

New developed 3.3kV2.4kA Trench IGBT module for Traction Application

Xing Chen, Liheng Zhu, Bin Wang, Rongzhen Qin, Qiang Xiao
State key Laboratory of Advanced Power Semiconductor Devices

Zhuzhou CRRC Times Semiconductor Co. Ltd, China

INTRODUCTION—Since IGBT is the core of the traction system of high speed train, increasing high voltage IGBT module's power density and operation temperature becomes an essential trend. Based on CRRC high voltage trench IGBT technology, the new 3.3kV/2.4kA module was developed. By employing a new buffer design and thinner wafer thickness, IGBT's total loss was decreased and the robustness was maintained. Furthermore, with the advanced buffer design, there is no oscillation even at -40°C during the turn-off process. Compared with the last generation IGBT module, the total switching loss was reduced by 21.45% and the output power was increased, which is favorable to new generation high-speed traction application

Design Concept

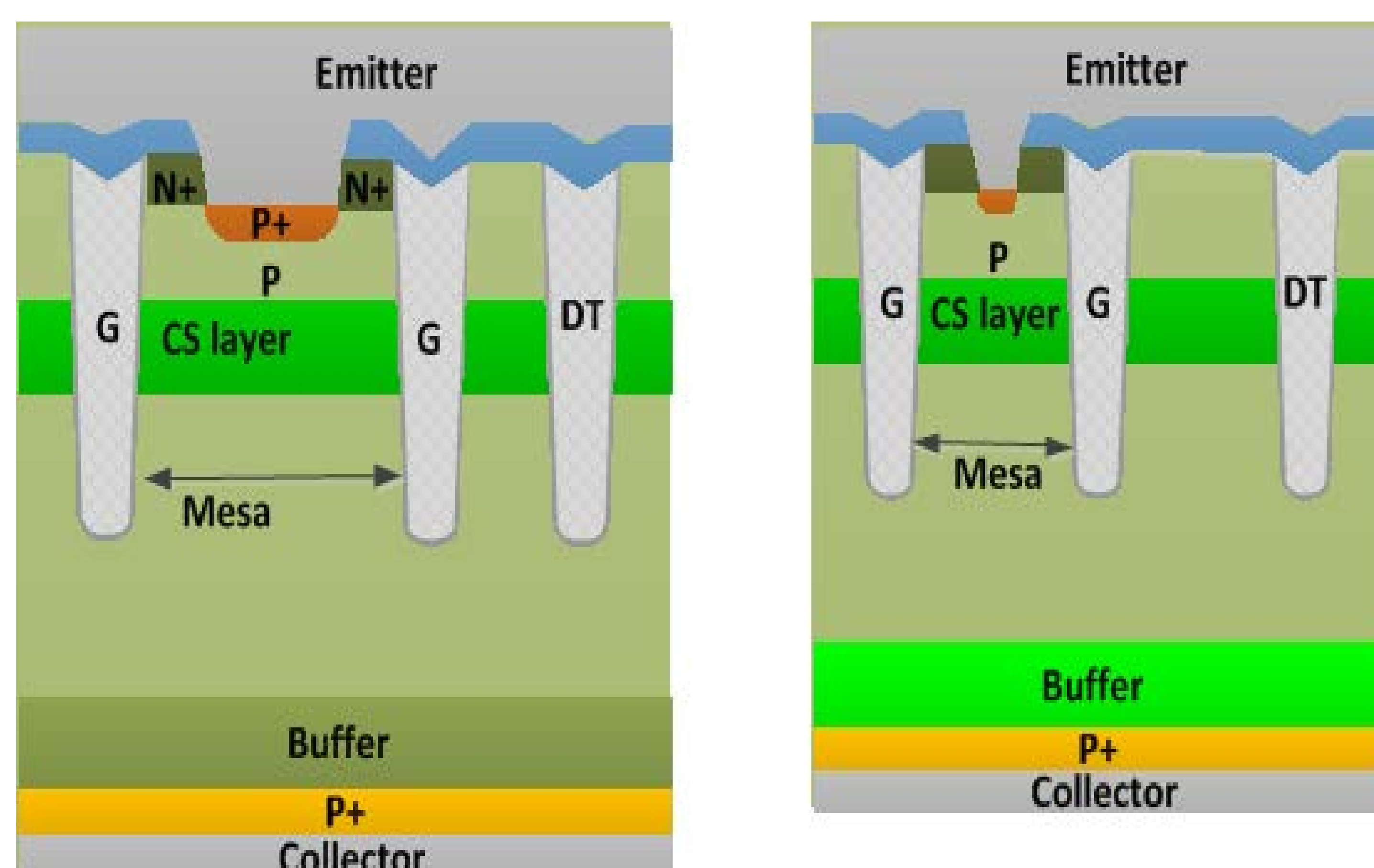


Fig.1 TMOS IGBT (left); TMOS IGBT with refined cell(right).

