SERIES: V78E-1000-SMT | **DESCRIPTION:** NON-ISOLATED DC SWITCHING REGULATOR

FEATURES

- 1 A of output current
- efficiency up to 95%
- SMT package
- industrial operating temp -40~+85°C
- industry standard footprint
- no load input current of 0.2 mA
- output short circuit protection on output



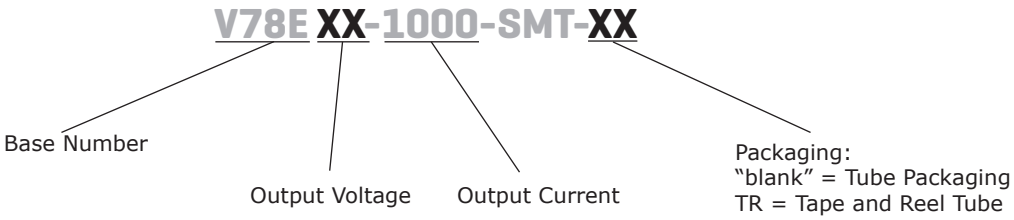
RoHS

MODEL

MODEL	input voltage[1] typ (Vdc)	input voltage[1] range (Vdc)	output voltage (Vdc)	output current max (mA)	output power max (W)	ripple & noise[2] max (mVp-p)	efficiency[3] typ (%)
V78E01-1000-SMT	12	4.75~32	1.5	1000	1.5	75	76
V78E02-1000-SMT	12	4.75~32	2.5	1000	2.5	75	86
V78E03-1000-SMT	24	6.5~36	3.3	1000	3.3	75	90
V78E05-1000-SMT	24	8~36	5	1000	5	75	93
V78E06-1000-SMT	24	10~36	6.5	1000	6.5	75	93
V78E09-1000-SMT	24	13~36	9	1000	9	75	94
V78E12-1000-SMT	24	16~36	12	1000	12	75	95

Notes:
1. For input voltages higher than 30 Vdc, a 22 µF / 50 V input capacitor is required.
2. Tested at nominal input, 20~100% load, 20 Mhz bandwidth, with 10 µF electrolytic and 1 µF ceramic capacitor on the output. At loads below 20%, the max ripple and noise will be 150 mVp-p.
3. Measured at min Vin, full load.
4. All specifications are measured at Ta=25°C, humidity < 75%, nominal input voltage, and rated output load unless otherwise specified.

PART NUMBER KEY



Please read our datasheet & drawing disclaimer here.

INPUT

parameter	conditions/description	min	typ	max	units
operating input voltage[5]		4.75		36	Vdc
filter	capacitor filter				
input reverse polartiy protection	no				
no-load input current			0.2	1.0	mA
remote on/off[6]	turn on (3.2~5.5 Vdc or open circuit) turn off (<0.8 Vdc) input current when switched off		 0.2	 1	 mA

Note: 5. See Model section on page 1 for specific input voltage ranges.
6. The voltage of remote ON/OFF pin is relative to GND pin.

OUTPUT

parameter	conditions/description	min	typ	max	units
maximum capacitive load[7]				680	µF
voltage accuracy	at full load, input voltage range 1.5, 2.5, 3.3 Vdc output models all other models		 ±2 ±2	 ±4 ±3	 % %
line regulation	at full load, input voltage range 1.5, 2.5 Vdc output models all other models		 ±0.3 ±0.2	 ±0.6 ±0.4	 % %
load regulation	at 10~100 % load, input voltage range 1.5, 2.5 Vdc output models all other models		 ±0.8 ±0.3	 ±1.5 ±0.6	 % %
voltage adjustment	input voltage range		±10		%Vo
switching frequency	at full load, input voltage range 1.5, 2.5 Vdc output models 3.3, 5, 6.5 Vdc output models all other models		 370 520 700		 kHz kHz kHz
transient recovery time	at nominal input voltage, 25% load step change		0.2	1	ms
transient response deviation	at nominal input voltage, 25% load step change		50	150	mV
temperature coefficient	operating temperature -40 °C to +85 °C			±0.03	%/°C

Note: 7. The maximum capacitive load was tested at nominal input voltage, full load.

