CUI INC
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SERIES: PRC600 | DESCRIPTION: DC-DC CONVERTER

FEATURES

- 600 W isolated output
- industry standard full brick package
- 2:1 input range (180~400 Vdc)
- output voltage trim
- 4,200 Vdc isolation
- over current, over temperature, over voltage, and short circuit protections
- input under and over voltage shutdown
- remote ON/OFF, remote output sense
- output current sharing
- EN/IEC 62368-1 certified, meets EN 45545-2 and EN 61373

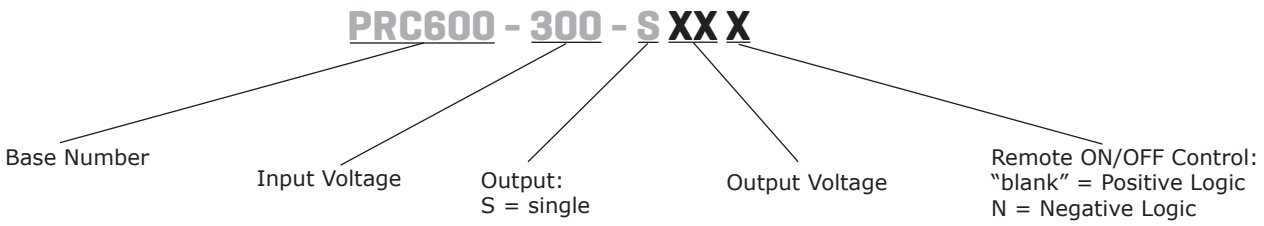


MODEL

MODEL	input voltage		output voltage	output current	output power	ripple & noise[1]	efficiency[2]
	typ (Vdc)	range (Vdc)	(Vdc)	max (A)	max (W)	max (mVp-p)	typ (%)
PRC600-300-S12	300	180 ~ 400	12	50	600	150	89.5
PRC600-300-S24	300	180 ~ 400	24	25	600	400	90.5
PRC600-300-S48	300	180 ~ 400	48	12.5	600	480	91.0

Notes:
1. Peak to peak, 5 Hz ~ 20 MHz bandwidth, full load, 470μF aluminum and 1.0μF ceramic capacitor.
2. At nominal input voltage.
3. An external input capacitor 330uF for all models are recommended to reduce input ripple voltage.
4. All specifications are typical at nominal input, full load at 25°C, unless otherwise noted.

PART NUMBER KEY



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INPUT

parameter	conditions/description		min	typ	max	units
operating input voltage			180	300	400	Vdc
surge voltage	at max. 100 ms				475	Vdc
input undervoltage lockout				10		Vdc
start-up voltage			160 150	170 160	180 170	Vdc Vdc
input current	at full load, 180 Vdc input			3.8		A
no load input current	at 300 Vdc input			10		mA
inrush current	as per ETS300 132-2			0.1		A^2s
reflected ripple current	peak to peak through 12 µF Inductor, 5 Hz ~ 20 Hz			60		mA
input filter	capacitance filter					
remote ON/OFF	positive logic	module off: CTRL pin pulled low to GND (0~1.2 Vdc) module on: CTRL pin open or pulled high (3.5~75 Vdc)				
	negative logic	module off: CTRL pin open or pulled high (3.5~75 Vdc) module on: CTRL pin pulled low to GND (0~1.2 Vdc)				
ON/OFF current[5]	I on/off at V on/off=0V			0.3	1	mA
off converter input current	shutdown input idle current			5	10	mA

Notes: 5. Applies to positive and negative logic.

OUTPUT

parameter	conditions/description		min	typ	max	units
maximum capacitive load	12 & 24 Vdc output 48 Vdc output				10,000 8,000	µF µF
voltage accuracy	at 300 Vdc input, nominal input			±1		%
line regulation	high line to low line at full load				±0.2	%
load regulation	0% ~ 100% load				±0.5	%
trim range	Po≤max. rated power, Io≤Io_max.		-40		10	%
remote sense	Po≤max. rated power, Io≤Io_max; % of nominal Vo				10	%
temperature coefficient	-40°C ~ 100°C				±0.03	%/°C
start-up time	from on/off control	Von/off to 10% Vo_set, remote on		100		ms
	from input	Vin_min to 10% Vo_set, power up		700		ms
rise time	10% ~ 90% Vo_set			40		ms
transient error band	75% ~ 100% load step change				±5	%
transient recovery time	75% ~ 100% load step change				500	µs
operating frequency	pulse width modulation (PWM) fixed		170	200	230	kHz
auxiliary output voltage			7	10	13	V
frequency output current					20	mA
power good signal (IOG)	Vout ready: low level, sink current Vout not ready: open drain output, applied voltage				20 50	mA V
load share accuracy	50% ~ 100% load					

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PROTECTIONS

parameter	conditions/description	min	typ	max	units
over voltage protection	limited voltage, % of nominal Vo	115	125	140	%
input over voltage protection	module on module off		480 500		Vdc Vdc
over current protection	continuous, auto recovery	105	115	125	%
short circuit protection	continuous, auto recovery		±10		%
over temperature protection	at the center part of base plate, non-latching		105		°C
over temperature recovery	at the center part of base plate, non-latching		95		°C

