

Charging System

The charging system provides electrical current for the lights, radio, heater blower and the engine's electrical systems. It also maintains the batteries in a charged state, recharging them as necessary to provide cranking power.

The charging system has three main components, or component areas: the alternator, the voltage regulator, and the battery.

The alternator is driven by a belt from the engine crankshaft and produces the electrical power to operate the systems on the bus. It also recharges the battery.

The voltage regulator acts as a "control valve" for the alternator output. It senses the current load and maintains a constant voltage in the charging system, independent of the current load, up to its rated output. The alternator on the Blue Bird All American has a "built in" voltage regulator. It is excited (started) by the ignition system.

The battery is the reservoir of chemical electrical power. Its primary purpose is to crank the engine. It also supplies power to the accessories for a short time when the demand is too high for the alternator alone (i.e., while the bus is at idle). Another key role of the battery is to act as a filter for the charging system by providing clean "electronic power" for the electronic control systems; ECU, ECM, TCM, and gauges.

Maintenance

Clean the alternator and all connection points. Dirt buildup restricting air flow through to the alternator will cause excessive heat and premature failure. Corrosion at any connecting point will produce resistance to current flow, heat and diminished power for the accessories.

Ensure that all the components in the charging system are mounted securely. Check the torque at all mounting bolts — both the bolts that hold the alternator in the mounting bracket and the bolts that secure the mounting brackets to the engine. The torque value for mounting bolts at the engine and at the alternator should be 60 – 70 ft lb.

Blue Bird All American buses are equipped with an automatic belt tensioner. Ensure that all the grooves fit properly into the pulleys in the correct path. The drive belt should be inspected every 11,000 miles (17,700 km), 250 hours of service life, or every 3 months; whichever occurs first.

Also check:

- Battery voltage
- Alternator output
- Starter current draw

Troubleshooting

Timely preventive maintenance of the charging system should keep it running smoothly. However, when a problem occurs, effective troubleshooting procedures will help locate and correct the problem quickly and economically.

WARNING Batteries emit an explosive gas. Never smoke while working on the charging system. Batteries can explode from a spark. Always remove the negative battery cable at the battery post before removing any other wires in the charging system. Be careful not to short the system while you are working on it. Do not wear jewelry.

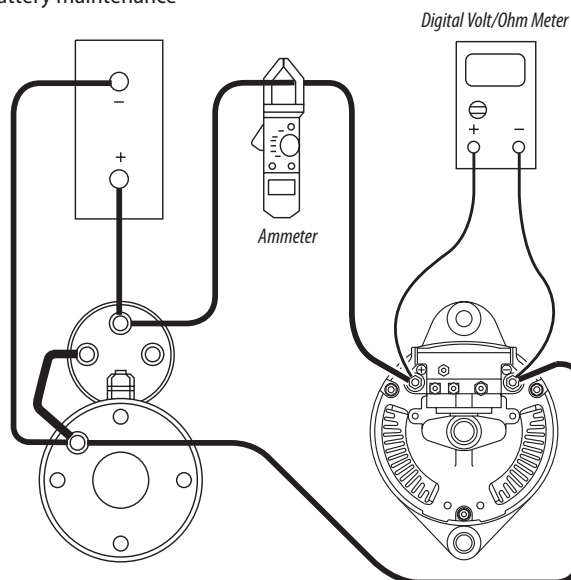
Before you begin to analyze the charging system, it is necessary that you ensure the battery is properly tested and charged to at least 75% of their rated capacity. Failure to confirm the condition of the battery will make the results of any diagnostic testing unreliable. Refer to the battery manufacturer's publications on battery maintenance and testing.

Alternator Performance Test

1. Connect a digital volt/ohmmeter (VOM) to the output terminals of the alternator.

CAUTION Ensure that the test leads are connected properly. Observe the polarity and make secure connections.

2. Connect an ammeter to the positive terminal of the alternator. Observe that the clamp on the ammeter is located at least 6 inches (15 cm) from the alternator to lessen the possibility of faulty readings due to spurious emissions.
3. Verify that the voltage output from the alternator is between 13.8 and 14.2 volts with the engine at operating RPM (1700 RPM minimum) and not idle.
4. Ensure that all "loads" are in the off position. The reading on the ammeter should be less than 20 amps.
 - If the amp reading is higher than 20 amps, ensure all accessories are turned off.
 - Ensure the battery is charged to at least 75% of their rated capacity.
5. Record the voltage. If the voltage is not within the specified range or the amperage is not within the specified range, the alternator is defective.



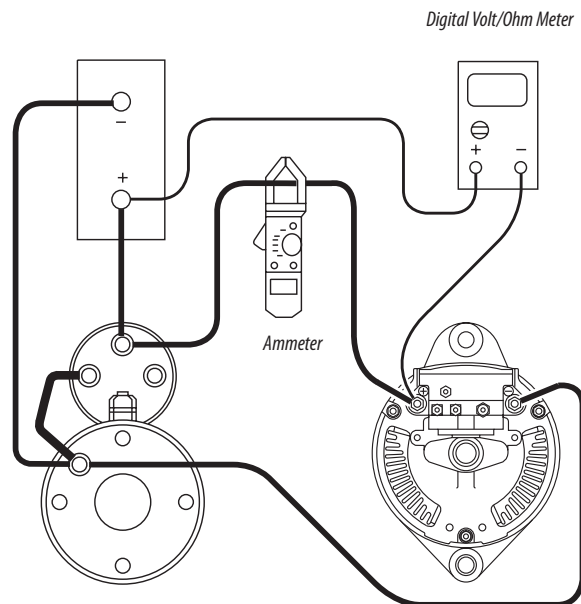
6. If the alternator is determined to be defective, repair or replace it in accordance with the instructions below. See Alternator Removal.
7. If the alternator is determined to be functioning properly, proceed as follows:
8. Continue to operate the engine at about 1700 RPM, and with the test equipment set up as illustrated.
9. Turn on vehicle loads (accessories) until the ammeter displays amps, 75% of the rated capacity of the alternator. Record the voltage at this point.
10. Compare the voltage reading with the voltage reading observed in Step 3 above.
11. If the alternator voltage drops more than .5 (1/2) volt, the alternator is defective.

An alternate method of checking the alternator under load is to use a carbon pile load. Connect the carbon pile across the battery and adjust it until the ammeter reads 75% of the alternator rated capacity. Record the voltage at this point, shut off the engine, and compare the readings.

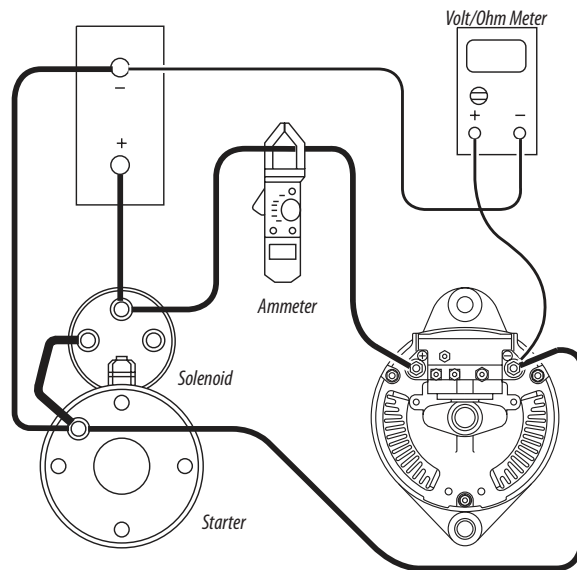
Alternator Cable Tests

To test the positive alternator cable:

1. Clamp the ammeter on the positive cable at least 6 inches (15 cm) from the alternator. See Figure 2.
2. Connect the negative lead of the VOM to the positive post of the alternator.
3. Connect the positive lead of the VOM to the positive battery post.
4. Start the engine and let it run at about 1700 RPM.
5. Turn on accessories until the ammeter reads amps, which is 75% of the rated alternator capacity. Use a carbon pile if necessary to achieve the load.
6. Record the voltage reading on the VOM.



7. If the VOM reads more than -.25 volts, there is a problem with the positive cable.
 - Check and clean all the connections and the condition of all the cables/wires in the circuit.
 - Re-test the circuit.
8. If the reading is less than -.25 volts, the cable and connections are good.
9. Connect the negative lead of the VOM to the negative terminal of the battery.
10. Connect the positive lead of the VOM to the negative terminal of the alternator.
11. Repeat Steps 4 through 8 for the negative cable.

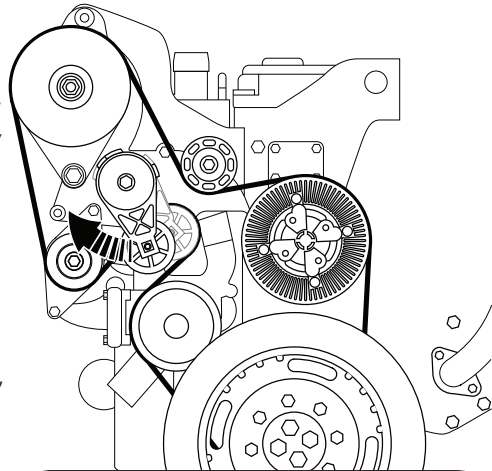


Alternator Removal

WARNING Always disconnect the negative (-) cable from the battery terminal first to avoid arcing, which could ignite explosive battery gases.

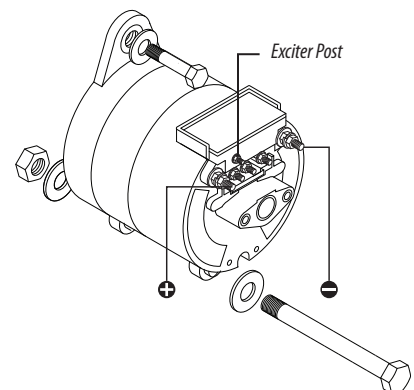
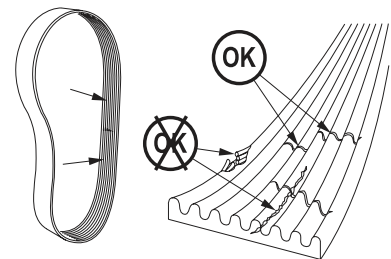
1. Park the bus on a smooth, flat surface.
2. Chock the wheels in both directions.
3. Ensure the engine is not running, the ignition switch is in the "OFF" position and the key is removed.
4. Disconnect the negative (ground) cable from the battery post.
5. Lift the automatic belt tensioner to remove the drive belt from the alternator.
6. Remove the drive belt.
7. Inspect the drive belt; discard it if any signs of wear are present.

A few minor cracks across the belt are acceptable. Longitudinal cracks are NOT acceptable. Replace the drive belt when any crack is observed to be running lengthwise or with the belt, or when the belt appears frayed.



WARNING Always disconnect the negative (-) battery cable at the battery before removing any wiring from the alternator.

8. Remove the negative (-) cable from the alternator.
9. Remove the positive (+) cable from the alternator.
10. Remove the ignition wire from the exciter post.
11. Remove the locknut and washer from the bottom mounting bolt. Remove the bolt from alternator mounting bracket.
13. Remove the bolt and split ring lock washer from the top of the alternator.
14. Remove the alternator.



Alternator Reinstallation

Installation of the alternator is accomplished in the reverse order of the removal instructions above.

1. Position the alternator under the top holding bracket.
2. Install the washer (7) on the bolt (8). See Figure 7.
3. Install the bolt (8) and washer (7) assembly finger tight.
4. Install lock washer (5) on the through bolt (6).
5. Install the through bolt/washer assembly through the holding bracket and the alternator mounting holes.
6. Install the washer (5) onto the through bolt.
7. Install the locknut (4) on the through bolt.
8. Torque bolts (6 and 8) to 60 – 70 ft lb.
9. Install the ignition exciter wire on the IGN post (3). Tighten carefully to avoid breaking or stripping the stud. See Figure 6.
10. Install the positive cable (2) on the B+ post. Carefully tighten to avoid breaking or stripping the stud.
11. Install the negative cable (1) on the B - post. Carefully tighten to avoid breaking or stripping the stud.
12. Using a square drive tool, position the automatic tensioner so that the drive belt can be installed. Inspect the drive belt carefully. Replace the belt if any signs of wear are present.
13. Install the drive belt. Ensure that the grooves in the belt fit into the proper places on all the pulleys.



Automatic Belt Tensioner

The automatic tensioner is spring loaded to provide the proper tension for the drive belt.

The automatic tensioner should travel at least 71°, and the torque to move the tensioner 25° from the “at rest” position must be 9 – 11 ft lb (12.4 – 15.8 Nm). Inspect the belt tensioner for any unusual noise, excessive looseness and shaking at the bearings.

Automatic Tensioner Removal

1. Remove the drive belt in accordance with the instructions above.
2. Remove the capscrew (1) from the automatic tensioner. See Figure 8.

To install a new automatic tensioner, reverse the removal instructions. Torque the capscrew (1) to 28 – 42 ft lb (38 – 56 Nm).

Starter

There are 5 main components or component areas in the starting system: the ignition switch, a neutral safety switch, the starter solenoid, the starter motor and the batteries.

When the key is turned to the start position, electrical current flows to the starter solenoid from the batteries. The flow is interrupted if the transmission shift lever is not in the neutral position or if the neutral sensor switch is defective.

The starter solenoid is an electromagnetic switch mounted on the starter motor. When electric current energizes coils inside the solenoid, a magnetic field is induced which pulls a plunger. At one end of this plunger is a lever. The lever is connected to the starter drive pinion of the starter motor. The plunger also connects the electrical power from the batteries to the starter motor as the drive pinion engages the flywheel ring gear.

The starter motor is a relatively small electric motor, but it can deliver large amounts of torque for a short time.

When the operator releases the ignition switch it returns to the run position. The solenoid is disconnected from the batteries and the magnetic field collapses. This allows the spring in the solenoid to move the plunger in the opposite direction, disengaging the drive pinion from the flywheel and removing electrical current from the starter motor.

The Blue Bird All American has a 12-volt electrical system.

Preventative Maintenance

There are two preventative maintenance procedures that can greatly enhance the efficiency of the starting system. These two steps are also the first two steps taken when troubleshooting a malfunctioning starting system.

- An engine that needs a tune up will be difficult to crank; over cranking will lead to starter motor failure.
- Poor connections due to road dirt, grease, corrosion, loose connectors, or broken insulation at any connecting point rob the starting system of electrical power and cause it to over-crank.

Troubleshooting

Before beginning to troubleshoot the starting system, ensure the batteries are properly maintained and charged to at least 75% of their rated capacity. A drained battery will cause any further diagnostic tests to be inaccurate. Common causes of starting system malfunction include:

1. A battery that is low, poorly charged, or defective places high demands on the starting system; voltage at the battery should be 12.5 volts or greater to crank the engine. If the batteries aren't adequately charging, a problem in the charging system. Refer to the Alternator section of this Service Manual for information on the charging system.

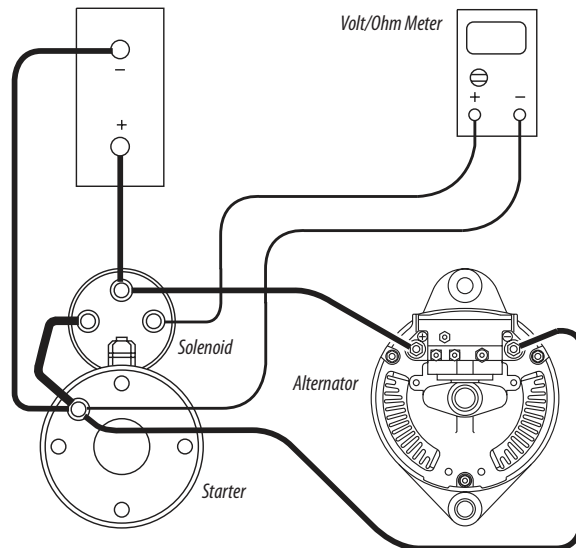


2. A starter motor can be damaged by heat that is generated by excessive cranking. The starter should never be engaged for more than 30 seconds. It must "rest" (cool off) a minimum of 2 minutes between starting attempts.
3. Loose, dirty, or corroded connections in the starting system rob the system of the power needed to turn the engine. The case of the starter motor is the ground or "return" connection for the starter motor and solenoid.
4. A loose starter motor will allow vibration that can damage the motor. In addition, the ring gear could be damaged.
5. Improper or excessive use of starting fluid will cause extra stress on the starting system.
6. A defective solenoid will fail to engage the starter drive pinion of the starter motor. A failed pull-in coil will cause the plunger to fail to pull in. A failed hold-in coil may cause the starter to fail to stay engaged, or may fail to switch the starter motor on. If the solenoid is suspect, test the wiring of the solenoid circuit before replacing the solenoid.

Ignition/Run Test

Begin by determining whether the problem is with the ignition switch or the pilot relay, and their associated wiring; or if it is in the solenoid and/or starting motor. To begin with the ignition switch:

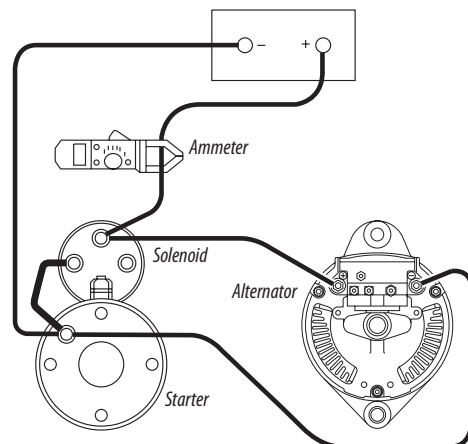
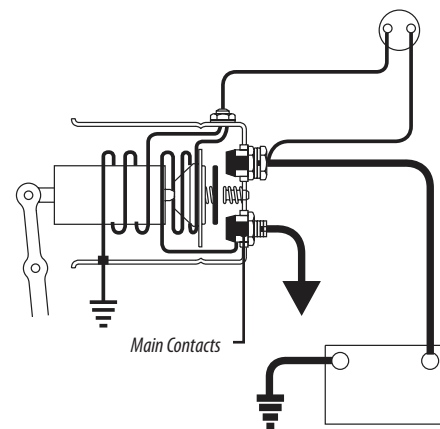
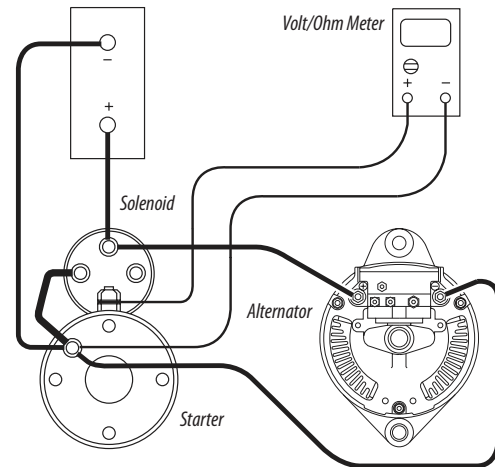
1. Connect the positive lead of a VOM to the ignition switch terminal on the solenoid.
2. Connect the negative lead of the VOM to the chassis ground.
3. While attempting to crank the engine, record the voltage displayed on the VOM. Observe the following:
 - No voltage
 - Low voltage
 - Normal voltage with slow cranking
 - Normal voltage with no cranking at all.
4. Connect a remote start switch to the positive battery post.
5. Connect the other end of the remote start switch to the ignition post of the solenoid.
6. Attempt to crank the engine with the remote switch. Record the voltage displayed on the VOM. If there is less than 1 volt difference from the previous reading, the ignition switch is okay. If there is more than 1 volt difference, the switch is defective.
7. With the VOM negative lead connected to the chassis ground, move through the switch system one connection at a time. If your first voltage test has revealed low voltage, the starter motor may be shorted.
8. If the first voltage test indicated normal voltage, but there is slow cranking or no cranking at all, a problem with the batteries, battery cables, or a damaged starter motor is indicated.



Low Voltage Test

There are various reasons for low voltage but the troubleshooting methods are the same. If the solenoid clicks, it means that either current is flowing through the solenoid contacts but not through the main contacts; or that the current through the main contacts is insufficient due to low batteries.

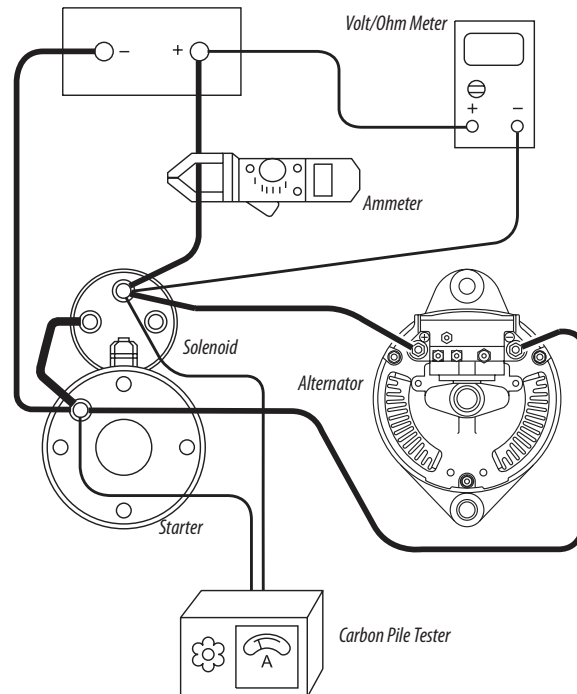
1. Connect the positive lead of the VOM to the starter motor terminal of the solenoid.
2. Connect the negative lead of the VOM to the chassis ground.
3. While attempting to crank the engine, if there is no voltage displayed on the VOM, the main contacts are not functioning properly.
4. If there is voltage present at the solenoid terminal during Step 3, the problem is in the starter motor or its cabling.
5. If the first voltage check in Step 3 under Ignition/Run Test indicated normal voltage but slow or no cranking, the next step is to check the starter motor and its connections.
6. If the drive pinion jumps out of mesh with the flywheel ring gear, check for a broken or loose ground wire at the solenoid.
7. While attempting to crank the engine, place an ammeter on the positive battery cable. If the power drain is higher than the OEM specifications, the starter motor is defective. An exception would be if the engine was not properly tuned or is difficult to turn over; in which case, a new starter motor would be a temporary fix.



Slow Cranking

Sluggish cranking can be caused by a small amount of extra resistance in the cranking circuit. This extra resistance can come from loose or dirty (corroded) connections, or broken wires and/or cables. First check the positive cables and connections of the starter motor, then the negative circuit.

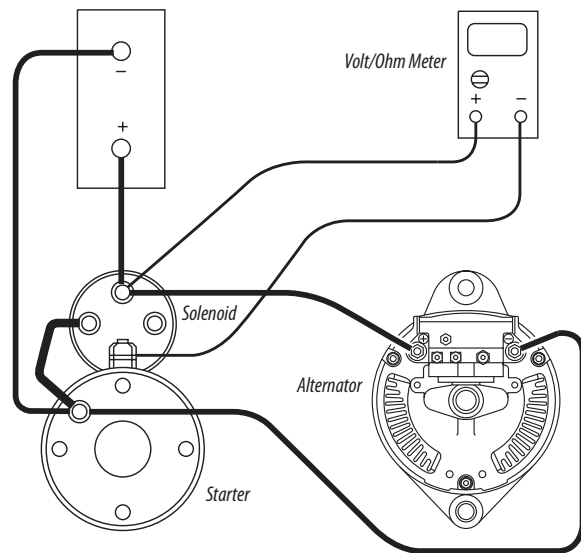
1. Connect the positive lead of a VOM to the positive battery terminal.
2. Position an ammeter between the solenoid and the positive terminal of the solenoid.
3. Connect the negative lead of the VOM to the positive terminal of the solenoid.
4. Connect the negative lead of the VOM to the negative battery post. This is the "unloaded" voltage. Record the reading; leave the VOM connected.
5. Connect one lead of a carbon pile tester to chassis ground.
6. Connect the other lead from the carbon pile tester to the positive terminal of the solenoid.
7. Adjust the carbon pile tester until the ammeter on the tester reads 500 amps.
8. Record the voltage display on the VOM; it should not be less than 0.4-volts less than the unloaded value.
9. Turn the carbon pile tester to the "OFF" position.
10. Connect the positive lead of the VOM to chassis ground.
11. Connect the negative lead of the VOM to the negative battery post. Record the reading; leave the VOM connected.
12. Position the ammeter in on the negative battery cable.
13. Turn on the carbon pile tester and adjust it to read 500 amps.
14. Record the voltage on the VOM; it should not drop more than 0.5-volts from the unloaded reading.



15. Turn the carbon pile tester to the OFF position.
16. If the voltage drop was more than 0.5-volts in step 8, the positive cabling is defective. Look for a broken cable or a loose or corroded connection.
17. If the voltage drop in step 14 is more than 0.4 volts, look for a problem in the negative cabling; look for broken or defective cables, and loose or corroded connections.

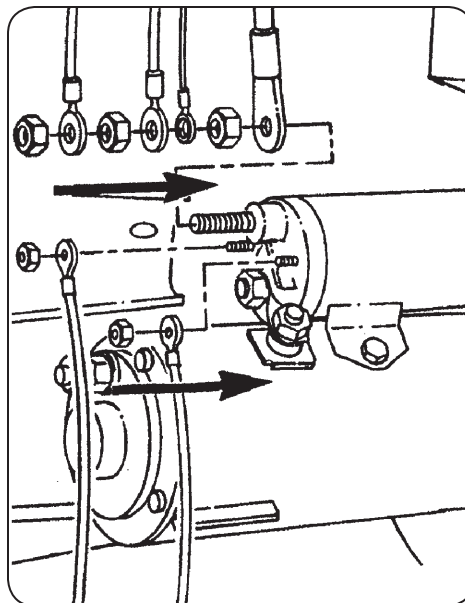
Final check at solenoid terminals.

1. Disconnect the carbon pile tester.
2. Disconnect the VOM.
3. Remove the ammeter.
4. Connect the positive lead of the VOM to the positive (battery) terminal of the solenoid.
5. Set the VOM so that it can read the full battery volt-age; at least 14 volts.
6. Connect the negative VOM lead to the starter motor terminal of the solenoid.
7. Crank the engine and record the voltage while cranking. There should be no more than 0.2 volts drop between the solenoid contacts while cranking.
8. The voltage reading in these last three tests (the positive cable check, the negative cable check and the solenoid test), should not total more than 1.0 volts. If the voltage drop is more than allowable, repeat the cable tests using a jumper cable. If the tests then indicate an acceptable drop, the cable(s) is (are) defective.



Starter Motor Removal

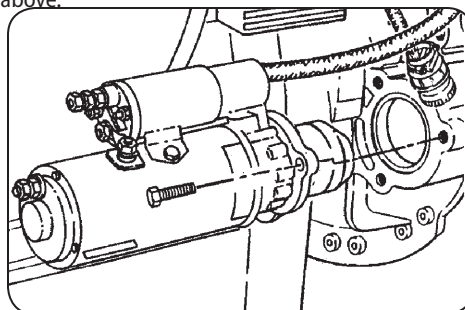
1. Disconnect the negative (ground) cable from the battery. Wrap it with tape or other suitable insulation to prevent shorts.
2. Disconnect positive cable from the battery. Wrap it with tape or other suitable insulation to prevent shorts.
3. Identify and tag each wire on the starter motor for reinstallation.
4. Remove all electrical connections from the starter motor. Be sure to identify and tag all electrical connection locations.
5. Remove 3 capscrews.
6. Remove starter motor from flywheel housing.



Starter Motor Installation

The starter motor is installed in the reverse order of the removal instructions above.

1. Carefully place the starter motor into position on the flywheel housing.
2. Install 3 capscrews (1). Torque to 32 ft lb (43 Nm). See Figure 8.
3. Being careful to observe the identification of the electrical wires, connect the wires to the appropriate terminal on the starter motor. See Figure 7.

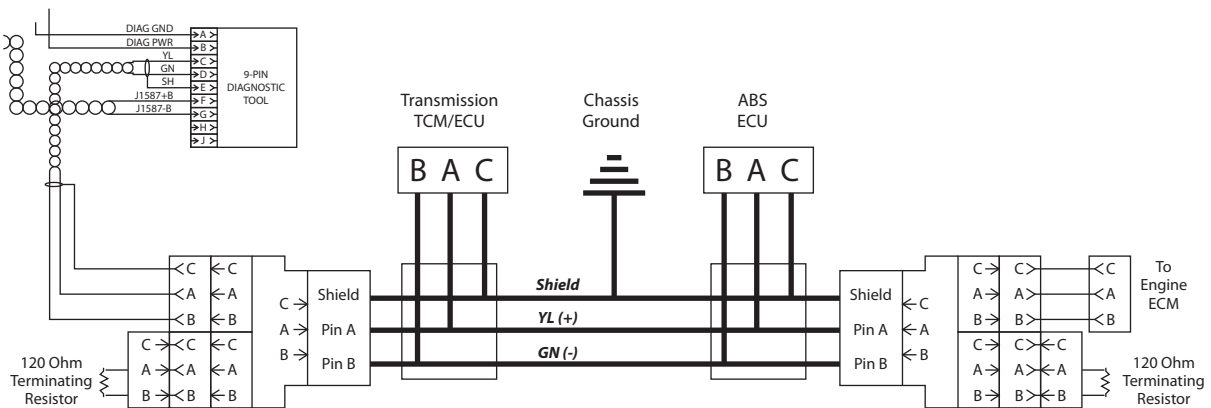


WARNING Always remove the negative (-) cable from the battery terminal first. Always connect the negative (-) cable to the battery terminal last to avoid arcing that could ignite explosive battery gases.

