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## REMOVABLE POWER SUPPLY FOR AN AUDIO DEVICE

### Field of the Invention

[0001] The field of the invention relates to audio devices. More particularly, the invention relates to power supplies for audio devices.

### Background of the Invention

[0002] Power supplies for audio devices such as portable microphones and amplifiers are generally provided as an integral part of the device that it powers. A power supply cord is typically provided to connect the power supply in to an alternating current (AC) supply. The AC supply is usually obtained from a public power grid.

[0003] Within the power supply, a transformer is usually provided to reduce a voltage of the AC supply to a level convenient for use within a set of integrated circuits of the audio device. The reduced voltage is often rectified within the power supply to further simplify powering the integrated circuits.

[0004] As a recent trend, unitary power supplies have become available that are separate from the devices which they power. Often the newly available power supplies are provided with their own enclosure and a cord for connecting the power supply to the device that it is intended to power. A set of prongs are usually provided on an exterior surface of the enclosure for engaging a wall outlet or power strip.

[0005] While the unitary power supplies are useful, they are often inconvenient to use. Because of the size of the enclosure, only one (or at most two) power supplies may be used in adjacent outlets. Because of the importance of



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audio devices, a need exists for a more convenient way of powering audio devices.

#### Summary of the Invention

[0006] A method and apparatus are described for providing power to an audio signal processor. The method includes the steps of providing a receptacle for a housing of a voltage converting power supply within an enclosure of the audio signal processor and removably disposing the voltage converting power supply within the enclosure of the audio signal processor.

#### Brief Description of the Drawings

[0007] FIG. 1 is a perspective view of an audio system in accordance with an illustrated embodiment of the invention;

[0008] FIG. 2 is a rear prespective view of the base station of the system of FIG. 1;

[0009] FIG. 3 is a cross-sectional view of the power supply of the base station of FIG. 2;

[0010] FIG. 4 is a top cut-away view of the base station of FIG. 2;

[0011] FIG. 5 is a block diagram of the signal processing functions performed by the base station of FIG. 2;

[0012] FIG. 6 is a detailed schematic of the block diagram of FIG. 5;

[0013] FIG. 7 is a detailed schematic of the block diagram of FIG. 5;

[0014] FIG. 8 is a top view of a circuit board used within the base station of FIG. 2 and

[0015] FIG. 8 is a bottom view of a circuit board used within the base station of FIG. 2.

#### Detailed Description of a Preferred Embodiment

[0016] FIG. 1 depicts a microphone/amplifier system 10 under an illustrated embodiment of the invention. The system 10 may be used in any of a number of environments where the microphone user cannot be encumbered by a wires connected to an amplifier.

[0017] The system 10 includes a handheld microphone transmitter 12, belt-worn transmitter 16 and base station receiver 14. As would be familiar to persons of skill in the performing arts, the transmitters 12, 16 are equipped with a radio-frequency (RF) transmitter. The RF transmitter may be of a relatively low power and have a relatively short range. During use, the transmitters 12, 16 may transmit a signal 13, 22 to the base station receiver 14.

[0018] The transmitter 16 may be provided with a clip 18 that may be attached to a belt of the user (not shown). An antenna 20 may be provided for transmitting a signal 22 to an antenna 24 of the base station 14.

[0019] The base station 14 and transmitters 12, 16 may include a channel selector 26. The channel selector 26 may be used to select one of a number of RF channels, free of noise from nearby noise sources.

[0020] A squelch control 41 (FIG. 2) may be provided on a back surface of an enclosure 15 of the base station 14. The squelch control 41 may be used to further reduce interference from the other noise sources.

[0021] The base station 14 may also include a volume control 28. The volume control 28 may be used to

control an amplitude of an output signal available through an AF output 43.

[0022] The base station 14 may receive and amplify the signal received from the transmitters 12, 16. The amplified signal may, in turn, be provided to a power amplifier and speakers (not shown) through the AF out 43.

[0023] In order to reduce space, the base station 14 may be equipped with a removable, unitary power supply 30. The enclosure 15 of the base station 14 may be provided with a receptacle 32 (FIG. 2) to slidably receive the unitary power supply 30. A set of dimensions of the inside of the receptacle 32 may be complementary to (e.g., 1/8 inch larger than) the outer dimensions of the power supply 30.

