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An Optimal Procedure for RF Conditionning at the FREIA Laboratory

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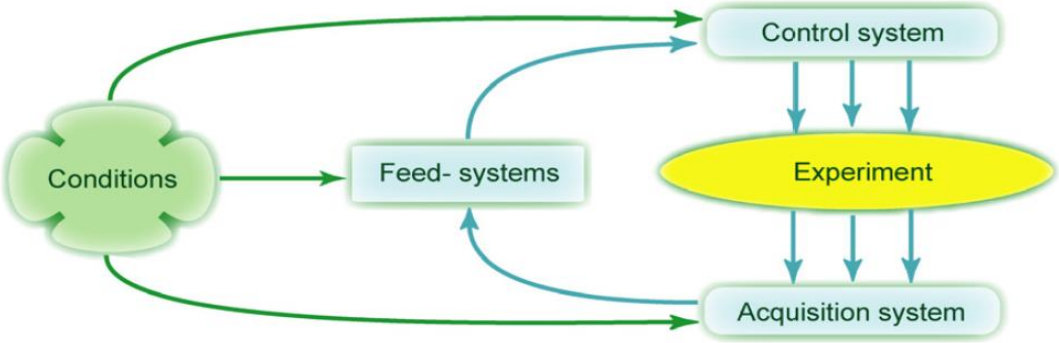
A Conditioning System

Acquisition system, control system and feedback can help to adjust and control the testing parameters with respect to the conditions.



- Condition: defined by experts
  (interlock trig threshold and auto conditioning threshold)
- Acquisition system: RF power, vacuum levels and all the interlocked signals.
- Control system : software controlling
  (duty and peak power of pulse, switching on and off the RF power, and resetting system)

RF-Vacuum Feedback system

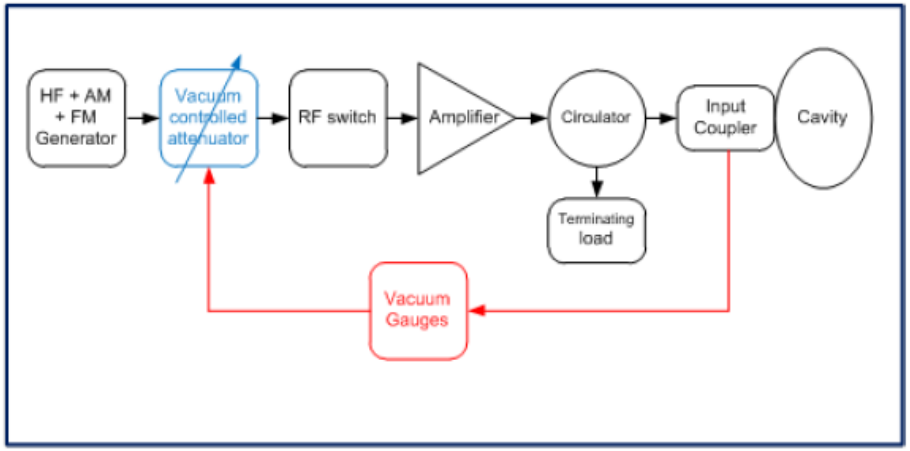


Fig. Layout of a simple RF-Vacuum Feedback system

Following principles need to fulfil for an effective feedback system:

- Regulate RF power as a function of vacuum pressure around the coupler as fast as possible.
- Apply a longer repetition period than the vacuum reading delay.
- Conditioning procedure logic

