16.13. Remove the self-tapping screws on the left side of the tractor that secure the front pivot bracket. See Figure 16.13.

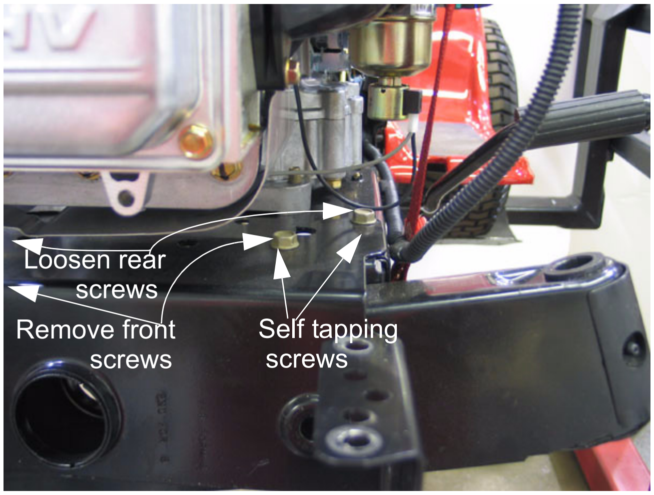


Figure 16.13

16.14. Remove the front screws only. Loosen the rear screws. this will allow the bracket to pivot forward, freeing the pivot bar from the frame. See Figure 16.14.

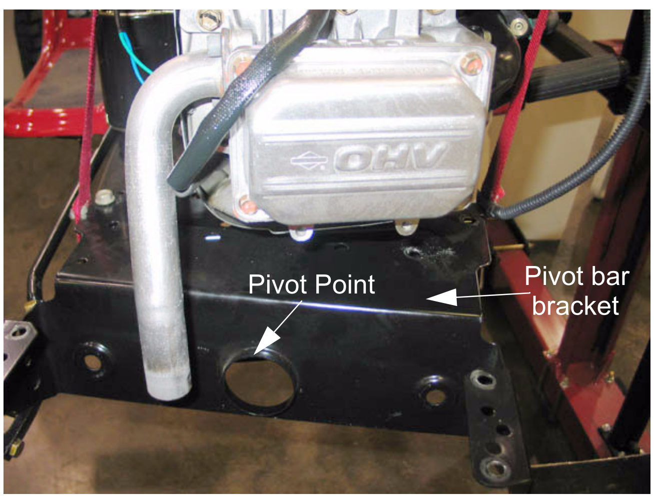


Figure 16.14

16.15. Installation notes:

- Apply anti-seize compound liberally to all of the friction surfaces of the pivot bar, particularly the round boss that serves as the central pivot point.
- Replacing all of the plastic bushings while the pivot bar is disassembled makes economic and mechanical sense.
- Grease all moving parts on reassembly, using MTD P/N 737-0300A (Benelene), or similar grease.

17. ELECTRICAL SYSTEM

17.1. **Introduction:** The electrical system was designed with the RMC module that was introduced for the '05 season as an integral component.

- The **RMC module contains electronic logic circuits**. When diagnosing anything that is connected to the RMC module, high impedance test light or a high impedance digital volt-ohm meter (DVOM) should be used. The amperage draw of a standard incandescent test light may over-burden some internal electronic circuits, burning-out the module.

  NOTE: These tools are not outrageously expensive or exotic. High impedance test lights (Thexton model 125 is typical) can be purchased locally from stores like NAPA for under $30.00. Appropriate multi meters can be purchased for under $100.00, and are an invaluable tool for any competent technician.

- It is typical when industries **shift from electro-mechanical to electronic controls** that diagnosis shifts from tracing through a number of independent circuits to checking the in-puts to and out-puts from a central processor. This is similar to, but much less complex than the transition that the auto industry made with the conversion to fuel injection in the 1980s.
- The **starter safety circuit** has no connection to the RMC module.
- The **safety circuits that are capable of turning-off the engine** work through the RMC module.
- It is still important to be familiar with the workings of the individual components of the electrical system, but **some** of them **can now be checked from a central point on the tractor**. This makes life easier on the technician, frequently making it unnecessary to connect to difficult to reach switches in the preliminary stages of diagnosis.
- The function of individual safety switches can be seen as providing information "inputs" to the RMC module.
- The next part of this section gives a **detailed description of the electrical components** on this tractor, their function in the system, and their physical location on the tractor. Armed with this information and the proper tools, a technician should be able to efficiently diagnose most electrical problems.

Electrical Diagnostic Over-view

17.1-17.9	Key Switch and Module
17.3	Key Switch OFF
17.4	Key Switch START
17.5	Key Switch RUN
17.6	Key Switch REVERES CAUTION
17.9	Module Function
17.1O-17.24	Single-point Diagnosis
17.11-17.23	RMC Plug Test
17.14-17.17	Pigtail Plug Test
17.16	Pigtail Plug Test: seat safety
17.17	Pigtail Plug Test: PTO safety
17.19	RMC Plug Test: reverse safety
17.2O	RMC Plug Test: ground
17.21	RMC Plug Test: power
17.22	RMC Plug Test: park-brake
17.23	RMC Plug Test: module arm signal
17.25-17.31	Direct testing of switches
17.25	Direct test: PTO safety switch
17.26	Direct test: Brake safety switch
17.27	Direct test: park brake safety switch
17.28	Direct test: reverse safety switch
17.29	Direct test: seat safety switch
17.3O	Direct test: starter solenoid
17.31	Lighting circuit
17.32	Fuse and Ammeter
17.33	Engine harness connector: White
17.34	Engine harness connector: Troy-Bilt
17.35	Voltage drop test

17.2. The **Key Switch** is similar to those used in a variety of MTD applications since 1999. The difference in this case is that it is incorporated in the same housing as the RMC module; the two items are not available separately. See Figure 17.2.

