



# **Walter M601 TSLM**



## **Operational & Install Manual**

**Updated: Thursday, October 08, 2009**

Copyright 2009 by VR Avionics

© 2009 VR Avionics Inc.

All rights reserved.

This User and Installation Guide and the information contained herein is the proprietary data of VR Avionics. No part of this manual may be reproduced, copied, transmitted, disseminated or stored in any storage medium, for any purpose without the express written permission of VR Avionics, Inc. VR Avionics hereby grants permission to download a single copy of this manual and of any revision to this manual onto a hard drive or other electronic storage medium to be viewed for personal use, provided that such electronic or printed copy of this manual or revision must contain the complete text of this copyright notice and provided further that any unauthorized commercial distribution of this manual or any revision hereto is strictly prohibited. Information in this document is subject to change without notice. VR Avionics reserves the right to change or improve its products and to make changes in the content without obligation to notify any person or organization of such changes. Visit the VR Avionics website ([www.vravionics.com](http://www.vravionics.com)) for current updates and supplemental information concerning the use and operation of this and other VR Avionics products.

VR Avionics

[www.vravionics.com](http://www.vravionics.com)

## Contents

<b>Introduction.....</b>	<b>5</b>
System Options.....	5
The New TSLM.....	5
<b>Operations.....</b>	<b>6</b>
Power-up (Master ON).....	6
Initiating a Start.....	6
Initiating a Run .....	8
Automatic Protection Limiting.....	8
Start Limiting.....	8
Beta & Reverse Propeller Limiting.....	8
Anti-Flameout Operation (AFO).....	8
Parameter Exceeds.....	9
TSLM Light Codes.....	9
Electrical & Mechanical Specifications.....	10
Module Dimensions.....	10
RS232 Data Interface.....	11
<b>Installation.....</b>	<b>12</b>
Tools and Equipment.....	12
Electrical Installation.....	13
Power and Ground.....	14
Ignition Circuit.....	15
Start/Run Selection.....	16
Start Contactor.....	16
Start Interrupter Valve.....	17
Limiting (EHT) Circuit.....	18
TSLM Status Light.....	19
Exceed Light.....	19
Gas Generator Speed Sensing (N1).....	20
Propeller Speed Sensing (N2).....	20
Inter Turbine Temperature Sensing (ITT).....	21
Voltage Sensing.....	22
Beta Switch Sensing.....	22
Torque and Oil Pressure Sensing (optional).....	23
Adding a VR-3PD Display (optional).....	24
Adding a FAM (optional).....	24
TSLM Pin Definitions.....	25
<b>System Link Software .....</b>	<b>26</b>
Introduction.....	26
System Requirements.....	26
Downloading and Installing the System Link Software.....	26
Using the System Link Software.....	26
Viewing the System Parameters.....	27
Synchronizing with the System.....	27
Viewing the Configuration.....	28
Opening and Viewing History Files.....	28
Changing the Configuration.....	29
Configuration Properties.....	30
History Recorded (bytes).....	30
Start Cycles.....	30
Flight Hours.....	30
Upper ITT Exceeds.....	30
Lower ITT Exceeds.....	30
N1 Exceeds .....	30
N2 Exceeds .....	30

Torque Exceeds .....	30
Max. Unit Temperature °C .....	31
Min. Unit Temperature °C .....	31
Last Attempted Start Time (seconds) .....	31
Last Attempted Start Min Voltage (V) .....	31
Last Attempted Start Max ITT (°C) .....	31
Last Attempted Start EHT Resistance (Ohms) .....	31
Internal Temperature Calibration .....	31
ITT Calibration .....	31
Voltage Calibration .....	31
Torque Span Calibration .....	31
Torque Offset Calibration .....	31
Oil Pressure Span Calibration .....	31
Oil Pressure Offset Calibration .....	31
Oil Temperature Span Calibration .....	31
Oil Temperature Offset Calibration .....	31
Alternative Interrupter Activation .....	32
Force a Start sequence when double-clicking Start Button .....	32
Walter Engine Type (0=M601D, 1=M601E-11, 2=M601E-11A) .....	32
Start ITT Control Setting .....	32
Display Brightness.....	32
Display Contrast .....	32
Show FAM Fuel Page .....	32
Show TSLM 2nd Page (with OIL-TEMP) .....	32
Fuel Remaining Maximum (Fill-up value) .....	32
Fuel Flow Sensor K-Factor.....	32
Low Endurance Fuel Warning Level (minutes) .....	32
Low Remaining Fuel Warning Level .....	33
Diagnostic Test and Troubleshooting.....	33

## Introduction

### ***System Options***

There are three system configurations that involves the following units:

1. the TSLM,
2. the VR-3PD display, and
3. the FAM fuel computer.

The most basic system is the TSLM only system, which provides the bulk of the functions required. The second configuration adds a VR-3PD display to the system, which greatly enhances operation with a feature-rich pilot interface. The third configuration adds a FAM fuel computer to the system. This module will add fuel calculations to the VR display such as fuel flow, fuel remaining and fuel endurance. Please visit the ([www.vravionics.com/tslm\\_m601.htm](http://www.vravionics.com/tslm_m601.htm)) web page if you are not yet familiar with these configurations and what they provide.

This manual will attempt to describe both the installation and the operation of the above mentioned units. If there exists unclarity, please feel free to phone or email us. Our contact details are posted on our website ([www.vravionics.com](http://www.vravionics.com)).

### ***The New TSLM***

This manual covers the new TSLM from VR Avionics. While maintaining backward compatibility with the first generation TSLM, it is equipped to extend the system's Limiting and Monitoring capabilities.

New TSLM serial numbers begin at 5001 whereas first generation TSLM numbers range between 3001 and 4100. Another manual on our website deals with old TSLM units.

## Operations

### ***Power-up (Master ON)***

When power is applied to the TSLM it will turn on the TSLM light for about 2 seconds while the unit performs a self-check. If everything checks out fine the TSLM light will be turned off. If however a problem / concern is detected the TSLM light will indicate as follows:

<b>Problem or Concern</b>	<b>TSLM light indication</b>
<b>EHT Error:</b> The EHT valve is being powered externally from TSLM due to possible wiring problem	4 blinks.. pause.. 4 blinks.. pause, etc
<b>Memory Warning:</b> The TSLM memory used for recording start and exceed graphs has reached the 90% mark. You may want to synchronize (and download) the history to your laptop first in order not to lose it.	7 blinks (directly after power-up)
<b>TSLM Internal Fault:</b> The TSLM has failed the self-check and needs to be serviced.	Solidly on or slowly flashing (no code)

### ***Initiating a Start***

By depressing the START button (or momentary toggle switch) you initiate a start. The TSLM will first perform pre-start checks – it will check that the ITT is connected properly and lower than 200°C, that the bus voltage is at least 20 volt and that the EHT can be detected electrically by the TSLM. These checks have been included for safer starting and if one fails the TSLM will decline the start and report the cause via the TSLM light as follows:

<b>Cause of Error</b>	<b>TSLM light indication</b>
<b>ITT Error:</b> ITT is above 200°C or not connected properly. If above 200°C you can do a RUN first to cool it down.	2 blinks.. pause.. 2 blinks.. pause, etc.
<b>Voltage Error:</b> The bus voltage is too low for safe starting	3 blinks.. pause.. 3 blinks.. pause, etc.
<b>EHT Error:</b> Access by the TSLM to the EHT valve could not be confirmed electrically. The reason could be that the limiter enable/disable switch is not in the proper position.	4 blinks.. pause.. 4 blinks.. pause, etc

If one of these pre-start checks have failed, you can correct the cause and try again. In order to do this you need to acknowledge and reset the error first. This is done by depressing the RUN button for about 1 second. The TSLM will now stop flashing and you are free to issue another start attempt.

If all the pre-start checks pass, the TSLM will activate the start sequence – by engaging the starter, turning on the ignition and sequencing the fuel to the torch igniters. You should be able to hear the starter/generator spin and the ignition making sparks. From the moment it starts spinning there is 10 seconds for light-off. Light-off is where the main fuel in the combustion chamber ignites and can clearly be heard and seen in the ITT rising sharply. In case light-off does not occur within the 10 seconds (which implies some system problem), the TSLM will turn off the

ignition and stop the fuel to the torch igniters, but continue spinning the engine for 10 more seconds.

If this happens the pilot must close the fuel (shut-off valve lever to closed) just after the first 10 second period had expired. With the engine spinning for the next 10 seconds or so, closing the fuel will purge fuel vapors from the combustion chamber.

If the engine lights off before the first 10 second period expired (as would normally happen), the TSLM will sense this and immediately start controlling the rise in ITT and the absolute ITT value as required by activating the EHT valve. Both the TSLM light and the EHT light (if fitted) will turn on when the EHT is activated by the TSLM during the start.

If the ITT leads (from the thermocouples) is connected the wrong way around (maybe after a service) or become disconnected in some way that would only become apparent after light-off, the TSLM will sense this and immediately turn on the EXCEED light. Since the TSLM can no longer measure the ITT accurately in this condition, the pilot needs to abort the start by cutting fuel as earlier mentioned to avoid possibly damaging the turbine. The starter will remain active for another 10 seconds so that fuel can again be purged from the combustion chamber.

The EXCEED light will also be turned on when the ITT increases to over 700°C. The TSLM should be able to control the ITT to below this temperature. If it is unable to, this would imply some mayor problem – for example accidental isolating valve activation, dead batteries, or fuel control unit problems. An abort of the start is recommended in this case also.

When the compressor reaches idle speed ( $N1 > 55\%$ ), the starter, ignition and fuel to the torch igniters will be turned off. Otherwise these devices will timeout 20 seconds after light-off was sensed.

#### Start check list:

- ◆ Power ON
- ◆ Inverter on if necessary
- ◆ Fuel ON
- ◆ Fuel pump(s) ON
- ◆ Condition lever forward to OPEN (detent)
- ◆ Propeller in feather position
- ◆ Throttle in IDLE position
- ◆ Ensure ISOL valve is OFF (normal position)
- ◆ Ensure Limiter Enable switch (if installed) is ON (normal position)
- ◆ Press START. Keep hand ready on the condition lever in case of problem
- ◆ If engine fails to light after 10 seconds - shut fuel down by pulling the condition lever, and wait for starter motor to disengage before turning power off to investigate problem.
- ◆ If engine lights - monitor increasing ITT temperature. If the EXCEED light comes ON or the ITT exceeds 700°C, quickly pull the condition lever (fuel shut-off lever) to CLOSED.
- ◆ Ensure N1 (gas generator speed) increases to at least 60%. If not, forward the throttle slightly and monitor ITT.
- ◆ After N1 and ITT have stabilized, switch the generator ON.
- ◆ Check Oil and Fuel Pressure
- ◆ Forward Prop to full fine pitch

***Initiating a Run***

A run operation will purge possible fuel vapors inside the combustion chamber. If your ITT is above 200°C performing a run will also cool down the turbine temperature as new air is forced through the engine.

