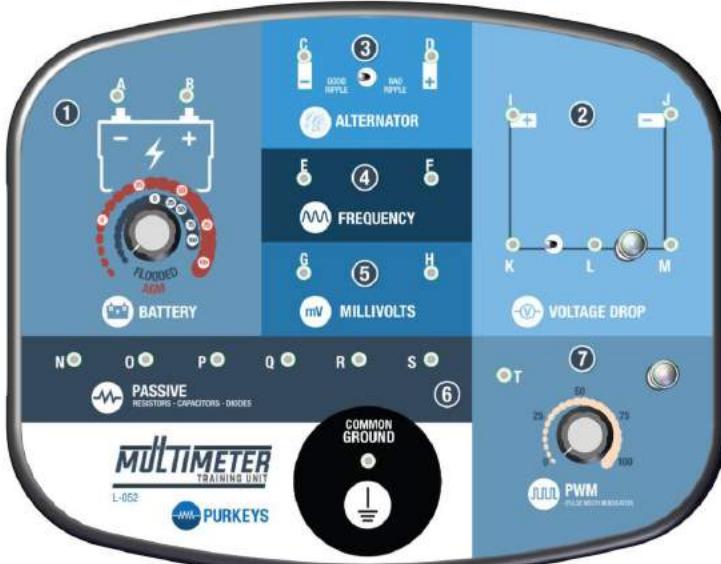


# PURKEYS

A MISSION CRITICAL ELECTRONICS BRAND

## MULTIMETER TRAINING UNIT

### USER GUIDE





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## GENERAL INFORMATION

With Purkeys' Multimeter Training Unit (MTU), technicians can hone their skills with a multimeter in common electrical troubleshooting situations found on fleet vehicles. Scenarios found on Purkeys' MTU include:

- Battery state of charge
- Resistance
- Voltage drop
- Capacitance
- AC ripple of alternator
- Diodes
- Frequency
- Pulse Width Modulation (PWM)

### CAUTION!

- Whenever using a multimeter, follow all of the manufacturer's safety guidelines and instructions.
- Always connect leads to the correct input terminals of the multimeter.
- Multimeter current input terminals are for measuring current only!
- Internal fuses will blow if improperly used.

### SETUP

Connect the provided wall transformer to the left side of the MTU, then plug the wall transformer into an AC outlet. To verify the unit has power, turn the PWM knob to 100%. The PWM light will be on when power is properly connected.

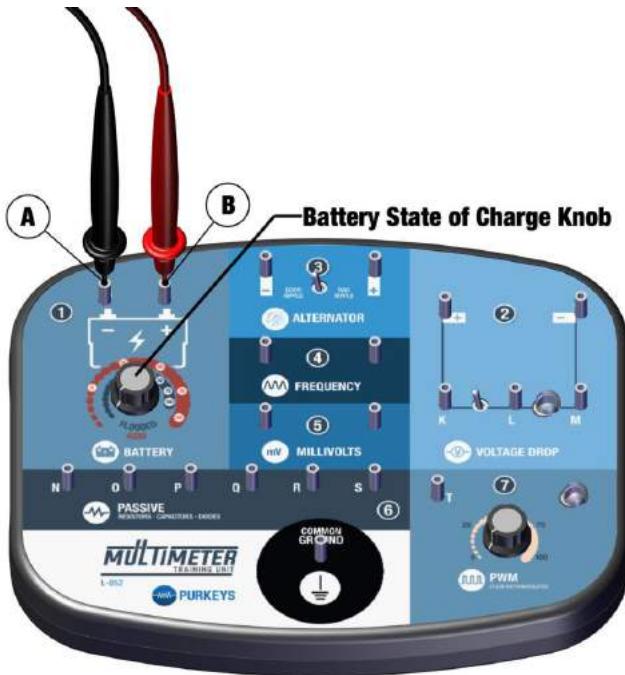


# MTU INSTALLATION GUIDE

## BATTERY

The DC voltage of a lead-acid battery can be used to determine the battery State of Charge (SOC). The two scales around the Battery State of Charge Knob (Flooded and AGM) are for the percent state of charge of a 12 V lead-acid battery based upon the open circuit voltage (OCV). (For example, an AGM battery at 75% SOC would have an OCV of approximately 12.5 V).

