HitMaster 2-Stage Clutch Hit Control System

Basic System Components & Initial Setup Guide

Our "patent pending" HitMaster 1st stage control valve (shown below with optional -4 AN fittings installed).

HitMaster 1st Stage Control Valve functions to allow instant return of a controlled/adjustable volume of clutch fluid as soon as the clutch pedal is released. It's adjustment knob controls the intensity of the clutch's 1st stage "hit". With the adjustment knob facing you, rotating the knob counter-clockwise makes the clutch's 1st stage hit harder. Rotating the knob clockwise makes the clutch's 1st stage hit softer. We usually secure the valve in a convienient "driver accessible" location, to a saddle type mounting tab using a couple conventional "zip ties".

2nd Stage Transition Valve functions to divert clutch fluid return flow to the 1st stage control valve when the clutch pedal is released. The 2nd stage transition valve also contains an internal one-way check valve, which functions to allow clutch fluid to bypass the 1st stage control valve when the system is active and the clutch pedal is depressed. The valve includes a removable mounting pad to make remote mounting easy. The transition valve can alternately be mounted directly to the clutch master cylinder using a steel "T" fitting.

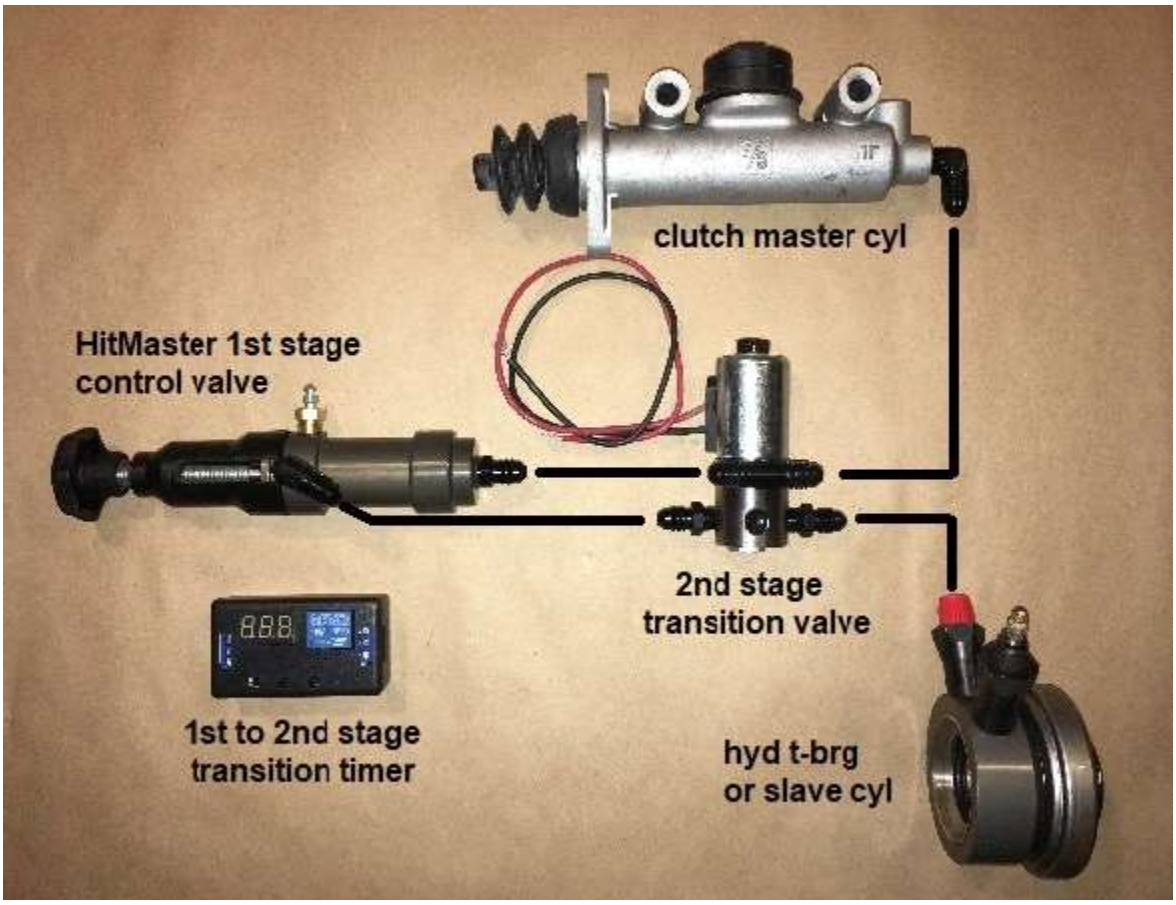
1st to 2nd Stage Transition Timer functions to control the timing of the system's transition from 1st stage to 2nd stage after launch. We typically mount the transition timer using a couple strips of Velcro's "extreme outdoor" product. Very secure flexible mount which protects the timer from excessive vibration.

