TROUBLESHOOTING THE MODEL A FORD ELECTRICAL SYSTEM

Electrical System Basics

- Battery/Charging/Starting sub-system
  - 6 Volt, Positive ground battery
  - Four pole starter
  - Generator with cutout relay
    - “Powerhouse” style on early models
    - “Third brush style on later models
  - Dashboard ammeter

Electrical System Basics

- Ignition sub-system
  - Ignition coil
  - “Pop-out” ignition switch
  - Distributor

Electrical System Basics

- Accessory harness
  - Light switch
  - Headlights
  - Parking and/or cowl lights
  - Taillights
  - Stoplights
  - Horn

Electrical System Basics

- Miscellaneous
  - Dash light
  - Dome light (deluxe models)
  - Electric windshield wiper (early production)

What is “normal”?

- Voltage
  - Six volts on battery when not running (5.7 to 6.4v mostly temperature dependent)
  - 7.2 to 7.6 volts when running
- Current
  - Charging rate: 3 to 6 amps, no accessories on
  - Ignition coil: 4-6A not running, points closed, 2-3A running

What is “normal”?

- Current
  - Head lamps: 2 to 5 A per bulb, depending on candlepower
  - Stop lamps: 2 to 5 A per bulb, depending on candlepower
  - Parking and cowl lamps: ~1/2A per bulb
  - Horn: ~6 to 10A
  - Electric wiper: ~6 to 10A

What is “normal”?

- Terminals that always have voltage
  - Battery negative terminal
  - Starter terminal
  - Terminal box screws
  - Cut-out output terminal
  - Ammeter
  - Ignition coil
  - Stop switch
  - Light switch
  - Dash light wire
  - Electric wiper terminal (early models)

Trouble-shooting equipment

- VOM
  - Stands for “Volt-Ohm-Milli-ammeter”
  - Checks voltage, measures continuity, and can measure current (path needs to be broken)
  - A cheap one will work just fine
- Soldering iron and solder: For repairing loose terminals on wire ends
- Electrical tape: For repairs of insulation
- Jumper wires: For checking grounds and suspect open wires

Trouble-shooting techniques

- Voltage: Set the VOM to DC volts and measure the voltage across the suspect device when turned on. Fresh connections should be within .2 volts of the battery voltage. Older connections should be within .4 volts.

Trouble-shooting techniques

- Checking grounds
  - Set the VOM to DC volts and measure between the battery positive terminal and the device ground. The reading should not exceed .2 volts.
  - Connect a length of wire from the battery positive terminal and the suspect device. If the performance improves “significantly” the ground connection needs work.

Trouble-shooting techniques

- Continuity check
  - Set the VOM to “Ohms”. The meter will indicate how much resistance there is, the lower the reading, the easier current will flow through the device. Most 6v devices will read under 1 ohm, but BEWARE! A zero reading is a SHORT CIRCUIT!

Trouble-shooting techniques

- Measuring current: Set the VOM to measure current (highest range first). The probes usually need to be plugged into different holes to do this. With the battery disconnected, connect the positive lead of the meter to the battery cable, and then touch the negative lead to the battery terminal. Be careful! A short circuit could blow the fuse in the meter.

Where to start?

- REMEMBER THESE BASICS!
  - Battery: The heart of the system, “fresh”, terminals tight, all cells topped off.
  - Wires: Should be in good shape, no insulation cracking or knicks, all terminals intact and soldered on well.
  - Grounds: All devices should have a good ground path free of paint or rust.
- NO DEVICE WILL WORK PROPERLY WITHOUT THESE, AND THEY CAUSE MOST PROBLEMS!

So the first thing you do is…

- VISUAL INSPECTION
  - Take a good look at the electrical system and check for obvious problems such as broken wires, loose parts or obvious signs of distress (scorch marks?).
  - Don’t stop at the first problem, the wire that came out of its terminal may have done so because a short circuit caused it to get too hot!

So you saw a problem?

- Fix it! OK, long version: repair any loose terminals, broken wires, or obvious damage. Since the damage you see may have been caused by other problems, disconnect power first. When the repair is complete, use the AMMETER function of the VOM to make sure that no current flows when everything is off. If OK, then reconnect power.

Is it fixed?

- OK, you fixed the obvious problems. Now turn on the device and see if it works.
  - Yes? CONGRATULATIONS!
  - No? OK, now you need to start in depth troubleshooting.

Got voltage?

- Check the voltage at the device using the VOM voltage function. You should check it with the device turned off and if OK, then with the device turned on. There are three possibilities here:
  - No voltage at all
  - Voltage OK when off, drops when turned on.
  - Voltage OK, both off and on.

No voltage at all

- You have an open connection somewhere!
- Using the VOM in voltage mode, start tracing back along the circuit to the battery to find the break.
- Remember, the break can be in either the wiring OR the ground path.

