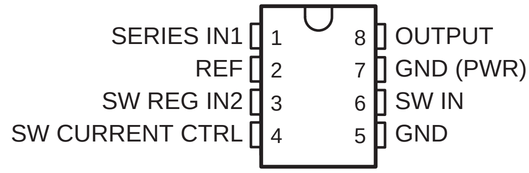
- **Internal Series-Pass and Step-Up Switching Regulator**
- **Output Adjustable From 2.9 V to 30 V**
- **1-V to 10-V Input for Switching Regulator**
- **4.5-V to 32-V Input for Series Regulator**
- **Externally Controlled Switching Current**
- **No External Rectifier Required**

P OR PS PACKAGE
(TOP VIEW)



description

The TL499A is an integrated circuit designed to provide a wide range of adjustable regulated supply voltages. The regulated output voltage can be varied from 2.9 V to 30 V by adjusting two external resistors. When the TL499A is ac-coupled to line power through a step-down transformer, it operates as a series dc voltage regulator to maintain the regulated output voltage. With the addition of a battery from 1.1 V to 10 V, an inductor, a filter capacitor, and two resistors, the TL499A operates as a step-up switching regulator during an ac-line failure.

The adjustable regulated output voltage makes the TL499A useful for a wide range of applications. Providing backup power during an ac-line failure makes the TL499A extremely useful in microprocessor memory applications.

The TL499AC is characterized for operation from –20°C to 85°C.

