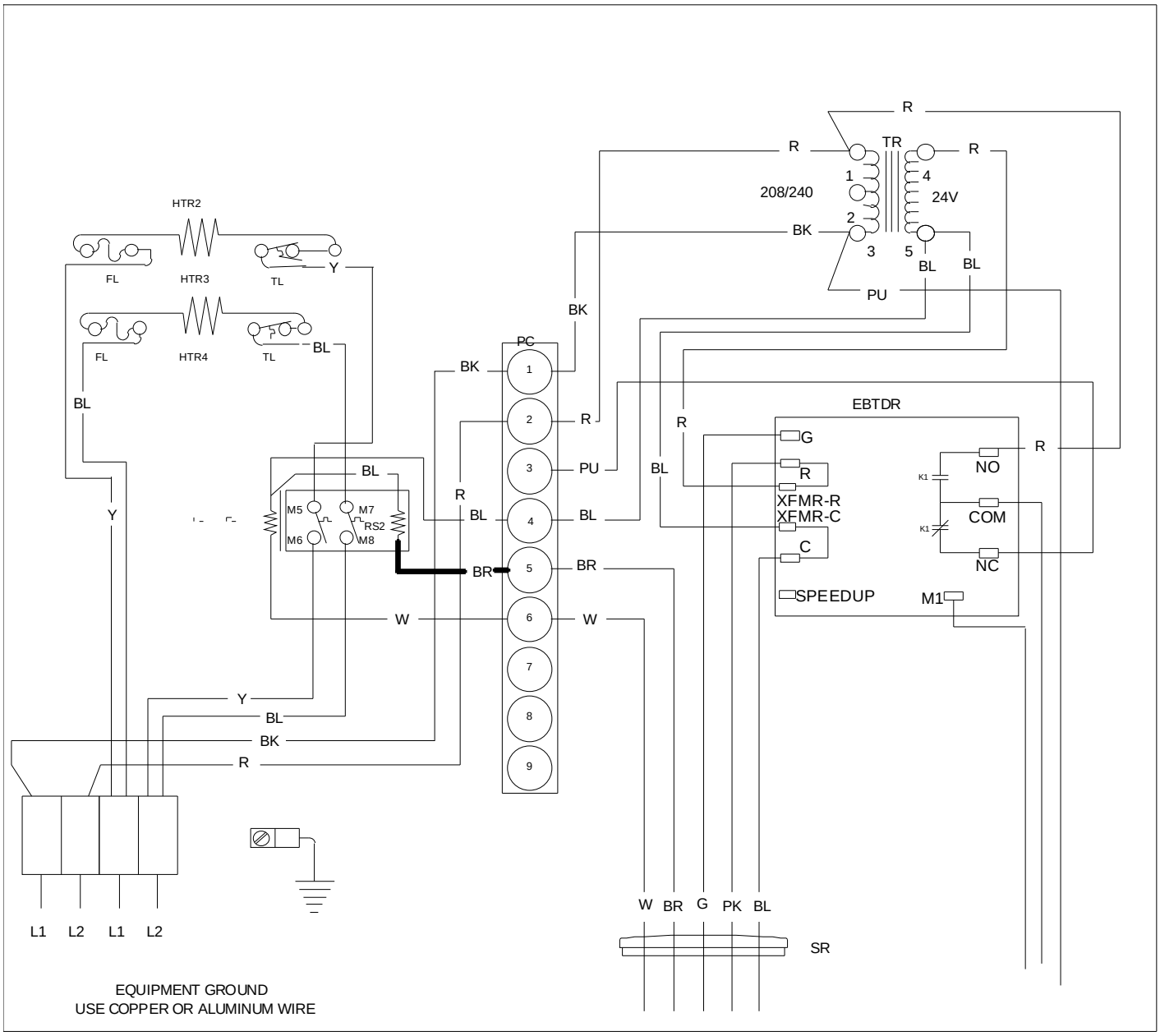
0140M00037

Typical Wiring Schematic ADPF, ARPF, ARUF with Electric Heat.
This wiring diagram is for reference only. Not all wiring is as shown above.
Refer to the appropriate wiring diagram for the unit being serviced.

