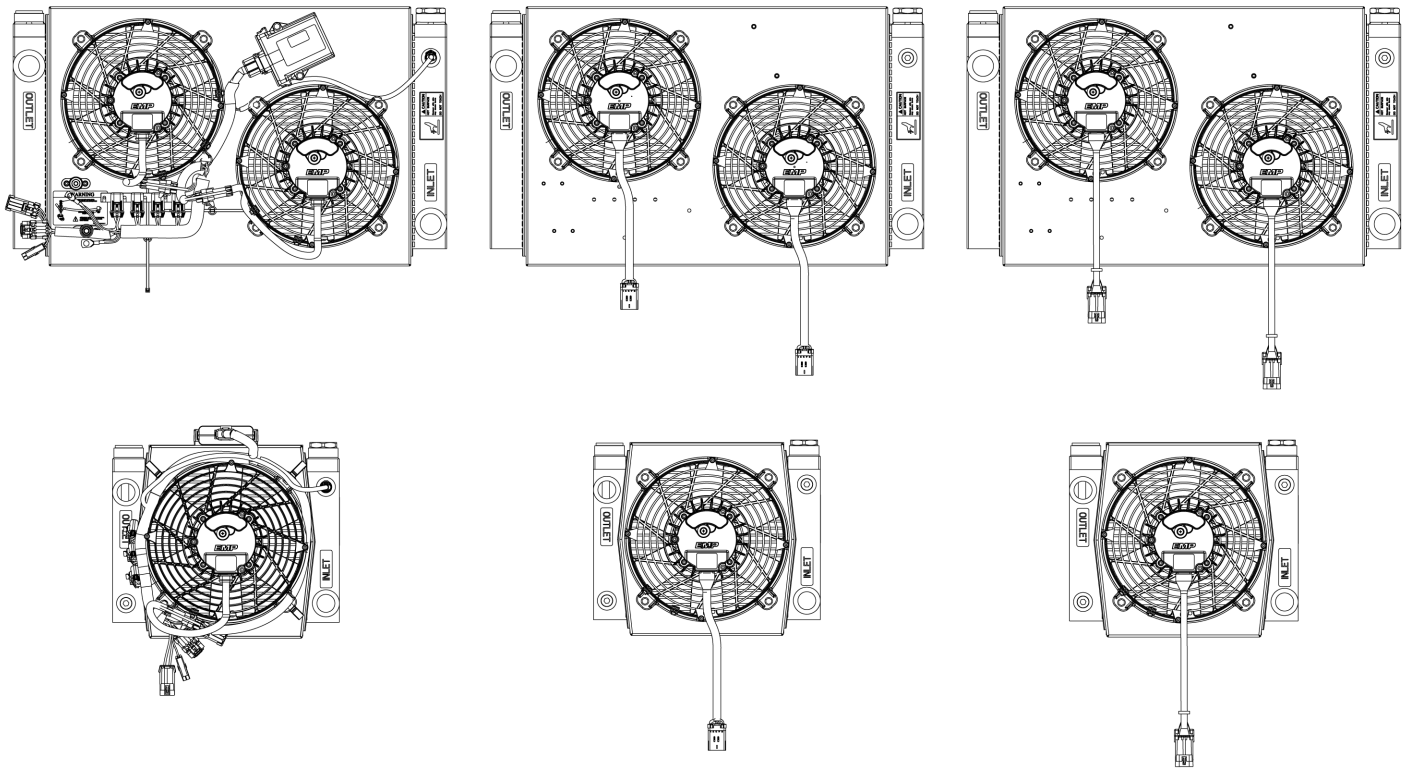
Installation and Service Manual
OK1/OK2 Oil Cooler Assembly



This manual is effective for the installation and service of OK1 and OK2 systems with 11” fans. See System Part Numbers for a complete list of systems.

Rev	Rev By	Date	Description of Change	Approved By
G	ME	5/19/22	Revisions	ECN7628
H	ME	1/10/23	Revisions	ECN8814

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Product Overview

The EMP OK1/OK2 oil cooling systems are advanced thermal management products designed for applications requiring cooling of hydraulic oil, system oil, transmission oil, fluid or any other general cooling application using oil or a similar fluid. Benefits include lower energy consumption, reduced noise, individual fan diagnostics and improved temperature control. This document defines the installation requirements and service parts replacement requirements for the OK1 and OK2 system part numbers listed in System Part Numbers.

The installation requirements defined in this document must be followed in order to ensure the proper operation and service life of OK1 and OK2 thermal systems.

Table of Contents

Introduction

Purpose

The purpose of this document is to define the installation and service requirements of the OK1 and OK2 system part numbers that are listed in System Configurations. The requirements defined in this document must be followed in order to ensure proper operation and service life of OK1 and OK2 thermal systems.

Service Technician Responsibilities

Ensure that all safety messages and information messages are read and understood before installation, maintenance, or repairs are performed. It is important to use caution when service work is performed. Knowledge of impacted systems and their operation are important before the removal or disassembly of any component. Knowledge of hazards present and risk of injury to the service technician while working on these systems is critical to personal safety.

Liability Disclaimer

EMP cannot anticipate every possible circumstance that might involve a potential hazard. The safety messages in this document, in related manuals, and on the product are therefore not all inclusive. If a tool, procedure, work method, or operating technique that is not specifically recommended by EMP is used, you must satisfy yourself that it is safe for you and for others. You should ensure that the product will not be damaged or be made unsafe by the operation, maintenance, or repair procedures that you choose.

More Information

Documents and software referenced in this manual are available for download from the support section of the EMP website, https://www.emp-corp.com/support/.

Routine Maintenance

Routine maintenance schedule and procedures are outlined in service bulletin 9910039031.

Technical Help

Contact EMP Technical Service for technical help at +1 (906) 789-7497 or service@emp-corp.com.

Warranty

Mail, Fax, or Email the completed warranty registration form at the end of the document to:

EMP Advanced Development, LLC
2701 North 30th Street
Escanaba, MI, USA 49829
Fax: +1 (906) 789-7825
warranty@emp-corp.com

About This Document

Warnings, Cautions and Notes

Two headings are used in this document to stress your safety and safe operation of the system. They are styled with a graphic bullet and bold, uppercase text: **WARNING** and **CAUTION**. Warnings highlight risks to personnel — hazards, unsafe conditions and practices that can result in personal injury or death. Cautions indicate conditions or practices that can cause damage to components, systems, or other equipment.

A third heading, styled as **NOTE**, calls attention to additional information about components and procedures discussed in the document.

Definition of Terms

CAN ..... Controller area network.
LED ..... Light-emitting diode.
EMP-Link ..... EMP proprietary component to component communication network.
µTMC ..... EMP micro thermal management system controller.

Product Safety Warnings

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WARNING: Ensure that all safety messages and information messages are read and understood before installation, maintenance, or repairs are performed. It is important to use caution when service work is performed. Knowledge of impacted systems and their operation are important before the removal or disassembly of any component. Knowledge of hazards present and risk of injury to the service technician while working on these systems is critical to personal safety

WARNING: Ensure that the equipment cannot move before doing any work or diagnostic procedures on the EMP component, system, or vehicle.

WARNING: When working on or near electrical components, ensure that they have been disconnected from their energy source, cannot be accidentally re-energized, and verify the system is in a zero energy state.

WARNING: Use extreme caution when working on systems under pressure (i.e. coolant, hydraulic fluids, air, fire suppression, etc.).

WARNING: Ensure the work area is ventilated and well lit.

WARNING: Ensure charged fire extinguishers are in the work area.

WARNING: Ensure all safety guards, shields, and covers are reinstalled when tasks are completed.

WARNING: Ensure all tools, parts and service equipment are removed from the work area.

WARNING: Ensure that all system power and ground connection points are torqued to EMP and/or OEM specifications to prevent system damage. Failure to follow specified torque requirements can result in loose connections which can damage electronic components and will void EMP warranty.

System Configurations

Product Identification

The system product label, located on the upper left of the fan side on both OK1 and OK2 systems, lists the model code, system part number, and serial number of the system. The serial number can be used to obtain system configuration and all information necessary for component replacements.

Each fan has a product label giving the model code, part number, and serial number of the fan. Fans should be replaced with a matching part number. The serial number can be used to obtain information about the hardware and software configuration of the fan.

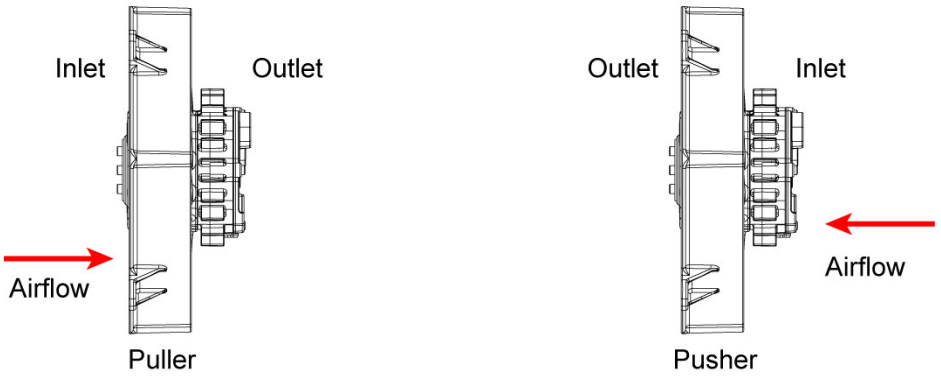
Model Codes

The OK1 and OK2 oil coolers discussed in this manual share 12 model codes indicating the number of fans, main dimensions, voltage, and certifications of each system.

Model Code	Fans	Dimensions (in)	Voltage (V)	Certification
OK1-1714-12V	1	17x14	12	-
OK1-1714-24V	1	17x14	24	-
OK1-1714-12V C	1	17x14	12	CSA
OK1-1714-24V C	1	17x14	24	CSA
OK1-1714-12V U	1	17x14	12	UL
OK1-1714-24V U	1	17x14	24	UL
OK2-3219-12V	2	32x19	12	-
OK2-3219-24V	2	32x19	24	-
OK2-3219-12V C	2	32x19	12	CSA
OK2-3219-24V C	2	32x19	24	CSA
OK2-3219-12V U	2	32x19	12	UL
OK2-3219-24V U	2	32x19	24	UL

Airflow Direction

Systems are available with pusher or puller fans, and with different control strategies. The system part number tables in this section give the fan direction (in the description) and control strategy for each part number.

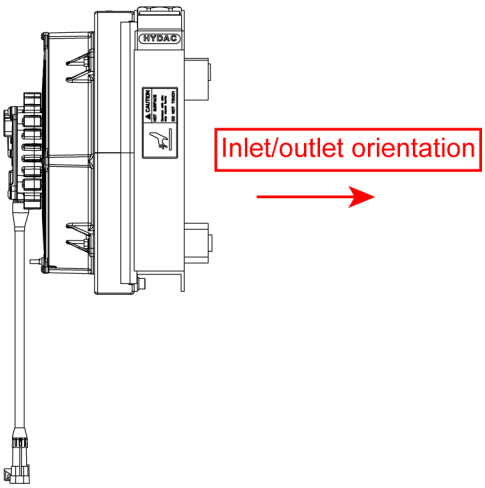


System Part Numbers

OK1 and OK2 system configurations vary in voltage, control strategy, fan.

12 Volt Part Number	24 volt Part Number	Type	Control	Cert	Fan
2020029049	2020029050	OK1	µTMC	-	Pull
2020029051	2020029052	OK1	µTMC	-	Push
2020029150*	-	OK1	µTMC	-	Push
2020029053	2020029054	OK1	R20L	-	Pull
2020029055	2020029056	OK1	R20L	-	Push
2020029148*	-	OK1	R20L	-	Push
2020029076	2020029077	OK1	R20L	CSA	Push
2020029078	2020029079	OK1	R20L	CSA	Pull
2020029080	2020029081	OK1	R20L	UL	Push
2020029082	2020029083	OK1	R20L	UL	Pull
2020029084	2020029085	OK1	µTMC	CSA	Push
2020029086	2020029087	OK1	µTMC	CSA	Pull
2020029088	2020029089	OK1	µTMC	UL	Push
2020029090	2020029091	OK1	µTMC	UL	Pull
2020029125	2020029126	OK1	R20C	-	Push
2020029127	2020029128	OK1	R20C	-	Pull
2020029058	2020029059	OK2	µTMC	-	Pull
2020029060	2020029061	OK2	µTMC	-	Push
2020029062	2020029063	OK2	R20L	-	Pull
2020029064	2020029065	OK2	R20L	-	Push
2020029093	2020029094	OK2	µTMC	CSA	Pull
2020029095	2020029096	OK2	µTMC	CSA	Push
2020029097	2020029098	OK2	µTMC	UL	Pull
2020029099	2020029100	OK2	µTMC	UL	Push
2020029101	2020029102	OK2	R20L	CSA	Pull
2020029103	2020029104	OK2	R20L	CSA	Push
2020029105	2020029106	OK2	R20L	UL	Pull
2020029107	2020029108	OK2	R20L	UL	Push
2020029121	2020029122	OK2	R20C	-	Pull
2020029123	2020029124	OK2	R20C	-	Push

* 2020029148 and 2020029150 have the fluid inlet and outlet oriented opposite the fan.



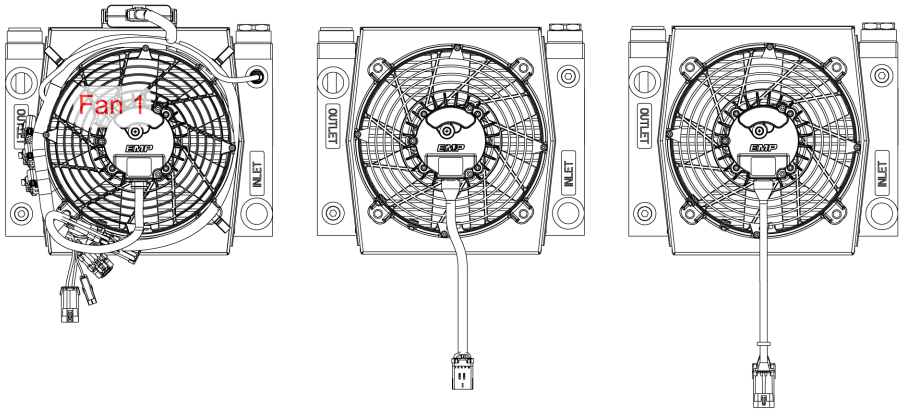
System Information

Operation

Systems with a µTMC provide temperature-based fan speed control. A harness connects the µTMC and fans and provides power, ground, a connector for an optional on-board diagnostic lamp/pushbutton and a connector for interfacing with service tools. Reference Appendix B, *Operation Manual µTMC System Controller* for more information. For assistance with system calibrations or settings please contact EMP Technical Service at service@emp-corp.com and provide a serial number for the part in question.

For information about interfacing with and operating the fans on systems with R20L and R20C control strategy, refer to *Service and Installation Manual 11 Inch Axial Fan Assembly*, EMP document 9980036021.