PROTECTIONS

parameter	conditions/description	min	typ	max	units
short circuit protection	continuous, auto recovery				

SAFETY AND COMPLIANCE

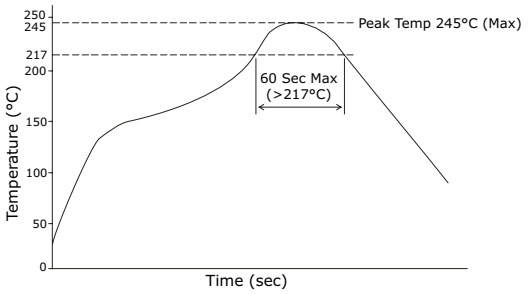
parameter	conditions/description	min	typ	max	units
safety approvals	designed to meet 62368: EN, BS EN				
conducted emissions	CISPR32/EN55032, class B (external circuit required, see Figure 3-b)				
radiated emissions	CISPR32/EN55032, class B (external circuit required, see Figure 3-b)				
ESD	IEC/EN61000-4-2, contact ± 4kV, class B				
radiated immunity	IEC/EN61000-4-3, 10V/m, class A				
EFT/burst	IEC/EN61000-4-4, ± 1kV, class B (external circuit required, see Figure 3-a)				
surge	IEC/EN61000-4-5, line-line ± 1kV, class B (external circuit required, see Figure 3-a)				
conducted immunity	IEC/EN61000-4-6, 3 Vr.m.s, class A				
MTBF	as per MIL-HDBK-217F, 25°C	2,000,000			hours
RoHS	yes				

ENVIRONMENTAL

parameter	conditions/description	min	typ	max	units
operating temperature	see derating curves	-40		85	°C
storage temperature		-55		125	°C
storage humidity	non-condensing	5		95	%

SOLDERABILITY

parameter	conditions/description	min	typ	max	units
reflow soldering	see reflow profile, refer to IPC/JEDEC J-STD-020D.1			245	°C



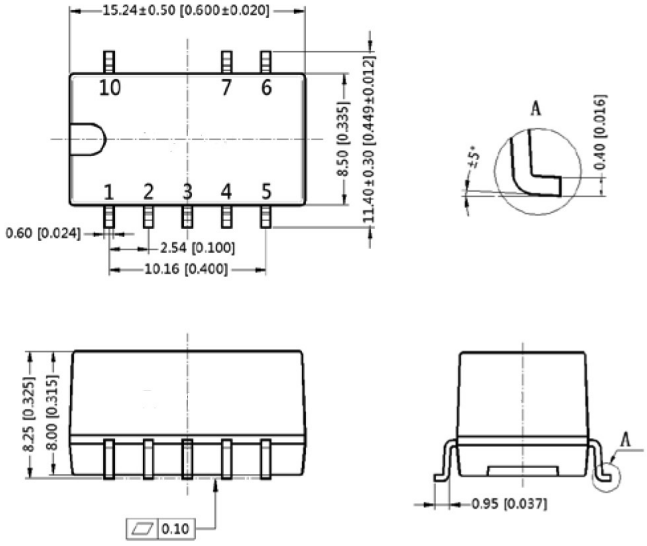
MECHANICAL

parameter	conditions/description	min	typ	max	units
dimensions	15.24 x 8.50 x 8.25 [0.60 x 0.335 x 0.325 inch]				mm
case material	black flame-retardant and heat resistant plastic (UL94V-0)				
weight			1.7		g

MECHANICAL DRAWING

units: mm [inch]
tolerance: ±0.25[±0.010]
pin section tolerance: ±0.10[±0.004]

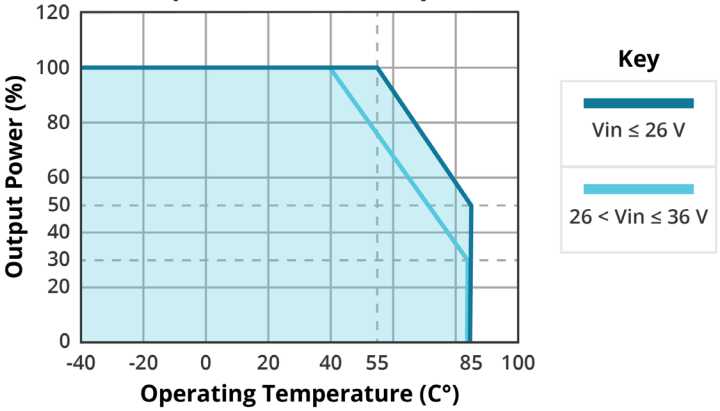
PIN CONNECTIONS	
PIN	FUNCTION
1	+VIN
2	+VIN
3	GND
4	+VOUT
5	+VOUT
6	V adj
7	GND
10	remote on/off



