

# G-10

## QuickTune-Pro

### Computerized Speed Control



With  
Digital Tuning  
Race Setup.

- QuickTune Pro Digital Setup  
- Gives precise parametric tuning of every critical operating parameter.
- TPC Throttle Priority Circuit™  
Guarantees that full bottom-end reserve driving power is always available.
- Replaceable power wires
- High Frequency Optimized 4500 Hz Linear Current Motordrive with efficient CoolSwitch II circuitry.  
- Makes your motor's commutator last 2 to 5 times longer while also extending run time by 15-25%
- High speed processor-native software
- Built-In 32 Amp "Quad" Schottky Regenerating Diode
- Highest Performance power MosFETs with attached maximum power under any load.



Team  
**TEKIN**<sup>®</sup>  
WORLD CHAMPION RAC-

TEKIN ELECTRONICS, INC. guarantees this speed control to be free from factory defects in materials and workmanship for a period of 120 days from date of purchase, when verified by sales receipt. This warranty does not cover: suitability for specific application, components worn by use, application of reverse or improper voltage (fuse provides protection in most cases), tampering, misuse, or shipping. Our warranty liability shall be limited to repairing unit to our original specifications. Because we have no control over the installation or use of this product, in no case shall we be liable for damages.

Additionally, these items void the warranty:

1. Using the same polarity connectors on the battery and motor wires from the Speed Control.
2. Allowing water or moisture into the speed control.
3. Incorrect wiring.
4. Use inconsistent with the instructions.

By the act of using this Speed Controller, the user accepts all resulting liability.

**TEKIN**<sup>®</sup>  
ELECTRONICS, INC

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# INTRODUCTION

Thank you for purchasing Tekin's innovative new series of advanced speed control. The G-10 continues the winning performance tradition of the 411-G2, G-9, and G-12c III, but adds new multiple-setup tuning capabilities. Simple two button operation allows quick and accurate adjustment of all critical operating parameters. This results in better operation over a wider variety of car and track use conditions. Our new double-shunted, surface-mounted GoldFET III-b power MosFET transistors offer the highest performance available, and CoolSwitch II-Pro circuitry with Copper-Clad mounting delivers extreme performance with reduced heat. This allows higher sustained peak power delivery throughout the whole run. The new rear-mounted transistors also lower the center-of-gravity, for better cornering. The slim case fits easily into any make chassis, and the wiring layout is improved. Other features include Tekin's Throttle Priority Circuitry (TPC) which guarantees full bottom-end power under the most severe loads, versatile QuickTune PRO setup for optimum performance at all times, reverse voltage protection for total reliability, built-in 32 amp high power Schottky diodes, reduced weight, native machine-code software for higher processing speeds, and 16 bit wide math computations for the most accurate, low distortion link between the driving trigger and motor output.

<u>Specifications:</u>	<u>TSC G-10</u>
ON Resistance	.0010 ohm max
Input Power	4 -10 Cells
BEC Volts/Amps	6.0V / 5.0A High Amp Servo rated
Motor Limit	None (12t on 8-10 cells)
Amp Limiter Current	10 to 90 Amps and Bypass (over 140+)
Dimensions	1.85 x 1.25 x .65 inch
Weight	1.25 oz.
Power Wires	(3) 12 Gauge Silicone
Plugs (user installed)	Airtronics/Sanwa, Futaba J, JR, KO Propo and Kyosho Pulsar

Specifications are subject to change without notice.

## STEP 1 - CONNECTOR SELECTION

This speed control features the Tekin Universal Radio Connector System. This allows you to use it with Tekin, Airtronics/Sanwa, Futaba J, JR, KO Propo, and other receivers.

The standard connector on this unit is the Tekin / Futaba J. If your receiver is a Tekin or a Futaba, then the standard plug will fit without modification.

