ROADRUNNER MOBILITY

On-Line Technical Training Course

Roadrunner Mobility
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Richardson, TX 75081
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www.roadrunnermobility.com

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CONTACT LIST

Technical Support Hotline Calling Tips **1-800-832-4707**

☑ Please write down the model and serial number.
☑ Please write down the software version and error codes.
☑ It is necessary that you are with the product, before contacting technical support.
☑ Before troubleshooting any chair, make sure the batteries are in good condition.

Miscellaneous Contacts:	**Phone and website**
MK Battery	1-800-372-9253 www.mkbattery.com
TASH	1-800-463-5685 www.tashinc.com
ASL	1-800-626-8698 www.asl-inc.com
Peachtree	1-830-693-6030 www.asl-inc.com
Magitek	1-800-347-9928 www.magitek.com
New Abilities	1-800-829-8889 www.newabilities.com
Therafin	1-800-843-7234 www.therafin.com
U.S. Rehab	1-800-987-7342 www.usrehab.com
Motion Concepts	1-888-433-6818 www.motionconcepts.com
The Aftermarket Group/TAG	1-888-824-8200 www.aftermarketgroup.com
Invacare	1-800-333-6900 www.invacare.com

Need access to Invacare's Tech Zone for helpful tips and more login using
Username = techzone
Password = invacare

RECOMMENDED TOOL LIST

Remote Programmer (PN 1109091)
Scooter Programmer (PN 1124242)
Remote Programmer Mk6i (PN 1142215)
Professional SD Card (PN 1144515)
Wire Crimping Pliers
Tire Tools (available from TAG)
1/4” Socket Set (Metric/SAE)
1/2” Socket Set (Metric/SAE)
SAE Wrench Set ¼”-1”
Channel Locking Pliers
Dead Blow Hammer
Small Pry Bar Set
Tie Wrap Assortment
Brush Chalk
6” & 12” Crescent Wrench
Hacksaw
Compressed Air Source
Remote Battery Charger 12 volts
Wire Brush
Small Files
Soldering Iron

Digital Multimeter
Flashlight
Pitch Angle Gauge
Basic SD Card (PN 1144516)
Electrical Connector Assortment
Hex T-Handle Wrenches (Metric/SAE)
3/8” Socket Set (Metric/SAE)
3/8” & 1/2” Torque Wrench
Metric Wrench Set 4mm-19mm
Vise Grip Pliers
Screw Driver Set
Tape Measures
Shrink Wrap Assortment
Scissors/Razor Blade Knife
Tire Gauge
Bench with Vise and Bench Grinder
Drill with Drill Bits
Remote 8 amp 24 Volt Charger
Heat Gun
Assorted Fasteners
Glue Gun

Safety Items
First Aid Kit
Eye Wash
Safety Glasses
Shop Apron
Rubber Gloves
Antibacterial Cleaner
Lint Free Shop Rags
Back Support Devices
Baking Soda
Anti-Static Strap

Optional Items for Service Tech’s
Electronic Temperature Gauge
Wheelchair/Scooter Lift
Computer with Internet Access
Instant Camera or Digital Camera
Cell Phone
Portable Van Ramps
Invacare IVS Software
1/4” and 3/8” Torque Wrench
RPM Gauge for Motors
Line Amp Gauge for Motor Leads

SERVICE MANUALS

You can download a FREE copy of all manuals from our website at www.invacare.com, or place an order with our parts department

Service Manual	Part Number
Lynx/Panther Scooters	1091860
Invacare Scooter 300 & 400 (HMV)	1122167
Invacare Scooter 220 (HMV)	1125065
At'm & At'm QT	1125078
Pronto M41	1145724
Pronto M50/51/61	1125075
Pronto M71	1118377
Pronto M91/94	1125038
Pronto R2 & R2 - 250	1098315
Formula PTO Plus	1125031
Formula TRE	1123820
Adjustable ASBA Seating	1143238

WHAT CONSUMERS NEED TO KNOW ABOUT POWER MOBILITY PRODUCTS

(Recommendations courtesy of Invacare & MK Battery)

Batteries:

* ALWAYS follow the manufacturers recommendations for battery type and size.
* ALWAYS use Deep Cycle batteries, due to the fact that they are designed to be discharged and recharged on a regular basis.
* Cold Cranking Amp or Marine type batteries are for starting purposes only, and are not intended for power mobility products.
* *Deep Cycle batteries are FAA and DOT approved and are the safest for transport both private and public*.
* Deep Cycle batteries are Maintenance Free batteries, NEVER open or modify.
* Deep Cycle batteries DO NOT have a memory.
* *NEVER allow Deep cycle batteries to completely discharge.*
* The depth of discharge does effect the life of Deep Cycles batteries, the greater the discharge the sooner they will need replaced.

Charging Systems:

* Use only manufacturers charger on all models, and no more than 8 amps MAX.
* *Charge Deep Cycle batteries frequently to maintain a high level of charge.*
* Charge mobilty products with the power “ON” to reduce current rollback.
* *All Deep Cycle batteries have a Break In Period of 20 days. Charge power mobility products everyday for the first 20 days reguardless of use.*
* *Charging of power mobility products may take 8 hours under normal use and up to 16 hours with severely discharged products.*
* *NEVER top off power mobility products with short charges, once recharging begins it must be allowed to finish. This could take +10 hours.*
* NEVER leave charger connected for times exceeding 36 hours.
* NEVER charge power mobility products with both an ON-BOARD & OFF-BOARD chargers at same time.
* DO NOT use an extension cord to charge power mobility products.
* DO NOT charge power mobility products outside.
* Chargers may get warm, if excessive heat is detected, discontinue and call dealer.

Storing Batteries:

All batteries should be fully charged before putting the unit away for storage (regardless of storage lengthof time). It is also recommended that you disconnect the main power source, to avoid the possibility of discharging the batteries (which could cause permanent damage).

WHAT CONSUMERS NEED TO KNOW ABOUT POWER MOBILITY PRODUCTS

(Recommendations courtesy of Invacare & MK Battery)

Other important information:

* Check all air tires often to ensure proper level of inflation. This will result in better product performance.
* *DO NOT engage or disengage motor locks/clutches with the power in the "ON" position.*
* DO NOT operate power mobility products on roads, streets or highways.
* DO NOT travel up or down ramps, inclines or slopes greater than 9 degrees.
* DO NOT attempt to traverse inclines with water, ice or oil film on it.
* *DO NOT enter or exit a power mobility product with power in the "ON" position. Injury may occur.*
* *DO NOT expose any power mobility product to any liquids or leave in a damp area for prolonged time.* This could cause rusting and corrosion that will damage the product and void the limited warranty.
* DO NOT lift power mobility products by any removeable parts. Damage or injury may occur.

POWER WHEELCHAIR TROUBLESHOOTING PROCEDURE

1. Check the static battery voltage with a digital multimeter.
   _____ Static DC Volts at Charger Connector

2. Test battery charger to ensure that it is functioning properly.
   _____ DC Voltage at Batteries with Charger ON

3. Check all fuses and connections for damage.
   - Battery Box Fuses OK Bad
   - Wiring Harness Fuses OK Bad
   - Motor Connections OK Bad
   - Joystick Connections OK Bad
   - Control Module Connections OK Bad
   - Power Seating Connections OK Bad

4. Test both motor and brake components with a digital multimeter.
   - Test Motor Connection
     .5 - 5 Ohms Good (higher Ohm reading indicate internal problems).

RWD **CWD**

RT M1_____ohms **LT M2**_____ohms **LT M1**_____ohms **RT M2**_____ohms

M1 Motor Brushes OK Bad M2 Motor Brushes OK Bad

   - Test Brake Coil (make sure the lever is engaged)
     40 - 80 Ohm Ranges Good (O.L. indicates an internal problem).

_____ M1 Motor Ohms _____ M2 Motor Ohms

M1 Micro Switch OK Bad M2 Micro Switch OK Bad

5. Check the Others Menu for any error codes with a remote programmer.
   - First 3 Error Codes _____

INVACARE SERVICE & PARTS

Battery and Charging Systems

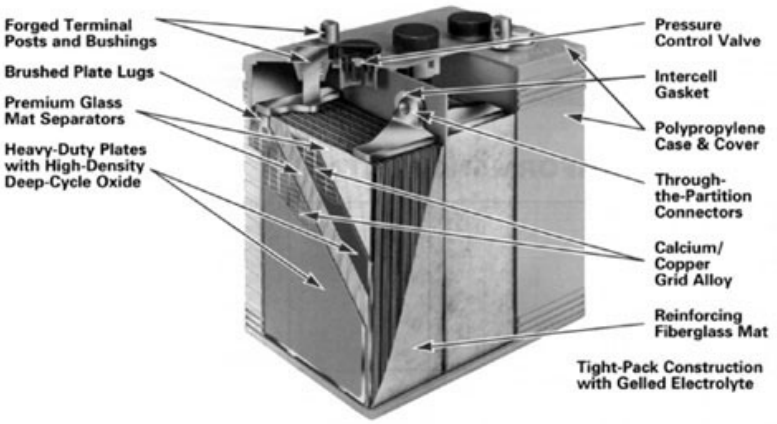
Visit the Technical Zone at www.invacare.com
or Call us Toll FREE at 1-800-832-4707

BATTERY SIZES CHART

Power Chairs	Qty.	Volts	Battery Type
*TDX3	2/3	12	22NF/GR24
*TDX4	2/3	12	22NF/GR24
*TDX5	2	12	22NF/GR24
TDXSP	2	12	22NF
TDXSC	2	12	U-1
TDXSI	2	12	22NF
*TDXSR	2/3	12	22NF/GR24
TDXSpree	2	12	22NF
*2G Storm Series	2/3	12	22NF/GR24
*3G Storm Series	2/3	12	22NF/GR24
Ranger II RWD	2	12	22NF
Ranger II JR.	2	12	U-1
P7E/P9000 XDT	2	12	U-1
Excel	2	12	22NF
P9000	2	12	U-1/22NF
Power Tiger	2	12	22NF
Pronto M6	2	12	U-1
Xterra GT CWD	2	12	22NF
Pronto M41/50	2	12	U-1
Pronto M51/61	2	12	U-1
Pronto M71/R2	2	12	U-1/22NF
Pronto M91/M94	2	12	22NF
Nutron Series	2	12	U-1/22 NF
ATM/Adventure SX-3	2	12	12AH
Lynx L-3	2	12	12AH
Lynx L-3X	2	12	36AH
Lynx L-4	2	12	12AH
220/300/400	2	12	12AH or U1
Lynx SX-3P	2	12	17AH
Lynx SX-3	2	12	17AH
Lynx LX-3	2	12	31AH
Adventure LX-3	2	12	U-1
Lynx LX-3 Plus	2	12	31AH
Panther LX-4	2	12	31AH
Panther MX-4	2	12	40AH

*__NOTE__: TDX chairs equipped with a Vent Tray will require 3 22NF batteries. The third battery will supply power to the Ventilator (wiring harness shipped with base).

SEALED LEAD ACID & GEL CELL DEEP CYCLE BATTERIES

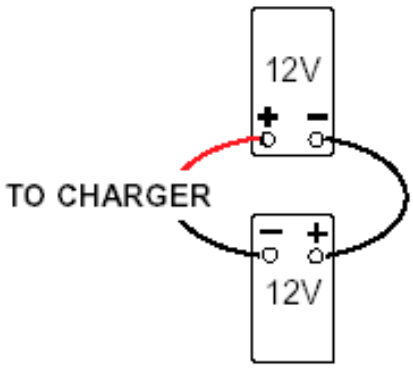


How does maintenence free batteries work?

A Gel cell is a “recombinant” battery. This means that the oxygen that is normally produced on the positive plate in all lead-acid batteries recombines with the hydrogen given off by the negative plate. The “recombination” of the hydrogen and oxygen produces water (H_20), which replaces the moisture in the battery. Therefore, the battery is maintenance-free, as it never needs water replenishment.

Source:

MK Battery Technical Manual, www.mkbattery.com



24 VOLT

How does a Series Connection work with two 12V Batteries?

Circuit (Series) - A circuit which has only one path for the current flow. Batteries arranged in series are connected with negative of the first to positive of the second, negative of the second to positive of the third, etc. If two 12-volt batteries of 50 ampere-hours capacity each are connected in series, the circuit voltage is equal to the sum of the two battery voltages or 24-volts, and the ampere-hour capacity of the combination is 50 ampere-hours.

CYCLE OF DEEP CYCLE BATTERIES

DISCHARGE

RECHARGE

A battery CYCLE is a discharge and recharge of a battery. Once a recharging part of the cycle begins the charger must be able to reach its cut off voltage. Frequent short charges will decrease the life of batteries by reducing the number of cycles in them.

ALL SEALED LEAD ACID AND GEL CELL DEEP CYCLE BATTERIES DO NOT HAVE A MEMORY.*

DOES THE DEPTH OF THE DISCHARGE AFFECT BATTERY LIFE?

YES! The greater the load on the batteries, the sooner they will have to be replaced.

***Typical Gel Cell Cycling Ability vs. Depth of Discharge**

Capacity Discharged	Typical Life Cycles
100%	500 (15 mo.)
*75%	750 (2 yrs.)
50%	1100 (3 yrs.)

***75% is the average capacity withdrawn for an active user.**

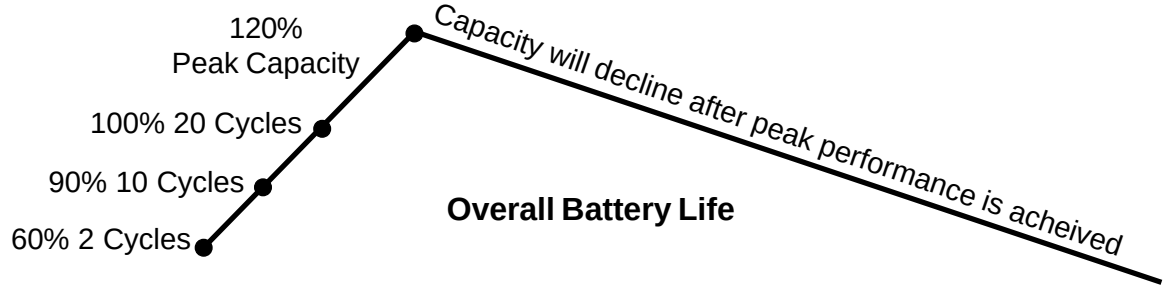
***NOTE:** Consumers may experience longer or shorter battery life, depending on driving/ charging habits, terrain, temperature, programming values, and 24 volt accessories in the system. Instructing the consumer is IMPORTANT for maintaining the batteries.