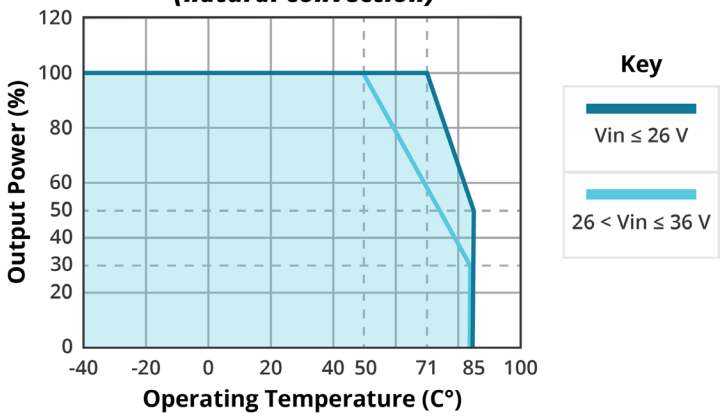
Note: Grid 2.54*2.54mm
Recommended PCB Layout
Top View

DERATING CURVES

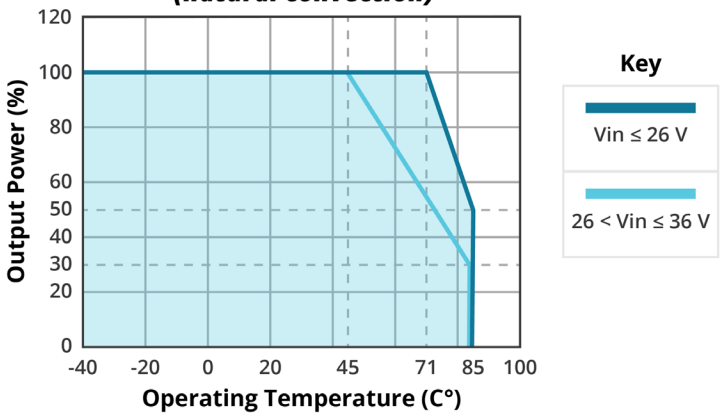
TEMPERATURE DERATING CURVE
9 Vdc output
(natural convection)



TEMPERATURE DERATING CURVE
12 Vdc output
(natural convection)

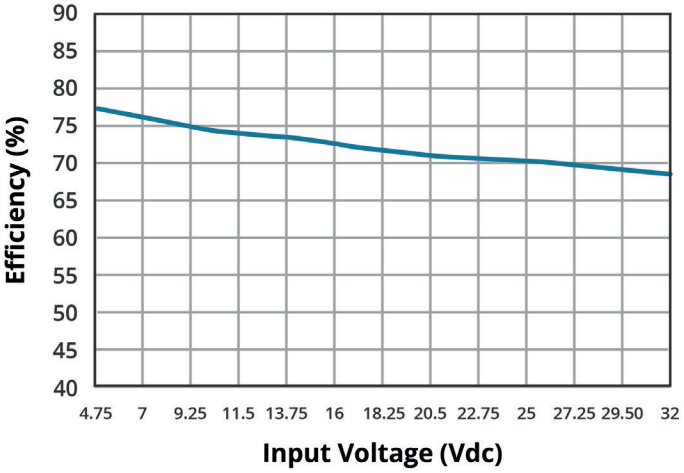


TEMPERATURE DERATING CURVE
all other outputs
(natural convection)

