Power electronics cover different disciplines ranging from magnetics design, EMI filter design, analog electronics, power semiconductors, circuit protection, and now recently digital signal processing. The objective of a power electronics circuit is to modify energy in the form of voltage and current at different frequencies, or, in other words, to modify the input voltage and current conditions. This circuit conditioning short form brochure provides information on the Bourns® product portfolio for power electronic applications.

A switch mode power supply and drive can be described as a series of building blocks as shown in figure 1, each with the following functions:

A) Protection
   a. Protection of the circuit from lightning and switching transients on the AC mains (IEC 61000-4-4 and IEC 61000-4-5)
   b. Short Circuit Protection
      i. For agency short circuit testing of low power circuits
      ii. For prevention of short circuiting of IGBTs on inverter legs

B) EMI
   a. Conducted emissions (IEC 61000-4-6)
   b. Radiated emissions (EN 61000-4-3)

C) Transformer and Output Filter

CONSUMPTION

CUSTOM TRANSFORMER DESIGN EVALUATION WORKSHEET

In order to facilitate the initial feasibility study, the design engineer should fill out the appropriate information in the worksheet below. This will allow the Bourns transformer designer to propose the optimum design that will achieve the highest possible efficiency.

Bourns has standard cores, bobbins, enamel and single, double and triple insulated wire in stock for custom transformer and inductor designs.

**Transformer Requirements**

<table>
<thead>
<tr>
<th>Transformer Requirements</th>
<th>Specification Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Topology</td>
<td>(see page 3 topology tables)</td>
</tr>
<tr>
<td>Power</td>
<td></td>
</tr>
<tr>
<td>Primary Inductance</td>
<td></td>
</tr>
<tr>
<td>Leakage Inductance</td>
<td></td>
</tr>
<tr>
<td>Switching Frequency</td>
<td></td>
</tr>
<tr>
<td>Input and Output Voltage(s)</td>
<td></td>
</tr>
<tr>
<td>Interwinding Capacitance</td>
<td></td>
</tr>
<tr>
<td>Sketch of Windings</td>
<td></td>
</tr>
<tr>
<td>Auxiliary Winding Voltage</td>
<td></td>
</tr>
<tr>
<td>Safety Requirements</td>
<td>(Reinforced, Single, Functional, Operational)</td>
</tr>
<tr>
<td>Coupling Between Secondaries</td>
<td></td>
</tr>
<tr>
<td>Operating Temperatures</td>
<td></td>
</tr>
<tr>
<td>Name of Controller IC</td>
<td></td>
</tr>
</tbody>
</table>

**Figure 1 - Shaded areas outline where Bourns® Components are used in power applications**
## Topologies

<table>
<thead>
<tr>
<th>Flyback Converter Topology</th>
<th>Forward Topology</th>
<th>Two-Switch Forward Topology</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image" alt="Flyback Converter" /></td>
<td><img src="image" alt="Forward" /></td>
<td><img src="image" alt="Two-Switch Forward" /></td>
</tr>
<tr>
<td><strong>Isolation</strong></td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td><strong>Max. Power (W)</strong></td>
<td>100</td>
<td>200</td>
</tr>
<tr>
<td><strong>Strengths</strong></td>
<td>Ground referenced switch, multiple outputs, fewer components</td>
<td>Large step-down ratio</td>
</tr>
<tr>
<td><strong>Weaknesses</strong></td>
<td>Limited to 10 A output, high stress on diode, inefficient (use of ZVS converters improves losses)</td>
<td>High voltage on-switch increases power lost</td>
</tr>
<tr>
<td><strong>Applications</strong></td>
<td>AC/DC, DC/DC appliances, solar inverters, LED lighting, AC adaptors, E-meters, battery charging, automotive, circuit breakers, TVs, STBs, PoE</td>
<td>AC/DC, DC/DC industrial controls</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Half Bridge Forward Topology</th>
<th>Full Bridge Forward Topology</th>
<th>Full Bridge Resonant Topology</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image" alt="Half Bridge Forward" /></td>
<td><img src="image" alt="Full Bridge Forward" /></td>
<td><img src="image" alt="Full Bridge Resonant" /></td>
</tr>
<tr>
<td><strong>Isolation</strong></td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td><strong>Max. Power (W)</strong></td>
<td>500</td>
<td>5000</td>
</tr>
<tr>
<td><strong>Strengths</strong></td>
<td>Reduced core loss</td>
<td>Clamped primary switch and minimal switching losses</td>
</tr>
<tr>
<td><strong>Weaknesses</strong></td>
<td>Does not work well with current mode making it less than ideal for off line power supplies</td>
<td>Requires experience to get working properly</td>
</tr>
<tr>
<td><strong>Applications</strong></td>
<td>DC/DC industrial controls, telecom, data processing</td>
<td>AC/DC, DC/DC industrial controls, telecom, data processing, automotive HEV / EV</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Push Pull Converter Topology</th>
<th>Boost Converter Topology</th>
<th>Buck Converter Topology</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image" alt="Push Pull Converter" /></td>
<td><img src="image" alt="Boost Converter" /></td>
<td><img src="image" alt="Buck Converter" /></td>
</tr>
<tr>
<td><strong>Isolation</strong></td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td><strong>Max. Power (W)</strong></td>
<td>500</td>
<td>1000</td>
</tr>
<tr>
<td><strong>Strengths</strong></td>
<td>Ground referenced switches</td>
<td>Low noise input</td>
</tr>
<tr>
<td><strong>Weaknesses</strong></td>
<td>Can only tolerate low input voltages</td>
<td>Requires current mode control and has no isolation</td>
</tr>
<tr>
<td><strong>Applications</strong></td>
<td>DC/DC battery charging, servers</td>
<td>AC/DC, DC/AC power factor correction circuits, automotive electric vehicles, motor drives (appliances)</td>
</tr>
</tbody>
</table>
# Product Configuration Chart