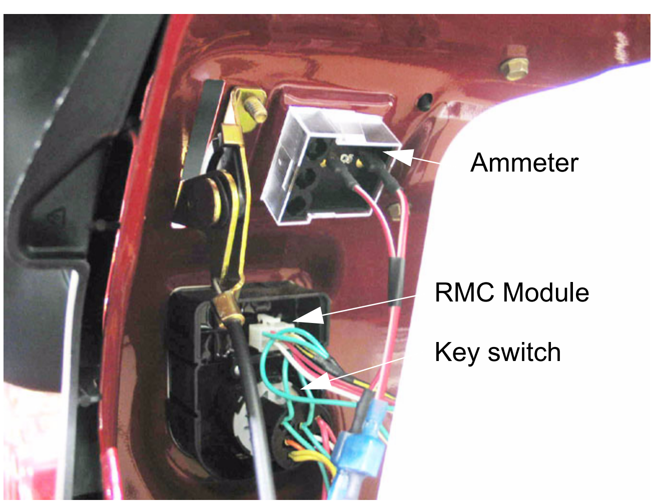


Figure 17.2

17.3. In the **OFF** position, continuity can be found between the M, G, and A1 terminals. See Figure 17.3.

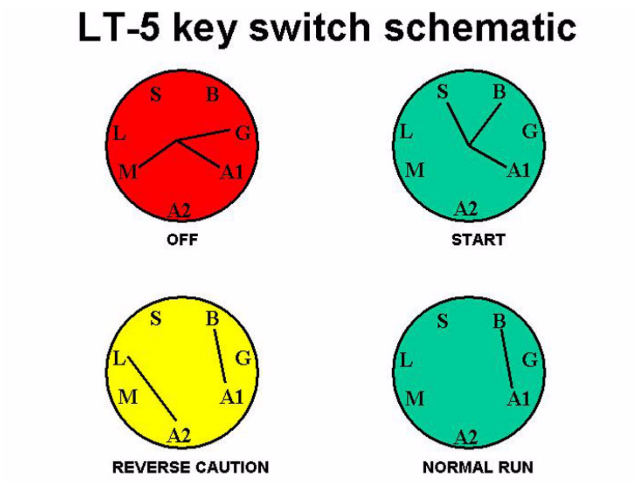


Figure 17.3

- M is connected to the magneto by a yellow wire, G is connected to ground by a green wire, and A1 is connected to the after fire solenoid and alternator.
- In the **OFF** position, the magneto primary windings are grounded, disabling the ignition system. The alternator output that normally keeps the after fire solenoid powered-up is given a more direct path to ground, depriving the after fire solenoid of power. This turns-off the fuel supply.
- **Symptom**-<u>engine runs with key in OFF position</u>: The key switch is not completing the path to ground either because of an internal fault or a bad ground connection elsewhere in the harness. Check continuity between M, G, and A1 terminals with key switch in OFF position. Check green wire continuity to ground.
- **Symptom**-<u>loud "BANG" when key is turned to the OFF position</u>: The after fire solenoid is not closing, either because it is physically damaged or the alternator output is not getting grounded. Check continuity between G and A1 terminals. Check continuity from red wire to afterlife solenoid.
- **Symptom**-<u>Engine runs 3-5 seconds after key is turned to OFF position</u>: The after-fire solenoid is turning-off the fuel supply, but the ignition is continuing to operate. Check continuity between the M and G terminals in the OFF position. Check continuity from yellow wire connection all the way to the spade terminal on the magneto.

17.4. In the **START** position, continuity can be found between B, S, and A1 terminals.

- Battery power from the B terminal is directed to the start circuit through the S terminal and to the afterlife solenoid through A1. There is no alternator output to A1 until the engine is running.
- **Symptom**-No crank and no starter solenoid click: Power is not getting to the trigger spade on the starter solenoid. Assuming good battery, check for power where the fused red wire with white trace connects to the B terminal.
Check for continuity between B and S terminals in START position. If power is getting to the S terminal in the START position, the problem lies down-stream in the starter circuit;
Check continuity from the orange wire on the S terminal to the orange wire with white trace on the trigger spade on the starter solenoid. If it is broken, trace through the brake and PTO switches.
- **Symptom**-No crank, solenoid click: The problem lies in the heavy-gauge side of the starter circuit; battery cables, starter cable, solenoid, or ground issue.
- **Symptom**-Crank, spark, but not fuel: Power is not reaching the afterlife solenoid.
Check continuity from B to A1 in the START position. If power is reaching the red wire that connects to the A1 terminal in the start position, the problem lies down-stream of the key switch.
A handy quick-check is to apply power to the red wires where they connect to the S terminal (whole circuit) or directly to the afterlife solenoid to listen for the audible “click” that it makes when functioning.
- **Symptom**-Crank, but no spark: This is a highly unlikely scenario. If it occurs after a key switch has been changed independently of the RMC module, this would arouse suspicion that the wrong key switch was installed. Otherwise, the problem lies elsewhere in the safety circuits or engine. Do not over-look the possibility of a bad magneto or chafed ground lead within the engine harness.

17.5. In the **NORMAL RUN** position (green zone), the B and A1 terminals should have continuity. Once the engine is running, the alternator produces current that tracks-back from the A1 circuit to charge the battery, via the red wire with white trace connected to the B terminal.
The plain red wire carrying alternator current to the A1 terminal doubles-back, with the second plain red wire on that terminal supplying power directly to the after-fire solenoid.

- **Symptom**-Battery does not charge: If the switch has continuity between B and A1 in the RUN position, follow the engine manufacturer’s recommendations for testing alternator output.
If alternator output is getting to and through the key switch, but not reaching the battery, the fuse may have blown after start-up. A blown fuse will disable the starter circuit.
A simple quick-test for the presence of alternator output at the battery is to check across the battery posts for DC voltage.
- **Symptom**-After-fire solenoid does not work: engine starts and dies: The after-fire solenoid is powered directly by the red wire carrying alternator output, and should operate independently of anything else on the tractor once the engine is running. If the alternator fails *and* battery power is not reaching the afterlife solenoid through the key switch, it will not work. This is an unusual set of circumstances.

17.6. In the **REVERSE CAUTION MODE** (yellow zone), the same characteristics are true as for the normal run position, but *in addition* the L terminal will have continuity with the A2 terminal. The A2 terminal is connected to the RMC module by a white wire. The L terminal (formerly used for the lighting circuit) connects directly to the ground circuit of green wires.
When the key is in the REVERSE CAUTION MODE position, the white wire carries a ground signal to the RMC module. When the parking brake is not set, this ground signal tells arms (enables), *but does not turn-on* the RMC module.

- **Symptom**-RMC module will not turn-on: Check for continuity between A2 and L terminals on the key switch when it is in the REVERSE CAUTION MODE position. Confirm that the green wire has continuity to ground. If the switch is capable of establishing a ground signal to the RMC module, the problem is likely to lie elsewhere in the system.

- **Symptom**-RMC module will not turn-on: confirm that the ground path (continuity to ground) to the white wire is broken when the key switch is in any position other than REVERSE CAUTION MODE. The RMC module is disarmed (disabled) when the parking brake is set. To re-arm the module, the key is moved to another position, breaking the ground signal, then returned to the REVERSE CAUTION MODE, re-establishing the ground signal. It works something like a latched relay. If it is not possible to break the ground-path, it is not possible to freshly establish it either, and the RMC module will not be arm-able.
  Causes for such a condition might include a shorted or incorrect key switch, or a chafed white wire shorting to ground between the key switch and the RMC module.

17.7. The RMC Module is in the same housing as the key switch, and is not available separately. For the purpose of diagnosis it is treated separately. Diagnosis in unit with the key switch introduces too many over-lapping variables.
See Figure 17.7.

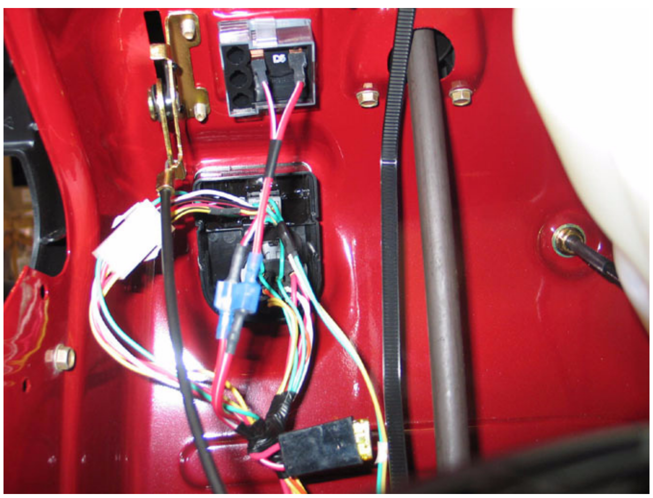


Figure 17.7

17.8. **Principle**: To diagnose the module, the simplest approach is to check all of the inputs (safety circuits) that are connected to it. If the inputs work properly, but the RMC module does not work properly (outputs), then the module can be determined to be faulty. A specific procedure is covered, following the description of the correct operation of the RMC module.

17.9. **Working properly**: The module cannot be diagnosed if its function is not understood. It is designed to work as follows: See Figure 17.9.

Figure 17.9

- When the **RMC module is disarmed**, the tractor will operate as MTD tractors have historical operated:
  If reverse is engaged when the manual PTO is ON, the engine will turn-off.
  If the operator leaves the seat with the bad running, the engine will turn-off.
  If the operator leaves the seat with the PTO in the OFF position, the engine will turn-off unless the brake is applied, whether by the presence of a foot on the pedal or the setting of the parking brake.
  Be aware that there are separate switches for the brake and the parking brake latch.
  Bear in mind that there represented no electric PTO versions of the 700 series lawn tractor.
- When the **RMC module is armed**, the tractor will operate identically to when the module is disarmed.
- When the **RMC module is armed and turned-on**: The tractor will operate identically to when the module is disarmed, except that the operator will be able to put the transmission in reverse with the PTO engaged and the engine and cutting deck will continue to run.
  The operator may put the tractor into and out of reverse as many times as they wish without having to re-arm or turn-on the module again.
- **To arm the RMC module**: the operator must turn the key switch to the REVERSE CAUTION MODE (yellow zone), with the parking brake released.

