

PKU 4000B PI series Intermediate Bus Converters Input 36-75 V, Output up to 20 A / 100 W	EN/LZT 146 376 R3B July 2009
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Key Features

- Industry standard Sixteenth-brick
33.0 x 22.9 x 8.3 mm (1.3 x 0.9 x 0.327 in.)
- High efficiency, typ. 93.4 % at 5 Vout 50 % load
- 1500 Vdc input to output isolation
- Meets safety requirements according to IEC/EN/UL 60950
- More than 1.6 million hours MTBF

General Characteristics

- 1+1 parallelable
- Input under voltage protection
- Over temperature protection
- Output over voltage protection
- Output short circuit protection
- Remote control
- Highly automated manufacturing ensures quality
- ISO 9001/14001 certified supplier



Safety Approvals



Design for Environment



Meets requirements in high-temperature lead-free soldering processes.

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Ordering Information

Product program	Output
PKU 4101B PI	5.0 V, 20 A / 100 W
PKU 4104B PI	12.0 V, 8.3 A / 100 W

Product number and Packaging

PKU XXXXX n ₁ n ₂ n ₃ n ₄				
Options	n ₁	n ₂	n ₃	n ₄
Mounting	X			
Remote Control logic		X		
Lead length			X	
Delivery package information				X

Options	Description
n ₁	PI Through hole SI Surface mount
n ₂	Negative * P Positive
n ₃	5.30 mm * LA 3.69 mm LB 4.57 mm
n ₄	/B Tray /C Tape and Reel

Example a through-hole mounted, positive logic, short pin product with tray packaging would be PKU 4101B PIPLA/B.

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

General Information
Reliability

The Mean Time Between Failure (MTBF) is calculated at full output power and an operating ambient temperature (T_A) of +40°C, which is a typical condition in Information and Communication Technology (ICT) equipment. Different methods could be used to calculate the predicted MTBF and failure rate which may give different results. Ericsson Power Modules currently uses two different methods, Ericsson failure rate data system DependTool and Telcordia SR332.

Predicted MTBF for the series is:

- 1.6 million hours according to Telcordia SR332, issue 1, Black box technique.

The Ericsson failure rate data system is based on field tracking data. The data corresponds to actual failure rates of components used in ICT equipment in temperature controlled environments (T_A = -5...+65°C). Telcordia SR332 is a commonly used standard method intended for reliability calculations in ICT equipment. The parts count procedure used in this method was originally modelled on the methods from MIL-HDBK-217F, Reliability Predictions of Electronic Equipment. It assumes that no

reliability data is available on the actual units and devices for which the predictions are to be made, i.e. all predictions are based on generic reliability parameters.

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 Ericsson Power Modules products include:

- Lead in high melting temperature type solder (used to solder the die in semiconductor packages)
- Lead in glass of electronics components and in electronic ceramic parts (e.g. fill material in chip resistors)
- Lead as an alloying element in copper alloy containing up to 4% lead by weight (used in connection pins made of Brass)

Quality Statement

The products are designed and manufactured in an industrial environment where quality systems and methods like ISO 9000, 6σ (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 our products.

Warranty

Warranty period and conditions are defined in Ericsson Power Modules General Terms and Conditions of Sale.

Limitation of Liability

Ericsson Power Modules 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**

Ericsson Power Modules DC/DC converters and DC/DC regulators are designed in accordance with safety standards IEC/EN/UL60950, *Safety of Information Technology Equipment*.

IEC/EN/UL60950 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 Directives for the final product.

Component power supplies for general use should comply with the requirements in IEC60950, EN60950 and UL60950 "Safety of information technology equipment". There are other more product related standards, e.g. IEEE802.3af "Ethernet LAN/MAN Data terminal equipment power", and ETS300132-2 "Power supply interface at the input to telecommunications equipment; part 2: DC", but all of these standards are based on IEC/EN/UL60950 with regards to safety.

Ericsson Power Modules DC/DC converters and DC/DC regulators are UL60950 recognized and certified in accordance with EN60950.

The flammability rating for all construction parts of the products meets requirements for V-0 class material according to IEC 60695-11-10.

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/UL60950.

Isolated DC/DC converters

It is recommended that a slow blow fuse with a rating twice the maximum input current per selected product 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 in the input filter or in the DC/DC converter that imposes a short circuit on the input source, this fuse will provide the following functions:

- Isolate the faulty DC/DC converter 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 for 60 seconds (refer to product specification). Leakage current is less than 1 μ A at nominal input voltage.

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 TNV2 circuit and testing has demonstrated compliance with SELV limits and isolation requirements equivalent to Basic Insulation in accordance with IEC/EN/UL60950.

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.

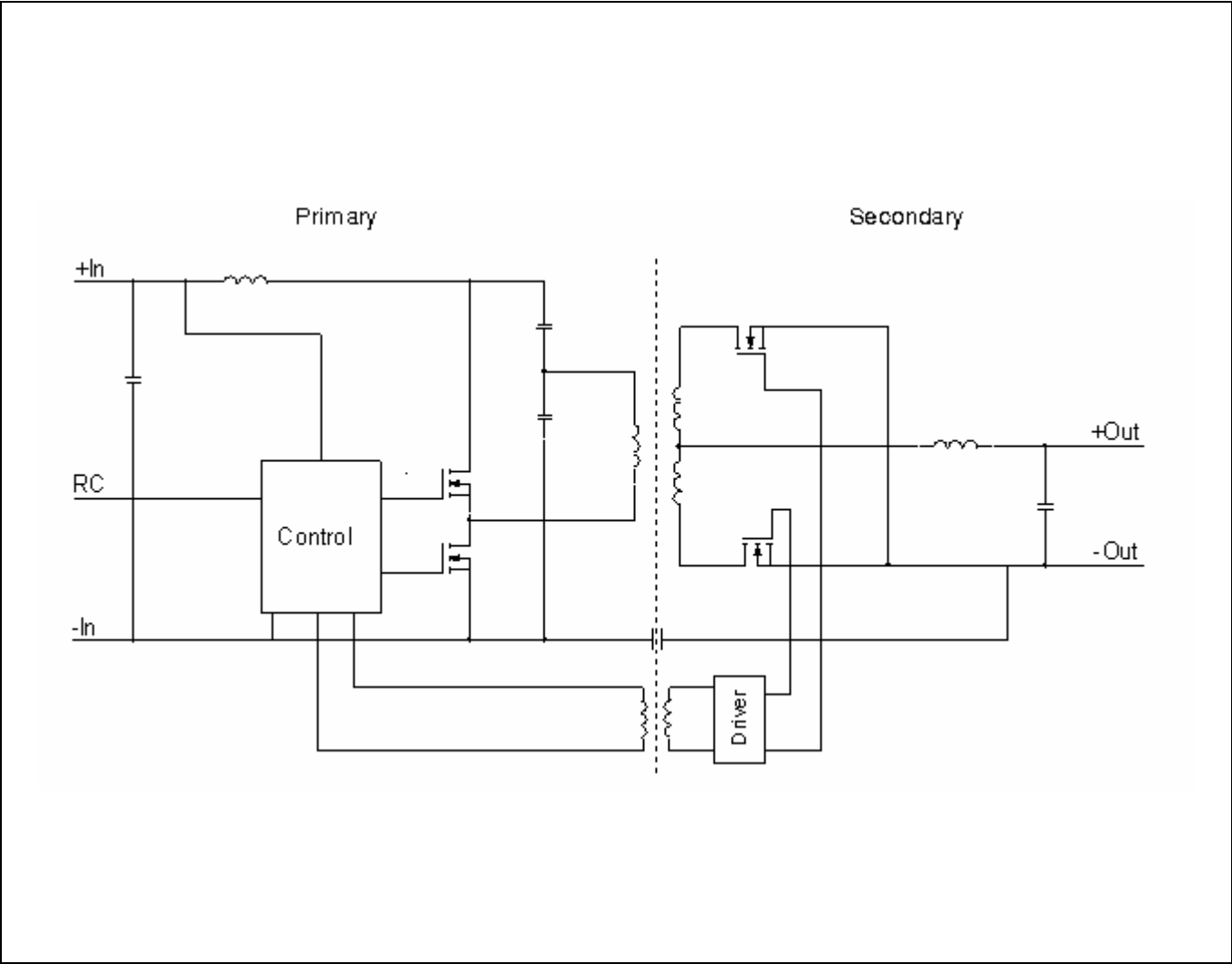
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Absolute Maximum Ratings