OK1

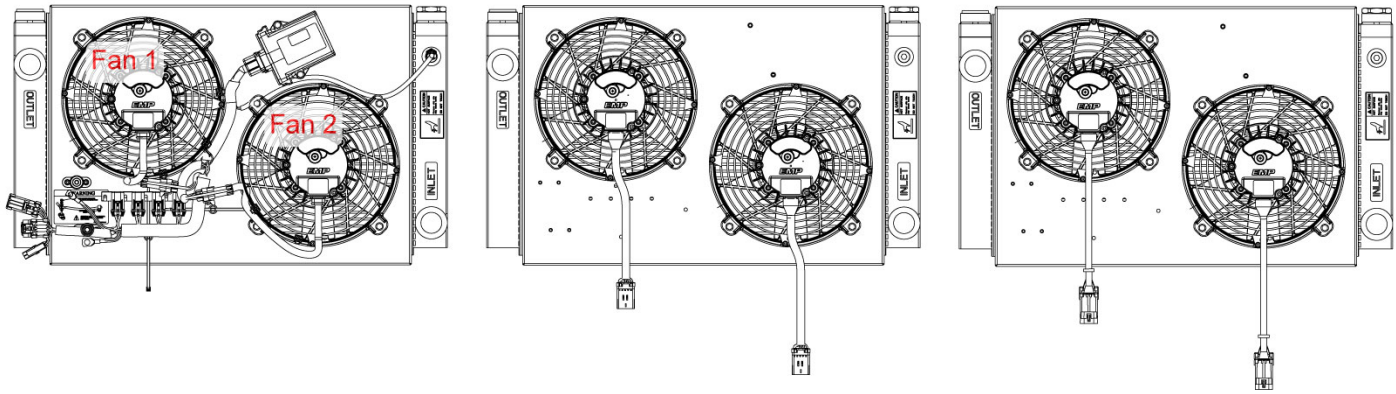


Maximum current consumption	25 amps
Ignition enable	switched 9–32 volt source
Overall package length	16.5 inches
Overall package width	14 inches
Overall package depth	9 inches
Weight (without fluid)	33 pounds
SAE O-ring port size	-16
Inlet and outlet thread size	1 5/16-12 UN
Maximum pressure drop in cooler @ 30 mm^2/sec and 30 gpm	8 psi
Heat exchanger volume	0.6 gallons

µTMC Controlled Systems

Harness assembly	3170029067
Fan 1 address resistance	Open

OK2



Maximum current consumption	50 amps
Ignition enable	switched 9–32 volt source
Overall package length	32 inches
Overall package width	19 inches
Overall package depth	10 inches
Weight (without fluid)	75 pounds
SAE O-ring port size	-20
Inlet and outlet thread size	1 5/8-12 UN
Maximum pressure drop in cooler @ 30 mm^2/sec and 30 gpm	12 psi
Heat Exchanger Volume	0.8 gallons

µTMC Controlled Systems

Harness assembly	3170029068
Fan 1 address resistance:	Open
Fan 2 address resistance:	Short

Common Specifications and Operating Limits

Fluids Range from Mineral Oil to DIN 51524 Part 1 and Part 2.

Heat exchanger material	Aluminum
Shroud material	Steel
Maximum ambient operating temp	95 °C
Minimum operating temp	-40 °C
Maximum storage temp	125 °C
Minimum storage temp	-50 °C
Maximum oil temp	130 °C
Minimum operating speed	750 rpm
Maximum operating speed (12V)	4000 rpm
Maximum operating speed (24V)*	4600 rpm
Maximum continuous operating pressure	230 psig
Internal bypass pressure value	45 psig
Maximum recommended oil flow rate**	45 gpm
Heat exchanger fin/inch	12 fins/inch
Maximum viscosity	2000 cSt

NOTE: Higher fan speeds are available but conditions must be approved by EMP.

NOTE: Higher flow rates can be used but fluid conditions must be reviewed.

Wiring and Fusing Requirements

Maximum continuous operating ambient temp	95 °C
Wire jacket temp rating	125 °C
Wire sleeve and loom temp rating	125 °C
Nominal fuse rating/fan	30 amps
Wire jacket material	XLPE

Heat Rejection

Inlet Temperature Differential (ITD) = (oil temperature into cooler - air temperature into cooler)

The performance of the system can vary ±10%.

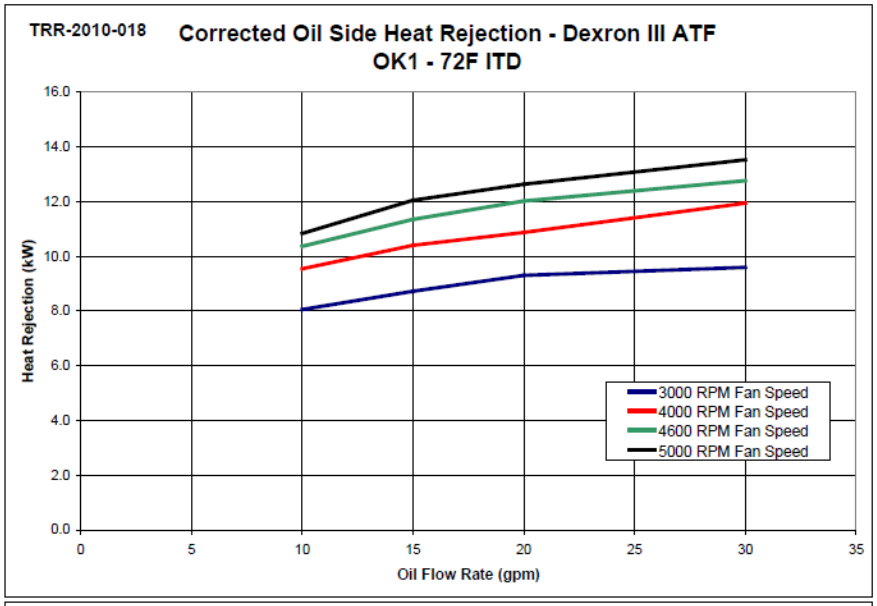
No external system restriction or airflow recirculation represented in test data. The system must be validated in the application to determine the affect additional system restriction and airflow recirculation have on performance.

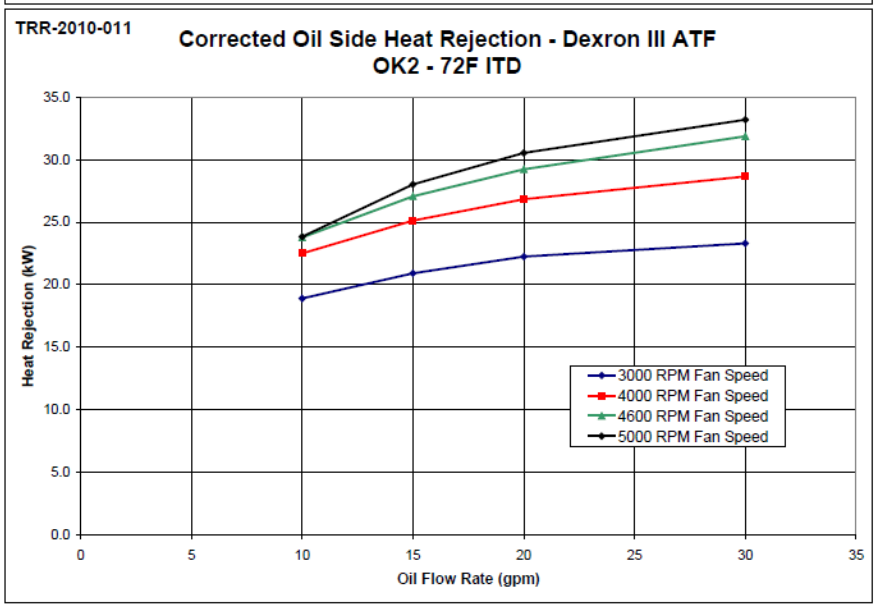
4000 rpm is the maximum speed setting on 12V OK1 and OK2. The 4000 rpm line represents the maximum performance achievable at 12V.

4600 rpm is the maximum speed setting on 24V OK1 and OK2. The 4600 rpm line represents the maximum performance achievable at 24V.

Depending on ambient conditions and duty cycles, cooler performance exceeding the 4600 rpm line can be achieved with 24V systems. Contact EMP to discuss these special cases.

The test results are for fans in puller configuration. Contact EMP for pusher configuration data.





µTMC Controlled Systems

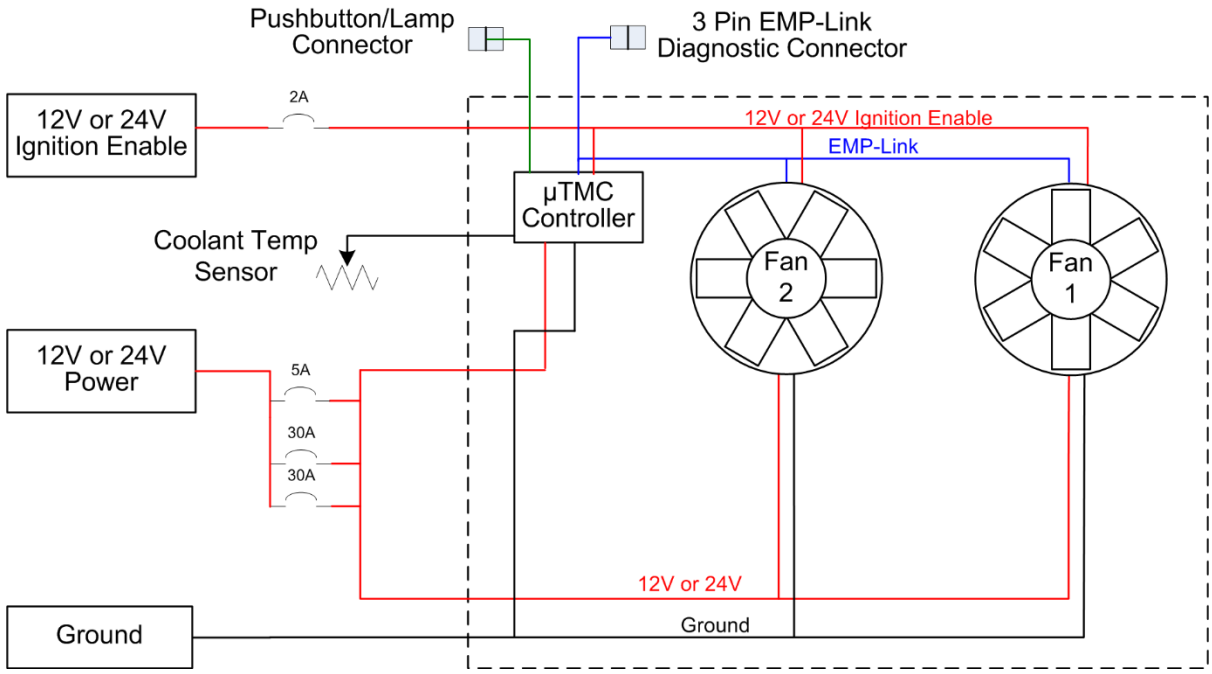
On µTMC systems, a harness is used to distribute vehicle power from the power and ground studs, for component fusing, for component communication and for temperature input. The harness also has connections for ignition enable, an onboard diagnostic lamp/pushbutton, and for communication with software service tools. Open and short addressing within the harness assembly is used to set the EMP-Link addresses for the individual FIL11 fans. The harness is secured to the OK1/OK2 shroud using cable ties and/or J clips.

Operation initiates when the µTMC controller and fans receive the ignition enable signal. The µTMC monitors temperatures and adjusts fan speeds to provide the required cooling. If communication is disrupted, the fans will continue to run at a programmed default speed.

A single fan part number is used for both locations on OK2 systems. The EMP-Link addresses used by the fans are set by reading resistance values from the harness.

System Schematic

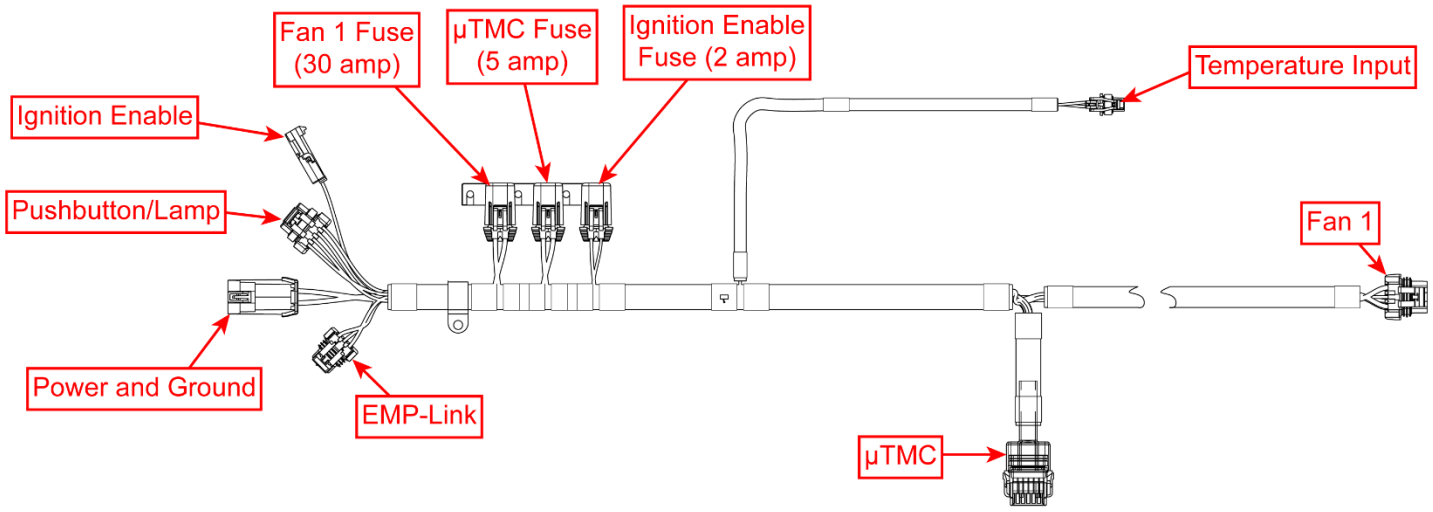
NOTE: OK2 schematic shown. For OK1 remove wiring to second fan and eliminate second 30A fuse.



Temperature Controlled OK1/OK2 Schematic

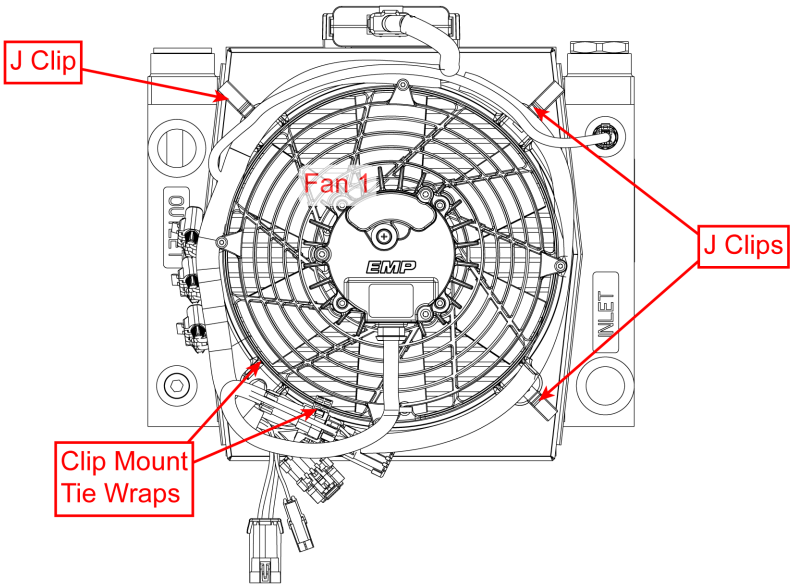
CAUTION: Ensure that all system power and ground connection points are torqued to EMP specifications to prevent system damage. Failure to follow specified torque requirements at any point of the vehicle system power and ground can result in loose connections which can damage electronic components on the system and will void EMP warranty.

