



Installation Instructions

Audio Output Transformer for NGX Jukebox Kit #22180806

These instructions outline the procedures to install and connect an Audio Output Transformer to the NGX Jukebox.

Tools and fasteners Required

- #2 Philips Screwdriver
- Fasteners appropriate for your mounting location

Parts Included with this Kit:

<u>Item #</u>	<u>Part Number</u>	<u>Description</u>	<u>Quantity</u>
1	40832124	Transformer Assembly - Output These Instructions	1



40832124
Output Transformer

Low Impedance Speaker Taps	E1, E2, E3, E4, E5, E6, E7
70 Volt Speaker Taps	Ch1 A1, A2, Ch2 A1, A2

Figure 1-A – Output Transformer Assembly

The Audio Output Transformer Assembly is designed to enable the NGX jukebox to connect to a wider variety of speakers and speaker configurations, including 70 volts speakers.

The transformer assembly is too big to be mounted inside the jukebox cabinet. Select an appropriate mounting location somewhere near the jukebox. It may be mounted to the wall directly below the jukebox or up inside the ceiling above the jukebox. The transformer assembly weighs close to 20 lbs. so make sure your fasteners and the wall or other mounting location can support this weight.

Connect the four wires from the transformer assembly to the NGX amplifier after passing the wires through either the upper or lower access holes in the jukebox. See Figure 1-B. Be sure to close up the access holes using the hole covers provided with the jukebox.

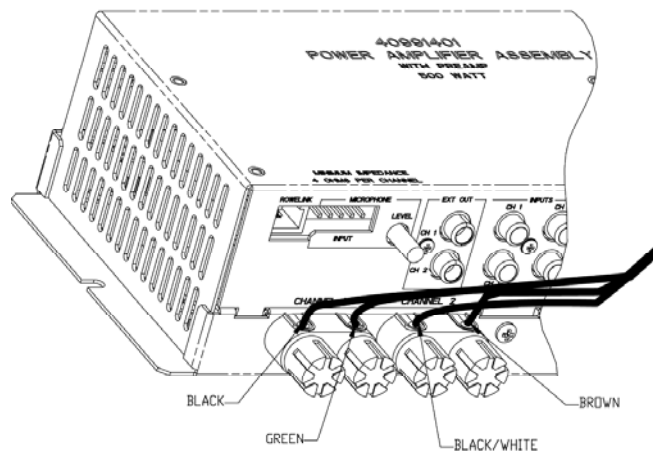


Figure 1-B – Connect Audio Output Transformer to Amplifier

Connect your extension speaker wires to the E1 through E7 taps for Channel 1 and Channel 2. Connect your 70 volt speakers to the A1, A2 taps.

Be sure to properly configure your speaker connections. The amplifier in the NGX jukebox can deliver a total of 500 watts to speakers, 250 watts maximum per channel. However, the E1 through E6 taps and A1, A2 taps combined are limited to 125 watts maximum per channel.

Use the tables and examples in the following sections to design your speaker installation and verify the speaker load is within the power limits described above.

Sound System Set Up

Extension Speaker Operation

To avoid poor sound quality, care must be taken when adding extension speakers. The following requirements must be met:

Speakers connected to the Output Transformer Assembly must be wired so the power consumed by the extension speakers does not exceed the amplifier power rating of 250 watts per channel.

An Output Transformer Assembly has:

- two transformers
- two 7 position terminal strips for low impedance speakers marked E1 through E7
- one 4-position terminal strip for 70-volt speakers marked Ch1 A1-A2, Ch 2 A1-A2.
- Speakers connected across terminals E1 to E7 bypass the transformer and are driven directly by an amplifier channel.
- Each transformer provides 70V terminals for driving 70V speakers, and provides taps (E1-E6) for driving extension speakers at a lower volume. The power consumed by speakers driven by a transformer must not exceed the transformer rating of 125 watts per channel.
- The power consumed by all connected speakers must not exceed the channel rating of 250 watts. For example, each channel could drive 125 watts directly from the amplifier (E1 to E7), and the remaining 125 watts through the transformer (lower taps and 70V terminals).
- Complete the Extension Speaker Worksheet (*Tables 1-1 through 1-5*) for each channel and verify it does not exceed the 125-watt transformer rating and the 250-watt amplifier channel rating. After wiring the speakers, perform the Amplifier Overload Check immediately following *Table 1-5*.

All speakers must be connected with the correct polarity (see *Figure 2-A through 2-E*).

Channel 1 E1-E7 output is in phase with channel 2 E1-E7 output. The speaker connections for channel 1 speakers are in phase with channel 2 speakers. The 70V phasing is reversed inside the output transformers. See *Figure 2-C* for correct polarity hookup of extension speakers. If the (+) and (-) terminals are not wired properly, the speakers will be out of phase, causing a reduction in low frequencies (bass).

70-Volt Speakers

To avoid prohibitive cable losses on long speaker lines (over 100 feet), use 70 V speakers. The power level in the 70 V speakers is set at each speaker. For each channel, 125 watts are provided for 70 V speakers by terminal connections on the audio output transformer assembly.

