PKE 8000A series Direct Converters
Input 9-75 V, Output up to 10 A / 40 W

Key Features
• Industry standard case dimensions
  50.8 x 25.4 x 11.9 mm (2 x 1 x 0.47 in)
• High Efficiency up to 91%
• 2250 Vdc input to output isolation
• Meets functional insulation and safety requirements according to IEC/UL 62368
• Complies with EN 45545-2 standard

General Characteristics
• Input under voltage shutdown
• Remote control
• Output over voltage protection
• Over temperature protection
• Output short-circuit protection
• Output voltage adjust function

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Safety Approvals
Design for Environment
Meets requirements in high-temperature lead-free soldering processes.
Technical Specification

PKE 8000A series Direct Converters
Input 9-75 V, Output up to 10 A / 40 W

Ordering Information

<table>
<thead>
<tr>
<th>Product program</th>
<th>Output</th>
</tr>
</thead>
<tbody>
<tr>
<td>PKE 8410A PIP</td>
<td>3.3V, 10A / 33 W</td>
</tr>
<tr>
<td>PKE 8411A PIP</td>
<td>5V, 8A / 40 W</td>
</tr>
<tr>
<td>PKE 8413A PIP</td>
<td>12V, 3.33A / 40 W</td>
</tr>
<tr>
<td>PKE 8415A PIP</td>
<td>15V, 2.67A / 40 W</td>
</tr>
</tbody>
</table>

Product number and Packaging

<table>
<thead>
<tr>
<th>Options</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Remote Control logic</td>
<td>P</td>
</tr>
<tr>
<td>n1</td>
<td>Negative*</td>
</tr>
</tbody>
</table>

Example: a product with positive logic, tray packaging would be PKE 84XX PIP.

* Standard variant (i.e. no option selected).

Compatibility with RoHS requirements

The products are compatible with the relevant clauses and requirements of the RoHS directive 2011/65/EU 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.

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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The information and specifications in this technical specification is believed to be correct at the time of publication. However, no liability is accepted for inaccuracies, printing errors or for any consequences thereof. Flex reserves the right to change the contents of this technical specification at any time without prior notice.
PKE 8000A series Direct Converters
Input 9-75 V, Output up to 10 A / 40 W

Safety Specification

General information
Flex Power DC/DC converters and DC/DC regulators are designed in accordance with the safety standards
IEC 62368-1, EN 62368-1 and UL 62368-1 Audio/video, information and communication technology equipment -
Part 1: Safety requirements

IEC/EN/UL 62368-1 contains requirements to prevent injury or damage due to the following hazards:

- Electrical shock
- Electrically-caused fire
- Injury caused by hazardous substances
- Mechanically-caused injury
- Skin burn
- Radiation-caused injury

On-board DC/DC converters, Power interface modules 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 shall comply
with the requirements in IEC/EN/UL 62368-1. Product
related standards, e.g. IEEE 802.3af Power over Ethernet,
and ETS-300132-2 Power interface at the input to telecom
equipment, operated by direct current (dc) are based on
IEC/EN/UL 60950-1 with regards to safety.

Flex Power DC/DC converters, Power interface modules
and DC/DC regulators are UL 62368-1 recognized and
certified in accordance with EN 62368-1. 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.

Isolated DC/DC converters & Power interface modules

The product may provide basic or functional insulation
between input and output according to IEC/EN/UL 62368-1
(see Safety Certificate), different conditions shall be met if
the output of a basic or a functional insulated product shall
be considered as ES1 energy source.

For basic insulated products (see Safety Certificate) the
output is considered as ES1 energy source if one of the
following conditions is met:

- The input source provides supplementary or double or
  reinforced insulation from the AC mains according to
  IEC/EN/UL 62368-1.
- The input source provides functional or basic insulation
  from the AC mains and the product’s output is reliably
  connected to protective earth according to
  IEC/EN/UL 62368-1.

For functional insulated products (see Safety Certificate)
the output is considered as ES1 energy source if one of the
following conditions is met:

- The input source provides double or reinforced
  insulation from the AC mains according to
  IEC/EN/UL 62368-1.
- The input source provides basic or supplementary
  insulation from the AC mains and the product’s output is
  reliably connected to protective earth according to
  IEC/EN/UL 62368-1.
- The input source is reliably connected to protective
  earth and provides basic or supplementary insulation
  according to IEC/EN/UL 62368-1 and the maximum
  input source voltage is 60 Vdc.

Galvanic isolation between input and output is verified in an
electric strength test and the isolation voltage (Viso) meets
the voltage strength requirement for basic insulation
according to IEC/EN/UL 62368-1.

It is recommended to use a slow blow fuse 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
**Technical Specification**

**PKE 8000A series Direct Converters**  
Input 9-75 V, Output up to 10 A / 40 W

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2/28701- BMR712 Rev. C December 2019

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### 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_{TH} Operating Temperature</td>
<td>-40</td>
<td>+115</td>
<td>°C</td>
<td></td>
</tr>
<tr>
<td>T_{SS} Storage temperature</td>
<td>-55</td>
<td>+125</td>
<td>°C</td>
<td></td>
</tr>
<tr>
<td>V_{i} Input voltage</td>
<td>9</td>
<td>75</td>
<td>V</td>
<td></td>
</tr>
<tr>
<td>V_{iso} Isolation voltage (input to output)</td>
<td></td>
<td>3000</td>
<td>Vdc</td>
<td></td>
</tr>
<tr>
<td>V_{iso} Isolation voltage (input to case)</td>
<td></td>
<td>2000</td>
<td>Vdc</td>
<td></td>
</tr>
<tr>
<td>V_{iso} Isolation voltage (output to case)</td>
<td></td>
<td>1500</td>
<td>Vdc</td>
<td></td>
</tr>
<tr>
<td>V_{TR} Input voltage transient (Tp 1s)</td>
<td></td>
<td>+100</td>
<td>V</td>
<td></td>
</tr>
<tr>
<td>V_{RC} Remote Control pin voltage</td>
<td>-0.3</td>
<td>+10</td>
<td>V</td>
<td></td>
</tr>
</tbody>
</table>

Stresses above those listed under Absolute Maximum Ratings may cause permanent damage to the device. This is a stress rating only; functional operation of the device at these or any other conditions above those indicated in the Electrical Specification section of this specification is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

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### Fundamental Circuit Diagram

![Circuit Diagram](image)
### Electrical Specification

**3.3 V, 10 A / 33 W**

Typical values given at: \( T_{PI} = +25^\circ C, V_i = 48 V \), max \( I_o \), unless otherwise specified under Conditions.

