



Digital Duo Charge Installation/Operation

© Revised July, 2011

Introduction

The Digital Duo Charge provides a safe, intelligent alternative for the care of your vessel's engine starting battery. Unlike switches, isolators and other charge splitting devices, the Duo Charge is mounted between the vessel's house and starting batteries rather than between the alternator and batteries. This allows the alternator and regulator to concentrate output based on the house battery's needs. When the Duo Charge senses charging voltage at the house battery, it works like a DC-to-DC battery charger, providing up to 30 amps of regulated charging current to support the starting battery.

In most installations, the Duo Charge requires just four wires for operation; a fused input wire, a fused output wire, a ground wire and an ON/OFF wire. In applications where the Duo Charge is used to supply a battery bank that may require more than 30 amps of regulated charging current, the Duo Charge may be used to *manually* control an external solenoid. Please note the section in the manual relating to solenoid control.

The Duo Charge is designed specifically to enable its user to control charging voltage output -- making it possible to safely mix house and starting battery technologies. The Duo Charge features four different programs based on four battery technologies: Standard Flooded, Deep Cycle Flooded, Gel and AGM battery types. In addition, the Duo Charge can be programmed for 12-volt or 24-volt operation. When used with an optional Battery Temperature Sensor cable (MC-TS-B), the Duo Charge responds to a battery over-temperature condition by automatically discontinuing charging output.

Safety Considerations

Before installing your Duo Charge, please take a moment to consider these guidelines for safe regulator installation. Failure to work safely could result in injury or damage to your electrical system.

1. Always disconnect your battery banks and ensure that switches are "OFF" prior to installing your regulator.
2. Remove loose-fitting clothing or jewelry, which could become entangled in your motor or other machinery.
3. Wear ANSI-approved safety glasses.
4. DO NOT attempt to modify the Duo Charge. Alterations could result in damage to your charging system, and will void your warranty.
5. Do not attempt installation if tired or fatigued.
6. Ensure the engine has cooled before initiating installation.
7. Do not attempt installation while using alcohol or medication that could impair your judgment or reaction time.
8. Always use the right tool for the job. Improper tool use may damage regulator or your boat, and could result in personal injury.
9. Take time to read the manual. Equipment damage and possible injuries may result from an incomplete understanding of the installation and operation of the Duo Charge. If you are unfamiliar with DC electrical systems, consult with a licensed marine electrician.

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Unpacking The Box

Prior to installing the Duo Charge, we recommend that you inventory the contents of the packaging and ensure that the following items are included. Contact Balmar Customer Service at 360-435-6100 if any items listed below are missing.

- Digital Duo Charge
- Input Cable (Includes two ring terminal connectors and 30-amp ATC fuse and fuseholder)
- Output Cable (includes one ring terminal and one butt connector, with a 30-amp ATC fuse and fuseholder)
- Programming screwdriver (magnetic tip at end of screwdriver handle is used for programming, not the blade end)
- Instructional manual

Installation Basics

The Duo Charge MUST be mounted within the length of the Input Cable from the house battery. Four mounting holes are included on the mounting tabs of the Duo Charge. Ensure that the mounting location is protected from moisture and temperatures in excess of 120° F. The Duo Charge should be installed far enough from inverters, navigational, and communications equipment to ensure protection from radio frequency noise. The location of the Duo Charge should make it possible to easily view its LED display. The short length of the Input Cable and longer Output Cable allow the wiring to act like an electric spring, enabling the Duo Charge to address high battery loads more efficiently.

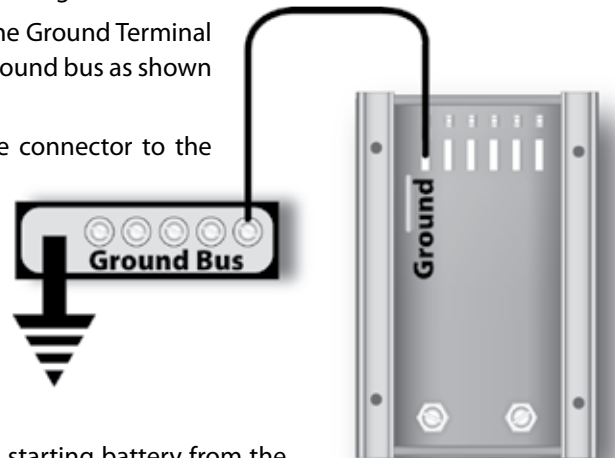
Wiring Basics

Once installed as described above, the Duo Charge can be wired for proper operation. The following sections will describe the recommended connection points for optimal charging performance. **The four following connections are required.**

Ground Wire

The Duo Charge must be properly connected to system ground, which must be shared between the house and starting battery banks, for proper operation. Failure to do so will result in non-operation and potential damage to the device. Connection to system ground can be made at one of the following: house battery negative post, starting battery negative post, or system ground bus. User-supplied 14-gauge wire is recommended. To install the ground wire:

