Installation & Operation Manual
10 EER Vertical Wall-Mount Air Conditioners

MODELS:
MGA3090A & MGA3120A
(Dual Compressor)

IMPORTANT
This manual may include information for options and features which may not be included on the unit being installed. Refer to the unit data label or Model Identification to determine which features and options this unit is equipped with.

INSTALLER: Affix the instructions on the inside of the building adjacent to the thermostat.
END USER: Retain this manual for future reference.

Manufactured By:
Marvair Division of the AIRXCEL® Commercial Group
P.O. Box 400 • Cordele, Georgia 31010 • 156 Seedling Drive • Cordele, Georgia 31015
(229) 273-3636 • Fax (229) 273-5154

The most current version of this manual can be found at www.Marvair.com.
How To Use This Manual

This manual is intended to be a guide to Marvair's line of vertical air conditioners. It contains installation, troubleshooting, maintenance, warranty, and application information. The information contained in this manual is to be used by the installer as a guide only. This manual does not supersede or circumvent any applicable national or local codes.

If you are installing the air conditioner first read Chapter 1 and scan the entire manual before beginning the installation as described in Chapter 2. Chapter 1 contains general, descriptive information and provides an overview which can speed up the installation process and simplify troubleshooting.

If a malfunction occurs, follow this troubleshooting sequence:

1. Make sure you understand how the air conditioner works (Chapters 1 & 3).
2. Identify and correct installation errors (Chapter 2).
3. Refer to the troubleshooting information in Chapter 4.

If you are still unable to correct the problem, contact the Factory at 1-229-273-9558 for additional assistance.

Please read the following “Important Safety Precautions” before beginning any work.

Important Safety Precautions

1. USE CARE when LIFTING or TRANSPORTING equipment.
2. TRANSPORT the UNIT UPRIGHT. Laying it down on its side may cause oil to leave the compressor and breakage or damage to other components.
3. TURN ELECTRICAL POWER OFF AT THE breaker or fuse box BEFORE installing or working on the equipment. LINE VOLTAGES ARE HAZARDOUS or LETHAL.
4. OBSERVE and COMPLY with ALL applicable PLUMBING, ELECTRICAL, and BUILDING CODES and ordinances.
5. SERVICE may be performed ONLY by QUALIFIED and EXPERIENCED PERSONS.
   * Wear safety goggles when servicing the refrigeration circuit
   * Beware of hot surfaces on refrigerant circuit components
   * Beware of sharp edges on sheet metal components
   * Use care when recovering or adding refrigerant
6. Use COMMON SENSE - BE SAFETY-CONSCIOUS

This is the safety alert symbol ⚠️. When you see this symbol on the air conditioning unit and in the instruction manuals be alert to the potential for personal injury. Understand the signal word DANGER, WARNING and CAUTION. These words are used to identify levels of the seriousness of the hazard.

⚠️ DANGER
Failure to comply will result in death or severe personal injury and/or property damage.

⚠️ WARNING
Failure to comply could result in death or severe personal injury and/or property damage.

⚠️ CAUTION
Failure to comply could result in minor personal injury and/or property damage.

⚠️ IMPORTANT
Used to point out helpful info that will result in improved installation, reliability or operation.

SPECIFICATIONS SUBJECT TO CHANGE WITHOUT NOTICE.
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WARNING

• If the information in these instructions are not followed exactly, a fire may result causing property damage, personal injury or loss of life.

• Read all instructions carefully prior to beginning the installation. Do not begin installation if you do not understand any of the instructions.

• Improper installation, adjustment, alteration, service or maintenance can cause property damage, personal injury or loss of life.

• Installation and service must be performed by a qualified installer or service agency in accordance with these instructions and in compliance with all codes and requirements of authorities having jurisdiction.

INSTALLER: Affix the instructions on the inside of the building adjacent to the thermostat.

END USER: Retain these instructions for future reference.

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Chapter 1 Description & Specifications

1.1 General Description

The Marvair MGA3090 and MGA3120 are a series of vertical wall-mounted air conditioning systems that provide heating, cooling, and ventilation for telecommunication shelters, and other applications with high internal heat gains. The series is available in nominal cooling capacities of 90,000-120,000 BTUH. A factory installed economizer, resistance heating elements and reverse flow configurations are available.

All of Marvair's wall mount air conditioners feature an exclusive electronic control board or PLC-based controls.

The control board and PLC consolidate several of the electrical components, improves the air conditioner’s reliability and has LED’s to indicate operating status and fault conditions to assist the service technician. A complete description of functions is in Section 1.6

Other standard components include:

- Hot gas by-pass valve to allow operation in cold temperatures
- Thermal expansion valve to improve both efficiency and capacity over a wide range of ambient temperatures
- Phase monitor to prevent operation if the unit is not properly phased

Marvair air conditioners are designed for easy installation and service. Major components are accessible for service beneath external panels.

All units have internal disconnects. Depending upon state and local code requirements, this feature may eliminate the need for an external breaker or disconnect.
### 1.2 Model Identification

The model identification number is found on the data sticker. Rating plate located on side panel.

| Example | M | G | A | 3 | 0 | 9 | 0 | A | D | 1 | 5 | 0 | C | + | + | + | 1 | C | A | + | A | 1 | + | + | + | + | + |
| Position | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 |
| 1 | Unit Designation/Family | M = Marvair Wall Mount |
| 2 | Energy Efficiency Ratio (EER) | G = 10 |
| 3 | Refrigerant Type | A = R-410a |
| 4 | Compressor Type/Quantity | E = Single |
| 5 | Unit Capacity/Nominal Cooling (BTUH) | 900 = 90,000 |
| 6 | System Type | A = Air Conditioner |
| 7 | Power Supply (Volts-Phase-Hz) | A = 208/230-1-60 |
| 8 | Heat Designation @ Rated Voltage | 000 = No Heat |
| 9 | KW = Kilowatt | 150 = 15KW |
| 10 | Ventilation Configuration | A = Solid Front Door |
| 11 | Dehumidification | A = Power Fail Alarm w/Additional Lockouts |
| 12 | Controls | A = Evaporator Freeze Sensor (EFS) |
| 13 | Operating Condition | A = Evaporator Freeze Sensor (EFS) |
| 14 | Indoor Air Quality Features | D = Dry Bulb Sensor |
| 15 | Air Flow | I = Top Supply/Bottom Return |
| 16 | Compressor Location | C = Center |
| 17 | Filter Option | A = 25 Pleated (MERV 8, AC/HP-C) |
| 18 | Corrosion Protection | A = Condenser Coil Only |
| 19 | Engineering System Type | A = 25 Pleated (MERV 8, AC/HP-C) |
| 20 | Revision Level | A = 25 Pleated (MERV 8, AC/HP-C) |
| 21 | Cabinet Color | A = Marvair Beige |
| 22 | Sound Attenuation | A = Marvair Beige |
| 23 | Security Option | A = Lockable Access Plate/Tamper Proof |
| 24 | Packaging | A = Crating |
| 25 | Fastener/DRAIN Pan Option | A = Stainless Steel Fasteners |
| 26 | Unused | A = Stainless Steel Fasteners |
| 27 | Special Variation | A = Stainless Steel Fasteners |

### 1.3 Serial Number Date Code

- **A** = January
- **B** = February
- **C** = March
- **D** = April
- **E** = May
- **F** = June
- **G** = July
- **H** = August
- **I** = September
- **J** = October
- **K** = November
- **L** = December

**Example:**

- **Position 17:** Indoor Air Quality Features
- **Position 18:** Air Flow
- **Position 19:** Compressor Location
- **Position 20:** Filter Option
- **Position 21:** Corrosion Protection
- **Position 22:** Engineering System Type
- **Position 23:** Revision Level
- **Position 24:** Cabinet Color
- **Position 25:** Sound Attenuation
- **Position 26:** Security Option
- **Position 27:** Packaging
- **Position 28:** Fastener/DRAIN Pan Option
- **Position 29:** Unused
- **Position 30:** Special Variation

**Example Position:**

- **Example 1:** M = 2015
- **Example 2:** H = 2018
- **Example 3:** F = June
- **Example 4:** K = October
- **Example 5:** G = 2017
- **Example 6:** K = 2021

Marvair MGA3090/3120 I&O Manual 05/2020 Rev.2
1.4 Capacities, Weights and Filter Sizes

Complete electrical and performance specifications and dimensional drawings are in the Product Data Sheet.

**Note:** Follow local codes and standards when designing duct runs to deliver the required airflow. Minimize noise and excessive pressure drops caused by duct aspect ratio changes, bends, dampers and outlet grilles in duct runs.

<table>
<thead>
<tr>
<th>Basic Model</th>
<th>Cooling BTUH</th>
<th>EER</th>
<th>Rated Air Flow (CFM)</th>
</tr>
</thead>
<tbody>
<tr>
<td>MGA3090A</td>
<td>89,000</td>
<td>10</td>
<td>3,500</td>
</tr>
<tr>
<td>MGA3120A</td>
<td>118,000</td>
<td>10</td>
<td>4,000</td>
</tr>
</tbody>
</table>

1. Cooling rated at 95°F (35°C) outdoor and 80°F DB/67° WB (26.5°C DB/19.5°C WB) return air.
2. EER=Energy Efficiency Ratio
3. CFM=Cubic Feet per Minute

Ratings are with no outside air. Performance will be affected by altitude.