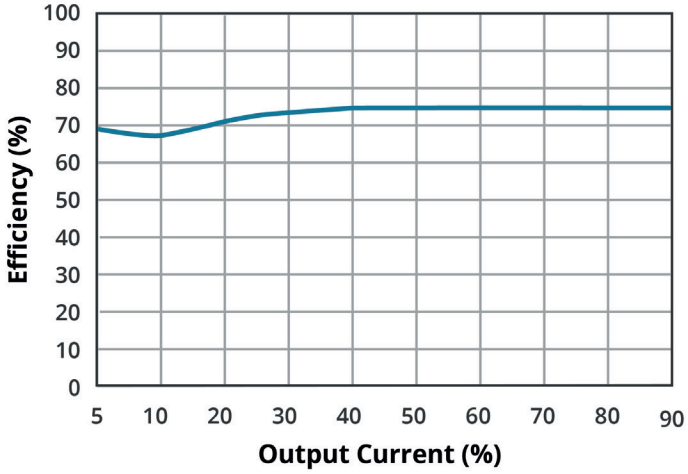


EFFICIENCY CURVES

EFFICIENCY VS INPUT VOLTAGE (full load)
V78E01-1000-SMT

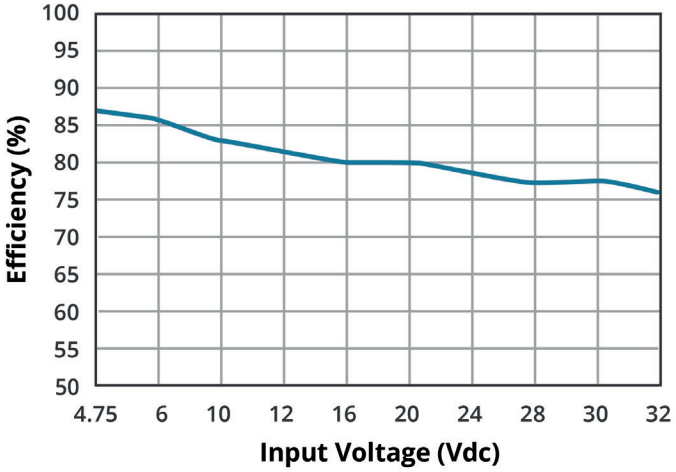


EFFICIENCY VS OUTPUT LOAD (at nominal input)
V78E01-1000-SMT

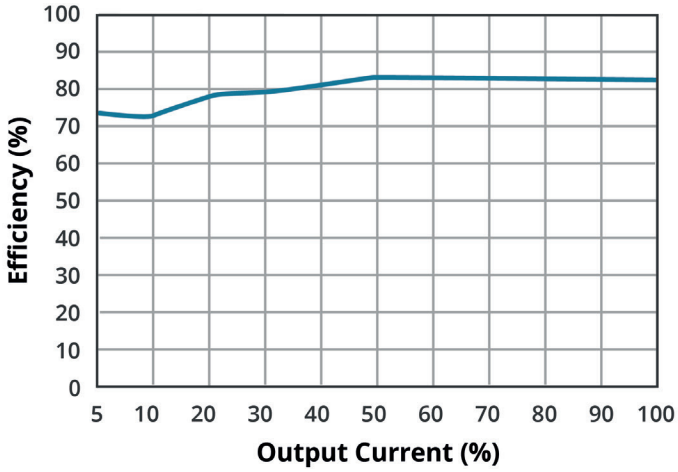


EFFICIENCY CURVES (CONTINUED)

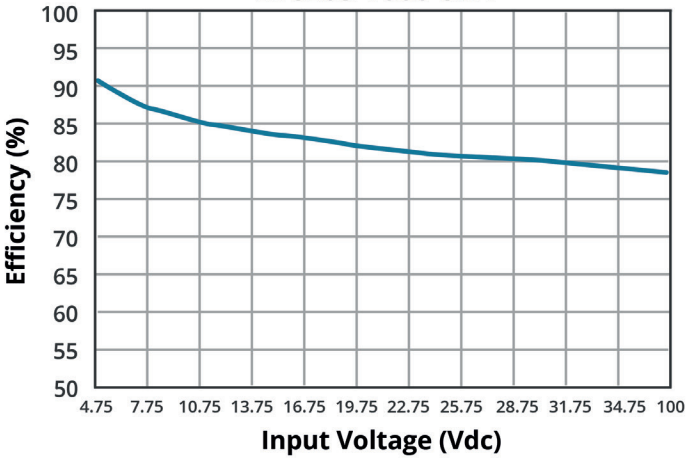
EFFICIENCY VS INPUT VOLTAGE (full load)
V78E02-1000-SMT



