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Abstract

To improve productivity on semiconductor manufacturing processes enables to accelerate countermeasure for global warming. By changing wafer diameter from 200mm to 300mm, the productivity can be improved twice simply. Conventional RC-IGBT is applied 200mm wafer and is already installed to our SLIMDIP to achieve compact and inexpensive home appliance inverter system worldwide. RC-IGBT which is produced using 300mm wafer is installed in SLIMDIP as first trial. This paper introduces initial evaluation results that are equivalent to conventional electrical test results.

1. Introduction

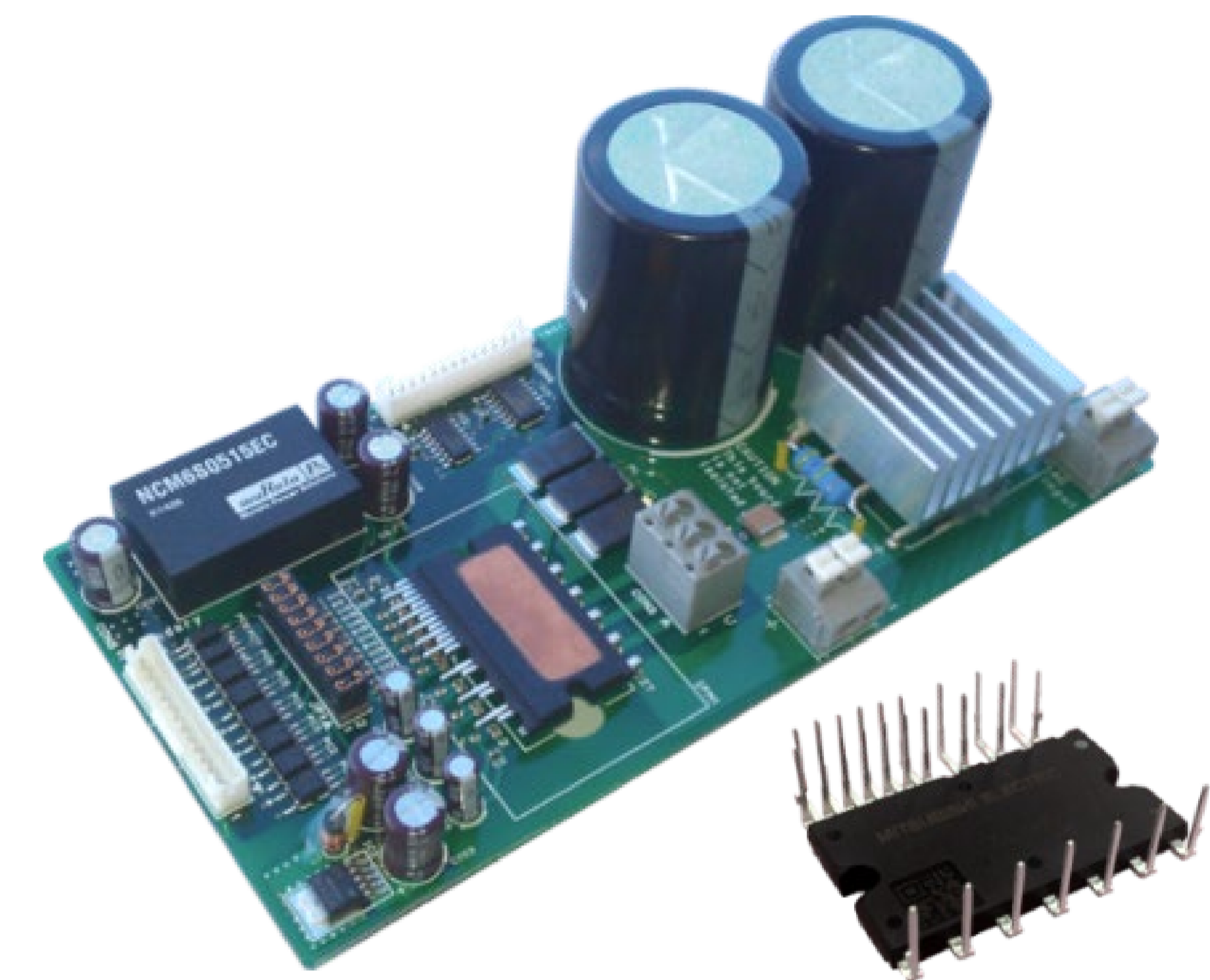
Power semiconductors are highly expected as one of key technologies to contribute to the improvement of energy efficiency.

- ✓ RC-IGBT* has attracted attention as a power device that greatly contributes to making power modules smaller and lighter.
- ✓ By adopting RC-IGBT, our SLIMDIP achieves approx. 30% compact and light weight to compared with conventional Super Mini DIIPM.

SLIMDIP is becoming new de-facto-standard module in home appliance inverter system worldwide

- ✓ The conventional RC-IGBT has been produced using 200mm wafer, but it is planned to start mass production using 300mm wafer which have high productivity efficiency.

