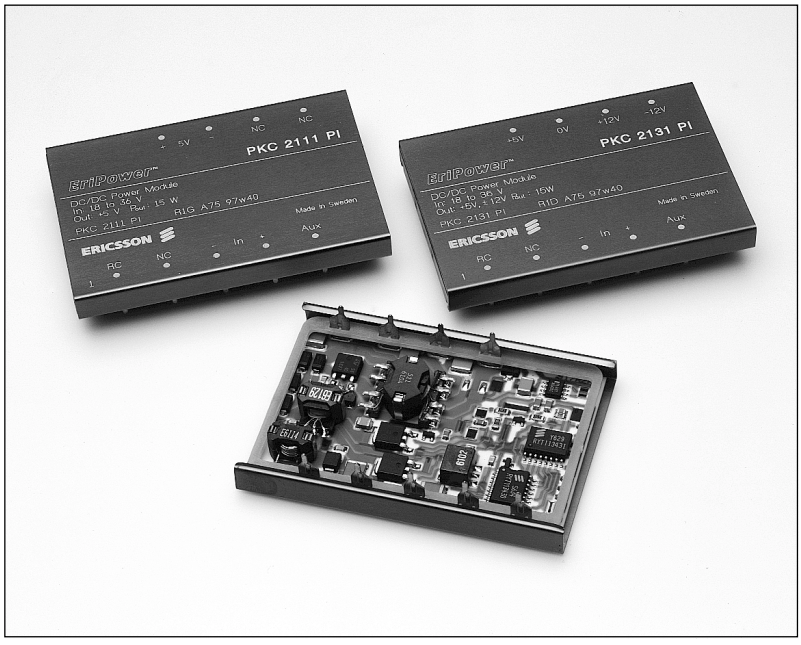
15–18 W DC/DC Power Modules
24 V Input Series

- *Regulated single, dual and triple outputs*
- *Low profile 10.7 mm (0.42 in.), allows 0.8" board pitch – 0.6 in. if recessed in the printed board*
- *Proven MTBF >2,000,000 hours at +75 °C case temperature and a rugged mechanical construction*
- *Efficiency 85% typ, at full load. No extra heatsink up to +85°C ambient. Max.+115°C case*
- *Low EMI in conformance with class A in EN 55022 and FCC part 15J*



The 15–18 watts PKC series DC/DC power modules are especially designed for decen-tralized 24 and 28 Vdc systems with distributed on-board DC/DC converters. Their low profile allows very narrow board pitches and slim designs. By using thickfilm technology, which provides a high degree of integration as well as efficient thermal management, and by utilizing a 300 kHz switching frequency based on proprietary drive & control circuits, these highly reliable products can be used in demanding applications within e.g. cellular radio, medical, industrial and aircraft industry.
By using magnetic integration of the output voltages in the feedback loop, all outputs are kept within a ±3% total tolerance band. Input to output isolation is 500 Vdc and mechanical ruggedness – specified in conformance with IEC 68-2 – is close to requirements for discrete components. Extreme temperature conditions can be met since the PKC power modules can operate with full output power in ambient temperatures from –45 to +85°C, or up to +115°C case temperature also making the products ideal for applications within not temperature controlled environments.
The PKC series are manufactured using highly automated manufacturing lines with a world-class quality commitment and a five-year warranty. Ericsson Microelectronics AB has been an ISO 9001 certified supplier since 1991. *For a complete product program please reference the back cover.*

ERICSSON

General

Absolute Maximum Ratings

Characteristics		min	max	Unit
T_C	Case temperature[1)]	–45	+115	°C
T_S	Storage temperature	–55	+125	°C
V_I	Input voltage	–0.5	36	Vdc
V_{ISO}	Input to output isolation	500		Vdc
W_{tr}	Transient input energy[2)]		0.6	Ws
V_{RC}	Remote control voltage pin 1	0	5	Vdc

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.

Input $T_C < T_{Cmax}$ unless otherwise specified

Characteristics		Conditions	min	typ	max	Unit
V_I	Input voltage range[3)]		18		36	V
V_{Ioff}	Turn-off input voltage	(See Operating Information)	13		17	V
V_{Ion}	Turn-on input voltage	(See Operating Information)	14		18	V
r_{Irush}	Equivalent inrush current resistance			600		mΩ
C_I	Input capacitance			1.4		µF
P_{Ii}	Input idling power	$I_O = 0, T_C = 0...+95$ °C		2		W
P_{RC}	Input stand-by power	V_I = 26V, I_O = 0, T_C = 0...+95 °C, RC connected to pin 3		0.6		W

Environmental Characteristics

Characteristics	Test procedure & conditions		
Vibration (Sinusoidal)	IEC 68-2-6 F_c	Frequency Amplitude Acceleration Number of cycles	10…500 Hz 0.75 mm 10 g 10 in each axis
Shock (Half sinus)	IEC 68-2-27 E_a	Peak acceleration Shock duration	200 g 3 ms
Bump (Half sinus)	IEC 68-2-29 E_b	Peak acceleration Bump duration Number of bumps	40 g 6 ms 1000 in 6 directions
Temperature change	IEC 68-2-14 N_a	Temperature Number of cycles	–40°C…+125°C 10
Damp heat	IEC 68-2-3 C_a	Temperature Duration	40°C 56 days
Accelerated damp heat	IEC 68-2-3 C_a with bias	Temperature Humidity Duration	85°C 85% RH 500 hours
Solder resistability	IEC 68-2-20 T_b 1A	Temperature,solder Duration	260°C 10…13 s

Safety

The PKC 2000 I DC/DC power modules are designed in accordance with EN 60 950. *Safety of information technology equipment including electrical business equipment*. and certified by SEMKO.

The isolation is an operational insulation in accordance with EN 60950. The PKC power modules are recognized by UL and meet the applicable requirements in UL 1950 *Safety of information technology equipment*, the applicable *canadian safety requirements* and UL 1012 standard for power supplies. The DC/DC power module shall be installed in an end-use equipment.

The isolation voltage between input and output and between case and input/output is 500 Vdc and the capacitor between the input and output has a value of 10 nF. The leakage current is less than 1uA @ 26 Vdc.

The case is partly designed in non-coductive plastic. Flammability ratings meets UL 94V-0.

Notes:

1) Corresponding ambient temp. range (T_A) at full output power is –45 to +85°C.

2) P<1 kW, t_r/t_d = 10/1000 ms, I_I<8 A. Transient supressor threshold voltage is 39 V typ.

3) The converters will operate down to $V_I \leq 17$ V, when V_I decreases, but will turn on at $V_I \leq 18$ V, when V_I increases (see also Operating information).