Adjust the Battery State of Charge Knob to a desired setting at any time during use. To get an accurate reading on your multimeter, make sure it is set to the DC volt scale. Touch the black and red leads of the multimeter to contact points A and B of the MTU respectively. Read the voltage on the multimeter.



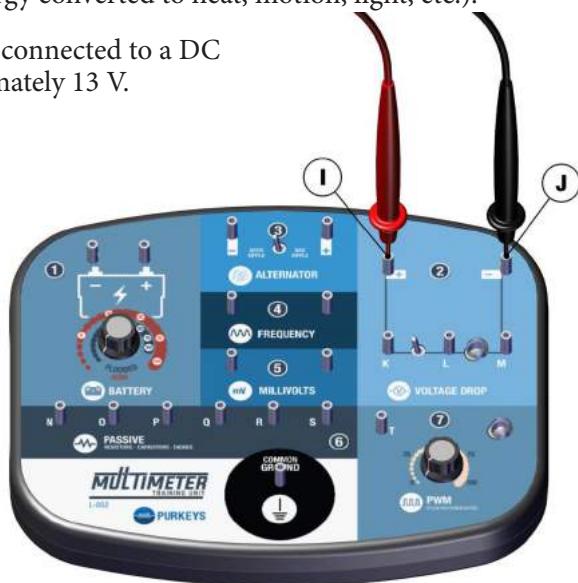
## VOLTAGE DROP

Voltage drop is the difference in voltage between two points due to energy conversion (electrical energy converted to heat, motion, light, etc.).

Contact points I and J are connected to a DC voltage source of approximately 13 V.

Adjust the multimeter to measure DC Volts.

Touch the red and black leads of the multimeter to the MTU contact points listed below:



RED	BLACK	MULTIMETER WILL DISPLAY
I	J	Source voltage
M	J	0 V with switch open (LED off), approximately 3.3 V with switch closed (LED on)*
L	M	0 V with switch open (LED off), approximately 6.5 V with switch closed (LED on)**
K	L	Source voltage with switch open (LED off), 0 V with switch closed (LED on)***
I	K	0 V with switch open (LED off), approximately 3.3 V with switch closed (LED on)*

\*Energy is converted to heat in the conductor between points (similar to a long wire)

\*\*Energy is converted to light and heat in the lamp

\*\*\*No measurable amount of energy is converted to heat in the conductor between points

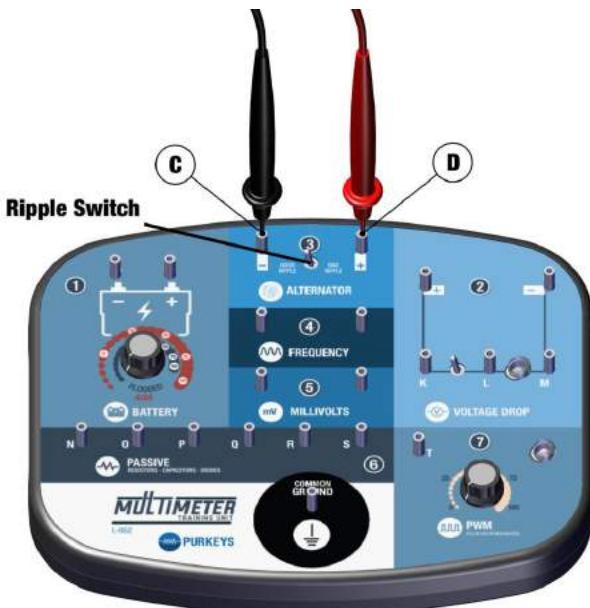
# MTU INSTALLATION GUIDE

## ALTERNATOR

Alternators produce AC voltage and current that is changed (rectified) to DC voltage and current by diodes inside the unit. Although the diodes are effective at rectifying, small fluctuation in the DC voltage and current remains. This fluctuation in voltage is often referred to as AC ripple. An excessively high alternator ripple voltage is a good indicator of a faulty component such as a failed stator or rectifier diode.

