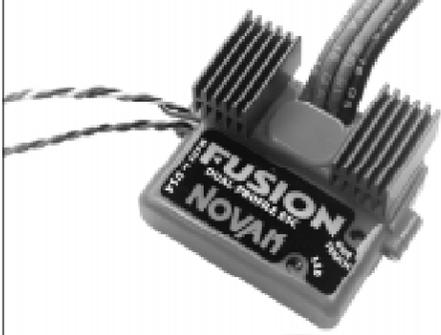


OPERATING INSTRUCTIONS

FUSION DUAL-PROFILE ESC

PART #1970



FUSION DUAL-PROFILE

The Fusion Dual-Profile high-frequency ESC (Electronic Speed Control) features **Two User-Selectable Throttle Profiles** and Novak's exclusive **One-Touch Set-Up™**. With **Polar Drive Technology™** and **Digital Anti-Glitch Circuitry™**, the Fusion runs faster, longer, and smoother than other sport level ESCs. While **Radio Priority Circuitry™** maintains steering control even after the battery has discharged.

The Fusion also has built-in **brake light circuitry** to power two external LEDs for added realism with Touring Sedans and Formula One cars. (*Two high-power brake LEDs and versatile mounting hardware available in Novak kit #5655*)

Novak's **Solid State RVP™** provides rugged protection against reverse voltage application without the need for fuses, while the built-in **BEC (Battery Eliminator Circuit)** powers the radio system with no external receiver battery.

Other features include the **Novak Input Plug System™** for compatibility with all major radio systems, **Thermal Overload Protection**, and purple anodized Micro Fin™ heat sinks for cooling. The factory installed JST/Tamiya style battery connectors and bullet style motor connectors make for quick and easy installation of the speed control into your car or truck without the need to solder.

SPECIFICATIONS

Input Voltage	6-7 cells (1.2 volts DC/cell)	
Case Width	1.98 inches	[50.29 mm]
Case Depth	1.42 inches	[36.07 mm]
Case Height	0.70 inch	[17.78 mm]
Weight (w/o heat sinks)	1.87 ounces	[50.01 g]
On-Resistance @ Transistors	0.0013 Ω	@ 25°C transistor junction temp.
Rated Current	240 amps	
Braking Current	80 amps	
BEC Voltage / Current	5.0 volts DC / 0.5 amps	
Wire Size (Battery/Motor)	16 gauge	
Wire Length (Battery/Motor)	6 inches	[152 mm]
Signal Harness Length	6 inches	[152 mm]
Transistor Type	HYPERFET III	
PWM Drive Frequency**	(1) 7.8 KHz	(2) 1.0 KHz
Minimum Drive Value**	(1) 3 %	(2) 6 %
Part Number	1970	
Brake Light Part Number	5655 (<i>optional accessory kit</i>)	

**Number in parentheses indicates Profile: 1=Modified / 2=Stock

FUSION ACCESSORIES

BRAKE LIGHT KIT

The Fusion speed control comes equipped with built-in circuitry to power two high-power brake light LEDs. Novak's optional Brake Light Kit (#5655) comes complete with two premium quality LEDs, versatile mounting brackets to install brake lights behind the taillight section of the car body or onto most any vertical or horizontal surface on the chassis, and necessary wiring.

MOTOR CAPACITORS

To prevent radio interference problems, you must have three 0.1µF capacitors properly installed on every motor. Included with the Fusion speed control are three 0.1µF (50V) capacitors for one motor. Additional 0.1µF (50V) capacitors are available in Novak kit #5620. Please refer to Step 4 on the back page for proper motor capacitor installation instructions.

HEAT SINKS

Replacement heat sinks are available for the Fusion ESC in Novak kit #5408. These purple anodized Micro-Fin heat sinks provide the cooling needed for the lower operating temperatures and higher operating efficiencies, and also help to prevent overheating.