- **To turn the RMC module ON**: The module must first be armed, then the orange triangular button is depressed, illuminating the red LED indicator to indicate that it is ON. It is important that the operator must take two actions to turn the RMC module ON so that they do not do so inadvertently.
- **The RMC module will turn-OFF and disarm if**: The operator moves the key to any position other than REVERSE CAUTION MODE.
  The operator sets the parking brake.
  If the operator leaves the seat without setting the parking brake, the engine will turn-off. The key movement necessary to re-start the engine will make it necessary to re-arm and turn-on the RMC module if the operator wishes to continue with the ability put the tractor in reverse while the PTO is running.
- **To re-arm and turn the module ON**: If the key is in REVERSE CAUTION MODE position, it must be turned to another position (Normal Run), then returned to REVERSE CAUTION MODE. Once re-armed, the module can be turned-on by pressing orange triangular button. It will be confirmed that the module is ON by the illumination of the red LED on the module.

17.10. **To identify a faulty RMC module**: If the RMC module does not function as described, the **RMC plug test** should be the first step in diagnosis.

- If the RMC plug test confirms that the safety circuits (inputs) work as designed, yet the RMC module does not work properly, the RMC module is faulty.
- The RMC plug test will give an indication of what the problem is if it is not a faulty RMC module. If the problem is identified in a particular circuit, check the safety switch that is associated with the circuit. If the switch is good, then the problem lies within the wiring harness.

  NOTE: Like the electronic components found on most cars, the RMC module requires a fully charged battery to work properly. If the system voltage falls below 12 V. an accurate diagnosis of the RMC module is impossible because the module will be temporarily disabled by low voltage.

17.11. Disconnect the molded 8-pin plug from the RMC module. See Figure 17.11.

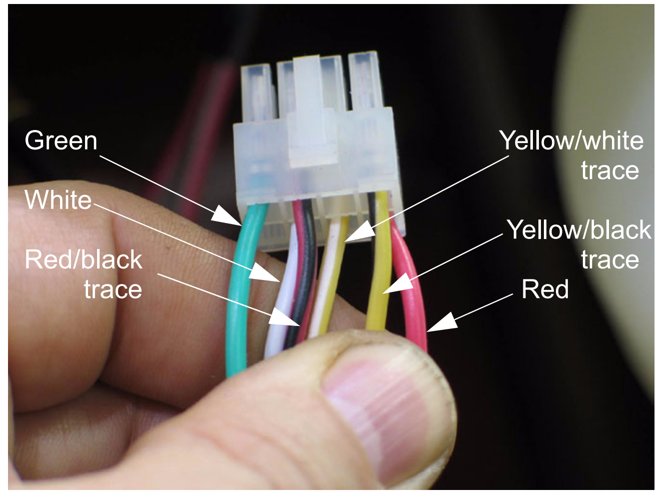


Figure 17.11

NOTE: It may be necessary to unfasten the fuel tank and move it aside for easier access to the plug.

17.12. Looking at the plug head-on, it will be configured as shown in the diagram: There will be 8 female pin terminals. When probed they should yield the results described in the following sections. See Figure 17.12.

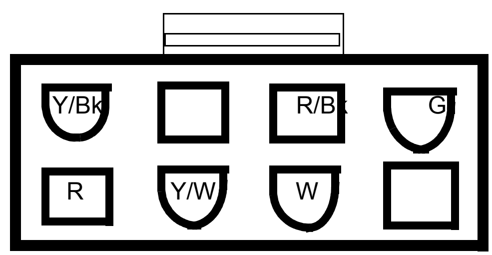


Figure 17.12

17.13. Top left, D-shape: Yellow wire with Black trace:

- **Behavior**: Should have continuity to ground when seat is empty *or* the PTO is ON *and* the brake is released.
- **Circuitry**: The black wire with yellow trace splits into two yellow wires with black traces, and enters a second 8-pin connector (pigtail) within 6” of the 8-pin connector at the module.

17.14. From the other side of the 8-pin pigtail connector, it emerges as one yellow wire with a black trace, and a second yellow wire with a white trace. See Figure 17.14.

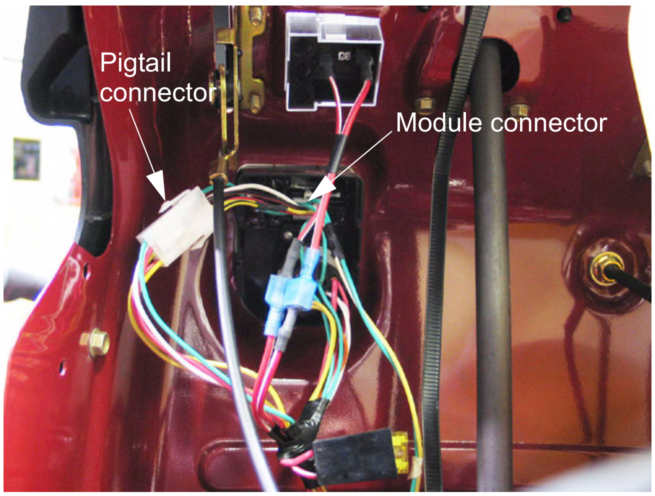


Figure 17.14

17.15. Check the PTO and seat safety circuits with the 8-pin pigtail connector unplugged, then reconnect it and continue with the RMC plug test.

17.16. Yellow wire with white trace from 8-pin pigtail connector: See Figure 17.16.

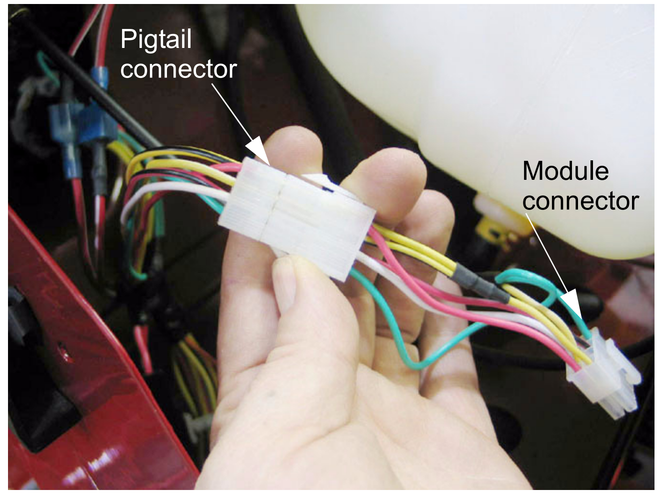


Figure 17.16

- **Behavior**: When the female pin terminal leading into the main harness is probed, there should be continuity to ground *only* when the seat is empty.
- **Circuitry**: The yellow wire with white trace leads to the forward terminal on the seat safety switch, where it finds a path to ground when the seat is empty.
- **Interpretation**: If behavior is correct, the seat safety circuit is good.
  If there is continuity to ground when the seat is occupied, the switch may be inoperative, or there may be a short to ground in the wire leading to it. If there is not continuity to ground when the seat is empty, the switch may be inoperative or there may be an open condition in the wire leading to it.

17.17. Yellow wire with black trace from the 8-pin pigtail connector provides input to the module from the **PTO switch**: See Figure 17.17.

