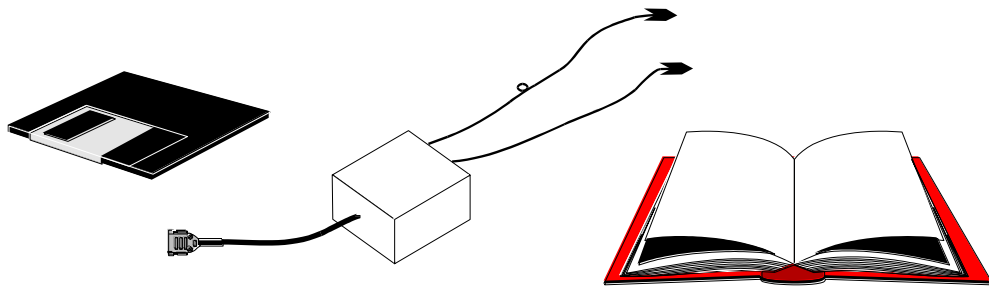


The Accutach Tachometer Calibrator/Tester

Instructions



Revision 1.0

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Mark Olson

**The Accutach Tachometer Calibrator/Tester
Instructions**

Table of Contents

Table of Contents.....	1
System Requirements.....	2
Installation Guide.....	3
Using the calibrate program.....	5
Using the sweep program.....	6
Bench power supply considerations.....	7
Tachometer background information (Smiths).....	8
Troubleshooting.....	11
How to get product support.....	14

Disclaimer:

This calibrator/tester was designed to work with inductively-coupled electronic tachometers such as the Smiths type found in Sunbeam Alpines and Tigers. This calibrator/tester was designed using optical and inductive coupling to minimize any chance of causing any damage. However, I am not responsible for any damage that might occur through the use or misuse of this product. Before you use this product, please check the readme.txt file on the floppy disk to see if there is any last minute information you may need.

Conventions:

Arial font is used to indicate what you should type on the keyboard.
Courier font is used to show what the computer puts on the screen.
<enter> means press the enter or return key on your keyboard.

The Accutach Tachometer Calibrator/Tester Instructions

System Requirements

The Accutach Tachometer Calibrator/Tester consists of a computer peripheral device and several computer applications programs. The computer it is used with must be an Intel compatible Personal Computer. It must have a 3.5" floppy disk drive. It must have a hardware-level compatible 9 pin serial port, either COM1: or COM2.

A computer with a 25 pin serial port can be used if a 25 pin to 9 pin adapter (not included) is used. You can purchase this adapter at a local electronic or computer retail store.

The operating system of the computer must be DOS. Unpredictable results can occur if any other operating system is used. Examples of other operating systems with unpredictable results include:

- DOS under Windows (any version)
- DOS under OS/2 (any version)
- DOS under HP's Application Manager

DOS computers without floppy disk drives (such as the HP LX100 Palmtop Computer) can be used if there is a mechanism for loading the software from a 3.5" floppy disk to the computer.

List of Parts

Your Accutach Tachometer Calibrator/Tester consists of the following parts:

- These Instructions
- The CSC (Current Switching Circuit) Unit
- A 3.5" floppy disk containing the software and documentation

The following optional items are NOT included with the Calibrator/Tester:

- Bench power supply
- 9 to 25 pin serial port adapter

These optional items can be purchased at a local electronic or computer retail store.

If the Accutach Tachometer Calibrator/Tester is to be used with a computer with a non-standard serial port (such as an HP 100LX Palmtop PC), other optional adapters such as null modem adapters or gender changers may be required. (See Troubleshooting Section.)

The Accutach Tachometer Calibrator/Tester Instructions

Installation Guide:

This section of the instructions will tell you how to install the Tachometer Calibrator/Tester software on your computer, how to connect the Tachometer Calibrator/Tester CSC unit to your computer and how to connect the CSC unit to your tachometer.

Installing the software on the computer:

Before you start, make a backup copy of your Accutach Tachometer Calibrator/Tester floppy disk. If you need help copying a DOS disk, please refer to your DOS manual.

