

Sol 102

TEGA Cal Valve Anomaly

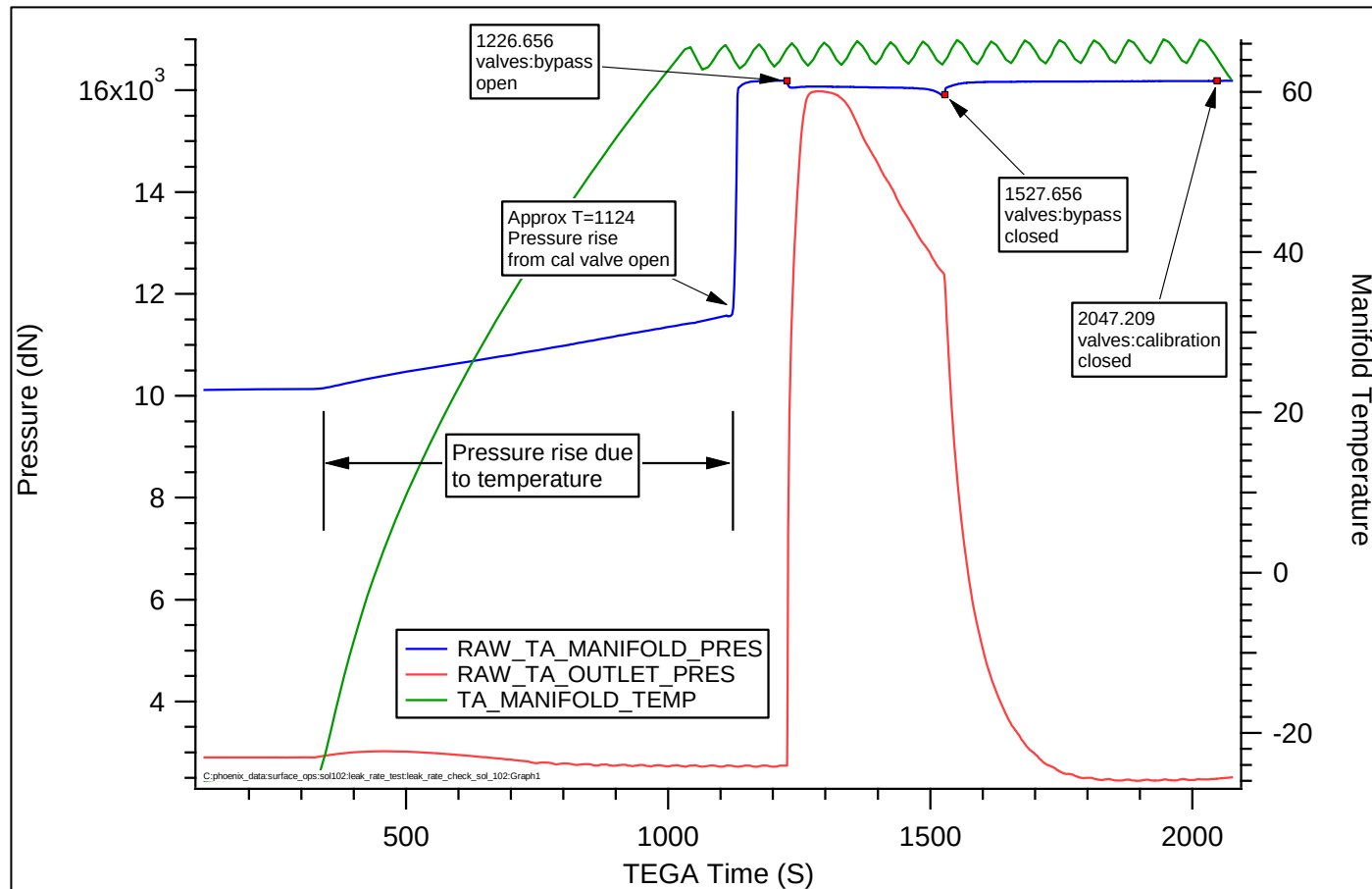
9/7/2008

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Cal Valve Anomaly

- Partway through the carrier leak rate test on sol 102, the manifold pressure shot up to something well over 1 bar
- The FPGA dump prior to shutdown showed that the calibration valve was reporting OPEN
- The automatic valve close commands at shutdown reported closing the calibration valve
- Two subsequent operations on sol 102 (pump and EEPROM update) confirmed that the calibration valve was closed

