Xcelerator - QX-250 UAV Program

FMECA (MIL-STD-1629A, Custom)

This FMECA report is a composite report based upon the MIL-STD-1629A standard with additional fields capturing qualitative failure information. The report lists Failure Modes for each item in the system model that leads to the selected End Effect with additional fields capturing failure predictability and compensating provisions.

PROJECT DETAILS

Project Name:	Quadcopter Demo
Date of Issue:	Jul 10, 2026, 9:18:59 AM
Report Author:	Chris Martini
Revision:	

DOCUMENT SIGNOFF

Name(s):			
Signature(s):			
Role(s):			
Date:			

DOCUMENT CONTROL

CONTACT DETAILS

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GLOSSARY OF TERMS

TERM	DEFINITION
Aggregate Mission Parameter	The name/type of the Mission Parameter selected to be aggregated over the total Mission Profile.
Aggregate Total	The total of the Aggregate Mission Parameter for the Mission Profile.
Approved By	The manager or superior approving the analysis report.
Compensating Provisions	Actions that are available or can be taken by an operator to negate or mitigate the effect of a failure on a system.
Compiled By	The current user or analyst creating the analysis report.
Description (Mission Profile)	An entry field allowing the user to give a detailed narrative of the Mission Profile.
Description (Phase)	An entry field allowing the user to give a detailed narrative of the Mission Phase.
Description (Segment)	An entry field allowing the user to give a detailed narrative of the Mission Segment.
Duration	A numerical value of the length of time for a Mission Profile, Phase or Segment.
Failure Data Source	The source of failure data such as a reliability database, OEM documentation or operational data.
Failure Effect Probability	The conditional probability that the failure effect will result in the identified criticality classification, given that the failure mode occurs. Represents the analyst`s judgement as to the conditional probability of the loss occurring.
Failure Mode Criticality Number	The portion of the criticality number for the item due to a specific failure mode.
Failure Mode Ratio	Assuming a failure has occurred the probability expressed as a decimal fraction that the part or item will fail in the identified mode over other failure modes possible.
Failure Modes and Causes	The manner by which a failure is observed. Generally describes the way the failure occurs and its impact on equipment operation.
Failure Modes and Causes #	The Path Control Number segment that identifies the Failure Mode and Failure Condition(s), if any, of a Failure Path within a Component.
Failure Rate (or Part Failure Rate)	The total number of failures within an item population, divided by the total number of life units expended by that population, during a particular measurement interval under stated conditions. It is a statistical measure of the reliability of a system element, commonly expressed as failures per million, or failures per million life units. The failure rate is assumed to be constant over a given operational scenario.
Function	The listed functional description or intended purpose of a system item.
Function #	The Path Control Number segment that identifies the Function, Flow and Flow Property of a Failure Path within a Component.
Group Cycles	The number of Mission Cycles for the Mission Profile in the Group.
Group Ratio	The (time-based) ratio of the Mission Profile with respect to other included Mission Profiles.
ID Number	The unique item number that describes a failure path.
Indenture Level	The item levels which identify or describe relative complexity of assembly or function. The levels progress from the more complex (system) to the simpler (part) divisions.
Item / Functional Identification	The listed identifier and name or nomenclature of the item or system function being analyzed for failure mode and effects.
Item Criticality Number	The number of system failures of a specific type expected due to the item`s failure modes. Represents the sum of an items failure mode criticality numbers.
LCN	The Logistic Control Number (LCN) structure represents a topdown physical or functional breakdown of hardware and software for use within Logistics Support Analysis (LSA).
Mission	An exercise involving sequential and / or concurrent operations that have been planned in order to achieve one or more stated objectives / capabilities.
Mission Cycles	The number of cycles of a mission profile that have been completed. This value is multiplied by the duration of an item to determine its overall Duration of Operation.
Mission Phase / Operational Mode	A concise statement of the mission phase and operational mode in which the failure occurs. It includes the most definitive timing information entered for the assumed time of failure occurrence, where subphase, event, or time can be defined from the system definition and mission profiles.
Name (Mission Profile)	The listed identifier or name of the Mission Profile selected in the Report Wizard.
Name (Phase)	The listed identifier or name of a Mission Phase defined in the Mission Phases and Segments page of the Mission Profile.
Name (Segment)	The listed identifier or name of a Mission Segment defined in the Mission Phases and Segments page of the Mission Profile.

GLOSSARY OF TERMS

TERM	DEFINITION
Operating Duration	The duration of operation for that specific item. Duration is measured in time or other assigned unit.
Phase	A primary division of time for each Mission Profile.
Reference Drawing	Design data and drawings identify each item and the item configuration that perform each of the system functions. System design data and drawings usually describe the system's internal and interface functions beginning at system level and progressing to the lowest indenture level of the system. Design data will usually include either functional block diagrams or schematics that will facilitate construction of reliability block diagrams.
Remarks	Includes any pertinent remarks pertaining to and clarifying any other column in the worksheet line shall be noted. This entry also may include a notation of unusual conditions, failure effects of redundant items, recognition of particularly critical design features or any other remarks that amplify the line entry.
Segment	A secondary division of time profile under each Mission Phase.
Severity Class	Severity classifications are assigned to provide a qualitative measure of the worst potential consequences resulting from design error or item failure.
System	Lists the defined item name of the system in the highest level of indenture.
Time	A rolling cumulative by adding time durations for Phases and Segments in a Mission Profile.

