Electronic Brake Controller
Hayes Brake Controller Company P/N 81760

INSTALLATION MANUAL

For trailers with 2-6 electric brakes and vehicles with 12 volt negative ground systems only.

READ AND SAVE THESE INSTRUCTIONS

- Before beginning installation, read and become familiar with these instructions.
- Leave in tow vehicle for future reference.
- **Improper installation and operation could cause personal injury and/or equipment and property damage.**

SAFETY INFORMATION

WARNING: Indicates a potentially hazardous situation that, if not avoided, could result in death or serious, personal injury.

CAUTION: Indicates a potentially hazardous situation that, if not avoided, could result in damage to product or property.

TIP: Contains helpful information to facilitate installation.

Installation

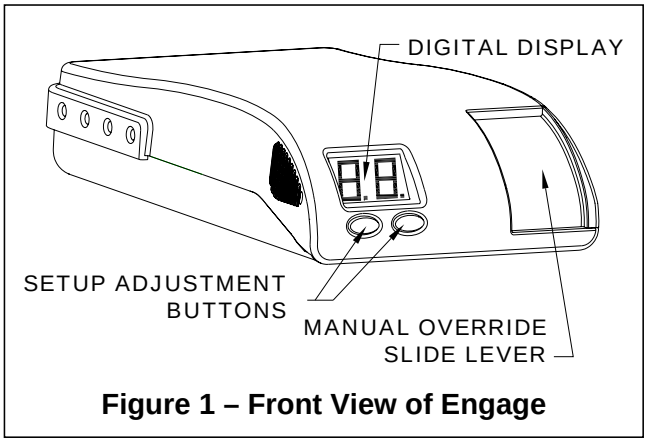

Figure 1 – Front View of Engage

Mounting angle and mounting direction

The Engage can be mounted at any angle and in any direction. **It must be mounted in a location that the driver can see and read the display. The driver must be able to reach and operate the manual slide.**

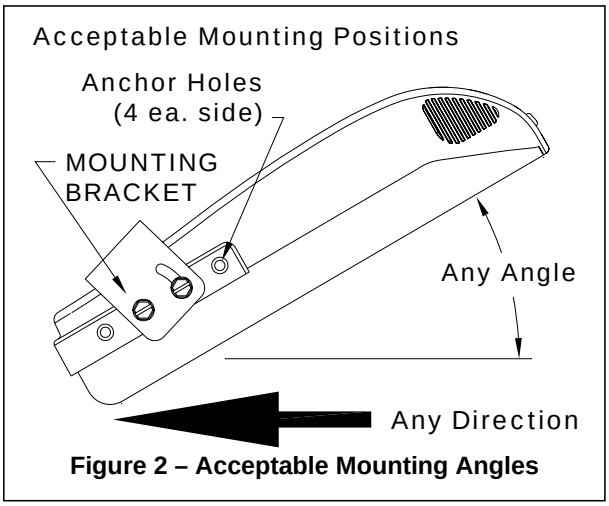

Figure 2 – Acceptable Mounting Angles

Controller Mounting and Installation

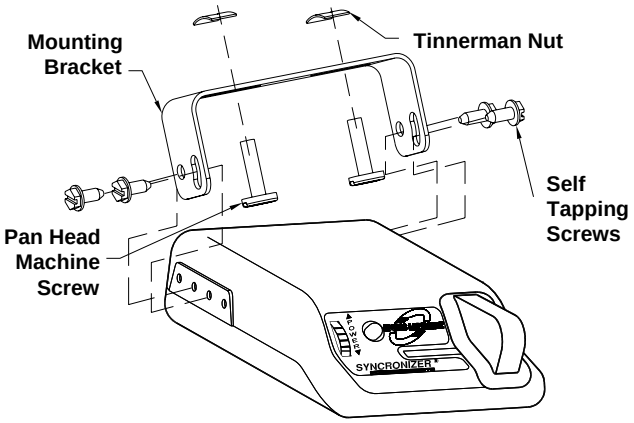

Figure 3 – Attachment of Mounting Bracket

Controller and Bracket Mounting

1. Install the mounting bracket to a solid surface under the tow vehicle dash or other suitable location in the tow vehicle using the two machine screws and fasteners provided. Tighten until snug. See Figure 2 – Acceptable Mounting Angles and Figure 3 – Attachment of Mounting Bracket.
2. Insert four of the self tapping screws provided through the mounting bracket holes and into the desired controller anchor holes. Tighten until snug.
3. **Mount in a location which allows the driver to easily apply the manual override and to see the digital display.**

WARNING:

- Use of longer screws than those provided can damage the unit and cause loss of braking.

