

CUSTOMIZING THE SHIELDED AMPLIFIER MODULE PERSONALITY CARD

Scott Bobo

Revised: March 19, 1999

Copyright 1999, Tripath Technology, Inc., All Rights Reserved

Description of the SAM Personality Card

The Shielded Amplifier Module can be divided into 3 major blocks: the amplifier(s), the power supply, and the personality card. The power supply is a “fixed-function” circuit, and no modifications are required or provided for in this area. The amplifier is general-purpose configuration, designed for optimum performance into most any anticipated load. Some customization is possible in the output filters (for loads of less than 4Ω or greater than 8Ω), but the SAM, as supplied, will provide outstanding performance into 4Ω and 8Ω loads.

The third major block of the SAM is the personality card. The personality card is designed to incorporate 99% of the customer-specific functionality of the system. Customization of the following features is possible with minor modification to the standard personality card:

- Broadband gain
- Bass control frequency and slope
- Treble control frequency and slope
- Speaker equalization
- Bass boost frequency and gain
- Auto-on threshold and delay

The standard personality card shipped with the SAM is set up for a "2.1 system" with a subwoofer and two external speakers. Volume, tone controls, equalization and bass boost are provided with values appropriate for a typical 2.1 application. The personality card also includes an input signal detection circuit that enables power whenever a signal is present and disables power after a period of inactivity.

The default (as shipped) values are shown below:

Gain	14dB
Bass Control	+/- 12dB total min +3dB @ 150Hz max –3 dB @ 50Hz
Treble Control	+/- 12dB total min +3dB @ 2kHz max –3 dB @ 8kHz
Bass Boost	+7dB @ 50Hz, Q=1
Equalization	Supplied, but configured as inverting buffers
Auto-on	15mV threshold, 2 minute delay to turn-off

Input and Volume Control

Signals are input to the personality card using RCA connectors. The customer can configure gain by changing components in the "Line Level Input and Gain Circuit" schematic block. Resistors R65 and R66 set the gain for the left channel and R70 and R71 set the gain for the right channel. The gain is set to the ratio R65/R66 (and R70/R71).

A second order Sallen-Key high pass filter sets the low frequency pole for the remainder of the personality card (and amplifier). This circuitry is shown in the block labeled "SK High Pass". The frequency, gain, and damping factor of the filter are determined as shown in the equations below. Note that the left channel is implemented as a non-inverting amplifier and the right channel is implemented as an inverting amplifier. This is intentional, as it provides for simpler bridging and a "friendlier" power amplifier load for the power supply.

In the default configuration

- $F_C = 10 \text{ Hz}$, $A_v = 1$, and the damping factor $\alpha = 1.414$
- Set $C29=C30=.1\mu\text{F}$
- $R62 = \alpha / k(2 + 1/A_v)$, where $k = 2\pi F_C \times 10^{-7}$
- $R61 = (2A_v + 1) / k\alpha$
- $C57 = C29/A_v$

Speaker Equalization

Equalization is provided by two Friend Biquad circuits. These very flexible circuits are used to perform system-dependent speaker equalization. A Microsoft Excel spreadsheet is provided on the CD to help with the design of custom equalizations. Design equations for these circuits can also be found in "Passive and Active Filters" by Wai-Kai Chen (ISBN 0-471-82352-X). These circuits are shown in the blocks labeled "Speaker EQ1" and "Speaker EQ2".

Tone Control

The tone control circuitry was duplicated from the National Semiconductor LM833 data sheet. Design equations can be found in that data sheet and on the schematic page for the tone control. This circuitry is shown in the schematic block labeled "Bass-Treble Control". The following formulas will derive the values required for the left channel (right channel is similar).

- Max bass gain = $1 + (R13/R14)$, so for 12dB, $1 + (R13/R14) = 4$
- Max treble gain = $1 + ((R14 + 2 \times R16) / R17)$,
- so for 12dB, $4 = 1 + ((R14 + 2 \times R16) / R17)$
- Bass frequency (+3dB from flat) = $1 / (2\pi \times R14 \times C14)$
- Bass frequency (–3dB from max) = $1 / (2\pi \times R13 \times C14)$
- Treble frequency (+3dB from flat) =
 $1 / (2\pi \times (R14 + 2 \times R16 + R17) \times C17)$
- Treble frequency (–3dB from max) = $1 / (2\pi \times R17 \times C3)$

Bass Boost

The bass boost circuitry is a Friend BiQuad circuit, which has been configured for bass boost only. Bass boost is activated when resistors R12 and R7 are grounded. When R12 and R7 are floating, the bass boost circuit forms a unity-gain follower. To modify this circuit, choose the center frequency F_C , the Q, and the gain A_v . Then, using the left channel values:

- $R5 = R6 = (Q/kA_v)/2$, where $k = 2\pi F_C \times 10^{-7}$
- $R7 = Q/(2Q^2 - A_v)k$
- $R3 = 2Q/k$

Auto Power Control

The system has an auto power-on feature that turns on the amplifiers when a signal is detected at the audio inputs of the SAM. This feature is shown in the schematic block labeled "On/Auto/Off Circuit".

The input threshold detection circuitry is configurable at R75 in the schematic. With $R75=120k\Omega$, the turn-on threshold is approximately 17mV. Doubling this value will result in decreasing the threshold by a factor of two (threshold is reduced to approximately 8.5 mV).

The designer can control of the amount of time that the circuit will stay active after the signal has stopped by modifying the time constant of R79 and C35. To increase the time that the circuit remains active, increase the values of C35 and/or R79. The default values of 100uF (C35) and 1M (R79) will turn the amplifier off after about 3 minutes of "no input". Doubling either C35 or R79 will increase this time to about 6 minutes.

THERMAL PROTECTION

Thermal protection for the amplifier is built into the personality card in the "On/Auto/Off Circuit". When the thermal switch in JP4 opens, the "Amplifier Disable" line is floated and the amplifiers will mute. With the amplifiers muted, the SDM will cool down and the thermal switch will close allowing the amplifiers to turn on again. This thermal switch setting has been preset for the thermal profile of this unit. No modifications are recommended.