ACCESSORIES WIRING DIAGRAMS

WARNING

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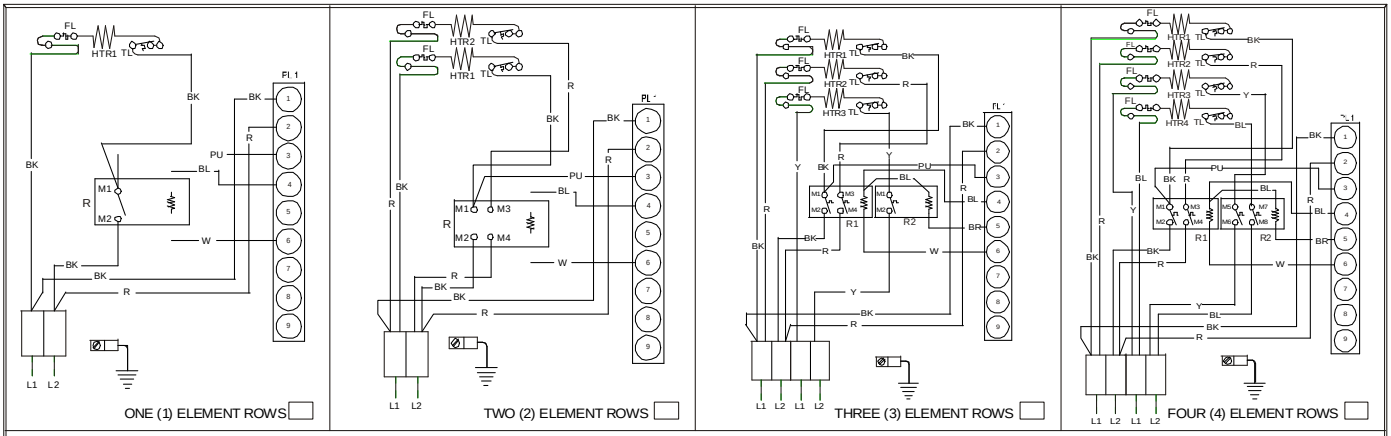


Typical Wiring Schematic MBR Blower with Electric Heat.
This wiring diagram is for reference only. Not all wiring is as shown above.
Refer to the appropriate wiring diagram for the unit being serviced.