To first apply RC-IGBT using 300mm wafer to SLIMDIP



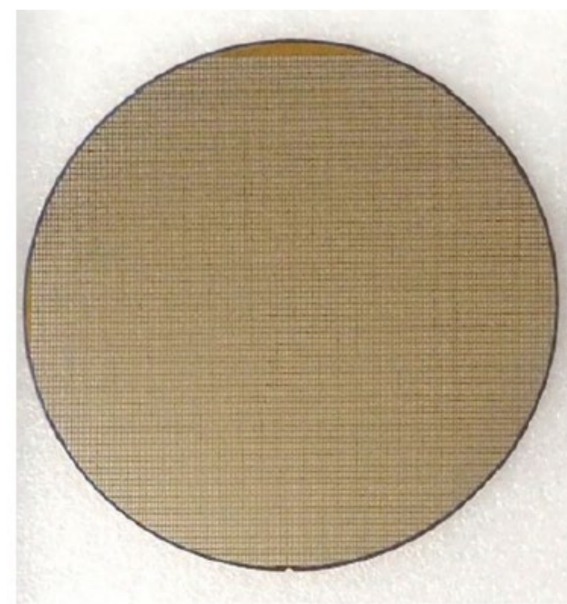
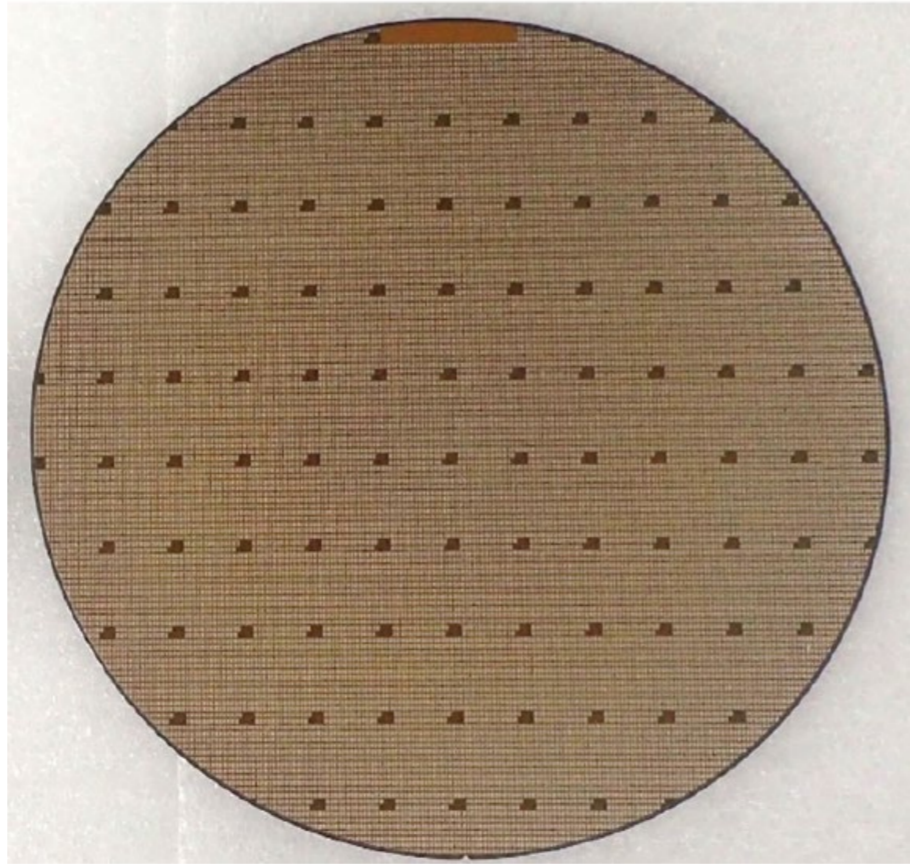
SLIMDIP

*RC-IGBT : Reverse Conducting-IGBT

2. RC-IGBT comparisons between 200mm and 300mm wafers

600V/15A RC-IGBT of 200mm and 300mm were produced

Different points each wafer

Items	Conventional	New
Wafer size	200mm	300mm
Process	A	B
Machine	A	B
Picture		

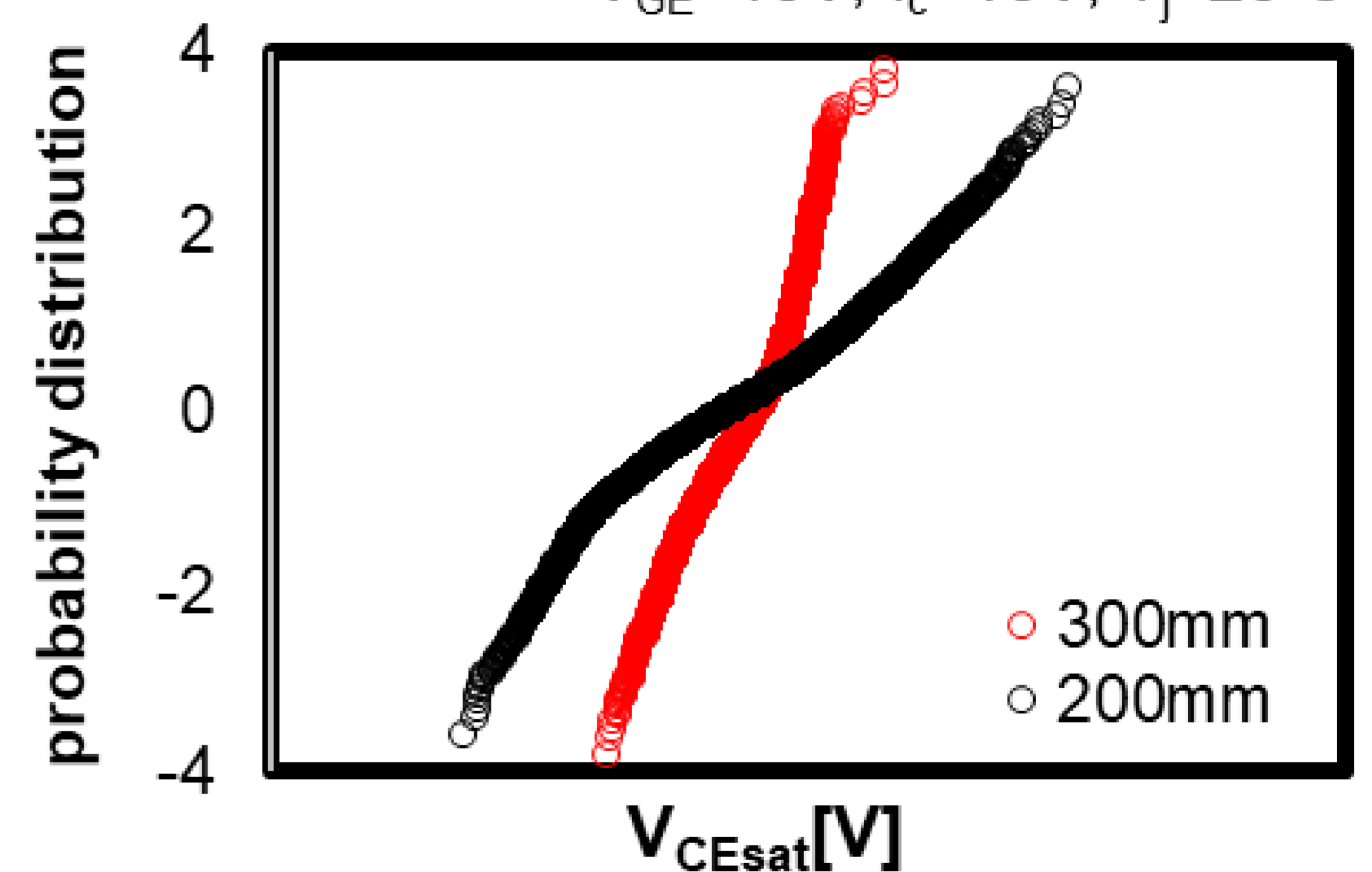
Probability distributions of $V_{CE(sat)}$ and V_F (single wafer)

