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LOTUS ENGINEERING

ACTIVE TECHNOLOGY REPORT

TRACK TENSIONING PROGRAMME FOR TACOM ON THE ACTIVE SUSPENSION SCORPION (P3) TANK

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Report Number - 2809/94

22nd June 1994



The Power of Innovation

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REPORT NO.

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DATE OF ISSUE:

22nd June 1994

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ACTIVE TECHNOLOGY REPORT

TRACK TENSIONING PROGRAMME FOR TACOM ON THE ACTIVE SUSPENSION SCORPION (P3) TANK

Summary

This report is in two sections and covers the two outstanding contracts with TACOM with regard to hydraulic system improvement and the implementation and testing of Active track tensioning on the Active Suspension Scorpion (P3) tank.

Section 1 (contract number DAJA45-93-M-0421) covers the specification of an improved control valve plus the design, manufacture and installation of new valve manifolds. The contract also covers the hydraulic commissioning of the vehicle up to the 3rd September 1993. This work was completed on schedule and was necessary in order to complete the main programme described in Section 2.

Section 2 (contract number DAJA45-92-C-0001) forms the final (eighth) report under this contract number for the implementation and testing of Active track tensioners.

Active track tensioning, as has been shown by DRA data (taken at the tank trials in November 1993), offers ride performance improvements over an uprated passive vehicle and also over the Active suspension vehicle with fixed tensioners. However, it is believed that software corrections made after the trials and the implementation of alternative algorithm ideas, could further improve the vehicle ride performance.

Much improved system reliability, due to the hydraulic work carried out prior to the trials, has been a cornerstone to the vehicle performance and ride data collection.

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1. Vehicle Servicing Contract DAJA45-93-M-0421

1.1 Introduction

Contract DAJA45-93-M-0421 was awarded by TACOM to Lotus for the improvement of the suspension actuator manifolds fitted to the Scorpion P3 vehicle. This followed a period of high attrition for servovalves combined with the general level of difficulty in servicing the valves due to the design of the manifolds.

1.2 Contract Objectives (as Defined Within the Contract)

- The design and specification of a new valve assembly for the Scorpion test vehicle's Active suspension units, followed by installation and commissioning of the new units.
- A new manifold will be designed to accommodate both the current power valve and an
 externally mounted bypass valve. The design will accommodate the current interface
 connections with the existing hoses and electrical connections and will form a direct
 replacement for the existing units.
- The new components will be installed in the vehicle and basic operational tests will be conducted, i.e. electrical continuity and hydraulic pressure tests.
- Using the existing energy saving suspension system software, the performance of the new installation will be tested and verified and any initial problems rectified.

1.3 Action Taken

A manifold was designed to mount both the power and bypass valves at each actuator. During the design process a three dimensional CAD model was created to ensure ports and drillings did not clash. The internal design also ensured that drillings were as direct as possible and were of maximum diameter.

Four manifolds were machined and five bypass valves procured. The manifolds were mounted in the vehicle to give best possible access to fittings and to provide good flow paths. All hydraulic lines on the vehicle were flushed through the manifolds and the system filter replaced. Hydraulic connections were pressure tested and valves were cycled to ensure that they were fully operational and had correct polarity.

During this period it was found that the relief valves for the suspension actuators had been connected to the incorrect side of each actuator. This had led to the failure of valves due to overpressurising and was corrected.

All work was completed successfully prior to the vehicle trials described in Section 2.



2. Track Tensioning Contract (DAJA45-92-C-0001)

2.1 Introduction

This section of the report describes the tuning and testing of the Scorpion P3 tank fitted with Active suspension and Active track tensioners. The testing took place between 1st and 12th November 1993 at DRA's Barnsfield Heath test site located at Hurn, Dorset, England. The report format is a chronological work log to enable easier correlation between the DRA data runs and the parameter sets described in Appendix 4. In addition to the trials log is an explanation of control software changes that have taken place; firstly, prior to the trials and during the commissioning phase of the vehicle in September/October 1993 (Appendix 1); secondly, as a direct result of running the vehicle at the trials (Appendix 2); and finally, as a result of writing the strategy book - requiring detailed inspection of the software (Appendix 3).

2.2 Trial Objectives

The aims of the trials at Hurn were to ensure that the Active suspension and track tensioning systems were operating as designed. DRA were to collect data to determine the relative performance between passive and Active track tensioners. Analysis by DRA of the data following the trials would then provide the results.

2.3 Trial Procedure

Data collection runs were made in both directions of the random course at each speed increment, starting at 5 kph and increasing in 3 kph steps until it was jointly decided that the inputs to the vehicle were moderately severe. This was carried out with the vehicle in different system configurations. Higher speed runs were conducted at a later stage once all low speed data had been collected. This was to ensure maximum survivability of the tank.

The intended programme of data runs was to start with baseline Active suspension parameters with fixed track tension. This was followed by Active suspension with variable modal damping implemented (still with fixed track tension). Finally, data was collected with Active track tensioning introduced.

Active suspension system parameters were to be initially as setting "E" which DRA stated had given the best ride performance in previous trials. The key parameters that formed this setting were inserted in the initial parameter set, the remainder being either "historically" fixed or modified from previous numbers to cater for recent changes in the control software. This formed the baseline condition for testing.

Data was acquired through the Active controller and PC on occasions for diagnostic purposes.



2.4 Trial Worklog

Monday 1st November

The tank arrived at Hurn. The Active tensioners were depressurised, two links removed from each track and the Active tensioners were re-charged to 100 bar.

Tuesday 2nd November

In the morning the operation of system was briefly checked. The initial parameter set was downloaded and saved to the file 2-1.PAR. The parameters included -3000 in Preq (pitch requirement - nose upwards) and fixed gain bypass valve linearisation (GnB) function. The tensioners at this ride height were locked off after the left and right hand tensioner loads (FTenL and FTenR) were set by adjusting left and right hand required tensioner displacement (XreqTL and XreqTR) to approximately -250 counts each. This equates to approximately 8.6 kN with the load cell scalings of 0.029 counts/N. The vehicle ride height was checked by DRA with zero Preq which gave front = 883 mm, rear = 890 mm, measuring from the underside of the track shield to ground.

On the random course the 5 kph runs were made followed by one run of 8 kph. It was observed that there was little bump travel at the rear actuators which was thought to be detrimental to the ride.

Wednesday 3rd November

The tensioners were set up again to have approximately -250 counts of load at a different ride height set-up of Preq = -2000 and Hreq (heave requirement) = -1000. This would have actuator stroke benefits at the rear but still keep the nose of the vehicle raised to avoid sprocket impacts. Parameters were saved as 3-1.PAR.

Much vibration was noticed from the interior of the vehicle when the engine was idling and the system pressured, and whilst this was being investigated it was noticed that the RHR suspension power valve had a bulging torque motor cap. This is one sign of an internal failure of the valve. The valve was removed and replaced by a spare. On returning the faulty valve to Moog, they informed us that the valve was in perfect working order but had previously failed and been reassembled with the same distorted torque motor cover.

Rain delayed proceedings but a repeat of the previous day's 5 kph runs in both directions of the random course was made.



Thursday 4th November

It was decided again to modify the ride height parameters with the rear again lifted a little to increase bump travel (Hreq = -2000, Preq = -1000). Track tension, through the use of XreqTL and XreqTR, was set as before. These parameters were saved as 4-1.PAR.

One complete set of (low speed) data was taken, i.e. 5, 8, 11 and 14 kph with fixed tensioners and constant modal damping. After these data runs, a check was made on the tightness of the power and bypass valve securing bolts. These had worked their way loose due to thermal effects and were re-tightened.

The Active RPM signal failed during this data set and towards the end, the dump solenoid opened several times whilst the tank was stationary. This may have been due to temporary drops in supply voltage to the solenoid. The fault occurred once or twice more during the trial period but not whilst the vehicle was moving and hence was not a factor during the data runs and ride evaluation.

Bdrycf (the boundary value for the software bumpstop for front actuators in compression - the parameter reflects the displacement at which the bumpstop starts taking effect in units of 8 times actuator displacement) was moved from 0 to 5000 to allow the variable damping space to work. A complete low speed (5 to 14 kph) set of data runs was carried out with variable modal damping enabled. This set was with power valve only operation on the LHR after the bypass valve's response became "sticky" (i.e. probably contaminated).

By the last 14 kph run it was apparent that the vehicle was operating asymmetrically left to right and the ride quality was visibly bad. Upon investigation the tensions in the tracks had drifted, the left hand tension greater than the right hand. The reason for this was probably due to a marginally incorrect bias on one of the tensioners. [As fluid and valve temperatures change, so do the flow characteristics of the valve and the null position may shift by a few counts. The tensioners during the trials were run with fixed bias values].

Friday 5th November

The RHF power valve was replaced as a precautionary measure because the mounting lugs which are part of the torque motor cap had become severely distorted due to repeated high bolt torque.

The LHR bypass valve was removed and replaced by a spare, whose bias value (B3biasm) was determined at +50 counts by a manual bias evaluation.

The RPM signal was fixed and was found to be due to a bad Lemo connection at the junction box.



The LHR actuator also had a squeak from the rear mounting bush, which was improved by lubrication.

The tensioners were set and locked for another run with variable damping operating. XreqTL and XreqTR were adjusted until FienL and FTenR were both approximately -250 counts and parameters were saved as 5-2.PAR. A complete low speed data set was taken up to 14 kph with the system appearing to operate symmetrically and consistently. This was a repeat of the previous day's data with fixed tensioners and variable modal damping.

Monday 8th November

The engine had been removed on the Saturday to correct a leak in one of the gearbox to oil cooler hoses and to repair a broken alternator mounting. By the end of Monday the vehicle was running again.

Tuesday 9th November

The tensioner fluid charges were checked, the right hand tensioner being down to 80 bar. It was thought that this may be due to gas pressure leakage, so the fluid was allowed to depressurise, and the gas spring pressure was checked at 30 bar (i.e. no change). The tensioner fluid was then charged to 100 bar.

At the random waves 2 complete runs of low speed (5, 8, 11 and 14 kph) data were collected. Initially, this was with Active track tensioning and fixed modal damping (9-2.PAR) followed by Active tensioning with variable modal damping (9-3.PAR).

A valve was heard to be "singing" intermittently towards the end of these data runs. This occurs when the flexure tube within the valve oscillates. It was thought to be the left hand tensioner valve (located on the right hand side of the vehicle) and it was replaced.

Because of the ease with which the vehicle had managed the random course at 14 kph, it was decided to conduct 17 kph tests with each of the four conditions, i.e. track tensioning fixed and Active with modal damping fixed and variable.

It was noticed during these runs that the pitch control performance of the vehicle was improved with Active tensioning implemented and the front sprocket did not impact the test surface at points on the course where it had done with locked track tensioners.

It was felt that additional parameter tuning would be beneficial before testing the vehicle at higher speeds.



Wednesday 10th November

Wednesday morning was devoted to tuning the Active system without DRA data collection, with the aim of defining a parameter set that would enable the tank to traverse the random wave course at 20 kph (or faster). Because it had been observed that at 17 kph with a "non-optimised" set-up the front sprocket could ground, initial parameter tuning and evaluation took place at 14 kph.

