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Electrical Basics

Inside a vehicle, electricity is supplied through powered, or hot, wires. This is comparable to the pressurized supply pipes of a plumbing system. At various points along the wires are outlets in the form of lights, switches and receptacles. Turning on a light switch allows the electric current to flow through the hot wire to illuminate the light. Once the electricity has done its work, its potential drops to zero, just as water loses pressure after flowing through a sink or laundry tub. The electrical system uses ground wires to return the current to its source. Just as a plumbing system has drainpipes through which water runs into the sewer mains or the ground.

The light or equipment powered by the current, technically called the load, can be compared to a water wheel that remains motionless until a stream of water causes it to turn. A load may be one of 2 kinds. The first consists of a resistance — a material that permits the passage of electric current, but only with difficulty, and thereby creates heat. The tungsten filament of an incandescent bulb is resistance; so is the heating element of an electric heater of a coffee pot. A load may also be an inductance — typically a motor with windings of copper wire, in which the magnetic fields generated by the current create motion. At any moment, the demand on an electrical system depends on the number of loads in operation and their consumption of energy, just as demand on a water system depends on how many faucets are opened and how wide they are opened.

The mechanics and physical fittings of the system are simple. Current moves throughout the vehicle in wires of different sizes, according to the current a circuit may have to carry. Power is supplied directly to equipment through connectors.

Electrical Terms

VOLT is the unit of electrical potential, equal to the difference of electrical potential between 2 points on a circuit.

AMPERE is the unit used to measure the amount of current - that is, the number of electrically charged particles called electrons - that flows past a given point on a circuit each second. It is similar to measuring the amount of water flowing through a pipe at any given point. The larger the pipe is, the more water that can flow past the point per second. Similarly, the bigger the wire is, the more current that can flow through it at any given point. Current that has lost its voltage still has amperage as it completes the circuit and returns to the battery.

WATT is the unit of power. It indicates the rate at which a device converts electric current to another form of energy, either heat or motion, or to put it another way, the rate at which a device consumes energy.

The relationship of volts, amperes and watts to one another is expressed in a simple equation that enables you to make any calculations you may need for correct and safe electrical modifications to the vehicle. Volts x amperes = watts. If the current is at 12 volts and a device requires 4 amperes of current, the equation will read 12 volts x 4 amperes = 48 watts.

To figure the current needed for a device rated in watts, turn the equation around: watts/volts = amperes. For example, if you have a piece of equipment, such as a communications radio, that uses 120 watts: 120 watts/12 volts = 10 amperes.

Electrical Systems Management

Care must be given in deciding what equipment should be installed into a police vehicle given the power demands of the equipment and the power available from the vehicle. A power load strategy should be developed to minimize the risk of running out of power. Examine the proposed equipment for vehicle installation. Add up the current requirements. If the current requirements exceed what the vehicle can reasonably be expected to be able to provide, the battery will begin discharging to provide the power to the equipment that the generator is unable to provide. After some period of time, the vehicle will shut off as the battery voltage decreases to a level that cannot sustain vehicle operation.

There are alternatives that can be considered to minimize system electrical overload. Consider the current requirements of equipment before it is purchased and installed. Modern light bars and radios use a fraction of the current than units made as recently as 1996. As the light bar is typically the most power intensive unit installed on most police vehicles, considerable attention should be given to its current requirements. Changes in officer habits while in the field can make a difference as well. When a vehicle is sitting at an accident scene and no one is in the car, the A/C can be turned off until the officer is ready to get back into the vehicle. The A/C is among the largest current users of non-police equipment. As such, it can impact available power for other uses as well.

Generator Output

The 240 amp generator used by the F-150 is controlled by the Powertrain Control Module (PCM).

Charging Margins

Generator output varies with engine speed and ambient temperature. The worst case for police vehicles is when the vehicle is idling for long periods of time on a very hot day. Lower engine speeds while idling, coupled with high underhood temperatures that may approach 93°C (200°F), combine to minimize power output from the generator. At the same time, electrical demand on the vehicle is often at its highest because the A/C loads are added to the usual electrical loads experienced in emergency situations.

Vehicle Component Electrical Loads

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Vehicle component electrical loads are shown in the table below. Not all features are powered all the time, so actual vehicle loads on the power supply system will vary.

Component	Amps
Base	
Miscellaneous base loads	19.6
Cooling	
Cooling fan (increase high) 800W X 75%	43.4
Climate Control	
A/C clutch	3.3
A/C Fan-to-Face — High Speed	21.3
A/C Fan-to-Face — M/H Speed	17.2
Heater Fan-to-Foot — M/H Speed	12.2
Heater Fan — Defrost — High Speed	16.9
Rear climate control	56.8
Lighting	
Exterior and Instrument Panel Lamps (non-dimmable)	3.2
Headlamps — Low Beam	8.9
Headlamps — High Beam (incremental)	9.9
Incandescent brake lights with CHMSL	10.7
Heated Features	
Heated rear windows	21.4
Other	
Radio	6.0
Front wiper low speed	4.0
Electric trailer brake	8.0
Typical Vehicle Load = 140- 170 Amps	

Typical Police Equipment

Loads for equipment commonly found on police vehicles are shown in the table below. Not all equipment will be operating at the same time, so actual loads on the power supply system will vary.

Component	Amps
Communications radio	4.0 (8.0 with microphone active)
Mobile data transmitter	3.0
Light bar	28-43
Light bar with all internal accessory lights activated	36-63
Spotlights (each)	7.8
Alley lights (each)	1.0
Radar	0.8
Camcorder	0.5

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Powertrain Control Module (PCM) — Red Area

NOTICE:
DO NOT make electrical connections to vehicle electrical systems not specifically designed for police equipment installations. Damage to the electrical system can occur.

Do not install any components into the PCM or PCM harness. Connecting into this system may affect engine and transmission operation. Connecting any aftermarket electrical equipment into the brake light circuit or any other circuit connected to the PCM, anti-lock brake computer, air bag system or any other vehicle system will cause a vehicle malfunction.

Disabling Brake Lights

Do not disable the brake light circuits for any reason. For additional information, refer to Section 1: General Information in this guide.

Auxiliary Power Point (12V DC)

NOTICE:
Do not plug optional accessories into the cigar lighter socket (if equipped). Incorrect use of the lighter/socket can cause damage not covered by the warranty.

NOTICE:
Power outlets are designed for accessory plugs only. Do not insert any other object in the power outlet as this will damage the outlet and blow the fuse. Do not hang any type of accessory or accessory bracket from the plug. Incorrect use of the power outlet can cause damage not covered by the warranty.

The auxiliary power point is located on the instrument panel. Do not use the power point for operating the cigar lighter element (if equipped). To prevent blowing the fuse, do not use the power point(s) over the vehicle capacity of 12V DC/180W. If the power point or cigar lighter socket is not working, a fuse may have blown. To prevent the battery from being discharged, do not use the power point longer than necessary when the engine is not running. Always keep the power point caps closed when not being used.

Sealing Pass-Thru Points/Openings

Underbody

- Any holes in the body must be sealed with Motorcraft® Seam Sealer (TA-2-B).
- Any damaged parts must be replaced. Following are some examples:
- spare tire tub
- auxiliary A/C pass-through
- air extractors (replace if damaged)
- wiring grommets
- body plugs
- floor pan

Examples of wiring pass-throughs that were sealed incorrectly and correctly Proper care and due diligence must be used on all openings at any location on the vehicle from the dash panel to the rear of the vehicle.

