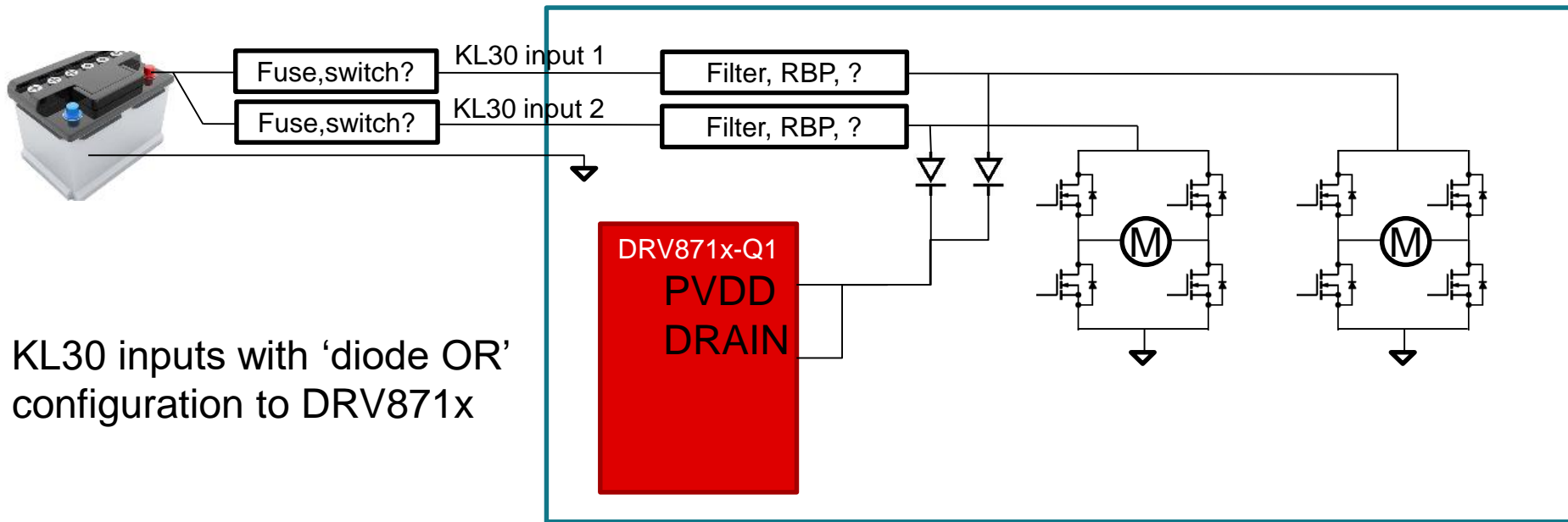# DRV871x-Q1

Operation with multiple supplies

TEXAS INSTRUMENTS

Background

- DRV871x-Q1 PVDD pin supplies power to the charge pump and gate drives

- DRV871x-Q1 DRAIN pin monitors the high-side drain connection of half-bridges

- When all half-bridges share a common high-side supply, both PVDD and DRAIN are typically connected to that point.

- Several designers have asked whether DRV871x-Q1 can operate with <u>separate</u> high-side connections for the different half-bridges.

- In this case, PVDD and DRAIN may be connected to a different point in the circuit, not directly to the high-side supplies of the different half-bridges.

TEXAS INSTRUMENTS

Example multiple KL30 inputs to ECU

KL30 inputs with 'diode OR' configuration to DRV871x

KL30 input 1

KL30 input 2

Fuse,switch?

Fuse,switch?

Filter, RBP, ?

Filter, RBP, ?

