S-Series Technician's Troubleshooting Guide

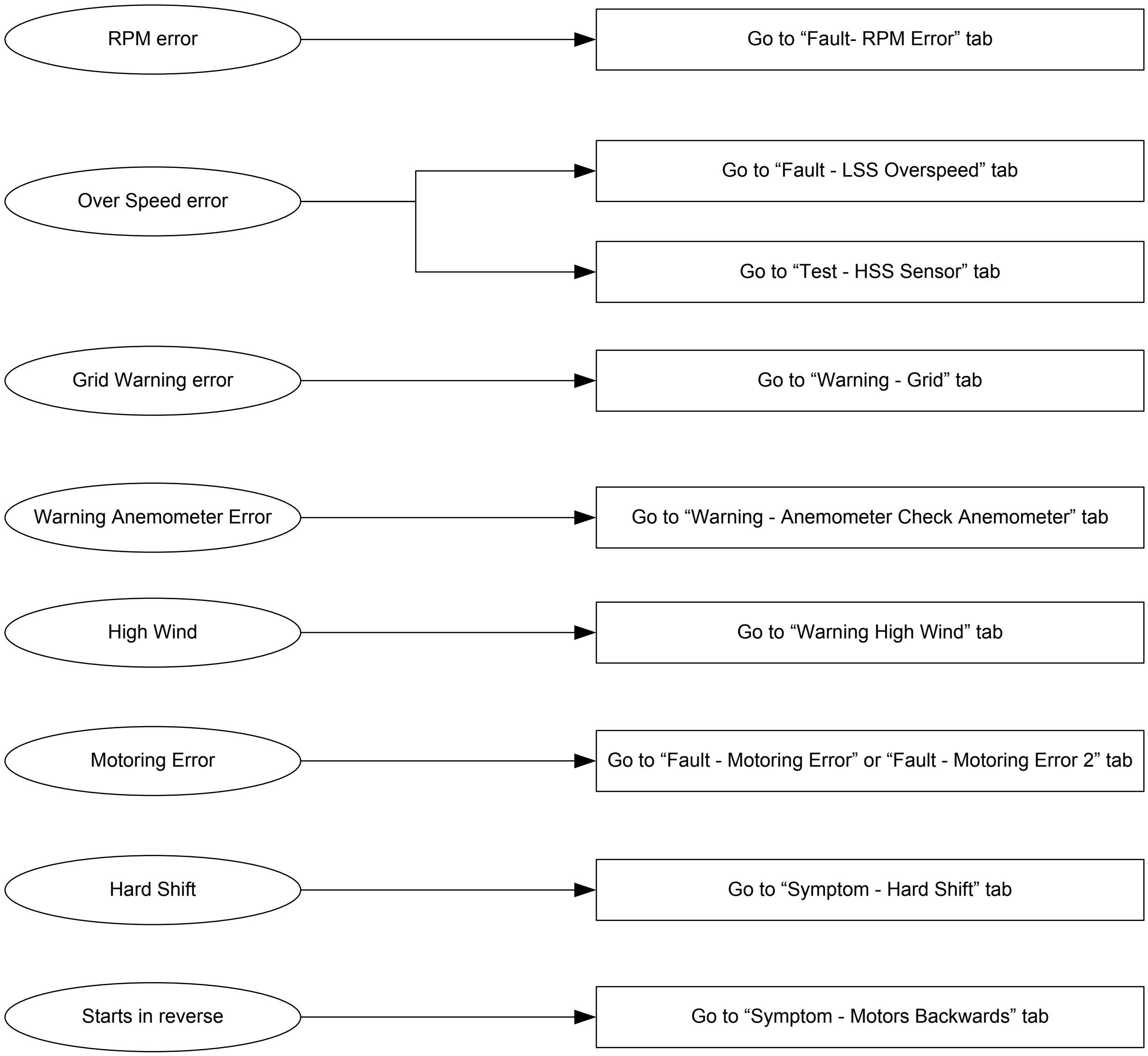
S-Series

endurancewindpower.com

Green energy that works™

Table of Contents

Endurance S-Series Errors, Warnings and Performance Symptoms



Definition of Fault States

Manual input will be needed to exit FAULT state and return to RUN state.

LSS or HSS OVER SPEED: if the turbine rotor ever exceeds 183.1RPM (S-343) or 220.7RPM (S-250) for 0.2 seconds, the controller registers an error and stops the turbine. This error should not occur during normal operation of the turbine and indicates a serious problem that should be addressed before returning the turbine to service.

RPM ERROR: the turbine control system uses redundant rotor speed sensors to ensure the control system always knows the actual rotor speed. If these two rotor speed signals do not agree with each other, the controller registers an error and shuts the turbine down. This error indicates a serious problem with one of the rotor speed sensors or signals that should be rectified prior to returning the turbine to service.

Definition of Warning States

ANEMOMETER ERROR: if the control system ever detects the turbine is producing power and the anemometer reading is less than 1m/s (2.2 mph) the turbine is shut down as a precaution. Normally this condition signifies the anemometer has stopped due to icing (though a more permanent failure of the anemometer could also trigger this condition). Once the icing (or other condition) has cleared for one minute, the turbine will resume normal operation.

MOTORING ERROR: if the turbine attempts to motor to bring the rotor up to speed and fails to turn the rotor, or fails to accelerate it to speed in the specified time, this error is registered and the turbine is shut down. This error could result from a failure to release the brakes (due to icing in the pneumatic system for example) or an electrical problem with the motoring circuits. The turbine will revert to normal operation after a time-out period of three hours, allowing time for transient conditions (such as pneumatic system icing) to clear. The condition can be cleared manually through HALT and RUN commands from the remote. The error will clear and the turbine will try to restart after 3 hours.

GRID FAULT: the Endurance control system monitors grid voltage and frequency for compliance with IEEE 1547 standards to ensure safety of the electrical system. If the voltage or frequency is determined to be out of range, the turbine will shut down. Once normal grid conditions resume for at least five minutes, the turbine reverts to normal operation.

HIGH WINDS: the turbine will shut down when winds exceed approximately 25m/s (55mph) to protect the rotor from potentially damaging gusts. Once wind speeds subside to less than 20m/s (45mph) for at least 30 minutes, the turbine will return to normal operation.

Commissioning Tests

RPM Error Test: This test sets the error tolerance to 3RPM. Even without wind, this mode will advance the turbine to the motoring state within approximately one minute. Once through the motoring state, the rapid RPM change of the rotor will trigger a RPM error. This is a result of the use of different averaging times for the two RPM signals. If the rotor speed is changing rapidly, the two average values will differ by more than 3RPM.

Over-speed Test: This test sets an over-speed limit of 83.2RPM (S-343) or 100.2RPM (S-250). Even without wind, the turbine will motor within approximately one minute. Motoring will bring the turbine up to 83RPM (S-343) or 100RPM (S-250) and momentum will carry the speed over the low limit, triggering an over-speed error.

Cut-out Test: This test sets a low limit for the cut-out wind speed (6-7m/s). This test requires at least a light wind. If the instantaneous wind speed exceeds 7 m/s, or the 1-minute average wind speed exceeds 6m/s, a HIGHWIND shutdown will occur. The controller will automatically return to the CALM state (after 30 minutes) if the 1-minute average wind speed drops to 5m/s.

Anemometer Test: The anemometer test requires sufficient wind to bring the turbine up to synchronous speed. This tests the minimum wind speed required for reaching synchronous speed to 30m/s. With this setting an error will occur once the turbine reaches synchronous speed if the winds remain below 30m/s.

S-Series RPM Parameters

RPM Parameters – Dependant on Turbine Model Type

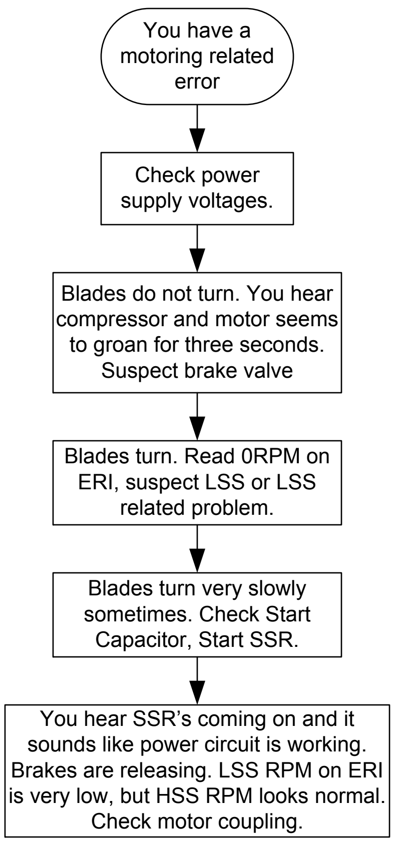
Parameter	% of Synchronous	LSS RPM (S-343)	LSS RPM (S-250)	HSS RPM (both turbines)
Synchronous	100.0%	166.4	200.4	1800
Motor Start Max	25.0%	41.6	50.1	450
Motor Stop Threshold	50.0%	83.2	100.2	900
Offline Threshold	99.8%	166.0	200.0	1796
Upswitch Threshold	103.1%	171.4	206.6	1855
Downswitch Threshold	100.5%	167.1	201.4	1808

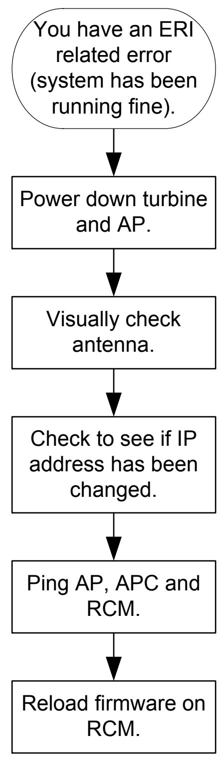
Abbreviations

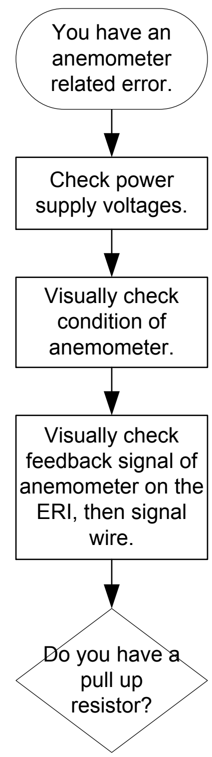
AP	Access Point (Wireless device at home computer)
APC	Access Point Client (Wireless device at Turbine controller)
Cap	Capacitor
Coyote Board	The large red board mounted under the Rabbit Core Module
DVM	Digital Volt Meter
ERI	Endurance Remote Interface
Gnd	Ground
HSS	High Speed Shaft
HSS Sensor	High Speed Shaft Sensor
Hz	Hertz
IP	Internet Protocol
J-box	Junction Box located under the mainframe in the nacelle
LED	Light Emitting Diode
LSS	Low Speed Shaft
LSS Encoder	Low Speed Shaft Encoder
MCC	Main Control Cabinet
Microcontroller	RCM/Coyote board together (large red board with small red board as an assembly)
N/C	Normally Closed
N/O	Normally Open
Power Down	Turn start key to „OFF" position and pull main disconnect (all power to the turbine is removed)
PS	Power Supply
PSI	Pounds per Square Inch
RCM	The little red board mounted to the coyote board is the Rabbit Core Module
R-X	X is the Relay identifier
SEL	Schweitzer Engineering Laboratories, distributed generator interconnection relay (grid monitor relay)
SSR	Solid State Relay
Terminal #	Terminal on block in lower right controller panel
T-X	Terminal block in the lower center of cabinet that motor connects to
VAC	Voltage Alternating Current
VDC	Voltage Direct Current

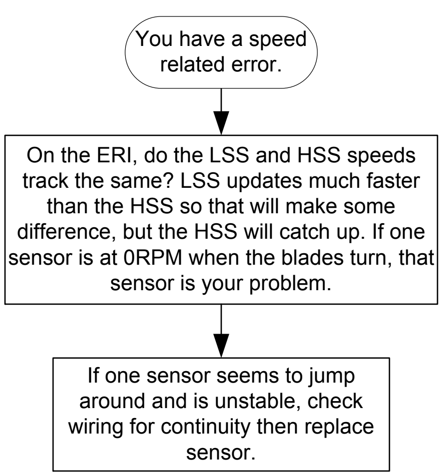
Quick Troubleshooting for the Expert

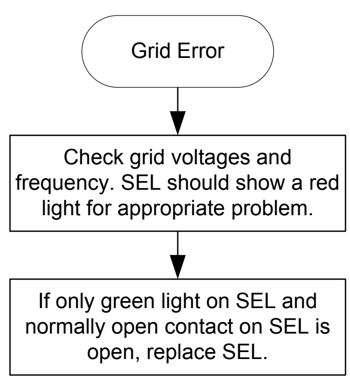
This is intended to be a rough guide to troubleshooting go to specific problem tab for more info.