WARNING:

- All four controller wires must be connected properly for the controller to operate correctly.
- Failure to properly connect all four wires can cause loss of trailer braking.
- Improper wiring will destroy the controller and void the manufacturer's warranty.

CAUTION:

- Care must be taken to ensure that the mounting surface is rigid enough to prevent excessive vibration.
- Excessive vibration may result in poor performance.

Read all wiring instructions prior to making electrical connections to the tow vehicle.

WARNING:

To reduce the risk of injury or damage to property:

- Always connect the **white wire first** and the **black wire second**.
- All four controller wires must be connected properly for the controller to operate correctly.
- Failure to connect the wires correctly can cause loss of trailer braking.

WARNING:

- The white wire must be connected to a known good ground (preferably the negative battery post).
- Improper or no ground will result in poor controller performance or lack of performance altogether.
- Improper ground connection can destroy the controller and void the manufacturer's warranty.

WARNING:

- Improper connections may result in no trailer brakes or destroy the controller and void the manufacturer's warranty.

WARNING:

Follow wiring instructions.

- Improper wiring will destroy the controller and void the manufacturer's warranty.

CAUTION:

- **DO NOT** connect the black wire to any vehicle power supply line or fuse panel that could cause circuit overload or damage to tow vehicle wiring and vehicle electronics.
- Route the black wire through a grommet hole in the fire wall to prevent wire grounding and away from the radio antenna to reduce any possible AM radio interference.

Controller Wiring

TIP:

- Special Dual-Mated "Quik Connect™" Wiring Harnesses are available for all Hayes Brake Controllers fitted with a connector on the wire leads, making connection a snap. Harnesses are available through all dealer resources. Ask specifically for the Hayes Brake Controller Company (HBC) brand harnesses to match your controller.

The following chart describes the function of each of the controller's wires:

Order	Color	Function	Wire Size (AWG)	Connect To
1st	White	Ground	16	grounded metal part of the firewall or directly to the negative (-) terminal of the battery. **Connect this wire first.**
2nd	Black	+ connection to the vehicle's power system	**12**	positive (+) terminal of the battery. **MUST** have a self-resetting Circuit Breaker in-line between the controller and the battery. See chart for proper size. Route the black wire through a grommet hole in the fire wall to prevent wire grounding and away from the radio antenna to reduce any possible AM radio interference. **Connect this wire second.**
3rd	Red	Stoplight	14	non-powered stop lamp wire (of the stop lamp switch) or trailer tow wiring harness. It is recommended that a 20-amp inline fuse be installed between the controller's red wire and the stop lamp switch. **The fuse is required in 1999 & later Fords.**
4th	Blue	Output to trailer brakes	12	the trailer brake wire or tow vehicle / trailer connector.

IMPORTANT: Make all controller wiring connections to the wiring harness before connecting the harness to the vehicle.

SELF-RESETTING CIRCUIT BREAKER SIZE CHART

Number of Brake Light Bulbs (tow vehicle plus trailer)	Number of Trailer Brakes		
	2 Brakes	4 Brakes	6 Brakes
4 Bulbs (minimum)	20 AMP	30 AMP	30 AMP
5 Bulbs	20 AMP	30 AMP	30 AMP
6 Bulbs	20 AMP	30 AMP	40 AMP
7 Bulbs	30 AMP	30 AMP	40 AMP
8 Bulbs	30 AMP	30 AMP	40 AMP
9 Bulbs	30 AMP	40 AMP	40 AMP
Note: Each trailer brake magnet is assumed to draw 3 amps of current and each brake lamp bulb is assumed to draw 2 amps.			

Special Conditions

For tow vehicles equipped with factory trailer towing package:

- Refer to your vehicle's owner's manual or other information provided by the manufacturer in determining the correct connection points for the controller.
- See Appendix section for partial list of manufacturer wiring harness to controller conversions.

For vehicles <u>without</u> trailer-towing package: refer to the wiring diagram in Figure 4.