- Run 1: Parameters as optimised the previous day with variable modal damping, Active track tensioning with the tensioner forces set at approximately -250 counts.
- Run 2: Track tension reduced such that tensioner forces were -190 counts statically. This did little to improve the vehicle visually, but the driver believed it to give a softer ride.
- Run 3: As above but Hreq lowered to -1500 with Bdrycf reduced from 5000 to 0. The change in ride height caused the front sprocket to be closer to grounding but the bumpstop boundary change was believed to be beneficial.
- Run 4: Hreq returned to -2000 and the left and right hand tensioner gains (GTenL and GTenR) raised to 15,000. This proved to be a good run but appeared a little asymmetric towards the end. The fluid pressures in the tensioners were checked (LHS 112 bar, RHS 95 bar). The left hand tensioner pressure was relieved to about 103 bar and the right hand tensioner was pumped up to this amount.
- Run 5: For the purpose of further protecting the front sprocket, OPFcf (output factor, compression, front) was lowered from 24,000 to 22,000 and the run was made at 20 kph. On the return journey (which every time appeared more severe than the forwards journey) the front sprocket crashed in a couple of places.
- Run 6: Variable modal damping parameters modified. Pfmn (filtered pitch force, lower threshold) was lowered from 6000 to 5000, IPCcMn (minimum inverse pitch damping) was lowered from 2000 to 1000 and Pfmx (filtered pitch force, upper threshold) was lowered from 10,000 to 9000 (parameters saved as 10-6.PAR). The effect of these changes was to enable adaptive damping in pitch at lower pitch forces and increase the maximum pitch damping. The sprocket did not crash on either leg of the course at 20 kph and these were defined as the "optimised" set.

With this parameter set DRA collected a full data set over 5, 8, 11, 14, 17 and 20 kph, the only modifications made being with XreqTL and XreqTR between runs to ensure that static tensioner forces did not drift. There was confidence that these parameters could be used at 23 kph, but running the vehicle at that speed would be jointly decided on Thursday (once the vehicle had been demonstrated to Bruce Maclaurin of the DRA at lower speeds). With this data set DRA then had enough random course data to be sufficient for ride performance analysis between the different vehicle conditions. Further data was now only required from the sine wave courses.



At one or two points along the course, particularly at the higher speeds, the front wheels seemed to be held up immediately after the front of the vehicle had traversed a crest (i.e. when it was expected that the actuators would be extending). The reason for this behaviour was not known.

A valve was heard to be "singing" again which was thought to be a tensioner valve but due to its intermittent nature and the time required to get inside the tank once it had stopped at the end of a test, it was impossible to identify which valve was the culprit.

Thursday 11th November

It was decided to do some vehicle checks before demonstrating the vehicle.

The tensioner loads were set to approximately -200 counts with the vehicle at its running height (including Hreq = -2000 and Preq = -1000) and the ride height was checked.

Ride height (Hreq and Preq = 0, LHF,RHF,LHR,RHR): 507,510,510,517

Ride height (Hreq = -2000, Preq = -1000; LHF,RHF,LHR,RHR): 565,567,527,535

These ride heights were measured from the underside of the track shield to the wheel centres - this being the standard method at Lotus of evaluating suspension location.

The pump attenuator was checked for charge. It was possible that some of the pipe vibration that may have contributed to "singing" valves, was due to incorrect charge in the pump attenuator and hence undamped pressure pulses from the pump. Fluid emerged from the charging valve and hence the bladder had a leak. As the attenuator is located before the system filter in the pressure line, any system contamination due to the split attenuator bladder had been contained. It was therefore decided to continue with testing to the point at which DRA had enough data from the trials.

At each speed the tank was driven over the 4.5m and 7m sine waves. The speed of these runs was successively increased by 3 kph and DRA took data from all runs. Runs successfully completed were 5, 8, 11, 14, 17, 20, 23, 26, 29, 32 and 35 kph by which time the tank was tending to jump from one crest to the next and using full suspension travel. Pitch control of the vehicle was good throughout and it was possible to "drive through" the pitch resonance [ref. 1 (page 26)] which occurred between 20 and 23 kph.

DRA stated that they had as much data as they required and it was decided that the health of the system should then take priority over further demonstrations. The system accumulator charges were checked (all but the LHF due to it being inaccessible) and were still at 70 bar. (A new attenuator bladder has since been fitted to the vehicle).

- End of Trials -



2.5 Discussion

The DRA results [ref. 1 (pages 14 and 16)] show that the best ride across the random course was given by Active suspension without variable modal damping and with Active track tensioning enabled.

The use of Active tensioners gives benefits both in improving the ride performance and reducing the chance of sprocket grounding [ref. 1 (pages 15 and 17)]. The latter effect implies improved pitch control of the vehicle compared with fixed tensioners although this is only just apparent at high vehicle speeds from DRA's rms pitch angle measurements [ref. 1 (page 24)].

From analysis of Lotus data taken during the trials, it has been discovered that the tensioners, when assumed to be locked still, in fact moved and the displacements seen are significant. Figure 1 shows left hand tensioner displacement on the random course at 17 kph with "fixed" tensioners. Figure 2 shows the same channel and conditions with Active track tensioning. [The scaling of the graph's y-axis is approximately 20 counts/mm].

The current means of fixing the tensioners is by way of a manual valve that isolates the third volume of the tensioner from the gas spring. The other two volumes are connected, as before, to the servovalve output ports. The design assumption was that by closing the manual valve the third volume would totally lock the actuator. For this reason, the valve drive signal was not inhibited during the fixed tensioner runs. Pressure transducer data (this sensor is gas spring side of the locking valve) shows that the gas spring is isolated from the actuator. It can be seen in Figures 3 and 4 that there is a relationship between valve drive signal and tensioner displacement; the implication being that there remained compliance in the third volume such as trapped gas. Future trials where fixed tension is required should be conducted with the tensioner servovalves set to null (by setting GTenL and GTenR to zero) which would then lock all three volumes.

It has been demonstrated that Active track tensioning as currently implemented does improve ride over fixed (although as seen, not totally fixed) tensioners. The question to be answered is, "How does Active track tensioning in its current form give ride improvement?"

It was anticipated that the Active track tensioners would give a more constant track force than the passive equivalent. DRA data, manipulated to show standard deviation of track tensioner load [ref. 1 (page 22)], shows this not to be the case. Lotus data taken at the time also suggests that tensioner load is not being smoothened by the current use of Active control.

It was thought that Active tensioning would allow greater articulation of the suspension actuators but from the trials data this appears not to be the case.

The control strategy for track tensioning currently attempts to ensure a constant track perimeter based on the signals from suspension displacement transducers. If an actuator attempts to extend, it has to work against the rack tension. The tensioner will only contract and relieve the tension once the displacement has been achieved. In contraction, there would



appear to be no problem in actuator motion. However, the tensioner will "follow" the motions of the end wheel stations and extend to cater for the expected reduced tension. This will work against the next "extend" request to the suspension actuator. Due to this, the average amount of time that the suspension actuators work against the track will be increased and the consequent variation actuator travel reduced. This may be the reason for the reduction in wheel station 1 actuator stroke between the baseline condition and Active tensioners [ref. 1 (page 21)]. It is seen that when variable modal damping is introduced, wheel travel again is increased. This is thought due to the "slackening" of the bumpstop boundary parameter (Bdrycf) made at the same time (to give variable damping "space to work").

The reason for improved ride, as DRA suggest [ref. 1 (page 7)], may be due to the pitch centre moving forward (in response to lower actuator displacements at the front). Further investigation into the reasons for improved ride should be pursued.

An alternative approach to the current tensioner strategy could be to derive the perimeter estimation from desired suspension actuator position (modelled displacement plus dynamic required displacement) rather than actual displacement. This could aid suspension movement (in droop) and reduce suspension actuator displacement error. This may enable displacement error feedback gain (Gdf and Gdr) to be reduced for the purpose of improving ride comfort.

Force control strategies are an option for the track tensioners. There is little doubt that this would reduce tensioner load fluctuations but effective sprocket torque resisting software would need to be devised and written such that it would inhibit the track "jumping" on the sprocket during neutral or low speed turns. A speed dependant force gain may be the solution to this.

Ride performance with variable modal damping enabled [ref. 1 (pages 14 and 16)] is seen to be worse than with it disabled. The variable damping routine as currently written increases damping (in heave and/or pitch modes) based upon the level of (filtered) force being measured. At all vehicle speeds the "variable damping only" parameter set, is seen to give worse ride performance than all other Active conditions. Even at low vehicle speeds it would appear that modal damping was being increased by the routine with consequently worse ride. Increased damping at all speeds will cause higher vehicle body accelerations except in the case where sprocket grounding is avoided.

Further tuning of the variable damping parameters may give a better ride performance by making the nominal level of pitch and heave damping lower. However, the process of tuning is difficult as quantified changes in ride performance are not available until long after the runs. A useful improvement to the trials method to aid tuning would be an immediate (within two minutes, maximum) ride discomfort value output. A more "intelligent" adaptive algorithm is possibly required. This could increase damping level sharply due to perhaps a high front hub acceleration and decay down to a softer damping level at a slower rate.



The "optimised" parameter set, 10-6.PAR, (which was set up for traversing the random course as fast as possible - and not for general ride improvement) included both variable damping and Active track tensioning but gave worse ride performance than when variable damping was not used. Only at the fastest vehicle speeds do the optimised parameters appear to give benefit.

Software Errors

In compiling the strategy book for the software documentation, detailed analysis of the algorithms was required. An error in the implementation of parallel spring terms (explained in Appendix 3) was found and is believed to have had an effect on vehicle performance.

An incorrect spring compensation will have led to an incorrect actuator response to road inputs. This would have been a problem during pitch motions and single wheel inputs, where there was a difference between the estimated positions of the second and fourth wheel stations (XC2 and XC4 respectively) of each side. If, for instance, the scenario is taken of the rear of the vehicle riding over a bump giving the calculated position of XC4 as into compression (positive counts). F1sp (left hand front parallel spring correction term), with the trial's software, would have been calculated as being too large a positive number to correctly compensate for the actual front load cell signal change. In the modal force calculations (ignoring local force input) this would have resulted in an overall negative velocity demand for that corner (DX1mod), extending the actuator. Conversely, if the rear of the vehicle was in a dip (again ignoring local force input), the front actuator would compress. It is this latter case that may have been causing the front actuators to be held up as described in the worklog. These reactions to inputs suggest that on average a higher level of heave acceleration will be imparted to the vehicle body, worsening the ride. (With the corrected code, the torsion bar parallel spring terms should be re-evaluated and checked by moving the vehicle in heave and pitch and observing that the changes in spring force correction (F1sp...F4sp) match the change in the load cell readings (F1...F4)).

The performance of the vehicle over the sinewaves was good and it did not suffer the severe pitching motions experienced in earlier trials.

Due to the hydraulic reworking of the tank in the spring and summer of 1993, the reliability of the vehicle has been much improved. During the trials, there was only one valve replacement that could be attributed to the contamination of the system. The "singing" valves, it is believed were caused by the pressure pulses in the supply line as a result of the damaged attenuator bladder.



2.6 Conclusions

- 1. Active track tensioning when implemented on the Active Suspension Scorpion P3 has shown an improvement in ride performance over the passive suspension vehicle and also over the Active suspension vehicle with fixed tensioners.
- 2. Hydraulic system reliability, due to improved design and system cleanliness has been greatly improved.
- 3. The correction of control software errors found since the trials, it is felt, would further improve the Active suspension ride performance.



2.7 Recommendations

- 1. Trials data shows that some of the vehicle parameters influenced by Active track tensioning (standard deviation of tensioner loads, suspension articulation) have not changed in the manner originally expected and yet ride quality has been improved. Investigation is recommended to fully understand the reasons for these effects.
- 2. It is believed that due to recent control algorithm modifications, improvements in ride performance can be made from the Active suspension. The ride of the vehicle could also benefit from modifying the track perimeter estimation to take account of desired, rather than actual, suspension displacement. These and other control algorithms (alternative methods of variable modal damping, force control of tensioners) should be investigated in the light of much improved hydraulic system reliability.



2.8 References

1. D.F. Turner and E.B. Maclaurin; Results of Ride Performance Trials of the Active Suspension Scorpion fitted with Actively Controlled Tensioners. Report number DRA/FVS/FV&S4/WP9424/1.0.