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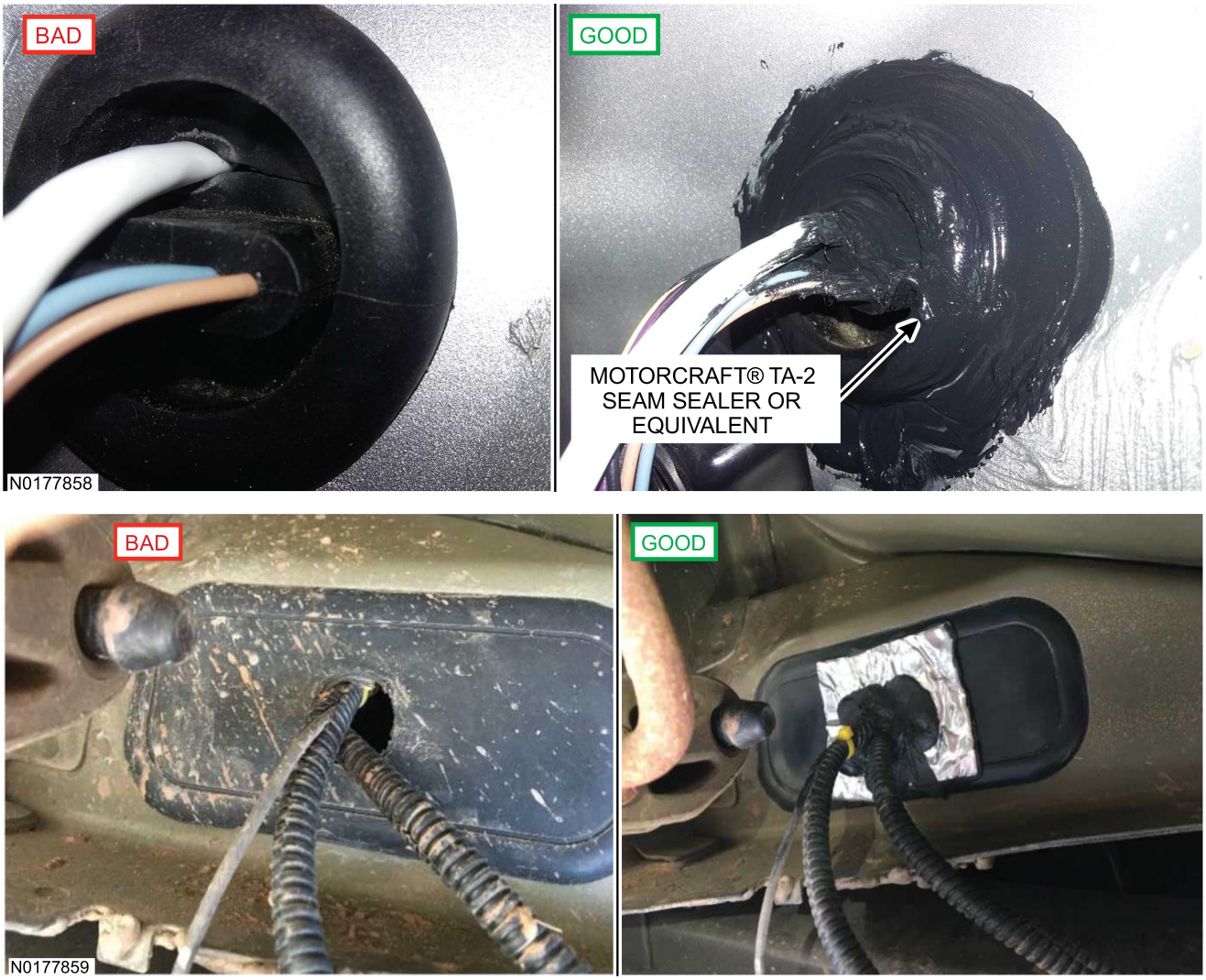

Dash Panel

Any seals and/or holes in the dash panel must be replaced and/or properly sealed using Motorcraft® Seam Sealer (TA-2-b).

Sealing Option For Body Openings/Pass-Through Points

- Pass-through or other openings of similar size should be sealed using the recommended foil-backed mastic patch.
- Foil-backed mastic patch should be used to cover and seal body openings.
- Part number for foil-backed mastic patch:
- Following are service part numbers for two different size foil-backed mastic patches:
- 4L3Z18203A16AA; size of patch - 1.5 x 147 x 330mm
- DA5Z65203A16A; size of patch - 1.5 x 100 x 300mm

Decommissioning

Vehicle Sealing of Aftermarket Equipment

At the end of its useful life as a police vehicle, many vehicles are decommissioned having lights, wiring and other equipment removed and vehicles are sold for other uses such as retail applications. The openings remaining in the body/components are potential leak paths for exhaust gas into the cabin under certain conditions. These openings must be sealed prior to the vehicle going to auction or any other application.

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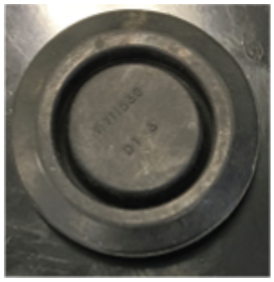
When customized equipment has been removed from your vehicle, body panels and seals may be compromised. Thoroughly inspect your vehicle for any signs where the equipment has been removed, for example: holes and damage to body seals.

Any openings should be sealed with a plug and a sealant. The opening can be modified to enable a plug to seat properly promoting a better sealing surface. The sheet metal surface with the opening should be treated to prevent corrosion prior to inserting the plug and sealant.

Any items that remain on your vehicle must be inspected and any sign of damage repaired immediately. Failure to follow this instruction may result in water and exhaust fumes entering the passenger compartment.

See your authorized ford dealer for more information and direction regarding proper sealing procedures.



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Common Ford Plug Part Number	Hole Diameter
W716284–S	0.859 inches / 21.83 mm
W714104–S	1.07 inches / 27.25 mm
W711539–S	1.378 / 35.0 mm
W651021–S	1.683 inches / 42.75 mm

Tools For Creating A Circular Opening

Two suggestions for tools that can be used for creating and/or modifying an existing opening for a plug are a Knockout Punch or Step Bit.

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General Guidelines

- Provide circuit protection (fuses) for all wiring. The fuse rating should not exceed either the rated wiring current capacity or the total current requirements for all the add-on components on the circuit. Install fuses as close to the point of tapped power as possible.
- Document all revisions to the electrical system and place with the vehicle Owner's Literature. Color code and/or label all revisions or additions to wiring.
- Provide protective covering in all areas that could be damaged during normal equipment installations.
- Disconnect the negative battery cable of vehicles stored on-site to reduce the possibility of draining the battery by lights or other equipment.
- Do not allow control panels attached to the instrument panel to protrude into the driver and passenger air bag deployment zones. For additional information, refer to Section 5: Reference Information in this guide.
- Do not install switches and gauges in the driver or passenger knee impact areas.
- Inspect all Ford gauges, lights and switches for correct operation after instrument panel work is performed.
- Correctly secure all wiring relocated or removed while working behind the instrument panel to prevent chafing, squeaks and rattles.
- Provide adequate retention for wiring harnesses so that they are clear of bolts, corners or edges which could abrade the wires during normal vehicle operation.

