US 20110243354A2

(19) **United States**

(12) **Patent Application Publication**

McCarty et al.

(10) **Pub. No.: US 2011/0243354 A2**

(43) **Pub. Date: Oct. 6, 2011**

REPUBLICATION

(54) **WIRED, WIRELESS, INFRARED, AND POWERLINE AUDIO ENTERTAINMENT SYSTEMS**

(75) Inventors: **William McCarty**, San Diego, CA (US); **Yadir Rodriguez**, San Ysidro, CA (US)

(73) Assignee: **KSC INDUSTRIES, INC.**, San Diego, CA (US)

(21) Appl. No.: **12/966,719**

(22) Filed: **Dec. 13, 2010**

Prior Publication Data

(65) US 2011/0142267 A1 Jun. 16, 2011

Related U.S. Application Data

(63) Continuation of application No. 10/783,718, filed on Feb. 20, 2004, which is a continuation-in-part of application No. 10/353,805, filed on Jan. 27, 2003.

(60) Provisional application No. 60/351,843, filed on Jan. 25, 2002. Provisional application No. 60/353,806, filed on Feb. 1, 2002. Provisional application No. 60/371,268, filed on Apr. 8, 2002. Provisional application No. 60/407,432, filed on Aug. 28, 2002.

Publication Classification

(51) **Int. Cl.**

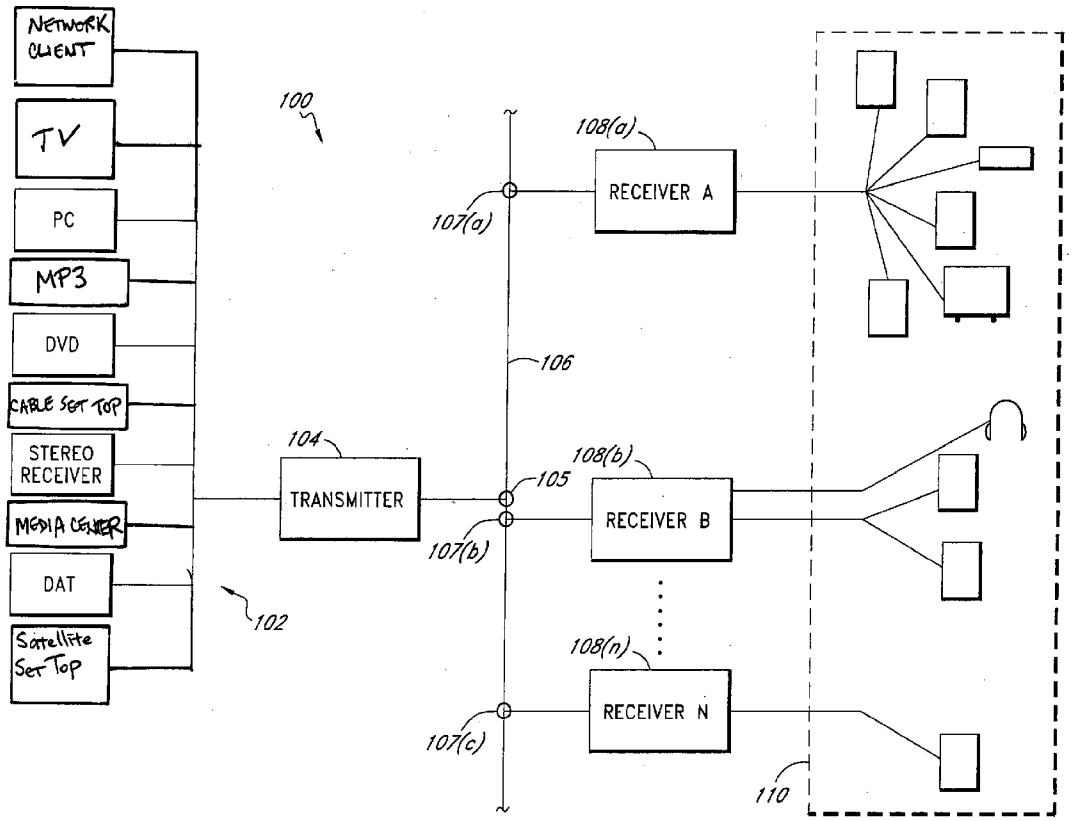
H04R 5/02 (2006.01)

H04B 3/00 (2006.01)

(52) **U.S. Cl.** **381/311**; 381/77

(57) **ABSTRACT**

A method and system for communicating audio, video, and/or control signals within a home entertainment system. One or more signals are communicated between an input device and one or more output devices via one or more networks. The output device can include loudspeakers, display devices, and headphones. In some embodiments an output device, for example a center channel loudspeaker, transmits signals to other output devices. For example, the center channel loudspeaker can transmit a combined audio signal and control signal to a remote loudspeaker over a first network and transmit a video signal to a display device over a second network. The display device displays the video signal. The networks can be wireless, wired, infrared, RF, and powerline.



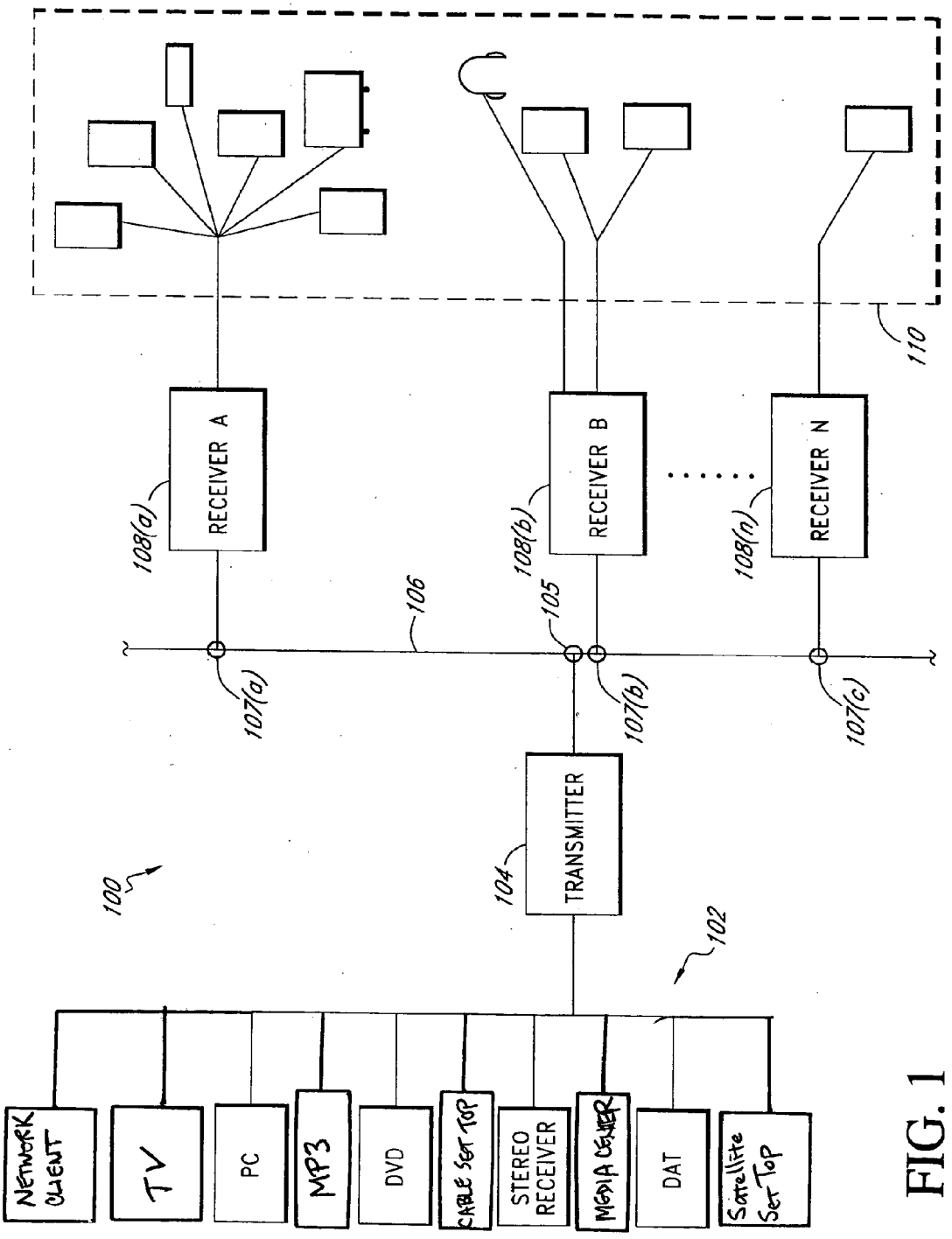

RECEIVER A
RECEIVER B
RECEIVER N
TRANSMITTER
108(a)
108(b)
108(n)
104
105
106
107(a)
107(b)
107(c)
110
100
102
NETWORK CLIENT
TV
PC
MP3
DVD
CABLE SET TOP
STEREO RECEIVER
MEDIA CENTER
DAT
Satellite Set Top

FIG. 1

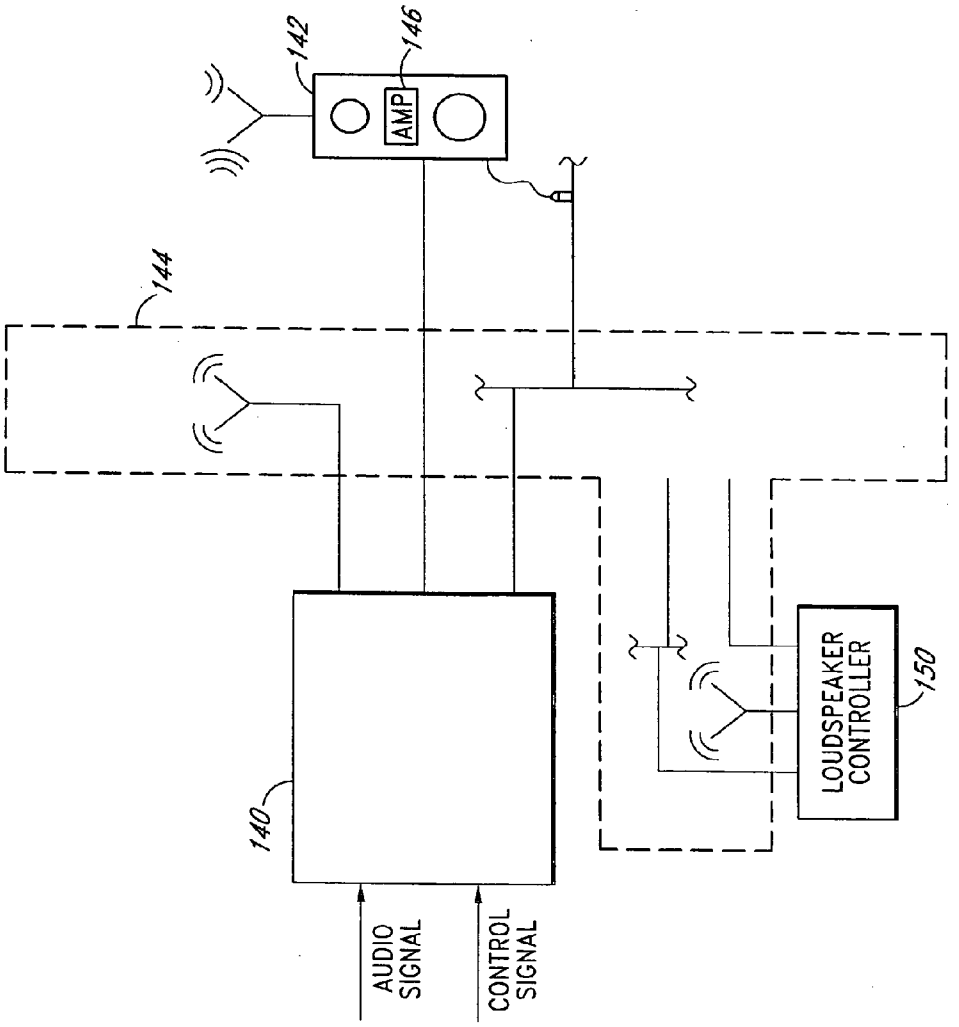

142
146
AMP
144
140
LOUDSPEAKER CONTROLLER
150
AUDIO SIGNAL
CONTROL SIGNAL

FIG. 1A

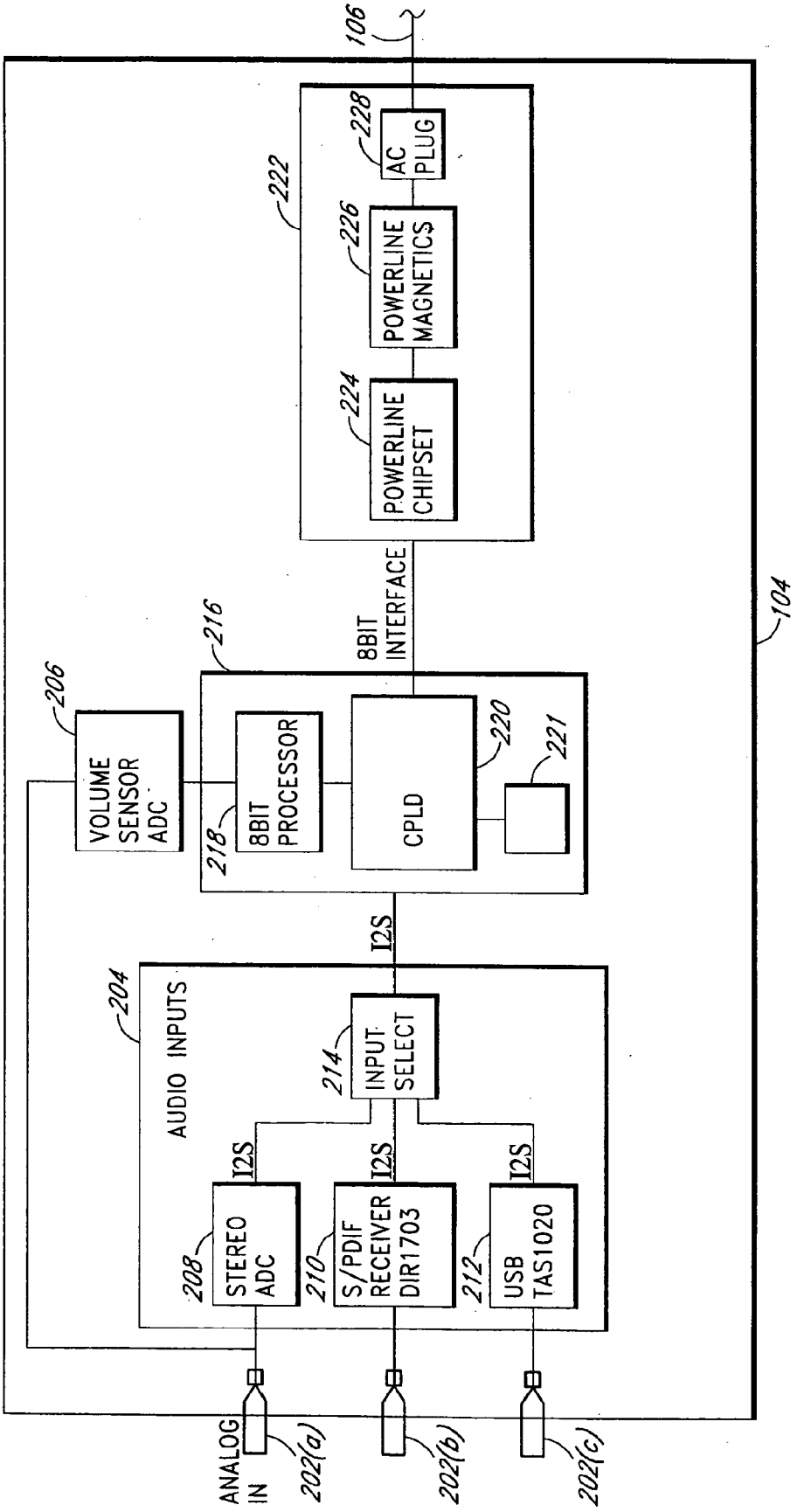

106
222
228
AC PLUG
226
POWERLINE MAGNETICS
224
POWERLINE CHIPSET
8BIT INTERFACE
216
206
VOLUME SENSOR ADC
218
8BIT PROCESSOR
CPLD
220
221
104
I2S
204
AUDIO INPUTS
214
INPUT SELECT
I2S
I2S
I2S
208
STEREO ADC
210
S/PDIF RECEIVER DIR1703
212
USB TAS1020
ANALOG IN
202(a)
202(b)
202(c)

