

**E160i**

160W Stereo Integrated Amplifier

**Owners Manual**





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## Introducing the Perreaux E160i Integrated Amplifier

Congratulations on your Perreaux E160i purchase. To realise the full potential of your unit you need to appreciate all aspects of its operation.

Before installing the E160i into your system, read the entire manual carefully. Endeavor to understand every detail by familiarising yourself with the controls and features as you read. You will find it easier to install using the relevant sections of this manual as a reference.

We have attempted to explain every feature and operational facet clearly and concisely. In the event that something is still unclear to you, your Perreaux dealer will be happy to assist you further.

Read this manual, install your unit correctly and realise the sonic significance of your investment in Perreaux.

Perreaux products are designed to provide the utmost in sonic realism and electronic reliability with a functional yet elegant appearance that reflects the care and craftsmanship applied during all stages of construction.

### Features at a Glance

- Rugged build quality
- Stiff power supply
- Hybrid Class A/AB output stages
- MOSFET output devices
- High power
- Advanced PCB design and earthing techniques
- Earth isolation switch
- Preamp bypass function
- Full function infrared remote control
- Preamp coupling switch

To maintain the consistently high quality that you expect from us, and we expect from ourselves, Perreaux products are essentially handcrafted.

We maintain the human-link throughout, from design and construction, through to the ultimate test, your music, your system, your ears.

Because we too listen to our products, we know that with your Perreaux you will discover many more of the musical secrets we strive to reveal.

From all of us at Perreaux Industries Limited, thank you for choosing the Perreaux E160i integrated amplifier.

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# Important Safety Instructions

Note: All safety and operation instructions should be read carefully before the E160i is operated. Keep the Owners Manual in a safe place for future reference.

- The E160i should not be used near water, for example near a bathtub, kitchen sink, in a wet basement, near a swimming pool, etc.
- The E160i should be rack mounted only in a heavy-duty rack or stand that is recommended for audio equipment use.
- Mounting to a wall or ceiling should be via a heavy-duty bracket or shelf designed for audio equipment use.
- The E160i should be situated away from heat sources such as radiators, stoves, or other appliances that produce excessive amounts of heat.
- Always ensure the E160i heat sinks have adequate ventilation enabling air circulation both above and below.
- DO NOT place the E160i directly onto carpeted surfaces.
- Avoid exposing the E160i to extremely high or low temperatures.
- The E160i should be connected to a mains power supply only of the type described in the operating instructions, or as marked on the rear of the unit.
- DO NOT disconnect the mains earth from the system.
- The mains power supply cord should be routed so that it is not likely to be walked on or pinched by items placed on or against it.
- The power cord of the E160i should be unplugged from the mains outlet when the unit is to be left unused for long periods or when attempting to connect or disconnect cables and before cleaning your unit.
- Care should be taken so that objects and/or liquids do not accidentally fall inside the E160i.
- Please keep electrical equipment out of reach of children.
- Please unplug sensitive electronic equipment during electrical storms.
- Please replace any fuse with the value and type specified.
- Avoid operating the E160i with the cover removed.
- DO NOT bypass any fuse.



- DO NOT attempt to repair the E160i. In the event of a problem, please contact your Perreaux dealer.
- DO NOT operate this product in an explosive atmosphere.

Caution!

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The E160i is a convection-cooled amplifier. The finned outer heat sinks may become very hot when delivering high volume levels – to avoid injury; care should be taken not to touch the heat sinks during operation.

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# 1

## Unpacking and Placement

### Unpacking Procedure

The E160i is packaged for maximum protection. Please carefully read the instructions below before proceeding to unpack the unit. Be extremely careful.

- Inspect both ends of the cardboard box and open at the end without the central staple by slitting the reinforced tape at either side.
- Fold back the flaps and tip the package on end and the inner box will slide out.
- Lay the inner box down flat and upright, open it conventionally by separating the top tray from the bottom.
- The product can now be removed from the bottom packaging. This will be easier if you have someone to help you by holding the base of the box.
- Alternately, the bottom tray and amplifier could be tipped upside down and the bottom packaging removed. If opened in this manner, please ensure that you turn the contents over again.

Note: Be very careful to secure the unit if you are planning to flip the package upside down.

- Remove the two white polystyrene protectors off either side of the amplifier, leaving the black material covering.
- Pull back the material and remove the protective black tissue from the front panel.

The amplifier is now unpacked and ready for further installation.

Note: Please retain all packaging material for future transport.

### Box

the **contents** ensure

you





## Ventilation Requirements

For optimal performance, the unit MUST receive adequate ventilation.

- Please do not install in a sealed cabinet.
- Please do not stack products directly on top of the unit.
- Please do not cover the product with a cloth or similar.
- Please do not mount the E160i directly onto carpeted surfaces.
- As a “rule of thumb”, allow 80-100mm (3-4 inches) around all sides of the product and mount the E160i on a flat surface, ensuring that the unit has adequate access to free flowing air.
- In the event that the E160i is to be incorporated into custom cabinetry, please refer to Chapter 15 “Physical Dimensions”.

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Note: Please take all necessary steps to ensure that the unit receives adequate ventilation

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If you are like us, the first thing you will want to do is to play your favourite piece of music through your new E160i. The following instructions are written to enable you to achieve this as quickly as possible. These are not comprehensive instructions, but are designed to enable you to play music now!

Note: Please take the time to read the E160i manual thoroughly as it incorporates many features, which will enhance its operation.

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### **Placement**

The E160i is a convection-cooled amplifier and best results will be achieved when placed on a solid surface with adequate ventilation. DO NOT place on a carpeted floor or cover the amplifier!

### **Turn off associated components**

This minimises the potential to damage any other components when connecting your E160i into the system.

### **Connect source to E160i**

Connect the output of your source component to the un-balanced (*RCA*) inputs at the rear of the E160i.

Note: Try to keep all interconnect cables as far from loudspeaker cables as possible and well away from all AC mains leads.

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### **Connect speaker cables to the left and right speaker terminals**

We recommend using high quality connectors for your speaker cables, spade lugs are the preferable option as they combine a larger surface area with the possibility of a strong mechanical connection; however, high quality banana terminals are also acceptable.

Note: Be careful to maintain channel integrity, i.e. left to left, right to right, and phase integrity, positive (+) to positive (+), negative (-) to negative (-).

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### **Switch on source component**

Turn on the source component and prepare your favourite recording.

### **Switch on E160i**

After checking the supply voltage compatibility with the voltage rating on the E160i rear panel, insert the power cord-set supplied into the rear of the unit and into the wall. Switch on the socket at the wall and power up the E160i using the switch on the front panel.

### **Press 'play' on source**

Press 'play' on your source component.

