AN1743
APPLICATION NOTE

AUDIO AMPLIFIER SYSTEM USING THE ANALOG SWITCH STG3699

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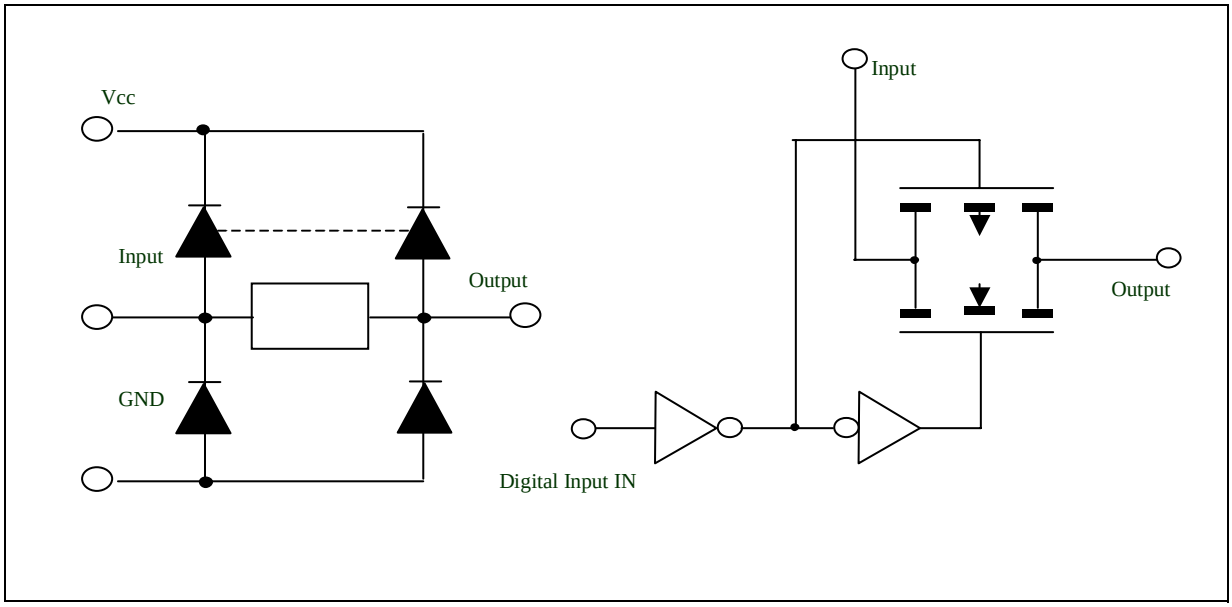
1. ABSTRACT

This application note is an explanation of the correct use of the STG3699 Analog Switch in mobile telecom applications.

2. E.S.D. PROTECTION CIRCUITRY DESCRIPTION

The STG Analog Switch can be used bi-directionally (one input/two outputs or two inputs/one output) depending on the application. Both inputs and outputs are protected from the E.S.D. discharge by a circuit that can be synthesized as four protection diodes (two versus V_{CC} and two versus GND).

Figure 1: Generic Circuit for E.S.D. Discharge Protection



To correctly use these devices it is very important to consider the presence of the protection diodes.
For example, a possible problem area is applying a wrong input level signal (input level higher than power supply). In fact, in this condition the diode versus V_{CC} is forward biased, so a current will flow from the input to V_{CC}, damaging the device or causing incorrect function of the Analog Switch.

The values of the Human Body Model discharge for the STG3699 are very good. In fact the device was good after a 3KV discharge.

The following tables show the absolute maximum rating characteristics for the STG3699 device and the correct signal level applicable to these devices to avoid possible problems.

Table 1: Absolute Maximum Rating

Symbol	Parameter	Value	Units
Vcc	Supply Voltage	-0.5 to +4.6	V
VI	DC Input Voltage	-0.5 to Vcc +0.5	V
VIC	DC Control Input Voltage	-0.5 to +4.6	V
VO	DC Output Voltage	-0.5 to Vcc +0.5	V

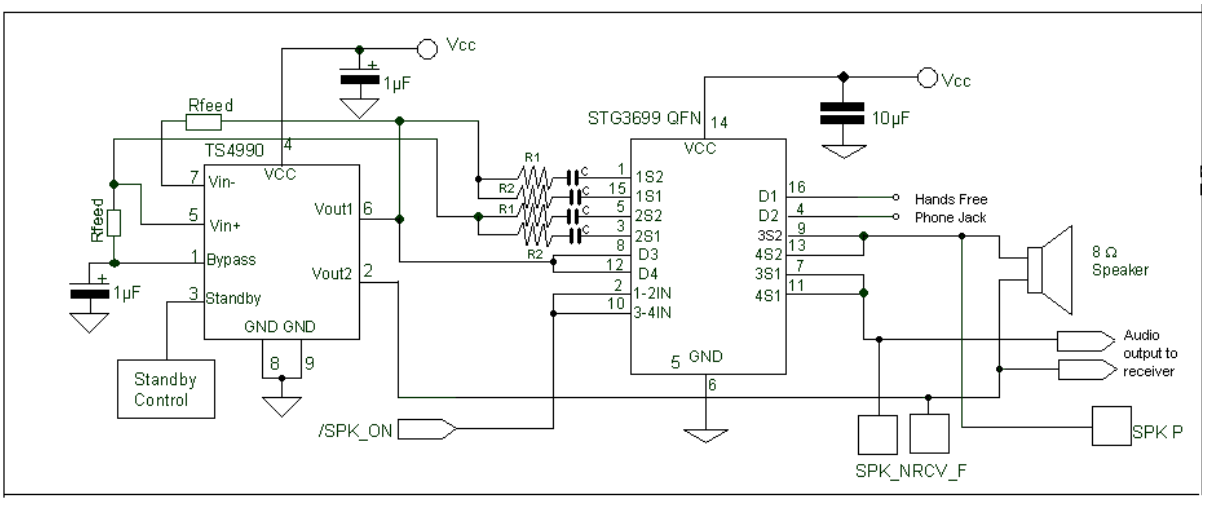
Table 2: Right Level Applicable in Operating Conditions