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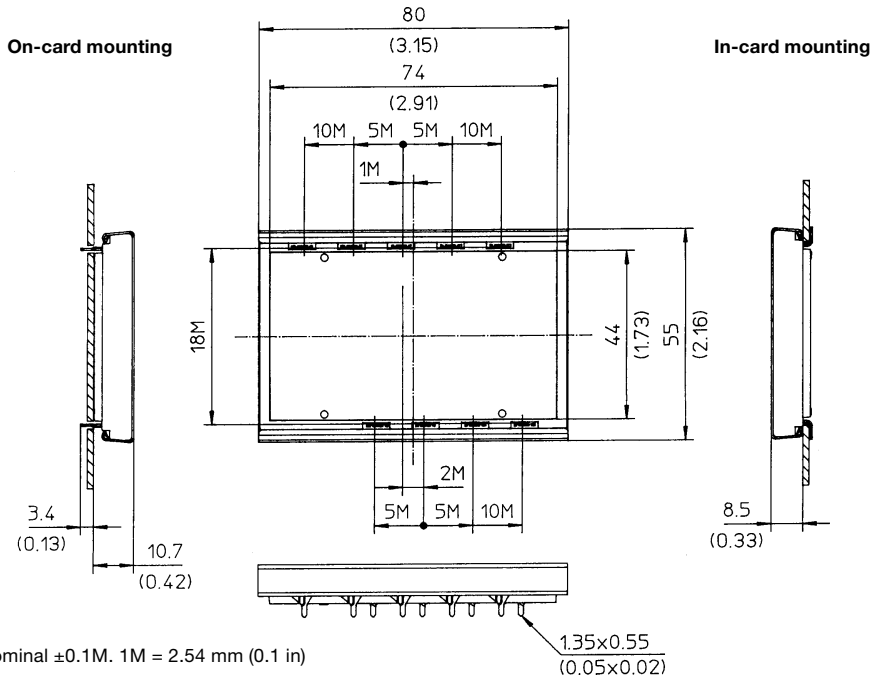
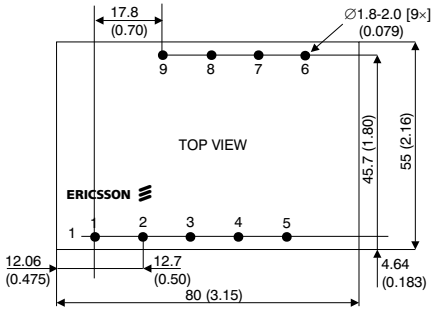
Mechanical Data



Pin spacing figures are nominal ±0.1M. 1M = 2.54 mm (0.1 in)

Footprint



Dimensions in mm (in)

Connections

Pin	Designation	Function
1	RC	Remote Control to turn-on and turn-off the output. It is also used to adjust the turn-off input voltage threshold (see V_{loff} p.15)
2	NC	The pin is Not Connected
3	–In	Negative Input terminal
4	+In	Positive Input terminal
5	Aux	Auxiliary terminal (see V_{loff} p. 15)
6	Out	Negative Output terminal. Output 2 in dual and Output 3 in triple output models
7	Out	Positive Output terminal. Output 2 in triple output models. Additional return in dual versions
8	Rtn	Return terminal for all outputs
9	Out	Positive Output terminal. Output 1 in all models

Weight

50 gr (1.76 oz).

Case

Blue anodized aluminum case with a plastic bottom cover and with tin plated brass pins.

Thermal Data

Two-parameter model

Power dissipation is generated in the components mounted on the ceramic substrate. The thermal properties of the PKC power module is determined by thermal conduction in the connected pins and thermal convection from the substrate via the case.

The two-parameter model characterize the thermal properties of the PKC power module and the equation below can be used for thermal design purposes if detailed information is needed. The values are given for a module mounted on a printed board assembly (PBA).

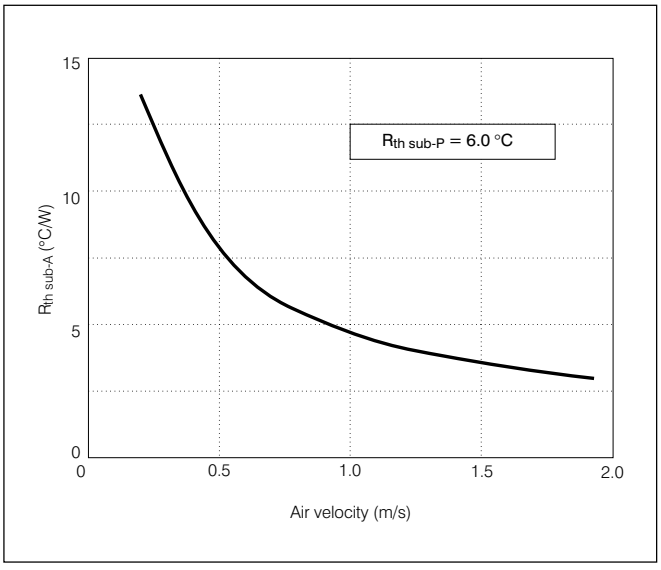
Note that the thermal resistance between the substrate and the air, $R_{th\ sub\text{-}A}$ is strongly dependent on the air velocity.

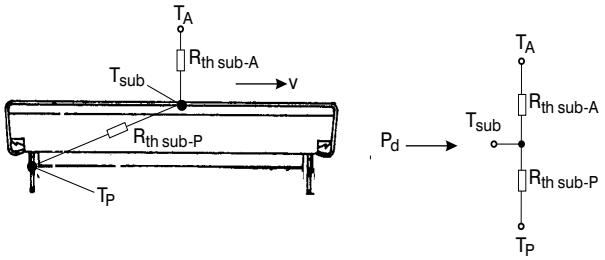
$T_{sub} = P_d \times R_{th\ sub\text{-}P} \times R_{th\ sub\text{-}A}/(R_{th\ sub\text{-}P} + R_{th\ sub\text{-}A}) + (T_P - T_A) \times R_{th\ sub\text{-}A}/(R_{th\ sub\text{-}P} + R_{th\ sub\text{-}A}) + T_A$

Where:

P_d : dissipated power, calculated as $P_O \times (1/\eta - 1)$.
T_{sub} : max average substrate temperature, $\approx T_{C\,max}$.
T_A : ambient air temperature at the lower side of the power module.
T_P : average pin temperature or solder joint temperature.
$R_{th\ sub\text{-}P}$: thermal resistance from T_{sub} to the pins.
$R_{th\ sub\text{-}A}$: thermal resistance from T_{sub} to T_A.
v : velocity of ambient air.

Air velocity in free convection is 0.2–0.3 m/s (40-60 lfm).