SAFETY AND COMPLIANCE

parameter	conditions/description	min	typ	max	units
isolation voltage	input to output, for 1 minute			3,000 4,200	Vac Vdc
	input to case, for 1 minute			2,500 3,500	Vac Vdc
	output to case, for 1 minute			500 700	Vac Vdc
isolation capacitance	input to output input to case (base plate) output to case (base plate)		- - 9,400		 pF
leakage current[6]	positive logic, Von/off = 15 V			30	µA
safety approvals	certified to 62368-1: EN, IEC certified to 60950-1: UL/cUL designed to meet 45545-2: EN designed to meet 61373: EN				
EMI[7]	meets EN 55032 Class A				
ESD	meets IEC/EN 61000-4-2 Air ± 8 kV, Contact ± 4 kV, perf. Criteria A				
radiated immunity	meets IEC/EN 61000-4-3 3 V/m, Perf. Criteria A				
fast transient[8]	meets IEC/EN 61000-4-4 ±1 kV, Perf. Criteria A				
surge[8]	meets IEC/EN 61000-4-5 EN 55024: Line to Earth ±2 kV, Line to Line ±2 kV, perf. Criteria A				
conducted immunity	meets IEC/EN 61000-4-6 3 Vrms, perf. Criteria A				
magnetic field immunity	meets IEC/EN 61000-4-8 50/60 Hz, 3 A/m (r.m.s.), perf. Criteria A				
shock / vibration	complies with MIL-STD-810F/EN 61373				
thermal shock	MIL-STD-810F				
fire and smoke	complies with EN 45545-2				
MTBF	as per MIL-HDBK-217F Notice 1, GB, at 25°C		420,000		hours
RoHS	yes				

Notes: 6. Applies to positive and negative logic.
7. With external filter.
8. External components required.

ENVIRONMENTAL

parameter	conditions/description	min	typ	max	units
operating temperature	at center of the case (see derating curve)	-40		100	°C
storage temperature		-55		105	°C
humidity	non-condensing	0		95	%
altitude	operating transport		2,000 12,000		m m

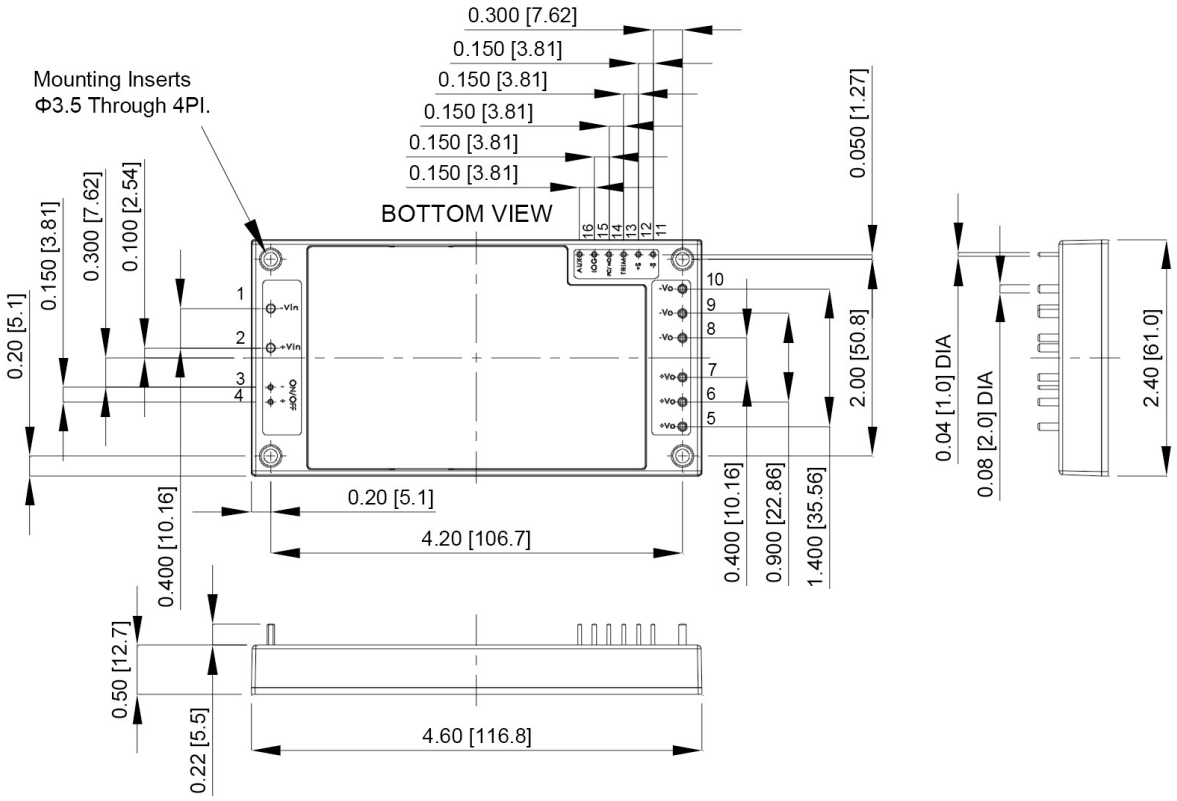
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MECHANICAL

parameter	conditions/description	min	typ	max	units
dimensions	4.60 x 2.40 x 0.50 [116.8 x 61.0 x 12.7 mm]				inch
weight			230		g
case material	plastic, DAP, UL 94V-0				
base plate material	aluminum				
potting material	UL94V-0				
pin material	base: copper plating: nickel with matte tin				

MECHANICAL DRAWING

units: inch [mm]
general tolerance: inches: x.xx = ±0.02mm, x.xxx = ±0.010
mm: x.x = ±0.5, x.xx = ±0.25
pin size: 0.04 ±0.004 inch [1.0 ±0.1 mm] Ø
pin size: 0.08 ±0.004 inch [2.0 ±0.1 mm] Ø

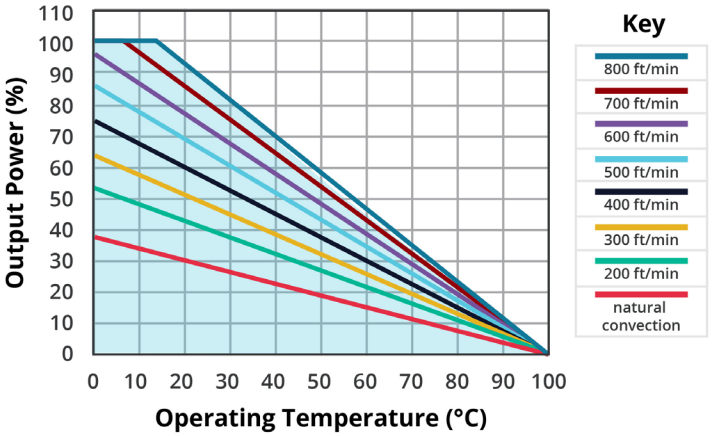


Pin Out	
PIN	Function
1	-Vin
2	+Vin
3	-on/off
4	+on/off
5-7	+Vout
8-10	-Vout
11	-Sense
12	+Sense
13	Trim
14	PC/NC
15	IOG
16	AUX