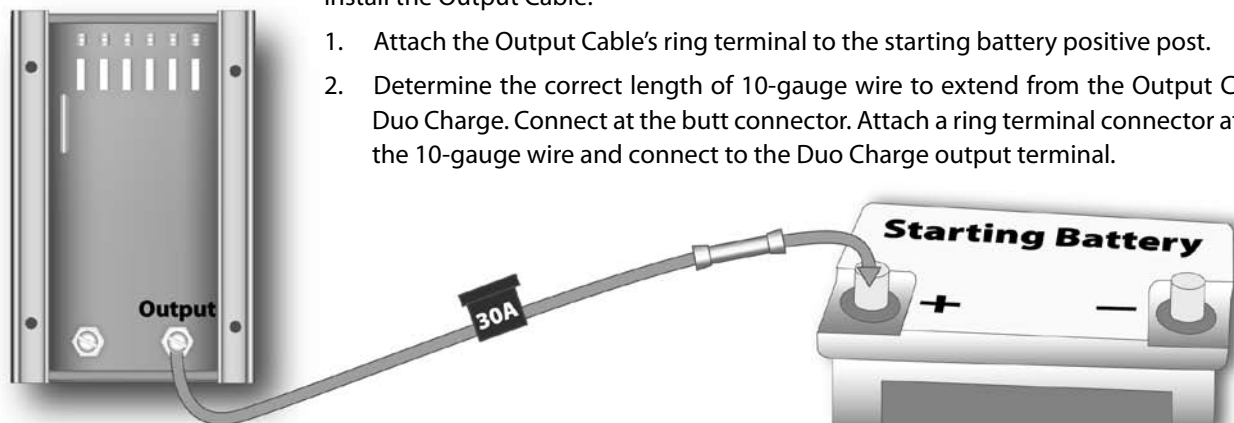
1. Select a length of 14-gauge wire long enough to extend from the Ground Terminal on the Duo Charge to your intended ground source, such as a ground bus as shown at right.
2. Crimp appropriately-sized ring terminal and 1/4" female spade connector to the wire ends.
3. Connect the female spade terminal to the Ground Terminal on the Duo Charge.
4. Connect the ring terminal to the desired ground source.

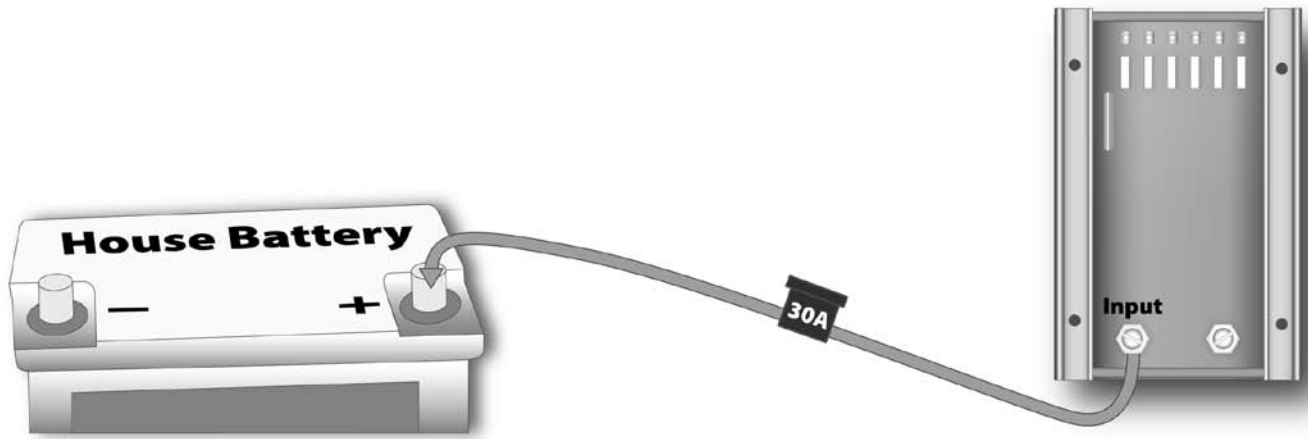


Output Cable

The Duo Charge includes a 30-amp, fused 10-gauge cable with one ring terminal and a butt connector terminal. The installer must supply the length of 10-gauge wire required to extend to the starting battery from the butt connector end of the Output Cable. **A minimum run of eight feet of wire from the Output Cable to the starting battery is recommended.** Again, the reason for the extra wire length is to act like an electric spring which allows the Duo Charge to produce a higher current. To install the Output Cable:

1. Attach the Output Cable's ring terminal to the starting battery positive post.
2. Determine the correct length of 10-gauge wire to extend from the Output Cable to the Duo Charge. Connect at the butt connector. Attach a ring terminal connector at the end of the 10-gauge wire and connect to the Duo Charge output terminal.





