DataVault Installation and Configuration

Introduction

This document describes the workflow required to configure and test a DataVault for any aircraft. It comprises a series of checklists and the corresponding actions required in response to the selected items.

Although DataVault supports several different types of aircraft, it is possible that one aircraft of the same type may have slightly different characteristics to the specific machine for which the configuration was originally created. It is therefore recommended that the steps are completed in their entirety.

This document presumes no previous knowledge of the DataVault.

Summary of Steps

1. Survey the aircraft to determine the sense of the inputs required by the DataVault.
2. Use the data gathered to create a basic interconnect schedule showing how each pin of the DataVault will be connected to the aircraft's electrical systems.
3. Set the electrical configuration of the DataVault inputs.
4. Install the equipment.
5. Set the software configuration of the unit, once it is powered up.
6. Test the completed installation.

Equipment Required

1. A multi-meter for measuring voltage levels.
2. A laptop (Windows or Mac) for software configuration.

DataVault Basics

A DataVault takes signals from various parts of the aircraft to determine flight state and then combines these with information from the drop control system to create “events” which are then transmitted via a built-in satellite modem or a third party device.

A source of speed data is essential as this is used for both helicopter and fixed types to determine if the aircraft is flying (or in hover in the case of rotary types).

The other signals required vary according to aircraft type.

Fixed Wing

The only signal collected from the basic aircraft systems is an appropriate input to determine if the engine is running. In general, this is the engine oil pressure sensed by an appropriate pressure switch.

Fixed aircraft dispense material from a tank and the DataVault is able to collect drop configuration (drop quantity, coverage) information and volume data from a variety of tank control systems:

Tank Control System	Interface Type	Parts required
Trotter Controls GEN3	None	None
Trotter Controls GEN2	I2C	
Trotter Controls GEN1	Bespoke	
ConAir	Serial	Cable p/n
Transland	Serial	Cable p/n

If an aircraft does not have a tank control system, the DataVault can provide basic event data by using inputs as follows:

Input	Typical Source	Purpose
Tank volume	Level probe	Determine the quantity of material uploaded.
Drop	Drop button	Determine the start and end of a drop.

DataVault supports a variety of level probes:

Probe Type	Signal	Notes
Analog	A voltage related to the level of water in the tank.	DataVault can hold transformation tables to convert a signal voltage to a volume.
Trotter Scoop Control	Serial	
Reabe	Serial	

In addition, the DataVault may receive an input to determine if foam or gel has been injected.

The DataVault has standard configuration settings for an Air Tractor AT802 and AT802F variant. This setting affects the speeds used to determine if the aircraft is airborne or, in the case of an AT802F, if it is scooping. The taking off/landing threshold speed of 50knts will be appropriate for most aircraft.

Helicopter

The following signals are required in order to generate events associated with helicopter fire-fighting operations:

Signal	Typical Source	Purpose
Engine running	Oil pressure (engine or transmission)	Detect the engine state
Weight On Wheels*	Undercarriage WOW switch	Air or ground state
Collective*	Microswitch triggered by the collective control stick	Air or ground state

* only one of these is required

DataVault supports tank operations for Trotter supplied tank controllers and a belly tank made by Isolair. Other types require bespoke software development.

The following signals are required for bucket operations:

Signal	Typical Source	Purpose
Bucket weight	Weigh system output	Determine the current volume of water.
Bucket open*	The drop push-button	Determine the start of a drop.
Bucket close*	The drop push-button	Determine the end of a drop

* some larger buckets have separate button for open and close.

The DataVault can also receive a signal from a Foam or Gel injection system to determine the material being dropped.

DataVault supports a variety of different helicopter types. The main difference between types is the use of Weight on Wheels or collective input. The table below shows the parameters set for each type:

Type	Standard Setting
BlackHawk	WOW
CH46	WOW
CH47	WOW
B214	Collective
KMax	WOW
S61	WOW

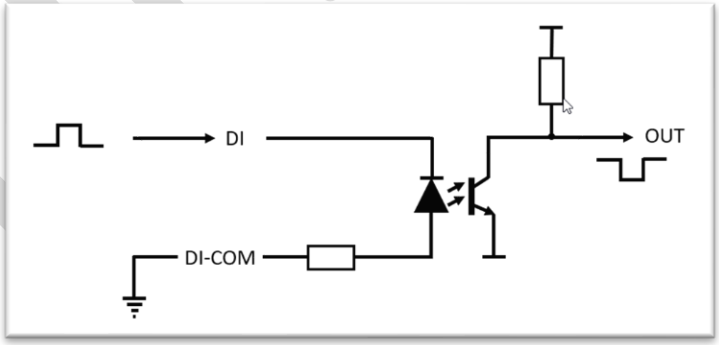
These settings can be over-ridden for any specific installation.