Ratings are at 230 volts for 208/230 volt units (“A” & “C” models) and 460 volts for “D” models. Operation of units at a different voltage from that of the rating point will affect performance and airflow.

### Table 1. Efficiency and Capacity Ratings at ANSI/AHRI Standard 390

<table>
<thead>
<tr>
<th>Return Air DB/ WB</th>
<th>Sensible Cooling Capacity</th>
<th>Outside Air Temperature °F (°C)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>75 (24)</td>
</tr>
<tr>
<td>79/66</td>
<td></td>
<td>40,953</td>
</tr>
<tr>
<td>75/61</td>
<td></td>
<td>42,039</td>
</tr>
<tr>
<td>80/63</td>
<td></td>
<td>43,700</td>
</tr>
<tr>
<td>85/65</td>
<td></td>
<td>45,320</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Return Air DB/ WB</th>
<th>Sensible Cooling Capacity</th>
<th>Outside Air Temperature °F (°C)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>75 (24)</td>
</tr>
<tr>
<td>79/66</td>
<td></td>
<td>67,834</td>
</tr>
<tr>
<td>75/61</td>
<td></td>
<td>62,176</td>
</tr>
<tr>
<td>80/63</td>
<td></td>
<td>64,632</td>
</tr>
<tr>
<td>85/65</td>
<td></td>
<td>67,028</td>
</tr>
</tbody>
</table>

### Table 2. Sensible Capacities - Single Compressor Operation

<table>
<thead>
<tr>
<th>Return Air DB/ WB</th>
<th>Sensible Cooling Capacity</th>
<th>Outside Air Temperature °F (°C)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>75 (24)</td>
</tr>
<tr>
<td>79/66</td>
<td></td>
<td>74,445</td>
</tr>
<tr>
<td>75/61</td>
<td></td>
<td>77,983</td>
</tr>
<tr>
<td>80/63</td>
<td></td>
<td>87,060</td>
</tr>
<tr>
<td>85/65</td>
<td></td>
<td>96,006</td>
</tr>
</tbody>
</table>

### Table 3. Sensible Capacities - Dual Compressor Operation

<table>
<thead>
<tr>
<th>Return Air DB/ WB</th>
<th>Sensible Cooling Capacity</th>
<th>Outside Air Temperature °F (°C)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>75 (24)</td>
</tr>
<tr>
<td>79/66*</td>
<td></td>
<td>92,925</td>
</tr>
<tr>
<td>75/61</td>
<td></td>
<td>96,932</td>
</tr>
<tr>
<td>80/63</td>
<td></td>
<td>107,346</td>
</tr>
</tbody>
</table>

### Table 4. Single Compressor Cooling Performance (BTUH) at Various Outdoor Temperatures

<table>
<thead>
<tr>
<th>Basic Model</th>
<th>Outdoor Temperature</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>75ºF / 24ºC</td>
</tr>
<tr>
<td>MGA3090A</td>
<td>46,980</td>
</tr>
<tr>
<td>MGA3120A</td>
<td>69,484</td>
</tr>
</tbody>
</table>

*Based upon ANSI/AHRI std. 390 return air conditions of 80°F DB/67° WB (26.5°C DB/19.5°C WB) at various outdoor temperatures.
Based upon ANSI/AHRI std. 390 return air conditions of 80°F DB/67° WB (26.5°C DB/19.5°C WB) at various outdoor temperatures.

Table 5. Dual Compressor Cooling Performance (BTUH) at Various Outdoor Temperatures

<table>
<thead>
<tr>
<th>Basic Model</th>
<th>Outdoor Temperature ºF (ºC)</th>
<th>75ºF / 24ºC</th>
<th>80ºF / 26.5ºC</th>
<th>85ºF / 29ºC</th>
<th>90ºF / 32ºC</th>
<th>95ºF / 35ºC</th>
</tr>
</thead>
<tbody>
<tr>
<td>MGA3090A</td>
<td>50 (10)</td>
<td>110,128</td>
<td>91,140</td>
<td>72,153</td>
<td>53,165</td>
<td>34,178</td>
</tr>
<tr>
<td></td>
<td>55 (13)</td>
<td>125,240</td>
<td>104,160</td>
<td>82,460</td>
<td>60,760</td>
<td>39,060</td>
</tr>
<tr>
<td>MGA3120A</td>
<td>60 (16)</td>
<td>139,034</td>
<td>124,651</td>
<td>119,857</td>
<td>114,167</td>
<td>98,067</td>
</tr>
<tr>
<td></td>
<td>65 (18)</td>
<td>134,240</td>
<td>120,460</td>
<td>115,657</td>
<td>110,167</td>
<td>94,067</td>
</tr>
<tr>
<td></td>
<td>70 (21)</td>
<td>129,446</td>
<td>116,251</td>
<td>110,857</td>
<td>105,567</td>
<td>88,067</td>
</tr>
</tbody>
</table>

Based upon indoor setpoint temperature of 79 (26).

Table 6. Economizer Cooling Performance

<table>
<thead>
<tr>
<th>Model</th>
<th>Description</th>
<th>INCHES</th>
<th>MILLIMETERS</th>
<th>PART NO.</th>
<th>FILTERS PER UNIT</th>
<th>MERV RATING</th>
</tr>
</thead>
<tbody>
<tr>
<td>MGA3090</td>
<td>Exterior Access Return Air Filter</td>
<td>25&quot; x 16&quot; x 2&quot;</td>
<td>635 x 406 x 51</td>
<td>80137</td>
<td>3</td>
<td>8</td>
</tr>
<tr>
<td>MGMA3090 Reverse Flow</td>
<td>Exterior Access Return Air Filter</td>
<td>15&quot; x 20&quot; x 2&quot;</td>
<td>381 x 508 x 51</td>
<td>92365</td>
<td>3</td>
<td>8</td>
</tr>
<tr>
<td>MGA3090 Reverse Flow w/Economizer</td>
<td>Exterior Access Return Air Filter</td>
<td>25&quot; x 16&quot; x 2&quot;</td>
<td>635 x 406 x 51</td>
<td>80137</td>
<td>3</td>
<td>8</td>
</tr>
<tr>
<td></td>
<td>Interior Access Return Air Filter</td>
<td>15&quot; x 20&quot; x 2&quot;</td>
<td>381 x 508 x 51</td>
<td>92365</td>
<td>3</td>
<td>8</td>
</tr>
<tr>
<td>MGA3120</td>
<td>Exterior Access Return Air Filter</td>
<td>25&quot; x 16&quot; x 2&quot;</td>
<td>635 x 406 x 51</td>
<td>80137</td>
<td>3</td>
<td>8</td>
</tr>
<tr>
<td>MGA3120 Reverse Flow</td>
<td>Exterior Access Return Air Filter</td>
<td>15&quot; x 20&quot; x 2&quot;</td>
<td>381 x 508 x 51</td>
<td>92365</td>
<td>3</td>
<td>8</td>
</tr>
<tr>
<td>MGA3120 Reverse Flow w/Economizer</td>
<td>Exterior Access Return Air Filter</td>
<td>25&quot; x 16&quot; x 2&quot;</td>
<td>635 x 406 x 51</td>
<td>80137</td>
<td>3</td>
<td>8</td>
</tr>
<tr>
<td></td>
<td>Interior Access Return Air Filter</td>
<td>15&quot; x 20&quot; x 2&quot;</td>
<td>381 x 508 x 51</td>
<td>92365</td>
<td>3</td>
<td>8</td>
</tr>
<tr>
<td></td>
<td>For Optional Fresh Air Hood, #K/04657</td>
<td>11&quot; x 22&quot; x 1&quot;</td>
<td>279 x 559 x 25</td>
<td>80119</td>
<td>2</td>
<td>N/A</td>
</tr>
<tr>
<td>MGA3120 Reverse Flow</td>
<td>Exterior Access Return Air Filter</td>
<td>25&quot; x 16&quot; x 2&quot;</td>
<td>635 x 406 x 51</td>
<td>80137</td>
<td>3</td>
<td>8</td>
</tr>
<tr>
<td>MGA3120 Reverse Flow w/Economizer</td>
<td>Exterior Access Return Air Filter</td>
<td>25&quot; x 16&quot; x 2&quot;</td>
<td>635 x 406 x 51</td>
<td>80137</td>
<td>3</td>
<td>8</td>
</tr>
<tr>
<td></td>
<td>Interior Access Return Air Filter</td>
<td>15&quot; x 20&quot; x 2&quot;</td>
<td>381 x 508 x 51</td>
<td>92365</td>
<td>3</td>
<td>8</td>
</tr>
<tr>
<td>Fresh Air Hood Pre-filters</td>
<td>26&quot; x 12&quot; x 1&quot;</td>
<td>660 x 305 x 25</td>
<td>92526</td>
<td>2</td>
<td>N/A</td>
<td></td>
</tr>
<tr>
<td>Ecooanizer Pre-filter</td>
<td>9.25&quot; x 37&quot; x .375&quot;</td>
<td>235 x 940 x 10</td>
<td>92127</td>
<td>1</td>
<td>N/A</td>
<td></td>
</tr>
</tbody>
</table>