By depressing the RUN button (or momentary toggle switch) you initiate a dry motor-run. The TSLM will turn on the starter for 8 seconds to spin the engine. After the 8 seconds, the starter is turned off. The TSLM will monitor the N1 signal and alert you after the run if no signal was detected from the N1 tach-generator sensor by pulsing the TSLM light as follows:

<b>Caution</b>	<b>TSLM light indication</b>
<p><b>N1 Error:</b> While conducting the run the TSLM did not detect any signal from the N1 sensors. A signal should have been detected. Check wiring.</p>	<p>5 blinks.. pause.. 5 blinks.. pause, etc</p>

If you get the above warning, check your wiring to rectify this.

**Run Check List:**

- ◆ Master switch On
- ◆ Throttle to idle
- ◆ Propeller to Feather
- ◆ Condition lever in shut off (CLOSED) position
- ◆ Press the RUN switch and monitor ITT temperature drop.

***Automatic Protection Limiting***

The TSLM provides automatic engine limiting when it restricts fuel to the engine by activating the EHT valve. The EHT light (if installed) will come ON whenever limiting is performed. Limiting is restricted to only the start and beta-propeller speed limiting. Limiting may also be disabled, by an external limiter enable / disable switch (see page 18 for the electrical circuit).

**Start Limiting**

During the start process the engine’s temperature (ITT) can be exceeded – more so when it is started without any form of limiting (no activation of the EHT). The amount of limiting required vary according to conditions such as outside air temperature, altitude, battery charge and initial ITT. The TSLM utilizes an algorithm to control both the rate of rise and the absolute value of the inter-turbine temperature (ITT).

If you have forgotten the limiter enable / disable switch (if installed) in the disable position when initiating a start attempt, the TSLM's pre-start checks will detect it, decline the start attempt and inform you via the TSLM light as to the problem. See the section on initiating a start for more.

**Beta & Reverse Propeller Limiting**

To prevent a propeller exceed in Beta and Reverse thrust mode as well as to ensure effective reverse thrust application, the TSLM will limit the propeller speed (N2) while in BETA mode.

***Anti-Flameout Operation (AFO)***

In the anti-flameout mode of operation the igniters and ignition fuel valves are continuously activated as a precautionary measure against engine flameout. This mode is manually activated by the pilot when the engine has already been started (is running) by depressing the START switch for at least one second before releasing it. The TSLM status light will light up to indicate that the AFO mode has been entered. To deactivate this mode in-flight, the pilot depresses the

RUN switch for at least one second before releasing it. The TSLM status light should go out indicating the anti-flameout mode has been exited.

**Parameter Exceeds**

Should any of the engine parameters be go over their maximum limits the EXCEED light (if installed) will come ON for the duration of the exceed. All relevant parameters are recorded versus time by the TSLM and a dedicated counter incremented within the TSLM. This information can be viewed in the Configuration and History sections of the System Link software.

Parameter exceeds are recorded in TSLM history according to the type of M601 engine used:

Engine Type	Max. ITT	Max. N1	Max. N2	Max. Torque
M601D	735 °C	100.00%	2080 RPM	132 psi
M601E-11	735 °C	100.00%	2080 RPM	145 psi (106%)
M601E-11A	710 °C	98.50%	1950 RPM	134 psi (98%)

Make sure that you set the “Engine Type” configuration property to the appropriate model engine you are using (see page 32).

**TSLM Light Codes**

The TSLM light provides feedback to the pilot concerning the system's status. The light will blink a certain pattern to report the problem to the pilot. The following table shows the codes:

Problem	TSLM light indication
ITT Error	2 blinks.. pause.. 2 blinks.. pause, etc
Voltage Error	3 blinks.. pause.. 3 blinks.. pause, etc
EHT Error	4 blinks.. pause.. 4 blinks.. pause, etc
N1 Error	5 blinks.. pause.. 5 blinks.. pause, etc
ISOL Error	6 blinks.. pause.. 6 blinks.. pause, etc
Memory Warning	7 blinks.. pause.. 7 blinks.. pause, etc
TSLM Internal Error	Solid ON, or slowly flashing

See also the sections that describes initiating a start and a run.

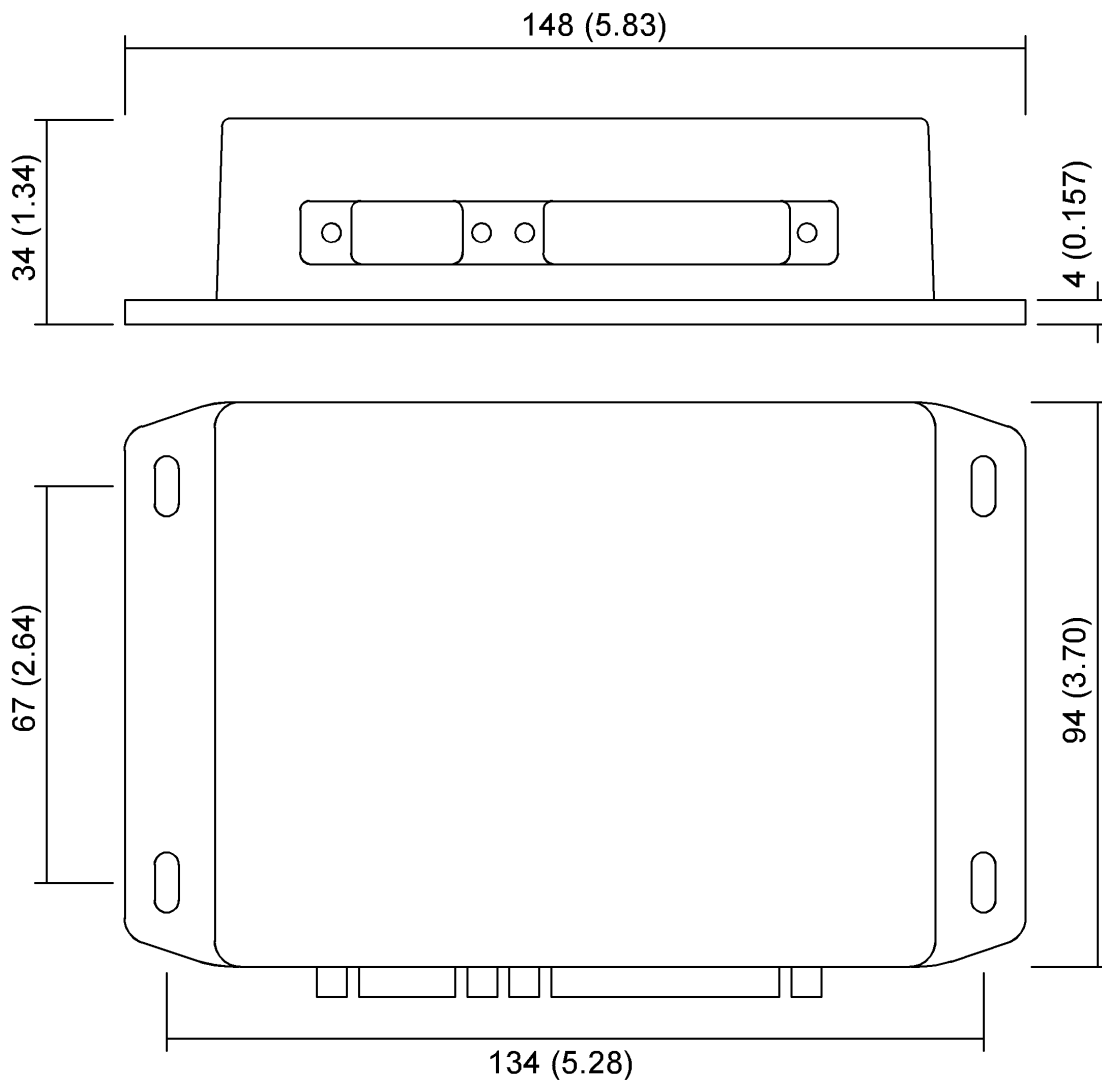
**Acknowledging the TSLM light Indication:**

An error code can be acknowledged and reset by holding either the start or run button / switch down for at least 1 second. The TSLM light will then stop blinking, which will indicate that the TSLM is now ready to accept new commands from the pilot (start, run, etc.).

**Electrical & Mechanical Specifications**

Power Requirements	10 to 32 VDC
Supply Current (start or run sequence)	< 10 A
Supply Current (monitoring only)	< 50 mA
Operating Temperature	-40°C to +70°C
Storage Temperature	-55°C to +85°C
Weight	½ Kg (1 lb)
Dimensions	5.9" x 3.74" x 1.38" (150 x 95 x 35mm)

**Module Dimensions**



DIMENSIONS IN MM. (INCHES ARE IN BRACKETS)

***RS232 Data Interface***

The TSLM uses a RS232 interface (9600 baud, 8 data-bits, 1 stop-bit, no parity) to link to a Personal Computer, Laptop or similar device. The pins used on the DB-9 port are as follows:

- 2 – RXD
- 3 – TXD
- 5 – GND

The TSLM will transmit a stream of data 10 times per second out on pin 2. Please contact VR Avionics should you require detailed protocol information.

## Installation

### *Tools and Equipment*

Tools and equipment required for installation (not included in the purchase) are:

- ◆ Wire cutters
- ◆ Wire strippers
- ◆ Wire (single core, Teflon insulated 20 AWG)
- ◆ Thermocouple wire (K-type)
- ◆ Connector crimp tool
- ◆ DB-25 female connector with crimp pins
- ◆ Personal computer running Windows 98 or higher, with a spare serial port. If no serial port, a USB port together with a USB-to-serial adapter will do.
- ◆ Standard RS-232 cable (DB-9 male to DB-9 female)
- ◆ Torque and Oil Pressure transducers (see page 23)

Description	Part Numbers		
Crimp contacts	M24308/10-1	M39029/63-368	AMP 205090-1
Crimp tool	M22520/2-01	AFM8 (DMC)	
Crimp tool positioner	M22520/2-08	K13-1 (DMC)	
Insertion tool	MS1969/1-02	DAK 145	
Extraction tool	MS1969/1-02	DAK 145	

### ***Electrical Installation***

The following section describes the wiring requirements for using the TSLM. Please follow these instructions explicitly as improper wiring can result in permanent damage to your unit. All electrical power and data lines interface with the TSLM via the 25-pin D-Sub connector on the side of the unit.

#### **Important Note:**

After completing the TSLM system installation, verify it by performing the following tests before you do the first engine start:

- Do a Diagnostic Test (Diagnostic Test and Troubleshooting, page 33)
- Do a RUN/MOTOR sequence (Run Operation, page 8)

#### **Recommended wiring practices**

NOTE: For all electrical connections, use correct splicing techniques, taking care to properly insulate any exposed wire. A short circuit between any of the wires may cause damage to the TSLM and/or your airplane.