**Increase the volume**

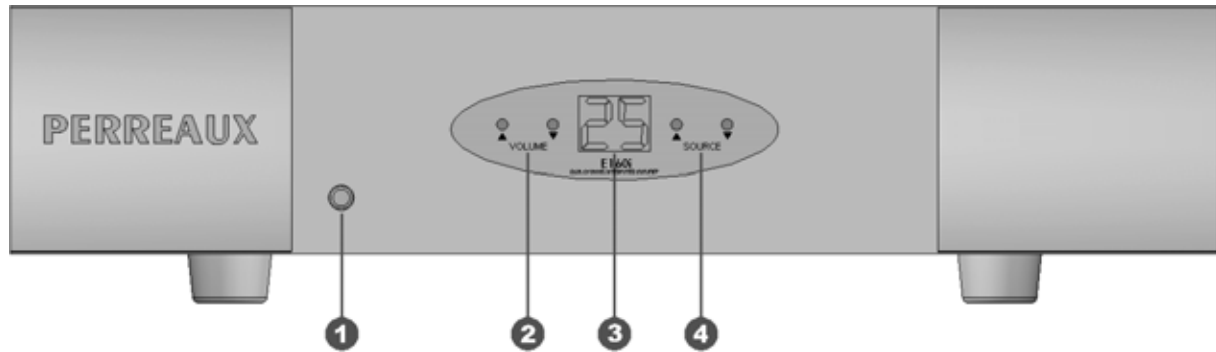
Slowly increase the volume control of the E160i to achieve a comfortable listening level.

**CONGRATULATIONS!**

Now that you have achieved your first objective, sit back, relax and please read the rest of the manual at your own pace, in your favourite armchair, whilst sipping a hot cup of coffee. You'll find the whole experience much more pleasurable whilst listening to music.

# 3

## Front Panel Functions



### 1 Power Switch

Depress this switch to turn power ON. Mute relay circuitry is employed in the E160i so output is muted momentarily after the power switch is actuated. Depress the switch again to turn the unit off, at which time the outputs will be disconnected.

### 2 Volume Control

When depressed, these buttons will alter the volume setting. The volume adjustment range is 00 – 59.

### 3 Alphanumeric Display

The display will illuminate when the power is turned on at the mains power switch or when various remote or front panel adjustments are made. At turn-on, the display will illuminate with 00 and default to the CD input. If no commands are selected within two minutes, the display will revert to the standby mode displaying a green dot only to indicate power is still on.

### 4 Source Select

When depressed, these buttons select the desired source input.

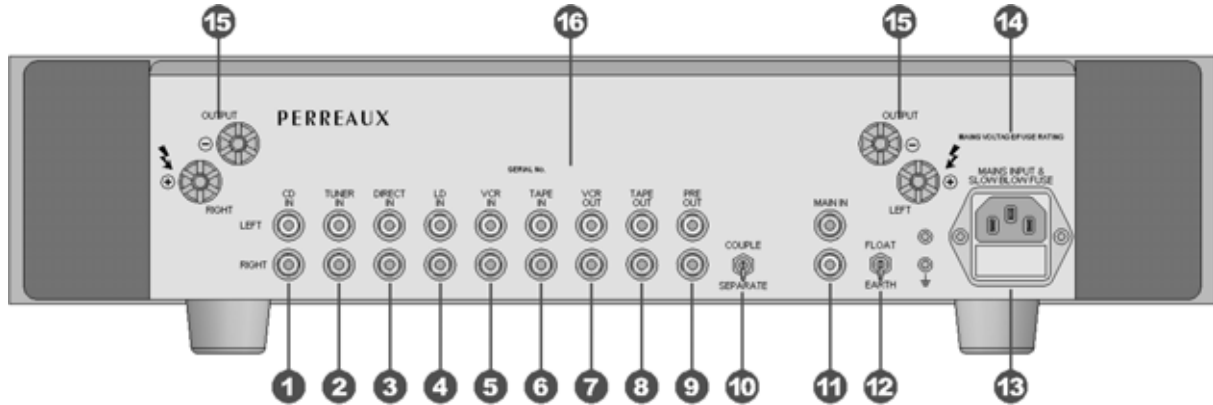
The order of source inputs and display indication is as follows:

Source Input	Display
Compact Disc	Cd
Tuner	TU
Direct Input	dI
Laser Disc	Ld
VCR	VR
Tape	TA

Note: If the VCR or Tape source is selected no signal is supplied to its applicable output to avoid a potentially damaging feed back loop.

# 4

## Rear Panel Functions



**Caution!** Please make all changes at minimum volume setting. Only increase the volume after the connections have been made.

### **1 2 4 5 6** Line Inputs

Accepts a standard single-ended input (RCA) from source components with single-ended analogue outputs. These high quality gold plated sockets are highly conductive, corrosion resistant, and provide less potential for corrosion induced distortion.

Refer to Chapter 14 “Specifications”, for detail on input sensitivity and impedance.

### **3** Direct Input

Accepts a standard single-ended input (RCA) from source components with single-ended analogue preamplifier outputs. Bypasses the preamplifier, enabling seamless integration into home theatre applications.

**Caution!** This input bypasses the preamplifier and signal is directly applied to the power amplifier. Ensure the component connected to this input has preamplifier functionality, as full power output will be available with a 1.3V input voltage.

Refer to Chapter 14 “Specifications”, for detail on input sensitivity and impedance.

### **7** VCR Line Outputs

This single-ended (RCA) output will provide a line level audio signal, suitable for recording, from the selected source input. This output is disconnected when the VCR source input is selected; to prevent any potentially damaging feedback loops.

### **8** Tape Line Outputs

This single-ended (RCA) output will provide a line level audio signal, suitable for recording, from the selected source input. This output is disconnected when the Tape source input is selected; to prevent any potentially damaging feedback loops.

### **9** Preamp Output

This single-ended (RCA) output provides the audio signal from the preamplifier section, and can drive virtually any amplifier to full power.

### **10** Preamp Couple Switch

Enables the preamplifier and power amplifier sections to be used independently of each other. Setting this switch DOWN disconnects the preamplifier from the power amplifier. Setting UP connects the preamplifier to the power amplifier section and is the default position.

### **11** Power Amplifier Input

Use in conjunction with the Preamp Couple switch to connect the output from a preamplifier directly to the power amplifier section.

### **12** Earth Lift Switch

This switch enables the user to isolate the internal signal earth of the amplifier from the mains earth and is useful if system hum is a problem. Setting this switch DOWN connects the internal signal earth to mains earth and is the normal position. Setting to UP disconnects the signal earth from the mains earth.

Note: Activating this switch has no effect on chassis earth, maintaining the connection to mains earth.

### **13** AC Mains Input and Fuse

AC Mains Input

An IEC-standard mains input is provided at the rear of the unit. The AC cord set is removable, allowing you to upgrade to a cord set of your preference.

Caution! Prior to connection to the AC mains, please check the voltage label on the rear panel to ensure that your unit conforms to the power supply in your area. Never attempt to connect the unit to the incorrect voltage. Severe damage can result from applying incorrect voltage to the unit.

Mains Fuse

The E160i is equipped with a user serviceable AC mains fuse. In the event of fuse failure, always replace with the same type and value fuse. Remember, fuses do not usually blow without a reason. Any doubts about fuse failure should be conveyed directly to your Perreux dealer.

For more information on fuse ratings, please refer to Chapter 14 “Specifications”.