SEVERITY CLASSIFICATION DEFINITION & TABLES

SEVERITY CATEGORY	RANGE	SEVERITY CLASSIFICATION
Category I - Catastrophic	9.0 - 10.0	I
Category II - Critical	7.0 - 8.9	II
Category III - Marginal	4.0 - 6.9	III
Category IV - Minor	1.0 - 3.9	IV

MISSION PROFILE SUMMARY

NAME	QX-250 Nominal Sortie	**DESCRIPTION**	
DURATION	10.5m	Representative 10-minute QX-250 quadcopter sortie: startup, takeoff/climb, cruise, hover payload task, aggressive maneuver, return, and landing. Used to accrue stress/duty on the battery, ESC, motor, and propeller for RBD and criticality analysis.	
MISSION CYCLES	1.00		

ID	CODE	NAME	DURATION	ELAPSED TIME	DESCRIPTION
1	P1	Startup & Pre-flight	2m	0.033h	
2	P2	Takeoff & Climb	0.5m	0.042h	
3	P3	Cruise / Transit	4m	0.108h	
4	P4	Hover / Payload Task	2m	0.142h	
5	P5	Aggressive Maneuver	1m	0.158h	
6	P6	Return / Descent	0.5m	0.167h	
7	P7	Landing	0.5m	0.175h	

SYSTEM Quadcopter UAV >Brushless Motor
INDENTURE LEVEL 2
REFERENCE DRAWING
MISSION QX-250 Nominal Sortie

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COMPILED BY Chris Martini
APPROVED BY

ID NUMBER	ITEM / FUNCTIONAL IDENTIFICATION (NOMENCLATURE)	FUNCTION #	FUNCTION	FAILURE MODES AND CAUSES #	FAILURE MODES AND CAUSES	MISSION PHASE / OPERATIONAL MODE	SEVERITY CLASS	FAILURE PREDICTABILITY	FAILURE EFFECT PROBABILITY (β)	FAILURE MODE RATIO (α)	FAILURE RATE (λ_p)	OPERATING DURATION (x)	FAILURE MODE CRIT # $C_m=\beta\alpha\lambda_p x$	ITEM CRIT # $C_r=\sum(C_m)$	CONTROL MEASURES	FAILURE DATA SOURCE
	Brushless Motor A machine that converts electrical energy into mechanical energy, typically rotational motion.	01-01-01	Convert Mechanical - rotational Angular velocity An electric motor functions to convert electrical voltage into mechanical rotational angular velocity.	B	Low Mechanical - rotational Angular velocity due to electrical potential decreasing of the Brushless Motor as a result of burnout caused by over-voltage resulting in Low Pneumatic Pressure (Quadcopter UAV)	1: Startup & Pre-flight [100%] 2: Takeoff & Climb [100%] 3: Cruise / Transit [100%] 4: Hover / Payload Task [100%] 5: Aggressive Maneuver [100%] 6: Return / Descent [100%] 7: Landing [100%]	I		1.00	0.125	2.5E-5	0.175hrs	5.469×10^{-7}	4.375×10^{-6}		This item does not have a failure data source annotation
				B	Low Mechanical - rotational Angular velocity due to electrical potential decreasing of the Brushless Motor as a result of burnout caused by over-current resulting in Low Pneumatic Pressure (Quadcopter UAV)		I									
				B	Low Mechanical - rotational Angular velocity due to electrical potential decreasing of the Brushless Motor as a result of burnout caused by transient electrical loads resulting in Low Pneumatic Pressure (Quadcopter UAV)		I									
				B	Low Mechanical - rotational Angular velocity due to electrical potential decreasing of the Brushless Motor as a result of burnout caused by short circuit resulting in Low Pneumatic Pressure (Quadcopter UAV)		I									
				B	Low Mechanical - rotational Angular velocity due to electrical potential decreasing of the Brushless Motor as a result of burnout caused by electrical potential high resulting in Low Pneumatic Pressure (Quadcopter UAV)		I									
				B	Low Mechanical - rotational Angular velocity due to electrical potential decreasing of the Brushless Motor as a result of burnout caused by electrical resistance low resulting in Low Pneumatic Pressure (Quadcopter UAV)		I									
				B	Low Mechanical - rotational Angular velocity due to fracturing of the Brushless Motor as a result of thermal fatigue caused by temperature fluctuations resulting in Low Pneumatic Pressure (Quadcopter UAV)		I		1.00	0.125	2.5E-5	0.175hrs	5.469×10^{-7}			
				B	Low Mechanical - rotational Angular velocity due to fracturing of the Brushless Motor as a result of high cycle fatigue caused by cyclic mechanical loads and imbalanced mechanical loads and vibration loading resulting in Low Pneumatic Pressure (Quadcopter UAV)		I									
				B	Low Mechanical - rotational Angular velocity due to decreasing dielectric strength of the Brushless Motor as a result of dielectric breakdown caused by line defects resulting in Low Pneumatic Pressure (Quadcopter UAV)		I		1.00	0.125	2.5E-5	0.175hrs	5.469×10^{-7}			
				B	Low Mechanical - rotational Angular velocity due to decreasing dielectric strength of the Brushless Motor as a result of dielectric breakdown caused by over-current resulting in Low Pneumatic Pressure (Quadcopter UAV)		I									

SYSTEM Quadcopter UAV >Brushless Motor
INDENTURE LEVEL 2
REFERENCE DRAWING
MISSION QX-250 Nominal Sortie

