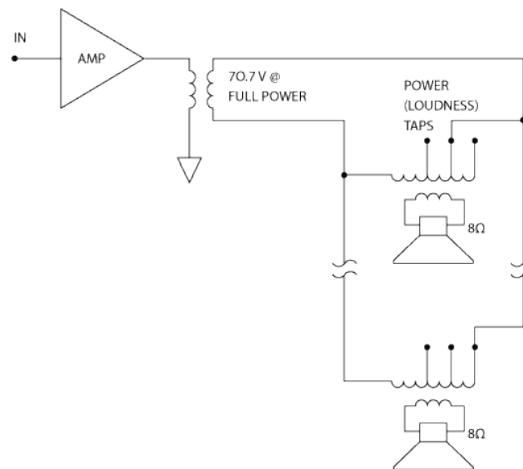


ISP Technologies HDDS High Definition Distributed System vs 70 volt Constant Voltage Systems

Background: 70 Volt distributed audio systems have been in use since the late 1920's and became a standard in the US in 1949. It is of notable interest that technology introduced in the 1920 is still common place in 2017. While this technology was state of the art in the late 1920's it is anything but high tech today. The basic concept is that many speakers can be connected in a network by increasing the impedance of the speakers by using matching transformers. Connecting multiple speakers, which are typically 8 or 4 ohms in a parallel network would produce an extremely low load impedance which becomes impossible to drive especially over long distances. The output voltage of the power amplifier used is increased by using a step up transformer allowing the use of step down impedance matched transformers in each speaker. In the diagram below the output of the power amplifier is connected to a step up transformer with a higher impedance output. The output voltage is stepped up and so is the output impedance of the transformer. Each speaker then has a step down transformer in the speakers with several output taps, which allow different power to be delivered to the speaker. There are many disadvantages to this design concept developed in the 1920's.



Disadvantages

- **Frequency Response:** Inexpensive transformers are used especially in the speakers and these transformers will have poor reproduction of both the low and high frequencies.
- **Distortion:** Overdriven transformers can add ringing distortion to the audio signal. Low cost transformers are prone to distortion at higher power levels, especially with regard to low frequency response. Low level signals can fail to energize a poorly designed transformer core enough to prevent higher than normal amounts of harmonic distortion.
- **Variation:** Unit-to-unit variation can be observed in poorly made transformers.
- **Insertion Loss:** The transformers themselves commonly reduce total power applied to the loudspeakers, requiring the amplifier to be some twenty to forty percent more powerful than the total power that is intended to be applied to the loudspeakers.
- **Capacitance:** To achieve higher power levels, transformers must be physically larger. Large transformers (above 200 watts) begin to suffer from high frequency attenuation due to self-capacitance.
- **More sensitive:** Since constant-voltage systems operate at relatively high impedances, they are more sensitive to small amounts of leakage current and partial

short circuits. Running 70-volt speaker lines in conduit that may collect water can result in crackling sounds heard in the system.

The largest of these problems is the Frequency Response errors and the Insertion Loss. Both of these problems become significant when trying to provide a higher powered high fidelity audio distributed system.

The ISP Technologies Patent Pending HDDS Solution

ISP Technologies High Definition Distributed System (HDDS) is a new state of the art patent pending technology offering performance far beyond that of the 1920's 70 volt systems. There are 3 current patents pending on the HDDS technology. The HDDS innovation uses low voltage and low level audio distributed over Category 6 cable with the power amplifiers built into each speaker. This eliminates the transformer frequency response error, insertion loss, distortion, variation between transformers, capacitance and sensitivity problems. The patent pending HDDS system operates with extremely low voltage of only 20 volts AC plus low level audio connected over low cost Category 6 cable. The 20 volt AC signal is internally rectified and use to drive the speakers with up to 48 watts true RMS. ISP also has a new patented power amplifier technology which can multiply this low voltage to deliver up to 300 watts True RMS power for applications that require a higher power output. The typical 70 volt system cannot deliver more than 100 watts for a single speaker and adding in the insertion loss of the transformers, the maximum power is actually closer to 60 watts. At this higher level power the transformers used inside the 70 volt speaker will also saturate reaching the limits of what the transformer can handle. The distortion and frequency response become seriously degraded at the high power levels.

Figure 1 below shows a block diagram of IPS Technologies Patent Pending HDDS system. The Master Control Hub takes 120 volts AC power from the line and steps this down to 20 volts AC. This low voltage AC is combined with line level audio and is connected via low cost Category 6 cables to the HDDS internally powered speakers.