Cal Valve Anomaly



- Cal valve opens at approx T = 1124 – Manifold pressure jumps to > 1 bar
- At T = 1226, we command the bypass open – Manifold pressure drops slightly, outlet pressure jumps to slightly less than 1 bar
- At T = 1527, we command the bypass valve closed – Outlet pressure drops rapidly
- At T = 2047, the TEGA shutdown code detects the open cal valve and commands it closed

Cal Valve Anomaly

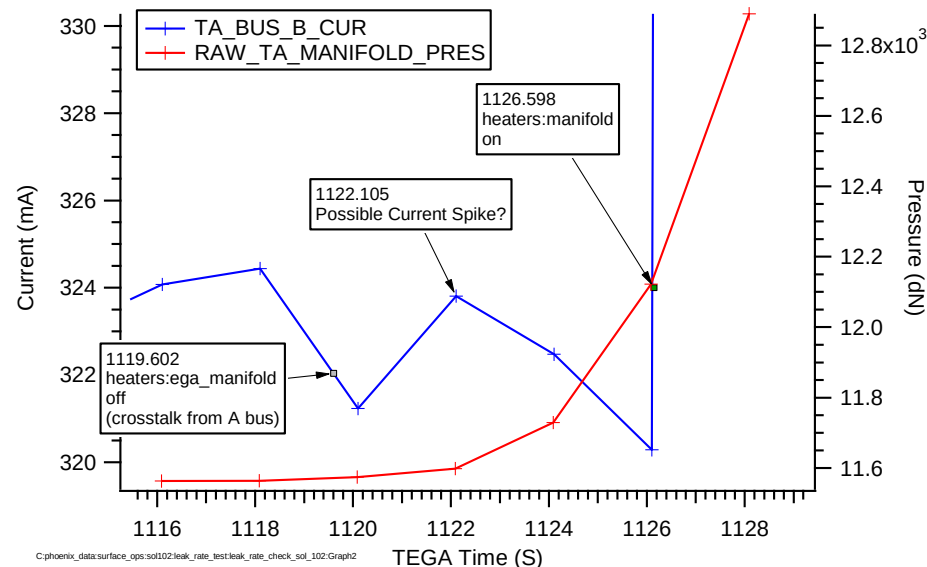
- There is no indication from the messages that the valve was commanded to do anything
 - When we command an Aker valve to move we get 2 messages
 - MSG_CMD_DONE when the FSW executes the command, and
 - MSG_AKER_CHANGE if the FSW actually pulses the valve
- Below are all the messages received around the time the valve changed state
 - Messages indicate no commands received, no Aker state change
 - All that is happening is automatic regulation of the TA and EGA manifold heaters