300mm wafer process show small in-plane wafer variation despite the larger wafer size

- ✓ New high performance equipment
- ✓ New process technology at the new plant

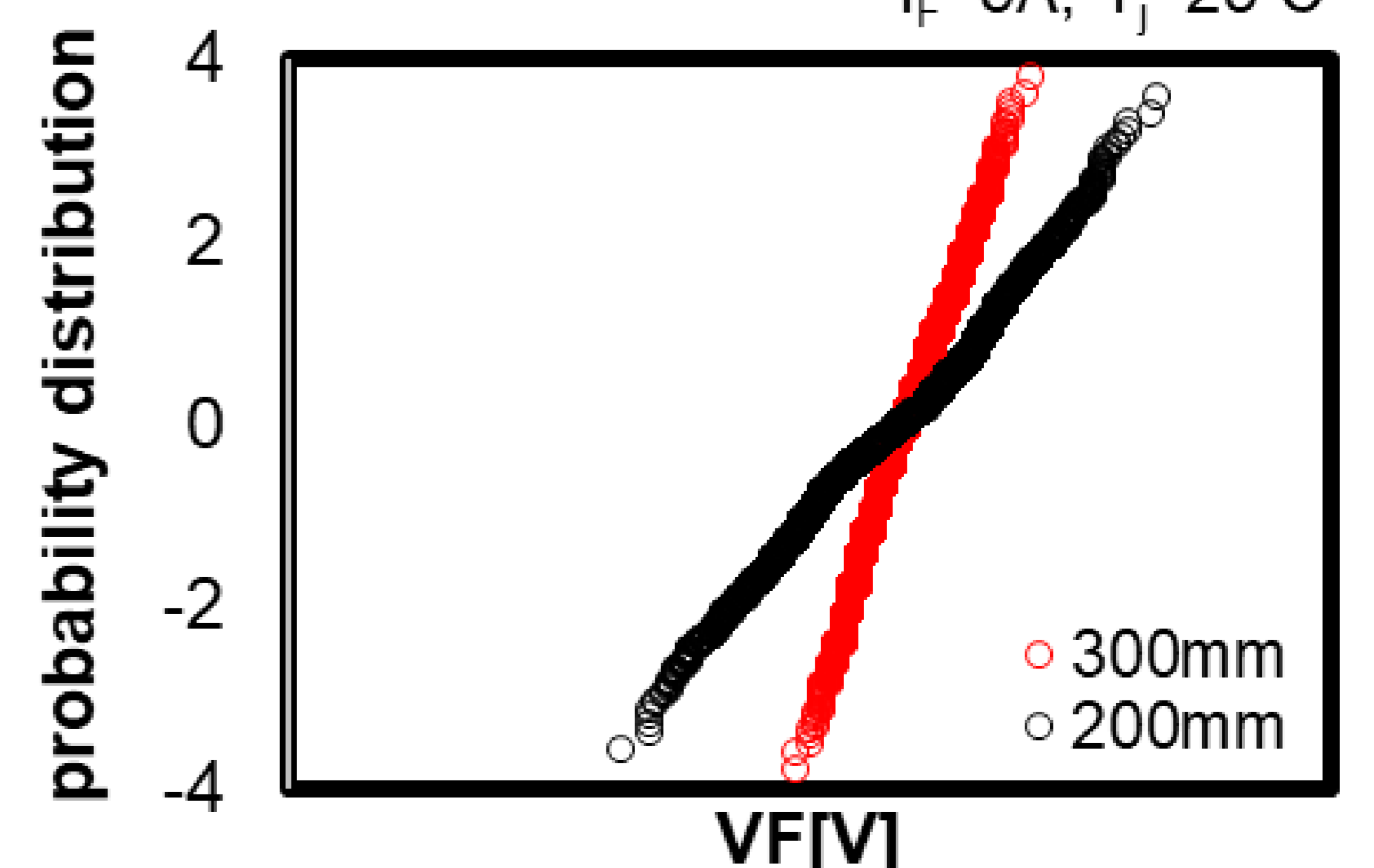
$V_{CE(sat)}$ probability distribution