At least 330uF E-Cap be added in the input terminal for stabilize input voltage source. (680uF E-Cap be added in the output terminal for stabilize)

<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>9</td>
<td>75</td>
<td>V</td>
<td></td>
</tr>
<tr>
<td>( V_{loff} ) Turn-off input voltage Decreasing input voltage</td>
<td>7.5 V</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>( V_{lon} ) Turn-on input voltage Increasing input voltage</td>
<td>8.5 V</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>OVP Input Over voltage protection</td>
<td>77.5 V</td>
<td>80</td>
<td></td>
<td>V</td>
<td></td>
</tr>
<tr>
<td>( C_i ) Internal input capacitance</td>
<td>12 μF</td>
<td></td>
<td></td>
<td>μF</td>
<td></td>
</tr>
<tr>
<td>( P_o ) Output power Note2</td>
<td></td>
<td>0</td>
<td>33 W</td>
<td></td>
<td></td>
</tr>
<tr>
<td>( \eta ) Efficiency 50% of max ( I_o ), ( V_i = 12 V )</td>
<td>89 %</td>
<td></td>
<td></td>
<td>%</td>
<td></td>
</tr>
<tr>
<td>max ( I_o ), ( V_i = 12 V )</td>
<td>85 %</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>50% of max ( I_o ), ( V_i = 24 V )</td>
<td>89 %</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>max ( I_o ), ( V_i = 24 V )</td>
<td>87 %</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>50% of max ( I_o ), ( V_i = 48 V )</td>
<td>87 %</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>max ( I_o ), ( V_i = 48 V )</td>
<td>87 %</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>( P_d ) Power Dissipation max ( I_o )</td>
<td>8.3 W</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>( P_i ) Input idling power ( I_o = 0 A, V_i = 48 V )</td>
<td>0.42 W</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>( f_s ) Switching frequency 0-100 % of max ( I_o )</td>
<td>198 kHz</td>
<td>220 kHz</td>
<td>242 kHz</td>
<td>kHz</td>
<td></td>
</tr>
<tr>
<td>( V_{oi} ) Output voltage initial setting and accuracy ( T_{PI} = +25^\circ C, V_i = 48 V, I_o = 10 A )</td>
<td>3.267 V</td>
<td>3.3 V</td>
<td>3.333 V</td>
<td>V</td>
<td></td>
</tr>
<tr>
<td>Output adjust range</td>
<td>2.97 V</td>
<td>3.63 V</td>
<td></td>
<td>V</td>
<td></td>
</tr>
<tr>
<td>Output voltage tolerance band 0-100 % of max ( I_o )</td>
<td>3.201 V</td>
<td>3.399 V</td>
<td></td>
<td>V</td>
<td></td>
</tr>
<tr>
<td>Idling voltage ( I_o = 0 A )</td>
<td>3.201 V</td>
<td>3.399 V</td>
<td></td>
<td>V</td>
<td></td>
</tr>
<tr>
<td>Line regulation max ( I_o )</td>
<td>-33 mV</td>
<td>33 mV</td>
<td></td>
<td>mV</td>
<td></td>
</tr>
<tr>
<td>Load regulation ( V_i = 48 V, 0-100 % of max ( I_o )</td>
<td>-33 mV</td>
<td>33 mV</td>
<td></td>
<td>mV</td>
<td></td>
</tr>
<tr>
<td>( V_{tr} ) Load transient voltage deviation ( V_i = 48 V ), Load step 50-75-50% of max ( I_o ), ( \frac{di}{dt} = 1 A/\mu s )</td>
<td>±200 mV</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>( I_{tr} ) Load transient recovery time</td>
<td>500 μs</td>
<td></td>
<td></td>
<td>μs</td>
<td></td>
</tr>
<tr>
<td>( I_{ramp} ) Ramp-up time (from 10–90% of ( V_o )) 10-100% of max ( I_o ), ( T_{PI} = +25^\circ C, V_i = 48 V )</td>
<td>20 ms</td>
<td></td>
<td></td>
<td>ms</td>
<td></td>
</tr>
<tr>
<td>( I_{st} ) Start-up time (from ( V_i ) connection to 90% of ( V_o ))</td>
<td>24 ms</td>
<td></td>
<td></td>
<td>ms</td>
<td></td>
</tr>
<tr>
<td>( I_{shu} ) ( V ) shut-down fall time (from ( V_i ) off to 10% of ( V_o )) max ( I_o )</td>
<td>200 us</td>
<td></td>
<td></td>
<td>us</td>
<td></td>
</tr>
<tr>
<td>( I_{RC} ) RC start-up time max ( I_o )</td>
<td>12 ms</td>
<td></td>
<td></td>
<td>ms</td>
<td></td>
</tr>
<tr>
<td>( I_o ) Output current</td>
<td>10 A</td>
<td></td>
<td></td>
<td>A</td>
<td></td>
</tr>
<tr>
<td>( I_{lim} ) Current limit threshold ( T_{PI} &lt; \max T_{PI} )</td>
<td>12.5 A</td>
<td>20 A</td>
<td></td>
<td>A</td>
<td></td>
</tr>
<tr>
<td>( I_{sc} ) Short circuit current ( T_{PI} = +25^\circ C )</td>
<td>0.32 A</td>
<td></td>
<td></td>
<td>A</td>
<td></td>
</tr>
<tr>
<td>( C_{out} ) Recommended Capacitive Load ( T_{PI} = +25^\circ C )</td>
<td>680 μF</td>
<td>5000 μF</td>
<td></td>
<td>μF</td>
<td></td>
</tr>
<tr>
<td>( V_{on} ) Output ripple &amp; noise See ripple &amp; noise section, ( V_o ), max ( I_o ), see Note 1</td>
<td>20 mVp-p</td>
<td>40 mVp-p</td>
<td></td>
<td>mVp-p</td>
<td></td>
</tr>
<tr>
<td>OVP Over voltage protection ( T_{PI} = +25^\circ C, V_i = 48 V, 10-100% of max ( I_o )</td>
<td>4.3 V</td>
<td></td>
<td></td>
<td>V</td>
<td></td>
</tr>
</tbody>
</table>

**Note 1:** Measured with 0.1uF ceramic Cap. and 10uF tantalum(or EE) Cap. cross to output.
PKE 8000A series Direct Converters
Input 9-75 V, Output up to 10 A / 40 W

Note 2: PKE 8410A PIP Power Derating Curve
(Output Power VS Input Voltage)
Typical Characteristics
3.3 V, 10 A / 33 W

**Efficiency**

Efficiency vs. load current and input voltage at +25°C.