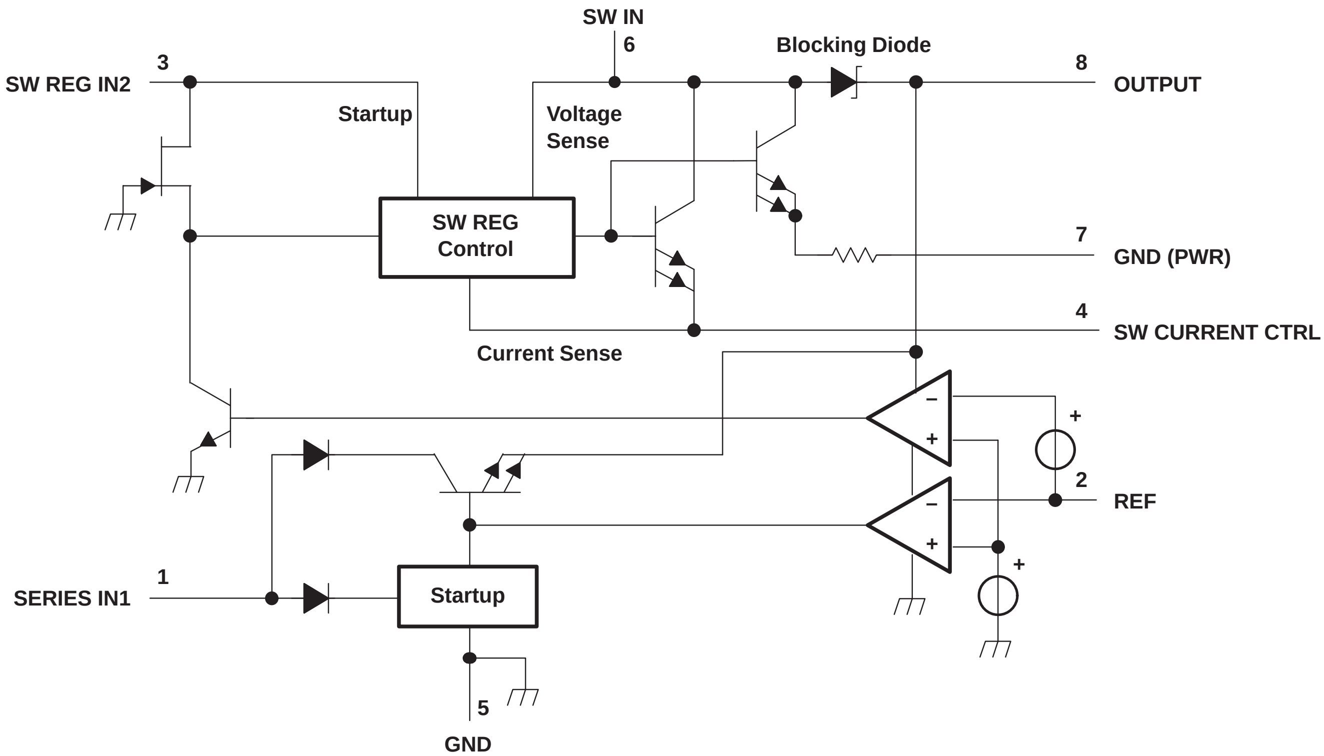
AVAILABLE OPTIONS

T_A	PLASTIC DIP (P)	PLASTIC SMALL-OUTLINE (PS)	CHIP FORM (Y)
–20°C to 85°C	TL499ACP	TL499ACPS	TL499AY

The PS package is available taped and reeled. Add the suffix R to device type (e.g., TL499ACPSR). Chip forms are tested at 25°C.

Please be aware that an important notice concerning availability, standard warranty, and use in critical applications of Texas Instruments semiconductor products and disclaimers thereto appears at the end of this data sheet.

functional block diagram



absolute maximum ratings over operating free-air temperature range (unless otherwise noted)†

Output voltage, V_O (see Note 1) . . . . . . 35 V
Input voltage, series regulator, V_I1 . . . . . . 35 V
Input voltage, switching regulator, V_I2 . . . . . . 10 V
Blocking-diode reverse voltage . . . . . . 35 V
Blocking-diode forward current . . . . . . 1 A
Power switch current (SW IN) . . . . . . 1 A
Package thermal impedance, θ_{JA} (see Notes 2 and 3): P package . . . . . . 85°C/W
PS package . . . . . . 95°C/W
Lead temperature 1,6 mm (1/16 inch) from case for 10 seconds . . . . . . 260°C
Storage temperature range, T_{stg} . . . . . . –65°C to 150°C

† Stresses beyond those listed under "absolute maximum ratings" may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated under "recommended operating conditions" is not implied. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.

NOTES: 1. All voltage values are with respect to network ground terminal.
2. Maximum power dissipation is a function of T_J(max), θ_{JA}, and T_A. The maximum allowable power dissipation at any allowable ambient temperature is $P_D = (T_J(max) – T_A)/\theta_{JA}$. Operating at the absolute maximum T_J of 150°C can affect reliability.
3. The package thermal impedance is calculated in accordance with JESD 51.

recommended operating conditions

	MIN	NOM	MAX	UNIT
Output voltage, V_O	2.9		30	V
Input voltage, V_I1 (SERIES IN1)	4.5		32	V
Input voltage, V_I2 (SW REG IN2)	1.1		10	V
Output-to-input differential voltage, switching regulator, $V_O – V_I2$ (see Note 4)	1.2		28.9	V
Continuous output current, I_O			100	mA
Power switch current (at SW IN)			500	mA
Current-limiting resistor, R_{CL}	150		1000	Ω
Filter capacitor	100		470	µF
Pass capacitor		0.1		µF
Inductor, L (dcr ≤ 0.1 Ω)	50		150	µH
Operating free-air temperature, T_A	–20		85	°C

NOTE 4: When operating temperature range is $T_A \le 70°C$, minimum $V_O – V_I2$ is ≥ 1.2 V. When operating temperature range is $T_A \le 85°C$, minimum $V_O – V_I2$ is ≥ 1.9 V.

electrical characteristics over recommended operating conditions (unless otherwise noted)