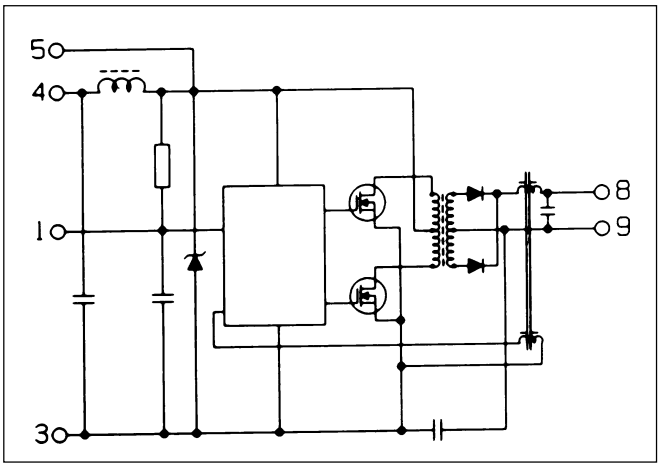




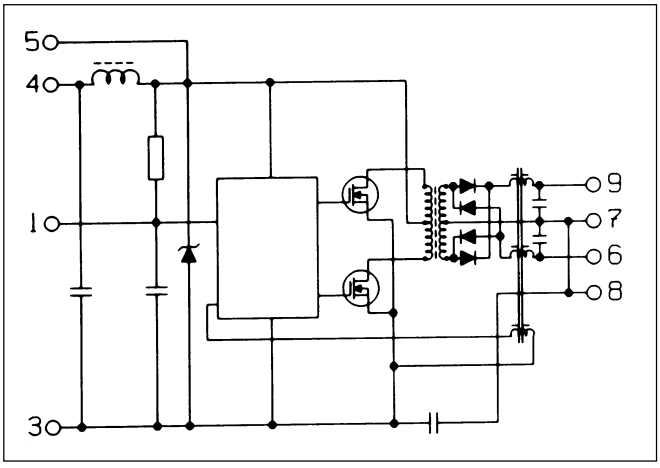
Electrical Data

Fundamental circuit diagrams

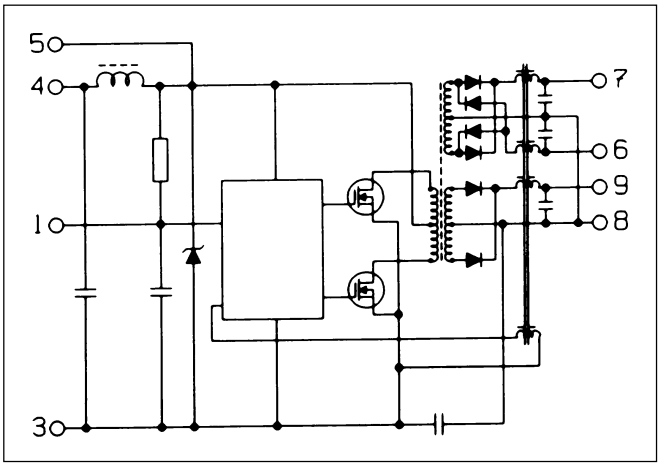
Single output



Dual output



Triple output



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PKC 2111 PI

T_C = 0…+95°C, V_I = 18...36 V unless otherwise specified.

Output

Characteristics		Conditions		Output 1 min	Output 1 typ	Output 1 max	Unit
V_{Oi}	Output voltage initial setting and accuracy	T_C = +25°C, I_O = 3 A, V_I = 26 V		5.02	5.06	5.11	V
V_O	Output voltage tolerance band	I_O = 0.1… 1.0 × $I_{O\,max}$ and long term drift		4.90		5.25	V
	Idling circuit voltage	I_O = 0 A				5.25	V
	Line regulation	I_O = $I_{O\,max}$				90	mV
	Load regulation	I_O = 0.1… 1.0 × $I_{O\,max}$, V_I = 26 V				150	mV
t_{tr}	Load transient recovery time	I_O = 0.1… 1.0 × $I_{O\,max}$, V_I = 26 V load step = 2.4 A $\frac{di}{dt}$ < 1A/µs			100		µs
V_{tr}	Load transient voltage				+250		mV
					–250		mV
	Short term drift	t = 0...10 minutes			–15		mV
T_{coeff}	Temperature coefficient	I_O = $I_{O\,max}$, T_C < $T_{C\,max}$			–0.5		mV/°C
t_r	Ramp-up time	I_O = 0.1… 1.0 × $I_{O\,max}$, V_I = 26 V	0.1… 0.9 × V_O		20		ms
t_s	Start-up time		From V_I connection to V_O = 0.9 × V_{Oi}		30		ms
I_O	Output current			0		3.0	A
$P_{O\,max}$	Max output power	*		15			W
I_{lim}	Current limiting threshold	T_C < $T_{C\,max}$		3.1			A
I_{sc}	Short curcuit current	V_O = 0.2… 0.5 V, T_A = 25°C Hick-up			<0.5		A
$V_{O\,ac}$	Output ripple & noice	I_O = $I_{O\,max}$	20 Hz… 5 MHz			100	mV_{p-p}
			DC… 50 MHz			120	mV_{p-p}
			1 MHz bandwidth			35	mV_{rms}
SVR	Supply voltage rejection (ac)	f = 100 Hz sine wave, 1 V_{p-p}, V_I = 26 V (SVR = 20 log (1 V_{p-p}/$V_{O\,p-p}$))		50			dB

* See also Power derating p. 12

Miscellaneous

Characteristics		Conditions	min	typ	max	Unit
η	Efficiency	I_O = $I_{O\,max}$, V_I = 26 V	80.5	81.5		%
P_d	Power dissipation	I_O = $I_{O\,max}$		3.4		W

PKC 2113 PI

T_C = 0…+95°C, V_I = 18...36V unless otherwise specified.

Output

Characteristics		Conditions		Output 1 min	Output 1 typ	Output 1 max	Unit
V_{Oi}	Output voltage initial setting and accuracy	T_C = +25°C, I_O = 1.5A, V_I = 26 V		11.94	12.00	12.06	V
V_O	Output voltage tolerance band	I_O = 0.1… 1.0 × $I_{O\,max}$ and long term drift		11.80		12.35	V
	Idling circuit voltage	I_O = 0 A				12.40	V
	Line regulation	I_O = $I_{O\,max}$				168	mV
	Load regulation	I_O = 0.1… 1.0 × $I_{O\,max}$, V_I = 26 V				360	mV
t_{tr}	Load transient recovery time	I_O=0.1… 1.0 × $I_{O\,max}$, V_I = 26 V load step = 1.2 A $\frac{di}{dt}$ <1A/µs			200		µs
V_{tr}	Load transient voltage				+600		mV
					−600		mV
	Short term drift	t = 0...10 minutes			−45		mV
T_{coeff}	Temperature coefficient	I_O = $I_{O\,max}$, T_C < $T_{C\,max}$			−1.5		mV/°C
t_r	Ramp-up time	I_O= 0.1… 1.0 × $I_{O\,max}$, V_I = 26 V	0.1… 0.9 × V_O		20		ms
t_s	Start-up time		From V_I connection to V_O = 0.9 × V_{Oi}		30		ms
I_O	Output current			0		1.5	A
$P_{O\,max}$	Max output power	*		18			W
I_{lim}	Current limiting threshold	T_C < $T_{C\,max}$		1.6			A
I_{sc}	Short curcuit current	V_O = 0.2… 0.5V, T_A = 25°C Hick-up			<0.5		A
$V_{O\,ac}$	Output ripple & noice	I_O = $I_{O\,max}$	20 Hz… 5 MHz			80	mV_{p-p}
			DC… 50 MHz			100	mV_{p-p}
			1 MHz bandwidth			25	mV_{rms}
SVR	Supply voltage rejection (ac)	f = 100 Hz sine wave, 1 V_{p-p}, V_I = 26 V (SVR = 20 log (1 V_{p-p}/V_{Op-p}))		43			dB

