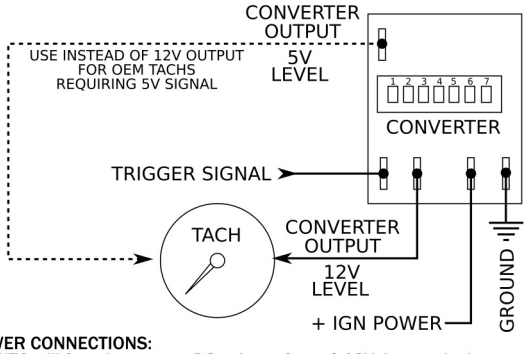
UNIVERSAL TACHOMETER ADAPTOR

JUST RACE PARTS

INSTALLATION INSTRUCTIONS

WIRING



POWER CONNECTIONS:
The UTC will function on any DC voltage from 4-18V, but works best at 5.8-16V. Ground can be connected to the chassis or to any convenient ground wire (3-wire COP systems usually have a handy ground lead at each coil). Power should be connected to a "switched" source that is off with the ignition, so the UTC does not draw current when out of use. The unit is internally fused and draws less than 50mA of current when active (micro-amps in standby), so virtually any circuit on the vehicle can be used for power.

COIL-ON-PLUG [COP] SYSTEMS:
Most COP ignitions have 3 wires for each coil, +12V, ground and trigger. The adaptor can be placed on or near any coil and the power, ground and signal inputs spliced into the corresponding coil leads. Only the output signal wire to the tach will need to be routed separately. Some COP systems use only 2 wires, with the ECU grounding each coil directly. These COPs will have power available like a 3-wire COP, but will lack a ground wire. Ground can be obtained from any handy spot on the block or chassis. IMPORTANT: The UTC trigger does not attach to coil+ like some adaptors which sense current and not voltage. On COPs of any type, the correct trigger wire for the UTC will almost always be a different color on each coil. Power and ground wires will be the same color on all coils.

INDIVIDUAL COIL SYSTEMS:
Motorcycles often have a coil for each cylinder like COP, but not mounted atop the plug. These can be wired just like a distributor with external coil (see below), but should be configured like COP. Note also that many cycle ignitions are CDI types with the signal on coil-positive and not coil-negative.

DISTRIBUTOR SYSTEMS with EXTERNAL COILS:
For normal inductive systems (non-CDI), the UTC can be placed on or near the coil, with the trigger signal connected to coil-negative. Power can be taken from the positive coil wire, and ground connected to any convenient engine or chassis bolt. Only the output signal wire to the tach will need to be routed separately. For CDI, including most "ignition boxes" like the MSD 6 series, the hookup will be reversed. Signal will be on coil+ and ignition power must be obtained elsewhere, since coil- is grounded. Most "boxes" have a 12V tachometer output that can feed the UTC instead of tapping the coil, but this is untrue of most motorcycle and marine CDI's.

SPARK MODULES and DISTRIBUTOR SYSTEMS with INTERNAL COILS:
You'll need to identify the module's tachometer output and connect the UTC's trigger input to it. The UTC can be mounted on or near the distributor or module, with power taken from module's supply wire. Ground can be connected to any convenient engine or chassis bolt. Only the output signal wire to the tach will need to be routed separately.

ALTERNATOR and LIGHTING-COIL PHASE WIRES:
The trigger can be wired to one phase of any alternator or lighting coil, provided the phase wires are accessible. On motorcycles and outboards, since there is no "belt ratio" to worry about, the alternator is often a better choice than a coil since the stator signal is very clean. On diesels, there is often a "W" output which is directly connected to one of the 3 alternator phases. If there is no dedicated output but the voltage rectifier is external to the alternator (common on cycles and outboards), any of the 2 or 3 wires connecting the coils to the rectifier can be tapped. To configure correctly, you simply need to know the number of pulses per revolution from the phase. This is easy to calculate if you have a picture of your stator. Count the pole windings, divide by 2, then divide by the number of phase wires. For example, a Harley stator with 18 windings and 3 phase wires will output 18 / 2 = 9, 9 / 3 = 3 pulses per revolution.