**When using this speed control with Airtronics, Airtronics Z, JR, KO Propo, or other receivers, follow the steps below:**

**\*\*NOTE:** Kyosho Receivers use the "JR" plug housing\*\*

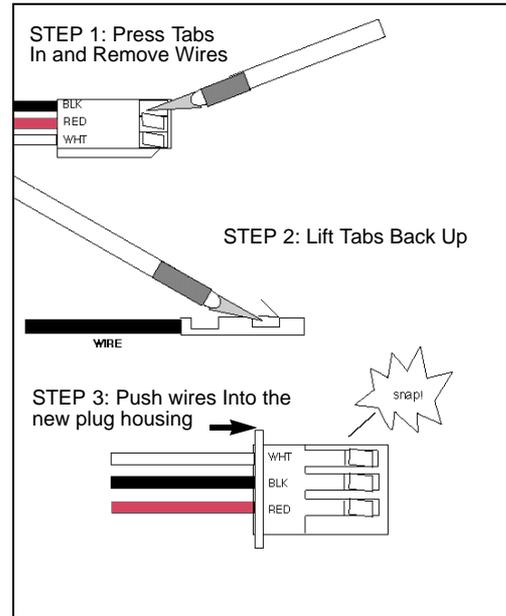
1) First, disconnect the battery from the speed control. Using a small hobby knife or jeweler's screwdriver, press in the three metal tabs only far enough

that each of the wires can be removed from the black plastic plug housing. (Figure 1, step 1)

2) After removing the wires from the receiver plug, use a hobby knife or jeweler's screwdriver to lift the metal tabs on each of the wires back up. (Figure 1, step 2.)

3) Select the plug housing that matches your radio system and insert the wires into the housing. Make sure that you put the wires in according to the lettering on the plastic housing. The red wire inserts into "RED", the black wire goes into "BLK", and the white wire inserts into "WHT" (figure 1, step 3). The wires will snap into place when inserted into the plug housing correctly.

## Figure 1 - CHANGING PLUG TYPES



### IMPORTANT:

As long as the instructions are followed correctly, and proper polarity is observed, the warranty will not be voided by changing the motor, battery, or radio plugs. **Wiring the plugs incorrectly may damage the speed control or radio receiver and void the warranty.**

## STEP 2 - MOUNTING

A) Mount the speed control using the double-sided tape provided or "Shoe Goo". It is best to cut the tape to fit the plastic area on the back of the speed control. Clean the chassis and speed control first with motor spray or solvent to provide maximum adhesion. The new generation MosFET transistors are mounted on the back of the unit in a spaced-apart manner which provides increased surface cooling area. All normal mounting locations are acceptable. There are no special air-flow requirements, but it is best to avoid closing off the side vent areas. Most installations will be with the speed control on the chassis, on the same side as the motor brushes. Be sure to keep the power wires away from the receiver and to allow access to the Setup Buttons.

B) Mount the on/off switch with servo tape or the screws supplied. **DO NOT USE SUPER GLUE.**

## FUSE REPAIR

This speed control uses an exclusive zero-loss solder-drop fuse link for higher efficiency, for improved performance, and the coolest operation. The patented circuit also delivers longer run time than any other Schottky diode circuit. This special fuse also eliminates damaged diodes due to an overload or accidental reverse voltage hookup. Instead, you need only replace the solder on the fuse link.

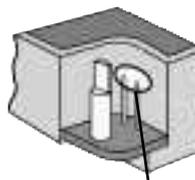
To repair the fuse, use a small-tipped soldering iron, and always wipe the tip off before starting. Touch the tip of the iron to the metal pins on the fuse, then apply a small amount of solder as close to the pins as possible. Hold the iron upright so the solder can flow down the iron onto the pins.

If you apply too much solder, hold the speed control upside down and touch the iron to the solder allowing it to melt and flow down onto the iron tip. Wipe the solder off the tip and start over.

This speed control has its own exclusive circuit with the Schottky diode built in for maximum performance. There is no need to use an external Schottky diode on the motor. If you do use a second diode on the motor, the speed control will not be damaged but such a second diode will slow the car down slightly.

If you follow these simple instructions, your speed control will have a long life offering great performance and trouble-free operation.

### SOLDER DROP FUSE



Apply Solder

## STEP 4 - MOTOR & BATTERY HOOK-UP

Please exercise extreme care when installing your speed control, as damage can easily occur. Check with your dealer if you think you might need help.