Low Impedance Speakers

Low impedance speakers (16- 8- or 4-ohm) can be used when the connecting cable is less than 100 feet. Keep the following two things in mind when wiring your speakers:

1. No more than one 4-ohm speaker should be connected to a speaker line. If several 4-ohm speakers are to be used, each speaker should have its own line.
2. The loss in 100 feet of 18-gauge zip-cord feeding on an 8-ohm speaker is 15%. The loss for two 8-ohm speakers is 30%.

Selecting Speaker Power

General Instructions

This section will lead you through the power and speaker selection process. This process consists of three major steps and several smaller steps. The major steps are:

1. Identify the extension speakers and compute the speaker power for speakers connected:
 - a. directly across the amplifier (E1 to E7)
 - b. to the 70V taps
 - c. to lower power taps on the transformer (E1 through E6).
2. Make the extension speaker connections.
3. Perform an amplifier overload check (see instructions immediately following *Table 1-5*).

Selection Procedures

- Use a pencil (you may want to revise your figures) to fill in the Extension Speaker Worksheet on the following pages.
- Extension speakers are available in two general categories: general purpose speakers (16- 8- and 4-ohm), and 70V speakers. Power level in 70V speakers is set at each speaker.
- Use the *Tables 1-1 through 1-5* Worksheets to help you calculate the amount of power consumed by the extension speakers.
- An extension speaker RMS power rating should be at least 10% higher than the power it will consume at maximum jukebox volume.

When RMS power to speaker
at maximum jukebox volume is:

240 watts
120 watts
60 watts
30 watts

Then recommended RMS power
rating of speaker is:

300 watts
150 watts
75 watts
40 watts

**Table 1-1 – Extension Speaker Worksheet
Sheet 1**

Extension Speakers Connected E1 to E7

Place the quantity of speakers in the blank under **Qty** and multiply the quantity times the power consumption. Place your results in the blank under **Total**.

	Qty			Total	
	CH 1	CH 2		CH 1	CH 2
Two 8-ohm speakers in series: (30 watts to each speaker)	_____	_____	at 60 watts per series =	_____	_____ watts
Two 4-ohm speakers in series: (60 watts to each speaker)	_____	_____	at 120 watts per series =	_____	_____ watts
16-ohm speakers:	_____	_____	at 60 watts each =	_____	_____ watts
8-ohm speakers:	_____	_____	at 120 watts each =	_____	_____ watts
4-ohm speakers:	_____	_____	at 240 watts each =	_____	_____ watts
Sum totals for CH1 and CH2 then transfer totals to Table 1-5				_____	_____ watts

(Continued on next page)

**Table 1-2 – Extension Speaker Worksheet
Sheet 2**

4-Ohm Speakers Connected To Transformer Taps E1 through E6

Place the quantity of speakers in the blank under **Qty** and multiply the quantity times the power consumption. Place your results in the blank under **Total**.

4-Ohm Speakers connected to Channel 1 transformer taps:

	Connections	Qty			Total
Speakers for the 1-watt taps:	(E1 to E2)	___	at 1 watt each	=	___watts
Speakers for the 4-watt taps:	(E1 to E3)	___	at 4 watts each	=	___watts
Speakers for the 16-watt taps:	(E1 to E4)	___	at 16 watts each	=	___watts
Speakers for the 36-watt taps:	(E3 to E5)	___	at 36 watts each	=	___watts
Speakers for the 49-watt taps:	(E2 to E5)	___	at 49 watts each	=	___watts
Speakers for the 64-watt taps:	(E1 to E5)	___	at 64 watts each	=	___watts
Speakers for the 100-watt taps:	(E3 to E6)	___	at 100 watts each	=	___watts
Speakers for the 121-watt taps:	(E2 to E6)	___	at 121 watts each	=	___watts

Sum totals for CH1 then transfer total to Table 1-5 ___watts

4-Ohm Speakers connected to Channel 2 transformer taps:

	Connections	Qty			Total
Speakers for the 1-watt taps:	(E1 to E2)	___	at 1 watt each	=	___watts
Speakers for the 4-watt taps:	(E1 to E3)	___	at 4 watts each	=	___watts
Speakers for the 16-watt taps:	(E1 to E4)	___	at 16 watts each	=	___watts
Speakers for the 36-watt taps:	(E3 to E5)	___	at 36 watts each	=	___watts
Speakers for the 49-watt taps:	(E2 to E5)	___	at 49 watts each	=	___watts
Speakers for the 64-watt taps:	(E1 to E5)	___	at 64 watts each	=	___watts
Speakers for the 100-watt taps:	(E3 to E6)	___	at 100 watts each	=	___watts
Speakers for the 121-watt taps:	(E2 to E6)	___	at 121 watts each	=	___watts

Sum totals for CH2 then transfer total to Table 1-5 ___watts

(Continued on next page)

**Table 1-3 – Extension Speaker Worksheet
Sheet 3**

8-Ohm Speakers Connected To Transformer Taps E1 through E6

Place the quantity of speakers in the blank under **Qty** and multiply the quantity times the power consumption. Place your results in the blank under **Total**.

