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CEA 2006

GET TO THE HEART OF THE CEA'S NEW CEA 2006 AMPLIFIER RATINGS STANDARD WITH ONE OF THE MINDS THAT HELPED DESIGN AND WRITE IT.

So, you just found a great deal on a 3000-watt subwoofer amplifier —3000 watts for only $399. Holy cow! That's almost too good to pass up...well...maybe.

In these days of inflated marketing claims, mature technology, and a battle for your hard-earned dollars, it can be really difficult to sort out all of those performance numbers that appear on amplifier boxes, in the owner's manuals, on marketing brochures, and on amplifiers themselves. What's peak power? What's RMS power? What's signal-to-noise ratio? How about damping factor? I know the answers to those questions. Do you?

If you shop like I do, you probably rely somewhat on salespeople to help you sort out features, benefits, and performance specs. Before writing this article, I went on a few secret-shopper fact-finding missions to test the knowledge of retail salespeople and customers at specialty car audio dealers, regional stereo and appliance chains, and at national retailers. After driving nearly 200 miles in New York traffic, I came to the conclusion that the accuracy of sales pitches isn't predictable, and the technical prowess of many consumers leaves them vulnerable. If you're lucky, you'll get to talk to someone who knows audio. If you're unlucky, you may not. If you don't believe in luck, take a physics course and remember, if it seems too good to be true, it probably is.

During my secret shopper trips, I asked salespeople and customers who were shopping in the same stores a couple of questions: "What's the difference between RMS power and peak power?" and "Why should I buy a 35-watt amplifier if my radio puts out 60 watts?" The answers were varied. Some were correct. The worst answers to my questions sounded something like this: "Peak power is the amount of watts that the amp puts out if you turn this (he pointed to the gain control) knob all the way up, but if you want the amp to sound good, you gotta turn the knob down. RMS stands for 'Real Maximum Something-or-other, I can't remember what the "s" stands for, but it's the amount of clean power the amp makes if you turn the knob down." His answer to the head-unit vs. amplifier question was a little less ridiculous: "An amplifier can make more peak power than a radio even if it has a lower rating."

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Until now, amplifier specifications were loosely based on an old Consumer Electronics Association standard, called EIA 517B. According to the old standard, amplifier companies could rate their product just about any way they wanted to, as long as they indicated the conditions of the test. Power output was originally supposed to be stated as ___watts x ___channels at ___ohms, ___VDC, ___Hz and ___% THD (distortion). This left a wide range of possible values that were meaningful only if all the information was included and only if the consumer knew the relationship between the various specs. Over the years, the form above was truncated, and, in many cases, was stated as ___watts x ___channels at ___ohms. The problem with recent usage is that, in many cases, amplifier ratings from one manufacturer to another aren't apples-to-apples comparisons because different manufacturers state output power at various supply voltages, load impedance, and levels of distortion. Varying supply voltage, load impedance, or allowing high levels of distortion in the output can vary the power output numbers significantly. That makes determining which amplifier is most powerful, best sounding, and the best value for your money a difficult task. How can you sort all of this out without taking four years of electrical engineering courses? Keep reading.

TIRED OF ALL THAT TECHNO MUMBO-JUMBO? ENJOY THIS BRIEF INTERLUDE...

AMPLIFIERS 101

Amplifiers have a simple job. They make small signals that come from the head unit bigger. The head unit sends a low-voltage signal to the amplifier, and the amplifier converts it to a higher-voltage signal which can deliver more current than the head unit can. Amplifiers use power that the battery provides to make up the difference. In short, amplifiers convert the power available from the car's electrical system into power sent to the speaker according to the signal that comes from the head unit.

Amplifiers are people-pleasers — they'll try to make all the power you ask them for without thinking twice about the damage they may cause to speakers or themselves. Every amplifier is designed to have a maximum output voltage and a maximum current delivery. When an amplifier clips, or runs out of voltage or current (voltage times current equals power), it produces distortion. Distortion is that scratchy, crackling sound you hear in a midrange speaker or a tweeter when the system is turned up too loud. If the amplifier is driving a subwoofer, distortion can sound like a "thud" or a "brap" coming from the woofer. It's pretty hard to determine, without some test gear, whether the distortion you hear is caused by a speaker being overdriven or an amplifier being overdriven. In either case, it's a sure sign of impending disaster — something is going to fail, and, usually, it's the speaker.

When you're shopping for an amplifier, there are two really important performance criteria: how loud will it play and how good will it sound? All of the specifications you read on boxes, in brochures, and in owner's manuals should answer those questions in a way that's clear and concise. Fortunately, the car-audio aftermarket industry, along with the CEA (Consumer Electronics Association), has expressed a need for a return to apples-to-apples comparisons. To make that comparison easy for consumers to understand, the CEA has published a new amplifier rating standard called CEA 2006.

