



**TSLM**  
**for**  
**Walter M601**  
**Engines**

**OPERATIONAL &**  
**INSTALL MANUAL**

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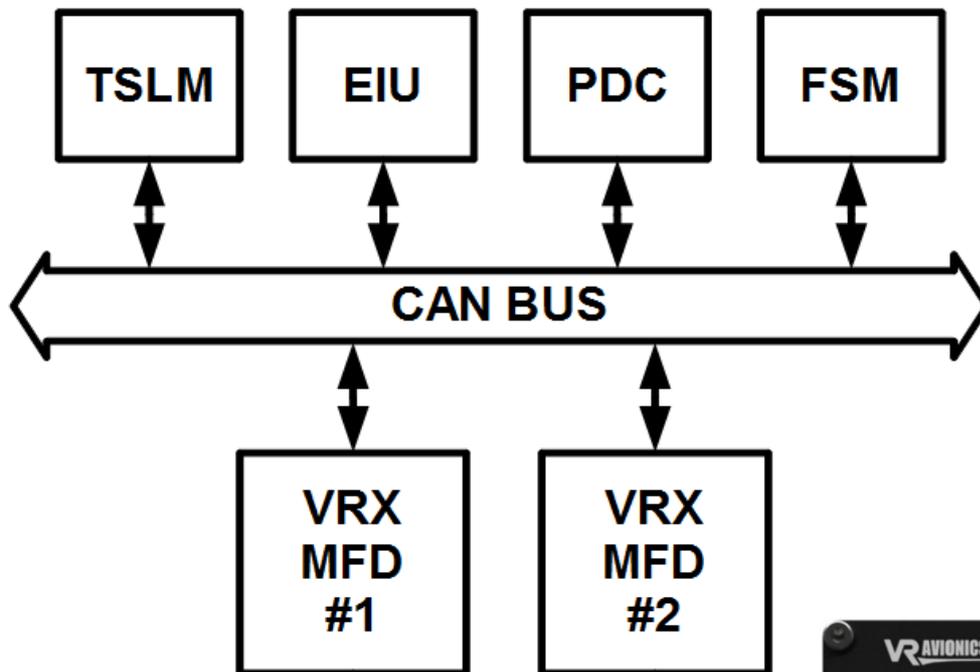
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## Introduction

### System Options

This manual describes the installation and operation of the Turbine Start Limit & Monitor (TSLM) from VR Avionics when used with a Walter/GE M601 engine. The TSLM is a unit (black box) which can function standalone or with other units (black boxes) from VR Avionics as shown below. This manual is dedicated to the TSLM, so when planning to install further units the user must also include the manuals of these other units. For example, should you plan to use one or more VRX multi-function displays, you need to read the **VRX-M601 Operational & Installation manual**.



### Retrofit to existing systems

The TSLM unit can be easily retrofitted to an already existing aircraft system. Since it is remote mount, it will have little to no impact on your current instrument panel if start control and limiting is all you require. You can however choose to add a VRX multi-function display (shown here) for the added monitoring it provides, in which case you need to make a little space for this on your panel.



### TSLM versions

A few versions of the TSLM have been produced over the years. Later versions have remained backward compatible with earlier ones by retaining the connector and pin-outs for the most part. The following table lists the differences other than normal general performance improvements of the various versions as referenced by their serial numbers:

Serial number range	Differences
3001 - 4100	First Generation
5001 - 6200	Oil-temperature measurement added
7001 and later	New more compact enclosure No serial port connector

Units with serial numbers 5001 and up are handled in this manual.

## Operation

### Introduction

The following sections describe the working of the TSLM (firmware version 3.1 or later) in detail. Near the end of this chapter we provide the various [checklists and error codes](#) on one page for your convenience.

### Power-up (Master ON)

When first the TSLM is powered it turns on the TSLM light for about 2 seconds while it does a self-check. If everything checks out the TSLM light is turned off. If a problem or concern is detected the TSLM light indicates as follows:

Problem or Concern	TSLM light indication
<b>EHT Error:</b> The EHT valve is being powered externally from the 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 retrieve this history and clear the TSLM's memory.	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 you initiate a start sequence. The TSLM performs pre-start checks first unless commanded to bypass them (see later). It checks that the ITT is connected properly and reads below 200°C, that the bus voltage is at least 20 volt and that the EHT is detected electrically. 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:

Cause of Error	TSLM light indication
<b>ITT Error:</b> ITT is above 200°C or not connected properly. If above 200°C you may want to do a RUN to cool it down before attempting another start.	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 correct position.	4 blinks.. pause.. 4 blinks.. pause, etc

The pre-start checks can be bypassed by double-clicking the START button. The “double-click start override” setting must be enabled in the TSLM configuration for this to work.

If one of the pre-start checks failed, you should correct the cause before trying again. To acknowledge or reset the error code on the TSLM light you can press the START or RUN button for 1 second. The TSLM light shall stop flashing and you are ready to issue another start.

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 wind up and the igniters producing sparks. From the moment the starter engages there are 10 seconds reserved 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 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 have 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 needed 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 major problem – for example unintended isolating valve activation, dead batteries, or fuel control unit problems. An abort of the start is recommended in this case.

When the compressor reaches idle speed (above 50%), the starter, ignition and fuel to the torch igniters will be turned off. Otherwise these devices will timeout 20 seconds after light-off was detected.

See also [Determining Engine State](#).

### ***Initiating a Run***

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

By depressing the RUN button you initiate a RUN / MOTOR sequence. 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:

Caution	TSLM light indication
<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. See also [Determining Engine State](#).

### ***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 19 for its [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 mode as well as to ensure effective reverse thrust application, the TSLM will limit the propeller speed (N2) while in BETA mode. The TSLM knows the propeller is in beta mode by sensing the BETA micro-switch.

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

In anti-flameout 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. See also [Determining Engine State](#).

### ***Determining Engine State***

The TSLM mainly uses the N1 (NG) parameter to determine whether the engine is **running** or **not-running** (above 50% N1 means **running** and below means **not-running**). This engine state is important since it impacts the start-run switch functionality. If not-running the start-run switch(es) initiate [start](#) and [run](#) sequences, while if the engine is running the switch(es) activate and deactivate [anti-flameout operation](#) (AFO). This is why proper N1 wiring and signaling to the TSLM is emphasized and why we have a dedicated [TSLM light code](#) for **N1 error**. The TSLM has an alternative to determine engine state if for example N1 become disconnected or the tach-generator ceases to provide an alternating signal. In this alternative (where N1 will read zero) both the ITT and N2 parameters need to be above 400 (400 °C ITT and 400 rpm N2) for the engine state to be considered as **running**.

### Parameter Exceeds

Should any of the engine parameters go over their maximum limits the EXCEED light (if installed) will come ON for the duration of the exceed. During this time all relevant parameters gets recorded versus time and a dedicated counter increments within the TSLM. This information can be viewed in the Configuration and History sections of the [SetView](#) software.

Parameter exceeds (maximum values) are 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 28).

### Required Actions

Should the EXCEED light have come on during flight, you can retrieve and analyze the time-graph recorded within the TSLM to decide on what action to take next. Required actions vary from no action to returning the engine to an overhaul facility for inspection/repair. With the graph you will not only identify the parameter exceeded, but obtain both the maximum it reached as well as the time it spent above the maximum limit. With this you will be able to look-up the required action you need to take using the engine's manual, or asking a qualified person.

### TSLM Light Codes

The TSLM light provides feedback to the pilot concerning the system. The light will blink a certain pattern to report any 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.).

## Operational Check Lists and Codes

### START:

1. Power ON
2. Inverter on if necessary
3. Fuel ON
4. Fuel pump(s) ON
5. Condition lever forward to OPEN (detent)
6. Propeller in feather position
7. Throttle in IDLE position
8. Ensure ISOL valve is OFF (normal position)
9. Ensure Limiter Enable switch (if installed) is ON (normal position)
10. Press START. Keep hand ready on the condition lever in case of problem
11. 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.
12. 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.
13. Ensure N1 (gas generator speed) increases to at least 60%. If not, forward the throttle slightly and monitor ITT.
14. After N1 and ITT have stabilized, switch the generator ON.
15. Check Oil and Fuel Pressure
16. Forward Prop to full fine pitch

### RUN:

1. Master switch On
2. Throttle to idle
3. Propeller to Feather
4. Condition lever in shut off (CLOSED) position
5. Press the RUN switch and monitor ITT temperature drop.

