MADASS

Monitoring and Data Acquisition Storage System
Part Number 900063

Operating Manual and Installation Guide
Version 2.35

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1.0 Introduction

The MADASS, **M**onitoring **A**nd **D**ata **A**cquisition **S**torage **S**ystem, is a vehicular data recording device designed to record relevant vehicle operating parameters before and after the occurrence of an incident, defined as an event where lateral or axial acceleration has exceeded pre-defined G force limits.

Lateral and axial acceleration are monitored continuously until an incident occurs. Once an incident occurs the MADASS stores the data from 120 seconds before and 15 seconds after the event. A battery backup system ensures the MADASS will continue to record even if vehicle power is not available after the incident has occurred.

The complete system consists of:

- The MADASS main recording system; which records the 3 acceleration signals from the LG-Alert, as well as pertinent vehicle operating data from a J1939 CANBUS interface , such as engine RPM, throttle position, brake system pressure, brake position, and vehicle position (longitude, latitude), course and speed from a GPS receiver.

- The LG-Alert unit; which provides lateral, axial, and vertical acceleration signals to the MADASS system.

- A remote display unit; which displays current operating status, system diagnostic information, and the number of stored incident record files. It also provides a communication port for a PC to download incident data for analysis.

- GPS antenna

- J1939 CANBUS interface connector to vehicle ECU data bus

- Steering wheel position sensor

- Brake air pressure sensor

- Brake status indicator (from Brake light switch signal)

- USB to Serial converter, for newer computers without a built in COM port
- CD ROM with Madass Toolbox Software install for a PC (Windows only) , and Installation / User Manual in pdf format
- Paper copy of Installation / User Manual

The system records data continuously while the vehicle master power is turned on. Once an incident occurs all data is stored in non-volatile memory. A total of 5 incident records are stored in the MADASS unit for retrieval and analysis. If the total number of stored incidents exceeds five the next incident overwrites the data of the previous incident in the order of 1 to 5. Data from any of the 5 incidents can be downloaded from the unit for analysis through a serial data cable to a computer using a terminal emulation program.

2.0 Installation Overview

The block diagram of the complete MADASS system is shown below.

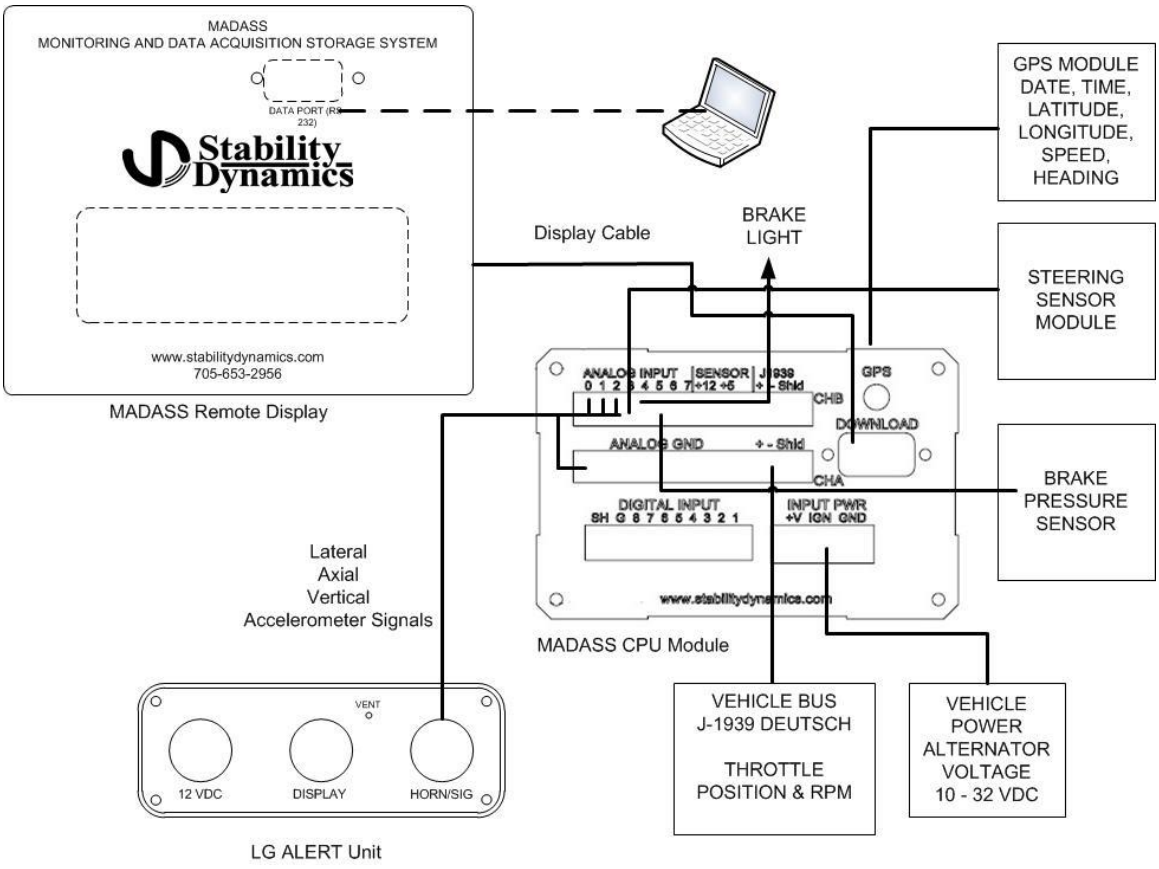


Fig. 1 – MADASS System Block Diagram

2.1 Component List

Components supplied:

- Madass Adapter Cable complete with 6' LG-Alert sensor signal cable
- MADASS main module
- MADASS main unit power cable and black 3 pin connector
- Mounting bracket, 4 6-32x1/4" machine screws, 4 self-drilling 8-32x 3/4" zinc pan-head Phillips mounting screws
- MADASS user / installation guide and MADASS Toolbox CD
- MADASS remote LCD display, with 4 6-32 x 5/8" pan head mounting screws
- 15' HD15 display cable for Main unit to Display connection
- 6’ DB-9 Female-Female cable for PC connection to Display unit
- USB to Serial Converter
- 6' LG-Alert sensor signal cable and qty. 2 orange 10 pin connectors
- J1939/CAN Bus connector, with orange 3 pin connector mated to stub cable with triangular Deutsch connector
- GPS antenna with integral 15ft cable with SMA Male connector
- Brake pressure sensor (0-200 PSI range) with 16' cable attached
- 16’ brake position (on/off) status cable with ¼ inch ring terminals
- Steering sensor assembly kit consisting of:
    - 25-turn rotary potentiometer w/ gear with bushing and set screw
    - mounting bracket
    - large split gear with 2 8-32x1" zinc pan-head phillips and 1/4-20x1/2" set screw
    - 16' steering sensor cable (connects to 25 turn potentiometer)

The user must provide an installed, and functioning LG-Alert sensing unit. Installation instructions for the LG-Alert are provided with that unit.

3.0 Component Installation

Prior to operating the MADASS, complete the installation per the instructions listed below.

3.1 MADASS Main unit installation:

The MADASS Main unit should be installed in a protected location within the vehicle to prevent exposure to adverse environmental conditions. It mounts to any flat surface using the supplied bracket.

Position the bracket so that there is a min. 4 inches open space at the back to connect wiring to the unit. The bracket is mounted in the center of the unit body.

Placing the bracket on the selected mounting location, mark the 4 holes for the bracket with a hole punch and drill holes to accept a 10-32 bolt. Fasten the bracket using 4 10-32 machine screws provided. Attach the MADASS to the bracket using the 4 black 6-32 pan screws provided.

+12 or 24 VDC
Vehicle Switched Power

MADASS attached
to bracket mounted in vehicle

Fig. 2 -Sample MADASS Main Unit installation

Route the modular plug power cable from the rear of the MADASS to a master power switched 9-30 VDC power source.
Strip the ends of the Madass Main unit power cable, white and black wires approximately 0.250 inches.
Attach the white wire to pin 1 of the black Weidmuller 3 pin connector, and attach the black wire to pin 3 as shown in the diagram below, and tighten the screw terminals.

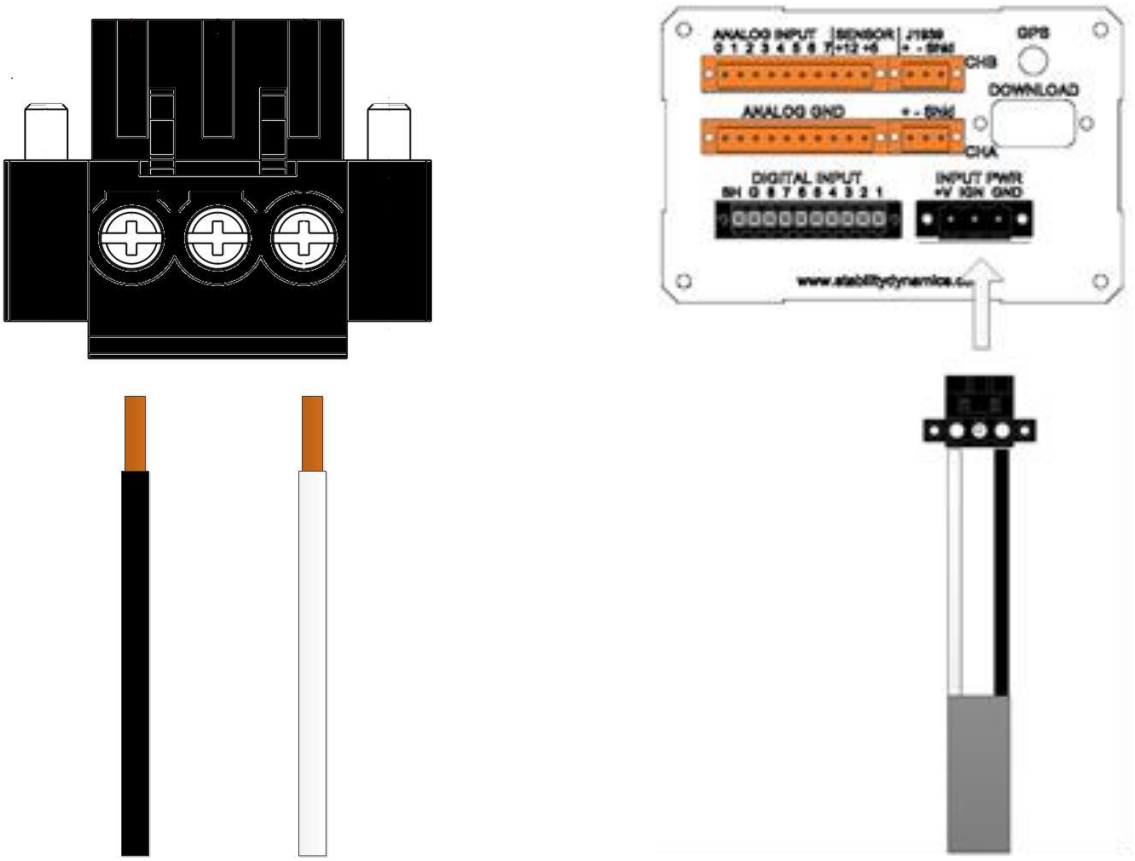
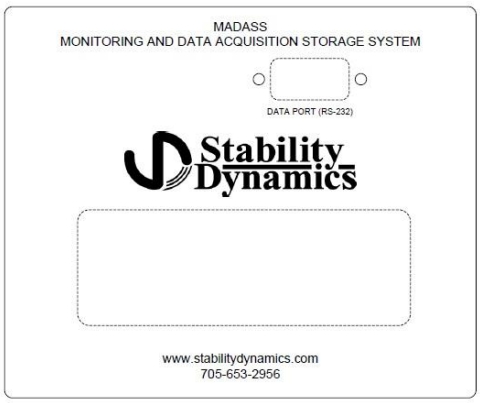


Fig. 3 – MADASS Main unit power connection

Push the completed wire assembly into the 3 pin receptacle marked ‘ INPUT PWR’ when installation is complete.
The connector is keyed for proper polarity, please do not force the unit in if rotated 180 degrees.