Caution! This is the ONLY user accessible fuse.  
Never replace the fuses with any other ratings other than the one specified on the rear panel.  
Always ensure your E160i is disconnected from the mains supply before attempting to change the mains fuse.

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#### **14 Input Voltage and Fuse Rating**

##### Input Voltage

It is important that the E160i be operated from the correct AC mains voltage. This unit is factory set for the voltage applicable to the original country of destination.

The E160i will operate satisfactorily within a voltage variation of up to  $\pm 5\%$  of that voltage at which the unit has been set.

If you require the voltage setting to be altered, e.g. relocation to another area, city or country, or extraordinarily high or low voltages, please contact your Perreaux dealer. Qualified service personnel can only perform this modification.

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Caution! Never attempt to connect the unit to the incorrect voltage. Severe damage can result from applying incorrect voltage to the unit.

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##### Fuse Rating

The fuse rating displayed here, refers to the rating of the mains inlet fuse.

For more information on fuse ratings, please refer to Chapter 14 “Specifications”.

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Caution! Never replace the fuses with any other ratings other than the one specified.

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#### **15 Speaker Output Terminals**

The E160i is equipped with one set of gold plated output terminals per channel. All terminals are clearly marked and colour coded RED Positive (+) and BLACK Negative (-). This polarity must be observed when connecting loudspeakers, i.e. positive terminal of the E160i to the positive terminal of the loudspeaker and negative terminal of the E160i to the negative terminal of the loudspeaker.

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Caution! Never connect the amplifier's output terminals to any device other than a loudspeaker.

Please do not short circuit the amplifier's output terminals.

Never connect the output of one amplifier to the output terminals of another amplifier.

Do not over-tighten the binding posts on your amplifier.

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## **16** Serial Number

The serial number is unique to your E160i. Please record this number and store it in a safe place. For any service related enquiry, please be prepared to quote the product serial number to Perreux personnel or their service representative.




# 5

## Remote Control Functions

The E160i comes supplied with a 29 button Perreaux Universal infrared remote control.

The remote control uses 2 x AAA batteries and may be changed by sliding forward the plastic cover located on the bottom of the remote.


Note: Press the red  button on the remote to select the code-set required to control the E160i.

The E160i uses the following functions:

### **Mute**

Depressing this control causes minimum volume to be selected. The display will indicate "MU" until any front panel or remote control button is actuated, or the mute button is depressed again at which stage volume will be returned to the previous setting.

Note: After one minute, the E160i will enter standby mode and volume will be set to zero. The display will revert to a green dot, indicating standby.

The mute control has a 'punch through' function and will operate regardless of the code-set selected i.e. you can be operating the CD player remote functions and still use the mute control without selecting the  button first.

### **Display**

Pressing this button will cause the display to revert to the standby indication (one green dot) and is intended for use if the light of the display is distracting (for instance in a darkened room). Depressing any key will cause the display to revert to its normal operation.

### **Balance Left** / **Balance Right**

The balance controls allow you to vary the level of either the Left or Right channel to obtain the correct stereo balance for your listening position. Pushing the Balance Left button will cause the level of the right channel to be attenuated (decreased in volume). Pushing the Balance Right button will cause the level of the left channel to be attenuated.

During any balance adjustment the display will indicate the direction of adjustment, left or right, with an "L" or an "R" followed by a number indicating the level of adjustment. The range is L1-L9 and R1-R9. "LR" on the display indicates the balance is centred. Pushing either button will initially cause the display to indicate the current balance position.

Note: Balance settings are not stored, should the E160i be turned off at the mains power switch.

 **Tuner Source Select**

Depressing this control selects the Tuner source input and the relevant code-set. The Tuner input is indicated by “TU” on the display of the E160i.

 **Compact Disc Source Select**

Depressing this control selects the Compact Disc source input and the relevant code-set. The Compact Disc input is indicated by “Cd” on the display of the E160i.

 **Tape Source Select**

Depressing this control selects the Tape source input. The Tape input is indicated by “TA” on the display of the E160i.

 **VCR Source Select**

Depressing this control selects the VCR source input. The VCR input is indicated by “VR” on the display of the E160i.

 **Laser Disc Source Select**

Depressing this control selects the Laser Disc source input. The Laser Disc input is indicated by “Ld” on the display of the E160i.

 **Direct Input Source Select**


Depressing this control selects the Direct Input source input, bypassing the preamplifier. The Direct Input is indicated by “dI” on the display of the E160i.

 **Volume Up**

Depressing this button increases the volume.

 **Volume Down**

Depressing this button decreases the volume.

Note: The Volume control has a ‘punch through’ function and will operate regardless of the code-set selected i.e. You can be operating the CD player remote functions and still use the volume controls without selecting the  button first.

# 6

## Special Design Philosophies

### Minimalist Design

Perreaux has been designing and manufacturing only the highest quality audio componentry for more than a quarter of a century. Technology has continued to evolve rapidly over that time and our knowledge and application of design, materials and manufacturing techniques has advanced in tandem with this. Today's Perreaux range comes closer to fulfilling our shared vision than at any other time in the past.

To follow is a discussion on some of Perreaux design philosophies that have been incorporated into the entire range.

Leading British architect, John Pawson, writes:

*“The Minimum can be defined as the perfection that an object achieves when it is no longer possible to improve it by subtraction. This is the quality that an object has when every component, every detail, and every junction has been reduced or condensed to the essentials. It is the result of the omission of the inessentials”.*

Perreaux has historically embraced the minimalist ethic from an audio design perspective only. The concept of “less equating to more” has been at the heart of all Perreaux audio designs for more than a quarter of a century.

#### Minimalist Electronics

We wish to maximise the quality of your listening pleasure by keeping the componentry and signal path as uncluttered, short and clean possible. All components in the signal path, even those of the highest quality have an effect on the signal, thereby altering the quality of the reproduction in some way. Our aim is to recreate in its entirety, the original performance by not adding or subtracting anything, irrespective of the source.

#### Minimalist User Interface

We carefully study the user interface and par down the number of buttons and associated clutter leaving just the essential and no more. How tempting it has been over the years to loose sight of our core values as technology or trends have made it possible. That is one of the reasons why our older products still have such a high resale value today. The user interface has and always will remain simple, free from adornments, clean and uncluttered.

#### Minimalist Aesthetics

Our products appeal to those who seek the ultimate in audio exclusivity, namely the perfect blend of “form and function”.

“Form and function” are both tough masters. That is why our amplifier heat sinks are not hidden, but instead feature prominently in all our designs. We make no excuses for producing some of the most distinctive high-end audio products on the planet. We let “form and function” blend together in perfect harmony. This surely is the essence of true minimalist utilisation.

#### Minimalism in a Wider Context

John Pawson writes:

*“Clearly simplicity has dimensions to it that go beyond the purely aesthetic: it can be seen as the reflection of some innate, inner quality, or the pursuit of philosophical or literary insight into the nature of harmony, reason, and truth”.*

# 7

## Special Design Features

### **Rugged Build Quality**

Mechanical strength has been a hallmark of Perreaux products since the company first started production back in 1974. The concept behind the physical design and construction is that each structural member should contribute to both rigidity and performance.