## Overcurrent Protection

<table>
<thead>
<tr>
<th>Model</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>FW Series</td>
<td>UL listed fusible resistors</td>
</tr>
<tr>
<td>WS Series</td>
<td>Capable of withstanding up to 10 kV</td>
</tr>
</tbody>
</table>

## Surge Protection

<table>
<thead>
<tr>
<th>Model</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>ACTP250J1BJ</td>
<td>SMB packaged protector</td>
</tr>
<tr>
<td>SA Series</td>
<td>GDT with up to 7,200 V breakover</td>
</tr>
<tr>
<td>2017 Series</td>
<td>Ultra-low profile GDT</td>
</tr>
</tbody>
</table>

## Common Mode Inductors

<table>
<thead>
<tr>
<th>Model</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>7100 Series</td>
<td>Toroid Max 10 A</td>
</tr>
<tr>
<td>7300 Series</td>
<td>Split Bobbin Model Max. 1.5 A</td>
</tr>
<tr>
<td>7400 Series</td>
<td>Split Bobbin Model Max. 2.8 A</td>
</tr>
<tr>
<td>7500 Series</td>
<td>Split Bobbin Model Max. 4.4 A</td>
</tr>
<tr>
<td>8100 Series</td>
<td>Toroid Max. 20 A</td>
</tr>
</tbody>
</table>

## Diodes

<table>
<thead>
<tr>
<th>Model</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>CDNBS04 Series</td>
<td>Bridge rectifier 800 V VR</td>
</tr>
<tr>
<td>CD2320 Series</td>
<td>Bridge rectifier 1,000 V VR</td>
</tr>
<tr>
<td>CD1408 Series</td>
<td>Ultra-fast rectifier diode 1,500 V VR</td>
</tr>
</tbody>
</table>

## Differential Mode Filters

<table>
<thead>
<tr>
<th>Model</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>5300 Series</td>
<td>Axial leaded inductor with 500 Vrms rating</td>
</tr>
<tr>
<td>8230 Series</td>
<td>Axial leaded high Q 500 Vrms rating</td>
</tr>
<tr>
<td>9250A Series</td>
<td>Axial leaded high Q 1,000 Vrms Up to 125 °C</td>
</tr>
<tr>
<td>RLB Series</td>
<td>Radial 5 - 11.7 mm up to 6 A</td>
</tr>
<tr>
<td>RLB0912 Series</td>
<td>Radial 9 mm up to 10 A, 125 °C</td>
</tr>
</tbody>
</table>
**FB = Feedback to Controller**