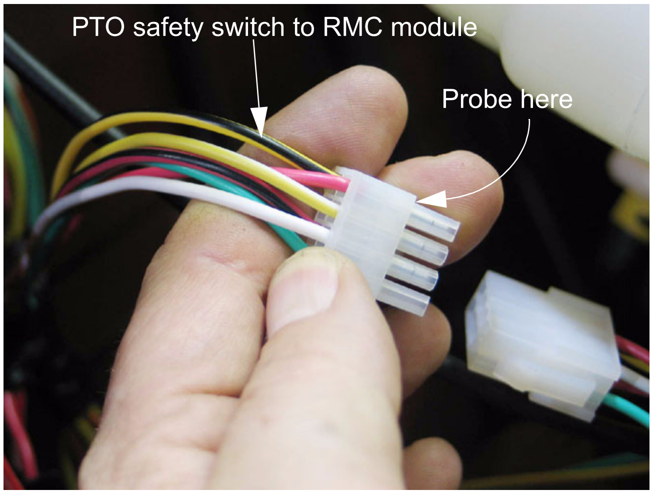


Figure 17.17

- **Behavior**: When the female (metal) pin terminal leading into the main harness is probed, there should be continuity to ground only when the PTO is ON, regardless of whether the brake is applied or the seat is occupied.
- **Circuitry**: The yellow wire with black trace leads to the PTO switch, where it finds a path to ground when the PTO is ON.
- **Interpretation**: If behavior is correct, the N.C. side of the PTO switch /circuit is functioning properly.
  If there is continuity to ground when the PTO is OFF, the switch may be inoperative or there may be a short to ground in the wire leading to it.
  If there is not continuity to ground when the PTO switch is ON, the PTO switch may be inoperative, or there may be an open condition in the wire that leads to it.

17.18. Reconnecting the pigtail, and returning to the RMC Plug: there is a blank space next to the yellow wire with black trace.

17.19. There is a red wire with black trace next to the blank space in the RMC connector. This wire provides the module with input from the **reverse switch.**

- **Behavior**: When the tractor is in reverse, this terminal should have continuity to ground.
- **Circuitry**: This wire runs directly to the reverse safety switch under the right fender. This is a simple metal tang switch that grounds-out against the transmission control lever.
- **Interpretation**: Continuity to ground when the tractor is not in reverse would indicate a short to ground in the circuit. This could take the form of a chafed wire contacting ground, a bent reverse safety switch that is always in contact with another metal part, or a broken plastic insulator that separates the switch from the fender.
  Lack of continuity to ground would indicate a broken or disconnected wire leading to the reverse safety switch, or a switch that is not closing because of physical damage or corrosion.

17.20. At the opposite end of the top row from the yellow wire with black trace is a green wire.

- **Behavior**: The green wire should always have continuity to **ground**.
- **Circuitry**: The green wire leads to ground.
- **Interpretation**: If this ground path is not good, there will probably be other ground-related issues with the tractor: slow starter motor, slow battery charge, dim lights. All ground connections should be mechanically secure and corrosion free.

17.21. The red wire immediately below the Yellow wire with black trace on the OCR plug carries **battery voltage**.

- **Behavior**: D.C. battery voltage should show-up on a volt meter when the red probe is touched to this terminal and the black probe is grounded, regardless of the key switch position.
- **Circuitry**: This wire draws power directly from the B terminal on the key switch.
- **Interpretation**: If there is not battery voltage at this terminal, the tractor is probably not functional at all. Look for a blown fuse, disconnected battery, disconnected ammeter or some other major fault.

17.22. The yellow wire with white trace that is adjacent to the red wire in the bottom row goes to the **parking brake switch** that is riveted to the inside of the left front edge of the dash panel.

- **Behavior**: There should be continuity to ground from this terminal *only* when the parking brake lever is in the ON position.
- **Circuitry**: The yellow and white wire leads directly to the parking brake switch. When the parking brake is ON, the plunger on the switch is down, closing the contacts. When the contacts close, a circuit is completed to the green ground wire.

- **Interpretation**: The wires that lead to this switch are readily visible and traceable.
  If there is no continuity to ground when the parking brake is ON, look for broken wires, a loose connector, or mechanical damage that prevents the linkage from depressing the plunger on the switch.
  If there is continuity to ground when the parking brake is in the RUN position, look for a chafed wire contacting metal or physical damage that prevents the plunger on the switch from extending when the linkage moves.

17.23. The <u>white wire</u> that is adjacent to the yellow wire with white trace provides a **ground signal** to the RMC module when the key switch is placed in the **REVERSE CAUTION MODE.**

- **Behavior**: There should be continuity to ground at this terminal when the key switch is in the REVERSE CAUTION MODE position.
- **Circuitry**: When the key switch is in the REVERSE CAUTION MODE position, a ground path is established by connecting terminal A2 to terminal L within the key switch. The white wire from the RMC module connects to A2, and a green ground wire connects to L.
- **Interpretation**: If the white wire fails to reach a ground path when the key switch is in the REVERSE CAUTION MODE position, the RMC module will not arm or operate. Check the key switch for continuity between A2 and L in the REVERSE CAUTION MODE position, confirm that the green wire connecting to the L terminal does have good continuity to ground, and check for any loss of continuity in the white wire that extends from the key switch to the RMC module, including the molded connector between the two components.

17.24. If the RMC plug test or the pigtail plug test indicates fault with any of the safety switches, the next step is to test the suspect switch. The operation of those switches is described in the following sections.

17.25. The **PTO Switch** is located just to the rear of the mounting point for the PTO lever. See Figure 17.25.

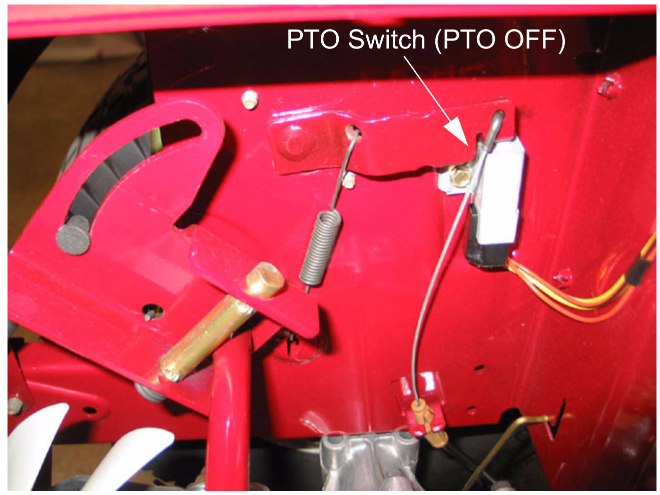


Figure 17.25

- The plunger on the switch is depressed when the PTO lever is drawn rearward into the OFF position. The switch contains two sets of contacts.
- A normally open (NO) set of contacts is in the starter inhibit circuit. When the PTO is OFF, and the contacts are closed, power coming from the brake switch (key switch in START, brakes ON) through the <u>orange wire with black trace</u> is passed on to the trigger terminal on the starter solenoid through the <u>orange wire with white trace</u>.
- A normally closed (NC) set of contacts is in the safety shut-down circuit. A circuit is completed from the M terminal on the key switch through the <u>yellow wire</u> to the Magneto terminal on the RMC module through the <u>yellow wire with black trace</u> when the contacts are closed. This gives the RMC module the ability to turn-off the engine when the PTO is ON.

17.26. The **Brake Switch** is mounted to the left frame channel, just beneath the running board and immediately behind the clutch / brake pedal. See Figure 17.26.

