

Introduction

Dear Coachworks Owner:

Welcome - Thanks for choosing a Blue Bird Coachworks Motor Home!

We want to personally welcome you to our Family of Friends and we invite you to visit us at our Fort Valley facilities whenever you wish. We are always happy to see you and we are deeply interested in your experiences as you use and enjoy your Coachworks motor home. We recognize that it is our relationship to you, the Coachworks owner, which contributes most to the prestige of ownership of this finest over-the-road motor home.

We trust that as you become more intimately acquainted with your new motor home, the sound, careful thoughts behind every aspect of its design will become increasingly evident and your initial decision to choose Coachworks will be positively reinforced with every mile.

We encourage that you take the time to become familiar with this introduction section before taking your first trip in your new motor home. Inside you will find information that will be beneficial on future trips with your motor home such as: vehicle loading, emergency exits, safety information, etc.

Coachworks acknowledges the good faith you have demonstrated in choosing this product. All of us at Coachworks take great pride in our handiwork and want to do everything possible to beget in you what has become the Coachworks experience; the deep satisfaction that comes from years of a sure confidence of having chosen the very best.

BLUE BIRD
Coachworks®
Limited Warranty
Wanderlodge Recreational Vehicle

Blue Bird Coachworks, a division of Complete Coachworks, Inc., warrants each Wanderlodge to the original purchaser to be free from defects in material and workmanship under normal use and service within the limits described below:

1. For a period of five (5) years/50,000 miles/80,000 kilometers, whichever occurs first, from date of delivery to the original purchaser, Coachworks warrants the:
 - a. Chassis frame rails and cross members to be free from defects in structural integrity (breaking or cracking).
 - b. Body shell (those structural metal components welded or riveted together forming floor, sidewalls, roof, front and rear sections) to be free from defects in structural integrity (breaking or cracking) including rust-through.
 - c. Paint adhesion to the body shell (those structural components forming side walls, roof, front and rear sections). Paint failures caused by corrosive atmospheric conditions and road chemicals are specifically not covered.
2. For a period of three (3) years/36,000 miles/60,000 kilometers, whichever occurs first from the date of delivery to the original purchaser, Coachworks warrants all other components not covered in sections 1 and 3 except diesel engines, automatic transmissions, tires and batteries, which are warranted by their manufacturers.
3. For a period of one (1) year from the date of delivery to the original purchaser, Coachworks warrants plasma televisions installed by Coachworks.

For demonstrators, the delivery date to the dealer will be the warranty start date. Mileage accumulated by the factory or dealer apply to any warranty mileage limits stated above. This limited warranty applies to the original purchaser during the warranty period. A transfer request and fee are required within thirty (30) days of resale to transfer the warranty.

Blue Bird Coachworks' obligation covered in this limited warranty is limited to the repair or replacement of such parts as shall, under normal use and service, appear to have been defective in workmanship or material. Without restricting the generality of this limitation, loss of use, commercial loss, maintenance, towing charges, lodging, telephone calls, inconvenience, and loss of time are specifically not covered. This warranty shall not apply to any parts or components which must be repaired or replaced during the warranty period as a result of what is, in the opinion of Coachworks, normal wear and/or deterioration in the course of normal operations and use, accident damage, misuse and/or abuse.

If distributors, dealers or customers have any vehicle modifications or equipment installations performed without the written approval of Coachworks to the extent of modifications or equipment installations adversely affect other vehicle components or performance. Coachworks shall not accept any product liability or claims under the terms of the limited warranty. These claims become the sole responsibility of the company performing the modifications and/or installations.

ANY IMPLIED WARRANTIES, INCLUDING THOSE OF MERCHANTABILITY OR FITNESS, ARE LIMITED TO THE WARRANTY PERIOD OF THIS WRITTEN WARRANTY. BLUE BIRD COACHWORKS SHALL NOT BE LIABLE FOR INCIDENTAL OR CONSEQUENTIAL DAMAGES RESULTING FROM BREACH OF THIS WRITTEN WARRANTY OR ANY IMPLIED WARRANTY. NO PERSON, INCLUDING SALESPEOPLE, DEALERS, SERVICE CENTERS, OR FACTORY REPRESENTATIVES OF BLUE BIRD COACHWORKS, IS AUTHORIZED TO MAKE ANY REPRESENTATION OR WARRANTY CONCERNING COACHWORKS PRODUCTS EXCEPT TO REFER TO THIS LIMITED WARRANTY.

Blue Bird Coachworks reserves the right to make changes in design and changes or improvements upon its products without imposing any obligations upon itself to install the same option upon products theretofore manufactured. Defects shall be repaired promptly after discovery of the defect and within the warranty period as stated herein. All claims for warranty adjustments must be received by Blue Bird Coachworks not later than 30 days after the repair date, and shall be channeled through an authorized Blue Bird Coachworks dealer or factory representative. Any suit alleging a breach of this limited warranty or any other alleged warranty must be filed within one year of breach.

All rights under this limited warranty shall be governed by the law of Georgia, U.S.A.

NOTE: This information was correct at time of printing. For any vendor changes made to equipment and/or manual after printing date refer to the actual vendor owner manual supplied with motor home.

Blue Bird Coachworks

One Wanderlodge Way • Fort Valley, Georgia 31030, U.S.A.

North American (USA & CAN)

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INTRODUCTION

This section of your Owner's Manual contains general hints and recommendations for using your motor home. Checklists and suggestions are offered which cover just about every phase of motor home travel.

The remaining sections of this manual describe the operation and use of the individual items and systems which comprise your motor home.

Manufacturer's manuals for components and appliances are included in your owner's kit. If the information you need is not contained in this manual, refer to the specific manufacturers literature supplied in the owner's kit.

We hope that this manual will help answer questions that may arise about the use, operation and maintenance of your motor home. Any suggestions or recommendations that you might have for including or expanding on material of interest will be carefully considered for incorporation in future publications. We are always interested in providing our motor home owners with the most current and comprehensive information about their product.

Some Other Thoughts to Consider before Travel

- Automobile insurance to cover you and your family.
- Avoid cash. Use traveler's checks and credit cards wherever possible.
- Confirm reservations well in advance of arrival.
- Make a clothing check list for everyone.

Citizen's Band Transceiver

You might also bear in mind that your motor home is equipped with a CB unit (Citizen's Band receiver-transmitter) In the event of an emergency situation which requires outside assistance; remember to call for help on Channel 9. This channel is restricted to emergency use only and it is monitored 24 hours per day! Don't hesitate to use your CB if you see someone else in need of assistance.

Hot Weather Operation

Wherever possible, choose a shaded parking site so that the motor home will be cooler during the hottest part of the day. The optional patio awning will be especially useful in lowering inside temperature. Air conditioning units are indispensable in hot climates. Keep in mind that their proper operation depends on adequate line voltage. Low voltage causes motors to run hotter and reduces compressor motor life. Supply voltage in some campgrounds may not be as high as necessary, especially where there are heavy loads on the lines from other air conditioners. Check the right hand overhead auxiliary panel 120 VAC meters when in doubt.

Cold Weather Operation

If frost or condensation accumulates in closets or cabinets during long periods of cold weather operation, leave the doors to these areas slightly ajar to provide air circulation. Be sure that roof vents are open when using the cook top.

Campground Courtesy

Don't forget the "Golden Rule". Being considerate of your neighbors will help make friends. A few of the "do's" and "don'ts" are:

- Good housekeeping – put all litter in the proper receptacles and leave your site neat and clean.
- Don't allow your water or sewer hook-ups to leak.
- Respect your neighbor's desire to retire at an early hour. Avoid loud noises and bright lights after dark.
- Drive slowly through camp areas at any hour for the safety of pedestrians.

Insurance

As with your automobile, it is important that you have adequate protection with insurance coverage for personal liability, property damage, comprehensive, collision, medical payments, loss of use, etc.

Canadian and Mexican Insurance

Insurance for travel in Canada can usually be covered by your present U.S. policy for the recreational vehicle, often at no extra cost. Consult your individual company for procedures and be sure of your coverage before entry.

For travel in Mexico (at the present time), there are no U.S. insurance companies that can provide recognized Mexican coverage, with the exception of that required for travel through a narrow strip of Mexican territory in and around parts of entry and the U.S./Mexican border.

Mexican insurance is controlled and rates are set by the Mexican government. There are several reliable companies handling Mexican insurance, with similar rates for the necessary coverage. The principle differences between them are the “fringe benefits”, received in the form of informational travelogues and other helpful information, such as dining places considered acceptable for sanitary conditions, fuel stations, and so on.

Some insurance services include detailed route maps with “where to stay” recommendations and “things to see” mile-by-mile (or kilometer-by-kilometer post). While the rates set by Mexico may seem quite expensive at first glance, you usually end up not spending quite as much as expected because you can usually arrange to hold your state-side policy in abeyance during the same period you are in Mexico, thus not having to pay unnecessarily for double coverage. In addition, you may be able to obtain substantial refunds on the Mexican collision insurance after your return to the U.S. Be sure to obtain a certification from the park operator at each location in Mexico to certify the dates that your motor home was parked there. If your motor home is parked for most of the time, instead of constantly traveling, your refund may be a major portion of the original cost. This feature is referred to as the “in-storage” credit. (It is a good idea to always check with your insurance company before taking a trip to find out whether applicable insurance rules and regulations have changed. Keep up to date on your coverage.)

Carry insurance papers at all times!

Safety Considerations

Using LP Gas

Check for leaks at the connections on the LP gas system soon after purchase and initial filling of the LP tank; continued periodic checks of the system are recommended. Even though the manufacturer and dealer have already made tests for leakage, this check is advisable because of the vibrations encountered during travel. Apply a soapy water solution to the outside of gas piping connections to find gas leakage (bubbles). Do not use products that contain ammonia or chlorine. Usually, tightening of connections will be sufficient. If not, ask your authorized dealer service to make the needed repairs. Liquefied Petroleum Gas (LPG) is heavier than air. Leaking gas tends to flow to low places, and will sometimes pocket in a low area. LP gas can usually be detected by an identifiable odor characteristic to garlic.

CAUTION!!

Never light a match or allow any open flame in the presence of leaking gas! Be sure that the main LP gas supply valve is closed or galley panel switch is OFF during refueling to prevent accidental ignition of gas fumes by appliance igniters.

WARNING!!

When motor home is to be stored in a confined area, turn off the LPG at the main tank shutoff valve, or more conveniently, at the galley systems control panel. Your Wanderlodge has been provided with an automatic 80% fill valve to protect you from the dangers of an overfilled LPG tank.

Electrical Systems

Your motor home has been engineered and checked for your complete electrical system safety. The motor home is wired with Multiplex wiring throughout. Circuit breakers and fuses are installed to protect electrical circuits from overloading. Before making modifications or additions to the electrical system, consult your dealer for assistance in obtaining a safe and secure installation. For more information on the wiring system refer to Electrical Information found later in manual.

Do not “jump” circuit protectors!

Emergency Stops

Always carry road flares and/or reflective triangular highway warning markers for emergency warning display. Pull off the roadway as far as possible when changing flats or for other emergency situations. Turn on your hazard warning flashers when parked alongside a roadway, even if only for a short while. Have your motor home occupants leave the vehicle and stand clear of the area when parked on the edge of a highway.

In Case of Tire Blowout

As a result of extensive tests, leading tire manufacturers recommend the following when a blowout occurs:

1. Quickly step on the gas
2. Adjust steering as needed.
3. Stay off the brakes.
4. Keep driving until you find a safe place to pull over.

Engine Exhaust Gas

Avoid inhaling exhaust gases because they contain carbon monoxide, which by itself is colorless and odorless. Carbon monoxide is a dangerous gas that can cause unconsciousness and is potentially lethal. If at any time you suspect that any exhaust fumes are entering the passenger compartment, have the cause determined and corrected as soon as possible.

The best protection against carbon monoxide entry into the vehicle body is properly maintained engine exhaust system, body and ventilation system. It is a good practice to have the exhaust system and body inspected by a competent mechanic each time the vehicle is raised for lubrication or oil change. It should also be inspected whenever a change is noticed in the sound of the exhaust system, and if the exhaust system, underbody or rear of the vehicle has been damaged.

To allow proper operation of the vehicle's ventilation system, keep ventilation inlets clear of snow, leaves or other obstructions.

Sitting in a parked vehicle with the engine on for extended periods of time, without proper ventilation, is not recommended!

More Safety Considerations

- Sanitize fresh water supply system periodically.
- Prevent water connection fittings from contacting the ground or drain the hose to reduce chances of contamination.
- Consider using a qualified technician for repairing gas or electrical appliances.
- Check fire extinguishers periodically for proper charge.
- Avoid overloading your vehicle.
- Be careful not to cause an improper load distribution which can adversely affect road ability.
- Ensure that tires are in good condition and properly inflated at all times.
- Under-inflated tires overheat and are prone to blowouts!
- Check and tighten wheel lug nuts; manufacturer recommends after first 50-100 miles and every 1,000 miles thereafter.

Emergency Exits

Sliding windows, which can be easily opened, may be used as an emergency exit. Squeeze the window latch and slide the window open. Emergency exit windows are identified by an EXIT decal on the glass.

Owner's Manual Requirements

The minimum required educational information in the owner's manual shall include:

1. A sample of the weight label's contents affixed to the unit as appropriate.
2. An explanation of the following:
 - Vehicle weight distribution
 - How to weigh the vehicle
 - » These definitions:
 - » Gross Axle Weight Rating (GAWR)
 - » Gross Combination Weight Rating (GCWR)
 - » Gross Vehicle Weight Rating (GVWR)
 - » Unloaded Vehicle Weight (UVW)
 - » Net Carrying Capacity (NCC)
3. Towing guidelines.



MOTOR HOME WEIGHT INFORMATION *(to be filled out by owner for future reference)*

Model _____

GVWR _____

UVW _____

NCC _____

GCWR _____

GVWR

(Gross Vehicle Weight Rating) means the maximum permissible weight of this motor home. The GVWR is equal to or greater than the sum of the Unloaded Vehicle Weight plus the Net Carrying Capacity.

UVW

(Unloaded Vehicle Weight) means the weight of this motor home as built at the factory with full fuel, engine oil, and coolants. The UVW does not include cargo, fresh water, LP gas, occupants, or dealer installed accessories.

NCC

(Net Carrying Capacity) means the maximum weight of all occupants including the driver, personal belongings, food, fresh water, LP gas, tools, tongue weight of towed vehicle, dealer installed accessories, etc., that can be carried by this motor home. (NCC is equal to or less than GVWR minus UVW).

GCWR

(Gross Combination Weight Rating) means the value specified by the motor home manufacturer as the maximum allowable loaded weight of this motor home with its towed trailer or towed vehicle.

This motor home is capable of carrying up to 98 gallons of fresh water (including water heater) for a total of 816 pounds. Reference: Weight of fresh water is 8.33 lbs./gal.; Weight of LP gas is 4.5 lbs./gal. (average).

CONSULT WEIGHT DECAL LOCATED IN MOTOR HOME FOR ACTUAL WEIGHTS**Vehicle Loading**

The Federal Certification Label, located inside and above the driver's windshield between the sun visor mounting brackets describes the maximum weight-carrying capacities of your motor home and for each axle, respectively abbreviated by "GVWR" and "GAWR".

The Gross Vehicle Weight Rating (GVWR) is the maximum motor home weight allowable with all systems filled and with passengers and supplies aboard.

Each axle also has a maximum load-bearing capacity referred to as the Gross Axle Weight Rating (GAWR).

The load capacity is the difference between the GVWR and the actual weight. This means that the total weight of all food, clothing, other supplies and passengers must not permit the load capacity to be exceeded.

To find the actual weight, with the motor home fully loaded, drive to a scale and read the weight on the front and rear wheels separately to determine axle loading. The load on each axle should not exceed its GAWR. If weight ratings are exceeded, move or remove items to bring all weights below the ratings.

When loading your motor home, store heavy gear first. Be sure to keep heavy gear on or as close to the floor as possible. Heavy items should be stored centrally to distribute the weight evenly between the front and the rear axles. Store only light objects on high shelves. Distribute weight to obtain even side-to-side balance of the loaded unit. Secure loose items to prevent weight shifts that could adversely affect the balance and road ability of the vehicle.

Motor Home Service – Replacement Parts

A paint color label is located adjacent to the Federal Certification Label above the pilot's sun visor.

Data plates located on the rear of the chassis (raise rear engine compartment door for access) provide information useful for identifying your motor home if you are planning on ordering parts. Identification plates provide information such as:

1. Body Serial Number
2. Model Year
3. Body Service Number
4. Chassis Serial Number
5. Chassis Service Number

Economical Driving

How you drive, where you drive and when you drive – these factors all have an effect on determining how many miles you can get from a gallon of fuel. Careful maintenance will also contribute to fuel economy.

Frequent stops and starts during a trip diminish miles per gallon. Planning even short shopping trips so you can take advantage of through-streets to avoid the traffic lights. Pace your driving like the professional drivers to avoid unnecessary stops.

An idling engine also consumes fuel. If you are faced with more than a few minutes wait, and you are not in traffic, it may be advisable to shut off the engine and re-start later.

A properly lubricated vehicle means less friction between moving parts. Consult the maintenance schedules for proper lubricants, lubrication intervals and general motor home maintenance scheduling.

Fuel economy is also related directly to the amount of work accomplished by the engine. Heavier loads require more power: Keep excess weight to a minimum.

Cellular Phone Wiring

A roof mounted antenna and wiring (terminals in driver's area) are supplied for cellular phone hookup.

Fog Lights

Clear fog lamps are mounted stationary in the front bumper. The fog lamps illuminate only with low beam headlights, provided the dash switch is activated.

Traveling in Your Motor Home

NOTE:

1. Overall length - 44'-0", Interior Height - 83", Interior Width - 95", Exterior Width - 102", Wheelbase - 296", Front Overhang - 85", Rear Overhang 99", Cargo Carrying Capacity - 3,800 lbs. (depending on options).

2. It is recommended that compartment doors be locked so they do not open while in transit. There are many modern recreational vehicle parks with good facilities, including State, County and Federal Parks, where electrical, water and sewer connections are readily available. Directories are published which describe these parks in detail, and list available services and hookups.

On overnight short weekend trips, your motor home has more than adequate holding tanks and water supply capacity in the event that campgrounds or parking sites are not equipped with these facilities.

On longer trips, where sewer connections and utility hookups are unavailable, it will be necessary to stop from time to time to dispose of holding tank wastes and replenish the water supply. Many gas stations (chain and individually-owned) have installed sanitary dumping stations for just this purpose.

When stopping for the night, park the motor home in a location that is relatively level and where the ground is firm. This will ensure your comfort as well as the leveling of your refrigerator (for most efficient operation).

Making a long trip is not very different from making a weekend excursion since everything you need is right at hand and you are home wherever you travel. When packing for an extended trip, try to avoid taking nonessential items.

When planning to stay in the same location for several days, weeks, or even months, be sure to maintain the motor home level. Use the leveling jacks system for this purpose. (See Leveling Jacks in Section 4-5 of this manual).

Hook up to the water supply by attaching the water hose to the commercial water supply inlet.

Plug the electrical cable into the shoreline receptacle. Be sure to observe all grounding and connection precautions!

Connect sewage hookup into the disposal facility.

Winter Traveling

Certain precautions should be taken when traveling in your motor home during the cold winter months. Keep these suggestions in mind:

- Provide heat in the motor home at all times.
- Have a plentiful supply of LPG and diesel.
- If your stay is longer than overnight and you do not use the generator, try to have a shoreline hooked up to outside AC power.
- Minimize your use of electricity if 120 vac is unavailable.
- Leave cabinet doors and wardrobe doors slightly open at night to allow for proper air circulation.

Remember that low temperatures in combination with high winds will cause an equivalent chill temperature much below that indicated by your thermometer. For instance, with an outside temperature of zero degrees and a wind velocity of 10 miles per hour the equivalent chill temperature would be -20 °F!

There is no substitute for common sense when traveling in cold weather.

General Storage Notes

Drawing draperies will reduce fading of rugs and upholstery. Leaving an air freshener agent will minimize odors from plastics and other materials. Slight opening of windows and vents will allow air circulation without worry of water entering. Covering wheels to eliminate direct rays of the sun on tires will reduce sidewall cracking.



NOTE: Remove all items from the motor home that may freeze, including canned foods, miscellaneous liquids, etc. Remove all contents of the refrigerator/freezer, clean unit and leave doors ajar.

Countertop Care



NOTES:

Proper care of all countertops is the owner's responsibility. Scratches will occur if proper care is not implemented. Use cleaners and cleaning materials only recommended for these types of countertops. For example, using a scrub brushes or abrasive cleaners not recommended for this type of countertop could cause unsightly scratches.

Chipping of countertops is not covered under the warranty. Abrasive cleaners can cause chipping. Please take special care to avoid the chipping of countertops.

Reporting Safety Defects

If you believe your vehicle has a safety defect which could cause a crash or could cause injury or death, you should immediately inform the National Highway Traffic Safety Administration (NHTSA) in addition to notifying Blue Bird Wanderlodge.

If NHTSA receives similar complaints, it may open an investigation, and if it finds that a safety defect exists in a group of vehicles it may order a recall and remedy campaign. However, NHTSA cannot become involved in individual problems between you, your dealer, or Blue Bird Wanderlodge.

To contact NHTSA, you may either call the Auto Safety Hotline toll free at 1-800-424-9393 (or 366-0123 in Washington, D.C., area). Or write to: NHTSA, U.S. Department of Transportation, Washington, D.C. 20590. You can also obtain other information about Motor Vehicle Safety from the hotline.

1-1 Safety Features

1-1.1 Seat Belts and Restraint Systems

Pic of Pilot
Safety Belt

1-1.1.1 Pilot and Co-Pilot Seats

The seatbelts in the pilot and co-pilot area use a 3-point system built into the seat itself. Seatbelts can be operated by grasping the shoulder buckle and moving it diagonally across the body and buckling it into the red and black receptacle. To remove simply press red button located at receptacle on seatbelt. Seatbelts automatically retract.

1-1.1.2 Living Room Area

Pic of Living Room
Safety Belt

Two lap belts are provided at the sofa area in living room. These are manual non-retracting lap belts. These belts are operated by sitting between the belts and manually latching over your waist. Be sure to pull snug to your waist. An improperly adjusted seatbelt can be hazardous. To remove, simply press red button on seatbelt buckle.



NOTE: these are the only four approved areas for seating while motor home is in transit.

1-1.2 Smoke Alarm



Your motor home is equipped with two Safe T Alert smoke alarms located on the ceiling in the front and rear of the coach. These alarms meet U.L. Standard 217 and NFPA Standard 74 for operation of smoke detection devices.

1-1.2.1 Smoke Alarm Features

- Listed to UL 10/1/99 smoke alarm standard for Residential and Recreational Vehicle.
- New distinctive horn sound. Loud 85-decibel alarm horn.
- Test button checks smoke alarm functions.
- Alarm mute Models (S/SLL) feature Mute/Test button used to temporarily silence the alarm during ventilation. Alarm automatically resets.

IMPORTANT SAFETY INFORMATION READ AND SAVE THESE INSTRUCTIONS

1-1.2.2 Warnings and Cautions

- Smoke Alarms can only work if they are properly located, installed, and maintained, and if smoke reaches them. They are not foolproof.
- This alarm meets the 10/1/1999 UL standard for a new horn “alarm” pattern for smoke alarms. This sound is different than other Smoke Alarms you may have installed or may have heard in other locations. You must test this alarm and educate all members and guests of the residence of this different horn pattern.
- Different Smoke Alarm Sounds. If this unit replaces another 9 volt smoke alarm or is being used for additional protection where other smoke alarms are present, than everyone who might hear this alarm must be made aware of the different smoke alarms horn sounds.
- Smoke Alarms cannot work without power. Battery operated units cannot work if the batteries are missing, disconnected or dead, if the wrong type of batteries are used, or if the batteries are not installed correctly AC units cannot work if the AC power is cut off by an electrical fire, an open fuse, a circuit breaker or any other reason. If you are concerned about the limitations of battery or AC power, install both types of units.
- Smoke Alarms cannot detect fires if the smoke does not reach them. Anything preventing smoke from reaching the alarm may delay, or prevent an alarm. A smoke alarm cannot detect fire in the walls, chimney or roof unless and until a significant amount of smoke reaches the alarm. A closed door may prevent smoke from reaching an alarm on the other side of the door.
- Smoke Alarms may not be heard. Though the alarm horn in this unit meets or exceeds current UL standards, it may not be heard for many reasons. These include, but are not limited to: the unit is located outside a closed or partially closed door, residents recently consumed alcohol or drugs, the alarm is drowned out by other noise like the TV, stereo, traffic, weather, air conditioner or other appliances, residents are hearing impaired or sound sleepers.
- Smoke alarms have a limited life and are not foolproof. Smoke alarms will wear out over time like any appliance. Test your alarm at least once per week. Always replace detectors immediately if they are not working properly, if they display any type of problem, or prior to 10 years of use. They are not a substitute for property or life insurance.
- Smoke alarms may not have time to alarm before the fire causes damage, injury or even death. Examples of this include persons smoke in bed, children playing with matches or lighters, fires caused by violent explosions, natural causes like lighting, arson, escaping gas, overloaded electrical circuits, carelessness or by other safety hazards.
- Never disconnect the battery to silence the alarm.
- This unit will not alert hearing-impaired residents. Special alarms with flashing strobe lights are needed for the hearing impaired.
- This is a single station alarm. Do not attempt to connect this to any other device.
- Do not install this alarm over an electrical box. Do not use this detector as a replacement for an AC or AC/DC smoke alarm. Only use as an additional alarm for greater protection or as a replacement for a battery operated smoke alarm.

CAUTION!!

Do not paint this unit. Paint may clog the openings to the sensing chamber and will prevent the unit from working properly

CAUTION!!

Do not stand too close to the unit when testing, silencing or during an alarm as the loud horn could damage your hearing. When testing move away when the horn starts sounding.

CAUTION!!

This smoke alarm may not give adequate warning to those with physical limitations of any kind. Additional measures should be taken to insure their safe evacuation if a fire does occur. Install a professional fire alarm system that is connected to a call center.

CAUTION!!

!!CAUTION: Smoke alarms sound their horns when they detect smoke. They do not detect heat, flame or gas. They will not operate if smoke does not reach them.

1-1.2.3 Practice Fire Safety

Putting up smoke alarms is just one part of protection against fires. You must also reduce the chances of a fire starting and have a plan that you have practiced for everyone escaping if a fire does occur.

1-1.2.4 Escape Planning

- Determine a meeting location outside the coach where you can safely meet if a fire does occur.
- Familiarize everyone with the sound of this smoke alarm. Train them to safely exit the coach when the smoke alarm occurs.
- Update and practice your escape plan at least every six months. Inform guests and others of your plan and meeting place.
- Teach everyone how to check doors and not to open them if they are hot. Also to stay low and not to breathe smoke, fumes or gases.

1-1.2.5 What to Do When the Alarm Sounds

WARNING!!

Never ignore any alarm. If the alarm sounds and you are not absolutely certain of the source of the smoke, get everyone out of the coach immediately.

- Leave immediately by your plan of escape. Every second counts, do not waste time getting dressed or picking up valuables.
- Feel doors before opening them to see if they are hot. If a door is cool, open it slowly and check for fire and heat before you proceed. Do not open a hot door - use an alternate escape route.
- Stay close to the floor if air is smoky. Take short shallow breaths through a wet cloth if possible.
- Once outside, go to your selected meeting place and make sure everyone is there.
- Call the Fire Department from outside of the coach with the activated alarm, at a safe location.
- Do not return to coach until fire officials say that it is safe.

1-1.2.6 Operation, Testing and Maintenance

Operation: The smoke alarm is operating once the battery is correctly connected. The LED will flash every minute to show the battery is supplying power to the alarm. When production of combustion are sensed, the unit sounds a loud alarm which continues until the air is cleared.

False Alarms “Mute” control: Models (S/SLL) with the mute feature have the capability of temporarily reducing the sensitivity of the alarm circuit for approximately 10 minutes. This feature is to be used only when a known alarm condition such as smoke from cooking activates the smoke alarm. The smoke alarm horn is muted by pushing and holding the test button on the alarm cover for 5 seconds. The smoke alarm will automatically reduce sensitivity and the LED will “flash” every 10-20 seconds for approximately 10 minutes to indicate the alarm is in temporary mute condition. The smoke alarm is completely operational during the mute cycle and will alarm if the smoke density increases. After the 10 minute mute cycle the alarm will “beep” twice letting you know it has automatically returned to normal sensitivity.

CAUTION!!

Before using the “mute” feature, identify the source of smoke and be certain that safe conditions exist.

Testing: Test the alarm by pushing the test button on the smoke alarm cover for at least three seconds, until the alarm sounds. The alarm sounds if all electronic circuitry, horn and battery are working. If no alarm sounds, the unit has a defective battery or other failure and should be replaced immediately.

- Test each smoke alarm weekly to be sure it is installed correctly and operating properly.
- Stand at arm’s length from the smoke alarm when testing. The alarm horn is loud to alert you to an emergency. The alarm horn may be harmful to your hearing.
- The test button accurately tests all functions. Never use an open flame from a match or lighter to test this smoke alarm. You may ignite and set fire to the smoke alarm and your home.
- Test smoke alarm operation after vehicle has been in storage, before each trip, and at least once per week during use.
- Maintenance: This smoke alarm has been designed to be as maintenance free as possible, but there are a few simple things you must do to keep it working properly.
- Test each smoke alarm at least once a week.
- Keep a supply of approved 9 volt replacement batteries on hand.
- Test smoke alarms used in RVs after vehicle has been in storage, before each trip and at least once per week during use. Failure to test smoke alarm used in RV’s as described may remove your protection.
- Gently vacuum off any dust on the cover of the smoke alarm monthly with your vacuum’s soft brush attachment. Test unit once you have vacuumed the cover.
- Never use water, cleaners or solvents since they may damage the smoke alarm.
- Relocate the smoke alarm if it sounds frequently with unwanted alarms.
- When the battery becomes weak, the unit will “beep” about once a minute (the low battery warning). This, low battery warning should last for 30 days, but you should replace the battery immediately to continue your protection.
- Replace your Smoke Alarms at least every 10 years. This includes models with 10-year batteries (SA-668LL and SA-668SLL). Manufacturers date code is on the back of the Alarm.

1-1.2.7 Battery Information

Battery Removal Indicator - This Unit will not operate without a battery. When the battery is removed from the alarm, the battery flag in the compartment will pop up; therefore the alarm cannot be installed to the mounting bracket without a battery.

Battery Replacement - This smoke alarm requires one standard 9V battery. The Battery Gold Peak #1604P is approved (its reference: Gold Peak #16048; Eveready #522, #1222, #216; Duracell #MN1604 and #MN1604B). You may also use the long-life 10 Year Lithium battery Ultralife #89VL-J.

WARNING!!

Use only the replacement batteries listed. The unit may not operate properly, with other batteries. Never use rechargeable batteries since they may not provide a constant charge.



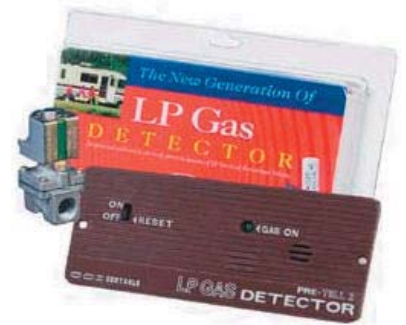
NOTE: Most carbon zinc batteries have an average service life of 1 year, most alkaline batteries have an average service life of 1-2 years. All the batteries specified above are acceptable replacement batteries for this unit.

IMPORTANT! Regardless of the manufacturer's suggested battery life, you **MUST** replace it immediately once the unit starts "beeping" ("the low battery warning").

1-1.3 LP-Gas Detector

The LP-Gas detector is provided for safety. The gas leakage detector sounds an alarm and closes down the main LPG supply in the event of an LPG leak. This unit does meet California requirements. It detects both LP-Gas and methane gas. Liquefied Petroleum (LP) Gas is heavier than air; methane gas is lighter than air. LP-Gas will settle to the lowest point, generally the floor of the motor home. Methane gas will rise. The gas detector is also sensitive to other fumes such as hair spray, of which most contain butane as the propellant. Butane, like propane, is heavier than air and will settle to the floor level where it will be detected. When this occurs, press reset button for 60 seconds to stop the alert.

Other combustibles, which will be detected, include alcohol, liquor, deodorants, colognes, perfumes, wine, adhesives, lacquer, kerosene, gasoline, glues, most cleaning agents and propellant of aerosol cans. Most are lighter than air in their vapor state and will only be detected when the motor home is closed up.



1-1.3.1 Operation

Upon first application of power, the LED will flash yellow for three minutes, while the detector is stabilizing. At the end of the start cycle, the LED will turn Green, indicating full operation. If the detector senses unsafe levels of gas, it will immediately sound an alarm. The gas detector operates on 12 Volt DC, with a current draw less than 1/10th of one amp.

CAUTION!!

The detector will not alarm during the three minutes warm up cycle.

1-1.3.2 Alarm

The red LED will flash and the alarm will sound whenever a dangerous level of propane or methane gas is detected. The detector will continue to alarm until the gas clears or the TEST/MUTE switch is pressed.

1-1.3.3 Procedures to take during an alarm:

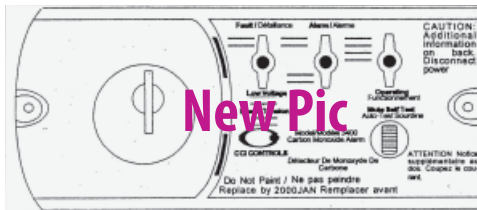
1. Turn off all gas appliances, (stove, heaters, furnace), extinguish all flames and smoking material. Evacuate, leave doors and windows open.
2. Turn off the propane tank valve.
3. Determine and repair the source of the leak. Seek professional help if necessary.

CAUTION!! Do not re-enter until the problem is corrected.

1-1.3.4 Fault Alarm:

Should the microprocessor sense a fault in the gas detector, a fault alarm will sound twice every 15 seconds. The LED will alternately flash red to green and the MUTE switch will not respond to any command. The gas detector must be repaired or replaced.

1-1.4 Carbon Monoxide Detector



This motor home is equipped with a CCI Controls Carbon Monoxide detector. Carbon monoxide (CO) is a colorless, odorless and tasteless gas. Even low levels of CO have been known to cause brain and other vital organ damage in unborn infants, with no effect on the mother. In cases of mild exposure, the symptoms may include: a slight headache, drowsiness, confusion and fast heart rate. Extreme exposure can result in unconsciousness, convulsions, cardio-respiratory failure and death. Young children and household pets may be the first affected.

The CO detector is designed to detect the toxic CO fumes that result from vehicle exhaust and incomplete combustion sources like a furnace, gas stove or water heater. Consequently, it is uncommon for household smoke from cigarettes or normal cooking to cause the alarm to sound.

NOTE: Activation of this device indicates the presence of carbon monoxide (CO), which can be fatal. A concentration of above 100 PPM will cause a warning condition. Individuals with medical problems may consider using detection devices with lower carbon monoxide alarming capabilities. Prolonged exposure to the horn at a close distance may be harmful to your hearing.

1-1.4.1 Getting Started

These instructions include information on the installation, maintenance, and operation of the carbon monoxide (CO) alarm that is installed in your recreational vehicle (RV). It is important to keep these instructions in a handy location so you can refer to them as necessary. A properly installed and maintained CO alarm is an important part of your RV safety plan. Therefore, you and your family should read this manual thoroughly before operating your RV.

Your CO gas detector is operating at all times when it is connected to its power source. This detector will only operate when supplied with the stated operating voltage. This detector is a safety device. It must not be connected in such a way as to allow it to be switched off by the use of a wall switch or similar device, or to become disconnected from its power supply due to the use of a GFCI protected circuit. When the coach is equipped with an optional master cutoff switch for storage only, the detector will be turned off when this switch is turned OFF. This is acceptable as the coach is not to be used with the optional master cutoff switch in the off position.

In the event you have questions regarding the use of this CO alarm, call (800) 521-5228, Monday through Friday, 8 a.m. to 5 p.m. Pacific Standard Time. For the most current information visit the CCI website at: <http://www.ccicontrols.com>.

WARNING!!

Actuation of your CO alarm indicates the presence of carbon monoxide (CO) which can KILL YOU.

When the alarm sounds on this device and the RED Alarm Indicator light flashes, they indicate the presence of carbon monoxide (CO) which can be FATAL. The alarm will continue to sound until the carbon monoxide has dissipated or until the mute button is activated.

If alarm sounds:

1. Press the MUTE button.
2. Call for emergency services. (fire department 911)
3. Immediately move to fresh air outside or by an open door or window. Do a head count to check that all persons are accounted for. Do not re-enter the premises or move away from the open door or window until the emergency service personnel have arrived, the premises have been aired out, and your alarm returns to its normal condition.
4. After following steps 1-3, if your alarm reactivates within a 24 hour period, repeat steps 1-3 and call a qualified appliance technician.

Have the technician investigate for sources of CO from fuel burning equipment and appliances, and inspect for proper operation of this equipment. If problems are identified during this inspection have the equipment and appliances serviced immediately.

NOTE: Have technician inspect any combustion equipment or appliance and consult the manufacturer's instructions, or contact the manufacturers directly, for more information about CO safety of this equipment. Make sure that coach is not, and has not been, operating in an attached garage or adjacent to the residence.

CAUTION!!

This alarm will only indicate the presence of carbon monoxide (CO) gas at the sensor. CO gas may be present in other areas of the RV.

1-1.4.2 Operation

The CO alarm will only detect CO gas if the proper power is supplied. Once power is supplied (or re-supplied) to the alarm, it will perform a brief warm-up and self-check process before beginning to monitor for carbon monoxide gas.

CAUTION!!

This alarm will only indicate the presence of carbon monoxide gas at the sensor. Carbon monoxide gas may be present in other areas.

1-1.4.3 CO Alarm Indicator Lights and Conditions

Power. Once 12 volts DC power is supplied, the GREEN power indicator will turn on indicating the alarm is ready to detect CO gas.

