
AARTS Workflow Paradigms

April 29, 2010

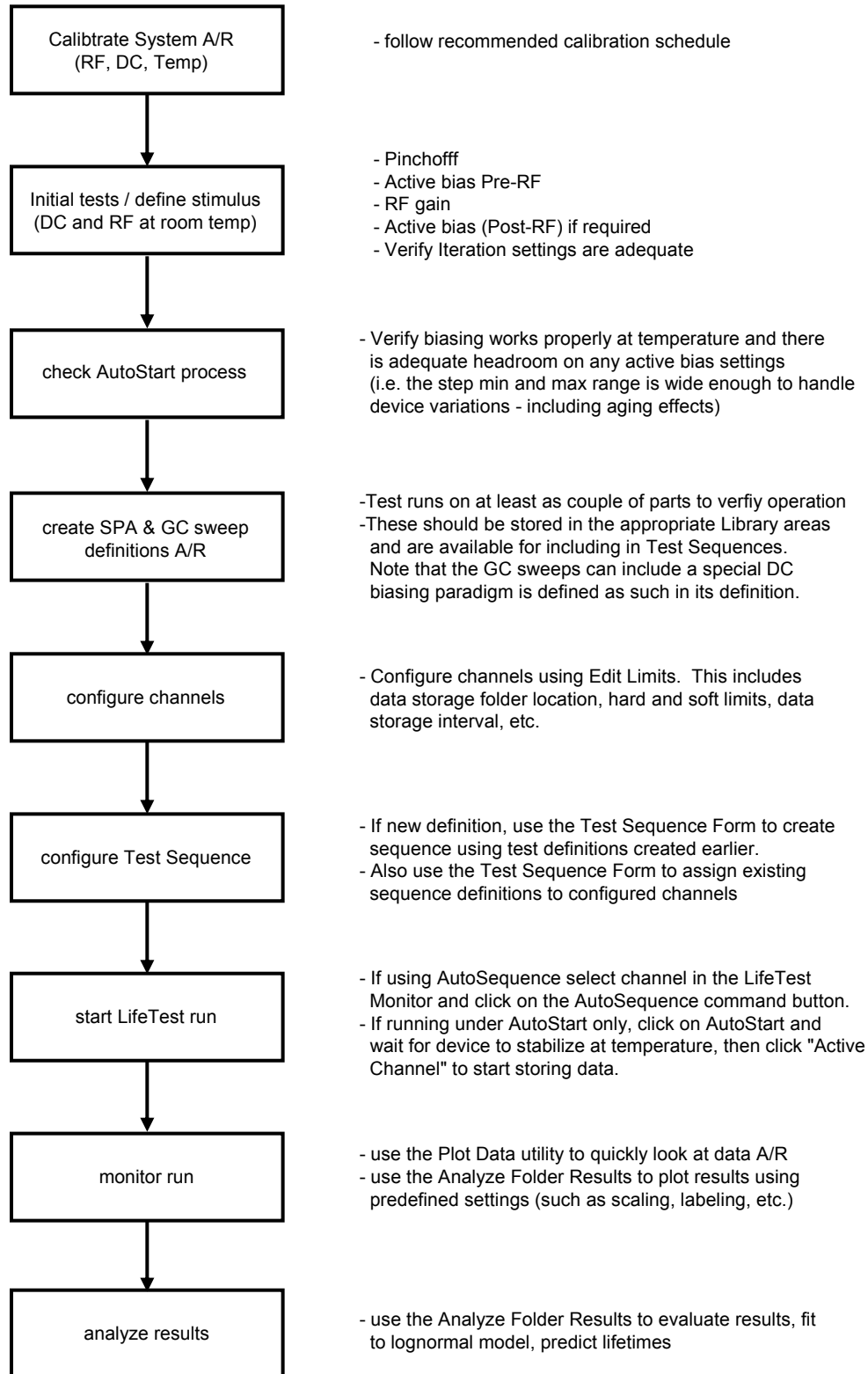
compiled by: David Sanderlin

This document contains a several examples of how to setup and configure channels for performing life tests using the Accel-RF AARTS systems. Please refer to the software manual for further details on using the various Forms referenced.

Note that the software supports a wide variety of device technologies and operating paradigms. These are just a few examples to help get started. Specific conditions may be modified as needed to support a wide variety of requirements.

