Key Features
- Industry standard Eighth-brick
  58.4 x 22.7 x 8.10 mm (2.300 x 0.894 x 0.323 in.)
- High efficiency, typ. 92 % at half load
- 2250 Vdc input to output isolation
- Meets isolation requirements equivalent to basic insulation according to IEC/EN/UL 60950
- More than 4.7 million hours predicted MTBF at +40°C ambient temperature

General Characteristics
- Suited for narrow board pitch applications (15 mm/0.6 in)
- Output over voltage protection
- Input under voltage shutdown
- Over temperature protection
- Output short-circuit protection
- Remote sense
- Remote control
- Output voltage adjust function
- Highly automated manufacturing ensures quality
- ISO 9001/14001 certified supplier
- Optimized for high capacity load

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General Information

Ordering Information
See Contents for individual product ordering numbers.

<table>
<thead>
<tr>
<th>Option</th>
<th>Suffix</th>
<th>Ordering No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Positive Remote Control Logic</td>
<td>P</td>
<td>PKB 4717 PINB</td>
</tr>
<tr>
<td>Increased stand-off height</td>
<td>M</td>
<td>PKB 4717 PINBM</td>
</tr>
<tr>
<td>Lead length 3.69 mm (0.145 in)</td>
<td>LA</td>
<td>PKB 4717 PINBLA</td>
</tr>
<tr>
<td>Lead length 4.57 mm (0.180 in)</td>
<td>LB</td>
<td>PKB 4717 PINBLB</td>
</tr>
</tbody>
</table>

Note: As an example a positive logic, increased standoff, short pin product would be PKB 4717 PINBM.

Reliability
The failure rate ($\lambda$) and mean time between failures (MTBF = $1/\lambda$) is calculated at max output power and an operating ambient temperature ($T_A$) of +40°C. Flex uses Telcordia SR-332 Issue 2 Method 1 to calculate the mean steady-state failure rate and standard deviation ($\sigma$).

Telcordia SR-332 Issue 2 also provides techniques to estimate the upper confidence levels of failure rates based on the mean and standard deviation.

<table>
<thead>
<tr>
<th>Mean steady-state failure rate, $\lambda$</th>
<th>Std. deviation, $\sigma$</th>
</tr>
</thead>
<tbody>
<tr>
<td>214 nFailures/h</td>
<td>34.5 nFailures/h</td>
</tr>
</tbody>
</table>

MTBF (mean value) for the PKB series = 4.7 Mh.
MTBF at 90% confidence level = 3.9 Mh

Compatibility with RoHS requirements
The products are compatible with the relevant clauses and requirements of the RoHS directive 2002/95/EC and have a maximum concentration value of 0.1% by weight in homogeneous materials for lead, mercury, hexavalent chromium, PBB and PBDE, and of 0.01% by weight in homogeneous materials for cadmium.

Exemptions in the RoHS directive utilized in Flex products are found in the Statement of Compliance document.

Flex fulfills and will continuously fulfill all its obligations under regulation (EC) No 1907/2006 concerning the registration, evaluation, authorization and restriction of chemicals (REACH) as they enter into force and is through product materials declarations preparing for the obligations to communicate information on substances in the products.

Quality Statement
The products are designed and manufactured in an industrial environment where quality systems and methods like ISO 9000, Six Sigma, and SPC are intensively in use to boost the continuous improvements strategy. Infant mortality or early failures in the products are screened out and they are subjected to an ATE-based final test. Conservative design rules, design reviews and product qualifications, plus the high competence of an engaged work force, contribute to the high quality of the products.

Warranty
Warranty period and conditions are defined in Flex General Terms and Conditions of Sale.

Limitation of Liability
Flex does not make any other warranties, expressed or implied including any warranty of merchantability or fitness for a particular purpose (including, but not limited to, use in life support applications, where malfunctions of product can cause injury to a person’s health or life).

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Safety Specification

General Information

Flex DC/DC converters and DC/DC regulators are designed in accordance with safety standards

IEC/EN/UL 60950-1 Safety of Information Technology Equipment.