Basic System Plumbing

Our HitMaster System components all come with female 1/8" npt fluid ports. From there, it's pretty easy to plumb the system with just about any style of fittings/hose you might choose. The typical hydraulic clutch release system operates on less than 500psi and although the system could be plumbed with hard line, we prefer using either nylon tubing or hose as the added flexibility can make it easier to bleed the system.

The least expensive way to plumb the system is to use DOT 1/4" nylon tubing and fittings that are typically used in semi truck air brake systems. This type of tubing/fittings can be found at most well stocked auto and truck supply shops. Even though these parts are typically rated for a 300psi working pressure, the tubing burst pressure is up around 1200psi. It's the same grade of nylon tubing that you will find inside many stainless braided hose assemblies. Just be sure to protect the exposed nylon tubing from direct heat sources like exhaust components with some sort of insulating sleeve.

If you choose to plumb the system with AN style fittings and hose, either -3 or -4 sizes are suitable. The smaller passages inside -3 fittings seem to work just as well as -4, but we prefer the larger passages of -4 just to make sure the system reacts as quick as possible. AN fittings are basically the same as JIC as far as sealing geometry, so it's pretty common to see mixing/matching of the two in an automotive application. JIC can be found at hydraulic supply shops. JIC fittings and hose ends are typically made of steel and are generally less expensive than the typical anodized aluminum AN counterpart. Below is a typical plumbing schematic of the HitMaster system...



Basic System Operation

When the system is at rest (casual driving), no voltage is applied to the 2nd stage transition valve. The 2nd stage transition valve is "normally open" when no power is applied, so fluid is allowed to flow freely *in both directions* between the clutch master cylinder and slave cylinder.

When the line lock button is depressed, the transition timer also recieves a 12v trigger signal. This causes the transition timer's relay section to close the contacts between it's "common" and "NO" terminals, which in-turn energizes the 2nd stage transition valve with 12v, causing the transition valve to "close". Because the transition valve is now closed, pushing the clutch pedal will result in fluid flowing from the master cylinder, thru the transition valve's internal check valve, then on to the slave cylinder.

