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NOVAK

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Printed in the USA 6/90
Instruction Manual No. 410M1/Xc-1

Team
NOVAK ALD

**410-
MXc**



**HI-FREQUENCY
MEGAFET
SPEED CONTROL
with Current Limiting**

**410-
M1c**



**INSTRUCTION
MANUAL**

IT IS IMPORTANT THAT YOU TAKE THE FOLLOWING PRECAUTIONS WITH YOUR M1c/MXc TO PREVENT POSSIBLE DAMAGE TO THE SPEED CONTROL.

(ESC = Electronic Speed Control)

- The ESC may overheat and shut itself off if the heat sinks are not properly installed and cooled.
- NEVER cross-connect or apply reverse voltage to the ESC. The speed control will be damaged.
- The ESC may become damaged if the required THREE 0.1 μ F motor capacitors are not used.
- Never use more than 10 cells (12 V). The brake circuitry will be damaged.
- ALWAYS use different polarity plugs on the ESC's battery and motor power wires to prevent possible damage.
- Never allow water, moisture or any other foreign material on the ESC's PC board. The electronics may be damaged.
- When using an external battery pack, always disconnect the red input wire of the ESC.
- Installing an alternate input plug incorrectly may damage the receiver, servo and/or ESC.
- ALWAYS disconnect the battery pack from the ESC when not in use. Nickle-cadmium batteries can carry extremely high currents for a short period of time and may explode.
- Frayed wire may cause damage to the ESC. ALWAYS insulate exposed wires with heat shrink tubing or electrical tape.
- NEVER turn on ESC without first connecting it to the receiver and turning on the transmitter (the model may take off).

CAREFULLY FOLLOW ALL INSTRUCTIONS!

THE 410 SERIES



The Team Novak 410 Series MEGAFET electronic speed controls are true digital, high-frequency controllers designed to give the racer the absolute advantage on the race track.

Features exclusive MEGAFET transistors for the lowest ON-resistance, 2500 Hz high-frequency pulse width modulation for more efficient recharging of batteries during partial throttle and braking, perfect linearity for smooth acceleration, and adjustable current limiting for maximum efficiency and performance.

Other features include a built-in BEC to power the radio system, an input signal filter to eliminate electronic noise, a dual-color LED for easy pot adjustments, and the exclusive Novak Input Plug System™.

R/C APPLICATIONS

- Electric Cars
Both on and off road,
1/12 and 1/10 scale.
- Electric Boats
With proper cooling
and water protection.
- Electric Airplanes
4-10 cells.

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FEATURES OF THE M1c/MXc

- Re-charging of the drive battery during brake and partial throttle for up to 20% longer run times.
- Increased motor commutator life.
- Ruggedized MEGAFET transistor for lowest ON-resistance and highest performance.
- Linear acceleration for ultra-smooth driving.
- BEC circuit (5.7 V) to power the radio system.
- Fully-adjustable current limiter (with accurate test point) to maximize run time. And, for off-road driving, to minimize tire slip.
- Thermal shut-down to protect the ESC's electronics when dangerous overloads occur.
- Three-wire system for less resistance and weight.
- Surface mount components for lighter weight and greater reliability.
- Manufactured 100% in-house for added quality.

SPECIFICATIONS

	410-M1c	410-MXc
Case Size (L"/W"/H")	1.58/1.39/0.62	1.58/1.78/0.62
Weight w/Plugs (oz.)	1.76 (49.90 g)	2.29 (64.92 g)
Voltage Input ¹ (cells)	4-10	4-10
ON Resistance ² (Ω)	0.0030	0.0015
PWM Frequency (Hz)	2500 nominal	2500 nominal
Rated Current ² (A)	up to 250	up to 500
Braking Current ² (A)	50	50
Current Efficiency	over 99%	over 99%
BEC Voltage (V)	5.7	5.7
Current Limiting (A)	Active: 20-140	Active: 20-140
Test Point Ratio ³	2:1 (A:mv)	1:1 (A:mv)
Overload Protection	Thermal	Thermal
LED	red/green	red/green
Plug Types Included ⁴	A, J, KO, KYO, JR	A, J, KO, KYO, JR

¹ Nickel-cadmium batteries of 1.2 volts each connected in series.