COIL PACKS (DIS):
The UTC can accept signals from a coil-pack trigger wire just like a COP coil, but since more than one coil is being triggered, the ratio will be different. Dual packs can generally be treated as dual-fire COP, but if you're unsure of the pulses per rev, you may need to simply try ratios. The UTC cannot be harmed by selecting a wrong ratio, so you can experiment freely until you get the correct reading.

ECU TACH OUTPUTS and OTHER LOW-VOLTAGE SIGNALS:
For purposes of the UTC, any signal below 16V peak is considered "low-voltage" and requires switch 7 to be on. In this configuration, the UTC can detect signals as low as 4.1V peak. This mode will be used for almost all ECU and "ignition box" signals, as well as cam and crank sensors, injector signals, external inductive or Hall effect sensors, etc. Note that many add-on sensors and some ECU outputs require a "pullup resistor" to function. If needed, 10 Kohm is usually a good generic value and it should be connected between the sensor or ECU supply and the data output.

PLUG WIRE WRAP:
The magnetos on many outboard, mower, and similar small engines are so noisy electrically that getting a stable signal is impossible, even with switch 6 on and external filtering. However, there is one technique that will defeat any amount of coil ring. Simply wrap 2~6 turns of insulated hookup wire (18~24 AWG) around one of the spark plug leads, then connect the other end to the UTC trigger. Thanks to the UTC's internal Schmitt trigger, this makes a DIY "inductive pickup" that can be adjusted merely by changing the number of turns. Switch 7 must be on.

MOUNTING

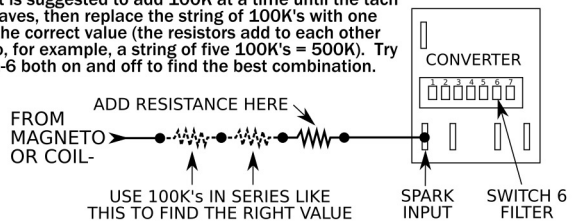
The UTC can be mounted anywhere with double-stick tape or adhesive. It can operate at temperatures up to 250 degF and all circuitry except the configuration switches are sealed against moisture. IMPORTANT: THE PROTECTIVE TAPE ON THE CONFIGURATION SWITCHES CANNOT BE RE-USED. IT IS STRONGLY RECOMMENDED THAT YOU RE-SEAL THE SWITCHES WITH RTV SILICONE ONCE YOUR INSTALLATION IS WORKING PROPERLY.

LOW-VOLTAGE TRIGGER [DIP switch-7]

The UTC has a special switch that enables it to function with trigger voltages as low as +4.1V. This is intended to allow the UTC to work with ECU outputs, sensors, and other signals that do not exceed 15V. LEAVE SWITCH-7 "OFF" IF YOU ARE TRIGGERING FROM COIL- OR ANY OTHER SOURCE THAT MIGHT EXCEED 15V. SWITCH-7 DISABLES MOST OF THE OVERVOLTAGE PROTECTION IN THE UTC. HIGH VOLTAGE OPERATION WITH SWITCH-7 "ON" CAN DESTROY IT.

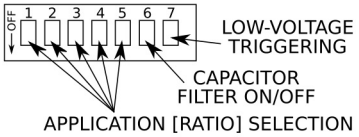
FILTERING

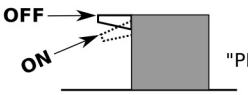
If your trigger source is relatively noise-free, such as an OEM tach output or 3-wire COP trigger from an ECU, then you shouldn't need filtering. Leave DIP switch-6 in the "off" position. "Noisy" systems like magnetos and points-distributors often produce severe "ringing" from the coil negative. This can cause erratic tach behavior, such as needle-flutter or readings that change above/below a certain RPM. The UTC has a built-in capacitor filter to stabilize noisy signals. Turning switch-6 "on" enables the filter. If the built-in value (R=100K, C=0.1uF) is not sufficient, an external resistor can be added to the spark input to increase the filtering. Added resistance of 100~500 Kohm will generally stabilize the input. If needed, it is suggested to add 100K at a time until the tach needle behaves, then replace the string of 100K's with one resistor of the correct value (the resistors add to each other in series, so, for example, a string of five 100K's = 500K). Try with Switch-6 both on and off to find the best combination.