FIG. 2

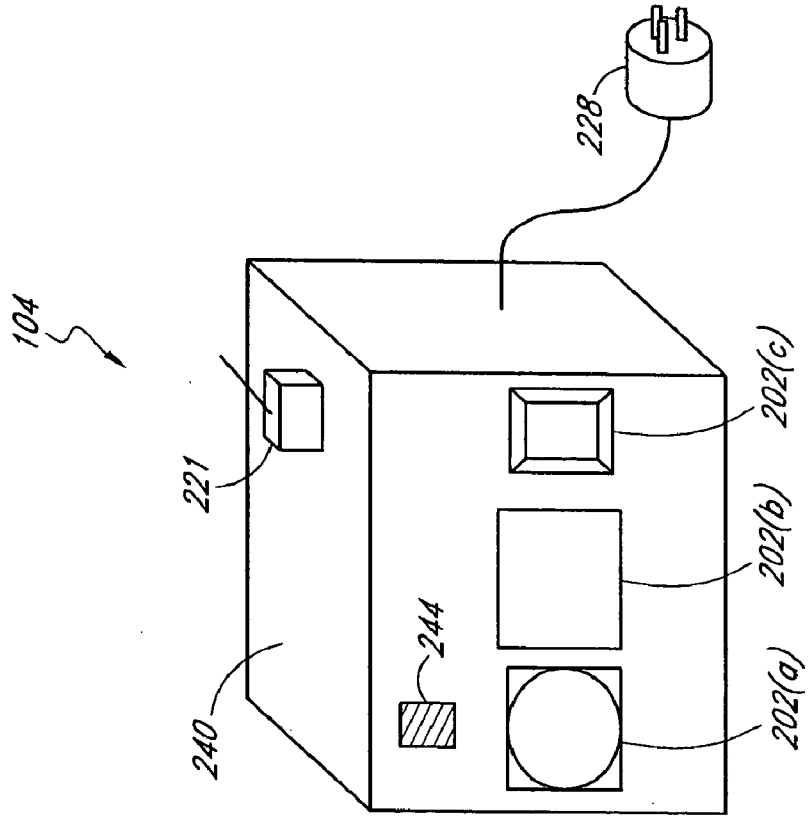


FIG. 3

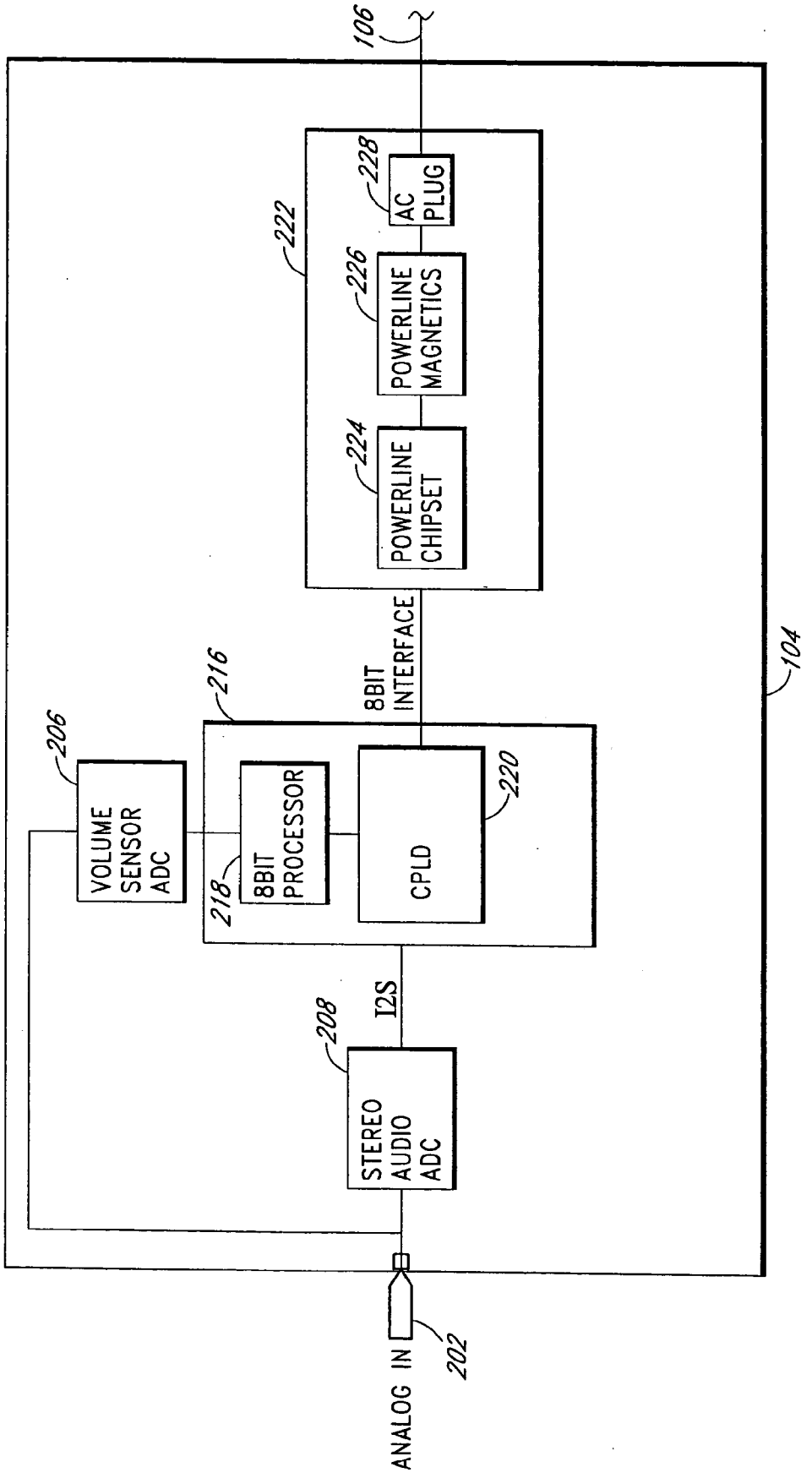

106
222
228
AC PLUG
226
POWERLINE MAGNETICS
224
POWERLINE CHIPSET
8BIT INTERFACE
216
206
VOLUME SENSOR ADC
218
8BIT PROCESSOR
CPLD
220
I2S
208
STEREO AUDIO ADC
104
ANALOG IN
202

FIG. 4

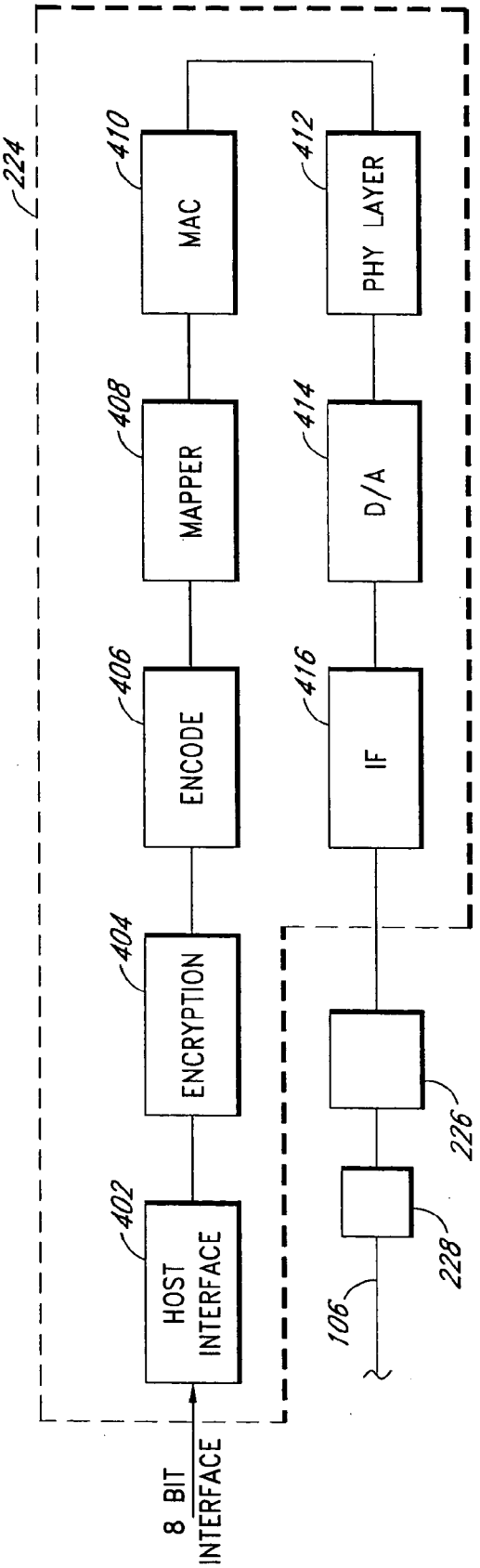

224
410
MAC
412
PHY LAYER
408
MAPPER
414
D/A
406
ENCODE
416
IF
404
ENCRYPTION
226
402
HOST INTERFACE
228
106
8 BIT INTERFACE

FIG. 5

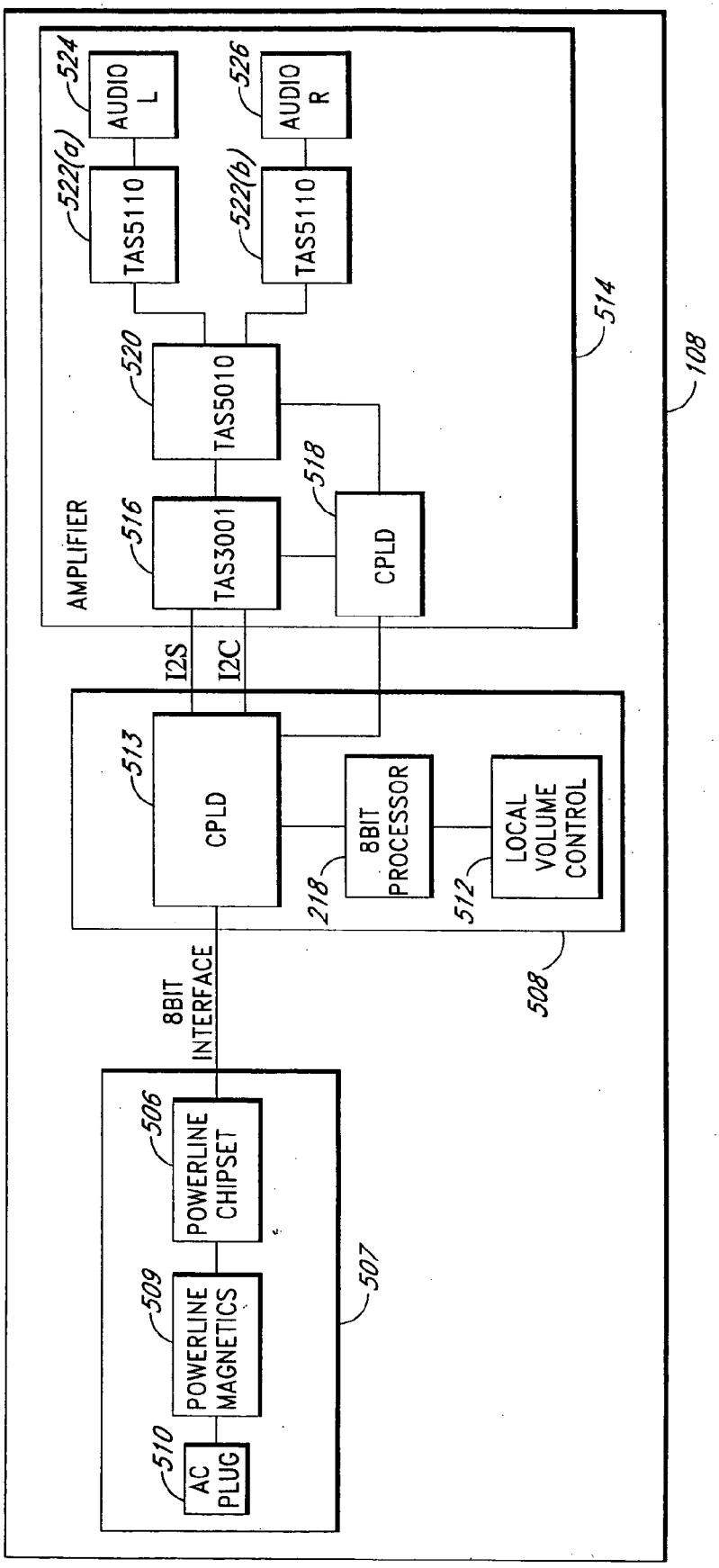

524
AUDIO L
526
AUDIO R
522(a)
TAS5110
522(b)
TAS5110
514
520
TAS5010
518
516
TAS3001
CPLD
AMPLIFIER
108
I2S
I2C
513
CPLD
8BIT PROCESSOR
LOCAL VOLUME CONTROL
218
512
508
8BIT INTERFACE
506
POWERLINE CHIPSET
509
POWERLINE MAGNETICS
507
510
AC PLUG

FIG. 6

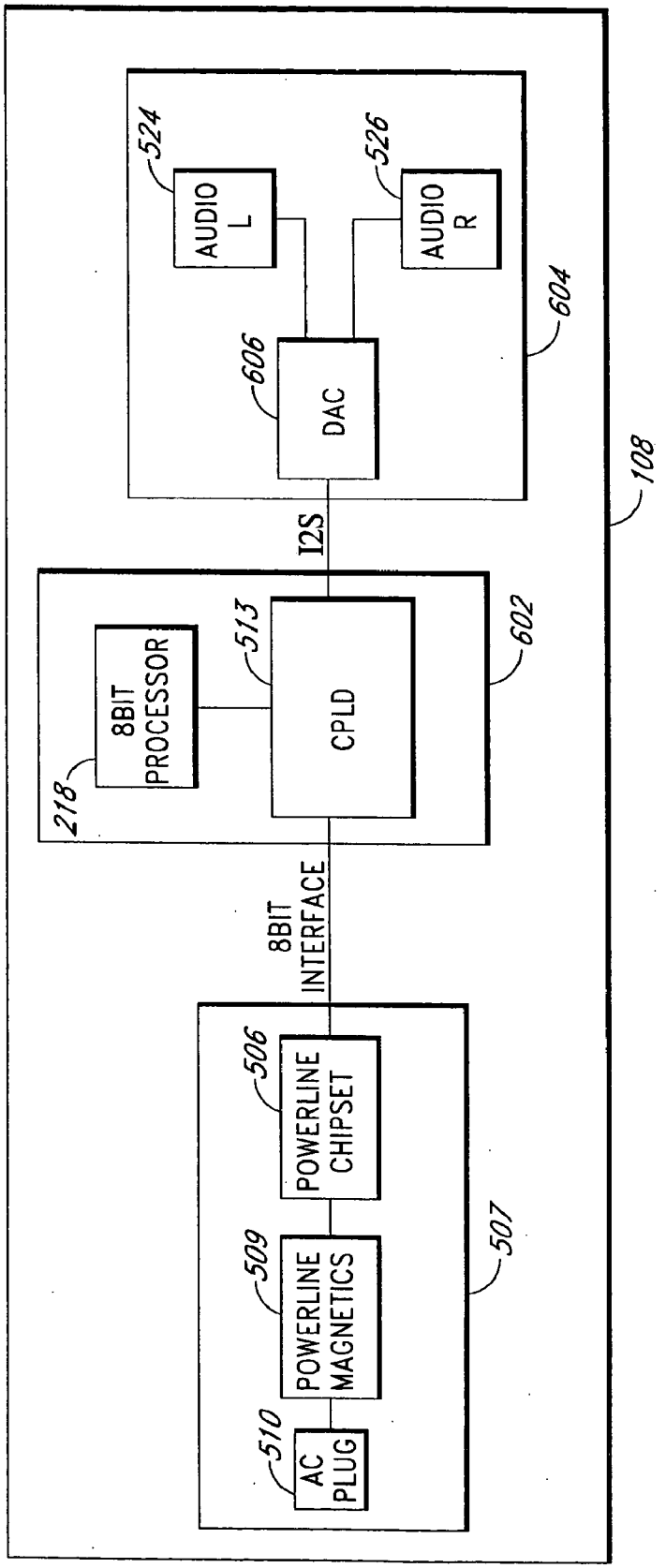

108
524
AUDIO L
526
AUDIO R
604
606
DAC
I2S
602
513
CPLD
218
8BIT PROCESSOR
8BIT INTERFACE
506
POWERLINE CHIPSET
509
POWERLINE MAGNETICS
507
510
AC PLUG