**Power Dissipation**

Dissipated power vs. load current and input voltage at +25°C.

**Output Current Derating (Vin=48V)**

Available load current vs. ambient air temperature and airflow at Vᵢ=48 V. See Thermal Consideration section.

**Current Limit Characteristics**

Output voltage vs. load current at Iₒ > max Iₒ at +25°C.

**Output Current Derating (Vin=9V)**

Available load current vs. ambient air temperature and airflow at Vᵢ=9 V. See Thermal Consideration section.

**Output Current Derating (Vin=48V) with heat sink**

Available load current vs. ambient air temperature and airflow at Vᵢ=48 V. See Thermal Consideration section.
Typical Characteristics

3.3 V, 10 A / 33 W

Start-up

Start-up enabled by connecting V1 at:

$T_{in} = +25^\circ C$, $V_i = 9\, \text{V}$,

$\text{Io} = 10\, \text{A}$ resistive load.

Top trace: output voltage (2 V/div.).

Bottom trace: input voltage (5 V/div.).

Time scale: (50 ms/div.).

Output Ripple & Noise

Output voltage ripple at:

$T_{in} = +25^\circ C$, $V_i = 48\, \text{V}$,

$I_o = 10\, \text{A}$ resistive load.

Trace: output voltage (20 mV/div.).

Time scale: (5 µs/div.).

Output Load Transient Response

Output voltage response to load current step-change (5.0-7.5-5.0 A) at:

$T_{in} = +25^\circ C$, $V_i = 48\, \text{V}$.

Top trace: output voltage (500 mV/div.).

Bottom trace: load current (1 A/div.).

Time scale: (2 ms/div.).

Output Voltage Adjust (TRIM UP/TRIM DOWN)

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

Output Voltage Adjust, Increase:

$$R_{\text{ADJ\_UP}} = \left( \frac{1.9528}{\Delta} - 12 \right) \, \text{k}\Omega$$

Output Voltage Adjust, Decrease:

$$R_{\text{ADJ\_DOWN}} = \left( \frac{1.8627}{\Delta} - 15.815 \right) \, \text{k}\Omega$$

Example:

To trim up the 3.3V model by 8% to 3.56V the required external resistor is:

$$R_{\text{ADJ\_UP}} = \left( \frac{1.9528}{0.08} - 12 \right) = 12.41 \, \text{k}\Omega$$

Example:

To trim down the 3V3 model by 7% to 3.07V the required external resistor is:

$$R_{\text{ADJ\_DOWN}} = \left( \frac{1.8627}{0.07} - 15.815 \right) = 10.79 \, \text{k}\Omega$$

Output Voltage=3.3V

PKE 8410A PIP


**Electrical Specification**

**5 V, 8 A / 40 W**

Typical values given at: $T_{TP1} = +25^\circ C$, $V_i = 48 V$, max $I_o$, unless otherwise specified under Conditions.

At least 330uF E-Cap be added in the input terminal for stabilize input volta.

<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>$V_i$</td>
<td>Input voltage range</td>
<td>9</td>
<td>75</td>
<td>V</td>
<td></td>
</tr>
<tr>
<td>$V_{tup}$</td>
<td>Turn-off input voltage</td>
<td>Decreasing input voltage</td>
<td>7.5</td>
<td>V</td>
<td></td>
</tr>
<tr>
<td>$V_{tow}$</td>
<td>Turn-on input voltage</td>
<td>Increasing input voltage</td>
<td>8.5</td>
<td>V</td>
<td></td>
</tr>
<tr>
<td>OVP</td>
<td>Input Over voltage protection</td>
<td>77.5</td>
<td>80</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$C_i$</td>
<td>Internal input capacitance</td>
<td>12</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$P_O$</td>
<td>Output power</td>
<td>Note2</td>
<td>0</td>
<td>40</td>
<td></td>
</tr>
<tr>
<td>$\eta$</td>
<td>Efficiency</td>
<td>50% of max $I_o$, $V_i = 12 V$</td>
<td>87</td>
<td>%</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>max $I_o$, $V_i = 12 V$</td>
<td>85</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>50% of max $I_o$, $V_i = 24 V$</td>
<td>89</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>max $I_o$, $V_i = 24 V$</td>
<td>89</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>50% of max $I_o$, $V_i = 48 V$</td>
<td>86</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>max $I_o$, $V_i = 48 V$</td>
<td>88</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$P_d$</td>
<td>Power Dissipation</td>
<td>max $I_o$</td>
<td>11.1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$P_i$</td>
<td>Input idling power</td>
<td>$I_o = 0 A$, $V_i = 48 V$</td>
<td>0.38</td>
<td>W</td>
<td></td>
</tr>
<tr>
<td>$f_s$</td>
<td>Switching frequency</td>
<td>0-100 % of max $I_o$</td>
<td>198</td>
<td>kHz</td>
<td></td>
</tr>
</tbody>
</table>

| $V_{oi}$       | Output voltage initial setting and accuracy | $T_{TP1} = +25^\circ C$, $V_i = 48 V$, $I_o = 8 A$ | 4.95 | 5   | 5.05 | V |
| $V_o$          | Output adjust range | 4.5  | 5.5  | V   |
|                | Output voltage tolerance band | 0-100 % of max $I_o$ | 4.85 | 5.15 | V   |
| Idling voltage | $I_o = 0 A$ | 4.85 | 5.15 | V   |
| Line regulation | max $I_o$ | -50  | 50   | mV  |
| Load regulation | $V_i = 48 V$, 0-100 % of max $I_o$ | -50  | 50   | mV  |
| $V_{tr}$       | Load transient voltage deviation | $V_i = 48 V$, Load step 50-75-50% of max $I_o$, $dl/dt = 1 A/\mu s$ | ±200 | mV  |
| $t_r$          | Load transient recovery time | 500  | μs   |
| $t_r$          | Ramp-up time | (from 10–90% of $V_o$) | 10-100% of max $I_o$, $T_{TP1} = 25^\circ C$, $V_i = 48 V$ | 20  | ms  |
| $t_s$          | Start-up time | (from $V_i$ connection to 90% of $V_o$) | 24  | ms  |
| $t_s$          | $V_s$ shut-down fall time | (from $V_i$ off to 10% of $V_o$) | max $I_o$ | 200 | us  |
| $t_{RC}$       | RC start-up time | max $I_o$ | 12  | ms  |
| $I_o$          | Output current | 8    | A    |
| $I_{lim}$      | Current limit threshold | $T_{TP1} < max T_{TP1}$ | 14.5 | 17  | A   |
| $I_{sc}$       | Short circuit current | $T_{TP1} = 25^\circ C$ | 0.32 | A   |
| $C_{out}$      | Recommended Capacitive Load | $T_{TP1} = 25^\circ C$ | 3000 | μF  |
| $V_{Osc}$      | Output ripple & noise | See ripple & noise section, $V_o$, max $I_o$, see Note 1 | 20  | 40  | mVp-p |
| OVP            | Over voltage protection | $T_{TP1} = +25^\circ C$, $V_i = 48 V$, 10-100% of max $I_o$ | 6.2  | V   |