$V_{GE}=15V, I_c=15V, T_j=25^\circ C$



V_F probability distribution

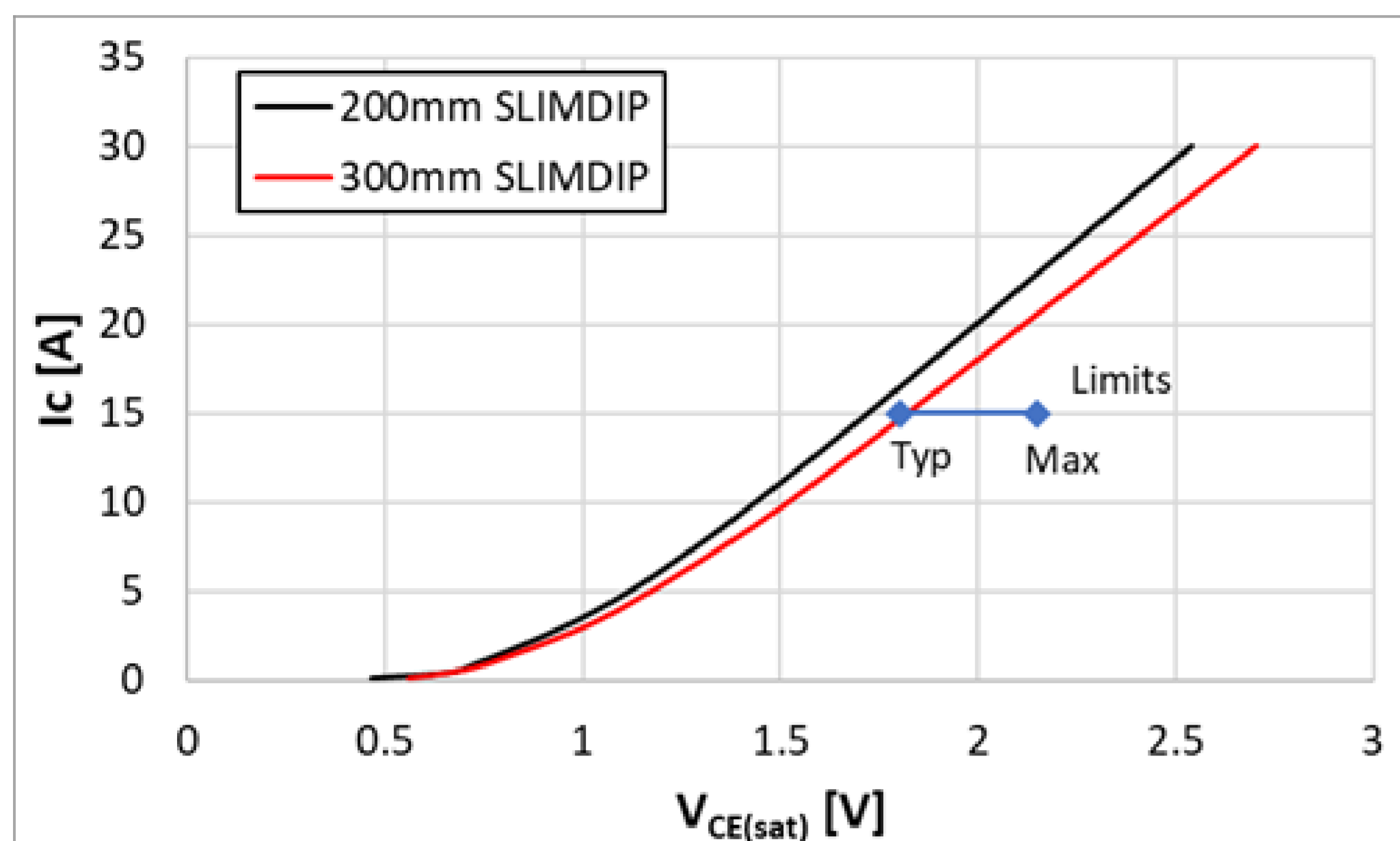
$I_F=5A, T_j=25^\circ C$



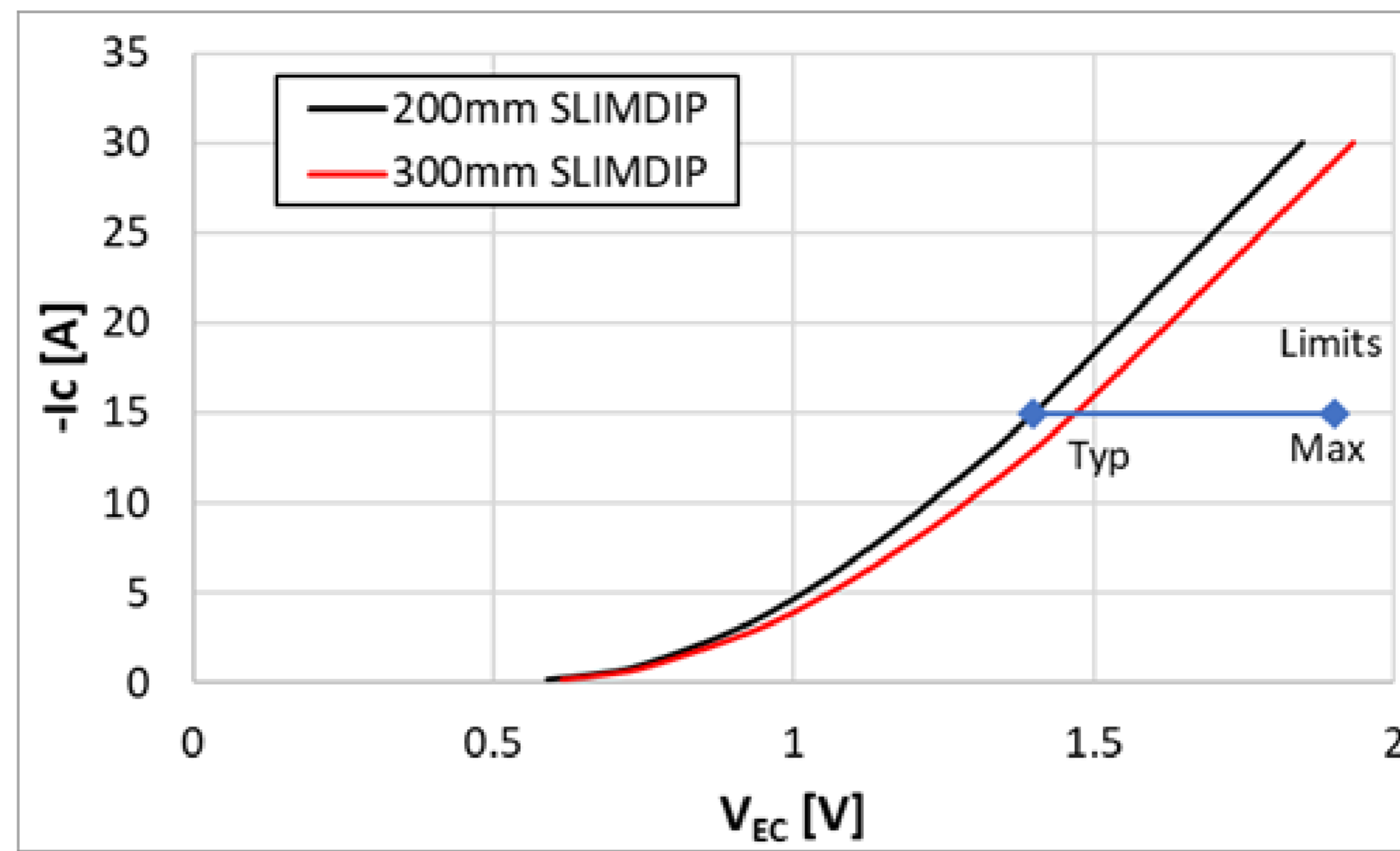
3. SLIMDIP comparisons between 200mm and 300mm wafers

