1964-1970 Sequential Turn Signal System

Installation Manual

Sequential-Turn-Signals.com
PO Box 11929
Prescott AZ 86304

Warning!
LED light
emission. Risk
of eye injury

www.Sequential-Turn-Signals.com

Thank You for buying this product!

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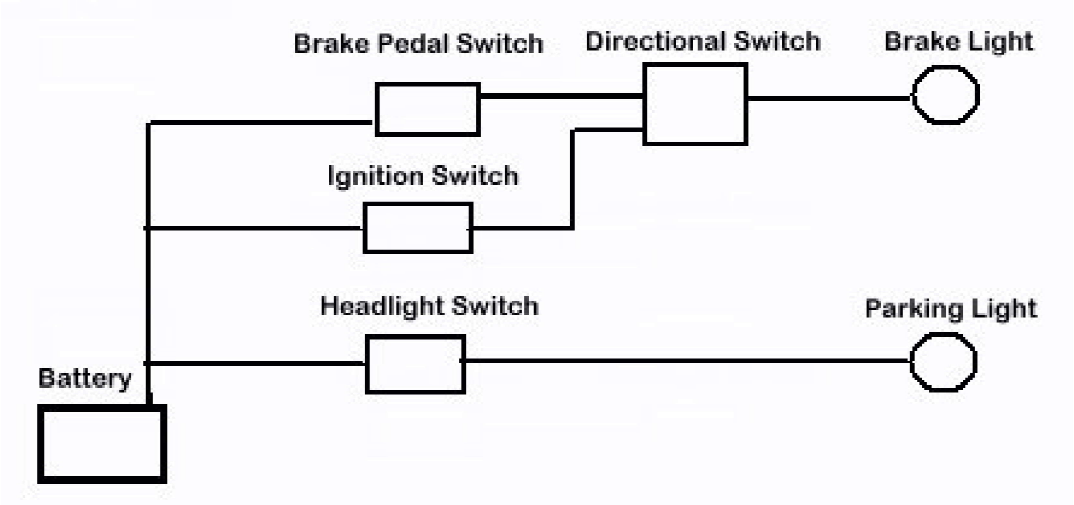
The LED emission presents a hazard to eyesight at a distance of 4 - 40 cm (1.6 -16 inches) when the eye is exposed to the beam for longer than 0.25 seconds.

Do not look at LEDs from a distance of less than 40 cm (1 ft. 4 in.) without suitable protective eye wear.

Do not look at LEDs with magnifiers or similar optical instruments that may concentrate the light output.

Brake Light Systems

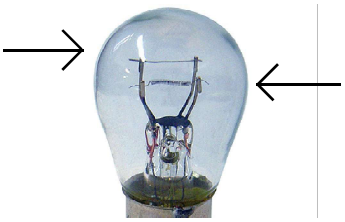
The vintage Mustang (1964-1968) electrical system is simplicity itself. So, too, is the Brake and Parking lighting system.



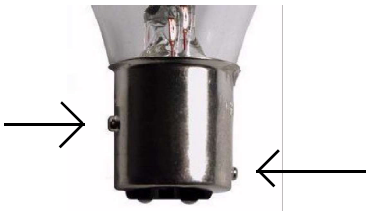
Power is routed to the Brake Light system from the Battery through the Brake Pedal Switch, through the Directional Signal Switch and on to the dual purpose tail lamps. Power for your Parking Light system is routed from the Battery, through the dash mounted Headlight Switch to the dual purpose tail lamps. The Directional Light system power comes from the Battery, through the Ignition Switch, through your Directional Signal Switch to your dual purpose tail lamps.

Power to the Parking and Brake lights is available all the time. Power to the Directional Signals is only available when the ignition is on.

Vintage Mustang Tail Light Reflectors house only one dual purpose lamp. The lamp has two filaments. Each filament illuminates at a different intensity. The lower intensity filament is used for the Parking Light Circuit, the higher intensity filament supports Brake and Directional functions.



Filaments



Pegs

Solder Bumps

If you look at a typical dual purpose (dual circuit) tail lamp you will notice two offset pegs on the base of the lamp itself. These are for polarizing the base so it will connect to the socket connector only one way (unless you really force the lamp into the socket the wrong way, then you will have the Parking & Brake lights reversed). With all else being normal, the pegs make sure that the Brake and Parking elements are connected to the correct vehicle circuitry in the socket.

On the bottom of the tail lamp you will notice two electrical (solder) bumps. Each bump controls an filament within the lamp. One bump is the electrical contact for the Brake/Directional filament, one bump is the contact for the Parking filament. Both circuits are completed through the ground of the metal base itself.

A Note About Which Way Is Up...

Each Red Lens Assembly is manufactured to be installed only on the left (Driver) or right (Passenger) side of your Mustang.

Unpack your new Lens Assemblies and set them down side by side, face up.

Observe that each of the Red Lens Assemblies has text molded in the top front of the Lens.

If you have 64-66 Lenses, the text is:

SAE
TSDB-64 CR

If you have 67-68 Lenses, the text is:

SAE-TSDB-67 MG

If you have 1969 Lens, the text is

SAE TSDB-69 MG

If you have 1970 Lens, the text is

SAE TSIA-70 MG

and (true Ford) Lenses have a graphic molded at the bottom :

FOMOCO

Now, if you turn both assemblies over, keeping the molded text at the top, you will see that one of the circuit boards (PCB) has silkscreening that has right-side-up text that says “UP - Passenger Side”, and the other Lens reads “UP - Driver Side” - Ignore the text that is upside down.

You are looking at the Lenses correctly designated for the Passenger side and the Driver side of youe Mustang. We usually mark which is which with a felt tip pen during manufacture, but if we missed doing it to yours, you know how to do it yourself.

As a further check, the PCB silkscreening that says INNER MIDLE and OUTER, is refering to the position of the three LED sgments and how they are positioned on the vehicle. INNER refers to the position closest to the centerline of the car, OUTER refers to the position furthest from the centerline of the car.

So, keep the molded text on the Lens at the top and read the right-side-up text of the circuit board and you should be in good shape.

The LED emission presents a hazard to eyesight at a distance of 4 - 40 cm (1.6 -16 inches) when the eye is exposed to the beam for longer than 0.25 seconds.