Characteristics		min	typ	max	Unit
T _{ref}	Operating Temperature (see Thermal Consideration section)	-40		+125	°C
T _S	Storage temperature	-55		+125	°C
V _I	Input voltage	-0.5		+80	V
V _{iso}	Isolation voltage (input to output test voltage)			1500	Vdc
V _{tr}	Input voltage transient (t _p 100 ms)			100	V
V _{RC}	Remote Control pin voltage (see Operating Information section)	-0.5		10	V

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



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5 V, 20 A / 100 W Electrical Specification
PKU 4101B PI
 $T_{ref} = -40$ to $+90^{\circ}\text{C}$, $V_I = 36$ to 75 V, unless otherwise specified under Conditions.

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

 $C_{out} = 2000$ μF , for details see note 1.

Characteristics	Conditions	min	typ	Max	Unit
V_I	Input voltage range	36		75	V
V_{loff}	Turn-off input voltage	29	30	32	V
V_{lon}	Turn-on input voltage	30	32	35	V
C_I	Internal input capacitance		3.3		μF
P_O	Output power	0		100	W
η	Efficiency	50 % of max I_O	93.1		%
		max I_O	91.9		
		50 % of max I_O , $V_I = 48$ V	93.4		
		max I_O , $V_I = 48$ V	91.8		
P_d	Power Dissipation	max I_O	8.5	11	W
P_{li}	Input idling power	$I_O = 0$ A, $V_I = 53$ V	1.8		W
P_{RC}	Input standby power	$V_I = 53$ V (turned off with RC)	0.11		W
f_s	Switching frequency	0-100 % of max I_O	250		kHz

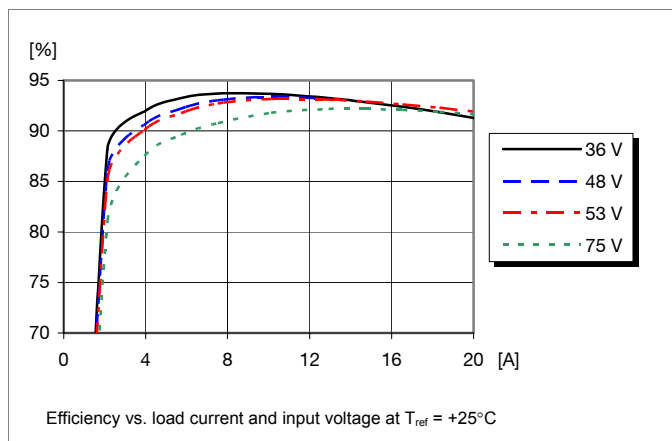
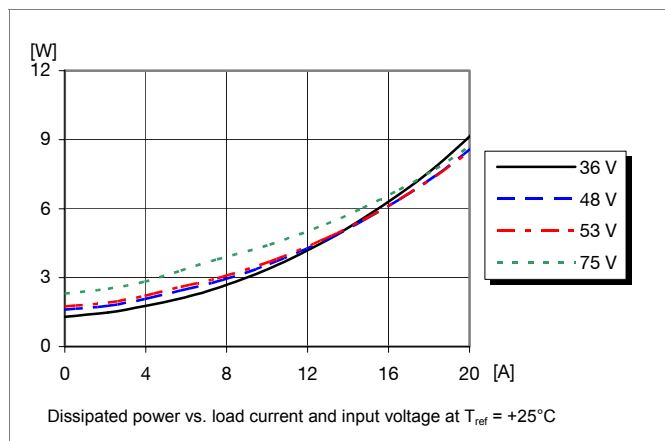
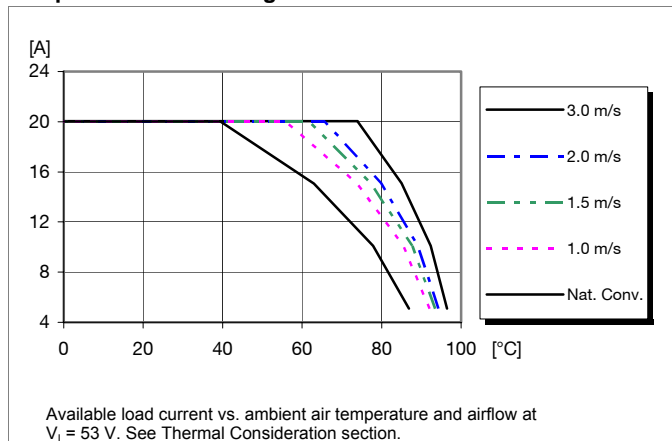
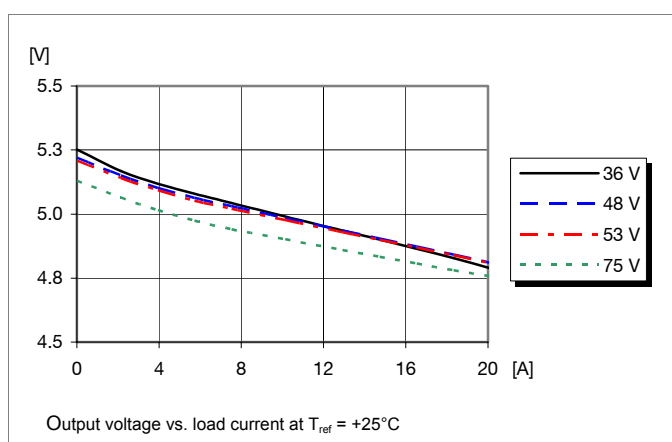
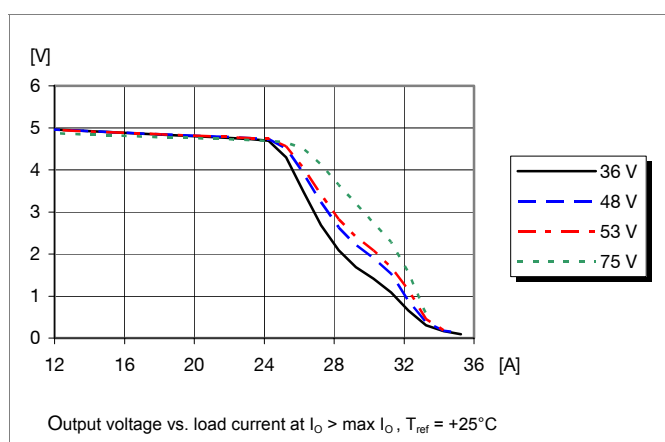
V_{oi}	Output voltage initial setting and accuracy	$T_{ref} = +25^{\circ}\text{C}$, $V_I = 53$ V, 50 % of max I_O	4.8	5.0	5.2	V
	Output voltage tolerance band	0-100 % of max I_O	4.5		5.5	V
	Idling voltage	$I_O = 0$ A	5.0		5.5	V
	Line regulation	max I_O		0.06	0.25	V
	Load regulation	$V_I = 53$ V, 0-100 % of max I_O		0.4	0.6	V
V_{tr}	Load transient voltage deviation	$V_I = 53$ V, Load step 25-75-25 % of max I_O , $di/dt = 5$ A/ μs .		± 40		mV
t_{tr}	Load transient recovery time			80		μs
t_r	Ramp-up time (from 10-90 % of V_{oi})		5	6	10	ms
t_s	Start-up time (from V_I connection to 90 % of V_{oi})		15	18	21	ms
t_f	V_I shut-down fall time (from V_I off to 10 % of V_O)	max I_O		1.5		ms
		$I_O = 0$ % of max I_O		22		s
t_{RC}	RC start-up time	max I_O		16		ms
	RC shut-down fall time (from RC off to 10 % of V_O)	max I_O		1.5		ms
		$I_O = 0$ % of max I_O		22		s
I_O	Output current		0		20	A
I_{lim}	Current limit threshold	$T_{ref} < \max T_{ref}$		25		A
I_{sc}	Short circuit current	$T_{ref} = 25^{\circ}\text{C}$, $V_O = 0.5$ V		32		A
V_{Oac}	Output ripple & noise	See ripple & noise section, max I_O , V_{oi}		20	50	mVp-p
OVP	Over voltage protection	$T_{ref} = +25^{\circ}\text{C}$, $V_I = 53$ V, 0-100 % of max I_O		6.2		V