* See also Power derating p. 12

Miscellaneous

Characteristics		Conditions	min	typ	max	Unit
η	Efficiency	I_O = $I_{O\,max}$, V_I = 26 V	84	85		%
P_d	Power dissipation	I_O = $I_{O\,max}$		3.2		W

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PKC 2121 PI

T_C = 0…+95°C, V_I = 18...36V unless otherwise specified. I_{O1nom} = 0.75A, I_{O2nom} = 0.75A

Output

Characteristics		Conditions		Output 1			Output 2			Unit
				min	typ	max	min	typ	max	
V_{Oi}	Output voltage initial setting and accuracy	T_C = +25 °C, I_O = $I_{O\,nom}$, V_I = 26 V		11.91	12.00	12.09	–11.84	–12.00	–12.16	V
V_O	Output voltage tolerance band	I_{O1} = 0.1 … 1.0 × $I_{O\,nom}$, I_{O2} = $I_{O\,nom}$ and long term drift		11.75		12.35	11.64		12.36	V
	Idling circuit voltage	I_O = 0 A				12.40		15	20	V
	Line regulation	I_O = $I_{O\,nom}$				120			144	mV
	Load regulation	I_{O1} = 0.1 … 1.0 × $I_{O\,nom}$, I_{O2} = $I_{O\,nom}$, V_I = 26 V				360				mV
t_{tr}	Load transient recovery time	I_O = 0.1 … 1.0 × $I_{O\,nom}$, V_I = 26 V load step = 0.6 A symmetrical load, I_{O1} = I_{O2} $\frac{di}{dt}$ <1A/µs			200			200		µs
V_{tr}	Load transient voltage				+600			+600		mV
					–600			–600		mV
	Short term drift	t = 0...10 minutes			–30			–30		mV
T_{coeff}	Temperature coefficient	I_O = $I_{O\,nom}$, T_C < $T_{C\,max}$			–1.0			–1.0		mV/°C
t_r	Ramp-up time	I_O = 0.1 … 1.0 × $I_{O\,nom}$, V_I = 26 V	0.1 … 0.9 × V_O		20			20		ms
t_s	Start-up time		From V_I connection to V_O = 0.9 × V_{Oi}		30			30		ms
I_O	Output current			0		1.2	0		1.2	A
$P_{O\,max}$	Max total output power	*			min 18					W
I_{lim}	Current limiting threshold	T_C < $T_{C\,max}$			min 1.02 × $P_{O\,max}$**					
I_{sc}	Short curcuit current	V_O = 0.2 … 0.5 V, T_A = 25 °C Hick-up			<0.5			<0.5		A
$V_{O\,ac}$	Output ripple & noice	I_O = $I_{O\,nom}$	20 Hz … 5 MHz			90			90	mV_{p-p}
			DC … 50 MHz			110			110	mV_{p-p}
			1 MHz bandwidth			25			30	mV_{rms}
SVR	Supply voltage rejection (ac)	f = 100 Hz sine wave, 1 V_{p-p}, V_I = 26 V (SVR = 20 log (1 V_{p-p}/V_{Op-p}))		43			43			dB

* See also Power derating p. 12

** I_{lim} on each output is set by the total load

Miscellaneous

Characteristics		Conditions	min	typ	max	Unit
η	Efficiency	I_O = $I_{O\,nom}$, V_I = 26 V	84	86		%
P_d	Power dissipation	I_O = $I_{O\,nom}$		2.9		W

PKC 2126 PI

T_C = 0…+95°C, V_I = 18...36V unless otherwise specified. I_{O1nom} = 0.6A, I_{O2nom} = 0.6A

Output

Characteristics		Conditions		Output 1			Output 2			Unit
				min	typ	max	min	typ	max	
V_{Oi}	Output voltage initial setting and accuracy	T_C = +25°C, I_O = $I_{O\,nom}$, V_I = 26 V		14.89	15.0	15.11	–14.82	–15.0	–15.18	V
V_O	Output voltage tolerance band	I_{O1} = 0.1… 1.0 × $I_{O\,nom}$, I_{O2} = $I_{O\,nom}$ and long term drift		14.70		15.40	14.55		15.45	V
	Idling voltage	I_O = 0 A				15.45		18	23	V
	Line regulation	I_O = $I_{O\,nom}$				240			270	mV
	Load regulation	I_{O1} = 0.1… 1.0 × $I_{O\,nom}$, I_{O2} = $I_{O\,nom}$, V_I = 26 V				450				mV
t_{tr}	Load transient recovery time	I_O = 0.1… 1.0 × $I_{O\,nom}$, V_I = 26 V load step = 0.48 A symmetrical load, I_{O1} = I_{O2} $\frac{di}{dt}$ <1A/µs			250			250		µs
V_{tr}	Load transient voltage				+750			+750		mV
					–750			–750		mV
	Short term drift	t = 0...10 minutes			–30			–30		mV
T_{coeff}	Temperature coefficient	I_O = $I_{O\,nom}$, T_C < $T_{C\,max}$			–1.0			–1.0		mV/°C
t_r	Ramp-up time	I_O= 0.1… 1.0 × $I_{O\,nom}$, V_I = 26 V	0.1… 0.9 × V_O		20			20		ms
t_s	Start-up time		From V_I connection to V_O = 0.9 × V_{Oi}		30			30		ms
I_O	Output current			0		1.0	0		1.0	A
$P_{O\,max}$	Max total output power	*			min 18					W
I_{lim}	Current limiting threshold	T_C < $T_{C\,max}$			min 1.02 × $P_{O\,max}$**					
I_{sc}	Short curcuit current	V_O = 0.2… 0.5 V, T_A = 25 °C Hick-up			<0.5			<0.5		A
$V_{O\,ac}$	Output ripple & noice	I_O = $I_{O\,nom}$	20 Hz… 5 MHz			90			90	mV_{p-p}
			DC… 50 MHz			110			110	mV_{p-p}
			1 MHz bandwidth			25			30	mV_{rms}
SVR	Supply voltage rejection (ac)	f = 100 Hz sine wave, 1 V_{p-p}, V_I = 26 V (SVR = 20 log (1 V_{p-p}/V_{Op-p}))		40			40			dB

* See also Power derating p. 12

** I_{lim} on each output is set by the total load

Miscellaneous

Characteristics		Conditions	min	typ	max	Unit
η	Efficiency	I_O = $I_{O\,nom}$, V_I = 26 V	84	86.5		%
P_d	Power dissipation	I_O = $I_{O\,nom}$		2.8		W

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PKC 2131 PI

T_C = 0…+95°C, V_I = 18...36V unless otherwise specified. I_{O1nom} = 2.0A, $I_{O2, 3nom}$ = 0.2A

