



P R I M A R E

THE SOUND AND VISION OF SCANDINAVIA

## UFPD Amplification

Primare's exclusive **Ultra Fast Power Device**, or **UFPD™**, is the result of three decades of dedication to creating industry-leading amplifiers. This experience led to the eventual understanding that no other design topology could offer the total package of advantages that a properly implemented class D design could provide.

- Instant and Sustained Delivery of Immense Power – lightning-fast rise times, over the entire operating frequency bandwidth.
- Precise Control of that Power – flat frequency response, independent of speaking load, in part due to low output impedance.
- No Noise – as a result of this power delivery capacity, very low total harmonic distortion throughout the entire audio band, coupled with extremely low overall system noise.
- No Heat – virtually no heat generated by the amplification technology, even at full output, reducing the need for the kind of heat dissipation that inevitably leads to longer signal path and much larger physical design associated with more conventional solid state or tube amplifier designs.
- Compact Electrical and Physical Design – due not only to the lack of heat generated by this technology, but also to the inherently small size of the module, the amplifier's electrical design can be astonishingly compact, leading to the shortest possible signal path and contributing to lower noise and distortion – and further to compact physical designs that allow for ease of placement, for both improved sonic and aesthetic considerations.
- Considerate of the Environment – minimal power draw from the AC mains circuit, particularly at idle, and virtually no effect on the total system's AC power environment when used with Primare's **APFC** (Active Power Factor Correction) power supply.

Based on these inherent capabilities, Primare has optimized the performance of its innovative **UFPD** amplifier module designs with a precise selection of circuit component values and quality, verifying the design with extensive measurement and, of course, careful listening.

This research led to the development of an equally unique isolated power supply for the UFPD modules: APFC technology uses the full energy potential of the AC line, providing controlled and unfailingly constant power to the UFPD modules on demand and in such a way that if even 1,000 watts is taken from the mains, other equipment in the system will not be affected. The amplifier's presence becomes virtually invisible to the mains voltage! Meanwhile, at idle, barely any power is drawn from the outlet, conserving energy in either extreme.

Which means that a Primare **UFPD** amplifier module can provide massive, stable, low-distortion power output over the entire ruler-flat frequency bandwidth into any speaker load with minimal operating power draw from the wall and no negative effects on the power supplied to partnering system components – and all that with positive considerations for AC power demands and heat, leading to an easily installed, compact cabinet.

Using variations on these synergistic circuit topologies, Primare creates amplifiers of absolutely convincing capabilities, characterized by an inherently musical, balanced, and harmonious sound that allows for explosive power with rhythm, agility, and finesse.

At Primare, **UFPD** is the ultimate building block for the present and future production of amplifiers that provide the most revealing and musical performance, bringing the listener closer to the recording than ever before.

### **How UFPD is like an all-electric car**

**UFPD** may be better explained through a comparison to modern high-end electric cars, with electric powertrains being seen as the future of performance, as is becoming clear in some of the latest offerings from the automobile industry.

Well-executed, high-performance, all-electric-powered luxury performance cars, such as those made by Tesla, have many virtues in addition to fuel economy and low carbon footprint. What they have is immediate transfer of torque, meaning power, to the wheels, providing them with instantaneous speed, while producing virtually no heat or noise from their compact electric motors optimally positioned to transfer that power to the wheels they are driving. That's zero emissions with acceleration from zero to 60 mph in, for example, just over 3.0 eerily silent seconds for one remarkable new model.

To see what this is like, go to the link below for a short film made by DragTimes:

Tesla S P85D Insane Mode Launch Reactions Compilation [Clean Version]  
<https://www.youtube.com/watch?v=1qFV5i8tBhs>

Manufacturers of super cars, like BMW, Porsche, McLaren, and Ferrari, as well as the Formula One racing governing body, have taken notice of these virtues and created hybrid "hyper-cars" (costing anywhere from around \$135,000 to \$1,350,000, and, in the case of Formula One cars, multiple millions more) that utilize a combination of their traditional internal combustion engines with high-performance electric motors to wring the last bit of performance from their vehicles that the old technology internal power plants, no matter how advanced, simply cannot provide on their own.

In comparing the performance characteristics of Primare's **UFPD/APFC** based amplifiers to an all-electric high-performance car **UFPD**, the following similarities can be found:

- Instant and Sustained Delivery of Immense Power – the first and foremost characteristic most enthusiastically commented on by anyone lucky enough to drive an elite all-electric or hyper-car vehicle) is its ability to deliver full power instantaneously, for astonishingly fast starts off the line. Unlike conventional power plants, these advanced motors do not need to spool up the revs in order to apply the torque needed to set the vehicle in motion.

Primare's **UFPD** power module also provides instantaneous power delivery as a result of very fast rise times supplying immense current, allowing for explosive dynamics and massive power delivery, on demand, as needed.

Additionally, in an electric car this power delivery remains smooth and constant from standing start to top speed, or, in the Primare amp, from silence to full output – a marked distinction from the shift lag, or crossover distortion, found in more conventional power delivery systems, whether automobile engine or audio amplifier.

