**SPOC+ – SPI Power Controller**

The Benchmark in Integration and Modularity

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**Introduction**

The complexity and density of electronic modules is constantly increasing as more and more loads and functions keep on being implemented. Car manufacturers, automotive suppliers and also industry players are looking for modular and scalable solutions to be able to adapt to a variety of options and re-use the developed electronics for further projects. At the same time, the modules need to be optimized in terms of size and weight.

The SPOC+ family, scaled by number of channels and added features, addresses these trends by implementing smart high-side drivers together with added intelligence inside one package. Full scalability is provided through the footprint and software compatibility of all SPOC+ devices. Integration helps reducing the complexity of the electronics, allowing board space reduction and decreasing the need for external components. Control, configuration and diagnosis are carried out via a Serial Peripheral Interface (SPI), which saves I/Os on the microcontroller and provides flexibility for the solution. Furthermore, fail safe modes are supported, which enhance safety in operation.

SPOC+ provides decisive advantages on system level and for a wide range of applications.

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**Applications Overview**

- For 12V grounded high-side loads
- Qualified for automotive and industrial applications, such as lighting, heating, motor driving, energy and power distribution
- Capacitive loads such as lamps with high inrush current, together with specific mode for LEDs and adapted diagnosis
- Resistive loads, such as heating streamer
- Inductive loads, such as motors and solenoids
- Replacement of electromechanical relays and fuses
- Replacement of discrete smart high side chip sets

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**Key Features and Benefits**

**Basic Features**

- 8-bit serial peripheral interface (daisy chain capable SPI) for control and diagnosis
- CMOS compatible parallel input pins for four channels
- Selectable AND-/OR-combination for parallel inputs
- PWM driving possible through direct inputs or via SPI
- Load type configuration via SPI(bulbs or LEDs) for optimized load control
- Very low stand-by current
- Fail safe activation via limp home pin and configuration via input pins only
- Device ground independent from load ground
- AEC Qualified

**Protection Features**

- Current limitation
- Short-circuit protection, robust against repetitive events
- Thermal shutdown with latch and dynamic temperature sensor and limited retries
- Reverse battery protection (with external diode and resistor)
- Undervoltage shutdown
- Loss of ground and loss of battery protection
- Fast inductive energy demagnetization

**Diagnostic Features**

- Multiplexed proportional load current sense signals
- High accuracy of current sense signal at wide load current range
- Current sense ratio (k_{ILIS}) configurable for LEDs or bulbs
- Latching feedback on over temperature via SPI
- Diagnosis using PWM with small duty cycle possible

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**Pin Description**

<table>
<thead>
<tr>
<th>Pin Name</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>VDD</td>
<td>Logic supply (5V)</td>
</tr>
<tr>
<td>INx</td>
<td>Input signal of channel x</td>
</tr>
<tr>
<td>EDO</td>
<td>External driver output</td>
</tr>
<tr>
<td>EDD</td>
<td>External driver diagnosis enable</td>
</tr>
<tr>
<td>IS</td>
<td>Multiplexed current sense output</td>
</tr>
<tr>
<td>CS, SCLK, SO, SI</td>
<td>SPI signals</td>
</tr>
<tr>
<td>LHI</td>
<td>Limp home mode activation</td>
</tr>
<tr>
<td>GND</td>
<td>Ground connection</td>
</tr>
<tr>
<td>OUTx</td>
<td>Power output of channel x</td>
</tr>
<tr>
<td>VS</td>
<td>Power supply (12V)</td>
</tr>
</tbody>
</table>

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**System Partitioning**

Example: Automotive Lighting System

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**System Level Benefits**

8-channels System Example: need for GPIOs

- Assembly and logistics
- Reduced bill of material
- Less pick and place costs
- Less testing

**System Level Benefits**

Valuable advantages for the whole system

- PCB
  - Simplified layout
  - Less PCB area
  - Less external components
- Microcontroller
  - Less I/O and AD channels need
  - PWM optimized solution
  - PWM operation over SPI
- Diagnosis via SPI
  - Feedback on overload and overtemperature
  - Sense current feedback multiplexing

**Product Portfolio Overview**

4-channels Devices

<table>
<thead>
<tr>
<th>Product Name</th>
<th>65W</th>
<th>27W</th>
<th>10W</th>
<th>Ext. Driver</th>
</tr>
</thead>
<tbody>
<tr>
<td>BTS54220-LBA</td>
<td>3 x 95mΩ</td>
<td>2 x 27mΩ</td>
<td>0</td>
<td>no</td>
</tr>
<tr>
<td>BTS54220-LBE</td>
<td>2 x 95mΩ</td>
<td>2 x 27mΩ</td>
<td>0</td>
<td>yes</td>
</tr>
<tr>
<td>BTS54400-LBA</td>
<td>0</td>
<td>4 x 39mΩ</td>
<td>0</td>
<td>no</td>
</tr>
<tr>
<td>BTS54400-LBE</td>
<td>0</td>
<td>4 x 39mΩ</td>
<td>0</td>
<td>yes</td>
</tr>
</tbody>
</table>

5 and 6-channels Devices

<table>
<thead>
<tr>
<th>Product Name</th>
<th>65W</th>
<th>27W</th>
<th>10W</th>
<th>Ext. Driver</th>
</tr>
</thead>
<tbody>
<tr>
<td>BTS56032-LBA</td>
<td>3 x 39mΩ</td>
<td>2 x 110mΩ</td>
<td>0</td>
<td>no</td>
</tr>
<tr>
<td>BTS56033-LBA</td>
<td>0</td>
<td>3 x 39mΩ</td>
<td>2 x 110mΩ</td>
<td>no</td>
</tr>
</tbody>
</table>

**Channel Main Parameters**

- $R_s$ (max.): 9mΩ, 27mΩ, 19mΩ, 110mΩ
- $R_s$ (typical): 650Ω, 2000Ω, 2000Ω, 100Ω
- LED Mode Available: no, yes, yes, no
- LED Mode Factor: 3.5, 3.5, -

**Package Information**

TSON-24: Leadless package with smallest form factor

**Product Naming System**

- A: Basic (no ext. drive)
- E: with External Drive
- Variant
- A: Basic (no ext. drive)
- E: with External Drive
- Package Denomination
- A: 65W Ch. #
- B: 27W Ch. #
- C: 10W Ch. #

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