

## FEATURES

- Wide Input Voltage Range: 4V to 28V
- Low Quiescent Current: 25 $\mu$ A
- $\pm$ 1% Initial Accuracy
- Very Low Dropout Voltage:  
300 mV @ 50mA
- Fixed 3.3V and 5V Voltage Options
- Adjustable Output from 1.2V to 5.0V
- Optimized for Small 1 $\mu$ F Ceramic Capacitors
- Short Circuit Protection
- Thermal Overload Protection
- Spacing-saving Thermally Enhanced MSOP package

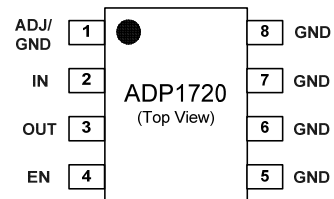
## APPLICATIONS

- Industrial Applications
- Battery-Power Regulators

## GENERAL DESCRIPTION

The ADP1720 is a high-voltage, micro-power, low dropout linear regulator. Designed for robust operation, the ADP1720 includes current limiting and short-circuit protection, and thermal overload protection. With just 25 $\mu$ A of quiescent supply current and a micro-power shutdown mode, this device is ideal for applications that require low quiescent current. The small thermally-enhanced MSOP package and 1 $\mu$ F ceramic output capacitor provides a compact solution with low thermal resistance for high power dissipation.

The ADP1720 is available in fixed output voltages of 3.3V and 5V, or its output voltage can be adjusted over a range of 1.2V to 5V. The ADP1720 operates over the -40°C to 125°C ambient temperature range.



## TYPICAL APPLICATION CIRCUIT

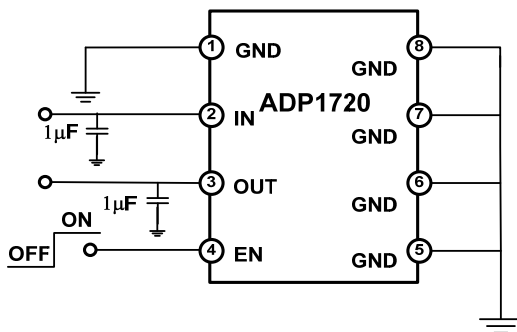


Figure 1. ADP1720 typical operation circuit for fixed output voltage options.

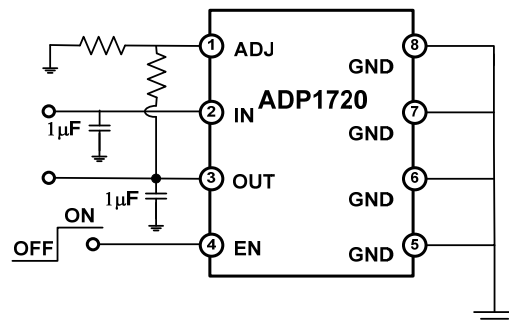


Figure 2. ADP1720 typical operation circuit for variable output voltage options.

### Rev. PrA

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## ADP1720 TARGET SPECIFICATIONS

Table 1. Electrical Characteristics

$V_{IN}=12V$ ,  $T_A = 25^\circ C$ , **BOLD** values indicate spec applies over  $T_J=-40^\circ C$  to  $125^\circ C$ , unless otherwise noted.