NOTE : Connection of power to the Madass Main unit is the final step in the installation, as the unit automatically powers up when vehicle power is supplied.
Connect the assembled power cable to the Madass Main unit only when all other connections have been completed, and you are ready to power up the device.

3.2 MADASS Remote Display unit installation:



The Remote Display unit must be mounted in a location where the front panel display can be easily seen.

The selected location must also allow access to connect the 9-pin serial cable from the PC, used to download incident information, to the front panel Data Port.

The Remote Display unit must also be close enough to the MADASS main unit, i.e. less than 8 feet, to allow the supplied 15 pin cable to attach to the MADASS.

Using the template provided in Fig. 3, mark the 4 mounting holes using a hole punch.
Mark the location for the large hole for the 15-pin cable to feed through to the back of the display unit.

Drill the 4 5/32 inch diameter screw holes, and drill or punch a 1.5 inch diameter round opening, or a 1.5 x1.0 inch rectangular opening for the large hole for the 15-pin connector.

Fasten the remote display panel using 6-32 Pan-head screws and washers of sufficient length to fasten the display through the panel on which it is mounted.

Plug the 15 pin cable into the rear of the Remote Display and connect the other end of the cable to the MADASS Main unit connector marked 'DOWNLOAD'. Please see diagram below.

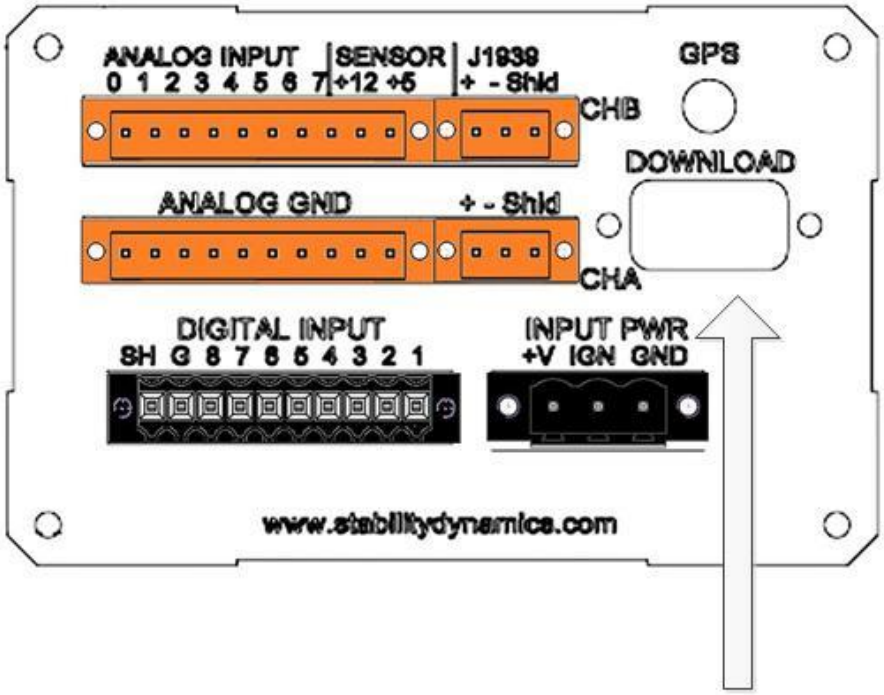


Fig. 4 – MADASS Display cable to Main unit connection

Tighten the thumbscrews on the connector into the post on the sides of the Display unit connector.

Secure the cable with ties to provide strain relief.

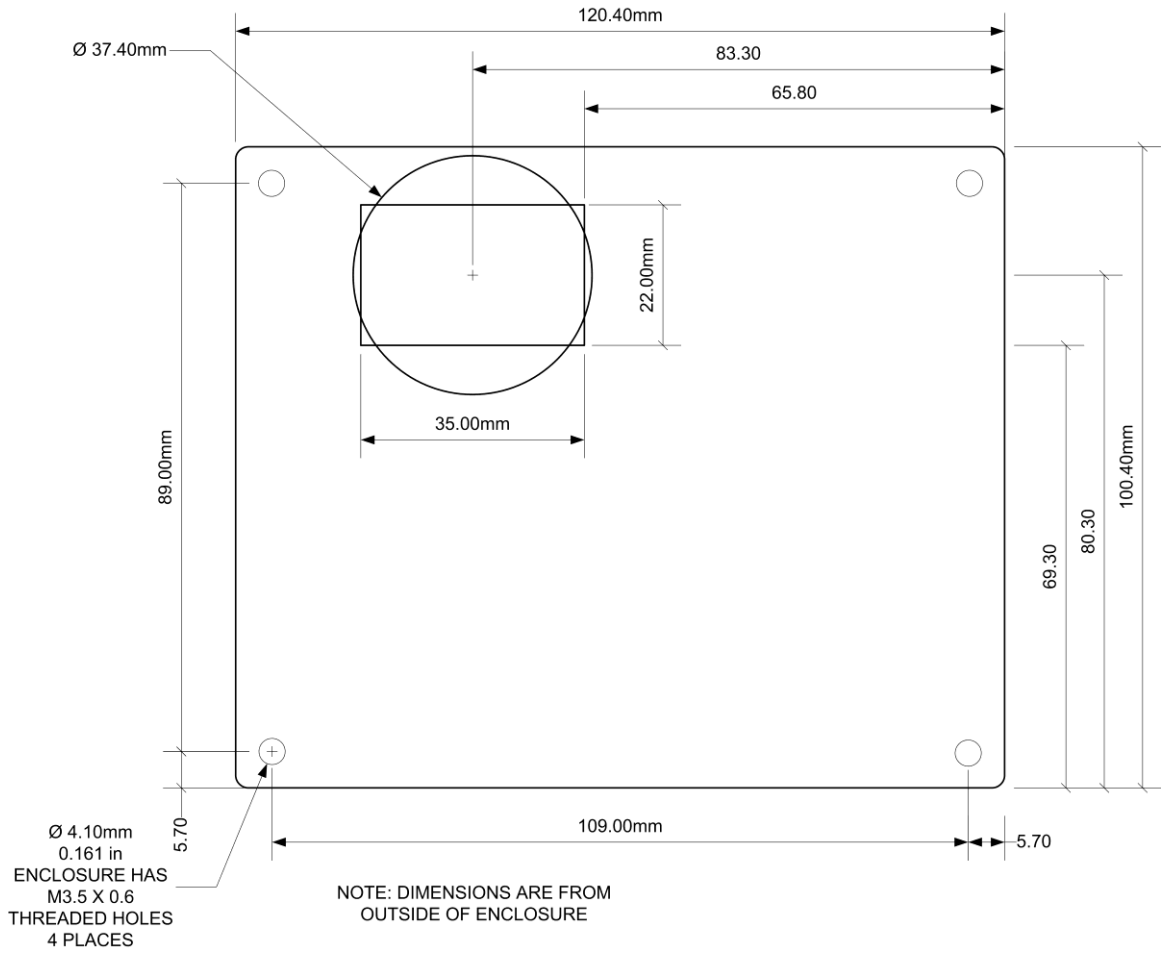


Fig. 5 - Remote Display Mounting Drill Template

3.3 LG-Alert installation

Install the LG-Alert unit per the documentation provided with that unit. Ensure it unit is aligned correctly with the front facing to the back of the vehicle.

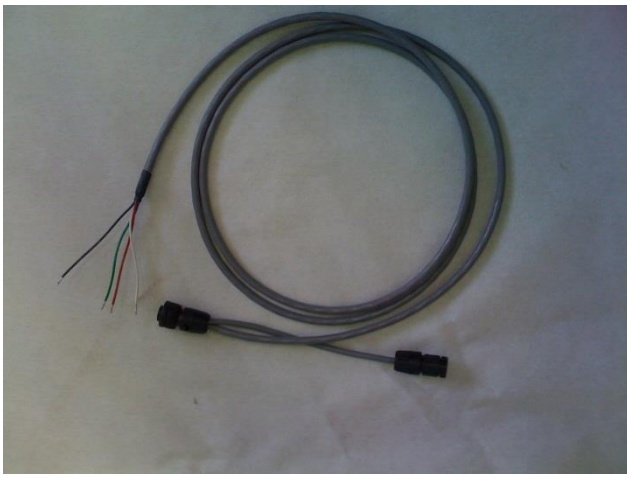


Fig. 6 - LG Alert to Madass adapter cable:

Connect the LG Alert Adapter male connector to the 5 pin connector labeled " HORN" to the back of the LG-Alert unit

Fig- 7- LG Alert Rear panel connection

Route the 6 foot LG signal cable, from the LG Alert unit,
with the 4 colored tinned wires, and the rear plug-in connector to the rear of the MADASS Main unit.

Connect the LG Alert Siren to the female connector side of the 6 inch section of cable.

Fig 8- LG Alert Siren connected to Madass Adapter cable

The LG Alert signal cable connects to the MADASS Main unit using 2 removable 10 pin screw terminal mating connectors. The top connector is for the 'Analog Input' Channels connector on the back of the MADASS main unit.

Signal grounds and shield connector use a similar connector below the analog input connector block, labeled 'ANALOG GND'.
All 10 positions on this connector are connected to Vehicle power ground return point.

