2D Graphical Event Sequence

3/14/2003

Timing based on Time Line
Team Data Rev. 15
Introduction

• **The graphical event sequence is a visual time history of relevant sensor information in the left wing and wheel well areas**
  – Covers approximately 8 minute timeframe, from first anomalous sensor reading through last available telemetry
  – Documents known anomalous sensor responses per the latest revision of events timeline from OVEWG Data Review and Timeline team

• **Information contained in the graphical event sequence include:**
  – Sensor location on orbiter and its associated wire bundle in X-Y plane
  – Wire bundle routing
  – Description of each anomalous sensor event
  – Time annotation by (a) GMT, (b) time relative to LOS, (c) time history bar, and (d) ground track
  – Graphical display of temperature rise (based on delta temperature from point it is determined to be anomalous)
Sensor Cabling

Sensor is color coded to the cable harness/bundle it routes through.
Systems appear **Nominal**

13:52:00 (LOS -7:32)

**Good Sensor**
**Off Nominal ΔT>0°F**
**Off Nominal ΔT>15°F**
**Off Nominal ΔT>30°F**
**Offline Sensor**
**Expected Prox State**
**Unexpected Prox State**
First clear indication of off-Nominal aero increments

13:52:05 (LOS -7:27)

GOOD SENSOR
OFF NOMINAL \( \Delta T > 0°F \)
OFF NOMINAL \( \Delta T > 15°F \)
OFF NOMINAL \( \Delta T > 30°F \)
OFFLINE SENSOR
EXPECTED PROX STATE
UNEXPECTED PROX STATE
V58T1703A
Left Main Gear Brake Line Temp D
Off Nominal temp rise

13:52:17 (LOS -7:15)

Good Sensor
Off Nominal ΔT>0°F
Off Nominal ΔT>15°F
Off Nominal ΔT>30°F
Offline Sensor
Expected Prox State
Unexpected Prox State
Supply Water Dump Nozzle A/B
Off Nominal temp rise rate

V62T0440A
V62T0439A

13:52:32 (LOS -7:00)

Good Sensor
Off Nominal ΔT>0°F
Off Nominal ΔT>15°F
Off Nominal ΔT>30°F
Offline Sensor
Expected Prox State
Unexpected Prox State
Vacuum Vent
Off Nominal temp rise rate

Good Sensor
Off Nominal \( \Delta T > 0^\circ F \)
Off Nominal \( \Delta T > 15^\circ F \)
Off Nominal \( \Delta T > 30^\circ F \)
Offline Sensor
Expected Prox State
Unexpected Prox State
V58T1700A
Left Main Gear Brake Line
Temp A
Off Nominal temp rise

13:52:41 (LOS -6:51)

Good Sensor
Off Nominal ΔT>0°F
Off Nominal ΔT>15°F
Off Nominal ΔT>30°F
Offline Sensor
Expected Prox State
Unexpected Prox State
V58T1702A
Left Main Gear Brake Line
Temp C
Off Nominal temp rise

13:52:41 (LOS -6:51)

Good Sensor
Off Nominal $\Delta T > 0°F$
Off Nominal $\Delta T > 15°F$
Off Nominal $\Delta T > 30°F$
Offline Sensor
Expected Prox State
Unexpected Prox State
V09T1006A
Left Inboard Elevon Lower
Skin Temp
Shows wire damage trend

13:52:56 (LOS -6:36)
V09T1006A

Left Inboard Elevon Lower
Skin Temp
Goes off line

13:52:59 (LOS -6:33)
First clear indication of off-nominal rolling moment increment

13:53:01 (LOS -6:31)

Good Sensor
Off Nominal $\Delta T>0^\circ F$
Off Nominal $\Delta T>15^\circ F$
Off Nominal $\Delta T>30^\circ F$
Offline Sensor
Expected Prox State
Unexpected Prox State
V58T0157A
Hyd Sys 1 Left Inboard Elevon
Actuator Return Line Temp
Shows wire damage trend

13:53:02 (LOS -6:30)

