1000 mA DC-DC Step Down Converter P78NS_D-Series

PHI-CON

- Non isolated
- 6 pad SMD package
- Efficiency up to 94 %
- Operating temperature range -40...105 °C
- Continuous short circuit protected
- Adjustable output voltage

CE

Model guide

Type	Input voltage		Output		Efficiency			Capacitive load
	Nominal [V_{DC}]	Range [V_{DC}]	Voltage [V_{DC}]	Current [mA] max.	@ V_{in} min. [%] typ.	@ V_{in} nom. [%] typ.	@ V_{in} max. [%] typ.	[µF] max.
P78NS3R3D	24	4.5..36	3.3	1000	89	84	81	680
	12	8..27	-3.3	-500	85	85	81	330
P78NS05D	24	6.5..36	5.0	1000	92	87	84	680
	12	8..27	-5.0	-500	85	85	83	330
P78NS6R5D	24	8..36	6.5	1000	92	88	86	680
	12	8..24	-6.5	-500	83	85	84	330
P78NS09D	24	12..36	9.0	1000	92	90	87	680
	12	8..24	-9.0	-500	81	85	84	330
P78NS12D	24	15..36	12.0	1000	94	91	89	680
	12	8..20	-12.0	-300	83	85	84	330
P78NS15D	24	16..36	15.0	1000	94	93	90	680
	12	8..18	-15.0	-300	82	84	84	330

Specifications

Input		
Filter		Capacitor
No load quiescent current		0.1 mA, typ.
ON/OFF remote control threshold	ON	≥ 1.6 … 5 V or open CTRL pin
	OFF	≤ 0.6 V, or Ctrl with GND connected (see Figure 4)
Ctrl. OFF state quiescent current		0.24 mA, typ.
Output		
Output voltage tolerance		P78NS3R3D: ≤ ± 4 % All others: ≤ ± 3 %
Line regulation		±0.2 %, typ.
Load regulation		±1 % @ load change 10..100 %
Ripple and noise		≤ 150 mVp-p, (see Figure 1) @ load 20..100 % load
Output voltage trim range		± 10 % (see Page 4)
Temperature coefficient		± 0.02 % / °C
Short circuit protection		Continuous, automatic recovery
Transient response deviation @ 25 % load change steps	-3R3D, -05D, -6R5D, -09D	≤ 150 mV
	-12D, -15D	≤ 300 mV
Transient recovery time@ 25 % load change steps		≤ 0.8 ms
General		
Reliability calculated MTBF (MIL-HDBK-217F@ 25 °C)		≥ 8.5 Mio. h
Switching frequency		1 MHz, typ.
Moisture sensitivity level (MSL)		MS Level 3
Pollution Degree		PD 3

Safety standard		EN 62368-1
EMS		
CE	EN 55032, CISPR 32	Class B (see Figure 3)
RE	EN 55032, CISPR 32	Class B (see Figure 3)
EMI		
ESD	EN-, IEC 61000-4-2	Contact ± 2 kV, perf. Crit. B
RS	EN-, IEC 61000-4-3	10 V/m perf. Crit. A
EFT	EN-, IEC 61000-4-4	± 1 kV perf. Crit. B (see Figure 3)
Surge	EN-, IEC 61000-4-5	Line to Line ± 1 kV perf. Crit. B (see Figure 3)
CS	EN-, IEC 61000-4-6	3 Vrms perf. Crit. A
Environmental		
Operating ambient temperature		-40...105 °C
Storage temperature		-55...125 °C
Derating		see diagram
Storage humidity		Up to 95 %, non condensing
Cooling		Free air convection, 30…65 LFM
Physical		
Dimensions		7 x 9 x 3.1 mm
Weight		0.58 g
Case material		Black epoxy resin (UL94V-0 rated)
Reflow soldering temperature IPC/JEDEC J-STD-020D.1.		≤ 245 °C peak duration ≤ 10 s, ≤ 217 °C duration ≤ 60 s

1. All specifications measured at Ta 25 °C, humidity < 75 %, nominal input voltage and rated output load unless otherwise specified.
2. Do not connect the converter parallel or a hot swap

