

**SERIES:** P78E-1000 | **DESCRIPTION:** NON-ISOLATED DC SWITCHING REGULATOR

**FEATURES**

- 1 A of output current
- efficiency up to 96%
- industry standard SIP package
- industrial operating temp -40~+85°C
- drop in equivalent LM78 regulator
- no load input current of 0.2 mA
- output short circuit protection on output
- designed to meet EN/BS EN 62368

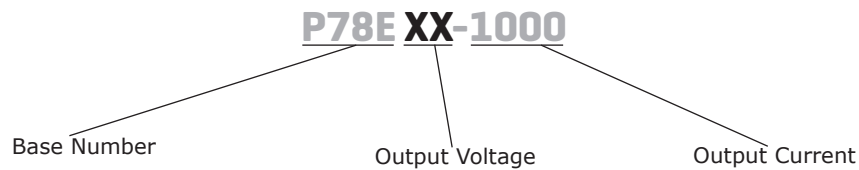


**MODEL**

MODEL	input voltage <sup>1</sup>		output voltage (Vdc)	output current max (mA)	output power max (W)	ripple & noise <sup>2</sup> max (mVp-p)	efficiency <sup>3</sup> typ (%)
	typ (Vdc)	range (Vdc)					
P78E03-1000	24	6~36	3.3	1000	3.3	75	90
P78E05-1000	24	8~36	5	1000	5	75	93
	12	8~27	-5	-500	2.5	75	85
P78E09-1000	24	13~36	9	1000	9	75	94
P78E12-1000	24	16~36	12	1000	12	75	95
	12	8~20	-12	-300	3.6	75	88
P78E15-1000	24	20~36	15	1000	15	75	96
	12	8~18	-15	-300	4.5	75	87

- Notes:
1. For input voltages higher than 30 Vdc, a 22  $\mu$ F / 50 V input capacitor is required.
  2. Tested at nominal input, 20~100% load, 20 MHz bandwidth, with 10  $\mu$ F electrolytic and 1  $\mu$ F ceramic capacitor on the output. At loads below 20%, the max ripple and noise of the 3.3 & 5 Vdc outputs will be 100 mVp-p, and the other outputs will be 2% Vo.
  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**



## INPUT

parameter	conditions/description	min	typ	max	units
operating input voltage <sup>5</sup>	for positive output applications	6		36	Vdc
	for negative output applications	8		27	Vdc
filter	capacitor filter				
input reverse polarity protection	no				
no-load input current	positive outputs		0.3	1	mA
	negative outputs		1	4	mA

Note: 5. See Model section on page 1 for specific input voltage ranges.

## OUTPUT

parameter	conditions/description	min	typ	max	units
maximum capacitive load <sup>6</sup>	for positive output applications			680	μF
	for negative output applications			330	μF
voltage accuracy	at full load, input voltage range		±2	±4	%
	3.3 Vdc output model		±1.5	±3	%
	all other models				
line regulation	at full load, input voltage range		±0.2	±0.4	%
load regulation	at nominal input, 10~100% load				
	positive output applications		±0.4	±0.6	%
	negative output applications		±0.4	±0.8	%
switching frequency	at nominal input voltage, full load		520		kHz
transient recovery time	at nominal input voltage, 25% load step change			1	ms
transient response deviation	at nominal input voltage		±60	±200	mV
temperature coefficient	at full load			±0.03	%/°C

Note: 6. 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

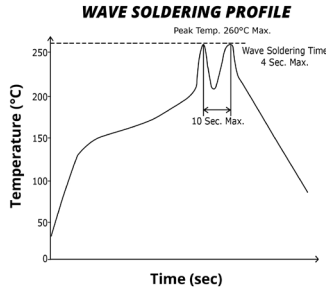
parameter	conditions/description	min	typ	max	units
safety approvals	designed to meet 62368: EN/BS EN				
conducted emissions	CISPR32/EN55032, class B (external circuit required, see Figure 4/5-b)				
radiated emissions	CISPR32/EN55032, class B (external circuit required, see Figure 4/5-b)				
ESD	IEC/EN61000-4-2, 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 4/5-a)				
surge	IEC/EN61000-4-5, line-line ± 1kV, class B (external circuit required, see Figure 4/5-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			95	%