 Note 1: Low ESR type (ESR approx 11 m Ω). Minimum recommended capacitance for monotonic start up at 0 % load is 1000 μF / 20 m Ω .

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5 V, 20 A / 100 W Typical Characteristics
PKU 4101B PI
Efficiency

Power Dissipation

Output Current Derating

Output Characteristics

Current Limit Characteristics


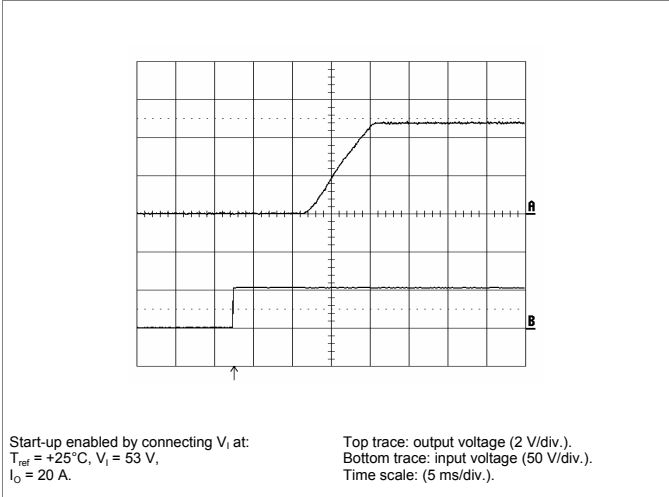
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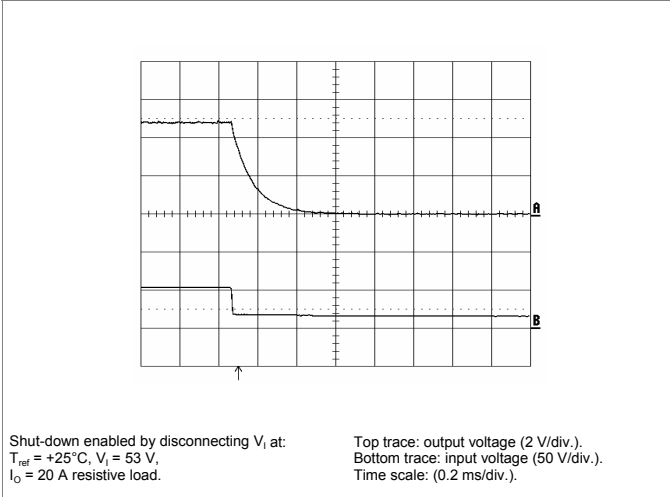
5 V, 20 A / 100 W Typical Characteristics

PKU 4101B PI

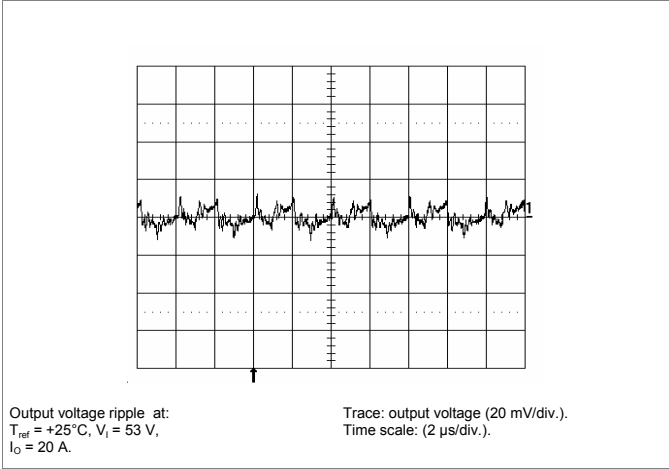
Start-up



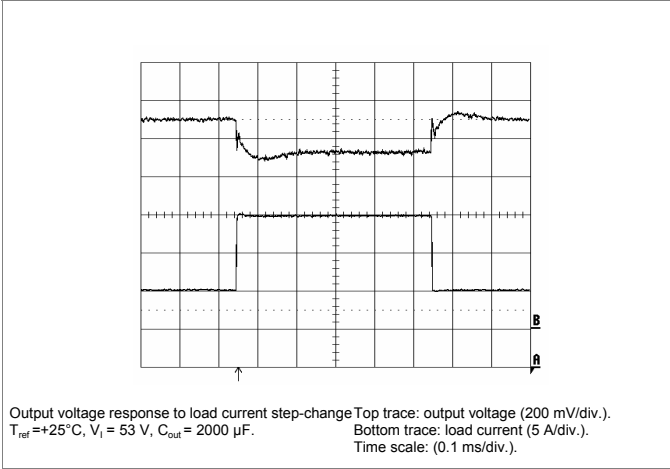
Shut-down



Output Ripple & Noise



Output Load Transient Response



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12V, 8.3A / 100 W Electrical Specification
PKU 4104B PI
 $T_{ref} = -40$ to $+90^{\circ}\text{C}$, $V_I = 36$ to 75 V, unless otherwise specified under Conditions.

