

500 mA DC-DC Step Down Converter P78MS_D-Series



PHI-CON

- Non isolated
- 6 pad SMD package
- Efficiency up to 92 %
- Operating temperature range -40...105 °C
- Continuous short circuit protected
- Adjustable output voltage



Model guide								
Type	Input voltage		Output		Efficiency			Capacitive load [μF] max.
	Nominal [V _{DC}]	Range [V _{DC}]	Voltage [V _{DC}]	Current [mA] max.	@ V _{in} min. [%] typ.	@ V _{in} nom. [%] typ.	@ V _{in} max. [%] typ.	
P78MS3R3D	24	4.5..36	3.3	500	89	79	71	680
	12	4.5..32	-3.3	-300	80	82	71	470
P78MS05D	24	6.5..36	5.0	500	91	83	78	680
	12	7..31	-5.0	-300	78	78	71	470
P78MS6R5D	24	8..36	6.5	500	91	85	81	680
	12	7..28	-6.5	-250	80	79	73	470
P78MS09D	24	12..36	9.0	500	92	90	86	680
	12	8..27	-9.0	-200	82	82	77	470
P78MS12D	24	15..36	12.0	500	92	91	86	680
	12	8..24	-12	-150	81	83	79	470
P78MS15D	24	16..36	15.0	500	91	91	87	680
	12	8..21	-15	-150	80	81	84	470

Specifications

Input	
Filter	Capacitor
No load quiescent current	0.1 mA, typ.
ON/OFF remote control threshold	ON: ≥ 2.5 ... 5 V or open CTRL pin OFF: ≤ 0.6 V or CTRL pin connected to GND (see Figure 3)
Ctrl. OFF state quiescent current	0.24 mA, typ.
Output	
Output voltage tolerance	P78MS3R3D: ≤ ± 4 % All others: ≤ ± 3 %
Line regulation	±0.2 %, typ.
Load regulation	±0.4 % @ load change 10..100 %
Ripple and noise	≤ 45 mVp-p, @ load 20..100 % load (see Figure 1)
Output voltage trim range	± 10 % (see Page 4)
Temperature coefficient	± 0.02 % / °C
Short circuit protection	Continuous, automatic recovery
Transient response deviation	≤ 120 mV @ 25 % load change steps
Transient recovery time	≤ 0.8 ms @ 25 % load change steps
General	
Reliability calculated MTBF @ 25 °C MIL-HDBK-217F	≥ 9 Mio. h
Switching frequency	2 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 ± 4 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 Vr.m.s. 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)

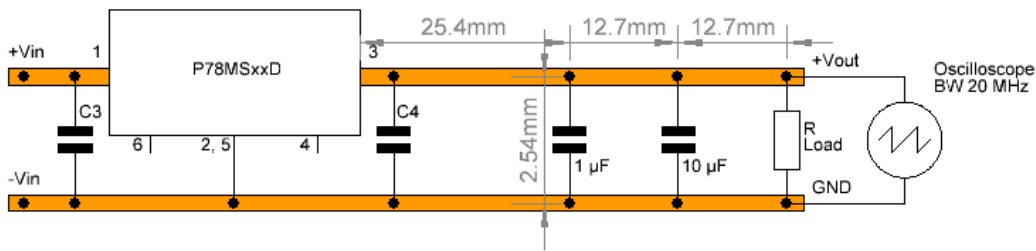


Figure 1b Measure circuit for output ripple and noise at negative output configuration (BW 20 MHz)

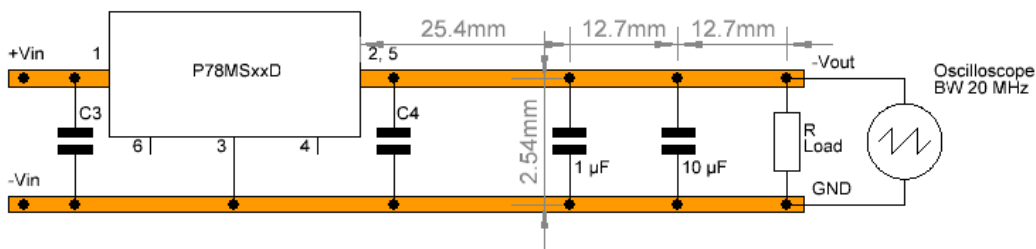
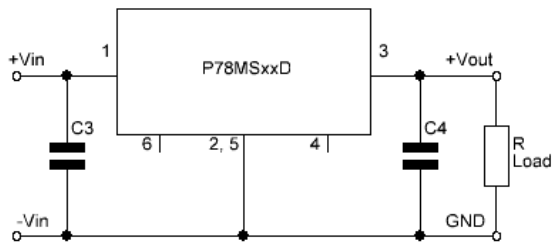
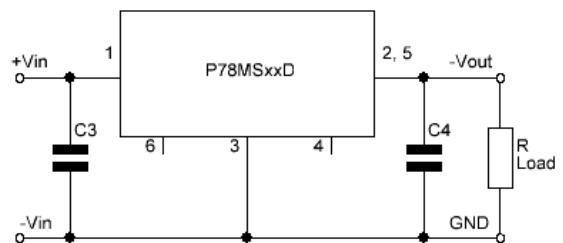