These connectors will normally come pre-installed on the LG Alert signal cable.
The connections listed below are for reference should the connections have to be serviced.

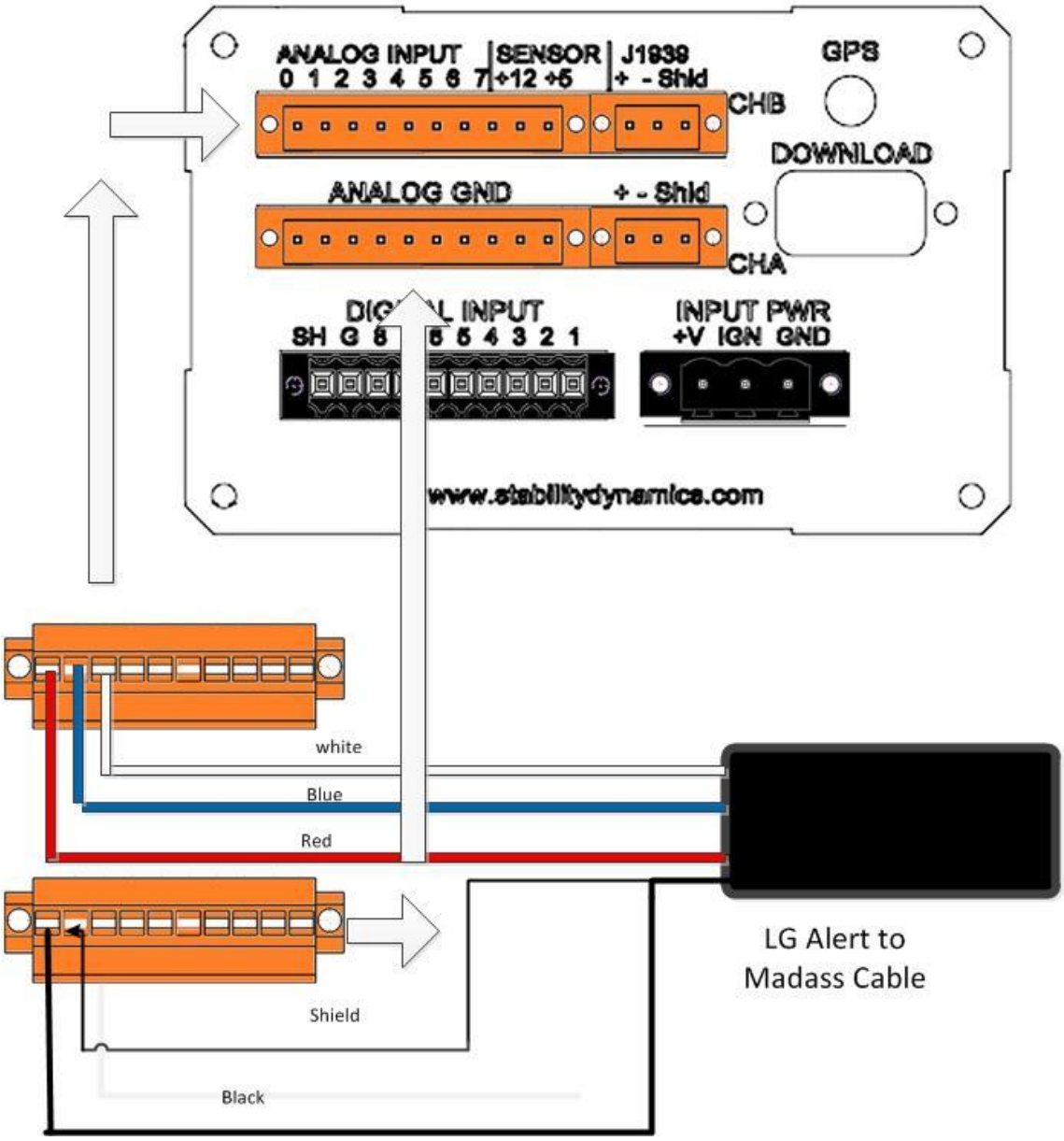


Fig 9 – LG Alert to Madass Main unit wiring

- Insert the Red wire into pin marked ‘0’ on the ‘ANALOG INPUT’ terminal strip
- Insert the Blue wire (or Green in older units) into pin marked ‘1’ on the ANALOG INPUT’ terminal strip
- Insert the White wire into pin marked ‘2’ on the ANALOG INPUT’ terminal strip
- Insert the common black wire of the cable into pin 1of the second connector marked ‘ANALOG GND’.

- Insert the bare shield wire of the cable into pin marked 2 of the second connector marked ‘ANALOG GND’.
- Tighten all of the screws on the terminal strip that are used so that the wires are tight and do not come loose.
- Insert the terminal strip plugs into the Madass Main unit as shown in the diagram above

3.4 Vehicle J1939 ECM connection

Install the J1939 vehicle bus cable into the small 3 pin orange connector as shown.

The high level connection connects to pin marked '+', and the low level is connected to pin marked '- '.
The shield wire for the cable connects to the pin marked 'Shld'

Push the 3 pin modular connector into the connector on the rear of the MADASS main unit marked J1939, CHA.

Note: CHB J1939 port is optional and currently not installed in this model.

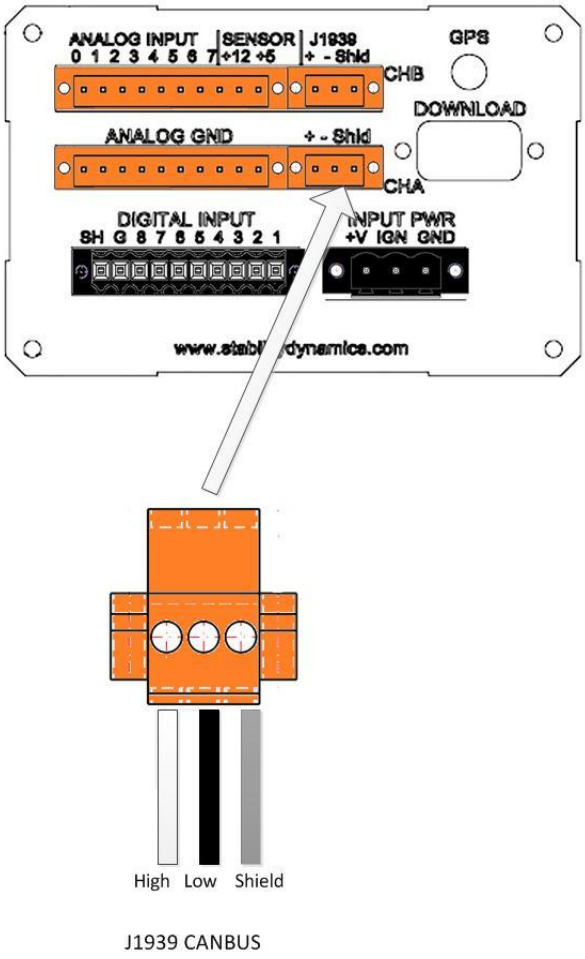


Fig 10 - J1939 ECM wiring

Route the cable to the Engine Control Module harness triangular shaped connector. Connect the triangular Deutsch connector of the MADASS J1939 harness to the mating connector on the vehicle CAN J1939 harness.

3.5 GPS Antenna Installation

The GPS antenna must be located so that it has a clear view of the sky, so a vehicle roof mounting location is required.
Be sure not to obstruct the antenna field of view with metal structures around it, or the recorded vehicle position accuracy will be compromised.

The antenna is designed to be mounted through the vehicle roof using a 7/8 inch hole for the cable to reach the cab interior.
Place the antenna on the chosen roof location.
Drill the access hole for the cable and make sure the gasket seal on the bottom of the GPS antenna is seated properly.
Tighten the nut on the bottom of the GPS unit until the unit is firmly seated on the vehicle roof. Do not over tighten as this may damage the GPS unit housing.
Route the cable to the MADASS main unit, and connect it to the SMA female connector labeled ‘ GPS ‘ on the rear of the MADASS main unit.

The GPS Antenna is supplied with a 15 foot cable. Should a longer cable be required, an optional 10 foot extension cable can be ordered from Stability Dynamics.

