SUPER DUTY F-650/750
ELECTRICAL WIRING
CUSTOMER ACCESS CIRCUIT INSTALLATION

WIRING INSTALLATION GUIDELINES

Although there are many points in the truck electrical system to connect additional circuits, certain connection points are recommended for reliability and convenience. This section defines the recommended connection points for each Ford Truck model and the maximum electrical loads allowable. CAUTION: Improper electrical tie-ins may affect vehicle operation (i.e., engine transmission).

After all electrical or vehicle modifications, perform the on-board diagnostics procedures as described in the powertrain control/emissions diagnosis manual to clear all diagnostic trouble codes (DTC's). Road test vehicle and rerun the on-board diagnostics to verify that no DTC's are present. If DTC's are generated perform the appropriate diagnostic procedures and repairs. Vehicle operation (engine/transmission) may be affected if DTC's are not serviced.

Alternative connections or wiring practices are not recommended as certain modifications may result in other circuits becoming non-functional. Disconnect the battery negative (ground) cable and remove it from the battery carrier prior to any vehicle modification. Upon completion of body or equipment installation, all wiring should be checked for proper routing, etc. to preclude electrical shorts upon reinstallation of the battery negative cable.

Do not splice into the Powertrain System (EEC-V). Connecting to any component or wires or this system may adversely affect Engine/Transmission operation.

Listed below are recommended wiring installation guidelines.

1. Most taps are fused, having locations under the instrument panel, in the engine compartment, and on the frame.
2. The Ford starting and the charging system should not be altered.
3. The completed vehicle total electrical load must not exceed the maximum output of the alternator.
4. Do not route or attach electrical wires to fuel lines.
5. Engine compartment wiring must not be rerouted in any manner.
6. The electronic Powertrain Control Module (PCM) requires battery power to be supplied at all times so as to maintain the keep alive memory. Keep this in mind when installing load disconnect switches or solenoids.
7. The 7.3L diesel engine requires two batteries wired in parallel for proper starting operation and must not be isolated. Do not modify the Glow Plugs Power Circuit.
8. Ford recommends that all additional under hood and underbody wiring:
   - be cross-linked polyethylene, or equivalent, high temperature insulation wire 125°C [257°F] minimum rating.
   - meet SAE specifications J1128 type SXL, GXL or TXL.
   - meet SAE J1127 type SGX or STX for battery cables.
   - be protected with nylon convoluted tubing.
   - be located so as to avoid or minimize restriction of airflow through the engine compartment, underbody and fuel system.
   - be of sufficient length to be properly routed, so as not to interfere with operating zones of such components as throttle or transmission linkage.
   - not be routed near the exhaust system or any other source of high heat; melted insulation can result in electrical shorts and system failure.
   - be routed away from hostile surfaces and sharp edges and be secured in its intended location.
   - be protected by rubber grommets when it passes through body or frame openings. Use customer access pass-thru circuits provided between cab and engine compartment and cab and frame (to avoid additional openings between passenger and engine compartments). Refer to page 38 Figure B and page 42 Figures A and B for additional information.
   - be protected from electrical shorts by fuses or circuit breakers.
   - use load distribution chart for air/hydraulic brake vehicles when determining wire length and gauge; charts shown on pages 36-37.
9. Interior wiring not exposed to high temperatures may be SAE approved, general purpose wire.
10. Ground the second unit body to the frame in at least two locations, and if required, add an additional frame to engine ground cable to improve the ground path to the battery.
11. Splicing into circuitry relating to the powertrain control systems is not acceptable because of the adverse effect on the electronic system operation.
12. Before welding to the body or chassis, disconnect the batteries, ABS models, and PCM. Note that disconnecting the batteries will result in a memory loss on electronic engine/ transmission controlled vehicles. The vehicle will require several miles of driving in various driving modes to restore its memory and regain optimum operating conditions. This includes knowledge of PTO capability on the automatic transmissions with PTO opening.
13. Electrical connections exposed to the elements should be appropriately protected.
14. Do not ground the body to the transmission or transmission crossmember.
15. Ignition circuit of any engine should not be altered.
16. Alternator circuit wiring must not be altered by cutting, soldering, or splicing.
17. Aero type headlamps are plastic and have protective coatings which can be damaged by solvents or tape. Refer to the *Owner Guide* for proper cleaning procedures.
18. Added wiring must have sufficient electrical capacity for the accessory load and must be protected by appropriate fuse or circuit breaker. The current draw must not cause the total loads to exceed capabilities of the base vehicle wiring.

RADIO FREQUENCY INTERFERENCE (RFI)

During modifications to the vehicle, manufacturers, service technicians, owners and users should take the necessary precautions to maintain the RFI integrity of components. (Both the United States and Canada have RFI regulation in effect). Precautionary procedures and components listed below are examples and do not necessarily represent a complete list.

1. All components required to suppress RFI emissions, which are removed during service, repair, or completion of the vehicle, must be reinstalled in the manner in which they were installed by Ford.
2. Do not modify or change any RF device in a manner not expressly approved by Ford Motor Company.
3. Shields on distributor and ignition coil must remain installed.
4. Replacement spark plugs, ignition wires, ignition coils, distributor caps and distributor rotor must be equivalent in their RFI suppression properties to original equipment.
5. Electrical grounds on all components must be retained.
6. Metallic components installed on the body or chassis must be grounded to the chassis.
7. Electrical circuits added to the vehicle should not be installed near the high tension ignition components.
8. Only "static conductive" accessory drive belts should be used.
9. Fan, water pump, power steering and other belts should be of the OEM type or equivalent that will not build up a static electrical charge.
10. For any completed vehicle, additional measures may be needed to adequately suppress RFI emissions.

SUPER DUTY F-650/750
BODY BUILDER LOAD DISTRIBUTION

AIR BRAKE VEHICLES

Circuit Description	Location	Fuse Size (Amps)	Max Fuse Load by Body Builder	Type	Harness	Circuit #	Circuit Color	Circuit Gauge	Recommended Insulation	Recommended Maximum Wire Length											
										10 Gauge (Meters)		12 Gauge (Meters)		14 Gauge (Meters)		16 Gauge (Meters)		18 Gauge (Meters)		20 Gauge (Meters)	
										XLPE	PVC	XLPE	PVE	XLPE	PVC	XLPE	PVC	XLPE	PVC	XLPE	PVC
Park Lamps	PDB #111	30	21	Maxifuse	14A341	962	BN-WH	14	XLPE	9.588	9.588	5.995	5.995	3.804	3.804	NR	NR	NR	NR	NR	NR
Backup Lamps	PDB #116	30	10*	Maxifuse	14A341	963	BK-LG	16	XLPE	9.084	9.084	5.680	5.680	3.604	3.604	NR	NR	NR	NR	NR	NR
Stop Lamps	PDB #116	30	10*	Maxifuse	14A341	123	RD	16	XLPE	9.084	9.084	5.680	5.680	3.604	3.604	NR	NR	NR	NR	NR	NR
LH Stop/Turn	PDB #116	30	10*	Maxifuse	14A341	52	YE	16	XLPE	9.084	9.084	5.680	5.680	3.604	3.604	NR	NR	NR	NR	NR	NR
RH Stop/Turn	PDB #116	30	10*	Maxifuse	14A341	64	DG	16	XLPE	9.084	9.084	5.680	5.680	3.604	3.604	NR	NR	NR	NR	NR	NR
Accessory Feed #1 (Run Only)	PDB #102	20	13	Maxifuse	14401	730	GY-LB	14	PVC	29.766	29.766	18.610	18.610	11.810	11.810	7.283	7.283	4.834	4.834	3.009	NR

***** Sum of loads for Backup, Stop, LH Stop/Turn, RH Stop/Turn lamps not to exceed 21 amps.

NR (Not Recommended) - Do not use, wire gauge is not intended for this application.

SUPER DUTY F-650/750
BODY BUILDER LOAD DISTRIBUTION

HYDRAULIC BRAKE VEHICLES

Circuit Description	Location	Fuse Size (Amps)	Max Fuse Load by Body Builder	Type	Harness	Circuit #	Circuit Color	Circuit Gauge	Recommended Insulation	Recommended Maximum Wire Length											
										10 Gauge (Meters)		12 Gauge (Meters)		14 Gauge (Meters)		16 Gauge (Meters)		18 Gauge (Meters)		20 Gauge (Meters)	
										XLPE	PVC	XLPE	PVE	XLPE	PVC	XLPE	PVC	XLPE	PVC	XLPE	PVC
Park Lamps	PDB #111	30	21	Maxifuse	14A341	962	BN-WH	14	XLPE	9.588	9.588	5.995	5.995	3.804	3.804	NR	NR	NR	NR	NR	NR
Backup Lamps	PDB #116	30	10*	Maxifuse	14A341	963	BK-LG	16	XLPE	9.084	9.084	5.680	5.680	3.604	3.604	NR	NR	NR	NR	NR	NR
Stop Lamps	PDB #15	7.5	5.5*	Maxifuse	14A341	123	RD	16	XLPE	274.278	274.278	171.482	171.482	108.822	108.822	67.107	67.107	44.540	44.540	27.730	27.730
LH Stop/Turn	PDB #116	30	10*	Maxifuse	14A341	52	YE	16	XLPE	9.084	9.084	5.680	5.680	3.604	3.604	NR	NR	NR	NR	NR	NR
RH Stop/Turn	PDB #116	30	10*	Maxifuse	14A341	64	DG	16	XLPE	9.084	9.084	5.680	5.680	3.604	3.604	NR	NR	NR	NR	NR	NR
Accessory Feed #1 (Run Only)	PDB #102	20	13	Maxifuse	14401	730	GY-LB	14	PVC	29.766	29.766	18.610	18.610	11.810	11.810	7.283	7.283	4.834	4.834	3.009	NR

* Sum of loads for Backup, Stop, LH Stop/Turn, RH Stop/Turn lamps not to exceed 21 amps.