SETTING A STANDARD

CEA 2006 differs greatly from the standard it replaces, EIA 517-B. There are now two primary ratings: Output Power and Signal-to-Noise Ratio. These two specs are the most basic indicators of amplifier performance and give fundamental answers to the two questions posed above: How loud can the amplifier play and how good does it sound? There are several other specifications defined by CEA 2006, and I'll explain them all, one-by-one, here.

In order for a manufacturer to be compliant with CEA 2006, there are two specifications that must appear on the product's packaging. Those are Output Power and Signal-to-Noise Ratio. These specs must appear in conjunction with the CEA 2006 logo. (For more information about that, see the sidebar written by Brian Markwalter of the CEA.)

Output Power: All amplifiers are designed to deliver power. This is the spec that indicates just how much power an amplifier can provide. The reference characteristics for this spec are tightly controlled, so this spec provides a true apples-to-apples comparison that's useful when you're trying to figure out which amplifier to buy. Primary Output Power is always expressed as watts RMS and measured with 14.4V DC supply, a 4-ohm load, and with 1% or less total harmonic distortion in the amplifier's output. You may be thinking, "Hey, wait a minute. If I'm going to drive a 1-ohm load, how will I know how much power the amplifier will make driving that impedance?" There are other specs included in CEA 2006 that indicate the

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output power of the amplifier for specialized use, like lower impedance, different supply voltage, or with multiple channels bridged. We'll get to those later.

Signal-to-Noise Ratio: The signal-to-noise ratio of an amplifier indicates how much extraneous noise is present in the amplifier's output signal compared to the signal the amplifier is reproducing. That noise is usually a "hiss" that you can hear in the amplifier's output during quiet musical passages, or when there's no music playing. Better amplifiers have a higher signal-to-noise ratio. The old amplifier rating standard compared the noise to the signal at maximum output power. You may be asking "So, what's wrong with that?" In many cases, more powerful amplifiers have more noise than lower power amplifiers, contrary to what the old spec seems to indicate. Plus, who cares how much background hiss an amplifier makes when you're listening to a pair of 15-inch woofers being driven by a 6000-watt amplifier? You'll never hear the hiss. CEA 2006 requires the noise to be compared to output signal at 1 watt. There's not much music at 1 watt, and that's where the noise is most easily heard. If you're used to seeing signal-to-noise numbers hovering around 90 dB, don't freak out when you look at the new spec. A good amplifier may have a signal to noise rating in the 60 dB range when measured according to CEA 2006. The difference in the two numbers is simply the output power of the amplifier. A 30 dB increase in the signal-to-noise ratio of an amplifier is equal to 1000 watts of output power. A 1000-watt amplifier with a signal-to-noise ratio of 60 dB, measured according to CEA 2006, would have a signal-to-noise ratio of 90 dB, according to the old rating. The new specification is easier to use and provides a clear and concise way to compare one amplifier with another regardless of output power.

AND HERE'S ONE FOR THE LADIES...

ADDITIONAL SPECIFICATIONS

Additional Power Output: Additional output power may be specified at loads other than 4 ohms and supply voltages other than 14.4V DC. This allows the manufacturer to indicate the conditions that make the amplifier perform optimally. If you intend to connect the amplifier to a 1-ohm load, look for a power output rating that indicates performance into 1 ohm. If you'll use the amplifier in SPL competition, and want to provide more than 14.4V DC as a supply, look for an additional Power Output spec that indicates performance with a higher supply voltage. If you'll bridge the amplifier, look for an additional spec that indicates what the amplifier's output will be when the channels are bridged. This is the spec that's intended to indicate what you should do to get all the power that you paid for from your amp. It's not necessarily an apples-to-apples comparison, unless the reference characteristics between the two amplifiers you're comparing are the same.

Dynamic Power: This spec used to be called "headroom". Headroom was an indication of how much power an amplifier could make reproducing short bursts or musical transients. Amplifiers can make more power when reproducing transients than they can sustain for long periods of time. Headroom used to be stated in decibels, but dynamic power is expressed in watts. It's easier to understand without breaking out your scientific calculator to convert dB to watts. You always carry a scientific calculator when you shop, right?

Frequency Response: The frequency response spec indicates the range of frequencies that the amplifier will reproduce. It's not different from the old frequency response spec, but, these days, nearly every amplifier made can easily reproduce the full audio band (20 Hz-20 kHz) unless it's an amplifier designed to drive only subwoofers. Good frequency response is available in almost every amplifier made now, so the importance of this spec when comparing amplifiers isn't what it used to be.