Fig. 11 – Typical GPS Antenna mounted on fiberglass / metal type roof

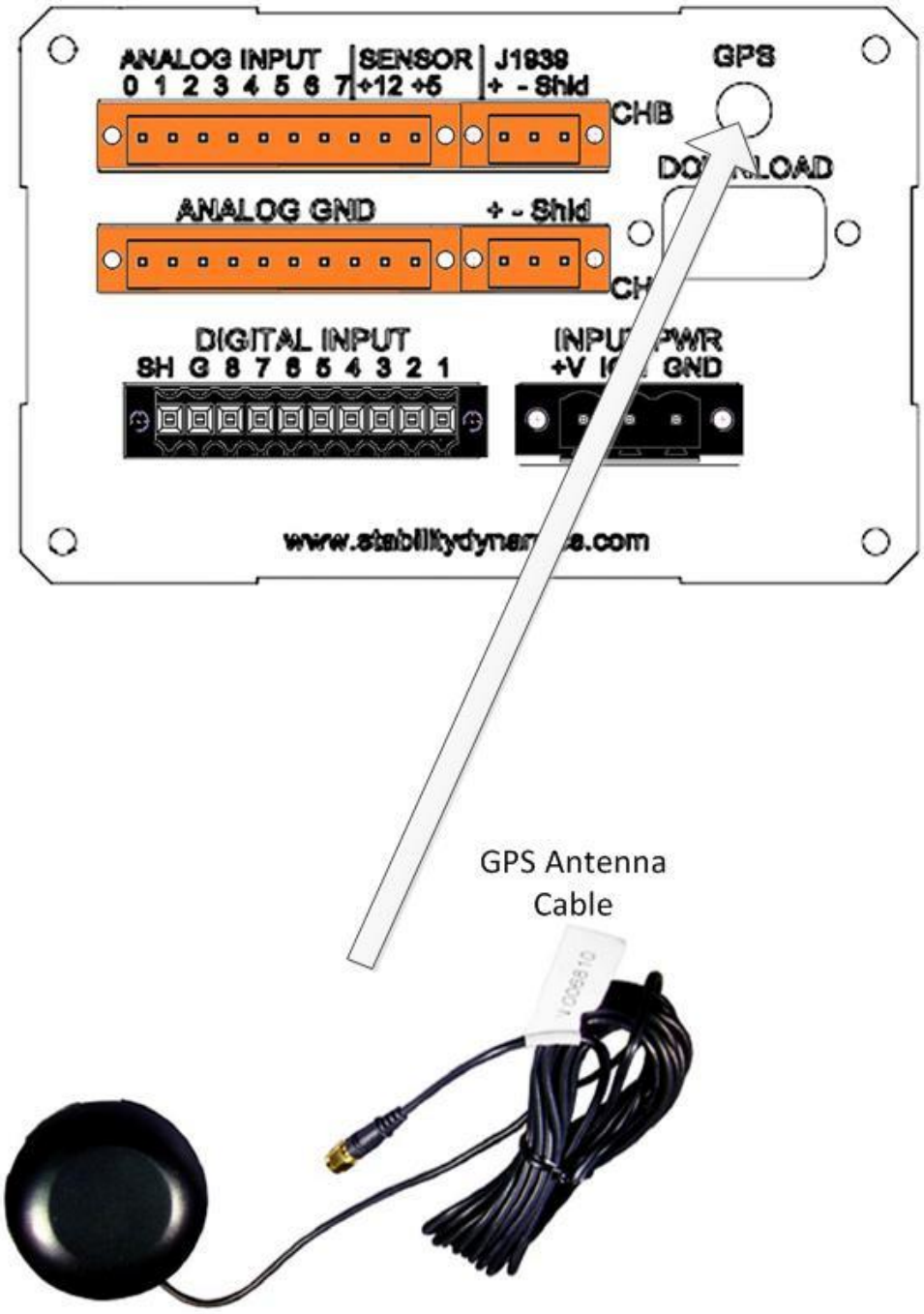


Fig. 12 – GPS Antenna connection to Madass Main Unit

3.6 Steering Sensor Connection

Please refer to Appendix A for Steering Sensor Installation Instructions.

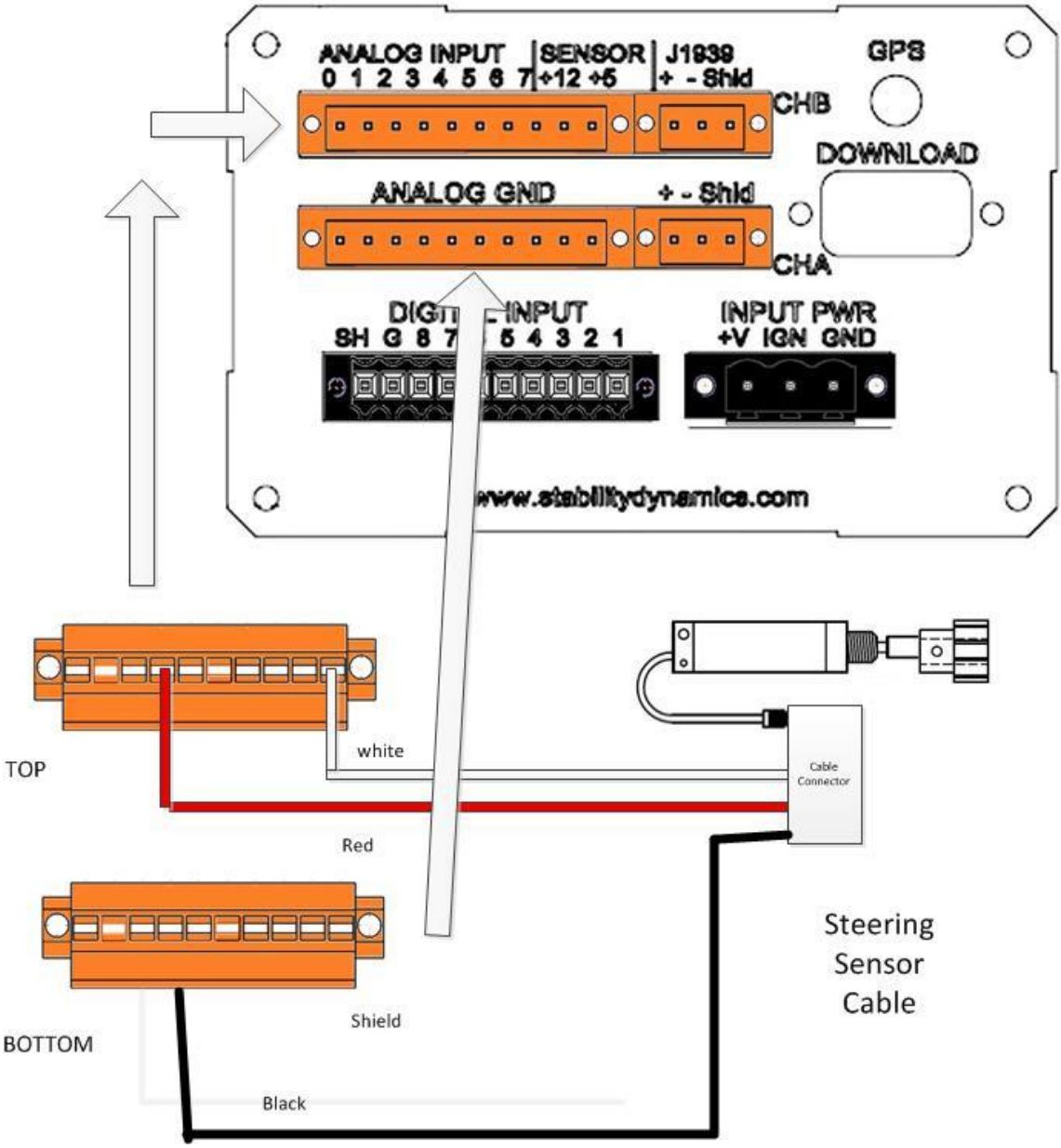


Fig. 13 – Steering Sensor connection to Madass Main Unit

Route the Steering Sensor cable harness to the back of the MADASS main unit.

Using the supplied 10 pin screw terminal mating connector for the Analog Input Channels connector on the back of the MADASS main unit;

- Insert the Red wire into pin marked 3 on the TOP terminal strip
- Insert the White wire into pin marked +5 (last pin on right) on the TOP terminal strip
- Insert the Black wire into pin 3 on the BOTTOM terminal strip.

Note: The entire BOTTOM connector is analog ground, so any available pin can be used for this connection

Tighten all of the screws on the terminal strip that are used so that the wires are tight and do not come loose.

3.7 Brake Status Indicator Connection

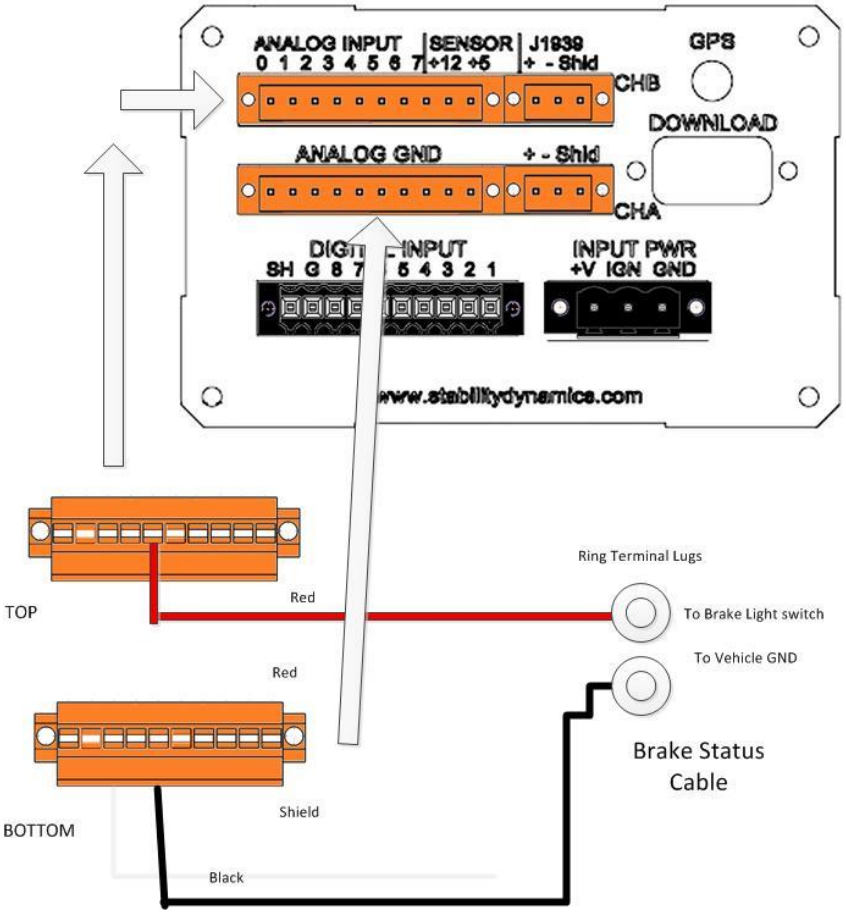


Fig. 14 – Brake Status Indicator connection to Madass Main Unit

Insert the Red wire into pin marked 4 on the TOP terminal strip
Insert the Black wire into any available pin on the BOTTOM terminal strip
Connect the Red wire Ring Terminal to the Brake Light terminal of the vehicle
Connect the Black wire Ring Terminal to any suitable vehicle ground point.