CONFIGURATION

The UTC's switches come sealed with a protective cover that must be peeled and discarded before setting up. The switch bank is marked 1-7. On top-slide type switches, an arrow indicates the ON/OFF positions. On piano type switches, the "up" position is OFF and the down position is ON. The factory default position for all the switches is always OFF.





"PIANO" TYPE SWITCHES (SIDE VIEW)

The UTC works by multiplying or dividing the number of input pulses received, sending a "corrected" train of pulses to your tach. Switches 1-5 determine the output ratio of the unit. On the application card, the ratio is represented as pulses-in to pulses-out. So, for instance, a ratio of 3:1 will reduce 3000 pulses to 1000 pulses, while a ratio of 1:3 will increase 1000 pulses to 3000. In most instances, you will find the correct settings simply by looking up your application. If the results are incorrect, you can simply change the ratio. For instance, if you thought your system was single-fire but it turned out to be dual, the tach would read double. Simply find the next-lower divide-by-2 ratio to correct it. The UTC can never be harmed by incorrect ratios, so you can experiment freely if needed.

Here are some general rules for determining how many pulses per revolution your system will output:

Four-stroke engines fire each plug once every other revolution, so all 4-6-8 tachometers expect to see HALF the number of cylinders on each cycle. I.e., a 4-cylinder tach expects to see only two pulses for each revolution. This is called "distributor output" because it is what you would see on the negative coil wire of any distributor engine, regardless of the number of cylinders.

Tach outputs from OEM spark modules are almost always set up to mimic distibutor output for that particular engine. However, it is important to know the type of output. Late model DIS and ECU outputs are usually true "digital" outputs producing a 12V or 5V square wave, so they are usually suitable for operation with switch-7 on. In contrast, most older systems like GM HEI and Ford Duraspark actually connect the tach output to coil-negative. These outputs are high voltage and should NEVER be connected with switch-7 in the on position.

The signal from any COP coil is identical to the signal from a 1-cylinder engine, so no compensation for the number of engine cylinders is ever needed. Just set the adaptor for COP and determine single- or dual-fire. The trigger lead on a 3-wire COP system is generally low-voltage, usually 12V. Switch-7 needs to be on for these systems. On 2-wire COP systems, the trigger lead is actually coil-negative, so virtually all of them require switch-7 to be OFF. This also applies to many coil packs and DIS units. If in doubt, leave switch-7 off until you're certain the UTC won't trigger with it off.

Two-stroke cylinders fire once per revolution just like a COP dual-fire. If the engine isn't COP, treat it as double the actual number of cylinders.

Most diesel engine and external pickups trigger once per rev, regardless of the number of cylinders. Treat them as a COP dual-fire.

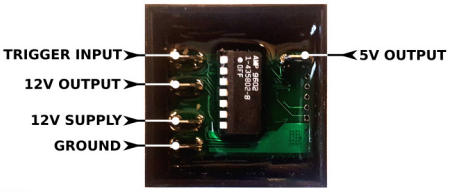
Most alternator phases produce 2~5 pulses per revolution. The voltage is actually AC and is generally +/- 40V or more, so switch 7 should always be OFF when connecting to them.

Many magneto systems produce spark on both the positive and negative phases of the windings, so they may produce double the expected outputs. In addition, some magneto "kill" outputs have proven so noisy that the UTC won't read them correctly, even with the filter on and maximum resistance. If there is no alternate trigger source available (such as a lighting coil phase), a good trigger can always be obtained by wrapping several turns of the trigger wire around one spark plug lead (essentially making a DIY inductive clamp). The number of turns needed for a particular engine will vary, but more turns will always increase the signal voltage, fewer turns will reduce it.