- Precise Control of that Power – in an electric super car, the ability to efficiently deliver power to the drive wheels is aided in part by the fact that an electric car's engines can be positioned closer to the wheels they drive, enabling more direct transfer of power. As an example of this effect, what sets the one of the newest "higher-performance" Tesla P85D all-electric cars apart from the already class-leading performance found in earlier P85 models is that the new version has double the motors, providing more balanced and direct power distribution to all four wheels with astonishing improvements in already remarkable performance, for sheer speed as well as crisp and precise handling.

In a parallel, the class-leading Primare A34.2 stereo amplifier, powered by two **UFPD** modules (one per channel), provides exemplary performance, in part due to the short signal path allowed by the **UFPD** technology that enables more direct and noise-free delivery of the audio signal. Now, the new A60 reference class stereo amplifier from Primare's 60 Series builds upon the A34.2's performance by doubling the number of **UFPD** modules to two per channel, delivering power to each half of the balanced stereo output of the amplifier, providing remarkable improvements in performance, and resulting in unparalleled power with control.

- No Noise – another attribute noted by drivers of electric cars is their eerily silent operation – so quiet that, in some cases, the cars' audio systems have been equipped with the ability to duplicate the sound of a powerful gas engine, for those who miss that familiar noise from past experience. The same surprise holds true for **UFPD** amplifiers, in that the absolutely silent backdrop upon which they present the musical spectrum can be unfamiliar for those used to the noise inherent in the sound of older, more conventional amplifier topologies. (But unlike with cars, users of **UFPD** amps tend not to miss the noise for long!)
- No Heat – the electric car motors produce virtually no heat, which means no bulky radiator and cooling systems, allowing them to be more compact, even with the necessarily large size of their battery packs. Similarly, the **UFPD** design does not require massive heat sinks to cool transistors or the space for exposed super-heated tubes to be able to remain stable and in optimal operating conditions.
- Compact Electrical and Physical Design – not only for a lack of need for cooling, but also because electric motors, like the full **UFPD** amplification module, are remarkably small, electric vehicles can be compact yet provide surprisingly large interior space and load capacity. (One particular all-electric, five-passenger four-door coupe, for example, has more cargo space than several popular mini-vans, including two trunks, front and rear, with the rear "trunk" allowing for additional child seating for two.)

In the case of the **UFPD** module, even the most powerful stereo amp and seven-channel amplifier from Primare is housed in a remarkably compact cabinet, allowing for the possibility of placement in smaller spaces and convenient installation in environments that would not be able to accommodate similarly powerful amplifiers of more conventional design.

- Considerate of the Environment – electric cars are “fuel” efficient and have a low carbon footprint. In this aspect, the **APFC** power supply is quite similar, requiring little power at idle, or even when called upon to deliver high current during bone-crushing dynamic peaks, as well as having the quality of “zero emissions,” by not sending noise back down the AC line to pollute the electric environment serving the other components in the system.

In sum, a Primare **UFPD/APFC** amplifier is the best high-performance vehicle for being transported by the sheer beauty of peerless sound for the present, as well as for the future.

### For the more technically inclined

The term "Class D" is sometimes misunderstood as meaning a "Digital" amplifier. While some Class D amps may indeed be controlled by digital circuits or include digital signal processing devices, Primare's **UFPD** modules operate entirely in the analogue domain. Basically, the **UFPD** amplifier module takes an analogue input sine wave and converts it into a high-frequency pulse-width modulated square wave for amplification. This square wave is then filtered, resulting in an amplified analogue sine wave at the output.

Many of the performance benefits derived from class D amplification are the result of the significantly greater ability of the circuit to deliver more of the power fed into it as musical signal output.

- Class A 20% efficient
- Class B 50% efficient
- Class AB 75% efficient
- Class D 90–95% efficient

Primare builds upon this basic efficiency advantage in the **UFPD** circuit design by treating all signals equally, regardless of frequency or slew rate. This results in the ability to suppress filter resonance entirely. Consequently, THD is kept very low at all frequencies. With a very wide “load independent” frequency response, **UFPD** amplifiers are able to drive virtually any speaker with control and accuracy.

Rather than have the amplifier and filter as discrete stages, the **UFPD** design integrates the two, making control with feedback much more immediate and accurate. The **UFPD** amplifier actively adapts the feedback loop gain to keep the total loop stable during startup, clipping, and current limit. It senses the changes to the filter output and compensates by applying the precise amount of feedback. This adaptive control allows for several more dB of constant loop gain across the audio band and maintains performance irrespective of load (impedance) variations.

The **APFC** power supply controls the current from the mains voltage so that it is a pure sine wave with the same frequency and phase as the mains voltage. The isolating stage of the converter works in a ZVS mode, and as a result, the switch flanks contain a lower quantity of harmonics, providing lower EMI and a clean environment for the amplifiers to work in.