3.8 Brake Pressure Sensor Connection

Please refer to Appendix B for Pressure Sensor Installation Instructions

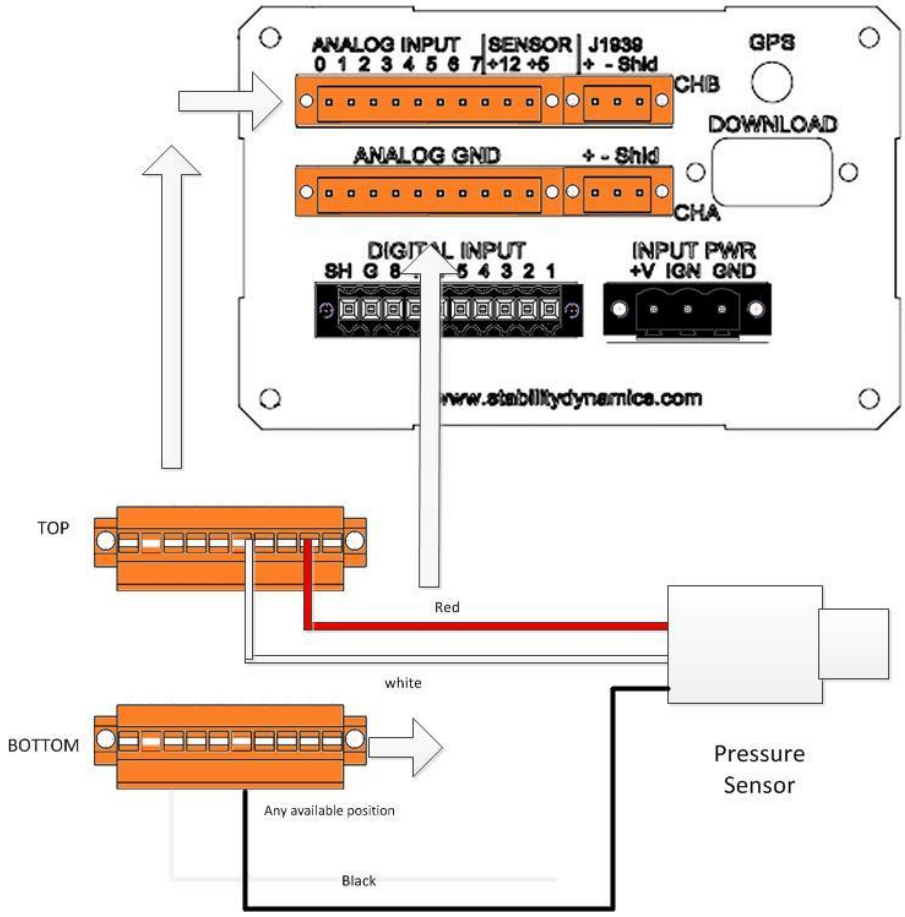


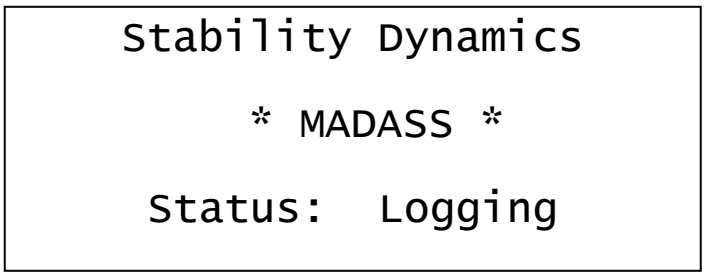
Fig 15. – Pressure Sensor Connection to Madass Main Unit

Insert the White wire into pin marked 5 on the TOP terminal strip.
Insert the Red wire into pin marked '+12' (9th pin from left) on the TOP terminal strip
Insert the Black wire into any available pin on the BOTTOM terminal strip.
Tighten all of the screws on the terminal strip that are used so that the wires are tight and do not come loose.

3.9 Connecting Power

Connecting Power

- Install the MADASS power lead supplied connecting the white wire terminal to an ignition switched + 12VDC source, and connect the black wire terminal to a chassis ground point.
- Plug the modular power jack at the other end of the cable into the INPUT PWR jack on the back panel of the MADASS.
- Connect the DISPLAY unit to the MADASS main unit using the supplied DB-15 Male-Female cable, if not already connected.
- Turn on the vehicle master power and verify the voltage is 13.8VDC min. when the vehicle alternator is running. Make sure the LG-Alert unit is receiving power also.
- Verify the front of the MADASS has the red Power light on the left turned on. This light will then flash while the unit is recording data
- The MADASS remote display unit should have the power light illuminated, and display should look like the example shown below.



The system is now ready for operation.

4.0 Software Installation and Operation

4.1 PC Connection

Connect the DB-9 pin female-female serial communication cable between the RS-232 port on the MADASS Display unit and a RS-232 COM port on your PC.
Record the COM port number used on the PC for this connection (COM1, COM2 etc.) as the user is required to indicate which port to use during setup of the MADASS Toolbox software.
If you are using a newer computer without a COM port please use the included USB to Serial Converter following the directions provided with the unit.
The COM port selected by the adapter must be recorded for setting up the MADASS Toolbox Software.

4.2 MADASS Toolbox Software Installation

- Insert the CD provided into the your CD drive
- Open the CD file folder using 'My Computer'
- Double-click on the **MADASS Toolbox Setup.exe** application and follow directions

The MADASS Toolbox icon will be placed on the desktop of your PC.

4.3 Setting up PC Communication

Make sure the power to the MADASS main unit is turned on.
Double-click the MADASS Toolbox icon to start the program.

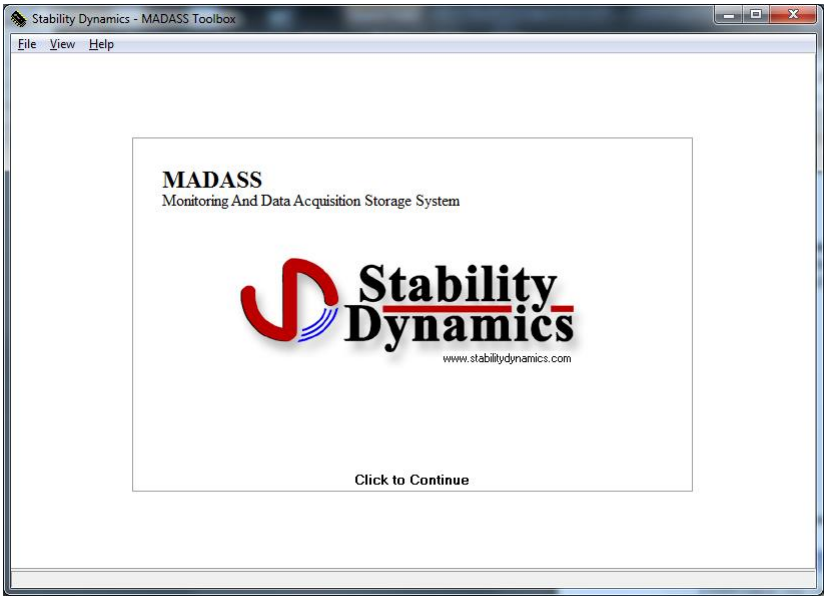


Fig 16 – Madass Startup Screen

Select **File** then **Preferences**

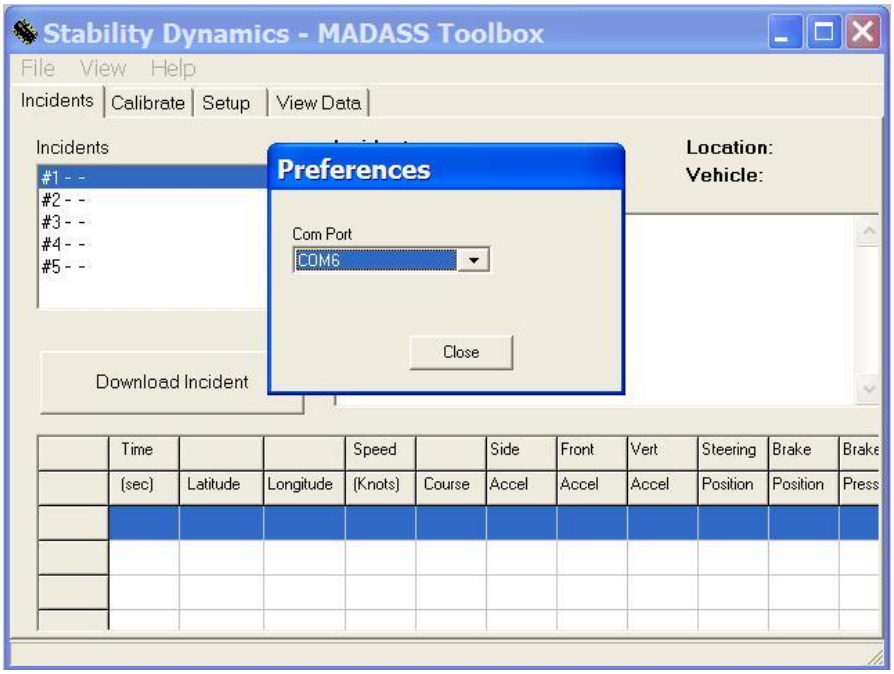


Fig.17 – Setting Communications Port Screen

All Com ports on your PC will be displayed in the drop-down list box. Set the **Com Port** to match the port used to communicate with the MADASS unit. Click **Close**.

The MADASS main unit is now ready to communicate with the PC.

4.5 Sensor Calibration and setting Incident threshold limits

Each of the sensors inputs for the system must be calibrated for the software to know the at rest midpoint values. Make sure the vehicle is on level ground.

Click on the **Calibration** tab.

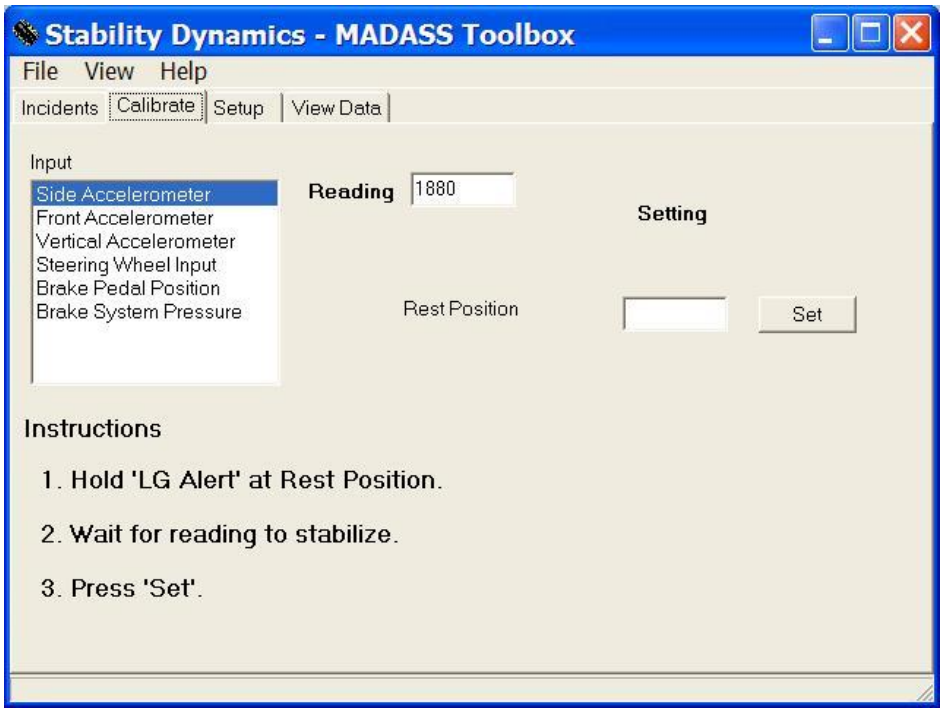


Fig.18 – Sensor Calibration Screen

For each of the inputs listed, instructions are displayed to store the value of the rest position for each of the different inputs.

Clicking each the **Set** button will set the current value from the **Reading** block for the appropriate calibration setting.

Click on each of the inputs listed, and follow the instructions given at the bottom of each screen.

Once the last input in the table has been setup, select the **Setup** tab to enter user information and incident threshold limits.