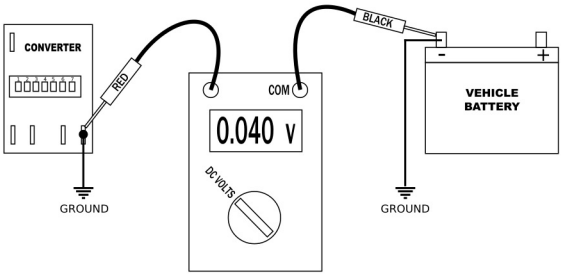
TROUBLESHOOTING

WIRING

The first step in any troubleshooting is to make sure your wiring is correct. The label on the UTC is oriented as if you are looking "through" the unit. Mirror-imaged connections will not usually harm the UTC, but it won't work.

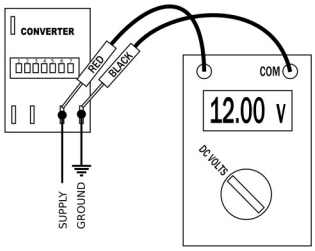


GROUNDING:
Like any digital circuitry, the UTC depends on a solid ground connection. Checking the integrity of your ground wire is easy using a voltmeter (VOM). Set your meter for the lowest voltage scale so you can read millivolts (mV) and test as shown below, with the UTC powered and the engine running. You should read 40 mV (0.04V) or less. If the reading is higher, there is a problem with either your UTC ground or the engine ground in general. You can determine which by using the same test to measure between battery-minus and the engine block. If both readings are high then check the vehicle's ground cabling, if only the UTC ground reads high then the problem is in your hookup.



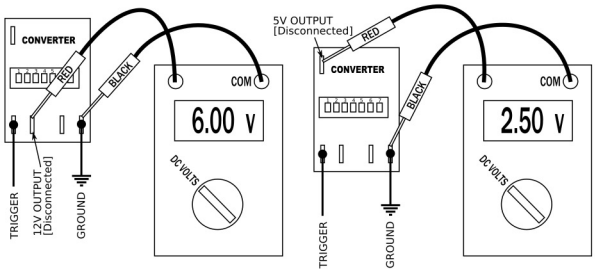
VOLTAGE DROP TEST FOR GROUND INTEGRITY

POWER:
Of course the UTC needs solid 12V power (or 6V, in a 6V system). It's best to check the supply voltage at the UTC terminals, not from battery or chassis ground. You should read near battery voltage between the UTC power/ground terminals with the UTC powered.



SUPPLY VOLTAGE TEST

TRIGGERING



TRIGGERING TEST

Because the UTC produces a "50% duty" output, a VOM can easily tell you whether the unit is "seeing" trigger pulses. With both tach outputs open (disconnected) and the engine running, you should see about 50% of battery voltage on the 12V output terminal and about 2.5V on the 5V output terminal. If the 12V terminal reads 12V and the 5V terminal reads 0V, the UTC is not seeing your trigger pulses.

NO TRIGGER

If the UTC isn't seeing pulses and your trigger is a high-voltage source such as coil-negative, a 2-wire COP trigger, an HEI tach output, or an alternator phase, then chances are there is a problem with your wiring. Often this is simply from connection to the wrong wire, such as coil+ instead of coil- on an inductive system or coil- instead of coil+ on a CDI. With HEI, 2-wire COP outputs, and most DIS packs, there can also be an issue with the internal transistor not driving a ground solid-enough to trip the UTC. Usually this will show up as a tach that "drops out" at high RPM. The UTC has a 2-diode drop that prevents this problem in a healthy system, but you may need to add a diode on the UTC input if your transistor isn't healthy.

If your source is a 3-wire COP or ECU output, you most likely need to turn DIP-7 on. The triggers for 3-wire COPs don't generally use or need high voltage, they are usually 12V outputs from the ECU that drive transistors inside each coil. Thus, it's a "low voltage" signal even though it's driving a high voltage coil.

Turning DIP-6 on unnecessarily can also cause loss of signal, either completely or at high RPM. The filter is there primarily for points and magneto applications that experience extreme noise. Very few electronic ignitions need it.

