ALPHA SEMICONDUCTOR
Excellence in Analog Power Products

AS2940

1A Low DropOut Voltage Regulators

(Advanced Information) - Production 2Q '97

FEATURES

- Output Current 1A
- Internal Short Circuit Current Limit
- Dropout Voltage 0.5V at 1A Output
- Extremely Tight Load and Line Regulation
- Very Low Temperature Coefficient
- Mirror Image Insertion protection
- Unregulated DC Input Can Withstand -20V Reverse Battery and +60V Positive Transients
- Direct Replacement For LM2940 Socket

APPLICATIONS

- Battery powered Systems
- Cordless Telephones
- Automotive Electronics
- Portable / Palm Top / Notebook Computers
- Portable Consumer Equipment
- Portable Instrumentation
- SMPS Post-Regulator
- Voltage Reference

PRODUCT DESCRIPTION

The ALPHA Semiconductor AS2940 is a low power positive voltage regulator. The AS2940 offers 1A output current with dropout voltage of only 0.5 Volt and over temperature dropout is up to 1 Volt. The quiescent current is 30mA at differential output of 5V and output current of 1A. The higher quiescent current can be exist when the device is in dropout mode (V_{in} - $V_{out} \leq 3V$).

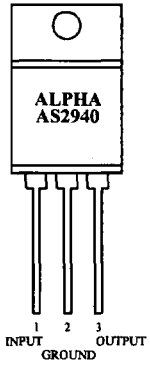
Other key additional features of this device includes higher output current, positive transient protection up to 60V (load dump), and ability to survive an unregulated input voltage transient of -20V below ground (reverse battery). The regulator will automatically shut down to protect both the internal circuits and the load. This device also features short circuit and thermal overload protection.

The AS2940 is offered in 3-pin TO-220 package compatible with other 5 Volt regulators. This device offers a variety of output voltages; 5V, 8V, 10V, 12V, and 15V. AS2940 is direct replacement to LM2940.

ORDERING INFORMATION

TO-220 3-PIN	Output Voltage	Oper. Temp. Range
AS2940U-5.0	5.0V	IND.
AS2940U-8.0	8.0V	IND.
AS2940U-10	10.0V	IND.
AS2940U-12	12.0V	IND.
AS2940U-15	15.0V	IND.

PIN CONFIGURATIONS



ABSOLUTE MAXIMUM RATINGS

Power Dissipation (Note 1).. Internally Limited
Lead Temperature (Soldering, 5 seconds).. 260°C
Storage Temperature Range.. -65°C to +150°C
Operating Junction Temperature Range.. -40°C to +125°C
TO-220 θ_{JC}..... 2 °C/W
TO-263 θ_{JC}..... 2 °C/W

Input Supply voltage.. -20V to +60V
Operating Input Supply voltage.. 2V[1] to 26V
Adjust Input Voltage (Notes 9 and 10).. -1.5V to +26V
Shutdown Input Voltage.. -0.3V to +30V
Error Comparator Output Voltage.. -0.3 to +30V

ELECTRICAL CHARACTERISTICS

$V_{IN} = V_O + 5V$, $I_O = 1A$, $C_O = 22\ \mu F$, unless otherwise specified. **Boldface limits apply over the entire operating temperature range of the indicated device.** All other specifications apply for $T_A = T_J = 25°C$.

