ERICSSON

Technical Specification

PKR 5000 SI series DC/DC converters, Input 18-75 V, Output 1.5 A/11 W	EN/LZT 146 303 R4A March 2006

Key Features
- Industry standard MacroDens™ footprint 47.8 x 28.1 x max height 8.0 mm (1.88 x 1.11 x max height 0.32 in.)
- Typ. 79 % efficiency at 3.3 Vout full load
- 1500 Vdc input to output isolation.
- Meets isolation requirements equivalent to basic insulation according to IEC/EN/UL 60950
- More than 5.1 million hours predicted MTBF at 40ºC ambient temperature

General Characteristics
- Suited for narrow board pitch applications (15 mm/0.6 in)
- Over current protection
- Soft start
- Remote control
- Output voltage adjust function
- Input voltage adjust function
- Highly automated manufacturing to ensure highest quality
- ISO 9001/14001 certified supplier

Safety Approvals

Design for Environment

RoHS compatible

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

Contents

General Information

Ordering Information

See Contents for individual product ordering numbers.

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 one method, Telcordia SR332.

Predicted MTBF for the series is:

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

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 in other applications other than lead in solder, lead in high melting temperature type solder, lead in glass of electronics components, lead in electronic ceramic parts and lead as an alloying element in copper containing up to 4% lead by weight, mercury, hexavalent chromium, PBB and PBDE and of 0.01% by weight in homogeneous materials for cadmium.

Exemptions in the RoHS directive utilized in the products:

- Lead as an alloying element in copper alloy containing up to 4% lead by weight (used in connection pins made of Brass)
- 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 in solder for servers, storage and storage array systems, network infrastructure equipment for switching, signaling, transmission as well as network management for telecommunication
(Note: the products are manufactured in lead-free soldering processes and the lead present in the solder is only located in the terminal plating finishes on some components)

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).

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 are defined as component power supplies. As components they cannot fully comply with the provisions of any Safety requirements without “Conditions of Acceptability”. 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 µA 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 Ericsson Power Modules 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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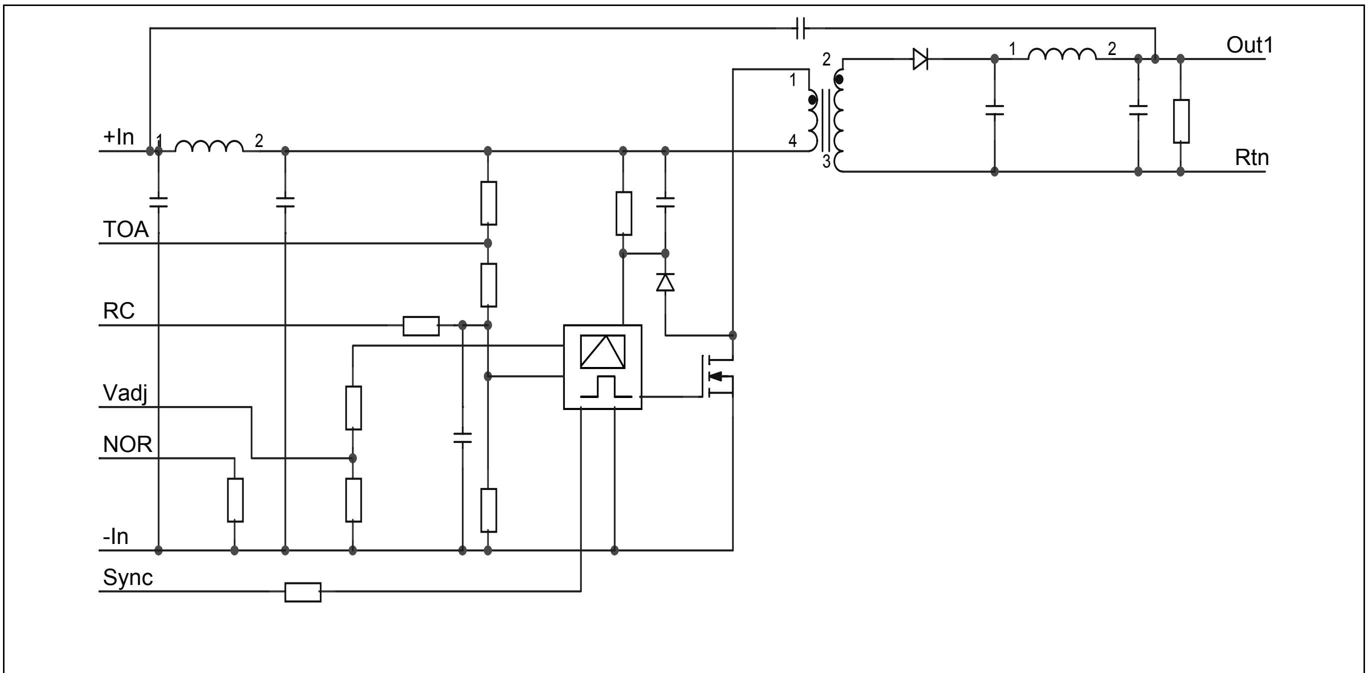
Absolute Maximum Ratings

