TEST CONTROL MODULE USER GUIDE

The Test Control Module utilizes Command Module signals, Auxiliary inputs for vehicle speed and roll velocity, and Flag signals, to provide additional automation to a test program.

1. Gain and offset controls are available on this module for Aux1 and Aux2 signals.
2. A vehicle speed signal input (to Aux1) is used to start a steer program at a precise selected speed.
3. A roll velocity signal input signal input (to Aux2) is used to begin a steer reversal precisely at maximum roll angle. This is done by pausing and then continuing the steer program.
4. The same roll velocity signal may be input to a second comparator. This may be used to control brake, throttle, etc. without pausing the steer program.
5. Additional flags are available for throttle and brake interfaces. These are for possible future use and are not discussed further in this guide.

AUX1 & AUX2 CALIBRATION

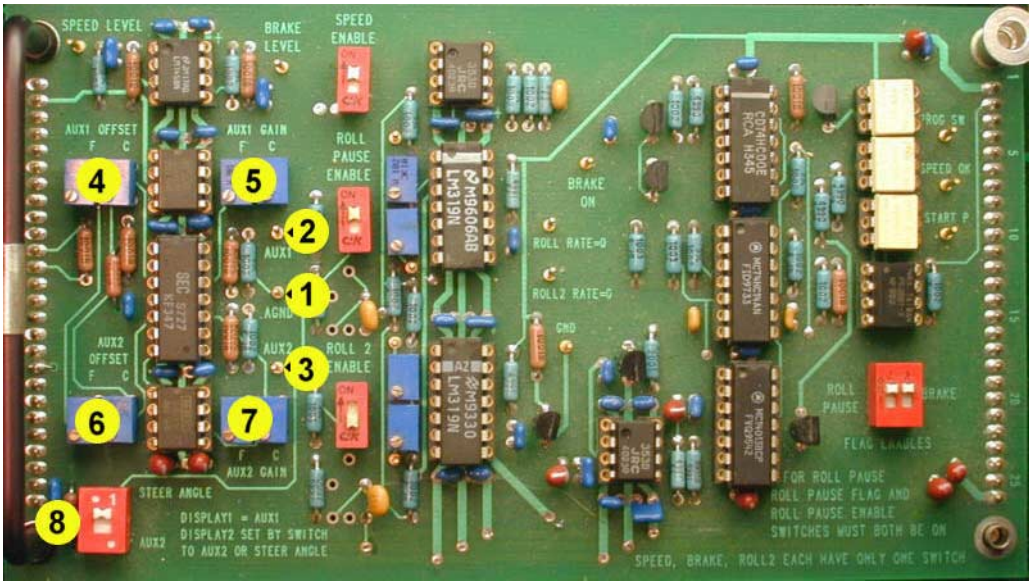

Figure 1: Test Control Module identifying controls for Aux1 & Aux2

1: Test point for Analog Ground. This is the reference ground for analog signals.

2: Test point for Aux1 voltage output to display and test control circuit.

3: Test point for Aux2 voltage output to display and test control circuit.

4: Aux1 offset adjustment potentiometers (fine and coarse).

5: Aux1 gain adjustment potentiometers (fine and coarse).

6: Aux2 offset adjustment potentiometers (fine and coarse).

7: Aux2 gain adjustment potentiometers (fine and coarse).

8: Switch that selects either steer angle (↑) or Aux2 (↓) for display on the lower handwheel LCD display.

Procedure for calibration of the Aux1 input:

1. The power must be on to the Battery/Electronics box (green and yellow buttons are lit). The Signal in/out cable must be attached. The Command Module and Machine cables may be attached, but this is not necessary.
2. A variable DC voltage source is applied to the Aux1 input of the Signal in/out cable (blue wire).
3. The Aux1 output voltage is measured at test point (2) with ground at test point (1).
4. Set the input voltage for a desired 0V output. Note that this input may or may not be 0V. For example, if the transducer or acquisition system uses 0V for negative full scale and 10V for positive full scale, then zero is at 5V. In this case the input voltage is 5V for a desired 0V output.
5. Adjust the Aux1 offset potentiometers (4) so that the output voltage is 0V. The “coarse” pot is adjusted to get close to the desired output, and then the “fine” pot is used for better precision.
6. Set the input voltage for a desired 10V output or full-scale output if that is less than 10V.
7. Adjust the Aux1 gain potentiometers (5) so that the output voltage is as desired.
8. Recheck the offset and gain adjustments, since changing gain may also affect the offset.