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Figure 1a Measure circuit for output ripple and noise at positive output operation (BW 20 MHz)

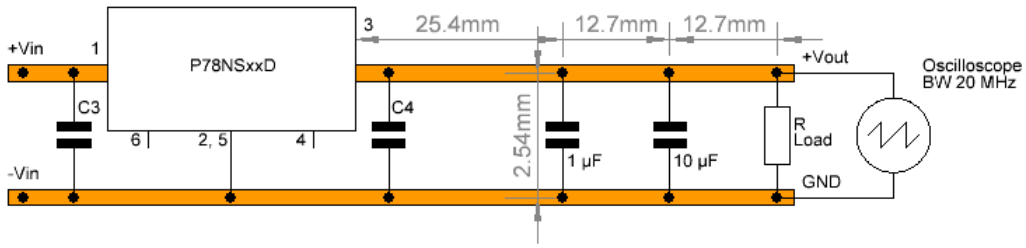


Figure 1b Measure circuit for output ripple and noise at negative output configuration (BW 20 MHz)

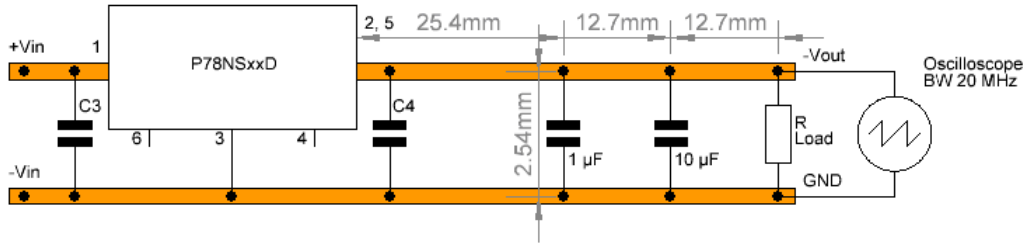
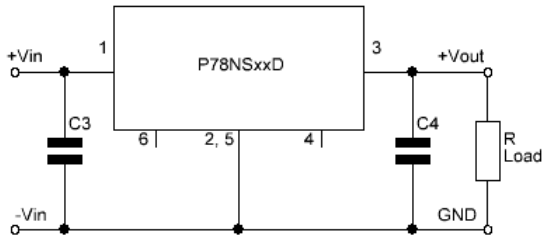
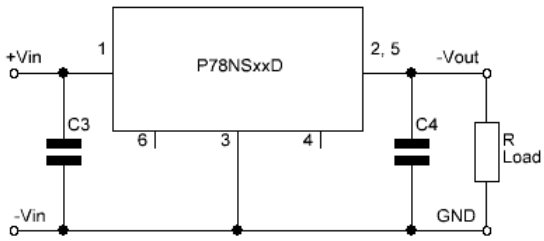


Figure 2….Typical application circuit for positive output



Typical application circuit for negative output



C3 and C4 should be placed as close as possible to the pads of the DC/DC-converter.

Capacitor list for Figure 2		
Type	C3	C4
P78NS3R3D	10 µF, 50 V, MLCC	22 µF, 10 V, MLCC
P78NS05D	10 µF, 50 V, MLCC	22 µF, 10 V, MLCC
P78NS6R5D	10 µF, 50 V, MLCC	22 µF, 16 V, MLCC
P78NS09D	10 µF, 50 V, MLCC	22 µF, 16 V, MLCC
P78NS12D	10 µF, 50 V, MLCC	22 µF, 25 V, MLCC
P78NS15D	10 µF, 50 V, MLCC	22 µF, 25 V, MLCC

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Figure 3a Positive output test circuit for EMS EN 55032 Class B and EMI EN 61000-4-4 and EN 61000-4-5 compliance

