

[1282] Wed-Mo-Po3.08-12 : Study on AC Over-Current Transport Characteristics of the ReBCO Thin-Film-type Superconducting Wire with the Different Specific Resistance Values

Before Title : Study on the current limiting characteristics of YBCO coated conductor according to different stabilizer layer with iron core and coil

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1. Abstract

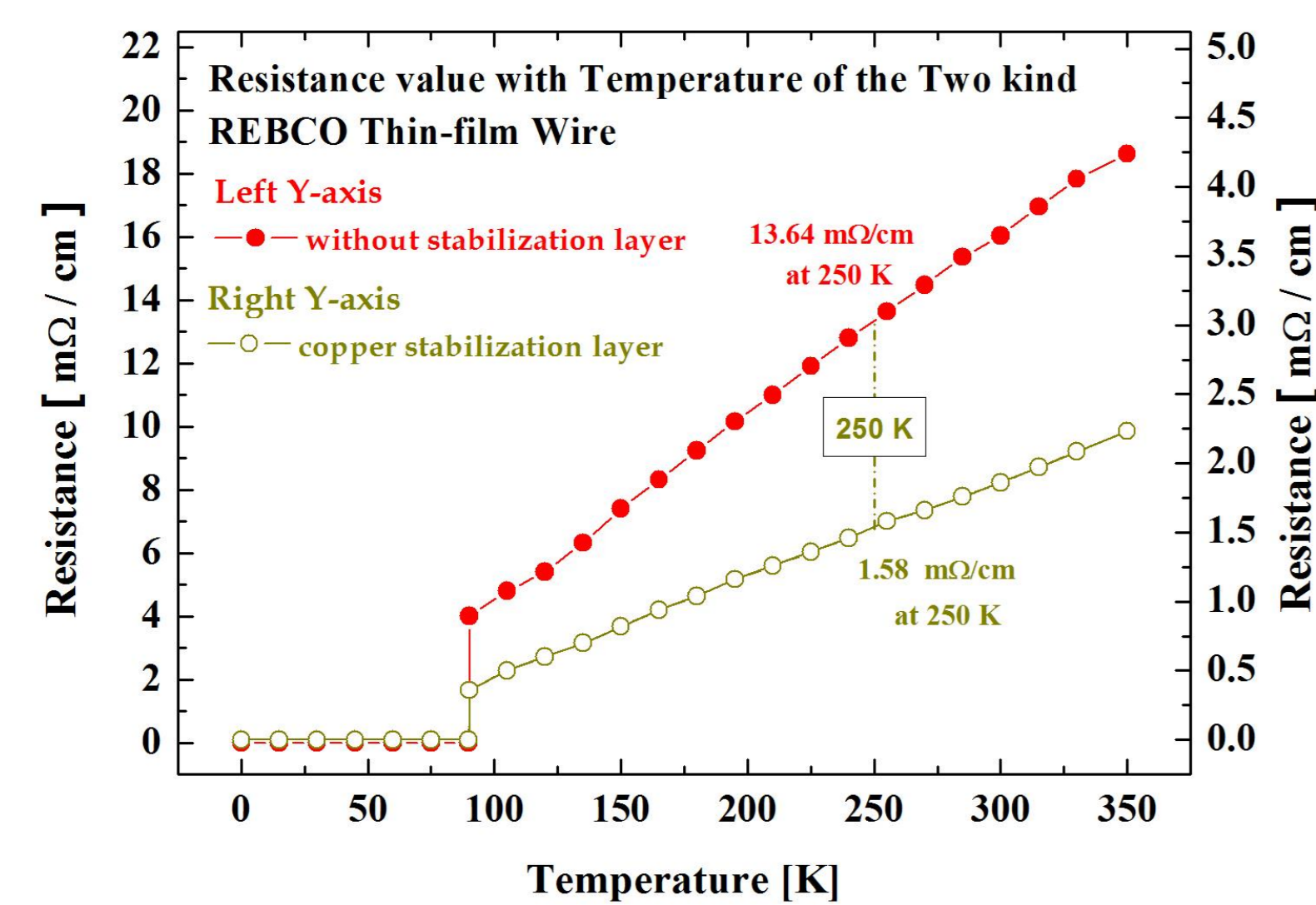
The main goal of the superconducting cable is lossless power transmission, and it does not function the fault current limiting performance. In this study, the use of the fault current limiting type superconducting power cable model is proposed to maximize its current limiting performance within the stable range using only the relationship between the current transporting and current limiting parts, without additional devices. For this, the current transporting and current limiting parts were configured using ReBCO thin film wires with different specific resistance characteristics, and a jig was fabricated to integrate the whole parts. After a fault current was applied, the current transporting, current limiting, and thermal stability characteristics were examined. The current transport characteristic was normal under the suggested condition, and the current limiting rate also complied with the operation condition at the 1/2th, 3rd, and 5th cycles. The thermal stability was analyzed, and the temperature of the current limiting part increased to 270 K at the 5.5th cycle, which might present a possibility of damaging the superconducting wires. The aforementioned results are highly valuable as the basic data for the design of fault current limiting superconducting cables.