Figure 2

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
P78MS3R3D	10 µF, 50 V, MLCC	22 µF, 10 V, MLCC
P78MS05D	10 µF, 50 V, MLCC	22 µF, 10 V, MLCC
P78MS6R5D	10 µF, 50 V, MLCC	22 µF, 16 V, MLCC
P78MS09D	10 µF, 50 V, MLCC	22 µF, 16 V, MLCC
P78MS12D	10 µF, 50 V, MLCC	22 µF, 25 V, MLCC
P78MS15D	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

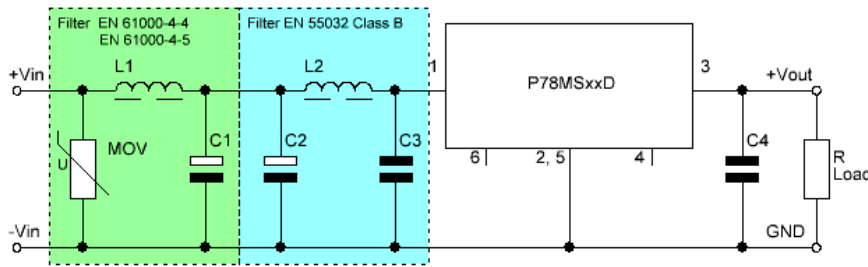
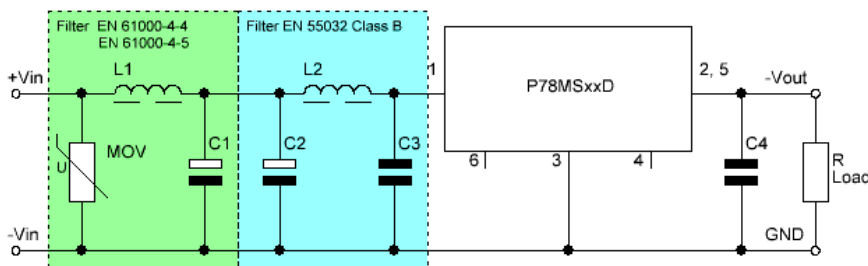
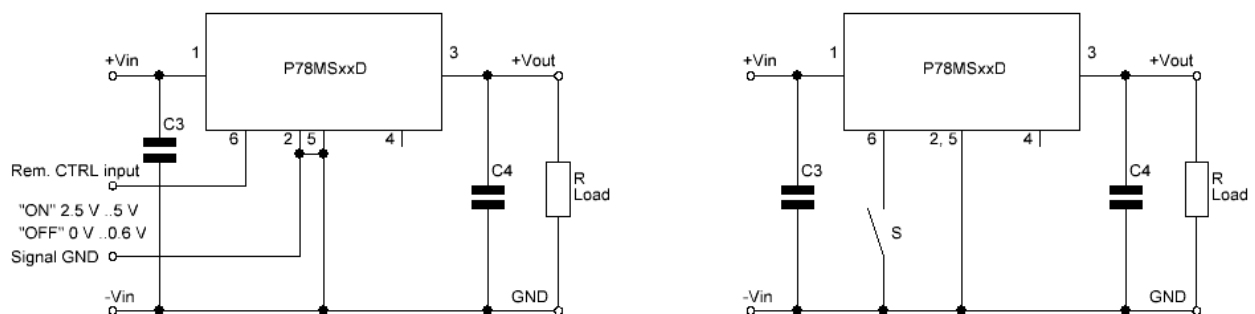


