Application Information

Application for an Inverter

Enhancing everyday life

PV(Photovoltaic) and motor applications require the inverters as power conversion devices which include the power semiconductors for. An inverter for PV system is used to convert DC power from PV panels to AC power for grid or off-grid connection. Its topology is usually used the single phase H-bridge inverter with sinusoidal PWM modulation to generate sine wave waveform. The single phase H-bridge inverter is as shown in Fig. 1. An inverter for motor drive system is used to convert DC wave voltage/current to AC sine wave or square wave voltage/current to drive induction motor (IM), permanent magnet synchronous motor (PMSM) or DC brushless motor, etc. Its topology is usually used three phase full bridge inverter shown as Fig. 2.

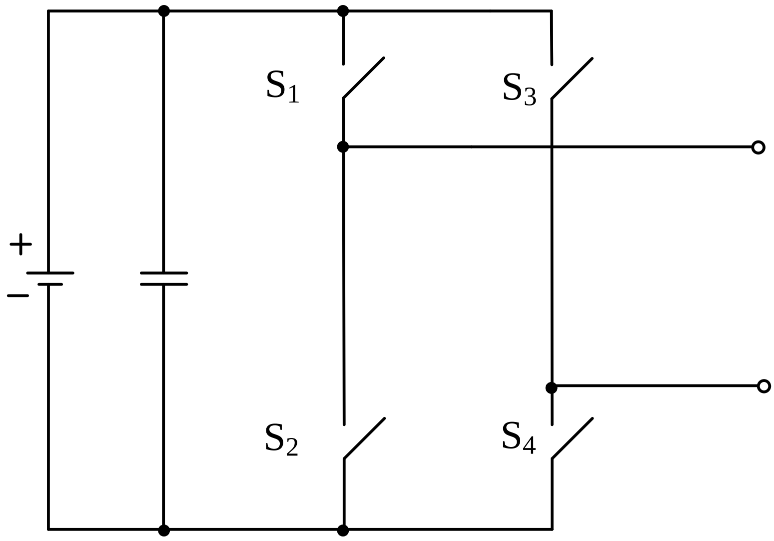

Fig. 1 single phase H-bridge inverter

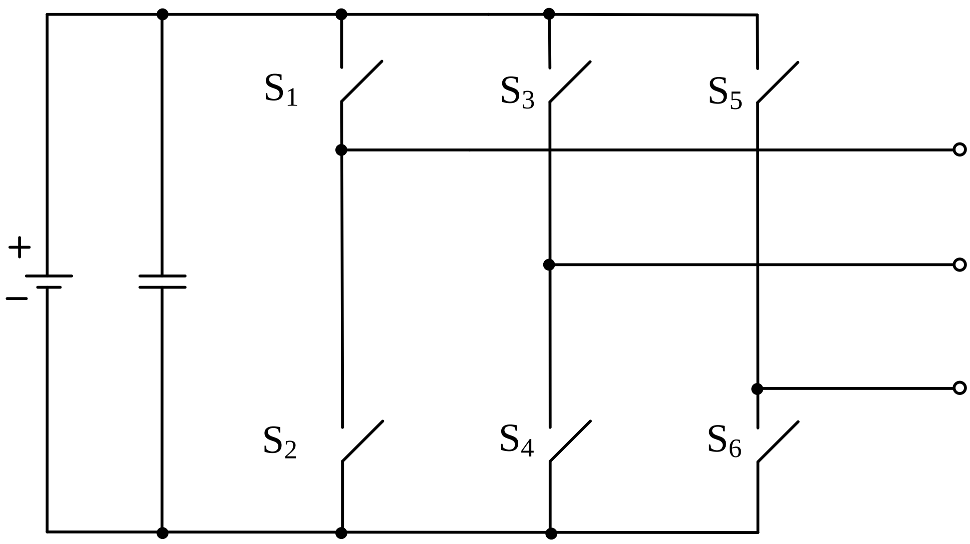

Fig. 2 three phase H-bridge inverter

For example, there is a single phase H-bridge inverter with four MOSFETs in parallel per power switch as shown in Fig. 3.The part number of N-channel MOSFET is PDP89D8BH (80V, 165A, 3.4mΩ). The DC bus voltage is 50V, the input current of the inverter is 120A and assuming uniform parallel current. So the I_D current flowing through a single MOSFET is 30A. Fig. 4 shows that the switching waveform of the H-bridge inverter with 33 kHz switching frequency and 50% PWM duty. For the switch, the average power loss calculated by power dissipation from math function of the oscilloscope is :

$$P_{D,avg} \cong 25W \quad (1)$$

Due to 50% operation region of the H-bridge inverter. The total average power loss of the inverter can be derived as

$$P_{D,inverter} = 25W \times 50\% = 12.5W \quad (2)$$

Assume that the thermal resistance with fan cooled heat sink of the junction to ambient is 3 °C/W. Then the junction temperature of the MOSFET can be easily obtained.