### Anti-Flameout Operation: (only if engine is running)

#### Engage:

1. Press START and hold for 1 second.
2. Confirm TSLM light turn ON.

#### Disengage:

1. Press RUN and hold for 1 second.
2. Confirm TSLM light turn OFF.

### ERROR codes (via TSLM light):

(Acknowledge / reset errors by pressing START or RUN for 1 second)

1. Internal error (solid on or blinking slowly)
2. ITT error – ITT above 200 °C, or wiring fault.
3. VOLT error – Bus voltage too low or faulty.
4. EHT error – Limiting circuit disabled or faulty.
5. N1 error – No N1 signal detected during RUN
6. ISOL error – Start attempted in ISOL without double-click (pre-start checks override)
7. Memory error – History log more than 90% full

### Notes:

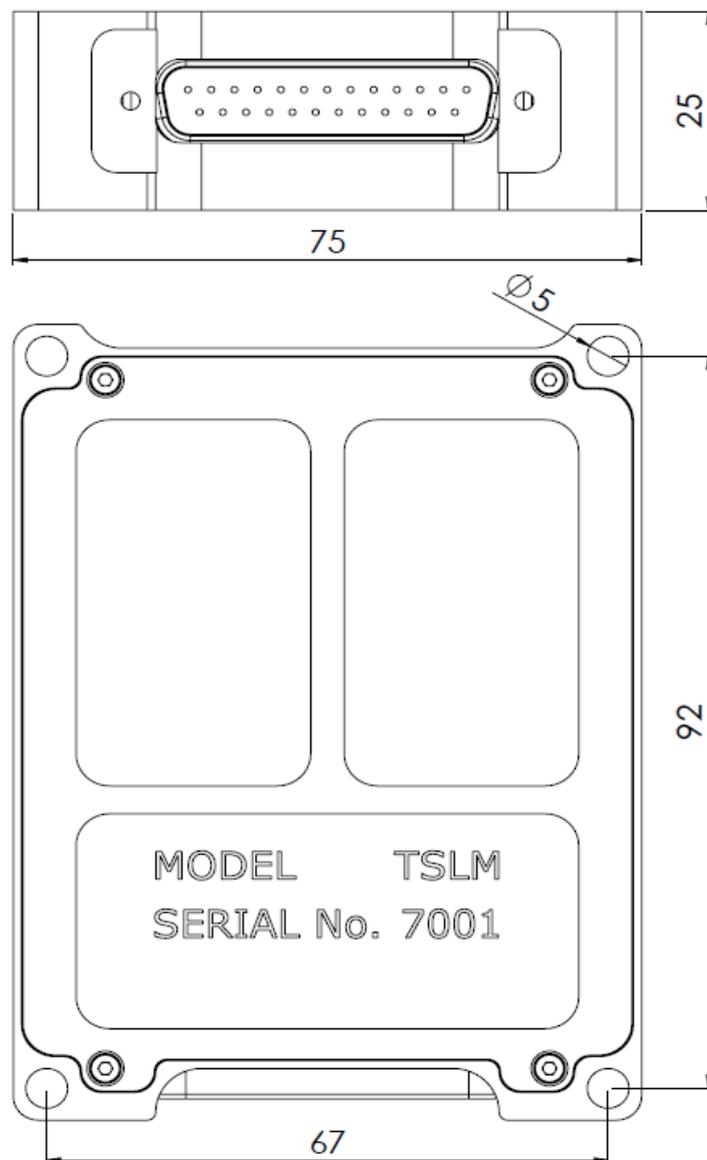
To bypass the TSLM pre-start checks initiate the start by pressing START twice in quick succession (double-click instead of one click).

**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 +85°C
Storage Temperature	-55°C to +125°C

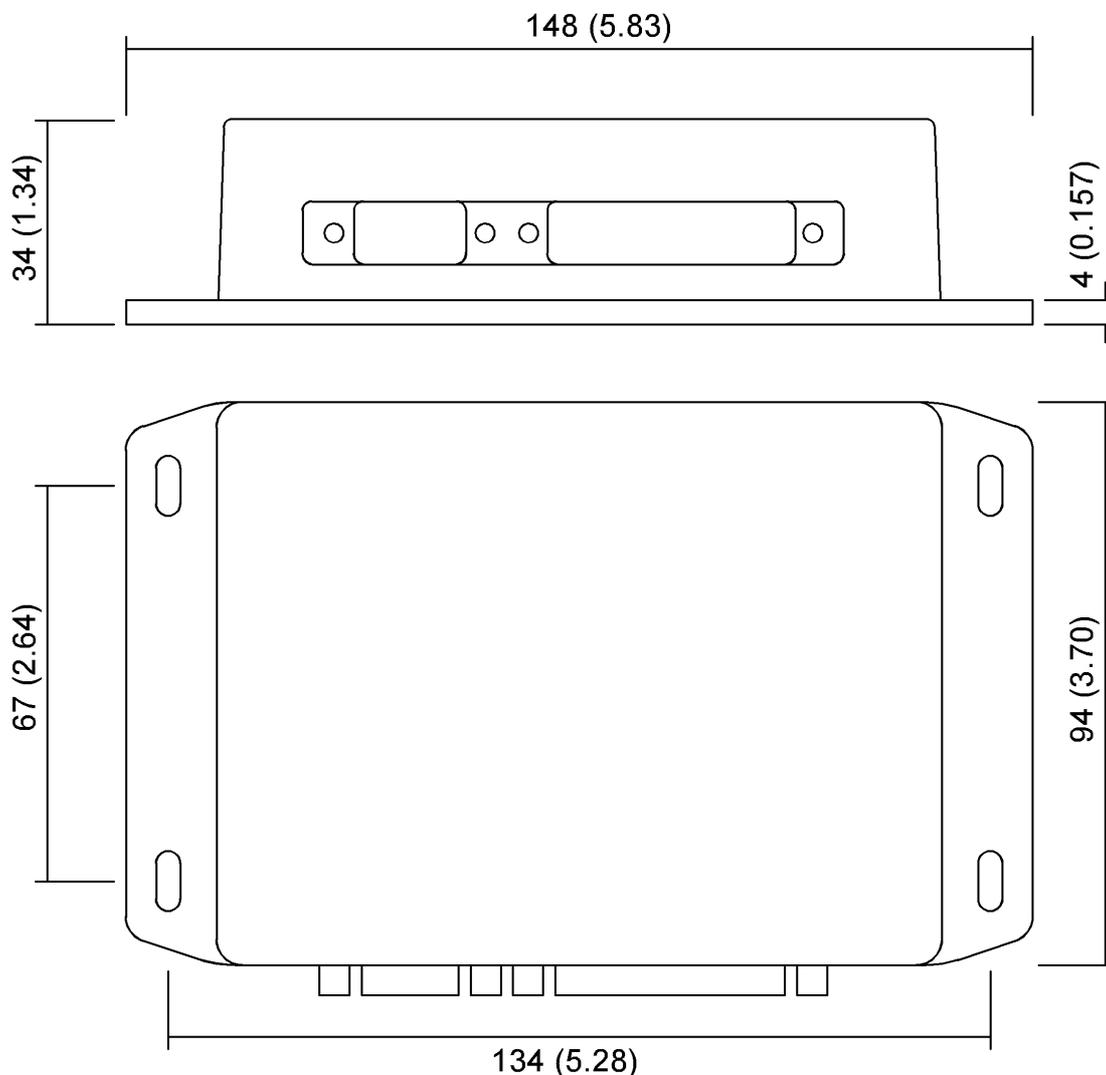
**Dimensions (SN 7001 and later)**

Weight	180g (0.4 lb)
Dimensions	100 x 75 x 25mm (3.94" x 2.95" x 0.98")



**Dimensions (SN 5001 – 6200)**

Weight	350g (0.772 lb)
Dimensions	150 x 95 x 35mm (5.9" x 3.74" x 1.38")



DIMENSIONS IN MM. (INCHES ARE IN BRACKETS)

**RS232 Data Interface (SN 5001 – 6200)**

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 7)

#### **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 other equipment.

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. Another option is to use Teflon insulated wire which is available in various colors.

Connectors: We recommend you use machined pin connectors to mate with the TSLM connector. Crimp connections have proven to be the most reliable in aircraft installations. D sub shells to hold the pins are available from various sources. Purchasing quality connectors is a very wise investment.

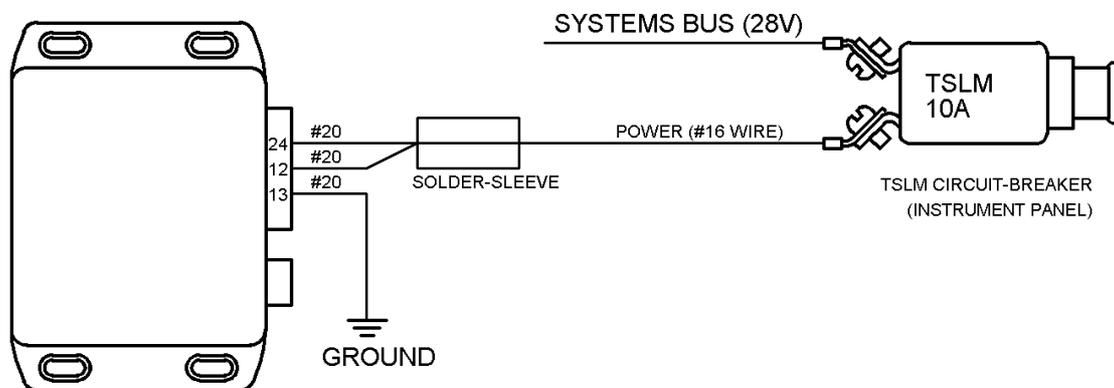
Installing: Make sure all connections are secure and all wires are routed and strain relieved to ensure the wires will not chafe against any other object in the aircraft.