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ID NUMBER	ITEM / FUNCTIONAL IDENTIFICATION (NOMENCLATURE)	FUNCTION #	FUNCTION	FAILURE MODES AND CAUSES #	FAILURE MODES AND CAUSES	MISSION PHASE / OPERATIONAL MODE	SEVERITY CLASS	FAILURE PREDICTABILITY	FAILURE EFFECT PROBABILITY (β)	FAILURE MODE RATIO (α)	FAILURE RATE (λ_p)	OPERATING DURATION (x)	FAILURE MODE CRIT # $C_m=\beta\alpha\lambda_p x$	ITEM CRIT # $C_r=\sum(C_m)$	CONTROL MEASURES	FAILURE DATA SOURCE
	Brushless Motor A machine that converts electrical energy into mechanical energy, typically rotational motion.	01-01-01	Convert Mechanical - rotational Angular velocity An electric motor functions to convert electrical voltage into mechanical rotational angular velocity.	B	Low Mechanical - rotational Angular velocity due to decreasing dielectric strength of the Brushless Motor as a result of dielectric breakdown caused by over-voltage resulting in Low Pneumatic Pressure (Quadcopter UAV)	1: Startup & Pre-flight [100%] 2: Takeoff & Climb [100%] 3: Cruise / Transit [100%] 4: Hover / Payload Task [100%] 5: Aggressive Maneuver [100%] 6: Return / Descent [100%] 7: Landing [100%]	I		1.00	0.125	2.5E-5	0.175hrs	5.469×10^{-7}	4.375×10^{-6}		This item does not have a failure data source annotation
				B	Low Mechanical - rotational Angular velocity due to circuit breaking of the Brushless Motor as a result of dielectric breakdown caused by over-voltage resulting in Low Pneumatic Pressure (Quadcopter UAV)		I		1.00	0.125	2.5E-5	0.175hrs	5.469×10^{-7}			
				B	Low Mechanical - rotational Angular velocity due to circuit breaking of the Brushless Motor as a result of burnout caused by electrical potential high resulting in Low Pneumatic Pressure (Quadcopter UAV)		I									
				B	Low Mechanical - rotational Angular velocity due to circuit breaking of the Brushless Motor as a result of burnout caused by transient electrical loads resulting in Low Pneumatic Pressure (Quadcopter UAV)		I									
				B	Low Mechanical - rotational Angular velocity due to circuit breaking of the Brushless Motor as a result of burnout caused by over-current resulting in Low Pneumatic Pressure (Quadcopter UAV)		I									
				B	Low Mechanical - rotational Angular velocity due to circuit breaking of the Brushless Motor as a result of dielectric breakdown caused by over-current resulting in Low Pneumatic Pressure (Quadcopter UAV)		I									
				B	Low Mechanical - rotational Angular velocity due to circuit breaking of the Brushless Motor as a result of burnout caused by over-voltage resulting in Low Pneumatic Pressure (Quadcopter UAV)		I									
				B	Low Mechanical - rotational Angular velocity due to circuit breaking of the Brushless Motor as a result of burnout caused by short circuit resulting in Low Pneumatic Pressure (Quadcopter UAV)		I									
				B	Low Mechanical - rotational Angular velocity due to circuit breaking of the Brushless Motor as a result of dielectric breakdown caused by line defects resulting in Low Pneumatic Pressure (Quadcopter UAV)		I									
				B	Low Mechanical - rotational Angular velocity due to circuit breaking of the Brushless Motor as a result of burnout caused by electrical resistance low resulting in Low Pneumatic Pressure (Quadcopter UAV)		I									

SYSTEM Quadcopter UAV >Brushless Motor
INDENTURE LEVEL 2
REFERENCE DRAWING
MISSION QX-250 Nominal Sortie

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ID NUMBER	ITEM / FUNCTIONAL IDENTIFICATION (NOMENCLATURE)	FUNCTION #	FUNCTION	FAILURE MODES AND CAUSES #	FAILURE MODES AND CAUSES	MISSION PHASE / OPERATIONAL MODE	SEVERITY CLASS	FAILURE PREDICTABILITY	FAILURE EFFECT PROBABILITY (β)	FAILURE MODE RATIO (α)	FAILURE RATE (λ_p)	OPERATING DURATION (x)	FAILURE MODE CRIT # $C_m=\beta\alpha\lambda_p x$	ITEM CRIT # $C_r=\sum(C_m)$	CONTROL MEASURES	FAILURE DATA SOURCE
	Brushless Motor A machine that converts electrical energy into mechanical energy, typically rotational motion.	01-01-01	Convert Mechanical - rotational Angular velocity An electric motor functions to convert electrical voltage into mechanical rotational angular velocity.	B	Low Mechanical - rotational Angular velocity due to pitting of the Brushless Motor as a result of corrosive attack caused by corrosive contaminant and damaged surface protection and insufficient cleaning resulting in Low Pneumatic Pressure (Quadcopter UAV)	1: Startup & Pre-flight [100%] 2: Takeoff & Climb [100%] 3: Cruise / Transit [100%] 4: Hover / Payload Task [100%] 5: Aggressive Maneuver [100%] 6: Return / Descent [100%] 7: Landing [100%]	I		1.00	0.125	2.5E-5	0.175hrs	5.469×10^{-7}	4.375×10^{-6}		This item does not have a failure data source annotation
				B	Low Mechanical - rotational Angular velocity due to pitting of the Brushless Motor as a result of corrosive attack caused by corrosive contaminant and damaged surface protection and untimely maintenance actions resulting in Low Pneumatic Pressure (Quadcopter UAV)		I									
				B	Low Mechanical - rotational Angular velocity due to corroding of the Brushless Motor as a result of corrosive attack caused by corrosive contaminant and damaged surface protection and insufficient cleaning resulting in Low Pneumatic Pressure (Quadcopter UAV)		I		1.00	0.125	2.5E-5	0.175hrs	5.469×10^{-7}		
				B	Low Mechanical - rotational Angular velocity due to corroding of the Brushless Motor as a result of corrosive attack caused by corrosive contaminant and damaged surface protection and untimely maintenance actions resulting in Low Pneumatic Pressure (Quadcopter UAV)		I									
				B	Low Mechanical - rotational Angular velocity due to property mismatching of the Brushless Motor as a result of burnout caused by electrical potential high resulting in Low Pneumatic Pressure (Quadcopter UAV)		I		1.00	0.125	2.5E-5	0.175hrs	5.469×10^{-7}		
				B	Low Mechanical - rotational Angular velocity due to property mismatching of the Brushless Motor as a result of burnout caused by over-current resulting in Low Pneumatic Pressure (Quadcopter UAV)		I									
				B	Low Mechanical - rotational Angular velocity due to property mismatching of the Brushless Motor as a result of burnout caused by over-voltage resulting in Low Pneumatic Pressure (Quadcopter UAV)		I									
				B	Low Mechanical - rotational Angular velocity due to property mismatching of the Brushless Motor as a result of burnout caused by transient electrical loads resulting in Low Pneumatic Pressure (Quadcopter UAV)		I									
				B	Low Mechanical - rotational Angular velocity due to property mismatching of the Brushless Motor as a result of burnout caused by short circuit resulting in Low Pneumatic Pressure (Quadcopter UAV)		I									

SYSTEM Quadcopter UAV >Brushless Motor
INDENTURE LEVEL 2
REFERENCE DRAWING
MISSION QX-250 Nominal Sortie