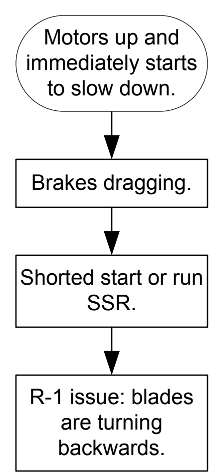


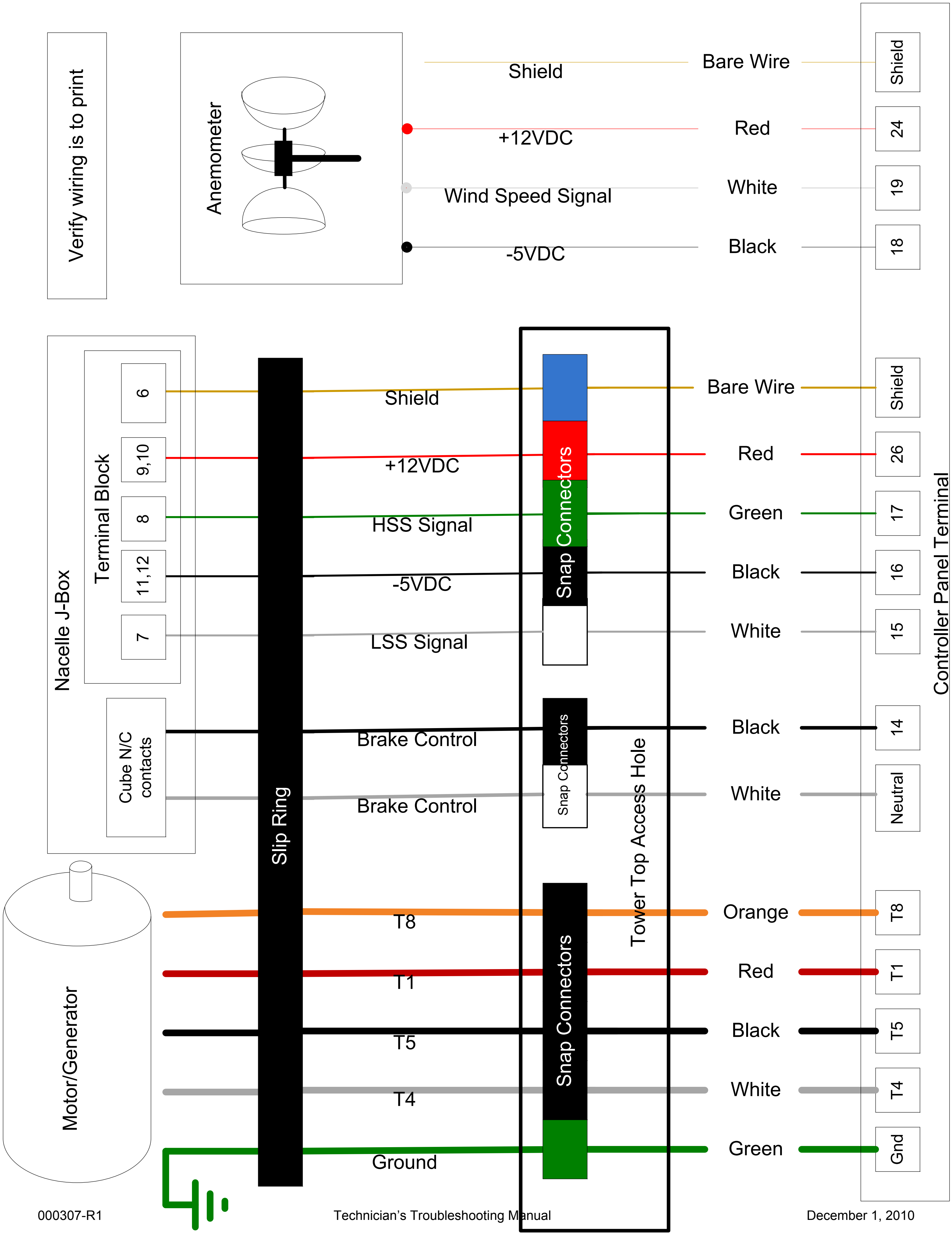




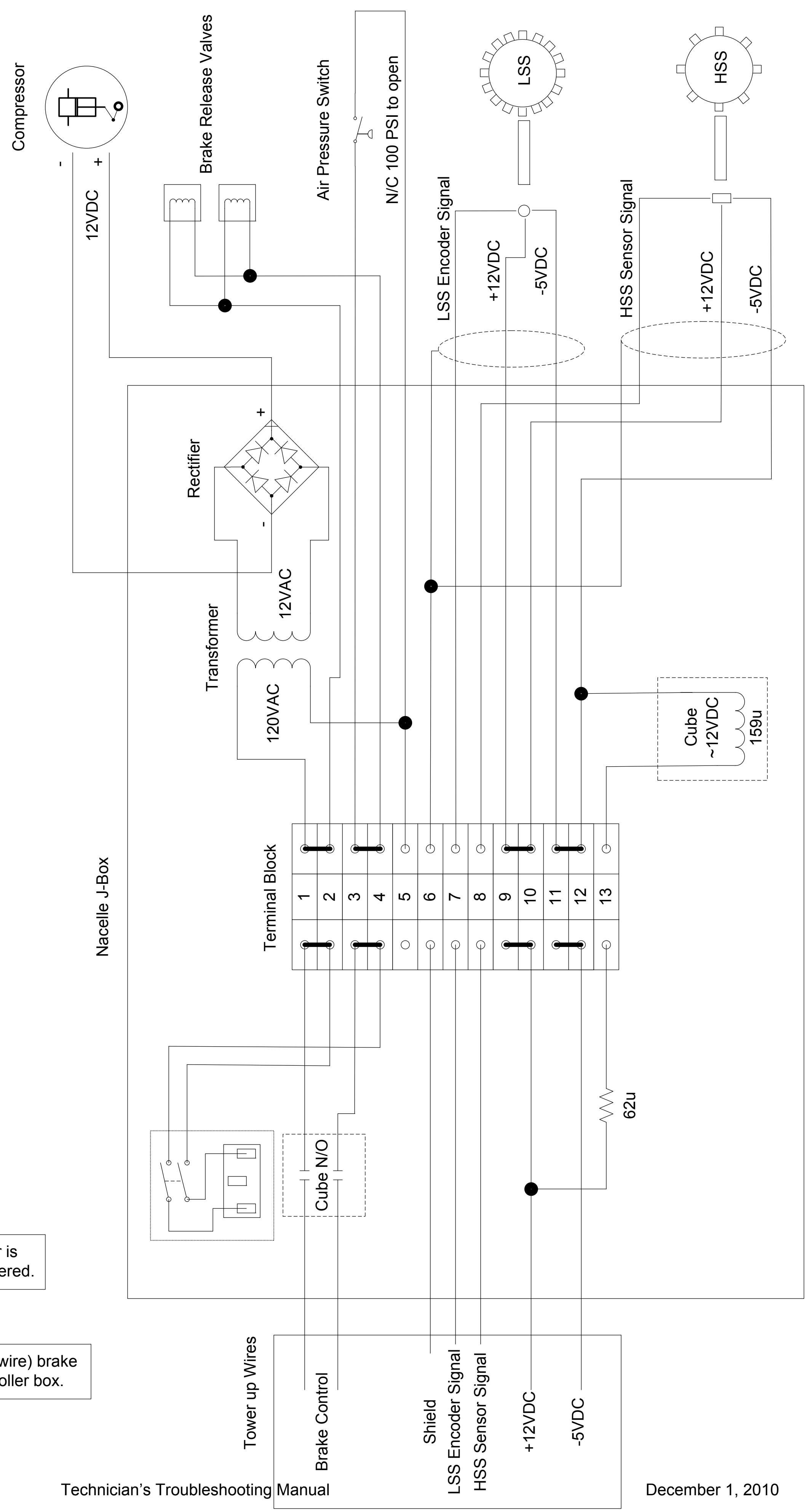


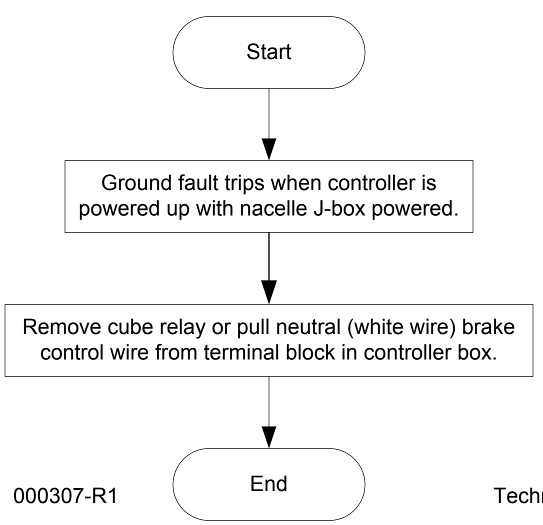




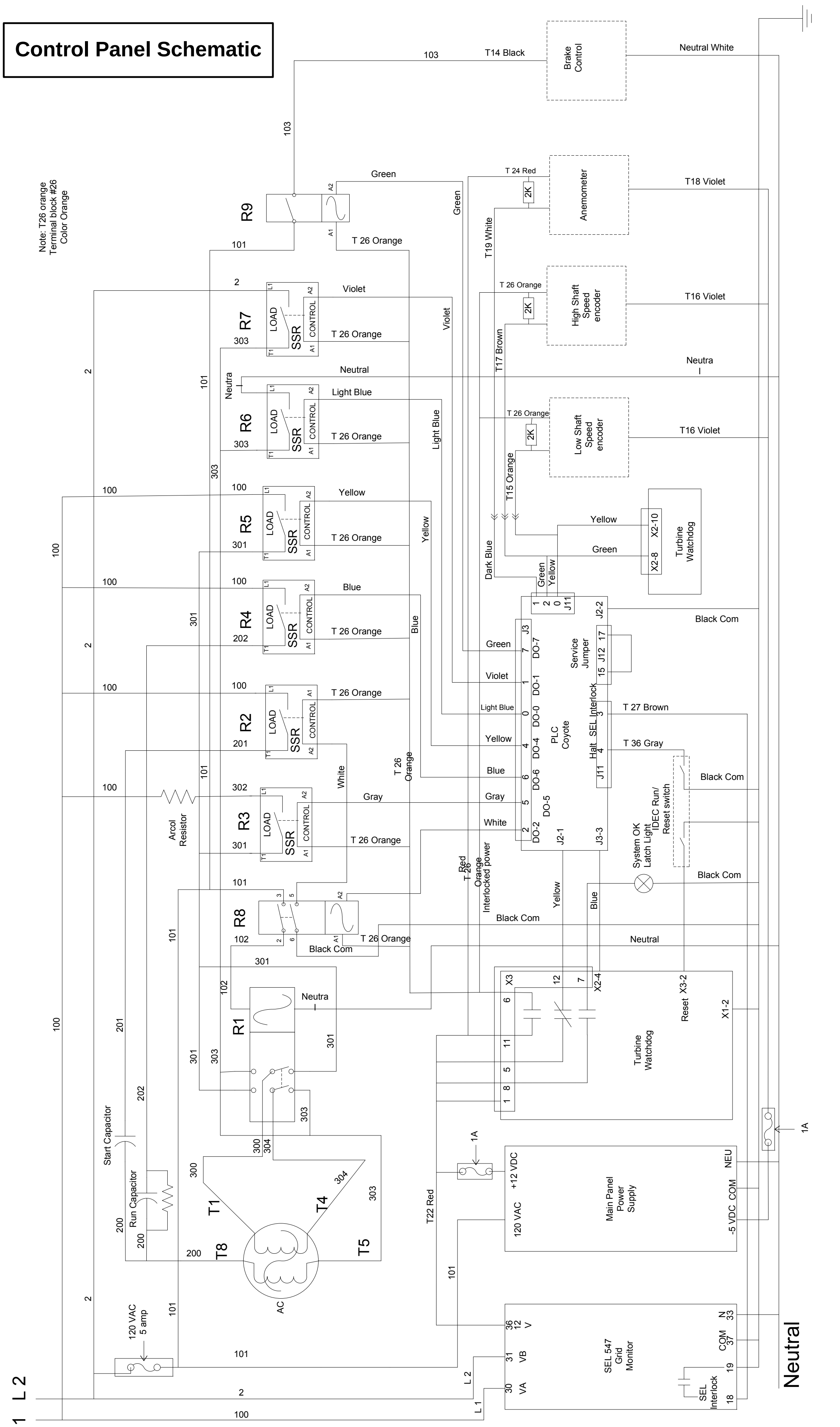

Verify wiring is to print
Anemometer
Shield
Bare Wire
Shield
+12VDC
Red
24
Wind Speed Signal
White
19
-5VDC
Black
18
Nacelle J-Box
Terminal Block
6
9,10
8
11,12
7
Cube N/C contacts
Slip Ring
Shield
+12VDC
HSS Signal
-5VDC
LSS Signal
Brake Control
Brake Control
Snap Connectors
Snap Connectors
Tower Top Access Hole
Bare Wire
Shield
Red
26
Green
17
Black
16
White
15
Black
14
White
Neutral
Motor/Generator
T8
T1
T5
T4
Ground
Snap Connectors
Orange
T8
Red
T1
Black
T5
White
T4
Green
Gnd
Controller Panel Terminal