3.1 Static characteristics

$V_{CE(sat)}$ characteristics at $T_j=125^\circ\text{C}$



V_{EC} characteristics at $T_j=125^\circ\text{C}$



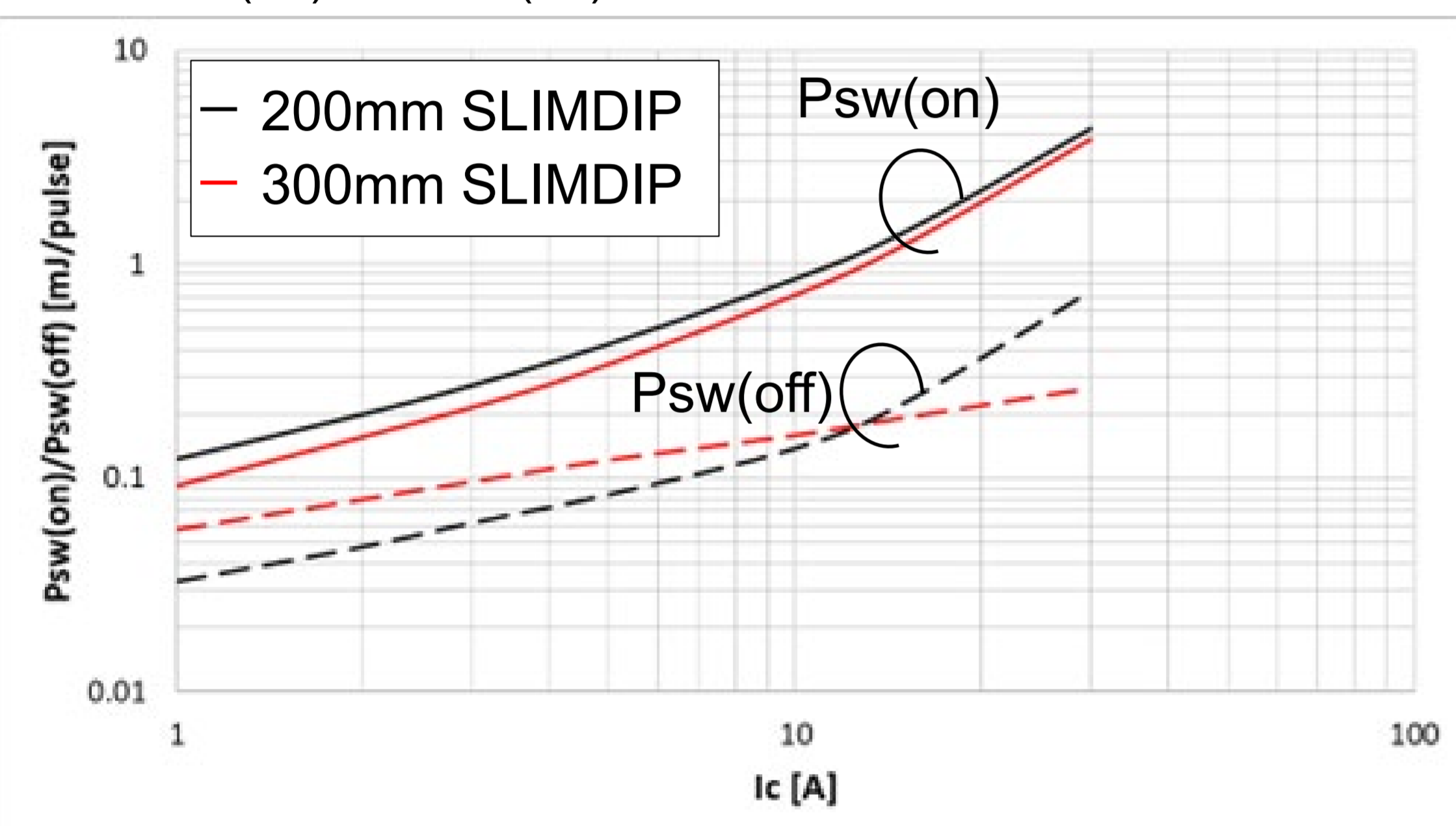
Static characteristics is similar
Within the limitation values

