Production Readiness Review (ASSCON) Vapor Phase Vacuum Reflow for TX/RX Converter Sub-Attached (-0011) Assembly

March 30, 2012

Table of Contents

Project Overview

- **Project Name**: ASSCON Vapor Phase Vacuum Reflow for TX/RX Converter Sub-Attached (-0011) Assembly
- **Project Objectives**: To qualify and introduce the ASSCON Vapor Phase Vacuum Reflow in the factory and to be use for TX/RX converter sub-attached (-0011) assemblies
- **Project Benefits**:
  - To reduce solder voids by less than 30% between the substrate and baseplate for the -0011 converter sub-attached assembly process.
  - To improve testing and tuning time of converters by reducing the number of test run at VSWR (RF-RL) and Test & Tune

Machine Overview

- Machine Specifications

VP6000 ASSCON

Vapor Phase Vacuum Reflow

Item	Specification
Max height of solder product	80mm
Machine Dimensions	(W)2260 x (L)1599 x (H)1420 mm
Load & Unloading height (SMEMA)	886-935mm
Power Supply	400 V/50 Hz
Ave. Power consumption @ full load	4KW
Ave. Power consumption @ standby mode	2.5 KW
Medium Consumption ca	15/20 gal/h
Medium basic filling qty	30 Kg
Heating up-time	30 mins

Machine Overview

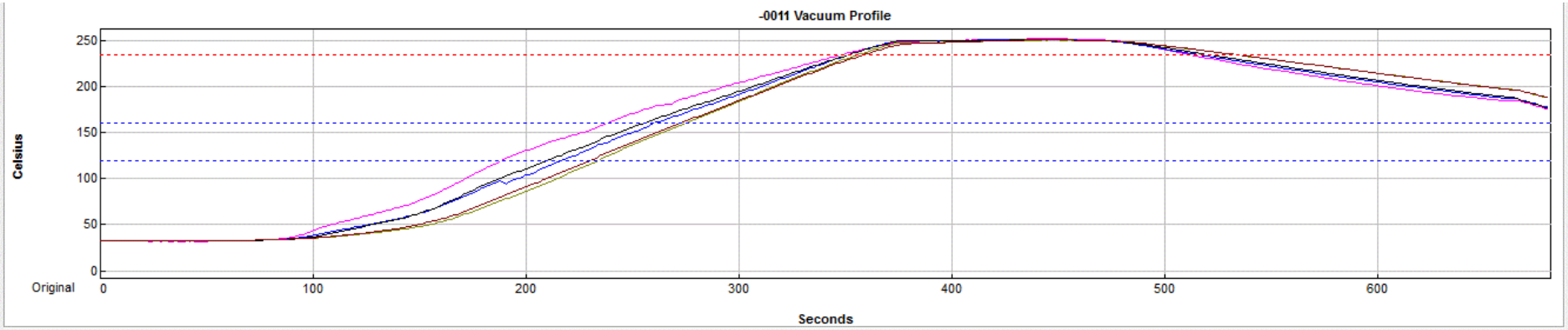
- Also known as VP soldering, or vapor phase vacuum reflow, is currently the most flexible, simplest, and most reliable method of soldering.
- It allows processing of all components without the need of any complicated calculations or having to maintain temperature profiles.
- The temperature of the vapor can never exceed the temperature of the boiling liquid and it is fixed.

Machine Overview

- Benefits of Vapor Phase Vacuum Reflow
  - Final temperature of “ALL“ components exactly defined by temperature of the vapor. This is a physical constant.
  - 100% oxygen free solder process without using inert gas.
  - Pre-selection of temperature gradient during heating process
  - Lowest possible peak temperatures. PB free 230°C
  - Void free soldering due to vacuum technique.
  - Minimum temperature difference between components. Max. delta t<3°C
  - Lowest risk of damage compared to other soldering technologies
  - Most effective heat transfer method for reflow soldering
  - Low operational and maintenance cost
  - Low power consumption
  - Small footprint means less floor space requirement

Vapor Phase Reflow Profile Data

- Vapor Phase Reflow Profile applied for Converter sub attached assembly.



TCs	Max Rising Slope		Soak Time 120-160C		Reflow Time /235C		Peak Temp	
<TC1>	1.18	-64%	48.64	91%	161.36	10%	251.84	-82%
<TC2>	1.01	-98%	43.17	54%	162.53	12%	250.93	-91%
<TC3>	1.04	-91%	40.38	36%	174.96	31%	250.45	-96%
<TC4>	1.08	-85%	44.75	65%	166.89	18%	250.69	-93%
<TC5>	1.00	-100%	42.02	47%	172.32	27%	250.63	-94%
Delta	0.18		8.26		13.60		1.39	