8-Ohm Speakers connected to channel 1 transformer taps

	Connections	Qty	Total
Speakers for the .5-watt taps:	(E1 to E2)	___ at .5 watt each	= ___ watts
Speakers for the 2-watt taps:	(E1 to E3)	___ at 2 watts each	= ___ watts
Speakers for the 8-watt taps:	(E1 to E4)	___ at 8 watts each	= ___ watts
Speakers for the 18-watt taps:	(E3 to E5)	___ at 18 watts each	= ___ watts
Speakers for the 24-watt taps:	(E2 to E5)	___ at 24 watts each	= ___ watts
Speakers for the 32-watt taps:	(E1 to E5)	___ at 32 watts each	= ___ watts
Speakers for the 50-watt taps:	(E3 to E6)	___ at 50 watts each	= ___ watts
Speakers for the 72-watt taps:	(E1 to E6)	___ at 72 watts each	= ___ watts
Speakers for the 95-watt taps:	(E3 to E7)	___ at 95 watts each	= ___ watts
Sum totals for CH1 then transfer total to Table 1-5			___ watts

8-Ohm Speakers connected to channel 2 transformer taps

	Connections	Qty	Total
Speakers for the .5-watt taps:	(E1 to E2)	___ at .5 watt each	= ___ watts
Speakers for the 2-watt taps:	(E1 to E3)	___ at 2 watts each	= ___ watts
Speakers for the 8-watt taps:	(E1 to E4)	___ at 8 watts each	= ___ watts
Speakers for the 18-watt taps:	(E3 to E5)	___ at 18 watts each	= ___ watts
Speakers for the 24-watt taps:	(E2 to E5)	___ at 24 watts each	= ___ watts
Speakers for the 32-watt taps:	(E1 to E5)	___ at 32 watts each	= ___ watts
Speakers for the 50-watt taps:	(E3 to E6)	___ at 50 watts each	= ___ watts
Speakers for the 72-watt taps:	(E1 to E6)	___ at 72 watts each	= ___ watts
Speakers for the 95-watt taps:	(E3 to E7)	___ at 95 watts each	= ___ watts
Sum totals for CH2 then transfer total to Table 1-5			___ watts

(Continued on next page)

**Table 1-4 – Extension Speaker Worksheet
Sheet 4**

16-Ohm Speakers Connected To Transformer Taps E1 through E6

Place the quantity of speakers in the blank under **Qty** and multiply the quantity times the power consumption. Place your results in the blank under **Total**.

16-Ohm Speakers connected to channel 1 transformer taps

	Connections	Qty	Total
Speakers for the .25-watt taps:	(E1 to E2)	___ at .25 watt each =	___ watts
Speakers for the 1-watt taps:	(E1 to E3)	___ at 1 watts each =	___ watts
Speakers for the 4-watt taps:	(E1 to E4)	___ at 4 watts each =	___ watts
Speakers for the 9-watt taps:	(E3 to E5)	___ at 9 watts each =	___ watts
Speakers for the 12-watt taps:	(E2 to E5)	___ at 12 watts each =	___ watts
Speakers for the 16-watt taps:	(E1 to E5)	___ at 16 watts each =	___ watts
Speakers for the 25-watt taps:	(E3 to E6)	___ at 25 watts each =	___ watts
Speakers for the 36-watt taps:	(E1 to E6)	___ at 36 watts each =	___ watts
Speakers for the 47-watt taps:	(E3 to E7)	___ at 47 watts each =	___ watts
Sum totals for CH1 then transfer total to Table 1-5			___ watts

16-Ohm Speakers connected to channel 2 transformer taps

	Connections	Qty	Total
Speakers for the .25-watt taps:	(E1 to E2)	___ at .25 watt each =	___ watts
Speakers for the 1-watt taps:	(E1 to E3)	___ at 1 watts each =	___ watts
Speakers for the 4-watt taps:	(E1 to E4)	___ at 4 watts each =	___ watts
Speakers for the 9-watt taps:	(E3 to E5)	___ at 9 watts each =	___ watts
Speakers for the 12-watt taps:	(E2 to E5)	___ at 12 watts each =	___ watts
Speakers for the 16-watt taps:	(E1 to E5)	___ at 16 watts each =	___ watts
Speakers for the 25-watt taps:	(E3 to E6)	___ at 25 watts each =	___ watts
Speakers for the 36-watt taps:	(E1 to E6)	___ at 36 watts each =	___ watts
Speakers for the 47-watt taps:	(E3 to E7)	___ at 47 watts each =	___ watts
Sum totals for CH2 then transfer total to Table 1-5			___ watts

(Continued on next page)

**Table 1-5 – Extension Speaker Worksheet
Sheet 5**

Combine power consumption of all speakers:

	Channel 1	Channel 2	
Connected E1 to E7	_____	_____	
Tapped 4-Ohm	_____	_____	} Sum of tapped and 70-Volt A1, A2 must not exceed 125 watts per channel.
Tapped 8-Ohm	_____	_____	
Tapped 16-Ohm	_____	_____	
70-Volt A1, A2	_____	_____	
	Channel 1	Channel 2	Grand Total
Totals:	_____	+ _____	= _____

The Grand Total is the amount of power that the jukebox will need to supply to the extension speakers. If the Channel 1 Total or the Channel 2 Total is more than 250 watts, you must reduce the power used by that channel's extension speakers, and then recalculate that channel's power consumed.

NOTE: In any speaker installation, the total RMS speaker load (the sum of all power to all speakers) must not exceed 250 watts per channel. It is strongly recommended that "Efficient" extension speakers be used.