PRECAUTIONS

- **READ INSTRUCTIONS CAREFULLY BEFORE USING!**
- **WATER & ELECTRONICS DON'T MIX!** Do not operate model in or around water. Never allow water, moisture, or other foreign materials to get inside the ESC.
- **6 OR 7 CELLS ONLY** Never use more than 7 or fewer than 6 cells (1.2 volt DC/cell) in the main battery pack.
- **MOTOR CAPACITORS REQUIRED** Three 0.1µF (50V) ceramic capacitors must be properly installed on every motor to prevent radio interference.
- **DON'T LET TRANSISTOR TABS TOUCH** Never allow the two transistor tab banks or the heat sinks to touch each other or any exposed metal, as this will create a short circuit and damage the speed control.
- **DISCONNECT THE BATTERIES** Always disconnect the battery pack from the speed control when not in use.
- **TRANSMITTER ON FIRST** Always turn on the power of your transmitter first so that you will have control of the radio equipment when you turn on the speed control.
- **DON'T GET BURNT!** Transistor tabs can get hot, so be careful not to touch them until they cool.
- **INSULATE WIRES** Always insulate exposed wiring with heat shrink tubing to prevent short circuits.

RADIO INTERFERENCE

The high frequency switching operation of electronic speed controls can generate radio interference. Here are some common causes of radio interference problems:

- **CAPACITORS NOT INSTALLED ON MOTOR** Electric motors generate radio noise that can interfere with the receiver. To prevent radio problems, every motor must have three 0.1µF (50V) ceramic capacitors installed on it. Refer to Step 4 on back page for proper installation.
- **RECEIVER/ANTENNA INCORRECTLY MOUNTED** The receiver and antenna should be mounted as far from the motor, power wires, battery, and servo as possible, as these components all emit radio noise. On graphite or aluminum, place receiver on edge with the crystal and antenna as far above the chassis as possible. Mount the antenna close to receiver and trail any excess wire off the top of antenna. Do not cut or coil excess wire!
- **MOTOR BRUSHES WORN** As motor brushes continue to wear, excessive motor noise will be generated. To avoid radio interference, worn motor brushes should be replaced. The motor commutator may also need to be cleaned or trued and can be machined to help the motor run more efficiently.

STEP 1

CHANGING THE INPUT HARNESS

Included with the Fusion ESC is the Novak Input Plug System™ to convert the Futaba J style signal harness for compatibility with Sanwa, KO, Kyosho, JR, Airtronics Z, and Hitec radios. Refer to Figures 1 through 3 to change plug.



FIGURE 1 With a small standard screwdriver, press on each of the three metal prongs until the wires are easy to remove. Remove wires.

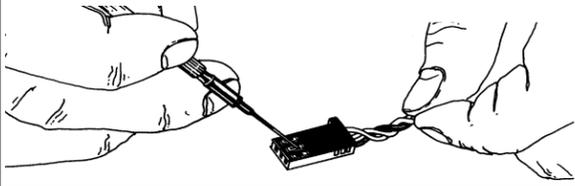


FIGURE 2 With the screwdriver, carefully lift each of the metal locking tabs to the angle shown.

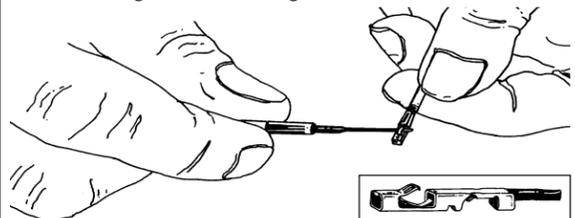
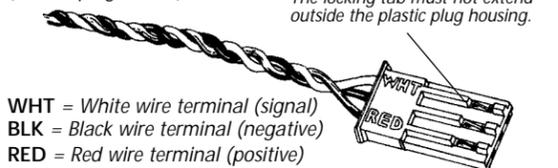


FIGURE 3 Insert each pin into the correct plug slot. Each pin should "click" into place. (Sanwa plug shown)



CAUTION Improper installation of these wires may cause damage to the receiver, servo, and speed control.

STEP 2

HEAT SINK INSTALLATION

Two Micro Fin™ heat sinks have been included to provide proper cooling for the Fusion ESC. The speed control will operate cooler and run faster when the heat sinks are installed. **DO NOT** use the Fusion without the heat sinks, as this voids the warranty and may cause the speed control to overheat and thermally shut down.

1. INSTALL THE LEFT HEAT SINK

Place the speed control on a flat surface and press one heat sink (*longer fins go down onto transistor tabs*) onto the left bank of 3 transistor tabs.

NOTE: Do not use too much force when installing the heat sinks because you can damage the transistors or other components on the PC board. Never use a vise or pliers to install the heat sinks.