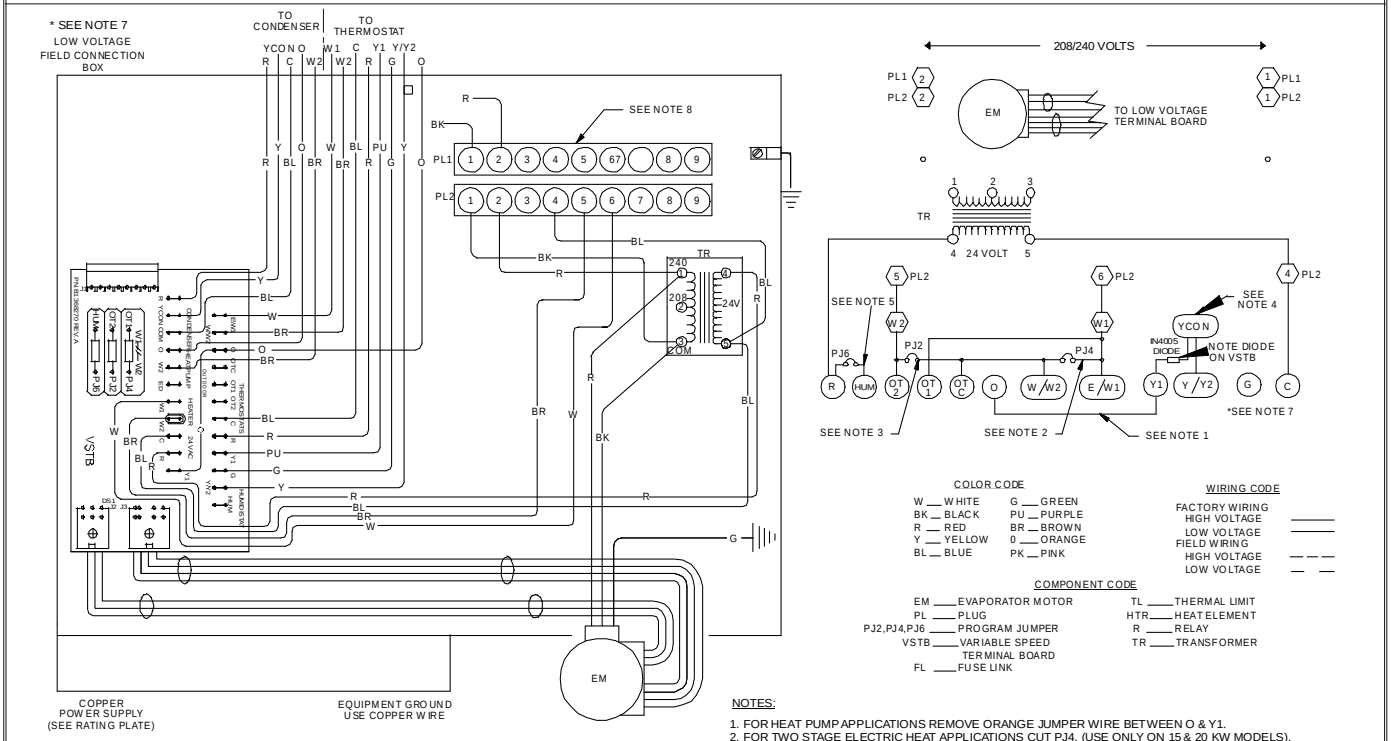
ACCESSORIES WIRING DIAGRAMS

WARNING

HIGH VOLTAGE!
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AFTER INSTALLING OPTIONAL HEAT KIT, MARK AN "X" IN THE ☐ PROVIDED ABOVE.
MARK ACCORDING TO NUMBER OF HEATER ELEMENT ROWS INSTALLED
NO MARK INDICATES NO HEAT KIT INSTALLED



COLOR CODE

W ___ WHITE	G ___ GREEN
BK ___ BLACK	PU ___ PURPLE
R ___ RED	BR ___ BROWN
Y ___ YELLOW	O ___ ORANGE
BL ___ BLUE	PK ___ PINK

WIRING CODE

FACTORY WIRING
HIGH VOLTAGE
LOW VOLTAGE
FIELD WIRING
HIGH VOLTAGE
LOW VOLTAGE

COMPONENT CODE

EM ___ EVAPORATOR MOTOR	TL ___ THERMAL LIMIT
PL ___ PLUG	HTR ___ HEAT ELEMENT
PJ2,PJ4,PJ6 ___ PROGRAM JUMPER	R ___ RELAY
VSTB ___ VARIABLE SPEED TERMINAL BOARD	TR ___ TRANSFORMER
FL ___ FUSE LINK	

NOTES:

1. FOR HEAT PUMP APPLICATIONS REMOVE ORANGE JUMPER WIRE BETWEEN O & Y1.
2. FOR TWO STAGE ELECTRIC HEAT APPLICATIONS CUT PJ4. (USE ONLY ON 15 & 20 KW MODELS).
3. FOR OUTDOOR THERMOSTAT OPERATION OF SECOND STAGE HEAT, CUT PJ2 & ADD OT18-60 TO OTC & OT2.
4. FOR SINGLE STAGE COOLING APPLICATIONS CONNECT THERMOSTAT TO Y/Y2 ONLY, TAPE OR REMOVE Y1 CONNECTION. CONNECT CONDENSING UNIT TO YCON & C.
5. WHEN HUMIDSTAT IS PROVIDED CUT PJ6. THERMOSTAT OPENS ON HUMIDITY RISE.
6. RED WIRES TO BE ON TRANSFORMER TERMINAL 3 FOR 240 VOLTS AND ON TERMINAL 2 FOR 208 VOLTS.
7. SEE COMPOSITE WIRING DIAGRAMS IN INSTALLATION INSTRUCTIONS FOR PROPER LOW VOLTAGE CONNECTIONS AND DETAILS ON COMPATIBLE THERMOSTATS AND THEIR CONNECTIONS.
8. DISCARD ORIGINAL "PL1" PLUG CONNECTOR WHEN INSTALLING OPTIONAL HEAT KIT.

CONTROLS SHOWN WITH UTILITIES IN "ON" POSITION AND THERMOSTAT IN "OFF" POSITION.
IF REPLACEMENT OF THE ORIGINAL WIRES SUPPLIED WITH THIS ASSEMBLY IS NECESSARY, USE 105°C. WIRE. SIZE TO CONFORM TO THE NATIONA L ELECTRIC CODE.