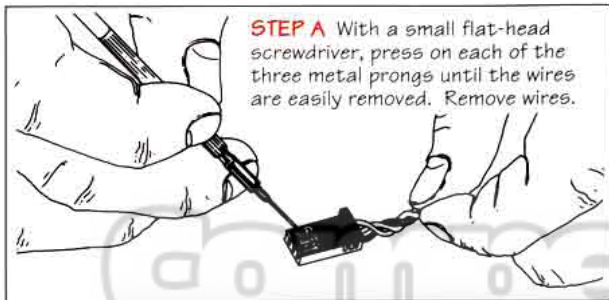
² Transistor's rating at 25°C junction temperature.

³ The current limit of the speed control as compared to the voltage measurement at the test point (voltmeter on a 200 mv scale).

⁴ The five plugs of the Novak Input Plug System™ only included in the #1620 model of the M1c and the #1720 model of the MXc.

CHANGING THE INPUT PLUG

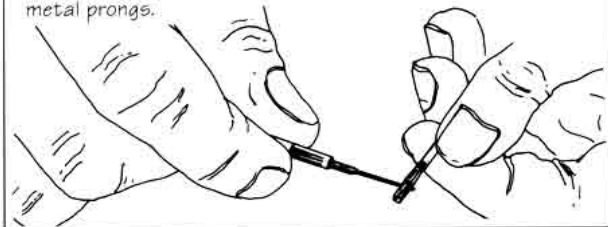
Included with the 410-M1c (#1620) and 410-MXc (#1720) is the exclusive Novak Input Plug System™ to convert the input harness to be compatible with the Airtronics, Futaba J, KO, Kyosho, and JR radio systems†.



STEP A With a small flat-head screwdriver, press on each of the three metal prongs until the wires are easily removed. Remove wires.

† If the ESC is not harnessed with the Futaba J plug, the Novak Input Plug System will not be included.

STEP B With the screwdriver, carefully lift up each of the metal prongs.



STEP C Insert each wire pin into the correct plug slot. Each pin should click in.



RED= Red wire terminal
WHT= White wire terminal
BLK= Black wire terminal

PRECAUTION: Improper installation of these wires may cause damage to the receiver, servo and/or ESC and will void the warranty.

HEAT SINK INSTALLATION

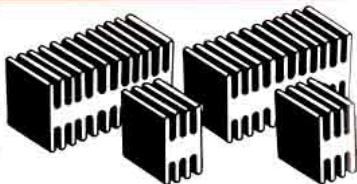
PRECAUTIONS

(1) The ESC may overheat and shut itself off if the included heat sinks are not used. (2) Heat sinks can get hot while running. DO NOT touch hot heat sinks.

WARRANTY VIOLATIONS (1) The brake circuitry may be damaged on the MXc if the two included small heat sinks are not used, and on the M1c if the one included small heat sink is not used. (2) Allowing the large heat sink to touch the small heat sink, or allowing metal to come between the large and small heat sink will short the MOSFETs and damage the ESC. (3) **Do not force heat sinks on with a vise-- the internal electronics of the ESC may be damaged!**

INSTALLING THE HEAT SINKS

- Place the ESC on a flat surface and press the heat sinks onto the MOSFETs' metal tabs until they are secure.
- If the small heat sink fits loosely, carefully bend the outside tab of the heat sink with a pair of pliers until the fit is secure.
- The heat sinks are designed for a tight fit for maximum heat transfer. Heat sink compound is NOT required. Do NOT glue heat sinks on!



4. **M1c Model:** Mount the large heat sink on ^{ALD} one of five in-line MOSFETs (figure 1a). Mount the small heat sink on the two offset MOSFETs.

MXc Model: Mount the two large heat sinks on the two rows of six in-line MOSFETs. Mount the two small heat sinks on the two offset MOSFETs.