**NOTE:** The speed control supplies power to the receiver and servo. No additional power supply should be used for the receiver. Make sure the battery plug of the receiver is disconnected. Avoid turning on the radio when the batteries are charging.

A) Plug the wire harness from the speed control into the throttle channel of the receiver. The speed control supplies a regulated 5.8 Volts to the receiver and servo when running on 4 to 8 cells. The regulator puts out enough current for up to 4 micro servos or 1 high power servo.

B) Connect power wires as follows:

SPEED CONTROL	BATTERY	MOTOR
Black Wire	( - ) Negative	
Light Blue Wire		( - ) Negative
Red Wire	(+ ) Positive	
(Second Red Wire)	(+ ) Positive	(+ ) Positive

Table 1: Wiring connections. Also check the label on the speed control for wiring information.

## STEP 5 - QUICKTUNE RADIO CALIBRATION

Once you have completed the wiring and hooking up your speed control, the speed controller must be calibrated to your transmitter. Tekin's QuickTUNE electronic setup feature allows this to be done quickly, easily, and accurately. For optimum performance, first adjust the transmitter according to the chart below, then proceed with the following steps.

1) Turn on the transmitter, then the speed control, and leave the transmitter in the neutral position.

2) Press and hold **EITHER BUTTON** (but not both at once) for about 5 seconds until the left hand red light starts blinking rapidly. Then pull full throttle on the transmitter, and then push forward to full brake. Release the trigger. (You have about 5 seconds to do this). After the light stops blinking, the calibration is complete and you are ready to drive.

3) To adjust the maximum brakes, use the brake trim or EPA / ATL / ATV low adjustment on the transmitter. You may need to do this to reduce the braking somewhat. Whenever you re-set the speed control, be sure to put the transmitter brake trim or EPA / ATL / ATV back to maximum first.

**Note:** If you do not apply brakes during the calibration procedure, the brakes will be disabled.

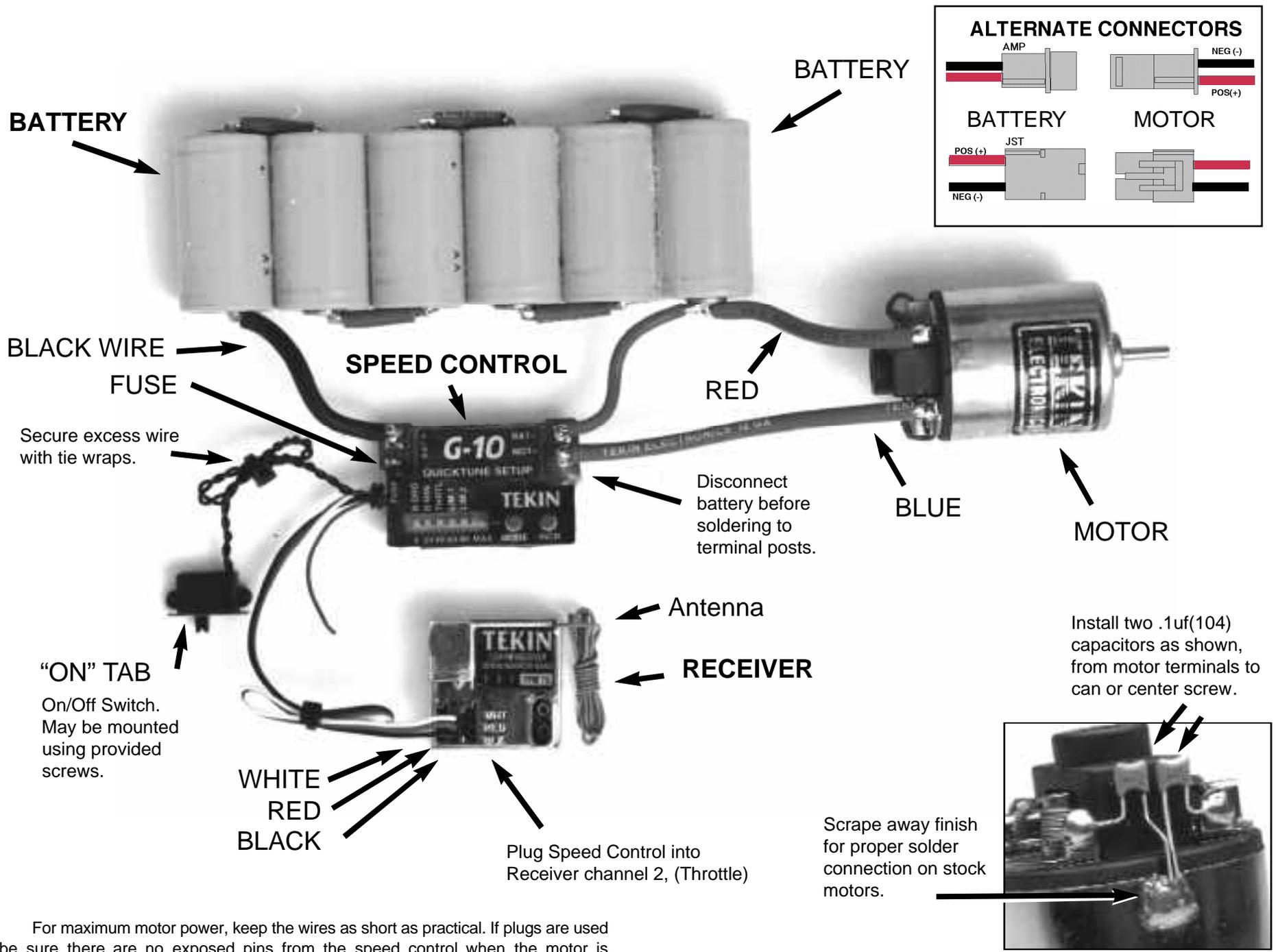
Table 2: Recommended transmitter adjustments.