### **Stiff Power Supply**

The E160i incorporates a custom designed, toroidal power transformer, employing heavy gauge wire that reduces copper losses to a minimum. An electrostatic shield prevents AC line borne interference from entering the signal path. The power supply filter capacitors, totaling 20,000 $\mu$ F have exceptionally low inductance and internal resistance. They charge and discharge in response to load demand far more rapidly than conventional storage capacitors and are capable of delivering the instantaneous current required by the output stages, providing optimum dynamic range and transient response. The wiring from the power supplies to the output boards is designed for unimpeded transmission of the required current and voltage and utilizes heavy gauge, copper wire cables. Since power supply leads radiate at signal frequencies, all wiring is carefully loomed to minimise this effect.

### **Hybrid Class A/AB**

The bi-polar transistors used in the E160i are run in Class A mode. This avoids the crossover notch distortion and the resulting odd-order harmonics present, to some degree, in all other classes of operation. The devices used in the E160i output stage are MOSFETs, which with high quiescent current circuitry, are run in the equivalent of Class A to 10 watts. Beyond this point the output class is technically Class AB (hence the hybrid nomenclature), but with a major difference. The combination of MOSFET characteristics and their application in this circuitry, result in crossover distortion so minimal that it is virtually non-existent.

### **MOSFET Output Stage**

The E160i output stage takes full advantage of the unique qualities of MOSFET devices and in many ways they are superior to bi-polar transistors. A major advantage is their tendency to draw less current over a large section of the power bandwidth as their temperature rises (Negative Temperature Coefficient), hence self stabilising thermally, whereas bi-polar transistors draw more current as their temperature rises (Positive Temperature Coefficient) and protection circuits become mandatory to prevent thermal runaway and eventual self destruction. MOSFETs have the ability to swing fully across the amplifier's internal DC voltage and are therefore true "rail-to-rail" devices. Using MOSFETs encourages the highest performance from the balance of the internal amplifier circuitry.

### **Earthing**

Perreaux engineers pay particular attention to designing the product to ensure maximum separation between internal signal and power earths, only meeting at a central starred point.

**Earth Isolation Switch**

The toggle switch on the rear of the E160i allows the internal circuitry to be isolated from the mains earth, whilst still maintaining an earth connection to the chassis. This ensures the potentially fatal practice of using an AC cord-set with no earth connection, to alleviate system hum, is not required.

**Highest Quality PCBs and Components**

Quality fibreglass PCBs, featuring heavy copper tracks and high-grade components, are used throughout the E160i. This provides added stability under variable thermal or electrical loads and assures maximum signal integrity, separation and product life.

**High Power**

Capable of continuously delivering  $160W_{RMS}$  into  $8\Omega$  ( $200W_{RMS}$  into  $4\Omega$ ), the E160i is highly powered. Utilising six high current Hitachi MOSFETs per channel, the E160i handles even the most difficult loads with ease.

**Preamp Bypass**

The 'Direct Input' function allows the preamplifier to be bypassed and the power amplifier section connected to directly. Perfect for seamless home theatre integration.

# 8

## Maximising System Potential

### Interconnects and Speaker Cables

An often-ignored area in high fidelity systems is the cabling connecting the various components. Interconnect leads should be high quality cable with substantial terminations. Gold plate is inherently resistant to corrosion, and an excellent conductor. The presence of corrosion induces distortion and poor conductivity will seriously interfere with sound quality. Terminations must plug snugly into sockets to maintain maximum conductivity and to avoid annoying earthing problems.

Speaker cabling is equally critical. Use only solidly constructed cable of high purity copper or silver content. Again, gold plated terminations are recommended, of the spade or banana plug type. Use cables of equal length and as short as possible to maintain uniform electrical resistance at the lowest possible level. If your amplifier is closer to one of your speakers than the other, avoid coiling the longer lead as this can create inductance, with the potential of reduced high frequency performance. Keep all connections clean, firm and tight. The traditional adage that a chain is only as strong as its weakest link most certainly applies to audio systems.

### Bi-amping

Bi-amping uses two similarly powered amplifiers, with exactly the same input sensitivity so that, when the same input signal is provided to each of them, the output level will be exactly the same. This can often be done with one power amplifier connected to the tweeters and another to the woofers, as it spreads the power requirement between the two amplifiers. Bi-amping can achieve greater control, dynamics and resolution than if you try to run everything from a single stereo amplifier.

### Positioning Ancillary Equipment

Positioning of your source equipment (tuner, video, disc, tape, record, decks) is important. To avoid airborne frequency peaks, place them well away from your loudspeakers and not in the corners of your listening area.

### Loudspeaker Placement

Loudspeaker placement is a controversial issue; suffice to say that room corners are generally the worst situation. Everything which constitutes your listening area, including the materials used in its construction, will affect the sound itself and the sound stage created. Equally, you have to live with your system and therefore compromises will have to be made in line with your particular priorities. The best advice we can give concerning the choice of loudspeakers is, establish clearly in your mind your requirements; listen to many makes and models, and if at all possible audition your preferred choice in your own listening area and trust your own ears.

### Matching Amplifier and Speaker Ratings

When matching speakers to amplifier wattage – ordinarily, the amplifier should have a continuous RMS output power rating the same as or higher than the speakers at the same impedance rating. For example,  $160W_{RMS}$ ,  $8\Omega$  speakers driven by a  $160W_{RMS}$  at  $8\Omega$  amplifier is not as ideal as  $120W_{RMS}$ ,  $8\Omega$  speakers driven by a  $160W_{RMS}$  at  $8\Omega$  amplifier.



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Note: 160 Watts is twice as loud as 16 Watts, not ten times as loud.

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Perreaux equipment is designed with substantial headroom built in – that is, the reserve necessary to reproduce musical peaks without clipping.

**Final  
Thoughts**

High fidelity systems are an investment deserving of careful thought and personal time. Your preferences, priorities and constraints will dictate the parameters of your purchase, your ears will tell you what is the right choice for you. Our experience tells us that the bitterness of dissatisfaction lingers long after the fragrance of cheap price is forgotten, hence our use of the term – investment.



# 9

## The Power MOSFET

Today with the vast number of technical achievements occurring around the world, many discoveries are overshadowed or obscured by some that may appear more important to the general media. One such discovery of importance, to the audiophile at least, is that of the power MOSFET device.

### The MOSFET

The field effect transistor (FET) and then the MOSFET transistor have been around for a number of years, but only as a small signal-handling device, mostly employed in radio tuners and communications equipment. The electrical advantages of these have long been realised by manufacturers of hi-fi. If only they could be made to handle large amounts of power – what a benefit to the audiophile.

The term power MOSFET describes a device capable of handling reasonably large amounts of electrical energy as an amplifier itself – hence power. MOSFET stands for “Metal Oxide Silicon Field Effect Transistor”, this in turn means that the device is constructed of Silicon. Similar to a transistor – but the part that controls the power flow through the device is insulated from the remainder of the device by a metal oxide insulating layer and the controlling of the power is achieved by the development of an electrostatic field between the controlling element and the conducting element.