Table 7. Return Air Filter Sizes

<table>
<thead>
<tr>
<th>Model</th>
<th>Unit Weight</th>
<th>Shipping Weight</th>
<th>Height</th>
<th>Width</th>
<th>Depth</th>
</tr>
</thead>
<tbody>
<tr>
<td>MGA3090</td>
<td>1,085</td>
<td>492</td>
<td>527</td>
<td>98</td>
<td>1,422</td>
</tr>
<tr>
<td>MGA3090 Reverse Flow</td>
<td>1,085</td>
<td>492</td>
<td>527</td>
<td>98</td>
<td>1,422</td>
</tr>
<tr>
<td>MGA3090 Reverse Flow w/Economizer</td>
<td>1,131</td>
<td>513</td>
<td>550</td>
<td>98</td>
<td>1,422</td>
</tr>
<tr>
<td>MGA3120</td>
<td>1,195</td>
<td>542</td>
<td>579</td>
<td>98</td>
<td>1,422</td>
</tr>
<tr>
<td>MGA3120 Reverse Flow</td>
<td>1,195</td>
<td>542</td>
<td>579</td>
<td>98</td>
<td>1,422</td>
</tr>
<tr>
<td>MGA3120 Reverse Flow w/Economizer</td>
<td>1,245</td>
<td>565</td>
<td>604</td>
<td>98</td>
<td>1,422</td>
</tr>
</tbody>
</table>

Table 8. Shipping Weights & Dimensions

1.5 General Operation

Hot Gas By-Pass

Normally used in specialty applications (i.e Magnetic Resonance Imaging (MRI) buildings) to prevent magnetic voltage disturbance caused by cycling. This technology is applied in this product to extend the operation envelope for the compressor to 20º F (-6.6ºC). Combined with a condenser low ambient Fan Cycle feature, compressor operation can be extended to 0º F (-17.8ºC). During Hot Gas operation mode, system performance will be reduced. If product operation is in mild outdoor ambient conditions, the installed shut-off ball valve may be closed, thus disabling the Hot Gas By-Pass feature.
Refrigerant Cycle (Cooling Mode)
The air conditioners use R-410A refrigerant in a conventional vapor-compression refrigeration cycle to transfer heat from air in an enclosed space to the outside. A motorized impeller assembly blows indoor air across the evaporator. Cold liquid refrigerant passing through the evaporator is boiled into gas by heat removed from the air. The warmed refrigerant gas enters the compressor where its temperature and pressure are increased. The hot refrigerant gas condenses to liquid as heat is transferred to outdoor air drawn across the condenser by the condenser fan. Liquid refrigerant is metered with a thermal expansion valve (TXV) into the evaporator to repeat the cycle.

MGA3090/3120 (Dual Compressor) Units: These units are factory wired for maximum cooling utilizing both compressors. If 2 stage compressor operation is desired, the factory installed jumper between terminals 1 and 2 of the low voltage terminal strip must be removed. The 1st stage cooling input is terminal 1 of the low voltage terminal strip and the 2nd stage cooling input is terminal 2 of the low voltage terminal strip. The thermostat must be programmed for 2 stage cooling operation when 2 stage compressor operation is desired.

Heating Mode
A wall-mounted thermostat controls the heating cycle of models which incorporate resistance heating elements. On a call for heat, the thermostat closes the heat relay to energize the indoor fan and the resistance elements.

1.6 Electronic Control Board Mode of Operation (MGA3090)

Normal
24 VAC power must be continuously applied to “R” and “C”. Upon a call for cooling “Y” and with the high pressure switch (HPS) closed, the compressor will be energized. (Note: See the delay on make feature.) The compressor will remain energized during the 3 minute timed low pressure by-pass cycle. If the low pressure switch (LPS) is open after the 3 minute by-pass cycle, the compressor will de-energize.

Lock-out
If either of the fault conditions (LPS or HPS) occurs twice during the same call for cooling, the control board will enter into and indicate the lockout mode. In the lockout mode, the compressor is turned off. If there is a call for indoor air flow “G”, the blower remains energized, the alarm output is energized and the status LED will blink to indicate which fault has occurred. When the lockout condition is cleared, the unit will reset if the demand for the thermostat is removed or when the power is reset. With the control board, the user can now have either normally closed or normally open remote alarm dry contacts. The air conditioners are factory wired to be normally open.

Delay on Break
If the compressor is de-energized due to a loss of a cooling “Y” call or the first fault, the unit re-start will be delayed 3 minutes from the time the contactor is de-energized. (Note: There is no delay on break if the lockout condition is reset.)

Delay on Make
On initial power up only, the unit will wait 0.03 to 10 minutes from the cooling “Y” call before allowing the contactor to energize. The delay can be adjusted by the DOM wheel on the board. Factory recommended wait is 3 minutes.

Low Pressure By-Pass Time
When starting, the low pressure switch (LPS) fault condition will be by-passed for 3 minutes before the contactor is de-energized.
**Post Purge**
Upon a call for indoor airflow “G” the blower will energize immediately. When in the cooling mode, the blower will remain energized for 10 to 90 seconds (adjustable) after the compressor has been de-energized. The time period can be changed by fan purge wheel on the board. Factory setting is 90 seconds.

**LED Indicator Lights**

<table>
<thead>
<tr>
<th>COLOR</th>
<th>TYPE</th>
<th>STATUS</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Green</td>
<td>Power</td>
<td>Constant On</td>
<td>24 VAC power has been applied</td>
</tr>
<tr>
<td>Red</td>
<td>Status</td>
<td>Constant On</td>
<td>Normal operation</td>
</tr>
<tr>
<td>Red</td>
<td>Status</td>
<td>1 Blink</td>
<td>High pressure switch has opened twice</td>
</tr>
<tr>
<td>Red</td>
<td>Status</td>
<td>2 Blinks</td>
<td>Low pressure switch has opened twice</td>
</tr>
</tbody>
</table>

**High Pressure Switch**
The high pressure switch is mounted on the liquid line. It is electrically connected to a lockout circuit on the board which shuts down the system if the refrigerant pressure rises to 650 PSIG. This protects the unit if airflow through the condenser is blocked or if the outdoor fan motor fails.

Although the contacts of the high pressure switch close when the refrigerant pressure falls to approximately 450 PSIG, the system must be manually reset once the lockout circuit is activated. A manual reset is necessary to prevent harmful short-cycling. To reset switch, turn primary power off, then back on or turn thermostat system switch off, then back on.

**Low Pressure Switch**
The low pressure switch is mounted on the compressor suction line. It is designed to open if the refrigerant pressure drops to 40 PSIG; it resets when the pressure rises to 60 PSIG. The switch protects the unit if airflow through the indoor blower is impeded, if the blower motor fails, or if there is a loss of refrigerant.

1.7 **Programmable Logic Controller (MGA3120)**
MGA3120 models include a factory installed PLC to control the operation of the HVAC system. LEDs on the PLC show operational status and provide assistance with diagnosis if troubleshooting is ever required. Various control functions are field selectable and programmable. The PLC is also capable of communicating to other PLCs to allow run time leveling and does not require additional equipment to be installed. The PLC provides improved reliability because of the reduction of components. The components utilized are more durable and the control box wiring has been simplified. Pertinent statistical data about the life of the refrigeration system can be accessed through the PLC.
The PLC is factory installed and tested, requires no adjustments or changes when the air conditioning system is installed.

**Location**
The PLC is located in the unit control panel. Remove the HVAC unit front access panel and open the panel door to the control cabinet.

![Programmable Logic Controller](image)

**Figure 1. Programmable Logic Controller**

**PLC Inputs & Outputs**
The PLC has inputs located along the top right of the controller and outputs along the bottom right of the controller. An input is a signal to the PLC from either the thermostat, sensors in the air conditioner, or a customer supplied input, e.g., EMS (Energy Management System). An output is a signal from the PLC to the air conditioner, to the thermostat or to the customer.

**PLC Inputs**
The PLC inputs are powered by 24 VDC. The inputs are:

- **Y** – Compressor
- **Y2** – Dual Compressor
- **HUM** – Humidifier (uses optional electric heat)
- **HPS** – High Refrigerant Pressure Switch. The HPS is ON during normal operation. No light indicates an open switch. See lockout indicator “A” under Outputs. HPS B available for dual compressor systems.
- **LPS** – Low Refrigerant Pressure Switch. The LPS is ON during normal operation. No light indicates an open switch. See lockout indicator “A” under Outputs. LPS B available for dual compressor systems.
- **EMS** – Energy Management System. A shutdown input from an external source. When EMS input is de-energized, the unit compressor and fans will also de-energize.
- **PMF** - Phase monitor fault to monitor phase operation for 3 phase systems, light is on when 3 phase power is powered and connected correctly

**PLC Outputs**
The PLC outputs are connected to 24VDC and supply 24VDC loads within the control panel. These outputs are:

- **OFM** – Outdoor Fan Motor Starter
• **IBM** – Indoor Blower Motor Starter
• **CC** – Compressor Starter
• **CC2** – Compressor Starter B (Dual Systems)
• **LOI** – Lock Out Indicator. A blinking LED indicates that a pressure switch has opened or a motor fault has occurred. Refer to section 1.8 for additional information concerning this indicator.
• **FR** – Fault Relay. An isolated form C relay contact is provided for the customer’s use to monitor for fault conditions with the HPS or LPS switches.

