Robotics
Motor control BOM (Bill-of-Material) proposals

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System Architect Robotics

2022 Edition
Infineon offers the right BOM solution from price/performance to highest performance motor control needs.

- **Price/Performance**
  - 3A & 25V
  - 10A & 25V & HMI capability
  - 10A & 25V
  - 4A & 25V

- **Good Performance**
  - 8A & 50V
  - 20A & 50V

- **High Performance**
  - 40A & 50V
  - 10A & 100V
  - 20A & 50V
  - 40A & 50V
Proposed BOM DC-Motor drive: PRICE/PERFORMANCE with up to 4A & 25V

<table>
<thead>
<tr>
<th>Product type</th>
<th>Device</th>
<th>Part number</th>
<th>Description</th>
<th>Package mm x mm</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>N+N dual MOSFET</td>
<td>Q1, Q2</td>
<td>IPG20N06S2L-65</td>
<td>55V OptMOS® Power-Transistor 65mΩ with continuous I_D 20A at 25°C, V_GS 10V &amp; typ. Q_g 9.4nC</td>
<td>SSO8 5x6</td>
<td>2</td>
</tr>
<tr>
<td>Gate driver</td>
<td>U2, U3</td>
<td>IRS2005S</td>
<td>200V high side &amp; low side gate driver with 0.29A &amp; 0.6A I_D source &amp; sink, propagation delay 160 &amp; 150ns</td>
<td>SOIC8 4x5</td>
<td>2</td>
</tr>
<tr>
<td>Integrated U2 to U4</td>
<td>6EDL04N02PR</td>
<td></td>
<td>200V 3-Phase gate driver with OCP, Enable, Fault &amp; integrated BSD with 0.165A &amp; 0.375A I_D source &amp; sink, propagation delay 530ns</td>
<td>TSSOP28 9.7x4.4</td>
<td>--</td>
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<tr>
<td>Microcontroller</td>
<td>U1</td>
<td>XMC1302-T038X0032AB</td>
<td>Cortex-M0 32bit 32/64MHz C/P clock 16KB SRAM &amp; 32KB Flash with CCU8 PWM for easy 3-phase inverter implementation &amp; POSIF interface for hall sensors/encoder</td>
<td>TSSOP38 9.7x4.4</td>
<td>1</td>
</tr>
<tr>
<td>Position sensor</td>
<td>Motor assy.</td>
<td>TLI4961-1M</td>
<td>Bipolar Hall latch with 3 – 32V operating supply voltage</td>
<td>SOT23-3</td>
<td>--</td>
</tr>
</tbody>
</table>

**Key features and benefits**
- Low cost solution
- Available firmware of FOC with Hall sensors or sensorless for BLDC and PMSM motors
- MCU direct interface for either Hall sensors or encoder
- Low gate charge MOSFET enabling higher switching frequency
- Dual N-channel MOSFET and integrated 6-channel gate driver with bootstrap diode (BSD) for BLDC motor reducing the required PCB footprint significantly

**Application assumptions**
- DC Motor powered up by Li-ion battery pack of 4S to 6S with typical voltage 14.4 – 21.6V and max. voltage 16.8 – 25.2V
- DC Motor voltage within 12 – 24V
- Average current up to 4A (at 25V)

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Proposed BOM BLDC-Motor drive: GOOD PERFORMANCE with up to 10A & 25V

Key features and benefits
- Cost competitive with high performance solution
- Available firmware of FOC with Hall sensors or sensorless for BLDC and PMSM motors
- MCU direct interface for encoder
- Dual N-channel MOSFET and integrated 6-channel Smart gate driver with integrated power supplies, current sense amplifiers, ADC, and Hall sensor comparators reducing the required PCB footprint significantly

Application assumptions
- DC Motor powered up by Li-ion battery pack of 4S to 6S with typical voltage 14.4 – 21.6V and max. voltage 16.8 – 25.2V
- DC Motor voltage within 12 – 24V
- Average current up to 10A (at 25V)