Parameter	Conditions	Min	Typ	Max	Unit
Input Voltage		<b>4</b>		<b>28</b>	V
GND Pin Current	$I_{OUT} = 0mA$		25	<b>50</b>	$\mu A$
	$I_{OUT} = 1mA$		100	<b>180</b>	$\mu A$
	$I_{OUT} = 10mA$		400	<b>700</b>	$\mu A$
	$I_{OUT} = 50mA$		1800	<b>3300</b>	$\mu A$
Output Voltage Accuracy	$I_{OUT}=100\mu A$	-1		+1	%
	$4V \leq V_{IN} \leq 28V$ , $I_{OUT} = 100\mu A$ to $50mA$	-2		+2	%
	$4V \leq V_{IN} \leq 28V$ , $I_{OUT} = 100\mu A$ to $50mA$	<b>-3</b>		<b>+3</b>	%
ADJ Pin Voltage	$I_{OUT}=100\mu A$	1.188	1.2	1.212	
	$V_{ADJ}=V_{OUT}$ , $4V \leq V_{IN} \leq 28V$ $I_{OUT} = 100\mu A$ to $50mA$	1.176		1.224	
	$V_{ADJ}=V_{OUT}$ , $4V \leq V_{IN} \leq 28V$ $I_{OUT} = 100\mu A$ to $50mA$	<b>1.164</b>		<b>1.136</b>	
ADJ Inupt Bias Current	$V_{ADJ}=V_{OUT}$		30	100	nA
Line Regulation	$V_{IN} = 4V$ to $28V$ , $I_{OUT} = 1mA$		$\pm 0.15$		%/V
Load Regulation	$1mA < I_{OUT} < 50mA$		0.01		%/V
Ripple Rejection	$F=120Hz$ , $I_{LOAD}=50mA$	65	75		dB
Dropout Voltage <sup>1</sup>	$I_{OUT} = 1mA$ , $V_{IN} = 4V$		100	<b>190</b>	mV
	$I_{OUT} = 10mA$ , $V_{IN} = 4V$		200	<b>350</b>	
	$I_{OUT} = 50mA$ , $V_{IN} = 4V$		300	<b>550</b>	
Current Limit Threshold	$V_{OUT} = 90\%$ of nominal setpoint	<b>60</b>	<b>85</b>	<b>120</b>	mA
Thermal Shutdown Temperature	$T_J$ rising, Hysteresis = $15^\circ C$		150		$^\circ C$
Shutdown Supply Current	EN = GND		3	5	$\mu A$
EN Input Logic High	$4V \leq V_{IN} \leq 28V$	<b>1.5</b>			V
EN Input Logic Low	$4V \leq V_{IN} \leq 28V$			<b>0.4</b>	V
EN Input Leakage Current	EN = IN or GND	<b>-1</b>	0	<b>+1</b>	$\mu A$

<sup>1</sup> Dropout voltage is defined as the input to output voltage differential when the input voltage is set to the nominal output voltage. Also Dropout voltage does not apply to fixed output voltage options below 4V.

<sup>2</sup> All limits at temperature extremes are guaranteed via correlation using standard Statistical Quality Control (SQC). Typical values are at  $T_A = 25^\circ C$ . Specifications subject to change without notice.

<sup>3</sup> Current limit threshold is defined as the current at which the output voltage drops to 90% of the specified typical value. For example, for a 1.0V output voltage, the current limit is defined as the current that causes the output voltage to drop to 90% of 1V, or 0.9V.

## ABSOLUTE MAXIMUM RATINGS

Table 3. Absolute Maximum Ratings (at 25°C, unless otherwise noted)

Parameter	Rating
IN, EN to GND	-0.3V to +30V
IN to OUT	-0.3V to +30V
VOOUT, ADJ to GND	-0.3V to +7V
Storage Temperature Range	-65°C to +150°C
Operating Temperature Range	-40°C to +125°C
Operating Junction Temperature	150°C
Lead Temperature Range (Soldering, 10sec)	300°C

Table 2. Thermal Resistance

Package Type	$\theta_{JA}$ <sup>1</sup>	$\theta_{JC}$	Unit
8-lead MSOP <sup>2</sup>	TBD	TBD	°C/W

## ESD CAUTION

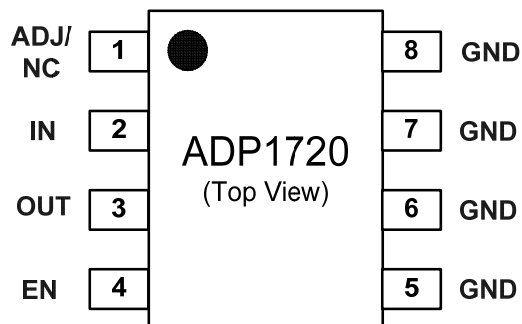
ESD (electrostatic discharge) sensitive device. Electrostatic charges as high as 4000 V readily accumulate on the human body and test equipment and can discharge without detection. Although these products feature proprietary ESD protection circuitry, permanent damage may occur on devices subjected to high energy electrostatic discharges. Therefore, proper ESD precautions are recommended to avoid performance degradation or loss of functionality.