Static Performance

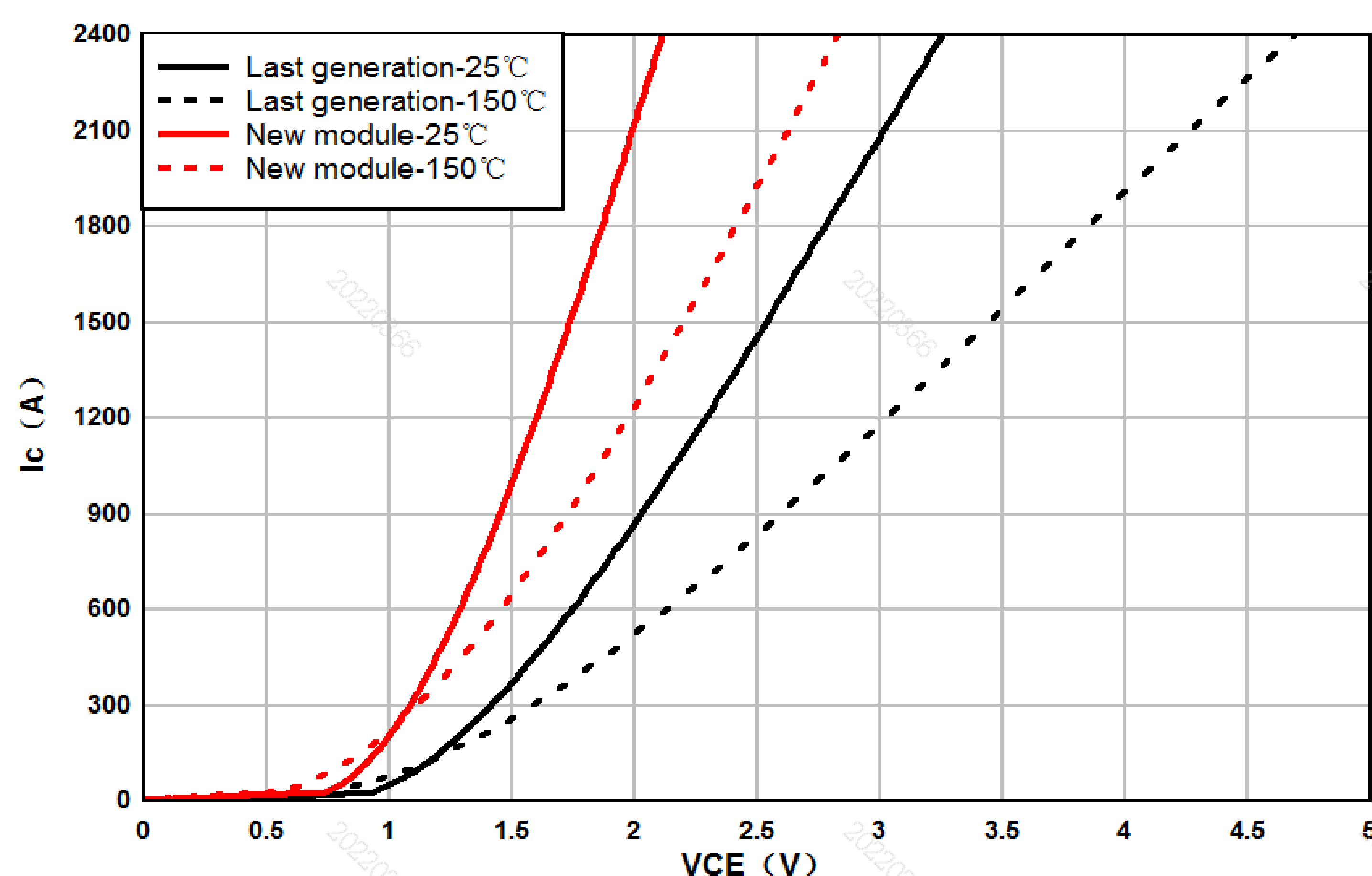


Fig. 2 IGBT output characteristics

