



VRX-FA402

operational &
installation
manual

revision A

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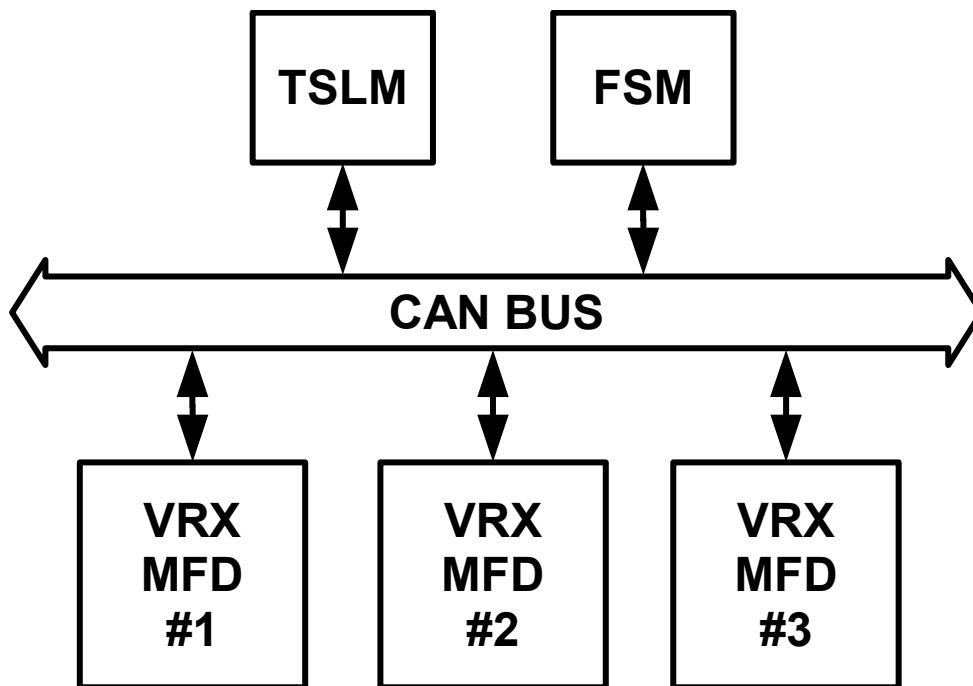
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Introduction

This manual supplements VR Avionics' VRX-M601 and TSLM-M601 operational and installation manuals to describe our solution for the FA402 aircraft – a single Walter M601D turbine powered Cessna 402 conversion.

System Description

Our VRX-FA402 solution consist of one TSLM, one FSM unit and three VRX multifunction displays.

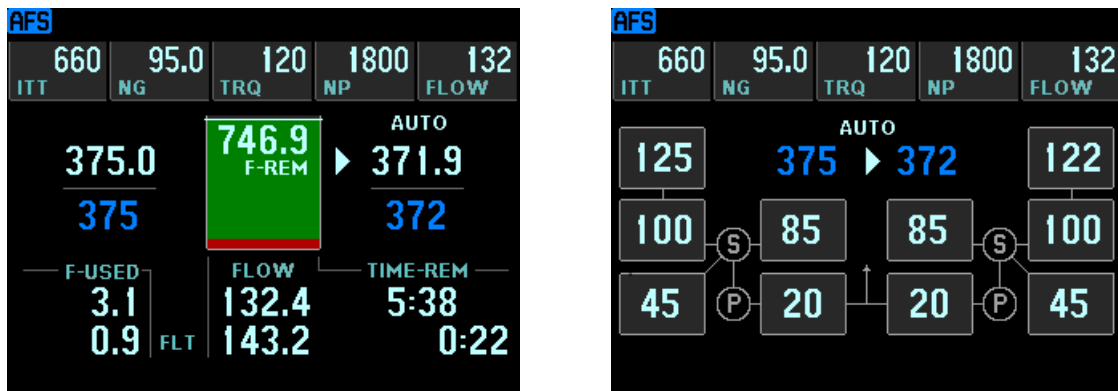


It provides for normal engine monitoring with ITT, N1, N2, torque, bus voltage, oil pressure and temperature, fuel flow, fuel pressure, fuel remaining, time remaining, etc. Also fuel levels of 10 fuel tanks (5 in each wing) and manual or auto fuel selection.