<sup>1</sup>  $\theta_{JA}$  is specified for the worst-case conditions, i.e.,  $\theta_{JA}$  is specified for device soldered in circuit board for surface mount packages.

<sup>2</sup> This is a thermally-enhanced MSOP.

## PIN CONFIGURATION



## PIN DESCRIPTIONS

(Pin number are preliminary and subject to change)

PIN	PIN NAME		DESCRIPTION
	ADP1720-XX	ADP1720-ADJ	
2	IN	IN	Input. Connect IN to the input power source. Bypass IN to GND with a 1 $\mu$ F or greater capacitor.
5,6,7,8	GND	GND	Ground.
4	EN	EN	Enable control input. EN turns on/off the ADP1720. Drive EN high to turn on the regulator, drive it low to turn it off. Connect EN to IN for automatic startup.
1	GND	ADJ	In fixed output voltage option of ADP1720, connect this pin to Ground. In variable output voltage option of ADP1720, this is the Output Voltage Adjust Pin. To set the adjustable output voltage connect a resistive voltage divider from OUT to ADJ.
3	OUT	OUT	Output. Bypass OUT to GND with a 1 $\mu$ F or greater capacitor. See <i>Output Capacitor Selection</i> .

TYPICAL PERFORMANCE CHARACTERISTICS

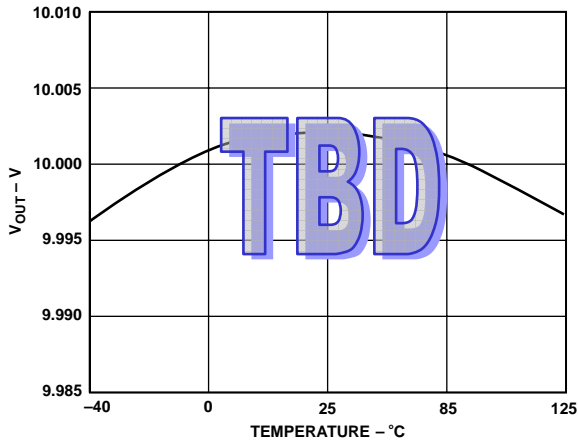


Figure 1. Output Voltage vs. Load Current

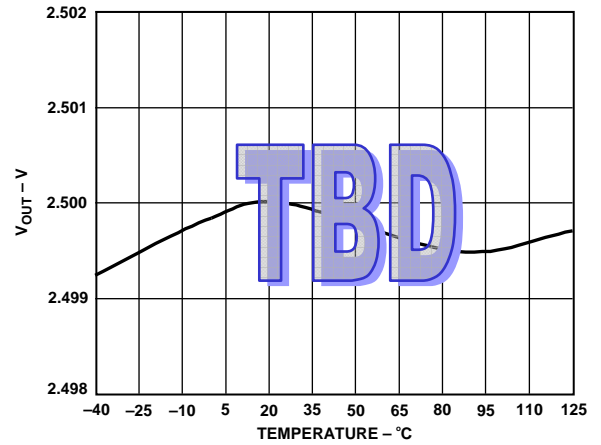


Figure 3. Output Voltage vs. Temperature

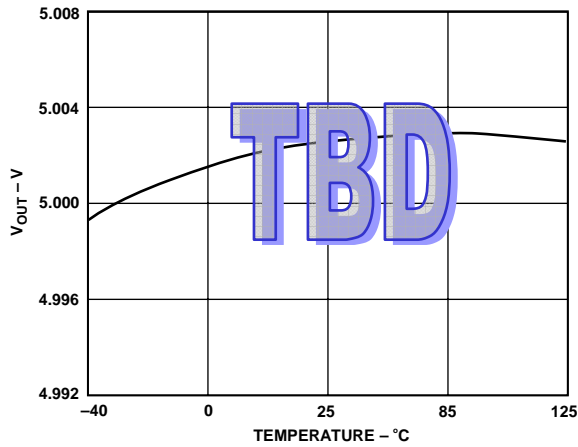


Figure 2. Ground Current vs. Input Voltage

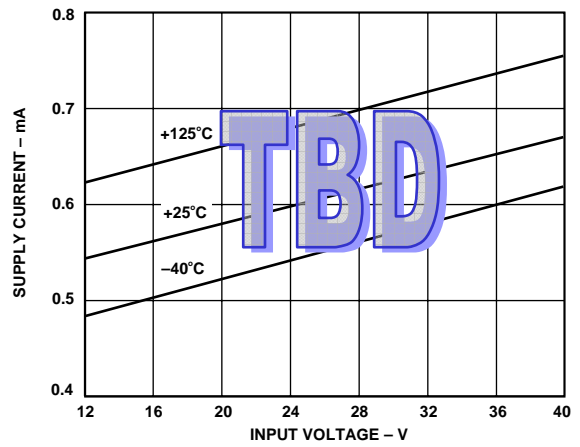