SEALED BATTERY BREAK-IN PROCEDURE

A battery CYCLE is a discharge and a complete recharge. A new battery out of the box has 2 cycles completed prior to initial use and about 60-65% capacity while continuing to grow in capacity in as many as 20 cycles. Though after 10 cycles a gel battery should reach 90% capacity or higher.

When educating your customers about their new batteries, it is very important that you inform them about the Break-in Procedure and recharge cycle.

Break-in Procedure:
All deep cycle gel batteries require a complete recharging (regardless of use) for the first 20 days of use in any power mobility product. Failure to do this could shorten the driving range, and may effect the overall life of the batteries.



The reason for this procedure, is that if either battery is not FULLY charged it will begin to sulfate. This happens because Lead Sulfate produced in the discharge process is not completely removed and begins to set up crystalline structures, which will not return to acid and lead in the recharge process. This typically is the reason for reduced capacity (range) in fairly new batteries.

Reduced capacity (range) can be due to a mechanical failure (charger, connection, wiring, etc.) or a consumer problem (too short a charging routine, incomplete charging). Charging is also not a one time function. A batteries depth of discharge (resistance level less than 50%) affects its ability to accept full charge current (100%) when in the initial charge process. Also time of use does not correspond directly to recharge time requirements.

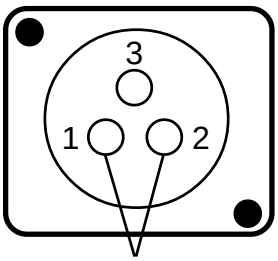
Source:
MK Battery Technical Manual, www.mkbattery.com

BATTERY STATE OF CHARGE

A battery state of charge or a static voltage reading is a test of the battery voltage while the power mobility product is at rest (not driving). Use a digital multimeter to check the static battery voltage by:

- Inserting the multimeter leads into pins 1 and 2 of the charger/programmer port on the front of the driver control. (see diagram below)
- If you receive a negative reading on the meter, switch the leads to the opposite pins.
- Do not allow the leads to touch each other while connected this will cause damage to the multimeter and driver control.
- A relatively good reading of a set of gel batteries should display at least 25.0 volts or higher. (+75%)

Charger Connector



Static Battery Voltage Test Point
Pin 1 = positive (+)
Pin 2 = negative (-)

GEL/SEALED Lead Acid Type Deep Cycle

Charge Level	Specific Gravity	Static Reading	On Charge
100%	N/A	25.6 VDC	28.8 VDC
75%	N/A	**25.0 VDC**	28.2 VDC
50%	N/A	24.6 VDC	27.8 VDC
25%	N/A	24.4 VDC	27.4 VDC
DISCHARGED	N/A	**24.2 VDC**	27.0 VDC

If the batteries are not fully charged or appear weak, recharge them overnight before performing a load test.Severely discharged batteries could take up to 10-16 hours to recharge back up to 100%. Severely discharged batteries could also rise rapidly, giving the charger a false reading causing the charger to shut off too soon.

FIELD LOAD TEST PROCEDURE

Old batteries lose their ability to store/release power, due to increased internal resistance. This means that as you try to take power from the battery, some of that power is used up in the process of passing through the battery, resulting in less voltage at the posts. The more power drawn, the lower the voltage available. When this lost voltage drops (as a pair) 0-2 volts the batteries are GOOD, 2-2.5 their POOR, and 2.5 or higher BAD.

Testing under a load is the only way to spot this problem. While special battery load testing equipment is available, it is costly and difficult to transport.

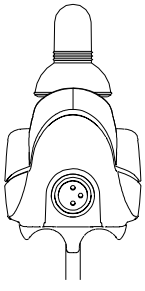
Use a digital multimeter to check battery charge level at the charger connector. It is located on the side of the wheelchair frame or at the front of the joystick or display.

Field Load Test Procedure

1. Ensure that power is OFF.
2. Make sure battery voltage is above 25.0 VDC.
3. Remove the footrests from the wheelchair, and seat yourself into the chair. Place yourself and the chair in front of a stationary object (door jam, or a brick wall).
4. Insert your multimeter leads into the charger connector on the wheelchair (see Figure 1). Most digital multimeters are not affected by polarity, however, analog meters (meters with swinging needles) can be and should be used carefully. A good meter reading should be 25.0 VDC or higher.
5. Have two (2) individuals (one [1] on each arm) apply as much downward pressure as possible on the arms of the wheelchair.
6. Turn the power ON and push the joystick forward, trying to drive the wheelchair through the stationary object. This puts a heavy load on the batteries as they try to push through the stationary object. Read the meter while the motors are stalling to determine the voltage under a load.

NOTE: If the voltage drops to less than 23.0 volts from a pair of fully charged batteries while under load, they should be replaced regardless of the unloaded voltages.

Figure 1.

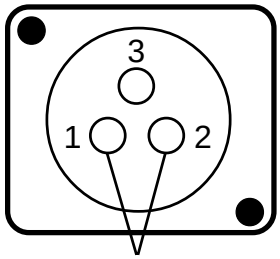


MK5 Charger Connector

CAUTION

Avoid stalling motors for longer than 15 seconds. Stalling the motors for more than 15 seconds may cause hot spots on the commutator plates, or cause the chair to go into 100% Current Rollback.

Charger Connector on chair base MKIV



Static Battery Voltage Test Point

HAND HELD FIELD LOAD TEST PROCEDURE

The tester draws current from the battery while measuring its voltage level. The voltage level of a good battery will remain relatively steady under load, but a defective battery will show a rapid loss in voltage.

1. Turn the power switch to the off position.
2. Make sure the static battery voltage is above 25.0 VDC.
3. Disconnect batteries from equipment.
4. Connect negative (black) clamp to the negative (NEG, N,-) battery post. Connect positive (red) clamp to positive (POS, P, +) battery post. “Rock” clamps back and forth to insure a good electrical connection. CAUTION: do not let the positive and negative to make contact.
5. With clamps connected, tester’s meter will indicate battery’s STATE OF CHARGE. If state of charge is less then 12 volts, the battery should be recharged before load testing. If recharging does not bring voltage to 12.4 or higher battery is defective. If meter needle is off scale to the left, check for loose or reversed clamps; otherwise battery is defective.
6. Depress load switch for 10 seconds.
7. Read meter at the end of 10 seconds - with switch depressed. Refer to LOAD TEST ANALYSIS CHART.

LOAD TEST ANALYSIS CHART	
Meter Action >10Seconds	**Battery Condtion**
Needle in Green	GOOD
Needle in Yellow	WEAK/CHARGE & TEST
Needle in Red	BAD/REPLACE

NOTE: Read all of the supplied instructions for analyzer before use.

RULES FOR CHARGING BATTERIES

Rule #1 - New batteries MUST be fully charged prior to initial use. There have been occasions when new batteries have failed out of the box. This will also help in verifing that the charging system is functioning properly. Save yourself an unnecessary service call and charge the batteries the night before your delivery, or before the customer is scheduled to pick up their chair.

Rule #2- New batteries DO have a break-in period of 20 cycles. Regardless of use, re-charge the batteries every night for the first 20 days. After the 20 day break-in period, re-charge the batteries on a regular basis.

Rule #3 - Be aware that if your customer had lead acid batteries and you are replacing them with gel batteries, please double check their battery charger. If they have a dual mode charger, then make sure the switch (Schauer and Lester models only) is in the correct position prior to initial use (permanent damage can be done to a set of batteries if not set correctly, see the Owner's Manual or call Invacare Technical Support if not sure). If the customer does NOT HAVE a dual mode charger, then they will need to upgrade to a newer style dual mode charger.

Rule #4 - Allow at least eight (8) hours for normal charging. Larger batteries (greater than 55 ampere-hours) or severely discharged batteries may require up to sixteen (16) hours to be properly charged and equalized. If the charger operates for sixteen (16) hours and is unable to fully charge the batteries, an internal timer turns the charger off. Perform a load test on the batteries to determine if replacements are needed.

Rule #5 - The range per battery charge (using recommended batteries) should be approximately 5 to 9 hours of typical operation. Extensive use on inclines may substantially reduce per charge mileage. A good rule of thumb, is for every hour of actual drive time, you should equal that amount of time or exceed it when recharging.

Rule #6 - Charge the batteries through the power mobility product with the power "ON" to help eliminate current rollback at start up. This resets overheat timer and thermastat to normal levels. Refer to the Electronics Service Manuals for further explanation.

ON-BOARD FULLY AUTOMATIC BATTERY CHARGERS

All power wheelchairs Invacare delivers today have some form of Fully Automatic Battery Charger as standard equipment. The term “Fully Automatic” means that once a recharge cycle begins, the charger will stay on until it reaches its cutoff voltage point. Once the cutoff voltage is noticed by the charger, the charger will automatically stop charging the batteries. Fully Automatic Chargers also have a start-up voltage reference point. The term “Start-up Voltage”, means that once the battery charger is plugged in and turned ON, it must notice a minimum voltage in order to stay on and recharge the batteries.

24 Volt 2 Amp Battery Charger (on-board)

2 amp On-board battery chargers have a start-up voltage of 20-22 VDC. These chargers have no on/off switch or fuses, also it determines battery type and adjusts the cut off voltage accordingly. These chargers also have 1 LED that light up to inform the user that the power is on and the charging condition. These chargers are normally found on scooters.

24 Volt 3 Amp Battery Charger (on-board)

3 amp On-board battery chargers have a start-up voltage of 18-22 VDC. These chargers have no on/off switch or fuses, also it determines battery type and adjusts the cut off voltage accordingly. These chargers also have 2 LED’s that light up to inform the user that the power is on and the charging condition. These LED’s also will show faults in the system. These chargers are normally found on scooters and low end consumer power chairs.

24 Volt 5 Amp Battery Charger (on-board)

5 amp On-board battery chargers have a start-up voltage of 18-22 VDC. These chargers have no on/off switch or fuses, also it determines battery type and adjusts the cut off voltage accordingly. These chargers also have 1 or 2 LED’s that light up to inform the user that the power is on and the charging condition. These LED’s also will show faults in the system. These chargers are found on the high end consumer power chairs.

NOTE: Lower Amp charger require extended charging time if the batteries are less than 25%.

OFF-BOARD FULLY AUTOMATIC BATTERY CHARGERS

24 Volt 8 Amp Lester Battery Charger
Lester Dual Mode Charger has a start-up voltage of 18-22 VDC.This charger has an on/off switch and a mode switch to change the cut off voltage depending on battery type. This Lester Charger has 2 led's that light up to inform the user that the power is on and the charging condition. These led's also will show faults in the system.

24 Volt 8 Amp CTE Battery Charger
CTE Battery Charger has a start-up voltage of 8-10 VDC. The CTE Battery Charger has no on/off switch or fuses, also it determines battery type and adjusts the cut off voltage accordingly. The CTE Battery Charger is a "Smart Charger" which means that the charger will begin charging anytime the batteries require a charging and will automatically transition to "Sleep Mode" when the batteries do not require a charge, therefore this charger can be connected to the batteries Indefinitely (though not recommended). This charger has 4 led's that light up to inform the user that the power is on and the charging condition. These led's also will show faults in the system.

ON-BOARD CHARGERS	**OFF-BOARD CHARGERS**
Advantages: - no switches to confuse user - easier transport, stays with product	Advantages: - easier to see status lights - faster charge times
Disadvantages: - harder to see status lights - slower charging times	Disadvantages: - heavier, harder to transport - user may notice charger heating up

BATTERY CHARGER TROUBLESHOOTING TIPS

Problem	Possible Cause	Corrective Action
No power	Bad power cord	Replace power cord
	Bad AC outlet	Replace outlet
	Blown internal fuse	Replace fuse
	Switch not turned ON	Turn ON power switch
	Bad LED on panel	Send in for repair
	Internal damage	Send in for repair
Charger ON batteries not charging	Static battery voltage too low (as a pair)	Test batteries or replace if necessary
Charging cycle starts then stops	Bad Connection	Replace connector or replace wiring harness.
Short charge time	One or both batteries may be bad	Test batteries or replace if necessary

NOTE: Read all instructions provided with the charger and view the diagnostic codes printed on the charger for LED indicator explanation.

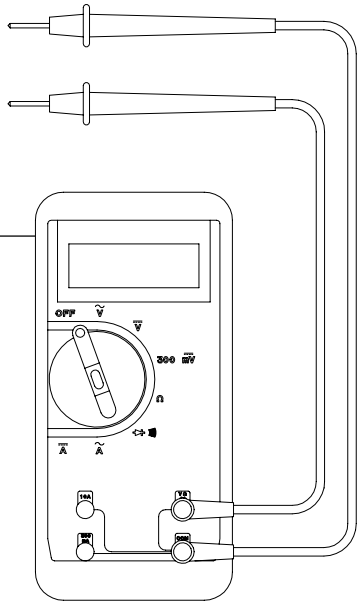
WIRING HARNESS TESTING

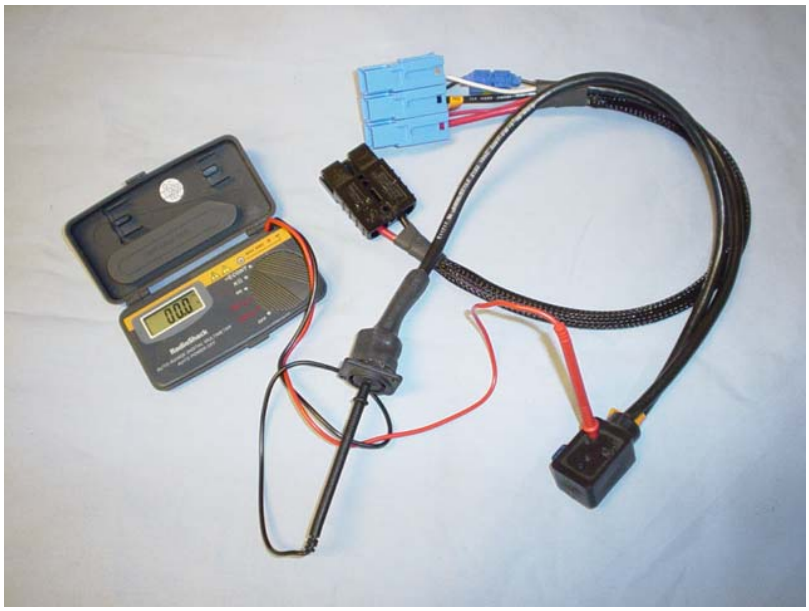
1. Check the wiring harness for visible damage, broken/loose connections, and corrosion. If any damage is found replace harness. If the damage is due to corrosion, clean all connections thoroughly. Corrosive connections can create high resistance, which could cause problems with the electronics.