FIG. 7

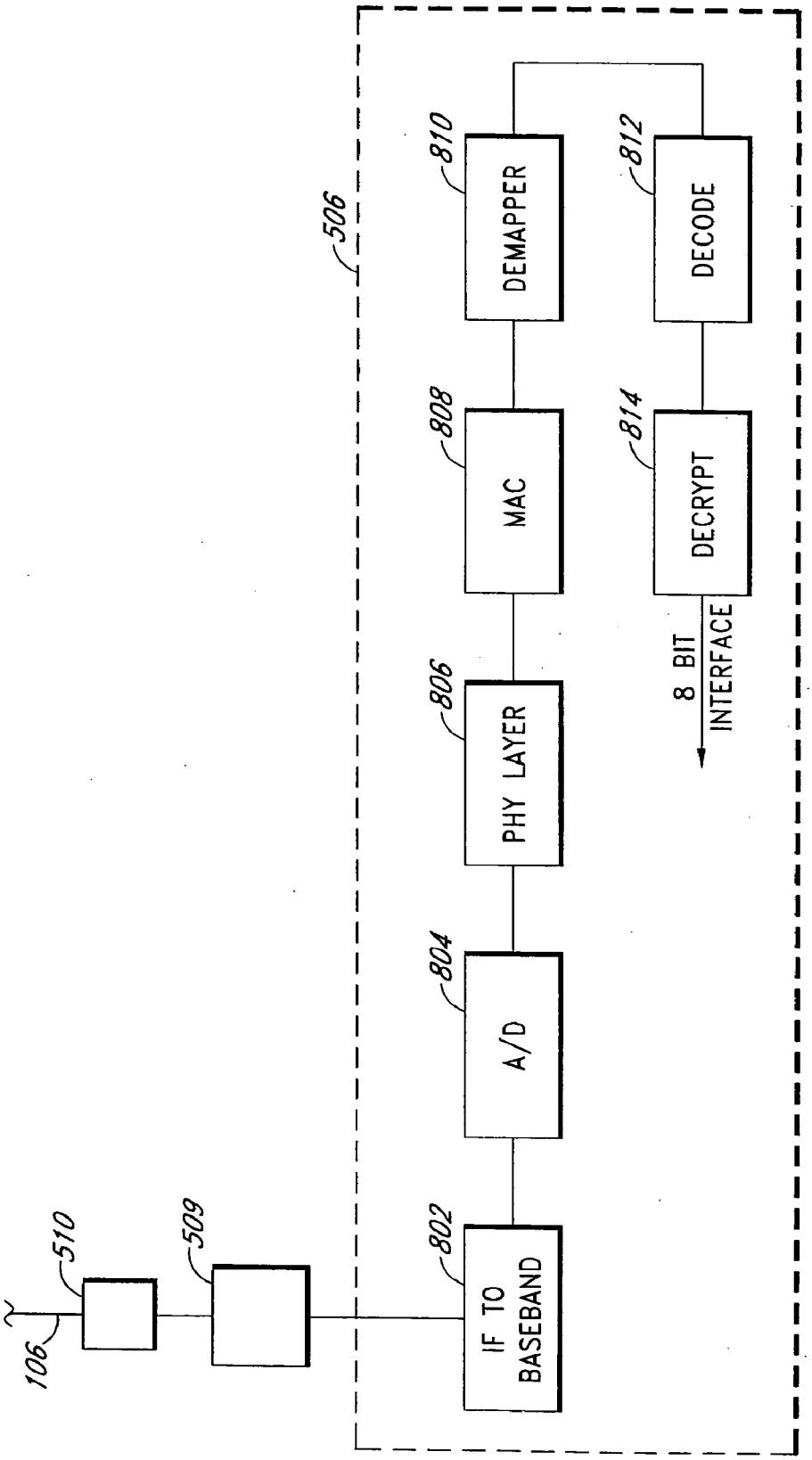

506
810
DEMAPPER
812
DECODE
808
MAC
814
DECRYPT
8 BIT
INTERFACE
806
PHY LAYER
804
A/D
802
IF TO
BASEBAND
509
510
106

FIG. 8

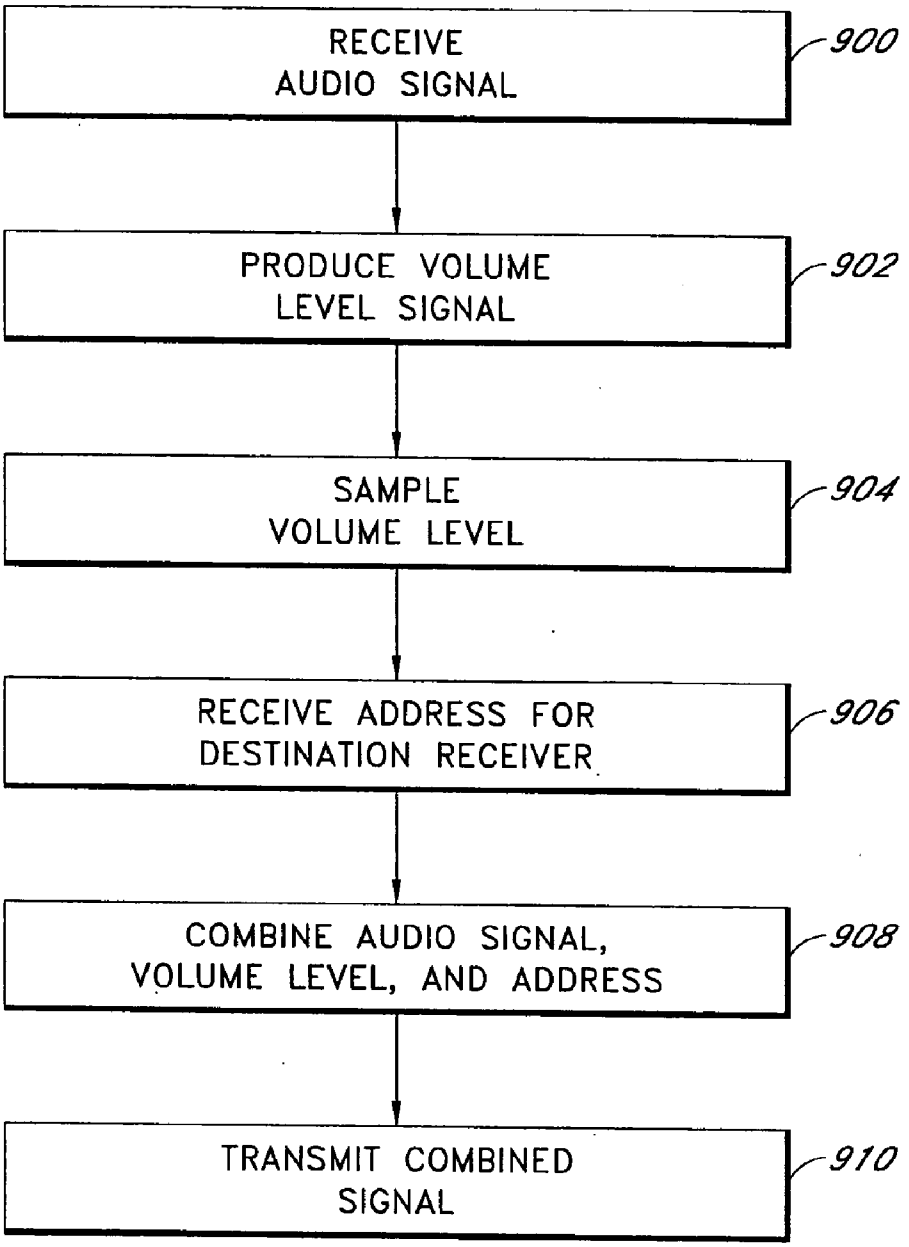

RECEIVE AUDIO SIGNAL
900
PRODUCE VOLUME LEVEL SIGNAL
902
SAMPLE VOLUME LEVEL
904
RECEIVE ADDRESS FOR DESTINATION RECEIVER
906
COMBINE AUDIO SIGNAL, VOLUME LEVEL, AND ADDRESS
908
TRANSMIT COMBINED SIGNAL
910

FIG. 9

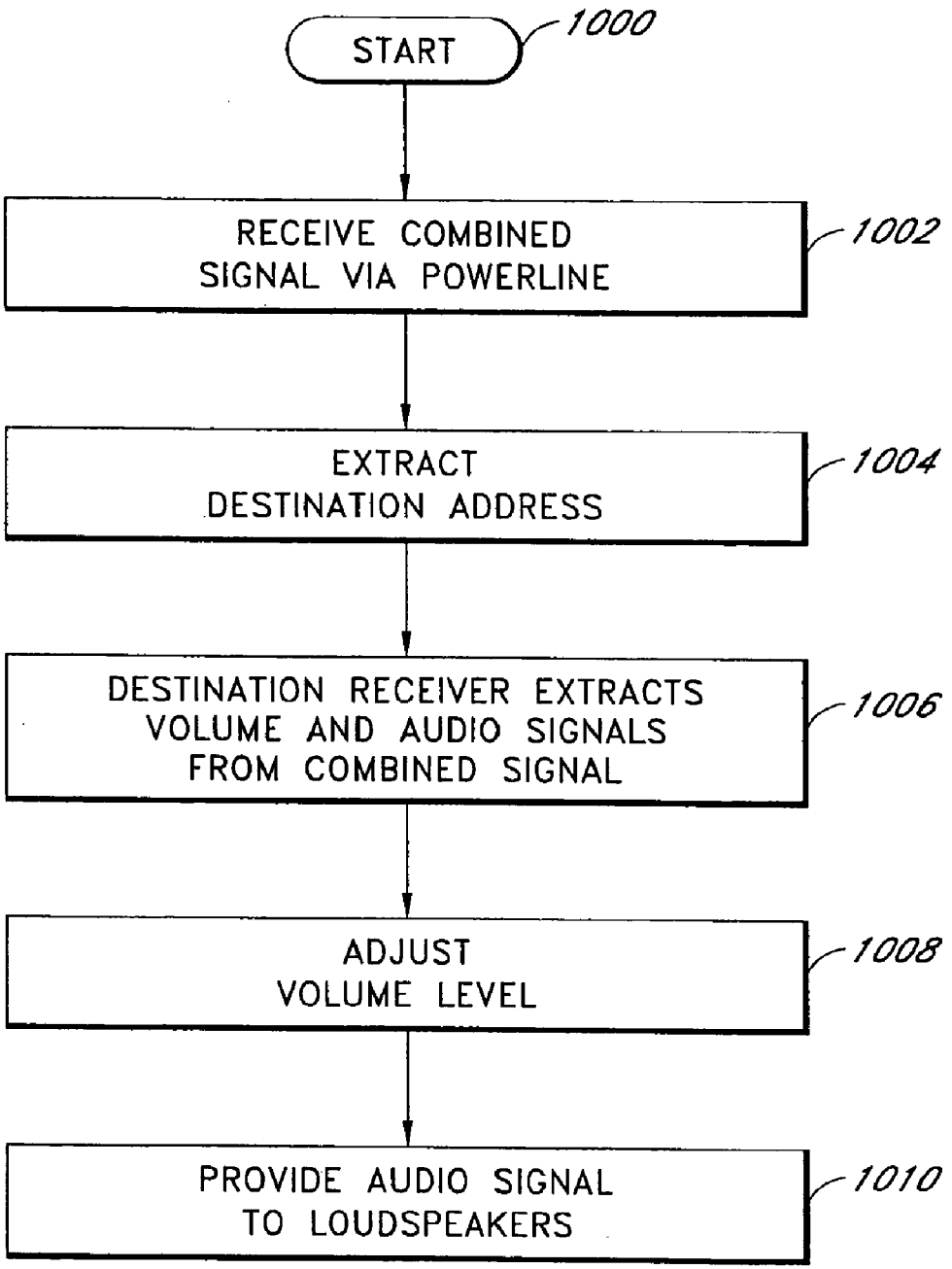

START
1000
RECEIVE COMBINED SIGNAL VIA POWERLINE
1002
EXTRACT DESTINATION ADDRESS
1004
DESTINATION RECEIVER EXTRACTS VOLUME AND AUDIO SIGNALS FROM COMBINED SIGNAL
1006
ADJUST VOLUME LEVEL
1008
PROVIDE AUDIO SIGNAL TO LOUDSPEAKERS
1010

FIG. 10

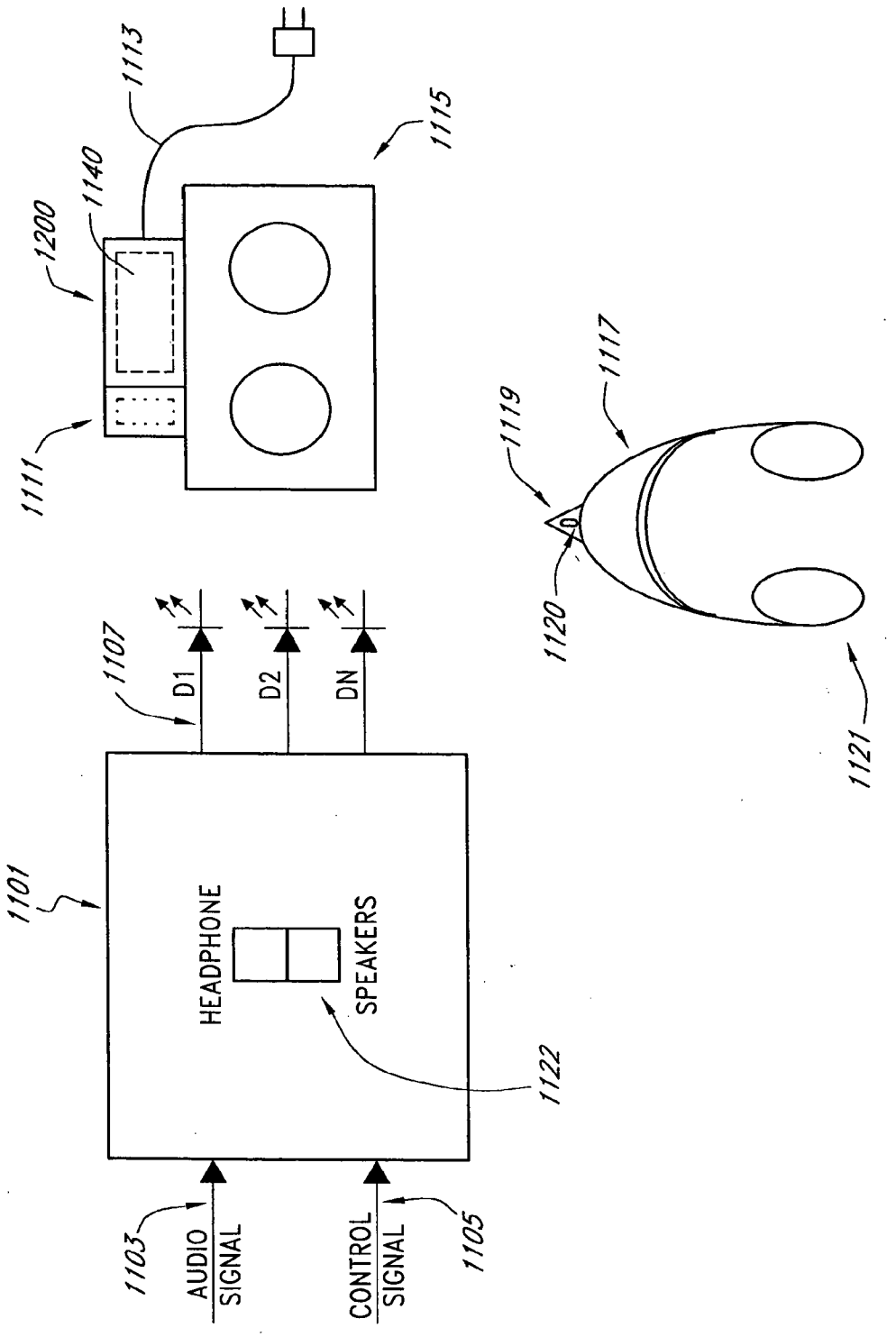

1113
1115
1140
1200
1111
1119
1117
1120
1121
1107
D1
D2
DN
1101
HEADPHONE
SPEAKERS
1122
1103
AUDIO SIGNAL
CONTROL SIGNAL
1105

FIG. 11

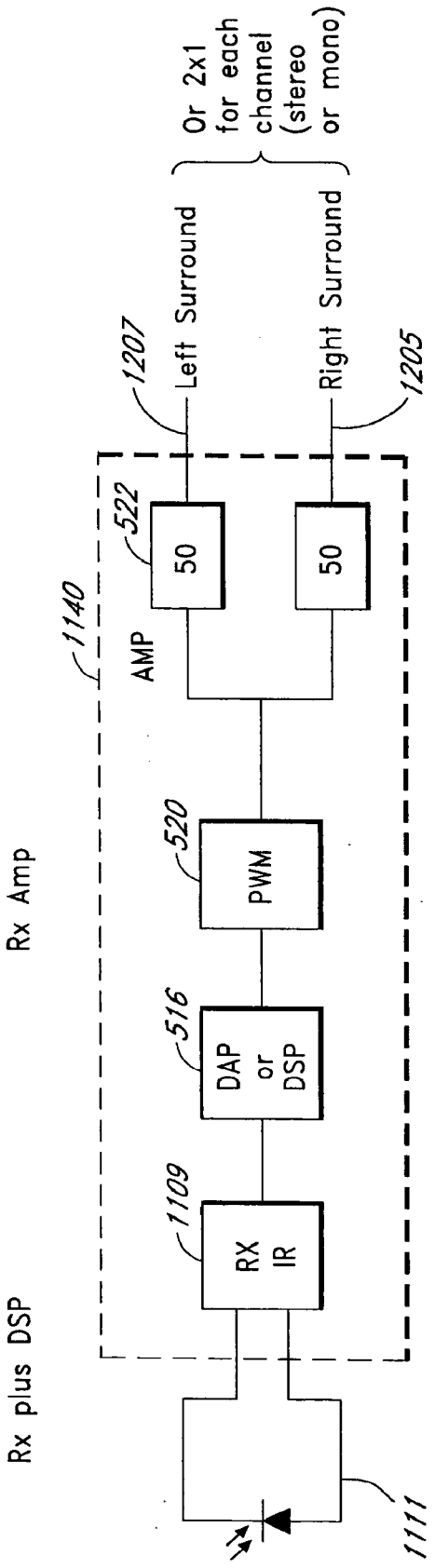

Rx plus DSP
Rx Amp
1140
AMP
1109
RX IR
516
DAP or DSP
520
PWM
522
50
50
1207
Left Surround
1205
Right Surround
Or 2x1 for each channel (stereo or mono)
1111

FIG. 11A

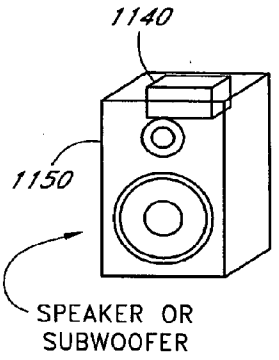


FIG. 11B(1)

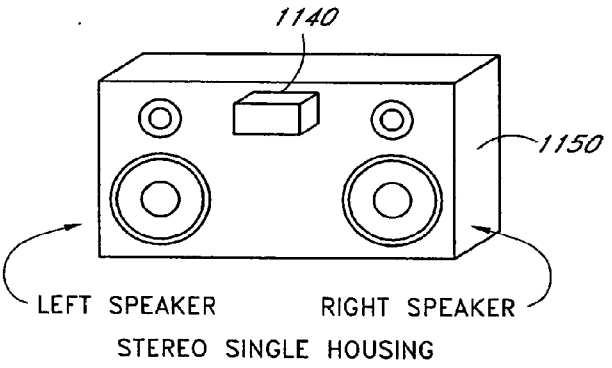


FIG. 11B(2)

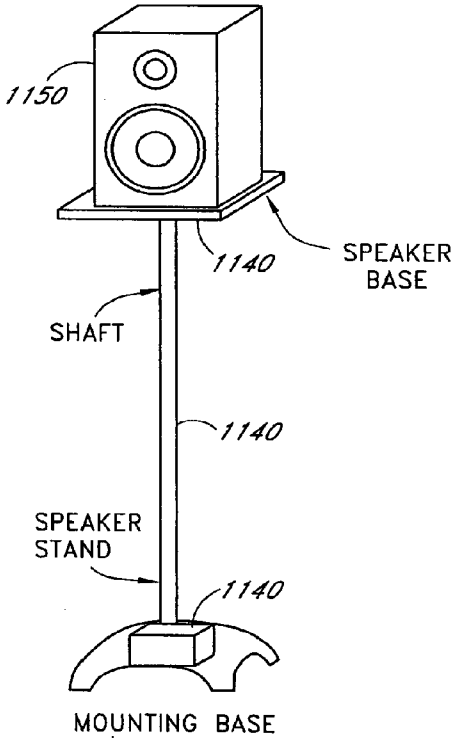


FIG. 11B(3)

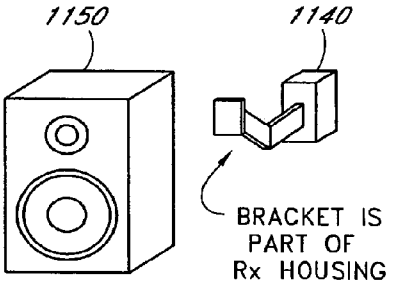


FIG. 11B(4)

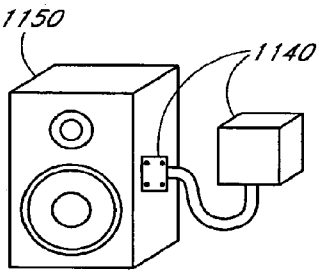


FIG. 11B(5)