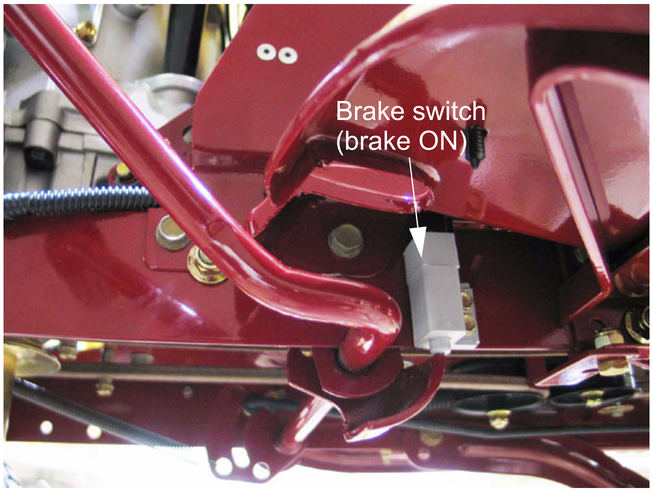


Figure 17.26

- The plunger on the switch is depressed when the clutch / brake pedal is pressed-down, de-clutching the drive belt and applying the brakes. The switch contains two sets of contacts.
- A normally open (NO) set of contacts is in the starter inhibit circuit. When the clutch / brake pedal is depressed, the contacts are closed, power coming from the key switch (key switch in START) through the orange wire is passed on to the PTO switch through the orange wire with black trace.
- A normally closed (NC) set of contacts is in the safety shut-down circuit. A circuit is completed from the M terminal on the key switch, and directly from the magneto primary windings through the pair of yellow wires to the clutch / brake switch through to the yellow wire with black trace when the contacts are closed.
- The yellow wire with black trace leads to one element of the seat switch. If the seat is vacant *and* the pedal is up, the engine will turn-off.

17.27. The **Park Brake Switch** is riveted inside the left front edge of the dash panel. See Figure 17.27.

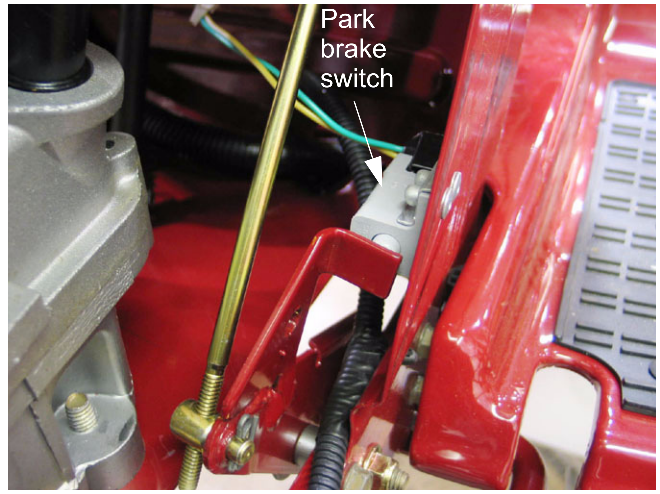


Figure 17.27

- The switch contains two sets of contacts, one set normally open (NO), and one set normally closed (NC). Only the normally open set is used in this application.
- The switch plunger is extended (contacts open) when the parking brake is released: "RUN" position on the label.
- The plunger is depressed (contacts closed) when the parking brake is applied: "ON" position on the label.
- To insure that the correct spade terminals on the switch are tested, it may be best to identify the yellow wire with white trace and the green wire that connect to the switch where they enter the connector for the RMC module, and test from that point.
- When the park brake is set, this switch sends a ground signal to the RMC module. The module responds by turning-off and disarming itself.

NOTE: Once the operator has set the parking brake, they may leave the seat of the tractor while the engine continues to run. Because the tractor cannot tell if the same operator has returned to the seat when operation resumes, the module must be re-set (armed) and turned-on by the operator who is currently in the seat.

NOTE: The electric PTO clutch system found on some 600 and 800 series tractors does not use a park brake switch. The electric PTO version disarms whenever the seat becomes vacant.

17.28. The **Reverse Safety Switch** is a simple metal contact tang. The gear selector touches it when placed in the reverse position, providing a ground path through the gear selector lever itself. See Figure 17.28.

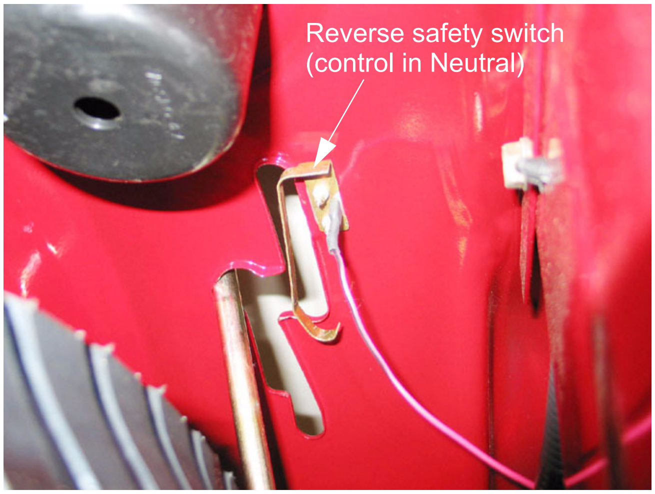


Figure 17.28

- The <u>red wire with black trace</u> leads directly back to the RMC module.
- When the RMC module is turned-on, the rest of the system effectively does not "see" the reverse safety switch.
- This wire can be identified at the RMC module connection, and tested for continuity to ground in REVERSE position.
- The most common problems are likely to be caused by physical damage: a broken insulator between the switch and the fender, an unplugged wire, or a bent tang.

17.29. The **Seat Safety Switch** consists of a pair of simple metal contact tangs attached to the seat mounting bracket. See Figure 17.29.

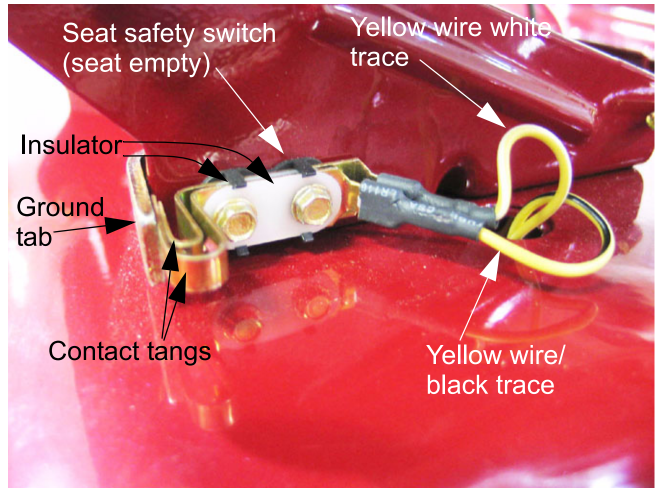


Figure 17.29

- The <u>yellow wire with white trace</u> is connected to the front spade terminal on the seat safety switch. When the seat is vacant, the tab on the seat bracket closes a ground path in series with the PTO switch. If the PTO is ON and the seat is empty, the circuit is completed, shorting-out the primary windings of the magneto, turning-off the engine.
- The <u>yellow wire with black trace</u> is connected to the rear spade terminal on the seat safety switch. When the seat is vacant, the tab on the seat bracket closes a ground path in series with the brake switch. If the brake is not applied, and the seat is empty, the circuit is completed, shorting-out the primary windings of the magneto, turning-off the engine.
- The most common problems are likely to be caused by physical damage: a broken insulator between the switch and the seat bracket, an unplugged wire, or a bent tang.

17.30. The **starter solenoid** is mounted at the left rear corner of the frame. The mounting bracket is visible beneath the left fender, and the solenoid itself is accessibly by removing the battery. See Figure 17.30.

