500 mA DC-DC Step Down Converter P78AS-Series

PHI-CON

- Non isolated
- 10 Pin SMD package
- Function compatible with 78Mxx linear regulator
- Efficiency up to 96 %
- Operating temperature range -40...+85 °C
- Continuous short circuit protected
- Thermal shut down
- Adjustable output voltage

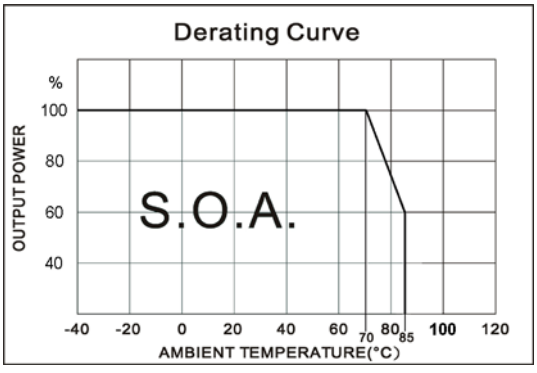
Model guide

Type	Input voltage		Output				Efficiency	
	Range [V_{DC}]	Nominal [V_{DC}]	Voltage [V_{DC}]	Adjust trim range [V_{DC}]	Current [mA]	Capacitive load max. [µF]	@ V_{in} min. [%]	@ V_{in} max. [%]
P78AS3R3	4.5..28	12	3.3	1.8…5.5	500	1000	90	75
P78AS05	6..28	12	5.0	2.5…8	500	1000	94	81
P78AS09	11..28	24	9.0	3…11.5	500	1000	95	87
P78AS12	14..28	24	12.0	4.5…13.5	500	1000	95	90
P78AS15	17..28	24	15.0	4.5…15.5	500	1000	96	92

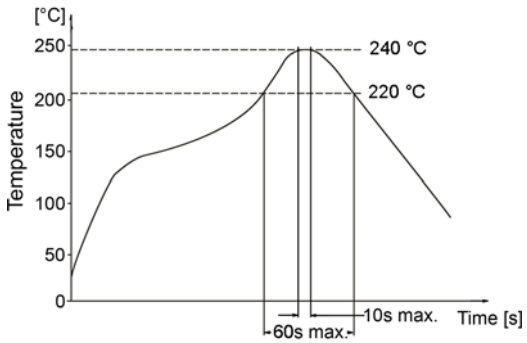
Specifications

Output	
Voltage accuracy	± 3 %, max.
Input voltage regulation	± 0.5 %, max.
Load regulation	± 0.75 % @ load 10..100 %
Dynamic load stability	± 75 mV @ load 10..100 %
Temperature coefficient	± 0.02 % / °C
Ripple and noise (at 20 MHz BW)	25 mVp-p, max.
Short circuit protection (hiccup mode)	Continuous, automatic recovery
Thermal shutdown	150 °C, typ. internal temp.
Output current limit	1.8 A, typ.
Input	
Short circuit input power	1.8 W, max.
Quiescent current	15 mA, typ.
ON control threshold	> 1.5 V, max. 6 V
OFF control threshold	< 1 V
ON / OFF control current	< 2 µA
Shut down quiescent current	30 µA, max.

General	
Thermal shutdown	160 °C, internal junction
Switching frequency	330 kHz, typ.
Reliability calc. MTBF @ 25 °C MIL-HDBK-217F	> 2 Mio. h
Environmental	
Operating ambient temperature	-40 °C ... +85 °C
Operating case temperature	100 °C, max.
Storage temperature	-55 °C ... +125 °C
Derating	see diagram
Humidity	Up to 95%, non-condensing
Cooling	Free air convection
Physical	
Dimensions	SMD10 15.24 x 8.5 x 7.25 mm
Weight	2.3 g
Case material	Plastic UL94-V0
Soldering temperature	See soldering profile



Recommended reflow soldering profile



This curve applies only to hot air reflow soldering.