OK1 harness 3170029067



OK1 Harness Connections

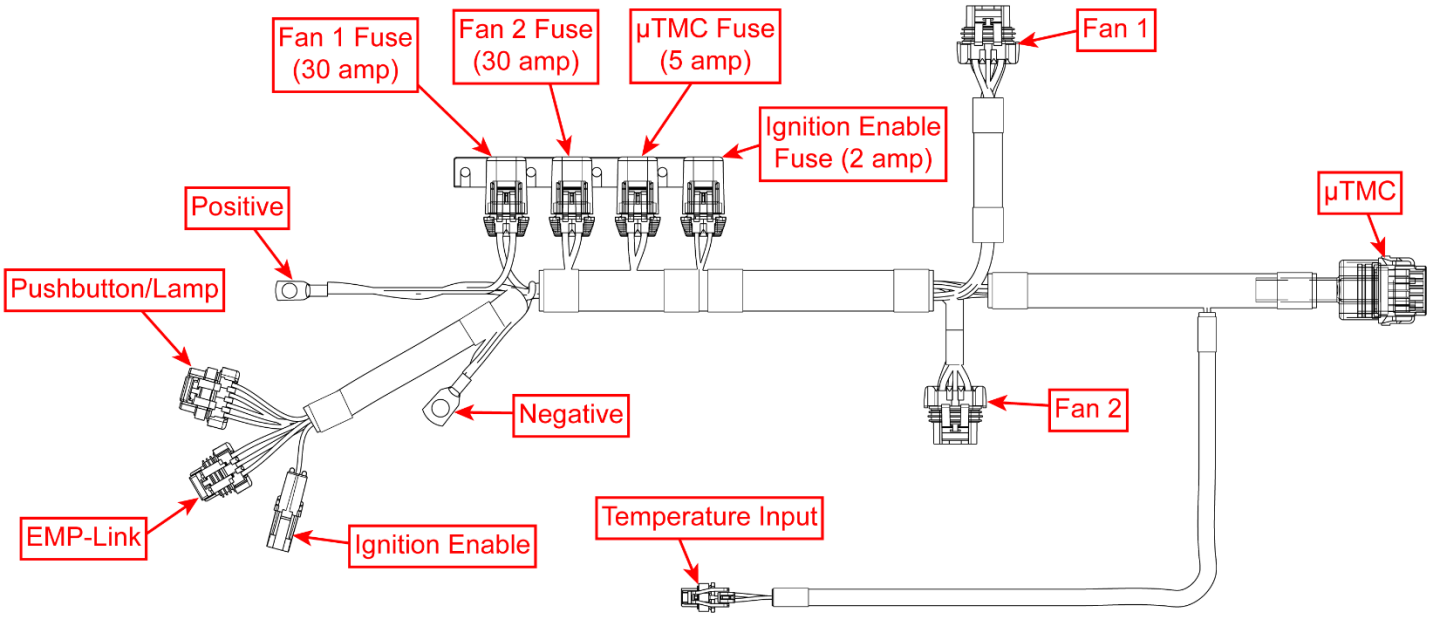
NOTE: The harness is routed and secured to the system to prevent water damage, premature wear, and other system damage. When replacing the harness, take care to properly route and secure the system harness.



OK1 Harness Layout

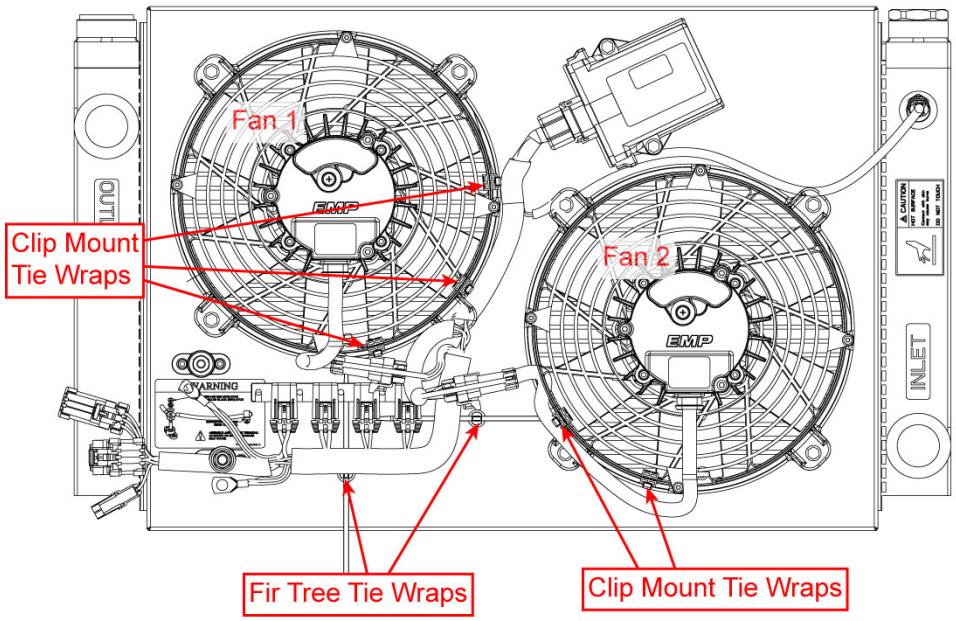
OK2 Harness 3170029068

NOTE: Harnesses shipped after June 2021 remove a wire from Fan 1 and the EMP-Link connector. The removed wire does not impact the function of the system.



OK2 Harness Connections

NOTE: The harness is routed and secured to the system to prevent water damage, premature wear, and other system damage. When replacing the harness, take care to properly route and secure the system harness.



OK2 Harness Layout

Manual Fan Reverse Input

A fan reverse input is available on µTMC systems. The input is designed for use with a momentary switch. Momentarily closing and opening the fan reverse input will trigger the calibrated fan reverse cycle.

Diagnostic Lamp Output

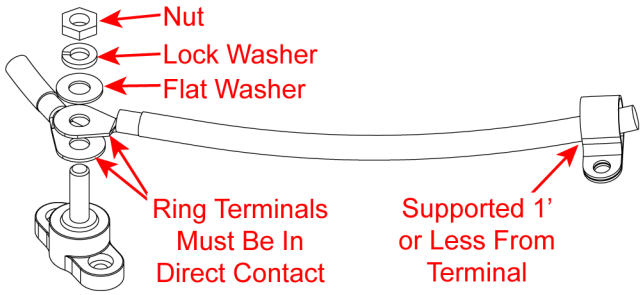
A diagnostic lamp can be connected to the system through a 4-pin connector. This diagnostic lamp will flash out blink codes to the technician to indicate the source of the fault when the vehicle is running. The format for the blink fault codes is XX-YY where:

XX is the first number of the fault code
YY is the second number of the fault code

The blink codes are read out in the following manner:

1. Warning lamp on for 4 seconds to mark the start of the fault code list
2. Off for 2.5 seconds to indicate the start of a fault code
3. A sequence of 0.5 second blinks the number of which indicates the first number (XX) of the fault code.
4. Off for 1.25 seconds to indicate the start of the second digit of the fault code.
5. A sequence of 0.5 second blinks the number of which indicates the second number (YY) of the fault code.
6. If multiple fault codes are active, the next fault code will be communicated beginning with step 2. When all fault codes have been communicated, the fault code list will be repeated beginning with the long on time of step 1.
7. The sequence will be repeated until the fault condition is removed or cleared manually
8. A table listing the meaning of the blink codes can be found in the Help menu of the Service Tool.

Power and Ground Stud Assembly



WARNING: To avoid serious personal injury, possible death, or damage to the vehicle, disconnect the main negative battery terminal and/or switch off the battery disconnect switch first before removing or installing any electrical components.

CAUTION: Ensure that all system power and ground connection points are torqued to EMP specifications to prevent system damage. Failure to follow specified torque requirements at any point of the vehicle system power and ground can result in loose connections which can damage electronic components on the cooling system and will void EMP warranty.

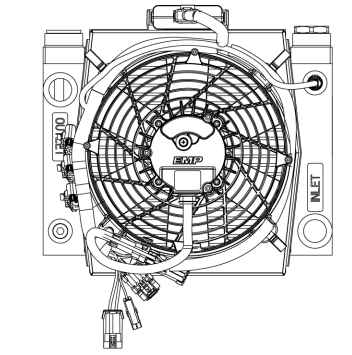
Installation

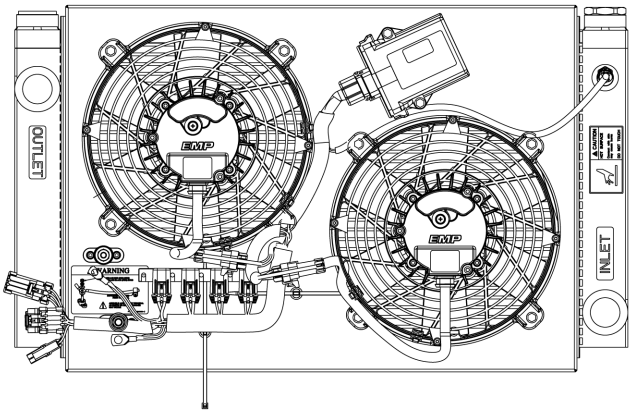
Orientation

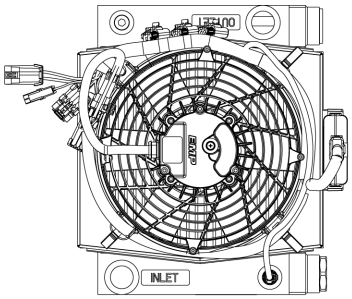
OK1 and OK2 systems must be installed in an orientation that minimizes trapped air. It is preferred that the installation orientation prevent pooling of liquid on sealed surfaces.

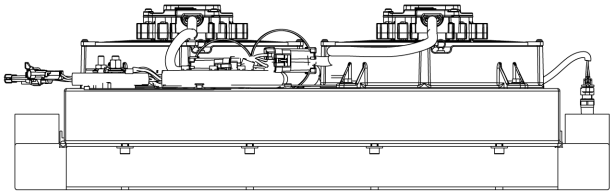
Preferred Orientations

All connectors are properly oriented to prevent pooling of fluid on sealing surfaces. Tanks oriented to minimize chances of air entrapment.



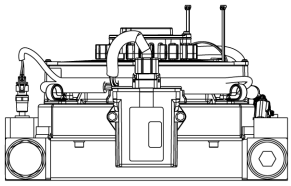


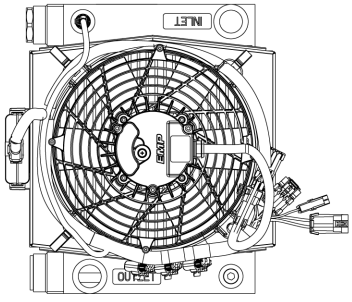


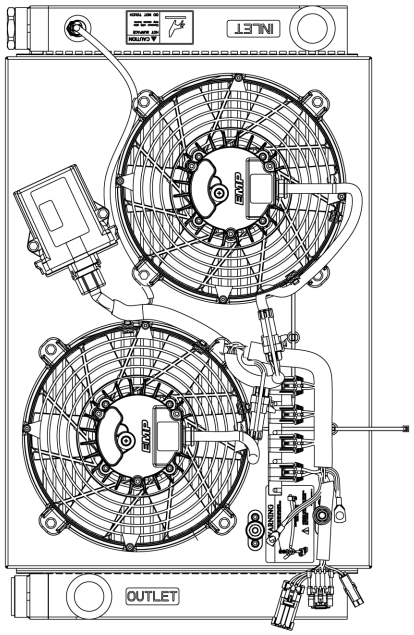


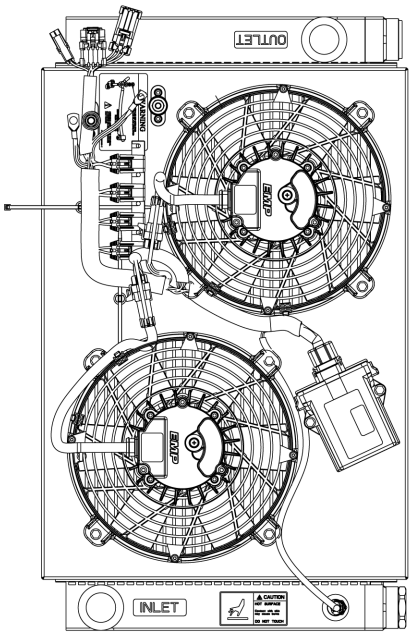
Not Preferred Orientations

Some connectors are not properly oriented to prevent pooling of fluid on sealing surfaces.



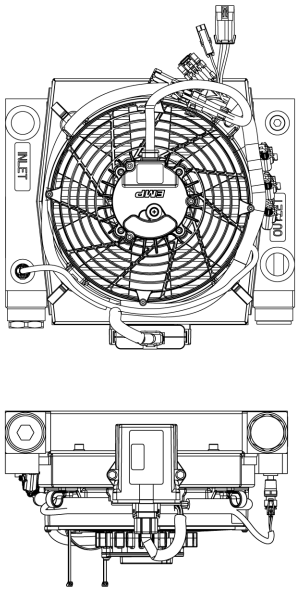


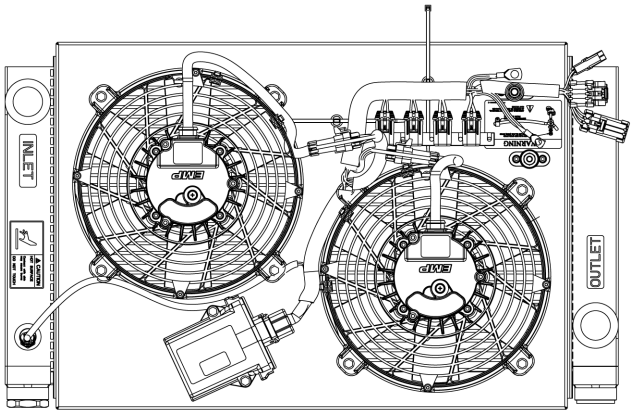


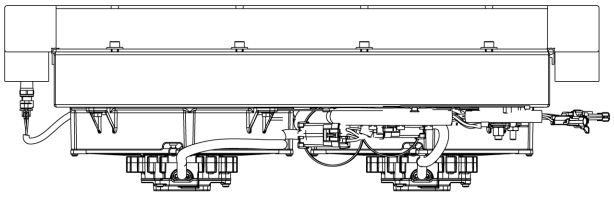


Unacceptable Orientations

The tanks are not oriented to minimize chances of air becoming trapped and most connectors are not oriented properly to prevent pooling of fluid on sealing surfaces.







Mounting

The oil cooler may be rigid mounted if vibration levels are not excessive. For excessive vibration, the cooler must be isolation mounted. Due to variance in mounting brackets, fasteners and vibration levels, the cooler should be validated in each unique application by the end user to ensure it meets the end user's requirements. Contact EMP for assistance and approval.