[0024] To prevent insertion of the power supply upside down, the sides 60 (FIG. 3) of the power supply 30 and the sides of the receptacle 32 may be tapered. More specifically, the edge 60 may taper inwards by an appropriate angle (e.g., 5 degrees) to ensure proper insertion of the power supply 30 into the enclosure 15 of the power supply 30.

[0025] As shown in FIG. 2, the power supply 30 may be easily and conveniently moved 34 into and out of the receptacle 32. Once fully inserted into the receptacle 32, the power supply 30 may be substantially enclosed by the enclosure 15 with only a back surface of the power supply 30 exposed for making power connections.

[0026] Once the power supply 30 is fully inserted into the receptacle 32, a resiliently biased detent (e.g., a peg) 42 may engage a recessed area 46 of the power supply 30 securing the power supply within the receptacle 32. Alternatively, the detent 42 may engage a back edge of an

enclosure of the power supply 30, thereby securing the power supply within the receptacle 32.

[0027] Whether inserted into the receptacle 32, or not, an external set of conductors 36 may be provided to couple electrical power from the power supply 30 to the base station 14. A plug 38 may be provided on one end of the conductors 36 to engage an electrical receptacle 40 on the enclosure 15. The receptacle 40 may receive power from the plug 38 and, in turn, function as a source of power for the base station 14.

[0028] Also provided on the power supply 30 is a recessed male plug 50. The recessed plug 50 may be adapted to receive a female plug 52 of an external power cord (mains plug) 54. The power supply cord 54 may be provided to conduct AC power from another male plug 56 to the female plug 52. The male plug 56 may receive power from a wall outlet or outlet strip, in turn, receiving power from a public utility.

[0029] In order to further reduce interference, the power supply 30 and receptacle 32 may be located remotely from any low-level signal processing functions. FIG. 4 may be used to depict a top view of a component layout map of the base station 14. As shown, the power supply 30 may be substantially located at a first end of the base station 14. In contrast, low-level signal processing of a circuit board 66 may be located proximate a second end of the base station 14.

[0030] The positioning of the power supply 30 at an opposing end of the base station 14 allows the low-level signal processing board 66 to be shielded from interference. For example, a separate shield 68 may be installed around the receptacle 32 to further shield a

class 2 transformer 64 and rectifier 62 of the power supply 30.

[0031] In addition, a person of skill in the art would recognize the importance of the specifics of the physical separation between the transformer 64 and noise sensitive signal processing elements. For example, FIG. 5 is a block diagram of signal processing functions occurring within the base station 14 and FIGs. 6 and 7 are detailed schematics of the physical devices providing the processing functions of the circuit of the base station 14. FIGs. 8 and 9 are top and bottom views of the layout of the circuit board of the base station 14 showing the physical separations of the noise sensitive signal processing elements and the transformer 64.

[0032] The bandpass filtering provided by FIL 30 and the second mixing functions occurring within IC 100 (FIGs. 5-7) would be recognized as being functions that would be particularly susceptible to noise. In order to reduce noise, a separation of 5 cm may be provided between the filter FIL 30 and the transformer 64. A separation of 7.5 cm may exist between the IC100 and the transformer 64.

[0033] Another sensitive element may be the tank circuit used in conjunction with the second mixer of the IC100. An inductor L100 of this tank circuit may be placed 7.5 cm from the transformer 64.

[0034] Further, the AF OUT provided through connector JK201 would be recognized as another sensitive device. The separation between the connector JK201 and transformer 64 may be 6 cm.

[0035] In order to improve the separation between the noise sensitive components and the transformer 64, other components may be moved closer to the transformer 64

to allow greater separation for the noise sensitive components. In effect, the separation of the sensitive components may be achieved by preferentially separating noise sensitive components at the expense of less sensitive components.

[0036] Under the illustrated embodiment, the base station 14 may be used with an integral power supply 30 (i.e., the power supply 30 inserted into the receptacle 32) or with the power supply 30 located remotely from the base station 14. The ability of the base station 14 to use the power supply 30 in either configuration improves the utility of the base station 14 in a number of regards. First, the use of a removable power supply 30 eliminates obstructions at the power source by providing a transformer module that may be located away from the power source within the enclosure 15. For example, a common complaint of prior art wall adapter units is that they take up too much room in an audio equipment power rack or power strip.

[0037] Further, the integrated AC supply 30 can be located at any convenient location. This is of benefit when many base stations 14 are to be used in close proximity to avoid interference among receivers 14.