Dynamic Performance at 150°C

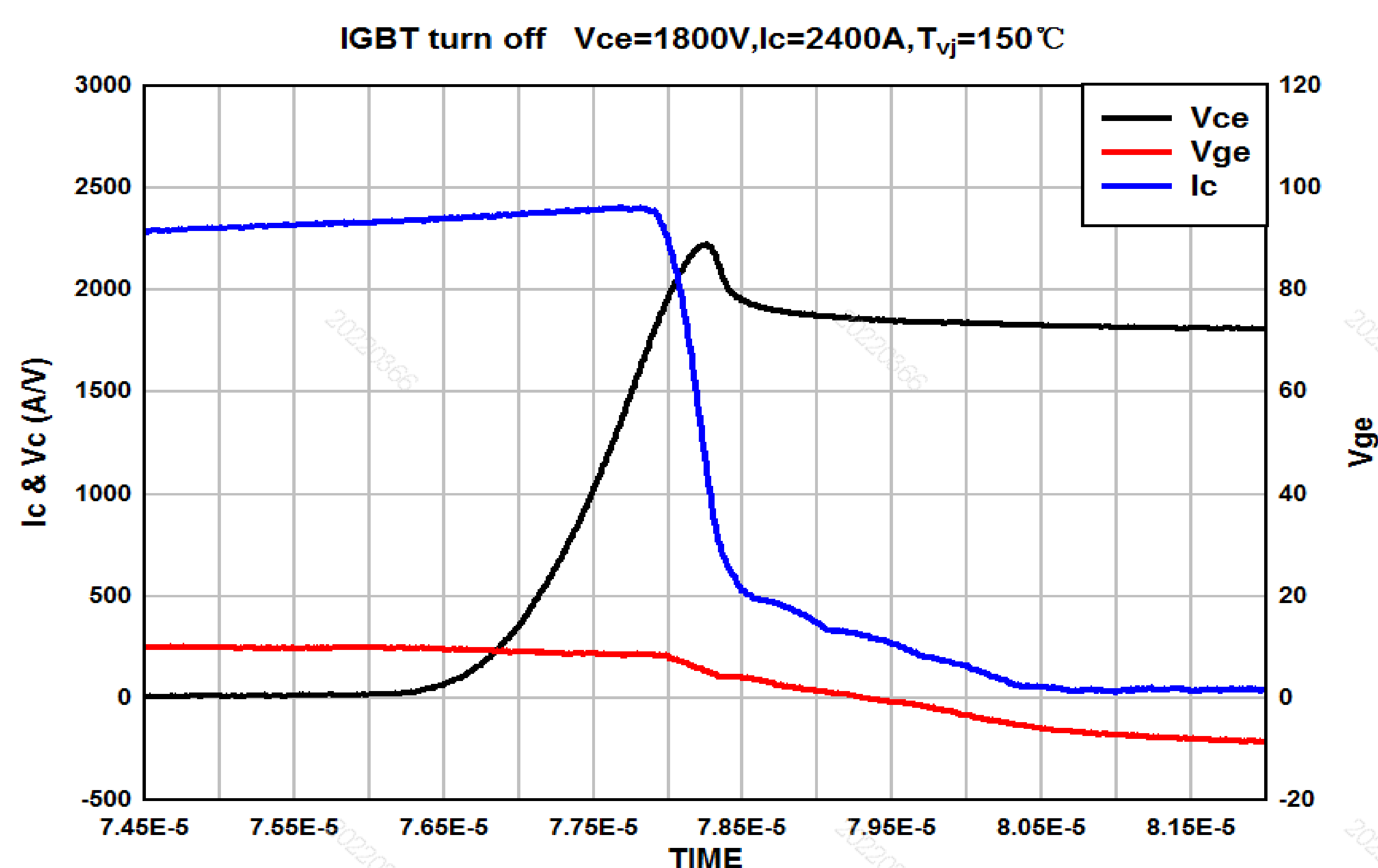
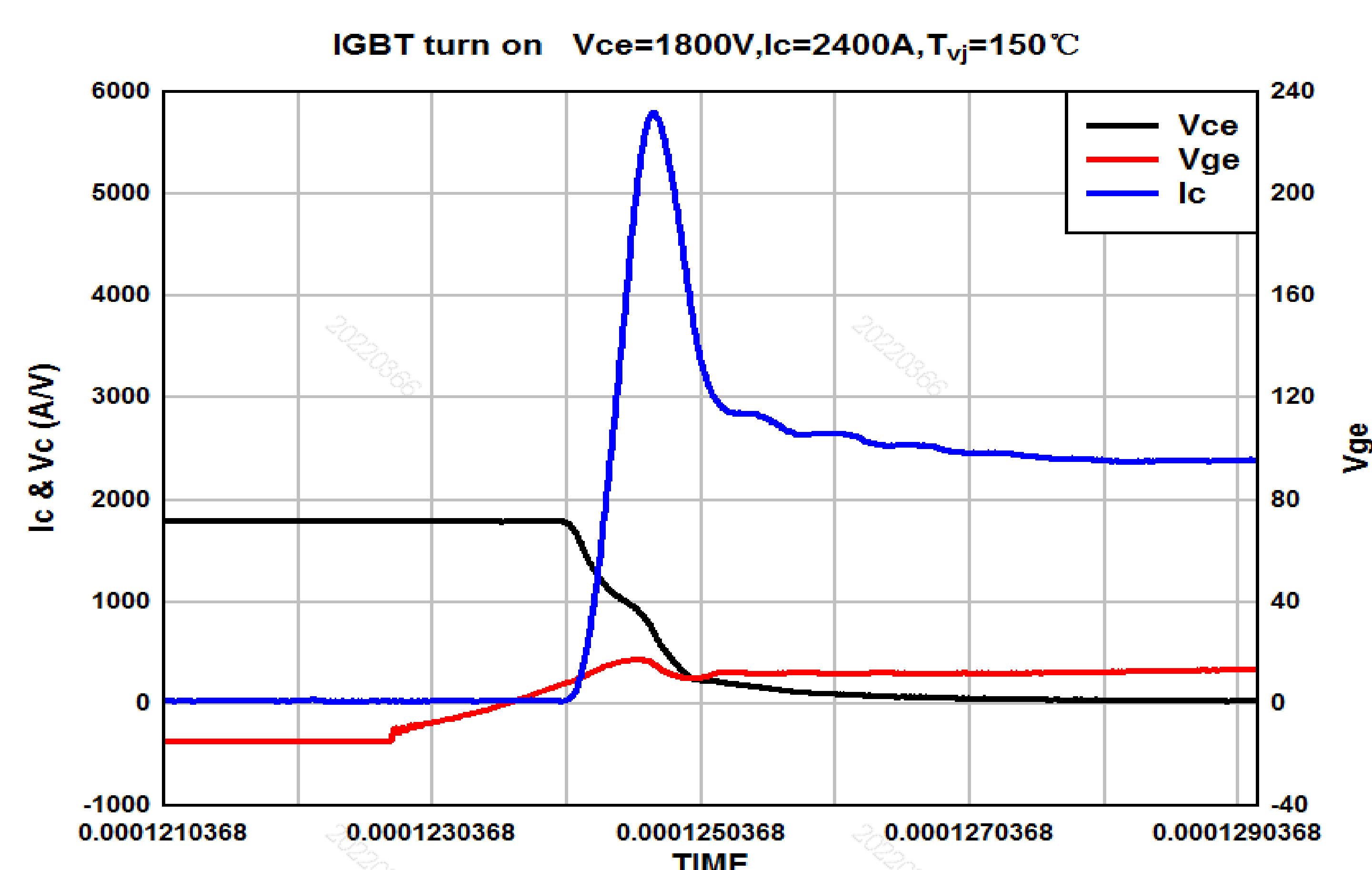