IEC/EN/UL 60950-1 contains requirements to prevent injury or damage due to the following hazards:

- Electrical shock
- Energy hazards
- Fire
- Mechanical and heat hazards
- Radiation hazards
- Chemical hazards

On-board DC/DC converters and DC/DC regulators are defined as component power supplies. As components they cannot fully comply with the provisions of any safety requirements without “Conditions of Acceptability”. Clearance between conductors and between conductive parts of the component power supply and conductors on the board in the final product must meet the applicable safety requirements. Certain conditions of acceptability apply for component power supplies with limited stand-off (see Mechanical Information for further information). It is the responsibility of the installer to ensure that the final product housing these components complies with the requirements of all applicable safety standards and regulations for the final product.

Component power supplies for general use should comply with the requirements in IEC 60950-1, EN 60950-1 and UL 60950-1 Safety of Information Technology Equipment.

There are other more product related standards, e.g. IEEE 802.3 CSMA/CD (Ethernet) Access Method, and ETS-300132-2 Power supply interface at the input to telecommunications equipment, operated by direct current (dc), but all of these standards are based on IEC/EN/UL 60950-1 with regards to safety.

Flex DC/DC converters and DC/DC regulators are UL 60950-1 recognized and certified in accordance with EN 60950-1.

The flammability rating for all construction parts of the products meet requirements for V-0 class material according to IEC 60695-11-10, Fire hazard testing, test flames – 50 W horizontal and vertical flame test methods.

The products should be installed in the end-use equipment, in accordance with the requirements of the ultimate application. Normally the output of the DC/DC converter is considered as SELV (Safety Extra Low Voltage) and the input source must be isolated by minimum Double or Reinforced Insulation from the primary circuit (AC mains) in accordance with IEC/EN/UL 60950-1.

Isolated DC/DC converters

It is recommended that a slow blow fuse is to be used at the input of each DC/DC converter. If an input filter is used in the circuit the fuse should be placed in front of the input filter.

In the rare event of a component problem that imposes a short circuit on the input source, this fuse will provide the following functions:

- Isolate the fault from the input power source so as not to affect the operation of other parts of the system.
- Protect the distribution wiring from excessive current and power loss thus preventing hazardous overheating.

The galvanic isolation is verified in an electric strength test. The test voltage (V_{iso}) between input and output is 1500 Vdc or 2250 Vdc (refer to product specification).

24 V DC systems

The input voltage to the DC/DC converter is SELV (Safety Extra Low Voltage) and the output remains SELV under normal and abnormal operating conditions.

48 and 60 V DC systems

If the input voltage to the DC/DC converter is 75 Vdc or less, then the output remains SELV (Safety Extra Low Voltage) under normal and abnormal operating conditions.

Single fault testing in the input power supply circuit should be performed with the DC/DC converter connected to demonstrate that the input voltage does not exceed 75 Vdc.

If the input power source circuit is a DC power system, the source may be treated as a TNV-2 circuit and testing has demonstrated compliance with SELV limits in accordance with IEC/EN/UL60950-1.

Non-isolated DC/DC regulators

The input voltage to the DC/DC regulator is SELV (Safety Extra Low Voltage) and the output remains SELV under normal and abnormal operating conditions.
Absolute Maximum Ratings