Figure 3b Negative output test circuit for EMS EN 55032 Class B and EMI EN 61000-4-4 and EN 61000-4-5 compliance



Component list for Figure 3							
Type	MOV	L1	C1	C2	L2	C3	C4
P78MS3R3D positive operation	S20K30	82 μ H	680 μ F, 50 V	10 μ F, 50 V	10 μ H	0.47 μ F, 50V	22 μ F, 10 V
P78MS3R3D negative operation	S20K30	82 μ H	680 μ F, 50 V	10 μ F, 50 V	22 μ H	-	22 μ F, 10 V
P78MS05D	S20K30	82 μ H	680 μ F, 50 V	10 μ F, 50 V	10 μ H	-	22 μ F, 10 V
P78MS6R5D	S20K30	82 μ H	680 μ F, 50 V	10 μ F, 50 V	10 μ H	1 μ F, 50V	22 μ F, 16 V
P78MS09D	S20K30	82 μ H	680 μ F, 50 V	10 μ F, 50 V	10 μ H	1 μ F, 50V	22 μ F, 16 V
P78MS12D	S20K30	82 μ H	680 μ F, 50 V	10 μ F, 50 V	22 μ H	0.47 μ F, 50V	22 μ F, 25 V
P78MS15D	S20K30	82 μ H	680 μ F, 50 V	10 μ F, 50 V	22 μ H	0.47 μ F, 50V	22 μ F, 25 V

Figure 4 Application circuit for ON / OFF Remote control function

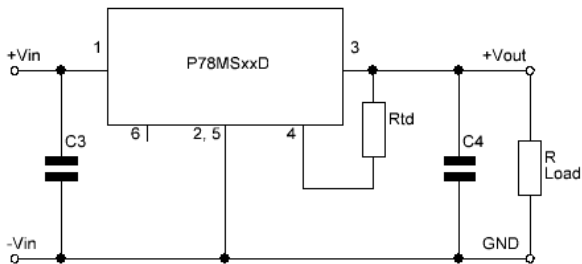




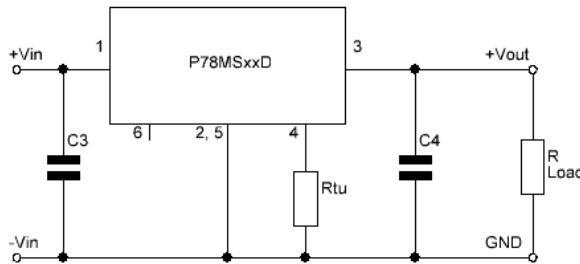
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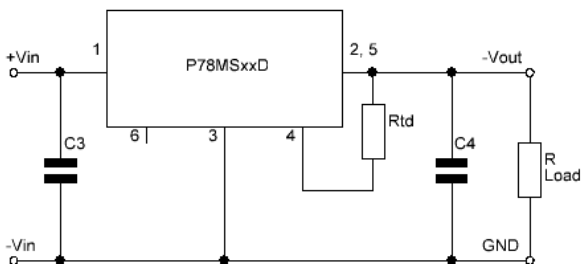
Figure 4
Application circuit for positive output voltage trim down



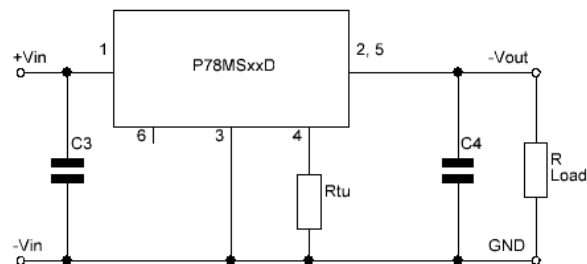
Application circuit for positive output voltage trim up



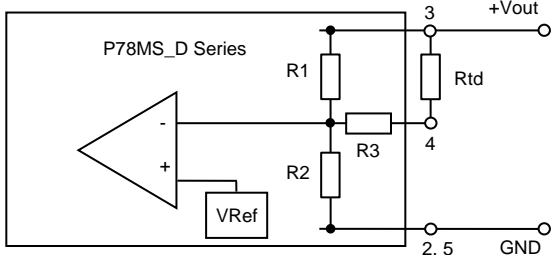
Application circuit for negative output voltage trim down



