WinFrog Device Group:	**INS**
Device Name/Model:	**TSS DMS**
Device Manufacturer:	**TSS (UK) LTD HQ** New Mill New Mill Lane, Witney Oxfordshire, UK OX8 5TF Tel: +44 (0)1993 777700 Fax: +44 (0)1993 777701 Email: tssmail@tssuk.co.uk http:// www.tss-realworld.com
Device Data String(s) Output to WinFrog:	Heave, Pitch, Roll, and Status Flag. See Configuration Details for status flags.
WinFrog Data String(s) Output to Device:	Nil
WinFrog .raw Data Record Type(s):	Type 888 HEAVE Type 413 ATTITUDE

DEVICE DESCRIPTION:
TSS Dynamic Motion Sensors (DMS) are devices that are used to measure the vertical displacement (heave) and attitude (roll/pitch) of a vessel or platform when no stationary reference is available.

TSS produces three models of DMS sensors, differing only in the accuracy of their measuring capability, and hence in their applications:

- **DMS-25** Dynamic measurement and singlebeam echosounder compensation
- **DMS-10** Shallow water multibeam compensation and dynamic measurements
- **DMS-05** Ultimate in high accuracy performance i.e. swath bathymetry

As well, there is a DMS-2 model that is a physically smaller version of the DMS.

The attitude sensor is housed in an IP65 enclosure. It contains three linear accelerometers and three vibrating structural gyroscopes, mounted in an orthogonal array. High-speed circuitry converts the signals from the sensing elements into actual measurements of heave, roll and pitch. These measurements are then communicated via RS232 or 422 and analogue to a receiving PC, terminal, datalogger or appropriate receiving equipment. The sensor can communicate via a remote repeater unit for transmission over long distances.

WinFrog can be configured to apply the attitude data to remove device and tracking offsets caused by the vehicle's pitching and rolling motion. These calculations include reducing the GPS antenna position to the Z datum zero reference, removing apparent vehicle wandering due to the vehicle's pitch and roll.

DEVICE CONFIGURATION INSTRUCTIONS:
Baud Rate: 9600 (configurable)
Data Bits: 8
Stop Bits: 2
Parity : None

Digital (RS232 or RS422) or analogue output. By default the DMS uses RS232, with the above parameters, and sends the TSS1 data format. Refer to Configuration Details for information on the TSS1 data string.

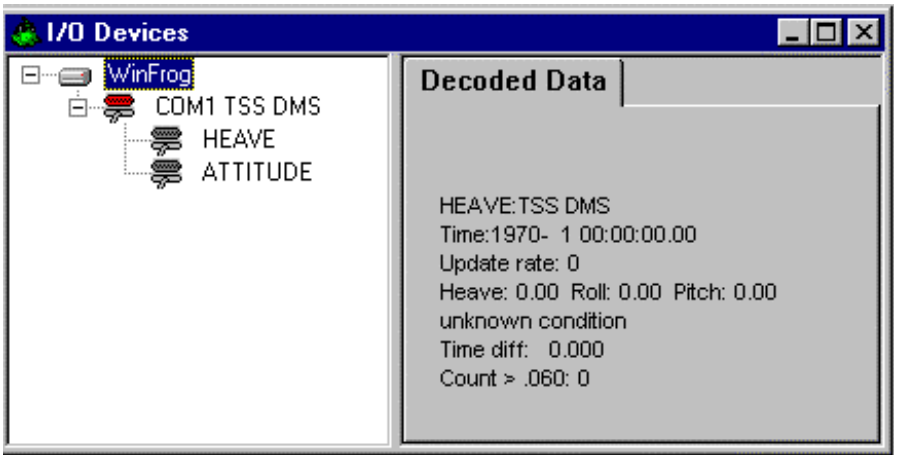
Data Input (TSIP):
The DMS can also receive data for use in its calculations: It will accept NMEA 0183 VTG and GGA or GLL, TSIP, or Doppler Speed log inputs.