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

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

### ***Power and Ground***

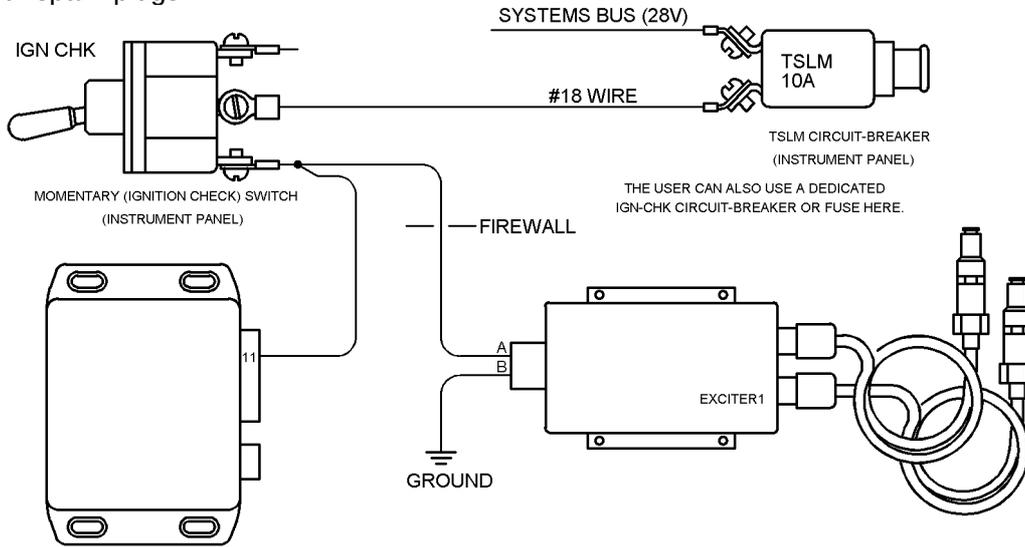
The maximum current drawn by the TSLM unit is 10 Amps, thus we have to ensure the circuit-breaker and the positive power wire will carry this current. This can be achieved by running one 16 AWG wire into one side of a solder-sleeve and two 20 AWG wires on the other side. The two 20 gauge wires then go 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**

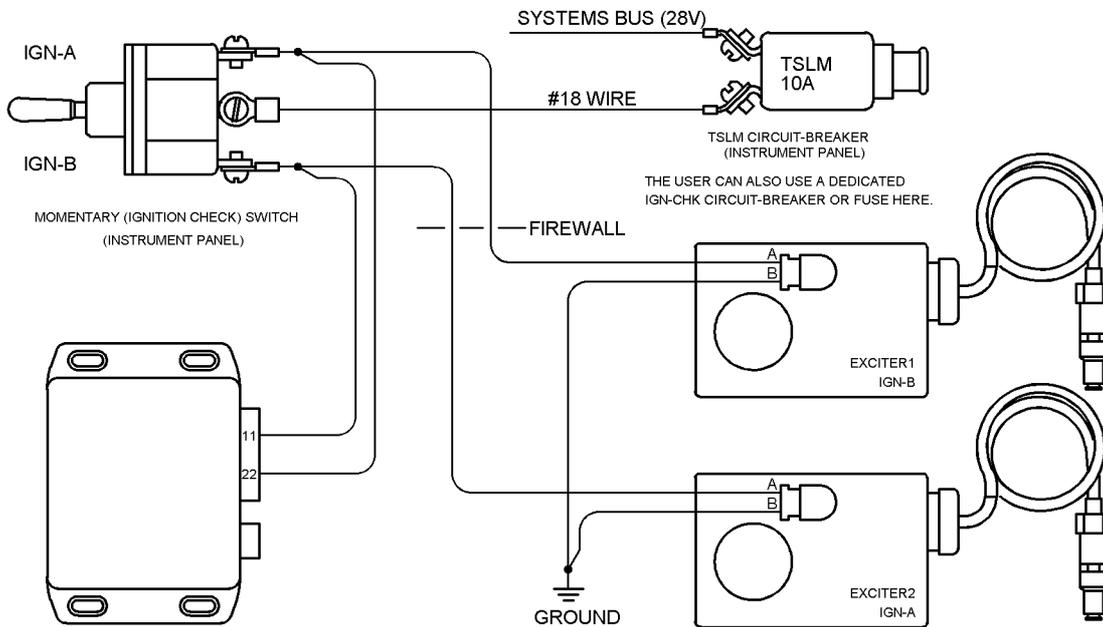
**Ignition Circuit**

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**

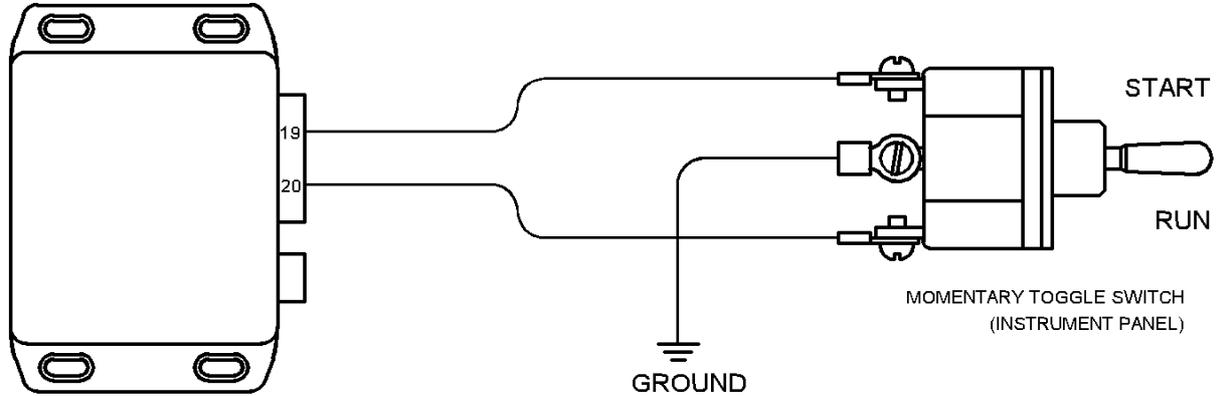
When using two separate exciter (igniter) boxes, each one only capable of driving one spark-plug, the ignition circuit in the following figure may be used instead...



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

**Start/Run Selection**

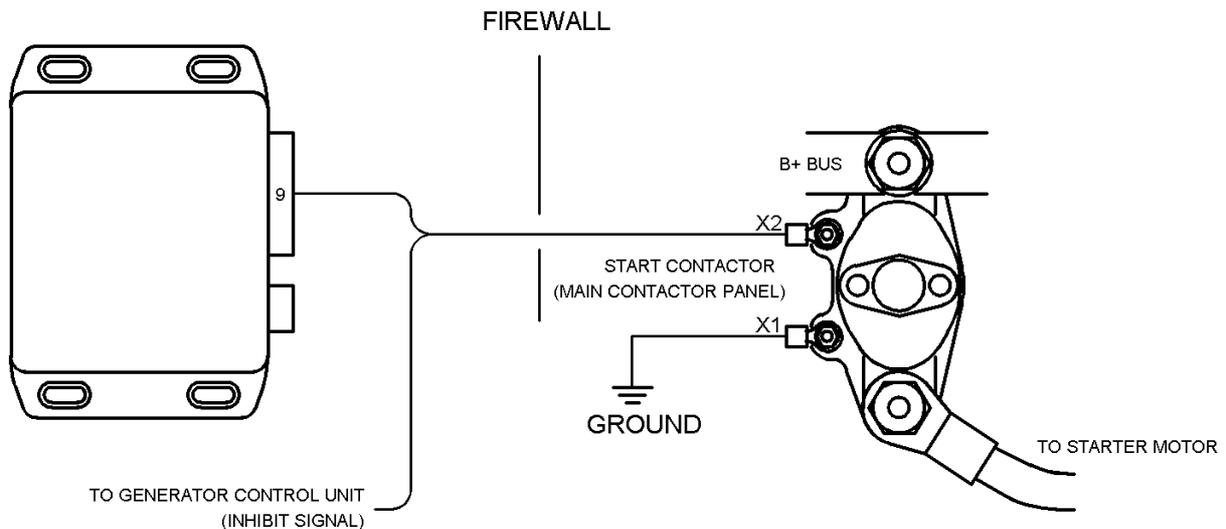
To initiate either the start or run sequence two wires from the TSLM need to be connected. Grounding the start wire (pin 20) will initiate a start attempt, while grounding the run wire (pin 19) will initiate a run sequence. The figure below shows how the start/run selection can be accomplished using 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 used during the start process and in anti-flameout operation. For older TSLM SN 5001-6200 units there are two ways to wire the interrupter to the TSLM module – the normal way and the alternative way. On the newer TSLM (SN 7001 and up) units you must wire it the normal way. In the normal way the interrupter is activated with a positive voltage on the valve's pin A as shown below.