2. INSTALL THE RIGHT HEAT SINK

Press the second heat sink (*again, long fins down*) onto the right bank of 3 transistors tabs.

The heat sinks should press onto the transistor tabs with a snug fit. If heat sinks are installed upside-down or shifted off-center, they will be too loose and will not work properly.

3. DO NOT USE GLUE

Do not use glue or other types of adhesives to attach the heat sinks to the transistor tabs.

4. DO NOT SHORT CIRCUIT HEAT SINKS

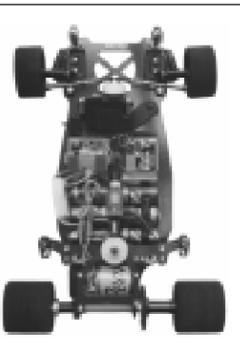
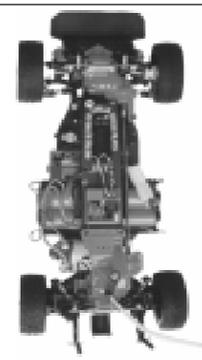
The two separate banks of transistor tabs or heat sinks should never contact each other or other conductive objects (metal, graphite, etc.), or they will short circuit and damage the speed control.

STEP 3

MOUNTING INSTRUCTIONS

- 1. DETERMINE THE BEST ESC MOUNTING LOCATION**
The speed control should be positioned away from the receiver and antenna as shown in set-up photo on back page. Choose a mounting position that will keep power wires away from the receiver and antenna. Choose a position that will provide maximum airflow through the heat sinks to allow for proper cooling.
- 2. INSTALL THE SPEED CONTROL**
Use the included double-sided tape to mount ESC.
- 3. INSTALL THE ON/OFF SWITCH**
Determine a convenient place to mount switch where it will be easy to get to. Mount switch using a piece of double-sided tape. If your car has a switch mount molded into the chassis, remove the two phillips head screws from the switch housing and reassemble switch into chassis using the 3/8" long screws that are included in the speed controls accessory kit. Note the direction of ON/OFF cover and reverse it if necessary.
- 4. INSTALL THE RECEIVER**
Mount the receiver as far from the speed control, motor, power wires, battery, and servo as possible. These components all emit radio noise when the throttle is being applied. If your car has a graphite or aluminum chassis, place the receiver on its edge with the crystal and antenna as far above the chassis as possible. The receiver can also be mounted on the shock tower.
- 5. INSTALL THE ANTENNA**
Mount the antenna as close to the receiver as possible. Trail any excess wire off the top of the antenna mast—Do not cut or coil excess wire. *Cutting or coiling excess wire will reduce radio range.*

INSTALLATION EXAMPLES



NOVAK ELECTRONICS, INC.
18910 Teller Avenue
Irvine, CA 92612
www.teamnovak.com



STEP 4

HOOK-UP INSTRUCTIONS (Refer to set-up photo)

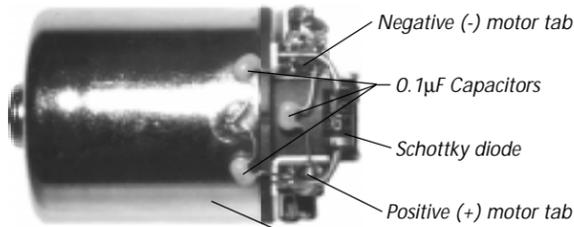
1. INSTALL MOTOR CAPACITORS

Electric motors generate radio noise that can interfere with your receiver and cause radio problems. Included in the accessory kit with the speed control are three 0.1µF (50V) non-polarized, ceramic capacitors. These capacitors must be installed on every motor to help reduce the noise generated by the motor and also to prevent possible damage to the speed control.

Solder 0.1µF (50V) capacitors between:

- POSITIVE (+) motor tab & NEGATIVE (-) motor tab.
- POSITIVE (+) motor tab & GROUND tab*.
- NEGATIVE (-) motor tab & GROUND tab*.

*If your motor does not have a ground tab, solder the capacitor leads to the can of the motor as shown below.



Extra 0.1µF capacitors available in Novak kit #5620.

2. CONNECT SPEED CONTROL TO THE RECEIVER

After the proper input plug plastic has been installed to match the receiver (Refer to Step 1), plug the speed control into the **THROTTLE CHANNEL** of the receiver.