Input Cable

The Duo Charge includes a 30-amp, fused 10-gauge cable with two ring terminals. To install the Input Cable:

1. Connect the larger of the two ring terminal connections to the positive post of your house battery. Most marine batteries will include a secondary stud on the battery lug that will provide a satisfactory connection point.
2. Connect the smaller of the two ring terminal connections to the input terminal of the Duo Charge.

While it may be more convenient to mount the Duo Charge a further distance than is allowed by the length of the Input Cable, we strongly recommend limiting that distance to the length provided. Again, the shorter length of the input wire allows for a longer run of the output side of the Duo Charge wiring to add greater ability to address larger loads.

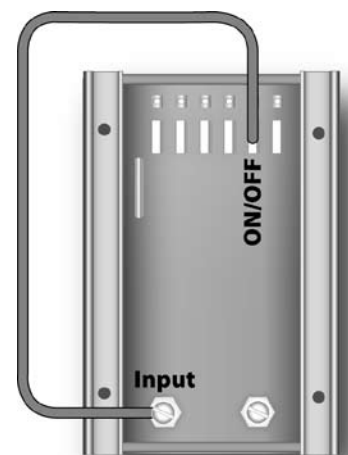
ON/OFF Wire

The fourth and final wire required for basic operation is the ON/OFF wire, which supplies either switched or constant power to the Duo Charge. If automatic activation of the Duo Charge is desired whenever a source of charging is available at the house battery bank, the ON/OFF wire can be connected directly to the positive post of the house battery or at the Input terminal of the Duo Charge (as shown in diagram at right).

When connected directly to house battery voltage, the Duo Charge will remain in a sleep mode whenever input voltage remains below 13 volts in a 12-volt charging system, or 26 volts in a 24-volt charging system. When voltage at the Input terminal exceeds that voltage threshold, the Duo Charge will provide charging current to the starting battery. When used in this mode, the Duo Charge will require a nominal amount of current while asleep (approximately 500mA). If the vessel remains disconnected from a charge source for an extended period, the Duo Charge can be disabled by disconnecting the ON/OFF wire from the ON/OFF terminal, or by installing and using an ON/OFF toggle in the ON/OFF wire.

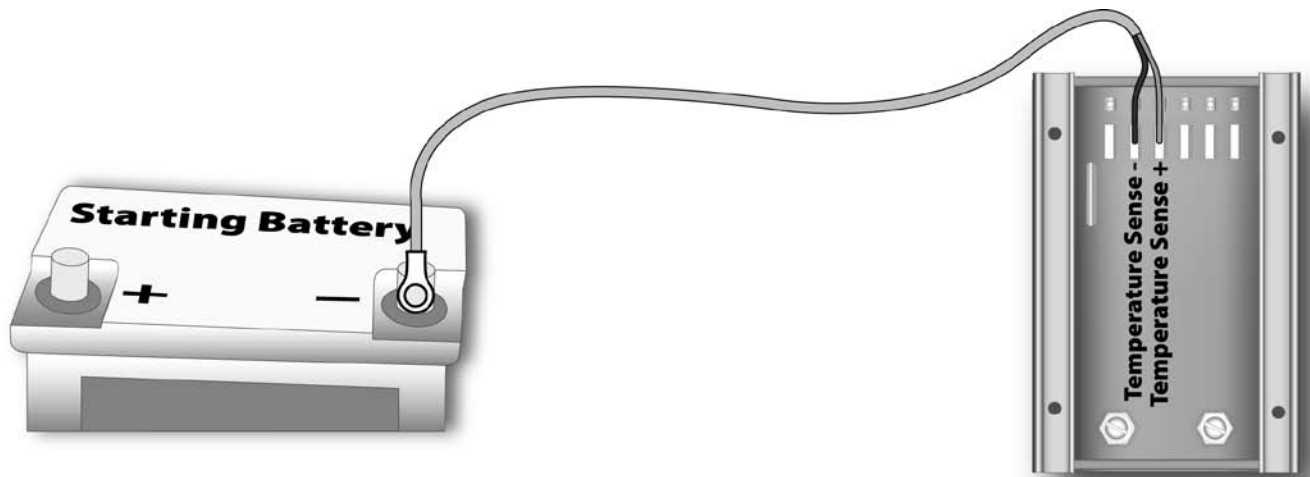
If the Duo Charge is only intended for use when the house battery is being charged by the alternator and regulator, the ON/OFF wire can be connected to the same switched voltage source that's used to supply the voltage regulator's ignition circuit. To install the ON/OFF wire:

1. Determine the preferred method for Duo Charge activation, and the preferred source for ON/OFF voltage.
2. Provide a length of 14-gauge wire suitable for the intended voltage source and the Duo Charge.
3. Attach one appropriately sized ring terminal or other suitable termination connector, and a 1/4" female spade connector to the ends of the wire.
4. Plug the 1/4" spade terminal onto the Duo Charge's ON/OFF connector pin.
5. Connect the other end of the wire, as required, to the desired source of ON/OFF voltage.