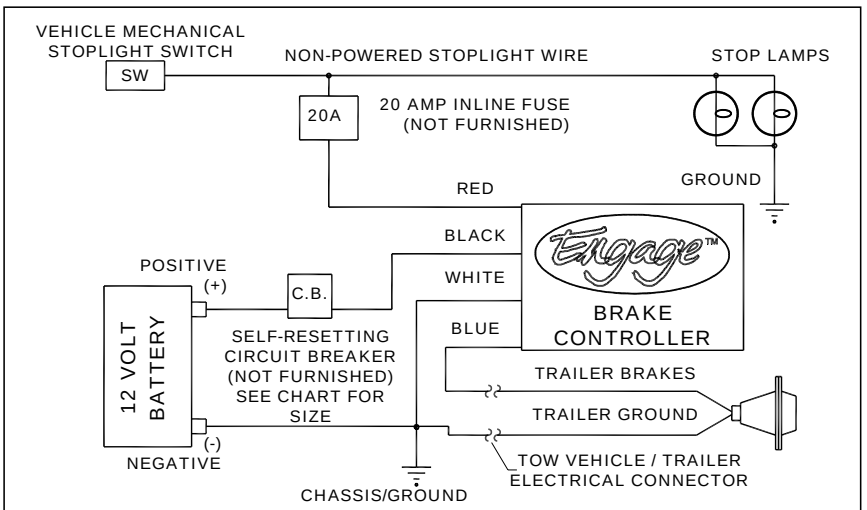

Figure 4 – Wiring Diagram

WARNING:

1989-1991 Ford Bronco, Econoline, F-Superduty, and F150-350 Series:

- The red stoplight wire MUST splice into the turn signal connector harness and NOT to the stoplight switch.
- Connecting to the terminal of the stoplight switch will break the switch and result in no stoplights and no trailer braking.

WARNING:

All 1999 and later Ford vehicles without the trailer wiring package:

- The red controller wire must be connected to the light green wire of the brake stop lamp through a 20-amp inline fuse.
- Failure to install a 20-amp inline fuse can destroy the controller and void the manufacturing warranty.

OEM TOW VEHICLE WIRING CONVERSION

CHRYSLER (THROUGH 2002)	CONTROLLER	FUNCTION	CHRYSLER (NEW)
RED W/BLACK TRACE	BLACK	+12 VOLT SUPPLY	WHITE WITH RED TRACE
WHITE W/TAN TRACE	RED	STOPLIGHT	BLUE WITH WHITE TRACE
BLUE	BLUE	TRAILER BRAKES	BLUE
BLACK	WHITE	GROUND	GREEN WITH BLACK TRACE

FORD (THROUGH 2002)	CONTROLLER	FUNCTION	FORD (NEW)
RED	BLACK	+12 VOLT SUPPLY	PINK
LIGHT GREEN	RED	STOPLIGHT	RED
BLUE	BLUE	TRAILER BRAKES	BLUE
WHITE	WHITE	GROUND	WHITE
BROWN	NOT USED	ILLUMINATION	BROWN

FORD EXPEDITION	CONTROLLER	FUNCTION
RED	BLACK	+12 VOLT SUPPLY
RED/GREEN TRACE	RED	STOPLIGHT
BLUE	BLUE	TRAILER BRAKES
BLACK	WHITE	GROUND

GENERAL MOTORS	CONTROLLER	FUNCTION
RED	BLACK	+12 VOLT SUPPLY
LIGHT BLUE	RED	STOPLIGHT
DARK BLUE	BLUE	TRAILER BRAKES
BLACK	WHITE	GROUND
BROWN	NOT USED	ILLUMINATION

2004 INFINITY	CONTROLLER	FUNCTION
RED	BLACK	+12 VOLT SUPPLY
RED/GREEN	RED	STOPLIGHT
BROWN/WHITE	BLUE	TRAILER BRAKES
BLACK	WHITE	GROUND
RED/BLUE	NOT USED	ILLUMINATION

RANGE ROVER	CONTROLLER	FUNCTION
REMOVE TAIL LIGHT AND	BLACK	+12 VOLT SUPPLY
CONNECT RED	RED	STOPLIGHT
CONTROLLER WIRE TO	BLUE	TRAILER BRAKES
BLACK/BLUE TRACE, NO	WHITE	GROUND
LIGHT WITH MANUAL	NOT USED	ILLUMINATION