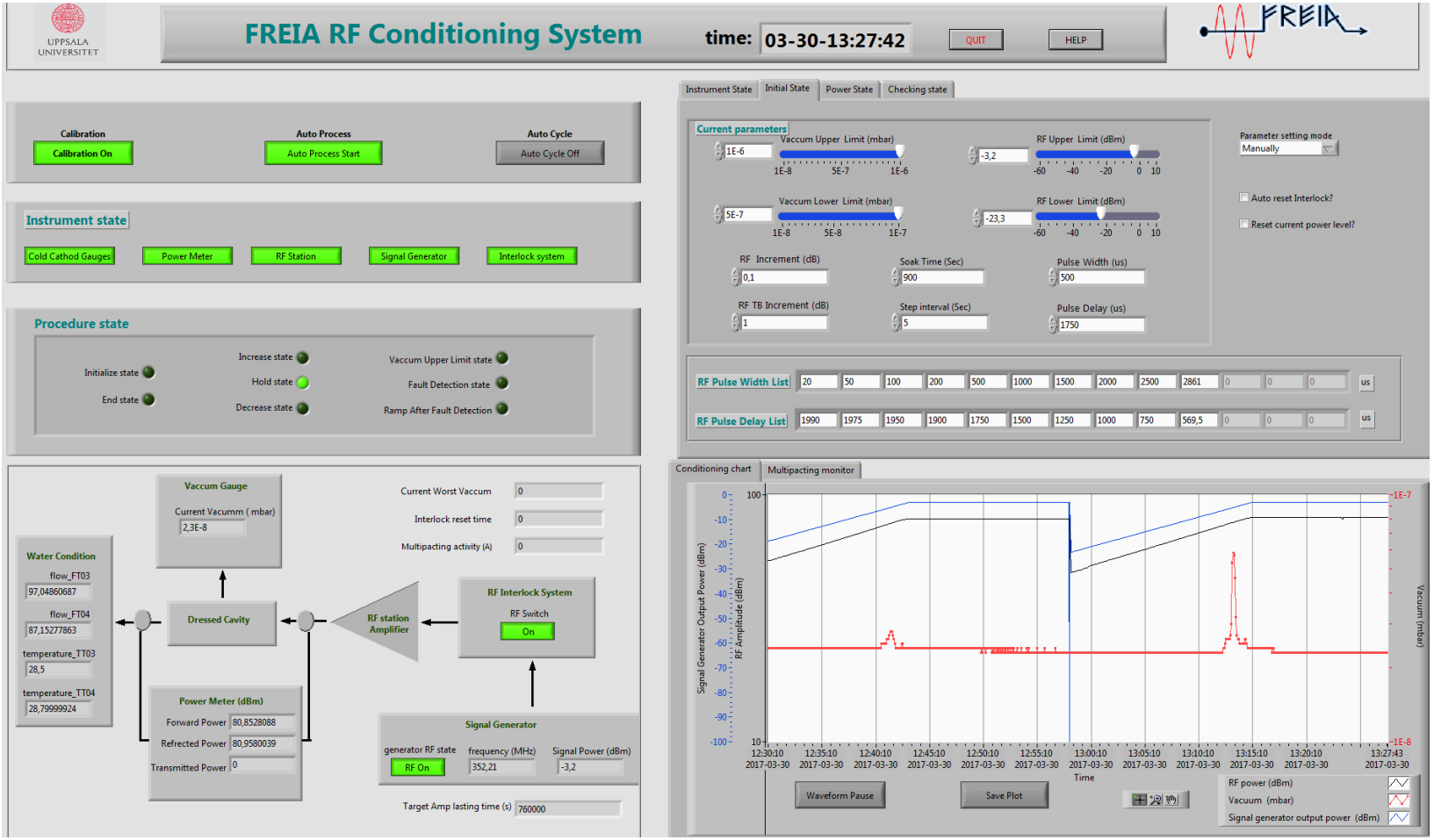
Hardware list

The main devices for the RF conditioning process are:
Programmable Logic Controller (PLC)

- Signal Generator
- Power Meter
- Vacuum Gauge Controller (VGC)
- Cold Cathode Gauges (CCG)
- Arc Detector
- Electron Detector
- Fast RF Interlock Switch
- Voltage Controlled Attenuator
- Vacuum Pumping Cart

Conditioning program

- FREIA conditioning system has been verified on ESS spoke package.
- The overall FREIA system worked as expected



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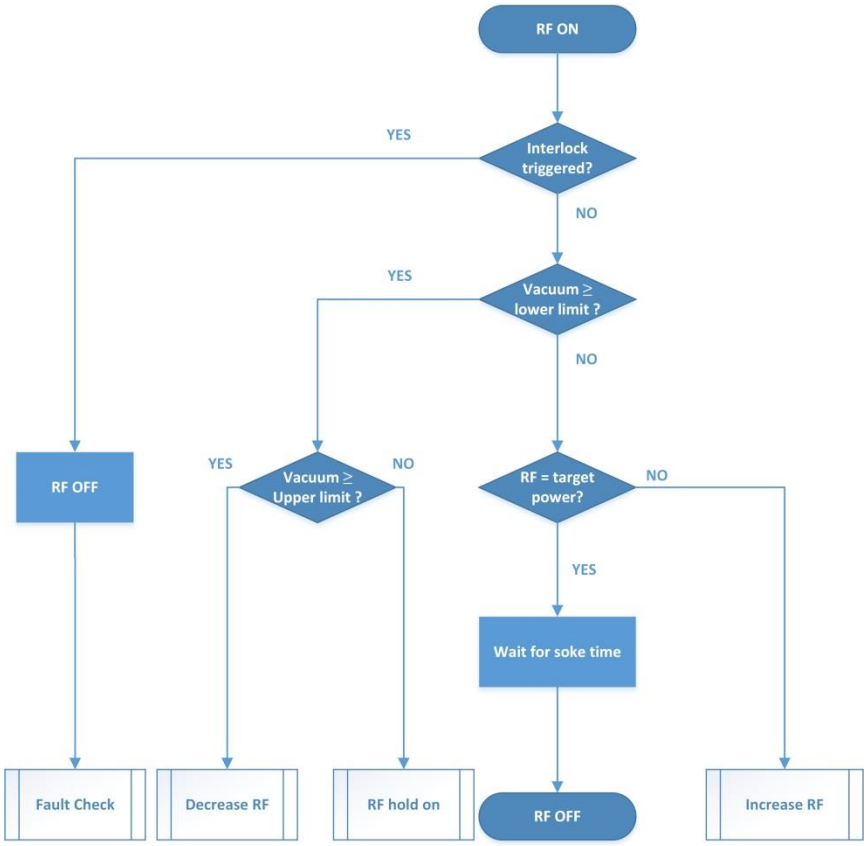
Main Parameters of Spoke Cavity Conditioning