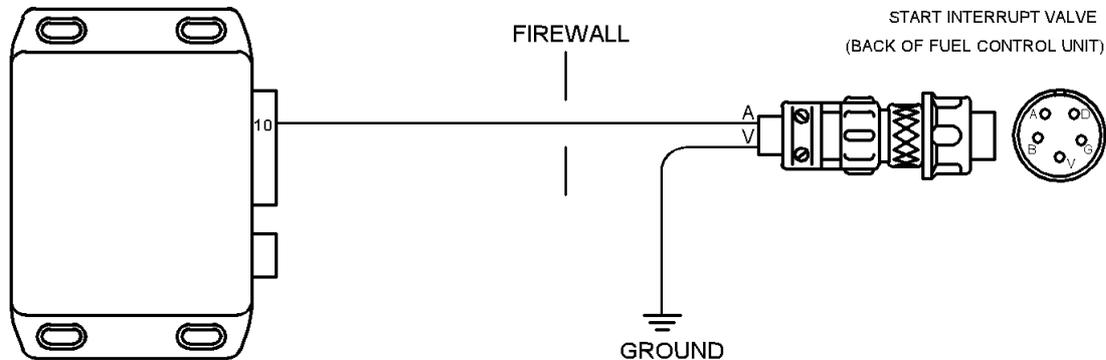


Figure 6 - Normal Interrupter Wiring

The alternative way on the other hand activates the interrupter valve by grounding pin V instead as shown below.

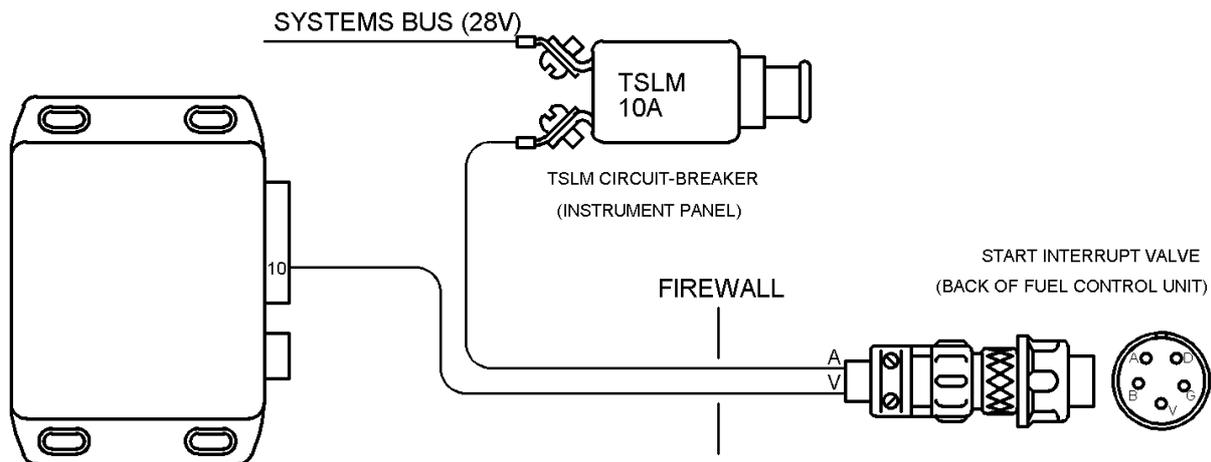


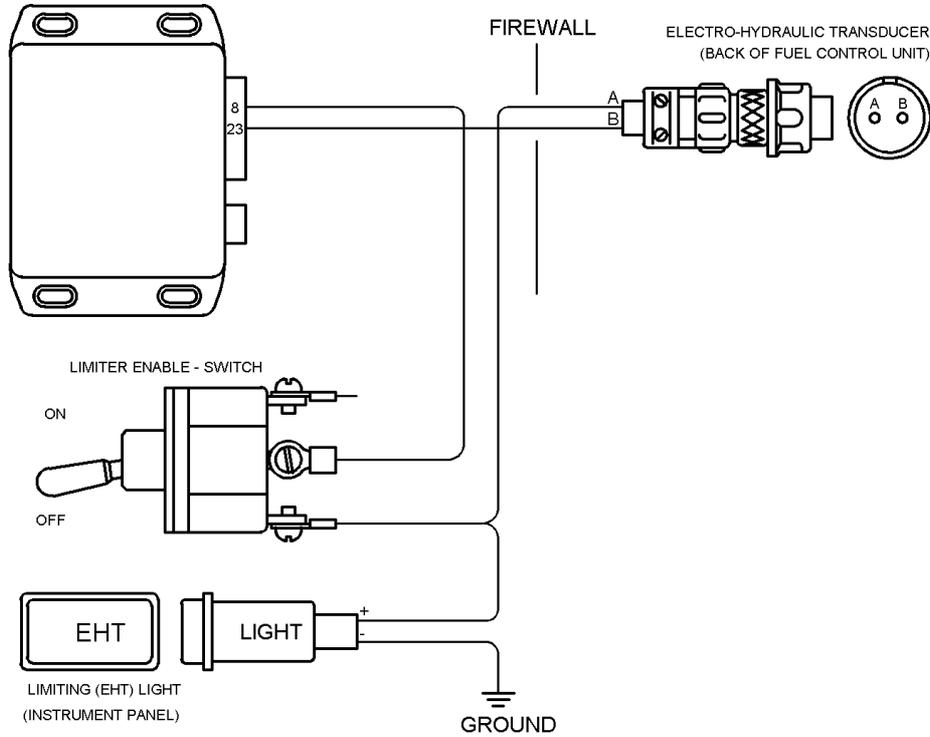
Figure 7 - Alternative Interrupter Wiring

### Important:

For an older TSLM (SN 5001-6200) the unit needs to be configured to either the normal or alternative interrupter setting. The [SetView Software](#) chapter explains how to do it. 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 in the [Alternative Interrupter Activation setting](#).

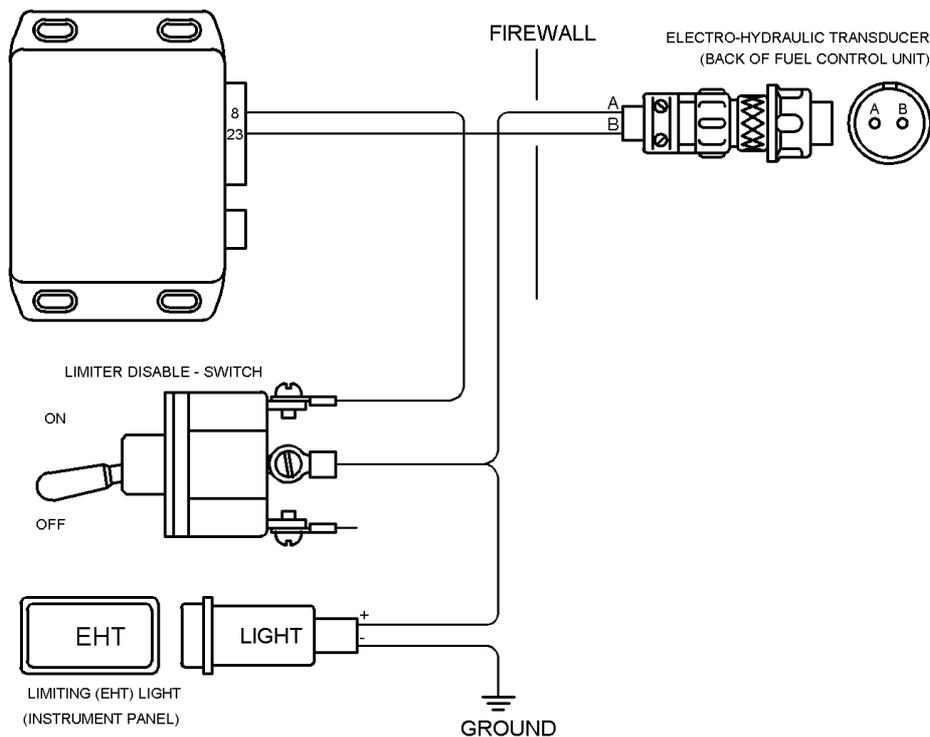
**Limiting (EHT) Circuit**

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. This switch allows the pilot to remove any doubt that the TSLM may be activating the EHT valve when it is not supposed to.