Symbol	Parameter	Value	Units
Vcc	Supply Voltage	1.65 to 3.6	V
VI	DC Input Voltage	≤Vcc	V
VIC	DC Control Input Voltage	≤Vcc	V
VO	DC Output Voltage	0 to Vcc	V

3. APPLICATION

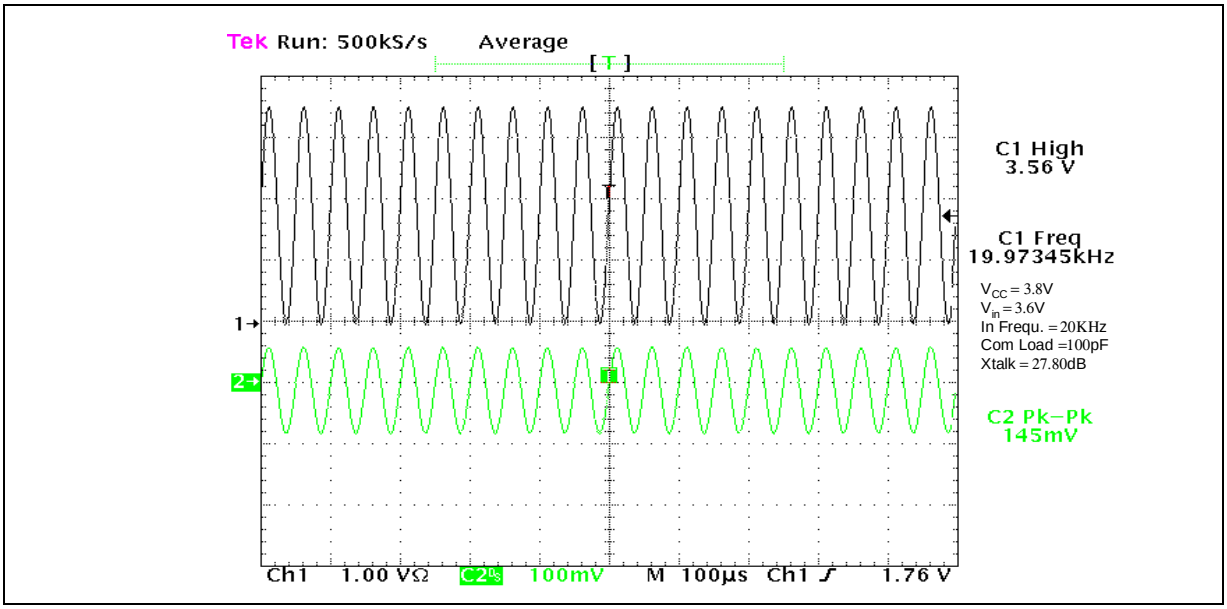
Usually, in telecom mobile applications, an Audio Amplifier drives the Analog Switch. So the designer must consider different parameters to realize a PCB without problems.
A channel-to-channel Cross Talk or a drift of a few parameters are typical problems of bad coupling between the Audio Amplifier and the Analog Switch.
The following schematic shows a typical speaker amplifier system for telecom mobile phones.

Figure 2: Audio System Amplifier Schematic



For correct power supply stability, it is necessary to apply a capacitance of 10µF to the STG Analog Switch and 1µF to the Audio Amplifier between the V_{CC} pin signal and GND to filter all possible noise from the Power Supply voltage.
To use the audio amplifier TS4990 correctly in differential mode, it is important to apply two resistors with different values as a function of the gain and the right power coupling between possible loads applied to the Analog Switch.
The values of the resistors can be found using the formula 2*Rfeed/R1 or 2*Rfeed/R2.
As the TS4990 does not have common mode feedback, an input-coupling capacitor before resistors R1 and R2 is mandatory. The capacitor value is calculated by the formula C = 1/2π*R1* FC or C = 1/2π*R2*FC where FC is the lowest cut off frequency signal required.
Usually the hands free phone jack circuitry presents a capacitance that when coupled with the analog switch inputs (D1 or D2 for example) creates cross talk between channel OFF and channel ON.
For instance a 100pF capacitance present on the D1 input generates a noise between channels of 145mV as shown in the following picture.

Figure 3: Noise Present on Analog Switch Channel OFF



Using the formula: XTALK (dB) = 20log Vout /Vin, it is possible to get back to the cross talk value. If this value is low a possible signal interference can induce noise between two different loads applied to the outputs of the Analog Switch, therefore causing the system to function badly.

4. CONCLUSION

These pages describe possible problems applying the STG3699 Analog Switch when the operating conditions stated in the specifications are not adhered to, resulting in less than the guaranteed functionality for these devices being achieved.