Each MFD can display all parameters sent from other MFD's, the TSLM and FSM units via CAN bus, however they will start with different initial pages when powered up, one will show the ENGINE page, and the second the FUEL page and the third the FSM page.

Operation

Fuel Level Monitoring



The screen-shots above show the FUEL and FSM system pages as presented by VRX-MFD's. Both have a persistent annunciation bar and row of engine parameters at the top.

The **FSM system page** shows all 10 fuel tanks (5 on each side), the interconnecting fuel lines, selectors and pumps. Each tank box has its fuel quantity measured by fuel level probes inside. The units is liters. The values in blue represent the sum total on each side. Each wing in the FA402 has 5 fuel tanks. Tank 1 (the tip tank) feeds to tank 2, which in turn feeds a three input manual fuel selector. The other two inputs are fed by tank 6 and the combined tank of 3 and 4. The output from the manual 3-to-1 fuel selector then runs through a pump to tank 5 – the header tank. The same arrangement exists in the other wing. Both header tanks run through boost pumps and non-return valves before coming together into the same line feeding the engine.

The **FUEL system page** shows a total fuel remaining value in the middle with two values both to its left and right side. The values in blue present the sum of all fuel levels on each side and is the same as displayed on the FSM system screen (in blue). The values in white (above) present the fuel remaining totals on each side. These fuel remaining totals are entered by the pilot and maintained by monitoring of the fuel flow to the engine. They decrease as fuel flows through the fuel flow sensor and consumed by the engine. Fuel selection at that moment determines which side's total is deducted from.

An arrow on both the FUEL and FSM pages indicate the side fuel is drawn from at a particular moment. Both screens also indicates either MAN or AUTO depending on whether fuel selection occurs manually or automatically. It confirms the position of fuel selection switch under the control of the pilot.

Auto fuel selection (AFS)

With AFS engaged the FSM will either activate the left or the right pump to keep the left and right Fuel Remaining values with the [Auto Fuel Leveling Differential](#) from each other.

Manual or Auto fuel selection at start-up

Before starting the engine ensure the Fuel Remaining totals on the left and right side reflect the actual quantities on each side. If you have just added fuel you should make adjustments to these totals by selecting MENU.. then either ADD, SET or FULL. After selecting one select either LEFT or RIGHT corresponding to the side you want to adjust. Complete the procedure until the correct values are reflected on both sides.

To select Auto fuel selection turn the fuel selection switch to AUTO, then turn both left and right fuel selectors ON and to the same setting, which would typically first be the outboard tanks. One selection pump of the fullest side should turn on. AUTO with a left-or-right arrow will indicate on both the FUEL and FSM screens.

To select Manual fuel selection turn the fuel selection switch to MANUAL, then turn either left or right fuel selector to the appropriate selection as required (typically outboard tanks at first). The other fuel selector

must be in the OFF position and the pump lights should reflect this. MAN and left-or-right arrow will be indicated on both the FUEL and FSM screens.

After starting the engine the relevant fuel remaining totals will decrease depending on selection as fuel is consumed by the engine.

Manual fuel selection in flight

In Manual fuel selection the pilot must from time to time switch from left to right and vice versa during the flight. Two actions are required for each switchover. The pilot either turns the selected side OFF and the opposite side ON or vice versa. In either case the time between these two actions should be kept as short as possible. This will ensure the left and right fuel remaining totals stay as accurate as possible. In case both selectors are OFF or both are ON for prolonged periods, the fuel quantity consumed during this time will be deducted 50/50 between left and right fuel remaining totals. Therefore make the manual fuel switch-overs as short as possible.