3.2 Switching characteristics

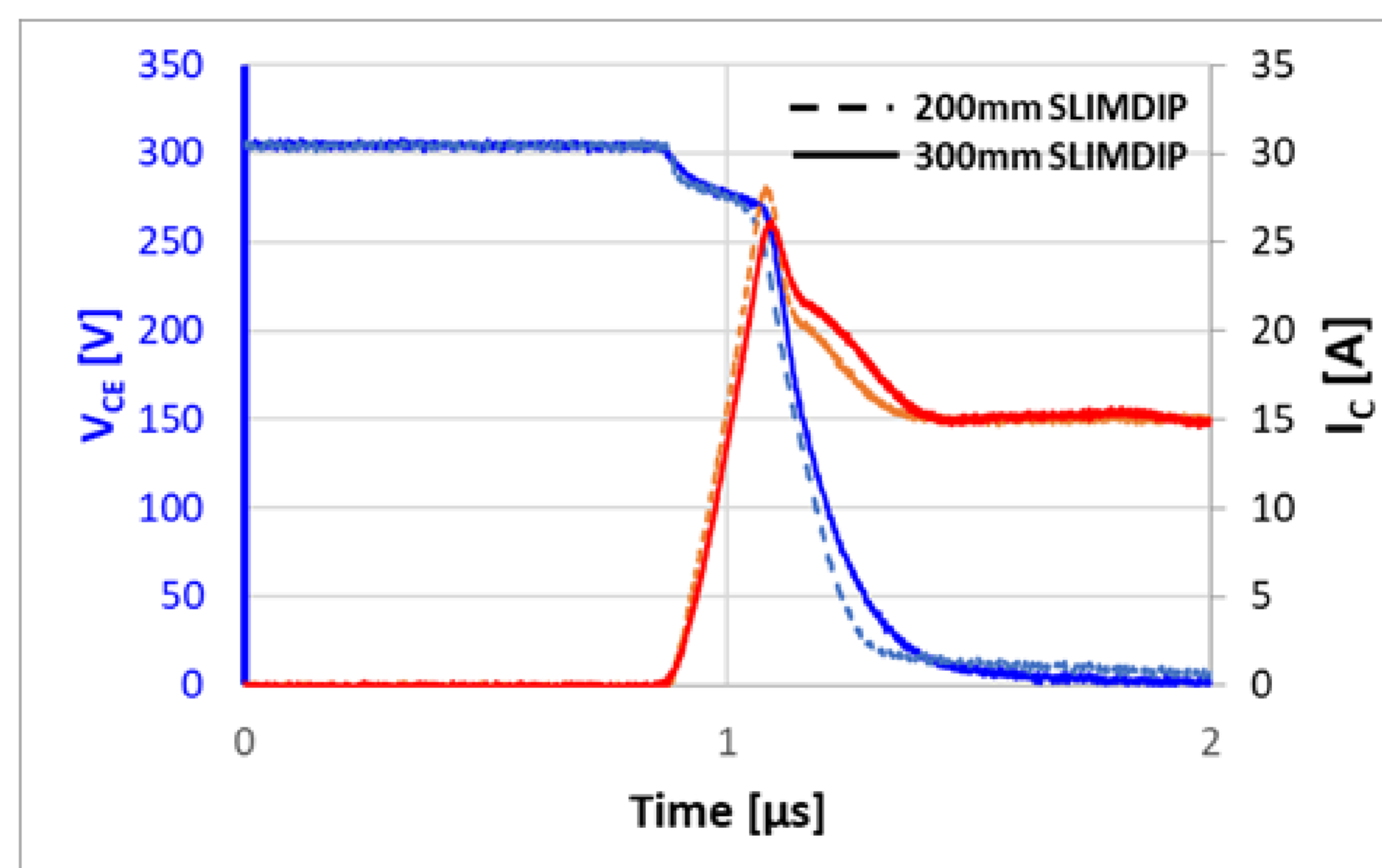
Switching characteristics is similar

Conditions: $V_{CC} = 300\text{V}$, $V_D = 15\text{V}$, $V_{IN} = 0 \leftrightarrow 5\text{V}$, Inductive Load, $T_j=125^\circ\text{C}$