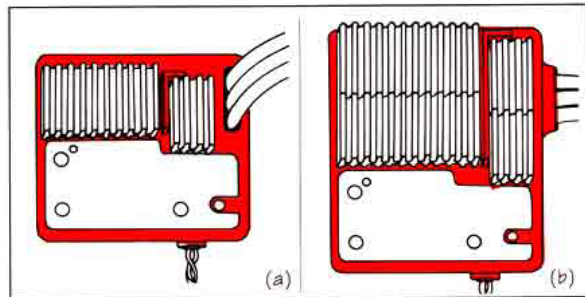


FIGURE 1 Proper heat sink installation for the (a) M1c and (b) MXc.

(Make sure ESC is on a flat surface when pressing on the heat sinks. DO NOT force heat sinks on!)

RACER'S TIP:

The ESC's ON-resistance increases as the temperature of the MOSFETs increases. To maximize run time and speed, all included heat sinks should be used.



PRECAUTIONS (1) DO NOT allow the heat sinks to short out to any metal components of the model-- such as the chassis, solder joints, or motor case (this will damage the speed control and void the warranty). (2) DO NOT drape any wire or plastic parts over the ESC-- they may melt. (3) The ESC may overheat and shut itself off if the MOSFETs are not properly cooled.

- 1. SPEED CONTROL** Mount the ESC with the included double-sided sticky tape and install in your model to obtain MAXIMUM AIRFLOW THROUGH THE HEAT SINKS (Figure 2). The motor has more power when the heat sinks are properly cooled. For an RC-10, the speed control MUST be placed in the pan.

To prevent radio interference, ALWAYS mount the ESC as far away from the receiver as possible.

Mount the ON/OFF switch in a convenient place with the included double-sided sticky tape.

- 2. RECEIVER** For maximum range, mount the receiver and antenna as high in the model as possible. For an RC-10, the receiver and antenna should ALWAYS be mounted on the rear shock tower.

If your radio is on the 75 Mhz band and your model has a metal chassis, DO NOT mount the receiver or antenna on the chassis. This set up may decrease the

range of your radio by as much as 50%.

AL D

To decrease radio interference, always keep your receiver and antenna at least two inches away from the motor, servo or any wiring.

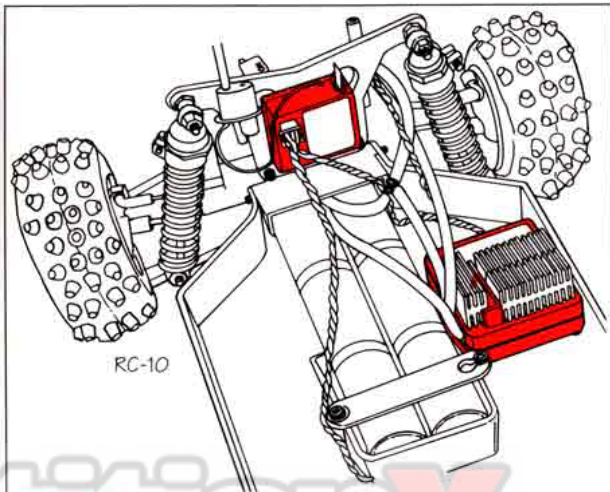


FIGURE 2 Always mount the ESC to obtain maximum parallel air flow THROUGH the transistors. For an RC-10 or other metal chassis car, the ESC should mount on the chassis as shown, and the receiver and antenna should mount on the rear shock tower.

PRECAUTIONS (All Will Void Warranty) (1) Cross connecting or applying reverse voltage to the ESC will cause internal damage. (2) Three 0.1 μF capacitors must be properly installed on each motor to prevent damage to the ESC. (3) Using more than 10 cells may damage the ESC. (4) Frayed wire may cause damage to the ESC-- insulate exposed wire.

1. MOTORS

The M1c and MXc are designed to be used with any motor (stock or modified with any number of turns).

2. MOTOR CAPACITORS (Figure 3)

Motors are capable of producing high voltage spikes which will lower the ESC's performance and may damage the unit. The three included 0.1 μF ceramic disc capacitors **MUST** be installed on **EVERY** motor (a 47 μF capacitor is not needed). Solder a 0.1 μF between:

- **POSITIVE** motor brush tab and **NEGATIVE** motor brush tab.
- **POSITIVE** motor brush tab and **GROUND** motor tab.
- **NEGATIVE** motor brush tab and **GROUND** motor tab.