Characteristics			min	typ	max	Unit
T_{ref}	Operating Temperature (see Thermal Consideration section)		-45		+110	°C
T_S	Storage temperature		-55		+125	°C
V_I	Input voltage		-0.5		+75	V
V_{iso}	Isolation voltage (input to output test voltage)				1500	Vdc
V_{tr}	Input voltage transient (Tp 100 ms)				100	V
V_{RC}	Remote Control pin voltage (see Operating Information section)	Positive logic option			+16	V
						V
V_{adj}	Adjust pin voltage (see Operating Information section)		-5		+40	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



PKR 5000 SI series DC/DC converters, Input 18-75 V, Output 1.5 A/11 W	EN/LZT 146 303 R4A March 2006

3.3 V/1.5 A Electrical Specification — PKR 5510 SI

T_{ref} = -30 to +95°C, V_I = 18 to 75 V, unless otherwise specified under Conditions.
Typical values given at: T_{ref} = +25°C, V_I= 53 V, max I_O, unless otherwise specified under Conditions.

Characteristics		Conditions	min	typ	max	Unit
V_I	Input voltage range		18		75	V
V_{Ioff}	Turn-off input voltage	Decreasing input voltage	15	16		V
V_{Ion}	Turn-on input voltage	Increasing input voltage		17.4	17.9	V
C_I	Internal input capacitance			2		μF
P_O	Output power	Output voltage initial setting	0		5	W
SVR	Supply voltage rejection (ac)	f = 100 Hz sine wave, 1 Vp-p		71		dB
η	Efficiency	50 % of max I_O		73		%
η	Efficiency	max I_O		79		%
η	Efficiency	50 % of max I_O , V_I = 27 V		79		%
η	Efficiency	max I_O , V_I = 27 V		81		%
P_d	Power Dissipation	max I_O		1.3	2.0	W
P_{li}	Input idling power	I_O= 0 A, V_I = 53 V		0.21		W
P_{RC}	Input standby power	V_I = 53 V (turned off with RC)		74		mW
f_s	Switching frequency	10-100% of max I_O	477	510	533	kHz

V_{Oi}	Output voltage initial setting and accuracy	T_{ref} = +25°C, V_I = 53 V, max I_O	3.27	3.3	3.33	V
V_{Oi}	Output adjust range	T_{ref} = +25°C, V_I = 53 V, max I_O	2.8		3.8	V
V_O	Output voltage tolerance band	10-100% of max I_O	3.15		3.46	V
V_O	Idling voltage	I_O = 0 A	3.34	3.55	4.1	V
V_O	Line regulation	max I_O		43	70	mV
V_O	Load regulation	V_I = 53 V, 10-100% of max I_O		54	200	mV
V_{tr}	Load transient voltage deviation	V_I = 53 V, Load step 25-75-25 % of max I_O, di/dt = 1 A/μs, see Note 1		±165		mV
t_{tr}	Load transient recovery time	V_I = 53 V, Load step 25-75-25 % of max I_O, di/dt = 1 A/μs, see Note 1		60		μs
t_r	Ramp-up time (from 10–90 % of V_{Oi})	10-100% of max I_O	0.1	2.4	6	ms
t_s	Start-up time (from V_I connection to 90% of V_{Oi})	10-100% of max I_O	0.8	4.5	12	ms
I_O	Output current		0		1.5	A
I_{lim}	Current limit threshold	Vo = 3 V, T_{ref} < max T_{ref}	1.7	2.6	2.8	A
I_{sc}	Short circuit current	T_{ref} = 25°C		3.0	3.4	A
V_{Oac}	Output ripple & noise	See ripple & noise section, max I_O, V_{Oi}		9	50	mVp-p

Note 1: Output filter according to Ripple & Noise section

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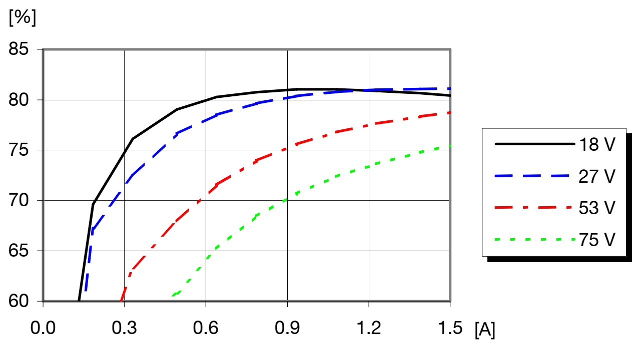
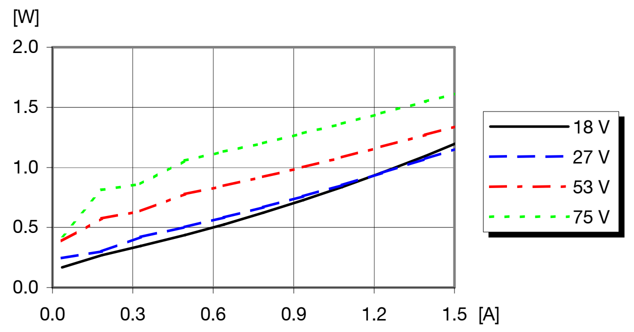
3.3 V/1.5 A Typical Characteristics **PKR 5510 SI**

