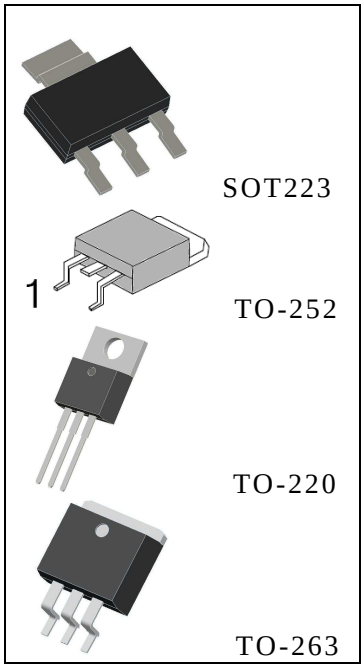
1A Low-Dropout Regulator BL2940

DESCRIPTION

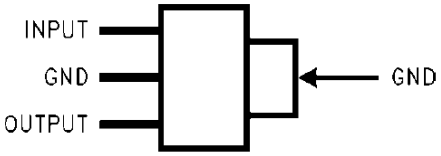


The BL2940 positive voltage regulator features the ability to source 1A of output current with a dropout voltage of typically 0.5V and a maximum of 1V over the entire temperature range. Furthermore, a quiescent current reduction circuit has been included which reduces the ground current when the differential between the input voltage and the output voltage exceeds approximately 3V. The quiescent current with 1A of output current and an input-output differential of 5V is therefore only 30 mA. Higher quiescent currents only exist when the regulator is in the dropout mode ($V_{IN} - V_{OUT} \leq 3V$). Designed also for vehicular applications, the BL2940 and all regulated circuitry are protected from reverse battery installations or 2-battery jumps. During line transients, such as load dump when the input voltage can momentarily exceed the specified maximum operating voltage, the regulator will automatically shut down to protect both the internal circuits and the load. The BL2940 cannot be harmed by temporary mirror-image insertion. Familiar regulator features such as short circuit and thermal overload protection are also provided.

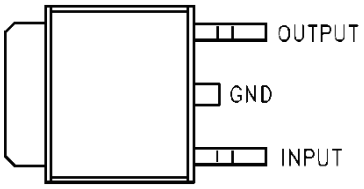
FEATURES

- Dropout voltage typically 0.5V @I_O = 1A
- Output current in excess of 1A
- Output voltage trimmed before assembly
- Reverse battery protection
- Internal short circuit current limit
- Mirror image insertion protection
- P+ Product Enhancement tested