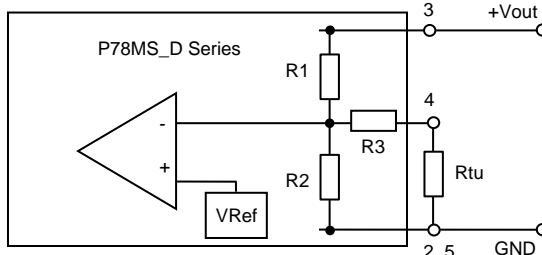
Application circuit for negative output voltage trim up



Trim down internal circuit for positive Vout mode



Trim up internal circuit for positive Vout mode



Calculation
Trim down resistor

$$b = \frac{V_{out} - V_{ref}}{V_{ref}} \cdot R_2$$

$$R_{td} = \frac{R_1 \cdot b}{R_1 - b} - R_3$$

Calculation
Trim up resistor

$$a = \frac{V_{ref}}{V_{out} - V_{ref}} \cdot R_1$$

$$R_{tu} = \frac{R_2 \cdot a}{R_2 - a} - R_3$$

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]
P78MS3.3D	47	15	82	0.8	221	34.3
P78MS05D	36	6.875	36	0.8	236	20.4
P78MS6.5D	47	6.596	36	0.8	329	21.9
P78MS09D	75	7.318	47	0.8	562	19.6
P78MS12D	120	8.571	51	0.8	948	29
P78MS15D	100	5.634	36	0.8	811	17.3

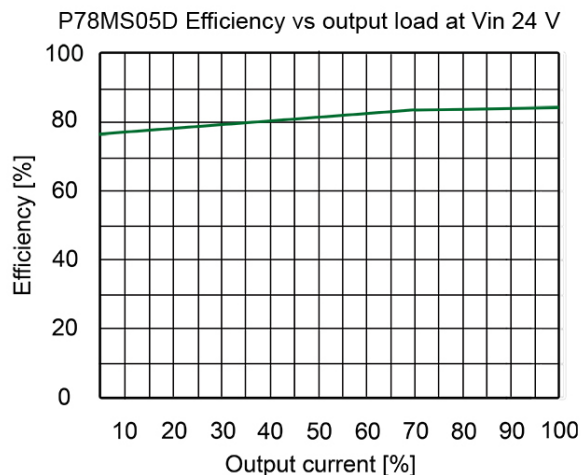
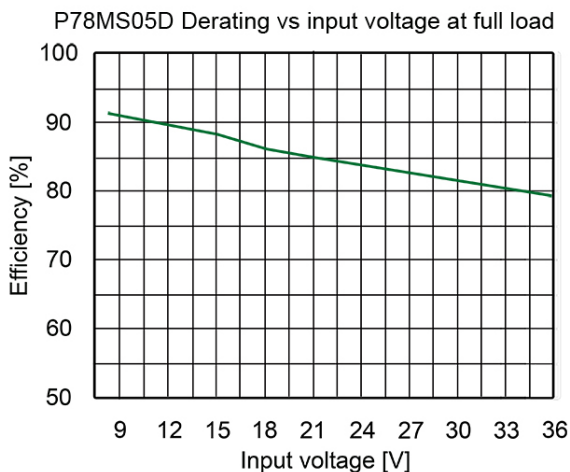
Maximum output voltage adjust range ± 10 % of Vout nominal, see min. value Rtd and Rtu