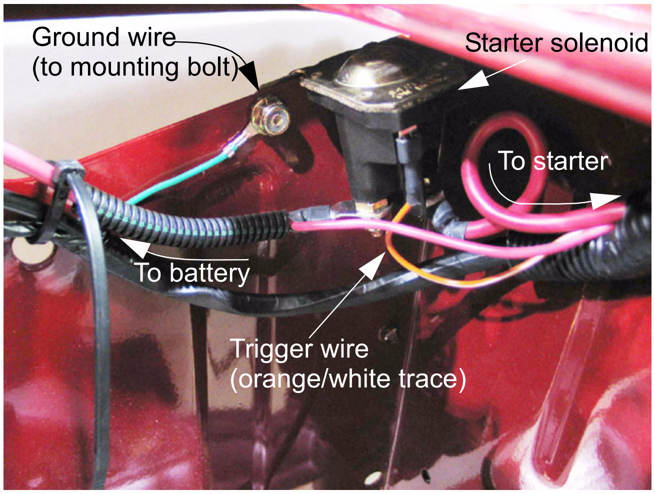


Figure 17.30

- When the proper safety conditions are met, (brake applied, PTO OFF) the <u>orange wire with white trace</u> energizes the windings that magnetize an iron core, pulling the contacts closed between the two heavy posts, connecting battery power to the starter motor.

17.31. The **lighting circuit** is hot whenever the engine is running. It does not draw from the battery, but runs directly off its own circuit on the alternator. See Figure 17.31.

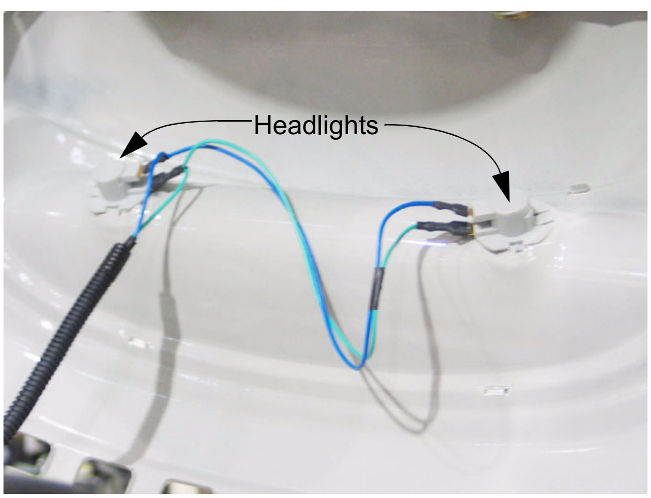


Figure 17.31

- The <u>blue wire</u> carries alternator current, the green wire is a ground.

17.32. The 20A fuse and ammeter are both located near the RMC module / key switch assembly, under the dash panel. See Figure 17.32.

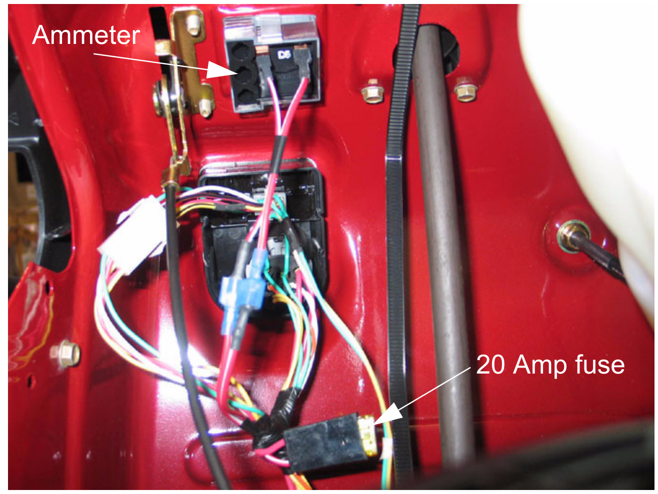


Figure 17.32

- The solid <u>red wire</u> feeds the fuse with power picked-up from the battery cable connection to the “hot” post of the starter solenoid.
- The <u>red wire with white trace</u> carries fused power to the ammeter, and from there to the B terminal on the key switch.
- The <u>ammeter leads</u> both have female spade connectors at the ammeter, but are male / female where they connect to the rest of the harness to maintain correct polarity. The female spade connector that comes off the fuse holder could be plugged directly to the inboard terminal on the ammeter, maintaining correct polarity.
- Incorrect polarity will have no ill effects other than a backward reading on the ammeter.
- A failed fuse, internally failed ammeter, or disconnected ammeter will disable most of the tractor’s electrical system.
- Remember that a failed fuse has done it’s job of protecting the rest of the circuit from an overload. If a fuse blows, figure-out why and correct the core problem before returning the tractor to service.

17.33. The engine harness connector on the White tractor has alternator and safety circuit components. See Figure 17.33.

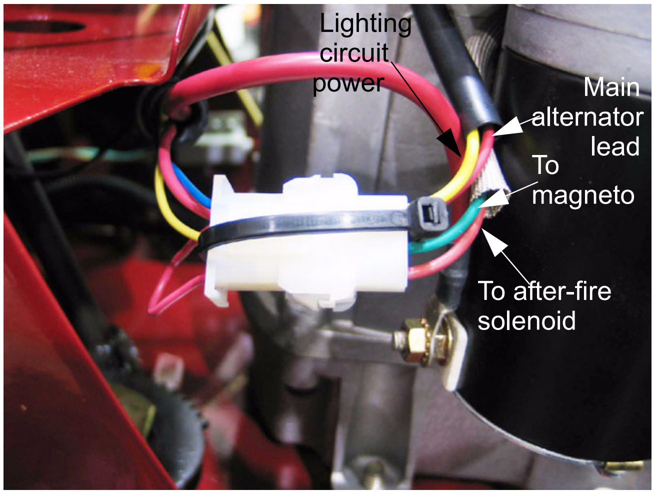


Figure 17.33

- The red wire in the thermally insulated conduit near the starter motor leads to the after-fire solenoid. It receives power from the battery and the alternator through red jumper wire.
- The green wire in the thermally insulated conduit near the starter motor leads to the magneto primary winding connection. On the tractor side of the connection is the yellow wire that provides engine shut-down capability through a variety of possible ground paths.
- The yellow wire in the PVC conduit that emerges from under the engine shroud connects to the blue wire in the tractor harness, providing dedicated power for the lights.
- The red wire in the PVC conduit that emerges from under the engine shroud connects to paired red wires in the tractor harness. One feeds power to the B terminal on the key switch, while the other provides power to the after-fire solenoid when the engine is running.
- Refer to the engine manufacturer's specifications to test starting and charging systems.

17.34. The engine harness connector on the Briggs and Stratton powered Troy-Bilt tractor also contains alternator and safety circuit components. See Figure 17.34.

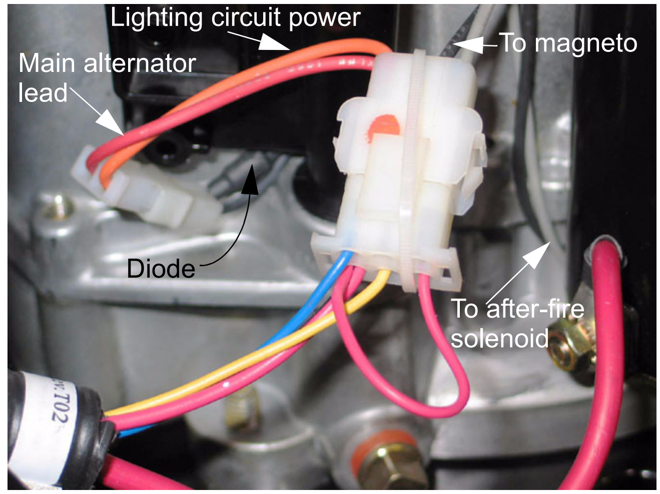


Figure 17.34

- The gray wire in the engine harness leads to the after-fire solenoid. It receives power from the battery and the alternator through red jumper wire.
- The black wire in the engine harness leads to the magneto primary winding connection. On the tractor side of the connection is the yellow wire that provides engine shut-down capability through a variety of possible ground paths.
- The red wire in the engine harness contains a diode. It provides D.C. power to paired red wires in the tractor harness. One feeds power to the B terminal on the key switch, while the other provides power to the after-fire solenoid when the engine is running.
- The orange wire carries unregulated, non-rectified alternator output to the blue wire in the tractor harness, providing dedicated power for the lights.
- Refer to the engine manufacturer's specifications to test starting and charging systems.