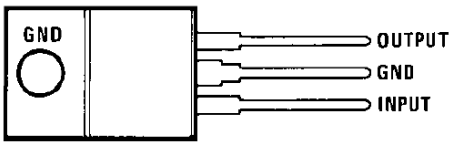
PIN CONFIGURATION



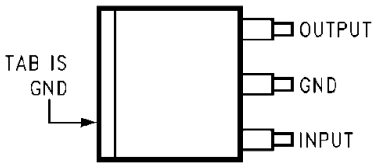
SOT223



TO-252

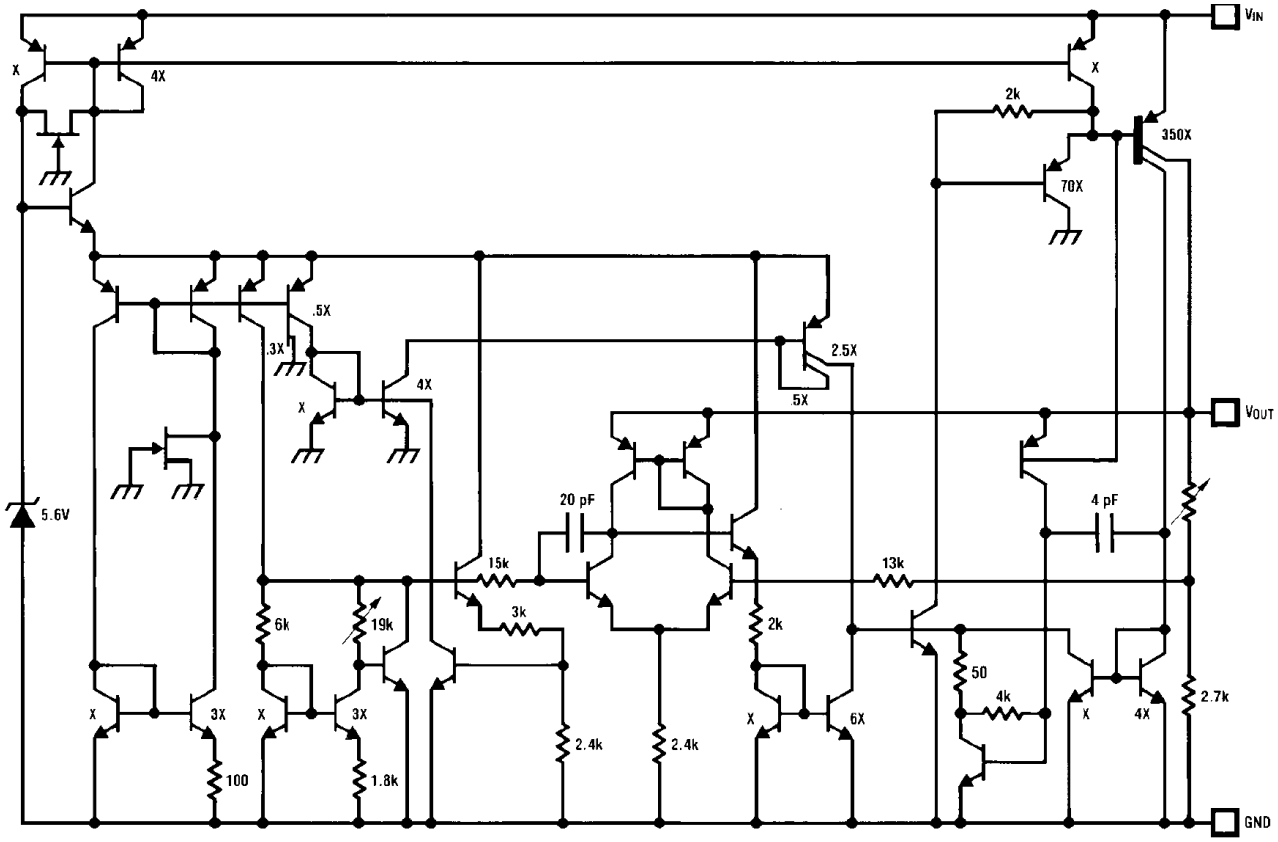


TO-220



TO-263

BLOCK DIAGRAM



ABSOLUTE MAXIMUM RATINGS (Ta=25℃) *1

Characteristic	Limit	Unit
Surge Supply voltage(t≤100ms)	60	V
Input Voltage	26	V
Internal power dissipation	Internally Limited	
Maximum junction temperature	150	℃
Storage temperature range	-65 ~ +150	℃
ESD susceptibility （HBM）	2	kV

ELECTRICAL CHARACTERISTICS

(V_{IN}=V_O+5V, I_O=1A, C_O=22μF, T_A= 25℃ unless otherwise specified.)

Characteristic	Conditions	5V			8V			Unit
		Min.	Typ.	Max	Min.	Typ.	Max	
Output voltage	5mA≤I_O≤1A	6.25V≤V_{IN}≤26V			9.4V≤V_{IN}≤26V			V
		4.85	5.00	5.15	7.76	8.00	8.24	
Line regulation	V_O+2V≤V_{IN}≤26V I_O =5mA		20	50		20	80	mV
Load regulation	50mA≤I_O≤1A		35	50		55	80	mV
Output impedance	100mADC and 20mArms, f_O =120Hz		35			55		mΩ
Quiescent current	V_O+2V≤V_{IN}≤26V I_O =5mA		10	15		10	15	mA
	V_{IN}=V_O+5V I_O=1A		30	45		30	45	mA
Output noise voltage	10Hz-100kHz, I_O =5mA		150			240		μVrms
Ripple rejection	f_O =120Hz,1Vrms I_O =100mA	60	72		54	66		dB
	f_O =1kHz,1Vrms I_O =5mA	60			54			
Long term stability			20			32		mV/ 1000Hr
Dropout voltage	I_O =1A		0.5	0.8		0.5	0.8	V_{MAX}
	I_O =100mA		110	150		110	150	mV_{MAX}
Short circuit current		1.6	1.9		1.6	1.9		A
Maximum line transient	R_O =100Ω T≤100ms	60	75		60	75		V
Reverse polarity DC input voltage	R_O =100Ω		-30	-15		-30	-15	V
Reverse polarity transient input voltage	R_O =100Ω T≤100ms		-75	-50		-75	-50	V

ELECTRICAL CHARACTERISTICS

(V_{IN}=V_O+5V, I_O=1A, C_O=22μF, T_A= 25℃ unless otherwise specified.)