Alarm Condition. When CO gas is present in alarm concentrations, an alarm will sound and the RED alarm indicator light will flash. The detector will continue to alarm until the CO gas has dissipated or until the MUTE button is momentarily pressed. If the MUTE button is pressed during an alarm condition, the alarm will stop sounding and the RED alarm indicator light will also stop flashing. If CO gas is still present in alarm concentrations, the alarm will resume within a few minutes depending on the concentration.

Fault/Low Voltage. In addition to sounding an alarm when CO gas reaches a specific concentration at the gas sensor, the CO alarm also performs two other valuable functions:

1. An automatic self diagnostic system check (called supervision) on the alarm's electronics to ensure reliable, trouble-free operation.
2. CO device acts as a low voltage indicator for the battery that supplies voltage to the alarm.

Fault Condition. In the event the CO alarm senses a fault in its electronics, the ORANGE Fault indicator light will illuminate continuously (not flashing) and then sound a beep once every five seconds. The GREEN power indicator will then turn off, indicating that the alarm is no longer monitoring for CO gas. If such action should occur, call CCI Controls for assistance during normal business hours. (8 a.m. to 5 p.m. PST).

Low Voltage Condition. This CO alarm has been designed to operate from a 12 volt DC power source. Without the correct voltage, the CO alarm may not detect carbon monoxide at the gas sensor. In the event that the CO alarm senses that a low voltage condition exists, the ORANGE Low Voltage indicator will illuminate continuously (not flashing) and then sound a beep once every sixty seconds. The GREEN Power indicator light will then turn off indicating that the alarm is no longer monitoring for CO gas.

In many instances, low voltage is an indication that the battery supplying voltage to the CO alarm needs recharging. If recharging your battery does not cause the ORANGE Low Voltage Indicator to turn off and the GREEN Power Indicator to turn on, call CCI Controls for assistance during normal business hours. (8 a.m. to 5 p.m. PST)

NOTE: Unlike the separate indicator lights for the GREEN power and the RED alarm, the Fault and Low Voltage conditions share the same ORANGE indicator light.

Mute/Self-Test. The Mute/Self-Test button serves two purposes: (1) to mute or silence the alarm and (2) to perform a self-test. See [Alarm Condition](#) above and [Testing Your CO Alarm](#).

1-1.4.4 Testing Your CO Alarm

WARNING!!
 Test alarm operation after vehicle has been in storage, before each trip, and at least once per week during use.

It is important to test your CO alarm regularly.

To test the electronics of the CO alarm, press and release the test button. The alarm should sound a beep four times and the RED alarm indicator light will flash four times. In addition, the indicator lights are also tested. The GREEN power indicator light will turn off and the ORANGE Fault/Low Voltage indicator light will illuminate temporarily. If the CO alarm does not respond in this manner, then refer to the troubleshooting section.

1-1.4.5 Cleaning

Use a vacuum cleaner to remove dust or any other buildup on the detector. Do not wash. Wipe the detector with a damp cloth and dry it with a towel. Do not open the detector for cleaning. Do not paint the detector. It is recommended that the carbon monoxide detector be replaced every 10 years.

1-1.4.6 Troubleshooting

Description	Green Light	Red Light	Orange	Sounder	Resolution
Normal Operation	On	Off	Off	No Sound	
CO Gas Detected	On	Flashing	Off	Four Beeps then a pulse, every 5 seconds	Follow " What you should know if the CO alarm sounds " section
Low Battery Condition	Off	Off	On	A single beep once every 60 seconds.	Recharge the vehicle battery.
No Power	Off	Off	Off	Off	You only have protection if the unit is powered.
Fault Condition	Off	Off	On	Beep Once every 5 seconds	Call CCI Controls
Test Mode	Dims off, then turns back on.	Flashes four times, then stops.	Dims on, then turns back off.	Four Beeps then a pulse, every 5 seconds.	Unit functional when Green light turns back on.

1-1.4.7 What You Should Know About Interaction with Other Products

Never ignore a CO alarm. A true alarm is an indication of potentially dangerous levels of carbon monoxide. This CO alarm is designed to provide an early warning signal to alert you to the presence of CO gas at the gas sensor. The alarm is designed to sound before most people will experience dangerous symptoms of CO poisoning. If you have special health conditions or medical problems, you should consider purchasing other warning devices which provide audible and visual signals for CO concentrations under 30 parts per million (PPM).

The glues, paints and other materials used in construction of new RV's and RV's that have been in storage often produce hydrocarbon vapors that may be detected. These hydrocarbon vapors may cause the alarm to sound. When this occurs, air out the RV.

In concentrated amounts, some common household products may cause the alarm to sound. These items could include alcohol, liquor, kerosene, gasoline, deodorants, colognes, and household cleaning products and aerosols. When this occurs, air out the RV and the CO alarm with fresh air.

1-1.4.7.1 Sometimes the CO Alarm Will Sound Because Of:

- Simultaneous use of several fuel burning appliances competing for internal air.
- Negative air pressure resulting from the use of exhaust fans
- High outside wind causing CO to back up in the air vent pipes
- Vent pipe connections vibrating loose from clothes dryers, heaters or furnaces
- Obstructed vent pipes or unvented fuel burning appliances
- Temperature inversions which can trap exhaust gases near the ground.
- Car or RV idling nearby

IMPORTANT NOTES: Some products may prevent or delay your CO gas alarm from detecting carbon monoxide. Therefore, your CO gas alarm should not be:

- Installed too low where items such as water and other household chemicals can pollute the sensor
- Covered, obstructed or painted
- Exposed to sulfur products or powders of any kind

1-1.4.8 Technical Information

Sensor Level	70 ppm or more of carbon monoxide gas and before 10% carboxyhermoglobin (COHb) exposure level.
Operating	Green LED Illuminated
Alarm	Alarm will sound and red LED will flash.
Fault Condition	Orange LED illuminated. Alarm will beep every 5 seconds.
Low Voltage Condition	Orange LED illuminated. Alarm will beep every 60 seconds.
Audio Alarm	85dB at 10 Feet
Supply Voltage	12 volts DC nominal
Current Draw	50 milliamps maximum
Dimensions	3½ x 7 x 1-5/8 inches 8.89x17.78x4.12 cm
Storage Temperature	-40° F to 100° F -40° C to 37.8° C Humidity 95% max noncondensing
Operating Temperature	40° F to 100° F 4.4° C to 37.8° C Humidity 95% max noncondensing
Listing	Humidity 95% max noncondensing UL/CSA Listed

Call (800) 521-5228 if you have any questions about your Carbon Monoxide Gas Alarm

1-1.4.9 Limited Warranty

CCO Controls Warrants the equipment described hereon to be free from defects in material and workmanship under normal use and service when installed and used in accordance with all applicable state and local laws and regulations. CCI Controls sole obligation hereunder shall be limited to repairing or replacing the component or components shown to have been defective at time of shipment or to have become inoperative within the term of the warranty. This warranty does not cover transportation to and from the service locations, loss of time, inconvenience, commercial loss, loss of use, incidental changes, or other consequential damages. This warranty shall be for the term of two years from the date of the first sale by the dealer to the consumer. The consumer may be asked to produce the original sales contract or receipt to identify the date of purchase.

This CO gas alarm contains no user-serviceable parts. If you have questions as to servicing this alarm, contact CCI Controls. This warranty is voided if the alarm's casing is opened.

1-1.5 Fire Extinguisher

Your motor home is equipped with two Badger fire extinguishers. One located by the entrance door and the other by an outside bay. Please read the following operating instructions below before using your fire extinguisher. If there is any doubt on how to operate the fire extinguisher, you and your family should practice using it. Be sure to replace or recharge the extinguisher immediately after use.



1-1.5.1 Basic Operation and Use

In case of fire. . .

1. Call the fire department
2. Get everyone out.
3. Plan your retreat.
4. The contents are discharged by pressure - DO NOT DISCHARGE AT A PERSON'S FACE - STAND A MINIMUM OF 6' to 10' FROM THE FIRE.
5. Hold the extinguisher firmly in an upright position.
6. Stay low to avoid inhalation of smoke and aim discharge just under the flames, using a side to side motion, sweeping the entire width of the fire. For wall fires, start at the bottom, sweep from side to side and progress upward. For floor fires, sweep side to side and move forward as fire diminishes to reach far edge of fire.
7. NEVER move into area where fire was burning even though it appears to have been extinguished. You could be trapped and burned if the fire reflash.
8. NEVER use water extinguishers on electrical fires.
9. NEVER use extinguishers at distances of less than 6 to 10 feet.

Use the PASS word!

Pull the pin to unlock the extinguisher

Aim at the base (bottom) of the fire and stand 6-10 feet away.

Squeeze the lever to discharge the agent.

Sweep the spray from left to right until totally extinguished.

1-1.5.2 Inspection and Care

Be sure that the extinguisher is in its proper location so that there will be no delay in case of fire.

Your extinguisher should be checked once each month or more frequently if necessary to determine that:

1. The pointer on the pressure gauge is in the green operable area.
2. The nozzle opening has not been closed with some foreign object.
3. A ring pull is provided to prevent accidental discharge. This pin is secured by means of a plastic wire lock seal. On some models, the carry handle is sealed in place by a tape crossing over the lower portion. Check to make sure that the lock seal is intact. A broken lock seal is in indication of tampering and that there may have been a partial or total loss of contents.
4. Weigh the extinguisher at least every six months; and if below the weight designated under "Maintenance" on the extinguisher label, the extinguisher should be recharged.

1-1.5.3 Fire Classification Symbols

If your extinguisher bears these A, B or C symbols it can be used on the following fire types.



Ordinary Combustibles: Can be used on paper, cloth, wood, upholstery, and other ordinary combustibles.



Flammable Liquids: Can be used on gasoline, oil, grease, and other flammable liquids.



Electrical Equipment: Can be used on live electrical equipment.



Combustible Cooking Media: For use on cooking appliances that use combustible cooking media (vegetable or animal oils and fats).

FIRE EXTINGUISHER AND AGENTS		
TYPE EXTINGUISHER	BASIC AGENT	MAY BE USED ON
Regular (ordinary) Dry Chemical	Sodium Bicarbonate	B C
Multi-Purpose (ABC) Dry Chemical	Ammonium Phosphate	A B C
Purple "K" Dry Chemical	Potassium Bicarbonate	B C
Carbon Dioxide	An Inert Gas	B C
Water	Tap Water	A
Halotron 1	Vaporizing Liquid	A B C
		B C
Wet Chemical	Potassium Acetate Solution	A B C (WC-25)
		B C (WC-10)
		K (WC-100 & WC-250)



1-1.6 Emergency Egress

An egress window is designated for use as an exit in the case of an emergency. Inside the motor home the egress is easily identified by the red locking handle. It is also marked as an "EXIT." Outside of the motor home, the egress window is identified by hinges along the top of the window. The glass slider in the egress window operates the same as all other windows. To open the egress window, lift the red handle and push outward on the window. Pull the window closed and lower the handles to lock the egress window.

1-1.6.1 Maintenance

The egress window should be opened twice a year to ensure proper operation. Over time, the rubber seal will tend to stick to the egress window. Occasional operation will help prevent the rubber seal from sticking.

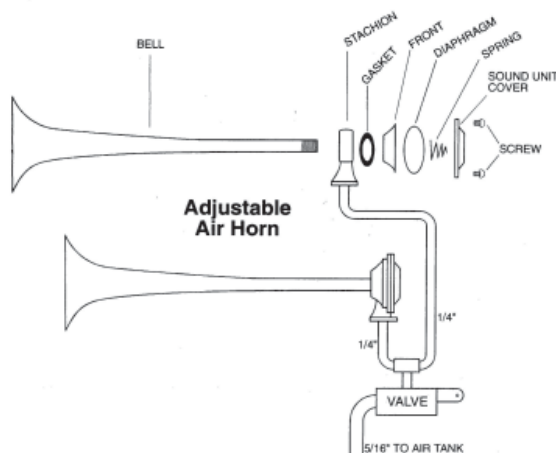
1-1.7 Backup Alarm

Anytime motor home is in reverse a backup alarm will sound to warn that motor home is backing up. The alarm may be turned off by a switch on the dash marked Backup Alarm. A good reason to turn alarm off would be backing up a motor home into a spot in the early hours of the morning to avoid disturbing other residents.

1-1.8 Air/City Horns

Operate the horn by pressing on the center section of the wheel. Select air or city horn with the HORN SELECTOR switch on the dash. The air horn is a very loud horn much like the one on a semi-truck. The city horn is similar to your typical vehicle horn.

The air horn is a simple device, with limited parts, easy to adjust or repair. In most cases this can be done without removing or replacing the complete unit.



The Grover Product Line consists of two basic styles. There is the Adjustable model and Non-Adjustable model. These can be recognized by the mounting of the bell to the sound unit, examples below. The Adjustable models are all part numbers starting 10 in the four digit part number. The Non-Adjustable models start with 16, 17 and 20 in the four-digit number.

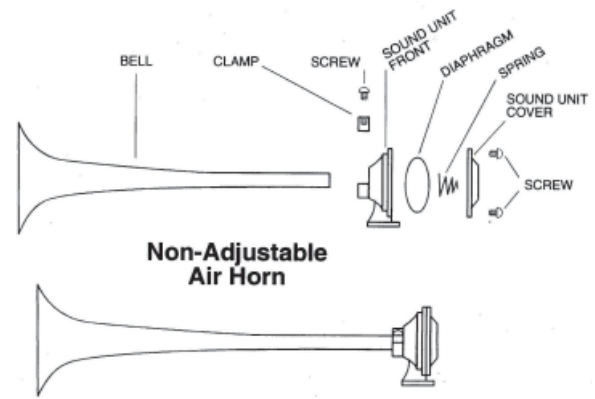
All Grover Air Horns are designed to operate at a minimum air pressure of 60psi and are factory tested at this pressure. The other main factor is the air volume, this is especially important in the 10 series dual mounted installation. By volume we are talking about the ability to pass enough air through a given line size. With dual 10s line size of at least 5/16" is required from tank to valve, from there through a tee 1/4" tube is OK. Kit #1098 Tubing, Fitting are recommended for large horns.

Common Complaint

Air horn does not blow, or sounds weak. Assuming the plumbing is correct, we will check for tuning, when we refer to tune we are not talking about adjusting to high or low tone, it is in tune or out, blows weak or without the intensity you would expect from a air horn approximately 130db.

Procedure:

To tune a horn, first check bushing threads exposed forward of sound unit should be one or two in most cases. To tune, hold bell end firmly with left hand and with right hand grasp complete sound unit and rotate counter clockwise slightly, only enough to turn bell, in or out to expose threads slightly forward of sound unit. A good starting point to tune is one thread exposed, tighten bell up to sound unit and try, if sound is not pronounced, loosen unit move slightly 1/8 turn in or out, and retry until sound is bright and crisp.



In some cases it becomes necessary to replace Spring, Diaphragm, or Gasket. Use Kit #1094.

On the Non-Adjustable style horns, Use Repair Kit #1681 for 1700 series and Kit #1607 for 1600 series horns. The only other item to check on these models, is the bell seating into the sound unit and tightness of clamp.

1-1.8.1 Backup Lights

Backup lights are similar to vehicle backup lights. They engage when the motor home is in reverse to warn motor home is backing up.

1-1.9 Landing Lights

There are three sets of landing lights. Two are on the left side of the motor home, two are on the right side of the motor home, and two are on the rear of the motor home. They may be switched on or off by selecting one of three buttons marked REAR LAND, LEFT LAND, or RIGHT LAND, on the panel just to the left of the main instrument panel on the dash. A common use would be to aid owner in various operations performed such as loading the motor home, entertaining, or anytime light is needed in that area of the motor home. The reverse landing lights will only operate while the motor home is in reverse or neutral. They will not operate if motor home is in drive.

1-1.10 Spot Lights

The spotlights are located on the roof in the front of the motor home. They are operated by and on/off switch and toggle switch used for directional purposes on the right hand side of the dash beside the ignition switch.

1-1.11 Vehicle Loading

The Federal Certification Label, located inside and above the driver's windshield between the sun visor mounting brackets describes the maximum weight-carrying capacities of your motor home and for each axle, respectively abbreviated by "GVWR" and "GAWR."

The Gross Vehicle Weight Rating (GVWR) is the maximum motor home weight allowable with all systems filled and with passengers and supplies aboard.

Each axle also has a maximum load-bearing capacity referred to as the Gross Axle Weight Rating (GAWR).

The load capacity is the difference between the GVWR and the actual weight. This means that the total weight of all food, clothing, other supplies and passengers must not permit the load capacity to be exceeded.

To find the actual weight, with the motor home fully loaded, drive to a scale, read the weight on the front, and rear wheels separately to determine axle loading. The load on each axle should not exceed its GAWR. If weight ratings are exceeded, move or remove items to bring all weights below the ratings.

When loading your motor home, store heavy gear first. Be sure to keep heavy gear on or as close to the floor as possible. Heavy items should be stored centrally to distribute the weight evenly between the front and the rear axles. Store only light objects on high shelves. Distribute weight to obtain even side-to-side balance of the loaded unit. Secure loose items to prevent weight shifts that could adversely affect the balance and road ability of the vehicle.

1-1.12.1 Motor Home Weight Information

Model _____

GVWR _____

UVW _____

NCC _____

GCWR _____

GVWR

(Gross Vehicle Weight Rating) means the maximum permissible weight of this motor home. The GVWR is equal to or greater than the sum of the Unloaded Vehicle Weight plus the Net Carrying Capacity.

UVW

(Unloaded Vehicle Weight) means the weight of this motor home as built at the factory with full fuel, engine oil, and coolants. The UVW does not include cargo, fresh water, LP gas, occupants, or dealer installed accessories.

NCC

(Net Carrying Capacity) means the maximum weight of all occupants including the driver, personal belongings, food, fresh water, LP gas, tools, tongue weight of towed vehicle, dealer installed accessories, etc., that can be carried by this motor home. (NCC is equal to or less than GVWR minus UVW).

GCWR

(Gross Combination Weight Rating) means the value specified by the motor home manufacturer as the maximum allowable loaded weight of this motor home with its towed trailer or towed vehicle.

This motor home is capable of carrying up to 100 gallons of fresh water (including water heater) for a total of 830 pounds. Reference: Weight of fresh water is 8.3 lbs./gal.; Weight of LP gas is 4.2 lbs./gal. (average).

 **NOTE: Consult weight decal located in motor home for actual weights.**

1-2 Security Features

1-2.1 Electric Compartment Locks

1-2.1.1 Entrance Door Dead Bolt Lock Operation

The entrance door has an automotive style two position catch. The second position is required for FMVSS certification. For maximum security and minimum wind noise be sure the door is fully closed. A dead bolt lock is also provided for your security; however, it will only engage and retract if the door is fully closed. Should you inadvertently open the automotive latch with the dead bolt engaged, you will have to shut the door to retract the dead bolt.

Dead bolt can be activated from switches located on the upper right hand dash panel; the entrance door systems control panel, and the bedroom control panel.

1-2.2 Black Widow Security System

The security system that is supplied with this coach is the Black Widow Security System. Basic operation directions for this system are as follows:

1-2.2.1 About Your Black Widow Security System

The security systems combine the benefits of easy-to-use convenience with “no nonsense” protection of person and property. Please review this manual to become familiar with your Black Widow vehicle security system. To operate your security system, the three principle components are first described: the Remote Control Transmitter, the Red Status Indicator Light, and the Easy Valet™ Switch.

1-2.2.2 Standard Features

The system has the following standard features:

- 5-button remote transmitter
- Status indicator (LED)
- Valet/Service mode switch
- Remote Start capabilities
- Extended Range Receiver
- Multi-tone siren (120 dB)
- Dual stage impact detector
- Remote panic
- Valet mode
- Remote chirp delete
- Remote sensor bypass
- Passive or active arming
- Stop and Go Feature
- Auto Cold Start
- Flashing Parking Lights
- Auto Rearm
- Passive/Active Arming
- Bay Door Release
- Rear Engine Door Release

1-2.2.3 Optional Features

This system has many optional features that may require additional parts and/or labor. Please contact your dealer for more details.

Remote keyless entry (Door lock/unlock)

- Illuminated entry
- LCD FM 2-way Remote
- Horn honk
- Window roll-up
- Back up battery
- Additional sensors: glass breakage/microwave

NOTE: Some features may not be appropriate for certain models. Automatic transmission and electronic fuel injection are required on models using this system.

1-2.2.4 Remote Transmitter Functions

Button 1 Arms the system and locks the doors*. Button 1 also activates the Panic feature.

Button 2 Disarms the system and unlocks the doors*.

Button 3 Activates the Bay Door Release feature.

Button 4 Activates the Remote Start Feature.

Button 5 Auxiliary Shift Key.

Button 5 then 4 Activates the 2nd auxiliary function.

1-2.2.5 Arming Operation

To arm the system press transmitter button 1:

- The siren will chirp once.
- The parking lights will flash once.
- The doors will lock*.
- The LED will turn solid for 10 seconds then start flashing slowly, the system is now armed.

While the system is armed the alarm will trigger if:

- A door is opened.
- The bay door is opened.
- The shock sensor detects an impact to the vehicle.

When the alarm is triggered the siren will sound, the parking lights will flash, and the horn will honk*. If the alarm is triggered while the remote start is engaged, the remote start will immediately shut down.

1-2.2.6 Passive Arming

The passive arming feature allows the system to arm automatically without user intervention. This programmable feature may be enabled during installation.

To arm the system passively:

1. Turn the ignition key off. †
2. Exit the vehicle and close all doors.
 - The LED will start flashing rapidly to indicate that the system is preparing to arm. (The system can be armed at any time by pressing transmitter button 1.)
 - The siren will chirp 30 seconds after the last door is closed to indicate the system is now armed.
 - The doors will lock ‡*

*Optional feature

† The ignition must have been on for at least 10 seconds prior to exiting the vehicle or Passive Arming will be bypassed.

‡ If the Passive Locking feature was enabled during installation.

1-2.2.7 Disarming Operation

To disarm the system press transmitter button 2.

- The siren will chirp twice ¥
- The parking lights will flash twice. ¥
- The doors will unlock. †
- The dome light will turn on for 30 seconds. *

¥ if the siren was triggered while away, the system will respond with 3 chirps and 3 parking light features.

† If the Passenger Unlock Feature is enabled, pressing the unlock button will unlock only the driver's door. Pressing the unlock button again unlocks all doors.

1-2.2.8 Tamper Alert

If the alarm was triggered while away from the vehicle, the siren will chirp 3 times on disarming for tamper indication. After disarming the alarm, enter vehicle and turn ignition on. The LED will flash the zone that was triggered 5 times (see LED chart).

1-2-2.9 Auto Rearm

The Auto Rearm feature allows the system to automatically re-arm itself in the event the system is disarmed and ignition is not turned on within 30 seconds.

 **NOTE: This programmable feature may be disabled during installation. The Passive Arming feature and Auto Rearm feature are related. In order to disable the Auto Rearm feature, the Passive Arming feature must also be disabled during installation. This feature will not work on vehicles with the illuminated entry feature enabled.**

1-2.2.10 Silent Arming/Disarming

Press transmitter button 5 (the Shift Button) then the Arm or Disarm button for one-time silent operation.

1-2.2.11 Chirp Delete

For full time silent operation, the ARM/DISARM chirps can be permanently disabled. This feature must be programmed during installation.

1-2.2.12 Ignition Lock*

The ignition locking feature allows the doors to automatically lock when the ignition key is turned on, and automatically unlock when the ignition key is turned off. This feature may be disabled during installation.

1-2.2.13 Remote Panic

In the event of an emergency (PANIC) situation, the system's siren can be triggered for 45 seconds to attract attention. To activate the Panic Feature, press transmitter button 1 for 3 seconds:

- The siren will sound.
- The parking lights will flash.

Press button 1 to exit panic mode and rearm the system. Press button 2 to exit panic mode and disarm the system. The Panic Feature will operate when the ignition is on.

1-2.2.14 Emergency Override

If the transmitter becomes lost or fails to operate, the system can be disarmed by using the emergency override feature.

To override the system:

1. Enter the vehicle.
 - Because the system is armed, the siren will sound.
2. Turn on the ignition key.
3. Press the Valet switch for 5 seconds.
 - The siren will stop sounding.
 - Starter defeat bypassed.

*Optional feature

† The ignition must have been on for at least 10 seconds prior to exiting the vehicle or Passive Arming will be bypassed.

‡ If the Passive Locking feature was enabled during installation.

1-2.2.15 Valet Mode

When the system is placed in the Valet Mode the security system will be disabled. However, the optional keyless entry and remote start features will still function if installed.

 **NOTE: Remote Start feature may be disabled during valet mode if programmed during installation.**

To enter the Valet Mode:

1. Be sure the system is disarmed.
2. Turn the ignition key on.
3. Press and hold the valet/service mode switch for 3 seconds.
 - The siren will chirp once.
 - The LED will turn on solid indicating the system is in Valet Mode.

To exit Valet Mode:

1. Turn the ignition key on.
2. Press and hold the valet/service mode switch for 3 seconds.
 - The LED will turn off.
 - The Siren will chirp 2 times.

1-2.2.16 Bay Door Release

Press button 3 for approximately 2 seconds to open the bay door.

1-2.2.17 Bay Door Disarm

The Bay Door Disarm feature allows the alarm to disarm automatically whenever transmitter button 3 is used to activate the optional trunk release. This eliminates having to first, disarm the alarm before activating the bay door release.

 **NOTE: The feature is programmed during installation.**

1-2.2.18 Remote Sensor Bypass

To arm the system and bypass the shock sensor, press button 1 to arm, then within 2 seconds press button 2 again. The siren will chirp 5 times and sensors will be ignored until the system is disarmed and rearmed.

1-2.2.19 Optional Secure Override Code

If your system was programmed to override with a personal override code-pressing the override switch from 1 to 15 times.

To disarm the system with your personal override code please use the following steps:

1. Open Door, Alarm system will trigger
2. Turn ignition key to on.
3. Press the override switch to the selected number of times and hold on the last one for 5 seconds until the alarm turns off.

1-2.2.20 Remote Starting the Motor Home

IMPORTANT: Only start the motor home in a well ventilated area. Do not use in a closed garage or indoors. Be sure to familiarize yourself with all features prior to using this product.

To remote start the motor home:

Press the transmitter button 4 for 3 seconds.

- The parking lights turn on.
- Approximately 2 seconds later the system will attempt to start the motor home.
- Once the motor home has started, the heater or air conditioner will turn on and run for the pre-programmed time (15 or 25 minutes). If the engine fails to start on the first attempt, it will repeat the starting procedure 2 more times. If the vehicle fails to start after a total of 3 times the system will shut down.

Driving motor home after Remote Starting:

Unlock the door by pressing button 2 on the remote transmitter. Enter motor home, turn ignition key to the on position.

 **NOTE: Do not turn the key all the way to the start position as you may damage the starter.**

Once the ignition key is turned to the on position, press the brake pedal and shift the motor home into the proper gear and you may now drive the motor home.

 **NOTE: If brake pedal is pressed prior to turning on ignition, engine will turn off.**

1-2.2.21 Remote Engine Shutdown

If the motor home has been remotely started and you desire to turn the vehicle off, simply press and hold button 4 on the remote transmitter for three seconds. After the motor has turned off the doors will relock. This feature must be programmed during installation.

1-2.2.22 Auto Cold Start

This feature allows the system to start and run the motor home every one or two hours (selectable by the installer) for a period of 24 hours. This allows the engine to remain at an operational temperature in extremely cold weather. Auto Cold Start must be enabled during installation or it cannot be engaged.

Engaging the Auto Cold Start feature:

To turn Auto Cold Start on:

1. Press and hold the brake pedal.
2. While holding the brake pedal down, push the Valet switch and transmitter button 2 for two seconds.
 - The parking lights will flash four times to indicate the Cold Start feature is engaged.
3. Release the brake pedal.

Disengaging the Auto Cold Start feature:

The Auto Cold Start feature can be deactivated in one of three ways:

- Press the brake pedal.
- Turn on the ignition.
- Remote start the motor home using the transmitter.

1-2.2.23 Stop and Go

The Stop and Go features allows the motor home to remain running without use of the ignition key during short stops.

To activate the Stop and Go feature:

1. With engine running push transmitter button 4 (on FM 2-way press button 2).
 - The parking lights will turn on.
2. Remove the key from the ignition.
3. Exit the motor home and lock the doors manually or using transmitter button 1.

To resume driver control:

1. Unlock the doors manually or by pressing transmitter button 2.
2. Turn on the ignition.
 - The motor home resumes driver control.

1-2.2.24 Safety Features

The system will not start the motor home if the brake pedal is pressed. Also, if the brake pedal is pressed while remote running, the remote start will shut down.

1-2.2.25 Replacing Lost or Stolen Remote Transmitters

This system can “learn” a maximum of 4 remote transmitters. To add a transmitter or replace lost/stolen transmitters, please consult with an authorized dealer.

SYSTEM REFERENCE INDICATORS

STATUS INDICATOR (LED) FUNCTIONS

On Solid = Valet Mode
 Slow Flash = System Armed
 Rapid Flash = Passive Arming

TAMPER ALERT LED FUNCTIONS

1 Flash = Sensor #2
 2 Flashes = Shock Sensor
 4 Flashes = Door
 5 Flashes = Bay Door
 flash-flash-pause-flash-pause = Shock Sensor

PARKING LIGHTS FUNCTIONS

On Solid = Coach Remote Starting
 Flash 1x = System Armed
 Flash 2x = System Disarmed
 Flash 3x = Tamper indication (after disarming)
 Flash 4x = Defective zone warning (after arming)

1-2.2.26 Entering Programming

To enter System Programming:

1. Turn on ignition.
2. Within 5 seconds, press valet switch 5 times.
 - The siren will chirp 3 times, indicating that you have entered Programming.
3. Press the valet switch the number times equal to the Feature you want to change.
 - The siren will chirp each time the valet switch is pressed.
4. Within 5 seconds, press the transmitter button corresponding to the desired operating mode for that Feature.
 - The siren will chirp to indicate the setting.
 - One chirp = Button 1
 - Two chirps = Button 2
 - Three chirps = Button 3
5. Repeat steps 3 and 4 to change additional features.
6. Turn off ignition to save changes.

 **NOTE: The optional FM transmitter may not be used for feature programming.**

PROGRAMMABLE FEATURES				
Step	Function	Button 1	Button 2	Button 3
1	Arming Mode	Active	Passive	
2	Auto Rearm	Off	On	
3	Normal/Silent Arming	Normal	Silent	
4	Ignition Locking	On	Off	Override Code Set
5	Ignition Locking	All Doors	Driver Only	Off
6	Door Unlock Pulse	Single	Double	
7	Door Lock Pulse Width	1 Second	3 Seconds	
8	Passive Locking	Off	On	
9	Entry Delay with Passive Arming	Off	On	
10	Bad Zone Report	5 Seconds	Off	
11	Auxiliary 2 Auto Activate on Arming	Off	On	
12	Auxiliary 1 Output	Momentary	10 Seconds Timed	Latched
13	Auxiliary 2 Output	Momentary	10 Seconds Timed	Latched
14	Bay Door Disarm Feature	Off	On	
15	Remote Start in Valet Mode (optional)	Enabled	Disabled	
16	Lock with Remote Start	On	Off	
17	Lock with Remote Shutdown	On	Off	
18	Engine Run Time	12 Minutes	24 Minutes	
19	Cold Temperature Starting	Every 2 hours	Every hour	
20	Engine Start Sense	Smart Start	Tach Start	
21	Engine Programming	Learn RPM	Gas Engine	Diesel Engine
22	FM Module Program (optional)	Learn Module	Learn FM Transmitter	
23	Ignition 2 Relay Programming	Ignition 2	Accessory 2	Starter 2
24	Horn Output	Horn Output	Ignition 3 Output	

1-2.2.27 Programmable Features

- 1. Arming Mode.** Select between manual arming (Active) or automatic arming (Passive).
- 2. Auto Rearm.** Automatically rearms the system in case of accidental disarming. The system must be armed for at least 10 seconds before disarming, and the bay door must not be opened or Auto Rearm will be bypassed.
- 3. Arming Chirps.** Select Normal or Silent Arming.
- 4. Ignition Locking / Override Code Set.** Automatically locks the doors when the ignition is turned on. The system will not lock the doors if any door is open with then ignition is turned on. Pressing Button 3 during this step enters the Override Code Set mode. Press the valet switch the desired number of times from 1-15 to set the code.
- 5. Ignition Unlocking.** Automatically unlocks the doors when the ignition is turned off. Select from all door unlock, driver's door only unlock, or no unlock.



NOTE: Driver's door only unlock requires wiring the system for Passenger Unlock.

- 6. Door Unlock Pulse – Single/Double.** Selects between a single pulse or a double pulse door unlock output.

- 7. Door Lock Pulse Width.** Selects between a 1-second and a 3-second output for motor homes equipped with vacuum door locking systems.
- 8. Passive Locking.** Selects whether or not the system will automatically lock the doors with Auto Rearm and Passive Arming.
- 9. Door Entry Delay with Passive Arming.** When selected, the door input trigger will be delayed for 15 seconds, allowing access to the emergency override switch. Only delays when the system is armed passively.
- 10. Bad Zone Report.** Siren will chirp 3 times if any zone remains open 5 seconds after arming. If motor home has delayed dome light, program this feature to OFF.
- 11. Auxiliary 2 Auto Activate on Arming.** When selected, the Auxiliary 2 output will pulse upon system arming to activate accessory items when the system is armed.
- 12. Auxiliary Function 1 –** Selectable for Momentary, Timed or Latched operation.
When Momentary operation is selected, the system will provide an output for as long as the Transmitter button is held.
When Latched operation is selected, the system will provide an output that turns on when the transmitter button is pressed and turns off when the transmitter button is pressed again.
When Timed operation is selected, the system will provide an output that turns on for 10 seconds each time the transmitter button is pressed. If the button is pressed again during the 10 seconds, the output will turn off.
- 13. Auxiliary Function 2 –** Selectable for Momentary, Timed, or Latched operation.
- 14. Bay Door Disarm Feature.** When selected, activating the Auxiliary 1 function to open the bay door will automatically disarm the system.
- 15. Remote Start in Valet Mode.** Determines if the remote start feature will operate when the alarm is set for valet mode.
- 16. Lock with Remote Start.** Automatically locks the doors after successfully remote starting.
- 17. Lock with Remote Shutdown.** Automatically locks the doors 5 seconds after the remote start is shut down.
- 18. Engine Run Time.** Selects between 12 and 24 minutes run cycle.
- 19. Cold Temperature Starting.** Allows the vehicle to automatically start and run every 2 hours or every hour for severe cold weather.
- 20. Engine Start Sense.** Selects between Smart Start for tachless operation, or Tach Start for actual RPM monitored starting. (see Step #21)
- 21. Engine Programming.** Pressing transmitter button 1 “learns” the RPM. For diesel vehicles, after learning Tach signal enter step #21 again and set for diesel by pressing button 3.
- 22. FM Transmitter Module.** Pressing button 1 learns the add-on FM module ID so the FM transmitter can operate the system. Pressing button 2 learns the FM transmitter. After pressing button 2 on the AM remote, press transmitter button 1 on each FM remote (max 2).
- 23. Ignition 2 Relay Programming.** Selects between second ignition, second accessory, or second starter output operation for heavy gauge BROWN wire.
- 24. Horn Output.** Selects between horn output or ignition 3 output for the horn wire.

Engine Programming for Remote Start

In order for the system to properly start and run the motor home, the unit must be able to determine if the motor home is cranking or if the engine is actually running. This system is equipped with two means of detecting the engine's run status: Smart Start and Tach Start.

The **Smart Start** feature detects the engine's run status using specially designed software that interprets certain characteristics of the engine, and does not require a connection to the motor home's tachometer wire. This feature allows a faster installation, but may not be compatible with all motor homes, or under extreme temperatures.

The **Tach Start** feature requires connection to the motor homes tachometer wire, or an injector wire if the tach wire is not available. The Tach Start feature provides reliable operation with virtually any vehicle and in severe temperature extremes. When the Tach Start feature is selected, the vehicle's tach signal must be "learned" through system programming. (see below)

To Program the Tach Start feature:

1. Enter System Programming, (see Entering Programming)
2. Program Step #20 to Tach Start using transmitter button 2.
3. Re-enter system programming, and go to Step #21.
4. Immediately start the vehicle with the key to avoid the programming sequence timing out.
5. Press transmitter button 1 to learn the vehicle's tach signal.
 - The siren will chirp and the LED will flash once if the tach was learned.
 - The siren will chirp and the LED will flash 5 times if the tach was not learned.
6. Turn off ignition to save settings.

The default setting for the engine mode is Gas Engine. For diesel vehicles, the engine type for Step #21 must be set to Diesel Engine. When programmed for diesel engines, the BLUE/YELLOW wire (glow plug input) is monitored to make sure the glow plugs have warmed up before the engine begins cranking. If the glow plug wire is not connected, the unit has a built-in timer that waits 15 seconds before cranking the starter.

Complete Default Reset

Following this procedure will set all User and Installer Programming Parameters to factory default settings.

1. Enter System Programming.
2. Press Transmitter Button 3.
 - The siren will chirp 6 times indicating the reset signal was received.
 - All Programming options are now set to factory default settings.
3. Turn ignition off.


Test System and Adjust Shock Sensor

Arm, disarm, and start the system, checking that the siren and parking lights are functioning normally. Make sure that the programmed features are performing correctly, ie.: ignition locks, passive arming, passive locks, etc.

1. Test the doors and bay door inputs (make sure all doors trigger the system.)
2. Adjust the shock sensor. (see Real-time Sensor Adjustment Mode).
3. Arm the system and disarm it with the ignition and valet switch.
4. If programmed to passively arm make sure that the system arms properly.
5. Tie up wire harness, and replace any under dash panels.
6. Make sure the customer has physical knowledge of the location of the valet/override switch.

Real-time Sensor Adjustment Mode

This mode allows active testing of the shock sensor and optional sensor input making adjustments without arming the alarm.