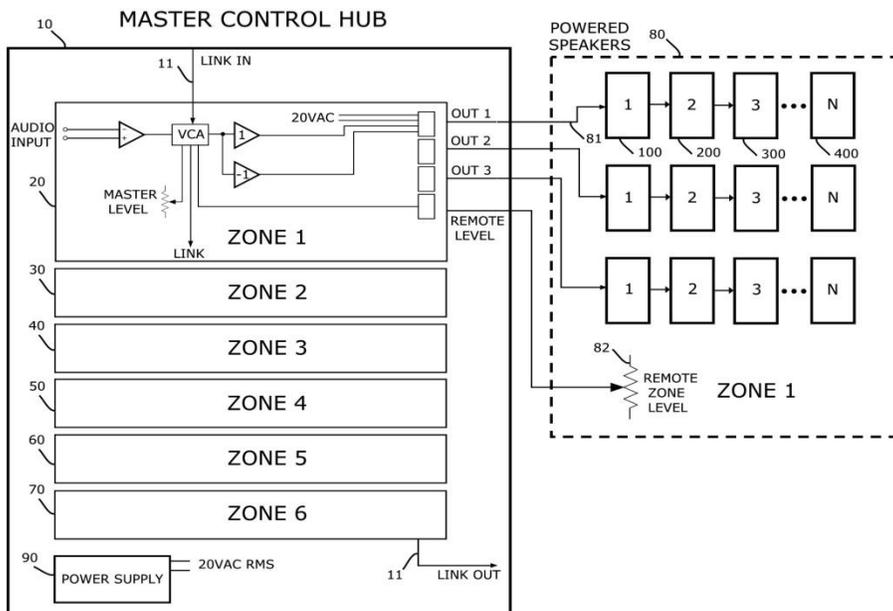


FIGURE 1

Figure 2 below shows a block diagram of the HDDS Powered Speaker. Low voltage power and line level audio is received via an RJ45 standard Ethernet connector. The HDDS speaker includes an on board power supply differential amplifier 105. The speaker includes on board precision crossover network 107 and dual equalization blocks 108 and 109, which are used for precision tuning and equalization for both the low and high band of the HDDS speaker. The equalized low and high band signals are then amplified by power amplifiers 110 and 111 to power both woofer 113 and tweeter 112. The internal available power ranges from 48 watts RMS up to 300 watts RMS. The higher powered HDDS speakers are designed using ISP Technologies patented DAA power amplifier technology, which multiplies the supply voltage up to 6 times to provide upward of 300 watts using only 20 volts of power for the HDDS Master Control Module.

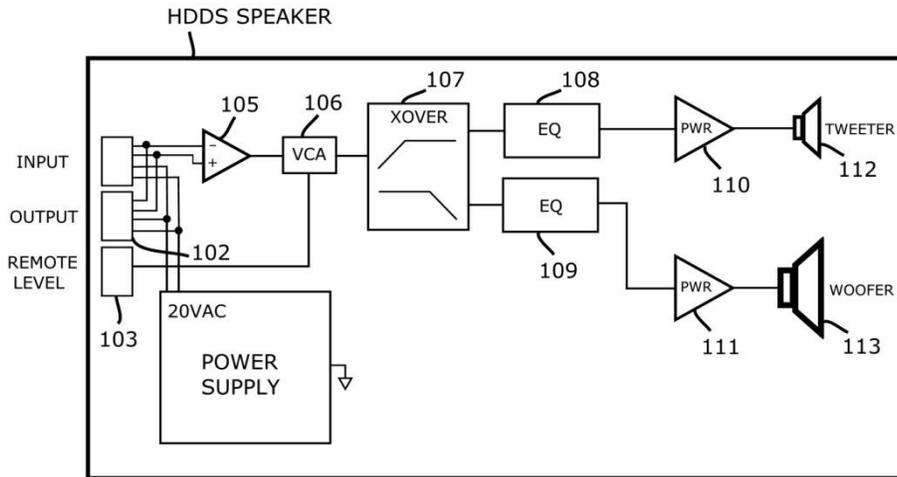


FIGURE 2

The following is a performance comparison between ISP Technologies HDDS SM800 powered 150 watt RMS speaker and the JBL Control 29AV 70 volt speaker powered by a Crown CDi1000 power amplifier is shown below. The JBL sensitivity specification for the Control 29AV is 91db SPL at 1 watt 1 meter. If the Control 29AV can deliver 91db with 1 watt assuming the speaker will remain linear all the way up to peak output level, we will see a 3db increase every time you double the power into the speaker. With the typical insertion loss with a 70 volt system of even 20% and the fact that the maximum power tap available with the Control 29AV is 110 watts you get a maximum available power of 88 watts ($110 - 20\% = 88$ watts) per speaker. Using this maximum available power and the sensitivity specification of 91db and you get a maximum SPL (Sound Pressure Level) output of 110db. Compare this with the maximum SPL of the ISP Technologies SM800 with a true 150 watt RMS power amplifier and you get an 8db higher SPL with the HDDS SM800. Since decibels is a logarithmic scale this means the 8db higher SPL level and the SM800 will play more than two times louder than the Control 29AV.