VR Avionics does not supply connectors or wire for wiring up your TSLM. We recommend that standard aircraft grade wiring and connectors be used during installation. 20 gauge wire is sufficient for most lines to the unit. Make sure you protect the power lines with either a circuit breaker or fuse sized appropriate to the wire you select. We recommend you use wire meeting Mil Standard MIL-W-22759/16 (Tefzel insulation) which is available from various suppliers such as Aircraft Spruce. Another option is to use Teflon insulated wire (Alpha brand is available from Mouser electronics [www.mouser.com](http://www.mouser.com)) which is available in various colors.

Connectors: We recommend you use machined pin connectors to mate with the TSLM connector. One source of the machined pins is B&C Specialty Products ([www.aeroelectric.com/Catalog/BCcatalog.html](http://www.aeroelectric.com/Catalog/BCcatalog.html)) which also supplies the required crimp tool. Crimp connections have proven to be the most reliable in aircraft installations. D sub shells to hold the pins are available from various sources such as Mouser mentioned above. Purchasing high quality connectors is a very wise investment in your aircraft.

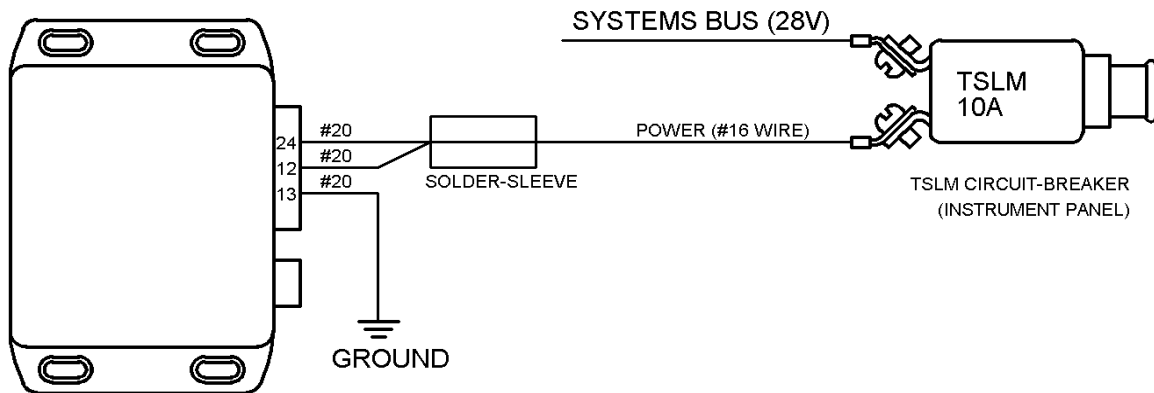
Installing: Make sure all connections are secure and all wires are routed and strain relieved to ensure the wires will not chafe against any other object in the aircraft.

Electrical installation of the TSLM system is divided in sections according to function. Sections marked as 'optional' are not required for proper operation, but would be recommended. The following sections are however required:

- ◆ Power and Ground
- ◆ Ignition Circuit
- ◆ Start/Run Selection
- ◆ Start Interrupter Valve
- ◆ Start Contactor
- ◆ Limiting (EHT) Circuit
- ◆ TSLM Status Light
- ◆ Exceed Light
- ◆ Gas Generator Speed Sensing (N1)
- ◆ Propeller Speed Sensing (N2)
- ◆ Inter Turbine Temperature Sensing (ITT)
- ◆ Voltage Sensing

**Power and Ground**

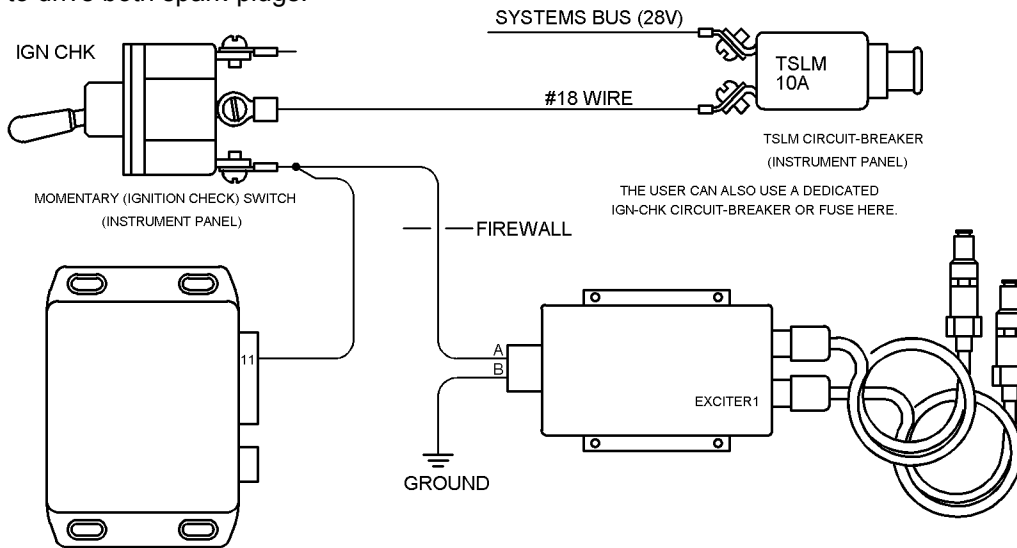
The maximum current drawn by the TSLM unit is 10 Amps, thus we have to ensure the circuit-breaker and the positive power wire will carry this current. This can be achieved by running one 16 AWG wire into one side of a solder-sleeve and two 20 AWG wires on the other side. The two 20 gauge wires then go to pins 12 and 24 of the TSLM module. The ground wire will not be carrying large current, which means a single 20 AWG wire to pin 13 will be sufficient.



**Figure 1 - Power and Ground Wiring**

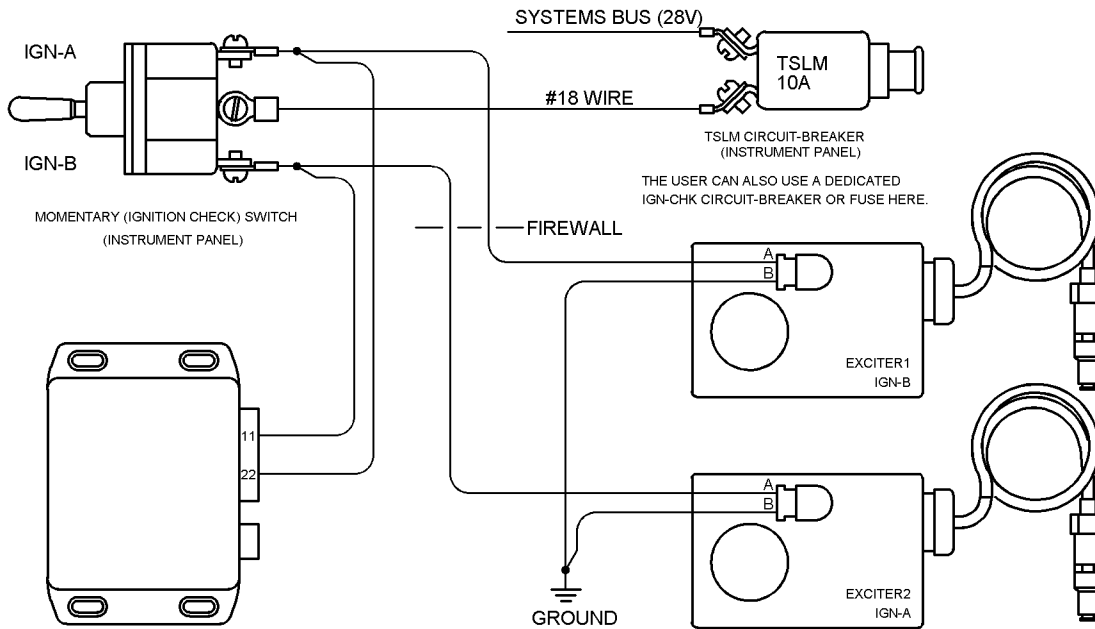
**Ignition Circuit**

The ignition circuit consists of either one or two exciter (igniter) boxes that generates pulses to the spark plugs. The TSLM is capable of powering two exciter boxes with power requirements of up to 5 Amp each and also allow for independent ignition checking through a toggle switch. The next figure shows the wiring diagram for a single exciter ignition circuit. The single exciter is able to drive both spark-plugs.



**Figure 2 – Single Exciter Ignition Circuit Wiring**

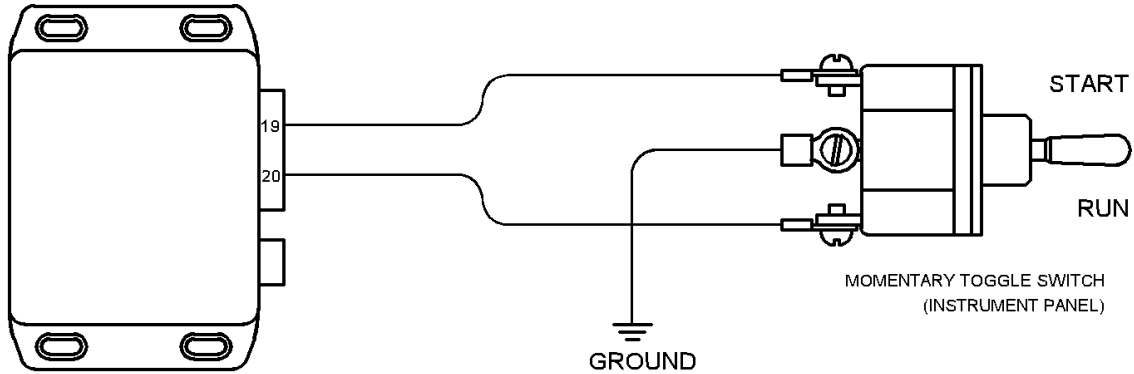
When using two separate exciter (igniter) boxes, each one only capable of driving one spark-plug, the ignition circuit in the following figure may be used instead...



**Figure 3 - Dual Exciters Ignition Circuit Wiring**

**Start/Run Selection**

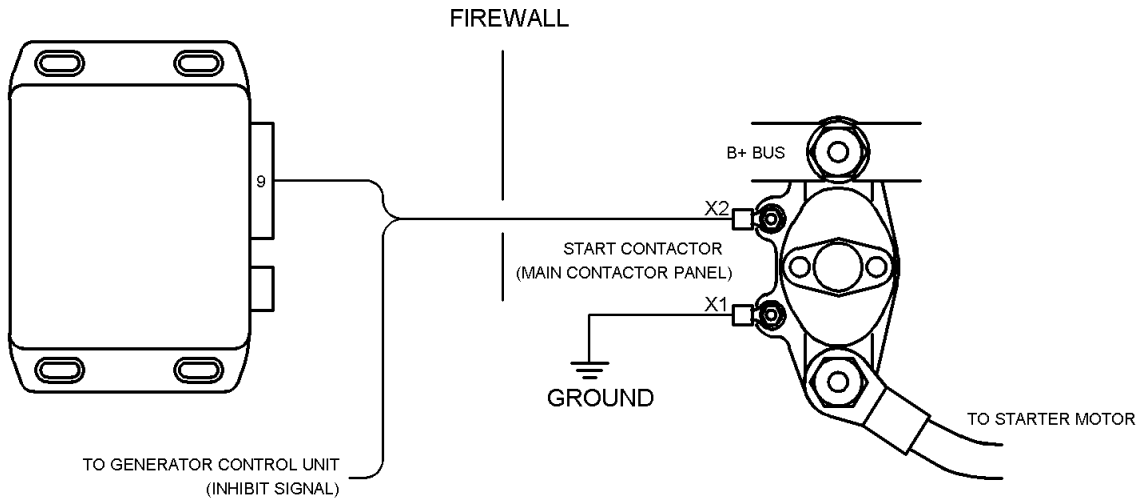
To initiate either the start or run sequence two wires from the TSLM need to be connected. Grounding the start wire (pin 20) will initiate a start attempt, while grounding the run wire (pin 19) will initiate a run sequence. The figure below shows how the start/run selection can be accomplished using a momentary toggle switch.