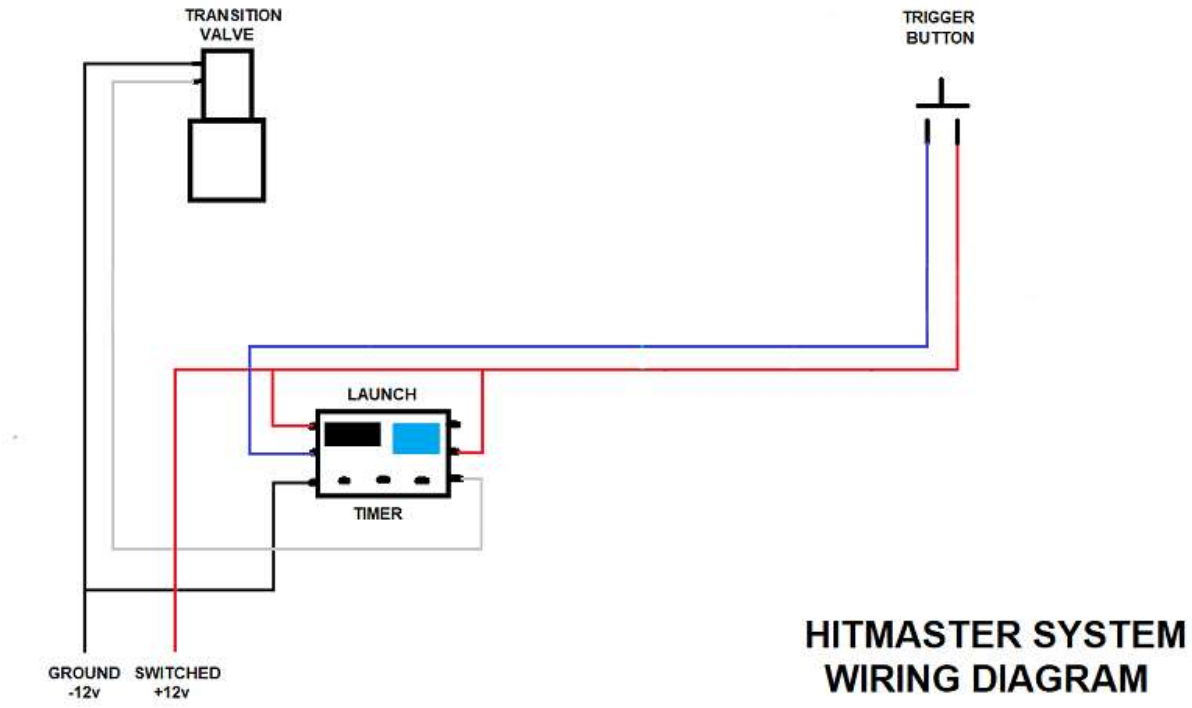
On release of the line lock button, the transition timer loses it's trigger signal, causing it to begin it's countdown. For the duration of the countdown, the transition timer keeps the transition valve

energized/closed. With the transition valve closed and it's internal check valve blocking return flow, releasing the clutch pedal results in fluid returning from the slave cylinder to enter the middle "inlet" section of the 1st stage control valve. This causes the 1st stage control valve's internal piston to move against it's internal bias spring, which pushes fluid from the 1st stage control valve's "outlet" port back to the master cylinder. When the 1st stage control valve's internal piston reaches the limit of it's travel, return fluid flow effectively stops, which in-turn effectively stops slave cylinder travel well short of it's fully released position. This temporarily limits the clutch's overall clamp pressure to a reduced 1st stage level of controlled clutch "hit".

When the transition timer times out, it's relay section "opens" the contact between it's "common" and "NO" terminals. With the transition valve no longer recieving power, it then reverts to it's "normally open" mode, which then allows the remaining fluid to bypass the 1st stage control valve and return to the master cylinder. This allows the clutch to almost instantly transition from it's 1st stage of "controlled hit" to it's 2nd stage of "full clutch clamp pressure".

