

## **Important Safeguards**

The following list of 'Important Safeguards' has been compiled to help you achieve optimum satisfaction and the highest quality performance from your new mobile audio amplifier accessory. **Please take the time to review these safeguards before operation and/or installation of your new Art Series amplifier accessory.**

### **Read Instructions**

We all have a tendency to read instructions only after something doesn't work as anticipated. This manual provides specific information concerning the operation and installation of your new amplifier accessory. **Please read this manual thoroughly and retain it for future reference.**

### **Keep Your Sales Receipt**

Your **PPI** amplifier accessory has a three year limited warranty when it is installed by an Authorized **PPI** dealer. Non Authorized dealer installed (**PPI**) products carry a one-year parts / ninety days labor limited warranty. To establish the starting date of warranty coverage, a copy of your sales receipt must accompany your accessory for all warranty service. Please file your sales receipt away for future reference. For your convenience, a complete limited warranty statement is located at the back of this manual.

### **Follow Instructions**

All use and installation instructions should be followed to assure proper operation of your new Art Series amplifier accessory.

### **Heed All Wiring Requirements**

A high-performance mobile audio system requires minimum wire gauges be used for the Power, Ground, Remote Turn-On, and Speaker cables. To assure proper operation of your Art Series amplifier and accessories, follow all wiring requirements.

### **Heed all Fusing Requirements**

The fusing requirements of your Art Series amplifier and accessory have been established for their continued safe operation. Replacement with a higher value fuse may result in damage and voiding of warranty.

### **Installation Accessories**

The Art Series amplifier accessory will require non-supplied installation accessories. Please refer to the Installation Section of this manual for a list of requirements or consult your Authorized **PPI** dealer before installation.

### **Water and Moisture**

Never mount your Art Series amplifier and/or accessory in a location which would subject it to immersion or exposure to water.

### **Servicing**

Do not attempt to service a **PPI** product yourself. Opening or removing covers may void your warranty. For service information, consult your Authorized **PPI** dealer or call Precision**Power**, Inc. at 1-800-62-POWER. Our customer service representatives are available Monday through Friday from 8am to 5pm Mountain Standard Time.

### **Caution!**

The use of a high powered audio system may cause hearing loss or damage. While **PPI** systems are capable of "Concert level" volumes with incredible accuracy, they are designed for you to enjoy the subtleties created by musicians while listening at reasonable sound pressure levels. The use of a high powered audio system may impair your ability to hear traffic sounds and, therefore, may constitute a traffic hazard. We advise lower volume levels while driving.

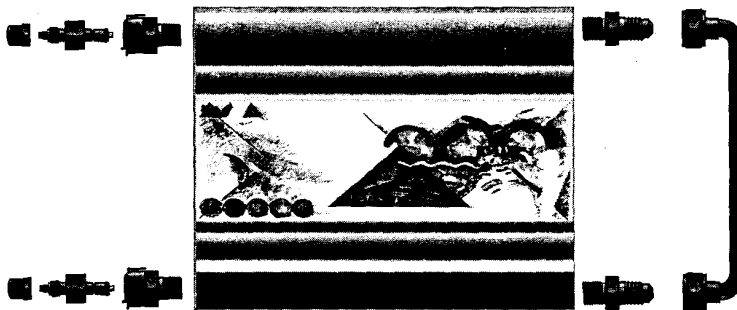


# Precision Power

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*Absolutely State of the Art*  
Mobile Audio Electronics

**CONGRATULATIONS AND THANK YOU** for your choice of a Precision Power, Inc. high performance mobile audio amplifier accessory. Precision Power is proud to be a world leader specializing in the design, engineering, and manufacture of "State of the Art" mobile audio electronics. Our success is derived from the fact that we do not incorporate gadgets or passing fads into our products. Sound engineering practice, combined with deceptively simple yet highly effective circuit designs, characterize every PPI product. Yet, our demand for maximum value dictates that every ounce of fat be trimmed if it does not contribute to sound quality or reliability. This is why PPI products have consistently enjoyed an unparalleled reputation for sound value. We are sure that your new Art Series amplifier accessory will provide you with the "State of the Art" in mobile audio performance.



This manual is designed to cover all aspects of liquid cooling your Precision Power Art Series amplifier(s). On pages 16 and 17 you will find a complete list of accessory parts available from PPI as well as the parts that you will need to purchase to complete your cooling system.

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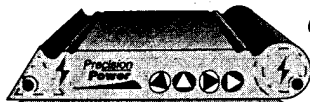
## **Glossary**

*The following terms are used in this manual. Since they may be unfamiliar, the following definitions are provided.*

<b>Conduction</b>	<i>The process by which heat is transferred through matter, without transfer of the matter itself.</i>
<b>Convection</b>	<i>The transfer of heat from one place to another by the movement of heated particles of a gas or liquid.</i>
<b>Distillation</b>	<i>The process of heating a mixture and condensing the resulting vapor to produce a more nearly pure substance. An example of this process is distilled water.</i>
<b>Heat Exchanger</b>	<i>An apparatus for collecting and radiating heat (ie radiator).</i>
<b>ID</b>	<i>Inside Diameter.</i>
<b>Manifold</b>	<i>Machined aluminum fluid distribution block (ie multi-amp cooling)</i>
<b>OD</b>	<i>Outside Diameter.</i>
<b>PSI</b>	<i>Pounds per Square Inch.</i>
<b>Radiation</b>	<i>The process of giving out light, heat, or other radiant energy.</i>
<b>Remote Turn-On:</b>	<i>Low current automatic switching circuit that turns the amplifier on and off. Typically connected to the remote antenna or amp turn-on lead of most car radios, cassette, or CD players.</i>
<b>Reservoir</b>	<i>A place where water or a liquid is collected and stored for use.</i>

## Why Liquid Cooling?

As a leader in the design and manufacture of high-performance mobile audio amplifiers, Precision**Power**, Inc.'s commitment to being "Absolutely State of the Art" demands that we create products that offer high reliability and superior sound quality. To do this, we must recognize and find solutions to the unique problems which affect the performance of electronics in the mobile environment.



