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# Comparison of Active Filtered Cigar/Cigarette Lighter Cables/Cords

**Don Dorward, VA3DDN**

Manufacturers of Amateur Radio equipment still offer accessory 12-volt plug-in mobile power cables for handhelds (HT), but they are usually advertised as 12-volt power adaptors with noise filtering. These are actually *not* “chargers”; nor are they regulated power sources. They are intended specifically as filtered power sources to operate your HT while in your car or boat.

The automotive (or boat) electrical system is known for transients, alternator whine and the like.

The “business” end of the adaptor is designed to plug into any conventional cigar(ette) lighter outlet, commonly found in automotive vehicles and boats.

***Note:*** *In today’s cars, these outlets are mostly referred to as DC power outlets, but they may also be called auxiliary power outlets, automotive power sockets and so on.*

In my own experience, I used the Kenwood PG-3J adaptor (see Figure 1) in my boat for several years to power my trusty Kenwood THF-6A Tribander while boating on Lake Scugog and the Trent-Severn Waterway in central Ontario. Powered from the boat’s 12-volt battery and charging system, it always worked like a charm without any interference or noise.

Recently, I came across another similar unit, the Alinco EDC-36 shown in Figure 2 and that prompted me to have a look at what’s inside both of these electronic filters to compare the two. The photos and schematics provided here show the main plug-in end of each adaptor, which contains a built-in fuse and the electronics. A DC power cord with plug is attached to connect to a compatible HT.

When I first cracked these power adaptors open, I was expecting to see some kind of inductor and one or more capacitors. However, I found no sign of an inductor, just a few ordinary looking capacitors, transistors and a small aluminum heatsink. However, the circuit inside each is configured to act as what is called a “Capacitance Multiplier” (CM).

In a capacitance multiplier, one or more transistors are used to make an ordinary capacitor function like one that is very much larger and, logically then, more effective in filtering out noise and/or ripple.

In the Kenwood PG-3J circuit shown in Figure 3 on the next page, an NEC C4331 transistor has been used as Q1, and I assume due to its extraordinarily high current gain of typically 200. Smoothing capacitor C3 is 2200 μF, but together with Q1 it is made to function like a capacitor of 200 x 2200 μF, or 440,000 μF!

In the circuit, Kenwood has also added varistor R1 to help protect against transients greater than 16 volts.


**Figure 1: Kenwood PG-3J filtered cigarette lighter adaptor.**

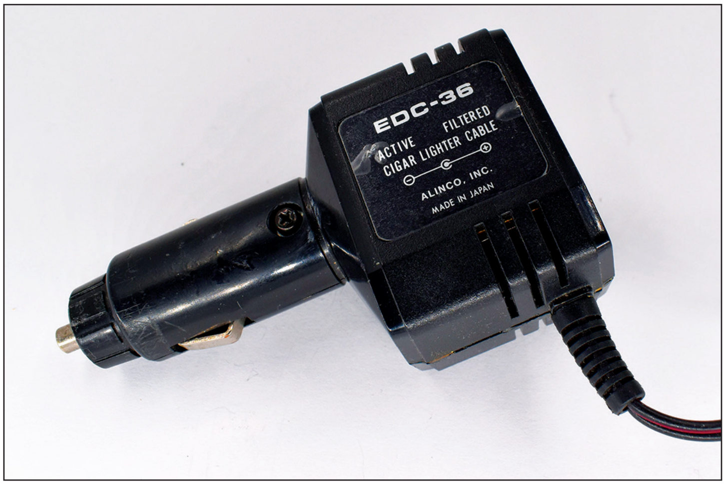


**Figure 2: Alinco EDC-36 mobile cigarette lighter adaptor.**

In the Alinco EDC-36 circuit shown in Figure 4, transistors Q1 and Q2 are connected in the well-known “Darlington” configuration, where the current gains of the two transistors multiply.

If we assume the current gain of each is approximately 100, then the overall current gain becomes 100 x 100 or 10,000.

Here smoothing capacitor C3 (330 μF) – together with both Q1 and Q2 – are made to function like a capacitor of 10,000 x 330 μF, or 3.3 Farads!

Using the gain of transistors in this way to simulate large value capacitors has been around for a long time, although not in what I would call common use.

In addition to being effective in reducing or eliminating noise and ripple, a further advantage of the capacitance multiplier is space saving in power supply design, by allowing the use of physically smaller capacitors.

