

LC Requirements to Design Traceability

LC Version 2.2.0

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| **Requirement Number** | **Requirement Text** | **Software Design Element** | **Applicable Software Functions** | |
| LC1000 | Upon receipt of a No-Op command, LC shall increment the LC Valid Command Counter and generate an event message. | Execution | LC\_NoopCmd | |
| LC1001 | Upon receipt of a Reset command, LC shall reset the following housekeeping variables to a value of zero:   a) Valid Command Counter  b) Command Rejected Counter  c) Passive RTS Execution Counter  d) Actionpoint Sample Count  e) TLM Count  f) RTS Execution Counter | Execution | LC\_ResetCmd | |
| LC1002 | For all LC commands, if the length contained in the message header is not equal to the expected length, LC shall reject the command and issue an event message. | Execution | LC\_NoopCmd  LC\_ResetCmd  LC\_SetLCStateCmd  LC\_SetAPStateCmd  LC\_SetAPPermOffCmd  LC\_ResetAPStatsCmd  LC\_ResetWPStatsCmd | |
| LC1003 | If LC accepts any command as valid, LC shall execute the command, increment the LC Valid Command Counter and issue an event message. | Execution | LC\_NoopCmd  LC\_ResetCmd  LC\_SetLCStateCmd  LC\_SetAPStateCmd  LC\_SetAPPermOffCmd  LC\_ResetAPStatsCmd  LC\_ResetWPStatsCmd | |
| LC1004 | If LC rejects any command, LC shall abort the command execution, increment the LC Command Rejected Counter and issue an error event message. | Execution | LC\_NoopCmd  LC\_ResetCmd  LC\_SetLCStateCmd  LC\_SetAPStateCmd  LC\_SetAPPermOffCmd  LC\_ResetAPStatsCmd  LC\_ResetWPStatsCmd | |
| LC2000 | The flight software shall monitor a maximum of <PLATFORM\_DEFINED> Watchpoints. | Execution | LC\_AppPipe  LC\_CheckMsgForWPs | |
| LC2001 | For each Watchpoint specified in the Watchpoint Definition Table (WDT) LC shall specify an age value which indicates when the data becomes “stale”. | Execution | LC\_ProcessWP | |
| LC2002 | For each Watchpoint specified in the Watchpoint Definition Table (WDT) LC shall maintain the age of the data. | Execution | LC\_ProcessWP | |
| LC2003 | Upon receipt of a message, LC shall compare the data in the message to the table-defined value using the table-defined comparison value and comparison operator for each data point defined in the Watchpoint Definition Table (WDT) if the LC Application State is one of the following:   a) Active  b) Passive | Execution | LC\_AppPipe  LC\_CheckMsgForWPs  LC\_ProcessWP  LC\_OperatorCompare  LC\_CustomFunction | |
| LC2003.1 | LC shall support the following comparison values:   a) =  b) !=  c) >  d) >=  e) <  f) <= | Execution | LC\_OperatorCompare | |
| LC2003.2 | If the WDT comparison operator specifies that a Custom Function shall be performed, LC shall apply the custom function to the data contained in the message. | Execution | LC\_ProcessWP  LC\_CustomFunction | |
| LC2003.3 | If the comparison result for a Watchpoint results in a False, LC shall set the Number of Consecutive True values to zero. | Execution | LC\_ProcessWP | |
| LC2003.4 | If the Watchpoint cannot be evaluated, LC shall set the Watchpoint Results Table to ERROR for the erroneous Watchpoint. | Execution | LC\_ProcessWP | |
| LC2004 | For each Watchpoint, the flight software shall maintain the following statistics in the dump-only Watchpoint Results Table:   a) The result of the last relational comparison (False, True, Error, or Stale)  b) The number of times this Watchpoint has been compared  c) The number of times this Watchpoint has crossed from the False to True result  d) The number of consecutive times the comparison has yielded a True result  e) The cumulative number of times the comparison has yielded a True result  f) Most recent FALSE to TRUE transition value  g) Most recent FALSE to TRUE transition timestamp  h) Most recent TRUE to FALSE transition value  i) Most recent TRUE to FALSE transition timestamp  j) Most recent comparison age | Execution | LC\_ProcessWP | |
| LC2005 | Upon receipt of a table update indication, LC shall validate the Watchpoint Definition Table for the following:   a) Valid operator  b) Data size  c) Message ID | Execution | LC\_ManageTables  LC\_ValidateWDT | |
| LC2006 | LC shall convert telemetry to native byte order prior to evaluating actionpoint or watchpoint equations. | Execution | LC\_ProcessWP  LC\_GetSizedWPData  LC\_EvaluateRPN | |
| LC3000 | Limit Checker shall support up to a maximum of <PLATFORM\_DEFINED> Actionpoints | Execution | LC\_SampleAPReq | |