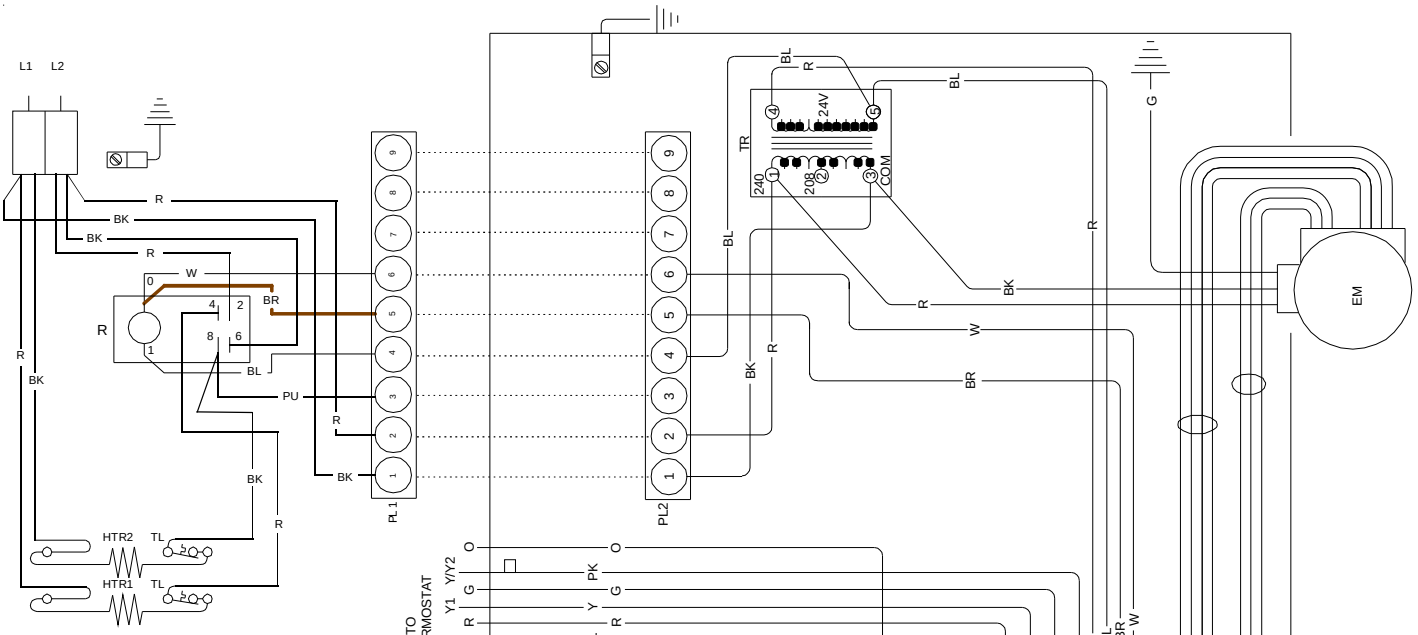
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Typical Wiring Schematic AEPF with Electric Heat.
This wiring diagram is for reference only. Not all wiring is as shown above.
Refer to the appropriate wiring diagram for the unit being serviced.