Note 1: Measured with 0.1uF ceramic Cap. and 10uF tantalum(or EE) Cap. cross to output.
PKE 8000A series Direct Converters
Input 9-75 V, Output up to 10 A / 40 W

Note 2: PKE 8411A PIP Power Derating Curve
(Output Power VS Input Voltage)
FLEX PRODUCT SPECIFICATION

Typical Characteristics
5 V, 8 A / 40 W

Efficiency

Power Dissipation

Typical Characteristics

PKE 8000A series Direct Converters
Input 9-75 V, Output up to 10 A / 40 W

PKE 8411A PIP

Efficiency vs. load current and input voltage at +25°C.

Dissipated power vs. load current and input voltage at +25°C.

Output Current Derating (Vin=48V)

Available load current vs. ambient air temperature and airflow at Vin=48 V. See Thermal Consideration section.

Output Current Derating (Vin=9V)

Available load current vs. ambient air temperature and airflow at Vin=9 V. See Thermal Consideration section.

Output Current Derating (Vin=48V) with heat sink

Available load current vs. ambient air temperature and airflow at Vin=48 V. See Thermal Consideration section.
Typical Characteristics
5 V, 8 A / 40 W

Start-up

Start-up enabled by connecting $V_i$ at:

- $T_i = +25^\circ C$, $V_i = 9$ V,
- $I_o = 8$ A resistive load.

Top trace: output voltage (2 V/div.),
Bottom trace: input voltage (5 V/div.),
Time scale: (100 ms/div.).

Shut-down

Start-up enabled by connecting $V_i$ at:

- $T_i = +25^\circ C$, $V_i = 9$ V,
- $I_o = 8$ A resistive load.

Top trace: output voltage (2 V/div.),
Bottom trace: input voltage (5 V/div.),
Time scale: (100 ms/div.).

Output Ripple & Noise

Output voltage ripple at:

- $T_i = +25^\circ C$, $V_i = 48$ V,
- $I_o = 8$ A resistive load.

Trace: output voltage (20 mV/div.),
Time scale: (5 µs/div.).

Output Load Transient Response

Output voltage response to load current step-change (4.0-6.0-4.0 A) at:

- $T_i = +25^\circ C$, $V_i = 48$ V.

Top trace: output voltage (500 mV/div.),
Bottom trace: load current (1 A/div.),
Time scale: (2 ms/div.).

Output Voltage Adjust (TRIM UP/TRIM DOWN)

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

Output Voltage Adjust, Increase:

$$ R_{ADJ\_UP} = \left( \frac{1.5}{\Delta} - 10 \right) k\Omega $$

Output Voltage Adjust, Decrease:

$$ R_{ADJ\_DOWN} = \left( \frac{1.5}{\Delta} - 13 \right) k\Omega $$

Example:

To trim up the 5.0V model by 8% to 5.4V the required external resistor is:

$$ R_{ADJ\_UP} = \left( \frac{1.5}{0.08} - 10 \right) = 8.75 k\Omega $$

Example:

To trim down the 5.0V model by 7% to 4.65V the required external resistor is:

$$ R_{ADJ\_DOWN} = \left( \frac{1.5}{0.07} - 13 \right) = 8.43 k\Omega $$

Output Voltage=5.0V
### Electrical Specification

**PKE 8413A PIP**

**12 V, 3.33 A / 40 W**

Typical values given at: $T_{PI} = +25^\circ C$, $V_i = 48$ V, max $I_o$, unless otherwise specified under Conditions. At least 220uF E-Cap be added in the input terminal for stabilize input voltage source.