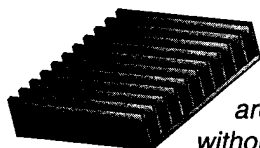
One such problem is dissipating the heat generated by high-performance amplifiers when mounted in the mobile environment. Precision**Power** engineered the Art Series amplifier heatsink, both inside and out, to address this problem. To understand why **PPI** created this unique heatsink, it's important to understand what purpose a heatsink serves and how it works.

When an amplifier operates, the internal components develop heat. This heat must be transferred away from the components for them to operate properly. By securing the components to the underside of the heatsink, the process of conduction transfers the heat from the components to the heatsink. The heatsink, in turn, must dissipate this heat or becomes too hot for the internal components to operate properly. The heat can be transferred from the heatsink by three different processes: **Conduction, Radiation, or Convection.**

**Conduction** is defined as the process by which heat is transferred through matter, without transfer of the matter itself. A practical example of this would be the cooling system in your car which circulates a liquid (matter) in order to transfer the heat away from your engine.

In the mobile environment, conduction is not the primary process of transferring heat from the heatsink. The use of a circulating liquid or gas is impractical, unless specific provisions were made in the design of a heatsink to accommodate this type of transfer. Obviously **PPI** has made such provisions, but more about that later. Since there is nothing in the vehicle which could easily be used to heatsink the heatsink, air is the only practical conductive medium involved when you install an amplifier in your car. As we will discuss, heat radiated by the heatsink is conducted out into the environment, triggering the process of convection.

**Radiation** is defined as the process of giving out light, heat, or other radiant energy. An example of this process would be the sun. It radiates heat, light, and other radiant energy.

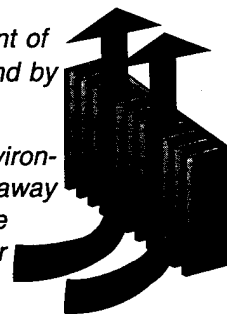


Radiation is the primary process of heat transfer for a heatsink. As the conducted heat builds (from the internal components), it radiates from the surface out into the surrounding environment. The amount of heat radiated by the heatsink is determined by its surface area. The traditional way to add surface area is to use fins, expanding the radiating surface without increasing the overall dimensions of the amplifier.

So why doesn't the Art Series heatsink employ the traditional use of fins since it must adhere to the same rules of thermodynamics that all other heatsinks do? We must discuss the third process – convection before the answer will become clear.

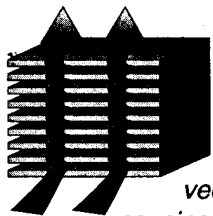
**Convection** is defined as the transfer of heat from one place to another by the movement of heated particles of a gas or liquid. An example of this process would be warming your hand by holding it in the hot air rising from an oven.

When an amplifier's heatsink becomes warm, it conducts heat out into the surrounding environment, warming the air. The warm air begins to rise, creating air currents which draw heat away from the heatsink. With a traditional finned heatsink, this process is most effective when the amplifier is mounted on its vertical axis. As with a chimney, the air circulates upward, over the fins, improving the heat transfer process.



Your ability to take advantage of convection is limited by the installation constraints imposed by automobiles.

Mounting an amplifier on the vertical axis is not always possible and generally, not preferred cosmetically. Therefore, the amplifier's heatsink is left with only one primary process for heat transfer – radiation.



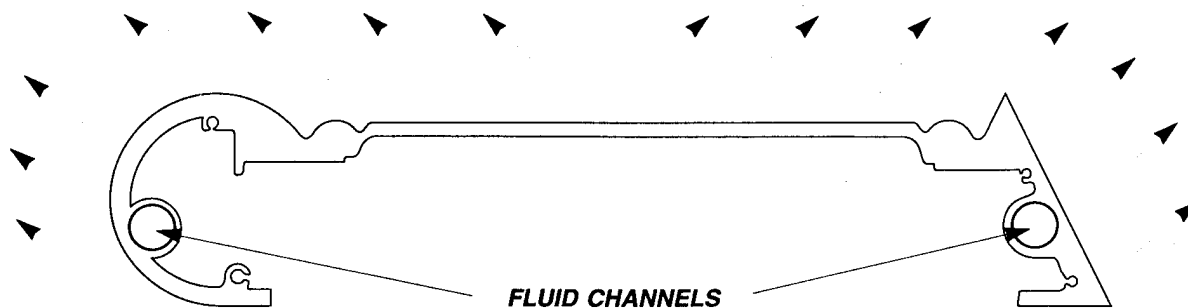
Engineers have long recognized the importance of radiant surface area, but the constraints of the automotive environment have forced heatsink designs to remain compact. In order to improve radiating efficiency, designers have simply added more fins. With limited space, adding more fins means that they get closer together. What **PPI's** engineers observed was that fins in close proximity radiate heat from fin to fin rather than into the environment. If convection is not available to draw the heat out from between the fins, the heat becomes trapped, causing a reduction in heat transfer efficiency. This can lead to thermal shutdown.