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<tr>
<th>Product type</th>
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<th>Part number</th>
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<th>Package mm x mm</th>
<th>Qty.</th>
</tr>
</thead>
<tbody>
<tr>
<td>N+N dual MOSFET</td>
<td>Q1, Q2, Q3</td>
<td>BSC072N04 LD</td>
<td>40V OptiMOS® T2 Power Transistor 7.2mΩ with continuous ( I_D ) 20A at 25°C, ( V_{GS} ) 10V &amp; typ. ( Q_r ) 39nC</td>
<td>SSO8 5x6</td>
<td>3</td>
</tr>
<tr>
<td>N-MOSFET</td>
<td>Separated Q1, Q2, Q3</td>
<td>BSC032N04 LS</td>
<td>40V OptiMOS® Power MOSFET 3.2mΩ with continuous ( I_D ) 98A at 25°C, ( V_{GS} ) 10V &amp; typ. ( Q_r ) 25nC</td>
<td>SSO8 5x6</td>
<td>6</td>
</tr>
<tr>
<td>Gate driver</td>
<td>Integrated U2 to U4</td>
<td>6EDL7141*</td>
<td>3-Phase smart gate driver with ( I_D ) source / sink 1.5A, operating ( V_{GS} ) 5.5 – 60V, integrated power supplies, current sense amplifiers, Hall sensor comparators, ADC</td>
<td>VQFN48 7x7</td>
<td>1</td>
</tr>
<tr>
<td>Microcontroller</td>
<td>U1</td>
<td>XMC1404-0Q64X0200*</td>
<td>Cortex-M0 with MATH, 32bit 48MHz CPU clock 16KB SRAM &amp; 200KB Flash, 12-bit ADC, multiCAN module (2 CAN nodes), 2x CCU8 PWM for easy 3-phase inverter implementation &amp; 2x POSIF interface for hall sensors/encoder, ( T_A ) -40 to 105°C</td>
<td>VQFN64 8x8</td>
<td>1</td>
</tr>
<tr>
<td>Position sensor</td>
<td>Motor assy.</td>
<td>TL4961-1M</td>
<td>Bipolar Hall latch with 3 – 32V operating supply voltage</td>
<td>SOT23-3</td>
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* Near future: integrated to IMD701A of VQFN64 9x9 further reducing the PCB footprint
Proposed BOM BLDC-Motor drive: GOOD PERFORMANCE with up to 10A & 25V & HMI capability

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<td>Q1, Q2, Q3</td>
<td>BSC072N04LD</td>
<td>40V OptiMOS® T2 Power Transistor 7.2mΩ with continuous ( I_D ) 20A at 25°C, ( V_{GS} ) 10V &amp; typ. ( Q_g ) 39nC</td>
<td>SSO8 5x6</td>
<td>3</td>
</tr>
<tr>
<td>N-MOSFET</td>
<td>Separated Q1, Q2, Q3</td>
<td>BSC032N04LS</td>
<td>40V OptiMOS® Power MOSFET 3.2mΩ with continuous ( I_D ) 98A at 25°C, ( V_{GS} ) 10V &amp; typ. ( Q_g ) 25nC</td>
<td>SSO8 5x6</td>
<td>6</td>
</tr>
<tr>
<td>Gate driver</td>
<td>Integrated U2 to U4</td>
<td>6EDL7141</td>
<td>3-Phase smart gate driver with ( I_D ) source / sink 1.5A, operating supply voltage 5.5 – 60V, integrated power supplies, current sense amplifiers, Hall sensor comparators, ADC</td>
<td>VQFN48 7x7</td>
<td>1</td>
</tr>
<tr>
<td>Microcontroller</td>
<td>U1</td>
<td>CY8C4146AZI- S423T</td>
<td>Cortex-M0+ 32bit 48MHz CPU clock 8KB SRAM &amp; 64KB Flash with 5 TCPWM blocks &amp; Comparator-based triggering of Kill signals for motor drive, 2 opamps, CapSense, LCD drive capability on GPIOs</td>
<td>TQFP48 9x9</td>
<td>1</td>
</tr>
<tr>
<td>Position sensor</td>
<td>Motor assy.</td>
<td>TLI4961-1M</td>
<td>Bipolar Hall latch with 3 – 32V operating supply voltage</td>
<td>SOT23-3</td>
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Key features and benefits:
- Cost competitive with high performance solution
- Available firmware of FOC with Hall sensors or sensorless for BLDC motors
- Dual N-channel MOSFET and integrated 6-channel Smart gate driver with integrated power supplies, current sense amplifiers, ADC, and Hall sensor comparators reducing the required PCB footprint significantly
- MCU HMI capability i.e. capacitive touch sensing & LCD drive