<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>$V_i$</td>
<td>Input voltage range</td>
<td>9</td>
<td>75</td>
<td>V</td>
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<tr>
<td>$V_{thf}$</td>
<td>Turn-off input voltage</td>
<td></td>
<td></td>
<td></td>
<td>V</td>
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<tr>
<td>$V_{thm}$</td>
<td>Turn-on input voltage</td>
<td>8.5</td>
<td></td>
<td>V</td>
<td></td>
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<tr>
<td>OVP</td>
<td>Input Over voltage protection</td>
<td>77.5</td>
<td>80</td>
<td>V</td>
<td></td>
</tr>
<tr>
<td>$C_l$</td>
<td>Internal input capacitance</td>
<td>12</td>
<td></td>
<td>μF</td>
<td></td>
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<tr>
<td>$P_O$</td>
<td>Output power</td>
<td>0</td>
<td>40</td>
<td>W</td>
<td></td>
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<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Conditions</th>
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<th>typ</th>
<th>max</th>
<th>Unit</th>
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<tbody>
<tr>
<td>$\eta$</td>
<td>Efficiency</td>
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<td></td>
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<td>%</td>
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<tr>
<td>$P_d$</td>
<td>Power Dissipation</td>
<td>max $I_o$</td>
<td>4</td>
<td>W</td>
<td></td>
</tr>
<tr>
<td>$P_k$</td>
<td>Input idling power</td>
<td>$I_o = 0$ A, $V_i = 48$ V</td>
<td>0.5</td>
<td>W</td>
<td></td>
</tr>
<tr>
<td>$f_s$</td>
<td>Switching frequency</td>
<td>0-100 % of max $I_o$</td>
<td>198</td>
<td>242</td>
<td>kHz</td>
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<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Conditions</th>
<th>min</th>
<th>typ</th>
<th>max</th>
<th>Unit</th>
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</thead>
<tbody>
<tr>
<td>$V_{oi}$</td>
<td>Output voltage initial setting and</td>
<td>$T_{PI} = +25^\circ C$, $V_i = 48$ V, $I_o = 3.33$ A</td>
<td>11.88</td>
<td>12</td>
<td>12.12</td>
</tr>
<tr>
<td></td>
<td>accuracy</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$V_{oi}$</td>
<td>Output adjust range</td>
<td>10.8</td>
<td>13.2</td>
<td>V</td>
<td></td>
</tr>
<tr>
<td>$V_{o}$</td>
<td>Output voltage tolerance band</td>
<td>0-100 % of max $I_o$</td>
<td>11.856</td>
<td>12.144</td>
<td>V</td>
</tr>
<tr>
<td></td>
<td>Idling voltage</td>
<td>$I_o = 0$ A</td>
<td>11.856</td>
<td>12.144</td>
<td>V</td>
</tr>
<tr>
<td></td>
<td>Line regulation</td>
<td>max $I_o$</td>
<td>-120</td>
<td>120</td>
<td>mV</td>
</tr>
<tr>
<td></td>
<td>Load regulation</td>
<td>$V_i = 48$ V, 0-100 % of max $I_o$</td>
<td>-120</td>
<td>120</td>
<td>mV</td>
</tr>
<tr>
<td>$V_{tr}$</td>
<td>Load transient voltage deviation</td>
<td>$V_i = 48$ V, Load step 50-75-50% of max $I_o$, $\frac{di}{dt} = 1$ A/μs</td>
<td>±200</td>
<td></td>
<td>mV</td>
</tr>
<tr>
<td>$t_o$</td>
<td>Load transient recovery time</td>
<td></td>
<td>500</td>
<td>μs</td>
<td></td>
</tr>
<tr>
<td>$t_r$</td>
<td>Ramp-up time (from 10–90% of $V_o$)</td>
<td>10-100% of max $I_o$, $T_{PI} = 25^\circ C$, $V_i = 48$ V</td>
<td>20</td>
<td></td>
<td>ms</td>
</tr>
<tr>
<td>$t_s$</td>
<td>Start-up time (from $V_i$ connection to 90% of $V_o$)</td>
<td></td>
<td>24</td>
<td>ms</td>
<td></td>
</tr>
<tr>
<td>$t_{vsh}$</td>
<td>$V_i$ shut-down fall time (from $V_i$ to 10% of $V_o$)</td>
<td>max $I_o$</td>
<td>200</td>
<td>us</td>
<td></td>
</tr>
<tr>
<td>$t_{RC}$</td>
<td>RC start-up time</td>
<td>max $I_o$</td>
<td>12</td>
<td>ms</td>
<td></td>
</tr>
<tr>
<td>$I_O$</td>
<td>Output current</td>
<td>0</td>
<td>3.33</td>
<td>A</td>
<td></td>
</tr>
<tr>
<td>$I_{lim}$</td>
<td>Current limit threshold</td>
<td>$T_{PI} &lt; max T_{PI}$</td>
<td>4</td>
<td>6.66</td>
<td>A</td>
</tr>
<tr>
<td>$I_{sc}$</td>
<td>Short circuit current</td>
<td>$T_{PI} = 25^\circ C$</td>
<td>0.32</td>
<td>A</td>
<td></td>
</tr>
<tr>
<td>$C_{out}$</td>
<td>Recommended Capacitive Load</td>
<td>$T_{PI} = 25^\circ C$</td>
<td>0</td>
<td>1500</td>
<td>μF</td>
</tr>
<tr>
<td>$V_{Oac}$</td>
<td>Output ripple &amp; noise</td>
<td>See ripple &amp; noise section, $V_i$, max $I_o$, see Note 1</td>
<td>20</td>
<td>40</td>
<td>mVp-p</td>
</tr>
<tr>
<td>OVP</td>
<td>Over voltage protection</td>
<td>$T_{PI} = +25^\circ C$, $V_i = 48$ V, 10-100% of max $I_o$</td>
<td>15</td>
<td></td>
<td>V</td>
</tr>
</tbody>
</table>

**Note 1:** Measured with 0.1uF ceramic Cap. and 10uF tantalum(or EE) Cap. cross to output.
PKE 8000A series Direct Converters
Input 9-75 V, Output up to 10 A / 40 W

Note 2: PKE 8413A PIP Power Derating Curve
(Output Power VS Input Voltage)
**Typical Characteristics**

12 V, 3.33 A / 40 W

**Efficiency**

*Efficiency vs. load current and input voltage at +25°C.*

**Power Dissipation**

*Dissipated power vs. load current and input voltage at +25°C.*

**Output Current Derating (Vin=48V)**

*Available load current vs. ambient air temperature and airflow at Vin=48 V. See Thermal Consideration section.*

**Output Current Derating (Vin=9V)**

*Available load current vs. ambient air temperature and airflow at Vin=9 V. See Thermal Consideration section.*

**Output Current Derating (Vin=24V)**

*Available load current vs. ambient air temperature and airflow at Vin=24 V. See Thermal Consideration section.*

**Current Limit Characteristics**

*Output voltage vs. load current at I_o > max I_o at +25°C.*

---

**PKE 8000A series Direct Converters**

Input 9-75 V, Output up to 10 A / 40 W

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© Flex
Typical Characteristics

12 V, 3.33 A / 40 W

Start-up

Start-up enabled by connecting V_i at:
T_{in} = +25°C, V_i = 48 V,
I_o = 3.33 A resistive load.

Top trace: output voltage (5 V/div.).
Bottom trace: input voltage (20 V/div.).
Time scale: (200 ms/div.).

Output Ripple & Noise

Output voltage ripple at:
T_{in} = +25°C, V_i = 48 V,
I_o = 3.33 A resistive load.

Trace: output voltage (20 mV/div.).
Time scale: (5 µs/div.).

Output Voltage Adjust (TRIM UP/TRIM DOWN)

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

Output Voltage Adjust, Increase:

\[ R_{ADJ_{UP}} = \left( \frac{3.5998}{\Delta} - 24 \right) \text{kΩ} \]

Output Voltage Adjust, Decrease:

\[ R_{ADJ_{DOWN}} = \left( \frac{3.5796}{\Delta} - 31.179 \right) \text{kΩ} \]

Example:

To trim up the 12V model by 8% to 12.96V the required external resistor is:

\[ R_{ADJ_{UP}} = \left( \frac{3.5998}{0.08} - 24 \right) = 21 \text{kΩ} \]

Example:

To trim down the 12V model by 7% to 11.16V the required external resistor is:

\[ R_{ADJ_{DOWN}} = \left( \frac{3.5796}{0.07} - 31.179 \right) = 19.96 \text{kΩ} \]

Output Load Transient Response

Output voltage response to load current step-change (1.66-2.49-1.66 A) at:
T_{in} = +25°C, V_i = 48 V.