2. Check all fuses in the system, including the fuses inside the battery boxes.

3. When checking the wiring with your multi meter, be sure to move the connection around while testing. By moving the wiring around while your test leads are still in place, you will notice intermediate connection problems.

TECHNICIANS NOTE: Use your multi meter to perform an audible continuity test, or take an Ohm reading (should see less than 1 Ohm). Check all connections for damage or corrosion, if either is noticed replace wiring with OEM parts.





TECH TIP: If the wiring was damaged due to incontinence, replace immediately. Cut an old pneumatic tire tube into six inch sections, and slip them over the new connections and tie wrap each end to protect the new connections.

Invacare Corporation has initiated a field correction involving certain Invacare power wheelchairs manufactured from 1988 through June 2000. Some of these power wheelchairs utilize a battery box harness and a charger harness that have the remote possibility to short and cause a fire. While the likelihood of this occurring remains remote, all potential for fire must be eliminated. If you have a consumer who has purchased a power wheelchair during these time periods, please contact Invacare for details on how to get the new components installed.

INVACARE SERVICE & PARTS

Power Drive Systems

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or Call us Toll FREE at 1-800-832-4707

M1 AND M2 MOTOR ERROR CODES (E09 AND E10)

"IMPORTANT"

RWD chairs will display Error Codes and represent them in the following manner.

RWD M1 = RIGHT SIDE MOTOR/BRAKE ERROR
RWD M2 = LEFT SIDE MOTOR/BRAKE ERROR

CWD chairs will display Error Codes and represent them in the following manner.

CWD M1 = LEFT SIDE MOTOR/BRAKE ERROR
CWD M2 = RIGHT SIDE MOTOR/BRAKE ERROR

Troubleshooting Tips:

- Before unplugging the motor lead to test for resistance, note the orientation of each lead plugging into the motor slots on the controller.
- Mark leads if necessary going into the controller "M1" and "M2".
- Ohm each connector one at a time to ensure that they don't get mixed up when plugging them back into the controller.

RWD Storm Series

CWD TDX Series

DC MOTOR IDENTIFICATION

Invacare has two types of motors: pole motors and GB motors. A Pole motor is a motor with brushes that make connection between the communtator and the motor connection. Pole motors are further defined by the number of motor brushes. 2 Pole motors have either 2 internal or external motor brushes. 4 Pole motors all have 4 external brushes and have a removable gearbox while coming geared standard or for heavy duty applications. GB motors have “NO” brushes or gears and is considered an electromagnetic motor.

2 POLE DC MOTORS

Schmitt motor with 2 external brushes

Older 2 pole motor with 2 internal brushes

M41 motor with 2 internal brushes

4 POLE DC MOTORS

High speed or H/D motors with 4 external brushes

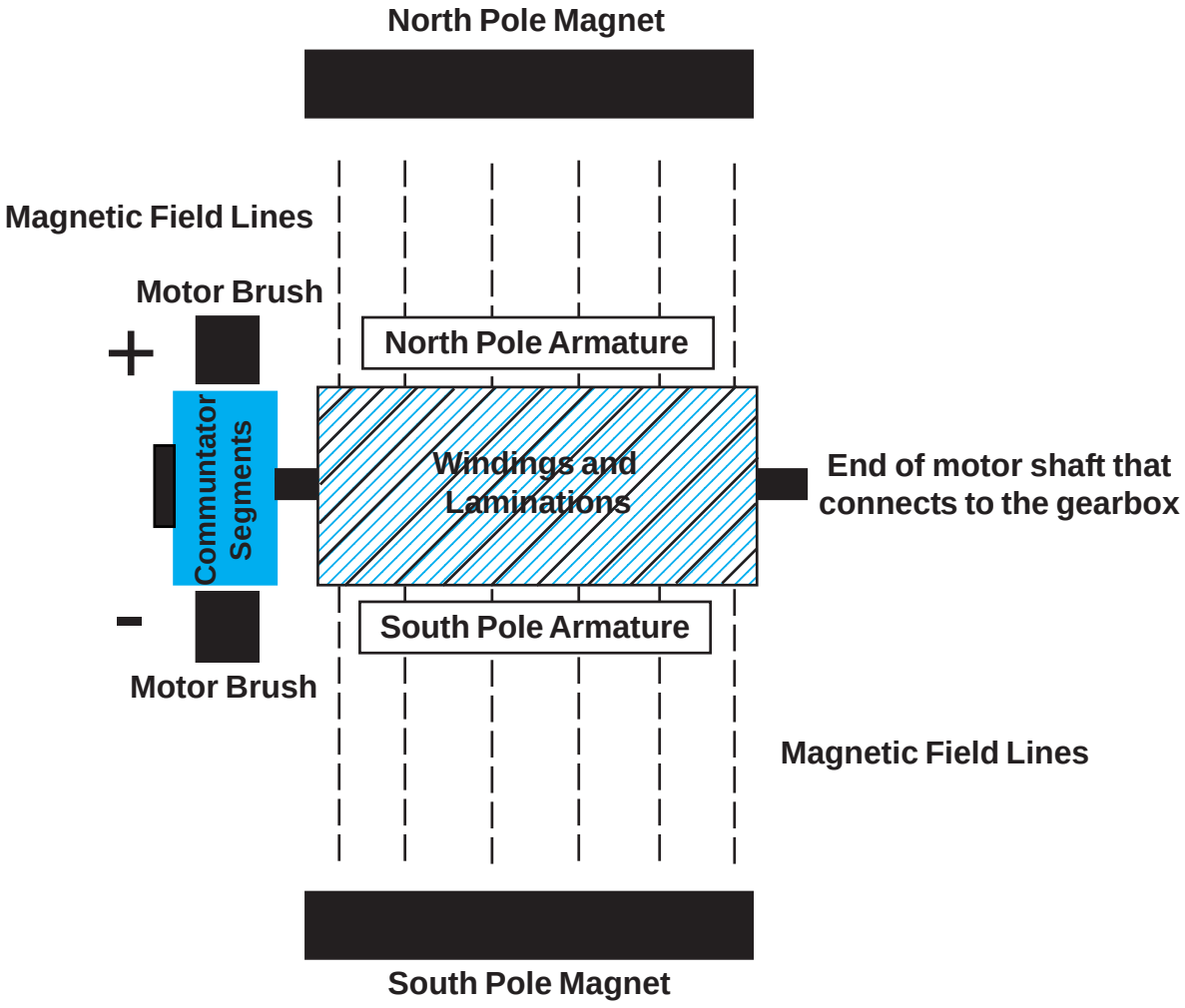
GB MOTORS

GB motor with NO brushes or gearbox

TECH TIP: Knowing the difference in the motor types and how the chair was set up originally will help in replacing the motor with the correct one, and choosing the correct programming profile.

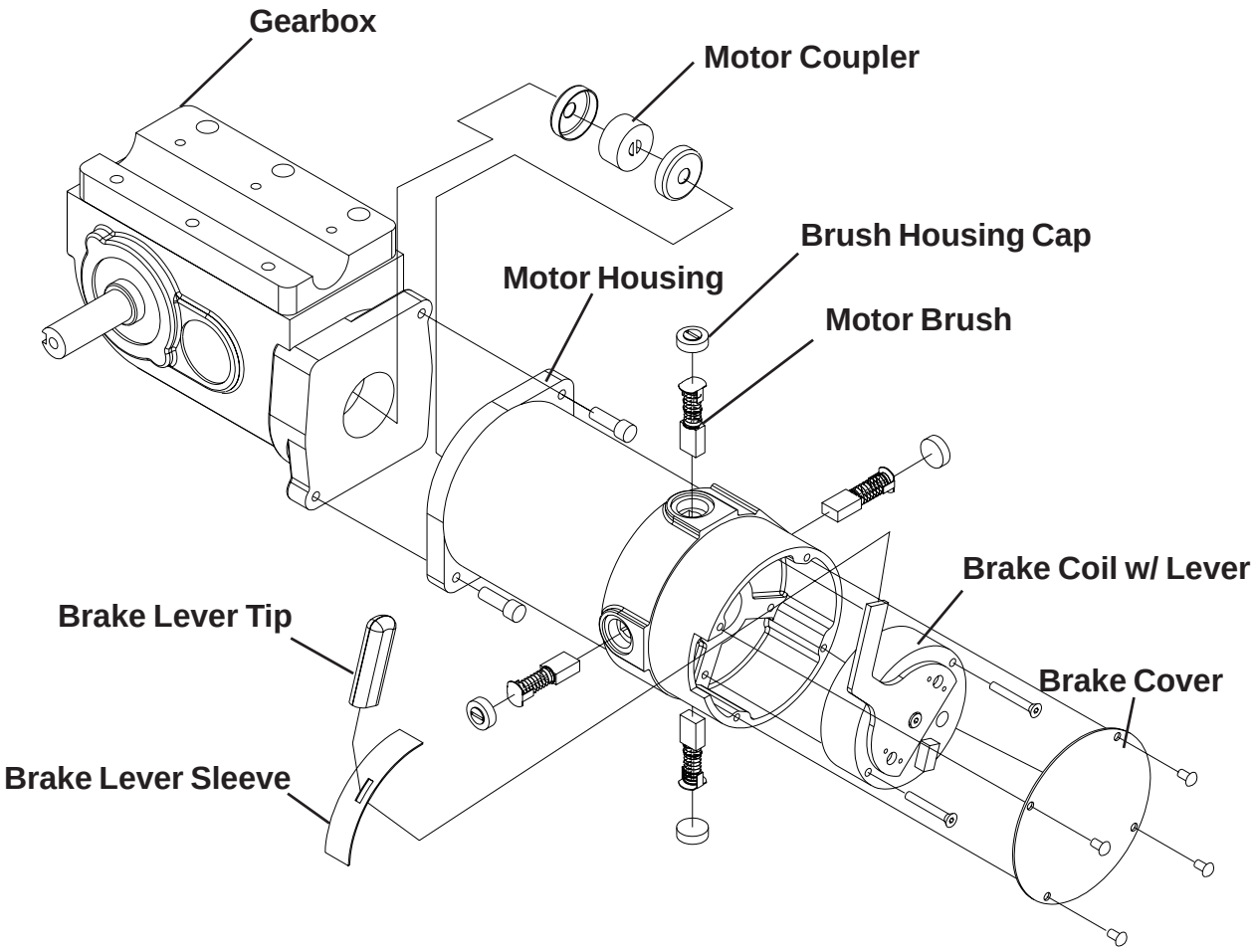
PERMANENT MAGNET DC MOTORS

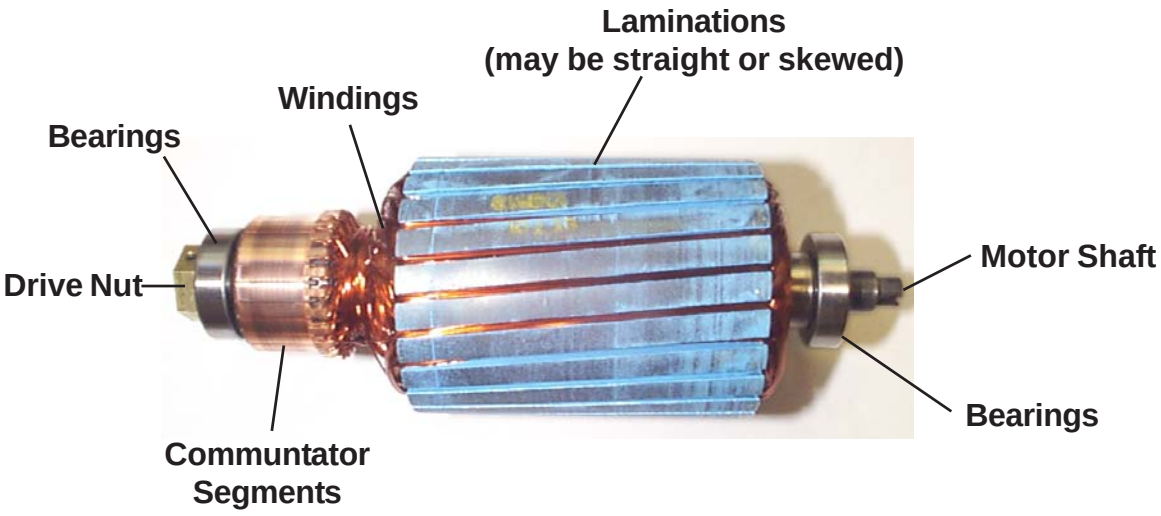
DC Motor Operation - Electrical current supplied by the power wheelchair batteries passes through the motor brushes to the windings, and energizes the coil and laminations thus it becomes an electrical magnet. One end magnetizes as the north pole, and the opposite as the south pole. The north pole windings are positioned next to the motor casings north pole permanent magnets, and the south pole of the windings are positioned next to the motor casings south pole permanent magnets. Armature rotation is caused by like poles repelling, and opposite poles attracting one another. The direction, speed, torque, and braking of the motor is controlled by the wheelchairs electronics.



DC MOTOR COMPONENT IDENTIFICATION

(4-Pole Shown in Illustration)





GEARBOX AND COUPLER INSPECTION

Power wheelchairs equipped with a conventional DC motor with a removable gearbox, come equipped with a serviceable motor coupler. The motor coupler provides a flexible connection between the motor and the gearbox (it will eventually wear out over time). If it is never serviced, it may cause severe damage to the motor. To inspect the coupler you will need to remove the motor (refer to the service manual for motor removal instructions).

Serviceable Motor Coupler

1. Inspect gearbox output shaft for damage, and check keyway slot for damage.

2. Inspect the entire casing for leaks, including the area where the motor coupler is located.

4-Pole Gearbox Drive Ratios
18:1 (High Speed)
or
24:1 (Heavy Duty/High Speed GT CWD)

DC MOTOR TESTING AND BRUSH INSPECTION

1. Turn the power OFF on the chair, and disconnect the motor lead you wish to test.

2. Setup your multimeter to take an Ohm reading.

3. Measure the resistance on the two (2) motor contacts, (be sure to rotate motor and take at least two readings). A normal reading is between .5 to 5 ohms. A reading of 0.L. (Overload) or in excess of 15 Ohms indicates a problem. High readings are generally caused by bad contacts, worn brushes, and internal motor problems.
   Most motor problems can be fixed by replacing motor brushes, and completing the brush seating procedure (see page 2-9).