| LC3001 | Upon receipt of a Sample Request, LC shall process the request specified Actionpoints defined in the Actionpoint Definition Table (ADT) if the LC Application State is one of the following:   a) Active  b) Passive | Execution | LC\_SampleAPReq  LC\_SampleAPs |
| LC3001.1 | LC shall support the following Reverse Polish Operators:   a) And  b) Or  c) Xor  d) Not  e) equals | Execution | LC\_EvaluateRPN | |
| LC3001.2 | If the equation result for an Actionpoint results in a Pass, LC shall set the Number of Consecutive Fail values to zero. | Execution | LC\_SampleSingleAP | |
| LC3001.3 | If the Actionpoint cannot be evaluated, LC shall set the Actionpoint Results Table to ERROR for the erroneous Actionpoint. | Execution | LC\_SampleSingleAP | |
| LC3002 | For Each table-defined Actionpoint, LC shall store the results in the dump-only Actionpoint Results Table if the Actionpoint state is either:   a) Active  b) Passive | Execution | LC\_SampleSingleAP | |
| LC3002.1 | If the Actionpoint equation results in a transition from PASS to FAIL, LC shall issue an event message indicating the failure. | Execution | LC\_SampleSingleAP  CFE\_EVS\_SendEvent | |
| LC3002.1.1 | If the PASS to FAIL transition event message has been sent for the table-defined number of times, LC shall apply the table-defined event message filter. | Execution |  | |
| LC3002.2 | If the Actionpoint equation results in a transition from FAIL to PASS, LC shall issue an event message indicating that the actionpoint is now within limits. | Execution | LC\_SampleSingleAP  CFE\_EVS\_SendEvent | |
| LC3002.2.1 | If the FAIL to PASS transition event message has been sent for the table-defined number of times, LC shall apply the table-defined event message filter. | Execution |  | |
| LC3002.3 | If the equation has yielded a Fail result for the table-defined consecutive number of times limit and the Actionpoint is currently Active, LC shall:   a) generate an event message  b) send a command to start the table-defined RTS  c) Increment the counter indicating Total count of commands sent to SC task to start an RTS | Execution | LC\_SampleSingleAP  LC\_ExecuteRTS  CFE\_EVS\_SendEvent | |
| LC3002.3.1 | Once an RTS is initiated, LC shall change the current state of the associated Actionpoint to Passive. | Execution | LC\_SampleSingleAP | |
| LC3002.4 | If the equation has yielded a Fail result for the defined consecutive number of times and the Actionpoint is currently Passive, LC shall:   a) generate an event message indicating that the Actionpoint Failed but the action was not taken  b) Increment the Passive RTS Execution Counter | Execution | LC\_SampleSingleAP | |
| LC3003 | If the Actionpoint is Disabled, LC shall skip processing that actionpoint. | Execution | LC\_SampleSingleAP | |
| LC3004 | If the Actionpoint is Unused, LC shall skip processing that actionpoint | Execution | LC\_SampleSingleAP | |
| LC3005 | If the Actionpoint is Permanently Disabled, LC shall skip processing that actionpoint | Execution | LC\_SampleSingleAP | |
| LC3006 | For each Actionpoint, the flight software shall maintain the following statistics in the dump-only Actionpoint Results Table:   a) The result of the last Sample (Pass, Fail, Error, or Stale)  b) The current state (PermOff, Disabled, Active, Passive, Unused)  c) The number of times this Actionpoint has crossed from the Fail to Pass state  d) The number of times this Actionpoint has crossed from the Pass to Fail state  e) The number of consecutive times the equation result = Failed  f) The cumulative number of times the equation result = Failed  g) The cumulative count of the RTS executions  h) Total number of event messages sent | Execution | LC\_SampleSingleAP | |
| LC3007 | Upon receipt of a table update indication, LC shall validate the Actionpoint Definition Table for the following:   a) valid default state  b) RTS number (in range)  c) Event Type (DEBUG, INFO, ERROR, CRITICAL)  d) Failure Count (in range)  e) Action Equation syntax | Execution | LC\_ManageTables  LC\_ValidateADT | |
| LC4000 | Upon receipt of a Set LC Application State To Active Command, LC shall set the state of the LC Application to Active. | Execution | LC\_SetLCStateCmd | |
| LC4001 | Upon receipt of a Set LC Application State to Passive Command, LC shall set the LC Application State to Passive. | Execution | LC\_SetLCStateCmd | |
| LC4002 | Upon receipt of a Set LC Application State to Disable Command, LC shall set the LC Application State to Disabled. | Execution | LC\_SetLCStateCmd | |