Fig. 3 IGBT switching waveform at 150°C: Vce=1800V, Ic=2400A.(a) turn on;(b) turn off.

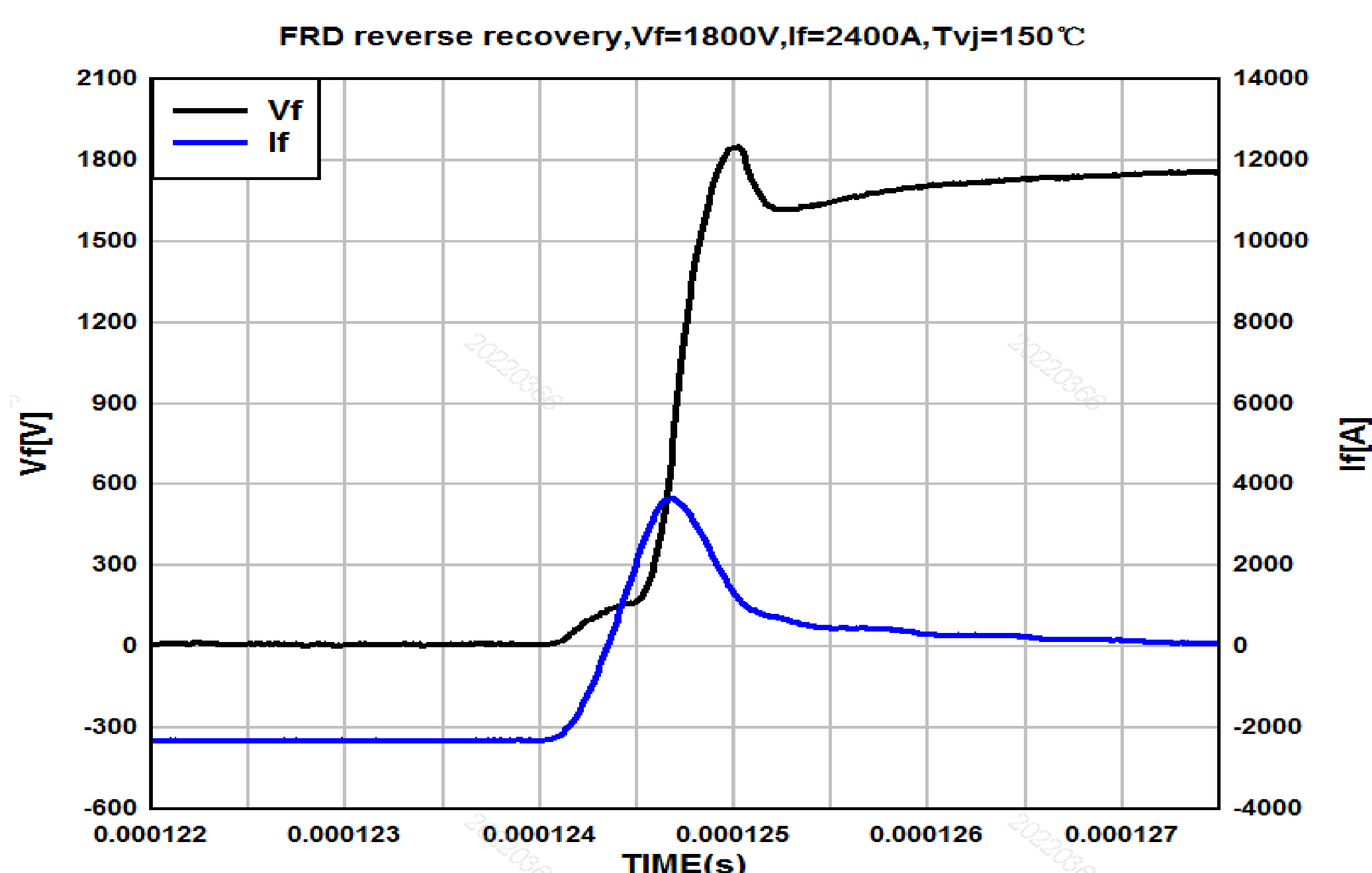


Fig. 4 FRD reverse recovery waveform at 150°C.