If your PC has a 3.5" floppy disk drive, you can execute your programs directly from the floppy disk. No software installation is required. If you want to put the software onto the hard disk, simply copy all the files from the floppy disk to whatever hard disk directory you desire. I created a directory called "TACH" on my hard disk and copied all the Accutach Tachometer Calibrator/Tester files to it.

Type `readme<enter>` to view the readme.txt file to get any last minute instructions or changes. Type `print readme.txt<enter>` to make a hardcopy of the readme.txt file.

Connecting the CSC to the computer:

The Accutach Tachometer Calibrator/Tester was designed to work on either the COM1: or COM2: serial port. Check your computer documentation to find the standard 9 pin D type male serial port connector(s). You may need to disconnect a modem, mouse or some other external peripheral device in order free up a port with which to use the Accutach Tachometer Calibrator/Tester. Merely connect the 9 pin connector on the end of the CSC cable to the available COM port, and make a note of whether you are using the COM1: port or the COM2: port.

If the COM port on your computer uses a 25 pin D type male serial port connector, you will need to buy a 25 to 9 pin adapter from a computer or electronics retail store. be careful to ensure that the gender of the connectors is correct.

If your computer has a non-standard connector, as my HP 100LX Palmtop PC does, you will need to consult its manual or the dealer for the information you'll need to connect to the CSC unit. Connection to my HP 100LX serial cable can only be done using a 9 pin null modem adapter and a 9 pin gender changer. (See Troubleshooting Section)

Connecting the CSC to the tachometer (In the car):

An inductively coupled tachometer such as the Smiths tach used in Sunbeam products can be tested and the calibration checked while it is still in the car. The CSC receives its power from the ignition wire. The first step is to turn the car's ignition key off and

The Accutach Tachometer Calibrator/Tester Instructions

disconnect the ignition wire from the coil. DO NOT try to run the calibrator/tester without disconnecting the ignition wire from the coil or you could destroy the CSC unit. With a negative ground car, clip the red cliplead to the ignition wire and clip the black cliplead to a convenient ground. With a positive ground car, clip the black cliplead to the ignition wire and clip the red cliplead to a convenient ground.

Warning: Make sure that the ignition wire and the alligator clip do NOT touch ground during testing and calibration, or whenever the ignition switch is on. If they do, you'll be lucky if you just blow a fuse in your car. If you are unlucky you may burn your car, garage and house down. It's a good idea to put a rag or some other electrical insulator under the alligator clip. And, needless to say, don't do electrical work around gasoline fumes.

Double check the power connections before turning on the ignition key. You can now go to the section entitled "Using the Calibrate Program" or the section entitled "Using the Sweep Program."

Warning: The CSC unit dissipates 9W at 12V, so it gets quite warm if used for a long period of time with a 12V supply. In order to avoid overheating, you may not want to run the CSC unit at 12V for extended periods of time when the weather is particularly hot.

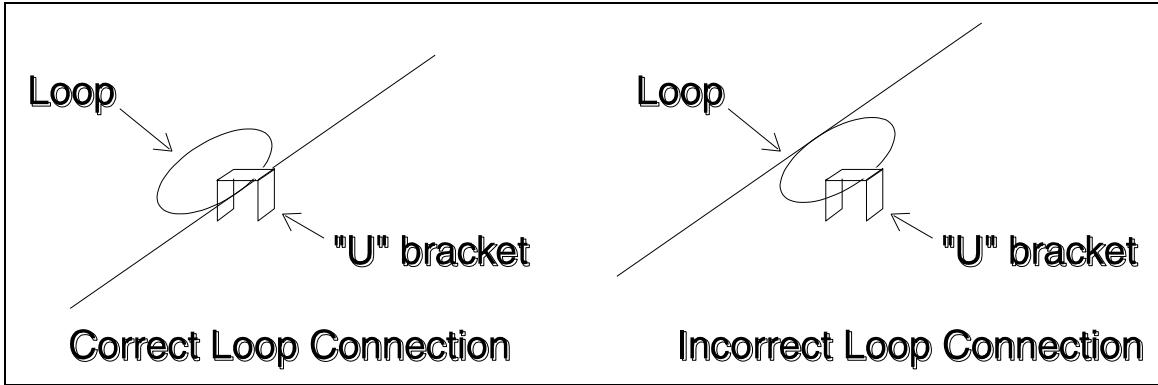
Connecting the CSC to the tachometer (On the bench):

You will need to obtain some sort of power supply in order to test or calibrate tachs on the bench. Please refer to the section entitled "Bench Power Supply Considerations" for a discussion of suitable and non-suitable bench power supplies.

