

## Features

- Turbine auto-start control for simple and consistent starts
  - Lessens operator workload and frees up one hand
  - External Exceed light to guide the operator to:
    - abort the start if a hot-start is imminent, etc.
    - reduce in-flight power or adjust prop lever
  - External Auto-Start light to:
    - indicate the auto-start sequence activation
    - guide the operator to forward the fuel lever (fuel on at safe/optimum N1)
- Various auto-ignition / auto-relight possibilities to address flame-outs
- Full engine monitoring when combined with VRX display(s) with unmatched redundancy options
- Detailed event-driven or continuous in-flight recording
- Designed for easy retrofit as well as for new installs
- Manual starting ability may be retained if a backup is desired



## Description

The TSM brings auto-start control to turboprop, turbofan and jet engines not equipped with electric fuel valves, etc. providing a simple and consistent platform to execute start procedures from. It not only lessens operator workload, but enables start-ups using just one hand on the condition/fuel lever, while the other hand holds the flight control stick, etc.

Initiating a start the operator is guided by two lights, the Auto-Start light and the Exceed light. The Auto-Start light not only signals start sequence activation, but also guides the operator as to when to forward the condition/fuel lever. The criteria used to determine this safe/optimum fuel introduction moment are configured specific to each engine model.

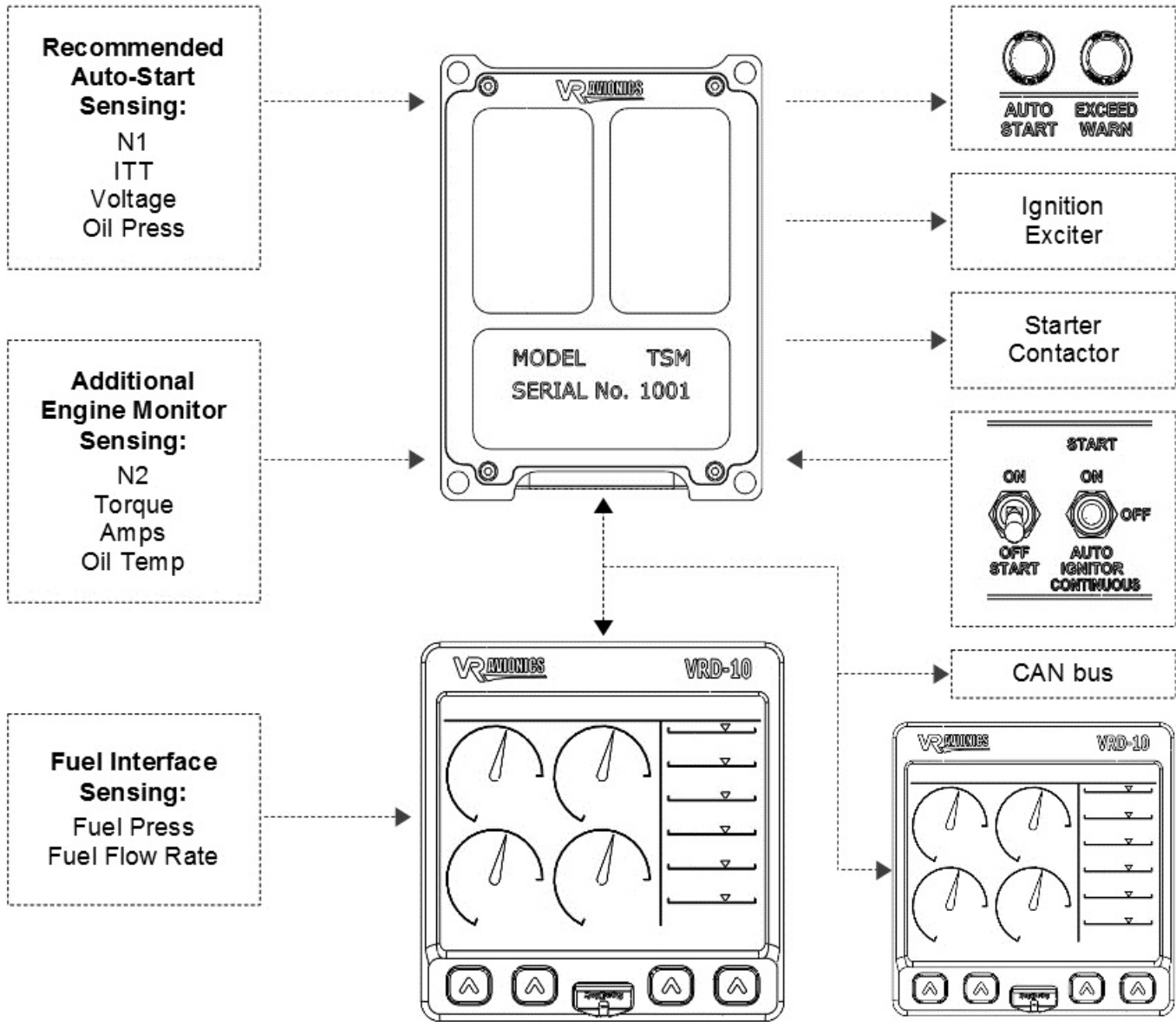
Illumination of the Exceed light on the other hand tells the operator to abort the start, which can be because the TSM predicts a hot-start to be imminent or otherwise senses the existence of an unsafe condition. Hot-start prediction takes into account the time/duration dependent limits as found in a specific engine's maintenance manual. In-flight the Exceed light also illuminates should any of the primary engine parameters exceed. The operator can then make the necessary adjustment to the power or prop lever to let the light to go out.

