MIT Output Terminator Series Two - A Look at Energy, Efficiency, & Audio Cables

Energy is the ability to perform work; energy is expended when work is done. Power is the rate at which work is performed. Power is always related to time.

The music signal, in its electric form, is comprised of voltages and currents. (Each frequency is composed of its own voltage and current.) On their way between source and load, these two elements are stored for a short time in the cable as energy. These stored elements combined form a final component that MIT calls the **Energy Component**. (This Energy Component is to electricity what gasoline is to an automobile engine.) The Energy Component is ultimately released and transported to the load as **Transportable Power**. In transportation, how well the cable maintains phase relationships between voltage and current MIT quantifies as **Efficiency**.

Brief Tutorial on Joules, Watts, & Horsepower

(1) Joules. Electrical energy is defined in joules: 1 joule equals 1 watt in 1 second. (2) Watts. This energy is released over a specific period of time as power, quantified in watts. In a speaker cable, for instance, this energy will ultimately be converted to power at the speaker in a stereo system. The speaker draws energy from the cable (as well as the amplifier's power supply) and converts it to power. An important concept concerning power in an electrical circuit is that before true power, or watts, can exist, some type of energy change or conversion must take place. In other words, electrical energy must be changed or converted into some other form of energy - heat or mechanical energy - before there can be power or watts. (3) Horsepower. When James Watt first began to try to market steam engines, he needed a way to compare them to the horses they were to replace. After conducting experiments, Watt found that the average horse could work at a rate of 550 foot-pounds per second This became the basic horsepower measurement. Horsepower can also be expressed in the basic electrical unit for power, which is the watt: 1 horsepower equals 746 watts.

MIT Terminator Technology, Energy & Efficiency

Typical cables store very little energy and have problems transporting the Energy Component to the load efficiently. The new MIT Output Terminator **Series Two** technology stores more energy and is able to store this energy in a more stable, noise-free manner than was possible in the 330/750 Series. In addition, these new Output Terminators transport the Energy Component to the load with even greater Efficiency.

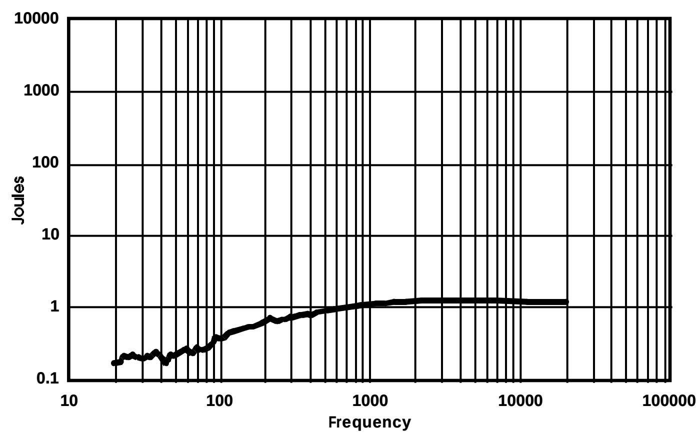
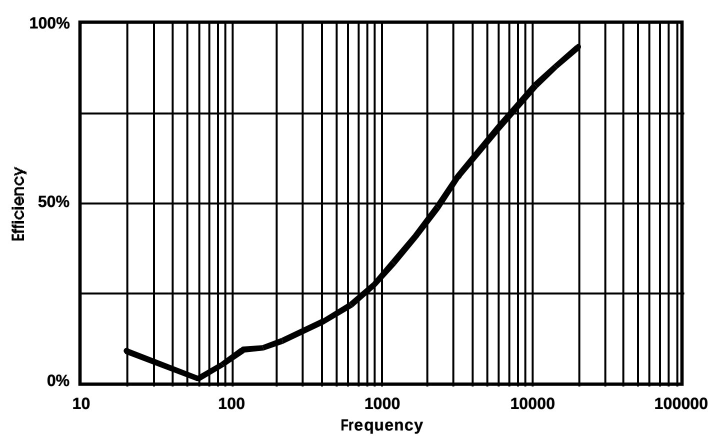


Figure 1A. (above) **Energy Component, Typical Inexpensive Audio Cable**. This is a typical cable sold in audio stores worldwide. Note how little Energy Component this type of cable stores (rising to 1.3 joules). Also note the non-linear manner in which the cable stores this Energy Component (dropping down to about 0.2 joule at 20 hertz). **Figure 1B.** (below) **Efficiency, Typical Inexpensive Audio Cable**. Note how inefficiently the cable transports the small amount of energy it has stored (reaching the 50% line, -3 dbw down point, at about 2.5 KHz).