When removing the tach from the dash, be careful not to lose the knurled nut, lockwasher and "U" shaped metal bracket that hold the ignition wire loop to the back of the tach. Leave any plastic material holding the ignition wire in a loop on the wire. Be sure to take the "U" bracket, nut and lockwasher with the tach as they are required for calibration.

First, put one leg of the tach's "U" shaped bracket through the loop in the CSC unit's red cliplead wire as shown in the drawing.

**The Accutach Tachometer Calibrator/Tester
Instructions**



With the wire loop through the “U” shaped bracket, attach it to the back of the tach with the knurled nut. Attach the red cliplead to the 5V to 12V power supply for the CSC unit. Attach the CSC unit’s black cliplead to the supply’s ground connection. If the tach is a negative ground unit, attach the 12V tach power supply to the bayonet connector on the back of the case and attach the tach power supply ground to the case, or a ground connection if the case is removed. If the tach is a positive ground unit, attach the tach power supply ground wire to the bayonet connector on the back of the case and attach the 12V tach power supply to the case, or an internal ground connection if the case is removed.

Double check the power connections before turning on the power supplies.

Using the calibrate program

There are 6 programs that can be used to calibrate tachometers, two for four cylinder cars, two for six cylinder cars and two for V8 cars. There are two programs for each type of car because one program is used if the CSC unit is connected to the COM1: serial port and the other program is used if the CSC unit is connected to the COM2: serial port. Be sure to select the disk and directory that contains the calibrator/tester programs. Also be sure you are not running DOS under Microsoft Windows, IBM’s OS/2 or any other higher level operating system, or the timing signals will be uncertain. The programs are invoked by typing the following when at the DOS prompt:

- V8TACH1<enter> to calibrate a V8 tach with the CSC unit on COM1:
- V8TACH2<enter> to calibrate a V8 tach with the CSC unit on COM2:
- 6CTACH1<enter> to calibrate a 6 cylinder tach with the CSC unit on COM1:
- 6CTACH2<enter> to calibrate a 6 cylinder tach with the CSC unit on COM2:
- 4CTACH1<enter> to calibrate a 4 cylinder tach with the CSC unit on COM1:
- 4CTACH2<enter> to calibrate a 4 cylinder tach with the CSC unit on COM2:

The computer will respond with the following:

Inductively Coupled Tachometer Calibration Program

The Accutach Tachometer Calibrator/Tester Instructions

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V8 tachometer calibration on serial COM2: port.

Enter the desired RPM between 500 and 10000,
or anything else to quit:

If you enter anything other than a number between 500 and 10000, the program will drop you back out to the DOS prompt again after displaying an error message. If you enter a number between 500 and 10000, the cursor will move to the leftmost character of the line and the computer will begin to send the timing signals to the CSC unit via the serial port. Once the program is running, the computer will continue to send the timing signals until a key is pressed on the keyboard. The key that is pressed is passed to DOS, so you can get clever in ending the program. For example, if you end the program by pressing the F3 function key, DOS will put the last command executed in the command line for you. For example, if you want to check the calibration of the tach at another RPM point, just hit F3<enter> and you'll be back at the prompt for the new RPM you want to use. If I want to switch to another program, I terminate this one by pressing the space bar key.

I generally calibrate the tach at redline and then check and record the deviations at 500RPM intervals.

Using the sweep program

The sweep programs are used to sweep the tach back and forth between 500RPM and a maximum RPM that you enter. This is used to test the tach to see if there are any odd RPM points at which the tach fails. I've seen some tachs fail in small RPM bands that calibration at 500 RPM intervals wouldn't have found. It is also good to sweep the tach for a while in order to ensure that it continues to work as the electronics inside the tach warm up.