3. CONNECT SPEED CONTROL TO THE BATTERY PACK

Plug the white JST connector from the speed control into the JST/Tamiya style connector on a fully charged 6 or 7 cell battery pack (1.2 volts DC/cell). The black wire is negative (-) and the red wire is positive (+).

4. CONNECT SPEED CONTROL TO THE MOTOR

Plug the bullet connector on the red wire (+) of the speed control to motor positive. Plug the other bullet connector, on the blue wire (-), to motor negative.

A wiring kit with bullet connectors and a JST/Tamiya connector is available in Novak kit #5810.

5. OPTIONAL USE OF SCHOTTKY DIODE

The Fusion ESC does not require an external Schottky diode. However, using one will increase the efficiency and reduce the operating temperature of the ESC.

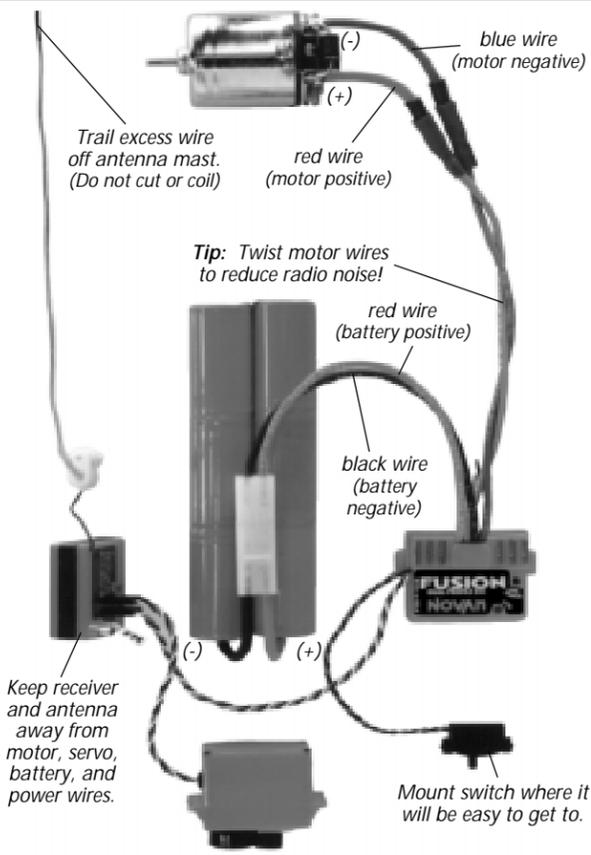
Solder the lead **CLOSEST** to the silver stripe on the body of the Schottky diode to the **POSITIVE (+)** motor tab.

Solder the lead **OPPOSITE** the silver stripe on the body of the Schottky to the **NEGATIVE (-)** motor tab.

Schottky diodes are available in Novak kit #5640.

If installed backwards, a Schottky diode will be destroyed. The body of a bad diode will normally crack open. Replace only with Schottky diodes that have a minimum rating of 35 volts / 8 amps.

FUSION SET-UP



BRAKE LIGHTS

The Fusion is equipped with built-in brake light circuitry to power two LEDs. (Novak Brake Light accessory kit #5655)

To connect brake lights to the Fusion:

1. Strip about 1/8" of insulation off of both the red and the black small (26 gauge) wires that exit the back of the speed control along with the battery and motor wires.
2. Strip about 1/8" of insulation off both ends of the small (26 gauge) extension wires that are the correct length to reach the position that the brake light is mounted.
3. Solder extension wires onto the brake light wires from the speed control. If two LEDs are to be used, then solder two extension wires to each brake light wire from the speed control. Insulate solder joints with heat shrink tubing.
4. Solder end of the extension wire from the red brake light wire to the lead on the notched/flat side of the LED. Solder end of the extension wire from the black brake light wire to other LED lead. Insulate solder joints with heat shrink.

Note: Some LEDs have the flat on the negative side. If LED does not illuminate, reverse the red and black brake light wires.