On the left side of the PLC unit, there are three LED’s that indicate the operational status of the PLC.

1. **STOP/RUN**
   a. Solid yellow indicates STOP mode
   b. Solid green indicates RUN mode
   c. Flashing (alternating green and yellow) indicates that the CPU is in STARTUP mode

2. **ERROR**
   a. Flashing red indicates an error, such as an internal error in the CPU, an error with the memory card, or a configuration error (mismatched modules)
   b. Solid red indicates defective hardware
   c. All LEDs flash if the defect is detected in the firmware

3. **MAINT** – (Maintenance) flashes whenever you insert a memory card. The CPU then changes to STOP mode. After the CPU has changed to STOP mode, perform one of the following functions to initiate the evaluation of the memory card:
   a. Change the CPU to RUN mode
   b. Perform a memory reset (MRES)
   c. Power-cycle the CPU

The PLC has indicator LED’s that show the status of all thermostat inputs and outputs. For example, if the “G” LED is on, this means that voltage is present from the “G” terminal on the thermostat.

1.8 **Unit Operation**

**Modes of Operation**

• **Normal Start-Up** – On a call for cooling, and with the high pressure switch closed, the cooling system (compressor, indoor blower motor and outdoor fan motor) will be energized. (Note: See the Delay on Make feature). The cooling system will remain energized during the three minute low pressure switch bypass cycle. If the low pressure is closed, the cooling system will continue to operate after the three-minute bypass. If the low pressure switch is open after the three-minute bypass, the cooling system will be de-energized.

• **Lockout Mode** – If either the high or low pressure switch opens on the same call for cooling, the PLC system enters into and indicates the lockout mode. In the lockout mode, the compressor is turned off, the alarm output is energized and the status LED’s will blink to indicate which fault has occurred. If there is a call for air flow, the indoor blower will remain energized. When the lockout condition has cleared, the unit will reset if the demand of the thermostat is removed or when power is reset. The lockout circuit has a 3-second delay to prevent premature activation and is factory wired for normally open contacts. The user can select either normally closed or normally open remote alarm dry contacts.
### PLC External LED Indicator Lights

<table>
<thead>
<tr>
<th>Type</th>
<th>LED Indicator</th>
<th>Color</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Power</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>RUN/STOP</td>
<td>Green</td>
<td></td>
<td>PLC is in run mode</td>
</tr>
<tr>
<td></td>
<td>Yellow</td>
<td></td>
<td>PLC is in stop mode</td>
</tr>
<tr>
<td>ERROR</td>
<td>Red</td>
<td></td>
<td>PLC has encountered an error</td>
</tr>
<tr>
<td>MAINT</td>
<td>Yellow</td>
<td></td>
<td>Maintenance is required</td>
</tr>
<tr>
<td>Inputs</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>DI a .0</td>
<td>Green</td>
<td></td>
<td>High Pressure Switch A</td>
</tr>
<tr>
<td>DI a .1</td>
<td>Green</td>
<td></td>
<td>Low Pressure Switch A</td>
</tr>
<tr>
<td>DI a .2</td>
<td>Green</td>
<td></td>
<td>High Pressure Switch B</td>
</tr>
<tr>
<td>DI a .3</td>
<td>Green</td>
<td></td>
<td>Low Pressure Switch B</td>
</tr>
<tr>
<td>DI a .4</td>
<td>Green</td>
<td></td>
<td>Emergency Management System</td>
</tr>
<tr>
<td>DI b .1</td>
<td>Green</td>
<td></td>
<td>Phase Monitor</td>
</tr>
<tr>
<td>DI b .2</td>
<td>Green</td>
<td></td>
<td>Call for first stage cooling from thermostat</td>
</tr>
<tr>
<td>DI b .3</td>
<td>Green</td>
<td></td>
<td>Call for second stage cooling from thermostat</td>
</tr>
<tr>
<td>DI b .4</td>
<td>Green</td>
<td></td>
<td>Call for heating from thermostat</td>
</tr>
<tr>
<td>DI b .5</td>
<td>Green</td>
<td></td>
<td>Call for indoor blower from thermostat</td>
</tr>
<tr>
<td>Outputs</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>DQ a .0</td>
<td>Green</td>
<td></td>
<td>Output to call for compressor A</td>
</tr>
<tr>
<td>DQ a .1</td>
<td>Green</td>
<td></td>
<td>Output to call for the indoor blower</td>
</tr>
<tr>
<td>DQ a .2</td>
<td>Green</td>
<td></td>
<td>Output to call for the outdoor fan</td>
</tr>
<tr>
<td>DQ a .4</td>
<td>Green</td>
<td></td>
<td>Output to call for compressor B</td>
</tr>
<tr>
<td>DQ a .5</td>
<td>Green</td>
<td></td>
<td>Output to call for the heater</td>
</tr>
<tr>
<td>DQ a .6</td>
<td>Green</td>
<td></td>
<td>Flashing lockout indicator (See below for flash code)</td>
</tr>
<tr>
<td>DQ a .7</td>
<td>Green</td>
<td></td>
<td>Fault relay</td>
</tr>
</tbody>
</table>

### PLC Flash Code for Lockout Indicator

<table>
<thead>
<tr>
<th>Number of Flashes</th>
<th>Description of Fault</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>High pressure switch A fault</td>
</tr>
<tr>
<td>2</td>
<td>Low pressure switch A fault</td>
</tr>
<tr>
<td>3</td>
<td>High pressure switch B fault</td>
</tr>
<tr>
<td>4</td>
<td>Low pressure switch B fault</td>
</tr>
<tr>
<td>5</td>
<td>Phase fault</td>
</tr>
<tr>
<td>10</td>
<td>Heater current overload fault</td>
</tr>
<tr>
<td>11</td>
<td>Emergency Management System fault</td>
</tr>
</tbody>
</table>

- **Delay on Make** – On initial power up or on resumption of power, the air conditioner will wait 3 minutes from a call for cooling before allowing the contactor to energize.

### 1.9 Optional Controls & Packages

**Protective Coating Packages**

Two corrosion protection packages are offered- one for the condenser section (the Coastal Environmental package) and the other for the entire unit (the Coat-All Package).

The condenser protection package includes:
• Corrosion resistant fasteners
• Sealed or partially sealed condenser fan motor
• Two layer epoxy/urethane applied to all exposed internal copper and metal in the condenser section
• A protective coating on the condenser coil

The Coat-all package includes all of the above but also includes a protective coating on the evaporator coil and the two layer epoxy/urethane on all exterior and interior components and sheet metal. (Note: the internal sheet metal which is insulated and the internal control box are not coated).

**Dirty Filter Indicator**
A diaphragm type of indicator measures the air pressure on either side of the filter and when the pressure drops below the set point, a red LED is illuminated. The set point is adjustable.

**Protective Coil Coatings**
Either the condenser or evaporator coil can be coated. For harsh conditions, e.g., power plants, paper mills or sites were the unit will be exposed to salt water, the condenser coil should be coated. Note: Cooling capacity may be reduced by up to 5% on units with coated coils.

**Cabinet Color and Material**
The air conditioners are available in two standard cabinet colors -the standard grey with beige as an option. The standard cabinet’s sides, top and front panels are constructed of 16 gauge painted steel. Contact your Marvair representative for color chips, custom colors and 316 stainless steel cabinets.

**Dual Compressors With Lead/Lag Operation**

**Freeze Sensor On Indoor Coil**
Prevents frost on the indoor coil caused by a loss of air flow or restrictive duct work.

**Filter Access From Return Air Grille**
Factory or field installed filter bracket allows changing and access to the filters from the return air grille. See model ID, special option code “I”.

**Reverse Air Flow Configuration**
Location of Supply and Return Air Openings are reversed.

1.10 Electrical Operation

The compressor and condenser fan are energized with a contactor controlled by a 24 VAC pilot signal. Some compressors incorporate an internal PTC crankcase heater that functions as long as primary power is available. The heater drives liquid refrigerant from the crankcase and prevents loss of lubrication caused by oil dilution. Power must be applied to the unit for 24 hours before starting the compressor.

The condenser (outside fan) motor is energized by the same contactor.

The indoor evaporator fan motor is controlled by the fan purge on the electronic control board.
RELAY OUTPUTS

- X12
- DQ.a
- 1L.0.1.2.3.4
- 2L.5.6.7.0.1
- DQ b

- CPU 1215C
- DC/DC/RLY

L+M

- X12
- 24VDC

24VDC INPUTS

- 3M01
- X11

ANALOG OUTPUTS

- ANALOG
- Al

PLC

Figure 2. Typical Electrical Schematic
Chapter 2 Installation

⚠️ WARNING

Failure to observe and follow Warnings and Cautions and these Instructions could result in death, bodily injury or property damage. Read this manual and follow its instructions and adhere to all Cautions and Warnings in the manual and on the unit.

2.1 Equipment Inspection

Concealed Damage
Inspect all cartons and packages upon receipt for damage in transit. Remove cartons and check for concealed damage. Important: keep the unit upright at all times. Remove access panels and examine component parts. Inspect refrigerant circuit for fractures or breaks. The presence of refrigerant oil usually indicates a rupture. If damage is apparent, immediately file a claim with the freight carrier.