To measure alternator ripple voltage, set the switch in Section 3 of the MTU to good ripple or bad ripple at any time during use. Adjust the multimeter to measure AC Volts. Touch the black and red leads of the multimeter to contact points C and D of the MTU. With the switch in the good ripple position, the multimeter will display a value typical of a normal AC ripple and proper alternator function\*. With the switch in the bad ripple position, the multimeter will display a value typical of a bad AC ripple, indicating a potential alternator problem. If this is the case, further performance testing of the alternator is needed to confirm if it has a problem\*.

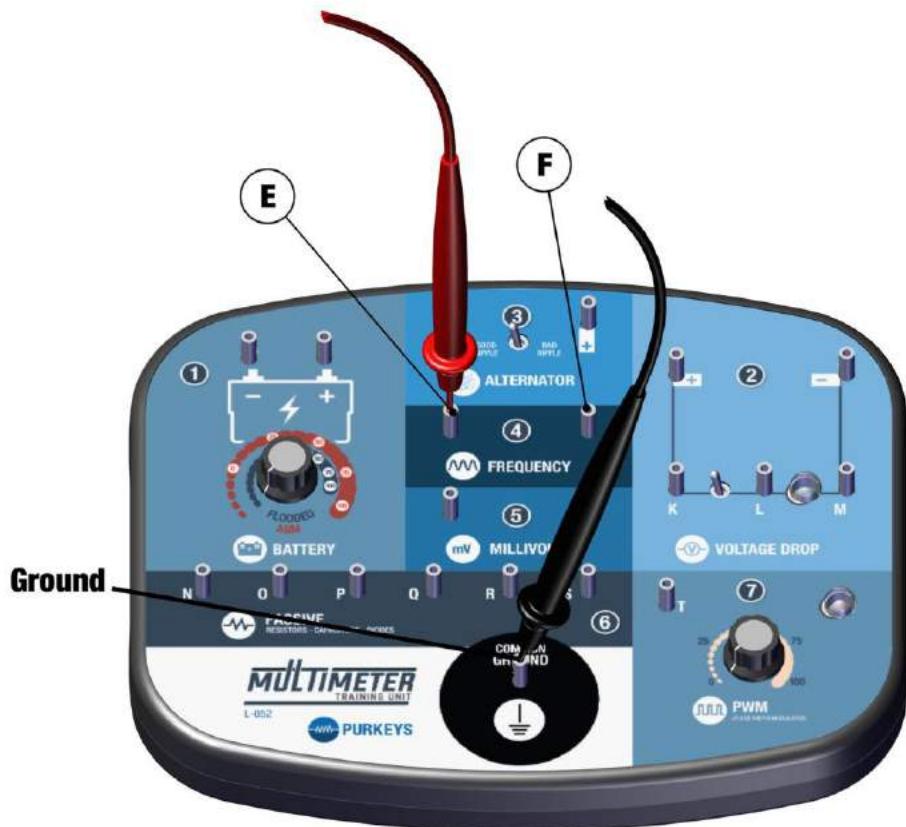
\*Different models of multimeters measure AC ripple differently. Individual results may vary. For EXTECH multimeter, adjust range to measure AC ripple.



## FREQUENCY

To measure frequency, adjust the multimeter to the frequency (Hz) setting. Touch the black lead of the multimeter to contact point GROUND and the red lead to contact point E of the MTU\*. Moving the red lead to contact point F will provide another signal to measure.

\*The Frequency section can be configured to output various frequencies (see page 12).