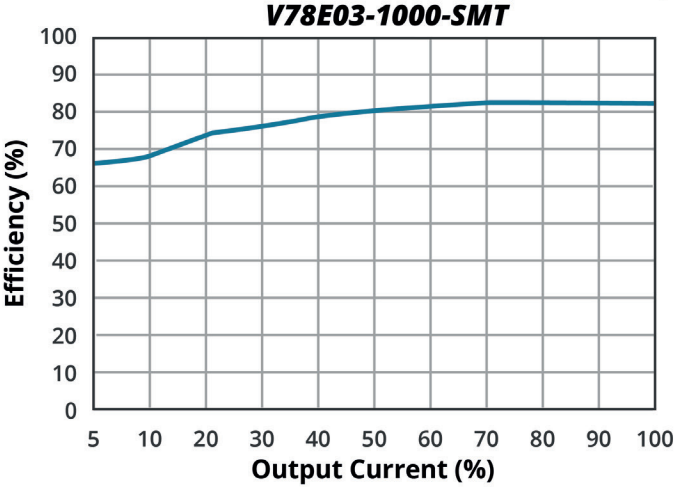
EFFICIENCY VS OUTPUT LOAD (at nominal input)
V78E02-1000-SMT



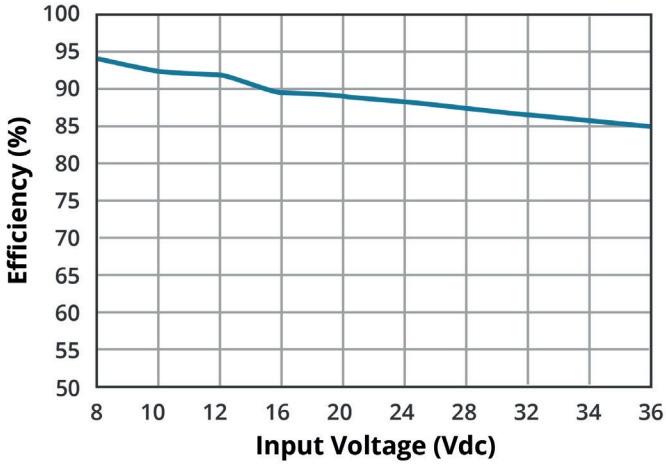
EFFICIENCY VS INPUT VOLTAGE (full load)
V78E03-1000-SMT



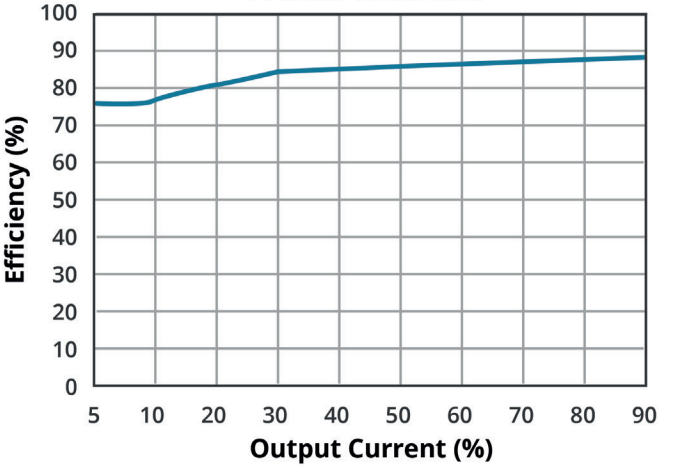
EFFICIENCY VS OUTPUT LOAD (at nominal input)
V78E03-1000-SMT