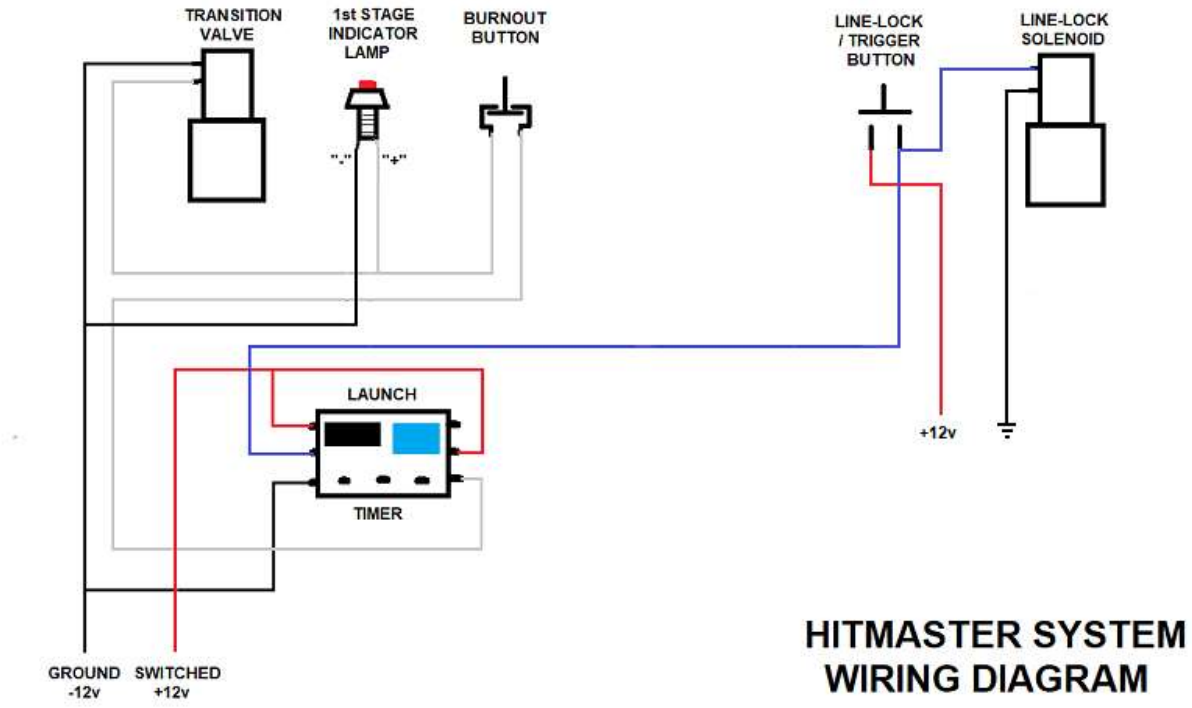
Wiring Diagrams and Options

BASIC SYSTEM WIRING- here's a schematic for a simple basic system, triggered by a manually released shifter mounted button. Configured this way, the system is active only during launch, and not on the shifts.



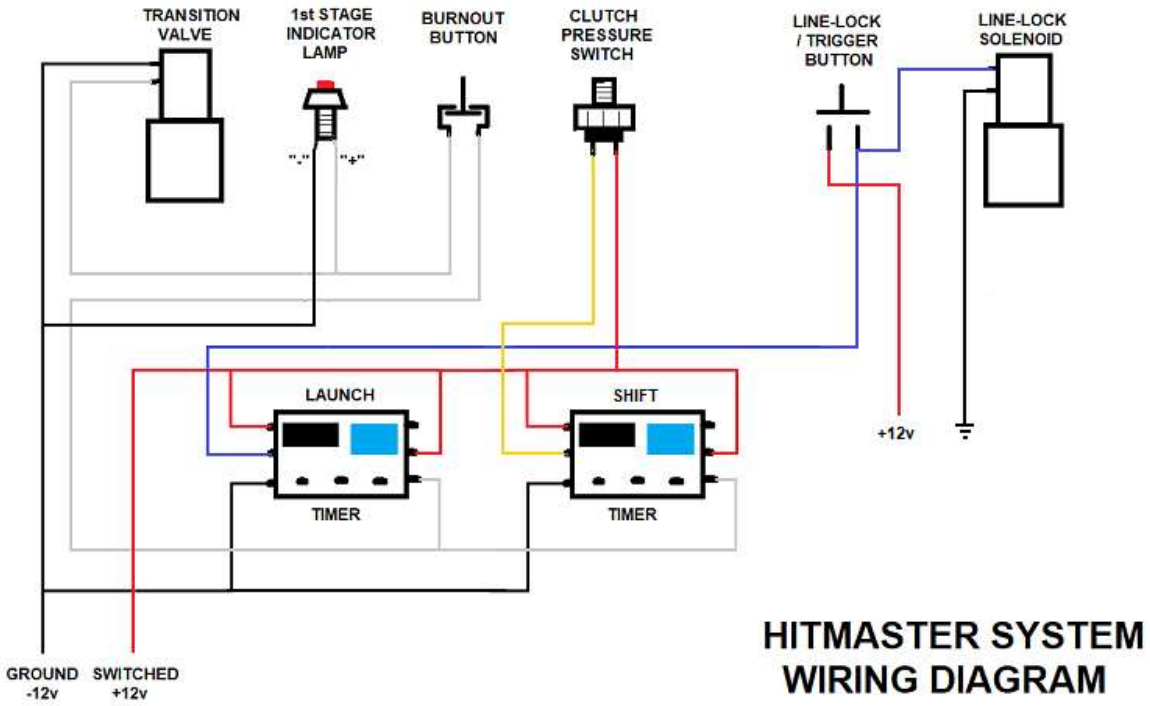
ADDING A BURNOUT BUTTON- some customers like to do 2nd or even 3rd gear burnouts, which require a more aggressive clutch setting to get the tires spinning. Holding a "momentary off" button down allows the clutch to go directly to the 2nd stage when starting the burnout. You could achieve the same result by installing a toggle switch and turning the system off, but then you would have to remember to turn the switch back on when staging the car. Since many of our customers have fragile drivetrains, forgetting to turn the system back on before launch could cost them a lot of money or at minimum an aborted pass. This schematic also shows how to trigger the system from an existing linelock system, just connect the blue wire in the schematic below to the solenoid side of your existing linelock button.