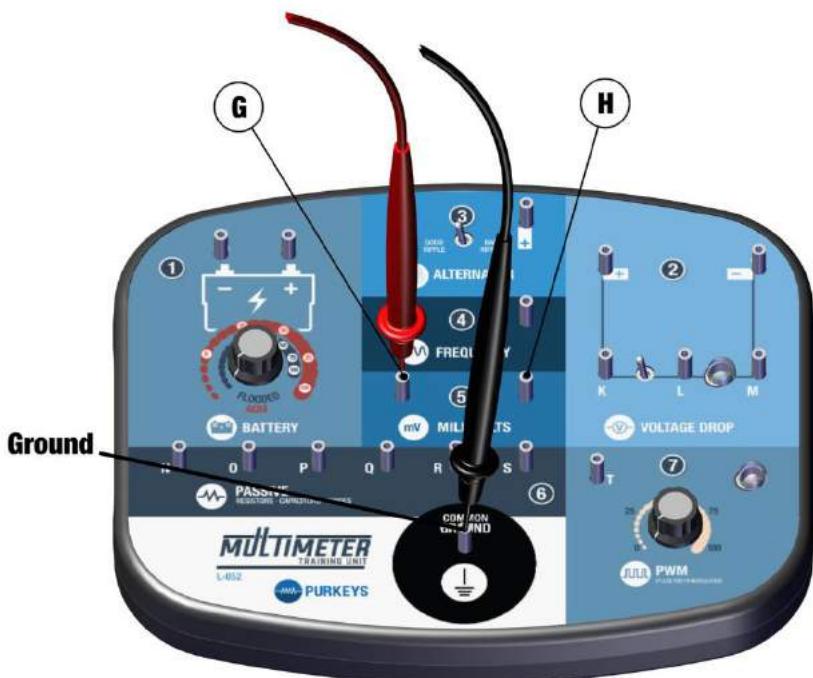


# MTU INSTALLATION GUIDE

## MILLIVOLTS

Understanding millivolt or volt readings can sometimes be confusing, especially with the auto-ranging function on the multimeter or manually changing the scale from volts to millivolts. Practice is generally all that is needed to become proficient at changing voltage ranges and knowing when the meter has auto-ranged. Adjust the multimeter settings to measure DC millivolts. Touch the black lead of the multimeter to contact point GROUND of the MTU and the red lead of the multimeter to contact point G of the MTU\*. Moving the red lead to contact point H will provide another voltage to measure.

\*The Millivolts section can be configured to output various values (see page 12).



## PASSIVE

### RESISTANCE

Accurately measuring resistance and continuity is an important electrical diagnostic skill. It is useful for measuring opens, shorts, and grounds in electrical components or circuits. Adjust the settings of the multimeter to measure resistance (Ohms or  $\Omega$ ). Touch the black lead of the multimeter to contact point GROUND and the red lead to contact point N, O, or P\*.

Note: Touching the black lead to one of the above mentioned contact points other than GROUND will provide other options of resistances to measure.

### DIODES

Adjust the settings of the multimeter to diode. Touch the red lead of the multimeter to contact point GROUND and the black lead to contact point Q. Connecting the multimeter in this fashion will forward bias the diode, turning it on, providing a low reading. Reversing the leads will reverse bias the diode, providing a high (or OL) reading.

### CAPACITANCE

Adjust the settings of the multimeter to measure capacitance. Touch the black lead of the multimeter to contact point GROUND and the red lead to contact point R or S\*.