Output

Characteristics		Conditions		Output 1			Output 2			Output 3			Unit
				min	typ	max	min	typ	max	min	typ	max	
V_{Oi}	Output voltage initial setting and accuracy	T_C = +25 °C, I_O = I_{O}nom, V_I = 26 V		5.02	5.06	5.11	11.94	12.10	12.26	–11.94	–12.10	–12.26	V
V_O	Output voltage tolerance band	I_O = 0.1 … 1.0 × I_{O}nom, $I_{O2, 3}$ = I_{O}nom and long term drift		4.90		5.25	11.64		12.36	11.64		12.36	V
	Idling voltage	I_O = 0 A				5.25		15.00	16.80		15.00	16.80	V
	Line regulation	I_O = I_{O}nom				81			288			288	mV
	Load regulation	I_{O1} = 0.1 … 1.0 × I_{O}nom, $I_{O2, 3}$ = I_{O}nom, V_I = 26 V				162							mV
t_{tr}	Load transient recovery time	I_O = 0.1 … 1.0 × I_{O}nom, V_I = 26 V load step = 80% of I_{O}nom $\frac{di}{dt}$ < 1A/µs			100			200			200		µs
V_{tr}	Load transient voltage				+250			+600			+600		mV
					–250			–600			–600		mV
	Short term drift	t = 0...10 minutes			–15			–36			–36		mV
T_{coeff}	Temperature coefficient	I_O = I_{O}nom, T_C < $T_{C\,max}$			–0.5			–1.2			–1.2		mV/°C
t_r	Ramp-up time	I_O = 0.1 … 1.0 × I_{O}nom, V_I = 26 V	0.1 … 0.9 × V_O		20			20			20		ms
t_s	Start-up time		From V_I connection to V_O = 0.9 × V_{Oi}		30			30			30		ms
I_O	Output current			0		3.0	0		0.6	0		0.6	A
$P_{O\,max}$	Max total output power	*		min 15									W
I_{lim}	Current limiting threshold	T_C < $T_{C\,max}$		min 1.02 × $P_{O\,max}$**									
I_{sc}	Short curcuit current	V_O = 0.2 … 0.5 V, T_A = 25 °C Hick-up			<0.5			<0.5			<0.5		A
$V_{O\,ac}$	Output ripple & noice	I_O = I_{O}nom	20 Hz … 5 MHz			100			110			100	mV_{p-p}
			DC … 50 MHz			130			150			150	mV_{p-p}
			1 MHz bandwidth			40			40			40	mV_{rms}
SVR	Supply voltage rejection (ac)	f = 100 Hz sine wave, 1 V_{p-p}, V_I = 26 V (SVR = 20 log (1 V_{p-p}/V_{Op-p}))		50			43			43			dB

* See also Power derating p. 13. Max output power on output 2 and 3 jointly is min 10 W

** I_{lim} on each output is set by the total load

Miscellaneous

Characteristics		Conditions	min	typ	max	Unit
η	Efficiency	I_O = I_{O}nom, V_I = 26 V	79.5	81		%
P_d	Power dissipation	I_O = I_{O}nom		3.5		W

PKC 2132 PI

T_C = 0…+95°C, V_I = 18...36V unless otherwise specified. I_{O1nom} = 2.0A, $I_{O2, 3nom}$ = 0.17A

Output

Characteristics		Conditions		Output 1			Output 2			Output 3			Unit
				min	typ	max	min	typ	max	min	typ	max	
V_{Oi}	Output voltage initial setting and accuracy	T_C = +25°C, I_O = $I_{O\,nom}$, V_I = 26 V		5.03	5.06	5.10	14.80	15.00	15.20	–14.80	–15.00	–15.20	V
V_O	Output voltage tolerance band	I_O = 0.1… 1.0 × $I_{O\,nom}$, $I_{O2, 3}$ = $I_{O\,nom}$ and long term drift		4.90		5.25	14.40		15.60	14.40		15.60	V
	Idling voltage	I_O = 0 A				5.25		18.00	19.80		18.00	19.80	V
	Line regulation	I_O = $I_{O\,nom}$				81			330			330	mV
	Load regulation	I_{O1} = 0.1… 1.0 × $I_{O\,nom}$, $I_{O2, 3}$ = $I_{O\,nom}$, V_I = 26 V				182							mV
t_{tr}	Load transient recovery time	I_O = 0.1… 1.0 × $I_{O\,nom}$, V_I = 26 V load step = 80% of $I_{O\,nom}$ $\frac{di}{dt}$ <1A/µs			100			250			250		µs
V_{tr}	Load transient voltage				+250			+750			+750		mV
					–250			–750			–750		mV
	Short term drift	t = 0...10 minutes			–15			–45			–45		mV
T_{coeff}	Temperature coefficient	I_O = $I_{O\,nom}$, T_C < $T_{C\,max}$			–0.5			–1.5			–1.5		mV/°C
t_r	Ramp-up time	I_O = 0.1… 1.0 × $I_{O\,nom}$, V_I = 26 V	0.1… 0.9 × V_O		20			20			20		ms
t_s	Start-up time		From V_I connection to V_O = 0.9 × V_{Oi}		30			30			30		ms
I_O	Output current			0		3.0	0		0.5	0		0.5	A
$P_{O\,max}$	Max total output power	*		min 15									W
I_{lim}	Current limiting threshold	T_C < $T_{C\,max}$		min 1.02 × $P_{O\,max}$**									
I_{sc}	Short curcuit current	V_O = 0.2… 0.5V, T_A = 25°C Hick-up			<0.5			<0.5			<0.5		A
$V_{O\,ac}$	Output ripple & noice	I_O = $I_{O\,nom}$	20 Hz… 5 MHz			100			110			100	mV_{p-p}
			DC… 50 MHz			130			150			150	mV_{p-p}
			1 MHz bandwidth			40			40			40	mV_{rms}
SVR	Supply voltage rejection (ac)	f = 100 Hz sine wave, 1 V_{p-p}, V_I = 26 V (SVR = 20 log (1 $V_{p-p}/V_{O\,p-p}$))		50			40			40			dB

* See also Power derating p. 13. Max output power on output 2 and 3 jointly is min 10 W

** I_{lim} on each output is set by the total load

Miscellaneous

Characteristics		Conditions	min	typ	max	Unit
η	Efficiency	I_O = $I_{O\,nom}$, V_I = 26 V	80	82		%
P_d	Power dissipation	I_O = $I_{O\,nom}$		3.3		W

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PKC 2135 PI

T_C = 0…+95°C, V_I = 18...36V unless otherwise specified. I_{O1nom} = 2.0A, I_{O2nom} = 0.2A, I_{O3nom} = 0.5A