This schematic also shows the correct way to add a 1st stage indicator lite, it lites up any time 1st stage is electrically active.



ADDING AN OPTIONAL SEPARATE SHIFT TIMER- connections to a separate shift timer are basically the exact same as above with one exception- the shift timer needs to be triggered by a clutch pedal switch instead of the line-lock signal. Because the launch timer will have a longer setting than the shift timer, and the fact that both timers are basically wired in parallel, it's the launch timer that will determine the effective transition valve timing when the line-lock button is released. Because the line-lock button is not used during the shifts, the clutch switch triggered shift timer will then determine the effective transition valve timing for the shifts. A good place to start with a shift timer setting is 0.50 sec.

The clutch pressure switch should be plumbed in somewhere in the line between the clutch master cyl and the Hitmaster valve's center port. If you are looking to add a shift timer to an existing Hitmaster installation that uses -4 fittings, the easiest way is the use an in-line -4 gauge tap "T" with female 1/8"npt threads on the branch.



Transition Timer Wiring & Programming

12v + connects to a 12v "switched" power source
TRIGGER connects to line lock "+" or trigger button/switch
GROUND connects to 12v - or good chassis ground

NC (normally closed) not used in the basic configuration
COMMON connects to 12v "switched" power source
NO (normally open) connect to transition valve "red" wire

Connect transition valve "black" wire to 12v - or good chassis ground

Here's a guide to transition timer programming...

PROGRAM MODE...
Push P and hold 3 seconds to enter program mode
Push P momentarily until "P4" is displayed
Push 2 once to exit program mode

DELAY ADJUST...
Push 2 momentarily until the digit you want to change starts to flash
Push 3 momentarily until the desired change has been made
Push 2 again until the next digit you want to change starts to flash
Push 3 momentarily until the desired change has been made
When finished making changes, push 2 a few times until the display stops flashing

Start with an initial transition timer setting of about 0.70 sec. If the tires initially stick for a few feet but then start spinning before 15'-20' into the run, add 0.10sec to the timer setting with each run until the tires quit spinning or the 60's stop improving.

Bleeding Air From the System

Before connecting the hoses to the Hitmaster valve- first screw it's adjuster knob all the way out. Then while holding the valve vertical with it's adjuster knob pointing down and its tail fitting pointing up, pre-fill the end chamber of the valve with brake fluid (some find it easier to use a syringe for this). After the end chamber is full of fluid, you can then connect the hoses to the valve. After the hoses are connected, screw the valve's adjuster knob all the way in. Doing this automatically pre-bleeds the clutch master, making it easier to then bleed the system. Here's the bleed proceedure we have found most effective...

Step 1- with the Hitmaster valve's bleeder screw pointing up, bleed all air bubbles from below the screw
Step 2- adjust the HitMaster valve's knob all the way out
Step 3- bleed the slave cylinder or hydraulic throw-out bearing
Step 4- power up the system electrically by pressing the line-lock button
Step 5- push the clutch pedal to the floor once, then release it.
Step 6- release the line-lock button and allow the system's timer to time out.