Nacelle Wiring Diagram

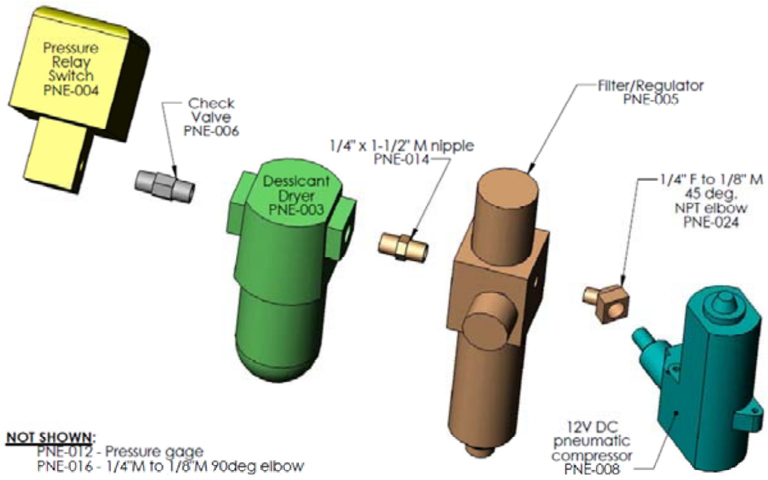


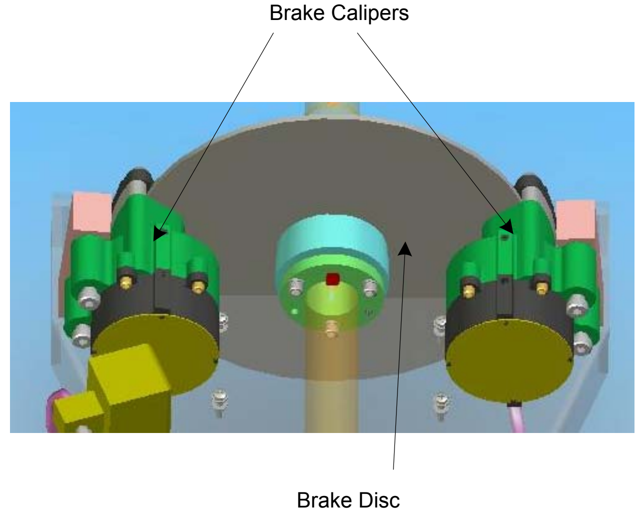


Control Panel Schematic

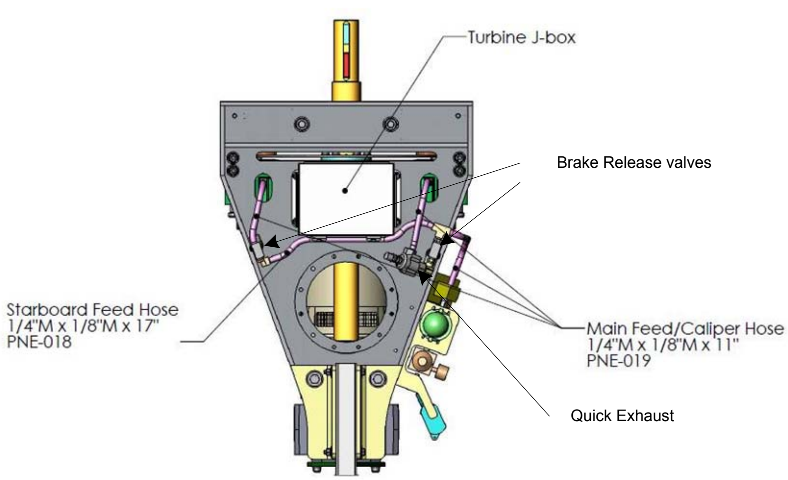


Brake System Pnuematics

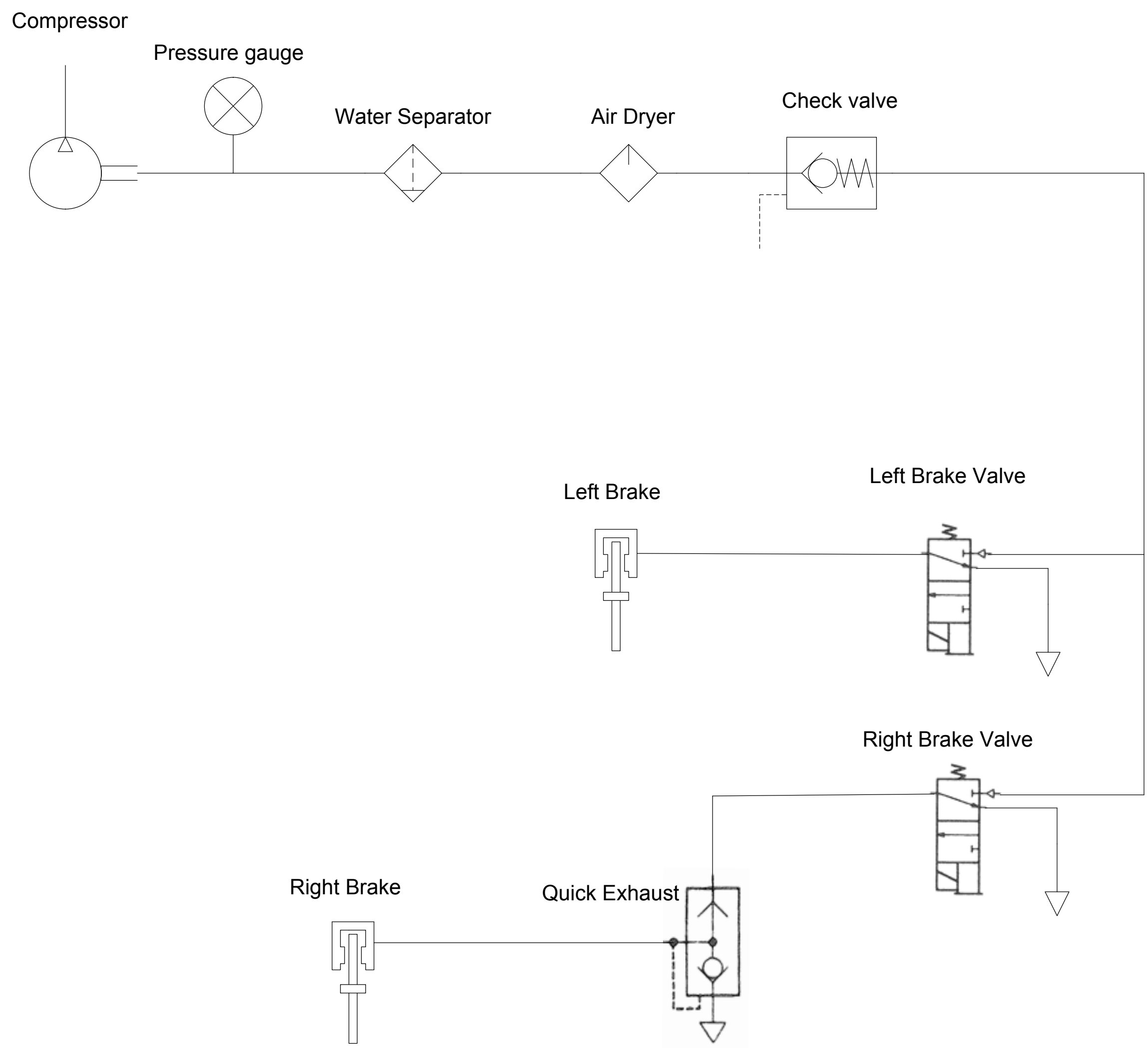




Turbine bottom

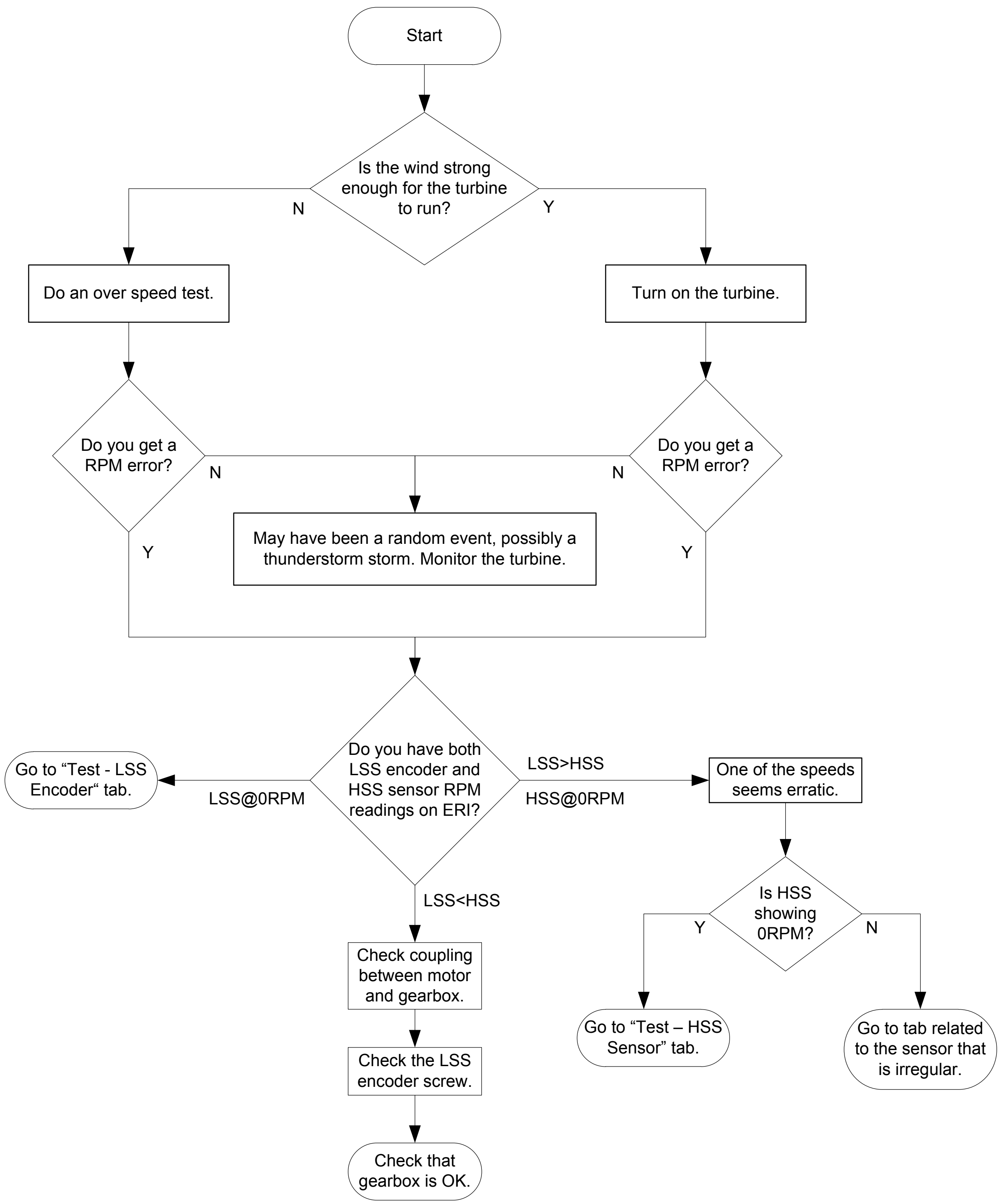


Pnuematics Schematic



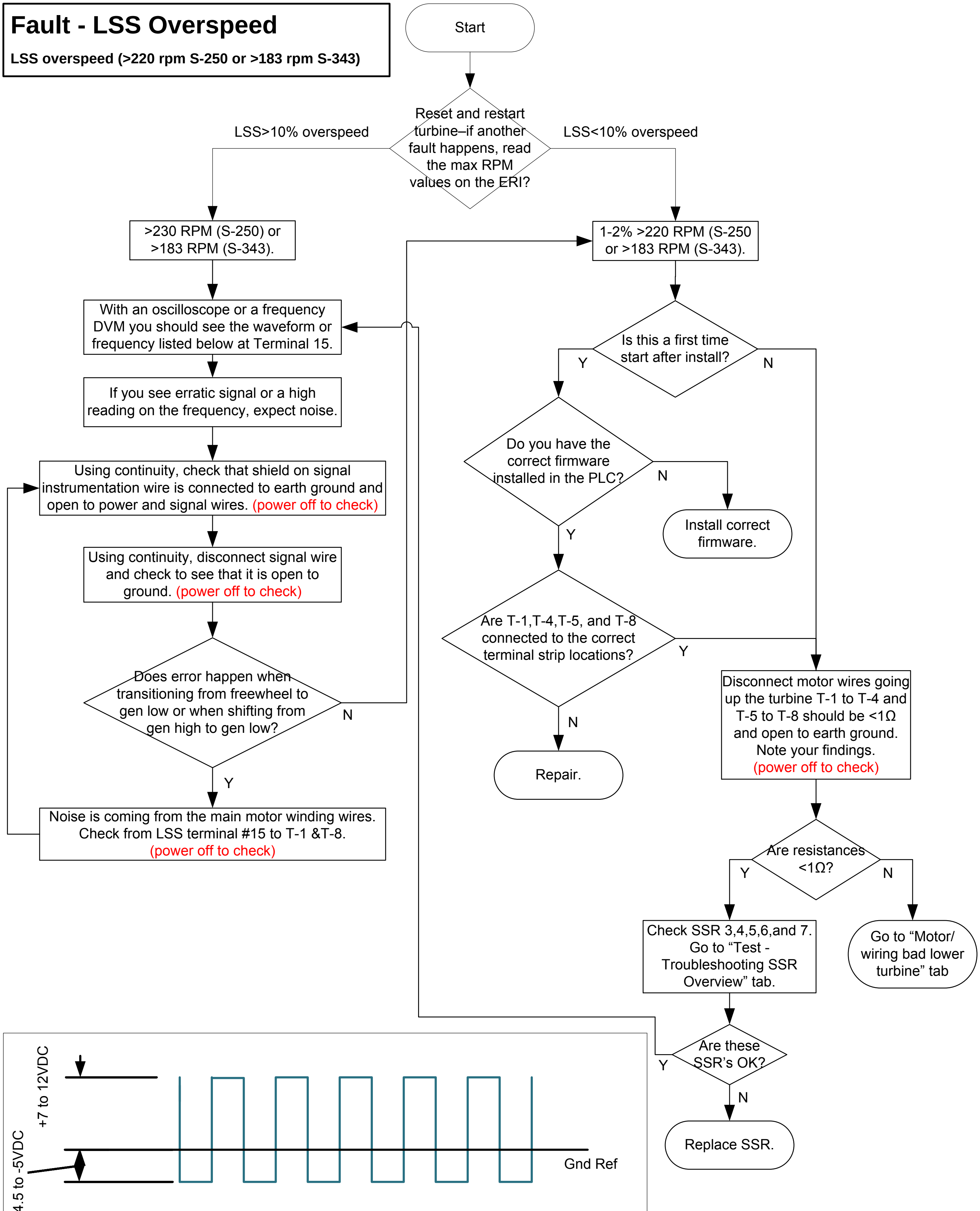
Fault - RPM Error

The turbine control system uses redundant rotor speed sensors to ensure the control system always knows the actual rotor speed. If these two rotor speed signals do not agree with each other, the controller registers an error and shuts the turbine down. This error indicates a serious problem with one of the rotor speed sensors or signals that should be rectified prior to returning the turbine to service.



Fault - LSS Overspeed

LSS overspeed (>220 rpm S-250 or >183 rpm S-343)

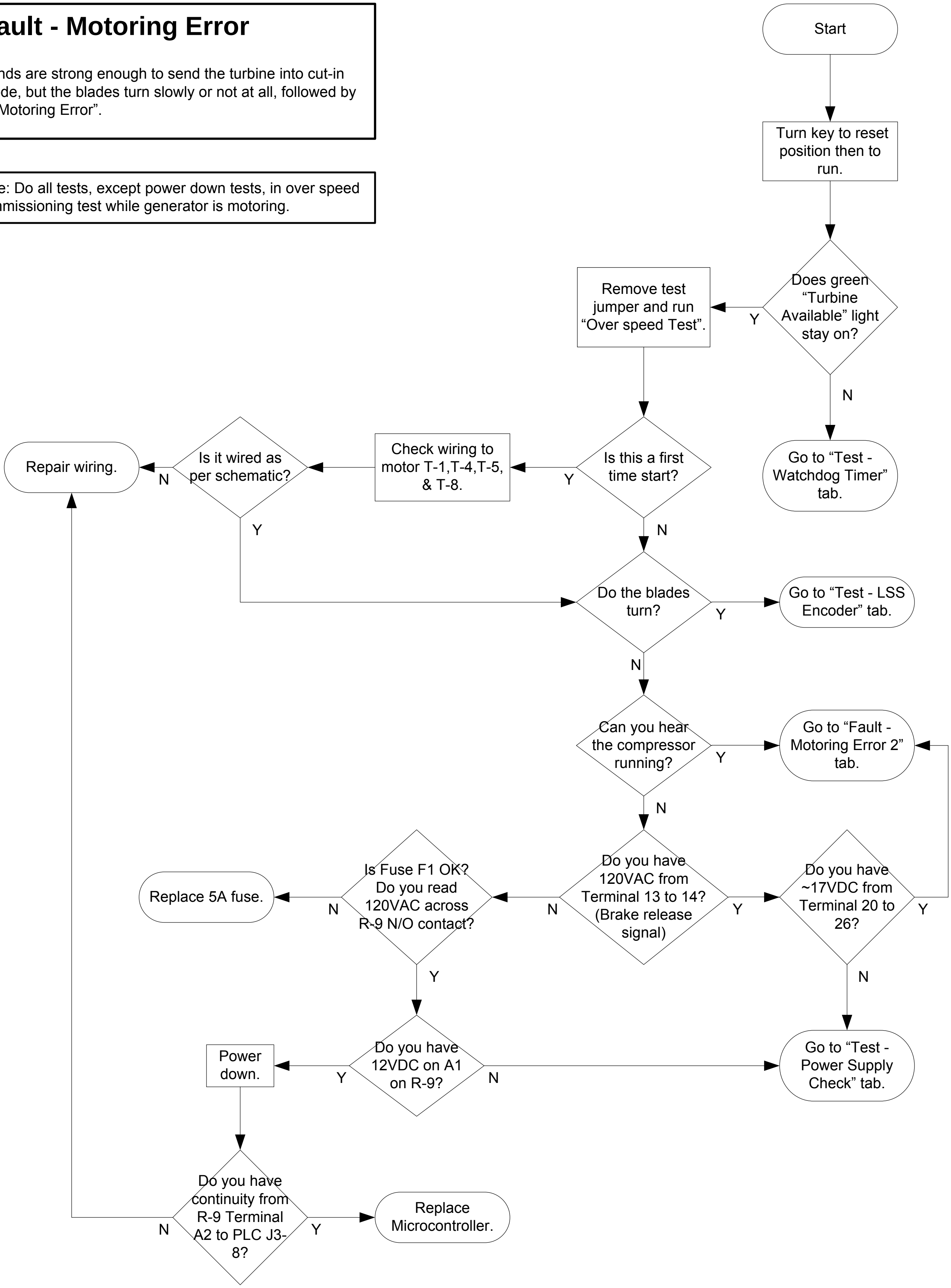


The frequency should be around 3414Hz at 200 rpm rotor speed for S-250. 2834 Hz for 166 RPM on a S-343