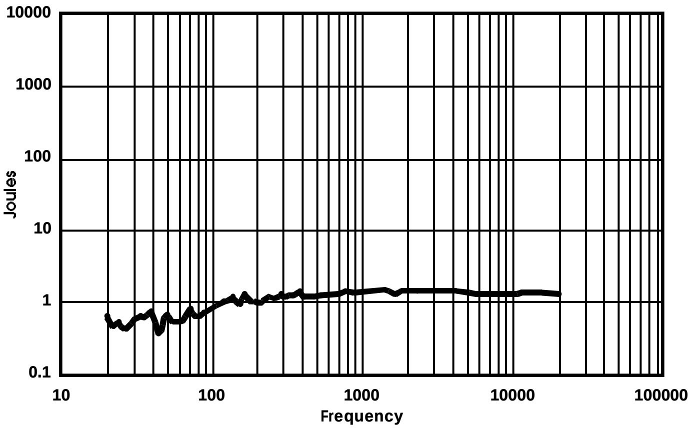


Figure 2A. (above) **Energy Component, High End Audio Cable.** This is a high-quality high end cable sold throughout the 1980s. Although this cable stores a little more Energy Component than the cable in Figure 1A, and stores it a little more linearly (dropping only down to 0.6 joule at 20 Hz), it transports its Energy Component more efficiently. As you will see, however, this still leaves much to be desired see.

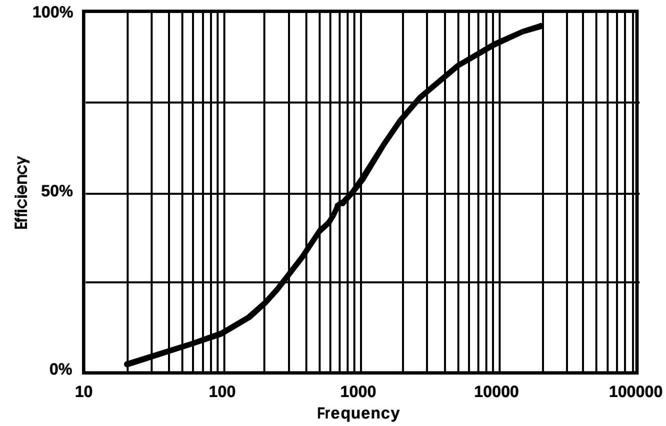


Figure 2B. (above) **Efficiency, High End Audio Cable.**

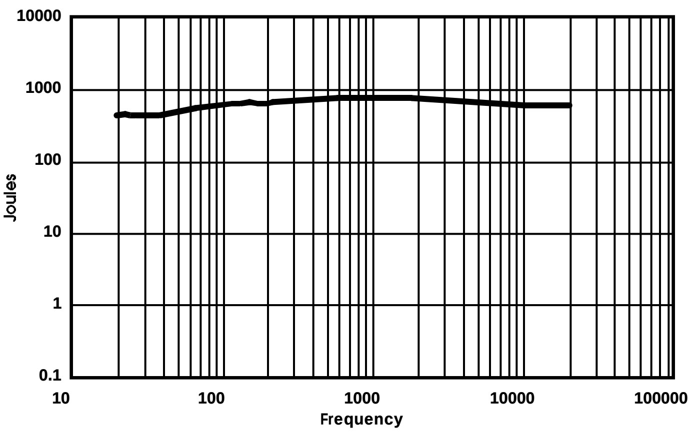


Figure 3A. (above) **Energy Component. The new MH-750 Plus Series Two.** In comparison to the two other plots, notice how much more Energy Component the MH-750 Plus Series Two has stored (rising to 723.5 joules). Note also how much flatter and more linear the response is to frequency.