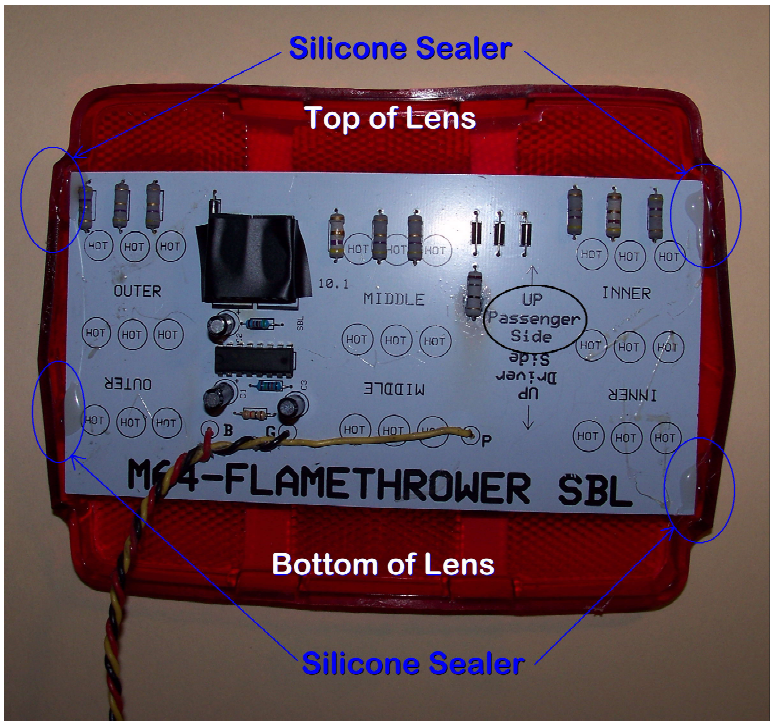
Do not look at LEDs from a distance of less than 40 cm (1 ft. 4 in.) without suitable protective eye wear.

Do not look at LEDs with magnifiers or similar optical instruments that may concentrate the light output.

1964-66 Kit- Installing PCB into Lens

On the 1964-66 Sequential Kit, you have to install the PCB into your red lens,

1) Place your empty lens face down on your workbench with the TOP and Bottom oriented correctly (see page 4).
2) Locate the PCB and note the circled area on the back side. The circled arrow should be pointing UP towards the TOP of your red lens.
3) Center the PCB in the lens with the LEDs pointing toward the lens, making sure the circled UP ARROW is pointing toward the TOP of your lens.
4) Use a dab of Clear Silicone Sealer to secure the PCB to the lens in four places (see photo).



5) Alternatively, you may use a dab of high temperature Hot Melt Glue in a glue gun to perform the same function of holding the PCB to the red lens.
6) Tape the pcb to the red lens while the Silicone Sealer cures (usually 8 hours, hot melt glue cures in minutes)

Use the sealer/glue sparingly to ensure a good fit of the lens assembly into the rear lamp tub assembly after the glue/sealer cures. Trim any glue that has found its way onto the gasket mating surface of the lens before installation in vehicle.

LED Sequential Brake Light Installation

1964-66 Mustang

Installation of our SBL Conversion Kit is dirt-simple. All that is needed is a screwdriver for most Mustang Models.

Please read the disclaimer.

1) Unpack the shipping box and make sure that the Kit you received is the Kit you need for your year vehicle.

2) Unscrew the four corner phillips-head screws holding the chrome bezel, red lens and gasket.

3) Remove the bezel, the red lens, gasket and 1157 lamp. The reflector remains bolted to the car body.

4) Unwrap the SBL Tail Light Assembly for the side of the car on which you are working (Driver's or Passenger's Side).

5) Locate the electrical connector on the assembly, note the offset pegs near the base of the connector. Align the connector and plug with the vehicle's taillight connector in the reflector. Insert the connector & twist the required amount to seat the connector in the socket. If the connector will not twist in the socket, then be sure that the polarized pegs are not 180* reversed. These connectors are under some spring pressure, so a little inward pressure on the base, then a slight turn, will lock the base into the connector. It looks and feels exactly the same as it would if you were installing an incandescent lamp into the connector.

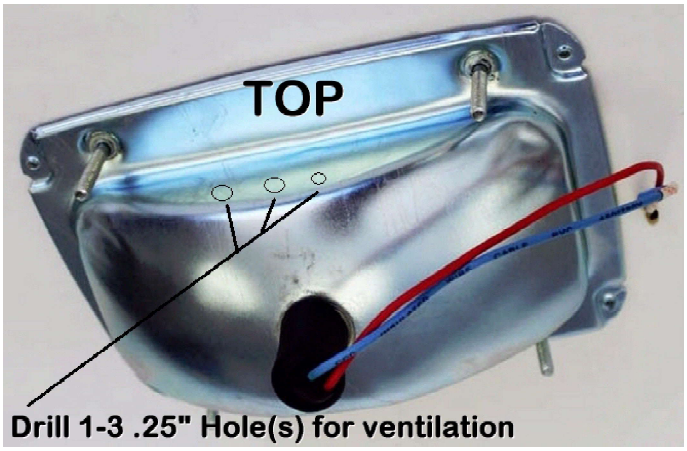
6) Center the new Red Lens with the LED Assembly over the Reflector Gasket.

7) Install your chrome Bezel over the Red Lens Assembly.

8) Secure Bezel, Red Lens Assembly and Gasket with 4 Phillips-head screws. Tighten enough only to compress the gasket - over tightening may crack the Red Lens Assembly.

9) Test the circuit by engaging the brake lights, turning on the directional signals and energizing the parking lights.

10) Repeat for the other side.



For a few installations, the design of the 64-66 tail light tub does not provide for sufficient cooling of the LED circuitry in our Sequential Brake Light System, and results in premature failure of the onboard LEDs.

This can be effectively avoided by drilling vent hole(s) in the top of the 64-66 OEM or equivalent tail light tub as indicated in the photo. Caution, drill the hole with the tub empty, and no wires nearby which could be damaged. Make sure the hole will not allow moisture to enter the tub when normally installed.

1966-67 Mustang

Installation of our SBL Conversion Kit is dirt-simple. All that is needed is a screwdriver for most Mustang Models.

Please read the disclaimer.

1) Unpack the shipping box and make sure that the Kit you received is the Kit you need for your year vehicle.

2) From inside the trunk, remove the six nuts that hold the Reflector, Gasket, Red Lens, Rubber Spacer and three Bezels together.

3) Remove the Reflector with the Gasket, Red Lens, and Spacer from the rear of the body and pull the bezels from outside of the car body. Set the bezels and their nuts aside.

4) Separate the large thick spacer from the reflector. a plastic moulding tool will help in losening the spacer from the sides of the reflector.

5) Unscrew the 4 Hi-Lo phillips head screws holding the Red Lens to the Reflector. Carefully separate the Red Lens from the reflector. The Gasket will probably stay attached to the reflector. Reuse the Gasket if it is in good shape.

6) Unwrap the SBL Tail Light Assembly for the side of the car on which you are working (Driver's or Passenger's Side).

7) Locate the electrical connector on the assembly, note the offset pegs near the base of the connector. Align the connector and plug with the vehicle's taillight connector in the reflector. Insert the connector & twist the required amount to seat the connector in the socket. If the connector will not twist in the socket, then be sure that the polarized pegs are not 180* reversed. These connectors are under some spring pressure, so a little inward pressure on the base, then a slight turn, will lock the base into the connector. It looks and feels exactly the same as it would if you were installing an incandescent lamp into the connector.

8) Align the new Red Lens/LED Assembly over the Reflector and Gasket. Secure the Red Lens/LED assembly the four Hi-Lo phillips head screws. Install thick Rubber Spacer over Red Lens

9) Install reflector into the vehicle from the rear of the body. Push the bezels in from the outside of the body.

10) Secure Reflector, Gasket, Red Lens Assembly and spacer with the six nuts on the Bezel Studs. Tighten enough only to compress the gasket - over tightening may crack the Red Lens Assembly.