Good Sensor
Off Nominal ∆T>0°F
Off Nominal ∆T>15°F
Off Nominal ∆T>30°F
Offline Sensor
Expected Prox State
Unexpected Prox State
V58T0394A
Hyd Sys 3 Left Outboard Elevon Actuator Return Line Temp
Shows wire damage trend
V58T0394A
Hyd Sys 3 Left Outboard Elevon Actuator Return Line Temp

Goes off line

13:53:10 (LOS -6:22)
V58T0157A
Hyd Sys 1 Left Inboard Elevon Actuator Return Line Temp
Goes off line

13:53:11 (LOS -6:21)
V58T0193A
Hyd Sys 1 Left Outboard Elevon Actuator Return Line Temp
 Goes off line

13:53:34 (LOS -5:58)

1

V58T0193A
Hyd Sys 1 Left Outboard Elevon Actuator Return Line Temp
 Goes off line

13:53:34 (LOS -5:58)

1
V58T0257A  
Hyd Sys 2 Left Inboard Elevon  
Actuator Return Line Temp  
Shows wire damage trend

13:53:34 (LOS -5:58)

Good Sensor
Off Nominal $\Delta T>0^\circ$F
Off Nominal $\Delta T>15^\circ$F
Off Nominal $\Delta T>30^\circ$F
Offline Sensor
Expected Prox State
Unexpected Prox State
Supply Water Dump Nozzle A/B
Return to Nominal temp rise rate

13:53:35 (LOS -5:57)

Good Sensor
Off Nominal ΔT>0°F
Off Nominal ΔT>15°F
Off Nominal ΔT>30°F

Expected Prox State
Offline Sensor
Unexpected Prox State
V62T0551A
Vacuum Vent
Return to Nominal temp rise rate
V58T0257A
Hyd Sys 2 Left Inboard Elevon Actuator Return Line Temp
Goes off line

13:53:36 (LOS -5:56)
Debris #1 - 1st report of debris observed leaving the Orbiter (time is ± 2 sec)
Debris #2 - 2nd report of debris observed leaving the Orbiter (time is ± 2 sec)
Debris #3 - 3rd report of debris observed leaving the Orbiter (time is ± 2 sec)

13:53:56 (LOS -5:36)

Good Sensor
Off Nominal $\Delta T > 0^\circ F$
Off Nominal $\Delta T > 15^\circ F$
Off Nominal $\Delta T > 30^\circ F$
Offline Sensor
Expected Prox State
Unexpected Prox State
Debris #4 - 4th report of debris observed leaving the Orbiter (time is ± 2 sec)

13:54:02 (LOS -5:30)

Debris #4 - 4th report of debris observed leaving the Orbiter (time is ± 2 sec)
Debris #5 - 5th report of debris observed leaving the Orbiter (time is ± 2 sec)
Left Main Gear Brake Line
Temp B
Off Nominal temp rise

V58T1701A

13:54:10 (LOS -5:22)

Good Sensor
Off Nominal ΔT>0°F
Off Nominal ΔT>15°F
Off Nominal ΔT>30°F
Offline Sensor
Expected Prox State
Unexpected Prox State
Start of slow aileron trim change
Reversal in growth trend of
derived roll moment coefficient

13:54:20 (LOS -5:12)
V34T1106A
Mid Fuselage Left Body Line
Temp at x1215
Off Nominal temp rise

13:54:22 (LOS -5:10)

Good Sensor
Off Nominal ΔT>0°F
Off Nominal ΔT>15°F
Off Nominal ΔT>30°F
Offline Sensor
Expected Prox State
Unexpected Prox State
V09T1724A
LH Aft Fuselage Sidewall
Temp at x1410
Off Nominal temp rise

13:54:22 (LOS -5:10)

Good Sensor
Off Nominal \(\Delta T>0^\circ F\)
Off Nominal \(\Delta T>15^\circ F\)
Off Nominal \(\Delta T>30^\circ F\)
Offline Sensor
Expected Prox State
Unexpected Prox State
Left Main Gear Strut
Actuator Temp
Off Nominal temp rise