MK5 & MK6i Motor Test Point

MKIV Motor Test Point

4. Inspect brushes and the motor communtator for abnormal wear, replace brushes if necessary. After replacing brushes refer to page 2-7 for brush seating procedures.

1. Remove brush cap with a flat screwdriver.

2. Remove the brush and inspect it for wear.

When should you replace brushes?

Brushes should be replaced before the tamped shunt wire has a chance to score the communtator, (and before the brush is at the end of the spring travel). When a brush has less than a 1/4" of material remaining, it should be replaced. Also check the shunt wire for any discoloring, and check the spring for damage. If either is noticed replace the brush. Make sure the brush housing is clean so the brush can travel freely without any resistance.

2-POLE MOTOR BRUSH REMOVAL AND REPLACEMENT

(please order replacement brushes by model)

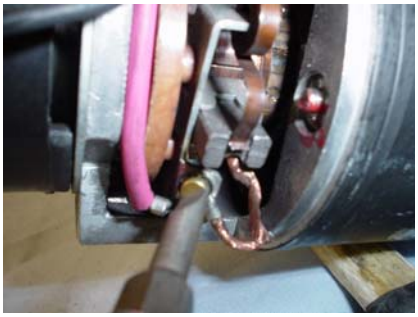
Please refer to the (specific model) power wheelchair service manual, for motor removal procedures if necessary.

1. Locate the two phillips head screws at the front of the motor, and remove these two screws. Remove the long plastic cap and locate the brush assembly on each side of the motor.

2. Before removing brushes review these technical tips.

a. The brush spring retainer is not available as a service part, caution should be used when removing brushes.

b. The screw and washer that attaches the shunt wire to the motor is not available as a service part, caution should be used when removing this screw.



3. Remove the screw that attaches the shunt wire to the motor assembly (please keep the screw and washer to attach the new motor brush).

4. Release the tension on the brush spring retainer with a small screwdriver, and position the screwdriver in place to hold the spring tension. Remove the brush and inspect the commutator for damage. Place the new brush into the brush housing, and release the tension on the spring to hold the brush in place. Attach the shunt wire to the motor housing by reusing the small screw and washer to secure the shunt wire. Repeat this procedure for the opposite brush.

5. Replace the motor cap and screws, and the test motor. Please review page 2-9 for the brush seating procedure.

2 POLE SCHMITT & 4-POLE MOTOR BRUSH REMOVAL AND REPLACEMENT

(Brush Seating Procedure)

1. Disengage the motors and make sure the power is off on the display or driver control. With a flat screwdriver locate the brush cap, and remove the brush cap by turning the screwdriver counter clockwise.

2. Before removing the brush for inspection, place a temporary mark on the motor casting, and on the top of the brush. (If not replacing the brush with a new one, it must be put back into the brush holder in its original position.) Remove the brush from the brush holder and inspect the brush thoroughly. Look for excessive wear or chips in the brush, and any discoloration in the shunt wire.

3. Install the new brush (or original brush) back into the brush holder, and replace the brush cap (turn the screwdriver clockwise to tighten cap). DO NOT OVERTIGHTEN the brush cap, tighten and loosen the cap a couple of times to ensure proper seating of the brush in the brush housing. After inspecting all brushes on the chair, raise the drive wheels off of the ground, and block the front casters to secure the chair. Do not leave the chair unattended when performing STEP 4.

4. Begin the brush seating process by turning the power on, and verify again that the drive wheels are off of the ground. Engage the motors and use a rubber band to hold the joystick in the forward position. Allow the motors to run in the forward direction for at least one hour. After one hour allow the motors to cool off for a half hour, and repeat this procedure in the reverse direction. After completing this procedure test drive the chair, and you should notice an increase in performance.

ELECTROMECHANICAL PARKING BRAKE TESTING

(E09 and E10 Error Code Problems)

1. Turn the power OFF, and disconnect the motor lead you wish to test.

2. Setup your multimeter to take an Ohm reading (make sure the motor is in the drive mode).

3. Measure the resistance in the brake coil, by placing your meter leads on the two brake contacts. A normal reading is in the range of 40 - 80 Ohms (depending on type and manufacturer of motor). A reading of zero or a very high reading could indicate a damaged brake or an open or poor connection respectively.

4. Check the motor leads for damage or corrosion, if corroded or damaged clean or repair connection and re-test.

5. The controllers will store an E09 or an E10 error code for brake problems, try switching the motor leads to ensure that problem is the brake or the controller. If you have an E09 error code present, switch the motor leads. If the error code changes to an E10, the problem is the brake. If the error code does not change and still states E09, then the problem is in the controllers brake output section.

6. One last test point will be the micro switch that allows the motor to be in the drive mode or the free wheel mode. Place your meter leads on the two brake contacts with your meter set up to read Ohms or Continuity. Engage and disengage the brake lever and watch your meter, you should see a resistance value, then a near zero reading as the switch opens and closes. If you have a meter that has an audible continuity feature perform the same steps, but you will hear and audible come ON then OFF as you open and close the switch. If the switch fails this test you must replace the brake or the motor.

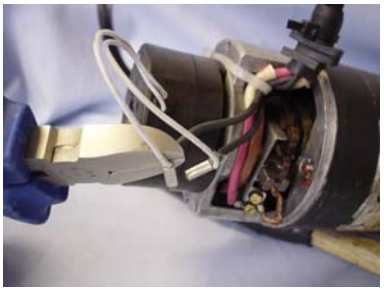
“IMPORTANT NOTE”

A bad electromechanical brake will damage the brake output section in the controller.
DO NOT connect a bad electromechanical brake to a good controller module.
A bad electromechanical brake MUST be replaced.

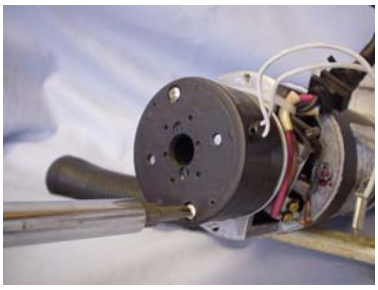
OLDER 2-POLE MOTOR BRAKE COIL REPLACEMENT

Please refer to the specific model power wheelchair service manual, for motor removal procedure.

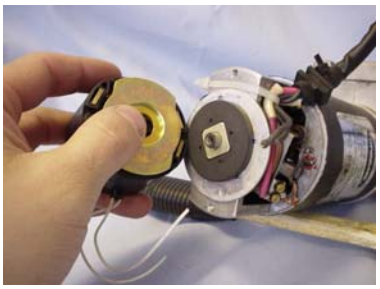
1. Locate the two phillips head screws at the front of the motor, and remove these two screws. Remove the long plastic cap to expose the brake coil assembly on the end of the motor.



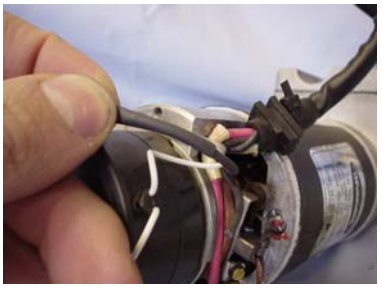
2. Locate the two white wires on the brake coil, and cut off the shrink wrap to expose the wire connectors. Cut the wires just below the connector to retain the length of the two black wires on the motor leads.



3. Locate and remove the two phillips head screws that attach the brake coil to the motor assembly. Remove the brake coil, clapper plate with springs, friction disk, and reaction plate. The new brake coil kit will include all of these items to complete the repair.



4. Remove the contents of the new brake coil and begin to replace the brake coil assembly. The new brake coil is spring loaded, so the clapper plate will need to be held together to hold the springs in place. Line up the brake coil assembly with the screw holes, and tighten the screws to secure the brake coil to the motor assembly.



5. Connect the two white wires to the two black wires with an insulated connector, and cover the two connections with heat shrink to protect the connections. Reverse step 1 and reattach the long plastic cap and two screws to the motor assembly. Temporarily connect the motor plug to the controller and test the motor before putting it back on the chair. Make sure that there are no E09 or E10 error codes when testing motor. When testing is complete reattach motor to the chair and test drive chair.

4-POLE DC MOTOR BRAKE COIL REPLACEMENT

1. It is best if you remove the entire motor from the chair. Refer to the Service Manual for motor removal instructions.

   Once the motor is removed from the chair, remove the cap on the end of the motor to expose the brake coil.

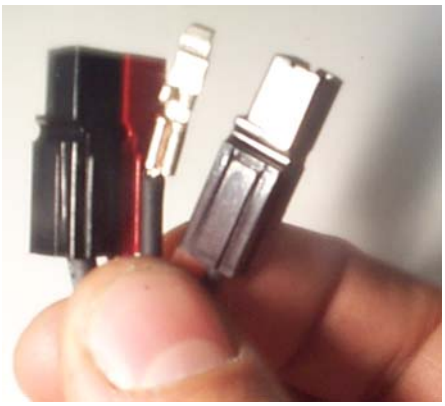
2. Remove the screws that attach the coil to the motor housing.

3. The motor lead has a protective sleeve and a strain relief that needs to be removed in order to replace the brake coil. Some motors have a plastic threaded nut, and others have a plastic connector that prevent the motor leads from being damaged. Use caution when removing the strain relief and the protective sleeve, due to the fact that they will have to be reused when putting the brake assembly back together.

4-POLE DC MOTOR BRAKE COIL REPLACEMENT
(continued)

4. Begin to disassemble the motor connector by removing the roll pin at the top of the connector. Then remove the two screws and clamp at the base of the connector.

5. Slide the Anderson housing back to expose the individual motor and brake connectors. The red and black connectors are for the motor, and the two black connectors are for the brake. You will need to separate the individual housings from the contacts (as shown in the picture to the right). The new brake coil will have new contacts already crimped to the wire leads.



6. Upon completing step 5, slide the Anderson housing off of the motor lead, and remove the protective sleeve to expose the wires coming out of the motor housing.

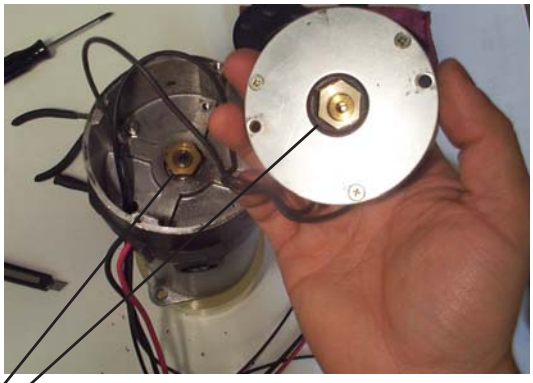
Caution

Do not cut this protective cover, slide it off of the wires unless you have replacement protective covering for the wires. If you are cutting off the protective covering, be careful not to damage the original motor wiring. If you do cut into the insulation of the motor wiring, it must be repaired before putting the protective covering back onto the wiring.

4-POLE DC MOTOR BRAKE COIL REPLACEMENT

(continued)

7. With the wiring loose and the brake coil screws removed, begin to remove the brake coil from the motor housing. Pull up on the brake coil and pull the brake coil wires through the opening on the motor housing. Mark the brake coil defective and discard it. Install the new brake coil and pull the brake coil wiring through the motor housing opening.



NOTE: Before going onto step 8, make sure that the brake coil pad is mated with the hex drive nut on the end of the motor shaft. Release the brake lever to realign the brake coil pad if necessary.

Reattach the brake coil to the motor housing using the fasteners you removed in step 2.

8. Reapply the protective covering or use new material to protect the wiring from being damaged. Then slide the Anderson housing on before reassembling the individual Anderson connectors to the contacts. The two brake coil wires go together side by side, and the red and black motor connectors go beneath the brake coil connectors. View the opposite motor connector in case you have forgotten.

9. Before reattaching the motor to the power chair, temporarily hook it up the controller. Test your repair for the brake coil by raising the drive wheels off of the ground.
Verify again that the drive wheels are off of the ground, and power up the chair with both motors engaged (If the joystick is equipped with a speed potentiometer, turn it down to the slow setting).
Give the joystick a forward and reverse command to verify the motor and brake operation, if an error code exist (E09 or E10) call Technical Services.

Raise both of the drive wheels off of the ground . Place a block in front of both caters before testing motor and brake assembly.

GB MOTORS

(Gearless/Brushless DC Motor)

A DISCOVERY FROM THE PAST THAT WILL CHANGE THE FUTURE

It was once one of those moments of discovery that is easily taken for granted by later generations. English physicist Michael Faraday had studied early experiments in electromagnetism with great interest. In fact, he had already created the world's first electric motor, a crude model in which a wire rotated around a fixed magnet. But if an electrical current could influence a magnetic field, Faraday reasoned, then perhaps the opposite was true, as well. He set a magnet spinning within an uncharged, horseshoe-shaped coil. And, true to his hypothesis, the magnet's motion generated an electric charge in the coil. What Faraday had discovered was the phenomenon of induced electromagnetism. What he had created was the world's first electric generator.

(GB Motors are Non-Serviceable)

GB Motors used on chairs prior to February 2003

Heavy Duty GB Motors used on chairs after to February 2003

TECH NOTE:	**When replacing a GB motor or controller, you must calibrate the motors with your Remote Programmer. See page 2-15 for the Calibration Procedure.**

GB MOTOR CALIBRATION PROCEDURE

On chairs equipped with GB motors, motor calibration must be done when the following conditions occur.

- When replacing a GB Motor.
- When replacing a GB Controller.

NOTE: An Invacare Remote Programmer is necessary for this procedure.

1. Raise both drive wheels off of the ground, and block the front casters to prevent the chair form rolling forward. The chair must be secure to prevent any injuries.

2. Engage the motors, and plug in the Remote Programmer into the chairs controller.

3. Turn on the chair, then the Remote Programmer. Select the Calibration Menu and arrow down to Calibrate Motor.

   The programmer screen will prompt you with the following questions:
   1. WHEELS WILL MOVE! DRIVE WHEELS RAISED? YES OR NO
   2. CHAIR WILL DRIVE! ARE DRIVE WHEELS RAISED? YES OR NO

4. Press the Select button on the programmer to begin the Calibration procedure. To CANCEL the Calibration press the MENU button.

5. When the calibration is complete, the screen will display the following:
   COMPLETED TEST SAVING NEW VALUES

TECH NOTE:

Make sure the rear drive wheels are clearly off of the ground (they will begin to MOVE when calibration begins).

Place an object in front of the two casters, to prevent the chair from rolling forward off of the stationary stand.