11) Test the circuit by engaging the brake lights, turning on the directional signals and energizing the parking lights.

12) Repeat for the other side.

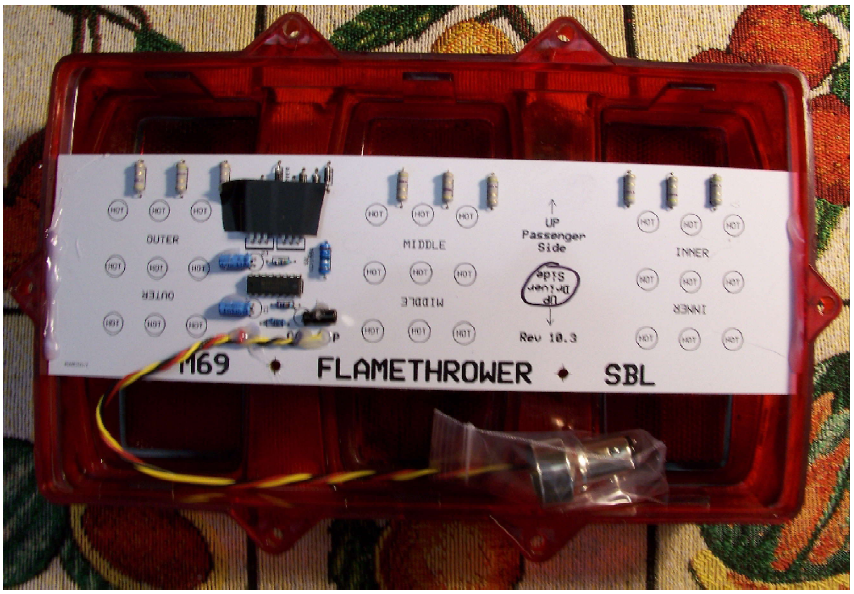
1969 Kit - Installing PCB into Lens

With the 1969 Sequential Kit, you have to install the Sequencer Board onto your red lens,

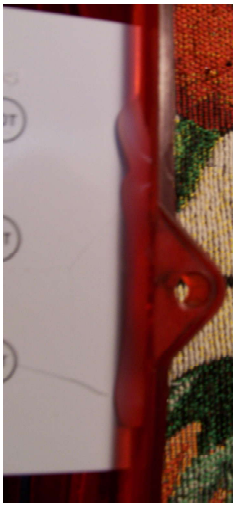
1) Place your empty lenses, face down on your workspace with the TOP away from you, and the Bottom closest to you. Identify which is your Left (Drivers) and Right (Passenger) lenses.

2) Note the circled area on the back side of the Board, denoting Drivers Side UP, or Passenger Side Up.

3) Place the Boards in their respective Lenses, with the arrow head on the Board pointing towards the TOP of your lens, and centered vertically on the lens segments, with the left and right edges of the Board riding on the recessed ridge of the lens. See photo.



4) Apply a bead of glue or hot melt to the left and right edges of the Board where they meet the lens ridge. Press the boards solidly against the lens ridge.



5) Secure the Board to the lens with tape, while the glue cures.

6) After the glue cures, remove the tape.

7) Install the Lenses with Boards into your metal Tubs in your vehicle. Pay attentions to orientation (Driver/ Passenger Top/Bottom). Note the polarity of the Tub's socket, then push and turn to lock connector in the socket of the Tub.

8) Test Sequencing.

1970 Kit - Installing PCB into Lens

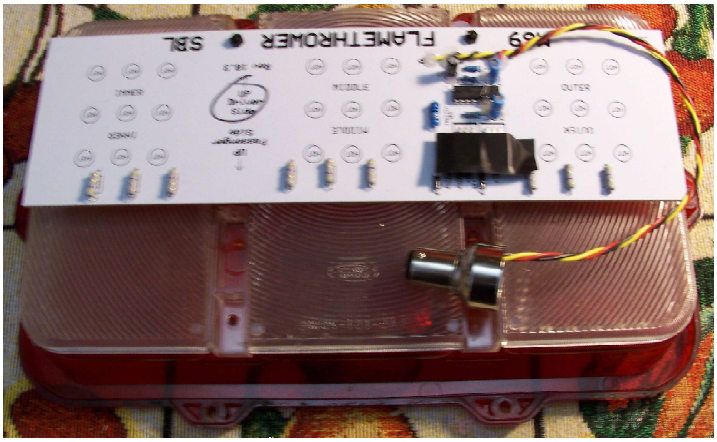
With the 1970 Sequential Kit, you have to install the Sequencer Board onto your red lens,

Note that the Passenger Side Board and the Driver Side Board have four Standoffs at the top and bottom of the Board.

1) Place your empty lenses, face down on your workspace with the TOP away from you, and the Bottom closest to you. The Top of the lens has the following part number molded in the front of the lens: SAE TIA 70MG, and FOMOCO ID in the lower 1/3 of the lens. Identify which of the lenses will be your Left (Drivers) and Right (Passenger) lenses.

2) Locate the Left & Right Boards and note the circled area on the back side of each Board denoting Drivers Side UP, or Passenger Side Up.

3) Place the Boards on their respective clear Fresnel Lenses, with the arrowhead on the Board pointing towards the TOP of your lens, and the four plastic stand-offs located in the spaces between lens segments. Power up the Boards to be sure that they are centered on the lens assembly for maximum visibility.



4) Align the center-most LED on the Board directly over the center of the EYE of the clear Fresnel lens and make sure the four standoffs are located in the spaces between the segments.

5) Lift the board slightly, and apply a dab of Clear Silicone Sealer (or hot melt) to the bottom of the four standoff feet and position the Board back onto the Fresnel lens with the standoffs located in the sections between the lens segments (see photo).

6) Tape the Boards to the red lenses to keep the Boards from moving while the glue cures.

7) Remove the tape when glue has cured. Test the centering and the sequencing by powering up the board. If not centered correctly, remove plastic spacer nuts, remove the board, cut the standoffs out, reassemble the board and standoffs and try centering again with a small temporary dab of silicon sealer or hot glue.

7) When you are satisified with the centering, squeeze in sufficient glue around the standoffs to attach them securely to the lens. Don’t let the glus spill out onto the Fresnal lens.

8) Mount lenses and Boards to the metal Brake Assembly Tub

9) Get the Connector polarity right (see Plug & Sockets section), then push and turn to lock connector into the socket.

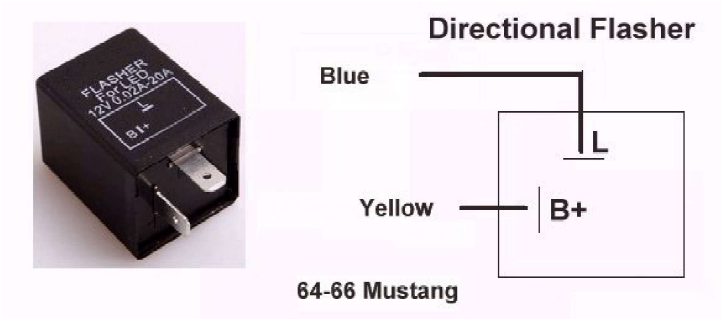
10) Test Sequencing, and install on vehicle.