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- Anticipate misrouted wiring situations and protect all wiring from penetration by screws and raw edges. See Wire Routing for further information.
- Weather seal all exposed electrical connections exposed to the elements.
- Do not use quick splice connectors or wire nuts.
- Install the fuse panel so fuses are readily accessible.
- Make sure that connections are easily accessible for assembly and service.
- Make sure submersible connectors do not lose their seals under extreme assembly conditions such as bending wires 90 degrees immediately after the connector.
- Whenever using connectors, use a socket (female) connector on the electrical source side and a plug (male) connector on the electrical load side to reduce the possibility of a short circuit when disconnected.
- Supplemental restraint systems must remain intact as received from Ford Motor Company. Before modifications are done to the vehicle, the system must be disarmed by following the instructions provided in the current F-150 Workshop Manual.
- Adherence to the above guidelines is not to be understood as approval by Ford Motor Company of any specific revisions or additions to the vehicle's original electrical system.

Keep Alive Memory (KAM) Power

The electronic engine and transmission control modules require battery power to be supplied at all times to maintain the KAM. Keep this in mind when installing load disconnect switches or solenoids.

Equipment Grounding Guidelines

- Factory ground locations are not to be removed for any reason.
- Do not ground the body to the transmission or transmission crossmember. Ground accessories to the chassis or the vehicle battery.
- Splicing into circuitry relating to the electronic engine and/or transmission control systems is not acceptable because of the adverse effect on the electronic system operation.
- Protect exposed electrical connections.

Wire Insulation

- Polyvinyl Chloride (PVC), rated at 90°C (194°F), is the standard wire insulation that is acceptable for inside body use, but is not acceptable for underhood/underbody wiring.
- Hypalon insulation should be used on links only (Ford Specification ESB-M1L54-A).
- Cross-linked Polyethylene (XPLPE or SXL), rated at 135°C (275°F), is the required insulation for underhood/underbody applications (Ford Specification ESB-M1L123-A).
- GXL can be used as an alternate wire (Ford Specification ESB-M7L85B) as long as the concentricity specifications are met. To provide a water-resistant seal in conjunction with crimp connectors, a Duraseal crimp connector is recommended since it is designed to account for outside wire diameter that is smaller than the present SXL wire.

Terminals and Connectors

Connector Types

- Submersible (sealed) — A connector capable of being immersed in water.
- Weather-resistant — A connector that will retain its sealing and connection qualities while being exposed to adverse weather conditions.
- Duraseal crimp — A supplier trade name for a sealed wiring repair or splice.

When a connection is not defined (typical situation — harness-to-harness connectors), the following suggestions should be implemented:

- Determine the connector type. If it will be located in a hostile environment, use a submersible (sealed) connector; if not, use an open connector. A hostile environment is defined as being exposed to water and/or salt accumulation and/or high temperatures (for example, underhood, exterior panels and footwells). Use in-line connectors with secondary locks to prevent the terminal from being pushed out.

— Do not use single wires smaller than 14-gauge in a 2-way or larger weather-resistant connector (the very large style), since the wire may break during disengagement.

— Use Hypalon, XLPE or Elexar insulation in submersible connectors to maintain sealing integrity. PVC is not acceptable because it cold flows and allows setting in a deformed pattern, therefore compromising the integrity of the seal.

- Determine the terminal type. Base your decision on wire gauge, current carrying capacity, connector type and insulation type.

— Use non-detent low insertion force terminals whenever possible.

— Do not use low insertion force female terminals in weather-resistant connectors.

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— Analyze circuit requirements (signal levels, current, voltage) to determine the correct plating material (such as gold). Use of non-plated terminals is not recommended.
— Do not use plugs to seal holes in micropin connector grommets. It is very easy to forget to insert them during manufacturing and ruin the seal. Use a grommet with only the necessary number of holes or use dummy wires at least 600 mm (24 in) long.
— Fully align connectors prior to terminal connection — terminal cavities should have minimum tolerance to prevent terminals from floating, bending or pin push-out during mating/engagement.
— Make sure connectors of similar type and color can be identified by operator to eliminate crossed connections and minimize assembly time. Avoid using similar types and colors of connectors close together.
— Be sure that connectors have positive locking devices that allow easy installation with a low insertion force and easy removal. The connector snap should be easily felt and heard.
— Eliminate the use of edgeboard, tang-type and molded-over connectors. The use of blade-type weather-resistant connectors is restricted to high-current applications which cannot be handled by submersible connectors.

Circuit Protection and Electrical Load

- Modification to existing vehicle wiring should be done only with caution and careful consideration of effects on the completed vehicle electrical system. Anticipated circuitry should be studied to determine the required circuit protection and to avoid feedback loops.
- Added circuitry must be protected either by a base vehicle fuse or circuit breaker, or by a similar device supplied by the modifier.
- When adding loads to a base vehicle-protected circuit, make sure that the total electrical load through the base vehicle fuse or circuit breaker is less than the device's load rating.
- Use 80% of the fuse rating to determine maximum steady state load to reduce nuisance fuse failures.
- Use 135% of the fuse rating when sizing wiring to protect the circuit in the event of an overload. Fuses will last for 1 hour at 135% of their rating.

— Total current draw is the sum of the base vehicle's circuit current requirement (measured with an ammeter) and the anticipated add-on component current requirements.
— Never increase the rating of a factory installed fuse or circuit breaker.
— If the total electrical load including additional electrical components on any circuit, is less than the fuse protection rating or the capacity of some limiting component (switch, relay), the items to be added can be connected directly to that circuit. The headlamp switch circuits should never have additional lighting or electrical components directly connected.
— Added devices that exceed the current capabilities of the factory-installed system are best controlled through the use of a relay or separate switch. The coil of the relay can be fed from the circuit in the factory harness (now acting as a signal circuit) with added wiring providing feeds to the added electrical device. 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, the load should be reduced or divided through the use of additional relays.

Wire Protection Requirements

General Notes

- Anticipate problems and design accordingly. Try to anticipate what could go wrong and modify your designs to address any adverse impact.
- Review all connector applications and electrical systems to determine the need for solder, grease, weather-resistant or sealed connectors. Make sure components and wire insulation are compatible with greased connectors (important for long-term durability).
- Make sure that drip loops or other means are provided to prevent water leakage into the vehicle through wiring assemblies that pass through the dash panel.
- Use greased or sealed connectors in floor pan troughs which are subject to moisture coming through the carpeting.
- Use XLPE insulation for uncovered runs that exceed 305 mm (12 in).

Electrical Protection

- Correctly route wires away from noise-generating wires or components. However, if routing near noisy wires or plugging into noisy components is unavoidable, additional protection must be designed into the harness.
- Shielding — Electro Magnetic Interference (EMI) — Consider shielding if you must route close to high-current or noisy circuits. Use shielded wire and ground one side. Seal all splices in wire assemblies that use bare coaxial shielding (braid or tape) for EMI suppression, and insulate or tape over all shielding ends that terminate near any open connectors. This prevents splice and terminal shorts to the shielding. Minimize the length of conductors which extend beyond the shield. Failure to do this reduces the effectiveness of the shield.
- Spike suppression, in general, is accomplished by connecting a diode or resistor-diode combination across the terminals of the noisy component. The diode should be sufficiently close to the component (both electrically and physically) so that inductive spikes are clamped off. Make sure the diode is connected with the correct polarity.

