

MUTING CIRCUIT

The present invention relates to a muting circuit for eliminating transients. Illustrative embodiments of the invention concern an audio signal processing system in a television receiver or the like arranged to suppress the audible effects of transients produced when the system is energized or de-energized.

In an audio-frequency amplifier, sound is sometimes generated from a loudspeaker of the system when the system is energized and de-energized. Upon turn-on or turn-off of the TV receiver, radio receiver, or the like, the audio circuit may produce a very noticeable "pop" or "click" despite the absence of noise at its input because of rapid transitions of potentials within the amplifier or components coupled to the amplifier due to power supply transitions. If such a phenomenon occurs in a pre-amplifier, the aforesaid sound can be greatly amplified by the power amplifier. To eliminate this source of undesirable sound or noise, it is desirable to silence or mute the signal during these transient conditions. Accordingly, the audible effects of transients associated with energization and de-energization of the system are suppressed by apparatus arranged according to the present invention.

According to one aspect of the present invention, there is provided a muting circuit for eliminating transients generated signals due to power supply turn-on and turn-off comprising : a first amplifier having a signal input terminal, a second amplifier having a signal output terminal having a DC status and DC coupled to the signal input terminal of the first amplifier by a path, a switchable power supply coupled to the second amplifier, a microprocessor for switching the power supply between an "on" state and an "off" state, said microprocessor providing a microprocessor signal indicative of the power supply status, and means AC coupled to a junction in the path and responsive to the microprocessor signal for eliminating transient signals at the junction generated by switching the power supply from one state to another state but without affecting the DC status of the junction.

According to another aspect of the present invention,

there is provided a muting circuit for eliminating transients generated sounds due to power supply turn-on and turn-off comprising:

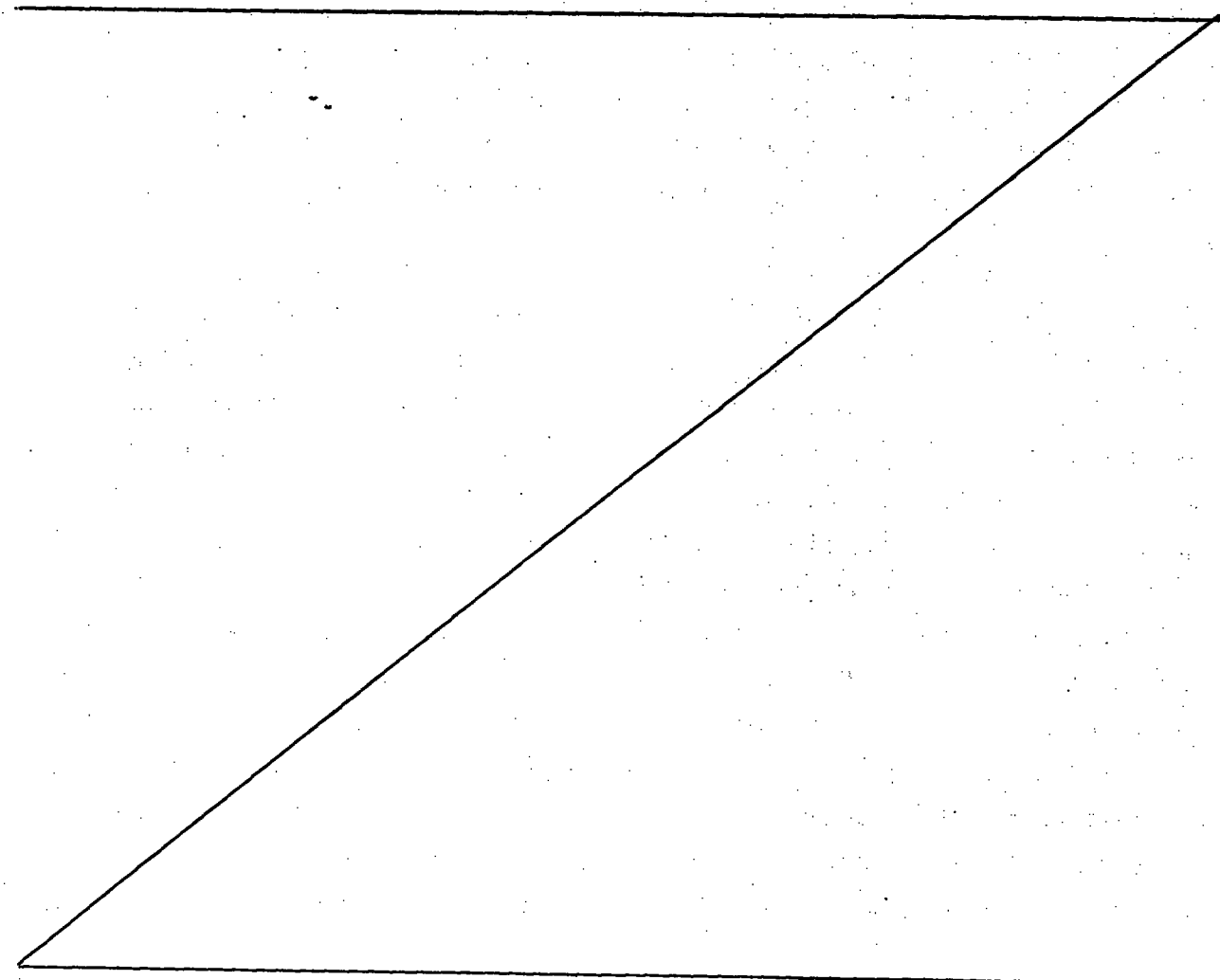
a first amplifier having a signal input terminal,