 **NOTE: Arm and Disarm chirps must be enabled for proper operation. Sensor Adjustment Mode does not operate with the optional FM transmitter.**

To Enter Sensor Adjustment Mode:

1. Turn the ignition on.
2. Press the Shift Button (Button 5) 3 times, then press Button 3.
 - The siren will chirp 4 times, indicating that the sensor is ready to be tested.
3. Test the sensitivity. The siren will chirp to indicate a sensor is triggered.
 - One chirp indicates the shock sensor.
 - Two chirps indicates the warn away.
 - Three chirps indicates the optional sensor.
4. To make shock sensor adjustments:
 - Turn the adjustment screw on the sensor clockwise to increase the sensitivity.
 - Turn the adjustment screw on the sensor counter clockwise to decrease the sensitivity.
5. Turn off the ignition when the desired sensitivity level is reached.

Adding Transmitters

To add a new transmitter to the system have the desired transmitters ready and follow the Code Learning sequence.

To Enter Code Learning Mode:

1. Turn the ignition on, off, on, off and leave on.
 - The siren will chirp.
2. Press the Override switch.
 - The status LED will turn on red.
 - The siren will chirp.
3. Press the Lock Button on the transmitter.
 - The siren will chirp once.
4. Press Lock Button on the transmitter again.
 - The siren will chirp twice.
5. Repeat steps 3 and 4 for each additional transmitter.
6. Turn off the ignition.
 - The siren will chirp 3 times.

1-2.3.28 Troubleshooting

Problem	Probable Cause	Suggested Correction
Alarm does not operate.	Alarm in Valet Mode; Ignition input has voltage on it; Missing +12V or ground.	Take alarm out of Valet Mode, Turn key off and verify yellow wire is connected to correct ignition wire; Check +12V and ground connections.
Alarm will not Passively Arm.	Unit is not programmed for Passive Arming, wrong polarity door input wire, Yellow ignition input has 12V+ on it.	Program step #1 for Passive Arming, Correct door switch polarity; Change Ignition input wire; make sure alarm is not in Valet.
Alarm will not enter Code Learning Mode.	Ignition was not left in the On position after turning it On and Off three times; Sequence not performed rapidly enough (5 sec.); Valet/Override Switch is defective or not plugged in.	Leave Ignition in On position; Repeat procedure quicker, Replace Valet Switch.
Alarm chirps 4 times 5 seconds after system is Armed.	Factory Dome Light Delay is longer than 5 seconds; Door open or defective pin switch; Shock sensor is not properly adjusted or defective.	If dome light delay is longer than 5 seconds program step #10 to OFF. Replace defective pin switch; Adjust or replace shock sensor.
Parking lights do not flash.	Wrong wire connected, Wrong polarity selected, or RED Wire #1 not connected to battery power.	Connect WHITE wire to proper wire, Reverse jumper polarity (see Jumper Settings), Connect RED wire #1 to +12V.
Door locks do not lock or unlock correctly, or action is reversed.	Defective GREEN or BLUE wire in door lock connector plug, GREEN and BLUE wires reversed, or wrong door lock wiring diagram used.	Check GREEN and BLUE wires on door lock connector plug; Verify vehicle's type of door lock system; Reverse wiring to door relays.
Illuminated Entry does not activate on upon disarm.	External relay required, or Wrong polarity wired for relay.	Add relay.
Range is poor.	Antenna wire is grounded; Module is picking up interference from coaches electrical system.	Make sure antenna is not connected to ground; Relocate module or route antenna away from computer modules.
Coach will not remote start.	Safety inputs are triggered.	Check Brake Switch input (+) or Bay Door Input (-).
Coach cranks and begins to run, then shuts off.	Smart Start is not compatible with this coach; Coaches tach signal is not learned.	Connect the BLACK/GRAY wire, and program the unit to learn the coaches tach signal.
Keyless entry does not operate with remote.	Wrong door lock polarity; Wrong lock wires connected.	See Bypassing Factory Theft Deterrent Systems.
Ignition triggered door lock feature does not operate.	Yellow wires shows +12V; Door is open; Door trigger input wrong polarity.	Connect yellow wire to proper ignition wire; Close door; Change door trigger polarity.
Coach horn honks when system disarmed and door is opened.	Coaches factory security system needs to be disarmed.	Locate the disarm wire (usually located in driver's kick panel) and connect VIOLET/WHITE wire to disarm factory system.
Coach will not start and alarm does not function properly.	Coach battery dead or drops below 9 volts when trying to start the coach.	Change or replace battery.

1-2.3 Entrance Door Air Lock

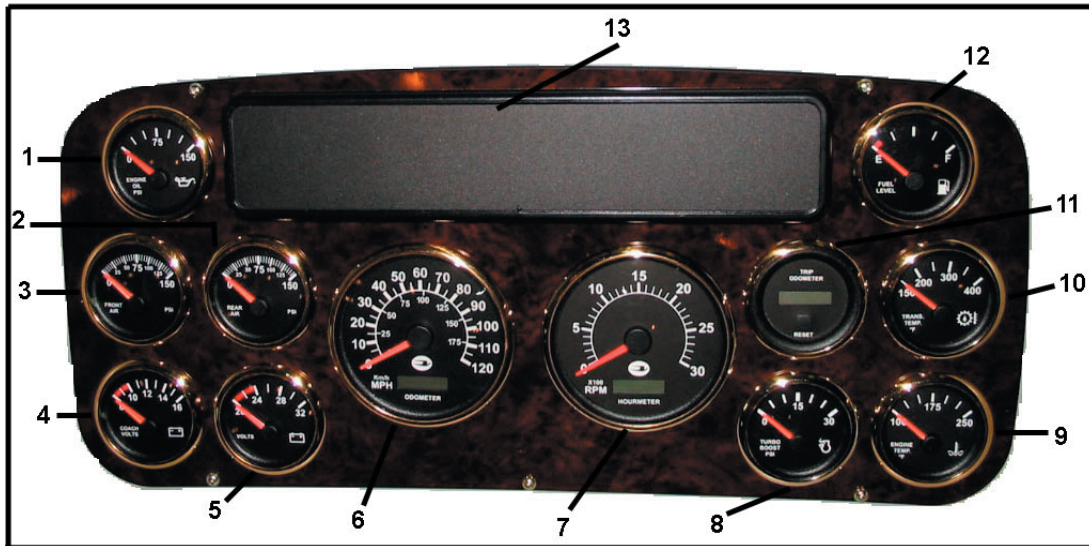
An air-operated lock is installed at the top of the entrance door for a tight seal. This lock engages automatically when the unit is put in drive after reaching 3 mph. This lock also disengages when unit drops below 3 mph. An override switch is located on the main dash panel. This keeps door locked all the time until the unlock switch is manually pushed.

2-1 Dash and Monitor Panels

This section is an overview of the Instrument and Control panels on your coach. Below you will find a illustration and an explanation for each button or dial that is installed in the coach. This is as it appears on a standard coach with all the standard options. Coaches purchased with different options may have a slightly different appearance.

2-1.1 Main Instrument Panel

Below is an photograph of the main instrument panel on the coach.



1. **ENGINE OIL GAUGE** - Gives constant reading of the engine oil in the supply line from the pump.
2. **REAR AIR GAUGE** - Normal: 110 to 135 psi. The Dual Air Service Brake Pressure systems are engine-operated and supply independent brake system air pressure for front and rear service brakes and the parking brake. During normal operation, each air pressure gauge reading will build up to 110 psi to 135 psi shortly after the engine is started.
3. **FRONT AIR GAUGE** - Normal: 110 to 135 psi. The Dual Air Service Brake Pressure systems are engine-operated and supply independent brake system air pressure for front and rear service brakes and the parking brake. During normal operation, each air pressure gauge reading will build up to 110 psi to 135 psi shortly after the engine is started.
4. **COACH VOLTAGE GAUGE** - Measures voltage of coach + 12v.
5. **VOLTAGE GAUGE** - Measures voltage on chassis +24 system.
6. **SPEEDOMETER IN MPH** - Measures miles per hour coach is traveling. Includes odometer.
7. **TACHOMETER IN RPM** - Measures engine revolutions per minute. Includes hourmeter which keeps track of how many actual hours engine has been used.
8. **TURBO BOOST PSI** - Registers the pressure of the Turbo Compressor outlet. This gauge should read an approximate maximum of 30 psi at maximum power.
9. **ENGINE TEMPERATURE GAUGE** - Monitors temperature of engine.
10. **TRANSMISSION TEMPERATURE GAUGE** - Indicates temperature of the transmission oil. If the WARNING LIGHT comes on, reduce speed or load.
11. **TRIP ODOMETER** - Allows user to track how long each trip is. This can be reset at any time to start counter over.
12. **FUEL GAUGE** - Indicates the amount of diesel fuel remaining in the fuel tank.
13. **TELLTALE PANEL** - Serves as a message center for the coach. See Telltale Panel section later in manual for further explanation.

2-1.2 Left Side of Main Instrument Panel Controls

Described below are the panel buttons that are found on the left side of the main instrument panel. All buttons are explained left to right. When top portion of button is depressed, the feature is engaged.



HEADLIGHTS, PARK AND CLEARANCE LIGHTS - Use this switch to select headlights, park and clearance lights.



PARK AND CLEARANCE LIGHTS - Use this switch to select your park and clearance lights only.



FOG LAMPS - Switches fog lamps on and off.



REAR LAND - Turns rear landing lights on/off.



LEFT LAND - Turns left landing lights on/off.



RIGHT LAND - Turns right landing lights on/off.



CLEARANCE LIGHTS - Turns clearance lights on and off.



SUSP DUMP - Switch for main suspension air. See Air Suspension System for operation.



AIR/CITY HORN - Allows user to toggle between the air and city horns. It is recommended the air horn be used for highway travel, and the city horn be used in residential areas.



ENG BRAKE - Enables the engine brake.



BRK HI/LOW - Selects HI or LOW if engine brake is engaged.



TRACTION CONTROL - Allows driver to select traction control in slippery or adverse weather conditions.



HIGH IDLE - When the engine is cold, the engine can be placed in the high idle state by turning on this switch.





2-1.3 Right Side of Main Instrument Panel Controls

Described below are the panel buttons that are found on the right side of the main instrument panel.



120V AIR COMP - This switch operates the auxiliary air compressor (*optional equipment*), which is a 120 vac operated back up air compressor.



ENT AIR LOCK - Enables entrance air lock. Locks door and overrides 3mph speed sensor.



ENT DR LOCK - Locks/unlocks entrance door.



ENT STEP - When switch is selected step is set to the EXTENDED position, with the ignition off, activates a relay locking the outside entry step in the EXTENDED position. When the ignition is turned on, the entry step automatically extends when the door is opened and automatically retracts when the door is closed. The indicator reminds you that your switch is in the ON position.



RADAR - Turns on power to the radar detector. The radar detector is a high-sensitivity super heterodyne microwave radar detector. This unit is designed to activate when transmissions are received from radar-type speed detection equipment.



BAY LOCK/UNLOCK - Locks/unlocks bay area.



BRIGHT/DIM GAUGE - This switch adjusts the gauge lights from bright to dim.



GEN ON/OFF - Turns Generator on and off.



BATTERY CONNECT/BATTERY DISC - This switch connects and disconnects the house and chassis batteries.



ENG PRE HT - This button is used to preheat the engine.



CAMERA A/CAMERA B - Camera A selects rear view. Camera B is available for future use.



BACK UP - Turns back up alarm on and off. Leave off when leaving RV park early in the morning. When top portion of switch is depressed, alarm is set to off.



HAZARD FLASHERS - Turns on emergency flashers. When the switch is used, both left and right turn signals will flash in unison.





MIRROR HEAT - This switch turns on a thermostatically controlled heater in the right and left outside mirrors (convex mirrors excluded). With the switch ON, the mirror heaters will automatically come on to defog the mirrors. Switch is shown in the off position.



LEFT/RIGHT VISOR - Use to raise/lower either left or right hand visor.



FRONT A/C - Turns front air conditioning on and off.



KIT/BATH A/C - Turns kitchen and bathroom air conditioning on and off.



LIV RM A/C - Turns living room air conditioning on and off.



REAR A/C - Turns rear air conditioning on and off.

2-1.4 Left Armrest Panel Transmission Gear Panel (under driver's window)

This panel is used to switch gears and modes in the transmission. The top box lights up to reflect which gear/mode is selected.

R - Reverse - Puts transmission in reverse.

N - Neutral - Transmission is in neutral.

D - Drive - Transmission is in drive.

ECONOMY MODE - Puts transmission in economy mode. This shifts transmission from 2000 to 1800 rpm which will save on fuel.

ARROW UP - Allows driver to shift up one gear at a time. For instance from 4th to 5th gear.

ARROW DOWN - Allows driver to shift down one gear at a time. For instance shifts from 5th to 4th gear.

ARROW UP AND DOWN PUSHED TOGETHER - When these are pushed at the same time the transmission will go into diagnostic mode. To use this feature the coach has to have the engine running, transmission must be at normal operating temperature. This mode will check the transmission fluid level and transmission defect codes. If this mode is selected and you have not met the conditions stated the system will let you know.



HORN PWR - Select to turn power on to horn.



HORN SONG SEL - This will allow user to select the song to play on the horn.



HORN PLAY - Select to play the horn.



LEFT AND RIGHT OUTSIDE MIRRORS - Use these controls to adjust outside mirrors as needed.

2-1.5 Leveling Panel

This panel controls the functions of the leveling system. Complete instructions on operating the leveling apparatus can be found in [Section 4-5 Leveling](#) found later in this manual.












2-1.6 Smart Wheel Controls

The steering wheel in the coach is a "Smart Wheel". Many functions can be performed from this wheel. The cruise control switches are located on the left hand side of the steering wheel and the windshield wiper functions are located on the right side of the steering wheel.

HEADLAMP FLASH - The button at the top left of the cruise panel flashes the headlights on and off.

The four buttons under the Headlamp Flash Button are for using the cruise control. These four buttons are explained below.

NOTE: The coach must be traveling at least 35 mph before the cruise control will operate properly.

-  **SET** - Use this button to set the cruise control to the desired cruising speed. Once engine is at desired speed press the button and hold momentarily and this will lock in that speed.
-  **RES** - This allows coach to resume cruising speed that was previously set when the off button was selected. If the brake was pushed down the cruise would be cancelled until this button has been pushed.
-  **ON OFF** - This turns cruise on and off.
-  **CANCEL** - Cancels all cruise control activity.
-  **CLEARANCE LIGHTS INTERRUPT** - This is the first button at the top on the right hand panel. Use this switch to turn off your clearance lights momentarily.
-  **OFF** - This turns windshield wipers off.
-  **HI-LO** - This controls two speeds at which the windshield wipers work, Hi or Lo.
-  **BOTTOM LEFT** - This switch is for the windshield washer fluid.
-  **BOTTOM RIGHT** - Is an intermittent switch. Use this when something other than HI-LO is needed. This regulates speed more accurately to allow for amount of moisture that is collecting on windshield. After off, press this switch once, wait the amount of delay you want in the wiper, and press the switch again. Wipers will continue to wipe at that delay.

2-1.7 Heat and Air Conditioning Dials

This panel is used to select the amount of heat and/or air conditioning that is needed, as well as defrost and fan.



2-1.8 Telltale Panel

The Telltale Panel shall contain the electronics necessary to interface to the vehicle system indicator inputs. This panel shall have a maximum of 34 indicators, which shall be arranged with two rows of eleven indicators located on the top and bottom separated by a single center row of twelve indicators. The turn signals shall be housed in the center row, outer indicator locations. Refer to the following tables for indicator source information. When the Indicator Bar is first powered on and sees the ignition signal, it shall run a lamp check on all lamps for a two second sound delay.

See Table 1 for details on signal source, audible alarm requirements, symbol or nomenclature, color function, and location on telltale panel.









Location	Indicator Lights	Signal Source	Audible Alarm	Symbol or Letters	Color	Function
1	Spare	N/A	-	SPARE	RED	SPARE
2	Spare	N/A	-	SPARE	RED	SPARE
3	Low Fuel	INSTR. ECU	-		AMBER	TURNS ON IF < 1/8 TANK
4	Traction Control (ATC)	ABS	-	ATC	RED	TURNS ON FOR DIAGNOSTICS, AND WHEN IN TRACTION CONTROL MODE
5	Park Brake	VEH	-		RED	TURNS ON WHEN PARK BRAKE IS SET
6	Hi Beam	VEH	-		BLUE	TURNS ON IF HI BEAM HEADLIGHTS ARE ON.
7	Stop Engine	ENGINE	BUZZER	STOP ENGINE	RED	TURNS ON IF ENGINE FAULT
8	WAIT TO START (GRID HEATER)	ENGINE	-	WAIT TO START	RED	TURNS ON WHEN ENGINE IS TURNING ON THE GRID HEATERS
9	ENGINE MAINTENANCE	ENGINE	-	ENGINE MAINT	AMBER	TURNS ON IF ENGINE NEEDS MAINTENANCE
10	LOW COOLANT	VEH	BUZZER		AMBER	TURNS ON IF COOLANT IS LOW
11	Spare	N/A	-	SPARE	RED	SPARE
12	LH TURN INDICATOR ARROW	VEH	CLICK		GREEN	TURNS ON IF LEFT TURN SIGNAL HAS BEEN ACTIVATED
13	Spare	N/A	-	SPARE	RED	SPARE
14	WATER IN FILTER (RACOR)	VEH	See Note 1	WATER IN FILTER	AMBER	TURNS ON IF WATER IN FUEL SENSOR DETECTS WATER
15	ABS	ABS	-		AMBER	TURNS ON IF ABS SYSTEM HAS A FAULT OR DIAGNOSTIC INFORMATION
16	LOW AIR	PRX1	See Note 2	LOW AIR	RED	TURNS ON IF AIR PRESSURE IS LESS THAN 62 PSI
17	ENGINE BRAKE	VEH	-	ENGINE BRAKE	RED	TURNS ON IF ENGINE BRAKE DASH SWITCH IS ON
18	ENGINE COMPARTMENT (Fire) ALARM	VEH	See Note 3		RED	TURNS ON IF ENGINE COMPT. FIRE SENSORS DETECT A FIRE
19	TRANSTEMP	TRANS	-	TRANS TEMP	RED	TURNS ON IF TRANSMISSION FAULT

Table 1 - Telltale Panel Definitions

Table 1 - Telltale Panel Definitions - Continued from previous page

Location	Indicator Lights	Signal Source	Audible Alarm	Symbol or Letters	Color	Function
20	CHECK ENGINE	ENGINE	BUZZER (See Note 4)	CHECK ENGINE	AMBER	URNS ON IF ENGINE DETECTS A PROBLEM
21	HYDRAULIC OIL TEMP WARNING	VEH	BUZZER		AMBER	URNS ON IF HYDRAULIC OIL TEMPERATURE IS EXCESSIVE (>200°f)
22	Spare	N/A	-	SPARE	RED	SPARE
23	RH TURN INDICATOR ARROW	VEH	CLICK		GREEN	URNS ON IF RIGHT TURN SIGNAL HAS BEEN ACTIVATED
24	DRL	VEH	-	DRL	GREEN	URNS ON IF DAYTIME RUNNING LIGHTS ARE ON
25	Spare	N/A	-	SPARE	RED	SPARE
26	Spare	N/A	-	SPARE	AMBER	SPARE
27	HEADLIGHT ALERT	VEH	BUZZER		AMBER	URNS ON IF HEADLIGHTS ARE LEFT ON BUT THE KEY IS OUT OF THE IGNITION
28	LEVEL WARNING	VEH	BUZZER	LEVEL WARNING	RED	NOT ON 45 FOOT VEHICLES
29	SUSPENSION DUMP	VEH	BUZZER	SUSP DUMP	RED	URNS ON AFTER SUSP IS DUMPED (2 SEC. ON DELAY) TURNS BACK OFF (AFTER 1 MINUTE) AFTER SUSP. PRESSURE BACK UP
30	TAG DUMP	VEH	-		RED	NOT ON 45 FOOT VEHICLES
31	CHECK TRANS	TRANS	-	CHECK TRANS	AMBER	URNS ON IF TRANSMISSION FAULT
32	TV ANT/SAFELINE	VEH	BUZZER (See Note 5)		FLASHING AMBER	URNS ON IF SAFELINE PLUG IS LEFT PLUGGED IN AND IGNITION IS TURNED ON.
33	Spare	N/A	-	SPARE	RED	SPARE
34	Spare	N/A	-	SPARE	GREEN	SPARE

Audible Outputs: The Indicator bar shall have two audio transducers to produce the sounds listed in the table above. These sounds are identified as being a buzzer, a click, and a chime.

Click: The click output is used to indicate that the turn signals are flashing. Every time a turn signal indicator is turned on, the Buzzer output will be turned on for 10 ms.

Single Chime: The single chime output is used to indicate a Next Stop Request. The Indicator Bar will output 1.0 kHz for 1000 ms (including 800 ms of decay) when the Next Stop Request function is first activated, with a minimum sound pressure level of 85dB at 10cm.

Double Chime: The double chime output is used to indicate a Wheel Chair Next Stop Request. The Indicator Bar will output 1.0 kHz for 1000 ms (including 800ms of decay), then output 1.0 kHz for 1000 ms (including 800 ms of decay) when the Wheel Chair Next Stop Request function is first activated, with a minimum sound pressure level of 85dB at 10cm.

Buzzer: The buzzer output is the primary audible output. The Indicator Bar output 3.6 kHz +/- 0.5 kHz for as long as a buzzer function is activated, with a minimum sound pressure level of 90 dB at 10cm with 12 Volts applied.

Buzzer Notes:

Note 1: Water in Filter Buzzer. The Water in Filter (L14) input will activate the Buzzer during initial startup for a duration of 30 seconds, if the corresponding input was at ground when power was first applied.

Note 2: Low Air Buzzer. The buzzer and Low Air Indicator shall come on if the air pressure in EITHER front OR rear system has decreased to $\leq 62 +2/-0$ PSI. Once the air pressure in EITHER front OR rear system falls below $62 +2/-0$ PSI, the buzzer and indicator light shall remain on until the air pressure in BOTH front AND rear systems has reached a minimum of $70 + 1/-1$ PSI.

Note 3: Engine Compartment Fire Alarm Buzzer. The Engine Compartment (Fire) Alarm (L18) input will activate the Buzzer at the rate of 2.0 Hz with a 50% duty cycle when the corresponding input is at +12 Volts.

Note 4: Stop and Check Engine (engine warning) Buzzer. The buzzer shall be continuously energized when either the stop engine OR check engine lamps are commanded by the engine AND critical limits are exceeded on EITHER the oil pressure data OR the coolant temperature data received off the data link. These limits shall be programmable. Default values for engine are in the following table:

Table 2

ENGINE	COOLANT TEMP	OIL PRESSURE
Deleted	Deleted	Deleted
C13	220	10

Note 5: TV/Safeline Buzzer. The TV/Safeline input will activate its indicator and the Buzzer at the rate of 1.0 Hz with a 50% duty cycle when the corresponding input is at ground.

Priority Buzzer: Priority shall be as follows with a priority 1 as the highest.

Table 3

BUZZER APPLICATION	PRIORITY
ENGINE COMPARTMENT FIRE ALARM	1
LOW AIR	2
ENGINE WARNING	3
TV / SAFELINE	4
WATER IN FILTER	5
TURN SIGNALS	7

Indicator Signal Source: See Table 4 for details on source for indicator light.

Table 4: 450 LXi Telltale Panel Signal Sources

FUNCTION					
	CUM	WT	BENDIX	PRX 1	VEHICLE
LOW OIL PRES ALARM				GND	
HIGH COOL TEMP ALARM				GND	
TRANS TEMP		GND			
CHECK TRANS		GND			
STOP ENGINE	GND				
CHECK ENGINE	GND				
ENGINE MAINTENANCE	GND				
WAIT TO START	GND				
LOW AIR				GND	
ABS			GND		
TRACT CONTROL (ATC)			GND		
PARK BRAKE					GND
RH TURN IND ARROW					+12V
LH TURN IND ARROW					+12V
HIHG BEAM					+12V
HYD OIL TEMP WARNING					GND
LOW COOLANT					GND
DRL					GND
ENG COMP FIRE ALARM					+12V
ENGINE BRAKE					GND
LOW FUEL				GND	
WATER IN FUEL					GND
WATER IN FILTER					GND
SUSPENSION DUMP					+12V
TAG DUMP					GND
LEVEL WARNING					+12V
HEADLIGHT ALERT					+12V
SPARE					GND
SPARE					GND
TV/ANT SAFELINE					GND

Indicators that need to come on without Ignition On: RH indicator, LH indicator, High Beam indicator, Level Warning indicator, Headlight Alert indicator, and Engine Compartment (fire) alarm indicator.

Low Fuel Indicator: This indicator input shall come from the PRX1 module, which will have special requirements. See the section on the PRX module.

Power Up and Power Down Requirements: Upon start up the indicator lights will turn on for a two second delay.

Table 5: Telltale Panel Pin Assignments

450LXi			
SIGNAL NAME	PIN #	SIGNAL NAME	PIN #
Spare Indicator	B1	DRL	B8
Spare Indicator	B4	Spare Indicator	C18
Low Fuel SIGNAL	A1	Spare Indicator	C19
Tract. Control (ATC)	A3	Headlight Alert (Not Used)	B12
Park Brake	C4	Level Warning (Not Used)	C2
High Beam	C15	Suspension Dump	C5
Stop Engine	C7	Tag Dump (not used)	C10
Wait To Start	A8	Check Trans	C11
Engine Maintenance	C16	TV Ant/Safeline	A4
Low Coolant	C9	Spare Indicator	C12
Spare Indicator	B3	Spare Indicator	C14
LH Turn Indicator	A18	Coolant Temp SIGNAL	A5
Spare Indicator	B3	Oil Pressure SIGNAL	A6
Water in Filter	B5	Spare Buzzer 4	A16
ABS	A2	Spare Buzzer 5	A17
Low Air	C1	Spare Buzzer 6	A15
Engine Brake	C3	Spare Buzzer 1	A14
Eng. Compartment (Fire) Alarm	C6	Spare Buzzer 2	A12
Trans Temp	C8	Spare Buzzer 3	A13
Check Engine	C17	Switched +12V	B6
Hydraulic Oil Temp Warning	C13	Ground	B7
Spare Indicator	B9	Spare Indicator	B10
RH Turn Indicator	C20		

2-2 Driver and Co-Pilot Area

2-2.1 CB Receiver Transmitter

Your motor home is equipped with a forty channel, CB receiver/transmitter installed in the lower left armrest with all controls in the hand held portion.



2-2.2 Closed Circuit Rear-Vision TV System

A color LCD rear view monitor is standard on the motor home. This allows you to see behind motor home. This is especially helpful when towing a vehicle, or backing up, allowing driver to see behind and keep an eye on what is in tow. Some features of this are:

- Wide Viewing Area (6.4" Diagonal)
- High Resolution (640 x 480)
- High Brightness (300 nit)
- Slimline Housing (1" Deep)
- Flat Rear Housing for easy Surface Mounting
- Automatic Video Signal Sensing for Turn-On Surface
- Designed and Tested for Automotive Use

Specifications:

Video Input System:	NTSC
Power Input:	12VDC; 850mA Current Draw
Video Input:	1V Peak to Peak Composite Video; 75 Ohm
Operating Temperature:	-10 °C to 60 °C
Storage Temperature:	-30 °C to 80 °C
Viewing Temperature:	6.4" Diagonal Measurement
Display Type:	Color TFT Active Matrix
Resolution:	640 x 480
Brightness	300 nit
View Angle Range (Left-Right)	±60°
View Angle Range (Top):	15°
View Angle Range (Down):	35°
Contrast Ratio:	120:1
Overall Dimensions:	5.22"(H) x 6.66" (W) x 1" (D)
Weight	16.0 oz.

2-2.2 Compass/Thermometer

The Compass/Thermometer is located in the center rear view mirror. There is also a thermometer located on the water tank monitor panel found in the pantry. Both thermometers measure outside ambient temperature in °F.



2-2.3 Remote Controlled, Heated Outside and Rear View Mirrors

Your motor home has two electronically adjustable heated mirrors. Each mirror has a flat mirror and a convex mirror. There are two switches, one that controls the left hand flat convex mirror and the other controls the right hand flat convex mirror. By flipping the switch from left to right this allows the driver to adjust the flat and convex mirrors separately.

Mirrors are electronically heated thermostatically controlled, designed not to overheat. Switches on the dash allow driver to turn heat on and off as desired.



Front View

Back View

2-2.4 Auto-Dimming Comp/Temp Mirror

The coach is supplied with a Gentex NVS® Auto-Dimming Comp/Temp Mirror. This mirror is equipped with the following features:

- Fully automatic electrochromic auto-dimming mirror
- Full range dimming - 75% to 6%
- Automatically disables dimming during daytime
- Digital compass with PathPoint™ continuous calibration software
- Outside temperature display
- Ice alert warning below 38°F
- Vacuum fluorescent display brightens and dims automatically

Auto-Dimming Switch Function

- Hold Temp switch for 15 seconds to disable Auto Dimming and Auto LED will go off. Repeat step to enable Auto Dimming and the Auto LED will come on.

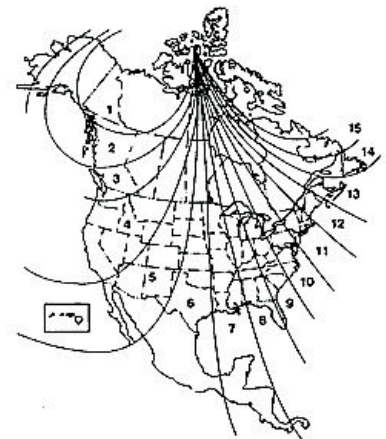
Display Switch Functions

- Depress either the Comp or Temp switch to turn the display on/off.

Zone Variation

This compass must be set to compensate for the variation between true north and magnetic north. To set variation:

- Turn ignition on.
- Using the map at right to find your geographic location, note the zone that you are in.
- To select Zone, push in the Comp switch for 3 seconds until the Zone selected comes up. Release, then toggle until correct zone is found and release switch. After 5 seconds of no switch activity, display will return to normal temperature reading.



Compass Calibration

This compass automatically calibrates itself while the vehicle is driven as your route takes you in complete circles. Therefore no calibration should be required, though it may take up to an hour. A quicker method is listed below. If the vehicle's compass headings become inaccurate, the compass can be manually calibrated by:

- Turn ignition on.
- Zone variation needs to be changed to use in different areas of the country.
- For a different Zone selection, push in the Comp switch for 3 seconds until the Zone selection comes up. Release, then toggle until correct zone is found and release switch.
- To re-calibrate, hold the Comp switch for 6 seconds until CAL is displayed. Drive the coach in at least 3 circles, allowing 45 seconds to complete one circle

Temperature Function

- Push Temp switch for 3 seconds until display blinks °F or °C. Release, then toggle Temp switch to select between °F and °C. After 5 seconds of no switch activity, display will return to normal temperature reading.

Ice Feature

Display will indicate “ICE” to alert driver of potential driving hazard when temperatures are below 38°F.

WARNING!!

Do not locate a cellular antenna within 24” of the mirror.

2-2.5 Entrance Door Electric Lock

The entrance door electric lock is operated by the right hand dash mounted switch that controls entry door locks.

2-2.6 Entrance Door Air Lock

The entrance door air lock is controlled by a signal generated by transmission which energizes the door air lock solenoid when motor home reaches 3 mph. There is also a switch located on the right hand dash panel which will override 3mph signal and lock the doors. When this switch is selected the motor home will not unlock automatically when it comes to a stop. Since this sound can be loud and annoying this feature will alleviate that problem when motor home is in stop-and-go traffic.

2-2.7 Six-Way Power Seats and Seat Belts

The seats in the motor home are Villa. They are mounted on a six way adjustable power and swivel base with electrically operated lumbar support. The seat is covered in Ultraleather.

3-1 Starting and Driving

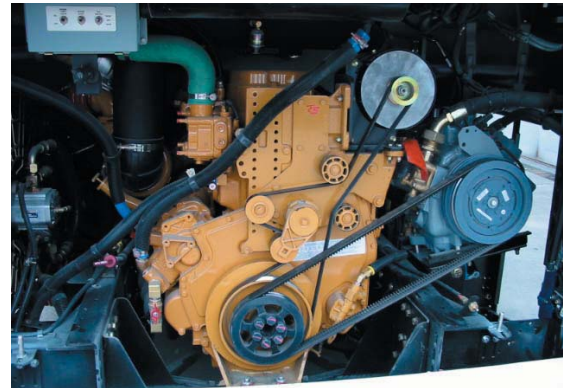
3-1.1 General Information

The 450 LXi is equipped with a Caterpillar C13 Engine. The C13 engine is an in-line six cylinder arrangement. The engine has a bore of 130 mm (5.12 inch) and a stroke of 157 mm (6.18 inch). The displacement of the engine is 12.5 L (763 in3). Each cylinder has two inlet valves and two exhaust valves. The firing sequence of the engine is 1-5-3-6-2-4.

The engine has two turbochargers. The engine arranges the two turbochargers in a series. The two turbochargers allow the engine to have boost over the entire engine rpm range. The use of two turbochargers increases the maximum boost pressure to 310 kPa (45 psi). The engine also uses a precooler before the air-to-air aftercooler (ATAAC).

The Electronic Unit Injector (EUI) provides increased control of the timing and increased control of the fuel to air mixture. Engine speed is controlled by adjusting the injection duration. Engine timing is controlled by the precise control of fuel injection timing.

Modern electronic engines have the capability to perform self-diagnostic tests when the system detects an active problem, the operator will be alerted to the condition by the use of a check engine light and an event code will be stored in permanent memory in the Engine Control Module (ECM). Cat Electronic Technician ((ET) Caterpillar electronic service tool) can be connected to the engine in order to read any logged faults. Also, the cruise control switches and be used to flash the code on the check engine light. Intermittent faults are logged and stored in memory.



3-1.2 Starting the Engine

The engine's ECM will automatically provide the correct amount of fuel in order to start the engine. Do not hold the throttle down while the engine is cranking. If the engine fails to start in 30 seconds, release the starting switch. Allow the starting motor to cool for at least two minutes before attempting to use it again.

NOTICE: Excessive ether (starting fluid) can cause piston and ring damage. Use ether for cold weather starting purposes only.

3-1.2.1 Cold Mode Operation

The ECM will set the cold start strategy when the coolant temperature is below 18°C (64°F).

When the cold start strategy is activated, low idle rpm will be increased to 1000 rpm and the engine's power will be limited until the engine reaches normal operation temperatures.

Cold mode operation will be deactivated when any of the following conditions have been met:

- Coolant temperature reaches 18°C (64°F).
- The engine has been running for fourteen minutes.

Cold mode operation varies the fuel injection amount for white smoke cleanup. Cold mode operation also varies the timing for white smoke cleanup. The engine operating temperature is usually reached before the walk-around inspection is completed. The engine will idle at the programmed low idle rpm in order to be put in gear.

NOTICE: Do not move the vehicle with the engine in the cold mode condition. Engine power could be noticeably reduced. At a vehicle speed above 8 km/h (5 mph), low idle rpm will be reduced to the customer programmed low idle and the power will still be reduced.

After the cold mode is completed, the engine should be operated at low rpm until normal operating temperature is reached. The engine will reach normal operating temperature faster when the engine is operated at low rpm and low power demand.

3-1.3 Remote Engine Starting

Because it may sometimes be necessary to start diesel engine remotely, a separate switch is located on the right side of the engine compartment. Toggle switch must be down (REAR) to start from the engine compartment. Engine will not start from front with rear engine door open. Front ignition key must be ON to start from rear.

3-1.4 Stopping Engine

NOTICE: Stopping the engine immediately after it has been working under load can result in overheating and accelerated wear of the engine components.

If the engine has been operating at high speed and/or high loads, run at low idle for at least three minutes to reduce and stabilize internal engine temperature before stopping the engine.

Avoiding hot engine shutdowns will increase turbocharger shaft and bearing life.

Prior to stopping an engine that is being operated at low loads, operate the engine at low idle for 30 seconds before stopping. If the engine has been operating at highway speeds and/or at high loads, operate the engine at low idle for at least three minutes. This procedure will cause the internal engine temperature to be reduced and stabilized.

Ensure that the engine stopping procedure is understood. Stop the engine according to the shutoff system on the vehicle.

- To stop the engine, turn the ignition key switch to the OFF position.

3-1.4.1 After Stopping the Engine

- Check the crankcase oil level. Maintain the oil level between the “ADD” mark and the “FULL” mark on the oil level gauge.
- If necessary, perform minor adjustments. Repair any leaks and tighten any loose bolts.
- Note the service hour meter reading. Perform the maintenance that is in the “Maintenance Interval Schedule” section of this manual.
- Fill the fuel tank in order to help prevent accumulation of moisture in the fuel. Do not overfill the fuel tank.

NOTICE: Only use antifreeze/coolant mixtures recommended in the Coolant Specifications of this manual. Failure to do so can cause engine damage.

- Allow the engine to cool. Check the coolant level. Maintain the cooling system at 13 mm (.5 inch) from the bottom of the pipe for filling.
- If freezing temperatures are expected, check the coolant for proper antifreeze protection. The cooling system must be protected against freezing to the lowest expected outside temperature. Add the proper coolant/water mixture, if necessary.
- Perform all required periodic maintenance on all driven equipment.

3-1.5 Cold Weather Operation

3-1.5.1 Radiator Restrictions

Caterpillar discourages the use of airflow restriction devices that are mounted in front of radiators. Airflow restriction can cause the following conditions:

- High exhaust temperatures
- Power loss
- Excessive fan usage
- Reduction in fuel economy

Shutters can be properly used for parking overnight, very cold temperatures, and high winds. In those particular cases, the coolant temperature and the inlet manifold temperature must be carefully monitored and controlled.

NOTICE: Failure to open the winter fronts in the morning could cause engine damage and/or loss of fuel economy.