NR (Not Recommended) - Do not use, wire gauge is not intended for this application.

SUPER DUTY F-650/750 ELECTRICAL WIRING
CUSTOMER ACCESS CIRCUIT INSTALLATION

PTO/Dash Panel Pass Thru/Vehicle Speed/Run

There are three customer access locations under the IP. The customer access circuits are blunt cut and the ends are protected with heat shrink tubing. The circuits are secured together with white tape.

The first customer access circuit location is in the right hand kick panel (Cat 3126 and Cummins ISB engines only). The circuits interface with the engine electronic control module. The circuit bundle is labeled “Diagnostic Access”.

Figure A shows the location of the takeout and a table which defines each circuits function, wire gage and color.

The second customer access circuit location is adjacent to the OBDII diagnostic connector in the center of the instrument panel; the circuit bundle is labeled “Customer Access”.

The bundle contains:

— six dash panel pass-thru circuits
— vehicle speed
— a dedicated run feed

Figure B shows the location of the takeout and a table which defines each circuits function, wire gage and color.

Of the six dash panel pass-thru circuits, four are located in the engine compartment and two are located on the left hand frame rail.

The vehicle speed output is configured to 30,000 pulses/mile.

The dedicated run only feed is fused in the Power Distribution Box (PDB) #102 by 20A. Figure C is a schematic of the circuit.

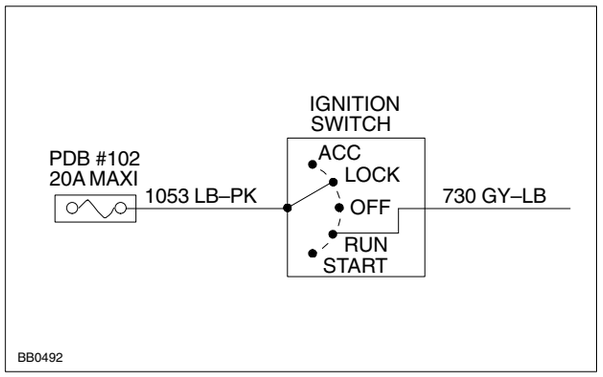
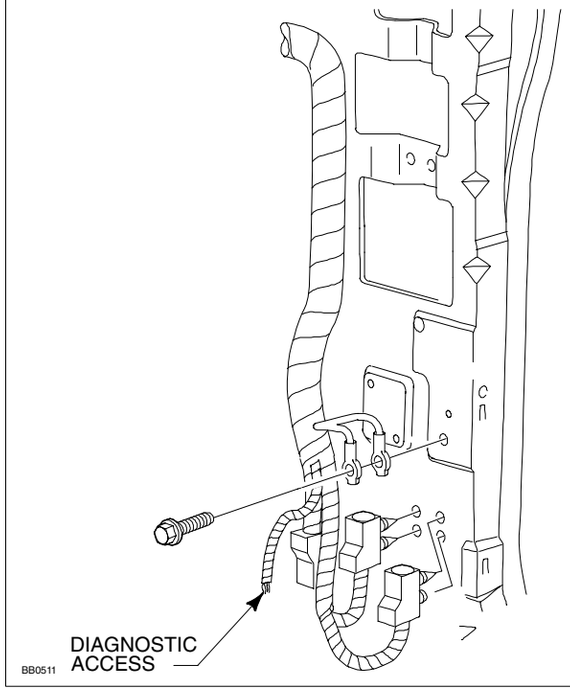


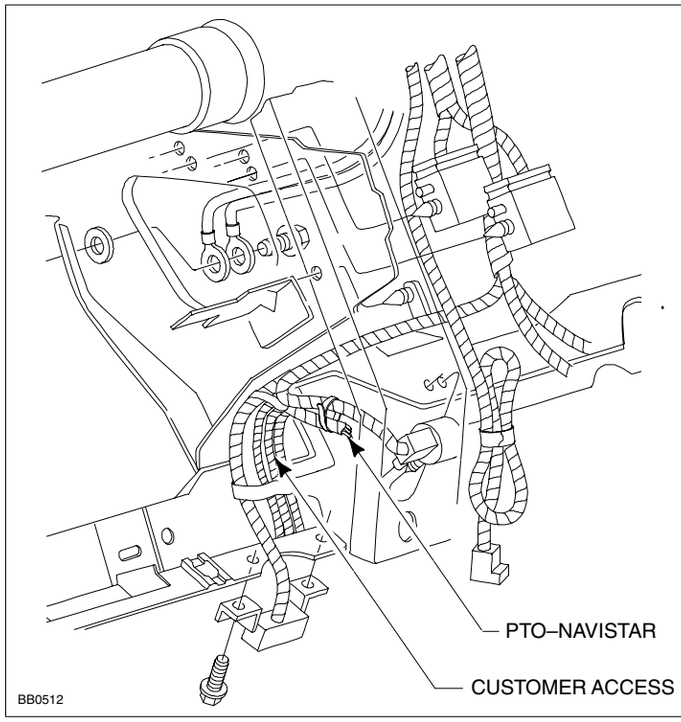
FIGURE C



POWERTRAIN CUSTOMER ACCESS

ENGINE	PIN# AT ENGINE ECU	CIRCUIT NUMBER	COLOR CODE	WIRE GAGE	FUNCTIONAL DESCRIPTION
CAT 3126	56	900	BK	18	PTO on/off switch
	58	921	GY-OG	18	PTO set/resume
	60	922	WH-RD	18	PTO set/resume
	3	766	BK-LG	18	PTO sensor common
	30	80	BK-OG	18	PTO mode lamp
	68	1283	TN-YE	18	PTO remote accelerator position input
	40	312	OG-WH	18	Fast idle enable switch
CUMMINS ISB	7	848	DG-OG	18	Cruise and PTO resume/accel switch
	13	154	PK-LG	18	Cruise and PTO set/coast switch
	14	151	LB-BK	18	Cruise and PTO on/off switch

FIGURE A



DASH PANEL PASS-THRU CIRCUITS

CIRCUIT NUMBER	COLOR CODE	WIRE GAGE	FUNCTIONAL DESCRIPTION
43	DB	14	Dash panel pass thru- LH frame
49	OG	14	Dash panel pass thru - LH frame
838	LG-VT	14	Dash panel pass thru - engine compartment
839	LG-WH	14	Dash panel pass thru - engine compartment
845	TN-BK	14	Dash panel pass thru - engine compartment
870	VT-YE	14	Dash panel pass thru - engine compartment

FIGURE B

PTO/Dash Panel Pass Thru/Vehicle Speed/Run (Continued)

The third customer access circuit location is for the Navistar 7.3L engine. A single circuit is secured to the APCM connector takeout. Figure B on page 38 shows the location of the circuit. The circuit function supports integration of a power-take-off (PTO) on/off switch. The PTO supplier must complete a PTO circuit as shown in Figure A. Failure to complete this circuit may result in erroneous emission codes and inadvertent illumination of the “Service Engine Soon” light during PTO operation. In electrically actuated PTO systems, circuit 322 must be isolated from the solenoid or PCM damage may result.

Allison WTEC III Transmission

The customer access circuits for the Allison WTEC III transmission are located within the floor mounted shift selector pedestal. The circuits are housed in a standard 16-way connector. Figure B shows the pinout configuration of the 16-way connector.

Figure C shows the location of the takeout and a table which defines each circuits function, wire gage and color.

Refer to the Allison WTEC III Controls Trouble Shooting Guide, Appendix P for system wiring configuration.