Units that have been turned on their sides or tops may have concealed damage to compressor motor mounts or to the oil system. If the unit is not upright, immediately file a claim for concealed damages and follow these steps:

1. Set unit upright and allow to stand for 24 hours with primary power turned on.
2. Attempt to start the compressor after 24 hours.
3. If the compressor will not start, makes excessive noise, or will not pump, return the unit to the freight carrier.

2.2 Installation Requirements

General
1. Inspect unit for completeness. Check for missing parts (e.g. hardware). Refer to the installation kit information in section 2.3.
2. Remove access panels and check for loose wires. Tighten screw connections.
3. Complete and mail the warranty registration card.

You must consider all of the following when choosing the installation site:

1. Noise. Install the unit so that the least amount of noise will be transmitted to inhabited spaces.
2. Condensate Drainage. Condensate produced during operation must be discharged to a suitable drain.
3. Placement.
   A) Place the unit in a shaded area, if possible.
   B) Install it above ground for protection against flooding.
   C) The unit exhausts air. Be sure that the airflow is not impeded by shrubbery or other obstructions.
   D) When installing multiple units, please note the recommended clearances noted in Table 4.

4. Airflow Requirements:

<table>
<thead>
<tr>
<th>Maximum Static Pressures</th>
<th>MGA3090</th>
<th>MGA3120</th>
</tr>
</thead>
<tbody>
<tr>
<td>IWG</td>
<td>1.8</td>
<td>0.65</td>
</tr>
<tr>
<td>Pa</td>
<td>450</td>
<td>162</td>
</tr>
</tbody>
</table>

Keep duct lengths as short as possible. Do not obstruct airflow through the unit.

Duct work should be designed and installed in accordance with all applicable safety codes and
standards. Marvair strongly recommends referring to the current edition of the National Fire Protection Association Standards 90A and 90B before designing and installing duct work. The duct system must be engineered to insure sufficient air flow through the unit to prevent over-heating of the heater element. This includes proper supply duct sizing, sufficient quantity of supply registers, and adequate return and filter areas. Duct work must be of correct material and must be properly insulated. Duct work must be constructed of galvanized steel with a minimum thickness of .019 inches. Duct work must be firmly attached, secured, and sealed to prevent air leakage. See section 2.4 for additional duct work requirements.

5. **Clearances:**
Note the minimum clearances required for proper operation and service.

<table>
<thead>
<tr>
<th>MODEL</th>
<th>MIN. CLEARANCE AROUND SIDES (SINGLE UNIT)</th>
<th>MIN. CLEARANCE BETWEEN UNITS (TWO UNITS)</th>
<th>MIN. SPACE ABOVE UNIT</th>
<th>MIN. SPACE BEHIND UNIT</th>
</tr>
</thead>
<tbody>
<tr>
<td>MGA3090</td>
<td>24 inches (61 cm)</td>
<td>24 inches (61 cm)</td>
<td>24 inches (61 cm)</td>
<td>120 inches (305 cm)</td>
</tr>
<tr>
<td>MGA3120</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 9. Minimum Clearances

6. **Codes:**
Make sure your installation conforms to all applicable electrical, plumbing, building, and municipal codes. Some codes may limit installation to single story structures.

7. **Electrical Supply:**
The power supply must have the appropriate voltage, phase, and ampacity for the model selected. Voltage must be maintained above minimum specified values listed below. Refer to the data sticker on the unit for ampacity requirements.

<table>
<thead>
<tr>
<th>Electrical Rating Designations*</th>
<th>A</th>
<th>C</th>
<th>D</th>
<th>E</th>
<th>F</th>
<th>Z</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nominal Voltage</td>
<td>208/230</td>
<td>208/230</td>
<td>460</td>
<td>380</td>
<td>220</td>
<td>575</td>
</tr>
<tr>
<td>Phase</td>
<td>1</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>Minimum Voltage</td>
<td>197</td>
<td>197</td>
<td>414</td>
<td>342</td>
<td>198</td>
<td>518</td>
</tr>
<tr>
<td>Maximum Voltage</td>
<td>253</td>
<td>253</td>
<td>506</td>
<td>418</td>
<td>242</td>
<td>632</td>
</tr>
</tbody>
</table>

* Letters refer to model number code designations. Refer to page 5.

Table 10. Voltage Limitations

2.3 **Installation Materials**
The air conditioners may be shipped with an optional top bracket and lifting brackets. The top bracket provides a method of sealing the top of the unit from water intrusion. The bracket is shipped attached to the top of the unit. Before installing the unit, remove the bracket and reattach as described in Section 2.5

The Lifting brackets are shipped attached to the back panel of the unit. These brackets provide a method for lifting it. The installation of the brackets is described in Section 2.6.
Kit Components:

Accessories:
The package may include other factory-supplied items (optional):

<table>
<thead>
<tr>
<th>P/N</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>K/10439</td>
<td>CommStat Touch Controller, Solid State Lead/Lag Controller w/Touch Screen</td>
</tr>
<tr>
<td>S/07846</td>
<td>CommStat 4 Controllers, Solid State Lead/Lag Controller</td>
</tr>
</tbody>
</table>

Supply Grille

<table>
<thead>
<tr>
<th>P/N</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>93189</td>
<td>MGA3090 &amp; MGA3120: 42½” x 151/4” (1,080 mm x 387 mm)</td>
</tr>
</tbody>
</table>

Return Grille

<table>
<thead>
<tr>
<th>P/N</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>93188</td>
<td>MGA3090 &amp; MGA3120: 42½” x 21½” (1,080 mm x 546 mm)</td>
</tr>
</tbody>
</table>

Additional Items Needed:
Additional hardware and miscellaneous supplies (not furnished by Marvair®) are needed for installation.

- Mounting bolts for unit mounting flanges. The length needed is typically the wall thickness plus one inch (25 mm).
- Washers
- Hex nuts
- Silicone Sealer to seal around cracks and openings
- Minimum 5 conductor low voltage multicolored wire cable (i.e. thermostat wire)
- Appropriate electrical supplies such as conduit, electrical boxes, fittings, wire connectors, etc.
- High voltage wire, sized to handle the MCA (minimum circuit ampacity) listed on the data plate.
- Over-Current Protection Device sized in accordance with the MFS (maximum fuse size) listed on the unit data plate.

⚠️ WARNING FIRE HAZARD

Improper adjustment, alteration, service, maintenance or installation could cause serious injury, death and/or property damage.

Installation or repairs made by unqualified persons could result in hazards to you and others. Installation MUST conform with local codes or, in the absence of local codes, with codes of all governmental authorities having jurisdiction.

The information contained in this manual is intended for use by a qualified service agency that is experienced in such work, is familiar with all precautions and safety procedures required in such work, and is equipped with the proper tools and test instruments.
2.4 Porting and Duct Work

General Information
Note: The following instructions are for general guidance only. Due to the wide variety of installation possibilities, specific instructions will not be given. When in doubt, follow standard and accepted installation practices, or contact Marvair® for additional assistance.

Wall Openings
Measure the dimensions of the supply and return ports on the unit.

Cut the openings in the exterior wall for the supply and return. IMPORTANT: All units with electric heat must have 1" (25.4mm) clearance on all four sides of the supply outlet duct flange on the unit. The 1" (25.4mm) clearance must extend on all sides of the supply duct for the first 3 feet (1 meter) from the unit.

IMPORTANT: Marvair requires a minimum of 1" (25.4mm) from the surface of any supply ducts to combustible material for the first 3 feet (1 meter) of the duct.

Ducting
Extensions should be cut flush with the inside wall for applications without duct work.

Applications using duct work should be designed and installed in accordance with all applicable safety codes and standards. Marvair strongly recommends referring to the current edition of the National Fire Protection Association Standards 90A and 90B before designing and installing duct work. The duct system must be engineered to insure sufficient air flow through the unit to prevent over-heating of the heater element. This includes proper supply duct sizing, sufficient quantity of supply registers, adequate return and filter area. Ductwork must be of correct material and must be properly insulated. Duct work must be constructed of galvanized steel with a minimum thickness of .019 inches for the first 3 feet (1 meter). Ductwork must be firmly attached, secured and sealed to prevent air leakage. Do not use duct liner on inside of supply duct within 4 feet (122cm) of the unit.

Galvanized metal duct extensions should be used to simplify connections to duct work and grilles. Use fabric boots to prevent the transmission of vibration through the duct system. The fabric must be U.L. rated to a minimum of 197°F (92°C).

Minimum Airflow Requirements
The duct system must be engineered to assure sufficient air flow through the unit even under adverse conditions such as dirty filters, etc.

2.5 Top Flange Installation (See Figure 3)

1. All models have built-in side mounting flanges.
2. Attach the top flange to the top of the air conditioner. The holes in the top of the air conditioner have been predrilled. Remove the 4 screws in these holes and use these screws to attach the top flange to the air conditioner.
3. Apply a bead of silicone sealer on the wall side of the bottom support brackets on the unit. Circle the mounting holes with the silicone bead.
2.6 **Installing the Lifting Brackets**

The units have lifting brackets that can be installed on the top of the side panels. These brackets allow the unit to be picked up thru lifting eyes in the brackets. The lifting brackets are shipped attached to the back panel of the unit. Attach the brackets to the left and right side panels as shown in Figure 3. The 4 screws for attaching the brackets are shipped in the holes at the top of the side panels. When attaching the brackets, make sure the top of the bracket is angled towards the center of the unit.