Characteristic	Conditions	9V			10V			Unit
		Min.	Typ.	Max	Min.	Typ.	Max	
Output voltage	5mA≤I_O≤1A	10.5V≤V_{IN}≤26V			11.5V≤V_{IN}≤26V			V
		8.73	9.00	9.27	9.70	10.0	10.3	
Line regulation	V_O+2V≤V_{IN}≤26V I_O =5mA		20	90		20	100	mV
Load regulation	50mA≤I_O≤1A		60	90		65	100	mV
Output impedance	100mADC and 20mArms, f_O =120Hz		60			65		mΩ
Quiescent current	V_O+2V≤V_{IN}≤26V I_O =5mA		10	15		10	15	mA
	V_{IN}=V_O+5V I_O=1A		30	45		30	45	mA
Output noise voltage	10Hz-100kHz, I_O =5mA		270			300		μVrms
Ripple rejection	f_O =120Hz,1Vrms I_O =100mA	52	64		51	63		dB
Long term stability			34			36		mV/ 1000Hr
Dropout voltage	I_O =1A		0.5	0.8		0.5	0.8	V
	I_O =100mA		110	150		110	150	mV
Short circuit current		1.6	1.9		1.6	1.9		A
Maximum line transient	R_O =100Ω T≤100ms	60	75		60	75		V
Reverse polarity DC input voltage	R_O =100Ω		-30	-15		-30	-15	V
Reverse polarity transient input voltage	R_O =100Ω T≤100ms		-75	-50		-75	-50	V

ELECTRICAL CHARACTERISTICS

(V_{IN}=V_O+5V, I_O=1A, C_O=22μF, T_A= 25℃ unless otherwise specified.)

Characteristic	Conditions	12V			15V			Unit
		Min. *5	Typ.	Max *5	Min. *5	Typ.	Max *5	
Output voltage	5mA≤I_O≤1A	13.6V≤V_{IN}≤26V			16.75V≤V_{IN}≤26V			V
		11.64	12.0	12.36	14.55	15.0	15.45	
Line regulation	V_O+2V≤V_{IN}≤26V I_O =5mA		20	120		20	150	mV
Load regulation	50mA≤I_O≤1A		55	120				mV
Output impedance	100mADC and 20mArms, f_O =120Hz		80			100		mΩ
Quiescent current	V_O+2V≤V_{IN}≤26V I_O =5mA		10	15				mA
	V_{IN}=V_O+5V I_O=1A		30	45		30	45	mA
Output noise voltage	10Hz-100kHz, I_O =5mA		360			450		μVrms
Ripple rejection	f_O =120Hz,1Vrms I_O =100mA	54	66					dB
	f_O =1kHz,1Vrms I_O =5mA							
Long term stability			48			60		mV/ 1000Hr
Dropout voltage	I_O =1A		0.5	0.8		0.5	0.8	V
	I_O =100mA		110	150		110	150	mV
Short circuit current		1.6	1.9		1.6	1.9		A
Maximum line transient	R_O =100Ω T≤100ms	60	75		60	75		V
Reverse polarity DC input voltage	R_O =100Ω		-30	-15		-30	-15	V
Reverse polarity transient input voltage	R_O =100Ω T≤100ms		-75	-50		-75	-50	V

APPLICATION SUMMARY

External Capacitors

The output capacitor is critical to maintaining regulator stability, and must meet the required conditions for both ESR(Equivalent Series Resistance) and minimum amount of capacitance.

MINIMUM CAPACITANCE:

The minimum output capacitance required to maintain stability is 22 µF (this value may be increased without limit). Larger values of output capacitance will give improved transient response.

ESR LIMITS:

The ESR of the output capacitor will cause loop instability if it is too high or too low. The acceptable range of ESR plotted versus load current is shown in the graph right. It is essential that the output capacitor meet these requirements, or oscillations can result.