3-1.5.2 Fuel and the Effect from Cold Weather

The following fuels are in the grades that are available for Caterpillar engines:

- No. 1
- No. 2
- Blend of No. 1 and No. 2

No. 2 diesel fuel is the most commonly used fuel. Either No. 1 diesel fuel or a blend of No. 1 and No. 2 is best suited for cold weather operation.

Quantities of No. 1 diesel fuel are limited. No. 1 diesel fuels are usually available during the months of the winter in the colder climates. During cold weather operation, if No. 1 diesel fuel is not available, use No. 2 diesel fuel, if necessary.

There are three major differences between No. 1 and No. 2 diesel fuel. No. 1 diesel fuel has the following properties:

- Lower cloud point
- Lower pour point
- Lower rating of BTU per unit volume of fuel

When No. 1 diesel fuel is used, a decrease in power and in fuel efficiency may be noticed. Other operating effects should not be experienced.

The cloud point is the temperature when a cloud of wax crystals begins to form in the fuel. These crystals can cause the fuel filters to plug. The pour point is the temperature when diesel fuel will thicken. The diesel fuel becomes more resistant to flow through fuel pumps and through fuel lines.

Be aware of these values when diesel fuel is purchased. Anticipate the average ambient temperature of the area that the engine will be operated. Engines that are fueled in one climate may not operate well if the engines are moved to another climate. Problems can result due to changes in temperature.

Before troubleshooting for low power or for poor performance in the winter, check the type of fuel that is being used.

When No. 2 diesel fuel is used the following components provide some means of minimizing problems in cold weather:

- Starting aids
- Engine oil pan heaters
- Engine coolant heaters
- Fuel heaters

3-1.5.3 Fuel Related Components in Cold Weather

Fuel Tanks

Condensation can form in partially filled fuel tanks. Top off the fuel tanks after operating the engine.

Fuel tanks should contain some provision for draining water and sediment from the bottom of the tanks. Some fuel tanks use supply pipes that allow water and sediment to settle below the end of the fuel supply pipe.

Some fuel tanks use supply lines that take fuel directly from the bottom of the tank. If the engine is equipped with this system, regular maintenance of the fuel system filter is important.

Drain the water and sediment from any fuel storage tank at the following intervals:

- Weekly
- Oil changes
- Refueling of the fuel tank

This will help prevent water and/or sediment from being pumped from the fuel storage tank and into the engine fuel tank.

Fuel Filters

A primary fuel filter and/or a water separator is installed between the fuel tank and the engine mounted fuel filter. The primary fuel filter and the fuel supply line are commonly affected by cold fuel. The primary fuel filter is mounted in the engine compartment. The primary fuel filter will benefit from the radiant heat of the engine.

Fuel Heaters

Fuel heaters help to prevent fuel filters from plugging in cold weather due to waxing. If coach is going to be driven extensively in cold weather a fuel heater may want to be considered. If a fuel heater is purchased it should be installed so that the fuel is heated before the fuel enters the primary fuel filter.

To select a fuel heater, contact your Caterpillar dealer.

The following fuel heaters are recommended for use with Caterpillar engines:

- 7C-3557 Fuel Heater Group
- 7C-3558 Heater Kit

Your Caterpillar dealer can give you full information on the benefits of fuel heaters and which type would be best for you.

3-1.6 Adding Antifreeze

3-1.6.1 Adding Shell Heavy Duty Extended Life Antifreeze

The 450LXi comes with KOSTGard Pre-Charged Antifreeze made especially for Blue Bird Corporation. Kost does not recommend that Shell's Heavy Duty Extended Life Antifreeze be added to this solution. Though it will not cause any permanent damage, it will cause maintenance to be done more frequently. The KOST USA product is formulated with a conventional additive system that is less aggressive when reacting with the components of the cooling system. The Shell Extended Life product is made with an organic acid technology based additive system. These two additive systems will not create a major problem in the cooling system when mixed together, but they do not particularly like each other and essentially revert to the lowest common denominator, which would be approximately a 30,000 mile coolant.

If you do choose to mix these two technologies together Kost recommends servicing the cooling system at this 30,000 mile interval which includes draining and refilling the cooling system.

3-1.6.2 Acceptable Products

Any conventional type antifreeze that is low in silicates and is phosphate free would be suitable to mix with the KOSTGuard Pre-Charged Antifreeze. Some of these products include:

- Fleet Charge - by Old World
- Zerex Pre-Charged - by Valvoline
- Shell Diesel Ready with SCA's added - by Shell

3-2 Towing

3-2.1 Receiver Type Trailer Hitch

This is a 10,000 pounds rated capacity and 1,000 pounds tongue weight capacity receiver type hitch.

When using the rear hitch remember that the motorhome is intended for towing light loads. Your motorhome is designed to be used primarily as a recreational vehicle, towing will affect durability and economy. Your safety and satisfaction depends on proper use. Avoid excessive loads. Do not use the motorhome to tow anything until it has been driven 500 miles (800 kilometers). Weight pushing down on the rear hitch must not exceed 1,000 pounds. We recommend weighing your motorhome, as it will be operated, to be certain that there is proper weight distribution. When weighing the motorhome be sure to take the passenger locations into consideration. Total weight of your motorhome and any vehicle towed by it must not exceed the GCWR.

WARNING!!

Any trailer being towed by your motorhome must have adequate brakes. Failure to follow these instructions will create a safety hazard and may result in an accident.

3-2.2 Tow Hooks

Two tow eyes are located at the front of the motorhome. Removable tow hooks are provided. Insert hooks into receivers and secure with pins provided.



NOTE: If towing a vehicle from tow hooks generator access panel must be removed prior to towing.

WARNING!!

DO NOT LIFT MOTORHOME WITH TOW EYES. TOW EYES ARE FOR FLAT GROUND MANEUVERING ONLY.

3-2.3 Having Your Motorhome Towed

3-2.3.1 Towing Procedures

It is recommended that if a towing company is called make sure they use a wheel grid (an arm that goes under motorhome and lifts from the front tires.) *Refer to figures 1 and 2* below.



Figure 1



Figure 2

The towing company may need to locate the air valve (see fig. 3) to release the air brakes. The air fitting is located in the front electrical compartment and should only be used by towing or service personnel. If the motorhome ever needs to be towed, use the following instructions:

- Secure any loose or protruding parts if the motorhome is damaged.
- Inspect points of attachment on a disabled motorhome. If attachment points are damaged, select other attachment points at a substantial frame structural member.
- Never allow anyone to go under a motorhome while it is being lifted by towing equipment unless the disabled motorhome is adequately supported by safety stands.
- Do not lift the motorhome from the rear. Lifting from the rear will cause the front tires and suspension to be seriously overloaded, possibly resulting in a tire or front suspension failure. Rear frame extensions are not designed to withstand loads imposed by lifting the rear of the motorhome. Flat towing of motorhome from rear is acceptable.
- If rear wheels are disabled, place the motorhome on a flat bed trailer or use a heavy-duty dolly under the rear wheels and tow from the front of the motorhome.
- The drive shaft must be removed to protect transmission.



Air Fitting

Figure 3

WARNING!!

In the event the motorhome requires towing ensure all precautions are followed. The drive-line must be disconnected and the mud flap may need to be removed. Blue Bird Coachworks will not cover damage to the motorhome caused by a towing company.

3-2.3.2 Disabling the Parking Brake

Block wheels securely before attempting this procedure.

- Remove the plug from the center of drive and tag axle brake cans. (see fig. 4)
- Use a wrench to tighten the bolt, which compresses the internal spring, releasing the brake.
- Repeat for the other brake cans.
- After towing, or when air pressure is again available, loosen the bolt and replace plug.
- Repeat for the other brake cans.



Figure 4

WARNING!!

Do not attempt to disassemble brake canisters without special tools and without having studied specific manufacturer's instructions. Canisters contain springs under very high tension. Improper handling could result in component damage or personal injury.

3-2.3.3 Towing With a Wheel Grid (Front End Only)

Make sure the tow truck can safely handle the weight of the motorhome. Give the towing company the weight of your motorhome when you call. If your motorhome is going to be towed with a wheel grid do the following:

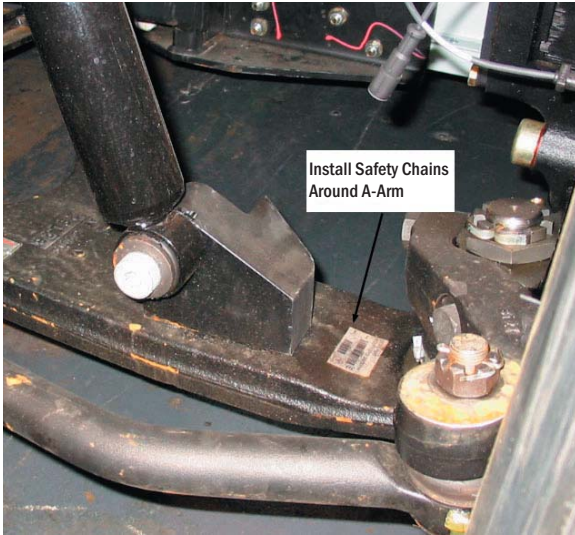


Figure 5 - Front Axle

- Maneuver wheel grid into position. After motorhome has been lifted, install safety chains on lower A-arms. (See Fig. 5)
- Attach safety chains, which are completely independent of the primary lifting device, to the tow eyes.
- When the motorhome is under tow allow enough room between the front of the motorhome and the rear of the tow vehicle while turning corners.

4-1 Interior/Exterior Storage

4-1.1 Interior Storage

Your coach comes equipped with the finest cabinets. There is storage located in cabinets, closets and under the bed, except for slide-out cross-island beds (see note below).

4-1.1.1 Cabinets

Cabinets in the coach have positive latches. This keeps them closed when moving designed to keep things inside when in over-the-road-use. What this means is a little force needs to be used when opening them up.

4-1.1.2 Cleaning Cabinets

The motor coach are finished with a high quality nitro-cellulose lacquer. Select a non-alcohol based cleaner for cleaning cabinets. Cleaners recommended for cleaning cabinets are Pledge, Endust, etc.

IMPORTANT: Do not use any alcohol based cleaners. They will dull and strip the finish of the wood.

4-1.1.3 Closets

At least one full-length hanging closet is standard in each floor plan. A 12 VDC light fixture in the ceiling of the closet is standard. Closet lighting is automatic when swinging doors are opened. Swinging doors provide access. Sliding doors in bedroom closets have manually switched lights.

4-1.1.4 Under Bed

The Wanderlodge 450 LXi island bed provides storage underneath the bed. This storage is accessed with the assistance of gas cylinders. This area is carpeted with the floor carpet selected for the remainder of the bedroom.

NOTE: Slide-out cross-island beds do not have storage underneath due to the slide-out mechanism.

4-1.1.5 Accessing Under Bed Storage

Under bed storage area in island beds is accessed by a hinged bed board. Gas cylinders are installed on bed board for easy operation. Storage area is carpeted using floor carpet selected per each interior.

4-1.1.6 Overhead Cabinet

A full-length overhead cabinet is installed over the head of the bed.



4-1.6 Dinette Cabinets

Cabinets are installed over the dining area. These cabinets are made of a laminate surface with a 5/8" lite plywood solid core substrate.

To clean these cabinets, wipe off with warm water. Cabinets may be cleaned with any non-abrasive, non-volatile cleaner.

4-1.2 Exterior Storage

4-1.2.1 Cargo Bays

The 450 LXi has exterior storage in compartments below the coach called cargo bays (basement). There are four cargo bays located beneath the coach. The bays are constructed of ridged stainless steel to control slipping of personal items.



Cargo Bays Closed

Cargo Bays #1, #2 and most of #3 are left empty for storage use.



Cargo Bays Open



Cargo Bay #3 - Curbside

Cargo Bay #3 - Curbside - This is mostly used for storage with a small portion housing the Webasto Hydronic Heating System. For a full explanation of this system as well as the uses and benefits refer to Section 4-8 Heating Systems found later in this manual.

Cargo Bay #4 houses the gray and black tanks, water systems and the outside water and air hookups. As well as switches for:

- Fresh Tank Fill
- Water Hose Reel
- Black Dump Valve
- Left Porch Light
- Panel Lights Master
- Water Pump
- Gray Dump Valve
- RS Land Lights



Bay 4 - Roadside



Bay 3 - Inverter

Bay 3 also houses the Vanner inverter. The inverter has the ability to pull power out of 12-volt batteries and convert it to 120 VAC to run appliances. It can also pull 120 VAC power and convert it to 12 volt as needed. A full explanation on how this device is used can be found in Section 4-3 Inverter later in this manual.

4-2 PowerTech PTSMH20.0 Generator

A PowerTech PTSMH20.0 Generator is supplied with the 450 LXi Coach. This is located in the front of the coach under the windshield area. The area can be extended out by pushing the “out” button located under the driver’s panel inside the coach. See Instruments and Controls section for more details. This allows for easy access for repairs and maintenance procedures. Pushing the “in” button will push the generator back in the coach.



4-2.1 Safety Precautions

Careful operation is your best insurance against an accident. Read and understand this entire section carefully before operating the generator engine. All operators, no matter how much experience they may have had, should read this and other related manuals before operating the engine or any equipment attached to it. It is the owner’s obligation to instruct all operators in safe operation.

4-2.1.1 Observe Safety Instructions

- Read and understand carefully this “Operator’s Manual” and “Labels on the Engine” before attempting to start and operate the engine.
- Learn how to operate and work safely. Know your equipment and its limitations. Always keep the engine in good running condition.
- Before allowing other people to use engine, explain how to operate and have them read this manual before operation.
- Do not modify the engine by yourself. Unauthorized modifications to the engine may impair the function and/or safety and affect engine life.

4-2.1.2 Wear Safety Clothing

- Do not wear loose, torn or bulky clothing around the machine that may catch on working controls and projections causing personal injury.
- Use additional safety items, e.g. hard hat, safety protection, gloves, etc., as appropriate or required.
- Do not operate machine or any equipment attached to it while under the influence of alcohol, medication, or other drugs, or while fatigued.
- Do not wear radio or music headphones while operating engine.

4-2.1.3 Check Before Operating and Starting the Engine

- Be sure to check the engine before operation. If something is wrong with the engine, do not fail to repair it quickly.
- Keep all guards and shields in place before operating the engine. Replace any that are damaged or missing.
- Check to see if there is a safe distance from the engine before starting.
- Always keep the engine at least 3 feet (1 meter) away from buildings and other facilities.
- DO NOT allow children or livestock to approach the machine while the engine is running.
- DO NOT start the engine by shorting across starter terminals. The machine may start.

4-2.1.4 Keep Area Around the Engine Clean

- Be sure to stop the engine before cleaning.
- Keep the engine clean and free of accumulated dirt, grease and trash to avoid a fire. Store flammable fluids away from sparks and fire.
- Keep the engine idling for about 5 minutes or over before stopping. Temperatures around the engine rise suddenly.

4-2.1.5 Safe Handling of Fuel and Lubricants

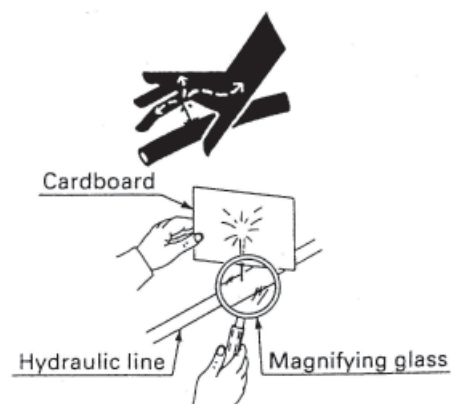
- Always stop the engine before refueling or/and lubricating.
- DO NOT smoke or allow flames or sparks in your working area. Fuel is extremely flammable and explosive under certain conditions.
- Refuel at a well ventilated and open place. When fuel and lubricants are spilled, refuel after letting engine cool off.
- DO NOT mix gasoline or alcohol with diesel fuel. The mixture can cause a fire.

4-2.1.6 Exhaust Gases & Fire Prevention

- Engine exhaust fumes can be very harmful if allowed to accumulate. Be sure to run the engine in a well ventilated place and where there are no people or livestock near the engine.
- The exhaust gas from the muffler is very hot. To prevent a fire, do not expose dry grass, mowed grass, oil and any other combustible materials to exhaust gas. Also, keep the engine and muffler clean all the time.
- To avoid a fire, be alert for leaks of flammables from hoses and lines. Be sure to check for leaks from hoses or pipes, such as fuel and hydraulic by following the maintenance check list.
- To avoid a fire, do not short across power cables and wires. Check to see that all power cables and wirings are in good condition. Keep all power connections clean. Bare wire or frayed insulation can cause a dangerous electrical shock and personal injury.

4-2.1.7 Escaping Fluid

- Relieve all pressure in the air, the oil and the cooling systems before any lines, fittings or related items are removed or disconnected.
- Be alert for possible pressure when disconnecting any device from a system that utilizes pressure. DO NOT check for pressure leaks with your hand. High pressure oil or fuel can cause personal injury.
- Escaping hydraulic fluid under pressure has sufficient force to penetrate skin causing serious personal injury.
- Fluid escaping from pinholes may be invisible. Use a piece of cardboard or wood to search for suspected leaks: do not use hands and body. Use safety goggles or other eye protection, when checking for leaks.
- If injured by escaping fluid, see a medical doctor immediately. This fluid can produce gangrene or severe allergic reactions



4-2.1.8 Cautions Against Burns and Battery Explosion

- To avoid burns, be alert for hot components, e.g. muffler, muffler cover, radiator, pipes, engine body, coolants, engine oil, etc. during operation and just after the engine has been shut off.
- DO NOT remove the radiator cap while the engine is running or immediately after stopping. Otherwise hot water will spout out from radiator. Wait for more than ten minutes to cool the radiator, before removing the cap.
- Make sure to shut the drain valve off coolant and close oil pressure cap, and to hand fasten pipe before operating. If those parts are taken off, or loosened, it will result in serious personal injury.
- The battery presents an explosive hazard. When the battery is being activated, hydrogen and oxygen gases are extremely explosive.
- Keep sparks and open flames away from the battery, especially when charging the battery. DO NOT strike a match near the battery.
- DO NOT check battery charge by placing a metal object across the terminals. Use a voltmeter or hydrometer.
- DO NOT charge battery if frozen. It can be explosive. When frozen, warm the battery up more than 16°C (61°F).

4-2-1.9 Keep Hands and Body Away From the Rotating Parts

- Be sure to stop the engine before checking or adjusting belt tension and cooling fan.
- Keep your hands and body away from any rotating parts, such as cooling fan, V-belt, fan drive V-belt pulley or flywheel to avoid causing personal injury.
- DO NOT run the engine with installed safety guards detached. Install safety guards securely during operation.

4-2.1.10 Anti-Freeze and Disposal of Fluids

- Anti-freeze contains poison. Wear rubber gloves to avoid personal injury. In case of contact with skin, wash it off immediately.
- DO NOT mix different types of anti-freeze. The mixture can produce a chemical reaction causing harmful substances. Use approved or genuine KUBOTA anti-freeze.
- Be mindful of the environment and the ecology. Before draining any fluids, find out the correct way of disposing of them. Observe the relevant environmental protection regulations when disposing of oil, fuel, coolant, brake fluid, filters and batteries.
- When draining fluids from the engine, place a container underneath the engine body.
- DO NOT pour waste onto the ground, down a drain, or into any water source.

4-2.1.11 Conducting Safety Checks and Maintenance

- When checking engine or servicing, place the engine on a wide and level ground. DO NOT work on anything that is supported ONLY by lift jacks or a hoist. Always use blocks or correct stands to support the engine before servicing.
- Detach the battery from the engine before conducting service. Put a "DO NOT OPERATE" tag in the key switch to avoid accidental starting.
- To avoid sparks from an accidental short circuit always disconnect the battery's ground cable first and connect it last.
- Be sure to stop the engine and remove the key when conducting daily and periodic maintenance, servicing and cleaning.
- Check or conduct maintenance after the engine, coolant, muffler, or muffler cover, have been cooled off completely.
- Always use the appropriate tools and jig-figure in good condition when performing any service work. Make sure you understand how to use them before service.
- Use ONLY correct engine barring techniques for manually rotating the engine. DO NOT attempt to rotate the engine by pulling or prying on the cooling fan and V-belt. This practice can cause serious personal injury or premature machine damage to the cooling fan.
- Replace fuel pipes and lubricant pipes with their hose clamps every 2 years or earlier whether they are damaged or not. They are made of rubber and are aged gradually.
- When service is performed together by two or more people, take care to perform all work safely.
- Keep first aid kit and fire extinguisher handy at all times.

4-2.1.11 Warning and Caution Labels



4-2.1.12 Care of Warning and Caution Labels

1. Keep warning and caution labels clean and free from obstructing material.
2. Clean warning and caution labels with soap and water, dry with a soft cloth.
3. Replace damaged or missing warning and caution labels with new labels from your local KUBOTA dealer.
4. If a component with warning and caution label(s) affixed is replaced with new part, make sure new label(s) is (are) attached in the same location(s) as the replaced component.
5. Mount new warning and caution labels by applying on a clean dry surface and pressing any bubbles to outside edge.

4-2.2 Pre-Operation Check

4-2.2.1 Break-In

1. During the engine break-in period, by all means, observe the following:
Change engine oil and oil filter cartridge after the first 50 hours of operation (See “Engine Oil” in Periodic Service Section).
2. When ambient temperature is low, operate the machine after the engine has been completely warmed up.

4-2.2.2 Daily Check

To prevent trouble from occurring, it is important to know the conditions of the engine well. Check it before starting.

CAUTION!!

To avoid personal injury:

- **Be sure to install shields and safeguards attached to the engine when operating.**
- **Stop the engine at a flat and wide space when checking.**
- **Keep dust or fuel away from the battery, wiring, muffler and engine to prevent a fire. Check and clear them before operating everyday. Pay attention to the heat of the exhaust pipe or exhaust gas so that it cannot ignite trash.**

ITEM	
Parts which had trouble in previous operation.	
1. By walking around the machine	(1) Oil or water leaks
	(2) Engine oil level and contamination
	(3) Amount of fuel
	(4) Amount of coolant
	(5) Dust in air cleaner dust cup
	(6) Damaged parts and loosened bolts and nuts
2. By inserting the key into the starter switch	(1) Proper functions of meters and pilot lamps; no stains on these parts.
	(2) Proper functions of glow lamp timer.
3. By starting the engine	(1) Color of exhaust fumes
	(2) Unusual engine noise

4-2.2.3 Stopping the Engine

1. Return the speed control lever to low idle, and run the engine under idling conditions.
2. Set the engine stop lever to the "STOP" position.
3. With the starter switch placed at the "OFF" position, remove the key. (Be sure to return the engine stop lever to the "START" position to be ready for the next start.)

4-2.2.4 Checks During Operation

While running, make the following checks to see that all parts are working correctly.

Radiator Cooling Water (Coolant)

WARNING!!

To avoid personal injury:

Do not remove radiator cap until coolant temperature is well below its boiling point. Then loosen cap slightly to the stop position, to relieve any pressure, before removing cap completely.

When the engine overheats and hot coolant overflows through the overflow pipe and cannot be stopped, stop the engine immediately and make the following checks to determine the cause of trouble:

Check Item

1. Check to see if there is any coolant leak;
2. Check to see if there if any obstacle around the cooling air inlet or outlet;
3. Check to see if there is any dirt or dust between radiator fins and tube;
4. Check to see if the fan belt is too loose;
5. Check to see if radiator water pipe is clogged; and
6. Check to see if anti-freeze is mixed into coolant in warm seasons.

Oil Pressure Lamp

The lamp lights up to warn the operator that the engine oil pressure has dropped below the prescribed level. If this should happen during operation or should not go off even after the engine is accelerated more than 1000 rpm, immediately stop the engine and check the following:

1. Engine oil level (See "Engine Oil" in Maintenance Section).
2. Lubricant system (See "Engine Oil" in Maintenance Section).

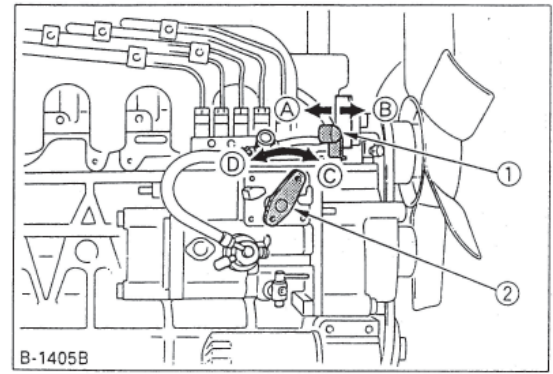
Fuel

CAUTION!!

To avoid personal injury:

- Fluid escaping from pinholes may be invisible. Do not use hands to search for suspected leaks; Use a piece of cardboard or wood, instead. If injured by escaping fluid, see a medical doctor at once.
- This fluid can produce gangrene or a severe allergic reaction.
- Check any leaks from fuel pipes or fuel injection pipes. Use eye protection when checking for leaks.

Be careful not to empty the fuel tank. Otherwise air may enter the fuel system, required fuel system bleeding. (See "FUEL" in Maintenance Section).



(1) Speed control lever
(2) Engine stop lever

(A) "IDLING"
(B) "OPERATION"
(C) "START"
(D) "STOP"

Color of Exhaust

While the engine is running within the rated output range:

- The color of exhaust remains colorless.
- If the output slightly exceeds the rated level, exhaust may become a little colored with the output level kept constant.
- If the engine is run continuously with dark exhaust emission, it may lead to trouble with the engine.

Immediately Stop the Engine If:

- The engine suddenly slows down or accelerates.
- Unusual noises suddenly sound.
- Exhaust fumes suddenly become very dark.
- The oil pressure lamp or the water temperature alarm lamp lights up.

4-2.2.5 Reversed Engine Revolution and Remedies

CAUTION!!

To avoid personal injury:

Reversed engine operation can make the machine reverse and run it backwards. It may lead to serious trouble.

Reversed engine operation may make exhaust gas gush out into the intake side and ignite the air cleaner; it could catch fire.

Reversed engine revolution must be stopped immediately since engine oil circulation is cut quickly, leading to serious trouble.

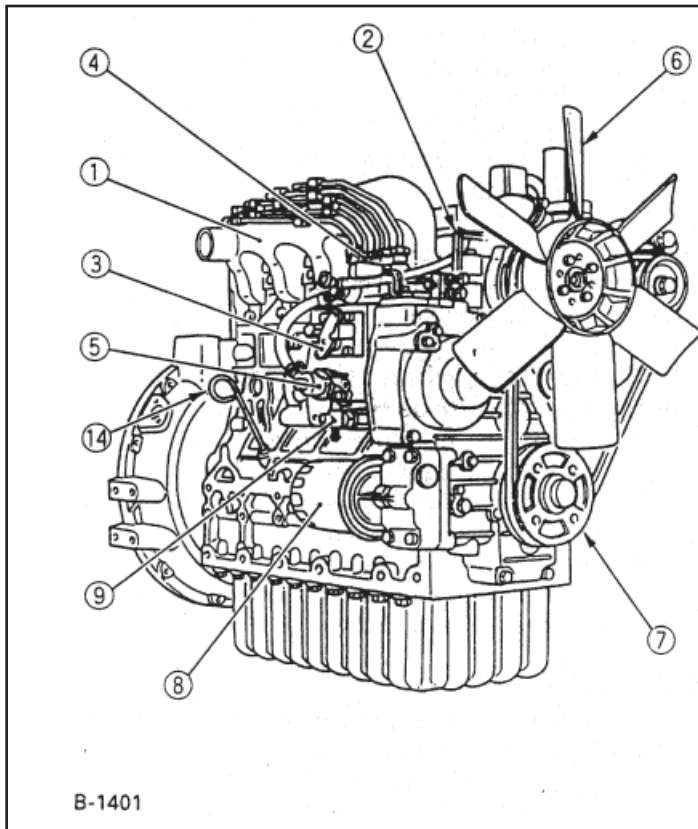
How to Tell When the Engine Starts Running Backwards

1. Lubricating oil pressure drops sharply. Oil pressure warning light, if used, will light.
2. Since the intake and exhaust sides are reversed, the sound of the engine changes, and exhaust gas will come out of the air cleaner.
3. A louder knocking sound will be heard when the engine starts running backwards.

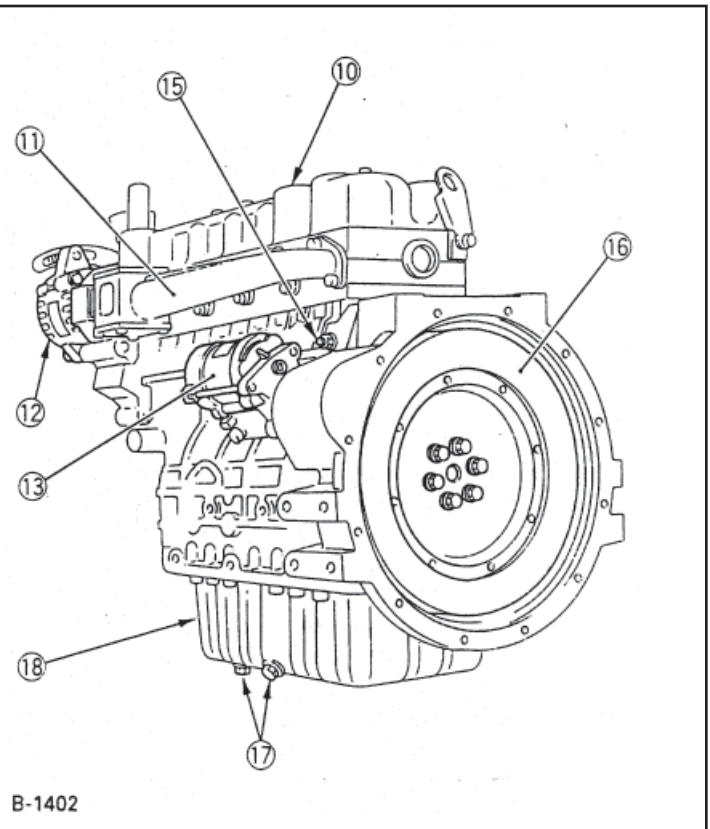
Remedies

1. Immediately set the engine stop lever to the "STOP" position to stop the engine.
2. After stopping the engine, check the air cleaner, intake rubber tube and other parts and replace parts as needed.

4-2.3 Names of Parts



- (1) Intake manifold
- (2) Speed control lever
- (3) Engine stop lever
- (4) Injection pump
- (5) Fuel feed pump
- (6) Cooling fan
- (7) Fan drive pulley
- (8) Oil filter cartridge
- (9) Water drain cock



- (10) Oil filler plug
- (11) Exhaust manifold
- (12) Alternator
- (13) Starter
- (14) Oil level gauge
- (15) Oil pressure switch
- (16) Flywheel
- (17) Oil drain plug
- (18) Oil pan

4-2.4 Principles of Operation

The exciter pole pieces contain residual magnetism, setting up lines of force across the air gap to the exciter armature. When the exciter armature begins to rotate a voltage is induced and current flow is initiated in the exciter armature AC windings. This voltage is fed to the rotating rectifier assembly, rectified and fed to the alternator field coils. This DC voltage is sufficient to magnetize the laminated alternator field which will set up lines of force across the air gap to the alternator stator. As the generator rotor rotates a voltage will be induced and current will flow in the alternator stator windings and to the output circuit.

A static type voltage regulator is connected to the generator output. The regulator will rectify part of the output voltage to provide a DC voltage to the exciter field coils. This will increase the density of the lines of force in the exciter, increasing the voltage induced into the exciter armature windings, and therefore to the rotating rectifiers.

The rotating rectifier output will be increased, which will increase the alternator field strength and the generator output will build up to its rated voltage.

Adjustment of the generator output to the rated voltage level is accomplished by controlling the current fed to the exciter field coils.

Regulation is automatic with the static type voltage regulator. An additional voltage adjustment range is provided if desired by operating the voltage adjust rheostat.

ROTATING FIELD ASSEMBLY (ROTOR) - The rotating field assembly consists basically of four members; the shaft assembly, the core assembly, field coil damper windings and balance lugs to provide a high degree of static and dynamic balance. The exciter rotor and rotating rectifier-hub assembly are separate units which are heat shrunk onto the generator shaft.

CORE ASSEMBLY - The core assembly consists of one piece electrical steel laminations which are stacked on the shaft assembly.

FIELD COIL - Field coils of heavily insulated wire are "wet" wound directly onto the poles. Field coil leads are brought out to the rectifier assembly for connection to the source of DC excitation voltage.

GENERATOR SHAFT - The generator shaft is made of forged high strength steel, which is turned to close tolerances and then ground to a closer tolerance.

GENERAL DESCRIPTION - The revolving field type generators have a DC field revolving within a stationary AC winding called the stator. AC power is distributed from the generator through leads connected to the stator windings. There are no sliding contacts between the AC winding and the load, therefore, great amounts of power may be drawn from this generator.

VOLTAGE CONNECTIONS - The generator may be connected at the terminal board to deliver 120/240 volts to a 3 wire grounded neutral system, or 120 volts only to a 2 wire distribution system. If any equipment requires 240 volts, then the 120/240 volt connection must be used. If all equipment requires 120 volts, then the 120 volt connection is preferred even if two lines leave the switch box. The two lines at the input to the switch box are both connected to the ungrounded 120 volt lines from the generator. The 120 volt connection enables the EVR to hold the voltage very close the 115 or 120 volts (as initially adjusted) regardless of the power distribution among the different distribution lines. The 120 volt connection is recommended if all the electrical load requires only 115 or 120 volts.

Although the 120/240 volt connection may also be used when all load requires only 120 volts, it should be pointed out that this connection the 240 volt is regulated and the lightly loaded phase will deliver a high line-to-neutral voltage and the heavily loaded phase will deliver a low line-to-neutral voltage. The heavily loaded line may have such a low voltage that air conditioning will have more difficulty in starting, and long starting time may over-load generator and trip circuit breakers.

ELECTRONIC VOLTAGE REGULATION - Electronic Voltage Regulation (sometimes called automatic voltage regulation by many users) regulates the voltage by using a solid state electronic circuit of transistors, integrated circuits, SCR's, resistors, capacitors, etc., to sense the generator voltage and feed a DC current into the exciter field of the proper average value to hold the generator voltage constant from no-load to full rated load and above. These electronic voltage regulators are very reliable devices which regulate the voltage to 2% or less.

BRUSHLESS EXCITER - The brushless exciter consists of an armature with a three phase AC winding and rotating rectifier assembly within a stationary field.

The stationary exciter field assembly is contained in the main generator frame. The exciter armature is bolted fit and keyed onto the shaft assembly. The rotating rectifier assembly slides over the bearing end of the generator rotor shaft.

DC OUTPUT POWER FOR EXCITER FIELD - The EVR rectifies the AC power input with a full wave rectifier to provide DC current (a series of half sine waves) with a high ripple content at a frequency of 120 HZ. This DC current is fed to the exciter field through one (or two) SCR's to provide a pulsed output in one direction only. The resistance and impedance within the regulator is very low and the peak value of the current into the exciter field is limited only by the impedance and resistance of the exciter field. For this reason exciter fields must have a minimum specified resistance or the peak current delivered by the regulator will be so high that the regulator components will be damaged. The regulators are commonly designed for a minimum exciter field resistance of 25 OHM's, although sometimes a slightly lower resistance can be tolerated. Connections to the exciter field are made of two DC output terminals, F+ and C.

ROTATING RECTIFIER BRIDGE - The rotating rectifier bridge consists basically of rectifying diodes mounted on a heat sink which is in turn mounted on an insulating ring. The entire assembly bolts to the adaptor on the generator shaft. Therefore, the rotating rectifier assembly will rotate with the exciter armature eliminating the need for any sliding contacts between the exciter output and the alternator field. (See Figure 1).

EXCITER FIELD - The exciter field on the high frequency exciter consists of laminated segments of high carbon steel which are fitted together to make up the field poles. The field coils are placed into the slots of the field poles.

EXCITER FIELD COIL VOLTAGE SOURCE - Field coil DC voltage is obtained by rectifying the voltage from phase to neutral line of the generator output, or other appropriate terminal to provide the needed voltage reference.

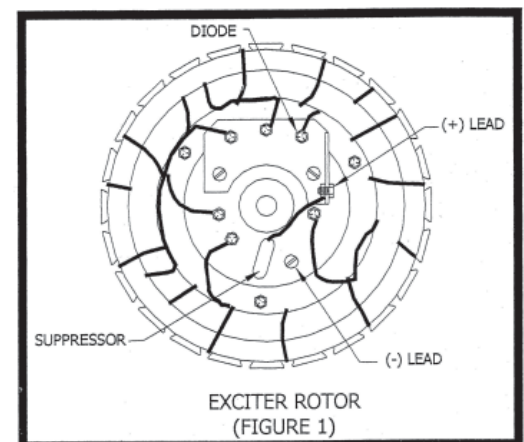
The rectifier bridge is an integral part of the static regulator. The static regulator senses a change in the generator output and automatically regulates current flow in the exciter field coil current to increase or adjustable rheostat sized to be compatible with the regulator is used to provide adjustment to the regulator sensing circuit.

BALANCE - The rotor assembly is precision balanced to a high degree of static and dynamic balance. Balance is achieved with the balance lugs on the field pole tips. Although the balance will remain dynamically stable at speed in excess of the design frequencies, the prime mover should be adequately governed to prevent excessive over speed. High centrifugal forces at excessive over speed can damage the damper winding and field coils.

BEARING - The generator rotor assembly is suspended on shielded, factory lubricated ball bearings. They are greased for life and should not require regreasing.

STATOR ASSEMBLY - The stator assembly consists of laminations of steel mounted in a rolled steel frame. Random wound stator coils are fitted into the insulated slots.

STANDBY UNITS - Generators used as an auxiliary power source in case of commercial power failure must be isolated from the commercial line before being placed in operation.

**CAUTION!!**

Make sure the unit is completely shut down and free of any power source before attempting any repair or maintenance on the unit.