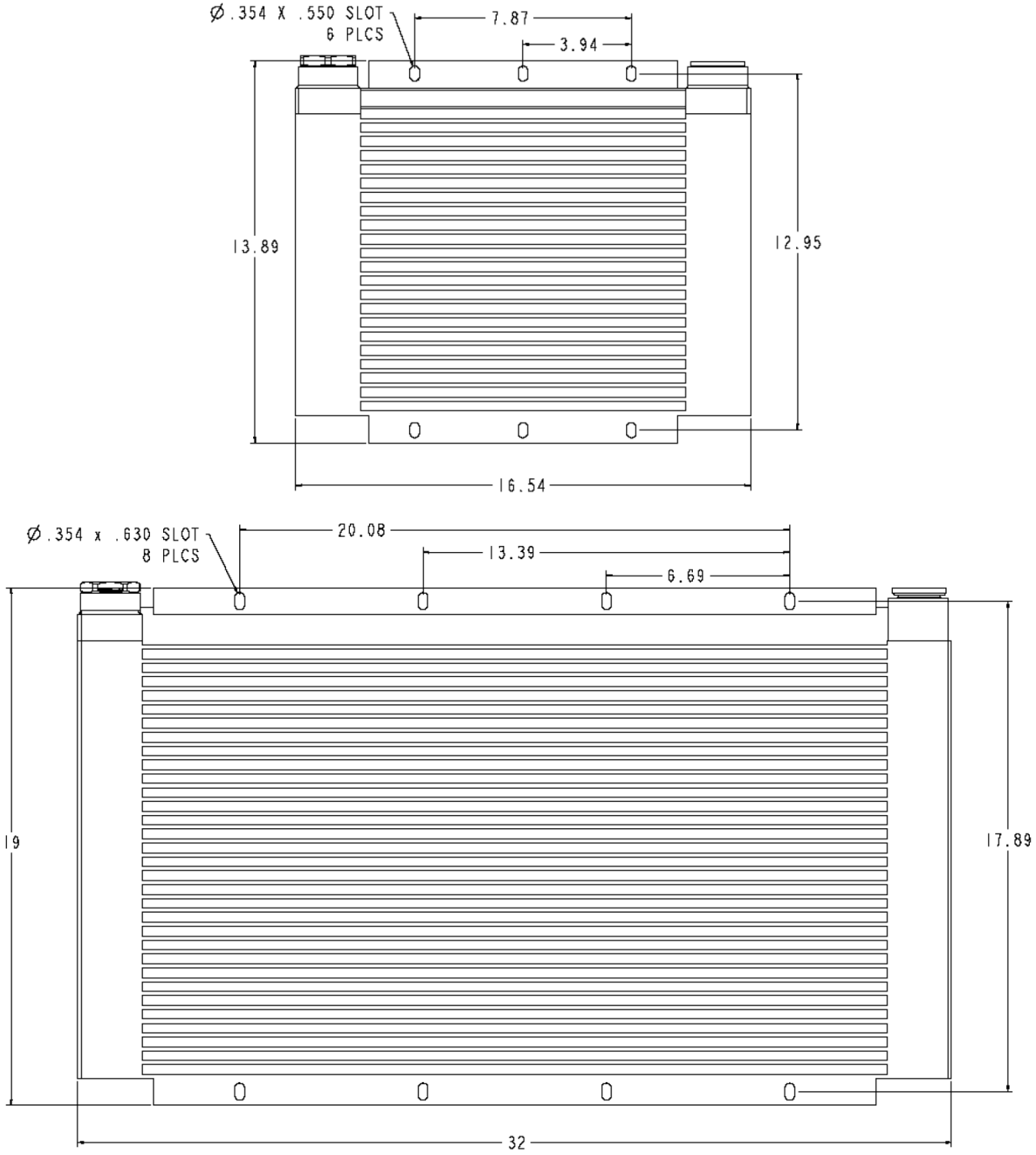
Airflow obstructions should be kept at least 2 inches from the inlet and outlet of the fan/heat exchanger assembly for optimal performance.

Refer to the orientation recommendations made above. They are intended to minimize the chance of trapping air in the system and to provide the best possible wire management for component sealing.

For optimum performance ensure the cooler draws in the lowest temperature air available. Seal the air inlet side of the cooler from the air outlet side to avoid the recirculation of the hot air coming out of the cooler.

M8 or 5/16" fasteners are recommended for mounting the cooler. Eight fasteners should be used on the OK2 and six fasteners on the OK1. The recommended torque value is 20±2 ft-lbs. Due to variance in fasteners and threaded inserts, the mounting needs to be validated in each application.

NOTE: The mounting flange thickness on the OK1 and OK2 is 6mm.



Plumbing

The oil cooler inlet and outlet must be plumbed in the configuration shown below in order for the 45 psi internal bypass to operate correctly. If the inlet and outlet are reversed, the cooler will operate correctly, but there will be no bypass protection. The inlet and outlet are labeled on the system.

The thermistor supplied with the system has a 3/8” NPT thread. A bushing must be used if threading it into the 1/2” NPT fittings on the cooler. The thermistor has pre-applied sealant on the threads. No additional sealant is required. For all NPT fittings tighten 2–3 turns past finger tight. The thermistor may also be remote mounted if the temperature at another location is desired for fan control. Note that the location of the thermistor will control the fan speed. This location must be carefully selected.

See the table below for recommendations on fitting torque for the OK1 and OK2 inlet and outlet. Lubricate the O-ring lightly with the system fluid or compatible oil prior to installing the fitting.

Lubrication of the female and male threads prior to installation is recommended.

It is recommended to place the cooler on the low pressure side of the installation to ensure the pressure stays below the 230 psi maximum rating. Pressure must be carefully observed with cold oil.

Any hosing or tubing must not rub on a sharp edge.

Any hosing or tubing must not rub or make contact with a hot surface. There should be 5” minimum clearance from the exhaust.

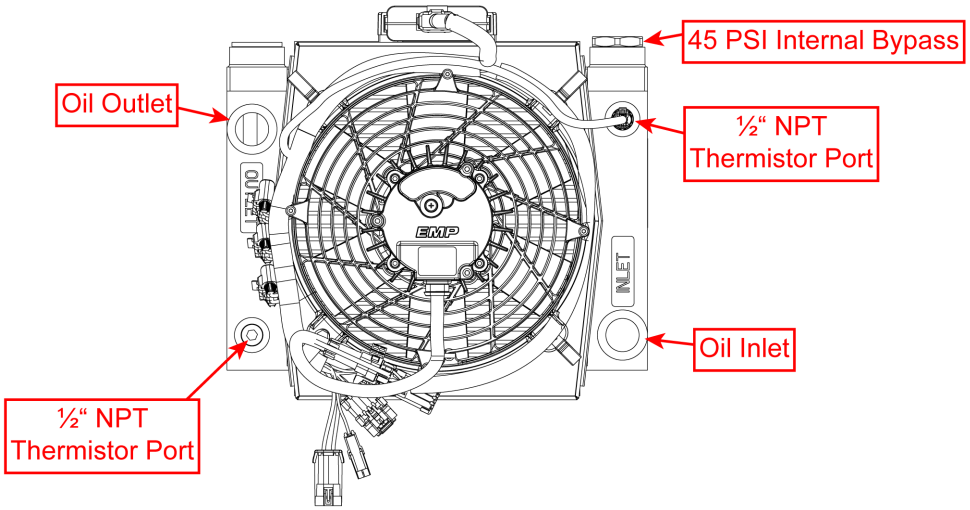
Any hosing or tubing should be supported at least every 18" to 20".

The cooler should be located on the low pressure side of the filter to avoid having pressure spikes in the cooler due to the filter clogging. If a filter bypass is used, the cooler can be located on the high pressure side. Typically the cooler should be placed directly before the reservoir or inlet to the pump.

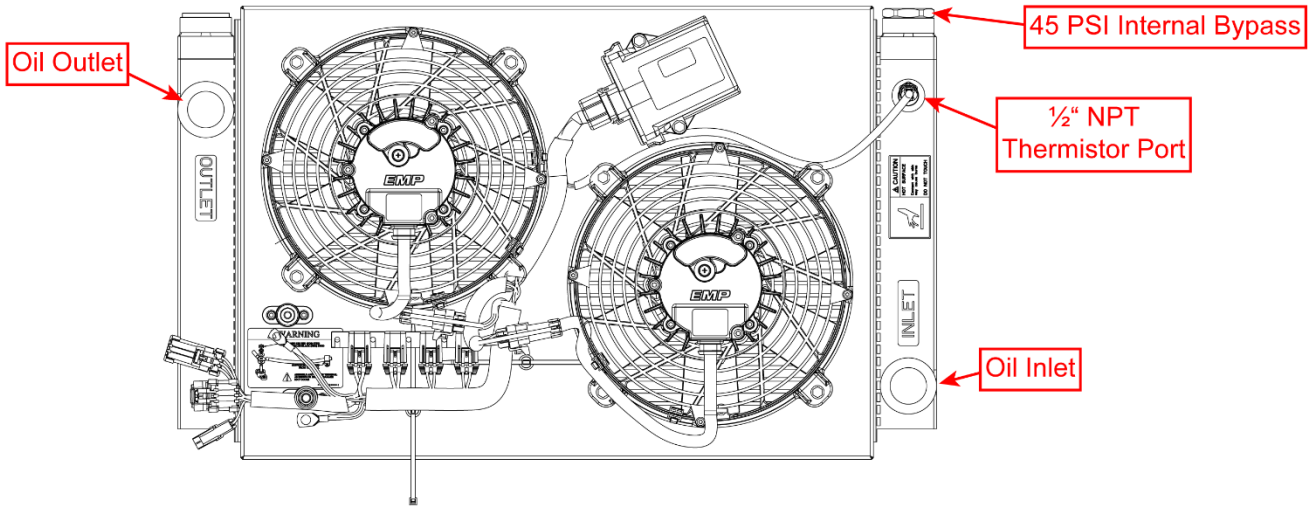
NOTE: The inlet and outlet fitting torque specifications are recommendations only — verify torques with fitting supplier.

Inlet and Outlet Fitting Torques (ft-lbs, ±5%)

	OK1	OK2
Brass Fitting	130	160
Steel Fitting	160	200
Stainless Steel Fitting	160	200



OK1 System



OK2 System

Wiring and Fusing Recommendations

The fan power connection(s) must be fused at 30 amps maximum to protect the controllers and external wiring. Attention must be paid to the fuse derate curves with temperature.

The fuses for the fans and system controller are built into the system on the µTMC controlled systems. These fuses protect the system wiring. It is recommended that the cables connecting the system to the source also be fused to protect the vehicle cables.

The system contains a 3-pin connector for interfacing with the PC based service tools. The service tool can be used to download new calibrations, view fault codes, download history data and monitor data during a test. The 3-pin connector is supplied with a sealed cap. The connector must remain capped when not in use to prevent moisture from getting into the harness.

Any unused connectors must remain capped to prevent moisture from entering the harness.

The power and signal grounding of the system in the application must conform to SAE 1908 Oct 2002. The signal ground must conform to the Low Current Ground requirements and the power grounding falls under the Medium Current Ground classification. Good grounding is required to prevent noise and ground potential differences from affecting the fan control and performance.

To ensure optimum fan life, the wire management of the fan harness must include drip loops to keep liquid from pooling on the seal areas. The seals should also be oriented down or to the side to keep fluid from pooling on the seal. This applies to the connector seals and the seal for the wires as they exit the fan and controller. The fan and controller have been thoroughly tested to ensure resistance to water intrusion. However, proper wire management can help ensure this seal is maintained over the life of the product. In addition, the fan connector should be supported to keep it from contacting nearby objects when subjected to the vibration levels seen in the field.

Any wiring must not rub on a sharp edge.

Any wiring must not rub or make contact with a hot surface. There must be a minimum 5” clearance between any wiring and the exhaust.

Any wiring should be supported at least every 18” to 20”.

Fusing on the system protects the wiring on the system. If there is a long run of wire to the system, it is recommended that it be fused at the source also. This wire must be sized and fused for the full amperage capacity of the system.

Software Calibration Options

Configurable Software Options: Several of the configurable options for the OK1 and OK2 systems are shown below. These are not the only options available but are the most common configurable items; for other software options contact EMP engineering.

Fan minimum speed temperature (°C) – Temperature fans come on at minimum speed.

Fan maximum speed temperature (°C) – Temperature fans will be on at maximum speed.

Fan minimum speed (rpm) – Lowest speed fans will run. 750 rpm is the minimum value.

Fan maximum speed (rpm) – Highest speed fans will run. The maximum allowable value is 4000 rpm for 12V and 4600 rpm for 24V. Contact EMP engineering for applications requiring more than 4600 rpm for a 24V system. 5000 and 5500 rpm options are available depending on the environmental conditions.

Fan default speed (rpm) – The speed the fans will run if the fluid thermistor or EMP-Link communication is lost. It is typically set to equal the maximum speed.

Reverse at startup (on/off) – Controls whether the fans reverse for a set duration when ignition is first applied. This feature is available on Temp Control and On/Off versions.

Reversal Time (seconds) – Controls the length of time for the fan reversal. The reversal time will be used for both the reverse at startup and the interval based reversal. This feature is available on Temp Control and On/Off versions.

Reversal Interval (seconds) – Controls the amount of time between fan reversals. This feature is available on Temp Control and On/Off versions.

Reversal Delay (seconds) – The number of seconds after ignition enable is applied before the fans reverse for the first time.

Reversal Speed (rpm) – The speed the fans run in reverse. This can be any speed between minimum rpm and maximum rpm.

Number of Fan steps – Controls the number of steps of fan speed between the minimum and maximum speeds. The fans can be set to run in a group or to run individually based on temperature.

Push Button Reversal – This feature runs the fans in reverse for a specified period of time when the optional push button input is pressed.

Lamp output – This parameter can be used to make the optional diagnostic lamp blink the diagnostic codes continuously or to have it blink out the diagnostic code a specified number of times and then quit.

PWM Input Frequency – This is the input frequency for the PWM speed control. It can be any value between 100 and 1500 Hz.

NOTE: To ensure the correct performance of the system, the parameters should be verified with EMP engineering.

Troubleshooting

Use EMP Service Suite to communicate with the system, troubleshoot and obtain fault information. Software can be obtained at no charge from the EMP website.

Appendix B and *Service and Installation Manual 11 Inch Axial Fan Assembly* have more information about interfacing with the system or fans.

Additional troubleshooting information is available and varies by system control strategy:

µTMC 9980029118 – *Troubleshooting Manual CP04 and CP05*
R20L 9980036083 – *Troubleshooting Manual CP02*
R20C 9980039116 – *Troubleshooting Manual CP14*

Service Parts Replacement

NOTE: Reference the service drawings for important notes, specifications, component locations, orientations, and torque specifications. Service drawings for this manual can be obtained at http://www.emp-corp.com/support/documents by searching for the system part number.

Connector Greasing

NOTE: See *Service Bulletin Approved Grease*, document 9910039075, for a list of dielectric grease products that have been approved for use in maintenance and service.

NOTE: Only use clean dielectric grease.

1. Apply dielectric grease to each harness side electrical connector and the power and ground studs. See the table below for specified grease amounts.
2. Remove any excess grease after proper connections have been made, if needed.