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ID NUMBER	ITEM / FUNCTIONAL IDENTIFICATION (NOMENCLATURE)	FUNCTION #	FUNCTION	FAILURE MODES AND CAUSES #	FAILURE MODES AND CAUSES	MISSION PHASE / OPERATIONAL MODE	SEVERITY CLASS	FAILURE PREDICTABILITY	FAILURE EFFECT PROBABILITY (β)	FAILURE MODE RATIO (α)	FAILURE RATE (λ_p)	OPERATING DURATION (x)	FAILURE MODE CRIT # $C_m=\beta\alpha\lambda_p x$	ITEM CRIT # $C_r=\sum(C_m)$	CONTROL MEASURES	FAILURE DATA SOURCE
	Brushless Motor A machine that converts electrical energy into mechanical energy, typically rotational motion.	01-01-01	Convert Mechanical - rotational Angular velocity An electric motor functions to convert electrical voltage into mechanical rotational angular velocity.	B	Low Mechanical - rotational Angular velocity due to property mismatching of the Brushless Motor as a result of burnout caused by electrical resistance low resulting in Low Pneumatic Pressure (Quadcopter UAV)	1: Startup & Pre-flight [100%] 2: Takeoff & Climb [100%] 3: Cruise / Transit [100%] 4: Hover / Payload Task [100%] 5: Aggressive Maneuver [100%] 6: Return / Descent [100%] 7: Landing [100%]	I		1.00	0.125	2.5E-5	0.175hrs	5.469×10^{-7}	4.375×10^{-6}		This item does not have a failure data source annotation
				B	Low Mechanical - rotational Angular velocity due to perforating of the Brushless Motor as a result of corrosive attack caused by corrosive contaminant and damaged surface protection and untimely maintenance actions resulting in Low Pneumatic Pressure (Quadcopter UAV)		I		1.00	0.125	2.5E-5	0.175hrs	5.469×10^{-7}			
				B	Low Mechanical - rotational Angular velocity due to perforating of the Brushless Motor as a result of corrosive attack caused by corrosive contaminant and damaged surface protection and insufficient cleaning resulting in Low Pneumatic Pressure (Quadcopter UAV)		I									

SYSTEM Quadcopter UAV >Flight Controller (ESC)
INDENTURE LEVEL 2
REFERENCE DRAWING
MISSION QX-250 Nominal Sortie

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ID NUMBER	ITEM / FUNCTIONAL IDENTIFICATION (NOMENCLATURE)	FUNCTION #	FUNCTION	FAILURE MODES AND CAUSES #	FAILURE MODES AND CAUSES	MISSION PHASE / OPERATIONAL MODE	SEVERITY CLASS	FAILURE PREDICTABILITY	FAILURE EFFECT PROBABILITY (β)	FAILURE MODE RATIO (α)	FAILURE RATE (λ_p)	OPERATING DURATION (x)	FAILURE MODE CRIT # $C_m=\beta\alpha\lambda_p x$	ITEM CRIT # $C_r=\sum(C_m)$	CONTROL MEASURES	FAILURE DATA SOURCE
	Flight Controller (ESC) This control unit senses the electrical energy output of the alternator. Based on this output energy it then controls the voltage supplied to the rotor, therefore controlling the output power of the alternator. It also sends a signal to the engine governor to maintain engine speed so the AC output of the generator is always 50Hz.	01-01-01	Process Continuous Amplitude Modelled as a resistive device, dissipating a small amount of electrical energy as a result of internal resistance.	D	Low Continuous Amplitude due to circuit breaking of the Flight Controller (ESC) as a result of dielectric breakdown caused by over-current resulting in Low Continuous Amplitude (Quadcopter UAV)	1: Startup & Pre-flight [100%] 2: Takeoff & Climb [100%] 3: Cruise / Transit [100%] 4: Hover / Payload Task [100%] 5: Aggressive Maneuver [100%] 6: Return / Descent [100%] 7: Landing [100%]	I		1.00	0.25	1.0E-5	0.175hrs	4.375×10^{-7}	1.75×10^{-6}		This item does not have a failure data source annotation
				D	Low Continuous Amplitude due to circuit breaking of the Flight Controller (ESC) as a result of burnout caused by electrical potential high resulting in Low Continuous Amplitude (Quadcopter UAV)		I									
				D	Low Continuous Amplitude due to circuit breaking of the Flight Controller (ESC) as a result of burnout caused by transient electrical loads resulting in Low Continuous Amplitude (Quadcopter UAV)		I									
				D	Low Continuous Amplitude due to circuit breaking of the Flight Controller (ESC) as a result of burnout caused by electrical resistance low resulting in Low Continuous Amplitude (Quadcopter UAV)		I									
				D	Low Continuous Amplitude due to circuit breaking of the Flight Controller (ESC) as a result of burnout caused by over-voltage resulting in Low Continuous Amplitude (Quadcopter UAV)		I									
				D	Low Continuous Amplitude due to circuit breaking of the Flight Controller (ESC) as a result of dielectric breakdown caused by line defects resulting in Low Continuous Amplitude (Quadcopter UAV)		I									
				D	Low Continuous Amplitude due to circuit breaking of the Flight Controller (ESC) as a result of burnout caused by short circuit resulting in Low Continuous Amplitude (Quadcopter UAV)		I									
				D	Low Continuous Amplitude due to circuit breaking of the Flight Controller (ESC) as a result of burnout caused by over-current resulting in Low Continuous Amplitude (Quadcopter UAV)		I									
				D	Low Continuous Amplitude due to circuit breaking of the Flight Controller (ESC) as a result of dielectric breakdown caused by over-voltage resulting in Low Continuous Amplitude (Quadcopter UAV)		I									
				D	Low Continuous Amplitude due to circuit shorting of the Flight Controller (ESC) as a result of burnout caused by electrical resistance low resulting in Low Continuous Amplitude (Quadcopter UAV)		I		1.00	0.25	1.0E-5	0.175hrs	4.375×10^{-7}			
				D	Low Continuous Amplitude due to circuit shorting of the Flight Controller (ESC) as a result of dielectric breakdown caused by over-voltage resulting in Low Continuous Amplitude (Quadcopter UAV)		I									