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Dynamic Performance at -40℃

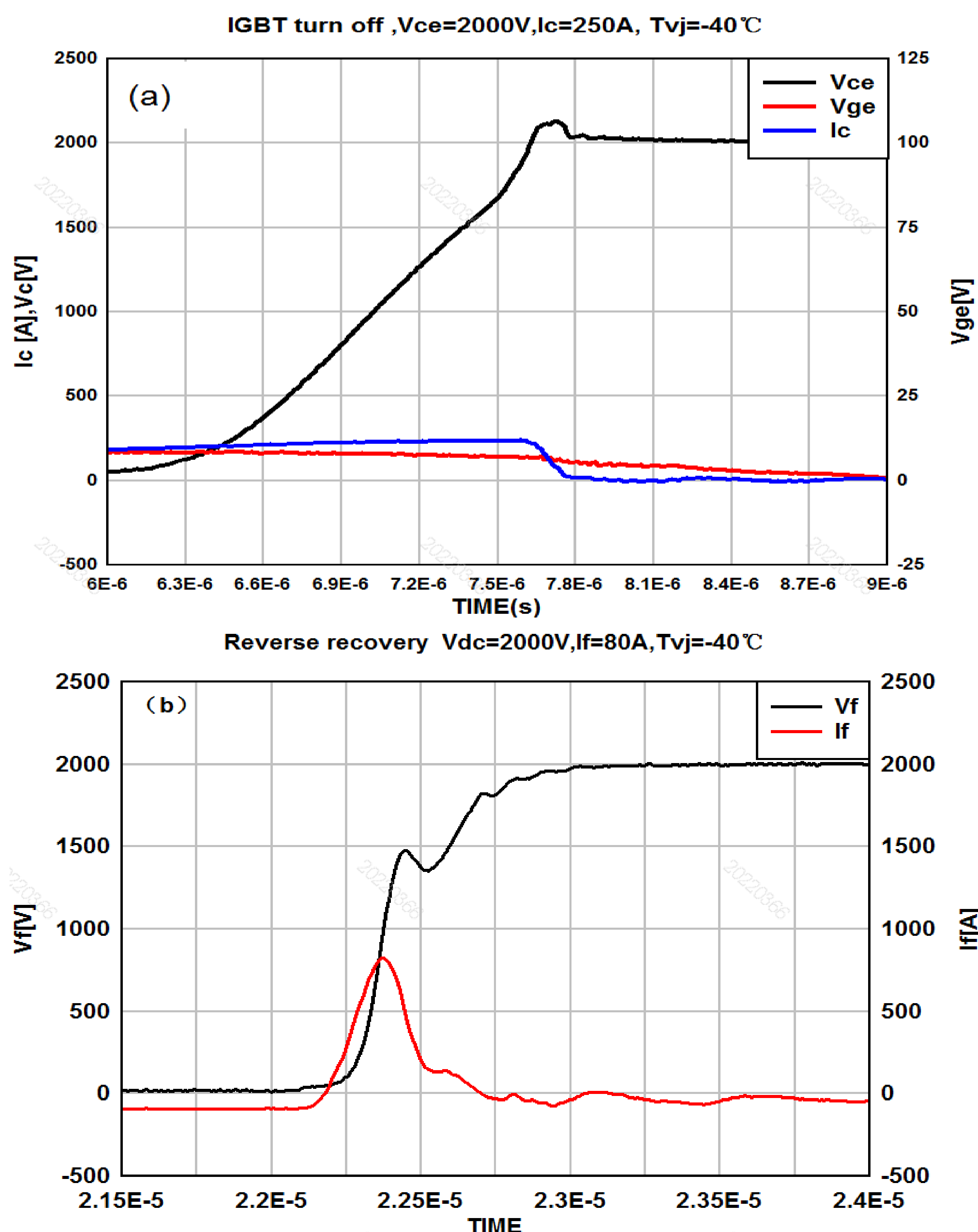


Fig.5 Dynamic waveform at -40℃:(a)IGBT turn off waveform at Vce=2000V,Ic=250A;(b) FRD reverse recovery waveform at Vce=2000V,Ic=80A;