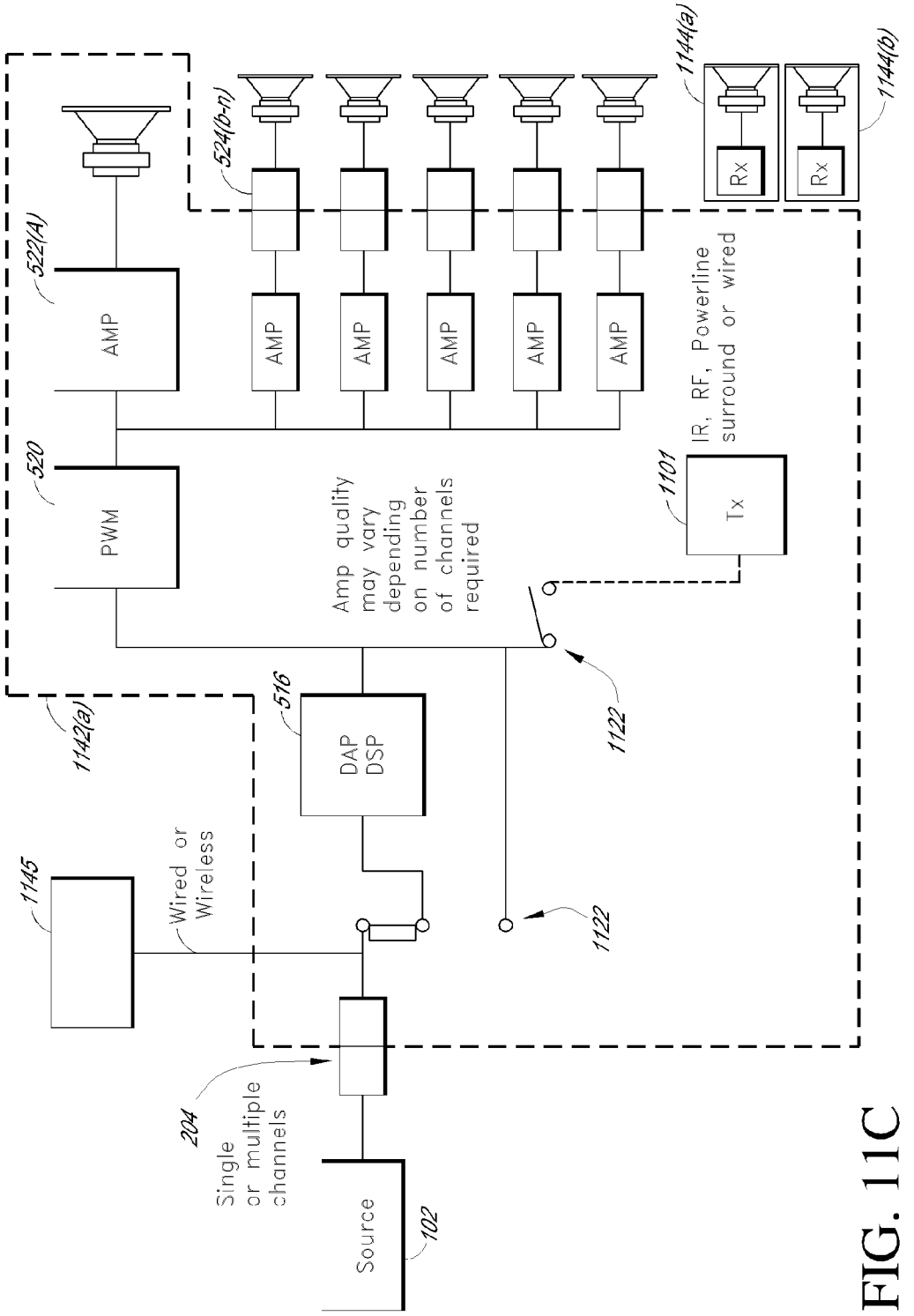

1144(a)
1144(b)
524(b-n)
Rx
Rx
522(A)
AMP
AMP
AMP
AMP
AMP
AMP
IR, RF, Powerline surround or wired
520
PWM
1101
Tx
Amp quality may vary depending on number of channels required
1142(a)
516
DAP DSP
1122
1122
1145
Wired or Wireless
204
Single or multiple channels
Source
102

FIG. 11C

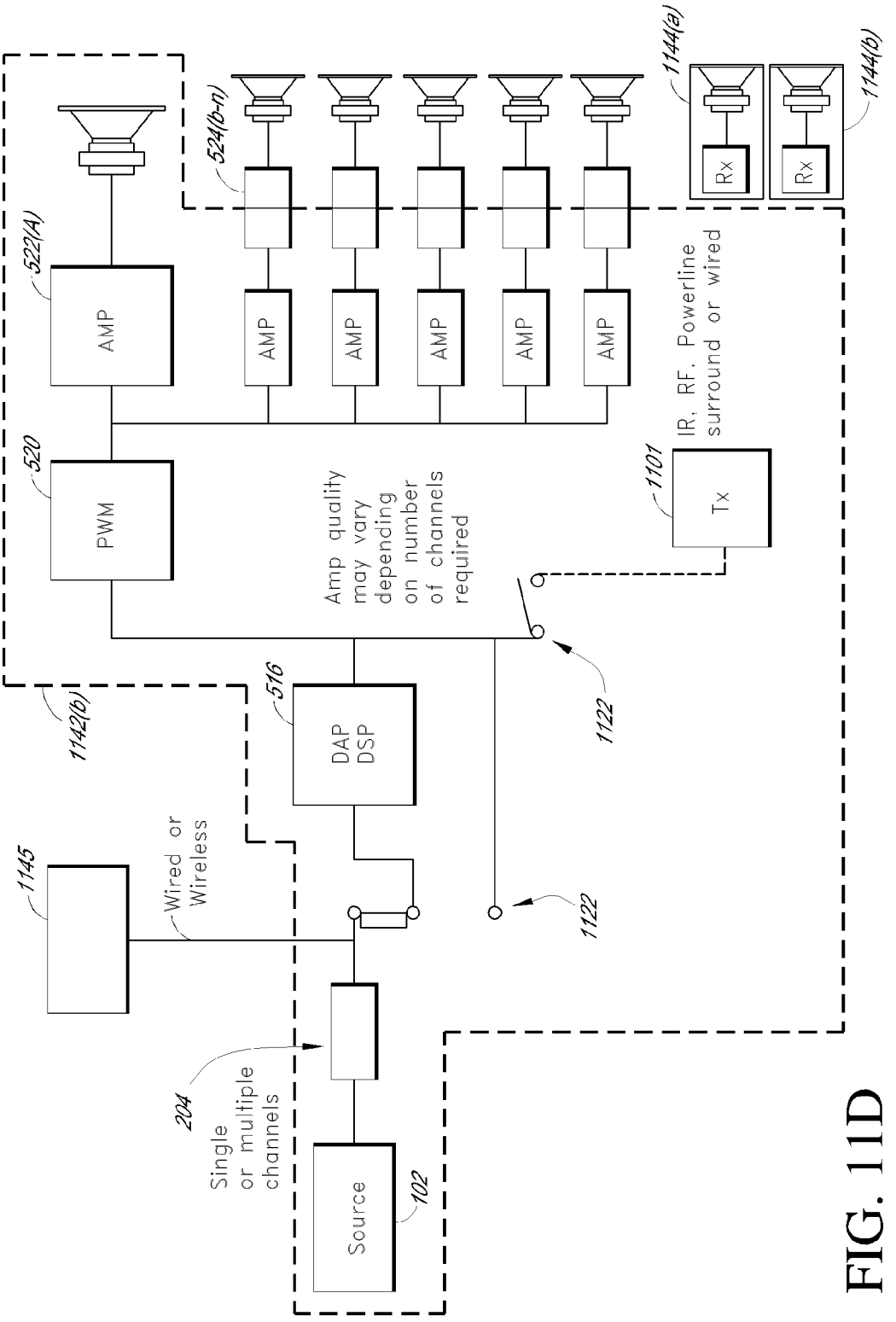

1144(a)
1144(b)
524(b-n)
Rx
Rx
522(A)
AMP
AMP
AMP
AMP
AMP
AMP
IR, RF, Powerline surround or wired
520
PWM
1101
Tx
Amp quality may vary depending on number of channels required
1142(b)
516
DAP DSP
1122
1122
1145
Wired or Wireless
204
Single or multiple channels
Source
102

FIG. 11D

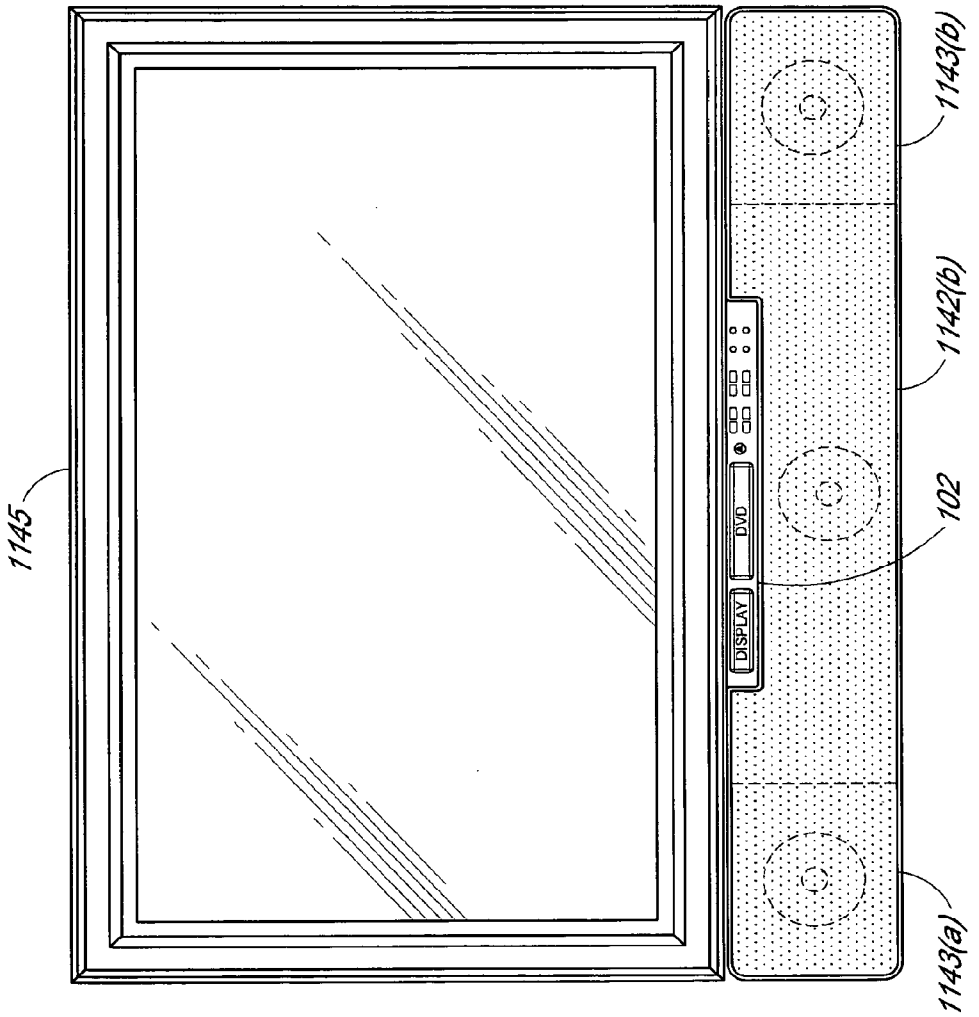


FIG. 11E

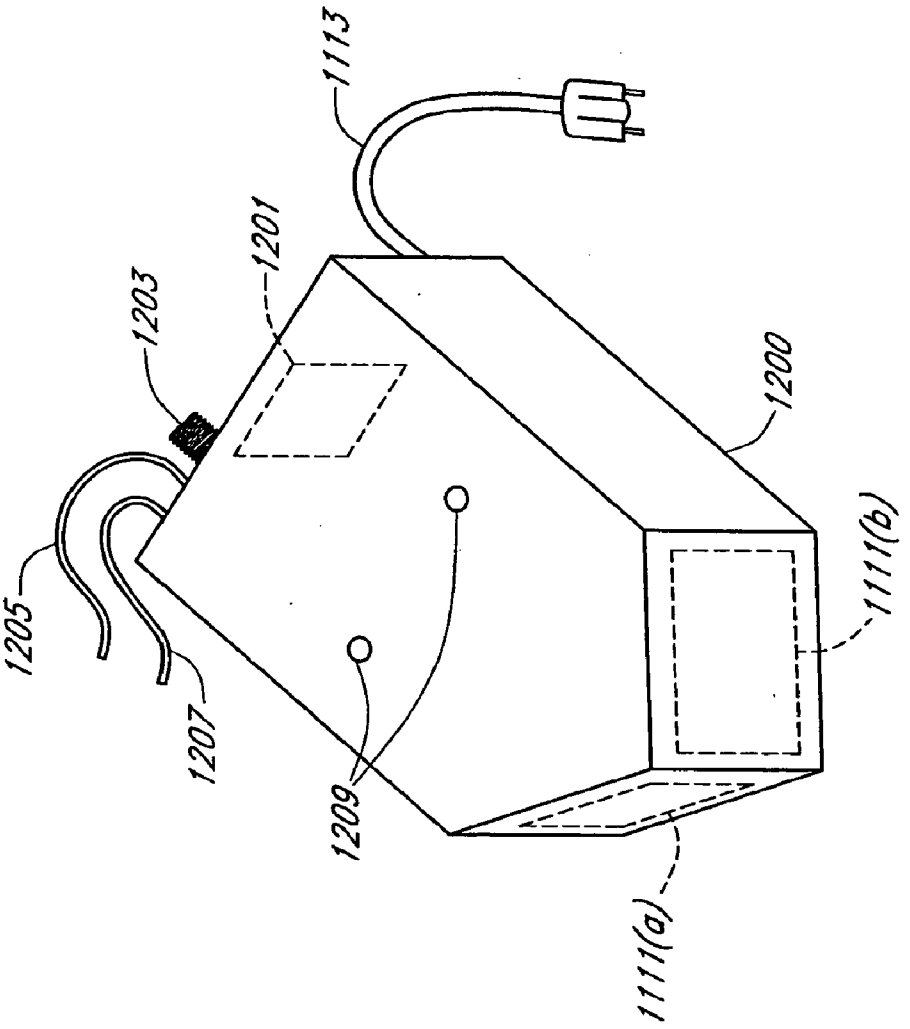


FIG. 12

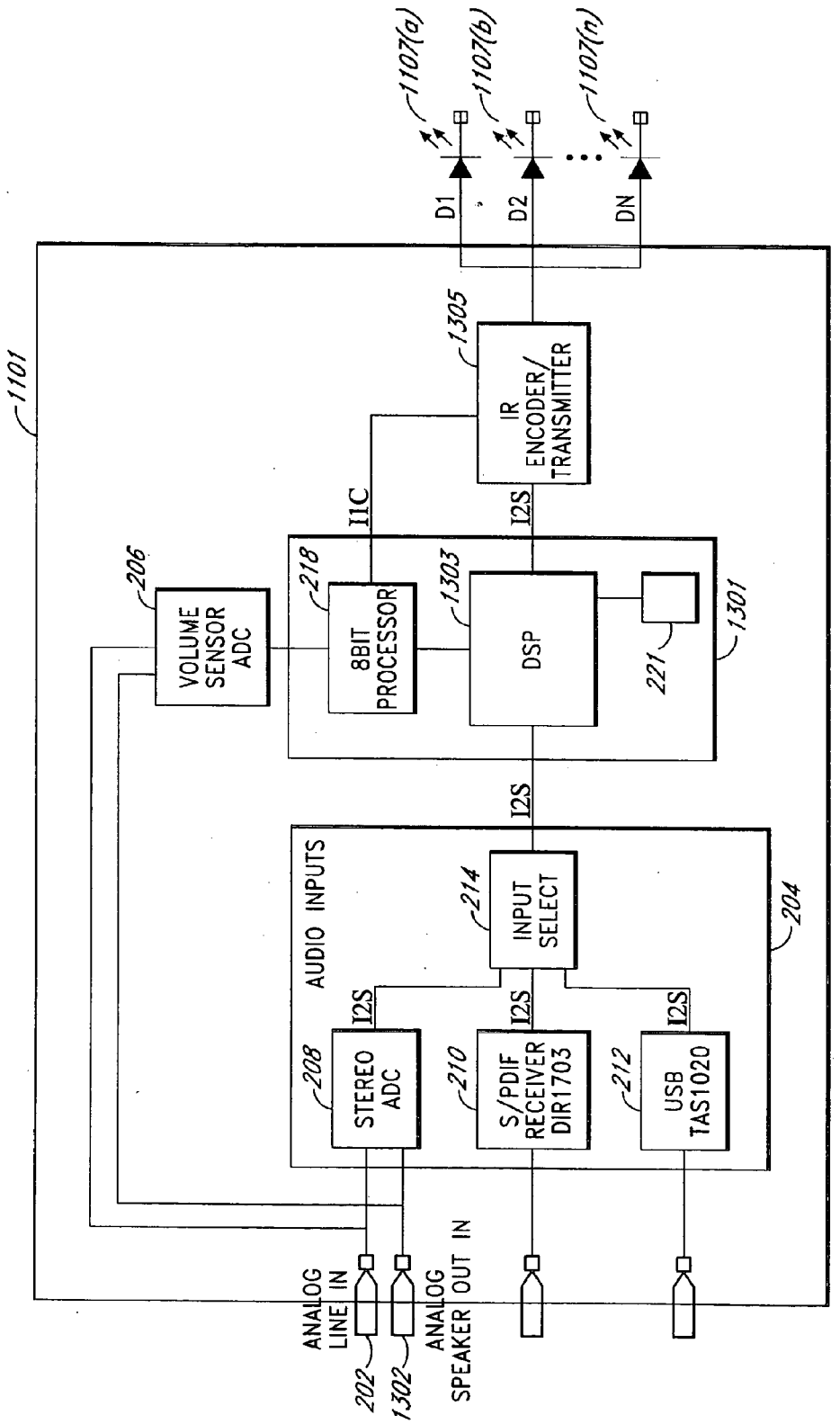

1107(a)
1107(b)
1107(n)
D1
D2
DN
1101
1305
IR ENCODER/ TRANSMITTER
I2C
I2S
206
VOLUME SENSOR ADC
218
8BIT PROCESSOR
1303
DSP
221
1301
I2S
AUDIO INPUTS
214
INPUT SELECT
204
I2S
I2S
I2S
208
STEREO ADC
210
S/PDIF RECEIVER DIR1703
212
USB TAS1020
ANALOG LINE IN
ANALOG SPEAKER OUT IN
202
1302