| LC4003 | Upon receipt of a Set Actionpoint to Active Command, LC shall set the state for the command-specified Actionpoint to ACTIVE such that the actionpoint is evaluated and the table-defined actions are taken based on the evaluation. | Execution | LC\_SetAPStateCmd | |
| LC4004 | Upon receipt of a Set All Actionpoints to Active Command, LC shall set the state for all Actionpoints to ACTIVE such that the actionpoints are evaluated and the table-defined actions are taken based on the evaluation. | Execution | LC\_SetAPStateCmd | |
| LC4005 | Upon receipt of a Set Actionpoint to Passive Command, LC shall set the state for the command-specified Actionpoint to PASSIVE such that the actionpoint is evaluated, however, no actions are taken. | Execution | LC\_SetAPStateCmd | |
| LC4006 | Upon receipt of a Set All Actionpoints to Passive Command, LC shall set the state for the all Actionpoints to PASSIVE such that all actionpoints are evaluated, however, no actions are taken. | Execution | LC\_SetAPStateCmd | |
| LC4007 | Upon receipt of a Set Actionpoint to Disabled Command, LC shall set the state for the command-specified Actionpoint to DISABLED such that the actionpoints are not evaluated and no actions are taken. | Execution | LC\_SetAPStateCmd | |
| LC4008 | Upon receipt of a Set All Actionpoints to Disabled Command, LC shall set the state for all Actionpoint to DISABLED such that:   a) the actionpoints are not evaluated  b) no actions are taken  c) no event messages generated. | Execution | LC\_SetAPStateCmd | |
| LC4009 | Upon receipt of a Set Actionpoint to Permanent Disable, LC shall mark the command-specified Actionpoint such that the Actionpoint cannot be Activated. | Execution | LC\_SetAPPermOffCmd | |
| LC4009.1 | If a command is received to Activate an Actionpoint which has been permanently disabled, the command shall be rejected. | Execution | LC\_SetAPStateCmd | |
| LC4010 | Upon receipt of a Reset Actionpoint Statistics Command, LC shall set to zero, all of the following Actionpoint Statistics for the command-specified Actionpoints:   a) Total number of FAIL to PASS transitions  b) Total number of PASS to FAIL transitions  c) Number of consecutive FAIL results  d) Total number of FAIL results  e) Total number of RTS executions  f) Total number of event messages sent relating to that Actionpoint | Execution | LC\_ResetAPStatsCmd  LC\_ResetResultsAP | |
| LC4011 | Upon receipt of a Reset All Actionpoint Statistics Command, LC shall set to zero, all of the following Actionpoint Statistics for all Actionpoints:   a) Total number of FAIL to PASS transitions  b) Total number of PASS to FAIL transitions  c) Number of consecutive FAIL results  d) Total number of FAIL results  e) Total number of RTS executions  f) Total number of event messages sent relating to that Actionpoint | Execution | LC\_ResetAPStatsCmd  LC\_ResetResultsAP | |
| LC4012 | Upon receipt of a Reset Watchpoint Statistics Command, LC shall set to zero all of the following Watchpoint Statistics for the command-specified Watchpoints:   a) Total sample count for this watchpoint  b) Number of times result transitioned from FALSE to TRUE  c) Number of consecutive TRUE results  d) Total number of TRUE results  e) Most recent FALSE to TRUE transition value  f) Most recent FALSE to TRUE transition timestamp  g) Most recent TRUE to FALSE transition value  h) Most recent TRUE to FALSE transition timestamp | Execution | LC\_ResetWPStatsCmd  LC\_ResetResultsWP | |
| LC4013 | Upon receipt of a Reset All Watchpoint Statistics Command, LC shall set to zero, all of the following Watchpoint Statistics for all Watchpoints:   a) Total sample count for this watchpoint  b) Number of times result transitioned from FALSE to TRUE  c) Number of consecutive TRUE results  d) Total number of TRUE results  e) Most recent FALSE to TRUE transition value  f) Most recent FALSE to TRUE transition timestamp  g) Most recent TRUE to FALSE transition value  h) Most recent TRUE to FALSE transition timestamp | Execution | LC\_ResetWPStatsCmd  LC\_ResetResultsWP | |
| LC8000 | LC shall generate a housekeeping message containing the following:   a) Valid Command Counter  b) Command Rejected Counter  c) Passive RTS Execution Counter (Total count of RTS sequences not initiated because either the LC application state or the state of the actionpoint that failed is set to Passive)  d) Current LC Application State (LC\_ACTIVE, LC\_PASSIVE, LC\_DISABLED)...  e) Total count of actionpoints sampled while LC\_ACTIVE or LC\_PASSIVE...  f) Total count of packets monitored for watchpoints (cmd and tlm)  g) RTS Execution Counter (Total count of commands sent to SC task to start an RTS)  h) Selected data from watchpoint results table  i) Selected data from actionpoint results table | Execution | LC\_HousekeepingReq  CFE\_SB\_TransmitMsg | |