The Art Series heatsink addresses this problem by providing more effective radiating surface area. Its unique shape has an exceptionally low 2" profile and offers efficient cooling regardless of whether the amplifier is mounted on its horizontal or vertical axis. This unique blend of form and function provides remarkable installation flexibility.

### So Why the Holes?

No matter how extensive the research into heatsink design, there will always be situations where, regardless of design ingenuity, conventional methods of heat dissipation just won't work. Consequently, alternative methods must be used. The most common method being fan cooling. This method is both simple and efficient. In the majority of installations where an alternative method of cooling is needed, forced air cooling is the simple answer.

But what if the use of a fan is not practical or the installation requirements demand a different method of cooling? Precision**Power's** engineers recognized this dilemma and developed a heatsink which allows circulating liquid to be channeled through the mass of the heatsink to, literally, carry the heat away. This silent means of cooling requires more hardware than forced air cooling but offers a new level of system design versatility.

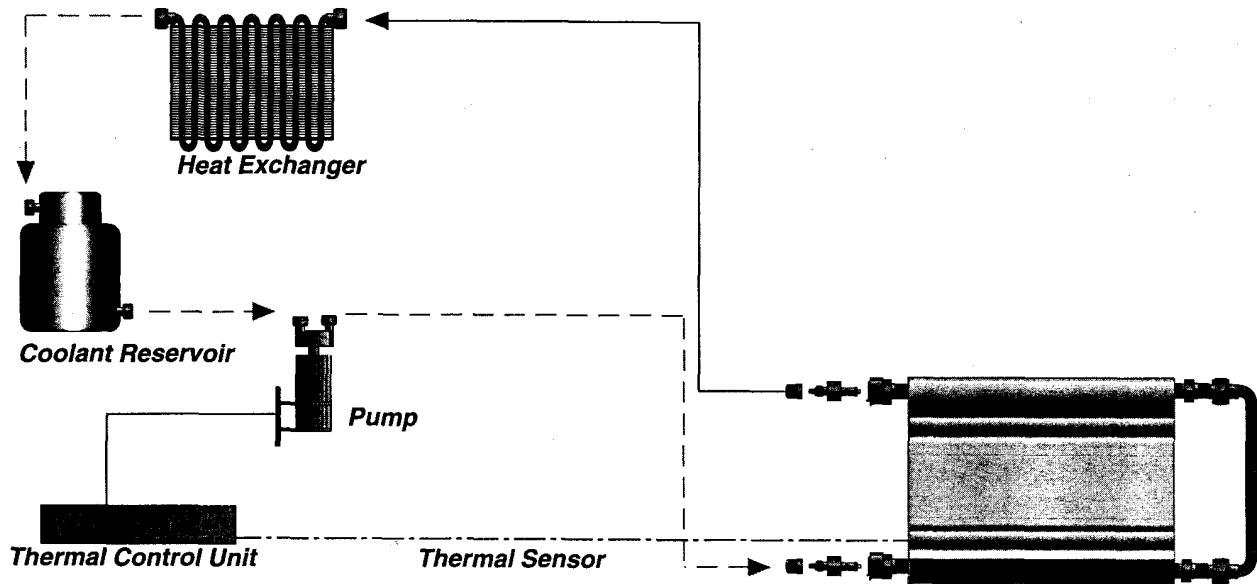


### System Layout

The liquid cooling system offered by Precision**Power** consists of accessories parts available from **PPI** and some items which you must purchase through your local automotive parts store. Prior to assembling your amp rack, plot on paper the layout of your cooling system. Keep in mind that whatever pump system you choose to use will (most likely) produce some mechanical noise. The pump can be isolated from the interior by placing it either in the trunk or, in the case of a hatchback, outside the vehicle. When mounting the pump outside the car, do not place it in the engine compartment. Fluid lines running through metal walls must be insulated with a grommet to prevent chafing which could rupture the line. Once you have determined the layout of your liquid cooled system, it is essential that all **PPI** specified component parts be used to insure proper operation.

Please refer to the list of component parts and diagrams on the following pages prior to installation. If you intend to liquid-cool a multi-amp system, Precision**Power** offers a group of products which distribute coolant from a single pump / reservoir to multiple amplifiers.

## Single Amp Liquid Cooling System



### Single Amp System

The following items are needed to liquid-cool an Art Series amplifier. Unless otherwise stated, all items are available from **PPI**:

An Art Series amplifier factory prepared for fluid cooling.

(If you already possess an Art Series amplifier, it must be sent to **PPI** for fluid cooling modification).

Two **Quick Disconnect (QD) Couplings**.

Two **Quick Disconnect (QD Straight / 90°) fittings**.

Two **male fluid transfer fittings**.