Application assumptions:
- DC Motor powered up by Li-ion battery pack of 4S to 6S with typical voltage 14.4 – 21.6V and max. voltage 16.8 – 25.2V
- DC Motor voltage within 12 – 24V
- Average current up to 10A (at 25V)
Proposed BOM BLDC-Motor drive: HIGH PERFORMANCE with up to 30A & 25V

**Product type** | **Device** | **Part number** | **Description** | **Package mm x mm** | **Qty.**
---|---|---|---|---|---
N-MOSFET | Q1 to Q6 | ISC019N04NM5 | 40V OptiMOS® 5 Power MOSFET 1.9mΩ with continuous $I_D$ 170A at 25°C, $V_{GS}$ 10V & typ. $Q_g$ 42nC | SSO8 5x6 | 6
Gate driver | Integrated U2 to U4 | 6EDL7141* | 3-Phase smart gate driver with $I_D$ source / sink 1.5A, operating $V_S$ 5.5 – 60V, integrated power supplies, current sense amplifiers, Hall sensor comparators, ADC | VQFN48 7x7 | 1
Microcontroller | U1 | XMC1404-Q064X0200* | Cortex-M0 with MATH, 32bit 48MHz CPU clock 16KB SRAM & 200KB Flash, 12-bit ADC, multiCAN module (2 CAN nodes), 2x CCUB PWM for easy 3-phase inverter implementation & 2x POSIF interface for hall sensors/encoder, $T_A$ -40 to 105°C | VQFN64 8x8 | 1
Position sensor | Motor assy. | TLI4961-1M | Bipolar Hall latch with 3 – 32V operating supply voltage | SOT23-3 | 3

* Option: Integration to IMD701A (MCU + Gate driver) in VQFN64 9x9 package is further reducing the PCB footprint

**Key features and benefits**
- High performance solution
- Available firmware of FOC with Hall sensors or sensorless for BLDC and PMSM motors
- MCU direct interface for encoder
- Integrated 6-channel Smart gate driver with integrated power supplies, current sense amplifiers, ADC, and Hall sensor comparators, in addition to high power density MOSFET reducing the required PCB footprint quite significantly

**Application assumptions**
- DC Motor powered up by Li-ion battery pack of 4S to 6S with typical voltage 14.4 – 21.6V and max. voltage 16.8 – 25.2V
- DC Motor voltage within 12 – 24V
- Average current up to 30A (at 25V)

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Proposed BOM DC-Motor drive: PRICE/PERFORMANCE with up to 8A & 50V