STEP 5

TRANSMITTER ADJUSTMENT

Proper transmitter adjustment is important for optimum performance from your speed control. The basic throttle channel adjustments for the transmitter are as follows:

1. Set **HIGH ATV** or **EPA** to **maximum** setting. [Controls amount of throw from neutral to full throttle]
2. Set **LOW ATV, EPA, or ATL** to **maximum** setting. [Controls amount of throw from neutral to full brakes] [Reduce this after ESC adjustment to reduce amount of brakes]
3. Set **EXPONENTIAL** to **zero** setting. [Controls the linearity of the throttle channel]
4. Set **THROTTLE CHANNEL TRIM** to **middle** setting. [Adjusts the neutral position of speed control] [Increase or decrease after ESC adjustment to adjust coast brakes—can be used to give braking in neutral trigger position]
5. Set **THROTTLE CHANNEL REVERSING SWITCH** to **either** position. [Do not change switch position after programming]
6. Set **ELECTRONIC TRIGGER THROW ADJUSTMENT** to **70% throttle and 30% brake throw** (or 7:3). [Adjusts pistol-grip transmitter's throttle trigger throw]
7. Set **MECHANICAL TRIGGER THROW ADJUSTMENT** to position with **2/3 throttle and 1/3 brake throw**. [Adjusts pistol-grip transmitter's throttle trigger throw]

STEP 6

SPEED CONTROL ADJUSTMENT

Before beginning this step, the speed control should be connected to the receiver and to a charged 6 or 7 cell battery pack, and the transmitter should be adjusted.

Adjustment of your Fusion speed control is required for proper operation. When the status LED is red, the speed control is in the neutral position (no throttle or brake). When the status LED is green, the speed control is either at the full throttle or full brake position.

1. CONNECT THE BATTERY

Plug the speed control into a fully charged 6 or 7 cell nickel-cadmium battery pack.

2. TURN ON TRANSMITTER THEN THE SPEED CONTROL

With transmitter throttle at neutral, press and hold the **ESC SET** button until the status LED **turns solid red**.

4. RELEASE ESC SET BUTTON WHEN LED IS RED

Hold it there until the status LED **turns solid green**.

NOTE: The motor will not run during programming even if it is connected to the speed control.

6. PUSH THROTTLE TO FULL-BRAKE POSITION

Hold it there until the status LED **blinks green**.

7. RETURN TRANSMITTER THROTTLE TO NEUTRAL

Status LED **will turn solid red**, indicating that throttle is at neutral and proper programming has been completed.

8. CHECK OPERATION OF THE SPEED CONTROL

Connect the motor and check for proper operation. With no throttle or brake applied, the status LED should be solid red and the motor should not be running. At full throttle position, the status LED should be solid green and the motor running full speed. At full-brake position, the status LED should be green and the motor should not be running.

9. SET THE COAST BRAKE AT TRANSMITTER (optional)

Adjust the **THROTTLE CHANNEL TRIM** on the transmitter to get more or less coast brake. This is accomplished by slightly shifting the neutral position. After adjustment be sure that the status LED is still green at full throttle.

Speed control is programmed & ready to run!

If transmitter settings are changed at any time after the speed control has been set-up, it will be necessary to complete the programming sequence once again.

If you experience any problems during programming, turn off the speed control and repeat the programming process.

STEP 7

THROTTLE PROFILE SELECTION

The Fusion is equipped with dual-profile throttle circuitry that allows you to choose the right drive frequency for the type of motor that you are using. **Modified or Stock**

To check or change the active throttle profile:

1. **TURN ON TRANSMITTER THEN THE SPEED CONTROL**
2. **PRESS AND HOLD THE ESC'S ONE-TOUCH BUTTON**
Continue to hold button until the status LED **turns solid green**. The LED will first turn solid red, and then it will turn solid green.
3. **RELEASE THE ONE-TOUCH BUTTON**
After releasing, status LED **will blink red**. The speed that the LED blinks indicates the active profile.
Quick = MODIFIED Slow = STOCK
4. While the status LED is blinking, **PRESS AND RELEASE THE ONE-TOUCH BUTTON**. This will select the next profile and the LED will blink the appropriate speed to indicate which profile is selected.
5. Once the desired throttle profile is selected and the One-Touch button has not been pressed for approximately five seconds, the speed control loads the selected profile into memory, exits the profile selection mode, and the **status LED turns solid red** (neutral position). At this point the selected throttle profile has been stored in the speed control's non-volatile memory (it will remain the active profile even after speed control is shut off). The speed control is ready to run.

TROUBLE-SHOOTING GUIDE

This section describes possible speed control problems, causes, and solutions.