3. INPUT HARNESS

After the proper input plug plastic has been installed to match the receiver (Step 1), plug it into the throttle channel of the receiver. Remove any power harness going to

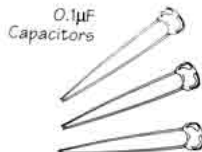
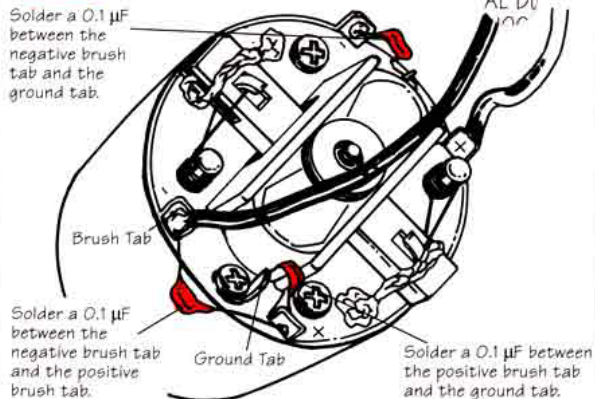


FIGURE 3 Proper motor capacitor installation.



the battery channel of the receiver (unless an external battery pack is used--refer to Step 5). The ESC has an internal voltage regulator which supplies the proper voltage (5.7V) to the receiver and servo.

If more than one servo is used, as in an electric airplane, an external battery pack must be used to power the radio system (refer to Step 5).

4. BATTERY PACK

The M1c and MXc are designed to be used with 4 to 10 nickel-cadmium cells (1.2 V connected in series) in the main battery pack.

continued on page 13

FIGURE 4 410-M1c & 410-MXc Hook-up Diagram
(MXc model shown with Dean's plugs)

The ESC may overheat and shut itself off if the heat sinks are not used.

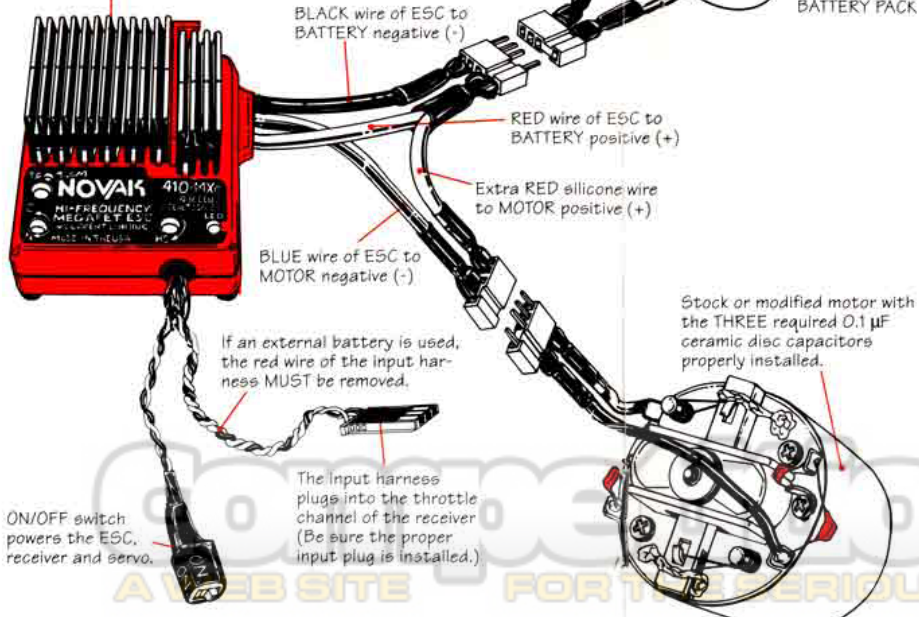
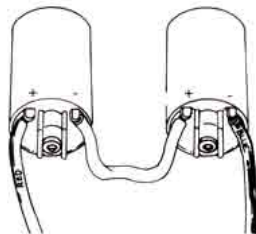


FIGURE 5 OPTIONAL DUAL MOTOR HOOK-UP

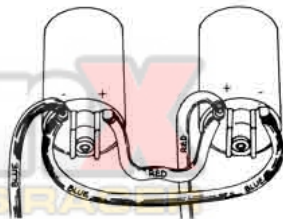
(a) MOTORS IN SERIES

Each motor receives half the pack voltage, giving half the power and twice the run time as compared to a single motor.