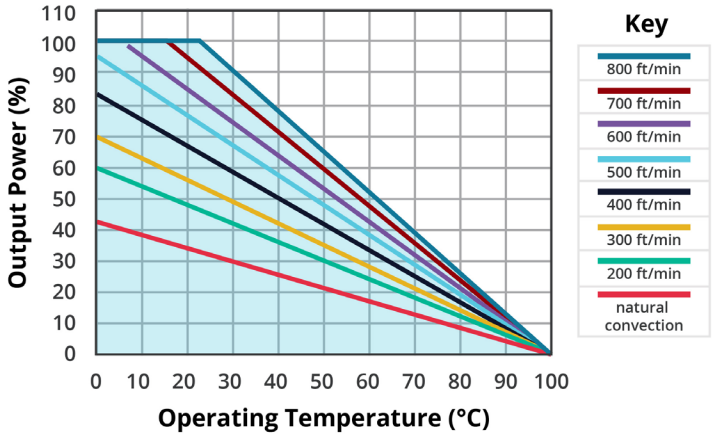
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DERATING CURVES

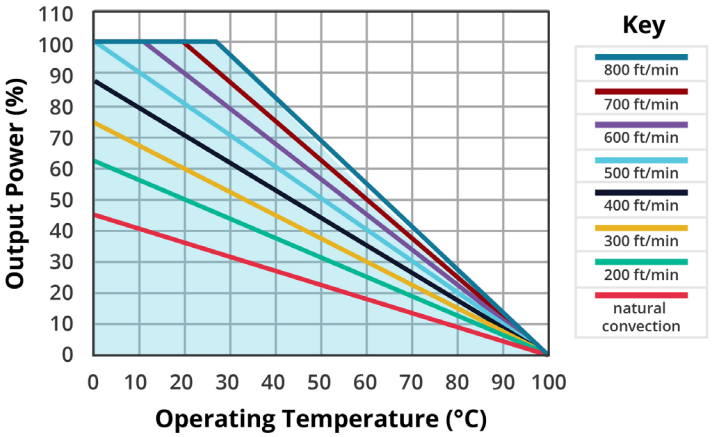
TEMPERATURE DERATING CURVE
PRC600-300-S12
(without heatsink / Vin = 300V)



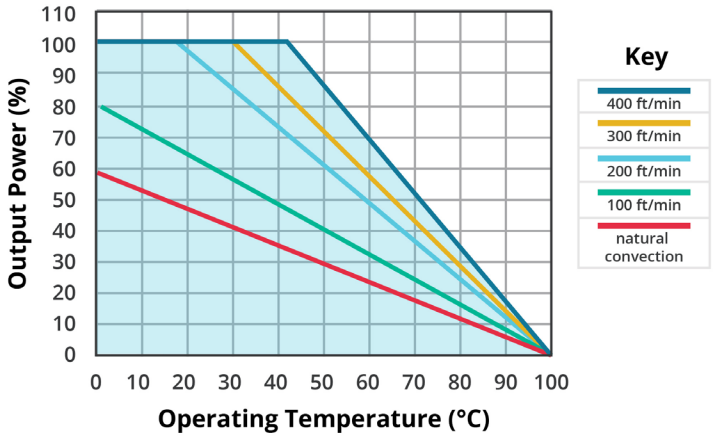
TEMPERATURE DERATING CURVE
PRC600-300-S24
(without heatsink / Vin = 300V)



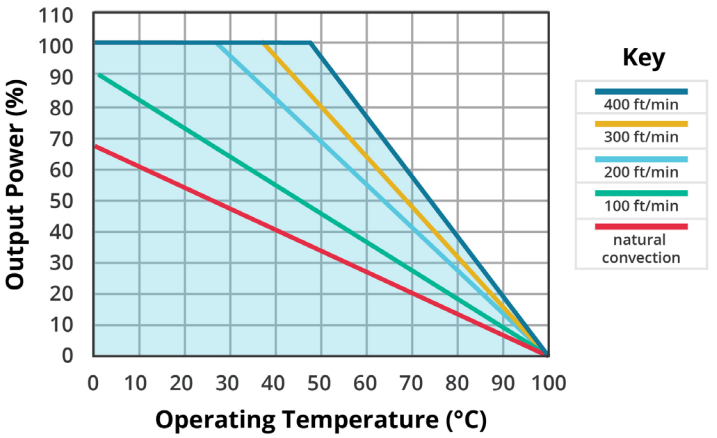
TEMPERATURE DERATING CURVE
PRC600-300-S48
(without heatsink / Vin = 300V)



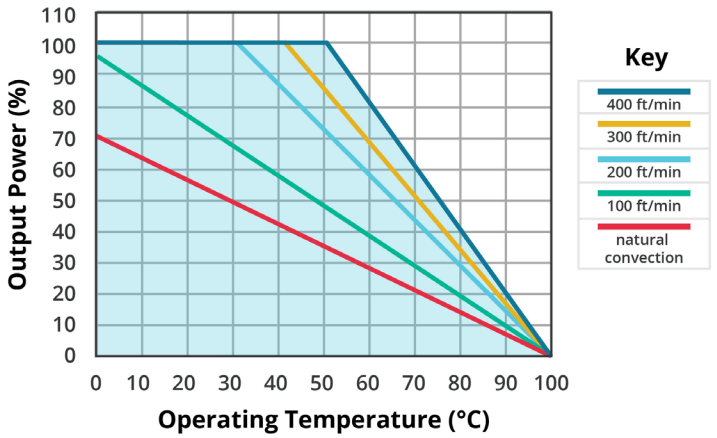
TEMPERATURE DERATING CURVE
PRC600-300-S12
(with heatsink / Vin = 300V)