There are 6 programs that can be used to sweep tachometers, two for four cylinder cars, two for six cylinder cars and two for V8 cars. There are two programs for each type of car because one program is used if the CSC unit is connected to the COM1: serial port and the other program is used if the CSC unit is connected to the COM2: serial port. Be sure to select the disk and directory that contains the calibrator/tester programs. Also be sure you are not running DOS under Microsoft Windows, IBM's OS/2 or any other higher level operating system, or the timing signals will be uncertain. The programs are invoked by typing the following when at the DOS prompt:

V8SWEEP1<enter>to test a V8 tach with the CSC unit on COM1:

V8SWEEP2<enter>to test a V8 tach with the CSC unit on COM2:

**The Accutach Tachometer Calibrator/Tester
Instructions**

6CSWEEP1<enter>to test a 6 cylinder tach with the CSC unit on COM1:
6CSWEEP2<enter>to test a 6 cylinder tach with the CSC unit on COM2:
4CSWEEP1<enter>to test a 4 cylinder tach with the CSC unit on COM1:
4CSWEEP2<enter>to test a 4 cylinder tach with the CSC unit on COM2:

The computer will respond with the following:

```
Inductively Coupled Tachometer Sweep Program

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V8 tachometer sweep on serial COM2: port.

Enter the desired RPM between 500 and 10000,
or anything else to quit:
```

If you enter anything other than a number between 500 and 10000, the program will drop you back out to the DOS prompt again after displaying an error message. If you enter a number between 500 and 10000, the cursor will move to the leftmost character of the line and the computer will begin to send the timing signals to the CSC unit via the serial port. Once the program is running, the computer will continue to send the timing signals until a key is pressed on the keyboard. The program will continue its current sweep until it has swept up to its maximum and back down to 500RPM before it stops and drops you back to the DOS prompt. The key that is pressed is passed to DOS, so you can get clever in ending the program here as well. For example, if you end the program by pressing the F3 function key, DOS will put the last command executed in the command line for you. For example, if you want to sweep the tach to another maximum RPM point, just hit F3<enter> and you'll be back at the prompt for the new RPM you want to use. If I want to switch to another program, I terminate this one by pressing the space bar key.

Bench power supply considerations:

On the bench, you will need a good, well-regulated power supply to power the tach and the CSC unit. The tach requires a well-regulated 12V supply while the CSC unit requires a 5V to 12V supply.

I don't have power consumption specifications for the tachs, but they don't seem to require too much current to operate. However, it is very important that the 12V supply to the tach be a very clean, steady 12V. Ripple or noise on the power signal will confuse the tach completely. A 12 battery charger can't be used, for example, because there is far too much ripple in the power supply and it can't respond well to sudden changes in current.

The Accutach Tachometer Calibrator/Tester Instructions

The CSC unit uses almost no power when it is not being driven by the computer. However, when the calibrator/tester is driving the tach, the CSC unit draws a maximum current of 3/4 Amp if powered by a 5V supply to 1.5 Amps if powered by a 12V supply. Since the timing signal from the computer keeps the maximum current duty cycle at 50%, the power dissipation is to 2.1W if powered by a 5V supply and 9W if powered by a 12V supply. Clearly, the CSC unit will run considerably cooler when powered by a 5V supply.

A 12V car battery is a very well-regulated power supply for bench testing tachs, but it is big, dirty, and difficult to hook a cliplead to. An ideal bench setup is a small, regulated 12V supply for powering the tach and a separate, larger well-regulated 5V supply for powering the CSC unit.

The power supply in your computer should NOT be used, as the calibrator/tester could easily overload your supply or inject noise into the system that could cause your computer to have severe problems. I have tried using a power supply out of an old original IBM PC (Not even a PC-XT.) The switching regulator didn't respond well to the demands of the calibrator/tester. More modern, higher power personal computer supplies may work better, but you'll have to check it out yourself.

Tachometer background information:

This section is intended to give you some background information on tachometers to enable you to determine if the Accutach Tachometer Calibrator/Tester can help you calibrate your tach, help you do calibration, and, if you are real adventuresome, help you repair broken tachs.

I know of two types of electronic tachometers in cars, inductively coupled and direct coupled.

Direct connect electronic tachs have a direct electrical connection to the ignition circuit. These tachs use voltage signals in the ignition circuit to drive the tach. This model of the calibrator/tester is not designed to directly connect to direct coupled electronic tachs, so it can't be used to calibrate them.