FIG. 13

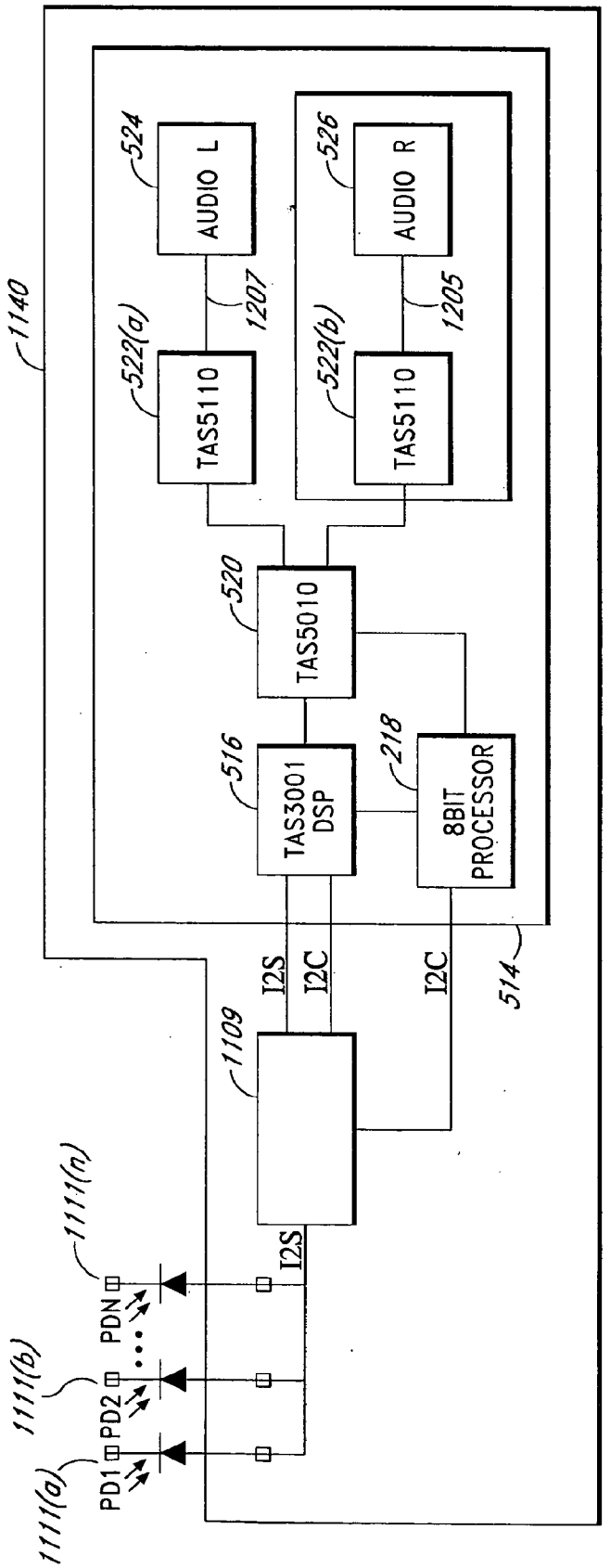

1140
524
AUDIO L
526
AUDIO R
1207
1205
522(a)
TAS5110
522(b)
TAS5110
520
TAS5010
516
TAS3001 DSP
218
8BIT PROCESSOR
I2S
I2C
I2C
514
1109
I2S
1111(n)
PDN
1111(b)
PD2
1111(a)
PD1

FIG. 14

WIRED, WIRELESS, INFRARED, AND POWERLINE AUDIO ENTERTAINMENT SYSTEMS

RELATED APPLICATIONS

[0001] This application is a continuation of patent application Ser. No. 10/783,718, filed Feb. 20, 2004 and entitled Wired, Wireless, Infrared, and Powerline Audio Entertainment Systems, which is a continuation-in-part of patent application Ser. No. 10/353,805, filed Jan. 27, 2003 and entitled Wired, Wireless, Infrared, and Powerline Audio Entertainment Systems which itself claims priority to provisional patent application Ser. Nos. 60/351,843, filed Jan. 25, 2002 and entitled Wired, Wireless, and Powerline Audio Entertainment Systems, 60/353,806, filed Feb. 1, 2002 and entitled Wired, Wireless, and Powerline Audio Entertainment Systems, 60/371,268, filed Apr. 8, 2002, and entitled Wired, Wireless, Infrared, and Powerline Audio Entertainment Systems, and 60/407,432, filed Aug. 28, 2002, and entitled Wired, Wireless, Infrared, and Powerline Audio Entertainment Systems, all of which are hereby incorporated by reference in their entireties.

BACKGROUND OF THE INVENTION

[0002] 1. Field of the Invention

[0003] This invention relates to home networks. More particularly, the invention provides a method and system for communicating one or more signals, via a wired, wireless, infrared, RF, or a powerline medium, to control one or more remote entertainment systems throughout a home.

[0004] 2. Description of Related Art

[0005] A communication system for a home network facilitates two-way communication between a plurality of devices within the home. These devices can be fixed or portable and can include, for example, televisions, computers, stereos, speakers, monitors, printers, and other electronic appliances. For these devices to communicate throughout a home, they interface with the home network.

SUMMARY OF THE INVENTION

[0006] The systems and methods of the present invention have several features, no single one of which is solely responsible for its desirable attributes. Without limiting the scope of this invention, its more prominent features will now be discussed briefly. After considering this discussion, and particularly after reading the section entitled "Detailed Description of the Preferred Embodiments" one will understand how the features of this invention provide several advantages over traditional audio entertainment systems.

[0007] One aspect of the invention relates to a home entertainment system configured to provide an audio signal to a remote loudspeaker. The system comprises a left front channel loudspeaker, a right front channel loudspeaker, and a housing. The housing encloses a device providing one or both an audio signal and a video signal, a center channel loudspeaker coupled to receive at least a first portion of said audio signal from the device, and a transmitter configured to receive at least a second portion of the audio signal from the device and transmit audio signals to a remote loudspeaker.

[0008] Another aspect of invention is a loudspeaker housing that comprises an input coupled to receive two or more signals from an input device, a loudspeaker configured to broadcast one of the two or more received signals to a listener, and a transmitter configured to transmit one or more signals to a remote loudspeaker.

[0009] Still another aspect of the invention relates to a home entertainment system which comprises a housing which comprising a transmitter module configured to receive an audio signal from an input device and wirelessly transmit the signal to at least one remote loudspeaker, wherein the audio signal comprises a plurality of different audio tracks, a device located within the housing and configured to provide the audio signal, and at least one loudspeaker external to said housing having a receiver configured to wirelessly receive the audio signal.

[0010] Yet another aspect of the invention relates to a home entertainment system which comprises a housing enclosing at least (1) a device providing an audio signal and a video signal, and (2) a center channel loudspeaker, a left front channel loudspeaker coupled to receive at least a portion of said audio signal, a right front channel loudspeaker coupled to receive at least a portion of said audio signal, and a display device coupled to receive the video signal.

BRIEF DESCRIPTION OF THE DRAWINGS

[0011] FIG. **1** is a block diagram of a communication system for a home network that can be connected using a wired, wireless, RF, or powerline network.

[0012] FIG. **1A** is a block diagram of an embodiment of the communication system that has a set top box connected to a loudspeaker using a wired, wireless, RF, or powerline network.

[0013] FIG. **2** is a block diagram of a first embodiment of the transmitter module from FIG. **1**, which includes a plurality of audio inputs.

[0014] FIG. **3** is a perspective view of the transmitter shown in FIG. **2**.

[0015] FIG. **4** is a block diagram of a second embodiment of the transmitter module from FIG. **1**, which includes a single audio input.

[0016] FIG. **5** is a block diagram of an Tx powerline module from FIG. **2**.

[0017] FIG. **6** is a block diagram of a first embodiment of the receiver module from FIG. **1**, which includes an amplifier.

[0018] FIG. **7** is a block diagram of a second embodiment of the receiver module from FIG. **1**.

[0019] FIG. **8** is a block diagram of an Rx powerline module from FIG. **6**.

[0020] FIG. **9** is a flowchart of an exemplary process that is performed by the transmitter module to transmit a Tx signal and a Tx control signal into a powerline network.

[0021] FIG. **10** is a flowchart of an exemplary process that is performed by the receiver module to receive an Rx signal and an Rx control signal from the transmitter module via the powerline network.

[0022] FIG. **11** is a block diagram of an embodiment of a communication system that utilizes a wireless network, for example, an infrared (IR) network.

[0023] FIG. **11**A is a block diagram of receiver components which can be located in a surround or speaker enclosure.

[0024] FIG. **11**B is a diagram showing multiple embodiments of a loudspeaker and receiver components from FIG. **11**A.

[0025] FIG. **11**C is a block diagram of signal paths through components of an embodiment of a home entertainment system.

[0026] FIG. **11**D is a block diagram of signal paths through components of another embodiment of a home entertainment system.

[0027] FIG. **11**E is a front view of the display device from FIG. **11**D arranged adjacent to the center channel loudspeaker from FIG. **11**D.

[0028] FIG. **12** is a perspective view of a housing for the receiver components from FIG. **11**A.

[0029] FIG. **13** is a block diagram of one embodiment of the IR transmitter shown in FIG. **11**.

[0030] FIG. **14** is a block diagram of audio and control signal paths through an embodiment of the receiver components **1140** from FIG. **11**.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0031] Preferred embodiments of the present invention will now be described with reference to the accompanying figures, wherein like numerals refer to like elements throughout. The terminology used in the description presented herein is not intended to be interpreted in any limited or restrictive manner simply because it is being utilized in conjunction with a detailed description of certain specific preferred embodiments of the present invention.

[0032] In connection with the following description many of the components of the various systems and the entire systems, some of which are referred to as "module," can be implemented as software, firmware or a hardware component, such as a Field Programmable Gate Array (FPGA) or Application-Specific Integrated Circuit (ASIC), which performs certain tasks. Such components or modules may advantageously be configured to reside on the addressable storage medium and configured to execute on one or more processors. Thus, a module may include, by way of example, components, such as software components, object-oriented software components, class components and task components, processes, functions, attributes, procedures, subroutines, segments of program code, drivers, firmware, microcode, circuitry, data, databases, data structures, tables, arrays, and variables. The functionality provided for in the components and modules may be combined into fewer components and modules or further separated into additional components and modules. Additionally, the components and modules may advantageously be implemented to execute on one or more computers.

[0033] FIG. **1** is a block diagram of a communication system **100** configured to provide network connectivity throughout a home. The communication system **100** receives an input signal from an input device **102**. Types of input signals can include, for example, audio, video, textual, and control signals. These signals can originate from one or more input devices **102** depending on the type of input signal. For ease of explanation, the following description uses an audio signal as an exemplary input signal to the communication system **100**. However, the communication system **100** is not so limited and can be used with video, textual, and any other information signal. Examples of input devices **102** that generate an audio signal include a personal computer, digital video disk (DVD) player, a stereo receiver, MP3 player, compact disk (CD) player, digital audio tape (DAT), TV, MP3 player, cable set top, satellite set top, media center, network client, and the like. Examples of control signals include, volume level, fader level, balance level, sub-bass level, destination source, sound processing selection, equalizer levels, power on, power off, or any other manipulation of the audio signal.

[0034] Connected to the input devices **102** is a transmitter module **104**. Alternatively, the transmitter module **104** may be located within the input device **102**. The connection between the input device **102** and the transmitter module **104** can utilized digital or analog specialty cable. The specialty cable combines the signals from the input device **102** into a single cable. The single cable can connect to the rear panel of the input device **102**. The transmitter module **104** can be located inside or outside of the input device **102**. For example, the transmitter **104** can be located inside the media center, PC, network client, DVD, receiver, MP3 player, and cable set top. The transmitter module **104** receives the audio signal, and any control signals, from the input devices **102**. As mentioned above, an exemplary control signal is a desired volume level. The sources of the control signal can include the input device **102**. In one embodiment, the transmitter module **104** includes a Digital Signal Processor (DSP) (not shown). The DSP is configured to process and encode the control signal and the audio signal prior to their transmission by the transmitter module **104**. For example, the address of a destination receiver module **108**(*a*)-(*n*) can be encoded by the DSP. Alternatively, control signals can originate at the transmitter module **104**. For example, a switch (not shown) can be coupled to the transmitter **104** to allow a user to select the destination receiver module **108**(*a*)-(*n*) that will receive the audio signal.

[0035] The network or transmitter module **104** forms a bridge between the input devices **102** and a network, for example, a powerline medium **106**. A powerline network uses an existing infrastructure of alternating current (AC) electrical power outlets in the walls of a home or building to form multiple electrical connections between any two of the power outlets. Power outlets are located almost everywhere someone might want to use a networked device in a home or building. Thus, the powerline network allows a user to remotely connect to the networked device via the existing power outlets. The network in FIG. **1** is a powerline **106** network. However, the communication is not so limited. Other exemplary networks include wireless, infrared, IRDA, and wired networks.

[0036] The transmitter module **104** is configured to combine the control signal with the audio signal produced by the input device **102** to form a combined signal. The transmitter module **104** is further configured to modulate the combined signal so as to convert the signals to a form which is compatible with transmission via the powerline **106**. An exemplary method for this conversion includes the use of a media access control (MAC) protocol coupled with a physical layer (PHY). The MAC and PHY can utilize data packets for the transmission of the combined signal. The MAC protocol controls the

sharing of a PHY layer among multiple transmitters **104** and receivers **108**(*a*)-(*n*), while the PHY specifies the modulation, coding, and basic packet formats which are used to transmit along the powerline **106**. An exemplary transmission technique used by the communication system **100** is orthogonal frequency division multiplexing (OFDM). The detail components which perform the conversion of the combined signal for its transmission via the powerline **106** are illustrated in, and will be explained with reference to, FIG. **5**.

[**0037**] Alternatively, the audio signal and the control signal that are converted from an analog to a digital form are formatted at the input source **102** for their transmission. The formatted signals are sent to the network **106** without being processed by the transmitter **104**.

[**0038**] The transmitter module **104** can connect with the powerline **106** via input power receptacle **105**, such as a standard 3-prong electrical outlet. Alternatively, the transmitter module **104** is directly hard wired to the powerline **106**. More detailed block diagrams of the transmitter module **104** are illustrated in, and will be described with reference to, FIGS. **2**, **3**, and **4**. A process for formatting and transmitting a combined signal via the powerline **106**, that can be performed by the transmitter module **104** of FIG. **1**, is shown in, and will be described with reference to, FIG. **9**.

[**0039**] The powerline **106** connects with one or more receiver modules **108**(*a*)-(*n*) via an output power receptacle **107**(*a*)-(*n*). The output power receptacle **107**(*a*)-(*n*) operates in the same fashion as the input power receptacle **105**. The output power receptacle **107**(*a*)-(*n*) directly connects with the receiver module **108**(*a*)-(*n*) while the input power receptacle **105** directly connects with the transmitter module **104**. However, the input and output power receptacles can be cross identified depending on how they are utilized within the powerline communication system **100**. For example, input power receptacle **105** can be used by the receiver module **108**(*a*)-(*n*). Moreover, the input power receptacle **105** can be used simultaneously by the receiver module **108**(*a*)-(*n*) and the transmitter module **104** to, for example, couple both for use in the same room of the home.

[**0040**] A powerline **106** is a difficult environment for audio signals. The communication path between any two power receptacle **105**, **107** in the home can have a complicated transfer function with many branches of the powerline **106** having terminating loads at each receptacle with different impedances. Further, the transfer function can change with time due to the connection or removal of common electrical devices into the powerline **106**. Thus, the amplitude and phase response of the powerline **106** can vary widely with frequency.

[**0041**] The network or receiver module **108**(*a*)-(*n*) is configured to receive the data packets from the powerline **106** and extract the audio signal and the control signal included therein. The detail components which may be used to perform the extraction of the control and audio signals are illustrated in, and will be explained with reference to, FIG. **8**.

[**0042**] The receiver module **108**(*a*)-(*n*) utilizes the control signal to manipulate the audio signal. This manipulation can include, for example, detection of audio signal peaking and clipping. The receiver module **108**(*a*)-(*n*) may be configured to automatically adjust the audio signal's level to adjust for detection of peaking or clipping. The receiver module **108**(*a*)-(*n*) may also be configured to receive a code which determines a phase for the audio signal. The receiver **108**(*a*)-(*n*) then manipulates the audio signal such that a desired phase relationship is maintained with other loudspeakers on the network based on the code. This can be accomplished by coding a time or phase delay in the control signal. More detailed block diagrams of the receiver module **108**(*a*)-(*n*) are illustrated in, and will be described with reference to, FIGS. **6** and **7**. A process for receiving and extracting the audio signal and the control signal from the received combined signal, that can be performed by the receiver module **108**(*a*)-(*b*) of FIG. **1**, is shown in, and will be described with reference to, FIG. **10**.

[**0043**] Still referring to FIG. **1**, an output device **110** is connected to the receiver module **108**(*a*)-(*n*) and receives the manipulated audio signal from the receiver module **108**(*a*)-(*n*). The output device **110** is configured to change the audio signal into sounds loud enough to be heard at a selected distance. Output devices **110** can include, for example, stereo loudspeakers, home theater loudspeakers, and headphones.

[**0044**] As one can now recognize, the communication system **100** of FIG. **1** provides connectivity between the input devices **102** and the output devices **110**. As explained above, the network can be wired or wireless. For example, the network can use a wireless data transmission method, such as IrDA, to communicate between the input devices **102** and the output devices **108**. IrDA is a standard defined by the IrDA consortium (Infrared Data Association) for both the input and output devices and the protocols they use to communicate with each other. IrDA specifies a way to wirelessly transfer data via infrared radiation using infrared light emitting diodes (IR-LED's). Moreover, a wireless data transmission method, such as radio frequency (RF), can be used for the network. An RF network uses the electromagnetic spectrum associated with radio wave propagation.

[**0045**] The input and output devices can be position at fixed or portable locations within the home. For example, receiver module **108**(*a*) and receiver module **108**(*b*) can be located in different areas of the home while communicating with transmitter module **104**. The transmitter module **104** may service a few or several receiver modules **108**(*a*)-(*n*).

[**0046**] FIG. **1**A is a block diagram of an embodiment of the communication system that has a set top box **140** connected to a loudspeaker **142** using a wired, wireless, or powerline network. The set top box **140** is configured to combine an audio signal and a control signal. The combined signal is transmitted via the network **144** to the loudspeaker **142**.

[**0047**] The loudspeaker **142** is coupled to an amplifier **146**. The amplifier **146** may be configured to amplify and/or manipulate the audio signal based on the control signal. The amplifier can thus be further coupled to or incorporate an equalizer (not shown). The equalizer is configured to manipulate the received audio signal prior to the loudspeaker **142** broadcasting the audio signal.

[**0048**] The communication system can further include a loudspeaker controller **150**. The loudspeaker controller **150** connects to the network **144** and is configured to manipulate the equalizer of one or more loudspeakers **142**. For example, the loudspeaker controller **150** can wirelessly connect to the loudspeaker **142** via the network **144**. Alternatively, the loudspeaker controller **150** can connect via a wired network **144** to

the loudspeaker **142**. The wired network can be, for example, an Ethernet LAN or a powerline network.

[**0049**] The loudspeaker controller **150** can connect to the loudspeaker **142** via a different network than the network **144** utilized by the set top box **140**. For example, the set top box **140** can connect to the loudspeaker **142** via the powerline network and the loudspeaker controller **150** connects to the loudspeaker **142** via a wireless network. The settings of the equalizer can be stored in the amplifier **146**.

