Optimized Power Application Controllers® (PAC™) for Power and Garden Tools

Single system-on-chip performs multiple motor control and drive functions
Maximize Efficiency and Minimize Weight in Low-to High-Voltage Tools

Garden and power tools are a mainstay in nearly every home, and consumers are increasingly demanding that these items deliver more and longer-lasting power in ever smaller, lighter footprints.

Qorvo® is meeting those challenges with the industry’s most efficient family of Power Application Controller (PAC) products for brushless DC (BLDC) motor control and drive. This system-on-chip (SoC) platform integrates a programmable MCU, power management, gate drive and signal conditioning in a single, small QFN package.

Combining these features has created the most integrated and compact solution available to designers of BLDC motors. It is the only device on the market for 160 V integrated MCU, gate drivers and power supply, making it ideal for low-voltage power tools and high-voltage garden tools with complex control, monitoring and diagnostic requirements. The Qorvo PAC portfolio also has the lowest standby current available, which means consumers can immediately use their tools even after months of storage.

Qorvo’s SoC approach enables smaller tools, reduces bill of material and lowers design costs.

The PAC5xxx Family

The PAC5xxx portfolio offers the most flexible microcontroller-based motor controllers and drivers on the market, suitable for power tools, garden tools, home appliances, industrial automation, drones and remote-control vehicles and other applications.

As part of Qorvo’s complete range of battery- and AC-powered motor control and drive solutions, the PAC5xxx platform also enables IoT connected devices when coupled with Qorvo’s low-power, wireless Bluetooth® Low Energy solutions.

Key features include:

- High integration that enables small size, low cost and high-performance drive
- Integrated 50 MHz Arm® Cortex®-M0 or 150 MHz Arm® Cortex®-M4F MCUs
- Integrated, configurable power management up to 160 V supply input; support for buck and charge pump topologies
- Integrated high-side and low-side gate drivers, with up to 2A gate drive capability
- Ultra-low standby power consumption of 8 µA in hibernation mode
- Flexible and configurable power and temperature monitoring to build a more reliable motor drive control system
- Integrated 3 differential and 4 single-ended programmable-gain amplifiers (PGAs) for voltage and current sensing
- Dedicated phase comparators for sensor-less BLDC zero-crossing detection, to simplify external circuit and algorithm design

This system block diagram illustrates the very high degree of integration in the Qorvo PAC5532, which supports low- and mid-voltage applications.
A Range of Solutions for a Variety of Home Tool/Appliance Applications

The table below details the specifications of the Qorvo low- and mid-voltage PAC portfolio of ICs:

### Battery Powered BLDC: Tools, DC Fans, RC, ESC

12 V-48 V battery-powered applications

<table>
<thead>
<tr>
<th>Part Number</th>
<th>Package (mm)</th>
<th>MCU</th>
<th>IO</th>
<th>Power Management</th>
<th>Gate Drivers</th>
<th>Signal Conditioning</th>
<th>Applications</th>
</tr>
</thead>
<tbody>
<tr>
<td>PAC5222</td>
<td>6x6 48L</td>
<td>50 MHz Arm® Cortex®-M0 32 kB FLASH, 8 kB SRAM 10b 1 MSPS ADC UART/SPI, I2C</td>
<td>3 @ 3.3 V 13 @ 3.3 V 5 V 10 @ 5 V</td>
<td>44 V Buck/SEPIC DC/DC Core, IO, Analog LDOs</td>
<td>3 HS: 56 V/1.5A 3 LS: 20 V/1.5A</td>
<td>3 Diff PGA 4 Single PGA</td>
<td>12 V-18 V Power Tools</td>
</tr>
<tr>
<td>PAC5223</td>
<td>6x6 48L</td>
<td>50 MHz Arm® Cortex®-M0 32 kB FLASH, 8 kB SRAM 10b 1 MSPS ADC UART/SPI, I2C</td>
<td>2 @ 3.3 V 12 @ 3.3 V 5 V 10 @ 5 V</td>
<td>70 V Buck/SEPIC DC/DC Core, IO, Analog LDOs</td>
<td>3 HS: 70 V/1A 3 LS: 20 V/1A</td>
<td>3 Diff PGA 4 Single PGA</td>
<td>12 V-48 V DC Fans</td>
</tr>
<tr>
<td>PAC5225*</td>
<td>6x6 48L</td>
<td>50 MHz Arm® Cortex®-M0 32 kB FLASH, 8 kB SRAM 10b 1 MSPS ADC UART/SPI, I2C</td>
<td>2 @ 3.3 V 12 @ 3.3 V 5 V 10 @ 5 V</td>
<td>70 V Buck/SEPIC DC/DC Core, IO, Analog LDOs</td>
<td>3 HS: 70 V/1A 3 LS: 20 V/1A</td>
<td>3 Diff PGA 4 Single PGA</td>
<td>12 V-48 V DC Fans</td>
</tr>
<tr>
<td>PAC5523</td>
<td>6x6 48L</td>
<td>150 MHz Arm® Cortex®-M4F 128 kB FLASH, 32 kB SRAM 12b 1 MSPS ADC 2xUART/CAN, 12C, I2C</td>
<td>15 @ 3.3 V 10 @ 5 V</td>
<td>70 V Buck/SEPIC DC/DC Core, IO, Analog LDOs</td>
<td>3 HS: 70 V/1A 3 LS: 20 V/1A</td>
<td>3 Diff PGA 4 Single PGA</td>
<td>High-Performance Power Tools</td>
</tr>
<tr>
<td>PAC5527</td>
<td>6x6 48L</td>
<td>150 MHz Arm® Cortex®-M4F 128 kB FLASH, 32 kB SRAM 12b 1 MSPS ADC 3xUART/CAN, 12C, I2C</td>
<td>16 @ 3.3 V 10 @ 5 V</td>
<td>48 V Buck/SEPIC DC/DC Core, IO, Analog LDOs</td>
<td>3 HS: Programmable 3LS: Programmable</td>
<td>3 Diff PGA 4 Single PGA</td>
<td>10 V-24 V Power Tools</td>
</tr>
</tbody>
</table>

* UL/IEC60730 Class B Safety Optimized

### Garden Tools, EV, Industrial Robotics

40 V-80 V battery-powered applications

<table>
<thead>
<tr>
<th>Part Number</th>
<th>Package (mm)</th>
<th>MCU</th>
<th>IO</th>
<th>Power Management</th>
<th>Gate Drivers</th>
<th>Signal Conditioning</th>
<th>Applications</th>
</tr>
</thead>
<tbody>
<tr>
<td>PAC5232</td>
<td>8x8 51L</td>
<td>50 MHz Arm® Cortex®-M0 32 kB FLASH, 8 kB SRAM 10b 1 MSPS ADC UART/SPI, I2C</td>
<td>2 @ 3.3 V 14 @ 3.3 V 5 V 10 @ 5 V</td>
<td>160 V Buck DC/DC Core, IO, Analog LDOs</td>
<td>3 HS: 180 V/2A 3 LS: 20 V/2A</td>
<td>3 Diff PGA 4 Single PGA</td>
<td>40 V-88 V Garden Tools, EV, Scooters, E-skateboard</td>
</tr>
<tr>
<td>PAC5532</td>
<td>8x8 51L</td>
<td>150 MHz Arm® Cortex®-M4F 128 kB FLASH, 32 kB SRAM 12b 1 MSPS ADC 3xUART/CAN, 12C, I2C</td>
<td>16 @ 3.3 V 10 @ 5 V</td>
<td>160 V Buck DC/DC Core, IO, Analog LDOs</td>
<td>3 HS: 180 V/2A 3 LS: 20 V/2A</td>
<td>3 Diff PGA 4 Single PGA</td>
<td>40 V-88 V Garden Tools, EV, Scooters, E-skateboard</td>
</tr>
</tbody>
</table>

Lower Costs and Faster Time-to-Market

The PAC5xxx family’s efficient and highly configurable system architecture helps designers work faster and lowers the cost of creating AC motor control and drive solutions for a new generation of white goods and other AC-powered equipment.

The Qorvo PAC eco-system also enables faster time-to-market, by more than 50%, by providing customers with hardware, software, evaluation tools, and third-party design partners and production tools. IEC and UL Class B pre-certified firmware speeds system-level certification.
Designed With a Purpose

Qorvo’s innovative power management solutions deliver a highly efficient, flexible platform for high performance, high reliability and high integration in motor control. Our scalable core platforms are used for charging, powering and embedded digital control systems for end applications in the industrial, commercial and consumer equipment markets.

For more information about our integrated motor control and drivers, visit:
www.qorvo.com/products/power-management/intelligent-motor-controllers