Amplifier Overload Check

Check that the amplifier is not overloaded by performing the following steps:

1. Make sure that the extension speakers are connected to the audio output transformer terminals properly (E1 through E7, and A1, A2).
2. Make a selection and set the volume control to maximum.
3. If the red OVERLOAD LED is always lit, the amplifier is overloaded and will shut down. You must perform Step 4.
4. Do this step only if the OVERLOAD LED came on as described in Step 3.
 - Find the source of the overload (shorted speaker wires, shorted speaker, too many speakers connected, speaker power taps too high).
 - After you fix the short, disconnect a few speakers or lower the speaker power tap selection to reduce the wattage. Repeat from Step 2.
 - If no overload is detected, reconnect the disconnected speakers (ensure you do not have too many speakers). Repeat from step 2.
5. If the red OVERLOAD LED does not turn on but the sound through the speakers sounds distorted, the sound system may be over driven. Reduce the equalizer settings using the jukebox Service Mode screen *Hardware Setup – Equalizer Setup* until there is clean sound heard from the speakers.

Sample Speaker Connections

Speaker Synopsis

500 Watts of RMS Power per Amplifier or 250 Watts per Channel.

The generic speaker wiring diagrams cover 6 to 18 speakers.

These speakers can be expensive, providing a lot of sound in a localized area, which does not always optimize the room sound. The power rating indicated for each speaker is the actual power delivered to each speaker. We recommend using a higher rated speaker to ensure adequate performance (See the table on page 4). This is to provide a safety factor and will also provide extended life for the speakers. However, using a speaker with a rating much higher than absolutely necessary will be more expensive and not cost effective.

The best way to distribute the sound is by adding more speakers.

Using these diagrams as a guide, you will readily see how many different schemes can be achieved. The key things to keep in mind are:

- The load on each channel must be less than 250 watts.
- The maximum you can connect via the Output Transformers (any connections not across E1 and E7) is 125 Watts per channel.
- Pay attention to speaker polarization. Ensure speaker terminal are connected properly.

Power Calculations

If you are inclined to perform your own power calculations, the formula to use is:

$$P = E^2 / R$$

P is power in watts

E is the voltage indicated at the transformer tap

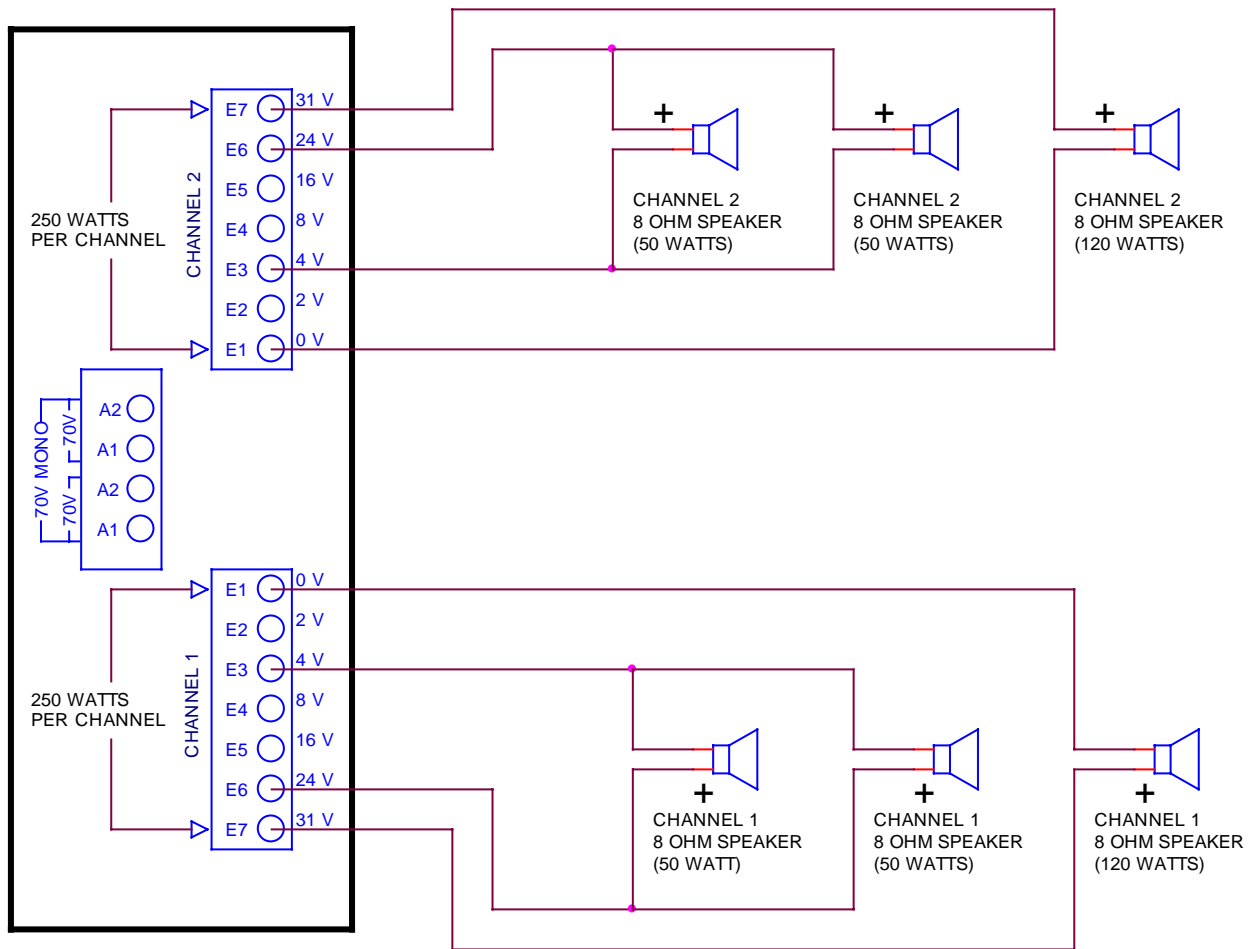
R is the equivalent impedance of the speaker(s) across the tap