Note: When you set the rest position for the side and front accelerometers the software automatically sets the impact limit to the equivalent of .8 G force for that axis. See the setup page to manually change these limits from the default.

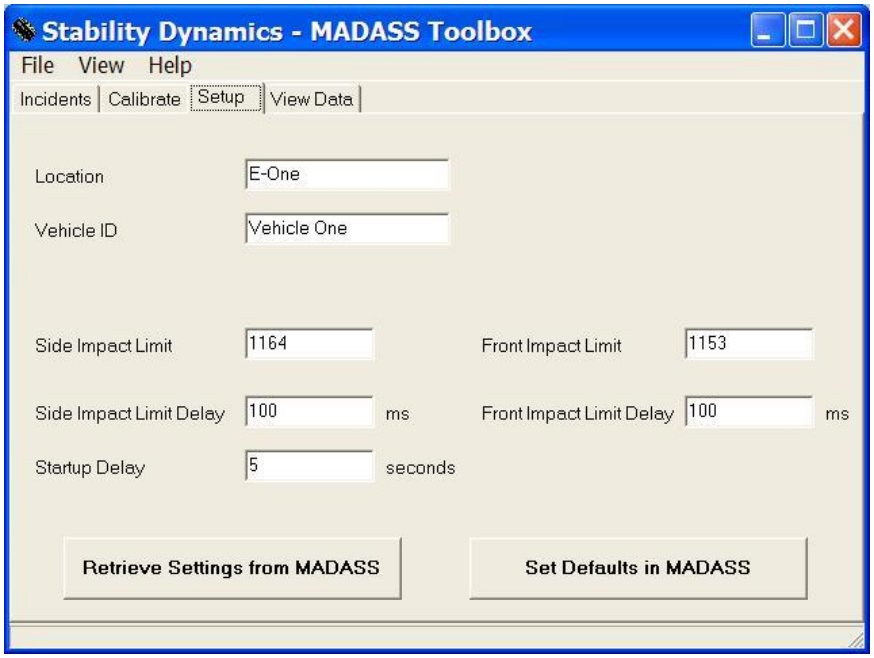


Fig.19 – Limit Settings Screen

Set **Location** and **Vehicle ID** by entering information and clicking the **Set Defaults in MADASS** button.

When you set the rest position for the side and front accelerometers the software automatically sets the impact limit to the equivalent of .8 G force for that axis. This limit can be set manually by entering a value in the Side and Front Impact Limit text boxes.
The delay for setting an incident can also be changed by entering the number of seconds in the Startup Delay box, and saving.
Click on **Retrieve Settings from MADASS** button to retrieve the current settings from the MADASS. Click the **Set Defaults in MADASS** button to store the displayed values into the MADASS unit.

The MADASS System is now configured for use.

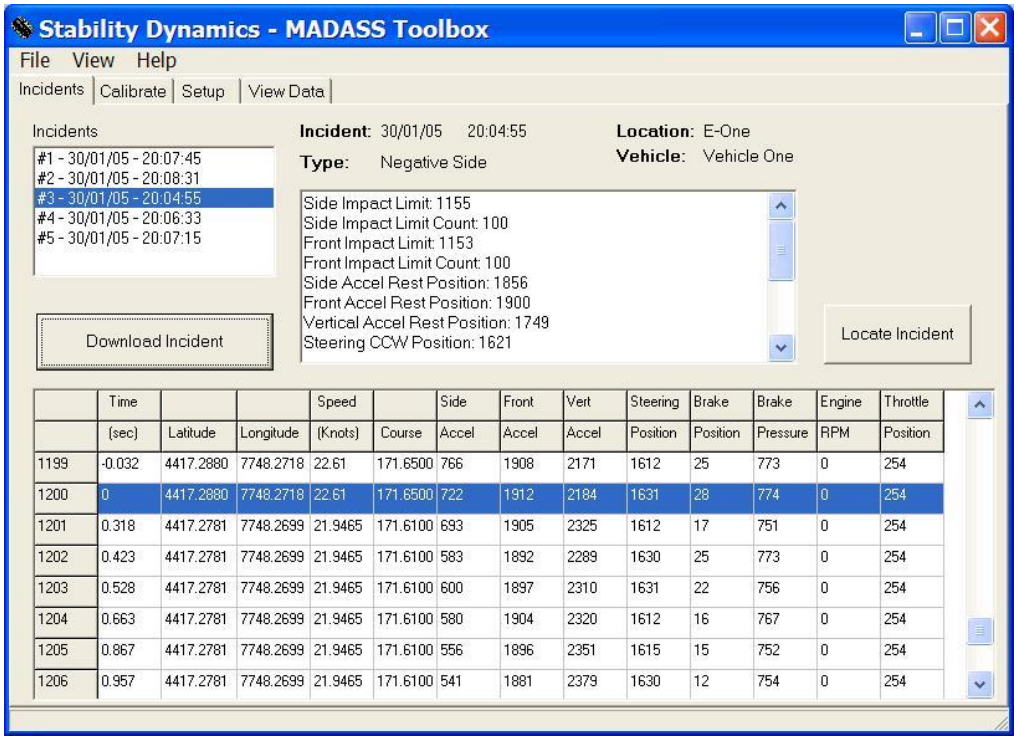
Exit the MADASS Toolbox software and disconnect the serial Rs-232 communication cable from the front of the MADASS Remote Display unit front panel.

4.6 Downloading and Viewing Incident Data

When an incident occurs the user can download the information recorded to the PC.

The user can download data from any one of the 5 incidents stored in the MADASS. Connect the PC to the MADASS Remote Display panel using the 9 pin serial connection, and start the MADASS Toolbox software.

Click the **Incidents** tab on the main screen



	Time			Speed		Side	Front	Vert	Steering	Brake	Brake	Engine	Throttle
	(sec)	Latitude	Longitude	(Knots)	Course	Accel	Accel	Accel	Position	Position	Pressure	RPM	Position
1199	-0.032	4417.2880	7748.2718	22.61	171.6500	766	1908	2171	1612	25	773	0	254
1200	0	4417.2880	7748.2718	22.61	171.6500	722	1912	2184	1631	28	774	0	254
1201	0.318	4417.2781	7748.2699	21.9465	171.6100	693	1905	2325	1612	17	751	0	254
1202	0.423	4417.2781	7748.2699	21.9465	171.6100	583	1892	2289	1630	25	773	0	254
1203	0.528	4417.2781	7748.2699	21.9465	171.6100	600	1897	2310	1631	22	756	0	254
1204	0.663	4417.2781	7748.2699	21.9465	171.6100	580	1904	2320	1612	16	767	0	254
1205	0.867	4417.2781	7748.2699	21.9465	171.6100	556	1896	2351	1615	15	752	0	254
1206	0.957	4417.2781	7748.2699	21.9465	171.6100	541	1881	2379	1630	12	754	0	254

Fig. 20 – Incident Download Screen

The incident data stored in the MADASS is displayed in the **Incidents** list box. To download the incident data, click on the incident Time/Date and press the **Download Incident** button.

A progress bar displays the download status. When the data download is complete all the information is displayed in the data grid and the incident limits are also displayed.

Press the Locate Incident button to scroll the data grid to the row where the incident occurred, row 1200.

Rows 1 to 1200 are the incident data from 120 seconds before the incident, and rows 1200 to 1350 are the incident data for 15 seconds after the incident. Data is stored at the approximate rate of 10 per second.
To store the incident data to a comma-separated file, suitable for importing into a data analysis program (Excel, etc), choose the **Save CSV File** menu choice from the File menu. This will create a text file with comma-separated data. The csv file can be used by various analysis programs to chart the data.

4.7 – Monitoring Live Data

The real time sensor data can be viewed in real time by selecting the View Data tab.

Click on the **View Data** tab

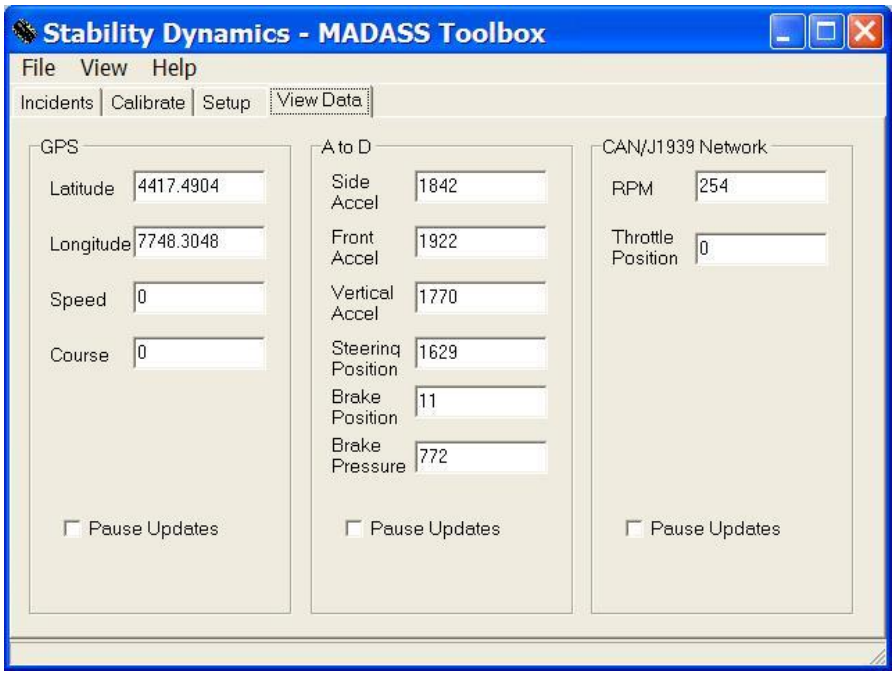


Fig. 21 – View Data Screen

All data in the A to D section are in # of counts, 0 is minimum, 4096 is maximum.

Selecting the **Pause Updates** checkbox under each data field will stop the data from being updated. This screen can be used to diagnose any problem with the sensor inputs.

Appendix A: Steering Sensor Installation

E-1: Steering Sensor Installation (example shown for E-One vehicle)

Tools Required:

One Cordless Drill
One #7 or 13/64" drill bit
One ¼-20 Tap and hand holder
One 4 mm Allen key
One 3/32" Allen key
One 7/16" Socket and Socket wrench
One 9/16" Socket
One Marker
One Centre Punch
One Pair of Wire Snips

Steering Sensor Components Required:

One 36 tooth split gear set consisting of:
- Two gear halves
- Two #8/32 x 1 ¼" machine screw, pan head phillips
- One 5/16" x 5/16" set screw

One pre-assembled Steering Sensor Potentiometer set consisting of:
- One 25-turn potentiometer
- One mounting bracket
- One nut and lock washer set
- One 11 tooth gear
- One bronze bushing
- One 8/32 x 5/16 set screw

Two ¼-20 x ½" #2 Hex Cap Screws
Two ¼" lock washers
Two Cable ties (minimum 6" in length each)

Steps to install the Steering Sensor on an E-One Titan ARFF Vehicle

The following steps are taken to properly install the MADAS steering sensor on the vehicle. Note that while the pictures included with this explanation show the steering column and steering wheel removed from the truck, it is not necessary to do this if the column is already mounted, although it is highly recommended for ease of assembly.

