

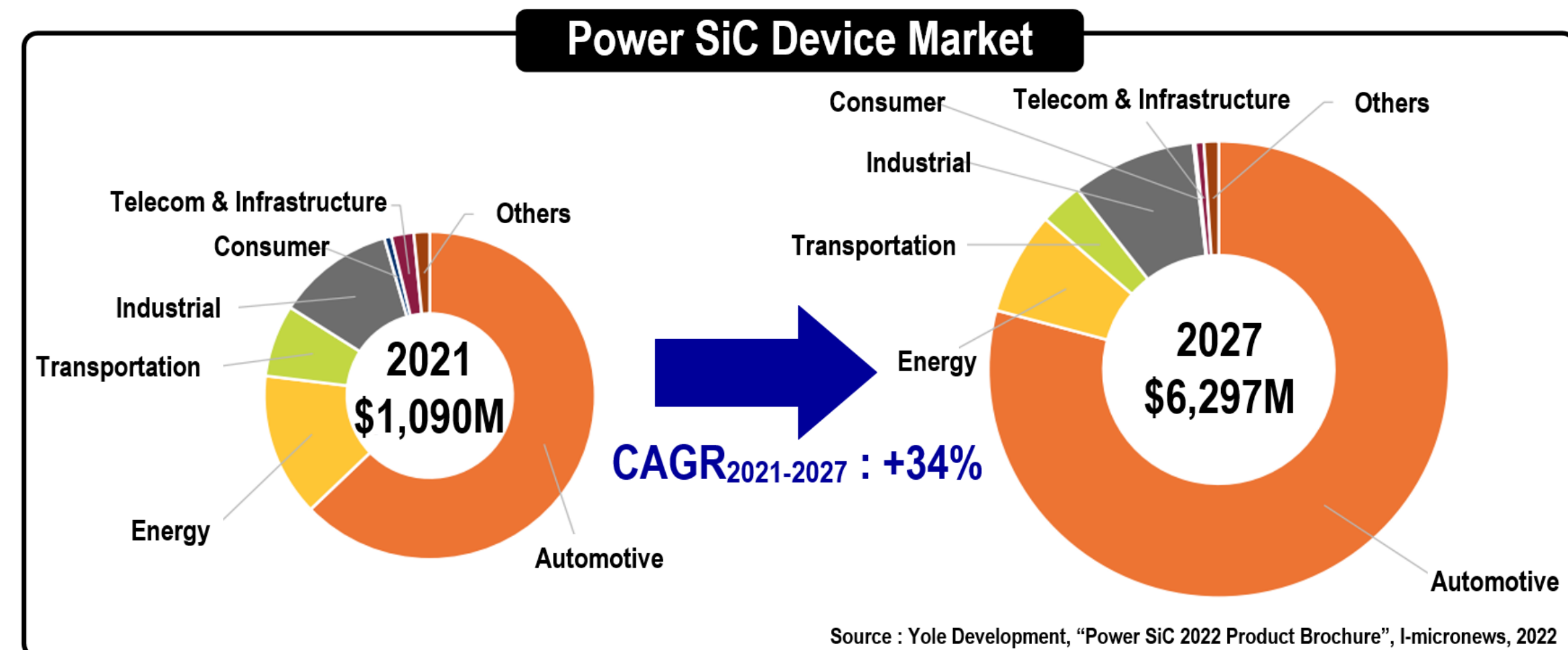
dv_{DS}/dt Sensing Based Active Gate Driver IC for SiC MOSFETs