Example 1: one 8 ohm speaker across taps E2 (2 volts) to E5 (16 volts) would be:

$$P = (16 - 2)^2 / 8 = 24.5 \text{ watts}$$

Example 2: two 4 ohm speakers in series across taps E1 (0 volts) to E6 (24 volts) would be:

$$P = (24 - 0)^2 / (4 + 4) = 72 \text{ watts (36 watts per speaker)}$$



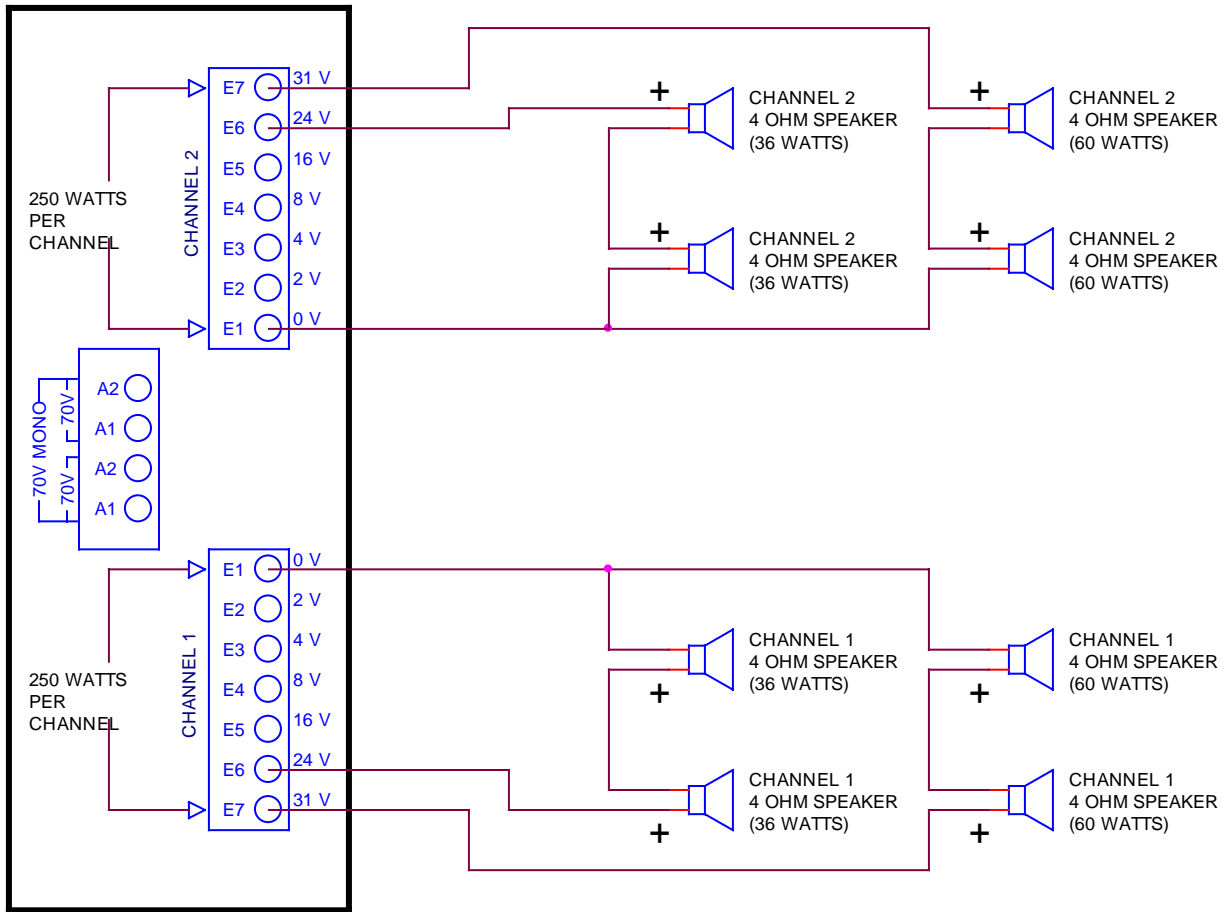
**Load as shown is
220 Watts total per channel.**

**100 W per channel through the transformer
 120 W per channel across the amplifier**

NOTES:

- 1. 70V phasing is reversed inside the output transformer assembly.**
- 2. Wattage indicates actual power. Select speakers with a higher rating.**

