P220 Planar Magnetics For 1 kW to 3.0 kW Converters

Application:
Transformers based on our 220 size core are designed for a wide variety of topologies such as forward, half and full bridge, full bridge ZVS, and push-pull. These parts are used in 1 kW to 3.0 kW off-line power supplies and DC-DC converters delivering up to 250 amperes for a single output or 20-50 amperes for multi-output magnetics. Applications vary from commercial and computer to military and space systems where high quality, reliability, repeatability and superior thermal management are of the most importance.

Planar transformers and inductors based on 220 size have small footprints and low profiles, such as 0.600" to 0.800". Two 220 size transformers with 2kW capacity each but without tabs can fit on a single credit card. Depending on power rating 220 parts can run without any air flow for cooling. They may be attached to a base plate with controlled temperature.

Transformers can be customized, and multi-winding coupled inductors are available.

### 1.0 kW Output P/N 1043

**Description: P220-12-6**

**Topology: 2-Switch Forward**

**P/N 1043 Application:**

This transformer is based on our proprietary 220 size ferrite core and utilizes heavy copper multilayer planar winding technology. It delivers 1.0 kW of continuous power in a two-switch forward topology, 150 kHz military power supply. Input is 180 to 320 VDC bus and output is 34VDC with 29.5 amperes maximum current. Primary winding is well isolated from the core and from the secondary winding and has at least 8mm creepage and clearance distance from them. 98.7 % efficiency and low thermal impedance allow for...
only 40 deg. C temperature rise when mounted on +60 deg.C base plate. No air air flow is required. Because of high voltage isolation capability and sufficient creepage and clearance distance this transformer can be also used in industrial applications.

**P/N 1043 Specification:**
1. Input Bus Voltage Range: 180 to 320 VDC
2. Converter Output After Rectification maximum: 1003W
3. Turns Ratio Np/Ns: 34V/29.5A
4. Optimum Clock Switching Frequency: 150 kHz
5. Maximum Duty Cycle: 40.0 %.
6. Efficiency At Full Power: 98.7 %.
7. Base Plate/Heatsink Maximum Temperature: +60 °C
8. Air Flow temperature: Not Required
9. Temperature Rise Hot Spot- Base Plate maximum: 40 °C
10. Minimum Isolation Voltage: Primary To Secondary and To Core 5000 VDC
    Secondary to Core 500 VDC
11. Minimum Primary Inductance: 720 uH
12. Maximum resistance Rdc, Primary Winding: 17 mOhm
13. Maximum resistance Rdc, Secondary Windings Ns: 3.3 mOhm
14. Maximum Dimensions: 2.730” x 1.640” x .750”
15. Maximum Weight: 200 g

**Forward Transformers Similar To P/N 1043**
Table below shows additional 1kW, 150 kHz transformers designed for the same environment as P/N1043. P/N 1041 and 1042 dimensions are the same as shown above for P/N 1043. Transformers P/N 1037 through 1040 have different output tabs because they deliver higher currents. Their mechanical drawings are shown below.