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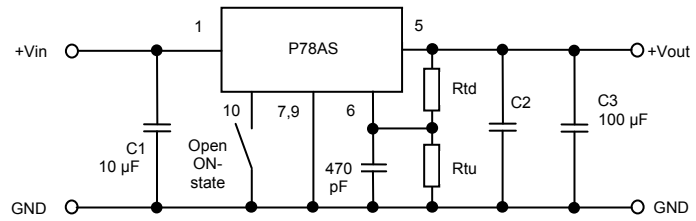
Standard application circuit



Type	C2
P78AS3R3	22 µF, 16 V
P78AS05	
P78AS09	
P78AS12	10 µF, 25 V
P78AS15	

1. C1,C2: Choose a ceramic type capacitors; C3 is require ,for best performance , use a 100 µF or more capacitance.
2. C1,C2 are require and should be placed close to the pins of the converter, with shortest possible traces.
3. Do not connect the converter parallel or a hot swap connection.

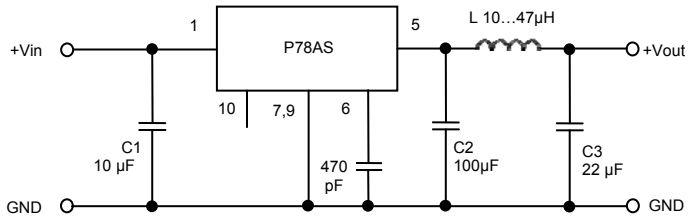
Adjustment resistor values

Type	P78AS3R3		P78AS05		P78AS09		P78AS12		P78AS15	
Adj. range	1.8…5.5 V		2.5…8 V		3…11.5 V		4.5…13.5 V		4.5…15.5 V	
Adj. Vout [V]	Rtd [kΩ]	Rtu [kΩ]	Rtd [kΩ]	Rtu [kΩ]	Rtd [kΩ]	Rtu [kΩ]	Rtd [kΩ]	Rtu [kΩ]	Rtd [kΩ]	Rtu [kΩ]
1.8	24.31									
2.5	98.9		25.28							
3.0	364		47.5		3.1					
3.3	∞	∞	67.3		5.79					
3.6		129.1	95.8		8.47					
3.9		59.1	140.9		11.8					
4.5		24.3	411		19.14		4.55		2.69	
4.9		15.25	2060		25.77		8.05		5.55	
5.0		14.05	∞	∞	27.3		9.16		6.17	
5.1		12.8		208.5	29.22		10.41		6.98	
5.5		8.65		58.5	37.8		15		10	
6.5				15.57	70.8		29.8		18.5	
7.2				7.8	115.3		43.5		26.2	
8.0				3.15	243.1		64.8		36.7	
9.0					∞	∞	105		52.9	
10.0						18.84	180.6		76.3	
11.0						4.47	370		111	
11.5						1.61	635		134.1	
12.0							∞	∞	167.7	
13.0								40.6	277.8	
13.5								15	385	
14.0									586	
14.5									1128	
15.0									∞	∞
15.5										88.2

Note: The above dates only are as reference, you could make corresponding adjustment with actual output when they are at practical application.

Application circuit to reduce output ripple.

It is recommented to add a LC filter to output.



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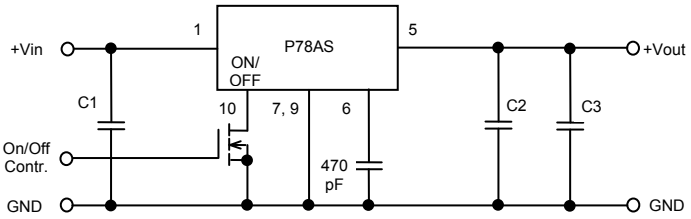
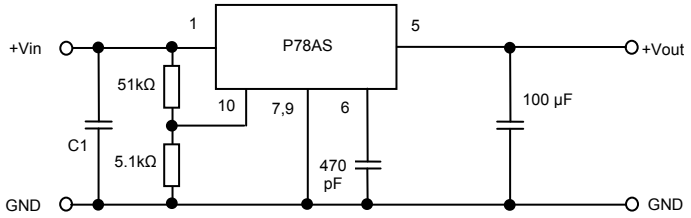
ON / OFF control function

The ON/OFF pin 10 provides several features for adjusting and sequencing the power supply.
An user has the flexibility of using the ON/OFF pin 10 as:

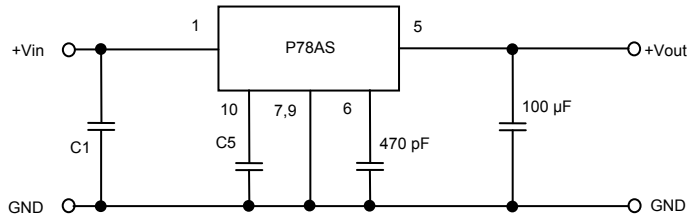
1) A digital on/off control by pulling down the ON/OFF pin with an open-drain transistor.

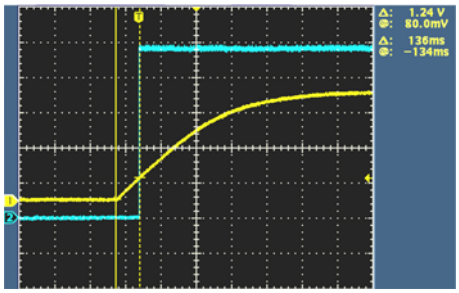


2) Line UVLO. If desired to achieve a UVLO voltage, an resistor divider from Vin to ON/OFF to GND can be used to disable the converter until a higher input voltage is achieved. For example, it is not useful for a converter with 12 V output to start up with a 12 V input voltage, as theoutput cannot teach regulation. To enable the converter when the input voltage reaches 14 V, a 51 kΩ / 5.1 kΩ resistor divider from Vin to GND can be connected to the ON/OFF pin. Both the precision 1.25 V threshold and 150 mV hysteresis are multiplied by the resistor ratio, providing a proportional 12 % hysteresis for any startup threshold. So, the turn off threshold would be between 12.3 V to 15.7 V.



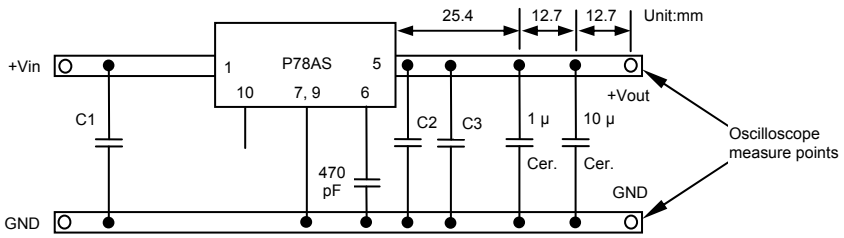
3) Power supply sequencing. By connecting a small capacitor from ON/OFF to GND, the 2 µA current source and 1.25 V threshold can provide a stable and predictable delay between startup of multiple power supplies. For example, a startup delay of roughly 64 ms is provided using C5 100 nF, or roughly 136 ms by using 220 nF.





C5 220 nF, Power on delay 136 ms
Channel 1 yellow: Voltage on pin 10,
Channel 2 blue: + Vout

Test circuit for output ripple & noise, start up time and load tansient response



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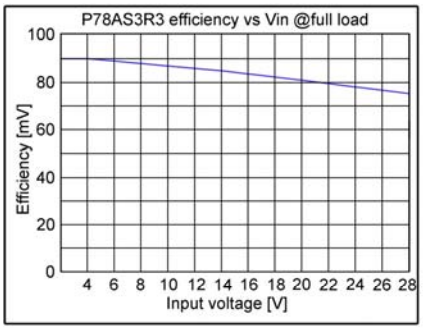