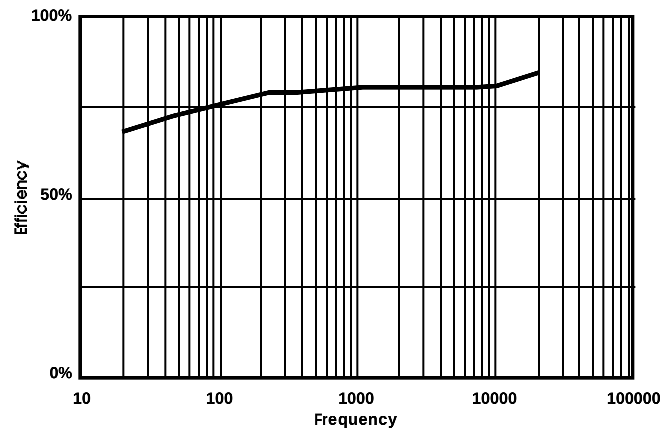


Figure 3B. (above) **Efficiency, MH-750 Plus Series Two.** Notice how much more efficiently the MH-750 Series 2 transports the power to the load as compared to the other two products, Figures 1B & 2B.

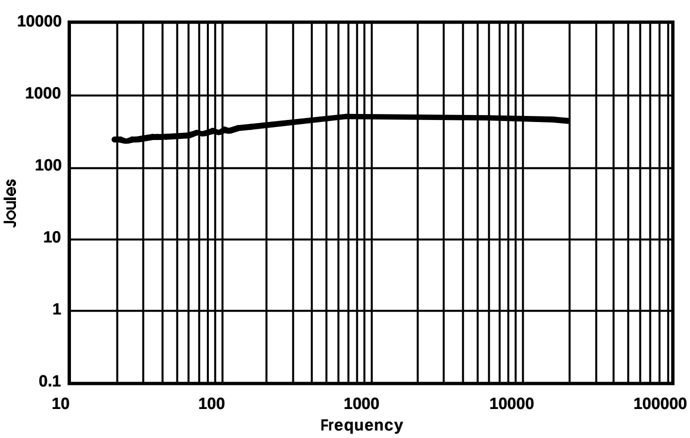


Figure 4A. (above) **Energy Component of MIT's Original MH-750 Plus.** These test results show the clear superiority of the MIT Output Terminator technology over "Just Cable."