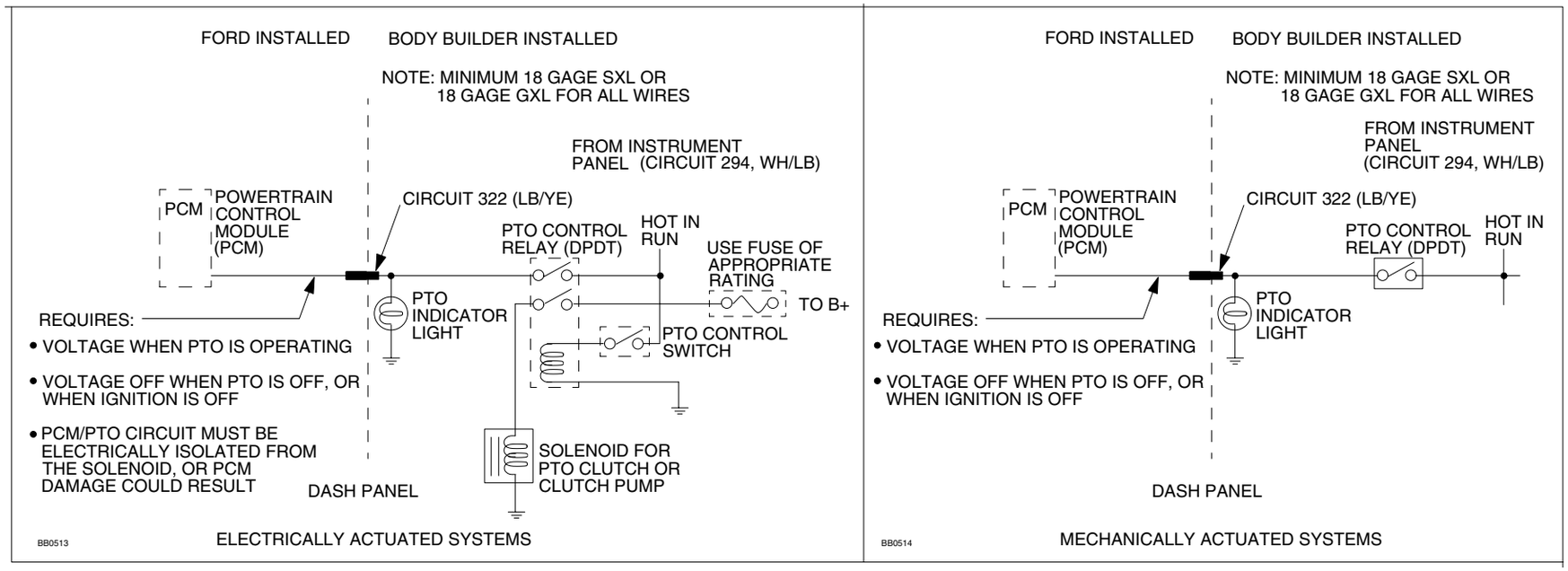


FIGURE A

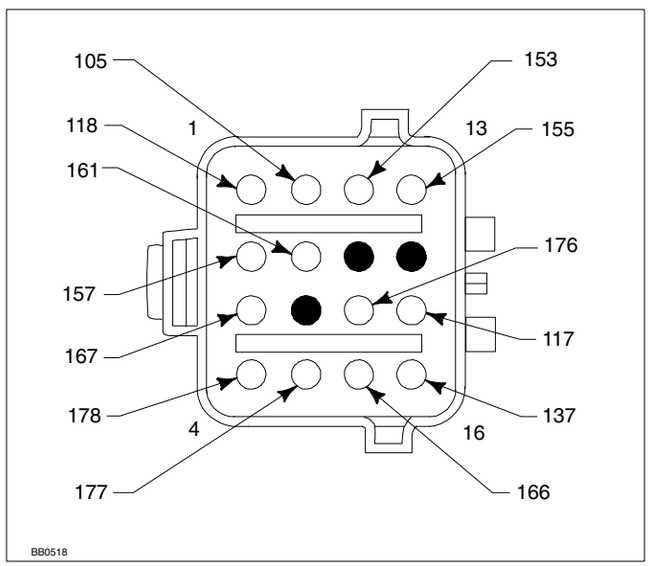
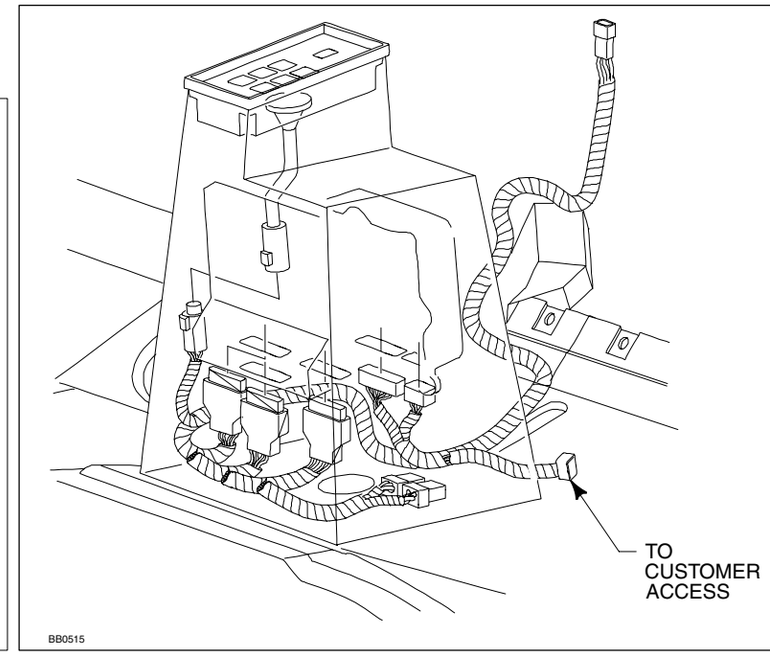


FIGURE B



GROUP 70 PACKAGE 113 - MD TRANSMISSIONS - WORLDWIDE

PIN # AT TRANSMISSION ECU	CIRCUIT NUMBER	COLOR CODE	WIRE GAUGE	FUNCTIONAL DESCRIPTION
V11	155	GY-RE	18	Aux. function range inhibit
V12	153	PK–YE	18	Secondary shift schedule
V13	118	PK-OG	18	PTO enable
V19	105	RD-WH	18	Sump/retarder temp indicator
V31	161	DG-OG	18	Digital ground
V30	117	PK-BK	18	Automatic neutral for PTO
V28	178	DG-OG	18	Not applicable
V14	177	WH	18	Not applicable
V29	137	YE-BK	18	Not applicable
V5	167	BR-OG	18	Output speed indicator A
S15	176	PK-LG	18	Not applicable
S18	166	WH-OG	18	Not applicable
S30	157	PK-LB	18	Vehicle speed

FIGURE C

SUPER DUTY F-650/750
POWER TAKE-OFF HIGH IDLE CONTROL

AUXILIARY POWERTRAIN CONTROL MODULE (APCM)

Application

Navistar 7.3L Diesel Engine Power Stroke

Installation

- Reference Figure A for installation. Detailed instructions (12B639) included with kit (12B641).
- The APCM connector (Connector C249) is located under center instrument panel. Figure B shows pin-out.

Basic Operation

- The APCM provides a method of elevating engine idle speed in stationary applications.
- Charge Protection mode maintains battery voltage under high electrical loads.
- RPM Control mode includes four (4) programmable presets and the ability to manually adjust the idle speed.
- Reference Figure C for APCM key pad function.
- The tables shown below describe the inputs required to enable or disable the APCM.

APCM Enabling Inputs
(all are required)

	Condition	Circuit Index	Circuit #	Voltage	Comments
1	Parking brake set	PBA	162	Ground	Parking Brake Applied Switch
2	Service brake off	BOO	810	Open (Air Brake) Ground (Hydraulic Brake)	Brake On/Off Switch
3	Foot off clutch (manual trans.)	CPP	306	12v	Clutch Pedal Position Switch
4	Foot off accelerator pedal	AP	355	0.5v	Accelerator Pedal Sensor
5	Vehicle speed is 0 mph	VSS +	679	freq. signal	Vehicle Speed Signal
6	Brake lights are functional				

APCM Disabling Inputs
(any one is required)

	Condition	Circuit Index	Circuit #	Voltage	Comments
1	Disengage parking brake	PBA	162	Open	Parking Brake Applied Switch
2	Depress service brake	BOO	810	12v	Brake On/Off Switch
3	Depress clutch (manual trans.)	CPP	306	Open	Clutch Pedal Position Switch
4	Disconnect brake lights				
5	Vehicle speed > 0	VSST	679	freq. signal	Vehicle Speed Signal