**Figure 4 – Start/Run Switch Wiring**

**Start Contactor**

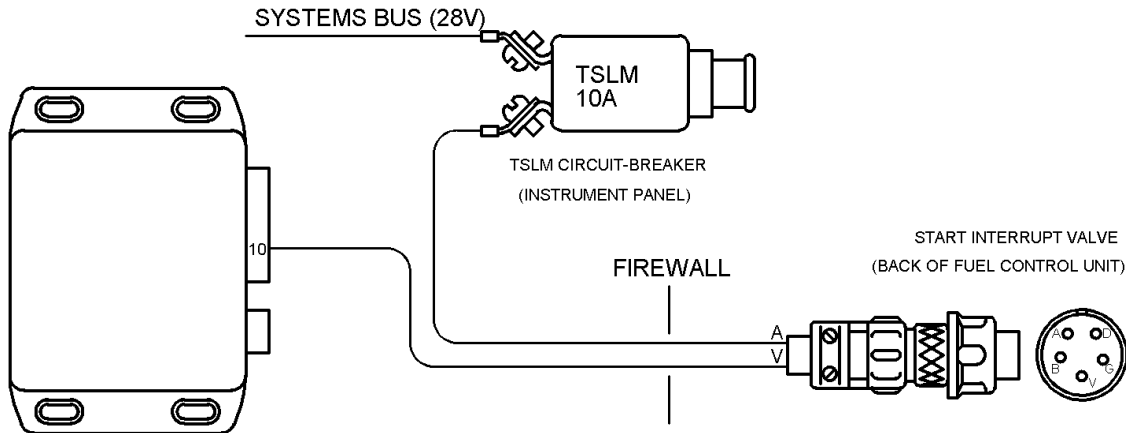
The start contactor is used to engage the starter motor during the start process. The diagram below shows how to connect the TSLM to the start contactor. The thick cable from the start contactor runs to terminal C on the starter/generator.



**Figure 5 – Start Contactor Wiring**

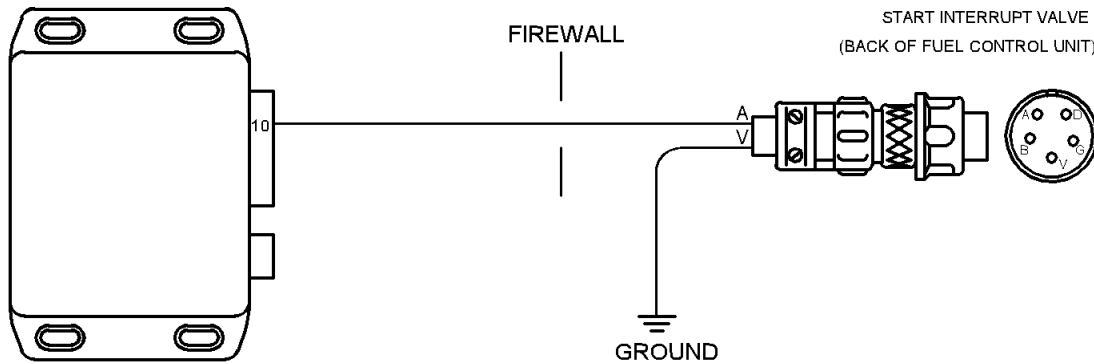
**Start Interrupter Valve**

The start interrupter valve regulates the fuel to the two torches and is only used during the start process or in anti-flameout operation. There are two options to wire the interrupter to the TSLM module. Most of the start circuits currently in operation uses a system where the interrupter signal (pin V) is grounded to activate the valve. For retro-fitting these systems, the alternative connection diagram shown below can be used.



**Figure 6 - Alternative Interrupter Wiring**

On the other hand, for new installations, the normal connection diagram can be used instead. This provides a more logical method where the interrupter is activated with a positive voltage on the valve's pin A.



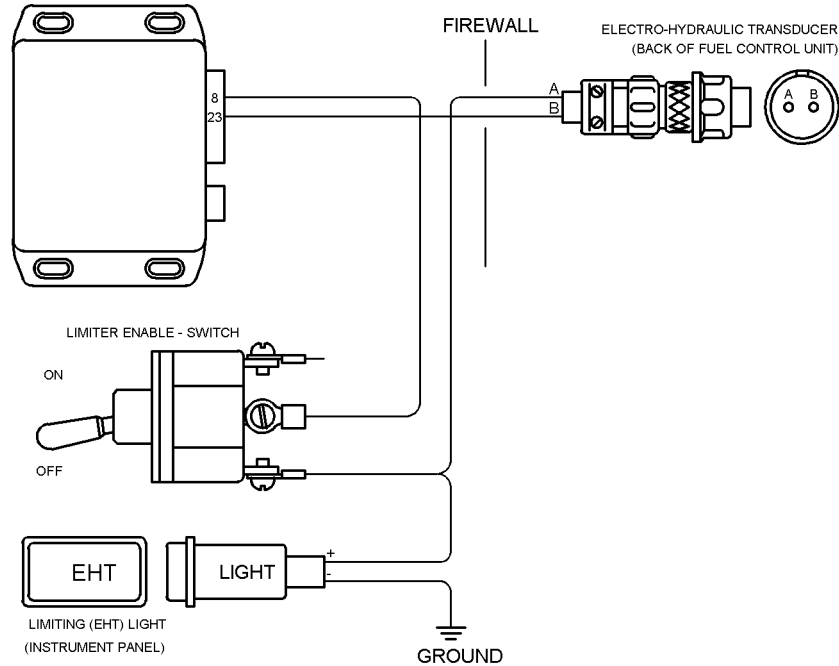
**Figure 7 - Normal Interrupter Wiring**

**Important:**

The TSLM needs to be configured via a laptop or personal computer to either the normal or alternative interrupter setting. You can learn how to do this from the System Link Software chapter. The configuration property to be set is called 'Alternative Interrupter Activation'. If you choose the alternative circuit, this configuration property needs to be set to 1 instead of 0 as explained on page 32.

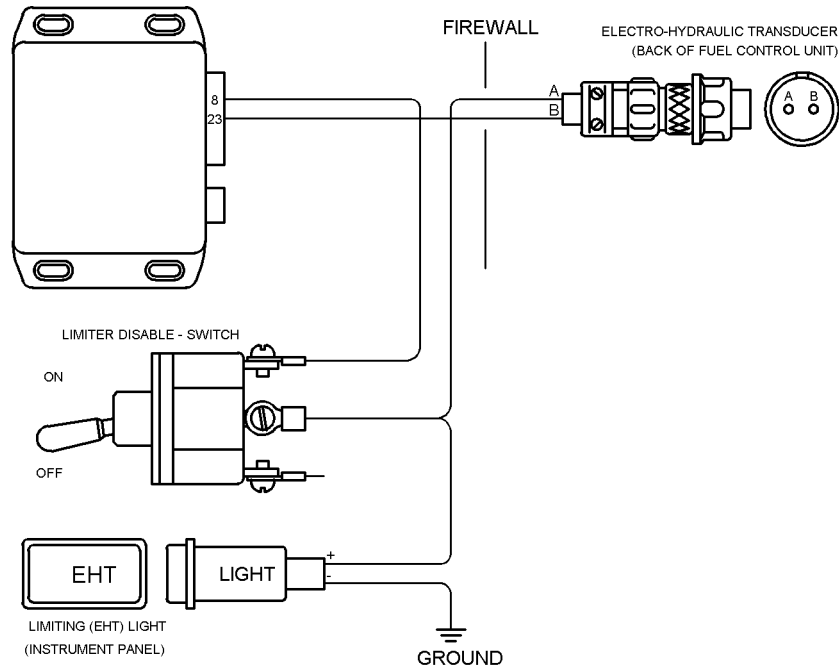
**Limiting (EHT) Circuit**

The limiting valve or EHT (electro-hydraulic transducer) is used to restrict fuel flow to the engine when activated. As a precaution we recommend incorporating a LIMIT ENABLE switch as shown below.



**Figure 8 – EHT wiring with Limiter Enable Switch**

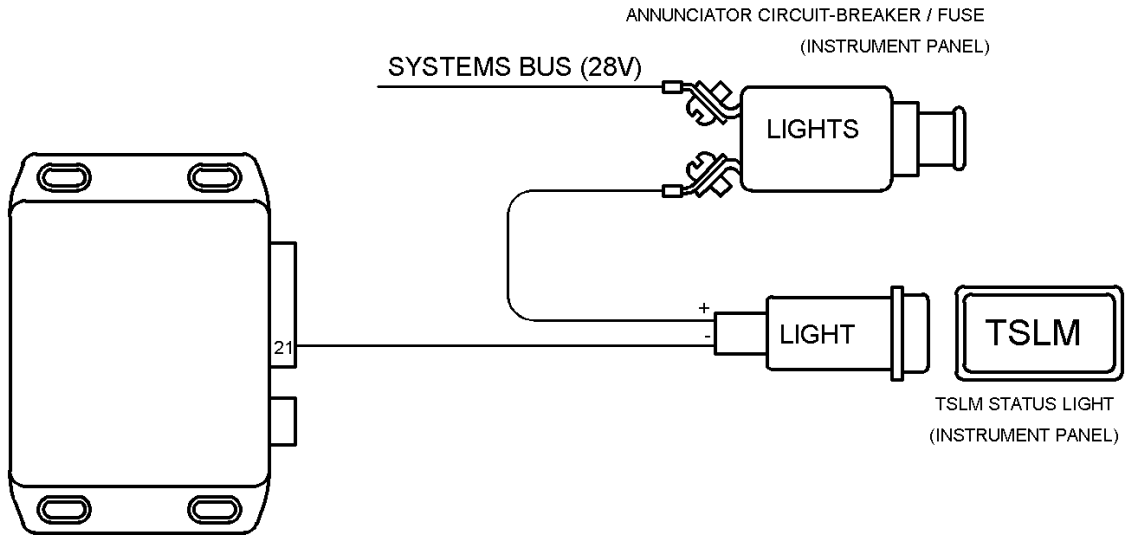
Alternatively a LIMITER DISABLE switch can be incorporated as shown below.