Fault - Motoring Error

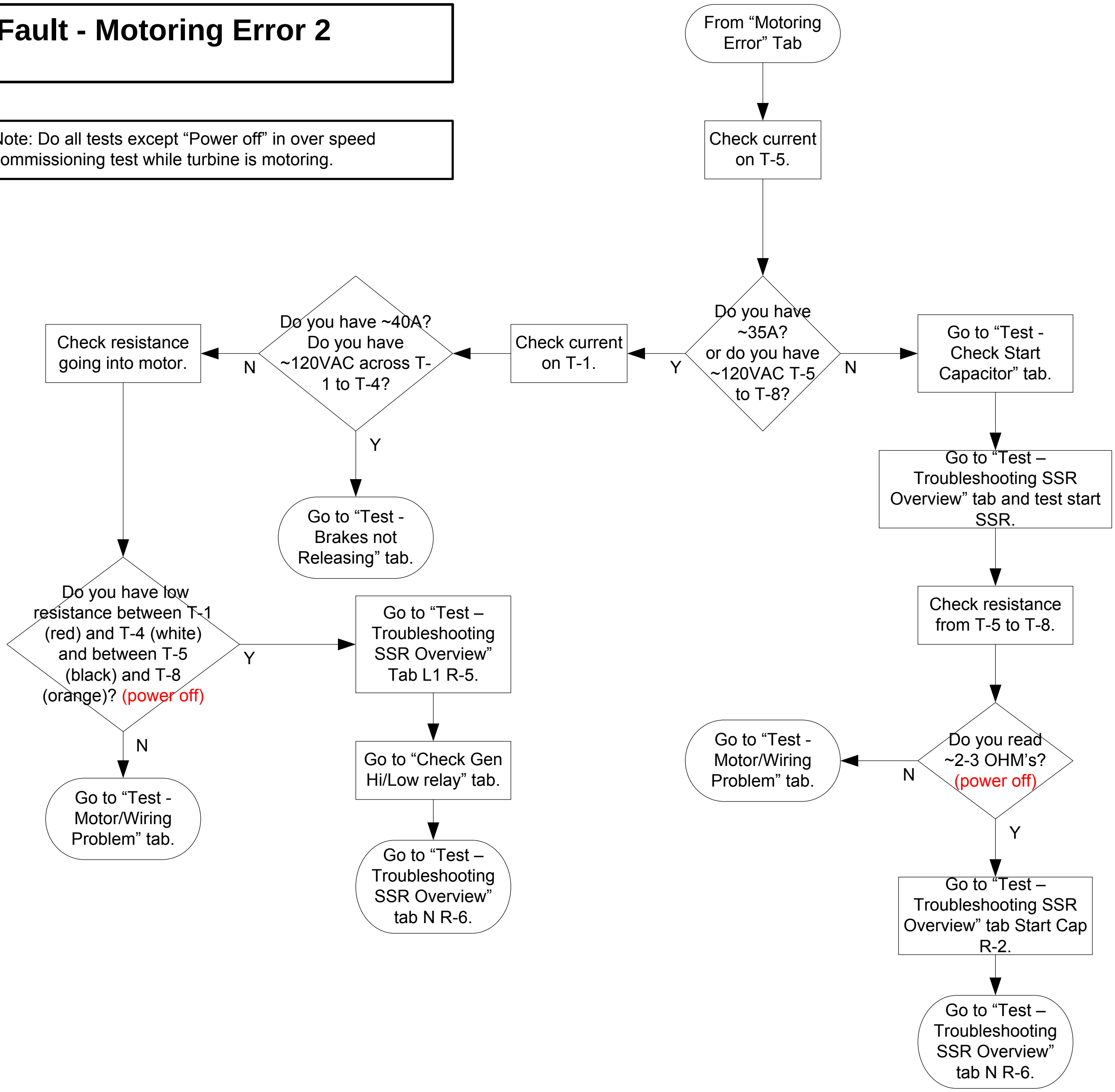
Winds are strong enough to send the turbine into cut-in mode, but the blades turn slowly or not at all, followed by a “Motoring Error”.

Note: Do all tests, except power down tests, in over speed commissioning test while generator is motoring.

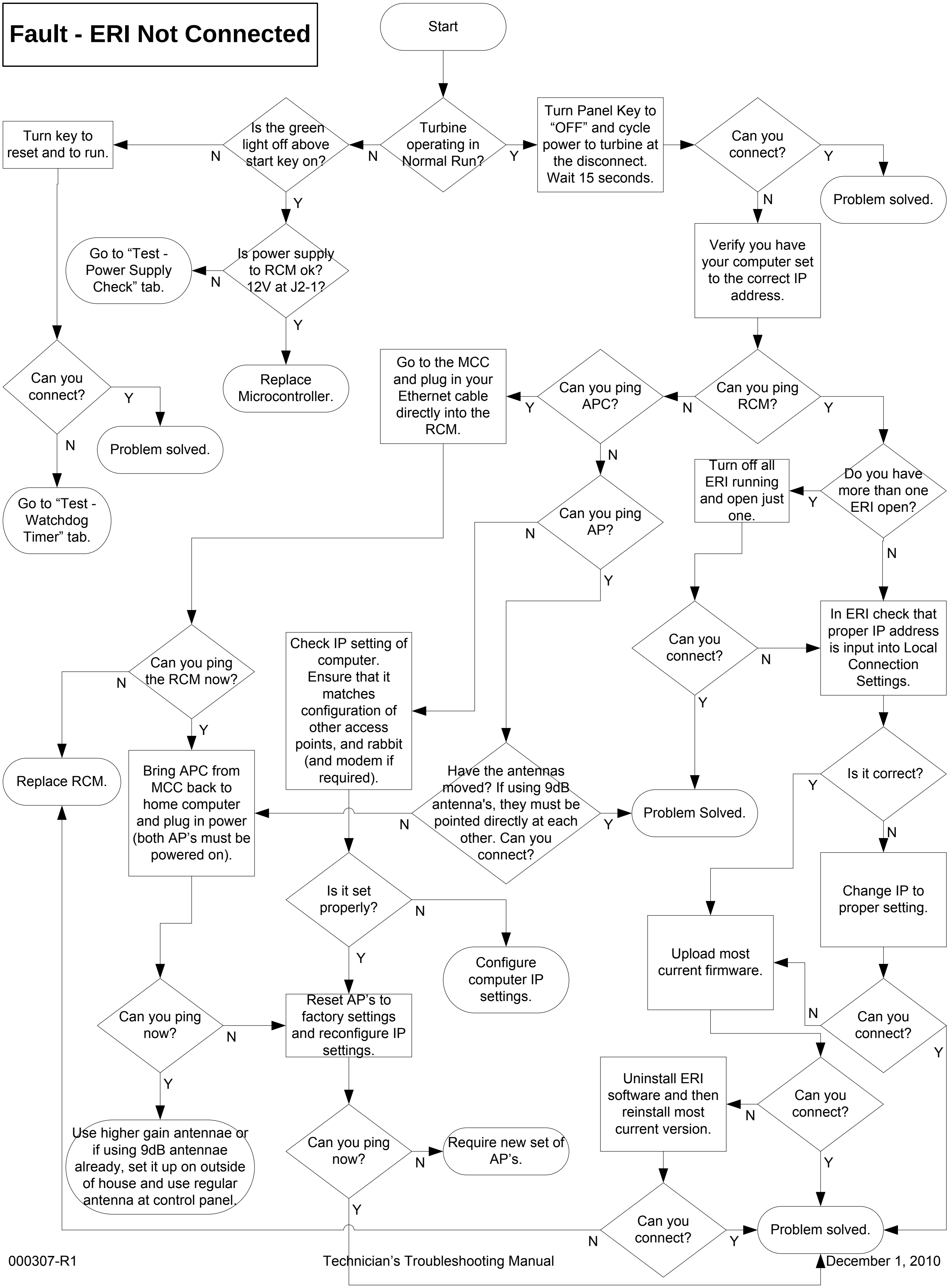


Fault - Motoring Error 2

Note: Do all tests except “Power off” in over speed commissioning test while turbine is motoring.

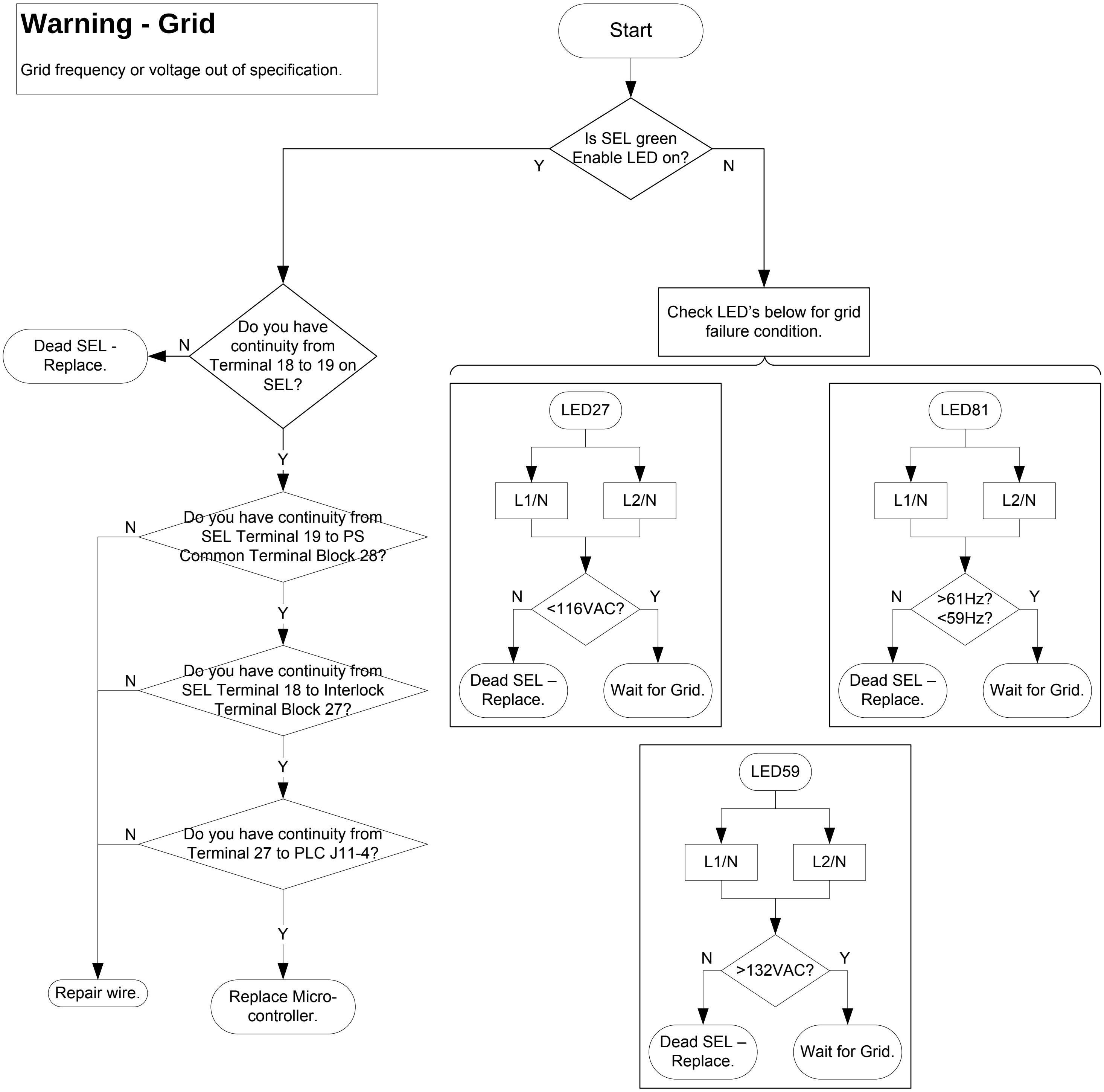


Fault - ERI Not Connected



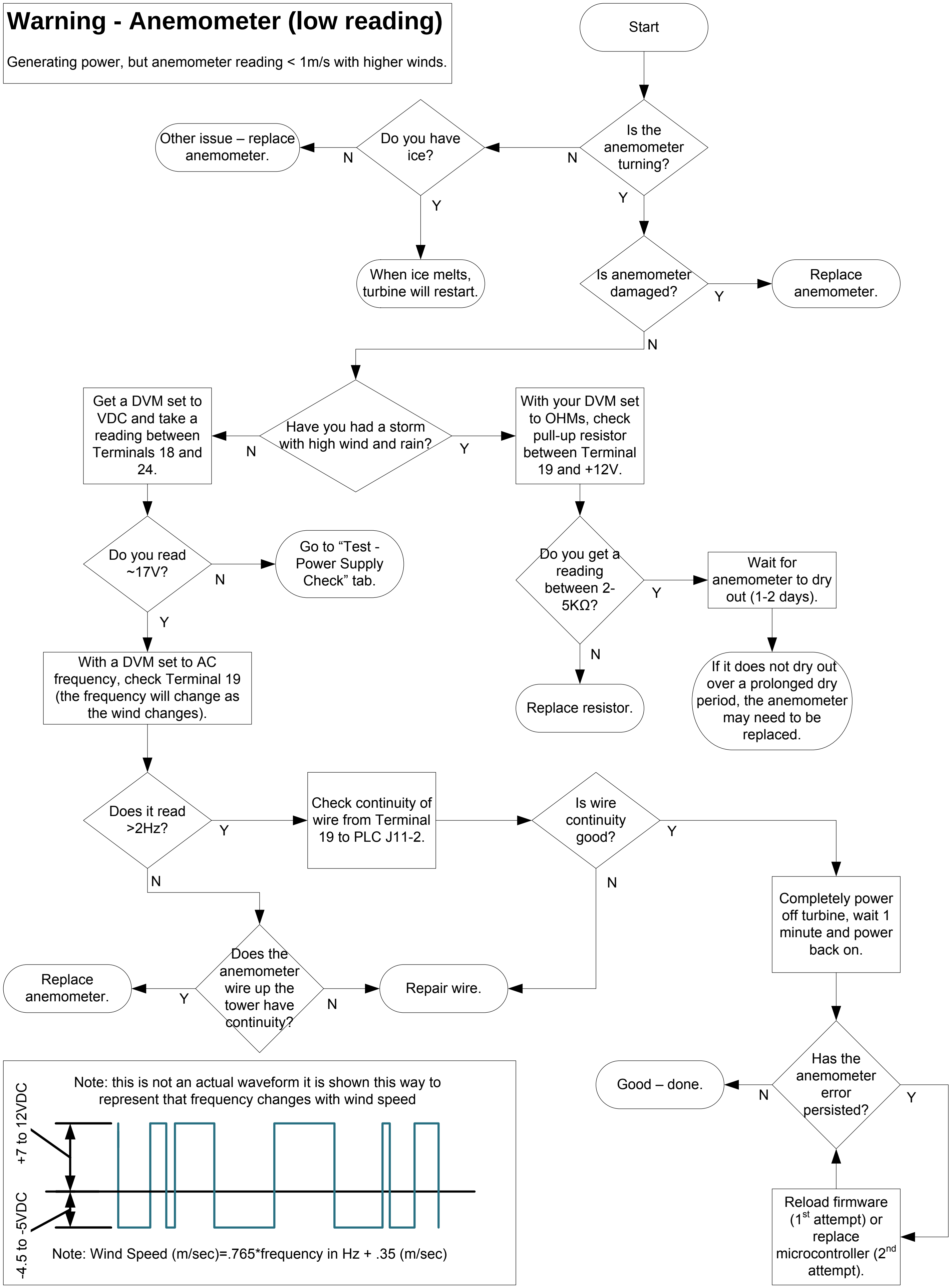
Warning - Grid

Grid frequency or voltage out of specification.