Efficiency



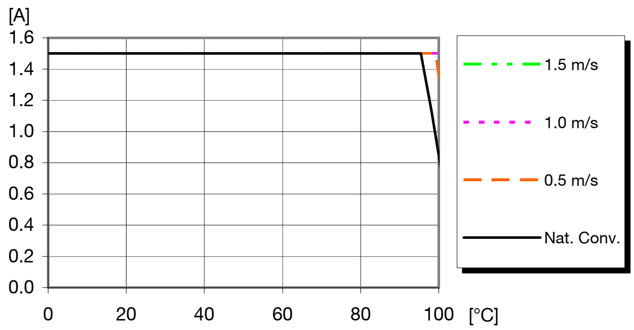
Efficiency vs. load current and input voltage at T_{ref} = +25°C

Power Dissipation



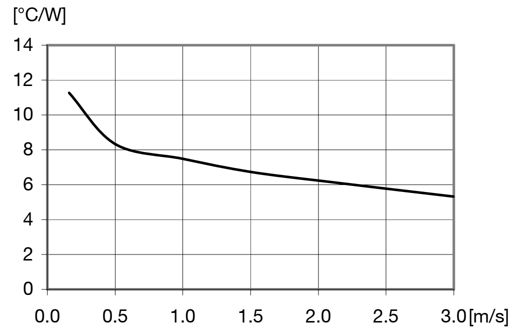
Dissipated power vs. load current and input voltage at T_{ref} = +25°C

Output Current Derating



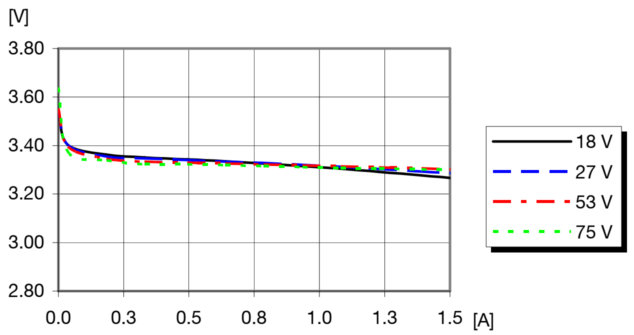
Available load current vs. ambient air temperature and airflow at V_I = 53 V. See Thermal Consideration section.

Thermal Resistance



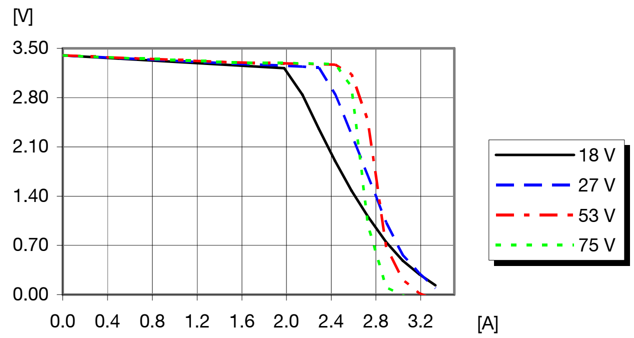
Thermal resistance vs. airspeed measured at the converter. Tested in wind tunnel with airflow and test conditions as per the Thermal consideration section.

Output Characteristics



Output voltage vs. load current at T_{ref} = +25°C

Current Limit Characteristics

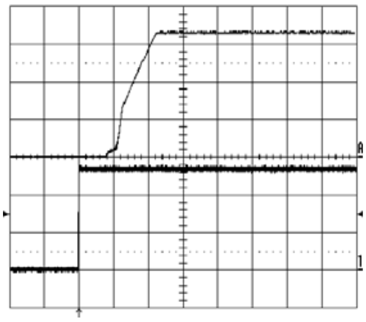


Output voltage vs. load current at I_O > max I_O, T_{ref} = +25°C

3.3 V/1.5 A Typical Characteristics

PKR 5510 SI

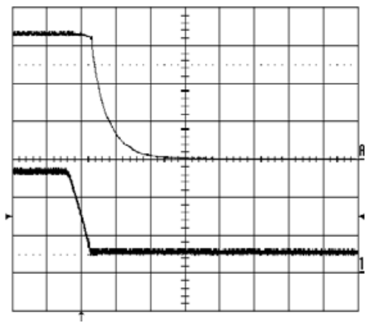
Start-up



Start-up enabled by connecting V_I at: T_{ref} = +25°C, I_O =1.5 resistive load, V_I = 53 V.