The inductively coupled type of tach uses a one turn loop of the ignition wire as the primary side of a transformer that couples the current pulses caused by the car's ignition circuit into the inside of the tach. The timing of those current pulses are used to drive the tach. The Accutach Tachometer Calibrator/Tester is designed to calibrate these type of tachs.

While this calibrator/tester will work with any inductively coupled electronic tach, it was developed and tested with Smiths tachometers from the mid 1960's. These tachometers were used in Sunbeam Tigers and Alpines as well as in Shelby Cobras and many other

The Accutach Tachometer Calibrator/Tester Instructions

British cars of the period. Since this is the tach I've had the most experience with, this is the tach I will describe in detail.

The Smiths tach must be disassembled in order to calibrate or repair it. Carefully rotate the chrome bezel until the tabs on the bezel line up with the slots on the case. This can be a very difficult job if the seals have aged badly and stuck. Whatever you do, DON'T pry up the tabs on the bezel or you'll ruin it. If you need to, you can CAREFULLY pry a tiny bit around the bezel in an attempt to break it loose. Don't tap the edge as the meter is very fragile.

Once you get the chrome bezel off the tach, the face glass and inside bezel must come out, if they didn't come out with the chrome bezel. Carefully pry the inner bezel from the case. It is not necessary to separate the glass from either bezel if it is stuck to one of them. Be careful prying on anything, especially if the glass is still in place, as it is very easy to damage it or the bezels. I have not been able to locate a source for the seals, so I just try to be very careful, and reuse what I can with what's left of the seals. I always use a lint free cloth and glass cleaner to clean the glass while the tach is apart.

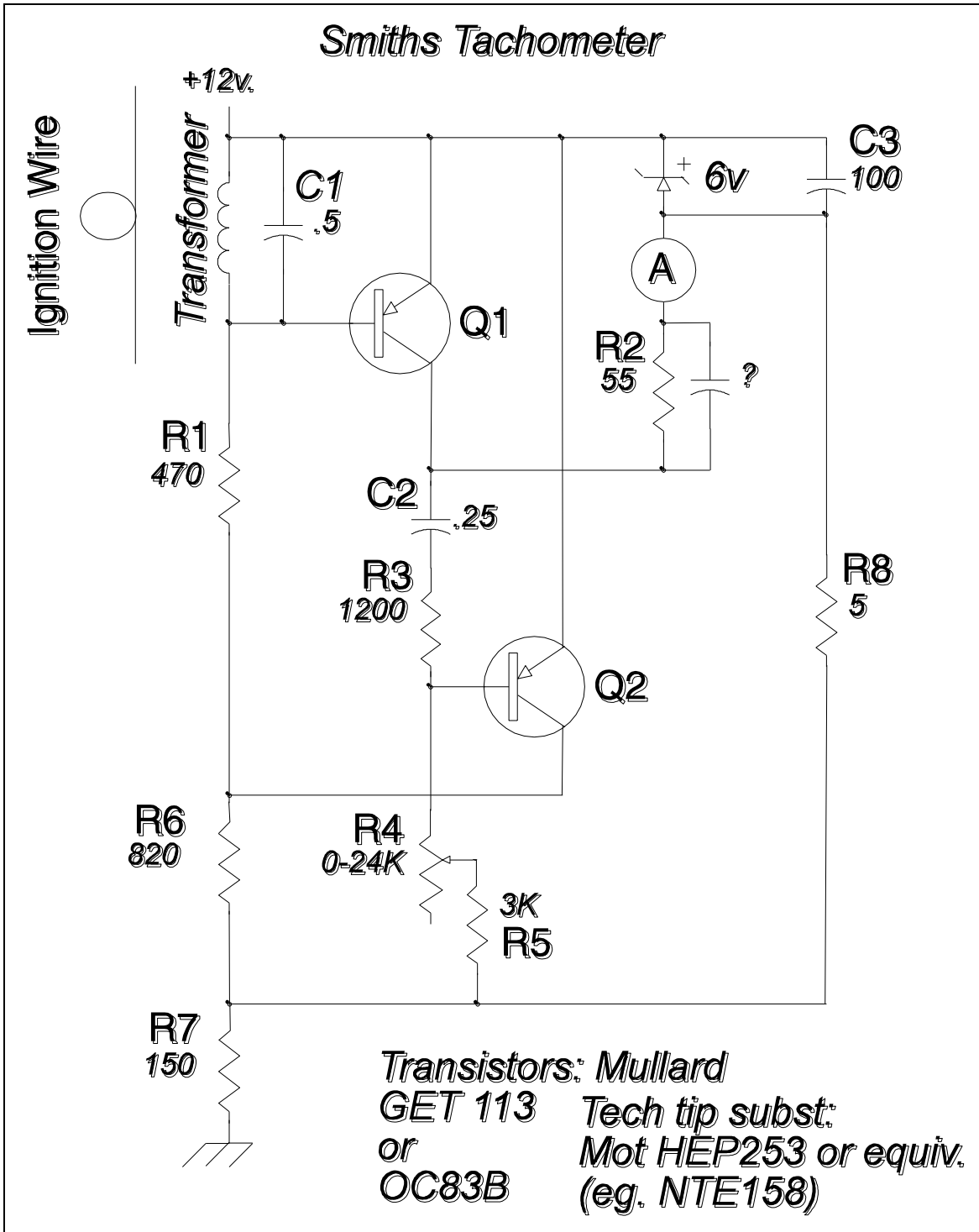
Once the meter face is exposed, be very careful not to mar or get finger prints on the face or break the needle. The next step is to remove the tach innards from the case. There are four screws on the back of the case, two of which are recessed in holes in the case and two of which are not. The two in the recessed holes hold the innards of the tach together so don't take them out. Put the tach case face down on the bench. While pinching the "U" bracket stud with one finger and the power spade lug with another to hold up the tach innards, remove both of the non-recessed screws. The tach innards are now being held in the case by your two fingers. Pick up the case and cup your other hand under the face of the case. Carefully let the stud and spade lug slide out of your fingers and catch the face of the tach by the edges in the cup of your hand. You can then pull the case off of the tach innards and turn it over. You are now ready to calibrate or debug the tach.