DataVault Inputs

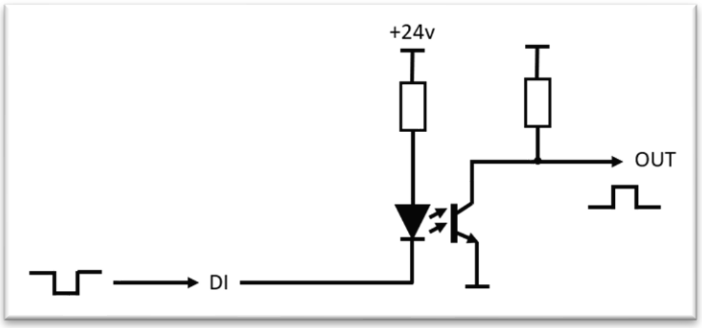
All inputs to the DataVault are opto-isolated internally. It is important to identify both the nature of the input (source or sink) as well as its sense (the level corresponding to “ON”).

From the perspective of the DataVault, source and sink have the following meanings:

Source. A signal is a source if it presents a known voltage to a DataVault input. Drop buttons are typically sources. The following figure shows a typical source connection and show how the opto-isolator will respond to changes in input state:



Sink. A signal is a sink if it is grounded when active. The following figure shows the operation of a sinking input:



Irrespective of the source or sink characteristic, signals can also be inverted. For example a pressure switch may be OPEN when pressure is sensed, or CLOSED.

Note: Some aircraft have multiple electrical buses with slight differences in voltage between ground references. This can result in a ground signal from one electrical bus being at a slightly higher voltage than the ground plane to which the DataVault is connected. In certain circumstances, this voltage can be sufficient to prevent reliable operation of the opto-isolator when the sensor is producing a "ground" output. In the surveys below, it is important to measure voltages referenced to the DataVault ground connection.

A DataVault can be connected to an optional Message Interface display. This provides basic data about the contents of the tank (or bucket) as well as mission related data such as engine start/stop, airborne times, drop count and quantity. These require no additional configuration, but various parameters can be adjusted via on-screen menus.

DataVaults have internal SD card storage which captures the event data as well as a variety of system messages which can be used for diagnostic purposes.

There are two models of DataVault: Standard and Pro. The Standard model is used in most telemetry applications. The Pro model has additional input capability.

Survey – Fixed Wing

Basic Aircraft Data

#	Parameter	Notes	Survey Result
1.1	Aircraft Type	If the aircraft type is AT802 or Fireboss, question 1.3 may be skipped	
1.2	Registration	This is used internally to create unique log files on the SD storage.	
1.3	Vthresh	A threshold speed used to determine if the aircraft is airborne or not. The value for an AT902 is 50knts.	

Tank System

#	Parameter	Notes	Survey Result
2.1	System Type	If the system type is in the list of supported tanks in X.X.X, questions N to N may be skipped	
2.2	Drop button	This will be used to determine the start and end of a drop.	
	2.2.1	Input type – source or sink	
	2.2.2	Voltage in normal (not drop state)	
	2.2.3	Voltage in drop state	
2.3	Tank volume	Usually a probe. If the probe is a supported type in section X.X.X, questions X.X.X may be skipped	
	2.3.1	Probe Type	
	2.3.2	Tank max gallons	

	2.3.3	Tank minimum measurable gallons		
	2.3.4	Probe voltage to volume table (provide up to 8 data points)	**Gallons**	**Volts**

Foam System

#	Parameter	Notes	Survey Result
3.1	Foam injection button	This will be used to determine if foam has been injected	
	2.2.1	Input type – source or sink	
	2.2.2	Voltage in normal (not injecting state)	
	2.2.3	Voltage when injecting triggered	

Survey – Helicopter

Basic Aircraft Data

#	Parameter	Notes	Survey Result
3.1	Aircraft Type	If the helicopter is a known type, the configuration parameters can be set automatically. However, because some aircraft of the same type may produce different signals, gathering the data in this section is recommended to ease future diagnostics.	
3.2	Registration	This is used internally to create unique log files on the SD storage.	
3.3	Bucket ground	Some aircraft have a special connector or switch to determine the presence or absence of a bucket. DataVault is able to use this to send events appropriate to the firefighting configuration. The signal us grounded when the bucket is present, but the input must be pulled up with a resistor for the input to work correctly as shown in figure X.X.X	
3.4	Weight On Wheels or Collective Switch	Does the aircraft have a WOW sensor or collective switch?	
		Input type – source or sink	
		Voltage when the helicopter is on the GROUND	
		Voltage when the helicopter is IN THE AIR	

Tank System (if fitted)

#	Parameter	Notes	Survey Result
4.1	System Type		

Bucket Control

#	Parameter	Notes	Survey Result
5.1	Bucket Type	The manufacturer and model of the bucket.	
5.2	Bucket Operation	Does the bucket control system have separate control actions for opening and closing a bucket? For example, some buckets are controlled via a "China Hat" on the cyclic control column which is moved in one direction to OPEN the bucket and in another direction to CLOSE it.	
5.2	Bucket Open	This will be used to determine the start (and possibly end) of a drop.	
	2.2.1	Input type – source or sink	
	2.2.2	Voltage in normal (not drop state)	
	2.2.3	Voltage in drop state	
5.2	Bucket Close	This will be used to determine the end of a drop, if fitted.	
	2.2.1	Input type – source or sink	
	2.2.2	Voltage in normal (not drop state)	
	2.2.3	Voltage in drop state	
5.3	Bucket weight	The notional weight of the bucket and line. This is used to determine if the weigh system output is in the correct range on lift.	
5.4	Bucket capacity	The maximum capacity of the bucket in gallons	

5.5	Weigh system	The manufacturer and model of the weigh system	
	5.5.1	Maximum analog output voltage (typically 5v)	
	5.5.2	Voltage at 0lbs (typically 0v or 0.5v)	
	5.5.3	The load in lbs when the output is at maximum.	