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>min</th>
<th>typ</th>
<th>max</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>$T_{\text{ref}}$ Operating Temperature (see Thermal Consideration section)</td>
<td>-45</td>
<td>+110</td>
<td>°C</td>
<td></td>
</tr>
<tr>
<td>$T_S$ Storage temperature</td>
<td>-55</td>
<td>+125</td>
<td>°C</td>
<td></td>
</tr>
<tr>
<td>$V_i$ Input voltage</td>
<td>-0.5</td>
<td>+80</td>
<td>V</td>
<td></td>
</tr>
<tr>
<td>$V_{\text{iso}}$ Isolation voltage (input to output test voltage)</td>
<td>2250</td>
<td></td>
<td>V</td>
<td></td>
</tr>
<tr>
<td>$V_{tr}$ Input voltage transient ($t_p$ 100 ms)</td>
<td>100</td>
<td></td>
<td>V</td>
<td></td>
</tr>
<tr>
<td>$V_{\text{RC}}$ Remote Control pin voltage (see Operating Information section)</td>
<td>-0.5</td>
<td>6</td>
<td>V</td>
<td></td>
</tr>
<tr>
<td>$V_{\text{adj}}$ Adjust pin voltage (see Operating Information section)</td>
<td>-0.5</td>
<td>2x$V_{\text{oi}}$</td>
<td>V</td>
<td></td>
</tr>
</tbody>
</table>

Stress in excess of Absolute Maximum Ratings may cause permanent damage. Absolute Maximum Ratings, sometimes referred to as no destruction limits, are normally tested with one parameter at a time exceeding the limits of Output data or Electrical Characteristics. If exposed to stress above these limits, function and performance may degrade in an unspecified manner.

Fundamental Circuit Diagram
7.2 V/10.5 A Electrical Specification

$T_{\text{ref}} = -40$ to $+90^\circ \text{C}$, $V_{I} = 36$ to 75 V, sense pins connected to output pins unless otherwise specified under Conditions.

Typical values given at: $T_{\text{ref}} = +25^\circ \text{C}, V_{I} = 53\text{ V}, \text{max } I_{O}$, unless otherwise specified under Conditions.

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Conditions</th>
<th>min</th>
<th>typ</th>
<th>max</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>$V_{I}$ Input voltage range</td>
<td></td>
<td>36</td>
<td>75</td>
<td></td>
<td>V</td>
</tr>
<tr>
<td>$V_{\text{off}}$ Turn-off input voltage</td>
<td>Decreasing input voltage</td>
<td>30</td>
<td>31</td>
<td>35</td>
<td>V</td>
</tr>
<tr>
<td>$V_{\text{on}}$ Turn-on input voltage</td>
<td>Increasing input voltage</td>
<td>32</td>
<td>34</td>
<td>36</td>
<td>V</td>
</tr>
<tr>
<td>$C_{\text{in}}$ Internal input capacitance</td>
<td></td>
<td>3</td>
<td></td>
<td></td>
<td>$\mu\text{F}$</td>
</tr>
<tr>
<td>$P_{O}$ Output power</td>
<td>Output voltage initial setting</td>
<td>0</td>
<td>75</td>
<td></td>
<td>W</td>
</tr>
<tr>
<td>SVR Supply voltage rejection (ac)</td>
<td>$f = 100\text{ Hz sinewave, }1\text{ Vp-p}$</td>
<td>66</td>
<td></td>
<td></td>
<td>dB</td>
</tr>
<tr>
<td>$\eta$ Efficiency</td>
<td>50 % of max $I_{O}$</td>
<td>91.7</td>
<td></td>
<td></td>
<td>%</td>
</tr>
<tr>
<td></td>
<td>max $I_{O}$</td>
<td>90.7</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>50 % of max $I_{O}$, $V_{I} = 48\text{ V}$</td>
<td>92.0</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>max $I_{O}$, $V_{I} = 48\text{ V}$</td>
<td>90.7</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$P_{D}$ Power Dissipation</td>
<td>max $I_{O}$</td>
<td>7.8</td>
<td>9.8</td>
<td></td>
<td>W</td>
</tr>
<tr>
<td>$P_{I}$ Input idling power</td>
<td>$I_{O} = 0\text{ A, }V_{I} = 53\text{ V}$</td>
<td>1.7</td>
<td></td>
<td></td>
<td>W</td>
</tr>
<tr>
<td>$P_{\text{RC}}$ Input standby power</td>
<td>$V_{I} = 53\text{ V (turned off with RC)}$</td>
<td>0.15</td>
<td></td>
<td></td>
<td>W</td>
</tr>
<tr>
<td>$f_{s}$ Switching frequency</td>
<td>0-100 % of max $I_{O}$ (see Note 1)</td>
<td>200</td>
<td></td>
<td></td>
<td>kHz</td>
</tr>
</tbody>
</table>