Top trace: output voltage (500 mV/div.).
Bottom trace: load current (1 A/div.).
Time scale: (2 ms/div.).
## Electrical Specification

**15 V, 2.67 A / 40 W**

Typical values given at: $T_{PI} = +25^\circ C, V_i = 48 V$, max $I_o$, unless otherwise specified under Conditions. At least 330uF E-Cap be added in the input terminal for stabilize input voltage source.

### Characteristics

<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>$V_i$</td>
<td>Input voltage range</td>
<td>9</td>
<td>75</td>
<td>V</td>
<td></td>
</tr>
<tr>
<td>$V_{t off}$</td>
<td>Turn-off input voltage</td>
<td>7.5</td>
<td>V</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$V_{t on}$</td>
<td>Turn-on input voltage</td>
<td>8.5</td>
<td>V</td>
<td></td>
<td></td>
</tr>
<tr>
<td>OVP</td>
<td>Input Over voltage protection</td>
<td>77.5</td>
<td>80</td>
<td>V</td>
<td></td>
</tr>
<tr>
<td>$C_i$</td>
<td>Internal input capacitance</td>
<td>12</td>
<td>μF</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$P_o$</td>
<td>Output power</td>
<td>0</td>
<td>40</td>
<td>W</td>
<td></td>
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<tr>
<td>$\eta$</td>
<td>Efficiency</td>
<td>50% of max $I_o$, $V_i = 12 V$</td>
<td>91</td>
<td>%</td>
<td></td>
</tr>
<tr>
<td></td>
<td>max $I_o$, $V_i = 12 V$</td>
<td>89</td>
<td></td>
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<tr>
<td></td>
<td>50% of max $I_o$, $V_i = 24 V$</td>
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<td></td>
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<tr>
<td></td>
<td>max $I_o$, $V_i = 24 V$</td>
<td>91</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>50% of max $I_o$, $V_i = 48 V$</td>
<td>89</td>
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<td></td>
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<tr>
<td></td>
<td>max $I_o$, $V_i = 48 V$</td>
<td>90</td>
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<tr>
<td>$P_d$</td>
<td>Power Dissipation</td>
<td>max $I_o$</td>
<td>5.4</td>
<td>W</td>
<td></td>
</tr>
<tr>
<td>$P_i$</td>
<td>Input idling power</td>
<td>$I_o = 0 A, V_i = 48 V$</td>
<td>0.48</td>
<td>W</td>
<td></td>
</tr>
<tr>
<td>$f_s$</td>
<td>Switching frequency</td>
<td>0-100 % of max $I_o$</td>
<td>119</td>
<td>140</td>
<td>161</td>
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### Electrical Parameters

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Condition/Value</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>$V_{oi}$</td>
<td>Output voltage initial setting and accuracy</td>
<td>$T_{PI} = +25^\circ C, V_i = 48 V, I_o = 2.67 A$</td>
</tr>
<tr>
<td>$V_o$</td>
<td>Output adjust range</td>
<td></td>
</tr>
<tr>
<td>$OVP$</td>
<td>Output voltage tolerance band</td>
<td>0-100 % of max $I_o$</td>
</tr>
<tr>
<td>Idling voltage</td>
<td>$I_o = 0 A$</td>
<td></td>
</tr>
<tr>
<td>Line regulation</td>
<td>max $I_o$</td>
<td>-150</td>
</tr>
<tr>
<td>Load regulation</td>
<td>$V_i = 48 V$, 0-100 % of max $I_o$</td>
<td>-150</td>
</tr>
<tr>
<td>$V_{tr}$</td>
<td>Load transient voltage deviation</td>
<td>$V_i = 48 V$, Load step 50-75-50% of max $I_o$, $di/dt = 1 A/\mu s$</td>
</tr>
<tr>
<td>$t_{tr}$</td>
<td>Load transient recovery time</td>
<td></td>
</tr>
<tr>
<td>$t_r$</td>
<td>Ramp-up time (from 10-90% of $V_o$)</td>
<td>10-100% of max $I_o$</td>
</tr>
<tr>
<td>$t_s$</td>
<td>Start-up time (from $V$ connection to 90% of $V_o$)</td>
<td>$T_{PI} = 25^\circ C, V_i = 48 V$</td>
</tr>
<tr>
<td>$t_i$</td>
<td>V; shut-down fall time (from $V$ off to 10% of $V_o$)</td>
<td>max $I_o$</td>
</tr>
<tr>
<td>$t_{RC}$</td>
<td>RC start-up time</td>
<td>max $I_o$</td>
</tr>
<tr>
<td>$I_o$</td>
<td>Output current</td>
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</tr>
<tr>
<td>$I_{lim}$</td>
<td>Current limit threshold</td>
<td>$T_{PI} &lt; max T_{PI}$</td>
</tr>
<tr>
<td>$I_{sc}$</td>
<td>Short circuit current</td>
<td>$T_{PI} = 25^\circ C$</td>
</tr>
<tr>
<td>$C_{out}$</td>
<td>Recommended Capacitive Load</td>
<td>$T_{PI} = 25^\circ C$</td>
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<td>$V_{osc}$</td>
<td>Output ripple &amp; noise</td>
<td>See ripple &amp; noise section, $V_o$, max $I_o$, see Note 1</td>
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<td>OVP</td>
<td>Over voltage protection</td>
<td>$T_{PI} = +25^\circ C, V_i = 48 V$, 10-100% of max $I_o$</td>
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</tbody>
</table>

Note 1: Measured with 0.1uF ceramic Cap. and 10uF tantalum(or EE) Cap. cross to output.
PKE 8000A series Direct Converters
Input 9-75 V, Output up to 10 A / 40 W

Note 2: PKE 8415A PIP Power Derating Curve
(Output Power VS Input Voltage)
Typical Characteristics
15 V, 2.67 A / 40 W

Efficiency vs. load current and input voltage at +25°C.

Power Dissipation vs. load current and input voltage at +25°C.