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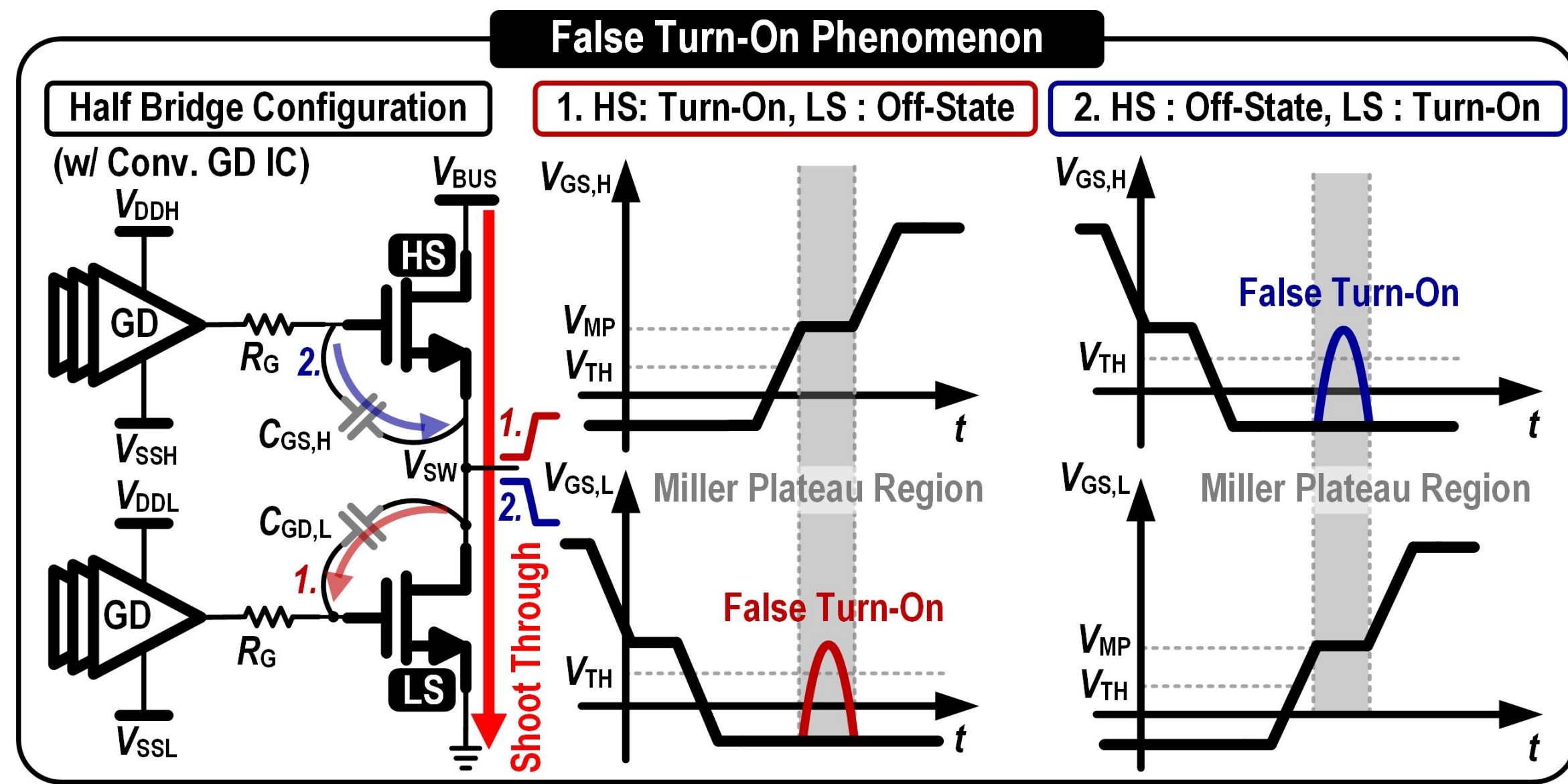
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1. Introduction

- Many advantages of SiC devices compared to Si devices :
 - High breakdown voltage, low on-resistance, low parasitic capacitance, etc.
- There is a significant increase in demand in fields such as automotive, energy, and the power industry.