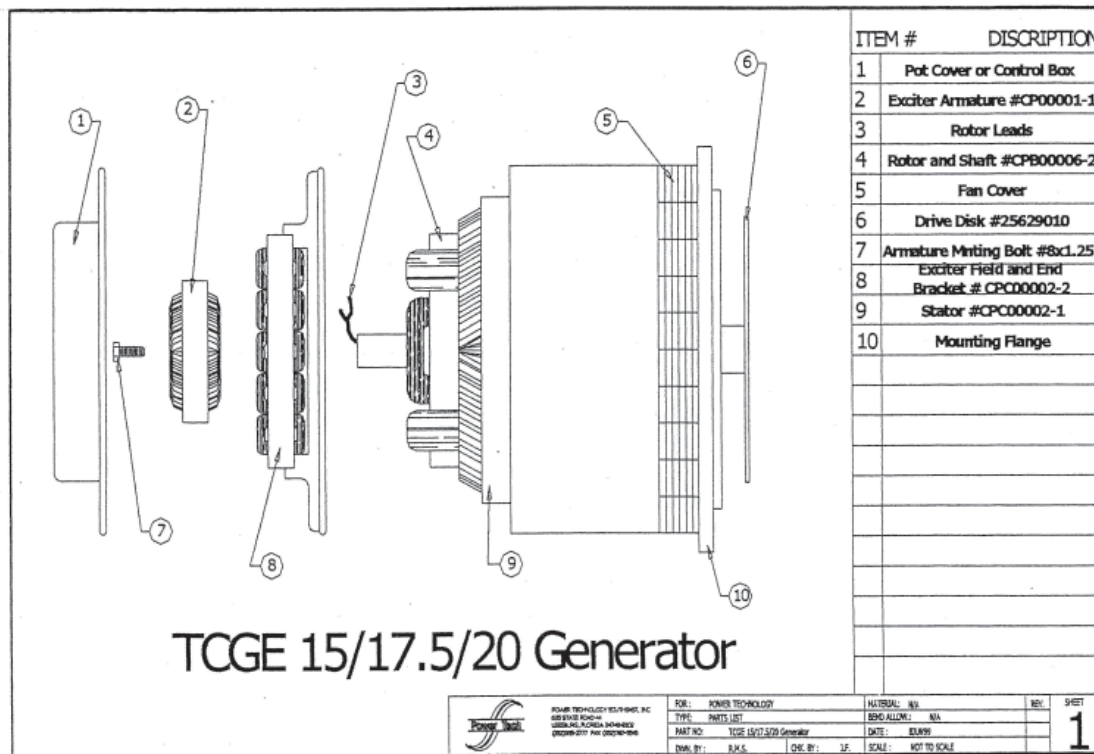


FIGURE 2

4-2.5 Service and Maintenance

4-2.5.1 Preventative Maintenance and Operating Precautions

Costly repairs and down time can usually be prevented by operating electrical equipment under conditions which are compatible with those at which the equipment was designed to operate. Follow the instructions outlined below to ensure maximum efficiency of the electrical equipment.

CAUTION!!

- Do not exceed air temperature rise as shown for 50 deg. C above 40 deg. C ambient.
- Do not exceed the rated voltage or load.
- Operate Genset at rated speed.
- Keep regulating equipment at proper adjustment.

4-2.5.2 Cooling

Keep all cooling parts clean and make certain sufficient room is left on all sides for a plentiful supply of fresh coolant air flow. Do not exceed air temperature rise as shown for 50°C above 40°C ambient. This ensures that the insulation NEMA class “F” will not be damaged. Do not exceed the rated voltage or load. Operate generator at rated speed. Keep regulating equipment in proper adjustment. Failure to operate generators at rated voltages, load or speed will cause overheating and possibly damage to the windings due to over voltage or current.

4-2.5.3 Regulating Equipment

Regulating equipment should be kept in proper adjustment at all times. Read all instructions carefully before adjusting or repairing the regulating equipment.

CAUTION!!

Read all instructions carefully before adjusting or repairing the regulating equipment.

4-2.5.4 Bearing Replacement

Factory lubricated shielded bearings will normally provide several years of trouble free service when operated under normal conditions. Excessive bearing load and adverse environment conditions will greatly shorten bearing life. Should bearing failure occur, bearings can be replaced. ALWAYS REPLACE WITH THE SAME TYPE BEARING AS INSTALLED AT THE FACTORY. CHECK PART LIST FOR PART NUMBER. Include generator serial number when ordering bearings.

4-2.5.5 Rotating Diode Bridge

The rotating diode bridge can be removed and replaced. Excessive over current, over voltage, overspend, or reverse currents can cause damage to the assembly or any of the component parts.

All rotors are static and dynamically balanced to a high degree on precision machines to assure minimum vibration. They will therefore, remain dynamically stable at speeds well beyond the synchronous speed of the generator. The rotors on generators are, however, subjected to extreme centrifugal forces which can increase beyond safe operating limits at excessive over speed. Therefore, the prime mover should be adequately governed to prevent over speed. Damage to the rotor can also occur due to overheating which can be caused by one of the following:

1. Excessive field current due to failure of the regulator.
2. The exciter being operated below the rated speed which can result in excessive field current due to the regulator trying to maintain rated voltage.
3. The air flow is restricted from dust or other foreign objects collecting in the air passage.

If a rotor becomes defective, it should be returned to the factory with full nameplate data, because the rotor coils are enclosed in welded squirrel cage winding. Should a failure occur, the factory should be notified immediately and steps will be taken to get the generator back into service with the least expense; and more important, to determine the cause of the failure and take steps to prevent recurrence.

4-2.6 Precautions

4-2.6.1 Generator Winding (Drying)

Generators that have been in transit or storage for long periods may be subjected to extreme temperature and moisture changes. This can cause excessive condensation, and the generator windings should be thoroughly dried out before bringing the generator up to full nameplate voltage. If this precaution is not taken, serious damage to generator can result. The following steps should be taken to effectively dry the generator windings:

1. Short circuit the generator lead wires. Start the generator and separately excite the exciter with DC battery power of approximately 50 volts to produce rated AC nameplate current. To accomplish this excitation, the leads (F+ and C-) must be disconnected from the voltage regulator. Nameplate current can be measured with a clip-on ammeter at the generator leads. Make sure the AC current does not exceed the nameplate rating. Be sure to reconnect the leads to the proper terminals on the voltage regulator after the drying exercise.
2. Another procedure would be to put the generator in a heated room or to moderately heat with a heat source.

Experience has shown that it is necessary to take these precautions in locations such as seaboard installations and other highly humid areas. Some installations will be in atmospheres that are much more corrosive than others. A little precaution along the lines outlined here could eliminate an unnecessary repair job.

WARNING!!

High voltage (dielectric) testing must not be performed to the machine without first observing NEMA rules. The insulation of this generator winding may be safely checked by using a megger. A high megger reading indicates low insulation leakage.

Each generator was subjected to a standard NEMA insulation test, which means 1000 volts plus twice the highest voltage for which the generator is rated was impressed between the windings and the frame. All machines are insulated with a high safety factor for the class of insulation used. The latest and newest in insulation and baking techniques are used.

The finest insulation job can be very quickly broken down by carelessly applying high voltage to windings in a moisture saturated condition. Mishandling in this respect can easily cause a break down, making it necessary to return the generator to the factory for repair, and consequent expense and loss of time.

4-2.6.2 Field Flashing

The direct current (DC) necessary to magnetize the alternator field is obtained from the exciter. Initially, upon starting the generator, current flow and voltage are induced into the exciter armature by the magnetic lines of force set up by the residual magnetism of the exciter field poles.

Residual magnetism of the exciter field poles may be lost or weakened by a momentary reversal of the field connection, a strong neutralizing magnetic field from any source, or if the generator is not operated for a long period of time.

To restore the small amount of residual magnetism necessary to being the voltage build up, connect a battery from 6 to 32 volts to the exciter field coil circuit. Normally, a battery of 6 or 12 volts is large enough.

Procedure for Field Flashing to Restore Residual Magnetism

1. Disconnect the exciter field coil wire F+ at terminal F+.
2. Connect a batteries positive lead to the field coil lead F+. Use 12 volt battery.
3. Connect the batteries negative lead to the field coil circuit terminal C.
4. Disconnect the battery leads after approximately 3 to 5 seconds. If the battery is connected for too long, over heating and subsequent damage to the exciter can occur.
5. Reconnect the field coil lead F+ to terminal F+.
6. Start the unit and observe the generator build up.

NOTE: If the polarity of the exciter is reversed by flashing the field, it may be corrected by interchanging the battery leads.

Reflash field (steps 1 through 5 above) if the generator voltage does not build up.

4-2.6.3 Alternate Procedure for Field Flashing

Apply either an alternating current or a direct current voltage of approximately 12 volts to any tow generator leads. Do not make a positive connection but rather touch the leads together until the generator voltage begins to rise and then separate the leads. It is suggested than a 30 ampere fuse be inserted in the circuit to prevent any damage in case the build up voltage is not removed quickly enough.

Start the generator and observe generator build up. Reflash field if generator output voltage does not build up. This procedure should be performed by Trained Service Personnel only. (See Figure 1)

4-2.6.4 Testing Diodes with an Ohmmeter

Isolate the rectifier assembly by disconnecting the lead from the main rotor and tree leads from the exciter rotor. Test each diode by applying the probes of an ohmmeter to the anode and cathode.

A good diode will produce a meter reading of only a few OHM's when the probes are applied in one direction, and a reading of near infinity when the probes are reversed. If both readings are high, or both are low, the diode is defective and must be replaced.

Diode failure after 25 hours "run in" period is generally traceable to external causes such as overheating or a reverse current fed into the alternator. To save excessive service time and call backs, it is a generally accepted practice to replace all diodes where failure can be traced to external causes after the cause of the diode failure is identified and corrected.

4-2.6.5 Troubleshooting Procedure for AC Brushless Generator

As with any machine, trouble may develop in electrical generators. It may be due to long service or neglect of regular maintenance, servicing, and checking. Should trouble develop, the following instructions will be helpful in tracing the cause and making repairs.

Brushless generators are not complete units without added control equipment, therefore, reference will be made to control components.

4-2.6.6 Voltage Deviations

The generator output voltage should be kept as close as possible to the rated voltage shown on the generator nameplate. High voltage, low voltage and fluctuating voltage (hunting) may cause serious damage to the generator and its control equipment. A high voltage could damage sensitive equipment and low voltage could cause motors to burn out.

4-2.6.7 Speed Deviation

The generator speed should be maintained at rated nameplate speed. The frequency of the generator output depends on speed. If the generator runs slower than the rated speed, the voltage may drop off. Automatic control equipment may burn out trying to maintain voltage by forcing the field.

4-2.6.8 Visual Examination

The first step in investigating any generator failure or trouble should be to look for obvious evidence such as: burned areas, loose or open connections, wrong speed, incorrect reassembly and reconnection, etc.

4-2.6.9 Observe Voltage of Defective Generator

The next step is to carefully measure line to line voltage. A voltage about 10% of the rated voltage (at rated RPM) is probably the residual voltage (determined by residual magnetism in the exciter field). A normal residual voltage indicates exciter armature, rotor and stator are all good and that the trouble is probably in the excitation circuit. A very low voltage, or no voltage, indicates either the residual magnetism in the exciter field was lost (generally by disassembly or by sudden interruption of the exciter field current), or that a generator defect exists in the exciter armature, rotor or stator.

4-2.6.10 Battery Excitation

The behavior of the generator, when the exciter field is connected to a 12 volt battery for excitation current, is a useful guide for location the generator fault. Disconnect F+ from C- from EVR and open CBI circuit breaker/switch in lead 3 or 4 to EVR (lead for power input to the EVR). Connect F+ to the positive side of the battery. Connect the negative side of the battery to C-. Spin the generator at 1800 RPM.

- A. If residual voltage is normal, 12 volts across lead F+ and C- should cause the generator to deliver a voltage near rated voltage with no load. If 12 volt excitation produces near normal voltage, failure of the voltage regulator to provide the voltage could mean a defective voltage regulator, or an open circuit in leads to terminals 3 or 4 of the electronic regulator. Check the switch or circuit breaker in these leads. With 12 volt excitation, connect voltmeter across terminals 3 and 4. Voltage should be 200 to 240 volts with CBI closed.
- B. If 12 volt excitation produces no voltage, check the exciter field resistance. It should normally be 25 to 28 OHM's at 77 deg. F. If the field is open or shorted, then the exciter field is defective. An open or short in the main rotor behaves similarly, but is also accompanied by a very low line to line voltage (residual voltage) without 12 volt battery excitation. If an open or shorted rotors suspected, remove "R" lead from #10 base terminal on the armature and measure the resistance since "Q" lead is normally connected to ground. See "Resistance of Rotors".

- C. If 12 volt excitation causes the engine to growl and load the engine with no or very low generator output voltage, the stator could be grounded or shorted. Or, a short or ground in the wiring of the generator power circuit could be the main fault. In either case, the stator will develop hot spots or could even smoke after running a few minutes. Run the generator until a hot smell is detected, or stop in 5 minutes (whichever occurs first). Feel the stator winding. If it is not, the stator or power wiring contains a short circuit. Examine the stator for burned (black) insulation which indicates a defective or damaged stator. Measure the stator resistance T1 to T2 and T3 to T4 if possible. With 12 volt excitation measure the voltage of T1 to T2 and T3 to T4. If one of these voltages is very low while the other is close to normal, the low voltage winding has shorted turns.
- D. If 12 volt excitation causes an increase in voltage but the output voltage is less than 60% of the rated voltage, the rectifier (see 4) in the exciter armature could be defective or the exciter armature could have an open circuit. Also, one pole of the main field (rotor) could be shorted or grounded. If any of these effects exist, failure of the electronic regulator will occur. Replacement of the regulator alone will be followed by failure of the new regulator. If the electronic regulator has failed, it is wise to check the exciter current by placing a DC Ammeter in the F+ lead to the exciter field. Normal exciter current at no load rated voltage is 0.65 to 0.95 ampere. A higher current is another indication of a generator defect (described above), which could cause a new voltage regulator to fail.

4-2.6.11 Rectifier Checking

- A. Each armature full wave bridge rectifier has 5 terminals and 6 rectifying junctions. Rectifiers may be readily checked on the low range of an ohmmeter. From the "+" tab to the "AC" tab the ohmmeter should show a high resistance when polarity of the ohmmeter leads are reversed. The same conditions should be found from the "+" tab to any other "AC" tab and from "-" tab to "AC" tabs. If a ZERO resistance reading is found, this junction of the rectifier is shorted and the rectifier must be replaced. If a HIGH resistance is found with both polarities of the ohmmeter, this junction of the rectifier is "OPEN" and the rectifier must be replaced.
- B. Armature with 3 phase FULL-WAVE bridge rectifier. The three phase full-wave rectifier is now standard on most armatures used in generators. This 3 phase (full-wave rectifier) is a single unit with 6 diodes in a special case. The (+) terminal is identified by a red dot on the case and is connected by a short lead to the (+) terminal of the armature to which the (+) rotor lead and suppressor leads are connected. The other 3 terminals at the top of the rectifier are AC connections to each of the armature phase leads. The case is the (grounded) (-) lead to the rotor. To test the diodes disconnect the rectifier positive lead at the armature (+) terminal. Test between the rectifier (+) and any AC terminal. Make the test also between the rectifier (-) lead (ground to case) to any AC lead. The test determines that all diodes are good or that one or more is defective. Since a ground armature winding gives the same test results as a bad diode, it is necessary to disconnect all AC rectifier connections and test the armature windings for a short to ground before a fault can be positively identified. Also test each diode separately (-) to each AC terminal, and case to each AC terminal to positively identify which diode is bad.
- C. The armature with two full-wave bridge rectifiers. On some generator models an armature will be supplied with two full-wave bridge rectifiers very similar to the rectifiers used on armatures with one 3 phase FW rectifier. To test these rectifiers, remove the two rectifier (-) leads at the R (rotor) (+) terminal and test each rectifier separately, first from + lead (rectifier #10) to any AC terminal. Then go to rectifier #2 and test + to any AC terminal, then case to any AC terminal. A failure in the test "case to any AC terminal" could be a bad diode in either FW bridge rectifier. To determine which diode is bad, all AC terminals must be disconnected and each AC terminal of the rectifier tested to both + and to - (case) of that bridge rectifier.

4-2.6.12 Voltage Suppressor

Voltage suppressors are similar to rectifiers in that they contain in effect a single semiconductor one way junction. A suppressor should have a high resistance with one polarity of test leads and low but not zero resistance in the opposite direction. Resistance measurements sometimes fail to identify a defective suppressor. The best test is to remove the suppressor from the circuit. If an obvious improvement in the generator is observed, the suppressor is bad. Some suppressors have a high resistance in either polarity of applied voltage (if applied voltage is low), but have a low resistance of voltages of 300 to 450 volts.

4-2.6.13 Resistance of Windings

Frequently in troubleshooting a generator, a defective component can be identified by measuring the resistance of a winding. The Exciter field, armature, rotor and stator should withstand 1500 volts between winding and ground with less than 0.002 ampere of current between winding and ground. All electronic components such as rectifiers, suppressors, and resistors must be disconnected.

GENERATOR RESISTANCE VALUES								
ARMATURE		470-520 OHMS PER PHASE			5 TO 10 KW			
		650-720 OHMS PER PHASE			12.5 TO 50 KW			
FIELD		18-22 OHMS			5 TO 10 KW			
		23-28 OHMS			12.5 TO 50 KW			
Stator OHM's vary with KW rating, but less than 1 OHM per phase.								
ROTOR:								
8	10	12.5	15	17.5	20	25	30	50
1.47	1.58	1.73	1.84	2	2.1	2.2	2.5	3.8

4-2.6.14 Electronic Regulation

An electronically regulated generator has superior voltage regulation than other types (+/- 2 deg. within rated loads). Power Technology Southeast, Inc. uses voltage regulators made by Basler Electric Co., Highland, Illinois. The electronic voltage regulator, regulates the voltage using a solid state electronic circuit of transistors, integrated circuits, SCR's, resistors, etc. To sense the generator voltage and feed a DC current into the exciter field of the proper average value to hold the generator voltage constant from no load to full rated load and above.

Characteristics: Overload Protection - To prevent damage to devices receiving electrical power from the generator. The regulator provides both under load frequency and over load protection. The voltage regulator operates at 50 HZ, the voltage does not rise above that value set at the proper frequency (proper engine speed). AC Power Input - All EVR's must supply up to 4 amperes of DC output current into the exciter field at a voltage up to 70 volts DC. This voltage and current constitutes a power output of about 280 watts. This output power must come from the generator. The exciter field input power must be supplied at 190 to 240 volts AC at a volt ampere burden of 500 VA maximum. When the generator is connected to deliver 120 volts, a separate winding in the stator provides 208 to 240 volts for the voltage regulator power input.

DC Output Power for the Exciter Field - The EVR rectifies the AC power input with a full wave rectifier to provide DC current (a series of half sine waves) with a high ripple content at a frequency of 120 HA. This DC current is fed to the exciter field through one or two SCR's to provide a pulsed output in one direction only. The resistance and impedance within the regulator is very low and the peak value of the current into the exciter fields must have a minimum specified resistance or the peak current delivered by the regulator will be so high that the regulator components will be damaged. The regulator is commonly designed for a minimum exciter field resistance of 20 OHM's 8-10 KW and 25 OHM's 12-50 KW, although sometimes a slightly lower resistance can be tolerated. Connections to the exciter field are made at two DC output terminals, F+ and F-.

Operating Hour Service Log

The following chart is provided to help you keep an accumulative record of operation hours on the generator set and the dates required services were performed. Enter hours on the generator aaset and the dates required services were performed, enter hours to the nearest hour.

Date Run	Operating Hours		Service Record	
	Hours Run	Cumulative	Date	Service

Date Run	Operating Hours		Service Record	
	Hours Run	Cumulative	Date	Service

4-3 Inverter

The 450 LXi is equipped with a Vanner ITC-Series inverter/charger system. This is a very important system within the coach. This system can pull power out of 12-volt batteries and convert it to 120 VAC to run appliances. It can also pull 120 VAC power and convert it to 12 volt as needed to charge the house batteries when connected to 120 VAC shore power or generator. Lights on the motor home use 12 volt and appliances use 120. This is useful when you are some place that does not have plug-ins or you cannot run the generator for some reason. For example, maybe the park you are in has rules that state no running generator after a certain time; this is where your inverter would come in handy.

4-3.1 Inverter Overview

An inverter converts DC electrical power into AC power. This power can be used to operate various AC-driven appliances.

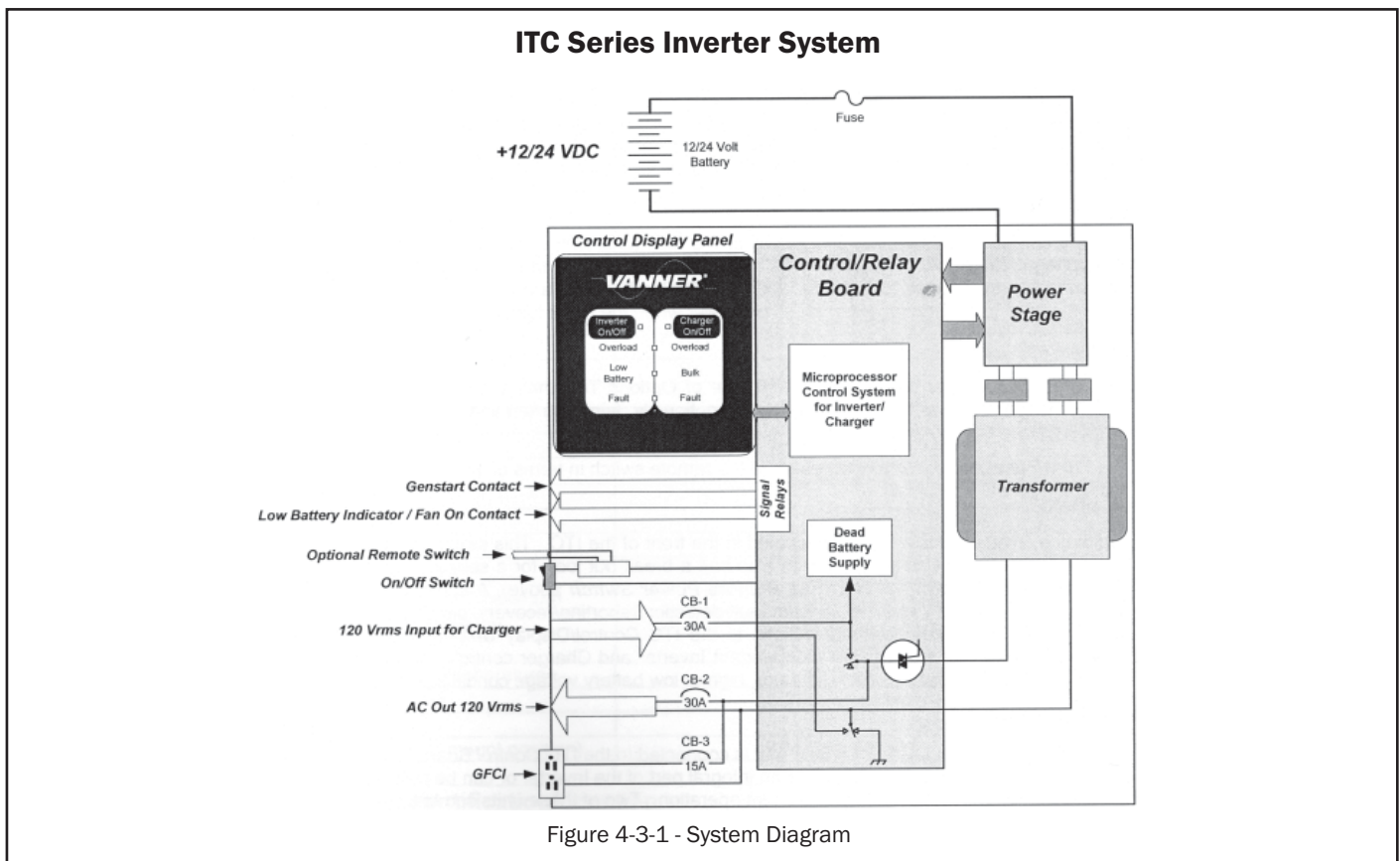
The most common battery systems are 12 or 24 volt. Some systems, however, operate on higher voltages such as 32, 36, 48, or 120 volts. The most common inverter AC output power is 120 volts at a frequency of 60 Hz, although some inverters are designed to produce 240 volts, or both 120 and 240 volts at 60 Hz. Because some countries use power of different voltage and frequency (e.g. 230 volts at 50 Hz), inverters are available to conform to these requirements.

Inverters use electronic circuits to switch DC input power at the required frequency, such as 60 Hz. This “switched” DC resembles AC power, and is then stepped up in voltage through a transformer. The result is a modified sine wave AC output of the required voltage and frequency that can power AC-driven equipment.

4-3.2 System Features and Specifications

4-3.2.1 General Description

The ITC-Series system consists of a DC to AC true sine wave inverter, a battery charger, an automatic AC transfer switch, and a microprocessor based controller. An important feature of this system is the ITC-Series Control/Display Unit user interface.



4-3.2.2 System Features

Inverter

The inverter consists of a true sine wave inverter that supplies power when AC loads are applied. This model develops 3600 watts of continuous power. Using TruSine® technology, a very high quality sine wave is produced. Total harmonic distortion (THD) is less than 4.0 percent.

Battery Charger with Automatic Power Management

The high efficiency, multi-stage battery charger allows automatic charging of flooded lead acid and gel type batteries. The efficient 0.85 power factor or PF, compared to typical 0.59PF on triac plus type chargers, allows full charger output from a 30-amp AC source. The system's Bulk, Absorption, and Float charge cycle quickly charges and maintains the battery bank. An Equalization charge cycle is available for flooded lead acid battery maintenance. In addition, there is an optional battery temperature sensor to reduce battery float voltage as temperature increases above 25° Celsius.

Automatic Power Management (APM) monitors the AC Input current and will reduce the battery charger output as needed to keep the AC input current below the preset APM Limit.

GenStart Contact

The GenStart feature provides a start/stop signal to control an automatic generator. The start/stop signal consists of a contact closure to start the GenStart based on battery voltage of 12.3 (24.6) VDC. The GenStart turns off when the battery charging current falls below 10 amps.

Low Battery or Fan On Contact

The Low Battery contact allows remote monitoring of the Inverter's battery status. The contact will close when battery voltage falls below 11.0 (22.0) volts. This will alert the user to take appropriate measures to avoid shutdown of the Inverter at 10.5 (21.0) VDC. The SP00172 offers a Fan On contact instead of the Low Battery contact for turning on an external fan or blower when the ITC's fan is on.

Remote Power Switch

This loop between Options Terminal 7 and 8 (left side of Options Terminal) allow remote control of the system On/Off. Tying these two terminals together or optionally, tying the terminal 7 (Remote Switch) to battery ground applies power to the unit.

 NOTE: The Front Panel switch will always overrule the remote switch in terms of disabling the unit.

System Control

The ITC contains a System ON/OFF Switch located in the front of the ITC. This switch is used to turn the control power ON and OFF. This power switch also has a break out loop for a series switch that can be placed in a remote location from the unit (See Remote Power Switch above). A control microprocessor provides a variety of protection interlocks, system fault detection/reporting, recovery, storage of system data parameters, and high-speed data communications to the ITC Control/Display Unit. This Control/Display Unit also has individual on/off switches for independent Inverter and Charger control. The ITC will protect itself in the event of any overload, over temperature, high or low battery voltage condition.

ITC Control/Display Unit

The ITC Control/Display Unit is a user interface that is connected to the ITC Control Board via a 6-wire modular cable. This Control/Display unit can be an integral part of the Inverter or can be removed and mounted in a remote area to allowing remote system operation. Two of these units can talk to the System Control Board one display would be configured as a Master, and the other as Slave. The configuration switches on top of the Master allow programming of the Charger current, Automatic Power Management and battery type settings.

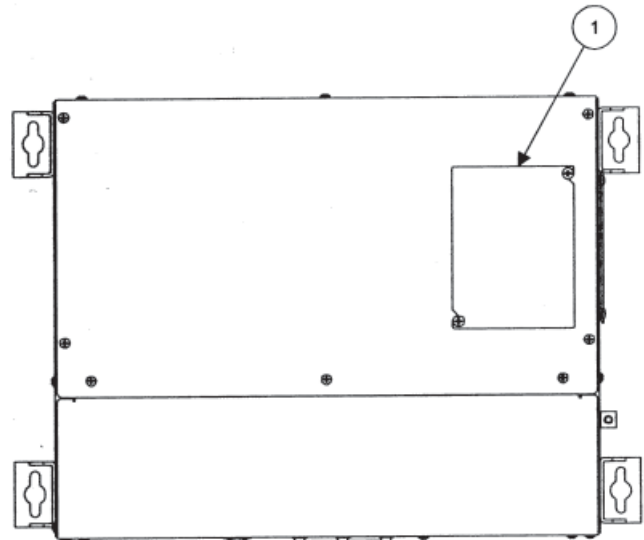
 NOTE: It should be noted that if the Control Display unit is taken out of the front of the unit, the cover plate (Vanner Part #D011339) must be installed in it's place to insure that debris does not enter the unit through the opening and to maintain proper airflow through the unit.

Model	ITC24-3600 SP00172	Model	ITC24-3600 SP00172
AC OUTPUT		INVERTER EFFICIENCY @ Nom.	
Voltage (RMS)	120 VAC	200 watts	77%
Frequency	60 Hz \pm 0.5%	500 watts	85%
AC Waveform	Pure Sine Wave	700 watts	87%
Total Harmonic Distortion (THD)	Less than 4.0% @ full power	1000 watts	89%
Power Factor Allowed	-1 to 1	1500 watts	90%
Continuous Output Rating @ 25°C		2000 watts	89%
Phase to Neutral	3600 watts (30.0 amps)	2500 watts	89%
Surge Capacity @ 25°C (3 sec.)	6400 watts	3000 watts	88%
DC INPUT:		3200 watts	87%
Operating Range (12 Volt Nominal)	21.0 to 31 Volts	3600 watts	87%
No Load, Inverter ON	2 amps	AC INPUT	
No Load, Inverter OFF	0.30 amps	Voltage	120 Volts Nominal
Full Power	175 amps	Frequency	60 Hz \pm 12.5% (52.5 to 67.5)
SYSTEM		AC TRANSFER SWITCH	
Ambient Operating Temperature	-40 to +40°C (-40 to +104°F)	Power Rating	30 amps @ 120 VAC
Cooling Exhaust Fan	Thermostatically Controlled	Transfer Time	Less than 40 milliseconds
Mounting	Shelf or suspended	BATTERY CHARGER	
Dimensions (Bottom mount position)	8¼"H x 18 7/16"W x 13⅝"D	Charger Output Current Maximum	60 amps
Weight	66 pounds	AC Input Current Maximum	30 amps (0.88PF @ rated output)

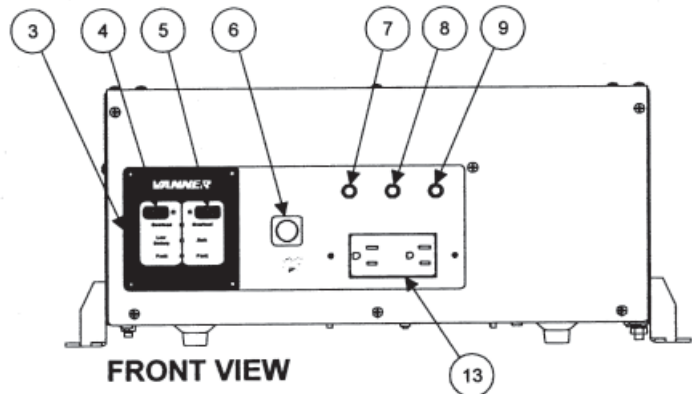
Component Identification/Location

The figures on the next page show the location of the various components of the ITC system.

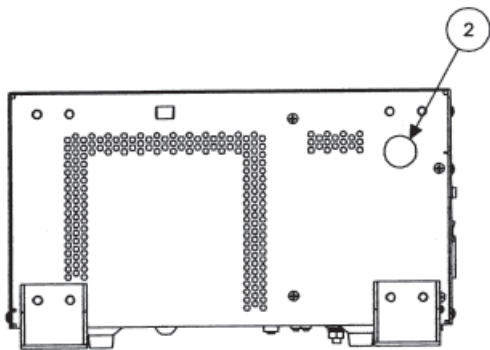
ITEM #	DESCRIPTION
1	BATTERY TERMINAL ACCESS
2	REMOTE CABLE INPUT
3	CONTROL/DISPLAY PANEL
4	INVERTER ON/OFF SWITCH
5	CHARGER ON/OFF SWITCH
6	SYSTEM ON/OFF SWITCH
7	AC INPUT BREAKER (CB-1)
8	AC OUTPUT BREAKER (CB-2)
9	GFCI BREAKER (CB-3)
10	AC INPUT CABLE ENTRY
11	BATTERY +
12	BATTERY -
13	GFCI OUTLET
14	AC OUTPUT CABLE ENTRY
15	OPTIONS CABLE ENTRY
16	CHASSIS GROUND



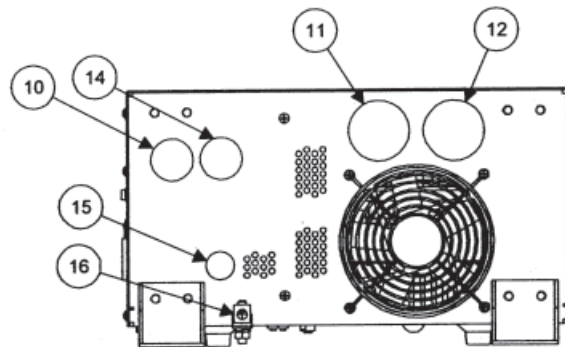
TOP VIEW



FRONT VIEW



LEFT SIDE VIEW



RIGHT SIDE VIEW

Figure 2 - Component Location

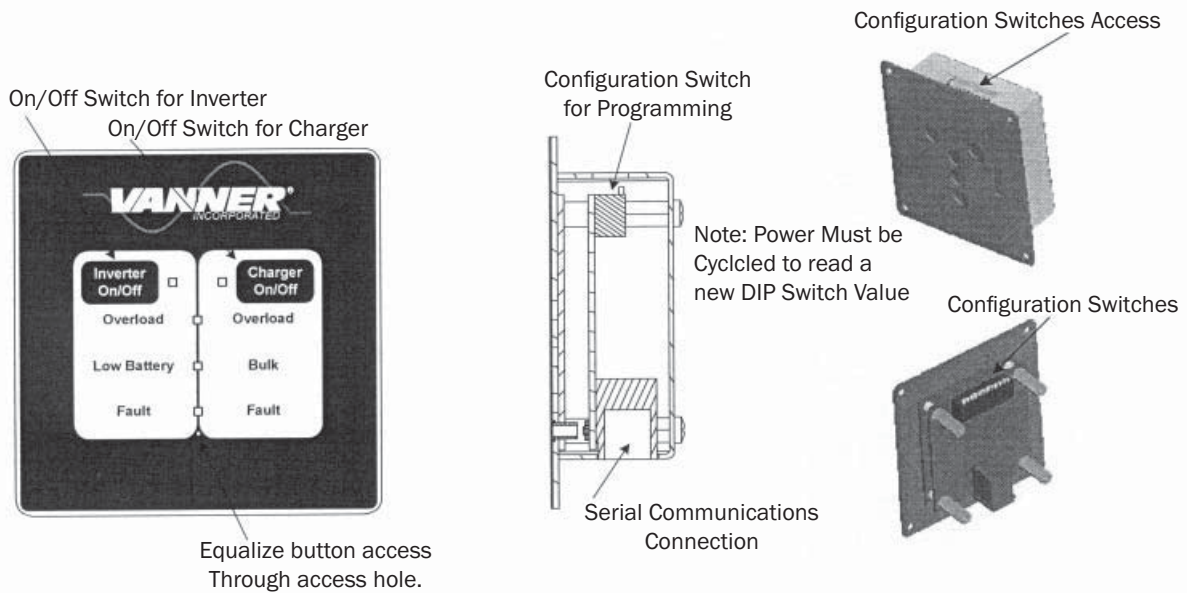


Fig. 3 - ITC Control/Display Unit

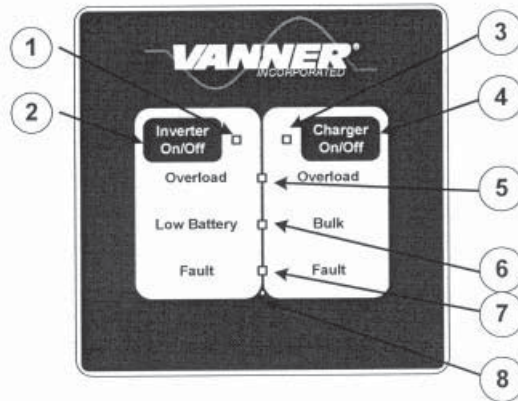


Fig. 4 - ITC Control/Display Unit Component Identification

ITEM	DESCRIPTION
1	Inverter Indicator Light Solid when on, flashes when enabled but not on
2	Inverter On/Off Button Enables/Disables Inverter Function
3	Charger Indicator Light Solid when on, flashes when enabled but not on
4	Charger On/Off Button Enables/Disables Charger Function
5	Overload Light Indicates if Inverter Overloaded
6	Low Battery/Bulk Light Dual Purpose - Indicates Low Battery in Inverter Mode. In Charger Mode - if on indicates that Charger is in Bulk Mode and if in Equalize, this light flashes.
7	Fault Light Dual Purpose - Indicates that a fault has occurred in the inverter or Charger. Could be a Over Temperature shutdown, Low/High Battery Shutdown, Power Stage Fault.
8	Equalize Button Access This is used to enable the equalization cycle on the battery during charging. Note: Master remote can only initiate the equalize cycle. Slave remote cannot initialize equalize cycle.

4-3.3 Description of Operation

4-3.3.1 Inverter

The System ON/OFF Switch, located on the front panel, allows the user to turn the system power ON and OFF and to reset the system after a fault.