Top trace: output voltage (1 V/div.). Bottom trace: input voltage (20 V/div.). Time scale: 2 ms/div.

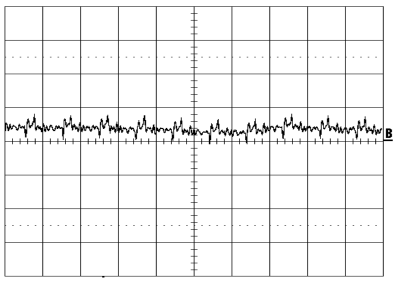
Shut-down



Shut-down enabled by disconnecting V_I at: T_{ref} = +25°C, I_O = 1.5 A resistive load, V_I = 53 V.

Top trace: output voltage (1 V/div.). Bottom trace: input voltage (20 V/div.). Time scale: 0.5 ms/div.

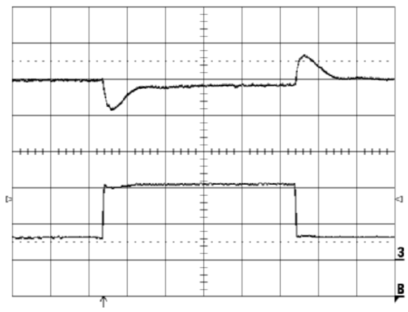
Output Ripple & Noise



Output voltage ripple (20mV/div.) at: T_{ref} = +25°C, I_O = 1.5 A resistive load, V_I = 53 V. Time scale: 2 µs/div.

See the filter in the Output ripple and noise section (EMC Specification).

Output Load Transient Response



Output voltage response to load current step-change (0.38-1.1-0.38A) at: T_{ref}=+25°C, V_I = 53 V.

Top trace: output voltage (200mV/div.). Bottom trace: load current (0.5 A/div.). Time scale: 0.1 ms/div.

Output Voltage Adjust (see operating information)

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

Output Voltage Adjust Upwards, Increase:
R_{ou}= 3.18 x (3.89 – V_{oi}) / (V_o – V_{oi}) kΩ, V_{oi} = initial output voltage, V_o = desired output voltage

E.g. Increase 4% =>V_o =3.43 Vdc
3.18 x (3.89 – 3.43) / (3.43 –3.3) = 11.2 kΩ

Output Voltage Adjust Downwards, Decrease:
R_{od}= 13 x (V_{oi} – V_o) / (V_o –2.72) kΩ, V_{oi} = initial output voltage, V_o = desired output voltage

E.g. Decrease 2% =>V_o = 3.23 Vdc
13 x (3.3 – 3.23) / (3.23 –2.72)= *1.8 kΩ*

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5 V/1.2 A Electrical Specification PKR 5611 SI

T_{ref} = -30 to +95°C, V_I = 18 to 75 V, unless otherwise specified under Conditions.
Typical values given at: T_{ref} = +25°C, V_I= 53 V, max I_O, unless otherwise specified under Conditions.

Characteristics		Conditions	min	typ	max	Unit
V_I	Input voltage range		18		75	V
V_{Ioff}	Turn-off input voltage	Decreasing input voltage	15	16		V
V_{Ion}	Turn-on input voltage	Increasing input voltage		17.2	17.9	V
C_I	Internal input capacitance			2		μF
P_O	Output power	Output voltage initial setting	0		6	W
SVR	Supply voltage rejection (ac)	f = 100 Hz sine wave, 1 Vp-p		70		dB
η	Efficiency	50 % of max I_O		77		%
		max I_O		82		
		50 % of max I_O , V_I = 27 V		83		
		max I_O , V_I = 27 V		84		
P_d	Power Dissipation	max I_O		1.3	1.8	W
P_{li}	Input idling power	I_O= 0 A, V_I = 53 V		0.27		W
P_{RC}	Input standby power	V_I = 53 V (turned off with RC)		85		mW
f_s	Switching frequency	10-100% of max I_O	477	510	533	kHz

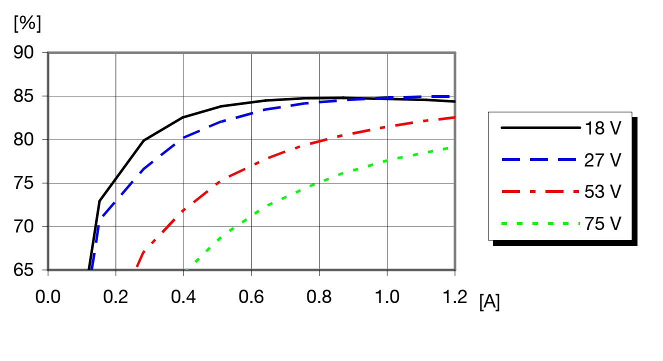
V_{Oi}	Output voltage initial setting and accuracy	T_{ref} = +25°C, V_I = 53 V, I_O = 0.2 A	5.02	5.05	5.08	V
	Output adjust range		4.3		5.8	V
V_O	Output voltage tolerance band	10-100% of max I_O	4.85		5.25	V
	Idling voltage	I_O = 0 A	5.2	5.4	6.0	V
	Line regulation	max I_O		17	40	mV
	Load regulation	V_I = 53 V, 10-100% of max I_O		90	160	mV
V_{tr}	Load transient voltage deviation	V_I = 53 V, Load step 25-75-25 % of max I_O, di/dt = 1 A/μs, see Note 1		±185		mV
t_{tr}	Load transient recovery time			100		μs
t_r	Ramp-up time (from 10–90 % of V_{Oi})	10-100% of max I_O	0.1	1.5	4.3	ms
t_s	Start-up time (from V_I connection to 90% of V_{Oi})		1.3	4.7	11	ms
I_O	Output current		0		1.2	A
I_{lim}	Current limit threshold	Vo = 4 V, T_{ref} < max T_{ref}	1.4	1.9	2.0	A
I_{sc}	Short circuit current	T_{ref} = 25°C		2.4	3.5	A
V_{Oac}	Output ripple & noise	See ripple & noise section, max I_O, V_{Oi}		8	60	mVp-p