	P.W.I.
Original Top	100%
Original Bottom	

PWI for this profile=

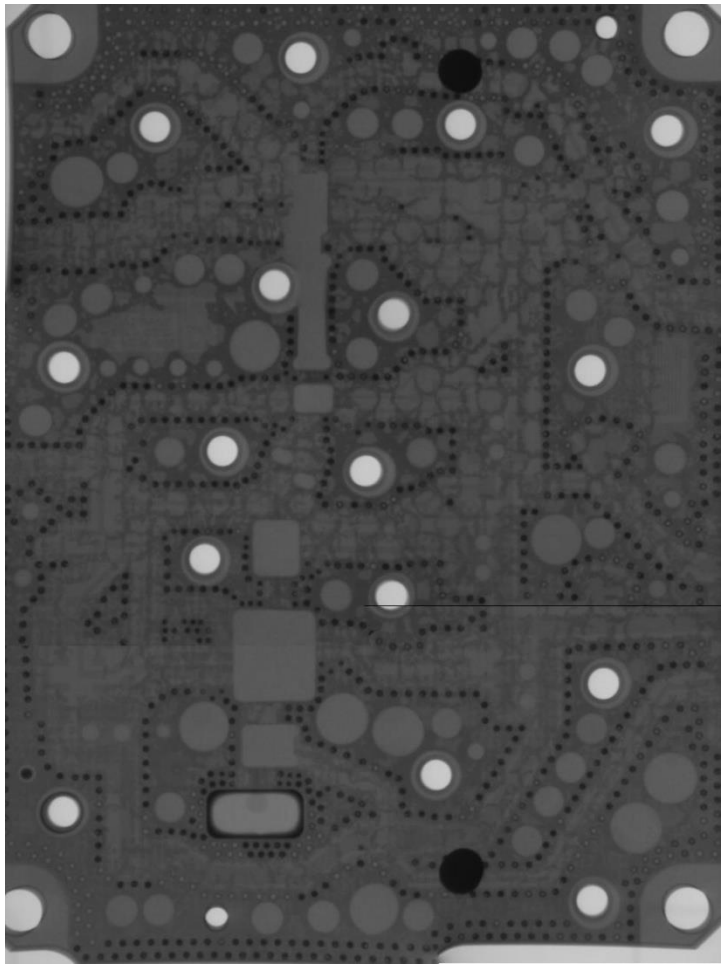
100%

Vapor Phase Reflow Profile Data

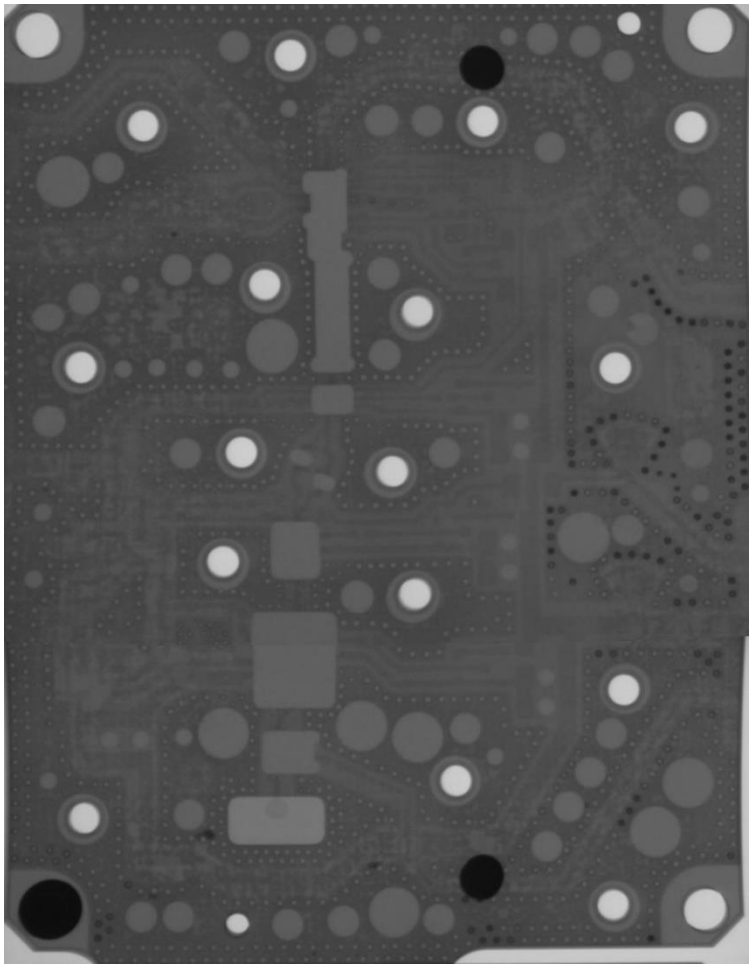
- Parameters
  - Profile name: cnvtr
  - ASB is activated
    - Soldering time: 180 secs
    - ETR soldering: 90
    - Min. soldering time: 60 secs
    - Max. soldering time: 600 secs.
    - Delay heating time : 40 secs
    - Evaporating time: 15 secs
    - Cooling time: 180 secs
  - Vacuum activated
    - Duration time: 20 secs
    - Time for bypass: 4 secs
      - Step 1 (80% rpm): 4 secs
      - Step 2 (90% rpm): 3 secs
  - Vacuum Heating is activated
    - ETR: 100