4. Install the positive cable on the battery post.
5. Install the negative cable on the battery post.

J-1939 Harness Diagnostics

1. Disconnect battery or J-1939 connector from the engine, ABS, transmission and instrument panel.
2. Measure resistance between pin A and pin B. Reading should be 60 ohms $\pm 1\%$ (0.6 ohms).
3. Measure continuity between shield (pin C) and ground. Reading should be minimal resistance.
4. Measure resistance between pin A and ground. Reading should be infinity (maximum resistance).
5. Measure resistance between pin B and ground. Reading should be infinity.
6. If all readings are correct, and problem appears to be intermittent:
 - 6.1 Inspect each connector for positive lock connection.
 - 6.2 Inspect for corrosion.
 - 6.3 Inspect for damage to connectors.
7. If resistance between pins A and B is 120 ohms, one of the terminating resistors is missing or bad.
8. If reading between pins A and B is infinity:
 - 8.1 One of the connectors is unplugged.
 - 8.2 Both resistors are bad or missing.
 - 8.3 A connector is damaged



Chassis Wiring Schematics

The following pages contain the main wiring schematics applicable to most All American chassis. These are provided for your convenience when you are limited to use of the print manual. However, the Tech Reference CD contains a duplicate set of these drawings which provides additional functionality to aid navigation while tracing circuits. When using the CD, click the Electrical Schematics Chassis link in the Bookmarks pane. The first page of the Chassis Electrical Schematics group contains instructions on how to use the linking and navigation features.

The drawings on the CD are in resolution-independent vector format. This allows you to zoom them at will, without the images becoming jagged as occurs with bitmap formats. This also means that you may print the drawing to your own office or desktop printer while maintaining legibility even at significant reductions.

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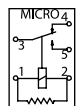
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Wire Colors

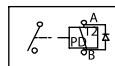
BL	BLUE
BK	BLACK
BN	BROWN
TN	TAN
WH	WHITE
YL	YELLOW
PK	PINK
OR	ORANGE
RD	RED
GN	GREEN
PU	PURPLE
GY	GRAY

Schematic Legend

PD	PDU PANEL
AC	AIR CLEANER BRACKET
IP	INSTRUMENT PANEL
FW	FIREWALL
SP	SHIFTER PANEL
DC	DCM



Micro Relay



Heavy Duty Relay



Fuse



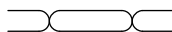
Voltage Stud



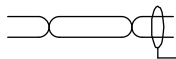
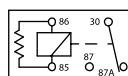
Shunt

Switch Ngr Rocker
(Non-typical)