**Figure 9 – EHT wiring with Limiter Disable Switch**

**TSLM Status Light**

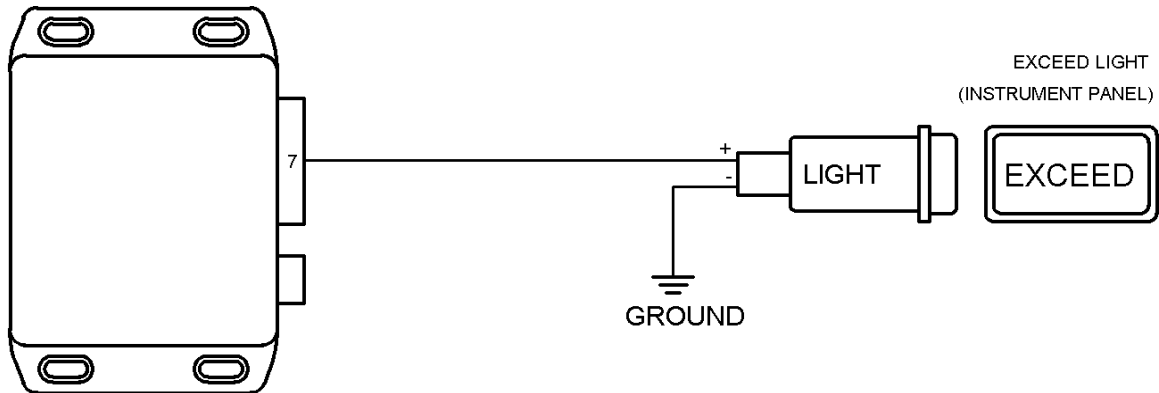
The TSLM drives an annunciator panel light in the cockpit that provides feedback to the pilot concerning the status of the TSLM system. The TSLM light's wiring in the next figure shows the common circuit-breaker used for the whole annunciator system.



**Figure 10 - Status Light Wiring**

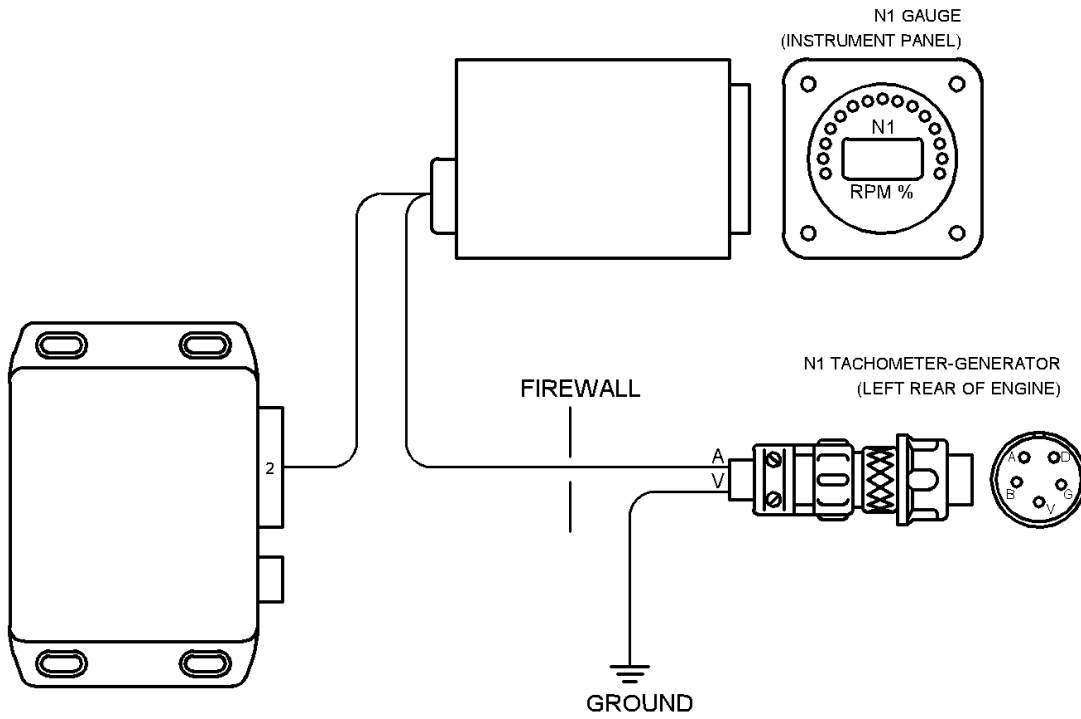
**Exceed Light**

The TSLM drives another annunciator panel light in the cockpit. Though not absolutely necessary we do strongly recommended installing this light. It is wired as shown in the following diagram:



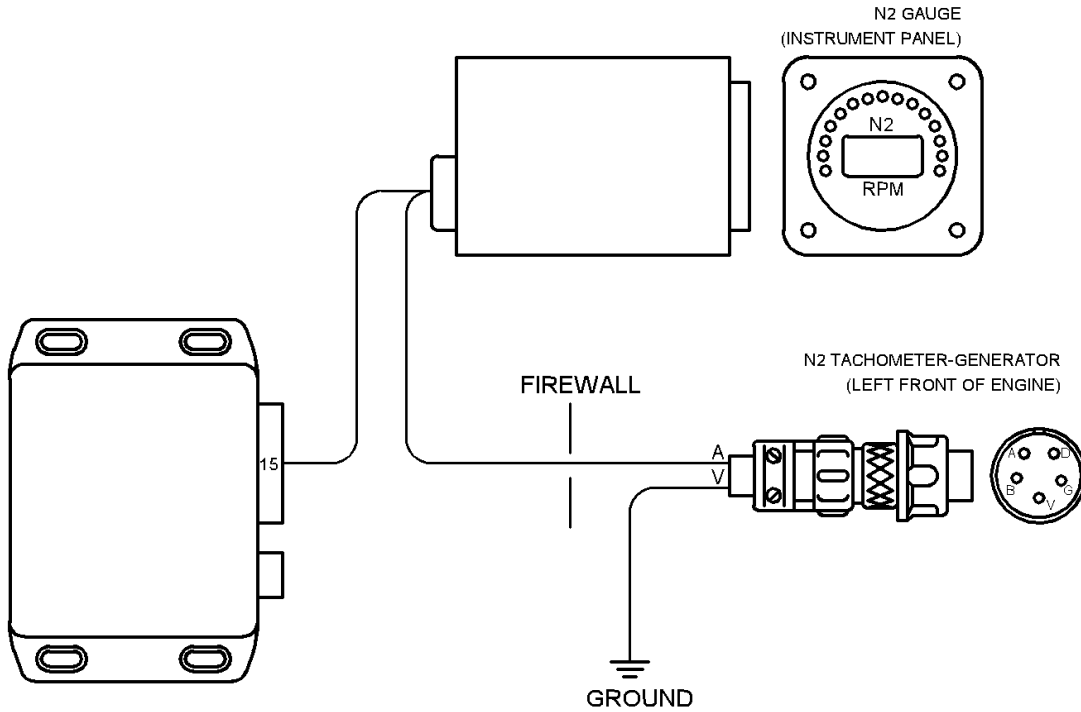
**Figure 11 - Exceed Light Wiring**

**Gas Generator Speed Sensing (N1)**



**Figure 12 - Gas Generator Speed Sense Wiring**

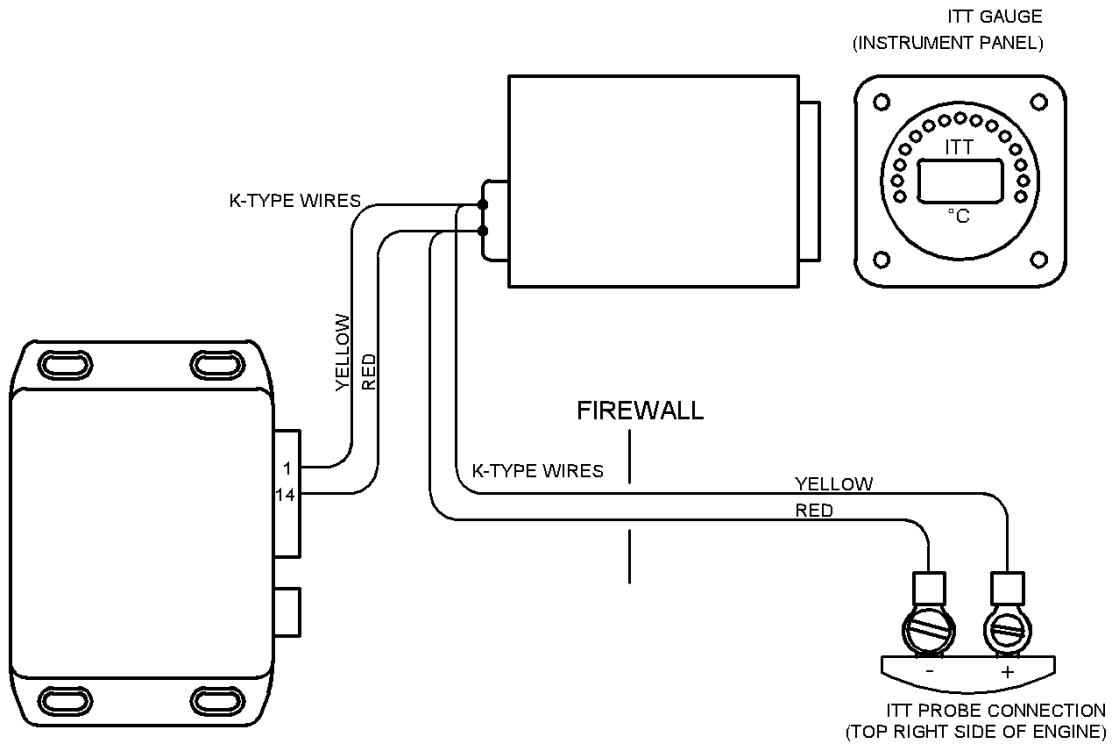
**Propeller Speed Sensing (N2)**



**Figure 13 - Propeller Speed Sense Wiring**

**Inter Turbine Temperature Sensing (ITT)**

The figure below shows the hookup of the ITT wires for the M601 D engine.