### Transformers

<table>
<thead>
<tr>
<th>Core Type</th>
<th>Power Capability (W)</th>
</tr>
</thead>
<tbody>
<tr>
<td>EP5, ER7.5</td>
<td>20</td>
</tr>
<tr>
<td>EPC10, EF10, EPC15</td>
<td>50</td>
</tr>
<tr>
<td>EP7, EPC20, EE10, EE13</td>
<td>100</td>
</tr>
<tr>
<td>EE16, EE19, EE20, EE25, EPC24</td>
<td>150</td>
</tr>
<tr>
<td>EPC125, EPC30, PQ26/20</td>
<td>500</td>
</tr>
</tbody>
</table>

### Power Inductors

<table>
<thead>
<tr>
<th>Model</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>SRP Series</td>
<td>SMD carbonyl powder inductors</td>
</tr>
<tr>
<td>SRR1280</td>
<td>SMD shielded ferrite inductors</td>
</tr>
<tr>
<td>SDR1006</td>
<td>SMD non-shielded ferrite inductors</td>
</tr>
<tr>
<td>SRN2012</td>
<td>SMD semi shielded ferrite inductors</td>
</tr>
<tr>
<td>SRU2013</td>
<td>SMD shielded ferrite inductors</td>
</tr>
</tbody>
</table>

### Current Sense Resistors

<table>
<thead>
<tr>
<th>Model</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>CRE2512</td>
<td>3 W 2512 size SMD</td>
</tr>
<tr>
<td>CST0612</td>
<td>1 W 0612 4-terminals</td>
</tr>
<tr>
<td>CRA2512</td>
<td>3 W 2512 size SMD</td>
</tr>
</tbody>
</table>

### Multifuse® PPTC Resettable Fuses

<table>
<thead>
<tr>
<th>Model</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>MF-RHT Series</td>
<td>High temperature PPTC (125 °C)</td>
</tr>
<tr>
<td>MF-LSMF Series</td>
<td>SMD 2320 size PPTC with 33 V rating</td>
</tr>
<tr>
<td>MF-MSMF Series</td>
<td>SMD 1812 size PPTC with 60 V rating</td>
</tr>
</tbody>
</table>

### SinglFuse™ Thin Film Chip Fuse

<table>
<thead>
<tr>
<th>Model</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>SF1206</td>
<td>Max. 63 V 1206 size fuse</td>
</tr>
</tbody>
</table>

### Thyristor Surge Protectors

<table>
<thead>
<tr>
<th>Model</th>
<th>Working Voltage (V)</th>
<th>Max. Breakover Voltage (V)</th>
</tr>
</thead>
<tbody>
<tr>
<td>TISP4015SH1BJ</td>
<td>5</td>
<td>15</td>
</tr>
<tr>
<td>TISP4025SH1BJ</td>
<td>12</td>
<td>25</td>
</tr>
</tbody>
</table>
### Inductors

<table>
<thead>
<tr>
<th>Model</th>
<th>Type</th>
<th>Max. Inductance</th>
<th>Max. Current</th>
<th>Max. Temperature</th>
</tr>
</thead>
<tbody>
<tr>
<td>SRP</td>
<td>Inductor</td>
<td>47 µH</td>
<td>46 A</td>
<td>150 °C</td>
</tr>
<tr>
<td>SDR</td>
<td>Inductor</td>
<td>15,000 µH</td>
<td>16 A</td>
<td>125 °C</td>
</tr>
<tr>
<td>SRU</td>
<td>Inductor</td>
<td>330 µH</td>
<td>8 A</td>
<td>125 °C</td>
</tr>
<tr>
<td>RL</td>
<td>Inductor</td>
<td>100,000 µH</td>
<td>10 A</td>
<td>105 °C</td>
</tr>
<tr>
<td>RLB</td>
<td>Inductor</td>
<td>82,000 µH</td>
<td>10 A</td>
<td>105 °C</td>
</tr>
<tr>
<td>SRR</td>
<td>Inductor</td>
<td>10,000 µH</td>
<td>20 A</td>
<td>125 °C</td>
</tr>
<tr>
<td>SRN</td>
<td>Inductor</td>
<td>470 µH</td>
<td>10 A</td>
<td>125 °C</td>
</tr>
<tr>
<td>SRF1260A</td>
<td>Inductor</td>
<td>4,000 µH</td>
<td>17.6 A</td>
<td>125 °C</td>
</tr>
<tr>
<td>7100</td>
<td>Inductor</td>
<td>2,000 µH</td>
<td>11 A</td>
<td>105 °C</td>
</tr>
<tr>
<td>5300</td>
<td>Inductor</td>
<td>10,000 µH</td>
<td>3.3 A</td>
<td>105 °C</td>
</tr>
</tbody>
</table>

