STSPIN
Configurable gate driving circuitry
L6480, L6482, and powerSTEP01

Technical details

life.augmented

Related parts

The presentation shows technical details about configurable gate driving circuitry which is integrated into the following devices:

- **L6480**: Stepper motor controller with voltage mode driving
- **L6482**: Stepper motor controller with advanced current control
- **POWERSTEP01**: Stepper motor driver system-in-package

Configurable gate drivers

The controllers of the STSPIN family integrate a gate driving circuitry which allows driving a wide range of power MOSFETs.

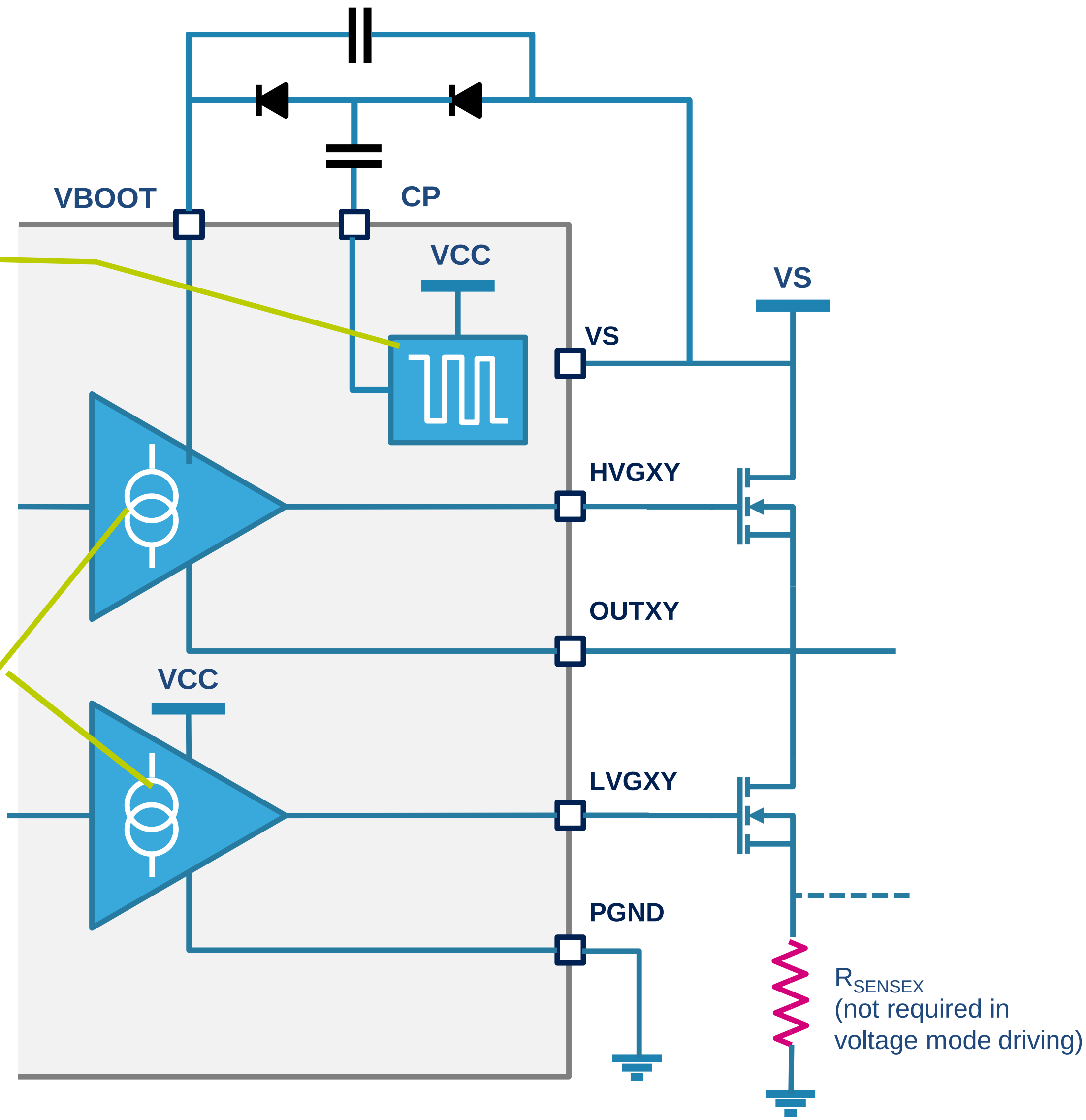
The following parameters can be set:

- Gate sink/source current
- Controlled current time (charging time)
- Turn-off current boost time
- Dead time
- Blanking time

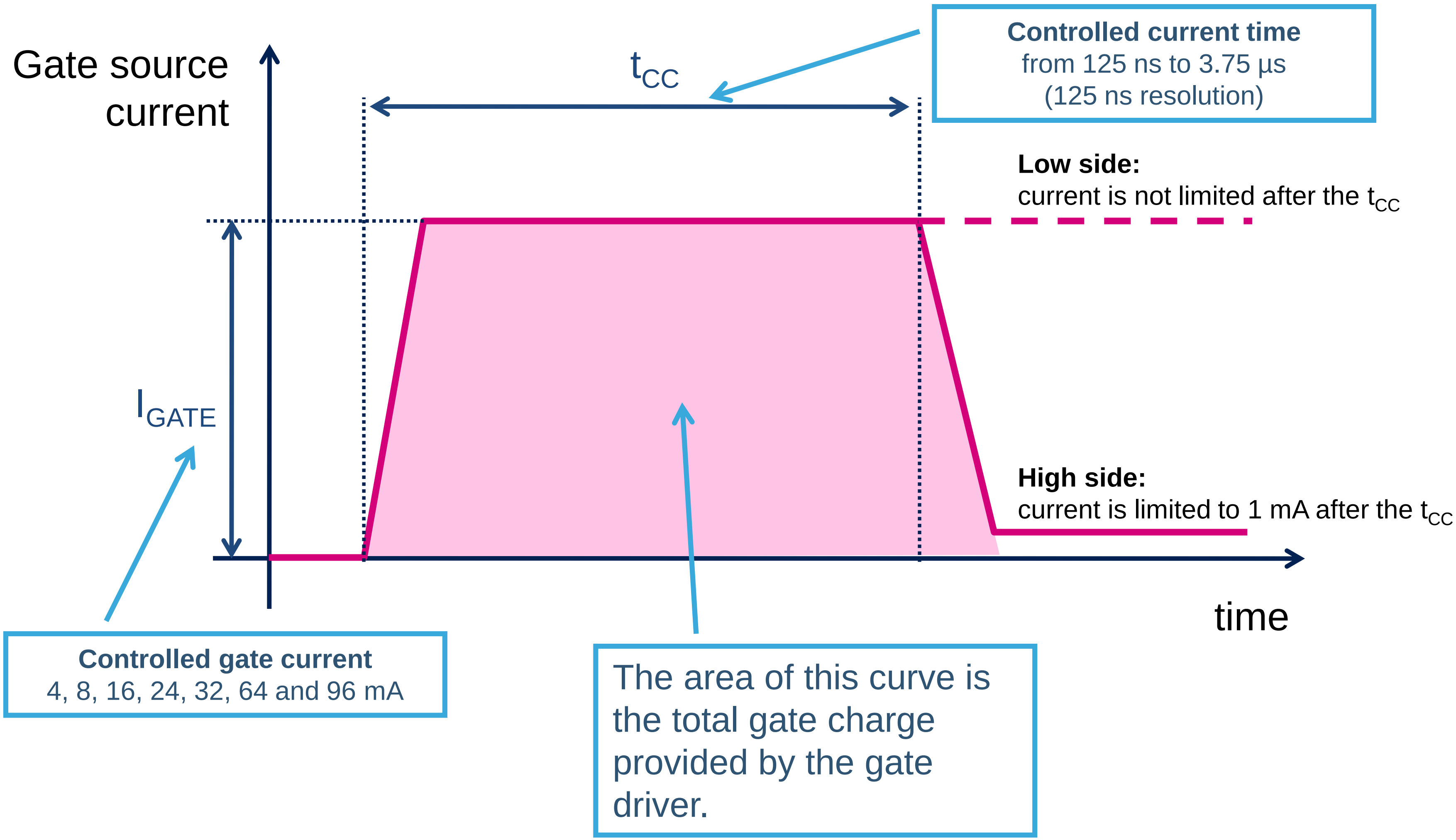
Gate driving circuitry schematic

The high-side gate driver is supplied by a charge pump circuitry. **The on time of the high-side MOSFET is not limited.**

The sink\source currents of both the gate drivers is limited to a configurable value. **No need for external gate resistors.**