Survey – Telemetry

#	Parameter	Notes	Survey Result
6.1	Modem Type	The manufacturer and model of the telemetry device and tracking service provider.	
6.2	ATU	Telemetry data is consumed by fire-fighting authority – usually USFS or NAFC. Indicate which data set is required – USFS, NAFC or another.	

Interconnection Schedule

In this step, the survey data is used to provide a summary schedule showing the connection between each pin of the DataVault and the aircraft systems. DataVault pins have standard functions – ie connections may not be swapped between pins. A standard DataVault has one 35 pin connector for the signals I/O together with a number of Eurofast connectors for other input types.

Fixed Wing – CN1

Pin	Function	Aircraft Connection
1 - 12	NC	
13	DI-1 Engine sense	
14	DI-2 NC	
15	DI-3 Drop	
16	DI-4 NC	
17	DI-COM	
18-29	NC	
30	Analog GND	
31	Analog In (Tank volume)	
32-33	NC	
34	+24v IN	
35	GND	

Helicopter – CN1

Pin	Function	Aircraft Connection
1 - 12	NC	
13	DI-1 Engine sense	
14	DI-2 Airborne sense (WOW or collective)	
15	DI-3 Drop	
16	DI-4 Snorkel pump (if part of supported tank system.)	
17	DI-COM	
18-29	NC	
30	Analog GND	
31	Analog In (Bucket weight)	
32-33	NC	
34	+24v IN	
35	GND	

All aircraft CN5 to CN10

The signal connectors CN5 to CN10 are used as follows:

Connector	Purpose
CN5	USB flash drive receptacle (if fitted)
CN6	Message Interface (if fitted)
CN7*	Serial interface for ConAir tank controller, Transland gate controller, Trotter Scoop System or Reabe probe
CN8*	Third party modem (if fitted)
CN9	GEN2 bus in
CN10	GEN2 bus out.

*CN7 may be used for the connection of a third party modem (if used).

All aircraft – antenna

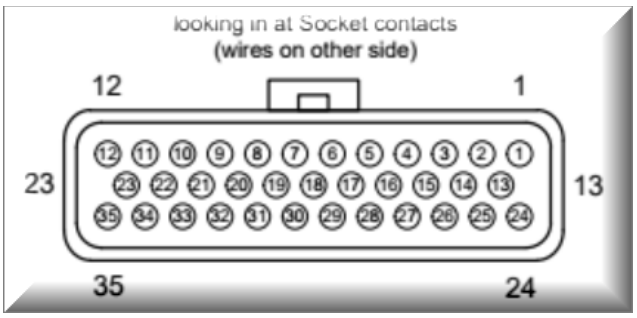
If an internal modem is fitted and active, the GPS and Iridium antenna must be connected to the appropriate SMA connectors:

Antenna	Label Color
GPS	Blue
Iridium	Red

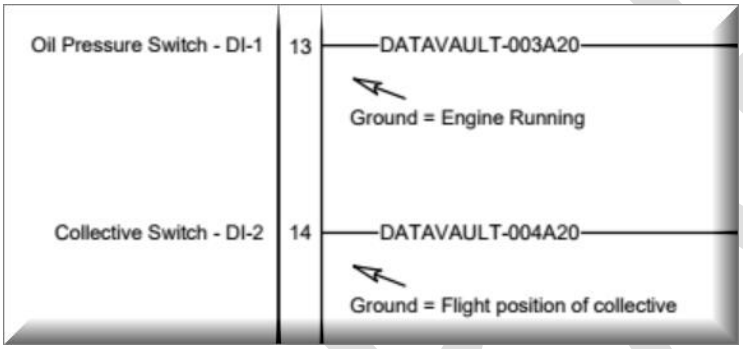
Interconnect Drawings

The above interconnect schedule together with the survey data can then be used to create an interconnect drawing. Example elements are shown below (courtesy of McDermott Aviation pty):