In a transistor, the control of the power through the device is effected by the application of a smaller, but nevertheless, significant amount of power to the controlling element. Whereas in the power MOSFET, the control of the power through the device is affected by the application of a very small and very insignificant amount of power to the controlling element – in fact, only the amount required to create a small electrostatic field. This makes the operation of a power MOSFET similar to that of a valve.

### Other Field Effect Devices

There are basically three types of power field effect device, they are: the junction FET, the vertical FET and the power MOSFET, all of which were independently developed by three different hi-fi equipment manufacturers in Japan and all were major technological breakthroughs in their own right.

The first of these was the junction FET, the second the vertical FET and lastly, the power MOSFET. Although all these devices are vast improvements over power transistors, the junction FET and vertical FET cannot compare with the power MOSFET, in terms of simplicity of the supporting driver stages and power supply requirements.

The power MOSFET, though having similar characteristics to the valve, can be divided into 2 types of polarities of device – P-channel and N-channel. Broadly speaking only one of these types exists in valve operations. This means that complementary power MOSFETs – P and N channel – can be used in an audio output stage providing greater linearity of operation than can be achieved with valves. In addition, further advantages over the valve include

## Audio Applications

their much smaller size, no filaments and greater reliability with reduced vulnerability to physical damage.

When used in an audio power amplifier, the advantages of the power MOSFET over the power transistor are much more difficult to describe and would require greater complexity than can be gone into here. However, they can be summarised as follows – the most important point is that the power MOSFET has a negative temperature coefficient whereas the power transistor has a positive temperature coefficient. This means that when a power transistor is handling power it heats up further and consumes more power. This characteristic, called thermal runaway, will result in the destruction of the power transistor if some means is not provided to control it. The power MOSFET on the other hand, although heating up due to the power flow through the device, does not continue to draw more and more power just because its temperature has risen. But in fact has a tendency to stabilize itself – provided adequate head sinking is available to remove the heat generated during normal operation. Incidentally this is less heat sinking than is required for a similarly power rated standard transistor.

## Secondary Breakdown

Then there is the appearance of secondary breakdown and ‘hot spots’ in a power transistor. This is related to thermal runaway. In order to understand this, one must imagine that the chip silicon inside the power transistor is in fact many smaller transistors connected in parallel. Now, if one of these smaller transistors or a spot on the chip has a greater gain (or amplification factor) than the rest, then that spot will heat up faster and to a greater temperature than the remainder of the transistor chip. This means that whole power dissipation capability of the transistor has been severely reduced and is a major cause of these unexplained output stage failures in large power amplifiers, i.e. over  $80W_{\text{rms}}$ .

The power MOSFET is largely immune to this problem because if a small part of this chip has a higher gain than the rest then its temperature will rise slightly causing that spot to reduce gain and hence stabilization occurs. The power is more evenly distributed throughout the chip and therefore reliability is maintained.

It can be seen from the above that the transistor power amplifier has to have a much larger margin of power dissipation capability and heat sinking in its output stage than the power MOSFET amplifier.

The transistor power amplifier of  $100W_{\text{rms}}$  output into  $8\Omega$  can require a driver stage capable of delivering 10W at 1kHz and up to 20W at 20kHz into the input of the output device. The power MOSFET only requires a maximum of 0.01W so a major saving in driver stage componentry and associated noise and distortion can be eliminated.

## **High Frequency Response**

Probably, from the sonic quality point of view, the most important improvement is the power MOSFETs vastly superior high frequency response. A large proportion of the power transistors used in modern hi-fi amplifiers start to show a decline in efficiency from 10kHz upwards. The efficiency of the power MOSFET does not start to decline until about 2MHz and is only down 3dB at 30MHz. This is due to the energy transfer being accomplished with minority charged carriers in the power MOSFET as opposed to majority charged carriers within the transistor, and results in hole storage at high frequencies causing the transistor to dissipate increasing amounts of energy within itself as the frequency increases.

Further sonic degradation of the transistor power amplifier occurs due to hole storage of the output transistors. As the output distortion increases with increasing signal frequency, it is obvious that the distortion products in the negative feedback path also increase.

Because the negative feedback system is employed to reduce distortion by cancellation, at high frequencies it causes even more power to be consumed within the output transistor just to cancel out the distortion.

Transient intermodulation (TIM) is also more prevalent in transistor power amplifiers because the signal transition in time is relatively slow. This means the distortion products in the signal of, say, a fast transient will not travel through the negative feedback system into the output stage fast enough to cancel at exactly 180 degrees out of phase – resulting in the amplifier being overloaded. This is not possible in power MOSFET amplifiers.

## **Other Advantages**

Further sonic improvement is achieved in power MOSFET amplifiers due to reduced crossover distortion, as power MOSFETs have a sharper “knee” than transistors at cut-off and provide a greater linearity when crossing over from one device to the other. Because crossover distortion is a major cause of odd order harmonic distortion in transistor amplifiers (be it small, i.e. 0.05% total) they are usually considered to sound more harsh than valve amplifiers which generally have large amounts of even order harmonic distortion up to 5% and are thought to sound more pleasant and musical.

However, which is more accurate? The valve amplifier at 5% THD with a pleasant sound and even order harmonics; the transistor amplifier with 0.05% THD with relatively unpleasant sound with even and odd harmonic output, or a power MOSFET amplifier with 0.02% THD and relatively pleasant even order harmonic distortion? In our opinion, the power MOSFET amplifier because the THD generated is virtually all second or even order harmonic distortion total 0.02% or less at 20kHz and down to 0.004% or less at 1kHz.

It can be seen that power MOSFETs are here to stay and that there are major sonic and electrical improvements to be had over other output devices.

# 10

## Care and Maintenance

The E160i has been designed to provide many years of trouble free enjoyment. It's important to keep the exterior of the unit clean and to periodically ensure that the air-cooling grills remain clear from obstruction.

**Note:** Please switch the unit off and remove the cord-set from the rear of the amplifier before attempting to clean your E160i in the manner described below.

Never apply liquid directly to the E160i.

Never use abrasives.

Never rub in a circular motion.

**Cover** The cover features a durable, high quality powder-coat finish. To remove finger marks and dirt, lightly rub the surface with a soft cloth.

If the dirt is not removed, dip your cloth in a mild solution of soap and water, squeeze excess moisture from it and then gently reapply to the surface.

Stubborn dirt may be removed by the application of a small quantity of methylated spirits, applied directly to the cleaning cloth only and reworking the effected area.

**Front Panel** Black Powder-coat Finish

The front panel is finished in the same durable powder coat as the cover and can be cleaned in a similar manner, as described above.

Chrome Finish

To remove finger marks and dirt on chrome finishes, lightly rub the surface with a soft cloth containing a very small quantity of isopropyl alcohol (methylated spirits) on it.



# 1 1

## Warranty Information and Obtaining Service

### **1 Year Limited Warranty**

The Perreaux E160i is warranted to be free from defects in material and workmanship under normal use to the original purchaser for a period of 1-year (365) days from the date of purchase from an authorised dealer or distributor.