For example: If the input range is –10V through +10V, and the same output is desired: First apply 0V to Aux1, then adjust the offset pots so that the Aux1 output is 0V. Next, apply 10V to the input and adjust the gain pots for 10V at the output. Finally repeat the procedure to check both the offset and gain values.

If the input range is 0 through 5V and the desired output is –10V through 10V: First apply 2.5V to the Aux1 input, then adjust the offset pots for 0V at the output. Next, apply 5V and adjust the gain pots for 10V at the output. Finally repeat the procedure to check both offset and gain values.

Note that the Aux1 output voltage will always be displayed on the handwheel upper LCD display. It will read “1000” at 10.00 volts and “-1000” at –10.00 volts.

Procedure for calibration of the Aux2 input:

1. The power must be on to the Battery/Electronics box (green and yellow buttons are lit). The Signal in/out cable must be attached. The Command Module and Machine cables may be attached, but this is not necessary.
2. A variable DC voltage source is applied to the Aux2 input of the Signal in/out cable (green wire).
3. The Aux1 output voltage is measured at test point (3) with ground at test point (1).
4. Set the input voltage for a desired 0V output.
5. Adjust the Aux1 offset potentiometers (6) so that the output voltage is 0V. The “coarse” pot is adjusted to get close to the desired output, then the “fine” pot is used for better precision.
6. Set the input voltage for a desired 10V output or full-scale output, whichever is less.
7. Adjust the Aux1 gain potentiometers (7) so that the output voltage is as desired.
8. Recheck the offset and gain adjustments, since changing gain may also effect the offset.

Note that the Aux2 output voltage will be displayed on the handwheel lower LCD display if that is selected by the display switch (8). The display will read “1000” at 10.00 volts. If the switch is set for Steer angle, then the Aux2 output will not be displayed.

SPEED AND ROLL RATE FEEDBACK

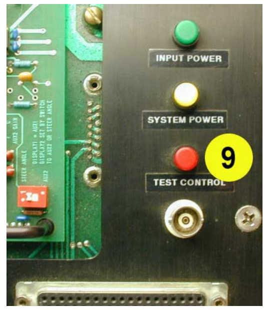

Figure 2: Test Control Enable Button on Electronics box (9)

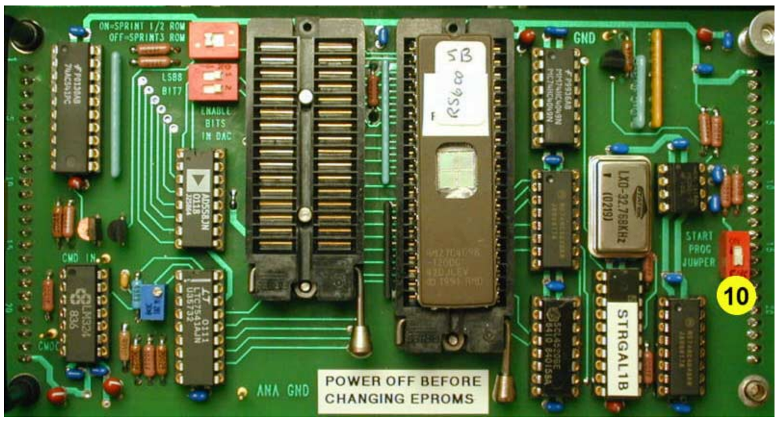

Figure 3: Program Module showing Start Program Switch as (10)

9: Test Control enable switch on Battery/Electronics box. Test control is disabled when OFF (unlit).

10: Start Program switch on Program Module. Test control is disabled when ON.

These two switches effectively perform the same function, though they have opposite polarities.

For the speed and roll rate feedback functions to operate, the test control enable switch button (9) must be ON (lit) AND the Start Program switch (10) must be off (↓).

If the Start Program switch (10) is ON (↑) then the pause functions of the test control module are disabled. Also in this case the Test Control module may be removed and the machine will function normally, though without speed and roll rate feedback and with no signals available to the handwheel displays. Thus it is preferable to leave the module installed.

The Test Control Enable button has no effect if the Test Control Module is not installed.

