Spartan Motors

ActiveRide
Operation Manual

Version 1.20

Spartan Motor Chassis
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Opening the Program

Login Form

User Id

The user identification establishes the security level of the user, which is set up within the program, in the User Administration screen, under the Tools Menu. Only the administrator can change the security levels of users.

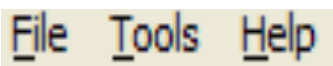
Main Screen

Screen Basics

Toolbar

New – Allows a new .csv file to be created
Open – Allows an existing .csv file to be located and opened
Save – Allows for a new or previous .csv file to be saved. A Save File box appears, so that the correct directory for the file can be chosen, or a file can be renamed.
Print – Sends file to the printer
Download FirmWare – Allows for a FirmWare Update to be obtained from the PC and downloaded to th4e CCM (Central Computer Module)

Menu



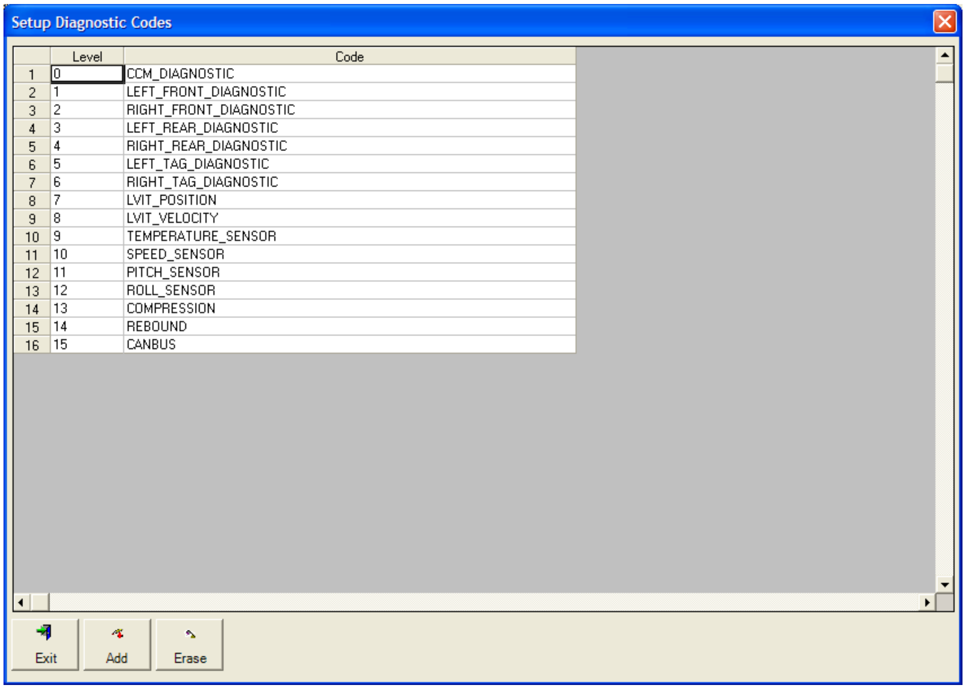
The menu bar provides access to most of the available ActiveRide features.

File – These options are also accessible through the system toolbar.

> **New –** Allows a new .csv file to be created
> **Open –** Allows an existing .csv file to be located and opened
> **Save –** Allows for a new or previous .csv file to be saved. A Save File box appears, so that the correct directory for the file can be chosen, or a file can be renamed.
> **Print –** Sends file to the printer
> **Update FirmWare –** Allows for a FirmWare Update to be obtained from the PC and downloaded to the CCM (Central Computer Module)

Tools –

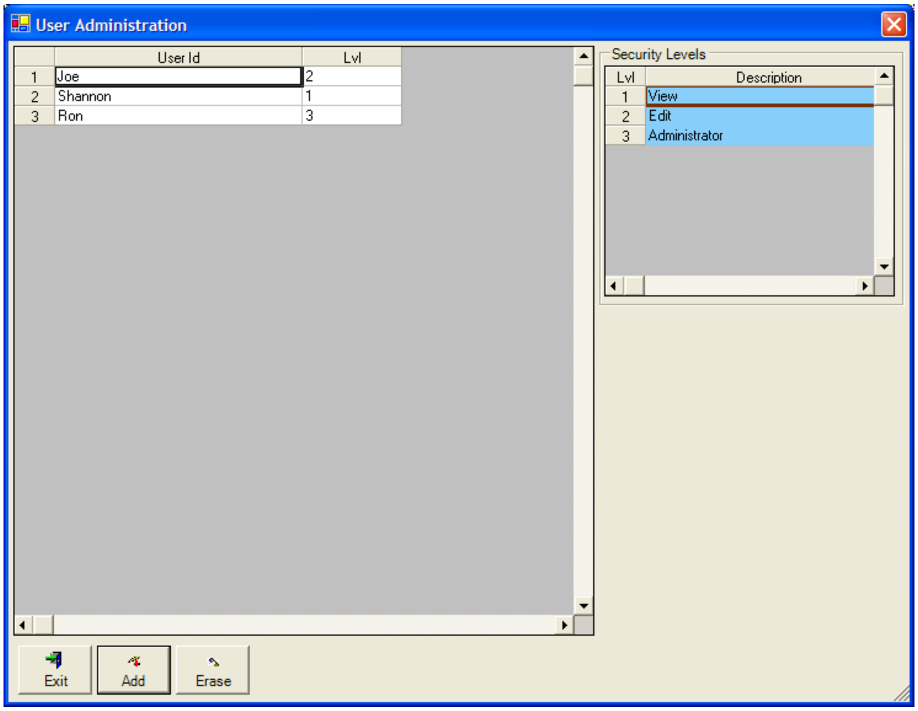
Set Up Diagnostic Codes - Allows the user to set up the approximate code language and level. There are options to Add, Edit or Erase the codes.



Serial Port Configuration - The Serial Port Settings allow the user to change he port number where the ActiveRide system is plugged. ActiveRide recognizes five port numbers (COM1-5). The operator can pick the relevant port by clicking on the right-hand down arrow, and selecting from the drop-down menu.
There is an option for a relay message to be sent at an editable margin, for example, every 200 milliseconds. This feature, when checked, keeps the system active and provides an immediate notification of system bugs or errors, although it significantly increases the Communications Traffic.

User Administration – The User Administration screen shows the different Id's of the permitted users and their security clearance levels.

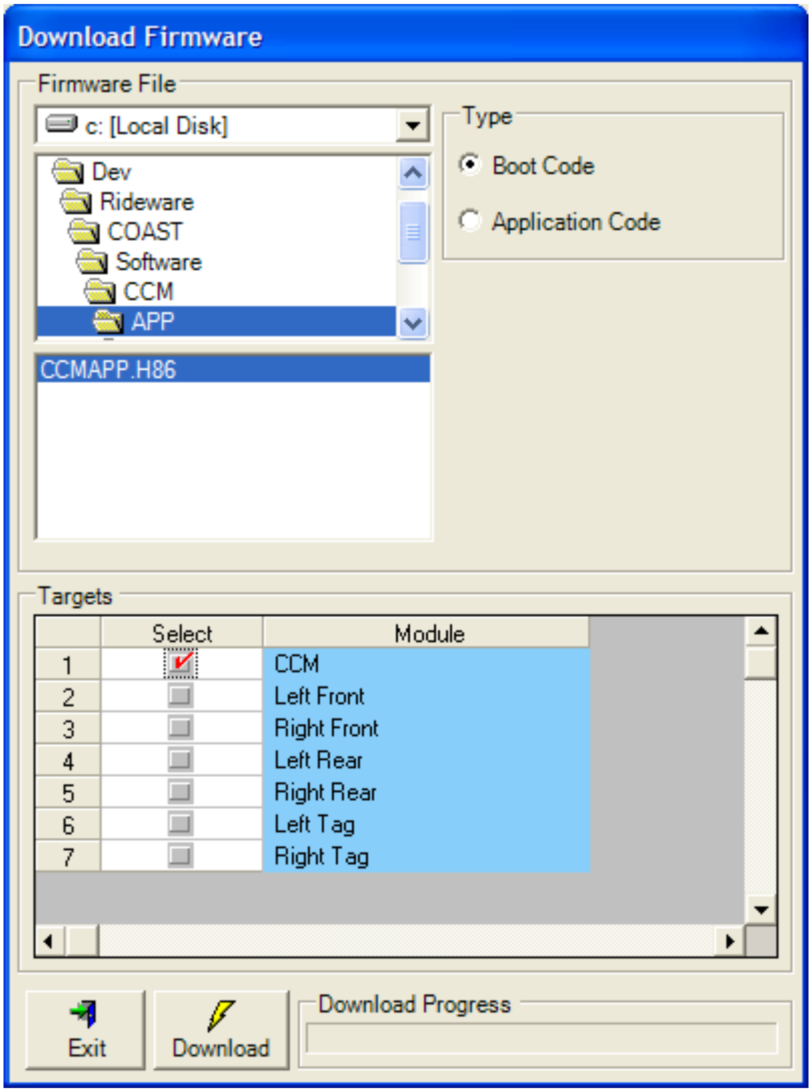
- Level one is defined as view – in other words, it is a read-only clearance.
- Level two is defined as edit – the program can be changed by this clearance.
- Level three is defined as administrator – the program can be changed by this clearance, and security settings can be added, edited or erased.