$V_{O}$ Output voltage initial setting and accuracy

| $V_{O}$                                      | $T_{\text{ref}} = +25^\circ \text{C}, V_{I} = 53\text{ V, }I_{O} = 10.5\text{ A}$ | 7.05 | 7.2 | 7.35 | V    |
| Output adjust range                         | See operating information (see Note 2)                                         | 6    | 7.8 |      | V    |
| Output voltage tolerance band               | 10-100 % of max $I_{O}$                                                      | 6.98 | 7.42|      | V    |
| Idling voltage                              | $I_{O} = 0\text{ A}$                                                        | 7.05 | 7.35|      | V    |
| Line regulation                             | max $I_{O}$                                                                  | 2    | 4   |      | mv   |
| Load regulation                             | $V_{I} = 53\text{ V, }0-100\text{ % of max }I_{O}$                          | 2    | 4   |      | mv   |
| $V_{O}$ Load transient voltage deviation    | $V_{I} = 53\text{ V, Load step 25-75-25 % of max }I_{O}$, di/dt = 1 A/μs      | ±330 |     |      | mv   |
| $t_{r}$ Load transient recovery time        |                                                                                  | 100  |     |      | μs   |
| $t_{r}$ Ramp-up time (from 10-90 % of $V_{O}$) | 10-100 % of max $I_{O}$                                                  | 6.5  | 11.6|      | ms   |
| $t_{s}$ Start-up time (from $V_{I}$ connection to 90 % of $V_{O}$) |                                                | 9.8  | 23.5|      | ms   |
| $t_{b}$ $V_{I}$ shut-down fall time (from $V_{I}$ off to 10 % of $V_{O}$) | max $I_{O}$                                                                  | 0.2  |     |      | ms   |
| $I_{O}$ Output current                      |                                                                                  | 0    | 10.5|      | A    |
| $I_{\text{lim}}$ Current limit threshold    | $T_{\text{ref}} < \text{max }T_{\text{ref}}$                                  | 14   |     |      | A    |
| $I_{\text{sc}}$ Short circuit current       | $T_{\text{ref}} = 25^\circ \text{C}$                                         | 16   |     |      | A    |
| $V_{\text{Oac}}$ Output ripple & noise      | See ripple & noise section, max $I_{O}, V_{O}$                                | 50   | 120 |      | mVp-p |
| OVP Over voltage protection                 | $T_{\text{ref}} = +25^\circ \text{C, }V_{I} = 53\text{ V, }0-100\text{ % of max }I_{O}$ | 8    |     |      | V    |

Note 1: Frequency may be adjusted with RT-pin. See Operating Information section.

Note 2: When input voltage is 36 V and output is trimmed up to 7.8V, output current can only be 20%–50% Max $I_{O}$. 

PKB 4717 PINB
DC/DC converters, Input 36–75 V, Output 10.5 A/75 W

EN/LZT 146 382 R3A November 2017
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Technical Specification

PKB 4717 PINB
DC/DC converters, Input 36–75 V, Output 10.5 A/75 W

EN/LZT 146 382 R3A November 2017
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7.2 V/10.5 A Typical Characteristics

**Efficiency**

![Efficiency graph](image)

Efficiency vs. load current and input voltage at $T_{ref} = +25^\circ C$

**Power Dissipation**

![Power Dissipation graph](image)

Dissipated power vs. load current and input voltage at $T_{ref} = +25^\circ C$

**Output Current Derating**

![Output Current Derating graph](image)

Available load current vs. ambient air temperature and airflow at $V_i = 53$ V. See Thermal Consideration section.

**Thermal Resistance**

![Thermal Resistance graph](image)

Thermal resistance vs. airspeed measured at the converter. Tested in wind tunnel with airflow and test conditions as per the Thermal consideration section.