2. Characteristics of the ReBCO thin film type wire

Properties of REBCO thin-film wire

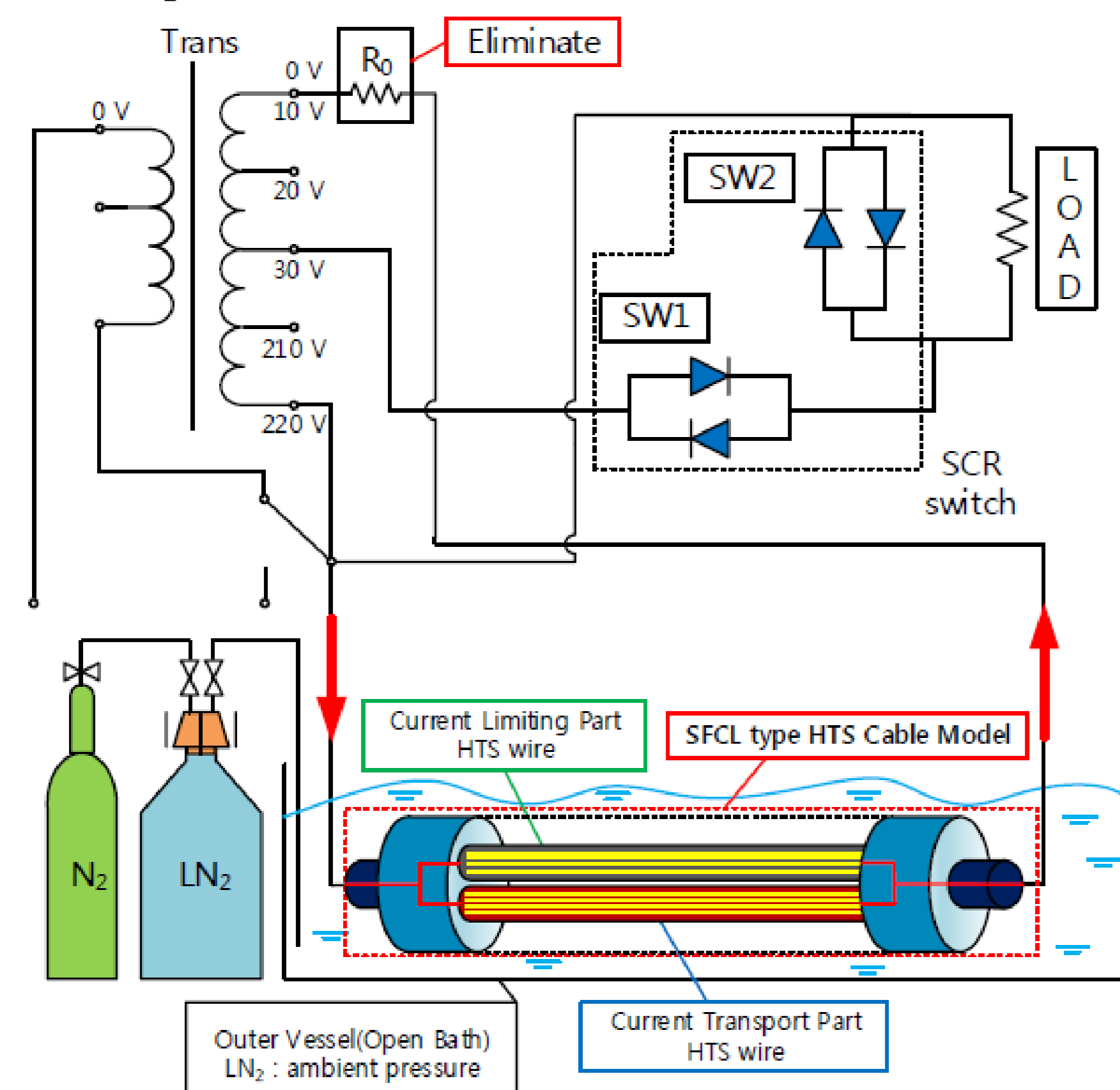
REBCO thin film wire(Superpower SCS2050)		REBCO thin film wire(Superpower SCS2050)	
Stabilizer	Copper	Stabilizer	Without a stabilization layer
Length of pattern/width/thickness	100cm/2.0mm/0.2mm	Length of pattern/width/thickness	100cm/2.04mm/0.055mm
I_c & T_c	49Arms (1 μ V/cm, @77K), 90K	I_c & T_c	52Arms (1 μ V/cm, @77K), 90K
Voltage rating & Resistance	1.2Vrms/cm, 1.58m Ω /cm (@250K)	Voltage rating & Resistance	0.3Vrms/cm, 13.6m Ω /cm (@250K)

The specific resistance value variations according to temperature of the ReBCO thin film wires.