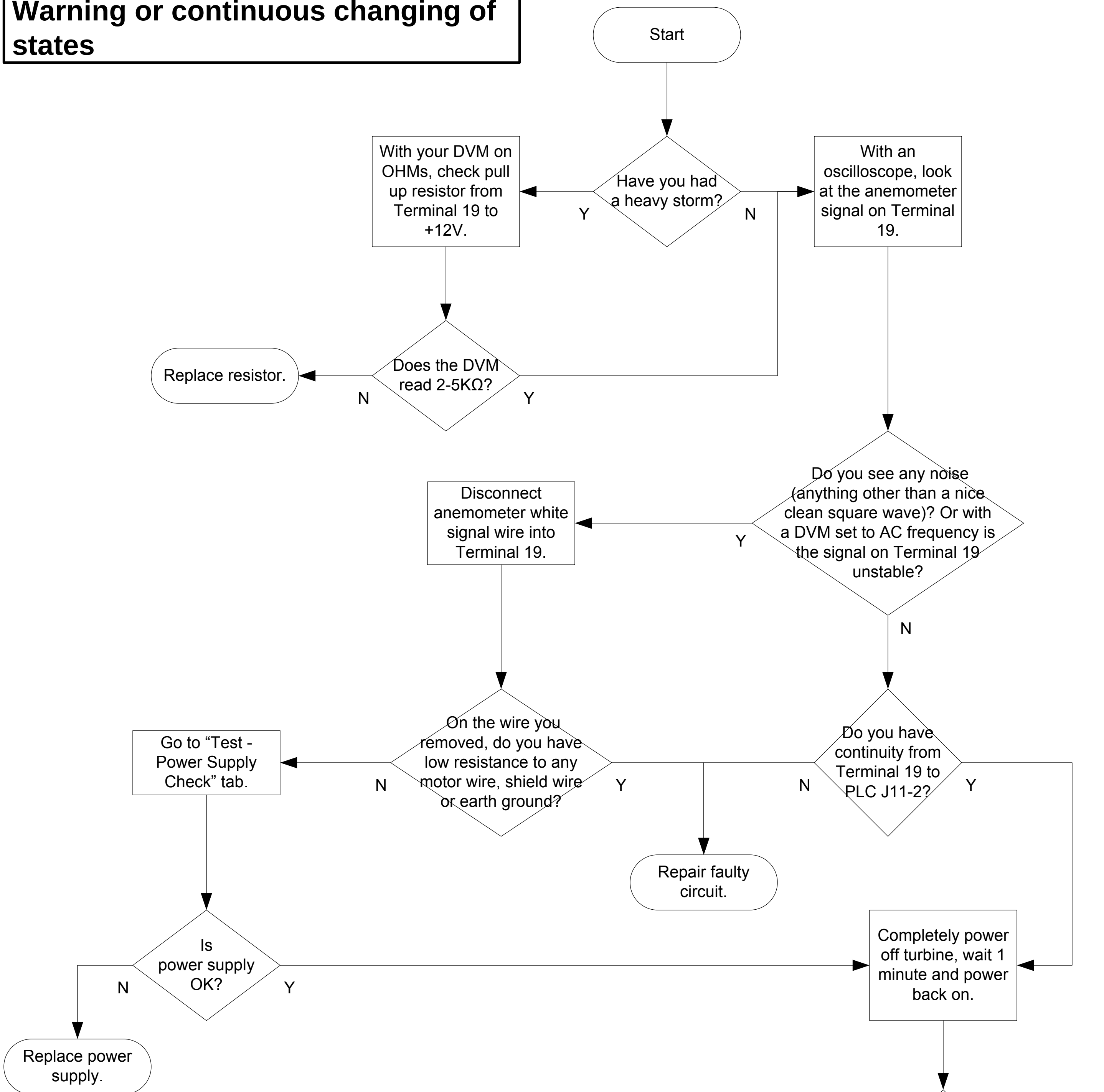


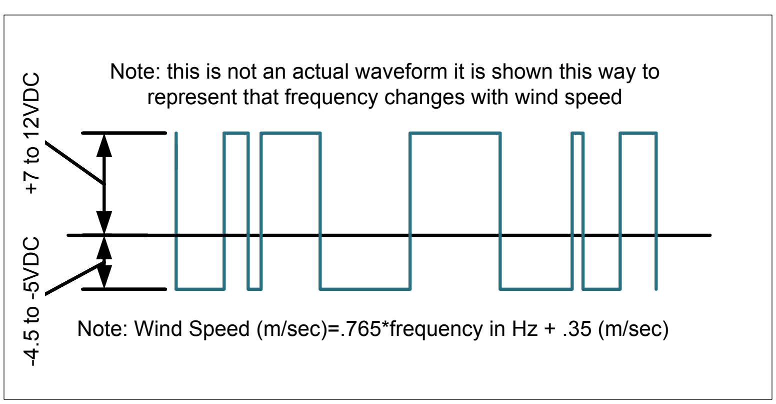
Warning - Anemometer (low reading)

Generating power, but anemometer reading < 1m/s with higher winds.



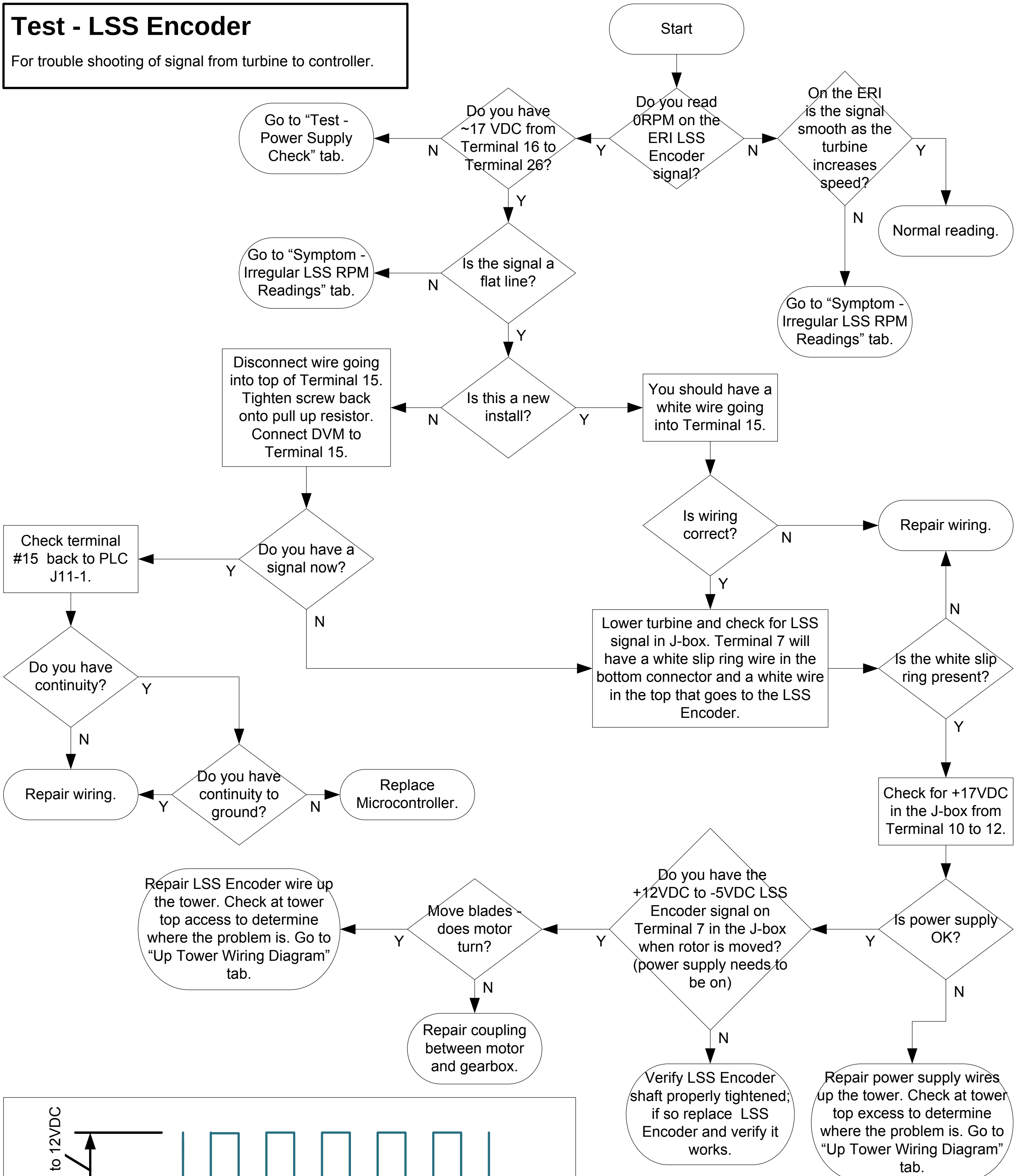
Warning - Anemometer High Wind Warning or continuous changing of states

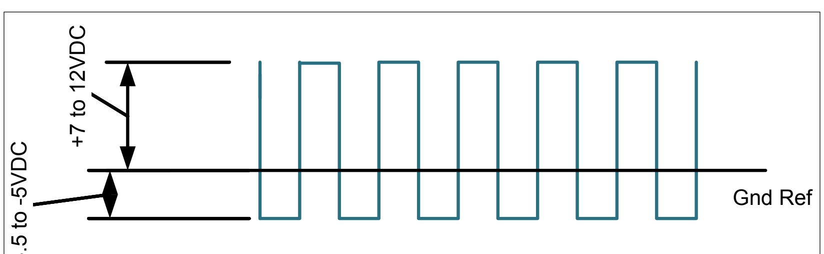




Test - LSS Encoder

For trouble shooting of signal from turbine to controller.

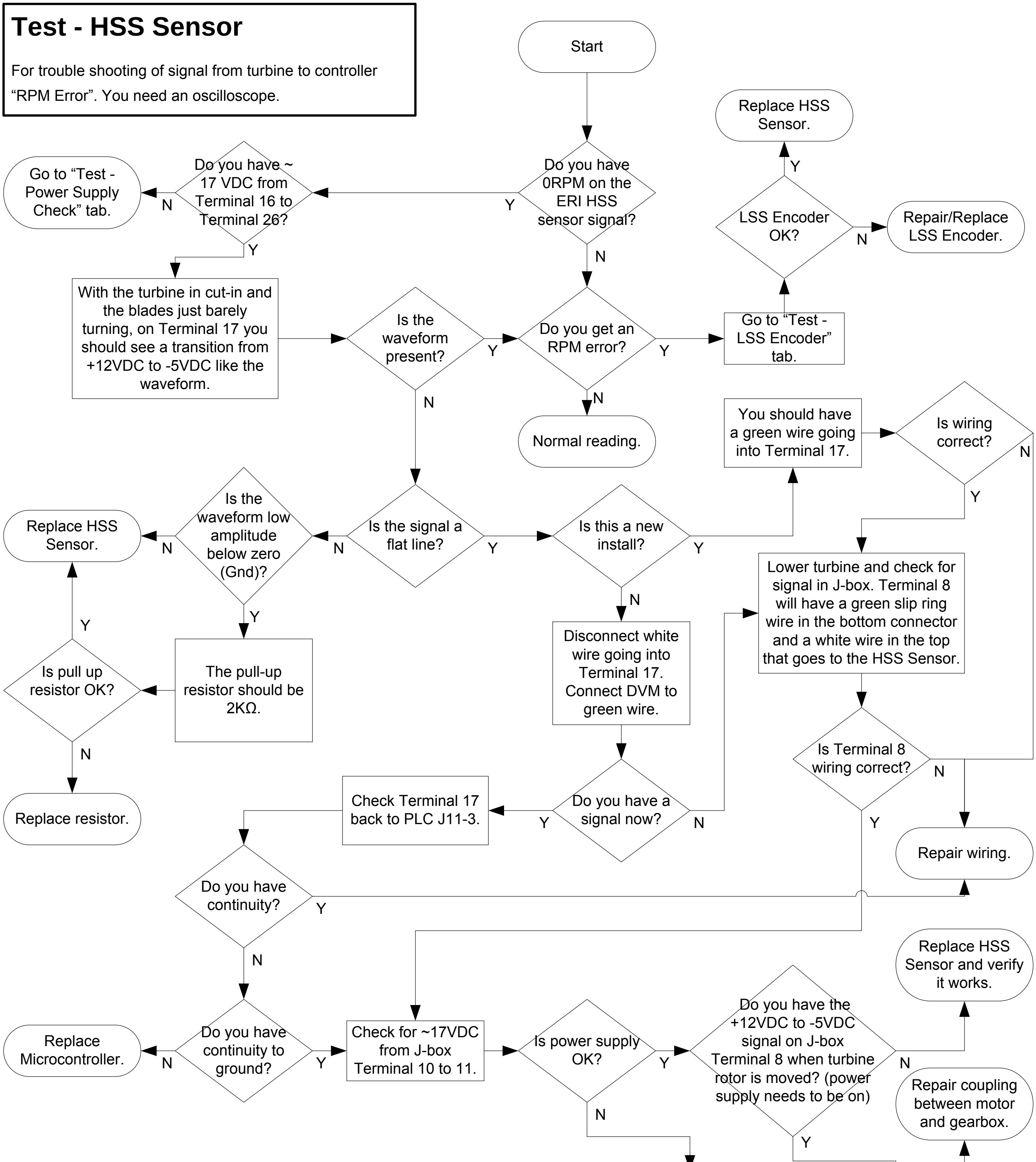


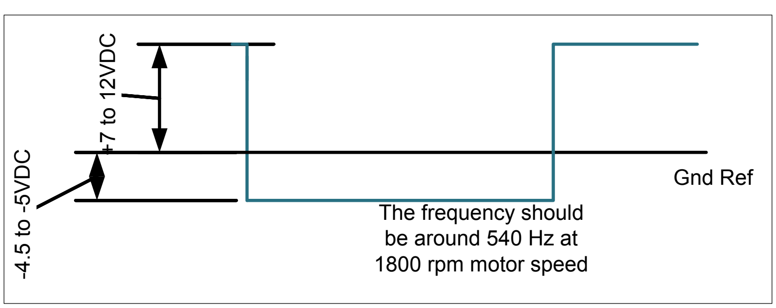


The frequency should be around 3414Hz at 200RPM rotor speed for S-250 or 2834Hz at 166RPM on a S-343