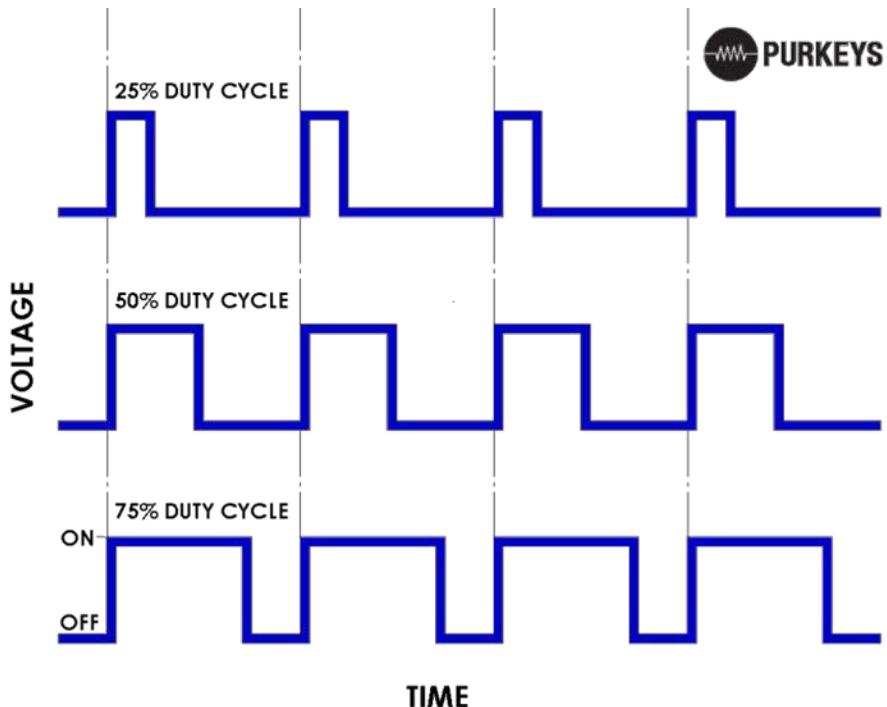
\*The Passive section can be configured to output various values (see page 12).



# MTU INSTALLATION GUIDE

## PULSE WIDTH MODULATED SIGNAL

Pulse width modulation (PWM) is increasingly being used on vehicles to control electrical components such as lights and electric motors. PWM is an electrical signal consisting of a square wave of fixed frequency (graphed as X = time, Y = Voltage). The percentage of “on” time is the duty cycle. (See figure below.)

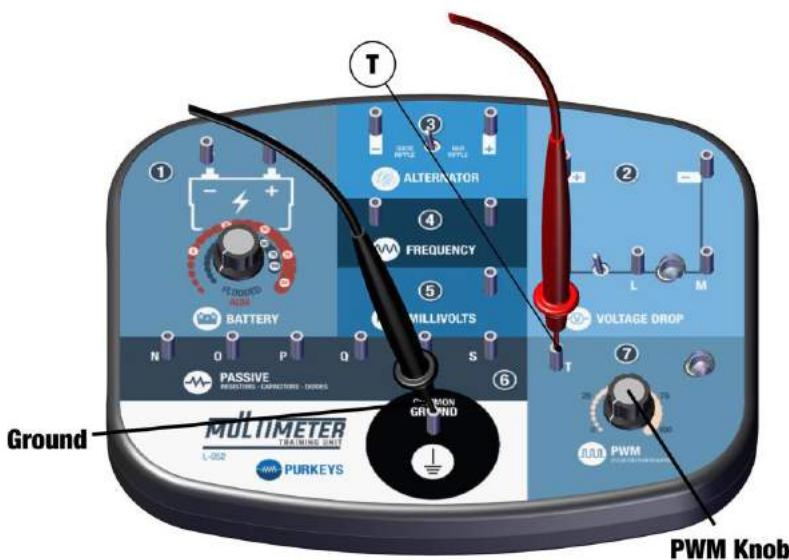


Continued on page 10.

Continued from page 9.

Adjust the PWM knob in Section 7 of the MTU to a desired setting at any time during use. To measure PWM, set the multimeter to the frequency (Hz) or duty cycle scale \*. Touch the black and red leads of the multimeter to contact points GROUND and T of the MTU respectively.

\*The frequency of this signal remains constant and the duty cycle can be varied between 0 and 100% as the knob is adjusted.