SYSTEM Quadcopter UAV >Flight Controller (ESC)
INDENTURE LEVEL 2
REFERENCE DRAWING
MISSION QX-250 Nominal Sortie

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ID NUMBER	ITEM / FUNCTIONAL IDENTIFICATION (NOMENCLATURE)	FUNCTION #	FUNCTION	FAILURE MODES AND CAUSES #	FAILURE MODES AND CAUSES	MISSION PHASE / OPERATIONAL MODE	SEVERITY CLASS	FAILURE PREDICTABILITY	FAILURE EFFECT PROBABILITY (β)	FAILURE MODE RATIO (α)	FAILURE RATE (λ_p)	OPERATING DURATION (x)	FAILURE MODE CRIT # $C_m=\beta\alpha\lambda_p x$	ITEM CRIT # $C_r=\sum(C_m)$	CONTROL MEASURES	FAILURE DATA SOURCE
	Flight Controller (ESC) This control unit senses the electrical energy output of the alternator. Based on this output energy it then controls the voltage supplied to the rotor, therefore controlling the output power of the alternator. It also sends a signal to the engine governor to maintain engine speed so the AC output of the generator is always 50Hz.	01-01-01	Process Continuous Amplitude Modelled as a resistive device, dissipating a small amount of electrical energy as a result of internal resistance.	D	Low Continuous Amplitude due to circuit shorting of the Flight Controller (ESC) as a result of burnout caused by over-voltage resulting in Low Continuous Amplitude (Quadcopter UAV)	1: Startup & Pre-flight [100%] 2: Takeoff & Climb [100%] 3: Cruise / Transit [100%] 4: Hover / Payload Task [100%] 5: Aggressive Maneuver [100%] 6: Return / Descent [100%] 7: Landing [100%]	I		1.00	0.25	1.0E-5	0.175hrs	4.375×10^{-7}	1.75×10^{-6}		This item does not have a failure data source annotation
				D	Low Continuous Amplitude due to circuit shorting of the Flight Controller (ESC) as a result of dielectric breakdown caused by over-current resulting in Low Continuous Amplitude (Quadcopter UAV)		I									
				D	Low Continuous Amplitude due to circuit shorting of the Flight Controller (ESC) as a result of burnout caused by short circuit resulting in Low Continuous Amplitude (Quadcopter UAV)		I									
				D	Low Continuous Amplitude due to circuit shorting of the Flight Controller (ESC) as a result of burnout caused by transient electrical loads resulting in Low Continuous Amplitude (Quadcopter UAV)		I									
				D	Low Continuous Amplitude due to circuit shorting of the Flight Controller (ESC) as a result of dielectric breakdown caused by line defects resulting in Low Continuous Amplitude (Quadcopter UAV)		I									
				D	Low Continuous Amplitude due to circuit shorting of the Flight Controller (ESC) as a result of burnout caused by electrical potential high resulting in Low Continuous Amplitude (Quadcopter UAV)		I									
				D	Low Continuous Amplitude due to circuit shorting of the Flight Controller (ESC) as a result of burnout caused by over-current resulting in Low Continuous Amplitude (Quadcopter UAV)		I									
		01-02-02	Process Electrical Voltage Modelled as a resistive device, dissipating a small amount of electrical energy as a result of internal resistance.	C	Low Electrical Voltage due to circuit shorting of the Flight Controller (ESC) as a result of burnout caused by short circuit resulting in Low Pneumatic Pressure (Quadcopter UAV)	1: Startup & Pre-flight [100%] 2: Takeoff & Climb [100%] 3: Cruise / Transit [100%] 4: Hover / Payload Task [100%] 5: Aggressive Maneuver [100%] 6: Return / Descent [100%] 7: Landing [100%]	I		1.00	0.25	1.0E-5	0.175hrs	4.375×10^{-7}			
				C	Low Electrical Voltage due to circuit shorting of the Flight Controller (ESC) as a result of burnout caused by electrical resistance low resulting in Low Pneumatic Pressure (Quadcopter UAV)		I									
				C	Low Electrical Voltage due to circuit shorting of the Flight Controller (ESC) as a result of dielectric breakdown caused by over-voltage resulting in Low Pneumatic Pressure (Quadcopter UAV)		I									
				C	Low Electrical Voltage due to circuit shorting of the Flight Controller (ESC) as a result of burnout caused by over-voltage resulting in Low Pneumatic Pressure (Quadcopter UAV)		I									

SYSTEM Quadcopter UAV >Flight Controller (ESC)
INDENTURE LEVEL 2
REFERENCE DRAWING
MISSION QX-250 Nominal Sortie

