

# The Elec-Trak Rides Again



## Reviving G.E.'s Electric Lawn Tractors

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Above: General Electric's 20 horsepower Elec-Trak E20 on the left and the 10 horsepower E10 on the right.

**T**he '70s sure were exciting. We saw the end of the Vietnam war, Nixon and his Watergate, the Arab oil embargo, Three Mile Island, and the General Electric "Elec-Trak" riding lawn tractors.

The Elec-Trak is a battery-operated lawn tractor. It was produced by General Electric in the early '70s. The power of these tractors ranged from the small 8 hp E8 to the 20 hp E20, with several models in between. Each tractor operated on a 36 volt DC system, supplied by lead-acid batteries. The battery pack consisted of six 6 volt golf cart batteries, or in the case of the smaller E8, three 12 volt batteries.

On the E8 and E10 tractors, the 36 inch (91 cm) mower deck was suspended below the belly of the tractor. Two 36 volt mower motors each turned an 18 inch (46 cm) mower blade. There were two blades and two mower motors on each deck. Most of the larger models had the mower deck out in front of the tractor, though some were longer in order to hold the mower deck under the tractor's belly. In either case, the cut width was increased to 42 inches (107 cm), using three motors driving three cutting blades.

Along with increases in horsepower, the larger models grew in complexity. Many of them had an electric lift motor to raise or lower the front-mounted mower deck. This lift motor could also raise and lower the snow blower. Why, the E20 even came with cruise control!

### Attachments

The entire line of Elec-Traks ran on 36 volts DC. You could purchase many attachments for the tractors, including a chain saw and a DC to AC rotary inverter. There was a snow blower and a tiller that would plug

Below: This beat-up E10 still works like a charm.

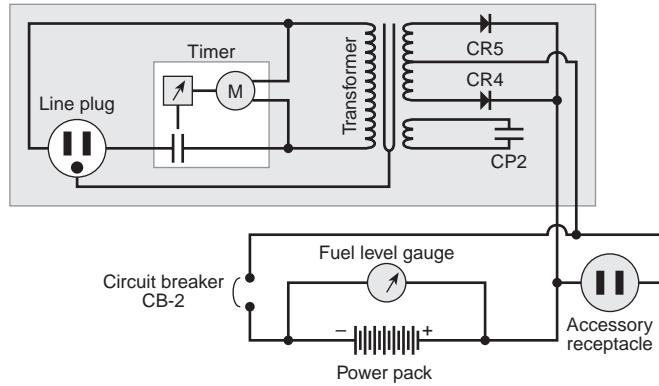




Above: Donna's hedge trimmer plugs directly into this E15 Elec-Trak.

All Elec-Trak chargers work the same. The heart of the charger is the specially wound ferro-resonant transformer. The output of the transformer is routed to two large diodes mounted on a heat sink. The transformer, along with a capacitor, regulates the current flow into the battery bank. To prevent overcharging the batteries, a motor-driven timer switches the charger off. No electronics are used to control the charging current to the battery bank.

**Figure 1: E10 Charger Circuit**



into the PTO (power take-off) that the mower deck normally used. With such foresight, many people in the '70s said the Elec-Trak was 20 years ahead of its time!

With one of these electric tractors, you could mow your yard and then trim the hedges without using a drop of gasoline. There was no oil to change or dirty oil to discard. When you were done, you plugged in the on-board charger and set the timer. Recharging a depleted battery bank required about twelve to eighteen hours.

### A Rose by Any Other Name

General Electric sold the rights to build their tractors to several different companies. Wheelhorse and New Idea produced the Elec-Trak under their own labels. Wheelhorse models were red, and used a completely different model-naming scheme. A Wheelhorse C145 is the same as a General Electric E15. New Idea changed the color scheme to orange and cream. Under the New Idea brand, the tractors were called EGT or Electric Garden Tractors. Although the basic tractor remained the same, each supplier made various changes in the circuitry and mechanics of the machines.

### Elec-Trak E10

Because of the sheer numbers of E10s produced, you are more likely to run into one of these than any other Elec-Trak. Also, of all the different models, the E10 is by far the easiest to get back into working condition. Plan to pay from nothing to about \$200 for a used E10. Prices will vary of course, depending on the condition of the basic tractor and battery bank.