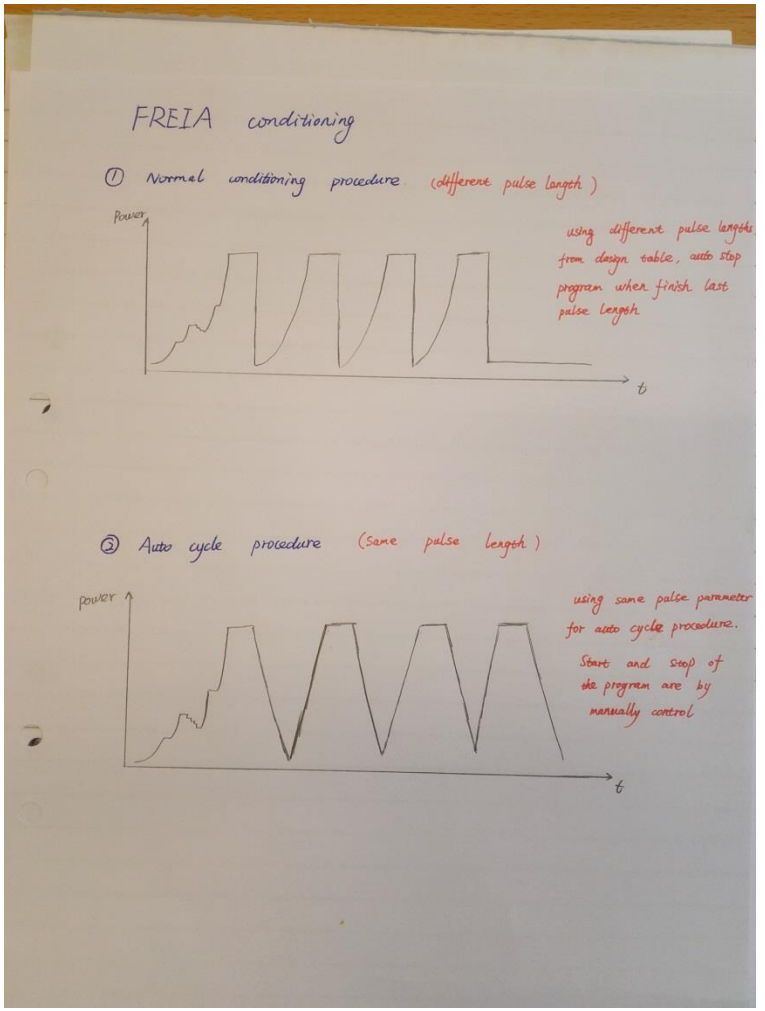
- For different cavity, parameter would varied.
- This depend on the highly likely outgassing region.

Parameter	value
Loop interval time(s)	1
Pulse repeat rate (Hz)	14
Power increase increment (dB)	0.1
Power TB increment (dB)	1
Vacuum upper limit (mbar)	1e-6
Vacuum lower limit (mbar)	5e-7
RF Lower limit (dBm)	-23.3 (generator) 100 W (coupler)
RF Upper limit (dBm)	-3.2 (generator) 120 kW (coupler)
Initial pulse length (µs)	20
pulse length step	20 µs, 50 µs, 100µs, 200 µs, 500 µs, 1ms, 1.5 ms, 2 ms, 2.5ms, 2.86ms