PARAMETER		TEST CONDITIONS	TL499AC MIN	TL499AC TYP	TL499AC MAX	UNIT
Voltage deviation (see Note 5)				20	30	mV/V
Dropout voltage	Switching regulator	T_A = –20°C to 70°C			1.2	V
					1.9	
	Series regulator	V_I1 = 15 V, I_O = 50 mA			1.8	
Reference voltage (internal)		V_I2 = 5 V, V_O = 3 V, I_O = 1 mA	1.2	1.26	1.32	V
Reference-voltage change with temperature				5	10	mV/V
Output regulation (of reference voltage)		I_O = 1 mA to 50 mA		10	30	mV/V
Output current (see Figure 1)	Switching regulator	V_I2 = 1.1 V, V_O = 12 V, R_{CL} = 150 Ω, T_A = 25°C	10			mA
		V_I2 = 1.5 V, V_O = 15 V, R_{CL} = 150 Ω, T_A = 25°C	15			
		V_I2 = 6 V, V_O = 30 V, R_{CL} = 150 Ω, T_A = 25°C	65			
	Series regulator				100	
Standby current	Switching regulator	V_I2 = 3 V, V_O = 9 V, T_A = 25°C		15	80	μA
	Series regulator	V_I1 = 15 V, V_O = 9 V, R_E2 = 4.7 kΩ		0.8	1.2	mA

NOTE 5: Voltage deviation is the output voltage difference that occurs in a change from series regulation to switching regulation:

$$\text{Voltage deviation} = V_O(\text{series regulation}) - V_O(\text{switching regulation})$$

electrical characteristics over recommended operating conditions, T_A = 25°C (unless otherwise noted)

PARAMETER		TEST CONDITIONS	TL499AY MIN	TL499AY TYP	TL499AY MAX	UNIT
Voltage deviation (see Note 5)				20	30	mV/V
Dropout voltage	Switching regulator	T_A = –20°C to 70°C			1.2	V
		T_A = –20°C to 85°C			1.9	
	Series regulator	V_I1 = 15 V, I_O = 50 mA			1.8	
Reference voltage (internal)		V_I2 = 5 V, V_O = 3 V, I_O = 1 mA	1.2	1.26	1.32	V
Reference-voltage change with temperature		T_A = –20°C to 85°C		5	10	mV/V
Output regulation (of reference voltage)		I_O = 1 mA to 50 mA		10	30	mV/V
Output current (see Figure 1)	Switching regulator	V_I2 = 1.1 V, V_O = 12 V, R_{CL} = 150 Ω	10			mA
		V_I2 = 1.5 V, V_O = 15 V, R_{CL} = 150 Ω	15			
		V_I2 = 6 V, V_O = 30 V, R_{CL} = 150 Ω	65			
	Series regulator				100	
Standby current	Switching regulator	V_I2 = 3 V, V_O = 9 V		15	80	μA
	Series regulator	V_I1 = 15 V, V_O = 9 V, R_E2 = 4.7 kΩ		0.8	1.2	mA

NOTE 5: Voltage deviation is the output voltage difference that occurs in a change from series regulation to switching regulation:

$$\text{Voltage deviation} = V_O(\text{series regulation}) - V_O(\text{switching regulation})$$