The above proceedure relys on fluid flow to sweep the air bubbles back to the clutch master cylinder, so you don't have to open the system to let them out. It usually only takes one time for this proceedure to be effective, so after the system is completely bled, you can mount the HitMaster valve in the car in pretty much any position.

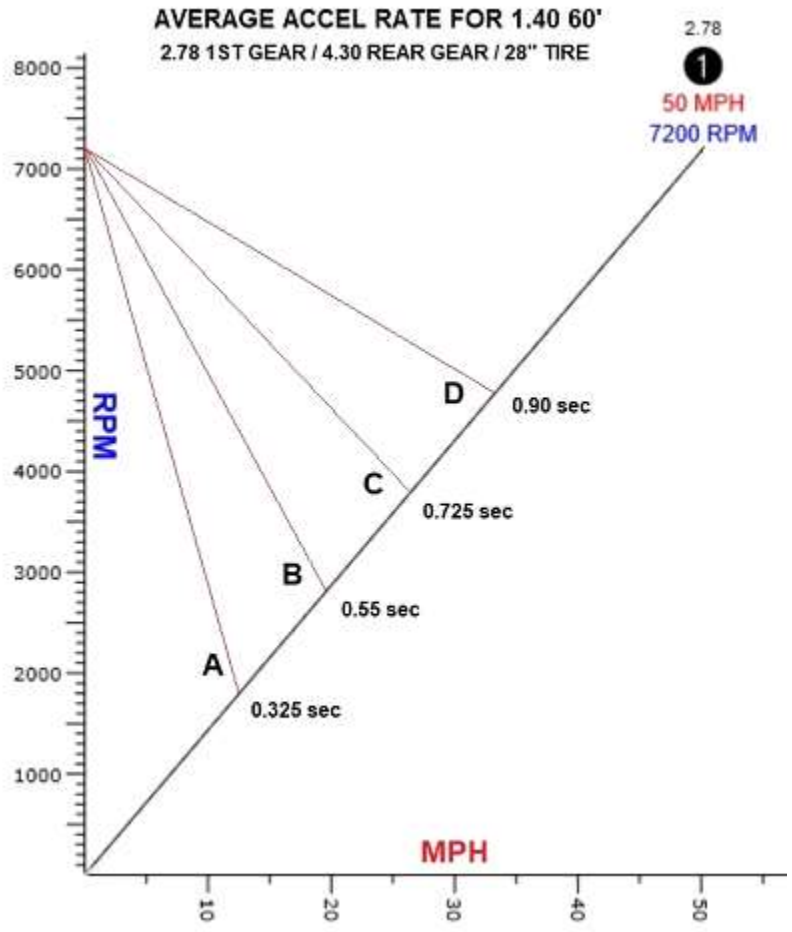
CAUTION- avoid pumping the clutch pedal multiple times with the system activated. This is because the 2nd stage transition valve contains an internal cleck valve which allows fluid to bypass the activated (closed) transition valve when you press the clutch pedal. If you pump the pedal multiple times without letting the system's timer time out, each additional stroke will "pump-up" the slave a little farther, eventually causing the slave or hyd t-bearing to over-travel, which in-turn could cause seal failure. When the timer is properly set, it automatically opens the valve before the next pedal stroke, allowing fluid to return which eliminates the pump-up effect.

Using The Hitmaster to "Stack The Deck"

Drag race style launches are unique in that you have the ability to store energy prior to the start, extra energy that can be released after the clocks start running, making more power available to accelerate the car than the engine is actually producing. This energy is basically inertia that gets stored in the engine's rotating assy as it gains rpm. The faster the rotating assy is spinning, the more energy it contains. The faster you can spin the engine prior to the start, the more energy that will be able to accelerate the car. The key to making all this work to your advantage is properly controlling the rate that the stored inertia energy gets fed into the chassis. You want to feed that energy into the chassis as quick as possible, but feed it in too quick and the results are either a bog, tire spin, or broken parts.