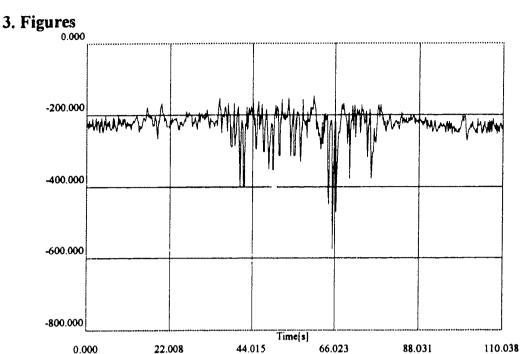


Figure 1: Left Hand Tensioner Displacement - Random Course at 17 kph (Fixed Tensioners)

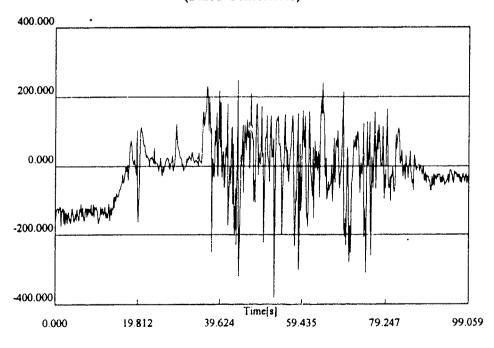


Figure 2: Left Hand Tensioner Displacement - Random Course at 17 kph (Active Tensioners)



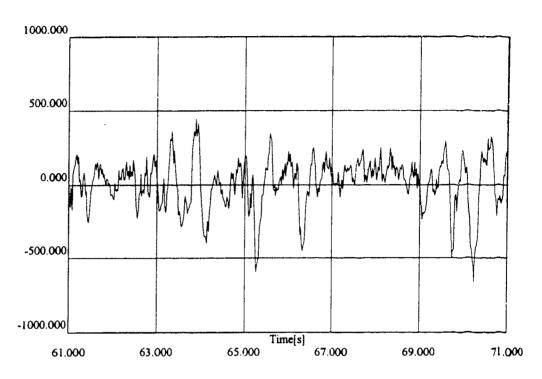


Figure 3: Left Hand Tensioner Valve Drive - Random Course at 17 kph (Fixed Tensioners)

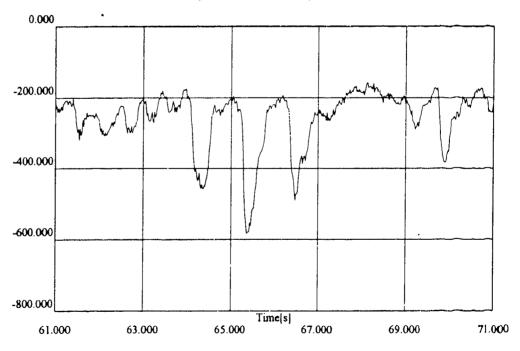


Figure 4: Left Hand Tensioner Displacement - Random Course at 17 kph (Fixed Tensioners)



Appendix 1 - Software Changes Prior to the Tank Trials

C25 Commands

The software has been made more efficient in several areas through the use of TMS320C25 commands. These require an updated assembler which was supplied (for use on PC) to DRA.

Energy Saving Subroutine

The efficiency of the valve linearising functions was improved and sources of potential software overflow removed.

Generalised Modal Displacements

The calculations of Hxs, Pxs, Rxs and Wxs were rewritten in a more efficient manner.

Variable Pitch and Heave Damping

This routine was rewritten for greater clarity. The code strategy remained the same.

Scaling of XTenL, XTenR, X5 and X6

The associated algorithms are now written in a manner that leaves the ADC values intact (for easier system diagnostics).

Auto Bias Tracking of Tensioners

Tensioner displacement error is integrated at a rate determined by the parameter Tbias, to produce the valve bias for each tensioner. This code is disabled by setting Tbias to zero.

Sign of GTen

The overall tensioner gain, GTen, in earlier software required a negative value. This has been made positive to be in line with active suspension software. GTen was also made specific to each tensioner, i.e. GTenL and GTenR.



TenOff replaced by XreqTL and XreqTR

It was found useful to be able to manually control the tensioner displacements individually rather than with one parameter for both tensioners.

PTenL Moved in ADC Frame

An intermittent spike seen in the left hand tensioner pressure signal was thought to be due to a hardware fault causing a voltage spike occasionally in ADC channel 1 only. PTenL was redirected to a spare ADC address.

Tensioner Biases as Parameters

In order to store and recall tensioner bias values (especially important if automatic tracking of tensioner biases is not being used).

CodeP1 Bit 11 Enabling Fixed GnB Gain of 8192

The Moog bypass valves fitted to the tank suspension have a more linear flow/pressure characteristic than the original TRW valves and a fixed gain was thought to be more appropriate than factoring by the GnB curve.

CodeP1 Bit 12 Enabling Tensioner Differential Pressure Software

It was known that there were problems in operating the tensioner lockout routine. This CodeP1 designation allowed the routine to be bypassed.



Appendix 2 - Software Changes as a Result of the Tank Trials

Differential Pressure Calculations

The tensioner stall code now takes valve bias into account and so gives a more accurate indication of required actuator velocity. This code was not implemented during the trials.

CodeP1 and TestP1

CodeP1 and TestP1 allocations have been made standard with other active vehicles.

Default Parameters

Default parameters were updated to 10-6.PAR with a change to the value of CodeP1 to reflect point 2 above.

Label File Information

Transducer scalings and units were added to the ADC frame. These produce scaling and unit information within the label file upon code assembly. Transducers can then be monitored in engineering units via DVI (Driver Vehicle Interface program) on the PC.

Routine Re-Ordering

Some of the software routines have been re-ordered to be more logical.

Bypass Valve Drive Limit

An unnecessary limit check on bypass valve drive was removed.



Appendix 3 - Software Changes as a Result of Writing the Strategy Book

Output Velocity Ratios

An error was found in the designation of output velocity ratios in the calculation of actual modal displacements (Hx, Px, Rx and Wx). The pitch velocity ratios were used in place of the heave values (and visa versa) and the roll and warp ratios were mismatched. This had no effect during the trials as the output velocity ratios all have the value 16384.

Torsion Bar Parallel Spring Terms

The proportion of force, attributable to the central wheel stations, accounted for at the end wheel station load cells has been found to be incorrect. The error is shown below for the left hand front. The pattern of error, however, is the same for all four corners.

Original Software:

$$F1sp = [Kbar1*X1*2 + KbarCl(XC2 + XC3*2 + XC4*3)]/65536$$

Corrected Software:

$$F1sp = [Kbar1*X1*2 + KbarCl(XC2*3 + XC3*2 + XC4)]/65536$$

Right Hand Track Tensioner Demanded Position

An error existed in the right hand track perimeter calculation. The algorithm in one place, when required to use the right hand rear displacement (X4), actually used X3. This is not thought to have had a major effect over the courses at Barnsfield Heath, Hurn. Over the random course and the sine waves the inputs to the vehicle are generally symmetrical left to right leading to similar actuator displacements X3 and X4.

Bypass Bias Evaluation Routine

The bypass bias routine has had some small errors removed which came about when the sign of bypass valve drive was switched (to be consistent with other active suspension vehicles) to be positive counts for a more closed position. This occurred during the hydraulic reworking that took place in the summer of 1993. This has had no effect on the running of the vehicle as bypass bias values have been determined manually in all cases since the modification.



Appendix 4 - Parameter Sets

		ThiasRm	0
File: 2-1		KTen	5000
Comment: Date: 2 A		XreqTL	-325
Date: c.	104 43 13.57.43	XregTR	-370
VALF	0	GTenL	10000
Kbar1	6000	GTenR	10000
Kbar2	6000	IVrfH	16384
Kbar2 Kbar3	6000	IVrrK	16384
Kbar4	6000	IVrfP	18579
KbarCl	6500	IVrrP	14189
KbarCr	6500	IVrfR	16384
XCpre4l	-1000	IVrrR	16384
XCpre4r	- 1000	IVrfW	18579
XScale	13500	IVrrW	14189
XScaleT	20832	MHKc	- 12000
TenPar1	10650	IHCc	20000
TenParZ	5717	MPKc	-6000
TenPar3	8700	I PCc	5000
SfF	12000	MRKc	-5000
SfC	6000	IRCc	20000
Sfoff	-67	MMKc	-1000
StTor	-225	IWCc	30000
KTor1	0	MHT	0
KTor2	0	MMn	0
KTor3	0	Kwl1	0
KTor4	0	Kbias	2
Blim	200	KbiasS	10
FScale	18459	IVrfHO	16384
PScale	12124	IVrrHO	16384
CodeP1	2176	IVrfPO	16384 16384
Umex	32000	IVrrPO IVrfRÖ	16384
KWV	0	IVrrRO	16384
WCny	-2000	IVrfWO	16384
KuVth	0 0	OWNTVI	16384
KuVf	0	Hreq	0
KuVr	15000	• Preq	-3000
Kufmx Kurmok	15000	Rbiasm	0
KuNy	2048	IPKt	ŏ
KuNyf	0	IRKt	ŏ
KuNyr	Ŏ	IWKt	Ó
Vlim	200	HCnx+	Ó
The	40	HCnx-	U
Bclose	0	HCny	0
BcloseS	2000	PCnx+	-30000
ESFLAG	15	PCnx-	-22000
IActAf	24395	PCny	- 1500
IACTAL	24395	RCnx+	Ō
AB1	200	RCnx-	0
AB2	- 105	RCny	-17000
AB3	21839	RCyRat	16384
DifBpMx	260	WCnx+	0
Dpvmin	1000	WCnx-	0
Opvmex	1000	8bend	20
GnBmin	4000	HfMx	5000 10000
Ck0	11583	HfMn IHCcMn	3000
Ck1	11583 -11584	PfMx	5000
Ck2		PfMn	10000
Cr3	11576 9000	IPCcMn	3000
Gf81 Gf82	9000	KModal	32000
G182 G183	9000	kV1	1994
G f 84	9000	KV2	750
81biasm	25	KV3	225
82biasm	50	Kdynf	8000
B3biasm	25	Kdynr	8000
84biasm	-25	Kuff	r
Bback	-50	Kurf	0
Badd	-10	MMfc	0
Thias	0	MMrc	0
ThiasLm	175	Hoftc	2

(OTUS)

File: 3		GTenL.	10000
	3/11/93	GTenR	10000
Date: 3	Nov 93 12:26:08	IVrfH IVrrH	16384 16384
VAI #	0	IVrfP	18579
VALF Kbar1	6000	IVrrP	14189
Kber2	6000	IVrfR	16384
Kbar3	6000	[VrrR	16384
Kbar4	6000	IVr:fW	18579
KbarCl	6500	IVrrW	14189
KbarCr	6500	HHKC	-12000
XCpre41	-1000	IHCc MPKc	20000 -6000
XCpre4r XScale	- 1000 13500	IPCc	5000
XScale	20832	MRKC	-5000
TenPar1	10650	IRCc	20000
TenPar2	5717	HWKc	-1000
TenPar3	8700	IWCc	30000
SfF	12000	MMf	0
SfC Sfoff	6000 -67	MMr Kwl1	0
StTor	-225	Kbias	2
KTor1	0	KbiesS	10
KTor2	0	IVrfHG	16384
K!or3	0	IVrrH0	16384
KTor4	0	IVrfPO	16384
Blim	200	IVrrPO	16384
FScale	18459	IVrfRO IVrrRO	16384 16384
PScale CodeP1	12124 2176	0 W 11V1	16384
Umax	32000	IVrrWO	16384
KWV	0	Hreq	-1000
Winy	-2000	Preq	-2000
KuVth	0	Rbiasm	0
KuVf	0	IPKt	0
KuVr	0	IRKt	0
Kufmx Kurmx	15000 15000	IWKt HCnx+	0
Kully	2048	HCnx-	ŏ
KuNyf	0 .	HCny	ŏ
KuNyr	0	PCnx+	-30000
Vlim	200	PCnx-	-22000
ThF	40	PCny	-1500
Bclose	0	RCnx+ RCnx-	0
BCLOSES ESFLAG	2000 15	RChy	-17000
IACTAT	24395	RCyRat	16384
IActAr	24395	WCnx+	0
AB1	200	WCnx-	0
AB2	- 105	Bband	20
AB3	21839	HfMx	5000
DifBpMx	260	HIMO	10000 2 00
Dpvmin Dpvmax	1000 1000	IHCcMn PfMx	5000
GnBmin	4000	PfMn	10000
Ck0	11583	IPCoMn	3000
Ck1	11583	KModal	32000
Ck2	-11584	KV1	1994
Ck3	11576	KV2	750
GFB1	9000	KV3	225
GfB2	9000 9000	Kdynf Kdynr	8000 8000
Gf83 Gf84	9000	Kuff	0
Bibiasm	25	Kurf	ŏ
B2biasm	50	MMfc	0
B3bi asm	25	MMrc	0
84biasm	- 25	Hpftc	2
Bback	-50	MKv	-6000
Badd	-10	ing C41	155
Thias	0 1 75	Gf1 Gf2	25000 25000
TbiasLm TbiasRm	0	613 R13	25000
KTen	5000	Gf4	25000
XreqTL	-475	Gdf	15000
XreqTR	-520	Gdr	15000