2004 TITAN/ARMADA	CONTROLLER	FUNCTION
RED	BLACK	+12 VOLT SUPPLY
RED/GREEN	RED	STOPLIGHT
BROWN/WHITE	BLUE	TRAILER BRAKES
BLACK	WHITE	GROUND
RED/BLUE	NOT USED	ILLUMINATION

2004 TOYOTA TUNDRA	CONTROLLER	FUNCTON
BLACK-RED	BLACK	+12 VOLT SUPPLY
GREEN-WHITE	RED	STOPLIGHT
RED	BLUE	TRAILER BRAKES
BROWN	WHITE	GROUND

HAYES BRAKE CONTROLLER COMPANY

Engage™

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OPERATION MANUAL

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Automatic Operation

During braking, the Engage operates on a **time-based circuitry**. The longer the brake pedal is depressed, the greater amount of current delivered to the trailer brakes.

The **"power ramp time"** and **power** is adjustable to achieve trailer brake responsiveness.

The **digital display** will indicate the amount of power being sent to the trailer brakes.

Once the brake pedal is released, the unit will return to **"stand by"** mode. While in "stand by" mode, the controller will display the currently selected mode of display (% power, voltage, or current).

A DETAILED EXPLANATION OF THESE MODES IS INCLUDED IN THIS DOCUMENT.

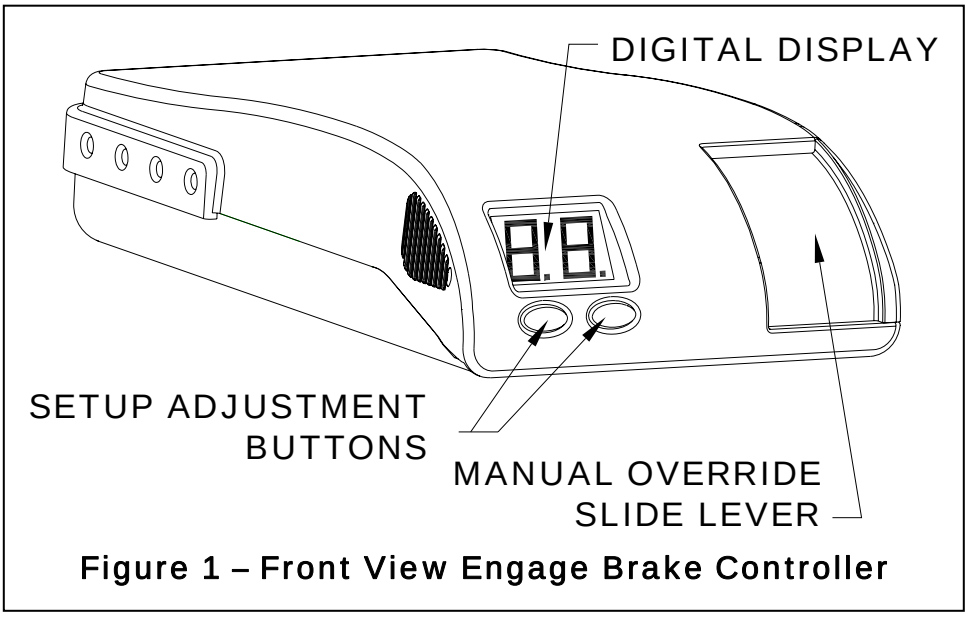

Figure 1 – Front View Engage Brake Controller

WARNING:

- Improper adjustment of the controller could result in loss of trailer brakes, aggressive, grabby, pulsating, or delayed trailer brakes.
- Power adjustments may be required based upon speed, trailer load, and road conditions.
- Maximum trailer braking occurs just prior to lockup of the trailer wheels.
- Trailer brake lockup could cause loss of control of the trailer and / or the tow vehicle.