| LC9000 | Upon cFE Power-On LC shall initialize the following Housekeeping data to Zero (or value specified):   a) Valid Command Counter  b) Command Rejected Counter  c) Passive RTS Execution Counter  d) Current LC State to <PLATFORM\_DEFINED> Default Power-on State  e) Actionpoint Sample Count  f) TLM Count  g) RTS Execution Counter  h) Watch Results (bitmapped)  i) Action Results (bitmapped) | Initialization | LC\_AppInit | |
| LC9001 | Upon cFE Power-On LC shall initialize the following Watchpoint data to Zero (or value specified) for all Watchpoints:   a) The result of the last watchpoint relational comparison to STALE  b) The number of times this Watchpoint has been compared  c) The number of times this Watchpoint has crossed from the False to True result  d) The number of consecutive times the comparison has yielded a True result  e) The cumulative number of times the comparison has yielded a True result  f) The value that caused the last False-to-True crossing, and the crossing time stamp  g) The value that caused the last True-to-False crossing, and the crossing time stamp | Initialization | LC\_AppInit  LC\_TableInit | |
| LC9002 | Upon cFE Power-On LC shall initialize the following Actionpoint data to Zero (or value specified) for all Actionpoints:   a) The result of the last Actionpoint Sample to STALE  b) The current state as defined in the ADT  c) The number of times this Actionpoint has crossed from the Fail to Pass state  d) The number of times this Actionpoint has crossed from the Pass to Fail state  e) The number of consecutive times the equation result = Failed  f) The cumulative number of times the equation result = Failed  g) The cumulative count of the RTS executions  h) Total number of event messages sent | Initialization | LC\_AppInit  LC\_TableInit | |
| LC9003 | Upon a cFE Processor Reset or LC Application Reset, if the <PLATFORM\_DEFINED> Save Critical Data parameter is set to NO, LC shall perform the same initialization as a cFE Power-on (see LC9000, LC9001, LC9002, and LC9003) | Initialization | LC\_AppInit  LC\_TableInit | |
| LC9004 | Upon a cFE Processor Reset or LC Application Reset, if the <PLATFORM\_DEFINED> Save Critical Data parameter is set to YES, LC shall restore the following data:   a) LC housekeeping data  b) WDT  c) Watchpoint Statistics  d) ADT  e) Actionpoint Statistics | Initialization | LC\_AppInit  LC\_TableInit  LC\_CreateTaskCDS | |
| LC9004.1 | LC shall initialize the LC Application State to <PLATFORM\_DEFINED> Default Reset State | Initialization | LC\_CreateTaskCDS | |
| LC9004.1.1 | If the platform defined Default Reset State indicates to use the state of the LC Application prior to the reset, LC shall set the state of the LC Application to the state restored from the CDS | Initialization | LC\_CreateTaskCDS | |
| LC9004.2 | If LC determines the Critical Data is invalid, LC shall perform the same initialization as a cFE Power-on (see LC9000, LC9001 and LC9002) | Initialization | LC\_CreateTaskCDS | |
| LC9005 | Upon any initialization, LC shall validate the Watchpoint Definition Table for the following:   a) valid operator  b) data size  c) Message ID | Initialization | LC\_AppInit  LC\_TableInit  LC\_ValidateADT | |
| LC9006 | Upon any initialization, LC shall validate the Actionpoint Definition Table for the following:   a) valid default state  b) RTS number (in range)  c) Event Type (DEBUG, INFO, ERROR, CRITICAL)  d) Failure Count (in range)  e) Action Equation syntax | Initialization | LC\_AppInit  LC\_TableInit  LC\_ValidateADT | |
| LC9007 | Upon any initialization, LC shall subscribe to the messages defined in the WDT. | Initialization | LC\_AddWatchpoint  LC\_CreateHashTable  LC\_TableInit | |
| LC9007.1 | For a cFE Processor Reset, If the Save Critical Data parameter is YES, LC shall subscribe to the messages defined in the WDT restored from the CDS | Initialization | LC\_AddWatchpoint  LC\_CreateHashTable  LC\_TableInit | |
| LC9007.2 | For an LC Application Reset, If the Save Critical Data parameter is YES, LC shall subscribe to the messages defined in the WDT restored from the CDS | Initialization | LC\_AddWatchpoint  LC\_CreateHashTable  LC\_TableInit | |