Reference Quantities

Grease	Description
5.00 g	Power/Ground Studs (applied directly to stud)
5.00 g	Power/Ground Studs with 220 Size Boots*
10.00 g	Power/Ground Studs with 232 Size Boots*
1.25 g	11" Fan Connectors
1.00 g	µTMC, CAN Connectors
0.75 g	Lamp/Pushbutton Connector
0.5 g	Ignition Connector

***NOTE:** Use this quantity if filling boot with grease instead of applying directly to stud.

- 220 size boots have a 1-1/8" diameter opening.
- 232 size boots have a 1-1/2" diameter opening.

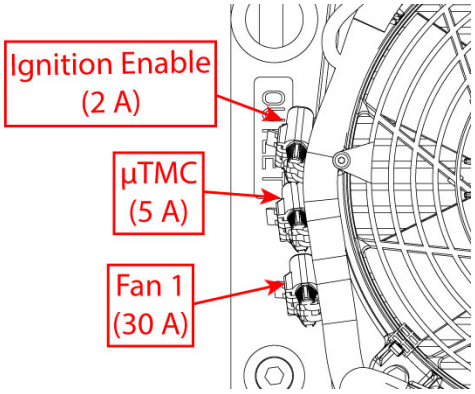
NOTE: Dielectric grease should be applied to completely cover all metal (ring terminals, washers, nuts, and studs). It is acceptable for grease to be visible on the outside of the boot.

Fuse Replacement

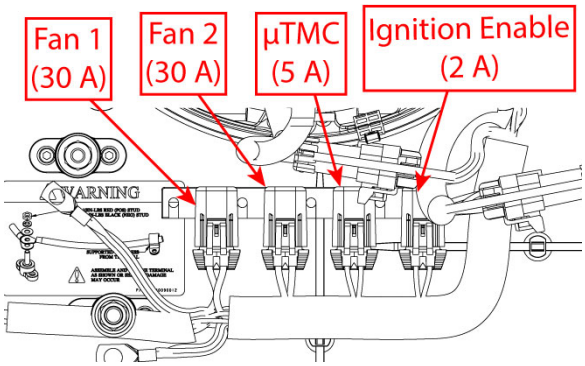
WARNING: To avoid serious personal injury, possible death, or damage to the vehicle, disconnect the main negative battery terminal and/or switch off the battery disconnect switch first before removing or installing any electrical components.

NOTE: Each fuse assembly contains a single fuse. Fuse location and assignments are shown below.

1. Remove the fuse holder housing of the suspected blown fuse by depressing the locking tab while pulling down on the on the fuse-holder holder base.
2. Remove the fuse by pulling the base away from fuse holder cap.
3. Insert new fuse by pressing into place until fully seated.
4. Replace fuse holder base into its cover ensuring the locking tab is fully engaged.
5. Reference OK2 Harness 3170029068 for the OK2 fan numbering scheme.

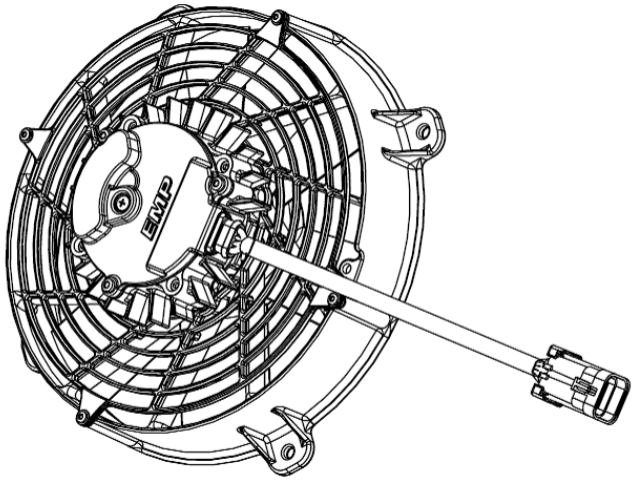


OK 1 Fuse Locations



OK2 Fuse Locations

FIL11 Fan



WARNING: To avoid serious personal injury, possible death, or damage to the vehicle, disconnect the main negative battery terminal and/or switch off the battery disconnect switch first before removing or installing any electrical components. When working on or near the electrical fans, ensure battery power is off or lockout vehicle ignition so the system cannot activate unexpectedly.

NOTE: Take note of any harness fastener locations and orientations that are attached to the fan, prior to removal (edge clip mount zip ties, fir tree mount zip ties, p-clips, j-clips, connector mounting clips, etc.).

Removal

1. Cut/remove any zip ties that are securing the fan to the system.
2. Disconnect the fan connector from the main system harness connector.

NOTE: To avoid damaging the wires and/or pin connections, do not pull back using the wire harness to disconnect the connection. Wiggling the connector body will help in freeing the connection.

NOTE: Ensure the harness connector electrical sockets remain free of dirt to ensure a solid electrical connection when reconnecting to the components.

3. Remove the fan mounting bolts (4 places).

NOTE: The fan mounting bolts will be reused when installing the replacement fan.

Installation

CAUTION: To avoid potential damage to the wiring, route all wires away from any sharp edges, moving objects, and heat sources.

CAUTION: All wires should be secured every 12–18 inches. All zip ties must be placed over wire loom/convoluted tubing and not over bare wires.

NOTE: Reference the service drawings for important notes, specifications, component locations, orientations, and torque specifications.

1. Place the replacement fan onto fan shroud and orient per the service drawing.

NOTE: Pre-coat the first few threads of the mounting bolts with Loctite 242 prior to reinstalling.

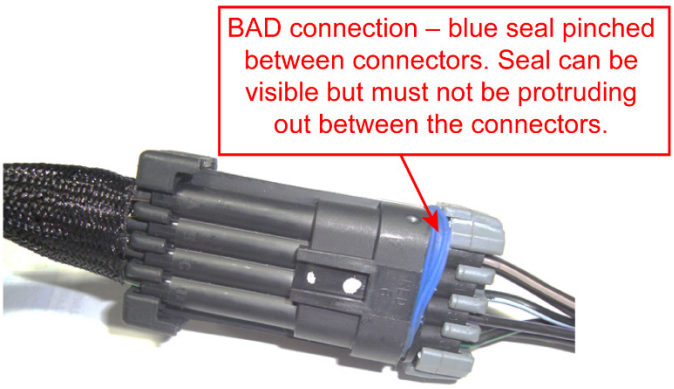
2. Install any harness fasteners (p-clips or j-clips), if applicable, onto the fan mounting holes that were removed during the removal process, along with the (4) mounting bolts. (Reference the service drawing and Harness Routing Details for fasteners and locations).
3. Torque the fan bolts to specification using a crisscross pattern for torque sequence.
4. Complete the steps in the Connection section.

Connection

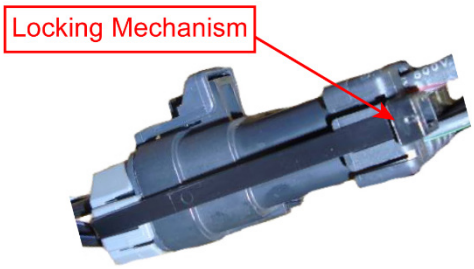
1. Clean any dust and debris from the harness connectors.
2. Apply dielectric grease to the main harness side electrical connector per the Connector Greasing section.
3. Connect the main harness connector to the fan connector.

NOTE: Ensure that the locking tabs are fully engaged.

4. Inspect the connection to verify that the blue seal that comes preinstalled on the harness connector is not pinched between the connectors.

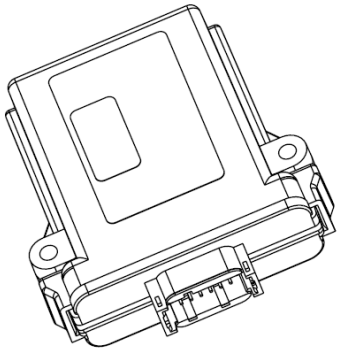


5. Zip tie the main system harness connector and the FIL11 fan connector together by installing the 11.8" zip tie around the center of the connectors in-between the wires. Position the locking mechanism on the zip tie in the location shown (pull the zip tie to hand tight only; do not over tighten zip tie). Cut off excess zip tie.



6. Route and secure the harness as shown in OK1 harness 3170029067 or OK2 Harness 3170029068.

µTMC System Controller



WARNING: To avoid serious personal injury, possible death, or damage to the vehicle, disconnect the main negative battery terminal and/or switch off the battery disconnect switch first before removing or installing any electrical components.

1. Remove the wire harness connections at the µTMC controller by depressing the locking tab on the harness connector and pulling back on the connector body. Wiggling the connector body will help in freeing the connection but do not pull back using the wire harness since damage to the wires and/or pin connections could occur.
2. Remove the (2) M6 x 25 mm bolts holding the µTMC to the shroud.
3. Clean any dust and debris off the harness connectors. Ensure the harness connector electrical sockets remain free of dirt to ensure a solid electrical connection to the new controller.
4. Mount the new controller to the shroud using the mounting bolts and torque to 50±5 in-lbs.

NOTE: Pre-coat the last few threads of the (2) mounting bolts with Loctite 242.

5. Connect the wire harness connector to the µTMC controller and ensure that the locking tabs are fully engaged. Apply a thin film of dielectric grease to the harness side of the connection prior to assembly (See Connector Greasing).
6. Once the new µTMC has been installed it must be configured for the vehicle using the EMP Service Tool unless the controller came pre-programmed with the proper calibration for the application.

Power/Ground Stud Replacement Kit (1370090014) – (If Required)

NOTE: Reference the service drawings for important notes, specifications, component locations, orientations, and torque specifications.

NOTE: See the table below for a list of the replacement parts for the power and ground studs. Discard the following parts that are not applicable on this assembly:

- Discard (3750090009) – Quantity 1
- Discard (2070090011) – Quantity 2

1370090014 Contents

Part Number	Part Description	Quantity
5009009004	M5-0.8 x 12 mm Bolt	4
3440090012	Terminal Stud Warning Label	1
2070090011	Screw	6
3750090009	Dual Small Post Mounting Plate Assembly	1
3210041032	3/8” Black Terminal Stud	1
3210041031	5/16” Red Terminal Stud	1

1. Remove the four M5-0.8 x 12 mm bolts holding the power and ground stud assembly on to the shroud and discard. Be sure to take note of the orientation of the power/ground studs.
2. Secure new power and ground stud assemblies into place using the provided screws (2070090011) and discard the extra two screws that will not be needed on this assembly.
3. Torque to specification.
4. Compare the decal shown on your system to the decal that is included with the replacement power and ground stud assemblies. If the decal that arrives with the replacement kit 1370090014 is different than what is on the assembly, replace the decal with the new one supplied.
5. Configure the power and ground cables as shown on the decal and as shown in Power and Ground Stud Assembly Details.

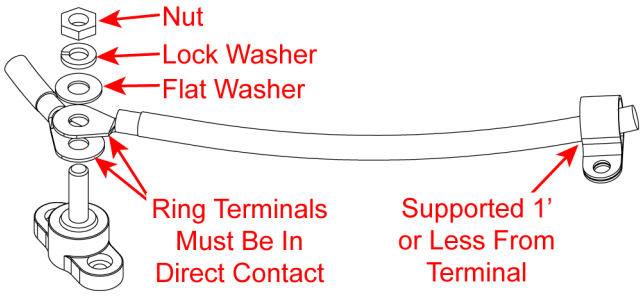
Main Wire Harness

WARNING: To avoid serious personal injury, possible death, or damage to the vehicle, disconnect the main negative battery terminal and/or switch off the battery disconnect switch first before removing or installing any electrical components.

OK1 and OK2 Harness Removal

1. Locate the µTMC System controller mounted on the fan shroud.
2. Disconnect the 12-pin connector at µTMC by depressing the locking tab on the harness connector and pulling back on the connector body. Wiggling the connector body will help in freeing the connection.
3. Remove the 4-pin connector (if used) that attaches the push button/LED to the system.
4. Disconnect each of the fans from the main wire harness cutting the tie wrap and depressing the locking tab and pulling back on the harness connector body.
5. Cut any cable ties attaching the harness to the shroud.
6. Remove the main harness from each of the J-clips (OK1 only) by bending the J clips away from the fan shrouds they are attached to.
7. Disconnect the power and ground ring terminals (OK2 only) from the studs on the system by turning the nut in the counterclockwise direction. Make sure to keep the lock washer for installing the new harness.
8. Disconnect the main system harness from the fluid thermistor by lifting up the locking tab on the harness and pulling away from the thermistor.
9. Remove the fuse holders from the mounting clip connectors by sliding the fuse holder in the direction of the wire.

Power and Ground Stud Assembly Details



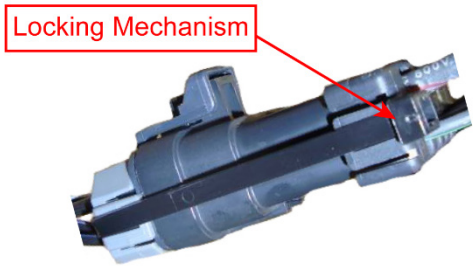
Power and Ground Stud Assembly

OK1 Harness Installation

This section applies to temperature controlled OK1 systems with a µTMC.

Only use clean dielectric grease. Apply dielectric grease to each harness side electrical connector and each side of the power and ground studs. See Service Bulletin: Approved Grease, 9910039075.

1. Lay harness assembly out across system as shown in OK1 harness 3170029067.
2. Connect the µTMC to the harness by inserting the 12-pin connector on the harness into the receptacle on the controller. Make sure the connector is fully inserted. Dielectric grease should be applied to the harness connector prior to inserting into the µTMC (See Connector Greasing).
3. Slide the three fuse holders onto the mounting clip connectors by lining up the slot in the holder with the slots in the mounting clip connector. Push the holder onto the clip connector until it is fully seated.
4. Attach the push button/lamp harness (if used) to the system harness by attaching the 4-pin connector. Care must be taken to ensure the connector is fully seated and the seal is properly contained inside the connector.
5. Attach the harness to the fan. Prior to attaching the harness to the fan, the fan side of the connection should be covered with dielectric grease (See Connector Greasing).
6. Tie wrap the fan connection using EMP part number 3330036029 (11 inch black tie wrap). The tie wrap must be positioned as shown.



Connector Tie Wrap

7. Route the harness as shown in OK1 harness 3170029067. Attach fan branch of the main harness to the fan shroud using the two clip tie wraps.
8. Bundle the thermistor branch of the main harness and the main trunk of the main harness together using the J-clips on upper left and upper right hand fan mounting fasteners.
9. Attach the fluid thermistor to the appropriate branch of the harness. Apply a thin film of dielectric grease to the harness side of the thermistor connection prior to assembly (See Connector Greasing). Ensure the connector is fully seated.
10. Attach the main branch of the wire harness to the shroud using the P-clip on the lower left hand fan mounting fastener. The torque for this fastener is 106±10 in-lbs.

OK2 Harness Installation

This section applies to temperature controlled OK2 systems with a µTMC.

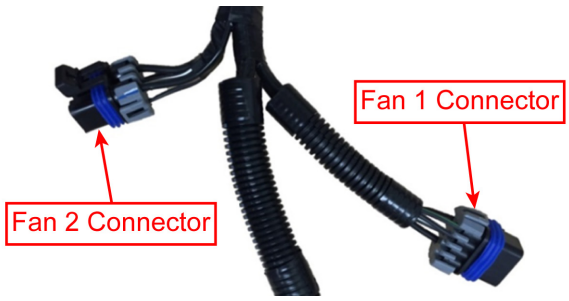
Only use clean dielectric grease. Apply dielectric grease to each harness side electrical connector and each side of the power and ground studs. See Service Bulletin: Approved Grease, 9910039075.