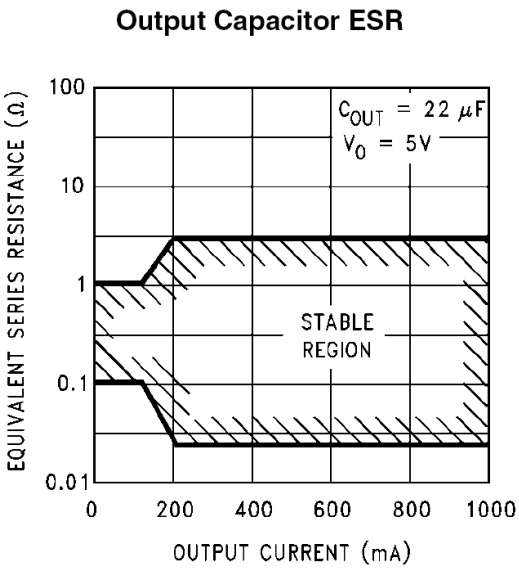


Fig. ESR Limits

It is important to note that for most capacitors, ESR is specified only at room temperature. However, the designer must ensure that the ESR will stay inside the limits shown over the entire operating temperature range for the design.

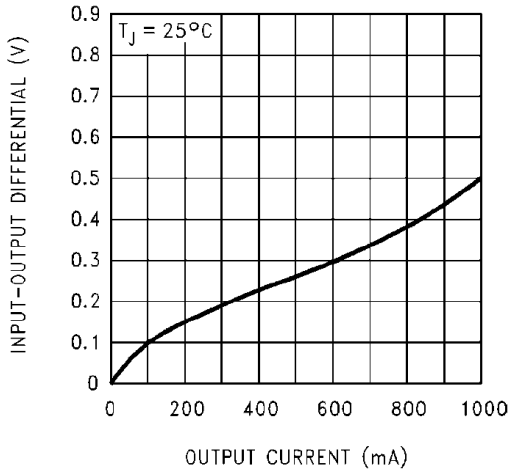
For aluminum electrolytic capacitors, ESR will increase by about 30X as the temperature is reduced from 25°C to −40°C. This type of capacitor is not well-suited for low temperature operation.

Solid tantalum capacitors have a more stable ESR over temperature, but are more expensive than aluminum electrolytics. A cost-effective approach sometimes used is to parallel an aluminum electrolytic with a solid Tantalum, with the total capacitance split about 75/25% with the Aluminum being the larger value.

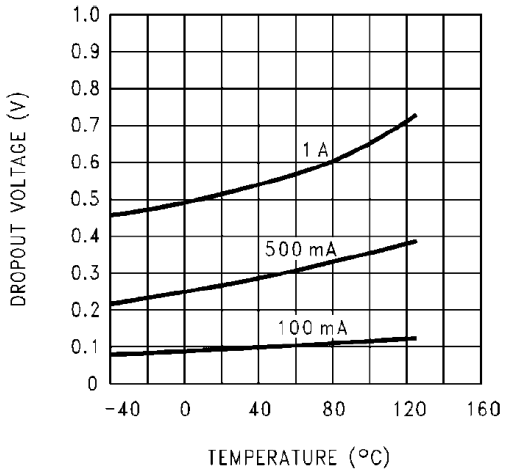
If two capacitors are paralleled, the effective ESR is the parallel of the two individual values. The “flatter” ESR of the Tantalum will keep the effective ESR from rising as quickly at low temperatures.