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

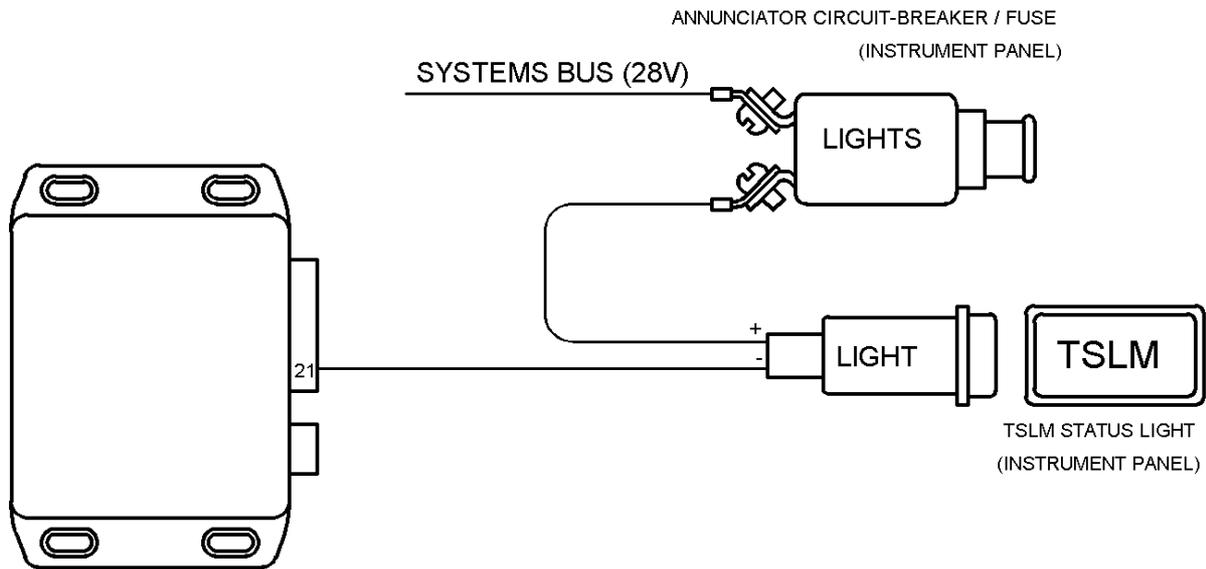
Alternatively a LIMITER DISABLE switch can be incorporated as shown below.



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

**TSLM Status Light**

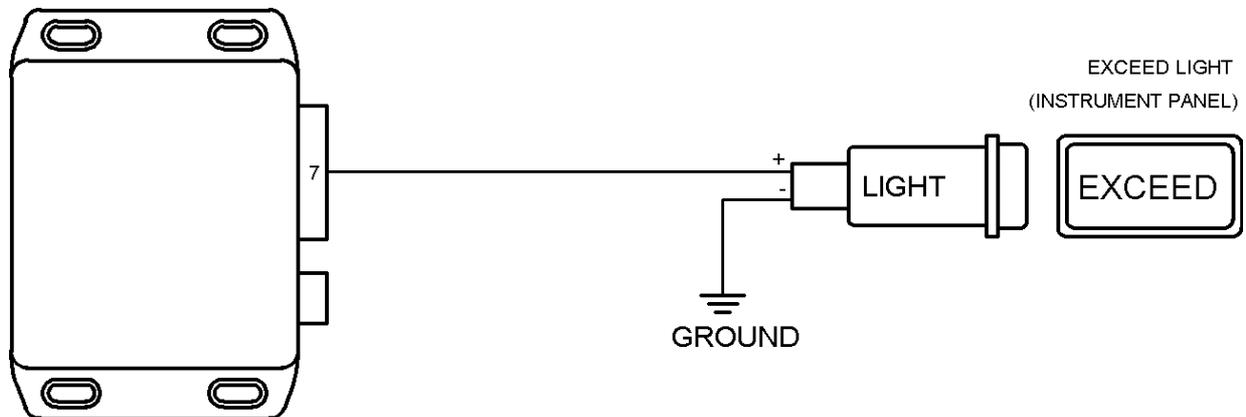
The TSLM drives an annunciator or panel light in the cockpit that provides feedback to the pilot concerning the status of the TSLM system such as [error codes](#). The TSLM light's wiring in the next figure shows the common circuit-breaker that may be used for the whole annunciator system.



**Figure 10 - Status Light Wiring**

**Exceed Light**

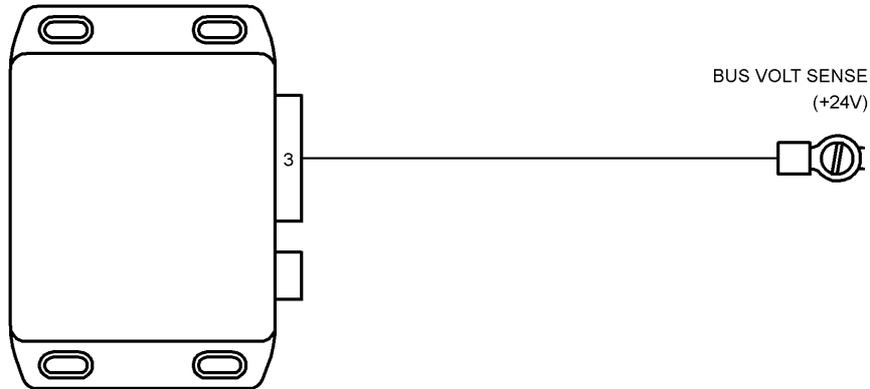
The TSLM drives another annunciator or panel light in the cockpit as shown in the following diagram. Though not absolutely necessary we do strongly recommend installing this light. It lights up during [start-up](#) or [in-flight](#) when an exceedence occurs, or is about to occur if no corrective action is taken. You can leave this out if not wanted or if this functionality is already provided for.



**Figure 11 - Exceed Light Wiring**

**Voltage Sensing**

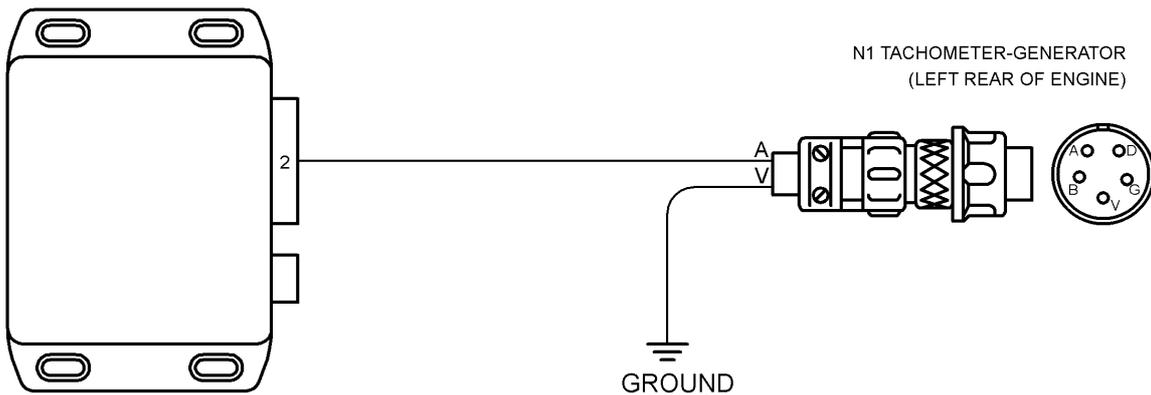
The TSLM has to sense the system voltage because low battery voltage can cause start-failures and “hot starts”. The TSLM will decline a start operation when the battery voltage is too low.