TX TYPE	*THR EXPO	ATL	ATV HIGH	EPA LOW	THR TRIM	SUB TRI	REV SW	MECH ADJ	COAST BRAKE
<b>FUTABA</b>									
FP-T2PKA	--	--	5	6	-5	--	Right	Pos. 2	
FP-3PG	0	--	10	--	-5	--	NOR	Pos. 2	ATV Low
FP-T2P	--	--	--	--	-5	--	Rev.	1/2	Brake Trim
FP-T2PB	--	--	--	--	-5	--	Rev.	Left	None
FP-T2TP	--	5	5	6	Low 5	--	Rev.	1/2	None
FP-T2PBKA	--	--	10	10	Low 5	0	Rev.	Left	ATL
FP-T2NCS	--	--	--	--	Down	--	--	--	ATV Low
FP-T2NBR	--	--	--	--	Down	--	Rev.	Up	Pot
PCM 1024	-4	10	5	5	N	--	Rev.	1/3	None None
<b>AIRTRONICS / SANWA</b>									
3P-FM	--	--	140%	CCW	CW	8	NOR	--	Throttle Trim
XL-2P	--	--	Max.	Max.	Mid.	--	NOR	--	Throttle Trim
CS-2P	NOR	--	CW	CW	Mid.	--	NOR	--	
VT-2P	--	--	--	--	Low	--	Left	Down	
<b>JR PROPO</b>									
ALPINA-2	--	--	10	10	Mid.	--	NOR	--	Throttle Trim
PCM	--	--	--	--	CCW	--	NOR	1	None Throttle Trim
<b>KO PROPO</b>									
R756	0	--	H100	B100	Up	--	Left	--	
EX-1	Min.	--	Max.	--	Mld.	0	Left	--	
EX-1 FM	Min.	--	CW	--	B	--	Down	--	None
EX-II	--	--	Max.	--	Mid.	--	Up	--	Trim Tab,
EX-5	--	--	Max.	--	Mid	--	Right	--	Knob
EX-7	--	--	--	--	CCW	--	Down	Pos. B	

CCW = Counter Clockwise CW=Clockwise

\* Adjust Throttle Exponential control for best balance of low speed and high speed driving power.

# STEP 4 continued - WIRING DIAGRAM



For maximum motor power, keep the wires as short as practical. If plugs are used be sure there are no exposed pins from the speed control when the motor is unplugged.