Output Voltage (V_O)		5V			8V			
Parameter	**Conditions**	**Typ**	**AS2940 Limit (Note 5)**	**AS2940/883 Limit (Note 6)**	**Typ**	**AS2940 Limit (Note 5)**	**AS2940/833 Limit (Note 6)**	**Units**
			$6.25V \le V_{IN} \le 26V$			**$9.4 \le V_{IN} \le 26V$**		
Output Voltage	$5\ mA \le I_O \le 1A$	5.00	4.85/**4.75** 5.15/**5.25**	4.85/**4.75** 5.15/**5.25**	8.00	7.76/**7.60** 8.24/**8.40**	7.76/**7.60** 8.24/**8.40**	V_{MIN} V_{MAX}
Line Regulation	$V_O + 2V \le V_{IN} \le 26V$, $I_O = 5\ mA$	20	50	40/**50**	20	80	50/**80**	mV_{MAX}
Load Regulation	$50\ mA \le I_O \le 1A$ AS2940, AS2940/833 AS2940C	 35 35	 50/**80** 50	 50/**100**	 55 55	 80/**130** 80	 80/**130**	 mV_{MAX}
Output Impedance	100 mADC and 20 mArms, $f_O = 120$ Hz	35		1000/**1000**	55		1000/**1000**	mΩ
Quiescent Current	$V_O + 2V \le V_{IN} \le 26V$, $I_O = 5\ mA$ AS2940, AS2940/833 AS2940C	 10 10	 15/**20** 15	 15/**20**	 10	 15/**20**	 15/**20**	 mA_{MAX}
	$V_{IN} = V_O + 5V$, $I_O = 1A$	30	45/**60**	50/**60**	30	45/**60**	50/**60**	mA_{MAX}
Output Noise Voltage	10 Hz - 100 kHz, $I_O = 5\ mA$	150		700/**700**	240		1000/**1000**	μV_{rms}
Ripple Rejection	$f_O = 120$ Hz, 1 V_{rms}, $I_O = 100$ ma AS2940 AS2940C	 72 72	 60/**54** 60	 	 66 66	 54/**48** 54	 	 dB_{MIN}
	$f_O = 1$ kHz, 1 V_{rms}, $I_O = 5\ mA$			60/**50**			54/**48**	dB_{MIN}
Long Term Stability		20			32			mV/ 100 Hr
Dropout Voltage	$I_O = 1A$	0.5	0.8/**1.0**	0.7/**1.0**	0.5	0.8/**1.0**	0.7/**1.0**	V_{MAX}
	$I_O = 100\ mA$	110	150/**200**	150/**200**	110	150/**200**	150/**200**	mV_{MAX}

ELECTRICAL CHARACTERISTICS $V_{IN} = V_O + 5V$, $I_O = 1A$, $C_O = 22\ \mu F$, unless otherwise specified. **Boldface limits apply over the entire operating temperature range of the indicated device.** All other specifications apply for $T_A = T_J = 25°C$. (Continued)

Output Voltage (V_O)		5V			8V			Units
Parameter	**Conditions**	**Typ**	**AS2940 Limit (Note 5)**	**AS2940/883 Limit (Note 6)**	**Typ**	**AS2940 Limit (Note 5)**	**AS2940/833 Limit (Note 6)**	
		$6.25V \le V_{IN} \le 26V$			$9.4 \le V_{IN} \le 26V$			
Short Circuit Current	(Note 7)	1.9	1.6	1.5/**1.3**	1.9	1.6	1.6/**1.3**	A_{MIN}
Maximum Line Transient	$R_O = 100\Omega$							
	AS2940, $T \le 100$ ms	75	60/**60**		75	60/**60**		
	AS2940/833, $T \le 20$ ms			40/**40**			40/**40**	V_{MIN}
	AS2940C, $T \le 1$ ms	55	45		55	45		
Reverse Polarity DC Input Voltage	$R_O = 100\Omega$							
	AS2940/833, $T \le 20$ ms	-30	-15/**-15**	-15/**-15**	-30	-15/**-15**	-15/**-15**	
	AS2940C	-30	-15		-30	-15		V_{MIN}
Reverse Polarity Transient Input Voltage	$R_O = 100\Omega$							
	AS2940, $T \le 100$ ms	-75	-50/**-50**		-75	-50/**-50**		
	AS2940/833, $T \le 20$ ms			-45/**-45**			-45/**-45**	V_{MIN}
	AS2940C, $T \le 1$ ms	-55	-45/**-45**					

ELECTRICAL CHARACTERISTICS $V_{IN} = V_O + 5V$, $I_O = 1A$, $C_O = 22\ \mu F$, unless otherwise specified. **Boldface limits apply over the entire operating temperature range of the indicated device.** All other specifications apply for $T_A = T_J = 25°C$. (Continued)