INVACARE SERVICE & PARTS

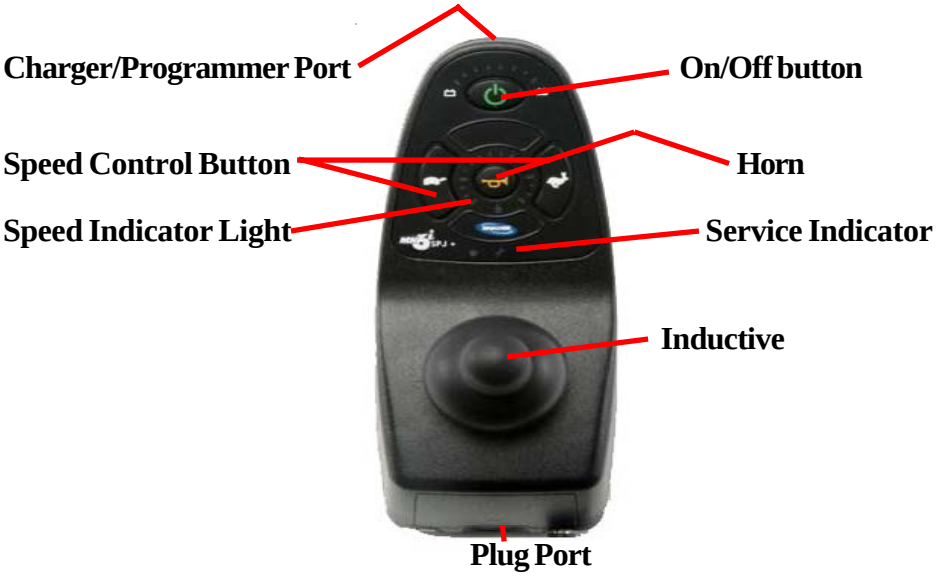
MK6i Consumer (NX) Electronics

Visit the Technical Zone at www.invacare.com
or Call us Toll FREE at 1-800-832-4707

MK6i CONSUMER (NX) ELECTRONICS

Consumer or NX electronics are Invacare's basic electronics that are intended for the basic power mobility product. These systems cannot usually be expanded through the electronics and have very limited programming ability. All lower end (consumer) power wheelchairs use a form of these NX electronics.

MK6i SINGLE PURPOSE JOYSTICK (SPJ+)



MK6i SPJ+ joystick is Invacare's standard joystick in our NX level of electronics. The SPJ+ has limited programming that is contained in the Control Module.

On/ Off Button = Used to turn On & Off the power.

Horn = Emits audible signal when pressed.

Speed Indicator Lights = Indicate maximum speed currently set.

Speed Control Button = Tortoise button is used to decrease the speed in 20% increments while the Hare button is used to increase the speed in 20% increments. To adjust in small increments hold both Tortoise and Hare until horn alarms, then press and hold either Tortoise or Hare to decrease or increase the speed setting.

Inductive or Gimble = Is the proportional drive control that allows the driver to control the product.

Charger/Programmer Port = Is the location where off-board chargers plug in to charge the product. This port is also used to program the Control Module.

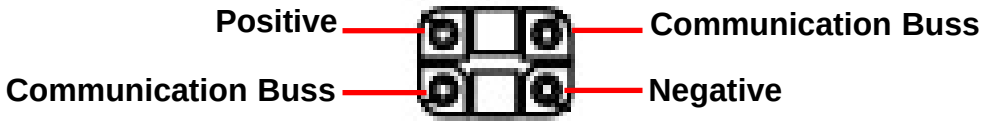
Service Indicator = This Amber light informs the driver and technician when an error or fault occurs. This light flashes a number of times with pause in between indicating the actual problem.

Plug Port = Is the location where the control module connects to joystick via joystick cable.

MK6i SPJ+ JOYSTICK CABLE

Joystick cable for the NX level of electronics can be removed, tested, and replaced if needed. Test this cable as you would any other wiring.

JOYSTICK CABLE PINOUT



MK6i BATTERY TO CONTROLLER CABLE

The battery to controller cable is connected between the battery connection and the controller.Test this cable as you would any other wiring. These connnections are marked as Positive (+) and Negative (-) to assist in troubleshooting.

BATTERY TO CONTROLLER CABLE PINOUT

MK6i CONTROL MODULES

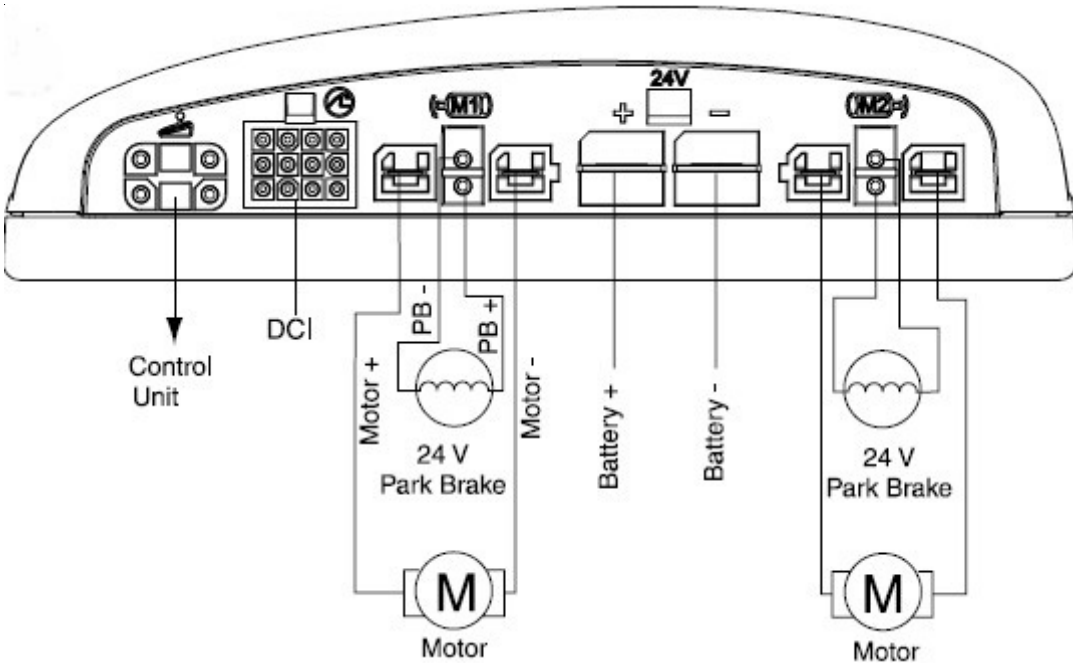
MK6i Control Modules in NX level of electronics holds all programming aspects, including any faults and error codes. Never open or modify control module. There are 3 types of MK6i NX controllers:

MK660ACC = MK6i controller for 2 pole motors *with or without* powered seating.

MK690 = MK6i controller for 4 pole motors *without* powered seating.

MK690ACC = MK6i controller for 4 pole motors *with* powered seating.

MK6i CONTROL MODULES PINOUT



MK6i PROGRAMMER

MK6i Programmer allows modification of the performance characteristics, gives diagonostic information, and permits calibration changes in the control module. On NX level of electronics this programmer will operate as a MK5 programmer and can not be utilized in conjunction with a SD Memory Card.

Up & Down Arrow Keys = scrolls through menu options as well as raise and lower selected values.

Left & Right Arrow Keys = scrolls along menu line items, as well as advance to the next or return to the previous screen of highlighted value.

Select Key = allows selection into highlighted and modified value. Other functions when prompted.

Save Key = allows programmed value and drives to be saved into system. Must be pressed twice to properly save changes.

Pwr/Info Key = Powers programmer On/Off.

To operate turn ON power wheelchair, plug MK6i Programmer into joystick charger/programming port, press power key on programmer and wait for communication. If communication error is present disconnect programmer, verify power is ON and/or test joystick charger/programmer port for proper voltage 25.0 dcv or higher, then retry.

The first display screen shown after powering on the programmer is the main menu and consists of the following options: Perfomance Adjust, Programs and Others.

MK6i NX PERFORMANCE ADJUST MENU

The first option in the main menu is Performance Adjust menu. The Perform Adjustment menu is used to modify driving parameters of the power wheelchair. These parameters are modified to enhance the performance of the power wheelchair for the end user.

Forward Speed = Sets maximum forward speed.

Turning Speed = Sets maximum turning speed.

Acceleration - Fwd = Sets how quickly the controller allows the chair to accelerate when the joystick is moved in a forward direction from neutral.

Acceleration - Rev = Sets how quickly the controller allows the chair to accelerate when the joystick is moved in a reverse direction from neutral.

Turn Acceleration = Sets how quickly the controller allows the chair to accelerate when the joystick is moved in a left or right direction from neutral.

Turn Deceleration = Sets how quickly the controller allows the chair to decelerate when the joystick is moved from a left or right direction to neutral.

Braking Forward = Sets how quickly the controller allows the chair to decelerate when the joystick is moved from a forward direction to neutral.

Braking Reverse = Sets how quickly the controller allows the chair to decelerate when the joystick is moved from a reverse direction to neutral.

Reverse Speed = Sets maximum reverse speed.

Tremor Dampening = Is used to adjust the sensitivity of the joystick out of the neutral position. Often used to assist end users with Ataxia / Tremors.

Higher value = delays response from joystick commands.
Lower value = increases respones from joystick commands.

Torque = Sets how quickly the chair has the power available to it. Simular to acceleration, torque ramps up to the full power level allowed by the controller. Used to climb over obsticals or ramps. *In MK6i adjust torque in 4 ohms increments only.*

High torque value could cause the chair to overheat.
Low torque could cause the chair to stall at obsticals.

MK6i NX PROGRAMS MENU

The second option in the main menu is Programs or Standard Programs. The Programs menu is used as a reference point for initial set-up of a power wheelchair, for final settings or whenever major changes have been made in the Performance Adjust and a starting point has to be reestablished. This setting also sets the motor configuration on the NX level of electronics.

Always set this initially before changing any perfomance changes. Once any Performance Adjustment has been made, in MK6i, the Programs values must be reset manually. To set the Programs you will set the motor configuration/type of chair and motor type (pole).

MK660w/ACC (2 pole)

MWD - M61 or M51 - M61
EURO - M61 European model only
MWD - M71 - 2P or SPREE/SC/M71
RWD - 2P

MK690 & MK690w/ACC (4 pole)

TDX 4P
RWD 4P
CWD M91/SP/SI
CWD M91 HD

MK6i NX PROGRAMS VALUES

Controller Type	MK660w/ACC		MK690 & MK690 w/ACC	
Motor configuration	MWD	RWD	CWD	RWD
Forward Speed:	100	95	95	90
Turning Speed:	30	25	20	20
Acceleration Fwd:	25	30	20	25
Acceleration Rev:	25	30	20	20
Turn Acceleration:	25	30	25	20
Turn Deceleration:	30	35	35	25
Braking Forward:	50	50	50	50
Braking Reverse:	55	55	55	45
Reverse Speed:	40	40	50	30
Tremor Dampening:	40	40	35	40
Torque (ohms):	144	144	36	48

MK6i NX OTHERS MENU

The last option in the main menu is Others. The Others menu provides calibration changes and the diagnostic menu.

Motor Balance: is a calibration used to correct veer when going straight. When performing motor balance you change the value to slower side. If major changes to Motor Balance is needed check motors for possible issues.
To properly adjust the Motor Balance

-Allow for alot of room.
-Straighten all casters and sit in chair.
-Put thumb and index finger together to make a V. Place them against the rear of the inductive.
-Close eyes and push inductive forward and hold for 5 seconds.
-Release the inductive and allow chair to stop.
-Verify ending position relative to starting position.
-Adjust balance to compensate for pull in left or right direction.

Joystick Throw: is a calibration used to calibrate the neutral and the full speed travel of the proportional joystick. The control module stores the maximum displace ment of the joystick and later, during driving, uses the values to generate a full speed command whenever that displacement is reached. Exceeding this displacement does not provide further increase in speed. The result of this method of calibration is a customized driving template. The Joystick Throw in MK6i NX level of electronics is seperated into three level:

Normal = full displacement of the inductive to access full programmed speed.
Short = half displacement of the inductive to access full programmed speed.
Very Short = quarter displacement of the inductive to access full programmed speed.

Fault Log: shows the error codes that have been detected by the diagnostic system since the control module was built in the factory. The Fault Log can be used by the service technician to uncover the cause of intermittent faults that may not be evident when the wheelchair is being serviced.

Usage Statistics: displays how long the wheelchair has been on in hours/minutes, the total number of times the wheelchair has been powered up and how many times the wheelchair has been driven.

MK6i NX ERROR CODES DESCRIPTION

# of Times Flashes	Fault Log Error Code	Fault Log Sub Code	Error Code Description	Details of Error Code
1	E01	00	User Fault	Stall Time-out
2	E02	00	Battery Fault	Recharge Batteries or Replace
3	E03	00	Left Motor Fault	Left Motor Short Circuit
		01		Left Motor Open Circuit
		02		Left Motor Connection Fault B-
		03		Motor Terminal Connected to B+
		04		Left Motor Voltage Fault
		05		Left Motor Bridge Fault
		06		Too Many Hardware Current Limit Events
		07		Current Offset Out of Range
		08		Hardware Current Limit Fault
4	E04	00	Right Motor Fault	Right Motor Short Circuit
		01		Right Motor Open Circuit
		02		Right Motor Connection Fault B-
		03		Motor Terminal Connected to B+
		04		Right Motor Voltage Fault
		05		Right Motor Bridge Fault
		06		Too Many Hardware Current Limit Events
		07		Current Offset Out of Range
		08		Hardware Current Limit Fault
5	E05	00	Left Park Brake Fault	Left Park Brake Drive-Time Test Failed
		01		Left Park Brake Output Enabled When Chair Idle
		02		Left Park Brake Output Did Not Enable When Entering Drive Mode
		03		Left Park Brake Fault During Power-Up Testing
		04		Left Park Brake Feedback Low During Drive (Park Brake Short?)
6	E06	00	Right Park Brake Fault	Right Park Brake Drive-Time Test Failed
		01		Right Park Brake Output Enabled When Chair Idle
		02		Right Park Brake Output Did Not Enable When Entering Drive Mode
		03		Right Park Brake Fault During Power-Up Testing
		04		Right Park Brake Feedback Low During Drive (Park Brake Short?)
7	E07	00	Remote Fault	Local SR Fault (CPU. EEPROM, ect.)
		01		Joystick Fault at the Remote
		02		Speed Pot Fault at the Remote
8	E08	00	Controller Fault	
		01		RAM Fault
		02		ROM Fault
		03		CPU Fault
		04		EEPROM Fault
		05		Watchdog Fault
		06		Stack Fault
		07		Software Fault
		08		Power-up Testing Fault
		09		Relay Fault or Precharge Fault
		10		Bridge Fault or Disable All Fault
		11		Electronics Fault: Thermistor
		12		Calibration Setting Fault
9	E09	00	Communication Fault	Remote Connection Lost
		01		Low Communication Mode
10	E10	00	General Fault	General Fault
11	E11	00	Incorrect Remote	Incompatible Remote

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MK6i Troubleshooting & Diagnostics

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MK6i TROUBLESHOOTING & DIAGNOSTICS

This section contains troubleshooting for both NX and EX levels of electronics. Each section of this book goes over troubleshooting of the 5 main components of Invacare's power wheelchair. This section primarily contains the Error Code Listing.