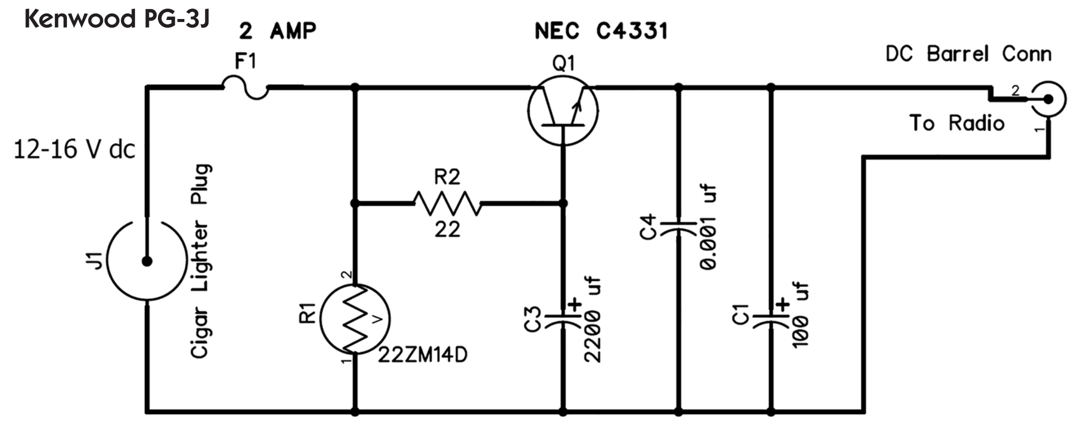


Figure 3: Schematic of the Kenwood PG-3J filtered cigarette lighter adaptor.

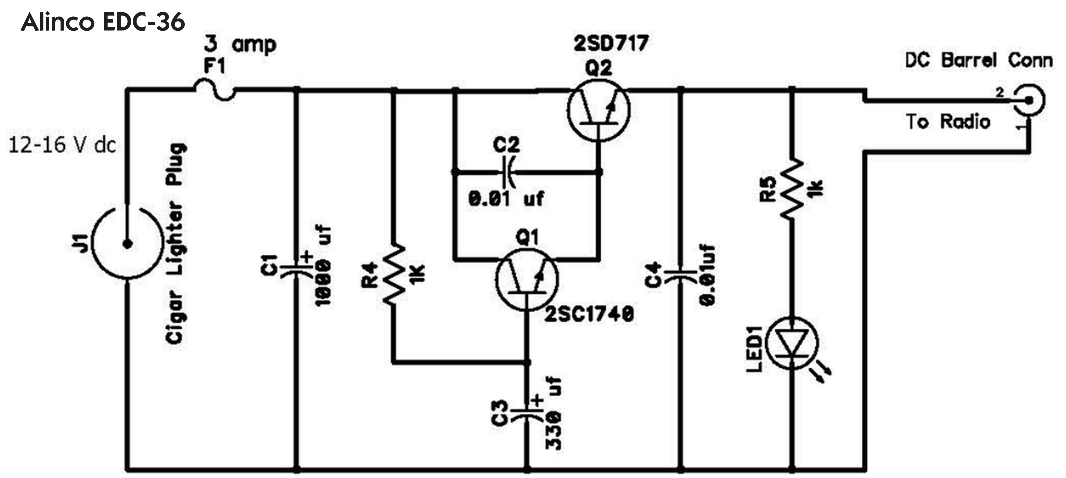


Figure 4: Schematic of the Alinco EDC-36 mobile cigarette lighter adaptor.

Interestingly, I have also found the CM circuit used in some instruments made by Hewlett Packard and have recently learned that audio industry circuit designers also often employ the circuit in power amplifiers to reduce hum.

## Variations

In the above two examples, both have used transistor-based circuits: one is a basic single transistor; and the other uses a Darlington pair for increased gain, thereby allowing a smaller capacitor.

Note that the two-transistor Darlington pair is readily available as a single transistor package; for example like the TIP131 or TIP132.

Another variation of the Darlington pair is called the Sziklai complementary pair, where the second transistor is of opposite polarity as shown in Figure 5 on the right.

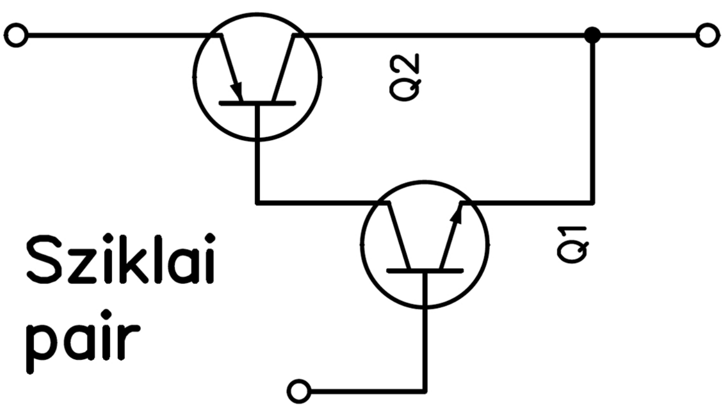


Figure 5: Schematic of the Sziklai complementary pair.

The configuration offers approximately the same high current gain as the Darlington, but the voltage drop across the series pass transistor is reduced and overall dissipation is slightly lower. It doesn't seem to have been widely accepted as there is no single integrated package of the Sziklai pair that I am aware of.

Note that the CM effect can be achieved in at least two more ways:

a) As a Mosfet-based capacitance multiplier

b) As an Operational amplifier-based capacitance multiplier

Both of these are beyond the scope of this present article and I encourage readers to research the topic.

## Reference:

"A Simple Capacitance Multiplier Power Supply for Class-A Amplifiers" by Rod Elliott, https://sound-au.com/project15.htm