**Output Characteristics**

![Output Characteristics graph](image)

Output voltage vs. load current at $T_{ref} = +25^\circ C$

**Current Limit Characteristics**

![Current Limit Characteristics graph](image)

Output voltage vs. load current at $I_O > I_{O,max}$, $T_{ref} = +25^\circ C$
7.2 V/10.5 A Typical Characteristics

**Start-up**

Start-up enabled by connecting V, at:

\[ T_{ref} = +25°C, V_{I} = 53 V, I_{O} = 10.5 A \text{ resistive load.} \]

Top trace: output voltage (2V/div.).
Bottom trace: input voltage (20V/div.).
Time scale: (5ms/div.).

**Shut-down**

Shut-down enabled by disconnecting V, at:

\[ T_{ref} = +25°C, V_{I} = 53 V, I_{O} = 10.5 A \text{ resistive load.} \]

Top trace: output voltage (2V/div.).
Bottom trace: input voltage (50V/div.).
Time scale: (0.1ms/div.).

**Output Ripple & Noise**

Output voltage ripple at:

\[ T_{ref} = +25°C, V_{I} = 53 V, I_{O} = 10.5 A \text{ resistive load.} \]

Trace: output voltage (20mV/div.).
Time scale: (2μs/div.).

**Output Load Transient Response**

Output voltage response to load current step-change (2.5-7.5-2.5 A) at:

\[ T_{ref} = +25°C, V_{I} = 53 V. \]

Top trace: output voltage (200mV/div.).
Bottom trace: load current (5A/div.).
Time scale: (0.1ms/div.).

**Output Voltage Adjust (see operating information)**

**Passive adjust**

The resistor value for an adjusted output voltage is calculated by using the following equations:

Output Voltage Adjust Upwards, Increase:

\[
R_{adj} = \left( \frac{5.11 \times 7.2 \left( V_{\text{out}} - 1.225 \right)}{1.225 \times V_{\text{out}} - 1225 \times 7.2} \right) \Omega
\]

Output Voltage Adjust Downwards, Decrease:

\[
R_{adj} = \left( \frac{5.11 \times \left( 2V_{\text{out}} - 7.2 \right)}{7.2 - V_{\text{out}}} \right) \Omega
\]

Example: Upwards => \( V_{\text{out}} = 7.85 \text{ Vdc} \)

\[
\left( \frac{5.11 \times 7.2 \left( 7.85 - 1.225 \right)}{1.225 \times 7.85 - 1225 \times 7.2} \right) \Omega = 296 \Omega
\]

**Active adjust**

The output voltage may be adjusted using a voltage applied to the Vadj pin. This voltage is calculated by using the following equations:

\[
V_{\text{adj}} = \left( 1.225 + 2.45 \times \frac{V_{\text{desired}} - 7.2}{7.2} \right) \text{ V}
\]

Example: Upwards => 7.85 V

\[
\left( 1.225 + 2.45 \times \frac{7.85 - 7.2}{7.2} \right) \text{ V} = 1.45 \text{ V}
\]
EMC Specification

Conducted EMI measured according to EN55022, CISPR 22 and FCC part 15J (see test set-up). See Design Note 009 for further information. The fundamental switching frequency is 200 kHz for PKB 4717 PINB @ \( V_i = 53 \) V, max \( I_o \).

**Conducted EMI** Input terminal value (typ)

![Conducted EMI Input terminal value (typ)](image1)

EMI without filter

**External filter (class B)**

Required external input filter in order to meet class B in EN 55022, CISPR 22 and FCC part 15J.

![External filter (class B)](image2)

Filter components:
- \( C_{1,2,6} = 1 \) μF/100 V Ceramic
- \( C_3, 4 = 2.2 \) nF/1500 V Ceramic
- \( C_5 = 100 \) μF/100 V Electrolytic
- \( L_1, L_2 = 1.47 \) mH 2.8 A, Common Mode

**Test set-up**

![Test set-up](image3)

**Layout recommendation**

The radiated EMI performance of the DC/DC converter will depend on the PCB layout and ground layer design. It is also important to consider the stand-off of the DC/DC converter.