[**0050**] As another example, the loudspeaker controller **150** may connect with the loudspeaker **142** via the Internet or other wide-area network (WAN). In this example, the loudspeaker **142** can include web server software configured to allow the equalizer to receive its settings from the loudspeaker controller **150** via the Internet.

[**0051**] The loudspeaker **142** can further be configured to sense the broadcast signal levels from other loudspeakers. The processing of the sensed signal level may be performed internal to the loudspeaker **142**. The sensed signal level is then utilized by the sensing loudspeaker and the other loudspeakers to dynamically adjust the equalizer and signal balance. Alternatively, the sensed signal level is transmitted to the loudspeaker controller **150**, host, or other remote processor via the network where adjustments are calculated and transmitted to the loudspeakers.

[**0052**] FIG. **2** is a block diagram of a first embodiment of the transmitter module **104** from FIG. **1**. The transmitter module **104** is configured to receive, format, and transmit a combined signal via the powerline **106**. The transmitter module **104** includes receptacles **202**(*a*)-(*c*), an audio input connector **204**, a signal processing module **216**, a volume sensor analog to digital converter (A/D) **206** which is coupled to the signal processing module **216**, and a powerline module **222**. Each of these components is described in detail below.

[**0053**] The audio input connector **204** includes a plurality of connector designs for connecting with different input devices **102**. For example, the audio input connectors can include RCA connector module **208**, Universal Serial Bus (USB) module **212**, miniplug, S/PDIF module **210**, and SACD. The audio input connector **204** can further include any combination of digital and analog receptacles **202**(*a*)-(*c*). For example, the RCA connector module **208** can be used to connect an analog stereo receiver to the transmitter module **104**. For this connection, the audio input connector **204** is coupled to an analog receptacle **202**(*a*) to receive the analog audio signal.

[**0054**] Coupled to the analog connector **202**(*a*) is the volume sensor A/D **206**. The volume sensor A/D **206** is configured to sense the input power level of the analog audio signal into the analog receptacle **202**(*a*) and digitize the input power level. The volume sensor A/D **206** senses a RMS value of the audio signal. Depending on the value, the volume sensor A/D **206** changes the control signal. The sensitivity between changing the control signal in response to changes in the RMS value can vary. The control signal can be in an a variety of future developed formats, such as the well known I^2C format. As explained below, the control signal is transmitted along with the audio signal via the powerline **106** as a combined signal.

[**0055**] The RCA connector module **208** can include an analog to digital converter (A/D). The A/D forms a digital signal from the inputted analog audio signal for its processing by the audio input connector **204**.

[**0056**] The S/PDIF module **210** is configured to receive digital signals from the input devices **102** via the receptacle **202**(*b*).

[**0057**] The USB connector module **212** is configured to connect the transmitter module **104** with a personal computer to receive a digital audio signal and an associated digital control signal. Since the control signal is in digital form, the volume sensor A/D **206** does not sense the control signal for the USB connector module **212** or the S/PDIF connector module **210**. An embodiment of the USB connector module **212** is a Stereo USB Audio Interface, part number TAS1020, which is manufactured by Texas Instruments Incorporated. Texas Instruments Incorporated is located at 12500 TI Boulevard in Dallas, Tex. 75243-4136.

[**0058**] The audio input connector **204** further includes an input selector module **214**. The audio input connector **204** is coupled to the RCA connector module **208**, the S/PDIF module **210**, and the USB connector module **212**. The input selector module **214** is configured to select the input device **102** that is to have its audio signal transmitted by the transmitter module **104**. The selected input source **102** can dynamically change from time to time.

[**0059**] The input selector module **214** receives digital signals, audio and control, from the selected input devices **102**. Various bus designs can be used to couple the input selector module **214** to the input connectors to receive the digital signals. Exemplary bus designs that are used in the audio field include, for example, inter IC sound (I^2S).

[**0060**] Connected to the audio input connector **204** is the signal processing module **216**. The signal-processing module **216** is configured to combine the digital signal, audio and control, from the input select module **214** with an analog control signal from the volume sensor A/D **206**. For input sources **102** that provide a digital audio signal and digital control signal, the analog signal is not used. The control signal and the audio signal for the selected input device **102** forms the combined signal.

[**0061**] The signal processing module **216** includes a processor **218** coupled to the volume sensor A/D **206** for processing analog control signals. The processor **218** can be an 8-bit processor. The processor **218** is configured to control the volume sensor A/D **206**. The signal-processing module **216** may further include a programmable logic device (PLD) **220**. The PLD **220** is configured to combine the control signal with its associated audio signal. For example, the PLD **220** combines the audio signal from the audio input connector **204** with its associated control signal. The processor **218** can assist in the combining of the audio signal with the control signal. For analog input sources, the digital version of the control signal is provided by the processor **218** using information obtained from the volume sensor A/D **206**. The PLD **220** is further configured to format the combined signal to be readable by the powerline module **222**.

[**0062**] The signal processing module **216** may also include a destination source switch **221**. The destination source switch **221** is configured to select a receiver **108**(*a*)-(*n*) for receiving the combined signal. For example in FIG. **1**, depending on the position of the destination source switch **221**, any of the receivers **108**(*a*)-(*n*) could receive the com-

bined signal. Alternatively, more than one receiver **108**(*a*)-(*n*) can receive the same combined signal. In one embodiment, the signal processing module **216** includes a digital signal processor (DSP) (not shown). The DSP is configured to process and encode the control signal and the audio signal. For example, the address of the destination receiver module **108**(*a*)-(*n*) can be encoded by the DSP.

[**0063**] Coupled to the signal processing module **216** is the powerline module **222**. The powerline module **222** is configured to modulate and transmit the combined signal via the powerline **106**. The powerline module **222** includes a powerline chipset **224**, a powerline magnetics module **226**, and an A/C plug **228**.

[**0064**] The combined signal is received by the powerline chipset **224** from the signal processing module **216**. The powerline chipset **224** is configured to transform the combined signal into symbols. The symbols are then arranged into data packets for their transmission on the PHY via the powerline **106**. The PHY can utilize one or more carrier frequencies. The detail components which perform the conversion of the combined signal for its transmission via the powerline **106** are illustrated in, and will be explained with reference to, FIG. **5**.

[**0065**] The powerline magnetics module **226** is coupled to the powerline chipset **224**. The powerline magnetics module **226** is configured to provide isolation between the low voltage powerline chip set **224** and the high voltage powerline **106**. The powerline magnetics module **226** is further coupled to an alternating current (AC) plug **228**. The AC plug **228** is configured to electrically connect the transmitter module **104** with the input power receptacle **105** (see FIG. **1**) for transmission of the packets.

[**0066**] FIG. **3** is a perspective view of the transmitter module **104** shown in FIG. **2**. The transmitter module **104** includes housing **240** and a plug **228**. The housing includes a plurality of receptacles **202**(*a*), (*b*), (*c*) each accessible for attaching a connector from input devices **102** to receive the audio signal. The housing **240** may include a control signal receptacle **244**. In this embodiment, the control signal receptacle **244** receives a separate analog or digital control signal from an input device. Alternatively, and as described with reference to FIG. **2** above, a control signal is generated via the analog signal.

[**0067**] FIG. **4** is a block diagram of a second embodiment of the transmitter module from FIG. **1**. In contrast to the first embodiment shown in FIG. **3**, the embodiment of FIG. **4** is specifically designed for receiving signals from analog input devices. Thus, FIG. **4** includes only the RCA connector module **208** from FIG. **3** for receiving input signals.

[**0068**] FIG. **5** is a block diagram of the powerline chipset **224**, from FIG. **2**, which performs the conversion of the combined signal for its transmission via the powerline **106**. The detail components of the powerline chipset **224** are described below.

[**0069**] The powerline chipset **224** receives the combined signal from the signal-processing module **216** via a host interface **402**. The encryption module **404** receives the combined signal from the host interface **402**. The encryption module **404** is configured to encrypt the combined signal so that it is unreadable except by authorized users, for example, a receiver **108** (*a*)-(*n*). Coupled to the encryption module **404** is an encode module **406**. The encode module **406** is configured to encode the combined signal. Exemplary encoding techniques include Reed-Solomon encoding.

[**0070**] A media access control (MAC) protocol **410** controls the sharing of a PHY layer **412** among multiple transmitters **104** and receivers **108**(*a*)-(*n*). In conjunction with the MAC protocol **410**, the PHY layer **412** specifies the modulation, coding, and basic packet formats which are used to transmit along the powerline **106**. An exemplary transmission technique used by the powerline communication system **100** is orthogonal frequency division multiplexing (OFDM).

[**0071**] OFDM divides the encoded signal into multiple parallel signals, each of which has a relatively low bit rate. Each encoded signal is provided to the mapper module **408**. The mapper module **408** converts the bits to symbols prior to their modulation on the PHY layer **412**. For example, the bit streams can form OFDM symbols. Alternatively, QAM symbols can be used.

[**0072**] The MAC protocol **410** arranges each series of symbols to form a payload for transmission in a data packet. Each payload can be associated with a frame control header. The frame control header includes MAC protocol **410** management information. For example, the packet's length and response status can be included in the frame control header. The data packet can further include a start-of-frame delimiter and an end-of-frame delimiter in addition to the payload and frame control header. For unicast transmissions to more than one receiver **108**(*a*)-(*n*), the destination receiver **108** (*a*)-(*n*) can respond by transmitting a response delimiter indicating the status of its reception. As mentioned above, the delimiters can be intended for more than one of the receiver modules **108**(*a*)-(*n*). However, the payload is intended for only the destination receiver module **108**(*a*)-(*n*).

[**0073**] Each data packet is then modulated one of a series of closely spaced carriers, or subcarriers of the PHY layer **412**, using, for example, OFDM. Many different types of modulation can be used to transmit the symbols on the individual carriers. Exemplary modulation techniques include differential quadrature phase shift keying (DQPSK) modulation and quadrature amplitude modulation (QAM), both well known in the art. DQPSK modulation encodes the data as the difference in phase between the present and previous symbol in time on the same subcarrier.

[**0074**] The payload is carried on subcarriers that have been previously agreed upon by the transmitter module **104** and destination receiver module **108**(*a*)-(*n*) during a channel adaptation procedure. The subcarriers are selected based on the transfer function between the transmitter module **104** and the receiver module **108**(*a*)-(*n*). For example, the transmitter module **104** could select a first set of subcarriers of the PHY layer **412** for transmission between itself and the receiver module **108**(*a*). The receiver module **104** could then select a different set of subcarriers of the PHY layer **412** for transmission between itself and receiver module (b) based on the transfer functions between itself and receiver modules **108**(*a*), **108**(*b*).

[**0075**] A digital to analog module **414** converts the modulated signal to an analog form. The outgoing signal is then upconverted to an intermediate frequency **416** prior to its transmission.

[**0076**] FIG. **6** is a block diagram of a first embodiment of the receiver module from FIG. **1**, which includes an amplifier

514. The amplifier **514** can be a digital amplifier. Digital amplifiers internally process the audio signal in the digital domain. The receiver module **108** is configured to receive and unformat a combined signal received via the powerline **106**. The receiver module **108** is further configured to manipulate and amplify the audio signal and then broadcast the amplified signal.

[**0077**] The receiver module **108** includes a powerline module **507**, a signal processing module **508**, and an amplifier module **514**. The powerline module **507** is similar to the powerline module **222** described with reference to FIG. **2** except that it operates in a reverse configuration. The powerline module **507** is configured to receive and demodulate the combined signal via the powerline **106**. The powerline module **507** includes a powerline chipset **506**, a powerline magnetics module **509**, and an A/C plug **510**.

[**0078**] The alternating current (AC) plug **510** is configured to electrically connect the receiver module **108** with an input power receptacle **107**(*a*)-(*c*) (see FIG. **1**) to receive the packets. The AC plug **228** is further coupled to the powerline magnetics module **509**. The powerline magnetics module **509** is configured to provide isolation between the low voltage powerline chip set **506** and the high voltage powerline **106**. The powerline magnetics module **509** is coupled to the powerline chipset **506**.

[**0079**] The symbols in the data packets are received by the powerline chipset **506**. After their transmission on the PHY via the powerline **106**, the symbols are removed from the data packets. The powerline chipset **506** is configured to transform the symbols into a combined signal. The detail components which perform the conversion of the data packets received via the powerline **106** are illustrated in, and will be explained with reference to, FIG. **8**.

[**0080**] The signal processing module **508** is similar to the signal processing module **216** described with reference to FIG. **2** except that it receives the combined signal and extracts the audio signal from the control signal. The signal processing module **508** includes a processor **218**. The processor **218** is coupled to a local volume control **512**. The local volume control **512** is configured to allow a user to change the volume level of the audio signal broadcast by the loudspeaker. The signal-processing module **508** further includes a programmable logic device (PLD) **513**. The PLD **513** is configured to extract or separate the control signal from its associated audio signal. The processor **218** can assist in separating the audio signal from the control signal. The audio signal can be in an I^2S format while the control signal can be in an I^2C format. The PLD **513** provides the signals to the amplifier **514**.

[**0081**] Coupled to the signal-processing module **508** is the amplifier **514**. The amplifier **514** receives the extracted audio signal and control signal from the signal-processing module **508**. The amplifier **514** is configured to manipulate and amplify the audio signal and then broadcast the amplified signal. The amplifier includes a digital signal processor (DSP) module **516**, an amplifier module **520**, a power stage module **522**(*a*)-(*b*), and outputs **524**, **526**.

[**0082**] The DSP module **516** is configured to manipulate the received audio signal based on the control signal associated with the received audio signal. The DSP module **516** can include a graphical user interface (GUI) for a user to control the DSP module **516**. A PLD **518** can be coupled to the DSP module **516** to provide control logic. This logic can include processing additional channels, for example, subwoofer and center channels, for the amplifier **514**. For example, the PLD **518** can create a delay in sending a center channel signal to the DSP module **516**. An embodiment of the DSP module **516** is a Stereo Audio Digital Equalizer, part number TAS3001, which is manufactured by Texas Instruments Incorporated. Texas Instruments Incorporated is located at 12500 TI Boulevard in Dallas, Tex. 75243-4136.

[**0083**] The amplifier module **520** is coupled to the DSP module **516** and receives the manipulated I^2S audio signal. The amplifier module **520** converts the I^2S audio signal to a pulse width modulation (PWM) signal. An embodiment of the amplifier module **520** is a Digital Audio PWM Processor, part number TAS5010, which is manufactured by Texas Instruments Incorporated. The PWM signal is amplified by the power stages **522**(*a*)-(*b*). An embodiment of the power stages **522** is a Digital Amplifier Power Stage, part number TAS5110, which is manufactured by Texas Instruments Incorporated. The amplified signal is broadcast via outputs **524**, **526**.

[**0084**] FIG. **7** is a block diagram of a second embodiment of the receiver module **108** from FIG. **1**. The second embodiment is similar to the first embodiment except that the signal-processing module **602** does not provide an I^2C control signal. Moreover, the embodiment of FIG. **7** provides the I^2S signal to an output module **604** and not to an amplifier. The output module **604** converts the I^2S signal to an analog form for broadcast via outputs **524**, **526**.

[**0085**] FIG. **8** is a block diagram of the Rx powerline chipset **506** from FIG. **6**. The Rx powerline chipset **506** operates similar to the Tx powerline chipset described in FIG. **5** except in a reverse configuration. The Rx powerline chipset **506** performs the conversion of the combined signal received via the powerline **106**. The detail components of the Rx powerline chipset **506** are described below.

[**0086**] The incoming signal is downconverted from an intermediate frequency **802** to a baseband signal. An analog to digital module **804** converts the baseband signal to a digital form. The received data packet is demodulated from one of a series of closely spaced carriers, or subcarriers of the PHY layer **806**. Many different types of modulation can be used to transmit the symbols on the individual carriers. Exemplary modulation techniques include differential quadrature phase shift keying (DQPSK) modulation and quadrature amplitude modulation (QAM), both well known in the art. DQPSK modulation encodes the data as the difference in phase between the present and previous symbol in time on the same subcarrier.

[**0087**] A media access control (MAC) protocol **808** controls the sharing of the PHY layer **806** among multiple transmitters **104** and receivers **108**(*a*)-(*n*). In conjunction with the MAC protocol **808**, the PHY layer **806** identifies the modulation, coding, and basic packet formats which were used to transmit along the powerline **106**.

[**0088**] The MAC protocol **808** removes the symbols from the received data packet. Each data packet can be associated with a frame control header. The frame control header includes MAC protocol **808** management information. For example, the packet's length and response status can be included in the frame control header. The data packet can

further include a start-of-frame delimiter and an end-of-frame delimiter in addition to the payload and frame control header. For unicast broadcast to more than one receiver **108**(*a*)-(*n*), the destination receiver **108** (*a*)-(*n*) can respond by transmitting a response delimiter indicating the status of its reception. As mentioned above, the delimiters can be intended for more than one of the receiver modules **108**(*a*)-(*n*). However, the payload is intended for only the destination receiver module **108**(*a*)-(*n*).

[**0089**] The symbols are provided to the demapper **810**. The demapper module **810** converts the demodulated symbols to bits. The bits are provided to a decode module **812**. The decode module **812** is configured to decode the bits into a combined signal. Exemplary encoding techniques include Reed-Solomon encoding. Coupled to the dencode module **812** is a decryption module **814**. The decryption module **814** receives the combined signal from the decode module **812**. The decryption module **814** is configured to decrypt the combined signal so that it is readable by the authorized user, for example, the receiver **108** (*a*). once decrypted, the powerline chipset **506** provides the combined signal to the signal-processing module **508**.

[**0090**] FIG. **9** is a flowchart of an exemplary process that is performed by the transmitter module to transmit a Tx signal and a Tx control signal into the powerline **106** when the input is an analog audio signal. The process begins at a state **900** where the signal-processing module **216** receives an audio signal from the audio input connector **204**. The process then moves to a state **902** where the analog audio signal is processes through, for example, low pass filtering or other additional signal processing to produce an analog volume signal level. The process moves to a state **904** where the volume sensor A/D **206** periodically samples the sensed volume and converts the sensed volume into a digital form. Next, at a state **906**, the signal-processing module **216** receives the destination address of the receiver **108**(*a*)-(*n*) from the destination source switch **221**. Flow proceeds to a state **908** where the signal processing module **216** combines the audio and control signal into a combined signal. At a state **912**, the powerline module **222** transmits the combined signal via the powerline **106** to the destination receiver (a)-(n).