BATTERY TROUBLESHOOTING GUIDE

Problem	Possible Cause	Corrective Action
Batteries won't charge	Blown fuse in wiring harness, or charger	Check all fuses on the chair, and in the charger
	Charger not plugged into outlet	Make sure charger is plugged into the outlet
	No AC power at the outlet	Check for AC power with a digital multi meter
	Charger power cord may be damaged, or the connector may be damaged	Check for damage and replace if necessary, or send in for repair
	Charger may have internal damage	Charge batteries with known good charger
	Battery voltage too low for charger to start charging cycle	Replace batteries
Batteries have short driving range during a single charge or battery gauge falls off faster than normal	Consumer not charging batteries long enough	Charge for 8-10 hours minimum
	Batteries may be weak	Perform load test, or check Battery Quality Menu with your programmer
	Check programming settings	Torque setting and Power Level setting may be to high
	Heavy load on motors	Chairs weight distribution may be offset (chair may be front loaded)
Batteries have swelled up	Batteries have been overcharged	Check or replace batteries

CHARGER TROUBLESHOOTING GUIDE

Problem	Possible Cause	Corrective Action
Batteries won't charge	Blown fuse or damaged wiring	Replace fuse and check wiring for damage
No LED's on Charger	Charger not plugged into outlet, or disconnected from wiring harness on chair	Make sure the charger is plugged into the outlet, and check the wiring on the chair
	No AC power at the outlet	Check for AC power with a digital multi meter
	Power cord may be damaged	Check for damage on the power cord, replace if damaged or send in for repair
	Charger LED's may be burnt out	Send charger to Invacare for repair
	Charger may have internal fuse that is blown	Remove charger cover and check for fuses
Charger starts up and shuts off after running for a short period of time, red or green lights may be flashing	Powerchairs batteries may be severely discharged (voltage too low for charger to start)	Remove each battery and use a 12 volt charger on <u>each</u> battery for 1 hour then put both batteries back into battery box(es), and restart OEM charger, or replace batteries if needed
Short charge time	One or both batteries may be bad, (if batteries charge up to soon)	Load test each battery, and replace if needed

WIRING TROUBLESHOOTING GUIDE

Problem	Possible Cause	Corrective Action
No power to chair motors	Bad connection or blown fuse Check Joystick connection	Check all connections and housings for damage Replace fuse if blown
	Loose battery connections	Check battery cable connections, may have vibrated loose when driving on rough terrain
E28 Error code	Damaged controller connections	Repair connection, or clean contacts
	Drive lockout condition in high back van seat, recliners, and any Power Seating System	Return to upright seat and back angle, recalibrate mercury switch or reconnect wiring (may have come loose) Check POT calibration or mercury switch on chairs equipped with power seating
	Internal Wiring Harness damage, perform a continuity test on each connection	Replace wiring harness
	Charger still plugged when user tries to drive the chair	Unplug charger to drive chair
No LED's on Joystick or Tiller	Tiller harness unplugged joystick connection to controller unplugged or damaged	Plug connections back together, and check for damage wiring
Corroded wiring or connections	Possible water, salt, or urine damage	Replace harness

MOTOR/GEARBOX/BRAKES TROUBLESHOOTING GUIDE

Problem	Possible Cause	Corrective Action
Motor makes a clicking noise	Bad coupler between motor and gearbox, or bad bearings inside of motor	Replace coupler, if bearings are bad replace motor
	Raised commutator plate inside of motor	Ohm out motor, and Replace motor if high reading is present .5 - 5 Ohms Normal
Grinding noise or motor is locking up	Bad gearbox	Replace gearbox
Motors stall and starts up again	Current Rollback	Leave power ON and allow controller to count down, and recharge the chair overnight with power ON
Chair will not drive with power on (E09 or E10)	Check motor locks	Engage motors to drive chair
Motor chatters or runs erratically, or only one motor turns	Damaged connector or worn brushes	Ohm out motors, check or replace brushes
	Controller malfunction	Swap out motor leads Check for error codes with programmer
Chair veers to the left or right when driving on level surface	Uneven tire pressure Motors out of balance	Inflate tires, or replace if worn Use programmer to balance motors (2/4-Pole Only)
	Joystick needs calibrated	Recalibrate joystick with programmer, or replace inductive if necessary
	GB motor calibration needed	Recalibrate motors with programmer
E09/E10 error code will not go away	Bad motor connection Bad brake Coil	Check all connections, Ohm out each brake coil 45 - 80 Ohms Good, Swap motor leads to see if code switches sides (call Tech Services)
Brake dragging causing chair to veer	Bad brake coil, or connection On early 2-Pole motors if the Brake Lever is bent, it may be rubbing on the brake pad	Replace brake coil

MOTOR/GEARBOX/BRAKES TROUBLESHOOTING GUIDE

Problem	Possible Cause	Corrective Action
Gearbox is leaking fluid	Bad seal around drive shaft, or loose hardware	If seal is bad replace gearbox, If loose hardware is found retighten hardware
Excessive clicking coming from motor/gearbox	Bad bearing in motor or gearbox	Replace motor or gearbox
	Loose wheel hardware	Tighten loose hardware
		Replace gearbox
Gearbox shaft movement, or bent shaft	Rough driving	Replace motor
GB motors clicking	Excessive load on chair, or damage from rough terrain	Bad internal bearings, replace motor.
	Loose hub on motor	Tighten loose hardware
Brake lever not engaging brake coil	Bent lever or internal damaged	Replace brake coil
	Bad micro switch or out of adjustment	Repair micro switch, readjust switch, or replace brake coil (or complete motor)
Motor stutters	Poor connection, or worn brushes	Check motor connector and brushes, replace if necessary
	GB motor calibration	Recalibrate motors

MOTOR/GEARBOX/BRAKES TROUBLESHOOTING GUIDE

Problem	Possible Cause	Corrective Action
Motor fails to start after initial installation	Motor is miswired	Verify wiring to motor from controller
	Battery voltage is too low	Check batteries and re-charge if necessary
	Switch motor leads	Replace motor or controller
Motor is running then fails to restart when stopped	Heavy load on the motors and, chair is in the Current Rollback mode	Leave power ON and allow controller to count down, and recharge the chair overnight with power ON
	Circuit breaker may have tripped	Reset breaker and check wiring
	Blown fuse in Wiring Harness	Replace fuse
	OHM out motor to check for possible internal damaged Worn out brushes may be possible	Replace brushes if necessary, or replace motor if internal damage is determined
	Controller power stage board, or relays may be damaged	Replace controller or send to Invacare for repair
Motor runs but loses power	Controller senses heavy load, and has entered the Current Rollback mode	Leave the power ON and allow the controller to count down, recharge overnight with power ON
Scooter or Chair loses all power while driving	“Soft Stop” is engaged, If key/ power is turned “OFF” while driving, the chair artificially holds power for 1.5 seconds slowly decelerating until to a stop	With key/power “OFF” position, wait 10 seconds and turn power back “ON”

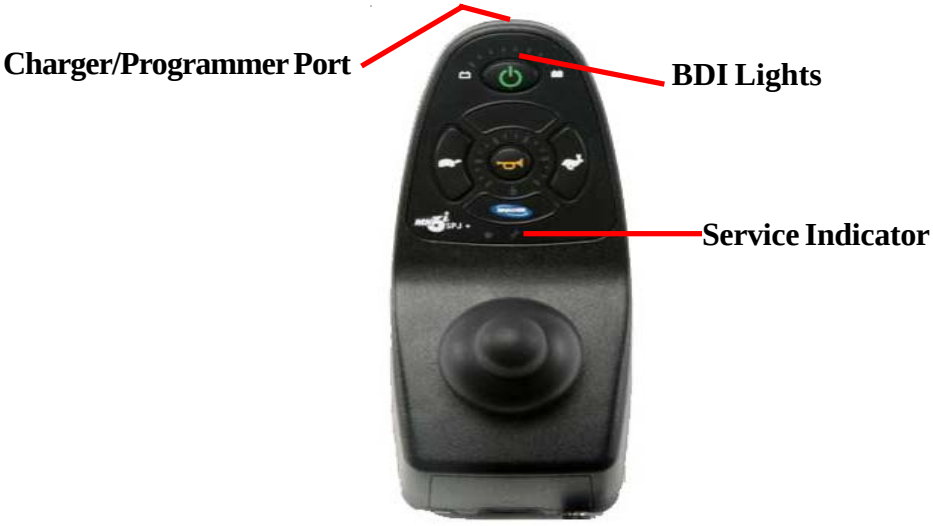
MK6i FORMULA TRE & CG TROUBLESHOOTING GUIDE

SYMPTOM	PROBABLE CAUSE	SOLUTIONS
Wheelchair Power ON but does not drive	System tilted beyond drive lock-out angle (20 degrees)	Return to seat/back to upright position Limit switch faulty or out of adjustment
Seating System not functioning or working intermittently	Low battery voltage Blown 15 amp fuse Faulty Connections	Charge batteries and verify load test Replace Fuse on Power adapter Check all connections
	Communication Error	Save proper 4W STD PRGM in the Calibrations Menu
	Actuator “HOT” due to heavy load for an extended period of time	Check turn power OFF to allow electronics to cool down (2 minutes or more) Check the Power Seating menu to verify speeds
	Communication Error in TRAM, 4WSB, SANODE and S4WSB	Check Powered Seating menu to verify proper programing and Diagnostics menu for version
	Bad Actuators	Check for 24 VDC when switch is activated with a multimeter at the actuator connector. Switch actuator leads from a functioning actuator to the one that is not working, activate switch to verify if the actuator is bad or the power seating control module is bad
	Bad or Loose Mercury switches	Check all Mecury switch on the chair make adjustments or replace
	Bad mode switch on the MPJ+	Replace joystick or send in for repair
E28 Error code	System tilted beyond drive lock-out angle (20 degrees)	Return to seat/back to upright position Possible bad wiring harness check pins 2 and 3 on charger connector for 5 VDC reference when seat is below 20 degrees, and 0 VDC when seat is tilted beyond 20 degrees
	Damaged wiring on joystick or 24 VDC power adapter	Check cables for wiring damage (inhibit line or charger plug faulty)
System not operating through the driver control	Communication Error	Check the control module for programming errors and verify the Version through the Diagnostics Menu.

MK6i PTO PLUS AND SUPER LOW TROUBLESHOOTING GUIDE

SYMPTOM	PROBABLE CAUSE	SOLUTIONS
Wheelchair Power ON but does not drive	System tilted beyond drive lock-out angle (20 degrees)	Return to seat/back to upright position Limit switch faulty or out of adjustment
Seating System not functioning or working intermittently	Low battery voltage	Charge batteries and verify load test
	Bad Mode switch on MPJ+	Replace Joystick or send in for repair
	Communication Error in TRAM or SANODE	Check Powered Seating menu to verify proper programing and Diagnostics menu for version
	Bad 4-way switch or QPB	Check all connections and test using new switch
	Actuator “HOT” due to heavy load for an extended period of time	Check Diagnostics menu to verify or turn power OFF to allow electronics to cool down (2 minutes or more) Check the Powered Seating Menu menu to verify speeds and adjust if necessary
	Bad Drive Limit switch or Tilt Limit switch	Check connections on Drive Limit and Tilt Limit switch or replace
	Bad Actuators	Check for 24 VDC when switch is activated with a multimeter at the actuator connector coming out of the power seating control module. Use new mode switch on Smart Actuators. Switch actuator leads from a functioning actuator to the one that is not working, activate switch to verify if the actuator is bad or the power seating control module is bad
E28 Error code	System tilted beyond drive lock-out angle (20 degrees)	Return to seat/back to upright position Possible bad wiring harness check pins 2 and 3 on charger connector for 5 VDC reference when seat is below 20 degrees, and 0 VDC when seat is tilted beyond 20 degrees
	Damaged wiring harness	Replace wiring harness (inhibit line or charger plug faulty)
System not operating through the driver control	Communication Error	Check the control module for programming errors and verify that the Tilt/Recline menu option is not OFF.

MK6i NX TROUBLESHOOTING



The SPJ+ has limited programming that is contained in the Control Module. There is No reprogramming necessary if replaced.

Charger/Programmer Port = Is the location where programmer plugs into for programing the Control Module which contains the fault log.

Service Indicator = This Amber light informs the driver and technician when an error or fault occurs. This light flashes a number of times with pause in between indicating the actual problem. See error codes list.

Battery Display Indicator Lights = will flash if in drive lockout informing the end user that the power wheelchair will not drive. These indicator lights will also flash if charger is running.

MK6i Control Modules in NX level of electronics holds all programming aspects, including any faults and error codes. In the EX level of electronics all programming aspects are stored in the driver control. Never open or modify control module.

MK6i NX TROUBLESHOOTING

MK6i Programmer gives diagonostic information in the control module. On NX level of electronics this programmer will operate as a MK5 programmer and can not be utilized in conjunction with a SD Memory Card.

Pwr = Powers programmer On/Off

Up & Down Arrow Keys = scrolls through the Others Menu options to access the Fault Log.

Select Key = allows selection into highlighted and modified value. Other functions when prompted. Tthe first 3 faults are the most recent Error Codes.

To operate turn ON power wheelchair, plug MK6i Programmer into joystick charger/programming port, press power key on programmer and wait for communication. If communication error is present disconnect programmer, verify power is ON and/or test joystick charger/programmer port for proper voltage 25.0 dcv or higher, then retry.

The Others menu provides calibration changes and the diagnostic menu that can be utilized to assist in troubleshooting and repair of consumer power wheelchair.

Motor Balance: is a calibration used to correct veer when going straight. When performing motor balance you change the value to slower side. If major changes to Motor Balance is needed check motors for possible issues.

Joystick Throw: is a calibration used to calibrate the neutral and the full speed travel of the proportional joystick. This can be used to recalibrate joystick if relative error code is present.

