

# ***Component Selection for DDX Amplifiers***

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## Introduction

This Applications Note addresses some of the critical components and their critical parameters to assist component selection while implementing DDX Power Amplifier ICs. The component IDs in Table 1 refer to the reference schematic shown in Figure 1. Schematic For Stereo 35w, 8 Ohm Per Channel Typical Application using the DDX-2060 Power Amplifier Chip.

**Table 1. Critical Components.**

Indicator	Reference	Part	TYPE	CRITICAL STATUS
◆◆	C12, C15	1uF	CAP, TANTALUM 35V ±20% or MLC X7R 10% 50V SM1812	RELIABILITY CRITICAL
◆	C7, C17, C24	100nF	CAP, MLC X7R ±10% 50V SM0805	RELIABILITY MODERATE
◆	C23, C10	330pF	CAP, MLC X7R ±10% 100V	RELIABILITY MODERATE
◆	R1, R5	20R	RES, THICK FILM 20 OHM ±5% 1/4W 200PPM SM1210	RELIABILITY MODERATE
●●	C27, C28	100nF	CAP, MLC X7R ±10% 50V SM0805	EMI PERFORMANCE CRITICAL
●	C8, C9, C21, C22	10nF	CAP, MLC X7R ±10% 50V SM0805	EMI PERFORMANCE MODERATE
■	C20, C6	470nF	CAP, POLYESTER FILM 63V ±5% RADIAL, NON-INDUCTIVE CONSTRUCTION	AUDIO PERFORMANCE CRITICAL
■	L1, L2, L3, L4	22uH	INDUCTOR, 22uH ±5% 3A 62mOHM DCR RADIAL	AUDIO PERFORMANCE CRITICAL
■	C4	1000uF	CAP, ELECTROLYTIC ±20% 50V RADIAL 7.5MM LS	AUDIO PERFORMANCE MODERATE
■	C1, C13, C16, C26	100nF	CAP, MLC X7R ±10% 50V SM0805	AUDIO PERFORMANCE MODERATE
■	C2, C11, C18, C25	100nF	CAP, MLC X7R ±10% 50V SM0805	AUDIO PERFORMANCE MODERATE
■	C5	100nF	CAP, MLC X7R 25V ±20% SM0805	AUDIO PERFORMANCE MODERATE
■	R2, R3, R6, R7	6.2R	RES, THICK FILM 6.2 OHM ±5% 1/4W 200PPM SM1210	AUDIO PERFORMANCE MODERATE
	C14		CAP, MLC Y5V 25V +80 -20% SM0805	---
◆	U1	DDX2060	DDX2060 POWER IC	---
	R4, R8	10k	RES, THICK FILM 10KOHM ±5% 1/10W SM0805	---

Legend:

RELIABILITY:

EMI PERFORMANCE

AUDIO PERFORMANCE

◆◆ = CRITICAL,

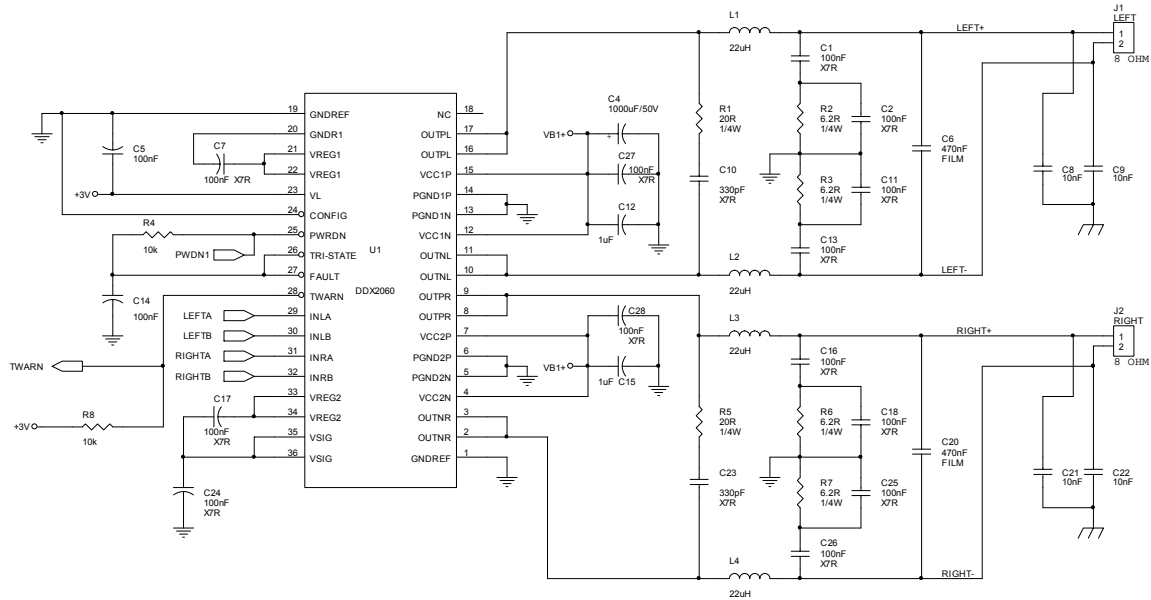
●● = CRITICAL,

■ = CRITICAL,

◆ = MODERATE

● = MODERATE

■ = MODERATE



**Figure 1. Schematic For Stereo 35w, 8 Ohm Per Channel Typical Application**

## Critical Components in the Design:

The selection of components can be classified into three categories:

- A) Components that affect the RELIABILITY and FUNCTIONALITY of DDX Power ICs. These components are marked as **◆◆** for RELIABILITY CRITICAL components or **◆** for components that MODERATELY affect RELIABILITY. These guidelines must be followed or else the Power IC failure can occur.
- B) Components that affect the EMI PERFORMANCE are marked as **●●** for EMI CRITICAL and **●** for EMI MODERATE.
- C) Components that affect the AUDIO PERFORMANCE, e.g. Signal to Noise Ratio, THD+N, etc., are marked as **■■** For AUDIO CRITICAL and **■** for AUDIO MODERATE. These component values are preferred and, if used, will provide performance similar to that of the Apogee Evaluation Board.
- D) Those that are not critical have no markings.

### RELIABILITY RELATED

1. **◆◆ C12, C15: 1uF 35V or 50V ±20% Tantalum Electrolytic.**  
These are Power Supply bypass capacitors and must be Tantalum type. The normal Aluminum Electrolytic Capacitors have high ESR compared to Tantalum electrolytic. The package density is higher for Tantalum compared to Aluminum Electrolytic, also. The SMD package is important because this will give less lead inductance and in turn help bypass high frequency noise on power supplies. The important specification to look for is Dissipation Factor, ( $\tan \delta$ ) which is typically around 0.04 max. Using the surface mount EIA size B allows the capacitor to be placed very near to the Power Chip. You can use Multilayer Ceramic Chip (MLC) types also, but note they must be X7R type only. Never use Y5V or Z5U types at these locations. If these instructions are not followed, the Power Chip can FAIL.
2. **◆ C7, C17, C24: 100nF 50V X7R ±10%**  
These capacitors are used for bypassing the internal Regulator voltage references. These must be, Multilayer Ceramic Chip (MLC) types with DC voltage rating of at least 50V. The important specification to look for is the dielectric type. It must be X7R dielectric & the tolerance must be ±10% or better.  
The reason for selecting the X7R type is that the capacitance variation over temperature is more stable than the more popular Y5V or Z5U types. The Temp Coefficient is important because DDX Power ICs use the PCB copper as a Heat Sink so the Capacitors close to the Power IC can drift in value as the temperature rises. This capacitance drift can destabilize the internal Regulator Reference voltages. Check the typical Temperature Coefficient curves from the manufacturer's data sheet to verify that it is within ±10% over the temperature range -25°C to +85°C.  
The next concern is Package selection. We recommend using Surface Mount SM0805. This will let you place the capacitors very close to the Power IC in the PCB layout. Close placement is a MUST. If you do not place them close to the Power Chip, the Power ICs can FAIL, due to large voltage variations (due to switching transients) on the regulator lines. It cannot be stressed enough; the popular Y5V and Z5U capacitor types CANNOT work at these locations.
3. **◆ C10, C23: 330 pF, 100V, X7R ±10%.**  
These components form a Snubber circuit, along with Resistors R1 for C10 & R5 for C23 respectively. These also MUST be MLC X7R types with 100 VDC rating. The 100 VDC rating is specified as these caps are across the bridge outputs. This is important because they serve as snubbers and a lot of high frequency energy is dissipated in them. The SM0805 package is the best suitable type.