Baud Rate: 9600
Data Bits: 8
Stop Bits: 2
Parity: Odd

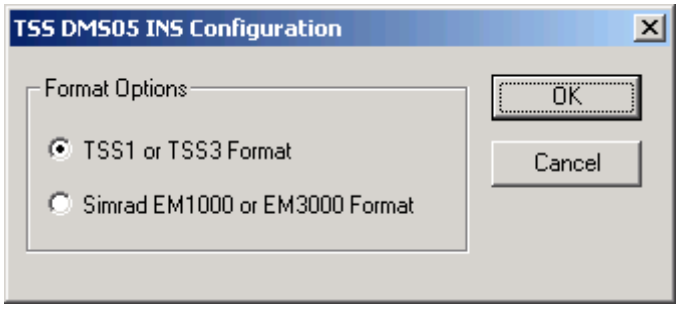
DMS Output protocols:
The DMS can output data in six different formats:

- TSS
- TSS1 with remote heave
- TSS3 – remote heave in digital format
- Simrad – for use with the Simrad EM1000 and EM3000 multibeam echo-sounders
- Simrad format with remote heave
- NMEA $PRDID

WINFROG I/O DEVICES > CONFIG OPTIONS:
The TSS DMS is added to WinFrog from the INS device category. Adding a TSS DMS to WinFrog creates Heave and Attitude Data Items, as seen in the I/O Devices window below.



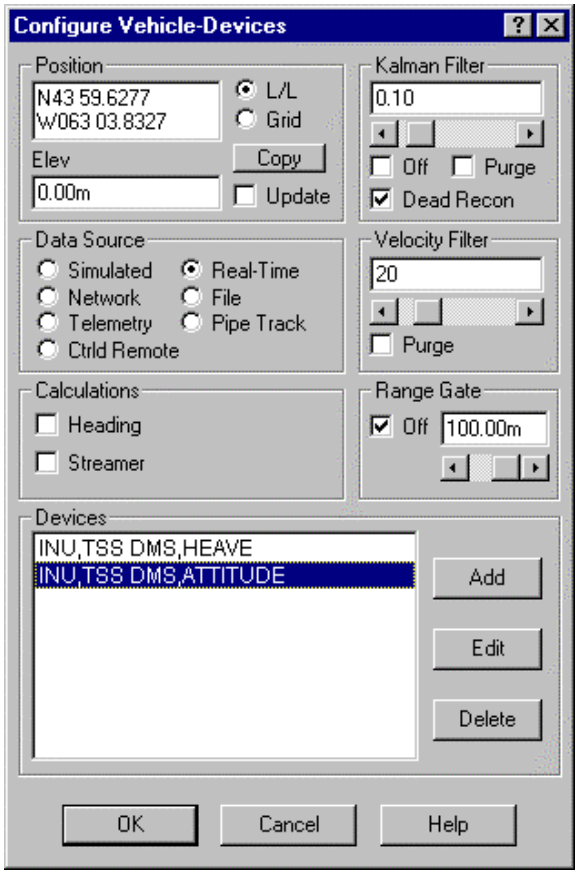
The TSS must be now edited at the I/O Device window level. In the I/O Devices window, highlight the TSS DMS then right-click and select Configure Device. The TSS DMS05 INS Configuration dialog box appears as seen below.



WinFrog will accept two different data formats for this device, the ASCII TSS1 format and the Simrad Binary format. Select the Simrad Binary Format checkbox if the TSS has been configured to output data in this format.

WINFROG VEHICLE TEXT WINDOW > CONFIGURE VEHICLE DEVICES > DEVICE > EDIT OPTIONS:

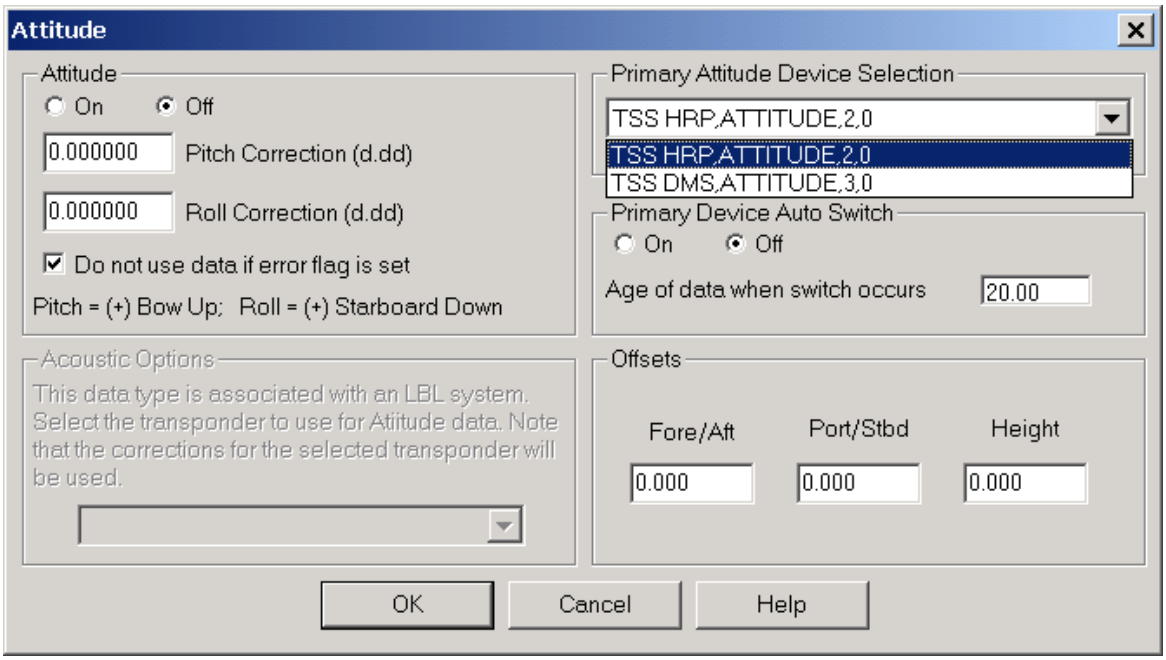
Once the TSS's HEAVE and ATTITUDE data items have been added to a vehicle's device list, they must be edited to suit the application. In the vehicle's Configure Vehicle Devices dialog box device list, highlight the appropriate TSS Data Item and click the Edit button. Adding the HEAVE data item to the vehicle allows storage of data in the 888 raw record and creation of a heave time series. Adding the ATTITUDE allows storage of data in the 413 raw record, creation of time series of the pitch and roll, a lever arm calculation for the heave, and assignment of corrected heave, pitch, and roll to the vehicle.



Edit of Heave Data Item:
There is no configuration for the heave data item.
Remote heave calculations are done using the ATTITUDE data item.

The heave data is only recorded for use in post processing, i.e., if an echo sounder is added to WinFrog, recorded depths are not corrected for heave. If real-time heave corrected depth data is required, you must use an echo sounder that is capable of interfacing to the TSS and applying the heave data internally.

Edit of Attitude Data Item:
When the Attitude data item is edited, the Attitude dialog box appears as seen below.



Attitude
By default, the sensor mode is off, meaning that data from the DMS will not be used in the vehicle's calculations. To turn the sensor on, and begin using the inclination corrections in the position output, click the 'On' radio button.

Correction values can also be added in this section of the window. The correction values (entered in units of degrees-decimal degrees) are added to the raw pitch and roll values received from the DMS before the data is applied to the vehicle's calculations. Ensure that entered values adhere to the sign convention used by WinFrog. You can verify that the corrections are entered properly by viewing the pitch and roll values in the I/O Device window and the Vehicle Text window.

Error flag testing
This allows you to enable or disable error detection – the default is on. When the instrument sends data with the status flag set to unsettled or the flag contains a blank, WinFrog will not use the data unless the box is unchecked.

Primary Attitude Device Selection
If more than one attitude device is present, you may select one of them to be primary and the others to be secondary and allow WinFrog to automatically switch between them should the primary system stop sending data or has bad data. There must be at least two attitude data items added to the vehicle to use this feature. (Note: The attitude and offset data displayed in this dialog is for the attitude device corresponding to the data item that is being edited. Selecting a Primary Attitude Device from the drop down list does not affect these values for any attitude device in the list. Every attitude device needs to be set up for its own corrections and offsets.)