The E10 can be broken down into four main components: battery charger, main drive motor, PTO, and mechanical subassemblies. If you find an E10, it's a good bet that the battery bank is kaput! The batteries in my E10 were fourteen years old. Remove a few battery caps and check for water. If the cells are empty or below the plates, don't add water. Instead, remove and replace the batteries. There are three 6 volt golf cart batteries in the front and three under the seat. I replace worn out batteries with Trojan T-105s.

Also, while you're working on the batteries, check the battery cables for cracked ends and burnt wires. The original E10 came with 6 gauge ( $13 \text{ mm}^2$ ) wire. I replaced mine with 4 gauge ( $21 \text{ mm}^2$ ) stranded wire. Mark the cables so you know what went where. It's best not to install the new set of batteries just yet, as you may need to repair the charger.

### On-board Charger

All Elec-Trak tractors use the same charger. The only differences between models are the physical shape of the mounting plate and the location of the charger. In our E10, the charger is under the steering column. The charger's schematic is shown in Figure 1.



Above: The three motors on the out-front mower deck of an E20.

By using a clamp-on DC amp probe and a Fluke 73 meter, I measured over 21 amps of charging current flowing into the batteries after a mowing job. After ten hours or so, the charging rate drops to about 10 amps. The finished charge current levels off at 6 amps. The bank of six batteries are wired in series for a 36 volt system with 220 amp-hours of storage. A complete sixteen-hour charge would be equal to about 10 KWH.

#### Testing the On-board Charger

You can test the charger without removing it from its hiding spot. With the batteries removed, connect your voltmeter to the positive and negative battery cables. Plug in the charger and move the timer knob past the "start" position. You should hear a loud hum from the transformer and read at least 39 volts on your meter. If you do, then the charger is working correctly.

However, if your meter reads 20 volts or so, then one of the diodes has opened. If the meter reads about 30 volts, the capacitor is defective. On two different occasions, I've found one of the wires leading to the capacitor had fallen off. Since these tractors take such a beating, look for loose wires before digging too deep.

If the transformer growls loudly, and the voltmeter reads zero, quickly unplug the charger. One or both of the diodes may be shorted, or there might be a rare short circuit on the battery side of the charger. There are no breakers or fuses on the AC input side of the charger. A 50 amp circuit breaker on the battery side is supposed to protect the charger in case of a short circuit between

the charger and the batteries. If this circuit breaker trips when the charger is unplugged, but with batteries in the circuit, then both diodes are shorted or there is a external short between the batteries and the charger.

No hum from the transformer and no output usually means a defective timer switch or connector. It's also possible to have an open primary winding on the transformer, but that's rare. Pay attention to the wires leading to and from the timer switch. These tend to fall off, shutting down the charger. Also, the wires coming out of the transformer will be brittle due to heat and old age. Use care when handling them.

#### Fixing the Charger

If one or more of the above tests indicates a faulty charger, the charger must be removed from the tractor for repair. The only way to get to the charger is by removing the front two batteries. If the battery compartment is badly corroded, then all three batteries must be removed to make extra room for the hammers and pry bars you'll need! There is a plastic tray on the bottom of the front compartment. Remove this tray by pulling it out. Be mindful of flying crud. Eye protection is a must!

With the plastic tray out, you'll need to remove three bolts on each side of the tractor. These bolts hold the charger mounting plate to the tractor's body. The bottom two bolts will probably be too corroded to be used again. Replace the hardware with stainless steel bolts and nuts when you reassemble the unit. With all

Below: The timer control knob is clearly visible on the E20 charger. The PTO socket is at lower left.



six bolts removed, tilt the top of the charger plate toward the front of the tractor. With the top of the charger exposed, the capacitor can be seen on the charger mounting plate, beside the transformer.

There should be two wires coming from the capacitor. Make sure they are both connected securely. If the wires have become disconnected from the capacitor, connect them and retest the charger before removing it from the tractor. This could save you a lot of time and effort.