Auto fuel selection in flight

In Auto fuel selection the required action by the pilot is greatly reduced. To make the engine consume fuel from another tank the pilot simply turns the relevant fuel selector to point to it. In order to maintain left-right balance both fuel selectors should mirror each other (for example both should be point to outboard tanks).

Switching from Manual to Auto fuel selection in flight

To switch from manual to auto fuel selection two actions are required. Turning the OFF fuel selector ON (to mirror the already ON fuel selector) and switching the fuel selector switch from MANUAL to AUTO. The MAN shown on both the FUEL and FSM pages should now show AUTO instead.

Switching from Auto to Manual fuel selection in flight

To switch from Auto to Manual fuel selection two actions are required. Turning the one fuel selector OFF and switching the fuel selector switch from AUTO to MANUAL. The AUTO shown on both the FUEL and FSM pages should now show MAN instead.

Annunciation Bar Indication

There are three indicators that will turn on up top as follows:

- AFS (blue): indicates Automatic Fuel Selection is active (mirrors the AUTO shown on both FUEL and FSM pages).
- FSUP (red): warns of fuel supply problem which could be one or more of the following:
 - both fuel selection pumps are off or both are on
 - fuel pressure is below the [Fuel Pressure Warning Level](#) setting
- FSM (red): warns if communication is lost with the FSM unit (over CAN bus)

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 20-24 AWG)
- A VRX MFD or a laptop computer or PC running Windows. If not equipped with a serial port, a USB port together with a USB-to-serial adapter is needed.
- A standard RS-232 cable (DB-9 male to DB-9 female) may be needed
- The following sensors (if you want the particular parameter):
 - Fuel pressure sensor
 - Fuel flow sensors
 - Fuel level (quantity) probes
 - Fuel pumps (24 volt powered)
- Connector crimp tool
- DSUB-50 female connector with crimp pins

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 FSM. 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 FSM via the 50-pin D-Sub connector on the side of the unit.