If your source is a 3-wire sensor such as a Cummins OEM crank sensor, chances are it won't function without a pullup resistor. ECU's using this type of sensor almost always have a pullup built-in, but the UTC doesn't have one. So, detached from the ECU, the sensor will appear to have zero output. To make it work, simply add a 3~10 Kohm pullup resistor to the sensor. Standard 1/4-watt resistors from any electronics store will work fine. Connect one end of the resistor to the sensor power supply (NOT the UTC supply), the other end to the sensor data wire.

INCONSISTENT TRIGGER

If your source is a coil and the UTC reads properly at some RPM's but wobbles or drops out above or below a certain point, chances are the problem is caused by "ring" in the coil signal. Adding a filtering resistor will generally stabilize it (see FILTERING).

Some signals are also simply not usable for the UTC, either because they are too fast, too asymmetric, or don't have sufficient voltage. Crankshaft sensors having more than 24 teeth are generally not usable. Cam sensors with large asymmetry (uneven teeth) are usable but will often produce severe wobble in the tach needle. These conditions can't be remedied, you need to find a different source. Two-wire inductive sensors produce higher voltage as the engine speed rises, and some produce too little voltage at idle to trigger the UTC. This can be fixed, but only by adding a transistor "front end" to the UTC to amplify the signal.

DRIVING THE TACH

If you're sure the UTC is triggering properly but the tach isn't responding, there are several possible issues. The UTC will drive virtually any modern aftermarket tach, because virtually all modern tachs will trigger at 12V. If you're using one, then chances are something is incorrectly wired. However, many older tachs, especially in-dash OEM types, need special triggering.

CURRENT-MODE TYPES:
The UTC cannot drive any type of current-mode tach. The archetype is the Smiths RVI tach used in MG's and Triumphs till about 1970. In cars, these can generally be identified by the hookup, they connect to coil+ instead of coil- and have only 2 terminals, 12V and signal. Some modern snowmobiles also use a variant, drive it off one pole of the lighting coil. These will generally connect straight to a stator wire with the other lead connected to ground. Both types sense current instead of voltage, they are all analog and all notoriously inaccurate. *The UTC cannot drive either kind.*

LOGIC-LEVEL TYPES:
Some OEM tachs, like certain Porsches from the 90's and 00's, require a 5V signal and will refuse to trigger on any higher voltage. If everything else seems right but your OEM tach won't trigger from the 12V UTC output, try using the 5V output.

HIGH-VOLTAGE and BACK-EMF TYPES:
Many tachs from the '70's, '80's and early '90's were "back-EMF" types which expected to see a high-voltage "spike" from the spark-coil. These tachs won't trigger at a 12V level (most require 24V or higher). There are also some German tachs, such as the VW Vanagon, that are triggered by the negative-going phase of the coil signal. The UTC can drive both kinds, but only with the help of a voltage booster on the output. If your tach reads when connected to the spark coil but doesn't read when connected to the UTC, run the test in CURRENT-MODE TYPES above. If the 12V output reads normal (~6V) but the tach isn't triggering, chances are you have a high-voltage or negative-trigger tachometer. Contact your UTC distributor about a model BTAC2 coil simulator to add to your UTC.

INTERNAL-PULLUP TYPES:
Some older OEM tachs like the Nissan Patrol diesel have a peculiar circuit where the ECU is "open collector", meaning it can drive the tach wire to ground but cannot push it to 12V. The tach contains a pullup resistor which sources the 12V. The UTC has no pullup, so it will fail to trigger if installed on one of these systems. The clue, with the engine running, is that the ECU tach wire will read 0V when disconnected from the tach, while the tach wire will read 12V when disconnected from the ECU. To use the UTC, simply add a 1 Kohm pullup resistor to the UTC input. Standard 1/4-watt resistors from any electronics store will work fine. Connect one end of the resistor to the UTC 12V power terminal, the other end to the UTC trigger terminal.

