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## **PurePath Digital™ AM Interference Avoidance**

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### **ABSTRACT**

This application note describes how the TAS5508 PWM modulator family (and later PurePath Digital™ devices) can automatically reduce possible AM radio interference caused by a switching audio amplifier. The problem discussed is the situation that exists in an audio unit (e.g. DVD Receiver) where a TI digital switching amplifier must co-exist with an AM tuner. Amplifier switching frequencies can interfere with certain tuned AM stations. A major component of the TI PurePath Digital™ amplifier is the TAS5508 PWM modulator. The TAS5508 has a new feature which automatically adjusts the amplifier switching rate to reduce the interference based on the tuned AM station. This feature and how to use it are presented here.

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## **1 Introduction**

Digital amplifiers produce AM interference by radio energy emissions near the digital amplifier switching rate and the harmonics of that switching rate. TAS5508 implements a patented proprietary algorithm to minimize interference with tuned AM radio frequencies. It provides four programmable sequences for AM interference avoidance.

## **2 Recommended Use of TAS5508 AM Interference Avoidance Features**

All programming for AM avoidance is done using a 4-Byte I2C register (subaddress 0xDE). [Table 1](#) shows how each bit is defined for upper 2 bytes. [Table 2](#) shows how each bit is defined when using the BCD mode to identify the tuned AM frequency. [Table 3](#) shows how each bit is defined when using the binary mode to identify the tuned AM frequency.

**Table 1. AM Mode Register (0xDE – Upper 2-Bytes)**

D31	D30	D29	D28	D27	D26	D25	D24	Function
0	0	0	0	0	0	0	0	Unused Bits

D23	D22	D21	D20	D19	D18	D17	D16	Function
0	0	0				0	0	Unused Bits
-	-	-	0	-	-	-	-	AM Mode Disabled
-	-	-	1	-	-	-	-	AM Mode Enabled
-	-	-	-	0	0	-	-	Select AM Interference Avoidance Sequence 1
-	-	-	-	0	1	-	-	Select AM Interference Avoidance Sequence 2
-	-	-	-	1	0	-	-	Select AM Interference Avoidance Sequence 3
-	-	-	-	1	1	-	-	Select AM Interference Avoidance Sequence 4
-	-	-	-	-	-	0	-	IF Frequency 455
-	-	-	-	-	-	1	-	IF Frequency 262.5
-	-	-	-	-	-	-	0	Use BCD Tuned Frequency
-	-	-	-	-	-	-	1	Use Binary Tuned Frequency

**Table 2. Tuned Frequency Register in BCD Mode (0xDE - Lower 2-Bytes)**

D15	D14	D13	D12	D11	D10	D9	D8	Function
0	0	0	X	-	-	-	-	BCD Frequency (1000s kHz)
-	-	-	-	-	-	-	-	
-	-	-	-	X	X	X	X	BCD Frequency (100s kHz)
0	0	0	0	0	0	0	0	Default Value

D7	D6	D5	D4	D3	D2	D1	D0	Function
X	X	X	X	-	-	-	-	BCD Frequency (10s kHz)
-	-	-	-	-	-	-	-	
-	-	-	-	X	X	X	X	BCD Frequency (1s kHz)
0	0	0	0	0	0	0	0	Default Value

**Table 3. AM Tuned Frequency Register in Binary Mode (0xDE - Lower 2-Bytes)**

D15	D14	D13	D12	D11	D10	D9	D8	Function
0	0	0	0	0	X	X	X	Binary Frequency
-	-	-	-	-	-	-	-	
0	0	0	0	0	0	0	0	Default Value

D7	D6	D5	D4	D3	D2	D1	D0	Function
X	X	X	X	X	X	X	X	Binary Frequency
-	-	-	-	-	-	-	-	
0	0	0	0	0	0	0	0	Default Value

## 2.1 TAS5508 AM Avoidance System Algorithm

Figure 1 shows a typical DVD receiver with a TI PurePath Digital (TM) audio amplifier with TAS5508 and AM tuner. Assuming that the TAS5508 is automatically detecting the input sample rate (from AM tuner or ADC), the basic system algorithm for using the TAS5508 AM Avoidance scheme is:

1. User selects desired AM station using front panel controls
2. System Micro writes the selected AM frequency to the AM tuner and also to TAS5508 (Micro also writes the pre-selected AM interference avoidance sequence - register 0XDE)

3. TAS5508 automatically selects the amplifier switching frequency to avoid interfering with the selected AM frequency

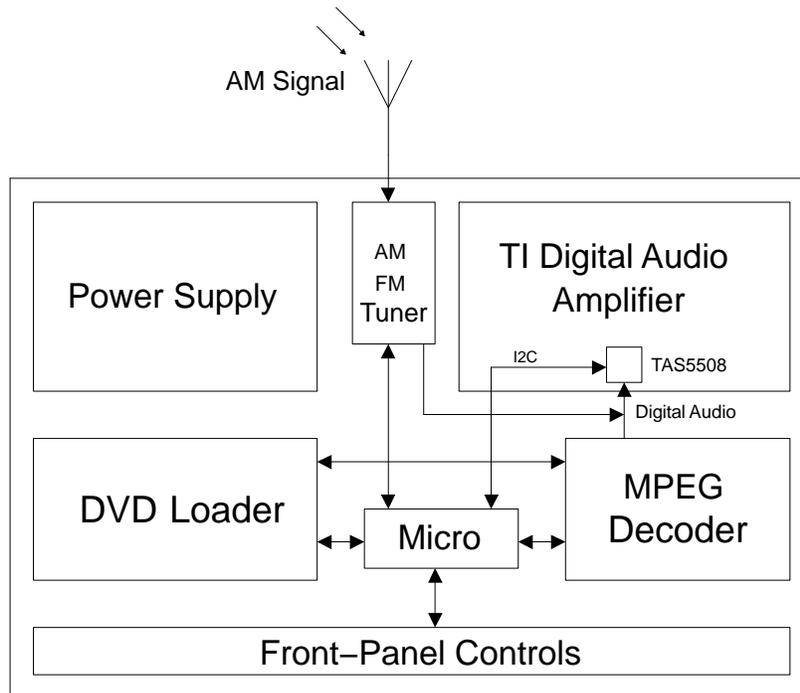


Figure 1. Typical DVD Receiver with TI Digital Audio Amp (TAS5508) and AM Tuner

## 2.2 TAS5508 AM Avoidance Example

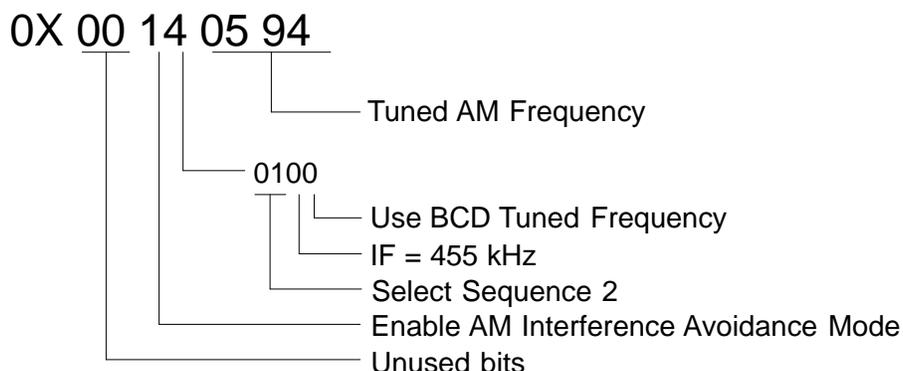
For this example assume the following:

1. AM audio sample rate is 48 kHz
2. Use the BCD (binary encoded decimal) format for specifying the tuned AM frequency
3. Tuned AM station is 594 kHz
4. Sequence 2 has been pre-determined to provide minimum interference

The following shows the details for this example:

1. User selects AM station 594 kHz using front panel controls
2. System Micro writes the selected 594 kHz to the AM tuner and also to TAS5508 (Micro also writes the AM interference avoidance sequence 2 - register 0XDE)

That means the Micro writes 0X 00 14 05 94 to register 0XDE where:



- TAS5508 uses Sequence 2 to automatically select the amplifier switching frequency to minimize amplifier interference with the 594 kHz tuned AM frequency

### 3 Example Procedure to Pre-Determine TAS5508 AM Interference Avoidance Sequence

During system testing the manufacturer using an AM tuner is commonly interested in measuring Useable Sensitivity. This figure-of-merit commonly measures how much AM signal strength is required to maintain the SNR of the AM tuner at a constant 20 dB. The AM signal strength to reach a tuner SNR of 20 dB is measured in dBuV (0dBuV = 1uV). The lower the required AM signal strength, the better the sensitivity.