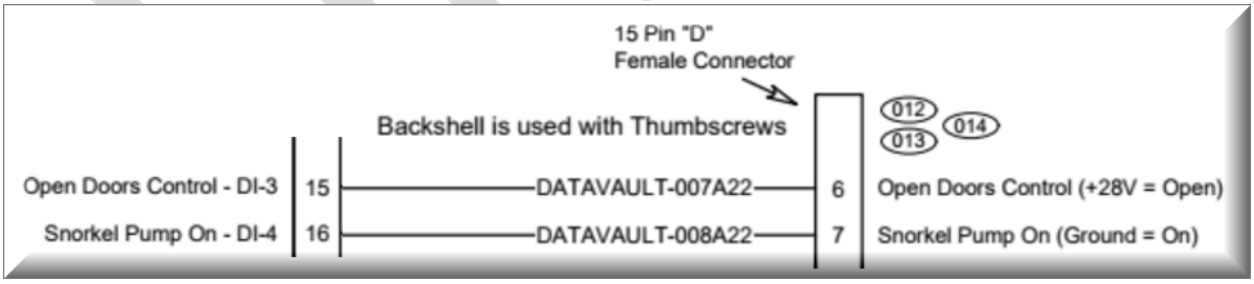
CN1 Layout



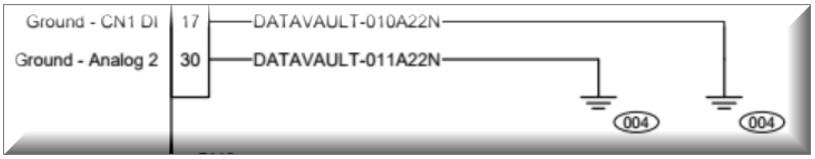
CN1 – Engine Running and Airborne States



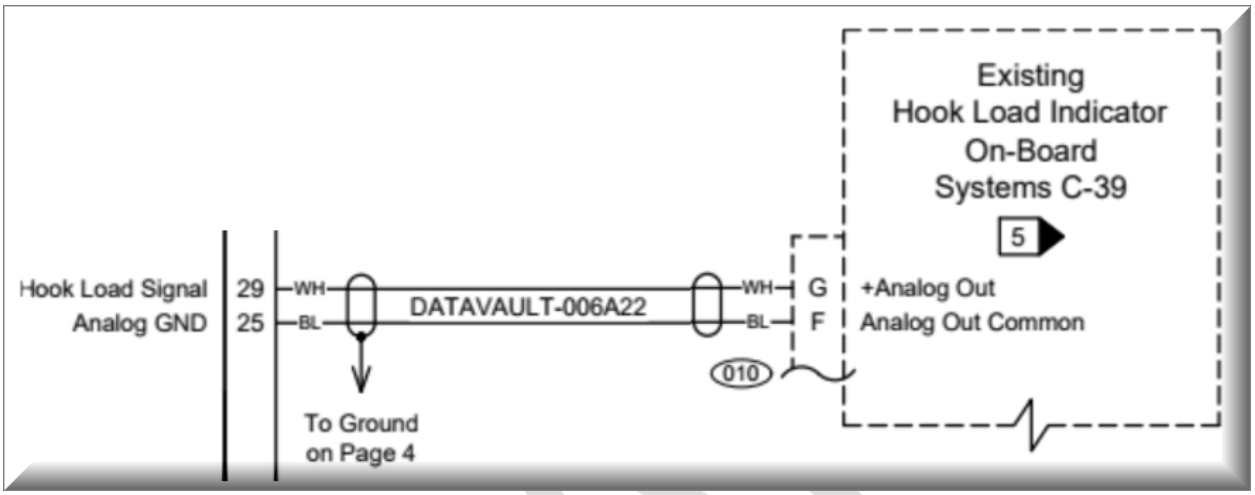
CN1 – Drop and Pump Control



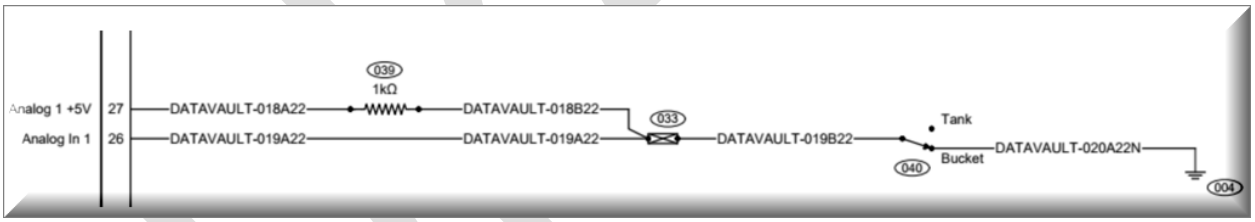
Grounding



Analog Input



Bucket Ground (showing pull-up)



Setting the Electrical Configuration of the DataVault

There are two electrical configurations which may need to be adjusted as a result of the aircraft survey:

a. Source and sink settings; and
b. Analog input voltage range.