X-Ray Results

- Convection Reflow vs Vapor Phase Vacuum Reflow



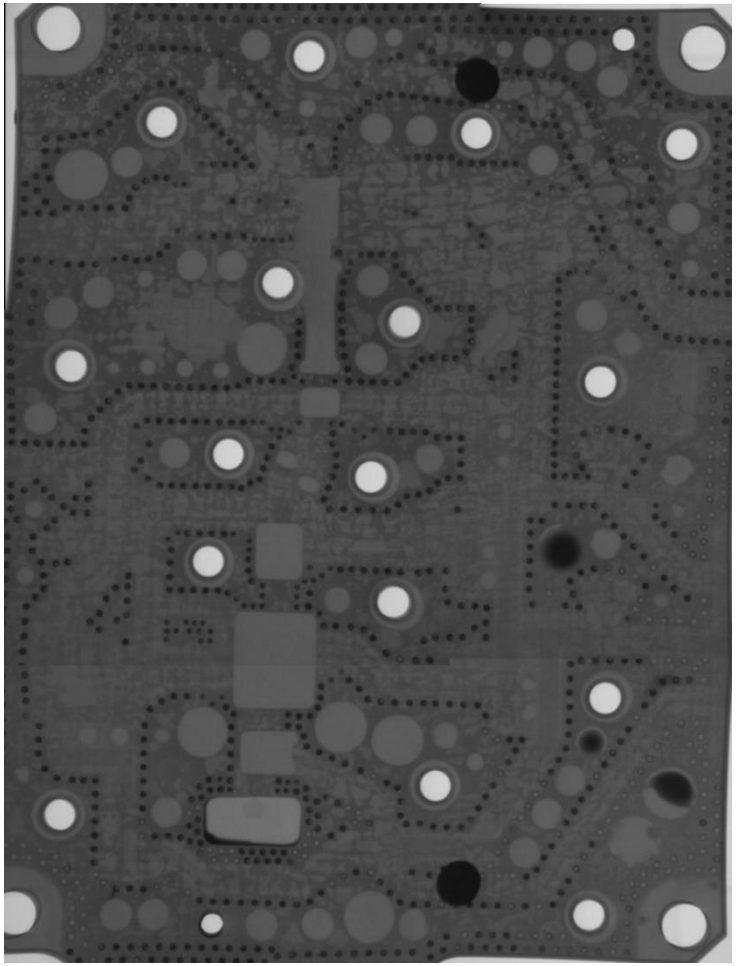
Convection Reflow



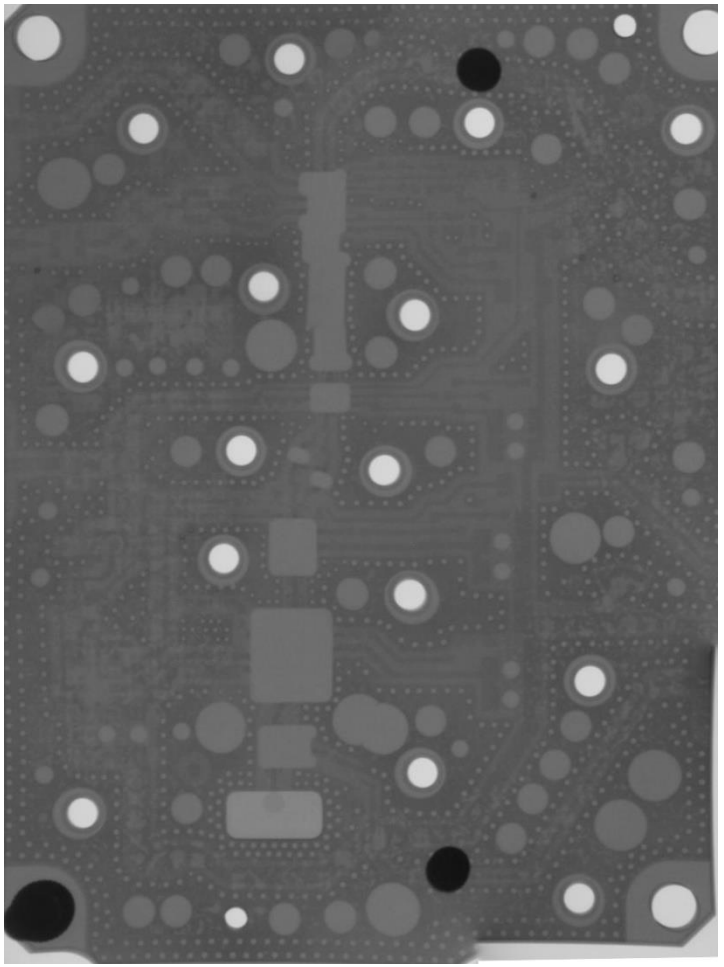
Vapor Phase Vacuum Reflow

X-Ray Results

- Convection Reflow vs Vapor Phase Vacuum Reflow



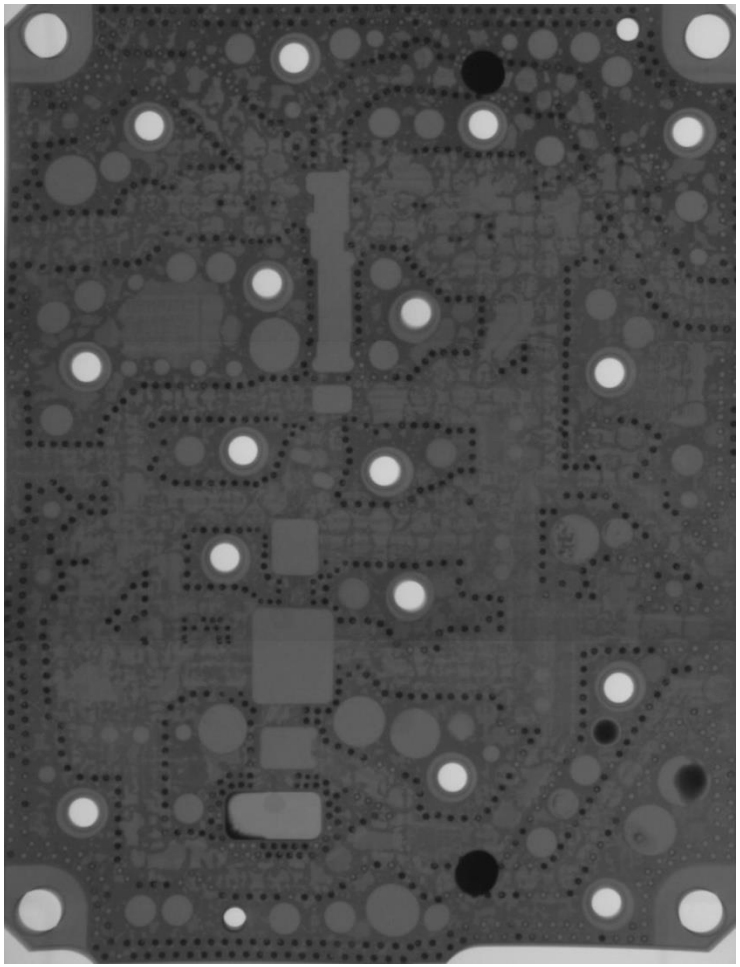
Convection Reflow