**Fluid return tube**.

**1/4" OD flexible tubing**.

**PrecisionPower Thermal Control Unit** (optional but recommended).

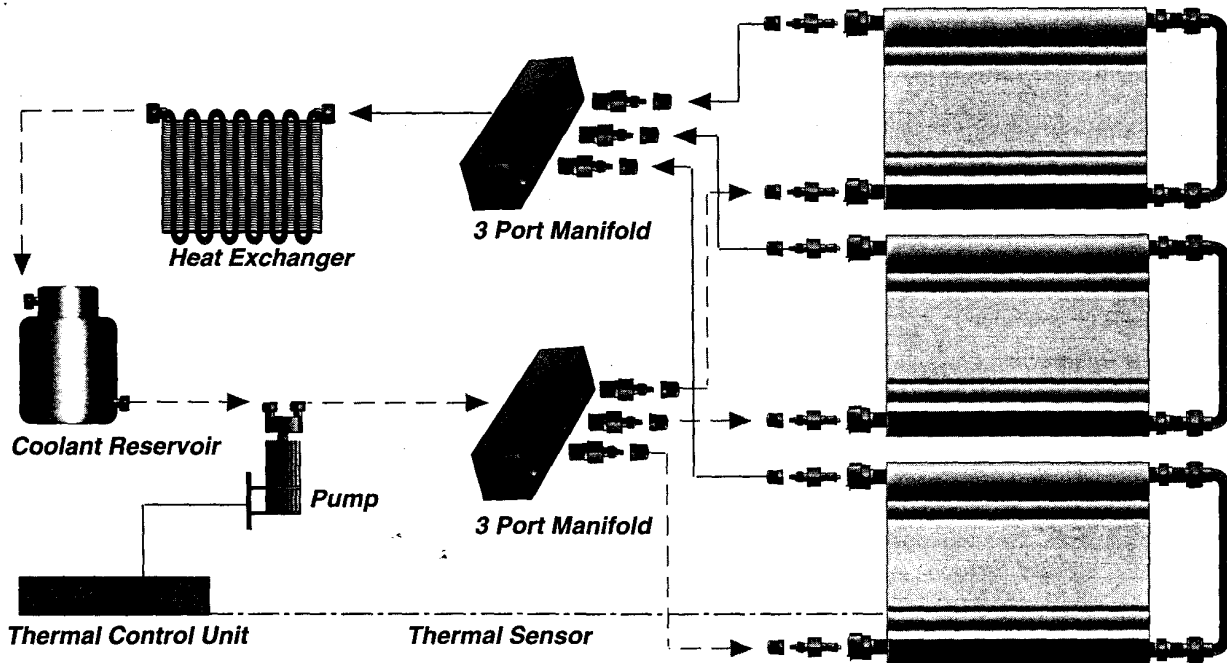
**12 volt fluid pump** (not available from **PPI**).

**Small heat exchanger** (not available from **PPI**).

**A small fluid reservoir** (not available from **PPI**).

**Distilled Water & Ethylene Glycol (anti-freeze)** (not available from **PPI**).

# Multi-Amp Liquid Cooling System



## Multi-Amp System

The following items are needed to liquid cool a multi-amp system. Unless otherwise stated, all items are available from **PPI**:

Art Series amplifiers that have been factory prepared for fluid cooling.

(If you already possess an Art Series amplifier, it must be sent to **PPI** for fluid cooling modification).

Two **Quick Disconnect (QD) Couplings** per amplifier.

Two **Quick Disconnect (QD Straight / 90°) fittings** per amplifier.

Two male fluid transfer fittings per amplifier.

Fluid return tube – one per amplifier.

1/4" OD flexible tubing.

Precision**Power** Thermal Control Unit (optional but recommended).

Two manifolds with couplings for fluid distribution.

12 volt fluid pump (**not available from PPI**).

Small heat exchanger (**not available from PPI**).

A small fluid reservoir (**not available from PPI**).

Distilled Water & Ethylene Glycol (anti-freeze) (**not available from PPI**).



## Installation

*PRIOR TO INSTALLATION of your Liquid Cooling System, it is important to consider the following: In your profession, your abilities and expertise insure a job well done. Trained professional car audio installers are no different. It's their chosen profession, and what they do best. **PPI** believes so strongly in its responsibility to you, that we invest heavily in the hands-on training of professional installers. Our comprehensive system design and installation seminar provides our authorized dealers with the latest techniques to deal with the complexities of car audio today. There is more than meets the eye to insure that a car stereo reaches its fullest potential. The trained professional, through experience, can approach, recognize, and address all the needs of the mobile audio environment. **PPI** highly recommends this amplifier accessory and/or any other mobile audio equipment be installed by a trained professional.*

*Although the Art Series amplifiers are designed for fluid cooling, unless ordered modified for Liquid Cooling, they do not come ready for plumbing. The fluid channels must be tapped for the fittings, and the end plates must be replaced with ones that provide access to the fluid channels. Also the larger Art Series amplifiers (ie. Ax400, A404, A600, and A1200) need an additional cooling device attached to the main power supply transformer. Once you have acquired an Art Series amplifier that has been retrofitted or was originally ordered as a fluid cooled unit, you can begin your installation.*

### **Tubing**

*The tubing needs to be 1/4" OD (.170" ID) flexible tubing that is chemically resistant and capable of handling temperatures up to 200 degrees F. Use of any other type of tubing may result in system failure. When routing the tubing, be sure to use a grommet when passing it through metal walls. Care should also be taken not to crimp or bend the tubing. We suggest keeping the fluid paths as short as possible to avoid pressure loss and overworking the pump.*

### **The Pump**

*The pump can be any 12 Volt DC pump with an isolated power and ground (no chassis ground), that is chemically resistant (such as a fuel pump) and can tolerate high fluid temperatures (200° F). Depending upon your system layout, the total length of tubing used will determine the pump size needed to run your system. Most systems will operate with a pump rated at 15 to 20 PSI. **The pump should be placed before the amplifier for optimum performance.***