(b) MOTORS IN PARALLEL

Each motor receives the full pack voltage, giving twice the power and half the run time as compared to a single motor.



STEP 4: HOOK-UP (con't)

3. POWER WIRES

When hooking up the M1c/MXc, keep all power wires as short as possible to minimize power loss, use different polarity plugs on the ESC's wires, and use heat shrink tubing on all solder joints.

USING PLUGS ON THE POWER WIRES (Figure 6)

USING THE INCLUDED POWER PLUGS: It is important that the red wire solders to the two pins on the bar side.

- Solder the ESC's black and red wires and the extra red wire to the male Dean's plug.
- Solder the black and red wires of the battery pack to the female Dean's plug.
- Solder the ESC's blue wire and the other end of the included red wire to the female Dean's plug.
- Solder the blue and red wires of the motor to the male Dean's plug.

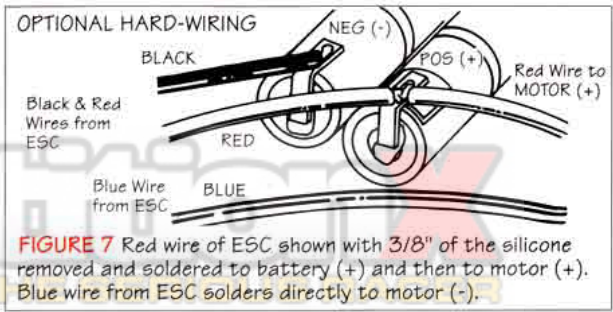
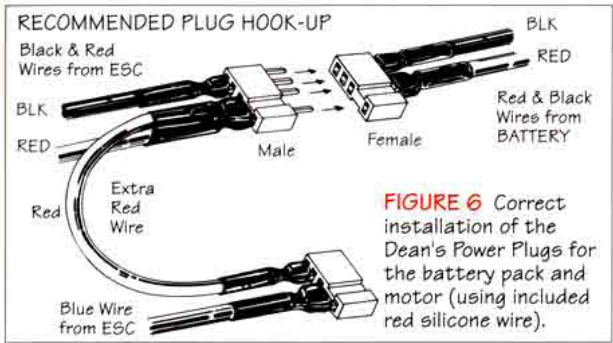
USING OTHER PLUGS: The SERMOS™ R/C Snap Connectors are the only other plugs we recommend†.

HARD-WIRING (Figure 7) Gives minimum voltage drop but greatly increases the chance of cross connection and application of reverse voltage (which causes damage to the ESC and voids the warranty). Use silver braid on the battery terminals (+ and -) and double-sided tape under the positive (+) terminal to prevent it from shorting out.

- Solder ESC's black wire to the battery negative (-).
- Solder ESC's blue wire to the motor negative (-).

† At the time of printing.

- Strip a 3/8" long ring of insulation off the ESC's red wire at a point which will reach the battery pack. Solder to battery positive (+).
- Solder the end of the red wire to the motor positive (+).



STEP 5 USING AN EXTERNAL BATTERY

PRECAUTION When using an external battery to power the radio system, the ESC will be damaged if the red wire of its input harness is not removed from the plastic housing (or cut if plug is Futaba G). Be sure to insulate exposed metal/wire.

An external battery pack (Figure 8) is recommended if more than one servo will be used, as in an airplane or boat, or if erratic radio operation is experienced during acceleration (especially when using low-turn motors).

For a car, the Novak MICRO PACK is recommended. After removing the red wire from the ESC's input harness, plug the Micro Pack's input harness into the battery slot of the receiver. The Micro Pack's switch should be turned on first and then turn on the ESC's switch.



FIGURE 8 Plug the radio battery pack into the battery terminal of the receiver. Be sure the ESC's red input wire is removed.