If a ground layer is used, it should be connected to the output of the DC/DC converter and the equipment ground or chassis.

A ground layer will increase the stray capacitance in the PCB and improve the high frequency EMC performance.

**Output ripple and noise**

Output ripple and noise measured according to figure below. See Design Note 022 for detailed information.

![Output ripple and noise](image4)

Output ripple and noise test setup

* Conductor from Vout to capacitor = 50mm (1.97in)
Operating information

**Input Voltage**
The input voltage range 36 to 75Vdc meets the requirements of the European Telecom Standard ETS 300 132-2 for normal input voltage range in —48 and —60 Vdc systems, 40.5 to -57.0 V and -50.0 to -72 V respectively. At input voltages exceeding 75 V, the power loss will be higher than at normal input voltage and T_{ref} must be limited to absolute max +110°C. The absolute maximum continuous input voltage is 80 Vdc.

**Turn-off Input Voltage**
The DC/DC converters monitor the input voltage and will turn on and turn off at predetermined levels. The minimum hysteresis between turn on and turn off input voltage is 1V.

**Remote Control (RC)**
The products are fitted with a remote control function referenced to the primary negative input connection (-In), with negative logic option available. The RC function allows the converter to be turned on/off by an external device like a semiconductor or mechanical switch. The RC pin has an internal pull up resistor to +In.

The maximum required sink current is 1 mA. When the RC pin is left open, the voltage generated on the RC pin is 12 – 15 V.

See Design Note 021 for detailed information.

**Input and Output Impedance**
The impedance of both the input source and the load will interact with the impedance of the DC/DC converter. It is important that the input source has low characteristic impedance. The converters are designed for stable operation without external capacitors connected to the input or output. The performance in some applications can be enhanced by addition of external capacitance as described under External Decoupling Capacitors. If the input voltage source contains significant inductance, the addition of a 100 μF capacitor across the input of the converter will ensure stable operation. The capacitor is not required when powering the DC/DC converter from an input source with inductance below 10 μH.

**External Decoupling Capacitors**
When powering loads with significant dynamic current requirements, the voltage regulation at the point of load can be improved by addition of decoupling capacitors at the load. The most effective technique is to locate low ESR ceramic and electrolytic capacitors as close to the load as possible, using several parallel capacitors to lower the effective ESR.
Operating information continued

Remote Sense
The DC/DC converters have remote sense that can be used to compensate for voltage drops between the output and the point of load. The sense traces should be located close to the PCB ground layer to reduce noise susceptibility. The remote sense circuitry will compensate for up to 10% voltage drop between output pins and the point of load.

If the remote sense is not needed +Sense should be connected to +Out and -Sense should be connected to -Out.

Over Temperature Protection (OTP)
The converters are protected from thermal overload by an internal over temperature shutdown function of the control IC. When $T_{\text{ref}}$ as defined in thermal consideration section exceeds 120°C the converter will shut down. The DC/DC converter will make continuous attempts to start up (non-latching mode) and resume normal operation automatically when the temperature has dropped >10°C below the temperature threshold.

Over Voltage Protection (OVP)
The converters have output over voltage protection that will shut down the converter in over voltage conditions. The converter will make continuous attempts to start up (non-latching mode) and resume normal operation automatically after removal of the over voltage condition.

Over Current Protection (OCP)
The converters include current limiting circuitry for protection at continuous overload.
The output voltage will decrease towards zero for output currents in excess of max output current ($I_{\text{O}}$). The converter will resume normal operation after removal of the overload. The load distribution should be designed for the maximum output short circuit current specified.

Thermal Consideration

General
The converters are designed to operate in different thermal environments and sufficient cooling must be provided to ensure reliable operation.
Cooling is achieved mainly by conduction, from the pins to the host board, and convection, which is dependent on the airflow across the converter. Increased airflow enhances the cooling of the converter.