TEMPERATURE DERATING CURVE
PRC600-300-S24
(with heatsink / Vin = 300V)



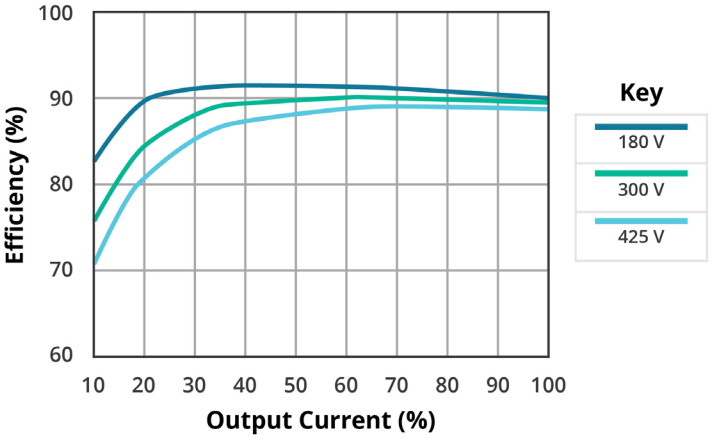
TEMPERATURE DERATING CURVE
PRC600-300-S48
(with heatsink / Vin = 300V)



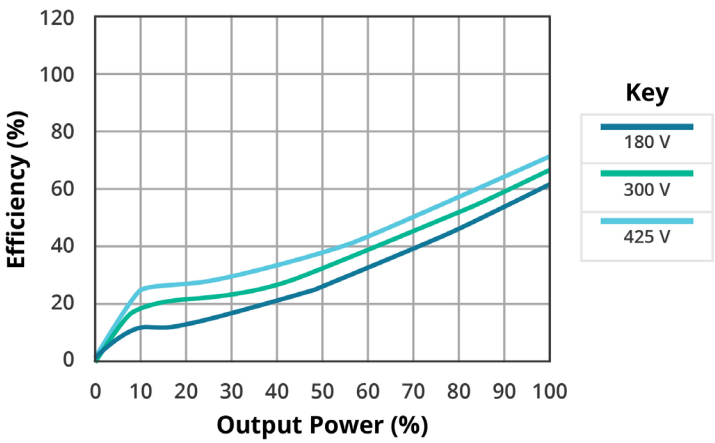
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EFFICIENCY CURVES

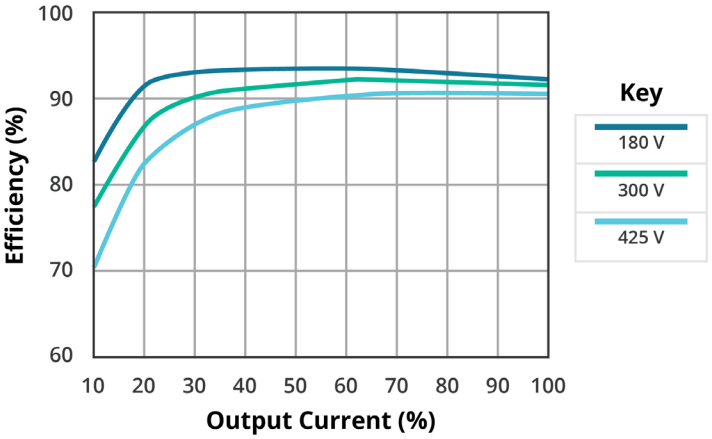
EFFICIENCY VS OUTPUT LOAD
PRC600-300-S12
(at 25°C)



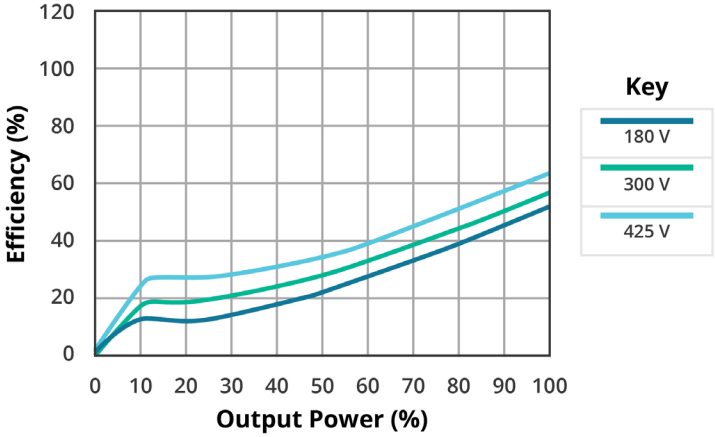
POWER DISSIPATION VS OUTPUT POWER
PRC600-300-S12
(at 25°C)



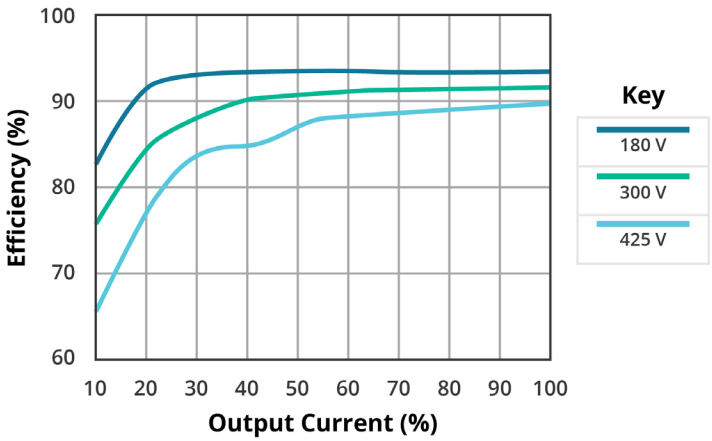
EFFICIENCY VS OUTPUT LOAD
PRC600-300-S24
(at 25°C)