Flead Rlead OPFef

9920

16384 17 16384

7840

Flead Rlead OPFef OPFer

OPFcf OPFcr Pkf Xmaxf Exfactf Xlimcf Xlimef Pkr

Xmaxr Exfectr Xlimer Xlimer

Bdrycf Bdryef Bdrycr Bdryer

File: 4-1.	PAR	GTenL	10000
	ew H/Preq & Xreqti/r	GTenR	10000
	93 12:15:07	IVrfH	16384
-= 4 80		IVrrH	16384
VALF	0	I Vr fP	18579
Kbar 1	6000	IVrrP	14189
Kbar2	6000	IVrfR	16384
Kbar3	6000	1 VrrR	16384
	6000	I VetV	18579
Kbar4	6500	IVrrW	14189
KbarCl KbarCr	6500	MHKc	-12000
	-1000	IHCc	20000
XCpre41	-1000	MPKc	-6000
XCpre4r	13500	IPCc	5000
XScale			-5000
XScaleT	20832	MRKC IRCC	20000
TenPar1	10350	MWKc	- 1000
Same	571." e700		30000
TanPar3	8700	IWCc	
SfF	12000	NKf	0
SfC	6000	MMr	0
Stoff	-67	Kwl1	0
Stior	-225	Kbias	2
KTor1	0	KbiesS	10
KTor2	0	IVrfko	16384
KTor3	0	IALLHO	16384
KTor4	0	IVrfPO	16384
Blim	200	IVrrPO	16384
FScale	18459	IVrfRO	16384
PScale	12124	IVERO	16384
CodeP1	2176	IVrfWO	16384
Umax	32000	1VrrW0	16384
KwV	0	Hreq	- 5000
Wony	-2000	Preq	-1000
KuVth	0	Rbiasm	0
KWf	0	IPKt	0
KuVr	0	IRKt	0
Kufmx	15000	IWKt	0
Kuniox	15000	HCnx+	0
Kully	2048	HCrux-	0
Kullyf	0 ,	KCny	0
Kuhlyri	Ö	PCnx+	-30000
VLim	200	PCnx-	-22000
The	40	PCny	-1500
Belose	0	RCnx+	0
BcloseS	2000	RCnx-	ō
ESFLAG	15	RCny	-17000
	24395	RCyRat	16384
IACTAL	24395	WCnx+	0
ABT	200	WCnx-	ŏ
AB2	-105	Bband	20
	21839	HfMx	5000
		11.614	10000
DifBpMx	260 1000	H7MN i HCcMn	3000
Dpwnin	1000	PfMx	5000
D pvmax		PfMn	10000
GnBanin GuA	4000		3000
Ck0	11583	I PCcMn	
	11583	KModal	32000
	11584	KV1	1994
ck3	11576	KV2	750
GfB1	9000	KV3	225
GfB2	9000	Kdynf	8000
GF B3	9000	Kdynr	8000
G f84	9000	Kuff	0
B1biasm	25	Kurf	0
82biasm	50	MMfc	0
B3biasm	25	HMrc	0
84biasm	- 25	Hpftc	2
Bback	-50	MKV	-6000
8add	-10	Ing	155
Thias	Q.	Gf1	25000
TbiasLm	175	Gf2	25000
Thiasem	0	Gf3	25000
KTen	5000	Gf4	25000
	-51 5	Gdf	15000
XreqTL		Gdr	15000
XreqTR	-570	GUI	15000

File: 4-2	PAR Bdrycf,var. damping &	XreqTR GTenL	-570 10000
		GTenR	1, 100
PV on LHR		IVrfH	16.384
Date: 4 A	104 42 14:10:42	IVrrH	16 384
	4000		18 579
VALF	1000	IVrfP	
Kbar1	6000	IVrrP	14 189
Kbar2	6000	ivrfR	16384
Kbar3	6000	IVrrR	16384 18579
Kbar4	6000	IVrfW	14189
KberCl	6500	IVrrW MHKc	-12000
KbarCr	6500	IHCc	20000
XCpre4l	-1000 -1000	MPKc	-6000
XCpre4r		IPCc	5000
XScale	13500	MRKc	-5000
XScaleT	20832		
TenPar1	10650	IRCc	20000
TenPar2	5717	MWKc	-1000
TenPar3	8700	IMCc	30000
SfF	12000	MMf	0
SfC	6000	MMr	0
Sfoff	-67	Kwl1	0
StTor	- 225	Kbias	2
KTor1	0	KbiasS	10
KTor2	0	IVrfHO	16384
KTor3	0	IVrrHO	16384
KTor4	0	IVrfP0	16384
Blim	200	IVrrPO	16384
FScale	18459	IVrfRO	16384
PScale	12124	IVrrRO	16384
CodeP1	2688	IVrfW0	16384
Limax	32000	IVrr W O	16384
KwV	0	Hreq	-2000
WCny	-2000	Preq	- 1000
KuVth	0	Rbiasm	0
KuVf	0	IPKt	0
KuVr	0	IRKt	0
Kufmx	15000	IWKt	0
Kur m ox	15000	HCnx+	0
KuNy	2048 -	HCnx-	0
Kunyf	0	HCny	0
Kullyr	Ö	PCnx+	-30000
Vlim	200	PCnx-	-22000
ThF	40	PCny	-1500
Bclose	0	RCnx+	0
BcloseS	2000	RCnx-	0
ESFLAG	11	RCny	-17000
IACTAF	24395	RCyRat	16384
IACTAL	24395	WCnx+	0
AB1	200	WCnx-	0
AB2	-105	Bband	20
AB3	21839	HfMx	5000
DifBpMx	260	HfMn	10000
Downin	1000	IHCcMn	10000
Dovinax	1000	PfMx	6000
Gn8min	4000	PfMn	10000
Ck0	11583	IPCcMn	2000
Ck1	11583	KModel	32000
Ck2	-11584	KV1	1994
Ck3	11576	KV2	750
GfB1	9000	KV3	225
GfB2	9000	Kdynf	8000
GfB3	9000	Kdynr	8000
	9000	Kuff	0
GfB4	25	Kurf	ŏ
Bibiasm		MMfc	0
B2biasm	50 25		Ö
83biasm	25	Mirc	
84biasm	-25	Hpftc	2
Bback	-50	MKV	-6000
Badd	-10	Ing	155
Thias	0	Gf1	25000
ThiasLm	175	Gf2	25000
	•	C47	25000
ThiasRm	0	Gf3	
	5000 -515	Gf4 Gdf	25000 15000

Gdr Flead

Rlead OPFer OPFer OPFer OPFer Pkf

Xmaxf Exfactf Xlimcf Xlimef

Exfactr Xlimor

Xlimer Bdrycf Bdryef Bdrycr Bdryer

Pkr Xmaxr

#21. F	4 545	W	/10
File: 5	-1.PAR : ES on LHR, var.	XreqTR GT en L	-610 10000
	corrected	GTenR	10000
Date: 5		IVrfH	16384
Dute. 3	100 /5 /11010/	IVrrk	16384
VALF	1000	IVrfP	18579
Kbar1	6000	IVrrP	14189
Kber2	6000	IVrfR	16384
Kbar3	6000	IVrrR	16384
Kbar4 KbarCi	6000 6500	IVrfW IVrrW	18579 14189
Kbarcr	6500	MHKc	-12000
XCpr=4l	-1000	IHCc	20000
XCpre4r	-1000	MPKc	-6000
XScale	13500	IPCc	5000
XScaleT	20832	MRKc	-5000
TenPar1	10650	IRCc	20000
TemPar2	5717 8700	MWKc IWCc	-1000
TenPar3 SfF	12000	MMf	30000 0
SfC	6000	Mr	ő
Sfoff	-67	Kwl1	ŏ
StTor	-225	Kbias	2
KTor1	0	KbiesS	10
KTOF2	0	IVrfHO	16384
KTor3	0	OHTTVI	16384
KTor4 Blim	0 200	IVrfPO IVrrPO	16384 16384
FScale	18459	IVrfRO	16384
PScale	12124	IVrrRO	16384
CodeP1	2688	IvrfWO	16384
Wmex	32000	[VrrWO	16384
KWV	0	Hred	-2000
WCny	-2000 0	Preq	-1000
KuVth KuVf	0	Rbi as m IPKt	0
KuVr	ŏ	IRKt	ŏ
Kufmx	15000	IWKt	ŏ
Kurmx	15000	HCnx+	0
Kuny	2048 .	HCnx-	0
KuNyf KuNyr	0 0	HCmy PCnx+	0 -30000
Vlim	200	PCnx-	-22000
ThF	40	PCny	- 1500
Bclose	0	RCnx+	0
BcloseS	2000	RCnx-	0
ESFLAG	15	RCny	-17000
lactaf lactar	24395 24395	RCyRat Wcnx+	16384 0
AB1	200	WCnx-	0
AB2	-105	Bband	20
AB3	21839	HfMx	10000
DifBpMx	260	HfMn	5000
Dpvmin	1000	IHCcMn	10000
Dpvmex GnBmin	1000 4000	PfMx PfMn	10000 6000
Ck0	11583	IPCcMn	2000
Ck1	11583	KHodal	32000
Ck2	- 11584	KV1	1994
Ck3	11576	KV2	750
GfB1	9000	KV3	225
Gf82 Gf83	9000 9000	Kdynf Kdynr	8000 8000
GfB4	9000	Kuff	0
B1biasm	25	Kurf	Ŏ
B2bf asm	50	MMfc	Ö
B3bi asm	50	MMrc	0
B4biasm	·25	Hpftc	2
Bback Badd	·50 -10	NKV Inc	-6000
Bacc Thias	0	Ing Gf1	155 25000
ThiasLm	175	Gf2	25000
TbiasRm	0	Gf3	25000
KTen	5000	Gf4	25000
XreqTL	-525	Gdf	15000

16384 17

Gdr Flead

Rlead OPFef OPFer OPFer

Pkf

Xmaxf Exfactf Xlimcf Xlimef Pkr

PKr Xmaxr Exfactr Xlimer Xlimer Bdrycf Bdrycf Bdrycr Bdryer

(OIUS)