Output Voltage (V_O)		9V		10V		Units
Parameter	**Conditions**	**Typ**	**AS2940 Limit (Note 5)**	**Typ**	**AS2940 Limit (Note 5)**	
		$10.5V \le V_{IN} \le 26V$		$11.5V \le V_{IN} \le 26V$		
Output Voltage	$5\ mA \le I_O \le 1A$	9.00	8.73/**8.55** 9.27/**9.45**	10.00	9.70/**9.50** 10.30/**10.50**	V_{MIN} V_{MAX}
Line Regulation	$V_O + 2V \le V_{IN} \le 26V$, $I_O = 5\ mA$	20	90	20	100	mV_{MAX}
Load Regulation	$50\ mA \le I_O \le 1A$					
	AS2940	60	90/**150**	65	100/**165**	mV_{MAX}
	AS2940C	60	90			
Output Impedance	100 mADC and 20 mArms, $f_O = 120$ Hz	60		65		mΩ
Quiescent Current	$V_O + 2V \le V_{IN} \le 26V$, $I_O = 5\ mA$					
	AS2940	10	15/**20**	10	15/**20**	mA_{MAX}
	AS2940C	10	15			
	$V_{IN} = V_O + 5V$, 1A	30	45/**60**	30	45/**60**	mA_{MAX}
Output Noise Voltage	10 Hz - 100 kHz, $I_O = 5\ mA$	270		300		μV_{rms}

ELECTRICAL CHARACTERISTICS $V_{IN} = V_O + 5V$, $I_O = 1A$, $C_O = 22\ \mu F$, unless otherwise specified. **Boldface limits apply over the entire operating temperature range of the indicated device.** All other specifications apply for $T_A = T_J = 25°C$. (Continued)

Output Voltage (V_O)		9V		10V		
Parameter	**Conditions**	**Typ**	**AS2940 Limit (Note 5)**	**Typ**	**AS2940 Limit (Note 5)**	**Units**
		$10.5V \le V_{IN} \le 26V$		$11.5V \le V_{IN} \le 26V$		
Ripple Rejection	f_O = 120 Hz, 1 V_{rms}, I_O = 100 mA					
	AS2940	64	52/**46**	63	51/**45**	dB_{MIN}
	AS2940C	64	52			
Long Term Stability		34		36		mV/ 1000 Hr
Dropout Voltage	I_O = 1A	0.5	0.8/**1.0**	0.5	0.8/**1.0**	V_{MAX}
	I_O = 100 mA	110	150/**200**	110	150/**200**	mV_{MAX}
Short Circuit Current	(Note 7)	1.9	1.6	1.9	1.6	A_{MIN}
Maximum Line Transient	$R_O = 100\Omega$, T ≤ 100 ms					
	AS2940	75	60/**60**	75	60/**60**	V_{MIN}
	AS2940C	55	45			
Reverse Polarity DC Input Voltage	$R_O = 100\Omega$					
	AS2940	-30	-15/**-15**	-30	-15/**-15**	V_{MIN}
	AS2940C	-30	-15			
Reverse Polarity Transient Input Voltage	$R_O = 100\Omega$, T ≤ 100 ms					
	AS2940	-75	-50/**-50**	-75	-50/**-50**	V_{MIN}
	AS2940C	-55	-45/**-45**			

ELECTRICAL CHARACTERISTICS $V_{IN} = V_O + 5V$, $I_O = 1A$, $C_O = 22\ \mu F$, unless otherwise specified. **Boldface limits apply over the entire operating temperature range of the indicated device.** All other specifications apply for $T_A = T_J = 25°C$. (Continued)

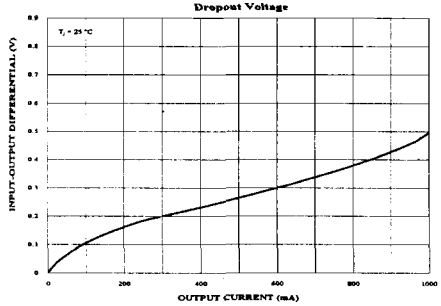
Output Voltage (V_O)		12V			15V			
Parameter	**Conditions**	**Typ**	**AS2940 Limit (Note 5)**	**AS2940/883 Limit (Note 6)**	**Typ**	**AS2940 Limit (Note 5)**	**AS2940/833 Limit (Note 6)**	**Units**
		$13.6V \le V_{IN} \le 26V$			$16.75 \le V_{IN} \le 26V$			
Output Voltage	5 mA ≤ I_O ≤ 1A	12.00	11.64/**11.40**	11.64/**11.40**	15.00	14.55/**14.25**	14.55/**14.25**	V_{MIN}
			12.36/**12.60**	12.36/**12.60**		15.45/**15.75**	15.45/**15.75**	V_{MAX}
Line Regulation	$V_O + 2V \le V_{IN} \le 26V$, I_O = 5 mA	20	120	75/**120**	20	150	95/**150**	mV_{MAX}
Load Regulation	50 mA ≤ I_O ≤ 1A							
	AS2940, AS2940/833	55	120/**200**	120/**190**			150/**240**	
	AS2940C	55	120		70	150		mV_{MAX}