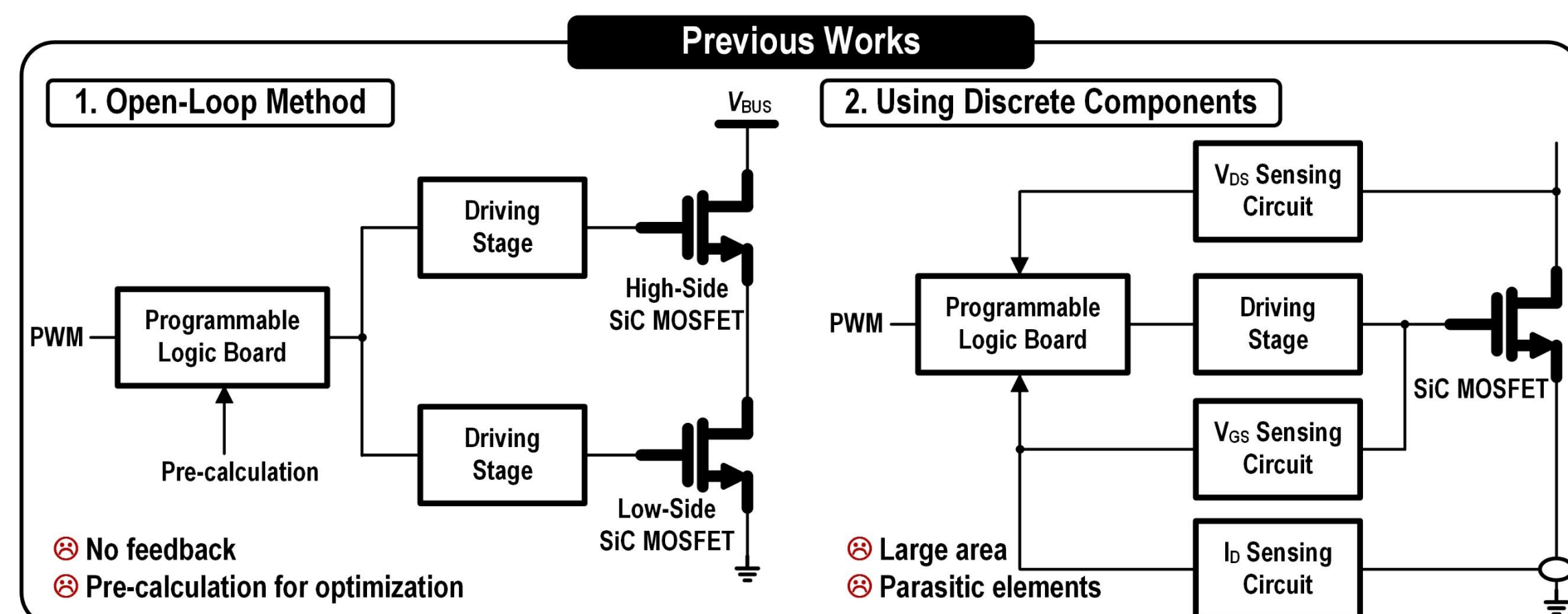


- With increasing the operating frequency, there are several issues due to high dv/dt and di/dt, parasitic elements :
 - False turn-on, gate ringing, EMI, etc.