EFFICIENCY VS INPUT VOLTAGE (full load)
V78E05-1000-SMT

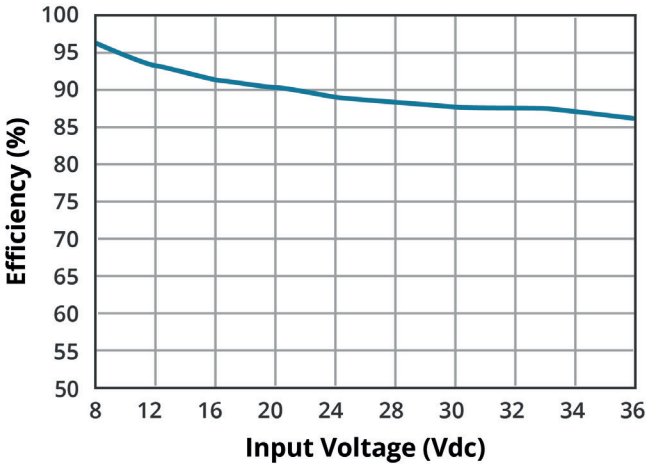


EFFICIENCY VS OUTPUT LOAD (at nominal input)
V78E05-1000-SMT

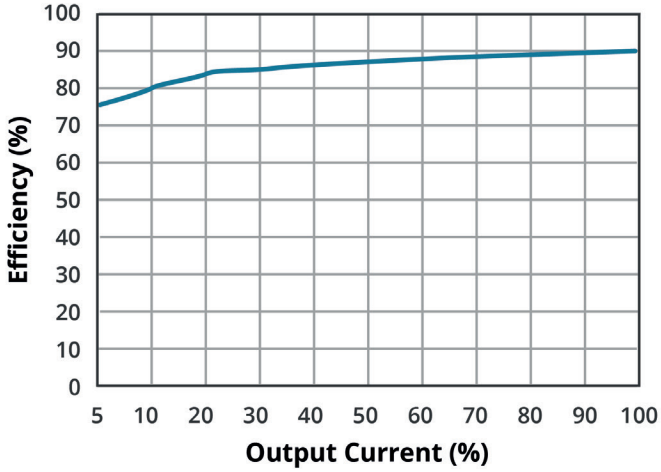


EFFICIENCY CURVES (CONTINUED)

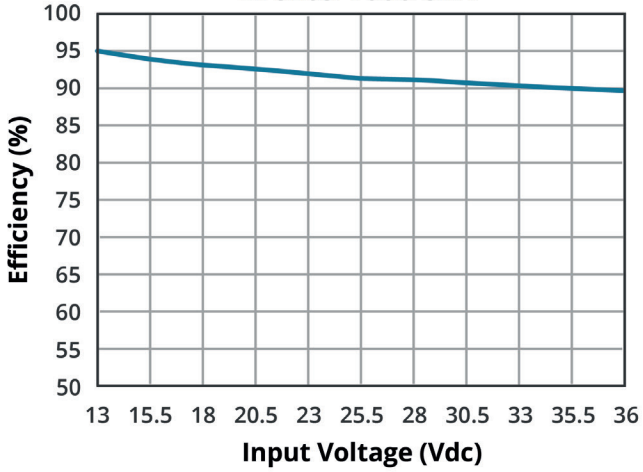
EFFICIENCY VS INPUT VOLTAGE (full load)
V78E06-1000-SMT



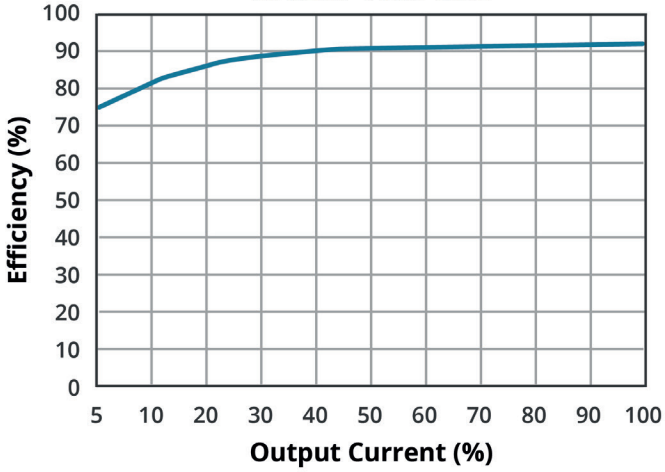
EFFICIENCY VS OUTPUT LOAD (at nominal input)
V78E06-1000-SMT



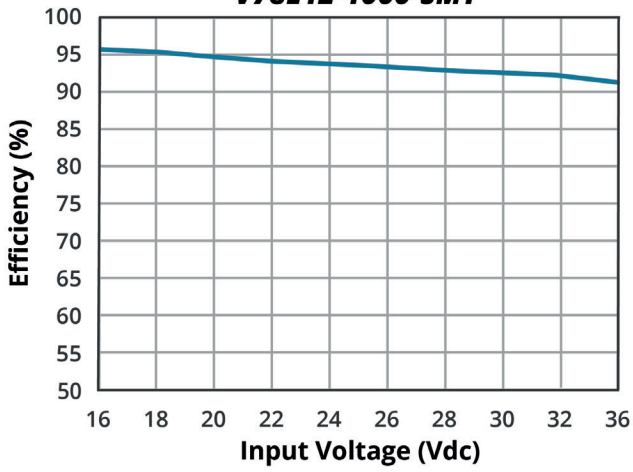
EFFICIENCY VS INPUT VOLTAGE (full load)
V78E09-1000-SMT