Optional Wiring Connections

While the Duo Charge does provide full functionality with the basic four-wire connections discussed above, there are a number of optional functions which may provide additional capacity or intelligence. These include battery temperature sensing and solenoid control, which enables the manual bypass of the Duo Charge's internal circuitry and activation of a solenoid drive circuit that can be used in conjunction with a higher capacity solenoid relay.



Battery Temperature Sensor

When used in conjunction with the optional MC-TS-B Battery Temperature Sensor, the Duo Charge can automatically respond to a potential battery thermal runaway by discontinuing charging output to the starting battery — adding a level of safety to the charging system. To install the MC-TS-B Battery Temperature Sensor:

1. Attach the lug that houses the sensor module to the *negative* post of the starting battery.
2. Using care to match polarity between the temperature sensor positive and negative wires and the positive and negative temperature sensor terminal pins on the Duo Charge, connect wires to the terminal pins.

Solenoid Drive

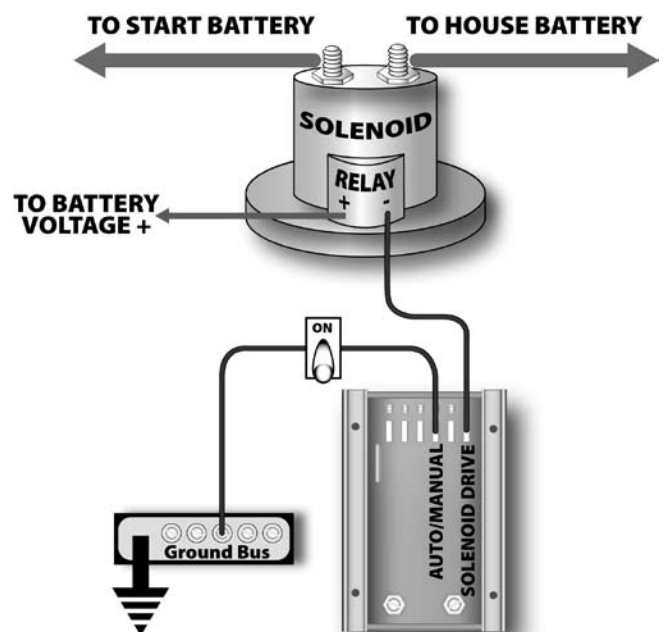
In applications where the Duo Charge is used to support larger capacity starting batteries (such as 4D and 8D models) or windlass and/or thruster batteries, there may be instances when the 30-amp capacity of the Duo Charge’s circuitry may not provide sufficient current to satisfy demands. When used as a stand alone charge source, the Duo Charge is designed to discontinue charging when demands exceed its capabilities. At that point, the Duo Charge will wait for a short period and query if the demand has diminished to below its 30-amp capacity. If so, the Duo Charge will continue charging. If demand continues to exceed capacity, the Duo Charge will continue to shut down, while checking periodically to see if demand has diminished.

If your application requires frequent charging levels in excess of 30 amps, it may be necessary to add a solenoid as a method to manually bypass the Duo Charge’s internal circuitry. Keep in mind, the Duo Charge *will not automatically activate* the solenoid if the demand exceeds its capacity. As such, it is important to monitor charging voltage closely at the battery being charged by the Duo Charge. To utilize the Duo Charge’s solenoid drive function, it will be necessary for the user to supply an appropriate-capacity solenoid and a toggle or other ON/OFF switching mechanism to control the bypass function.

To install the external solenoid control circuit:

1. Install solenoid between primary and secondary battery banks. Ensure that solenoid is properly sized to handle maximum current flow. Ensure that wire gauge is adequate to supply maximum current flow.
2. Connect positive solenoid relay terminal to a source of positive system voltage.
3. Connect the negative solenoid relay to the Solenoid Drive terminal on the Duo Charge.
4. Create a switched circuit between system ground and the Auto/Manual terminal on the Duo Charge.

Once installed, the Duo Charge will be in the Auto mode whenever the toggle switch is in the OFF position, and charging will occur via the Duo Charge’s internal circuitry. When the toggle switch is in the ON position, the Duo Charge will revert to manual mode, allowing the solenoid to control charge flow to the secondary battery bank.



Duo Charge Operation

When the four required wires are connected to the Duo Charge, a start-up sequence will initiate on the Duo Charge's six color-coded LED display. When powered up, the LEDs will:

1. Illuminate from right to left (amber to green) four times, indicating that the Duo Charge is set for 12-volt operation.
2. Illuminate the #1 and #2 amber LEDs, followed by a green LED, indicating battery program type. The #3 green indicates Standard Flooded; the #4 green indicates Deep Cycle Flooded; the #5 green indicates gel; and the #6 green indicates AGM.
3. Illuminate the #1 amber, followed by a combination of green LEDs, indicating low voltage activation. See the Balmar Duo Charge web page for detailed values for low and high voltage settings.
4. Illuminate the #2 amber, followed by a combination of green LEDs, indicating maximum voltage output.
5. Illuminate the #3 green LED, indicating that the Duo Charge is in operation.