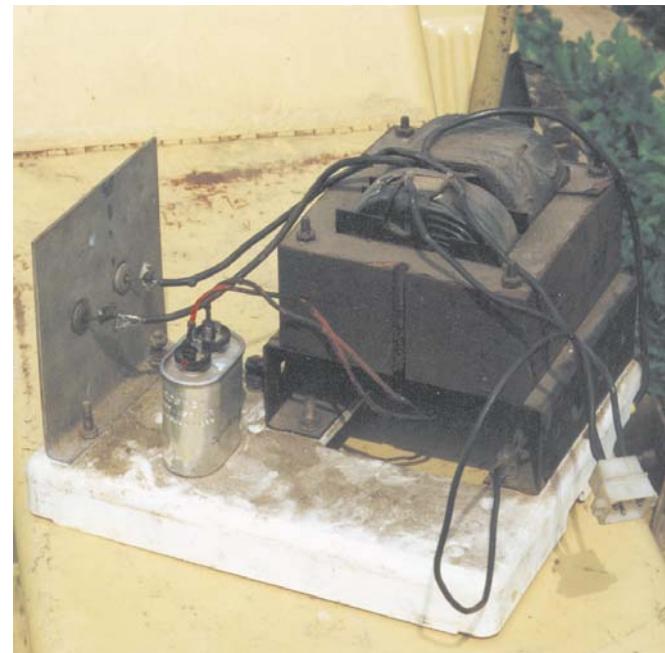
To make removal of the charger easier, I like to remove the deck plate under the transmission shift lever. To do this, unscrew the ball from the shift lever. Remove the bolts holding the deck plate. Lift the plate up over the shift lever. This exposes the main drive motor and the back side of the charger. Now it's easier to access the wiring harness leading to the charger.

If you need to remove the charger from the tractor, unplug the nylon connector leading from the timer motor. You will also need to remove the negative lead from the post on the charger and the positive lead connected to the heat sink. With these wires removed, you can take the charger out of the tractor. This sounds easy enough, but there may be enough corrosion from the battery acid to make it a struggle.

#### Testing for Bad Diodes on the Charger

One or both of the diodes on the heat sink may be no good. There are two wires coming from the transformer to the diodes, one wire to each diode. Unsolder both wires. Use your VOM (volt-ohm meter) to find the defective diode. With your VOM set to measure resistance, a shorted diode will read about zero ohms from cathode to anode, and zero ohms from anode to cathode too. Since a diode is like a one-way valve, you'll need to reverse the test probes while checking diodes. An open diode will show infinite ohms between cathode and anode. A good diode will show about 500 ohms in one direction and about 25 ohms in the other.

According to an old General Electric service manual, a defective diode means replacing the entire heat sink assembly. However, these assemblies are no longer being made. The diodes are pressed into the heat sink. You don't want to punch out the diodes and replace them, even if you can find replacement diodes. I leave both diodes alone, although one or both may be defective, and install two new 35 amp diodes. Drill a new hole for the replacement diodes on the heat sink, and use 1N1188A diodes. To help transfer heat from the diodes to the metal heat sink, use silicone heat sink compound, available at Radio Shack or through Hosfelt Electronics.



Above: The E20 charger removed from the tractor, showing the heat sink with two diodes, capacitor, and transformer.

Of all the Elec-Traks I've repaired, I've found only one with a cooked transformer. This one died because one of the diodes had shorted and the user kept on trying to charge the batteries. When I find a dead charger, nearly 80 percent of the time the problem is a defective diode on the heat sink.

To test the repaired charger, plug the connector from the timer motor into the charger. Apply power to the charger, and turn on the timer. Take your reading from the heat sink (positive) to the center tap of the transformer (negative). The center tap is fastened to the large stud near the heat sink. You should see 39 to 41

Below: The opened access panel on an E10. The larger relay on the right is the PTO contactor.



volts if everything is working correctly. Before you install the charger, clean out any crud you see.

## Main Drive Motor

The E10 uses a very simple drive motor and control circuit. The drive motor is a permanent magnet motor about the size of a large thermos. There are no special circuits used to reverse the drive motor or to change its speed. That's all done by the Peerless transmission. We only need to apply power to the drive motor to get it spinning. The motor start circuit for the E10 is shown in Figure 2.

## Start Circuit

Three things must happen to allow the main contactor ("L" in the schematic) to pull in. First, the key switch must be on. Then the operator must be on the seat, closing the seat switch. Finally, the clutch/brake pedal must be depressed, operating the clutch switch. With the clutch pedal depressed, the drive belt is prevented from transferring power from the motor to the transmission. This allows you to start the tractor without being thrown off the seat!