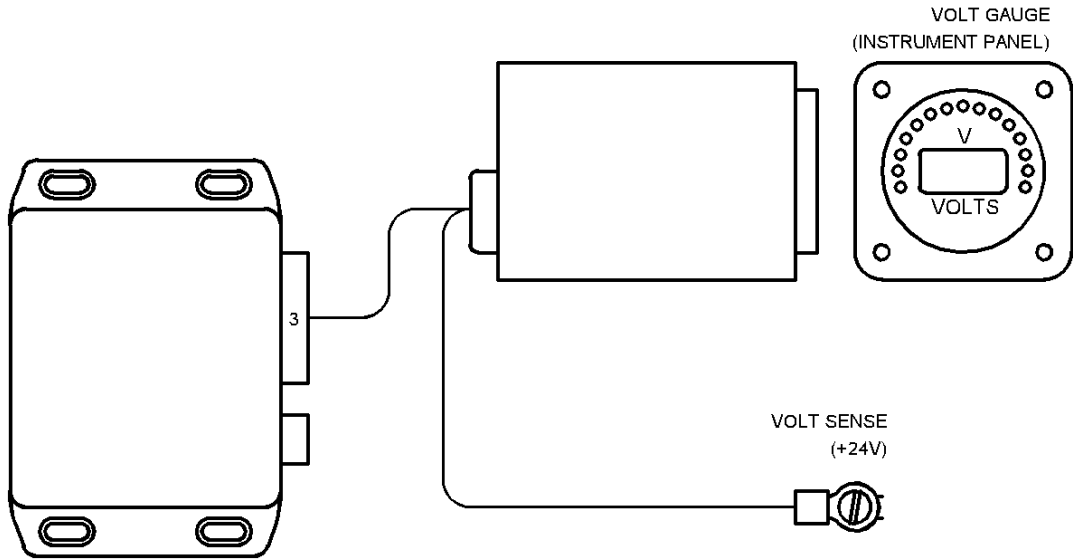


**Figure 14 - Inter-Turbine Temperature Sense Wiring**

The Walter M601 type E-11 engines are equipped with 4 ITT wires, 2 for main instrumentation and 2 for an electronic limiting unit. For conformity we recommend connecting the red wire (ITT+) to pin 1 and the green wire (ITT-) to pin 14 of the TSLM, when installing it on an type E-11 engine.

**Voltage Sensing**

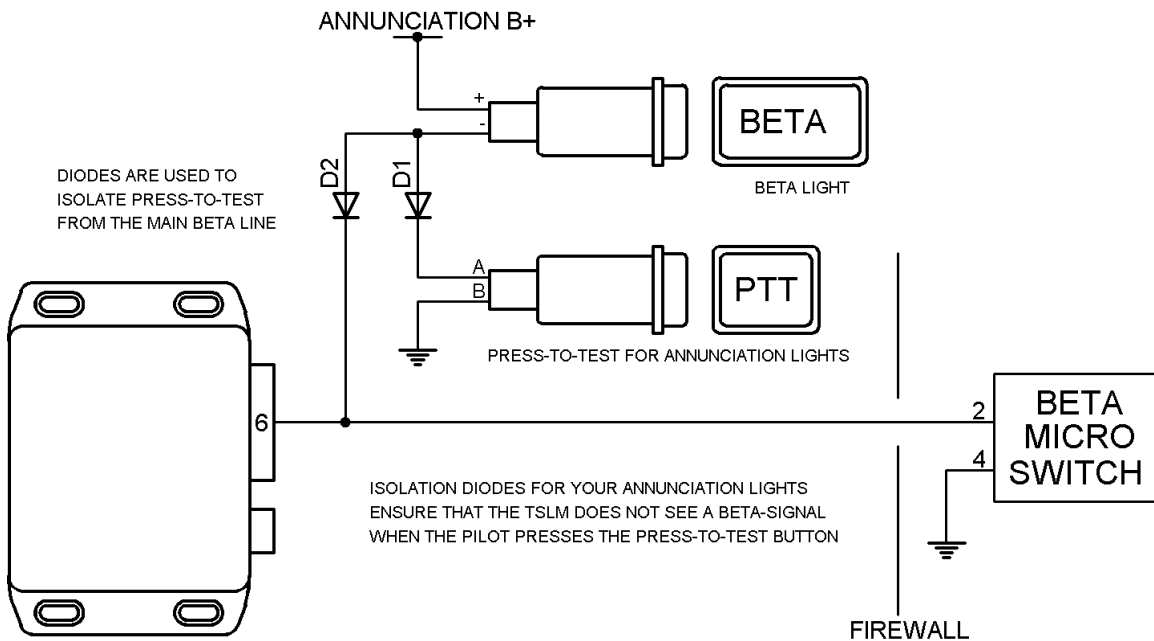
The TSLM has to sense the system voltage because low battery voltage can cause start-failures and “hot starts”. The TSLM will decline a start operation when the battery voltage is too low.



**Figure 15 - Battery Voltage Sense Wiring**

**Beta Switch Sensing**

The TSLM has an auxiliary input (pin 6) that should be connected to the Beta switch wire. This wire will be grounded when the propeller is in Beta and Reverse. The next diagram shows the practice to follow when using a simple annunciation light system with a press-to-test feature. Employing the diodes as shown below will prevent accidental beta propeller speed limiting when you push the press-to-test button when using this basic annunciation system:

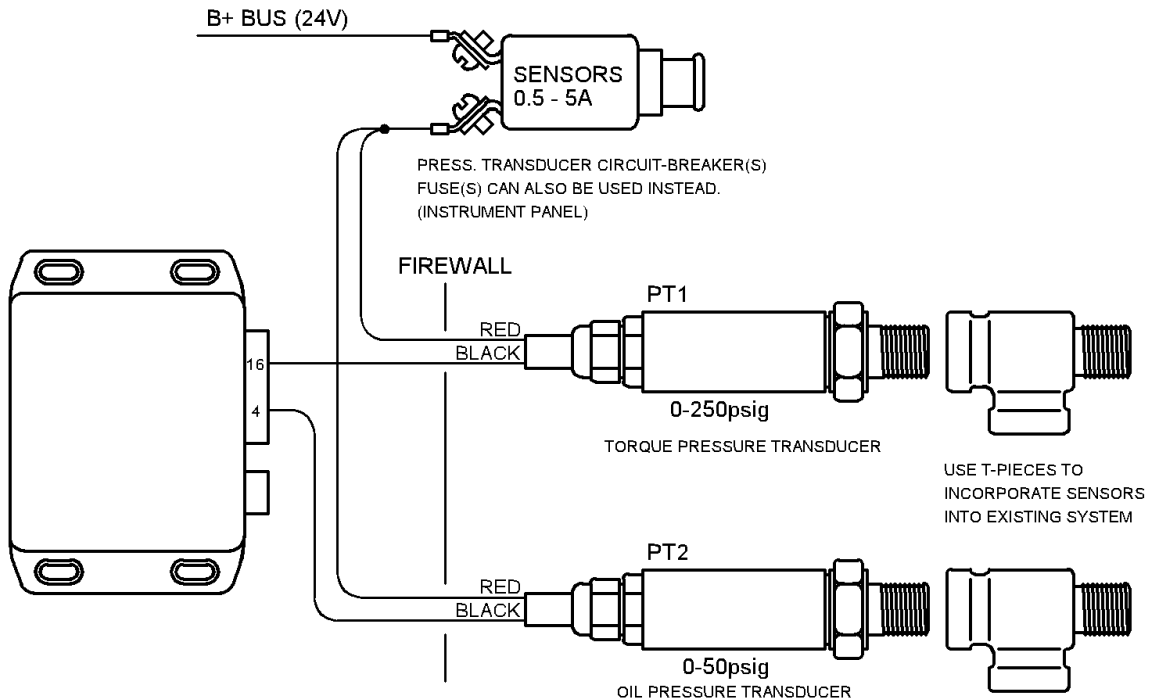


**Figure 16 - Beta Sense Wiring**

**Torque and Oil Pressure Sensing (optional)**

The TSLM is capable of measuring engine torque and oil-pressure via 4-20mA pressure transducers. If installed, these parameters are used for exceed monitoring and recording. Additionally these parameters will be shown on our VR display.

Please note that these transducers are a different set from the ones used by other companies like Electronics International (EI) or Chelton. They can be incorporated into any existing system with the use of T-pieces as shown below and will also provide transducer redundancy to your engine monitoring.



**Figure 17 - Torque & Oil Pressure Sense Wiring**

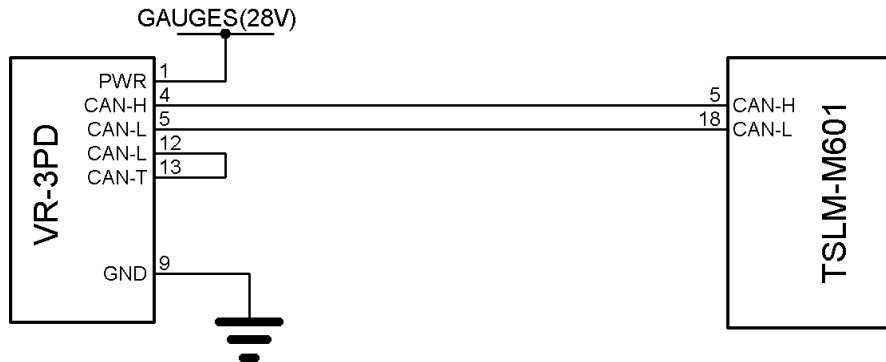
You will notice that we use 4-20mA transducers - they reduce the wire count (through the firewall) and are also less susceptible to noise (EMI). They are regularly available from various distributors such as Newark ([www.newarkinone.com](http://www.newarkinone.com)).

Pressure Transmitter	Port Style	Mfg Part Number	Newark Part Number
Oil Pressure Sensing	1/4" NPT	US381-000005-050PG	96H0212
Torque Sensing	1/4" NPT	MSP-600-250-P-5-N-1	96H0189

**Table 1 - Pressure Transducer Part Numbers**

**Adding a VR-3PD Display (optional)**

To integrate the VR-3PD to your system just mount the VR-3PD on your panel and connect as follows:

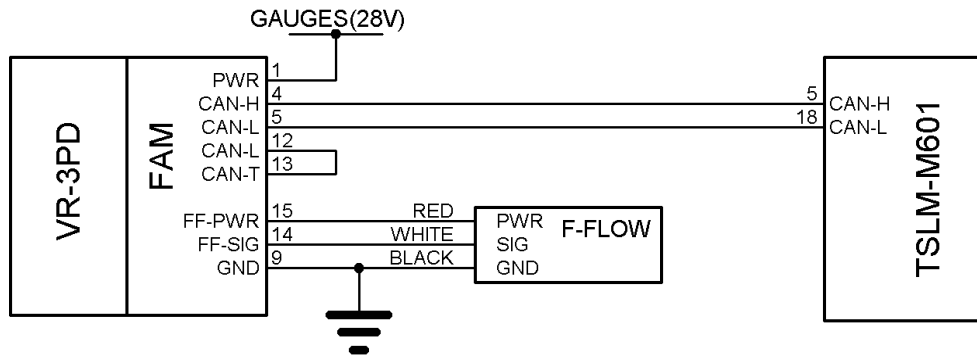


**Figure 18 - VR-3PD Integration Wiring**

With the VR display you have an optional second TSLM page that you want to show (or hide). To enable (or disable) the display of this TSLM2 page, you need to set the “Show TSLM 2nd Page (with OIL-TEMP)” configuration property as described on page 32.