**Figure 12 - Battery Voltage Sense Wiring**

**Gas Generator Speed Sensing (N1)**

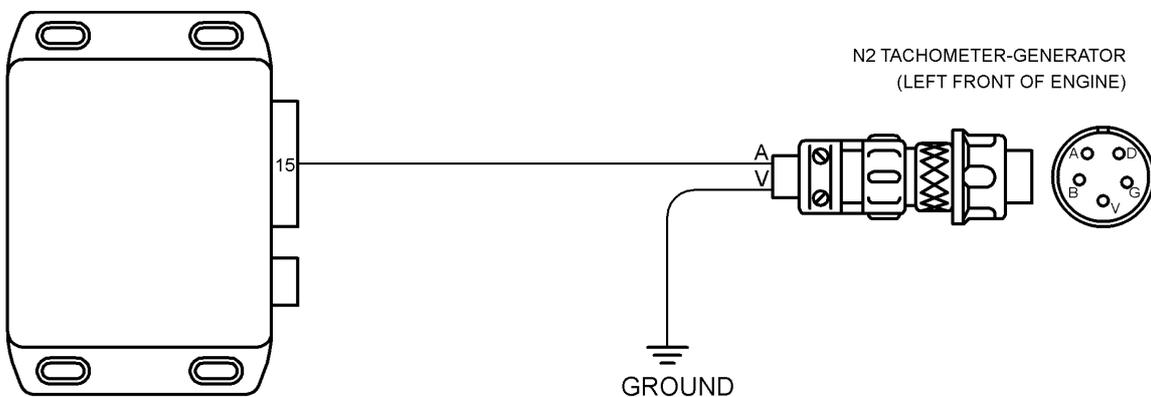
The diagram below shows the connection of the N1 tach-generator to the TSLM. The tach-generator signal is strong enough to be shared with other instruments.



**Figure 13 - Gas Generator Speed Sense Wiring**

**Propeller Speed Sensing (N2)**

The diagram below shows the connection of the N2 tach-generator to the TSLM. The tach-generator signal is strong enough to be shared with other instruments.



**Figure 14 - Propeller Speed Sense Wiring**

### Inter Turbine Temperature Sensing (ITT)

The figure below shows the hookup of the k-type thermocouple wires for ITT. At least within the engine compartment thermocouple cable with metal braiding should be used. Note the ring terminals where the one from the red wire is bigger than the other one.

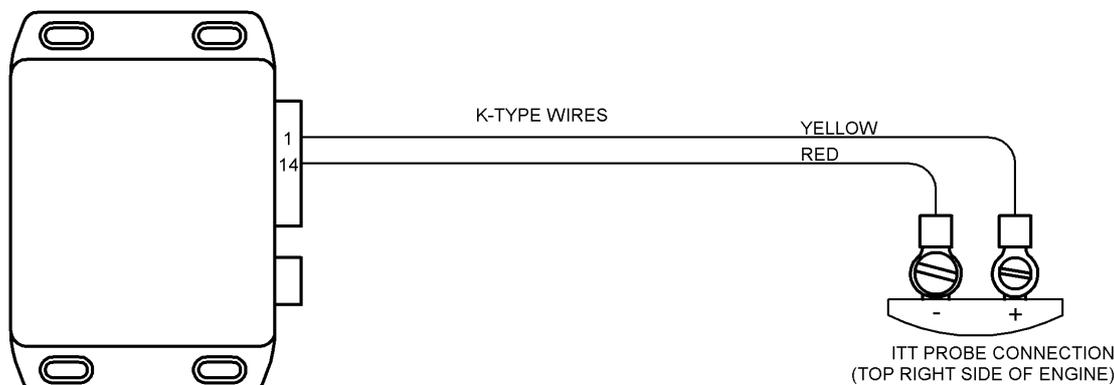


Figure 15 - Inter-Turbine Temperature Sense Wiring

**Sharing thermocouples with a temperature gauge** is not a problem. Though thermocouples provide a small signal (millivolts), this signal is strong (low source resistance). The TSLM's thermocouple inputs have both high impedance and a wide common mode voltage range, which ensure accurate but non-intrusive measurement.

**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 of the TSLM and the green wire (ITT-) to its pin 14, when installing it on an type E-11 engine.

### 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:

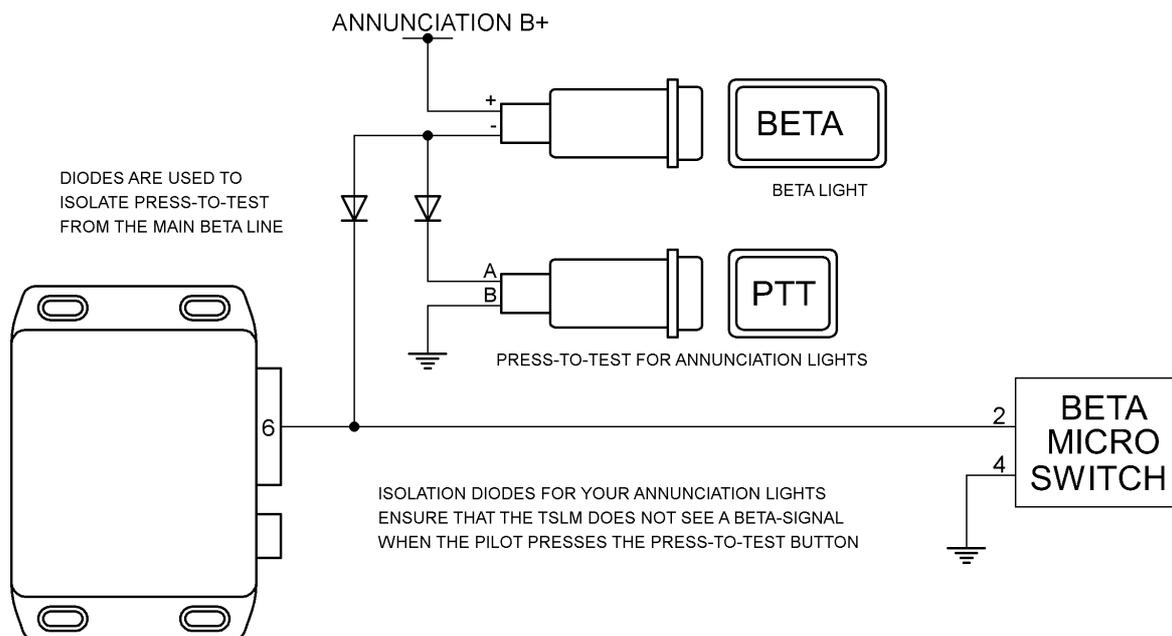


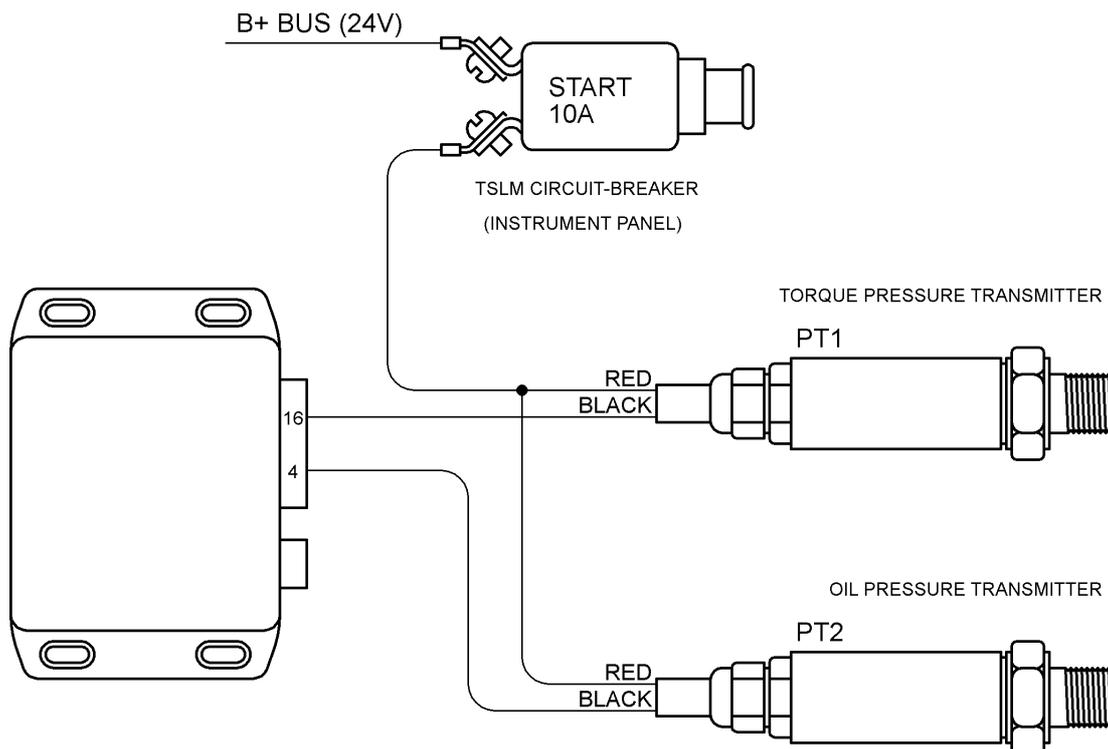
Figure 16 - Beta Sense Wiring

### Torque and Oil Pressure Sensing (optional)

The circuit below shows how the TSLM is able to measure engine torque and oil-pressure via separate 4-20mA pressure transducers. They are optional since the TSLM can fulfill all its primary functions (engine start control and limiting) without needing to sense torque or oil-pressure.