Figure 2-A



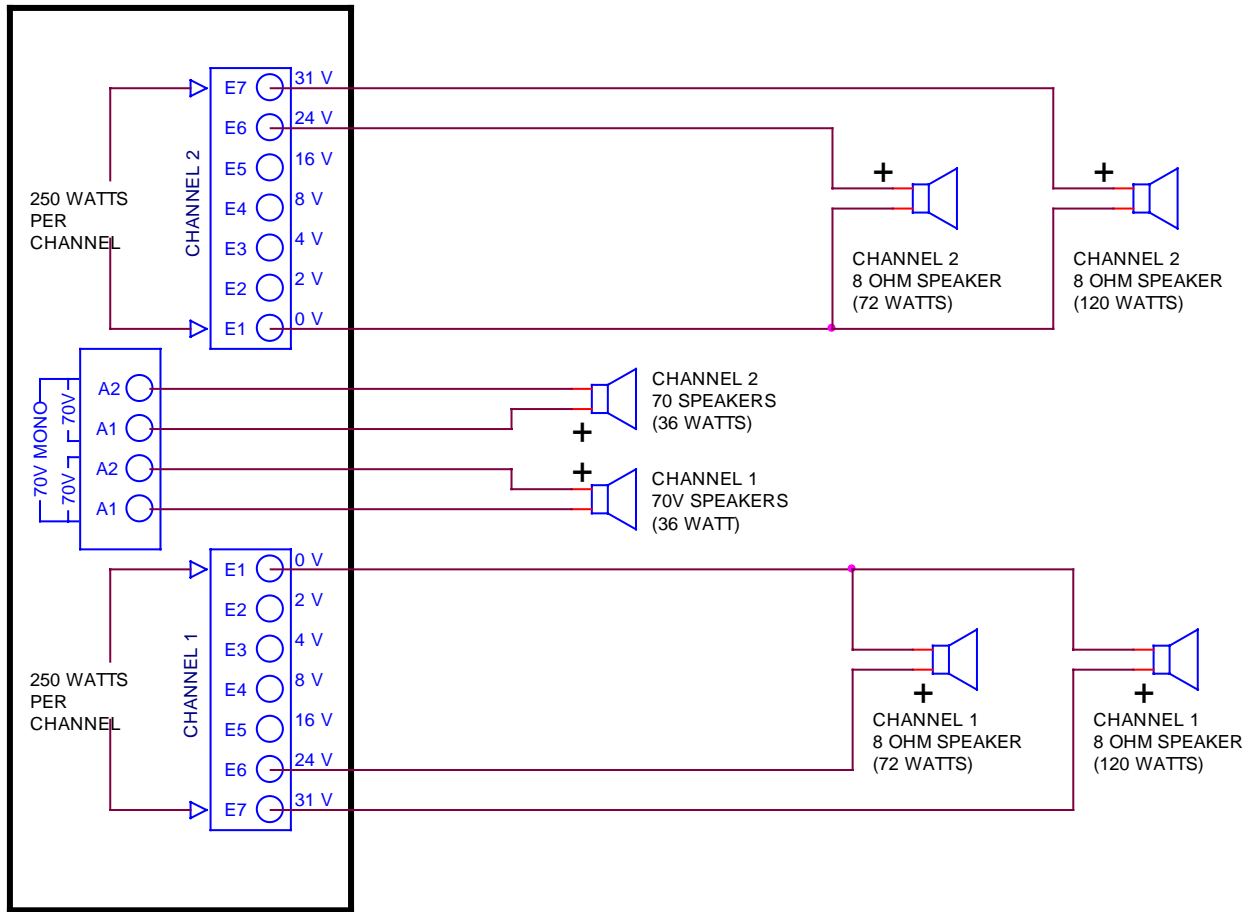
**Load as shown is
192 W per channel for extension speakers.**

**72 W per channel through the transformer
120 W per channel across the amplifier**

NOTES:

- 1. 70V phasing is reversed inside the output transformer assembly.**
- 2. Wattage indicates actual power. Select speakers with a higher rating.**