Recommended wiring practices

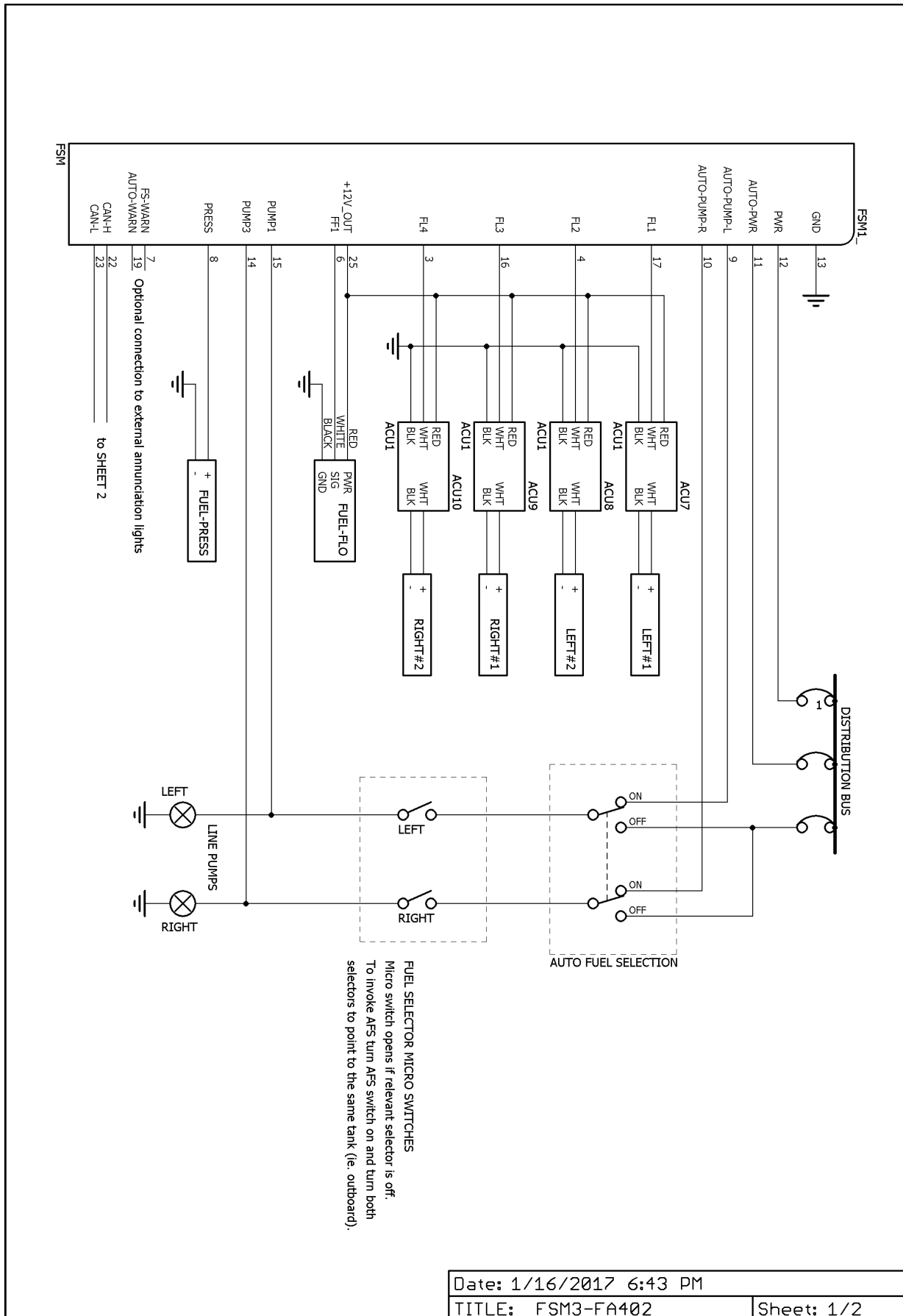
NOTE: For all electrical connections, use correct splicing techniques, taking care to properly insulate any exposed wire. A short circuit between any of the wires may cause damage to the FSM and/or other equipment.