ACCESSORIES WIRING DIAGRAMS

WARNING

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HKR Heat Kit

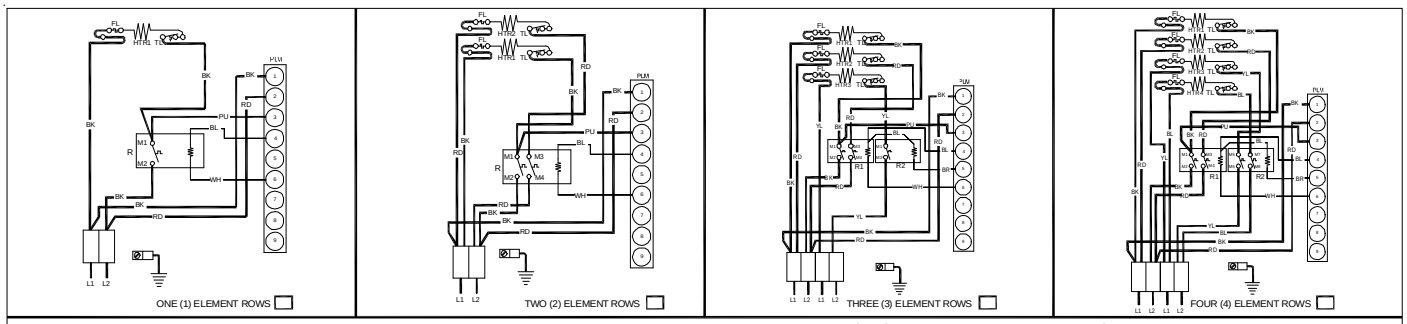
Blower Section

Typical Wiring Schematic MBE Blower with Electric Heat.
This wiring diagram is for reference only.
Not all wiring is as shown above.
Refer to the appropriate wiring diagram for the unit being serviced.

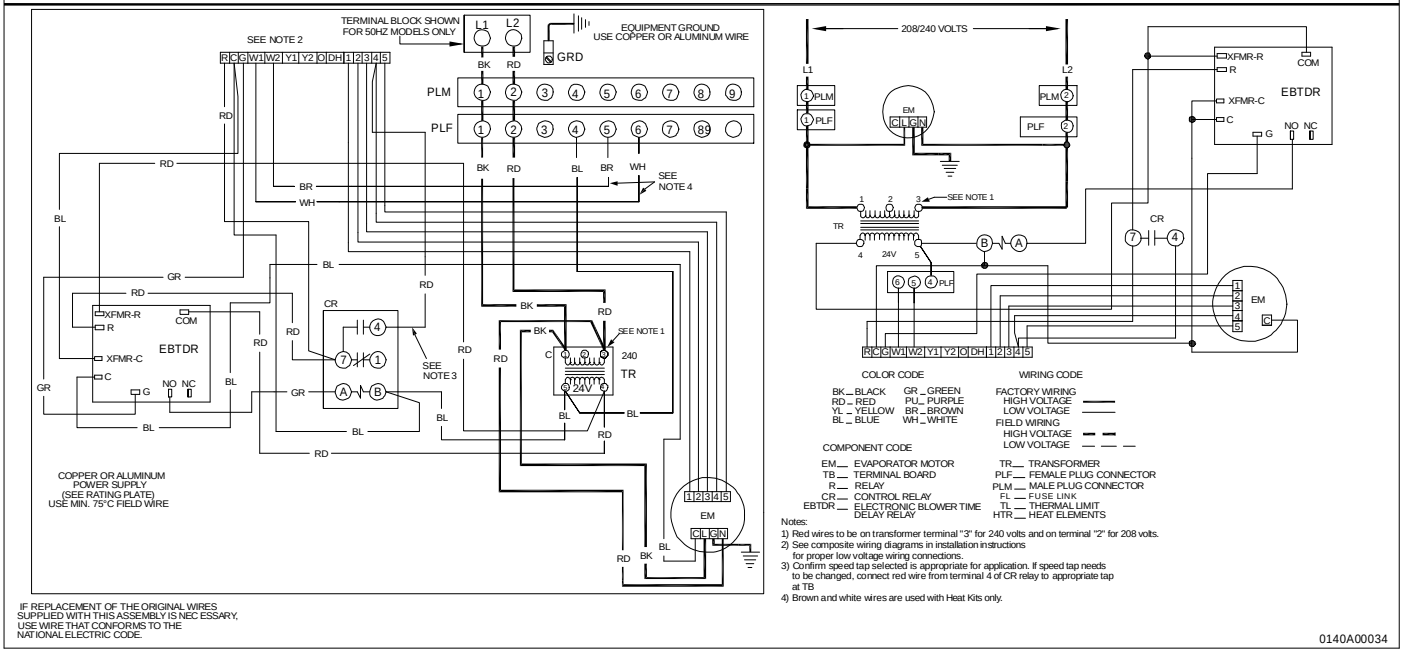
ACCESSORIES WIRING DIAGRAMS

WARNING

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0140A00034

Typical Wiring Schematic ASPF with Electric Heat.
This wiring diagram is for reference only. Not all wiring is as shown above.
Refer to the appropriate wiring diagram for the unit being serviced.