*Prior to mounting your pump, keep in mind whatever pump system you choose will produce some mechanical noise. The pump can be isolated from the interior by placing it either in the trunk or, in the case of a hatchback / van, outside the vehicle. When mounting the pump outside the car, do not place it in the engine compartment where the fluid lines, reservoir, and heat exchanger are exposed to the high levels of heat generated by the vehicle's engine. Fluid lines running through metal walls must be insulated with a grommet to prevent chafing which could rupture the line.*

*The flow rate of the pump is governed by the **Thermal Control Unit** which monitors the amplifier's heatsink temperature (via a thermal sensor) and regulates the pump's operation based upon the heatsink's temperature.*

### **Heat Exchanger**

*The heat exchanger can be any small automotive type radiator, such as an engine oil cooler that accepts .170" ID tubing. This device can be acquired at any automotive parts store. The heat exchanger can be placed anywhere in the car that meets the requirements of the design except in the engine compartment. **The heat exchanger should be placed in line after the amplifier for optimum performance.***

## Fluid Reservoir

The purpose of the fluid reservoir is to eliminate any air bubbles from the fluid system that can reduce the cooling efficiency of the system. The reservoir can be any small container that is chemically resistant, able to tolerate high temperatures (200° F), and can hold up to a pint of fluid. The fluid needs to flow into the top and draw out of the bottom of the reservoir. **Place the reservoir after the heat exchanger and before the pump for optimum performance.**

## Installing the System

Once you have assembled everything you will need to liquid-cool your amplifier(s), it's time to install the system. Carefully lay out the system, making sure there are no sharp turns or kinks in the tubing and the pump is in the proper location to prevent it from being heard in the listening environment. The heat exchanger should be placed in an area that has good air circulation and is free from objects that may come in contact with it.

The coolant fittings are designed so they can be quickly disconnected from the amplifier without losing any fluid. This feature allows you to remove the amplifier for service without the worry of fluid spillage. Care must be taken not to cross-thread the fittings when screwing them into the amplifier. **Remember, the heat sink is aluminum which is a soft metal, and the potential for cross-threading exists!** Prior to attaching the fittings to the amplifier, wrap the threads with Teflon tape to prevent leaking. Take caution to wrap the Teflon tape in the same direction as your fittings.

After all components have been assembled, the fluid can be introduced to the system. **The fluid must be a mixture of 20% anti-freeze and 80% distilled water.** The use of non-distilled water will cause deposits to build up inside the fluid channels and will eventually cause the channels to become blocked. The mixture of 20/80 is important because of the relative low temperature and slow flow rate. Any other mixture will cause the anti-freeze to separate from the water thus reducing its ability to cool. Fill the fluid reservoir three quarters full and then turn on the pump to circulate the fluid throughout the system. Depending on the total length of the fluid path you may or may not need to add additional fluid to the reservoir.

## Thermal Control Unit

Once the system is complete, **PPI's Thermal Control Unit (TCU)** will govern the operation of the cooling network. The TCU monitors the temperature of the heatsink via a thermal sensor that replaces one of the end panel screws on the amplifier. This sensor should be installed on the side of the amplifier where the speaker plug is located. When looking at the side of the amplifier, remove the upper right hand end-panel screw (top of the triangle) and replace it with the sensor, while being careful not to damage the wires coming out of the sensor. If for any reason you choose not to use this location for the thermal sensor, the secondary locations for the sensor are bottom right (bottom of triangle) or top left (top of circle). Do not attach the sensor at the bottom left position (bottom of circle). After the sensor is in place, connect the wires to the TCU (refer to the illustration on page 18). During operation, the Thermal Control Unit will turn the pump on and off when needed. The front panel diagnostic LED (labeled "Pump") will light when the TCU is sending output voltage to the pump or fan(s). Also, when the pump is active, the Thermal Control Unit will adjust the speed of the pump based on the temperature of the amplifier. **Please Note:** In a multi-amp system only one sensor is used, and it should be placed on the amplifier which potentially will work the hardest (i.e. subwoofer amp).

**When connecting the Thermal Control Unit to the pump system, it is important that the pump's main ground is not attached to the pump's case. Both the pump's 12 volt positive and negative must be connected to the control output of the TCU, or the pump will not work.** The Thermal Control Unit can be used to operate up to three 12 volt DC fans when fluid cooling is not being used. The connections are the same as when using it for Liquid Cooling. For more information on the TCU, please refer to the section in this manual titled: **Thermal Control Unit.**

## **System Troubleshooting**

If for some reason your system fails to operate properly, please refer to this guide. If you are unable to resolve the problem, consult your Authorized **PPI Dealer** or call **1-800-62-POWER**.