NOTE: See OK2 Harness 3170029068 for OK2 fan locations.

1. Lay harness assembly out across system as shown in OK2 Harness 3170029068.
2. Connect the µTMC to the harness by inserting the 12-pin connector on the harness into the receptacle on the controller. Make sure the connector is fully inserted. Dielectric grease should be applied to the harness connector prior to inserting into the µTMC (See Connector Greasing). Attach the µTMC branch of the harness to fan #1 using the two clip mount tie wraps shown in OK2 Harness 3170029068.
3. Attach the ground ring terminal of the system harness to the black ground stud.

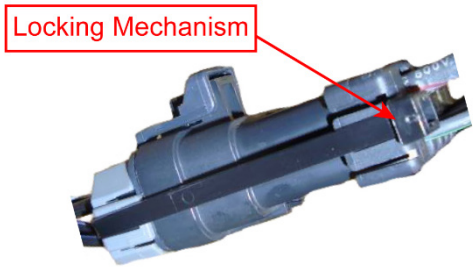
⚠ **WARNING**: Assemble and torque terminal as shown in Power and Ground Stud Assembly Details or serious damage may occur.

4. Attach the power ring terminal of the system harness to the red power stud.
5. Slide the four fuse holders onto the mounting clip connectors by lining up the slot in the holder with the slots in the mounting clip connector. Push the holder onto the clip connector until it is fully seated.
6. Attach the lamp (if used) to the system harness by pushing the two spade terminals onto the posts on the lamp. Push the spades onto the posts until they are fully seated. Care must be taken to ensure the white wire gets attached to the red post on the LED. If this is not connected properly, the LED will not operate.
7. Attach the harness branch with the open address to fan #1. This connector does not have a black address wire with a tan stripe and Pin A. Prior to attaching the harness to the fan, the fan side of the connection should be covered with dielectric grease (See Connector Greasing). Route this branch of the harness through the two shroud clips on fan #1. See Fan Connector Detail.



Fan Connector Detail

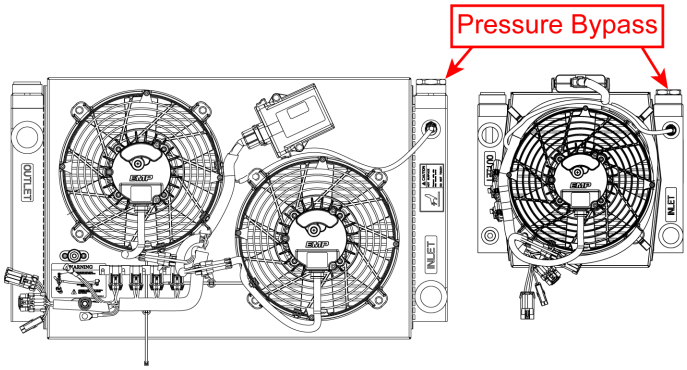
8. Attach the harness branch with the short (0 ohm) resistor to fan #2. This connector does have a black address wire with a tan stripe at Pin A. Prior to attaching the harness to the fan, the fan side of the connection should be covered with dielectric grease (See Connector Greasing). Route this branch of the harness using the clip mount tie wrap on fan #2. See Fan Connector Detail.
9. Tie wrap the fan connections using EMP part number 3330036029 (11 inch black tie wrap). The must be positioned as shown in the picture below.



Connector Tie Wrap

10. Route the harness as shown in OK2 Harness 3170029068. Attach the main branch to the shroud with the two fir tree tie wraps.
11. Bundle the thermistor branch of the main harness, all the fan branches of the main harness and fan #1 harness together using a tie wrap. This tie wrap should be located between fan #1 and fan #2 as shown in OK2 Harness 3170029068.
12. Attach the fluid thermistor to the appropriate branch of the harness. Apply a thin film of dielectric grease to the harness side of the thermistor connection prior to assembly (See Connector Greasing). Ensure the connector is fully seated.

Heat Exchanger Replacement for OK1/OK2



OK1/OK2 Heat Exchanger Assembly

⚠ **WARNING:** Contents under pressure – Do not replace the heat exchanger while the system is hot.

1. Ensure the system is cool and fully drained prior to removing heat exchanger.
2. Remove the inlet and outlet fittings by turning in a counterclockwise motion.
3. If the fluid thermistor is mounted in either tank of the heat exchanger, the thermistor must be removed. Disconnect the fluid thermistor from the system harness by lifting the locking tab on the connector of the system harness and pulling the connector away from the thermistor. Remove the thermistor by turning in a counterclockwise rotation.
4. Remove the shroud from the heat exchanger. All components are mounted to the shroud so none of the wiring needs to be disassembled. There are eight M8 x 25 mm fasteners that attach the fan shroud to the heat exchanger on OK2 and 4 M8 x 25 mm fasteners that attach the shroud to the heat exchanger on OK1. Remove these fasteners by turning them counterclockwise. Place the fan shroud in a location where it will not be damaged until it is assembled onto the new heat exchanger.
5. If the thermistor was located in the top or bottom tank on the original cooler, re-assemble the thermistor into the same location on the new cooler. Assemble the thermistor per the instructions in this document.
6. Ensure all NPT ports are plugged. All port plugs should be torqued 1–1.5 turns past hand tight. If the plug doesn't have pre-applied sealant, 1.5 wraps of Teflon tape should be used to seal the plugs.
7. Attach the inlet and outlet hoses to the heat exchanger. Tighten the fittings to the manufacturer recommended torque (See the table of fitting torques in Plumbing for reference). It is important to ensure the inlet hose is attached to the side of the cooler with the pressure bypass. If this is attached to the outlet side of the cooler, the pressure bypass will not operate correctly.
8. Assemble the shroud/fan/harness assembly to the new heat exchanger using the fasteners. Either lock washers or a thread locker (Loctite 242 or equivalent) should be used to prevent the fasteners from loosening over time. The torque for the M8 fasteners is 220±20 in-lbs
9. Refill the system and ensure there are no leaks.

⚠ **WARNING:** When starting the hydraulic pump in cold weather (below 0°C) it is important to not over pressure the hydraulic cooler. The viscosity of the oil is very high in cold weather and the pressure drop in the cooler can exceed the 230 psi maximum pressure. It is recommended to either bypass the cooler until the oil is above 0°C or use a low pump speed until the oil is above 0°C.

Shroud Replacement for OK1/OK2

WARNING: To avoid serious personal injury, possible death, or damage to the vehicle, disconnect the main negative battery terminal and/or switch off the battery disconnect switch first before removing or installing any electrical components.

1. Disconnect the fluid thermistor from the main system harness. This is done by lifting the locking tab on the main system harness and pulling the system harness connector away from the mating connector.
2. Remove the main system harness using the instructions detailed in OK1 and OK2 Harness Removal.
3. Remove the fans from the shroud by turning the four mounting fasteners counterclockwise. Note the J-clip location and orientation for OK1. Keep the three J-clips for attaching the harness to the replacement shroud (OK1 only).
4. Remove the controller by removing the two M6 x 25 mm fasteners. The main system wire harness can remain attached to the controller.
5. Remove the fuse holders by pulling or cutting the fir tree holders.
6. Remove the shroud by turning the remaining M8 x 25 mm fasteners counterclockwise (8 for OK2 and 4 for OK1). Make sure to keep the washers. Ensure the shroud is supported before completely removing the fasteners.
7. Remove the 3/8” bulb seal from the original shroud and inspect for damage. If the bulb seal is in good condition, press the 3/8” bulb seal over the top and bottom edges of the new shroud. If it is damaged, replace with a new seal. The bulb seal must be cut to a length of 17.75” for OK2 or 14.25” for OK1 to completely seal the shroud to the heat exchanger.
8. Assemble the FIL11 fans to the shroud using the M6 x 16 mm flange head fasteners. All fans must be oriented with the wire harness facing as shown in OK1 Harness Layout or OK2 Harness Layout. Ensure all three J-clips are in the locations for OK1 and all clip mounted tie wraps are in the proper locations. Coat the last 3–4 threads with a medium strength thread locker similar to Loctite 242 and torque to 106±10 in-lbs.
9. Assemble the shroud with fans onto the heat exchanger using the M8 x 25 mm socket head fasteners with washers. Coat the last 3–4 threads with a medium strength thread locker similar to Loctite 242 and torque to 220±20 in-lbs.
10. Assemble the wire harness per the instructions in the Main Wire Harness section of the service manual. Follow the instructions for either the OK1 or OK2 depending on which model it is.

WARNING: Assemble and torque terminal as shown in Power and Ground Stud Assembly Details or serious damage may occur.

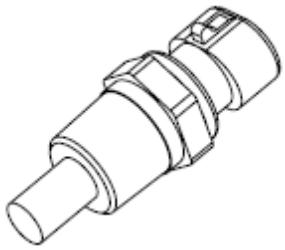
11. Connect the fluid thermistor to the main harness prior to providing power, ground, and ignition enable to the system. Make sure the connectors are fully seated.

Fluid Thermistor

WARNING: To avoid serious personal injury, possible death, or damage to the vehicle, disconnect the main negative battery terminal and/or switch off the battery disconnect switch first before removing or installing any electrical components.

NOTE: The fluid thermistor can be located in the inlet side of the cooler, outlet side of the cooler or in any other location. The fluid thermistor location must match the calibration to ensure the system operates properly.

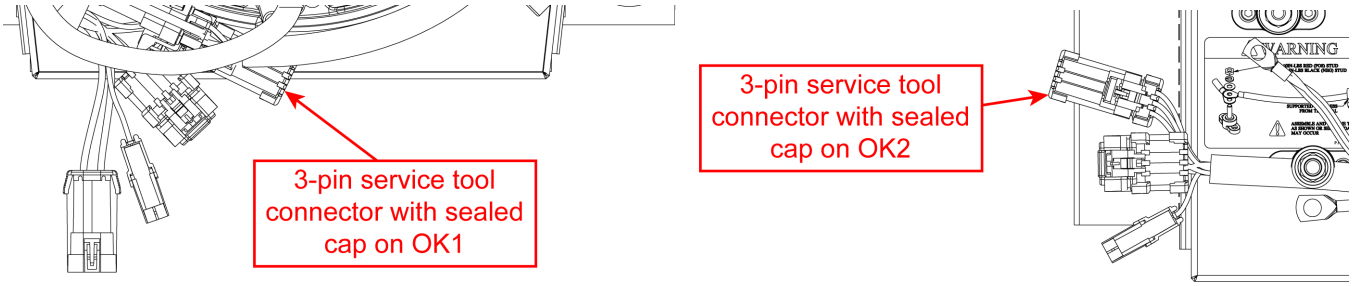
1. Ensure the system is completely drained of fluid.
2. Disconnect the wire harness connector attached to the thermistor.
3. Using a deep well socket, remove the thermistor in a counterclockwise rotation.
4. Install the new thermistor and torque to 1–1.5 turns past hand tight. There is pre-applied sealant on the thermistor threads.
5. Re-connect the thermistor wire harness connector.
6. Refill the system and check for leaks.



Service Tool Interface

CAUTION: The sealed cap must be installed after using the service tool interface to prevent moisture intrusion into the harness.

1. Remove the sealed cap from the 3-pin service tool connector.
2. Insert the 3-pin mating connector from diagnostic kit 7500038005.
3. Apply the enable signal to the system.
4. Follow the instructions for service tool installation and operation. This tool can be used for monitoring data, viewing diagnostic information, downloading new calibrations and downloading history data. (See Troubleshooting).
5. When finished, unplug the data link adapter harness and re-install the sealed cap.



OK1/OK2 Service Tool Connector

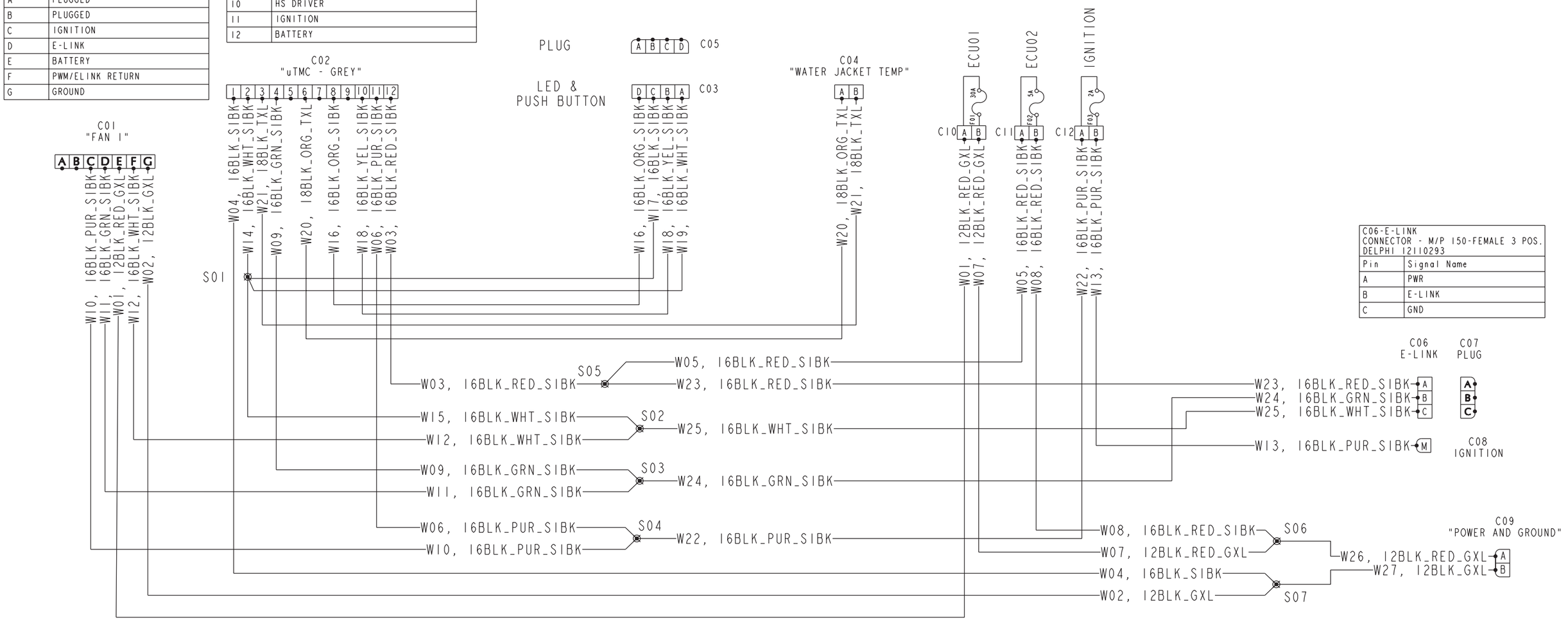
Appendix A – Wiring Schematics

C01-FAN 1 CONNECTOR - M/P 150/480-FEMALE 7 POS. DELPHI 12059472	
Pin	Signal Name
A	PLUGGED
B	PLUGGED
C	IGNITION
D	E-LINK
E	BATTERY
F	PWM/ELINK RETURN
G	GROUND

C02-uTMC - GREY CONNECTOR - DTM SERIES, GREY-FEMALE 12 POS. DEUTSCH DTM06-12SA-E007	
Pin	Signal Name
1	GROUND
2	EMP-LINK GROUND
3	ANALOG GROUND
4	EMP-LINK
5	PLUGGED
6	W/J TEMP
7	PLUGGED
8	PUSH BUTTON
9	PLUGGED
10	HS DRIVER
11	IGNITION
12	BATTERY

C03- CONNECTOR - M/P 150-FEMALE 4 POS. DELPHI 12162144	
Pin	Signal Name
A	LED RETURN
B	LED
C	BUTTON RETURN
D	BUTTON POS.