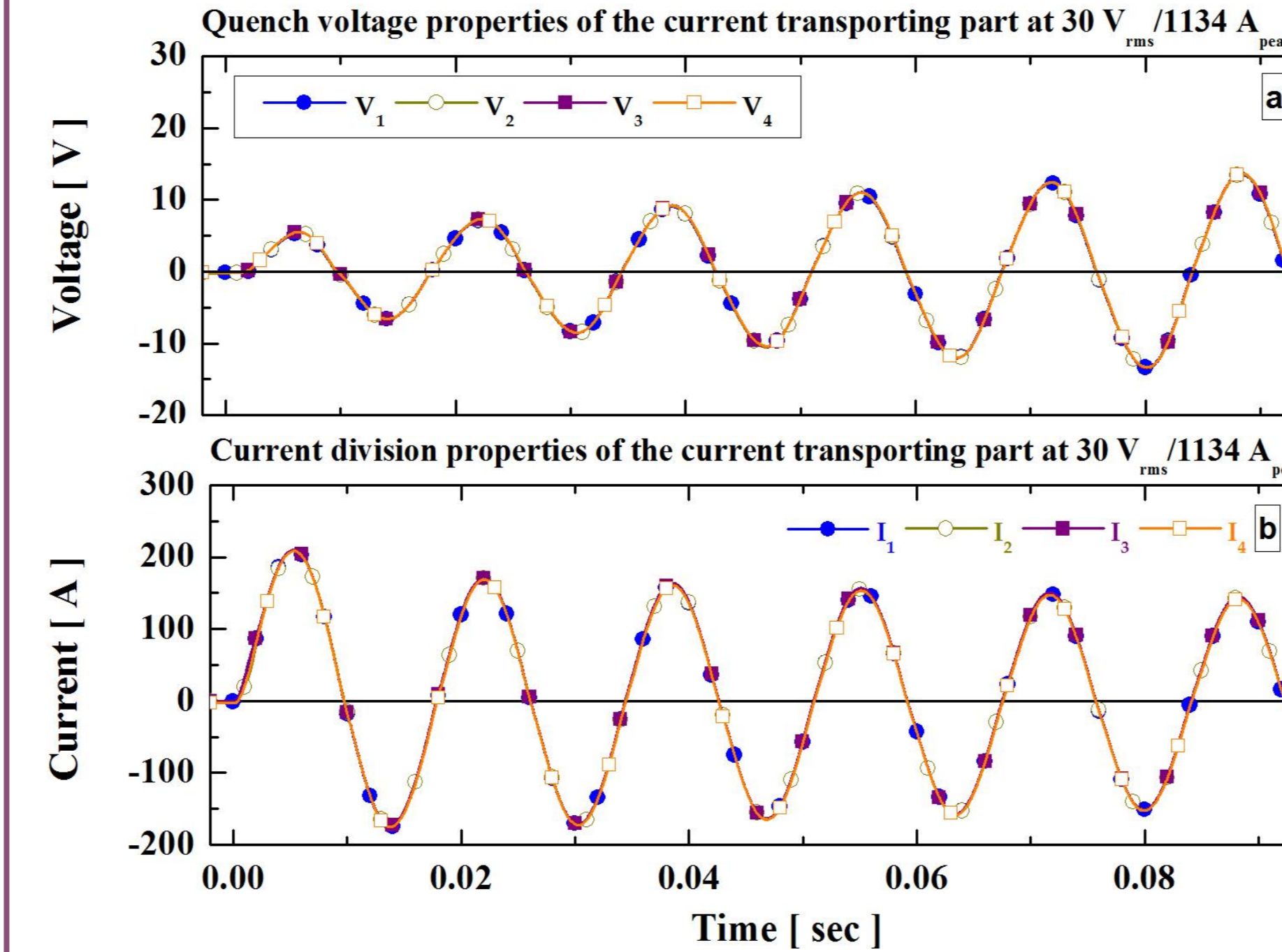
3. Operating principle of the FCLSC model and configuration for the testing system

Test system diagram of the experimental circuit.