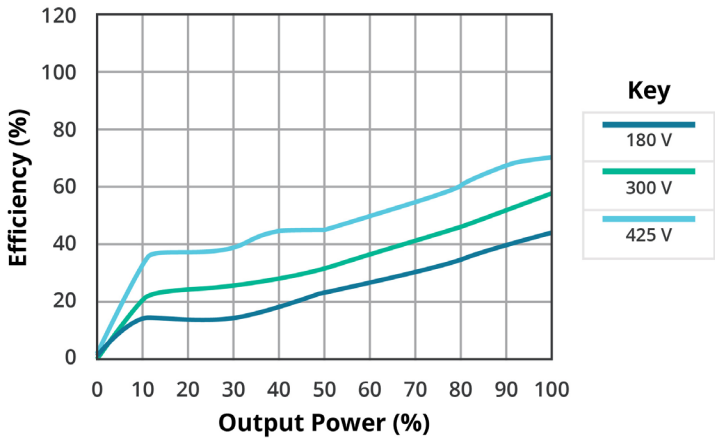
POWER DISSIPATION VS OUTPUT POWER
PRC600-300-S24
(at 25°C)



EFFICIENCY VS OUTPUT LOAD
PRC600-300-S48
(at 25°C)



POWER DISSIPATION VS OUTPUT POWER
PRC600-300-S48
(at 25°C)



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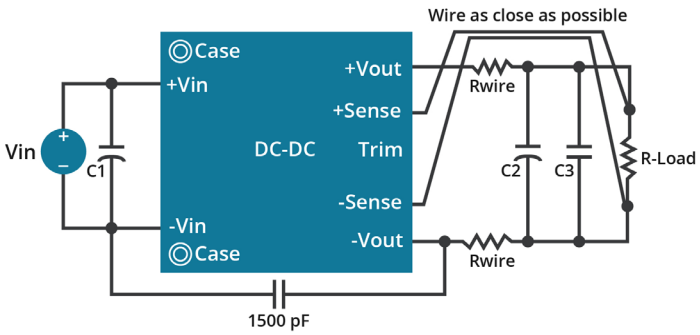
OUTPUT REMOTE SENSE

The PRC600 series converter has the capability to remotely sense both lines of its output. This feature moves the effective output voltage regulation point from the output of the unit to the point of connection of the remote sense pins. This feature automatically adjusts the real output voltage of the PRC600 series in order to compensate for voltage drops in distribution and maintain a regulated voltage at the point of load.

Equation 1 $[(+V_{OUT}) - (-V_{OUT})] - [(+Sense)] \leq 10\%$ of V_{OUT_NOM}

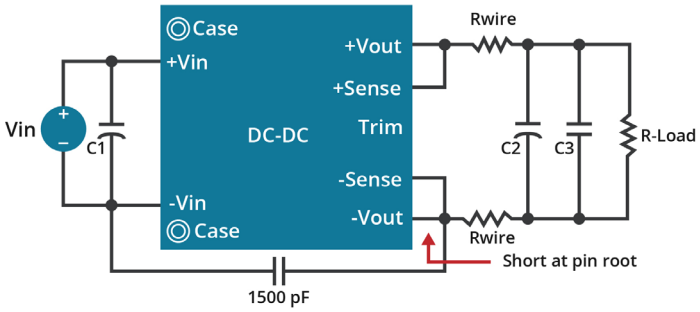
When remote sense is in use, the sense should be connected by twisted-pair wire or shield wire. If the sensing patterns short, heave current flows and the pattern may be damaged. Output voltage might become unstable because of impedance of wiring and load condition when length of wire is exceeding 400mm. See Fig. 1.

Figure 1



If the remote sense feature is not to be used, the sense pins should be connected locally. The +Sense pin should be connected to the +Vout pin at the module and the -Sense pin should be connected to the -Vout pin at the module. Wire between +Sense and +Vout and between -Sense and –Vout as short as possible. Loop wiring should be avoided. The converter might become unstable by noise coming from poor wiring. See Fig. 2.

Figure 2



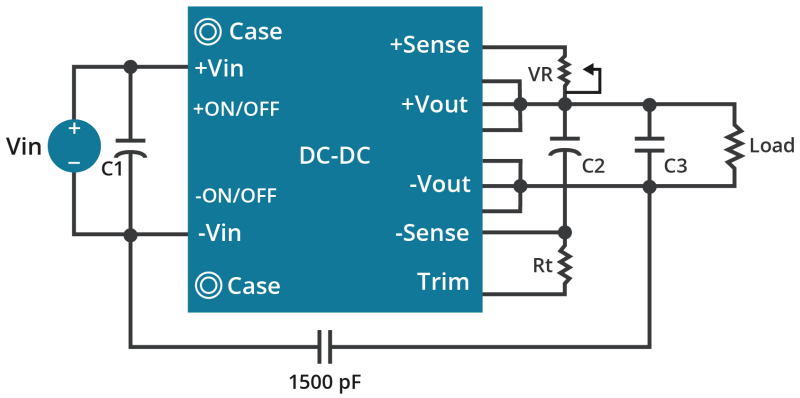
Note: Although the output voltage can be varied (increased or decreased) by both remote sense and trim, the maximum variation for the output voltage is the larger of the two values not the sum of the values. The output power delivered by the module is defined as the voltage at the output terminals multiplied by the output current. Using remote sense and trim can cause the output voltage to increase and consequently increase the power output of the module if output current remains unchanged. Always ensure that the output power of the module remains at or below the maximumrated power. Also be aware that if Vo.set is below nominal value, Pout.max will also decrease accordingly because Io.max is an absolute limit. Thus, Pout.max = Vo.set x Io.max is also an absolute limit.

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OUTPUT VOLTAGE ADJUSTMENT

The Trim input permits the user to adjust the output voltage up or down according to the trim range specification (60% to 110% of nominal output). This is accomplished by connecting an external resistor between the +Vout and +Sense pin for trim up and between the Trim and –Sense pin for Trim down.