**No Fluid Flow**      *Is the power LED illuminated on the TCU?*

*If no TCU, check pump connections.*

*Check fuses in power wire and TCU's chassis fuse.*

*Be sure turn-on lead is connected.*

*Is the TCU's pump LED illuminated? Be sure pump or fan has isolated power and ground.*

*Check TCU's sensor leads and inspect for a short to ground or an open connection.*

*Check connection on output voltage leads.*

*Measure voltage – if voltage is present then the problem is in the pump. If no voltage, then problem is either in the thermal sensor or in the TCU. Have your Dealer inspect the unit.*

*Check for kinks in tubing.*

*Check for blockage in connectors and fluid channels of amplifier(s).*

**Leaks**      *Tighten all connections.*

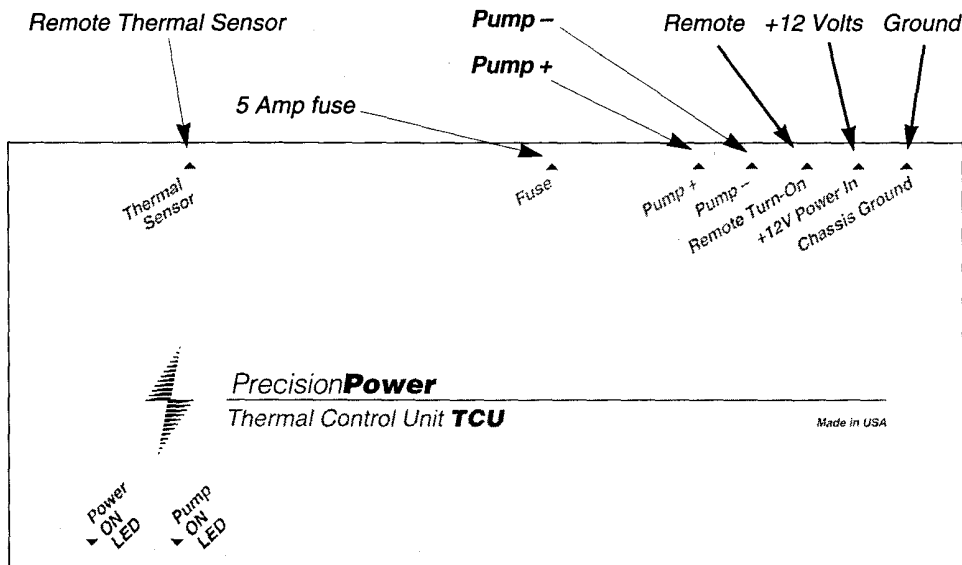
*Make sure teflon tape is used on connectors at the heatsink.*

## Thermal Control Unit

The Thermal Control Unit (TCU) was designed to monitor heatsink temperature via a remote thermal sensor and control the speed and frequency of a 12 VDC fluid pump or 12 VDC fan (up to three fans may be controlled by the TCU). As heatsink temperature rises, the TCU sends a progressive output voltage to a pump or fan(s). This function is triggered when the remote sensor measures a heatsink temperature of approximately 60° C. The output voltage will be maintained until the heatsink temperature falls below the 60° C threshold. A front panel LED (labeled "Pump") signals when the pump or fan(s) is activated.

### Specifications

<b>POWER REQUIREMENT:</b>	<b>11 TO 14 VDC</b>
<b>OUTPUT VOLTAGE:</b>	<b>11 TO 14 VDC</b>
<b>POWER OUTPUT:</b>	<b>33 – 42 WATTS</b>
<b>FUSE:</b>	<b>5 AMPS</b>
<b>THERMAL SENSOR:</b>	<b>60° C (+ / - 3°)</b>
<b>DIMENSIONS:</b>	<b>1" x 6.75" x 3.06"</b>



**Power On    Pump On**  
**TCU's Diagnostic LED's**

## Installation

**PRIOR TO INSTALLATION** of your Thermal Control Unit (TCU) it is important to consider the following: In your profession, your abilities and expertise insure a job well done. Trained professional car audio installers are no different. It's their chosen profession, and what they do best. **PPI** believes so strongly in its responsibility to you, that we invest heavily in the hands-on training of professional installers. Our comprehensive system design and installation seminar provides our authorized dealers with the latest techniques to deal with the complexities of car audio today. There is more than meets the eye to insure that a car stereo reaches its fullest potential. The trained professional, through experience, can approach, recognize, and address all the needs of the mobile audio environment. **PPI** highly recommends this amplifier accessory and/or any other mobile audio equipment be installed by a trained professional.

### Mounting

To prevent damage to the Thermal Control Unit (TCU), mount it in a secure place. Choosing the appropriate location will depend upon your vehicle and the complexity of your system design. Two types of brackets are provided which allow the TCU to be mounted vertically, horizontally, or in any compatible space that is convenient to your needs. **Please note: the wire leads of the thermal sensor (provided with the TCU) may be extended to accommodate your mounting location.**

If the unit is to be mounted in a dashboard, console, or other type of panel, a  $3\frac{1}{32}$ " x  $6\frac{25}{32}$ " rectangular hole should be cut to clear the chassis. A minimum depth of  $3\frac{3}{4}$ " is required behind the panel to allow space for the connecting cables. The TCU can be secured in place with the two supplied brackets. The brackets are connected with two  $6\text{-}32$ " x  $1/4$ " socket head cap screws (supplied). The brackets are adjustable to compensate for panel thickness. Since all dashboards are unique, the face of the brackets have been left blank for the installer's individual needs. The face brackets can be secured with nuts and bolts – (we suggest #6 metal screws).

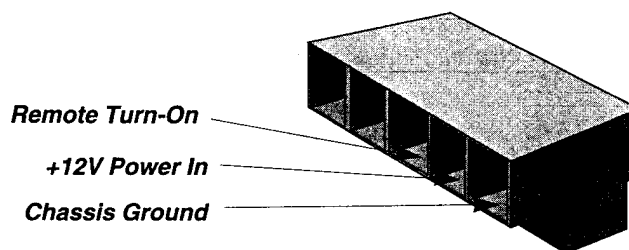
For under-dash or trunk mounting applications, use either of the two supplied brackets. These mounting brackets allow adjustment of the TCU into the desired operating position. **Please Note: never mount the TCU in a location which would subject it to immersion or exposure to water.**

### Power and Ground

Before beginning, disconnect the negative (-) terminal of the battery while working on your mobile audio sound system to prevent a short to ground. Reconnect the negative terminal only after all connections have been made.