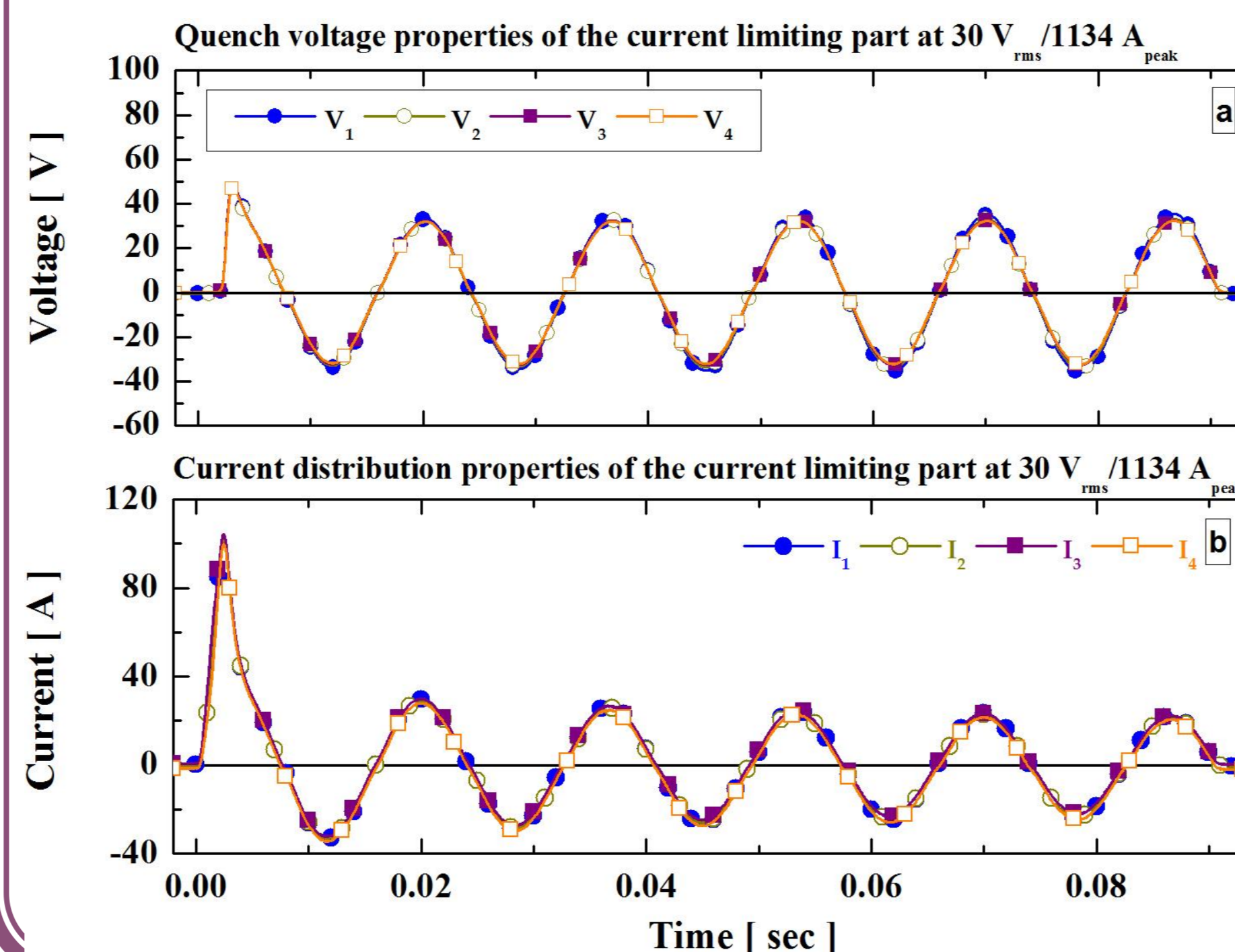


4. Evaluation on the current transport characteristics

Current transport characteristics of the current transporting part (a) quench voltage division, (b) current sharing.