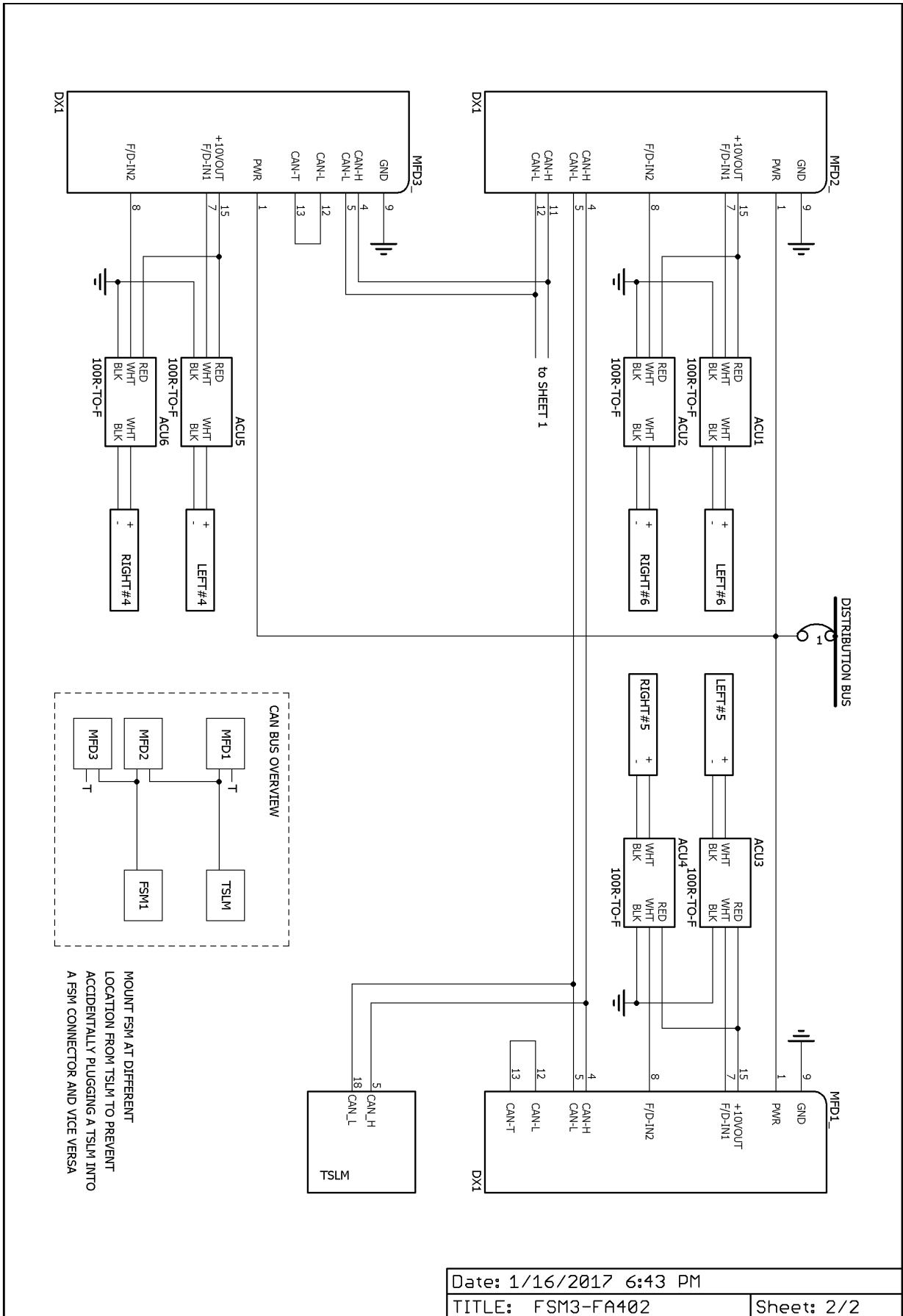
VR Avionics does not normally supply connectors or wire for wiring up your FSM. We recommend that standard aircraft grade wiring and connectors be used during installation. Gauges 20 through 24 AWG wire is sufficient for most lines to the unit. Make sure you protect the power lines with either a circuit 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 FSM 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.

Wiring Schematic





Date: 1/16/2017 6:43 PM

TITLE: FSM3-FA402

Sheet: 2/2

Configuration

Introduction

There exists various configuration settings on each of the units installed – TSLM, FSM and the MFD's. These settings which includes fuel level calibrations must be setup correctly prior to commissioning the system.

This manual will describe the configuration settings for the MFD's as well as the FSM unit. The configuration settings of the TSLM are described in a separate *TSLM-M601 operational and installation manual*.

The configuration settings of the TSLM and FSM may be viewed and adjusted via any one of the MFD's. A particular MFD's configuration settings however can only be accessed via the same MFD.

There is another way to setup the configuration of the TSLM and FSM units. See the [SetView Software](#) chapter later in this manual about how to do it through your Windows computer / laptop PC.

The *VRX-M601 Operational & Installation manual* (which can be downloaded from our website) describes how to view and adjust the TSLM's configuration settings.

Adjusting the configuration

To access the system configuration the right most button on the VRX MFD must be held in (or in case of DX1 the right toggle switch pushed to the right) when power is applied to the unit. Power is typically applied through the aircraft's battery master switch. Afterward a screen will appear.

Here the VRX-MFD and the units connected to it are listed, with each unit's serial number and firmware version next to it. The Menu bar at the bottom lists the actions available for each soft-key. EXIT terminates configuration mode, UP and DOWN scrolls the cursor to highlight a particular unit, and ENTER lets you view a particular unit's configuration.