The Charger ON/OFF and Inverter ON/OFF buttons, located on the Control/Display Unit enable or disable the Charger or Inverter Functions. The corresponding light next to Inverter/Charger buttons will be steadily on when the unit is in the Inverter or Charger mode. These Inverter and Charger lights will blink if the mode is not currently on, but are enabled.

For Example: The Inverter light will blink when the Inverter is Enabled, the ITC is plugged into the utility, and the Charger is Active.

The Inverter AC Output Circuit Breaker is a 1 pole, 30-amp breaker marked “CB-2” on the front unit. The CB-2 breaker protects the Inverter AC output and a second Breaker (CB-1) protects the Battery Charger AC input against a severe overload. This CB-1 breaker also protects AC Pass through Power. If this CB-1 breaker trips during charger operation, it must be reset.

4-3.3.2 Inverter Protective Interlocks

The Inverter operation is protected by a series of safety interlocks that protect against most failures such as overloads, over-temperature conditions or other conditions where the unit may be asked to operate outside safe battery voltages. These situations will trigger a display of the “Overload”, “Low Battery” and “Fault” indicators on the Control/Display panel and are listed below:

Overload	Inverter AC output current is at the Maximum Current allowed and is presently in “Surge”. The AC voltage will decrease if load increases. Overload Shutdown will occur if voltage goes below 105 VAC for 3 seconds.
Dead Battery	The inverter continually monitors battery voltage. If battery voltage falls below the Low Battery Shutdown 10.5 (21.0) VDC setpoint the inverter will shut OFF. Auto-reset will restart the inverter after battery voltage rises above the Low Battery Warning 11.0 (22.0) VDC setpoint (after 5 minutes).
High Battery	The inverter will shut OFF if battery voltage rises above the High Battery 16.0 (31.0) VDC setpoint.
Battery Low Warning	Battery voltage is below Low Battery Warning setpoint and soon may reach Low Battery Shutdown setpoint of 11.0 (22.0) VDC.
Over Temperature	The inverter will shut OFF if internal temperature sensors detect a high temperature condition that could damage the inverter.
Hardware Fault	Internal protection circuit activated or power brick high temperature will shut down system.

If the unit has faulted there are the two following options:

- 1. Auto-restart** After shutting down for any of the above fault conditions, the inverter will try to restart itself every 5 minutes if Auto-Restart is Enabled and the fault condition no longer exists.
- 2. Manual restart** You can manually restart the system after the fault conditions are removed. Reset the inverter by turning the System ON/OFF Switch OFF and then ON.

4-3.3.3 Battery Charger

The battery charger's advanced design incorporates an automatic, multi-stage charger. This design enables the unit to automatically charge batteries, which maintains the battery's integrity and reduces the likelihood of premature battery failure. In addition, the battery charger can utilize the remote battery temperature sensor to reduce the float voltage based on battery temperature. The battery charger is designed to be used with lead-acid type batteries including sealed and gel types, but not for nickel-cadmium (Ni-Cad) or nickel-iron types.

4-3.3.4 Battery Charging Sequence

Stage 1: Bulk Charge Stage

The charger always starts in the Bulk Charge Stage each time shore power becomes present and/or each time the charger is turned ON. In the Bulk Charge Stage, the system charges at the "Bulk Charge Amps" setpoint until the battery voltage rises to the "Bulk Charge Voltage" setpoint. Then the voltage is held at the setpoint until charging current has fallen to 5 amps above the "Battery Absorption Amps". This ends the Bulk Charge Stage and begins the Absorption Charge Stage. The charger will not enter the Bulk Stage again until shore power is re-applied, or until the charger or the system is turned ON again.

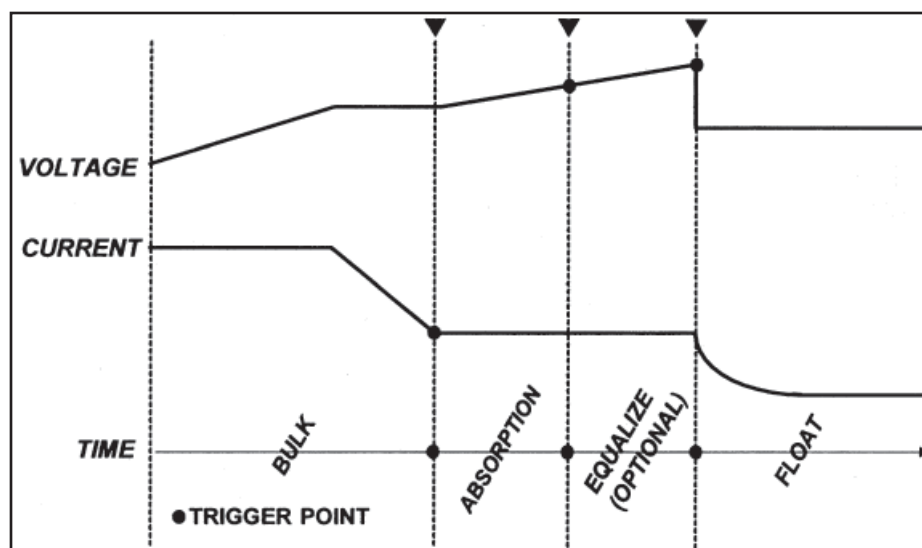


Figure 4 - Charging/Voltage Curves

Stage 2: Absorption Charge Stage

The Absorption Charge Stage provides a controlled "overcharging" of the battery that is necessary to bring the battery up to the full charge. The battery is charged at the "Absorption Charge" until one of the following three conditions occur that signals the end of the Absorption Stage:

Time: The Absorption Maximum Time setpoint is reached

Time: The Absorption Charge Stage time has reached $\frac{1}{2}$ of the duration of the Bulk Charge Stage.

Voltage: Battery voltage reaches the "Absorption Voltage" setpoint

Stage 2A: Equalize Charge Cycle

When Equalize Mode is ENABLED (by inserting a paperclip or similar device through the "master" Control/Display unit Equalizer Hole), one Equalize Charge Cycle will follow the Absorption Charge Stage. The Equalize Cycle will last for the "Equalize Time" setpoint of 15 minutes. Equalize Mode will automatically switch to DISABLED at the end of the Equalize Charge Cycle. During the Equalize Cycle the battery is charged at the "Absorption Charge Amps" setpoint and the Equalize Voltage 15.5 (30.0) VDC setpoint.

The Equalize Charge Cycle provides a deliberate overcharging of the battery to remove sulfate, which accumulates on the battery plates through normal use. Equalizing returns battery cells to equal performance levels, which improves battery performance and extends battery life. Consult the battery manufacturer for their recommendations regarding how often the Equalize Cycle should be performed.

CAUTION!!

Do not equalize sealed (valve regulated lead acid, AGM or gel) batteries! Consult battery manufacturer for equalizing guidelines. Do not equalize more often than approximately once a month. Check battery fluids after equalizing is complete, as gassing will occur. Use Equalize Mode only if batteries are in a well ventilated area!

Stage 3: Float Charge Stage - Maintenance Mode

In the Float Stage the charging voltage is reduced to the “Float Charge Voltage” setpoint and charging current is limited to the “Absorption Charge Amps” setpoint. The charger will remain in the Float Stage until shore power is reapplied, or until the charger or system is turned OFF and then ON again.

4-3.3.5 Charging Setpoints

The ITC’s battery charger factory setpoints are for wet batteries. Do not use GEL type batteries without changing the factory setpoints via the configuration switches.

CAUTION!!

Do not operate DC loads, such as DC lights, pumps, etc., during battery charging. The loads may cause overcharging by preventing the charging stages from reaching their “trigger points” or may cause the battery to run down even though the charger is ON.

Battery Charger Factory Setpoints

	Guideline	SP00172 24V	Factory Setpoint (for Wet Battery)		Factory Setpoint for Gel/AGM Battery		Units
			12V	24V	12V	24V	
Bulk Charge Volts		28.6	14.2	28.4	14.1	28.2	VDC
Bulk Charge Current	20% C Rate	60	80	60	80	80	Amps
Absorption Charge Volts		28.6	14.5	29.0	14.2	28.4	VDC
Absorption Charge Current		55	40	55	40	40	Amps
Absorption Maximum Time		10	10	10	10	10	Minutes
Float Charge Volts		26.6	13.2	26.4	13.7	27.4	VDC
Equalize Volts	Wet only	N/A	15.5	31.0	N/A	N/A	VDC
Equalize Maximum Time	Wet only	N/A	15	15	N/A	N/A	Minutes

Battery “C Rate” is equal to battery Amp Hour capacity.

4-3.3.6 Battery Temperature Sensor Option

The battery temp sensor is designed to reduce the float voltage when the battery temperature exceeds 25° Celsius. No reduction in float voltage should occur below 25°C (77°F). The battery temp sensor plugs into P7, which is located on the left side of the control board. See *F 13 Figure 6 - Customer Terminations*. The battery temperature sensor and 35’ cable kit part number is ITC-BTS. Individually, the temperature sensor part number is D012684 and the cable part number is D012638.

4-3.3.7 Automatic Power Management (APM)

A key feature of the battery charger operation is Automatic Power Management (APM). This feature monitors the AC input current and will reduce the battery charger output as necessary to keep the AC input current under the APM setpoint. The APM circuit will not limit power to the passthrough AC loads. If the passthrough AC loads exceed 30 Amp, the battery charger output will be reduced to zero and the breaker may trip.

4-3.3.8 GenStart

It should be noted that the Generator Start Operation is designed to minimize the generator run time, so at the preset set points there is no Absorption stage per se. Therefore, the batteries must be periodically conditioned by leaving the generator on, or charging them with another system.

The GenStart feature is designed for use in installations where a generator is used to provide AC input power for battery charging. The GenStart feature provides a contact closure to signal the generator to start when battery voltage falls below the "Generator Start Volts" 12.5 (25.0) VDC setpoint. The GenStart contacts open when bulk charging current fall below the "Generator End Amps" 20 Amp DC setpoint. The Bulk charging current is checked every 4 minutes, therefore the minimum generator ON time is 4 minutes. The contact are NEC Class 2, rated 2 amps at 24 VDC.

It should be noted that the GenStart contacts are shown in Figure 6 - Customer Terminations, and likewise a similar set of Normally Open Contacts are available to indicate a "Low Battery" or "Fan On" condition.

CAUTION!!

The battery charging process will be affected if 12 (24) VDC loads are being powered during battery charging. The increased charger output, required to power those loads, may keep the charger from reaching the "Generator End Amps" setpoint.

4-3.3.9 Charger and APM Programming

The chart below shows the control switch settings for programming the ITC Charger and APM settings.

NOTE: It should be noted that the power switch on the front of the unit must be cycled to read in the new Control Switch settings into memory. The new vales will not be recognized until this takes place.

The first 4 (1-4) switches program in the Maximum Charger Current and the next 4 (5-8) program in the APM Current Limit.

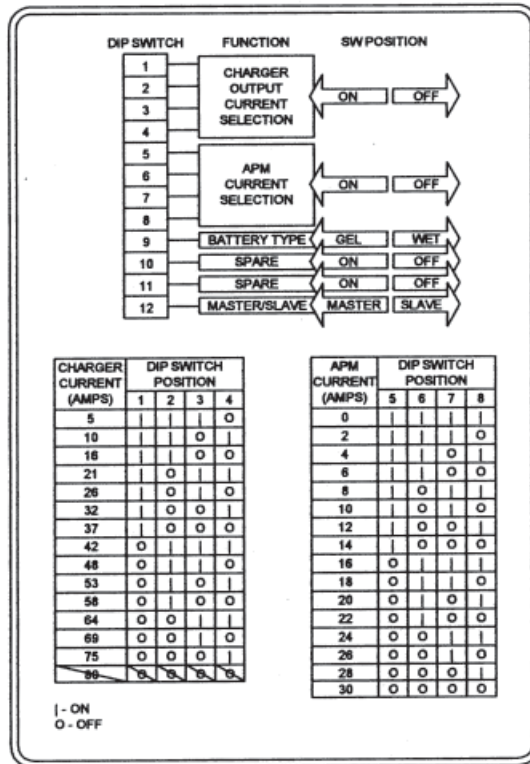
The next switch (switch 9) is for selecting either Wet or Gel type batteries.

The next switch (switch 10) is reserved for future expansion.

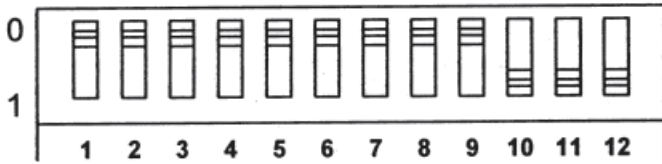
The next switch (switch 11) is reserved for future expansion.

The next switch (switch 12) is reserved for selecting a Master/Slave remote with multiple Control/Display Units.

NOTE: The figure on next page may be available on the Rear of the Control/Display Unit depending on model.

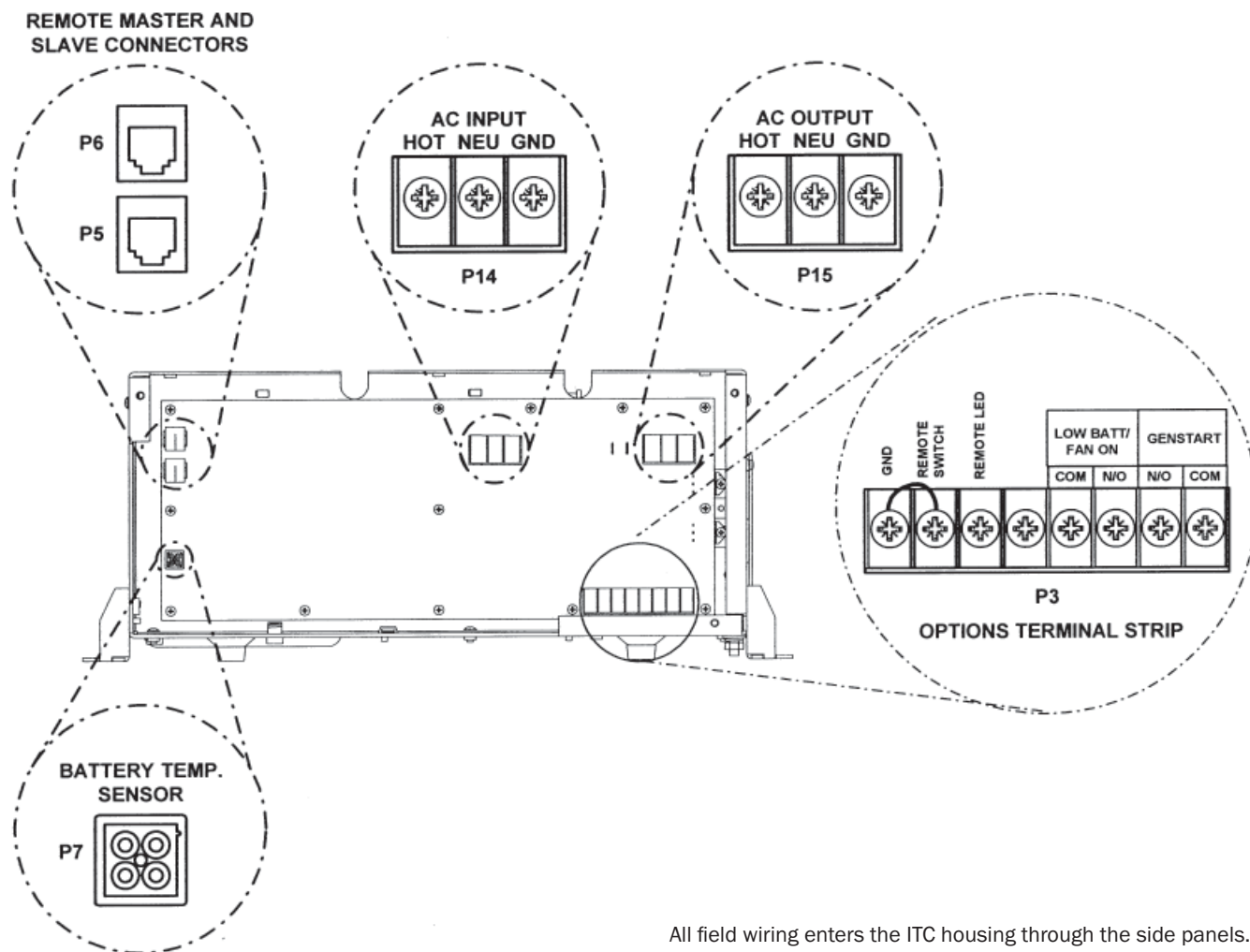


NOTE: After a new switch setting is set, the power switch must be cycled on the main unit for the new setting to take effect.



The graphic to the left indicates the factory defaults. Switches 1 through 4 show a maximum charger current setting. Switches 5 through 8 indicate 30-amp automatic power management. Switch 9 has selected West Cell battery configuration. Switch number 12 indicates "Master" display/control unit.

Figure 5 - APM/Charger/Config DIP Switch Settings



All field wiring enters the ITC housing through the side panels.

Figure 6 - Customer Terminations

4-3.4 Customer Wiring Identification

4-3.4.1 AC Input & Output Wiring

The AC wiring compartment is located on the front right side of the unit. A removable access cover covers this compartment. Two cable clamps are installed for the AC input and the AC output wiring. The removable access cover can be removed by simply removing the screws on the front panel of the unit (ONLY!). There is no need to remove screws from the top or sides of the unit to gain access to the AC wiring compartment. Inside the compartment is a terminal strip for making AC input and AC output connections (P14 and P15).

NOTE: The AC output voltage and the *required* AC input voltage of the ITC is 120 VAC, 60Hz.

4-3.4.2 DC (Battery) Wiring

A DC wiring compartment is located behind the wiring panel on the right side of the unit. The compartment contains a removable access cover on the top of the inverter and two cable clamps for the battery positive and battery negative cables. The inverter's battery cable terminal studs are 5/16-18 and can accommodate Cable sizes up to 250 MCM.

4-3.4.3 Front Panel Control/Display Outlet

This is a RJ-11 (6-Wire) jack (P5) for communications with the Control/Display Unit. A secondary Control/Display unit can be plugged into the P6 jack who would be configured as a slave.

4-3.4.4 System ON/OFF Switch

Use this rocker switch to turn the system ON and OFF and to reset the system. This switch is located on the front panel of the system. If placed in the "OFF" position, this switch will override the operation of a remote ON/OFF switch connected to terminals 7 and 8 of the Options connector shown in Figure 6 - Customer Terminations.

WARNING!!

The System ON/OFF Switch does not interrupt the DC input power to the system, so it must be noted that dangerous DC voltages still exist inside the unit, even if the power switch is turned off.

4-3.4.5 Remote Signal Contacts

Terminal Contacts provide capabilities for Remote Inverter Power ON/OFF and Power indication, Remote Low Battery Warning or Fan On indication, and GenStart control. Contacts are rated 2 amps at 24 volts. Class 2 circuits. Wiring connections are made through an 8 position Options terminal block. Screw pressure-clamp terminals accept up to 14-gauge wire.

A remote power switch will control the system by tying terminals 7 and 8 of the options connector (shown in Figure 6) together. This will actuate an internal relay that turns the control power on. The Power On/Off switch on the front panel defeats this remote switch.

In addition, a terminal for a remote LED indicator is provided (terminal 6) with a current limiting resistor integral to the circuit.

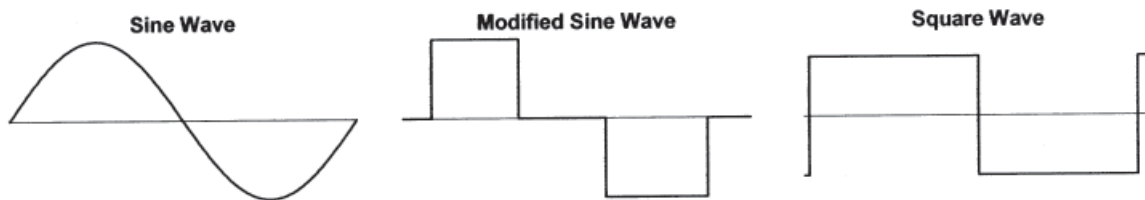
4-3.5 General Information

4-3.5.1 Generic Inverter Description

In general, an inverter converts DC electrical power into AC power. This power can be used to operate various AC-driven appliances. Typical DC power sources include batteries that store electrical energy, power generated from a vehicle alternator or renewable energy sources such as photovoltaic (solar) panels both with the appropriate regulator or charge controller to bring the DC source within the operating range of the inverter.

The most common battery systems are 12 or 24 volt. Some systems, however, operate on higher voltages such as 32, 36, 48, or 120 volts. The most common inverter AC output power is 120 volts at a frequency of 60 Hz. Some inverters, however, are designed to produce 240 volts, or both 120 and 240 volts at 60 Hz. Because some countries use power of different voltage and frequency (e.g., 230 volts at 50 Hz), inverters are available to conform to these requirements.

There are three available inverter types and they are distinguished by the type of AC output wave form they produce. Below is a graphic of the three types of inverters. The coach is supplied with a true Sine Wave Inverter.



Sine Wave Inverter

Sine Wave Inverters produce an AC output waveform like power produced by the electric utility companies and rotating generators. The sine wave inverter's waveform is characterized by the highest peak voltage and smooth voltage transitions (no square wave components). Such inverters are the most costly of the three inverter types because they contain additional electronics to produce the required waveform. A measure of the sine wave quality is Total Harmonic Distortion (THD), and is expressed in a percentage. The lower the THD the higher the quality of the sine wave power.

Modified Sine Wave Inverter

Modified Sine Wave Inverters are sometimes called "quasi sine wave inverters" or "modified square wave inverters." Modified sine wave inverters generally cost more than square wave inverters because they contain additional electronic circuitry to produce true RMS regulated AC output. Modified sine wave inverters have higher AC peak voltages than square wave inverters, and automatically control the width of the AC output waveform to regulate the output voltage (pulse-width modulation). The shape of the modified sine wave inverter's waveform includes a square wave component. It is stepped in such a way, however, to closely approximate the true sine wave produced by the electric utility companies. Although this waveform has a higher peak voltage than do square wave inverters, its peak voltage is not as high as a pure sine wave. Therefore, AC loads containing power supplies might not always operate properly on the modified sine wave inverter.

Square Wave Inverter

The Square Wave Inverter is a low cost device that produces a pure square wave AC power output. This AC power can be an accurate 60 Hz frequency if it is crystal controlled. It does not have the necessary peak voltage to properly operate many AC appliances that contain electronic power supplies (e.g., computers, TVs, and VCRs). The square wave is appropriate when operating AC loads such as resistive heating devices.

4-3.6 Maintenance and Troubleshooting

4-3.6.1 Preventative Maintenance

There are no user serviceable components inside the ITC-Series Inverter/Charger. For service refer to Vanner Incorporated or your Blue Bird Coachworks service department.

Maintenance Items:

For continued reliability and safety, a monthly maintenance program should be implemented to include the following:

1. Check to insure that all AC and DC wiring is secure and connections are tight and corrosion free.
2. Check air ventilation openings for dust and other obstructions.
3. Examine receptacle, indicators and switches for cracks and breaks in insulation material.

4-3.6.2 Troubleshooting

The Unit does not come on when Shore Power or DC is applied and the front Power Switch is on.

Suggestion:

Make certain that the remote switch connected to Options Terminal Strip P3 - terminals (Remote Power Switch P3-7 - To Ground P3-8) is functioning properly. If the switch is not installed, make certain that a jumper is present between the two left most terminals (GND and Remote Switch) as shown below.

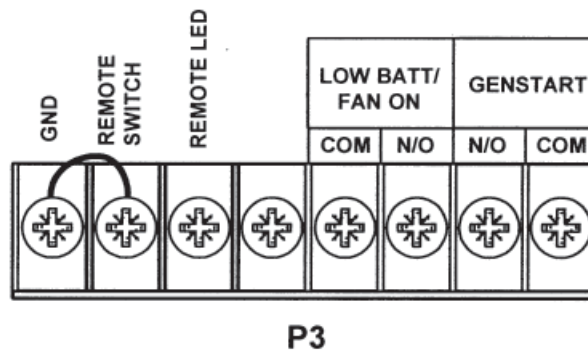


Figure 8 - Options Terminal Strip

4-4 Battery Systems

The battery system is comprised of two chassis (engine) batteries and eight house batteries, located in the last bay curbside of the coach. There is also a generator battery that is located in the nose of the coach next to the generator. Batteries are described below:

4-4.1 Chassis (engine) Batteries

Two 12-volt maintenance free 810 CCA batteries wired parallel produce power for starting the motor home engine.

4-4.2 Battery Charger

One 160-Amp battery charger (integral with the Vanner inverter) operates when a source of 120 volts of AC is supplied from either shoreline or generator. The charger is connected to the motor home batteries. Enabling the auxiliary battery switch on the lower dash may also charge the engine batteries.

4-4.3 Generator Battery

A separate 12V rated at 530 CCA battery is installed for starting the generator. This is located in the nose of the coach right next to the generator.

4-4.4 House Batteries

The house battery system consists of eight Lifeline 4D AGM batteries with an Amp-Hour rating of 210 alt each.

With the Lifeline batteries you get:

- Aircraft class cell construction:
 - » Lowers internal resistance for high repeated engine start current.
 - » Withstands shock and vibration much better than standard flooded or gelled electrolyte designs.
- Twice as many discharge/charge cycles as the leading gel battery depending on depth of discharges.
- Faster recharge, no current limitations with voltage regulated recharging
- Much better charge retention than low cost, flooded cell types, even at high ambient temperature.
- Full recharge after 30 days storage in a full discharge condition (77 °F rating).
- Less than 3% per month self discharge at 77 °F (25 °C); less at lower temperatures.
- Sealed construction with absorbed electrolyte-no shipment restrictions, submersible without damage; install in any position; no need for watering.
- Cell safety vent valves-pressure regulated, non-removable.
- Rugged, non-marring polypropylene (copolymer) case/cover.
- Safety-even during severe overcharge the Lifeline AGM battery produces less than 2% hydrogen gas (4.1% is required for flammability in air)

Deep Cycle Batteries Specifications

PART NUMBER	NOM VOLTS	OVERALL DIMENSIONS			UNIT WT Lbs. (Kgs)	CCA 68 ° F	CCA 32 ° F	CCA 0 ° F	CAPACITY AMPERE HOURS @20 HR. RATE	MINUTES OF DISCHARGE@		
		L in (mm)	W in (mm)	H in (mm)						25 AMPS	15 AMPS	8 AMPS
GPL-U1T	12	7.71 (196)	5.18 (132)	6.89 (175)	24 (10.9)	325	275	215	33	50	93	185
GPL-24T	12	11.13 (283)	6.77 (172)	9.25 (235)	56 (25.5)	800	680	550	80	149	259	524
GPL-27T	12	13.09 (333)	6.77 (172)	9.25 (235)	65 (29.5)	845	715	575	100	186	324	655
GPL-31T	12	12.90 (328)	6.75 (172)	9.27 (236)	69 (31.4)	880	750	600	105	195	340	688
GPL-4DA	12	20.75 (528)	8.71 (222)	10.09 (257)	135 (61.2)	1595	1360	1100	210	390	680	1375
GPL-4DL	12	20.75 (528)	8.71 (222)	10.44 (266)	135 (61.2)	1595	1360	1100	210	390	680	1375
GPL-8DA	12	20.72 (527)	10.94 (278)	9.88 (251)	162 (73.6)	1975	1675	1350	255	475	825	1670
GPL-8DL	12	20.72 (527)	10.94 (278)	10.23 (260)	162 (73.6)	1975	1675	1350	255	475	825	1670
GPL-4C	6	10.27 (261)	7.12 (181)	11.54 (294)	66 (30.0)	1095	925	750	220	492	856	1692

Terminals: GPL-24T, GPL-27T & GPL-31T are heavy duty silicon-bronze Marine Terminals and the GPL-U1T is a 6mm copper alloy threaded insert. All "T" batteries supplied with brass bolts and washers. A=Automatic Post. L=L bladed terminal 8mm bolt hole and supplied with bolts and washers. Handles: "T" models-Handles are built into cover design. GPL-24T and GPL-27T also incorporate strap handles. Handles not available on part numbers GPL-4C and GPL-31T. Models GPL-4D & GPL-8D are equipped with rope handles. Ratings: Capacity ratings are stated at 77 °F (25 °C) to 1.75 volts per cell. Drawings: Product drawings for each model available upon request.

Starting Batteries Specifications

PART NUMBER	NOM VOLTS	OVERALL DIMENSIONS			UNIT WT Lbs. (Kgs)	CCA 68 ° f	CCA 32 ° F	CCA 0 ° F	CAPACITY AMPERE HOURS @20 HR. RATE
		L in (mm)	W in (mm)	H in (mm)					
*GPL-1400T	12	9.78 (249)	5.17 (132)	5.83 (174)	32 (14.5)	850	700	550	57
*GPL-2400T	12	11.13 (283)	6.77 (172)	9.25 (235)	53 (24.1)	870	790	650	75
*GPL-2700T	12	13.09 (333)	6.77 (172)	9.25 (235)	63 (28.6)	1020	900	745	95
*GPL-3100T	12	12.90 (328)	6.75 (172)	9.27 (236)	67 (30.4)	1120	950	810	100

Ratings: Capacity ratings are stated at 77 °F (25 °C) to 1.75 volts per cell.

Drawings: Product drawings for each model available upon request.

***NOTE: These are starting batteries only. SPECIFICATIONS SUBJECT TO CHANGE WITHOUT NOTICE.**

4-4.5 Split Battery Power System

The coach is run by house and chassis batteries. The Battery Connect/ Battery Disconnect switch connects and disconnects the house and chassis batteries.

4-4.6 Battery Maintenance

Your motor home is equipped with separate engine and house battery systems for greater assurance that there will be sufficient voltage to crank the motor home engine.

The two engine batteries and the eight house batteries are all located in the last bay curbside of the coach.



The house and engine batteries are charged from either the alternator or the inverter battery charger. The auxiliary battery switch is in the ON position in order for the inverter battery charger to operate, either the generator must be running or the motor home must be connected to a shoreline supply.

To make sure that the batteries are always ready for use, periodically check and charge them as necessary.

A dirty battery may eventually dissipate its charge through conductive surface contamination. Clean the engine battery top surfaces with a damp cloth and dry thoroughly. Check that battery terminals and associated battery jumper terminals are tight and free of corrosion. To clean terminals, neutralize corrosive deposits with a solution of baking soda, rinse with clear water, and dry. Note that commercial type spray-on battery cleaners are available at automotive supply stores. Use as directed to keep the batteries clean. Spray-on cable and terminal protective coatings are also available, easy to use, and effective.

CAUTION!! Avoid sparking of any form in the vicinity of the batteries.

CAUTION!! Do not wear metal rings, watches or jewelry when working on or near the batteries, cable, solenoids or chassis wiring. These can short out electrical wiring and cause injury.

4-4.7 Battery Storage in Freezing Weather

Batteries that are not kept fully charged must be given protection against freezing. Partially charged batteries will freeze at low temperatures, so batteries must either be left charged or removed from the vehicle and stored in a warm location. The motor home can be left connected to the shoreline AC supply and the inverter battery charger will keep the motor home batteries charged.

NOTE: The inverter must be turned on to charge the batteries.

NOTE: Even in a warm location it is advisable to keep the batteries charged to prevent deterioration. The engine batteries are the sealed type and require no electrolyte service.

Coat battery terminals with lubricant or protective coating.

4-4.8 Battery Terminals and Jump Starting

The proper procedure for jump-starting, using the Wanderlodge® engine batteries, is as follows:

1. Turn off all main battery-operated accessories in both vehicles such as the lights, radio, etc.
2. Connect one end of the positive-coded jumper cable to the positive (+) battery terminal, and the opposite end of the cable to the positive (+) terminal on the other battery.
3. Connect one end of the negative-coded jumper cable to the negative (-) terminal on the other battery and the opposite end of the cable to the Wanderlodge engine block.
4. Once the engine of the disable vehicle is started and brought up to idle, reverse the above procedure to remove the jumper cables. Always remove the jumper cable connected to the engine block terminal first to prevent sparks at the other battery.

CAUTION!! Avoid sparks in the vicinity of a charging battery. The gas produced is explosive.

4-5 Leveling System

4-5.1 Introduction

4-5.1.1 What it Can Do

Your motorhome is equipped with a Hadley Air Leveling System which has two operational modes: Ride Mode and Parked Mode. The Ride Mode uses the Hadley Smart Air Management System (SAMS). The Parked Mode uses the Hadley Self-Leveling System (SLS). This microprocessor based system controls the inflate/deflate operation of the individual suspension air bags in accordance with the respective operational mode.

The Ride Mode, SAMS, is selected when the Park Brake is released. This mode automatically adjusts the ride height when the Ignition switch is ON and the engine driven air compressor is running.

With SAMS, the user can change the vehicle height by selecting one of several predetermined settings from the operator's control panel. This is useful when departing from a steep driveway; the rear end can be raised to increase the departure angle.

With SAMS, the user can also inflate/deflate the tag axle air bags when the vehicle is stationary or is traveling at slow speeds. By deflating the tag axle air bags, the turning radius can be reduced or additional traction can be transferred to the drive axle.

The Parked Mode, SLS, is selected when the Park Brake is engaged. This allows the user to level the vehicle when parked on an uneven surface. After the vehicle is leveled, the SLS can be placed into the Standby Mode to reduce House battery drain.

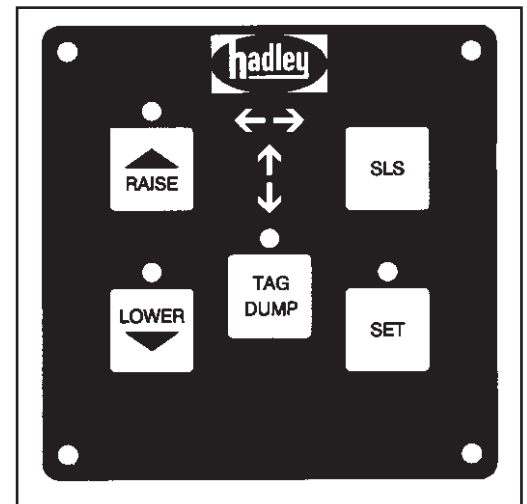
The transition from the Parked Mode to the Ride Mode occurs when the Park Brake is released. The vehicle attains ride height within 5-10 seconds after the engine is started.

4-5.1.2 What it Cannot Do

Many of the user settings are available only when operating below certain speeds or when the parking brake is applied.

4-5.1.3 User Interface

The Hadley operator's panel is located on the left side of the driver position. The user has the ability to select the predetermined ride height settings, SLS functions, and tag axle control. The indicator lights provide feedback to the operator.