DRV871x-Q1
PVDD
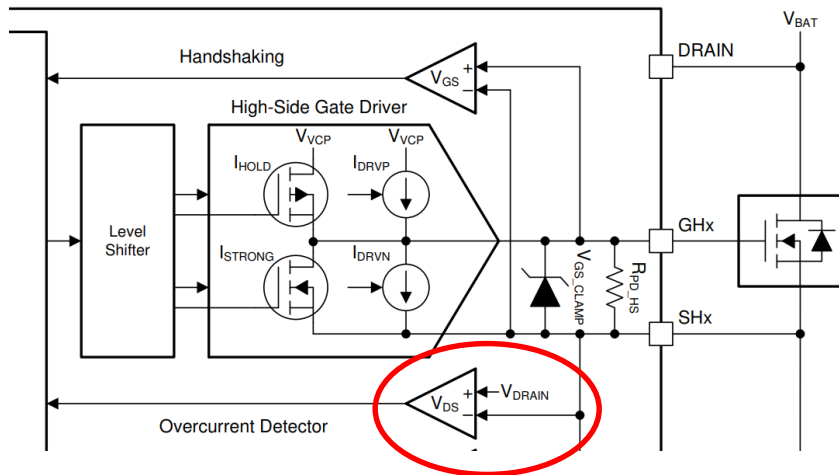DRAIN

TEXAS INSTRUMENTS

Brief summary

The DRV871x-Q1 is capable of operating with multiple power rail supplies, but some technical details need to be examined.

1. Diagnostic comparator offsets introduced by possible voltage difference between DRAIN sense connection and high-side supplies
   a) V_{DS} thresholds – applies to VDS overcurrent sensing
   b) V_{SH} thresholds – only if advanced gate drive options used
2. System conditions where one of the KL30 supplies are 0V (fuse or switch open) and other supplies are still connected to VBATT
   a. Charge pump reference
   b. High-side VGS clamp circuit

2a and 2b are not a concern as reverse battery protection blocks low impedance path from KL30 to GND

TEXAS INSTRUMENTS

HS VDS Monitoring

- The DRV871x-Q1 implements high-side MOSFET overcurrent detection through a differential voltage sense of the MOSFET drain and source terminals.

- The sense connections are made through the DRAIN (common) and SHx (1-8) pins of the DRV871x-Q1.

- In typical system configurations with a common KL30 supply, the common DRAIN sense presents no issues, but in a system with multiple KL30 supplies shared with a single DRV871x-Q1 care needs to be taken in the VDS monitoring setup.
  - A common connection will need to be made to the DRAIN pin of the DRV871x-Q1 OR the VDS overcurrent sense will need to be disabled.
  - Depending how the common connection is made, a voltage drop may be introduced into the VDS sense voltage and the VDS voltage threshold will need to be adjusted in order to compensate for this.
  - The common connection to DRAIN may introduce unintended leakage paths between the different KL30 supplies and cares should be taken on the design and review of this common connection.

TEXAS INSTRUMENTS

SHx Comparators for Advanced Gate Drive

- The DRV871x-Q1 implements a SHx threshold comparator for the Advanced Gate Driver functions (PDR, DCC, STC). This comparator is referenced to the common DRAIN. In a system configuration with multiple KL30 supplies and external circuitry creating a common DRAIN connection, the offset voltage from external circuitry may impact the accuracy of this threshold comparator.

- In the multiple supply system configuration the advanced gate driver functions are recommended to be disabled to prevent any issue.

- If Advanced Gate Drive is desired, the 2V threshold can be set in order to mitigate the impact from the offset voltage.