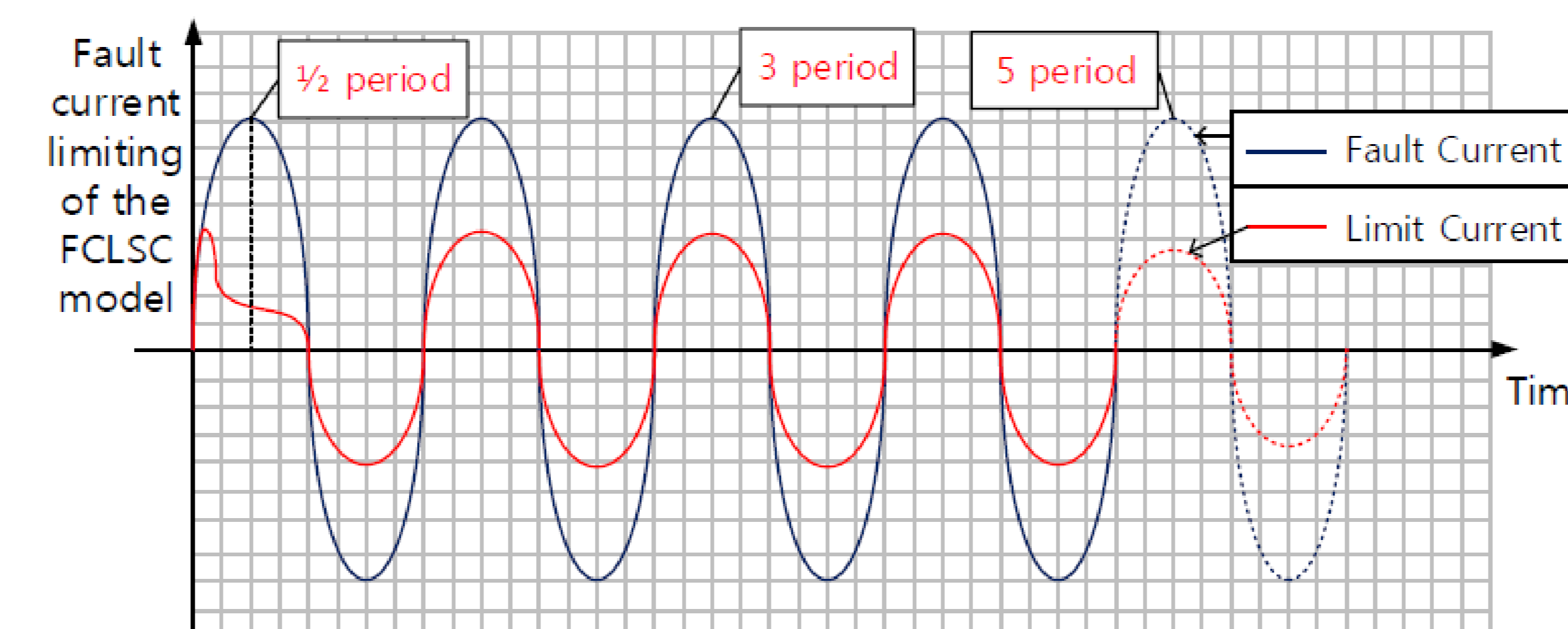


Considering that a current 2.5 times the rated breaking current should flow in the actual power system when a fault occurs, the result means that the stability of the current transporting part is secured. The current transport characteristics of the current limiting part also show the proper current sharing and quench voltage division.



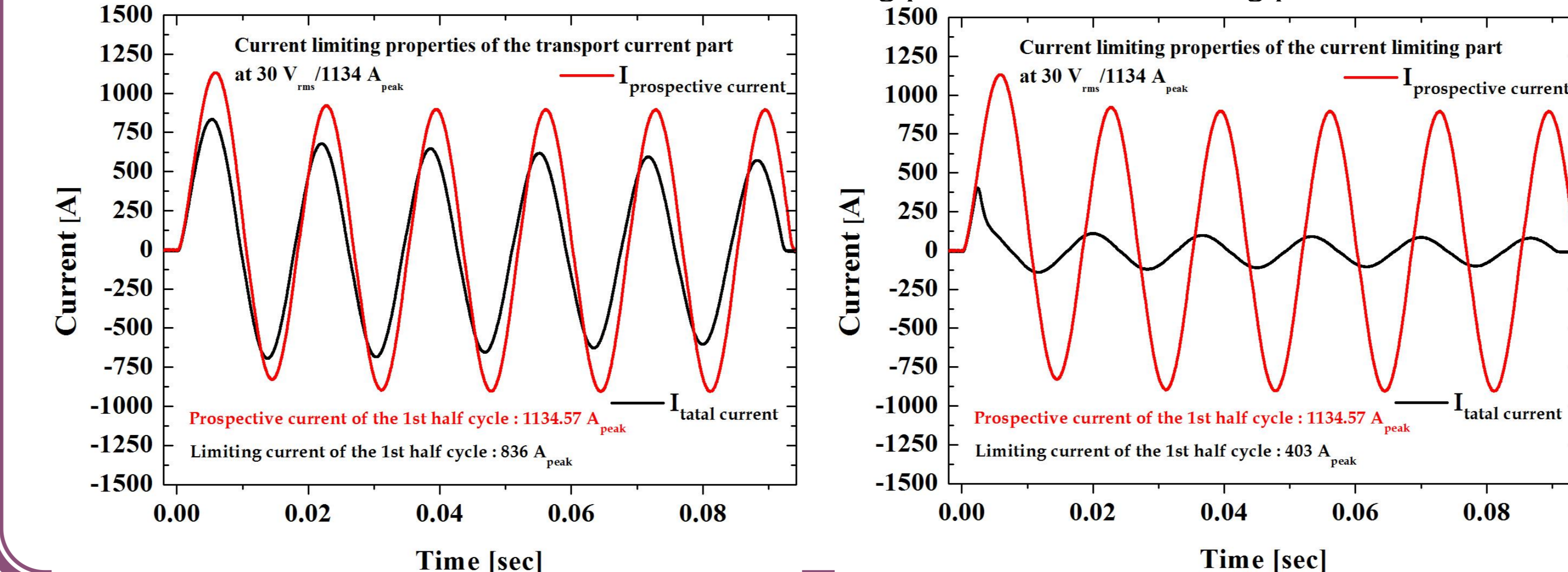
5. Evaluation on current limiting characteristics