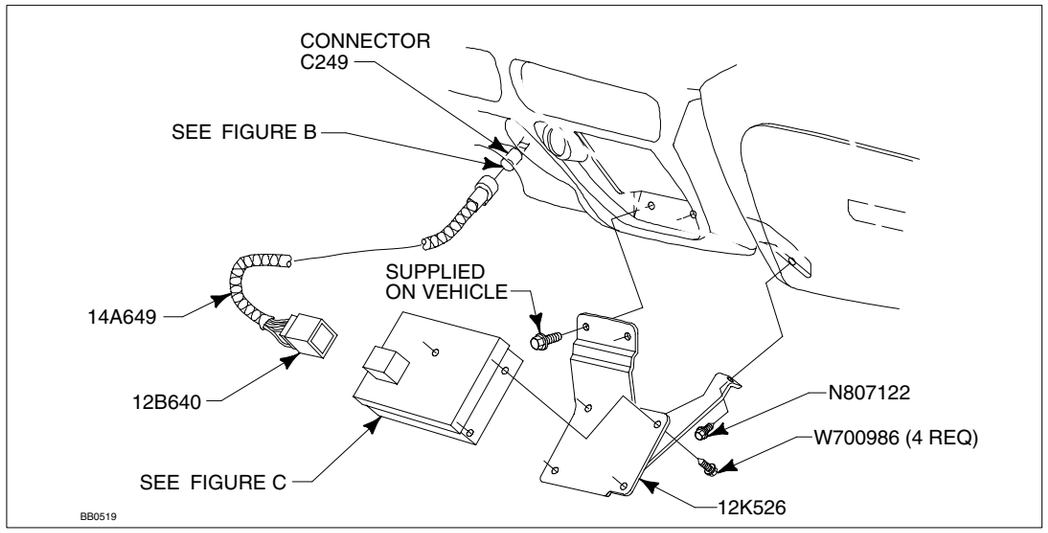


FIGURE A

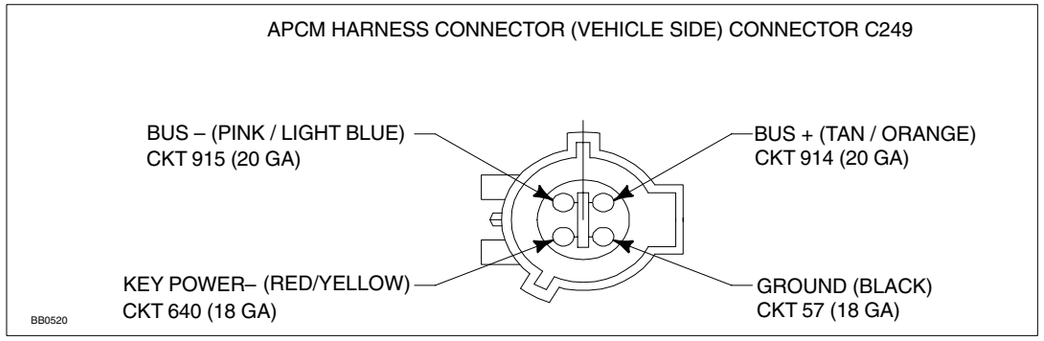


FIGURE B

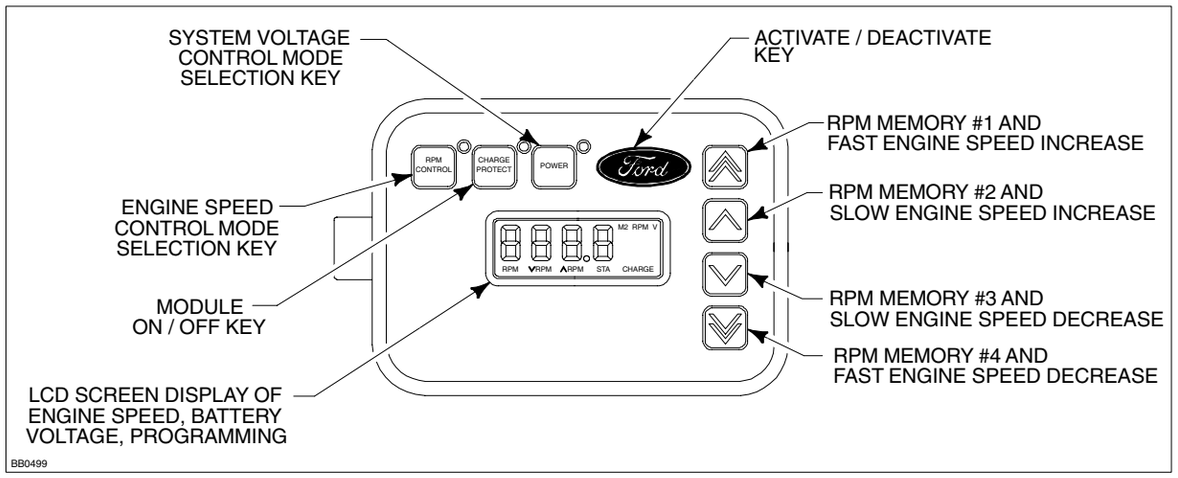
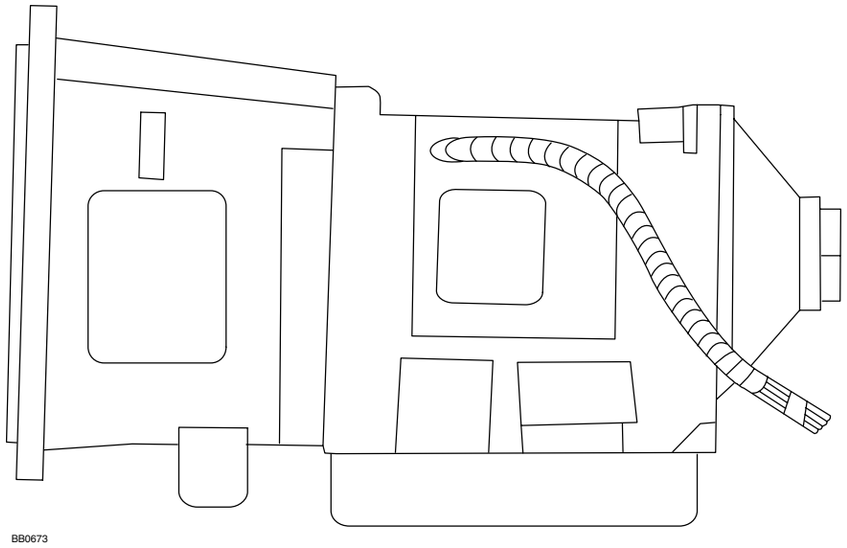


FIGURE C

SUPER DUTY F-650/750 ELECTRICAL WIRING
ALLISON 2000/2400 TRANSMISSION



ALLISON 2000/2400 TRANSMISSION

PIN # AT TRANSMISSION ECU	CIRCUIT NUMBER	COLOR CODE	WIRE GAUGE	FUNCTIONAL DESCRIPTION
J1-6	106	LB	18	PTO Enable Input
J1-7	107	VT	18	Exhaust Engine Brake Input
J1-8	108	BN-LB	18	Automatic Neutral for PT O
J1-10	110	WH-LG	18	Secondary Shift Schedule
J1-11	111	BK-OG	18	Aux. Function Range Inhibit
J1-19	119	PK-YE	18	PTO Enable Output
J1-20	120	PK-LG	18	Exhaust Engine Brake Output
J1-21	121	YE-BK	18	Range Indicator
J1-22	122	YE	18	Output Speed Indicator
J1-28	128	DB-YE	18	Signal Return

SUPER DUTY F-650/750 ELECTRICAL WIRING CUSTOMER ACCESS CIRCUIT INSTALLATION

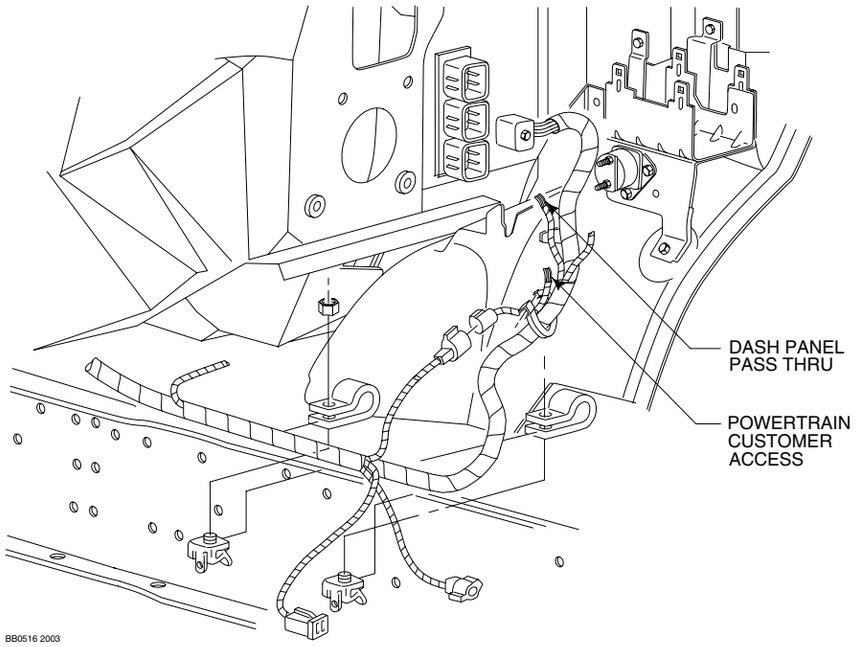
POWERTRAIN/DASH PANEL PASS-THRU

The Engine Compartment has two takeouts for customer access which are near the power distribution box. Figure A shows the location of each takeout and a table which defines each circuits function, wire gage and color.

All Customer Access Circuits are blunt cut and the ends are protected with heat shrink tubing.

One Customer Access Takeout supports the dash panel pass-thru circuits. The other takeout supports engine electronic control module features (CAT 3126 and Cummins ISB engines only).

Refer to the Cummins ISB or Cat 3126 Applications and Installation Guide for wiring schematic configuration.



POWERTRAIN CUSTOMER ACCESS

ENGINE	PIN# AT ENGINE ECU	CIRCUIT NUMBER	COLOR CODE	WIRE GAGE	FUNCTIONAL DESCRIPTION
CAT 3126	56	900	BK	18	PTO on/off switch
	58	921	GY OG	18	PTO set/off switch
	60	922	WH RD	18	PTO resume/off switch
	3	766	BK LG	18	PTO sensor common
	30	80	BK OG	18	PTO mode lamp
	68	1283	TN YE	18	PTO remote accelerator position input
	40	312	OG WH	18	Fast idle enable switch
CUMMINS ISB	7	848	DG OG	18	Cruise and PTO resume/accel switch
	13	154	PK LG	18	Cruise and PTO set/coast switch
	14	151	LB BK	18	Cruise and PTO on/off switch

DASH PANEL PASS THRU CIRCUITS

CIRCUIT NUMBER	COLOR CODE	WIRE GAGE
838	LG VT	14
839	LG WH	14
845	TN BK	14
870	VT YE	14

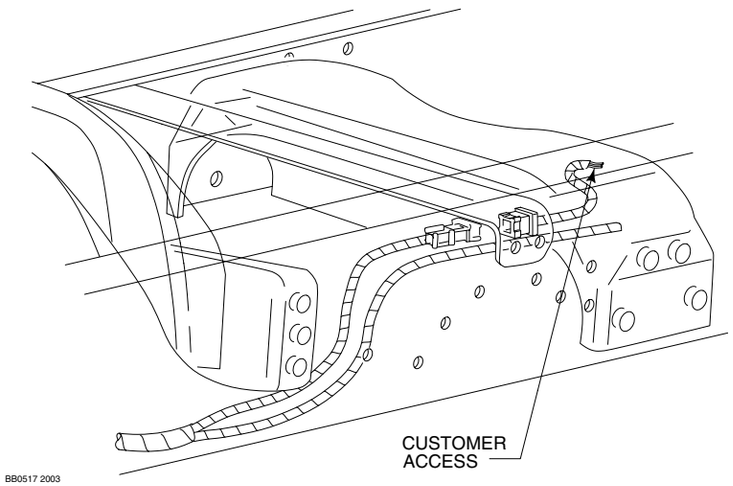
FIGURE A

TRAILER TOW

Customer Access Circuits which support exterior illumination, two dash panel pass thru circuits, and two ground circuits are secured to the left hand frame rail, rear of cab. Figure B shows the location of the takeout and a table which defines each circuits function, wire gage and color.