To get the most out of a drag race launch at the track, the general idea is to keep the engine operating in that rpm band between it's torque peak and it's HP peak. Figure a properly dialed in Hitmaster 1st stage hit is going to pull the engine down about 2000rpm. If the engine's torque peak is around 5200, launch rpm should be at least 7200 so that the engine gets pulled down to the rpm where it's pulling it's hardest. This approach makes best use of your ability to store energy prior to the start, also keeps your engine rpm up where it's making the most tq/hp.

The inclined line on the graph below represents the average overall acceleration rate of a 1.40 60'. We will use this graph to illustrate how our Hitmaster valve's 1st stage adjustment affects the rate that the clutch pulls an engine down...



In the graph above, lines A,B,C, and D represent different rates that the clutch is pulling down a 600ft/lb

engine after a WOT launch.

Line "A"- The clutch is pulling engine rpm down way too fast, didn't give the car enough time to gain speed before the clutch locked up. Even if the engine still made 600ftlbs at 1800rpm, that's only 205hp thru the low point of the bog. Obviously that 60' is going to suck.

Line "B"- the slower pulldown rate raised the rpm/mph sync point to about 2800 at 20mph, where the engine is obviously going to make a lot more power. Better, but that's still only 320hp thru the low point of the bog.

Line "C"- Much better pulldown rate, now rpm stays above 3700. The engine is now up to about 420hp thru the low point of the bog.

Line "D"- That extra slip time allows the engine to stay closer to it's rpm sweet spot for HP production. The engine is now up to about 550hp thru the low point of the bog.

The ability to raise launch rpm without over-powering the chassis with inertia is a big help for stick shift turbo cars. An instant soft hit from high rpm makes it much easier build/hold boost for launch.

HitMaster 1st Stage Control Valve Adjustment

The HitMaster 1st stage control valve has one simple dial type adjustment for controlling the intensity of the initial hit-

Rotate HitMaster dial clockwise = slower engine pulldown rate like line "D" in the graph above
Rotate HitMaster dial counter-clockwise = quicker engine pulldown rate like line "A" in the graph above

For best ET, you generally want to stage at least 2000rpm above your engine's torque peak. From there, adjust the HitMaster system for the crispest clutch hit you can get. We define a crisp hit as one where the clutch hits as deep within the sweet spot zone as possible, so deep it's just short of spinning the tires. Basically that means keep adding counter-clockwise turns to the HitMaster valve adjustment with each run, until either the tires start spinning or the 60's stop improving, then return to the previous setting.