Note 1: Output filter according to Ripple & Noise section

5 V/1.2 A Typical Characteristics

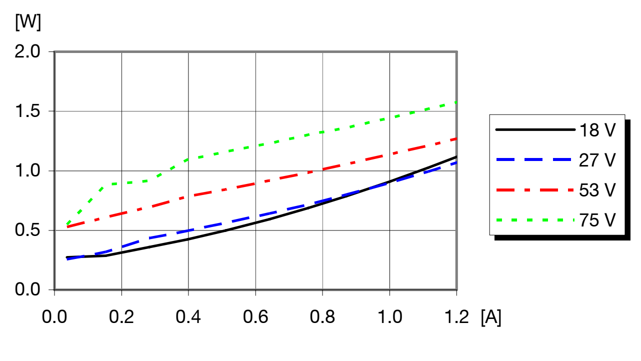
PKR 5611 SI

Efficiency



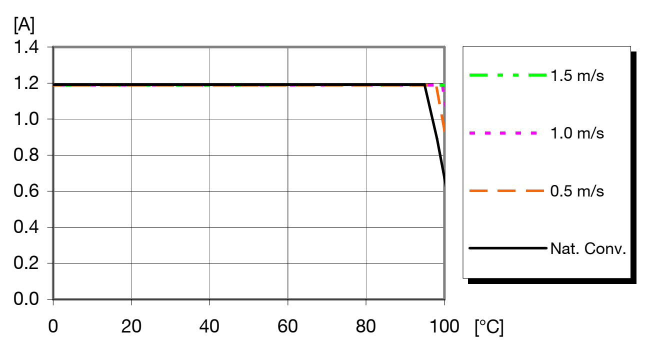
Efficiency vs. load current and input voltage at T_{ref} = +25°C

Power Dissipation



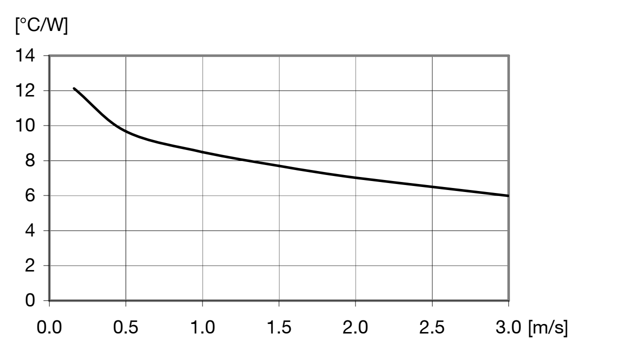
Dissipated power vs. load current and input voltage at T_{ref} = +25°C

Output Current Derating



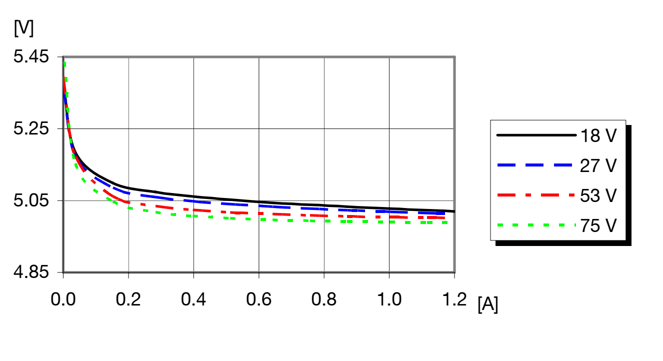
Available load current vs. ambient air temperature and airflow at V_I = 53 V. See Thermal Consideration section.