They must however be installed if you want these measurements to show on your VRX multi-function display(s), should you have this in your system. If torque rises above its **limit** an exceedence graph will be triggered where all parameters are recorded while the exceedence lasts.

Please note that these transducers are a different set from the ones used by other companies like Electronics International (EI). They can be incorporated with similar sensors (for other instrumentation) by T-pieces. They will thus provide transducer and measurement redundancy.



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

We use 4-20mA transducers that reduce the wire count and are less susceptible to noise (EMI). They are available commercially of the shelf from various vendors and their minimum requirements are as follows:

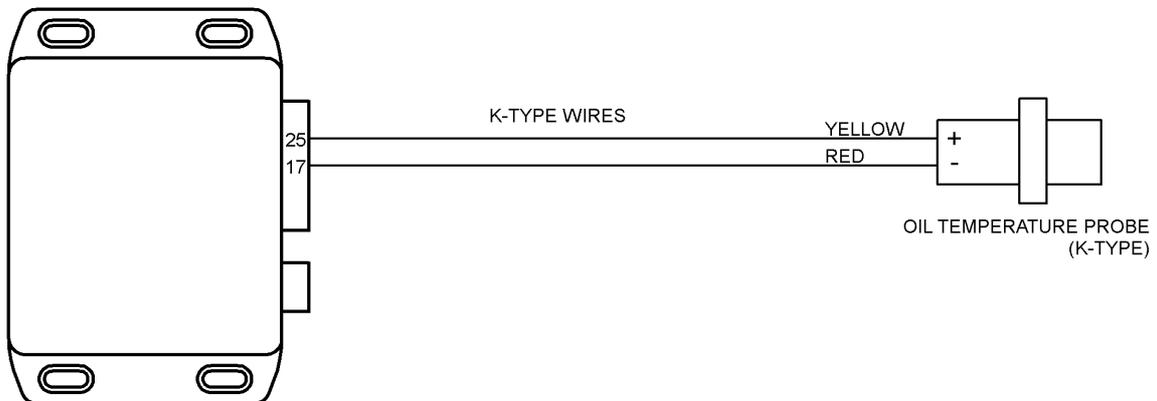
Sensor output type	4-20mA (two wires)
Measurement media	Gas, Fluid (oil)
Pressure type	Gage or sealed gage
Pressure range for oil-pressure sensor	0 – 50 psi
Pressure range for torque sensor	0 – 200 psi, or 0 – 250 psi The <a href="#">Torque 200psi enable setting</a> must reflect your choice
Operating temperature range	-40 to +125°C
Maximum operating voltage	30V

Examples of sensors that you can use are:

Measurement	Part Number	Pressure Port	Electrical termination
Oil-pressure	M5151-000005-050PG	¼ – 18 NPT	Cable (2 feet)
Torque	M5151-000005-250PG	¼ – 18 NPT	Cable (2 feet)

### ***Oil Temperature Sensing (optional)***

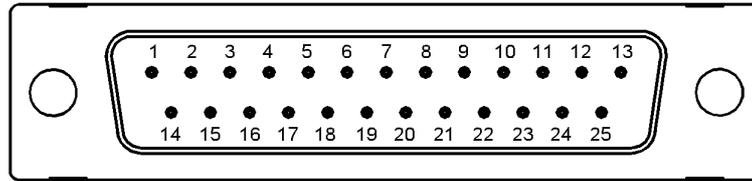
The TSLM can measure engine oil temperature via k-type thermocouple probe. At least within the engine compartment k-type thermocouple cable with metal braiding should be used. You must set the [Oil Temp measurement enable setting](#) to 1 in order to enable this measurement.



**Figure 18 - Oil Temperature Sense Wiring**

**Sharing thermocouples with a temperature gauge** is not a problem. Though thermocouples provide a small signal (millivolts), this signal is strong (low source resistance). The TSLM's thermocouple inputs have both high impedance and a wide common mode voltage range, which ensure accurate but non-intrusive measurement.

**TSLM Pin Definitions**



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

**Table 1 - TSLM Connector**

## Configuration

### Introduction

This chapter describes the configuration settings of the TSLM, which can be accessed in one of two ways, either:

- 1) through a Windows computer running our SetView software, or
- 2) through a VRX multi-function display.

See the [SetView Software](#) chapter later in this manual about how to do it through your Windows computer / laptop.

The VRX–M601 Operational & Installation manual (which can be downloaded from our website) describes how to do it through the VRX multi-function display.

### Configuration Settings

In this section we describe the various configuration properties of the TSLM. See [Adjusting the Configuration](#) about how to alter any of these settings.

#### History Recorded (bytes)

This property tells you how much bytes have been recorded in the TSLM history log.

#### Start Cycles

This counter tracks the number of start cycles.

#### Flight Hours

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

#### Upper ITT Exceeds

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

#### Lower ITT Exceeds

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

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

#### N1 Exceeds

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

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

#### N2 Exceeds

This counter 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 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 informs you of the highest temperature the unit have been exposed to. It can be reset to begin afresh.

### Min. Unit Temperature °C

This configuration property informs you of the lowest temperature the unit have been exposed to. It can be reset to begin afresh.

### 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 bus 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.

### ITT Calibration

This configuration property calibrates the ITT measurement.

### Voltage Calibration

This configuration property calibrates the voltage measurement.

### Torque Span Calibration

This configuration property calibrates the torque measurement.

### Torque Offset Calibration

This configuration property calibrates the torque measurement.

### Oil Pressure Span Calibration

This configuration property calibrates the oil-pressure measurement.

### Oil Pressure Offset Calibration

This configuration property calibrates the oil-pressure measurement.

### Oil Temperature Span Calibration

This configuration property calibrates the oil-temperature measurement.

### Oil Temperature Offset Calibration

This configuration property calibrates the 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).

This value defaults to zero for unit serial numbers 7001 and above.

See also [Start Interrupter Valve circuit](#).

### Enable Oil-Temperature Measurement

Set to 1 if you want the TSLM to measure and share the Oil-temperature with other devices. See also [Oil Temperature sensing circuit](#).

### Torque sensor is 200 psi type

Set to 1 if you are using a 200 psi torque sensor instead of the normal 250 psi sensor. See also [Torque sensor circuit](#).

### 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 only check that would not be bypassed is the EHT check. See also [Initiating a Start](#).

If set to 0, this feature will be disabled.

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

You select the 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. See also [Parameter Exceeds](#).

### 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, though your start durations may increase.

## History Logs Operations

### History retrieval

The TSLM history logs are automatically retrieved when you perform a [synchronize](#) through the SetView program. Alternatively these logs can be retrieved via the VRX multi-function display using it's menu to generate a history file on an inserted USB disk (stick).

### History clearance

The history logs are erased from the TSLM memory automatically after a successful retrieval when using the SetView program. On the other hand via the VRX display clearance of the history must be confirmed by the user after a successful retrieval.

### Viewing the history

History can only be viewed through the SetView software. A history file retrieved onto a USB disk via the VRX display can be opened from within SetView. See also [Opening and Viewing History files](#).

### ***Diagnostic Tests***

Through diagnostic and other tests you can confirm the integrity of your TSLM installation before you do a RUN or a START operation. For additional reading to this section see also [Diagnostic Tests through SetView](#).

#### **Ignition check**

To troubleshoot the ignition circuit this diagnostic test will power the exciter unit(s) through the TSLM. You can now listen for sound, etc.

#### ***Interrupter check***

To troubleshoot the interrupter circuit this diagnostic test will toggle the power to the interrupter valve through the TSLM. You can now listen for sound, etc.

#### ***EHT valve check***

To troubleshoot the EHT circuit this diagnostic test will toggle the power to the EHT valve through the TSLM. You can now listen for sound, etc. The TSLM will also test for electrical current through the valve.

#### **Exceed light check**

To troubleshoot the Exceed annunciation circuit this diagnostic test will toggle the power to the Exceed light through the TSLM. You can now confirm the light comes on.

## SetView Software

### Introduction

The SetView software connects to **older TSLM** units to allow you to:

- Update firmware
- View and record parameters
- View and adjust configuration / settings
- Retrieve and view history logs
- Share history, configuration and recordings via email
- Do diagnostic tests for troubleshooting

The **new TSLM** (serial numbers 7XXX) connect via VRX multi-function display in order to perform the above tasks. For details see the VRX-M601 Operational and Install Manual.

### System Requirements

- Operating System: Windows 7 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.

### SetView download and Installation

Find the latest version of SetView on our website ([www.vravionics.com](http://www.vravionics.com)) and install it onto your Windows computer or laptop:

- Click on the **SetView Software** link found at ([www.vravionics.com/downloads.html](http://www.vravionics.com/downloads.html))
- Click on **Install** and run the setup.exe until all is successfully installed.