### Surge Protectors

<table>
<thead>
<tr>
<th>Model</th>
<th>Type</th>
<th>Max. Sparkover Voltage</th>
<th>Peak Surge Current</th>
</tr>
</thead>
<tbody>
<tr>
<td>ACTP250J1BJ</td>
<td>AC Transient Surge Protector</td>
<td>Max. 250 V</td>
<td>1,000 A (Indefinite)</td>
</tr>
<tr>
<td>2039</td>
<td>Gas Discharge Tube</td>
<td>1,100 V</td>
<td>5,000 A</td>
</tr>
<tr>
<td>SA2</td>
<td>Gas Discharge Tube</td>
<td>7,200 V</td>
<td>5,000 A for 10 Strikes</td>
</tr>
</tbody>
</table>

### Fusible Wirewound Resistors

<table>
<thead>
<tr>
<th>Model</th>
<th>Type</th>
<th>Max. Power</th>
<th>Max. Resistance</th>
</tr>
</thead>
<tbody>
<tr>
<td>FW</td>
<td>Fusible Wirewound Resistor</td>
<td>7 W</td>
<td>100 Ω</td>
</tr>
</tbody>
</table>

### Wirewound Resistors

<table>
<thead>
<tr>
<th>Model</th>
<th>Type</th>
<th>Max. Power</th>
<th>Max. Resistance</th>
<th>Max. Peak Surge Voltage</th>
</tr>
</thead>
<tbody>
<tr>
<td>WS SERIES</td>
<td>Wirewound Resistor</td>
<td>8 W</td>
<td>3.3 KΩ</td>
<td>10 kV</td>
</tr>
</tbody>
</table>
### Multifuse® PPTC Resettable Fuses

<table>
<thead>
<tr>
<th>Model</th>
<th>Description</th>
<th>Max. Voltage</th>
<th>Max. Hold Current</th>
<th>Max. Temperature</th>
</tr>
</thead>
<tbody>
<tr>
<td>MF-LSMF</td>
<td>Multifuse® PPTC Resettable Fuse</td>
<td>33 V</td>
<td>3 A</td>
<td>85 °C</td>
</tr>
<tr>
<td>MF-MSMF</td>
<td>Multifuse® PPTC Resettable Fuse</td>
<td>60 V</td>
<td>2.6 A</td>
<td>85 °C</td>
</tr>
<tr>
<td>MF-USMF</td>
<td>Multifuse® PPTC Resettable Fuse</td>
<td>30 V</td>
<td>1.75 A</td>
<td>85 °C</td>
</tr>
</tbody>
</table>

### SINGLE BLOW FUSES

<table>
<thead>
<tr>
<th>Model</th>
<th>Description</th>
<th>Voltage</th>
<th>I’t</th>
<th>Current</th>
</tr>
</thead>
<tbody>
<tr>
<td>SF1206S</td>
<td>SinglFuse™ Slow Blow Fuse</td>
<td>24 V</td>
<td>5.68A’s</td>
<td>7 A</td>
</tr>
<tr>
<td>SF1206F</td>
<td>SinglFuse™ Fast Blow Fuse</td>
<td>24 V</td>
<td>3.25A’s</td>
<td>7 A</td>
</tr>
</tbody>
</table>

### CURRENT SENSE RESISTORS

<table>
<thead>
<tr>
<th>Model</th>
<th>Description</th>
<th>Power</th>
<th>Min. Resistance</th>
</tr>
</thead>
<tbody>
<tr>
<td>CRA2512</td>
<td>Current Sense Resistor</td>
<td>3 W</td>
<td>0.01 Ω</td>
</tr>
<tr>
<td>CRF2512</td>
<td>Current Sense Resistor</td>
<td>2 W</td>
<td>0.001 Ω</td>
</tr>
<tr>
<td>CRE2512</td>
<td>Current Sense Resistor</td>
<td>3 W</td>
<td>0.001 Ω</td>
</tr>
<tr>
<td>CST0612</td>
<td>Current Sense Resistor</td>
<td>1 W</td>
<td>0.0005 Ω</td>
</tr>
</tbody>
</table>