The Output Current Derating graph found in the Output section for each model provides the available output current vs. ambient air temperature and air velocity at $V_{\text{in}} = 53$ V.

The DC/DC converter is tested on a 254 x 254 mm, 35 μm (1 oz), 16-layer test board mounted vertically in a wind tunnel with a cross-section of 305 x 305 mm.

Proper cooling of the DC/DC converter can be verified by measuring the temperature at positions P1, P2 and P3. The temperature at these positions should not exceed the max values provided in the table below.

Note that the max value is the absolute maximum rating (non destruction) and that the electrical Output data is guaranteed up to $T_{\text{ref}} +90^\circ$C.

See Design Note 019 for further information.

<table>
<thead>
<tr>
<th>Position</th>
<th>Device</th>
<th>Designation</th>
<th>max value</th>
</tr>
</thead>
<tbody>
<tr>
<td>P1</td>
<td>Pcb</td>
<td>$T_{\text{ref}}$</td>
<td>110°C</td>
</tr>
<tr>
<td>P2</td>
<td>Mosfet</td>
<td>$T_{\text{ref}}$</td>
<td>120°C</td>
</tr>
<tr>
<td>P3</td>
<td>Mosfet</td>
<td>$T_{\text{ref}}$</td>
<td>120°C</td>
</tr>
</tbody>
</table>
Thermal Consideration continued

**Definition of reference temperature (T\text{ref})**

The reference temperature is used to monitor the temperature limits of the product. Temperatures above maximum T\text{ref} are not allowed and may cause degradation or permanent damage to the product. T\text{ref} is also used to define the temperature range for normal operating conditions. T\text{ref} is defined by the design and used to guarantee safety margins, proper operation and high reliability of the module.

**Ambient Temperature Calculation**

By using the thermal resistance the maximum allowed ambient temperature can be calculated.

1. The power loss is calculated by using the formula \(((1/\eta) - 1) \times \text{output power} = \text{power losses (Pd)}\).

   \[ \eta = \text{efficiency of converter. } E.g \text{ 89.5\%} = 0.895 \]

2. Find the thermal resistance (Rth) in the Thermal Resistance graph found in the Output section for each model. Calculate the temperature increase (\Delta T).

   \[ \Delta T = Rth \times Pd \]

3. Max allowed ambient temperature is:

   \[ \text{Max T}\text{ref} - \Delta T \]

E.g PKB 4717 PINB at 1m/s with full load:

1. \((\frac{1}{0.895}) - 1\) \times 75 W = 8.79 W
2. 8.79 W \times 6.0°C/W = 53°C
3. 110 °C - 53°C = max ambient temperature is 57°C

The actual temperature will be dependent on several factors such as the PCB size, number of layers and direction of airflow.

**Connections**

<table>
<thead>
<tr>
<th>Pin</th>
<th>Designation</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>+In</td>
<td>Positive input</td>
</tr>
<tr>
<td>2</td>
<td>RC</td>
<td>Remote control</td>
</tr>
<tr>
<td>3</td>
<td>-In</td>
<td>Negative input</td>
</tr>
<tr>
<td>4</td>
<td>-Out</td>
<td>Negative output</td>
</tr>
<tr>
<td>5</td>
<td>-Sen</td>
<td>Negative remote sense</td>
</tr>
<tr>
<td>6</td>
<td>Vadj</td>
<td>Output voltage adjust</td>
</tr>
<tr>
<td>7</td>
<td>+Sen</td>
<td>Positive remote sense</td>
</tr>
<tr>
<td>8</td>
<td>+Out</td>
<td>Positive output</td>
</tr>
</tbody>
</table>

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*PKB 4717 PINB  
DC/DC converters, Input 36-75 V, Output 10.5 A/75 W  
EN/LZT 146 382 R3A November 2017  
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PKB 4717 PINB
DC/DC converters, Input 36-75 V, Output 10.5 A/75 W