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ID NUMBER	ITEM / FUNCTIONAL IDENTIFICATION (NOMENCLATURE)	FUNCTION #	FUNCTION	FAILURE MODES AND CAUSES #	FAILURE MODES AND CAUSES	MISSION PHASE / OPERATIONAL MODE	SEVERITY CLASS	FAILURE PREDICTABILITY	FAILURE EFFECT PROBABILITY (β)	FAILURE MODE RATIO (α)	FAILURE RATE (λ_p)	OPERATING DURATION (x)	FAILURE MODE CRIT # $C_m=\beta\alpha\lambda_p x$	ITEM CRIT # $C_r=\sum(C_m)$	CONTROL MEASURES	FAILURE DATA SOURCE
	Flight Controller (ESC) This control unit senses the electrical energy output of the alternator. Based on this output energy it then controls the voltage supplied to the rotor, therefore controlling the output power of the alternator. It also sends a signal to the engine governor to maintain engine speed so the AC output of the generator is always 50Hz.	01-02-02	Process Electrical Voltage Modelled as a resistive device, dissipating a small amount of electrical energy as a result of internal resistance.	C	Low Electrical Voltage due to circuit shorting of the Flight Controller (ESC) as a result of burnout caused by electrical potential high resulting in Low Pneumatic Pressure (Quadcopter UAV)	1: Startup & Pre-flight [100%] 2: Takeoff & Climb [100%] 3: Cruise / Transit [100%] 4: Hover / Payload Task [100%] 5: Aggressive Maneuver [100%] 6: Return / Descent [100%] 7: Landing [100%]	I		1.00	0.25	1.0E-5	0.175hrs	4.375×10^{-7}	1.75×10^{-6}		This item does not have a failure data source annotation
				C	Low Electrical Voltage due to circuit shorting of the Flight Controller (ESC) as a result of burnout caused by over-current resulting in Low Pneumatic Pressure (Quadcopter UAV)		I									
				C	Low Electrical Voltage due to circuit shorting of the Flight Controller (ESC) as a result of dielectric breakdown caused by line defects resulting in Low Pneumatic Pressure (Quadcopter UAV)		I									
				C	Low Electrical Voltage due to circuit shorting of the Flight Controller (ESC) as a result of burnout caused by transient electrical loads resulting in Low Pneumatic Pressure (Quadcopter UAV)		I									
				C	Low Electrical Voltage due to circuit shorting of the Flight Controller (ESC) as a result of dielectric breakdown caused by over-current resulting in Low Pneumatic Pressure (Quadcopter UAV)		I									
				C	Low Electrical Voltage due to circuit breaking of the Flight Controller (ESC) as a result of dielectric breakdown caused by line defects resulting in Low Pneumatic Pressure (Quadcopter UAV)		I		1.00	0.25	1.0E-5	0.175hrs	4.375×10^{-7}			
				C	Low Electrical Voltage due to circuit breaking of the Flight Controller (ESC) as a result of burnout caused by electrical resistance low resulting in Low Pneumatic Pressure (Quadcopter UAV)		I									
				C	Low Electrical Voltage due to circuit breaking of the Flight Controller (ESC) as a result of burnout caused by electrical potential high resulting in Low Pneumatic Pressure (Quadcopter UAV)		I									
				C	Low Electrical Voltage due to circuit breaking of the Flight Controller (ESC) as a result of burnout caused by over-voltage resulting in Low Pneumatic Pressure (Quadcopter UAV)		I									
				C	Low Electrical Voltage due to circuit breaking of the Flight Controller (ESC) as a result of burnout caused by short circuit resulting in Low Pneumatic Pressure (Quadcopter UAV)		I									
				C	Low Electrical Voltage due to circuit breaking of the Flight Controller (ESC) as a result of burnout caused by over-current resulting in Low Pneumatic Pressure (Quadcopter UAV)		I									

SYSTEM Quadcopter UAV >Flight Controller (ESC)
INDENTURE LEVEL 2
REFERENCE DRAWING
MISSION QX-250 Nominal Sortie

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COMPILED BY Chris Martini
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ID NUMBER	ITEM / FUNCTIONAL IDENTIFICATION (NOMENCLATURE)	FUNCTION #	FUNCTION	FAILURE MODES AND CAUSES #	FAILURE MODES AND CAUSES	MISSION PHASE / OPERATIONAL MODE	SEVERITY CLASS	FAILURE PREDICTABILITY	FAILURE EFFECT PROBABILITY (β)	FAILURE MODE RATIO (α)	FAILURE RATE (λ_p)	OPERATING DURATION (x)	FAILURE MODE CRIT # $C_m=\beta\alpha\lambda_p x$	ITEM CRIT # $C_r=\sum(C_m)$	CONTROL MEASURES	FAILURE DATA SOURCE
	Flight Controller (ESC) This control unit senses the electrical energy output of the alternator. Based on this output energy it then controls the voltage supplied to the rotor, therefore controlling the output power of the alternator. It also sends a signal to the engine governor to maintain engine speed so the AC output of the generator is always 50Hz.	01-02-02	Process Electrical Voltage Modelled as a resistive device, dissipating a small amount of electrical energy as a result of internal resistance.	C	Low Electrical Voltage due to circuit breaking of the Flight Controller (ESC) as a result of dielectric breakdown caused by over-voltage resulting in Low Pneumatic Pressure (Quadcopter UAV)	1: Startup & Pre-flight [100%] 2: Takeoff & Climb [100%] 3: Cruise / Transit [100%] 4: Hover / Payload Task [100%] 5: Aggressive Maneuver [100%] 6: Return / Descent [100%] 7: Landing [100%]	I		1.00	0.25	1.0E-5	0.175hrs	4.375×10^{-7}	1.75×10^{-6}		This item does not have a failure data source annotation
				C	Low Electrical Voltage due to circuit breaking of the Flight Controller (ESC) as a result of dielectric breakdown caused by over-current resulting in Low Pneumatic Pressure (Quadcopter UAV)		I									
				C	Low Electrical Voltage due to circuit breaking of the Flight Controller (ESC) as a result of burnout caused by transient electrical loads resulting in Low Pneumatic Pressure (Quadcopter UAV)		I									

SYSTEM Quadcopter UAV >LiPo Battery
INDENTURE LEVEL 2
REFERENCE DRAWING
MISSION QX-250 Nominal Sortie