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

Characteristics	Conditions	min	typ	Max	Unit
V_I	Input voltage range	36		75	V
V_{loff}	Turn-off input voltage	29	30	32	V
V_{lon}	Turn-on input voltage	30	32	35	V
C_I	Internal input capacitance		3.3		μF
P_O	Output power	0		100	W
η	Efficiency	50 % of max I_O	92		%
		max I_O	93		
		50 % of max I_O , $V_I = 48$ V	92.5		
		max I_O , $V_I = 48$ V	93.3		
P_d	Power Dissipation	max I_O	7.0	10.5	W
P_{li}	Input idling power	$I_O = 0$ A, $V_I = 53$ V	3.2		W
P_{RC}	Input standby power	$V_I = 53$ V (turned off with RC)	0.1		W
f_s	Switching frequency	0-100 % of max I_O	250		kHz

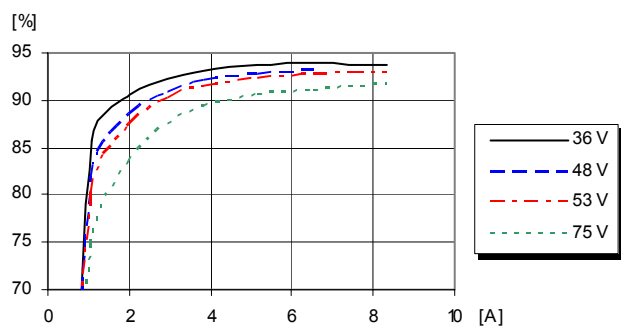
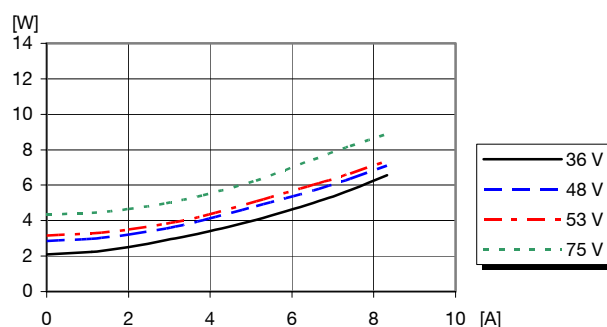
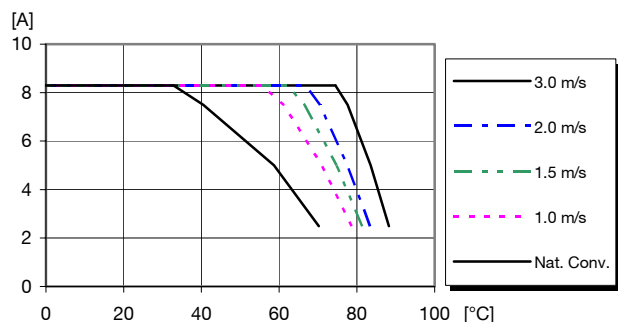
V_{Oi}	Output voltage initial setting and accuracy	$T_{ref} = +25^{\circ}\text{C}$, $V_I = 53$ V, 50 % of max I_O	11.5	12	12.5	V
	Output voltage tolerance band	0-100 % of max I_O	10.8		13.2	V
	Idling voltage	$I_O = 0$ A	11.7		12.9	V
	Line regulation	max I_O		0.2	0.65	V
	Load regulation	$V_I = 53$ V, 0-100 % of max I_O		0.7	1.0	V
V_{tr}	Load transient voltage deviation	$V_I = 53$ V, Load step 25-75-25 % of max I_O , $di/dt = 5$ A/ μs . See note 1:		± 100		mV
t_{tr}	Load transient recovery time			90		μs
t_r	Ramp-up time (from 10-90 % of V_{Oi})		4	8	12	ms
t_s	Start-up time (from V_I connection to 90 % of V_{Oi})		14	18	24	ms
t_f	V_I shut-down fall time (from V_I off to 10 % of V_{Oi})	max I_O		0.1		ms
		$I_O = 0$ % of max I_O		0.9		s
t_{RC}	RC start-up time	max I_O		17		ms
		max I_O		0.18		ms
		$I_O = 0$ % of max I_O		1		s
I_O	Output current		0		8.3	A
I_{lim}	Current limit threshold	$T_{ref} < \max T_{ref}$		14		A
I_{sc}	Short circuit current	$T_{ref} = 25^{\circ}\text{C}$		18		A
V_{Oac}	Output ripple & noise	See ripple & noise section, max I_O , V_{Oi}		50	100	mVp-p
OVP	Over voltage protection	$T_{ref} = +25^{\circ}\text{C}$, $V_I = 53$ V, 0-100 % of max I_O		13.4		V

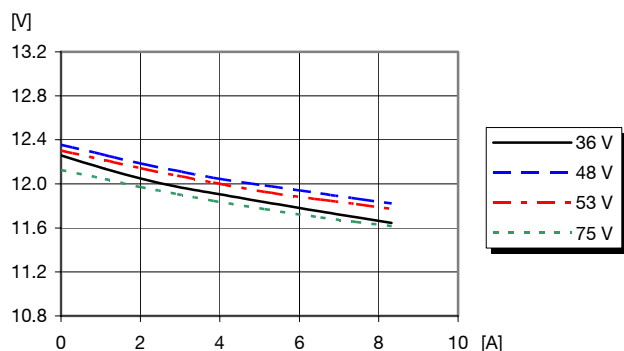
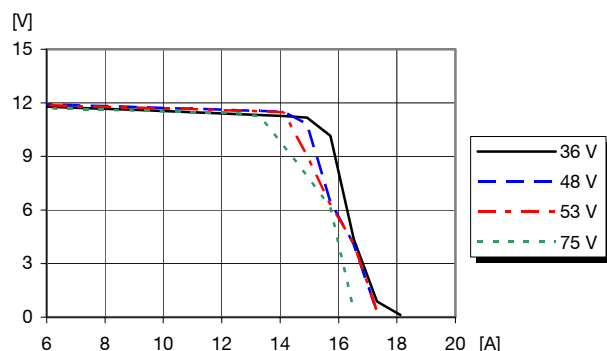
 Note 1: Capacitance on the output is 1000 μF (ceramics, ESR approx 5 m Ω)

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12V, 8.3A / 100W Typical Characteristics
PKU 4104B PI
Efficiency

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

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

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

Output Characteristics

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

 Output voltage vs. load current at $I_o > \max I_o$, $T_{ref} = +25^{\circ}\text{C}$

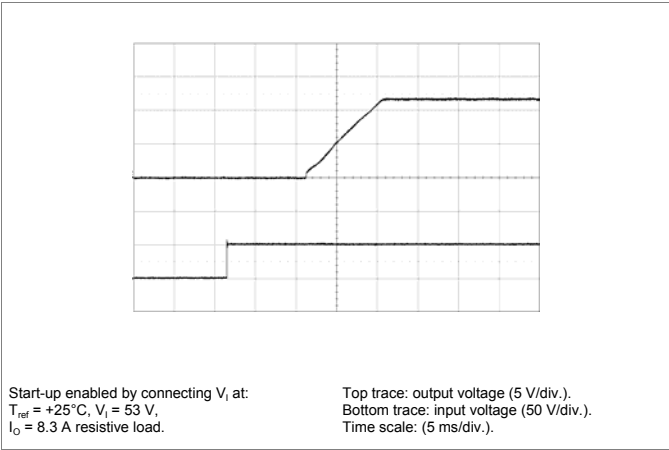
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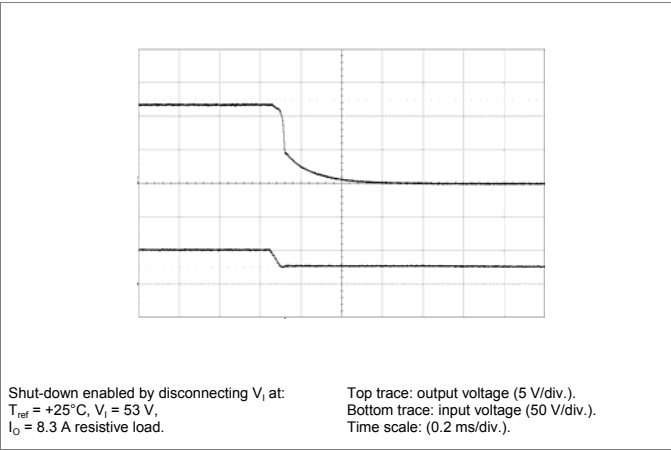
12V, 8.3A / 100W Typical Characteristics

