

Class D Audio: Product Selection Guide

A class D amplifier comprises three basic sections: the Pulse Width Modulator (PWM), which converts the audio signal into high frequency pulse waveform; The MOSFET Gate Driver, which level shifts and buffers the PWM signal suitable for driving the output MOSFETs; and the output stage, which includes a low pass filter in addition to the MOSFETs.

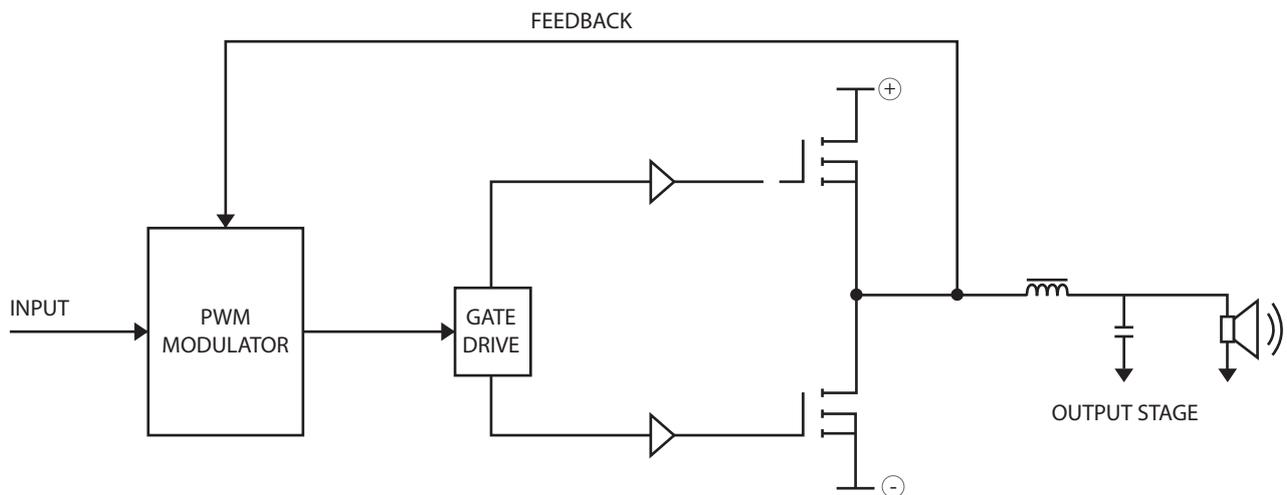


FIG. 1: TYPICAL CLASS D

There are several solutions for the modulation stage and MOSFET gate drivers, which often entail combining the two functions in a single integrated circuit. The disadvantage of combining the two stages in one IC is that the integrated circuit will need to be fabricated on a high voltage process, which is an expensive process.

A pure class D modulation stage is simply a triangle wave generator plus comparator, that transforms the audio content into a higher frequency signal. Distortion and noise arises for many reasons, including distortion in the triangle wave, imperfect comparator with finite slew rate and offset. In addition, there will be imperfect MOSFET switches, ground bounce and dead time. Feedback can be used to improve performance, and there are several proprietary methods from complex digital processing as used in Tripath's Class T ICs, to the all analog "Adaptive Modulation Servo" patented by Anaview.

For further information and guidance there are many useful application notes featuring integrated modulation ICs including: TC2001, TC2002A, TCD6000, Si824, IRS20957, IRS2902, IRS2052, IRS2053 and IRS2093...

For a complete solution, including a switch mode power supply, Anaview modules offer very high performance and are production ready (see Fig.2). Just add input processing.

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Part no.	Auxiliary supplies	Power into 4Ω	Pkg	Comments
ALC0100-2300	+/-14, +8V	2 x 50W	ALC0100	Stereo with mains PSU
ALC0180-2300	+/-14, +8V	2 x 90W	ALC0180	Stereo with mains PSU
ALC0300-1300	+/-14, +8V	1 x 300W	ALC0300	Monoblock with mains PSU
AMS1000-2600	+/-17, +5.5V	2 x 500W	AMS1000	2x500W Class D Amp

FIG. 2: ANAVIEW AMPLIFIER COMPARISON

Output Stage

The output stage MOSFETs are critical components in a class D design, as they will have a big effect on audio performance. Total Harmonic Distortion plus Noise (THD+N) is often thought to be the definitive figure of merit for audio quality in power amplifiers, and it is often only specified at 1 kHz. However, an amplifier with high THD+N can sound “good” and an amplifier with a low THD+N can sound “bad”. One important criteria to consider is which harmonics comprise the THD+N, and what interaction there is between signals of different frequencies, particularly the higher frequencies. The closer to ideal switching you can achieve the less “dead time” is needed, resulting in lower high-frequency intermodulation distortion (IHF-IM). The lower the IMF-IM the better the amplifier will sound.

A figure of merit for output MOSFETs is often used to compare performance, which is the Gate charge (Qg) x On Resistance (RDS on) - the lower the better. This is used as there is usually a trade off between Qg and Rds. Lower Rds results in lower on state losses, lower Qg in lower switching losses.

Sanken’s next generation low Qg MOSFETs offer a significant step forward in performance for class D amplifiers because they combine low Qg and low Rds on.

	Vds	Rds	Qg	Rds x Qg	FIGURE OF MERIT
GKI-06071-5G	75	10	25	250	
GKI1094-5G	100	30	17	510	

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Part no.	Vds	Id	Power	Rds	Trr	Qg	Pkg	Comments
2SK2701A-2G	450V	7A	35W	1.10Ω	0ns	0nC	TO220-ISO	N Ch Mosfet
2SK3199-2G	500V	5A	30W	1.50Ω	0ns	0nC	TO220-ISO	N Ch Mosfet
EKI-06051-5G	60V	85A	135W	0.0050Ω	46ns	45nC	TO220	N Ch Mosfet
EKI-10126-5G	100V	66A	135W	0.010Ω	55ns	45nC	TO220	N CH Mosfet
FKI-06051-5G	60V	69A	42W	0.0050Ω	46ns	45nC	TO220-ISO	N Ch Mosfet
FKI-06108-5G	60V	39A	38W	0.010Ω	35ns	17nC	TO220-ISO	N Ch Mosfet
FKI-07076-5G	75V	55A	42W	0.010Ω	48ns	43nC	TO220-ISO	N Ch Mosfet
FKI-10126-5G	100V	41A	42W	0.010Ω	55ns	45nC	TO220-ISO	N Ch Mosfet
FKP202-4G	200V	45A	40W	0.530Ω	-	-	TO220-ISO	N Ch Mosfet
FKP250A-4G	250V	50A	85W	0.430Ω	-	-	TO3P	N Ch Mosfet
FKP252-4G	250V	25A	40W	0.750Ω	-	-	TO220-ISO	N Ch Mosfet
GKI-06071-5G	60V	40A	77W	0.0050Ω	41ns	27nC	Outline	N Ch Mosfet Surface Mount
GKI-06259-5G	60V	22A	40W	0.020Ω	29ns	7nC	Outline	N Ch Mosfet Surface Mount
GKI-07113-5G	75V	40A	77W	0.010Ω	44ns	25nC	Outline	N Ch Mosfet Surface Mount
GKI-10194-5G	100V	40A	77W	0.020Ω	49ns	27nC	Outline	N Ch Mosfet Surface Mount
GKI-10301-5G	100V	26A	59W	0.030Ω	44ns	17nC	Outline	N Ch Mosfet Surface Mount

FIG. 3: FULL SANKEN MOSFET RANGE