Maximum Input Signal: This spec indicates the maximum amount of signal voltage that the amplifier

can take without overdriving (clipping) the input section, which increases the amount of distortion in the output signal. If the spec is 5V, it doesn't do any good to connect a preamp that outputs 9V.

Maximum Sensitivity: This spec indicates the minimum input signal voltage that's required to drive the amplifier to full output. If the spec is 250mV, a head unit with a maximum output voltage of 100mV won't allow you to get full power from your amplifier.

Effective Damping Factor: This replaces the old "Damping Factor" spec, which was originally used to indicate how much control an amplifier could exert over the speaker's moving cone. It's a hotly debated topic. If you're used to seeing damping factor specs of 500 or even 1000, you'll be surprised to find that nearly every amplifier available for use in cars will have a spec between 6 and 7. Why, you ask? Because amplifiers have gotten much better over the years and they all have relatively low output impedance and that's the characteristic upon which the damping factor spec is based. Effective Damping Factor better indicates the difference in audible performance between amplifiers than the old spec. In other words, it's really difficult to hear the difference between a damping factor of 500 and a damping factor of 1000. Now that difference will be expressed more accurately as the difference between, say, 6.39 and 6.85.

Output Regulation: This is a more meaningful representation of the effects output impedance. To completely explain output regulation may require another article, but here's a simple explanation: If an amplifier has high output impedance, especially if it's close to the speaker's impedance, the frequency response of the amplifier's output will no longer be "flat". Rather, it will resemble the impedance curve of the speaker. Output regulation is an indication of how much the frequency response may change when the amplifier is connected to a 4-ohm load. If the amplifier is connected to a load of lesser impedance, the error will be greater. For most amplifiers, the error will probably be less than a decibel, but if the output impedance is high, the amplifier's output, and, consequently, the speaker's output, may be reduced by a dB or more at frequencies where the speaker's impedance is lowest. An amplifier with a big number in the Output Regulation column may dramatically change the frequency response of the system.

CEA 2006 states that "*Power amplifiers designed for use in mobile applications include, but are not limited to: separate single and multi-channel, integrated amplifiers, and bandwidth-limited amplifiers that are connected to, and rely solely on, the vehicle's primary electrical system for power input and have output power ratings of greater than 5 watts when measured in accordance with CEA-2006.*" Hmmm...you may be thinking, "OK, so what does that mean?

Check this out: CEA 2006 defines an integrated amplifier as, "*A power amplifier integrated into a device whose primary purpose is not power amplification. An integrated amplifier, for example, may be the amplifier contained in a head unit whose primary purpose is media playback...*" That's right, head units are included in the rating standard. Enough said.

It's important to remember that manufacturer's compliance with CEA 2006 is voluntary. The CEA isn't the Federal Trade Commission and can't compel amplifier manufacturers to adhere to the spec. CEA 2006 isn't the law, it's just a good idea and was designed to help you and your customers make an informed decision about the amplifiers you'll spend your hard-earned money on. Look for the CEA 2006-compliant spec on the amplifier's box to be sure you're getting all the power you're paying for. Only you and your customers can compel amplifier manufacturers to adhere to the new rating standard.

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WHAT THE CEA-2006 LOGO MEANS

BY BRIAN MARKWALTER

Last year, CEA's Mobile Electronics manufacturing members recognized the need for a standard that defines how to measure important amplifier performance specifications. Product rating in accordance with CEA-2006, the resulting standard, allows the consumer to compare important parameters on an equitable basis. Since the outcome of this exercise is intended to benefit the consumer, it's critical that consumers know which products and ratings do indeed comply with the standard.

This is where the logo program comes in. CEA created the above logo and licenses use of the logo to manufacturers for use on products and in product literature. The rules for logo use are pretty simple, as long as products comply with the specifications established in the CEA-2006 standard. Manufacturers can use the logo exclusively with CEA-2006 ratings, that is, when there are no other ratings on the product that might be confused with CEA-2006 ratings. In this case, the logo can be used anywhere on the product. In the second case, manufacturers can use the logo on products with CEA-2006 ratings and other ratings not accommodated by CEA-2006. In this mixed-use case, the manufacturer must co-locate the logo with the CEA-2006 ratings and visually separate the logo and these ratings from other ratings on the product.

A large and growing list of manufacturers are already supporting the program. CEA and its mobile electronics members are backing the program with outreach to retailers and promotion to raise awareness.

Look for the logo on 2004 head units and amplifiers.