Good Sensor
Off Nominal $\Delta T > 0^\circ F$
Off Nominal $\Delta T > 15^\circ F$
Off Nominal $\Delta T > 30^\circ F$
Offline Sensor
Expected Prox State
Unexpected Prox State
Flash #1 - Orbiter envelope suddenly brightened (duration 0.3 sec)
Debris #6 - 6th report of debris observed leaving the Orbiter (Debris events 6 and 14 are visually the Biggest. Time is ± 1 sec)

Debris #6 - 6th report of debris observed leaving the Orbiter
(Debris events 6 and 14 are visually the Biggest. Time is ± 1 sec)
V51T0574A
MLG LH Outboard Wheel Temp
Off Nominal temp rise (2 bits)
Debris #7 - 7th report of debris observed leaving the Orbiter (time is ± 3 sec)


Debris #7 - 7th report of debris observed leaving the Orbiter (time is ± 3 sec)
V58T0842A
System 3 LH Forward Brake Switch Valve Return Line Temp
Off Nominal temp rise

13:55:12 (LOS -4:20)

Good Sensor
Off Nominal ΔT>0°F
Off Nominal ΔT>15°F
Off Nominal ΔT>30°F
Offline Sensor
Expected Prox State
Unexpected Prox State
Debris #8 - 8th report of debris observed leaving the Orbiter (time is ± 3 sec)

13:55:24 (LOS -4:08)
Debris #9 - 9th report of debris observed leaving the Orbiter (time is ± 2 sec)

13:55:27 (LOS -4:05)
Debris #10 - 10th report of debris observed leaving the Orbiter
(time is ± 2 sec)
Debris #11 - 11th report of debris observed leaving the Orbiter
(time is ± 3 sec)

V34T1118A
Mid Fuselage Port (Left) Sill
Longeron Temp at x1215
Off Nominal temp rise


Good Sensor
Off Nominal ΔT>0°F
Off Nominal ΔT>15°F
Off Nominal ΔT>30°F
Offline Sensor
Expected Prox State
Unexpected Prox State
Debris #12 - 12th report of debris observed leaving the Orbiter
(time is ± 2 sec)

13:55:47 (LOS -3:45)

Debris #12 - 12th report of debris observed leaving the Orbiter (time is ± 2 sec)
Debris #13 - 13th report of debris observed leaving the Orbiter
(time is ± 2 sec)

13:55:57 (LOS -3:35)

Good Sensor
Off Nominal ∆T>0°F
Off Nominal ∆T>15°F
Off Nominal ∆T>30°F
Offline Sensor
Expected Prox State
Unexpected Prox State
Debris #14 - 14th report of debris observed leaving the Orbiter
(Debris events 6 and 14 are visually the Biggest. Time is ± 1 sec)
Left Lower Wing Skin Temp
Shows wire damage trend
Debris #15 - 15th report of debris observed leaving the Orbiter (time is ± 2 sec)

13:56:11 (LOS -3:21)
V58T0125A
LMG Uplock Actuator Unlock
Line Temp
Off Nominal temp rise

13:56:16 (LOS -3:16)

Good Sensor
Off Nominal ΔT>0°F
Off Nominal ΔT>15°F
Off Nominal ΔT>30°F
Offline Sensor
Expected Prox State
Unexpected Prox State
V09T1024A
Left Upper Wing Skin Temp
Shows wire damage trend

13:56:24 (LOS -3:08)

13:59:32

Good Sensor
Off Nominal $\Delta T > 0^\circ F$
Off Nominal $\Delta T > 15^\circ F$
Off Nominal $\Delta T > 30^\circ F$
Offline Sensor
Expected Prox State
Unexpected Prox State
V51P0570A
MLG LH Outbd Tire Pressure 1
Off Nominal rise (1 bit)

13:57:19 (LOS -2:13)

Good Sensor
Off Nominal $\Delta T > 0^\circ F$
Off Nominal $\Delta T > 15^\circ F$
Off Nominal $\Delta T > 30^\circ F$
Offline Sensor
Expected Prox State
Unexpected Prox State
Debris #16 - 16th report of debris observed leaving the Orbiter
(time is ± 5 sec)