CHARACTERISTICS CURVE

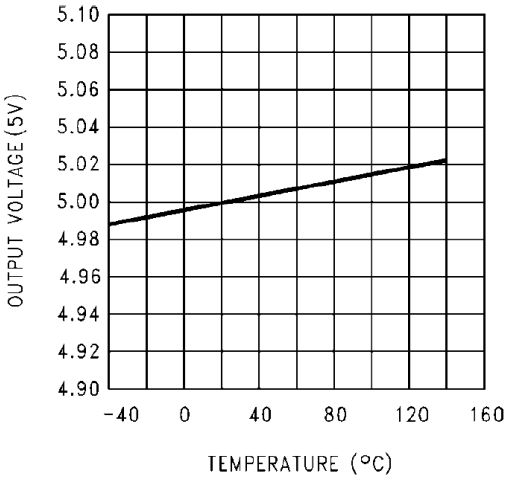
Dropout Voltage



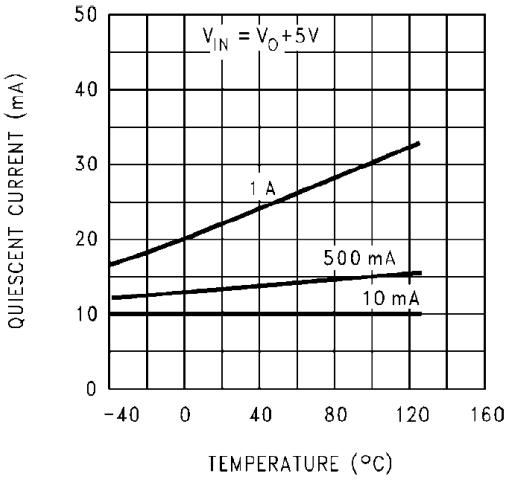
Dropout Voltage vs. Temperature



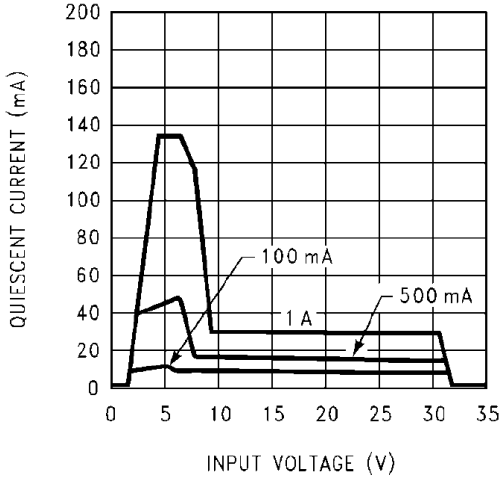
Output Voltage vs. Temperature



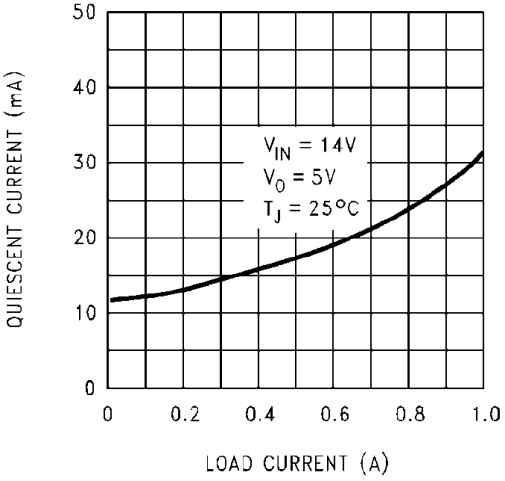
Quiescent Current vs. Temperature



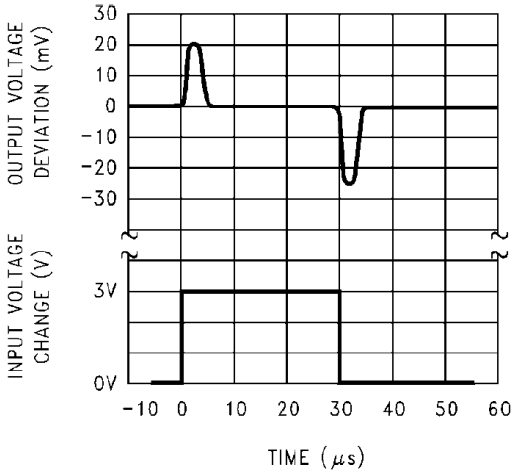
Quiescent Current