Source/Sink Settings

The default factory settings are as follows:

Input	Pin	Normal Use	Factory Setting
DI-1	13	DI-1 Engine sense	Sink
DI-2	14	DI-2 Airborne sense (WOW or collective)	Sink
DI-3	15	DI-3 Drop	Source
DI-4	16	DI-4 Snorkel pump (if part of supported tank system.)	Source

To change the settings, remove the top cover of the DataVault taking care to preserve the rubber washers around the screws:

[Picture of front with screws highlighted]

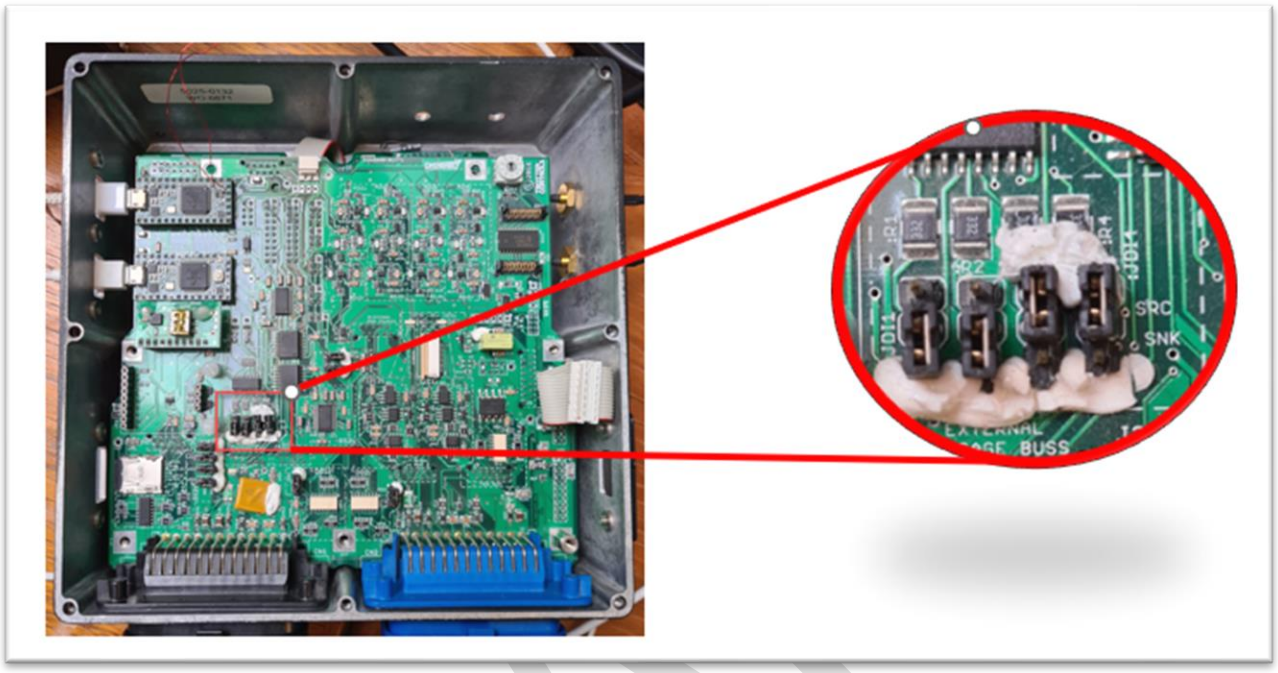
Note : There are two cables which connect faceplate mounted components to the PCBs below. These can be disconnected to ease the jumper change operation.

Carefully remove the fixing posts and lift the PCB assembly holding the LCD.

[Picture of LCD board with fixing posts highlighted]

Note : There are two cables which the LCD carrier PCB to the main circuit board below.

The jumpers which need to be changed are in the position show below. This image is of a DataVault Pro model with the LCD carrier completely removed:



Analog Range Adjustment

The default range for analog signals is 0 to 5v and should not normally need adjustment to connect to sensors and equipment commonly in use on most aircraft types. Contact Trotter Controls for details of how to adjust the analog range.

Case Re-assembly

The case can be re-assembled taking care to:

- Observe the correct orientation of any cables disconnected in the disassembly. The correct orientation is shown in the figures below:

  [Four figures showing ends of cables which might have been disconnected]

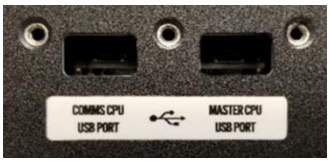
- Add the rubber washers on the screws holding the top of the case. Do not overtighten the screws as this will deform the rings.

Install The Equipment

The equipment can now be installed in the aircraft. The next steps require:

1. The DataVault to have power
2. Access to the CPU ports on the side of the unit. It is generally easier to connect a Micro-USB cable to the Master CPU USB port prior to installation.
3. A clear view of the sky for telemetry testing.
4. A laptop computer for software configuration.

Software Configuration



In this step, the survey data is used to change certain software parameters used in the generation of event data. This is achieved by connecting a laptop via a micro-USB cable to the Master CPU USB Port.

This section of the document shows how to determine the values for each parameter and then describes two methods to enter them into a DataVault.

Pre-requisite

Parameter adjustment requires the use of a software tool to connect to the main processor. There are two options:

1. A "command line" utility whereby configuration settings are entered into terminal emulator. The recommended utility is "TyCommander" which is available for both Mac and Windows environments, and can be downloaded from:

2. A Windows PC application which sends the appropriate settings to the DataVault based on data entered by the user. The Windows PC application may be downloaded from here:

Parameter Values

Note: All parameters are case sensitive

Common Parameters

Some parameters are applicable to both fixed wing and rotary types:

Aircraft Registration

Mnemonic	Allowed Values	Meaning	This installation
ACReg	Any, up to 6 characters	The registration is used to make unique log file references for the SD card log.	

