SmartTach

Universal Speed Measurement Tool

USER MANUAL

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Chapter 1
Introduction

INTRODUCTION

Introduction

Congratulations on the acquisition of your new SmartTach Universal Speed Measurement Tool!

The SmartTach is a precision speed measurement instrument designed specifically for the development and testing environment. Among its many innovations is the capability to continuously measure speed form virtually any type of signal.

The applications for SmartTach are widespread. Engine RPM, Vehicle Speed and Dynamometer Speed are just a few applications for SmartTach. Along with measured speed being continuously displayed, a precision analog voltage output representing measured speed is available on the Analog output connector. This signal can be connected to any test-cell computer, data acquisition system, or strip-chart recorder. This can allow the inclusion of speed measurements among other data used for transient testing analysis. Three user configurable Range Outputs are available on the SmartTach. These can be used as warnings to the dynamometer technician or test cell computer that an engine or test malfunction may have occurred.

SmartTach is ideally suited as an accessory to any data acquisition or dynamometer system. It can act as an interface unit allowing engine RPM or Dyno Speed to be treated exactly the same as any other measured analog signal. This alleviates the data acquisition system from difficult high-voltage signal conditioning and high-speed synchronous pulse processing. It also provides a universal interface for measuring speed, regardless of the engine specifics.

Installation of the SmartTach is intended to be practical and straightforward. The compact aluminum enclosure can easily be mounted in a test cell or vehicle. Microprocessor controlled Intelligent Signal Conditioning can automatically identify the input signal levels. For most automotive applications, SmartTach can be connected easily with the optional TachSensor or Inductive Pickup. This allows unintrusive speed measurements.

We hope that the SmartTach will provide many helpful solutions for your engine development and testing needs. Our goal is to provide our customers with practical solutions that make sense, not simply to sell products. We want to be on your side when it comes to solving problems. If at any time you have any comments, questions, or suggestions regarding SmartTach, we strongly encourage you to call us and discuss

them. We feel that customer participation is the ultimate way to providing the best possible products.

INTRODUCTION

About This Manual

This manual was written from the perspective of an engine test engineer/technician. General knowledge of internal combustion engines, ignition systems, and engine control modules is assumed. No presentation of engine or ignition system theory is made further than is necessary to install and operate the SmartTach.

We understand that most people do not have time to read an operating manual from cover to cover. Therefore, this manual is arranged as a reference oriented fashion. Our intention was for the person reading the manual to be able to find the desired information as quickly and efficiently as possible.

This manual does not present any form of internal description or theory of operation of SmartTach. This information is proprietary and confidential to Accurate Technologies Inc.

If you should have any comments regarding the organization of this manual, please do not hesitate to contact us.

Technical Support

Accurate Technologies Inc. stands behind its products with complete technical support. We understand engines as well as electronics and can be a valuable resource when questions arise regarding use of the SmartTach. We maintain information on a number of domestic and foreign engines to provide quick answers to your questions.

We can save you time and money by quickly answering your questions and helping you realize the maximum potential of the SmartTach. In general, there is no charge for basic questions and technical support via telephone or fax.

Phone: (248) 848-9200
Fax: (248) 848-9016
e-mail: ati@mail.id.net

On-site technical engineering assistance is available at a reasonable cost. Please contact us to discuss your exact application and support requirements.

Get to Know SmartTach

Prior to installation or operation of SmartTach, we strongly encourage you to spend a few minutes and study the diagram below while examining the unit to get to know its characteristics.

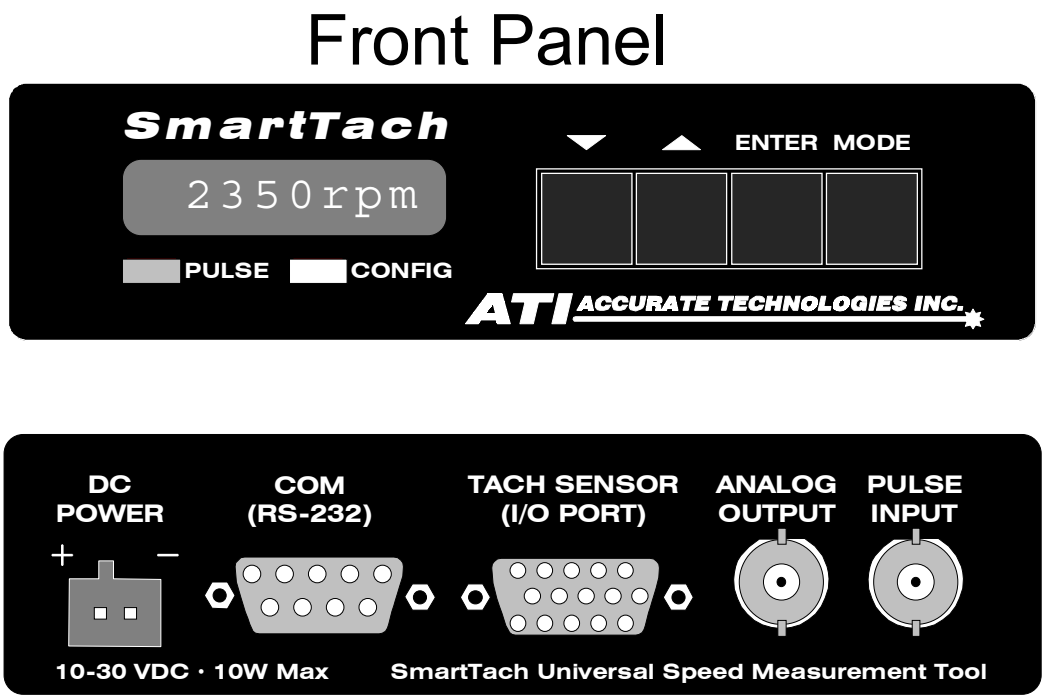


Figure 1 - 01: Front and Rear Panels

SmartTach Connections

CONNECTION	CONNECTOR TYPE
ANALOG OUTPUT	BNC Connector (Industry Standard)
PULSE INPUT	BNC Connector (Industry Standard)
COM (RS-232 Serial Port)	DB-9F Connector (Standard 9 pin female)
TACH SENSOR (I/O Port)	HDB-15F Connector (High-Density 15 pin female)
DC POWER	Plug-in Terminal Strip Connector

Important Safety Warnings

- ✓ NEVER WORK ON OR AROUND A RUNNING ENGINE.

- ✓ It is the responsibility of the installer of SmartTach to comply with the National Electrical Code and any other applicable Federal, State, or local safety codes.

- ✓ It is always better to spend extra time and care when installing the SmartTach. This will avoid unnecessary wasted time and money correcting the installation if the system does not function properly.

- ✓ Always route all wiring cables away from hot, sharp, or moving components as well as ignition coils and spark plug wires. All cables should be carefully and neatly fastened.

- ✓ When installing cables and sensors, any possible movement of the engine should be taken into consideration. Always leave enough extra cable length to accommodate for this movement.

- ✓ Always wear approved eye protection when working near engines, machinery, and vehicles.

- ✓ When operating the SmartTach in a moving vehicle, a passenger should perform all operating and data-taking tasks. The driver should always keep his eyes on the road.

Chapter 2
Installation

INSTALLATION

General Information

The SmartTach is a flexible engineering tool designed to be compatible with practically all automotive-type engines and ignition systems. Therefore, the specific installation procedure is largely dependent on the application. The following general steps are typically involved in the installation and setup of the SmartTach:

- Location for SmartTach unit
- Location of a DC power source to supply power to the SmartTach
- Installation of the wiring cables for the sensors and power supply
- Optional connection of the analog output, COM port, and I/O signals
- Configuration of the SmartTach system parameters

Placement of The SmartTach Unit

In general, a location should be selected which will not expose the SmartTach to excessive temperatures or harsh environments. The maximum recommended ambient temperature around the SmartTach is 50°C (122°F). The best rule of thumb is the unit should not be installed anywhere where the temperature would be unbearable for a human.

The unit can be installed in a dynamometer cell provided that it will not be exposed to excessively high or low temperatures. The temperature within a dynamometer cell can vary widely depending on the exact mounting location. The unit should never be mounted near or above the engine exhaust system or other hot surface. The unit should never be mounted directly to an engine.

If the unit is to be used for an in-vehicle application, it should be installed in the passenger compartment or trunk. The unit should never be installed in the engine compartment or anywhere where it will be exposed to the outside environment.

Selecting the DC Power Source

The SmartTach requires 10-30 volts DC, 10 watts maximum, for operating power. This can normally be supplied by the 12 or 24 volt DC power system of the engine or vehicle. If the engine does not have a DC power source, an external DC power supply must be used. Any standard 12 volt DC power supply with 1 amp output capability will be more than sufficient.

The unit does not have a built-in power switch. To avoid unnecessary power drain (especially in a vehicle), the power should be disconnected when the unit is not in use. This can be done easily in a vehicle by using the Switched-Ignition or Accessory power sources normally available at the fuse block. These power sources are usually disconnected when the ignition key is turned off.

Pulse Input Connection

The PULSE INPUT connection on the rear of the SmartTach unit accepts two types of signals, Spark and Trigger. Signals such as a inductive pickup on a secondary ignition wire or a direct connection to the ignition coil primary circuit are Spark type signals. Signals such as a Hall effect sensors, Magnetic pickups or Encoder pulses are Trigger type signals. In Trigger mode the input can accept signals up to ±75V, in Spark Mode the input can accept signals up to ±1KV. The PULSE INPUT connection can be switched to Trigger or Spark by changing parameter 06 (Input Signal Conditioning Select).

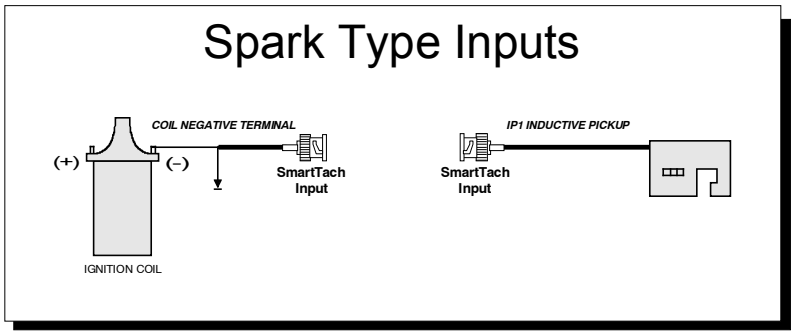


Figure 2 - 1: Spark Input Examples

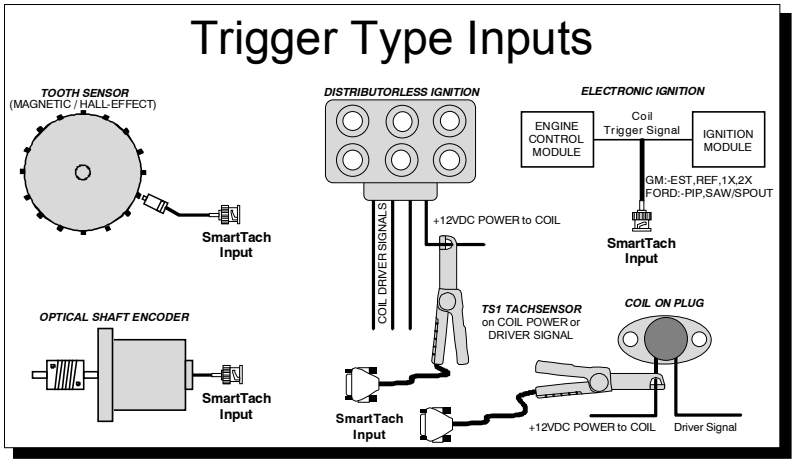


Figure 2 - 2: Trigger Input Examples

INSTALLATION

TachSensor Connection

This connection is for use with the optional TS1 TachSensor. This connection also functions as the I/O port for access to other signals (refer to the I/O Port connection section for details on these functions). When using the TachSensor make sure that nothing is connected to the PULSE INPUT connection. Input Signal conditioning (Parameter 06) must be set to TRG for the TachSensor to function properly.