Controller Features and Settings

This controller features the following options, selections, and settings. **Use illustration in Figure 1 to assist in adjustment of settings.**

HAYES BRAKE CONTROLLER COMPANY

Engage™ Brake Controller
Item # 81760
Quick Reference

Option	Available Selections	Change procedure
Display Mode (P is the default mode. This mode should be used unless PH mode is required.)	P : % of available power being sent to trailer brakes (PH for hydraulic actuators) E : Voltage (DC) being sent to trailer brakes (EH for hydraulic actuators) C : Current (DC) being applied to trailer brakes (for setup only)	• Press "+" button until the display flashes and release • Display mode will flash (P, E, C, PH, or EH) • Press "+" button to cycle through optional display modes • When desired display mode is displayed, press "–" button until the flashing stops and release • The new display mode is now set **Note:** PH or EH display modes do not check for trailer connection and will not flash "OC"
Power Ramp Time	(seconds) 1 2 3 4 5	• Press "-" button until the display flashes and release • Power Ramp Time will flash (1, 2, 3, 4, or 5) • Press "-" button to cycle through optional settings • When desired time is displayed, press "+" button until the flashing stops • The new Power Ramp Time is now set • The newly selected value will be displayed for a few seconds • After 15 seconds, the display will revert back to showing the display mode (P, E, C, PH, or EH) if no further selection is made
Maximum Power (Automatic Braking only) (50% is the factory default setting.)	5% increments 10% to 100%. 100% is displayed as "**99.**"	• Press "+" or "-" button and release • The current power setting will be displayed • To raise the displayed power setting, press "+" button and release • To lower the displayed power setting, press "-" button and release. When no change is made for several seconds, the displayed power setting will be stored as the current Maximum Power. The display will revert back to showing the display mode (P, E, C, PH, or EH) and stores the last selected power setting

The following is a list of potential trouble codes. Refer to the installation guide for complete explanation of the codes

Display	Code	Possible Cause
SC	Short Circuit	This indicates a direct short to ground in the blue wire (output) circuit
CL	Current Limit	Indicates that the brake controller is providing more than it's maximum rated power
OC	Open Circuit	Indicates that there is no trailer connection detected or the brake controller is connected to Electric/Hydraulic Actuated brakes
HF	Hazard Flash	Will display while hazard flashers are on
bF	Voltage on Blue Wire	Blue wire connected to wrong place, short in wiring / connector, faulty or disconnected breakaway switch

Definitions of Options

Display mode:

- The controller is factory pre-set to display mode P **(% of maximum power**)
    - **During braking conditions** - the number displayed indicates the % of power being applied to the trailer brakes.
    - It is recommended that display mode P (or PH for a hydraulic actuator) be used while operating the vehicle.
- PH mode also displays the % of power being applied to the trailer brakes. The scale for this is "0"-"99."
- Other available display modes:
    - Voltage (E or EH) can be used in operation, but **it should be noted** that the actual voltage supplied to the trailer brakes may vary from the displayed value by up to 1 Volt.
    - Current (C) reading can be used in troubleshooting and setup to ensure that the amperage draw of the trailer brakes is in the proper range based on the number of axles on the trailer
        - **DO NOT** use this setting while operating the vehicle. With the manual fully on, the brake coils should draw approximately 3 amps each.
        - **DO NOT** make current readings with the manual less than full on.
        - The current reading may vary significantly due to temperature swings in the brake magnets.

Changing Display Mode

The symbols (P, E, C, PH, or EH) that are displayed under normal braking conditions may be changed as follows:

1. **With the vehicle at rest**, press the "+" button until the display flashes and release. The display will flash a letter, which corresponds to the set display mode (P, E, C, PH, or EH).
2. To change the set mode, press the "+" button and release. The display will change from P to E to C to PH to EH with sequential presses of the "+" button.
3. Continue pressing the "+" button until the desired display mode is shown on the display.
4. Press the "-" button and hold until display stops flashing and release.
5. The new display mode is now set.

Notes:

- The P display mode is the factory default mode and is the recommended display mode. If the trailer has an Electric over Hydraulic Actuator, the PH display mode is recommended.
- The PH and the EH display modes do not test for a trailer connection.
- After a few hours of being inactive (with a trailer connected), the display will go blank. While the display is blank, very little power will be used by the Engage.

Maximum Power (Automatic braking only):

- The controller is factory pre-set to 50%. This means that approximately HALF of the power available through the vehicle's charging system can be applied to the brakes.
- For Example, under automatic braking (via the brake pedal), the maximum power is the % of available power that is sent to the trailer brakes upon completion of the Power Ramp Time.