If, upon start up, the Duo Charge display deviates from the sequence above, or if the #3 LED begins to blink, proceed to the troubleshooting instructions.

The Duo Charge performs like a DC to DC battery charger. When the Duo Charge recognizes 13 volt or greater on the input terminal the Duo Charge will turn on and start passing current to the start battery.

The maximum output amperage of the Duo Charge is 30 amps. When used as a stand alone charge source, the Duo Charge is designed to discontinue charging when demands exceed its capabilities. At that point, the Duo Charge will wait for a short period and query if the demand has diminished to below its 30-amp capacity. If so, the Duo Charge will continue charging. If demand continues to exceed capacity, the Duo Charge will continue to shut down, while checking periodically to see if demand has diminished. So, if you decided to install the Duo Charge to charge a bow thruster battery, windlass battery or a battery that can be highly discharged the Duo Charge may go into the over current condition because the demand is greater than 30 amps. If you intend to use the Duo Charge to support charging at a larger battery with demands greater than a typical starting battery, please contact Balmar Customer Service at 360-435-6100 for technical support.



If your application requires frequent charging levels in excess of 30 amps, it may be necessary to add a solenoid as a method to manually bypass the Duo Charge's internal circuitry. Keep in mind, the Duo Charge will not automatically activate the solenoid if the demand exceeds its capacity. As such, it is important to monitor charging voltage closely at the battery being charged by the Duo Charge.

To utilize the Duo Charge's solenoid drive function, it will be necessary for the user to supply an appropriate-capacity solenoid and a toggle or other ON/OFF switching mechanism to control the bypass function.

NOTES:

Programming The Duo Charge

The Duo Charge features four selectable program types for the following battery types: standard flooded, deep cycle flooded, gel and absorbed glass mat (AGM). Program changes are made by activating a magnetic reed switch located on the Duo Charge circuit board with the magnetic tipped programming tool provided. In addition to battery type, the Duo Charge can be programmed to support 12-volt or 24-volt charging systems.

Programming For System Voltage - 12 to 24-Volt

The Duo Charge is preset at the factory for 12-volt operation. To adjust the Duo Charge for 24-volt charging:

1. Remove the wire supplying the ON/OFF terminal from the ON/OFF pin.
2. Place the magnetic end of the programming screwdriver on the RED dot (or against one or the other end of the reed switch).
3. Reconnect the wire to the ON/OFF terminal while continuing to hold the magnet against the RED dot. After a couple of seconds, the #3 green LED will illuminate.. Continue to hold the magnet to the switch.
4. After a few additional seconds, the #3 green and #4 green will both illuminate. Remove the magnet from the switch. Wait until the green LEDs go dark.
5. After saving the program change, the display will indicate 24-volt mode by scrolling from left to right (green to amber) at start up.

Programming For System Voltage - 24 to 12-Volt

1. Remove the wire supplying the ON/OFF terminal from the ON/OFF pin.
2. Place the magnetic end of the programming screwdriver on the RED dot (or against one or the other end of the reed switch).
3. Reconnect the wire to the ON/OFF terminal while continuing to activate the reed switch with the magnet. After a couple of seconds, the #3 green LED will illuminate.. Continue to hold the magnet to the switch.
4. After another couple of seconds, the #3 green and #4 green will both be illuminated. Remove the magnet from the switch. Wait until the green LEDs go dark.
5. Re-activate and hold the magnet to the switch. After a couple of seconds, the #3 green LED will illuminate. Continue to hold. After several seconds, the #3 green and #5 green LEDs will illuminate. Release the magnet. After saving the program change, the display will indicate 12-volt mode by scrolling from right to left (amber to green) at start up.

Programming For Battery Type

The Duo Charge's factory default program is suitable, right out of the box, for the majority of cranking-type batteries – and will require no programming after installation. Some technologies, however, may benefit from some voltage adjustment. Four programs, based on standard flooded, deep cycle flooded, gel and AGM battery types are included in the Duo Charge's programming mode. To select the program that's best suited to your battery type:

1. Ensure that the #3 green LED is illuminated. Place the magnetic end of the programming screwdriver on the RED dot (or against one or the other end of the reed switch).
2. Continue to hold the magnet against the switch. After several seconds, the #3 green LED will go dark, and the #1 and #2 amber LEDs will illuminate.
3. Continue to hold the magnet against the switch. After several seconds, the #1 and #2 amber and the #3 LEDs will be illuminated.
4. Continue to hold the magnet to the switch. After a few more seconds, the #3 green light will go dark and the next green LED will illuminate.
5. When the green LED indicating your desired battery type is illuminated, release the switch by removing the magnet.
6. Should you need to change the programming selection, activate and hold the switch until the #1 and #2 amber and #6 green LEDs are illuminated. Release the switch until the LEDs go dark. Re-activate the switch. The LEDs will illuminate, and the green LEDs will scroll the opposite direction.