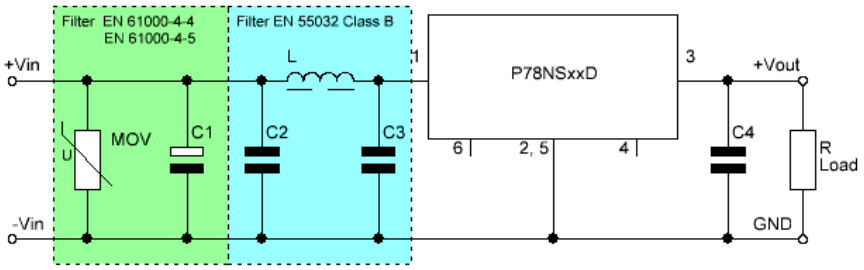


Figure 3b Negative output test circuit for EMS EN 55032 Class B and EMI EN 61000-4-4 and EN 61000-4-5 compliance

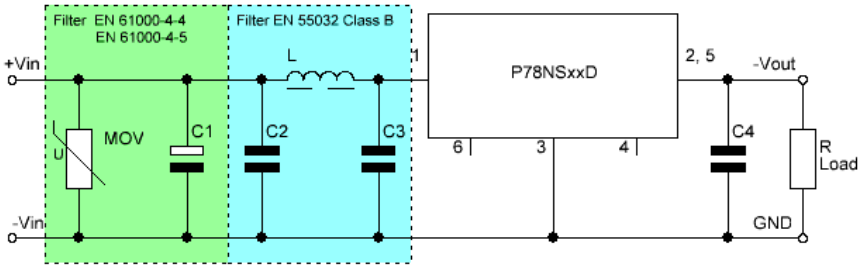
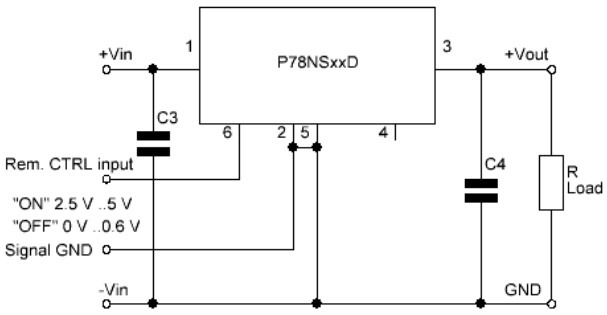
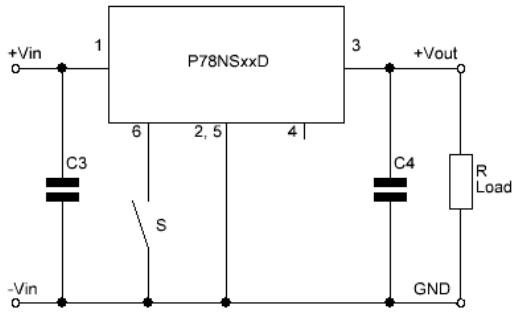


Figure 3a & Figure 3b: Recommended compliance circuit							
Part No.	Mode	MOV	C1	C2	L2	C3	C4
P78NS3R3D	positive operation	S20K30	680 µF/50 V	10 µF/50 V	68 µH	-	22 µF/25 V
P78NS3R3D	negative operation	S20K30	680 µF/50 V	10 µF/50 V	68 µH	10 µF/50 V	22 µF/25 V
P78NS05D	positive operation	S20K30	680 µF/50 V	10 µF/50 V	68 µH	-	22 µF/25 V
P78NS05D	negative operation	S20K30	680 µF/50 V	10 µF/50 V	68 µH	10 µF/50 V	22 µF/25 V
P78NS6R5D	positive operation	S20K30	680 µF/50 V	10 µF/50 V	68 µH	-	22 µF/25 V
P78NS6R5D	negative operation	S20K30	680 µF/50 V	10 µF/50 V	68 µH	10 µF/50 V	22 µF/25 V
P78NS09D	pos. & neg. operation	S20K30	680 µF/50 V	10 µF/50 V	68 µH	10 µF/50 V	22 µF/25 V
P78NS12D	pos. & neg. operation	S20K30	680 µF/50 V	10 µF/50 V	68 µH	10 µF/50 V	22 µF/25 V
P78NS15D	pos. & neg. operation	S20K30	680 µF/50 V	10 µF/50 V	68 µH	10 µF/50 V	22 µF/25 V