SOA Performance

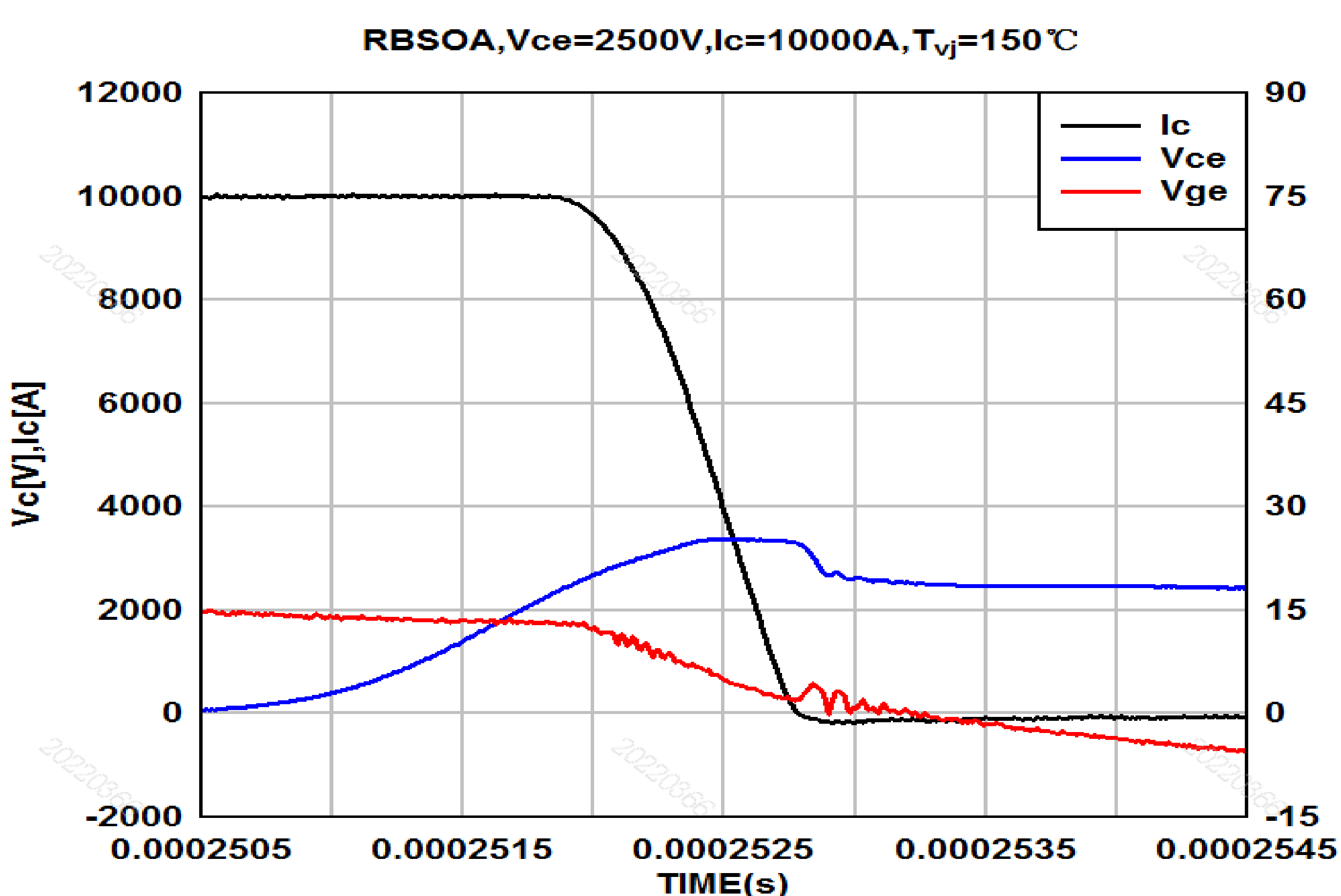


Fig.6 IGBT RBSOA, Vce=2500V, Ic=10kA, Tvj=150℃

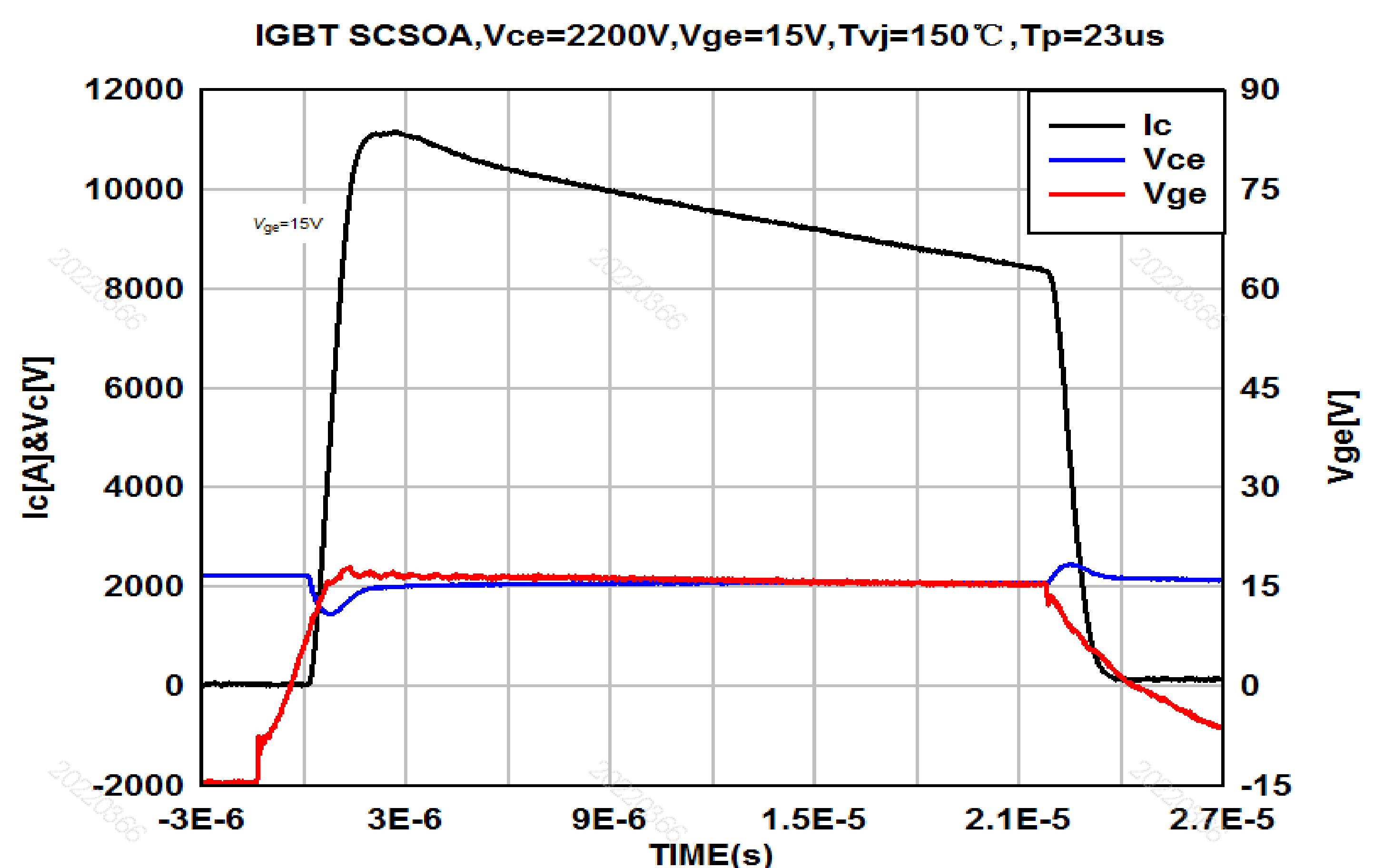