2.7 **Mounting The Unit**

1. For wiring into the back of unit, locate the lower of the two knockouts on the wall side of the unit. Drill a one inch hole in the shelter wall to match this opening. Allow sufficient clearance to run 3/4" conduit through the hole and to the unit.
2. Lift the unit into position using an appropriate and safe lifting device.
3. Make sure that the duct flanges are properly aligned with the wall opening. Adjust as necessary.
4. Note the holes in each side flange. Using the holes for guides, drill holes through the wall with a drill bit. Insert the bolts through the flanges. Install nuts and washers on the inside of the shelter. Tighten the bolts to secure the unit.
5. Apply a bead of silicone where the side and top flanges contact the exterior wall.
6. On the inside of the shelter, install the wall sleeves in the supply and return air openings. The sleeves may be trimmed to fit flush with the inside wall.
7. Check the fit of each sleeve to its mating flange for possible air leaks. Apply silicone sealer to close any gaps. Install the air return and supply grilles.
For units with electric heat, a one inch clearance is required around the duct extensions. The duct extensions must be constructed of galvanized steel with a minimum thickness of .019” as per the NFPA standards 90A & 90B.

Figure 4. Air Conditioner Wall Mount Detail

2.8 Electrical Connections

⚠️ **WARNING ELECTRICAL SHOCK HAZARD**

Failure to follow safety warnings exactly could result in serious injury, death, and/or property damage.

Turn off electrical power at fuse box or service panel BEFORE making any electrical connections and ensure a proper ground connection is made before connecting line voltage.

**Important**

All electrical work must meet the requirements of local codes and ordinances. Work should be done only by qualified persons.

The units may incorporate an internal crankcase heater for compressor protection. The crankcase heater must be energized for at least 24 hours prior to starting the compressor.

Scroll compressors, like several other types of compressors, will only compress in one rotational direction. The direction of rotation is not an issue with single-phase compressors since they will always start and run in the proper direction. However, three phase compressors will rotate in either direction depending upon phasing of power. Since there is a 50-50 chance of connecting power in such a way as to cause rotation in the reverse direction, it is imperative to confirm that the compressor is rotating in the proper direction at the initial field start-up of the system. Verification of proper rotation is made by observing that the suction pressure drops and the discharge pressure rises when the compressor is energized. An alternate method of verification for self contained system with small critical refrigerant charges, where
the installation of gauges may be objectionable, can be made by monitoring the temperature of the refrigerant lines at the compressor. The temperature should rise on the discharge line while the suction line temperature decreases. Reverse rotation also results in a substantially reduced current draw when compared to tabulated values.

There is no negative impact on durability caused by operating three-phase compressors in the reversed direction for a short duration of time, usually defined as less than one hour. However, after several minutes of operation the compressor's internal protector will trip. The compressor will then cycle on the protector until the phasing is corrected. Reverse operation for longer than one hour may have a negative impact on the bearings.

To change the rotation, turn off power to the unit and reverse L1 & L2 at the disconnect in the air conditioner.

The middle front panel provides access to the electrical/control box and to the filters. This panel has hinges on the left and right hand side. This panel should ONLY be opened by using the two hinges on the left side OR the two hinges on the right side. **NEVER OPEN ALL FOUR HINGES SIMULTANEOUSLY.**

If all four hinges are opened simultaneously, the front panel will drop and may cause serious injury and damage the panel.

---

**DANGER**

NEVER open all four hinges simultaneously. The panel should ONLY be opened by using the two hinges on the left side OR the two hinges on the right side.

---

**High Voltage Wiring**

The power supply should have the proper voltage, phase, and ampacity for the selected model.

1. Refer to the electrical data on the data sticker on the unit for field wiring requirements of the unit. Size the incoming power supply lines and the fuse(s) or HACR breaker(s) according to requirements described in the National Electric Code. Run the power conductors through the knockouts on the side or back of the unit. Use appropriate conduit and strain reliefs.

---

**CAUTION**

Note: Power supply service must be within allowable range (+10% - 5%) of rated voltage stamped on the unit rating plate. To operate nominal 230/208V unit at 208V, change the transformer line tap from 240V to 208V following the instruction on wiring label in unit.

2. Connect the wires to the input side of the internal breaker or terminal block L1, L2, & L3 for three-phase models.

3. Install the ground wire on the ground lug.

4. For units designed for operation on 208/230V, 60Hz power supply, the transformer is factory wired for a 230V power supply. For a 208V power supply, remove the orange lead from the transformer and connect the red lead. Insulate the orange lead.

---

**CAUTION**

The external breaker(s) that provide power to the air conditioner must be sized per the maximum Fuse Size (MFS) shown on the Unit's data label.

---

**Dual Unit Phasing**

For applications where one controller operates two units, e.g., the CommStat 4.

1. Wire each unit as described in steps 1 through 4 above.

2. Test for proper phasing as follows:
A. Power up the units.
B. Using an AC volt meter set to the 300 volt scale, measure voltage between terminal L1 on the compressor contactor of unit #1 and terminal L1 on the compressor contactor of unit #2 If voltage is present, units are wired out of phase and must be rewired.
C. If units are not in phase, turn off power and reverse the field power leads connected to the internal circuit breaker on one of the units only.
D. Restore power and retest the phase (step B). When the voltage reads "0", the units are in phase.
E. Turn off power and proceed.

**Low Voltage Wiring**

**IMPORTANT.** The following instructions are generic wiring instructions and may not be applicable for air conditioners with various options. Always refer to the wiring diagram in the air conditioner for the proper method to wire your unit.

1. On single units, pull the low voltage wiring (e.g., 18 gauge 4-conductor Class 2 thermostat wire) from the air conditioners into the thermostat / subbase assembly. See Figure 4a for connections to various thermostats.

2. Mount the thermostat on the wall of the shelter. The thermostat should be located so that the supply air from the unit does NOT blow directly on to the thermostat. Connect the thermostat to the terminal block in the air conditioner as shown in Figure 6a.

3. On dual units, refer to either the CommStat Touch or CommStat 4 Controller Specification sheet. Wire the two air conditioners to the Lead/Lag Controller, according to the wiring diagram on the specification sheet.

*Remote Signalling:* Terminals 5 & 7 (N.O.) and 6 & 7 (N.C.) on the air conditioners terminal board are dry contacts which can be used for remote signalling in the event of a/c cutoff on low or high pressure limit.

*Continuous fan operation:* For continuous indoor fan operation on single units, install a jumper between terminals 8 and 3.

**CommStat Touch and CommStat 4 Lead /Lag Controller**

Please refer to the Product Data sheet for the CommStat Touch or CommStat 4 controller for complete instructions on installing and programming this controller.
Figure 5a. Thermostat Connection Diagram

Figure 5b. CommStat 3 Wiring Diagram
Chapter 3 Start-Up

3.1 Check-Out of Cooling Cycle

Important: Be sure that the crankcase heater (if used) has been energized for at least 24 hours before starting the unit(s). Double-check all electrical connections before applying power. All air conditioners with scroll compressors running on 3Ø power must be checked for proper rotation during the initial start-up. Please refer to Section 2.8 for determining if the 3Ø compressors are rotating correctly. Incorrect rotation can damage the compressor and is not covered by the warranty.

Procedure:
1. Set the cooling set point temperature on the wall thermostat to a point higher than the ambient temperature. Set the heating set point temperature to a temperature that is lower than the ambient.
2. Set the thermostat system switch in the AUTO position. Nothing should operate at this time.
3. Set the time delay in the control box to three minutes. See Section 1.6.
4. Slowly lower the thermostat's cooling set point temperature until the switch closes. The indoor fan should operate. Once the indoor fan turns on, allow approximately three minutes for the compressor to start.
5. To stop cooling, slowly raise the thermostat cooling set point to a temperature higher than the ambient.

If the unit fails to operate, refer to the troubleshooting information in Chapter 4.

Follow the same procedure for additional units.

NOTE: The fan purge allows the indoor fan to run for approximately 90 seconds after the compressor is off. This operation provides a small improvement in system rated efficiency.

3.2 Check-Out of Heating Cycle

Procedure: (Applies only to units with resistance elements)
1. Raise the heating set point temperature to a setting which is higher than the ambient temperature. The fan and electric heat should immediately cycle on.
2. Move the system switch to the "OFF" position. All functions should stop.
Chapter 4 Troubleshooting

4.1 Overview

The middle front panel provides access to the electrical/control box and to the filters. This panel has hinges on the left and right hand side. This panel should ONLY be opened by using the two hinges on the left side OR the two hinges on the right side. NEVER OPEN ALL FOUR HINGES SIMULTANEOUSLY.

If all four hinges are opened simultaneously, the front panel will drop and may cause serious injury and damage the panel.

A comprehensive understanding of the operation of the air conditioner is a prerequisite to troubleshooting. Please read the Chapter 1 for basic information about the unit.

Our air conditioners are thoroughly tested before they are shipped from the factory. Although unlikely, it is possible that a defect may escape undetected, or damage may have occurred during transportation. However, the great majority of problems result from installation errors.

If you experience difficulties with the unit, please review the installation steps in Chapter 2.