Different groups have different philosophies on what is acceptable in the life test paradigm. The following lists a few control paradigms that vary greatly among users and applications:

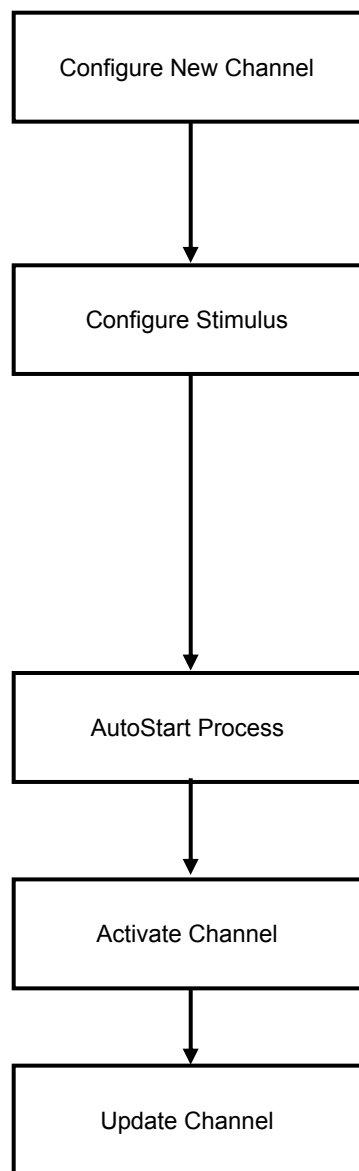
- 1) Temperature Control: Some groups wish to continue testing under constant power dissipation and surface temperature. Since the AARTS systems offer independent temperature control for each device, a constant channel temperature may be maintained by modulating the surface temperature as required to account for power dissipation change.
- 2) Active Biasing: For small signal devices, controlling the gate (or base) easily controls the drain (or collector) current (note: this is required if constant surface temperature control is defined in order to maintain channel temperatures among all devices). However, for large signal devices often the RF dominates the bias point. Hence, a variety of options are provided in the AARTS system to support a wide array of bias paradigms. Some users wish to set active bias until the time data storage begins, then hold the values previously found. Others like to use continuous active bias throughout the test.
- 3) Periodic Special Tests: Some users refuse to perform periodic SPA or GC sweeps because of concern that the device may experience some annealing effects when de-biased and cooled. Others require such periodic tests, since parameters such as Gain Compression or GM change are key degradation metrics.



This method is useful for small-signal RF devices. It comprises one uninterrupted stress test, the devices are actively biased in "Continuous" operating mode until data storage begins, then the power supplies simply hold the last set values. The channel temperature is to be held constant.

Assumptions:

- 1) RF, DC, and thermal calibrations are complete
- 2) AutoStart process is running, but NOT AutoSequence
- 3) One continuous stress run (i.e. no periodic special tests)
- 4) Temperature control set to "channel"
- 5) Active Bias continuous until data storage begins, then hold fixed
- 6) Device active bias is dominated by DC gate voltage (or base current), not RF



[Edit Limits]

- Delete any old channels as required to make room for new device
- Define Hard and/or Soft limits, data storage interval, storage folder, etc..
Note: only parameters that are displayed in the Edit Limits table are checked against in the LifeTest Monitor
- The Temp Goal parameter in Edit Limits overrides the Edit Levels target temperature; however, it does not supercede the AutoSequence definitions

[Edit Levels]

- Set RF, DC, and Temperature targets (note: use a temp delta that includes the effects of surface to channel temperature difference. For instance, if the TJC yield 50°C rise, and the goal is 250°C, an AutoStart Temp Delta of 60°C causes the initial surface temp goal to be 10°C below the expected final target.
- Set Pre-RF and Post-RF "Active Bias" controls to "Bias2->Bias1". Note: only the Post-RF DC levels are maintained throughout the LifeTest, Pre-RF DC levels are set only once at the start of the process.
- Set the DC Startup Paradigm to "Cont_Independent" - leave update interval set to 0s (this causes the update to occur every time the channel is serviced)
- Set the RF Startup Paradigm to "Continuous" - leave update interval set to 0s (this causes the update to occur every time the channel is serviced)
- Check the "Include" check boxes as desired.