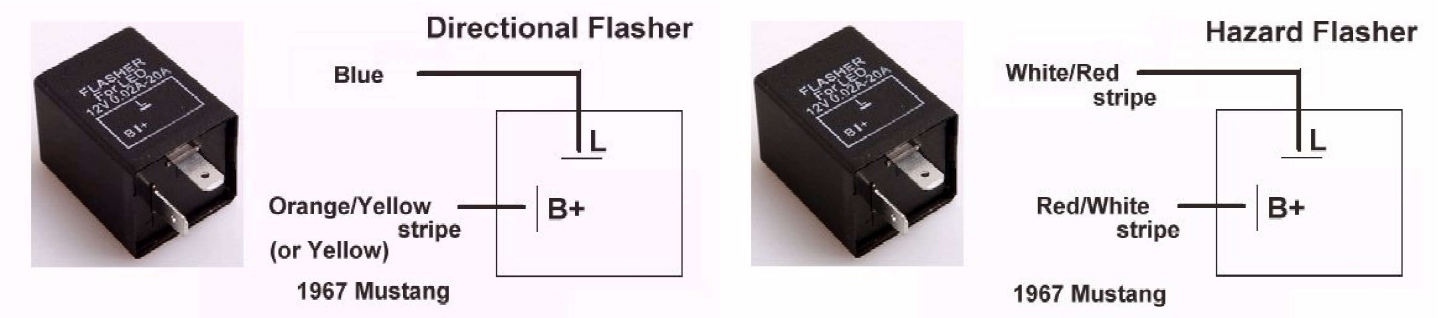
NOTE About True Electronic Flasher

The thermal flasher in your directional signal system is designed to operate with an incandescent bulb that draws a certain amount of current. The LED Brake Light System, while 2-3 times brighter than incandescent lamps, draws only a fraction of that current which may affect how your thermal flasher operates.

For most installations, your thermal flasher will probably work just fine, because you have other incandescent lamps (front directional, hood & Dash directionals, etc) in your Mustang helping the thermal flasher to work correctly.

If your existing thermal flasher is too slow, or not working at all, the solution is to replace your thermal flasher with our True Electronic Flashers (TEF) included in the kit. The TEF does not rely on bulb current to present proper directional signal timing.





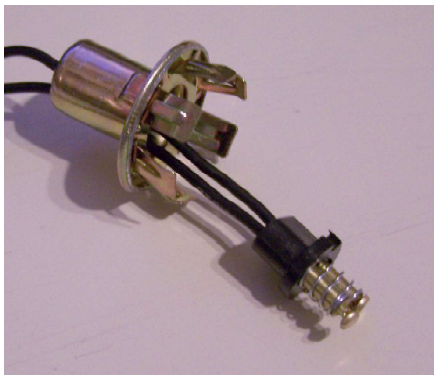
For most vintage Mustangs the flasher is located behind the dash board above the instrument cluster. Not the easiest place to have to locate something that needs to be relatively often. On some 1965 Mustangs, the Flasher is located in a clip behind the fresh air vent on the driver's side. Also '67-'68 Mustangs may have an extra flasher for 4-way (Emergency) Directionals. Make sure you are replacing the correct one - they look identical.

Note that the Mustang uses a 2-blade flasher. Our TEF is a true 2-blade flasher. Pay attention to how your old flasher comes out, so you can get the new TEF installed correctly. The wiring diagrams above showing color coding of the wires should be used only as a guide, there is no telling what your wiring harness looks like after 50 years.

You will note that the OEM flasher has a round body. Our TEF is mounted in a cube shell. The OEM clip will not hold our Flasher cube. A nylon cable-tie securing the cube wiring to adjacent wiring will minimize any movement of the cube. Aftermarket round Flashers designed for LEDS may work with our system and fit your mounting clip.

The Trouble with Sockets...

There is a potential problem with the tail light sockets that hold the dual purpose Brake Light and Parking Light bulb on a lot of older cars.



A typical socket is made up of the shell with molded offset channels that line up the pegs at the base of the bulb with the connectors in the bottom of the socket. The connector itself is a wafer of insulating material, usually phenolic, with two springs and brass pins, each crimped, or soldered, to the wiring in your car. These phenolic insulating wafers are keyed to fit in the socket so that the brass contacts line up perfectly with the contacts at the bottom of the bulb when you push the bulb into the socket and give it a 1/4 turn clockwise to lock it into position.

However, the wafers on some sockets actually can fit in the sockets in TWO positions:

1) The proper position, where the Park and Brake circuits of the vehicle wiring connect properly to the Park and Brake elements of the bulb, and

2) Rotated 180 degrees from the proper position, where the Park circuit of the vehicle is connected to the Brake element of the bulb, and the Brake circuit is connected to the Park element of the bulb.

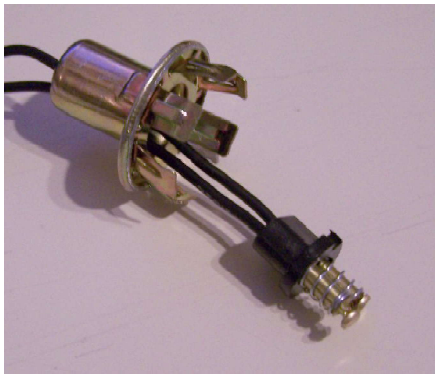
It is perfectly safe when this happens - the problem is your Brake light (the brighter element in the bulb) comes on when your Parking Lights are on, and your Parking Lights (the dimmer element of the bulb) come on when you hit your Brakes or turn on your Directional Signal switch. Not legal, and not the way your lighting system was designed to work.

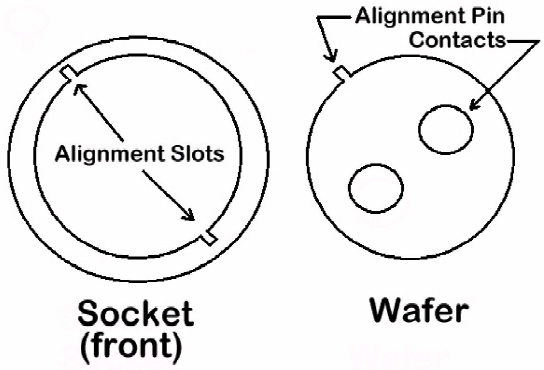
To add insult to injury, especially in older cars, there is nothing holding this phenolic insulating wafer in place while the bulb is not in the socket! That means that, when there is no bulb in the socket, the wafer can slip out of the socket shell and possibly rotate 180 degress. You pull out your old burned out bulb, go into the garage to find the replacement, return and find that the phenolic wafer has slipped out of the socket. You have a 50/50 chance of getting the wafer back in the shell correctly aligned.

New replacement sockets fair no better - we just purchased a few hundred brand new sockets for a client and found that they, too, would allow the wafer to slip out and mount in two positions, 180* from each other!

You'll know when the wiring of one of your sockets is not correct by looking at the brake/tail lights with the appropriate switches on. It might be a good idea to take a look the next time you fire up your Mustang, just to be sure. It might explain why your Brake lights are so dim and your Parking lights so bright.