APPLICATION INFORMATION

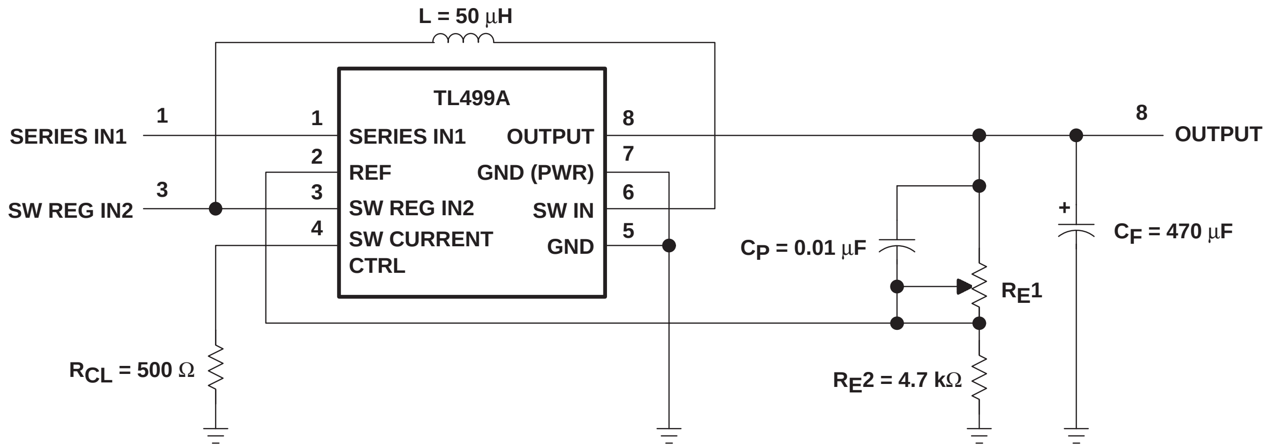


Figure 1. TL499A Basic Configuration

Table 1. Maximum Output Current vs Input and Output Voltages for Step-Up Switching Regulator With R_{CL} = 150 Ω

OUTPUT VOLTAGE (V)	SWITCHING REGULATOR INPUT VOLTAGE (SW REG IN2) (V)										
	1.1	1.2	1.3	1.5	1.7	2	2.5	3	5	6	9
	OUTPUT CURRENT (mA)										
30										65	90
25									50	80	100
20						20	25	30	80	100	100
15				15	20	30	45	55	100	100	100
12	10	15	20	25	30	40	55	70	100	100	100
10	15	20	25	30	35	45	65	80	100	100	
9	20	25	25	35	40	50	70	90	100	100	
6	30	35	40	45	55	75	95	100			
5	35	40	45	55	70	85	100	100	Circuit of Figure 1, except:		
4.5	35	45	50	60	75	95	100	100†	R_{CL} = 150 Ω		
3	55	65†	75†	95†	100†				C_F = 330 μF		
2.9	60†	70†	75†	100†	100†				C_P = 0.1 μF		

† The difference between the output and input voltage for these combinations is greater than the minimum output-to-input differential-voltage specification at 70°C (1.2 V), but less than the minimum at 85°C (1.9 V).

APPLICATION INFORMATION

Table 2. Maximum Output Current vs Input and Output Voltages for Step-Up Switching Regulator With R_{CL} = 200 Ω

OUTPUT VOLTAGE (V)	SWITCHING REGULATOR INPUT VOLTAGE (SW REG IN2) (V)										
	1.1	1.2	1.3	1.5	1.7	2	2.5	3	5	6	9
	OUTPUT CURRENT (mA)										
30										50	100
25									50	70	100
20						15	25	30	70	90	100
15				10	15	25	35	45	90	100	100
12	10	10	15	20	25	35	45	60	100	100	100
10	15	20	20	25	30	40	55	70	100	100	
9	20	20	25	30	35	45	60	80	100		
6	25	30	35	45	50	65	90	100			
5	30	35	40	55	60	75	100	100	Circuit of Figure 1, except:		
4.5	35	40	45	55	65	85	100	100†	R_{CL} = 200 Ω		
3	50	55†	65†	80†	90†				C_F = 330 μF		
2.9	50†	60†	65†	85†	100†				C_P = 0.1 μF		

† The difference between the output and input voltage for these combinations is greater than the minimum output-to-input differential-voltage specification at 70°C (1.2 V), but less than the minimum at 85°C (1.9 V).

Table 3. Maximum Output Current vs Input and Output Voltages for Step-Up Switching Regulator With R_{CL} = 300 Ω

OUTPUT VOLTAGE (V)	SWITCHING REGULATOR INPUT VOLTAGE (SW REG IN2) (V)										
	1.1	1.2	1.3	1.5	1.7	2	2.5	3	5	6	9
	OUTPUT CURRENT (mA)										
30										40	70
25									40	55	100
20						10	15	20	55	70	100
15				10	10	20	30	35	75	95	100
12	10	10	10	15	20	25	35	45	95	100	100
10	15	15	15	20	25	30	45	55	100	100	
9	15	15	20	25	30	35	50	60	100	100	
6	25	25	30	35	45	55	70	90			
5	30	30	35	45	50	65	85	100	Circuit of Figure 1, except:		
4.5	30	35	40	45	55	70	95	100†	R_{CL} = 300 Ω		
3	45	50†	55†	70†	90†				C_F = 330 μF		
2.9	45†	50†	60†	75†	95†				C_P = 0.1 μF		

† The difference between the output and input voltage for these combinations is greater than the minimum output-to-input differential-voltage specification at 70°C (1.2 V), but less than the minimum at 85°C (1.9 V).