Bundled with the latest software are the latest firmware for all VR units in your system (EIU, TSLM, PDC, FSM, etc.). This new firmware may provide new features or have corrected old problems.

### Using SetView

Through its dedicated 9 pin maintenance connector the TSLM can link with your computer / laptop connecting either directly to your computer's serial port or via a USB-to-Serial converter.

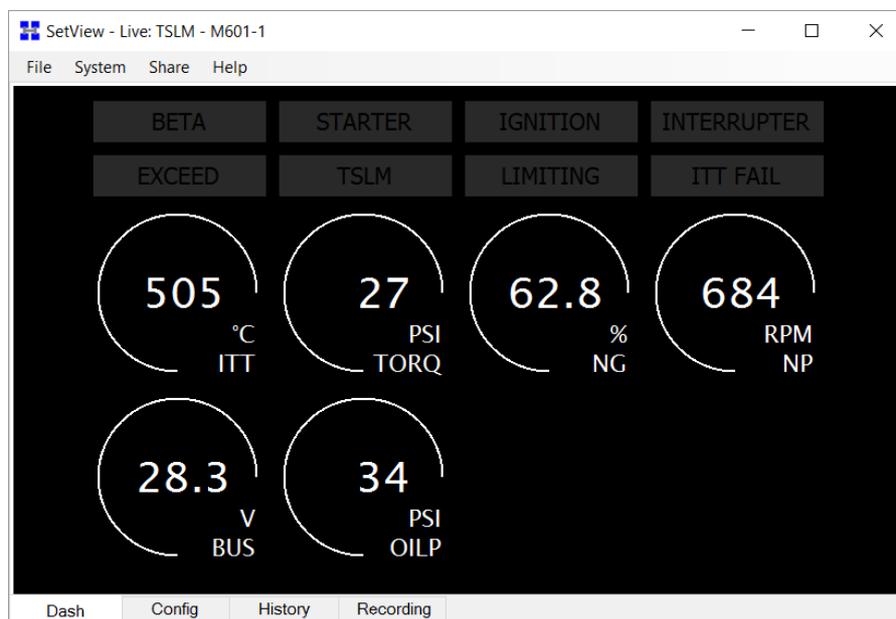
- Plug in your USB-to-Serial converter (if you are using one) to your Laptop. If this is the first time it have been plugged into a specific USB port, wait for Windows to recognize it and successfully install its driver.
- Connect the USB-to-Serial converter serial port to the 9 pin maintenance connector.
- Run the SetView Software.
- Select from the main menu System > Serial Port. Confirm you have a COM port selected and that it is the right one.
- Power the TSLM module (by switching on the aircraft's master switch).

Reasons for failing to establish communication could be:

- Power was not applied to the TSLM, or
- The serial cable between the unit 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 SetView software and switch the power on.

## Viewing and recording parameters

After running the SetView software, selecting the correct serial port and applying power to the system, the SetView software should start showing the following parameters:



To **make a recording** select from the main menu System > Record Parameter Stream. To stop recording thereafter select System > Stop Recording Parameter Stream. The recording will then be saved to a file and shown in graph format for you to view.

## Synchronizing with the system

By synchronizing (menu > system > synchronize) SetView will first check the firmware version of the TSLM and any other VR units in your system (connected via CAN bus). If there is a new version SetView will in each case ask you if you want to update. Only if you select Yes it will update the particular unit to the new version.

A synchronize will also make SetView read the TSLM's configuration as well as those for the other VR units in your system. The bundled configuration settings will be saved to file and can be viewed by simply clicking on the **Config** tab at the bottom of SetView.

A synchronize will lastly make SetView retrieve the TSLM history logs and save it to file. The history can then viewed by simply clicking on the **History** tab at the bottom of SetView or [opened](#) at a later stage.

## Sharing files via email

If you have made a recording and/or done a synchronize which will read the TSLM configuration, you can easily share these files with others via email (menu > Share). If troubleshooting and you require support from VR Avionics, you may email your recording and configuration to us so we can better be able to assist you.

### Adjusting the configuration

To make adjustments to the configuration (such as [ITT Calibration](#)), 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 #	Configuration Property	Setting	Access
TSLM	6038	History Recorded (bytes)	0	Viewonly
TSLM	6038	Start Cycles	0	Adjustable
TSLM	6038	Flight Hours	1.33	Adjustable
TSLM	6038	Upper ITT Exceedances	0	Adjustable
TSLM	6038	Lower ITT Exceedances	0	Adjustable
TSLM	6038	N1 Exceedances	0	Adjustable
TSLM	6038	N2 Exceedances	0	Adjustable
TSLM	6038	Torque Exceedances	0	Adjustable
TSLM	6038	Max. Unit Temperature °C	21	Resetable
TSLM	6038	Min. Unit Temperature °C	17	Resetable
TSLM	6038	Last Attempted Start Time (seconds)	200	Resetable
TSLM	6038	Last Attempted Start Min Voltage (V)	23.6	Resetable
TSLM	6038	Last Attempted Start Max ITT (°C)	156	Resetable
TSLM	6038	Last Attempted Start EHT Resistance (Ohms)	176	Viewonly
TSLM	6038	ITT Calibration	1105	Adjustable

To modify any specific configuration item, scroll to the item and hit <SPACE BAR> or double-click on it. A dialog box will appear where you can assign a new value to that configuration property...

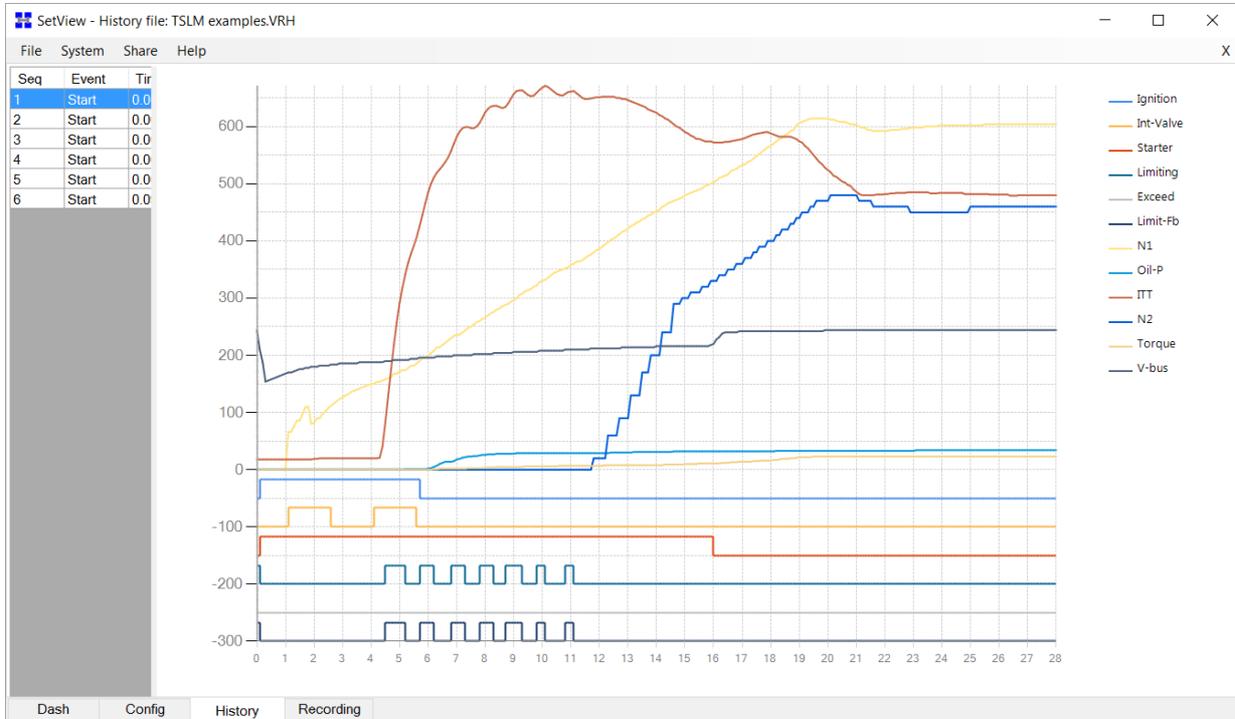
ITT Calibration

1105

When done click the Update button to change the configuration item setting.

### Opening and viewing history files

To open a History file in the SetView software, you 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.



### Diagnostic test and troubleshooting

Diagnostic tests are designed to verify the correct installation of the TSLM system and the proper operation of some system components. This is strongly recommended before you do your first start or motor/run operation. By selecting from the main menu System > Diagnostic Function > Ignitors (or Interrupter Valve, EHT valve, Exceed light, TSLM light, Run switch, Start switch or Beta switch) such a test begins. To terminate the test simply click inside the box.