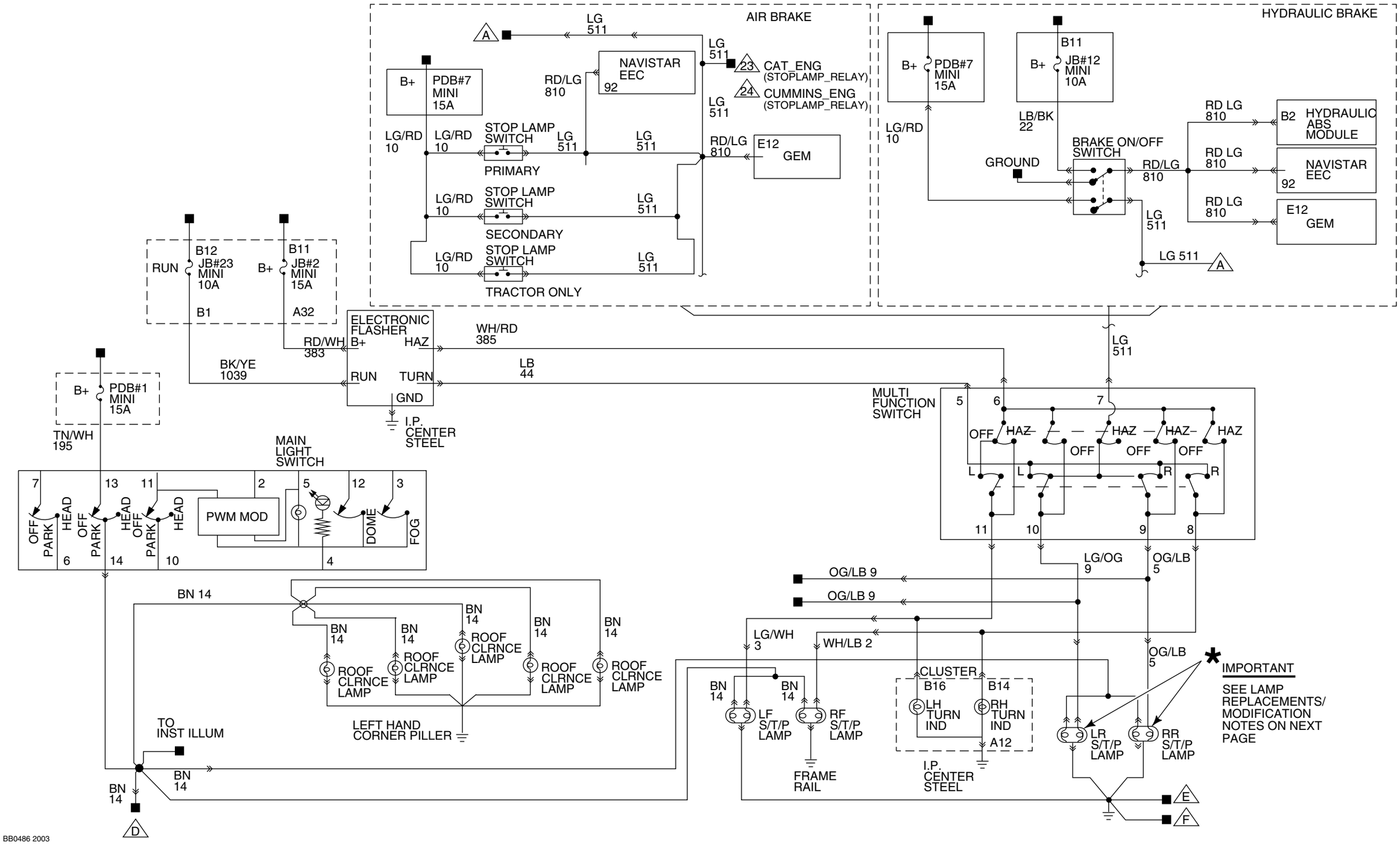
All Customer Access Circuits are blunt cut and the ends are protected with heat shrink tubing.

A system schematic of the Trailer Tow Circuits is shown on page 43-44.



CIRCUIT NUMBER	COLOR CODE	WIRE GAGE	FUNCTIONAL DESCRIPTION
123	RD	14	Relay feed stop lamps
52	YE	14	Relay feed LH turn/stop hazard
64	DG	14	Relay feed RH turn/stop hazard
57	BK	14	Ground
57	BK	14	Ground
962	BR WH	14	Relay feed park lamps
963	BK LG	14	Relay feed backup lamp
43	DB	14	Dash panel pass thru circuits
49	OG	14	Dash panel pass thru circuits

SUPER DUTY F-650/750
ELECTRICAL WIRING
TRAILER TOW SCHEMATIC

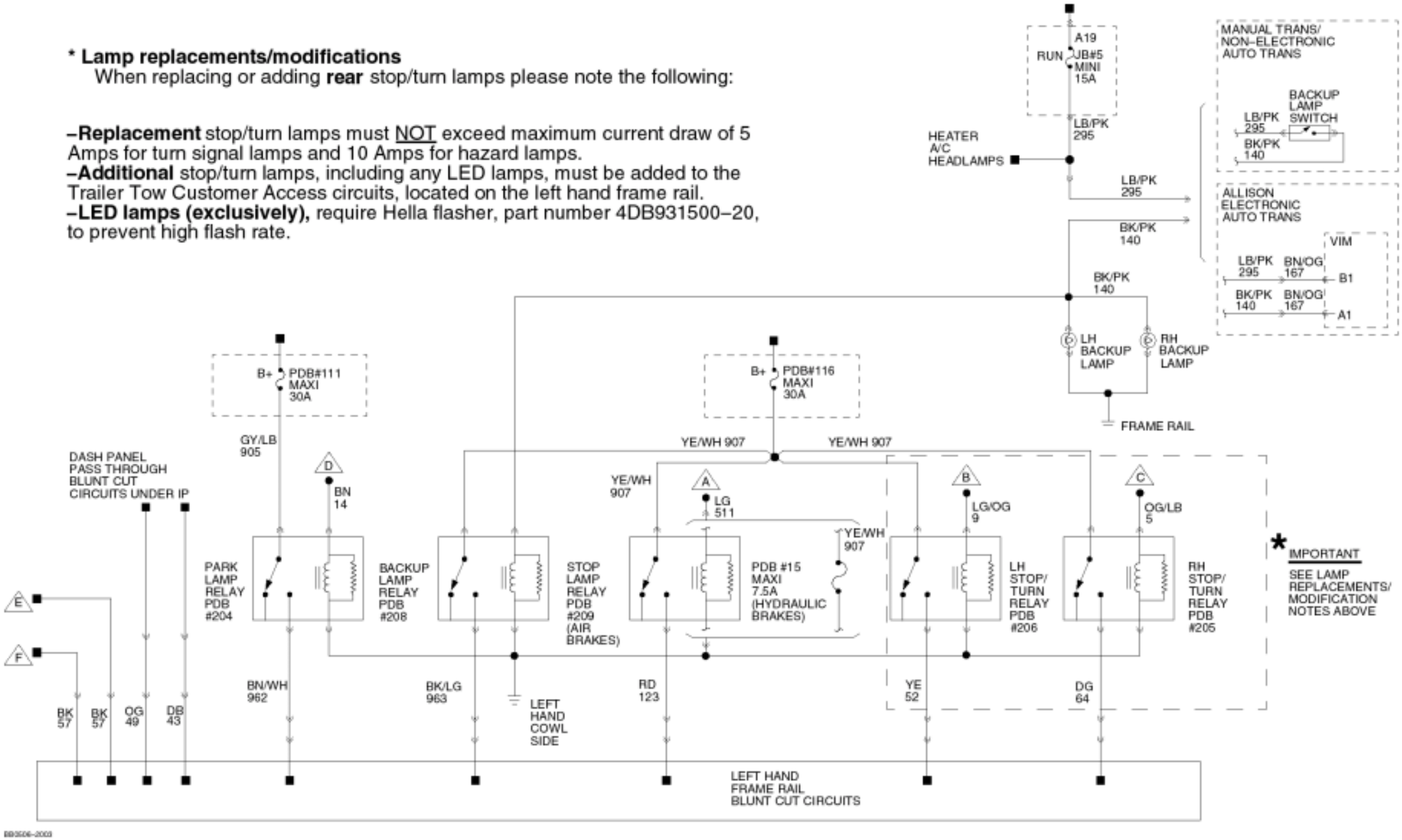


NOTE — SCHEMATIC CONTINUED ON NEXT PAGE.

SUPER DUTY F-650/750
ELECTRICAL WIRING
TRAILER TOW SCHEMATIC (Continued)

*** Lamp replacements/modifications**
When replacing or adding **rear** stop/turn lamps please note the following:

–**Replacement** stop/turn lamps must NOT exceed maximum current draw of 5 Amps for turn signal lamps and 10 Amps for hazard lamps.
–**Additional** stop/turn lamps, including any LED lamps, must be added to the Trailer Tow Customer Access circuits, located on the left hand frame rail.
–**LED lamps (exclusively),** require Hella flasher, part number 4DB931500–20, to prevent high flash rate.