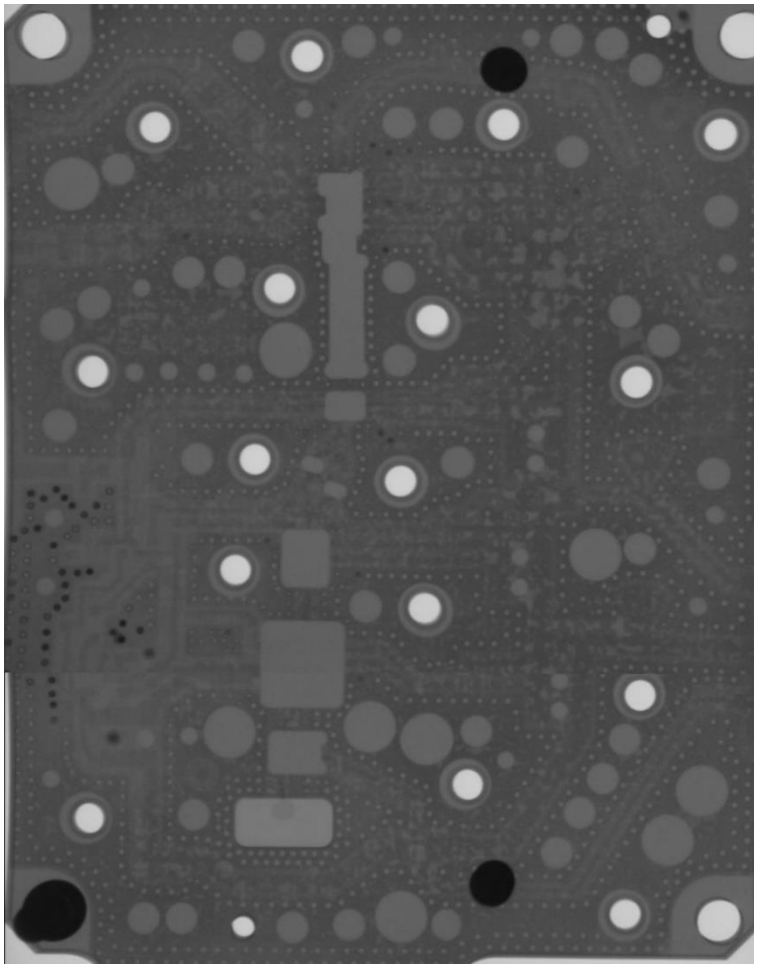
Vapor Phase Vacuum Reflow

X-Ray Results

- Convection Reflow vs Vapor Phase Vacuum Reflow



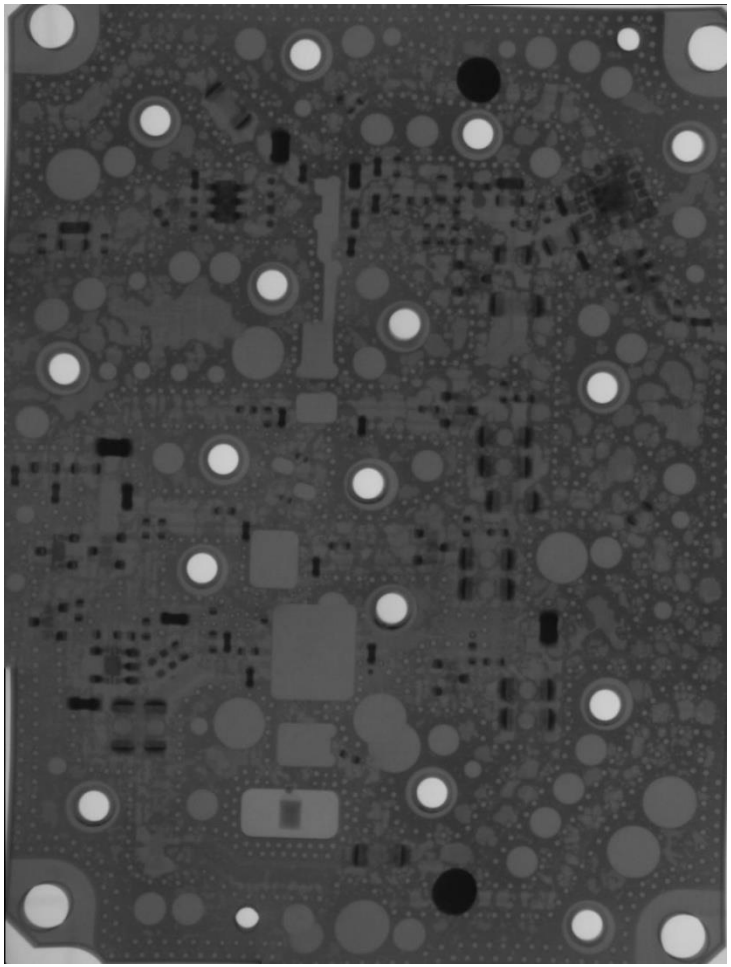
Convection Reflow



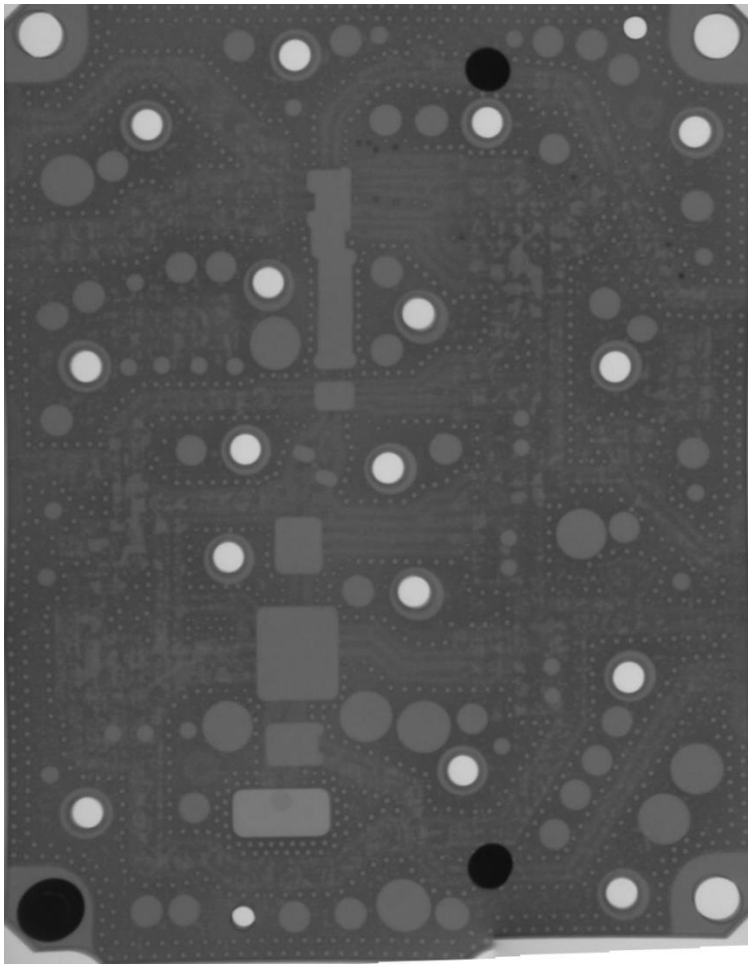
Vapor Phase Vacuum Reflow

X-Ray Results

- Convection Reflow vs Vapor Phase Vacuum Reflow