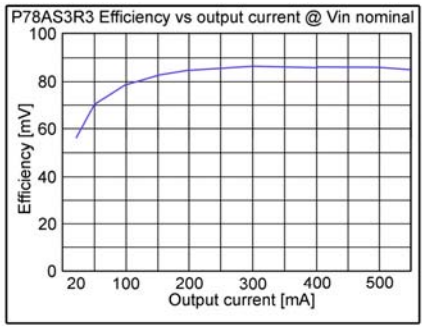

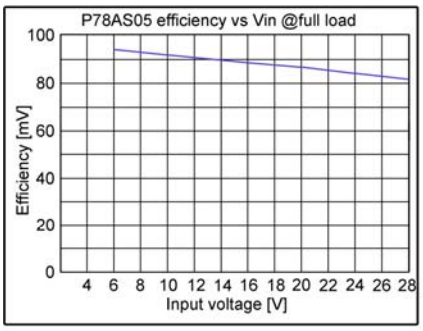

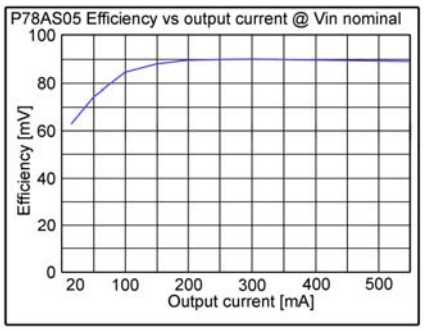

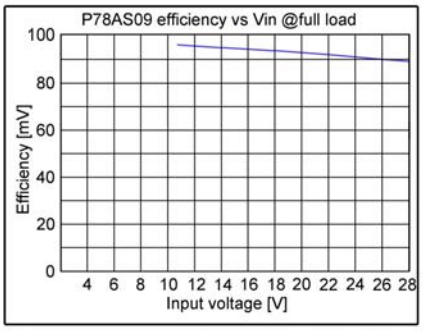

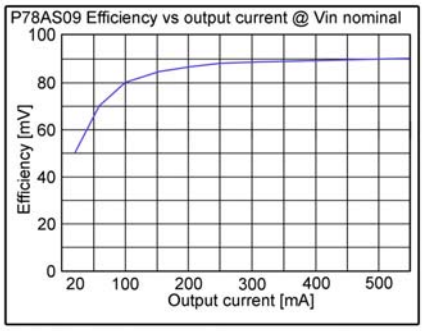

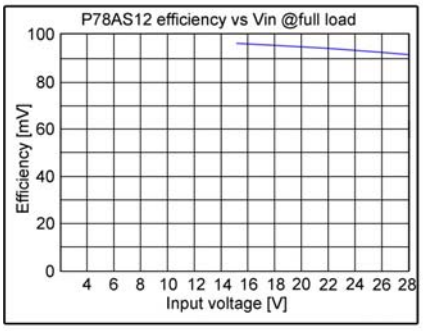

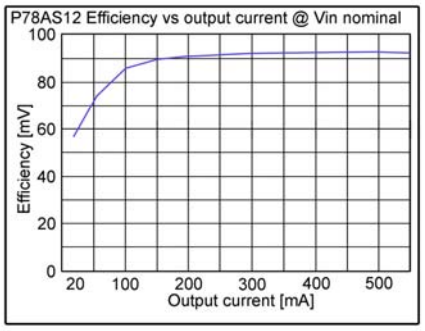

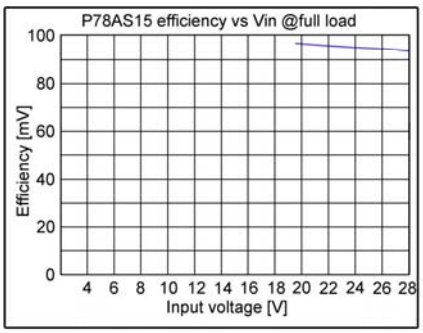

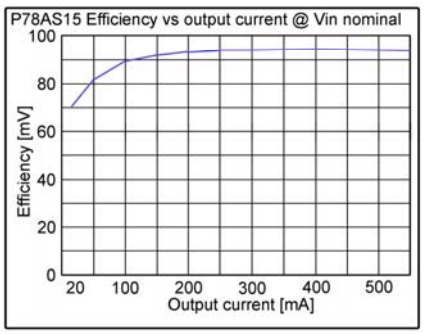

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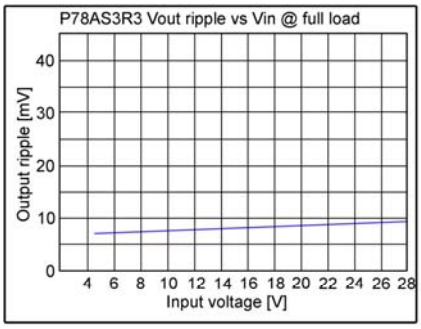