Mechanical Information

PKB 4717 PINB
DC/DC converters, Input 36-75 V, Output 10.5 A/75 W

Top View

Recommended Footprint - Top View

Width: Typical 20 g

Pins:
Material: pins 1-3, 5-7: Brass
Material: pins 4, 6: Copper alloy
Plating: 0.1 µm Gold over 2 µm Nickel

All dimensions in mm (inch)
Tolerances unless specified
xx mm ±0.05 mm (0.002)
xxx mm ±0.25 mm (0.01)
(not applied on footprint or typical values)
Soldering Information
No-clean flux is recommended to avoid entrapment of cleaning fluids in cavities inside the product or between the product and the host board. The cleaning residues may affect long time reliability and isolation voltage.

Delivery Package Information
The products are delivered in antistatic clamshell.

<table>
<thead>
<tr>
<th>Clamshell Specifications</th>
</tr>
</thead>
<tbody>
<tr>
<td>Material: PET with antistatic coated</td>
</tr>
<tr>
<td>Surface resistance: $10^6 &lt; \text{Ohm/square} &lt; 10^{12}$</td>
</tr>
<tr>
<td>Bake ability: The clamshells are not bakeable.</td>
</tr>
<tr>
<td>Clamshell capacity: 20 products/clamshell</td>
</tr>
<tr>
<td>Clamshell thickness: 20 mm [0.787 inch]</td>
</tr>
<tr>
<td>Box capacity: 100 products (5 full trays/box)</td>
</tr>
<tr>
<td>Clamshell weight: 130 g empty, 530 g full tray</td>
</tr>
</tbody>
</table>
Product Qualification Specification

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>External visual inspection</td>
<td>IPC-A-610</td>
</tr>
</tbody>
</table>
| Dry heat                                    | IEC 60068-2-2 Bd  
|                                            | Temperature Duration  
|                                            | +125 °C 1000 h                                                           |
| Cold (in operation)                         | IEC 60068-2-1 Ad  
|                                            | Temperature T_A Duration  
|                                            | -45°C 72 h                                                                |
| Damp heat                                   | IEC 60068-2-67 Cy  
|                                            | Temperature Humidity Duration  
|                                            | +85 °C 85 % RH 1000 hours                                                |
| Operational life test                       | MIL-STD-202G method 108A  
|                                            | Duration  
|                                            | 1000 h                                                                    |
| Change of temperature (Temperature cycling) | IEC 60068-2-14 Na  
|                                            | Temperature range  
|                                            | Number of cycles  
|                                            | Dwell/transfer time  
|                                            | -40 to +100 °C 1000 15 min/0-1 min                                        |
| Vibration, broad band random                | IEC 60068-2-64 Fh, method 1  
|                                            | Frequency Spectral density Duration  
|                                            | 10 to 500 Hz 0.07 g²/Hz 10 min in each 3 perpendicular directions       |
| Mechanical shock                            | IEC 60068-2-27 Ea  
|                                            | Peak acceleration Duration  
|                                            | Pulse shape Directions Number of pulses  
|                                            | 100 g 6 ms Half sine 6 18 (3 + 3 in each perpendicular direction)        |
| Robustness of terminations                  | IEC 60068-2-21 Test Ua1  
|                                            | Plated through hole mount products  
|                                            | All leads                                                                 |
| Resistance to soldering heat                | IEC 60068-2-20 Tb Method 1A  
|                                            | Solder temperature Duration  
|                                            | 270° C 10-13 s                                                           |
| Solderability                               | IEC 60068-2-20 test Ta  
|                                            | Preconditioning  
|                                            | Temperature, SnPb Eutectic Temperature, Pb-free  
|                                            | Steam ageing  
|                                            | 235° C 260° C                                                             |
| Immersion in cleaning solvents              | IEC 60068-2-45 XA Method 2  
|                                            | Water Glycol ether Isopropanol  
|                                            | +55° C +35° C +35° C                                                     |