File: 5		XreqTR	-610
	: Date run param		10000
5/11/93	AT 44.40.7	GTen/R	10000
Date: 5	Nov 93 11:18:3	1 IVrfH IVrrH	16384 16384
VALF	1000	IVrfP	18579
Kbar1	6000	, yrrP	14189
Kbar2	6000	IVrfR	16384
Kber3	6000	IVrrR	16384
Kbar4	6000	IVrfW	18579
KbarCl	6500	IVrrW	14189
KbarCr	6500	MHKc	-12000
XCpre41	-1000	IHCc	20000
XCpre4r	-1000	MPKc	-6000
xscale	13500	IPCc	5000
XScaleT	20832	ARKC	-5000
TenPar1	10650 5717	IRCC NWKG	20000 -1000
TenPar2 TenPar3	8700	IWCc	30000
SIF	12000	MHF	30000
SfC	6000	Mir	ŏ
Sfoff	-67	Kwi 1	ŏ
StTor	-225	Kbias	2
KTor1	0	KbiasS	10
KTor2	0	IVrfHO	16384
KTor3	0	IVrrHO	16384
KTor4	0	IVrfP0	16384
Blim	200	IVrrPO	16384
FScale	18459	IVrfRO	16384
PScale	12124	IVrrRO	16384
CodeP1	2688 32000	IVrfWO	16384
Wmax KwV	0	IVrrWO Hreq	16 38 4 -2000
WCny	-2000	Preq	-1000
KuVth	0	Rbiasm	0
KuVf	Ŏ	IPKt	ŏ
KuVr	Ŏ	IRKt	Ŏ
Kufmx	15000	IWKt	0
Kurmx	15000	HCnx+	0
KuNy	2048	- HCnx-	0
Kullyf	Ō	HCny	0
KuNyr	0	PCnx+	-30000
Vlim	200	PCnx-	-22000
The	40 0	PCny	- 1500
Bclose BcloseS	2000	RCnx+ RCnx-	0
ESFLAG	15	RCny	- 17000
IACTAT	24395	RCyRat	16384
IACTAR	24395	WCnx+	0
AR1	200	WCnx-	ō
AB2	-105	Bband	20
AB3	21839	HfMx	10000
DifBpMx	260	HfMn	6000
Opvmin	1000	IHCcMn	10000
Dovmex	1000	PfMx	10000
GnBmin	4000	PfMn	6000
Ck0 Ck1	11583 11583	IPCcMn KModal	2000 32000
Ck2	-11584	KV1	1994
Ck3	11576	KV2	750
GfB1	9000	KV3	225
G1B2	9000	Kdynf	8000
GfB3	9000	Kdynr	0003
GfB4	9000	Kuff	0
61biasm	25	Kurf	0
B2biesm	50	MMfc	0
83biasm	50	Mirc	0
B4biasm	-25	Hpftc	2
Bback	-50	MKV	-6000
Badd	-10	Ing c44	155
Thias	0 175	Gf1	25000
TbiasLm TbiasRm	0	Gf2 Gf3	25000 25000
KTen	5000	Gf4	25000 25000
XreqTL	-525	Gdf	15000
	-	,	

File: 9: Comment:	-1.PAR : Tensioner set-up	XreqTR GTenL	-640 10000
9/11/93		GTenik	10000
Date: 9	Nov 93 8:19:48	IVrfK	16384
		IVrrH	16384
VALF	1000	IVrfP	18579
Kber1	6000 6000	IVrrP	14189 1638-
Kber2 Kber3	6000	IVrfR IVrrR	16384
Kbar4	6000	IVrfW	18579
KbarCt	6500	IVrrW	14189
KbarCr	6500	MHKc	-12000
XCpre41	-1000	IHCc	20000
XCpre4r	-1000	MPKc	-6000
XScale	13500	IPCc	5000
XScaleT TenPar1	20832	MRKc	-5000
TenPar2	10650 5717	IRCc MWKc	20000 -1000
TenPar3	8700	IVCc	30000
SfF	12000	101 f	0
SfC	6000	MAr	0
Sfoff	-67	Kwl1	0
StTor	-225	Kbias	2
KTor1	0	KbiasS	10
KTor2	0	IVrfHO	16384
KTor3 KTor4	0 0	IVrrHO IVrfPO	16384 16384
Blim	200	IVrrPO	16384
FScale	18459	IVrfRO	16384
PScale	12124	IVrrRO	16384
CodeP1	2688	IVrfWO	16384
Umex	32000	IVrrW0	16384
KWV	0	Hreq	-2000
WCny KuVth	-2000 O	Preq	-1000
KuVf	Ö	Rbiesm IPKt	0
KuVr	ŏ	IRKt	ŏ
Kufmox	15000	IWKt	Ŏ
Kurrox	15000	HCnx+	Ű
KUNY	2048	HCnx-	0
KuNyf	0	HCny	0
KuNyr Vlim	0 200	PCnx+ PCnx-	-30000 -22000
The	40	PCny	- 1500
Bolose	Õ	RCnx+	
BcloseS	2000	RCnx-	Ō
ESFLAG	15	RCny	- 17000
IACTAF	24395	RCyRat	16384
IACTAR AB1	24395 200	WCnx+	0
AB2	-105	WCnx- 8bend	0 20
AB3	21839	HfMx	10000
Dif8pMx	260	HfMn	6000
Dpvmin	1000	IHCcMn	10000
Dpvmex	1000	PfMx	10000
Gn8min Ck0	4000 11583	PfMn	6000
Ck1	11583	IPCcMn KModal	2000 32000
Ck2	-11584	KV1	1994
Ck3	11576	KV2	750
GfB1	9000	KV3	225
GfB2	9000	Kdynf	8000
GfB3	9000	Kdynr	8000
Gf84	9000	Kuff	0
81biasm 82biasm	25 50	Kurf MMfc	0 0
B3biasm	50	MMrc	0
B4biasm	-25	Hpftc	2
Bback	-50	KKV	-6000
Bacid	-10	Ing	155
Thiss	0	Gf1	25000
TbiasLm TbiasRm	175 0	Gf2	25000
KTen	5000	Gf3 Gf4	25000 25000
XreqTL	·54 5	Gdf	15000
. 7' -			

Gdr	15000
Flead	0
Riead	0
OPFef	24000
OPFer	24000
OPFcf	24000
OPFcr	24000
Pkf	3
Xmexf	16160
Exfactf	13
Xlimcf	16160
Xiimef	9920
Pkr	3
Xmaxr	16384
Exfactr	17
Xlimor	16384
Xlimer	7840
Bdrycf	5000
Bdryef	10000
Bdrycr	13000
Bdrver	13000

(F)	

File: 9-	2.PAR	XreqTR	-620
	Data run param		10000
	Var.Damp.off	GTenR	10000
Date: 9	Nov 93 9:30:25	5 IYrfH IVrrH	16384 16384
VALE	1000	IVrfP	18579
VALF Kber1	6000	IVrrP	14189
Kber2	6000	IVrfR	16384
Kber3	6000	IVrrR	16364
Kber4	6000	IVrfV	18579
KbarCl	6500	IVrrW	14189
KberCr	6500	MHKc	-12000 20000
XCpre41	-1000 -1000	I HCc MPKc	-6000
XCpre4r XScale	13500	IPCc	5000
XScaleT	20832	MRKc	-5000
TenPar1	10650	IRCc	20000
TenPar2	5717	MAKC	- 1000
TenPar3	8700	IWCc	30000
SfF	12000 6000	HMf HMr	0
SfC Sfoff	-67	Kwl1	Ŏ
StTor	- z 25	Kbias	ž
KTOr1	0	KbiasS	10
KTorZ	0	IVrfHO	16384
KTor3	0	IVrrHO	16384
KTor4	0	IVrfPO	16384
Blim	200	IVrrPO IVrfRO	16384 16384
FScale PScale	18459 12124	IVrrRO	16384
CodeP1	2688	IVrfWO	16384
Umax	32000	IVrrW0	16384
KWV	0	Hreq	-2000
WCny	-2000	Preq	- 1000
KuVth	0	Rbiasm	Ů
KuVf	0	1PKt	0
KuVr	0 15000	IRKt IWKt	0
Kufex Kurex	15000	HCmx+	Ŏ
KUNY	2048	. HCnx-	Ŏ
Kunyf	0	HCmy	0
Kullyr	0	PCrix+	-30000
Vlim	200	PCnx-	-22000
ThF	40	PCny RCnx+	- 1500 0
Bclose BcloseS	0 20 00	RCnx-	0
ESFLAG	15	RCny	-17000
IACTAF	24395	RCyRat	16384
IACTAR	24 39 5	WCnx+	0
AB1	200	WCnx-	0
AB2	- 105	Bbend	20
AB3	21839	HTMX HTMn	10000 32 7 67
Oif8pMx Opvmin	260 1000	I HCcMn	10000
Dovmex	1000	PfMx	10000
Gramin	4000	PfMn	32767
Ck0	11583	IPCcMn	2000
Ck1	11583	KModel	32000
Ck2	-11584	KV1	1994 750
Ck3	11576 9000	KV2 KV3	225
GFB1 GFB2	9000	Kdynf	8000
GfB3	9000	Kdynr	8000
GfB4	9000	Kuff	0
B1biasm	25	Kurf	0
B2biasm	50	MMfc	0
83biasm	50 -25	MMrc Hpftc	0
84biasm Bback	-29 -50	NKV	-6000
Badd	-10	ing	155
Thias	ò	Gf1	25000
Ybiastm	175	Gf2	25000
ThiasRm	0	Gf3	25000
KTen	5000	Gf4	25000
XreqTL	-525	Gdf	15000

Gdr	15000
Flead	(
Rised	Ċ
OPFef	24000
OPFer	24000
OPFcf	24000
OPFCF	24000
Pkf	3
Xmexf	16160
Exfactf	13
Xlimcf	16160
Xlimef	9920
Pkr	3
XMexr	16384
Exfectr	17
Xlimor	16384
Xlimer	7840
Bdrycf	0
Bdryef	10000
Bdrycr	13000
Bdryer	13000
•	

Files 9-3.	PAR	XreqTR	-630
	ata run params	GTenL	10000
9/11/93 Va	r.Damp.on	GTenR	10000
Date: 9 No	ov 93 10:23:54	IVrfH	16384 16384
		IVrr# IVrfP	18579
VALF	1000	IVrrP	14189
Kbar1	6000 6000	IVrfR	16384
Kber2 Kber3	6000	IVrrR	16384
Kber4	6000	IVrfW	18579
KberCl	6500	IVrrW	14189
KberCr	6500	MHKc	-12000 20000
XCpre41	-1000	I HCc MPKc	-6000
XCpre4r	-1000 13500	IPCc	5000
XScale XScale?	20 83 2	MRKC	-5000
TenPar1	10650	IRCc	20000
TenPar2	5717	MAKC	-1000
TenPar3	8700	IUCc	30000
SfF	12000	900f 100c	0
SfC	6000	Kwl1	0
Sfoff	-67 -225	Kbies	ž
StTor KTor1	0	KbiasS	10
KTOP2	Ŏ	IVrfHO	16384
KTor3	Ö	1VrrH0	16384
KTor4	0	IVrfPO	16384 16384
Blim	200	IVrr P O IVrfRO	16384
FScale	18459	IVrr#0	16384
P\$cale CodeP1	12124 2688	IVrfWO	16384
Umex	32000	[VrrWO	16384
KwV	0	Hreq	-2000
WCmy	-2000	Preq	-1000
KuVth	0	Rbiasm	0
KuVf	0	IPKt IRKt	0
KuVr	0	IWKt	ŏ
Kufmx	15000 15000	HCnx+	Ŏ
Kurmx Kully	2048	HCnx-	0
Kuny Kunyf	0	HCmy	0
KuNyr	Ō	PCnx+	-30000
VLIM	200	PCnx-	-22000 -1500
ThF	40	PCny NCnx+	0
Bolose	0 2 00 0	RCnx-	ō
8closeS ESFLAG	15	RCny	-17000
IActAf	24395	RCYRAT	16384
IACTAT	24395	WCnx+	0
AB1	200	WCnx-	0
AB2	- 105	Bband 84M2	10000
AB3	21839	HfMx HfMn	10000 6000
DifBpMx	260	I HCcMn	10000
Downin	1000 1000	PfMx	10000
Dpvmex GnBmin	4000	PfMn	6000
Ck0	11583	IPCcMn	2000
Ck1	11583	KHodel	32000
Ck2	-11584	KV1	1994 750
Ck3	11576	KV2 KV3	750 225
Gf B1	9000 9000	Kdynf	8000
Gf82	9000	Kdynr	8000
Gf83 Gf84	9000	Kuff	0
B1biasm	25	Kurf	0
82biasm	50	Mifc	0
B3biasm	50	Mirc	0
B4biasm	-25	Hpftc	.4000
Bback	-50	MKV	-6000 155
Badd	-10	Ing Gf1	25000
Thias	0 175	Gf2	25000
Tbiasim TbiasRm	0	Gf3	25000
KTen	5000	Gf4	25000
XreqTL	-525	Gdf	15000
•			