This is a good time to slide a shield under the needle to shield the face and repaint the needle if you can find appropriate paint. (My artistic talents aren't very good, so I never try that step myself.)

Reassembly is the reverse of this process.

**The Accutach Tachometer Calibrator/Tester
Instructions**

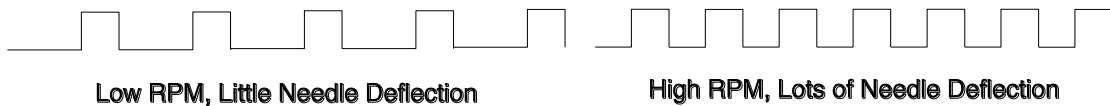
Electronically, the Smiths tach is a relatively simple two Germanium transistor inductively coupled electronic tach. The following diagram shows the schematic of the tach:



The two transistors together form a monostable multivibrator, or one-shot. Normally, the collector of Q1 is at 6V. An ignition pulse couples through the transformer to trigger a

The Accutach Tachometer Calibrator/Tester Instructions

one-shot voltage pulse to 12V on the collector of Q1 for a set amount of time. Every time an ignition pulse is detected through the transformer, the collector of Q1 will pulse from 6V to 12V for a fixed amount of time. While the collector of Q1 is at 12V, the top of the meter is held at 6V by the Zener diode, so current will flow through the meter, causing the needle to deflect. The width of the voltage pulse is determined by the combination of the 0.25uF capacitor C2 and the combination of resistors R3, R4 and pot. R5. The one-shot is triggered by every ignition pulse, so the voltage waveform looks like a series of pulses when the engine is running. Since the pulses are fixed in width and the frequency of the pulses is determined by the engine speed, the ratio of the time the waveform is at 12V vs. 6V goes up with increases in engine speed and down with decreases in engine speed. The way the meter works, the more time the waveform is at 12V, the more the needle is deflected and the less time the waveform is at 12V, the less the needle is deflected.



To calibrate the meter, you want to drive the tach with a very accurate, known signal at the correct frequency for the RPM reading that you want on the meter. Once you are driving the tach with the accurate frequency, you can adjust the needle deflection to the proper place by turning the calibration pot. R5. The tach can only be calibrated at one RPM. After that, all you can do is check to see how close you are at other RPMs.