3 Wire Twisting



2 Wire Twisting

2 Wire Twisting
with Shield

Mini Relay



Horn



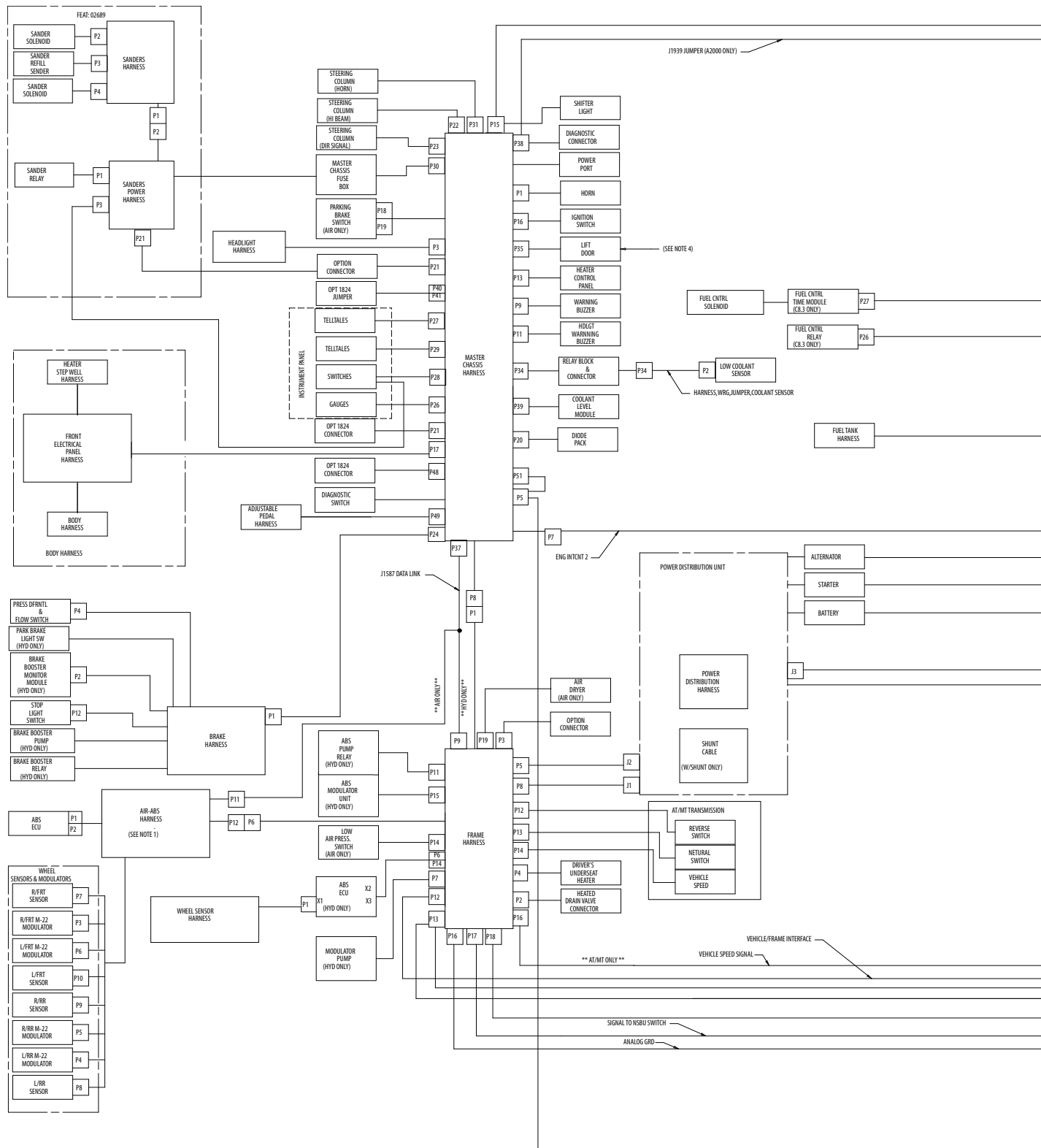
Speaker



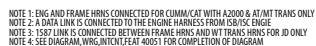
Light



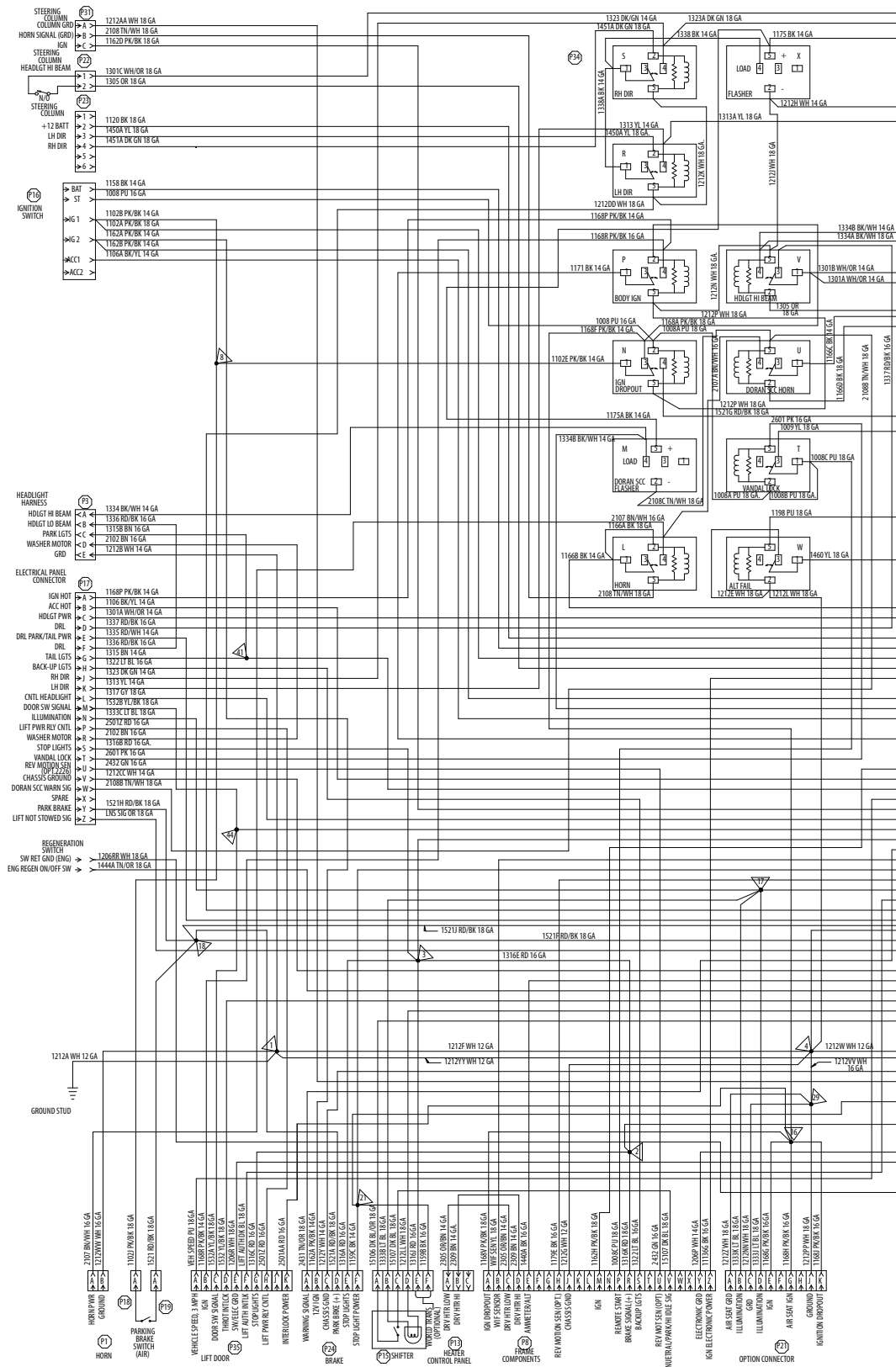
Circuit Breaker

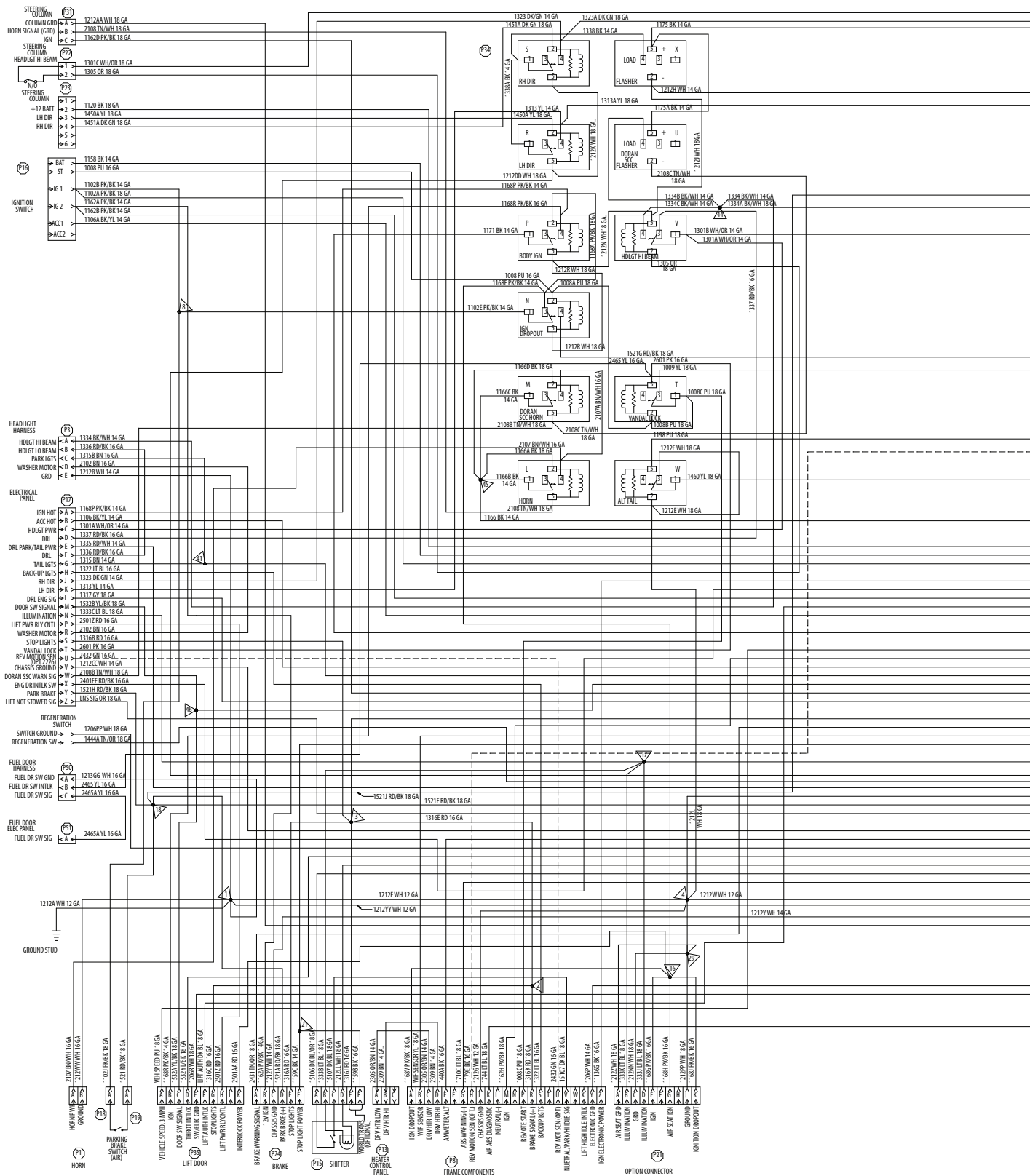




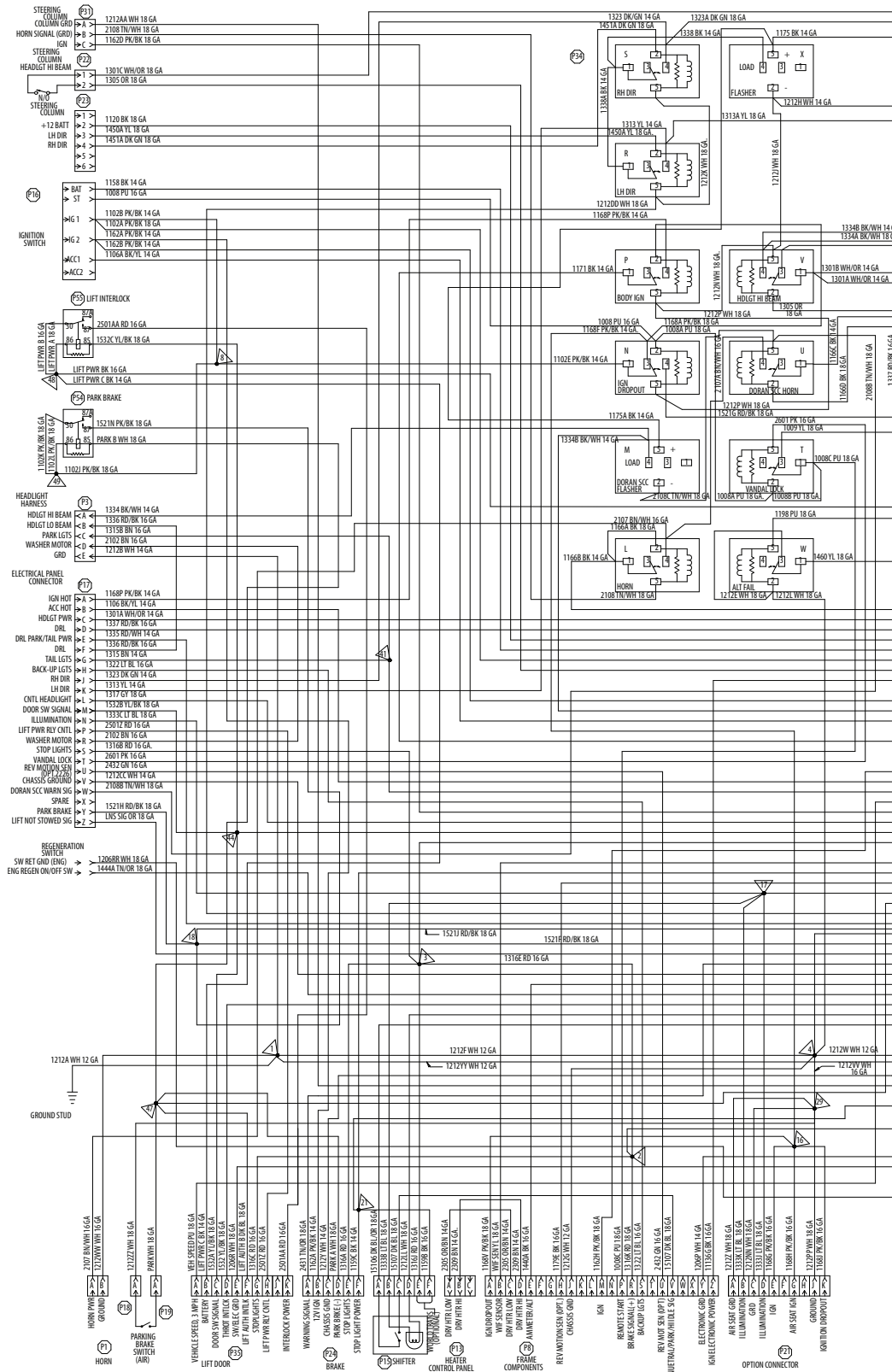




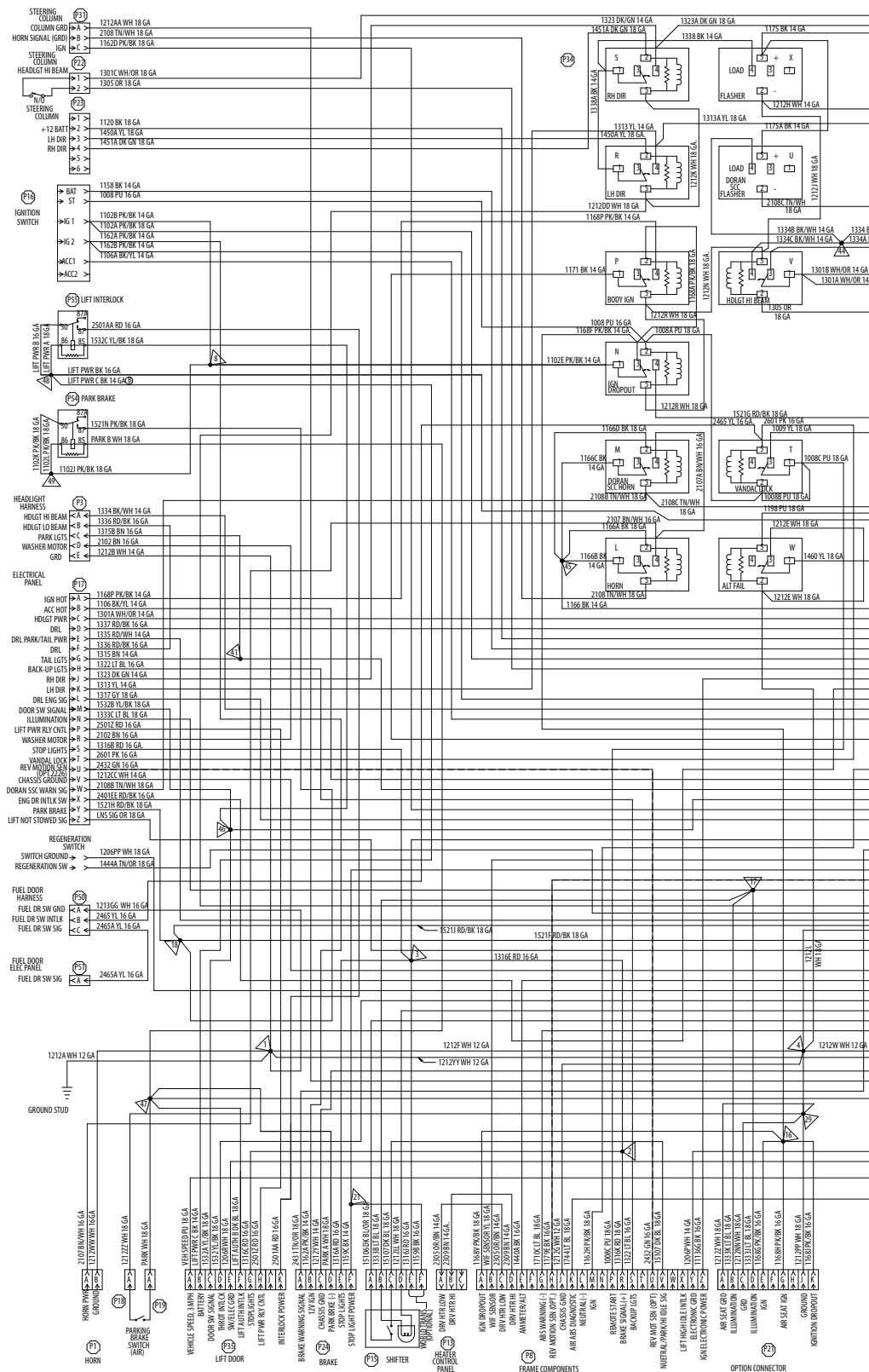




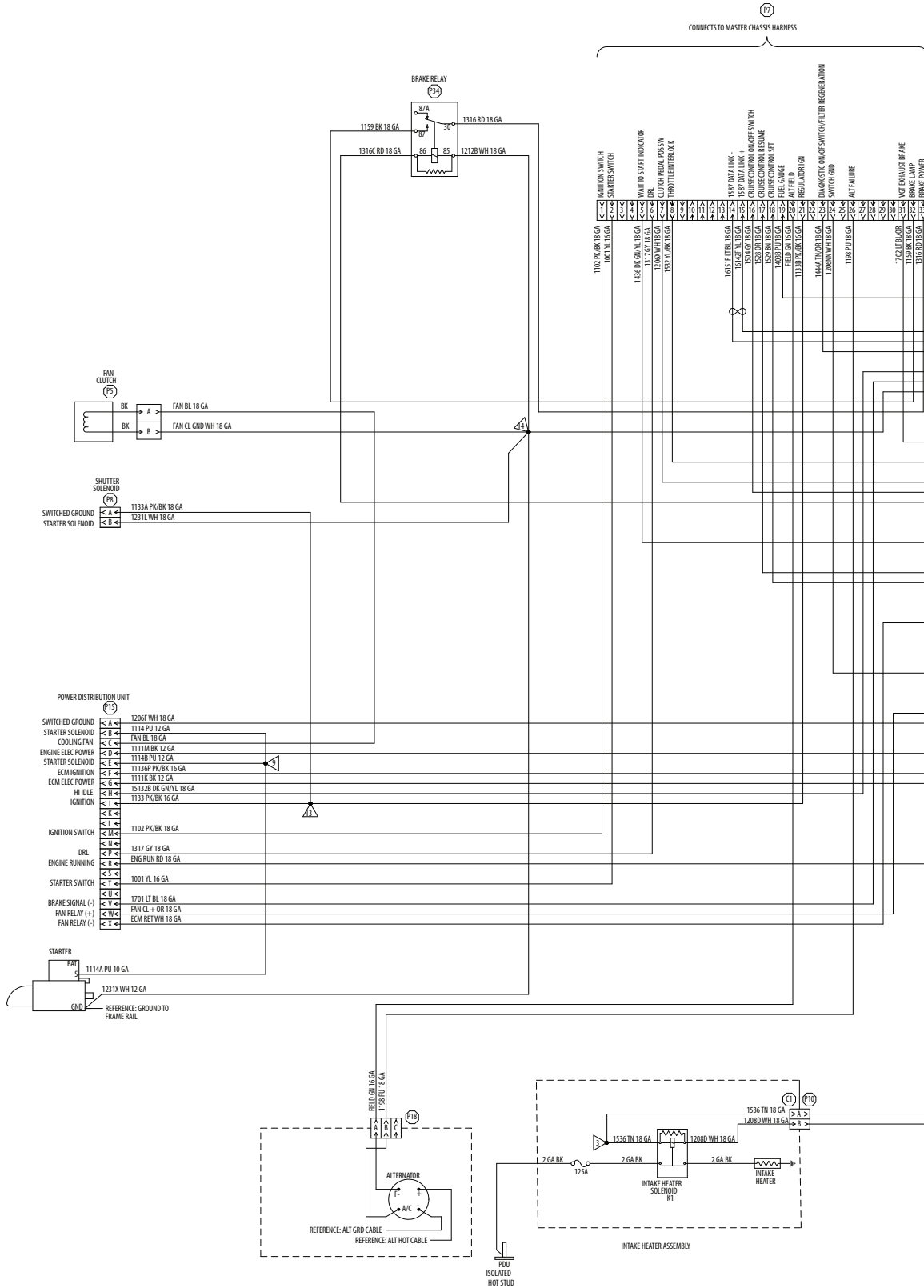




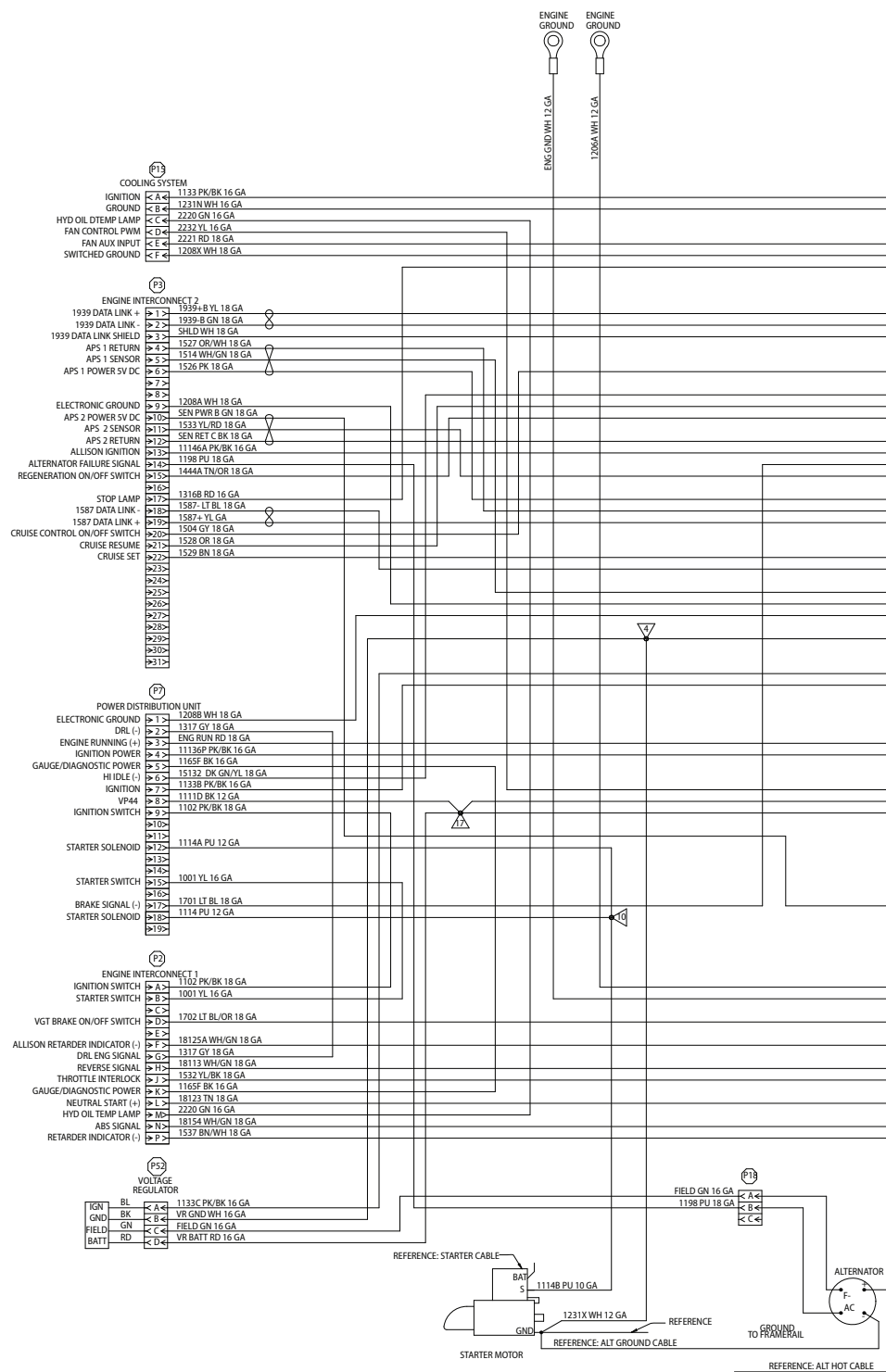




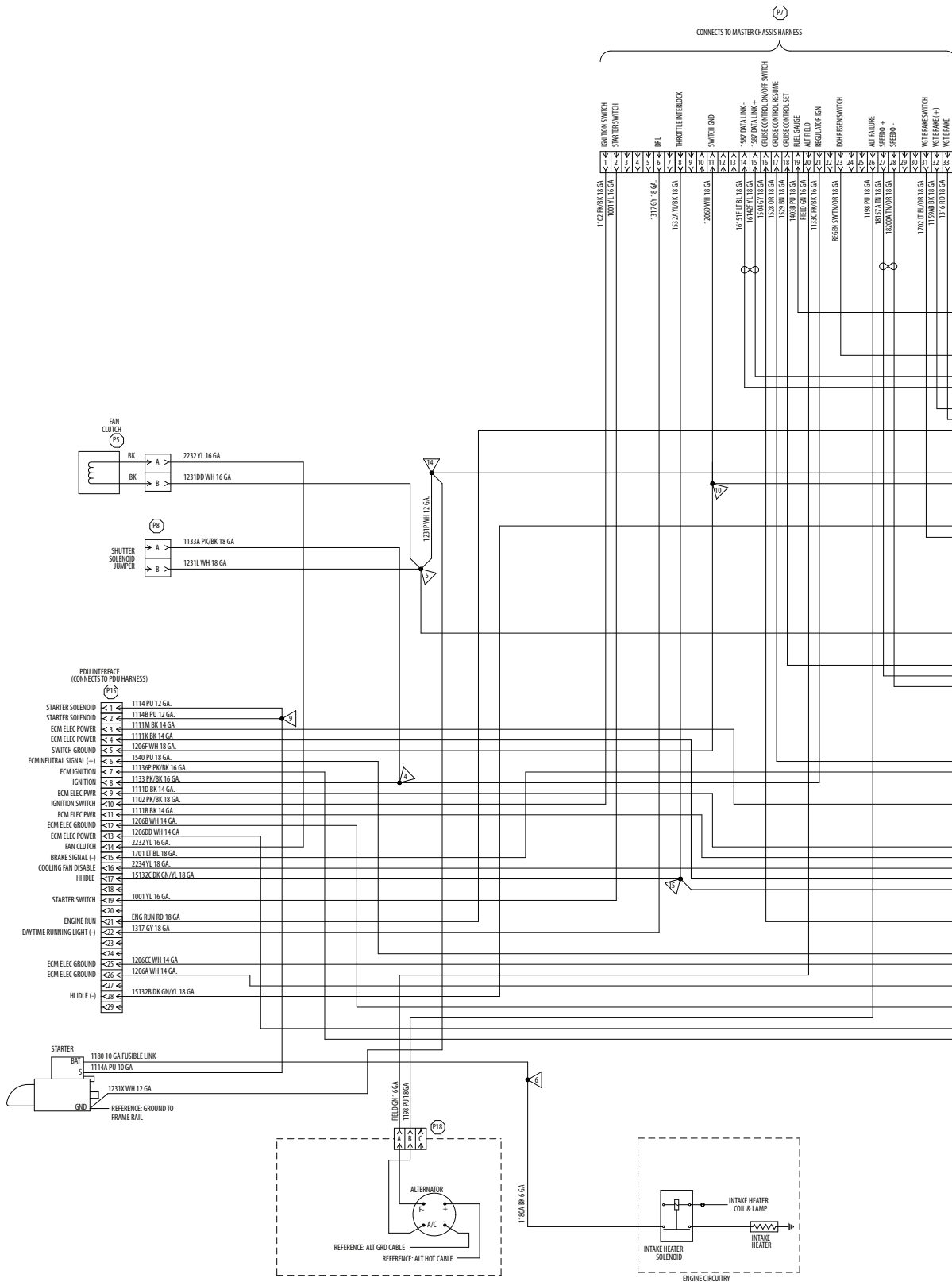


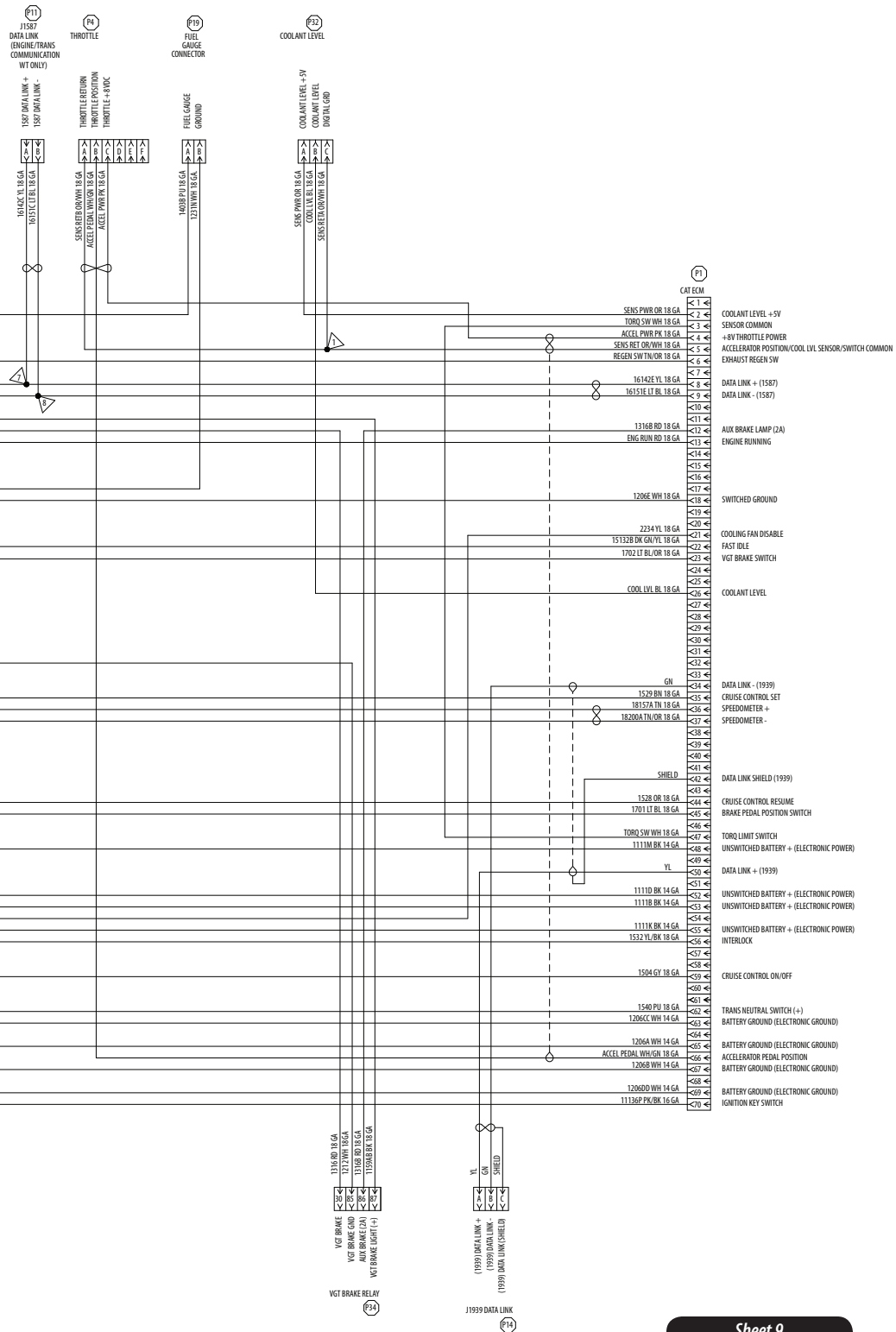


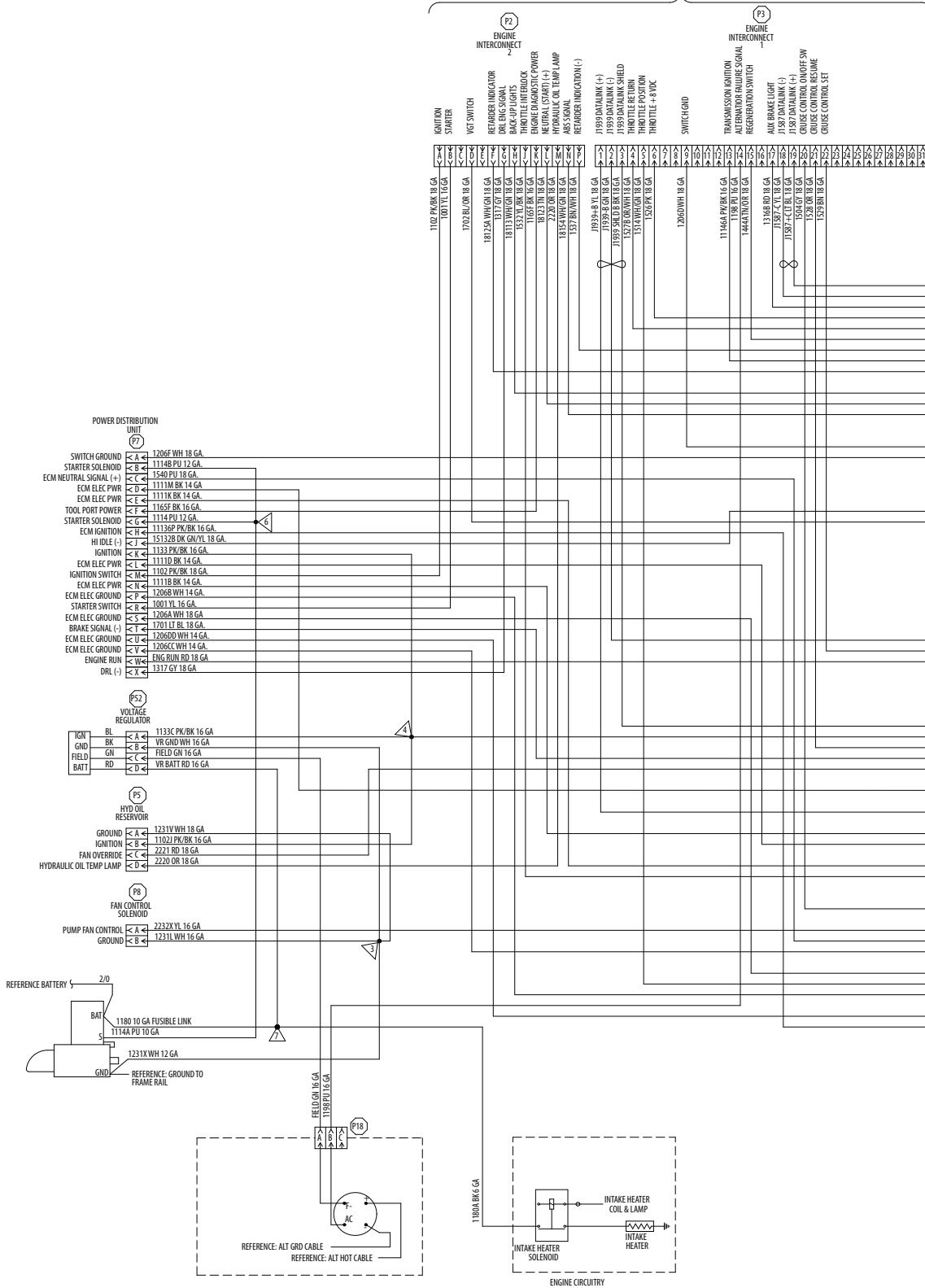




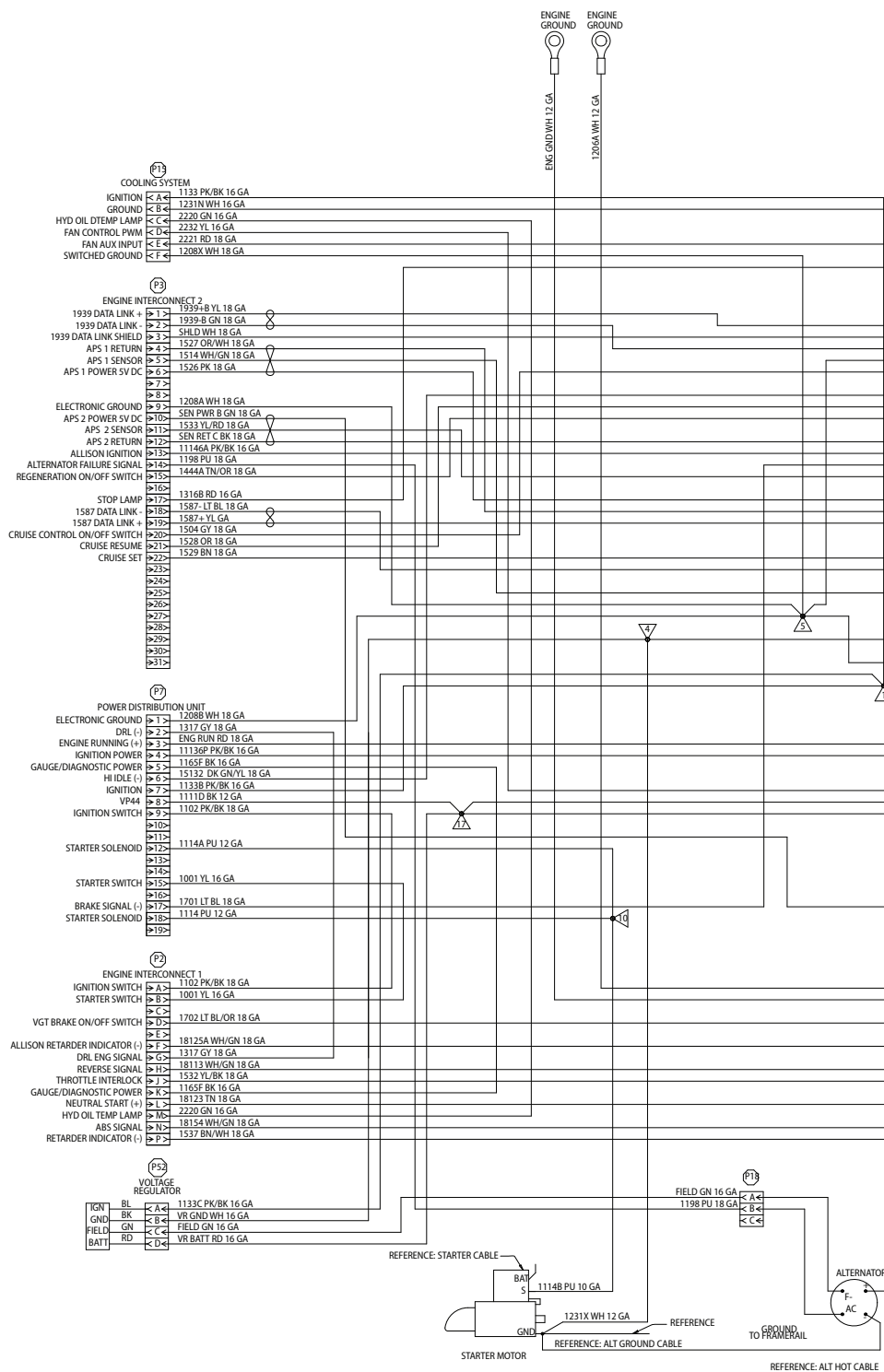




