Product Overview

Robust Tracking LDOs for Powering Off Board Sensors

Modern cars are equipped with sensors throughout the body of a vehicle. Sensors offer a variety of purposes such as measuring temperature, determining rotor position in motors, and detecting pressure.

Depending on the parameter being sensed, the sensor location can be in remote areas, away from the control module. Such ‘off-board’ sensors are often powered via wire harness and find applications in sectors like powertrain, body/zonal control modules, traction inverters and passive safety.

The harsh nature of the automotive environment places the wire harness at a high risk of exposure to various fault conditions. These fault conditions could result in short-to-ground or short-to-battery situations on the power supply line. It is critical therefore for the power supply IC’s to have integrated protection features against such fault conditions, and possibly to be able to also detect them quickly.

Tracking LDOs are ideal for powering ratio metric sensors and off board loads, because they come with a range of integrated protection features and a tight tracking tolerance of ±5-6mV. This tight tolerance ensures that the error between the ADC full scale reference and the sensor supply is minimal for achieving high-quality data acquisition.

TI Tracking LDOs have integrated protection features against fault conditions such as short-to-battery, short-to-ground, reverse polarity, reverse current and over temperature which reduce the risk of system failures and alleviate system complexity. For example, the integrated reverse current protection feature eliminates the use of an external diode, thus reducing the number of components in the design. This is depicted in Figure 1.

The tracking LDO can also act as a protective buffer while providing power supply as shown in Figure 2.

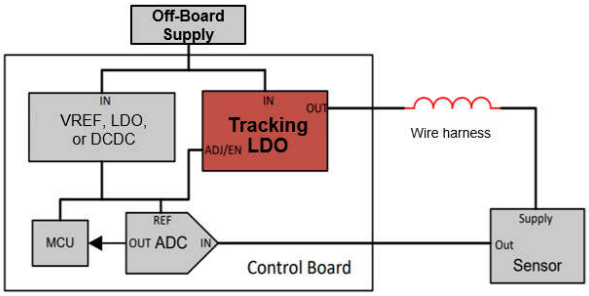

Figure 1. Conventional Tracking LDO implementation

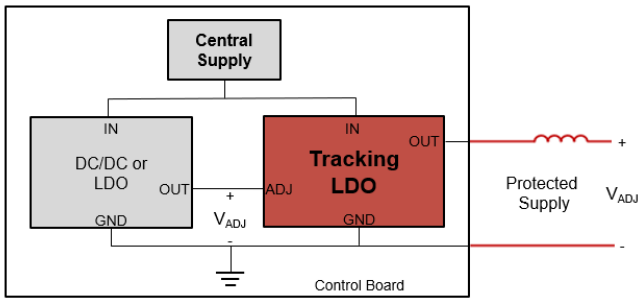

Figure 2. Tracking LDO as a Protected Supply

TI offers a wide range of products in this family. Table 1 depicts the latest Tracking LDOs.

Table 1. Tracking LDOs

Type	Output current (70mA)	Output current (150mA)	Output current (300mA)
Enable/Adj only	TPS7B4255-Q1		
Enable/Adj and Feedback	TPS7B4256-Q1	TPS7B4258-Q1	TPS7B4260-Q1
Independent Enable and Power Good		TPS7B4259-Q1	TPS7B4261-Q1

Enable/Adj only

TPS7B4255-Q1 operates in a unity gain configuration. The reference voltage applied at the ADJ/EN pin is effectively tracked at the OUT pin with a tight tolerance of ±5mV for loads up to 70mA (V_{OUT} = V_{REF}).

The configuration is shown in Figure 3.