Troubleshooting Sockets





To test whether the wafer has slipped back into its socket shell backwards (or 180 degrees out of sync), take a dual filament incandescent lamp, plug it into the socket, taking note that the wafer alignment peg is fully seated in the slot in the socket.

Energize the brake circuit by pressing and holding the brake pedal. Note whether the Bright or Dim element is lighted.

Release the brake pedal, and turn on the parking lights. Note whether the Bright or Dim element is lighted.

The Brake light circuit should light the Bright Filament, and the Parking light circuit should light the Dim Filament.

If these filaments are NOT correct, then the wafer has been rotated in the socket 180 degrees out of sync.

The 'fix' is relatively simple (see drawing above):

1) Remove the lamp from the socket
2) Push the wires from the rear of the socket until the wafer, its wires, brass contacts and contact springs are pushed out the front of the socket (Careful - note the orientation of the wafer guide pin in the slot of the socket - there are two possible orientations)
3) Rotate the wafer 180* to allow the wafer alignment pin to engage the opposite slot in the socket.
4) Push the wafer, wires, contacts and springs back into the socket by gently pulling on the wires from the rear of the socket. Make sure everything is seated securely and that the wafer alignment pin is riding in the socket alignment slot.
5) Test the socket again as above. Make sure the Brake pedal energizes the Bright Filament, and that the Parking light energizes the Dim filament.

To keep the wafer from popping out the next time you change a lamp, install a lamp and install a nylon tie-tie around the wires coming out of the rear of the socket spaced about 1/4" from the socket shell. This will give enough clearance for the spring contacts to contact the lamp, but will keep the wafer from popping out of the socket whenever you go to unplug the lamp from the socket.

Warranty

This product is warranted for 90 days from purchase against manufacturing defects, subject to repair or replacement (our choice).

Even though all of our products are tested before they leave the plant, sometimes a component will fail for no good reason at all. If you should experience an individual LED, or LED string failure, we will repair the LED PCB at no charge if the product is within our 90-day warranty period. Be sure to contact us for an RMA # before retuning merchandise to us. Refer to the last pages of this Manual for the Returm Merchandise Form.

Sequencer Timing

The Sequencer has been factory set for typical thermal flasher cycle time. The Sequencer cycle time and dwell can only be adjusted with a change in resistor/capacitor parts.

In extreme cases (very rarely) if the timing is not compatible with your (or our) flasher, then you may request us to reprogram your unit to meet your needs.

There is no charge for reprogramming (except for shipping - about $5), but please contact us first for an RMA #, and provide us with the cycle time (the ON time) of your particular thermal flasher in tenths of a second. We will do our best to reprogram the Sequencer to complete its timing cycle within that ON cycle time.

The circuitry of the LEDs and Sequencers are designed to run on a range of DC voltage between 12.6v - 13.8v - the values of a typical vehicle with the key off, or with the key on and the engine running. If your vehicle's battery, alternator and or regulator are faulty, too low and too high voltages may be experienced. Caution, these voltage extremes can be damaging to ANY electronics circuitry, including our LEDs and Sequencers. Measure your Brake Light voltage to be sure.

Troubleshooting Your Electrical System

An addendum to this Installation Manual is provided as a guide to troubleshooting your electrical system with respect to proper Brakelight/Taillight operation. It is an excerpt from "Diagnosing Vintage Mustang Electrical Systems" by Don Stewart and is available for $19.95 from Sales@MustangElectricalSystems.com.

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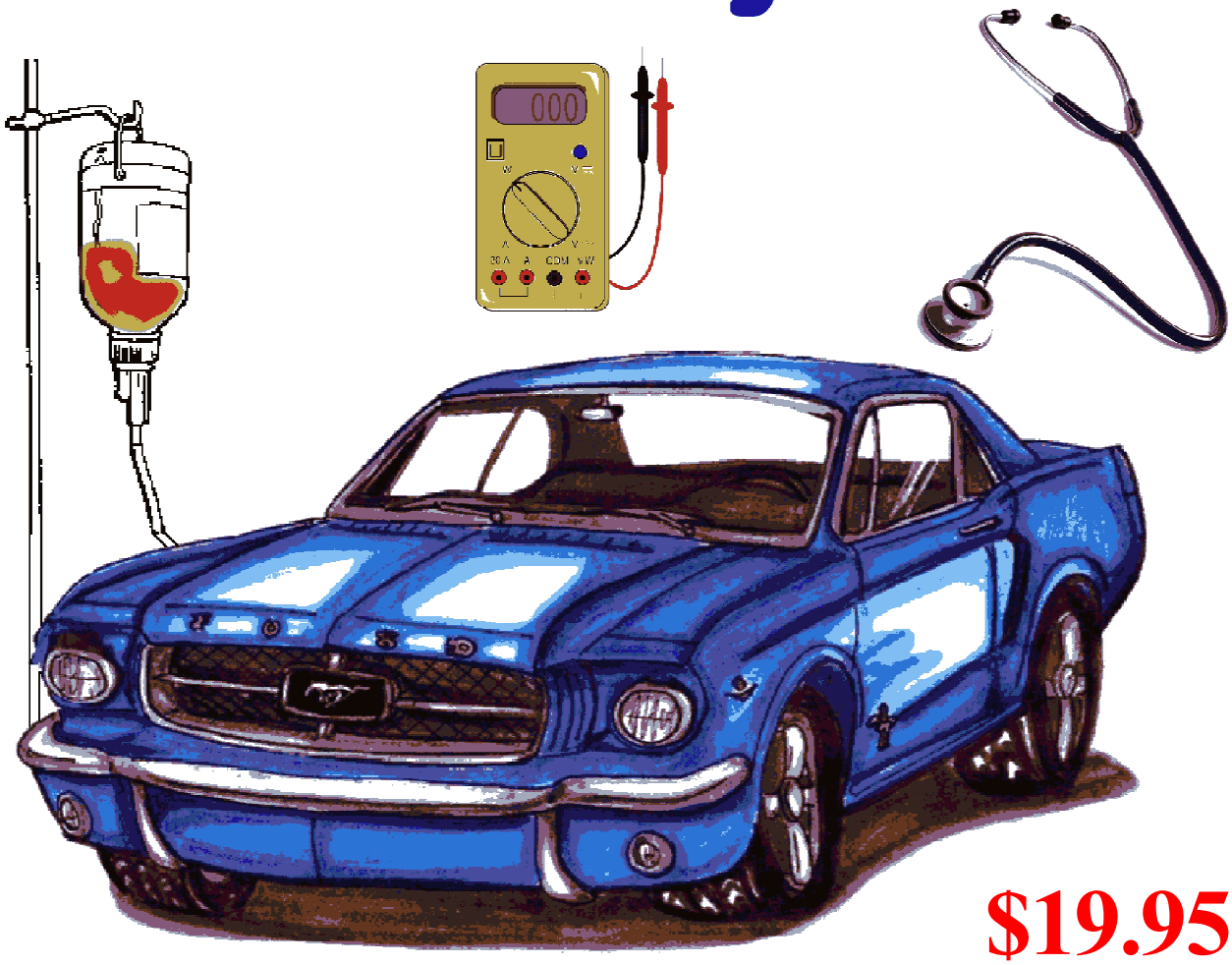
Excerpt from

DIAGNOSING
Vintage Mustang
Electrical Systems



$19.95

Don Stewart

Available from Sales@MustangElectricalSystems.com

Addendum
Excerpt from "Diagnosing Vintage Mustang Electrical Systems"
by Don Stewart
(available for $19.95 from Sales@MustangElectricalSystems.com)

I'm not certain why, but it is hard for folks to believe that their almost 50 year old Mustang friend could have anything wrong with its wiring or electrical system. The Mustang system by its nature, is very basic, simple and relatively easy to maintain and repair. But electrons traveling through wire can sometimes seem just too magical and uncertain, probably mostly because they are hard to see.