Installation of Wiring Cables

The wiring cables should be neatly installed in a manner which will avoid contact with hot engine components and high-voltage spark plug wires/ignition coils. We strongly recommend spending extra time and care when installing the wiring cables. This will avoid unnecessary troubleshooting time for an erratic or non-functional instillation caused by improper wiring.

The BNC cables at the SmartTach end should be clearly marked with their purpose to avoid accidental connection to the wrong inputs. The can easily happen if the unit is removed and replaced. Although the inputs are protected from damage, unnecessary troubleshooting hassles will be avoided by taking the proper precautions.

Power Supply Connection

The DC power supply connection is made through the plug-in terminal strip supplied with the unit. The terminal strip is polarized and will only plug into the unit in one direction. Care should be taken to insure that the wires are connected to the terminal strip with the correct polarity. Pin #1 is the positive terminal, and Pin #2 is the negative (ground) terminal. The unit is reverse-voltage protected and will not be damaged if the polarity is reversed (and also will not function). It is recommended that 16 gauge or heavier wire be used for the power connection. The SmartTach enclosure is isolated from power ground.

Other Connections

The following connections are optional and provide a means of interfacing the SmartTach with external electronic equipment such as test cell computers, data acquisition systems, strip-chart recorders, etc.

Analog Output Connection

The SmartTach precision analog output can be used to send real-time speed information to a test cell computer, data acquisition system, strip-chart recorder, etc. This output voltage is generated by a precision 12-bit digital-to-analog converter (output accuracy is ±0.005 volts). The update rate and low-pass filtering of this output are programmable using the configuration parameters.

The maximum output voltage range is 0 to +10 volts. Maximum current draw from the output should be limited to 10 milliamperes. The exact scaling, offset, and output voltage range limits are programmable through the configuration parameters. This allows the analog output to be tailored to the requirements of the device receiving the signal.

A common use for the analog output is for data acquisition or display measurements at a remote location. This can be easily done by using a digital voltmeter for the remote display.

COM Port Connection

The SmartTach contains an RS-232 Serial Communications Port. This port may be used by an external computer system to extract information from the SmartTach and perform a remote configuration of the unit.

The RS-232 port connection is an industry-standard female 9-pin D-SUB connector. Cables for connecting this port to a personal computer are generally available from most computer/electronic component vendors, or directly from Accurate Technologies Inc. The baud rate of the port is programmable using the configuration parameters. Optional hardware handshaking (DTR/DSR) can also be enabled.

Communication protocol information is available from Accurate Technologies Inc. for customers wishing to write their own software to communicate with the SmartTach. Please contact us for additional information.

COM Port Pin Description

1 - DCD Output (Data Carrier Detect)
2 - TXD Output (Transmit Data)
3 - RXD Input (Receive Data)
4 - DTR Input (Data Terminal Ready)
5 - GND (Signal common)
6 - DSR Output (Data Set Ready)
7 - RTS Input (Request to Send)
8 - CTS Output (Clear to Send)

9 - RNG Output (Ring Indicator)

Note: Pins 1, 6, and 8 are internally connected. Pins 7 and 9 are not used and not connected.

I/O Port Connection

In addition to the TachSensor connection, this port also provides access to several other SmartTach I/O signals. These signals include: Three Range Outputs for monitoring/warning signals, Digital pulse output, Pulse input and a Auxiliary analog voltage input (0-5V).

An optional "Y" adapter is available for the SmartTach unit. This adapter allows simultaneous use of the TachSensor and other SmartTach I/O functions.

The I/O port connection is an industry-standard female high-density 15-pin D-SUB connector. Cables and connectors for this port are available at most computer/electronic component vendors, or directly from Accurate Technologies Inc.

The Range Outputs are isolated solid state contact closures and have a maximum rating of 30 Vdc @ 1 amp.

I/O Port Pin Description

1 - Ground Shield
2 - Digital Pulse Out (0-5V, referenced to Pin 7)
3 - Range Output #1 terminal "B"
4 - Range Output #2 terminal "B"
5 - Range Output #3 terminal "B"
6 - Isolated Ground Shield
7 - Isolated Ground
8 - Range Output #1 terminal "A"
9 - Range Output #2 terminal "A"
10 - Range Output #3 terminal "A"
11 - Reserved, Do not connect to this pin.
12 - Reserved, Do not connect to this pin.
13 - Ground
14 - Aux. Analog Input (0-5V, referenced to Pin 13)
15 - Reserved, Do not connect to this pin.

Chapter 3
Configuration

CONFIGURATION

General Information

The SmartTach is a very flexible speed measurement system. To provide compatibility with practically all types of speed measurement, a wide variety of programmable parameters are incorporated into the unit. The configuration parameters effectively "customize" the unit to each specific application.

Configuration parameters set options such as input signal type, measurement type, and display options. The SmartTach will remember the parameter settings indefinitely until they are changed again. SmartTach can also save settings for later recall in any of six user memory locations. Therefore there is no need to re-configure the unit each time it is operated.

There are two general methods by which the SmartTach can be configured. Either method provides full access to all configuration parameters. The first method is using the built-in display and pushbuttons. This allows fast changes, especially when only one parameter needs to be modified, although requires knowledge of the parameter code numbers.

A more straightforward method is using an MS-DOS based Personal Computer and the supplied SmartTach Interface Software. This method provides a description of the parameters as well as their codes and values on the computer screen. While this method is easier, it also requires connecting a computer each time any parameters need to be changed. This can be inconvenient at times, especially when only one parameter needs to be changed or the SmartTach is used in a vehicle.

This manual describes the configuration process when using the built-in display and pushbuttons. The SmartTach Interface Software is described in a manual addendum included with the software package.

Operating Modes

Measure

This operating mode instructs the SmartTach to operate in its normal mode of measuring speed. This mode displays the current measured speed on the front panel LED display. The current configuration parameter settings retained in memory are used for all functions. This is always the default mode after power is applied to the unit.

Configure

This operating mode displays the configuration parameters or parameter groups (one at a time) on the built-in display. This mode is used to select the desired configuration parameter to be displayed and/or changed. All measurement operations are suspended when in this mode.

Default Configuration Values

The SmartTach has internal default settings for all of the configuration parameter values. These are the values which are programmed into the SmartTach when it is first shipped. Many of these values can be left at their default settings for most applications. Appendix A includes a list of all SmartTach parameters and default values.

NOTE: All SmartTach parameters can be reset to their default settings by selecting Item F2 from the Memory Group.

Configuration Controls

The SmartTach has four built-in Pushbutton switches which serve several purposes, one of which is to allow configuration of the unit. The other purposes are described in the Operation section of the manual. There are also two red LED lights (marked PULSE and CONFIG) on the front panel of the unit which indicate the current operating mode. The CONFIG LED will be illuminated when the SmartTach is in configure mode.

When the unit is in normal operation (Measure Mode), the display indicates the current measured value. When the unit is placed in the Configuration Mode by pressing the MODE button, the display format changes to Parameter Group Select.

Figure 3 - 1: Parameter Group Display

The display format in this mode is >XXXXXX< where XXXXXX=Parameter Group Name. Pressing the ENTER button again will display the Parameter List for the selected group.

Figure 3 - 2: Parameter List Display

The display format in this mode is XX>YYYYY where XX=Parameter Item Number and YYYYY=Current Value.

Using the Pushbutton Switches

The four built-in Pushbutton switches are used to access the various configuration parameters and make any necessary changes. The function of each switch depends on the current operating mode (as indicated by the LED lights on the front panel). All four Pushbutton switches are momentary-type with a snap-action. Depending on the switch and mode, holding a switch down will result in a repeating action of that switch similar to a computer keyboard. After an initial delay, the action caused by the particular switch will begin to repeat at a fixed rate.

Pushbutton Switch Functions

The function of each Pushbutton switch depends on the current operating mode. The information below describes the function of each Pushbutton in each operating mode.

Measurement Mode

Display: Measured data
PULSE: Flashing (if pulses are being received)
CONFIG: Off

▼: Display Min Input Value
▲: Display Max Input Value
ENTER: Toggle Display On/Off
MODE: Enter Configuration mode

Parameter Group Select

Display: Parameter Group name between >< symbols.
PULSE: Flashing (if pulses are being received)
CONFIG: On

▼: Scroll Group Names Down
▲: Scroll Group Names Up
ENTER: Select Displayed Parameter Group
MODE: Exit Configuration mode

Parameter Select

Display: Parameter Id and Current Value.
A steady > symbol indicates select mode.
PULSE: Flashing (if pulses are being received)
CONFIG: On

▼: Scroll Parameter Numbers Down
▲: Scroll Parameter Numbers Up
ENTER: Select Displayed Parameter for Editing
MODE: Exit to Parameter Group Select

Parameter Edit

Display: Parameter Id and Current Value.
A flashing > symbol indicates edit mode.
PULSE: Flashing (if pulses are being received)
CONFIG: On

▼: Scroll Parameter Value Down
▲: Scroll Parameter Value Up
ENTER: Accept New Value
MODE: Cancel Edit and Return to Parameter Select

Figure 3 - 3: Pushbutton Functions

Changing Parameters

This example describes a step-by-step procedure for setting the Input Signal Conditioning parameter. This procedure assumes that power has just been applied and no pushbuttons were depressed. Default starting values for the parameters are also assumed.

