Power Limiting

QSC's Power Limiting is a patent-pending technology that limits the power driven into a loudspeaker, thereby protecting it from thermal failure. Thermal failure may result when excessive power is driven into a loudspeaker for a sufficient amount of time, causing the loudspeaker's materials to exceed their thermal limits. The actual power driven into the loudspeaker is determined by measuring both the voltage and current at the output of the amplifier. Power Limiting is available on dataport-equipped models of BASIS™.

QSC's Power Limiting Difference

QSC's Power Limiting is different from limiters that measure only the output voltage of the amplifier. These so-called "power" limiters make assumptions about the load placed on the amplifier to estimate the power delivered to the loudspeaker. In some cases, the loudspeaker is assumed to be a fixed resistive load. A loudspeaker's impedance, however, varies with both frequency and temperature and cannot be estimated by a fixed resistive load. Since QSC's Power Limiting measures both the voltage and current at the output of the amplifier, the actual power driven into the loudspeaker can be calculated in real time.

The effect of Power Limiting is nearly imperceptible, as it was designed to be audibly transparent. Attenuation to the output level occurs over a relatively long period of time (typically seconds), and only a small amount of attenuation is required to significantly reduce the power level. For example, a 1 dB decrease in level reduces the power by 20%. Power Limiting reduces power to the loudspeaker by only the amount necessary to keep it within safe operating limits.

Why *Power* Limiting?

Loudspeakers are notoriously inefficient. In fact, most of the power driven into a loudspeaker is converted to heat in the driver's voice coil. This heat builds up and increases the voice coil's temperature. Gradually, this heat will be transferred to the driver's magnet and frame over several minutes or hours. The rate of temperature increase depends on the materials used to construct the loudspeaker's drivers.

If the temperatures of the materials that comprise a loudspeaker's drivers rise above their safe operating temperatures, they may begin to degrade, affecting the loudspeaker's performance and increasing the risk of premature failure. If their temperatures rise high enough, the driver may experience catastrophic thermal failure — the driver's materials may break, melt, or in rare cases, catch fire! In addition, increased temperatures make the loudspeaker more susceptible to *excursion* failure, since many of the materials that comprise a loudspeaker become weaker when hot. Excursion failure results when a large magnitude signal forces the driver beyond its mechanical limit.

Some Background

In practice, limiting the temperature of the voice coil will effectively limit the temperature of the magnet as well. Magnets made from rare earth materials such as neodymium have magnetic properties that can be irreversibly affected by temperatures achievable within a loudspeaker. Fortunately, many modern drivers are designed such that the voice coil reaches its thermal limit before the magnet does; therefore, we only need to be concerned with the temperature of the voice coil. Provided that we safely limit the temperature of the voice coil, we can be assured that the temperature of the magnet will remain within its safe operating area.

The continuous power that a loudspeaker can handle before it reaches its thermal limit is not simply the published power rating of the loudspeaker. A loudspeaker is rated by the power it can safely handle over a specified period of time. As the loudspeaker's temperature increases during use, its impedance rises, and the power driven into the loudspeaker decreases. This is called *power compression* and is shown in Figure 1.