Much time can be saved by taking a thoughtful and orderly approach to troubleshooting. Start with a visual check - are there loose wires, crimped tubing, missing parts, etc? Begin deeper analysis only after making this initial inspection.

The troubleshooting information in this manual is basic. The troubleshooting section contains problem/solution charts for general problems, followed by a compressor section.

Not every problem can be anticipated. If you discover a problem that is not covered in this manual, we would be very grateful if you would bring it to the attention of our service department for incorporation in future revisions.

As always, please exercise caution and good judgement when servicing the air conditioner. Use only safe and proven service techniques. Use refrigeration goggles when servicing the refrigeration circuit.

The refrigerant circuit has hot surfaces, and the electrical voltages inside of the unit may be hazardous or lethal. SERVICE MAY BE PERFORMED ONLY BY QUALIFIED AND EXPERIENCED PERSONS.
### 4.2 Failure Symptoms Guide

<table>
<thead>
<tr>
<th>PROBLEM/SYMPTOM</th>
<th>LIKELY CAUSE(S)</th>
<th>CORRECTION</th>
</tr>
</thead>
</table>
| **A. Unit does not run.** | 1. Power supply problem.  
2. Tripped internal disconnect.  
3. Shut off by external thermostat or thermostat is defective.  
4. Unit off on high or low pressure limit.  
5. Internal component or connection failure. | 1. Check power supply for adequate phase and voltage. Check wiring to unit and external breakers or fuses.  
2. Check internal circuit protection devices for continuity.  
3. Check operation of wall-mounted thermostat.  
4. Reset pressure switch.  
5. Check for loose wiring. Check components for failure. |
| **NOTE:** An internal anti-short-cycle timer will prevent the unit from starting for .2 to 8 minutes following start-up. |  | |
| **B. Unit runs for long periods or continuously; cooling is insufficient.** | 1. Dirty filter or reduced airflow  
2. Low refrigerant.  
3. Component failure.  
2. Check for proper charge and possible refrigerant leak.  
3. Check internal components, especially compressor for proper operation.  
4. Add additional units for greater capacity. |
| **C. Unit cycles on high/low pressure limit.** | 1. Loss or restriction of airflow.  
2. Restriction in refrigerant circuit.  
3. Refrigerant overcharge (following field service)  
4. Defective pressure control. | 1. Check blower assembly for proper operation. Look for airflow restrictions, e.g.: the air filter. Check blower motor and condenser fan.  
2. Check for blockage or restriction, especially filter drier and capillary tube assembly.  
3. Evacuate and recharge to factory specifications.  
4. Check limit cutout pressures. Control is set to actuate at approximately 60 PSIG (low pressure) and 650 PSIG (high pressure) | |
| **D. Unit blows fuses or trips circuit breaker.** | 1. Inadequate circuit ampacity.  
2. Short, loose, or improper connection in field wiring.  
3. Internal short circuit. Loose or improper connection(s) in unit.  
4. Excessively high or low supply voltage or phase loss (3φ only) | 1. Note electrical requirements in Chapter 2 and correct as necessary.  
2. Check field wiring for errors.  
3. Check wiring in unit. See wiring and schematic diagrams. Test components (especially the compressor) for shorts.  
4. Note voltage range limitations specific to the compressor troubleshooting section. |
| **E. Water on floor near unit.** | 1. Obstruction in condensate line.  
2. Obstruction or leak in condensate pan.  
3. Unit is not level. | 1. Check for clog or restriction.  
2. Check pan for leak or blockage.  
3. Level unit. |
| **F. No space heating or reduced heating (units equipped with resistance elements)** | 1. Defective heating element(s).  
2. Thermal limit open.  
3. Defective heater contactor. | 1. Check resistance element(s) for continuity.  
2. Check continuity across thermal limit switch.  
3. Check relay for proper operation. Replace if defective. |

### 4.3 Compressor Troubleshooting

**NOTE:** It is important to rule out other component failures before condemning the compressor.

The following electrical tests will aid diagnosis:
1. **Start-Up Voltage**: Measure the voltage at the compressor contactor during start-up. The voltage must exceed the minimum shown in Table 5, section 2.2, or compressor failure is likely. A low voltage condition must be corrected.

2. **Running Amperage**: Connect a clip-on type ammeter to the (common) lead to the compressor. Turn on the supply voltage and energize the unit. The compressor will initially draw high amperage; it should soon drop to the RLA value or less. If the amperage stays high, check the motor winding resistances.

   **NOTE:** Feel the top of the compressor to see if it has overheated. If it is hot, the internal overload may be open. You may have to wait several hours for it to reset.

3. **Motor Winding Resistances**: Using a digital volt-ohm meter (VOM), measure the resistance across the compressor windings as shown below.

   Resistance can be measured as shown above. Any deviation from above values could indicate a defective compressor.

4. **High Voltage/Insulation Test**: Test internal leakage with a megohmeter. Attach one lead to the compressor case on a bare metal tube and to each compressor terminal to test the motor windings. A short circuit at high voltages indicates a motor defect. **Do not** do this test under vacuum.

5. **Control Board Diagnosis**

   The control board (see section 1.6 for a complete description of the control board) has a red diagnostic LED which indicates the lockout fault. The control board will enter into and indicate lockout if either of the fault conditions (LPS or HPS) occur twice.

   The compressor contactor must be closed before the first fault condition can be recognized by the control board. The contactor will be closed 3 minutes after the unit is energized and only if cooling is required. The first fault condition will open the contactor and shutdown the unit. The contactor on the unit that has the fault condition must be closed before the second fault condition can be recognized by the control board. The compressor contactor on the unit with the fault condition will close after 3 minutes if the unit is still calling for cooling and if the fault condition no longer exists. If you get a second fault condition, the contactor will open and shutdown the unit. The “red” led will have one blink if the high pressure switch has opened twice and will have two blinks if the low pressure switch has opened twice. The unit must be in the cooling mode (compressor contactor Closed) before a fault condition can occur.
Chapter 5 Maintenance

The middle front panel provides access to the electrical/control box and to the filters. This panel has hinges on the left and right hand side. This panel should ONLY be opened by using the two hinges on the left side OR the two hinges on the right side. NEVER OPEN ALL FOUR HINGES SIMULTANEOUSLY. If all four hinges are opened simultaneously, the front panel will drop and may cause serious injury and damage the panel.

**DANGER**

NEVER open all four hinges simultaneously. The panel should ONLY be opened by using the two hinges on the left side OR the two hinges on the right side.

5.1 Scheduled Maintenance

Marvair strongly recommends that the air conditioner be serviced a minimum of twice a year – once prior to the heating season and once prior to the cooling season. At this time the filters, evaporator coil, condenser coil, the cabinet, and condensate drains should be serviced as described below. Also at this time, the air conditioner should be operated in the cooling and heating cycles as described in Chapter 3, Start-Up. In addition to this seasonal check-out, the air conditioner should be maintained as follows:

**Air Filter**
Replace the air filter whenever it is visibly dirty. Never operate the unit without the filter in place. Depending upon the configuration of your unit, access to the filter can be either from the outside through the hinged door or from the return grille on the inside of the building.

**Evaporator**
If the evaporator becomes clogged or dirty, it may be cleaned by careful vacuuming or with a commercial evaporator cleaning spray. DO NOT use a solvent containing bleach, acetone, or flammable substances. Turn off power before cleaning. Be careful not to wet any of the electrical components. Be sure the unit has dried before restarting.

**Condenser**
Periodically inspect the outdoor condenser coil and the cabinet air reliefs for dirt or obstructions. Remove foreign objects such as leaves, paper, etc.

If the condenser coil is dirty, it may be washed off with a commercial solvent intended for this purpose. TURN OFF POWER BEFORE CLEANING! Be sure that all electrical components are thoroughly dry before restoring power. Use a fin comb of the correct spacing to straighten mashed or bent fins.

**Cabinet**
The cabinet may be cleaned with a sponge and warm, soapy water or a mild detergent. Do not use bleach, abrasive chemicals or harmful solvents.

**Drains**
The condensate is drained from the condensate pan through two drains – one on the left side of the pan and the other on the right side. The condensate lines drain to the outside at the bottom of the unit through the base pan. Each of the drain lines is looped to form a trap.

Regularly check each drain line to make sure it is not obstructed. If a commercial drain solvent is used, flush out the drain pan and system with sufficient water to remove the solvent. Some solvents can cause the drain pan to corrode.

**Lubrication**
The condenser fan motor(s) and the evaporator blower motor(s) never require oiling.
Chapter 6 Warranty

6.1 Marvair, Inc. Limited Product Warranty

Marvair Inc., warrants its products to be free from defects in materials and workmanship under normal use to the original purchaser for the period of time in the table below. If any part of your product fails within 12 months from start-up, or 18 months from shipment from the factory, whichever comes first, Marvair, Inc. will furnish without charge, EXW Cordele, Georgia, the required replacement part. The owner must provide proof of the date of the original start-up. The contractor’s invoice, the certificate of occupancy, or similar documents are examples of acceptable proof of the date of the original start-up.