## SOLDERABILITY

parameter	conditions/description	min	typ	max	units
wave soldering	see wave soldering profile			260	°C



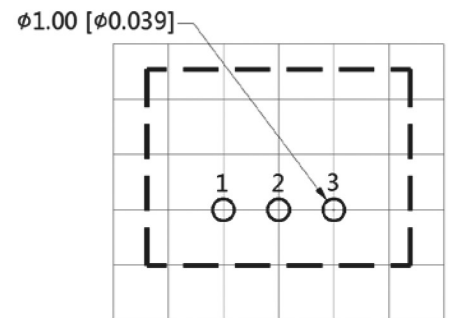
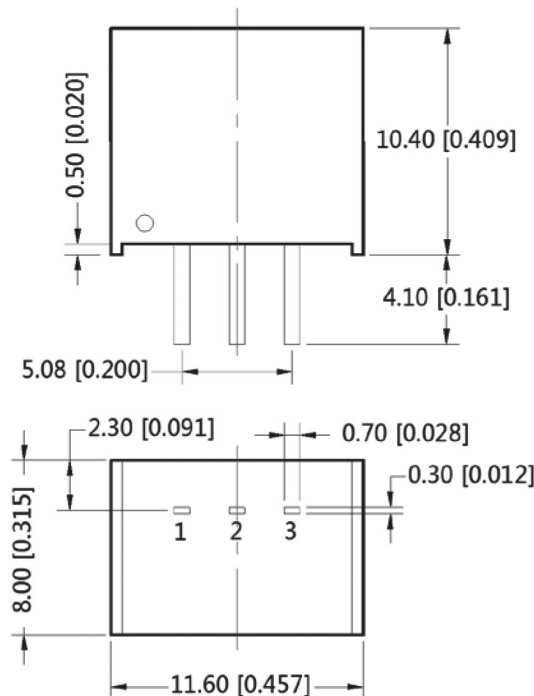
## MECHANICAL

parameter	conditions/description	min	typ	max	units
dimensions	11.6 x 8.0 x 10.40 [0.457 x 0.315 x 0.409 inch]				mm
case material	black flame-retardant and heat-resistant plastic (UL94 V-0)				
weight			1.9		g

## MECHANICAL DRAWING

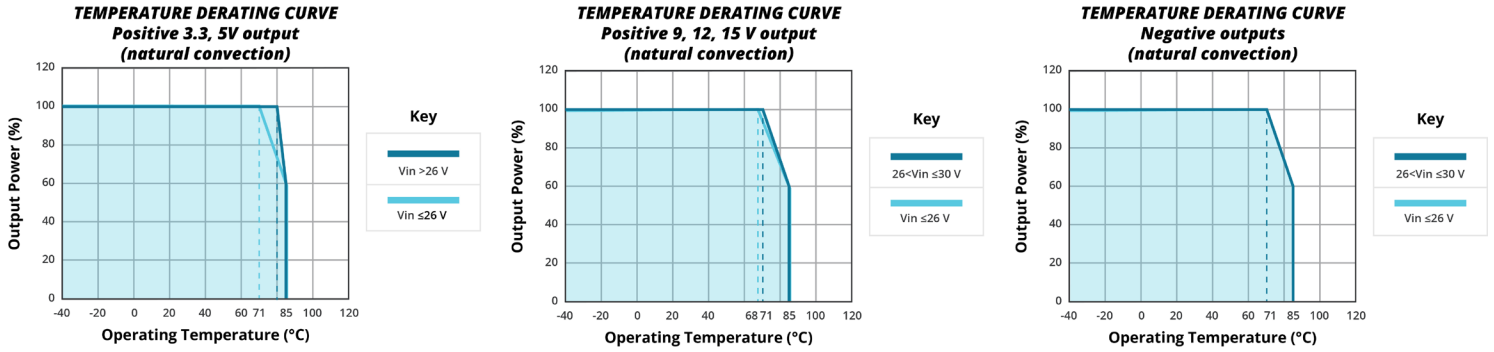
units: mm [inch]  
tolerance: ±0.50[±0.020]  
pin diameter tolerance: ±0.10[±0.004]