Fig.7 SCSOA waveform, Vce=2200V, Tp=23us, Tvj=150℃

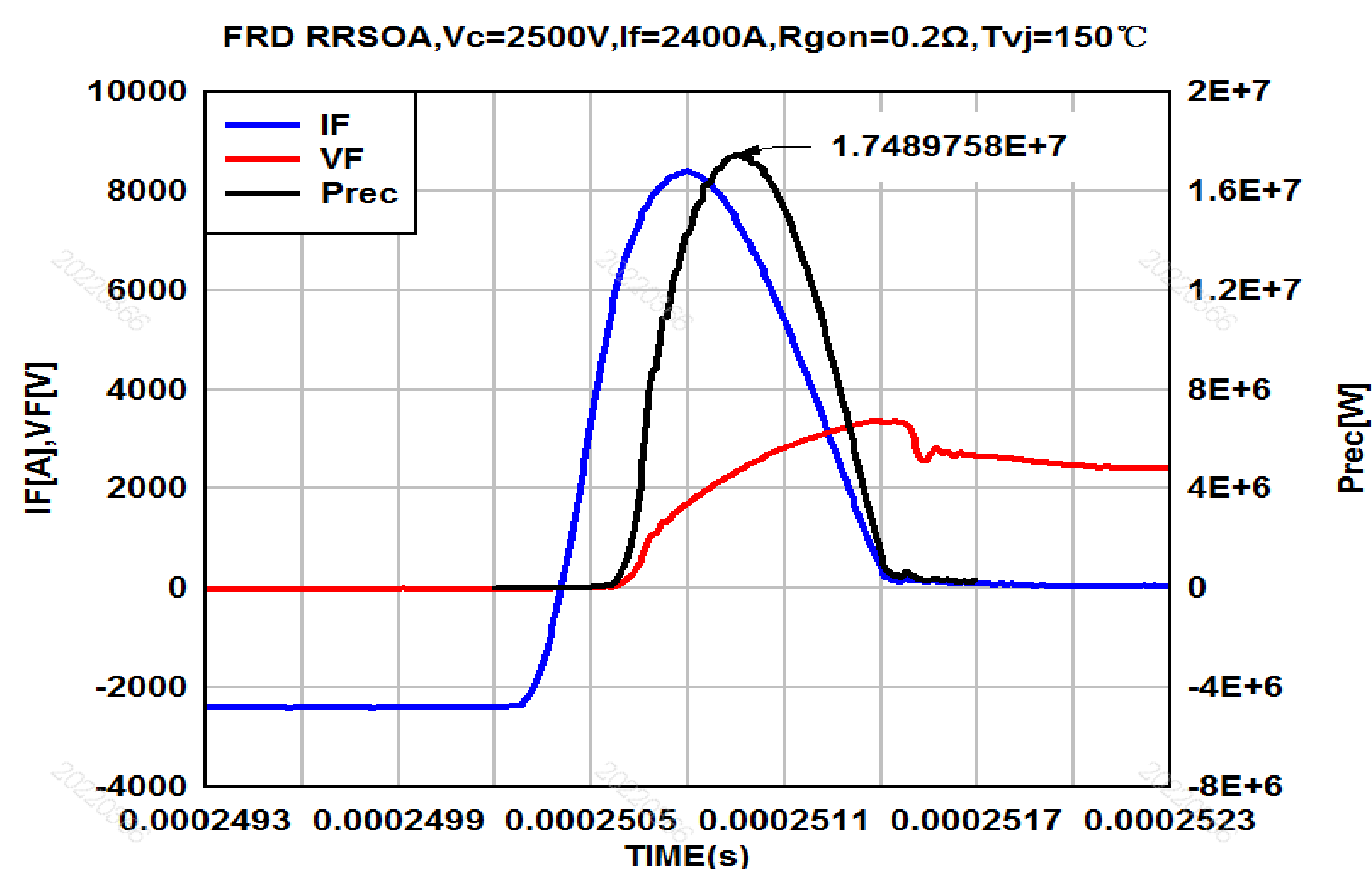


Fig. 8 RRSOA