Figure 3



The Trim pin should be left open if trimming is not being used. The output voltage can be determined by the following equations:

Equation 2

$$Vf = \frac{1.24 \times \left(\frac{R_T \times 33}{R_T + 33}\right)}{7.68 + \frac{R_T \times 33}{R_T + 33}}$$

Equation 3

$$V_{OUT} = (V_{OUT} + V_R) \times Vf$$

R_T, V_R Unit: KΩ
V_{OUT}: Nominal Output Voltage
Recommend R_T = 6.8 KΩ

For example, to trim-up the output voltage of 24V module (PRC600-300-S24) by 5% to 25.2V, to trim-down by 20% to 19.2V, The value Rtrim_up is calculated as follows:
R_T=6.8KΩ, Vf=0.525V

Equation 4

$$Vf = \frac{1.24 \times \left(\frac{6.8 \times 33}{6.8 + 33}\right)}{7.68 + \frac{6.8 \times 33}{6.8 + 33}} = 0.525$$

Equation 5

$$25.2 = (24 + V_R) \times 0.25,\ V_R = 24\ K\Omega$$

The value of R_{TRIM_DOWN} defined as:

$$19.2 = (24 + V_R) \times 0.525,\ V_R = 12.57\ K\Omega$$

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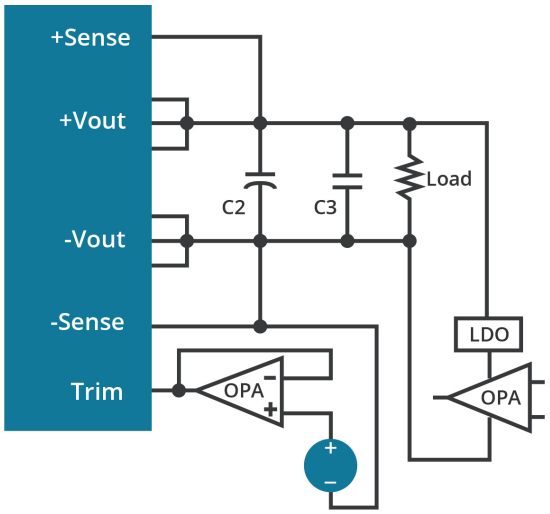
OUTPUT VOLTAGE ADJUSTMENT (CONTINUED)

Table 1
Typical value of R_{TRIM_UP}

Trim up (%)	12 V	24 V	48 V
	R_{TRIM_UP} (KΩ)		
1	11.09	22.17	44.34
2	11.31	22.63	45.26
3	11.54	23.09	46.17
4	11.77	23.54	47.09
5	12.00	24.00	48.00
6	12.23	24.46	48.91
7	12.46	24.91	49.83
8	12.69	25.37	50.74
9	12.91	25.83	51.88
10	13.14	26.29	52.57

The output voltage can also be adjustment by using external DC voltage. See Fig. 4.

Figure 4



Output Voltage = TRIM Terminal Voltage * Nominal Output Voltage

Table 2
Typical value of R_{TRIM_DOWN}

Trim down (%)	12 V	24 V	48 V
	R_{TRIM_DOWN} (KΩ)		
1	10.63	21.26	42.51
2	10.40	20.80	41.60
3	10.17	20.34	40.69
4	9.943	19.89	39.77
5	9.714	19.43	38.86
6	9.486	18.97	37.94
7	9.257	18.51	37.03
8	9.029	18.06	36.11
9	8.800	17.60	35.20
10	8.571	17.14	34.29
11	8.343	16.69	33.29
12	8.114	16.23	33.37
13	7.886	15.77	32.46
14	7.657	15.31	31.54
15	7.429	14.86	30.63
16	7.200	14.40	29.71
17	6.971	13.94	28.80
18	6.743	13.49	27.89
19	6.514	13.03	26.06
20	6.286	12.57	25.14
21	6.057	12.11	24.23
22	5.829	11.66	23.31
23	5.600	11.20	22.40
24	5.371	10.74	21.49
25	5.143	10.29	20.57
26	4.914	9.829	19.66
27	4.686	9.371	18.74
28	4.457	8.914	17.83
29	4.229	8.457	16.91
30	4.000	8.000	16.00
31	3.771	7.543	15.09
32	3.543	7.086	14.17
33	3.314	6.629	13.26
34	3.086	6.171	12.34
35	2.857	5.714	11.43
36	2.629	5.257	10.51
37	2.400	4.800	9.600
38	2.171	4.343	8.686
39	1.943	3.886	7.771
40	1.714	3.429	6.857

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PARALLEL & REDUNDANT OPERATION

The PRC600 series are also designed for parallel operation. When paralleled, the load current can be equally shared between the modules by connecting the PC pins together. There are two different parallel operations for PRC600 series, one is parallel operation when load can't be supplied by only one power unit; the other is the N+1 redundant operation which is high reliable for load of N units by using N+1 units.