<table>
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<tr>
<th>Product type</th>
<th>Device</th>
<th>Part number</th>
<th>Description</th>
<th>Package mm x mm</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>N-MOSFET</td>
<td>Q1 – Q4, (Q5, Q6)</td>
<td>IRFR540ZPbF</td>
<td>100V HEXFET® Power MOSFET 28.5mΩ with continuous $I_D$ 35A at 25°C, $V_{GS}$ 10V &amp; typ. $Q_g$ 39nC</td>
<td>DPAK</td>
<td>4 6</td>
</tr>
<tr>
<td>Gate driver</td>
<td>U2, U3, (U4)</td>
<td>2ED2181S06F</td>
<td>650V high side &amp; low side gate driver with integrated BSD &amp; $I_D$ source / sink 2.5A, propagation delay 200ns</td>
<td>DSO8 4x5</td>
<td>2 3</td>
</tr>
<tr>
<td>Microcontroller</td>
<td>U1</td>
<td>XMC1302-T038X0032AB</td>
<td>Cortex-M0 32bit 32/64MHz C/P clock 16KB SRAM &amp; 32KB Flash with CCU8 PWM for easy 3-phase inverter implementation &amp; POSIF interface for hall sensors/encoder</td>
<td>TSSOP38 9.7x4.4</td>
<td>1 1</td>
</tr>
<tr>
<td>Position sensor</td>
<td>Motor assy.</td>
<td>TLI4961-1M</td>
<td>Bipolar Hall latch with 3 – 32V operating supply voltage</td>
<td>SOT23-3</td>
<td>-- 3</td>
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Key features and benefits
- Low cost solution
- Available firmware of FOC with Hall sensors or sensorless for BLDC and PMSM motors
- MCU direct interface for either Hall sensors or encoder
- Dual-channel gate driver with integrated bootstrap diode (BSD) with high output current source and sink enabling high switching frequency

Application assumptions
- DC Motor powered up by Li-ion battery pack of 7S to 12S with typical voltage 25.2 – 43.2V and max. voltage 29.4 – 50.4V
- DC Motor voltage within 24 – 48V
- Average current up to 8A (at 50V)
Proposed BOM BLDC-Motor drive: HIGH PERFORMANCE with up to 20A & 50V

Key features and benefits

- High performance solution
- Available firmware of FOC with Hall sensors or sensorless for BLDC and PMSM motors
- MCU direct interface for either Hall sensors or encoder
- Integrated 6-channel Smart gate driver with integrated power supplies, current sense amplifiers, ADC, and Hall sensor comparators, in addition to high power density MOSFET reducing the required PCB footprint quite significantly

Application assumptions

- DC Motor powered up by Li-ion battery pack of 7S to 12S with typical voltage 25.2 – 43.2V and max. voltage 29.4 – 50.4V
- DC Motor voltage within 24 – 48V
- Average current up to 20A (at 50V)

<table>
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<tr>
<th>Product type</th>
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<tbody>
<tr>
<td>N-MOSFET</td>
<td>Q1 to Q6</td>
<td>IQE065N10NM5</td>
<td>100V OptiMOS® 5 Power MOSFET 6.5mΩ with continuous I_D 85A at 25°C, V_{GS} 10V &amp; typ. Q_g 34nC</td>
<td>TSON8 3.3x3.3</td>
<td>6</td>
</tr>
<tr>
<td>Gate driver</td>
<td>Integrated U2 to U4</td>
<td>6EDL7141*</td>
<td>3-Phase smart gate driver with I_D source / sink 1.5A, operating V_S 5.5 – 60V, integrated power supplies, current sense amplifiers, Hall sensor comparators, ADC</td>
<td>VQFN48 7x7</td>
<td>1</td>
</tr>
<tr>
<td>Microcontroller</td>
<td>U1</td>
<td>XMC1404- Q064X0200*</td>
<td>Cortex-M0 with MATH, 32bit 48MHz CPU clock 16KB SRAM &amp; 200KB Flash, 12-bit ADC, multiCAN module (2 CAN nodes), 2x CCUB PWM for easy 3-phase inverter implementation &amp; 2x POSIF interface for hall sensors/encoder, T_A -40 to 105°C</td>
<td>VQFN64 8x8</td>
<td>1</td>
</tr>
<tr>
<td>Position sensor</td>
<td>Motor assy.</td>
<td>TLI4961-1M</td>
<td>Bipolar Hall latch with 3 – 32V operating supply voltage</td>
<td>SOT23-3</td>
<td>3</td>
</tr>
</tbody>
</table>

* Option: Integration to IMD701A (MCU + Gate driver) in VQFN64 9x9 package is further reducing the PCB footprint
Proposed BOM BLDC-Motor drive: HIGH PERFORMANCE with up to 40A & 50V