Figure 2-B



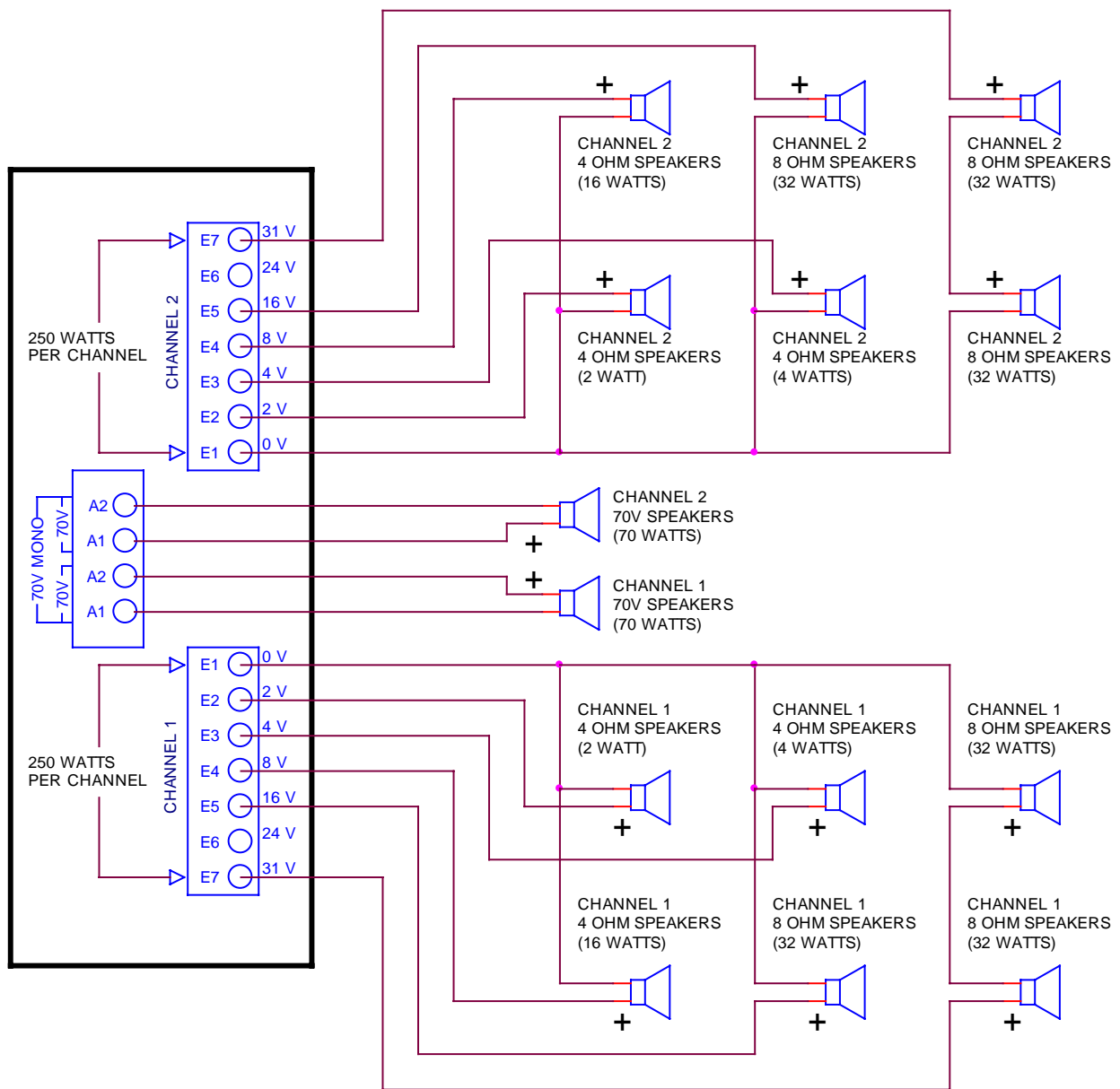
Load as shown is
**36 W per channel for 70V speakers +
 192 W per channel for extension speakers.
 228 Watts total per channel.**

**108 W per channel through the transformer
 120 W per channel across the amplifier**

NOTES:

- 1. 70V phasing is reversed inside the output transformer assembly.**
- 2. Wattage indicates actual power. Select speakers with a higher rating.**

Figure 2-C



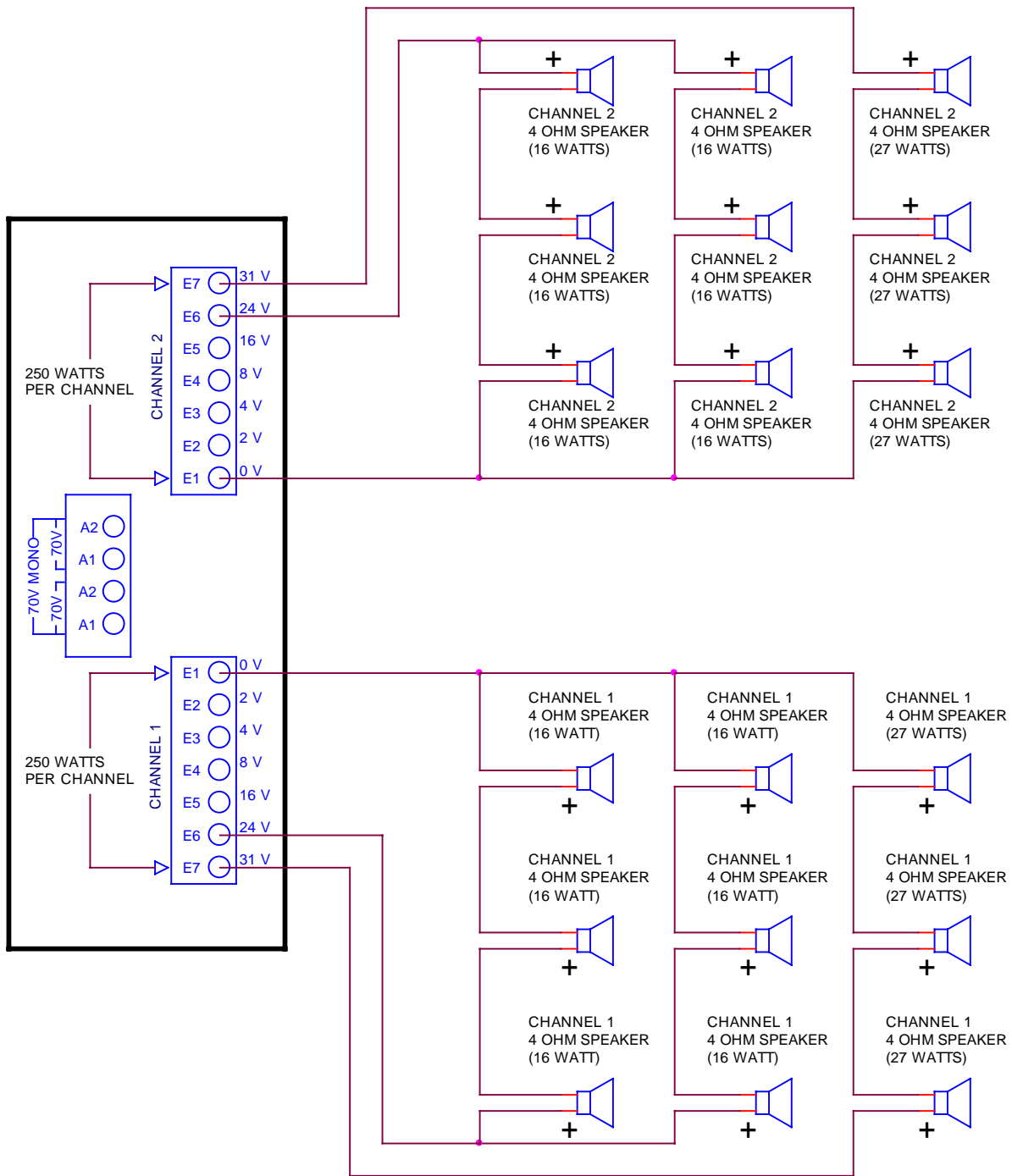
Load as shown is
70 W per channel for 70V speakers +
118 W per channel for extension speakers.
188 Watts total per channel.