[**0091**] FIG. **10** is a flowchart of an exemplary process that is performed by a receiver module to receive an Rx signal and an Rx control signal from the transmitter module via the powerline **106**. The process begins at a state **1000** where the combined signal is received by a destination receiver module via the powerline. The process moves to a state **1002** where the destination receiver module extracts its destination address from the combined signal. Flow moves to a state **1006** where the destination receiver extracts volume and audio signals from the combined signal. Next, at a state **1008**, the receiver module adjusts the volume level of the audio signal based on the volume signal. Flow proceeds to a state **1010** where the receiver module provides the adjusted audio signal to the loudspeaker.

[**0092**] FIGS. **11-14** illustrate embodiments of the communication system that are configured to utilize an infrared (IR) transmission and reception technique to communicate within the network. However, the communication system is not so limited. Other exemplary transmission and reception techniques that are within the scope of the invention comprise wireless, powerline, RF, and wired techniques. Thus, the following description equally applies to communication systems that use techniques besides IR as well as communication systems that use a combination of techniques within the network.

[**0093**] FIG. **11** is a block diagram of one embodiment of a communication system showing an infrared (IR) transmitter **1101** and a loudspeaker **1115** connected using an IR network. The IR transmitter **1101** is configured to combine an audio signal **1103** and a control signal **1105**. Alternatively, the control signal **1105** is sensed via the audio signal **1103**. The IR transmitter **1101** can include one or more diodes **1107**. The diode **1107** is configured to transmit the combined signal in the infrared spectrum of electromagnetic radiation. In one embodiment, the combined signal is transmitted via the IR network to the loudspeaker **1115**.

[**0094**] The loudspeaker **1115** can be coupled to a housing **1200**. The housing includes one or more receiver components **1140**, an IR detector **1111**, and a power supply **1113**. The receiver components **1140** are configured to receive the combined signal that is transmitted by the IR transmitter **1101**. The receiver components **1140** provide the received combined signal to the loudspeaker **1115**. As illustrated in FIG. **11**, the housing **1200** includes one IR detector **1111**. However, the housing can include additional IR detectors **1111**. The IR detector **1111** is configured to receive the transmitted combined signal from the IR transmitter **1101**. In another embodiment, the receiver components **1140** and the IR detector **1111** are incorporated within the loudspeaker **1115**. In such a configuration, the IR detector **1111** can be incorporated into the external surface of the loudspeaker **1115**. In still another embodiment, the IR detector **1111** is located external to the loudspeaker and coupled through the loudspeaker **1115** to internal receiver components.

[**0095**] In one embodiment, the IR transmitter **1101** is coupled to a headphone **1117** via the IR network. In this configuration, the IR transmitter **1101** transmits the combined signal via the diode **1107** to the headphone **1117**. The transmitter is configured with a switch **1122** to create an address to enable operation of the speakers or headphones. For example, when the switch **1122** is set to headphones, only the headphones will play. When the switch **1122** is set to speakers, only the speakers receiving the audio signal will play. The switching can be accomplished by many alternative means such as by creating an address that will be transmitted along with the audio signal. The headphone **1117** can include receiver components **1119**, one or more detectors **1120**, and one or more loudspeakers **1121**. The detector **1120** is configured to receive the combined signal from the IR transmitter **1101**. The detector **1120** further provides the combined signal to the receiver components **1119**. In one embodiment, a housing for the receiver components **1119** is shaped like a pyramid with detectors **1120** located on each of its four sides. In one embodiment, the receiver components **1119** are combined with the loudspeaker **1121** of the headphone **1117**. As will be recognized by one skilled in the art, various combinations of these components can be selected while staying within the scope of the invention.

[**0096**] As explained above with reference to FIG. **1**, the IR network of FIG. **11** can provide the combined signal to the loudspeaker **1115** and/or the headphone **1117** for a listener's enjoyment. In one embodiment, the receiver components of the system **1109** manipulates the audio signal portion of the

combined signal based on the associated control signal prior to the audio signal's broadcast by the loudspeaker **1115**. Similarly, the receiver components **1119** of the headphone **1117** can manipulate the audio signal portion of the combined signal based on the associated control signal prior to the audio signal's broadcast via the loudspeaker **1121** to the user.

[**0097**] FIG. **11**A is a block diagram of receiver components **1140** which can be located in a surround or speaker enclosure. The receiver components **1140** can comprise an IR receiver **1109**, a DSP module **516** for multiple channels, an amplifier module **520**, and power stage modules **522** for one or more surround or speaker channels. The IR receiver **1109** receives the transmitted audio signal from the IR detector **1111**. The DSP module **516** processes the audio signal using any control information that was transmitted with the audio signal. The DSP module **516** can further enhance the signal using signal processing techniques known in the art. The amplifier module **520** can be configured as a pulse width modulation (PWM) converter/amplifier driven directly from a digital input from the DAP/DSP. The power stage modules **522** receive the audio power signal from the amplifier module **520** and provides the audio signal to the audio output lines **1205**, **1207**. The audio output lines provide the manipulated audio signal to one or more surround or speaker enclosures. The surround or speaker enclosure and associated receiver components **1140** can be configured to operate in mono or stereo depending on the system requirements.

[**0098**] FIG. **11**B is a diagram showing multiple embodiments of a housing or speaker **1150** and associated receiver components **1140** from FIG. **11**A. One embodiment of the speaker is a housing for a surround speaker. However, as illustrated in FIGS. **11**B(**1**)-(**5**), the invention is not so limited. In the embodiment illustrated by FIG. **11**B(**1**), the receiver components **1140** are mounted inside a speaker enclosure **1150**. This enclosure can be any speaker. In the embodiment illustrated by FIG. **11**B(**2**), the receiver components are mounted inside a stereo speaker **1150**, all in one housing. One or more of the receiver components **1140** are mounted inside the enclosure. The receiver components may include signal processing techniques to enhance the audio signal to give the listener the impression of a wider separation of sound.

[**0099**] In the embodiment illustrated by FIG. **11**B(**3**), the receiver components **1140** are mounted in various possible locations within a speaker stand. This embodiment integrates the stand and the receiver components. A user can advantageously select any standard speaker to receive the audio signal from receiver speaker outputs. The stand can be configured to operate in a mono or stereo mode. In the embodiment illustrated by FIG. **11**B(**4**), the housing for the receiver is incorporated in a speaker wall mount. In this embodiment, the receiver housing, mount, and receiver components are integrated. As explained above with FIG. **11**B(**3**), any standard speaker receives the audio signal from the receiver speaker outputs and is further mounted on the bracket. In the embodiment illustrated by FIG. **11**B(**5**), the housing for the receiver components is wall mounted, floor mounted or mounted on a speaker. As explained above with FIG. **11**B(**3**), any standard speaker receives the audio signal from the receiver speaker outputs.

[**0100**] The embodiments of FIG. **11**B(**1**) and FIG. **11**B(**2**) form complete speaker systems where the receiver components are integral with the speaker. The embodiments of FIGS. **11**B(**3**), **11**B(**4**) and **11**B(**5**) are adapter systems which allow the user to transform any speaker system into a wireless system. This advantageously allows the user to incorporate the receiver components disclosed herein with a home entertainment system's pre-existing loudspeakers. Moreover, should the user decide to purchase new loudspeakers, the user may select from a myriad of speaker manufacturers and speaker designs for attachment to the receiver components.

[**0101**] The receiver components **1140** illustrated in FIGS. **11**B(**1**) and **11**B(**2**) can be configured to operate in a stereo or mono mode. In a preferred embodiment, the receiver components **1140** comprise the receiver module **1109**, PWM amplifier **520**, power stage modules **522**, and power supply. The receiver components **1140** may or may not include DSP **516** and signal processing depending on the application.

[**0102**] The transmitter which transmits the audio signal to the loudspeakers shown in FIG. **11**B can be mounted inside another speaker. For example, the transmitting speaker can be a center channel or other speaker. This is most likely to be a center channel for IR networks but alternatively, the subwoofer loudspeaker, left loudspeaker, right loudspeaker, effects loudspeaker, surround/satellite loudspeaker and the like is used instead of the center channel speaker. In an embodiment where the IR transmitter **1101** is located in a center loudspeaker, the IR transmitter **1101** transmits the signal to the surround or satellite loudspeakers or subwoofer. The transmitter may be combined with one or more digital amplifiers which will be described with reference to FIG. **11**C.

[**0103**] FIGS. **11**C and **11**D are block diagrams of audio, control, and video signal paths through components of home entertainment systems. The home entertainment systems receive one or more input signals from an input device **102**. Types of input signals can include, for example, audio, video, textual, and control signals. These signals can originate from one or more input devices **102** depending on the type of input signal. For example, a digital video disk (DVD) provides an audio signal and a video signal to the home entertainment system. For ease of explanation, the following description uses an audio signal and a video signal as exemplary input signals to the home entertainment systems. However, the communication system **100** is not so limited and can be used with textual and any other information signal. Examples of input devices **102** that generate an audio signal include a personal computer, DVD player, a stereo receiver, MP3 player, compact disk (CD) player, digital audio tape (DAT), TV, cable set top, satellite set top, media center, network client, and the like. DVD audio signals can include, for example, dolby digital and/or DTS digital signals.

[**0104**] Examples of input devices **102** that generate a video signal include a DVD player, laserdisc player, camcorders, VHS player, and the like. Examples of control signals include, volume level, fader level, balance level, sub-bass level, destination source, sound processing selection, equalizer levels, power on, power off, or any other manipulation of the audio signal.

[**0105**] Each of the home entertainment systems illustrated in FIGS. **11**C and **11**D comprises a housing for a center channel loudspeaker **1142**(*a*), **1142**(*b*). The embodiments of the center channel loudspeaker **1142**(*a*), **1142**(*b*) illustrated in FIGS. **11**C and **11**D comprise different components which are arranged within the housing for each respective center

channel loudspeaker **1142**(*a*), **1142**(*b*). The embodiment of the center channel loudspeaker **1142**(*a*) illustrated in FIG. **11**C receives one or more input signals from an input device **102** that is external to the center channel loudspeaker **1142**(*a*) housing. The connection between the input device **102** and the center channel loudspeaker **1142** can utilized digital or analog specialty cable. The specialty cable combines the signals from the input device **102** into a single cable. The single cable can connect to the rear panel of the input device **102**. In contrast, the embodiment of the center channel loudspeaker **1142**(*b*) illustrated in FIG. **11**D receives one or more input signals from an input source that is internal to the center channel loudspeaker **1142**(*b*) housing. Therefore, the center channel loudspeaker **1142**(*b*) can include loudspeakers, transmitters, a personal computer, a DVD player, a stereo receiver, a MP3 player, a compact disk (CD) player, a digital audio tape (DAT), a TV, a cable set top, a satellite set top, a media center, a network client, and the like.

[**0106**] Each home entertainment system can further comprise a TV, video monitor, or other display device **1145** for displaying one or more of the input signals. For example, the display device **1145** can display a video signal from the input device **102** when the input device is a DVD player. Continuing with this example, the audio signal associated with the video signal is processed by the center channel loudspeaker **1142**(*a*), **1142**(*b*) and transmitted to a remote loudspeaker. Textual information can also be displayed on the display device **1145**. For example, information related to an audio signal (song title, artist, track order, elapsed time and other information) can be displayed on the display device **1145**.

[**0107**] The display device **1145** can be connected directly to the input device **102** or, as illustrated in FIGS. **11**C and **11**D, indirectly to the input device **102** via the center channel loudspeaker **1142**(*a*), **1142**(*b*). The connection between the display device **1145** and the center channel loudspeaker **1142**(*a*), **1142**(*b*) or input device **102** can be wired or wireless. Since the center channel loudspeaker **1142**(*a*), **1142**(*b*) is advantageously located near the display device **1145**, ease of installation is enhanced by routing the video signal together with one or more other signals to the center channel loudspeaker **1142**(*a*), **1142**(*b*). However, as explained above, the invention is not limited to the video signal routing illustrated in FIGS. **11**C and **11**D.

[**0108**] The components of the center channel loudspeaker **1142**(*a*)/**1142**(*b*) may comprise a DSP module **516** for multiple channels, a PWM converter/amplifier module **520**, a power stage module **522** for the center channel, and an IR transmitter **1101**. Depending on the channel format available from the source **102**, the DSP processes the audio signal into the selected channel configuration, such as Dolby Digital, DTS, SRS or alike. These channel formats include, for example, stereo, 2.1, 3.1, 5.1, 6.1 and 7.1 and the like. The DSP may further process control information such as equalizer information, volume or other signal processing information.

[**0109**] The input device **102** may select from one or more surround sound formats for the audio signal associated with a selected DVD. The one or more surround sound formats may each have a different number of channels or the same number of channels.

[**0110**] Each of the multiple channels or audio tracks can be a discrete audio channel or a virtual audio channel. Discrete audio channels are unique channels with respect to the other channels received from the same input source **102** and are not derived from the other channels. Virtual or derived audio channels are created from the other channels. An exemplary virtual surround sound format is Sound Retrieval System (SRS). SRS make use of only a left channel and a right channel to create an acoustic effect which emulates a surround sound format. A DVD encoded with a 5.1 channel configuration may employ, for example, a dolby digital format or a DTS format. As explained below, dolby digital as well as DTS each may include discrete channels or a combination of discrete and virtual channels.

[**0111**] Dolby digital 5.1 is a surround sound format which provides up to five discrete (independent) channels (center channel, left front, right front, surround left, surround right; giving it the "5" designation) of full frequency effects (for example, from 20 Hz to 20,000 Hz). The center loudspeaker is placed at the front center of the audio listening area. The center channel is often aligned with a vertical axis that passes through the center of the display device **1145**. In this way, the center channel is preferably located above or below the display device **1145**. The left and right front loudspeakers are placed on both sides of the center channel loudspeaker. The surround left and surround right loudspeakers are placed on respective sides of the audio listening area. Thus, five discrete loudspeakers are located around the audio listening area for reproducing five discrete channels.

[**0112**] A dolby digital 5.1 signal further includes an optional sixth channel dedicated for low frequency effects (LFE). A subwoofer loudspeaker is often included in the audio listening area and is specifically designed to reproduce LFE. The LFE channel gives dolby digital the "0.1" designation. The "0.1" signifies that the sixth channel is not full frequency, as it contains only deep bass frequencies (for example, 20 Hz to 120 Hz). Many DVD titles come with a dolby digital 5.1 audio signal. Other variants of dolby digital include mono (dolby digital 1.0), two channel dolby digital (stereo or dolby digital 2.0), and five channels of audio (dolby digital). DTS Digital Surround (a.k.a. DTS) is another 5.1 channel configuration format.

[**0113**] Depending on the audio signal, the DSP module **516** may decode a hybrid 5.1 channel configuration format. Hybrid 5.1 channel configurations include, for example, THX Surround EX (a.k.a. dolby digital EX) and DTS Extended Surround (DTS-ES). THX Surround EX is the extended surround version of dolby digital 5.1, while DTS-ES is the extended surround version of DTS 5.1. These hybrid 5.1 channel configurations differ from their true 5.1 counterparts in that the hybrids derive or create a sixth full frequency channel or surround back channel from the existing channels. THX Surround EX and DTS-ES create the surround back channel from the surround left and surround right channels. Thus, the surround back channel is not a true discrete channel. This surround back channel is properly located behind the audio listening area.

[**0114**] Unlike the format described above, DTS-ES discrete 6.1 is a true 6.1 channel format. DTS-ES 6.1 supports a discrete surround back channel. Thus, the DSP module **516** decodes a surround back channel from a discrete data stream that is independent from those of the surround left and surround right channels. This surround back channel may be utilized with two surround back channel loudspeakers. Each

back channel loudspeaker can be spaced symmetrically behind the audio listening area. Since DTS-ES 6.1 only provides six discrete full frequency channels and one LFE channel, an audio listening area employing two surround back channels loudspeakers has a hybrid 6.1 channel configuration.

[0115] In the embodiment illustrated in FIGS. **11**C and **11**D, the receiver components **1142** further comprise power stage modules **524**(*b*)-(*n*) for other audio channels in addition to the amplifier for the center channel. In some embodiments, for example, the receiver components **1142** comprise power stage modules for the subwoofer loudspeaker, left loudspeaker, right loudspeaker, effects loudspeaker, surround/satellite loudspeaker and the like.

[0116] For example, depending on the channel format desired, a corresponding number of distinct loudspeakers and channels of amplification may be employed. Amplification for each discrete channel may be performed in separate amplifiers. Amplification may be employed in a different loudspeaker than the designated loudspeaker, for example, the center channel loudspeaker **1142**(*a*) can amplify the left front channel. Alternatively, the amplification may be performed in the designated loudspeaker. Due to the high power requirements to reproduce low frequency effects, amplification of the LFE (0.1 designation) subwoofer channel can be performed separately from amplification of the other full frequency channels. However, such an arrangement is not required to practice the invention.

[0117] In operation, the receiver components **1142** receive an input signal from the input device **102**. The input signal can be in the form of a digital or analog signal. The input signal(s) is provided to the receiver components **1142** via connector interface **204**. When the input signal comprises a video signal, the video signal is routed through the center channel loudspeaker **1142** and to the display device **1145**. The audio signal is routed to the DSP module **516**. The DSP module **516** processes the input signal for one or more of the channels. As shown in the embodiments of FIGS. **11**C and **11**D, the DSP module **516** may process the input signals for all the channels, some of the channels or none of the channels.

[0118] A series of jumpers or switches **1122** allows the input signals for the loudspeakers to be either processed by the DSP module **516**, sent directly to PWM or transmitted to the loudspeakers. The center channel loudspeaker **1142** illustrated in FIGS. **11**C and **11**D provides audio channel signals to the power stage modules **524**(*b*)-(*n*). FIGS. **11**C and **11**D illustrate five power stage modules **524**(*b*)-(*n*). In other embodiments, more or less power stage modules **524**(*b*)-(*n*) may be used depending on the number of channels that are amplified by the center channel loudspeaker **1142**. The center channel loudspeaker **1142** illustrated in FIGS. **11**C and **11**D further provides two audio channels to the IR transmitter **1101**. The two channels provided to the IR transmitter **1101** are wireless transmitted to the loudspeakers **1144**(*a*), **1144**(*b*). The wireless transmission technique may utilize, for example, RF or an IR transmitter **1101**. The IR transmitter **1101** is configured to transmit the combined signal to one or more loudspeakers **1144**(*a*)-(*b*). Each IR transmitter **101** can transmit one channel or multiple channels. Alternatively, multiple IR transmitters **1101** are utilized to transmit the audio channels.

[0119] In other embodiments, the center channel loudspeaker **1142** amplifies fewer audio channels and thus may require fewer power stage modules **524**(*b*)-(*n*). In such embodiments, the non-amplified audio channels are wirelessly transmitted to loudspeakers in addition to the loudspeakers **1144**(*a*), **1144**(*b*) that are illustrated in FIGS. **11**C and **11**D as receiving a wireless audio signal.