PIN CONNECTIONS		
PIN	+OUTPUT	-OUTPUT
1	+VIN	+VIN
2	GND	-VOUT
3	+VOUT	GND

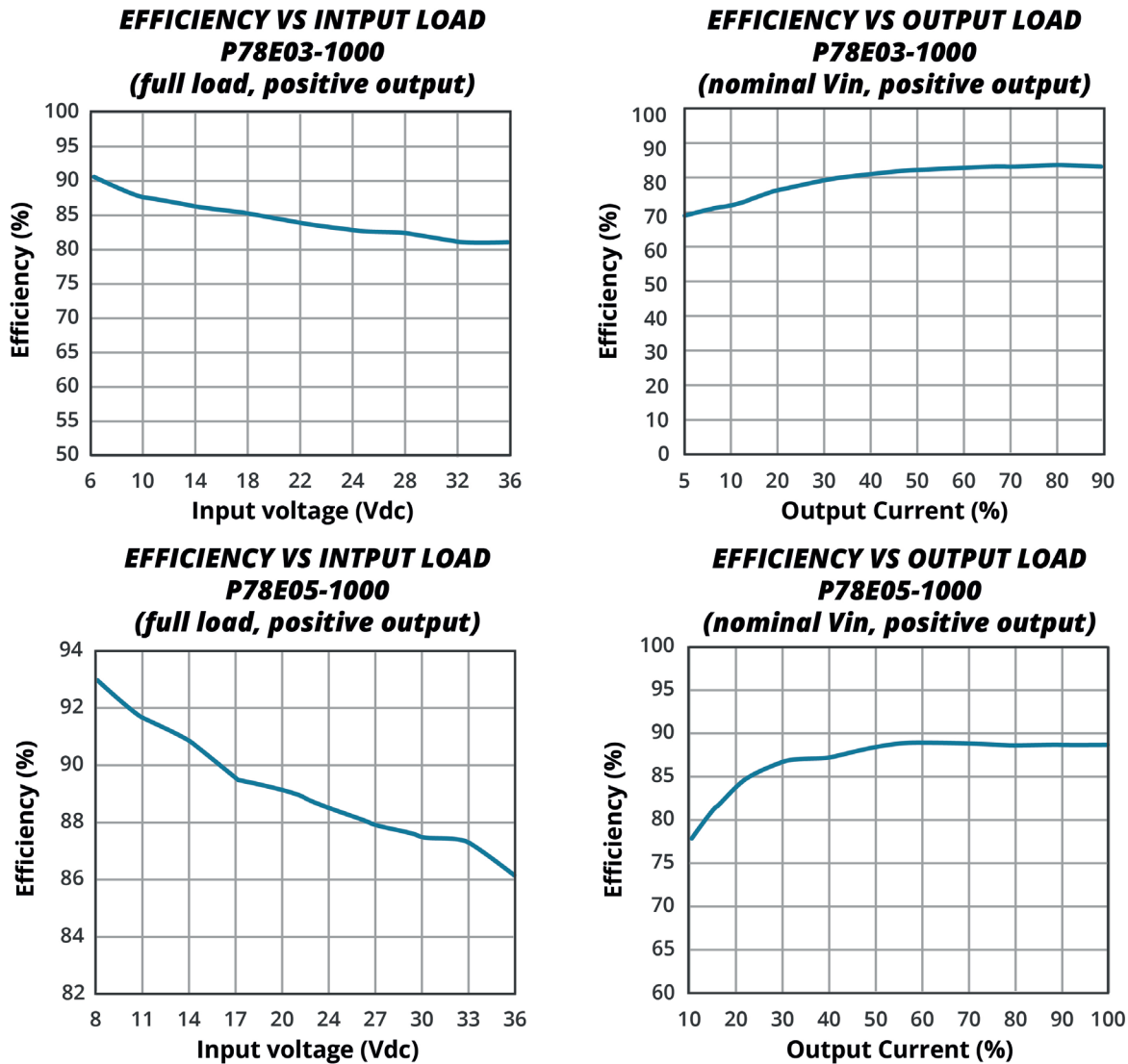


Note : Grid 2.54\*2.54mm  
Recommended PCB Layout  
Top View

## DERATING CURVES

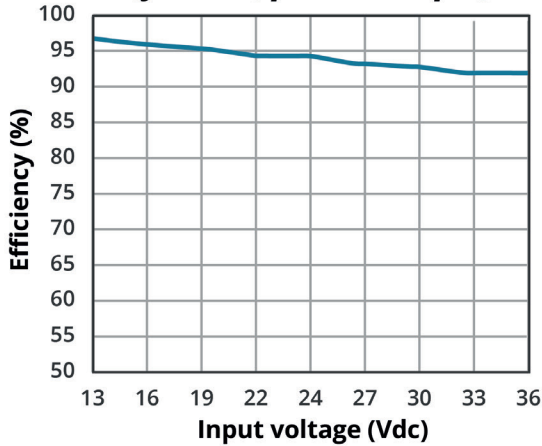


## EFFICIENCY CURVES

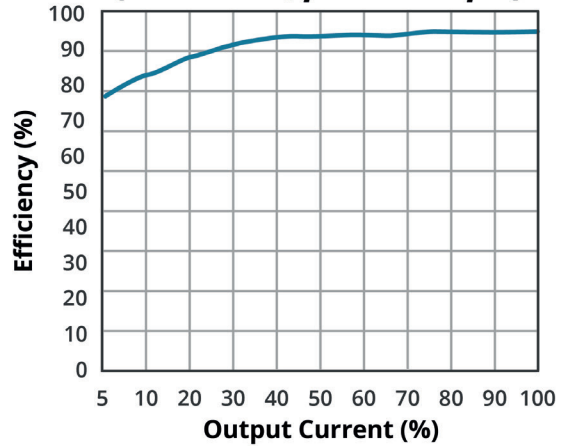