The vehicle electrical system is pretty easy to understand if you think of it as basically two systems. One system is designed to keep the battery charged, the other is to run all of the electrical equipment off of that same battery. Further, both systems are often operating at the same time. The battery, obviously, is the link between the two systems.

The part of the system that is charging the battery consists of the Alternator and Regulator. The alternator converts some of the rotational energy of the engine into electrical energy, which it tries to feed to the battery through the regulator. The job of the regulator is to control just how much charge the battery gets - too little and the battery will not get charged and everything will get dim kinda quickly, too much and the battery will overcharge, overheat and boil out.

The engine usually has to be running a little above 1000 rpm in order for the alternator to overcome all of its internal losses and start charging the battery. The regulator reads the voltage at the battery terminals in order to decide how much charge the battery needs.

A good battery at rest without the engine running will very slowly internally discharge until it gets to around 12.6v and levels off. There is plenty enough energy in the battery at this voltage to run the starter on your engine and power most of your electrical requirements for a sustained period of time. In other words, enough energy to get the engine started, assuming it is in good repair.

As soon as the engine is running and the alternator is up to speed, the regulator will read the 12.6v at the battery terminals and try to channel the alternator power over to the battery. As the alternator pours charging energy into the battery, the battery voltage slowly rises until the regulator senses that that the battery voltage has reached 14.4v approximately.

The regulator will fold back (slowly reduce) the alternator's charging current to the battery, the battery voltage will drop back to about 13.5v and will sit in happy balance with the alternator at this voltage while the engine is running.

If you should turn on the headlights at this time, the drain on the battery will cause the battery voltage to drop a little, which will be sensed by the regulator and cause it to raise the charging current from the alternator to keep the battery voltage up and offset the current drain by the electrical device. This all happens automatically – nothing special that you have to do.

So what can go wrong and how can you tell?

If you jump in your Mustang, turn the key and nothing happens, then the task of troubleshooting is in your court.

The first step is to learn how to use a voltmeter. Voltmeters are cheap (usually under $7 at Harbor Freight) and pretty foolproof. The voltmeter measures the voltage at the tip of the two probes attached to it. If you place the red probe on the Battery Positive post (it should be marked some where on the battery) and the black probe on the negative Battery Post, and turn on the meter, you will be reading the battery voltage just like the regulator is doing.

If your battery is good and has been sitting for a while, you should be reading 12.6v or so. If it is well below 12.6v and you have recently charged the battery, then you can be sure that your battery has pretty much seen as much service as it can give – probably a dead cell. Let Autozone check it for you just to be sure.

A battery reading of about 13.5v is pretty much normal for a recently charge battery in good condition. Let the battery sit long enough and you will see the voltage gradually drop towards 12.6v, and level off.

But if you are reading a quiescent (at rest – no engine running, no charger attached) battery voltage much above 14.6v, you have a seriously defective battery that you want to immediately disconnect and have a local battery shop (or AutoZone) test for you. There are some super capacity batteries (sealed gel) that can safely hold that 14.6v levels for considerable amount of time, so be sure to have such a battery tested so you know where you stand.

Sealed and unsealed wet cell batteries are not designed to withstand voltages above 15v for extended periods of time without bad things happening – the battery will overheat, and the electrolyte will boil out of them. Batteries are full of sulphuric acid, so wear eye protection whenever you are working around one. Under extreme stress a battery could actually rupture, which will seriously complicate your day, so pay attention.

So, let’s say that your car won’t start because you battery is low (or dead). First you measure the battery voltage, then attach a charger to the battery and watch the battery voltage rise. After a reasonable amount of time (usually the automatic shutoff in the battery charger will signal that a battery is fully charged), log (as in write down) the voltage reading at the battery, then hit the starter.

As the starter is running, the battery voltage will dip until the engine is running. After the alternator is up to speed, it will try to charge your battery though the regulator. If, after starting, your battery voltage isn’t rising towards 13.5v, then your charging circuit is not working. Statistically, the alternator is most likely at fault, next in line is some wiring boo-boo, then the regulator.

If the battery charged correctly on the bench, but the voltage with the engine running is all over the place and tends to track the speed of the alternator, then you can pretty much count on the fact that the regulator has bit the dust. This can be where the buzz that you all of a sudden hear in your radio comes from. Don’t let wild voltages go on for any length of time because they can seriously damage the battery and some of the electronics in your car.

So much for the charging side of the battery circuit in your car. The other circuitry that is operating on the battery in your Mustang contains the mass of electrical devices that are trying to drain the battery of whatever power it has. Big users, like head lights, starter, tail lights, brake lights, glovebox light, courtesy lights, ignition, dashlights, horn, windshield wipers, heater fan and the like, conspire to knock your battery out of commission. It is the charging circuit that helps keep the balance.

Now let's shift our attention to one of the power draws on the battery – the tail light system. Somehow power has to find its way from the positive post on your battery to the tail lights on your car, then back again to the negative post on your battery. The circuit must be completed from positive post through the electrical device (lamp) to the negative post on the battery in order for the device to turn on.

If the path is interrupted, the lamp won't light. Some interruptions are convenient, for instance, your head light switch interrupts the power coming from the battery to your parking and headlights, and your brake light switch attached to your brake pedal interrupts the power going to your brake lights. Kinda convenient.

But some interruptions are not so nice, like a broken wire in the wiring harness, or a corroded pin in a connector.

Some paths are very complicated, like the directional signal system. Power starts out at the battery positive post, travels to the ignition switch, where the key has to be turned on, then travels through your directional thermal flasher, then through your directional signal switch on your steering column, then through the wiring to your left or right brake light (which doubles as your directional light), then through the filament in your lamp, then back to the negative battery post using you car's metal chassis as a form of big huge wire. That's quite a trip.

Wiring diagrams of you car's electrical system can act like a roadmap through your wiring system, if you take the time to learn how to read it. Or you can pay (a lot) for someone else to read them for you. Some of these roadmaps are good, some are not. The free ones on the autozone.com website are surprisingly good. Give them a try.

Automakers since the beginning of time color-coded their wires ostensibly to help track down wiring troubles, but actually, they color-coded their wires to make manufacturing and assembling of your Mustang way easier and faster. But it also makes troubleshooting easier for the rest of us, thank you very much.

Generally, wire colors consist of either 1) a solid color, 2) a solid color with a different color stripe or (occasionally) 3) a solid color with a different color dotted line.