17.35. **Ground issues**: It is relatively easy to track where power is on the positive side of the system. The negative side is frequently neglected, though it may account for just as many electrical problems as the positive side.

17.36. Most technicians' first instinct when testing ground paths is to set the multimeter to the Ohms scale (Ω) and look for continuity using resistance as a measurement. This method does give a rough idea if the circuit is complete or not.

17.37. Resistance is not the most definitive scale for identifying circuits that are complete, but have reduced current carrying capacity because of bad connections, physical damage, or corrosion.

17.38. As a point of illustration, a short length of 12 or 14 gauge stranded wire can be stripped at the ends to facilitate an Ohm reading. See Figure 17.38.

Figure 17.38

17.39. For comparison, strip away insulation at the middle of the wire, and snip strands until only a few remain. Repeat the Ohm reading. There will not be a substantial change. See Figure 17.39.

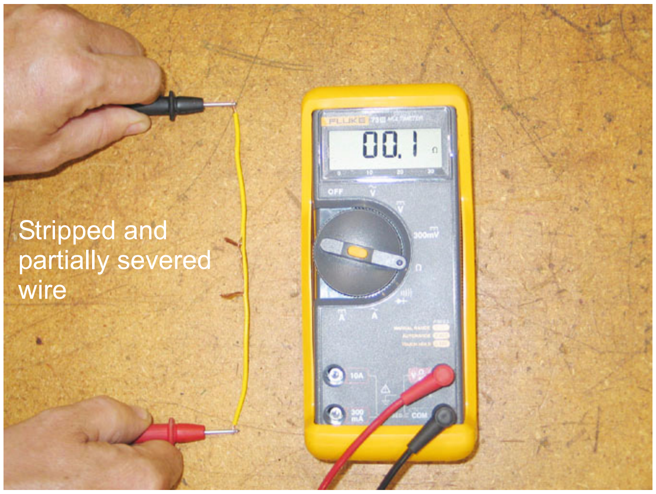


Figure 17.39

- While the actual resistance did not change, the ability of the whittled-down length of wire to carry current is vastly reduced.
- Similar effects occur when a terminal is not firmly crimped, a connection is loose, insulated by paint or corrosion, or the wire is chafed, cut, or corroded.

17.40. A more effective way to identify this reduced current carrying capacity is to look for “voltage drop”.

17.41. Voltage drop tests are useful on both the positive or the negative side of the system. We will concentrate on the negative side to begin with. See Figure 17.41.

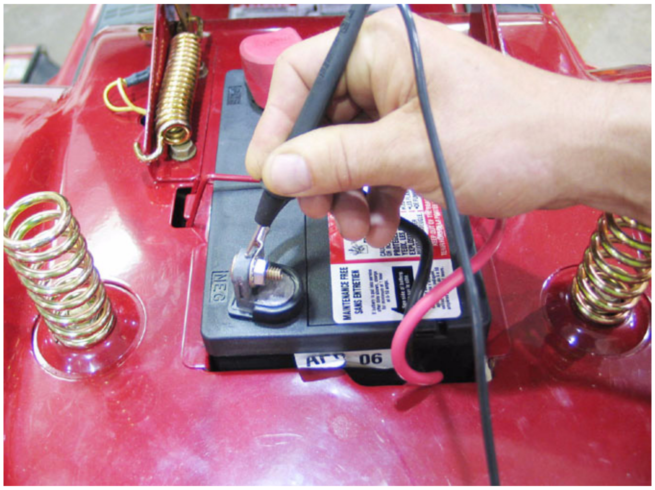


Figure 17.41

- Ultimately, any negative current should find its way back to the negative post of the battery.
- To check ground-side voltage drop: set-up a multimeter to measure 12V DC.
- Make a good electrical connection between the black (-) probe and the negative post on the battery.
- Make a good electrical connection between the red (+) probe and the suspect point of ground.
- Power-up the circuit in question.
- The voltage that shows-up on the meter is the power that is not following the intended path back to the negative battery post.
- Voltage drop on a good circuit should be less than 0.1 volts. A voltage drop reading on the meter of greater than 0.2 volts indicates a fairly substantial problem that demands attention.

17.42. As an example, if the starter solenoid does not engage properly, check for voltage drop between the ground point for the starter solenoid and the negative post on the battery. See Figure 17.42.

Figure 17.42

17.43. With the starter engaged, this machine exhibited a voltage-drop reading beyond 0.30 volts, indicating a poor ground connection.

17.44. A similar ground-side test on a tractor with a slow-cranking starter motor can be conducted between the engine block and the negative battery post. See Figure 17.44.

Figure 17.44

17.45. With the starter engaged, this machine exhibited a voltage-drop reading beyond 0.30 volts, indicating a poor ground connection.

17.46. Individually, these readings should lead a technician to inspect the connection between the solenoid and the ground path (e.g. mounting hardware, green wire with eyelet beneath head of solenoid mounting bolt), or the engine and the frame (e.g. loose or rusty engine mounting bolts).

17.47. If both of these readings were found on the same tractor, a common point in the system would be the primary suspect (e.g. poor connection between negative battery cable and frame).

17.48. Applying this principle to the positive side of the system: See Figure 17.48.

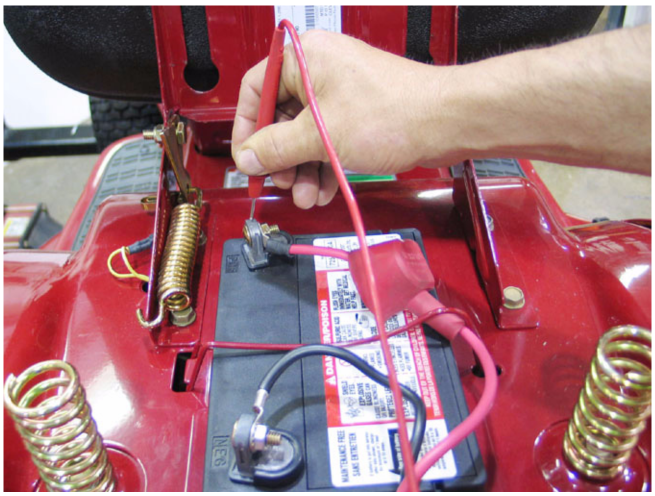


Figure 17.48

- Ultimately, any positive current should find its way from the positive post of the battery to its destination through the wiring harness.
- To check hot-side voltage drop: set-up a multimeter to measure 12V DC.
- Make a good electrical connection between the red (+) probe and the positive post on the battery.
- Make a good electrical connection between the black (-) probe and the suspect point of the circuit.
- Power-up the circuit in question.
- The voltage that shows-up on the meter is the power that is not following the intended path back to the negative battery post.
- Voltage drop on a good circuit should be less than 0.1 volts. A voltage drop reading on the meter of greater than 0.2 volts indicates a fairly substantial problem that demands attention.

17.49. As an example, if the tractor had a slow-turning starter, the ground-side voltage drop measured below 0.1 volts, and there was not a parasitic load on the engine (e.g. PTO clutch that is not fully disengaged), it would be logical for the technician to check voltage drop to the starter. See Figure 17.49.

Figure 17.49

17.50. With the starter motor engaged, the voltage drop reading here is nearly 0.6 volts, indicating a serious problem in the heavy-gauge circuit between the starter and the battery.