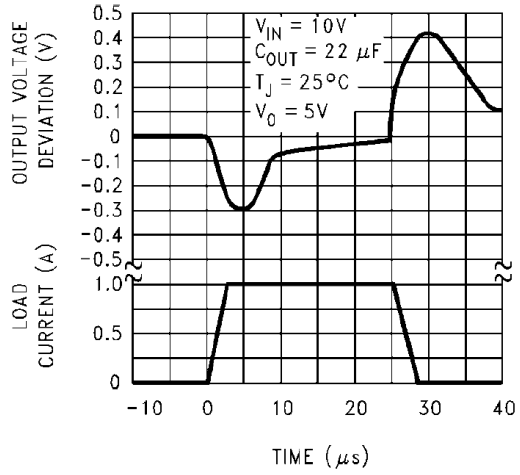
Quiescent Current



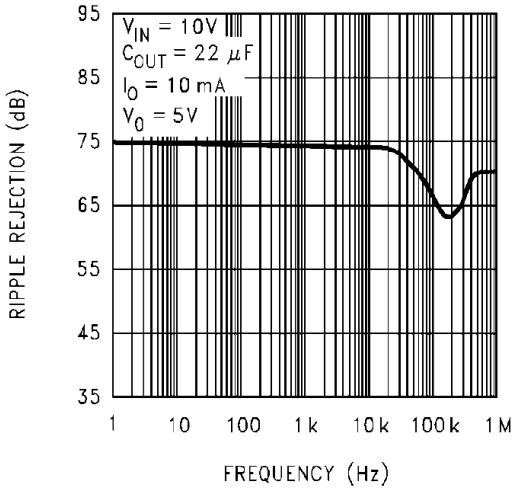
Line Transient Response



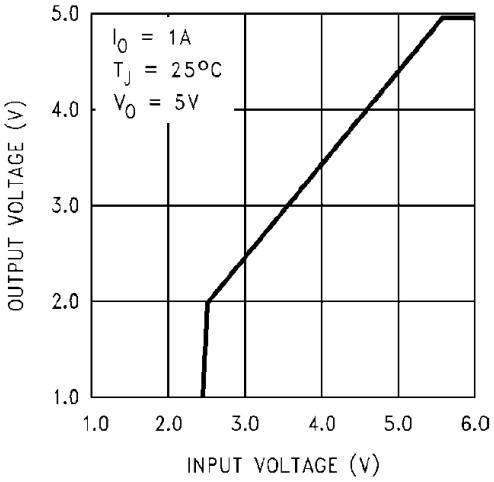
Load Transient Response



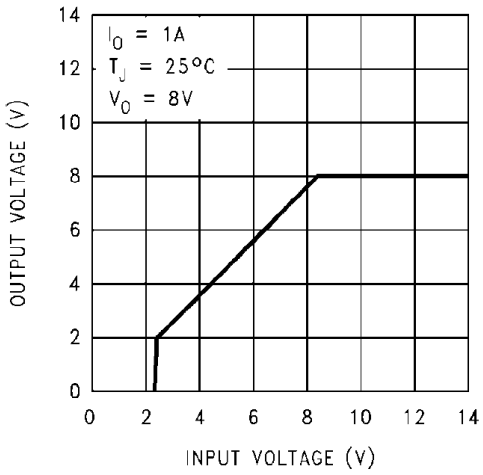
Ripple Rejection



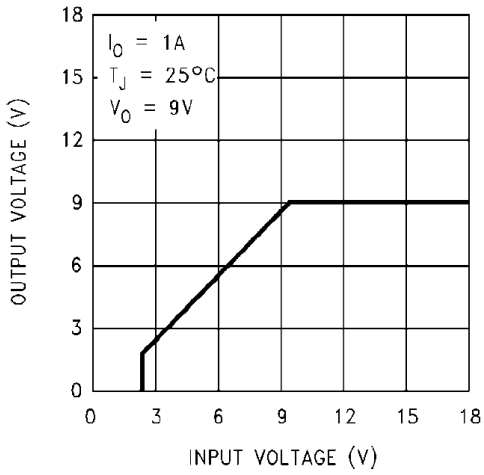
Low Voltage Behavior



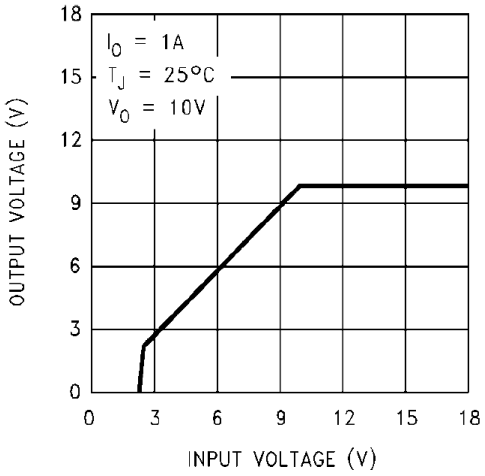
Low Voltage Behavior