Generally, each wire that runs between electrical devices uses a wire of the same color scheme, no matter how far it is between electrical devices. So the wire at the steering column that is destined to connect to the right side brake light filament will have the same color code at the direction switch connector at the steering column as it does at the brake light connector in the trunk.

You will note that the parking light wiring, that is shared by all the parking lights, both front and rear, also share the same wiring color code.

You actually have bunch of lights wired in the trunk of your Mustang: Brake lamps, parking lamps, license plate lamps, backup lamps, side marker lamps, trunk courtesy lamp. However you have only two types of lamps: single purpose, and dual purpose.

The single purpose lamp contains one filament and, depending on the part number, that filament will shine more or less bright. If the lamp is to be used for a backup lamp, then it will contain a filament that burns pretty bright. If the bulb is to be used as just a license plate illuminator, or just a parking light, then it will be outfitted with a somewhat dimmer filament (so it won't be confused with the brake light or blind someone following behind your car).

There is also a dual purpose lamp that actually contains one bright filament and one dimmer filament, packaged in one glass bulb. Very convenient, because this means that you can have a parking light and a brake light, both in one bulb! Very cool.

You can tell whether you have a single or dual purpose lamp by counting the number of solder 'bumps' on the bottom if the lamp. Each of these 'bumps' connect to one filament. One bump – single purpose lamp, two 'bumps' – dual purpose lamp. The metal shell of the lamp is the ground return for both filaments, and generally connects to the chassis ground on the car in order to complete the circuit back to the negative battery post.

Vintage Mustangs use a dual purpose lamp for Parking and Brake light, a single purpose bright lamp for Backup Light, and single purpose low brightness lamps for the license plate and side markers.

Sockets for these dual purpose lamps are manufactured with two wires (and the shell ground wire). Each filament of the bulb is connected to one of these wires (through these solder 'bumps') when the bulb is installed.

You will notice that dual purpose bulbs have two pins on opposite sides of the base, and those pins are staggered (single purpose lamps also have pins on opposite sides of their base, but are not staggered). These pins line up with grooves in the lamp socket in order to make sure that the 'bumps' line up with the connector contacts, and are held firmly in contact.

The sockets that hold the dual purpose lamps are made of metal and contain a small insulatinig disc with two holes in it, in which the wiring that connects with the solder 'bumps' on the lamp is mounted. The disc has holes in it for the wiring, a little spring and a small brass rivet. Each of the brake and parking wires is crimped to the rivet.

The insulated disc fits into the socket shell one of two ways. There are small pegs cut into the disc that are designed to line up with dimples molded in the shell. These dimples are 180 degrees apart, so the insulator can be installed and held firmly from rotating in the shell. This is a good thing.

Once the shell is assembled a rubber boot is installed on the wires coming out of the back of the shell, which retains the wire in the insulating disc, and keeps the disc from slipping out of the shell. What this means is that the vehicle brake light wiring that is connected to the brighter of the two filaments, always stays wired to the brighter filament. Same with the parking circuit and dimmer parking filament.

Why is it important to understand the filaments in a dual purpose bulk? Well, the sockets for these dual purpose brake and parking lamps have a troublesome attribute.

What happens, over the 50 year life of the socket and wiring, is the rubber boot deteriorates, comes loose, or disappears entirely. Which means that there is nothing holding the insulator in the shell except for the lamp. This does not cause any problems until you have to replace the lamp. When you remove the lamp, there is nothing holding the disc in the shell, so it tries to slip out of the shell.

Often times, while you are searching through your shop for the replacement lamp, the disc pops out. When you return with the new bulb, you pull on the wires to re-seat the disc (which is now 180 degrees backward in the shell) and install the lamp.

There is nothing dangerous about this. It is only a problem in that your brake light wiring is now connected to the dimmer filament in the bulb, and your parking circuitry is connected to the brighter filament. This, of course, is completely backwards, and liable to net you an equipment violation from a state trooper who is otherwise admiring your Mustang.

Take the time to verify that your brake light wiring is really connected to the bright filament of the bulb. If it is not, remove the bulb, push out the insulator by pushing on the wiring, rotate the insulator and pull it back into the shell, install the lamp, then test again.

With the shell already wired in the car, it is not easy to install a replacement boot, but a simple nylon wire tie can do pretty much the same function as the original rubber boot. Leave about ¼" between the shell and the nylon wire-tie to allow the springs attached to the wires to be able to press up against the lamp solder 'bumps' and hold the lamp securely in the socket. This is also a good thing.

So with the sockets sorted out, what else can go wrong with the tail light system?

Starting with the most likely first, one of your lamps can burn out. Actually it's the filament in the lamp that fails. Since there are two filaments in a dual purpose lamp, usually only one filament dies at any one time. Basically the filament gets weak after thousands of temperature cycles and vibration in the car causes it to physically break. Once it breaks, the circuit is interrupted between the battery positive post and negative post and, just like with a switch, the lamp shuts off.

Even though one filament is still good, the whole lamp needs to be replaced. Caution, don't let the insulator disc slip out of the shell when you replace the lamp!

Less often, the filament breaks and shorts against the ground inside the lamp (more likely), or against the other filament (less likely). The brake light usually is the culprit and the indication will be a thermal flasher flashing way too fast all of a sudden.

Technically, the broken filament resting against the ground wire has less resistance than a complete filament, hence draws higher current through the flasher, and makes the thermal flasher (which operates on current) flash faster.

Since, at any given time, both the front and rear directional lamps will be connected to the flasher at the same time, you won't immediately know which bulb (front or rear) is the culprit. Start with the most likely, which is the brake light.

Pretty much the last problem you could encounter with your tail light system, is having a lamp go out, and replacing the lamp doesn't fix the problem. This means that the electrical circuit has been unexpectedly interrupted somewhere between the positive battery post and the negative battery post.

This is not the time to go weak in the knees. Grab your voltmeter with the pointy probes and prepare to look like a genius.

The number one wiring failure in the trunk is a floating ground. This is where the socket, because of rust or corrosion, is not making a good connection to the vehicle chassis, or ground, or a wire ground eyelet is corroded or broken.

Floating grounds can be especially annoying when trying troubleshoot the tail light electrical system because the symptoms are not very intuitive without the voltmeter. For instance, with a floating ground, turning on the parking lights causes both the parking and brake light filaments to light at reduce intensity and the brake lights are almost not visible. It is really difficult to identify these kind of symptoms unless you are actually looking for them.

When our Sequential LED system is installed in a tail light wiring system with no (or floating) ground, indications are also not very intuitive. With the parking lights off, the brake lights will cause the LED system to sequence the brake light LED segments normally, but at reduced intensity. That is because the LED system is finding a ground return to the battery through the filaments of other bulbs in the system, namely your parking lamps.

With a floating ground and your parking light circuitry turned on, the ground that the Sequential Directional was using is upset by the parking light voltages, and the brakes and directionals will not operate.

So the first thing to do is anchor the black voltmeter probe to a really good chassis ground (scrap away a little crud to expose clean metal). Now with the correct circuit energized (brakes, parking, backup, whatever) stick the pointy end of the red probe right into the center of the wire behind the socket that is supposed to have power to it. If you get a good reading (12.6v-13.4v), then either the ground is floating or the shell is broken internally.