$$T_J = 25W \times 3°C/W + 25°C = 100°C \quad (3)$$

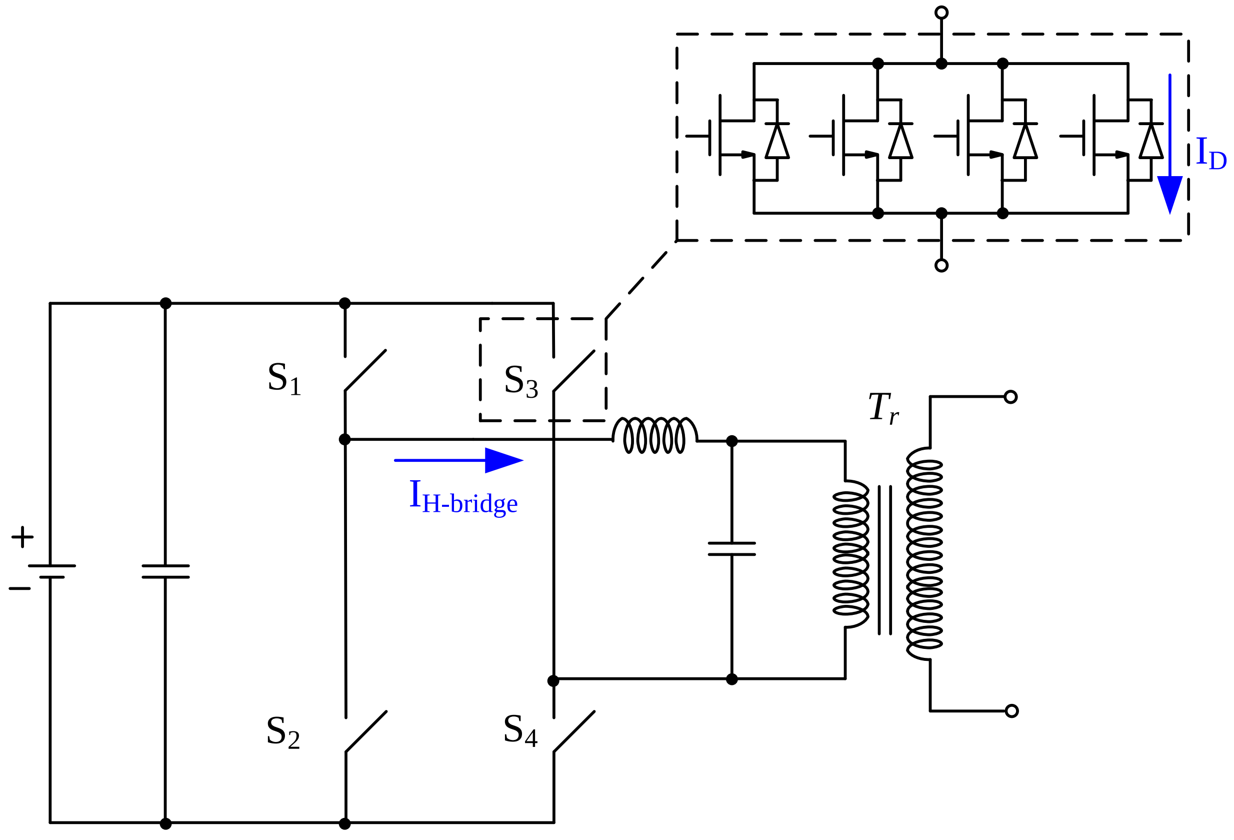

Fig. 3 H-bridge inverter with 4 MOSFETs in parallel per switch

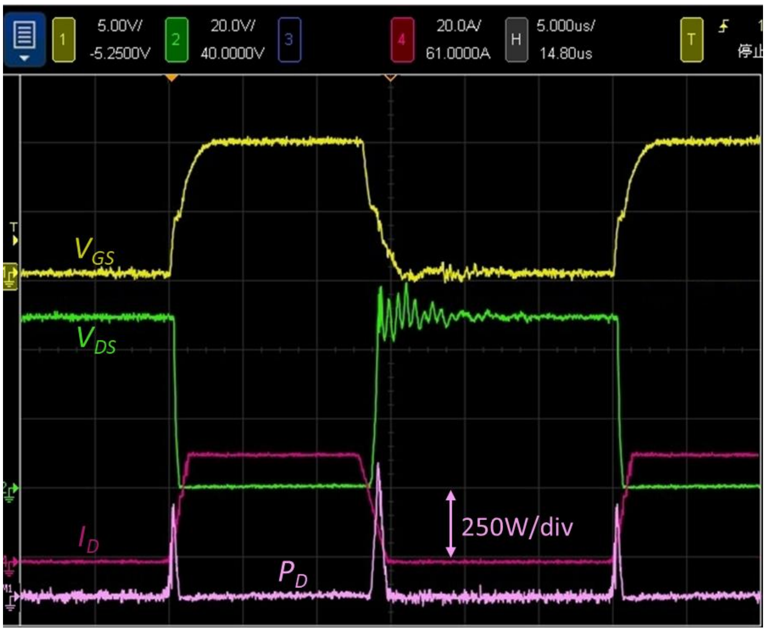

Fig. 4 switching waveforms of the H-bridge inverter

For high-side and low-side switches, high frequency interference noise as high side MOSFET turned on would flow through Cgd_ext of the PCB layout or Cgd of low side MOSFET into Cgs would cause G to S pin voltage over the threshold voltage. Fig. 5 shows the path of high frequency interference noise. This noise would turn on the MOSFET and cause high-side and low-side switches shoot-through. Fig. 6 shows high frequency interference