Gate turn-ON

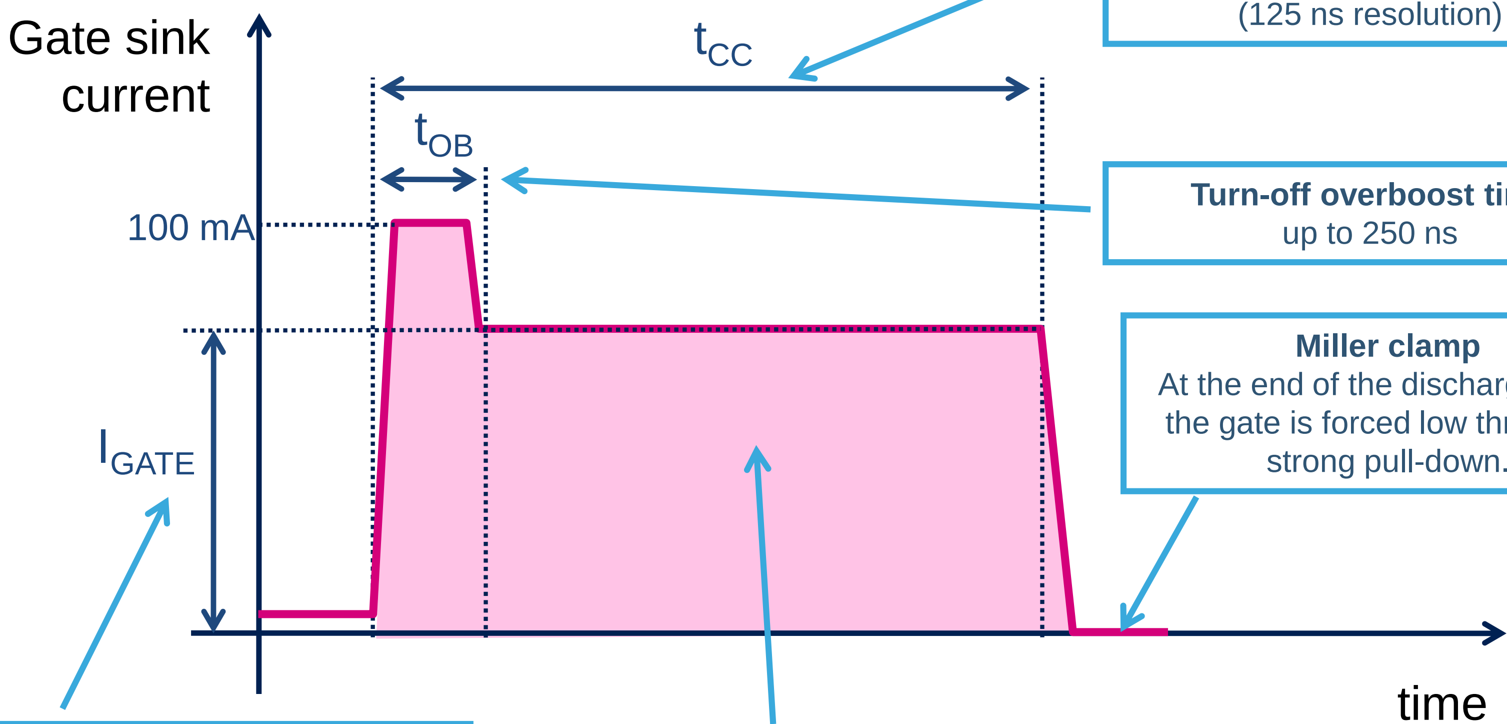

Controlled current time
from 125 ns to 3.75 µs
(125 ns resolution)
Gate source current
t_{CC}
Low side:
current is not limited after the t_{CC}
I_{GATE}
High side:
current is limited to 1 mA after the t_{CC}
time
Controlled gate current
4, 8, 16, 24, 32, 64 and 96 mA
The area of this curve is the total gate charge provided by the gate driver.