If there is no reading, work you way back towards the source of where the power is supposed to be coming from (a brake switch, or directional switch, or headlamp switch) carefully stabbing the same color coded wire. By following the wire guide roadmap that you downloaded for free from Autozone.com website, you will eventually find the point at which your power has been unexpectedly interrupted.

Sometimes it is a corroded junction connector that connects two harnesses together, sometimes it's a broken wire caught on a sharp edge, sometimes it is the switch itself. Remember, each time you stab the red pointy probe, that you also have the black probe solidly connected to chassis ground. Be circumspect when poking the wires for power – a careful single pin prick is all that is needed here. Anything more aggressive will expose the wire inside the insulation, and you will have created an additional problem with the exposed power wire (if it should happen, wrap a short piece of black electrical tape around the exposed wire to insulate it from harm's way).

If you get to a switch (for instance) where the battery side shows power on your meter, but the side of the switch which feeds your tail light is powerless while you manually operate the switch several times, you probably have just found the bad boy that is making your Mustang look bad. Recheck the wiring diagram to make sure that there is no other explanation, then replace the switch. Now marvel at the magic that you just performed.

Since our Sequential Brake Light System utilizes integrated Parking and Brake light circuits, they react somewhat differently to a reversed socket problem than would incandescent lamps. If a socket is wired backwards, turning on the parking lights will cause one sequence of the bright LEDs on both left and right sides, then the bright LEDs will stay on until the parking lights are turned off. While the parking lights are on lighting the bright LEDS, the brake and directional circuit will not result in any noticeable change in the LED intensity.

If the tail light sockets are wired backwards, and the parking lights are off, when the brake lights are energized, the LEDs will illuminate in dim (parking) mode and all three segments on each side will flash all at once at your thermal flasher's blink rate. The three dim LED segments will not sequence.

The broken brake switch and reversed tail light connectors are probably the most prevalent taillight problems.

However, the directional switch on your steering column is a very complicated switch – many wires connected to it and several power sources feed it. But its task is dirt simple, flash the right or left (or both) directional signal lights, and power the brake lights correctly.

It turns out that the entire brake, directional and emergency flasher power goes through the directional switch. And of couse the Direction Switch is mounted in one of most difficult spots to get to - inside the steering column

With the directional switch selector on the left side of your steering column set to its center position (off), brake light power is routed from your brake pedal switch, directly to both rear brake light wiring through the directional switch.

Selecting the right directional signal, causes the switch to send any brake light power to the opposite side (left) brake light wiring, while routing cyclic power from the thermal flasher to the right brake light wiring – the right brake light blinks.

If you enable the brake light switch, the left brake light will go on, while the right brake light blinks.

The opposite is also true, select the left directional switch position, and the left brake light will blink and right brake light will react to the brake light pedal switch.

If your directional signal switch is outfitted with an emergency flasher switch, then it takes precedence over the directional signal switch and will cause both brake light wires to be energized at the blink rate of your emergency flasher.

Some vehicles employ a separate thermal flasher for the directional system and the four-way emergency flashing system. Some directional system switches share their thermal flasher with the four-way emergency switch.

Almost 100% of the time, if a directional switch should fail, while the failure is not terminal (some things still work more or less), the switch does cause a whole lot of weird (non-standard) voltages at the tail light connectors.

Measure the voltage on all your tail and brake light wiring as each function is energized. Log the results on a copies of the form on the next page, one Log with the ignition On & engine off, and one Log with the Engine running. Compare the voltage Logs between the left side to right side, and the Logs from Engine On and Engine OFF.

This was an excerpt from "Diagnosing Vintage Mustang Electrical Systems" by Don Stewart, available for $19.95 from Sales@MustangElectricalSystems.com.

The LED emission presents a hazard to eyesight at a distance of 4 - 40 cm (1.6 -16 inches) when the eye is exposed to the beam for longer than 0.25 seconds.

Do not look at LEDs from a distance of less than 40 cm (1 ft. 4 in.) without suitable protective eye wear.

Do not look at LEDs with magnifiers or similar optical instruments that may concentrate the light output.

	Brake and Tail Light Wiring Voltages				
Socket Voltages		Left Side Brake Light	Left Side Tail Light	Right Side Tail Light	Right Side Brake Light
Parking Lights Off					
	No Action	volts	volts	volts	volts
	Left Directional Only	volts	volts	volts	volts
	Right Directional Only	volts	volts	volts	volts
	Brake Lights Only	volts	volts	volts	volts
	Brake & Left Directional Only	volts	volts	volts	volts
	Brake & Right Directional Only	volts	volts	volts	volts
Parking Lights On					
	No Action	volts	volts	volts	volts
	Left Directional Only	volts	volts	volts	volts
	Right Directional Only	volts	volts	volts	volts
	Brake Lights Only	volts	volts	volts	volts
	Brake & Left Directional Only	volts	volts	volts	volts
	Brake & Right Directional Only	volts	volts	volts	volts
	Build Two Sheets of Above Measurements: 1) Engine off, Key ON, and 2) Engine Running				
Resistance Measurements		To Left Socket	To Left tub	To Right Socket	Right Tub
All Power Off					
	From Chassis Ground	ohms	ohms	ohms	ohms

Returns

Please use this page if you are going to return one of our products

1) Please email Sales@Sequential-Turn-Signals.com for an RMA number. Please explain why you are returning your product. You will also be given the exact address to return your product. NOTE: The Voltage Log sheets (copies of Page 20) will need to be completed on your vehicle electrical system, and submitted with returned items.

2) Once you have the RMA number, please fill out the bottom of this form and include it with your product.

3) Package your product carefully so that it gets to us in the condition it left you. We are not responsible for any damage due to shipping and usually do not accept packages that have been damaged in transit. Package your product carefully and securely to minimize delay.

4) Generally the cost of Upgrades or Repairs are covered by Sequential-Turn-Signals.com if your product is within its warranty period. However, you are responsible for the shipping cost to our plant. If repair costs are indicated, we will email you with that info before we start repairs. We can send you a Paypal invoice for repair costs if you prefer. Product will be shipped when payment clears.

5) If you are retuning a NEW product for refund, you will still need to obtain an RMA (as above), and your product must be returned to us UNOPENED. Product that we receive that has been opened will be returned to you WITHOUT refund.

Name of Product: _____

Date you Purchased Product: _____

Dealer where you purchased product: _____

What was the price of the product: _$_____

Your Name: _____

Your Shipping Address: _____

City State Zip: _____

Your Email Address (Make this painfully legible, please): _____

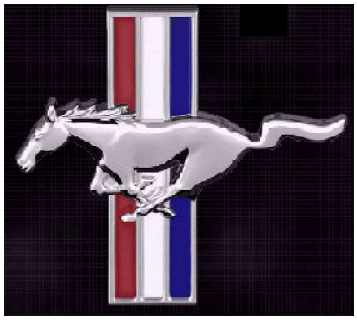
For Shipping Costs (Circle One): CHECK (enclosed) Credit Card (MC or VISA only) Paypal

Name on Credit Card: _____

Credit Card Number: _____Exp Date: _____

Credit Card Address: (From your statement)_____

City State Zip: _____ Your Paypal Account ID: _____



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