noise at G-S pin as as high side MOSFET turned on. You could avoid this noise by making the shortest gate driving loop, adding bead core at high/low side gate in series, and choosing MOSFET with high $V_{GS(th)}$ to filter and absorb high frequency interference sign or suppress the interference source.

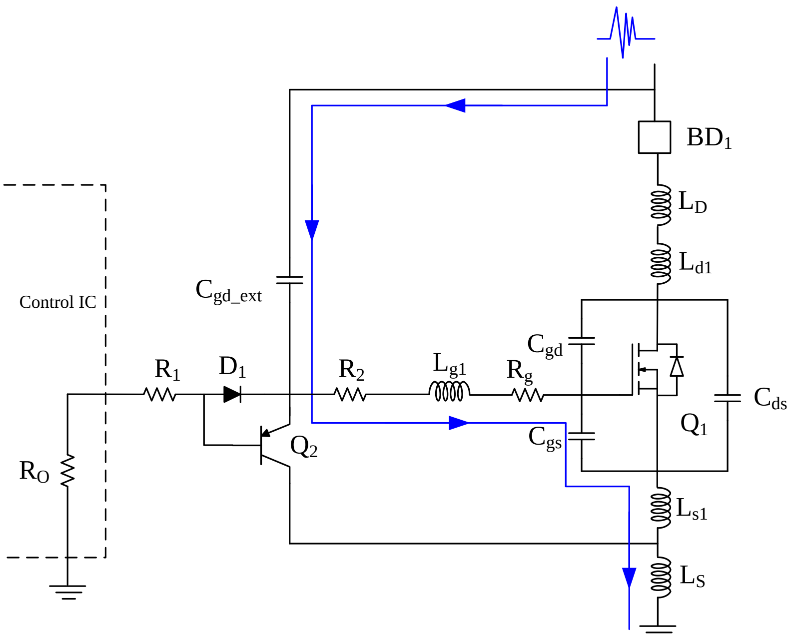

Fig. 5 the path of high frequency interference noise

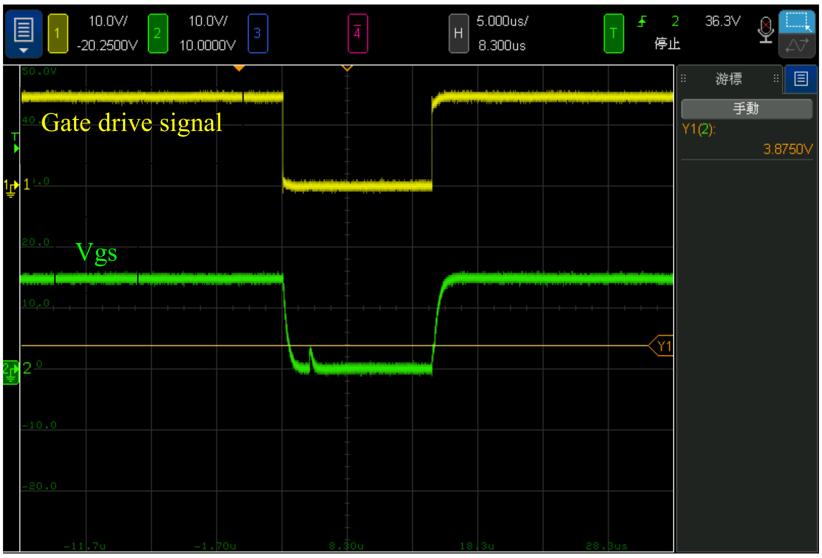

Fig. 6 High frequency interference noise at G-S pin

Reference

[1] Potens Semiconductor, “80V N-channel MOSFET,” PDP89D8BH datasheet. https://www.potens-semi.c4m/upload/product/PDP89D8BH.pdf.

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