17.51. Checking voltage-drop at various points along the circuit can help pin-point the problem.

- Check voltage-drop at the output lug on the starter solenoid:
  If there is a significant difference, the problem lies between the lug on the solenoid and the lug on the starter.
  If there is little change, the problem lies further up-stream.
- Check voltage drop at the input lug on the solenoid:
  If there is significant difference between the reading there and the reading at the output lug (greater than 0.10 volt), then the contacts inside the solenoid may be burned.
  If there is little change, the problem lies further up-stream, between the battery and the solenoid.
- Results may be cross-checked by testing voltage drop across the two posts of the starter solenoid while cranking the starter motor.

17.52. This test may also be applied to the light gauge circuits on the tractor.

17.53. Switches may be bench tested using an Ohm meter. Generally speaking, safety switches will have less than 0.2 Ω through the contacts.

17.54. On MTD switches:

- Normally Closed contacts are identified by the letters "NC" stamped on the spades that connect to those contacts.
- Paired spades (going to the same set of contacts) are next to each-other flat-to-flat (not edge to edge).
- It is good to test switch contacts in both modes: open and closed, confirming that each set of contacts is neither shorted nor faulted.

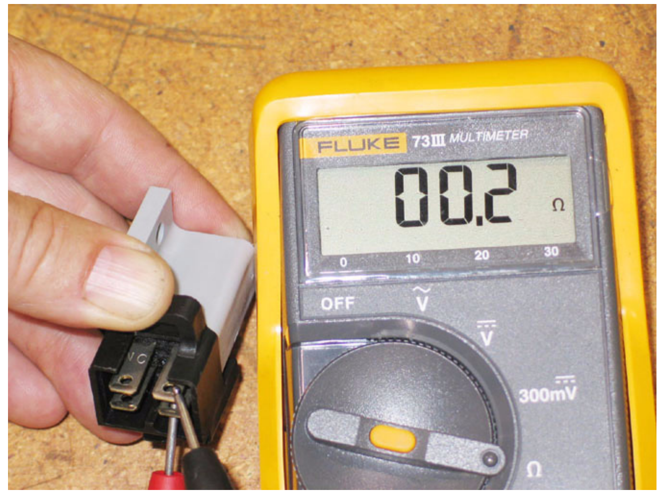
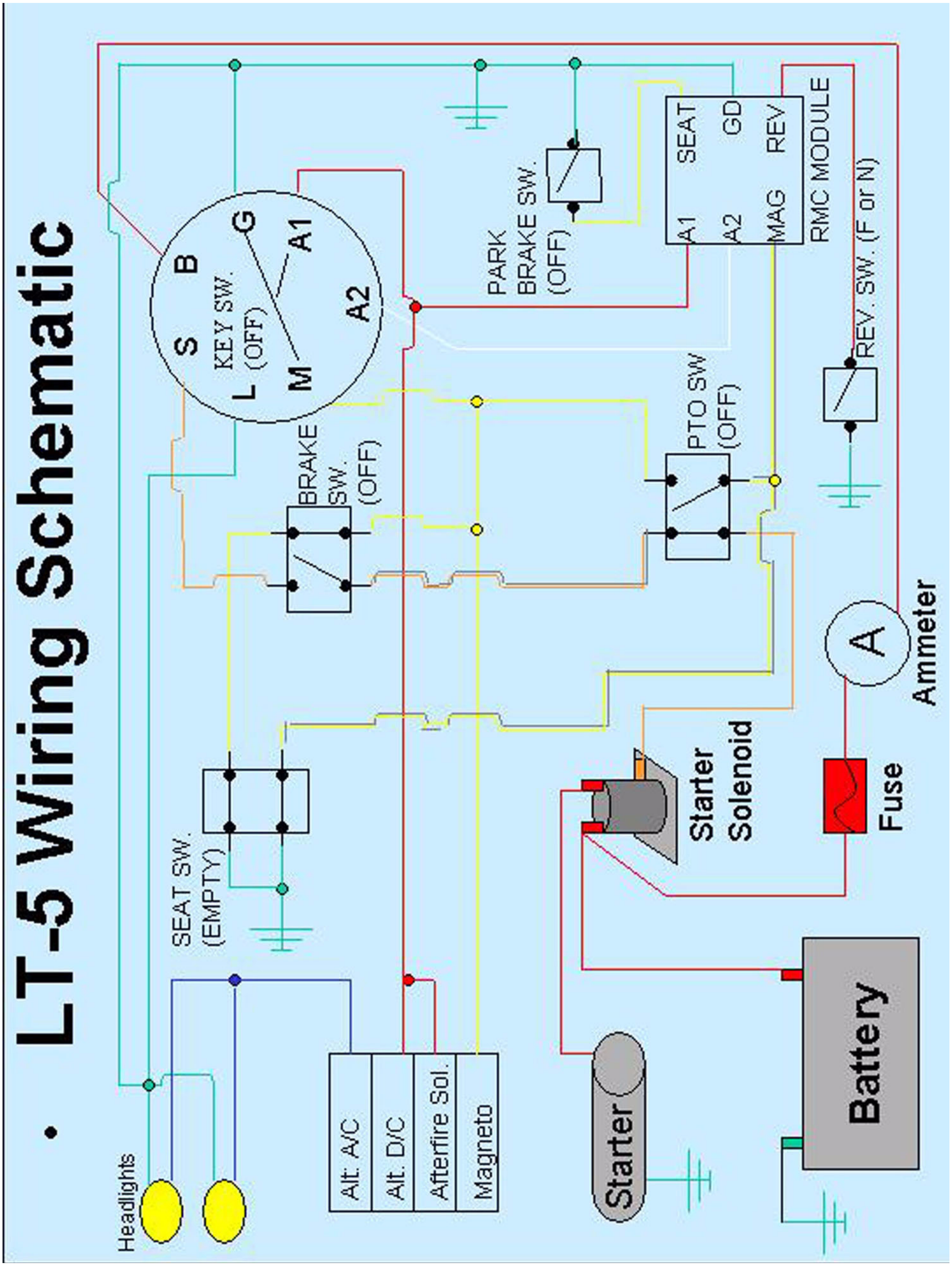


Figure 17.54


LT-5 Wiring Schematic
Headlights
Alt. A/C
Alt. D/C
Afterfire Sol.
Magneto
Starter
Battery
SEAT SW. (EMPTY)
BRAKE SW. (OFF)
KEY SW. (OFF)
S
B
G
A1
A2
M
L
PARK BRAKE SW. (OFF)
PTO SW (OFF)
Starter Solenoid
Fuse
Ammeter
A
SEAT
GD
REV
A1
A2
MAG
RMC MODULE
REV. SW. (F or N)

18. FASTENER INSTALLATION SPEC.S

Torque Settings	
Engine Pulley Bolt	450-600 in-lbs / 51-67 Nm
Segment Stop Bolt	200-260 in-lbs / 23-29 Nm
Segment Pivot Bolt	200-260 in-lbs / 23-29 Nm
Steering Block Bolts	200-260 in-lbs / 23-29 Nm
Lower Steering Shaft Screw *	17-20 ft-lbs / 23-27 Nm
Blade Nuts	70-90 ft-lbs / 95-122 Nm
Steering Wheel Screw *	17-20 ft-lbs / 23-27 Nm
Chute Mounting Screws	50-100 in-lbs /6-11 Nm
Idler Pulley	40-50 Ft-lbs /55-68 Nm
Idler Bracket Pivot Blot	40-50 Ft-lbs /55-68 Nm
Spindle screws	200-300 in-lbs /23-34 Nm
Engine Bolts	200-450 in-lbs / 23-51Nm
Trans Axle (single speed)	
Transmission Pulley Nut	10-15 ft-lbs / 14-21 Nm
V-Speed Bracket **	260-350 in-lbs / 29-40 Nm
Tension Pulley **	260-350 in-lbs / 29-40 Nm
Perimeter Bolts	90-120 in-lbs / 11-14 Nm
* Loctite	
** Nut w/nylon insert	
Note:	
Apply never seez to the crank shaft prior to re-installing	
the Engine pulley	