Programming Lower And Upper Voltage Limits

In addition to its ability to be programmed for specific battery type, the Digital Duo Charge offers the ability to adjust the upper and lower voltage limits for charging, enabling the Duo Charge to be used with battery types not included in the four selectable preset programs.

To program the lower voltage limit:

1. With the Duo Charge powered up, place the magnetic end of the programming screwdriver against the RED dot on the epoxy potting (or against one or the other end of the reed switch). The #1 and #2 Amber LEDs will illuminate, followed by the #3 green LED.
2. Release the magnet from the RED dot. Once the reed switch is disengaged, the LEDs will go dark. Shortly thereafter, the #1 Amber LED will illuminate.
3. Re-activate the switch by returning the magnetic screwdriver to the RED dot.
4. The #1 Amber LED will be joined by a number of sequenced Green LEDs as described in the chart below. Release the magnet from the switch when the desired value is indicated.
5. The #1 Amber LED will re-illuminate, followed by the #2 Amber LED.
6. If you choose to select the upper voltage value, continue to the following instructions.

To program the upper voltage limit:

7. Re-activate the switch by returning the magnetic screwdriver to the RED dot when the #2 Amber LED is illuminated.
8. The #2 Amber LED will be joined by a number of sequenced Green LEDs as described in the chart below. Release the magnet from the switch when the desired value is indicated.
9. The #2 Amber LED will re-illuminate, allowing you to change your programming choice, if needed.
10. If the reed switch is not re-activated, the display will cycle between the #1 and #2 Amber LEDs two more times. Both #1 and #2 LEDs will flash together a total of eight times, indicating that your program choices have been saved.

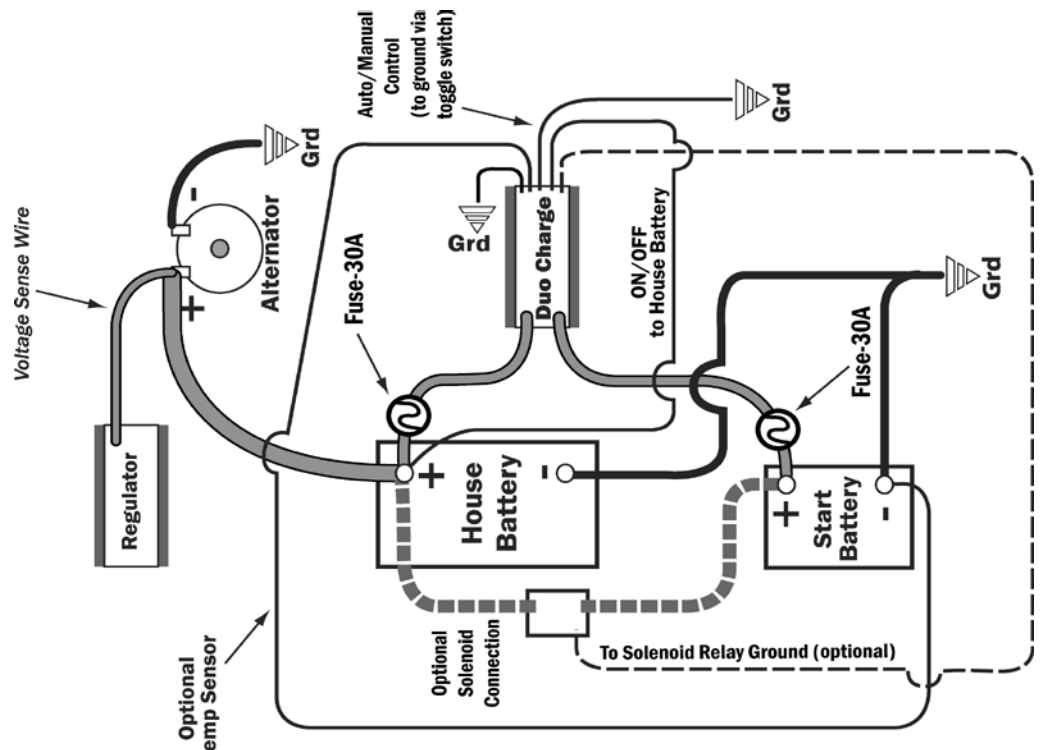
Lower & Upper Voltage Limits					
12V	24V		12V	24V	
12.3V	24.6V	G G G G A A	13.2V	26.4V	G G G G A A
12.4V	24.8V	G G G G A A	13.3V	26.6V	G G G G A A
12.5V	24.8V	G G G G A A	13.4V	26.8V	G G G G A A
12.6V	25.2V	G G G G A A	13.5V	27.0V	G G G G A A
12.7V	25.4V	G G G G A A	13.6V	27.2V	G G G G A A
12.8V	25.6V	G G G G A A	13.7V	27.4V	G G G G A A
12.9V	25.8V	G G G G A A	13.8V	27.6V	G G G G A A
13.0V	26.0V	G G G G A A	13.9V	27.8V	G G G G A A
13.1V	26.2V	G G G G A A	14.0V	28.0V	G G G G A A
14.1V	28.2V	G G G G A A			
14.2V	28.4V	G G G G A A			
14.3V	28.6V	G G G G A A			
14.4V	28.8V	G G G G A A			
14.5V	29.0V	G G G G A A			
14.6V	29.2V	G G G G A A			
14.7V	29.4V	G G G G A A			
14.8V	29.6V	G G G G A A			