# MTU INSTALLATION GUIDE

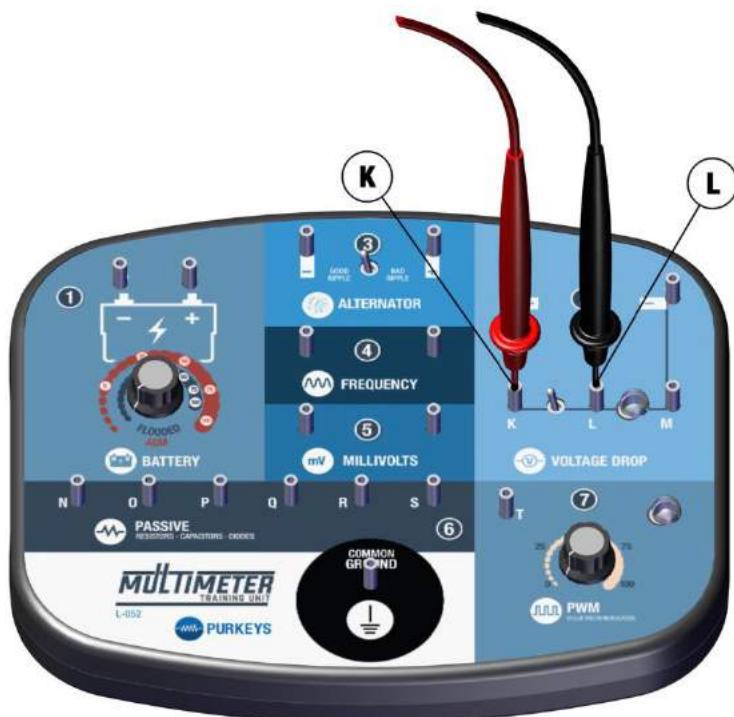
## DC CURRENT

Being able to measure small amounts of current (milliamps) is a useful diagnostic for measuring parasitic drains to determine if they are excessive. To measure current, the multimeter must be in the current path, completing the circuit.

Adjust the multimeter to measure DC Current (mA)\*. Turn off the switch between K and L (LED between L and M will be off). Touch the red and black leads of the multimeter to contact points K and L of the MTU respectively.

\*Red lead must connect to the appropriate input terminal of the multimeter for measuring current.

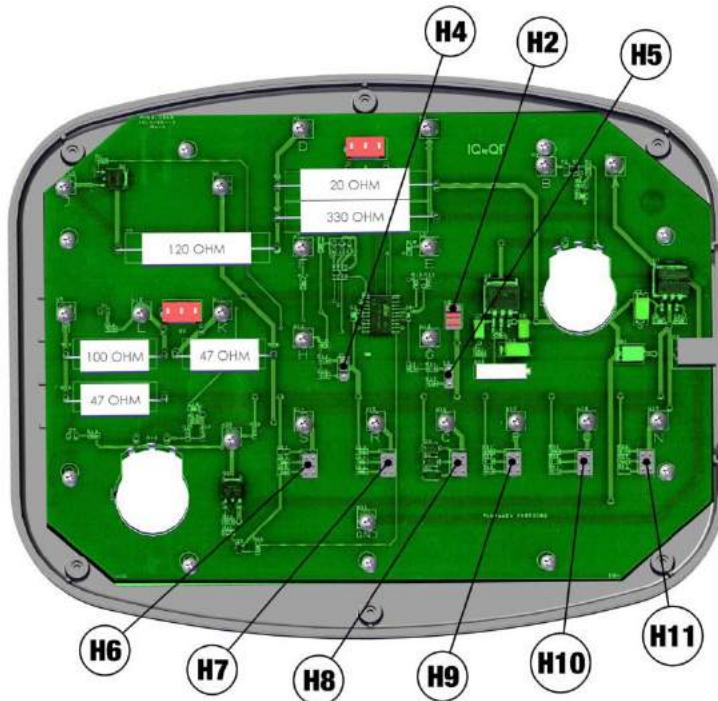
**WARNING:** Multimeter current input terminals are for measuring current only! Internal fuses will blow if used improperly.