[Edit Levels] or [LifeTest Monitor]

- Verify AutoStart process has headroom at temperature so it will not shut down prematurely
- Monitor parameters to verify stimulus stability
- Pull channel control to LifeTest Monitor if not already done

[LifeTest Monitor]

- Reset Limits if required. Note that any parameter with min and max bounding boxes will be re-centered around latest measured values.
- Check the "Active Channel" check box to begin storing data

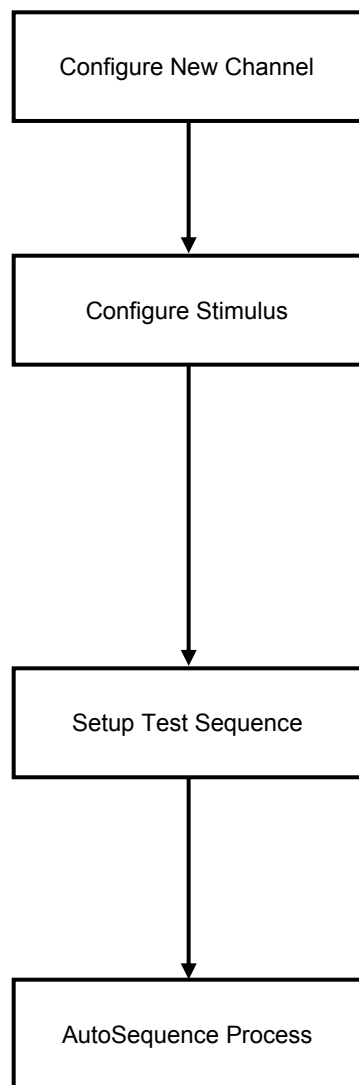
[Edit Levels]

- Capture the last measured "Active Bias" settings by selecting File->Update Channel. The program will query whether to change the active bias settings to "Independent"; answer "Yes". Note: this can happen even when the LifeTest Monitor owns control of the channel (i.e. it is not necessary to pull control)
- Store updates using the File->Save Channel menu item. This will cause the system to remember the settings later in case the channel needs to be restarted.

This method is useful for small-signal RF devices. It comprises one or more stress test intervals, one or more special test sweeps, the devices are actively biased in "Continuous" operating mode until data storage begins (then the power supplies simply hold the last set values each time a new stress interval is initiated). The channel temperature is to be held constant.

Assumptions:

- 1) RF, DC, and thermal calibrations are complete
- 2) AutoSequence definition is complete
- 3) Temperature control set to "channel"
- 4) Active Bias continuous on first stress setup until storage begins, then hold fixed
- 5) Device active bias is dominated by DC gate voltage (or base current), not RF
- 6) Default limits and stimulus are used (i.e. no special stimulus state of created and referenced)



[Edit Limits]

- Delete any old channels as required to make room for new device
- Define Hard and/or Soft limits, data storage interval, storage folder, etc..
Note: only parameters that are displayed in the Edit Limits table are checked against in the LifeTest Monitor
- The AutoSequence temperature definition supercedes both the Edit Levels and Edit Limits temperature targets

[Edit Levels]

- Set RF, DC, and Temperature targets (note: use a temp delta that includes the effects of surface to channel temperature difference. For instance, if the TJC yield 50°C rise, and the goal is 250°C, an AutoStart Temp Delta of 60°C causes the initial surface temp goal to be 10°C below the expected final target.
- Set Pre-RF and Post-RF "Active Bias" controls to "Bias2->Bias1". Note: only the Post-RF DC levels are maintained throughout the LifeTest, Pre-RF DC levels are set only once at the start of the process.
- Set the DC Startup Paradigm to "Cont_Independent" - leave update interval set to 0s (this causes the update to occur every time the channel is serviced)
- Set the RF Startup Paradigm to "Continuous" - leave update interval set to 0s (this causes the update to occur every time the channel is serviced)
- Check the "Include" check boxes as desired.