Gate turn-OFF

Controlled current time
from 125 ns to 3.75 µs
(125 ns resolution)

Turn-off overboost time
up to 250 ns

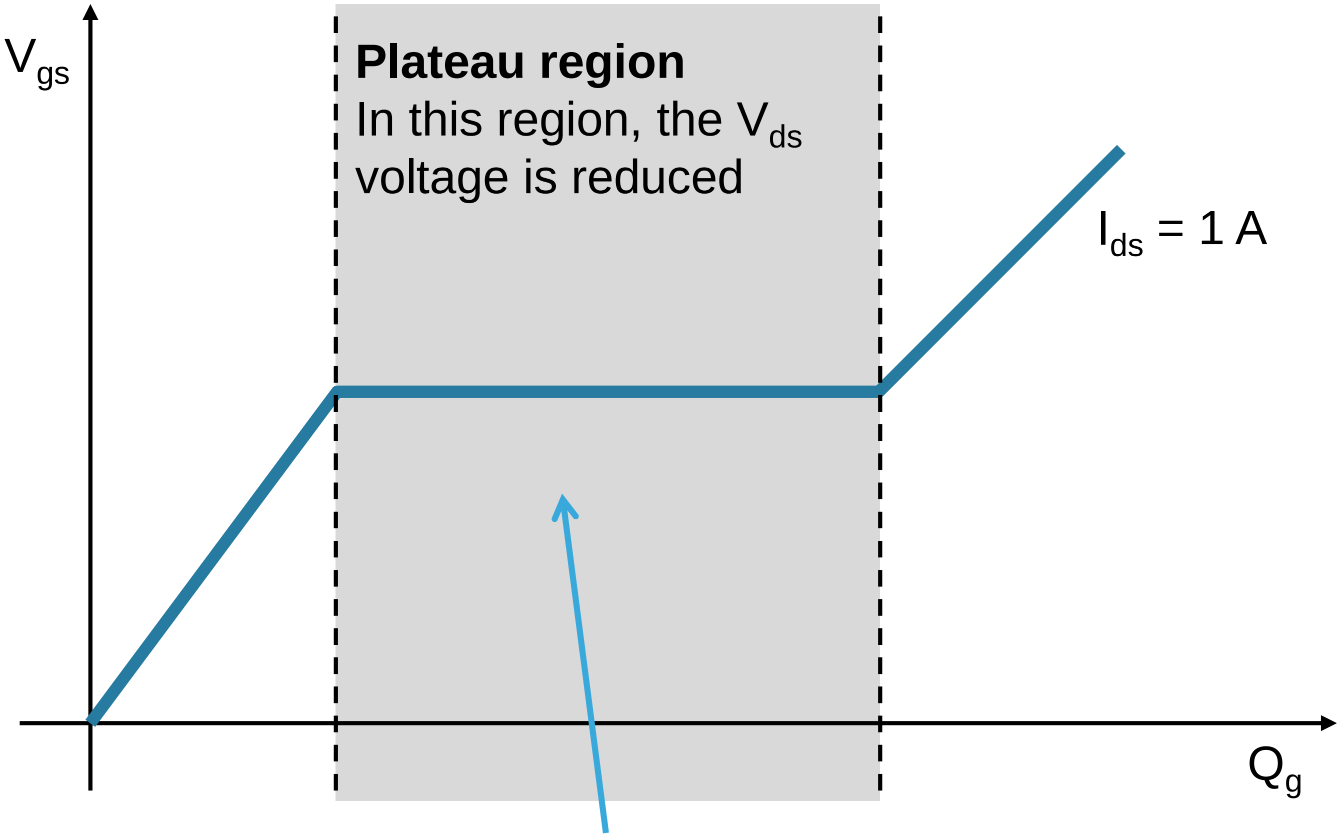
Miller clamp
At the end of the discharge time, the gate is forced low through a strong pull-down.



Controlled gate current
4, 8, 16, 24, 32, 64 and 96 mA

The area of this curve is the total gate charge sunk by the gate driver.

Why a controlled current



By charging the gate with a controlled current in this region, the slew rate of the power stage will be constant.

Gate drivers setup

The gate drivers should be set in order to obtain a gate charge greater than the **total gate charge required by the target MOSFET** when it is turned-on at V_{CC} ($V_{gs} = V_{CC}$).