Figure 4. Ground Current vs. Load Current

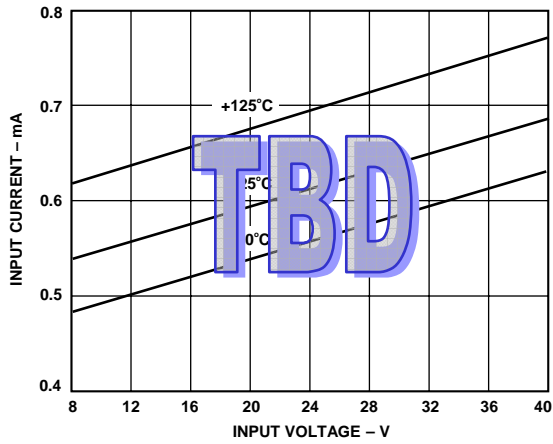


Figure 5. Shutdown and Ground Current vs. Temperature

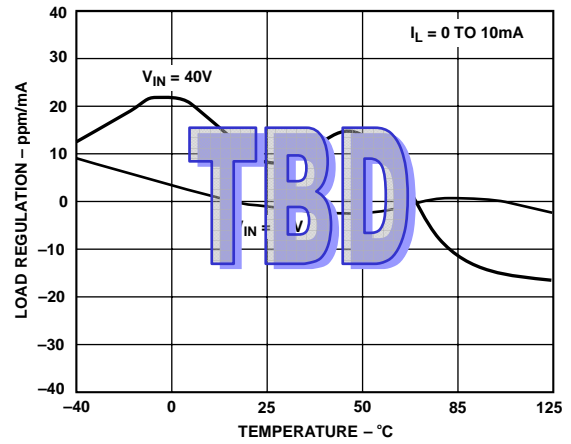


Figure 7. Dropout Voltage vs. Load Current,  $V_{OUT}=3.3V$  and  $2.5V$

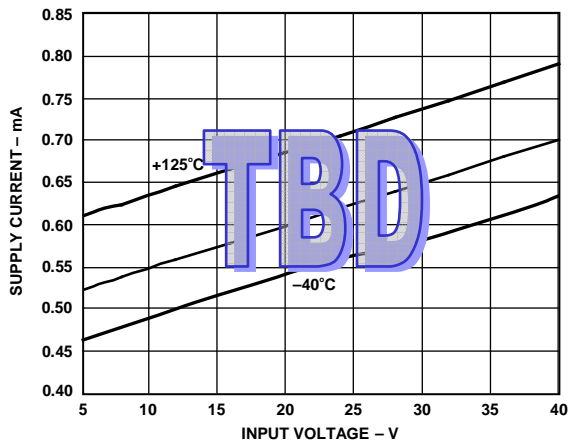


Figure 6. PSRR vs. Frequency

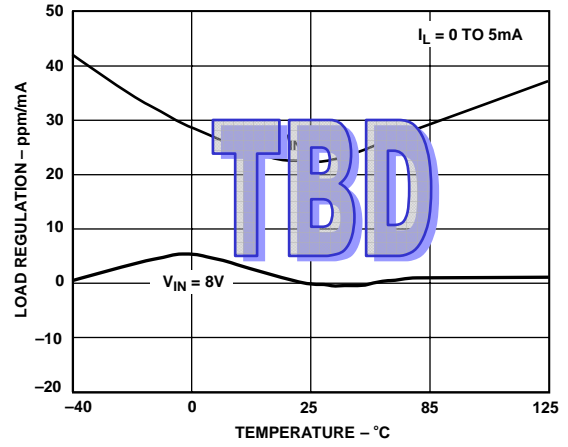


Figure 8. Load Transient Response

## THEORY OF OPERATION

### Introduction

The ADP1720 is a high-voltage, micro-power, low dropout linear regulator. Designed for robust operation, the ADP1720 includes current limiting and short-circuit protection, thermal overload protection. With just 25 $\mu$ A of quiescent supply current and a micro-power shutdown mode, this device is ideal for applications that require low quiescent current. The small thermally-enhanced MSOP package and 1 $\mu$ F ceramic output capacitor provides a compact solution with low thermal resistance for high power dissipation.

The ADP1720 is available in fixed output voltages of 3.3V and 5V, or its output voltage is adjustable over a range of 1.2V to 5V. The ADP1720 operates over the -40°C to 125°C ambient temperature range.

### Adjustable Output Voltage

The ADP1720 output voltage is adjustable over a 1.2V to 5.0 range. The output voltage is set by connecting a resistive voltage divider from OUT to ADJ. The output voltage is calculated using the equation  $V_{OUT} = 1.2V(1 + R_{TOP}/R_{BOTTOM})$  where  $R_{TOP}$  is the resistor from OUT to ADJ and  $R_{BOTTOM}$  is the resistor from ADJ to GND. The maximum bias current into ADJ is 100nA, so for less than 0.1% error due to the bias current, use values less than 12k $\Omega$  for  $R_{BOTTOM}$ .

### Output Capacitor Selection

The ADP1720 is optimized for operation with small 1 $\mu$ F ceramic capacitors. The ADP1720 maintains stability with capacitance greater than 1 $\mu$ F, 10 $\mu$ F maximum and over a wide range of capacitor ESR values (At least 1m $\Omega$  to 100m $\Omega$ ).

Ceramic capacitors are manufactured with a variety of dielectrics, each with different behavior over temperature and applied voltage. When choosing your capacitor be sure to choose a dielectric adequate to ensure the minimum capacitance over the necessary temperature range.

### Thermal Protection

The ADP1720 has an internal thermal shutdown function that protects itself from thermal overloads. The thermal protection circuitry activates and disables the output when the die temperature exceeds 150°C. The thermal protection circuitry has a typical hysteresis of 15°C. Once the die temperature decreases beyond the hysteresis, the output is enabled again.

### Current Limit

The ADP1720 uses internal current limiting to protect itself and its load during overload and short-circuit conditions.