[Edit Test Sequence]

- Create special test (SPA and GC) definitions using their respective Forms
- Use "Stimulus =" INITIAL.STIMULUS setting, but leave "Limits =" field blank.
This causes the channel to always use the initial stimulus condition upon restart of the channel. Blank fields cause the currently stored default values to be used.
- Set "Reset Limits" mode to "Initial". This causes the Hard failure parameters (min/max) to be re-centered about the last measured values just before first storage of data.
- Assign sequence definitions to channels of interest

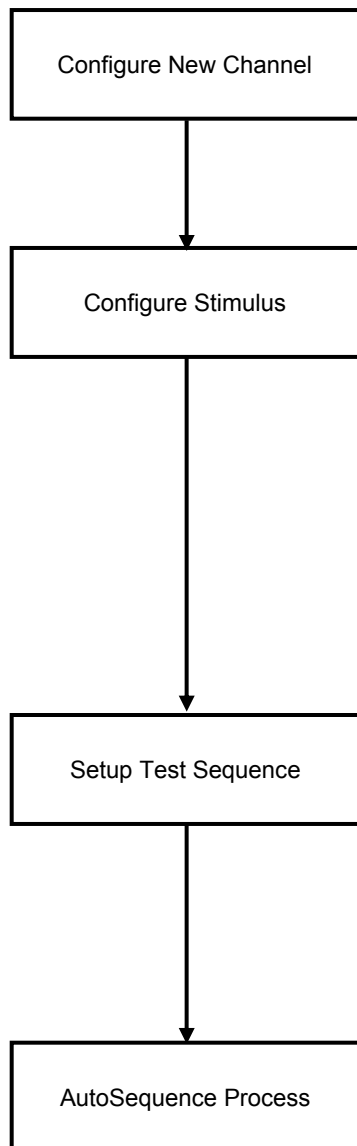
[LifeTest Monitor]

- Verify AutoStart process has headroom at temperature so it will not shut down prematurely
- Configure Temp Stability criteria as desired.
- Data storage will be initiated automatically when the Temp Stabilization flag is set.
- "Initial" stimulus state is automatically stored upon first data storage. It also deactivates any Active Bias modes if previously defined.

This method is useful for large-signal RF devices. Since RF power levels can dominate the bias point for high-power amplifiers, the active bias process is only applied to Pre-RF DC levels. It comprises one or more stress test intervals, one or more special test sweeps, the devices are actively biased in "Continuous" operating mode until data storage begins (then the power supplies simply hold the last set values each time a new stress interval is initiated). The channel temperature is to be held constant.

Assumptions:

- 1) RF, DC, and thermal calibrations are complete
- 2) AutoSequence definition is complete
- 3) Temperature control set to "channel"
- 4) Active Bias only on Pre-RF setup, then hold those values
- 5) Device bias point is dominated by RF, not DC gate voltage (or base current)
- 6) Default limits and stimulus are used (i.e. no special stimulus states are created and referenced)



[Edit Limits]

- Delete any old channels as required to make room for new device
- Define Hard and/or Soft limits, data storage interval, storage folder, etc..
Note: only parameters that are displayed in the Edit Limits table are checked against in the LifeTest Monitor
- The AutoSequence temperature definition supercedes both the Edit Levels Edit Limits and Edit Limits temperature targets

[Edit Levels]

- Set RF, DC, and Temperature targets (note: use a temp delta that includes the effects of surface to channel temperature difference. For instance, if the TJC yield 50°C rise, and the goal is 250°C, an AutoStart Temp Delta of 60°C causes the initial surface temp goal to be 10°C below the expected final target.
- Set Pre-RF "Active Bias" control to "Bias2->Bias1", and Post-RF DC levels control to "Previous". This causes the system to hold the bias points determined prior to applying RF to be held constant for all time. Note: only the Post-RF DC levels are maintained throughout the LifeTest, Pre-RF DC levels are set only once at the start of the process.
- Set the DC Startup Paradigm to "Continuous" - leave update interval set to 0s (this causes the update to occur every time the channel is serviced)
- Set the RF Startup Paradigm to "Continuous" - leave update interval set to 0s (this causes the update to occur every time the channel is serviced)
- Check the "Include" check boxes as desired.