Figure 5
Parallel Operation

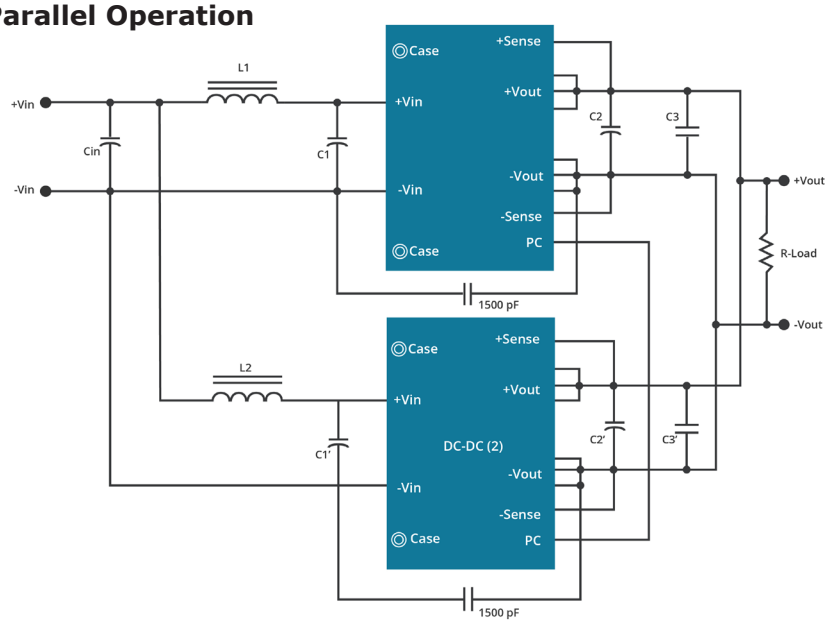
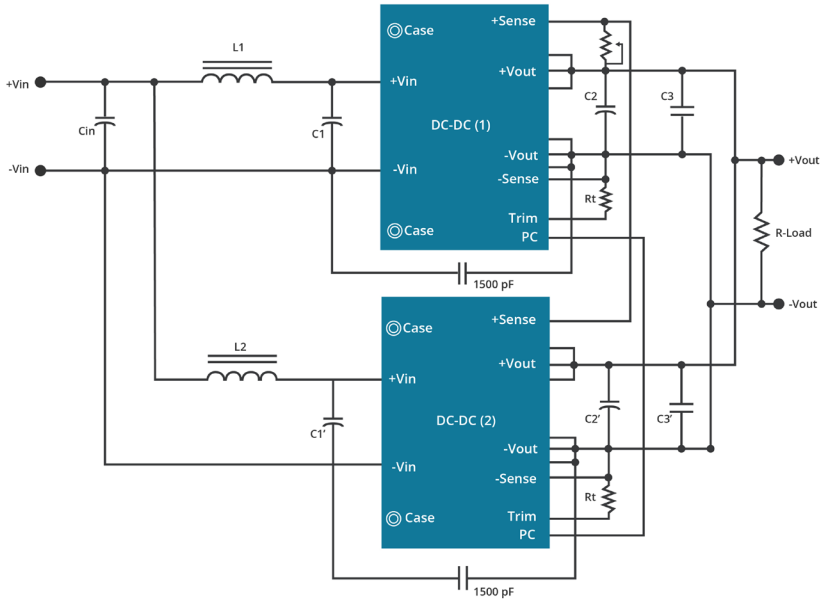


Figure 6
Parallel Operation with Programmed and Adjustable Output



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PARALLEL & REDUNDANT OPERATION (CONTINUED)

Figure 7
N+1 Redundant Connection

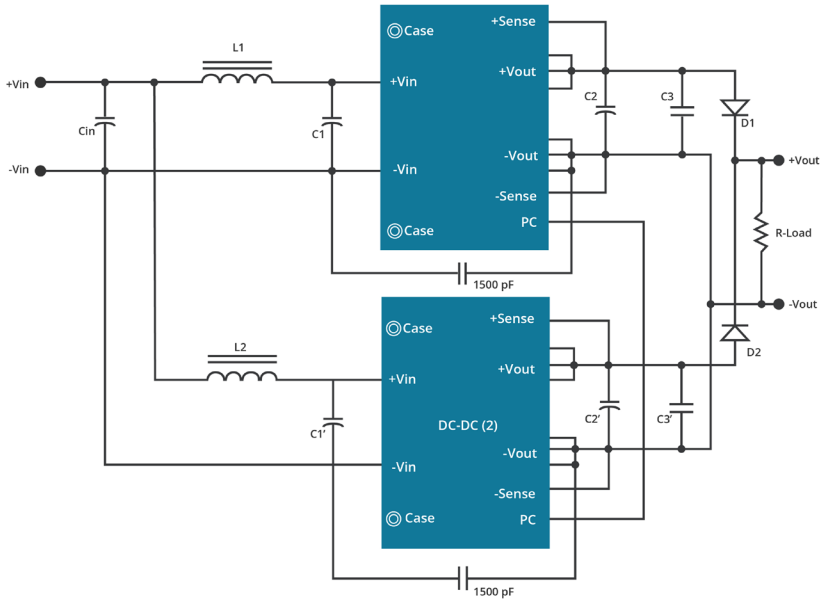


Figure 8
N+1 Redundant Connection with Programmed Output and Adjustable Output Voltage

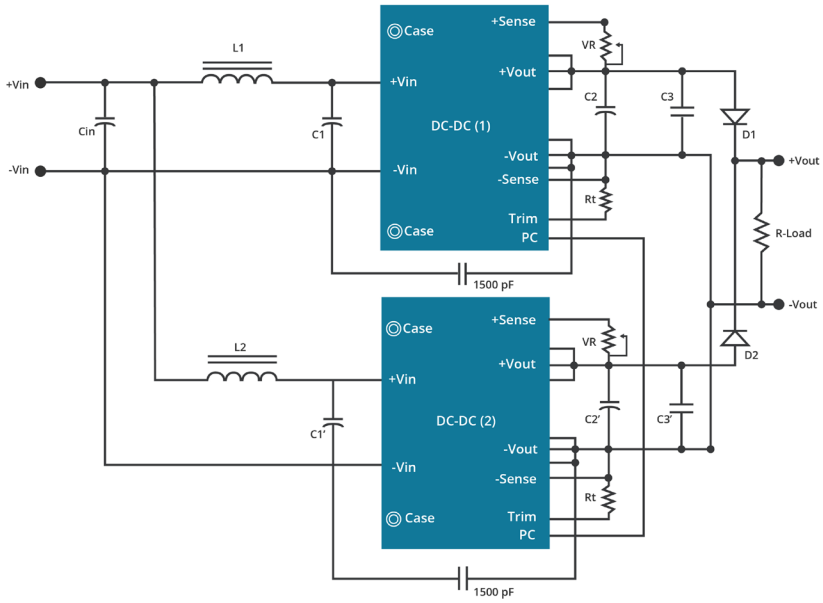


Table 3

Component Values	
L1, L2	1.0µH
Cin, C1, C1'	330µF/450V ESR <0.7
C2, C2'	470µF
C3, C3'	1µF MLCC

Note:
If the impedance of input line is high, Cin, C1 capacitance must be more than above. Use more than two recommended capacitor above in parallel when ambient temperature becomes lower than -20 °C.