Fault Log: shows the error codes that have been detected by the diagnostic system since the control module was built in the factory. The Fault Log can be used by the service technician to uncover the cause of intermittent faults that may not be evident when the wheelchair is being serviced.

Usage Statistics: displays how long the wheelchair has been on in hours/minutes, the total number of times the wheelchair has been powered up and how many times the wheelchair has been driven.

MK6i NX ERROR CODES DESCRIPTION

# of Times Flashes	Fault Log Error Code	Fault Log Sub Code	Error Code Description	Details of Error Code
1	E01	00	User Fault	Stall Time-out
2	E02	00	Battery Fault	Recharge Batteries or Replace
3	E03	00	Left Motor Fault	Left Motor Short Circuit
		01		Left Motor Open Circuit
		02		Left Motor Connection Fault B-
		03		Motor Terminal Connected to B+
		04		Left Motor Voltage Fault
		05		Left Motor Bridge Fault
		06		Too Many Hardware Current Limit Events
		07		Current Offset Out of Range
		08		Hardware Current Limit Fault
4	E04	00	Right Motor Fault	Right Motor Short Circuit
		01		Right Motor Open Circuit
		02		Right Motor Connection Fault B-
		03		Motor Terminal Connected to B+
		04		Right Motor Voltage Fault
		05		Right Motor Bridge Fault
		06		Too Many Hardware Current Limit Events
		07		Current Offset Out of Range
		08		Hardware Current Limit Fault
5	E05	00	Left Park Brake Fault	Left Park Brake Drive-Time Test Failed
		01		Left Park Brake Output Enabled When Chair Idle
		02		Left Park Brake Output Did Not Enable When Entering Drive Mode
		03		Left Park Brake Fault During Power-Up Testing
		04		Left Park Brake Feedback Low During Drive (Park Brake Short?)
6	E06	00	Right Park Brake Fault	Right Park Brake Drive-Time Test Failed
		01		Right Park Brake Output Enabled When Chair Idle
		02		Right Park Brake Output Did Not Enable When Entering Drive Mode
		03		Right Park Brake Fault During Power-Up Testing
		04		Right Park Brake Feedback Low During Drive (Park Brake Short?)
7	E07	00	Remote Fault	Local SR Fault (CPU. EEPROM, ect.)
		01		Joystick Fault at the Remote
		02		Speed Pot Fault at the Remote
8	E08	00	Controller Fault	
		01		RAM Fault
		02		ROM Fault
		03		CPU Fault
		04		EEPROM Fault
		05		Watchdog Fault
		06		Stack Fault
		07		Software Fault
		08		Power-up Testing Fault
		09		Relay Fault or Precharge Fault
		10		Bridge Fault or Disable All Fault
		11		Electronics Fault: Thermistor
		12		Calibration Setting Fault
9	E09	00	Communication Fault	Remote Connection Lost
		01		Low Communication Mode
10	E10	00	General Fault	General Fault
11	E11	00	Incorrect Remote	Incompatible Remote

UNDERSTANDING CURRENT ROLLBACK

Current Rollback is a protective condition the controller goes into when heat builds up if the motors ever draw excessive amounts of current through the controller for extended periods of time. This condition is protecting the power stage board in the controller. This part is approximately a $500.00 value and would be costly to replace.

The programming values for Torque and Power Level as well as the Center of Gravity setup of the chair, do affect the current draw through the controller.

- The higher the Torque, the faster the controller sends high current to the motors.
- The higher the Power Level, the more current the controller will allow the motors to draw under load.
- The higher the Speed, the more voltage the controller sends to the motors.
- The more Front Loaded the chair is, the more power the motors need to move the chair through the resistance of the weight over the casters.

High Torque + High Power Level + High Speed + Extended Driving Time + Stress to the Motors
Potential for Current Rollback

Continuous driving with these high levels would be similar to a fighter jet continuously flying with the After Burners ON. The controller may build up heat (Current Rollback) and the battery charge would be more quickly depleted.

There is no specific fault code for Current Rollback. Users may complain of an intermittent cutout of their chairs operation or a sensation of loss of power.

If Current Rollback does occur, the chair will still drive for a period of time before cutting out completely. In a Current Rollback condition, the controller cuts back on Current/Voltage to the motors in an attempt to prevent a complete shut down -or- the wheelchair will shut down as the controller protects the power stage board.

- As the current counter inside the controller approaches a preset cut off value, it cuts the power output to try and prevent complete shut down.
- If the user continues to push the chair and the current counter reaches the preset cut off value, the chair will shut down completely.
- If in Current Rollback the joystick battery indicator lights will show the left two bars flashing and the right battery level indicator light will still be on.
- If in Current Rollback the LCD Display may also record the word “HOT” or scroll an E176 - E179 fault code. Check the Fault Log in the Diagnostics Menu for the any two consecutive faults between E176 - E179.

The best remedy for Current Rollback is to leave the chairs power switch ON - without driving the chair - for approximately 40 minutes. This allows the current counter to reset to zero. This is easily achieved by charging the batteries with the chairs power left in the ON position.

The best way to prevent this problem is to make certain Torque and Power Level are appropriately for the desired drives / environments, and set the Center of Gravity of the chair appropriately for the user. This ensures that one of these things alone is not the causing factor.

UNDERSTANDING TORQUE AND POWER LEVEL

Torque - is one of the most commonly misunderstood performance adjustments on Invacare power chairs. Most people think Torque is the amount of power a chair has (not true). Torque is how fast the chair has the power available to it, or how quickly the chair can ramp up to the available power (Power Level).

A common demonstration of the Torque setting was to set the value high and have someone stand behind the chair and try and hold the chair back (while someone sitting in the chair tried to drive forward). The result being that no matter how hard the person tried, the chair would pull from their grip. Then turn the Torque setting down and try the same thing. The result would have been the same if the second attempt is done for 10 seconds or so. The problem was that most people would be able to hold that chair back for 3 or 4 seconds. If they would have counted to 10 they would have noticed the power ramping up, and the chair would have push them across the room as if the Torque setting was set high in the first demonstration.

The higher the setting the more responsive the chair becomes to the joystick commands. If the Torque value is set too high, the chair can have a jerky or jumpy feel.

If the user complains their power chair is too “jerky”, too “responsive”, too “jumpy”, etc. Try reducing the Torque value in the Performance Adjustment Menu with your MK6i Programmer. It is common that someone may have previously increased the Torque value in an attempt to give the chair more power (a common misunderstanding). If the chair is still too responsive, the turn down the Speed and Sensitivity (or Turn Acceleration and Deceleration).

A good general rule to follow:
***Low Speeds often require High Torque Values** - Immediate access to power to overcome obstacles and rough terrain.*
***High Speeds often require Low Torque Values** - Momentum prevails over obstacles. Soft response to driver commands at high speeds feels smooth and controlled to many drivers.*

Power Level - as a Performance Adjustment, is a true power output (Current or Amps) setting for the controller. Power Level does NOT impact speed on level surfaces. On an incline however, under a load, a chair may lose speed if there is insufficient power to maintain the speed under that load.

Setting the Power Level to a lower value limits the available (Current) to the motors. If the Power Level is set low, the chair will stall when it encounters situations that require more power that the set value. A good application like this is for a new driver, if they tend to accidentally run into walls or furniture (low settings would cause the chair to stall rather than causing further damage).

The Power Level can be set different on each available drive. Therefore, you can have one drive with less power to prevent damage to the user or the environment, and another drive with more power for different environmental situations (outdoor driving, ramps, and soft terrain).

***NOTE:** Power = Current * Voltage or IT^2 (I = Current and T = Time)*
The setting of Power Level affects the current in this setting when played with the value of time. Where I equals current and T equals time! This formula is squared - so with a higher value applied at Power Level the control has more output at a faster time!

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SCOOTER TROUBLESHOOOTING PROCEDURE

1. Check the static battery voltage with a digital multimeter (25.0 VDC or higher OK).
   Battery Voltage _____VDC.

2. Test the battery charger to ensure that it is functioning properly. Plug in the charger and check the on charge voltage at the batteries with a digital multimeter (27.0 VDC or higher OK).

3. Check all fuses and connections for damage, loose or broken connection, and corrosion.
   - Front Console Fuse (3 Amp) OK
   - Controller Fuse (5 Amp) OK
   - Battery & Motor Connections OK
   - Tiller Connections OK
   - Circuit Breaker Connections OK
   - Charger Connections OK

4. Test Motor and Brake Connections, and measure motor/brake resistance.
   - Test Motor Connection (M+ and M-).
     .5 to 5 Ohms Good (higher Ohm readings indicate internal problems).
     _____ Ohms Motor Brushes OK

   - Test Brake Coil (on B1 and B2).
     40-50 Ohm Ranges Good (O.L. indicates a shorted Brake Coil).
     _____ Ohms

   - Check Micro Switch on Brake. OK

5. Check the control module for any error codes. (see error code list on 5-2 & 5-3)
   _____, _____, _____, _____,

   Consult the Service Manual for each procedure listed above, or visit our website at www.invacare.com for more technical information.

   or

   Contact Invacare Technical Support toll free at 1-800-832-4707 for more information.
   Please have the following information prior to calling:
   - Model and Serial Number.
   - Version of Electronics and Error Codes.
   - It is recommended that you stay with the product while contacting Invacare.
   - Make sure you have already ruled out the batteries before contacting Invacare.

REAR BASE ASSEMBLY AND BATTERY/CHARGER BOX INSPECTION

1. Remove the seat, the battery/charger box, and rear base assembly. Then remove the top covering of battery/charger box and the shroud of the rear base assembly to begin the wiring inspection process.

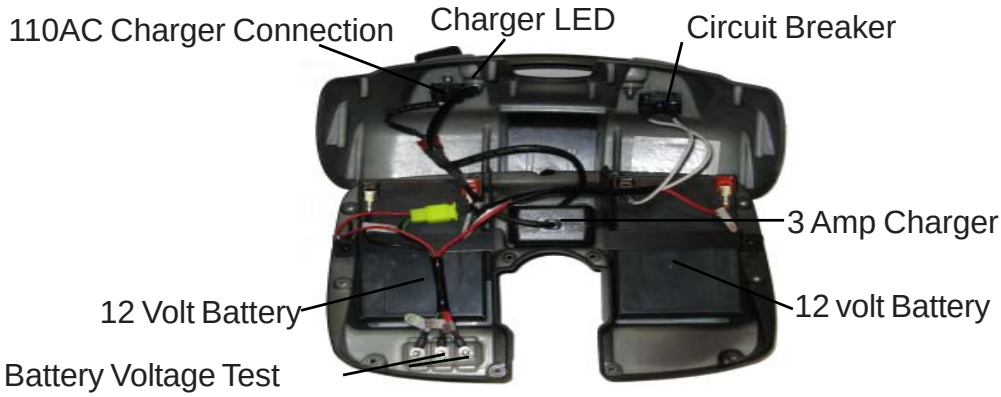
2. Inspect battery/charger box and rear base assembly for loose or broken connections, and corrosion. Replace if needed.

3. Take a static voltage reading from the batteries to verify state of charge. This can be performed easily by testing at battery box connection.
   - 25.0 VDC or higher for the pair is GOOD. (fully charged)

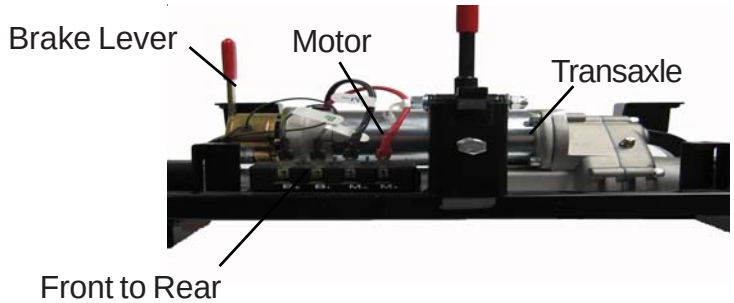
4. Plug in the charger to verify that it is in good working condition.
   - Static voltage with the charger ON should be above 27.0 VDC.

5. Perform a load test on the batteries if unsure of battery condition.
   - Field load test or Hand Held load test .

6. Check circuit breaker connections located in battery/charger box and reset if necessary. If circuit breaker continues to trip, an electrical problem is present contact Invacare Technical Support.
   - Ohm reading should be less than 1 Ohm.
   - Replace if circuit breaker has tripped multiple times.



Battery / Charger Box



Rear Base Assembly

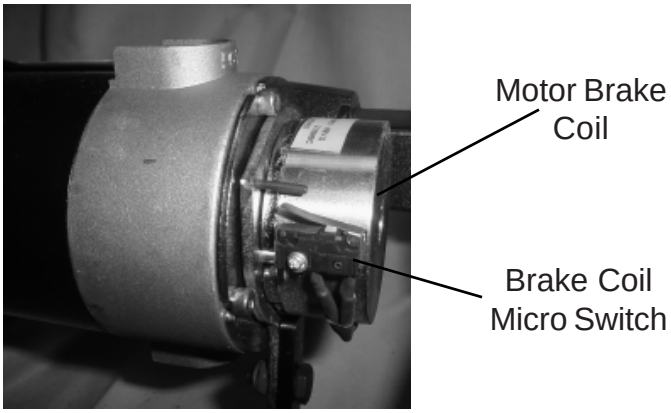
SCOOTER MOTOR AND BRAKE TESTING

Motor and Brake Ohm Testing Procedures

1. Before testing begins you will need to remove the seat and battery/charger box. Then remove rear motor section . Tip the rear section on the anti tipper wheels to locate 4-clip connection. Inspect these connections for damage or loose connections, and corrosion.

2. To test the motor circuit for proper resistance, insert meter leads into M+ and M-.
   - Normal motor Ohm range is .5 - 5 Ohms
   - High Ohms reading may be cause by bad motor brushes

3. To test parking brake circuit for proper resistance, insert meter leads into B+ and B-.
   - Normal brake coil Ohm range is 40 - 50 Ohms
   - Test and inspect the brake coil micro switch for damage

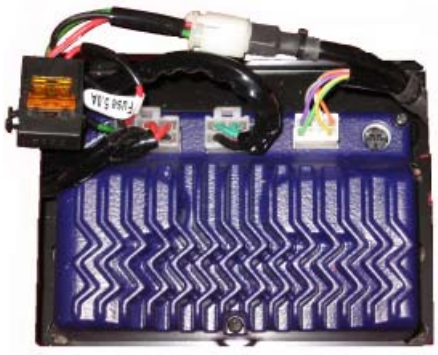


SCOOTER FRONT CONSOLE INSPECTION

1. Remove the 2 screws at the base of the front console faceplate.
2. Look for loose connections or damaged wiring.
3. Inspect the 3 amp fuse on the P.C.B. for a blown filament.
4. Inspect the P.C.B. for damage or loose connections.
5. Make sure key switch and P.C.B. attaching hardware is tight.