[Edit Test Sequence]

- Create special test (SPA and GC) definitions using their respective Forms
- Use "Stimulus =" INITIAL.STIMULUS setting, but leave "Limits =" field blank. This causes the channel to always use the initial stimulus condition upon restart of the channel. Blank fields cause the currently stored default values to be used.
- Set "Reset Limits" mode to "Initial". This causes the Hard failure parameters (min/max) to be re-centered about the last measured values just before first storage of data.
- Assign sequence definitions to channels of interest

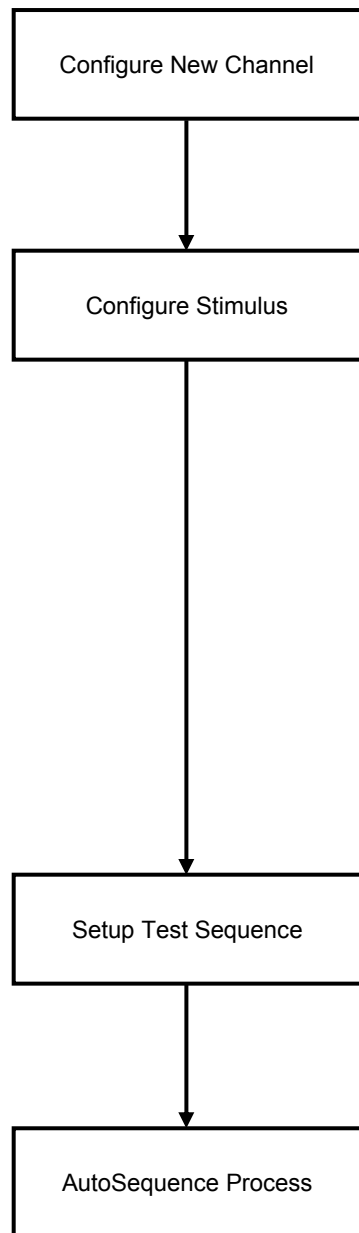
[LifeTest Monitor]

- Verify AutoStart process has headroom at temperature so it will not shut down prematurely
- Configure Temp Stability criteria as desired.
- Data storage will be initiated automatically when the Temp Stabilization flag is set.
- "Initial" stimulus state is automatically stored upon first data storage. It also deactivates any Active Bias modes if previously defined.

This method is useful for RF switch devices, such as a MEMS relay. The DC- and RF-power are both pulsed. Bias1 is used as the activation voltage, Bias2 is used as a stress condition, and RF power level is used as a metric for performance degradation.

Assumptions:

- 1) RF, DC, and thermal calibrations are complete
- 2) AutoSequence definition is complete
- 3) Temperature control point is set to "surface"
- 4) Fixed voltages & RF level
- 5) Pulsing is stopped for device measurement (i.e. measured in CW mode)



[Edit Limits]

- Delete any old channels as required to make room for new device
- Define Hard and/or Soft limits, data storage interval, storage folder, etc..
Note: only parameters that are displayed in the Edit Limits table are checked against in the LifeTest Monitor
- The AutoSequence temperature definition supercedes both the Edit Levels Edit Limits and Edit Limits temperature targets

[Edit Levels]

- Set RF, DC, and Temperature targets (note: use a temp delta of 0degC since these devices do not dissipate significant power).
- Set Pre-RF and Post-RF "Active Bias" control to "Independent". Note: only the Post-RF DC levels are maintained throughout the LifeTest, Pre-RF DC levels are set only once at the start of the process.
- Set the DC Startup Paradigm to "Continuous" - leave update interval set to 0s (this causes the update to occur every time the channel is serviced)
- Set the RF Startup Paradigm to "Continuous" - leave update interval set to 0s (this causes the update to occur every time the channel is serviced)
- Check the "Include" check boxes as desired.
- Set the Pulse Controls as desired and select the measurement control option "While Not Pulsing" (this causes the pulsing to be halted to perform measurements at the specified Halt time - it improves accuracy, which is more important for these types of devices since small changes comprise the failure criteria)
- Enter the fixture matching circuit and device load capacitances into the appropriate boxes in the Pulse Control Form. This limits the PRF (i.e. Period) setting. Otherwise, damage to the Pulser could occur. IMPORTANT - set the DC voltage levels prior to setting up the Pulse controls as the Period limitation is directly proportional to operating voltage.