### **5 Year Extended Warranty**

To extend the warranty on your Perreaux E160i to five (5) years from date of purchase, please return a fully completed warranty registration form along with a copy of the original receipt of purchase to:

Perreaux Industries Ltd  
PO Box 47413  
Ponsonby  
Auckland  
New Zealand

For the Extended Warranty Registration Form, please refer to Chapter 12.

### **Warranty Transfer**

Perreaux Industries Ltd may, at its discretion, allow the warranty on this product to be transferred. Please contact Perreaux on [info@perreaux.com](mailto:info@perreaux.com) requesting a transfer.

### **Information on the E160i Warranty**

If during the warranty period the Perreaux E160i exhibits defects in materials and/or workmanship, it will be repaired or replaced, at our option, without charge for either parts or labour. The warranty does not apply to any unit that has been misused, abused or altered.

Any unit that is not performing satisfactorily may be returned to the factory in Auckland, New Zealand for evaluation. Return authorisation must first be obtained by either calling or writing to Perreaux prior to shipping the unit. Perreaux Industries Ltd and its authorised distributors and dealers shall not be held liable for any freight or insurance charges. Freight and insurance charges to and from the Perreaux factory will be the sole responsibility of the owner of the unit.

There is no other express warranty on the E160i. Neither this warranty nor any other warranty, express or implied, including any implied warranties of merchantability of fitness, shall extend beyond the warranty period. No responsibility is assumed for any incidental or consequential damages.

### **Obtaining Service**

In the event that you are experiencing difficulty with the E160i, please as a first step, follow the faultfinding procedures in Chapter 13. If after following this procedure, you require further assistance, please contact your Perreaux dealer.



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# Extended Warranty Registration Form

Please complete this form and either fax, mail or scan and e-mail it to Perreux Industries Ltd.

Fax: +64 9 815 5981

Mail: Perreux Industries Ltd  
PO Box 47 413  
Ponsonby  
Auckland  
New Zealand

E-mail: info@perreux.com

Alternatively, complete the online Warranty Registration Form on our website  
– www.perreux.com.



## 5 Year Extended Warranty Form



Name:

Address:

Suburb:

City:

Country:

Telephone:

E-mail:

Website:

Product Purchased:

Serial Number:

Dealer:

Purchase Date:   
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# 13

## Faultfinding Your System

### Cause and Elimination of Hum

Hum is a particularly annoying form of noise in any high fidelity system and at some time has been experienced by many of us.

Hum may result from a number of different situations and to make matters worse maybe caused by a seemingly illogical combination of circumstances.

One or more of three specific causes creates hum in the system.

#### Induced Hum

Hum can be induced into the system from one or more sources and is generally associated with the radiation of noise from one system into another.

Hum and noise can be radiated from any object or system involving AC voltage and current such as power supplies in amplifiers, motors, switching equipment etc. All of these may be found in your hi-fi system or within your own home.

Hum may be induced into any part of the system, so there are no specific instructions that can be given which will offer a guaranteed cure. A good practice to adopt is to keep low-level signal equipment such as phono systems, tuners etc. well away from high-level signal equipment such as power amplifiers. Alternatively, careful designs must be employed to negate these effects on low-level signal equipment. Another good practice to adopt is to keep all signal leads away from power leads.

The practice of neatly tying excess leads together for a tidy looking installation should be resisted, as this could be the cause of induced hum in the system.

#### Earth Loops

Earth loops are a particularly annoying cause of hum in the system. Earth loops are created by mains frequency current flowing in the screen of signal leads and becomes apparent with the lack of adequate earthing between the various pieces of equipment making up the hi-fi system. This is further compounded by the fact that the equipment earthing considerations vary between different manufacturers and countries.

Perreux products used with equipment manufactured by other manufacturers may cause an earth loop situation, but Perreux products used with other Perreux products will not cause an earth loop situation provided the following precautions are observed:

- The entire hi-fi system must be connected to the same mains/line power outlet. This will ensure that each piece of the system shares the same earth or ground. This rule applies to all installations of all brands of equipment. A preamplifier or power amplifier may be operated from an extension cord plugged into the same mains/line outlet.

- When a piece of equipment is supplied with a three pin mains/line supply lead all three pins must be connected in the correct fashion - see your dealer if in doubt.
- Check all interconnecting signal leads for good connections, both internal connections and firm contact with the sockets. While the centre pin may make firm contact, it is very important that the outer contact is also firm.
- Never remove the earth/ground wire from the mains/line supply of any piece of equipment. This could be hazardous.

#### Broken Earth Connections

This is a common cause of hum and noise in the system. In many instances, the only way to eliminate the possibility of hum problems arising through a broken earth connection somewhere in the system is to physically check every connection.

#### Identifying and Isolating Problems

When experiencing a problem, such as one channel not working, or a noise in one channel, it is good practice to adopt a method of isolating the problem to a specific item or area. This practice will assist in diagnosing, curing, or at least advising your technician of the problem and result in a saving of time, money and perhaps frustration.

A logical approach to isolating the probable cause of the problem is to start at the loudspeakers and work back to the music source, eliminating each piece of equipment in turn.

#### Caution!

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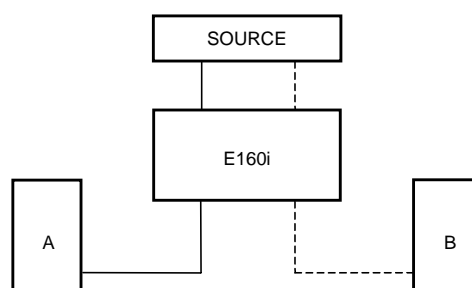
Observe precautions regarding volume control settings. Please make all changes at minimum volume setting. Only increase the volume after the connections have been made.

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Check that the entire system is connected in the proper manner and that the mains/line supply is connected and switched on.

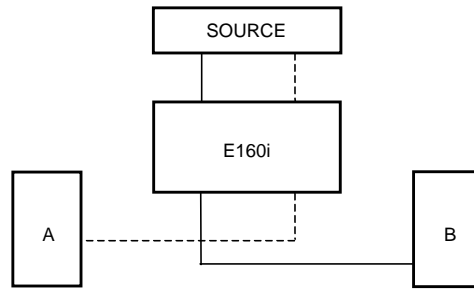
For clarity during this section, we have labeled one loudspeaker 'A' and the other loudspeaker 'B'. In this example, loudspeaker 'A' appears faulty.

#### Initial system connections





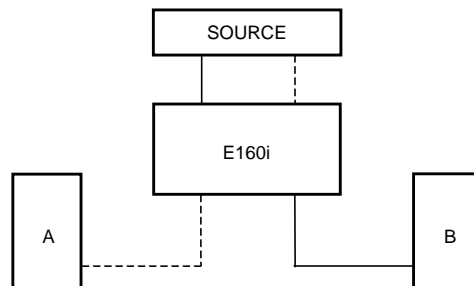
### Step 1 – Loudspeakers



Change the loudspeaker leads from one loudspeaker to the other. If the fault remains in loudspeaker 'A', then loudspeaker 'A' is at fault, go no further.