SCOOTER CONTROLLER INSPECTION

1. Remove the 6 push pins that secures the foot board mat to the base. Then remove the 2 screws that secures the controller cover plate.
2. Inspect wiring and controller for loose or broken connections, damage and corrosion. Replace if needed.
3. Inspect the 5 amp fuse in-line to the controller for a blown filament.
4. Use programmer to check for error codes.



SCOOTER THROTTLE POT CALIBRATION PROCEDURE

(Manual Adjustment without DS100 Programmer)

This procedure should only be done if one of the following occurs:

•Scooter will not drive, and 6 flashes are noticed on the Status Indicator LED.

•After Replacing a Throttle Assembly, and the Scooter will not drive (6 flashes are noticed on the Status Indicator LED).

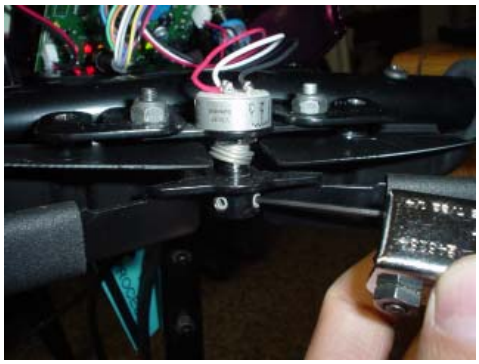
1. Turn key off and disengage the brake lever at the back of the scooter. Place an object under the frame to raise the drive wheels off of the ground for testing purposes. Locate the 2 phillips head screws underneath the tiller display and remove them. Locate and remove the 2 phillips head screws on the throttle handle (the throttle handle base should remain)

2. Using a “2mm” hex head tool, loosen the 2 set screws slightly (do not remove the screws).

3. Turn the key to the on position and locate the throttle potentiometers red and white wires. Use a multimeter to take a DC voltage reading from the red and white wires. You should see a reading of 2.5 VDC (+/- .2). A normal reading is around 2.3 VDC, but if you are experiencing 6 flashes on the Status Indicator LED, the throttle pot needs to be re-calibrated.

4. To re-calibrate the throttle pot, leave your digital multimeter hooked up to the red and white wires, and use a small flat common screwdriver to adjust the throttle pot. Turn the pot clockwise or counter clockwise until your multimeter reading is around 2.5 volts (+/- .2). When you have recalibrated the pot, tighten the two set screws. Engage the brake lever and turn the key off then back on. Look at the Status Indicator LED, you should notice a solid green LED, if you do, you should be able to drive the scooter. Test drive the scooter while the wheels are still raised.

1. Remove the top of the tiller.



2. Loosen the two “2mm” hex head screws slightly.

3 & 4. Using a digital multimeter, re-calibrate the throttle potentiometer.

SCOOTER THROTTLE POT CALIBRATION PROCEDURE
(Adjustment with DS100 Programmer)

This procedure should only be done if one of the following occurs:
•Scooter will not drive, and 6 flashes are noticed on the Status Indicator LED.
•After Replacing a Throttle Assembly, and the Scooter will not drive (6 flashes are noticed on the Status Indicator LED).

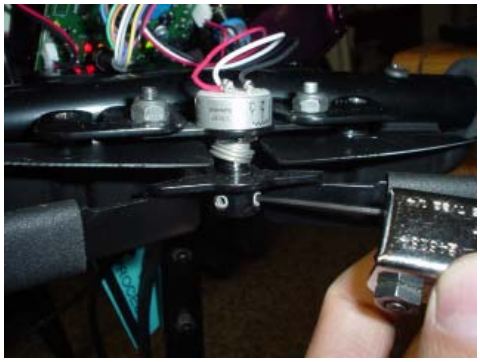
1. Turn key off and disengage the brake lever at the back of the scooter. Place an object under the frame to raise the drive wheels off of the ground for testing purposes. Locate the 2 phillips head screws underneath the front console and remove them. Locate and remove the 2 phillips head screws on the throttle handle (the throttle handle base should remain)

2. Using a “2mm” hex head tool, loosen the 2 set screws slightly (do not remove the screws).

3. Turn the key to the on position and connect the DS100 programmer. With the programmer on go to the SET UP option and verify the Buzzer Volume is on 2 or higher. Then go to the SPEED LEVER IN NEUTRAL OPTION. A neutral reading will cause the neutral alarm to sound until the programmer is taken out of this option, but if you are experiencing 6 flashes on the Status Indicator LED, the throttle pot needs to be re-calibrated.

4. To re-calibrate the throttle pot, leave your DS100 programmer hooked up, and use a small flat common screwdriver to adjust the throttle pot. Turn the pot clockwise or counter clockwise until your neutral alarm sounds. When you have re-calibrated the pot, tighten the two set screws. Engage the brake lever and turn the key off then back on. Look at the Status Indicator LED, you should notice a solid green LED, if you do, you should be able to drive the scooter. Test drive the scooter while the wheels are still raised.

1. Locate and remove the 2 screws under the console and the 2 screws that secures the throttle lever.



2. Loosen the two “2mm” hex head screws slightly.

3 & 4. Using the DS100 programmer to calibrate the throttle potentiometer.

SCOOTER PROGRAMMING INSTRUCTIONS

1. Turn OFF the scooter.
2. Remove the seat, the foot board mat, and the controller cover pan.

WARNING

The scooter cannot be driven while the programmer is plugged into the controller. Before making any connections to the controller either elevate the drive wheels, or secure the scooter.

3. Turn the scooter ON.
4. Locate the programmer socket.
5. Remove the protective plug, and plug in your scooter Programmer.
6. Press the MENU key to scroll through all of the menus available (see chart below).

Main Menu Options:

1) **Setup Menu** - Allows the scooter to be customized for the user's driving preferences or environment. Adjustable feature include:
   - Acceleration
   - Deceleration
   - Forward Speed
   - Reverse Speed
   - Reduce Speed
   - Buzzer Volume
   - Sleep Time
   - Park Brake Delay
2) **Options Menu** - Allows you to change two factory-preset values.
   - Pot Reverse
   - Enable Sleep
   - Sleep Beep
   - Sound Fault
3) **Speed Lever in Neutral Menu** - Allows you to calibrate the throttle about neutral.
4) **Controller Version Menu** - Provides you with the version of the controller software.

HOW TO MAKE ADJUSTMENTS IN THE SETUP MENU

From the Setup Menu Display, press ENTER to scroll through the options.

1. The first option is ACCELERATION (Factory Default 3)
   - Press the VARY key to change the current rate.
   - Range: 1 - slowest acceleration to maximum forward speed
     10 - fastest acceleration to maximum forward speed
   - Press ENTER to confirm the value when finished.

2. The second option is DECELERATION (Factory Default 7)
   - Press the VARY key to change the current rate.
   - Range: 1 - slowest deceleration from maximum forward speed
     10 - fastest deceleration from maximum forward speed
   - Press ENTER to confirm the value when finished.

3. The third option is FORWARD SPEED (Factory Default 10)
   - Press the VARY key to change the current rate.
   - Range: 1 - slowest forward speed
     10 - fastest forward speed
   - Press ENTER to confirm the value when finished.

SCOOTER PROGRAMMING INSTRUCTIONS

HOW TO MAKE ADJUSTMENTS IN THE SETUP MENU (continued)

4. The forth option is REVERSE SPEED (Factory Default 4)
   - Press the VARY key to change the current rate.
   - Range: 1 - slowest reverse speed
     10 - fastest reverse speed
   - Press ENTER to confirm the value when finished.

5. The fifth option is REDUCE SPEED (Factory Default 5)
   - Press the VARY key to change the current rate.
   - Range: 1 - slowest limit of maximum forward speed and maximum reverse speed
     10 - fastest limit of maximum forward speed and maximum reverse speed

   NOTE: For example , if REDUCE SPEED is set to 7, FORWARD SPEED to 10 and REVERSE SPEED to 6, maximum forward speed will reduce to 7, but maximum REVERSE SPEED will stay at 6, as it is already lower than REDUCE SPEED.
   - Press ENTER to confirm the value when finished.

6. The sixth option is BUZZER VOLUME (Factory Default 10)
   - Press the VARY key to change the current rate.
   - Range: 1 - a setting of 1 turns the horn/buzzer OFF
     10 - any other value turns the horn/buzzer ON, 10 being the highest volume
   - Press ENTER to confirm the value when finished.

7. The seventh option is SLEEP TIME (Factory Default 30 minutes)
   - Press the VARY key to change the rate.
   - Range: 5 min. - fastest sleep time setting for scooter (scooter powers down after 5 min. of inactivity)
     60 min. - slowest sleep time setting for scooter (scooter powers down after 60 min. of inactivity)
   - Press ENTER to confirm the value when finished.

8. The eighth option is PARK BRAKE DELAY (Factory Default 10)
   - Press the VARY key to change the current rate.
   - Range: 1 - fastest parking brake time engages after stop.
     30 - slowest parking brake time engages after stop.
   - Press ENTER to confirm the value when finished.

HOW TO MAKE ADJUSTMENTS IN THE OPTIONS MENU

1. The first option is POT REVERSE (Factory Default OFF)
   - The Option Menu settings are either ON or OFF.
   - Range: ON - Polarity of the throttle Pot is reversed. (Left Hand Drive)
     OFF - Normal Polarity of the throttle Pot. (Right Hand Drive)
   - Press ENTER to confirm the value when finished.

2. The second option is ENABLE SLEEP (Factory Default ON)
   - The Option Menu settings are either ON or OFF.
   - Range: ON - Sleep Time is enabled.
     OFF - Sleep Time is disabled.
   - Press ENTER to confirm the value when finished.

3. The third option is SLEEP BEEP (Factory Default ON)
   - The Option Menu settings are either ON or OFF.
   - Range: ON - Sleep Beep is enabled.
     OFF - Sleep Beep is disabled.
   - Press ENTER to confirm the value when finished.

4. The fourth option is SOUND FAULT (Factory Default OFF)
   - The Option Menu settings are either ON or OFF.
   - Range: ON - Sound Fault is enabled.
     OFF - Sound Fault is disabled.
   - Press ENTER to confirm the value when finished.

NOTE: ENABLING SOUND FAULT HELPS IN DIAGNOSIS OF THE SCOOTER, ALLOWING SERIES OF BEEPS TO ASSIST IN TROUBLE SHOOTING.

SCOOTER PROGRAMMING INSTRUCTIONS

HOW TO MAKE ADJUSTMENTS TO THE SPEED LEVER IN NEUTRAL

1. The SPEED LEVER IN NEUTRAL option is used to calibrate the throttle pot for neutral.
   - This menu allows you to calibrate the throttle pot about neutral so that when the throttle is at rest (in neutral), the controller sees a voltage that translates to zero speed. The default voltage for zero speed is 2.5 VDC.
   - Range: After entering this menu option loosen the two set screws in the throttle pot assembly, and rotate the throttle shaft slowly until the buzzer sounds. If the controller version is 2.46 or higher, the status light will also glow.
   - Press ENTER to confirm the value when finished.

CONTROLLER VERSION

1. The CONTROLLER VERSION Menu Option will display the current version of software.

SCOOTER SPECIFICATIONS

	LYNX L-3	LYNX L-4
Overall Dimensions		
Base length	39.8”	
Base Width	26”	
Step Height (floor pan to ground)	4”	
Seat Height (floor pan to seat)	14”-16”	
Overall Height	36”	
Seat Dimensions		
Width	16.5”	
Depth	14.5”	
Back Height	16”	
Arm Dimensions		
Length	11.6”	
Height between seat & arm	9”	
Width between arms	15”-22”	
Speed Range	0 - 5 mph	
Travel Range	estimated 7 miles	
Weight Capacity	250 lbs.	
Incline Capablity	8 deg grade	
Tire Size		
Front	8” x 2”	
Rear	8” x 2”	
Turning Radius	39.4”	51.2”
Product Weight		
Front base section	30 lbs.	39 lbs.
Rear base section	25 lbs.	25 lbs.
Seat	24 lbs.	24 lbs.
Battery / Charger Box	23 lbs.	23 lbs.
Total Weight	**103 lbs.**	**112 lbs.**

SCOOTER ERROR CODES

The scooter tillers are equipped with a status indicator LED that will flash diagnostic code information. The status indicator LED will flash in burst, separated by a pause to provide diagnostic information. See page 5-3 for tiller faceplate status indicator light location.

Number of Flashes	Fault	Impact on Scooter	Notes
1	Battery needs recharging	Will Drive	Battery charge is running low. Recharge the batteries as soon as possible.
2	Battery Voltage too low	Drive Inhibited	Battery charge is empty. Recharge the batteries. If the Scooter is left off for a few minutes, battery charge may recover sufficiently to allow driving for a short period of time.
3	Battery Voltage too high	Drive Inhibited	Battery charge is too high. Scooter will charge batteries when travelling down slopes or decelerating. Excessive charging in this manner may cause this fault. Turn the scooter power off and then back on again.
4	Current Limit time-out	Drive Inhibited	The scooter has drawn too much current for too long, possibly because the motor has been overworked, jammed or stalled. Turn the scooter power off, leave for a few minutes, and then turn back on again. The controller has detected a shorted motor. Check the wiring harness for shorts and check the motor.

SCOOTER ERROR CODES

(continued)

The scooter tillers are equipped with a status indicator LED that will flash diagnostic code information. The status indicator LED will flash in burst, separated by a pause to provide diagnostic information. See page 5-3 for tiller faceplate status indicator light location.

Number of Flashes	Fault	Impact on Scooter	Notes
5	Brake Fault	Drive Inhibited	Check that the park brake release lever is in the engaged position. The park brake coil or wiring is faulty. Check the park brake and wiring for open or short circuits.
6	Out of Neutral at power up	Drive Inhibited	Throttle is not in neutral position when turning the key switch on. Return throttle to neutral, turn power off, and back on again. Throttle may need to be re-calibrated. Check Throttle wiring.
7	Speed Pot Error	Drive Inhibited	The throttle or its wiring is faulty. Check for open or short circuits. Throttle may not be correctly set up.
8	Motor Volts Error	Drive Inhibited	The motor or its wiring is faulty. Check for open or short circuits.
9	Other Internal Errors	Drive Inhibited	Call Invacare Technical Services at 1-800-832-4707.

NOTE: If the SOUND FAULT ability is enabled the scooter will alarm the same number as the flashing LED.

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