Correct routing and retention will reduce the likelihood of chafing or pinching. When this ideal routing is unattainable, the following additional protection is needed:

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Mechanical/Environmental Protection

- Tape — Tape is the most basic means of protection. It contains the wires in a loose bundle and provides limited environmental protection. It does not protect against chafing and pinching.

— Kendall Polyken Fiberglass Base Tape (Ford Specification ESB-M3G38-A) is used for engine compartment applications. This durable tape provides against cut-through and abrasion commonly found in underhood applications.

— Polyken 267 is a substitute tape that may be used in lower temperature areas of the engine compartment (apron area).

- Convolute - Use convolute for all underhood/underbody applications or when increased temperature, abrasion or pinch resistance is required. Convoluted tubing comes in different diameters and materials to accommodate different temperature ranges and harness sizes.

— Use polyethylene convolute when abrasion is the only consideration; this convolute is adequate up to 96°C (205°F) maximum. Use nylon convolute when underhood/underbody or abrasion and temperature are considerations; nylon convolute is adequate up to 177°C (350°F) maximum.

— On all engine-mounted wiring or bend points, use vinyl tape on the outside of the convolute to prevent wiring from looping out. This tape must be able to withstand temperatures 135°C (275°F) or higher.

— Tape convolute junctions with abrasion-resistant tape (Polyken 267, fiberglass).

- Scroll — Similar to convolute, but without the ridges. Scroll is used where harness rigidity is required, especially for maintaining critical locator dimensions. Use scroll for short lengths only, as it is quite inflexible.

NOTE:
This is not meant to be an all-inclusive list of methods for physically protecting the wires. There are other means of protection available that are not listed.

Grommets and Sealing Requirements

Any additional wiring routed through sheet metal must pass through a grommet that both seals the opening and locates the wire(s). Two-piece grommets (rubber with plastic inserts) are recommended to facilitate installation and retention.

- Locate grommets so they are accessible for correct seating (achieved by pulling) in sheet metal holes.
- Ramp grommets at the insertion end to facilitate installation and sealing.
- Be sure the direction of the hole punch is in the direction of grommet seating and the hole is burr-free.
- Make sure the grommet molding compound will adhere to the harness to prevent slippage.
- Make sure the grommet will withstand the environment (temperature, splash).
- Be sure that holes are large enough to allow the harness to be installed without causing circuit damage.
- Use adhesive tape on main trunks or branches with at least a 50% overlap to prevent wicking through grommets. Be certain to diaper-wrap the takeouts.

Wire Routing

⚠ WARNING:

Do not place electrical component attachments or ground screws adjacent to vehicle fuel tanks, fuel filler pipes, fuel lines, fuel vapor lines or carbon canisters. Failure to follow these instructions may result in personal injury in the event of a collision.

Wire harness routing should conform to the following:

- Protect wires routed through holes in sheet metal or castings with a grommet whether or not conduit is used (see figure below).

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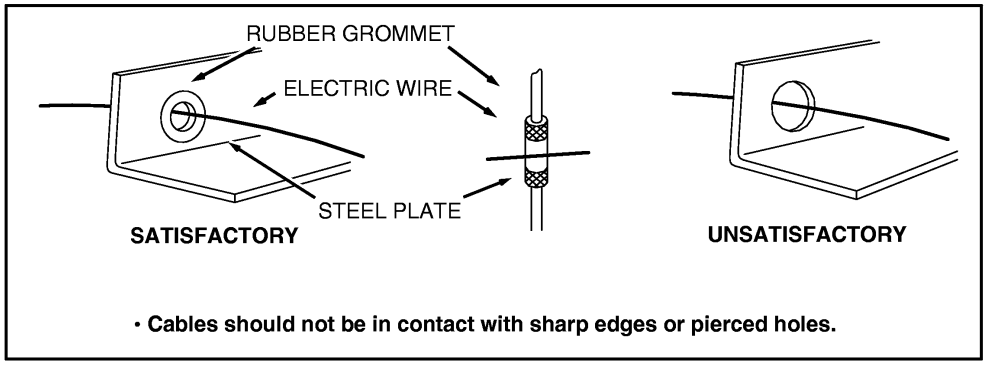

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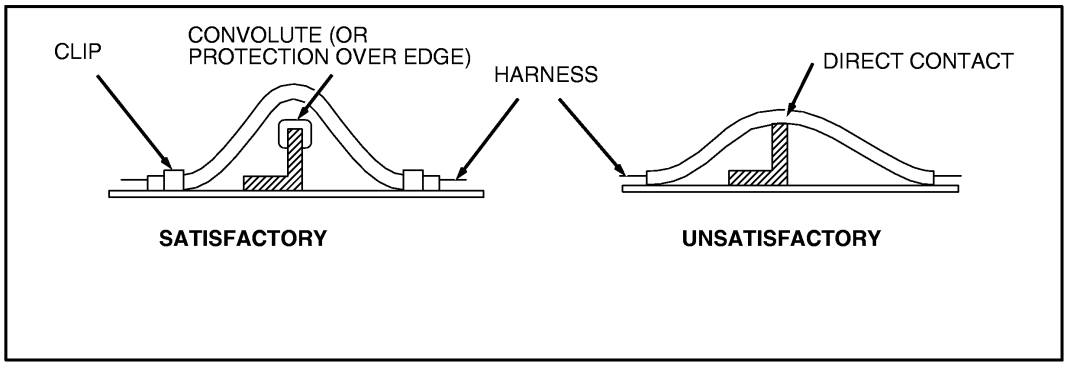
- Route wires to avoid metal edges, screws, trim fasteners and abrasive surfaces. When such routing is not possible, use protective devices (shields, caps) to protect the wires. Cover metal edges with a protective shield and fasten the wiring within 76 mm (3 in) on each side of the edge (see figure below).



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- Route wires to provide at least 76 mm (3 in) of clearance to moving parts in their extreme movement location, unless positively fastened and protected by a conduit.
- Avoid wire routing without conduit in areas where temperatures exceed 82°C (180°F). Maintain a minimum clearance of 152 mm (6 in) from exhaust system components. Heat insulation and heat shields must be used on the wires routed in high temperature areas.
- Make certain all underhood or underbody wiring is cross-linked polyethylene high temperature insulation wire with a 135°C (275°F) minimum rating, consistent with SAE specification J1128 Type SXL wire. Do not use normal PVC wire in underhood or underbody applications.
- Make sure all ground locations are readily accessible for installation, service and verification.
- Do not place ground attachments in high-splash areas.
- Do not route underbody wiring over the exhaust system.
- Route the underhood/underbody wiring in conduit for protection. Minimum conduit rating is 177°C (350°F).

Wire Retention and Routing

Use the following criteria to determine the location of retainers:

- Size and weight of wire bundle.
- Holes with poor accessibility that prevent installation of locators.
- Movement of wires that can result in abrasion, squeaks and rattles.
- When wiring is routed between 2 members where relative motion can occur, secure the wiring to each member with enough wire slack to allow flexing without damaging the wire.
- Wiring exposed to weather must provide a drip loop to prevent moisture from being conducted into the device through the wire connection (see figure below).