Software logic



Conditioning Logic Layout



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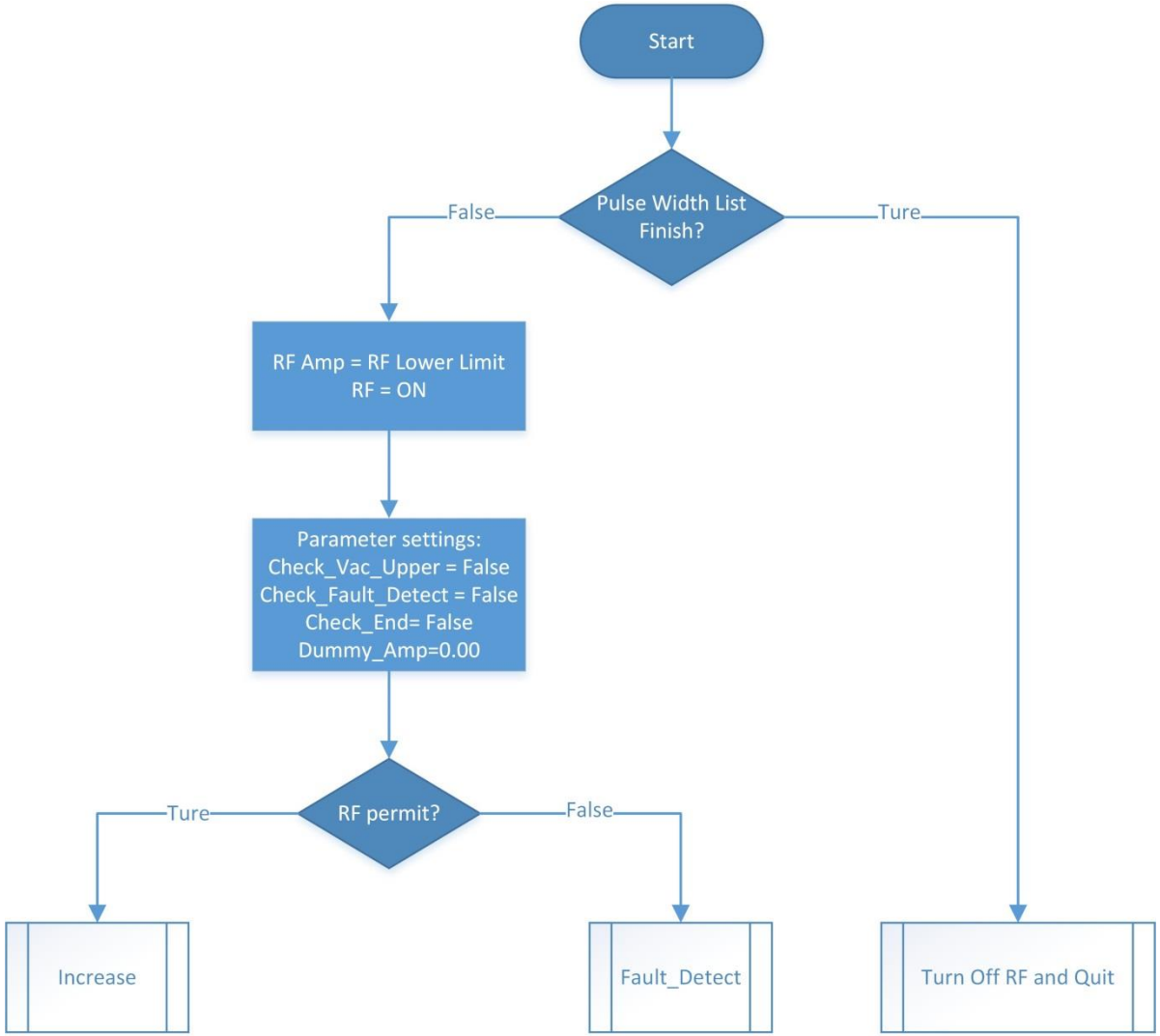
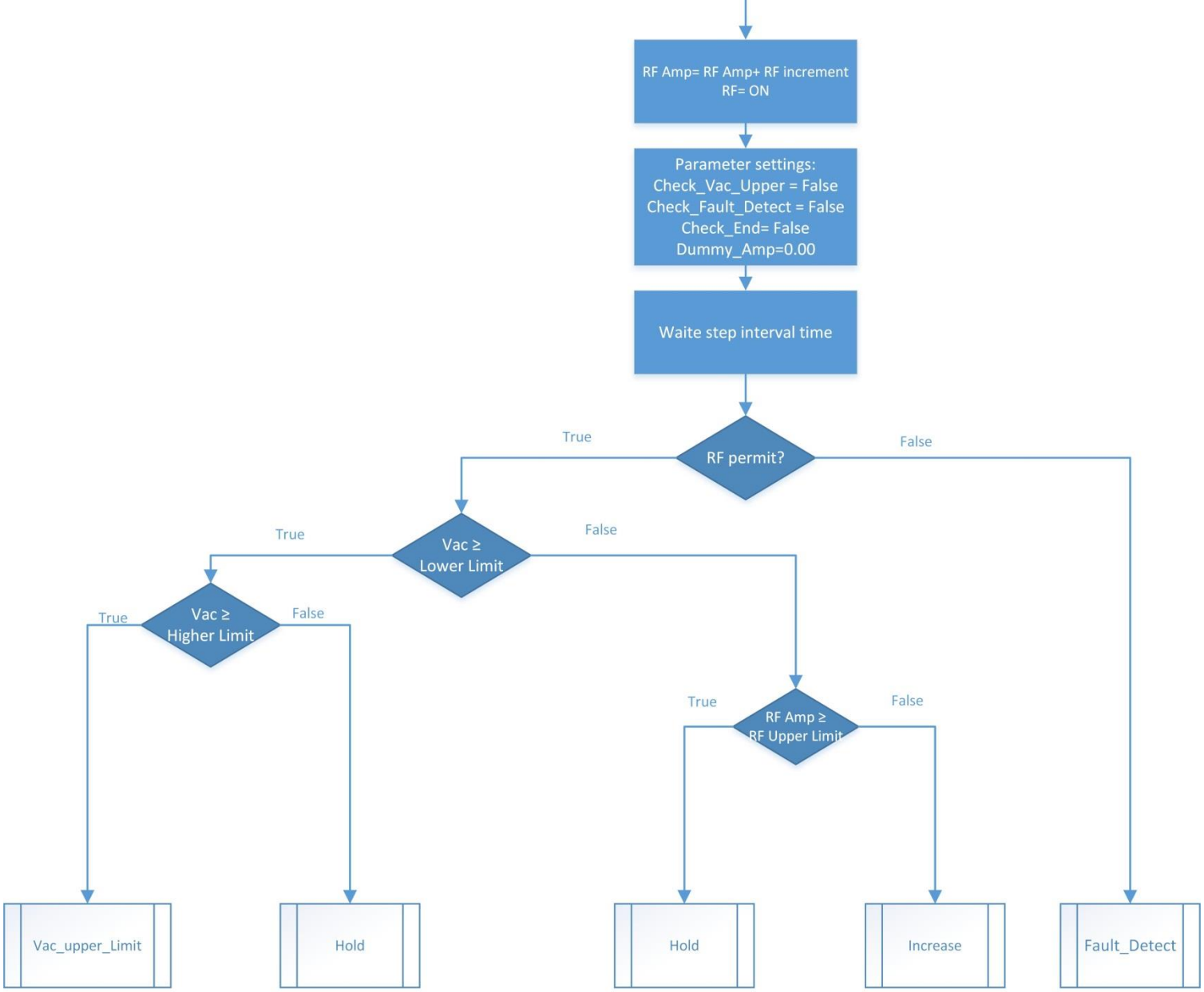
Stats