[Edit Test Sequence]

- Create special test (SPA and GC) definitions using their respective Forms
- Leave "Stimulus =" and "Limits =" fields blank. This causes the default values to be used.
- Set "Reset Limits" mode to "Initial". This causes the Hard failure parameters (min/max) to be re-centered about the last measured values just before first storage of data.
- Assign sequence definitions to channels of interest

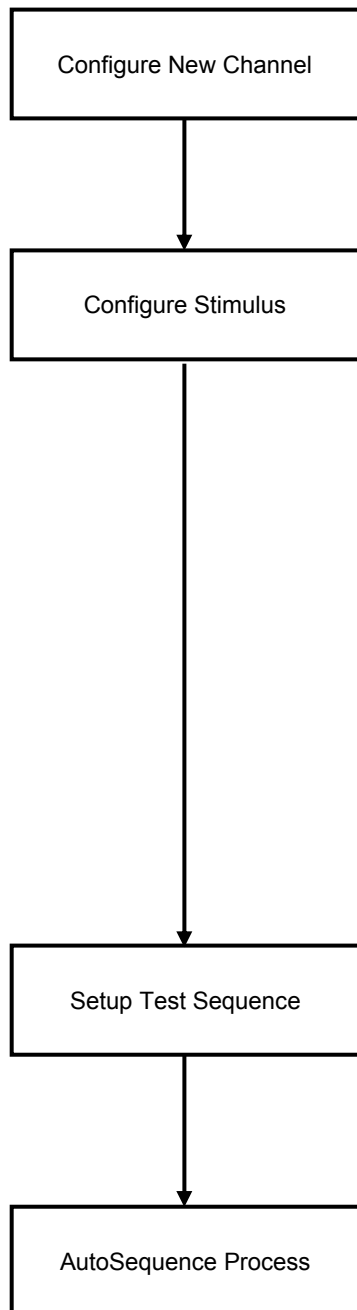
[LifeTest Monitor]

- Verify AutoStart process has headroom at temperature so it will not shut down prematurely
- Configure Temp Stability criteria as desired.
- Data storage will be initiated automatically when the Temp Stabilization flag is set.

This method is useful for RF power devices, such as would be employed in a radar application. The DC- and RF-power are both pulsed. The pulsing is not stopped for measurements as these devices generally cannot survive the power dissipation associated with CW operation.

Assumptions:

- 1) RF, DC, and thermal calibrations are complete
- 2) AutoSequence definition is complete
- 3) Temperature control point is set to "channel"
- 4) Active Bias only on Pre-RF setup, then hold those values
- 5) Pulsing is NOT stopped for device measurement (i.e. measured in Pulsed mode)



[Edit Limits]

- Delete any old channels as required to make room for new device
- Define Hard and/or Soft limits, data storage interval, storage folder, etc..
Note: only parameters that are displayed in the Edit Limits table are checked against in the LifeTest Monitor
- The AutoSequence temperature definition supercedes both the Edit Levels Edit Limits and Edit Limits temperature targets

[Edit Levels]

- Set RF, DC, and Temperature targets (note: use a temp delta that includes the effects of surface to channel temperature difference. For instance, if the TJC yield 50°C rise, and the goal is 250°C, an AutoStart Temp Delta of 60°C causes the initial surface temp goal to be 10°C below the expected final target.
- Set Pre-RF and Post-RF "Active Bias" control to "Independent". Note: only the Post-RF DC levels are maintained throughout the LifeTest, Pre-RF DC levels are set only once at the start of the process.
- Set the DC Startup Paradigm to "Continuous" - leave update interval set to 0s (this causes the update to occur every time the channel is serviced)
- Set the RF Startup Paradigm to "Continuous" - leave update interval set to 0s (this causes the update to occur every time the channel is serviced)
- Check the "Include" check boxes as desired.
- Set the Pulse Controls as desired and select the measurement control option "While Pulsing". Select "Apply DF to Measurement" options to force the software to "correct" the average reading instruments for the duty factor effects. Set the Auto Bias control option to "While Pulsing" to prevent CW operation during the setup of DC and RF levels
- Enter the fixture matching circuit and device load capacitances into the appropriate boxes in the Pulse Control Form. This limits the PRF (i.e. Period) setting. Otherwise, damage to the Pulser could occur. IMPORTANT - set the DC voltage levels prior to setting up the Pulse controls as the Period limitation is directly proportional to operating voltage.

[Edit Test Sequence]

- Create special test (SPA and GC) definitions using their respective Forms
- Leave "Stimulus =" and "Limits =" fields blank. This causes the default values to be used.
- Set "Reset Limits" mode to "Initial". This causes the Hard failure parameters (min/max) to be re-centered about the last measured values just before first storage of data.
- Assign sequence definitions to channels of interest

[LifeTest Monitor]

- Verify AutoStart process has headroom at temperature so it will not shut down prematurely
- Configure Temp Stability criteria as desired.
- Data storage will be initiated automatically when the Temp Stabilization flag is set.