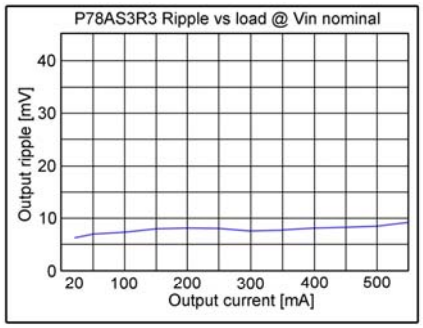

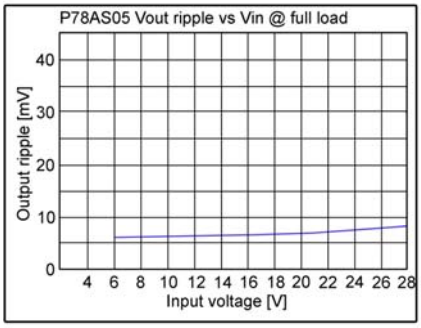

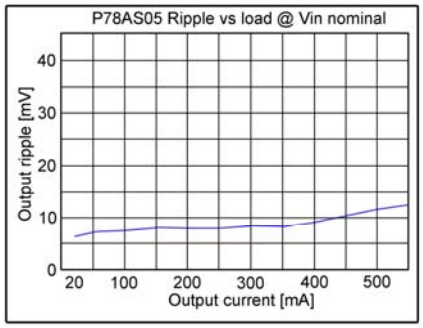

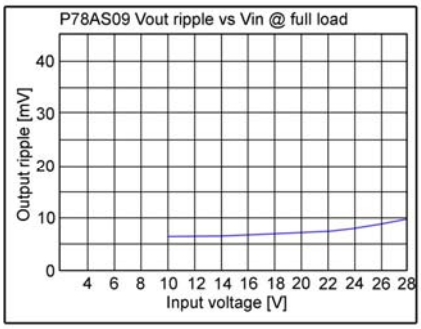

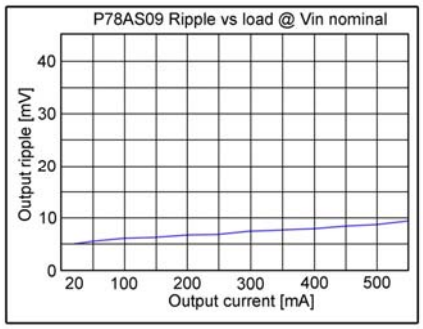

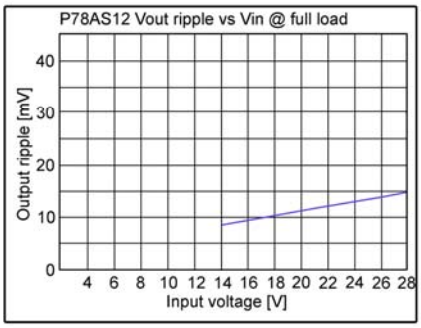

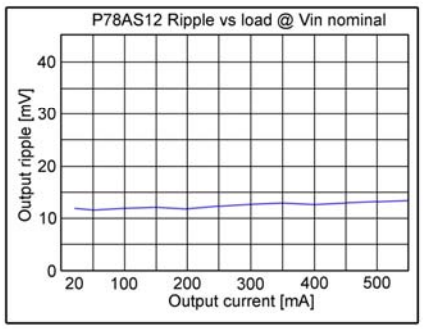

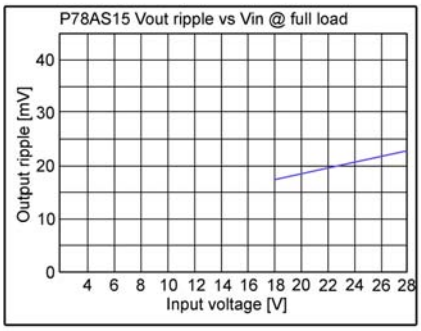

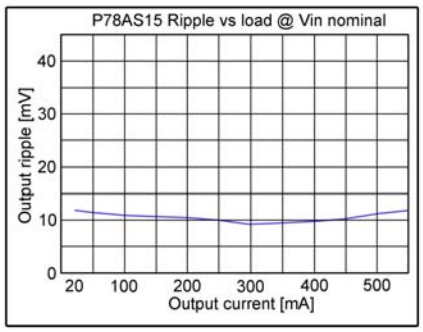

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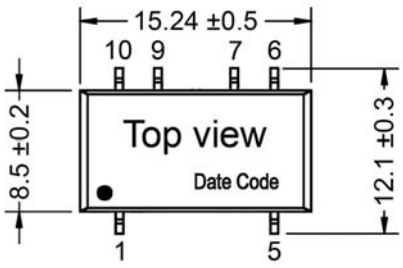
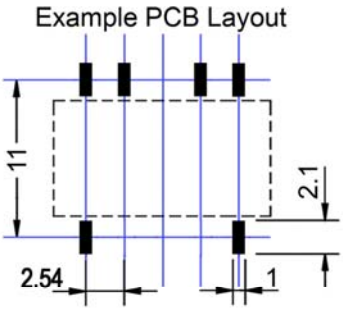
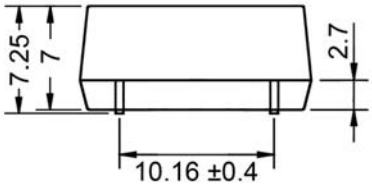
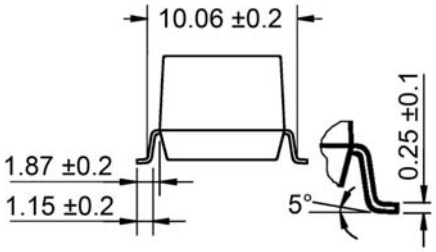
Dimensions



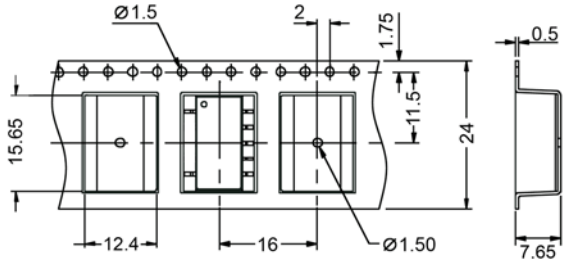




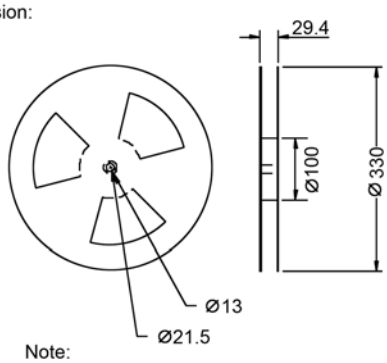


Notes:
All dimensions are in mm.
General tolerances ±0.25 mm
Pin tolerances ±0.1 mm

Tape dimension:

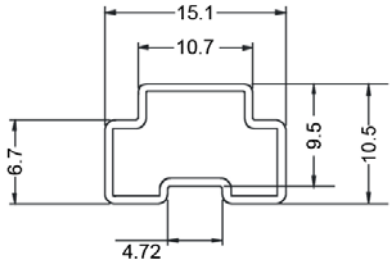


Reel dimension:



Note:
Unit: mm
General tolerances: ±0.5 mm
Quantity per reel: 500 pieces

Tube dimensions:



Note:
Unit: mm
General tolerances: ±0.5 mm

Short tube 220 mm, quantity 13 pieces,
Inner packing box dimensions L 255 mm, W 170 mm, H 80 mm.
Outer packing box contain six inner boxes,
dimensions: L 375 mm, W 280 mm, H 270 mm.

Long tube 530 mm, quantity 33 pieces,
Inner packing box dimensions L 580 mm, W 200 mm, H 100 mm.
Outer packing box with two inner packing boxes,
dimensions: L 600 mm, W 215 mm, H 220 mm.
Outer packing box with three inner packing boxes,
dimensions: L 600 mm, W 215 mm, H 325 mm.

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