Return to 2003 F-650/F-750 Super Duty INDEX

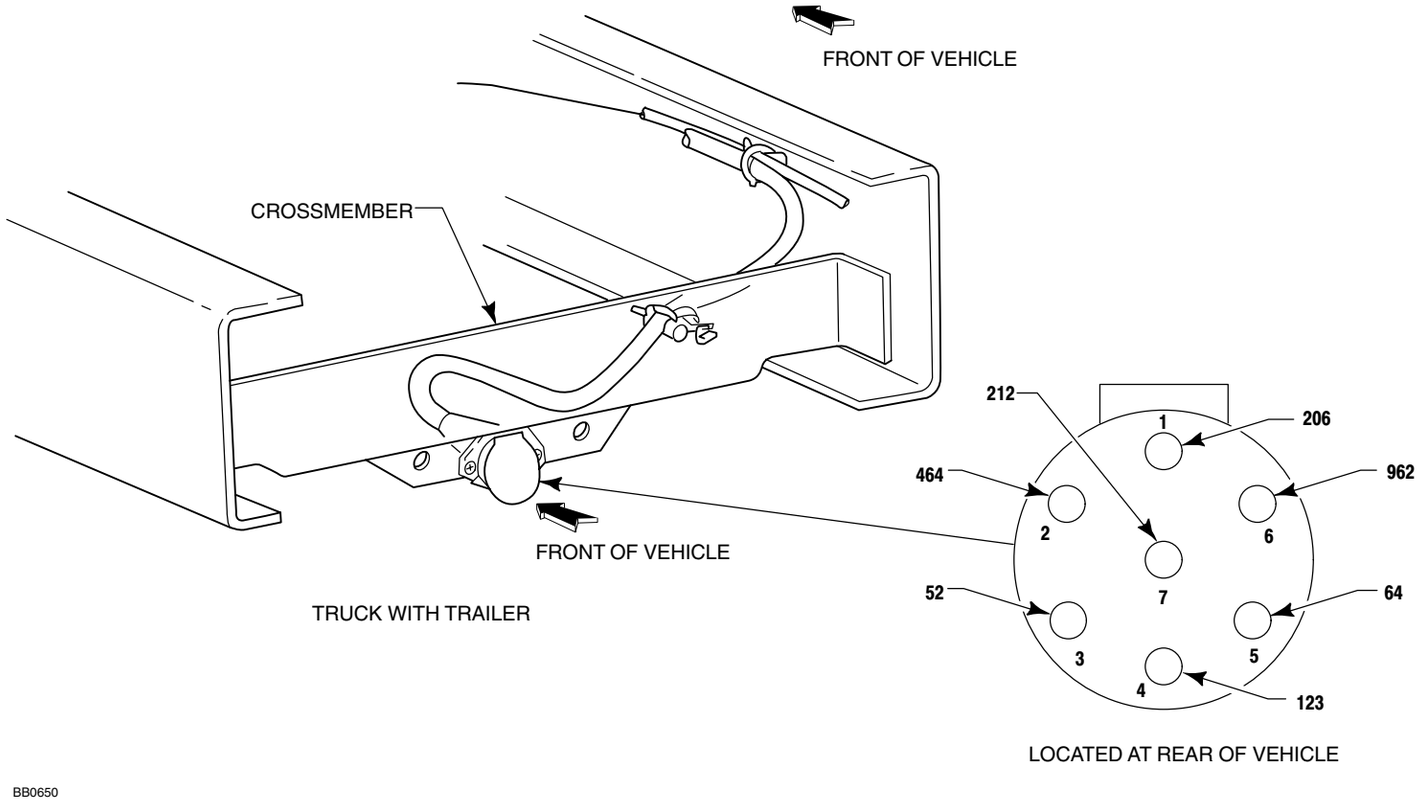
SUPER DUTY F-650/750 AIR BRAKE FOR TRAILER TOW CABLE

Circuit Description	Location	Fuse Size (Amps)	Max Fuse Load	Type	Harness	Circuit #	Circuit Color	Circuit Gauge	Recommended Insulation	Maximum Wire Length											
										10 Gauge (Meters)		12 Gauge (Meters)		14 Gauge (Meters)		16 Gauge (Meters)		18 Gauge (Meters)		20 Gauge (Meters)	
										XLPE	PVC	XLPE	PVC	XLPE	PVC	XLPE	PVC	XLPE	PVC	XLPE	PVC
Ground	—	—	—	—	13A576	206	WH	10	XLPE	—	—	—	—	—	—	NR	NR	NR	NR	NR	NR
Side Marker	Fuse #2	30(3)	10(1)	Maxifuse	13A576	464	BK-PK	12	XLPE	9.820	9.820	6.140	6.140	3.896	3.896	NR	NR	NR	NR	NR	NR
LH Stop/Turn	Fuse #4	30(3)	10(2)	Maxifuse	13A576	52	YE	14	XLPE	6.065	6.065	3.792	3.792	2.406	2.406	NR	NR	NR	NR	NR	NR
Stop/ABS	Fuse #3	30(3)	21	Maxifuse	13A576	123	RD	12	XLPE	7.890	7.890	4.933	4.933	3.130	3.130	NR	NR	NR	NR	NR	NR
RH Stop/Turn	Fuse #4	30(3)	10(2)	Maxifuse	13A576	64	DG	14	XLPE	6.065	6.065	3.792	3.792	2.406	2.406	NR	NR	NR	NR	NR	NR
Tail Lamps	Fuse #2	30(3)	10(1)	Maxifuse	13A576	962	BN-WH	12	XLPE	11.673	11.673	7.298	7.298	4.631	4.631	NR	NR	NR	NR	NR	NR
Accessory Feed (Run Only)	Fuse #1	30(3)	21	Maxifuse	13A576	212	DB	12	XLPE	11.228	11.228	7.020	7.020	4.455	4.455	NR	NR	NR	NR	NR	NR

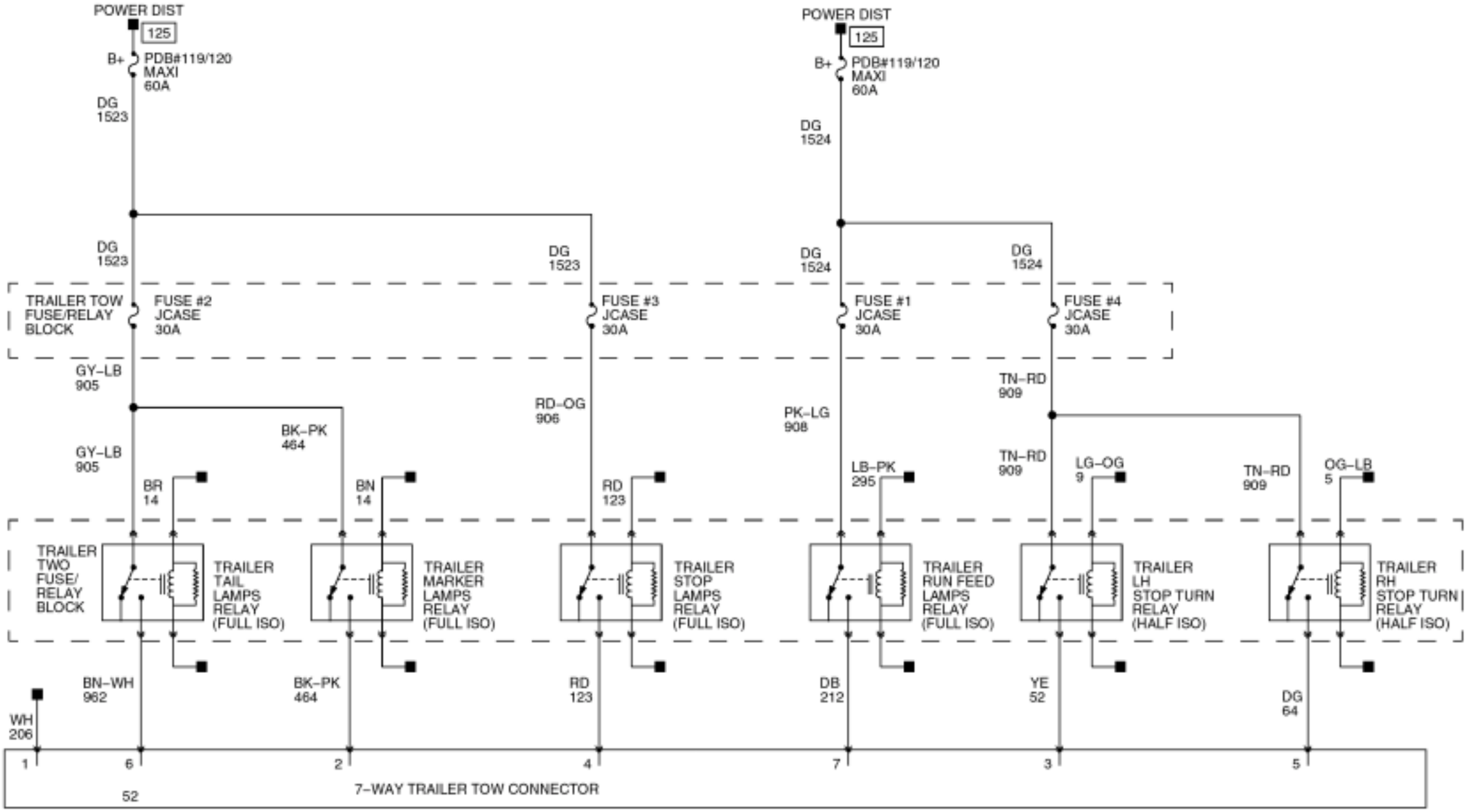
(1) Sum of loads for Side Marker, Tail Lamps not to exceed 21 amps.

(2) Sum of loads for LH Stop/Turn, RH Stop/Turn not to exceed 21 amps.

(3) Trailer Tow Fuse Relay Block located on LH Frame Rail; part of 13A576.



SUPER DUTY F-650/750 AIR BRAKE FOR TRAILER TOW CABLE



RB0509-2003

SUPER DUTY F-650/750
ELECTRICAL WIRING/GENERAL PRACTICES

This section provides instructions for the addition of electrical devices to the vehicle electrical system by body builders.

(Vehicles stored on site should have the negative battery cable disconnected to minimize "Dead battery" situation. This applies to both "incomplete" and "complete" vehicles in storage.)

After all electrical or vehicle modifications, perform the on-board diagnostics procedures as described in the powertrain control/emissions diagnosis manual to clear all diagnostic trouble codes (DTC's). Road test vehicle and rerun the on-board diagnostics to verify that no DTC's are present. If DTCs are generated perform the appropriate diagnostic procedures and repairs. Vehicle operation (engine/transmission) may be affected if DTC's are not serviced.