For normal standalone auto-starting only certain sensors need to be connected to the TSM. The unit will however accept further sensors in order to work with one or more of our VRX displays to realize full engine monitoring. This arrangement can also provide some instrumentation redundancy against a single unit failure, however rare to occur, to at least leave the operator enough engine indication to "limp home" with.

The TSM can record all engine parameters in up to 1/10<sup>th</sup> of a second sample periods. Recordings can be continuous, or triggered to only cover certain events such as parameter exceeds and start sequences.

The TSM easily retrofits to existing installations, requiring very little instrument panel alteration. If desired, manual starting ability can be retained as a backup/alternative starting method.

**Block Diagram - PT6 Auto-Start & Engine Monitor**



Illustrated above is a TSM application providing a combined auto-start and engine monitor solution. It shows how these functions can be divided up for an auto-start only solution and even an engine monitoring only solution.

The joint CAN bus allows one or more VRX displays as well as more VR Avionics units such as our PDC and FSM to be added easily allowing users to select the monitoring scope and level of redundancy they require.

Also shown are the typical panel switches allowing both automatic and manual starting procedures. Other switch arrangements may be selected to achieve the same or provide for automatic only start procedures.

## Pin-outs (male 25-pin d-sub)

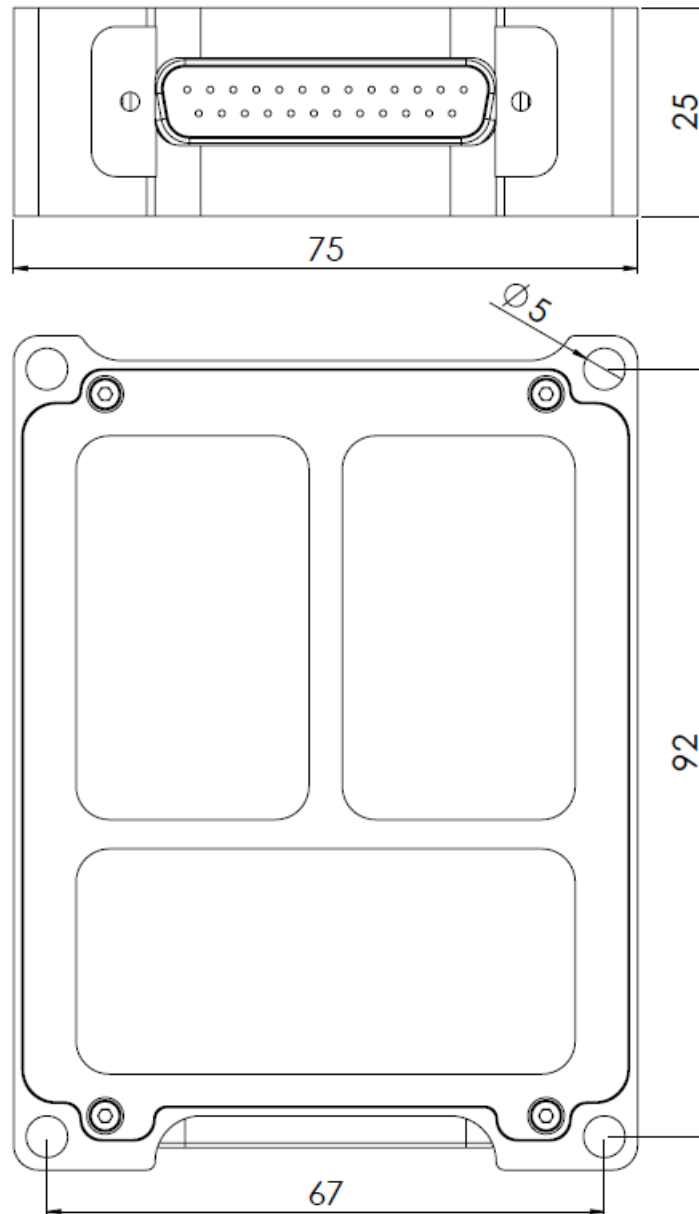
PINS	DIR	FUNCTION	DESCRIPTION
12	IN	MON-PWR	MONITORING POWER
11	IN	CTRL-PWR	CONTROL POWER (AUTO-START ENABLE)
13, 8	GND	GROUND	AIRCRAFT GROUND
16	IN	N1	SPEED SENSOR 1 (N1 TACHGEN)
17	IN	N2	SPEED SENSOR 2 (N2 TACHGEN)
1	IN	ITT+	TEMPERATURE SENSOR 1 (K-TYPE THERMOCOUPLE +)
2	IN	ITT-	TEMPERATURE SENSOR 1 (K-TYPE THERMOCOUPLE -)
3	IN	OIL-P	PRESSURE SENSOR 1 (4-20mA TRANSDUCER)
4	IN	TORQ	PRESSURE SENSOR 2 (4-20mA TRANSDUCER)
5	IN	TORQ2	PRESSURE SENSOR 3 (4-20mA TRANSDUCER)
14	IN	OILT+	TEMPERATURE SENSOR 2 (K-TYPE THERMOCOUPLE +)
15	IN	OILT-	TEMPERATURE SENSOR 2 (K-TYPE THERMOCOUPLE -)
7	IN	SHUNT-	AMPS SHUNT- INPUT (VOLTAGE SENSE INPUT)
6	IN	SHUNT+	AMPS SHUNT+ INPUT
18	IN	AUX-SW	DISCREET INPUT 1
19	IN	START-RUN-SW	DISCREET INPUT 2
9	OUT	STARTER	POWER OUTPUT 1 (STARTER CONTACTOR)
10	OUT	IGNITOR	POWER OUTPUT 2 (IGNITION EXCITER)
24	OUT	AUTO-START	GROUNDLED OUTPUT 1 (CAUTION LIGHT)
25	OUT	EXCEED	GROUNDLED OUTPUT 2 (WARNING LIGHT)
20	OUT	TX232	RS232 INTERFACE TRANSMIT
21	IN	RX232	RS232 INTERFACE RECEIVE
22	I/O	CAN-H	CAN BUS INTERFACE HIGH
23	I/O	CAN-L	CAN BUS INTERFACE LOW

## Maximum Ratings

1	POWER SUPPLY VOLTAGE RANGE	10 TO 32 VDC
2	STORAGE TEMPERATURE	-55 TO +125 °C
3	OPERATING TEMPERATURE	-40 TO +85 °C

## General Specifications

4	DIMENSIONS	100 x 75 x 25mm
5	WEIGHT	180 g
6	POWER CONSUMPTION (NOT SWITCHING ANY LOADS)	50mA (typical)

**Unit Outline**

1. The TSM uses a 25-pin DSUB (M24308 series) male connector. The recommended mating receptacle (female) for it is the M24308/2-3