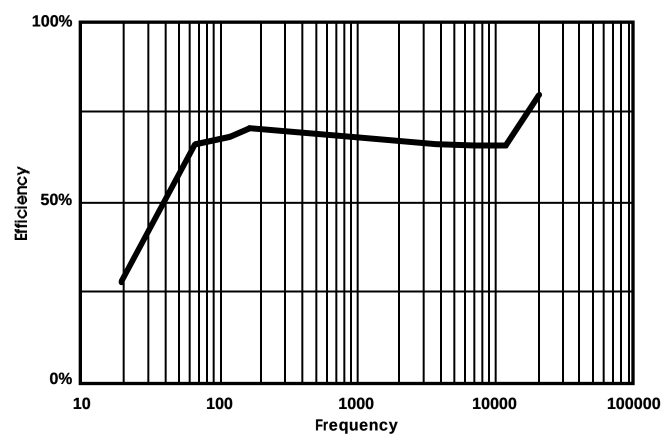


Figure 4B. (above) **Efficiency, Original MH-750 Plus.**

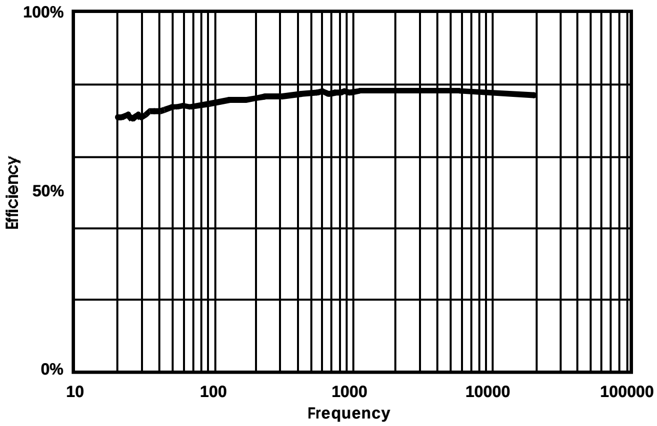


Figure 5A. (above) **Energy Component of MIT's Original MH-750 HE.**

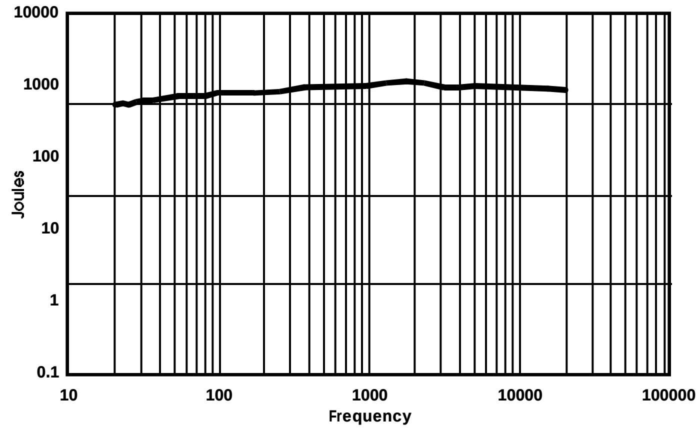


Figure 5B. (above) **Energy Component of the MH-750 HE Series Two.** Note that the new MH-750 HE Series Two has about 17% more Energy Component as well as a flatter response to frequency than the original.

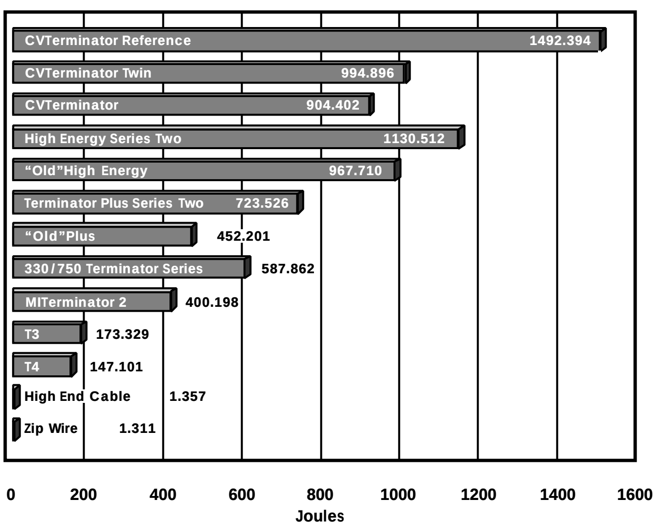


Figure 6. (above) **Comparisons, Energy Component.** This plot shows several MIT interface products compared with inexpensive audio cable and with high end cable. Remember, energy is released over a specific time as power, quantified in watts.