Example command line: "`set ACReg<N1234>`"

Aircraft Type

Mnemonic	Allowed Values	Meaning	Check for this installation
ACType	CH47*	CH47	
	CH46	CH46	
	BH60	BlackHawk	
	KMAX	Kaman KMAX	
	B214	Bell 214	
	S61	Sikorsky S61	
	AT802	Air Tactor 802 (or similar)	
	AT802F	Float equipped AT802 (or similar)	

* Factory default

Example command line: "`set ACType<CH47>`"

Engine Sensor

This parameter controls the sense of the input used to determine if the engine is running.

Mnemonic	Allowed Values	Meaning	Check for this installation
SenseEngine	y*	The engine sensor produces a positive voltage when the engine is running	
	i	The engine sensor produces a ground signal when the engine is running	

* Factory default

Example command line: "`set SenseEngine<y>`"

Gate Controller

Mnemonic	Allowed Values	Meaning	Check for this installation
GC	TO*	Telemetry Only. Should be used for exclusive bucket operations.	
	BellyTank	Used for Isolair tank model ????	
	S61Tank	Used for internal S61Tank model ????	
	ConAir	A ConAir tank controller	
	Transland	A Transland gate controller (note that this must have the firmware required to produce a serial datafeed output).	
	TAS	A generic tank and drop switch configuration.	

* Factory default

Example command line: "`set GC<TO>`"

Automated Flight Following (AFF)

This parameter is only valid if the DataVault is using its own internal modem. If a third party modem is connected, this parameter is ignored.

If the aircraft is to be used for NAFC contract in Australia, this parameter should be set to "n"

Mnemonic	Allowed Values	Meaning	Check for this installation
AFF	y*	The DataVault will produce AFF messages.	
	n	The DataVault will not produce AFF messages.	

* Factory default

Example command line: "`set AFF<y>`"

Additional Telemetry Unit (ATU)

This parameter determines if the DataVault is to generate ATU messages in the JSON format.

If the aircraft is to be used for NAFC contract in Australia, this parameter should be set to "n"

Mnemonic	Allowed Values	Meaning	Check for this installation
ATU	y*	The DataVault will produce ATU messages.	
	n	The DataVault will not produce ATU messages.	

* Factory default

Example command line: "`set ATU<y>`"

External Modem

DataVault supports third party tracking devices which transmit event messages to their provider (and onwards to the appropriate authority). A parameter is used to determine the external modem type:

Mnemonic	Allowed Values	Meaning	Check for this installation
ExternalModem	1*	Internal Iridium only modem	
	3	TracPlus supplied RockAir device	
	4	SpiderTracks SX device	
	5	V2Track device	

* Factory default

Example command line: "`set ExternalModem<1>`"

Tank Volume

The DataVault is able to determine the volume in a tank by reading the analog voltage (or milliamps) produced by an analog sensor, or by reading a feed provided by third party devices. This is controlled by the following parameters.

These parameters are generally used for tanked fixed wing aircraft but could also be applied to a tank on a helicopter.

Probe Type

Mnemonic	Allowed Values	Meaning	Check for this installation
ProbeType	T	A generic analog probe	
	R	A Reabe probe producing output in liters	
	r	A Reabe probe producing output in gallons	
	S	A standard Trotter scoop control device	
	s	A Trotter scoop control device producing output in liters	

* Factory default

Example command line: "`set ProbeType<T>`"

Tank Volume Map

This parameter is used by the DataVault to transform a probe voltage into a quantity of gallons. The default value is set for a Trotter probe in the tank of an AT802, and is of the form:

`MapTankVol<34,100,10,1,399,395,375,361,353,….5000,5500,6000,6500,7000,7500,8500,>`

The web page below provides a utility to create the command line from a given set of data points:

To use the utility, enter the desired number of points ands the values for each point into the table which will then appear:

The command line can then be copied if needs be.

Helicopter Parameters

For a helicopter, the required parameters are:

Bucket Switch Operation

Mnemonic	Allowed Values	Meaning	Check for this installation
UseNotDrop	n*	A single button is used to open the bucket. The bucket closes when the button is released	
	y	Two switches, usually in a "China Hat" configuration, provide separate open and close functions.	

* Factory default

Example command line: "`set UseNotDrop<n>`"

Weight On Wheels

This parameter is used to determine if the aircraft has a WOW sensor, and the sense of it.

Mnemonic	Allowed Values	Meaning	Check for this installation
UseWOW	y	The WOW sensor produces a positive voltage when the aircraft is on the ground	
	i*	The WOW sensor produces a ground signal when the aircraft is on the ground	
	n	The aircraft uses a collective microswitch	

* Factory default

Example command line: "`set UseWOW<i>`"

Maximum Measured Load

This is the load in lbs corresponding to the maximum output voltage from an OSI hook weight system (or any other in which an analog output is directly proportional to the applied load).

Mnemonic	Allowed Values	Meaning	This installation
OSIMaxLoadSet	Any integer up to 30,000	The weight in lbs when the weight system is producing 5.0v.	