Update FirmWare – Allows for a FirmWare Update to be obtained from the PC and downloaded to the CCM (Central Computer Module)

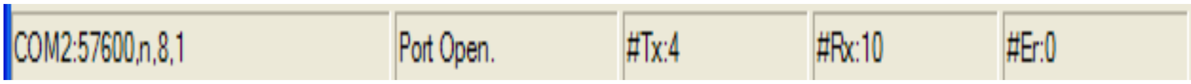
This screen allows the user to select the type of code to download and the location of desired file on the PC, and download the desired file in to the target, selected by checking the box next to the correct location.

The download will begin after pressing the Download button on the lower left of the window. The progress will show in the graph at the bottom of the window.



Help – This feature is currently unavailable

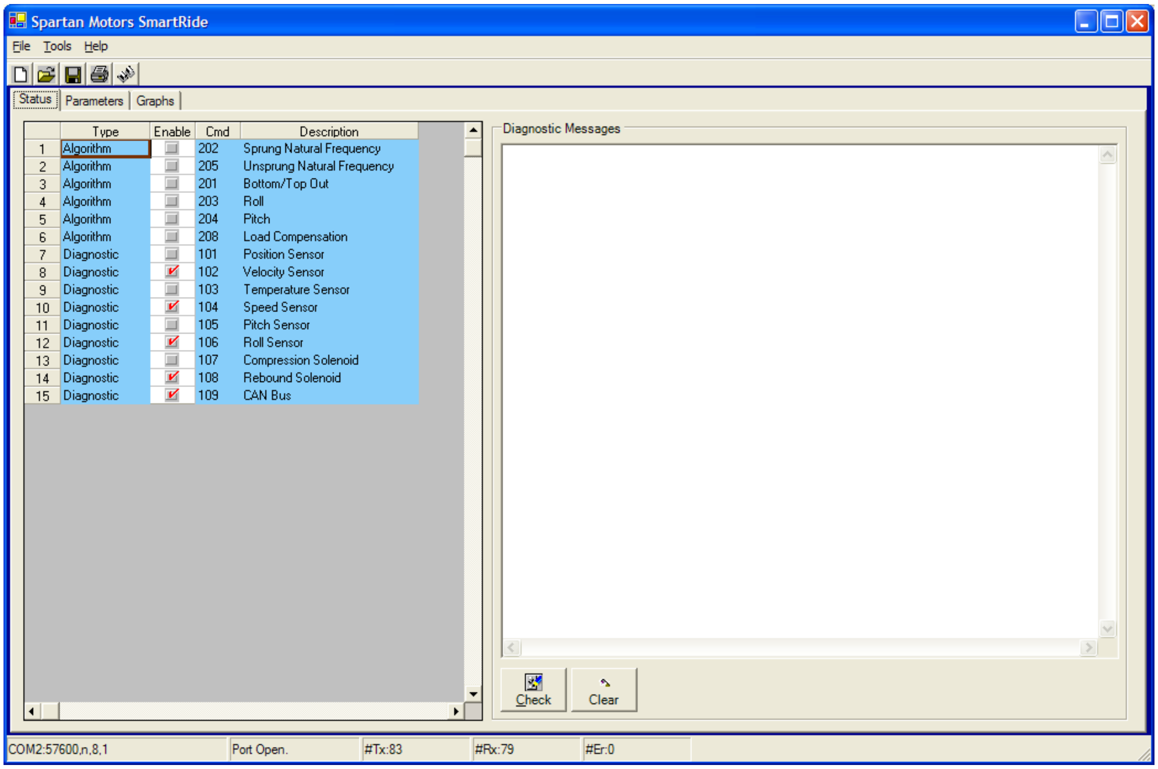
Status Bar



Located at the bottom of each of the tabs on the main screen, the Status bar consists of five panels:

Current Communication Port and Settings – Tells which COM port where the ActiveRide system is attached, and the settings that pertain to it.
Port Status – There are three different Port Status messages: Open, Closed, and Error. The Status should always read Open, or technical support should be consulted.
Number of Messages Transmitted – Represented by TX, this panel will give the number of messages that have been sent from the PC to the CCM.
Number of Messages Received – Represented by a RX, this panel will give the number of messages received by the CCM from the PC.
Number of Error Messages Received – Represented by an ER, this panel will give the amount of error messages received. A detail of these messages can be found in the Application Log.

Status Tab

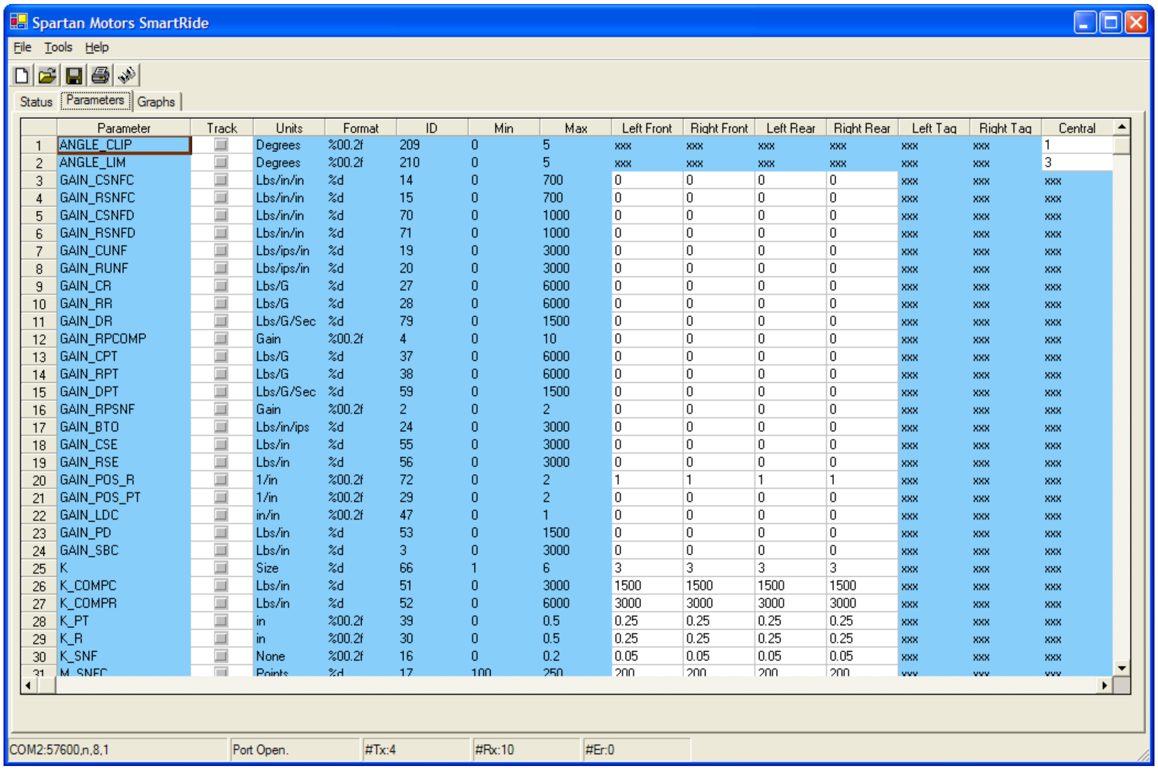


The first tab on the ActiveRide main screen, the Status tab keeps the operator aware of anything happening within the system.

The left field of the screen deals with module configuration, and enables and disables the different system sensors and algorithms, by placing checks in the boxes. The shaded fields cannot be edited.