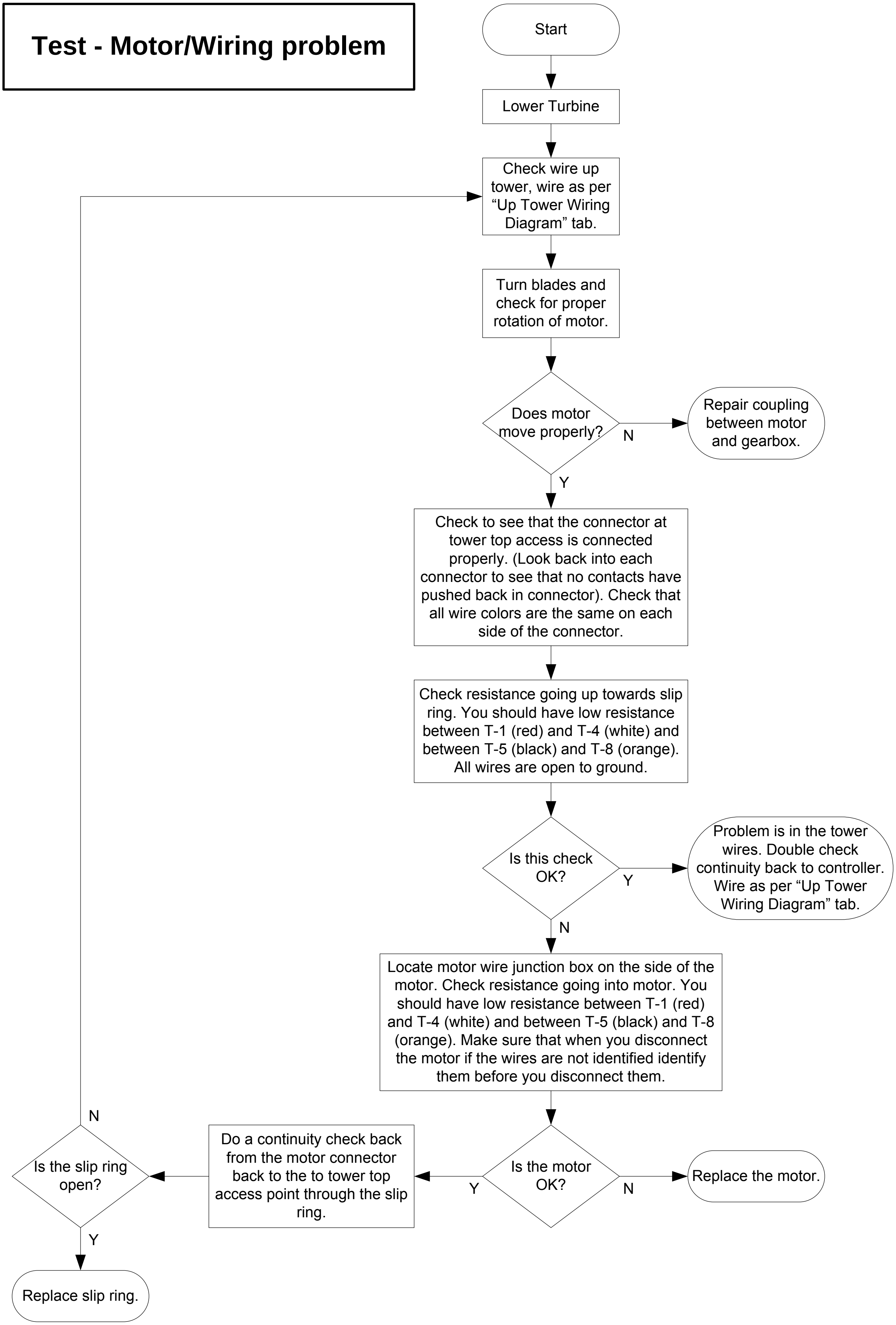
Test - HSS Sensor

For trouble shooting of signal from turbine to controller “RPM Error”. You need an oscilloscope.

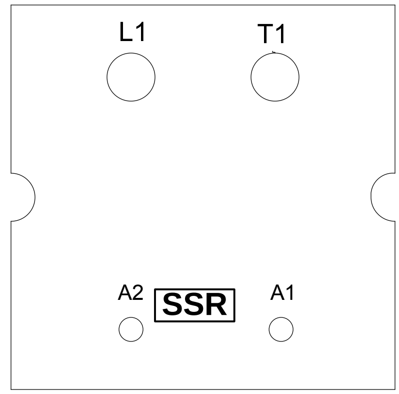


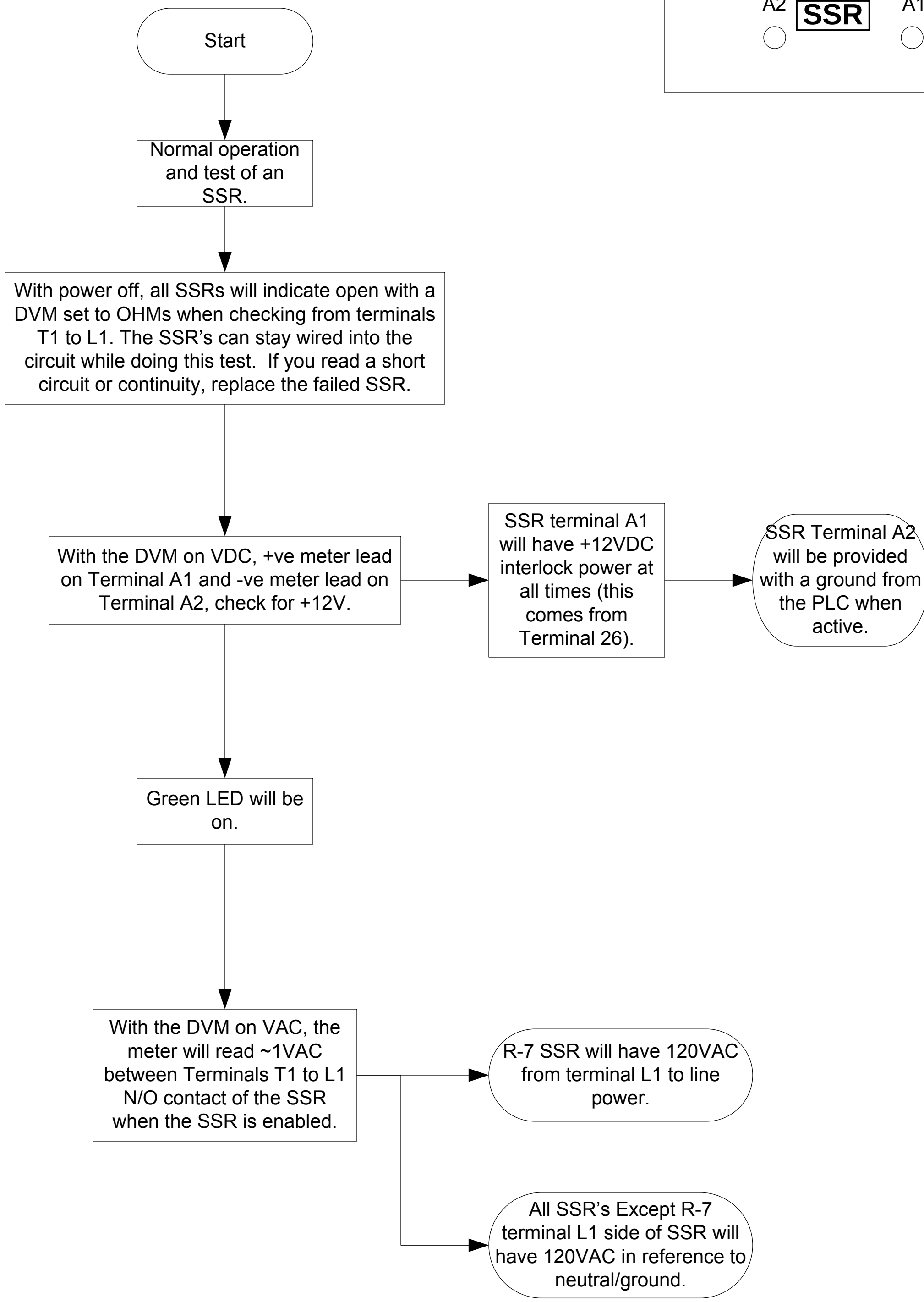


Test - Motor/Wiring problem

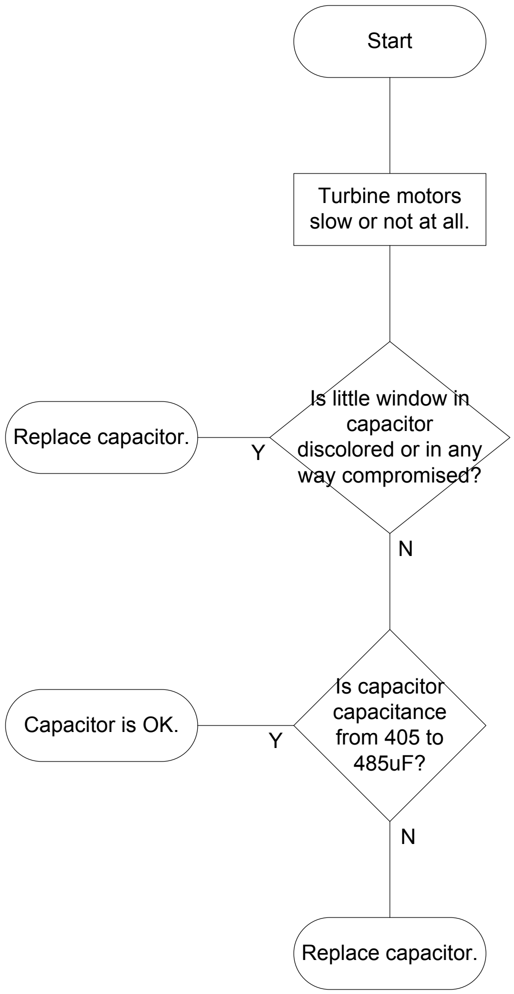


Test - Troubleshooting SSR Overview





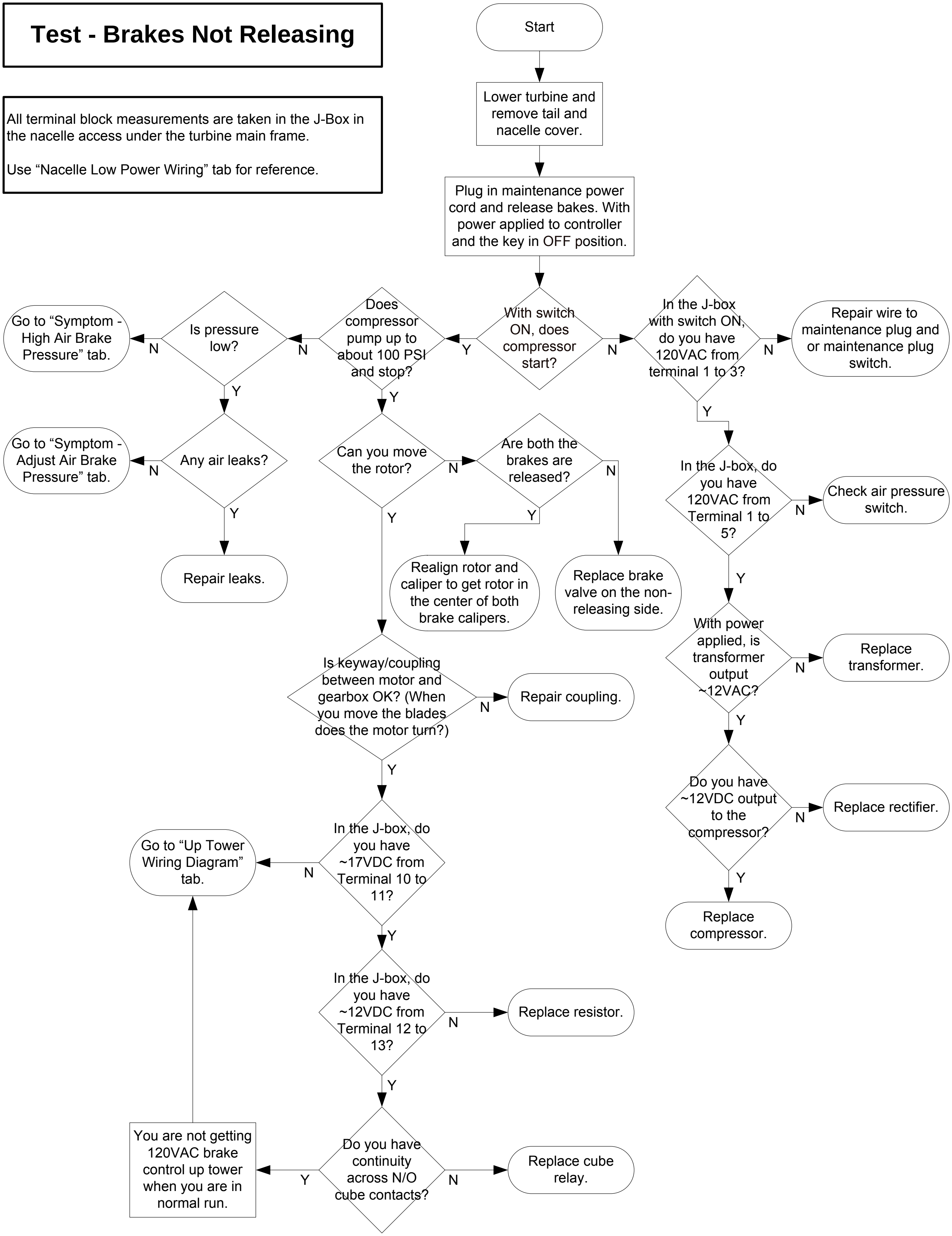
Test - Check Start Capacitor



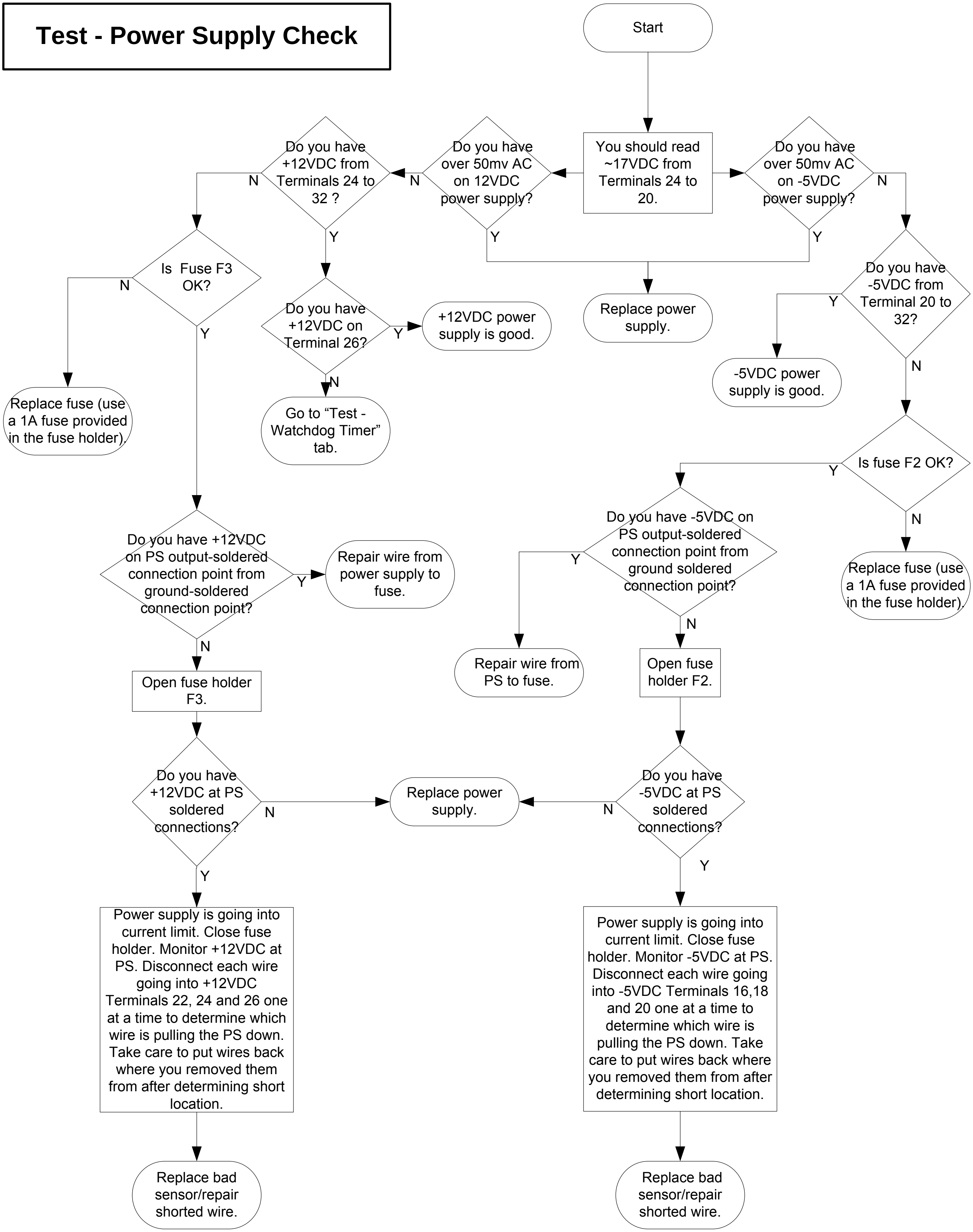
Test - Brakes Not Releasing

All terminal block measurements are taken in the J-Box in the nacelle access under the turbine main frame.