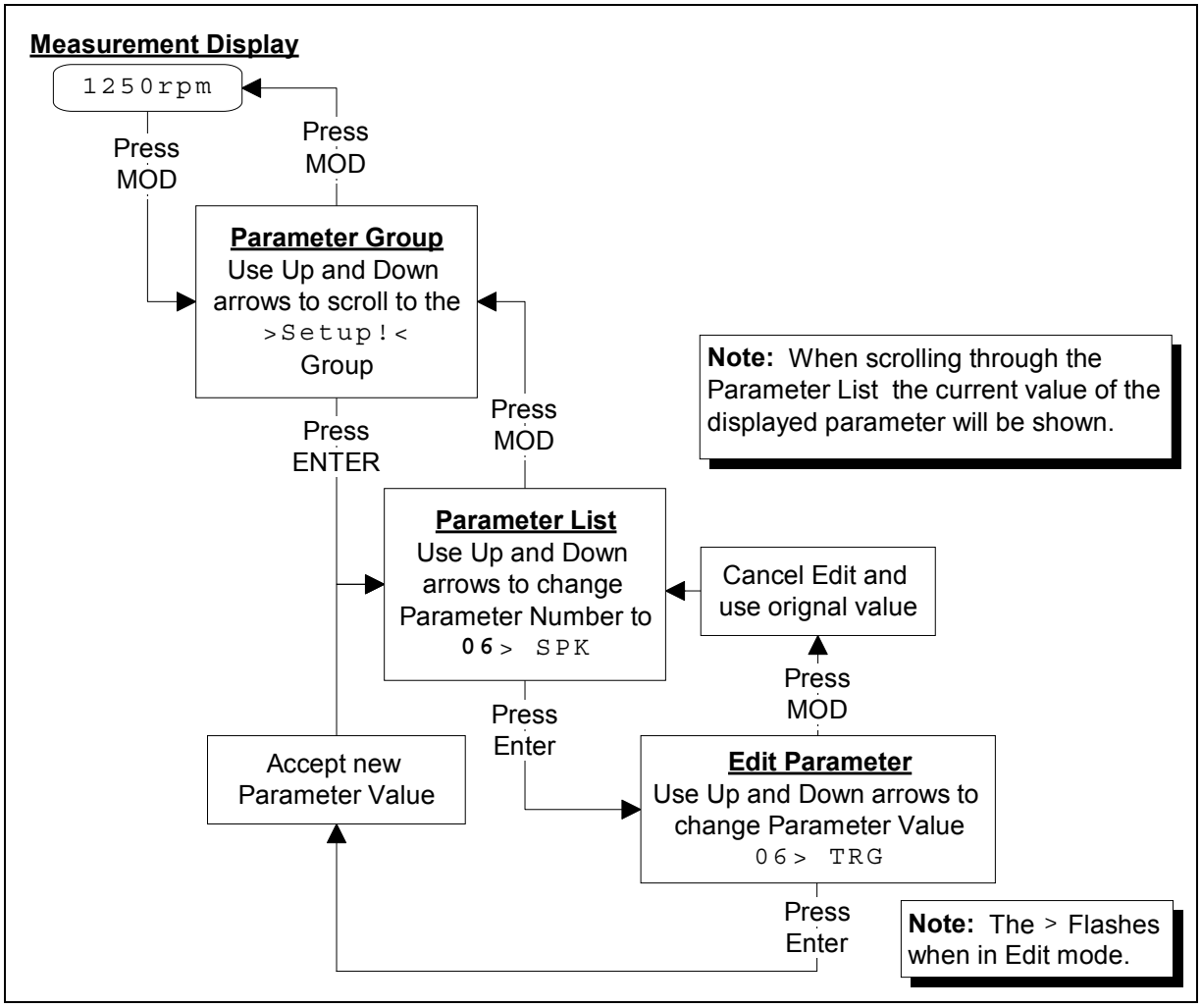


Figure 3 - 4: Parameter Edit Navigation

Configuration Examples

These are just a few examples of SmartTach configurations and the required parameter settings. Only required parameters are listed.

Configuration Example 1

Engine RPM measurement with a distributor type ignition system using a inductive pickup on a single spark plug wire. Analog output configured to 1volt/1000 rpm, 0 - 10,000 rpm range and 1ms update rate.

Parameter Group	Parameter ID and Description	Parameter Value
Setup!	00 Measurement Parameter	EngSp
	01 Displayed Engineering Units	RPM
	02 Pulses/Patterns Per Cam/Dyno Rev	1
	03 Pulses Per Pattern	1
	06 Input Signal Conditioning Select	SPK
TrgInp	20 Trigger Input Level	AutoT
AnlOut	30 Analog Output Scaling	1000
	31 Analog Output Offset	0
	32 Analog Output Maximum Voltage Limit	10.00
	33 Analog Output Minimum Voltage Limit	0.00
	35 Analog Output Update Period	1

Configuration Example 2

Engine RPM measurement on a V6 engine with a distributorless ignition system using the TachSensor on the coil power wire. Analog output configured to 1volt/1000 rpm, 0 - 10,000 rpm range and 1ms update rate.

Parameter Group	Parameter ID and Description	Parameter Value
Setup!	00 Measurement Parameter	EngSp
	01 Displayed Engineering Units	RPM
	02 Pulses/Patterns Per Cam/Dyno Rev	6
	03 Pulses Per Pattern	1
	06 Input Signal Conditioning Select	TRG
TrgInp	20 Trigger Input Level	TS1
AnlOut	30 Analog Output Scaling	1000
	31 Analog Output Offset	0
	32 Analog Output Maximum Voltage Limit	10.00
	33 Analog Output Minimum Voltage Limit	0.00
	35 Analog Output Update Period	1

Configuration Example 3

Engine RPM measurement on a QUAD 4 engine with a distributorless ignition system using the TachSensor on the igintion module power wire (pink). Analog output configured to 1volt/1000 rpm, 0 - 10,000 rpm range and 1ms update rate.

Parameter Group	Parameter ID and Description	Parameter Value
Setup!	00 Measurement Parameter	EngSp
	01 Displayed Engineering Units	RPM
	02 Pulses/Patterns Per Cam/Dyno Rev	4
	03 Pulses Per Pattern	1
	06 Input Signal Conditioning Select	TRG
TrgInp	20 Trigger Input Level	TS1
AnlOut	30 Analog Output Scaling	1000
	31 Analog Output Offset	0
	32 Analog Output Maximum Voltage Limit	10.00
	33 Analog Output Minimum Voltage Limit	0.00
	35 Analog Output Update Period	1

Configuration Example 4

Chassis dynamometer speed on a 48inch roll with 2800 pulses/rev. Analog output configured to 1volt/10 mph, 0 - 100 mph range and 1ms update rate.

Parameter Group	Parameter ID and Description	Parameter Value
Setup!	00 Measurement Parameter	DynSp
	01 Displayed Engineering Units	MPH
	02 Pulses/Patterns Per Cam Rev	2800
	03 Pulses Per Pattern	1
	04 Engineering Conversion Factor	48.00
	05 Engineering Conversion Units	in
	06 Input Signal Conditioning Select	TRG
TrgInp	20 Trigger Input Level	AutoT
AnlOut	30 Analog Output Scaling	10.0
	31 Analog Output Offset	0.0
	32 Analog Output Maximum Voltage Limit	10.00
	33 Analog Output Minimum Voltage Limit	0.00
	35 Analog Output Update Period	1

Chapter 4
Parameters

00 - Measurement Parameter

Parameter Group: **Setup!**

Options:
- EngSp - Engine Speed
- VehSp - Vehicle Speed
- DynSp - Dynamometer Roll Speed
- Freq - Signal Frequency
- Per - Period of the Signal
- PW - Pulsewidth
- Duty% - Duty Cycle
- Vaux - Auxillary Input Voltage

Default: EngSp

Purpose: To select the type of measurement you would like the SmartTach to perform. This is the main configuration parameter for the SmartTach and should be the first parameter set when setting up a new configuration. Changing this parameter will change the state of other parameters in the Setup! menu automatically.

How to Set: This parameter should be set to the type of measurement you want.

Selection	Measurement
EngSp	Used to measure the number of revolutions over time. Generally engine RPM, but can be used to measure any rotating components if a signal is available.
VehSp	Used to measure speed when the speed signal is in "pulses/distance" as in 300pulses/meter.
DynSp	Used to measure speed when the signal is in "pulses/revolution" as in 1200 pulses/revolution.
Freq	Used to measure the Frequency of the input signal.
Per	Used to measure the Period of the input signal.
PW	Used to measure the Pulsewidth of the input signal.
Duty%	Used to measure the Duty Cycle of the input signal.
Vaux	Used to monitor the auxillary input voltage. In this mode the Aux. input is treated as a speed measurement. The analog output and range outputs are a function of the Aux. input voltage.

01 - Displayed Engineering Units

Parameter Group: **Setup!**

Options:	RPM, RPS	- Engine Speed	(Parm 00 set to EngSp)
	MPH, KPH	- Vehicle Speed	(Parm 00 set to VehSp)
	MPH, KPH	- Dyno Speed	(Parm 00 set to DynSp)
	Hz, kHz	- Frequency	(Parm 00 set to Freq)
	ms, us	- Period	(Parm 00 set to Per)
	ms, us	- Pulsewidth	(Parm 00 set to PW)
	%	- Duty Cycle	(Parm 00 set to Duty%)
	volts	- Aux. Input	(Parm 00 set to Vaux)
Default:	RPM		

Purpose: To select the units to be displayed on the measurement display. The available settings are based on the value of parameter 00.

How to Set: This parameter should be set to the desired conversion units.

02 - Patterns/Pulses per Cam/Dyno Revolution

Parameter Group: **Setup!**

Range: 1-9999 pulses
Increment: 1 pulse
Default: 1 pulse

Purpose: This parameter is used calculate Engine RPM or Chassis Dynamometer speed. This parameter is required and if not set correctly will result in improper measurements.

How to Set: Before setting this parameter you must know if the signal is a pattern of pulses or a single pulse that repeats. Patterns refer to asymmetrical pulse groups where the period between pulses varies over one camshaft revolution, as in a trigger wheel with a missing tooth or an odd fire engine. For these asymmetrical "Patterns" you would enter the number of times the pattern repeats itself per Cam revolution, you will also need to enter the number of pulses per pattern(Parameter 03) . For equally spaced pulses you would enter the number of pulses per camshaft or Dyno revolution.

Examples:

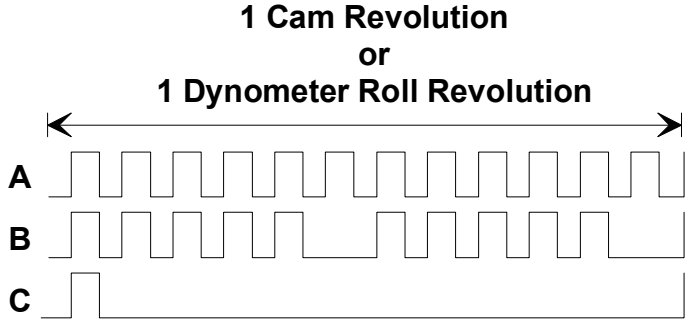


Figure 4 - 1: Parameter 2 Pulse Examples

A is a "Pulse" type signal from a sensor like a 12 Pulse/Rev Dyno Roll or a 6 Pulse/Rev Crankshaft sensor. For this example Parameter 02=12

B is a "Pattern" type signal from a sensor like a 6-1 tooth crankshaft sensor. For this example Parameter 02=2

C is a "Pulse" type signal from a single plug wire on a distributor. For this example Parameter 02=1

03 - Pulses per Pattern

Parameter Group: **Setup!**

Range: 1-60 pulses
Increment: 1 pulse
Default: 1 pulse

Purpose: This parameter is used to specify the number of pulses per pattern.

How to Set: With a pattern type signal this parameter should be set to the number of pulses per pattern. This is defined as the number of individual pulses that are input before the pattern repeats. If the signal is not a pattern type this parameter should be set to 1.