Changing Maximum Power for automatic braking only

The maximum power may be changed from the default 50% value by doing the following:

NOTE: To change the power, the controller must be in "normal" operating mode. (i.e., displaying P, E, C, PH, or EH not flashing)

1. **With the vehicle at rest**, press either the "+" or "-" button momentarily and release. The set maximum power will be displayed.
2. While this maximum power value is displayed, press either the "+" (increase) or "-" (decrease) button to make changes to the power setting. The power percentage will change in increments of 5% with each sequential button push.
3. The controller is instantly set to the newly displayed value.
4. When no button has been pressed for several seconds, the system will become idle and the display will change to Display mode (P, E, C, PH, or EH).

NOTE: when the value reaches 100%, the display will read "**99.**"

Power Ramp Time:

- The controller applies power to the trailer brakes based on a time-based circuitry.
  - The controller is factory pre-set to 3 seconds. - the number displayed indicates the selected power ramp time to deliver power to the trailer brakes.
  - When the Controller senses that the brake pedal has been depressed
    - 10% of the available power is immediately applied to the trailer brakes.
    - This power level continues to increase until it reaches a user-selectable setting (see **Changing Maximum Power** section).
    - **Power Ramp Time** - The elapsed time from the point that the brakes are first applied until the point that the power level reaches its maximum
      - Power Ramp Time can be adjusted (1 - 5 seconds) to obtain optimum trailer brake responsiveness between the tow vehicle brakes and the trailer brakes.
      - Figure 2 illustrates the effect of varying Power Ramp Time vs. the controller's output.

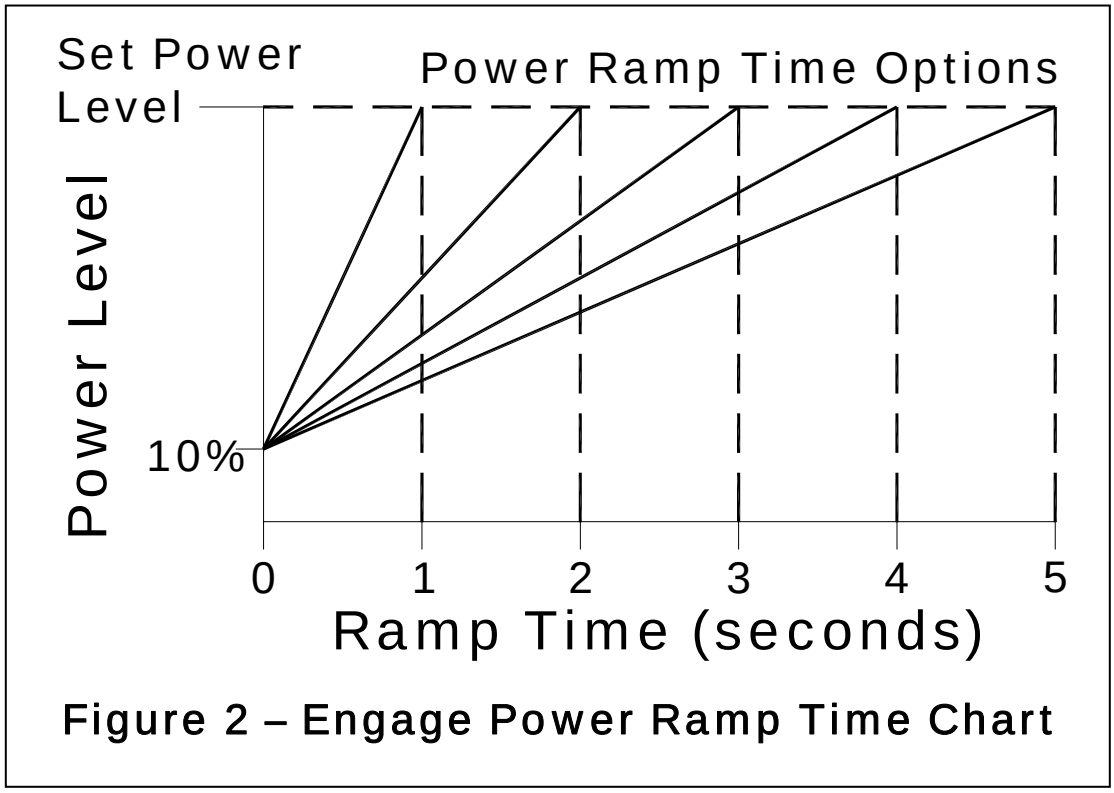

Figure 2 – Engage Power Ramp Time Chart

Changing Power Ramp Time

1. **With the vehicle at rest**, press the "-" button until the display flashes and release. The display will flash a number, which corresponds to the set Power Ramp Time (seconds).
2. To change the set value, press the "-" button and release. The display will change to the next highest available value with sequential presses of the "-" button.
3. Continue pressing the "-" button until the desired Power Ramp Time value is displayed. The range is 1 to 5 seconds.
4. Press the "+" button and hold until the display stops flashing.
5. The new Power Ramp Time is now set.