<table>
<thead>
<tr>
<th>Part No.</th>
<th>Description</th>
<th>Input</th>
<th>Converter Output</th>
<th>Ratio Np/ Ns</th>
<th>Frequency</th>
<th>Efficiency</th>
<th>Max. Duty Cycle</th>
</tr>
</thead>
<tbody>
<tr>
<td>P/N 1037</td>
<td>P220-16-1</td>
<td>180-320 V</td>
<td>3.3VDC / 240A</td>
<td>16 turns/ 1 turn</td>
<td>100 kHz</td>
<td>98.3 %</td>
<td>44% at low line</td>
</tr>
<tr>
<td>P/N 1038</td>
<td>P220-12-1</td>
<td>180-320 V</td>
<td>5VDC / 180A</td>
<td>12 turns/ 1 turn</td>
<td>150 kHz</td>
<td>98.5 %</td>
<td>38% at low line</td>
</tr>
<tr>
<td>P/N 1039</td>
<td>P220-12-2</td>
<td>180-320 V</td>
<td>12VDC / 85A</td>
<td>12 turns/ 2 turns</td>
<td>150 kHz</td>
<td>98.8 %</td>
<td>43% at low line</td>
</tr>
<tr>
<td>P/N 1040</td>
<td>P220-14-3</td>
<td>180-320 V</td>
<td>15VDC / 65A</td>
<td>14 turns/ 3 turns</td>
<td>150 kHz</td>
<td>98.6 %</td>
<td>44% at low line</td>
</tr>
<tr>
<td>P/N 1041</td>
<td>P220-12-4</td>
<td>180-320 V</td>
<td>24VDC / 42A</td>
<td>12 turns/ 4 turns</td>
<td>150 kHz</td>
<td>98.6 %</td>
<td>44% at low line</td>
</tr>
<tr>
<td>P/N 1042</td>
<td>P220-12-5</td>
<td>180-320 V</td>
<td>28VDC / 36A</td>
<td>12 turns/ 5 turns</td>
<td>150 kHz</td>
<td>98.7 %</td>
<td>40% at low line</td>
</tr>
</tbody>
</table>
1.0 kW Output P/N 1037, 1038, 1039, 1040

Top View for Transformers 1037, 1038, 1039, 1040

Topology: 2-Switch Forward

Notes:
1. Dimensions are in inches.
2. Tolerances +/- 2%
3. Drawing not to scale
1.0 kW Output P/N 1036
Description: P220-8-5
P/N 1036 Application:
This transformer is a good example of 1kW transformer for 150kHz military forward converter that does not require 4kV isolation. This part provides 500 VDC isolation between windings and between any winding and core. It utilizes copper leadframes, Polyimide insulators and has 1mm creepage and clearance distances. This is sufficient for a power supply with 120 to 200 VDC input bus delivering output of 28VDC with 36 amperes continuous load. Reduced isolation requirement enabled our designers to reduce the footprint by about 26% and the height by 10%. 98.6% efficiency and low thermal impedance allow for 42 deg. C temperature rise when mounted on +60 deg.C base plate. No air air flow is required.

P/N 1036 Specification:
1. Input Bus Voltage Range: 120 to 200 VDC
2. Converter Output After Rectification maximum: 1008W
3. Turns Ratio Np/Ns: 8 turns / 5 turns
4. Optimum Clock Switching Frequency: 150 kHz
5. Maximum Duty Cycle: 40.0%
6. Efficiency At Full Power: 98.7%
7. Base Plate/Heatsink Maximum Temperature: +60 °C
8. Air Flow temperature: Not Required
9. Temperature Rise Hot Spot- Base Plate max 40 °C
10. Minimum Isolation Voltage
   Ns: 28V/36A Primary To Secondary and To Core 500 VDC
   Secondary to Core 500 VDC
11. Minimum Primary Inductance: 320 uH
12. Max. resistance Rdc, Primary: 4.5 mOhm
13. Max. resistance Rdc, SecondaryNs: 2.2 mOhm
14. Maximum Dimensions 2.180'' x 1.640'' x .700''
15. Maximum Weight: 200 g

2220 W Output P/N 1031
Description: P220-24-2C

Planar Quality
P/N 1031 Transformer
PATENT PENDING

Diam. 0.200 for #10 screw 3 places

Topology: Full Bridge ZVS

Notes:
1. Dimensions are in inches.
2. Tolerances +/- 2%
3. Drawing not to scale
P/N 1031 Application:
This transformer is based on our proprietary 220 size ferrite core and utilizes heavy copper multilayer planar winding technology. It delivers 2220 W of continuous power in a Full Bridge ZVS topology, 100 kHz industrial power supply. Input is 380 to 410 VDC bus and output is 12VDC with 185 amperes maximum load. Primary winding is well isolated from the core and from the secondary winding and has at least 8mm creepage and clearance distance from them. Transformer operates with 99.0% efficiency and has 41 deg. C temperature rise when mounted on +60 deg.C base plate and also cooled with moderate air flow. The part is very rugged and reliable and can be also used in military applications.

