

## 1. Reliability test purpose

The purpose of semiconductor reliability tests are to simulate or accelerate all stresses that the device might be subjected to at the various phases of its life, including mounting, aging and operation. Environmental tests, endurance tests and functional tests were performed.

## 2. Reliability tests performed

The below described reliability tests are valid for all VINco E3 Power Modules.

Item Nr	Test Name	Standard	Test Parameters	Acceptance criteria	Tested modules	Evaluation
1	Temperature cycle	IEC 60749-25	Number of cycles: 1000 $T_{stg} = -40 / +125 \text{ }^{\circ}\text{C}$ , $t_{dwell} \geq 30 \text{ min}$	Electrical parameters $V_F$ , $I_R$ , $V_{Geth}$ , $V_{CEsat}$ , $I_{CES}$ , $I_{GES}$ , and R within datasheet limits. Dielectric strength $I_{isol} \leq 20 \text{ } \mu\text{A}$ at $V_{isol} = 6 \text{ kVDC}$ , 2 sec. No visible damage.	24	Pass
2	High Temperature Reverse Bias	IEC 60749-23	$T_{vj} = 150 \text{ }^{\circ}\text{C}$ , $t = 1250 \text{ h}$ $V_{CE} = 80\% * V_{CEmax} = 960 \text{ V}$		24	Pass
3	High Temperature High Humidity Reverse Bias	IEC 60749-5	$T_a = 85^{\circ}\text{C}$ , RH = 85 % $V_{CE} = 80\% * V_{CEmax} = 960 \text{ V}$	B10 lifetime $\geq 850 \text{ h}$	24	Pass
4	High Temperature High Humidity Isolation	IEC 60749-5	$T_a = 85^{\circ}\text{C}$ , RH = 85 % $t = 1000 \text{ h}$ $V_{isol} = 1610 \text{ VDC}$	Electrical parameters $V_F$ , $I_R$ , $V_{Geth}$ , $V_{CEsat}$ , $I_{CES}$ , $I_{GES}$ , and R within datasheet limits. Dielectric strength $I_{isol} \leq 20 \text{ } \mu\text{A}$ at $V_{isol} = 6 \text{ kVDC}$ , 2 sec. No visible damage.	12	Pass
5	Vibration	IEC 60749-12	$f = 20\text{-}2000 \text{ Hz}$ , $a = 200 \text{ m/s}^2$ Test axis: X/Y/Z, $t = 4 \text{ min/cycle}$ Number of cycles: 12		6 (2/axis)	Pass
6	Low Temperature Storage	IEC 60068-2-1 Test A	$T_a = -40 \text{ }^{\circ}\text{C}$ , $t = 1000 \text{ h}$		5	Pass
7	Power Cycle	IEC 60749-34	$T_{vj,min} = 25 \text{ }^{\circ}\text{C}$ , $\Delta T = 100 \text{ }^{\circ}\text{C}$ , $t_{on} = 2 \text{ s}$	Test passed $> 90\text{k}$ cycles. Failure is $R_{th}$ or $V_{CE,sat}$ increase $> 20\%$ compared to initial value. Weibull parameters: $\beta = 10.659$ , $\eta = 90682$	6	Pass
8	Press-fit Technology	IEC 60352-5	$F_{pres-in} = 70 - 120 \text{ N/pin}$ $V_{press-in} = 40 \text{ mm/min}$	Press-out force $> 50 \text{ N/pin}$	5	Pass
9	Thermal Paste Spreading	N/A	Phase-change material (PSX-P7) Thickness: $100 - 140 \text{ } \mu\text{m}$	Full coverage after 1 hour at $T_{hs} = 70 \text{ }^{\circ}\text{C}$	20	Pass

## 3. Results

All the tests have been passed according to the acceptance criteria. No abnormality detected after visual inspection.

## 4. References

Description of qualification tests, failure modes and mechanism:

[https://www.vincotech.com/fileadmin/user\\_upload/content\\_media/documents/pdf/Vincotech\\_Product\\_Qualification\\_at\\_Vincotech.pdf](https://www.vincotech.com/fileadmin/user_upload/content_media/documents/pdf/Vincotech_Product_Qualification_at_Vincotech.pdf)