**Adding a FAM (optional)**

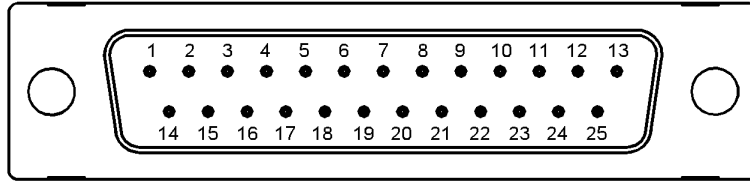
To integrate the Fuel and Auxiliary Module (FAM) to your system just mount the FAM to the back of VR-3PD. The connector that previously mated with the VR-3PD, now mates to the FAM instead. Only a few wires (pins 14, 15) need to be connected to the fuel-flow sensor as illustrated below. Remember to ground the fuel-flow sensor (normally a black wire).



**Figure 19 - FAM Integration Wiring**

To enable the display of the FUEL page that the FAM will enable, you need to set the “Show FAM Fuel Page” configuration property as described on page 32.

**TSLM Pin Definitions**



<b>ITT+</b>	<b>1</b>		
		<b>14</b>	<b>ITT-</b>
<b>N1</b>	<b>2</b>		
		<b>15</b>	<b>N2</b>
<b>VOLT</b>	<b>3</b>		
		<b>16</b>	<b>TORQUE</b>
<b>OIL PRESS</b>	<b>4</b>		
		<b>17</b>	<b>OILT- (RESERVED)</b>
<b>CAN H</b>	<b>5</b>		
		<b>18</b>	<b>CAN L</b>
<b>BETA</b>	<b>6</b>		
		<b>19</b>	<b>RUN</b>
<b>EXCEED+</b>	<b>7</b>		
		<b>20</b>	<b>START</b>
<b>EHT+</b>	<b>8</b>		
		<b>21</b>	<b>STATUS-</b>
<b>CONTACTOR+</b>	<b>9</b>		
		<b>22</b>	<b>IGNITION B+</b>
<b>INTERRUPTER+/-</b>	<b>10</b>		
		<b>23</b>	<b>EHT-</b>
<b>IGNITION A+</b>	<b>11</b>		
		<b>24</b>	<b>POWER</b>
<b>POWER</b>	<b>12</b>		
		<b>25</b>	<b>OILT+ (RESERVED)</b>
<b>GROUND</b>	<b>13</b>		

Table 2 - TSLM Connector

## System Link Software

### Introduction

This chapter describes how to use the System Link Software to connect to the TSLM module to perform the following functions:

- ◆ Synchronizing with the System
- ◆ Viewing Parameters
- ◆ Viewing Configuration
- ◆ Opening and Viewing History
- ◆ Changing the Configuration
- ◆ Diagnostic Test and Troubleshooting

### System Requirements

- ◆ Operating System: Windows 98 or higher
- ◆ One available serial port. If no serial port is available, a USB port together with a USB-to-Serial Converter can be used.

### Downloading and Installing the System Link Software

You may download the latest software from our website ([www.vravionics.com](http://www.vravionics.com)) onto your computer / laptop by doing the following:

- ◆ Click on the – System Link Software – link found at ([www.vravionics.com/tslm\\_m601.htm](http://www.vravionics.com/tslm_m601.htm))
- ◆ Save the Setup file to your computer at a location you desire – e.g. My Documents
- ◆ Execute the Setup file by double-clicking on it
- ◆ Go through the installation options mostly selecting NEXT at each window and FINISH at the end.

By downloading the latest software you'll also be receiving the latest TSLM firmware for all the system components (TSLM, VR-3PD, FAM). The firmware is continuously evolving to provide new features as well as correct some old problems that may surface and remain free of charge. On the TSLM webpage we will provide the latest version number (such as TSLM update 1.9) as well as a document that will describe the changes made in each new version.

If you would like us to keep you informed of the latest update that become available for your TSLM system, or even if you have some new feature in mind that you want to run by us, you are more than welcome to email us at either at ([tjaart@vravionics.com](mailto:tjaart@vravionics.com)) or ([maurits@vravionics.com](mailto:maurits@vravionics.com)).

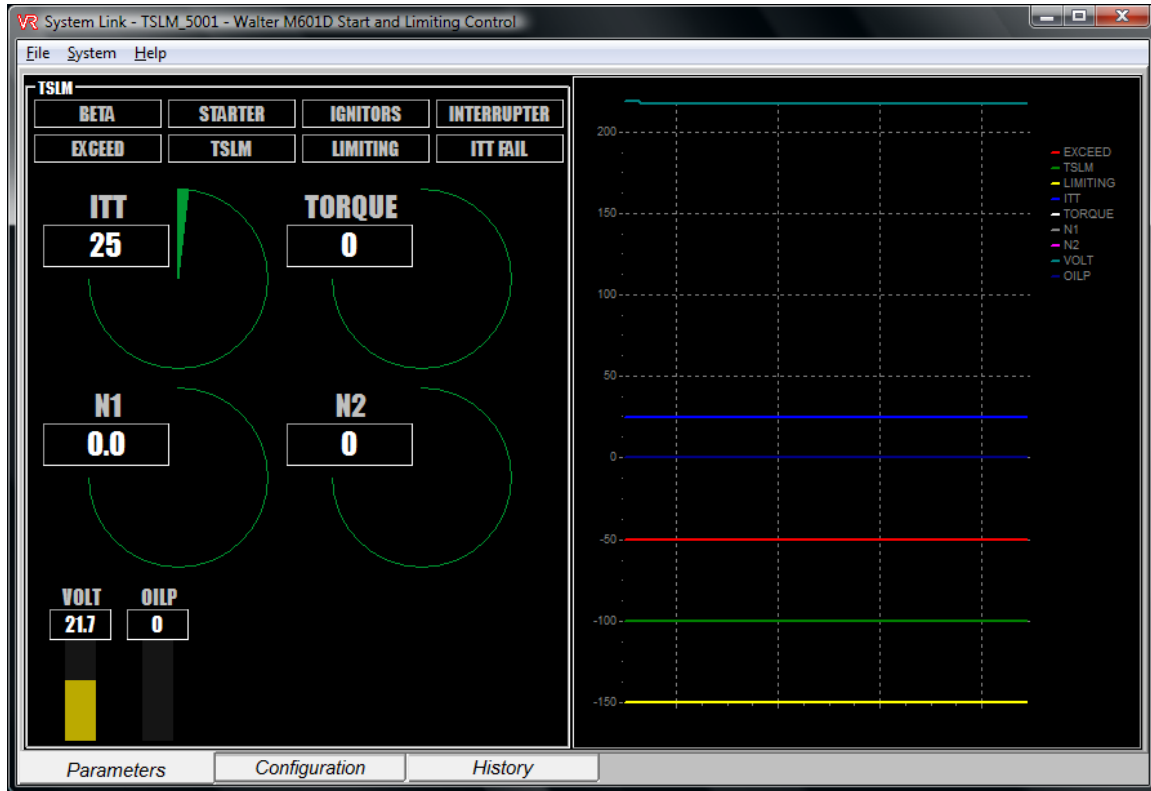
### Using the System Link Software

A separate connector (9-pin female) on the TSLM module is used for linking with your computer / laptop. Using a standard RS-232 serial cable, the module connects directly to your computer's serial port. If your computer is not equipped with a serial port and you have a spare USB port available, you can use a USB-to-Serial converter to perform the same task. Do the following:

- ◆ Plug in your USB-to-Serial converter (if you are using one) in your Laptop. If this is the first time that you have plugged it into a specific USB port, wait for Windows to recognize it and successfully install its driver first.
- ◆ Connect the USB-to-Serial converter serial port to the TSLM DB-9 connector.
- ◆ Run the System Link Software... Start > All Programs > VR Avionics > System Link
- ◆ Select from the main menu System > Serial Port. Make sure you have the correct COM port selected.
- ◆ Power the TSLM module (Switching on the master switch)

### Viewing the System Parameters

After running the System Link software, selecting the correct serial port and applying power to the system, the System Link software should start showing the system parameters as shown below:



### Synchronizing with the System

When synchronizing (menu > system > synchronize) the following will be performed:

- ◆ The system will be identified
- ◆ The system configuration will be read
- ◆ The system history (events) will be read and stored on your computer
- ◆ The system firmware will be updated to the latest version

Reasons for failing to establish communication can be as follows:

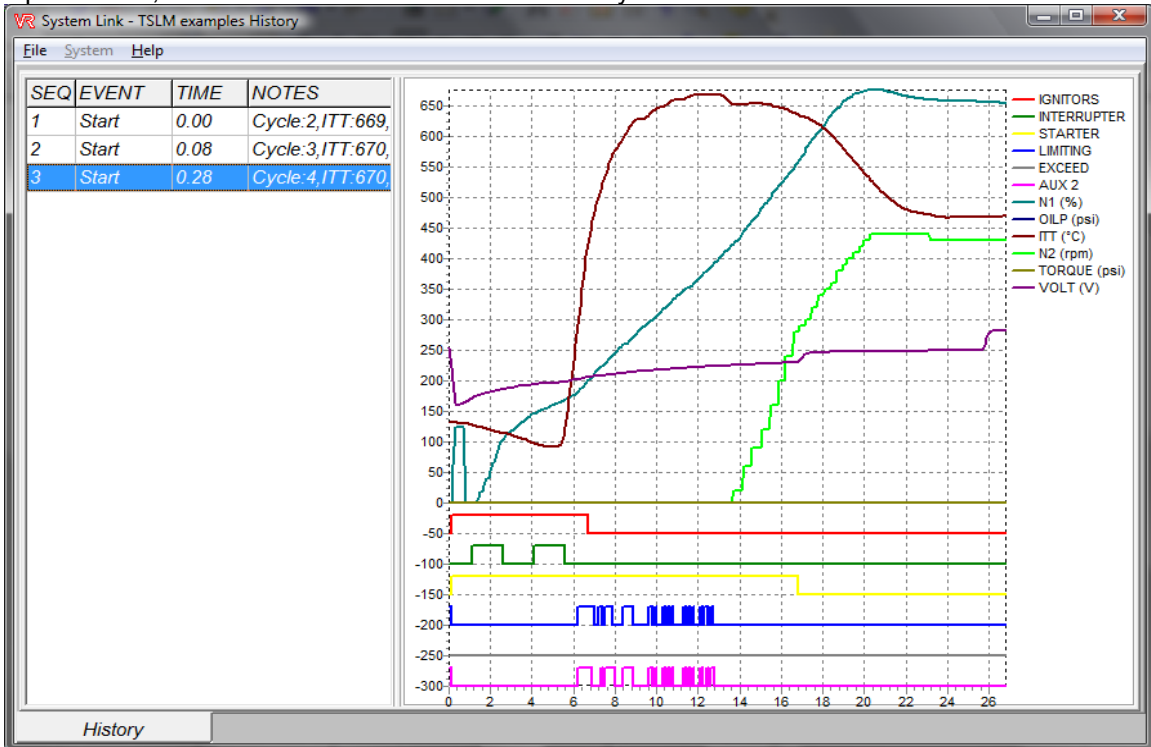
- ◆ Power was not applied to the TSLM module, or
- ◆ The serial cable between the module and the laptop is not connected properly, or
- ◆ The correct serial port was not selected, or
- ◆ The USB-to-serial converter driver was not properly installed. If you have bought a new USB-to-serial converter, you first need to get it to work with Windows on your computer. Plug only the USB-to-serial converter into the laptop / PC, let Windows recognize it and install the relevant driver first. Only when this is complete and Windows tells you that the device is ready to be used, should you plug it into the TSLM, start the System Link software and switch the power on.