Duo Charge Troubleshooting

Symptom	Cause/Solution
No Lights/No Output	<ol style="list-style-type: none"> 1. No voltage at input wire or ON/OFF wire – Check wiring and repair. 2. Bad fusing on input wire – Replace 30A fuse in input cable. 3. Voltage too low at house battery bank – Check house battery charging system. 4. Starting battery demanding >30A – Install solenoid and manual over-ride switch. Check grounding. 5. Bad Duo Charge unit – Contact Balmar Customer Service at 360-435-6100 or at balmar@balmar.net.
Interference at radio, autopilot or navigation equipment when Duo Charge is active	<ol style="list-style-type: none"> 1. Input, Output or ON/OFF wires causing interference – Re-route wiring. Check system grounding. 2. Output wire is coiled – Uncoil any surplus wire and re-arrange to ensure noise is reduced. 3. Duo Charge is mounted too close to electronics – Relocate Duo Charge. 4. Frequency interference – Install noise reduction filter on electronics power wire.
Output voltage is not appropriate for battery type selected	<ol style="list-style-type: none"> 1. Wrong battery program selected – Verify program and re-program as described above. 2. Voltage drop in output cable – Check wiring resistance and repair as needed. 3. Voltage drop in input cable – Check wiring resistance and repair as needed. 4. Voltage drop in output cable – Check wiring resistance and repair as needed.
No Output. #4 LED blinks once intermittent	<ol style="list-style-type: none"> 1. High system temperature – Determine source of overheating and repair.
No Output. #4 LED blinks twice intermittent	<ol style="list-style-type: none"> 1. Start battery voltage too high – Inspect starting battery for secondary charge sources and correct.
No Output. #4 LED blinks three times intermittent	<ol style="list-style-type: none"> 1. House battery voltage too low – Correct charging source for house battery bank. 2. House battery voltage too low – Check wiring resistance in Input wire and repair as needed.
No Output. #4 LED blinks four times intermittent	<ol style="list-style-type: none"> 1. House battery voltage too high – Correct charging source for house battery bank.
No Output. #4 LED blinks five times intermittent	<ol style="list-style-type: none"> 1. Start battery temperature too high – Shut down system. CAREFULLY inspect starting battery for signs of overheating. Repair condition and/or replace starting battery. 2. Bad Temperature Sensor cable – Check wiring resistance (approx. 34-40k). Repair or replace Temperature Sensor cable. 3. Bad system grounding – Test ground-side resistance between batteries and charging system. Repair.
No Output. #4 LED blinks six times intermittent	<ol style="list-style-type: none"> 1. Voltage too low at ON/OFF terminal – Repair or relocate ON/OFF wire.