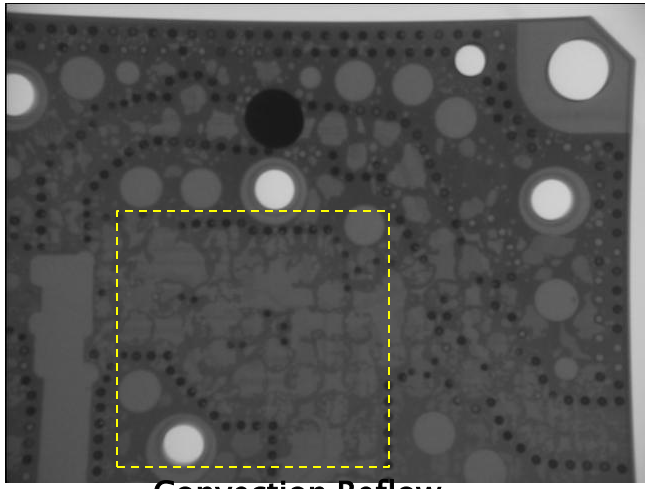
Convection Reflow



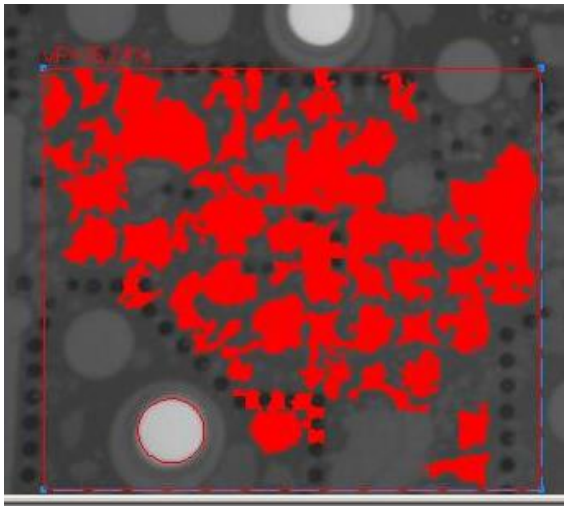
Vapor Phase Vacuum Reflow

Solder Voids Calculation

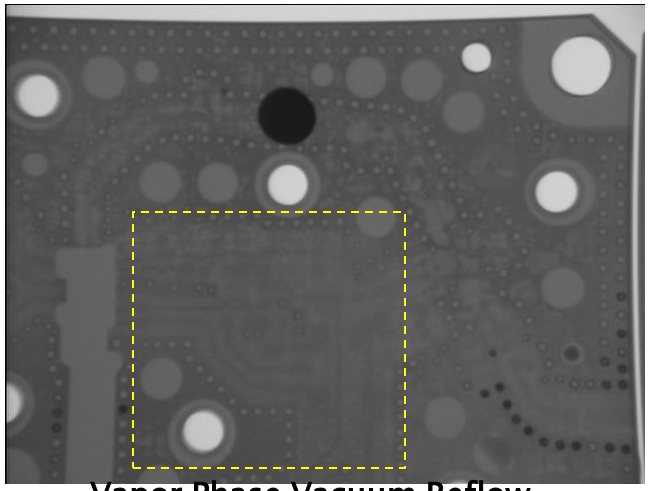
- The total % voids processed under convection reflow is 36% and less than 2% on for vapor phase reflow.