PKU 4104B PI

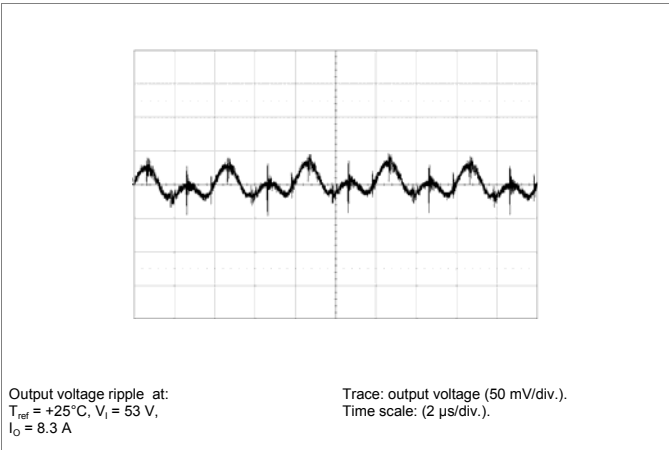
Start-up



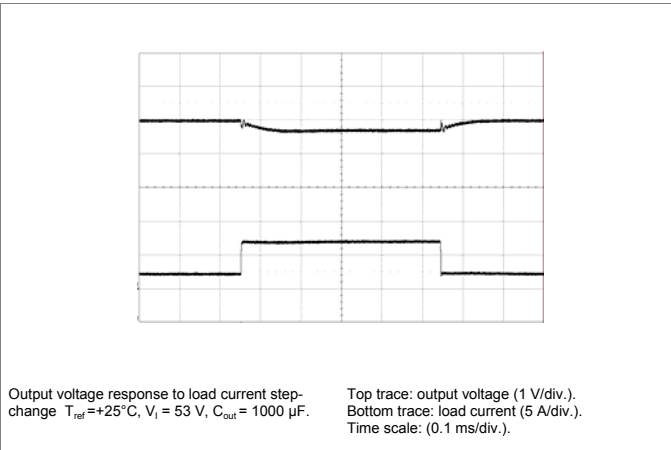
Shut-down



Output Ripple & Noise



Output Load Transient Response



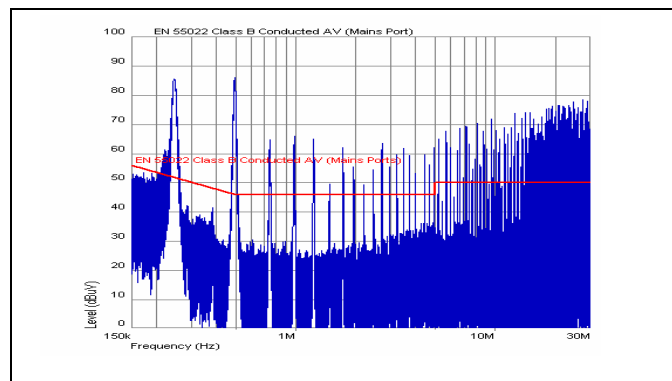
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EMC Specification

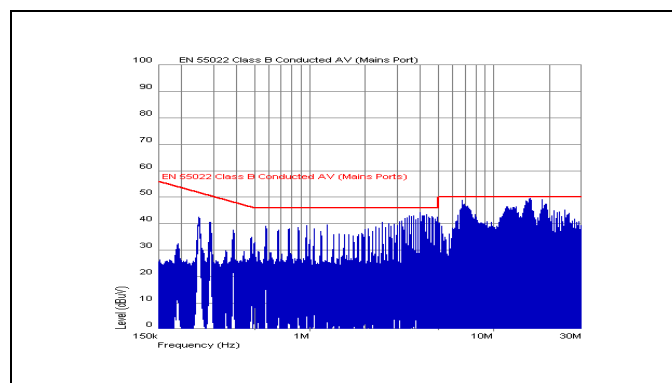
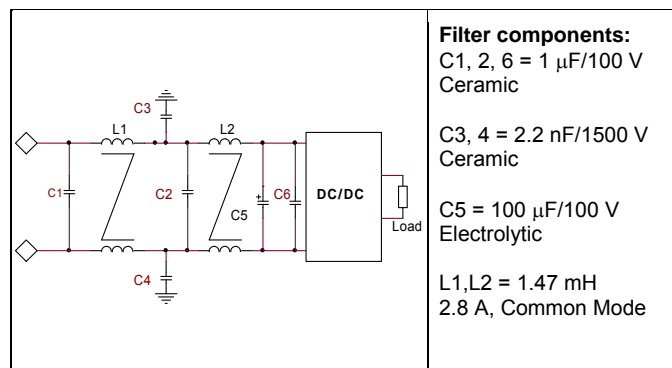
Conducted EMI measured according to EN55022, CISPR 22 and FCC part 15J (see test set-up). See Design Note 009 for further information. The fundamental switching frequency is 250 kHz for PKU 4101B.

Conducted EMI Input terminal value (typ)


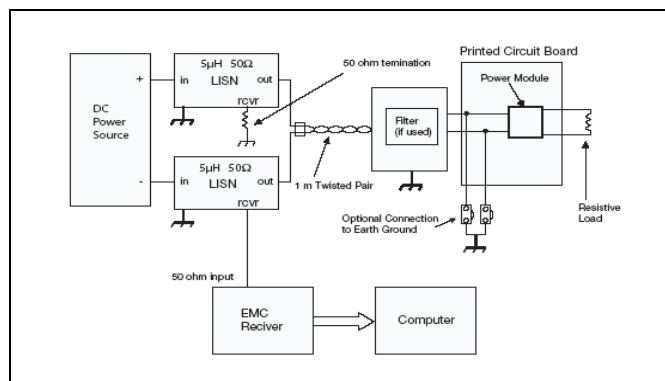
EMI without filter @ $V_i = 48$ V, max I_o .

External filter (class B)

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



EMI with filter @ $V_i = 48$ V, max I_o .