C06-E-LINK CONNECTOR - M/P 150-FEMALE 3 POS. DELPHI 12110293	
Pin	Signal Name
A	PWR
B	E-LINK
C	GND



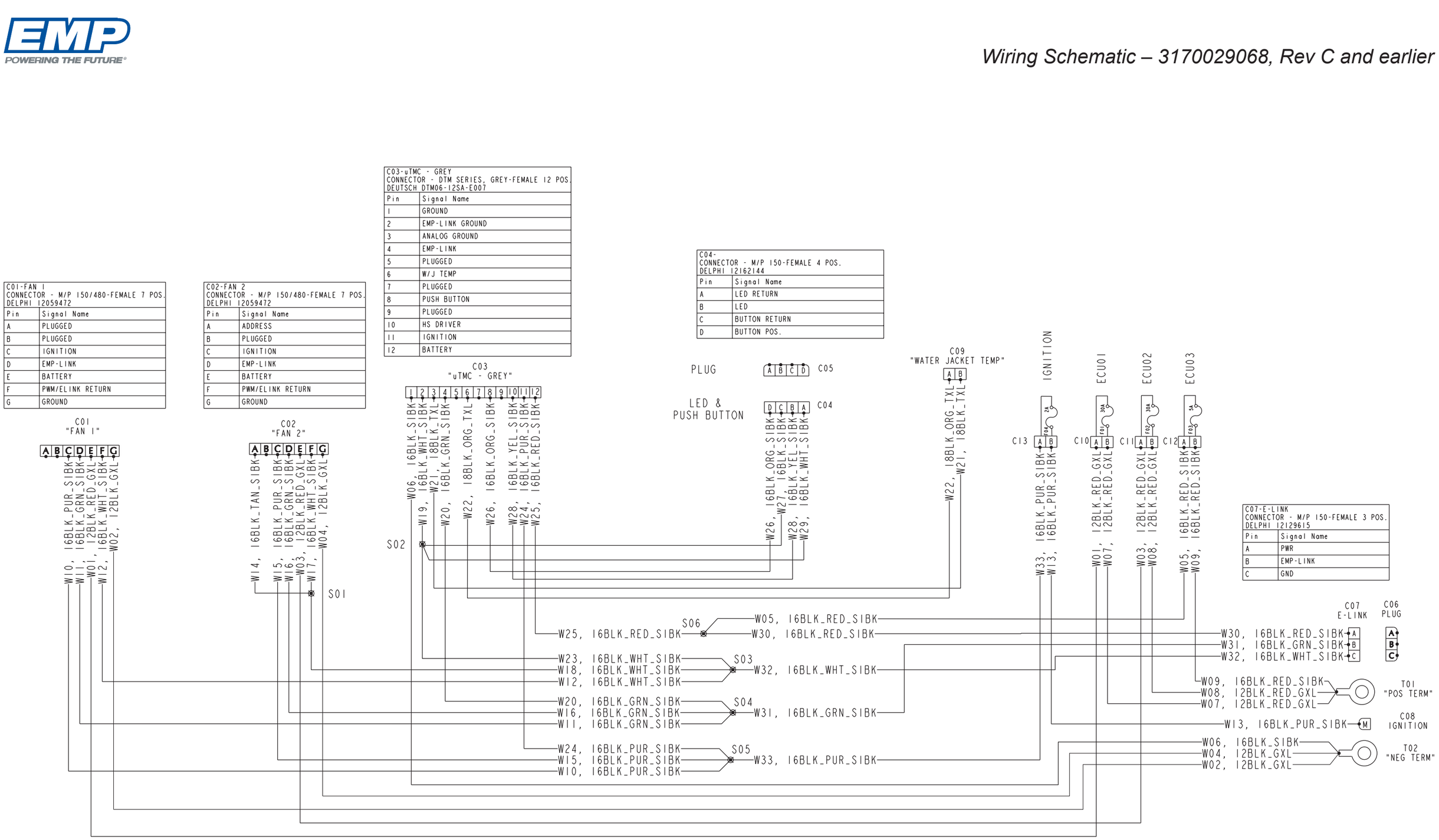
C01-FAN 1 CONNECTOR - M/P 150/480-FEMALE 7 POS. DELPHI 12059472	
Pin	Signal Name
A	PLUGGED
B	PLUGGED
C	IGNITION
D	EMP-LINK
E	BATTERY
F	PWM/ELINK RETURN
G	GROUND

C02-FAN 2 CONNECTOR - M/P 150/480-FEMALE 7 POS. DELPHI 12059472	
Pin	Signal Name
A	ADDRESS
B	PLUGGED
C	IGNITION
D	EMP-LINK
E	BATTERY
F	PWM/ELINK RETURN
G	GROUND

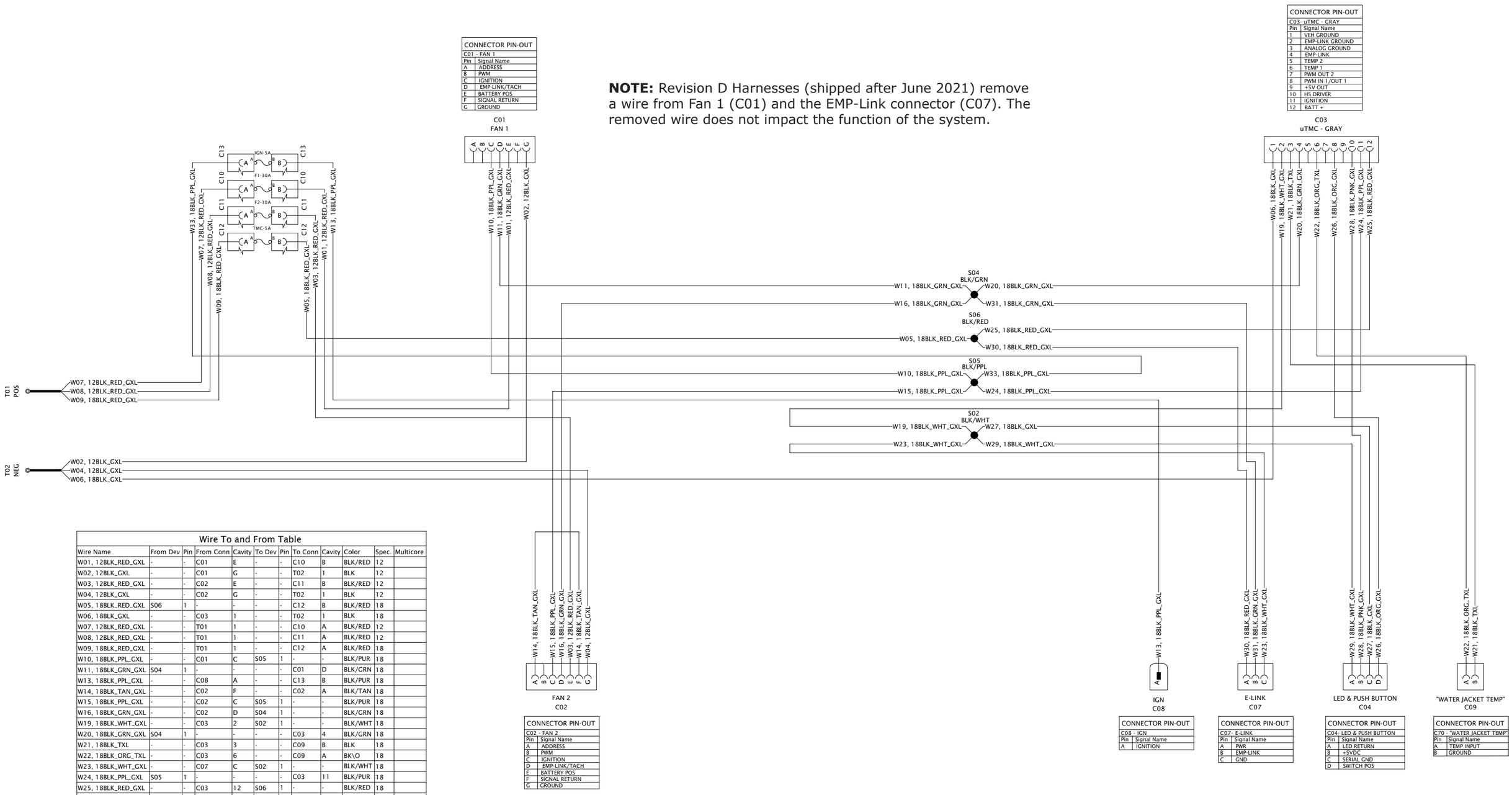
C03-uTMC - GREY CONNECTOR - DTM SERIES, GREY-FEMALE 12 POS. DEUTSCH DTM06-12SA-E007	
Pin	Signal Name
1	GROUND
2	EMP-LINK GROUND
3	ANALOG GROUND
4	EMP-LINK
5	PLUGGED
6	W/J TEMP
7	PLUGGED
8	PUSH BUTTON
9	PLUGGED
10	HS DRIVER
11	IGNITION
12	BATTERY

C04- CONNECTOR - M/P 150-FEMALE 4 POS. DELPHI 12162144	
Pin	Signal Name
A	LED RETURN
B	LED
C	BUTTON RETURN
D	BUTTON POS.

C07-E-LINK CONNECTOR - M/P 150-FEMALE 3 POS. DELPHI 12129615	
Pin	Signal Name
A	PWR
B	EMP-LINK
C	GND



NOTE: Revision D Harnesses (shipped after June 2021) remove a wire from Fan 1 (C01) and the EMP-Link connector (C07). The removed wire does not impact the function of the system.

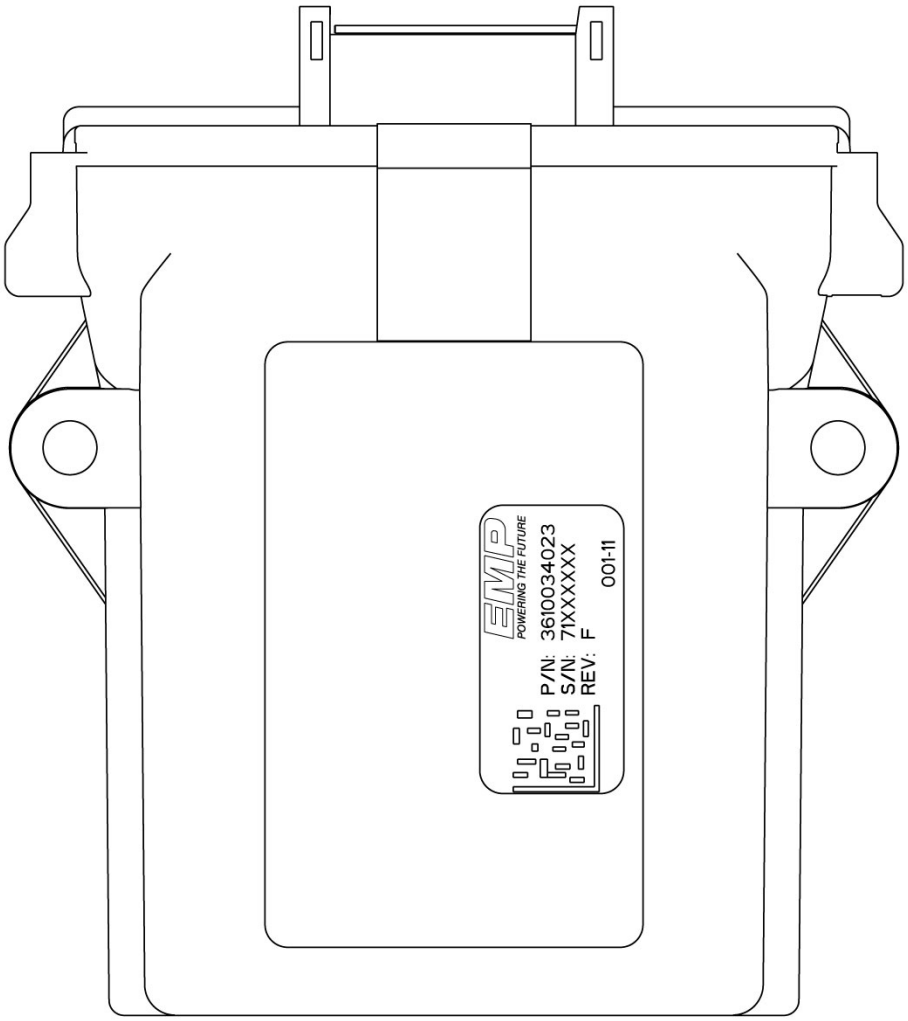


Wire To and From Table

Wire Name	From Dev	Pin	From Conn	Cavity	To Dev	Pin	To Conn	Cavity	Color	Spec.	Multicore
W01, 12BLK_RED_GXL	-	-	C01	E	-	-	C10	B	BLK/RED	12	
W02, 12BLK_GXL	-	-	C01	G	-	-	T02	1	BLK	12	
W03, 12BLK_RED_GXL	-	-	C02	E	-	-	C11	B	BLK/RED	12	
W04, 12BLK_GXL	-	-	C02	G	-	-	T02	1	BLK	12	
W05, 18BLK_RED_GXL	S06	1	-	-	-	-	C12	B	BLK/RED	18	
W06, 18BLK_GXL	-	-	C03	1	-	-	T02	1	BLK	18	
W07, 12BLK_RED_GXL	-	-	T01	1	-	-	C10	A	BLK/RED	12	
W08, 12BLK_RED_GXL	-	-	T01	1	-	-	C11	A	BLK/RED	12	
W09, 18BLK_RED_GXL	-	-	T01	1	-	-	C12	A	BLK/RED	18	
W10, 18BLK_PPL_GXL	-	-	C01	C	S05	1	-	-	BLK/PUR	18	
W11, 18BLK_GRN_GXL	S04	1	-	-	-	-	C01	D	BLK/GRN	18	
W13, 18BLK_PPL_GXL	-	-	C08	A	-	-	C13	B	BLK/PUR	18	
W14, 18BLK_TAN_GXL	-	-	C02	F	-	-	C02	A	BLK/TAN	18	
W15, 18BLK_PPL_GXL	-	-	C02	C	S05	1	-	-	BLK/PUR	18	
W16, 18BLK_GRN_GXL	-	-	C02	D	S04	1	-	-	BLK/GRN	18	
W19, 18BLK_WHT_GXL	-	-	C03	2	S02	1	-	-	BLK/WHT	18	
W20, 18BLK_GRN_GXL	S04	1	-	-	-	-	C03	4	BLK/GRN	18	
W21, 18BLK_TXL	-	-	C03	3	-	-	C09	B	BLK	18	
W22, 18BLK_ORG_TXL	-	-	C03	6	-	-	C09	A	BK\O	18	
W23, 18BLK_WHT_GXL	-	-	C07	C	S02	1	-	-	BLK/WHT	18	
W24, 18BLK_PPL_GXL	S05	1	-	-	-	-	C03	11	BLK/PUR	18	
W25, 18BLK_RED_GXL	-	-	C03	12	S06	1	-	-	BLK/RED	18	
W26, 18BLK_ORG_GXL	-	-	C04	D	-	-	C03	8	BLK/ORG	18	
W27, 18BLK_GXL	-	-	C04	C	S02	1	-	-	BLK	18	
W28, 18BLK_PNK_GXL	-	-	C04	B	-	-	C03	10	BLK/PNK	18	
W29, 18BLK_WHT_GXL	-	-	C04	A	S02	1	-	-	BLK/WHT	18	
W30, 18BLK_RED_GXL	-	-	C07	A	S06	1	-	-	BLK/RED	18	
W31, 18BLK_GRN_GXL	-	-	C07	B	S04	1	-	-	BLK/GRN	18	
W33, 18BLK_PPL_GXL	-	-	C13	A	S05	1	-	-	BLK/PUR	18	

Appendix B – Operation Manual µTMC System Controller

Operation Manual
µTMC System Controller



Rev	Rev By	Date	Description of Change	Approved By
A	ME	6/22/20	New Release	ECN5961
B	ME	1/10/23	Revisions	ECN8814

Engineered Machined Products, Inc.