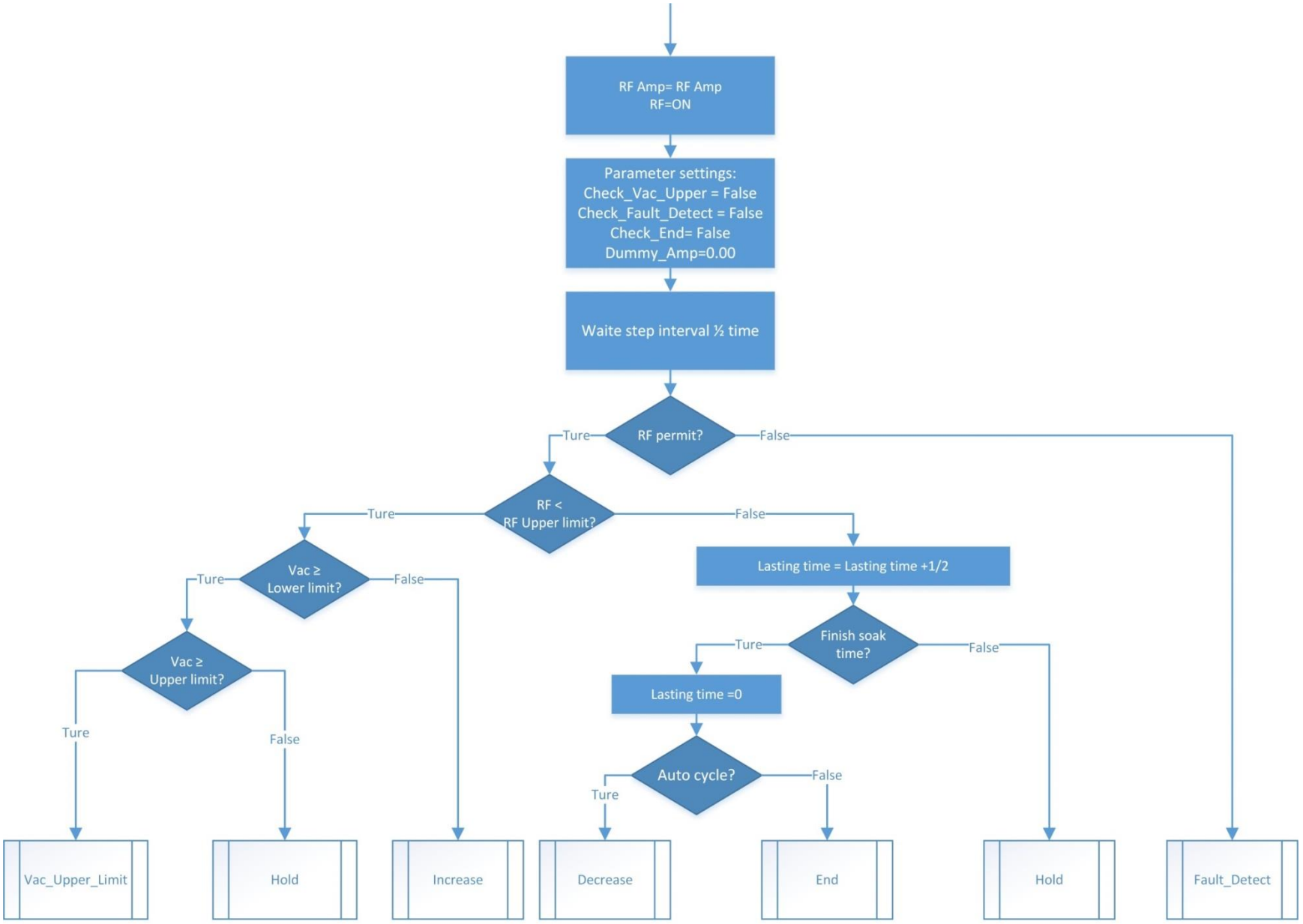
- Initialize state
- Increase state
- Hold state
- Decrease state
- Vacuum upper limit state
- Fault state
- Ramp after fault state
- End state