F/CMVSS, U.S. and Canadian RFI Requirements:

1. All Ford vehicles built and fully completed by Ford, comply with F/CMVSS No. 108, "Lamps, Reflective Devices and Associated Equipment" and other applicable F/CMVSS that affect electrical components.
2. Incomplete vehicles (i.e., Chassis Cab, Stripped Chassis, etc.) will conform to the F/CMVSS according to the provisions and conditions stated in the Incomplete Vehicle Manual (IVM) attached to each incomplete vehicle. Care must be taken that modifications do not conceal, alter or change components installed or provided by Ford Motor Company to achieve this conformance.
3. Devices that emit radio frequency (RF) energy, such as AM/FM radios and radio-controlled security systems, marketed for sale or use in the United States are subject to the rules and regulations of the Federal Communications Commission (FCC) 47 CFR Parts 2 and 15.

   These rules specify the following conditions of operation:

   This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

   In addition, the FCC's Rules may require the device to be tested and found to comply with various RF interference emission limits before it may be marketed. The FCC establishes different limits according to the particular use and installation of RF devices. In some cases, a grant of equipment authorization from the FCC also must be obtained before any RF device may be marketed. Labelling with certain FCC information may also be required.

   To insure continued compliance with the FCC's requirements, the owner, user, custom manufacturer, or service technician must not modify or change the RF device in a manner not expressly approved by Ford Motor Company. Such modifications could void the authority to operate the device.
4. All vehicles powered by spark ignition internal combustion engines (e.g., gasoline or liquid petroleum gas engines) and manufactured in Canada or for sale or use in Canada are subject to the Canadian "Regulations for the Control of Interference to Radio Reception," SOR/75-629, Canada Gazette Part II, Vol. 109, No. 21, November 12, 1975, as amended by SOR/77-860, Canada Gazette Part II, Vol. 111, No. 21, November 9, 1977, by SOR/78-727, Canada Gazette Part II, Vol. 112, No. 18, September 27, 1978, and by SOR/80-915, Canada Gazette Part II, Vol. 114, No. 23, December 10, 1980. Violation of these regulations is punishable by fine or imprisonment. Ford-built incomplete vehicles other than stripped chassis are designed and manufactured to be capable of meeting the regulatory requirements or such modifications thereof as may be authorized by the Canadian Department of Communications.

   However, because Ford has no control over how an incomplete vehicle is completed by subsequent stage manufacturers, Ford does not represent that the completed vehicle incorporating the Ford-built components will comply with applicable requirements.

Routing & Clipping:

1. It is strongly recommended that wiring in areas of heavy rework, or in areas where welding operations are to be performed, be removed prior to the rework operations and reinstalled after the rework is completed. If vehicle is equipped with an Electronic Engine Control System (EEC V), the EEC V Module must be disconnected before any electrical welding is performed, otherwise module damage may result. If wire removal is not practical, the wires must be shielded from damage due to the rework and welding heat. All components and wiring should be reinstalled as closely as possible to the way it was installed before removal.
2. Wire routings of newly installed components or wire routing revisions of the Ford harnesses necessitated by reworks must conform to the following:

- Wires routed through holes in sheet metal or castings must have the hole edges protected by a grommet.
- Wires should be routed to avoid metal edges, screws, trim fasteners and abrasive surfaces. When such routings are not possible, protective devices (shields, caps, etc.) must be used to protect the wires and when wires must cross a metal edge the edge should be covered with a protective shield and the wiring fastened within 3 inches on each side of the edge.
- Wires must be routed to provide at least 3 inches clearance to moving parts, unless positively fastened or protected by a conduit.
- Existing heat shields, insulation, and wire shielding/twisting must be maintained.
- Wire routings should avoid areas where temperatures exceed 180°F and a minimum clearance of 6 inches should be maintained from exhaust system components. Where compliance with this requirement is not possible, high temperature insulation and heat shields are required.
- When wiring is routed between two members where relative motion can occur, the wiring should be secured to each member, with enough wire slack to allow flexing without damage to the wire.
- Wiring to all circuit components (switches, relays, etc.) in exposed locations must provide a drip loop to prevent moisture from being conducted into the device via the wire connection.
- Routing wires into areas exposed to wheel wash should be avoided. When such routings cannot be avoided, adequate clipping or protective shields are required to protect the wires from stone and ice damage.
- The wire retainers and grommets installed by the assembly plant are usually designed to accommodate only the Ford-installed wires. Additional wiring or tubing should be retained by additional clips. When added wires or tubes are routed through sheet metal panels, new holes, with proper wire protection and sealing, must be used.
- All wiring connections to components of the factory-installed system must be accomplished by using the proper mating wire termination. (Connections on studs and ground connections must use eyelet terminations, connections to female bullets must terminate in male bullets, etc.)

Splice/Repair:

When necessary to splice wire for repair or circuit length revisions, the following guide should be followed:

- Wire ends should be stripped making sure that individual conductor strands are not damaged.
- When soldering, make sure an adequate mechanical joint exists **before** applying solder. Use only rosin core solder — **never** acid core.
- For crimp joints, use butt-type metal barrel fasteners and a proper tool (such as Motorcraft crimp tool S-9796) specifically designed for this type of work.
- Splice joints must be adequately sealed and insulated. Adhesive lined heat shrink tubing is highly recommended to cover soldered and bare, metal barrel, crimp joints. Quality electrical tape can be used inside the vehicle but is not recommended for an outside environment.
- Seal the ends of insulated barrel crimp devices with a silicone grease when in an outside environment.
- The most durable splice joint will be bare metal barrel crimped, flow-soldered and covered with adhesive lined heat shrink tubing. Use this type of joint as often as possible.

Circuit Protection:

1. Modification to existing vehicle wiring should be done only with extreme caution and consideration of effects on the completed vehicle electrical system. Anticipated circuitry should be studied to ensure that adequate circuit protection will exist and that feedback loops are not created.
2. Any added circuitry must be protected either by a base vehicle fuse or breaker, or by a similar device installed by the body builder.
3. When adding loads to a base vehicle protected circuit, make sure that the total electrical load thru the base vehicle fuse or breaker is less than 80% for fuses in the passenger compartment and 60% for fuses underhood or under body of the device rating to prevent nuisance fuse blows.

- Total **current** draw is the sum of the base vehicle circuit current requirement (measured with an ammeter) and the anticipated add-on components current requirements.
- **Never** increase the rating of a factory installed fuse or circuit breaker.
  - For added lamp loads, the "Bulb Chart" on the next page will aid in determination of common lamp current draws.

SUPER DUTY F-650/750 ELECTRICAL WIRING/BULB CHART

If the **total** electrical load on a factory circuit, after the addition of electrical equipment, is less than 88 % of the fuse or circuit breaker protection rating in that circuit or less than the capacity of some limiting component (Switch, Relay, etc.), the items to be added can be connected directly to that circuit.

If the total electrical load to be added on a factory circuit exceed the value of the circuit protection, or the value of some limiting component, the items to be added **cannot** be added directly to the circuit.

- Added electrical devices exceeding the current capabilities of the factory wiring system must be controlled through the use of a relay or switch. The coil of the relay can be fed from the factory wiring (now acting as a signal circuit) with the added wiring providing the power feed to the added electrical device through the relay power contacts. (The relay selection is important and depends on current requirements, number of cycles expected in the relay lifetime, whether the relay is to be operated intermittently or for long periods of time, and whether the relay is exposed to weather conditions or is installed in a protected area. When the current requirements of a circuit exceed the capacity of an available relay, more than one relay can be used if the circuit is wired to split the load).
- The factory wiring should not be used as a power feed to the relay power contacts or switches. Battery power is to be supplied from the starter motor solenoid positive terminal for added circuits requiring a maximum of 30 Amps or directly from the battery positive terminal for added circuits requiring greater than 30 Amps of current.

Caution — Never use the stud on the underhood fuse panel as a junction point.

Circuit protection (fuses or circuit breakers) must be provided for all added wiring. The protection device rating should not exceed the current requirements for the add-on components and should be installed as close to the point as possible.

WIRE GAGE:

1. When adding wiring, the wire gage size should be determined as follows:
   - Where wire is spliced to extend a circuit, the added wire should have a gauge at least that of the circuit being lengthened.
   - Where wire is being added to feed add-on devices, the **Wire Gage Table** on this page should be used. (note: Current capacity of a given wire varies with temperature and type of insulation. The table, however, represents generally accepted values as a guide).
2. All added underhood or underbody wiring should have a thermoset insulation (such as Hypalon or Cross-linked polyethylene).

   SAE specifications J1128 type SXL, GXL or TXL.

   SAE specifications J1127 type SGX or STX for battery cables.