13:57:24 (LOS -2:08)

Good Sensor
Off Nominal ΔT>0°F
Off Nominal ΔT>15°F
Off Nominal ΔT>30°F
Offline Sensor
Expected Prox State
Unexpected Prox State
V51P0572A
MLG LH Outbd Tire Pressure 2
Off Nominal rise (1 bit)

Good Sensor
Off Nominal $\Delta T>0^{\circ}F$
Off Nominal $\Delta T>15^{\circ}F$
Off Nominal $\Delta T>30^{\circ}F$
Offline Sensor
Expected Prox State
Unexpected Prox State
V09T1002A
Left Lower Wing Skin Temp
Goes off line

13:57:28 (LOS -2:04)

Good Sensor
Off Nominal ΔT>0°F
Off Nominal ΔT>15°F
Off Nominal ΔT>30°F
Offline Sensor
Expected Prox State
Unexpected Prox State
V09T1024A
Left Upper Wing Skin Temp
Goes off line

13:57:43 (LOS -1:49)

Good Sensor
Off Nominal $\Delta T > 0^\circ F$
Off Nominal $\Delta T > 15^\circ F$
Off Nominal $\Delta T > 30^\circ F$
Offline Sensor
Expected Prox State
Unexpected Prox State
V58T0841A
System 2 LH Aft Brake Switch Valve Return Temp
Off Nominal temp rise

13:57:54 (LOS -1:38)

Good Sensor
Off Nominal $\Delta T > 0^\circ F$
Off Nominal $\Delta T > 15^\circ F$
Off Nominal $\Delta T > 30^\circ F$
Offline Sensor
Expected Prox State
Unexpected Prox State
Flare 1: Asymmetrical brightening of Orbiter shape observed.
Flare 2: Asymmetrical brightening of Orbiter shape observed

13:58:00 (LOS -1:32)
Start of "sharp" aileron trim increase

13:58:03 (LOS -1:29)

Good Sensor
Off Nominal ∆T>0°F
Off Nominal ∆T>15°F
Off Nominal ∆T>30°F
Offline Sensor
Expected Prox State
Unexpected Prox State
Increase in derived rolling and yawing moment increments
V51P0570A
Main Landing Gear Left Hand
Outboard Tire Press 1
Shows wire damage trend
V51P0571A
Main Landing Gear Left Hand
Inboard Tire Press 1
Shows wire damage trend

Good Sensor
Off Nominal \( \Delta T > 0^\circ F \)
Off Nominal \( \Delta T > 15^\circ F \)
Off Nominal \( \Delta T > 30^\circ F \)
Offline Sensor
Expected Prox State
Unexpected Prox State
V51T0574A
MLG Left Outboard
Wheel Temp
Shows wire damage trend

13:58:32 (LOS -1:00)

Good Sensor
Off Nominal ΔT>0°F
Off Nominal ΔT>15°F
Off Nominal ΔT>30°F
Offline Sensor
Expected Prox State
Unexpected Prox State
Main Landing Gear Left Hand Inboard Wheel Temp
Shows wire damage trend
Main Landing Gear Left Hand
Outboard Tire Press 1
Goes off line

V51P0570A

13:58:38 (LOS -0:54)

Good Sensor
Off Nominal $\Delta T > 0^\circ F$
Off Nominal $\Delta T > 15^\circ F$
Off Nominal $\Delta T > 30^\circ F$
Offline Sensor
Expected Prox State
Unexpected Prox State
V51T0574A
MLG Left Outboard
Wheel Temp
Goes off line

13:58:39 (LOS -0:53)

Good Sensor
Off Nominal \( \Delta T > 0^\circ F \)
Off Nominal \( \Delta T > 15^\circ F \)
Off Nominal \( \Delta T > 30^\circ F \)
Offline Sensor
Expected Prox State
Unexpected Prox State
V51P0572A
Main Landing Gear Left Hand
Outboard Tire Press 2
Shows wire damage trend

13:58:39 (LOS -0:53)