Connecting an external resistor divider at the ADJ/EN pin, as shown in Figure 4, generates an output voltage that is lower than the reference voltage as per Equation 1.

$$V_{OUT} = V_{REF} \times \left(\frac{R_2}{R_1 + R_2}\right) \quad (1)$$

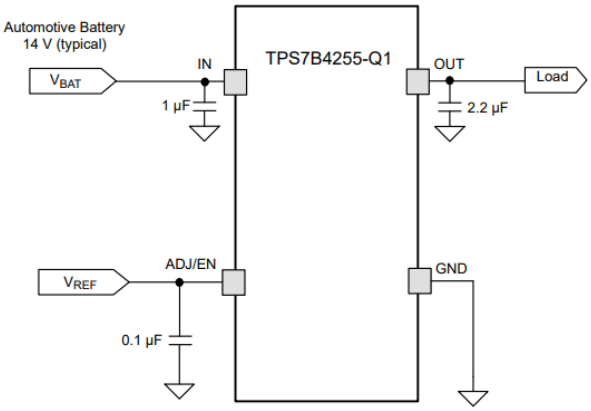

Figure 3. V_{OUT} = V_{REF}

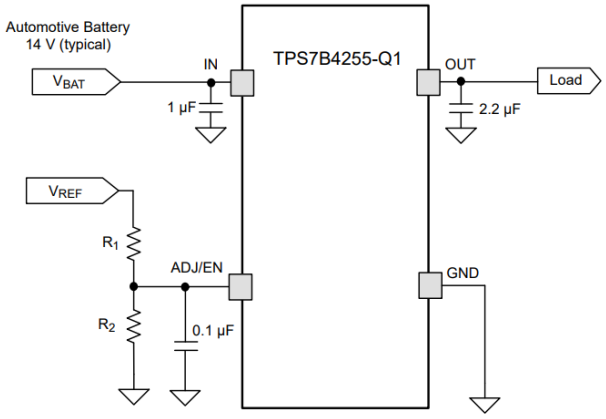

Figure 4. V_{OUT} < V_{REF}

Enable/Adj and Feedback

Tracking LDOs featuring a feedback pin generate an output voltage larger than the reference voltage at ADJ/EN pin. This can be achieved by simply connecting a resistor divider at the FB pin and V_{OUT} is calculated by Equation 2. This implementation is illustrated in Figure 5 taking an example of TPS7B4258-Q1.

$$V_{OUT} = V_{REF} \times \left(1 + \frac{R_1}{R_2}\right) \quad (2)$$

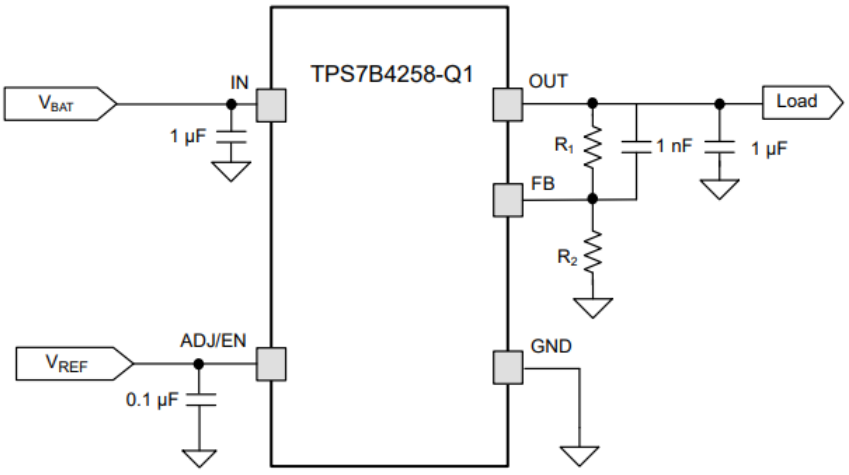

Figure 5. V_{OUT} > V_{REF}

Independent Enable and Power Good

TPS7B4259-Q1 and TPS7B4261-Q1 offer an independent enable and power good feature. Having a PG pin helps to detect both undervoltage and overvoltage fault conditions at the tracking LDO output.