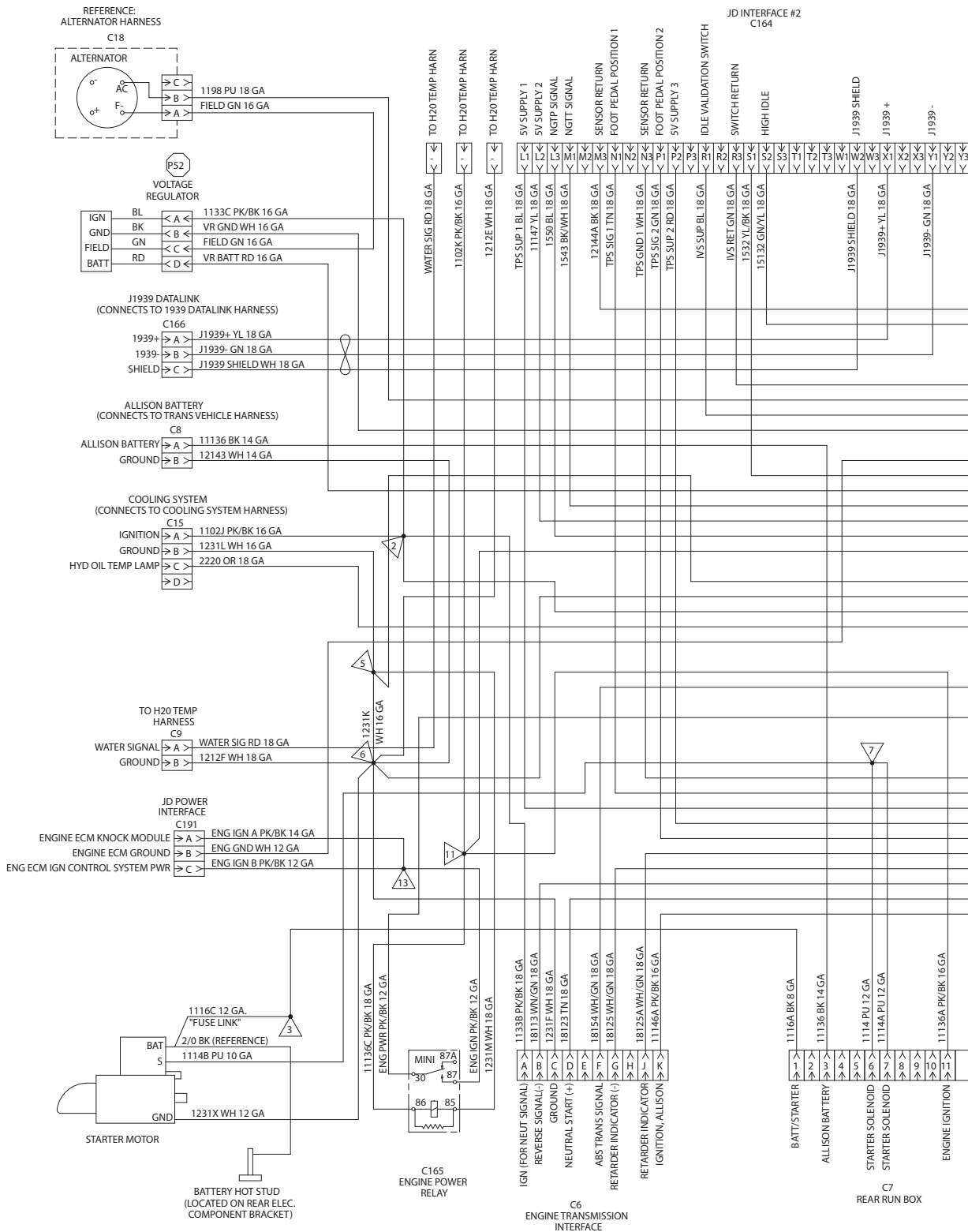


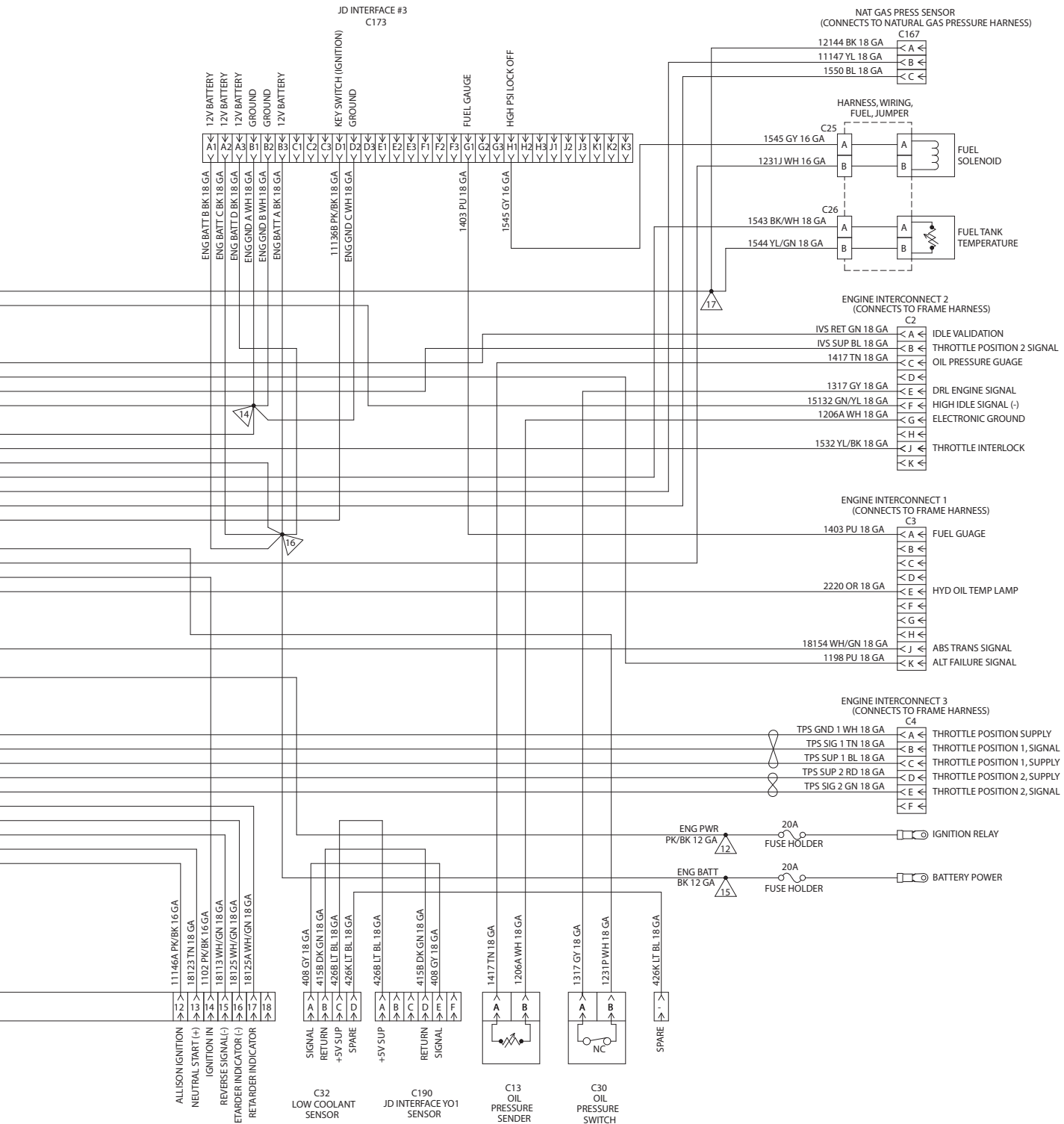


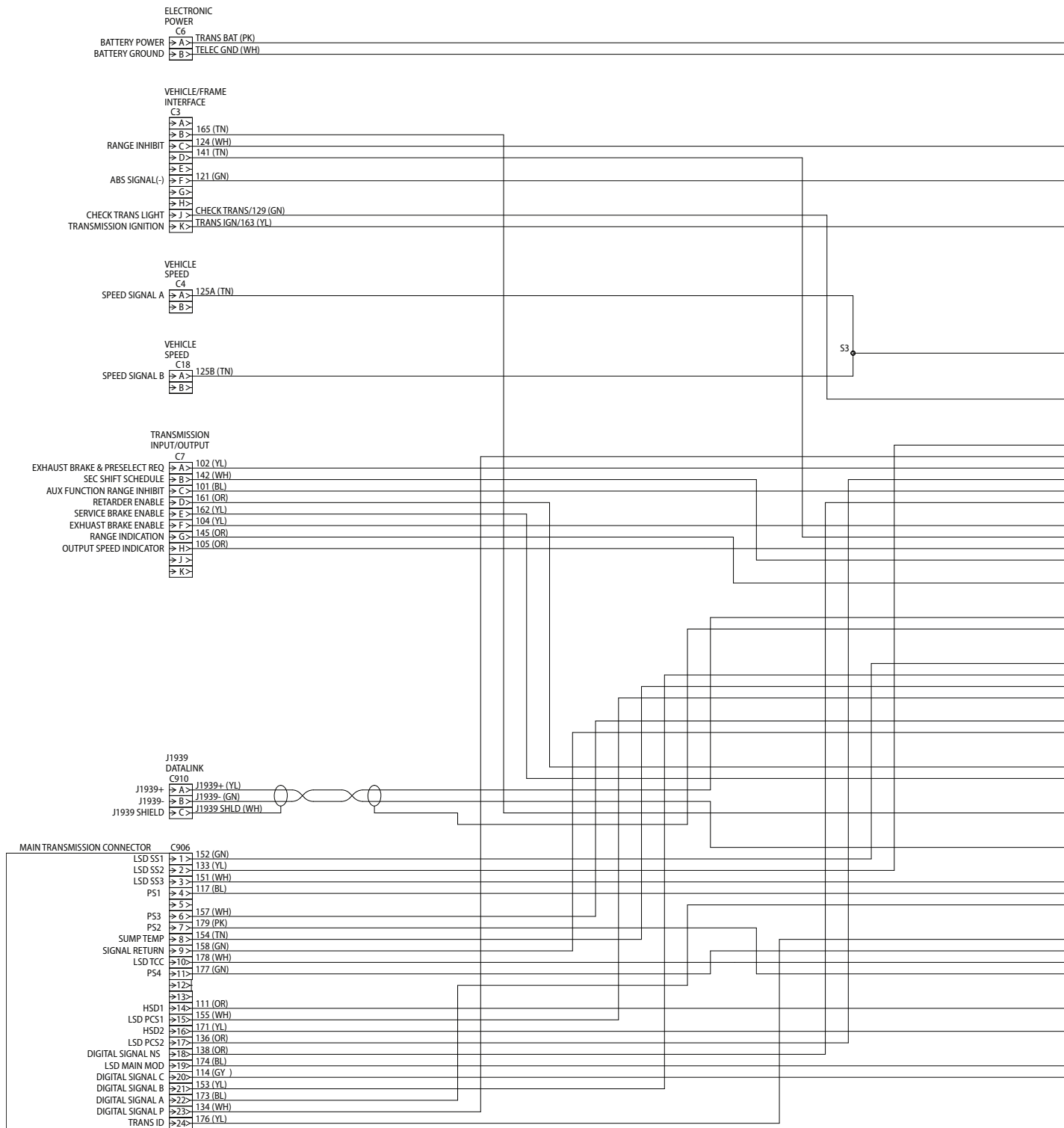


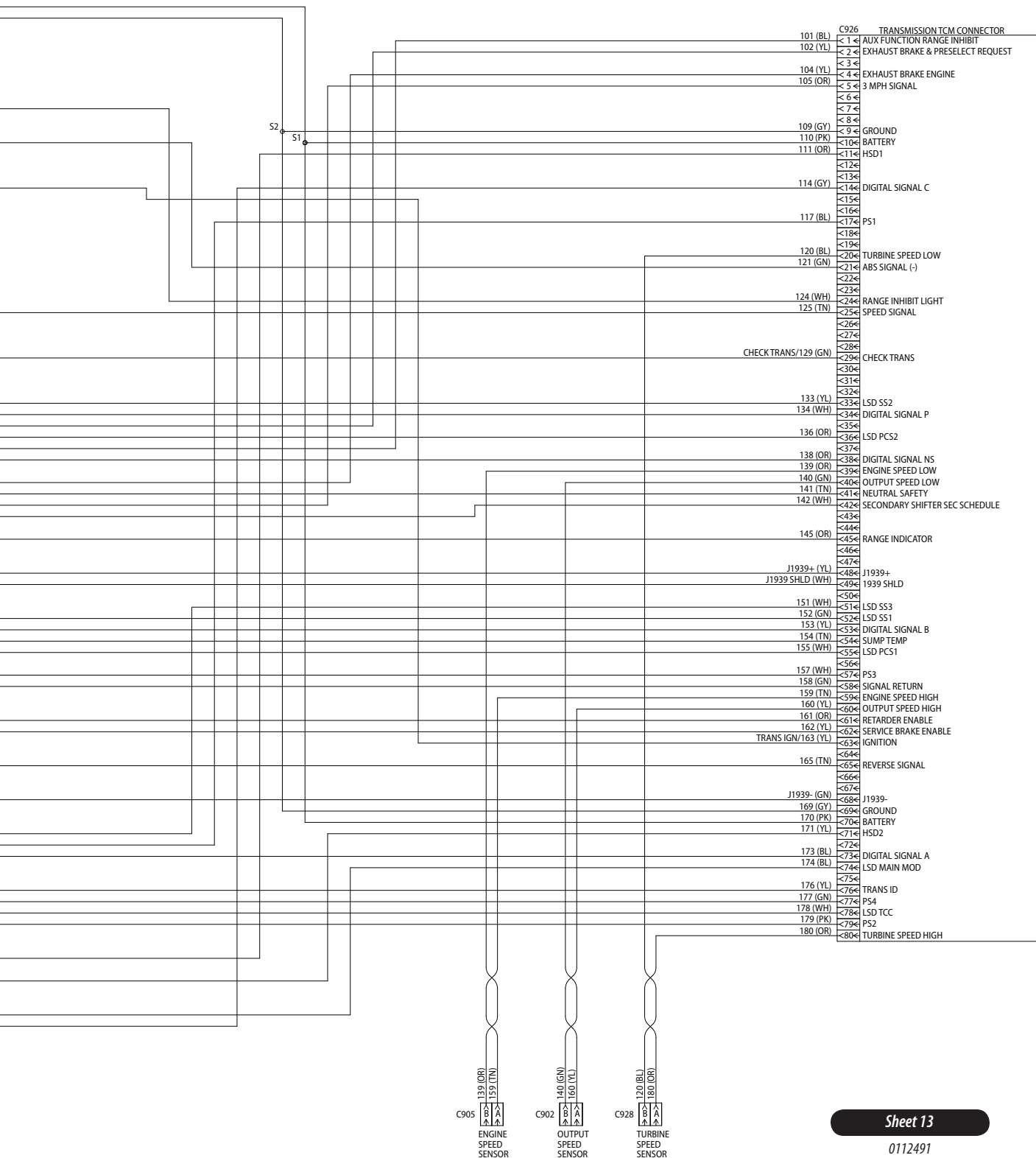


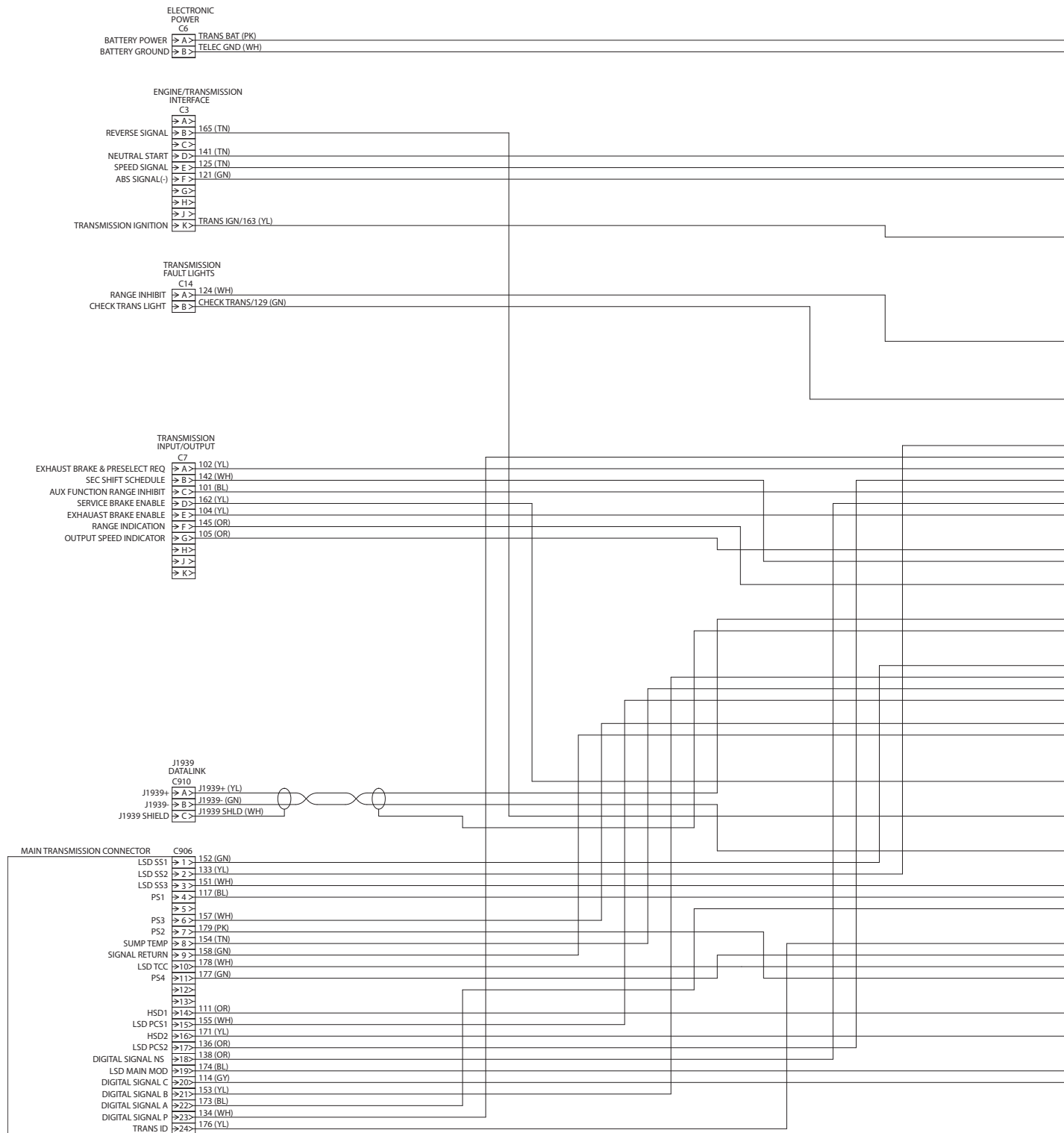


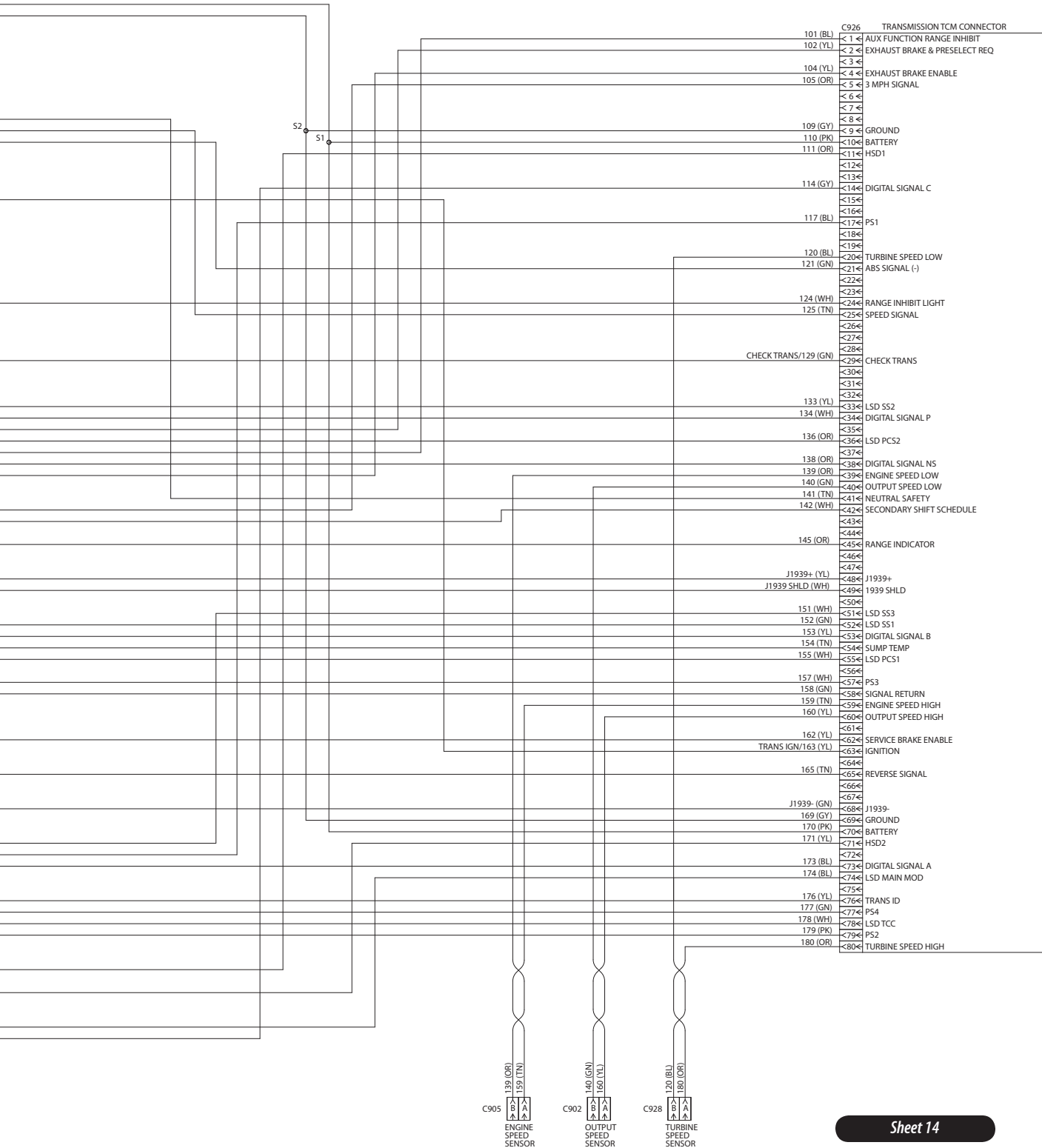


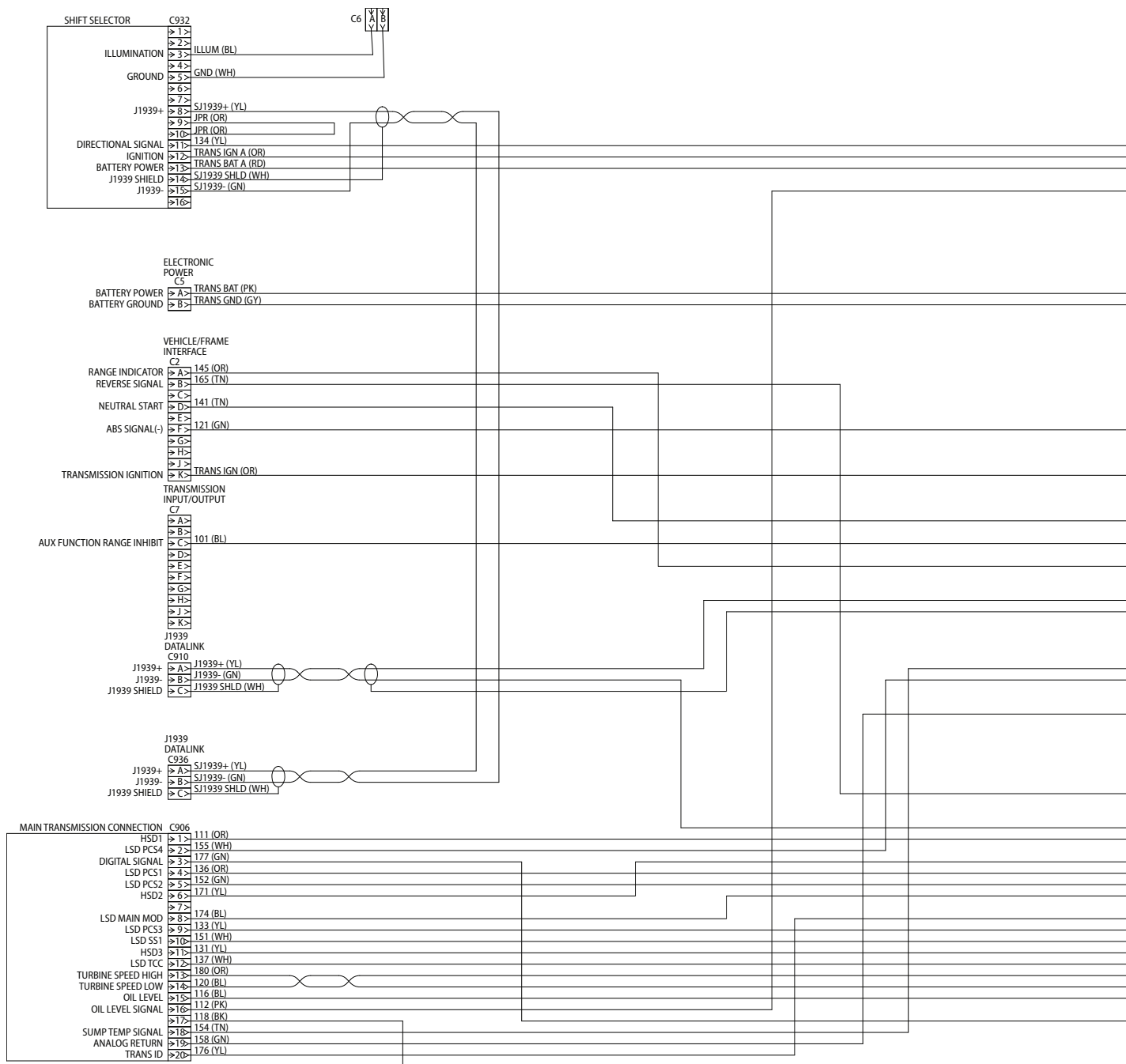


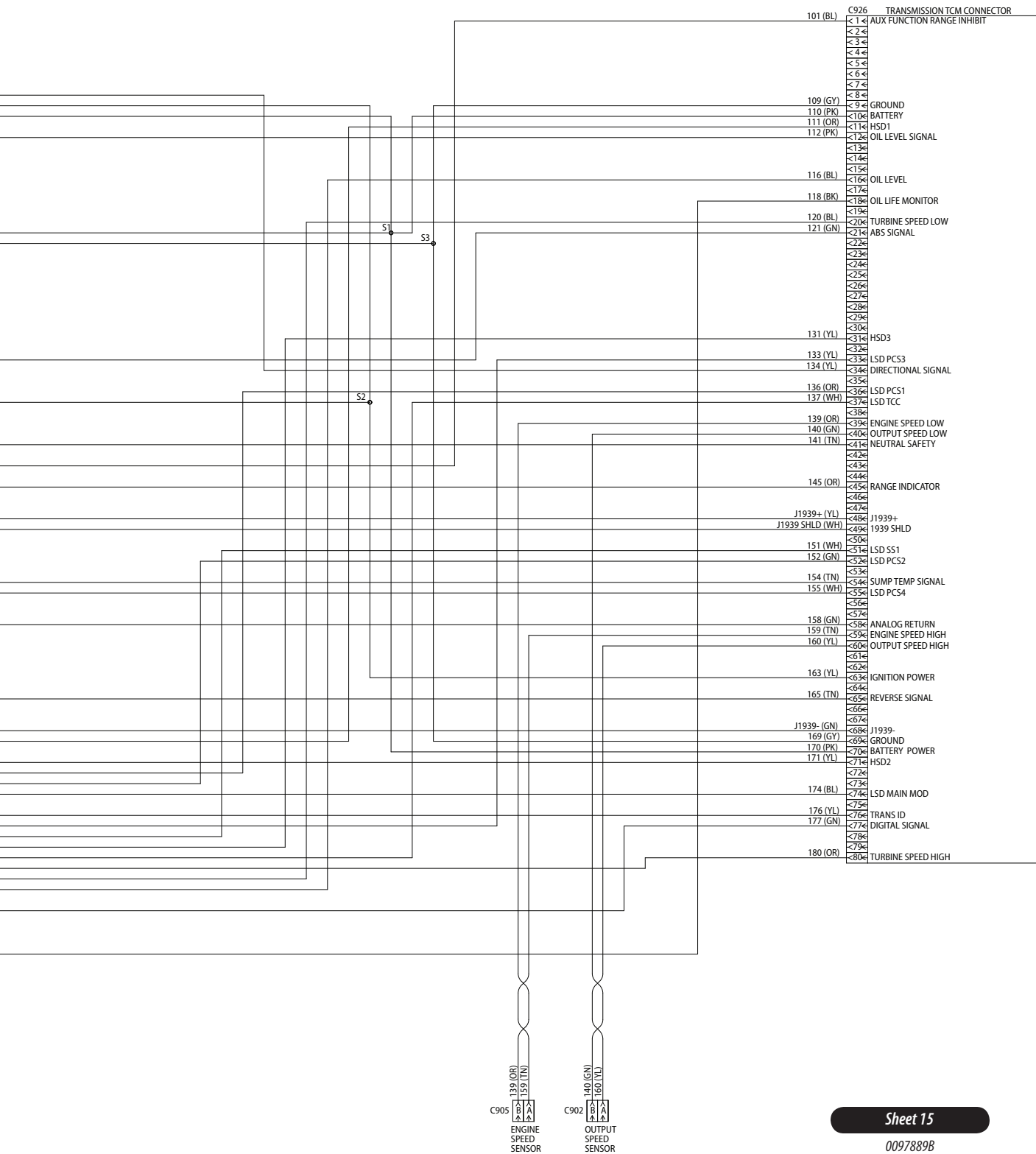


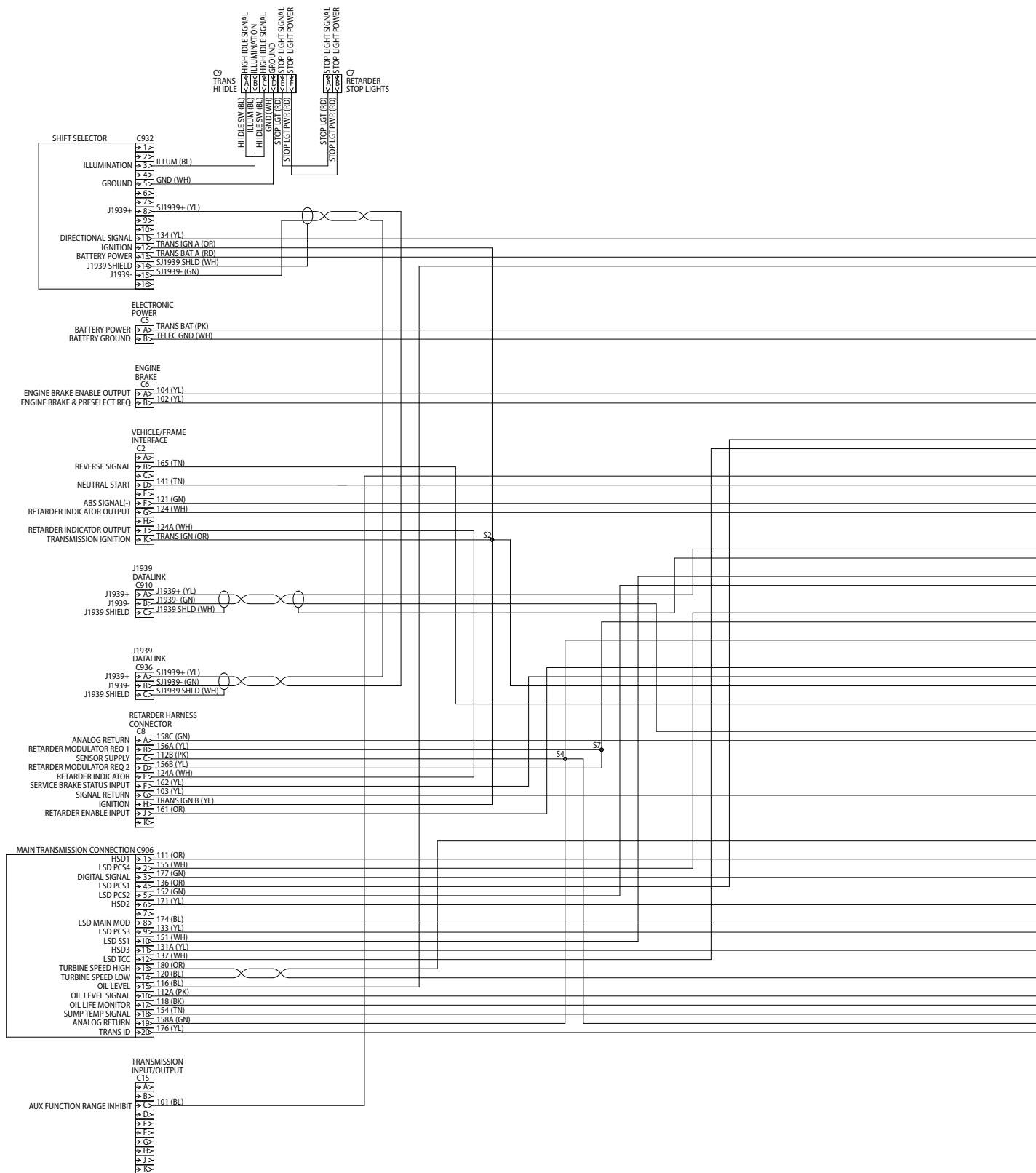




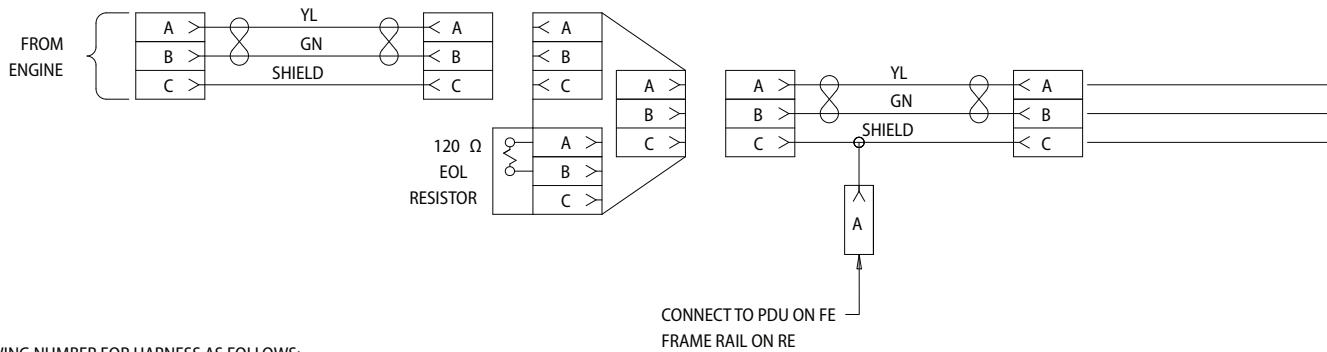










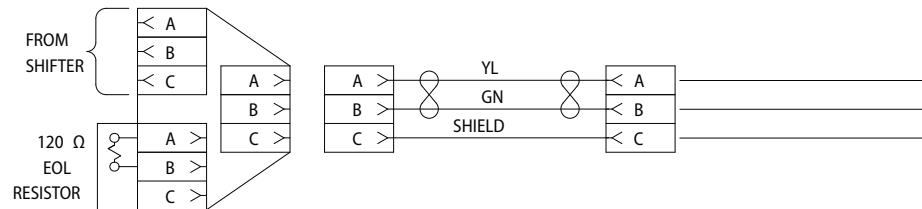


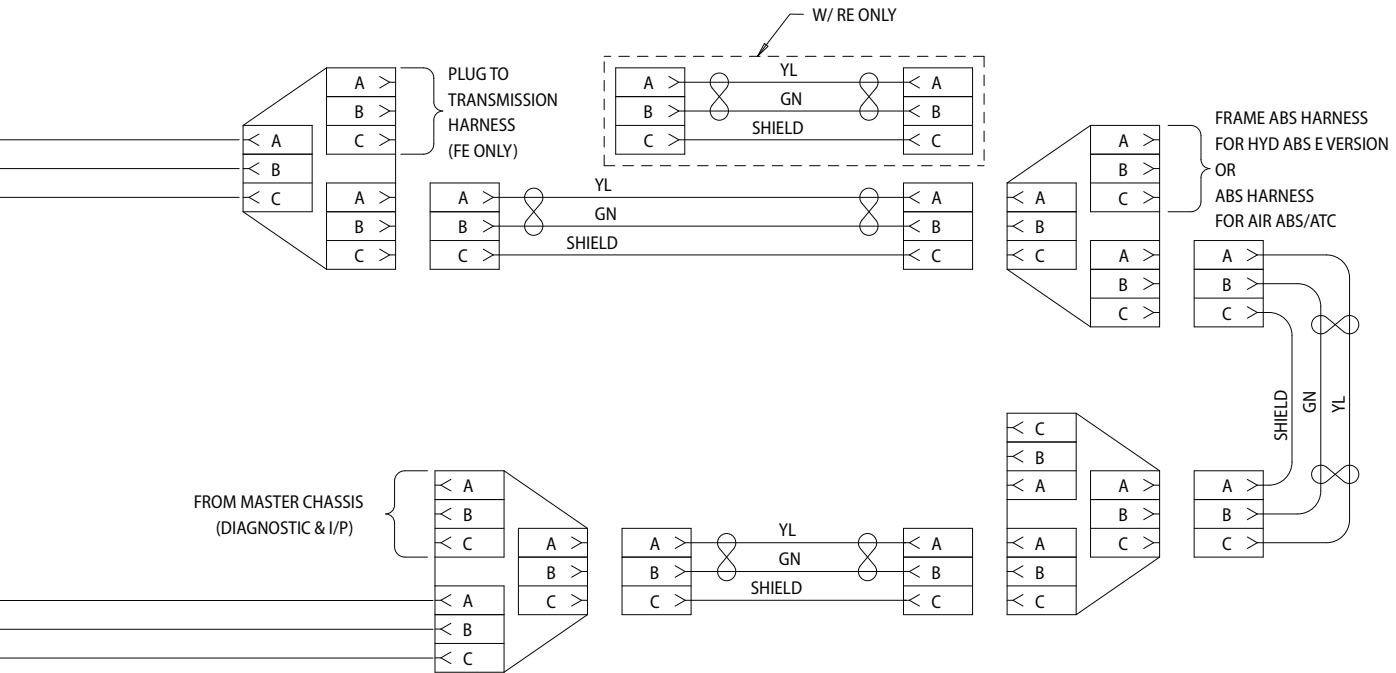
NOTE:

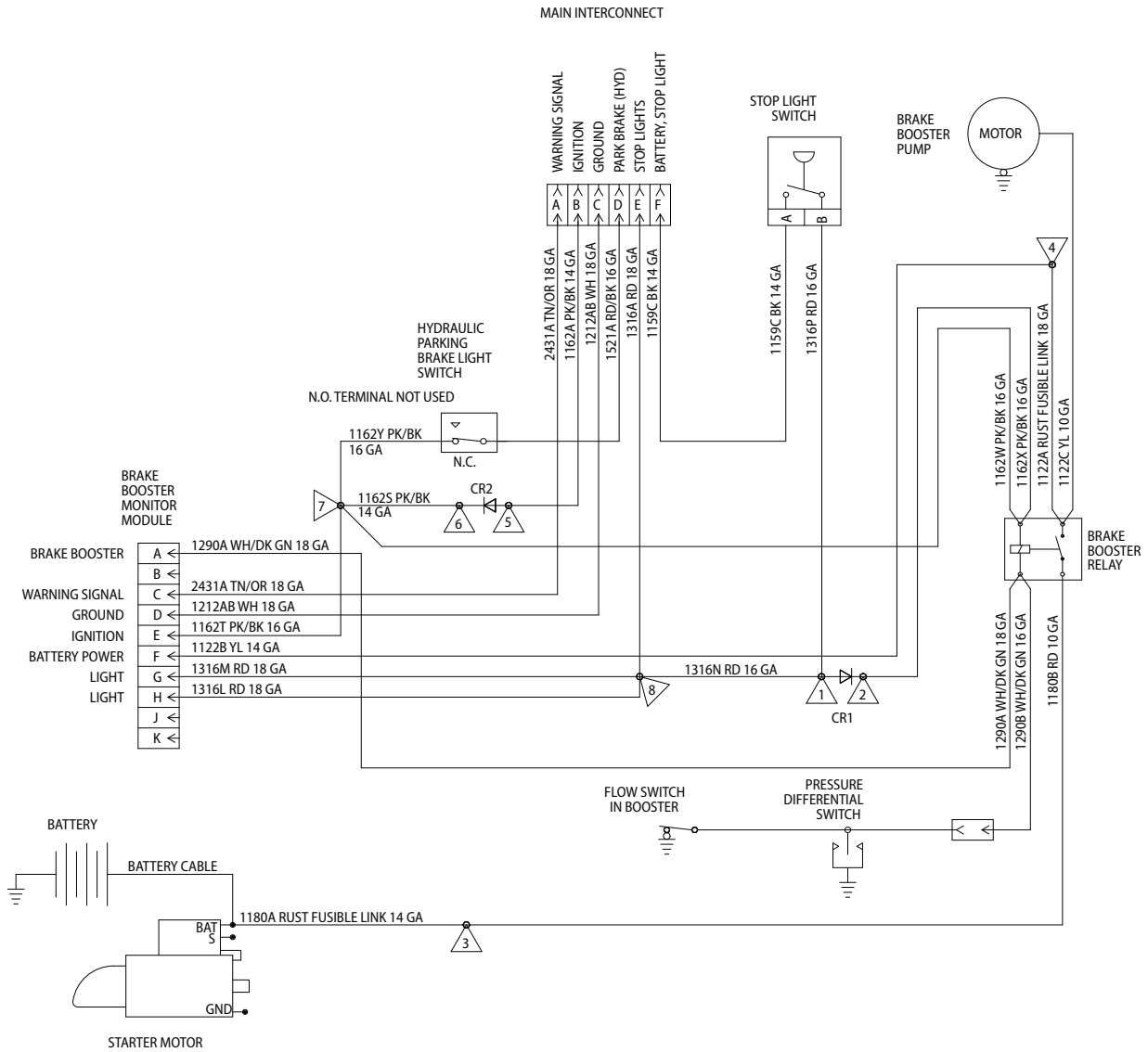
1. SEE DRAWING NUMBER FOR HARNESS AS FOLLOWS:

0117916 DIAGRAM,WRG,DATALINK,J1939,HYD,E-VER HD FE

0117924 DIAGRAM,HARNESS,WRG,DATALINK,J1939,BDX,HDFE



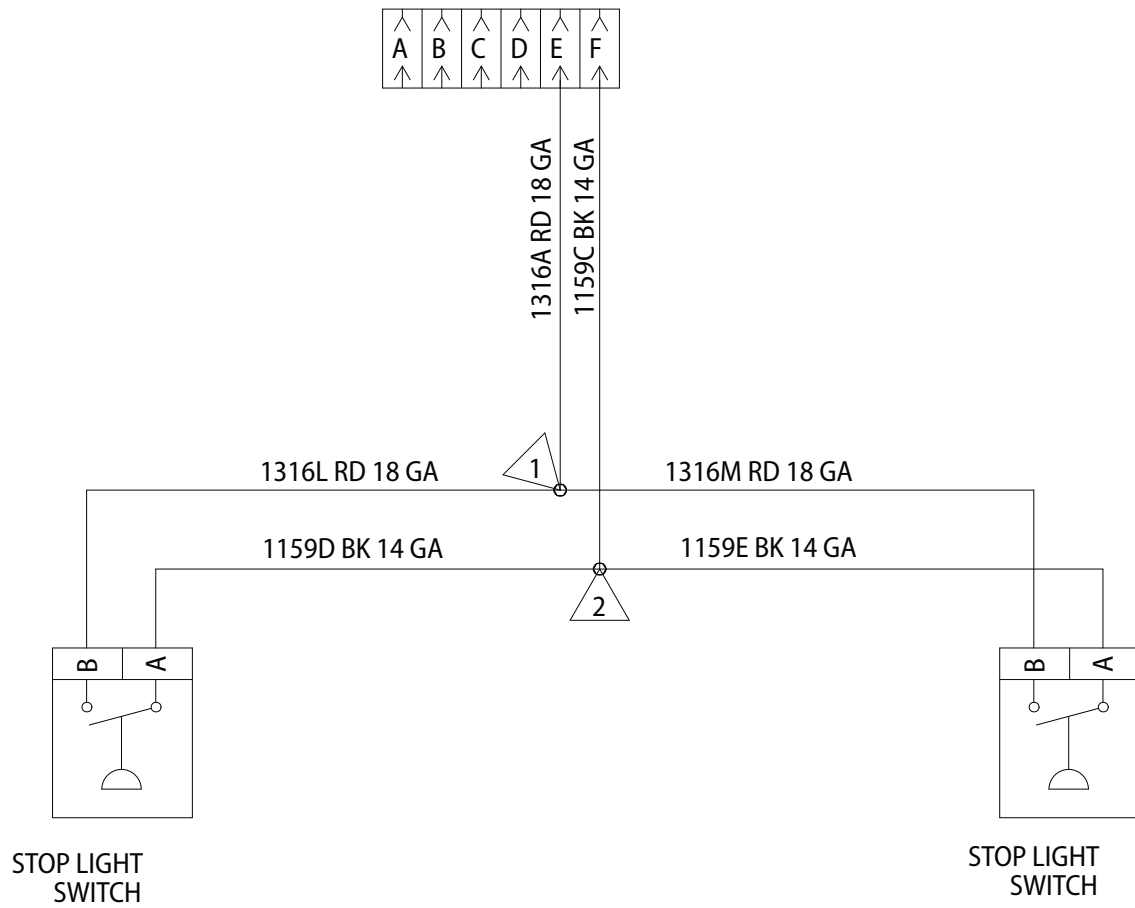


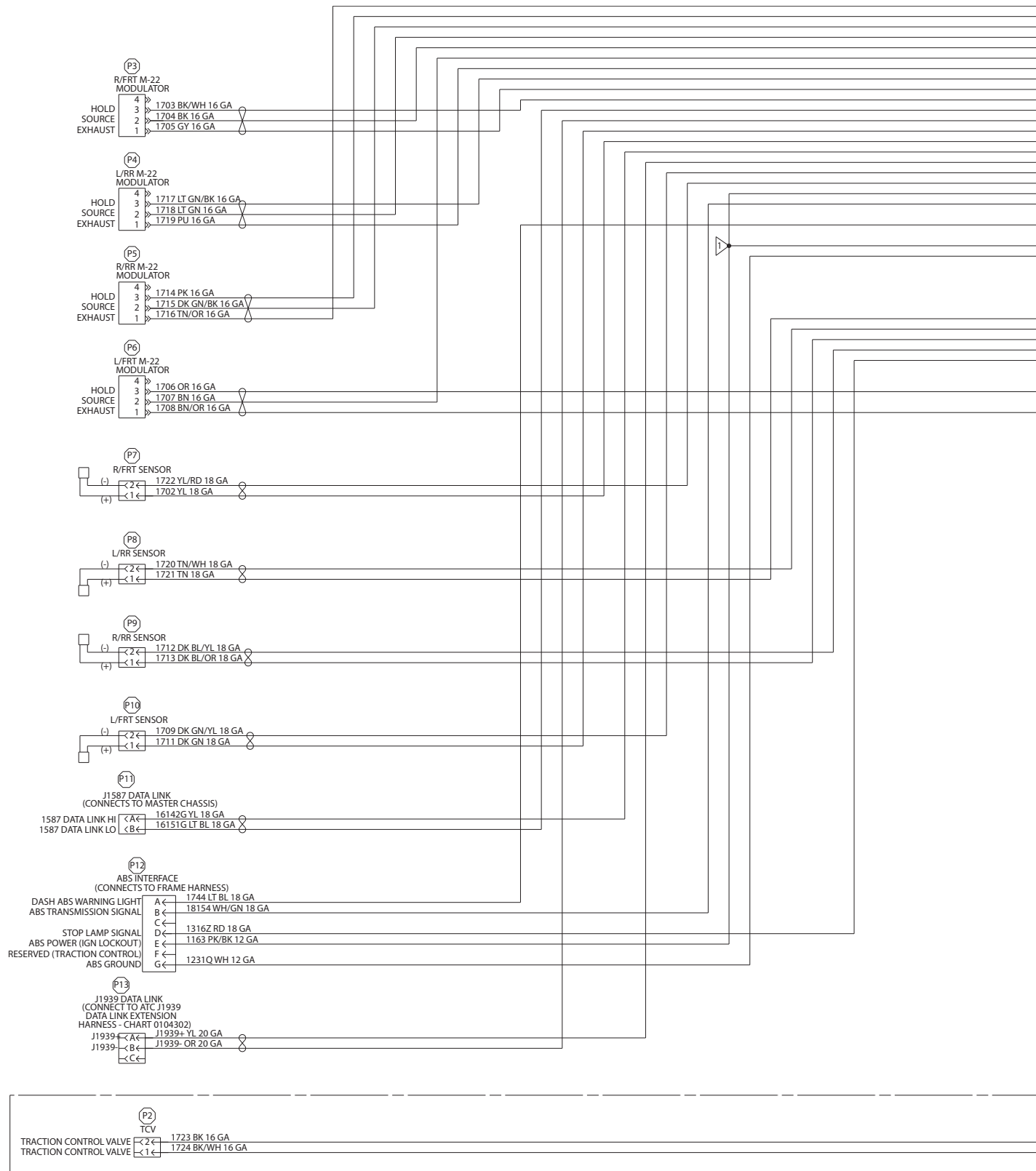


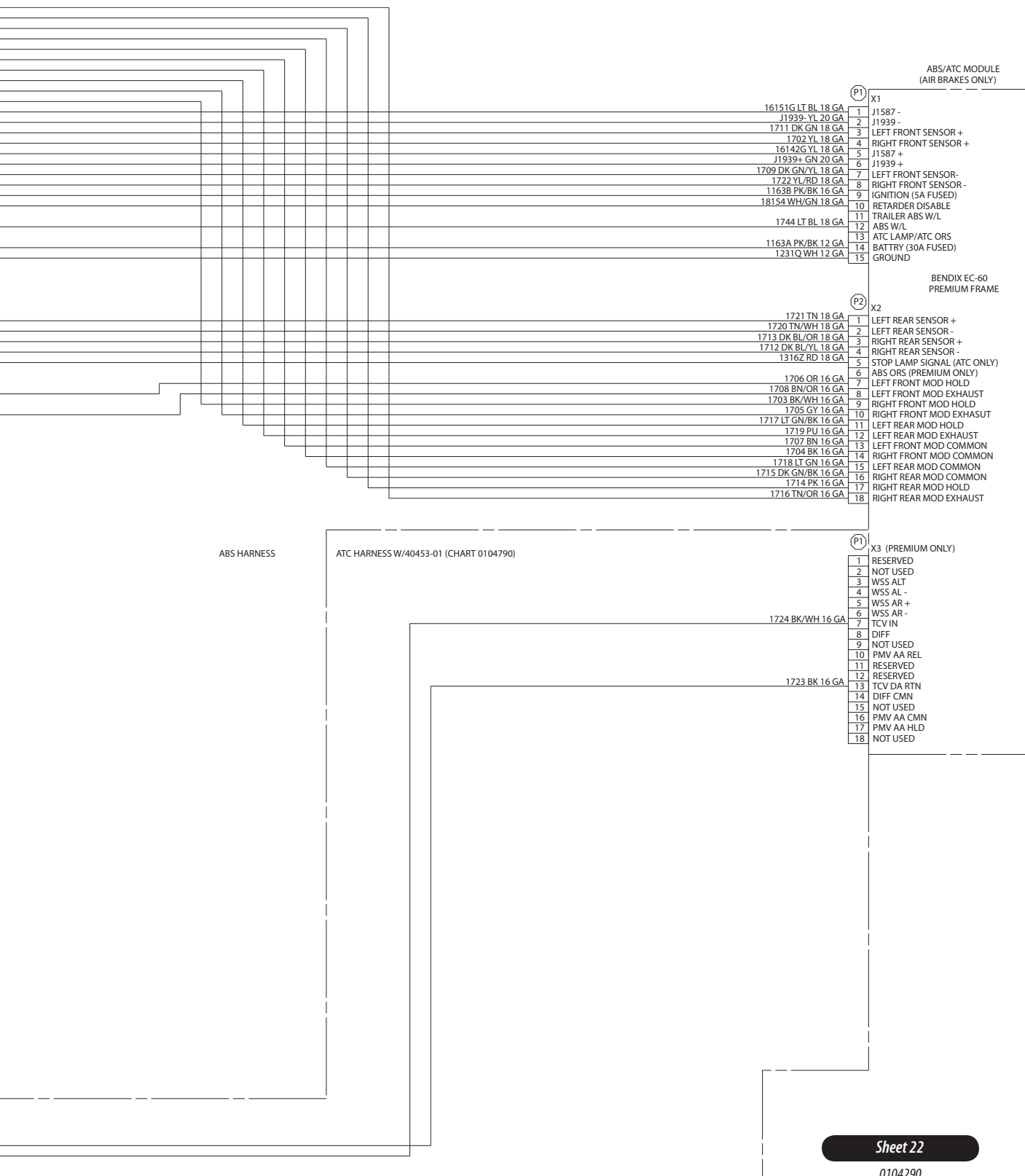
WARNING SIGNAL
IGNITION
GROUND
PARK BRAKE (HYD)
STOP LIGHTS
BATTERY, STOP LIGHT

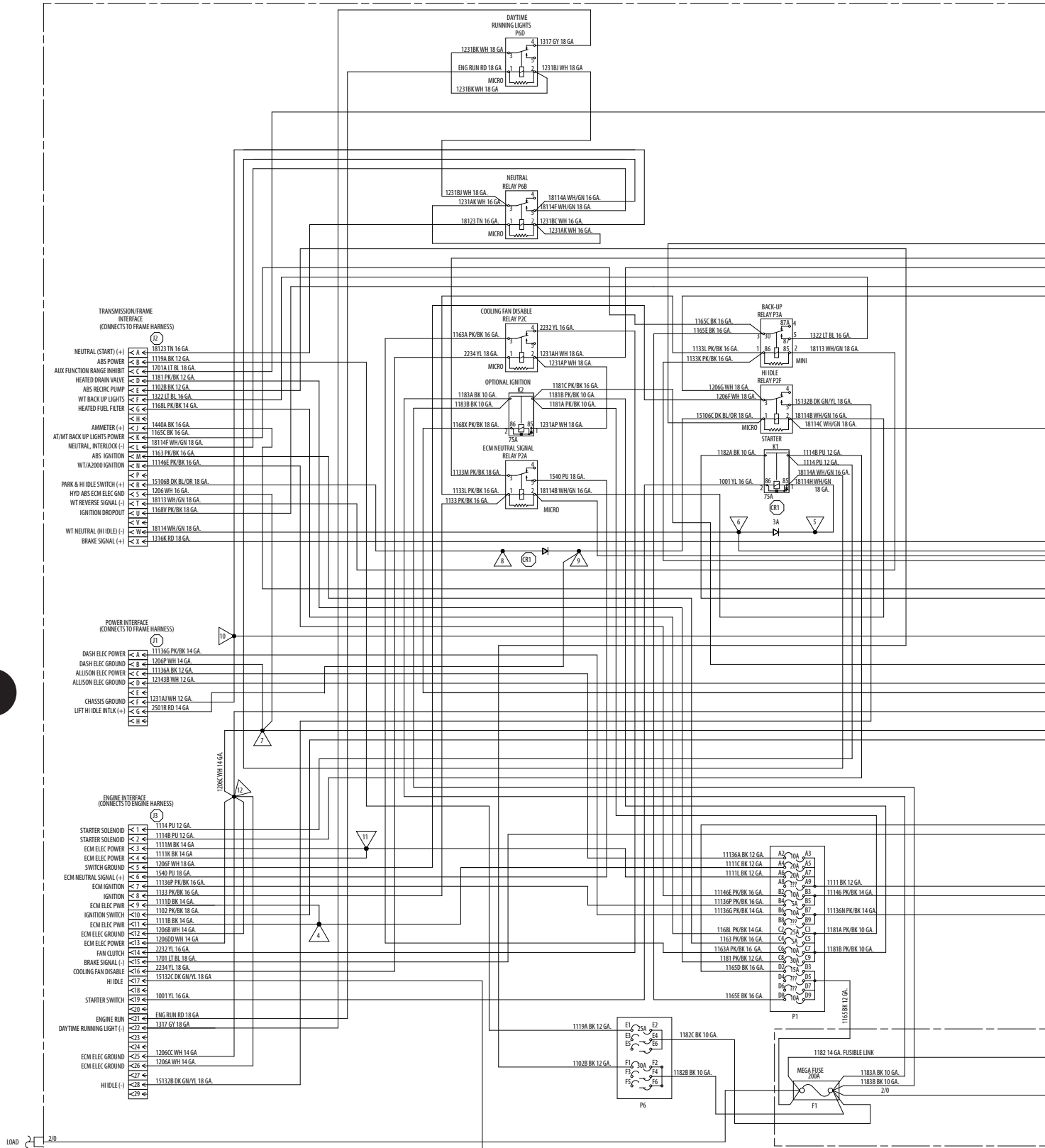


MAIN INTERCONNECT





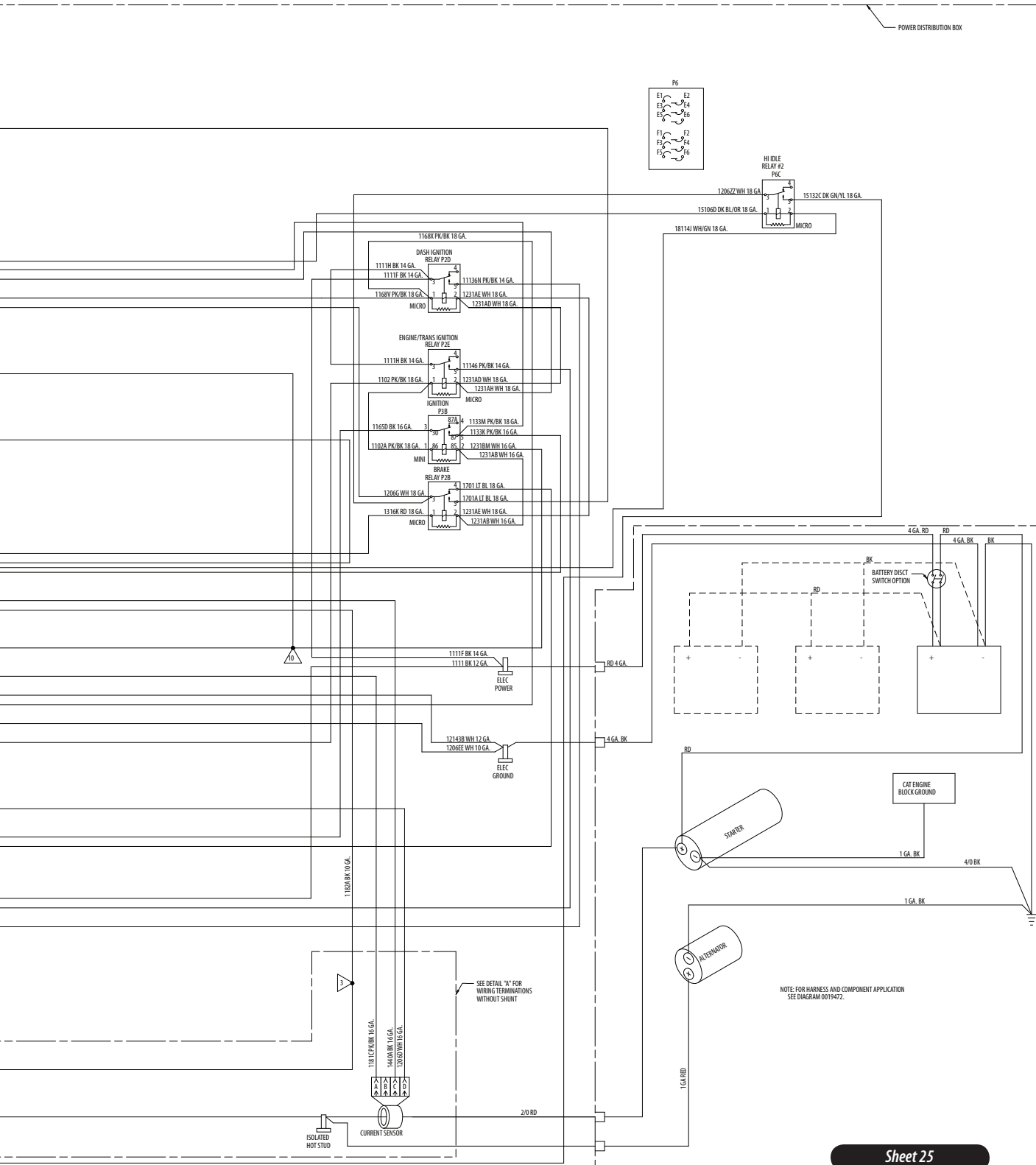


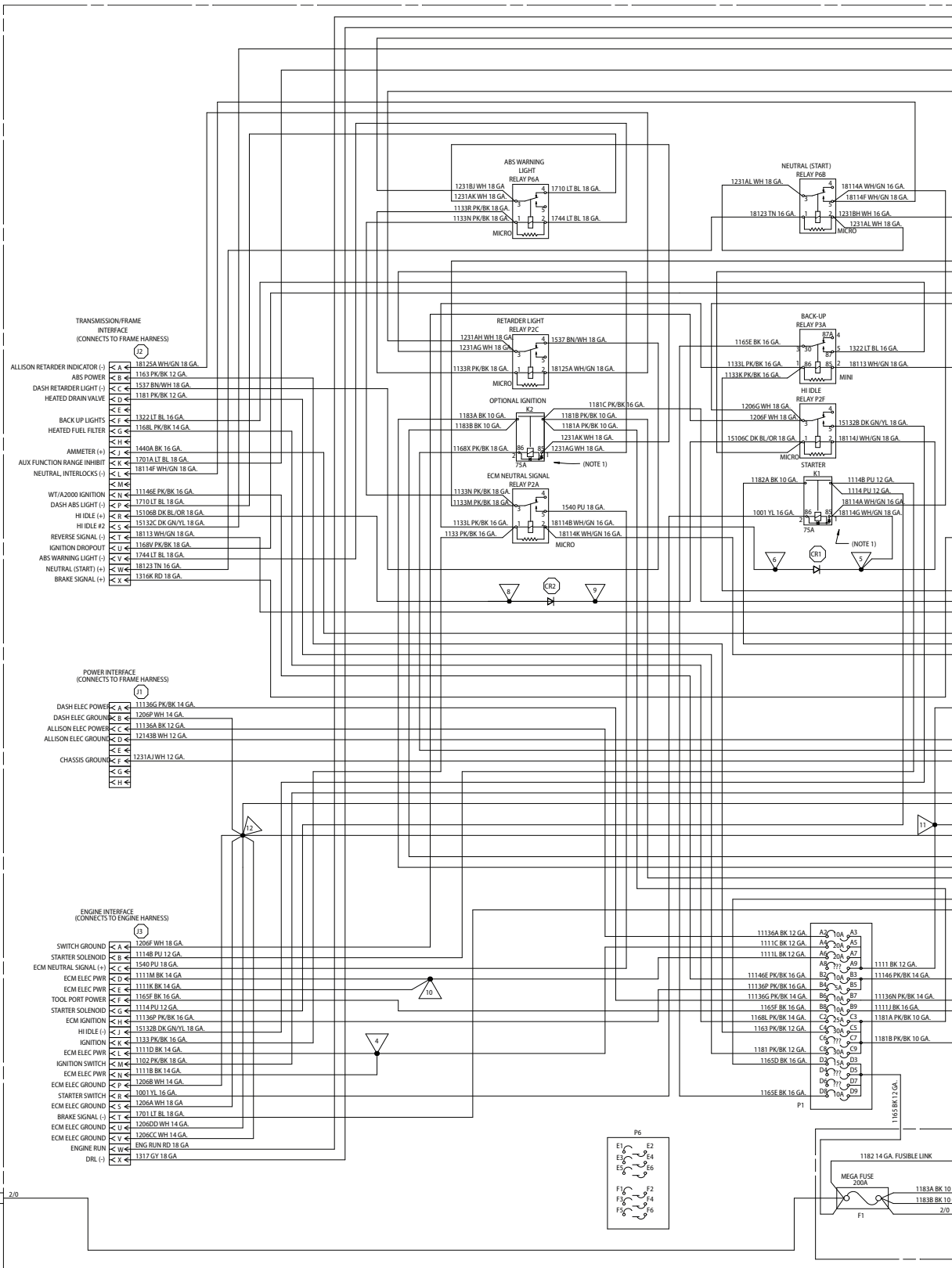


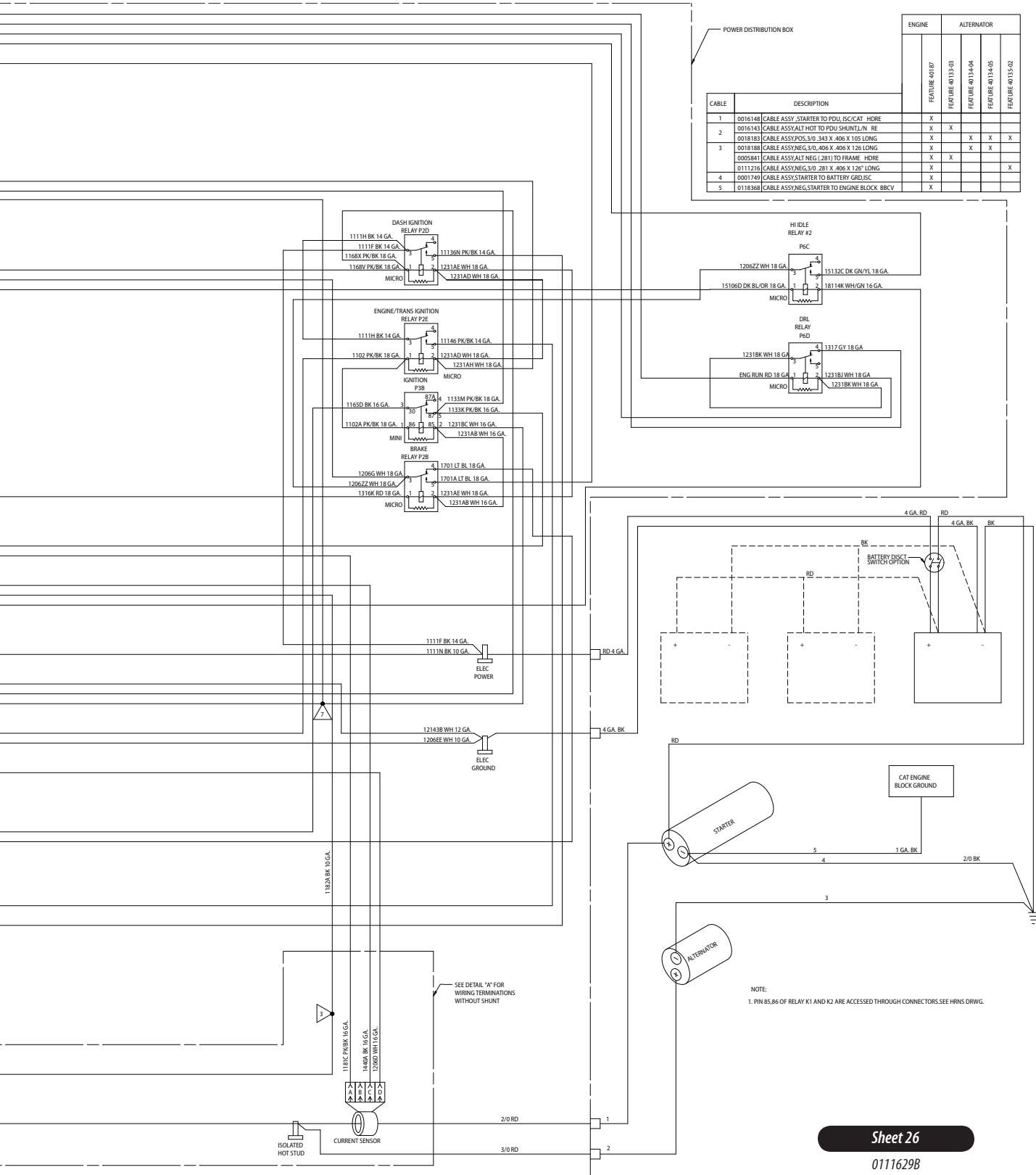


PDU, CAT C7-07, HYD-E, FE

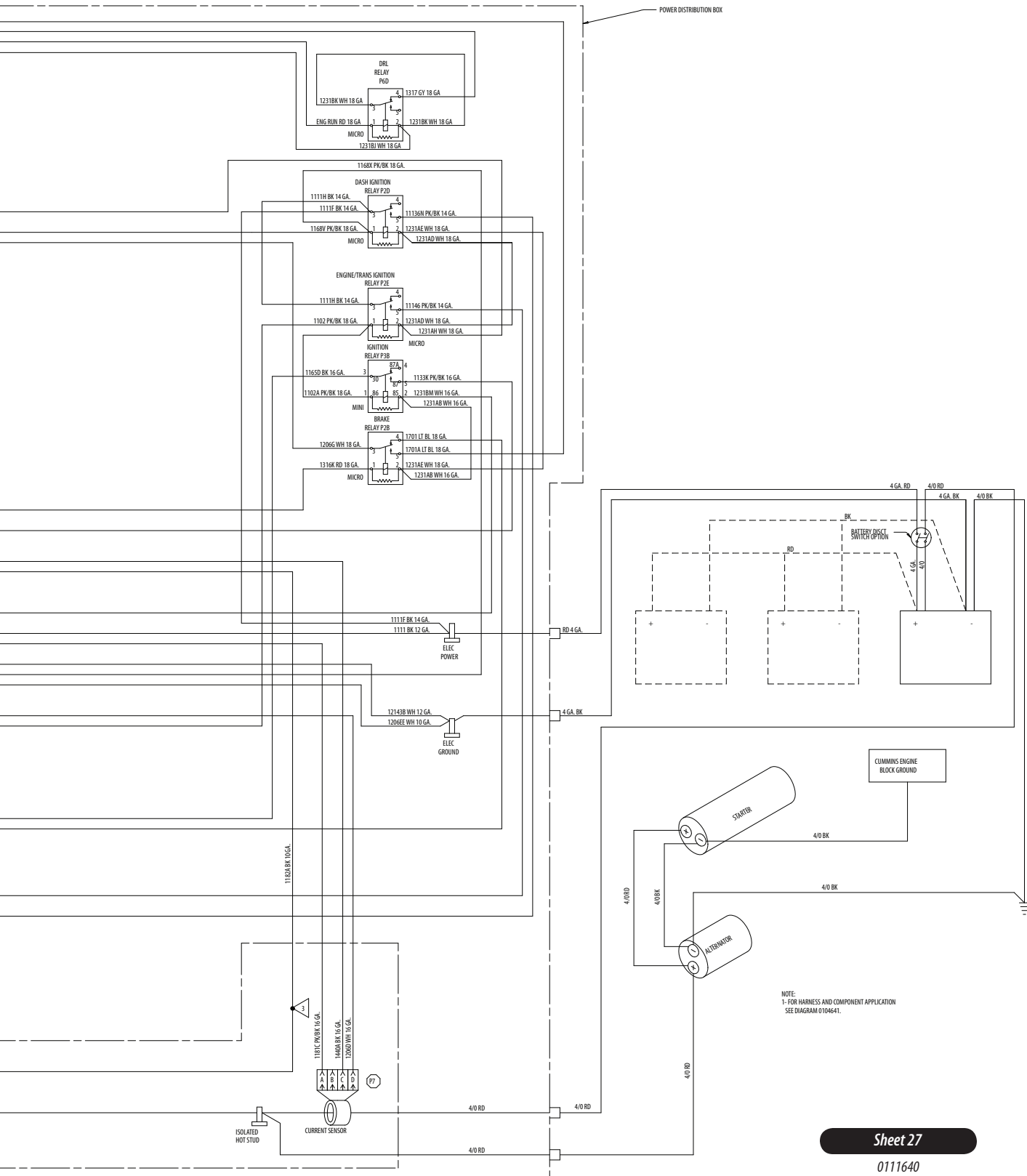












883

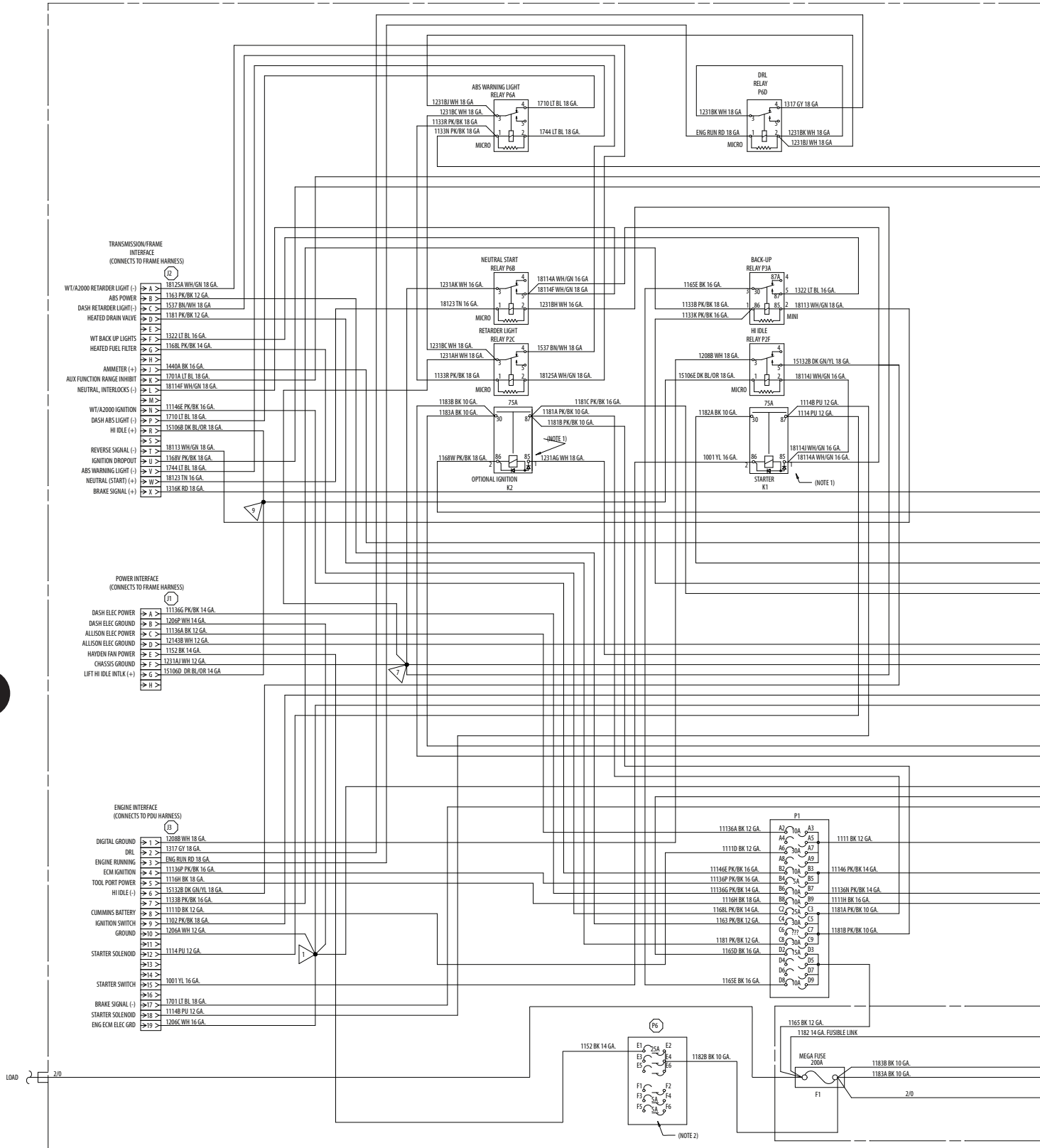
Sheet 27

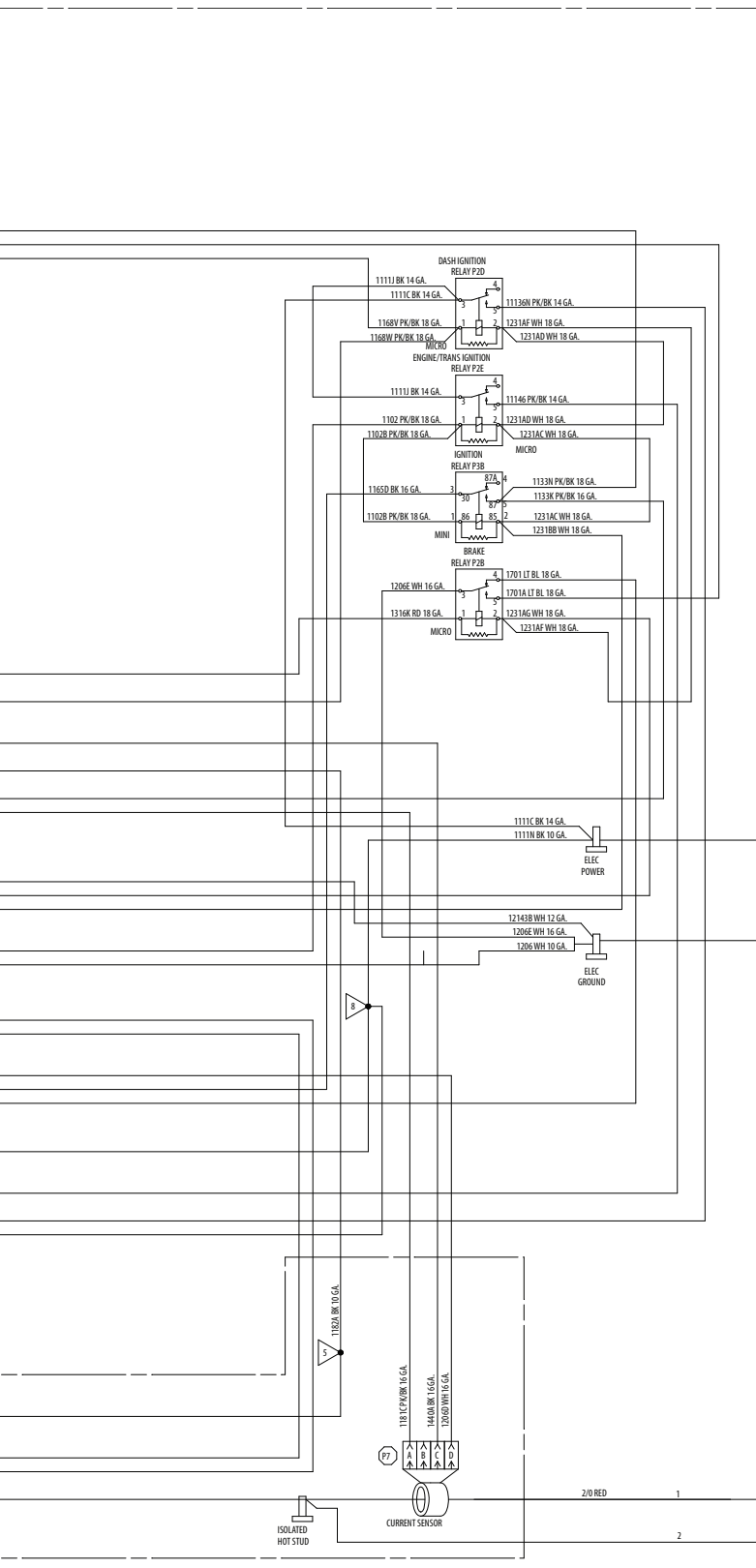
0111640

PDU, CUMMINS ISB-07, HYD-E, FE

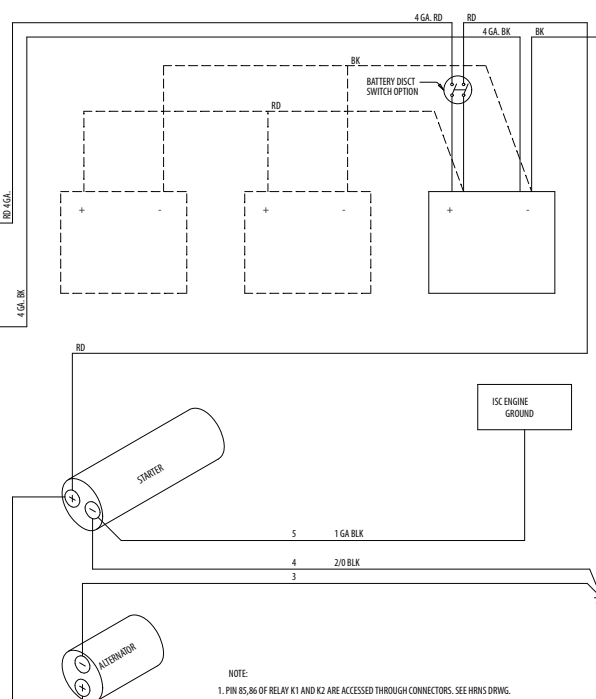


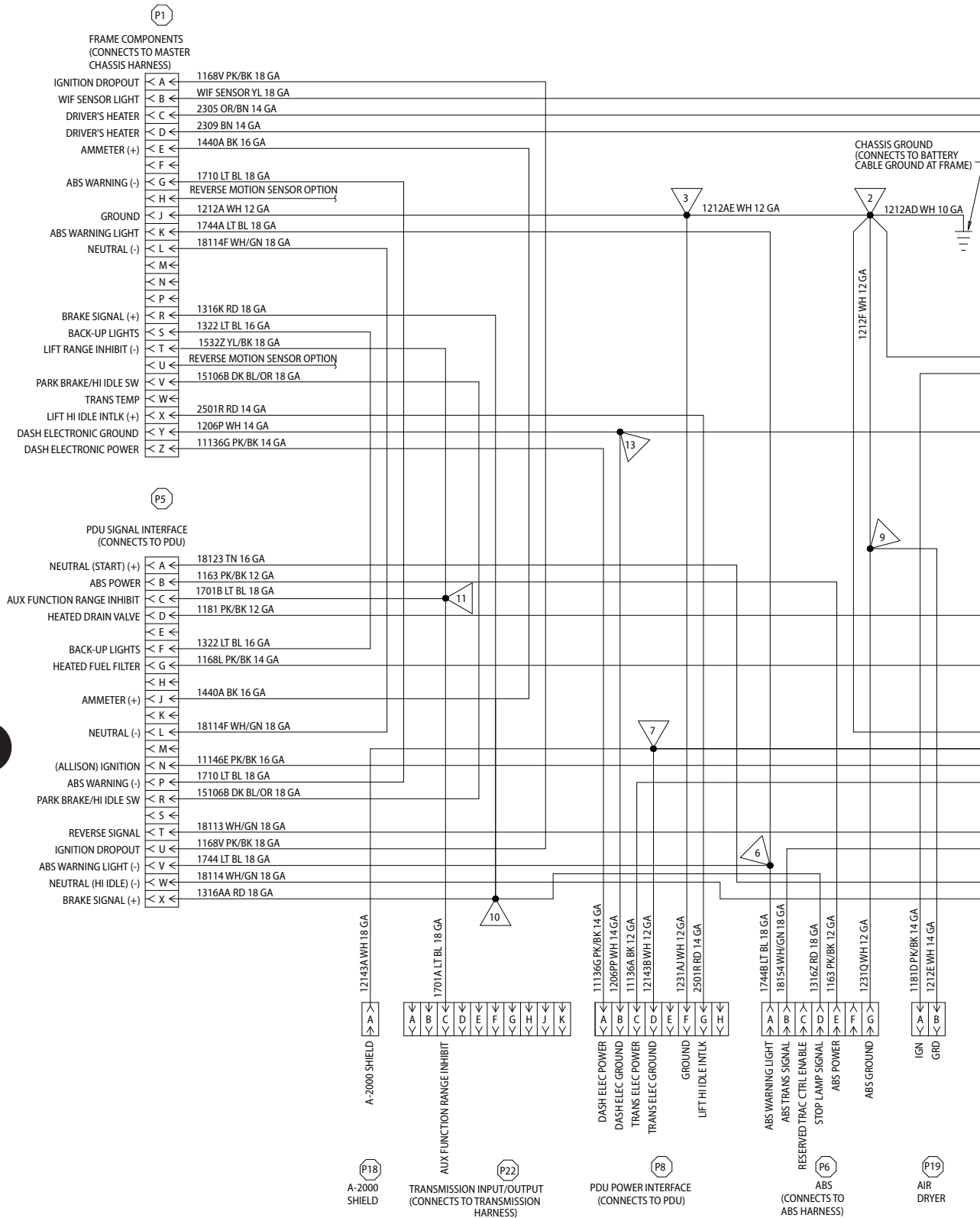


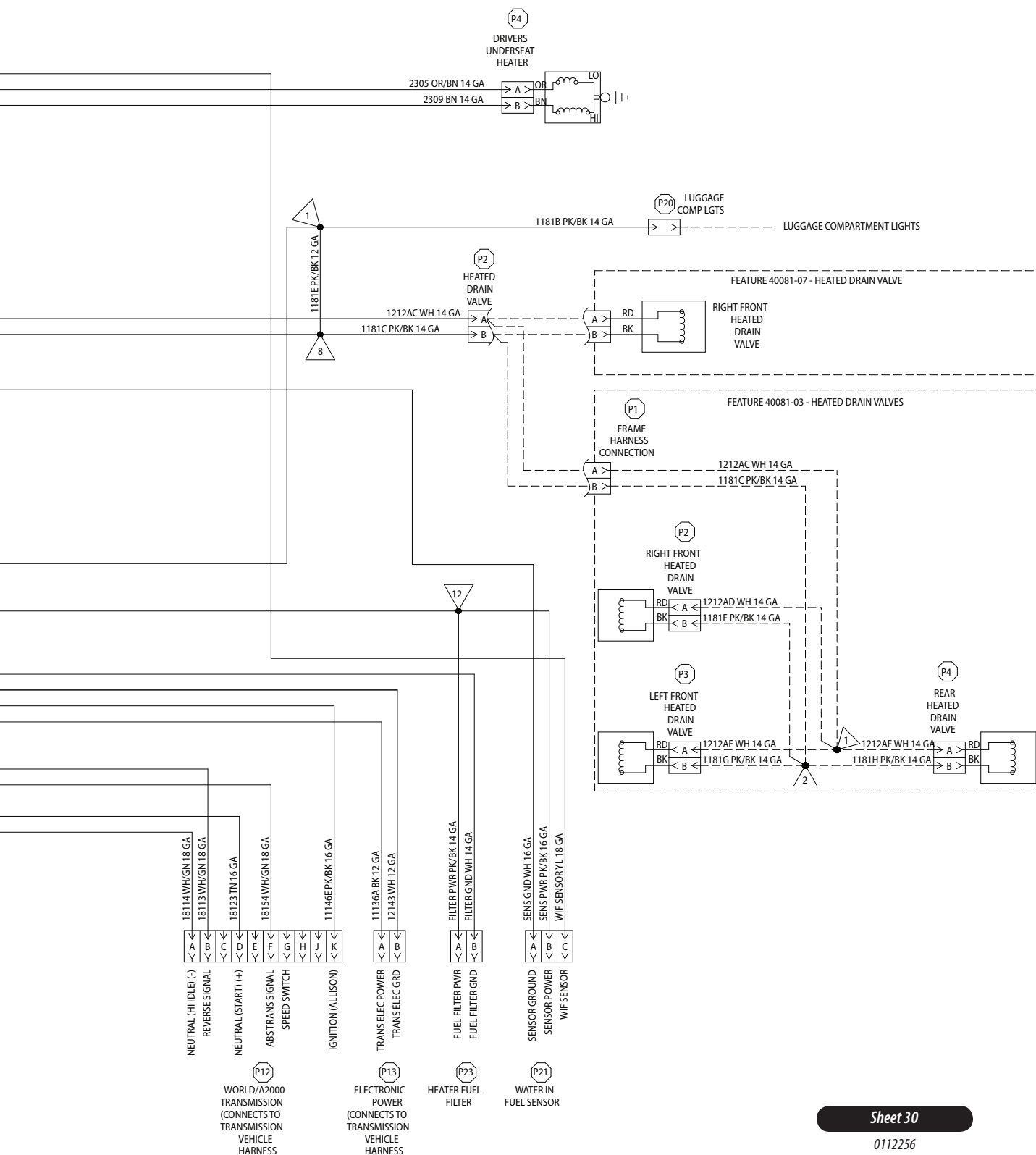