Thermal Resistance



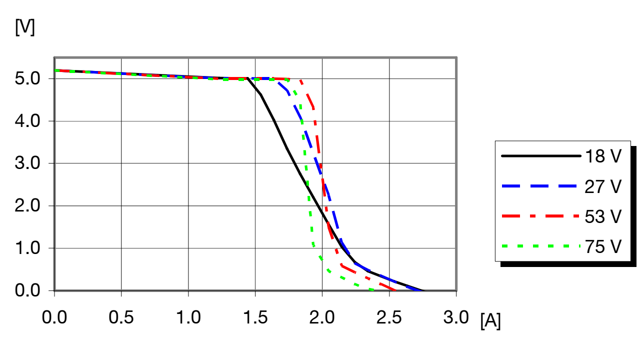
Thermal resistance vs. airspeed measured at the converter. Tested in wind tunnel with airflow and test conditions as per the Thermal consideration section.

Output Characteristics



Output voltage vs. load current at T_{ref} = +25°C

Current Limit Characteristics

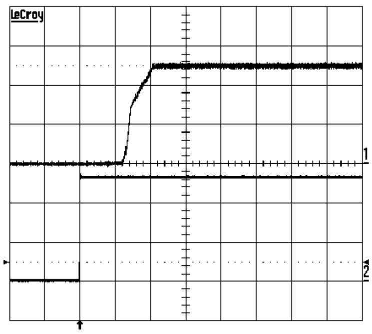


Output voltage vs. load current at I_O > max I_O, T_{ref} = +25°C

5 V/1.2 A Typical Characteristics

PKR 5611 SI

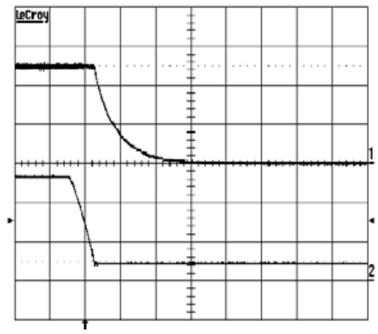
Start-up



Start-up enabled by connecting V_I at:
T_{ref} = +25°C, I_O =1.2 resistive load,
V_I = 53 V.

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

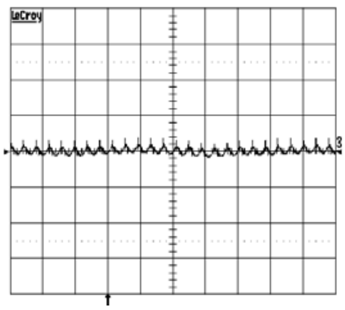
Shut-down



Shut-down enabled by disconnecting V_I at:
T_{ref} = +25°C, I_O = 1.2 A resistive load,
V_I = 53 V.

Top trace: output voltage (2 V/div.).
Bottom trace: input voltage (20 V/div.).
Time scale: 0.5 ms/div..

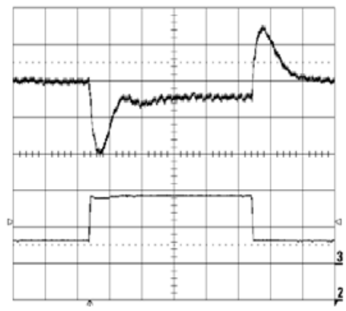
Output Ripple & Noise



Output voltage ripple (10mV/div.) at:
T_{ref} = +25°C, I_O = 1.2 A resistive load,
V_I = 53 V. Time scale: 5 μs/div.

See the filter in the Output ripple and noise section (EMC Specification).

Output Load Transient Response



Output voltage response to load current step-change (0.3-0.9-0.3A) at:
T_{ref}=+25°C, V_I = 53 V.

Top trace: output voltage (0.1V/div.).
Bottom trace: load current (0.5 A/div.).
Time scale: 0.1 ms/div.

Output Voltage Adjust (see operating information)

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

Output Voltage Adjust Upwards, Increase:
R_{ou}= 3.18 x (5.93 – V_{oi}) / (V_o – V_{oi}) kΩ, V_{oi} = initial output voltage, V_o = desired output voltage

E.g. Increase 4% =>V_o =5.25 Vdc
3.18 x (5.93 – 5.05) / (5.25 –5.05) = 14.0 kΩ

Output Voltage Adjust Downwards, Decrease:
R_{od}= 12.6 x (V_{oi} – V_o) / (V_o –4.28) kΩ, V_{oi} = initial output voltage, V_o = desired output voltage

E.g. Decrease 2% =>V_o = 4.95 Vdc
12.6 x (5.05 – 4.95) / (5.05 –4.28)= *1.6 kΩ*

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PKR 5113 SI

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Characteristics		Conditions	min	typ	max	Unit
V_I	Input voltage range		18		75	V
V_{Ioff}	Turn-off input voltage	Decreasing input voltage	15	16		V
V_{Ion}	Turn-on input voltage	Increasing input voltage		17.4	17.9	V
C_I	Internal input capacitance			2		μF
P_O	Output power	Output voltage initial setting	0		11	W
SVR	Supply voltage rejection (ac)	f = 100 Hz sine wave, 1 Vp-p		62		dB
η	Efficiency	50 % of max I_O		83.5		%
		max I_O		84.5		
		50 % of max I_O , V_I = 27 V		86		
		max I_O , V_I = 27 V		85		
P_d	Power Dissipation	max I_O		2.0	2.7	W
P_{li}	Input idling power	I_O= 0 A, V_I = 53 V		0.26		W
P_{RC}	Input standby power	V_I = 53 V (turned off with RC)		86		mW
f_s	Switching frequency	10-100% of max I_O	477	510	533	kHz