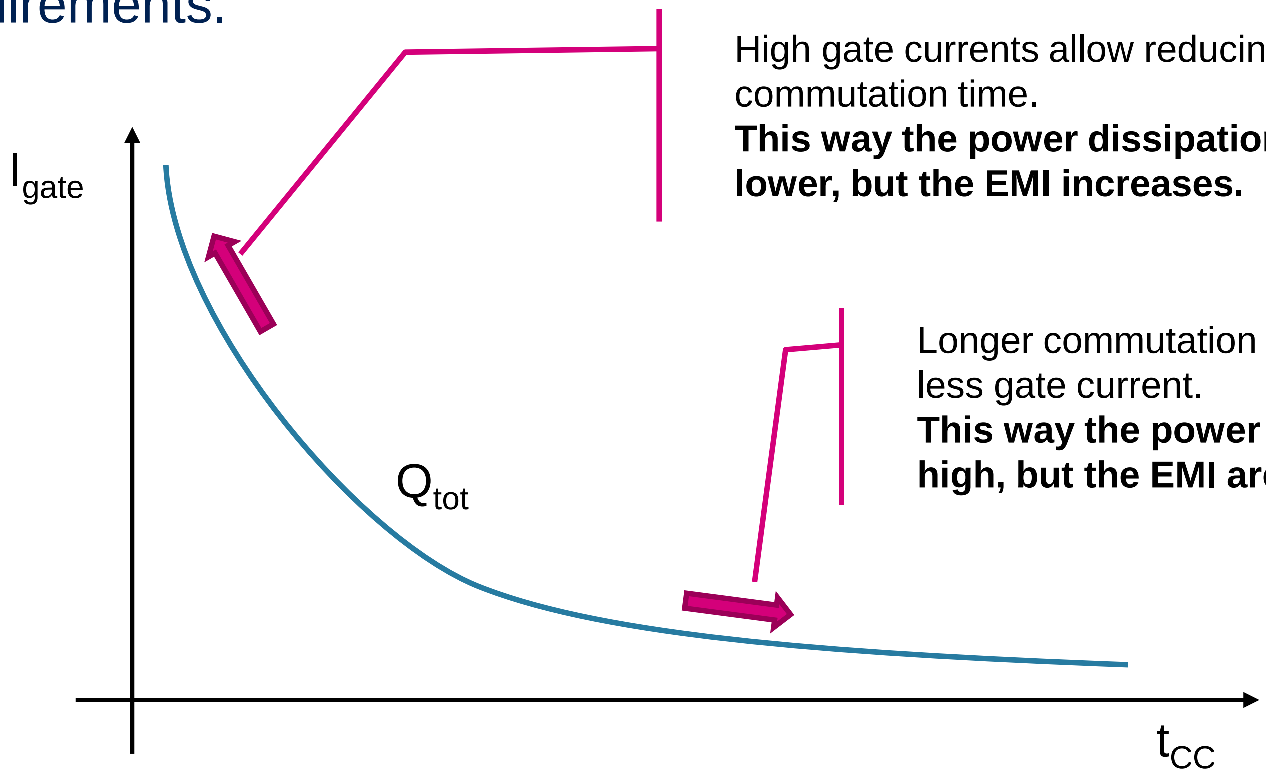
$$\mathbf{I_{gate}} \times \mathbf{t_{cc}} > Q_{tot}$$

The **total gate charge (Q_{tot})** is a parameter which can be found in the datasheet of the MOSFET.

Gate drivers setup

The same gate charge value can be obtained using different combinations of t_{CC} and I_{gate}.

The proper pair of parameters depends on the application requirements.



High gate currents allow reducing the commutation time.
This way the power dissipation is lower, but the EMI increases.

Longer commutation times require less gate current.
This way the power dissipation is high, but the EMI are lower.

Gate drivers setup

The dead time is a safe-guard time during which both MOSFETs of the half bridge are kept OFF.

Increasing this value avoids cross-conduction which is a potentially destructive event, but could increase the power dissipation of the power stage (the current flows into the MOSFET body diodes).

Its duration must be adjusted according to the t_{CC} and I_{gate} values: **faster commutations usually allow lower dead time values**.

Gate drivers setup

The blanking time is a period, after the commutation of the bridge, during which the sensing circuitry is disabled.

Increasing this value avoids spurious overcurrent or stall detections (L6480) such as errors of the current control algorithm (L6482).

Its duration must be adjusted according to the t_{CC} and I_{gate} values: **faster commutations usually need higher blanking time values**.

Incorrect setups

When the gate current and the controlled current time are not properly set, the following failures could occur:

The gate charge is too low:

- **The MOSFETs are not turned-on** as result an overcurrent event is detected and the power stage is immediately disabled.
- **The MOSFETs are turned-on with a lower VCC** as result the $R_{ds(ON)}$ value is higher and the power dissipation increases. An overcurrent event could also be detected.

The gate charge is too high:

- **The commutation time is excessively long** and the control algorithm is limited (both voltage mode and current mode).

Further information and full design support can be found at www.st.com/stspin