### THYRISTORS

<table>
<thead>
<tr>
<th>Model</th>
<th>Description</th>
<th>Max. Breakover Voltage</th>
<th>Voltage Rating</th>
</tr>
</thead>
<tbody>
<tr>
<td>TISP4025H1BJ</td>
<td>Thyristor</td>
<td>25 V</td>
<td>12 V</td>
</tr>
<tr>
<td>TISP4015H1BJ</td>
<td>Thyristor</td>
<td>15 V</td>
<td>5 V</td>
</tr>
</tbody>
</table>

### POWER RESISTORS

<table>
<thead>
<tr>
<th>Model</th>
<th>Description</th>
<th>Max. Power</th>
<th>Pulse</th>
</tr>
</thead>
<tbody>
<tr>
<td>PWR263S</td>
<td>Power Resistor</td>
<td>35 W</td>
<td>10 J in 0.1 sec</td>
</tr>
</tbody>
</table>

### RECTIFIER DIODES

<table>
<thead>
<tr>
<th>Model</th>
<th>Description</th>
<th>Max. Current</th>
<th>Max. Voltage</th>
</tr>
</thead>
<tbody>
<tr>
<td>CD2320</td>
<td>Rectifier Diode</td>
<td>1 A</td>
<td>1,000 V</td>
</tr>
</tbody>
</table>
Worldwide Sales Offices

<table>
<thead>
<tr>
<th>Country/Region</th>
<th>Phone</th>
<th>Email</th>
</tr>
</thead>
<tbody>
<tr>
<td>Americas:</td>
<td>+1-951-781-5500</td>
<td><a href="mailto:americus@bourns.com">americus@bourns.com</a></td>
</tr>
<tr>
<td>Brazil:</td>
<td>+55 11 5505 0601</td>
<td><a href="mailto:americus@bourns.com">americus@bourns.com</a></td>
</tr>
<tr>
<td>China:</td>
<td>+86 21 64821250</td>
<td><a href="mailto:asiacus@bourns.com">asiacus@bourns.com</a></td>
</tr>
<tr>
<td>Europe, Middle East, Africa:</td>
<td>+36 88 885 877</td>
<td><a href="mailto:eurocus@bourns.com">eurocus@bourns.com</a></td>
</tr>
<tr>
<td>Japan:</td>
<td>+81 49 269 3204</td>
<td><a href="mailto:asiacus@bourns.com">asiacus@bourns.com</a></td>
</tr>
<tr>
<td>Korea:</td>
<td>+82 70 4036 7730</td>
<td><a href="mailto:asiacus@bourns.com">asiacus@bourns.com</a></td>
</tr>
<tr>
<td>Singapore:</td>
<td>+65 6348 7227</td>
<td><a href="mailto:asiacus@bourns.com">asiacus@bourns.com</a></td>
</tr>
<tr>
<td>Taiwan:</td>
<td>+886 2 25624117</td>
<td><a href="mailto:asiacus@bourns.com">asiacus@bourns.com</a></td>
</tr>
<tr>
<td>Other Asia-Pacific Countries:</td>
<td>+886 2 25624117</td>
<td><a href="mailto:asiacus@bourns.com">asiacus@bourns.com</a></td>
</tr>
</tbody>
</table>

Technical Assistance Region

<table>
<thead>
<tr>
<th>Region</th>
<th>Phone</th>
<th>Email</th>
</tr>
</thead>
<tbody>
<tr>
<td>Asia-Pacific:</td>
<td>+886 2 25624117</td>
<td><a href="mailto:techweb@bourns.com">techweb@bourns.com</a></td>
</tr>
<tr>
<td>Europe, Middle East, Africa:</td>
<td>+36 88 885 877</td>
<td><a href="mailto:eurotech@bourns.com">eurotech@bourns.com</a></td>
</tr>
<tr>
<td>Americas:</td>
<td>+1-951-781-5500</td>
<td><a href="mailto:techweb@bourns.com">techweb@bourns.com</a></td>
</tr>
</tbody>
</table>

Bourns® products are available through an extensive network of manufacturer’s representatives, agents and distributors. To obtain technical applications assistance, a quotation, or to place an order, contact a Bourns representative in your area.

Specifications subject to change without notice. Actual performance in specific customer applications may differ due to the influence of other variables. Customers should verify actual device performance in their specific applications.

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