V_{Oi}	Output voltage initial setting and accuracy	T_{ref} = +25°C, V_I = 53 V, max I_O	11.94	12.0	12.06	V
	Output adjust range		6.7		15	V
V_O	Output voltage tolerance band	10-100% of max I_O	11.45		12.6	V
	Idling voltage	I_O = 0 A	12.15		15.6	V
	Line regulation	max I_O		30	86	mV
	Load regulation	V_I = 53 V, 10-100% of max I_O		300	346	mV
V_{tr}	Load transient voltage deviation	V_I = 53 V, Load step 25-75-25 % of max I_O, di/dt = 1 A/μs, see Note 1		±460		mV
t_{tr}	Load transient recovery time			62		μs
t_r	Ramp-up time (from 10–90 % of V_{Oi})	10-100% of max I_O	0.1	2.4	6	ms
t_s	Start-up time (from V_I connection to 90% of V_{Oi})		0.8	4.5	12	ms
I_O	Output current		0		0.92	A
I_{lim}	Current limit threshold	Vo=10 V, T_{ref} < max T_{ref}	1.1	1.7	2.1	A
I_{sc}	Short circuit current	T_{ref} = 25°C		2.2	2.6	A
V_{Oac}	Output ripple & noise	See ripple & noise section, max I_O, V_{Oi}		9	50	mVp-p

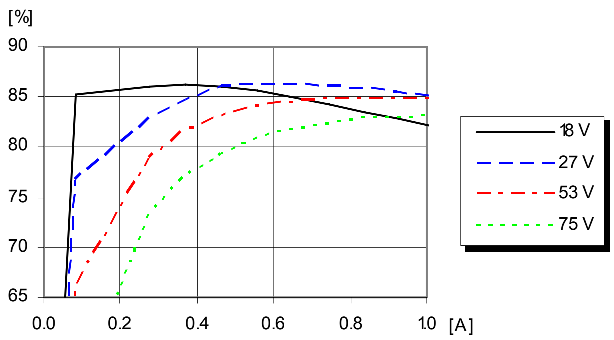
Note 1: Output filter according to Ripple & Noise section

PKR 5000 SI series DC/DC converters, Input 18-75 V, Output 1.5 A/11 W	EN/LZT 146 303 R4A March 2006 © Ericsson Power Modules AB

12 V/0.92 A Typical Characteristics

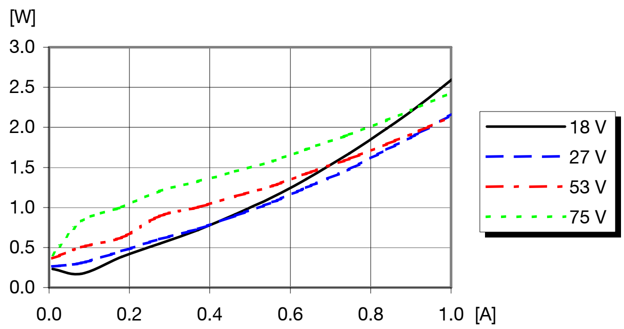
PKR 5113 SI

Efficiency



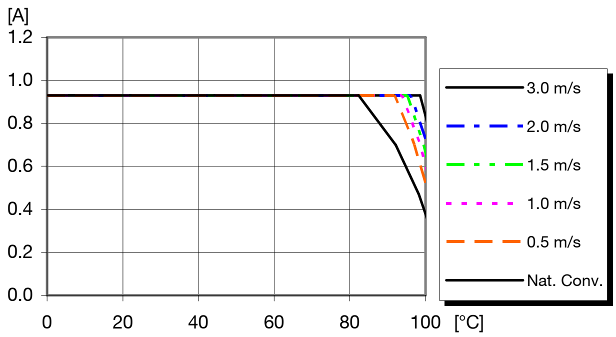
Efficiency vs. load current and input voltage at T_{ref} = +25°C

Power Dissipation



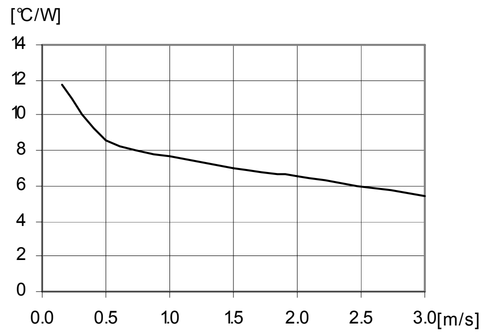
Dissipated power vs. load current and input voltage at T_{ref} = +25°C

Output Current Derating



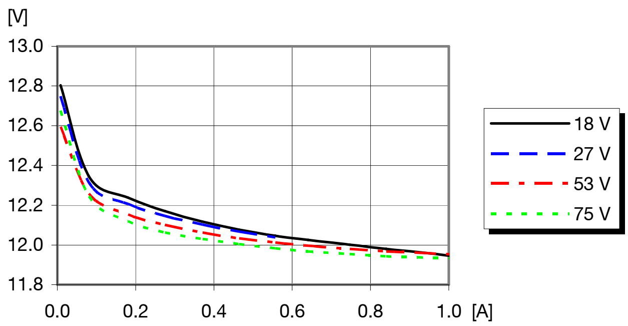
Available load current vs. ambient air temperature and airflow at V_I = 53 V. See Thermal Consideration section.