It is possible to recalibrate the 7,000RPM Alpine 4 cylinder tachs to work in V8 Tigers using this method.

The most common failure modes I have seen are failure of the main timing capacitor C2. Failure of this cap. has caused tachs to be erratic, temperature sensitive or just plain dead. If you suspect your tach to have this problem, locate the capacitor, carefully unsolder the capacitor, and replace it with a new one. I have not been able to locate a supply of 0.25uF capacitors, but available 0.22uF to 0.27uF capacitors work fine. I have yet to come across a tach with a failed transistor, but they are rumored to cause problems as well. The other major failure mechanism I have seen is a broken meter spring. The meter needs to be replaced in this case. Replacement meters must be gotten from a parts tach. As a matter of course, the tach will have to be recalibrated if any of the parts are replaced.

All of the Smiths tachs of this era use the same electronic and mechanical design, regardless of number of cylinders, positive or negative ground or the make of the car. The power and ground wires are reversed between tachs for positive or negative ground cars. The only other thing that changes is the face used on the meters. So don't throw away any vintage Smiths tachs or tach parts. They can be used to resurrect any other one.

Troubleshooting:

The Accutach Tachometer Calibrator/Tester Instructions

This section attempts to explain how to find problems with the Accutach Tachometer Calibrator/Tester or your test setup.

If the tach is working in the car with the engine running, and you can't get the calibrator to work with a tach in the car, first double check the cliplead attachment to the ignition wire and the ground. Make sure they are connected correctly for positive or negative ground. Reclip the leads to ensure good electrical connections. Make sure the cable from the CSC unit to the personal computer is well seated. Make sure you know if you are using COM1: or COM2: and make sure you are using the proper program for the COM port and engine.

It is possible your computer has a mismatched serial port connector. Please see the Serial Port Considerations section for more details.

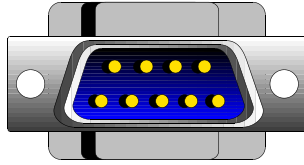
If the tach worked in the car with the engine running, and doesn't on the bench, check the power supplies and polarities for both the tach and the CSC unit. Check to make sure you have the loop in the red cliplead through the "U" bracket correctly on the back of the tach. Reclip the leads to ensure good electrical connections. Make sure the cable from the CSC unit to the personal computer is well seated. Make sure you know if you are using COM1: or COM2: and make sure you are using the proper program for the COM port and engine.

If the tach didn't work in the car and you want to ensure the calibrator/tester is working correctly, you will probably need to use an oscilloscope on the bench to see if the signal is being coupled through to the tach. If it isn't, There could be a problem with the power connections, the loop on the "U" bracket, or the COM port as above. If there is no problem there, it could be the input transformer or transistor Q1.

Serial Port Considerations:

Personal computer serial ports are either 25 or 9 pin male D type connectors. The Accutach Tachometer Calibrator/Tester uses a 9 pin female D type connector on the end of a cable to interface to the computer. If your computer uses the standard 25 pin connector, you must buy a 25 pin female to 9 pin male serial adapter or cable. The serial port standard for both is that the computer will transmit data on pin number 3 and receive data on pin 2 of the connector. In the case of some computers, cables and adapters, pins 2 and 3 are reversed. Your equipment MUST supply transmitted data from the computer on pin 3 of a 9 pin male serial connector. In some cases you will need a gender changer adapter or cable, in others you will need a null modem adapter or cable and in some case you will need both. Most likely, though, your computer will be standard.

**The Accutach Tachometer Calibrator/Tester
Instructions**



**The Accutach Tachometer Calibrator/Tester
Instructions**

How to get product support:

The Accutach Tachometer Calibrator/Tester is a very robust design and should give you years of very good service. If it breaks due to anything other than flagrant abuse, I'll repair it or replace it at my option for five years after purchase. You only need to pay the shipping and handling both ways.

Before you send it back, write or give me a call to see if we can debug things first.

I can be reached for support in the following ways:

US Mail: Mark Olson
 5467 Glennan Ct.
 San Jose, CA 95129

Email: mwolson@pacbell.net

Day Phone 1(408)398-2804