In a system with an AM tuner and a TAS5508-based digital amplifier, the following procedure can be used to select the appropriate sequence (TAS5508 register 0XDE):

- Run manufacturer Useable Sensitivity tests with Sequence 1 and record the results
- Run manufacturer Useable Sensitivity tests with Sequence 2 and record the results
- Run manufacturer Useable Sensitivity tests with Sequence 3 and record the results
- Run manufacturer Useable Sensitivity tests with Sequence 4 and record the results
- Select the best overall sequence for desired Useable Sensitivity or select the appropriate sequence for each test frequency
- Program micro with information from step 5

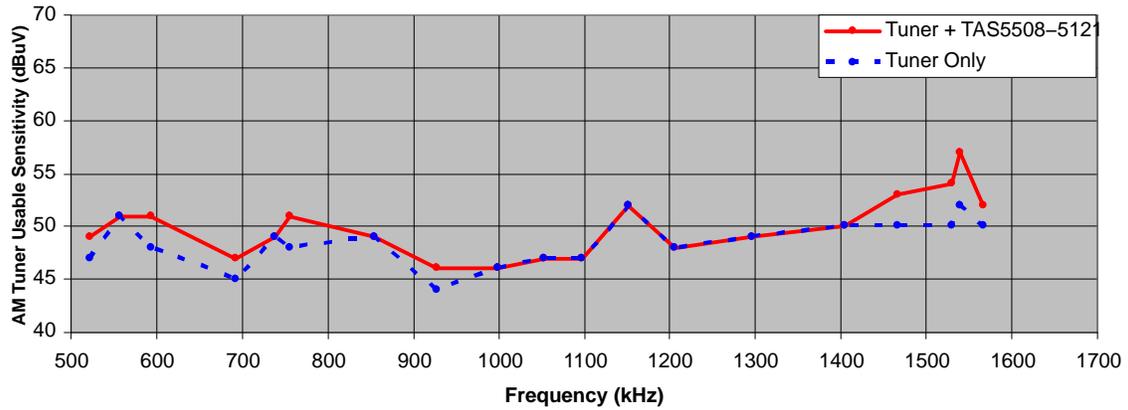
### 4 Comparison of AM Tuner Only Vs. AM Tuner + Amplifier

Figures 2, 3, 4, and 5 shows an example AM tuner vs. AM tuner + TAS5508-based digital amplifier using sequences 1, 2, 3, and 4. At tested frequencies, the TAS5508 AM interference avoidance algorithm shows that it reduces the AM interference to an acceptable level. In many cases it approaches the tuner only test.

These results show that Sequence 2 is best overall for this example tuner and amplifier.

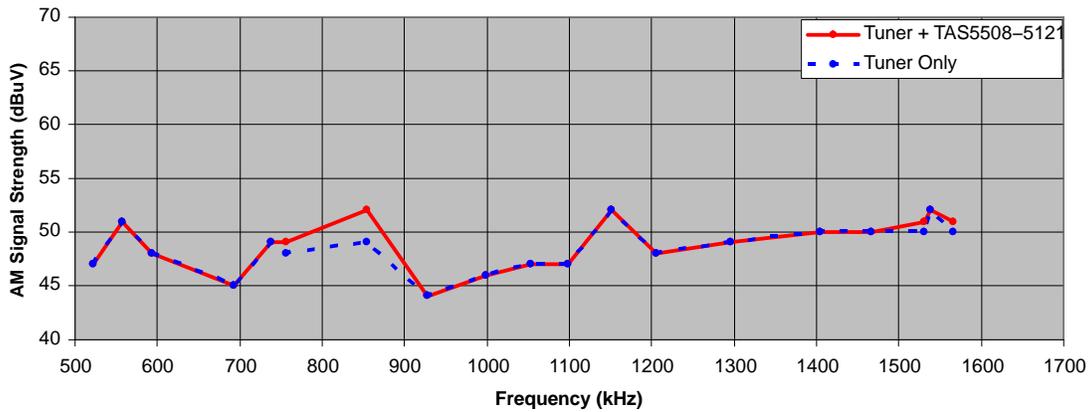
Note that results may vary depending on the AM tuner, the digital amplifier PCB design, the power supply, and the TAS5508 AM interference avoidance sequence.