## STEP 3 - SOLDERING

The wire terminal posts featured on this speed control (G-10 only) allow you to run wires of just the right length for any installation without worrying about them becoming too short. The posts are 10GA gold-plated copper for the lowest resistance. If you need to ever change a wire on the speed control, follow the steps below. You will need a very hot soldering iron (750°F to 850°F), and ordinary 60/40 electronic grade solder. **IMPORTANT:** Use extreme care and observe proper safety precautions when soldering. Always wear eye protection. Be sure that both wires are disconnected from the battery before soldering to the posts.

### REMOVING A WIRE FROM A POST:

- 1) Have the iron very hot and the speed control secured in place. Clean the tip of the iron and apply a small amount of solder. While the tip is still smoking from the flux in the solder, touch the tip of the iron to the top of the post.
- 2) As the solder on the post melts, pull on the wire you wish to remove. The wire will pull off easily.
- 3) If there is excess solder remaining on the post, you may remove it by heating the post until the solder just starts to melt, then quickly tapping the speed control firmly against the workbench to knock off the excess solder.

### ATTACHING A WIRE TO A POST:

Note: Disconnect wires from battery before soldering. Refer to markings on the speed control for proper wire locations.

- 1) Strip back the insulation of the wire by about 3/32 to 1/8" (2 to 3mm) and "pre-tin" the wire by heating the end and applying solder until it is thoroughly covered. You may shake off any excess while it is still hot. Be very careful to not splash yourself with hot solder.
- 2) If there is no solder on the post, touch the tip of the iron to the top of the post and apply a small amount of solder to the post. Wipe the tip clean and apply a small amount of fresh solder to it.
- 3) Secure the speed control in place on the workbench. Hold the wire so the tinned end is in contact with the flat side of the post. Now touch the iron tip to the wire pressing toward the post. Wait about 2 seconds for the solder to flow, then remove the iron while still holding the wire. You may let go after a second or two when the solder sets.

Note: It should only take a few seconds to solder a wire to a post. If you do not complete the solder joint in approximately 3 seconds, remove the iron, clean and tin the tip, and start over. The posts are attached to the circuit board with high-temperature silver solder for reliability, but excessive heat should be avoided.

- 4) Inspect the solder joints for shorts or solder bridges between wires, and repair when necessary.
- 5) These same techniques may be used to solder the wires to the batteries. You may need to scrape or sand the battery contact some before the solder will stick.

## STEP 6 - PROGRAM ADJUSTMENTS

### HAIRPIN TRIGGER:

If you wish to have a very short trigger range, then only squeeze the throttle trigger partially during the set-up procedure. Throttle response will not be quite as smooth, but you can pull full throttle very quickly.

Once Calibrated, the lights on the speed control will advance as the throttle or brake are applied. The "0" light is Neutral, and the "MAX" light is full throttle/brake. There may be some flickering in between lights as the throttle is advanced. This is normal, and is caused by modulation noise from the radio.

Initial set-up is now complete. You may proceed to step 7 if you do not wish to adjust the modes yet.

## MODE SET-UP

The G-10 offers unparalleled tuning options. Every performance influencing factor may be adjusted. Advanced exclusive software routines are used so you can obtain just the right action. Adjusting the modes on the speed control is very simple. There are just 2 steps.

1) First, press the MODE button to access the desired setup mode. The left light will start blinking to indicate that mode selection is under way. Continue pressing the mode button until the light advances to indicate the mode you wish to adjust. Do not wait longer than 5 seconds to select the mode, or the speed control will return to normal operation. Once the mode is selected, move on to step 2 within 5 seconds.