Examples:

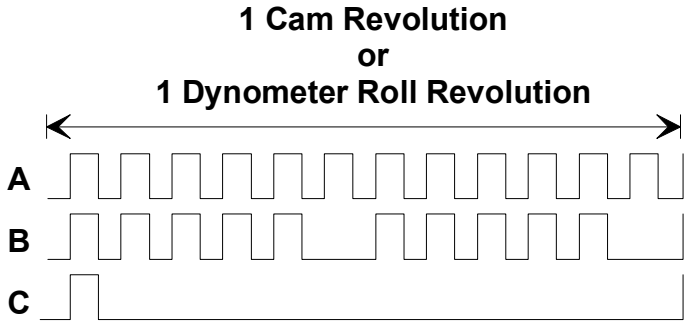


Figure 4 - 2: Parameter 3 Pulse Examples

A is a "Pulse" type signal from a sensor like a 12 Pulse/Rev Dyno Roll or a 6 Pulse/Rev Crankshaft sensor. For This example Parameter 03=1

B is a "Pattern" type signal from a sensor like a 6-1 tooth crankshaft sensor. For this example Parameter 03=5

C is a "Pulse" type signal from a single plug wire on a distributor. For this example Parameter 03=1

04 - Engineering Unit Conversion Factor

Parameter Group: **Setup!**

Range:	1-9999	- Vehicle Speed	(Parm 00 set to VehSp)
	0.01-99.99	- Dyno Speed	(Parm 00 set to DynSp)
Increment:	1	- Vehicle Speed	(Parm 00 set to VehSp)
	0.01in or 1mm	- Dyno Speed	(Parm 00 set to DynSp)
Default:	1	- Vehicle Speed	(Parm 00 set to VehSp)
	0.01in or 1mm	- Dyno Speed	(Parm 00 set to DynSp)

Purpose: This parameter is used set the number of pulses for a given distance or the dynamometer roll diameter. This parameter is required if the SmartTach is in vehicle speed mode or dynamometer speed mode and is will be set to n/a in other measurement modes.

How to Set: To set this parameter to the proper value, you must also set the engineering conversion units(parameter 05) properly. When in vehicle speed mode you may have to convert the known pulses/distance to one of the available options for parameter 05.

05 - Engineering Conversion Units

Parameter Group: **Setup!**

Options:	1ft	- Vehicle Speed	(Parm 00 set to VehSp)
	60ft	- Vehicle Speed	(Parm 00 set to VehSp)
	1m	- Vehicle Speed	(Parm 00 set to VehSp)
	20m	- Vehicle Speed	(Parm 00 set to VehSp)
	in	- Dyno Speed	(Parm 00 set to DynSp)
	mm	- Dyno Speed	(Parm 00 set to DynSp)
Default:	1ft	- Vehicle Speed	(Parm 00 set to VehSp)
	in	- Dyno Speed	(Parm 00 set to DynSp)

Purpose: This parameter is used set the distance for a given number of pulses or the measurement units used for the dynamometer roll diameter. This parameter is required if the SmartTach is in vehicle speed mode or dynamometer speed mode and is will be set to n/a in other measurement modes.

How to Set: If in vehicle speed mode select the unit distance used for the Engineering Unit Conversion Factor (Parameter 04). If in Dyno speed mode select the units that the dynamometer roll diameter was entered in.

06 - Input Signal Conditioning Select

Parameter Group: **Setup!**

Options: SPK - Spark mode signal conditioning (Inductive pickup, Coil -)
TRG - Trigger mode signal conditioning (TS1-TachSensor, Hall Sensors, Magnetic pickups)

Default: SPK

Purpose: This parameter is used to select the source for the event signal which will be used to measure speed.

How to Set: This parameter must be set to TRG when using the TachSensor. It must also be set to TRG when connecting to any pulse type signals such as a Dyno encoder or crankshaft position sensor. When connecting SmartTach to the Ignition Module Trigger signal (between the engine control unit and ignition module; i.e. General Motors EST and Ford SPOUT/SAW), this parameter should be set to TRG.

This parameter should be set to SPK if the SmartTach input is connected to an Inductive Pickup sensor (clamped to a spark plug wire), or directly to the ignition coil negative terminal.

IMPORTANT:	Never set this parameter to TRG when connected directly to a Coil(-) terminal or damage to the SmartTach mat occur.

07 - Measurement Low-Pass Filter

Parameter Group: **Setup!**

Range: 0-255
Increment: 1
Default: 0 (No Filtering)

Purpose: This parameter controls the low-pass filter on the pulse input.

How to Set: The default value should be adequate for most cases. If the input signal is noisy, increasing the value of this parameter may help.

08 - Multi-Strike Filter

Parameter Group: **Setup!**

Options: Off - Disable Multi-Strike filter
On - Enable Multi-Strike filter
Default: Off - Disable Multi-Strike filter

Purpose: To filter out the multiple firings of the same cylinder found on some engines with Multi-strike ignition systems.

How to Set: This parameter should be set to Off unless connected to a Multi-Strike type ignition system. When connecting to the primary or secondary sides of the ignition system, multiple firings of the same plug would be detected as separate spark events. Setting this parameter to ON will filter out the multiple sparks and produce accurate RPM measurements on Multi-Strike Ignition systems.

09 - Pulses per Measurement

Parameter Group: **Setup!**

Range: 1-16
Increment: 1
Default: 1

Purpose: This parameter is used to set the number of pulses to measure before updating the output. This creates a rolling average of speed over the specified number of pulses.

How to Set: The default value of 1 is suitable for most applications. This value should only be changed for very specific applications such as averaging the measurement over one crankshaft revolution or averaging over one camshaft revolution. Setting this parameter equal to parameter two will let SmartTach average the measurement over two crankshaft revolutions. This averaging helps eliminate ant noise caused by erratic timing variations.

10 - Spark Input Threshold Level

Parameter Group: **SpkInp**

Range: 0.00-5.08 volts
Increment: 0.04 volts
Default: 2.00 volts

Purpose: This parameter is used to adjust the input sensitivity of the Spark input signal conditioning circuit to accommodate weak signals without compromising noise immunity on strong signals.

How to Set: For normal operation, this parameter should be set as high as possible without causing the SmartTach to miss spark pulses. This is normally about 20% below the value at which erratic flashing of the front panel PULSE LED is noticed.

For the absolute maximum measurement accuracy this parameter should be set as low as possible, keeping in mind that if the setting is too low (too sensitive), the SmartTach may trigger on spurious noise. The Spark Input Phase Correction parameter should also be used to "tune-out" the phase error.

A typical setting of 2.00 volts will work well with most Inductive Pickup type sensors. Please note that the direction in which the pickup is clamped to the spark plug wire is important (effects its output level). The direction of the pickup should be reversed if good results are not obtained.

When connecting directly to the ignition coil negative terminal, a typical setting of 4.00 volts will work well for most applications.

11 - Spark Input Delay Period

Parameter Group: **SpkInp**

Range: 0.7 - 3.0 milliseconds
Increment: 0.1 milliseconds
Default: 3.0 milliseconds

Purpose: This parameter is used to provide a delay period after the Spark signal occurs, before additional spark pulses are accepted. This avoids typical ringing noise from the high voltage inductive pickup and coil negative signals.

How to Set: For most applications, this parameter should be set to the default value of 3.0 milliseconds. If the period of the pulses supplied into the Spark input is lower than 3.0 milliseconds, this parameter should be decreased accordingly. This may be encountered when connecting the Spark input to the Ignition Coil negative terminal on distributor-type engines with eight or more cylinders or using an Inductive Pickup Sensor clamped to the distributor coil wire.

20 - Trigger Input Level

Parameter Group: **TrgInp**

Options:	TS1	- Configure for TS1 TachSensor
	AutoT	- Automatic Threshold and Hysterisis
	AutoH	- Manual Threshold / Automatic Hysterisis
	ManTH	- Manual Threshold and Hysterisis
	0V	- Preset Zero-Cross Input (Magnetic Sensor)
	TTL	- Preset TTL Logic Input
	5V	- Preset 5V Logic Input
	5VPU	- Preset 5V Logic Input (with pull-up enabled)
	8V	- Preset 8V Logic Input
	10V	- Preset 10V Logic Input
	12V	- Preset 12V Logic Input
Default:	AutoT	- Automatic Threshold and Hysterisis

Purpose: This parameter is used to select the input signal level for the Trigger input. The flexibility of the input signal conditioning circuit provides compatibility with virtually all types of sensors and input signals.

How to Set: When using the TS1 TachSensor this parameter should be set to TS1, for most other applications, this parameter should be to AutoT (Automatic Threshold and Hysterisis). This will instruct the SmartTach to continuously measure the input signal levels and automatically set the threshold and hysterisis to their optimum values. In addition, for signals with varying amplitudes such as magnetic sensors, the SmartTach will dynamically adjust the levels as the amplitude changes to maximize noise immunity.

If the signal level is already known (and constant), one of the other parameter options can be selected. The manual settings allow full manual control over the input threshold and hysterisis values (set with other parameters).

NOTE: When this parameter is set to TS1, parameters 21-25 will be set to Auto and cannot be changed.

21 - Trigger Input Polarity

Parameter Group: **TrgInp**

Options: Neg - Falling Signal Edge Trigger
Pos - Rising Signal Edge Trigger
Default: Neg - Falling Signal Edge Trigger

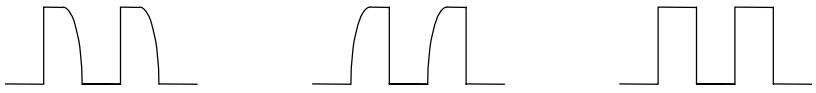
Purpose: This parameter is used to select the signal "edge" to be detected for the Trigger Input. Falling Edge refers to the positive-to-negative (high-to-low voltage) transition of the input signal. Rising Edge refers to the negative-to-positive (low-to-high voltage) transition of the input signal.

How to Set: The signal "edge" corresponding to the Input should be determined beforehand. This information may be available from an engine service manual, or actually measured with an oscilloscope. In general, the faster/straighter the edge, the more accurate the measurement.

When using a magnetic sensor (or other slow transition time type signal - as opposed to a square wave), it is recommended that the Falling Edge setting be used if possible. This is the edge normally used by production engine control systems. When the input is a square wave signal, either setting may be used and the accuracy will not be affected.

Examples:

Signal examples and recommended settings



Use Rising Edge Use Falling Edge Either Edge

NOTE: When parameter 20 is set to TS1, this parameter will be set to Auto and cannot be changed.

22 - Trigger Input Attenuator

Parameter Group: **TrgInp**

Options: AtOff - Attenuator disabled
AtOn- Attenuator enabled
Default: AtOff - Attenuator disabled

Purpose: This parameter is used to optionally increase the dynamic range of the Trigger input signal conditioning circuit to increase noise immunity with strong signals. When this parameter is enabled, the SmartTach effectively applies a divide-by-five Attenuator to the input signal. This also places approximately a 12Kohm resistive load across the input.

How to Set: For most applications, this parameter should be left in the disabled setting. This parameter should be enabled only when the input signal level exceeds 5 volts peak (and never drops below 3 volts peak). The signal source should also have a relatively low output impedance (under 1000 ohms).

NOTE: When parameter 20 is set to TS1, this parameter will be set to Auto and cannot be changed.

23 - Trigger Input 5V Pull-Up

Parameter Group: **TrgInp**

Options: PuOff - Pull-up disabled
PuOn - Pull-up enabled
Default: PuOff - Pull-up disabled

Purpose: This parameter is used to accommodate Trigger sensors having "open collector" outputs (typically some hall-effect type sensors). When this parameter is enabled, the equivalent of a 1000 ohm resistor is placed between the input and an internal 5 volt power supply.