APPLICATION	TACH TYPE	RATIO IN:OUT	S1	S2	S3	S4	S5
COP SINGLE-FIRE [ALL TYPES] 4-STROKE COIL-per-PLUG	8-CYL	1:8	ON	ON	OFF	OFF	OFF
	6-CYL	1:6	ON	OFF	OFF	OFF	OFF
	4-CYL	1:4	ON	ON	OFF	OFF	ON
	PULSE	1:2	OFF	OFF	OFF	OFF	OFF
COP DUAL-FIRE [ALL TYPES] 2-STROKE COIL-per-PLUG EXTERNAL PICKUP [1PPR]	8-CYL	1:4	ON	ON	OFF	OFF	ON
	6-CYL	1:3	ON	OFF	OFF	OFF	ON
	4-CYL	1:2	OFF	OFF	OFF	OFF	OFF
	PULSE	1:1	OFF	OFF	OFF	OFF	ON
12-CYL DISTRIBUTOR 12-POLE ALTERNATOR [6 PPR]	8-CYL	3:2	OFF	ON	ON	OFF	ON
	6-CYL	2:1	OFF	ON	ON	ON	OFF
	4-CYL	3:1	OFF	OFF	ON	OFF	ON
	PULSE	6:1	OFF	OFF	ON	OFF	OFF
10-CYL DISTRIBUTOR 10-POLE ALTERNATOR (5 PPR)	8-CYL	5:4	ON	ON	ON	ON	ON
	6-CYL	5:3	ON	OFF	ON	ON	ON
	4-CYL	5:2	OFF	ON	ON	ON	ON
	PULSE	5:1	OFF	OFF	ON	ON	ON
8-CYL DISTRIBUTOR	8-CYL	1:1	OFF	OFF	OFF	OFF	ON
	6-CYL	4:3	ON	OFF	ON	ON	OFF
	4-CYL	2:1	OFF	ON	ON	ON	OFF
	PULSE	4:1	OFF	OFF	ON	ON	OFF
6-CYL DISTRIBUTOR 6-POLE ALTERNATOR [3 PPR]	8-CYL	3:4	ON	ON	ON	OFF	ON
	6-CYL	1:1	OFF	OFF	OFF	OFF	ON
	4-CYL	3:2	OFF	ON	ON	OFF	ON
	PULSE	3:1	OFF	OFF	ON	OFF	ON
5-CYL DISTRIBUTOR	8-CYL	5:8	ON	ON	ON	OFF	OFF
	6-CYL	5:6	ON	OFF	ON	OFF	OFF
	4-CYL	5:4	ON	ON	ON	ON	ON
	PULSE	5:2	OFF	ON	ON	ON	ON
4-CYL DISTRIBUTOR 4-POLE ALTERNATOR [2 PPR]	8-CYL	1:2	OFF	OFF	OFF	OFF	OFF
	6-CYL	2:3	ON	OFF	OFF	ON	ON
	4-CYL	1:1	OFF	OFF	OFF	OFF	ON
	PULSE	2:1	OFF	ON	ON	ON	OFF
3-CYL DISTRIBUTOR	8-CYL	3:8	ON	ON	OFF	ON	OFF
	6-CYL	1:2	OFF	OFF	OFF	OFF	OFF
	4-CYL	3:4	ON	ON	ON	OFF	ON
	PULSE	3:2	OFF	ON	ON	OFF	ON
20-POLE ALTERNATOR [10 PPR]	8-CYL	5:2	OFF	ON	ON	ON	ON
	6-CYL	10:3	ON	OFF	OFF	ON	OFF
	4-CYL	5:1	OFF	OFF	ON	ON	ON
	PULSE	10:1	OFF	OFF	OFF	ON	OFF
18-POLE ALTERNATOR [9 PPR]	8-CYL	9:4	OFF	ON	OFF	OFF	ON
	6-CYL	3:1	OFF	OFF	ON	OFF	ON
	4-CYL	9:2	OFF	ON	OFF	ON	OFF
	PULSE	9:1	OFF	ON	OFF	ON	ON
14-POLE ALTERNATOR [7 PPR]	8-CYL	7:4	ON	ON	ON	ON	OFF
	6-CYL	7:3	ON	OFF	ON	OFF	ON
	4-CYL	7:2	OFF	ON	ON	OFF	OFF
	PULSE	7:1	OFF	OFF	OFF	ON	ON