If the fault now appears in loudspeaker 'B' then the problem lies further up the line. Move on to step 2.

### Step 2 – Loudspeaker Leads

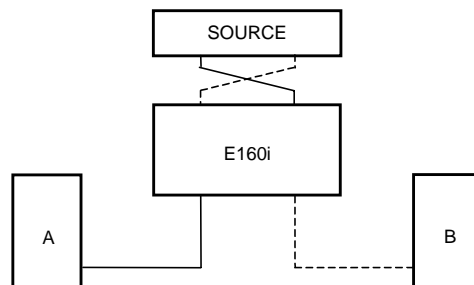


Change the loudspeaker leads completely from left channel to right and from right channel to left by now swapping them at the amplifier output. If the fault now appears in loudspeaker 'B', then that loudspeaker lead is at fault, go no further.

If the fault appears in loudspeaker 'A' then loudspeaker leads are OK. Move on to step 3.

**Caution!** Restore the loudspeaker leads to their original connections at both ends.

### Step 3a – Inputs (Channels)



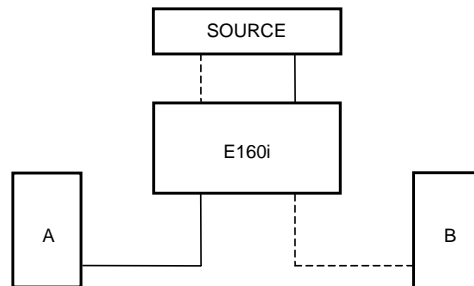
Change the input plugs on the rear of your amplifier, as follows: Change each input source in turn by swapping the plugs left to right and right to left. If the fault changes to loudspeaker 'B' on any one of the selected inputs, then that particular input source is possibly at fault. Move on to step 3b.

If the fault stays in loudspeaker 'A', then it is probable that the fault may exist within the amplifier.

Caution:

Changing of any connectors must be carried out at a minimum volume setting. Only increase the volume after the connections have been changed.

### Step 3b – Inputs (Interconnects)



Change the interconnect leads completely from left channel to right and from right channel to left by now swapping them at the source component's output. If the fault stays in loudspeaker 'B', then the interconnect lead is at fault, go no further.

If the fault appears in loudspeaker 'A', then the interconnect lead is OK.

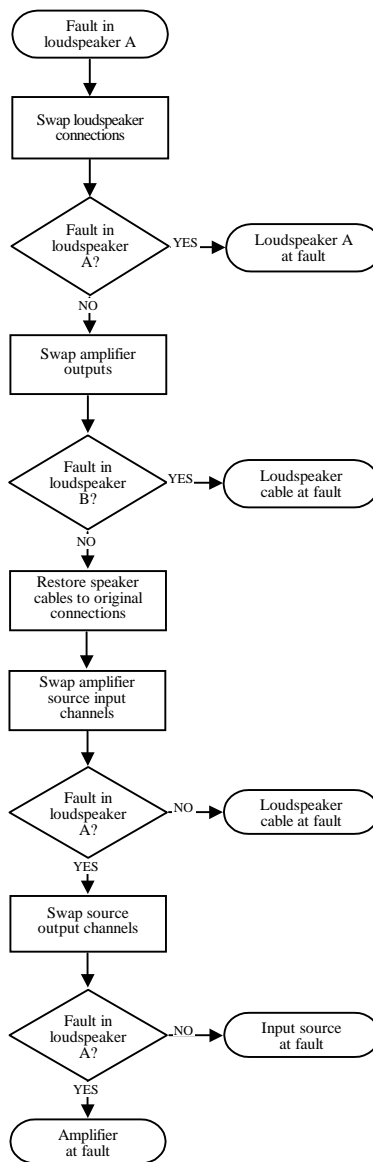
Caution!

Changing of any connectors must be carried out at a minimum volume setting. Only increase the volume after the connections have been changed.

Should the fault prove to be in the amplifier it will be necessary to determine where the fault actually lies. Most of this has been done, for instance, you now know what input/s and what channel is affected. This information will assist your Perreux dealer or service person when or if any service is required.

If the apparent fault is noise in one or both channels and has been localised to the amplifier, it will be necessary to determine whether or not the noise increases with the volume control; whether or not the noise exists when no input at all is connected to the amplifier; and what type of sound the noise is. For example, low frequency humming noise or high frequency hissing noise. This information will also assist your service person in making repairs or adjustments.

## Faultfinding Flowchart



The E160i specifications are detailed in brief and then subsequently in more detail. In the detailed version, we attempt to explain the significance of each specification.

The correlation between published specifications and sonic quality can be unreliable. A list of numbers reveals virtually nothing. All technical measurements must be subject to qualitative as well as quantitative interpretation. Measurements of the E160i reveal excellent results by any standards. Tested at 115V and 230V after a 10 minute warm up period.

## Specifications In Brief

### Preamplifier Section

Rated Output:	1.5V <sub>RMS</sub>
Maximum Output:	3.0V <sub>RMS</sub>
Input Sensitivity:	205mV
Input Overload:	3.8V <sub>RMS</sub>
Frequency Response:	5Hz to 60kHz, +0dB -0.2dB
Total Harmonic Distortion (THD+N)	
Rated Output:	<0.004%, 20Hz - 20kHz
Signal to Noise Ratio	
Rated Output (unweighted):	105dB
Input Impedance:	10kΩ
Dynamic Range:	110dB
Gain Range:	-95dB to 17dB
Gain Resolution:	1.5dB

### Power Amplifier Section

Rated Power Output:	160W <sub>RMS</sub> into 8Ω
(continuous, per channel, both channels driven from 20Hz-20kHz at < 0.020% THD)	
.....	200W <sub>RMS</sub> into 4Ω
(continuous, per channel, both channels driven from 20Hz-20kHz at < 0.035% THD)	
Frequency Response:	10Hz - 30kHz, +0dB -0.5dB
Total Harmonic Distortion (THD+N)	
Typically:	0.005%, @ 1kHz into 8Ω
20Hz to 20kHz:	<0.040%, into 8Ω
Voltage Gain:	28.6dB
Dynamic Headroom (rated with music):	>1.9dB
Voltage Swing:	156V <sub>p-p</sub>
Maximum Current Output:	24A per channel
Damping Factor:	>500, @ 1kHz into 8Ω
Signal to Noise Ratio	
Rated Output (unweighted):	95dB
Input Sensitivity:	1.3V <sub>RMS</sub>
Input Impedance:	22kΩ
Smoothing Capacitance:	20,000μF



Driver Stage:..... Class A  
Output Stage: ..... Class A/AB

#### Audio Connections

##### Audio Inputs

Unbalanced: .....6 pairs line level RCA connectors  
..... 1 pair preamp level RCA connectors

##### Audio Outputs

Unbalanced: ..... 1 pair RCA preamp level  
..... 2 pairs RCA line level  
Speaker: ..... 1 pair speaker binding posts per channel

#### Other Connections

1 x IEC AC mains input receptacle

#### Power Consumption

Idle .....40W  
Maximum .....450W  
*(at 4Ω rated output)*

#### Mains Input Voltage

100V, 110V, 120V, 220V, 230V or 240V AC at 50Hz or 60Hz  
*(Set within the E160i at time of manufacture)*