Output

Characteristics		Conditions		Output 1			Output 2			Output 3			Unit
				min	typ	max	min	typ	max	min	typ	max	
V_{Oi}	Output voltage initial setting and accuracy	T_C = +25°C, $I_O = I_{O\,nom}$, V_I = 26 V		5.03	5.06	5.10	11.90	12.10	12.30	–4.99	–5.06	–5.14	V
V_O	Output voltage tolerance band	I_O = 0.1 … 1.0 × $I_{O\,nom}$, $I_{O2,3} = I_{O\,nom}$ and long term drift		4.90		5.25	11.52		12.36	4.75		5.25	V
	Idling voltage	I_O = 0 A				5.25		15.00	16.00		6.00	6.50	V
	Line regulation	$I_O = I_{O\,nom}$				90			336			110	mV
	Load regulation	I_{O1} = 0.1 … 1.0 × $I_{O\,nom}$, $I_{O2,3} = I_{O\,nom}$, V_I = 26 V				190							mV
t_{tr}	Load transient recovery time	I_O = 0.1 … 1.0 × $I_{O\,nom}$, V_I = 26 V load step = 80% of $I_{O\,nom}$ $\frac{di}{dt}$ <1A/µs			100			200			100		µs
V_{tr}	Load transient voltage				+250			+600			+250		mV
					–250			–600			–250		mV
	Short term drift	t = 0...10 minutes			–15								mV
T_{coeff}	Temperature coefficient	$I_O = I_{O\,nom}$, $T_C < T_{C\,max}$			–0.5			–1.0			–0.5		mV/°C
t_r	Ramp-up time	I_O = 0.1 … 1.0 × $I_{O\,nom}$, V_I = 26 V	0.1 … 0.9 × V_O		20			20			20		ms
t_s	Start-up time		From V_I connection to V_O = 0.9 × V_{Oi}		30			30			30		ms
I_O	Output current			0		3.0	0		0.6	0		1.0	A
$P_{O\,max}$	Max total output power	*		min 15									W
I_{lim}	Current limiting threshold	$T_C < T_{C\,max}$		min 1.02 × $P_{O\,max}$**									
I_{sc}	Short curcuit current	V_O = 0.2 … 0.5 V, T_A = 25°C Hick-up			<0.5			<0.5			<0.5		A
$V_{O\,ac}$	Output ripple & noice	$I_O = I_{O\,nom}$	20 Hz … 5 MHz			100			110			100	mV_{p-p}
			DC … 50 MHz			130			150			120	mV_{p-p}
			1 MHz bandwidth			40			40			35	mV_{rms}
SVR	Supply voltage rejection (ac)	f = 100 Hz sine wave, 1 V_{p-p}, V_I = 26 V (SVR = 20 log (1 V_{p-p}/V_{Op-p}))		50			43			50			dB

* See also Power derating p. 13. Max output power on output 2 and 3 jointly is min 10 W

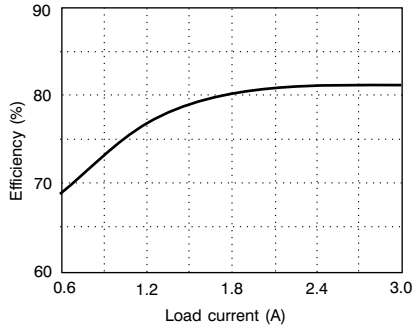
** I_{lim} on each output is set by the total load

Miscellaneous

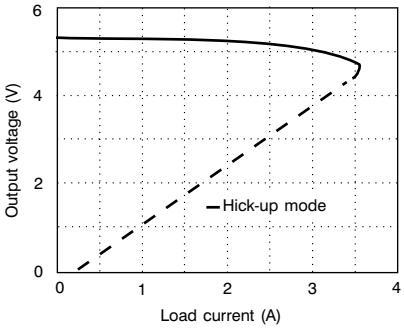
Characteristics		Conditions	min	typ	max	Unit
η	Efficiency	$I_O = I_{O\,nom}$, V_I = 26 V	79.5	81		%
P_d	Power dissipation	$I_O = I_{O\,nom}$		3.5		W

PKC 2111 PI

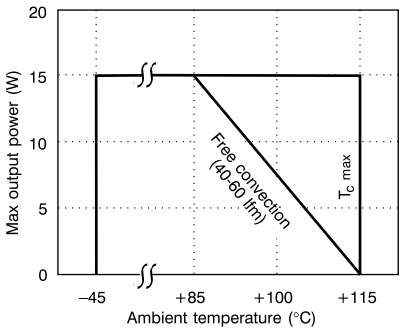
Efficiency (typ)



Output characteristic (typ)

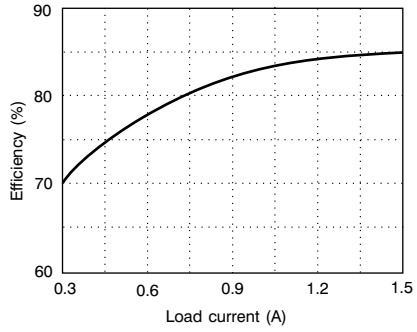


Power derating

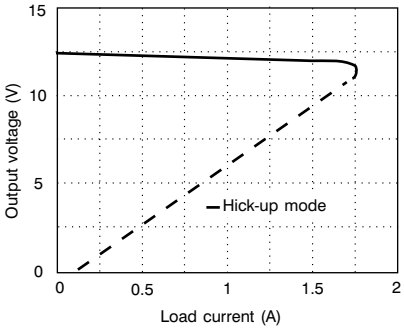


PKC 2113 PI

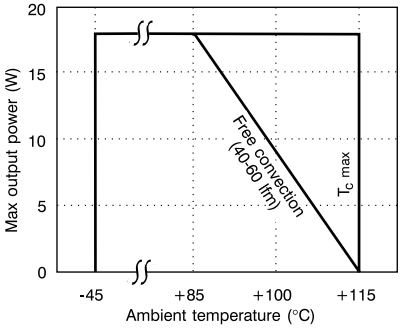
Efficiency (typ)



Output characteristic (typ)

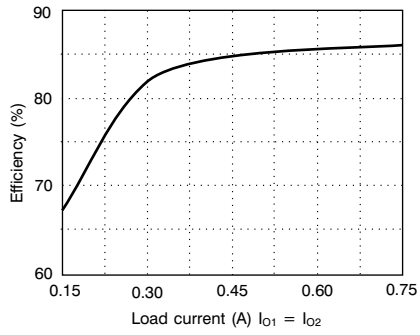


Power derating

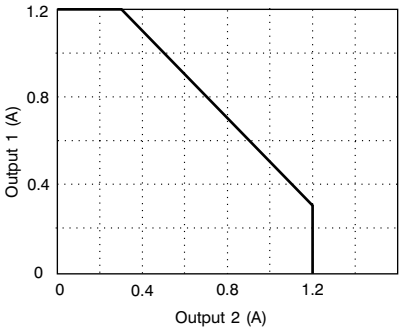


PKC 2121 PI

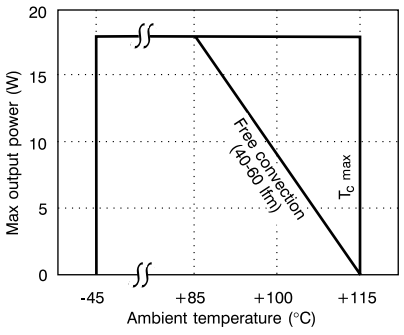
Efficiency (typ)