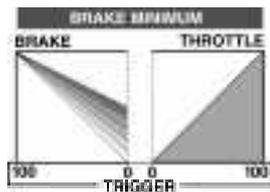
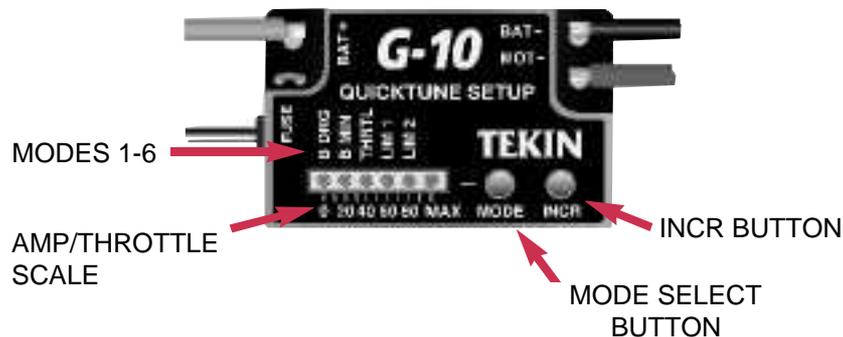
2) Second, press the "INCR" (increment) button to adjust the value. The first time the INCR button is pressed, the light(s) will indicate the existing setting. Each time the INCR button is pressed again, the value will advance toward MAX, then start over again at the low end of the scale. If two lights are on at once, it indicates a value mid-way between the LEDs. Most modes have 9 or 10 possible settings.

If you wish to set another mode, you may go back and press the MODE button again. After a 5 second pause, the values you selected will be saved in memory and the speed control will resume normal operation.

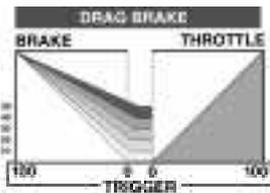
Mode	RANGE	Factory Default
DRAG BRAKE (B DRAG)	0-10	0
BRAKE MINIMUM (B MIN)	0-10	5
NEUTRAL WIDTH (NTRL)	1%-10%	5%
THROTTLE (THROT)	0-10	5
CURRENT LIMIT 1 (LIM 1)	10-90 AMPS & MAX	MAX
CURRENT LIMIT 2 (LIM 2)	10-90 AMPS & MAX	MAX

Table 3: Factory Default values for operating parameters.

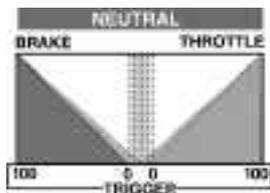
## STEP 6 - PROGRAM ADJUSTMENTS



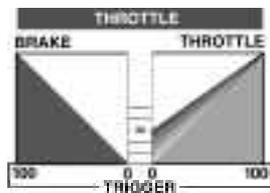
1. The BRAKE MINIMUM setting determines how strong the brakes begin initially. Higher values make the brakes come on strong with little trigger movement, and provide a generally more aggressive response. This can speed up trigger response by eliminating unused trigger motion, but very light braking will be lost. A value of zero provides very light, fine braking action.



2. The DRAG BRAKE control provides immediate braking action, even in the neutral or "coast" zone. This gently slows the car down when you let off the trigger. This can allow a better cornering approach. Higher values increase the drag braking. A value of 0 provides maximum coasting in neutral.



3. The NEUTRAL setting controls the deadband in between throttle and brake where the car just coasts. It adjusts from 1%-10%. Generally, narrower settings provide quicker response for tight racing applications. You may need to re-trim the throttle occasionally on the transmitter if an excessively narrow neutral point is used, as most radios fluctuate a bit. This will also depend on the transmitter battery level.



4. The THROTTLE curve controls how aggressively the throttle comes on at the bottom end. Higher values increase the bottom end response, and require less trigger travel to reach the same speed. A value of 0 is a linear response, with a very slow low speed crawl. You should select a value based on motor power and gearing that provides smooth fluid trigger motion when driving. Although shown as a straight line, the actual curve is slightly rounded. This feature provides smoother driving by allowing non-linear response matched to the motor power curve.

5. On a DC electric motor, torque is proportional to current flow. The current limiters LIM 1 and LIM 2 regulate how much current can flow to the motor to control torque and excessive wheelspin. They also provide longer motor life by reducing burned brushes. The G-10's exclusive fully digital current limiters provide precise, perfectly repeatable results every time.