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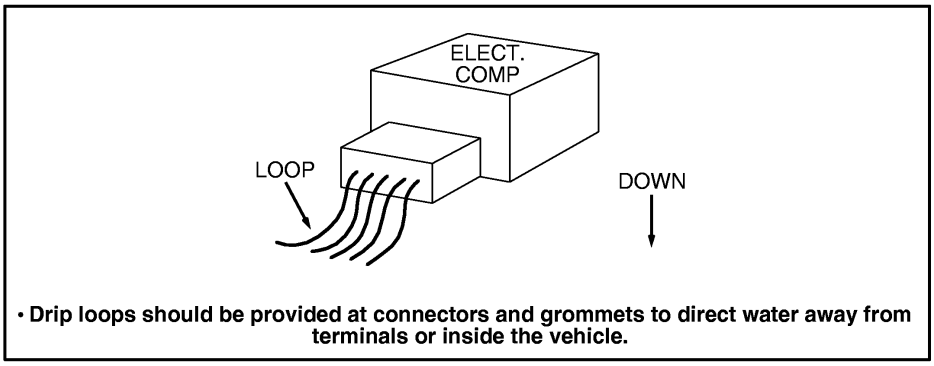

• **Drip loops should be provided at connectors and grommets to direct water away from terminals or inside the vehicle.**

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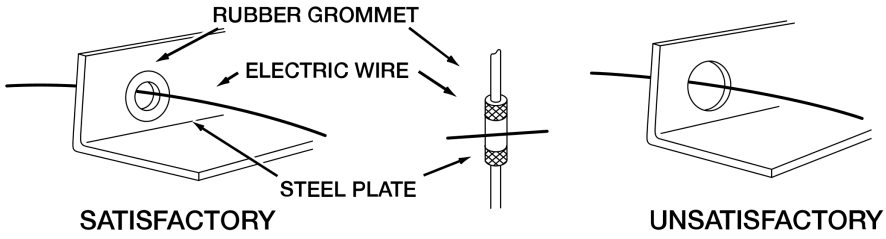
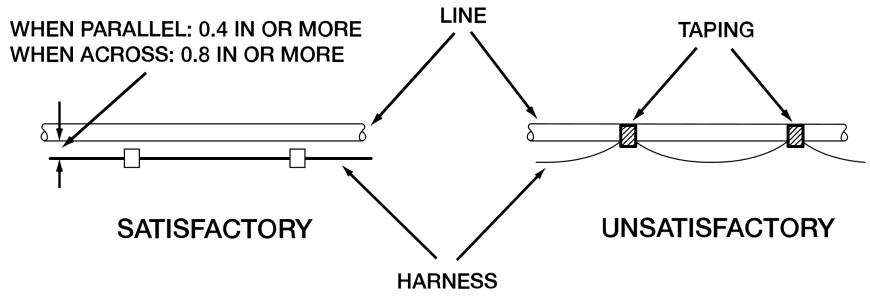
- Avoid routing wires into areas exposed to wheel splash. When such routing cannot be avoided, adequate clipping and/or protective shields are required to protect the wires from stone and ice damage. Allow adequate slack in wiring between the engine and stationary components to compensate for engine roll.
- Avoid routing wires under the frame side members or at points lower than the bottom frame flange.
- Use plastic cable ties for bundling only (securing to other wires).
- 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 additional wiring or tubing are routed through sheet metal panels, new holes with correct wire protection and sealing must be used.



• Cables should not be in contact with sharp edges or pierced holes.



• Harnesses should not be taped to fuel lines or other lines. A sufficient clearance should be maintained between harness and lines.

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For retainer screws, the following guidelines apply:

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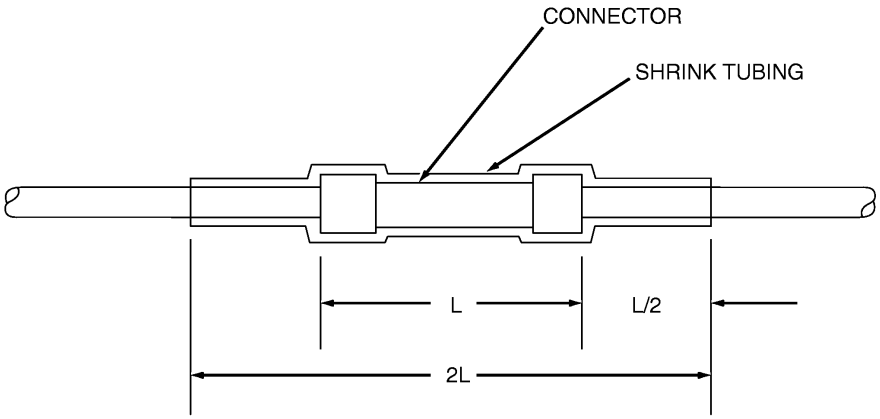
- Avoid using fasteners that are too long for the application or are in an area which might damage vehicle components, including wiring, brake lines, fuel tank and lines, powertrain components, exhaust system and suspension.
- Do not use pointed screws for attachments. Also check that screws used in the vicinity of the wiring are blunt-ended.
- To minimize the potential for wiring shorts, do not use drill point screws. Trim components (including wiring shields) should use pin-type attachments instead of screws.
- Always check areas that screws protrude into for verification that an interference condition to other components does not exist.
- Make sure that retainers used are capable of withstanding the environment over the vehicle's life expectancy.

Splices and Repairs

For quality splicing and to reduce potential problems, the following guidelines are recommended:

- Stagger the splices within a harness to reduce increased harness diameter. Splice only on straight areas as installed, not on bends.
- Strip wire ends making sure that individual conductor strands are not damaged.
- When soldering, make sure an adequate mechanical joint exists before applying solder. Use only resin-core solder. Acid-core solder should not be used since it may result in corrosion.
- For crimp joints, use butt-type metal barrel fasteners and the correct tool at the appropriate setting for the wire size (such as Motorcraft® Crimp Tool S-9796) specifically designed for this type of work.
- Make sure splice joints are adequately sealed and insulated. In an outside environment, use Duraseal butt connectors or equivalent. A durable substitute splice joint can be achieved by using a bare metal barrel, crimping, flow-soldering and covering with shrink tubing. Quality electrical tape can be used inside the vehicle, but is not recommended for an outside environment.
- Be sure the new wire is not a lesser gauge than its original mating wire.



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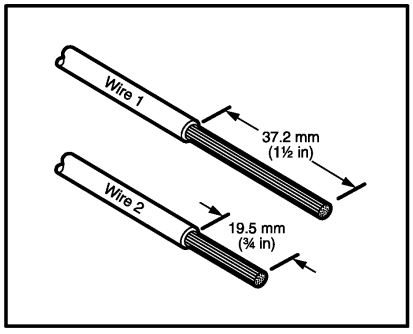
Recommended Splicing Method — Solder (For 16 AWG and Smaller Diameter Wire Only)

1. Disconnect the battery ground cable.
2. Strip wires to appropriate length.



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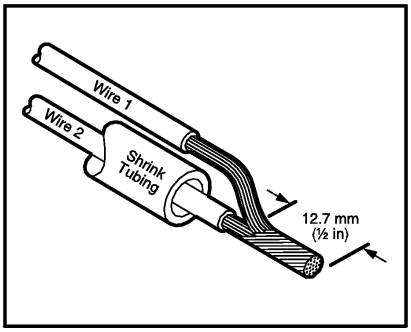
Section 2: Electrical

3. Install heat shrink tubing.
4. Twist the wires together.
5. **NOTE:**
   Use resin-core mildly-activated (RMA) solder. Do not use acid-core solder.