How to Set: This parameter should only be enabled if the input is used with an open collector output type sensor. This type of sensor has two output states, open and ground. It actually produces no output voltage. This parameter may be automatically set for certain Trigger Input Signal Level options.

NOTE: When parameter 20 is set to TS1, this parameter will be set to Auto and cannot be changed.

24 - Trigger Input Threshold Level

Parameter Group: **TrgInp**

Range: -5.12 - 5.08 volts (-25.6 - 25.4 volts if Attenuator enabled)
Increment: 0.04 volts (0.2 volts if Attenuator enabled)
Default: 0.00 volts (Attenuator disabled)

Purpose: This parameter is used to set the input threshold voltage level of the Trigger input. This is defined as the input signal voltage level at which the Trigger event is acknowledged. The direction of the voltage (rising or falling) must correspond to the Trigger Input Polarity setting.

How to Set: Setting this parameter is required only if the Trigger Input Level is set to allow manual setting of the Threshold level. This should only be done for special circumstances. This parameter may be automatically set for certain Trigger Input Signal Level options.

NOTE: When parameter 20 is set to TS1, this parameter will be set to Auto and cannot be changed.

25 - Trigger Input Hysterisis Level

Parameter Group: **TrgInp**

Range: -5.12 - 5.08 volts (-25.6 - 25.4 volts if Attenuator enabled)
Increment: 0.04 volts (0.2 volts if Attenuator enabled)
Default: 0.20 volts (Attenuator disabled)

Purpose: This parameter is used to set the input hysterisis voltage of the Trigger input. The actual available range is dependent on the input Threshold level.

How to Set: Setting this parameter is required only if the Trigger Input Level is set to allow manual setting of the Hysterisis level. This should only be done for special circumstances. This parameter may be automatically set for certain Trigger Input Signal Level options.

If the Trigger Input Level is set for automatic Hysterisis calculation, and a zero-crossing type input (magnetic sensor) is detected, this parameter will determine the minimum Hysterisis level which can be used for automatic control. The default value of 0.20 volts is suitable for most applications. If necessary, this value should be set slightly lower than the minimum expected peak sensor voltage under all operating conditions (most likely at the lowest engine speed).

NOTE: When parameter 20 is set to TS1, this parameter will be set to Auto and cannot be changed.

30 - Analog Output Mode

Parameter Group: **AnlOut**

Options:
- Norm - Track measured speed with filtering
- Max - Track maximum speed
- Min - Track minimum speed
- Raw - Track measured speed without any filtering

Default: Norm - Track measured speed with filtering

Purpose: This parameter is used to set the function of the analog output voltage. The default is appropriate for most uses. In normal mode the analog output voltage corresponds to the measured voltage including any filtering.

How to Set: This parameter should be set in accordance with the functional requirements of the device that the analog output is connected. When in Max or Min mode the analog output corresponds to the maximum or minimum measured speed. When connecting SmartTach to a control system for engine/vehicle speed control, normal(Norm) mode is recommended and Max and Min should not be used.

31 - Analog Output Scaling

Parameter Group: **AnlOut**

Range: 1-9999
Increment: 1
Default: Varies on the setting of parameter 00.
Note: Decimal place may vary with units, significant digits remain the same.

Purpose: This parameter is used to set the engineering units per volt scaling of the analog output signal. This effectively adjusts the "gain" of the analog output voltage. The maximum range of the output is 0 to +10 volts.

How to Set: This parameter should be set in accordance with the input requirements of the device to which the analog output is connected. The default setting of 1000 RPM/volt allows direct readout of RPM from the analog output voltage (shifting the decimal point right by three digits). This allows the use of a remote voltmeter to display measurements. Maximum and minimum voltage clamp limits can be set using other parameters.

32 - Analog Output Offset

Parameter Group: **AnlOut**

Range: 0-9999
Increment: 1
Default: 0
Note: Decimal place may vary with units, significant digits remain the same.

Purpose: This parameter is used to set the engineering units at zero-voltage output value. This setting corresponds to the measured value for which the analog output voltage will be 0 volts.

How to Set: This parameter should be set in accordance with the input requirements of the device to which the analog output is connected. The default setting of 0 degrees allows direct readout of RPM from the analog output voltage (shifting the decimal point right by three digits). This allows the use of a remote voltmeter to display measured speed.

33 - Analog Output Maximum Voltage Limit

Parameter Group: **AnlOut**

Range: 0.00-10.00 volts
Increment: 0.01 volts
Default: 10.00 volts

Purpose: This parameter is used to set the maximum output voltage limit of the analog output. This can be used to effectively "clamp" the maximum analog output voltage to accommodate external device inputs which cannot accept the full range of the analog output voltage.

How to Set: This parameter should be set in accordance with the input requirements of the device to which the analog output is connected. This is typically the maximum input voltage which the device will accept.

34 - Analog Output Minimum Voltage Limit

Parameter Group: **AnlOut**

Range: 0.00-10.00 volts
Increment: 0.01 volts
Default: 0.00 volts

Purpose: This parameter is used to set the minimum output voltage limit of the analog output. This can be used to effectively "clamp" the minimum analog output voltage to accommodate external device inputs which cannot accept the full range of the analog output voltage.

How to Set: This parameter should be set in accordance with the input requirements of the device to which the analog output is connected. This is typically the minimum input voltage which the device will accept.

35 - Analog Output Test Voltage

Parameter Group: **AnlOut**

Range: 0.00-10.00 volts
Increment: 0.01 volts
Default: 0.00 volts

Purpose: This parameter can be used to test the analog output voltage by allowing the operator to manually set the voltage to any level throughout the range. Accuracy of +/-0.005 volts.

How to Set: The Analog Output Test Voltage function is enabled when this parameter is selected. The output voltage can be adjusted using the up and down push-button switches. The change will not go into effect until the new value is accepted by pressing the ENTER push-button.

NOTE: This voltage is produced at the analog output whenever the SmartTach is in configure mode.

36 - Analog Output Update Period

Parameter Group: **AnlOut**

Range: 1-9,999 milliseconds
Increment: 1 millisecond
Default: 1 millisecond

Purpose: This parameter is used to set the update period of the analog output. This corresponds to the interval at which the SmartTach will update the analog output voltage from the most recently measured (and filtered) value.

How to Set: For most applications, this parameter can be left at the default setting of 1 millisecond. This corresponds to 1000 updates per second. This update period is asynchronous to the actual measurements. Therefore, the true update rate can only be as fast as the rate of the measured signal.

40, 50, 60 - Range Output Function

Parameter Group: **Range1 Range2 Range3**
Parameter Code: **40 50 60**

Options:
- Off - Output inactive
- On - Output always on(contacts closed)
- if N - Output is a function of the measured value
- if V - Output is a function of Aux. Input voltage.
- ifN&V - Output is on when the measurement condition "and" Aux. voltage condition are both true.
- ifN+V - Output is on when either the measurement condition "or" Aux. voltage condition are true.

Default: Off - Output inactive

Purpose: To select the type of functionality of the selected range output. SmartTach provides three separately configurable Range Outputs. The Range Outputs are isolated contact closures available at the I/O connector.

How to Set: This parameter should be set based on the desired functionality. Other parameters may need to be set for the outputs to function properly; such as Measurement condition, Voltage Condition and user variables A B C D.

Logic Table:

Setting	Measurement Condition	Aux. Voltage Condition	Range Output State
Off	Don't Care	Don't Care	Off
On	Don't Care	Don't Care	**On**
if N	False	Don't Care	Off
	True	Don't Care	**On**
if V	Don't Care	False	Off
	Don't Care	True	**On**
ifN&V	False	False	Off
	False	True	Off
	True	False	Off
	True	True	**On**
ifN+V	False	False	Off
	False	True	**On**

	True	False	**On**
	True	True	**On**

41, 51, 61 - Range Output Measurement Condition

Parameter Group: **Range1 Range2 Range3**
Parameter Code: **41 51 61**

Options:
- N>A - Measurement condition is True if N > A
- N<B - Measurement condition is True if N < B
- A<N<B - If A < B then, the measurement condition is True if A < N < B
  - If A > B then, the measurement condition is True if N < A or N > B

Default: N>A - Measurement is True if N > A

Purpose: To select the "Logic" applied to the measured value for the selected range output. SmartTach provides three separately configurable Range Outputs. These Range Outputs are isolated contact closures available at the I/O connector.

How to Set: This parameter should be set to the type of measurement you want.

Examples:

Setting	Measurement Value	Value of user variable A	Value of user variable B	Logic condition
N>A	1000	5000	Don't Care	False
	5500	5000	Don't Care	True
N<B	1000	Don't Care	500	False
	250	Don't Care	500	True
A<N<B	0	200	5500	False
A<B	2500	200	5500	True
	6000	200	5500	False
A<N<B	200	5000	400	True
A>B	1200	5000	400	False
	5250	5000	400	True

NOTE: These parameters are only valid if the corresponding Range Output Function is set to ifN, ifN&V or ifN+V. If set to A<N<B and A=B the condition is TRUE when N=A.

42, 52, 62 - Range Output Voltage Condition

Parameter Group: **Range1 Range2 Range3**
Parameter Code: **42 52 62**

Options: V>C - Measurement is True if V > C
V<D - Measurement is True if V < D
C<V<D - If C < D then, the measurement condition is True if C < V < D
- If C > D then, the measurement condition is True if V < C or V > D
Default: V>C - Measurement is True if V > C

Purpose: To select the "Logic" applied to the Aux. input voltage value for the selected range output. SmartTach provides three separately configurable Range Outputs. These Range Outputs are isolated contact closures available at the I/O connector.

How to Set: This parameter should be set to the type of measurement you want.

Examples:

Setting	Aux. Input Voltage	Value of user variable C	Value of user variable D	Logic condition
V>C	1.50	4.00	Don't Care	False
	4.50	4.00	Don't Care	True
V<D	2.00	Don't Care	1.00	False
	0.50	Don't Care	1.00	True
C<V<D	0.00	0.50	4.50	False
C<D	2.50	0.50	4.50	True
	5.00	0.50	4.50	False
C<V<D	0.00	4.50	0.50	True
C>D	2.50	4.50	0.50	False
	5.00	4.50	0.50	True

NOTE: These parameters are only valid if the corresponding Range Output Function is set to ifV, ifN&V or ifN+V. If set to C<V<D and C=D the condition is TRUE when V=C.

43, 53, 63 - Range Output "A" Value

Parameter Group: **Range1 Range2 Range3**
Parameter Code: **43 53 63**

Range: 0-9999
Increment: 1
Default: 0

Purpose: To assign a value to user variable "A" for use in range output control. This value is in engineering units and the position of the decimal point may vary.

How to Set: For the range output to function properly this parameter must be set under the following conditions:

- Range Output Function is set to ifN, ifN&V or ifN+V
- Range Output Measurement Condition is set to N>A or A<N<B

44, 54, 64 - Range Output "B" Value

Parameter Group: **Range1** **Range2** **Range3**
Parameter Code: **44** **54** **64**

Range: 0-9999
Increment: 1
Default: 0

Purpose: To assign a value to user variable "B" for use in range output control. This value is in engineering units and the position of the decimal point may vary.