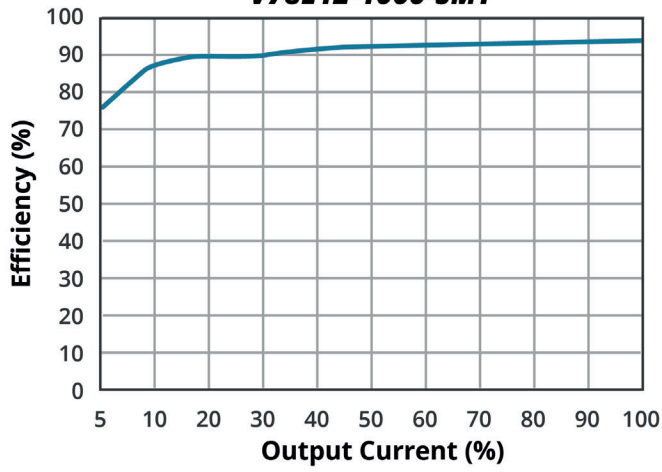
EFFICIENCY VS OUTPUT LOAD (at nominal input)
V78E09-1000-SMT



EFFICIENCY VS INPUT VOLTAGE (full load)
V78E12-1000-SMT



EFFICIENCY VS OUTPUT LOAD (at nominal input)
V78E12-1000-SMT



TYPICAL APPLICATION CIRCUIT

Figure 1
Application Circuit

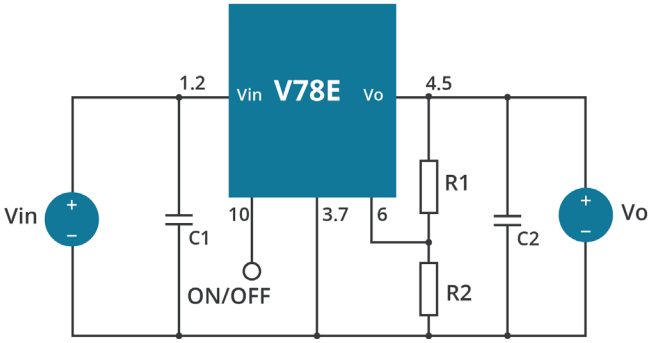


Figure 2
LC Filter Application Circuit

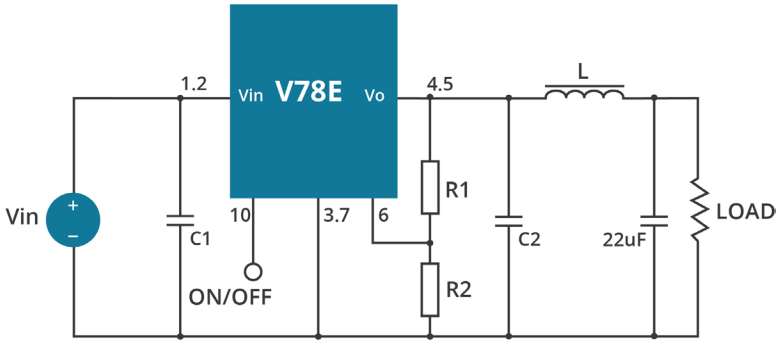


Table 1

Model Number	C1 (ceramic capacitor)	C2 (ceramic capacitor)	Ra1/Ra2 (Vadj resistance)
V78E01-1000-SMT	10 µF/50 V	22 µF/10 V	refer to Vadj resistance calculation
V78E02-1000-SMT	10 µF/50 V	22 µF/10 V	
V78E03-1000-SMT	10 µF/50 V	22 µF/10 V	
V78E05-1000-SMT	10 µF/50 V	22 µF/16 V	
V78E06-1000-SMT	10 µF/50 V	22 µF/16 V	
V78E09-1000-SMT	10 µF/50 V	22 µF/16 V	
V78E12-1000-SMT	10 µF/50 V	22 µF/25 V	