**Tuner Vs. Tuner + Amp (TAS5508 AM Interference Avoidance Sequence 1)**



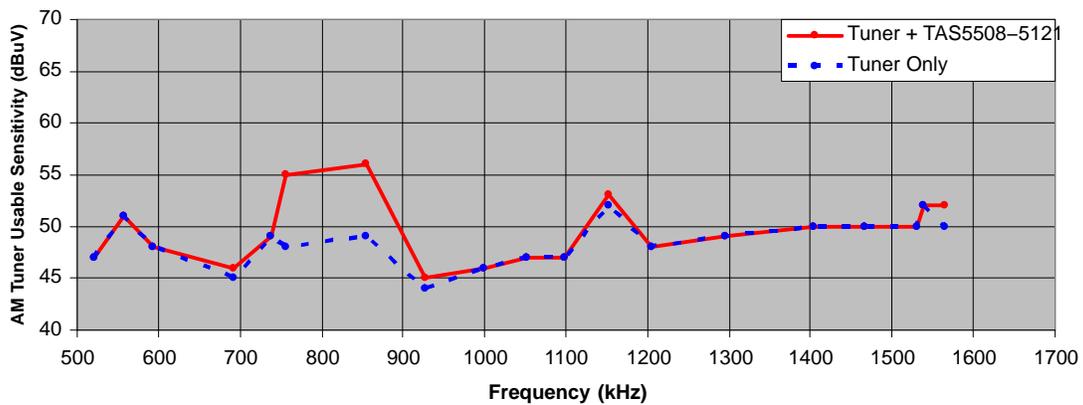
**Figure 2. Comparison of Example Tuner Only with Tuner + Amplifier (TAS5508) Using Sequence 1**

**Tuner Only Vs. Tuner + Amp (TAS5508 AM Interference Avoidance Sequence 2)**

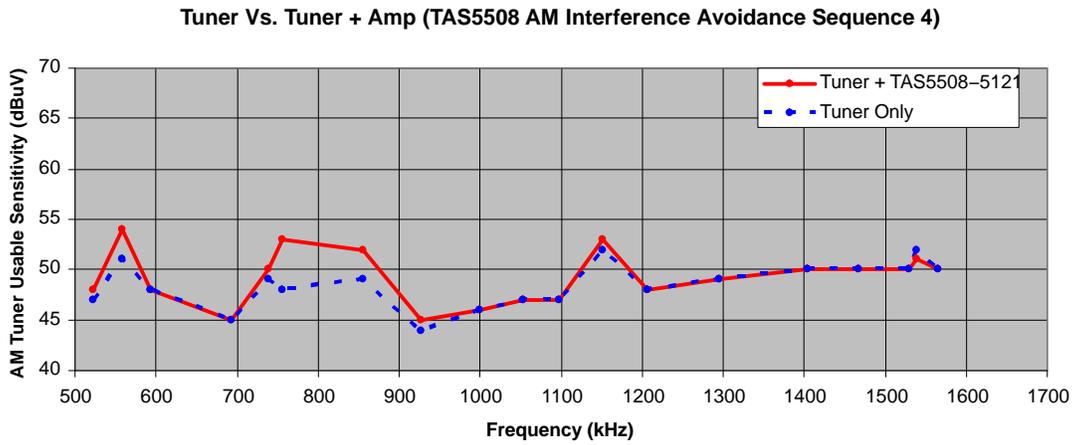


**Figure 3. Comparison of Example Tuner Only with Tuner + Amplifier (TAS5508) Using Sequence 2**

**Tuner Vs. Tuner + Amp (TAS5508 AM Interference Avoidance Sequence 3)**



**Figure 4. Comparison of Example Tuner Only with Tuner + Amplifier (TAS5508) Using Sequence 3**



**Figure 5. Comparison of Example Tuner Only with Tuner + Amplifier (TAS5508) Using Sequence 4**

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