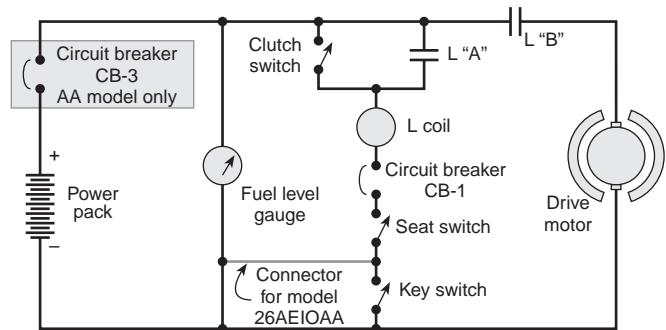
Once the contactor pulls in, a separate set of contacts seals the contactor in. You can then remove your foot from the clutch and drive off. Turning the key switch off or getting off the seat will unseal the contactor, stopping the drive motor. To restart the tractor, you must depress the clutch and reset the key switch to seal the contactor again. The operator, of course, has to be in the seat!

## Some Quick Tests for the Drive Motor

If you have removed the plate under the shift lever, the drive motor will be fully exposed. On the rear of the motor, you'll find the two armature terminals. One is connected to the negative battery lead. The other one runs back up to the main contactor located behind the steering column. To access this contactor, remove the two screws holding the cover panel in place. There is enough wire slack to allow the cover panel to lie flat. Place a piece of cardboard on top of the batteries if they are installed. This will prevent the cover panel from shorting out the battery terminals.

First either put the transmission in neutral, remove the drive belt from the pulleys, or jack up the rear end so the wheels are off the ground and block them. To verify that the drive motor works, check it with a 12 volt battery. Connect the tractor's negative battery cable to the negative post of the battery. Connect a heavy-duty clip lead to the positive battery post. Then briefly touch the other end of the lead to the contactor ("L") cable that goes to the main drive motor. If there are no problems with the drive motor, it will start spinning. This simple test shows whether the drive motor is working or not.

**Figure 2: E10 Start Circuit**



If you tested the drive motor with the external power source and the motor runs, the problem is in one of the control switches. In rare cases, you may have an open contactor coil. All electrical connections must be tight. Check for tightness at the main contactors and PTO contactors. These tractors shake and rattle, so loose wires are common.

The seat switch is the first one that ends up being defeated by the user, so look under the seat for a switch. It should be mounted on the cross member holding the small seat spring. If the switch is there, but you see no wires coming from the seat, look for them taped together somewhere in the battery compartment. Battery acid and water may have eaten away at the wires, preventing the motor from starting.

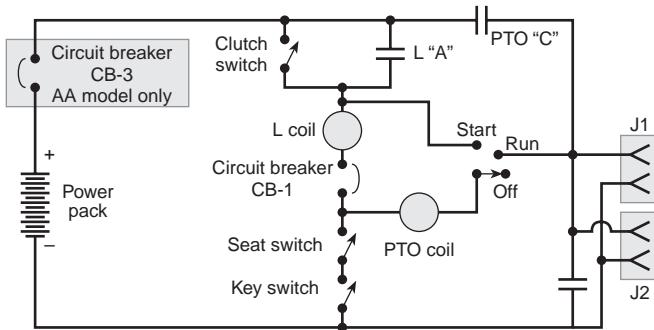
Check the clutch switch as well. It's located on the right side of the tractor under the transmission. With the clutch, seat, and key switches on, you should measure 36 volts across the contactor's coil. If you do get 36 volts but the contactor does not pull in, the coil is bad and needs to be replaced.

## PTO Circuit

On the E10, the PTO circuit works almost exactly the same way as the motor drive circuit, minus the clutch and seat switches. When the PTO start switch is moved to the start position, it seals in the PTO coil. This allows the spring-loaded switch to move to the run position. The mower motors are permanent magnet motors. When the PTO switch is turned off, the PTO contactor shorts out the mower motors, dynamically stopping the motors.

## Mechanical Subassemblies

All of the mechanical subassemblies are very basic and straightforward. It's beyond the scope of this article to cover all the details. A good dose of common sense will be your best guide. If it looks like it needs oil, then oil it. If you see a grease fitting, grease it. Check for wear and tighten loose fasteners. A few of the more common problems are discussed here, with suggestions on how to deal with them.

**Figure 3: E10 PTO Circuit**

### Don't Know Where You're Going?

Stripped-out steering columns are a very common problem in these tractors. What happens is that the steering shaft and pinion gear wear down the gear and sector assembly. If the wear is not excessive, you can add some shim washers to take up the slack. This job is messy and labor intensive. If you have all the batteries out of the tractor, I suggest you tilt the tractor over on its side. This will allow you to work on the steering components without standing on your head.

