

# Tuning the Terra Crusher

Tamiya's Terra Crusher is one of the most advanced radio-controlled nitro monster trucks available. Equipped with a 2-speed forward and reverse transmission, the Terra Crusher can move from forward to reverse on the fly while shifting gears automatically (all of which is done utilizing a 2-channel radio system). To take full advantage of the Terra Crusher's potential, please read the following information carefully. It explains how the Terra Crusher's features operate, as well as how to make adjustments.

## The FRAT Transmission:

The FRAT (Forward Reverse Automatic Transmission) system houses both the 2-speed and forward/reverse operations. Unlike other nitro-powered vehicles with reverse, the Terra Crusher does not require a 3-channel radio system. Instead, the advanced FRAT system, along with a remarkable bell crank linkage assembly enables the Terra Crusher to operate with only 2-channels.

## How does the transmission work?

The FRAT transmission utilizes a standard centrifugal clutch system for the 2-speed portion of the transmission. When the 2-speed clutch reaches a predetermined RPM, centrifugal force engages the clutch, shifting the transmission into second gear. The 2-speed clutch is directly inline with the main shaft and the forward clutch assembly, giving the Terra Crusher 2-speeds in both forward and reverse.

The heart of the FRAT transmission is the forward clutch. The forward clutch does not operate like a typical clutch in the sense of centrifugal force pulling the shoes outward. Instead, a combination of rotational force and centrifugal force rotate the cam-mounted shoes into the engaged or disengaged position. Shifting is operated through the shift rod and fork. The fork slides a shift ring away or towards the forward clutch. Sliding the shift ring away from the forward clutch allows the forward clutch to engage. Sliding the shift ring towards the forward clutch pulls the clutch shoes inward, disengaging the forward clutch. This action controls whether the Terra Crusher goes forward or reverse.

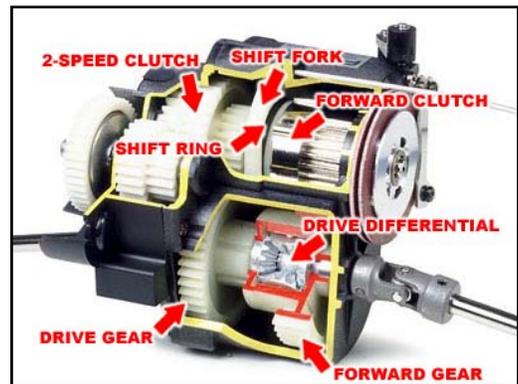


Figure 1

The next key element of the FRAT transmission is the drive differential. The drive differential has two separate gears that can rotate the assembly. First is the drive gear which is constantly engaged to the drive differential. Second is the forward gear and it is meshed to the forward clutch (which can be engaged or disengaged). When the forward clutch is engaged, both the drive gear and the forward gear rotate the drive differential resulting in forward drive. For reverse, the forward clutch disengages and the brakes engage. The brakes lock the forward clutch bell from moving so that only the drive gear provides input. This activates the drive differential to rotate the drive shaft backward making reverse possible. None of the internal gears have to re-mesh during any operation making on-the-fly direction changes instantaneous and virtually seamless. It also makes the FRAT transmission very difficult to damage.

## How do I adjust the shift point on the 2-speed?



Figure 2

To adjust the shift point, remove the small rubber grommet on top of the transmission (see figure 2). Line up the hole on the aluminum clutch bell with the 2-speed adjustment screw on the clutch shoes (see figure 3). This can be done by removing the spur gear cover and rotating the spur gear until the adjustment hole is visible. Once aligned, rotate the brake rotors to align the hole with the adjustment screw. Using a 1.5mm allen wrench rotate the screw clockwise to delay the shift point (shift later) and counter clockwise to advance the shift point (shift earlier). If the



Figure 3

shift point is close to the desired setting, avoid turning the adjustment screw more than 15 degrees at a time. Start with larger

adjustments if the transmission is not shifting at all and make smaller increments as the correct setting becomes closer. Run the Terra Crusher to check the shift point after each adjustment. *In order for the 2-speed transmission to operate correctly, the engine must be tuned properly and warmed up to operating temperature. Always shut down the engine before making adjustments.*

### **How do I tune the engine after break in?**

Tuning the Terra Crusher's .18 engine is made easy with a single needle carburetor. This needle controls the fuel air mixture entering the combustion chamber. It is very important to have the mixture set correctly in order for the transmission and the 2-speed clutch to function properly. If for some reason the mixture needle requires resetting, screw in the needle clockwise on the carburetor until it stops. **DO NOT USE FORCE** (forcing the needle further will cause damage to the carburetor). Then unscrew the needle 3 1/3rd turns out. This is a safe starting point.