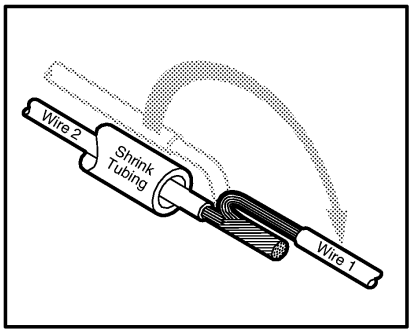
   Solder wires together.



A0075762

6. **NOTE:**
   Wait for solder to cool before moving wires.

   Bend wire 1 back in a straight line.



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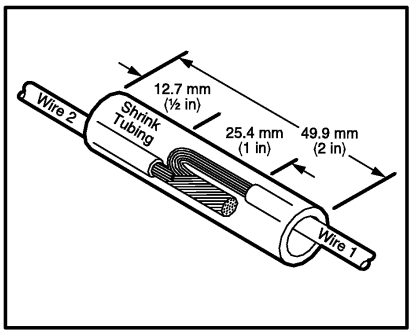
7. **NOTE:**
   Overlap tubing on both wires.

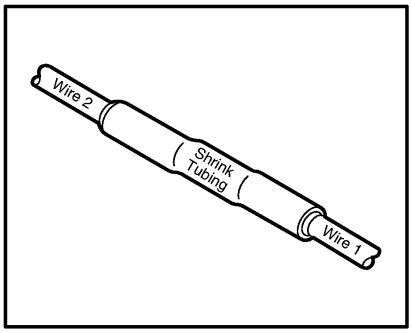
   Evenly position heat shrink tubing over wire repair.

Section 2: Electrical



A0075764

8. Use a shielded heat gun to heat the repaired area until adhesive flows out of both ends of the heat shrink tubing.



A0075765

9. Reconnect the battery ground cable.

Sealed Connectors

Ford Part Number	Part Name	Class
E6FZ-14488-A	Butt Connector Gauge: 18-22, Color: Red	C
E6FZ-14488-B	Butt Connector Gauge: 14-16, Color: Blue	C
E6FZ-14488-C	Butt Connector Gauge: 10-12, Color: Yellow	C

Heat Shrinkable Tubing (Heat Shrink) (Ford Specification ESB-M99D56-A2)

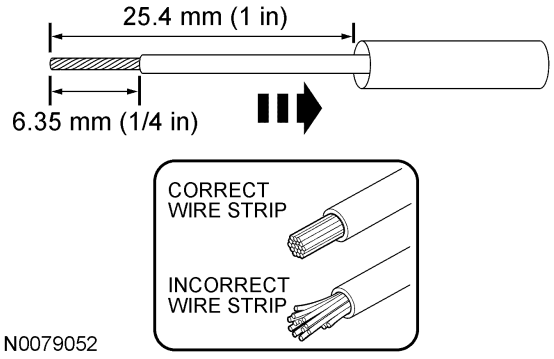
Heat shrinkable tubing is available in various diameters for different splice sizes and configurations. When shrunk, it forms a small, flexible hermetic seal.

Other methods (tape, PVC mold) do not provide a hermetic seal and are not recommended. Splice balancing is critical with heat shrink insulation. If the splice is extremely unbalanced (more circuits on one side than the other), heat shrink insulation will not provide a correct seal. Evaluate the use of double terminals instead of splices where practical in these situations.

Recommended Splicing Method — Crimp (For 10–22 AWG Diameter Wire to Like Wire Diameter)

1. Disconnect the battery ground cable.
2. Strip wires to appropriate length.
3. Install heat shrink tubing.

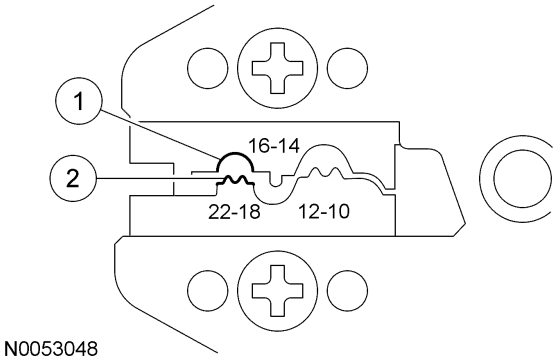
Section 2: Electrical



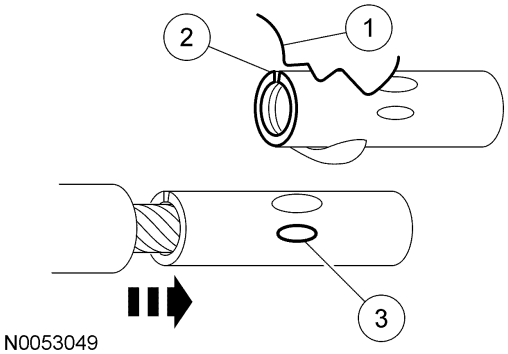
4. Select the appropriate wire splice for the wires to be spliced from Rotunda Wire Splice Kit 164-R5903.

5. **NOTE:**
   Rotunda 164-R5901 Pro-Crimper supplied with the wire splice kit is the only tool that can be used with these splices.

   Identify the appropriate chamber on the Rotunda Pro-Crimper by matching the wire size on the dies with the wire size stamped on the butt splice.
   (1) Cavity
   (2) Indenter



6. Crimp the connector.
   (1) Center one end of the wire splice in the appropriate crimping chamber.
   (2) Insert stripped wire into the barrel.
   (3) Holding the wire in place, squeeze the tool handles until ratchet releases.

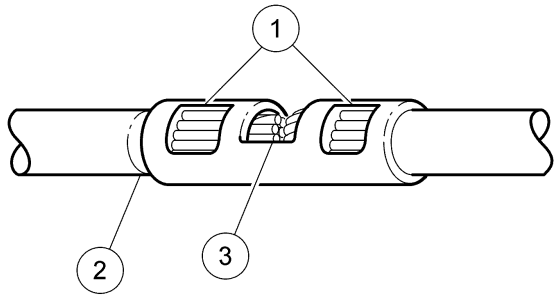


7. Repeating Step 6, crimp the other half of the splice.

8. Check for acceptable crimp.

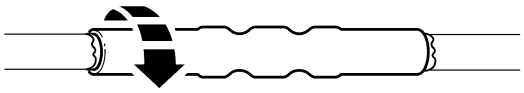
Section 2: Electrical

(1) Crimp should be centered on each end of the butt splice.
(2) Wire insulation does not enter butt splice.
(3) Wire is visible through inspection hole of splices.



N0053050

9. Evenly position supplied heat shrink tubing over wire repair.
10. Use shielded heat gun to heat the repaired area until adhesive flows out of both ends of the heat shrink tubing.



N0070450

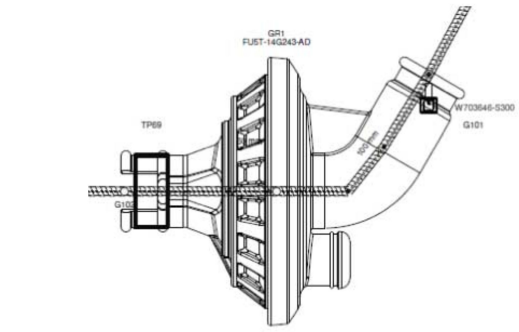
11. Reconnect the battery ground cable.

