Design Guide: TIPA-050072

AM263Px Power-Supply Design Using the TPS653860-Q1 for Safety-Relevant Applications

Description

This power design can be used as a guide for integrating the TPS65386x-Q1 Power Management IC (PMIC) into safety-relevant automotive systems powering the functional safety (FuSa) AM263Px Sitara™ processor.

Resources

TIPA-050072	Design Folder
TPS653860-Q1	Product Folder
AM263P4	Product Folder
TPS62903-Q1	Product Folder

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Features

- Outlines the power tree design needed to support the AM263Px MCU
- Provides integrated 3.3V and 5V linear regulators
- Includes buck-boost preregulator stage for external buck converter to power VCORE
- Provides support for controlling external peripherals through GPIO pins, such as the enable pin of the TPS62903-Q1 buck converter
- Provides support for watchdog and error signal monitoring (ESM) to help achieve safety requirements
- Optional integrated linear regulators for powering peripherals such as sensors and interfaces
- Optional diagnostics pin for internal signal monitoring and redundancy

Applications

- Traction inverter
- Integrated high voltage (OBC and DC/DC)
- Electric power steering (EPS)
- Zone control module
- High-voltage battery system

1 System Description

The TPS65386x-Q1 device integrates multiple supply rails to power the microcontroller (MCU), Controller Area Network (CAN), Ethernet, and FlexRay® transceivers, external sensors, and other peripheral devices. A buck-boost converter with internal field-effect transistors (FET) converts the input battery voltage to a pre-regulated output that supplies the other regulators and system loads.

TPS65386x-Q1 supports wake-up from two external sources through the WAKEx pins. These pins are compatible with supply referenced and digital signal levels and integrated low-power timer-based wakeup.

The device has four integrated linear regulators (LDO) with configurable output voltage and bypass mode. This device also has two linear regulators protected against shorts to chassis-ground (–2V) and supply (+36V) protected low dropout regulators (PLDO). These regulators are configurable for fixed mode output (configurable voltages) and tracking mode output voltage. Unused LDOs and PLDOs can be used as a voltage monitor. The LDOs and PLDOs are pre-configured by the respective device part number (NVM).

A voltage monitoring unit inside the device monitors undervoltage and overvoltage on all internal supply rails, regulator outputs, and supply input (battery). Regulator current limits and temperature protections are also implemented.

The TPS65386x-Q1 device features a question-answer watchdog, MCU error-signal monitor, and clock monitoring on an internal oscillator. The device includes self-check on clock monitor, cyclic redundancy check (CRC) on non-volatile memory, and serial peripheral interface (SPI) communication. A diagnostic output pin allows the MCU to observe device internal analog and digital signals. A reset circuit for the MCU and an enable output disable external power-stages on any detected system-failure. A built-in self-test (BIST) allows for monitoring the device functionality at start-up.

2 System Overview

Figure 2-1 shows the TPS65386x-Q1 powering the AM263P processor on a system with 12V input supply from a battery. The 12V coming from the pre-regulator connects to the power input of the buck-boost converter (VBATP). The buck-boost converter supplies an external buck converter (VESPA) at 4.3V, 5V, and 6V. This power approach requires an external, high-efficiency, low I_Q buck converter to supply the VCORE.

LDO1, with the configurable clamping load switch option, supplies VDDA33 and VDDS33 (3.3V at 600mA). LDO2, with a configurable clamping load switch option, can supply transceivers and peripherals. LDO3, with configurable clamping load switch option and 1% accuracy, serves external sensors and peripherals. LDO4, with configurable clamping load switch option and 1% accuracy for ADC reference, supplies VAREF / VDDM (3.3V at 200mA).

MCU error signal monitor and watchdog outputs supply the Safety Management Unit (SMU) and the Error Output pin. Watchdog and SPI outputs connect to the SPI pin. Diagnostics output GPO connects to ADC pins. Reset output connects to the RESET pin.

The device provides two wake-up timer pins (WAKE1 and WAKE2) for external use. The device includes two external voltage monitors (MON1 and MON2) for voltage monitoring of external system components. The device offers two safing outputs (Safing1 and Safing2) for external use in system.