### Shutdown

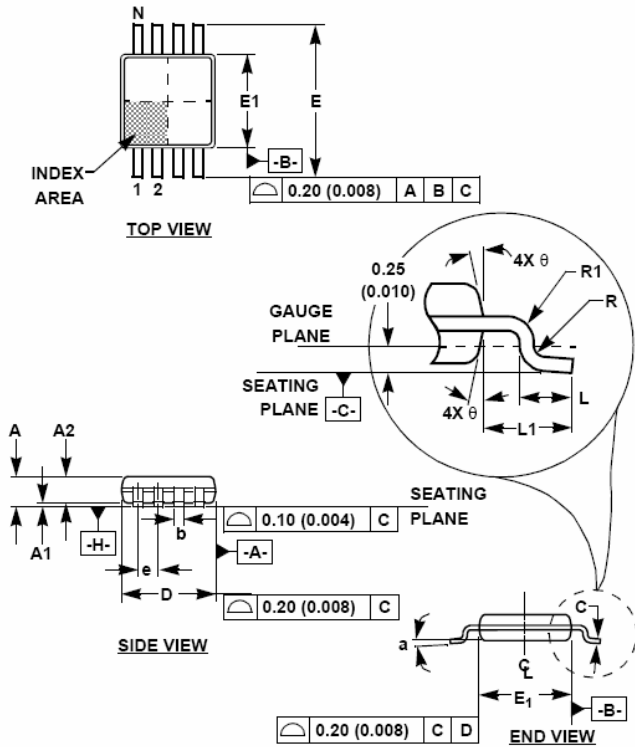
The ADP1720 enters a low power shutdown state by driving EN to GND. In shutdown, the ADP1720 consumes less than 5 $\mu$ A. For automatic startup connect EN to IN. Note that EN withstands up to the +28V input voltage without damage.

### Package and Power Dissipation

The ADP1720 use a thermally-enhanced MSOP package, which achieves a respectable TBD°C/W for such a small footprint.

# OUTLINE DIMENSIONS

## Mini Small Outline Plastic Packages (MSOP)



### M8.118 (JEDEC MO-187AA) 8 LEAD MINI SMALL OUTLINE PLASTIC PACKAGE

SYMBOL	INCHES		MILLIMETERS		NOTES
	MIN	MAX	MIN	MAX	
A	0.037	0.043	0.94	1.10	-
A1	0.002	0.006	0.05	0.15	-
A2	0.030	0.037	0.75	0.95	-
b	0.010	0.014	0.25	0.36	9
c	0.004	0.008	0.09	0.20	-
D	0.116	0.120	2.95	3.05	3
E1	0.116	0.120	2.95	3.05	4
e	0.026 BSC		0.65 BSC		-
E	0.187	0.199	4.75	5.05	-
L	0.016	0.028	0.40	0.70	6
L1	0.037 REF		0.95 REF		-
N	8		8		7
R	0.003	-	0.07	-	-
R1	0.003	-	0.07	-	-
θ	5°	15°	5°	15°	-
α	0°	6°	0°	6°	-

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NOTES:

1. These package dimensions are within allowable dimensions of JEDEC MO-187BA.
2. Dimensioning and tolerancing per ANSI Y14.5M-1994.
3. Dimension "D" does not include mold flash, protrusions or gate burrs and are measured at Datum Plane. Mold flash, protrusion and gate burrs shall not exceed 0.15mm (0.006 inch) per side.
4. Dimension "E1" does not include interlead flash or protrusions and are measured at Datum Plane. [-H-] Interlead flash and protrusions shall not exceed 0.15mm (0.006 inch) per side.
5. Formed leads shall be planar with respect to one another within 0.10mm (0.004) at seating Plane.
6. "L" is the length of terminal for soldering to a substrate.
7. "N" is the number of terminal positions.
8. Terminal numbers are shown for reference only.
9. Dimension "b" does not include dambar protrusion. Allowable dambar protrusion shall be 0.08mm (0.003 inch) total in excess of "b" dimension at maximum material condition. Minimum space between protrusion and adjacent lead is 0.07mm (0.0027 inch).
10. Datums [-A-] and [-B-] to be determined at Datum plane [-H-].
11. Controlling dimension: MILLIMETER. Converted inch dimensions are for reference only.



## ORDERING GUIDE

Table 3.

Part Number	Output Voltage	Package Description	Package Option	Top Mark	No. of Parts per Reel	Temperature Range (°C)
ADP1720-33	3.3V	8-lead MSOP	TBD	TBD	TBD	-40°C to +125°C
ADP1720-50	5.0V	8-lead MSOP	TBD	TBD	TBD	-40°C to +125°C
ADP1720-ADJ	1.2V – 5.0V	8-lead MSOP	TBD	TBD	TBD	-40°C to +125°C