Test set-up

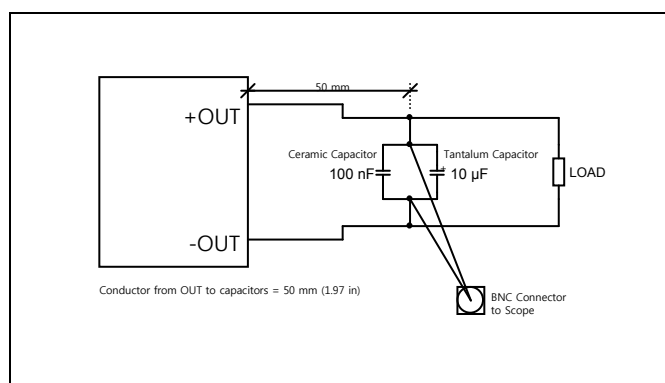
Layout recommendation

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. With regards to the isolation requirements avoid placing a conductor which is connected to the primary side below 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 test setup

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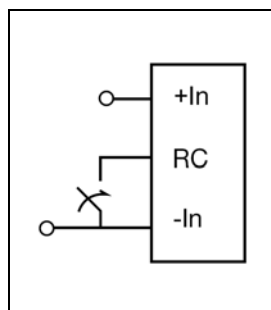
Operating information**Input Voltage**

The input voltage range 36 to 75 Vdc 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.
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 1 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 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 0.4 mA. When the RC pin is left open, the voltage generated on the RC pin is max 5 V. The maximum allowable leakage current of the switch is 50 μ A. With "negative logic" the converter will turn on when the input voltage is applied with the RC connected to the - In. Turn off is achieved by leaving the RC pin open, or connected to a voltage higher than 5 V referenced 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. The converter will turn on when the input voltage is applied with the RC pin open. Turn off is achieved by connecting the RC pin to the - In. To ensure safe turn off the voltage difference between RC pin and the - In shall be less than 1 V. The converter will restart automatically when this connection is opened.

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 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 μ F 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 an inductance below 10 μ H.

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. Ceramic capacitors will also reduce any high frequency noise at the load. It is equally important to use low resistance and low inductance PCB layouts and cabling.

For further information please contact your local Ericsson Power Modules representative.

Parallel Operation

Two converters may be paralleled for redundancy (1+1) if the total power is equal or less than P_{Omax} for one unit. To secure the function o-ring diodes may be used.

Pre-bias Start-up

These products has pre-bias start up functionality and will not sink current during start up if a pre-bias source is present at the output terminal up to the min-value of output voltage tolerance band, i.e 4.5 V for a 5 V version and 10.8 V for a 12 V version. Nor will there be any under or over shoot.

See Design Note 026 for detailed information.

Over Temperature Protection (OTP)

The converters are protected from thermal overload by an internal over temperature shutdown circuit. When T_{ref} as defined in thermal consideration section exceeds 135°C the converter will shut down. The DC/DC converter will resume normal operation automatically when the temperature has dropped approx 22°C below the temperature threshold.

Over Voltage Protection (OVP)

The converters have output over voltage protection that will clamp the output voltage to a continous fixed level. After removal of the over voltage condition the converter will resume to normal operation automatically.

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 (max I_O). The DC/DC converter will resume normal operation after removal of the overload. The load distribution should be designed for the maximum output short circuit current specified.

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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.

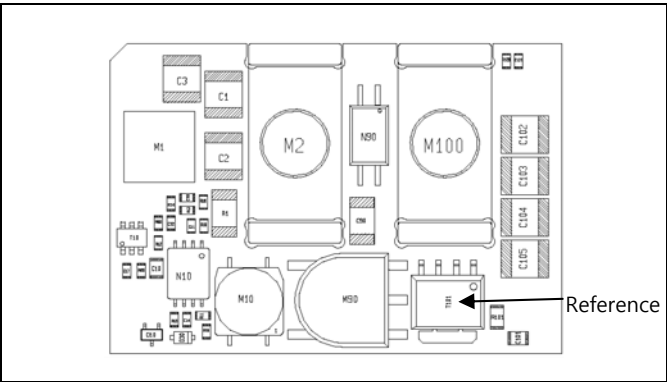
The Output Current Derating graph found in the Output section for each model provides the available output current vs. ambient air temperature and air velocity at $V_{in} = 53\text{ V}$.

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 reference point. The temperature at this position should not exceed the max values provided in the table below.

See Design Note 019 for further information.

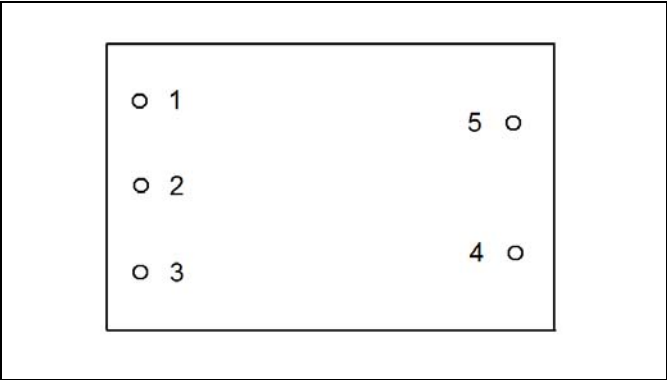
Position	Device	Designation	Max value
Reference	4101B PI	T_{ref}	120°C
Reference	4104B PI	T_{ref}	115°C



Definition of reference temperature (T_{ref})

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

Connections



Top View

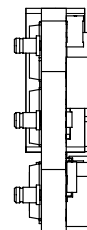
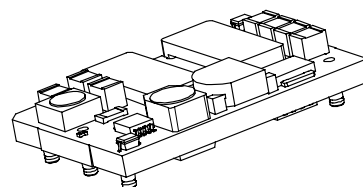
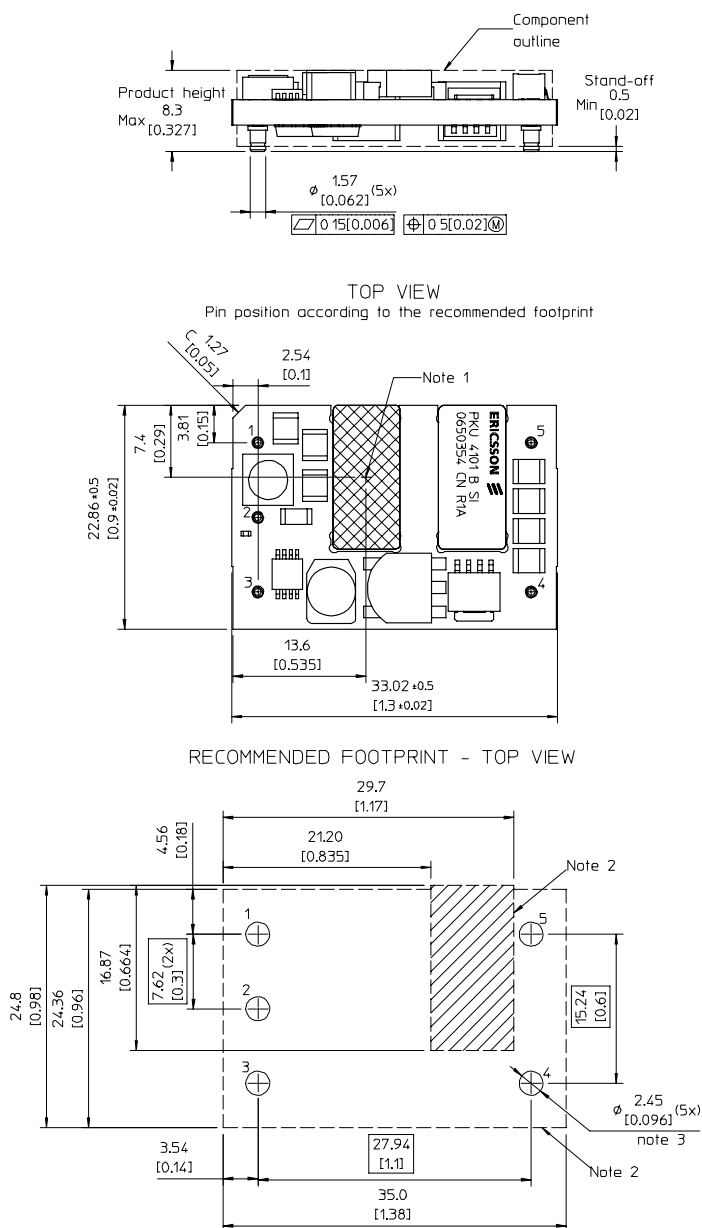
Pin	Designation	Function
1	+In	Positive Input
2	RC	Remote Control
3	-In	Negative Input
4	-Out	Negative Output
5	+Out	Positive Output