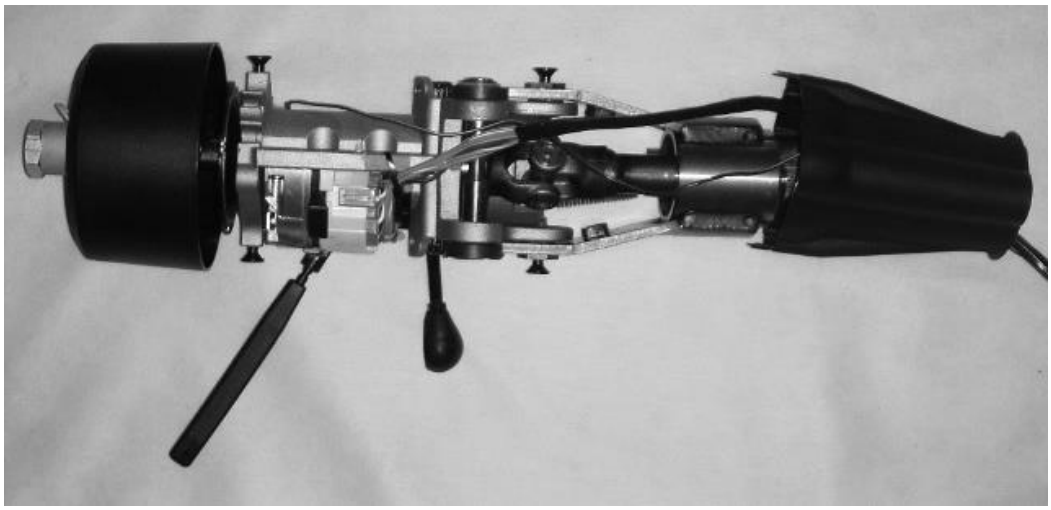
1. Ensure that the steering wheel is turned so the wheels of the truck are straight.

2. Telescope the steering wheel to its fully-extended position.

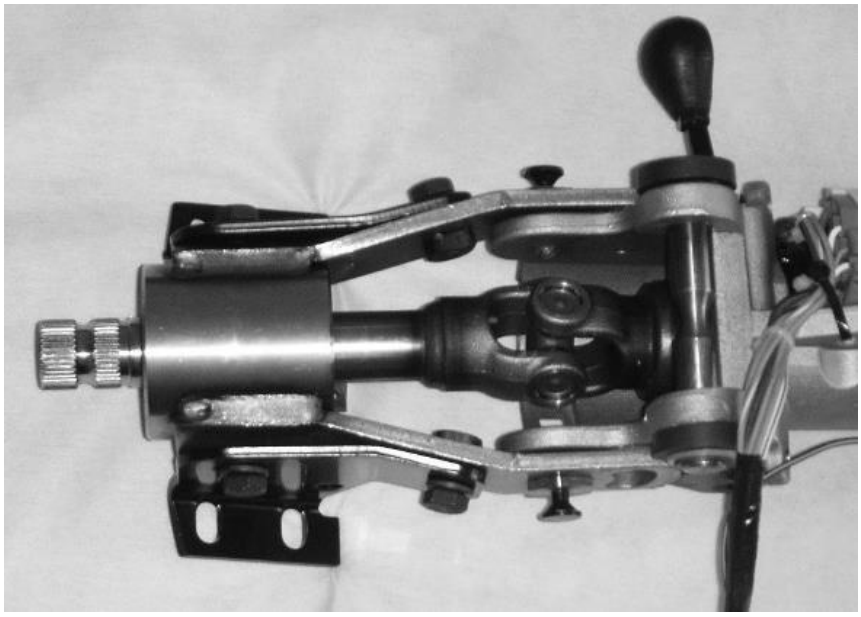
3. Remove the four mounting bolts (two shown in the following figure, two on the opposite side). **CAUTION** – Removal of these bolts will allow the steering column to freely move, and may result in vehicle damage or personnel injury if the column is not held in place when these bolts are removed.

4. Remove both halves of the upper plastic housing by pulling them outwards from the steering shaft off of the four mounting pins (it may take a bit of jostling to remove the housing from the upper pins, but the steering wheel does not need to be removed).

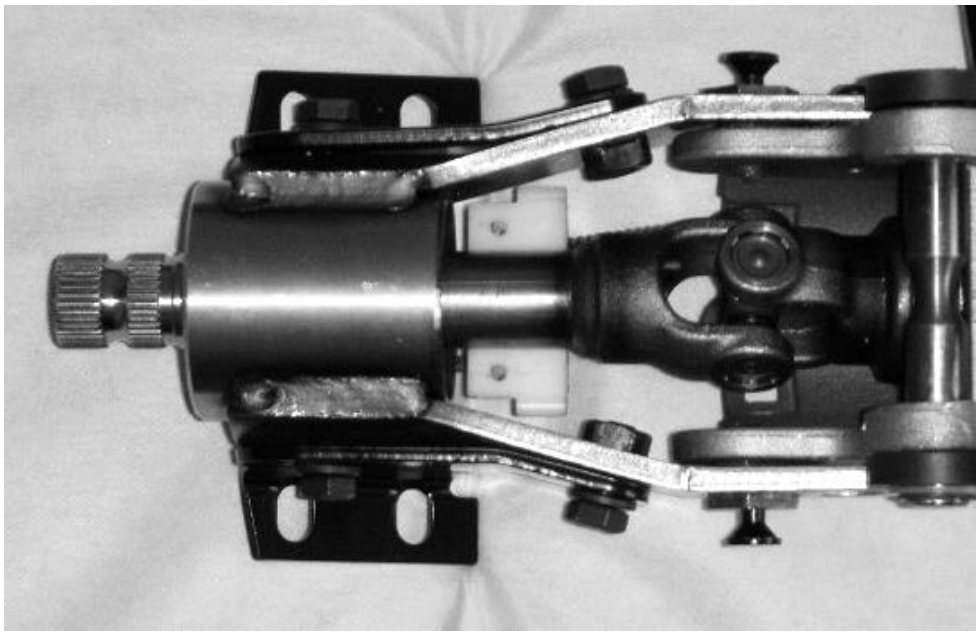
5. Remove the lower plastic housing by pulling the upper tabs off of the mounting pin and then pulling the housing down onto the lower steering column.



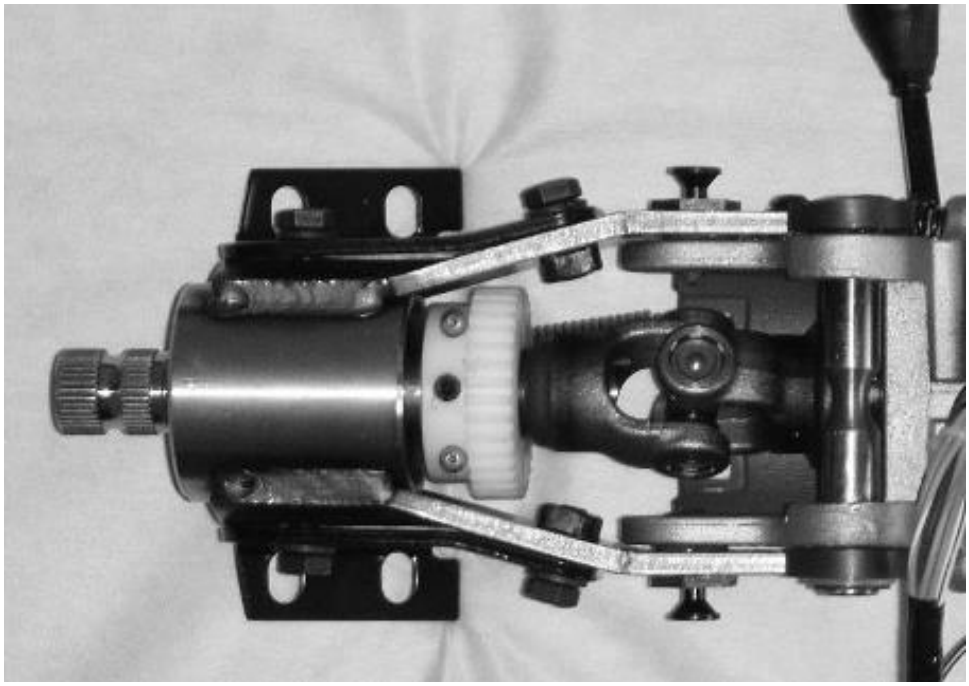
6. Place the steering column back between the brackets and tighten the bolts. This will allow for ease of installation by supporting the column while the remaining steps are completed.



7. Place the lower half of the split gear (the side without the set screw) onto the shaft. It should be placed on the back side of the shaft, with the hub towards the bottom bearing, and as close to the weld at the universal joint as possible.



8. Place the upper half of the split gear on the shaft, aligning the two bolt holes.



9. Tighten the two bolts which hold the split gear together using the 3/32” Allen key. Be sure to tighten them alternately and evenly to ensure that the split between the two halves of the gear is even on both sides of the shaft. Do not overtighten the bolts. They should only be tightened so the gaps between the two shafts are similar in size to the gaps between the other teeth on the gear.

10. Tighten the set screw on the gear with the 4 mm Allen key. When the screw contacts the shaft, turn it no more than ¼ turn to tighten or the threads may strip.

11. The potentiometer comes already calibrated at midpoint as long as the black tape is covering both the small gear & potentiometer body. If it is necessary to recalibrate then rotate the potentiometer counter-clockwise (as seen when looking at the flat side of the gear). When it begins to “click”, stop. Rotate the potentiometer 12.5 full turns clockwise to centre the mechanism.

12. Place the potentiometer on the steering column as shown in the figure below. Ensure that the top edges of the two gears are flush, the holder is as close to the weld on the bearing housing as practical, and the potentiometer body is aligned longitudinally with the steering column.