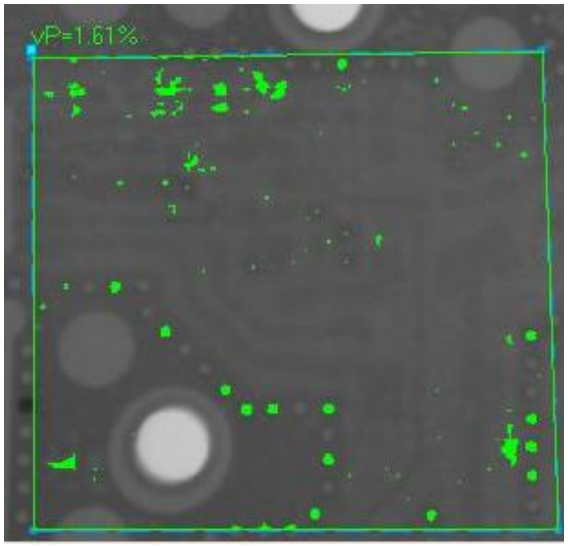
Convection Reflow



Voids % =36%



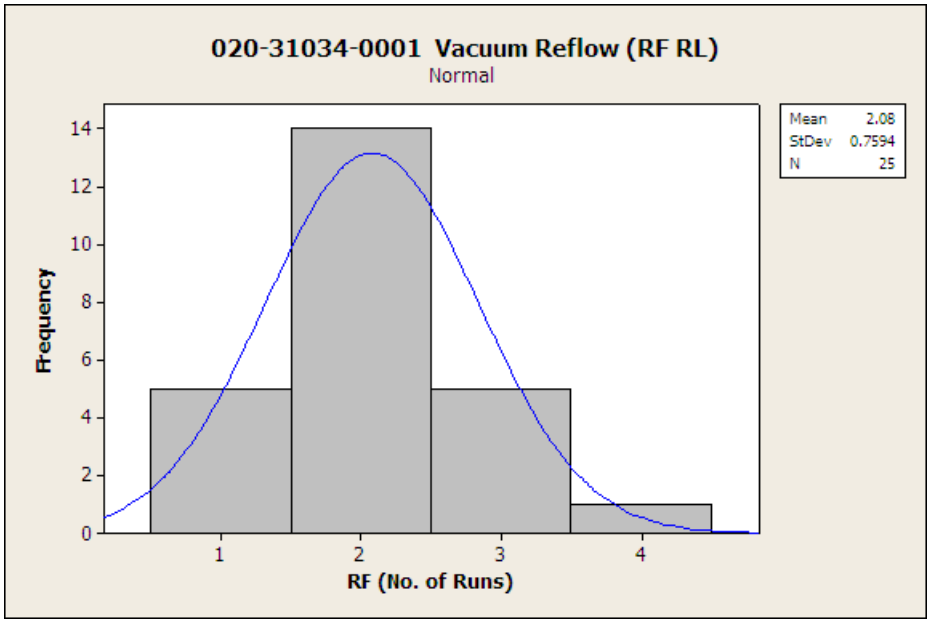
Vapor Phase Vacuum Reflow



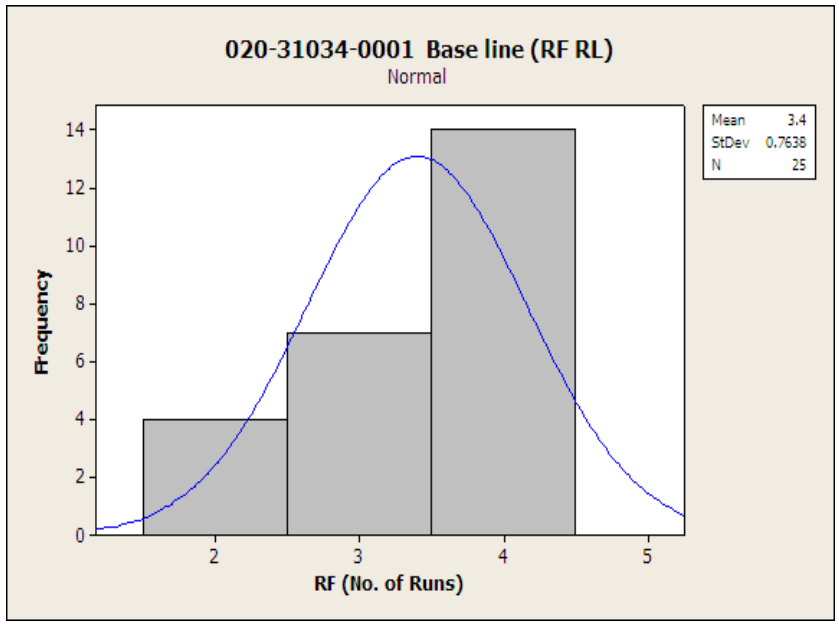
Voids % =1.6%

Converter Test Results

- RF-Return Loss for 020-31034-0001 38GHz TX LB



Vapor Phase Vacuum Reflow

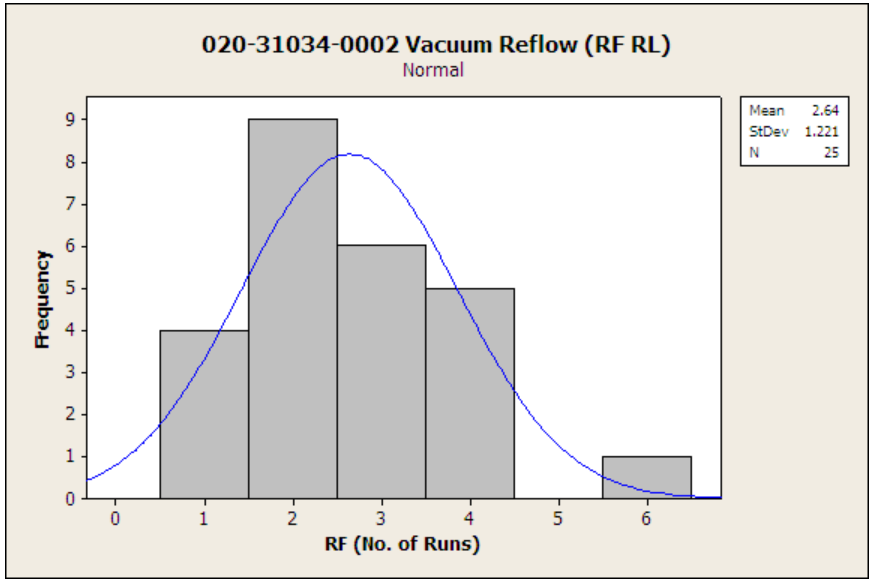


Convection Reflow

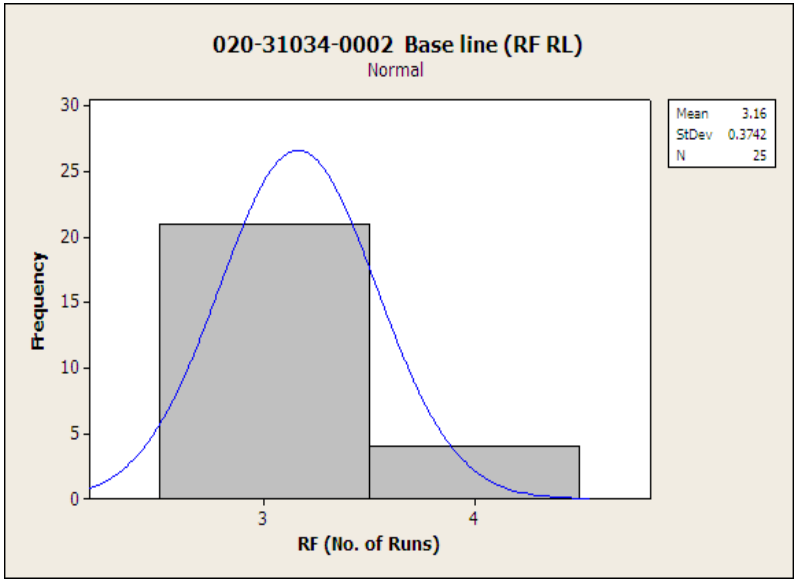
- Vacuum Reflow process shows less cycle in tuning of RF return loss for 020-31034-0001 38GHz Tx Converter. Most of units were