STEP 6 TRANSMITTER ADJUSTMENTS

TX TYPE	TH EXPO	ATL	ATV or EPA HIGH LOW		TH TRIM	SUB TRIM	REV SW	MECH ADJ	COAST BRAKE ADJ (Use...)
FUTABA (refer to manufacturer's original manual)									
FP-T2PKA	N/A	N/A	10	6	-5	N/A	Right	Pos. 2	ATV Low
FP-3PG	0	N/A	10	N/A	-5	N/A	NOR	Pos. 2	Brake Trim
FP-T2P	N/A	N/A	N/A	N/A	-5	N/A	Rev.	1/3	None
FP-T2PB	N/A	N/A	N/A	N/A	-5	N/A	Rev.	Mid.	None
FP-T2PD	N/A	5	10	10	Low 5	0	Rev.	1/3	ATL
FP-T2PBKA	N/A	N/A	10	10	Low 5	N/A	Rev.	Mid.	ATV Low Pot
FP-T2NCS	N/A	N/A	N/A	N/A	Down	N/A	N/A	N/A	None
FP-T2NBR	N/A	N/A	N/A	N/A	Down	N/A	Rev.	Down	None
PCM 1024	0	10	10	10	N	0	Rev.	1/3	Throttle Trim
AIRTRONICS (refer to manufacturer's original manual)									
XL-2P	N/A	N/A	Max.	Max.	Mid.	N/A	NOR	N/A	Throttle Trim
CS-2P	NOR	N/A	CW	CW	Mid.	N/A	NOR	N/A	Throttle Trim
VECTOR	N/A	N/A	N/A	N/A	Low	N/A	Left	Down	None
JR PROPO (refer to manufacturer's original manual)									
ALPINA-2	N/A	N/A	10	10	Mid.	N/A	NOR	N/A	Throttle Trim
PCM	N/A	N/A	N/A	N/A	CCW	N/A	NOR	3:1	None
KO PROPO (refer to manufacturer's original manual)									
EX-I	Min.	N/A	Max.	N/A	Mid.	N/A	Left	N/A	CH. 2 Trim
EX-II	N/A	N/A	Max	N/A	Mid.	N/A	up	N/A	Brake Trim
EX-5	N/A	N/A	Max	N/A	Mid.	N/A	Right	N/A	Brake Trim
EX-7	N/A	N/A	N/A	N/A	CCW	N/A	Down	Pos. B	None
EX-9	Min.	N/A	Max.	Max.	Mid.	N/A	Left	N/A	CH 2 Trim
PULSAR (refer to manufacturer's original manual)									
PRO 2000	N/A	N/A	N/A	N/A	Up	N/A	NOR	1/3	None

N/A= Not Applicable CCW= Counter Clockwise ↺ CW = Clockwise ↻

7 SPEED CONTROL ADJUSTMENTS

PRECAUTIONS (1) NEVER force the pots past their stops-- this can cause board and/or component damage. (2) For proper operation, transmitter MUST be adjusted (Step 6) before setting the ESC's HIGH SPEED or NEUTRAL adjustments.

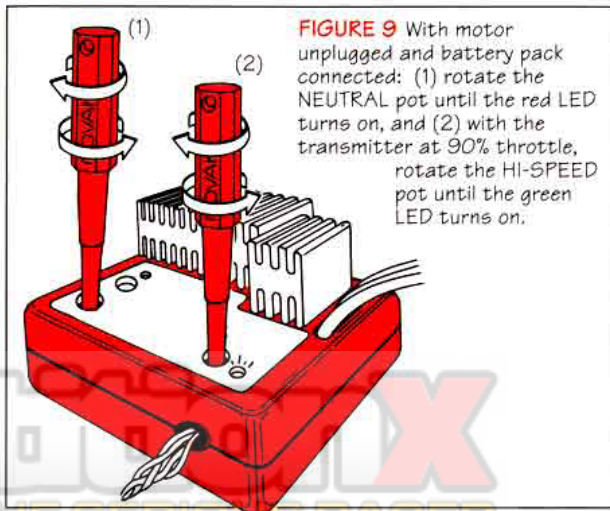
N = Neutral Pot **Red LED** Indicates Neutral
HS = High Speed Pot **Green LED** Indicates Full Throttle
C = Current Limiting Pot
TP = Test Point for accurate measure of Current Limit point.