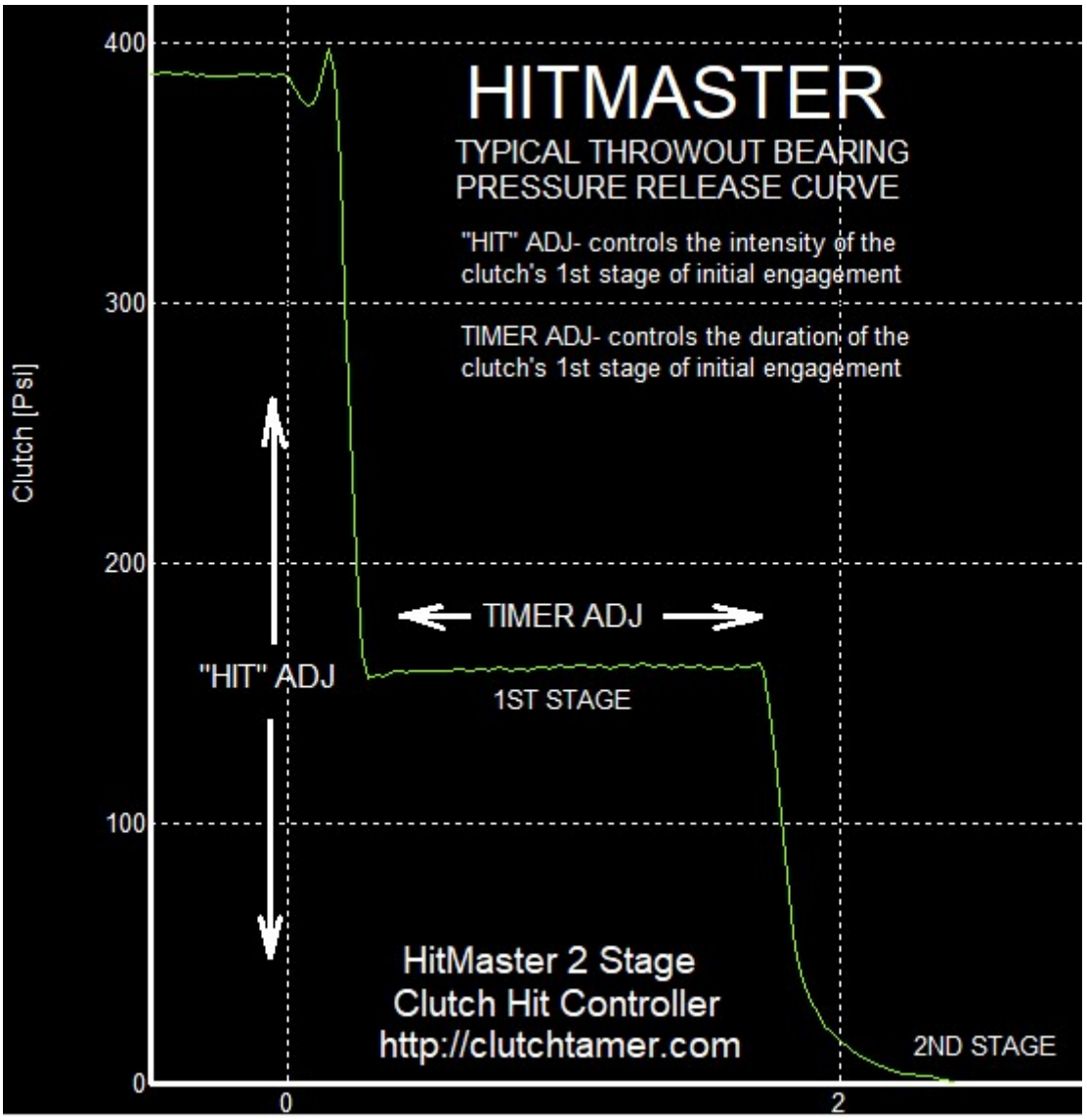
On the other hand if the tires spin instantly on the hit, keep adding clockwise turns to the HitMaster valve adjustment with each run, until either the tires stop spinning or the 60's stop improving.

It's not uncommon for our street/strip customers to find up to a 0.8sec or more of improvement in 1/4mi ET, along with much improved consistency. If you would like to get a ballpark idea of how much ET you may be leaving on the table, use the old formula "1320 divided by 1/4mi MPH = 1/4mi ET Potential"

If you launch your car on a variety of surfaces, you will likely find that different surfaces can require a different 1st stage control valve setting. When you find a good setting for a particular surface/condition, we strongly suggest you record those conditions/settings for future referance. The least expensive way to referance a particular setting is to use a caliper and measure/record the length of exposed threads between the 1st stage control valve's knob and nylon guide housing.

Another method to referance a particular setting is to install a digital pressure guage to measure psi at the slave/throwout bearing. Basically idle the car in neutral, and record the psi number at the "hit" during a simulated launch. We define a simulated launch as simultaneous release of both the clutch pedal and line lock button, with the engine idling and the transmission in neutral. The object is to cycle the components while the clutch is rotating, an idling engine makes the results more consistent by minimizing any added effects due to centrifugal forces.

On our Shop Mule test car, we added a pressure sensor to the end of our hydraulic throwout bearing's bleed hose. That pressure sensor's output is displayed to our driver by a Racepak Intelli-guage, allowing him to make quick percise on the spot changes without consulting the data.



If you have a data recorder, we would be happy to review your data and offer suggestions for further improvement. You can e-mail your data and vehicle info to grant@clutchtamer.com