DATE Jul 10, 2026, 9:18:59 AM
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COMPILED BY Chris Martini
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ID NUMBER	ITEM / FUNCTIONAL IDENTIFICATION (NOMENCLATURE)	FUNCTION #	FUNCTION	FAILURE MODES AND CAUSES #	FAILURE MODES AND CAUSES	MISSION PHASE / OPERATIONAL MODE	SEVERITY CLASS	FAILURE PREDICTABILITY	FAILURE EFFECT PROBABILITY (β)	FAILURE MODE RATIO (α)	FAILURE RATE (λ_p)	OPERATING DURATION (x)	FAILURE MODE CRIT # $C_m=\beta\alpha\lambda_p x$	ITEM CRIT # $C_r=\sum(C_m)$	CONTROL MEASURES	FAILURE DATA SOURCE
	LiPo Battery An electrical battery using combination of lead and acids to convert stored chemical energy into electrical energy.	01-01-01	Supply Electrical Voltage Modelled as an electrical storage device which converts stored chemical energy into electrical energy.	B	Low Electrical Voltage due to conductivity increasing of the LiPo Battery as a result of electrolysis caused by ionic contaminant resulting in Low Pneumatic Pressure (Quadcopter UAV)	1: Startup & Pre-flight [100%] 2: Takeoff & Climb [100%] 3: Cruise / Transit [100%] 4: Hover / Payload Task [100%] 5: Aggressive Maneuver [100%] 6: Return / Descent [100%] 7: Landing [100%]	I	Change in performance (LiPo Battery) AND Surface change (LiPo Battery)	1.00	0.1428571	1.0E-4	0.175hrs	2.5×10^{-6}	1.75×10^{-5}		This item does not have a failure data source annotation
				B	Low Electrical Voltage due to weakening of the LiPo Battery as a result of electrolysis caused by ionic contaminant resulting in Low Pneumatic Pressure (Quadcopter UAV)		I	Change in performance (LiPo Battery) AND Surface change (LiPo Battery)	1.00	0.1428571	1.0E-4	0.175hrs	2.5×10^{-6}			
				B	Low Electrical Voltage due to chemical reactivity decreasing of the LiPo Battery as a result of thermal decomposition caused by high temperature resulting in Low Pneumatic Pressure (Quadcopter UAV)		I	Change in performance (LiPo Battery) AND Temperature (LiPo Battery)	1.00	0.1428571	1.0E-4	0.175hrs	2.5×10^{-6}			
				B	Low Electrical Voltage due to circuit shorting of the LiPo Battery as a result of electrostatic spark discharge caused by mishandling resulting in Low Pneumatic Pressure (Quadcopter UAV)		I		1.00	0.1428571	1.0E-4	0.175hrs	2.5×10^{-6}			
				B	Low Electrical Voltage due to decreasing dielectric strength of the LiPo Battery as a result of dielectric breakdown caused by item life-span exceeded resulting in Low Pneumatic Pressure (Quadcopter UAV)		I	Change in performance (LiPo Battery)	1.00	0.1428571	1.0E-4	0.175hrs	2.5×10^{-6}			
				B	Low Electrical Voltage due to decreasing dielectric strength of the LiPo Battery as a result of dielectric breakdown caused by over-current resulting in Low Pneumatic Pressure (Quadcopter UAV)		I									
				B	Low Electrical Voltage due to decreasing dielectric strength of the LiPo Battery as a result of dielectric breakdown caused by line defects resulting in Low Pneumatic Pressure (Quadcopter UAV)		I									
				B	Low Electrical Voltage due to decreasing dielectric strength of the LiPo Battery as a result of dielectric breakdown caused by over-voltage resulting in Low Pneumatic Pressure (Quadcopter UAV)		I									
				B	Low Electrical Voltage due to decreasing dielectric strength of the LiPo Battery as a result of electrostatic spark discharge caused by mishandling resulting in Low Pneumatic Pressure (Quadcopter UAV)		I									
				B	Low Electrical Voltage due to corroding of the LiPo Battery as a result of electrolysis caused by ionic contaminant resulting in Low Pneumatic Pressure (Quadcopter UAV)		I	Change in performance (LiPo Battery) AND Surface change (LiPo Battery)	1.00	0.1428571	1.0E-4	0.175hrs	2.5×10^{-6}			
				B	Low Electrical Voltage due to circuit breaking of the LiPo Battery as a result of electrostatic spark discharge caused by mishandling resulting in Low Pneumatic Pressure (Quadcopter UAV)		I	Change in performance (LiPo Battery)	1.00	0.1428571	1.0E-4	0.175hrs	2.5×10^{-6}			

SYSTEM Quadcopter UAV >LiPo Battery
INDENTURE LEVEL 2
REFERENCE DRAWING
MISSION QX-250 Nominal Sortie

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ID NUMBER	ITEM / FUNCTIONAL IDENTIFICATION (NOMENCLATURE)	FUNCTION #	FUNCTION	FAILURE MODES AND CAUSES #	FAILURE MODES AND CAUSES	MISSION PHASE / OPERATIONAL MODE	SEVERITY CLASS	FAILURE PREDICTABILITY	FAILURE EFFECT PROBABILITY (β)	FAILURE MODE RATIO (α)	FAILURE RATE (λ_p)	OPERATING DURATION (x)	FAILURE MODE CRIT # $C_m=\beta\alpha\lambda_p x$	ITEM CRIT # $C_r=\sum(C_m)$	CONTROL MEASURES	FAILURE DATA SOURCE
	LiPo Battery An electrical battery using combination of lead and acids to convert stored chemical energy into electrical energy.	01-01-01	Supply Electrical Voltage Modelled as an electrical storage device which converts stored chemical energy into electrical energy.	B	Low Electrical Voltage due to circuit breaking of the LiPo Battery as a result of dielectric breakdown caused by line defects resulting in Low Pneumatic Pressure (Quadcopter UAV)	1: Startup & Pre-flight [100%] 2: Takeoff & Climb [100%] 3: Cruise / Transit [100%] 4: Hover / Payload Task [100%] 5: Aggressive Maneuver [100%] 6: Return / Descent [100%] 7: Landing [100%]	I	Change in performance (LiPo Battery)	1.00	0.1428571	1.0E-4	0.175hrs	$2.5x10^{-6}$	$1.75x10^{-5}$		This item does not have a failure data source annotation
				B	Low Electrical Voltage due to circuit breaking of the LiPo Battery as a result of dielectric breakdown caused by over-voltage resulting in Low Pneumatic Pressure (Quadcopter UAV)		I									
				B	Low Electrical Voltage due to circuit breaking of the LiPo Battery as a result of dielectric breakdown caused by item life-span exceeded resulting in Low Pneumatic Pressure (Quadcopter UAV)		I									
				B	Low Electrical Voltage due to circuit breaking of the LiPo Battery as a result of dielectric breakdown caused by over-current resulting in Low Pneumatic Pressure (Quadcopter UAV)		I									

SYSTEM Quadcopter UAV >Propeller
INDENTURE LEVEL 2
REFERENCE DRAWING
MISSION QX-250 Nominal Sortie