Primary Device Auto Switch
Select the On radio button to turn on this feature. Then enter the time out time in the edit box. If WinFrog does not receive data from the primary attitude device, or if it receives bad data for this length of time, it will switch to the next secondary that is enabled and has good data.

Auto Switch Feature Usage
To use this feature first turn the sensor on as described in the Attitude section above. Next, select the attitude device that you wish to be primary from the drop down list box. Then turn the primary device auto switch on and enter the time out time. Then edit all the other attitude data items and enable them in the Attitude group box. Note that the same selected primary will be displayed for all attitude data items; similarly, the automatic feature will be turned on and the time out time will be the same. However, you must individually enable each attitude device in the Attitude group box.

Offsets
These offsets are used to calculate remote heave (leaver arm). It is expected that these values are the offset from the center of gravity of the TSS sensor. Then using the observed pitch, roll, and heave, the heave at the center of gravity will be calculated and assigned to the vehicle, which may then be output using the INSIX output device. However, it is recommended that the sensor be placed at the center of gravity. If this is not possible, it is better to enter the lever arm offsets into the sensor and have the sensor make the correction, then have the sensor output the corrected values with respect to the center of gravity. The INSIX output device expects that the heave assigned to the vehicle is with respect to the center of gravity.

WinFrog records the DMS data to a type 413 raw data record. This record contains observed Heave, Pitch, Roll, status, accuracy, and a time stamp to indicate precisely when the data was observed. See Appendix B: WinFrog File Formats in the WinFrog User's Guide for details on the Type 413 raw data record.

CONFIGURATION DETAILS:
The TSS DMS should be mounted at the vessels' center of gravity (COG) or as close to this location as possible.

Output Rate:
The output rate of the unit is dependent upon the baud rate. At 9600bps, the unit updates 30 times per second. At 19200bps, the unit updates 60 times per second.

TSS1 Output Format:
This format consists of five fields containing 27 ASCII characters. Accelerations are supplied in ASCII hexadecimal values and heave, pitch and roll are supplied as ASCII coded decimal values. The string is as follows:

:XXAAAASMHHHHQMRRRRSMPPPP<CR><LF>

Field	Definition	Range	Units
:	Start of Packet Character	ASCII 3A Hex	
XX	Horizontal acceleration	0 to 9.81m/s^2	3.83cm/s^2
AAAA	Vertical acceleration	-20.48 to 20.47 m/s^2	0.0625cm/s^2
S	Space character	ASCII 20 Hex	
MHHHH	Heave	-99 to +99m	1cm
Q	Status Flag	u,U,g,G,h,H,f,F (see below)	
MRRRR	Roll	-90^o to +90^o	0.01^o
MPPPP	Pitch	-90^o to +90^o	0.01^o
<CR><LF>	Carriage return and line feed		

Where M=space if positive; or minus sign if negative. Positive Heave is up, positive roll is port side up, and positive pitch is bow up.

The Status Flags are as follows:

Status Flag	Description
U	"Unaided mode – settled condition" DMS operating without input from a GPS or gyrocompass sensor
u	"Unaided mode - settling" Operating as above but awaiting the 3-minute settling period after power on or a mode change
G	“GPS aided mode – settled condition" The DMS is receiving input from a GPS sensor
g	"GPS aided mode - settling" Operating as above but waiting out the 3-minute settling period after power on or a mode change
H	"Heading aided mode – settled condition " The DMS is receiving a heading input from a gyrocompass
h	"Heading aided mode - settling" The DMS is receiving a heading input from a gyrocompass but waiting out the 3-minute settling period after power on or a mode change. This status flag is not associated with the gyrocompass status, if there is one.
F	"Full aided mode - settled condition" The DMS is receiving input from a GPS and gyrocompass.
f	"Full aided mode - settling" The DMS is receiving input from a GPS and gyrocompass but waiting out the 3-minute settling period after power on or a mode change.

These flags are converted to 0 if the observed flag was capitalized and 1 if lower case. The 0 indicates the data is considered good.