Output Current Derating (Vin=48V)
Available load current vs. ambient air temperature and airflow at Vin=48 V. See Thermal Consideration section.

Output Current Derating (Vin=9V)
Available load current vs. ambient air temperature and airflow at Vin=9 V. See Thermal Consideration section.

Output Current Derating (Vin=48V) with heat sink
Available load current vs. ambient air temperature and airflow at Vin=48 V. See Thermal Consideration section.
Typical Characteristics
15 V, 2.67 A / 40 W

*Start-up*

Start-up enabled by connecting $V_i$ at:
- $T_{in} = +25^\circ C$, $V_i = 9$ V,
- $I_o = 2.67$ A resistive load.

Top trace: output voltage (10 V/div.).
Bottom trace: input voltage (5 V/div.).
Time scale: (50 ms/div.).

Output Ripple & Noise

Output voltage ripple at:
- $T_{in} = +25^\circ C$, $V_i = 48$ V,
- $I_o = 2.67$ A resistive load.
Trace: output voltage (50 mV/div.).
Time scale: (5 µs/div.).

Output Load Transient Response

Output voltage response to load current step-change (1.33-2.0-1.33 A) at:
- $T_{in} = +25^\circ C$, $V_i = 48$ V.
Trace: output voltage (500 mV/div.).
Bottom trace: load current (1 A/div.).
Time scale: (2 ms/div.).

Output Voltage Adjust (TRIM UP/TRIM DOWN)

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

Output Voltage Adjust, Increase:
$$R_{ADJ\_UP} = \left( \frac{4.4993}{\Delta} - 30 \right) \text{k}\Omega$$

Output Voltage Adjust, Decrease:
$$R_{ADJ\_DOWN} = \left( \frac{4.6}{\Delta} - 39.099 \right) \text{k}\Omega$$

Example:
To trim up the 15V model by 8% to 16.2V the required external resistor is:
$$R_{ADJ\_UP} = \left( \frac{4.4993}{0.08} - 30 \right) = 26.24 \text{ k}\Omega$$

Example:
To trim down the 15V model by 7% to 13.95V the required external resistor is:
$$R_{ADJ\_DOWN} = \left( \frac{4.6}{0.07} - 39.099 \right) = 26.62 \text{ k}\Omega$$
EMC Specification
Conducted EMI measured according to EN55032, CISPR 32 and FCC part 15J (see test set-up). See Design Note 009 for further information. The fundamental switching frequency is 220 kHz for PKE 8413A PIP (40W/12V) at $V_i = 48$ V and max $I_o$.

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

EMI without filter

Optional external filter for class B
Suggested external input filter in order to meet class B in EN 55032, CISPR 32 and FCC part 15J.

![Filter components: CY1: 100pF, CY2: 2.2nF, CY7,CY8: 1nF(Y-CAP.)
C01,C02: 330μF(EE-CAP.)
L1: 10mH(CM CHOKE)
NC: CY3,CY4,CY5,CY6](image)

EMI with filter

Layout recommendations
The radiated EMI performance of the product will depend on the PWB layout and ground layer design. It is also important to consider the stand-off of the product. If a ground layer is used, it should be connected to the output of the product and the equipment ground or chassis.

A ground layer will increase the stray capacitance in the PWB 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 test setup](image)
Operating Information

Input Voltage
The input voltage range 9 to 75 Vdc. At input voltages exceeding 80 V, the power loss will be higher than at normal input voltage and T_{P1} must be limited to absolute max +115°C. The absolute maximum continuous input voltage is 80 Vdc.

Short duration transient disturbances can occur on the DC distribution and input of the product when a short circuit fault occurs on the equipment side of a protective device (fuse or circuit breaker). The voltage level, duration and energy of the disturbance are dependent on the particular DC distribution network characteristics and can be sufficient to damage the product unless measures are taken to suppress or absorb this energy. The transient voltage can be limited by capacitors and other energy absorbing devices like zener diodes connected across the positive and negative input conductors at a number of strategic points in the distribution network. The end-user must secure that the transient voltage will not exceed the value stated in the Absolute maximum ratings. ETSI TR 100 283 examines the parameters of DC distribution networks and provides guidelines for controlling the transient and reduce its harmful effect.

Turn-off Input Voltage
The products 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 1.7 V.

Remote Control (RC)

The products are fitted with a remote control function referenced to the primary negative input connection (-In), with negative and positive logic options available. The RC function allows the product 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 external device must provide a minimum required sink current to guarantee a voltage not higher than maximum voltage on the RC pin (see Electrical characteristics table). When the RC pin is left open, the voltage generated on the RC pin is 3 - 5 V.

The standard product is provided with “negative logic” RC and will be on until the RC pin is connected to the -In. To turn off the product the RC pin should be left open, or connected to a voltage higher than 2.5 V referenced to -In. In situations where it is desired to have the product to power up automatically without the need for control signals or a switch, the RC pin can be wired directly to -In.

The second option is “positive logic” remote control, which can be ordered by adding the suffix “P” to the end of the part number. When the RC pin is left open, the product starts up automatically when the input voltage is applied. Turn off is achieved by connecting the RC pin to the -In. The product will restart automatically when this connection is opened.

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 product. It is important that the input source has low characteristic impedance. The products 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 220 µF capacitor across the input of the product will ensure stable operation. The capacitor is not required when powering the product from an input source with an inductance below 10 µH. The minimum required capacitance value depends on the output power and the input voltage. The higher output power the higher input capacitance is needed. Approximately doubled capacitance value is required for a 24 V input voltage source compared to a 48 V input voltage source.

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. The ceramic capacitors will handle high-frequency dynamic load changes while the electrolytic capacitors are used to handle low frequency dynamic load changes. It is equally important to use low resistance and low inductance PWB layouts and cabling.

External decoupling capacitors will become part of the product’s control loop. The control loop is optimized for a wide range of external capacitance and the maximum recommended value that could be used without any additional analysis is found in the Electrical specification. The ESR of the capacitors is a very important parameter. Stable operation is guaranteed with a verified ESR value of >5 mΩ across the output connections.