Test Control Enable button (9)	Start Program Switch (10)	Test Control
OFF	OFF	Disabled
OFF	ON	Disabled
ON	OFF	**Enabled**
ON	ON	Disabled

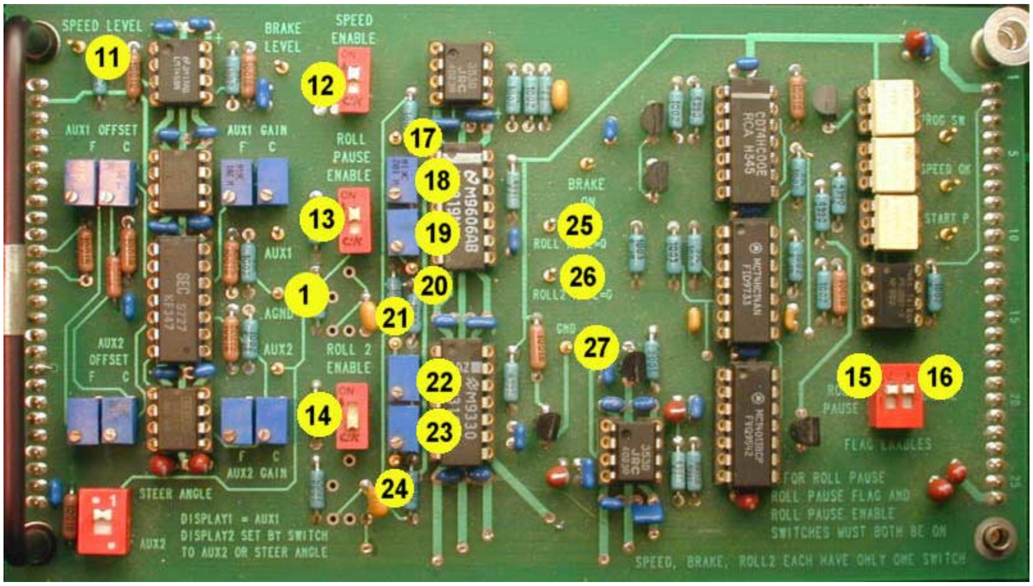

Figure 4: Test Control Module identifying controls for pause and brake

1: Test point for Analog Ground. This is the reference ground for analog signals.

11: Test point for Speed Level. This voltage is set by the Speed pushwheel switch on the Command Module.

12: Speed Enable switch. The Aux1 Speed input is enabled when this switch is ON (↑).

13: Roll Pause Enable switch. The Aux2 Roll rate input is enabled (for roll pause) when this is ON (↑).

14: Roll 2 Enable switch. The Aux 2 roll rate input is applied to the second comparator when this is ON (↑).

15: Roll Pause Flag Enable switch. The Roll Pause Flag is enabled when this switch is ON (↑).

16: Brake Flag switch. The brake flag input is enabled when this switch is ON (↑).

17: Test point for the upper limit of the “roll rate = 0” window for roll pause (roll rate feedback).

18: Potentiometer used to adjust window upper limit voltage at test point (17).

19: Potentiometer used to adjust window lower limit voltage at test point (20).

20: Test point for the lower limit of the “roll rate = 0” window for roll pause (roll rate feedback).

21: Test point for the upper limit of the “roll 2 = 0” window.

22: Potentiometer used to adjust “roll 2” window upper limit voltage at test point (21).

23: Potentiometer used to adjust “roll 2” window lower limit voltage at test point (24).

24: Test point for the lower limit of the “roll 2 rate = 0” window.

25: Test point for the “roll rate = 0” digital signal.

26: Test point for the “roll 2 rate = 0” digital signal.

27: Test point for Digital Ground. This is the reference ground for digital signals.

START PROGRAM AT A SET SPEED

Operation when the Start Program button on the handwheel is pressed:

If the speed is below the set point the program will always start immediately as usual.

If the speed is above the set point, the program will not start until speed drops below the set point. Once it starts it is latched, and will continue until the Start Program button is released, even if speed rises above the set point.

Releasing the Start Program button clears the latch. If the button is released and depressed again with speed above the set point, the program will be delayed until speed drops below the set point.