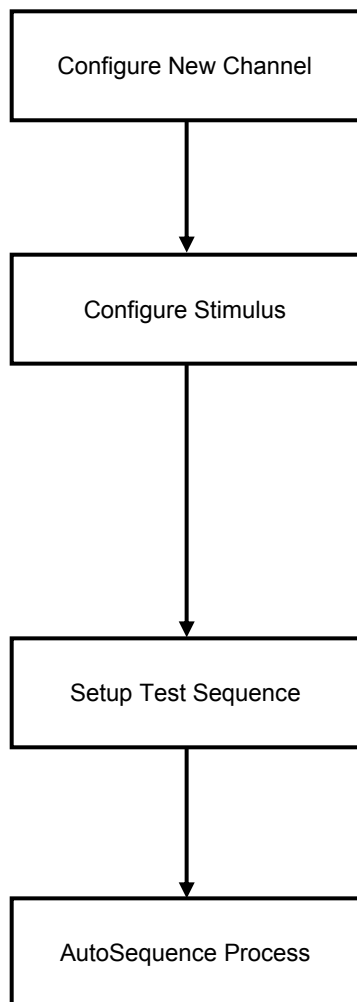
This method is useful for small-signal RF devices. It emulates the technique historically employed due to the fact that all devices were being heated by a common heat source (i.e. a hot plate or oven). In order to maintain all device channel temperature's equal, their power dissipation (e.g. DC voltage/current and RF Pout) must be held fixed. The disadvantage is that those parameters are key performance indicators.

NOTE: The AARTS DC systems have that same limitation. However, since the RF systems maintain independent control of all channels, "channel" temperature control is possible, whereby surface temperature is varied dynamically as power dissipation changes to maintain constant channel temperature.

This methodology comprises one or more stress test intervals, one or more special test sweeps, the devices are actively biased in "Continuous" operating mode until data storage begins (then the power supplies simply hold the last set values each time a new stress interval is initiated). The channel temperature is to be held constant.

Assumptions:

- 1) RF, DC, and thermal calibrations are complete
- 2) AutoSequence definition is complete
- 3) Temperature control set to "surface"
- 4) Active Bias continuous throughout the test
- 5) Device active bias is dominated by DC gate voltage (or base current), not RF
- 6) Default limits and stimulus are used (i.e. no special stimulus states are created and referenced)



[Edit Limits]

- Delete any old channels as required to make room for new device
- Define Hard and/or Soft limits, data storage interval, storage folder, etc..
Note: only parameters that are displayed in the Edit Limits table are checked against in the LifeTest Monitor
- The AutoSequence temperature definition supercedes both the Edit Levels Edit Limits and Edit Limits temperature targets

[Edit Levels]

- Set RF, DC, and Temperature targets (note: use a temp delta that includes the effects of surface temperature overshoot due to added device power dissipation).
- Set Pre-RF and Post-RF "Active Bias" controls to "Bias2->Bias1". Note: only the Post-RF DC levels are maintained throughout the LifeTest, Pre-RF DC levels are set only once at the start of the process.
- Set the DC Startup Paradigm to "Continuous" - leave update interval set to 0s (this causes the update to occur every time the channel is serviced)
- Set the RF Startup Paradigm to "Continuous" - leave update interval set to 0s (this causes the update to occur every time the channel is serviced)
- Check the "Include" check boxes as desired.

[Edit Test Sequence]

- Create special test (SPA and GC) definitions using their respective Forms
- Leave "Stimulus =" and "Limits =" fields blank. This causes the default values to be used.
- Set "Reset Limits" mode to "Initial". This causes the Hard failure parameters (min/max) to be re-centered about the last measured values just before first storage of data.
- Assign sequence definitions to channels of interest

[LifeTest Monitor]