#### **Terminology**

**Rich:** A rich fuel mixture has a large amount of fuel in proportion to air. Turning the mixture needle counterclockwise will richen the fuel mixture. This condition is safe for the engine, keeping the engine running cooler. A thick blue smoke exiting the exhaust as well as reduced throttle response can identify a rich mixture.

**Lean:** A lean fuel mixture has a small amount of fuel in proportion to air. Turning the mixture needle clockwise will lean the fuel mixture. A lean mixture will overheat the engine and will result in power loss. Little or no blue smoke and a high pitch operating tone can identify a mixture that is too lean. **Operating the engine under a lean condition will result in damage to the engine, voiding the warranty.**

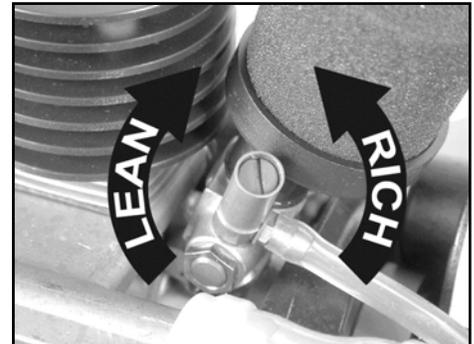


Figure 4

The maximum operating temperature for the Terra Crusher .18 engine is 225 degrees Fahrenheit (107 degrees Celsius). If the mixture is not compensated for driving through thick grass or other high resistance surfaces, the engine temperature can spike to dangerous levels. A thick blue exhaust smoke should always be exiting the muffler. Overheating the engine will result in trouble holding an idle due to loss of compression and power loss. Whenever possible, check the engine temperature regularly to avoid damage.

### **How does the bell crank assembly operate the Terra Crusher?**

The bell crank assembly makes use of a 2-channel radio possible by synchronizing the throttle, shift and brake linkages (see figure 5). When the trigger on the transmitter is pulled, the bell crank assembly simultaneously opens the carburetor, releases the brakes and pushes the shift linkage on the transmission inward allowing the forward clutch to engage (see figure 6). When the trigger is pushed (for reverse), the bell crank assembly simultaneously opens the carburetor, applies the brakes and pulls the shift linkage outward disengaging the forward clutch (see figure 7).

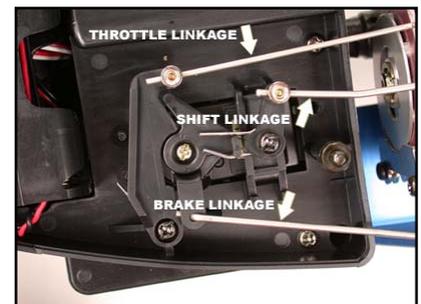


Figure 5

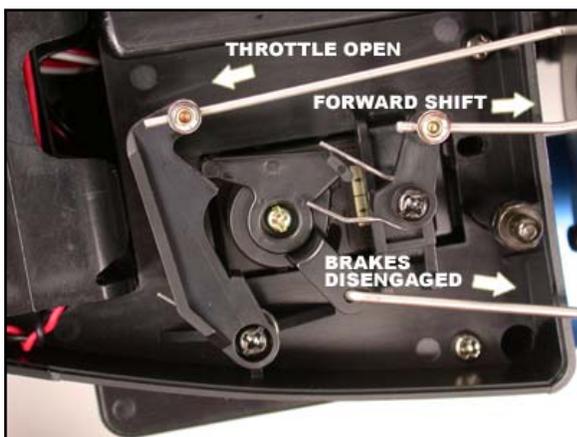


Figure 6

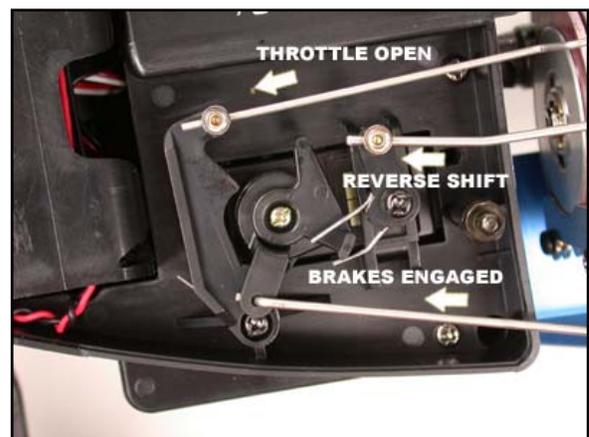


Figure 7

### **Should I make sure the bell crank assembly is set correctly?**



Figure 8

Yes. Although the Terra Crusher is set from the factory, checking the setting is recommended. Adjust the throttle trim knob on the transmitter to set the neutral position on the bell crank assembly (see figure 9). If the trim cannot center the bell crank to neutral, remove the bell crank assembly screw (see figure 9). Lift the bell crank assembly off the servo and turn the trim knob on the transmitter to neutral (see figure 8).