Remove the cotter pin from the gear and sector assembly. Pull the steering shaft and pinion gear away. Add your shim washer and reassemble. Try the fit. If you have too much slop, add more shim washers. If you can't get the assembly together, remove one shim at a time until the steering pinion and sector assembly are nice and tight. Replace the cotter pin with a roll pin and finish up with a nice glob of grease on both gear surfaces.

### Whoa! I Can't Stop!

Don't flip the tractor over just yet. Did you check to see if your brakes work? Now is the best time to work on them since the tractor is on its side. There are two basic brake designs used on the Elec-Trak, the die-cast caliper brake and the steel caliper brake.

### Die-cast Caliper Brake

On the transmission, you'll see the brake disk. If you have the die-cast caliper, there will be a small nut and cotter pin assembly. This nut is the brake adjustment. However, before you do anything, I suggest you watch the brake assembly while you operate the brake by hand. If nothing moves, you have lots of work to do. Plan on using plenty of WD-40! Adjust the brake by removing the cotter pin and turning the adjustment screw until it's finger tight. Back off the adjustment counterclockwise until a very slight drag is felt when rotating the brake disk by hand. Replace the cotter pin.

### Steel Caliper Brake

First jack the rear wheels off the ground and block the front wheels. Then remove the rear wheel on the brake

side of the transaxle. Remove the cotter pin from the brake clevis pin, then remove the clevis pin. Rotate the brake clevis to shorten the brake linkage until the brake drags, then back off one-half turn. The clevis and clevis pin must be reinstalled temporarily to check brake drag. Reinstall the clevis, clevis pin, and cotter pin on the brake actuating lever. Then reinstall the wheel and test brake function. You should now be able to go in the direction you want to go, and stop once you get there!

### Main Drive Belt

The E10 has a single drive belt. It runs from the drive motor to the transmission. A single idler pulley is controlled by the clutch pedal. There are no adjustments to take up any slack from a worn belt. If the main drive belt slips, then the belt must be replaced.

### Finding Parts and Supplies

I have had no contact with General Electric, and they no longer supply parts for the Elec-Trak. A local tractor dealer here has been very helpful. They used to sell these tractors, but don't have the time to deal with inquiries.

The diodes are available from Hosfelt Electronics or Mouser Electronics, among others. Any local golf cart supply house will sell you coils and relays. The belts are common Gates products, which any mower shop will be able to replace. I would be more than happy to help readers find sources for parts, and assist with any Elec-Trak problems.

### Life with an Elec-Trak

The first thing everyone asks is, "How long will it run on a charge?" That's a question that is hard to answer! There are so many variables one must take into account. How tall is the grass? Are the blades sharp? How fast will your forward speed be? What kind of grass will you be cutting?

Generally speaking, I can cut about three acres of grass on one charge, provided I keep the blades sharp and cut when the grass is dry. During the spring, when the grass is thicker, I have to reduce my forward speed to cut the grass cleanly. Going too fast through high grass will cause excessive current to be pulled, shortening run time. During late summer, when the grass grows slowly, I can really increase the forward speed of the tractor. In other words, your mileage may vary!

On my E20 tractor, with a mower motor idling, a single motor draws 7 amps. With three mower motors sitting there running, that's a hair over 20 amps. Drive motor current varies, depending on what gear you're in and if you're going up or down a grade. When you start putting a load on the mower motors, the current will increase. It would be interesting to know just what these

machines draw under load. But I decided that it would be unsafe to try measuring motor current while mowing the back forty!

All Elec-Trak tractors come with an analog voltmeter that serves as a "fuel gauge." I have found huge differences in meter accuracy. The higher end models also come with a "load meter" that monitors current draw from the battery bank. It's fun to watch the load meter increase as the tractor heads uphill!

### **What Happened to the Elec-Trak?**

Why did the Elec-Trak die out? I really don't know. Perhaps it was the expense of replacing the battery pack every several years. A life span of three to five seasons is about all you can expect from the batteries. To replace the battery pack, it cost up to \$450. And of course, you can't mow twenty acres on one charge, either.

With an increased dependence on imported oil, the Elec-Trak may be making a comeback. New laws governing emissions from small IC engines may also spark renewed interest in the Elec-Trak. If you can find

one, put an Elec-Trak back to work. There's nothing quite like mowing your yard while listening to the birds singing in the trees. That's something you can't do unless you're riding on a General Electric Elec-Trak!

### **Access**

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