Example command line: "`set OSIMaxLoadSet<10000>`"

If the weigh system does not produce a directly proportional output, then the load weight system map should be used and the value of this parameter should be set to 0.

Hook Load Weigh System Map

This is a table used to convert voltage from a weigh system into lbs weight, where the voltage output from the weigh system is not directly proportional to the load. To determine the correct command line, the following table should be completed. Example values are provided.

Lbs on hook	Voltage		Voltage * 100	
	Actual	Example	Actual	Example
0		0.5		50
9500		5.0		500

Example command line: "`set UserMap0<4,100,1,1,50,500,0,9500,>`"

Note: The vendor of the hook load weigh system should be able to provide details of the analog output and the steps and other accessories which may be needed to configure it for use with a DataVault.

Bucket Weight

This is the weight in lbs of the attached bucket and line. A precise value is not critical as the bucket and line are weighed when the aircraft departs from the hover on first lift. It is used to detect certain anomalies in the weigh system output.

Mnemonic	Allowed Values	Meaning	This installation
BucketWeight	Any integer up to 1,000	The weight of the bucket and line in lbs	

Example command line: "`set BucketWeight<10000>`"

Bucket Ground

This parameter is used to tell the DataVault to monitor a signal to determine if a bucket is connected.

Mnemonic	Allowed Values	Meaning	Check for this installation
UseBucketGround	n*	The DataVault will not read the bucket ground input	
	y	The DataVault reads the bucket ground.	

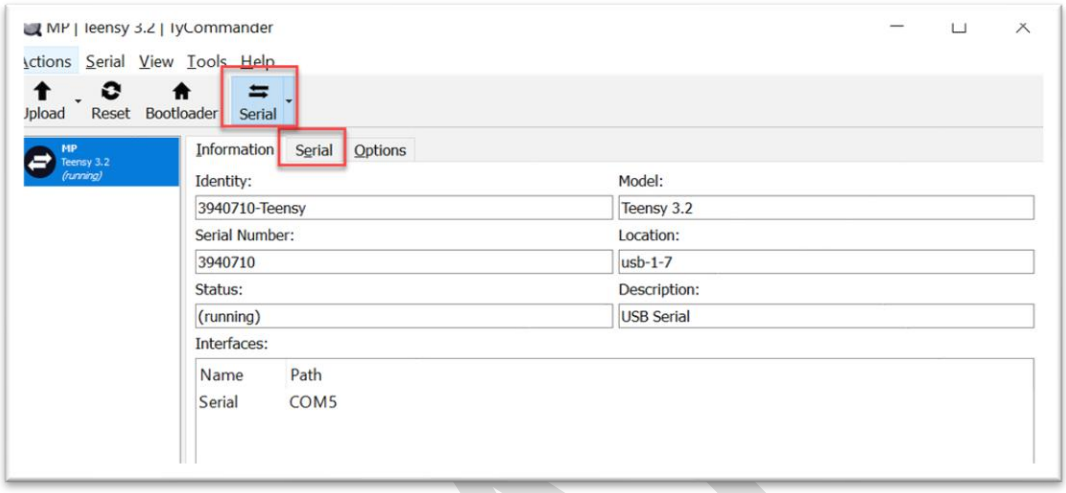
* Factory default

Example command line: "`set UseBucketGround<n>`"