Figure 4 Application circuits for ON / OFF Remote control function





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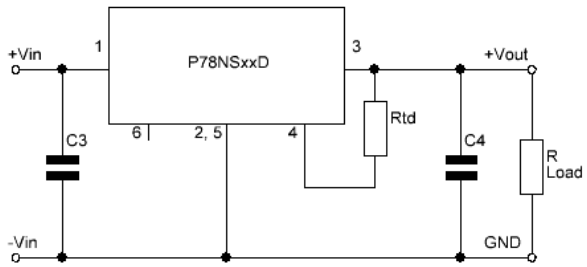
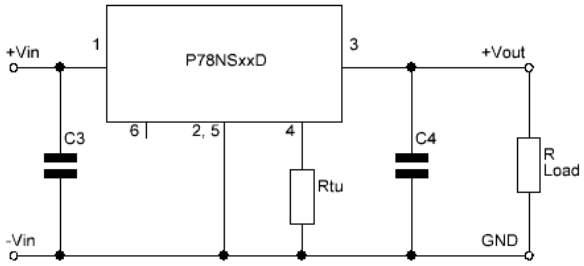
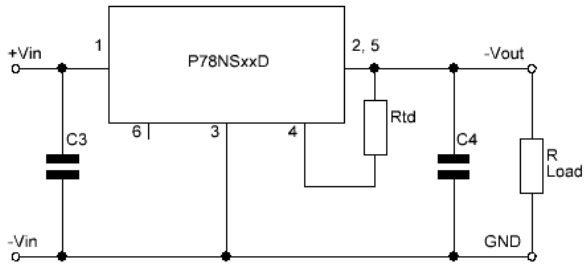
Application circuit for postive output voltage trim down



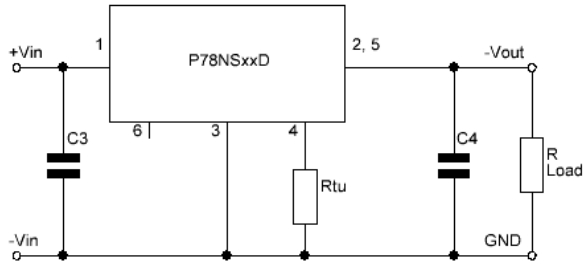
Application circuit for positive output voltage trim up



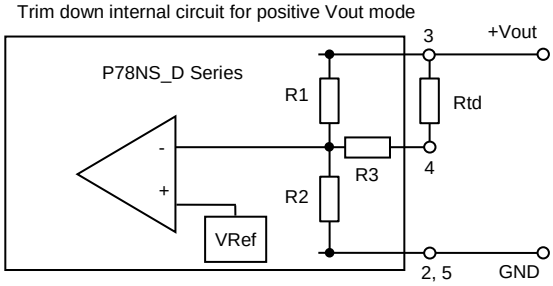
Application circuit for negative output voltage trim down



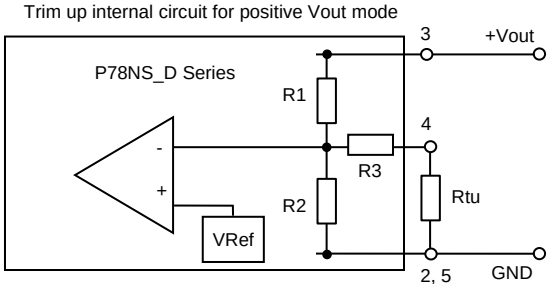
Application circuit for negative output voltage trim up



Trim down internal circuit for positive Vout mode



Trim up internal circuit for positive Vout mode



Calculation
Trim down resistor

$$b = \frac{Vout - Vref}{Vref} * R2$$

$$Rtd = \frac{R1 * b}{R1 - b} - R3$$

Calculation
Trim up resistor

$$a = \frac{Vref}{Vout - Vref} * R1$$

$$Rtu = \frac{R2 * a}{R2 - a} - R3$$

Value table for calculation of trim down resistor (Rtd) or trim up resistor (Rtu)						
Type	R1 [kΩ]	R2 [kΩ]	R3 [kΩ]	V Ref [V]	Rtd min. [kΩ]	Rtu min. [kΩ]
P78NS3.3D	150	33	180	0.6	815	117.3
P78NS05D	100	13,66	82	0.6	710	36.2
P78NS6.5D	32.4	3.3	20	0.6	245,4	9,5
P78NS09D	100	7.14	47	0.6	783.2	19.9
P78NS12D	100	5.28	43	0.6	833.6	5.53
P78NS15D	180	7.5	51	0.6	1497	21
Maximum output voltage adjust range ± 10 % of Vout nominal, see min. value Rtd and Rtu						