DATE Jul 10, 2026, 9:18:59 AM
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ID NUMBER	ITEM / FUNCTIONAL IDENTIFICATION (NOMENCLATURE)	FUNCTION #	FUNCTION	FAILURE MODES AND CAUSES #	FAILURE MODES AND CAUSES	MISSION PHASE / OPERATIONAL MODE	SEVERITY CLASS	FAILURE PREDICTABILITY	FAILURE EFFECT PROBABILITY (β)	FAILURE MODE RATIO (α)	FAILURE RATE (λ_p)	OPERATING DURATION (x)	FAILURE MODE CRIT # $C_m=\beta\alpha\lambda_p x$	ITEM CRIT # $C_r=\sum(C_m)$	CONTROL MEASURES	FAILURE DATA SOURCE
	Propeller A centrifugal pump uses rotational motion to turn mechanical energy into pneumatic pressure.	01-01-01	Control Pneumatic Pressure A centrifugarl pump functions to control a pneumatic pressure based on an angular velocity.	B	Low Pneumatic Pressure due to scratching of the Propeller as a result of abrasive wear caused by solid particle contaminants resulting in Low Pneumatic Pressure (Quadcopter UAV)	1: Startup & Pre-flight [100%] 2: Takeoff & Climb [100%] 3: Cruise / Transit [100%] 4: Hover / Payload Task [100%] 5: Aggressive Maneuver [100%] 6: Return / Descent [100%] 7: Landing [100%]	I		1.00	0.1587302	5.0E-5	0.175hrs	1.389×10^{-6}	8.75×10^{-6}		This item does not have a failure data source annotation
				B	Low Pneumatic Pressure due to fracturing of the Propeller as a result of high cycle fatigue caused by cyclic mechanical loads and imbalanced mechanical loads and vibration loading resulting in Low Pneumatic Pressure (Quadcopter UAV)		I		1.00	0.047619	5.0E-5	0.175hrs	4.167×10^{-7}			
				B	Low Pneumatic Pressure due to fracturing of the Propeller as a result of ductile fracture caused by high mechanical load resulting in Low Pneumatic Pressure (Quadcopter UAV)		I									
				B	Low Pneumatic Pressure due to fracturing of the Propeller as a result of ductile fracture caused by impact loads resulting in Low Pneumatic Pressure (Quadcopter UAV)		I									
				B	Low Pneumatic Pressure due to stretching of the Propeller as a result of ductile fracture caused by impact loads resulting in Low Pneumatic Pressure (Quadcopter UAV)		I		1.00	0.1587302	5.0E-5	0.175hrs	1.389×10^{-6}			
				B	Low Pneumatic Pressure due to stretching of the Propeller as a result of ductile fracture caused by high mechanical load resulting in Low Pneumatic Pressure (Quadcopter UAV)		I									
				B	Low Pneumatic Pressure due to blocking of the Propeller as a result of buildup of debris caused by insufficient cleaning and solid particle contaminants resulting in Low Pneumatic Pressure (Quadcopter UAV)		I		1.00	0.1587302	5.0E-5	0.175hrs	1.389×10^{-6}			
				B	Low Pneumatic Pressure due to blocking of the Propeller as a result of buildup of debris caused by contaminated input flow and insufficient cleaning resulting in Low Pneumatic Pressure (Quadcopter UAV)		I									
				B	Low Pneumatic Pressure due to seizing of the Propeller as a result of buildup of debris caused by insufficient cleaning and solid particle contaminants resulting in Low Pneumatic Pressure (Quadcopter UAV)		I		1.00	0.1587302	5.0E-5	0.175hrs	1.389×10^{-6}			
				B	Low Pneumatic Pressure due to seizing of the Propeller as a result of buildup of debris caused by contaminated input flow and insufficient cleaning resulting in Low Pneumatic Pressure (Quadcopter UAV)		I									
				B	Low Pneumatic Pressure due to interfering of the Propeller as a result of buildup of debris caused by contaminated input flow and insufficient cleaning resulting in Low Pneumatic Pressure (Quadcopter UAV)		I		1.00	0.1587302	5.0E-5	0.175hrs	1.389×10^{-6}			

SYSTEM Quadcopter UAV >Propeller
INDENTURE LEVEL 2
REFERENCE DRAWING
MISSION QX-250 Nominal Sortie

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ID NUMBER	ITEM / FUNCTIONAL IDENTIFICATION (NOMENCLATURE)	FUNCTION #	FUNCTION	FAILURE MODES AND CAUSES #	FAILURE MODES AND CAUSES	MISSION PHASE / OPERATIONAL MODE	SEVERITY CLASS	FAILURE PREDICTABILITY	FAILURE EFFECT PROBABILITY (β)	FAILURE MODE RATIO (α)	FAILURE RATE (λ_p)	OPERATING DURATION (x)	FAILURE MODE CRIT # $C_m=\beta\alpha\lambda_p x$	ITEM CRIT # $C_r=\sum(C_m)$	CONTROL MEASURES	FAILURE DATA SOURCE
	Propeller A centrifugal pump uses rotational motion to turn mechanical energy into pneumatic pressure.	01-01-01	Control Pneumatic Pressure A centrifugarl pump functions to control a pneumatic pressure based on an angular velocity.	B	Low Pneumatic Pressure due to interfering of the Propeller as a result of buildup of debris caused by insufficient cleaning and solid particle contaminants resulting in Low Pneumatic Pressure (Quadcopter UAV)	1: Startup & Pre-flight [100%] 2: Takeoff & Climb [100%] 3: Cruise / Transit [100%] 4: Hover / Payload Task [100%] 5: Aggressive Maneuver [100%] 6: Return / Descent [100%] 7: Landing [100%]	I		1.00	0.1587302	5.0E-5	0.175hrs	1.389×10^{-6}	8.75×10^{-6}		This item does not have a failure data source annotation
				B	Low Pneumatic Pressure due to abrading of the Propeller as a result of abrasive wear caused by solid particle contaminants resulting in Low Pneumatic Pressure (Quadcopter UAV)		I		1.00	0.1587302	5.0E-5	0.175hrs	1.389×10^{-6}			