Causes of circuit opens

- Bad ground connection (see next slide)
- Blown fuse (if equipped with one)
- Broken wires or terminals
- Ammeter blown out from short circuit
- Bad switch

A little bit more about grounds!

- The ground path includes not just the connection between the device and its mount, it also includes paths INSIDE the device itself and from the mounting point all the way back to the positive battery terminal. The voltage across a device can be normal and yet still be low internally. And don’t forget the connection between the battery ground cable and the frame.

Sagging voltage

- The voltage is normal when the device is off and then drops when turned on: you have a high impedance connection!
- Use the same technique as before to trace back towards the battery. When you find the point where the voltage is always normal, then whatever is between that point and the previous one is the fault.

Causes of high impedance

- Bad ground connections
- Damaged wire, only a few threads are left to handle the current.
- Bad terminals or solder joints.
- Dirty or oily connections (especially the headlight switch!)
- Bad ammeter

Plenty of voltage all the time

- If there is full battery voltage whether the device is on or off, then the device itself is bad.
- Special cases: The ignition coil and horn are always “hot” and are grounded to make them work. See the following slides for specifics

The ignition coil

- When the ignition is off, BOTH terminals of the ignition coil are at full battery voltage. When turned on, the ground side of the coil (red wire) will be either at battery voltage if the points are open, or ground if the points are closed. Readings between these two can be caused by:
  - Dirty or burned points
  - Leaky condenser (see next slide)

Is the condenser OK?

- Quicky ignition check when the engine is not running:
  - Remove main lead and distributor cap and rotor
  - Place piece of cardboard between points
  - Turn on ignition
  - Hold the main lead about ½ inch from head nut
  - Using metal object, place it against ground and then touch the points arm and pull it away
  - A good coil and condenser will produce a spark that easily jumps this gap. If not, replace condenser first, then try the coil.
  - If this test is OK and there is still no spark when cranking the engine, check that the points are opening and closing and then check timing.

Ahooga!

- Both terminals of the horn are normally “hot”. The horn button connects one to ground to blow the horn.
- Most horn problems are not in the horn, it is in the switch rod or the connection at the bottom of the steering column.
- Most common problems that are actually inside the horn are insufficient lubrication or mis-adjustment.
- If the horn blows fine with the cover off but not with it on, check to see if the cover screw is too long. If it is, it will hit the brush holder and short out the horn!
- If a horn relay is used, one terminal IS grounded normally and the other is only hot when the button is pushed.

Generators

- When at idle, the generator voltage is below 7.2 volts. When the engine is revved up, the cutout should close at between 7.2 and 7.6 voltage and the voltage should stay close to this range.
- NEVER run a generator without being connected to a battery! It WILL fry itself. This includes the ground connection.

Common generator problems

- Ground connection lost
- Cutout not closing or opening properly
- Mis-adjusted third brush
- Armature shorted
- Broken connections to commutator
- Bad internal connections
- Already burned up

Making things better

- Here are some things that can be done to the electrical system to make it better. None of these changes are permanent and can be easily un-done to restore it to authentic condition.
  - Fuses: HIGHLY RECOMMENDED!
  - Extra ground connections
  - Horn relay
  - Voltage regulator
  - Diode cut-out

Places to add extra grounds

- Frame ground to engine (get full starter power!) 4AWG strap from frame ground cable bolt to a bolt on the transmission
- Generator to engine (fewer generator burn-outs) 14AWG wire from the generator case to timing gear cover
- Taillights. Taillight mount screw, down the loom to a shock mounting screw
- Headlights. Tricky, but can be done!
- Body to frame (minimal improvement unless you have extra accessories
- Distributor plate (will keep you going if other things get borderline)

Extra! Extra! Extra!

- The following slides present a few tricky spots that people often miss and can be so troublesome!

Starter

- Internal grounds! Make sure that the following points are paint free when assembling a starter:
  - Ground brush mounting spots on case. Each brush carries 40 A. Sand the case clean here and make sure there are no burrs on the brush terminals from the threads being cut.
  - Edge of case to mounting flange, no paint on either surface for maximum contact. Paint the outside after assembly to seal this joint.

Generator

- Internal grounds! Make sure that the following spots make good, paint free contact.
  - Ground brush terminal to end plate
  - Rear end plate to housing
  - Field coil ground terminal
  - Front end plate to housing
  - Front end plate to timing cover!!!!! (see the “extra grounds” slide for this, a very common, very destructive fault!

Again… GROUNDS!

- So many problems are caused by bad grounds… and so many bad grounds are caused by… too much paint! Remember… there must be electrical contact for parts to work, if you over-paint, use “star washers” to dig in and give you a good ground connection. Headlights are especially prone to bad grounds causing them to be dim.

FINIS!