Electrical items for the F-150 Police Responder

- Location on dash panel to pass power through from the battery to police equipment in the cab/bed
- Park signal, pin number, wire color
- Brake signal, pin number, wire color
- Battery power access point and fuse rating, pin number, wire color
- Ignition power access point and fuse rating
- Vehicle speed output
- Driver door ajar signal
- Start fuse number/location (i.e Battery Junction box (BJB)), wire color
- Accessory delay fuse number/rating, location , wire color

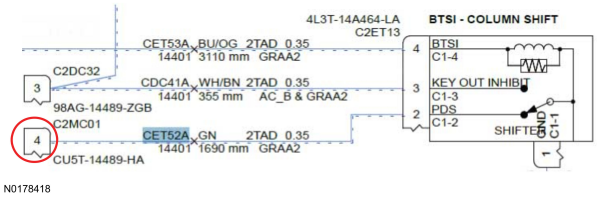
Section 2: Electrical

Dash Panel Pass Through From The Battery To Cab Interior



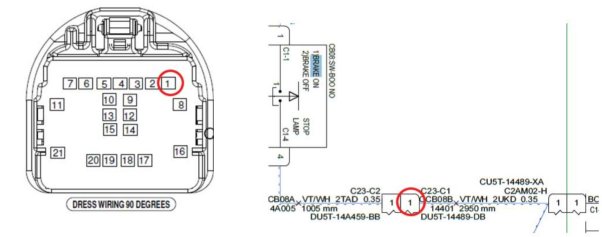
- Located at the front passenger footwell is a grommet on the bulk head , this is the shortest path from the battery to inside the cab interior
- Currently there is no production designed access from the cab interior to the bed of the vehicle. A grommet or other means should be used.

Park Signal (PDS – Park Detect Switch)



- Pin 4 on the cluster connector
- Wire color is green (GN)
- Circuit from brake shift interlock in shifter to cluster
- Park signal is grounded when in park

Brake Signal

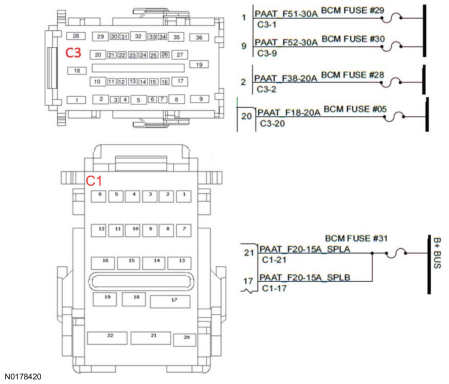


- Pin 1 on 14404 (IP harness)/14A005 (body harness interconnect
- Located at driver side outboard footwell
- Wire color is violet/White (VT/WH)
- Circuit is closed 12 volts when brake is depressed

Battery Power Access Points

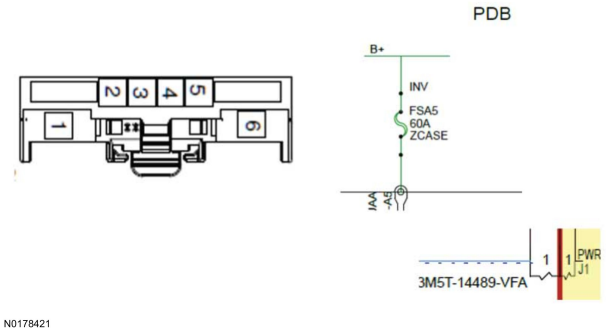
Battery (B+) power can be accessed at multiple points, but require adding terminals and circuits (terminal and wire information provided in the Body Control Module (BCM) information)

Section 2: Electrical



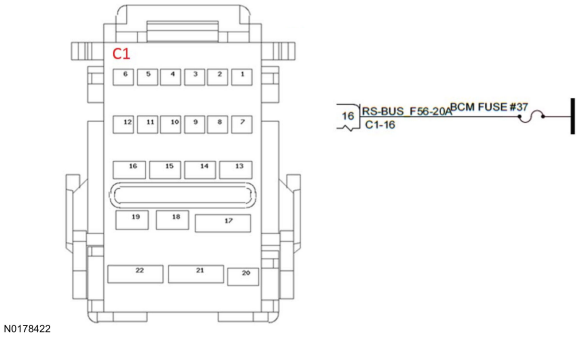
- BCM C3 Pin 1, fuse #29 rated at 30A
- BCM C3 Pin 2, fuse #28 rated at 20A
- BCM C3 Pin 9, fuse #30 rated at 30A
- BCM C3 Pin 20, fuse #05 rated at 20A
- BCM C1 Pin 17, fuse #31 rated at 15A

Battery (B+) power can be derived from the inverter power feed if vehicle is equipped with inverter and it is not needed. Inverter power connector is located at inverter under rear passenger side seat.



- At 6-way connector, Pin 1, wire color gray/red GY/RD
- Rated at 60A

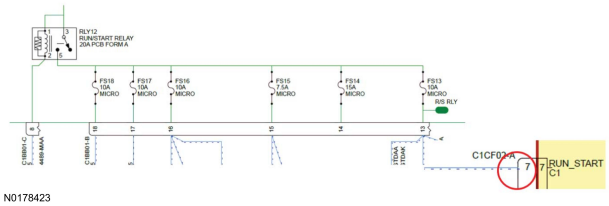
Ignition Power (Run/Start) Signal



- Run/Start signal is available via pin 16 of the 22 pin connector C1
- The circuit/terminal is not populated and will need to be added. Fuse 37 is rated at 20A

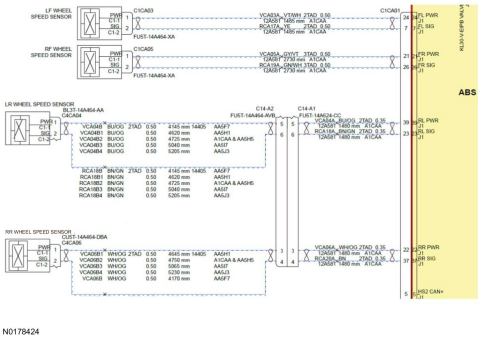
Section 2: Electrical

Ignition Power (Run/Start) Signal At 4X4 module



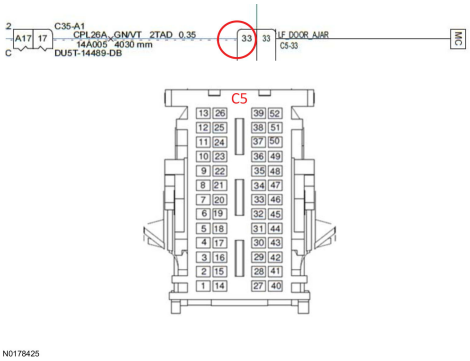
- Run/Start signal is available at pin 7 of the 20 pin connector to the 4X4 module gray/brown (GY/BN) wire
- The Power Distribution Box Fuse 13 is rated at 10A but is shared with the 4X4 module
- The 4X4 module is located up near the bulk head in the front passenger foot-well

Vehicle Speed Output



- Vehicle speed is recorded and sent to the Antilock Brake System (ABS) module for each wheel
- The vehicle speed reading wold be communicated via CAN messaging over the high speed 2 network or through the CAN message gateway
-