NOTE: when the value reaches 100%, the display will read "99."

Manual Operation

WARNING:
Manual operation via the manual slide lever may not disengage the Cruise Control on some vehicles.

- The **"Manual Slide Lever"** (Figure 1) is located on the front right side of the controller.
- The further the manual slide lever is moved from the right to the left, the greater the amount of trailer braking effort.
- The manual slide lever operation is an independent circuit and overrides the maximum power adjustment to allow full braking effort when required.
- Manual Slide Lever is used to apply the trailer brakes independently of the tow vehicle brakes or to override the automatic trailer brakes when more or less braking is required.
- The manual slide lever is used in emergency stop situations when more braking may be required than is available with the power wheel adjustment or for control of excessive trailer sway.
- The tow vehicle and trailer brake stoplights will be illuminated during the manual lever activation.

TIP:
It is normal to hear the trailer brake magnets "hum" when operating the trailer brakes.

Troubleshooting using the manual slide

To verify the brake controller is properly wired, follow these steps:

A. Disconnect the tow vehicle/trailer electrical connector. Set the display mode to PH. Move the manual slide lever (Figure 1) to the left. The displayed value should increase and the tow vehicle stop lamps must illuminate.
B. If SC is displayed, the tow vehicle has a short to ground in the trailer brake circuit or the white ground wire is not connected to ground. Check and/or repair wiring and tow vehicle/trailer connector.
C. If the stop lamps do not illuminate, check the red stoplight wire connection of the brake controller for connections to the non-powered stop lamp wire of the vehicle stop lamp switch. Set the display mode to P if trailer does not have electric/hydraulic brakes.
D. Connect the tow vehicle/trailer electrical connector.
E. If the display flashes OC, check and repair blue wire connections and brake coil connections. The controller does not see a brake coil connection.
F. Move the manual lever to the left. The displayed value should increase and the trailer stop lamps must illuminate.
G. If SC or CL is displayed, check the trailer brake magnets and trailer brake circuit (including the tow vehicle/trailer connector) for a short to ground.
H. If the trailer stop lamps do not illuminate, check and repair trailer wires, bulbs, bulb ground connections, and the tow vehicle/trailer connector.
I. Also check the red stop light wire connection of the brake controller for connections to the non-powered stop lamp wire of the vehicle stop lamp switch.

Road Test and Performance Adjustment

To set the controller up for optimum performance with your tow vehicle / trailer combination, follow these steps:

A. Position vehicle on a hard, flat, dry surface.
B. Set the display mode to % (P or PH for Hydraulic brakes). See "**Changing Display Mode**" section.
C. Adjust the power setting to 50%. See "**Changing Maximum Power**" section.
D. Accelerate to approximately 25 mph and apply the brakes in a normal manner. The vehicle should come to a stop without the trailer "pushing" the tow vehicle. A firm braking action should occur.
E. If the trailer brakes lock, decrease the power.
F. If more braking power is needed, increase the power.
G. Repeat this process until the desired amount of braking is achieved.
H. If needed, follow the instructions in **"Changing Power Ramp Time"** section to increase or decrease the Power Ramp Time.

There are two methods of adjusting the output and responsiveness of your Engage Brake Controller. They are listed here in the order in which they should be modified:

1. **Power Adjustment**:
   The power is adjustable from 10% to 100%. This figure is based on the amount of power available for delivery to the trailer brakes. The total amount of power available is determined by the size and condition of the vehicle's charging system.
2. **Power Ramp Time Adjustment**:
   As described earlier in this document, this is the amount of time the controller takes to raise the output from 10% to the user-selected Maximum Power level.

TIP:

- Warm trailer brakes tend to be more responsive than cold brakes.