TEXAS INSTRUMENTS
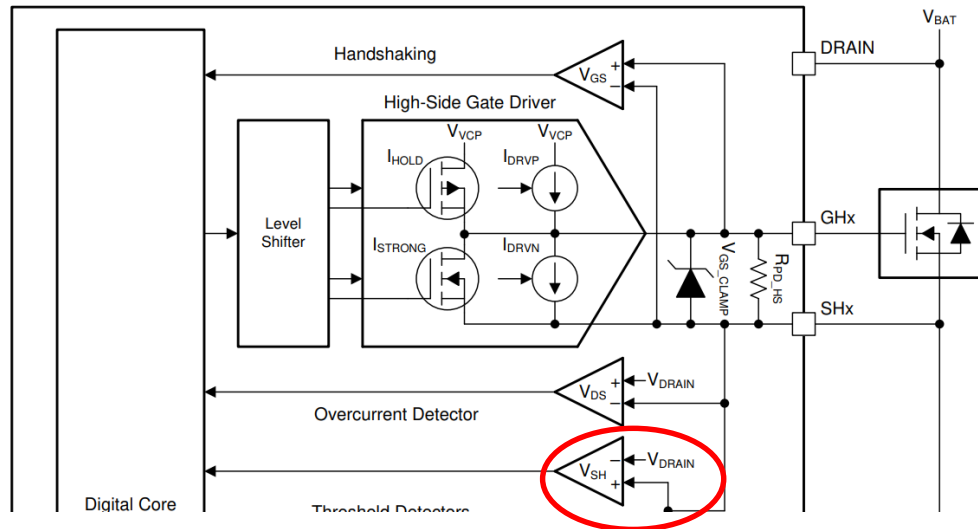
Charge Pump Supply Reference

- The DRV871x-Q1 utilizes an integrated tripler charge pump to generate the supply voltage for the high-side gate drivers.

- The charge pump outputs is regulated to ~PVDD+10V.

- In a system with multiple KL30 supplies it needs to be ensured that the differential voltage between the KL30 supplies and PVDD does not separate by more than what is tolerable by the external MOSFETs. For example, many MOSFETs may operate sufficiently with a VGS voltage between 8-10V, but below 8V performance may degrade depending on the specific MOSFET.

- In the scenario, that the KL30 supply moves outside of the recommended range, the high-side gate-drivers attached to that KL30 supply should be disabled.

TEXAS INSTRUMENTS
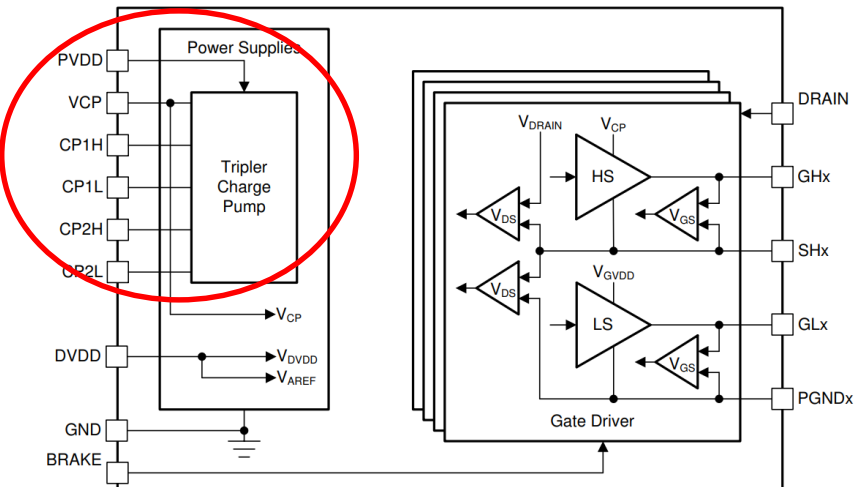
HS VGS Clamp

- The DRV871x-Q1 implements a high-side VGS clamping diode to prevent excessive voltage on the external MOSFET gate. Typically in a normal system configuration with a single KL30 supply it is assumed that PVDD/VCP (the power supplies of the high-side gate driver) will track to VBAT with only transient excursions due to potential short circuit events on the power MOSFETs.

- In the typical case, for example in an output short to ground on that half-bridge, the clamping diode protects the external high-side MOSFET gate until the protection circuits activate and the driver disables (usually done in <10us).

- But in a system with multiple KL30 supplies there is a potential scenario where PVDD is still powered, while one of the KL30 supplies is disconnected or shorted to GND. In this case, a high DC current can be present through the driver while the high-side gate driver is enabled VBAT is low impedance to 0V/GND.

- This scenario should be avoided by disabling the driver attached to the disabled KL30 supply to prevent overheating of the DRV871x-Q1 and overloading of the DRV871x-Q1 charge pump due to this condition.

TEXAS INSTRUMENTS