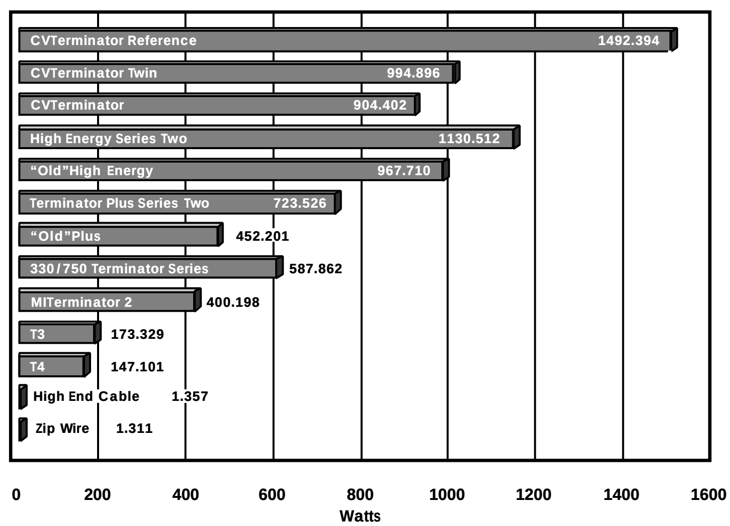
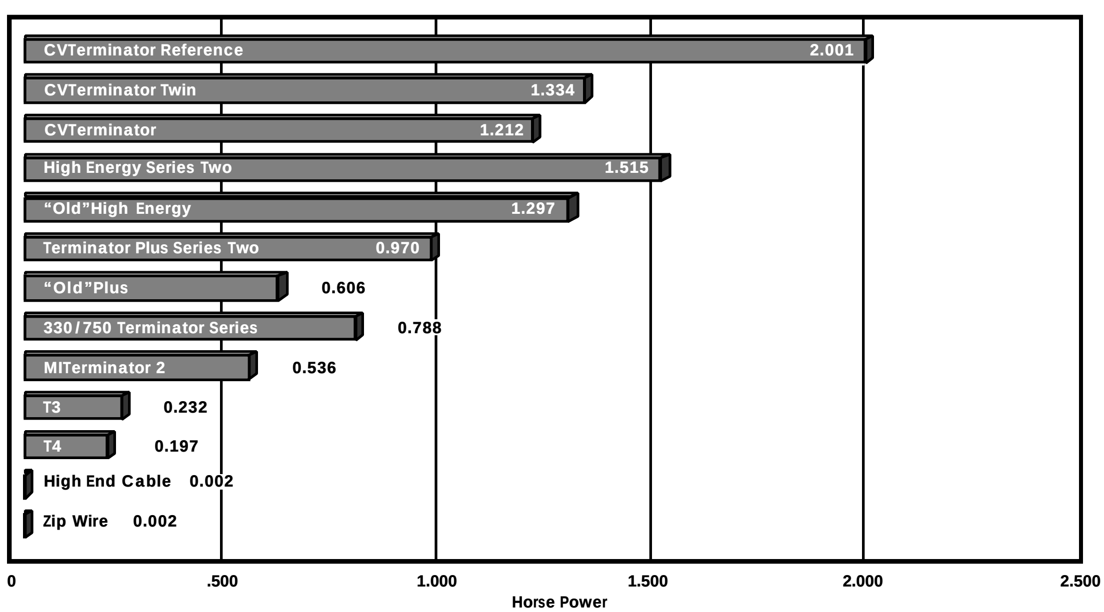


Figure 7A. (above) **Transportable Power.** This plot shows several MIT interface products compared with inexpensive audio cable and with high end cable. Remember, electrical energy must be converted into another form of energy before it can be call "watts." If 1 joule equals 1 watt in 1 Second , then 1492 joules would develop 1492 watts in 1 second!

Figure 7b. (right) **Transportable Horse Power.** Courtesy James Watt. Or as Mr. Watt also taught us, 1 HP equals 746 watts, so **MIT's MH-770 Reference CVTerminator transports 2.001 HP** in the same period of time "just cable" transports .002HP. Thank you, Mr. Watt!



A Note on the Measurements

In the calculation of the energy and power figures used in this paper, voltage and current must be entered into our simulator. When normal line levels are used, the energy actually stored is quite small - on the order of microjoules. This results in plots with axis scales in scientific notations that re difficult to read and understand.

In deference to humans accustomed to dealing with "normal" number, therefore, we increased the voltage and current to bring the energy and power up to comprehensible levels. While the levels were increased greatly, the same line levels were used for all products, and **no matter what the levels, the magnitude of difference between all products remains the same.**

Hardware used on this project:

QuadTech 7400 Precision LCR Meter

HP 428a Precision LCR Meter

Software used on this project:

Microsoft Windows NT

Microsoft Excel

Mathematica

Stanford Graphics

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