124 W per channel through the transformer
64 W per channel across the amplifier

NOTES:

- 1. 70V phasing is reversed inside the output transformer assembly.**
- 2. Wattage indicates actual power. Select speakers with a higher rating.**

Figure 2-D



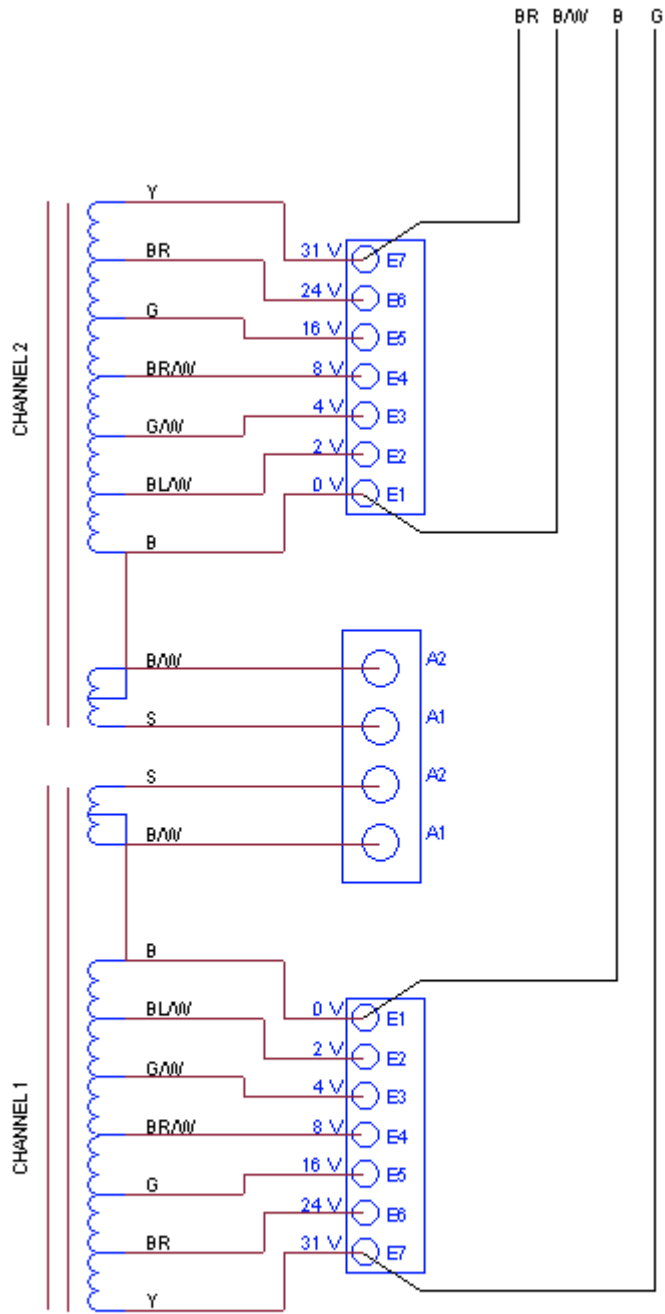
**Load as shown is
177 Watts total per channel.**

**96 W per channel through the transformer
81 W per channel across the amplifier**

NOTES:

1. 70V phasing is reversed inside the output transformer assembly.
2. Wattage indicates actual power. Select speakers with a higher rating.

Figure 2-E



40832124 Audio Output Transformer
Wiring Diagram