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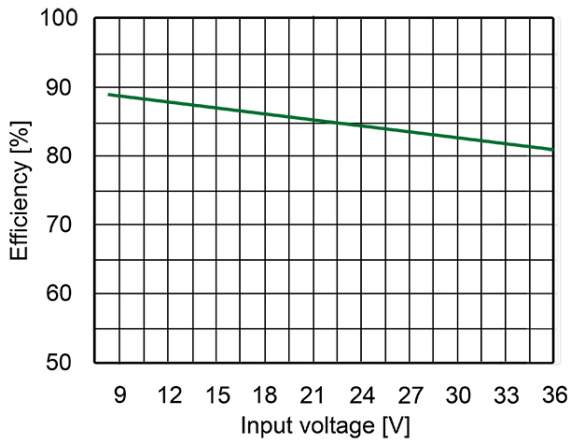
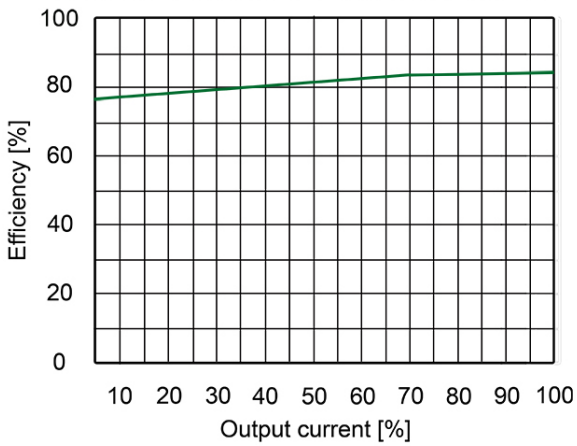
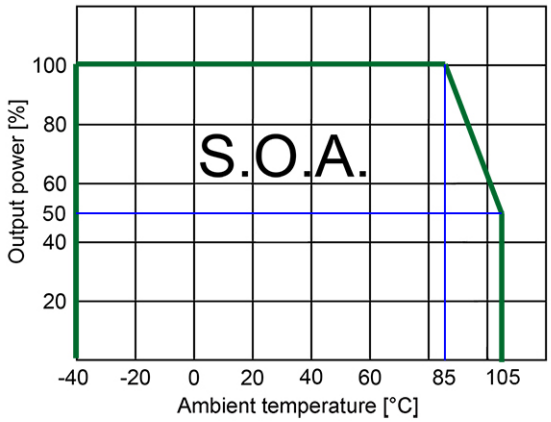
P78NS05D Derating vs input voltage at full load



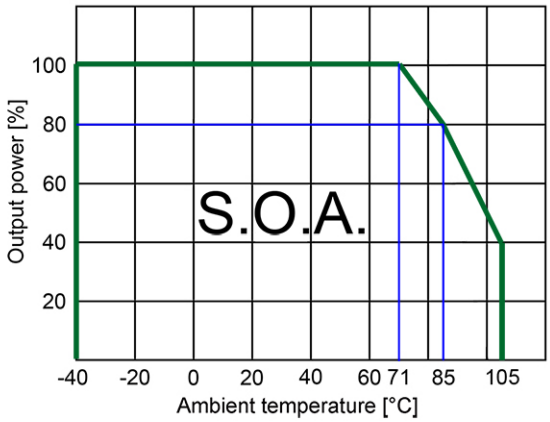
P78NS05D Efficiency vs output load at Vin 24 V