The Diagnostic Messages window allows a user-initiated check on the system for possible errors. The system will not perform scheduled checks. The operator must initiate the checks. The errors will list in the window, allowing for easier troubleshooting, and must be cleared by the user individually, as they are repaired. The user can clear specific checks by clicking on the “Clear” button.

Parameters Tab



	Parameter	Track	Units	Format	ID	Min	Max	Left Front	Right Front	Left Rear	Right Rear	Left Tag	Right Tag	Central
1	ANGLE_CLIP		Degrees	%00.2f	209	0	5	xxx	xxx	xxx	xxx	xxx	xxx	1
2	ANGLE_LIM		Degrees	%00.2f	210	0	5	xxx	xxx	xxx	xxx	xxx	xxx	3
3	GAIN_CSNFC		Lbs/in/in	%d	14	0	700	0	0	0	0	xxx	xxx	xxx
4	GAIN_RSNFC		Lbs/in/in	%d	15	0	700	0	0	0	0	xxx	xxx	xxx
5	GAIN_CSNFD		Lbs/in/in	%d	70	0	1000	0	0	0	0	xxx	xxx	xxx
6	GAIN_RSNFD		Lbs/in/in	%d	71	0	1000	0	0	0	0	xxx	xxx	xxx
7	GAIN_CUNF		Lbs/ips/in	%d	19	0	3000	0	0	0	0	xxx	xxx	xxx
8	GAIN_RUNF		Lbs/ips/in	%d	20	0	3000	0	0	0	0	xxx	xxx	xxx
9	GAIN_CR		Lbs/G	%d	27	0	6000	0	0	0	0	xxx	xxx	xxx
10	GAIN_RR		Lbs/G	%d	28	0	6000	0	0	0	0	xxx	xxx	xxx
11	GAIN_DR		Lbs/G/Sec	%d	79	0	1500	0	0	0	0	xxx	xxx	xxx
12	GAIN_RPCOMP		Gain	%00.2f	4	0	10	0	0	0	0	xxx	xxx	xxx
13	GAIN_CPT		Lbs/G	%d	37	0	6000	0	0	0	0	xxx	xxx	xxx
14	GAIN_RPT		Lbs/G	%d	38	0	6000	0	0	0	0	xxx	xxx	xxx
15	GAIN_DPT		Lbs/G/Sec	%d	59	0	1500	0	0	0	0	xxx	xxx	xxx
16	GAIN_RPSNF		Gain	%00.2f	2	0	2	0	0	0	0	xxx	xxx	xxx
17	GAIN_BTO		Lbs/in/ips	%d	24	0	3000	0	0	0	0	xxx	xxx	xxx
18	GAIN_CSE		Lbs/in	%d	55	0	3000	0	0	0	0	xxx	xxx	xxx
19	GAIN_RSE		Lbs/in	%d	56	0	3000	0	0	0	0	xxx	xxx	xxx
20	GAIN_POS_R		1/in	%00.2f	72	0	2	1	1	1	1	xxx	xxx	xxx
21	GAIN_POS_PT		1/in	%00.2f	29	0	2	0	0	0	0	xxx	xxx	xxx
22	GAIN_LDC		in/in	%00.2f	47	0	1	0	0	0	0	xxx	xxx	xxx
23	GAIN_PD		Lbs/in	%d	53	0	1500	0	0	0	0	xxx	xxx	xxx
24	GAIN_SBC		Lbs/in	%d	3	0	3000	0	0	0	0	xxx	xxx	xxx
25	K		Size	%d	66	1	6	3	3	3	3	xxx	xxx	xxx
26	K_COMPC		Lbs/in	%d	51	0	3000	1500	1500	1500	1500	xxx	xxx	xxx
27	K_COMPR		Lbs/in	%d	52	0	6000	3000	3000	3000	3000	xxx	xxx	xxx
28	K_PT		in	%00.2f	39	0	0.5	0.25	0.25	0.25	0.25	xxx	xxx	xxx
29	K_R		in	%00.2f	30	0	0.5	0.25	0.25	0.25	0.25	xxx	xxx	xxx
30	K_SNF		None	%00.2f	16	0	0.2	0.05	0.05	0.05	0.05	xxx	xxx	xxx
31	M_SNFC		Points	%d	17	100	250	200	200	200	200	xxx	xxx	xxx

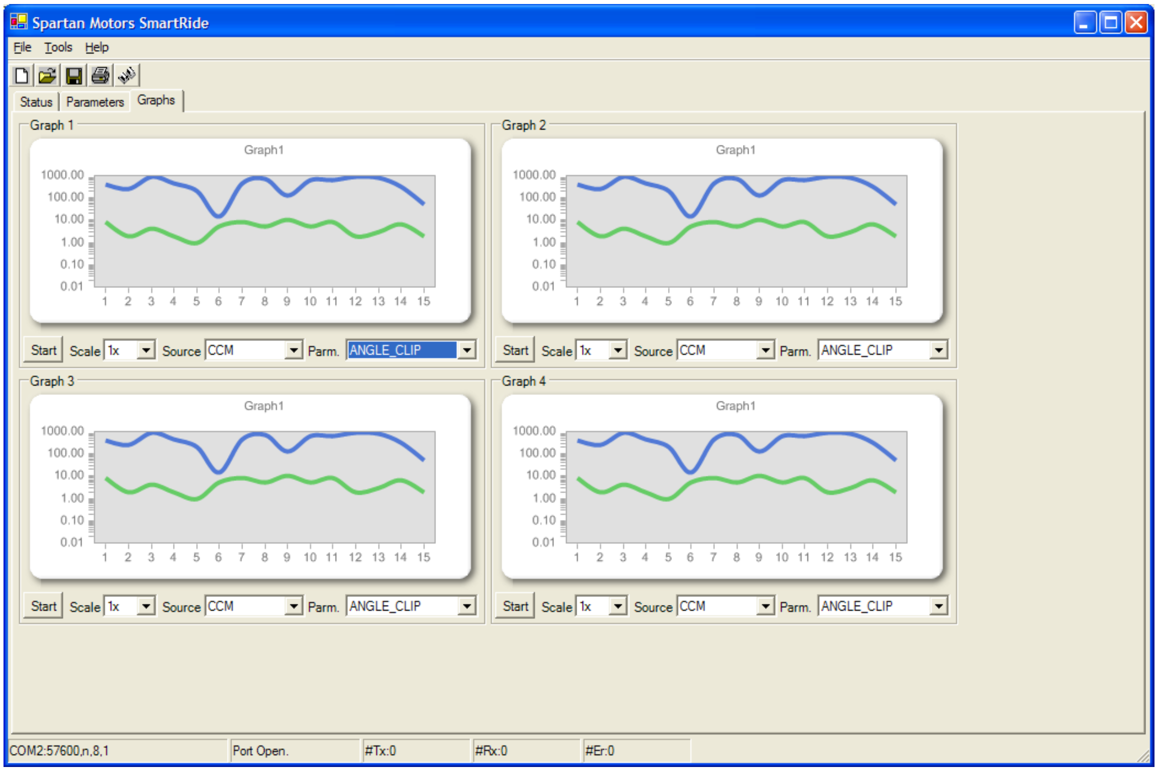
The Parameters tab allows the operator to change certain features of each of the ActiveRide parameters.

The cells that are shaded are fixed and cannot be changed by the operator.

The operator can edit the cells that are white. Once a cell value is changed, and a new cell is clicked on, the change is sent through the CCM.

The Track column allows a checkmark to be placed next to a specific parameter and monitor the activity within that parameter in a separate window.