Good Sensor
Off Nominal ΔT>0°F
Off Nominal ΔT>15°F
Off Nominal ΔT>30°F
Offline Sensor
Expected Prox State
Unexpected Prox State
V51P0571A
Main Landing Gear Left Hand
Inboard Tire Press 1
Goes off line

13:58:40 (LOS -0:52)

Good Sensor
Off Nominal ΔT>0°F
Off Nominal ΔT>15°F
Off Nominal ΔT>30°F
Offline Sensor
Expected Prox State
Unexpected Prox State
Main Landing Gear Left Hand
Inboard Tire Press 2
Shows 3.5 psia rise in 2 sec

V51P0573A

13:58:41 (LOS -0:51)

Expected Prox State
Unexpected Prox State

Good Sensor
Off Nominal \( \Delta T > 0^\circ F \)
Off Nominal \( \Delta T > 15^\circ F \)
Off Nominal \( \Delta T > 30^\circ F \)
Offline Sensor

1:40/J105
Main Landing Gear Left Hand
Inboard Tire Press 2
Shows wire damage trend

V51P0573A

13:58:43 (LOS -0:49)

Good Sensor
Off Nominal ΔT>0°F
Off Nominal ΔT>15°F
Off Nominal ΔT>30°F
Offline Sensor
Expected Prox State
Unexpected Prox State
V51T0575A
Main Landing Gear Left Hand
Inboard Wheel Temp
Goes off line

13:58:48 (LOS -0:44)
Main Landing Gear Left Hand
Inboard Tire Press 2
Goes off line

V51P0573A

13:58:48 (LOS -0:44)

Good Sensor
Off Nominal ∆T>0°F
Off Nominal ∆T>15°F
Off Nominal ∆T>30°F
Offline Sensor
Expected Prox State
Unexpected Prox State
Main Landing Gear Left Hand Outboard Tire Press 2 Goes off line

V51P0572A

13:58:54 (LOS -0:38)

Good Sensor
Off Nominal ∆T>0°F
Off Nominal ∆T>15°F
Off Nominal ∆T>30°F
Offline Sensor
Expected Prox State
Unexpected Prox State
V51X0125E
Left Main Gear Downlocked
Sensor bit flips state (indicates gear downlocked)

13:59:06 (LOS -0:26)

Good Sensor
Off Nominal ΔT>0°F
Off Nominal ΔT>15°F
Off Nominal ΔT>30°F
Offline Sensor
Expected Prox State
Unexpected Prox State
Good Sensor
Off Nominal $\Delta T > 0^\circ F$
Off Nominal $\Delta T > 15^\circ F$
Off Nominal $\Delta T > 30^\circ F$
Offline Sensor
Expected Prox State
Unexpected Prox State
ASA 4 Wiring to left wing
Shows evidence of wire damage

13:59:31 (LOS -0:01)

Good Sensor
Off Nominal ΔT>0°F
Off Nominal ΔT>15°F
Off Nominal ΔT>30°F
Offline Sensor
Expected Prox State
Unexpected Prox State
Just prior to Loss of Signal

13:59:32 (LOS -0:00)

Good Sensor
Off Nominal $\Delta T > 0^\circ F$
Off Nominal $\Delta T > 15^\circ F$
Off Nominal $\Delta T > 30^\circ F$
Offline Sensor
Expected Prox State
Unexpected Prox State
## Sensor Names and MSIDs (I)