The TCU is designed to operate from a car's 12 Volt, negative ground, electrical system. The power, ground, and remote turn-on cables should be 18 gauge (minimum) in size.

The TCU is connected to +12 Volts, chassis ground, and a remote switching +12 Volt source via the supplied five wire connector. Slip the wire into the back of the connector and secure it with the screw located on the bottom of the connector.



If a power cable is run from the TCU's location to the battery, care should be taken to avoid sharp corners, creases, and sharp body parts. When passing through any metal wall (i.e. fire wall, etc.), a grommet must be used to prevent the wire from chafing and shorting to ground. For safety reasons, **PPI** recommends that the +12 Volt power source (cable) be fused (1 Amp) at the positive terminal of the battery. If this fuse is not installed, and the power wire shorts to ground (between the battery and the TCU), a fire can result. Consult your Authorized **PPI** Dealer for an appropriate in-line fuse holder that meets the needs of your installation. We suggest crimping and soldering all wire connections. Insulate the connection with heat shrink to prevent a short to ground. If connecting to an existing +12 Volt power source, be sure the line is fused at the battery.

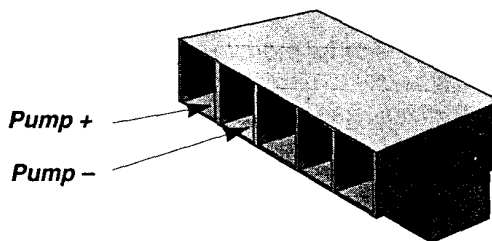
The ground wire should be of the same gauge as the power wire. As a "rule of thumb," use as short a length of wire as possible. Locate an area near the TCU that is metal, and clean an area about the size of a quarter to bare metal. Drill a pilot hole in the middle of this area. **Be Careful!** Inspect the area underneath to be sure you aren't drilling into wires, brake lines, or fuel lines etc. Terminate the wire with a ring connector and attach it to the bare metal using a #8 sheet metal screw and washer (not supplied). We suggest crimping and soldering this connection. Insulate the connection with heat shrink. It is important this connection be solid. After the connection is complete, coat the area with silicone or some other similar material to prevent rust from developing.

### Remote Turn-On

In order for the Thermal Control Unit to turn on, a remote turn-on wire must be connected to a switched +12 volt source. Typically, the source unit provides a power antenna (remote) turn-on lead which will activate the TCU when the source unit is turned on. If this is unavailable, a switched +12 volt source must be used. Run a wire from the TCU's location, through the vehicle to the switched +12 source. Observe the same precautions for routing this cable you followed for running the power cable. We suggest crimping and soldering this connection. Insulate the connection with heat shrink to prevent a short to ground.

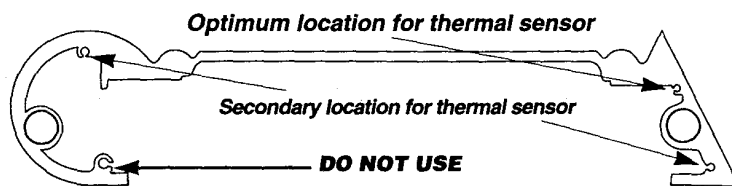
### Output Voltage to run Pump or Fan(s)

The Thermal Control Unit supplies 12 volt power to run a pump or fan(s) (up to three fans can be run by the TCU). When connecting the pump system to the Thermal Control Unit, it is important the pump's main ground be isolated – **not attached to the pump's case**. Both the pump's 12 volts positive and ground must be connected to the control output of the TCU, or the pump will not work. Observe the same precautions for routing this cable you followed for running the power cable. Be sure all connections are secure.



### Thermal Sensor

The Thermal Control Unit's output voltage is regulated via the thermal sensor which reads the heatsink temperature and at 60° +/- 3° C triggers the TCU to send a progressive output voltage to a pump or fan(s). The thermal sensor replaces one of the end-panel screws on the amplifier. Install the sensor on the side of the amplifier where the speaker plug is located. When looking at the side of the amplifier, remove the upper right hand end panel screw (top of the triangle) and replace it with the sensor, while being careful not to damage the wires coming out of the sensor. If for any reason you choose not to use this location, the secondary locations for the sensor are bottom right (bottom of triangle) or top left (top of circle). **Do not attach the sensor at the bottom left position (bottom of circle).** After the sensor is in place, connect the wires to the TCU.



The sensor leads are approximately 12 inches in length. If the TCU is to be located at a greater distance than this lead length will accommodate, extend the leads. Observe the same precautions for routing this cable you followed for running the power cable. Be sure all connections are secure. Insulate the connection with heat shrink to prevent a short to ground. Connect the thermal sensor leads to the TCU with the supplied two conductor connector. **Please Note: In a multi-amp system only one sensor is used, and it should be placed on the amplifier which potentially will work the hardest (i.e. subwoofer amp).**

If the Thermal Control Unit does not power-up, contact your Authorized PrecisionPower dealer or contact **PPI** at **1-800-62-POWER** for assistance.