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EMI & EMC APPLICATION

EMI Test standard: EN55022 / EN55032 Class A Conducted Emission
Test Condition: Input Voltage: Nominal, Output Load: Full Load

Figure 9
EMI and conducted noise meet EN55032 Class A

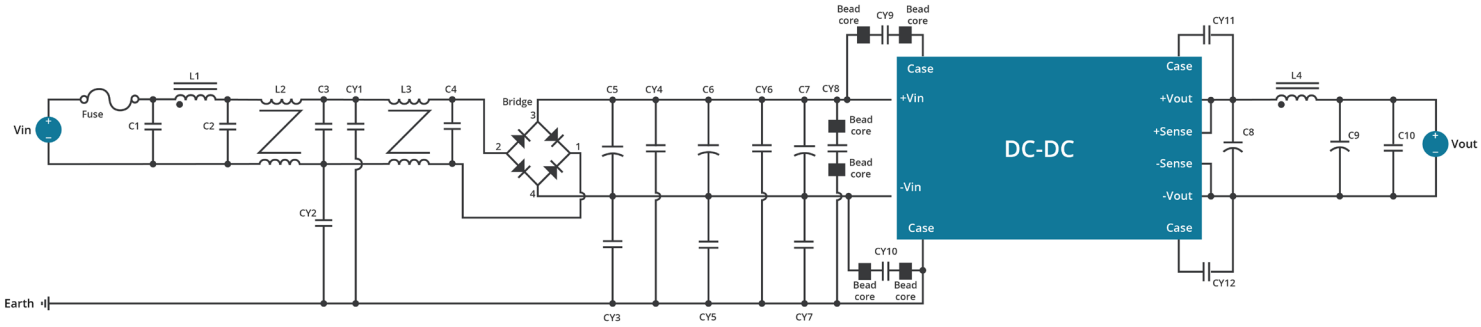


Table 4

Component Values	
C1, C2, C3, C4	0.68μF
C5, C6, C7	330μF
C8, C9	820μF
C10	1μF
CY1, CY2	2200pF
CY5	330pF
CY6	100pF
CY7	220pF
CY8	100pF
CY9, CY10	2200pF
CY11, CY12	0.022μF
C8, C9	820μF
L1	short
L2, L3	4.2mH
L4	short
bead core	CY8, CY9, CY10

Note:
C1, C2, C3, C4: metallized polypropylene film X2 capacitors
C5, C6, C7, C8, C9: aluminum capacitors
CY1,CY2, CY5, CY6, CY8, CY9, CY10, C10 ceramic capacitors
CY11, CY12: X2 capacitors
C1, C2, C3, C4: 0.68uF/305VAC or equivalent
C5, C6, C7: 330uF/450V or equivalent
C8, C9: 820uF/63V or equivalent
CY1, CY2, CY5, CY6, CY7, CY8, CY9, CY10: 100pF or equivalent
220pF or equivalent
330pF or equivalent
2200pF or equivalent
C10: 1uF/100V or equivalent
CY11, CY12: 0.022uF/275VAC or equivalent
L2, L3: 4.2mH or equivalent

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EMI & EMC APPLICATION (CONTINUED)

EMI Test standard: EN55022/EN55032 Class A Conducted Emission
Test Condition: Input Voltage: Nominal, Output Load: Full Load

Figure 10
EMI and conducted noise meet EN55032 Class A

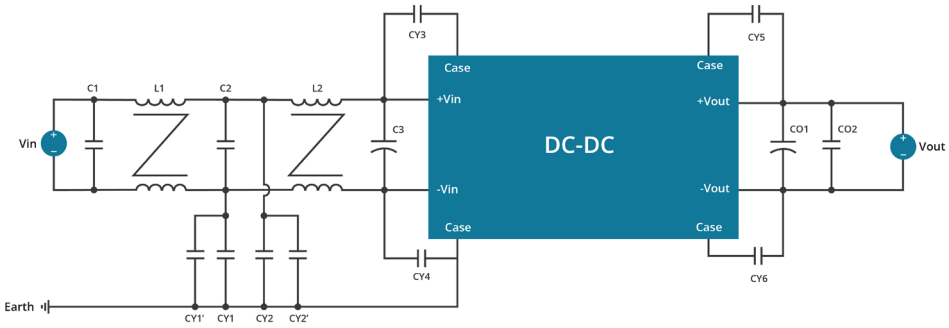


Table 5

Component Values	
C1, C2	0.68μF
C3	150μF
Co1	820μF
Co2	1μF
CY1	2200pF
CY1'	470pF
CY2	2200pF
CY2'	470pF
CY3, CY4	2200pF
CY5, CY6	0.022μF
L1, L2	4.2mH

Note:
C1, C2, CY5, CY6: metallized polypropylene film X2 capacitors
C3, Co1: aluminum capacitors
CY1, CY1', CY2, CY2', CY3, CY4, Co2: ceramic capacitors
C3: 150uF/450V or equivalent
Co1: 820uF/63V or equivalent
CY1, CY1', CY2, CY2, CY3, CY4: 2200pF or equivalent
470pF or equivalent
Co2: 1uF/100V or equivalent
C1, C2, CY5, CY6: 0.68uF/305VAC or equivalent
0.022uF/275VAC or equivalent
L1, L2: 4.2mH or equivalent

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REVISION HISTORY

rev.	description	date
1.0	initial release	08/16/2024
1.01	max input voltage updated	08/23/2024
1.02	pin connections table updated	09/06/2024

The revision history provided is for informational purposes only and is believed to be accurate.

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CUI offers a two (2) year limited warranty. Complete warranty information is listed on our website.

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