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www.emp-corp.com
service@emp-corp.com

Product Overview

The µTMC is a system controller designed to take inputs from either PWM or physical sensors to control EMP components in a system. The system controller may be configured to receive a reverse command via a reverse button and have a diagnostic lamp.

Table of Contents

Introduction

Purpose

The purpose of this manual is to provide information on how the µTMC system controller operates.

Service Technician Responsibilities

Ensure that all safety messages and information messages are read and understood before installation, maintenance, or repairs are performed. It is important to use caution when service work is performed. Knowledge of impacted systems and their operation are important before the removal or disassembly of any component. Knowledge of hazards present and risk of injury to the service technician while working on these systems is critical to personal safety.

Liability Disclaimer

EMP cannot anticipate every possible circumstance that might involve a potential hazard. The safety messages in this document, in related manuals, and on the product are therefore not all inclusive. If a tool, procedure, work method, or operating technique that is not specifically recommended by EMP is used, you must satisfy yourself that it is safe for you and for others. You should ensure that the product will not be damaged or be made unsafe by the operation, maintenance, or repair procedures that you choose.

Additional Information

Access https://www.emp-corp.com/support/ for service software, service bulletins, service manuals, service drawings, and other documents related to your installed EMP systems and components. First time users may create a free customer login at https://www.emp-corp.com/account/register/.

Technical Help

Contact EMP Technical Service for technical help at +1 (906) 789-7497 or service@emp-corp.com.

About This Document

Warnings, Cautions and Notes

Two headings are used in this document to stress your safety and safe operation of the system. They are styled with a graphic bullet and bold, uppercase text: **WARNING** and **CAUTION**. Warnings highlight risks to personnel — hazards, unsafe conditions and practices that can result in personal injury or death. Cautions indicate conditions or practices that can cause damage to components, systems, or other equipment.

A third heading, styled as **NOTE**, calls attention to additional information about components and procedures discussed in the document.

Definition of Terms

µTMC .....Micro thermal management controller. EMP system controller.
EMP-Link.....EMP proprietary serial communications.
Ignition Enable.....Switched voltage supply used to activate the controller.
OK.....EMP oil cooler.
PWM .....Pulse width modulation.
TK .....EMP thermal kit.

Product Safety Warnings

WARNING: EMP cannot anticipate every possible circumstance that might involve a potential hazard. The safety messages in this document, in related manuals, and on the product are therefore not all inclusive. If a tool, procedure, work method, or operating technique that is not specifically recommended by EMP is used, you must satisfy yourself that it is safe for you and for others. You should ensure that the product will not be damaged or be made unsafe by the operation, maintenance, or repair procedures that you choose.

WARNING: Ensure that all safety messages and information messages are read and understood before installation, maintenance, or repairs are performed. It is important to use caution when service work is performed. Knowledge of impacted systems and their operation are important before the removal or disassembly of any component. Knowledge of hazards present and risk of injury to the service technician while working on these systems is critical to personal safety

WARNING: Ensure that the equipment cannot move before doing any work or diagnostic procedures on the EMP component, system, or vehicle.

WARNING: When working on or near electrical components, ensure that they have been disconnected from their energy source, cannot be accidentally re-energized, and verify the system is in a zero energy state.

WARNING: Use extreme caution when working on systems under pressure (i.e. coolant, hydraulic fluids, air, fire suppression, etc.).

WARNING: Ensure the work area is ventilated and well lit.

WARNING: Ensure charged fire extinguishers are in the work area.

WARNING: Ensure all safety guards, shields, and covers are reinstalled when tasks are completed.

WARNING: Ensure all tools, parts and service equipment are removed from the work area.

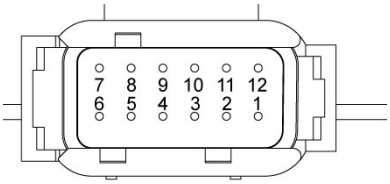
WARNING: Ensure that all system power and ground connection points are torqued to EMP and/or OEM specifications to prevent system damage. Failure to follow specified torque requirements can result in loose connections which can damage electronic components and will void EMP warranty.

Theory of Operation

The µTMC commands fan speed by referencing the inputs from a maximum of two temperature thermistors. When either or both of the thermistors report a temperature above the programmed thresholds, the µTMC controller will command the appropriate fans to a speed based on the calibrated set points. This is done to minimize the amount of electrical power being consumed by the system based on the amount of cooling required. A reversal routine for the fans can also be included to remove debris from the heat exchanger. The system can be calibrated to perform the reversal when ignition is first applied and at specified intervals. The I/O of the µTMC system controller includes an output to drive a warning lamp. Interfaces with the µTMC include an ignition enable signal, thermistor interfaces to monitor temperature and an EMP-Link bus to interface with FIL11 fans, reverse push button and diagnostic lamp. A significant part of the µTMC functionality is to implement diagnostics which give indication of the overall status of the system and blink out error codes via the lamp on the system if a problem is detected and interface with the service tool.

NOTE: Blink Codes are only available on systems with a diagnostic lamp.

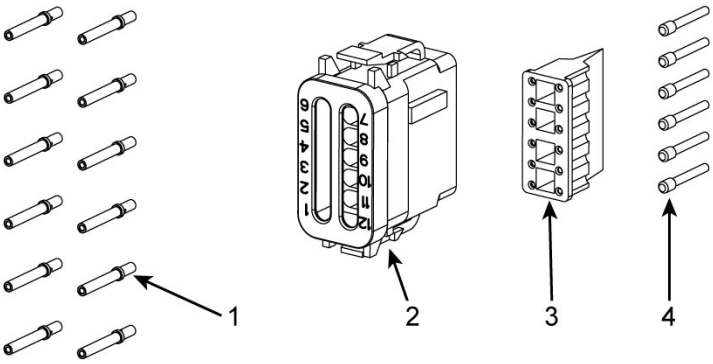
Connector Information



Pin	Description
1	Ground
2	Digital return
3	Analog return
4	EMP-Link
5	Temp. sensor 2
6	Temp. sensor 1
7	Unused
8	Pushbutton
9	Unused
10	Lamp
11	Ignition enable
12	Battery

Mating Connector Information

Deutsch DTM 12 Pin Connector kit, EMP part number 1370031031.



Item	Part Number	Description	Quantity
1	3220021041	Plug – Sealing #20	6
2	3250025027	Wedgelock – DTM, 12 position female	1
3	3250025033	Connector plug, 12 position	1
4	3230022077	Socket – Solid, size 20	12

Electrical Specifications and Requirements

Power Specification

The battery connection provides constant power to the component controller module. All power necessary to operate the controller comes from this pin.

12V Vehicle Battery Parameters

Parameter	Min	Nom	Max	Units
V_{in} – Operating	9.0	13.5	32.0	V
Operating current	-	30	100	mA
Ignition off current	-	-	300	µA

24V Vehicle Battery Parameters

Parameter	Min	Nom	Max	Units
V_{in} – Operating	9.0	27.0	32.0	V
Operating current		30	100	mA
Ignition off current	-	-	300	µA

Vehicle Ignition Enable Specification

The ignition enable pin is used in power management of the controller. When this input goes high, the module will “wake up.” This input was designed to be switched battery power and will not be damaged by vehicle transients. Ignition enable must be separate from component power so that power remains on when ignition is switched off to enable controller shutdown processes.

Vehicle Ignition Parameters

Parameter	Min	Nom	Max	Units
V_{in}	9.0	13.5 or 27	32.0	V
Ignition Current (13V)		2.5		mA
Ignition Current (27V)		5		mA
V_{in} – Low (sleep)	-50	0	1	V

Diagnostic Outputs

Diagnostic lamp, if equipped it will blink out diagnostic codes

The EMP Simple service tool may be used to interface with the µTMC.

EMP Simple Service Tool

Monitoring operation and manual control of the component can be accomplished using the EMP Simple Service Tool which is part of the EMP Service Suite available at no cost on the EMP website.

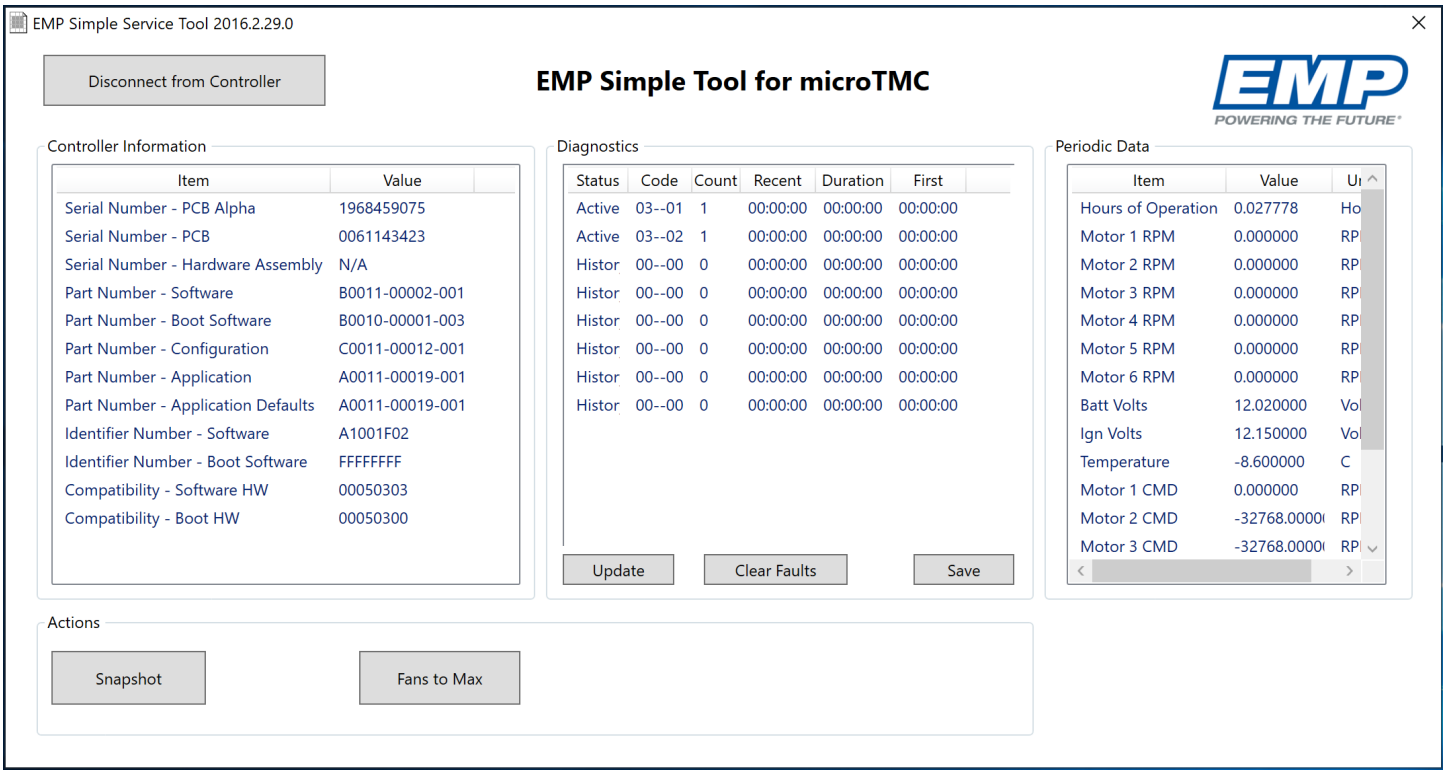
To use EMP Simple Service Tool, download and install the Service Suite software on your Windows PC. An interface device will be needed between the computer and the component.

For serial communication, use a breakout harness to interface with the communication connector and an EMP TTL/EMP-Link data link adapter. These are available together in diagnostic kits. For TK systems utilizing the 3-pin diagnostic connector use #7500038005. For OK6 systems using the J1939 9-pin diagnostic connector use #7500038002.

The *Service Suite User Guide and Tutorial,* including connection and control instructions, is embedded in the software and available on the EMP website.

General Troubleshooting

The Simple Service tool interfaces with the µTMC system controller and displays controller configuration, diagnostic code history, and real time operational data such a current fan speed commanded and read along with hours of operation and transmission oil temperature. The tool also allows the fans to be turned on manually and enables the download of system history data.



The interface to the µTMC OK6 system on New Flyer vehicles is through the rear 9-pin diagnostics connector located in the engine compartment. The OK6 is not connected to the front 9-pin diagnostics connector located in the passenger compartment. Most buses with an Allison hybrid system require the vehicle to be started from the front of the bus to enable the OK6 system. The OK6 system must be powered up and enabled to connect with the Simple Service Tool.

Other µTMC controlled systems have a 3-pin diagnostic connector on the system harness. The system must be powered up and enabled to connect with the Simple Service Tool.

Product Warranty Registration Form

A standalone PDF of this registration form suitable for electronic submission is available in the Product Documentation section of the EMP website. Search for document number 9960039049.

Product Registration

Customer Information

Customer/Business Name

Customer Contact Name

Customer Contact E-mail

Customer Contact Phone

Address

City

State/Province

Country

Postal Code

Product Information

Product Type Complete one form per product type. For complete thermal system assemblies you do not need to register each assembled fan, controller, and pump.

- ◯ **Electric Water Pump**
- ◯ **Individual Fan**
- ◯ **Controller**
- ◯ **EMP Alternator**
- ◯ **Oil Pump**
- ◯ **Other**
- ◯ **Electric Fan Cooling System**

Number of Fans

Model Purchased

Part Number

Serial Number

Installation Date

Model, Serial Number, and Part Number are located on the EMP product label.

Vehicle Information

Vehicle Fleet ID	
Vehicle Make	
Vehicle Model	
Vehicle Model Year	
Vehicle Identification Number (VIN)	
Vehicle Miles/Hours at Installation	
If New System, Alternator Serial Number	
Notes	

Contact EMP

Mail/Fax/E-mail completed registration forms to:

EMP Advanced Development, LLC
2701 North 30th Street
Escanaba, MI 49829
USA

Fax: +1 (906) 789-7825

E-mail: warranty@emp-corp.com