<table>
<thead>
<tr>
<th>No.</th>
<th>Measurement Nomenclature</th>
<th>MSID</th>
<th>No.</th>
<th>Measurement Nomenclature</th>
<th>MSID</th>
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<tbody>
<tr>
<td>1</td>
<td>LMG Brake Line Temp D</td>
<td>V58T1703A</td>
<td>20</td>
<td>MLG LH Inbd Wheel Temp</td>
<td>V51T0575A</td>
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<tr>
<td>2</td>
<td>LMG Brake Line Temp A</td>
<td>V58T1700A</td>
<td>21</td>
<td>MLG LH Inbd Tire Press 2</td>
<td>V51P0573A</td>
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<td>3</td>
<td>LMG Brake Line Temp C</td>
<td>V58T1702A</td>
<td>22</td>
<td>MLG LH Outbd Tire Press 2</td>
<td>V51P0572A</td>
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<tr>
<td>4</td>
<td>LH Inbd Elev LWR Skin Temp</td>
<td>V09T1006A</td>
<td>23</td>
<td>Hyd Sys 3 LH Inbd Elvn Rtn Ln Temp</td>
<td>V58T0833A</td>
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<td>5</td>
<td>Hyd Sys 3 LOE Rtn Ln T</td>
<td>V58T0394A</td>
<td>24</td>
<td>Hyd Sys 2 LH Otbd Elvn Rtn Ln Temp</td>
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<td>6</td>
<td>Hyd 1 LH Inbd Elvn Actr Rtn Ln T</td>
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<td>Hydr Sys LH Inbd Elvn Actr Temp</td>
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<td>Hyd Sys 1 LOE Rtn Ln T</td>
<td>V58T0193A</td>
<td>26</td>
<td>Hydr Sys LH Outbd Elvn Actr Temp</td>
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<td>8</td>
<td>Hyd 2 LH Inbd Elvn Actr Rtn Ln T</td>
<td>V58T0257A</td>
<td>27</td>
<td>Mid Fuselage Port (Left) Sill Longeron Temp at x1215</td>
<td>V34T1118A</td>
</tr>
<tr>
<td>9</td>
<td>LMG Brake Line Temp B</td>
<td>V58T1701A</td>
<td>28</td>
<td>LH Aft Fuselage Sidewall Temp at x1410</td>
<td>V09T1724A</td>
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<td>10</td>
<td>M-Fus Lt BL Temp at 1215</td>
<td>V34T1106A</td>
<td>29</td>
<td>Left Main Gear Up</td>
<td>V51X0100X</td>
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<td>11</td>
<td>L Main Gear Strut Actuator Temp</td>
<td>V58T0405A</td>
<td>30</td>
<td>Left Main Gear Door Up</td>
<td>V51X0116X</td>
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<td>12</td>
<td>Hyd Sys 1 LMG Uplk Actr Unlk Ln T</td>
<td>V58T0125A</td>
<td>31</td>
<td>Left Main Gear Down</td>
<td>V51X0125E</td>
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<td>13</td>
<td>Hyd 3 LH Fwd Brake Sw Vlv Rtn Ln T</td>
<td>V58T0842A</td>
<td>32</td>
<td>Left Main Gear No WOW</td>
<td>V51X0130X</td>
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<tr>
<td>14</td>
<td>LH UPR Wing Skin Temp</td>
<td>V09T1024A</td>
<td>33</td>
<td>Supply H2O dump Nozzle temps A</td>
<td>V62T0440A</td>
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<tr>
<td>15</td>
<td>LH LWR Wing Skin Temp</td>
<td>V09T1002A</td>
<td>34</td>
<td>Supply H2O dump Nozzle temps B</td>
<td>V62T0439A</td>
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<td>16</td>
<td>Hyd 2 LH Aft Brake Sw Vlv Rtn Ln T</td>
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<td>Waste H2O dump Nozzle temps A</td>
<td>V62T0520A</td>
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<td>17</td>
<td>MLG LH Outbd Tire Press 1</td>
<td>V51P0570A</td>
<td>36</td>
<td>Waste H2O dump Nozzle temps B</td>
<td>V62T0519A</td>
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<td>18</td>
<td>MLG LH Outbd Wheel Temp</td>
<td>V51T0574A</td>
<td>37</td>
<td>Vacuum vent</td>
<td>V62T0551A</td>
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<td>19</td>
<td>MLG LH Inbd Tire Press 1</td>
<td>V51P0571A</td>
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</table>
Sensors Names and MSIDs (II)

Good Sensor
Off Nominal $\Delta T > 0^\circ$F
Off Nominal $\Delta T > 15^\circ$F
Off Nominal $\Delta T > 30^\circ$F
Offline Sensor
Expected Prox State
Unexpected Prox State