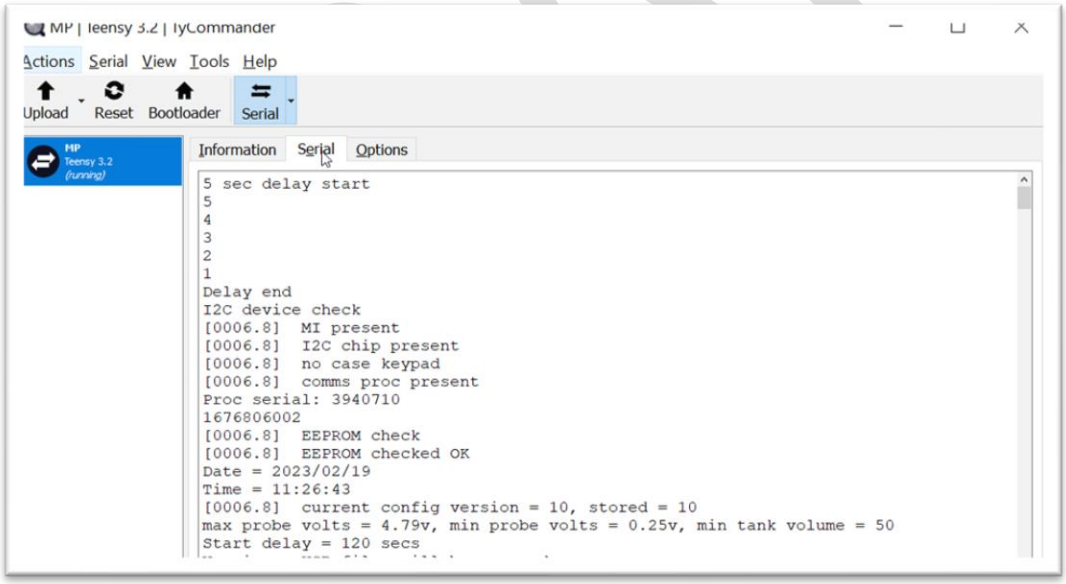
Using the command line

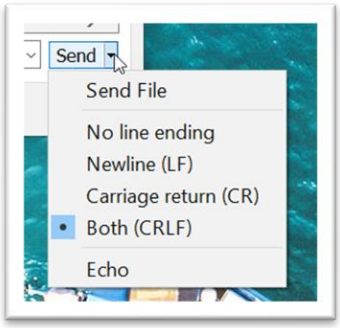
Having determined the command lines and downloaded an appropriate utility, the parameters can be set via a serial terminal. The following illustrates the use of TyCommander.

With the DataVault powered on and connected to a laptop via a micro-USB cable, launch TyCommander. The screen will resemble:

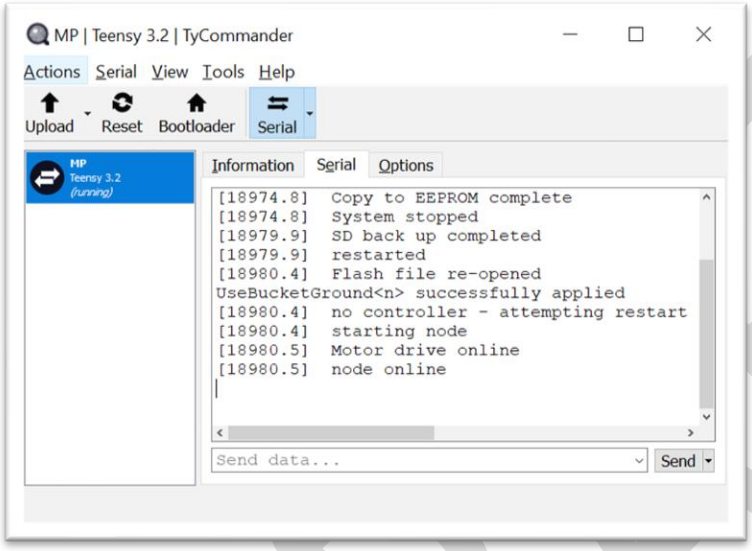


Select the serial tab and the display will show diagnostic messages:





Click the “Send” button and ensure that the line endings are set to “Both”



The command line parameters can now be entered into the “Send data…” window, one by one. After entering the command, click “Send” or press <Enter>. The diagnostic output will show the command being processed.

After all the parameters have been entered, it is best to reboot the DataVault by turning it off, leaving it for 5 minutes to allow any residual power to drain off, then powering it on.

This step completes setup and the device can now be tested.

Testing the DataVault

The DataVault's LCD screen can be used to verify that the system is detecting various basic inputs. To activate the screen, press BEFORE and NEXT on the case keypad within 20 seconds of power on.

Once the DataVault has started, press the SEL key and a display will indicate various parameters as follows. ***If it is safe to do so***, appropriate test equipment or wires can be used to force the sensors to appropriate states and the should show any changes.

The serial diagnostic output will also provide messages to show events being generated.

Notes:

1. ***Certain events will only occur if the aircraft is in motion, for example drops.***
2. ***Helicopter bucket events can generally not be simulated because it is impossible to apply sufficient load to the hook weigh system***

Fixed Wing Events

DataVault produces the following events for fixed wing aircraft:

Event	Trigger
StartUp	A time interval of 2 minutes after power on.
Engine Running	Engine on detected
Hopper Refill	A decrease in the rate of tank filling and a stable value for about 30 seconds
Take-off	GPS speed > Vthreshold and increasing
Drop start	Drop trigger ON
Drop end	Drop trigger release (or tank empty depending on type)
Load Settle	A time interval of 15 seconds after a drop
Landing	GPS speed < Vthreshold and reducing
Engine Off	Engine OFF detected

Helicopter Events

DataVault produces the following events for helicopters:

Event	Trigger
StartUp	A time interval of 2 minutes after power on.
Engine Running	Engine on detected
Airborne	WOW or collective signal
Hover Exit	GPS speed > 8knts
Hover Entry	GPS speed < 8knts
Bucket Refill	A significant increase in bucket weight **and** hover exit after dip
Drop start	Drop trigger ON
Drop end	Drop trigger release (or tank empty depending on type)
Load Settle	A time interval of 15 seconds after a drop, or on bucket empty
Landing	WOW or collective signal
Engine Off	Engine OFF detected

Flight testing

A flight test is the only sure method of confirming that the sensor inputs are all working correctly. The events will be displayed on the appropriate tracking service provider's web site using appropriate credentials:

Modem Used	Tracking Service Provider Web Site
Internal	www.tracplus.com
RockAir	www.tracplus.com
SpiderTracks SX	www.spidertracks.com
V2Track	www.v2track.com

Note: Trotter Controls does not by default have access to any customer tracking or event data. To enable this, the tracking service provider should be contacted directly.