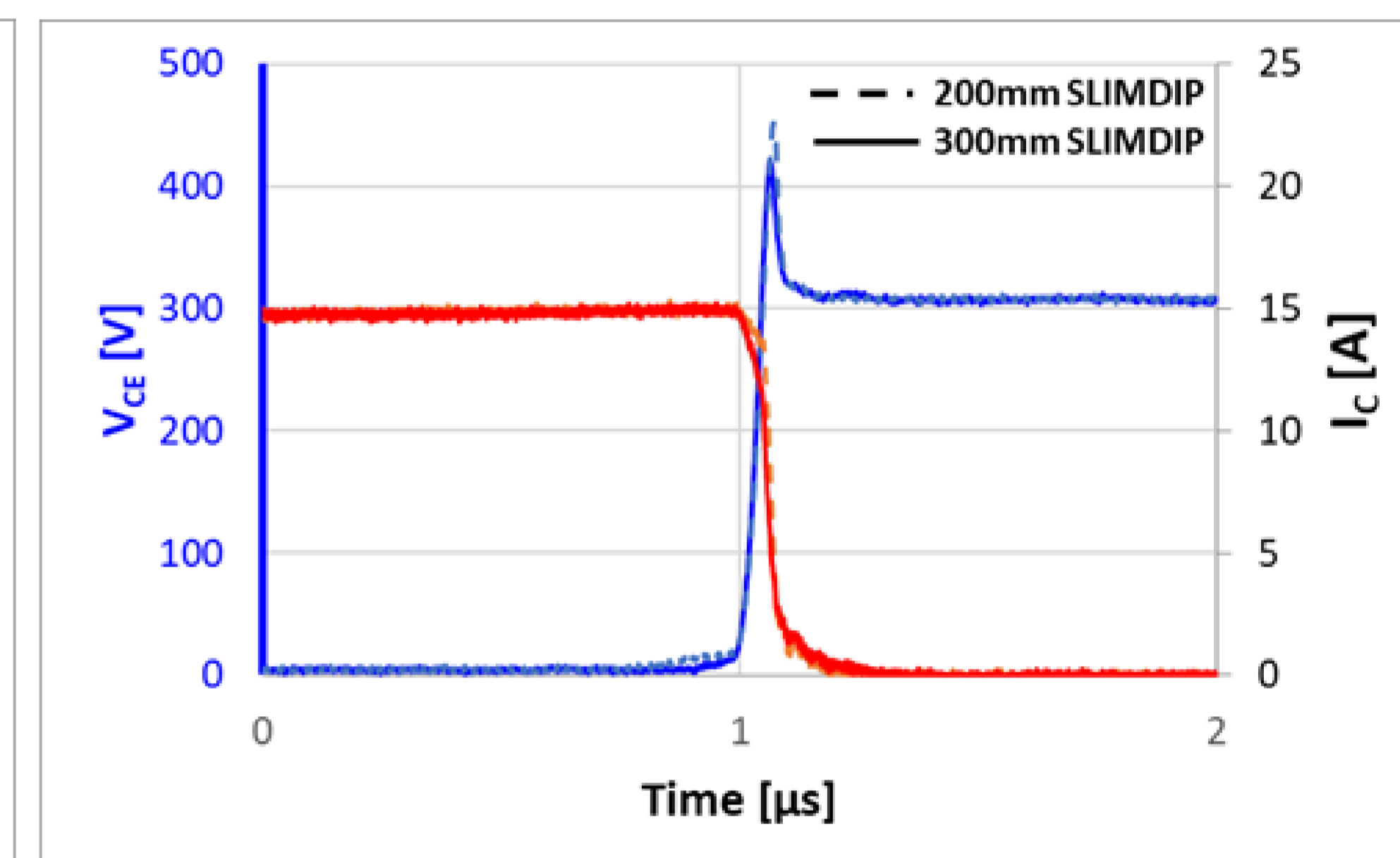
$P_{SW(on)} / P_{SW(off)}$ characteristics at 125°C