How to Set: For the range output to function properly this parameter must be set under the following conditions:

- Range Output Function is set to ifN, ifN&V or ifN+V
- Range Output Measurement Condition is set to N<B or A<N<B

45, 55, 65 - Range Output "C" Value

Parameter Group: **Range1 Range2 Range3**
Parameter Code: **45 55 65**

Range: 0.00-5.08 volts
Increment: 0.02 volts
Default: 0.00 volts

Purpose: To assign a value to user variable "C" for use in range output control.

How to Set: For the range output to function properly this parameter must be set under the following conditions:

- Range Output Function is set to ifV, ifN&V or ifN+V
- Range Output Measurement Condition is set to V>C or C<V<D

46, 56, 66 - Range Output "D" Value

Parameter Group: **Range1** **Range2** **Range3**
Parameter Code: **46** **56** **66**

Range: 0.00-5.08 volts
Increment: 0.02 volts
Default: 0.00 volts

Purpose: To assign a value to user variable "D" for use in range output control.

How to Set: For the range output to function properly this parameter must be set under the following conditions:

- Range Output Function is set to ifV, ifN&V or ifN+V
- Range Output Measurement Condition is set to V<D or C<V<D

47, 57, 67 - Range Output Test State

Parameter Group: **Range1 Range2 Range3**
Parameter Code: **47 57 67**

Options: Off - Range Output off
On - Range Output on
Default: Off - Range Output off

Purpose: This parameter can be used to test the range output circuit by allowing the operator to manually switch the output on and off.

How to Set: The Range Output Test State function is enabled when this parameter is selected. The output state can be adjusted using the up and down push-button switches. The change will not go into effect until the new value is accepted by pressing the ENTER Pushbutton.

NOTE: The Range Outputs are placed in the Test States whenever the SmartTach is in configure mode.

70 - Analog Input Update Period

Parameter Group: **AnlInp**

Range: 10-9999 milliseconds
Increment: 1 millisecond
Default: 10 milliseconds

Purpose: This parameter is used to set the time interval between reading the voltage on the Aux. input.

How to Set: Adjust this value to match the response time that you would like SmartTach to react to changes in Aux. input voltage.

71 - Analog Input Filter

Parameter Group: **AnlInp**

Range: 1-255
Increment: 1
Default: 0 (No filtering)

Purpose: To Filter the analog input voltage.

How to Set: Generally filtering of the analog input voltage is not required. If you are experiencing "false" triggering of the range outputs, there may be noise on the analog input signal. Increasing the value of this parameter may help eliminate the false triggering of the range outputs due to noise on the analog input

80 - Display Brightness

Parameter Group: **Disply**

Options: 13%, 20%, 27%, 40%, 53%, 80%, 100%
Default: 40%

Purpose: This parameter is used to set the brightness of the SmartTach display.

How to Set: Set this parameter to your preference.

81 - Display Update Period

Parameter Group: **Disply**

Range: 10-9999 milliseconds
Increment: 1 millisecond
Default: 250 milliseconds

Purpose: This parameter is used to adjust the time interval between updates to the SmartTach display.

How to Set: The default value should be sufficient for most applications. If the display is changing too rapidly, try increasing this value. If the display is updating too slow, try decreasing this value.

90 - RS-232 Baud Rate

Parameter Group: **Serial**

Options: 75, 150, 300, 600, 1200, 2400, 4800, 9600 BAUD
Default: 9600 BAUD

Purpose: This parameter is used to set the baud rate of the RS-232 serial port.

How to Set: This parameter should be set to the baud rate of the computer device to which the serial RS-232 communications port is connected. The higher the value, the faster the communication rate will be. The default setting of 9600 baud is recommended whenever possible.

91 - RS-232 DTR/DSR Handshake

Parameter Group: **Serial**

Options: Off - Handshake disabled
On - Handshake enabled
Default: Off - Handshake disabled

Purpose: This parameter is used to enable hardware (DSR/DTR) handshaking for RS-232 serial communications.

How to Set: This parameter can be left in the default setting (Handshake disabled) for most applications. If the parameter is enabled, DSR/DTR handshaking will be required for serial communications between the SmartTach and external computer.

A0 - Trigger Input High Peak Voltage

Parameter Group: **InpMon**

Purpose: This diagnostic parameter is used to display the current Trigger input high peak (maximum positive) voltage level. This effectively allows measurement of the signal's peak voltage without using external instrumentation.

How to use: The high peak voltage level can be observed in either real-time or peak-hold mode. The real-time mode is default, this mode will continuously display the real-time high peak (maximum positive) voltage level of the Trigger Input. Unlike the peak-hold mode, the real-time mode will track the high peak level of the input signal both up and down.

The peak-hold mode can be selected by pressing the ENTER Pushbutton (The arrow symbol will flash). This mode will display and hold the highest attained (maximum positive) voltage level of the Trigger Input. Over time, this value will begin to fade unless refreshed by more reference pulses of equal or greater magnitude.

The voltage measurement range is dependent on the setting of the *Trigger Input Attenuator* parameter. If the Attenuator is disabled (default), the voltage measurement range is -5.12 to +5.08 volts in 0.04 volt increments. If the Attenuator is enabled, this range increases to -25.6 to +25.4 volts in 0.2 volt increments.

NOTE: The Input Signal Conditioning Select parameter(06) must be set to TRG for this function to work properly.

A1 - Trigger Input Low Peak Voltage

Parameter Group: **InpMon**

Purpose: This diagnostic parameter is used to display the current Trigger Signal input low peak (maximum negative) voltage level. This effectively allows measurement of the signal's peak voltage without using external instrumentation.

How to use: The Trigger Low Peak voltage level can be observed in either real-time or peak-hold mode. The real-time mode is default, this mode will continuously display the real-time low peak (maximum negative) voltage level of the Trigger Input. Unlike the peak-hold mode, the real-time mode will track the high peak level of the Reference signal both up and down.

The peak-hold mode can be selected by pressing the ENTER Pushbutton (The arrow symbol will flash). This mode will display and hold the highest attained (maximum positive) voltage level of the Trigger Input. Over time, this value will begin to fade down unless refreshed by more reference pulses of equal or greater magnitude.

The voltage measurement range is dependent on the setting of the *Trigger Input Attenuator* parameter. If the Attenuator is disabled (default), the voltage measurement range is -5.12 to +5.08 volts in 0.04 volt increments. If the Attenuator is enabled, this range increases to -25.6 to +25.4 volts in 0.2 volt increments.

NOTE: The Input Signal Conditioning Select parameter(06) must be set to TRG for this function to work properly.

A2 - Power Supply Input Voltage

Parameter Group: **InpMon**

Purpose: This diagnostic parameter is used to display the current power supply input voltage at the SmartTach PWR connector. The accuracy of this measurement is typically +/-0.02 volts.

How to use: The Power Supply Input Voltage can be observed real-time when this parameter is selected. Pressing the ENTER key will have no effect on the measurement.

A3 - Auxiliary Input Voltage

Parameter Group: **InpMon**

Purpose: This diagnostic parameter is used to display the current input voltage at the SmartTach Aux. Input connector. The accuracy of this measurement is typically +/-0.5 volts.

How to use: The Auxiliary Input Voltage can be observed real-time when this parameter is selected. Pressing the ENTER key will have no effect on the measurement.

F0 - Load Parameters from Memory

Parameter Group: **Memory**

Purpose: To load a previously saved set of parameters from one of the six user memory locations.

How to use: Select the saved parameter set that you like to use.

F1 - Save Current Parameters to Memory

Parameter Group: **Memory**

Purpose: To store the current settings in one of the six user memory locations.

How to use: Select the memory location that you would like to store the current settings into.

F2 - Reset Current Parameters

Parameter Group: **Memory**

Purpose: To restore the current settings to their default values.

How to use: This function may help correct measurement problems by returning all settings to their default values. All parameters will need to be setup for proper measurement after a reset. This DOES NOT affect the six user memory configurations.

Chapter 5
Operation

OPERATION

General Information

Operation of the SmartTach is straightforward for most applications. When power is first applied to the unit, the default operating mode is Measure Mode. This operating mode instructs the SmartTach to function in its normal mode of measuring speed. The current configuration parameter settings (most recently set and retained in memory) are used for all functions.

Measure Mode

The SmartTach Measure Mode has several functions and capabilities other than simply displaying Speed.

Display Maximum/Minimum Attained Values

This feature will display the maximum or minimum attained speed values since the last reset. This is independent of the Range Outputs. When this feature is active, the measurement units will be replaced with max and min.

This feature is useful to observe the maximum/minimum values attained during transients (which would be difficult to see real-time visually on the display). This feature can also be used to see the value(s) which triggered any Range Outputs that may have been set.

After viewing the maximum/minimum values, the unit can be returned to normal Measure Mode with or without resetting the maximum/minimum values. If the values are reset, the new minimum/maximum values begin at the current measured speed.

After power is first applied, or connection/disconnection of the input cables, the maximum/minimum values may be corrupted due to intermittent noise while making connections. Therefore, if this function is to be used, the maximum/minimum values should be reset prior to initial use.

Pushbutton Switch Functions

The function of each Pushbutton switch is dependent on the current operating mode. The information below describes the function of each Pushbutton switch while in the Measure Mode. Please refer to the Configuration Section for Pushbutton switch functions when in the Configure mode.

Measure Mode

Measurement Mode

Display: Measured data
PULSE: Flashing (if pulses are being received)
CONFIG: Off

▼: Display Min Input Value
▲: Display Max Input Value
ENTER: Toggle Display On/Off
MODE: Enter Configuration mode

Figure 5 - 1: Normal Measurement Display

Max Value Display

Display: Maximum Value
PULSE: Flashing (if pulses are being received)
CONFIG: Off

▼: Display Min Input Value
▲: Return to measurement mode
ENTER: Reset Max and Min Values
MODE: Enter Configuration mode

Figure 5 - 2: Maximum Value Display

Min Value Dispay

Display: Minimum Value
PULSE: Flashing (if pulses are being received)
CONFIG: Off

▼: Return to Measurement Mode
▲: Display Max Input Value
ENTER: Reset Max and Min Values
MODE: Enter Configuration mode

Figure 5 - 3: Minimum Value Display

Using Other Instruments with the Analog Output Signal

The Analog Output signal of the SmartTach generates a real-time analog output voltage representation of Speed. This precision output can be used to continuously send speed information to a test cell computer, data acquisition system, strip-chart recorder, etc. This output voltage is generated by a precision 12-bit digital-to-analog converter (absolute output accuracy is ±0.002 volts).

To insure maximum measurement accuracy at the external instrument end, it is recommended that the analog output signal be connected to a device having a differential voltage input. The analog output signal is isolated from power ground. It is also recommended that coaxial cable be used for the connection to maximize noise immunity.

The maximum output voltage range is 0.00 to 10.00 volts. Maximum current draw from the output should be limited to 10 milliamperes. The exact scaling, offset, and output voltage range limits are programmable through the configuration parameters. The update rate of this output is also programmable. This allows the analog output to be tailored to the requirements of the instrument receiving the signal.

A common use for the analog output is to display speed at a remote location. This can easily be done by using a digital voltmeter for the remote display.

Many data acquisition systems and strip chart recorders allow calibration of their analog inputs to match the outputs of the devices to which they are connected. The SmartTach has a special feature which allows for easy calibration of this type of equipment.