## **Thermal Control Unit Troubleshooting**

*If for some reason your system fails to operate properly, please refer to this guide. If you are unable to resolve the problem, consult your Authorized **PPI** Dealer or call **1-800-62-POWER**.*

### **No Power**

*Is the power LED illuminated?*

*Check fuses in power wire and chassis fuse.*

*Be sure turn-on lead is connected.*

### **Pump / Fan**

#### **Doesn't Come On**

*Is the pump LED illuminated?*

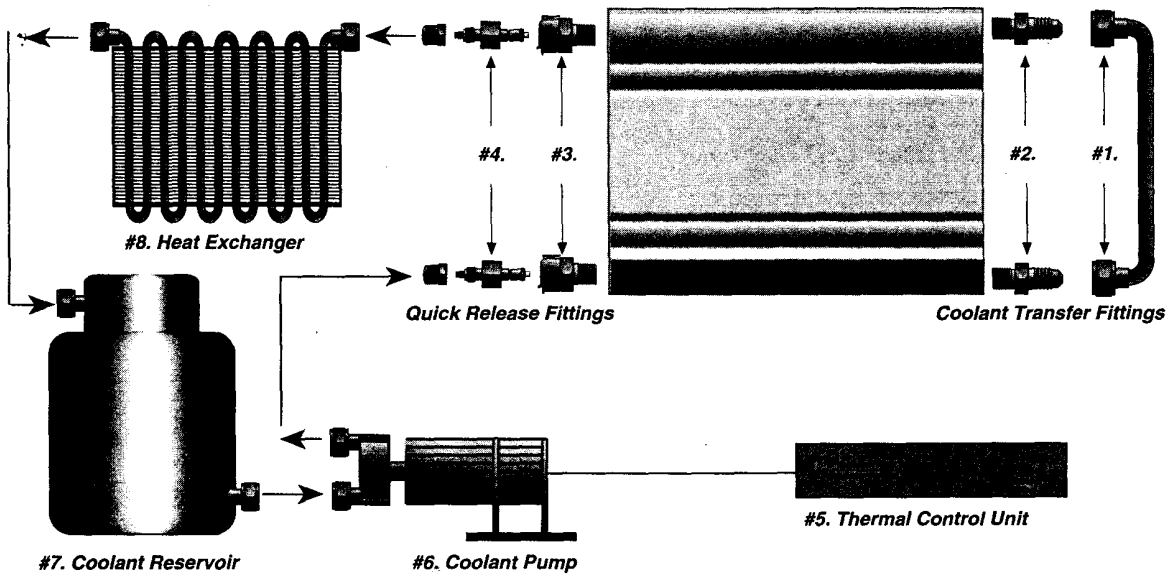
*Be sure pump or fan has isolated power and ground.*

*Check sensor leads and inspect for a short to ground or an open connection.*

*Check connection on output voltage leads.*

*Measure voltage – if voltage is present then the problem is in the pump. If no voltage, then problem is either in the thermal sensor or in the TCU. Have your Dealer inspect the unit.*

## Liquid Cooling System








## Liquid Cooling Accessories from PrecisionPower

- |                 |  |   |
|-----------------|--|---|
| #1. Return      |  | Aircraft quality, stainless steel 1/4 inch return tube.   |
| #2. Nipple      |  | 1/8 inch NPT fitting to connect <b>Return</b> to heatsink.  |
| #3. QD Coupling |  | Quick-disconnect coupling which threads into heatsink. Either a <b>QD Straight</b> or <b>QD 90</b> is used to connect the tubing. These connectors are designed with shut-off valves and close instantly when disconnected to seal liquids. |
| #4. QD Straight |  | Quick-disconnect fitting with shutoff valve.  |
| QD 90           |  | 90° quick-disconnect fitting with shutoff valve.  |
| #5. TCU         |  | Thermal Control Unit regulates the speed and frequency of the circulating pump. The TCU can also be used to control a fan.  |
| Hose            |  | 20 ft. of 1/4" OD Tubing.   |



## Multi-Amp Liquid Cooling Accessories from PrecisionPower

- Coupling**  1/8 inch NPT to hose manifold connector.
- Plug**  1/8 inch NPT threaded manifold port plug.
- MAN3**  1/8 inch threaded aluminum manifold with 1 input port and 3 output ports to connect multi-amp systems. With the use of the port **Plug**, this manifold can be used in two amp systems.
- MAN4**  1/8 inch threaded aluminum manifold with 1 input port and 4 output ports to connect multi-amp systems.
- MAN5**  1/8 inch threaded aluminum manifold with 1 input port and 5 output ports to connect multi-amp systems.

## Liquid Cooling Accessories not available from PrecisionPower

### #6. Coolant Pump



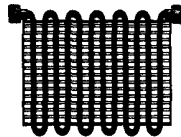
Available from most automotive supply stores, the coolant pump can be any 12 Vdc pump with an isolated power and ground. It needs to be chemically resistant (fuel pump), capable of handling temperatures up to 200°F, and produce 15 – 21 PSI.

### #7. Coolant Reservoir



Available from most automotive supply stores, the coolant reservoir can be any container that holds up to a pint of fluid and is chemically resistant. The coolant needs to flow into the top and out from the bottom of the reservoir.

### #8. Heat Exchanger



Available from most automotive supply stores, the heat exchanger can be any small automotive type radiator that accepts .170" ID tubing.

### #9. Coolant

Distilled water & Ethylene Glycol (anti-freeze).