Typically, at the end of the device start up or because of variations in line/load, the output voltage could overshoot or undershoot from the nominal value and the PG pin helps inform when the output voltage has stabilized to its nominal value. A logic high on the PG pin signifies that the tracking LDO output is within the accepted range. Therefore, apart from fault detection, the PG signal can also help in signal sequencing, by informing the MCU when the power supply to the sensor is stabilized, so the sampling of the sensor output may begin. An implementation of using the PG functionality for output voltage monitoring is shown in Figure 6.

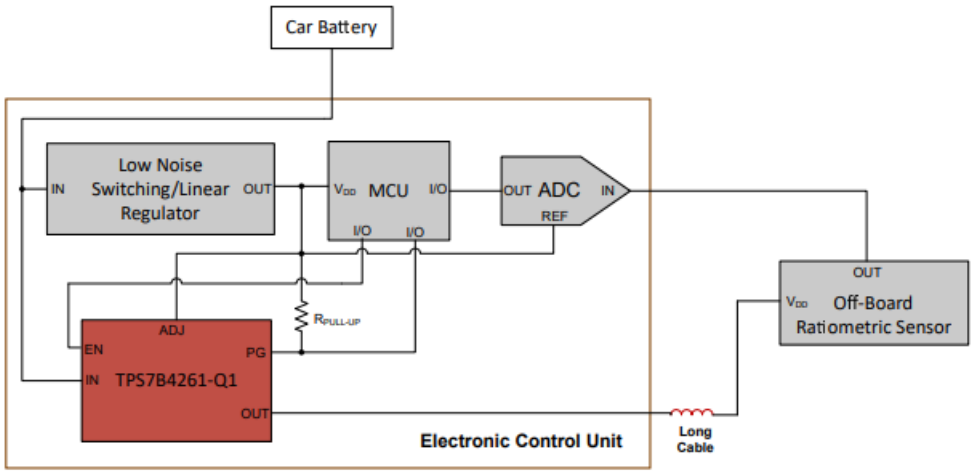

Figure 6. PG Pin to Assess Tracking Output Stability

Table 2 lists the part numbers for the latest TI tracking LDOs. TI offers these devices in different output current ratings – 70mA, 150mA, 300mA and various packages. The higher current Tracking LDOs are often used to power up multiple off board sensors having a common sensor voltage. The different packages allow for greater flexibility in the device selection for thermally sensitive applications.

Table 2. TI Tracking LDO Part Numbers

Generic Part Number	Orderable Part Number	Package Type	Thermal Resistance (°C/W)	Output Current (mA)	Features
TPS7B4255-Q1	TPS7B4255QDBVRQ1	SOT-23	176.3	70	Adj/EN only
	TPS7B4255QDYBRQ1	SOT-23	127.8		
TPS7B4256-Q1	TPS7B4256QDDARQ1	HSOIC	53.3	70	FB pin to achieve $V_{OUT} > V_{REF}$
	TPS7B4256QDRQ1	SOIC	101		
TPS7B4258-Q1	TPS7B4258QDDARQ1	HSOIC	48	150	FB pin to achieve $V_{OUT} > V_{REF}$
TPS7B4259-Q1	TPS7B4259QDDARQ1	HSOIC	48	150	Power Good and Independent Enable
TPS7B4260-Q1	TPS7B4260QDDARQ1	HSOIC	48	300	FB pin to achieve $V_{OUT} > V_{REF}$
TPS7B4261-Q1	TPS7B4261QDDARQ1	HSOIC	48	300	Power Good and Independent Enable

Learn more

- Watch the *Application of tracking LDOs and implementation in systems*
- *Automotive off-board sensor power considerations*
- *Fundamentals of designing with LDOs in automotive battery direct connect applications*
- *Various Applications of Voltage Tracking LDOs*

Evaluate the Design:

- TPS7B4255-Q1: *TPS7B4255EVM-062*
- TPS7B4256/58/60-Q1: *TRKRLDOEVM-119*
- TPS7B4259/61-Q1: *TPS7B4261EVM-151*
- Leverage existing *simulation models available in PSpice for TI*

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Mailing Address: Texas Instruments, Post Office Box 655303, Dallas, Texas 75265