Steering Channel Works But Motor Will Not Run

- Speed control has thermally shut down—Allow ESC to cool down—Use milder motor or smaller pinion gear.
- Check motor connections. Check motor and brushes.
- Make sure ESC is plugged into the throttle channel of receiver. Check throttle channel operation with a servo. Check wiring color sequence of receiver signal harness.
- Possible internal damage—Refer to Service Procedures.

Receiver Glitches/Throttle Stutters During Acceleration

- Motor capacitors broken or missing—Refer to Step 4.
- Receiver or antenna too close to speed control, power wires, battery, or motor—Refer to Step 3.
- Bad connections—Check wiring and connectors.
- Motor brushes worn—Replace brushes.
- Excessive current to motor—Use a milder motor or a smaller pinion gear.

Motor and Steering Servo Do Not Work

- Check wires, receiver signal harness wiring and color sequence, radio system, crystals, battery and motor connectors, and battery pack.
- Possible internal damage—Refer to Service Procedures.

Model Runs Slowly / Slow Acceleration

- Check motor and battery connectors—Replace if needed.
- Bad battery or motor—Check operation with another.
- Incorrect transmitter or speed control adjustment—Refer to Steps 5 and 6.
- Optional external Schottky diode (if used) installed backwards or damaged—Refer to Step 4.

Motor Runs Backwards

- Motor wired backwards—Check wiring and reverse.
- Backwards motor timing—Reverse motor end bell.

ESC Is Melted Or Burnt/ESC Runs With Switch Off

- Internal damage—Refer to Service Procedures.

*For more help call our Customer Service Department.

SERVICE PROCEDURES

Before sending in your Fusion for service, review the Trouble-Shooting guide and the instructions. The ESC may appear to have failed when other problems exist.

PLEASE NOTE: Speed controls that operate normally when received will be charged a minimum service fee and return shipping costs.

WHAT TO SEND: Fill out all of the information requested on the enclosed **ESC SERVICE CARD** (also available on our website) and return it with your speed control.

WARRANTY WORK: For warranty work, you **MUST CLAIM WARRANTY** on the **ESC SERVICE CARD** and include a valid cash register receipt with purchase date on it, or an invoice from previous service work. If warranty provisions have been voided there will be a service charge.

SERVICE COSTS: Customer is responsible for all service costs (parts, labor, and shipping/handling charges). See **ESC SERVICE CARD** for payment and shipping options.

ADDITIONAL NOTES:

- Hobby dealers or distributors are not authorized to replace speed controls thought to be defective.
- If a hobby dealer returns your speed control for service, submit a completed **ESC SERVICE CARD** to the dealer and make sure it is included with the speed control.
- Novak Electronics, Inc. does not make any electronic components (transistors, resistors, etc.) available for sale.
- To provide the most efficient service possible to our customers, it is not our policy to contact customers by phone or mail.

PRODUCT WARRANTY



Novak Electronics, Inc. guarantees the Fusion ESC to be free from defects in materials and workmanship for a period of 120 days from original date of purchase (verified by dated, itemized sales receipt). Warranty does not cover incorrect installation, components worn by use, damage from using fewer than 6 or more than 7 cells (1.2 volts DC/cell) input voltage, short-circuiting heat sinks, cross-connection of battery/motor, damage from incorrect installation of FET servo or receiver battery pack, damage from excessive force while installing heat sinks or pushing One-Touch button, not installing three 0.1µF (50V) capacitors on motor, splices to switch or receiver signal harnesses, using same type and gender battery and motor connectors, damage from disassembling case, tampering with internal electronics, allowing water, moisture, or any other foreign material to enter ESC or get onto PC board, incorrect installation of alternate input plug plastic, allowing exposed wiring to short-circuit, or any damage caused by a crash.

In no case shall our liability exceed product's original cost. We reserve the right to modify warranty provisions without notice. Because Novak Electronics, Inc. has no control over connection and use of the ESC, no liability may be assumed nor will be accepted for damage resulting from the use of this product. Every ESC is thoroughly tested and cycled before leaving our facility and is, therefore, considered operational. By the act of connecting/operating ESC, the user accepts all resulting liability.

CUSTOMER SERVICE

CUSTOMER SERVICE HOURS (PST)

Monday-Thursday: 8:00am-5:00pm
Friday: 8:00am-4:00pm (closed every other Fri.)

(949) 833-8873 • FAX (949) 833-1631

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FUSION