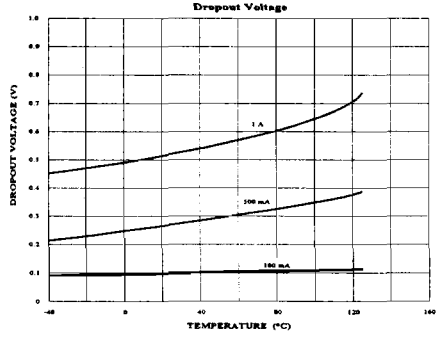
ELECTRICAL CHARACTERISTICS $V_{IN} = V_O + 5V$, $I_O = 1A$, $C_O = 22\ \mu F$, unless otherwise specified. **Boldface limits apply over the entire operating temperature range of the indicated device.** All other specifications apply for $T_A = T_J = 25°C$. (Continued)

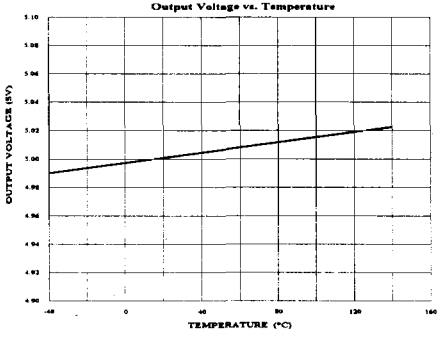
Output Voltage (V_O)		12V			15V			Units
Parameter	**Conditions**	**Typ**	**AS2940 Limit (Note 5)**	**AS2940/883 Limit (Note 6)**	**Typ**	**AS2940 Limit (Note 5)**	**AS2940/833 Limit (Note 6)**	
		$13.6V \le V_{IN} \le 26V$			$16.75 \le V_{IN} \le 26V$			
Output Impedance	100 mADC and 20 mArms, f_O = 120 Hz	80		1000/**1000**	100		1000/**1000**	mΩ
Quiescent Current	V_O +2V ≤ V_{IN} ≤ 26V, I_O = 5 mA							
	AS2940, AS2940/883	10	15/**20**	15/**20**			15/**20**	mA_{MAX}
	AS2940C	10	15		10	15		
	$V_{IN} = V_O + 5V$, I_O = 1A	30	45/**60**	50/**60**	30	45/**60**	50/**60**	mA_{MAX}
Output Noise Voltage	10 Hz - 100 kHz, I_O = 5 mA	360		1000/**1000**	450		1000/**1000**	μV_{rms}
Ripple Rejection	f_O = 120 Hz, 1 V_{rms}, I_O = 100 mA							
	AS2940	66	54/**48**					dB_{MIN}
	AS2940C	66	54		64	52		
	f_O = 1 kHz, 1 V_{rms}, I_O = 5 mA			52/**46**			48/**42**	dB_{MIN}
Long Term Stability		48			60			mV/ 1000 Hr
Dropout Voltage	I_O = 1A	0.5	0.8/**1.0**	0.7/**1.0**	0.5	0.8/**1.0**	0.7/**1.0**	V_{MAX}
	I_O = 100 mA	110	150/**200**	150/**200**	110	150/**200**	150/**200**	mV_{MAX}
Short Circuit Current	(Note 7)	1.9	1.6	1.6/**1.3**	1.9	1.6	1.6/**1.3**	A_{MIN}
Maximum Line Transient	R_O = 100Ω							
	AS2940, T ≤ 100 ms	75	60/**60**					
	AS2940/883, T ≤ 20 ms			40/**40**			40/**40**	V_{MIN}
	AS2940C, T ≤ 1 ms	55	45		55	45		
Reverse Polarity DC Input Voltage	R_O = 100Ω							
	AS2940, AS2940/883	-30	-15/**-15**	-15/**-15**			-15/**-15**	V_{MIN}
	AS2940C	-30	-15		-30	-15		
Reverse Polarity Transient Input Voltage	R_O = 100Ω							
	AS2940, T ≤ 100 ms	-75	-50/**-50**					
	AS2940/883, T ≤ 20 ms			-45/**-45**			-45/**-45**	V_{MIN}
	AS2940C, T ≤ 1 ms	-55	-45/**-45**		-55	-45/**-45**		