2.1 Block Diagram

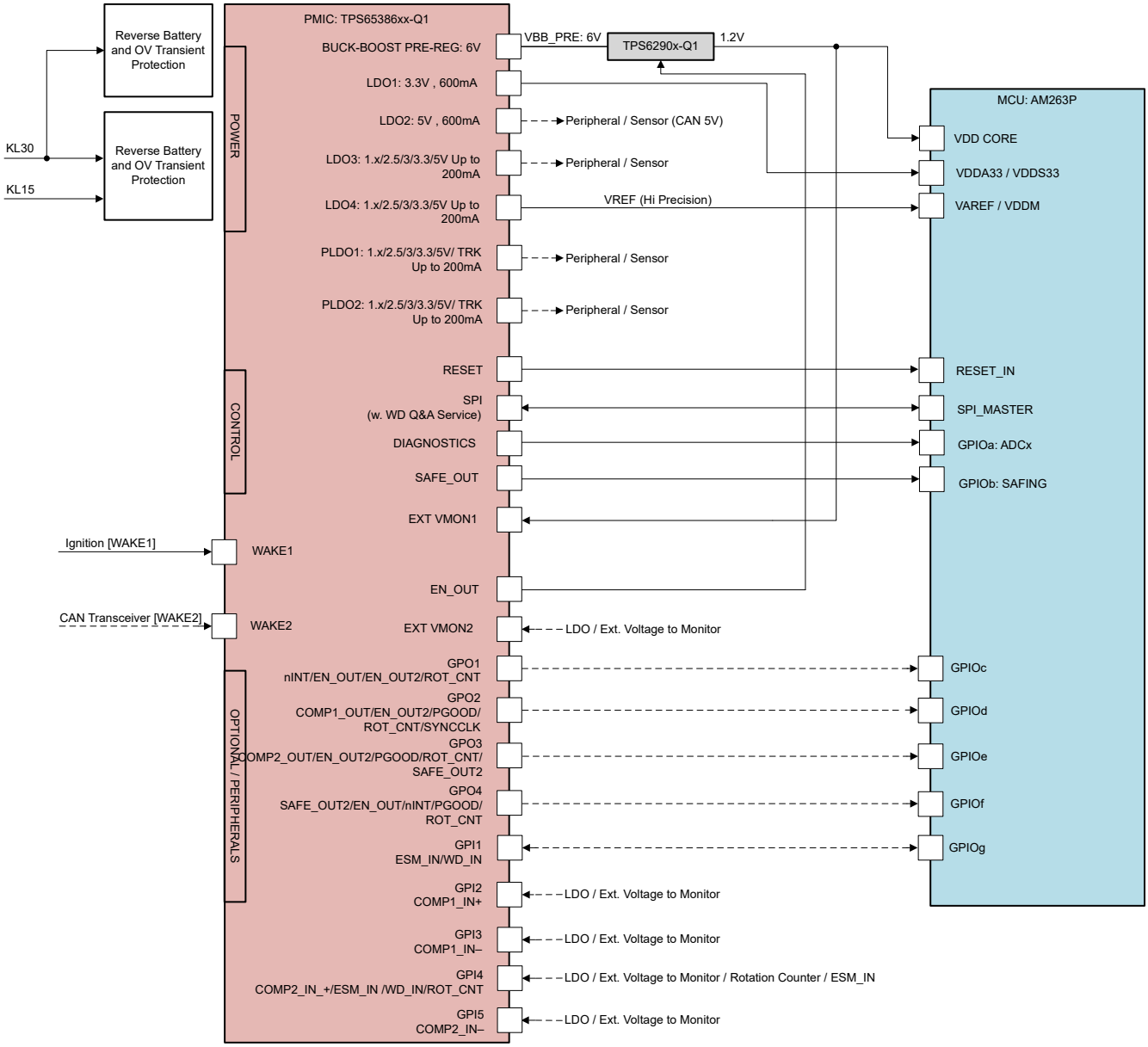

Figure 2-1. TIPA-050072 Power Attach

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