

## General Description of product

The product will have 2 inputs. A tachometer input from the fan that relates to the RPM of the fan via its input signal frequencies, and a nominal 28Vdc power bus. The product will output a discrete signal, alerting the pilot of the fan not operating properly, other the output will be open. The product will be a small box in the wire bundle. The product is needed as redundancy to the current system they have in place.

## Regulations

- DO-160
- Avoiding DO-178 or/and DO-254
  - Using nonprogrammable parts
  - These regulations can take years to test, while DO-160 can be done with 6 months or less
- Regulations on wire bundle and tachometer input are handled by Textron

## Constraints

### Input:

- Tachometer input from the fan: This input will have a 0-5V or 0-28V pulse/square wave based on which fan used. The input will have a varying frequency, from 0kHz to 1kHz, which is proportional to the RPM of the fan at the current time.
  - Tachometer input must be filtered.
- Bus input from wire bundle: The bus will give us a nominal 28Vdc. The bus will sometimes dip as low as 10Vdc and as high as 80Vdc (when turning on the engine).

### Output:

- The output will be based on a threshold frequency
- The output will be grounded if our frequency is above the threshold.
  - Ground must be able to deliver to 1A of continuous current.
  - The design must utilize only one electrical ground.
  - This output must be discrete.
- The output will be open if our frequency is below threshold or
  - output switches from ground to open once below threshold minus hysteresis

### Design:

- The design must be able to be configurable by changing values of components (i.e. resistor values). This configurability is for:
  - Change in tachometer input voltage
  - Change in threshold frequency
  - Change in hysteresis values
  - For prototyping we can start with 0-5V, 70Hz, 5Hz hysteresis
- The Physical size of this design must be within 0.5 x .05 x 1.5 inches
- The design must operate with NO programable devices (i.e. microprocessor, memory, ect.)

- This will trigger DO-178 or/and DO-254
- Components must be generic and easily able to source with low risk of becoming obsolete.

#### Environmental:

- This product must be able to operate in:
  - Temperature range of -55°C to 85°C.
  - Altitude range of -1,000 to 55,000 ft
- This product must be able to handle Vibration, Humidity, and indirect effects of lightning.
  - Vibration must pass DO-160G section 8 category S curve L test
  - Humidity must pass DO-160G section 6 category B
  - Indirect effects of lightning must pass DO-160G section 22 tests up to category A3J3L3
- This product will be zip tied to a wire bundle in an airplane
  - No sharp edges
- The Physical size of this design must be within 0.5 x .05 x 1.5 inches

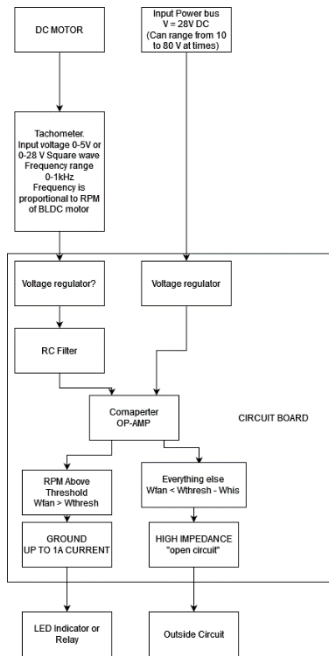
#### Documentation:

- The following is the documentation required by Textron:
  - PCB schematics
  - PCB layout
  - Package design
  - A report
    - Function description
    - Detail on hysteresis effect
    - Results of testing to prove design
    - What and how to change values to get configurability listed above

#### Real world constraints:

- Package must have no sharp edges as listed above.
  - Avoid damages to wire bundle.
- Economically we will be testing and prototyping using cheaper parts
  - Once implemented, it will use more precise parts and higher rated parts

## Alternatives



- On the left is our basic circuit.
  - Some alternatives we thought about are:
  - Comparator was debate between OP-AMP circuit and frequency measuring circuit.
    - Frequency measuring circuit was ditched due to the fact of memory needed to be used
  - RC filter circuit was debated as the input for OP-AMP as shown on the left.
    - Currently we plan to have something in between our RC filter and OP-AMP as filter outputs are not the desired output
  - RC filter was also debated between passive or active.
    - We plan to use passive as they both do what we want and passive was smaller circuit.
  - Voltage regulator was debated between **code your part or delete it up to you**

Signature:

I have read the entire report and it meets my personal quality standards

Date: \_\_\_\_\_

Sign: \_\_\_\_\_

**Citation:**

Clinton, T. (2021). Avionics and Electrical System. *Project Proposal*.

RTCA. (2010, December 8). *Product details*. Product - Community Hub. Retrieved October 22, 2021, from [https://my.rtca.org/NC\\_\\_Product?id=a1B36000001IcnSEAS](https://my.rtca.org/NC__Product?id=a1B36000001IcnSEAS).