Use “Nacelle Low Power Wiring” tab for reference.



Test - Power Supply Check



Test - Dynamic Check LSS

Start

Check power supply.

Remove nacelle and tail, then release brakes.

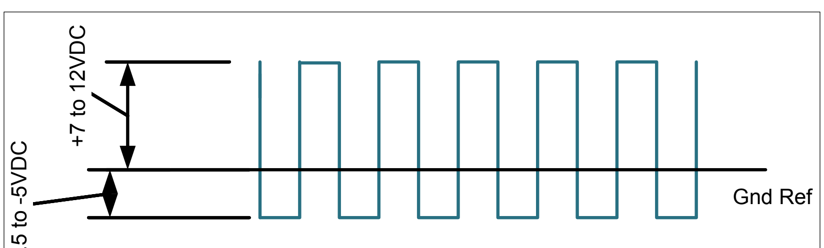
Rotate blades very slowly. You should see the +12VDC to -5VDC like the one below on terminal #15

Remove LSS sensor from rear of gearbox. This test will may two people.

Connect a 3/8" variable speed drill to the shaft of the encoder. Be very careful not to compromise the wires going to the encoder. Try to set your drill speed to the lowest speed around 200 RPM.

Using the ERI, monitor the LSS speed. The speed on the ERI should be steady. If you see any large jumps in RPM (>30) that don't seem realistic replace the LSS encoder.

A frequency reading DVM can also read the frequency at 200 RPM of around 3400 Hz. If DVM frequency reading seems to flash or come and go, replace the LSS encoder.

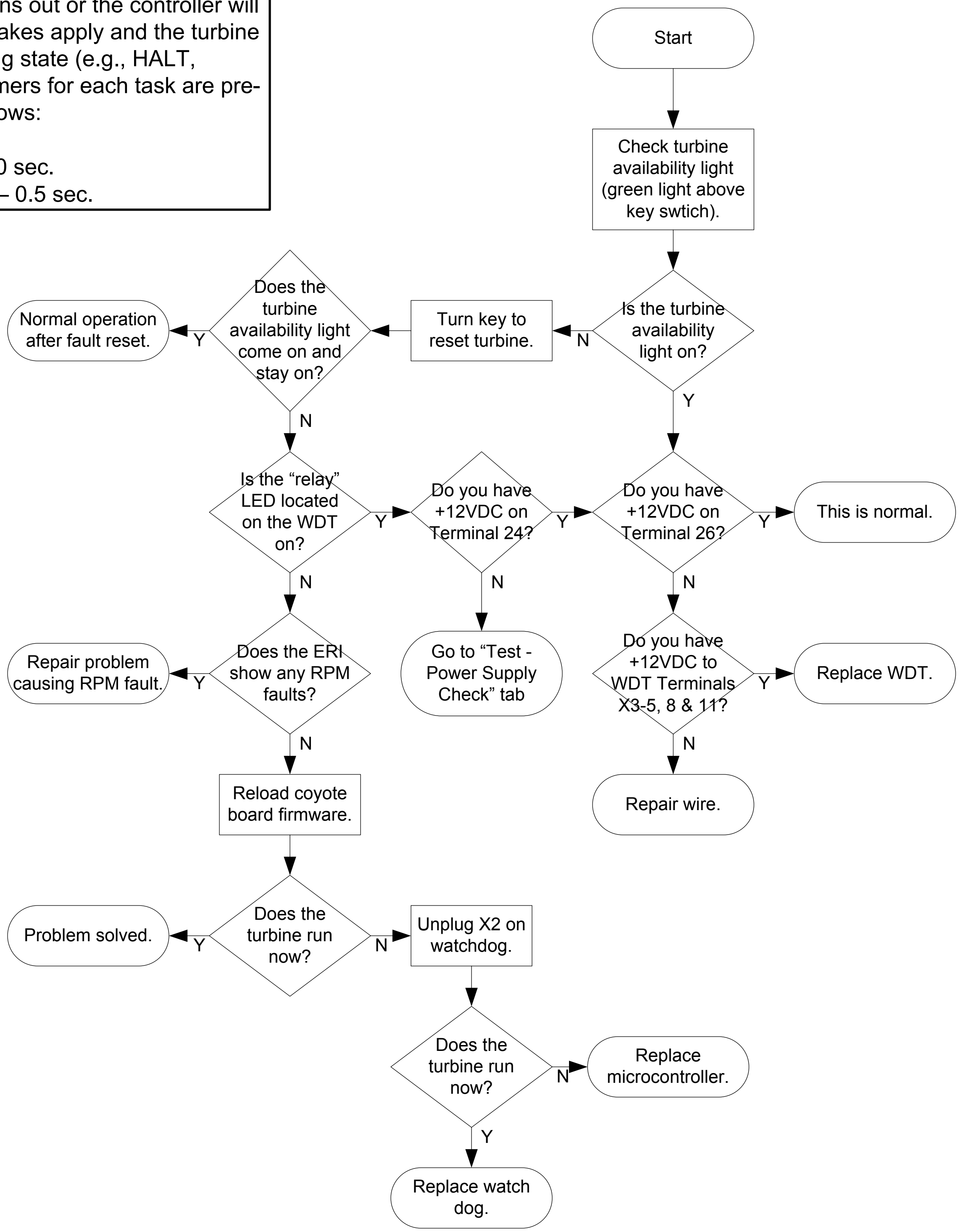


The frequency should be around 3414Hz at 200RPM rotor speed for S-250 or 2834Hz at 166RPM on a S-343

Test - Watchdog timer

The WDT is located just to the right of the coyote board. The controller features watch dog timers (WDT) to prevent the controller from “hanging-up” or “locking up” and, hence, ceasing to monitor the turbine. There are three critical, parallel tasks in the program, and each has an independent WDT that must be reset before it runs out or the controller will re-boot. On reboot the brakes apply and the turbine resets to the last operating state (e.g., HALT, FAULT or CALM). The timers for each task are pre-set in the program as follows:

- Main Task – 2.31 sec.
- Fault Monitor Task – 2.0 sec.
- Measure Speeds Task – 0.5 sec.



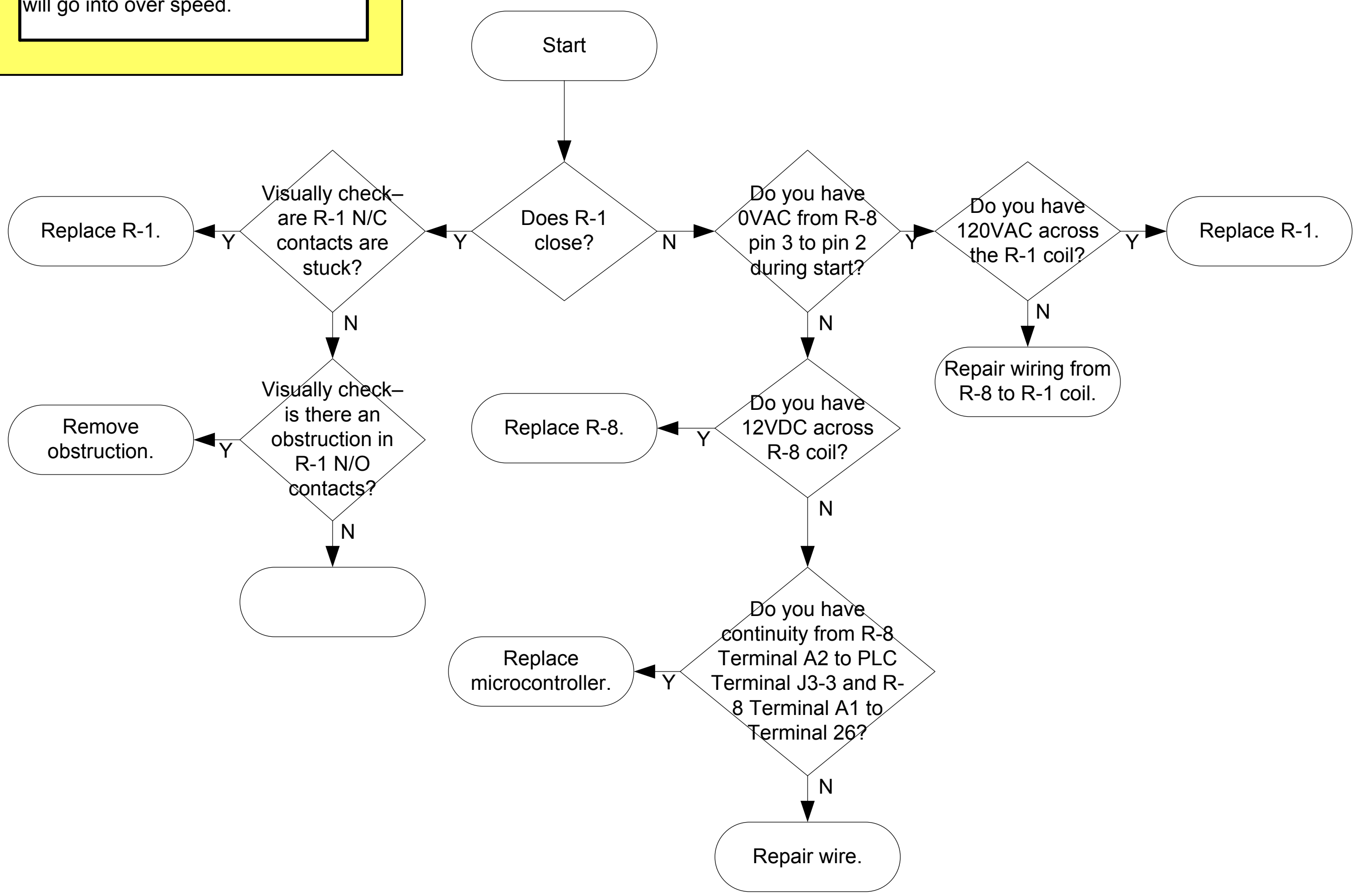
Symptom – Motors Backwards

Turbine starts and turns backwards very slowly.

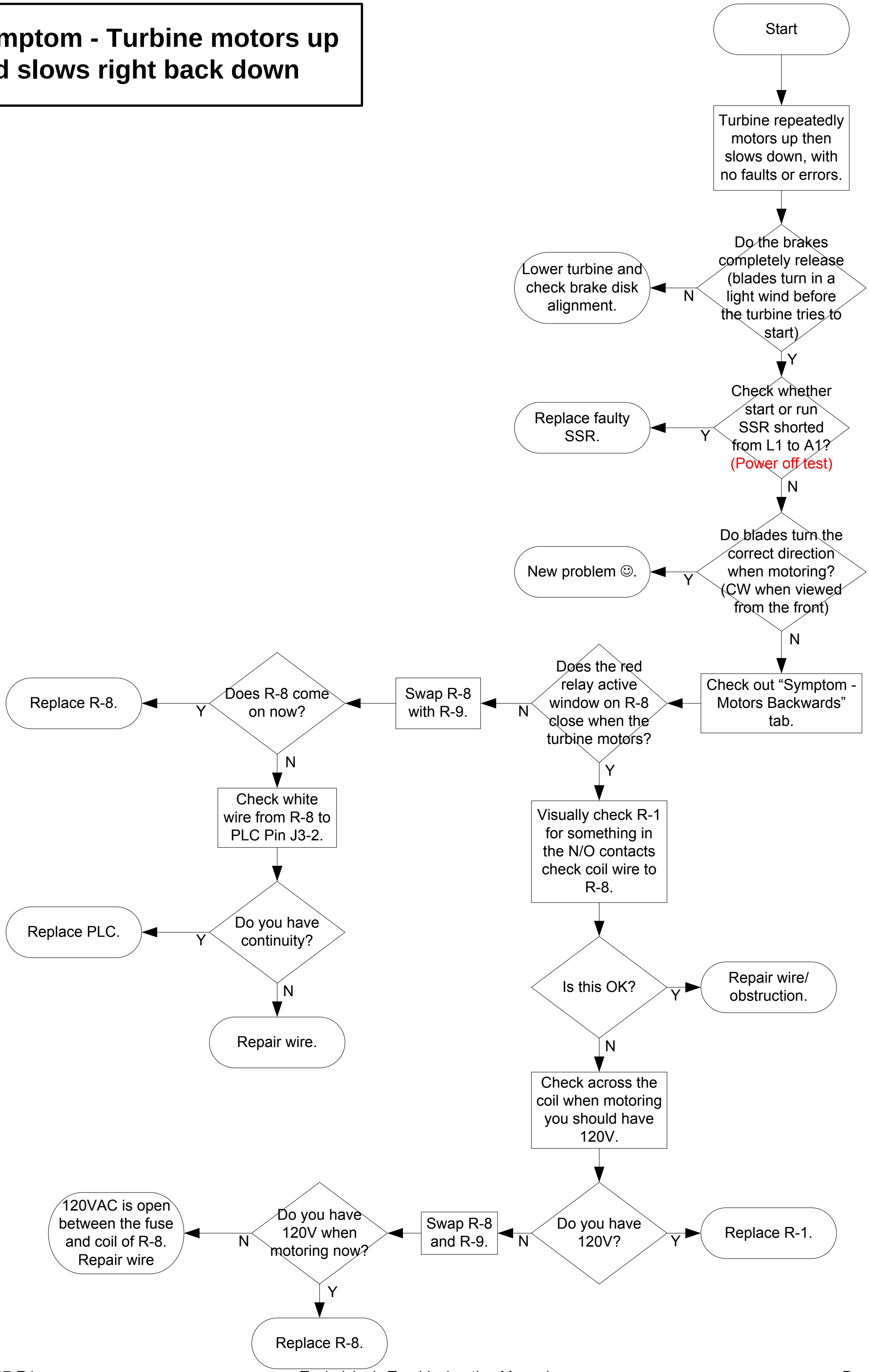
Troubleshooting notes:

If R-8 or R-1 coil fails, turbine will try to start backwards very slowly.

If N/C contact of R-1 fails, the motor will go into over speed.