Turn-on waveform at $I_c=15\text{A}$



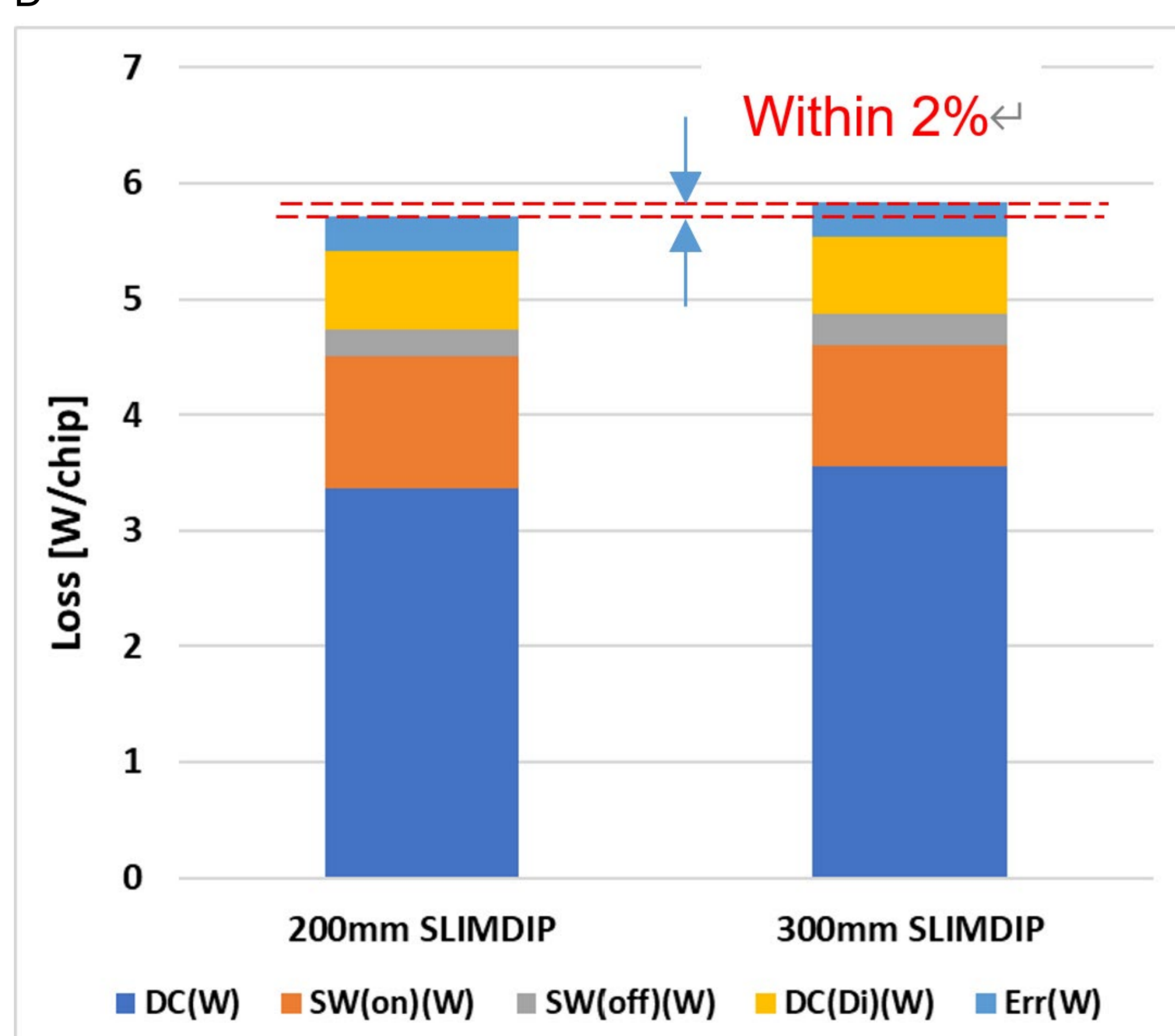
Turn-off waveform at $I_c=15\text{A}$



3.3 Power loss simulation

Power loss is almost same

Conditions :
Sinusoidal modulation, $V_{CC}=300\text{V}$, $I_o=7.0\text{Arms}$,
 $V_D=15\text{V}$, $f_c=5\text{kHz}$, $\text{PF}=0.8$, $M=1.0$

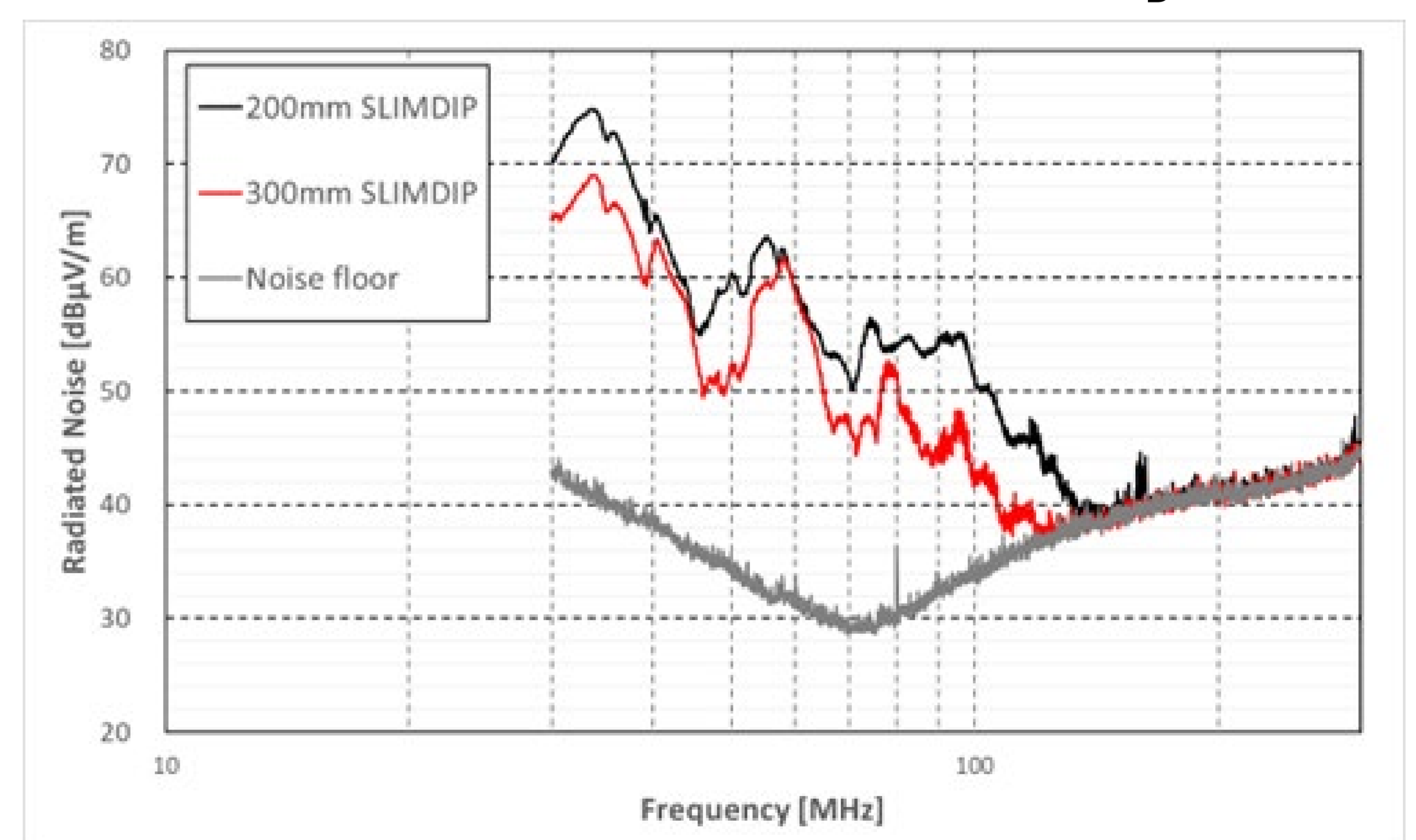


3.4 Radiated noise

Radiated noise is 5dB reduction

To achieve reduced radiated noise with the same level of loss by adjusting the profile inside

Conditions :
Sinusoidal modulation, $V_{CC}=300\text{V}$, $I_o=1.5\text{Arms}$, $V_D=15\text{V}$, $f_c=5\text{kHz}$



4. Conclusion

The initial evaluation result of electrical characteristic comparison between SLIMDIP using 200mm wafer and 300mm wafer.

- 1) The variations of electrical characteristics of $V_{CE(sat)}$ and V_F were suppressed
- 2) The loss was almost same when installed in SLIMDIP

In near future,

SLIMDIP equipped with RC-IGBTs using 300mm wafers will contribute to countermeasure of global warming.