- Plug the M1c/MXc into the battery pack.
DISCONNECT THE MOTOR.
- Turn on transmitter and then ESC. If an external Micro Pack is used, turn its switch on first and then the ESC's switch (to prevent runaway).

Adjusting NEUTRAL & HIGH SPEED (Figure 9)

1. Rotate the neutral pot until the red LED turns on.
2. Give 90% throttle on the transmitter and rotate the high speed pot until the green LED turns on solidly.
3. Plug in the motor and check for proper operation. When the green LED is on and motor is running, the ESC will be at full throttle.

4. If your transmitter is equipped with a coast brake adjustment, use it to dial in more or less brake. If there is no coast brake adjustment, rotate the ESC's neutral pot a few degrees counter-clockwise (↺) for desired brake and re-adjust the high speed pot.
5. Seal the N and HS holes with the enclosed rubber plugs to keep out dirt and moisture.



STEP 7: ESC Adjustments (con't)

Adjusting CURRENT LIMIT (Figure 10)

The Current Limit adjustment allows the user to limit the maximum current passed to the motor. Both the M1c and MXc can be adjusted between approximately 20-140 amps. The ESC is factory preset at approximately 60 amps.

To minimize the power loss of the battery pack and increase run time, the current should be set to the lowest setting the car can withstand without loss of acceleration at any point on the track.

A digital voltmeter with a probe is needed to accurately set the Current Limiter.

1. Disconnect the motor and turn on the ESC (the transmitter does not need to be on).
2. Set the voltmeter to the 200 mV scale.
3. Connect the negative probe/clip of the voltmeter to the battery pack negative (-).
4. Place the positive probe of the voltmeter in the ESC's hole marked TP (make sure contact is made on the circuit board).
5. Adjust the pot marked C for the desired setting. (Refer to chart).
6. Seal the hole with the enclosed rubber plug.
7. For beginner drivers or for use on a slippery track, set the current limiter so there is no wheel slipping anywhere on the track.

Current Setting (A)	40	50	70	80	90	100	120
410-M1c (mV)	20	30	35	40	45	50	60
410-MXc (mV)	40	60	70	80	90	100	120

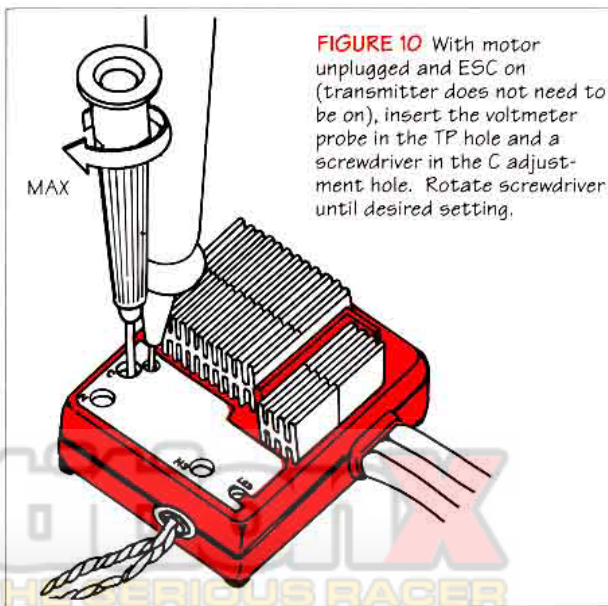


FIGURE 10 With motor unplugged and ESC on (transmitter does not need to be on), insert the voltmeter probe in the TP hole and a screwdriver in the C adjustment hole. Rotate screwdriver until desired setting.

TRUBLE-SHOOTING GUIDE

Speed Control DOES NOT Work

Problem	What's Wrong
Motor & Steering Servo are Dead	<ul style="list-style-type: none">• Dead batteries.• Bad power plug(s).• Internal damage†.
No Brakes	<ul style="list-style-type: none">• Brake transistor is blown†.• Transmitter adjusted incorrectly.
Case is Melted	<ul style="list-style-type: none">• Internal damage†.

† ESC has been damaged and should be sent in for repair (page 23).