Graphs Tab



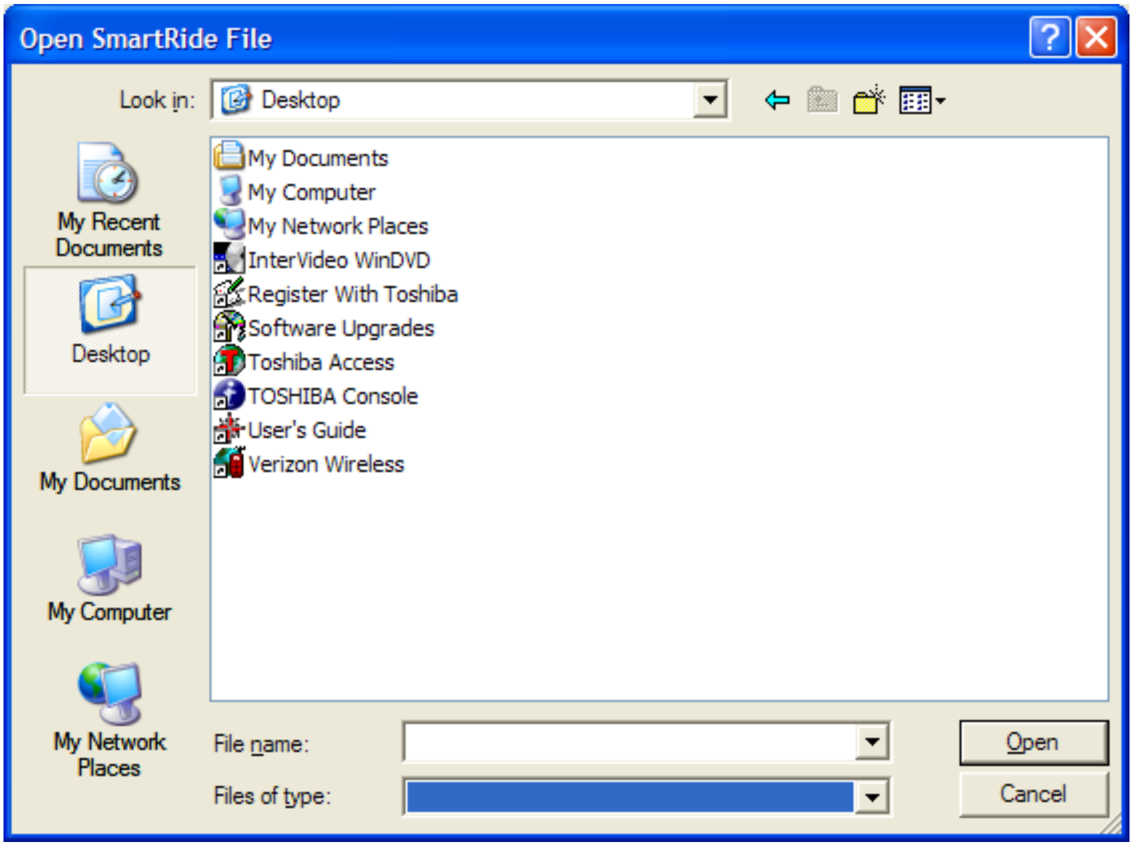
The Graph tab allows the user to monitor four separate parameters within multiple sources. Clicking on the down arrow to the right of each window, and selecting the appropriate value allows the field to change.

The Scale ranges from 1 – 5.

The Source is changeable. Although all messages go through the CCM, a more specific field can be chosen.

The parameters are outlined under the Parameters tab, if the operator is uncertain which to choose.

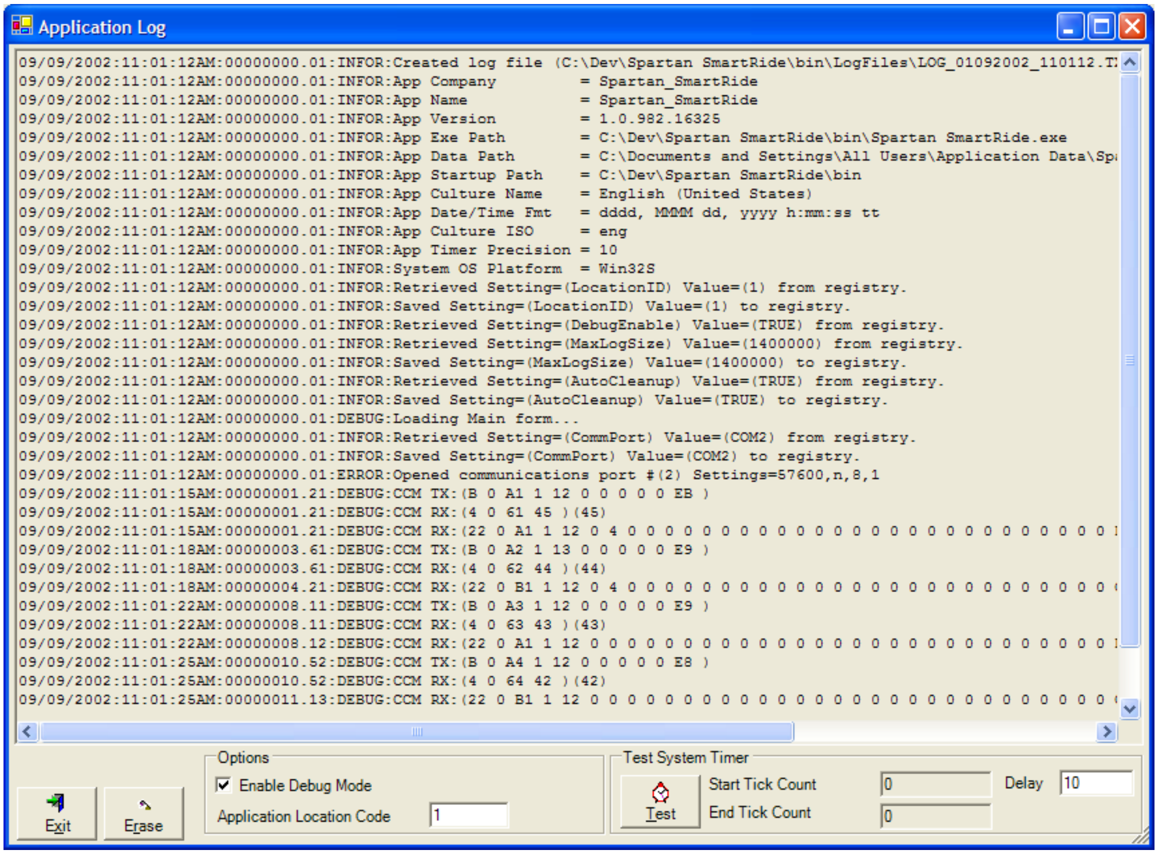
Open File Dialog



This screen allows the user to be able to view and easier navigate the ActiveRide files.

All ActiveRide files are .csv, or Comma Separated Value files. The default settings for this type of files is Microsoft Excel®, although the user should be strongly cautioned that opening these files under Excel can cause a format change and greatly increases the chances for technical difficulties.

Application Log



The application log window displays internal program messages that aid in troubleshooting the performance of the ActiveRide application. The fields displayed are:

Date – the current system date and time.
Timer Count – The number of timer ticks elapsed since starting the application. This is useful to determine the CCM message timing.
Log Record Type – This specifies the type of log message: Informational, Error, or Debug. Debug messages are only logged when the “Enable Debug Mode” setting is checked. This option is normally unchecked to reduce the size of the log file.
Log Message – This is the actual message from the application.