Reinstall the bell crank assembly onto the servo at neutral and tighten the screw. The throttle trim should now be able to set the bell crank assembly to neutral. Do not be concerned if the throttle trim knob is not in neutral once the bell crank assembly is set.

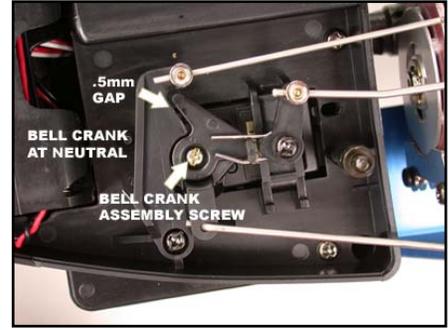


Figure 9

With the bell crank assembly at neutral, loosen the 1.5mm setscrew on the throttle arm (see figure 10). Push the throttle linkage towards the engine so the carburetor is in the idle position and retighten the setscrew.



Figure 11

Now loosen the 1.5mm setscrew on the shift arm (see figure 10). Push the shift linkage towards the transmission and retighten the setscrew. To adjust the brakes, slowly roll the Terra Crusher on a flat surface (without the engine running) and slowly apply brakes (push the trigger). The brakes should begin to engage with minimal trigger movement (approximately 3mm). If the trigger requires full travel to engage, the brakes need adjustment.

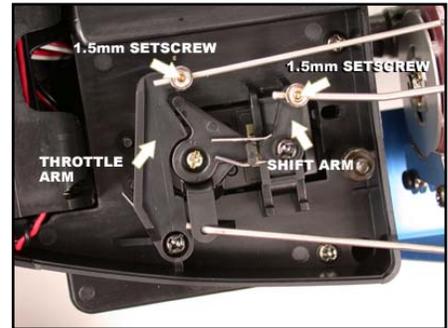


Figure 10

To adjust the brakes, remove the small e-clip on the brake lever and lift the brake lever off the shaft (see figure 11). Rotate and hold the hex shaped brake shaft clockwise and reinstall the brake lever and e-clip. Fine adjustments can be made by loosening the setscrew on the bottom of the brake lever and moving the brake linkage in or out (see figure 11). If the brakes still require excessive trigger movement to engage, replace the brake rotors and repeat the steps above. The brakes are a very important element of the reverse function. If the brakes do not engage properly, the Terra Crusher will not shift into reverse.

### **What type of fuel does the Terra Crusher use?**

It is recommended to use between 15 to 20 percent high-grade nitro car fuel in the Terra Crusher. Nitro fuel is a blend of nitromethane, methanol and castor oil. Nitromethane acts as a catalyst that helps boost the combustion process in model engines. Methanol is the stable portion of the fuel that controls the combustion and castor oil cools and lubricates the moving parts of the engine. Some fuel manufacturers use synthetic castor oil and others use natural castor oil. Although this is usually not printed on the label, either type is suitable with the Terra Crusher. The next thing to look for is the percentage of nitro in the fuel. The most common blends found in hobby stores are 10 percent, 15 percent and 20 percent nitro. The higher the percentage of nitro, the more power the fuel is capable of producing. However, this also results in higher engine temperatures if the engine is not tuned properly. Therefore, it is important to break in a new engine with **NO MORE THAN 15 PERCENT NITRO FUEL**. If you are unfamiliar with nitro engines and fuel, consult your local hobby dealer for a high grade, low nitro percentage fuel.

### **What is after-run oil and should I use it?**

After-run oil is a lubricant used to reduce gumming of internal engine parts as well as prevent various forms of corrosion. Nitro fuel attracts moisture and prolonged exposure to moisture in the engine will result in rust, leading to serious damage. After-run oil should be used after each day of use to prevent engine damage. Several types of lubricants are safe to use as after-run oil. Marvel Mystery oil, 3-in-1 oil, Mineral oil and even ATF fluid (automatic transmission fluid) can be used.

To apply after run oil, make sure the Terra Crusher is completely out of fuel. Then remove the glow plug and the air cleaner. Put four to five drops into the carburetor and another four to five drops in the glow plug hole. Cover the glow plug hole with a rag and crank the engine over with the starter unit for six seconds. The glow plug and air cleaner can now be reinstalled and the Terra Crusher is ready for another day of use.