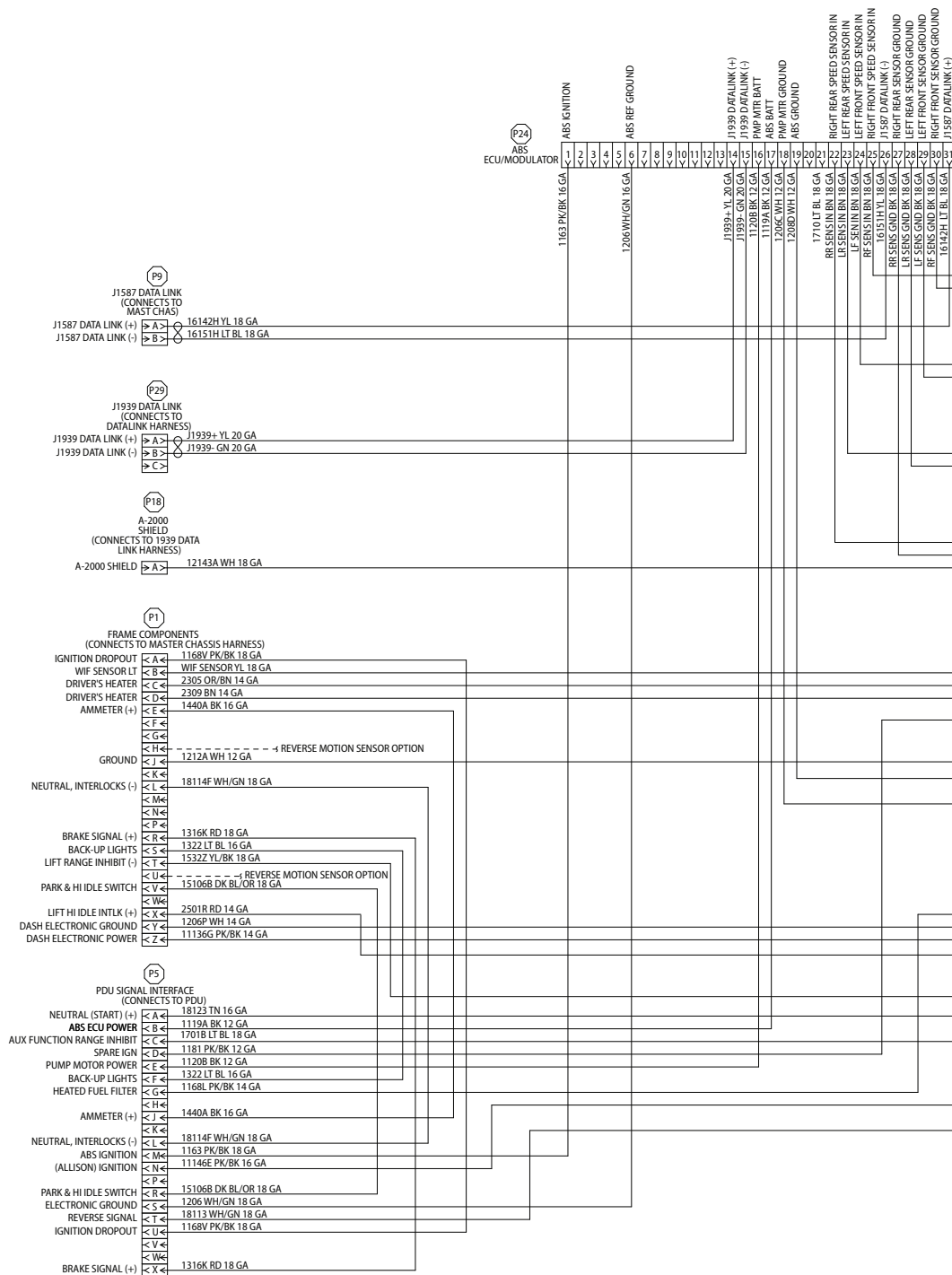


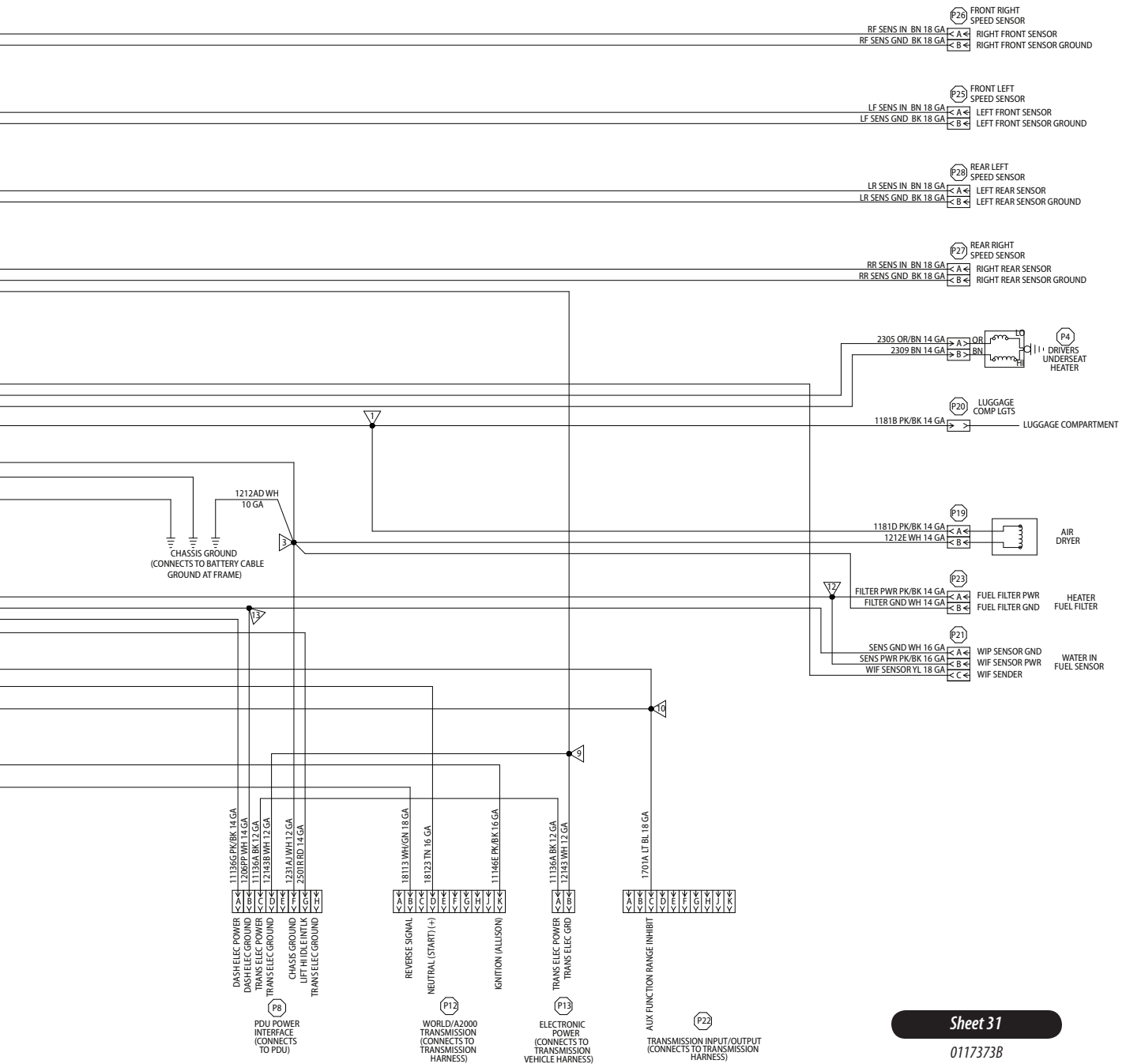
CABLE	DESCRIPTION	ENGINE		ALTERNATOR	
		FEATURE 40184	FEATURE 4015-02	FEATURE 40134-04	FEATURE 4014-05
1	001614B CABLE ASSY, STARTER TO PDU, ISC/CAT, HDRE	X			
2	0111215 CABLE ASSY POS, 3/0, 281 X .406 X 105 LONG	X	X		
	0018183 CABLE ASSY POS, 3/0, 343 X .406 X 105 LONG	X		X	X
3	0111216 CABLE ASSY NEG, 3/0, 281 X .406 X 126 LONG	X	X		
	0018188 CABLE ASSY NEG, 3/0, 406 X .406 X 126 LONG	X		X	X
4	0001749 CABLE ASSY STARTER TO BATTERY GND, ISC	X			
5	0000876 CABLE ASSY ENG GND TO STR GND, HDRE/RE	X			

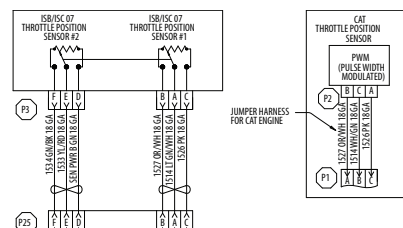
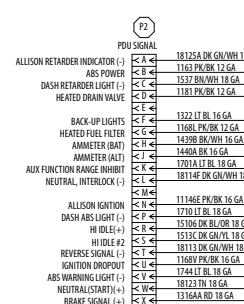
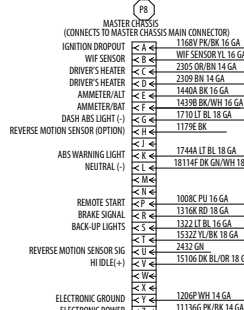
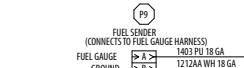
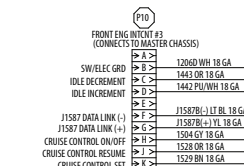
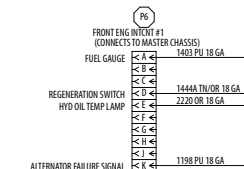
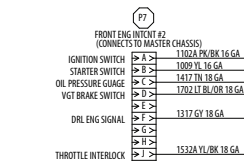