For further information please contact your local Ericsson Power Modules representative.
Output Voltage Adjust (V_adj)
The products have an Output Voltage Adjust pin (V_adj). This pin can be used to adjust the output voltage above or below Output voltage initial setting.
When increasing the output voltage, the voltage at the output pins (including any remote sense compensation) must be kept below the threshold of the over voltage protection, (OVP) to prevent the product from shutting down. At increased output voltages the maximum power rating of the product remains the same, and the max output current must be decreased correspondingly.
To increase the voltage the resistor should be connected between the V_adj pin and +Out pin. The resistor value of the Output voltage adjust function is according to information given under the Output section for the respective product.
To decrease the output voltage, the resistor should be connected between the V_adj pin and –Out pin.

Over Voltage Protection (OVP)
The products have output over voltage protection that will shut down the product in over voltage conditions. The product 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 products 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 (max I_out). The product will resume normal operation after removal of the overload. The load distribution should be designed for the maximum output short circuit current specified.

Definition of product operating temperature
The product operating temperatures is used to monitor the temperature of the product, and proper thermal conditions can be verified by measuring the temperature at positions P1. The temperature at this position (T_P1) should not exceed the maximum temperatures in the table below. Temperature above maximum T_P1, measured at the reference point P1 are not allowed and may cause permanent damage.
Thermal Consideration

General
The products are designed to operate in different thermal environments and sufficient cooling must be provided to ensure reliable operation.

For products mounted on a PWB without a heat sink attached, cooling is achieved mainly by conduction, from the pins to the host board, and convection, which is dependent on the airflow across the product. Increased airflow enhances the cooling of the product. 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 $V_i = 48$ V.

The product is tested on a 107 x 45 mm, 70 µm (2 oz), 1-layer test board in a wind box with 370 x 220 mm.

The product can be mounted with a heat-sink for operating in wider temperature range. For different customer requirement (customers add different sizes of heat-sinks), the product can be attached with thermal glue tape so that customers can attach different sizes of heat-sinks by themselves.

The heat-sink assembly drawing:
### Mechanical Information

#### PIN CONNECTIONS

<table>
<thead>
<tr>
<th>PIN NUMBER</th>
<th>PIN FUNCTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>On/Off Control</td>
</tr>
<tr>
<td>2</td>
<td>-Input</td>
</tr>
<tr>
<td>3</td>
<td>+Input</td>
</tr>
<tr>
<td>4</td>
<td>+Output</td>
</tr>
<tr>
<td>5</td>
<td>-Output</td>
</tr>
<tr>
<td>6</td>
<td>Trim</td>
</tr>
</tbody>
</table>

#### Notes:
1. All dimensions in inches (mm)
2. Tolerance .xx =±0.04”
   .xxx=±0.020”
Soldering Information - Hole Mounting
The hole mounted product is intended for plated through hole mounting by wave or manual soldering. The pin temperature is specified to maximum to 270°C for maximum 10 seconds.

A maximum preheat rate of 4°C/s and maximum preheat temperature of 150°C is suggested. When soldering by hand, care should be taken to avoid direct contact between the hot soldering iron tip and the pins for more than a few seconds in order to prevent overheating.

A 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 trays

<table>
<thead>
<tr>
<th>Tray Specifications</th>
</tr>
</thead>
<tbody>
<tr>
<td>Material</td>
</tr>
<tr>
<td>Surface resistance</td>
</tr>
<tr>
<td>Bakeability</td>
</tr>
<tr>
<td>Tray thickness</td>
</tr>
<tr>
<td>Box capacity</td>
</tr>
<tr>
<td>Tray weight</td>
</tr>
</tbody>
</table>
PKE 8000A series Direct Converters
Input 9-75 V, Output up to 10 A / 40 W

1. Q'ty: 6*3=18 Pcs/Tray
   18*9=162 Pcs
2. Carton size: 290X260X239mm ±6mm
3. Single weight: 32g
4. N.W.: 5.2Kgs
5. G.W.: 7.2Kgs
# Product Qualification Specification

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Standard Details</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>External visual inspection</td>
<td>IPC-A-610</td>
<td></td>
</tr>
<tr>
<td>Change of temperature (Temperature cycling)</td>
<td>IEC 60068-2-14 Na</td>
<td>Temperature range -55 to 105°C, Number of cycles 20, Dwell/transfer time 30 min/3 min</td>
</tr>
<tr>
<td>Cold (in operation)</td>
<td>IEC 60068-2-1 Ad</td>
<td>Temperature Tₐ -45°C, Duration 72 h</td>
</tr>
<tr>
<td>Damp heat</td>
<td>IEC 60068-2-30</td>
<td>Temperature, Humidity 45°C, 95 % RH, Duration 72 hours</td>
</tr>
<tr>
<td>Dry heat</td>
<td>IEC 60068-2-2 Bd</td>
<td>Temperature 125°C, Duration 1000 h</td>
</tr>
<tr>
<td>Electrostatic discharge susceptibility</td>
<td>IEC 61340-3-1, JESD 22-A114</td>
<td>Human body model (HBM) Class 2, 2000 V</td>
</tr>
<tr>
<td>Immersion in cleaning solvents</td>
<td>IEC 60068-2-45 XA, method 2</td>
<td>Temperature, Water 55°C, Glycol ether (isopropyl alcohol) 35°C (35°C)</td>
</tr>
<tr>
<td>Mechanical shock</td>
<td>IEC 60068-2-27 Ea</td>
<td>Peak acceleration 200 g, Duration 6 ms</td>
</tr>
<tr>
<td>Moisture reflow sensitivity</td>
<td>J-STD-020E</td>
<td>Level 1 (SnPb-eutectic) 225°C, Level 3 (Pb Free) 260°C</td>
</tr>
<tr>
<td>Operational life test</td>
<td>MIL-STD-202G, method 108A</td>
<td>Duration 1000 h</td>
</tr>
<tr>
<td>Resistance to soldering heat</td>
<td>IEC 60068-2-20 Tb, method 1A</td>
<td>Solder temperature 270°C, Duration 10-13 s</td>
</tr>
<tr>
<td>Robustness of terminations</td>
<td>IEC 60068-2-21 Test Ua1</td>
<td>Through hole mount products, All leads</td>
</tr>
<tr>
<td>Solderability</td>
<td>IEC 60068-2-20 test Ta</td>
<td>Preconditioning Temperature, SnPb Eutectic 235°C, Temperature, Pb-free 245°C</td>
</tr>
<tr>
<td>Vibration, broad band random</td>
<td>IEC 61373</td>
<td>Frequency 5 to 150 Hz, RMS acceleration 5 grms, Duration 5 hrs in each direction</td>
</tr>
</tbody>
</table>

Notes

1 Only for products intended for wave soldering (plated through hole products)