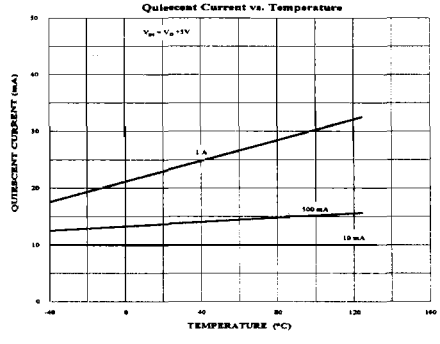
ELECTRICAL CHARACTERISTICS

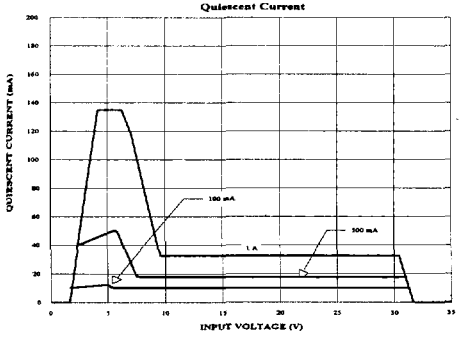
$V_{IN} = V_O + 5V$, $I_O = 1A$, $C_O = 22\ \mu F$, unless otherwise specified.

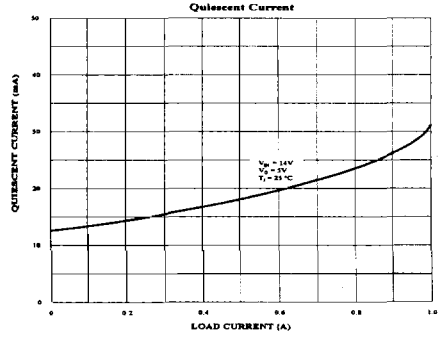








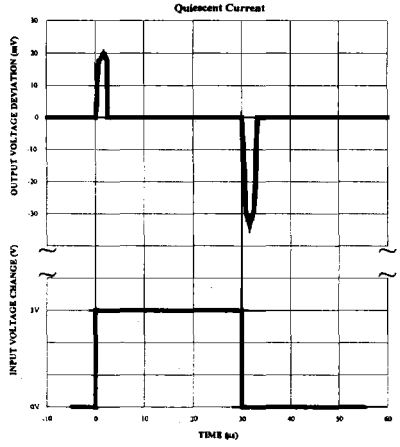




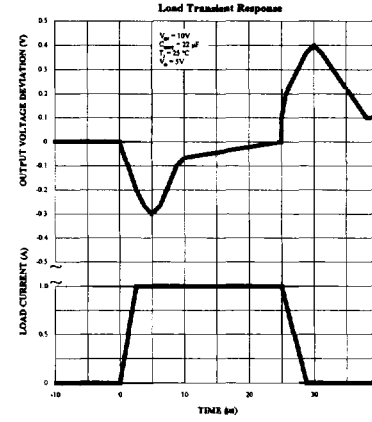
ELECTRICAL CHARACTERISTICS

$V_{IN} = V_O + 5V$, $I_O = 1A$, $C_O = 22\ \mu F$, unless otherwise specified.