EMC RECOMMENDED CIRCUIT

Figure 3

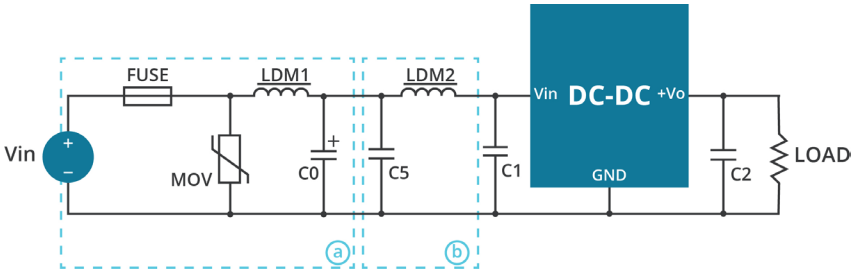


Table 2

Recommended external circuit components	
FUSE	choose according to actual input current
MOV	S20K30
LDM1	82 µH
C0	680 µF/50 V
C1, C2	refer to table 1
C5	4.7 µF/50 V
LDM2	68 µH

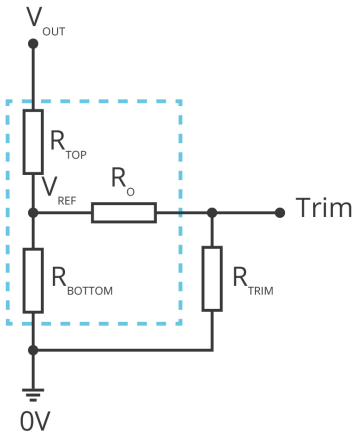
Note: 8. C1 & C2 are required and should be connected as close to the module pins as possible.
9. C1 & C2 can be increased as needed and the use of tantalum or low ESR electrolytic capacitors would be recommended.
10. To reduce the output ripple further, it is recommended to add an "LC" filter at the output (see figure 2) with a 10~47 µH L component.

APPLICATION NOTES

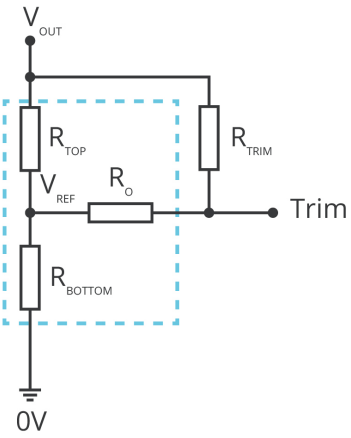
Output voltage trimming
Leave open if not used.

Figure 3

Trim up



Trim down



$$R_{TRIM} = \frac{a \cdot R_{BOTTOM}}{R_{BOTTOM} - a} - R_O \qquad a = \frac{V_{REF}}{V_{OUT} - V_{REF}} \cdot R_{TOP}$$

Formula for Trim up

$$R_{TRIM} = \frac{a \cdot R_{TOP}}{R_{TOP} - a} - R_O \qquad a = \frac{V_{OUT} - V_{REF}}{V_{REF}} \cdot R_{BOTTOM}$$

Formula for Trim down

Table 3

V_{NOM}	R_{TOP}	R_{BOTTOM}	R_O	V_{REF}
(Vdc)	(kΩ)	(kΩ)	(kΩ)	(V)
1.5[11]	7.5	7.5	15	0.75
2.5	9.1	3.9	8.2	0.75
3.3	75	22	75	0.75
5	43	7.5	33	0.75
6.5	43	5.6	22	0.75
9	43	3.9	22	0.75
12	36	2.4	10	0.75

Note: 11. The 1.5 Vdc output model can only be adjusted up.

Note: Value for R_{TOP}, R_{BOTTOM}, R_O, and V_{REF} refer to Table 3 (fixed internal values).
R_{TRIM}: Trim resistance
a: User-defined parameter, no actual meanings
V_{NOM}: Nominal output voltage
V_{OUT}: Target output voltage

REVISION HISTORY

rev.	description	date
1.0	initial release	09/12/2018
1.01	features and safety line updated	01/12/2021
1.02	product image updated, packaging removed	05/19/2021
1.03	updated derating and efficiency curves and circuit figures	06/09/2021
1.04	safeties updated	01/25/2023
1.05	pn key updated	03/24/2023

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

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