P/N 1031 Specification
1. Input Bus Voltage Range: 380 to 410 VDC
2. Converter Output After Rectification maximum: 2220W Primary To Secondary and To Core 5000 VDC
3. Ns (1T+1T with center-tap): 12V/185A Secondary to Core 500 VDC
4. Turns Ratio Np/Ns: 24 turns / 2 turns
5. Optimum Clock Switching Frequency: 100 kHz
6. Maximum Duty Cycle At Low Line: 80.0 %.
7. Efficiency At Full Power: 99.0 %.
8. Base Plate/Heatsink Maximum Temperature: +60 °C
10. Minimum Isolation Voltage 24 turns / 2 turns
11. Minimum Primary Inductance: 2880 uH
12. Max. resistance Rdc, Primary Np: 75 mOhm
13. Maximum resistance Rdc, Ns total: 0.21 mOhm
14. Max. Dimensions 2.600" x 1.640" x .800"
15. Maximum Weight: 220 g

2160 W Output P/N 1034
Description: P220-3-2C

Planar Quality
P/N 1034 Transformer
PATENT PENDING

Topology: Full Bridge

Notes:
1. Dimensions are in inches.
2. Tolerances +/- 2%
3. Drawing not to scale
P/N 1034 Application:
2.16 kW transformer for a full bridge industrial or military converter operates at a relatively low clock frequency of 60 kHz. At this frequency switching losses in semiconductors are quite manageable even for a standard full bridge without using ZVS technique. Because input bus voltage is limited to 160VDC isolation requirement is only 500VDC. This part utilizes copper leadframes, Polyimide insulators and has 1mm creepage and clearance distances. This is sufficient for a power supply that delivers output of 12VDC with 180 amperes continuous load. With 98.8 % efficiency and low thermal impedance temperature rise is 50 deg.C when mounted on +50 deg.C base plate and also cooled with a moderate air flow.

P/N 1034 Specification:

<table>
<thead>
<tr>
<th>Specification</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Input Bus Voltage Range:</td>
<td>90 to 160 VDC</td>
</tr>
<tr>
<td>2. Converter Output After Rectification maximum:</td>
<td>2160W</td>
</tr>
<tr>
<td>Ns (1T+1T with center-tap):</td>
<td>12V/180A</td>
</tr>
<tr>
<td>3. Turns Ratio Np/Ns:</td>
<td>3 turns / 2 turns</td>
</tr>
<tr>
<td>4. Optimum Clock Switching Frequency:</td>
<td>60 kHz</td>
</tr>
<tr>
<td>5. Maximum Duty Cycle:</td>
<td>89.0 %</td>
</tr>
<tr>
<td>6. Efficiency At Full Power:</td>
<td>98.8 %</td>
</tr>
<tr>
<td>7. Base Plate/Heatsink Maximum Temperature:</td>
<td>+50 °C</td>
</tr>
<tr>
<td>8. Air Flow temperature, Speed:</td>
<td>+50 °C, 200 LFM</td>
</tr>
<tr>
<td>9. Temperature Rise Hot Spot- Base Plate maximum:</td>
<td>50 °C</td>
</tr>
<tr>
<td>10. Minimum Isolation Voltage</td>
<td></td>
</tr>
<tr>
<td>Primary To Secondary and To Core</td>
<td>500 VDC</td>
</tr>
<tr>
<td>Secondary to Core</td>
<td>500 VDC</td>
</tr>
<tr>
<td>11. Minimum Primary Inductance:</td>
<td>45 uH</td>
</tr>
<tr>
<td>12. Maximum resistance Rd, Primary Winding:</td>
<td>0.62 mOhm</td>
</tr>
<tr>
<td>13. Maximum resistance Rd, Secondary Windings Ns total:</td>
<td>0.22 mOhm</td>
</tr>
</tbody>
</table>