Configuration parameter 35 is used to output a test voltage from the Analog Output. This test voltage can be set in the range of 0.00 to +10.00 volts in 0.01 volt increments. In general, most instrumentation will require calibration at the minimum and maximum values of the Analog Output signal. Please refer to Chapter 4, Parameter 34 for further details.

Using Range Outputs

The SmartTach unit is equipped with three individually configurable Range Outputs. Range Outputs are solid-state contact closures that can be opened or closed based on user defined functionality. There are two pins

for each Range Output (A and B) at the I/O Connector. The Range Output contacts are closed when the user specified condition is true.

The Range Outputs can be used for functions such as; safety stops, controlling warning lights, Triggering data acquisition systems and many more. The functions of the Range Outputs range from a simple "Always On" to a complex comparison of measured speed and Aux. input voltage. Chapter 4 contains complete descriptions of all Range Output Parameters.

Range Output Example 1

This configuration will cut power to the engine controller if the measured rpm exceeds the user specified limit of 6000 rpm

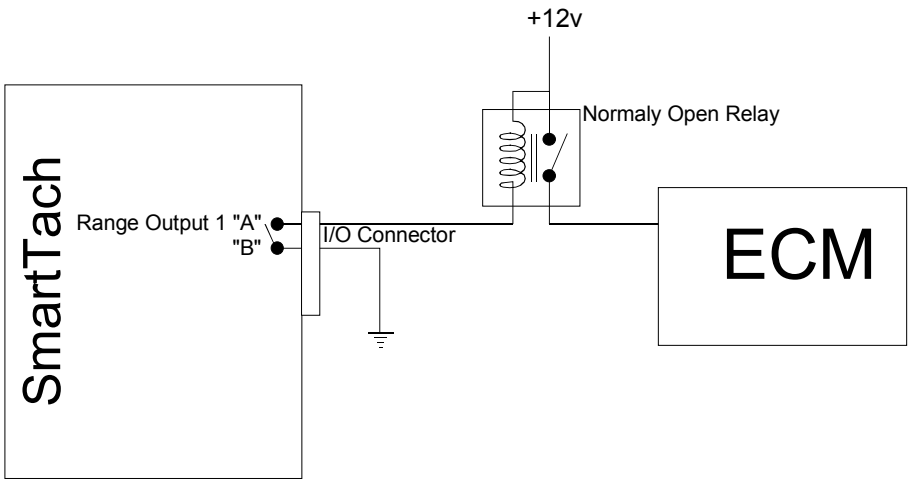


Figure 5 - 4: Range Output Overspeed

Parameter Settings

Parameter Group	Parameter ID and Description	Parameter Value
Range1	40 Range1 Output Function	ifN
	41 Range1 Output Measurement Condition	N<B
	44 Range1 Output Variable "B"	6000

Logic Table

Measured Speed	Aux. Input Voltage	Range1 Output Contacts	ECU Power Relay
500 rpm	Don't Care	Closed	Closed
6200 rpm	Don't Care	Open	Open

Range Output Example 2

This configuration will use two Range Outputs along with a oil pressure sensor connected to the Aux. input of the I/O connector. Power to the ECU will be cut if the measured rpm exceeds the user specified limit of 6000 rpm or if the signal from the oil pressure sensor is less than 0.5Vdc and measured rpm is greater than 300 rpm.

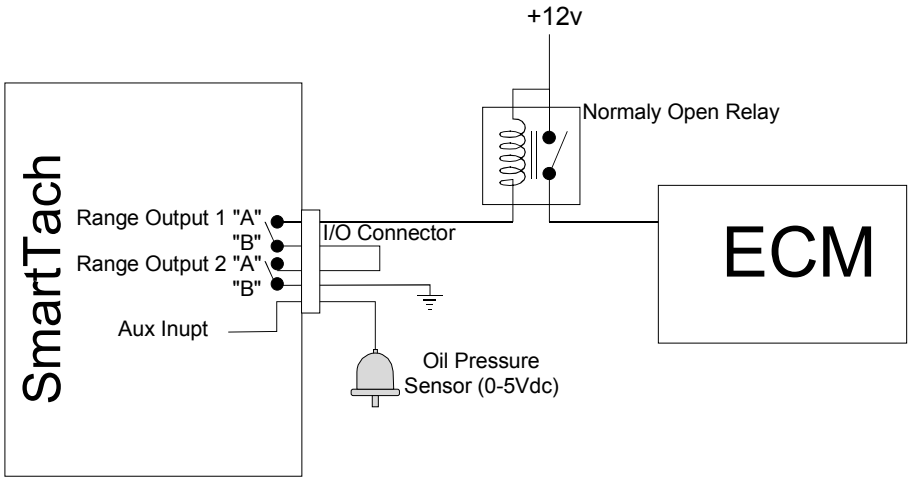


Figure 5 - 5: Range Output Overspeed/Low Oil Pressure

Parameter Settings

Parameter Group	Parameter ID and Description	Parameter Value
Range1	40 Range1 Output Function	ifN
	41 Range1 Output Measurement Condition	N<B
	44 Range1 Output Variable “B”	6000
Range2	50 Range2 Output Function	ifN+V
	51 Range2 Output Measurement Condition	N<B
	52 Range2 Output Voltage Condition	V>C
	54 Range1 Output Variable “B”	300
	55 Range1 Output Variable “C”	0.5

Logic Table

Measured Speed	Aux. Input Voltage	Output Range1	Contacts Range2	ECU Power Relay
100 rpm	0.1Vdc	Closed	Closed	Closed
1000 rpm	2.7Vdc	Closed	Closed	Closed
1000 rpm	0.2Vdc	Closed	Open	Open
6200 rpm	3.5Vdc	Open	Closed	Open

Chapter 6
Troubleshooting

TROUBLESHOOTING

General Information

This section is intended to describe problems which may be commonly encountered and solutions to eliminate those problems. In general, if all of the directions and precautions in this manual are properly followed, operation of the SmartTach should be trouble-free.

There may be certain cases when operation is not as expected. This does not necessarily mean that the SmartTach is defective. In most cases, the source of the problem will be either an improper configuration, installation, or defective sensors/cables. The internal circuitry of the SmartTach is fairly "bullet-proof" and should be suspected only if every other possible fault is eliminated.

We recommend that this entire section be read at least once, regardless of the problems symptoms. Problems such as erratic operation can be caused by a number of different faults and are the most difficult to track. Care in installation and configuration is the best method for avoiding problems.

Prior to tracking sensor/wiring/installation problems, we recommend that ALL of the configuration parameters be double-checked to insure that they are correctly set. This will solve 90% of the problems.

If assistance from Accurate Technologies Inc. is desired to help solve a problem, prior to calling please have ready all information pertaining to the specific installation, including a list of the current settings of ALL SmartTach configuration parameters.

Common Problems

Display does Not Light

This indicates that the SmartTach is not properly powered or the display has been turned off. Try pressing the ENTER key on the SmartTach to turn the display on. If the display does not light then check that the PWR input is connected to a 10-30 VDC power source providing a minimum power output of 10W. First, be sure that the power source is providing the necessary power. Second, check to be sure that the PWR connector is firmly plugged into the SmartTach and correct polarity is observed. Third, check that the power cable attached to the connector is firmly clamped by the screws in the top of the connector. If this connection is loose,

erratic operation may result. If none of these faults exist, please contact us for assistance.

TROUBLESHOOTING

Display is Always 0 or Erratic

This indicates that the input signal may be bad or the SmartTach is improperly configured. The front panel Pulse LED can be used to monitor the activity of this input. Possible faults include:

No signal from sensor (bad sensor or connection)
Solution: Check sensor output and wiring

Inductive Pick-up or other source connected to Pulse Input while using TachSensor
Solution: Disconnect input not being used

Improper Signal Conditioning Input Setting (06)
Solution: Verify Spark or Trigger input

Signal Conditioning Input set to SPK when using TachSensor
Solution: Set Parameter 6 to TRG

Improper Spark Input Threshold Setting (10)
Solution: Insure proper method selected for application, see Common Faults and Configuration Errors section for details.

Incorrect Value Displayed

This indicates an improper configuration. If the error is consistent in magnitude, the source of the fault is most likely configuration or system setup related. This can be as simple as an incorrectly set Pulses/Patterns Per Cam Rev (parameter 02).

Incorrect Analog Output Voltage

This indicates that the Analog Output related configuration parameters are incorrectly set, or the output is heavily loaded. First, verify that the parameters (30 - 36) are correctly set, parameter 30 set to "min" before startup will cause output to stay at zero volts. Second, disconnect the Analog output signal from the device to which it is connected and use a high input impedance voltmeter to check the voltage output. Parameter 35 is convenient for testing the full range of the analog output. Please refer to Chapter 2 for details on connecting the Analog output.

Erratic Analog Output Voltage

This indicates that there are major variations in measured speed. The problem is most apparent during hard acceleration and is caused by erratic ignition timing. This problem occurs mostly on distributor type ignition systems.

Possible solutions include:

- Move measurement source to one with higher resolution. A single spark plug wire has the lowest resolution in the ignition system. The coil wire or using the TachSensor on the coil power feed may produce better results.
- If the measurement source has more than 1 pulse per cam rev, try increasing the value of parameter 9.

Example:

V6 engine with distributor ignition. Inductive pick-up on a spark-plug wire. Parameters 2, 3 and 9 set to 1

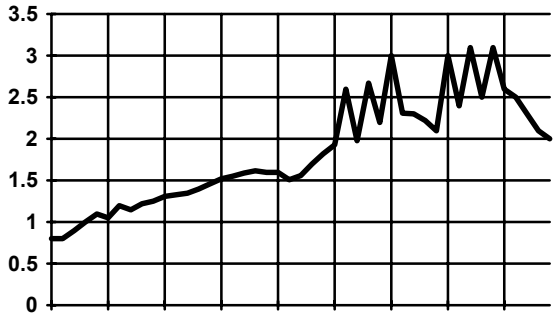


Figure 6 - 1: Erratic Analog Output

V6 engine with distributor ignition. Inductive pick-up moved to coil wire. Parameter 2 and 3 set to 1 and parameter 9 set to 2

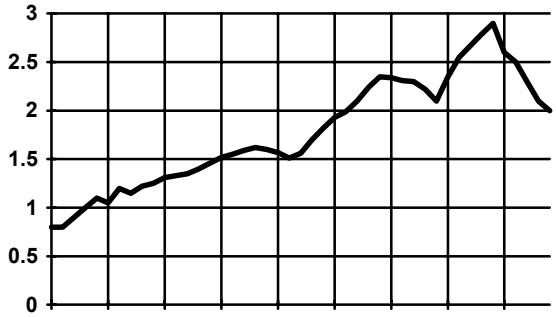


Figure 6 - 2: Normal Analog Output

Common Faults And Configuration Errors

Improper Setting of Input Conditioning Select (06)

This may result in erratic or no measurement. Verify that parameter 06 is set to the proper signal type.

Improper Setting of Spark Input Threshold Level (10)

This may result in erratic or no measurement. In general, a setting of 2 volts should be adequate when using an Inductive Pickup Sensor. Please refer to the information in chapter 4 for details. When connecting the input directly to the coil negative terminal, this parameter value should be raised to 4 volts. A low setting in this case may result in erratic readings.