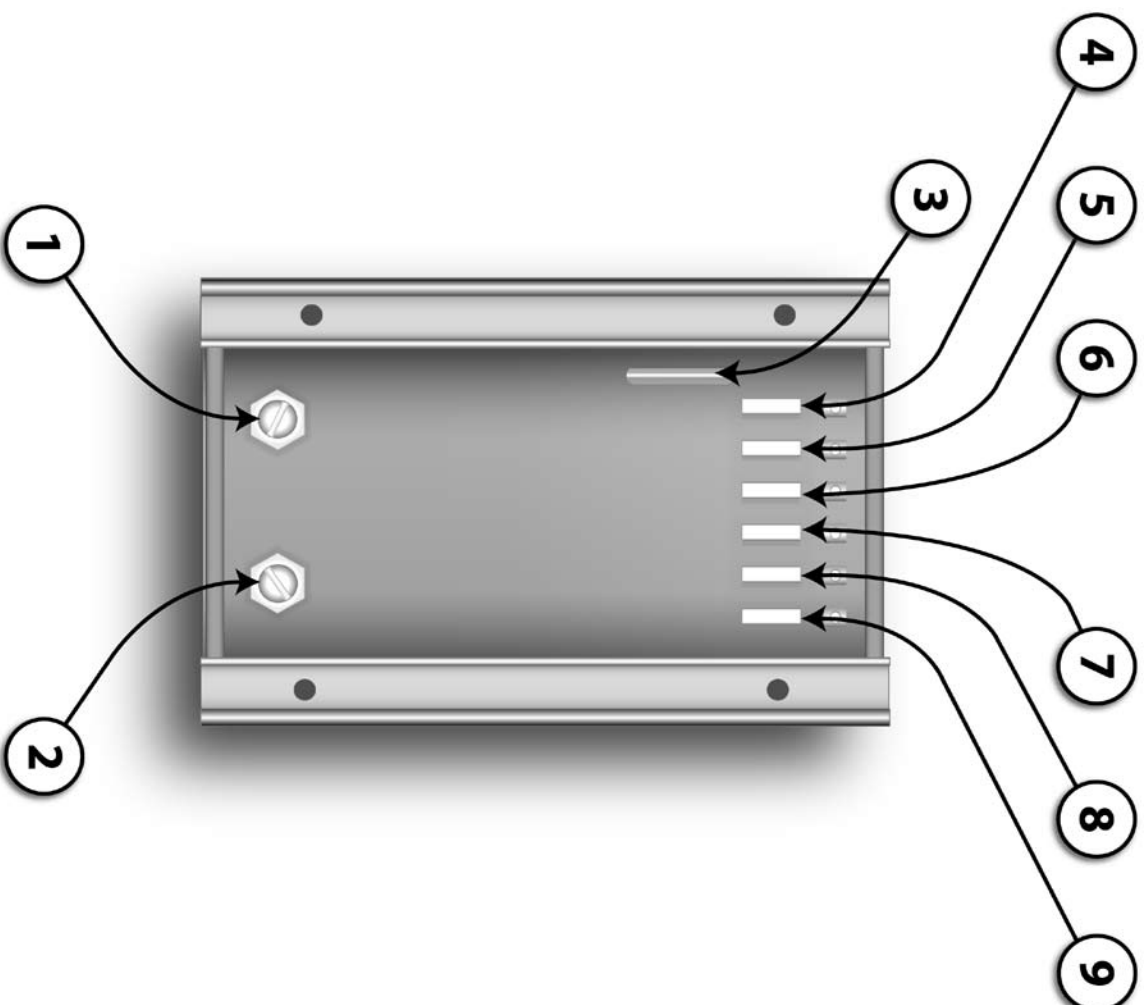
Balmar warrants the Digital Duo Charge for one year against defects in material or workmanship. The complete Balmar limited product warranty statement is available at www.balmar.net. Please contact our Customer Service department at 360-435-6100 prior to return for warranty evaluation. Balmar is not responsible for product returned without prior authorization. See website for detailed warranty info.

Duo Charge Wiring Diagram
 The following diagram illustrates a typical Duo Charge installation. Please note that the use of a separate solenoid and manual bypass is only required in installations where the 30-amp limitation of the Duo Charge's internal circuitry is unable to support starting battery loads. The optional Battery Temperature Sensor cable allows the Duo Charge to monitor for unsafe temperatures at the starting battery, as is recommended as an additional measure of safety.



Duo Charge Terminal Locations

1. Input Terminal - Connects to the positive terminal of the house battery via the battery input cable supplied. THIS TERMINAL CONNECTION MUST BE INSTALLED.
2. Output Terminal - Connects to the positive terminal of the starting battery via the battery output cable supplied. THIS TERMINAL CONNECTION MUST BE INSTALLED.
3. Magnetic Reed Switch - Used to program the Duo Charge for system voltage and battery type. A small screwdriver with a magnet at the end of the handle is provided for programming control.
4. Ground Terminal - Connects to system ground via a user-supplied 14-gauge wire. THIS TERMINAL CONNECTION MUST BE INSTALLED.
5. Temperature Sensor (Negative) - Used in conjunction with the MC-TS-B Battery Temperature Sensor. Connect sensor's BLACK wire to this terminal.
6. Temperature Sensor (Positive) - Used in conjunction with the MC-TS-B Battery Temperature Sensor. Connect sensor's RED wire to this terminal.
7. Auto/Manual Control (Negative) - Optional wiring connection allows the Duo Charge user to bypass the internal circuitry and supply a negative source to a solenoid relay via the Duo Charge's Solenoid Drive (#9). This option is used in cases where larger battery banks (such as thruster or windlass banks) may require a charge source exceeding the Duo Charge's 30-amp maximum output. This function is only required when a separate solenoid is used. To utilize this function: connect the terminal to system ground via a 14-gauge wire with an ON/OFF toggle inline.
8. ON/OFF Control (Positive) - The ON/OFF terminal provides the voltage that activates the Duo Charge. THIS TERMINAL CONNECTION MUST BE INSTALLED.
9. Solenoid Drive (Negative) - Provides a connection to ground when terminal #7 completes a pathway to ground.



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