Current limiting characteristics of the FCLSC model.

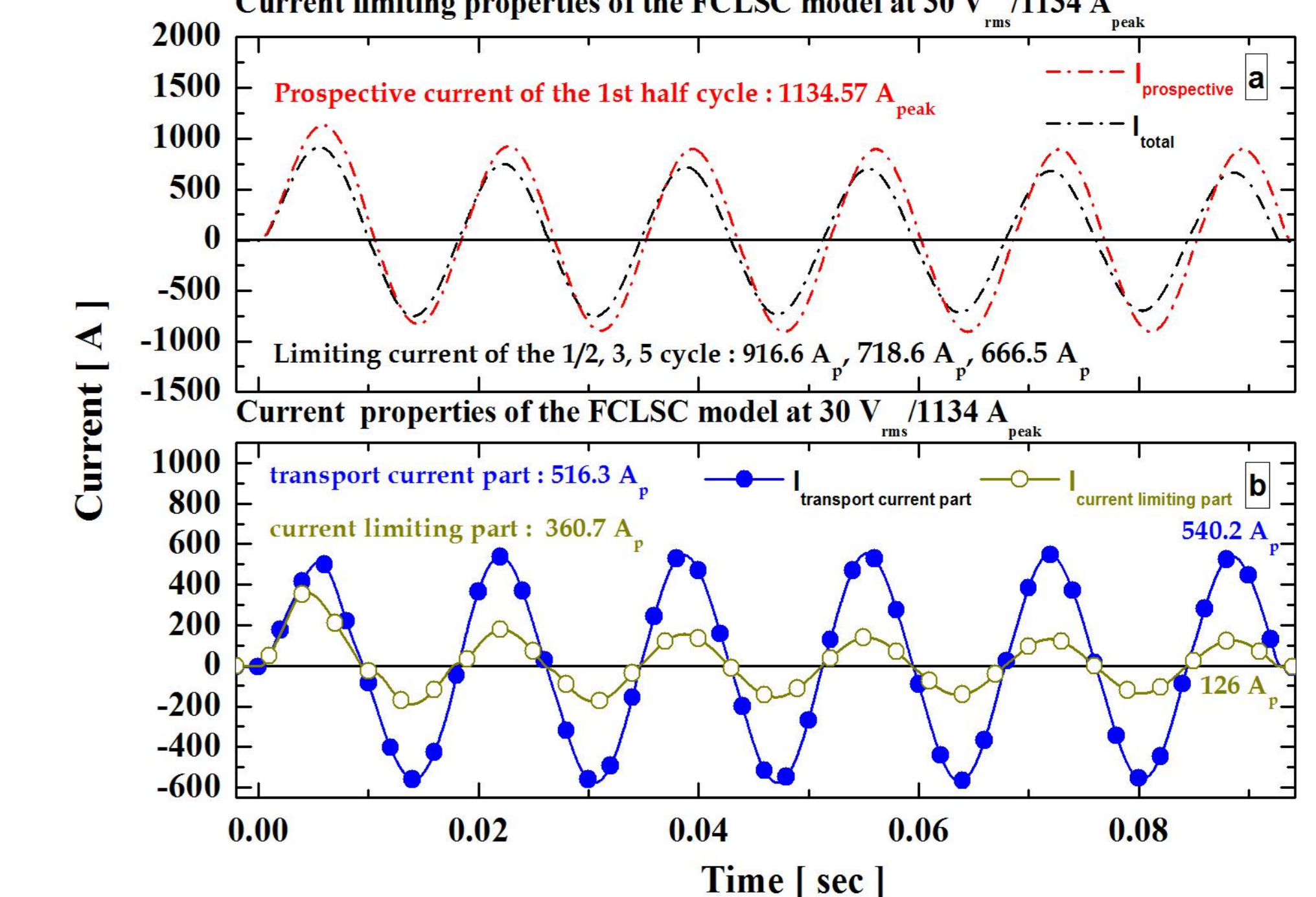


The first 1/2 cycle is the point at which the greatest fault current flows. The 3rd cycle is used for the detection of the fault current type, and is the limiting value just before the breaker operation. The 5th cycle is the point at which the limited fault current flows