LIMIT 1. This is the current limiter for the first 3 seconds. The 3 second timer begins the first time you pull full throttle after turning on the speed control. You may still drive the car and do trim adjustments on the starting line as long as you only use partial throttle. If you pull throttle, you may turn the speed control off and then back on to reset the timer. Lim 1 may be adjusted from 10 to 90 amps, plus bypass (MAX). In the MAX mode, the current limiter is totally disabled and the speed control can pass the full short-circuit battery current. Use LIM1 to set the amperage you need off the starting line. This will be a high value for high traction racing, and a low value for racing with capped tires, etc. The speed control also contains Tekin's exclusive Vari-Torque current limiter. This design provides a small change in the current limit amperage depending on how much throttle is applied. This means the driver has continuous control of the car's throttle – even when the current limiter has kicked in.

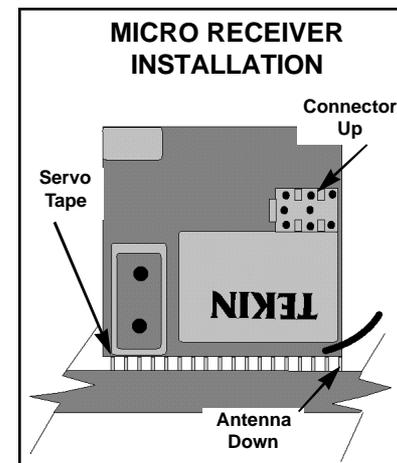
6. LIMIT 2. This current limiter takes over when the 3 second timer on LIM 1 expires. Set this limiter to a high value for normal driving, or to a low value to conserve battery power and motor life, or when driving on slippery tracks. NOTE: Setting the limiter to a value of 10 may not allow enough power for the motor to reach full RPM. In this case, increase the current limiter setting.

**Pit Tuning:** If you are in the pit area and do not have access to your transmitter, you may still make speed control adjustments by following this procedure: Hold down either the MODE or the INCR button (but not both) while turning the power switch on. The settings and controls will be active, but the motor will not run and the speed control will not respond to receiver signals. If the steering servo continues to run, you will need either to unplug the servo from the receiver, or remove the crystal from the receiver. Turn the speed control power off and back on to resume normal operation.

## STEP 7 - RADIO INSTALLATION TEST

If you have any sign of radio glitching (the throttle or steering does not always seem to respond to the transmitter correctly), perform this test. Turn the car on with fully charged batteries and hold the rear wheels so the motor is stalled. Apply PARTIAL throttle, and check the steering servo for any movement or jittering. If the servo remains still, the installation is fine. Otherwise you will need to move the receiver and/or the battery wires to a different location. Do not run the large battery wires or strap near the receiver.

A Tekin Micro Receiver is highly recommended. They are exclusively designed to operate down to 2.2 Volts for strong acceleration, and are available with chrome shielding for greater range.



## SELF-TEST & TROUBLESHOOTING

The G-10 has a built in SELF-TEST mode that checks all major systems on the speed control. Before using the self test mode, make sure the rear wheels are free to spin. To activate the self-test, turn the speed control on, then press and hold both the MODE and INCR buttons simultaneously for 3 seconds. After 3 seconds the motor will run. The motor should accelerate to full speed, then the brakes should come on. This should happen 3 times. Most other circuits and systems inside the speed control are also checked automatically. If everything tests okay, all the LED light's will flash simultaneously at the end of the cycle. A bad motor will cause the test to fail, check #2 below. If the motor is known to be good, and still only one or a few lights flash at the end of the test, there may be an internal problem – but this is unlikely.

Activating the self-test mode also resets all the *mode selection* and other *set-up* parameters to factory default values. (SEE CHART ON PAGE 8). The user's radio calibration settings will not be changed.

If the receiver does not supply a proper signal to the speed control, the speed control NEUTRAL LIGHT will blink. In this case, check the radio system.

### OTHER PROBLEMS:

#### 1) SERVO AND THROTTLE DEAD:

Dead batteries. Bad connections to speed control. Bad receiver plug connection. Customer-installed receiver plug is wired wrong. Switch needs replacing. Broken wires. Bad crystals, radio equipment or blown fuse.

#### 2) SERVO WORKS, THROTTLE DEAD:

Motor or connections to motor are bad. Motor brushes hanging up. Speed control not adjusted correctly. Receiver plug or connections are bad. TSC not plugged into throttle channel on receiver.