## EFFICIENCY CURVES (CONTINUED)

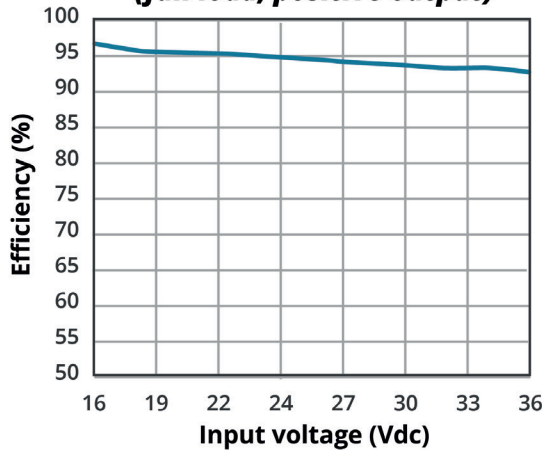
**EFFICIENCY VS INPUT LOAD  
P78E09-1000  
(full load, positive output)**



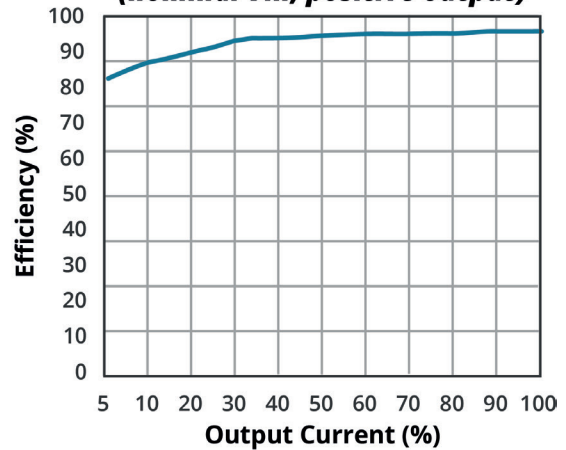
**EFFICIENCY VS OUTPUT LOAD  
P78E09-1000  
(nominal Vin, positive output)**