into the breaker, and is used to finally determine the magnitude of the limited fault current.

Current limiting characteristics of the current transporting part and current limiting part.

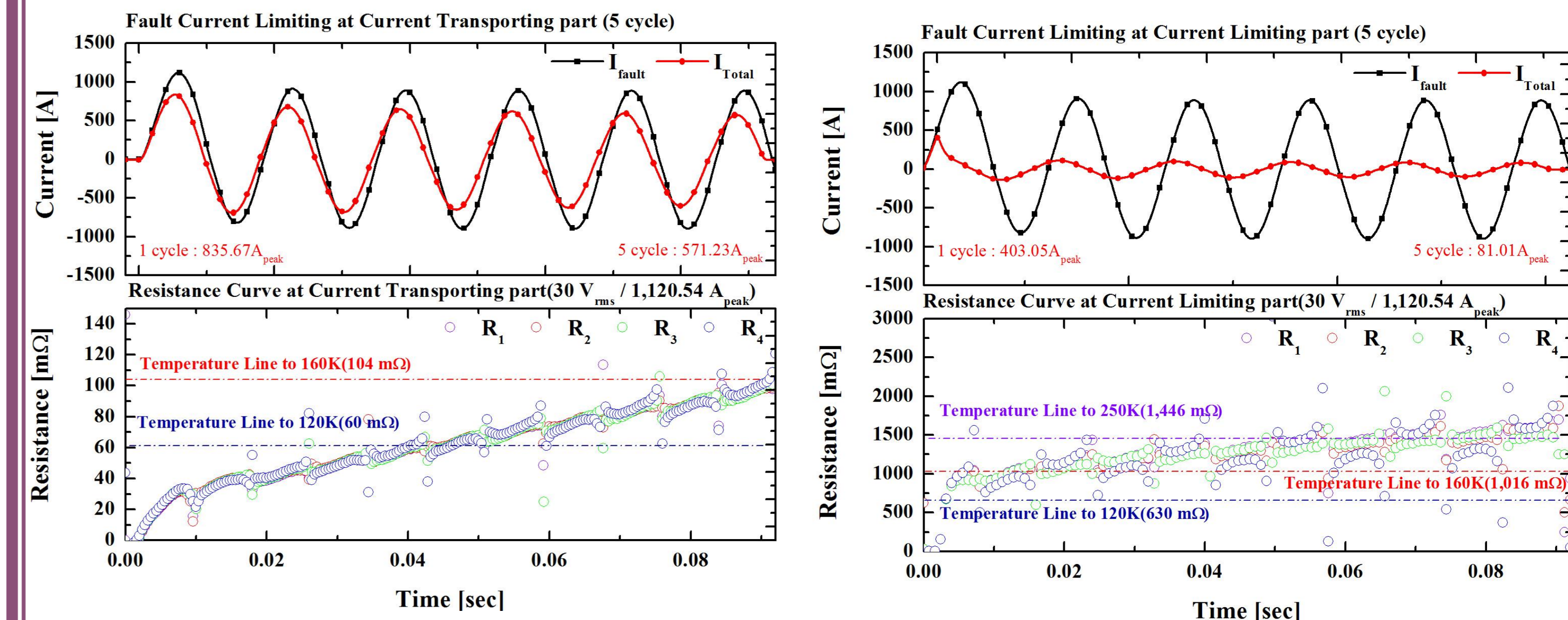


Characteristics of the fault current limiting for the FCLSC model (a) limited total fault current, (b) limited fault current by each parts.