#### Dimensions

Width .....430mm (16.9")  
Height ..... 88mm (3.5")  
Depth ..... 315mm (12.4")  
*(not including feet, terminals and handles)*

#### Fuse Ratings

##### Mains input fuse

100 – 125V: ..... 2SB slow blow 6A  
200 – 250V: ..... 2SB slow blow 6A  
*(user serviceable)*

Internal DC rail fuses.....4 x 2AG normal blow 6A  
*(NOT user serviceable)*

#### Weight

Net: ..... 10.0kg (22.0lb)  
*(amplifier only)*  
Gross: ..... 13.0kg (28.6lb)  
*(amplifier, accessories and packing material)*



## Preamplifier Specifications Explained

Rated Output.....	1.5V <sub>RMS</sub>
This is the reference output level to which other specifications, such as sensitivity, are referred. Rated output does not indicate the preamplifier's full capability, this is given by the maximum output, as follows.	
Maximum Output.....	3.0V <sub>RMS</sub>
The maximum voltage the preamplifier can output before starting to clip.	
Input Sensitivity.....	205mV
Indicates the amount of input voltage required to drive the preamplifier to its rated output with the volume control fully advanced.	
Input Overload.....	3.8V <sub>RMS</sub>
Specifies the maximum signal level the preamplifier can handle before it becomes overloaded and starts to clip.	
Frequency Response .....	5Hz to 60kHz, +0dB -0.2dB
Describes the frequency range where the amplitude or strength of the output signal deviates from the input reference by no more than 0.2dB	
Total Harmonic Distortion ( <i>THD+N</i> ) .....	<0.004%, 20Hz to 20kHz
Total Harmonic Distortion + Noise is the percentage of output signal which is made up of frequencies added due to harmonics of the fundamental frequency and noise.	
Signal to Noise Ratio ( <i>unweighted</i> ).....	105dB
The ratio of desired signal to noise signals present in the output. This figure is referenced to the rated output of the preamplifier, taking into full account all potentially annoying hum components.	
Input Impedance .....	10k $\Omega$
The resistance "load" that is presented to the component that is driving it. The high value indicates that the power amplifier will not load down the output of most high quality source components.	
Dynamic Range .....	110dB
The difference between the loudest and quietest portions of a signal. Due to the 96dB dynamic range limit inherent in CD format, there is more than enough dynamic range to cope with any musical transients the CD format can produce.	
Gain Range .....	-95dB to 17dB
The range of gain that the volume control spans over its 00 to 59 scale.	
Gain Resolution .....	1.5dB
The change in gain made with each increment of the volume control. The gain resolution is linear across the 00 to 59 volume control range.	



**Power  
Amplifier  
Specifications  
Explained**

Rated Power Output (*per channel*)..... 160W<sub>RMS</sub> into 8Ω

The E160i has been designed around the industry standard 8Ω load. The E160i delivers 160W<sub>RMS</sub> continuously into 8Ω loads and 200W<sub>RMS</sub> into 4Ω loads. The E160i will also handle complex and 2Ω loads with stability and ease.

Frequency Response ..... 10Hz to 30kHz, +0dB -0.5dB

This is the “standard” specification with which everyone is familiar. Actually, “frequency response” is a misnomer: technically, it should be called “amplitude response versus frequency” for it describes how uniform the amplitude or strength of signals of various frequencies is maintained. It is generally thought that a difference of 1db is the least that can be perceived by ear. To better that by a wide margin, the E160i is specified two times higher, thus exceeding the audible range of the human ear.

Total Harmonic Distortion (*THD+N*) ..... 0.005%, @ 1kHz into 8Ω

Measurements are made with fixed, purely resistive loads. However, since speakers are not purely resistive, an amplifier’s distortion specifications do not indicate what performance will be with the actual loads presented by speakers. Perreaux distortion measurements hold for any conditions presented by any known speaker. Further, any measurable distortion in the Perreaux is second-order harmonics – the least offensive to the ear.

Voltage Gain.....28.6dB

The amount of amplification the amplifier is asserting on the input signal. Gain can be calculated by dividing the rated output by the input sensitivity.

Dynamic Headroom .....>1.9dB

This indicates the E160i can provide more than enough extra power to cope with the sharpest musical transients. Without adequate headroom, an amplifier can become unstable under clipping conditions. Perreaux amplifiers are intrinsically stable under all dynamic conditions.

Voltage Swing.....156V<sub>p-p</sub>

Loud transients call for a sudden burst of power from the amplifier to drive the speakers. This force is voltage. Peak to peak voltage is a more useful specification than Watts when it comes to delivering power to a speaker.

Maximum Current Output..... 24A per channel

Current is the power reserve in the amplifier necessary to deliver the burst of voltage required by the ever-changing audio signal. With more than adequate continuous current per channel and high volts peak-to-peak, the E160i can easily meet any challenge music can present to it – whether instantaneous or continuous. To be specific it can deliver high power into low-impedance loads and provide great dynamic headroom.



Damping Factor..... >500, @ 1kHz into 8Ω

Another specification not always provided. One reason perhaps, this specification is important when indicating an amplifier's ability to control the cone behavior of speaker systems, which are difficult to drive. Perreaux power amplifiers have high damping factors. Thus exerting massive control over the speaker system.

Signal to Noise Ratio (*unweighted*)..... 95dB

The ratio of desired signal to noise signals present in the output. This figure is referenced to the rated output of the E160i, taking into full account all potentially annoying hum components.

Input Sensitivity..... 1.3V<sub>RMS</sub>

Indicates the amount of input voltage required to drive the power amplifier section to its rated output power (160W<sub>RMS</sub> into 8Ω).

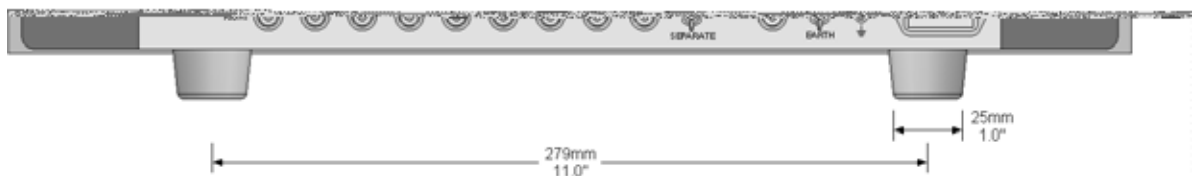
Input Impedance..... 22kΩ

The resistance "load" that is presented to the component that is driving it. The high value indicates that the power amplifier will not load down the output of most high quality preamplifiers.



# 15

## Physical Dimensions





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## Contact Details

For more information please contact your Perreaux dealer, or contact:

Perreaux Industries Ltd  
PO Box 47 413  
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Auckland  
New Zealand

Ph: +64 9 815-5452

Fax: +64 9 815-5981

E-mail: [info@perreaux.com](mailto:info@perreaux.com)

Internet: [www.perreaux.com](http://www.perreaux.com)