For those not familiar with audio performance here are a couple of facts.

1 Every time you double the power into a speaker you will get a 3db increase in SPL.

2 A 6db increase in SPL will sound twice as loud to the listener.

This means the SM800 will play more than twice as loud as the Control 29AV. Add to this the fact that each channel of the Crown CDi1000 is rated at 500 watts RMS Maximum and that this power will be divided by the number of speakers connected and you get an actual power per speaker of less than 100 watts RMS and the SPL level will drop once again.

The next major difference is the specified frequency response and the Control 29AV. The Control 29AV specification recommends a high pass of 90Hz when 3 or more speakers are used. This is to help reduce the transformer saturation which causes audible distortion at the low bass frequencies. By contrast the ISP SM800 does not have any low frequency roll off since the power amplifiers are built into the speaker. The SM800 low frequency response goes down to 45Hz. This is a large difference in the low frequency response of the speaker. The other major difference is the perceived clarity and distortion of the two systems. With an 8db higher output and zero transformer saturation distortion the SM800 will provide far superior vocal clarity and a clean articulate bass response. Add to this the fact that the SM800 is internally equalized and compensated to provide a nearly ruler flat frequency response eliminating the peaks and dips in the response. This provides two major advantages. First, a flat frequency response reduces the chance for feedback when using microphones and second, the fidelity of the system is greatly improved due to this internal equalization. This is not possible with a passive crossover. Since the SM800 has an active crossover with a 24db per octave response the voice clarity of the speaker is improved providing an improvement on vocal intelligibility.

	JBL Control 29AV	ISP HDDS SM800
MAXIMUM SPL	110db	118db
Frequency Response	90Hz - 18KHz	45Hz - 19KHz
Insertion Loss	20% typical	zero
Crossover	passive	active 24db per octave
Speaker Equalization	None	internal active = flat

Due to the patent pending operation of the system a Master Control Module is used to distribute power and audio in the network. The Master Control Module is capable of 300 watts of RMS AC power at 18 outputs. This means the Master Control Module can deliver enough power for over 4000 watts RMS of HDDS Speakers. Compared to the two channel Crown CDi1000 the Master Control Module can provide more than 4 times the power for any HDDS System.

Dynamic Adaptive Amplifier Technology (DAA) is used in the higher powered HDDS speakers including the HDDS SM800. This new power amplifier technology is covered under two US patents 9,402,128 and 9,641,133 with a third patent due to issue December 26 2017. The DAA power amplifier technology uses stored energy to dynamically increase low voltage power to the power amplifier and is the only power amplifier technology that can provide high power audio by using stored energy and low voltage power supply voltage. The maximum power available would be limited to 48 watts based on the low voltage HDDS Design. The DAA power amplifier technology increases the maximum power up to 300 watts RMS and is limited only by the available volt-amps using Category 6 wires.

The combined performance improvements with the HDDS and DAA Technology push the level of distributed audio far above the best available 1920's 70 volt distributed audio systems. The HDDS has been in use for a number of year in schools, restaurants,

Universities, Exercise Gyms and has even been selected and installed by the US Naval Academy due to the improved performance.

Overview of advantages of the ISP Technologies HDDS System vs JBL Control 29AV

1. The HDDS System is based on current state of the art patented and patent pending audio technologies vs 1920's distributed audio technology.
2. HDDS Provides a true 150 watts RMS per speaker capable of 118db Maximum SPL compared with the Control 29AV Maximum SPL of 110db
3. The HDDS System with 11 SM800 speakers will deliver a true 1650 watts RMS and 3300 watts Peak vs the Crown CDi1000 dual 500 watts channels powering 11 Control 29AV with transformer insertion loss of approx 800 watts RMS.
4. The HDDS SM800 Speaker will reproduce low bass frequencies down to 45Hz vs 90Hz with the JBL Control 29AV
5. HDDS system does not use matching transformers and provides considerably cleaner low distortion audio
6. The HDDS SM800 Speakers are true Bi-Amplified with dual internal amplifiers, which provides better vocal clarity and intelligibility due to reduced inter-modulation distortion.
7. The SM800 speakers are internally equalized for a flat frequency response reducing feedback and providing greatly improved fidelity.
8. The HDDS System uses state of the art patented Dynamic Adaptive Amplifier technology with higher efficiency than any amplifier available.
9. Ease of installation - plug and play with both power and audio over Category 6 cable.



ISP Technologies 5479 Perry Drive Suite B Waterford MI 48320 Phone: 248-673-7790