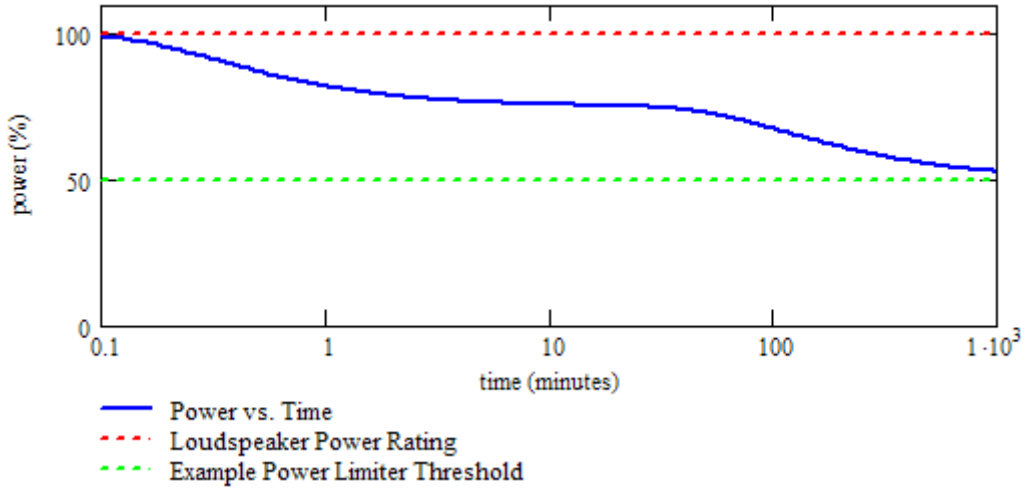

Figure 1. Typical Power Compression vs. Time.

The rated power is the power initially delivered to the loudspeaker, but by the end of the test, significantly less power is actually delivered. The Power Limiting threshold is based on a conservative estimate of the power that can be handled by the loudspeaker when it is hot (during power compression). In other words, the threshold is a derated version of the loudspeaker's power rating, and the derating factor depends on the method used to determine this rating.

A driver's voice coil heats up at a certain rate; likewise, it cools at a similar rate after signal has been removed. Power Limiting needs to know this rate so it can reduce power before the voice coil heats excessively and maintain this power reduction until the voice coil has cooled sufficiently. This rate is determined by the size of the voice coil and the materials that comprise it.

How to Set Up Power Limiting in QSControl.net

Power Limiting parameters for QSC loudspeakers are shown in Table 1. Simply look up your loudspeaker from the table and enter the values into QSControl.net.

Loudspeaker	Driver	Power Limit (W)	Averaging (sec)	Attack (sec)	Release (sec)
AD-S82H		111	8.4	1.7	5.2
ISIS 102	High	25	1.7	0.9	2.8
	Low	111	20.5	2.5	7.6
ISIS 122	High	25	1.7	0.9	2.8
	Low	130	15.3	2.2	6.7
ISIS 152	High	25	1.7	0.9	2.8
	Low	130	15.3	2.2	6.7
MD-F122	High	25	1.3	0.9	2.6
	Low	148	28.7	2.9	8.8
MD-F152	High	25	1.3	0.9	2.6
	Low	148	24.0	2.7	8.1
MD-L115		259	29.1	3.0	8.9
MD-L118		259	29.1	3.0	8.9
DCS HF-63		25	1.3	0.9	2.6
DCS HF-75		25	1.7	0.9	2.8
DCS MH-1063	High	25	1.3	0.9	2.6
	Mid	111	8.3	1.7	5.1
DCS MH-1075	High	25	1.7	0.9	2.8
	Mid	111	8.3	1.7	5.1
DCS LF-3115		167	15.3	2.2	6.7
DCS LF-3215		333	15.3	2.2	6.7
DCS LF-4115		222	29.1	3.0	8.9
DCS LF-4215		444	29.1	3.0	8.9
DCS LF-4315		667	29.1	3.0	8.9
DCS SR-110		83	8.4	1.7	5.2
DCS SB-5218		444	29.1	3.0	8.9
DCS SB-7218		519	29.1	3.0	8.9

Table 1. Power Limiting parameters for QSC Loudspeakers.

Power Limiting may be used with loudspeakers that have passive crossovers. Simply use the parameters for the low frequency driver to set up Power Limiting. Typically, there is far less power in the high frequency spectrum of audio signals. As a result, the high frequency driver will experience proportionately less temperature increase.

Power Limiting may also be used with loudspeakers that are chained, or wired in parallel, as long as the loudspeakers are the same type. Simply multiply the recommended threshold for one loudspeaker by the number of loudspeakers.

WARNING: While Power Limiting can significantly reduce the possibility of thermal failure, it will not protect against excursion failure. The system designer must still insure that the driver's excursion limits are not exceeded by limiting excess headroom at the amplifier and/or using peak limiters at the end of the signal chain.

Disclaimer: While Power Limiting has been designed to significantly reduce the possibility of thermally-related loudspeaker failure, QSC makes no guarantee that Power Limiting will prevent loudspeaker failure, thermal or otherwise.