ALGORITHM	I/O	VARIABLES	UNITS	DESCRIPTION
	I	Ebrake_Speed_Override	none	Sets SPEED to 0 if the emergency brake is ON (Used for Fire Truck where pumping water indicated speed)
	RO	**SPEED**	**MPH**	**Average (long-term integrated) Vehicle Speed**
	O	P_AtoD	in	Actual real time A/D position measured each cycle (converted to inches travel at the rod)
	O	P_LTI	in	Average (long term integration) measurement of P_AtoD. This is subtracted from P_AtoD to derive P
	RO	**P**	**in**	**Real time normalized position to P_LTI. This always integrates to 0, but only if the vehicle is level (R_A &PT_A are 0). This value is also normalized to movement of the axel by dividing the rod position by the shock ratio - RATIO.**
	O	V_AtoD	ips	Real time velocity of the damper piston.
	O	V_LTI	ips	TBD Average (long term integrated) damper piston Velocity V_AtoD. Used to cancel drift of an analog velocity circuit.
	RO	**V_P**	**ips**	**Real Time Velocity. It is currently the average of 5 P_A/D-P_A/Dt-1 values to eliminate noise. This value is also normalized to movement of the axel by dividing the rod position by the shock ratio - RATIO**
	O	X_AtoD	G	Actual real time X-axis accelerometer value measured each cycle (converted to G's). Depending on the location and orientation of the dual-axis accelerometer, this may measure Roll or Pitch.
	O	Y_AtoD	G	Actual real time Y-axis accelerometer value measured each cycle (converted to G's). Depending on the location and orientation of the dual-axis accelerometer, this may measure Roll or Pitch.
	O	ANGLE_A/D	Degrees	Actual real time Steering Angle measured each cycle (converted to Degrees)
	O	PRES_A/D	psi	Actual real time Brake Pressure measured each cycle (converted to psi)
	O	BRAKE	None	Alternative to Brake Pressure - Brake Light Status (T=Engage Dive PT_A)
	RO	**THROTTLE**	**%**	**Throttle Level**
	RO	**T_AtoD**	**Deg F**	**Actual real time A/D Temperature,(converted to degrees F)**
	O	G_AtoD	Steps	Raw binary output from the User Gain Knob (analog converted to digital)
SNF	**I**	**GAIN_CSNFC**	**Lbs/in/in**	**Common Mode Compression Sprung Natural Frequency Algorithm Gain**
	I	**GAIN_CSNFC**	**Lbs/in/in**	**Common Mode Rebound Sprung Natural Frequency Algorithm Gain**
	I	**GAIN_RSNFD**	**Lbs/in/in**	**Differential Mode Compression Sprung Natural Frequency Algorithm Gain**
	I	**GAIN_RSNFD**	**Lbs/in/in**	**Differential Mode Rebound Sprung Natural Frequency Algorithm Gain**
	I	M_SNFC & M_SNFD	Points	Number of points in orthogonal SNF DFT filters (SNF period)
	I	K_SNF	None	Integration constant to multiply P by each cycle to calculate P_SNF (non-linear)
	I	**FLOAT_TIME**	**Seconds**	**Number of cycles to apply the float force**
	I	**FLOAT_CBIAS**	**Lbs**	**Small fixed compression force that counteracts the force of a Hold Open spring on the Poppet. This causes the valve to quickly close upon any movement; enabling proper control when very small forces are required (controls float).**
	I	**FLOAT_RBIAS**	**Lbs**	**Small fixed compression force that counteracts the force of a Hold Open spring on the Poppet. This causes the valve to quickly close upon any movement; enabling proper control when very small forces are required (controls float).**
	I	**SPEED_MAXSNF**	**MPH**	**Maximum Vehicle Speed used to modify SNF forces - sets the slope of force multiplier (equals 1.00 at SPEED_MAXSNF**
	I	**SPEED_MINSNF**	**MPH**	**Minimum Vehicle Speed used to modify SNF forces - sets the minimum force multiplier (equals SPEED_MINSNF/SPEED_MAXSNF at SPEED_MINSNF)**
	RO	**P_C & P_D**	**in**	**Common Mode (Jounce) and Differential Mode (side-to-side) Orthogonal Position Inputs to the SNF algorithm**

ALGORITHM	I/O	VARIABLES	UNITS	DESCRIPTION
	O	P_SNFC & P_SNFD	in	Intermediate orthogonal position value for Sprung Natural Frequency Algorithm. It is the position after going through a non-linear low-pass filter to pre-filter high frequency inputs before the 1Hz filter (Discrete Fourier Transform)
	O	A_DFTSNFC & A_DFTSNFD	in	Amplitude of orthogonal position inputs at the SNF frequency (~1Hz). This is the output of a Discrete Fourier Transform (DFT).
	O	A_SNFC & A_SNFD	in	Orthogonal filter amplitudes modified by speed
	O	K_SSNF	Gain	Intermediate Linear Multiplier value for SNF Force modification based n Vehicle Speed and multiplied by GAIN_SNFRIDE. Before multiplication by GAIN_SNFRIDE, it is SPEED_MINSNF/SPEED_MAXSNF if SPEED<SPEED_MINSNF, 1 if SPEED= SPEED_MAXSNF, 65MPH/SPEED_MAXSNF if SPEED>65MPH
	O	GAIN_SNFRIDE	Gain	SNF Gain level adjustment multiplier from the optional User Gain potentiometer.
	RO	**F_CSNF**	**Lbs**	**Compression value desired by the Sprung Natural Frequency algorithm.**
	O	F_CSNFC & F_CSNFD	Lbs	Orthogonal Compression values desired by the Sprung Natural Frequency algorithm
	RO	**F_RSNF**	**Lbs**	**Rebound value desired by the Sprung Natural Frequency algorithm**
	O	F_RSNFC & F_RSNFD	Lbs	Orthogonal Rebound Values desired by the Sprung Natural Frequency algorithm
UNF	**RI**	**GAIN_CUNF**	**Lbs/ips/in**	**Compression Unsprung Natural Frequency Algorithm Gain**
	RI	**GAIN_RUNF**	**Lbs/ips/in**	**Rebound Unsprung Natural Frequency Algorithm Gain**
	RI	**MAX_UNF**	**Lbs**	**Maximum Unsprung Natural Frequency output force allowable - Limits force on large bumps**
	I	M_UNF	Points	Number of Points in UNF DFT filter (UNF period). Optionally adjustable via tire pressure
	I	N_UNF	Counter	Number of cycles between UNF Falling Edge integration update. Some explanation as for N_SNF
	O	A_DFTUNF	in	Amplitude of position inputs at the UNF frequency (~10Hz). This is the output of a discrete Fourier Transform (DFT)
	O	A_INTUNF	in	Falling edge integrated output of the UNF DFT filter.
	O	A_UNF	in	Falling edge integrated output of the UNF DFT filter after correction for 1Hz motions (SNF)
	RO	**F_CUNF**	**Lbs**	**Compression value desired by the Unsprung Natural Frequency algorithm.**
	RO	**R_RUNF**	**Lbs**	**Rebound value desired by the Unsprung Natural Frequency algorithm**
ROLL	**RI**	**GAIN_CR**	**Lbs/G**	**Compression Static Roll Algorithm Gain**
	RI	**GAIN_RR**	**Lbs/G**	**Rebound Static Roll Algorithm Gain**
	RI	**GAIN_DR**	**Lbs/G/Sec**	**Dynamic Roll Algorithm Gain**
	RI	**MAX_RA**	**G**	**Roll Acceleration above which Roll Control is constant**
	RI	**MIN_RA**	**G**	**Roll Acceleration above which Roll Control only uses R_A.**
	I	GAIN_SBC	Lbs/in	Gain control to offset/cancel Stabilizer bar forces (If present)
	O	F_SBC	Lbs	Stabilizer Bar Control Force
	I	R_ACLIP	G	Maximum +/-Normalized Roll Acceleration (R_A) allowed below which it is clipped to zero, and above which it is linearly expanded (scaled) to its actual size.
	I	R_ALIM	G	Maximum +/-Actual Roll Acceleration (R_ANORM) allowed above which the Normalized Roll Acceleration (R_A) is no longer integrated - allows for automatic compensation (normalizing) for crowned roads.
	I	K_R	in	Integration constant to add/sub every N_R cycles to calculate R_INT
	I	N_R	Counter	Number of cycles between Roll position K_R integration update
	I	POS_R	Lbs/in	Non-sensor Positional Roll Control. This emulates a physical anti-sway bar
	I	POS_WIND	Lbs/in	Dynamic force to limit side-to-side chassis movements of RV's when encountering strong crosswinds. A large value is substituted for POS_R. Part of Cross-winds Mode on RV applications
	I	R_CLIP	in	Maximum +/-Differential Integrated Roll Position (R_INT) allowed below which it is clipped to zero.