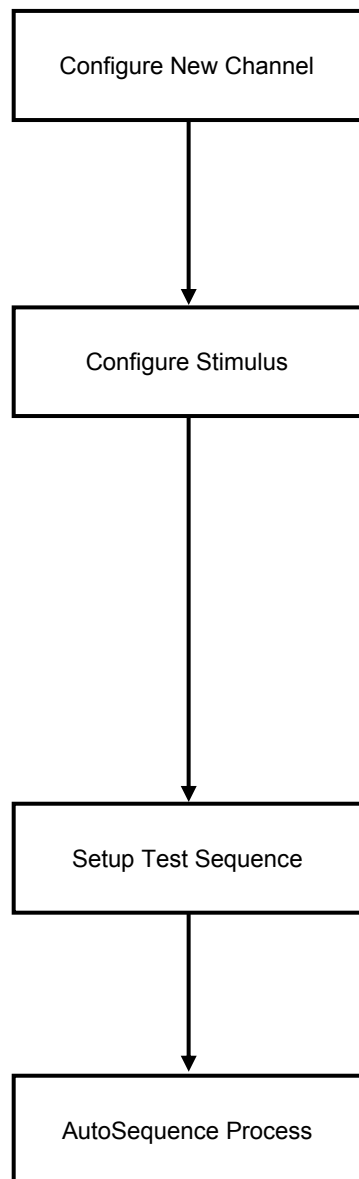
- Verify AutoStart process has headroom at temperature so it will not shut down prematurely
- Configure Temp Stability criteria as desired.
- Data storage will be initiated automatically when the Temp Stabilization flag is set.

This method is useful for stressing RF devices under a variety of stimulus conditions. Dynamic modelling is one such application. Temperature step stress tests, as defined in the JEP118 methodology, are useful for determining the proper 3 temperatures to be used for life testing. While this example focuses on temperature steps, DC & RF bias steps at a fixed temperature are supported as well.

This paradigm comprises multiple stress test intervals, the devices are actively biased in "Continuous" operating mode until data storage begins at each new temperature frame (then the power supplies hold the values determined prior to storing data at that interval).

Assumptions:

- 1) RF, DC, and thermal calibrations are complete
- 2) AutoSequence definition is complete
- 3) Temperature control set to "channel"
- 4) Active Bias continuous on stress setup until storage begins, then hold fixed
- 5) Device active bias is dominated by DC gate voltage (or base current), not RF
- 6) Special limits and stimulus are used



[Edit Limits]

- Delete any old channels as required to make room for new device
- Define Hard and/or Soft limits, data storage interval, storage folder, etc..
Note: only parameters that are displayed in the Edit Limits table are checked against in the LifeTest Monitor
- The AutoSequence temperature definition supercedes both the Edit Levels Edit Limits and Edit Limits temperature targets
- Create special limits files for each state to be used (e.g. "Limits =" xxx.LIMITS)
Suggestion: use the default Edit Limits values with no hard limit on Surface and Channel temps if all other parameter limits are static.

[Edit Levels]

- Set RF, DC, and Temperature targets (note: use a temp delta that includes the effects of surface to channel temperature difference. For instance, if the TJC yield 50°C rise, and the goal is 250°C, an AutoStart Temp Delta of 60°C causes the initial surface temp goal to be 10°C below the expected final target.
- Set Pre-RF and Post-RF "Active Bias" controls to "Bias2->Bias1". Note: only the Post-RF DC levels are maintained throughout the LifeTest, Pre-RF DC levels are set only once at the start of the process.
- Set the DC Startup Paradigm to "Cont_Independent" - leave update interval set to 0s (this causes the update to occur every time the channel is serviced)
- Set the RF Startup Paradigm to "Continuous" - leave update interval set to 0s (this causes the update to occur every time the channel is serviced)
- Check the "Include" check boxes as desired.
- Create special stimulus files for each state to be used (e.g. "Stimulus =" xxx.STIMULUS)
Suggestion: use the default Edit Levels values if the only variation is surface temp goal as that parameter is overridden by the Test Sequence definition.

[Edit Test Sequence]

- Create a "Stress" definition lines for each temperature. Use the entry boxes to apply any special Stimulus or Limits files defined earlier. Leave blank to use the defaults as defined in the Edit Limits and Edit Levels Forms.
- Set "Reset Limits" mode to "Once". This causes the Hard failure parameters (min/max) to be re-centered about the last measured values just before the first storage of data at each new temperature step.
- Assign sequence definitions to channels of interest

[LifeTest Monitor]

- Verify AutoStart process has headroom at temperature so it will not shut down prematurely
- Configure Temp Stability criteria as desired.
- Data storage will be initiated automatically when the Temp Stabilization flag is set.