waveform, Vce=2500V, If=2400A, Tvj=150℃

Reliability Performance

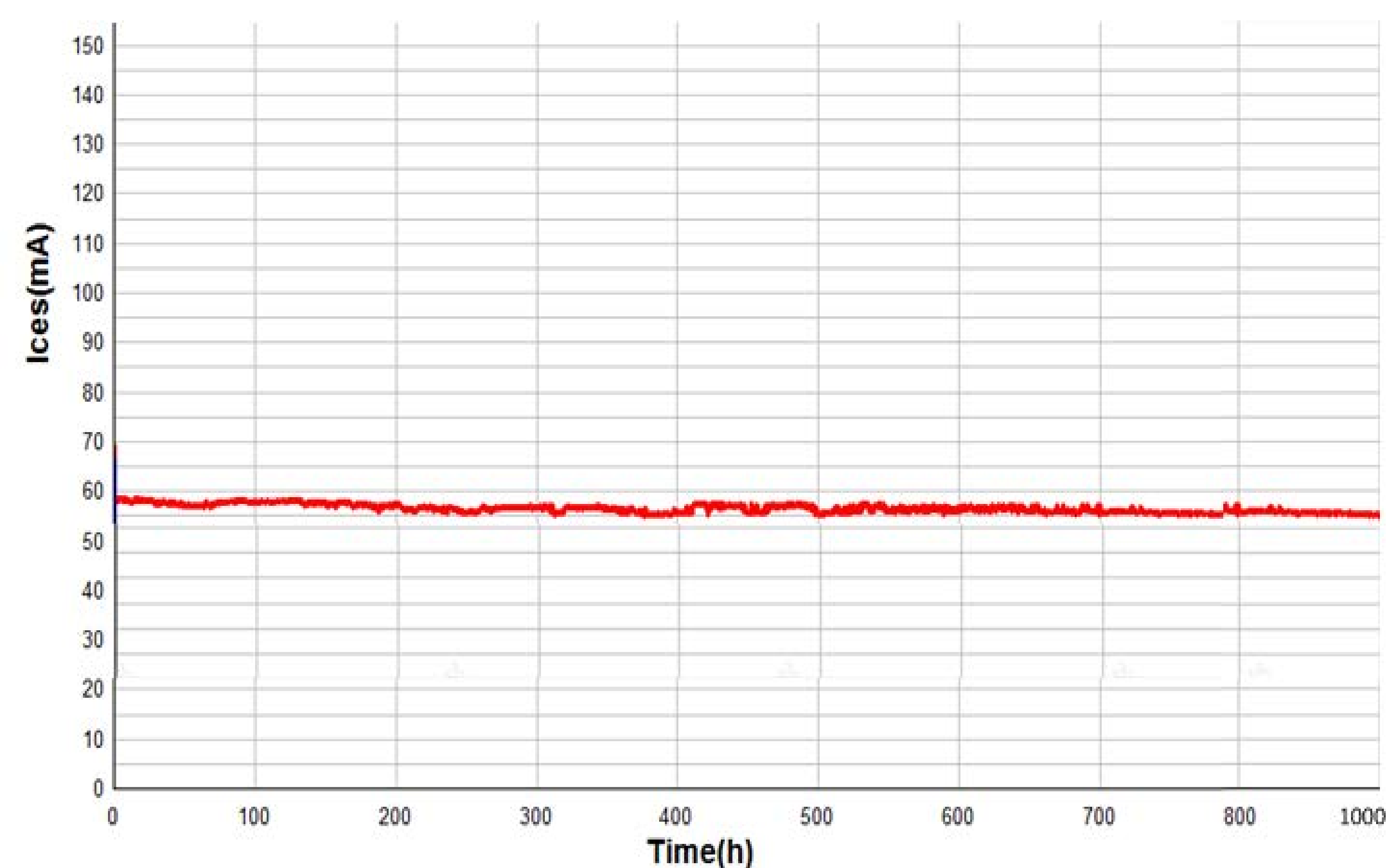


Fig.9 HTRB process leakage curve at 150℃;