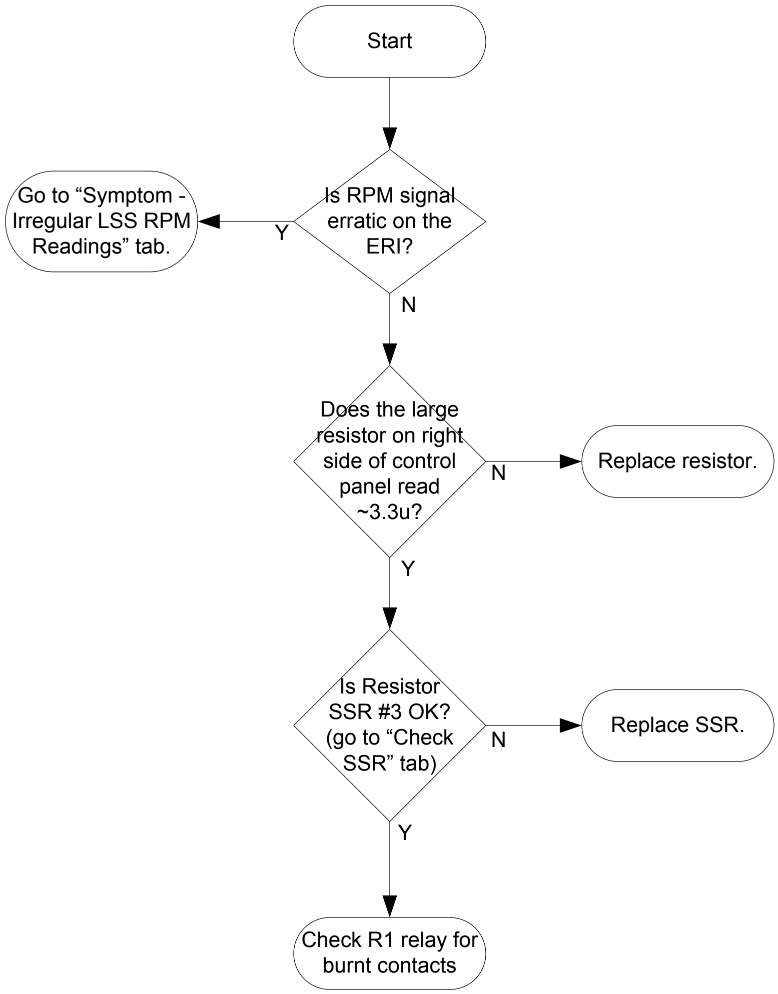


Symptom - Turbine motors up and slows right back down



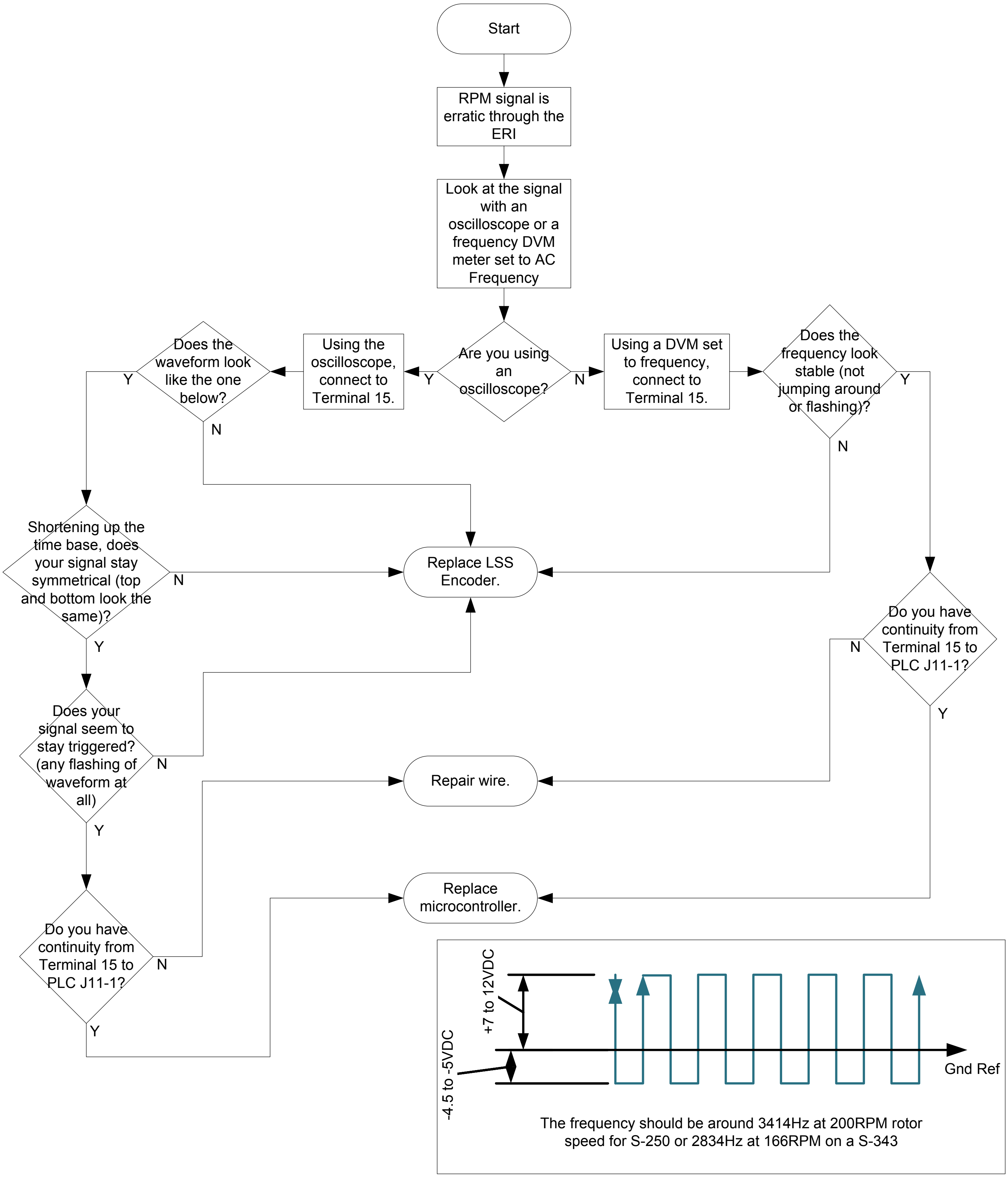
Symptom - Hard Shift

You hear a bang or bump noise when turbine goes from gen low to gen high, gen high to gen low or freewheel to gen low.



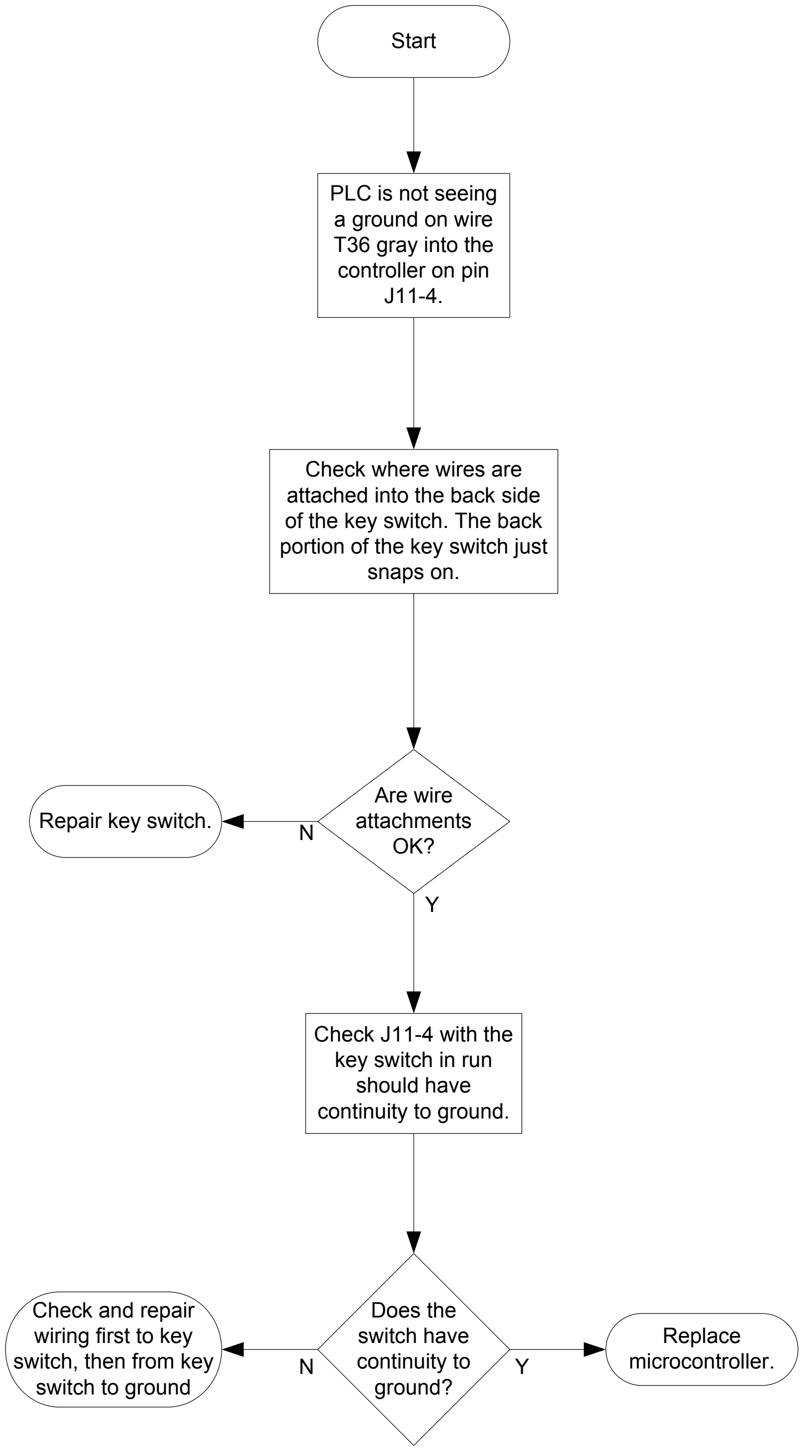
Symptom - Irregular LSS RPM Readings

Turbine generating power and RPM readings continually change over a broad range; thereby, causing frequent shifting between freewheel, gen-lo and gen-hi.



Symptom - Turbine will not come out of Halt.

You have tried the ERI and key switch and the turbine will not go to run.



Symptom - Nacelle Low Power Problem Fuse F1 Blows

Nacelle low power system design

When the control panel is powered up the cube relay closes because it is powered by the +12VDC to -5VDC power supply. A 62Ω resistor drops approximately 5VDC, so the relay sees 12VDC. With the cube closed, it allows 120VAC brake release power to nacelle terminal block. Air pressure switch powers the 120VAC to 13VAC transformer when air pressure is below 100 PSI. The 13VAC powers the rectifier that changes 13VAC to 12VDC to power the compressor. The 120VAC also powers the brake release solenoids that allow the spring applied brake calipers to release.

Start

It has been determined you have a nacelle low power problem. You have +12VDC, -5VDC and 120VAC up tower and fuse F1 blows.

Remove cube relay.

Does the fuse still blow?
- Y: You have a short in the wiring up tower. Go to “Up Tower Wiring Diagram” tab and check for short between brake wires and brake wires to ground.
- N: Do you smell anything or see any discoloration in the nacelle J-box?
  - Y: Replace damaged component. If the transformer is damaged, replace rectifier and check compressor circuit for shorts.
  - N: Disconnect all VAC output from nacelle terminal block except brake solenoids.

Does the fuse still blow?
- Y: Replace defective brake solenoid. Repair shorted brake wire.
- N: Reconnect air switch to terminal block.

Does the fuse still blow?
- Y: You have a short in the air switch circuit. Repair short.
- N: Reconnect Transformer and air switch to terminal block. Remove wires from rectifier to transformer.

Does the fuse still blow?
- Y: Replace damaged transformer, replace rectifier and check compressor circuit for shorts and grounds.
- N: Remove all wires from rectifier and check for short circuit between AC inputs and DC outputs.

Do you have any short circuits?
- Y: Replace rectifier and check compressor circuit for shorts and grounds.
- N: Reconnect rectifier to transformer wires and remove wires to compressor.

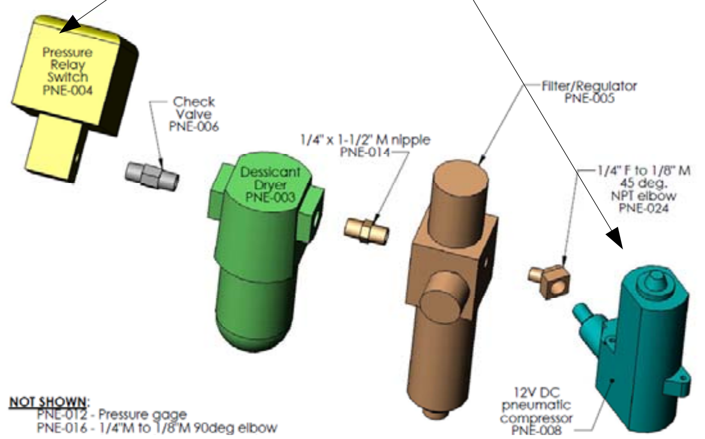
Does the fuse still blow?
- Y: Replace rectifier and check compressor circuit for shorts and grounds.
- N: Reconnect rectifier to compressor.

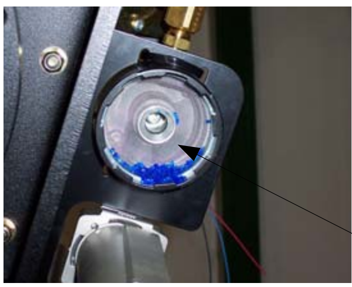
Does the fuse still blow?
- Y: Check compressor circuit for shorts and grounds. Replace compressor if circuit OK.
- N: You have a pinched wire and you inadvertently removed short.

Air pressure high around 140 PSI

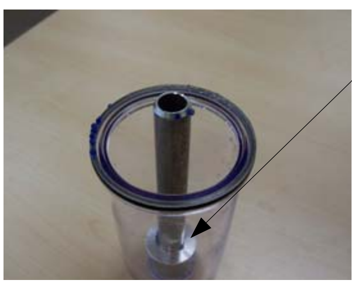
System air pressure is much higher than normal and brakes release slow or will not release.

You are experiencing a restriction between the compressor and the pressure switch

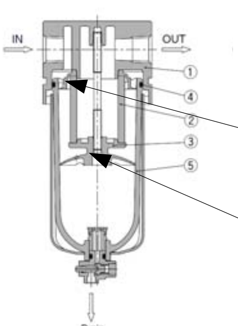




#1. Remove Bowl from Desiccant dryer and check screens on both inlet and outlet.



#2. Check the check valve to see if it is restricted



#3. Make sure air passages in filter are not restricted

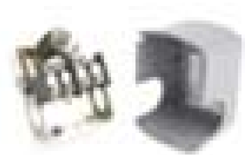
Symptom - Adjust system air brake pressure

If your system air pressure is not close to 100 psi, you may want to adjust the pressure.

Location of pressure switch

Pressure switch

Remove cover on pressure switch



Adjust spring tension, tighten to increase system pressure, decrease spring tension to reduce system pressure