ALGORITHM	I/O	VARIABLES	UNITS	DESCRIPTION
	I	R_EXP	in	Maximum +/-Differential Integrated Roll Position allowed above which values are used as is. Values between R_CLIP & R_EXP are linearly expanded (scaled).
	O	R_ANORM	G	Real time normalized Roll Acceleration. It is either X_AtoD or Y_AtoD normalized to the calibrated level R_AO
	O	R_ALTI	G	Average (long term integrated) Roll Acceleration. It is limited to R_ALIM, which is about 7 degrees and allows for crowned road (so R_A integrates to zero when traveling on crowned roads)
	RO	**R_A**	**G**	**Normalized and clipped Roll Accel Level (positive for right turn). It is R_ANORM after being normalized to R_ALTI and clipped by R_ACLIP**
	RO	**STEER_A**	**G**	**Equivalent Approximate Roll Acceleration derived from ANGEL*SPEED**
	RO	**dRAdt**	**G/Sec**	**Rate of change of Roll acceleration. The Dynamic Roll algorithm uses this.**
	O	F_DRL	Lbs	Calculated dynamic anti-roll forces required during the start of a Left turn
	O	F_DRR	Lbs	Calculated dynamic anti-roll forces required during the start of a Right turn
	O	R_ACT	in	Real Time diagonal Left to Right Positional Roll Difference (e.g. P_LF-P_RF).
	O	R_LTI	in	Intermediate average (long term integrated) R_ACT value (positive for right turn)
	RO	**R_INT**	**in**	**Clipped and expanded value for the Positional portion of the Roll Control Algorithm. It is 0 if R_LTI<R_CLIP, R_LTI if R_LTI>R_EXP and linearly "extrapolated" in between.**
	O	F_xSNFy	Lbs	GAIN_RPSNF Control Forces (x = C or R, y = F or B)
	RO	**F_CR**	**Lbs**	**Compression value desired by the anti-Roll algorithm**
	RO	**F_RR**	**Lbs**	**Rebound value desired by the anti-Roll algorithm**
Steering Angle	O	ANGEL	Degrees	Normalized Steering Angle Level (positive for Right turn)
	I	ANGLE_LIM	Degrees	Maximum +/- value above which integration is no longer performed
	I	ANGLE_CLIP	Degrees	Maximum +/- value allowed below which the value is clipped to zero
	I	N_ANGLE	Counter	Number of cycles between integration update
PITCH	**RI**	**GAIN_CPT**	**Lbs/G**	**Compression Pitch Algorithm Gain**
	RI	**GAIN_RPT**	**Lbs/G**	**Rebound Pitch Algorithm Gain**
	RI	**GAIN_DPT**	**Lbs/G/Sec**	**Dynamic Pitch Algorithm Gain**
	I	PT_ACLIP	G	Maximum +/- Normalized Pitch Accel (PT_ANORM) allowed below which it is clipped to zero and above which it is linearly expanded (scaled) to its actual value.
	I	PT_ALIM	G	Maximum +/- Actual Pitch Accel (PT_ANORM) allowed above which the Normalized Pitch Acceleration (PT_A) is no longer integrated - allows for automatic compensation (normalizing) for hills.
	I	N_PT	Counter	Number of cycles between Roll position K_PT integration update
	I	K_PT	in	Integration constant to add/sub every N_PT cycles to calculate PT_INT
	I	POS_PT	Lbs/in	Non-sensor Positional Pitch Control. This emulates a physical anti-sway bar.
	I	PT_CLIP	in	Maximum +/- Differential Integrated Pitch Position (PT_INT) allowed below which it is clipped to zero
	I	PT_EXP	in	Maximum +/- Differential Integrated Pitch Position above which values are used as is. Values between PT_CLIP & PT_EXP are linearly expanded (scaled).
	O	PT_ANORM	G	Real time normalized Pitch Acceleration. It is either X_AtoD or Y_AtoD normalized to the calibrated level PT_AO
	O	PT_ALTI	G	Average (long term integrated) Pitch Acceleration. It is limited to PT_ALIM, which is about 7 degrees and allows for hill climbing (so PT_A integrates to zero when going up or down hill).

ALGORITHM	I/O	VARIABLES	UNITS	DESCRIPTION
	RO	**PT_A**	**G**	**Normalized and clipped Pitch Accel Level (positive for vehicle accel). It is PT_ANORM after being normalized to PT_ALTI and clipped by PT_ACLIP.**
	RO	**BRAKE_A**	**G**	**Equivalent Approximate Dive Acceleration derived from -PRES**
	RO	**dPAdt**	**G/Sec**	**Rate of Change of Pitch Acceleration. The Dynamic Pitch algorithm uses this.**
	O	F_DPF	Lbs	Calculated Dynamic anti-pitch forces required during the start of braking.
	O	F_DPB	Lbs	Calculated Dynamic anti-pitch forces required during the start of acceleration
	O	PT_ACT	in	Real Time Diagonal Front to Rear Positional Pitch Difference (e.g. P_RR-P_LF
	O	PT_LTI	in	Intermediate average (long term integrated) PT_ACT value (positive for right turn)
	RO	**PT_INT**	**in**	**Clipped and expanded value for the Positional portion of the Pitch Control Algorithm. It is 0 if PT_LTI<PT_CLIP, PT_LTI if PT_LTI>PT_EXP and linearly "extrapolated" in between.**
	RO	**F_CPT**	**Lbs**	**Compression value desired by the Anti-Pitch algorithm**
	RO	**F_RPT**	**Lbs**	**Rebound value desired by the Anti-Pitch algorithm**
Brake Pressure	O	PRES	psi	Normalized Brake Pressure (positive for acceleration)
	I	PRES_LIM	psi	Maximum +/- value above which integration is no longer performed
	I	PRES_CLIP	psi	Maximum +/- value allowed below which value is clipped to zero
	I	N_PRES	Counter	Number of cycles between integration update
Squat	**RI**	**THROTTLE_MIN**	**%**	**Min Throttle Level above which Anti-Squat is engaged**
	RI	**SPEED_MAXS**	**MPH**	**Speed above which there are no forces (Inversely modifying Anti-Squat vs Speed)**
	RI	**SPEED_MINS**	**MPH**	**Speed below which Raw PT_ANORM is used**
	O	SQUAT_ON	T/F	Indicating the anti-squat should be applied (THROTTLE >THROTTLE_MIN) Defaults to true.
	O	K_SS	n/a	Anti-Squat Modification Based on Vehicle Speed - Intermediate Value
ROLL/PITCH	**RI**	**GAIN_RPSNF**	**GAIN**	**Gain Control to Offset/cancel R/PT Accelerometer induced forces from bumps**
	I	PUMP	lbs	Minimum R/PT force (any) before a leakage pump is enabled (low pressure bypass closed)
	I	GAIN_POS_R	1/in	Roll differential position feedback Gain. This increases anti-roll control proportional to actual positional Roll
	I	GAIN_POS_PT	1/in	Pitch differential position feedback Gain. This increases anti-pitch control proportional to actual positional Roll. [Set to 0 with leakage]
	RI	**SPEED_MAXRP**	**MPH**	**Maximum Vehicle Speed used to modify R/PT & UNF forces - sets the slope of force multiplier (equals 1.00 at SPEED_MAXRP**
	RI	**SPEED_MINRP**	**MPH**	**Minimum Vehicle Speed used to modify R/PT & UNF forces - Sets the Speed for no force (equals 0.00 at SPEED_MINRP)**
	I	N_A	Counter	Number of cycles between accelerometer integration update. This allows for compensation of hills & crown roads and must be slow enough not to effect cornering yet fast enough to normalize small acceleration values when on hills and crown roads
	I	PARK-BIAS	Lbs	Constant force to hold the valves relatively hard closed to stop chassis movements when parked. Part of Motion Lock Technology TM
	I	POS_PARK	Lbs/in	Dynamic force to close the valves when any chassis movement is detected when parked. A large valve is substituted for POS_R & POS_PT. Part of Motion Lock Technologies TM
	O	GAIN_RPRIDE	Gain	Roll and Pitch Gain level adjustment multiplier from the optional User Gain potentiometer.