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Mechanical Information- Surface mount version



Weight: Typical 13.5 g

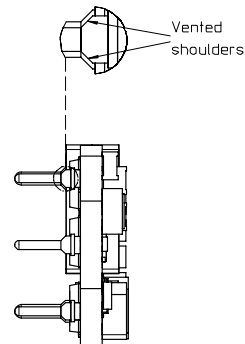
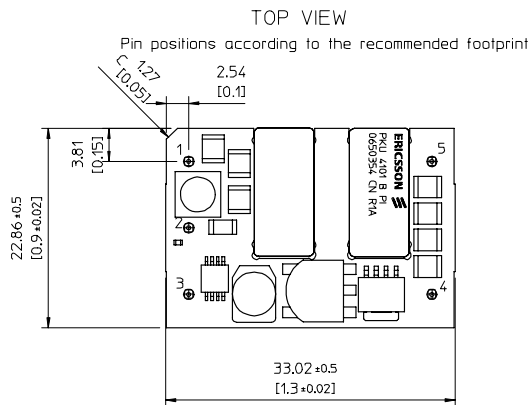
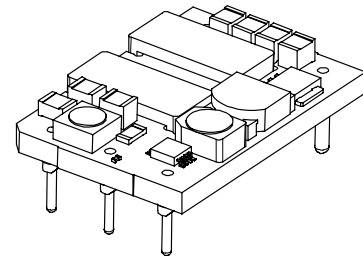
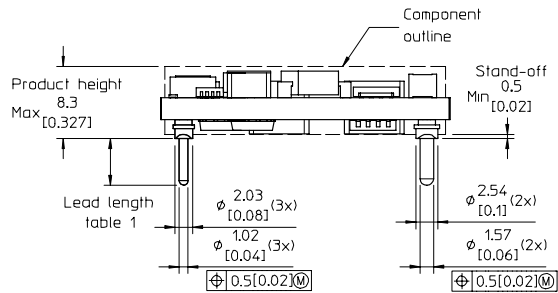
 Pins:
 Material: Copper alloy
 Plating: Min 0.1 µm Gold over 1-3 µm Nickel
 
 All dimensions in mm [inch].
 Tolerances unless specified
 x.x mm ±0.5 mm [0.02]
 x.xx mm ±0.25 mm [0.01]
 (Not applied on the recommended footprint)

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Mechanical Information- Hole mount version



RECOMMENDED FOOTPRINT -TOP VIEW

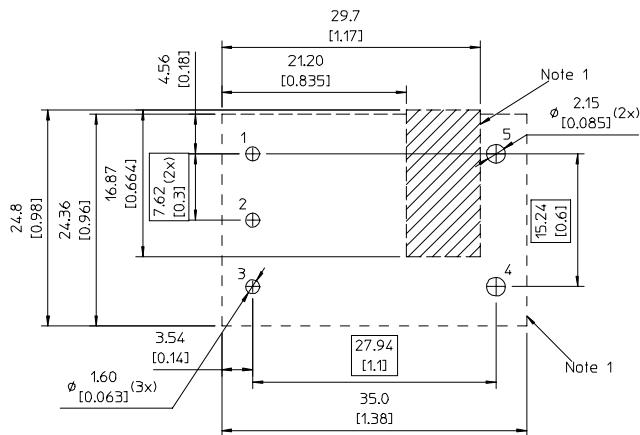


Table 1

Pin Option	Lead Length
Standard	5.33 [0.210]
LA	3.69 [0.145] (cut)
LB	4.57 [0.180] (cut)

Weight: Typical 14 g

Pins:

Material: Copper alloy

Plating: Min 0.1 µm Gold over 1-3 µm Nickel

Note 1: Recommended keep away area for user components.

Hatch area is under the output ferrite.

Do not place components, conductive parts or open vias connected to input circuit in this area. Open vias are allowed if there is a common input and output ground on the board, i.e. two-wire system.

All dimensions in mm [inch].

Tolerances unless specified

x.x mm ±0.5 mm [0.02]

x.xx mm ±0.25 mm [0.01]

(Not applied on the recommended footprint)



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Soldering Information - Surface Mounting

The surface mount product is intended for forced convection or vapor phase reflow soldering in SnPb or Pb-free processes.

The reflow profile should be optimised to avoid excessive heating of the product. It is recommended to have a sufficiently extended preheat time to ensure an even temperature across the host PCB and it is also recommended to minimize the time in reflow.

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, since cleaning residues may affect long time reliability and isolation voltage.

Minimum Pin Temperature Recommendations

Pin number 5 is chosen as reference location for the minimum pin temperature recommendation since this will likely be the coolest solder joint during the reflow process.

SnPb solder processes

For SnPb solder processes, a pin temperature (T_{PIN}) in excess of the solder melting temperature, (T_L , 183°C for Sn63Pb37) for more than 30 seconds and a peak temperature of 210°C is recommended to ensure a reliable solder joint.

Lead-free (Pb-free) solder processes

For Pb-free solder processes, a pin temperature (T_{PIN}) in excess of the solder melting temperature (T_L , 217 to 221°C for SnAgCu solder alloys) for more than 30 seconds and a peak temperature of 235°C on all solder joints is recommended to ensure a reliable solder joint.

Maximum Product Temperature Requirements

Top of the product PCB near pin 2 is chosen as reference location for the maximum (peak) allowed product temperature ($T_{PRODUCT}$) since this will likely be the warmest part of the product during the reflow process.

SnPb solder processes

For SnPb solder processes, the product is qualified for MSL 1 according to IPC/JEDEC standard J-STD-020C.

During reflow $T_{PRODUCT}$ must not exceed 225 °C at any time.

Pb-free solder processes

For Pb-free solder processes, the product is qualified for MSL 3 according to IPC/JEDEC standard J-STD-020C.

During reflow $T_{PRODUCT}$ must not exceed 260 °C at any time.

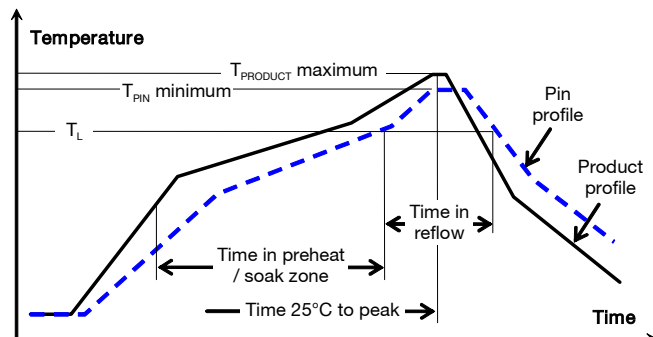
Dry Pack Information

Products intended for Pb-free reflow soldering processes are delivered in standard moisture barrier bags according to IPC/JEDEC standard J-STD-033 (Handling, packing, shipping and use of moisture/reflow sensitivity surface mount devices).