Time	ID	MSG 1	MSG 2	Raw Time	Message Name	Message Text	Parameters
9/7/2008 13:49:07	91	4	1	1103585	MSG_POWER_CHANGE	heater power changed	heater = 4 (0x0004), state = 1 (0x0001) --> EGA_MANIFOLD ON
	94	1	3	9	MSG_SEQ_EXEC	a sequence is being executed	side = 1 (0x0001), # of commands = 3 (0x0003), index = 9 (0x0009), Execute sequence 9b
9/7/2008 13:49:23	91	4	0	1119602	MSG_POWER_CHANGE	heater power changed	heater = 4 (0x0004), state = 0 (0x0000) --> EGA_MANIFOLD OFF
	Cal Valve opens somewhere about here						
9/7/2008 13:49:30	94	1	3	4	MSG_SEQ_EXEC	a sequence is being executed	side = 1 (0x0001), # of commands = 3 (0x0003), index = 4 (0x0004), Execute sequence 4b
	91	1	1	1126598	MSG_POWER_CHANGE	heater power changed	heater = 1 (0x0001), state = 1 (0x0001) --> MANIFOLD ON
9/7/2008 13:49:40	94	1	3	10	MSG_SEQ_EXEC	a sequence is being executed	side = 1 (0x0001), # of commands = 3 (0x0003), index = 10 (0x000A), Execute sequence 10b
	91	4	1	1136619	MSG_POWER_CHANGE	heater power changed	heater = 4 (0x0004), state = 1 (0x0001) --> EGA_MANIFOLD ON
9/7/2008 13:49:57	94	1	3	9	MSG_SEQ_EXEC	a sequence is being executed	side = 1 (0x0001), # of commands = 3 (0x0003), index = 9 (0x0009), Execute sequence 9b
	91	4	0	1153638	MSG_POWER_CHANGE	heater power changed	heater = 4 (0x0004), state = 0 (0x0000) --> EGA_MANIFOLD OFF

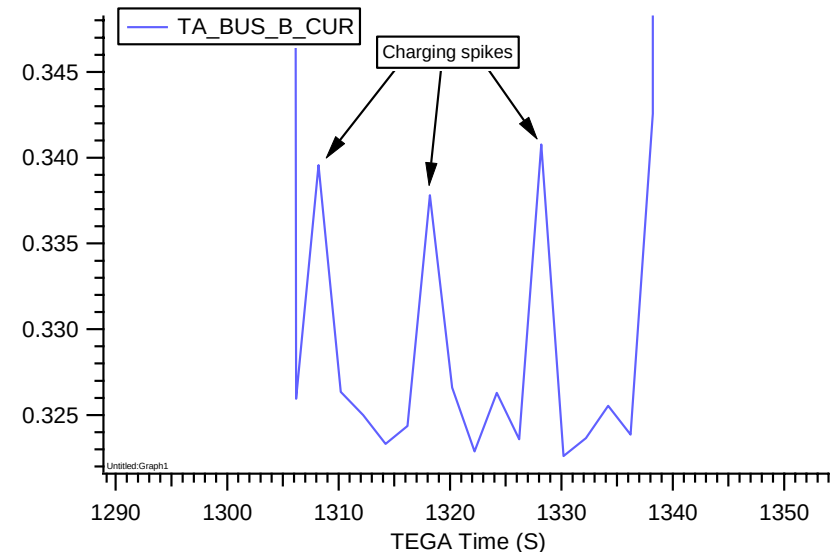
Cal Valve Anomaly

- We collect the bus B current on a 2 second timer
- Normally, we can see the current pulse when the storage capacitor recharges
- In this case, there is no clear current pulse.
 - I have, however, found a few cases where we clearly tried to move the valve but saw no current pulse
 - The time constant for recharging the capacitor is 270mS and the initial charging current is 30mA
 - If we take the measurement more than 1 second after the valve moves, the pulse could be in the noise
- There is what could *possibly* be a current spike at T = 1122, but it is just as likely noise
- There is also a high uncertainty on exactly when the valve opened (next slide)