ALGORITHM	I/O	VARIABLES	UNITS	DESCRIPTION
	O	K_SRP	Gain	Intermediate Linear Multiplier value for Roll/Pitch Force modification based n Vehicle Speed and multiplied by GAIN_RPRIDE. Before multiplication by GAIN_RPRIDE, it is) if SPEED<SPEED_MINRP, 1 if SPEED=SPEED_MAXRP, (65MPH-SPEED_MINRP)/(SPEED_MAXRP-SPEED_MINRP) if SPEED>65MPH.
	O	BIAS	Lbs	Force that is always added to both Compression & Rebound outputs- normally 0, but larger values for Firm Park RV Mode
	O	F_xSNFy	Lbs	GAIN_RPSNF Control Forces (x=C or R, y=L or R)
BTO	**RI**	**GAIN_BTO**	**Lbs/in/ips**	**Bottoming/Topping Out Algorithm Gain**
	RI	**P_TOP**	**in**	**Position threshold below zero position where Topping Out forces begin - Normally uses P_ABS if available, P otherwise**
	RI	**P_BOT**	**in**	**Position threshold below zero position where Bottoming Out forces begin - Normally uses P_ABS if available, P otherwise**
	RI	**SPEED_MAXBTO**	**MPH**	**Maximum Vehicle Speed used to modify BTO & SE forces - Sets the slope of force multiplier (equals 1.00 at SPEED_MAXBTO).**
	O	**P_ABS**	**in**	**Real time absolute position (0 at ride height). This is calculated based on a calibration cycle that uses the oil's temperature expansion coefficient, the oil volume & its temperature.**
	I	P_FOR _BTO	None	When set to 1, P is used for BTO rather than P_ABS
	I	SQUARE_BTO	None	When set to 1, force modulation is proportional to position Squared rather than directly (linear)
	O	K_SBTO	Gain	Intermediate Linear Multiplier value for BTO Force modification based on Vehicle Speed. It is 0 if SPEED=0MPH, 1 if SPEED=SPEED_MAXBTO, 65MPH/SPEED_MAXBTO if SPEED>65MPH.
	RO	**F_CBTO**	**Lbs**	**Compression value desired by the Bottoming/Topping Out algorithm**
	RO	**F_RBTO**	**Lbs**	**Rebound value desired by the Bottoming/Topping Out algorithm**
SE	**RI**	**GAIN_CSE**	**Lbs/in**	**Compression Stored Energy Algorithm Gain**
	RI	**GAIN_RSE**	**Lbs/in**	**Rebound Stored Energy Algorithm Gain**
	RI	**SE_CLIP**	**in**	**Maximum +/- Stored Energy Position allowed above which the value is used as is - the values between SE_CLIP & SE_EXP are linearly expanded (scaled).**
	RI	**SE_EXP**	**in**	**Maximum +/- Stored Energy Position allowed above which the value is used as is - the values between SE_CLIP & SE_EXP are linearly expanded (scaled).**
	O	K_EXPSE	Gain	Intermediate Expanded Filter Multiplier for Stored Energy Algorithm. It is 0 if P_DW<SE_CLIP, 1 if P_DW>SE_EXP and linearly "extrapolated" in between
	O	F_DWC	Lbs	Intermediate Diagonal Wheel Compression value of the Stored Energy Algorithm
	O	F_DWR	Lbs	Intermediate Diagonal Wheel Rebound value of the Stored Energy algorithm
	O	F_WUCC	Lbs	Intermediate Wheel Under Control Compression value of the Stored Energy algorithm
	O	F_WUCR	Lbs	Intermediate Wheel Under Control Rebound value of the Stored Energy algorithm
	RO	**F_CSE**	**Lbs**	**Compression value desired by the Stored Energy algorithm**
	RO	**R_RSE**	**Lbs**	**Rebound value desired by the Stored Energy algorithm**
PD	I	GAIN_PD	Lbs/in	Pumping Down algorithm Gain
	I	N_PD	Counter	Number of cycles between Pumping Down integration update
	O	P_PD	in	Not Used. Intermediate position value for Pumping Down Algorithm. It is the integrated pumping down control value.
	O	F_CPD	Lbs	Compression value desired by the Pumping Down algorithm

ALGORITHM	I/O	VARIABLES	UNITS	DESCRIPTION
	O	F_RPD	Lbs	Rebound value desired by the Pumping Down algorithm
Compensation	**RI**	**GAIN_LDC**	**Gain/in**	**Load Compensation Gain. This is a multiplication factor based on absolute position (P_ABSLTI) that increases the output level proportional to increased load. The value is the fractional increase in load per inch of compression (P_ABS) between the axle and body.**
	I	Cv	Lbs/ips^2	Not Used. Valve Flow Constant (F= Cv*Vp^2).
	O	P_ABSLTI	in	Average (long term integration) absolute position P_ABS. This is used for load compensation
	O	T_COMP	Deg F	Over-Temperature Compensation Factor. If T_AtoD<250 degrees then T_COMP=1 and as the temperature exceeds 225, then T_COMP is linearly reduced to) degrees at 250 (the design temperature)
	RO	**LOAD_COMP**	**Gain**	**Intermediate Linear Multiplier value for Load Compensation Factor. It is used with fixed springs ans is derived by comparing the average (long term integration) of absolute position (P_ABSLTI) with the unloaded absolute position (saved during calibration)**
	O	PRES_COMP	Gain	Intermediate Linear Multiplier value for Load Compensation factor. It is used with air springs and is derived by comparing the average (long term integrated) of air pressure with the unloaded air pressure (saved during calibration)
	O	F_CSUMLDC	Lbs	Sum of all Compression Algorithms Forces after Load Compensation but before Temperature Compensation
	O	F_CSUMTC	Lbs	Sum of all Compression Algorithms Forces after Temperature Compensation but before Base Damping Compensation
	O	F_CSUMBDC	Lbs	Sum of all Compensation Algorithms Forces after Base Damping Compensation but before Solenoid Power Compensation
	O	F_CAVE	Lbs	Solenoid Power Compensation. Integrated (average) compression force (power) per solenoid. This is used to automatically prevent solenoid overheating.
	RO	**F_CSUMC**	**Lbs**	**Sum of all Compression Algorithms Forces after Solenoid Power Compensation but before Compliance Emulation.**
	O	F_RSUMLDC	Lbs	Sum of all Rebound Algorithm Forces after Load Compensation but before Temperature Compensation
	O	F_RSUMTC	Lbs	Sum of all Rebound Algorithm forces after Temperature Compensation but before Base Damping Compensation.
	O	F_RSUMBDC	Lbs	Sum of all Rebound Algorithm Forces after Base Damping Compensation but before Solenoid Power Compensation
	O	F_RAVE	Lbs	Solenoid Power Compensation. Integrated (average) Rebound force (power) per solenoid. This is used to automatically prevent solenoid overheating.
	RO	F_RSUMC	Lbs	Sum of all Rebound Algorithms Forces after Solenoid Power Compensation but before Compliance Emulation
Compliance	I	K_COMPC	Lbs/in	Emulated Compliance Compression Rate - Simulates an accumulator at the valve input.
	I	K_COMPR	Lbs/in	Emulated Compliance Rebound Rate - Simulates an accumulator at the valve point.
	O	X_COMPC	in	Emulated Compression Compliance Stroke used to compute output force F_C (F_C=K_COMPC*X_COMPC).
	O	X_COMPR	in	Emulated Rebound Compliance Stroke used to compute output force F_R (F_R=K_COMPR*X_COMPR)
	RO	**K_COMPCM**	**Lbs/in**	**Compression Emulated Compliance Rate Modified by Roll**
	RO	**K_COMPRM**	**Lbs/in**	**Rebound Emulated Compliance Rate Modified by Roll**
	RI	**GAIN_RPCOMP**	**Gain**	**Roll/Pitch Compliance Gain**
	RO	**F_C**	**Lbs**	**Sum of all Compression Algorithm Forces after Compensation & Compliance Emulation, but before conversion to solenoid PWM output.**