PRODUCT WARRANTY Novak Electronics, Inc. guarantees the 410-M1c/410-MXc to be free from defects in materials or workmanship for a period of 90 days from the original date of purchase (verified by a sales receipt). This warranty does not cover poor installation, components worn by use, damage due to cross connection or application of reverse voltage to the ESC, not using three 0.1 μ F capacitors on the motor, not removing the red input wire when using an external radio pack, using more than 12 volts (10 cells) battery voltage, damage due to overheating, any splices to the input harness or switch harness, tampering with the internal electronics, pot damage, allowing water, moisture, or any foreign material on the ESC's PC board, installing an alternate input plastic incorrectly, or allowing any of the wires to become frayed.

In no case shall our liability exceed the product's original cost. We reserve the right to modify the provisions of this warranty without notice.

Because Novak Electronics, Inc. has no control over the installation and use of the ESC, no liability may be assumed nor will liability be accepted for any damage resulting from using this product. Every speed control is thoroughly tested and cycled before leaving our facility and is, therefore, considered operational. By the act of installing or operating this speed control, the user accepts all resulting liability.

TRUBLE-SHOOTING GUIDE

Speed Control WORKS (but other problems exist)

Problem	What's Wrong
Receiver Glitches (Stutters) <i>Refer also to page 7</i>	<ul style="list-style-type: none">• The 3 required motor capacitors are not installed or have broken.• Receiver is sensitive to voltage spikes. Need to use a radio battery or use a receiver that is designed to be used with ESCs, such as a Novak receiver.• Receiver mounted too close to ESC.• Bad connection between the speed control and battery pack.
Car Runs Slow or Has No Acceleration	<ul style="list-style-type: none">• Hi-Speed pot not properly adjusted.• Current Limit pot set too low.
Steering Servo Works & Motor is Dead	<ul style="list-style-type: none">• Motor brushes are hanging up or worn (replace!) or motor is bad.
Overheated Motor	<ul style="list-style-type: none">• Car is geared too high.• Shorted motor.
Car Stutters when Accelerating	<ul style="list-style-type: none">• Bad power plug(s).• Receiver is dropping out due to a large voltage drop during acceleration. Use an external battery such as the Novak Micro Pack.
Hot Power Plugs	<ul style="list-style-type: none">• Motor is geared too high.• Defective or loose plug(s).• Shorted motor.

SENDING YOUR SPEED CONTROL IN FOR REPAIR

PLEASE NOTE: Before sending your speed control in for repair, it is important that you review the Trouble-Shooting Guide. The ESC may appear to have failed when other problems exist in the system-- such as bad installation, incorrect adjustments or problems with other components. ESC's that operate normally when received will be charged a minimum service fee.

Hobby dealers and distributors are NOT authorized to replace speed controls thought to be defective.

Do not cut the input harness, switch harness, or power wires off the ESC before sending it in for repair. Cut wires must be replaced for testing and will be charged.

If your hobby dealer sends your ESC in for repair, be sure you receive ALL paperwork our company provides.

To provide our customers with fast repair service, it is not our policy to notify customers by phone or mail.

It is our company policy not to make any electronic components (i.e. transistors, pots) available.

SEND UNITS TO:

NOVAK ELECTRONICS, INC.
128-C East Dyer Road
Santa Ana, CA 92707

WHAT TO SEND WITH REPAIR

Include a brief letter explaining the problem for EACH item. Also include a legible name and return street address (no PO Boxes, please) inside the package.

Do not send header card, instructions, or accessories with repair. For the item to be warranted after repair, the entire unit (case intact) must be sent.

FOR WARRANTY WORK

Customer MUST CLAIM WARRANTY in the letter and include a valid, dated, cash register or charge card receipt WITH repair, or the previous repair invoice.

If any warranty provisions have been voided, there will be a charge for the repair. Warranty on page 21.

REPAIR COSTS

Repair costs vary and cannot be determined until the unit is repaired. Repair estimates can not be provided.

Customer assumes responsibility for repair costs (parts, labor and shipping charges). Repairs are returned UPS/COD (Cash only). Personal checks will not be accepted as payment and will be returned.

IN A HURRY?

Send to Novak by a one or two day shipping service, such as UPS Blue Label or Federal Express Overnight. Customer assumes all shipping charges and insurance.