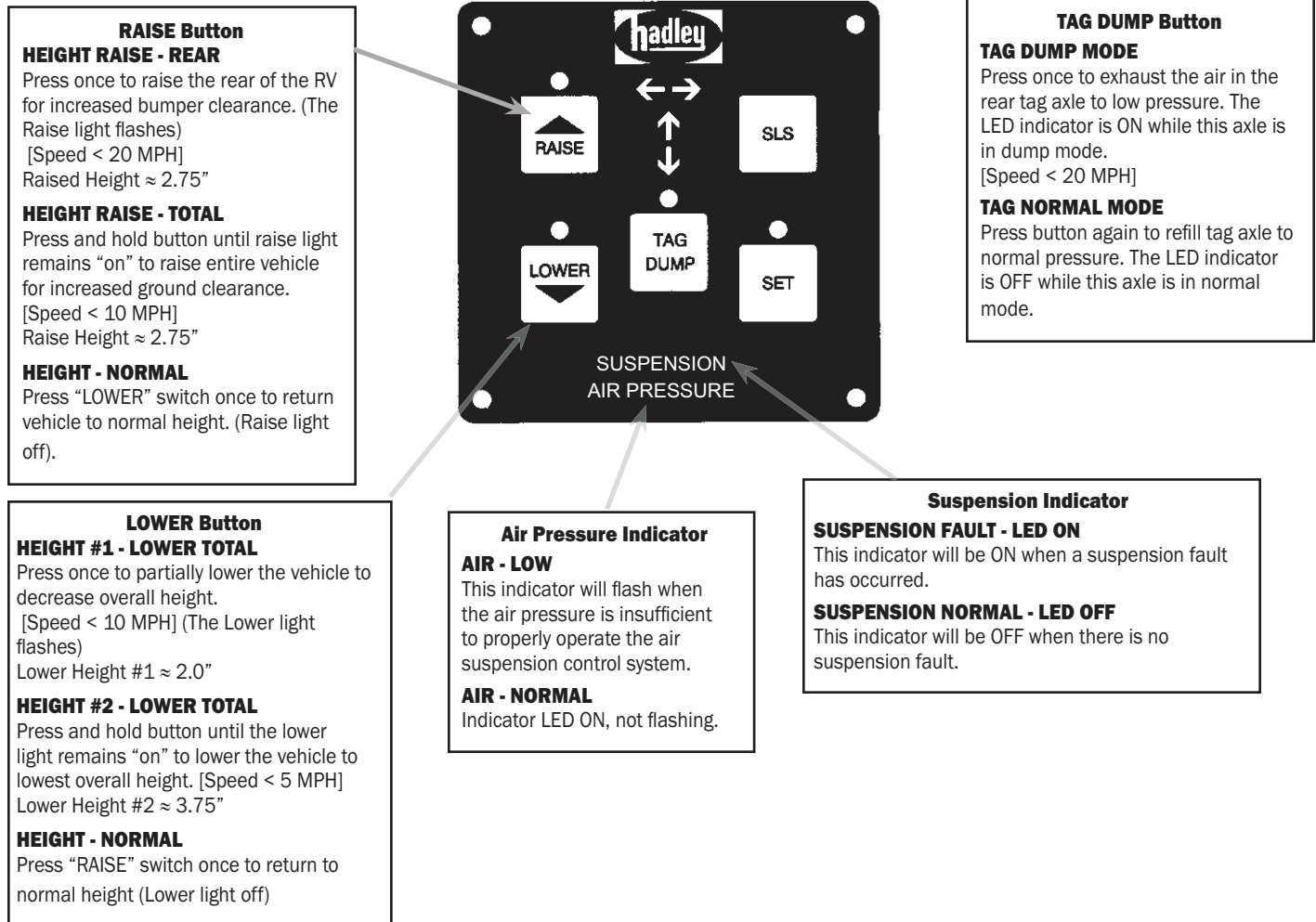


Leveling Operator's Panel

4-5.2 Operation Instructions

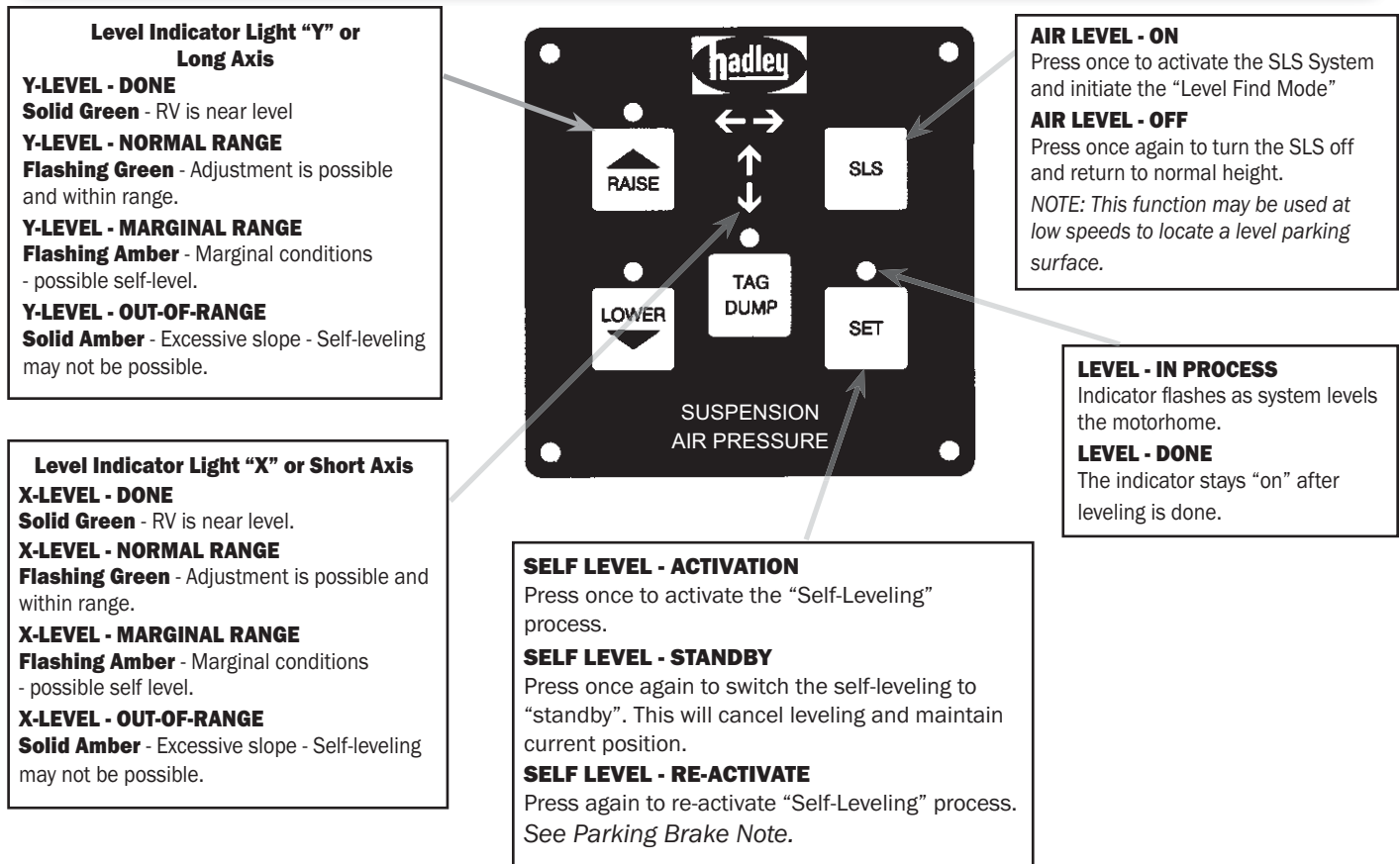
4-5.2.1 Location of Raise, Lower and Tag Axle Buttons and Indicator Lights

Ride Mode - Raise, Lower, and Tag Control



Parked Mode Buttons and Indicators

Note: The “Level Find Mode” is used to help locate a level surface on which to park before the SLS “SET” button is used.



SLS Control Functions and Indicators

Note: The parking brake must be applied before the SLS “SET” feature can be used.

4-5.2.2 Power ON

When the vehicle is first turned on, the Hadley SAMS will gather information from the sensors. This period of time will be approximately 5 seconds. The system will not make any adjustments during this time. See the troubleshooting section if the Suspension Light stays on or starts blinking.

4-5.3 Hadley SAMS Pressure Requirements - Ride Mode

4-5.3.1 Switch ON

Electrical power must be “ON” and system air pressure above 90 PSI.

WARNING!!

Failure to operate the vehicle without sufficient air pressure may cause vehicle damage or personal injury.

4-5.3.2 Switch OFF

The electrical power must be switched “OFF” when jacking, hoist towing or during designated service procedures.

WARNING!!

Failure to power off electrical system power and release air pressure may cause vehicle damage or personal injury.

4-5.4 Ride Height Mode Definitions

4-5.4.1 Normal Ride Height

This is the standard height for the vehicle during normal driving operation.

4-5.4.2 Raised Mode

The vehicle is raised to increase the clearance between the ground surface and the underside of the frame. The vehicle can be raised approximately 2.75 inches.

4-5.4.3 Lowered Mode

The vehicle is lowered to increase clearance above the vehicle. This mode will reduce the clearance between the ground and the vehicle frame. By pushing the Lower Button once, it will lower vehicle approximately 2.0 inches. If Lower Button is held down vehicle will lower approximately 3.75 inches.

4-5.4.4 Tag Dump

This button controls the air pressure in the tag axle air bags. This feature allows the user to reduce load on the rear axle to decrease turning radius and improve maneuverability. The dump feature is also used to increase traction on the drive axle.

4-5.4.5 Vehicle Height Change Procedures

IMPORTANT: The vehicle’s engine should be running when changing heights. This allows the vehicle to provide sufficient air supply to the air suspension system.

4-5.4.6 Normal Driving Mode to Raised Rear Mode

Press the “Raise” button once to enter the “Raise Rear Mode”. This mode is used to increase the clearance between the bumper and the ground.

The “Raise Rear Mode” may be activated at speeds up to 20 MPH, the vehicle will return to normal ride height mode when your speed exceeds 20 MPH or if the “Raise Rear Mode” has been on for more than 40 seconds.

The “Lower” button may be pressed once to return to the normal ride height mode.

4-5.4.7 Normal Driving Mode to Raise Mode

Press and hold the “Raise” button (about 3 seconds) until the indicator remains “on” to activate the “Raise Mode”. This mode is used to increase the clearance between the entire vehicle and the ground.

The “Raise Mode” may be activated at speeds up to 10 MPH, the vehicle will return to normal ride height mode when your speed exceeds 10 MPH or if the “Lower button” is pressed once.

4-5.4.8 Normal Driving Mode to Lower Mode

Press the “Lower” button once to enter the “Partial Lower Mode”. This mode is used to decrease the overall height of the vehicle to clear obstructions.

The “Lower Mode” may be activated at speeds up to 10 MPH, the vehicle will return to normal ride height mode when your speed exceeds 10 MPH or if the “Raise” switch is pressed once.

4-5.4.9 Normal Driving Mode to Full Lower Mode

Press and hold the “Lower” button (about 3 seconds) until the indicator light remains “on” to activate the “Full Lower Mode”. This mode is used to decrease the overall height of the vehicle to minimum to clear obstructions.

The “Full Lower Mode” may be activated at speeds up to 5 MPH, the vehicle will return to normal ride height mode when your speed exceeds 5 MPH or if the “Raise” button is pressed once.

4-5.4.10 Tag Dump Mode

The “Tag Dump” button controls the air pressure in the tag axle air bags. This feature allows the user to reduce the load on the rear axle to decrease turning radius and to improve maneuverability. This feature is also used to increase traction on the drive axle.

When the “Tag Dump” is active and the speed is less than 12 MPH, the system will reduce the tag axle pressure from normal pressure to about 5 PSI, if the speed increases above 12 mph the tag axle pressure will increase to about 30 PSI, when above 20 mph the tag axle will return to normal operating pressure and the “Tag Dump” mode indicator will switch off.

The “Tag Dump” button can be pressed at any time to either activate or switch off the “Tag Dump Mode”.

4-5.5 SLS/SET Controls - Parked Mode

The “SLS” and “Set” buttons are used to control the self leveling feature.

The SLS button is used to activate the system and two indicator arrows located to the left of the SLS button.

The SLS feature can be turned on when operating at slow speeds to help find a level location (“Level Find Mode”).

Refer to the information on page 6 regarding the arrow indicators.

Note: The “Set” button activates the self leveling feature. The SLS system must be switched ON and the parking brake applied before the “Set” button can operate.

The “Set” command levels the RV by first adjusting the “Y” axis and then adjusting the “X” axis. The “Set” indicator flashes while the RV is leveling and then stays “ON” when the leveling is complete.

By pressing the “Set” button after leveling is complete, the SLS is placed into “Standby” State. The “Standby” State disables the automatic leveling process and reduces the battery power consumption.

4-5.6 Roadside Emergencies and Service

4-5.6.1 Jacking or Towing

The electrical power to the Hadley SAMS system must be turned OFF whenever jacking or towing this vehicle.

4-5.6.2 Tire Replacement

The electrical power to the Hadley SAMS system must be turned OFF whenever jacking or towing this vehicle.

See **Towing Section** for instructions on how to tow the motorhome.



NOTES:

A series of 20 horizontal lines provided for taking notes.

4-6 Awning Operation

Your motor home comes equipped with three manual awnings, a patio awning, a slide-out awning and a window awning. Zip Dee, Inc manufactures all three. An optional power awning can be purchased for the patio awning, which is manufactured by Girard RV Products, Inc. See below for basic operation of these awnings.

4-6.1 Manual Awning Operation with Clamp Wheels

4-6.1.1 Opening

1. Insert the pull rod behind the Z-Lock lever and pull downward (Fig. 1A). This releases the awning. Then turn the clamp wheel counterclockwise and swing the assembly toward the center to free the hardware (Fig. 1B).

NOTE: Leave Z-Lock open when awning is open to avoid damage.

2. Insert the pull rod into the loop of the center control strap and unroll the awning by pulling it toward you (Fig. 2). Step under the awning and fold or roll the control strap toward the backside of the roller and tuck under restraining strap.

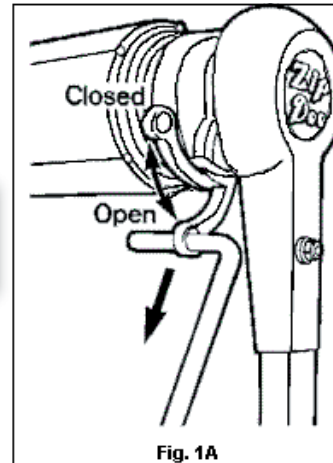


Fig. 1A

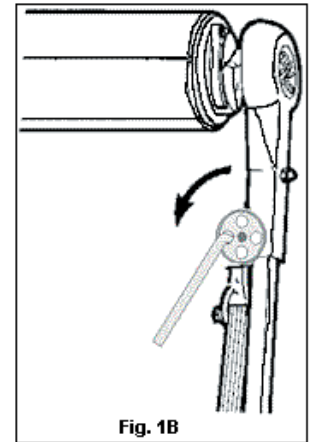


Fig. 1B

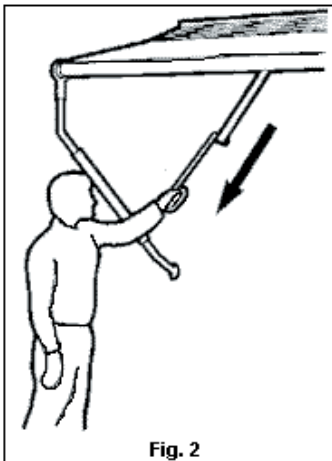


Fig. 2

3. Release the rafter arm by pulling outward on the cap of the ratchet stud located on the upper portion of the arm (Fig. 4). Extend the arm and place the claw over the shaft of the roller.

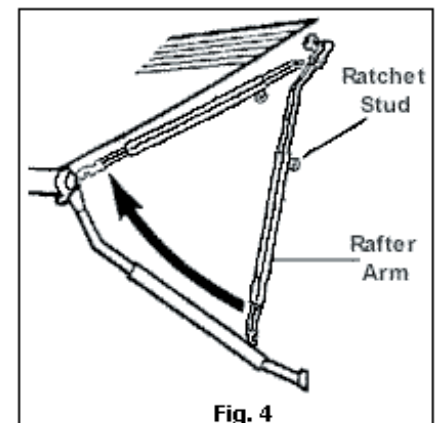


Fig. 4

4. Set the spring tension of the rafter arm by grasping the outer tube and pushing briskly forward in the direction of the arrow as shown in Fig. 5 until a click is heard indicating the arm is locked. At this point the awning fabric will be taut.

NOTE: Leave Z-Lock open when awning is open to avoid damage.

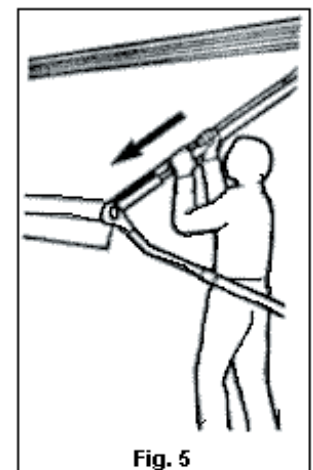


Fig. 5

5. Raise the awning to the desired height by releasing the snap stud on the main arm and pushing up and outward on the roller assembly (Fig. 6).

REPEAT STEPS 3-5 FOR THE OTHER END OF THE AWNING.

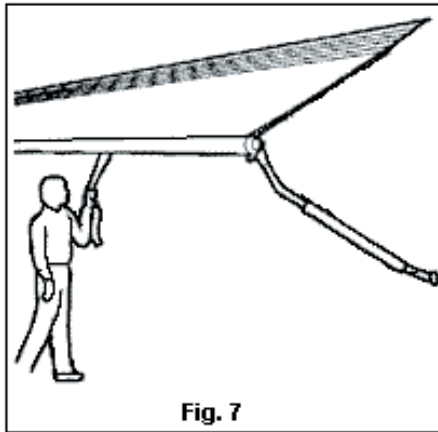


Fig. 7

Partial Extension or “Caravan” Position

1. Follow Steps 1 and 2 above.
2. Insert the pull rod in the loop of the center control strap and unroll the awning to the desired extension (Fig. 7).
3. To prevent billowing, hook the claw of the unextended rafter arm over the roller shaft (Fig. 4). This will require the awning be extended approximately four and one half feet.
4. Raise the awning to the desired height by following step above.

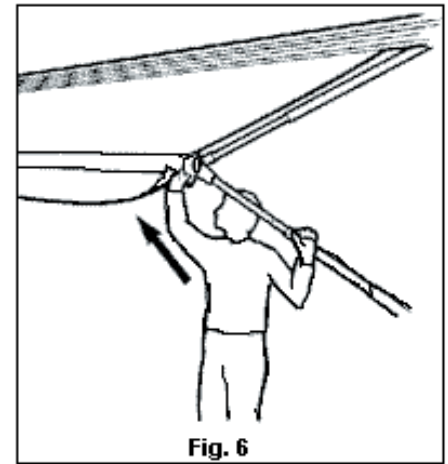


Fig. 6

4-6.1.2 Closing

1. Release the snap stud of the main arm and lower the awning.
2. Release the ratchet stud on the rafter arm by pulling outward on the cap. Lift the claw from the roller shaft and place it on the height adjustment stud located on the inside of the main arm. This allows a “scissors-like” action that helps guide the arm upward.
3. Repeat steps 1 and 2 for the other end of the awning.
4. Face the awning and hold the end of the control strap firmly in one hand then push the roller up briskly with a rolling motion until you feel the spring take over. Control the speed by holding the control strap and let the awning roll freely the rest of the way. This additional force will help tighten the fabric around the roller for the tightest, neatest appearance.
5. Lock the awning in place by reversing Steps 1 and 2 of the opening procedure (Figs. 1A and 1B).

NOTE: If you don't have clamp wheels (Fig. 1B), see Universal Operation later in this manual.

4-6.2 Universal Awning Operation

4-6.2.1 Opening

1. Insert the pull rod into the Z-Lock lever and pull down (Fig. 8). This releases the awning.

NOTE: Leave Z-Lock open when awning is open to avoid damage.

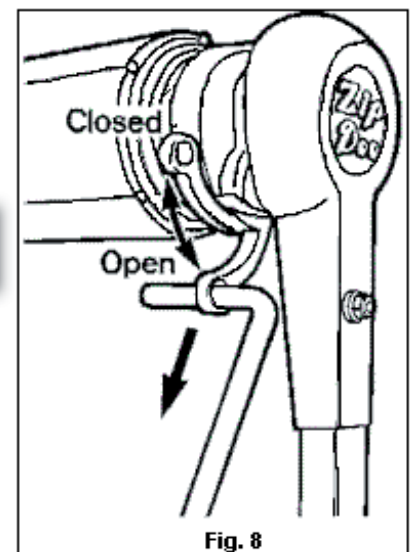
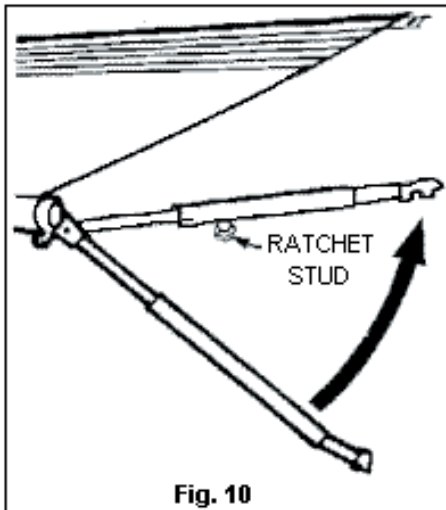
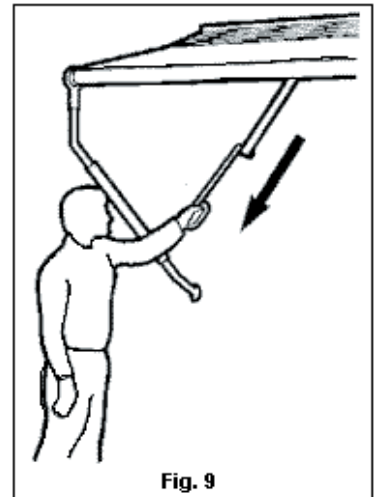
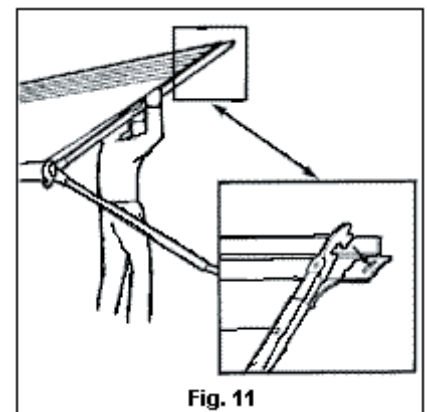


Fig. 8

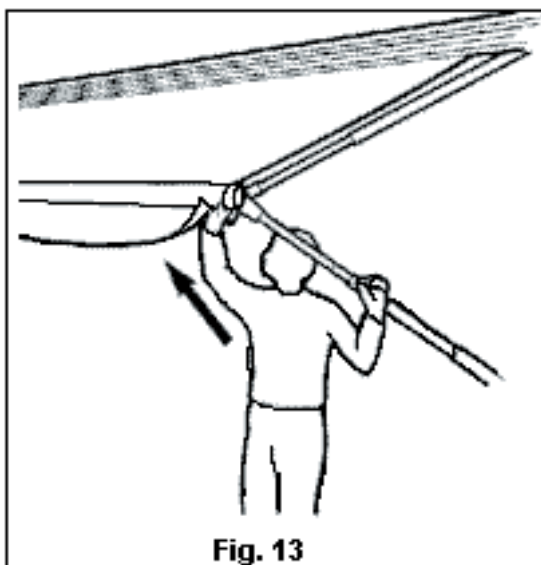
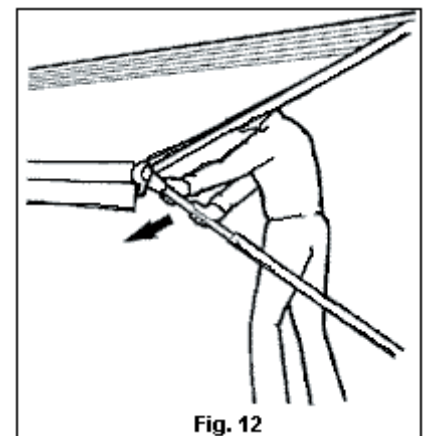
2. Insert the pull rod into the loop of the center control strap and unroll the awning by pulling it toward you. (Fig. 9). Step under the awning and roll or fold the control strap toward the backside of the roller and tuck under the restraining strap.



3. Release the rafter arm by pulling outward on the cap of the ratchet stud. Raise the arm upward toward the case (Fig. 10). Extend the arm and set the claw shaped end into the slot of the rafter lock (Fig. 11).



4. Lock the rafter arm in position by pressing down on the steel main arm bar (Fig. 12) until the ratchet stud clicks. At this point the fabric will be taut.
5. Raise the awning to the desired height by releasing the snap stud on the main arm and pushing up and out on the roller assembly (Fig. 13).



NOTE: Leave Z-Lock open when awning is open to avoid damage.

Partial Extension or “Caravan” Position

1. Follow Step 1 on previous page.
2. Insert the pull rod in the loop of the center control strap and unroll the awning to the desired extension.
3. To prevent billowing, release and raise the rafter arm (Fig. 10) and hook the claw of the arm into the slot of the rafter lock (Fig. 14). This will require the awning to be extended approximately four and one half feet.
4. Raise the awning to the desired height by following Step 5.

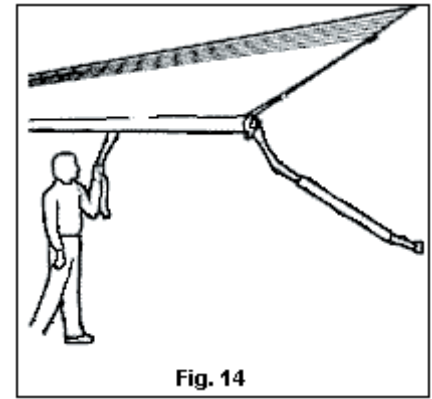


Fig. 14

4-6.2.2 Closing

1. Release the snap stud of the main arm and lower the awning to its bottom most position.
2. Release the ratchet stud of the rafter arm and lift the claw out of the rafter hook.
3. Place the claw casting on the protruding height adjustment stud. To lock the assembly in a travel position, push the other tube downward until the ratchet stud snaps closed. Repeat Steps 1-3 for the other end of the awning.
4. Face the awning and hold the end of the control strap firmly in one hand. Push the roller briskly upward with a rolling motion until you feel the spring take over. Control the speed of closure by holding the control strap until all but 6 inches of the fabric has rolled up. Release the strap and let the awning roll freely the rest of the way. This extra force will help tighten the fabric around the roller to insure the tightest, neatest appearance.
5. Lock the awning in place by flipping the Z-lock lever into the “closed” position using the pull rod.

If Awning Rolls Up Uneven

Observe if the roll-up is even and in line with the clamps (if any). If not, then unroll the awning and give the roller a slight push towards the direction it should go. If you wish to have the awning roll up more in either direction, then spiral the pull strap in that direction.

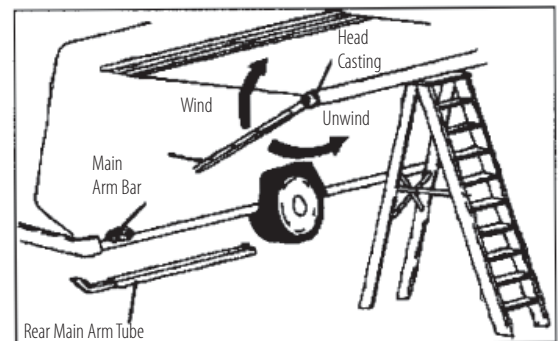


NOTE: The strap must be spiraled around the roller. This prevents a loose roll and bunching of the fabric.

How to Adjust Spring Tension

There is only one spring, located at the rear end of the awning. The winding procedure uses the main arm bar as a lever, since the spring is connected to the bar through the roller shaft and head casting.

1. Open the Z-Lock lever(s) carefully and allow the awning to open.
2. Support awning roller with ladder or with help of assistant.
3. Disconnect rear main arm from main hinge. Pull outward on snap stud and slide tube portion off from bar (to shorten arm for winding.)
4. Stand at the rear of awning facing front of vehicle and grasp main arm bar. Adjust the spring by winding clockwise to increase tension or counter-clockwise to decrease tension so that the open awning will not start to roll up until given a rolling start by hand of about 12 inches. This will eliminate the need to lock the awning open.



WARNING!!

The spring is under tension. Do not disconnect the bar from the head casting. The weight of the bar is enough to counterbalance the spring tension. Use of any other winding device could be dangerous if not controlled, resulting in personal injury or property damage.

- After winding, slip the main arm tube back onto the bar and reconnect it to the main hinge on the vehicle and test the tension.

NOTE: Leave Z-Lock lever (both ends) OPEN when awning is open to avoid damage.

For proper rafter arm operation the ratchet stud must be correctly installed.

The ratchet stud screws into the tube using a 7/16" wrench and the flat side of the stud should face the end of the rafter tube.

The off center pin can be pushed up or down using pliers so the cap (and the pin that's attached to it) can be re-positioned.

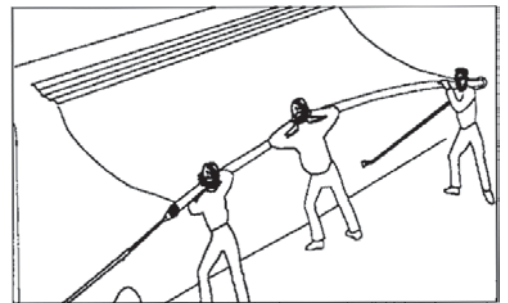
NOTE: The claw opening should face away from the motor home on "Universal Style" hardware and TOWARDS the motor home on "Contour Style" hardware.

On contour hardware the ratchet stud should release easily from the counter sunk stop hole at the top of bar when opening awning.

How to Repair a Bowed Roller

NOTE: This can only be done if there is no crimp or kink in the 3" tube. If the tube is crimped, it is necessary to replace the tube.

- Unroll the awning.
- The awning should be supported and held at both ends on the shoulders of two (2) individuals, see Fig. At left. Also, the awning should be walked in toward the motor home approximately one (1) foot, to provide slack in the fabric.
- Place the bow of the roller facing up.
- A third person should hang on the tube at the center point of the bow. Doing this gradually will remove the bow.
- To check for straightness, roll the awning up. If a wobble is present, further straightening is required.



4-6.3 Hardware and Mechanism Maintenance

Although your Zip Dee awning requires less maintenance than any other awning, a little care (about the same amount that you give to your motor home) will keep the metal parts in top shape. The rafter arm assemblies, main arm tubes, and the awning case are anodized aluminum; the castings are high-strength aluminum alloys. To keep these parts new looking they should be cleaned once a year with a good quality non-abrasive chrome or aluminum polish.

The main arm bar and all fasteners and stress bearing shafts are stainless steel. These need only be cleaned occasionally to remove accumulated grime that might hinder their operation.

At the end of each season:

- Tighten any loose bolts or screws (Replace missing parts only with factory authorized replacements).
- Clean accessible hardware with non-abrasive cleaner.
- Use a silicone lubricant only on the 1/2" round shafts that protrude from each end of the roller.
- Extend all telescoping arms as far as possible to wipe off accumulated sand and dirt that can clog and scratch the protective aluminum finish. No lubrication is required on those parts.

Replacement Parts

Use only genuine Zip Dee replacement parts when repairs are needed. Use of substitutes may damage your awning or void your warranty. Parts may be ordered through your local Zip Dee dealer. If you need help, we are as close as your telephone or post office. Use the number and description found on the parts list in the Zip Dee booklet provided with your motor home when ordering parts and be sure to include the make, model and year of your vehicle. Warranty claims must include the damaged part. If you cannot remove the damaged parts with a replacement, you must purchase the part at full price and receive a refund (if the warranty applies) when we get the damaged part back. Take a moment to copy your hardware serial number and hardware code number from your front main arm tube here _____

All parts are sent COD unless your charge card number or check accompanies your order.

4-6.4 Optional Power Awning

If you purchased the optional power awning by Girard RV Products, Inc. below you will find the basic operation instructions for this awning.

4-6.4.1 Operating Instructions

The Girard G-2000 Lateral Arm Awning incorporates the very latest in technology and design. The box awning offers total protection in all weather and features the following advanced features:

- Convenient push button operation - optional remote control for the ultimate in state of the art convenience.
- Heavy duty, lateral arms eliminate clumsy, unattractive, side support arms. The angle of the arms is adjustable from 5 to 35 degrees for maximum comfort..
- Provides 25% more shade than traditional roll-up awnings. The 100% acrylic fabric is weatherproof, permeable to air, and resistant to mildew, rotting and fading.
- Equipped with a manual crank for operation in the event of power failures.
- Exclusive wind sensor system automatically retracts awning in the event of excessively high winds.

4-6.4.2 Crank Operation:



A hand crank is supplied with every awning and easily telescopes from 50 to 82 inches. Simply insert the end of the crank into the receiver, which is located at either the right or left side of the awning. Push up and rotate the handle one-quarter turn clockwise, then let the handle drop about a half-inch. You should then feel the handle lodge in the receiver. You are now ready to extend the awning.

To open the awning, rotate the handle in a counter clockwise direction. To close the awning, rotate in a clockwise direction. When extending awning to full extension, extend only until the elbowing arms “click” and lock themselves into place. Unrolling the awning further than this point will result in excessive slack in awning fabric. Additionally, when awning is rolled past full extension, the fabric can reverse from the bottom of the roller tube to the top of the tub. The fabric must always roll from the bottom. If this should happen, simply crank the awning all the way out until the roller tube is exposed and continue cranking in the same direction. The fabric should then be rolling onto the bottom of the roller tube.

To open the awning, rotate the handle in a counter clockwise direction. To close the awning, rotate in a clockwise direction. When extending awning to full extension, extend only until the elbowing arms “click” and lock themselves into place. Unrolling the awning further than this point will result in excessive slack in awning fabric. Additionally, when awning is rolled past full extension, the fabric can reverse from the bottom of the roller tube to the top of the tube. The fabric must always roll from the bottom. If this should happen, simply crank the awning all the way out until the roller tube is exposed and continue cranking in the same direction. The fabric should then be rolling onto the bottom of the roller tube.

When the awning is extended to the desired position, push up on the crank handle and turn counter clockwise on quarter turn, which will release the crank handle from the housing. The crank handle can then be stored in a convenient place.

4-6.4.3 Motorized Operation (without wind sensor)

The motorized operation is simplicity in itself. The 110-volt motor is housed in the roller tube where it is protected from the elements.

To extend the awning all the way, move the switch to the down position.

After depressing the switch, the awning will then extend to its full projection. To retract the awning, press the switch in the up position. There is no need to hold the switch once it has been activated. To stop the awning at any point in its projection or retraction, move the switch to the middle position. The switch should be left in the center position at all times when the awning is stationary.

The motor used in the Girard G-2000 will use approximately 300 watts and will draw approximately 3 amps of power.

WARNING!!

The motor in the Girard G-2000 is not designed for continuous use. In the event that the motor is used to excess, it will automatically shut off and be inoperative until the internal breaker cools down and resets. Run time is 4-5 minutes per hour. Reset time is 30 minutes to 1 hour depending on outside temperature.

4-6.4.4 Wind Sensor Option:

Wind Sensor V with Remote Control Summary

If your Girard G-2000 awning is fitted with a wind sensor, your awning is designed to retract automatically in the event of high winds. The Wind Sensor will operate as long as it has a 110 volt power supply and the wind has unrestricted access to the wind sensor cups on the roof of your coach.

To operate the awning, simply push the button, momentarily, to extend the awning. The awning will continue to open until it reaches its full extension. It will then stop automatically. Pressing the button after the awning is fully extended will retract the awning automatically. Once the awning is fully closed, it will stop automatically, and the motor will turn off. The awning can be stopped at any point, and in either direction, by pushing the button while the awning is in process of either extending or retracting.

The wind sensor is dominant and will override any manual commands in the event of excessive winds. When the wind sensor is activated, the awning will close completely. The awning will NOT re-open automatically. It must be re-opened by once again pressing the button on the wall mount switch. It is recommended, however, to use the warnings of the wind sensor and leave the awning IN until the winds subside.



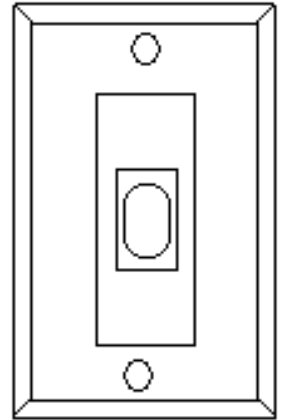
Wind Sensor V Control

Description

The Wind Sensor V is a single motor control designed for use on the Girard G-2000 Automatic Awning. The unit features the wind sensor control box, the wind sensor anemometer, and an attractive indoor, push-button wall mount switch. The Wind Sensor V Remote includes the additional, hand-held remote control, which is electronically integrated with the control box.

Operation

1. Always be sure that sufficient 110 Volt power is supplied to the awning system for correct functioning of all component parts (controller, anemometer, awning motor, etc.) i.e., be sure that either the inverter is on, the generator is functioning, or the vehicle is connected to shore power.
2. Turn the vehicle power ON and/or turn the circuit breakers to ON.
3. Push the button on the Wind Sensor V control switch to EXTEND the awning. The button can be released and the awning will continue to open until it reaches full extension. It will then stop automatically.
4. Push the button on the Wind Sensor V control switch to RETRACT the awning. The button can be released and the awning will continue to retract until it is fully closed. The awning motor will then turn off automatically.
5. Push the button during either the extend or retract mode to STOP the awning at any desired position. The button can also be used to change direction of the awning by pushing it twice.



NOTE: The motor supplied with your Girard G-2000 Awning is a high torque/low RPM motor, and has been carefully selected for its reliability and application compatibility. It is designed for intermittent use with a rating of 4 minutes/hour. If the motor's run-time exceeds this time period, a built-in circuit breaker will disable the motor from operation. This condition indicates normal operation of your awning system, and generally only occurs during excessive adjustment periods. If this condition should occur, please allow sufficient time (up to one hour, depending on the outside temperatures) for the motor to reset and use the manual override feature.

Wind Sensor Function

The Wind Sensor V Controller, and the Wind Sensor V Anemometer work together to continuously monitor the wind speeds, at any given minute, around your awning. If the actual wind speed becomes GREATER than the wind speed setting of your controller, a two (2) second delay occurs, and a signal is sent to the awning motor to retract the awning. THE AWNING WILL REMAIN IN THE RETRACTED POSITION UNTIL SUCH A TIME THAT IT IS ONCE AGAIN EXTENDED BY PRESSING THE BUTTON OF THE SWITCH PANEL.

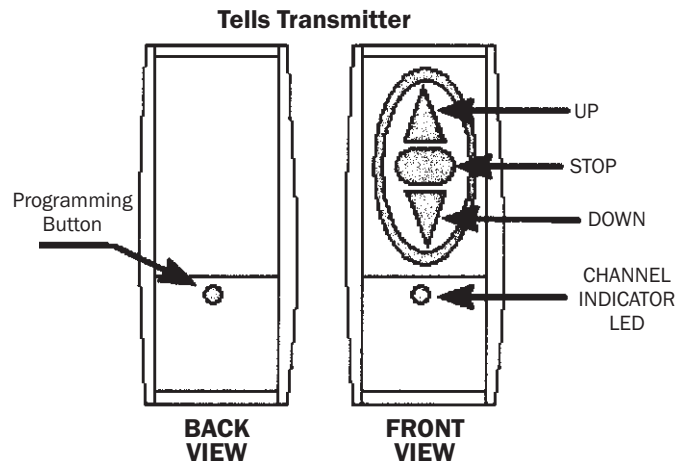
Adjusting the Wind Speed Setting

The Wind Sensor V has been factory pre-set to a maximum wind speed of 22 MPH. Under no circumstances should this level be set at higher speeds. It is recommended, however, that you become familiar with the location of your Wind Sensor Control Box. It is usually located inside of an upper cabinet. In the event that you wish to reduce the pre-set wind speed, locate your control box and remove the four (4) Phillips screws that secure the cover. Remove the cover and notice the small dial located near the center of the box. This dial should be pointed at 22. The minimum setting will be approximately 12 MPH.

4-6.4.5 Remote Control Programming

Normally, your remote control will come pre-programmed. However, if it is not, follow this procedure:

1. On the Control Box
 - To put the receiver in its programming mode, press the PROGRAM button and hold, until the LED lights up and then release. The Programming Button is located on the PCB Board inside the control box.
 - The receiver is now ready to memorize any transmitter/channel for a period of one (1) minute.
2. On the Transmitter
 - Press the Programming Button on the back of the transmitter. After one (1) minute, or once the receiver is programmed, the LED goes off. The transmitter is now programmed.
 - To verify the program, press the DOWN button to make sure that the awning is extending. If it does not, repeat the instructions from number one (1) above.



4-6.4.6 Remote Control Operation

Single channel transmitter:

- Press the UP, DOWN, or STOP button.
 - The programmed RTS receivers are activated.

Four channels transmitter:

- Select the channel of the motor module you wish to control.
 - The corresponding LED is blinking during 3 seconds (the channel is still memorized for 30s and then the transmitter returns to channel 1).
- Press the UP, DOWN or STOP button.
 - The programmed RTS receivers are activated.