<table>
<thead>
<tr>
<th>Marvair, ICE, Eubank Products</th>
<th>90 Days w/Flat Rate Labor (See Marvair, ICE, Eubank Flat Rate Labor Guidelines)</th>
<th>1 Year Parts</th>
<th>5 Years Compressor</th>
</tr>
</thead>
<tbody>
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</tr>
</tbody>
</table>

1. Any transportation, related service labor, diagnosis calls, filter, driers, refrigerant, or any other material charges.
2. Damages caused by shipping, accident, abuse, negligence, misuse, fire, flood, or Acts of God.
3. Damages caused by operating or staging the unit in a corrosive environment.
4. Damages caused by improper application of the product.
5. Damages caused by failing to perform proper routine maintenance.
6. Expenses incurred for erecting, disconnecting or dismantling the product or installing the replacement part(s).
7. Products not installed or operated according to the included instructions, local codes, and good trade practices.
8. Products moved from the original installation site.
9. Products lost or stolen.
10. CONSEQUENTIAL DAMAGES OR INCIDENTAL EXPENSES INCLUDING LOSSES TO PERSONS, PROPERTY OR BUSINESS.
11. Modifications to original unit after it leaves the factory, such as breaking into any part of the sealed systems unless authorized in advance in writing by Marvair, Inc.
12. Damages as a result of operating as a construction site cooler / dehumidifier.

When labor (first 90 days only) is required, it must be performed during normal working hours (8:00 AM - 5:00 PM) Monday - Friday and must be performed by Marvair, Inc., personnel or a designated Service Representative.

The owner of the product may ship the allegedly defective or malfunctions product or part to Marvair, Inc., at such owner’s expense, and Marvair, Inc., will diagnose and, if the defect is covered under this warranty, Marvair, Inc., will honor its warranty and furnish the required replacement part. All costs for shipment and risk of loss during shipment of the product to Marvair, Inc., and back to the owner shall be the responsibility and liability of the owner. Upon written request by an owner, Marvair, Inc., may arrange for remote diagnosis of the allegedly defective or malfunctioning product or part but all costs for transportation, lodging and related expenses with regard to such diagnostic services shall be the responsibility and liability of the owner.

An owner requesting performance under this Warranty shall provide reasonable access to the allegedly defective or malfunctioning product or part to Marvair, Inc., and its authorized agents and employees.

THIS WARRANTY CONSTITUTES THE EXCLUSIVE REMEDY OF ANY PURCHASER OF A MARVAIR HEAT PUMP OR AIR CONDITIONER AND IS IN LIEU OF ALL OTHER WARRANTIES, EXPRESSED OR IMPLIED, INCLUDING, WITHOUT LIMITATION, ANY IMPLIED WARRANTY OF MERCHANTABILITY OR FITNESS FOR USE, TO THE FULLEST EXTENT PERMITTED BY LAW. IN NO EVENT SHALL ANY IMPLIED WARRANTY OF MERCHANTABILITY OR FITNESS FOR USE EXCEED THE TERMS OF THE APPLICABLE WARRANTY STATED ABOVE AND MARVAIR SHALL HAVE NO OTHER OBLIGATION OR LIABILITY. IN NO EVENT SHALL MARVAIR BE LIABLE FOR INCIDENTAL OR CONSEQUENTIAL DAMAGES OR MONETARY DAMAGES.

THIS WARRANTY GIVES YOU SPECIFIC LEGAL RIGHTS, AND YOU MAY ALSO HAVE OTHER RIGHTS WHICH VARY FROM STATE-TO-STATE. Some states do not allow limitations or exclusions, so the above limitations and exclusions may not apply to you.
Chapter 7 Start-Up Check List

The middle front panel provides access to the electrical/control box and to the filters. This panel has hinges on the left and right hand side. This panel should ONLY be opened by using the two hinges on the left side OR the two hinges on the right side. NEVER OPEN ALL FOUR HINGES SIMULTANEOUSLY. If all four hinges are opened simultaneously, the front panel will drop and may cause serious injury and damage the panel.

<table>
<thead>
<tr>
<th>DANGER</th>
</tr>
</thead>
<tbody>
<tr>
<td>NEVER open all four hinges simultaneously. The panel should ONLY be opened by using the two hinges on the left side OR the two hinges on the right side.</td>
</tr>
</tbody>
</table>

7.1 Start-Up & Commissioning Form

Please complete the information on this form and return to Marvair by mail or fax. The mailing address and fax number can be found at the end of the form.

A. Equipment Information

Date: ____________________________ 
Equipment Owner __________________________________________
Installing Company: ____________________________ Installer: ____________________________
Address: ____________________________ State ____________________________
City: __________________________________________________________
Marvair Air conditioner: Model No. ____________________________
Serial No. __________________________________________
Compressor: Model No. ____________________________
Serial No. __________________________________________
Compressor: Model No. ____________________________
Serial No. __________________________________________

B. Pre-Start Up

Is there any shipping damage? ❑ Yes ❑ No
If so, where? __________________________________________
Will this damage prevent starting the unit? ❑ Yes ❑ No
Check Power Supply, does it agree with data sticker on air conditioner? ❑ Yes ❑ No
Has the ground wire been connected? ❑ Yes ❑ No
Has the circuit protection been sized and installed properly? ❑ Yes ❑ No

Controls

Are the thermostat control wiring connections made and checked? ❑ Yes ❑ No
Are all wiring terminals (including main power supply) tight? ❑ Yes ❑ No
If unit has a crankcase heater, has it been energized for 24 hours? ❑ Yes ❑ No
On a 208/230 v. units is control transformer (24 AC) wired for correct voltage? ❑ Yes ❑ No
Condensate Section
Has water been placed in drain pan to confirm proper drainage? ☐Yes ☐No
Are correct filters in place? ☐Yes ☐No

Refrigerant Piping
If leaks are found, report any leaks to Marvair Warranty Service Dept.

C. Check Rated Voltage at Terminal Block for Imbalance before starting of Unit.
☐208/230V 1 Phase ☐208/230V 3 Phase ☐460V 3 Phase
☐380V 3 Phase 50Hz. ☐575 3 Phase 60 Hz.

Measured Line to Line Volts  L1&L2_______ V.   L1&L3 _______ V.   L2&L3_______ V.

(L1&L2 + L1&L3 + L2&L3)/3 = Avg. Voltage = ______________

Max. Deviation from avg. voltage = ______________ volts

Voltage imbalance = (100 x Max. Deviation)/avg. Voltage = ___________%

A voltage deviation greater than 2% with the unit running should be addressed and corrected. Excess voltage deviation can cause the compressor to overheat and to operate inefficiently.

Example: Maximum Deviation from Average Voltage X 100 (for Percent)

Average voltage

Measured Voltages:
L1 & L2 = 241 Volts
L1 & L3 = 243 Volts = 717 / 3 = 239 Average Voltage
L2 & L3 = 233 Volts

239 - 233 = 6
100 x 6/239 = 2.5% Voltage Unbalance

Three phase units only check fan & compressor rotation.
D. Heating Mode Check & Record Readings

<table>
<thead>
<tr>
<th>Room Temperature</th>
<th>Circuit 1</th>
<th>Circuit 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Outside Temperature</td>
<td>________</td>
<td>________</td>
</tr>
<tr>
<td>Evap. Entering Air DB Temp</td>
<td>________</td>
<td>________</td>
</tr>
<tr>
<td>Evap. Entering Air WB Temp</td>
<td>________</td>
<td>________</td>
</tr>
<tr>
<td>Evap. Leaving Air DB Temp</td>
<td>________</td>
<td>________</td>
</tr>
<tr>
<td>Evap. Leaving Air WB Temp</td>
<td>________</td>
<td>________</td>
</tr>
<tr>
<td>Heater Contactor Amps (L1)</td>
<td>________</td>
<td>________</td>
</tr>
<tr>
<td>Heater Contactor Amps (L2)</td>
<td>________</td>
<td>________</td>
</tr>
<tr>
<td>Heater Contactor Amps (L3)</td>
<td>________</td>
<td>________</td>
</tr>
</tbody>
</table>

E. Cooling Mode Check & Record Refrigerant Pressures

Recheck voltage imbalance in cooling mode:

Measured Line to Line Volts  
L1&L2_______V.  
L1&L3_______V.  
L2&L3_______V.

(L1&L2 + L1&L3 + L2&L3)/3 = Avg. Voltage = ________________

Max. Deviation from avg. voltage = ________________volts

Voltage imbalance = (100 x Max. Deviation)/avg. Voltage = ___________%

After 10 minutes of compressor operation, record the following:

<table>
<thead>
<tr>
<th>Room Temperature</th>
<th>Circuit 1</th>
<th>Circuit 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Outside Temperature</td>
<td>________</td>
<td>________</td>
</tr>
<tr>
<td>Suction Pressure</td>
<td>________</td>
<td>________</td>
</tr>
<tr>
<td>Suction Line Temperature</td>
<td>________</td>
<td>________</td>
</tr>
</tbody>
</table>
Discharge Pressure
Discharge Line Temperature
Entering Condenser Air
Leaving Condenser Air
Evap. Entering Air DB Temp
Evap. Entering Air WB Temp
Evap. Leaving Air DB Temp
Evap. Leaving Air WB Temp
Compressor Amps (L1)
Compressor Amps (L2)
Compressor Amps (L3)

Notes:
_________________________________________________________________________
_________________________________________________________________________
_________________________________________________________________________
_________________________________________________________________________
_________________________________________________________________________
_________________________________________________________________________
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