Sol 102 – *maybe* a charging spike

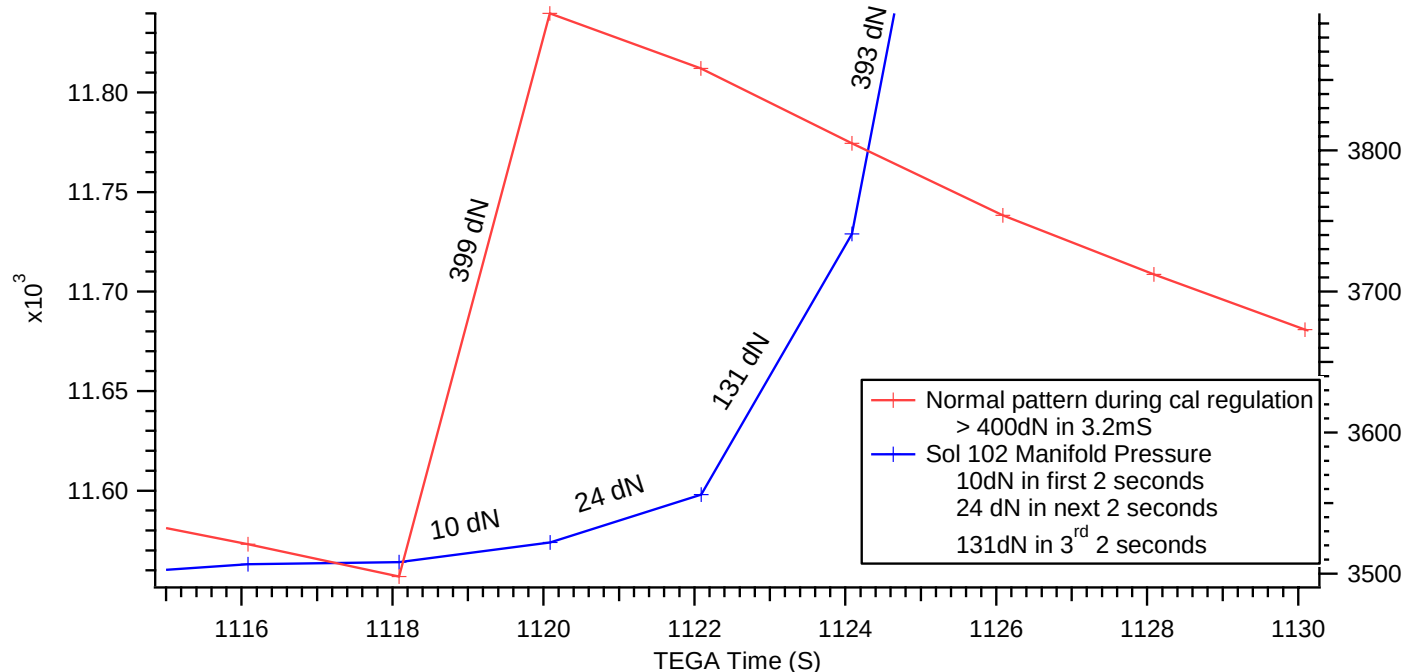


Sol 099 – “normal” charging spikes



Cal Valve Anomaly

- When we open either the carrier or calibration valve, the pressure in the manifold rises very quickly.
 - Typically > 400dN in 3.2mS
- Based on the pressure rise, the cal valve appears to have opened very slowly on sol 102.
 - Average slope due to heating is 5dN per 2 seconds around this time
 - Only 10 dN in the first 2 second interval where the delta exceeds 5dN (1118 – 1120)
 - 24 dN in the second 2 second interval
 - 131 dN in the third 2 second interval
- This is NOT consistent with the valve opening in response to a current pulse



Cal Valve Anomaly

- We have seen one of these valves open apparently spontaneously once before.
 - PFR 117 documents a case during the FM thermal vac where we knew the valve was closed, then we did a cold thermal cycle, then powered up when we crossed the lower AFT on the way back up. 46 seconds after power on, we checked the valve state with an FPGA dump and the carrier valve was OPEN.
 - We have very little useful data on this case because, well, we were off.
 - Also since this was the FM, there was no upstream pressure so no way to independently verify the state of the valve
 - One interesting point of note is that in this case it took 4 close commands before the valve reported closed.

Cal Valve Anomaly

- In Summary
 - The cal valve definitely did open
 - We see the pressure rise
 - Confirmation from FPGA dump before shutdown
 - TEGA failsafe detected the open valve and closed it
 - Two subsequent runs on sol 102 did FPGA dumps that confirm the valve is no longer showing an open indication
 - Sol 104 data will confirm this
 - This is NOT a commanding error
 - 386 would report command received, and no such message in the data
 - This does not look like the electronics spontaneously opened the valve
 - No current spike
 - but only a 50% chance of seeing it if there was one
 - Valve opened very slowly
 - Valve opens very quickly when commanded
 - We have seen one of these valves do this once before
 - PFR 117