Troubleshooting using the display

The Digital Display will “flash” a symbol to indicate a problem with the trailer, the tow vehicle, or the brake controller.

Short Circuit:
The display will flash “**SC**”. This indicates that the controller has sensed a direct short between the controller’s output and ground. **<u>This condition must be cleared before the controller is used</u>.** It is usually an indication that a “hot” wire is connected to ground.

Current Limit:
The display will flash “**CL**”. This indicates that the controller has sensed a power requirement greater than its recommended output. When this occurs, the controller will continue to supply all of the needed current (up to approximately 24 amps). This could result from an intermittent short to ground in the trailer wiring, a faulty brake coil, or too many brake coils connected to the controller.

Open Circuit:
The display will flash “**OC**”. This is an indication that there is no trailer connected to the tow vehicle. Flashing “OC” will display for a few minutes or until a trailer is connected to the tow vehicle. Connection to electric over hydraulic trailer brakes can also cause the display to flash “OC”. The display will go blank when no load is detected for several minutes.

TIP:

- If a trailer with electric over hydraulic brakes is connected and “OC” is flashing, change the display mode to PH or EH. PH is recommended.

TIP:

- If “OC” is flashing (with no trailer connected), the display will turn-off after several minutes.

TIP:

- During the time that the controller senses the Hazard Flash, no power will be sent to the trailer brakes. Therefore, there should be no pulsing of the brakes.

Hazard Flash:
The display will flash “**HF**”. This occurs when the controller senses a distinct cycling of power in the brake light circuit. The controller will continue to display “HF” until the cycle is broken either by a braking event or by a discontinuation of the power cycling.

Blue Wire Fault:
The display will flash “**bF**”. This occurs when external voltage is detected on the blue wire. The controller will continue to display “bF” until external voltage is removed. Possible causes can be the blue wire being connected to the wrong place, a short in the wiring or the connector, or a faulty or disconnected breakaway switch.

Troubleshooting

Symptom	Possible Cause	Remedy
Trailer Brakes “Lock Up”.	Power set too high.	Reduce maximum power setting.
Low output to trailer brakes.	Power set too low.	Increase maximum power setting.
Weak / Ineffective Brakes.	Overloaded trailer.	Check weight rating.
	Loose or poor quality. Connections.	Inspect connections / check with meter.
	Insufficient wire gauge	Inspect / replace.
No output to trailer brakes (manual or automatic).	Improper Wiring.	Check color codes of all wires.
	Improperly grounded.	Ensure that the following are grounded: • Controller (white wire). • Tow vehicle connector. • Trailer umbilical cord. • Each brake magnet.
No output to trailer brakes (automatic only).	Faulty Brake Light Circuit on tow vehicle.	Troubleshoot / repair brake light circuit.
Intermittent or surging brakes.	Improperly grounded.	Check and repair all ground connections.
	Out of Round brake drums.	Repair / replace.
	Worn wheel bearings.	Repair / replace.
No output to trailer brakes, display reads “SC” when brakes are applied.	Direct short to ground either in tow vehicle wiring or in trailer wiring.	Inspect and repair wiring.
	Faulty brake magnets.	Test / replace brake magnets.
Reduced output to trailer brakes, display reads “CL” when brakes are applied.	Too many brake magnets are attached to controller.	Controller only handles 1-3 axles with brakes.
	Intermittent short to ground in tow vehicle or trailer wiring.	Inspect and repair wiring.
	Defective brake magnets.	Test / replace brake magnets.
Trailer brakes lockup when trailer connector and cable is attached.	Faulty break-away switch.	Test / replace switch.
Controller displays flashing “bF”.	Indicates presence of an unexpected 12 Volts on the blue (output) wire due to one of the following: • Faulty wiring. • Malfunctioning or disconnected break-away switch.	Inspect wiring and break-away switch. Ensure that there is no voltage on the blue wire when the brake pedal is not depressed.
Controller displays flashing “OC”. **Note:** If the display mode is set to PH or EH, the controller will not check for a trailer connection and will not flash “OC”.	No trailer connected.	Flashing will stop in a few minutes.
	Trailer with Electric over Hydraulic brakes.	Change Display mode to PH or EH. **Note:** These two modes do not check for a trailer connection.
	Blue controller wire not connected to correct wire.	Inspect wiring and repair.