Gdr	15000
Fleed	0
Rlead	0
OPFef	24000
OPFer	24000
OPFcf	24000
OPFor	24000
Pkf	3
Xmaxf	16160
Exfactf	13
Xlimcf	16160
Xlimef	9920
Pkr	3
Xmaxr	16384
Exfactr	17
Xlimor	16384
Xlimer	7840
Bdrycf	5000
Bdryef	10000
Bdrycr	13000
Bdryer	13000
·	

File: 9-4		XreqTR GTenL	-620 10000
	Locked ten. fixed		10000
damping –		GTenR	
Date: 9 N	ov 93 13:43:13	IVrfH	15384
		IVrrH	16384
VALF	1000	IVrfP	18575
Kbar1	6000	IYrrP	14189
Kber2	6000	IVrf R	16384
Kbar3	6000	IVrrR	16384
Kbar4	6000	IVrfW	18579
KberCl	6500	IVrrW	14189
KberCr	6500	MHKc	-12000
.,		IHCc	20000
XCpre41	-1000	MPKc	-6000
XCpre4r	- 1000		5000
XScale	13500	IPCc	
XScaleT	20 832	MRKC	-5000
TenPar1	10650	IRCc	20000
TenPer2	5717	MWKc	-1000
TenPar3	8700	IVCc	30000
SfF	12000	MIT	(
	6000	Mir	ò
SfC		Kul1	ò
Sfoff	-67		à
StTor	- 225	Kbias	
KTor1	0	KbiasS	10
KTor2	0	IVrfHO	16384
KTor3	0	1VrrHO	16384
KTor4	0	1VrfP0	16384
Blim	200	IVrrP0	16384
FScale	18459	IVrfRO	16384
PScale	12124	IVERO	16384
	2688	IVrfWO	16384
CodeP1	=	OMUNVI	16384
Hmax	32000		-2000
KwV	0	Hreq	
WCny	-2000	Preq	- 1000
KuVth	0	Rbiasm	9
KuVf	0	IPKt	(
KuVr	0	IRKt	0
Kufax	15000	IWKt	(
Kurmox	15000	HCrx+	0
Kulky	2048	HCmx-	Ċ
	0 .	HCriy	Č
Kullyf	-	PCnx+	-30000
KuNyr	0		-22000
Vlim	200	PCnx-	
Thf	40	PCny	-1500
Bclose	0	RCnx+	(
BcloseS	2000	RCmx-	(
ESFLAG	15	RCny	-17000
IACTAF	24395	RCyRat	16384
IACTAL	24395	WCnx+	(
	200	WCnx-	Ċ
AB1	-	Bbend	20
AB2	- 105		
AB3	21839	HfMx	10000
D i fBpMx	260	HfMn	32767
Dpvmin	1000	IHCcMn	10000
Dovmex	1000	PfMx	10000
GnBmin	4000	PfMn	32767
Ck0	11583	IPCcMn	2000
Ck1	11583	KHodal	32000
Ck2	-11584	KV1	1994
	11576	KV2	750
Ck3		KV3	225
Gf81	9000		8000
GfB2	9000	Kdynf	
Gf83	9000	Kdynr	8000
G fB 4	9000	Kuff	C
Bibiasm	25	Kurf	C
82blasm	50	MMfc	0
B3blasm	50	MITC	ā
	-25	Hofte	2
84biasm			-6000
Bback	-50	HKV	
Badd	-10	Ing	155
Totas	0	Gf1	25000
TbiasLm	175	Gf2	25000
Thiasem	0	Gf3	25000
		Gf4	25000
KTen	5000	UT#	23000

Gdr	15000
Flead	0
Rlead	0
OPFef	24000
OPFer .	24000
PFcf	24000
OPFor	24000
Pkf	3
(mexf	16160
Exfactf	13
(limcf	16160
(limef	9920
kr	3
(mexr	16384
xfactr	17
(Limor	16384
(Limer	7840
Idrycf	0
ldryef	10000
Idrycr	13000
Idrver	13000

16160 13 16160

9920

16384 17

Flead Rlead OPFer OPFer OPFer

Pkf

Pkr

Xmaxr

Exfactr Xlimer Xlimer Bdryef Bdryef Bdryer Bdryer

Xmaxf Exfact? Xlimef Xlimef

(c)	TUS

File: 10	-1.PAR	GTenL	10000
	10/11/93 - Ru		10000
Date: 10	Nov 93 9:50	:21 IVrfk IVrrH	16384 16384
VALE	1000	IVrfP	18579
VALF Kberi	6000	IVrrP	14189
Kber2	6000	IVrfR	16384
Kber3	6000	IVrrR	16384
Kbar4	6000	IVrfW	18579 14189
KberCl	6500 6500	IVr r₩ MHKc	-12000
KbarCr XCpre4l	-1000	IHCc	20000
XCpre4r	-1000	HPKc	-6000
XScale	13500	IPCc	5000
XScaleT	20832	MRKC	-5000
TenPar1	10650	IRCC MAKC	20000 -1000
TenPar2 TenPar3	5717 870 0	IWCc	30000
SfF	12000	MHf	0
SfC	6000	MHr:	0
Sfoff	-67	Kul1	0
StTor	-225 0	Kbias KbiasS	2 10
KTor1 KTor2	Ö	IVrfHO	16384
KTor3	ŏ	IVrrHO	16384
KTor4	0	IVrfPO	16384
Blim	200	IVrrPO	16384
Facale	18459	IVrfRO	16 38 4 16 38 4
PScale	12124 2688	IVrrRO IVrfWO	16384
CodeP1 Umax	32000	IVrrWO	16384
KwV	0	Hreq	-2000
WCny	-2000	Preq	-1000
KuVth	0	Rbiasm	0
KuVf	0	IPKt IRKt	0
KuVr Kufmx	15000	IWKt	ŏ
Kurnok	15000	HCnx+	0
Kully	2048	HCrix-	0
Kullyf	0	, HCrry	00005-
Kullyr	0 200	PCnx+ PCnx-	-30000 -22000
Vlim ThF	40	PCny	-1500
Bclose	Ö	RCnx+	0
BcloseS	2000	RCnx-	0
ESFLAG	15	RCmy	-17000 16384
IACTA	24395 24395	RCYRut WCnx+	10304
IACTAT AB1	200	WCnx-	ŏ
AB2	- 105	Bbend	20
AB3	21839	HfMx	10000
DifBpMx	260	HřMn	6000
Dpvoin Dpvmex	1000 1000	IHCcMn PfMx	10000 10000
Gn Bmi n	4000	PfMn	6000
Ck0	11583	1PCcNn	2000
Ck1	11583	KNodal	32000
Ck2	-11584 -11874	KV1 KV2	1994 750
Ck3 GfB1	11576 9000	KV3	225
Gf82	9000	Kdynf	8000
GfB3	9000	Kdynr	8000
GfB4	9000	Kuff	0
B1biasm	25 50	Kurf Mifc	0
82biasm 83biasm	50 50	MATC MMrc	Ó
84biasm	-25	Hpftc	ž
Bback	-50	MK∀	-6000
Badd	-10	ing	157
Thiss	0	Gf1 Gf2	25006 25000
TbiasLm TbiasRm	175 0	Gf2 Gf3	25000
KTen	5000	Gf4	25000
XreqTL	-595	Gdf	15000
XreqTR	-630	Gdr	15000

16160 9920 3

Gdr Flead Rlead OPFef

OPFer OPFer OPFer Pkf

Xmexf Exfectf

Xlimef Xlimef Pkr

Xmaxr Exfactr Xlimor

Xlimer Edrycf Edrycf Edrycr Edrycr Edrycr

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File: 10	-2.PAR		XreqTR	-570
Comment:		Lower	GTenL	10000
	(-190)		GTenR	10000
Date: 'O	Nov 93 10:	03:00	IVrfH	16384
	1000		IVrrH IVr f P	16384 18579
VALF	6000		IVEEP	14189
Kber1 Kber2	6000		IVrfR	16384
Kbarz Kbar3	6000		IVEER	16384
Kbar4	6000		IVrfV	18579
KbarCl	6500		IVrrW	14189
KbarCr	6500		MHKc	-12000
XCpre41	- 1000		IHCc	20000
XCpre4r	- 1000		MPKc	-6000
XScale	13500		IPCc	5000
XScaleT	20832		MRKc	-5000 20000
TemPari	10650 5717		IRCc MWKc	-1000
TenPar2 TenPar3	8700		IWCc	30000
SfF	12000		MMf	0
SfC	5000		MHr	0
Sfoff	-67		Kwl1	0
StTor	- 225		Kbies	2
KTor1	0		KbiesS	10
KTor2	0		IVrfHO	16384
Kĭor3	0		IVrrHO	16384
KTor4	0		IVrfPO	16384
Blim	200		IVrrPO	16384 16384
FScale	18459		IVrfRO IVrrRO	16384
PScale CodeP1	12124 2688		IVETHO	16384
Umax	32000		IVrrWO	16384
KWV	0		Hreq	-2000
WCmy	-2000		Preq	-1000
KuVth	0		Rbiasm	0
KuVf	0		IPKt	0
KuVr	0		IRKt	0
Kufnox	15000		IUKt	0
Kurmox	15000		HCnx+	0
Kully	2045 0	•	HCnx- HCny	Ö
Kullyf	Ö		PCnx+	-30000
KuNyr Vlim	200		PCnx-	-22000
The	40		PCny	-1500
Bclose	Ō		RCnx+	C
BcloseS	2000		RCnx-	0
ESFLAG	15		RCny	- 17000
IActAf	24395		RCYRUT	16384
IACTAC	24395		WCnx+	0
AB1	200 - 105		MCnx- Bband	0 20
ABZ	21839		HfMx	10000
AB3 DifBpMx	260		HfMn	6000
Dovmin	1000		IHCcMn	10000
Dpvmax	1000		PfMx	10000
Jn8min	4000		PfMn	6000
Ck0	11583		1PCcMn	2000
Ck1	11583		KHodel	32000
Ck2	-11584		KV1	1994
Ck3	11576		KV2	750 225
GfB1	9000 9000		KV3 Kdynf	8000
GfB2 GfB3	9000		Kayını	8000
G184	9000		Kuff	0
81bi asm	25		Kurf	Ô
82bi esm	50		MMfc	0
83bi asm	50		MMrc	0
84biasm	- 25		Hpftc	2
Bback	-50		MKV	-6000
Badd	-10		Ing Gf1	155 25000
Thias	0 175		GT1 Gf2	25000 25000
TbiasLm TbiasRm	1/5		Gf3	25000
KTen	5000		Gf4	25000
XreqTL	-505		Gdf	15000
7				

44 7 848	VnnaTD	-570	Gdr	15000
File: 10-3.PAR	XreqTR GTenL	10000	flead	0
Comment: Bdrycf = 0, Hreq = -	GTenR	10000	Rlead	õ
1500		16384	OPFef	24000
Date: 10 Nov 93 10:04:11	IVrfA		OPFer	24000
	[VrrH	16384	OPFof	24000
VALF 1000	IVrfP	18579	OPFor	24000
Kber1 6000	IVrrP	14189		3
Kber2 6000	IVrfR	16384	Pkf	-
Kbar3 6000	IVrrR	16384	Xmaxf	16160
Kbar4 6000	ĮVr f₩	18579	Exfactf	13
KbarCl 6500	WnnVI	14189	Xlimcf	16160
KberCr 6500	MHKc	-12000	Xlimef	9920
XCpre41 -1000	INCc	20 00 0	Pkr	3
XCpre4r -1000	MPKc	-6000	Xmexr	16384
XScale 13500	IPCc	5000	Exfectr	17
XScaleT 20832	MRKC	-5000	Xlimor	16384
TenPar1 10650	IRCc	20000	Xlimer	7840
TerPar2 5717	MMKc	- 1000	Bdrycf	0
TanPar3 8700	1WCc	30000	Bdryef	10000
SFF 12000	MAF	0	Bdrycr	13000
sfC 6000	Mir	0	Bdryer	13000
Stoff -67	Kul 1	Ğ	•	
	Kbias	ž		
44	KbiasS	10		
	IVrfHO	16384		
Ktor2 0	IVrrHO	16384		
KTor3 0	IALLMO	10304		