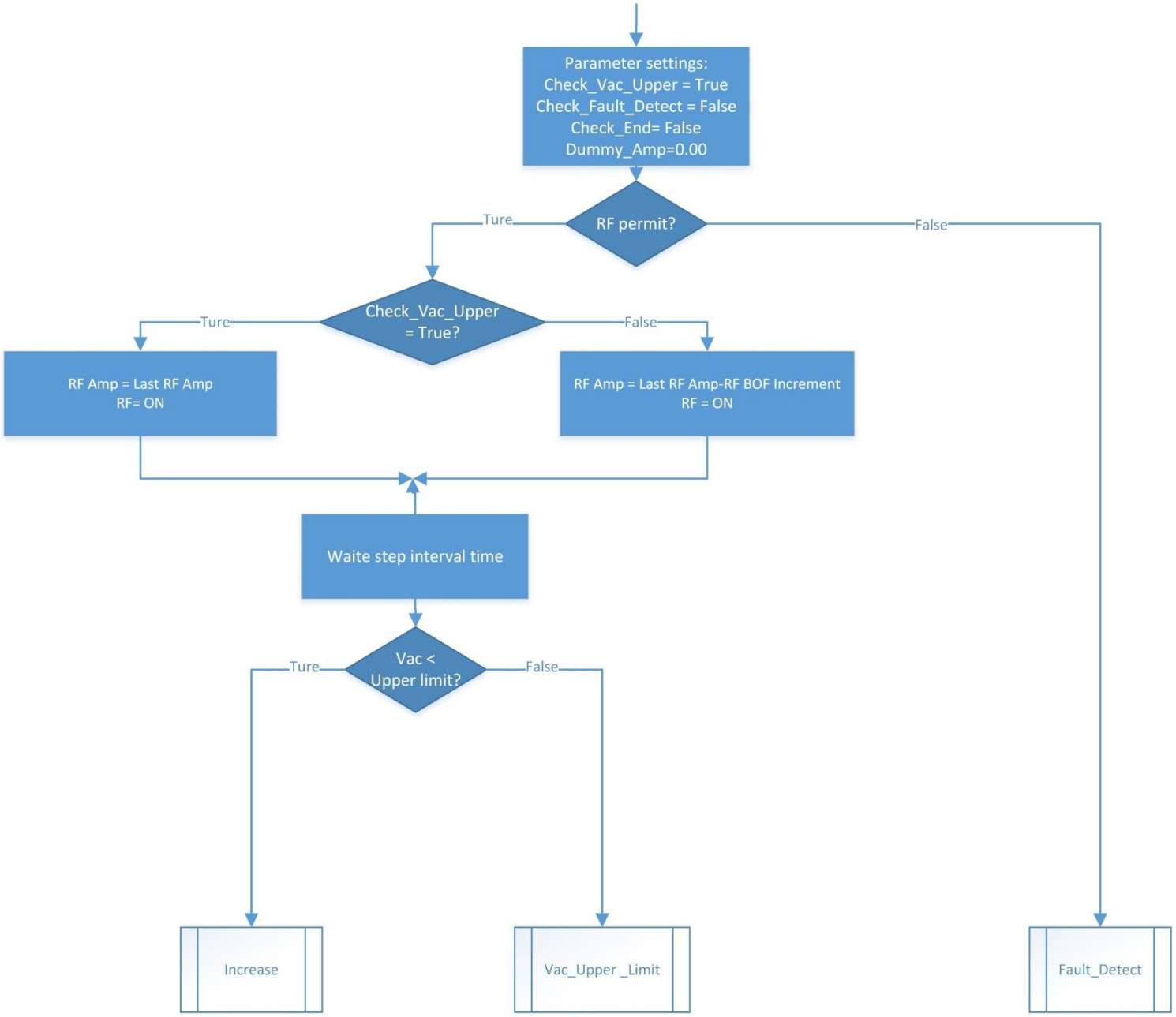
Initialize State



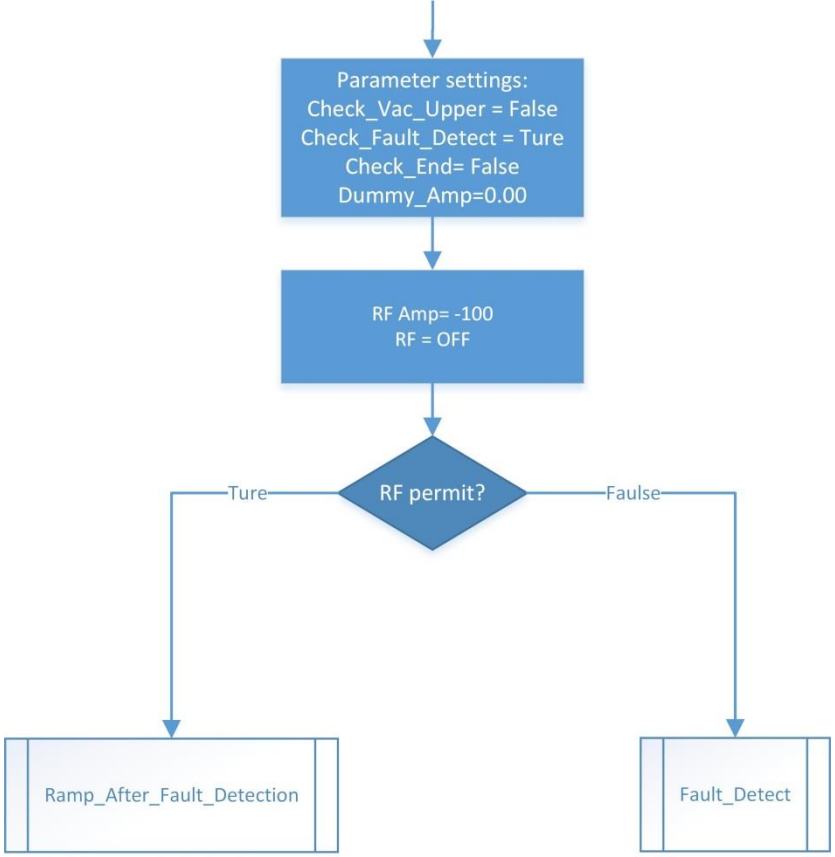
Increase State


RF Amp= RF Amp
RF=ON
Parameter settings:
Check_Vac_Upper = False
Check_Fault_Detect = False
Check_End= False
Dummy_Amp=0.00
Waite step interval ½ time
RF permit?
Ture
False
RF <
RF Upper limit?
Ture
False
Vac ≥
Lower limit?
Ture
False
Vac ≥
Upper limit?
Ture
False
Lasting time = Lasting time +1/2
Finish soak
time?
Ture
False
Lasting time =0
Auto cycle?
Ture
False
Vac_Upper_Limit
Hold
Increase
Decrease
End
Hold
Fault_Detect