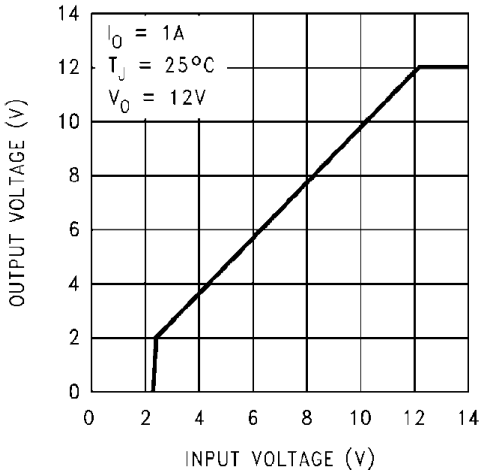
Low Voltage Behavior



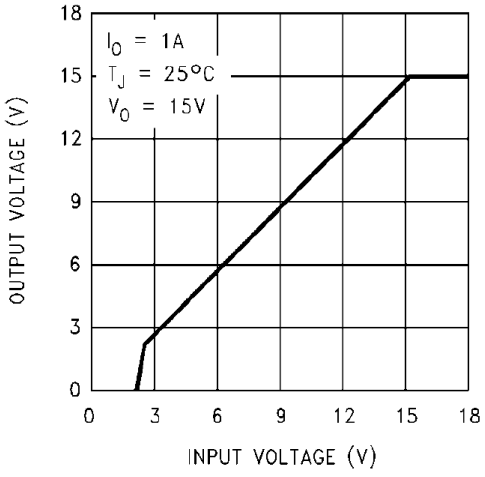
Low Voltage Behavior



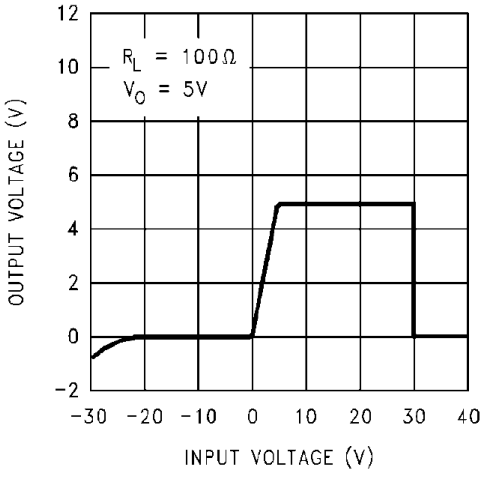
Low Voltage Behavior



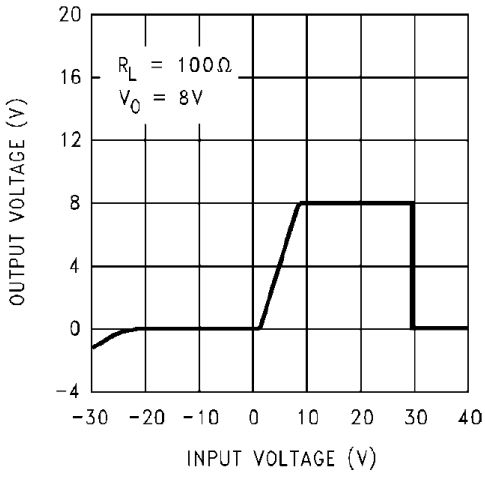
Low Voltage Behavior



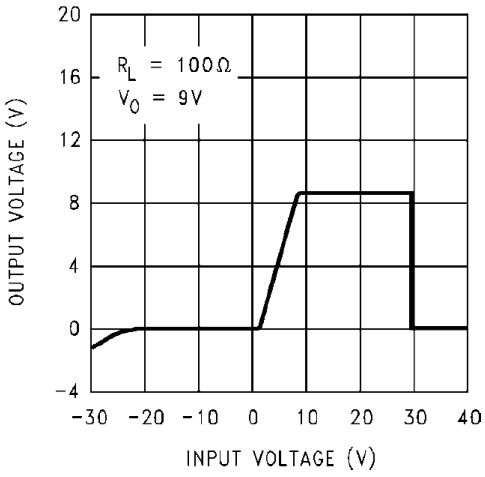
Output at Voltage Extremes



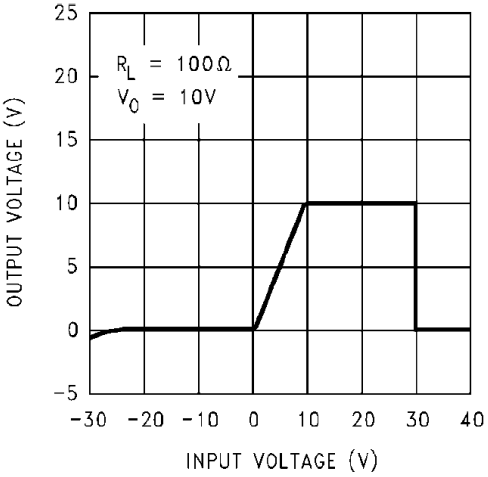
Output at Voltage Extremes