16384

16384

16384

16384

16384

-1500

-1000

0

0

0

0

0

0

-30000

-22000

-1500

-17000

16384

0

20

10000

6000

10000

10000

6000

2000

32000

1994

750

225

8000

8000

0

0

0

0

-6000

25000

25000

25000

25000

15000

155

IVrfPO

IVERPO

IVrfRO

IVrrRO

IVrfWO

IVrrWO

Rbiasm

p. H

Preq

[PKt

IRKt

IUKt

HCnx+

HCnx-

HCny

PCnx+

PCnx-

PCny

RCnx+

RCny

RCyRat

WCnx+

WCnx-

Bband

HfMx

HfMn

PfMx

PfMn

KV1

KV2

KV3

Kdynf

Kdynr

Kuff

Kurf

MMfc

MMrc

MKV

Ing

Gf1

Gf2

Gf3

Gf4

Gdf

Hpftc

1HCcMn

IPCcMn

KHoda i

KTOF4

Blim

FScale

PScale

CodeP1

Linex

KwV

WCmy

KuVth

KuVf

KuVr

Kufmx

Kurmx

Kully

KuNyf

KuNyr

Vlim

BcloseS

ESFLAG

IACTAF

IActAr

DifBpMx

Dovmin

Dpvmex

GnBmin

Ck0

Ck1

Ck2

Ck.:

GfB1

GfB2

GfB3

Gf84

Bibiasm

82biasm

B3bi asm

B4bi asm

Bback

Thias

ThiasLm

TbiasRm

Badd

KTen

XreqTL

AB1

ABZ

AB3

Thf Bclose 200

18459

12124

2688

32000

-2000

15000

15000

2048

0

0

200

2000

24395

24395

200

260

1000

1000

4000

11583

11583 -11584

11576

9000

9000

9000

9000

25

50

50

- 25

-50

-10

175

5000

-505

0

0

- 105

21839

15

40

0

0

0

16384 17

Gdr flead Rlead

OPFer OPFer OPFer OPFer Pkf

Xmaxf Exfactf Xlimcf Xlimef

Pkr Xmexr Exfectr

Xlimor Xlimer

Bdrycf Bdryef Bdrycr Bdrycr

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15000	Nov 93 1000 6000 6000 6000 6500 6500 -1000 -1000 20832	000, GTenL/R = 10:13:12	GTenL GTenR IVrfH IVrfP IVrfP IVrfR IVrR IVrfW IVrrW MHKc	15000 15000 16384 16384 18579 14189 16384 16384 18579
Date: 10 VALF Kbar1 Kbar2 Kbar3 Kbar4 KbarCl KbarCr XCpre4l XCpre4r XScale XScale TenPar1 TenPar2	1000 6000 6000 6000 6500 6500 -1000 -1000	10:13:12	IVrfH IVrrH IVrfP IVrfP IVrfR IVrrR IVrfW IVrrW	16384 16384 18579 14189 16384 16384 18579
VALF Kbar1 Kbar2 Kbar3 Kbar4 KbarCt KbarCr XCpre4t XCpre4t XScate XScate TenPar1 TenPar2	1000 6000 6000 6000 6500 6500 -1000 -1000	10:13:12	IVrrH IVrfP IVrfP IVrfR IVrfW IVrfW MHKc	16384 18579 14189 16384 16384 18579
Kbar1 Kbar2 Kbar3 Kbar4 KbarCl KbarCr XCpre4l XCpre4r XScale XScale TenPar1 TenPar2	6000 6000 6000 6500 6500 -1000 -1000		IVrfP IVrrP IVrfR IVrrR IVrfW IVrrW MHKc	18579 14189 16384 16384 18579
Kbar1 Kbar2 Kbar3 Kbar4 KbarCl KbarCr XCpre4l XCpre4r XScale XScale TenPar1 TenPar2	6000 6000 6000 6500 6500 -1000 -1000		IVrrP IVrfR IVrrR IVrfW IVrrW MHKc	14189 16384 16384 18579
Kbar2 Kbar3 Kbar4 KbarCl KbarCr XCpre41 XCpre4r XScale XScale TenPar1 TenPar2	6000 6000 6500 6500 -1000 -1000		IVrfR IVrrR IVrfW IVrrW MHKc	16384 16384 18579
Kbar3 Kbar4 KbarCl KbarCr XCpre4l XCpre4r XScale XScaleT TenPar1 TenPar2	6000 6000 6500 6500 -1000 -1000 13500		IVrrR IVrfW IVrrW MHKc	16384 18579
Kbar4 KbarCl KbarCr XCpre4l XCpre4r XScale XScaleT TenPar1 TenPar2	6000 6500 6500 -1000 -1000 13500		IVrfW IVrrW MHKc	18579
KbarCl KbarCr XCpre4l XCpre4r XScale XScaleT TenPar1 TenPar2	6500 6500 -1000 -1000 13500		IVrrW MHKc	
KbarCr XCpre4t XCpre4r XScale XScaleT TenPar1 TenPar2	6500 -1000 -1000 13500		MHKc	14107
XCpre41 XCpre4r XScale XScaleT TenPar1 TenPar2	-1000 -1000 13500			
XCpre4r XScale XScaleT TenPar1 TenPar2	-1000 13500		1110-	-12000
XScale XScaleT TenPar1 TenPar2	13500		INCC	20000 -6000
XScaleT TenPar1 TenPar2			MPKc	
TenPar1 TenPar2	20832		IPCc	5000
TenPar2			MRKc	-5000
	10650		IRCc	20000 - 1000
TenPar3	5717		MVKc	
	8700		IMCc	30000
SfF	12000		MHF	0
SfC	6000		MAR	0
Sfoff	-67		Kwl1	0
StTor	-225		Kbias	2
KTor1	0		KbiasS	10
KTor2	0		ivrfHO	16384
KTor3	0		IVERHO	16384
KTor4	0		IVrfPO	16384
Blim	200		IVrrP0	16384
FScale	18459		IVrfRO	16384
PScale	12124		IVrrRO	16384
CodeP1	2688		IVrfWO	16384
Umex	32000		IVrrWO	16384
KwV	0		Hreq	-2000
WCny	-2000		Preq	-1000
KuVth	0		Rbiasm	0
KuVf	0		IPKt	0
KuVr	0		IRKt	0
Kufmx	15000		IWKt	0
Kurnx	15000		HCnx+	0
KuNy	2048	•	HCnx-	0
KuNyf	0		HCny	0
Kullyr	0		PCnx+	-30000
Vtim	200		PCnx-	-22000
The	40		PCny	- 1500
Bclose	0		RCnx∻	0
BcloseS	2000		RCnx-	0
ESFLAG	15		RCny	-17000
I Act A f	24395		RCyRat	16384
IACTAr	24395		WCmx+	0
AB1	200		WCnx-	0
AB2	- 105		Bband	20
AB3	21839		MfMx	10000
DifBpMx	260		HfMn	6000
Opvmin	1000		IHCcMn	10000
Downex	1000		PfMx	10000
GnBmin	4000		PfMn	6000
Ck0	11583		IPCcMn	2000
Ck1	11583		KModel	32000
Ck2	- 11584		KV1	1994
Ck3	11576		KV2	750
äfB1	9000		KV3	225
G f 82	9000		Kdynf	5000
af83	9000		Kdynr	8000
3 1 84	9000		Kuff	0
31biasm	25		Kurf	0
32biesm	50		MMfc	0
33biasm	50		MMrc	0
34biasm	-25		Hpftc	2
Bback	-50		MKV	-6000
3add	-10		Ing	155
ibias	0		Gf1	25000
biestm	175		Gf2	25000
ibiaskm	.,,		Gf3	25000
(Ten	5000		Gf4	25000
(reqTL	-505		Gdf	15000

16160 13 16160

9920

16384 17

16384 7840 0

10000 13000 13000

Flead Rlead OPFef

OPFer OPFer OPFer Pkf

Xmexf Exfactf Xlimcf

Xlimef Pkr

Ymexr Exfectr Xlimer Sdrycf

Bdryef Bdrycr Bdryer

File: 10		GTenL	15000
Comment: Date: 10		GTenR 1VrfH	15000 16384
Date: IU	HON 29 10:34:5	IVerH	16384
VALF	1000	IVrfP	18579
Kbar1	6000	IVrrP	14189
Kbar2	6000	1VrfR	16384
Kbar3 Kbar4	6000 6000	IVrrR IVrfW	16 384 18579
KbarCl	6500	IVrrW	14189
KbarCr	6500	MXKc	-12000
XCpre41	-1000	IKCc	20000
XCpre4r XScale	-1000 13500	MPKc IPCc	-6000 5000
XScaleT	20832	MRKc	-5000
TenPar1	10650	IRCc	20000
TenPar2	5717	MMKc	-1000
TenPar3	8700	IWCc	30000
SfF	12000 6000	MHf	0
SfC Sfoff	-67	MMr Kwl1	0
Stror	- 225	Khias	2
KTor1	0	KbiasS	10
KTor2	0	IVrfHO	16384
KTor3 KTor4	0 0	1VrrH0	16384
RIOT4 Blim	200	IVrfPO IVrrPO	16384 16384
FScale	18459	IVrfRO	16384
PScale	12124	IVrrRO	16384
CodeP1	2688	IVrf W O	16384
Lima x	32000	IVrr40	16384
KWV WCny	0 -2000	Hreq Prea	-2000 -1000
KuVth	0	Rbiasm	0
KuVf	Ŏ	IPKt	ŏ
KuVr	0	IRKt	0
Kufax	15000	IWKt	0
Kurwx Kully	15000 2048	HCnx+ HCnx-	0
KuNyf	0 .	HCny	0
KuNyr	Ö	PCnx+	-30000
Vlim	200	PCnx-	-22000
THE	40	PCmy	-1500
Bclose BcloseS	0 2000	RCnx+ RCnx-	0
ESFLAG	15	RCny	-17000
IACTAF	24395	RCyRat	16384
IACTAL	24395	WCnx+	0
AB1 AB2	200	WCnx-	0
AB3	-105 21 8 39	8bend HfMx	20 10000
DifBpMx	260	HfMn	6000
Downin	1000	INCoMn	10000
Dpvmex	1000	PfMx	10000
Gr@min CkO	4000 11583	PfMn IPCcMn	5000
Ck0 Ck1	11583	KModal	2000 32000
Ck2	-11584	KV1	1994
Ck3	11576	KV2	750
GfB1	9000	KV3	225
Gf82 Gf83	9000 9000	Kdynf	8000 8000
Gf84	9000	Kdynr Kuff	0
B1bi asm	25	Kurf	Õ
B2biasm	50	MMfc	Ö
83biasm	50	Mirc	0
84biasm	-25 -50	Hpftc	4000
8back Badd	-50 -10	MKV Ing	-6000 155
Thias	0	Gf1	25000
Totastm	175	Gf2	25000
ThiasRm	0	Gf3	25000
KTen	5000 -505	Gf4 cdf	25000
XreqTL XreqTR	-570	Gdf Gdr	15000 15000
		4141	

(all)