passing after 2nd attempt . It was also verified that some units were passing at turn on (1st attempt).

Converter Test Results

- RF-Return Loss for 020-31034-0002 38GHz TX HB



Vapor Phase Vacuum Reflow

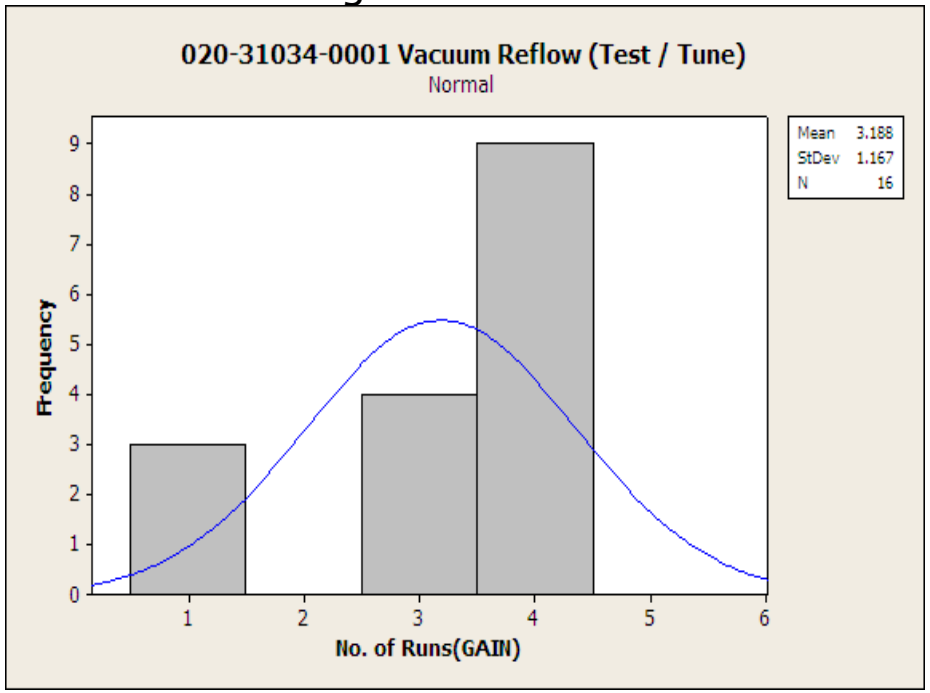


Convection Reflow

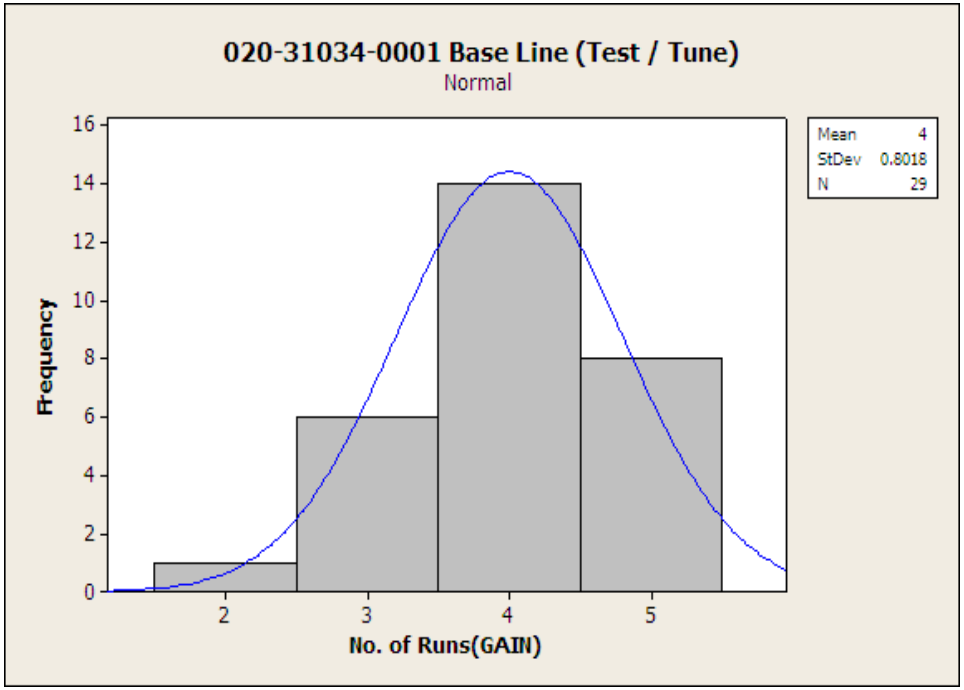
- Vacuum Reflow process shows less cycle in tuning of RF return loss for 020-31034-0002 38GHz Tx Converter. Most of units were passing after 2nd attempt . It was also verified that some units were passing at turn on (1st run).