5 a second amplifier having a signal output terminal having a DC status and DC coupled to the signal input terminal of the first amplifier by a path,

10 a power supply coupled to the second amplifier, said power supply being switchable between an energized state and an unenergized state, and

means AC coupled to a junction in the path for eliminating transient signals generated by the second amplifier when the power supply is switched between states without affecting the DC status of the junction.

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Reference may be had to the accompanying drawing wherein:

Figure 1 shows, partly in block diagram form and partly in schematic form, one embodiment of a portion of an audio signal processing network of a television receiver comprising apparatus according to the present invention.

Referring now the drawing, there is shown in Figure 1 an integrated circuit (IC) source of audio signals 10 including an amplifier. In the exemplary embodiment, audio signal source

10 is an integrated circuit M52038SP which also performs intermediate frequency (IF) video and sound processing in a color television receiver, provides color processing, and provides a video signal for driving a cathode ray tube (not shown). One of the functions of IC 10 is to detect the sound from a program source and provide such an audio signal at output terminal 12.

The low level audio signals at terminal 12 require further voltage and power amplification in order to drive loudspeaker 14 or the like, and such amplification is provided by amplifier 16 which in the exemplary embodiment is a TDA2030 integrated circuit coupled to loudspeaker 14 through capacitor 18. The main power supply is controlled by microprocessor 20 which also controls other functions, e.g., X-ray protection, and remote control commands. In many microprocessor controlled television receivers, there are a plurality of power supplies including a stand-by power supply so that the receiver can respond to a remote command to turn the set "on".

Circuit 10 is powered by a main power supply controlled by microprocessor 20, which in the exemplary embodiment is a TEA2260. However, amplifier 16 is constantly powered by a "stand-by" power supply because, in the exemplary embodiment, switching power supply current to amplifier 16 would require a switch of higher current capability than is provided within microprocessor 20.

Audio signals provided at terminal 12 are DC coupled via the parallel combination of resistor 22 and capacitor 24 to node or junction 26 wherein the signal is DC coupled to non-inverting input terminal 29 of amplifier 16 via resistor 28. Amplifier 16 is provided with feedback and frequency compensation components (not shown) coupled to the inverting input terminal (not shown). In the exemplary embodiment, DC bias for

terminal 29 of amplifier 16 is provided by terminal 12 of IC 10. When the main power supply which powers circuit 10 is de-energized (turned "off") or energized (turned "on") by microprocessor 20, transient DC voltages within circuit 10 are caused to be generated by the increasing or decreasing of power supply voltages. These transient generated signals propagate through the system and are amplified as a noise emitted by loudspeaker 14.