ALGORITHM	I/O	VARIABLES	UNITS	DESCRIPTION
	RO	**F_R**	**Lbs**	**Sum of all Rebound Algorithm Forces after Compensation & Compliance Emulation, but before conversion to solenoid PWM output.**
Float	RI	FLOAT_TIME	Seconds	Number of cycles to apply the float force
	RI	FLOAT_CBIAS	Lbs	Compression force to apply for float
	RI	FLOAT_RBIAS	Lbs	Rebound force to apply for float
	O	VFLOAT	ips	Filtered velocity - 4 full Vp cycles = 25ms (0.5ips resolution)
	O	FCFLOAT	Lbs	Compression force that will be applied for float
	O	FRFLOAT	Lbs	Rebound force that will be applied for float
Output	**RO**	**F_CSUM**	**Lbs**	**Sum of all Compression algorithm forces before Load Compensation.**
	RO	F_RSUM	Lbs	Sum of all Rebound algorithm forces before Load Compensation
	O	PWM_C	Duty Cycle	TBD Compression Solenoid Feedback (converted to PWM Duty Cycle Value)
	O	PWM_R	Duty Cycle	TBD Rebound Solenoid Feedback (converted to PWM Duty Cycle Value)
	O	DELTA_C	Duty Cycle	Used in Compression solenoid feedback algorithm to decrease the response time. It is the difference in duty cycle between that requested by the algorithm and the actual duty cycle feedback time from the solenoid (not yet implemented)
	O	DELTA_R	Duty Cycle	Used in Rebound solenoid feedback algorithm to decrease the response time. It is the difference in duty cycle between that requested by the algorithm and the actual duty cycle feedback time from the solenoid (not yet implemented)
	RO	**F_CPWM**	**Duty Cycle**	**PWM value sent to the Compression solenoid after Emulated Compliance (0-5000=> 0-100% Duty Cycle). This value is also normalized to force at the rod by dividing the force by the shock ratio - RATIO (e.g. the algorithms calculate the desired force at the axle).**
	RO	**F_RPWM**	**Duty Cycle**	**PWM value sent to the Rebound solenoid after Emulated Compliance (0-5000=> 0-100% Duty Cycle). This value is also normalized to force at the rod by dividing the force by the shock ratio - RATIO (e.g. the algorithms calculate the desired force at the axle).**
Diagnostics	I	Test Compression	PWM	Override PWM Duty Cycle sent to Compression Solenoid - 0 to 5000 => 0% to 100% (5001 forces normal algorithm operation)
	I	Test Position Enabled	None	Enables override Position signal input when set to 1- (0 forces normal algorithm operation)
	I	Test Position Freq	Hz	Frequency (Hz) of the override Position signal input. The integer sets the frequency.
	I	Test Position P-P Amp	Inches	Amplitude (Inches P_P) of the override Position signal input. The integer sets the amplitude.
	I	Test Rebound	PWM	Override PWM Duty Cycle sent to Rebound Solenoid - 0 to 5000 => 0% to 100% (5001 forces normal algorithm operation)
	I	Test Speed	MPH	Override Speedometer setting. The integer sets the speed (200 forces normal algorithm operation, using the actual Speedometer)
	I	Test User Gain	None	Gain switch A/D value. 0 - 31 represents Soft to Firm, respectively.
	I	Test_LED	None	Used to test failure LED's (0 = None, 1 = Green, 2 = Yellow, 3 = Red)
	RO	**Test Pressure**	**PSI**	**Test pressure being generated by the compression valve in a selected suspension unit**
	O	Raw A/D Batt	None	Raw binary A/D 12 Volt Battery Voltage (0-1024)
	O	Raw A/D Pos	None	Raw binary A/D LVIT Position (0-1024)
	O	Raw A/D Temp	None	Raw binary A/D Temperature (0-1024)
	O	Raw A/D Vcc	None	Raw binary A/D 5 Volt Vcc (0-1024)
	O	Raw A/D Vel	None	Raw binary A/D SPEED (0-1024)

ALGORITHM	I/O	VARIABLES	UNITS	DESCRIPTION
Air Suspension	I	SPEED_LIFTO	MPH	Vehicle Speed (MPH) for Adaptive Hwy, Lot entry and crosswinds
	I	SPEED_LIFTMED	MPH	Vehicle Speed (MPH) for Lot entry
	I	SPEED_LIFTHI	MPH	Vehicle Speed (MPH) for Adaptive Hwy
	I	N_AS	ips	Number of cycles between integration update
	I	C_AS	Counter	Counter variable for integration (From 1 to N_AS)
	O	P_AS	in	Integrated absolute position of PABS
	I	N_LEVEL	# of Cycles	Number of leveling cycles to allow
	I	C_LEVEL	Counter	Counter variable for counting leveling cycles
	I	**GAIN_AP**	**Gain/psi**	**Load compensation gain for air suspension systems using pressure**
	O	PRES_COMP	Gain	Load Compensation Factors to REM's
	O	PRES_A/D	psi	Actual real time A/D reading
	O	PRES_O	psi	Calibration Initial Pressures (used for load compensation)
	O	PRES_TK	psi	Tank Pressure (used to turn on electric air compressor in Park Mode)
	O	PRES_xx	psi	Operating Pressures for each point
	I	PRES_MIN	psi	Minimum Pressure expected for use in testing for oil leaks
	I	LEAK_xx	Seconds	Total pump time for each spring to detect air leaks
	I	DUTY	Duty Cycle	Maximum differential pump duty cycle from side to side to detect air leaks
		TANK_MIN	psi	Minimum tank pressure before turning on electric air compressor
	I	COMPRESSOR	Minutes	Number of minutes to run electric compressor
	I	L & W	in	Vehicle Length & width (wheel to wheel)
	O	SET	in	Current height setting depending on mode selected
	I	SET_FNORM	in	Front Height Normal Setting Inches above 0 (calibration)
	I	SET_RNORM	in	Rear Height Normal Setting Inches Above 0 (calibration)
	I	OFFSET_HWYHI	in	High Offest Setting Inches above Normal for Adaptive Highway
	I	OFFSET_HWYLO	in	Low Offest Setting Inches below Normal for Adaptive Highway
	I	OFFSET_LOT	in	High Offest Setting Inches above Normal for Lot Entry
	I	OFFSET_WIND	in	High Offset Setting Inches below Normal for Cross-Winds
	I	P_HYS	in	Height Adjustment hysteresis
	I	MAX_F	in	Maximum Allowable Front Position
	I	MIN_F	in	Minimum Allowable Front Position
	I	MAX_R	in	Maximum Allowable Rear Position
	I	MIN_R	in	Minimum Allowable Rear Position
	I	T_INTAKE_DF	Seconds	Drive Mode Intake Valve Activation Time - Front
	I	T_INTAKE_DR	Seconds	Drive Mode Intake Valve Activation Time - Rear
	I	T_INTAKE_PF	Seconds	Park Mode Intake Valve Activation Time - Front
	I	T_INTAKE_PR	Seconds	Park Mode Intake Valve Activation Time - Rear
	I	T_EXHAUST_DF	Seconds	Drive Mode Exhaust Valve Activation Time - Front
	I	T_EXHAUST_DR	Seconds	Drive Mode Exhaust Valve Activation Time - Rear
	I	T_EXHAUST_PF	Seconds	Park Mode Exhaust Valve-Activation Time - Front
	I	T_EXHAUST_PR	Seconds	Park Mode Exhaust Valve-Activation Time - Rear

ALGORITHM	I/O	VARIABLES	UNITS	DESCRIPTION
	I	AS_SYSTEM	T/F	Airspring System Present
	I	AS_SELFTEST	T/F	Calibrate the Airspring System and COAST
	O	VALVE_LF	Bit	LF Valve Status
	O	VALVE_RF	Bit	RF Valve Status
	O	VALVE_LR	Bit	LR Valve Status
	O	VALVE_RR	Bit	RR Valve Status
	O	VALVE_TANK	Bit	Tank Valve Status
	O	VALVE_EXHAUST	Bit	Exhaust Valve Status
	I	AS_MODE	Mode	Airspring Mode
	O	Firm Level	T/F	Firm Level Mode Request Flag
	O	Soft level	T/F	Soft Level Mode Request Flag
	O	Calibrate	T/F	Calibrate Mode Request Flag
	O	Self Test	T/F	Self Test Mode Request Flag
	O	Normal Hwy	T/F	Normal Highway Mode Request Flag
	O	Adaptive Highway	T/F	Adaptive Highway More Request Flag
	O	Lot Entry	T/F	Lot Entry Mode Request Flag
	O	Cross-Winds	T/F	Cross-winds Mode Request Flag
	O	Kneel	T/F	Kneel Mode Request Flag
	O	Dump	T/F	Dump Mode Request Flag
	O	Firm Level	T/F	Firm Level Mode Flag
	O	Soft Level	T/F	Soft Level Mode Flag
	O	Calibrate	T/F	Calibrate Mode Flag
	O	Self Test	T/F	Self Test Mode Flag
	O	Normal Hwy	T/F	Normal Highway Mode Flag
	O	Adaptive Highway	T/F	Adaptive Highway Mode Flag
	O	Lot Entry	T/F	Lot Entry Mode Flag
	O	Cross-Winds	T/F	Cross-winds Mode Flag
	O	Kneel	T/F	Kneel Mode Flag
	O	Dump	T/F	Dump Mode Flag
Other Flags	O	Initial Calibrate	T/F	Initial Calibration Successfully Completed Flag
	O	Reading Pressures	T/F	Reading Pressures Flag
	O	Adjust	T/F	Spring Needed Adjustment Flag
	O	Air Spring Leak xx	T/F	Air Spring xx Leaking Air Flag, where xx = LF, RF, LR, RR
	O	Oil Leak xx	T/F	Suspension Unit xx Leaking Oil Flag, where xx = LF, RF, LR, RR
	O	Air Manifold x	T/F	Air Manifold Fail Flag x, where x = 1,2,3,4,5 Failure Code
Diagnostics	I	FAIL_FLAGSLF	Bit Mask	LF Failure Status
	I	FAIL_FLAGSRF	Bit Mask	RF Failure Status
	I	FAIL_FLAGSLR	Bit Mask	LR Failure Status
	I	FAIL_FLAGSRR	Bit Mask	RR Failure Status