#### 3) THROTTLE WORKS, SERVO DEAD:

Bad Servo. Servo plug or wiring bad or incorrect.

#### 4) STUTTERING UNDER HEAVY ACCELERATION:

Receiver suffering magnetic field interference: Try mounting receiver on its side and/or spacing it 3/16 inch up from the chassis. If this does not work, try mounting it on its other side. Move power wires away from receiver. Also try wrapping the receiver in aluminum foil if it must be placed close to power wires, or use a Tekin chrome shielded receiver.

#### 5) MOTOR CUT OUT, RADIO INTERFERENCE or POOR RANGE:

No capacitors or insufficient capacitors on motor: Try 2 sets of capacitors. Incorrect control wiring to receiver or servo. Transmitter Batteries Low or radio out of tune. Three-wire cable from speed control to receiver may also be too long; 6 inches (152mm) is the maximum.

This speed control radiates very low noise and you should have no trouble with interference. If you do have interference, mount the speed control in the pan, and mount the receiver and antenna at the top of the shock tower. Also try wrapping the receiver in metal foil, or use Tekin's chrome shielded micro receiver.

Try to keep the receiver away from the batteries or power wires. Also try to space the receiver away from any metal or graphite. Using a double or more thick layer of servo tape helps. Do not run the antenna along a metal or graphite chassis; it

should mount straight up from where it exits the receiver. It is always a good idea to keep the receiver and antenna away from the motor, batteries, and power wires. Also see Step 7, page 10.

#### 6) AUTOCOUNT NOT WORKING:

Capacitors required on motor. (see step 4, -"Wiring Diagram") Mount transponder at front of car away from batteries and wires. Move autocount pickup to a place on the track where throttle is wide open (not accelerating). If these do not fix the problem, replace with new autocount system.

#### 7) MOTOR WILL NOT SHUT OFF OR RUNS SLOWLY:

Moisture in speed control: Unhook batteries and let the speed control dry.

#### 8) SPEED CONTROL SHUTS DOWN:

Motor or capacitor shorted, or motor stalled. Motor diode shorted. Gears or transmission are binding. Incorrect current limiter settings. Speed control overheating: Heatsinks and/or more airflow needed.

#### 9) BRAKES DO NOT WORK AT ALL:

Speed control improperly adjusted: Recalibrate (STEP 6). Also, be sure the brake adjustment on the transmitter is turned to maximum before calibrating.

## REPAIRS & SERVICE

This electronic Speed Control is the most advanced unit available and we believe also the most reliable. As long as it is not abused it will give years of frequent service. In the rare event you do have a problem, fill out the Service Return Card that is included with the unit and proceed as follows:

**WARRANTY:** Hobby dealers and distributors are not authorized to replace units thought to be defective. Repairs must be returned directly to the factory. A sales receipt must be enclosed. If the unit is working correctly, and you would just like the unit checked over, there may be a small inspection charge.

**NON WARRANTY:** Repairs may be sent directly to the factory. We are not responsible for independent service stations. No estimate is provided. Customer assumes responsibility for repair charges, which will never exceed 50% of the list price of the unit. Repairs are returned via UPS COD CASH or billed to a Credit Card. You must enclose a return card or note stating the problem, a legible return address and any special shipping instructions. We cannot return units to a P.O. Box unless payment is sent with the speed control. All addresses outside the U.S. require a credit card number with the unit. Hobby Dealers will not replace units thought to be defective. Such units must be returned directly to TEKIN ELECTRONICS, Inc. for repair. Estimated repair prices are as follows: Flat rate labor \$8.00; Replace wires \$4.00; Replace switch \$5.00; Replace plug \$5.00; Repair brakes \$6.00; COD \$4.50; 2-Day return shipping \$6.00; Next day return shipping \$15.00; Handling \$3.00. Most repairs are shipped back out within 3 working days. Average total is \$22.00-\$25.00. Repair prices on older models are slightly higher. Please allow sufficient shipping and delivery time (up to 3 weeks). Rates subject to change. Sorry, we do not repair non-TEKIN items.

Tekin, Inc.  
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