It is desirable to eliminate this transient generated noise in a manner which does not effect the DC quiescent status of the system otherwise the transient elimination circuit will introduce its own noise into the system. To this end, the transient noise elimination circuit 30 is provided. The microprocessor 20 of the exemplary embodiment provides what is called a "standby" signal at terminal 32 which, when it goes high, indicates that the main power supply has been switched "off". This "standby" signal can be provided by other appropriate means, such as another circuit powered from the standby power supply and providing a signal responsive to the status of the main power supply.

The standby signal at terminal 32 is low-pass frequency filtered by series resistor 35 and shunt capacitor 33 and is coupled to a base electrode of NPN transistor 34. Transistor 34 has an emitter electrode coupled ground and a collector electrode coupled to a junction 39 of a resistor 36 and a capacitor 38 with the other end of resistor 36 coupled to ground and the other end of capacitor 38 coupled to node 26. In this manner, there is a signal divider between resistor 22 and resistor 36. Capacitor 38 isolates the DC voltage at junction 26 from resistor 36 and transistor 34.

With a forward bias provided at the base-emitter junction of transistor 34 by the "standby" signal, the collector-emitter impedance to ground decreases so as to present a shunt impedance of a value much lower than resistor 36, which has a value of 10K ohms. This impedance change of transistor 34 is shown by commonly published emitter-collector characteristics for bipolar transistors for a family of base currents, that shows a sloped resistor-like characteristic for low collector voltages and currents. Thus, when the "standby" signal is present, the collector-emitter circuit shunts resistor 36 changing the signal divider ratio with resistor 22 and substantially attenuating any AC signal at junction 26 for the duration of the presence of the "standby" signal. Capacitor 38 prevents any change of the DC voltage present at junction 26 due to the shunting effect of transistor 34. In

this manner, the AC signal at node 26 will be substantially attenuated without effecting the DC voltage level present at node 26.

When the main power supply is energized, the standby signal is quickly provided from the standby power supply before the main power supply capacitors have developed appreciate charge. When the main power supply is de-energized in response to a control signal initiated by microprocessor 20, the shunting effect of transistor 34 is maintained to eliminate the turn "off" transient by the charge maintained on capacitor 33 for a short time after the main power supply is powered down.

Reference is invited to copending application 9416014.0
10 GB-A-2279192 derived from this application and which relates to a muting circuit for eliminating transient generated signals due to power supply turn-on and turn-off.

CLAIMS

1. A muting circuit for eliminating transients
5 generated signals due to power supply turn-on and turn-off comprising:

a first amplifier having a signal input terminal,
a second amplifier having a signal output terminal
having a DC status and DC coupled to the signal input
10 terminal of the first amplifier by a path,

a switchable power supply coupled to the second
amplifier,

a microprocessor for switching the power supply
between an "on" state and an "off" state, said micro-
15 processor providing a microprocessor signal indicative of
the power supply status, and

means AC coupled to a junction in the path and
responsive to the microprocessor signal for eliminating
transient signals at the junction generated by switching
20 the power supply from one state to another state but
without affecting the DC status of the junction.

2. A muting circuit for eliminating transients
generated sounds due to power supply turn-on and turn-off
25 comprising;

a first amplifier having a signal input terminal,
said signal input terminal having a DC status,

a second amplifier having a signal output terminal
DC coupled to the signal input terminal of the first
30 amplifier by a path, said signal output terminal also
having said DC status;

a switchable supply coupled to the second amplifier,

a microprocessor for switching the power supply
between an "on" state and an "off" state, said micro-
35 processor providing a microprocessor signal indicative of
the power supply status, and

means AC coupled to a junction in the path and
responsive to the microprocessor signal for eliminating
transient signals at the junction generated by switching



the power supply from one state to another state, said means not affecting the DC status.

3. A muting circuit for eliminating transients generated sounds due to power supply turn-on and turn-off comprising:

a first amplifier having a signal input terminal,
a second amplifier having a signal output terminal having a DC status and DC coupled to the signal input terminal of the first amplifier by a path,
10 a power supply coupled to the second amplifier, said power supply being switchable between an energized state and an unenergized state, and
means AC coupled to a junction in the path for eliminating transient signals generated by the second
15 amplifier when the power supply is switched between states without affecting the DC status of the junction.

4. A circuit substantially as hereinbefore described with reference to Figure 1 of the accompanying drawing.