4. **◆R1, R5: Thick film Type ¼ W ±5% 200ppm.**  
The Resistor type can be either Metal film or Thick film, depending on suitability, but note that these must be ¼ W rating and have a tolerance of ±5% as they form RC filter circuits. These serve to damp transients to the Amplifier when Outputs are unloaded & are useful at high frequencies. The best package would be a surface mount SM1210 type.

### **EMI RELATED**

5. **●● C27, C28: 100nF 50V X7R ±10%.**  
These bypass the high frequency EMI for the Amplifier Power Supply. The best type is MLC X7R with 50 VDC rating & SM0805 package. These should be placed as near as possible to the Power IC to be effective.
6. **● C8, C9, C21, C22: 10nF 50V X7R ±10%.**  
These act as a filter with L2, L5 to reduce very high frequency EMI. The best type is MLC X7R with 50V DC rating & SM0805 package. These are typical values & may require selection based on EMI tests.

### **PERFORMANCE RELATED**

7. **■ C6, C20: 470nF, 63V, ±5% Polyester Film.**  
These form the Differential LC filter along with inductor L1, L2, L3, and L4 respectively. These must be Polyester Film Dielectric type with 63 VDC voltage rating. The important specification to be looked for while selecting is Dissipation Factor ( $\tan \delta$  v/s Frequency curve), which should be 0.01 @ 10 kHz and must also be of a non-inductive construction. Be careful in selecting these, as normal available film capacitors can have inductive construction & will not be suitable for this application. The case size is not critical but a Box Type would be preferable, as they remain flush to the PCB.
8. **■ L1, L2, L3, L4: 22uH @ 3A Inductor.**  
These are important components in the output filter circuit. The important specifications to look for are DC Resistance value, Q, Magnetic Material and DC current capability. The DC saturation current specification must also be looked at. A saturated inductor can cause the filter performance to degrade.  
The typical specs are  
DC Resistance: 70 mOhms.  
Q: 40 @ 2.5 MHz.  
DC Current Capacity: 3A for 35W and 3.5A for 50W.  
Power Inductors designed for switching applications are the kinds to look for. Be careful when placing them. If either L1 or L2 is placed very near to either L3 or L4, the cross-talk figure can be severely degraded due to magnetic coupling.
9. **■ C4: 1000uF 35V ±20% Aluminum Electrolytic.**  
This can be Aluminum Electrolytic Capacitor with 35V DC rating and ±20% tolerance. The important specification to look for is  $\tan \delta$  typically around 0.12 @ 120 Hz. Please note that the impedance of an Electrolytic capacitor increases at higher frequencies, so select as LOW an ESR as possible. The package can be decided based upon individual requirement. Radial Can types are suitable.
10. **■ C1, C13, C16, C26: 100nF 50V X7R ±10%.**  
These filter capacitors on the output along with L1, L2, L3, L4 form an LC filter circuit to bypass common mode signals. These also must be MLC X7R types with 100 VDC voltage rating. The recommended package is SM0805. The X7R type is important here as this is the main filter component in bypassing the high frequency from the Output.

11. **■ C2, C11, C18, C25: 100nF 50V X7R ±10%.**  
These act as secondary Roll Off for R2, R3, R6, and R7 respectively. The recommended type is MLC X7R with 50 VDC rating and SM0805 package.
12. **■ C5: 100nF 25V.**  
This capacitor is a bypass for 3.3V. Is not very critical but noise on the 3.3 V supply can cause the degradation of internal clocks leading to poor Signal to Noise Ratio and increased THD+N. The best suitable type would be a MLC X7R type with ±20%, 25 VDC.
13. **■ R2, R3, R6, R7: Thick film Type ¼ W ±5% 200ppm.**  
These Resistors can be either Metal film or Thick film, depending on the suitability, but note that these must be ¼ W rating & have a tolerance of ±5%, as they form RC filter circuits. The best package would be a surface mount SM1210 type.
14. **R4, R8: Thick film Type 1/10 W 10% 200ppm type.**  
A surface mount SM0805 would be suitable. This is not a critical component.