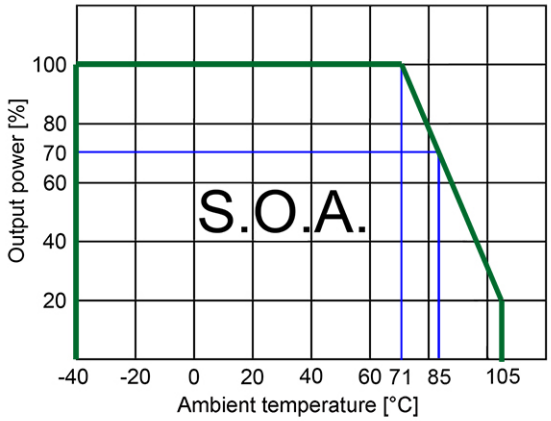
P78NS3R3D, P78NS05D, P78NS6R5D
derating diagram



P78NS09D, P78NS12D, P78NS15D,
derating diagram at Vin < 26 V



P78NS09D, P78NS12D, P78NS15D,
derating diagram at Vin 26...36 V



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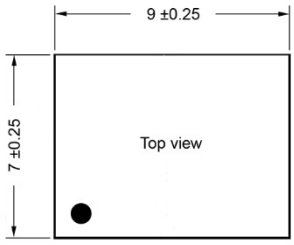
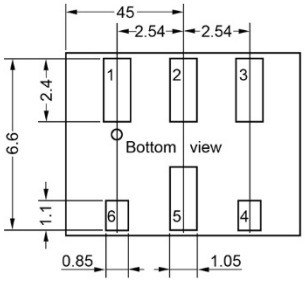
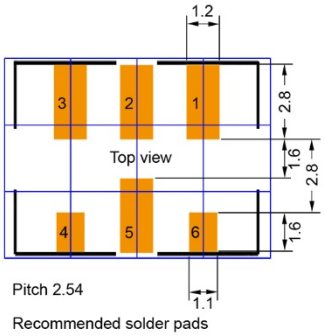
Mechanical dimensions

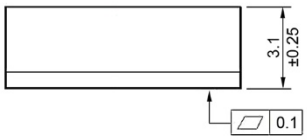


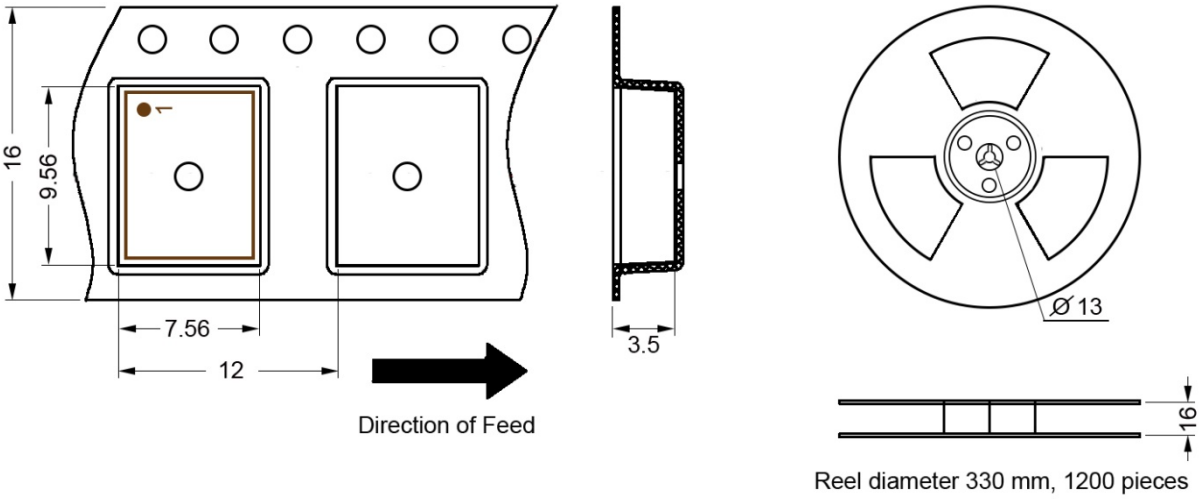
Pad assignment		
Pad	Positive operation	Negative operationt
1	+V Input	+V Input
2	GND	-V Output
3	+V Output	GND
4	Trim input	Trim input
5	GND	-V Output
6	ON/OFF control	ON/OFF control





Note:
All dimensions in mm
Lead tolerances: ± 0.1 mm
General tolerances: ± 0.25 mm





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