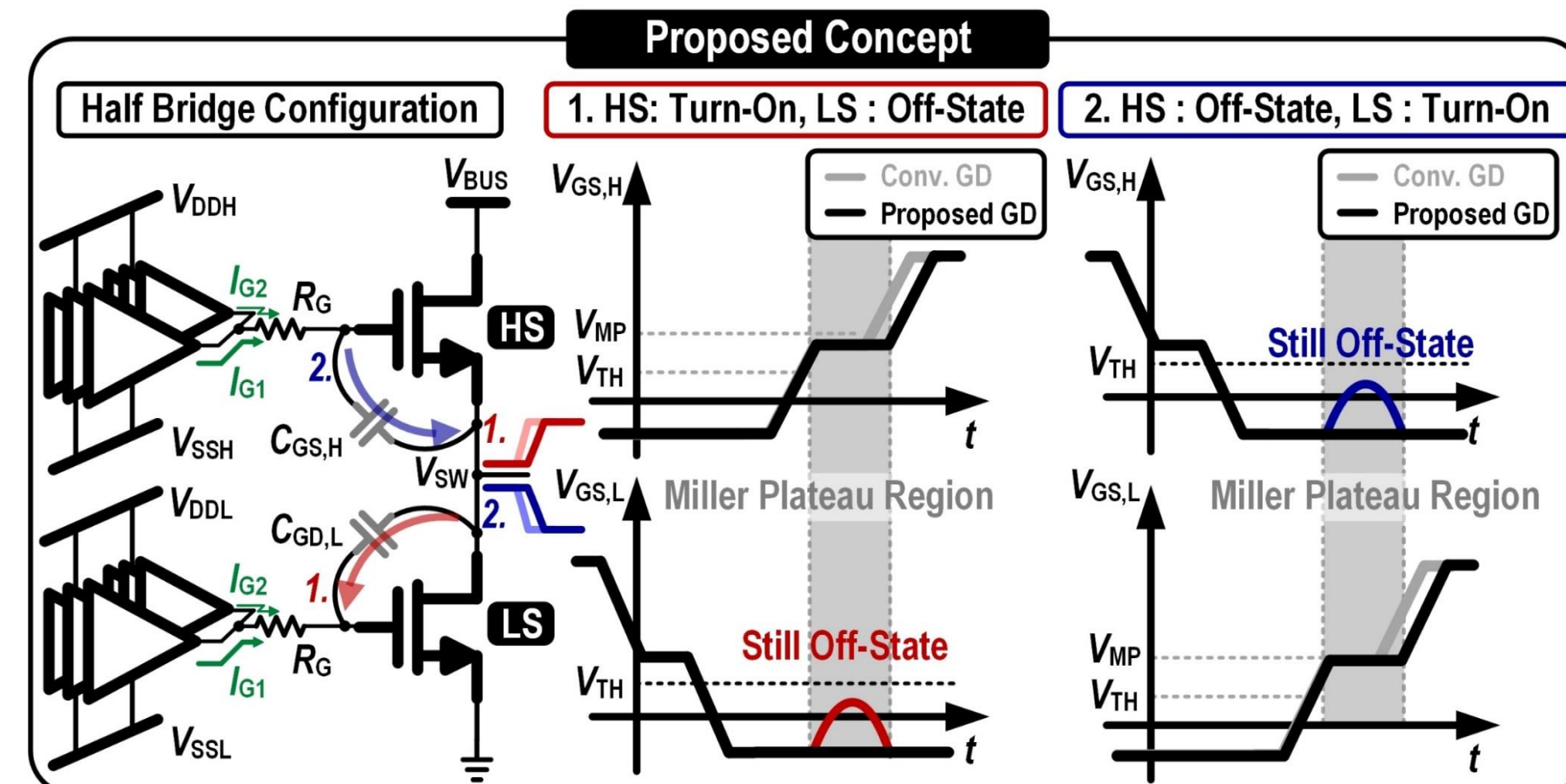


2. Previous Works

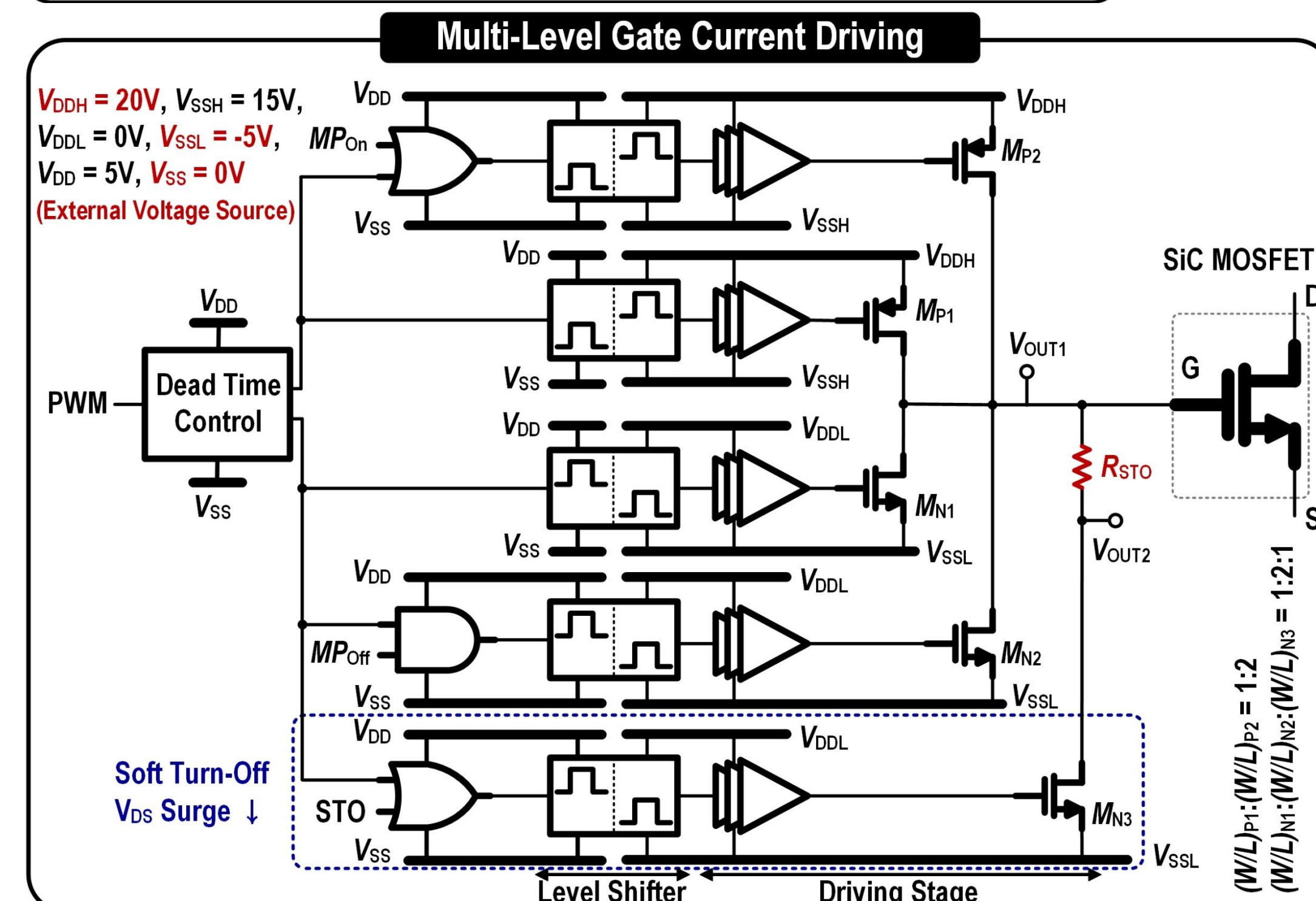
- Active Gate Driver (AGD) : Improve trade-offs between the issues and switching speed
- Limitations of previous works
 - Open-loop methods :
 - Lack of flexibility to operating condition variations
 - Impractical
 - Circuit implementation using discrete components
 - Large area
 - Increase in the influence of parasitic elements