APPLICATION INFORMATION

Table 4. Maximum Output Current vs Input and Output Voltages for Step-Up Switching Regulator With R_{CL} = 510 Ω

OUTPUT VOLTAGE (V)	SWITCHING REGULATOR INPUT VOLTAGE (SW REG IN2) (V)										
	1.1	1.2	1.3	1.5	1.7	2	2.5	3	5	6	9
	OUTPUT CURRENT (mA)										
30										30	50
25									25	40	75
20									40	55	90
15							15	20	55	70	100
12					10	15	25	35	65	80	100
10				10	20	25	30	40	70	85	
9	10	10	10	15	20	25	35	45	75	100	
6	15	20	20	25	30	35	50	60			
5	20	20	25	30	35	45	55	70	Circuit of Figure 1, except:		
4.5	20	25	30	35	40	50	65	90†	R_{CL} = 510 Ω		
3	35	35†	40†	50†	75†				C_F = 330 μF		
2.9	35†	35†	40†	55†	80†				C_P = 0.1 μF		

† The difference between the output and input voltage for these combinations is greater than the minimum output-to-input differential-voltage specification at 70°C (1.2 V), but less than the minimum at 85°C (1.9 V).

Table 5. Maximum Output Current vs Input and Output Voltages for Step-Up Switching Regulator With R_{CL} = 1 kΩ

OUTPUT VOLTAGE (V)	SWITCHING REGULATOR INPUT VOLTAGE (SW REG IN2) (V)										
	1.1	1.2	1.3	1.5	1.7	2	2.5	3	5	6	9
	OUTPUT CURRENT (mA)										
30											35
25										35	50
20										35	60
15								10	30	45	65
12								20	40	45	85
10							15	25	40	55	
9				10	10	15	25	30	45	60	
6	10	10	10	15	20	20	30	35			
5	10	10	15	20	20	25	35	40	Circuit of Figure 1, except:		
4.5	15	15	15	20	25	30	40	45†	R_{CL} = 1 kΩ		
3	20	25†	25†	30†	35†				C_F = 330 μF		
2.9	20†	25†	25†	30†	45†				C_P = 0.1 μF		

† The difference between the output and input voltage for these combinations is greater than the minimum output-to-input differential-voltage specification at 70°C (1.2 V), but less than the minimum at 85°C (1.9 V).

IMPORTANT NOTICE

Texas Instruments and its subsidiaries (TI) reserve the right to make changes to their products or to discontinue any product or service without notice, and advise customers to obtain the latest version of relevant information to verify, before placing orders, that information being relied on is current and complete. All products are sold subject to the terms and conditions of sale supplied at the time of order acknowledgment, including those pertaining to warranty, patent infringement, and limitation of liability.

TI warrants performance of its semiconductor products to the specifications applicable at the time of sale in accordance with TI's standard warranty. Testing and other quality control techniques are utilized to the extent TI deems necessary to support this warranty. Specific testing of all parameters of each device is not necessarily performed, except those mandated by government requirements.

Customers are responsible for their applications using TI components.

In order to minimize risks associated with the customer's applications, adequate design and operating safeguards must be provided by the customer to minimize inherent or procedural hazards.

TI assumes no liability for applications assistance or customer product design. TI does not warrant or represent that any license, either express or implied, is granted under any patent right, copyright, mask work right, or other intellectual property right of TI covering or relating to any combination, machine, or process in which such semiconductor products or services might be or are used. TI's publication of information regarding any third party's products or services does not constitute TI's approval, warranty or endorsement thereof.