Battery Life

The transmitters are filled with a 3V battery (type 2430) which provides about three years operation assuming 4 operations per day. When the battery becomes discharged, the control LED no longer lights up when a command is sent, and the command is not carried out. The module has an integrated backup control under the programming button. It operates by successive presses: raising, stop, lowering, stop.

How to Change the Battery:

- Remove the back cover of the transmitter with a screwdriver.
- Slide the battery out of its housing by pushing it with a screwdriver.
- Insert the new battery

4-6.4.7 Setting Motor Limits

IF THE AWNING DOES NOT CLOSE COMPLETELY, and there is no apparent binding of any awning components, then the fabric has most likely stretched or shifted slightly over time. This can be easily corrected by adjusting the motor limits. This will allow the awning roller tube to run a split second longer to draw the awning fabric in tighter.

The Adjustment:

- The MO (manual override) motor has manual limit switches for both the OUT (extend) and the IN (retract).
- The limit switches are adjusted by inserting the black plastic key (supplied) or a 5/32" / 4mm Allen wrench into the appropriate hole on the underside of the motor.
- The motor is usually located at the front of the awning inside the roller tube. The limit switches can be accessed by opening the awning a few feet, and are located above, at the end of the roller tube in the exposed end of the motor. These switches will appear as (2) hex shaped holes. You will also see a double arrow with a (+) and (-) sign next to each switch.
- The IN limit is the switch located closest to the vehicle side. The Girard G-2000 provides an exclusive current limiting device (MS-1) which detects the current increase as the awning box closes, and then shuts off power to the motor. This device eliminates the need or frequency for future in-bound limit switch adjustments. If this adjustment is still required however, and the awning box does not close completely, then this switch should be adjusted. To make the awning close MORE, first turn your main awning wall switch or wind sensor switch to the IN (retract) position. Place the plastic adjustment tool or Allen wrench into the switch and turn toward the (+) direction. This action will create a tighter fit as the awning box closes. Listen carefully to the motor to assure that the current limiting device has shut power off to the motor.
- The OUT limit is the switch located in the outer most location. This switch is factory pre-set so that the motor stops turning at the precise moment that the arms reach full extension. If further adjustment is required however, and to make the awning extend more and to release more fabric, first, place the main awning wall switch or wind sensor switch to the OUT (extend) position and extend the awning until the motor stops. Place the plastic adjustment tool or Allen wrench into the limit switch and turn toward the (+) arrow. The awning will "follow" as you turn. Turn switch until awning reaches full extension and the arms "click" into their locked position. To make the awning extend LESS, turn switch toward the (-) arrow, bring the awning in a few inches, then re-extend to see the new stop location.
 - To adjust IN Limits: Use the INNER most switch (+) closes more (-) closes less
 - To adjust OUT Limits: Use the OUTER most switch. (+) extends more (-) extends less.



NOTE: If motor is mounted on LEFT end of the awning, the functions of the limit switches will be reversed.

4-8.4.8 Lead Rail Adjustments**Lateral Shifting of Lead Rail***Tools Required:*

- 5mm (3/16") Allen Wrench
- Phillips Screwdriver
- Rubber Mallet
- 1/8" Drill Bit and Drill Motor

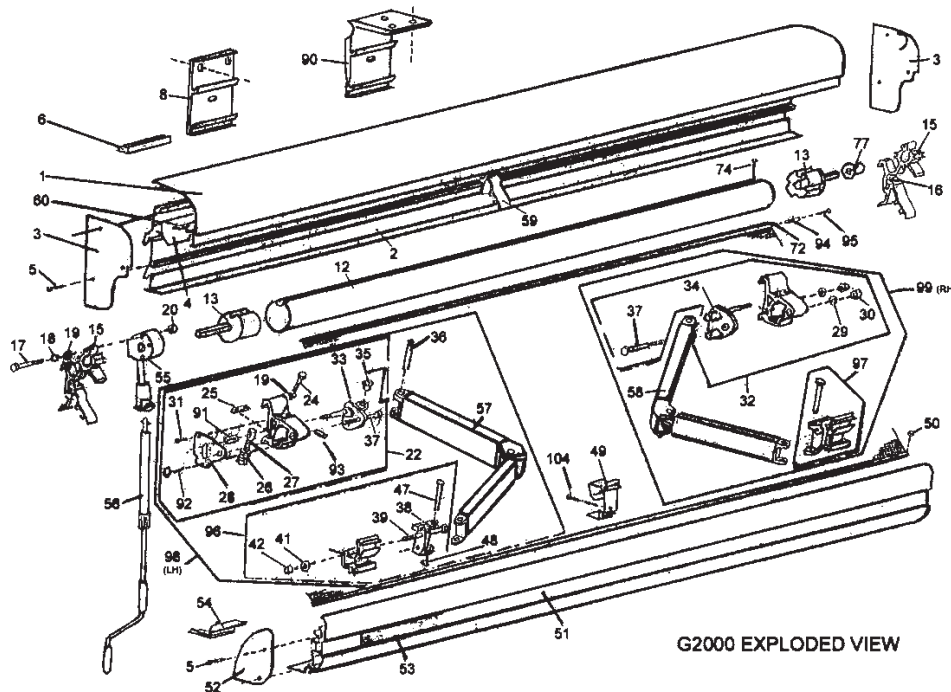
The Lead Rail has shifted toward the front or toward the rear of the awning casing, preventing the awning from closing properly.

1. Open the awning about 2 feet.
2. Locate the connection bracket at the forward most portion of the arm at the Lead Rail. (Item #43 of Exploded view). Using an Allen Wrench, loosen the center set screw on this bracket, by $\frac{3}{4}$ turn, which un-tightens this bracket from the Lead Rail. Repeat for all arms. Do NOT loosen the offset leveling screw found on the upper corner of the bracket assembly.
3. With a Phillips Head Screwdriver, remove the (2) fabric set screws (Item #50 of Exploded View) which secure the fabric to the Lead Rail.
4. Close the awning to about 4 inches and, using a rubber mallet, tap on the end of the Lead Rail, allowing it to shift relative to the fabric and arm attachments.

5. Close the awning to check for proper alignment.
6. Re-open the awning to about 2 feet and re-tighten set screws at each arm connection. Finish by replacing both fabric set screws.

NOTE: These screws should be located approx. $\frac{3}{4}$ " from the edge of the fabric. If the adjustment process places either of these 2 screws further than this point, drill new holes ($\frac{1}{8}$ " dia), and re-install fabric screws.

7. Close the awning completely to check for final fit.



“IN” Adjustment of Lead Rail

Tools Required

- 5mm (3/16") Allen Wrench
- Rubber Mallet

This adjustment may be required if the Lead Rail remains out from the awning casing at one end. The Limit Switches may need to be adjusted. Please see that section entitled ADJUSTING MOTOR LIMIT SWITCHES. Otherwise, arms may need to be adjusted as follows:

1. Open the awning about 16 inches.
2. At the selected arm, locate the connection bracket at the forward most portion of the arm at the Lead Rail (Item #43 of Exploded View). Using a 5mm (3/16) Allen Wrench, loosen the center set screw on this bracket, by $\frac{3}{4}$ turn, which un-tightens this bracket from the Lead Rail. This bracket should now be free to slide. Do NOT loosen the offset leveling screw found on the upper corner of this bracket assembly.
3. Close awning completely and the arms will relocate themselves to the proper location. Re-open the awning just far enough to re-tighten the arm screws.

Pivotal Adjustment of Lead Rail

Tools Required:

- 5mm (3/16") Allen Wrench
- 17mm (11/16) Open End Wrench

This adjustment, not being available on earlier models, affects the pivotal angle of the Lead Rail and is seldom required, as, this angle is factory preset. However, if adjustments are required, the procedures are:

1. Open the awning about 16 inches.
2. Locate the connection bracket at the forward most portion of the left/rear arm, i.e., the arm furthest from the motor. (*Item #43 of Exploded View*)
3. The “pivoting” style connection bracket can be identified by having one set screw in the center of the bracket, in addition to a second set screw at the upper portion of the pivoting section of the bracket assembly. The non-pivoting style bracket has two set screws, in-line, in the center of the bracket.
4. If the pivoting style bracket is present, grasp the Lead Rail with one hand and manually pivot, up and down, the Lead Rail on this bracket. It should pivot freely. If it does not pivot freely, loosen slightly, the large lock nut on the end of the horizontal bolt that fastens these two pivoting brackets together. This should free the two brackets and allow a pivot between them. Repeat for each arm, if necessary.
5. Using the awning switch and motor, close the awning to about 3”. Check the angle of the Lead Rail in relation to the awning casing. The Lead Rail should approach the awning casing with the TOP portion of the Lead Rail striking the casing FIRST. From the TOP of the Lead Rail, a 10 degree angle should occur as it angles away from the awning casing. If this angle is not present, again open the awning to about 18”. Locate the UPPER set screw in the pivoting portion of the connection bracket. Using a 5mm (3/16”) allen wrench, turn this set screw (counterclockwise) to achieve the desired 10 degree angle. Repeat this procedure for each of the arm connections, assuring that the proper angle and “free pivot” condition is maintained.

Height Adjustment of Arms (*see Exploded View - Item No. 37*)

Tools Required:

- 19mm (3/4”) Open End Wrench
- 10mm (3/8”) Open End Wrench

This adjustment may be required if, as the awning Lead Rail closes into the awning casing, the “elbow” of one of the arms is hanging downward, hitting the bottom of the casing. This adjustment is usually required after an arm replacement.

1. Open the awning about 18 inches.
2. At the selected turn, loosen the (2) locknuts located at the side of the upper arm connection using a 19mm (3/4”) open end wrench.
3. See *Item No. 92 in Exploded View*. Locate the smaller adjustment bolt located directly under the rear locknut that was just loosened. Place a 10mm (3/8”) open end wrench around this bolt head, and rotate the wrench in a TIGHTEN direction to RAISE the arm. Slight rotation is all that is necessary. Likewise, LOOSENING the bolt will LOWER the arm. As this adjustment is being performed, keep in mind that after re-tightening the Locknuts, the arm will raise slightly further.
4. Tighten the (2) locknuts located on the side of the arm connection.
5. Close the awning completely, and check for proper fit.

PITCH ANGLE: The awning comes factory pre-set with a pitch angle of approximately 20°. This represents the minimum angle recommended for proper rain run-off. If it is desired to increase this angle, loosen the two (2) lock nuts located on the outside upper joint of each arm using a 3/4” or 19 mm wrench (*see fig. 2a*). Adjust the arms downward by rotating the bolt head at the bottom of the arm connection in a counter clockwise direction (looking from the bottom up) (*see fig. 2b*). Likewise, rotating the bolt in a clockwise direction will raise the arm. After all arms are adjusted to an equal height, re-tighten lock nuts on the side of each arm (*see fig. 2c*).

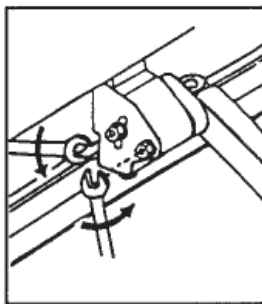


Figure 2a

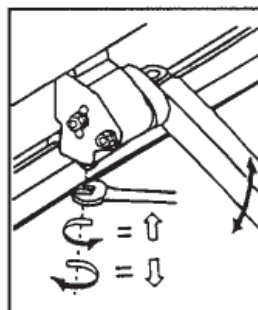


Figure 2b

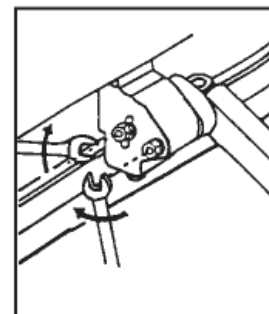


Figure 2c

4-6.4.9 Care and Cleaning of the Acrylic Fabric:

Acrylic fabric should be cleaned regularly before substances such as dirt, leaves, etc. are allowed to accumulate on, and become embedded in the fabric. The fabric can be cleaned without being removed from the awning casing. Simply brush off any loose dirt, leaves, etc. Hose down and clean with cloth and a mild solution of natural soap in lukewarm water. Rinse thoroughly to remove soap. **DO NOT USE DETERGENTS.** Allow to air dry, preferably on a warm sunny day. Should you have to retract the awning when the fabric is wet, it should be extended at the first opportunity to finish air drying.

A new acrylic fabric cleaner is now available at Girard Systems. This unique product has been specially formulated to clean all acrylic awning fabrics. Call (800) 382-8442 for ordering information.

Warranty: Girard Systems offers a five year warranty for its awnings to be free from defects in material and workmanship under normal and proper use. For the full warranty look in the black box material that was supplied with your coach or go to <http://www.girardrv.com>

Please remember that the Girard G-2000 Awning is a high-technology, retractable structure, and is built with a high level of pride and workmanship. All steps have been taken to provide a product of the highest quality, performance, and weather protection, including wind and rain protection. As any other investment, it should be respected and protected. It is the owners responsibility to use good judgment and assert caution when using this product in heavy weather conditions. During heavy or unpredictable rain conditions, or during strong winds, the awning should be retracted.

4-6.4.10 Troubleshooting

NOTE: These troubleshooting tips are offered to you for informational purposes and it is recommended that the following adjustments be made by an authorized service center. This guide will, however, allow you to become more familiar with your awning and will provide you with adequate knowledge in the event of an emergency.

PROBLEM	SOLUTION
Lead Rail is binding on side of awning casing, i.e. is offset from awning casing.	Open awning about three (3) feet. Loosen both set screws on each arm at their point of connection to the lead rail. Remove both fabric set screws located at each end of the lead rail. The lead rail is now ready to be shifted. Close the awning to about four (4) inches and, using a rubber mallet, tap on the end of the lead rail to move the rail over. Check for proper alignment, retighten the set screws, and replace the fabric set screws. For more information see " LATERAL SHIFTING OF LEAD RAIL. "
One part of the box (opposite end from motor) does not close tightly. Motor end closes correctly.	See " IN AND OUT ADJUSTMENT OF LEAD RAIL. "
After above adjustment, one end of box (opposite end from motor) STILL does not close tightly. Motor end closes correctly.	On later model awnings, a "pivotal" adjustment of the lead rail is available. This means that the lead rail is allowed to PIVOT on its connection bracket to the awning ARMS. First, check that this option is present. If so, check that the lead rail is free to pivot on its pivot bolt. If not, loosen the lock nut on the pivot bolt by 1/2 turn. Additionally, check that the pivot angle is correct.
The motor will not operate.	Check that the GFI circuit breaker in the vehicle is turned on. Also, if the vehicle is equipped with an awning main power switch, located inside the cabinets, check that it is turned on. The 110V motor in the Girard awning is for intermittent use only (4 Min Per Hour) and is designed to "temporarily cut out" if it is used to the point of overheating. In this event, the motor must be allowed to cool, to provide time for its built-in circuit breaker to reset. Please allow up to one hour, depending on outside air temperature, for this cool down period. The manual crank can be used during this period.
The motor will not operate, or the motor will operate long enough for the awning to extend 10 to 12 inches and then stops.	The motor is not receiving enough amps, i.e., the inverter output is low. Check that a minimum of 10 amps is running. If not, turn on the generator or go to shore power.
The fabric is loose when the awning is fully extended, i.e., the roller keeps turning after the awning arms have locked open.	The motor "OUT" limits need to be re-set (see Setting Motor Limits section) to ensure that the motor stops when the arms are fully extended and locked.
The box does not close completely, i.e., the motor stops before the lead rail has retracted completely (on either end) into the awning casing. There is no apparent binding of the awning components.	Your awning is equipped with a MO (manual override) motor which has manual limit settings. The "IN" limit may need to be re-set to allow the box to close tighter. See " Setting Motor Limits " section.
As the awning is closing, the "elbow" of one or more of the arms is hanging downward, preventing the case from closing.	Open the awning about 18 inches. At the selected arm, loosen the two (2) large lock nuts located at the side of the upper arm connection. Locate the smaller adjustment bolt head directly under the REAR lock nut and rotate SLIGHTLY UPWARD to raise the arm. Retighten lock nuts. NOTE: After re-tightening lock nuts the arm will raise slightly further. See Height Adjustment of Arms.

4-6.4.11 Adjustments

Adjusting Motor Limit Switches

Tools Required

Black plastic key provided with awning or 4mm Allen Wrench

PROCEDURE

The limit switches are adjusted at the factory, prior to shipment, such that the awning motor stops at the EXACT moment the awning box closes. Likewise, the awning motor is set to stop at the EXACT moment that, while opening, the elbowing arms “click” into an outward locked position. Occasionally, after shipment and installation, the motor rotational limits “creep” out of adjustment. It is always wise to check the motor limits after installation to assure that the awning is opening and closing correctly. Additionally, over a period of time the awning fabric can stretch, causing the need for simple motor limit adjustments.

VERY IMPORTANT: Extreme care must be taken when setting the “IN” limits of the motor, such that the motor turns off EXACTLY the same time the box closes. Otherwise, the motor will continue to run, as it has not reached its limit. This condition, if not corrected, will substantially reduce motor life. Turn the awning switch OFF.

If adjustments are required, please follow these instructions:

1. The BMO (Manual Override) motor has limit settings for both the OUT direction (projection) and the IN direction (retraction).
2. Limit switches are adjusted using the black plastic key (provided) or a 4mm Allen Wrench.
3. Open the awning a few feet and locate the awning motor, installed standard at the right end of the awning (front end). It is a cylindrical motor mounted inside the awning roller tube. The limit switches are mounted inside the black casing at the exposed end of the motor. Notice at the limit switches a BLACK arrow and a RED arrow, both with a (+) plus and (-) sign. The actual limit switch is the recessed hole next to the corresponding arrow.
4. The IN limit is the BLACK arrow. To make the awning close MORE, first turn the main awning wall switch or Wind Sensor switch to the IN (retract) position. At the motor, insert the tool and turn the switch next to the BLACK arrow in the direction of the (+) sign. $\frac{1}{4}$ turn represents approximately 1” of the awning movement. This action will create a tighter fit as the awning box closes. To make it close LESS, turn in the direction of the (-) sign. [See Fig. 1.](#)

 **NOTE: If the awning motor is installed on the LEFT end of the awning, the actions of the red and black arrows will be reversed.)**

FOR MOTORS WITH BLACK PLASTIC CASINGS ONLY

To adjust IN Limits: Use switch next to BLACK arrow (+) closes more (-) closes less

To adjust OUT Limits: Use switch next to RED arrow (+) extends more (-) extends less

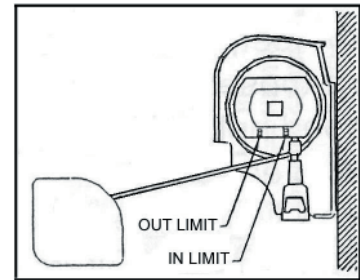


Fig. 1 Motors with Black Plastic Casings

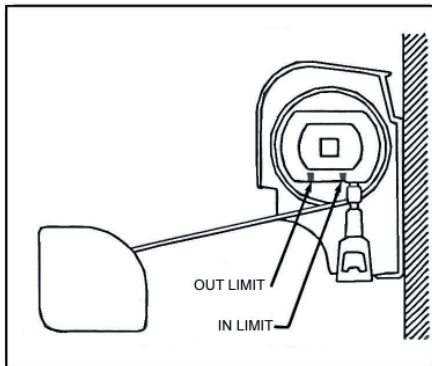


Fig. 2 Motors with Silver Aluminum Casings

FOR MOTORS WITH SILVER ALUMINUM CASINGS:

To adjust IN Limits: Turn the switch located toward the REAR of the motor. (+) closes more (-) closes less.

To adjust OUT Limits: Turn the switch located toward the FRONT of the motor. (+) extends more (-) extends less.

The OUT limit is the RED arrow. To make the awning extend MORE and release more fabric, first turn the main awning wall switch or the Wind Sensor switch to the OUT (extend) position and extend the awning to its maximum position. Proceed by turning the limit switch next to the RED arrow in the direction of the (+) sign. To make the awning extend LESS, turn the switch in the (-) direction. See Fig. 1.

NOTE: If the awning motor is installed on the LEFT end of the awning, the actions of the red and black arrows will be reversed.

NOTE: Never set outward limits such that slack fabric occurs after full extension of the arms. Adjust the limit switches such that the motor stops at the EXACT time that the elbowing arms “click” into a locked position.

4-6.4.12 Adjusting the Awning Pitch Angle

Tools Required:

19mm (3/4”) Open End Wrench

The awning comes factory pre-set with a pitch angle of approximately 20 degrees. If it is desired to increase the angle, loosen the (2) lock nuts located on the outside upper joint of each arm using a 3/4” or 19mm wrench. See Fig. 2a. Adjust the arms DOWNWARD by rotating the bolt head at the bottom of the arm connection in a CLOCKWISE direction (looking from the bottom up). See Fig. 2b. Likewise, rotating the bolt in a COUNTER CLOCKWISE direction will RAISE the arm. After all arms are adjusted to the desired height, re-tighten lock nuts on the side of each arm. See Fig. 2c

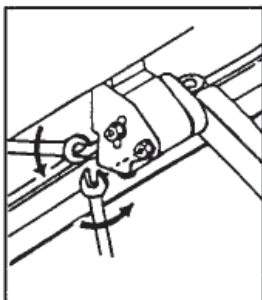


Figure 2a

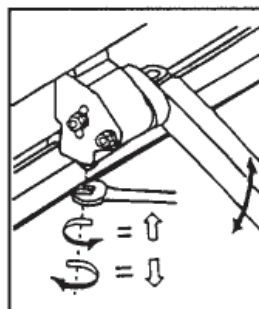


Figure 2b

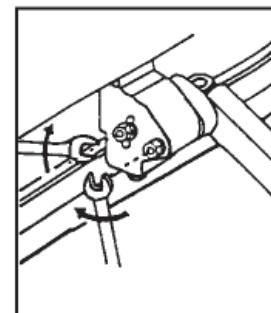


Figure 2c

4-6.4.13 Lead Rail Adjustments


Lateral Shifting of Lead Rail

Tools Required:

- 5mm (3/16") Allen Wrench
- Phillips Screwdriver
- Rubber Mallet
- 1/8" Drill Bit and Drill Motor

The Lead Rail has shifted toward the front or toward the rear of the awning casing, preventing the awning from closing properly.

1. Open the awning about 2 feet.
2. Locate the connection bracket at the forward most portion of the arm at the Lead Rail. (*Item #43 of Exploded View*). Using an Allen Wrench, loosen the center set screw on this bracket, by $\frac{3}{4}$ turn, which un-tightens this bracket from the Lead Rail. Repeat for all arms. Do NOT loosen the offset leveling screw found on the upper corner of the bracket assembly.
3. With a Phillips Head Screwdriver, remove the (2) fabric set screws (*Item #50 of Exploded View*) which secure the fabric to the Lead Rail.
4. Close the awning to about 4 inches and, using a rubber mallet, tap on the end of the Lead Rail, allowing it to shift relative to the fabric and arm attachments.
5. Close the awning to check for proper alignment.
6. Re-open the awning to about 2 feet, and re-tighten set screws at each arm connection. Finish by replacing both fabric set screws.

 **NOTE: These screws should be located approx. $\frac{3}{4}$ " from the edge of the fabric. If the adjustment process places either of these 2 screws further than this point, drill new holes (1/8" dia) and re-install fabric screws.**

7. Close awning completely to check for final fit.

4-6.4.14 "IN" Adjustment of Lead Rail

Tools Required:

- 5mm (3/16") Allen Wrench
- Rubber Mallet

This adjustment may be required if the Lead Rail remains out from the awning casing at one end. The Limit Switches may need to be adjusted. Please see that section entitled *ADJUSTING MOTOR LIMIT SWITCHES*. Otherwise, arms may need to be adjusted as follows:

1. Open the awning about 16 inches.
2. At the selected arm, locate the connection bracket at the forward most portion of the arm at the Lead Rail (*Item #43 of Exploded View*). Using a 5mm (3/16) Allen Wrench, loosen the center set screw on this bracket, by $\frac{3}{4}$ turn, which un-tightens this bracket from the Lead Rail. This bracket should now be free to slide. Do NOT loosen the offset leveling screw found on the upper corner of this bracket assembly.
3. Close awning completely and the arms will relocate themselves to the proper location. Re-open the awning just far enough to re-tighten the arm screws.

4-6.4.15 Pivotal Adjustment of Lead Rail

Tools Required:

- 5mm (3/16") Allen Wrench
- 17mm (11/16) Open End Wrench

This adjustment, not being available on earlier models, affects the pivotal angle of the Lead Rail and is seldom required, as, this angle is factory preset. However, if adjustments are required, the procedures are:

1. Open the awning about 16 inches.
2. Locate the connection bracket at the forward most portion of the left/rear arm, i.e., the arm furthest from the motor. (*Item #43 of Exploded View*).
3. The "pivoting" style connection bracket can be identified by having one set screw in the center of the bracket, in addition to a second set screw at the upper portion of the pivoting section of the bracket assembly. The non-pivoting style bracket has two set screws, in-line, in the center of the bracket.
4. If the pivoting style bracket is present, grasp the Lead Rail with one hand and manually pivot, up and down, the Lead Rail on this bracket. It should pivot freely. If it does not pivot freely, loosen slightly, the large lock nut on the end of the horizontal bolt that fastens these two pivoting brackets together. This should free the two brackets and allow a pivot between them. Repeat for each arm, if necessary.
5. Using the awning switch and motor, close the awning to about 3". Check the angle of the Lead Rail in relation to the awning casing. The Lead Rail should approach the awning casing with the TOP portion of the Lead Rail striking the casing FIRST. From the TOP of the Lead Rail, a 10 degree angle should occur as it angles away from the awning casing. If this angle is not present, again open the awning to about 18". Locate the UPPER set screw in the pivoting portion of the connection bracket. Using a 5mm (3/16") Allen Wrench, turn this set screw (counterclockwise) to achieve the desired 10 degree angle. Repeat this procedure for each of the arm connections, assuring that the proper angle and "free pivot" condition is maintained.

4-6.4.16 Height Adjustment of Arms

(*see Exploded View - Item No. 37*)

Tools Required:

- 19mm (3/4") Open End Wrench
- 10mm (3/8") Open End Wrench

This adjustment may be required if, as the awning Lead Rail closes into the awning casing, the "elbow" of one of the arms is hanging downward, hitting the bottom of the casing. This adjustment is usually required after an Arm replacement.

1. Open the awning about 18 inches.
2. At the selected arm, loosen the (2) Locknuts located at the side of the upper arm connection using a 19mm (3/4") Open End Wrench.
3. *See Exploded View Item #92.* Locate the smaller adjustment bolt located directly under the rear Locknut that was just loosened. Place a 10mm (3/8") Open End Wrench around this bolt head, and rotate the wrench in a TIGHTEN direction to RAISE the arm. Slight rotation is all that is necessary. Likewise, LOOSENING the bolt will LOWER the arm. As this adjustment is being performed, keep in mind that after re-tightening the Locknuts, the arm will raise slightly further.
4. Tighten the (2) locknuts located on the side of the arm connection.
5. Close the awning completely, and check for proper fit.

4-7 Slide-Out Operation

4-7.1 Introduction

The 450 LXi Slide-out Control System controls the extend/retract operation of the multiple slide-out rooms on the 450 LXi motor home platforms - 450LXi & 400LXi models. The control system is capable of operating one to three slide-out rooms with one or two electric motor actuators.

The 450 LXi structure can accommodate three slide-out rooms: two living room - left & right; one bedroom - left. The Slide-out Control System is capable of controlling three slide-out rooms, each with two electric motor actuators. The present configuration is setup for three slide-out rooms: two living room - left & right, each with two electric motor actuators; one bedroom - left, with one electric motor actuator.

Each slide-out room has two air cylinder locks which are sequenced by the Slide-out Control System. These air locks are retracted when the slide-out rooms are in any position other than fully extended or fully retracted; i.e. the air locks are only extended when the slide-out rooms are fully extended or fully retracted.



450 LXi shown here with two slide-out rooms.

CAUTION!!

If the locks are manually extended with the slide-out room in an intermediate position, the locks will cause severe damage to the slide-out room sides.

4-7.2 Overview

The Slide-out Control System applies power to the electric motor actuator(s) to move the slide-out room In or Out when the respective Room Motion switch is pressed. The Slide-out PLC Controller examines the state of five parameters: Ignition switch in the Accessory position, parking brake, system air pressure, lock state, & IN/OUT limit switches before processing the IN/OUT command from the respective Room Motion switches. When all parameters are in the correct states, the Slide-out PLC Controller sequences the air locks and executes a IN/OUT command.

The Power Supply Assembly operates from panel #2, circuit breaker 4B of the 120VAC load center. This converts 120VAC to 27VDC which provides power to the Slide-out PLC Controller, the Dual Motor Synchronizer, and the slide-out room motor actuators.

NOTE: Circuit Breaker 4B must be ON to operate slide-out room. If the locks are manually extended with the slide-out room in an intermediate position, the locks will cause severe damage to the slide-out room sides.

4-7.2.1 Room Motion Switch Assembly

The Room Motion Switch Assembly provides the slide-out room IN & OUT control switches along with eight status LED indicators. The IN switch moves the room inward as long as the switch is depressed. The IN switch should remain pressed until the LOCKED LED lights indicating that the Room In sequence has completed. The Room In motion can be stopped at an intermediate state by releasing the IN switch. The room in motion can resume by pressing & holding the IN switch or the Room Out motion can proceed by pressing the OUT switch. The OUT switch moves the room outward as long as the switch is depressed. The OUT switch should remain pressed until the LOCKED LED lights indicating the Room Out sequence has completed.

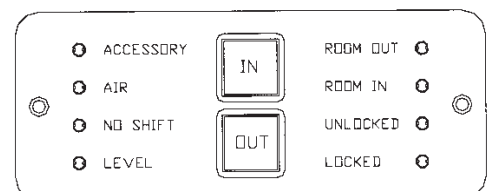


Figure 1 - Room Motion Switch Panel

Table 1 - Room Motion Switch Status LEDs - Normal Operation

LED	Type	Description
Accessory	Common	Air
Air	Common	Indicates the System AIR pressure is greater than 90 psi. The air pressure is required to operate the slide-out room locks.
No Shift	Common	Indicates the transmission cannot be shifted from its present state. The NO SHIFT state occurs whenever any slide-out room IN limit switch is not closed.
Level	Common	Indicates when the coach is LEVEL. This is not a necessary condition for slide-out operation and is only for status purposes.
Room Out	Specific	Indicates that the OUT limit switches are closed. <i>Note: the living room slide-out rooms have two OUT limit switches; the bedroom slide-out room has one OUT limit switch.</i>
Room In	Specific	Indicates that the IN limit switches are closed. <i>Note: the living room slide-out rooms have two IN limit switches; the bedroom slide-out room has one IN limit switch.</i>
Unlocked	Specific	Indicates the UNLOCKED limit switches are closed. Each slide-out room has two locks & two UNLOCKED limit switches.
Locked	Specific	Indicates the LOCKED limit switches are closed. Each slide-out room has two locks & two LOCKED limit switches.

4-7.3 Slide-Out Room Operation

4-7.3.1 Normal Mode

- Accessory State:** Ignition in Accessory position, Parking brake ON.
- Level State:** Level condition not required for slide-out operation. Level LED indicates Level state only.
- Locked State:** Both slide-out room locks are in the LOCKED state.
- Unlocked State:** Both slide-out room locks are in the UNLOCKED state.
- No Shift State:** Transmission inhibited from shifting gears. The Shift Inhibit relay closes when any Room IN limit switch is not closed which indicates the respective slide-out room is in the IN state. The NO SHIFT LED indicates the transmission cannot be shifted.

Note: The Shift Inhibit relay opens (disengages) when the 12V power to the Slide-out PLC Controller is not present which can occur when the 120VAC/27VDC power supply is unplugged or the 120VAC circuit breaker in respective load center is OFF, there is no utility power (shore or generator), or Inverter-1 is not ON.

- Air State:** System air pressure greater than 90 psi.
- In State:** Both slide-out room IN limit switches are closed.
- Out State:** Both slide-out room OUT limit switches are closed.

4-7.3.2 Service Mode

When the Service switch is in the "ON" position, the "Shift Inhibit" relay engages and prevents the coach transmission from shifting gears. The Service Mode overrides the "Accessory" and the "Air System" interlock conditions required for Normal Slide-out operation; i.e. the "Accessory LED" and "Air LED" on the Room Motion Switch Panel do not have to be lighted for Slide-out operation. The "No Shift LED" on the Room Motion Switch Panel is lighted.

4-7 Slide-Out Operation

4-7.1 Introduction

The 450 LXi Slide-out Control System controls the extend/retract operation of the multiple slide-out rooms on the 450 LXi motor home platforms - 450LXi & 400LXi models. The control system is capable of operating one to three slide-out rooms with one or two electric motor actuators.

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Each slide-out room has two air cylinder locks which are sequenced by the Slide-out Control System. These air locks are retracted when the slide-out rooms are in any position other than fully extended or fully retracted; i.e. the air locks are only extended when the slide-out rooms are fully extended or fully retracted.



450 LXi shown here with two slide-out rooms.

CAUTION!!

If the locks are manually extended with the slide-out room in an intermediate position, the locks will cause severe damage to the slide-out room sides.

4-7.2 Overview

The Slide-out Control System applies power to the electric motor actuator(s) to move the slide-out room In or Out when the respective Room Motion switch is pressed. The Slide-out PLC Controller examines the state of five parameters: Ignition switch in the Accessory position, parking brake, system air pressure, lock state, & IN/OUT limit switches before processing the IN/OUT command from the respective Room Motion switches. When all parameters are in the correct states, the Slide-out PLC Controller sequences the air locks and executes a IN/OUT command.

The Power Supply Assembly operates from panel #2, circuit breaker 4B of the 120VAC load center. This converts 120VAC to 27VDC which provides power to the Slide-out PLC Controller, the Dual Motor Synchronizer, and the slide-out room motor actuators.

NOTE: Circuit Breaker 4B must be ON to operate slide-out room. If the locks are manually extended with the slide-out room in an intermediate position, the locks will cause severe damage to the slide-out room sides.

4-7.2.1 Room Motion Switch Assembly

The Room Motion Switch Assembly provides the slide-out room IN & OUT control switches along with eight status LED indicators. The IN switch moves the room inward as long as the switch is depressed. The IN switch should remain pressed until the LOCKED LED lights indicating that the Room In sequence has completed. The Room In motion can be stopped at an intermediate state by releasing the IN switch. The room in motion can resume by pressing & holding the IN switch or the Room Out motion can proceed by pressing the OUT switch. The OUT switch moves the room outward as long as the switch is depressed. The OUT switch should remain pressed until the LOCKED LED lights indicating the Room Out sequence has completed.

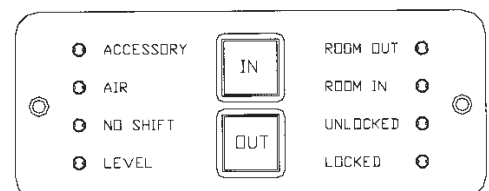


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Level	Common	Indicates when the coach is LEVEL. This is not a necessary condition for slide-out operation and is only for status purposes.
Room Out	Specific	Indicates that the OUT limit switches are closed. <i>Note: the living room slide-out rooms have two OUT limit switches; the bedroom slide-out room has one OUT limit switch.</i>
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4-7.3 Slide-Out Room Operation

4-7.3.1 Normal Mode

- Accessory State:** Ignition in Accessory position, Parking brake ON.
- Level State:** Level condition not required for slide-out operation. Level LED indicates Level state only.
- Locked State:** Both slide-out room locks are in the LOCKED state.
- Unlocked State:** Both slide-out room locks are in the UNLOCKED state.
- No Shift State:** Transmission inhibited from shifting gears. The Shift Inhibit relay closes when any Room IN limit switch is not closed which indicates the respective slide-out room is in the IN state. The NO SHIFT LED indicates the transmission cannot be shifted.

Note: The Shift Inhibit relay opens (disengages) when the 12V power to the Slide-out PLC Controller is not present which can occur when the 120VAC/27VDC power supply is unplugged or the 120VAC circuit breaker in respective load center is OFF, there is no utility power (shore or generator), or Inverter-1 is not ON.

- Air State:** System air pressure greater than 90 psi.
- In State:** Both slide-out room IN limit switches are closed.
- Out State:** Both slide-out room OUT limit switches are closed.

4-7.3.2 Service Mode

When the Service switch is in the “ON” position, the “Shift Inhibit” relay engages and prevents the coach transmission from shifting gears. The Service Mode overrides the “Accessory” and the “Air System” interlock conditions required for Normal Slide-out operation; i.e. the “Accessory LED” and “Air LED” on the Room Motion Switch Panel do not have to be lighted for Slide-out operation. The “No Shift LED” on the Room Motion Switch Panel is lighted.

4-7.3.3 Emergency Mode

When the Emergency switch is in the "ON" position, the "Shift Inhibit" relay disengages and allows the coach transmission to shift gears. The Emergency Mode overrides the "Accessory" and the "Air System" interlock conditions required for Normal Slide-out operation; i.e. the "Accessory LED" and "Air LED" on the Room Motion Switch Panel do not have to be lighted for Slide-out operation. The "No Shift LED" on the Room Motion Switch Panel is not lighted. This mode is used in an emergency situation and allows the coach to move when all interlock conditions are not satisfied. One such situation would be when slide-out rooms are not retracted.

IMPORTANT NOTE!! The Slide-Room Controller is located in Bay 2 - left.

4-7.4 Accessory Air System Moisture Purge Procedure

During humid weather or high air-use conditions, it is necessary to purge moisture (liquid) from the accessory air system frequently. This purging should be performed weekly or more often to ensure moisture-free air is supplied to the accessory components.

Please refer to the diagram below for location of drain valves. These valves are located in the front accessory compartment directly below the driver. Slowly open each valve to expel accumulated liquid and close tightly after clear air is observed.

CAUTION!! Point loose end of drain valve tube away from you - liquid is expelled at a high velocity!