**Viewing the Configuration**

Model	Serial #	Property	Setting	Access
TSLM	5001	Unit Reference (location)	None	Adjustable
TSLM	5001	Records Memory Used (bytes)	0	Viewable
TSLM	5001	Engine Starts / Cycles	0	Viewable
TSLM	5001	Engine Time (hours)	0.00	Viewable
TSLM	5001	Upper ITT Exceedance Counter	0	Viewable
TSLM	5001	Lower ITT Exceedance Counter	0	Viewable
TSLM	5001	N1 Exceedance Counter	0	Viewable
TSLM	5001	N2 Exceedance Counter	0	Viewable
TSLM	5001	Torque Exceedance Counter	0	Viewable
TSLM	5001	Max. Unit Temperature °C	23.0	Resetable
TSLM	5001	Min. Unit Temperature °C	19.6	Resetable
TSLM	5001	Last Attempted Start Time (seconds)	21	Resetable
TSLM	5001	Last Attempted Start Min Voltage (V)	16.0	Resetable
TSLM	5001	Last Attempted Start Max ITT (°C)	128	Resetable
TSLM	5001	Sensor Configuration	0	Adjustable
TSLM	5001	Internal Temperature Calibration	0	Adjustable
TSLM	5001	ITT Calibration	1109	Adjustable
TSLM	5001	Voltage Calibration	365	Adjustable
TSLM	5001	Torque Span Calibration	759	Adjustable
TSLM	5001	Torque Offset Calibration	0	Adjustable
TSLM	5001	Oil Pressure Span Calibration	154	Adjustable
TSLM	5001	Oil Pressure Offset Calibration	0	Adjustable

**Opening and Viewing History Files**

To open a History file in the System Link software, the user select File > Open History File... from the main menu. A dialog box will appear where you select the relevant history file. After hitting the Open button, the window will be filled with the history contained in that file.

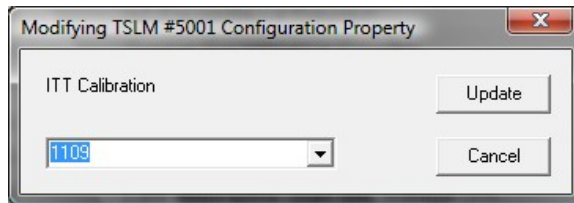


**Changing the Configuration**

To make adjustments to the configuration (such as calibrating the ITT reading), select from the main menu System > Adjust Configuration... The system will take a second or two to enable configuration adjustment as shown below.

Model	Serial #	Property	Setting	Access
TSLM	5001	Unit Reference (location)	None	Adjustable
TSLM	5001	Records Memory Used (bytes)	0	Viewable
TSLM	5001	Engine Starts / Cycles	0	Viewable
TSLM	5001	Engine Time (hours)	0.05	Viewable
TSLM	5001	Upper ITT Exceedance Counter	0	Viewable
TSLM	5001	Lower ITT Exceedance Counter	0	Viewable
TSLM	5001	N1 Exceedance Counter	0	Viewable
TSLM	5001	N2 Exceedance Counter	0	Viewable
TSLM	5001	Torque Exceedance Counter	0	Viewable
TSLM	5001	Max. Unit Temperature °C	23.0	Resetable
TSLM	5001	Min. Unit Temperature °C	19.1	Resetable
TSLM	5001	Last Attempted Start Time (seconds)	21	Resetable
TSLM	5001	Last Attempted Start Min Voltage (V)	16.0	Resetable
TSLM	5001	Last Attempted Start Max ITT (°C)	128	Resetable
TSLM	5001	Sensor Configuration	0	Adjustable
TSLM	5001	Internal Temperature Calibration	0	Adjustable
TSLM	5001	ITT Calibration	1109	Adjustable
TSLM	5001	Voltage Calibration	365	Adjustable
TSLM	5001	Torque Span Calibration	759	Adjustable
TSLM	5001	Torque Offset Calibration	0	Adjustable
TSLM	5001	Oil Pressure Span Calibration	154	Adjustable
TSLM	5001	Oil Pressure Offset Calibration	0	Adjustable

To modify any specific configuration item, scroll to that item and hit <ENTER>. A dialog box will appear where the user can assign a new value to a configuration property as shown next...



When done – hit the Update button and that configuration will have been changed.

**Configuration Properties**

In this section we describe the configuration properties of the TSLM system. Some properties contain information, others are adjustable in order to configure the system to suit your needs.

**History Recorded (bytes)**

This property tells you how much bytes have been recorded in the TSLM memory. Only start and run sequence time-graphs are recorded, as well as events of interest such as possible parameter exceeds.

**Start Cycles**

This counter within the TSLM tracks the number of start cycles.

**Flight Hours**

This counter within the TSLM tracks the flight hours (N1 over 70%).

**Upper ITT Exceeds**

This counter within the TSLM tracks number of times the ITT have exceeded 800 °C.

**Lower ITT Exceeds**

This counter within the TSLM tracks the number of times the ITT have exceeded:

M601D	735 °C
M601E-11	735 °C
M601E-11A	710 °C

**N1 Exceeds**

This counter within the TSLM tracks the number of times the N1 have exceeded:

M601D	100.00%
M601E-11	100.00%
M601E-11A	98.50%

**N2 Exceeds**

This counter within the TSLM tracks the number of times the propeller RPM (N2) have exceeded:

M601D	2080 RPM
M601E-11	2080 RPM
M601E-11A	1950 RPM

**Torque Exceeds**

This counter within the TSLM tracks the number of times the TORQUE have exceeded:

M601D	132 psi
M601E-11	145 psi
M601E-11A	134 psi

**Max. Unit Temperature °C**

This configuration property records the highest temperature the TSLM unit have been exposed to. It can be reset to repeat this installation temperature check.

**Min. Unit Temperature °C**

This configuration property records the lowest temperature the TSLM unit have been exposed to. It can be reset to repeat this installation temperature check.

**Last Attempted Start Time (seconds)**

This value provides feedback about the performance of the last start by telling you how long it took to go from zero to idle speed.

**Last Attempted Start Min Voltage (V)**

This value provides feedback about the performance of the last start by telling you what the lowest voltage was during the previous start. The weaker the batteries the lower this value.

**Last Attempted Start Max ITT (°C)**

This value provides feedback about the performance of the last start by telling you what the highest ITT value was during the previous start.

**Last Attempted Start EHT Resistance (Ohms)**

This value tells you what the measured resistance was of the EHT valve when the last start was initiated.

**Internal Temperature Calibration**

This configuration property calibrates the TSLM's internal temperature measurement.

**ITT Calibration**

This configuration property calibrates the TSLM's ITT measurement.

**Voltage Calibration**

This configuration property calibrates the TSLM's voltage measurement.

**Torque Span Calibration**

This configuration property calibrates the TSLM's torque measurement.

**Torque Offset Calibration**

This configuration property calibrates the TSLM's torque measurement.

**Oil Pressure Span Calibration**

This configuration property calibrates the TSLM's oil-pressure measurement.

**Oil Pressure Offset Calibration**

This configuration property calibrates the TSLM's oil-pressure measurement.

**Oil Temperature Span Calibration**

This configuration property calibrates the TSLM's oil-temperature measurement.

**Oil Temperature Offset Calibration**

This configuration property calibrates the TSLM's oil-temperature measurement.

**Alternative Interrupter Activation**

If set to 0, the interrupter will be normally activated (positive voltage out on pin).  
If set to 1, the alternative interrupter activation will be employed (pin is grounded).  
(Also see page 17)

**Force a Start sequence when double-clicking Start Button**

If set to 1, a start sequence can be forced (by bypassing certain pre-start checks) by “double-clicking” the START button / toggle switch. The pre-start checks that would be bypassed are, checking ITT and voltage. The only check that would still be performed is the EHT check as described on page 6.  
If set to 0, this feature will be disabled.

**Walter Engine Type (0=M601D, 1=M601E-11, 2=M601E-11A)**

You select which type of M601 engine you have here. This setting is used by the TSLM to know what exceed levels to trigger on. Set to 0 if you have the M601D. Set to 1 if you have the M601E-11. Set to 2 if you have the M601E-11A.

**Start ITT Control Setting**

This value can be adjusted in the range from 580 to 640. It sets the level of limiting for the start. The lower the value, the lower your start ITT's, though your start durations may increase.

**Display Brightness**

If you have a panel-display connected to the TSLM, you can set the display brightness (level of backlighting) of this gauge. Note that this can also be adjusted from the gauge itself.

**Display Contrast**

If you have a panel-display connected to the TSLM, you can set the display contrast (display clarity) of this gauge. Note that this can also be adjusted from the gauge itself.

**Show FAM Fuel Page**

If you have a panel-display and FAM (fuel computer module) connected to the TSLM, you can enable display of the FUEL page by setting this property to 1. If you do not have a FAM, or would not like to have the FUEL page displayed, set this to 0 (zero).

**Show TSLM 2nd Page (with OIL-TEMP)**

If you have a panel-display connected to a TSLM that measures oil-temperature also, you can enable display of the second TSLM page showing OIL-T by setting this property to 1. If your TSLM does not measure oil-temperature, or you would not like to have the second TSLM page displayed, set this to 0 (zero).

**Fuel Remaining Maximum (Fill-up value)**

If you have a FAM in your system, you can set the fill-up value of your fuel tank here. So when you select from the VR display's OPTIONS menu - “FILL-UP FUEL REMAINING”, the fuel remaining will instantly be set to this value. This value can be either in gallons or pounds.

**Fuel Flow Sensor K-Factor**

If you have a FAM in your system, you set the k-factor of the fuel-flow sensor here. If you want your fuel to be indicated in gallons, you input the pulses-per-gallon value for your sensor here. If your fuel is to be indicated in pounds, you input the pulses-per-pound (of fuel) value instead.

**Low Endurance Fuel Warning Level (minutes)**

If you have a FAM in your system, you can set LOW FUEL warning level in terms of time left to fly here. When the fuel endurance reaches this level (or go below) an LOW FUEL warning flag will appear on the FUEL page.

### Low Remaining Fuel Warning Level

If you have a FAM in your system, you can set LOW FUEL warning level in terms of gallons (or pounds) of fuel remaining here. When the fuel remaining reaches this level (or go below) an LOW FUEL warning flag will appear on the FUEL page.

### Diagnostic Test and Troubleshooting

The diagnostic test was designed to verify the correct installation of the TSLM system and the proper operation of all the related system components. This is required before you do your first start or motor/run operation. By selecting from the main menu System – Diagnostic Test – Ignitors the process begins. To move to the next diagnostic test simply click inside the diagnostic test box. To exit diagnostic testing one can re-synchronize by selecting System – Synchronize from the main menu.