Max output current

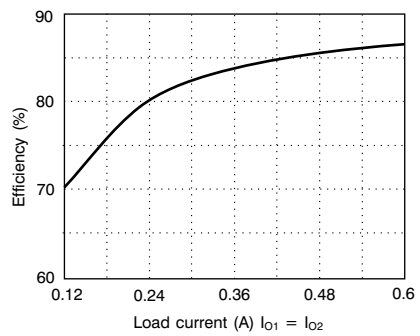


Power derating

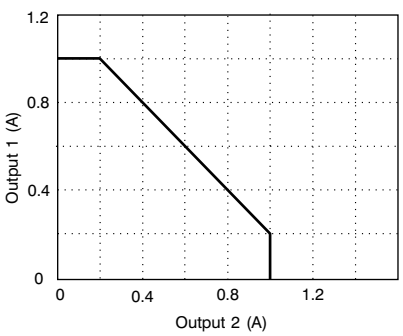


PKC 2126 PI

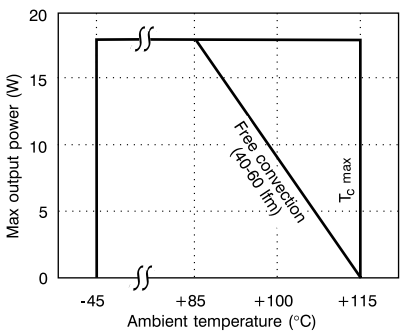
Efficiency (typ)



Max output current



Power derating



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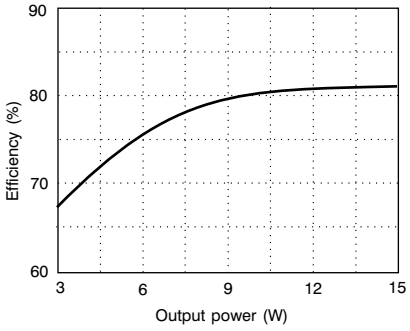
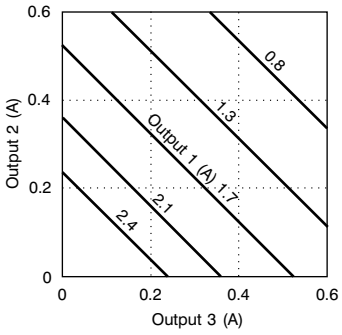
PKC 2131 PI

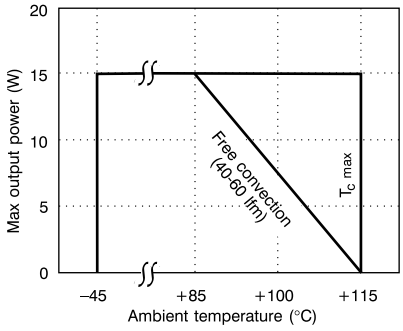
Efficiency (typ)



Max output current

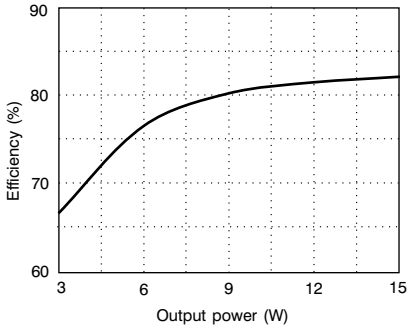


Power derating

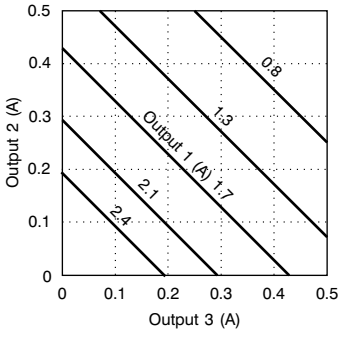


PKC 2132 PI

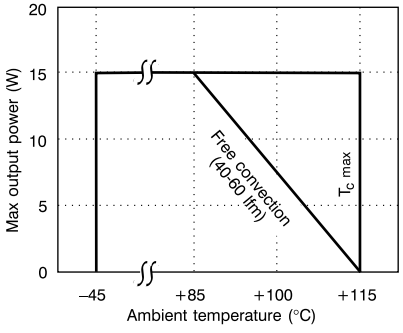
Efficiency (typ)



Max output current

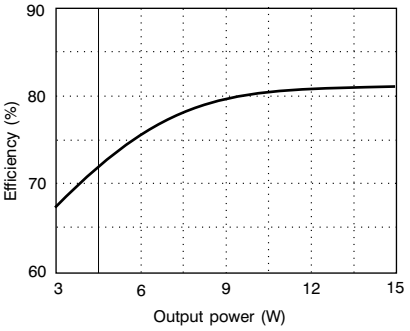


Power derating

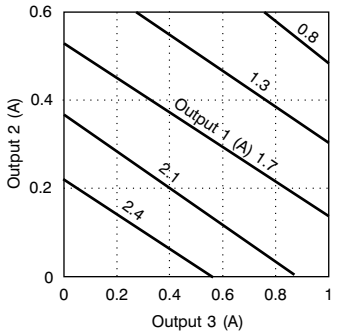


PKC 2135 PI

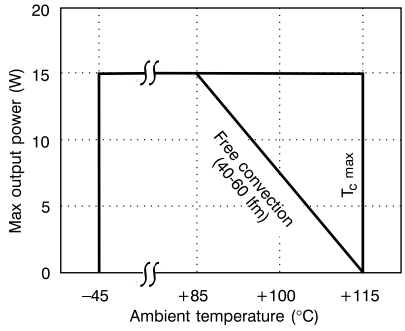
Efficiency (typ)



Max output current



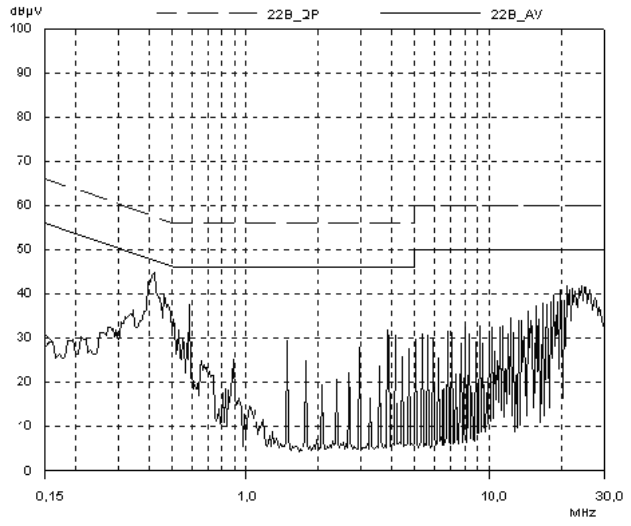
Power derating



EMC Specifications

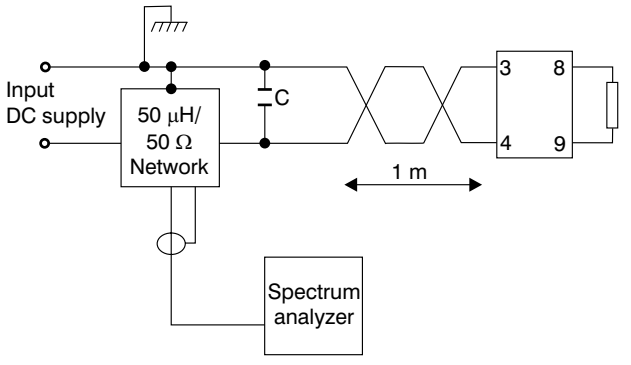
The PKC power module is mounted on a double sided printed circuit board (PB) with groundplane during EMC measurements. The fundamental switching frequency is 300 kHz ± 15% @ $I_O = I_{O\ max}$ or $I_{O\ nom}$

Conducted EMI (input terminals)



PKC series typical conducted EMI performance

Test set up



C = 4.7 µF electrolytic to prevent oscillations on supply mains

The PKC meets class A in VDE 0871/0878, FCC Part 15J, and CISPR 22 (EN 55022).