13. Mark the centre of the two holes in the potentiometer mounting bracket.

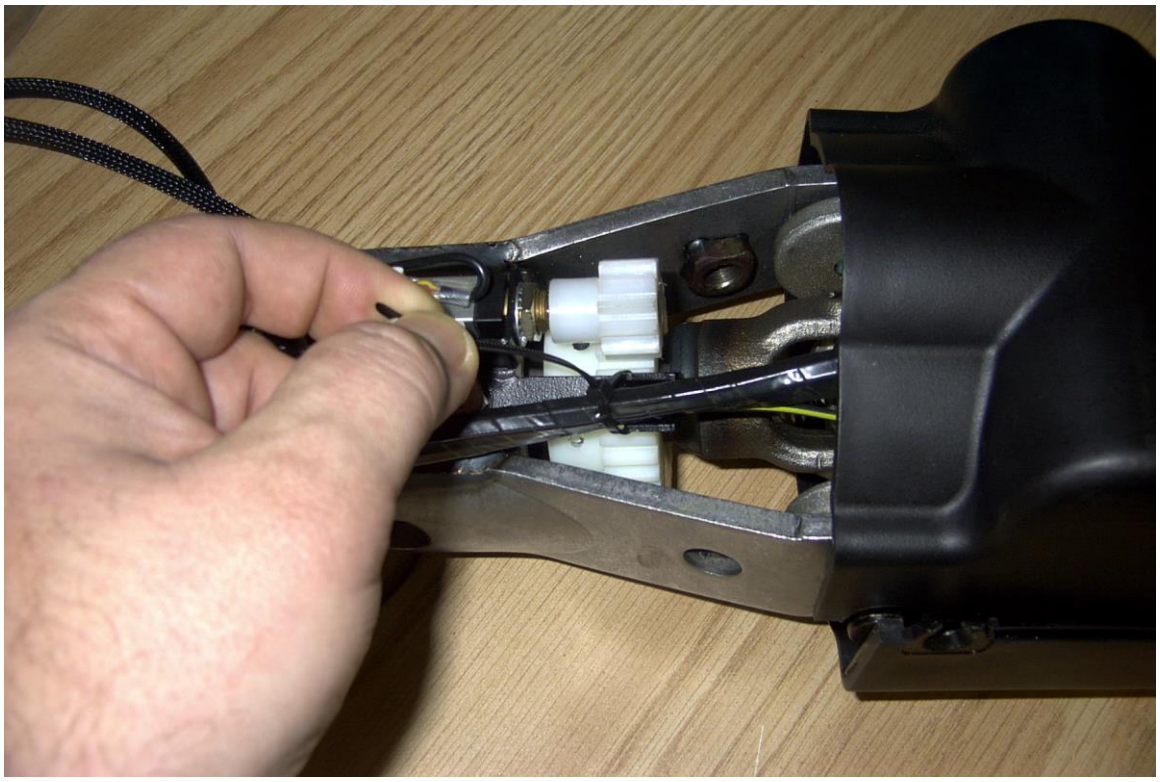
14. Remove the potentiometer and place it to the side.

15. Centre punch the two marks on the bearing housing. Drill and tap these two holes for ¼-20 NC thread.

Place the potentiometer back in place and hold it in place using the two ¼-20 Cap Head Screws and Lock washers. Tighten using the 7/16” Socket wrench. Remove the black tape holding the gear to the potentiometer body.

16. Loosen slightly the two steering column mounting bolts on the left side of the steering column.

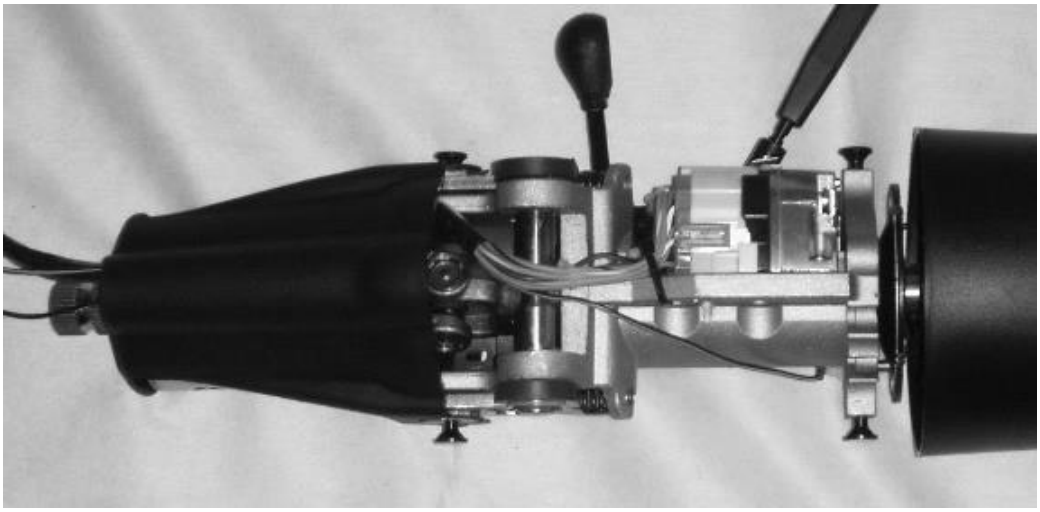
17. Fix the wires coming from the steering column ensuring that these wires are clear of the gearing, will not interfere with its operation, and are loose enough to allow functioning of the tilt mechanism. Place the wiring harness from the steering column into the rest provided on the potentiometer bracket, and secure them with a tie wrap. See figure below



18. Snip the ends of the cable ties using the wire snippers.

19. Carefully remove all four steering column mounting bolts, as in step 3.

20. Insert the steering potentiometer wire through the lower plastic shroud (following the other wires from the column). Replace the shroud around the column and ensure the upper taps clip properly around the metal mounting pins.



21. Replace the two upper plastic shrouds.

22. Mount the steering column in the brackets and tighten the four mounting bolts. The steering sensor is now completely mounted in the steering column.

Appendix B: Brake Sensor Installation

Mounting the Brake Pressure sensor

Tools Required:

- 19 & 22 mm wrenches
- Teflon thread sealing tape
- Phillips screwdriver

Prior to wiring the Braking Pressure sensor it must be installed in the air pressure supply lines to the brake cylinders.

Locate a suitable point in the brake hose line to install a T-junction manifold fitting (not supplied). One port of the manifold should be female threaded for mounting the sensor. Using Teflon thread sealing tape, wrap the threads of the sensor device, and tighten sensor assembly onto the manifold.
See picture below:

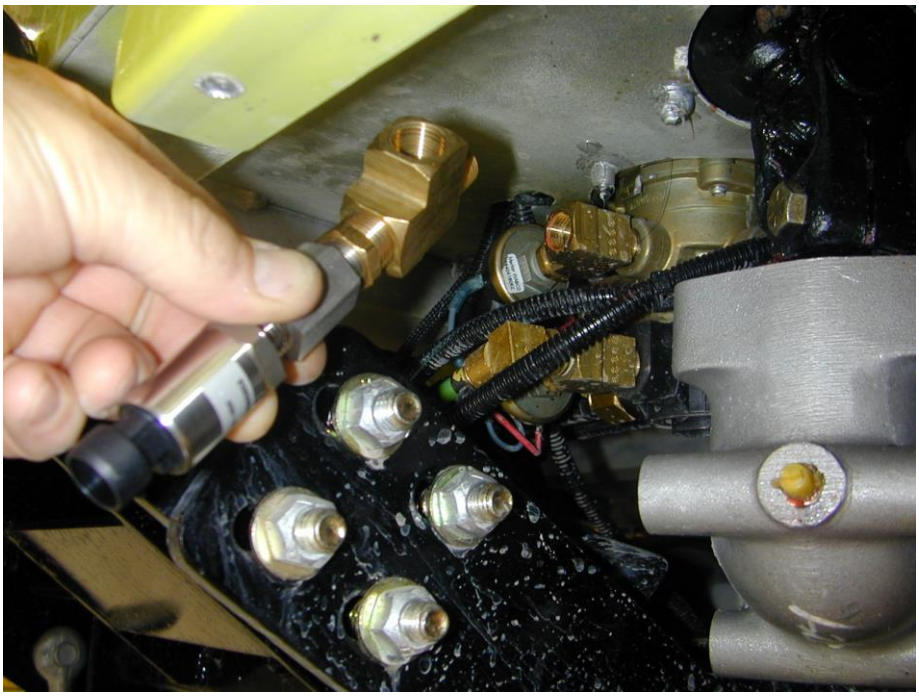


Fig. B1 - Pressure Sensor attached to T-junction manifold

Attach the sensor / T-junction assembly to the brake air supply line, and tighten the hose fittings.

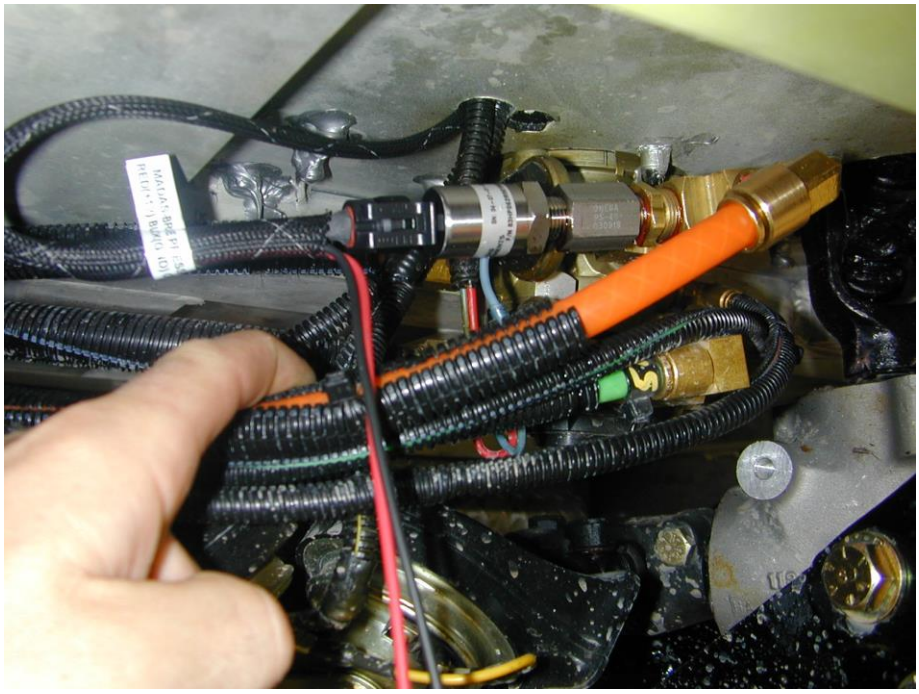


Fig. B2 - Brake Pressure Sensor installed to braking valve air output line, and sensor wiring harness connected to sensor

Route the harness assembly to the MADASS main unit.