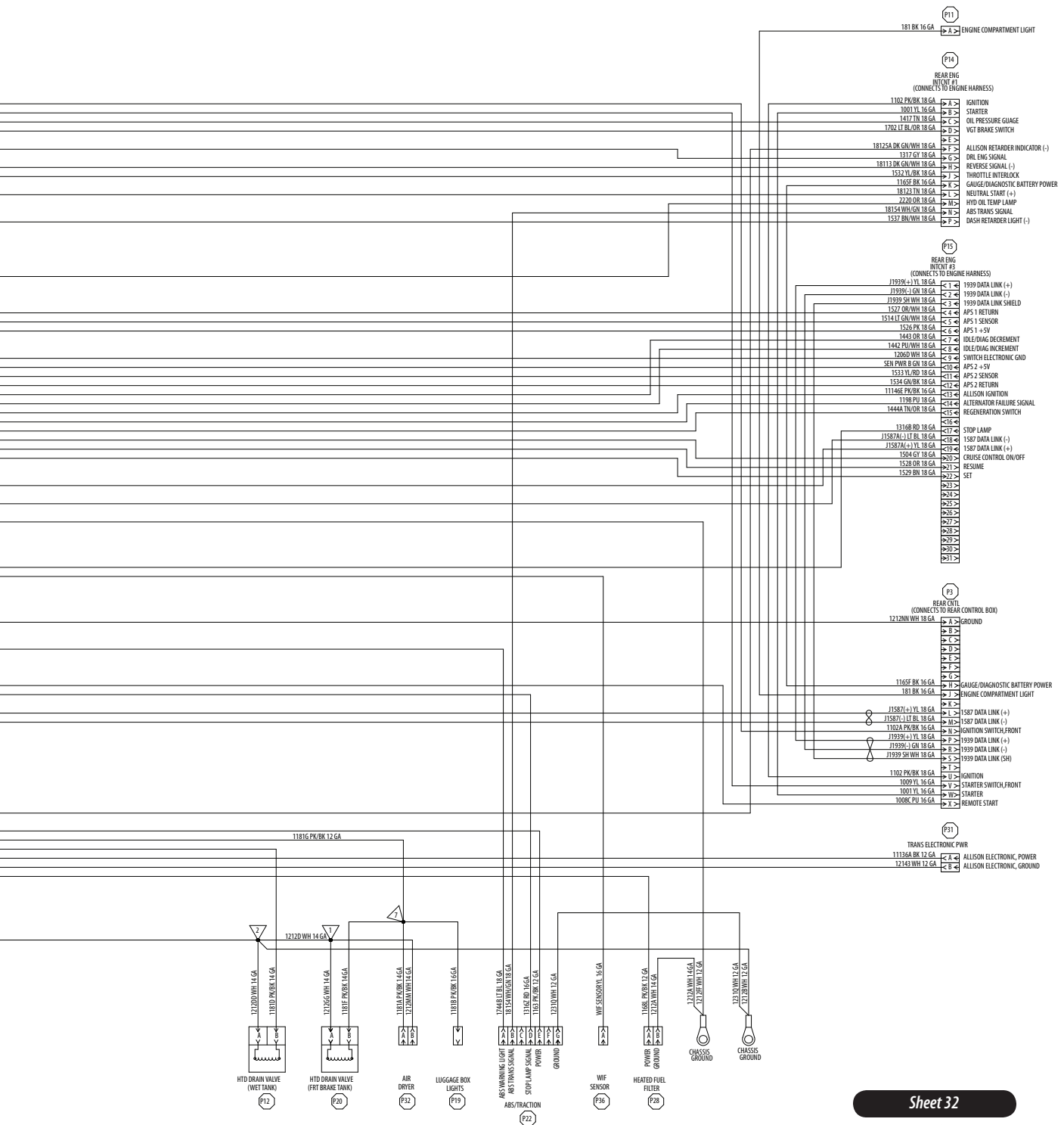




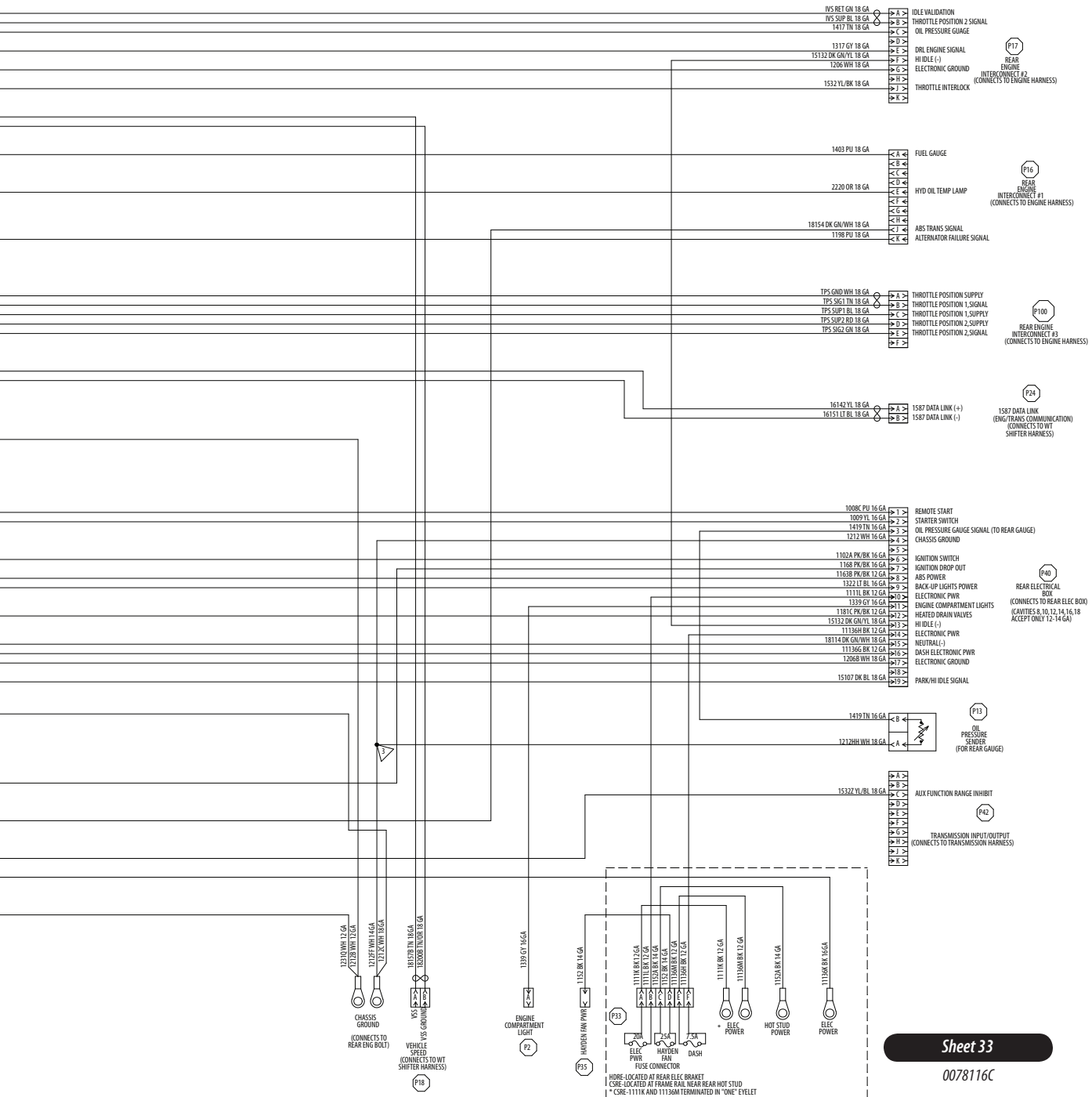


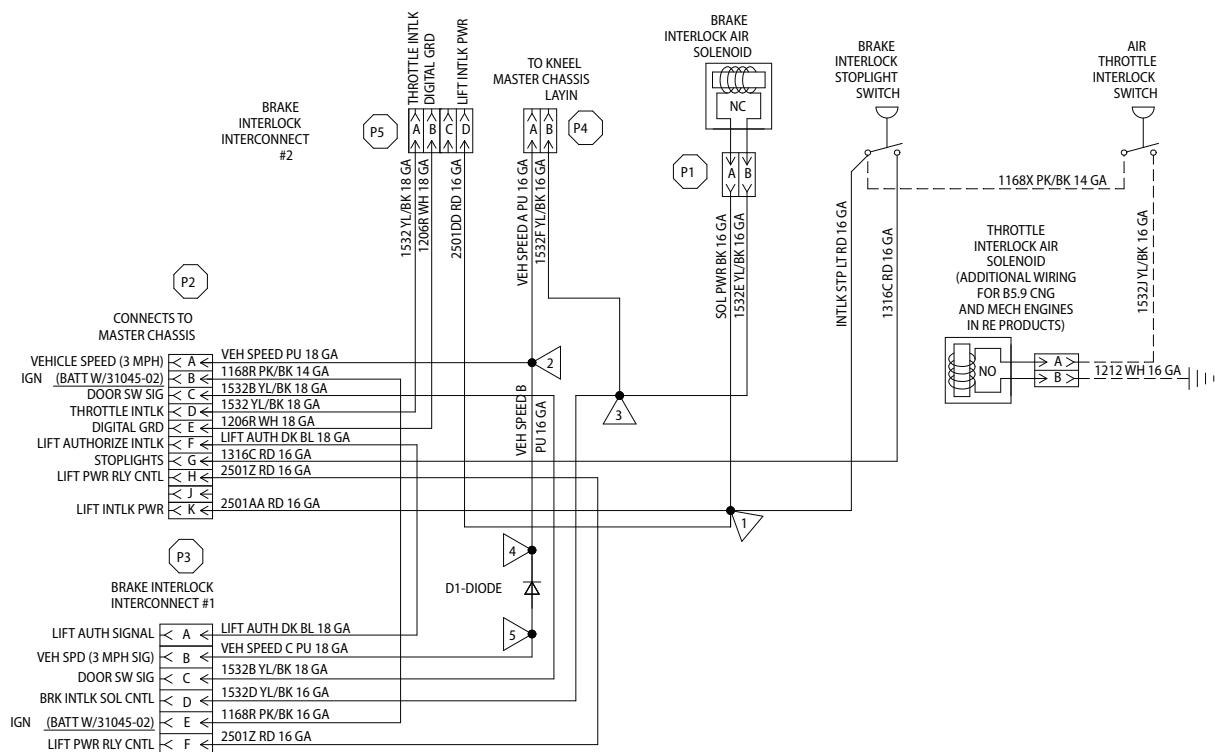


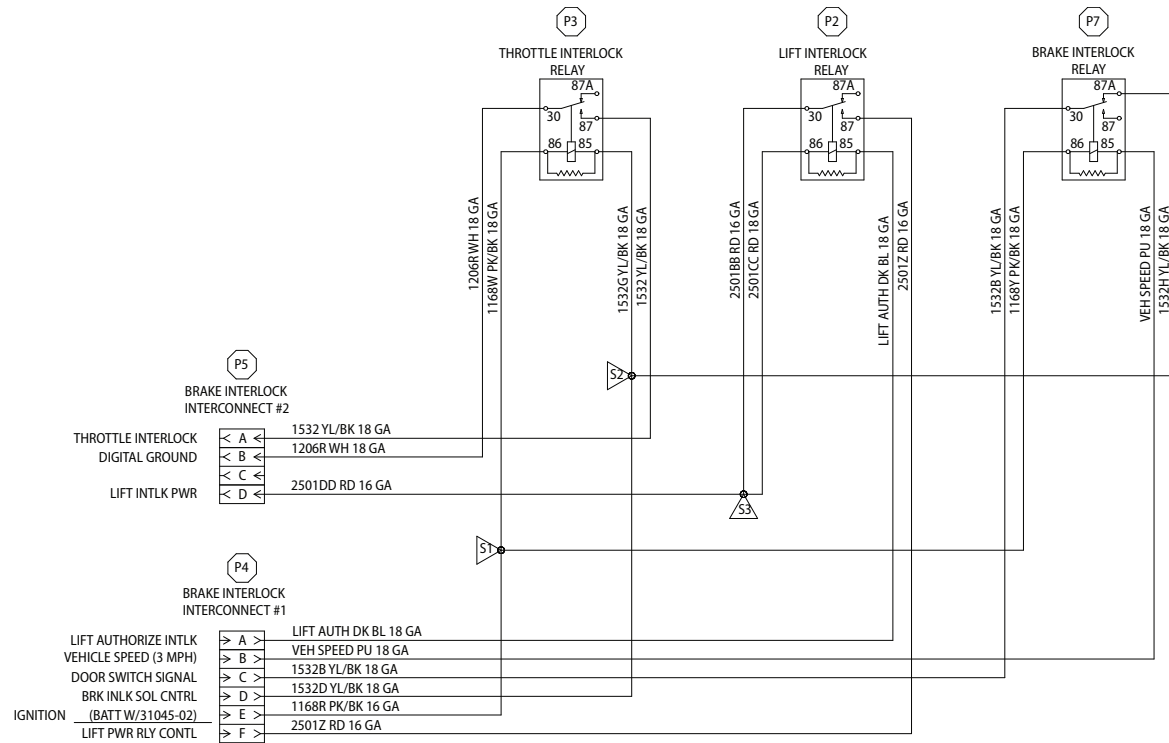


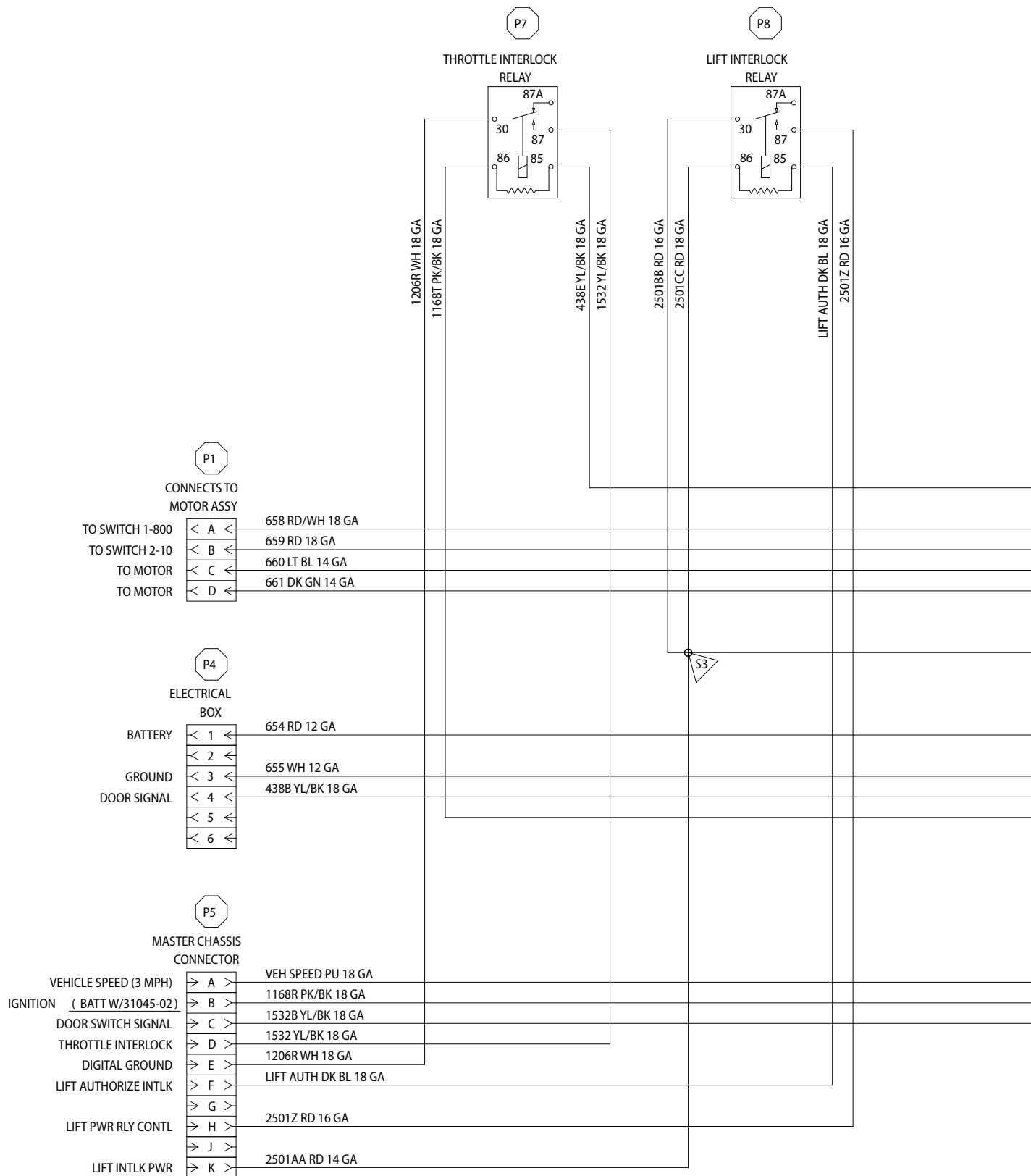


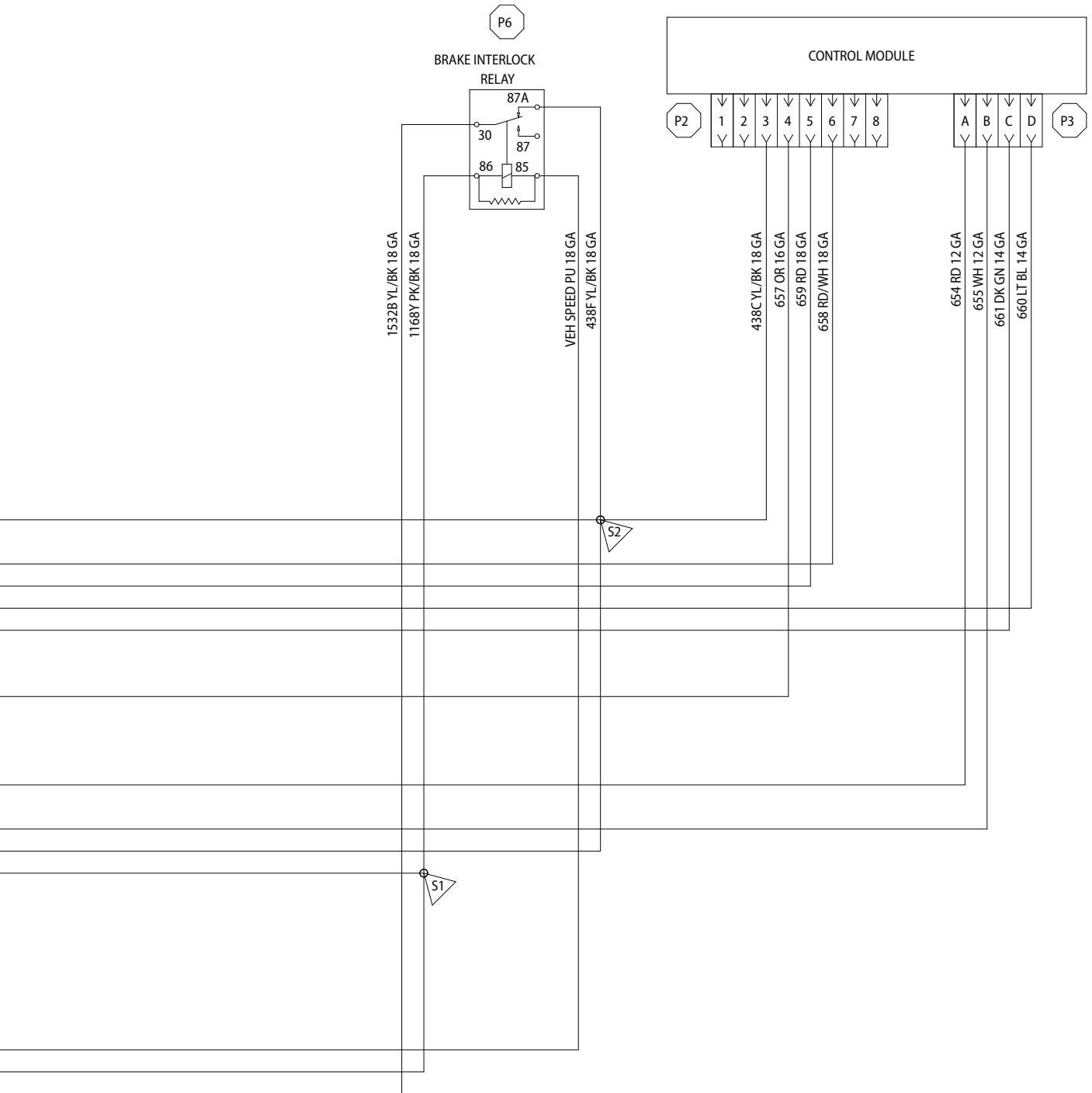




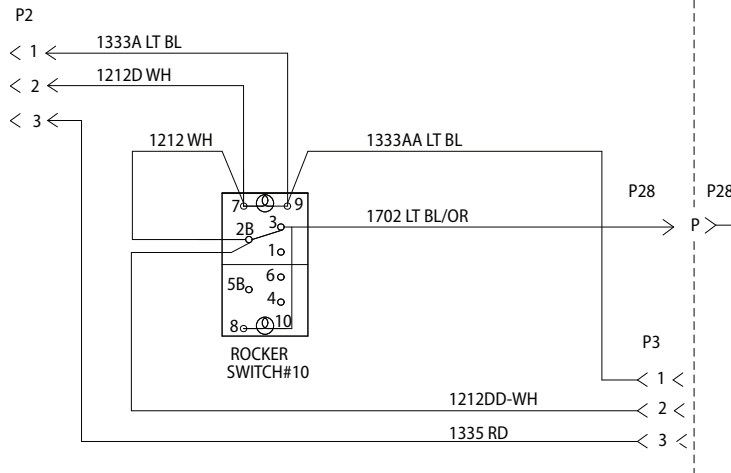




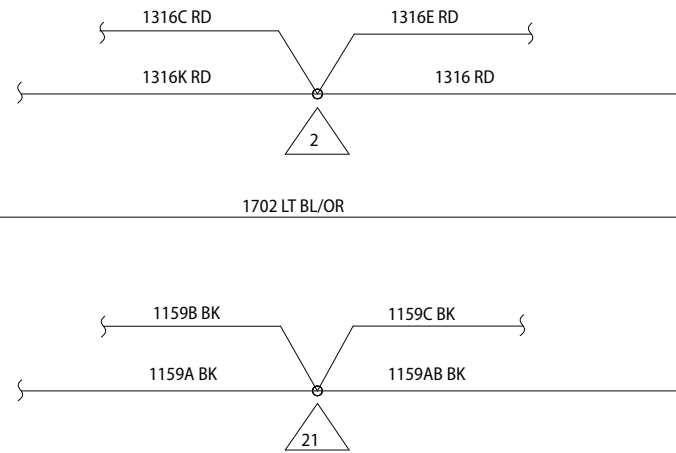




INSTRUMENT PANEL



MASTER CHASSIS



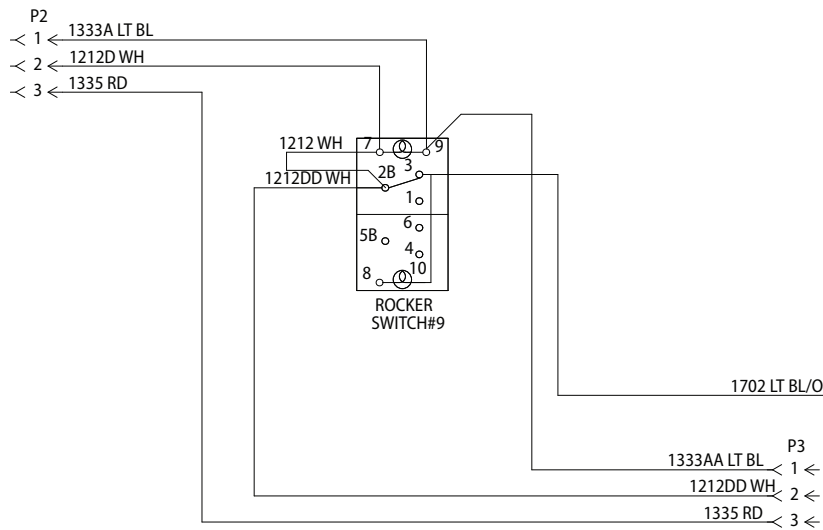
Sheet 37

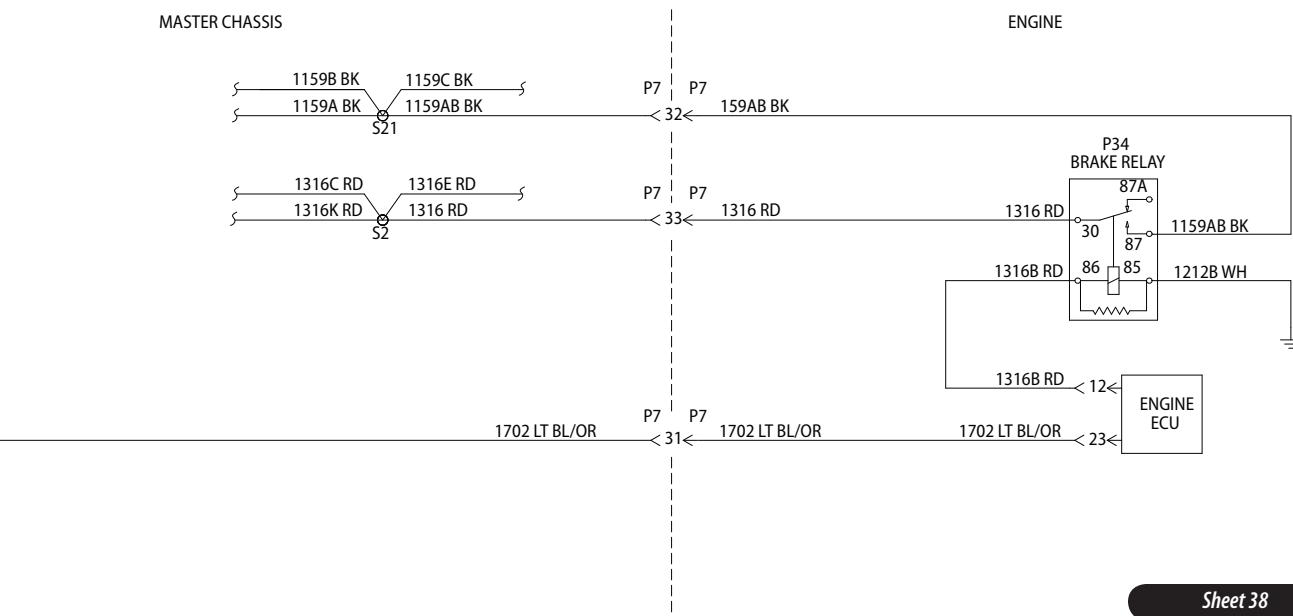
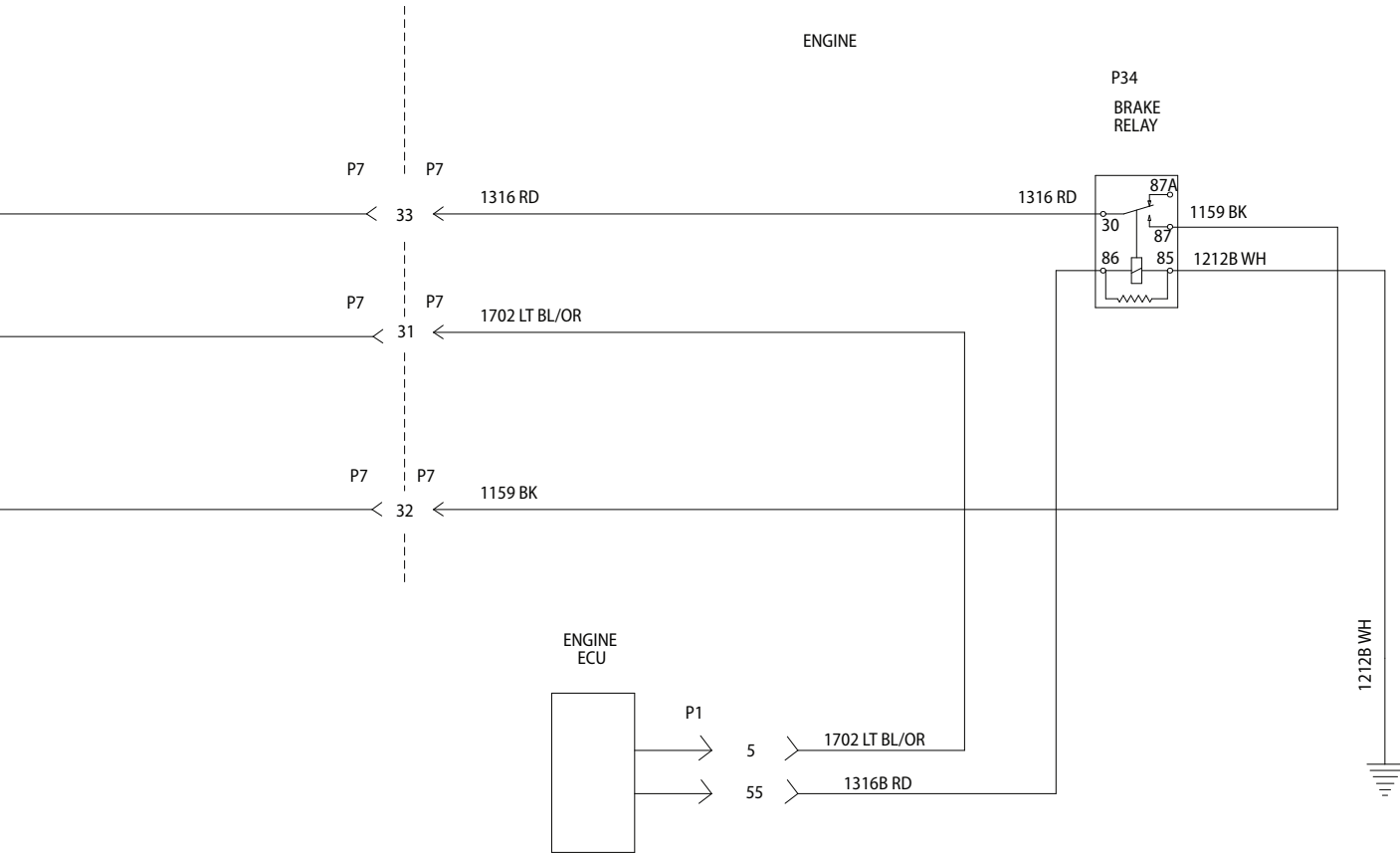
0106311