To make adjustments a password must be entered. If VRX-MFD is selected a screen will appear listing the configuration properties and settings for the particular unit. If you have entered the [password](#) on the first configuration page you can adjust settings. Select from the Menu bar BACK to return to the previous configuration list, UP and DOWN to scroll to a specific configuration property, and SET to adjust that property's setting. Some settings are YES or NO and others require the entry of a value. Some configuration properties are for viewing only.

Configuration Password

The configuration password must be entered to adjust settings in the configuration and also to allow [erasure](#) of TSLM history on the TSLM unit. The password is initially set to 0100, but the user may change this at any time. After entering the password on the first configuration page shown above a CHANGE PASSWORD item will appear with the current password. The user may now change it. Please make sure to keep this password in a safe place to remember.

VRX-MFD Configuration

Property	Setting range	Description / Notes
Display unit rank	1 – 3	This identifies each MFD in the FA402 system from 1, 2 or 3 according to the wiring schematic . <ul style="list-style-type: none"> MFD1 reads fuel level sensors for left and right header tanks (#5) and must be set to 1. After power-up it will start with the ENGINE page. MFD2 reads fuel level sensors for left and right inboard tanks (#6) and must be set to 2. After power-up it will start with the FUEL page. MFD3 reads fuel level sensors for left and right center tanks (#4) and must be set to 3. After power-up it will start with the FSM page.
Alerting if primary	Yes / No	Enables Annunciation alerting (blinking until acknowledgment).

Property	Setting range	Description / Notes
Alert delay in seconds	0 – 60	Delay in seconds before blinking begins and acknowledgment can be made.
Repeat acknowledged alerts	Yes / No	Set this to “No” to disable further alerting (blinking until acknowledgment) of those warnings that have been acknowledged by the pilot.
Show TSLM system page	Yes / No	Enables the TSLM system page to be shown.
Include TSLM	Yes / No	Makes the display expect a TSLM on the CAN bus.
Include FSM	Yes / No	Makes the display expect a FSM on the CAN bus.
Include PDC	Yes / No	Makes the display expect a PDC on the CAN bus.
Show oil-temp from TSLM	Yes / No	Makes the display use (prefer) the oil-temperature reading from the TSLM.
Fuel in liters	Yes / No	YES if fuel quantity should be in liter units instead of US gallons.
Fuel remaining warn level	0 – 9999	Fuel remaining where FUEL warning triggers. One count equates to 0.1 gallons (or liters).
Time remaining warn level	0 – 999	Time remaining where FUEL warning triggers. One count equates to 1 minute.
Flight timer start N1	0 – 999	N1 value where flight timer starts – take-off power application. One count equates to 0.1%
Flight timer stop N1	0 – 999	N1 value where the flight timer is stopped – engine shutdown. One count equates to 0.1%
Walter engine type	0 – 2	0 – M601D 1 – M601E-11 2 – M601E-11A
Flight number	0 – 9999	A number that increments each power-up. It is used for Flight Data Recording to track flight numbers.
Flight log interval	0, 3 – 100	The time interval at which Flight Data Recording is conducted. One count equates to 0.1 seconds. Set to 0 (zero) to disable flight logging.
Setup fuel level 1	...	Sets up the left #4, #5 or #6 fuel tank level measurement depending on the Display unit rank setting .
Setup fuel level 2	...	Sets up the right #4, #5 or #6 fuel tank level measurement depending on the Display unit rank setting .

FSM Configuration

Property	Setting range	Description / Notes
Unit ident	1-2	Set to 1.
Fuel layout	0-9999	Set to 9 to confirm FA402 fuel layout.
Fuel pressure warn level	0-9999	This sets the level where a FSUP warning is triggered. One count equates to 0.1 psi
Fuel flow filter	1-16	This setting adjusts the response of the fuel flow reading - from 1 to 16. The higher the number the more filtering is applied but the slower the response.
Auto fuel level differential	0-9999	See Auto fuel selection (AFS) discussion. One count equates to 0.1 volume unit.