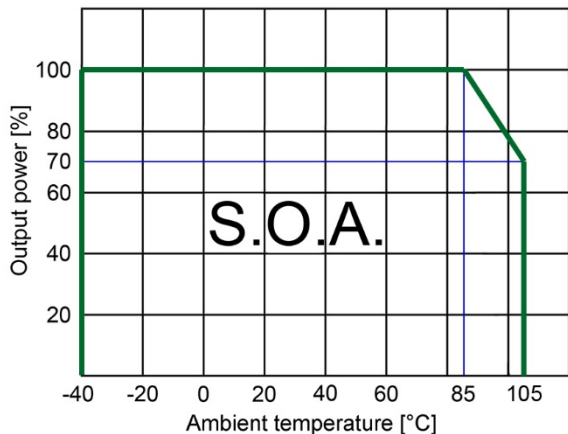


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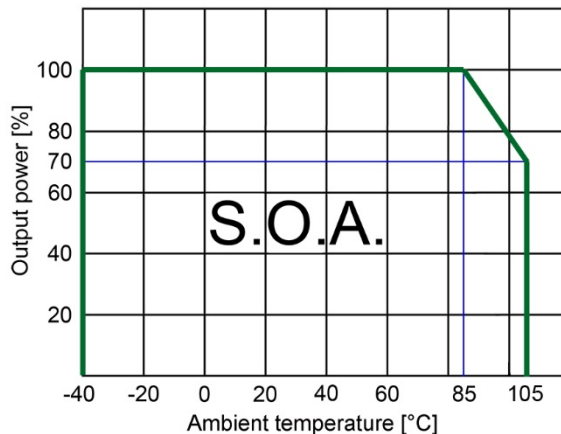
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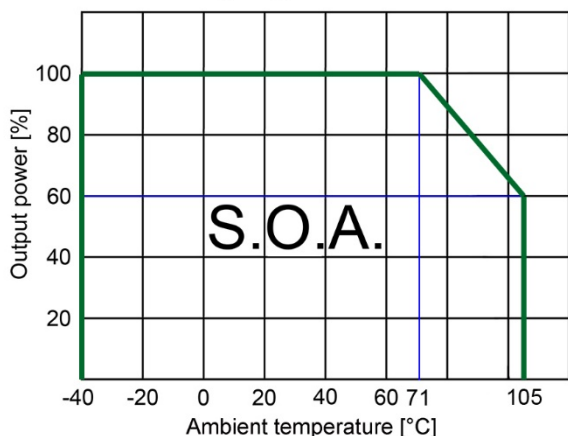
P78MS3R3D, P78MS05D, P78MS6R5D
derating diagram



P78MS09D, P78MS12D, P78MS15D,
derating diagram at Vin < 26 V



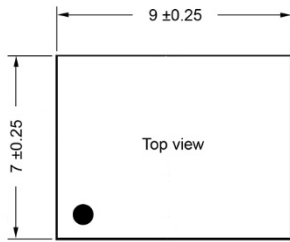
P78MS09D, P78MS12D, P78MS15D,
derating diagram at Vin 26...36 V



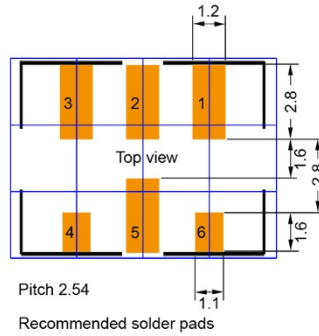
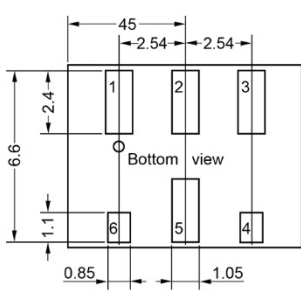
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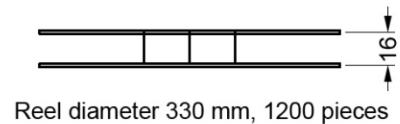
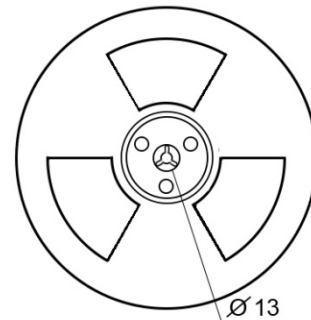
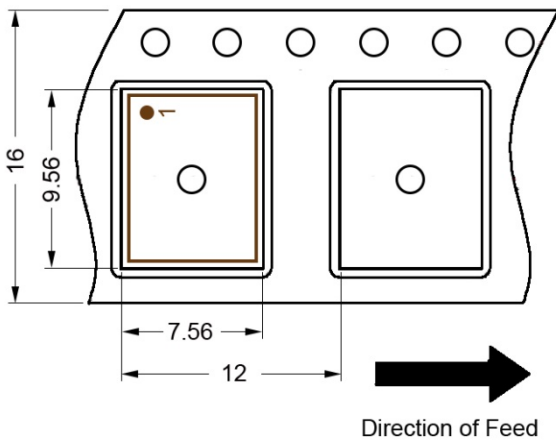
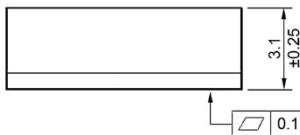
Mechanical dimensions



Pad assignment		
Pad	Positive output	Negative output
1	+V Input	+V Output
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



Reel diameter 330 mm, 1200 pieces

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