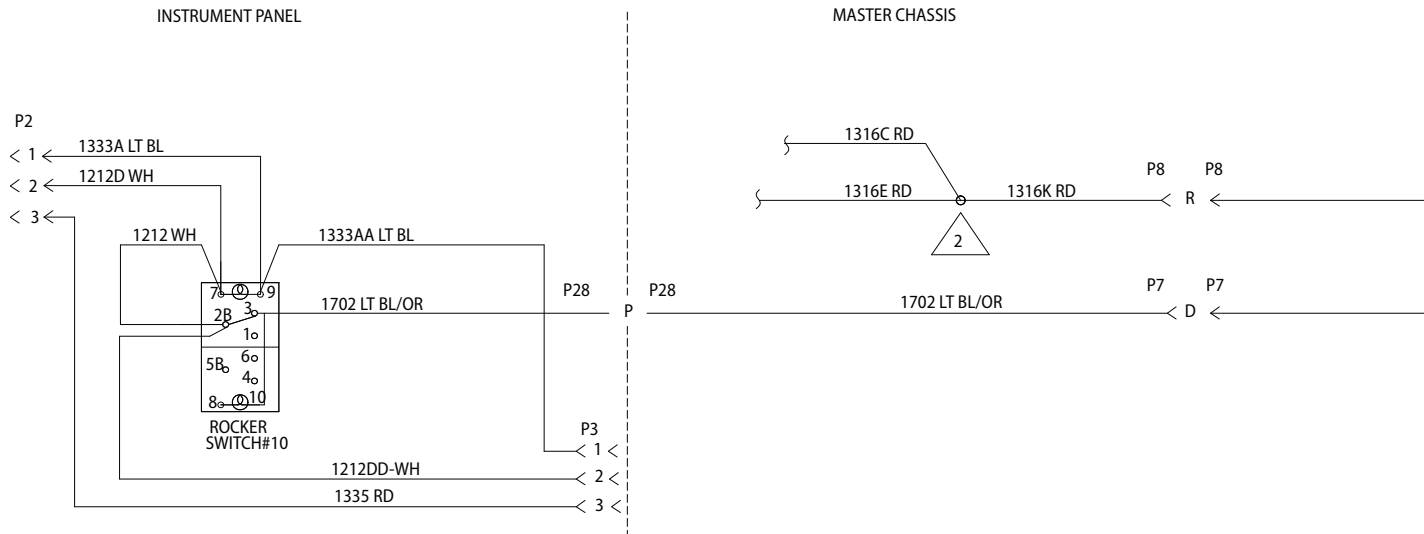
VGT BRAKE, ISB-07, FE

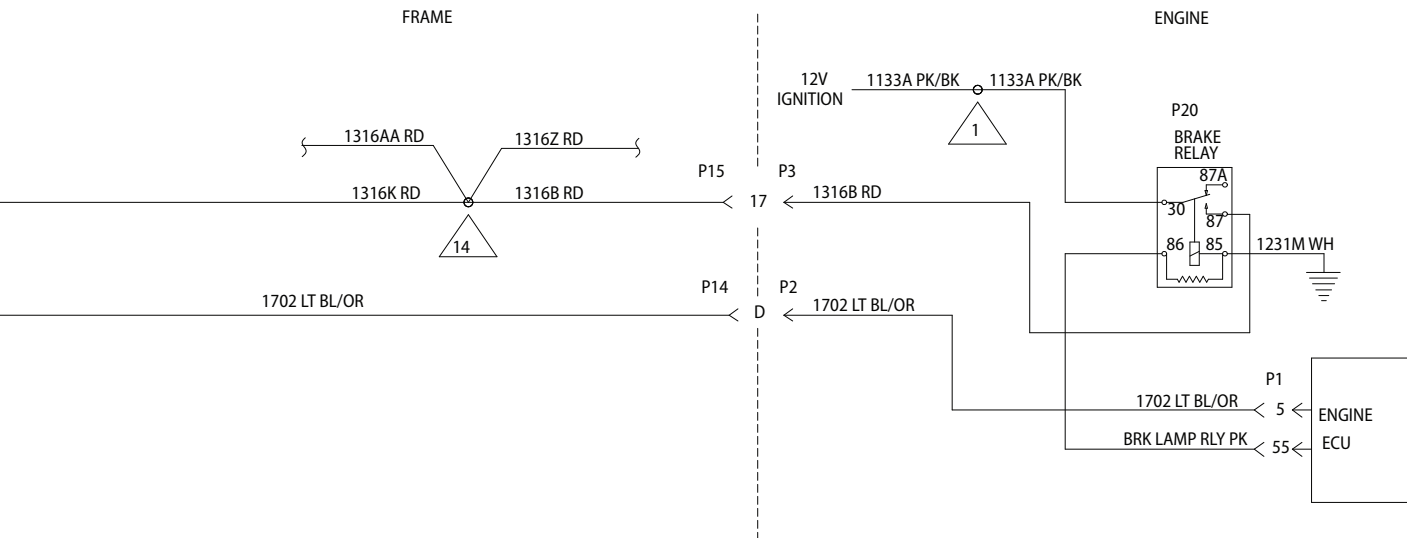
900

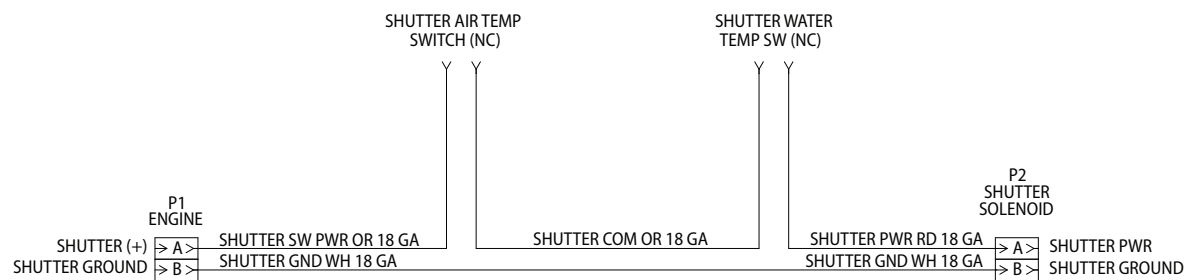
INSTRUMENT PANEL









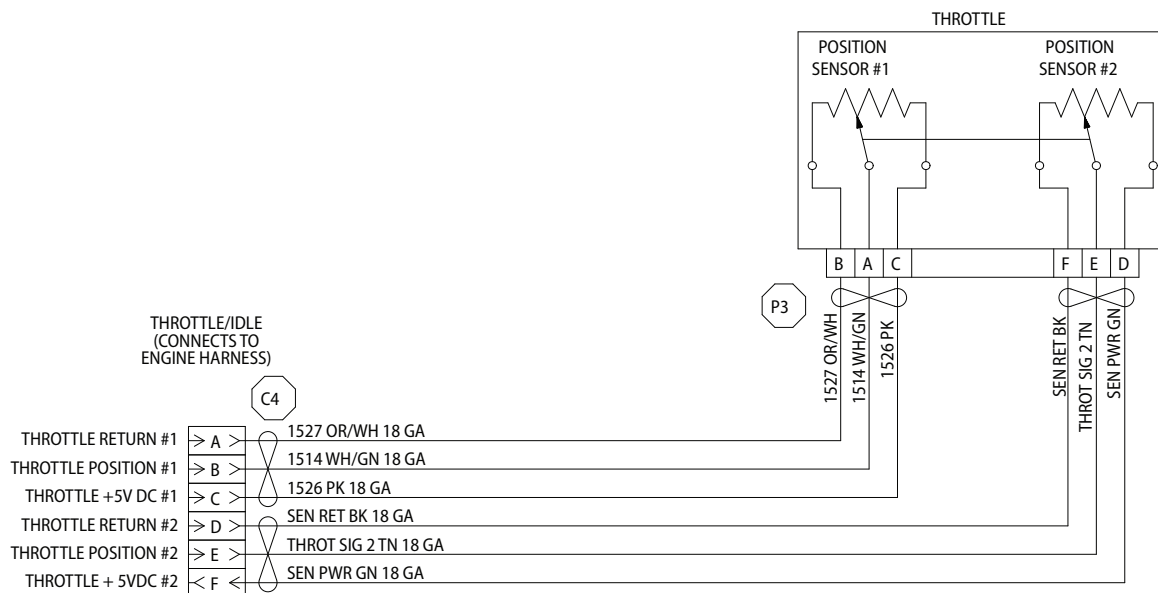


CHASSIS ELECTRICAL



905





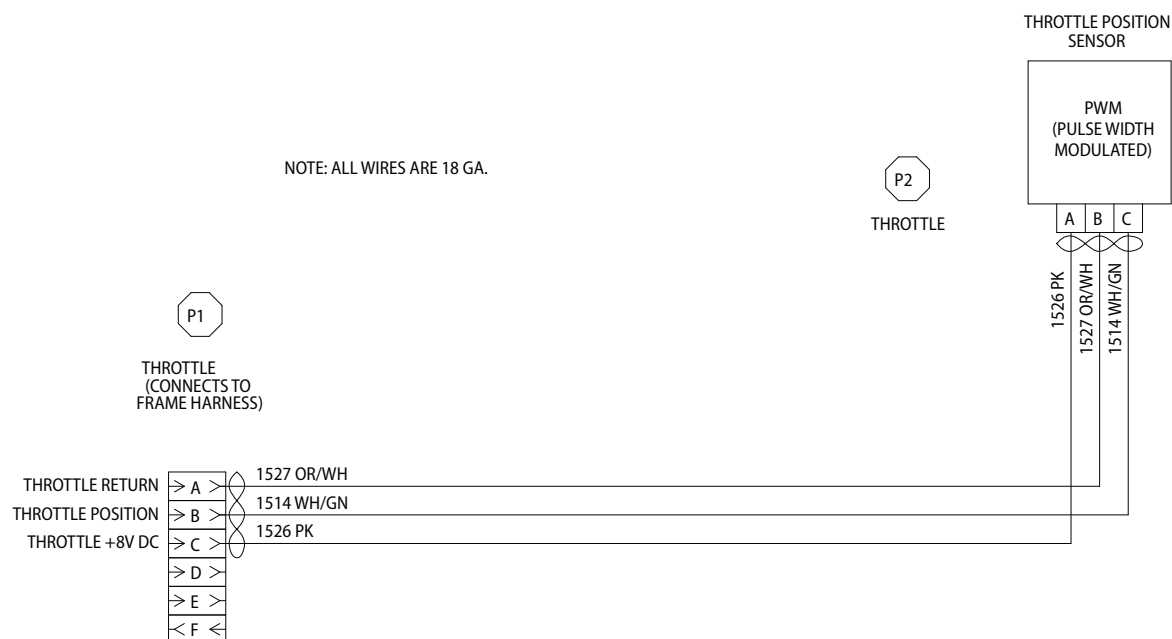
Sheet 43

0104653

THROTTLE, ISB-07, FE

906

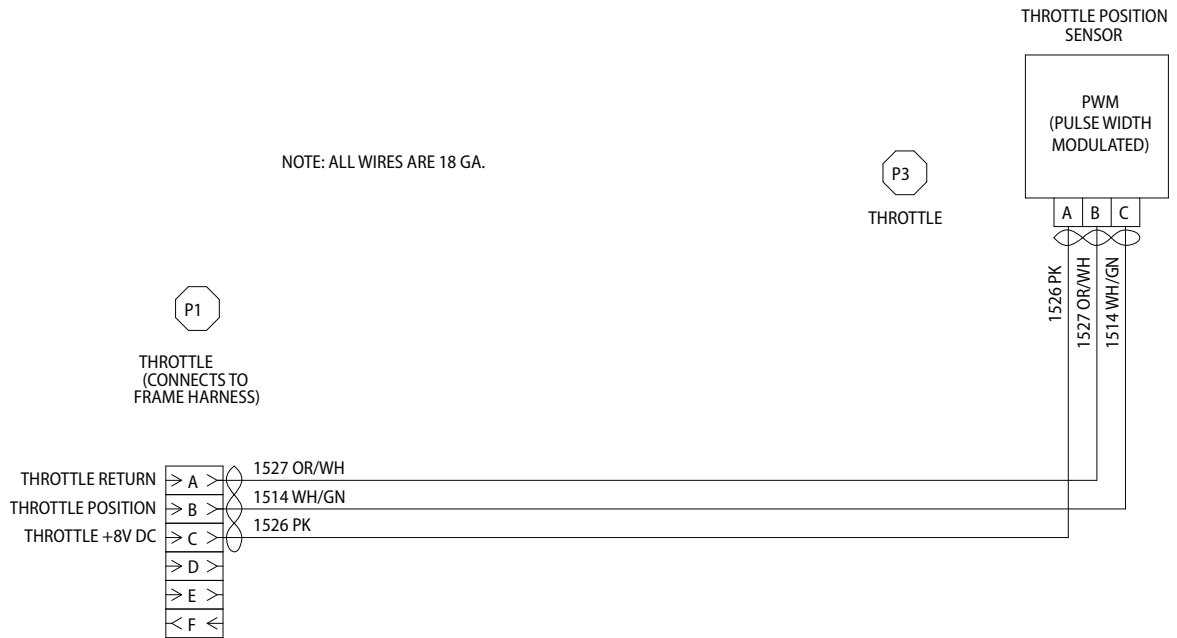
NOTE: ALL WIRES ARE 18 GA.



Sheet 44

0110243

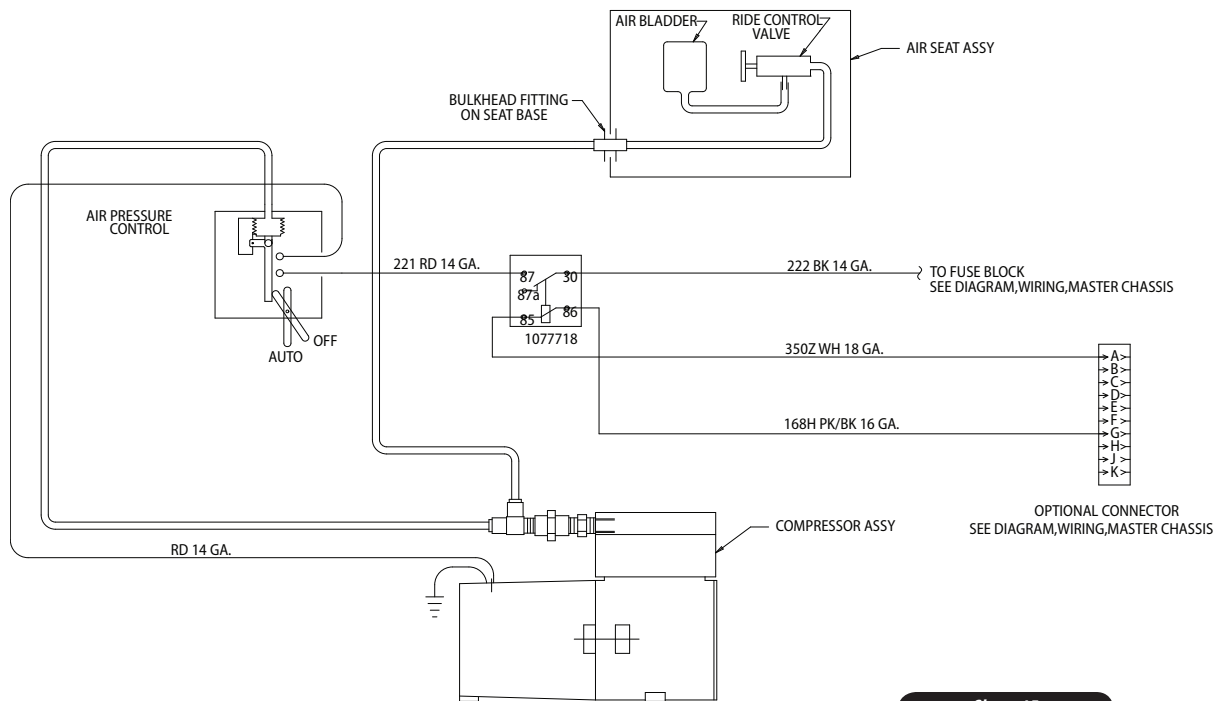
THROTTLE, CAT C7-07, RE



Sheet 44a

0014255

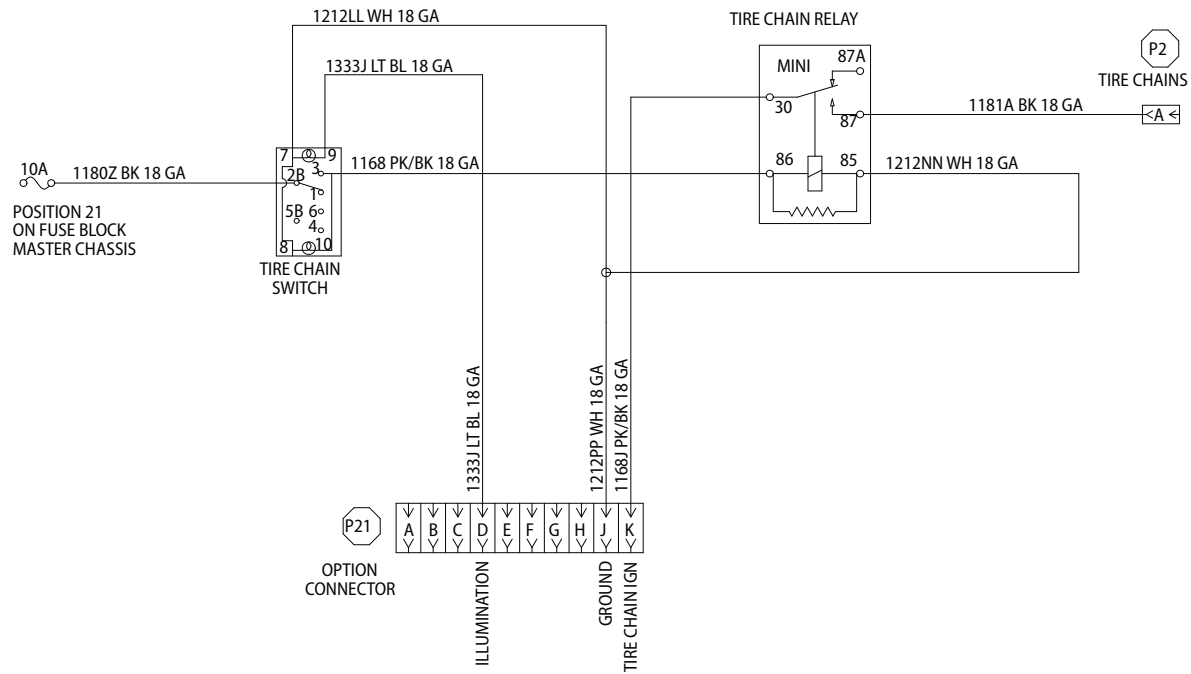
THROTTLE, CAT C7-07, FE

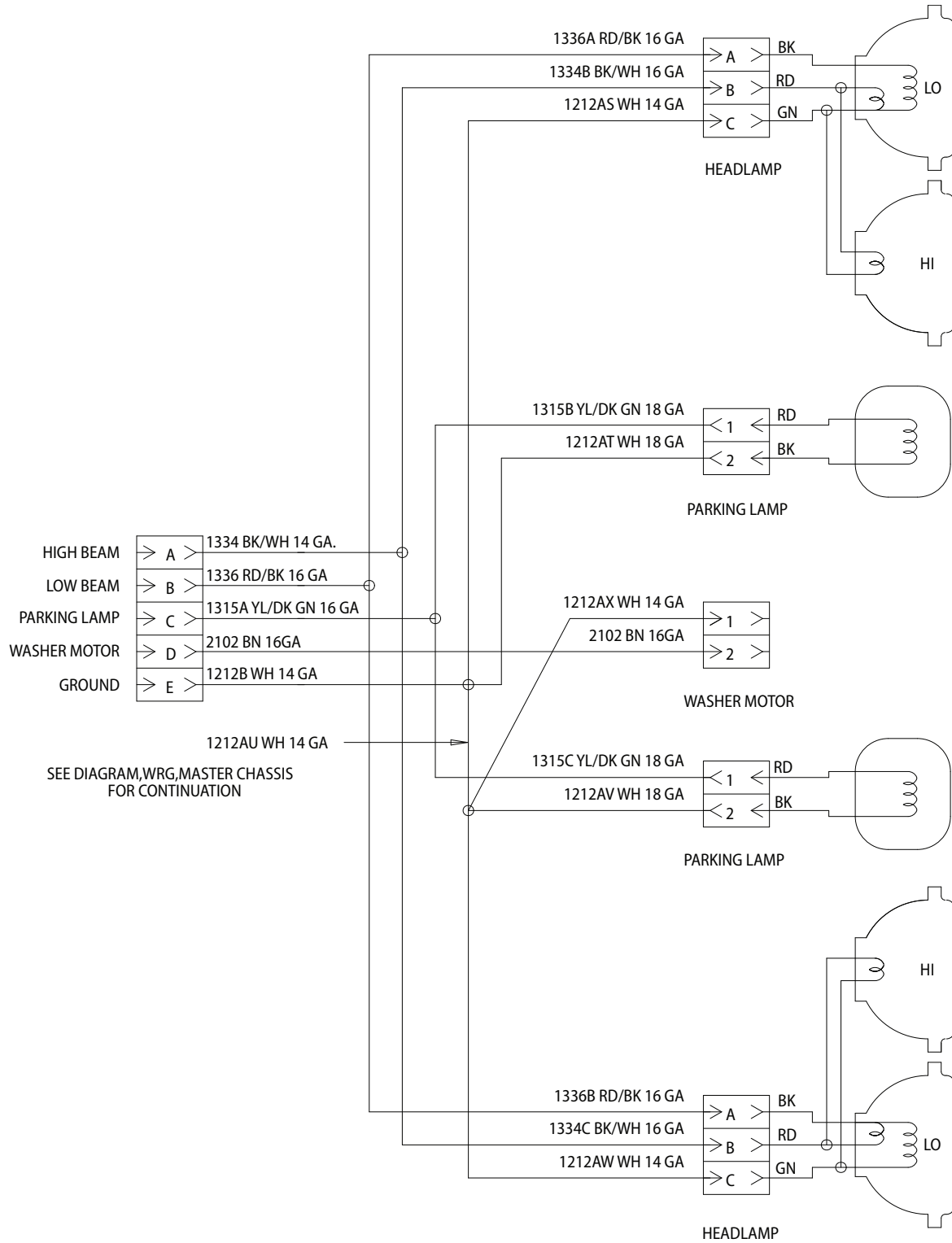


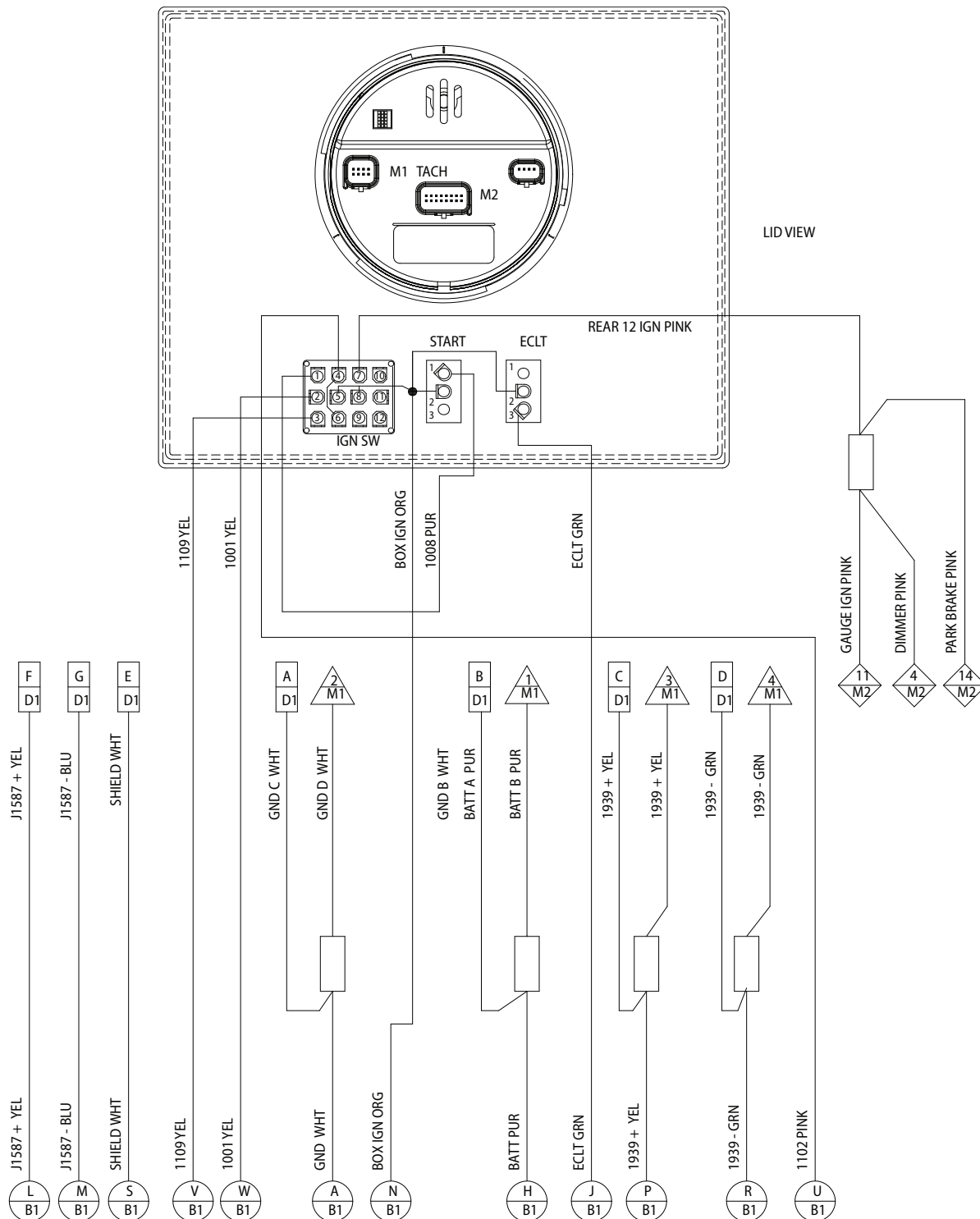
Sheet 45

1701887C

COMPRESSOR, AIR SEAT, FE & RE







Sheet 48

0079080B

REAR CONTROL BOX, ACTIA, RE