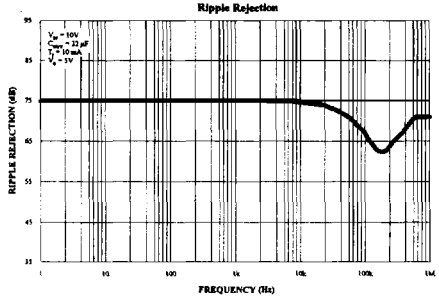
Quiescent Current



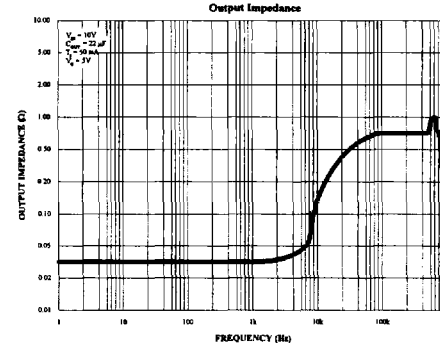
Load Transient Response



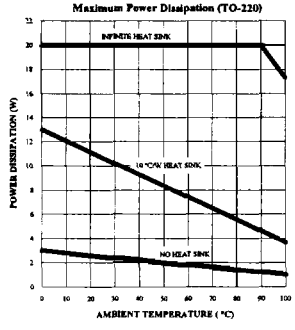
Ripple Rejection



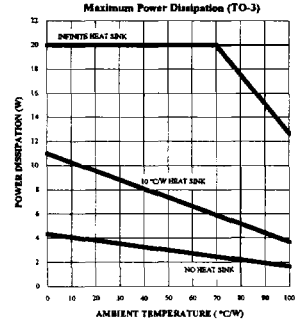
Output Impedance



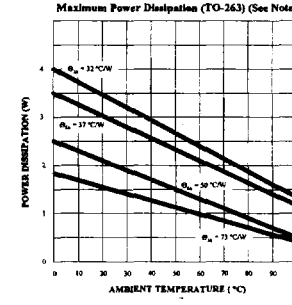
Maximum Power Dissipation (TO-220)



Maximum Power Dissipation (TO-3)



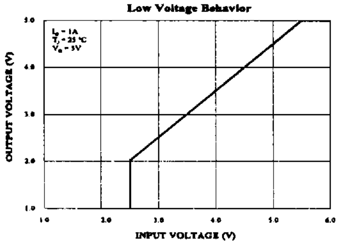
Maximum Power Dissipation (TO-263) (See Note 3)



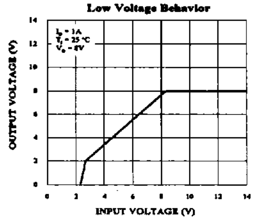
ELECTRICAL CHARACTERISTICS

$V_{IN} = V_O + 5V$, I_O =1A, C_O = 22 µF, unless otherwise specified.

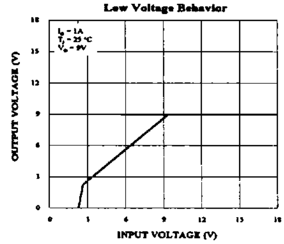
Low Voltage Behavior



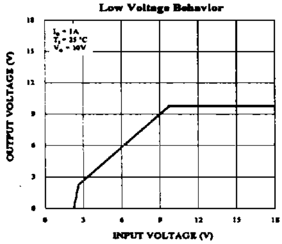
Low Voltage Behavior



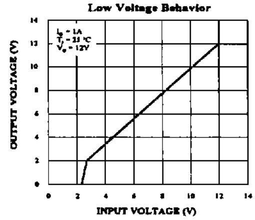
Low Voltage Behavior



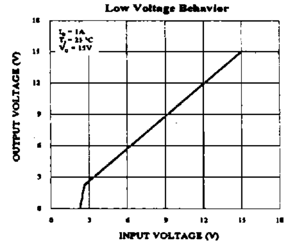
Low Voltage Behavior



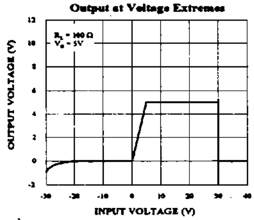
Low Voltage Behavior



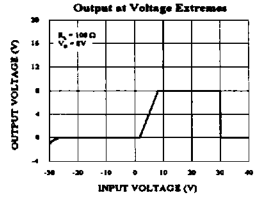
Low Voltage Behavior



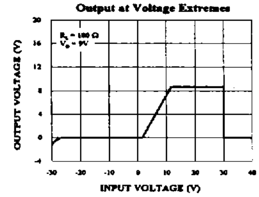
Output at Voltage Extremes



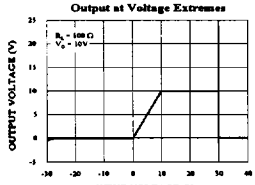
Output at Voltage Extremes



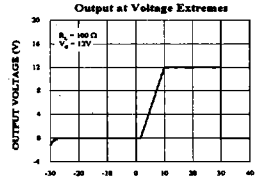
Output at Voltage Extremes



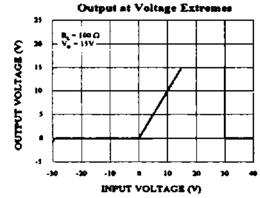
Output at Voltage Extremes



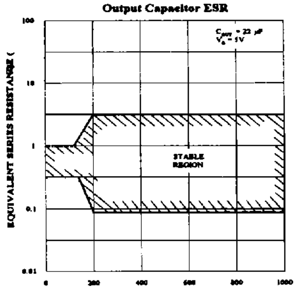
Output at Voltage Extremes



Output at Voltage Extremes



Output Capacitor ESR



Peak Output Current