[0038] Further the external power cord 54 may be equipped with an IEC-approved AC mains plug 56. This allows the end user to use whichever AC plug configuration is appropriate for his/her country.

[0039] Because the IEC mains cord 54 allows cables to be exchanged, it is easy for the end user to alter the length of the AC cable 54. Not only does this make things neater and more convenient, but it also helps in reducing hum and interference.

[0040] A specific embodiment of a method and apparatus for providing power to an audio device has been described for the purpose of illustrating the manner in which the invention is made and used. It should be understood that the implementation of other variations and modifications of the invention and its various aspects will be apparent to one skilled in the art, and that the invention is not limited by the specific embodiments described. Therefore, it is contemplated to cover the present invention and any and all modifications, variations, or equivalents that fall within the true spirit and scope of the basic underlying principles disclosed and claimed herein.

## Claims

1. A method of providing power to an audio signal processor, such method comprising the steps of:  
providing a receptacle for a housing of a voltage converting power supply within an enclosure of the audio signal processor; and  
removably disposing the voltage converting power supply within the enclosure of the audio signal processor.
2. The method of providing power to an audio signal processor as in claim 1 further comprising disposing a receptacle for a plug of an external power source within the housing of the power supply.
3. The method of providing power to an audio signal processor as in claim 1 further comprising providing a set of external conductors for coupling the power supply to the audio signal processor.
4. The method of providing power to an audio signal processor as in claim 3 further comprising disposing an electrical receptacle in the enclosure of the audio signal processor for coupling power from the power supply to the audio signal processor.
5. The method of providing power to an audio signal processor as in claim 3 further comprising disposing a plug on an end of the external conductors for engaging the electrical receptacle in the enclosure of the audio signal processor.

6. The method of providing power to an audio signal processor as in claim 3 further comprising defining the audio signal processor as being an audio amplifier.

7. The method of providing power to an audio signal processor as in claim 1 further comprising providing a inner set of dimensions of the receptacle that are complementary to an outer set of dimensions of the converting power supply.

8. The method of providing power to an audio signal processor as in claim 7 further comprising tapering the power supply and receptacle to prevent improper insertion.

9. The method of providing power to an audio signal processor as in claim 7 further comprising preferentially separating noise sensitive signal processing components from a transformer of the voltage converting power supply.

10. The method of providing power to an audio signal processor as in claim 9 further comprising shielding the noise sensitive signal processing components from the transformer.

11. An apparatus for providing power to an audio signal processor, such apparatus comprising:

- a voltage converting power supply; and

- a receptacle disposed within an enclosure of the audio signal processor, said receptacle being adapted to removably receive the voltage converting power supply.

12. The apparatus for providing power to an audio signal processor as in claim 11 further comprising a receptacle for a plug of an external power source disposed within the housing of the power supply.

13. The apparatus for providing power to an audio signal processor as in claim 11 further comprising a set of external conductors adapted to couple the power supply to the audio signal processor.

14. The apparatus for providing power to an audio signal processor as in claim 13 further comprising an electrical receptacle disposed in the enclosure of the audio signal processor for coupling power from the power supply to the audio signal processor.

15. The apparatus for providing power to an audio signal processor as in claim 13 further comprising a plug disposed on an end of the external conductors for engaging the electrical receptacle in the enclosure of the audio signal processor.

16. The apparatus for providing power to an audio signal processor as in claim 13 wherein the audio signal processor further comprises an audio amplifier.

17. The apparatus for providing power to an audio signal processor as in claim 11 wherein an inner surface of the receptacle and an outer surface of the voltage converting power supply further comprise a complementary set of dimensions.

18. The method of providing power to an audio signal processor as in claim 17 wherein the receptacle and converting power supply further comprise a tapered cross-section.

19. An apparatus for providing power to an audio signal processor, such apparatus comprising:

a voltage converting power supply; and

means disposed within an enclosure of the audio signal processor for removably receiving the voltage converting power supply.

20. The apparatus for providing power to an audio signal processor as in claim 19 further comprising means disposed within the housing of the voltage converting power supply for receiving power from an external source.

21. The apparatus for providing power to an audio signal processor as in claim 19 further comprising means coupled to the means for receiving power for coupling the power supply to the external power source.

22. The apparatus for providing power to an audio signal processor as in claim 19 further comprising means disposed in the enclosure of the audio signal processor for coupling power from the power supply to the audio signal processor.