Radiated EMI

To minimize radiation it is recommended to have a ground or earth plane in the printed board (PB).

Output Ripple & Noise ($V_O$ac)

Output ripple & noise is measured at the output terminals with a 50 MHz oscilloscope and a true rms DVM (crest factor >4.5). The oscilloscope's input impedance should be adapted to the impedance of the coax cable and the output terminal connection should have a minimum ground wire loop.

Operating information

Remote Control (RC)

Turn-on or turn-off can be realized by using the RC-pin. Normal operation is achieved if pin 1 is open (NC). If pin 1 is connected to pin 3 the PKC DC/DC power module turns off. To ensure safe turn-off the voltage difference between pin 1 and 3 shall be less than 1.8 V. RC is TTL open collector compatible (see fig. 1). Pin 1 is an output and no current should be driven into pin 1. Use a diode if necessary e.g. totem pole TTL logic. The internal pull-up resistance is 15 kW.

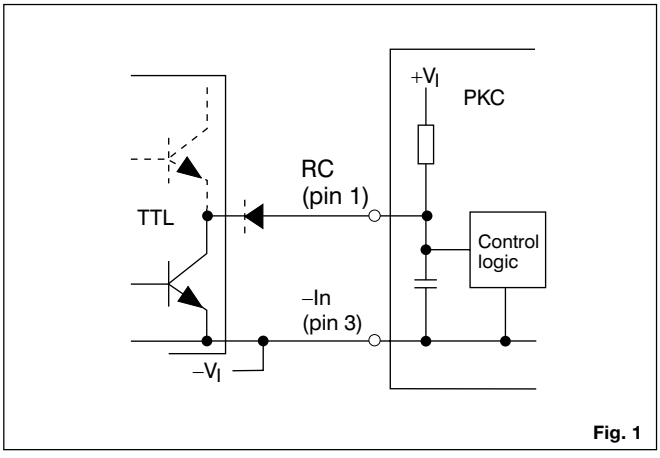


Fig. 1

Input and Output Impedance

Both the source impedance of the power feeding and the load impedance will interact with the impedance of the DC/DC power module.
It is most important to have the ratio between L and C as low as possible, i.e. a low characteristic impedance, both at the input and output, as the power modules have a low energy storage capability.
A capacitive compensation is necessary if the source or load inductance is larger than 10 µH. Use wet electrolytic capacitors. Their equivalent series resistance together with the capacitance acts as a lossless damping filter. Suitable capacitor values are in the range10–100 µF.

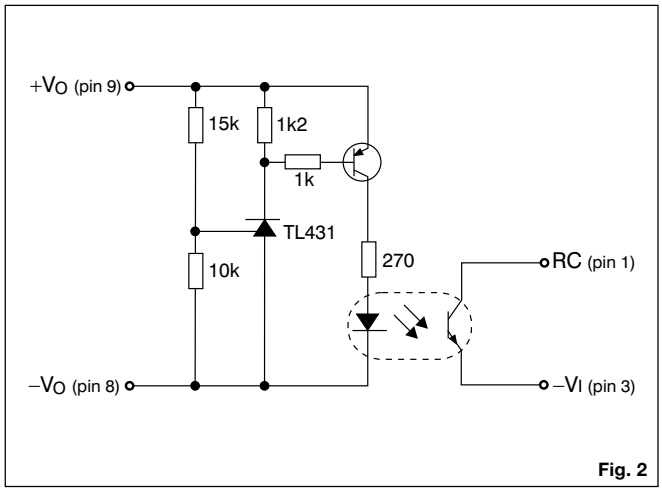


Fig. 2

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Turn-off Input Voltage (V_{Ioff})

The input voltage is monitored and the PKC DC/DC power module will turn on and turn off at predetermined levels. The levels can be decreased by means of an external resistor connected between pin 1 and pin 5.
A 80 kΩ resistor will decrease the shutdown voltage below 17 V. To maintain the nominal output voltage at input voltages below V_I min it may be necessary to decrease the load.

Maximum Capacitive Load

The maximum recommended capacitance connected direct t the PKC DC/DC power modules output without resistance or inductance in series is 100 µF/A (output current rating). Connect capacitors across the load for maximum effectiveness and maximum stability margins.

Over Voltage Protection (OVP)

The remote control can be utilized also for OVP by using the external circuitry in fig. 2. Resistor values are for 5 V output applications, but can easily be adjusted for other output voltages and the desired OVP level.

Current Limiting Protection

The output power is limited at loads above the output current limiting threshold (I_{lim}), specified as a minimum value.
As the PKC multiple output models are power limited, current limiting threshold for an individual output is set by the loads on the other outputs. The power module can withstand continuous short circuit without destruction. A hick-up mode is used on all models to minimize the internal power dissipation. The hick-up time constant is set by the slow start.

Quality

Reliability

Meantime between failure (MTBF) is calculated and verified by field data statistics to >2 million hours at full output power and a case temperature of 75°C, using the Ericsson failure rate data system. For more information see Design Note 002.

Quality Statement

The products are designed and manufactured in an industrial environment where quality systems and methods like ISO 9000, 6σ and SPC, are intensively in use to boost the continuous improvements strategy. Infant mortality or early failures in the products are screened out by a burn-in procedure and 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

Ericsson Microelectronics warrants to the original purchaser or end user that the products conform to this Data Sheet and are free from material and workmanship defects for a period of five (5) years from the date of manufacture, if the product is used within specified conditions and not opened. In case the product is discontinued, claims will be accepted up to three (3) years from the date of the discontinuation.
For additional details on this limited warranty we refer to Ericsson Microelectronics AB's "General Terms and Conditions of Sales", or individual contract documents.

Limitation of liability

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Specifications subject to change without notice.

Product Program

V_I	V_O/I_O max			P_O max	Ordering No.
	Output 1	Output 2	Output 3		
24 V	5 V/3 A			15 W	PKC 2111 PI
	12 V/1.5 A			18 W	PKC 2113 PI
	+12 V/1.2 A	−12 V/1.2 A		18 W	PKC 2121 PI
	+15 V/1 A	−15 V/1 A		18 W	PKC 2126 PI
	+5 V/3 A	+12 V/0.6 A	−12 V/0.6 A	15 W	PKC 2131 PI
	+5 V/3 A	+15 V/0.5 A	−15 V/0.5 A	15 W	PKC 2132 PI
	+5 V/3 A	+12 V/0.6 A	−5 V/1 A	15 W	PKC 2135 PI

Ericsson Microelectronics AB
SE-164 81 KISTA, Sweden
Phone: +46 8 757 5000
www.ericsson.com/microelectronics

For local sales contacts, please refer to our website
or call: Int. +46 8 757 4700, Fax: +46 8 757 4776

The latest and most complete information can be found on our website!

Data Sheet

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