Temperature sensing for electric power steering and transmission

Automotive technologies have evolved to increase vehicle performance, efficiency, and to increase driver/passenger convenience. Today, transmissions are advanced control systems that optimize the demands of fuel economy and driver performance. Additionally, electronic power steering (EPS) systems incorporate electric motors that greatly decreases the amount of driver effort to steer a vehicle. Both the transmission and EPS systems rely on electronic control units (ECU) to ensure these safety critical functions are functioning correctly.

The transmission control unit (TCU) uses data from the speed, position, temperature, and pressure transmission sensors to control shifting. The TCU module is often located in engine compartment near heat sources. The TCU board temperature must be monitored to ensure the TCU processor and other critical components do not overheat. The LMT87-Q1 is a low cost analog temperature sensor that interfaces with an ADC channel and will monitor TCU board temperature with an accuracy of ±2.7°C between -50°C to +150°C. The LM71-Q1 has a SPI interface that will directly communicate with the TCU processor, removing the need for an ADC channel and lookup table. Additionally, the LM71-Q1 offers an accuracy of +3/-2°C for -40°C to +150°C.

The EPS system contains an ECU that controls an electric motor that supplements the torque applied at the steering wheel.

The EPS system is located under the hood near the engine, which generates significant heat. The board temperature of the EPS ECU must be closely monitored to prevent a failure that can negatively impact vehicle operation. Similar to the TCU, the LMT87-Q1 is an easy-to-use option that will enable a complete thermal management strategy.

The TI automotive temperature sensor portfolio features both low cost, and high accuracy, temperature sensor products that make it easy to measure temperature. Additionally, TI’s integrated circuit solutions have the following advantages compared to thermistors:

- No device-level calibration required
- Highly linear temperature response
- Fewer external support components required

<table>
<thead>
<tr>
<th>Part number</th>
<th>Interface</th>
<th>Accuracy</th>
<th>Supply range</th>
<th>Package type</th>
<th>Package footprint</th>
</tr>
</thead>
<tbody>
<tr>
<td>LM71-Q1</td>
<td>SPI</td>
<td>+3/-2°C, -50°C to +150°C</td>
<td>2.65 V to 5.5 V</td>
<td>SOT-23</td>
<td>2.92 x 1.30 mm</td>
</tr>
<tr>
<td>LMT87-Q1</td>
<td>Analog</td>
<td>+2.7°C, -50°C to +150°C</td>
<td>2.7 V to 5.5 V</td>
<td>SC70</td>
<td>2.00 x 1.25 mm</td>
</tr>
</tbody>
</table>
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