Key features and benefits
- High performance solution
- Available firmware of FOC with Hall sensors or sensorless for BLDC and PMSM motors
- MCU direct interface for either Hall sensors or encoder
- Integrated 6-channel Smart gate driver with integrated power supplies, current sense amplifiers, ADC, and Hall sensor comparators, in addition to high power density MOSFET reducing the required PCB footprint quite significantly

Application assumptions
- DC Motor powered up by Li-ion battery pack of 7S to 12S with typical voltage 25.2 – 43.2V and max. voltage 29.4 – 50.4V
- DC Motor voltage within 24 – 48V
- Average current up to 40A (at 50V)

Product type | Device | Part number | Description | Package mm x mm | Qty.
--- | --- | --- | --- | --- | ---
N-MOSFET | Q1 to Q6 | ISC027N10NM6 | 100V OptiMOS® 6 Power MOSFET 2.7mΩ with continuous I_D 192A at 25°C, V_GS 10V & typ. Q_g 58nC | SSO8 5x6 | 6
Gate driver | Integrated U2 to U4 | 6EDL7141* | 3-Phase smart gate driver with I_D source / sink 1.5A, operating V_S 5.5 – 60V, integrated power supplies, current sense amplifiers, Hall sensor comparators, ADC | VQFN48 7x7 | 1
Microcontroller | U1 | XMC1404-Q064X0200* | Cortex-M0 with MATH, 32bit 48MHz CPU clock 16KB SRAM & 200KB Flash, 12-bit ADC, multiCAN module (2 CAN nodes), 2x CCUB PWM for easy 3-phase inverter implementation & 2x POSIF interface for hall sensors/encoder, T_A -40 to 105°C | VQFN64 8x8 | 1
Position sensor | Motor assy. | TLI4961-1M | Bipolar Hall latch with 3 – 32V operating supply voltage | SOT23-3 | 3

* Option: Integration to IMD701A (MCU + Gate driver) in VQFN64 9x9 package is further reducing the PCB footprint

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Proposed BOM DC-Motor drive: PRICE/PERFORMANCE with up to 10A & 100V

<table>
<thead>
<tr>
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<th>Device</th>
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<th>Package mm x mm</th>
<th>Quantity</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>N-MOSFET</td>
<td>Q1 – Q4, (Q5, Q6)</td>
<td>IRFS4227PbF</td>
<td>200V HEXFET® Power MOSFET 26mΩ with continuous $I_D$ 62A at 25°C, $V_{GS}$ 10V &amp; max. $Q_g$ 70nC</td>
<td>D2PAK</td>
<td>4</td>
<td>6</td>
<td></td>
</tr>
<tr>
<td>Gate driver</td>
<td>U2, U3, (U4)</td>
<td>IRS21867S</td>
<td>600V high side &amp; low side gate driver with $I_D$ source / sink 4A, propagation delay 170ns</td>
<td>SOIC8 4x5</td>
<td>2</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Microcontroller</td>
<td>U1</td>
<td>XMC1302- T038X0032AB</td>
<td>Cortex-M0 32bit 32/64MHz C/P clock 16KB SRAM &amp; 32KB Flash with CCUB PWM for easy 3-phase inverter implementation &amp; POSIF interface for hall sensors/encoder</td>
<td>TSSOP38</td>
<td>1</td>
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<tr>
<td>Position sensor</td>
<td>Motor assy.</td>
<td>TL14961-1M</td>
<td>Bipolar Hall latch with 3 – 32V operating supply voltage</td>
<td>SOT23-3</td>
<td>--</td>
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</table>

**Key features and benefits**
- Low cost solution
- Available firmware of FOC with Hall sensors or sensorless for BLDC and PMSM motors
- MCU direct interface for either Hall sensors or encoder
- Dual-channel gate driver with high output current source and sink enabling high switching frequency

**Application assumptions**
- DC Motor powered up by Li-ion battery pack of 13S to 24S with typical voltage 46.8 – 86.4V and max. voltage 54.6 – 100.8V
- DC Motor voltage within 48 – 96V
- Average current up to 10A (at 100V)