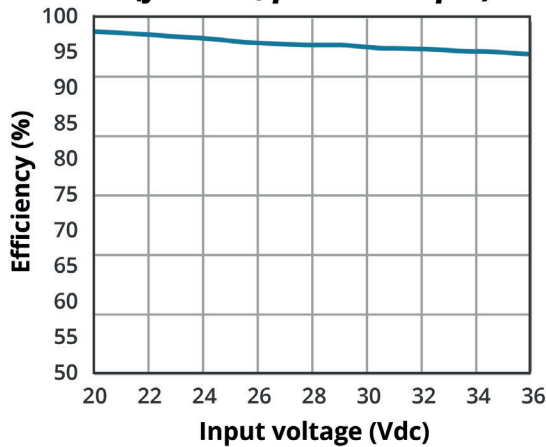
**EFFICIENCY VS INPUT LOAD  
P78E12-1000  
(full load, positive output)**



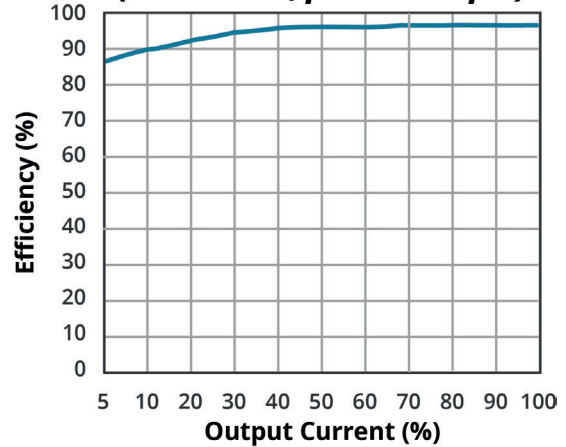
**EFFICIENCY VS OUTPUT LOAD  
P78E12-1000  
(nominal Vin, positive output)**



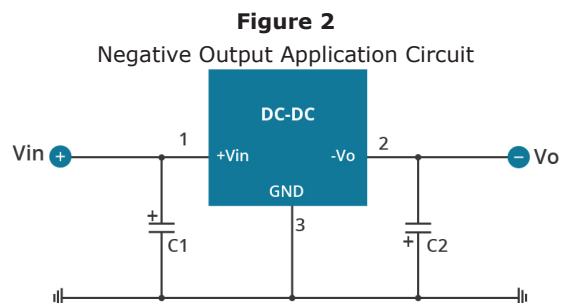
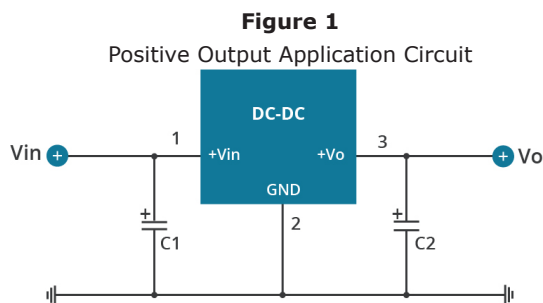
**EFFICIENCY VS INPUT LOAD  
P78E15-1000  
(full load, positive output)**



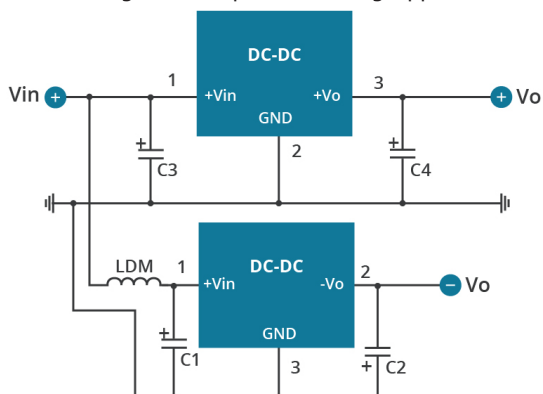
**EFFICIENCY VS OUTPUT LOAD  
P78E15-1000  
(nominal Vin, positive output)**