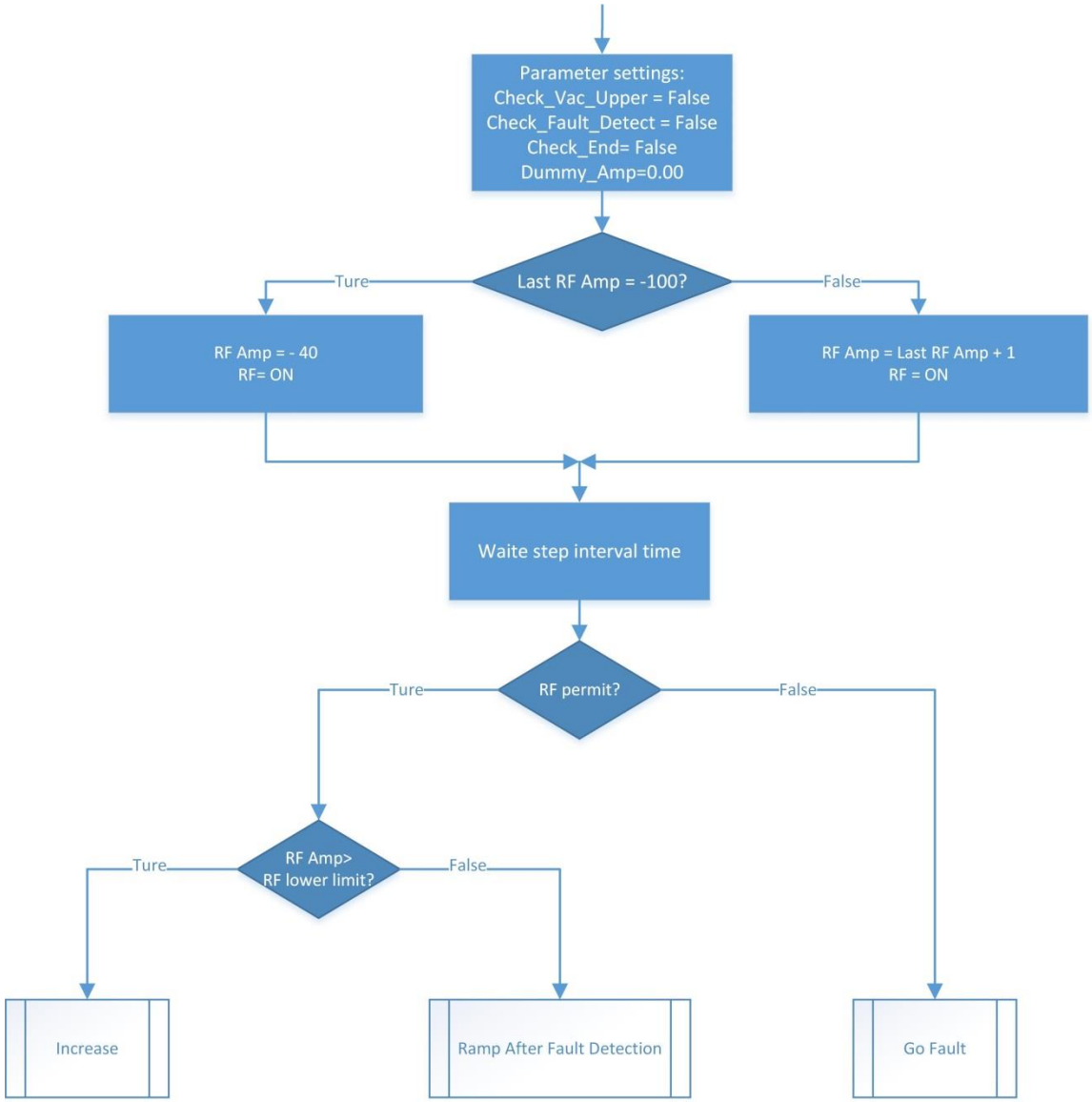
Hold State



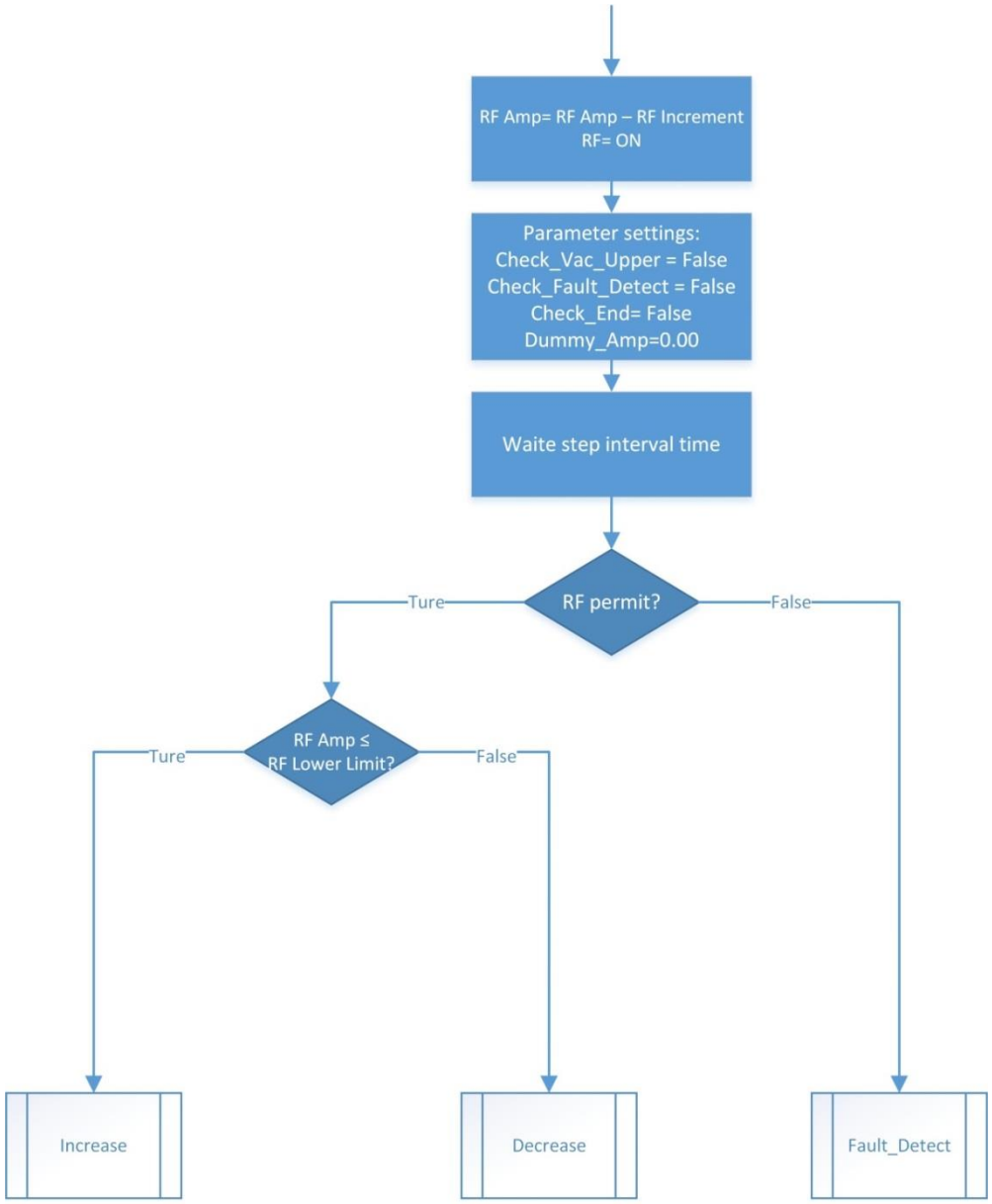
Vacuum Upper limit State



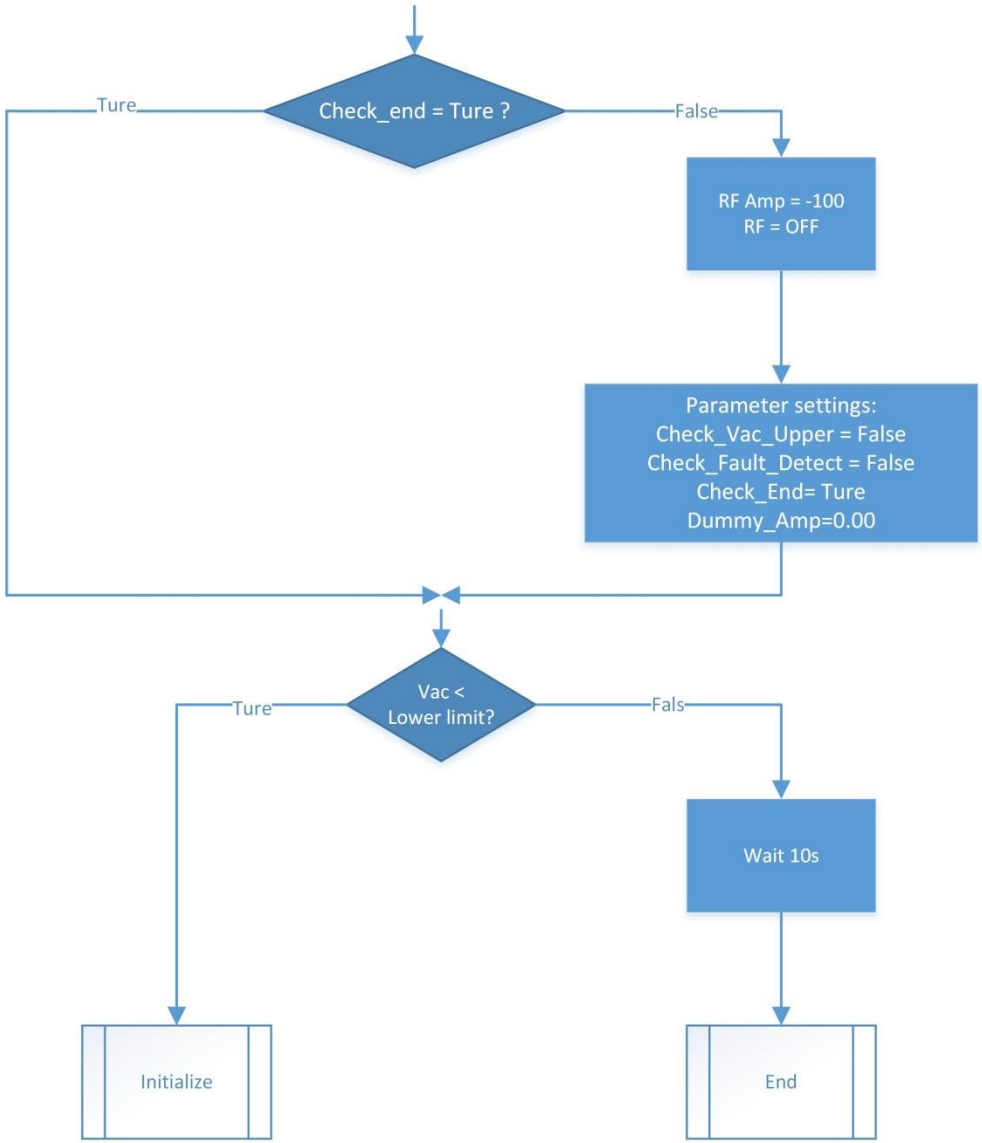
Fault Detect State



Ramp After Fault Detect



Decrease State


Check_end = Ture ?
Ture
False
RF Amp = -100
RF = OFF
Parameter settings:
Check_Vac_Upper = False
Check_Fault_Detect = False
Check_End= Ture
Dummy_Amp=0.00
Vac <
Lower limit?
Ture
Fals
Wait 10s
Initialize
End

End state