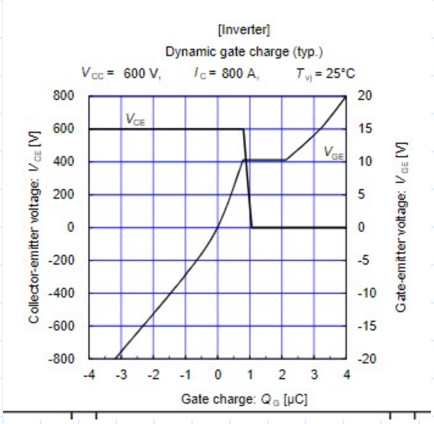
Gate charge from Fuji 1200V/800A Econo :



$Vcc := 18\ V$ $Vdc := 800\ V$

$Vee := -2\ V$ $f_{sw} := 16\ kHz$

$Q_{total} := 4\ \mu C$

Ron,Roff estimated using Vce du/dt. Ron,Roff values affects ringing and switching losses :

$R_{ginternal} := 1\ \Omega$ $R_{driver\_rdson} := 0.012\ \Omega$ $V_{gs\_miller} := 10\ V$

$$t_{voltage\_fall} := \frac{Vdc}{\frac{3000\ V}{\mu s}} = \left(2.667 \cdot 10^{-7}\right)\ s$$

$R_{driver\_rdsoff} := 0.012\ \Omega$

$Q_{miller} := 1.4\ \mu C$

$$R_{on\_ext} := \frac{\left(Vcc - V_{gs\_miller}\right) \cdot t_{voltage\_fall}}{Q_{miller}} - \left(R_{ginternal} + R_{driver\_rdson}\right) = 0.512\ \Omega$$

$$R_{tot\_on} := R_{ginternal} + R_{on\_ext} + R_{driver\_rdson} = 1.524\ \Omega$$

Turn on power coming from Vcc:

$$P_{gate\_on\_vcc} := Q_{total} \cdot \left(Vcc - Vee\right) \cdot f_{sw} = 1.28\ W$$

Half of Pgate_on_vcc is dissipated in gate resistor :

$$P_{ron\_ext} := \frac{P_{gate\_on\_vcc}}{2} \cdot \frac{R_{on\_ext}}{R_{on\_ext} + R_{ginternal} + R_{driver\_rdson}} = 0.215\ W$$

Power dissipated in driver in turn on :

$$P_{drv\_on} := \frac{P_{gate\_on\_vcc}}{2} \cdot \frac{R_{driver\_rdson}}{R_{driver\_rdson} + R_{ginternal} + R_{on\_ext}} = 0.005\ W$$

Turn off resistor chooosed same as turn on resistor:

$$R_{off\_ext} := R_{on\_ext} = 0.512\ \Omega$$

$$R_{tot\_off} := R_{ginternal} + R_{off\_ext} + R_{driver\_rdson} = 1.524\ \Omega$$

$$P_{gate\_off\_vee} := P_{gate\_on\_vcc} = 1.28\ W$$

$$P_{roff\_ext} := \frac{P_{gate\_off\_vee}}{2} \cdot \frac{R_{off\_ext}}{R_{off\_ext} + R_{driver\_rdsoff} + R_{ginternal}} = 0.215\ W$$

$$P_{drv\_off} := \frac{P_{gate\_off\_vee}}{2} \cdot \frac{R_{driver\_rdsoff}}{R_{driver\_rdsoff} + R_{ginternal} + R_{off\_ext}} = 0.005\ W$$

$$P_{gate\_power} := P_{gate\_on\_vcc} + P_{gate\_off\_vee} = 2.56\ W$$

Required gate current:

$$I_{g\_peak} := \frac{Vcc - Vee}{R_{ginternal} + R_{driver\_rdson} + R_{on\_ext}} = 13.125\ A$$

$$P_{ron\_ext\_peak} := {I_{g\_peak}}^2 \cdot R_{on\_ext} = 88.167\ W$$

$$P_{roff\_ext\_peak} := {I_{g\_peak}}^2 \cdot R_{off\_ext} = 88.167\ W$$

Switching times (turn on only):

$C_{ies} := 85\ nF \qquad C_{oes} := 2.9\ nF \qquad C_{res} := 0.76\ nF \qquad V_{th} := 6.5\ V$

Charging to Vth: $t_1 := R_{tot\_on} \cdot C_{ies} \cdot \ln\left(\frac{Vcc - Vee}{Vcc - Vee - V_{th}}\right) = \left(5.091 \cdot 10^{-8}\right)\ s$

Charging to Miller plateu: $t_2 := R_{tot\_on} \cdot C_{ies} \cdot \ln\left(\frac{Vcc - Vee}{Vcc - Vee - V_{gs\_miller}}\right) = \left(8.978 \cdot 10^{-8}\right)\ s$

Current rise time: $t_{rise} := t_2 - t_1 = \left(3.887 \cdot 10^{-8}\right)\ s$

Voltage fall time: $t_{fall} := \frac{Q_{miller} \cdot R_{tot\_on}}{Vcc - V_{gs\_miller}} = \left(2.667 \cdot 10^{-7}\right)\ s$

Charging to Vcc: $dt_{rest} := -R_{tot\_on} \cdot C_{ies} \cdot \ln\left(\frac{Vcc - 0.1\ V - Vcc}{-\left(Vcc - V_{gs\_miller}\right)}\right) = \left(5.676 \cdot 10^{-7}\right)\ s$

Total turn on time: $t_{on} := t_1 + t_{rise} + t_{fall} + dt_{rest} = \left(9.24 \cdot 10^{-7}\right)\ s$

$$I_{g\_ave} := \frac{Q_{total}}{t_{on}} = 4.329\ A$$