[0120] This other loudspeaker can be a surround loudspeaker, multiple surround loudspeakers, or other speaker. Typically, it is advantageous to transmit to loudspeakers other than left, right, or center in a surround sound system described above. In the embodiment illustrated in FIG. **11**C, the IR transmitter **1101** in the center channel loudspeaker encodes and transmits a signal to the surround or satellite loudspeakers via an infrared network. Alternatively, the IR transmitter **1101** in the center channel loudspeaker transmits the combined signal via powerline, RF, wireless, or a wired network to the surround or satellite loudspeakers.

[0121] The amplifier module **520** is coupled to the DSP module **516** and receives the audio signal. The amplifier module **520** converts the audio signal to a pulse width modulation (PWM) signal. The PWM signal is amplified by the power stage **522**. The amplified signal is broadcast via outputs **524**(*a*)-(*n*).

[0122] FIG. **11**E is a front view of the display device **1145** from FIG. **11**D arranged adjacent to the center channel loudspeaker **1142**(*b*) from FIG. **11**D. A left front loudspeaker **1143**(*a*) and a right front loudspeaker **1143**(*b*) are further illustrated in FIG. **11**E. The left front loudspeaker **1143**(*a*) is located below the display device **1145** and to the left side of the center channel loudspeaker **1142**(*b*). The right front loudspeaker **1143**(*b*) is located below the display device **1145** and to the right side of the center channel loudspeaker **1142**(*b*). As described above with reference to FIG. **11**D, the center channel loudspeaker **1142**(*b*) comprises an input device **102** which is internal to the housing for the center channel loudspeaker **1142**(*b*). In the embodiment, illustrated in FIG. **11**E, the input device **102** is a DVD player. Examples of other input devices **102** include a personal computer, a stereo receiver, MP3 player, compact disk (CD) player, digital audio tape (DAT), and the like.

[0123] FIG. **12** is a perspective view of a housing **1200** for the receiver components **1140** described in FIG. **11**A. As shown in FIG. **12**, the housing **1200** can include two detectors **1111**(*a*), (*b*) and a power supply **1113** as described with reference to FIG. **11**. Detectors can be located on the same or different surfaces of the IR receiver **1109**. For example, the embodiment shown in FIG. **12** further includes detector **1201** on a different surface of the housing **1200**. By locating one or more detectors **1111**, **1201** on different surfaces of the housing **1200**, the IR receiver can receive the transmitted combined signal from the IR transmitter **1101** from more than one direction. The housing **1200** can further include audio output lines **1205**, **1207**. The audio output lines provide the manipulated audio signal to one or more loudspeakers **1115** (see FIG. **11**). In one embodiment, the housing **1200** includes a female or male fastener **1203** for mounting the housing **1200** to a speaker bracket. The housing **1200** can further include mounting holes **1209**. The mounting holes **1209** allow the housing **1200** to be mounted inside or outside of the loudspeaker **1115**.

[0124] FIG. **13** is a block diagram of one embodiment of the IR transmitter **1101** shown in FIG. **11**. The IR transmitter **1101** can be configured to receive, format, and transmit a

combined signal via the IR network. The IR transmitter **1101** can comprise an audio input connector **204**, a signal processing module **1301**, a volume sensor analog-to-digital converter (A/D) **206**, and an IR encoder/transmitter module **1305**. The audio input connector **204** is the same as described with reference to FIG. **2** except that the audio input connector can additionally or alternatively comprise a speaker-level input connector **1302**. The speaker-level input connector **1302** allows the IR transmitter **1101** to receive speaker level analog signals and line level analog signals. The volume sensor **206** is the same as described with reference to FIG. **2**. The volume sensor analog-to-digital converter (A/D) **206** can be coupled to the signal processing module **1301**. The IR encoder **1305** is further connected to transmitting diodes **1107**(*a*)-(*n*).

[**0125**] The signal processing module **1301** can include an 8-bit processor **218**, a digital signal processor **1303**, and a destination source switch **221**. The 8-bit processor **218** and the destination source switch **221** are the same as described with reference to FIG. **2**. The digital signal processor **1303** can be configured to decode algorithms, for example, DTS, Dolby, Dolby Digital, and perform pre-processing before transmission by the IR transmitter **1101**. The signal processing module **1301** provides the control signal and the audio signal to the IR encoder **1305**. The IR encoder **1305** combines the audio signal and the control signal for its transmission via, for example, the diode **1107**. In one embodiment, the DSP is configured to process and encode the control signal and the audio signal. For example, the address of the destination receiver module can be encoded by the DSP. In this embodiment, the destination source switch **221** is not utilized.

[**0126**] FIG. **14** is a block diagram of audio and control signal paths through an embodiment of the receiver components **1140** from FIG. **11**. For ease of explanation, the following describes the IR receiver components **1140**. However, the following description also applies to the headphone embodiment of the IR receiver **1119**. The receiver components **1140** are configured to receive and decode the combined signal received via the IR network. The receiver components **1140** can be further configured to manipulate and amplify the audio signal and then broadcast the amplified signal. One embodiment of the receiver components **1140** includes optical detector **1111**(*a*)-(*n*), IR receiver **1109**, and an amplifier module **514**.

[**0127**] The detector **1111** is configured to receive the combined signal transmitted by the IR transmitter **1101** (see FIG. **11**). The detector **1111** provides the combined signal to the IR receiver **1109**. As shown in FIG. **14**, the combined signal can be in an I^2S format. Other formats for transmitting the combined signal are within the scope of the invention. The IR receiver **1109** receives the combined signal via the detector **1111**. The decoder/receiver **1109** is configured to decode and extract the audio signal from the control signal. In embodiments where an address corresponding to a destination receiver is transmitted, the extracted signals are only provided to the amplifier module **514** of the destination receiver. In one embodiment, the 8-bit processor **218** is configured to receive the address and determine whether its associated received corresponds to the address. If the address does not correspond, the receiver will enter a standby mode and not amplify the signal. Thus, depending on whether the address corresponds to the receiver receiving the signal, that receiver can be enabled and amplify the signal, or disabled and not amplify the signal. In one embodiment, the receiver components **1140** time out in response to not receiving their address for a period of time and power down to a standby mode. If the transmitted address changes and corresponds to the receiver components **1140** in standby mode, the receiver will be enabled, power up, and play.

[**0128**] The amplifier **514** receives the extracted audio signal and control signal from the IR receiver **1109**. The amplifier **514** is configured to manipulate and amplify the audio signal and then broadcast the amplified signal. The amplifier **514** can include, for example, a digital signal processor module **516**, an amplifier module **520**, a power stage module **522**(*a*)-(*b*), and outputs **524**, **526**. The components of the amplifier **514** are the same as described above with reference to FIG. **5**.

[**0129**] The foregoing description details certain preferred embodiments of the present invention and describes the best mode contemplated. It will be appreciated, however, that no matter how detailed the foregoing appears in text, the invention can be practiced in many ways. The embodiments of the receivers herein disclosed can be fixed or modular in design. For example, the digital amplifier can be designed for a DSP/DAP to plug into a digital bus. For a modular design, the receiver is configured to connect via Ethernet, wireless, wired, powerline, infrared, and/or RF through a common bus. Examples of common bus designs include I^2S, I^2C, parallel, and serial.

[**0130**] As is also stated above, it should be noted that the use of particular terminology when describing certain features or aspects of the present invention should not be taken to imply that the terminology is being re-defined herein to be restricted to including any specific characteristics of the features or aspects of the invention with which that terminology is associated. The scope of the present invention should therefore be construed in accordance with the appended claims and any equivalents thereof.

What is claimed is:

1.-**20**. (canceled)

21. A system for transmitting signals to speakers, the device comprising:

a user interface configured to receive a user input; and

a first speaker comprising:

an audio input configured to receive a multi-channel audio signal from at least one input device, the received multi-channel audio signal comprising a plurality of single-channel audio signals;

a processor configured to decode the received multi-channel audio signal to form at least a first audio signal and a second audio signal, each of the first and second audio signals being based on at least one of the plurality of single-channel audio signals;

an amplifier module configured to amplify the first audio signal;

a driver configured to output only the first audio signal; and

a transmitter configured to transmit the second audio signal and further configured to transmit data indicative of the user input to a second speaker via a wireless

interface, wherein the user input is configured to control playback of the second audio signal by at least the second speaker.

22. The system of claim 21, wherein the second audio signal comprises a plurality of channels.

23. The system of claim 21, wherein the user input is configured to control a volume of the second audio signal but not the first audio signal.

24. The system of claim 21, wherein the user input is configured to control a volume of the second audio signal and the first audio signal.

25. The system of claim 21, wherein the user input is configured to control a volume of a first channel of the second audio signal but not a second channel of the second audio signal.

26. The system of claim 21, wherein the user input is configured to control a volume of a first channel of the second audio signal and a second channel of the second audio signal.

27. The system of claim 21, wherein the multi-channel audio signal is encoded in one of the following channel format: DTS, Dolby Digital, and SRS.

28. The system of claim 21 further comprising a plurality of connectors and an input selector, wherein at least two of the connectors connect to different devices, and wherein the input selector is reconfigurable by a user to select one of the plurality of connectors from which to receive the multi-channel audio signal.

29. The system of claim 21, wherein the user interface comprises a controller separate from the first speaker.

30. The system of claim 29, wherein the transmitter transmits via a first network and the controller operates via a second network that is different than the first network.

31. The system of claim 29, wherein the transmitter transmits via a first network and the controller operates via the first network.

32. The system of claim 21, wherein the user interface is disposed in the first speaker.

33. The system of claim 21, wherein the user input is configured to control at least one of the following: a volume level, a balance level, a fader level, a sub-bass level, destination, source, sound processing selection, and equalizer levels.

34. The system of claim 21, wherein the second speaker comprises a subwoofer or a surround speaker.

35. A system for transmitting signals to speakers, the device comprising:

a user interface configured to receive a user input; and

a first speaker comprising:

an audio input configured to receive a multi-channel audio signal from at least one input device, the received multi-channel audio signal comprising a plurality of single-channel audio signals;

a processor configured to decode the received multi-channel audio signal to form at least a first audio signal and a second audio signal, each of the first and second audio signals being based on at least one of the plurality of single-channel audio signals;

an amplifier module configured to amplify the first audio signal;

a driver configured to output only the first audio signal; and

a transmitter configured to:

transmit the second audio signal;

transmit data indicative of the user input to a second speaker via a network, wherein the user input is configured to control playback of the second audio signal by at least the second speaker; and

transmit destination data that indicates selection of at least the second speaker to produce output based on the second audio signal.

36. The system of claim 35, wherein the second audio signal comprises a plurality of channels.

37. A system for transmitting signals to speakers, the device comprising:

a user interface configured to receive a user input; and

a first speaker comprising:

an audio input configured to receive a multi-channel audio signal from at least one input device, the received multi-channel audio signal comprising a plurality of single-channel audio signals;

a processor configured to decode the received multi-channel audio signal to form at least a first audio signal and a second audio signal, each of the first and second audio signals being based on at least one of the plurality of single-channel audio signals;

an amplifier module configured to amplify the first audio signal;

a driver configured to output only the first audio signal; and

a transmitter configured to:

transmit the second audio signal; and

transmit destination data that indicates selection of at least the second speaker to produce output based on the second audio signal, wherein the destination data is based on the user input.

38. A device for transmitting signals to speakers, the device comprising:

at least one input receiving a multi-channel audio signal from at least one input device, the multi-channel audio signal being encoded in a channel format having multiple channels;

a processor converting the received multi-channel audio signal into a plurality of single-channel audio signals, each single-channel audio signal representing at least a portion of one of the multiple channels and being assigned to either a first group or a second group of audio signals, each group comprising at least one of the single-channel audio signals;

a power amplifier module configured to amplify only the first group of audio signals;

a transmitter configured to transmit the unamplified second group of audio signals and at least one destination address to a plurality of speakers via a network, the destination address identifying one of the plurality of speakers for broadcasting at least one of the audio signals in the second group; and

a destination address input configured to receive an user input to select one of the speakers for broadcasting the at

least one of the audio signals, wherein the destination address is determined based on the user input.

39. The device of claim 38, wherein the transmitter is connected to the plurality of speakers via a powerline network.

40. The device of claim 38, wherein the transmitter is connected to the plurality of speakers via a wireless network.

41. The device of claim 40, wherein the network is RF.

42. The device of claim 40, wherein the network is IR.

43. The device of claim 38, wherein the input is further configured to receive a textual signal and wherein the transmitter is configured to send the textual signal to a display device.

44. The device of claim 38, wherein the processor is further connected to a display device configured to be a user interface for the processor.

45. The device of claim 38, wherein the input is further configured to receive a video signal and wherein the transmitter is configured to send the video signal to a display device.

46. The device of claim 38, wherein the input is configured to receive an analog signal, wherein the device further comprises a converter configured to convert the analog signal into a digital signal.

47. The device of claim 38, wherein the audio signal is encoded in one of the following channel format: DTS, Dolby Digital, and SRS.

48. The device of claim 38, wherein the processor is configured to decode the audio signal and select the one speaker for broadcasting the at least one of the audio signals in the second group based on a channel format of the audio signal.

49. The device of claim 38, wherein the destination address is determined based on user input.

50. The device of claim 38 further comprising a plurality of connectors and an input selector, wherein at least two of the connectors are configured to connect to different devices, and wherein the input selector is reconfigurable by a user to select one of the connectors and receive an audio signal from the selected connector.

51. The device of claim 50, wherein the connectors are configured to connect to at least one of the following inputs: analog, digital, SPDIF, and an inter IC sound (I^2S) format.

52. The device of claim 51, wherein the device is located inside or proximate to at least one of the following input devices: a television, a compact disc player, a digital video disc player, a MP3 player, a set-top box, a personal computer, a stereo receiver, a right speaker, a left speaker, a subwoofer, a center channel speaker, media center, network client, digital audio tape player, satellite set top, and cable set top.

53. The device of claim 38, wherein the processor is configured to (a) extract a characteristic from the audio signal, (b) code the characteristic into a control signal, (c) combine the second group of audio signals with the control signal to form a combined signal, and (d) send the combined signal to the transmitter, and wherein the transmitter sends the combined signal along with the destination address to the speakers.

54. The device of claim 53, wherein the control signal comprises at least one of the following: a volume level, a balance level, a fader level, and a sub-bass level.

55. The device of claim 38, wherein the transmitter is configured to transmit a combined signal comprising a control signal and the second group of audio signals.

56. The device of claim 55, wherein the control signal comprises at least one of the following: a sound processing selection, an equalizer level, a power on, a power off, a time delay, a phase, delay destination, source, and address.

57. The device of claim 38, wherein the plurality of speakers comprises a subwoofer.

58. The device of claim 38, wherein the plurality of speakers comprises a surround speaker.

59. The device of claim 38, wherein the transmitter further comprises an encryption module configured to encrypt the output signal prior to transmission.

60. The device of claim 38, wherein the second group of audio signals comprises a first and a second signal different from the first signal, wherein the transmitter transmits the first signal for a first speaker to broadcast and the second signal for a second speaker to broadcast, the first and second speaker being selected from the plurality of speakers.

61. The device of claim 38 further comprising a control input receiving control signal from a user, wherein the processor generates the second group of audio signals based on the control signal from a user.

62. The device of claim 38, wherein the transmitter is connected to a speaker via a receiver within or proximate to the speaker.

63. A device for transmitting signals to speakers, the device comprising:

means for receiving a multi-channel audio signal from at least one input device, the multi-channel audio signal being encoded in a channel format having multiple channels;

means for converting the received multi-channel audio signal into a plurality of single-channel audio signals, each single-channel signal representing at least a portion of one of the multiple channels and being assigned to either a first group or a second group of audio signals, each group comprising at least one of the single-channel audio signals;

means for amplifying only the first group of audio signals; and

a transmitter configured to transmit the unamplified second group of audio signals and at least one destination address to a plurality of speakers, via a network, the destination address identifying one of the plurality of speakers for broadcasting at least one of the audio signals in the second group; and

a destination address input configured to receive an user input to select one of the speakers for broadcasting the at least one of the audio signals, wherein the destination address is determined based on the user input.

64. A device comprising:

at least one input receiving a multi-channel audio signal from at least one input device, the multi-channel audio signal being encoded in a channel format having multiple channels;

a processor configured to decode the received multi-channel audio signal into a plurality of single-channel audio signals, each single-channel audio signal representing at least a portion of one of the multiple channels and being assigned to either a first group or a second group of audio signals, each group comprising at least one of the single-channel audio signals;

a power amplifier module configured to amplify only the first group of audio signals received from the processor; and

a transmitter configured to transmit the unamplified second group of audio signals and at least one control signal and one destination address to a plurality of speakers via a network, the destination address identifying one of the plurality of speakers for broadcasting at least one of the audio signals in the second group, wherein the control signal is to be used by the speaker to manipulate at least one of the audio signals in the unamplified second group; and

a destination address input configured to receive an user input to select one of the speakers for broadcasting the at least one of the audio signals, wherein the destination address is determined based on the user input.

65. The device of claim 64, wherein the processor is capable of converting an audio signal from any of the following group: a television, a compact disc player, a digital video disc player, a MP3 player, a digital audio tape player, a set-top box, a personal computer, a stereo player, and a media center.

66. The device of claim 64, wherein the processor is capable of converting an audio signal from at least one of the following group: a television, a compact disc player, a digital video disc player, a MP3 player, a digital audio tape player, a set-top box, a personal computer, a stereo player, and a media center.

67. The device of claim 64, wherein the transmitter is connected to a plurality of speakers via a network, the device further comprising a destination selection unit configured to select at least one speaker from the plurality of speakers to receive the output signal.

68. The device of claim 64, wherein the amplifier module is located in proximity to the transmitter.

69. The device of claim 64, wherein the control signal comprises an amplitude level indicating at which amplitude at least one of the audio signals in the second group is to be broadcasted.

70. The device of claim 64, wherein the control signal is received from a user at the device.

71. The device of claim 64, wherein the processor is configured to (a) extract a characteristic from the audio signal, (b) code the characteristic into a control signal, (c) combine at least one of the audio signals in the second group of audio signals with the control signal to form a combined signal, and (d) send the combined signal to the transmitter, and wherein the transmitter sends the combined signal to the speaker.

72. The device of claim 71, wherein the characteristic does not represent an encoding format of the received audio signal.

73. The device of claim 71, wherein the characteristic is extracted and coded into the control signal prior to the second group of audio signals and the control signal being transmitted to the speakers via the network.

* * * * *