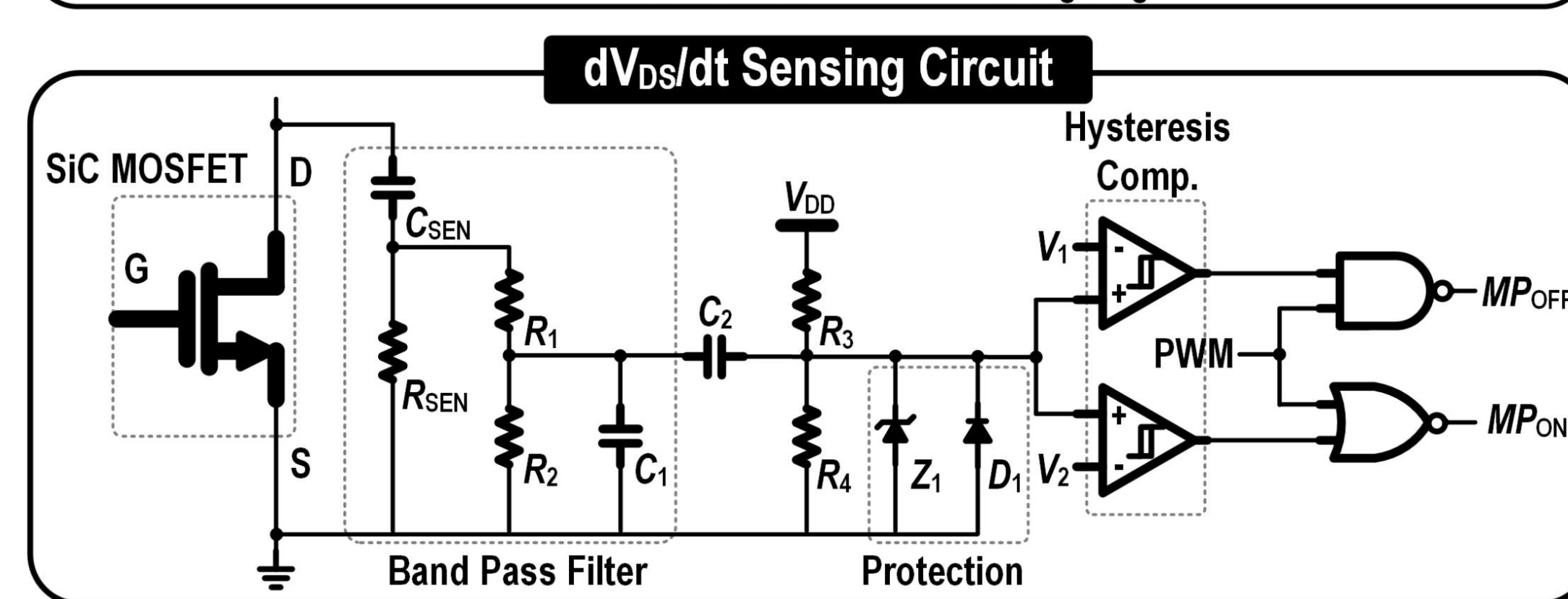
3. The Proposed Structure



- Adjusting the driving strength differently for each region with closed-loop method.
 - Preventing of false turn-on
 - Improving the trade-offs
 - Practical
 - Small area