Converter Test Results

- Tune & Align 020-31034-0001 38GHz TX LB



Vapor Phase Vacuum Reflow

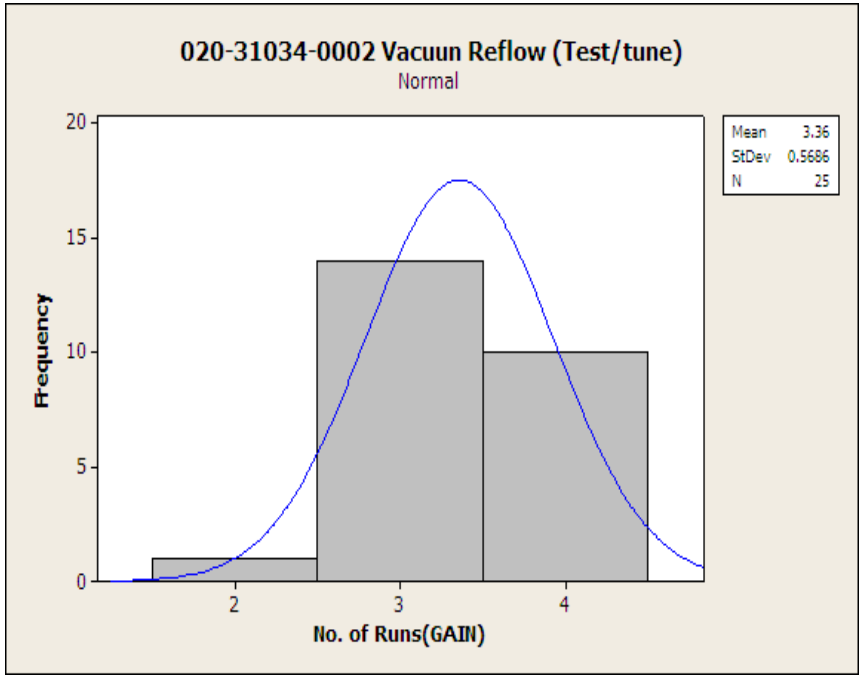


Convection Reflow

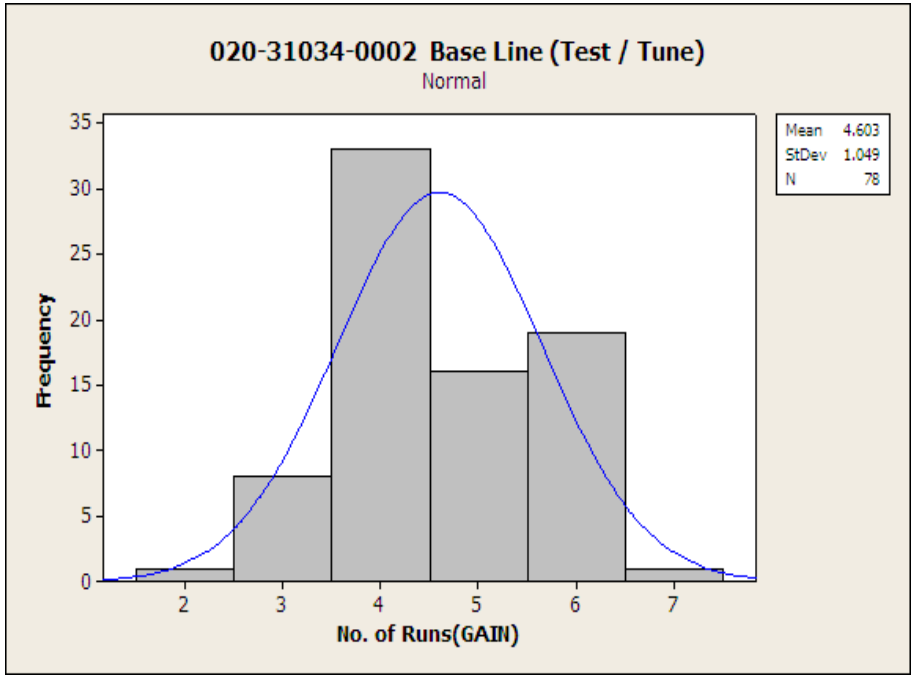
- Vacuum Reflow process shows less cycle in Tune / Align compared to Baseline (used old process) considering those units encounters batch of bad filters (9 units).
- Note: We did not include the number of tuning attempts of units affected with bad filters because failure is from different cause

Converter Test Results

- Tune & Align 020-31034-0002 38GHz TX HB



Vapor Phase Vacuum Reflow



Convection Reflow

- From the graph, it is obvious that units that used vacuum Reflow process show less cycles in Tune / Align compared to Baseline that used the old process. Vacuum reflow units were tuned from 2 to 4th attempts and mostly passed at the 3rd run, unlike units that used the old process which took up to 7 attempts to tune. Units are considered very hard to tune if they reach the 7th tuning attempt.

Converter Test Results

- Five units for 020-31034-0001 were subjected to overtemp process and passed the test.

- Other units that passed the test (per SBR-000389) by using vapor phase vacuum reflow process;
  - 020-31032-0001 38 GHz RX converter- 50 units; 5 units undergone overtemp and passed.
  - 020-31041-0001- 1 unit & passed overtemp
  - 020-31027-0001- 4 units & all passed overtemp
  - 020-31083-0001- 5 units & all passed overtemp
  - 020-31083-0002- 4 units & all passed overtemp

Conclusion

- 38GHz Tx Converter are the hardest units to tune. Reviewing the bell curves, the vapor phase, Vacuum reflow reduces the tuning cycle attempts and with the significant reduction of Hard to tune converters in the data, the performance against the specifications is improved
- It was also noted that we can further improve the times by evaluating and relocating the pre-tune tabs. Numerous units had the pre-tune tabs moved and still the tune cycles improved
- Based on the improvements to tune and cycle times and the data indicating no degradation of performance and showing improvements in VSWR and gain/flatness (further gains to be had with pre-tune tabs) It is recommended to release the ASSCON VP6000 for converter production of pcb sub-attach.
- As each new model of converter is released into the new reflow process, 5 samples of each will be built tested and compared against the existing data for performance and cycle times.