WIRE GAGE TABLE

WIRE GAGE	MAXIMUM CURRENT CAPACITY (PLASTIC INSULATED COPPER WIRE)
20	10 Amps
18	15 Amps
16	20 Amps
14	25 Amps
12	30 Amps
10	40 Amps

BULB CHART

BULB TRADE NUMBER	CANDLE POWER	CURRENT @ RATED VOLTAGE	BULB TRADE NUMBER	CANDLE POWER	CURRENT @ RATED VOLTAGE
90	6	0.58 Amps @ 13.0V	1196	50	3.00 Amps @ 12.5V
94	15	1.04 Amps @ 12 .8V	1445	0.7	0.14 Amps @ 14.4V
97	4	0.69 Amps @ 13.5V	1815	1.4	0.20 Amps @ 14.4V
97A	3	0.69 Amps @ 13.5V	1816	3	0.33 Amps @ 13.0V
105	12	1.00 Amps @	1891	2	0.24 Amps @ 14.0V
161	1	0.19 Amps @14.0	1892	0.75	0.12 Amps @ 14.0V
168	3	0.35 Amps @ 14.0V	1893	2	0.33 Amps @ 14.0V
194	2	0.72 amps @ 14.0V	1895	2	0.27 Amps @ 14.0V
211-2	12	0.97 amps @ 12.8	4000	37.5, 60 Watts	3.14. 5.04 Amps @ 12.8V
212-2	6	0.74 Amps @ 13.5V	4001	26,000	3.14 Amps @ 12.8V
214-2	4	0.50 Amps @ 13.5V	4405	50,000	2.58 Amps @ 12.8V
561	12	0.97 Amps @ 12.8V	4412	35 Watts	2.74 Amps @ 12.8V
582	6	0.74 Amps @ 13.5V	4414	18 Watts	1.41 Amps @ 12.8V
631	6	0.63 Amps @ 12.8V	H6054	35, 65 Watts	2.94, 5.46 Amps @ 14.0V
1076	32	1.80 Amps @ 12.8V	4415	35 Watts	2.73 Amps @ 12.8V
1156	32	2.10 Amps @ 12.8V	4416	30 Watts	2.34 Amps @ 12.8V
1157	32	2.10 Amps @ 12.8V	4435	75,000	2.34 Amps @ 12.8V
1157	3	0.59 Amps @ 14.0V	6015	27,500 Low 30,000 Hi	4.10, 4.97 Amps @ 12.8V
1157 NA	24	2.10 Amps @ 12.8V	6014	27,500 Low 30,000 Hi	4.20, 4.97 Amps @ 12.8V
1157 NA	2.2	0.59 Amps @ 14.0V	6112	40, 50 Watts	3.10. 3.91 Amps @ 12.8V
1178	4	0.69 Amps @ 13.5V	1295	50	3.0 @ 12.5
1195	50	3.00 Amps @ 12.5V	563	4	0.50
904	4	0.69 Amps @ 13.5	37	0.5	0.09 @ 14.0
906	6	0.69 Amps @ 13.0	2162	0.5	0.1 @ 14.0
912	12	1.0 Amps @ 12.8			
89	6	0.58 Amps @ 13.0			
1095	4	0.51 Amps @ 14.0			

ELECTRICAL:

Guidelines for Powertrain Control System Application

SYSTEM:

All EEC wiring, in particular the 12A581 and 14401, must be a minimum of 2 inches from secondary ignition coil wires and at least 4 inches from the ignition coil tower, and starter motor (and its wiring) as well as 4 inches from the alternator output wiring.

These clearances apply in particular to all EEC sensor and actuator pigtail wiring.

EEC wires shall not be in the same bundle as other high-current non-EEC circuits (e.g., tachometer wire from coil to TFI, power seat/door lock/window, horn, alternator reg.) for a distance of more than 20 inches.

COMPONENTS:

BOO Brake on/off Switch: Supplies the processor a signal for converter clutch operation. A connection here may have an adverse effect on transmission operation. Refer to the Trailer Tow Section on page 42.

CAUTION: Any connection to the EEC-V system (i.e., wiring, components) or alterations to the system may adversely affect vehicle operation (transmission and/or engine).

BARO/ MAP Barometer/Map Sensor: Must be physically in a higher location than the intake manifold and angled with the vacuum nipple at least 4 degrees downwards. MAP vacuum line must have a downward slope to the manifold without any potential kinking or twisting. BARO has no vacuum line.

EEC Electronic Engine Control Module**:** Location must be completely shielded from weather and case grounded to sheet metal. It should be oriented such that no moisture can accumulate in the 104-way connector. The ambient temperature at the EEC module shall not exceed 80 degrees centigrade (176° Fahrenheit). Exterior surface shall not exceed 140°F.

CONSTANT = AXLE RA6. **NOTE:** The electronic engine and transmission control modules require battery power to be supplied at all times to maintain the keep-alive memory. Keep this in mind when installing load disconnect switches or solenoids.

TP Throttle Position Sensor: Supplies a throttle position signal to the EEC-V processor. Do not tap into or splice any wire to the TP sensor.

HO_2 Heated Oxygen Sensor**:** Pigtail wire must be at least 4 inches from the exhaust pipe and exhaust manifold. If necessary, a clip should be used to secure its location.

VSS Vehicle Speed Sensor: Similar to the engine speed signal, must not be altered. Do not tap into or splice any wire to the VSS. If an additional vehicle speed signal is required.

SPEEDOMETER

The vehicle speedometer receives the calibrated speed signal (square wave) from the GEM through Circuit 679 (GY/BK). The speed input to the GEM is provided by the (Speed Sensor) in the transmission through Circuit 353 (LB) and Circuit 676 (PK/OG).

The square tooth tone wheel in the transmission is attached to the ring gear. A variable reluctance sensor is mounted to the rear transmission housing with a precise air gap with respect to the tone wheel. These two components make up the VSS (Speed Sensor). The trans case has a fixed mounting boss for the variable reluctance sensor and therefore the air gap is non-adjustable.

TONE RING SIZE

All factory tone wheels have 16 teeth for every rear axle ratio offered. If the rear axle is changed, the GEM must be reconfigured to reflect the correct vehicle speed. Figure A shows the rear axle ratio and tone ring size. The tone ring size parameter is a required input when reconfiguring the GEM. Once the tone ring size is known, proceed to GEM configuration.

Rear Axle Ratio	Tone Ring Size
3.42	00055
3.58	00057
3.73	00060
3.91	00063
4.10	00065
4.11	00066
4.30	00068
4.33	00069
4.56	00073
4.88	00078
4.89	00078
5.13	00082
5.38	00086
5.57	00089
5.63	00090
5.86	00094
6.14	00098
6.43	00103
6.83	00109
7.17	00115

FIGURE A

If the rear axle ratio on the vehicle is not listed in Figure A, then use the procedure below to determine tone ring size.

IF THE AXLE RATIO MULTIPLIED BY 16 (CONSTANT) IS A TWO DIGIT NUMBER, THEN THE TONE RING SIZE IS PREFACED BY 000 PLUS CONSTANT.

EXAMPLE: If axle ratio = 4
Then constant = 64 = 4 x 16
Tone Ring Size = 00064

IF THE AXLE RATIO MULTIPLIED BY 16 (CONSTANT) IS A THREE DIGIT NUMBER, THEN THE TONE RING SIZE IS PREFACED BY 00 PLUS CONSTANT.

EXAMPLE: If axle ratio = 7
Then constant = 112 = 7 x 16
Tone Ring Size = 00112

TIRE SIZE

If the tires are changed, it is necessary to configure the GEM to reflect the correct vehicle speed.

Figure B shows the tire size and revolutions per mile.

TIRE SIZE	MAKE/ APPLICATION	REVOLUTIONS/ MILE
10RX22.5F G124	GOODYEAR UNISTEEL	514
10RX22.5G G124	GOODYEAR UNISTEEL	514
11RX22.5G G124	GOODYEAR UNISTEEL	498
245/70RX 19.5	GOODYEAR UNISTEEL	625

FIGURE B

If the tire make and size are not listed in Figure B, the tire revolutions per mile must be calculated as outlined below. The tire manufacturer may be able to provide the revolutions per mile value. Once the tire revolutions per mile value is known, proceed to the GEM Configuration.

Position the vehicle on level ground, load with the standard weight for the specific application, and inflate the tires to the recommended pressure (ensure that the tires are cold).

Measure the rear tire height from the ground to the top of the tire in inches. Ensure an accurate reading to the nearest 1/8 inch.

Divide 20,168 by the tire height in inches to get the tire revolutions per mile.

EXAMPLE: Measured tire height = 33 inches
20168/33 = 611 Revolutions/Mile

REQUIRED TOOLS - GEM CONFIGURATION

Rotunda New Generation Star (NGS) Tester.

Ford Service Function (FSF) Program Card Version 3.2 or newer.

The Rotunda New Generation Star (NGS) Tester and the Ford Service Function (FSF) Program Card can be obtained from Hickok Electrical Instrument Company by contacting (216) 541-8060 Extension 225. If your company has an account with Rotunda, contact Rotunda - OTC Division at 1-800-533-5338.

GEM CONFIGURATION

1. Ensure that all harness connectors are connected to the module that requires configuration.
2. Plug the NGS tester into the data link connector located below and to the right of the steering column.
3. Actuate the ignition switch to the RUN position (engine off).
4. Insert the Ford Service Function (FSF) Program Card into the Rotunda New Generation Star (NGS) Tester.
5. Highlight **LANGUAGE** and press trigger to select.
6. Highlight **SERVICE BAY FUNCTIONS** and press trigger to select.
7. Highlight module **GEM** and press trigger to select.
8. Highlight **TIRE SIZE/AXLE RATIO CONFIG** and press trigger to select.
9. Select **TIRE SIZE** by pressing the trigger button. Use the dial to select the custom revolutions/mile entry and press the trigger button. Enter two zero's using the number buttons and enter the 3-digit revolutions/mile value for the desired tire using the number buttons. See Tire Size Section for input parameter.
10. Using the dial, select **TONE RING SIZE** and press the trigger button. Use the dial to select the rear axle ratio and press the trigger button If the rear axle ratio is not present, use the dial to select **#of teeth** and press the trigger button. Enter the TONE RING SIZE of the desired axle ratio using the number buttons. See Tone Ring Size Section for input papameter.
11. Using the dial, select **OPTION** and press the trigger button. Use the dial to select N/A and press the trigger button.
12. Using the dial, select **VEHICLE** and press the trigger button. Use the dial to select F650/750 and press the trigger button. If option is not present, select F250/350.
13. Press done (numeric 8 button) and the module will be programmed with the above data entered. To reprogram, repeat the above procedure.