Property	Setting range	Description / Notes
Fuel pressure type	0-9999	This setting selects the sensor type (or rating) used for the fuel pressure sensing. For example, set to 500 if using a 0 – 50 psi sensor.
Fuel pressure calibration	0-19999	This setting is unique to a particular FSM. It calibrates the 4-20mA torque sensing input. Before changing it make sure the Fuel Pressure Sensor Type is set correctly. Also good practice is to always remember what this setting was before.
Fuel flow k-factor	0-999999	This setting adjusts the k-factor of the main fuel flow sensor. The k-factor is the number of pulses your sensor sends out for every one volume unit (gallons, liters, etc.) that flows through it.
Fuel full value left	0-9999	This is the Fuel Computer full tank value for the left wing.
Fuel full value right	0-9999	This is the Fuel Computer full tank value for the right wing.
Setup fuel level 1	...	Sets up the left #1 fuel tank level measurement.
Setup fuel level 2	...	Sets up the left #2 fuel tank level measurement.
Setup fuel level 3	...	Sets up the right #1 fuel tank level measurement.
Setup fuel level 4	...	Sets up the right #2 fuel tank level measurement.

Setting up Fuel Levels

The fuel levels of the FSM or the MFD's are setup and mapped via a VRD-MFD by selecting the relevant **Setup fuel level X** from the configuration of a particular unit then:

1. You will be prompted to SET SENSOR TYPE - FUEL LEVEL X by entering in a value. Set it to the corresponding value below:

Fuel level sensor type	MFD	FSM
Not used / disabled	0	0
Frequency probe (0 – 20,000 Hz)	1	1
Voltage probe (0 – 5 volt)	-	2

2. The fuel level mapping screen will appear showing 3 values. On the left is the LITER or GALLON value, on the right the SENSOR value / reading, and below in the middle the total points count value.
3. Starting with an empty tank fill it to the lowest amount you want displayed. This can be an empty tank if you wish. Using INC and DEC buttons (for increment and decrement) set the LITER or GALLON value to the amount you have poured in.
4. Press the ADD button to add this point. You'll see the points count increment to indicate that the point was added to the internal mapping table.
5. Repeat by pouring another amount of fuel into the tank, setting the LITER or GALLON value, and then adding that point to the internal mapping table. Note that there is 50 points available in the table so make sure you don't make the fuel increments too small and exhaust the 50 spots before you reach a full tank.
6. When the fuel tank reaches it's full value, enter and add this last point to the table, then select the DONE button.
7. You'll be prompted on whether you want to proceed and write the calibration table, YES or NO. Select YES to complete the process or no to cancel out back to the main menu.

Note: See the [schematic](#) of how the different fuel tanks should be wired to the correct input pins on each unit. Also make sure the [Display unit rank](#) configuration value is properly set for each MFD.

Updating firmware

Download and setup of firmware onto USB disk

To update the system firmware go to the downloads page of our website (www.vravionics.com) and download the **VRX-FA402.zip** file found under the **VRX Firmware** header. After download extract the contents for this zip file onto the USB disk provided with your MFD unit. You can either do this directly or extract everything first onto your PC and afterward transfer the extracted VRX folder and its contents to the USB disk. Your USB disk must now have a folder in its root called VRX and contained in this folder should be the following files:

- FSM.VRB
- TSLM.VRB
- VRD10.VRB

Execute the update via MFD

Eject the removable disk from your PC and insert it into the first VRX-MFD's USB slot. Hold in button #3 (or on the DX1 hold the right toggle switch to left) while applying power through the battery master switch. After turning on the power you may release the button (or toggle switch). The VRX-MFD will begin updating it's own firmware and thereafter update any other VR unit connected to it according to the files in the VRX folder of the USB disk. Afterward a screen will appear showing that the update was successful. If you get an error, you can attempt one or more retries before troubleshooting what is wrong. For this we also recommend reading the *Update Firmware* section in the *VRX-M601 operational and installation manual*.

Afterward repeat the same with the other two MFD's until all units have been updated to the new version.