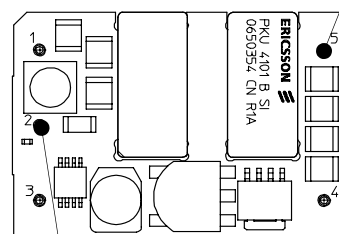
Using products in high temperature Pb-free soldering processes requires dry pack storage and handling. In case the products have been stored in an uncontrolled environment and no longer can be considered dry, the modules must be baked according to J-STD-033.

Thermocoupler Attachment

General reflow process specifications		SnPb eutectic	Pb-free
Average ramp-up ($T_{PRODUCT}$)		3°C/s max	3°C/s max
Typical solder melting (liquidus) temperature	T_L	183°C	221°C
Minimum reflow time above T_L		30 s	30 s
Minimum pin temperature	T_{PIN}	210°C	235°C
Peak product temperature	$T_{PRODUCT}$	225°C	260°C
Average ramp-down ($T_{PRODUCT}$)		6°C/s max	6°C/s max
Maximum time 25°C to peak		6 minutes	8 minutes



Pin 5 for measurement of minimum pin (solder joint) temperature, T_{PIN}



Pin 2 for measurement of maximum product temperature, $T_{PRODUCT}$

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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 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.

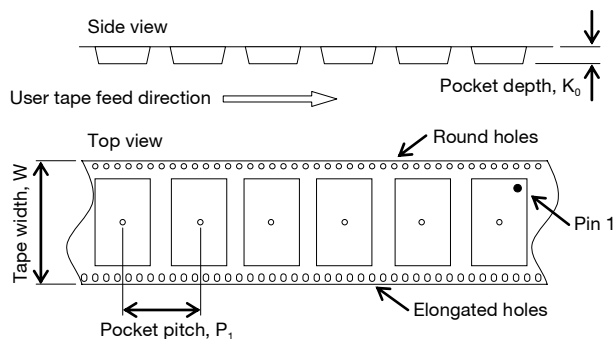
A no-clean flux is recommended to avoid entrapment of cleaning fluids in cavities inside the product or between the product and the host board. The cleaning residues may affect long time reliability and isolation voltage.

Delivery Package Information

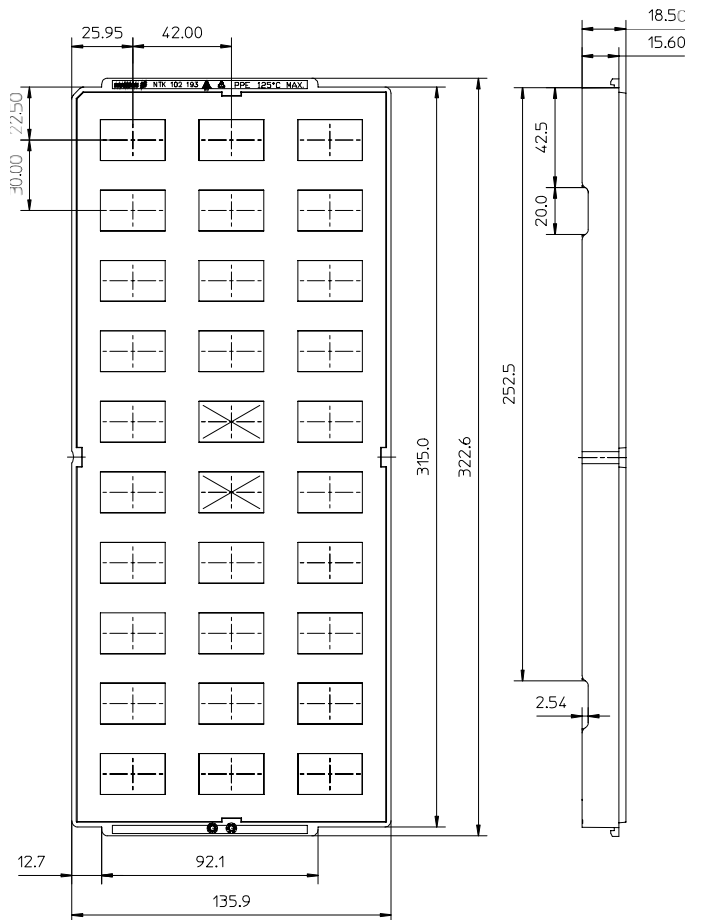
The surface mount products are delivered in antistatic injection molded trays (Jedec design guide 4.10D standard) and in antistatic carrier tape (EIA 481 standard). The through-hole mount products are delivered in antistatic injection molded trays (Jedec design guide 4.10D standard).

Carrier Tape Specifications

Material	Antistatic PS
Surface resistance	$< 10^7$ Ohm/square
Bakeability	The tape is not bakable
Tape width, W	56 mm [2.2 inch]
Pocket pitch, P_1	36 mm [1.42 inch]
Pocket depth, K_0	8.7 mm [0.343 inch]
Reel diameter	380 mm [15 inch]
Reel capacity	200 products /reel
Reel weight	Rounded 3 kg/full reel

EIA standard carrier tape

Tray Specifications

Material	Antistatic PPE
Surface resistance	$10^5 < \text{Ohm/square} < 10^{12}$
Bakability	The trays can be baked at maximum 125°C for 48 hours]
Tray thickness	18.5 mm [0.728 inch]
Box capacity	150 products (5 full trays/box)
Tray weight	190 g empty, 600 g full tray



X= Vacuum pickup area

All dimensions in mm [inch]

Tolerances: X.xx mm ± 0.13 mm [0.005], X.x mm ± 0.26 mm [0.01]

Note: tray dimensions refer to pocket center. For exact location of product pick up surface, refer to mechanical drawing.

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Product Qualification Specification

Characteristics			
External visual inspection	IPC-A-610		
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
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
Dry heat	IEC 60068-2-2 Bd	Temperature Duration	125°C 1000 h
Electrostatic discharge susceptibility	IEC 61340-3-1, JESD 22-A114 IEC 61340-3-2, JESD 22-A115	Human body model (HBM) Machine Model (MM)	Class 2, 2000 V Class 3, 200 V
Immersion in cleaning solvents	IEC 60068-2-45 XA, method 2	Water Glycol ether Isopropyl alcohol	55°C 35°C 35°C
Mechanical shock	IEC 60068-2-27 Ea	Peak acceleration Duration	100 g 6 ms
Moisture reflow sensitivity ¹	J-STD-020C	Level 1 (SnPb-eutectic) Level 3 (Pb Free)	225°C 260°C
Operational life test	MIL-STD-202G, method 108A	Duration	1000 h
Resistance to soldering heat ²	IEC 60068-2-20 Tb, method 1A	Solder temperature Duration	270°C 10-13 s
Robustness of terminations	IEC 60068-2-21 Test Ua1 IEC 60068-2-21 Test Ue1	Through hole mount products Surface mount products	All leads All leads
Solderability	IEC 60068-2-58 test Td ¹	Preconditioning Temperature, SnPb Eutectic Temperature, Pb-free	150°C dry bake 16 h 215°C 235°C
	IEC 60068-2-20 test Ta ²	Preconditioning Temperature, SnPb Eutectic Temperature, Pb-free	Steam ageing 235°C 245°C
Vibration, broad band random	IEC 60068-2-64 Fh, method 1	Frequency Spectral density Duration	10 to 500 Hz 0.07 g ² /Hz 10 min in each direction

Notes
¹ Only for products intended for reflow soldering (surface mount products)

² Only for products intended for wave soldering (plated through hole products)

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