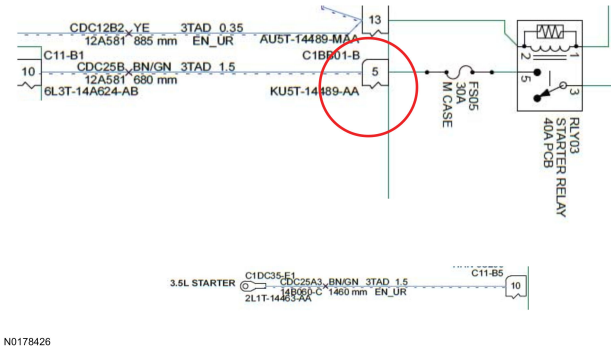
Driver Door Ajar



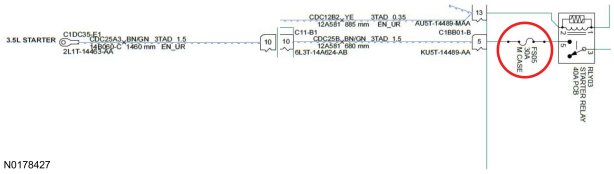
- Driver door ajar signal is available via pin 33 of the 52 pin connector C5 of the BCM (located at the outboard passenger foot-well)
- Wire is green/Violet GN/VT

Section 2: Electrical

Start Fuse



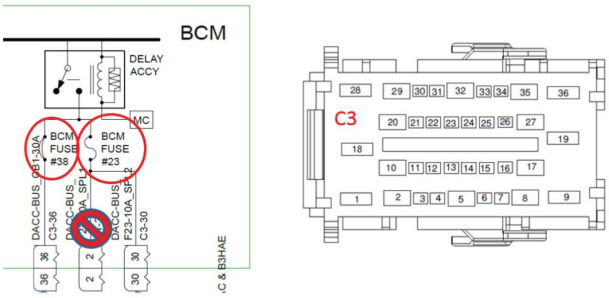
N0178426



N0178427

- Start fuse (FS05, 30A M Case) located in PDB
- Pin 5 on large black PDB 50-pin connector
- Wire is a brown/green (BN/GN) from the PDB connector to starter eyelet

Delayed Accessory

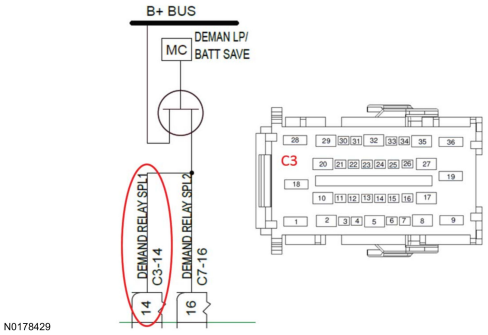


N0178428

- Delayed accessory fuses located in BCM
- Fuse 38, 30A pin 36 on BCM C3 connector, wire color gray/blue (GY/BU) supplies power to window switches for all four doors
- Fuse 23, 10A pin 30 on BCM C3 connector brown/yellow BN/YE drives driver window switches sliding backglass, inverter and moonroof

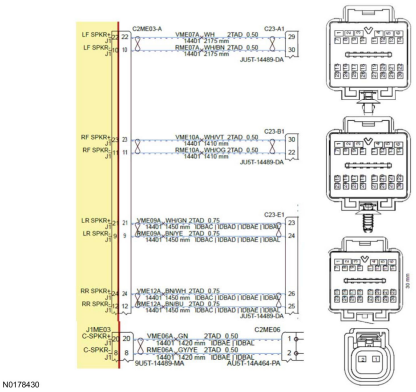
Section 2: Electrical

Battery Saver



- Battery saver demand output FET
- Pin 14 on BCM C3 connector, wire color yellow/green (YE/GN); demands console and media ambient light, glovebox light and cab dome lights

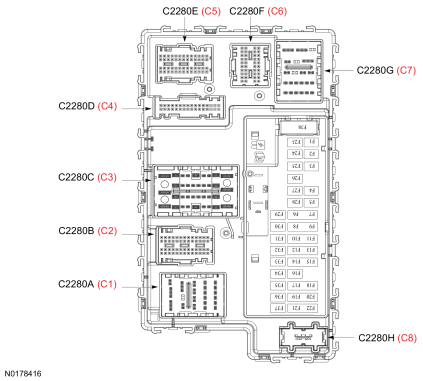
Police Radio Speaker Outputs



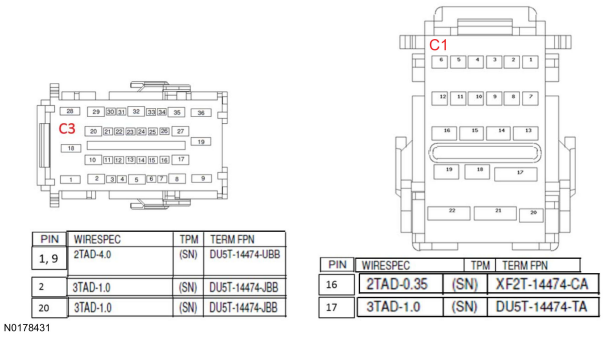
- Left Front speaker positive and negative circuits are available in the 30 pin connector located by the drivers outboard footwell at pins 29 and 30 wire color white/brown (WH/BN)
- Right Front speaker positive and negative circuits are available in the 30 pin connector located by the passengers outboard footwell at pins 30 and 22 wire color white/orange (WH/OG)
- Left Rear and Right Rear speakers positive and negative circuits are available in the 30 pin connector located under the middle front seat at pins 23/24 and 26/25 wire color white/green (WH/GN) brown yellow (BN/YE) brown/white (BN/WH) Brown Blue (BN/BU)
- Center speaker positive and negative circuits are available in the 2 pin connector located at the center speaker top of the instrument panel wire color green (GN) and gray/yellow (GY/YE)

Section 2: Electrical

Body Control Module (BCM)



Body Control Module Connector Terminal Information



PIN	WIRESPEC	TPM	TERM FPN
1, 9	2TAD-4.0	(SN)	DU5T-14474-UBB
2	3TAD-1.0	(SN)	DU5T-14474-JBB
20	3TAD-1.0	(SN)	DU5T-14474-JBB

PIN	WIRESPEC	TPM	TERM FPN
16	2TAD-0.35	(SN)	XF2T-14474-CA
17	3TAD-1.0	(SN)	DU5T-14474-TA

How To Change Option Content

Courtesy Lamp Disable (Dark Mode)

Move the panel dimmer control to the full down position, past the detent, to prevent the interior lights from illuminating when the doors are opened.

Rear Power Window Disable

The rear power windows of the F-150 Police Responder can be disabled by disconnecting the rear window motor connectors. These connectors are located inside the door, behind the door trim panel and must be secured to prevent interference with the window mechanisms. While they are disabled, the master window control switch will not control the rear windows. Refer to F150 Wiring Diagrams Manual for additional power window wiring information.

Wiring Reference Information

Ordering Information

To obtain information about ordering complete copies of Ford or Lincoln/Mercury publications, call 1-800-782-4356.

Available publications include Workshop Manuals, Wiring Diagrams, PC/ED Manuals and Owner's Literature.

In addition, a publications order form can be obtained by writing to: Ford Publications, c/o Helm Inc., P.O. Box 07150, Detroit, MI 48207.