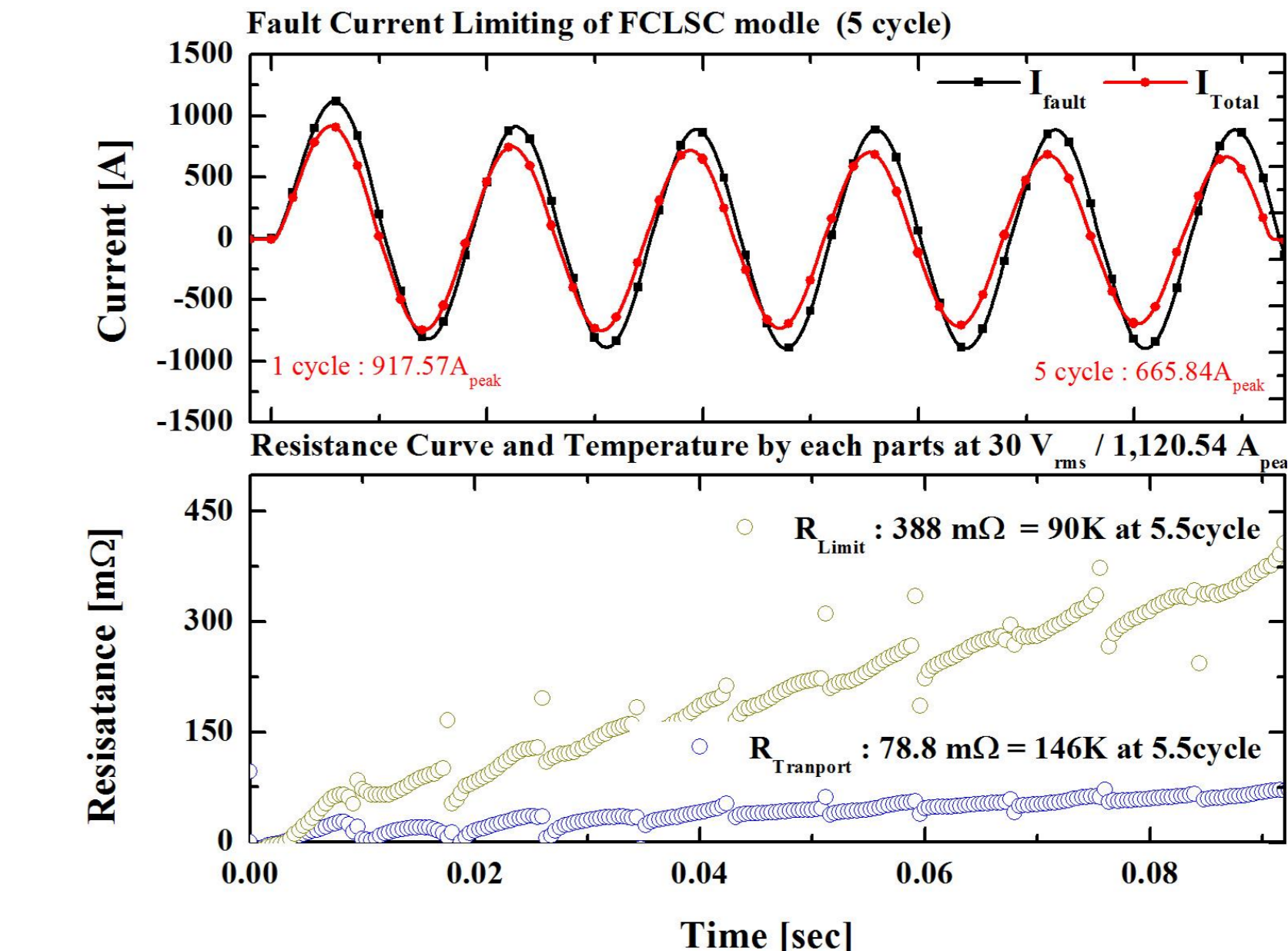


6. Evaluation on Thermal Stability

Thermal stability evaluation of the current transporting part.



Thermal stability evaluation of the FCLSC model.



7. Conclusion

The current transport characteristic of the FCLSC model was tested. The current sharing between the current transporting and current limiting parts were proper, and the current sharing and voltage division of the superconducting wire were stable. The current limiting capacity of the current limiting part that had the superconducting wire with high resistivity was high in all the measurement cycles in the current limiting characteristic analysis, but the temperature of the current limiting part increased to 270 K at the 5th cycle in the thermal stability examination, which showed a possibility of having incurred a damage. When the current limiting rate and thermal stability were examined after the current transporting and current limiting parts were combined, the current limiting rate was found to have increased to 41.12% at the 5th cycle, and the thermal stability was found to have been 160 K or below at the 5th cycle. Thus, the FCLSC model was satisfied the operating condition proposed in this study. Further studies are required to calculate the capacity of each part (current transporting and current limiting parts) considering its conduction capacity, fault current limiting rate, and thermal stability, and to address the problems in the AC current application.