Improper Input Polarity Setting (21)

The Intelligent Signal Conditioning circuitry can automatically configure the inputs for all types of sensor signals (zero-crossing, 5V, 12V etc.). However, it is impossible to automatically determine the correct trigger edge of the signal to use. Improper settings of these parameters may result in incorrect measurements. The polarity should always be set to edge of the signal which has the greatest slope (either positive or negative).

Incorrect Setting of Patterns/Pulses per Cam Rev (02)

The default value of this parameter is 1. When using engine starter ring-gear (flywheel) teeth or an encoder type signal, be sure to set this parameter to the number of teeth on the wheel. An incorrect setting will result in incorrect measurement values without any other indications of improper operation.

Cables Routed near Spark Plug Wires or Coils

All SmartTach cables should be routed away from all spark plug wire cables and ignition coils. Even though the cables are shielded, high frequency noise from the ignition system can penetrate into the inputs. This will result in erratic operation.

Bad Connections in Wiring Cables

It is always better to spend extra time to insure that all connections are properly made, especially when making custom cables. Loose connections, especially in the ground/common lines will result in problems which are very difficult to trace. This will almost always result in erratic operation.

Warranty

WARRANTY and DISCLAIMERS

Warranty

Accurate Technologies Inc. warrants the SmartTach Universal Measurement Tool to be free from defects in materials and workmanship for a period of three (3) years from the date of shipment to the buyer. Within this three (3) year warranty period, Accurate Technologies Inc. will at our sole option repair or replace the SmartTach if it is returned to us with shipping charges prepaid and determined by us to be defective. This warranty will be void if the SmartTach is subject to misuse, negligence, or accident, modified, improperly installed, or the enclosure is opened.

All sensors, cables, and other accessories are considered to be expendable parts and as such are not covered by any warranty.

This warranty comprises the sole and entire warranty pertaining to the SmartTach. Accurate Technologies Inc. makes no other warranty, guarantee, or representation of any kind whatsoever. All other warranties, including but not limited to merchantability and fitness for purpose, whether express, implied, or arising by operation of law, trade usage, or course of dealing are hereby disclaimed.

Limitation of Remedy

The liability of Accurate Technologies Inc. arising from or in any way connected with the items sold and/or services provided shall be limited exclusively to repair or replacement of the items sold or refund of the purchase price paid by the buyer, at our sole option. In no event shall Accurate Technologies Inc. be liable for any incidental, consequential, or special damages of any kind or nature whatsoever, including but not limited to lost profits arising from or in any way connected with the items sold and/or services provided to the buyer, whether alleged to arise from breach of contract, express or implied warranty, or in tort, including without limitation, negligence, failure to warn or strict liability. In no event shall the liability of Accurate Technologies Inc. to the buyer arising out of or relating to the sale of any product or service exceed the purchase price paid by the buyer to Accurate Technologies Inc. for such product or service.

Product Changes

Accurate Technologies Inc. reserves the right to discontinue a particular product or make technical changes at any time without notice.

Appendices

APPENDICES

Parameter Groups and Default Values

Parameter Group	Parameter ID and Description	Default Value
Setup!	00 Measurement Parameter	EngSp
	01 Displayed Engineering Units	RPM
	02 Pulses/Patterns Per Cam/Dyno Rev	1
	03 Pulses Per Pattern	1
	04 Engineering Unit Conversion Factor	N/A
	05 Engineering Conversion Units	N/A
	06 Input Signal Conditioning Select	SPK
	07 Measurement Low-Pass Filter	0
	08 Multi-Strike Filter	Off
	09 Pulses per Measurement	1
SpkInp	10 Spark Input Threshold Level	2.00
	11 Spark Input Delay Period	3.0
TrgInp	20 Trigger Input Level	AutoT
	21 Trigger Input Polarity	Neg
	22 Trigger Input Attenuator	AtOff
	23 Trigger Input Internal 5V Pull-Up	PuOff
	24 Trigger Input Threshold Level	Auto
	25 Trigger input Hystersis Level	0.20
AnlOut	30 Analog Output Mode	Norm
	31 Analog Output Scaling	1000
	32 Analog Output Offset	0
	33 Analog Output Maximum Voltage Limit	10.00
	34 Analog Output Minimum Voltage Limit	0.00
	35 Analog Output Test Voltage	0.00
	36 Analog Output Update Period	1
Range1	40 Range Output #1 Function	Off
	41 Range Output #1 Measurement Condition	N>A
	42 Range Output #1 Voltage Condition	V>C
	43 Range Output #1 "A" Value	0
	44 Range Output #1 "B" Value	0
	45 Range Output #1 "C" Value	0.00
	46 Range Output #1 "D" Value	0.00
	47 Range Output #1 Test State	Off

Parameter Group	Parameter ID and Description	Default Value
Range2	50 Range Output #2 Function	Off
	51 Range Output #2 Measurement Condition	N>A
	52 Range Output #2 Voltage Condition	V>C
	53 Range Output #2 "A" Value	0
	54 Range Output #2 "B" Value	0
	55 Range Output #2 "C" Value	0.00
	56 Range Output #2 "D" Value	0.00
	57 Range Output #2 Test State	Off
Range3	60 Range Output #3 Function	Off
	61 Range Output #3 Measurement Condition	N>A
	62 Range Output #3 Voltage Condition	V>C
	63 Range Output #3 "A" Value	0
	64 Range Output #3 "B" Value	0
	65 Range Output #3 "C" Value	0.00
	66 Range Output #3 "D" Value	0.00
	67 Range Output #3 Test State	Off
AnlInp	70 Analog Input Update Period	10
	71 Analog Input Filter	0
Disply	80 Display Brightness	40%
	81 Display Update Period	250
Serial	90 RS-232 Baud Rate	9600
	91 RS-232 DTR/DSR Handshake	Off
InpMon	A0 Trigger Input High Peak Voltage	No Default Value
	A1 Trigger Input Low Peak Voltage	No Default Value
	A2 Input Power Voltage	No Default Value
	A3 Aux. Input Voltage	No Default Value
Memory	F0 Load Parameters from Memory 1~6	No Default Value
	F1 Save Current Parameters to Memory	No Default Value
	F2 Reset Current Parameters to Defaults	No Default Value

APPENDICES

Connectors and Pin-Outs

Rear Panel

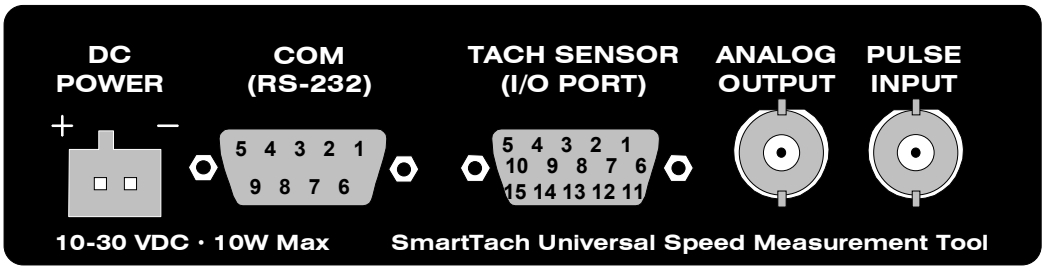


Figure A - 1: Connector Placement

Analog Output

Connector Type: BNC Connector (Industry Standard)

Pin	Description
Center	Analog Output Voltage (0-10Vdc)
Housing	Analog Output Ground (Isolated from Input Ground)

Pulse Input

Connector Type: BNC Connector (Industry Standard)

Pin	Description
Center	Pulse Input Signal (±75Vdc in Trigger mode) (±1KV In Spark Mode)
Housing	Pulse Input Ground (Isolated from Analog Output Ground)

COM Port

Connector Type: DB-9F (Standard 9-pin female)

Pin	Description
1	DCD Output (Data Carrier Detect)
2	TXD Output (Transmit Data)
3	RXD Input (Receive Data)
4	DTR Input (Data Terminal Ready)
5	GND (Signal common)
6	DSR Output (Data Set Ready)
7	RTS Input (Request to Send)
8	CTS Output (Clear to Send)
9	RNG Output (Ring Indicator)

Note: Pins 1, 6, and 8 are internally connected.
Pins 7 and 9 are not used and not connected.

APPENDICES

TachSensor - I/O Connector

Connector Type: HDB-15F (High Density 15-pin female)

Pin	Description
1	Ground Shield
2	Digital Pulse Out (0-5V, referenced to Pin 7)
3	Range Output #1 terminal "B"
4	Range Output #2 terminal "B"
5	Range Output #3 terminal "B"
6	Isolated Ground Shield
7	Isolated Ground
8	Range Output #1 terminal "A"
9	Range Output #2 terminal "A"
10	Range Output #3 terminal "A"
11	Reserved, Do not connect to this pin
12	Reserved, Do not connect to this pin
13	Ground
14	Aux. Analog input (0-5V, referenced to Pin 13)
15	Reserved, Do not connect to this pin

Power Supply Input

Connector Type Plug-in Terminal Strip Connector

Pin	Description
1	+10 to +30 Volts DC
2	Ground

SmartTach Accessories

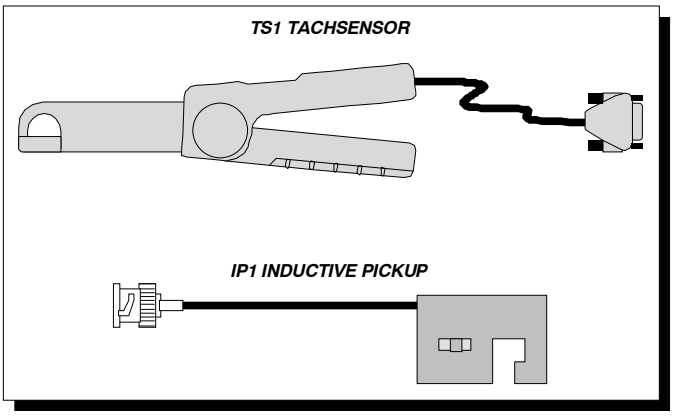


Figure A - 2: SmartTach Accessories

TS1 TachSensor

The TS1 TachSensor expands the SmartTach functionality by allowing engine RPM measurement without intrusive connections. Currently RPM measurements are made by connecting directly to the coil negative terminal or by using a inductive pickup on a secondary ignition cable, both of which have their problems. Connecting directly to the wiring harness can be difficult and in some instances not allowed. Using Inductive pickups can be noisy and provides the lowest measurement resolution (1pulse/2 crank revs). The TS1 TachSensor clamps easily around a coil driver cable and works equally well on distributor, distributorless and coil on-plug ignition systems. The TS1 TachSensor is designed for engine RPM measurement and is not recommended for Duty cycle and Pulsewidth measurements.

IP1 Inductive pickup

The IP1 is a high quality Inductive pickup. The IP1 is used to detect the electrical current flow through the spark plug wire. It uses an inductive principal which measures the magnetic field generated around the spark plug wire when current flows through it. This sensor is easily installed by clamping it onto a spark plug wire. The sensor has a locking ability which prevents it from accidentally falling off of the spark plug wire. Most inductive pickup sensors (including the IP1) are direction sensitive. This means that re-clamping it onto the spark plug wire in the opposite direction will affect the output level of the sensor. The sensor should be clamped on in the direction which provides the best output. The easiest method to determine this is to try it in both directions.

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