## TYPICAL APPLICATION CIRCUIT



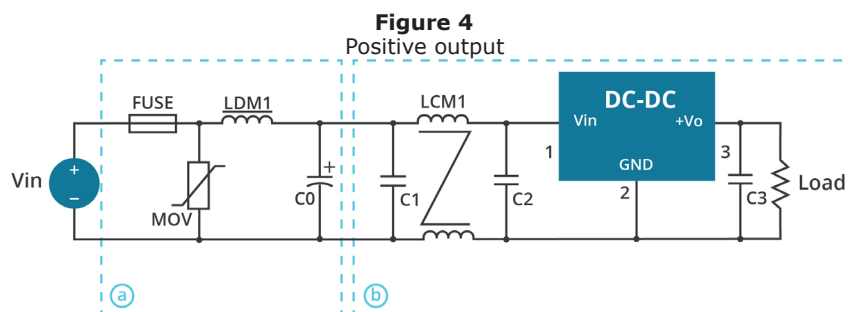
**Figure 3**  
Positive and Negative Output Paralleling Application Circuit



**Table 1**  
External Capacitor Table

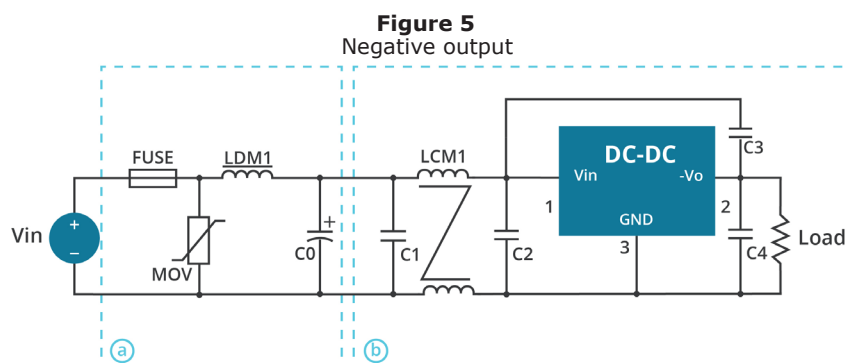
Model Number	C1, C3 (ceramic capacitor)	C2, C4 (ceramic capacitor)
P78E03-1000	10 $\mu$ F/50 V	22 $\mu$ F/10 V
P78E05-1000	10 $\mu$ F/50 V	22 $\mu$ F/10 V
P78E09-1000	10 $\mu$ F/50 V	22 $\mu$ F/16 V
P78E12-1000	10 $\mu$ F/50 V	22 $\mu$ F/25 V
P78E15-1000	10 $\mu$ F/50 V	22 $\mu$ F/25 V

## EMC RECOMMENDED CIRCUIT



**Table 2**  
Recommended external circuit components

Component	Value
FUSE	choose according to actual input current
MOV	20D470K
LDM1	82 $\mu$ H
C0	680 $\mu$ F/50 V
LCM1	4.7 mH
C1, C2	4.7 $\mu$ F/50 V
C3	10 $\mu$ F/50 V



**Table 3**  
Recommended external circuit components

Component	Value
FUSE	choose according to actual input current
MOV	20D470K
LDM1	82 $\mu$ H
C0	680 $\mu$ F/50 V
LCM1	4.7 mH
C1, C3, C4	4.7 $\mu$ F/50 V
C2	10 $\mu$ F/50 V

- Note:
- C1 & C2 (C3 & C4) are required and should be connected as close to the module pins as possible.
  - To reduce the output ripple further, C2 & C4 can be increased as needed and the use of tantalum or low ESR electrolytic capacitors would be recommended.
  - When using application circuit in Figure 3, a 10  $\mu$ H LDM component is recommended to reduce the interference.

## REVISION HISTORY

rev.	description	date
1.0	initial release	09/12/2018
1.01	features and safety line updated, packaging removed	01/14/2021
1.02	derating curves, efficiency curves and circuit figures updated	09/20/2021
1.03	CE removed	11/04/2022
1.04	application circuit updated	03/22/2023

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



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