Thermal Resistance



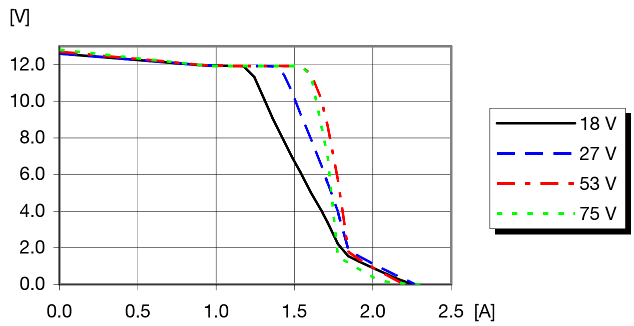
Thermal resistance vs. airspeed measured at the converter. Tested in wind tunnel with airflow and test conditions as per the Thermal consideration section.

Output Characteristics



Output voltage vs. load current at T_{ref} = +25°C

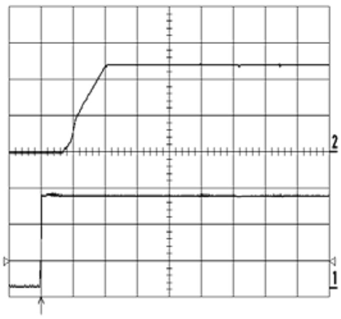
Current Limit Characteristics



Output voltage vs. load current at I_O > max I_O, T_{ref} = +25°C

12 V/0.92 A Typical Characteristics — PKR 5113 SI

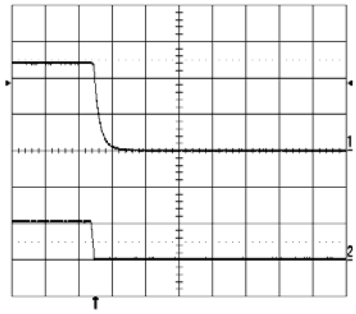
Start-up



Start-up enabled by connecting V_I at: T_{ref} = +25°C, I_O =0.92 resistive load, V_I = 53 V.

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

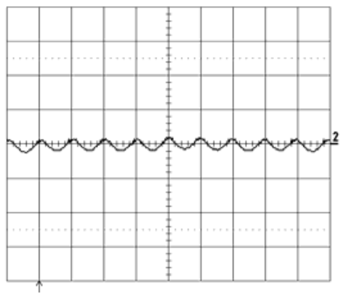
Shut-down



Shut-down enabled by disconnecting V_I at: T_{ref} = +25°C, I_O = 0.92 A resistive load, V_I = 53 V.

Top trace: output voltage (5 V/div.). Bottom trace: input voltage (50 V/div.). Time scale: 2 ms/div..

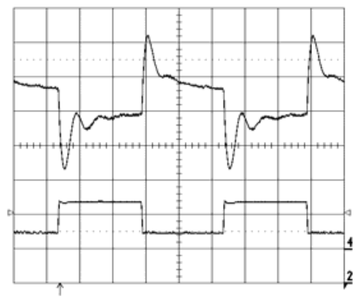
Output Ripple & Noise



Output voltage ripple (20mV/div.) at: T_{ref} = +25°C, I_O = 0.92 A resistive load, V_I = 53 V. Time scale: 2 µs/div.

See the filter in the Output ripple and noise section (EMC Specification).

Output Load Transient Response



Output voltage response to load current step-change (0.69-0.23-0.69A) at: T_{ref}=+25°C, V_I = 53 V.

Top trace: output voltage (200mV/div.). Bottom trace: load current (0.5 A/div.). Time scale: 0.2 ms/div..

Output Voltage Adjust (see operating information)

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

Output Voltage Adjust Upwards, Increase:
R_{ou}= 4.20 x (15 – V_o) / (V_o - V_{oi}) kΩ

E.g. Increase 4% =>V_o =12.48 Vdc
4.20 x (15 – 12.48) / (12.48 – 12) = 22.05 kΩ

Output Voltage Adjust Downwards, Decrease:
R_{od}= 18 x (V_{oi} – V_o) / (V_o –6.7) kΩ

E.g. Decrease 2% =>V_o = 11.74 Vdc
18 x (12 – 11.74) / (11.74 –6.7)= *0.908 kΩ*