SETUP

- The Start Program switch on the Program module must be OFF ("10" in Figure 3).
- The Test Control Enable button must be ON ("9" in Figure 2)
- The Speed Enable switch on the Test Control module must be ON ("11" in Figure 4).
- A speed signal must be input to Aux1 on the Power supply card. This signal must be calibrated to match the calibration of selected speed in the Command Module.
- The desired speed, below which the program is to be started, is dialed into the thumbwheel switch in the Command Module.

REVERSE STEER AT MAXIMUM ROLL ANGLE

Operation:

During a maneuver, the Roll Flag is pulsed as programmed (WaitforRollPeak function). This causes the program to pause until the roll rate drops to or through zero, which will occur when roll rate reverses at peak roll angle. At that point the program continues.

No pause occurs if the roll rate is zero at the time of the flag pulse.

"Zero" is actually a narrow window, with a size determined by the input voltage scale.

The upper and lower limits of the “zero” window are independently adjustable. The upper window can be 0V to at least 0.8V and the lower window from less than –0.8V to 0V.

The current “standard” window used in NCAP testing is ±1.5 deg/sec. Given a +/-10V input from Aux2, corresponding to ±100 deg/sec roll rate, the necessary voltage window is ±0.15V. Thus the upper limit is set to 0.15V ands the lower limit is set to –0.15V.

It may be desirable to increase the Aux2 gain in order to provide more noise immunity. For example a gain of 5 would provide ±10V at ±20 deg/sec and the window should be set at ±0.75V.

Window calibration:

1. Measure the voltage at the window upper limit test point (“17” in Fig. 4) with AGND as ground reference (“1” in Fig. 4).
2. Adjust the upper limit pot (“18 in Fig. 4) so that the test point voltage is correct.
3. Measure the voltage at the lower limit test point (“20” in Fig 4) with the same ground reference.
4. Adjust the lower limit pot (“19 in Fig. 4) so that the test point voltage is correct.

SETUP:

- The Test Control Enable button (“9” in Figure 2) must be ON (lit).
- The Start Program switch on the Program module must be OFF (“10” in Figure 3).
- The ROLL Pause Enable switch and the Roll Pause Flag Enable switch must both be ON (Marked “13” and “14” in Figure 4).
- A roll rate signal must be input to Aux2 on the Power supply card. If necessary this signal may be calibrated on that card so that the signal to the Test Control module (and display) is zero at zero roll rate. (e.g. a unipolar input such as 0 to 10V with 5V at zero roll rate may be recalibrated to bipolar, so that the function will work).

Sample fishhook program for NHTSA NCAP:

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30 degrees steer at 0.3g
desired fishhook steer angle is 30 deg x 6.5 = 195 deg

maxsteer(360 deg)
begin

wait(0.5s)
rampto(195d, 0.2708s)  ; 720 deg/s
waitforrollpeak
rampto(-195d, 0.5417s)
wait(3s);
rampto(0d, 1s)

end
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Notes:

1. The "maxsteer" angle must be greater than or equal to the greatest steer in the program. This value must then be entered on the command module steer angle switch before running the program, in order to achieve the correct angles and rates.
   We normally try to use the same value for all or most of the programs in a single EPROM. This is done to minimize driver error by reducing the number of changes he must make between programs. For example: The above was copied from a ROM program in which there is no steer over 360 degrees in any of the 16 programs.
2. There should be a short delay ("wait" command) before the first steer, especially if the first steer rate is large. This delay should be at least 0.15 seconds long.
3. This program will steer to 195 degrees, then wait for the roll rate to enter the "zero" window, then will ramp to –195 degrees where it will stay for 3 seconds before returning to 0 degrees.
4. The minimum pause length in the above program is 0 seconds, which will occur if the roll rate is within the "zero" window at the instant that the steer angle command reaches 195 degrees. It is possible to set a minimum pause by inserting a time parameter, e.g. WaitForRollPeak(0.1s). In that case the program would pause for 0.1 seconds before testing the roll rate condition. This is useful for some tests using relatively low initial steer angles where the steer is complete before the vehicle has reacted enough for roll rate to leave "zero".

SECOND WINDOW COMPARATOR

A second window comparator is present on the Test Control Module. Calibration of this is identical to the first comparator, with the obvious exception of the test points and pots used (21, 22, 23, 24 in Fig 4).

The intended use for this comparator is programmed brake control. It will not be further described here.