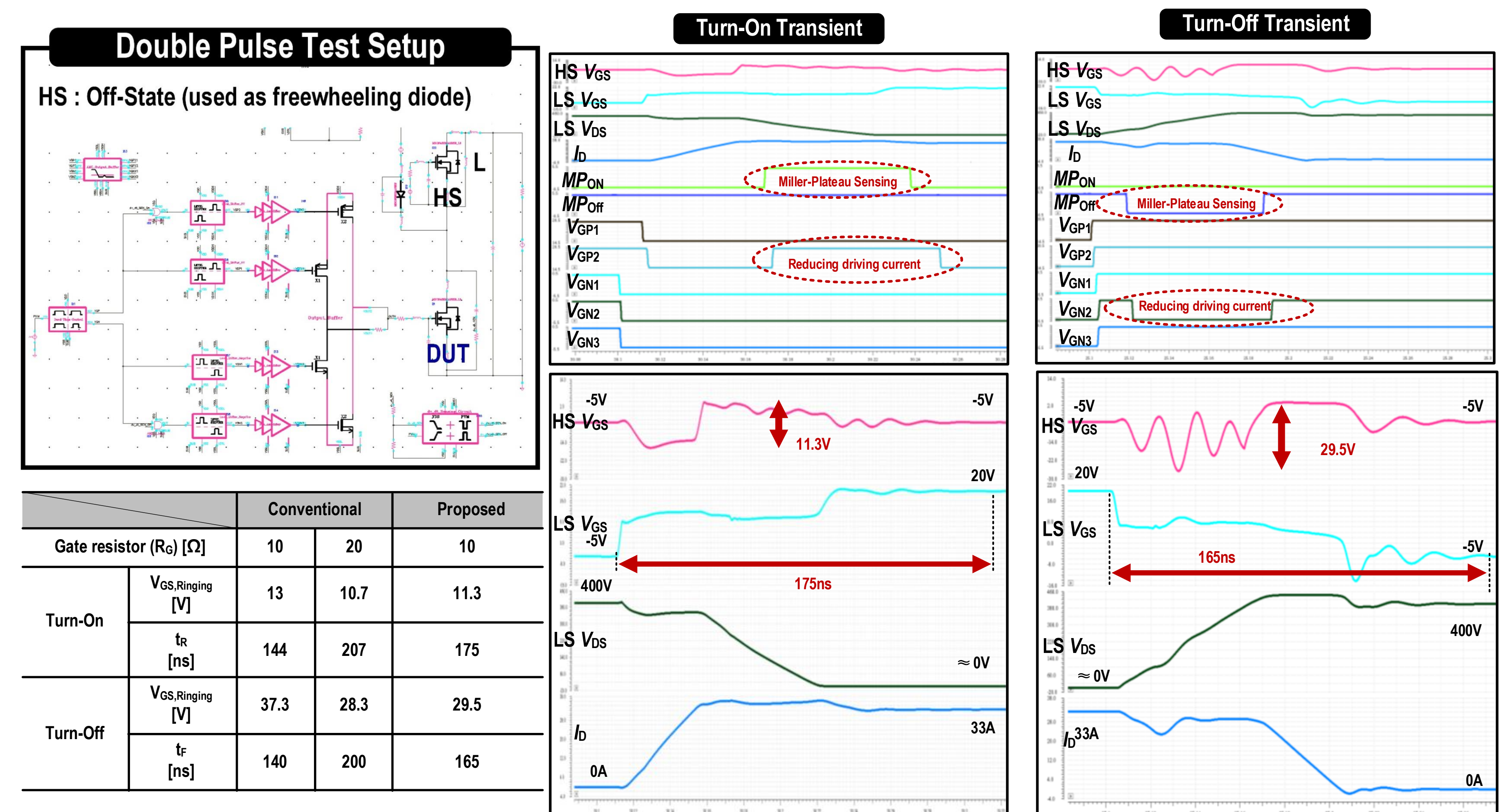
- Segmented output buffer
- Level shifter
- Dead time control circuit for buffer
- Limiter
- dv_{DS}/dt sensing circuit
- Desaturation circuit
- Under voltage lock out circuit
- etc.



- For preventing false triggering (due to noise)
 - Band-pass filter
 - Hysteresis comparator

4. Simulation Result

- Post-simulation result (Cadence), Double pulse test for evaluating the dynamic behavior
- V_{BUS} = 400V, I_D = 33A, f_{sw} = 200kHz, Driving voltage : 20V (Turn-on), -5V (Turn-off)



5. Conclusion

- This work proposes AGD IC for high-frequency operation of SiC MOSFETs that overcomes the limitations of previous works.
- Miller plateau region is sensed, and the gate current is controlled using a segmented output buffer, with a closed-loop method applied.
- Proposed circuit reduces the magnitude of ringing caused by high dv/dt without significantly slowing down the switching speed.