Comment: IPCcMn 1000, PfMx 9000 DRA date set Date: 10 Nov 93 11:23:02 VALF 1000 IV Kbar1 6000 IV Kbar2 6000 IV Kbar3 6000 IV Kbar3 6000 IV Kbar4 6000 IV Kbar6 6500 IV Kbar6 6500 IV Kbar6 1000 IV Kbar6 1000 IV Kbar7 1000 IV Kbar7 1000 IV Kbar7 1000 IV Kbar7 1000 IV Kbar8 1000 IV Kb	GC 20000 KC -6000 CC 5000 KC -5000 CC 20000 KC -1000 CC 30000 f 0 r 0 t1 0 tias 2 tiasS 10
9000 DRA data set GT Date: 10 Nov 93 11:23:02 IV VALF 1000 IV Kbar1 6000 IV Kbar2 6000 IV Kbar3 6000 IV Kbar4 6000 IV Kbar4 6500 IV Kbar6 6500 MM Kbar6 1000 IV Kbar7 1000 IV Kbar6 1000 IV Kbar6 1000 IV Kbar6 1000 IV Kbar7 1000 IV KScale 13500 IP IV	enR 15000 rfH 16384 rrH 16384 rrH 16384 rrFP 18579 rrP 14189 rrR 16384 rrW 18579 rrW 14189 Kc -12000 Cc 20000 Kc -6000 Cc 5000 Kc -6000 Cc 5000 Cc 30000 f 0 r 0 t1 0 tias 2 tiasS 10
Date: 10 Nov 93 11:23:02 IV VALF 1000 IV Kbar1 6000 IV Kbar2 6000 IV Kbar3 6000 IV Kbar4 6000 IV Kbar6 6500 IV Kbar6 6500 MMH XCpre41 -1000 MPH XCpre41 -1000 MPH XScale 13500 IP XScale 13500 IP XScale 13500 IP XScale 13500 IR TenPar1 10650 IR TenPar2 5717 MMF TenPar3 8700 IM SfF 12000 MMH SfC 6000 MMH SfOff -67 KM StTor -225 Kb KTor1 0 Kb KTor2 0 IV KTor3 0 IV KTor3 0 IV KTor4 0 IV Blim 200 IV FScale 18459 PScale 12124 IV CodeP1 2688 IV Wmax 32000 IV KWV 0 Hr WCny -2000 Pro KWV 1 Rb	rfH 16384 rrH 16384 rrH 16384 rfP 18579 rrP 14189 rfR 16384 rrR 16384 rrR 16384 rrW 18579 rrW 14189 Kc -12000 Cc 20000 Kc -6000 Cc 5000 Cc 5000 Cc 20000 Kc -1000 Cc 30000 f 0 r 0 L1 0 ties 2 tiesS 10
VALF 1000 IV Kbar1 6000 IV Kbar2 6000 IV Kbar3 6000 IV Kbar3 6000 IV Kbar4 6000 IV KbarCt 6500 IV KbarCr 6500 MH XCpre4r -1000 IM XCpre4r -1000 MP XScate 13500 IP XScate 13500 IP XScate 20832 MR Tempar1 10650 IR Tempar2 5717 MM Tempar3 8700 IM SfF 12000 MM Sf 6000 MM Sf 6000 MM KTOT2 0 IM KTOT2 0 Kb KTOT3 0 IV KTOT3 0 IV KTOT3 0 IV KTOT4 0 IV KTOT3 0 IV KTOT4 0 IV KTOT4 0 IV KTOT5 1200 IV KTOT6 12688 IV KMW 32000 IV KWW 0 MCCC PC KWWW 0 MCCC PC KWWW 0 MCCC PC KWWW 0 MCCC PC KWWW 0 MCCC PC KWWWW 0 MCCC PC KWWWW 0 MCCC PC KWWW 0 MCCC PC KWWWW 0 MCCC PC KWWWWW 0 MCCC PC KWWWW 0 MCCC PC KWWWWWWWWWWWWWWWWWWWWWWWWWWWWWWWWWWWW	rrH 16384 rfP 18579 rrP 14189 rfR 16384 rrR 16384 rrN 16387 rrN 14189 Kc -12000 Cc 20000 Kc -6000 Cc 5000 Cc 5000 Cc 20000 Kc -1000 Cc 30000 f 0 r 0 L1 0 ias 2 iasS 10
VALF 1000 IV Kbar1 6000 IV Kbar2 6000 IV Kbar3 6000 IV Kbar4 6000 IV Kbar4 6500 IV Kbar6t 6500 IV Kbar6t 6500 IV Kbar6t 1000 IV Kcpre4r 1000 IV Kcpre4r 1000 IV Kcpre4r 1000 IV I	rfP 18579 rrP 14189 rfR 16384 rrR 16384 rrW 18579 rrW 14189 Kc -12000 Cc 20000 Kc -5000 Cc 5000 Kc -5000 Cc 20000 Kc -1000 Cc 30000 f 0 r 0 L1 0 tias 2 tiasS 10
Kbar1	rfR 16384 rrR 16384 rfW 18579 rrW 14189 Kc -12000 Cc 20000 Kc -6000 Cc 5000 Kc -5000 Cc 20000 Kc -1000 Cc 30000 f 0 r 0 ties 2 tiesS 10
Kbar2 6000 IV	rrR 16384 rfW 18579 rrW 14189 Kc -12000 Cc 20000 Kc -6000 Cc 5000 Kc -5000 Cc 20000 Kc -1000 Cc 30000 f 0 r 0 t1 0 tias 2 tiasS 10
Kbar3 6000 IV	rfW 18579 rrW 14189 Kc -12000 Gc 20000 Kc -6000 Cc 5000 Gc 20000 Kc -1000 Gc 30000 f 0 r 0 L1 0 ias 2 iasS 10
KbarCl 6500 IV	TrW 14189 Kc -12000 Cc 20000 Kc -6000 Cc 5000 Cc 20000 Kc -1000 Cc 30000 f 0 r 0 L1 0 ias 2 iasS 10
KbarCr 6500 MH	Kc -12000 Cc 20000 Kc -6000 Cc 5000 Cc 20000 Cc 20000 Cc 30000 f 0 r 0 L1 0 ias 2 iass 10
XCpre41 -1000	GC 20000 KC -6000 GC 5000 KC -5000 CC 20000 KC -1000 GC 30000 f 0 r 0 tias 2 iiss 10
XCpre4r	Kc -6000 Cc 5000 Kc -5000 Cc 20000 Kc -1000 Cc 30000 f 0 T 0 tias 2 iiss 10
XScale	Cc 5000 Kc -5000 Cc 20000 Kc -1000 Cc 30000 f 0 r 0 t1 0 tias 2 tiasS 10
XScalef 20832 MRI TemPar1 10650 IRI TemPar2 5717 MM TemPar3 8700 IM SfF 12000 MM SfC 6000 IV SfC 6000 IV SfC 6000 IV SfC 6000 IV MM SfC 6000 MM SfC	Kc -5000 Cc 20000 Kc -1000 Cc 30000 f 0 r 0 t1 0 ias 2 iasS 10
Tempar1 10650 IR: Tempar2 5717 MMM Tempar3 8700 IW SfF 12000 MM SfC 6000 MMM SfOff -67 KM Stor -225 KD KTOr1 0 KD KTOr2 0 IV KTOr3 0 IV KTOr3 0 IV STOR4 0 IV Stor 1200 IV Sto	CC 20000 KC -1000 CC 30000 f 0 r 0 L1 C ias 2 iasS 10
TemPar2 5717 TemPar3 8700 SfF 12000 SfF 12000 SfC 6000 SfOff -67 StTor -225 KD KTor1 0 KD KTor2 0 IV KTor3 0 IV KTor3 0 IV STOR4 0 IV STOR4 0 IV STOR4 18459 PScale 18459 PScale 12124 CodeP1 2688 IV Umax 32000 IV KWV 0 Hrv VCTV VCTV VCTV VCTV VCTV VCTV VCTV VCT	Cc 30000 f 0 r 0 l1 0 ias 2 iasS 10
TemPar3 8700 IM SfF 12000 MM SfC 6000 MM SfC 6000 Sfoff -67 KW StTor -225 Kb KTor1 0 Kb KTor2 0 IV KTor3 0 IV KTor4 0 IV Blim 200 IV Scale 18459 IV FScale 18459 IV CodeP1 2688 IV LIMBER 3200 IV LIMBER 32000	f 0 r 0 l1 0 ias 2 ias\$ 10
SfC 6000 MMI Sfoff -67 Kw Stor -225 Kb KTor1 0 Kb KTor2 0 IV KTor3 0 IV KTor4 0 IV Blim 200 IV FScale 18459 IV PScale 12124 IV CodeP1 2688 IV Wmax 32000 IV KWV 0 Hr WCny -2000 Pro KuVth 0 Rb	r 0 l1 0 ias 2 iasS 10
Sfoff	11 0 ias 2 iasS 10
StTor -225 Kb KTor1 O Kb KTor2 O IV KTor3 O IV KTor4 O IV Stim 200 IV FScale 18459 IV PScale 12124 IV CodeP1 2688 IV Wmax 32000 IV KwV O Hre WCry -2000 Pro KwVth O Rb	ias 2 iasS 10
KTOri 0 Kb KTor2 0 IV KTor3 0 IV KTor4 0 IV KTor4 0 IV Stim 200 IV FScale 18459 IV FScale 12124 IV CodeP1 2688 IV KWV 0 Hrc WCny -2000 Pro KuVth 0 Rb	iesS 10
KTOr2	
KTor3	
KTOr4 0 IVI 81im 200 EVI FScale 18459 IVI FScale 12124 IVI CodeP1 2688 IVI Wmax 32000 IVI KWV 0 Hrv WCny -2000 Pro KuVth 0 Rb	rrHO 16384
Stim 200 IVI FScale 18459 IVI FScale 18459 IVI FScale 12124 IVI FScale 12124 IVI FScale 12124 IVI FScale IVI IV	rfPO 16384
FScale 18459 IVI PScale 12124 IVI CodeP1 2688 IVI Wmex 32000 IVI KWV 0 Hrc WCny -2000 Pro KuVth 0 Rb	rrP0 16384
PScate 12124 IV CodeP1 2688 IV Wmex 32000 IV KWV 0 Hrc WCny -2000 Pro KuVth 0 Rb	rfRO 16384
CodeP1 2688 IV Wmex 32000 IV KwV 0 Hre WCny -2000 Pro KuVth 0 Rb	rrRO 16384
KW 0 Hrs WCny -2000 Pro KuVth 0 Rb	rfk0 16384
WCny -2000 Pro KuVth 0 Rb	rr w o 16384
KuVth 0 Rb	
Rutti	•
	iasm 0 Ct 0
The state of the s	• •
Kuvr 0 IRI Kufmx 15000 IW	• •
14-0111-01	nx+ 0
KUNY 2048 . HCr	
KuNyf 0 HCr	ny 0
KuNyr 0 PC	
Vlim 200 PCr	
ThF 40 PCr	•
Bclose 0 RCr	
BCloseS 2000 RCr FSFLAG 15 RCr	
	Rat 16384
IActAf 24395 RC) IActAr 24395 WCr	
AB1 200 WCr	
	and 20
AB3 21839 Hft	4x 10000
DifBpMx 260 HfF	
Opening	cMn 10000
Dpymax 1000 Pff	
Gn8min 4000 Pff	4n 5000 CcMn 1000
	odal 32000
Ck1 11583 KMC Ck2 -11584 KV1	
Ck3 11576 KV2	
GfB1 9000 KV3	
Gf82 9000 Kdh	mf 8000
Gf83 9000 Kdy	mr 8000
Gf84 9000 Kut	
B1biasm 25 Kur	
B2biasm 50 MMf	
B3biasm 50 MHr	
84biasm -25 Hpf Bback -50 MKV	
Bback -50 MKV Badd -10 Ing	
Thias 0 Gf1	
TbiasLm 175 Gf2	
TbiasRm 0 Gf3	
KTen 5000 Gf4	25000
XreqTL -525 Gdf	25000 25000