## ALTERNATE CONFIGURATIONS

Sections Frequency, Millivolts, and Passive are re-configurable by changing the position of the internal jumpers (accessible by removing the back panel). To remove the back panel, disconnect the wall transformer from the MTU, then remove the six Phillips screws from the back.

- Frequency: 3 Positions of H2
- Millivolts: 2 Positions of H4 and 2 Positions of H5 for contact Points H and G respectively
- Passive: 3 Positions for each of H6 – H11 for contact points S – N respectively



# **MTU INSTALLATION GUIDE**

## **LIMITED COMMERCIAL WARRANTY POLICY**

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MCE Purkeys FE, LLC (hereafter "Purkeys"), warrants each product to be free of defects in material or workmanship under normal use and service. This warranty is for the benefit of Original Equipment Manufacturers, Dealers, Warehouse Distributors, Fleets, or other End Users (hereafter "Customers") and covers products manufactured by Purkeys and sold new to Customers either directly by Purkeys or by its authorized dealers, distributors, or agents. The length of the Warranty Period is 36 months.

The warranty period commences on the in-service or install date and is not transferable. Failure to provide the in-service or install date on the warranty claim form will cause the warranty period to begin on the date the part was manufactured, or date of sale recorded on the original sales invoice, whichever is earlier.

A completed warranty claim form should accompany all parts submitted to Purkeys for consideration for repair or replacement under warranty. The submitted claim form should contain all of the information required. Lack of a properly or fully completed claim form will result in delay or denial of warranty claim. Claims must be submitted no later than 30 days after part is removed.

This warranty does not apply if, in sole judgement of Purkeys, the product has been damaged or subjected to accident, faulty repair, improper adjustment, improper installation or wiring, neglect, misuse, or alteration or if the product failure is caused by defects in peripheral vehicle components or components attached to the Product or failure of a part not manufactured by Purkeys.

This warranty shall not apply if any Purkeys product is used for a purpose for which it is not designed or is in any way altered without the specific prior written consent of Purkeys. ANY product alleged by a Customer to be defective must be inspected by Purkeys as a part of the warranty claims process in order to confirm that the part has failed as a result of a defect in material or workmanship.

Transportation for products and parts submitted to Purkeys for warranty consideration must be prepaid by Customer. Repaired or replaced products and or components will be returned to Customer pre-paid by Customer or "freight collect" to the address provided by Customer in the warranty claim form. No charge will be made for labor or material in effecting such repairs.

The Warranty provided by Purkeys hereunder is specifically limited to repair or replacement of the Product as Purkeys deems most appropriate in its sole discretion. Purkeys neither assumes nor authorizes any other person to assume on its behalf any other warranty or liabilities in connection with Purkeys products. The Warranty does not apply to fuses or other "consumable" or maintenance items which are or may be a part of any Purkeys product.

**THIS WARRANTY DOES NOT APPLY TO LOSS OF VEHICLE OR EQUIPMENT, LOSS OF TIME, INCONVENIENCE, OR OTHER INCIDENTAL OR CONSEQUENTIAL DAMAGES. PURKEYS SPECIFICALLY DISCLAIMS AND SHALL NOT BE LIABLE FOR INCIDENTAL OR CONSEQUENTIAL DAMAGES arising out of or from the use of Purkeys products by the Customer.**

**THIS LIMITED WARRANTY IS IN LIEU OF ALL OTHER WARRANTIES, INCLUDING COMMON LAW WARRANTIES OF FITNESS FOR A PARTICULAR PURPOSE, MERCHANTABILITY, AND ANY OTHER EXPRESS OR IMPLIED WARRANTIES. ALL OTHER SUCH WARRANTIES ARE SPECIFICALLY DISCLAIMED.**

This Limited Commercial Warranty supersedes all previous Warranty Policies issued by Purkeys and any of its suppliers.