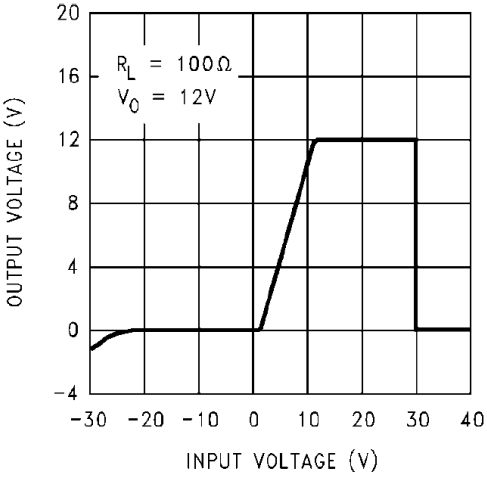
Output at Voltage Extremes



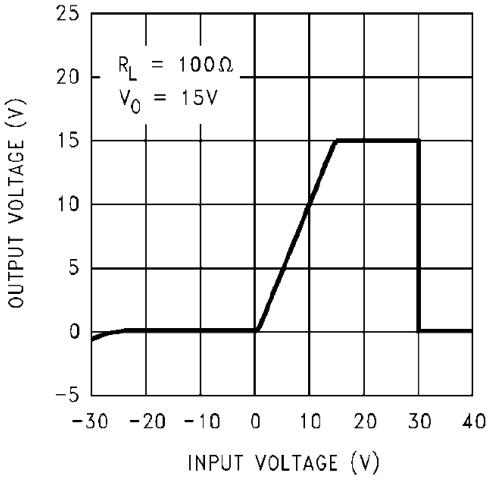
Output at Voltage Extremes



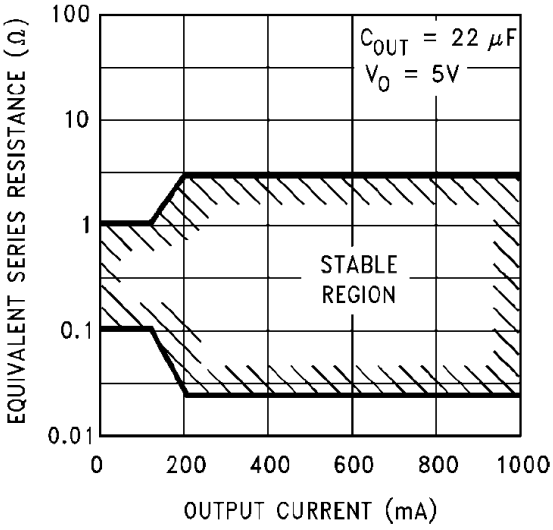
Output at Voltage Extremes



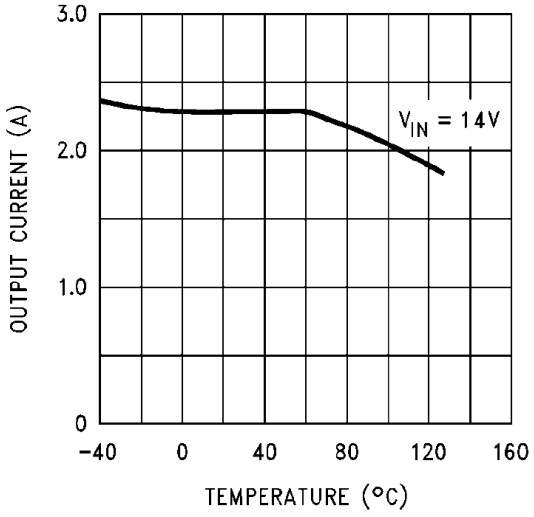
Output at Voltage Extremes



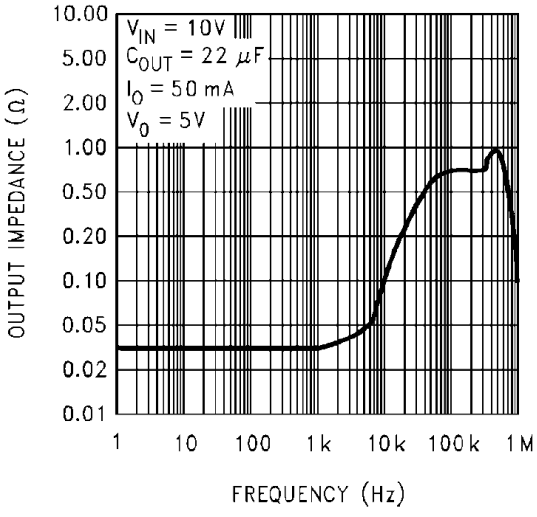
Output Capacitor ESR



Peak Output Current

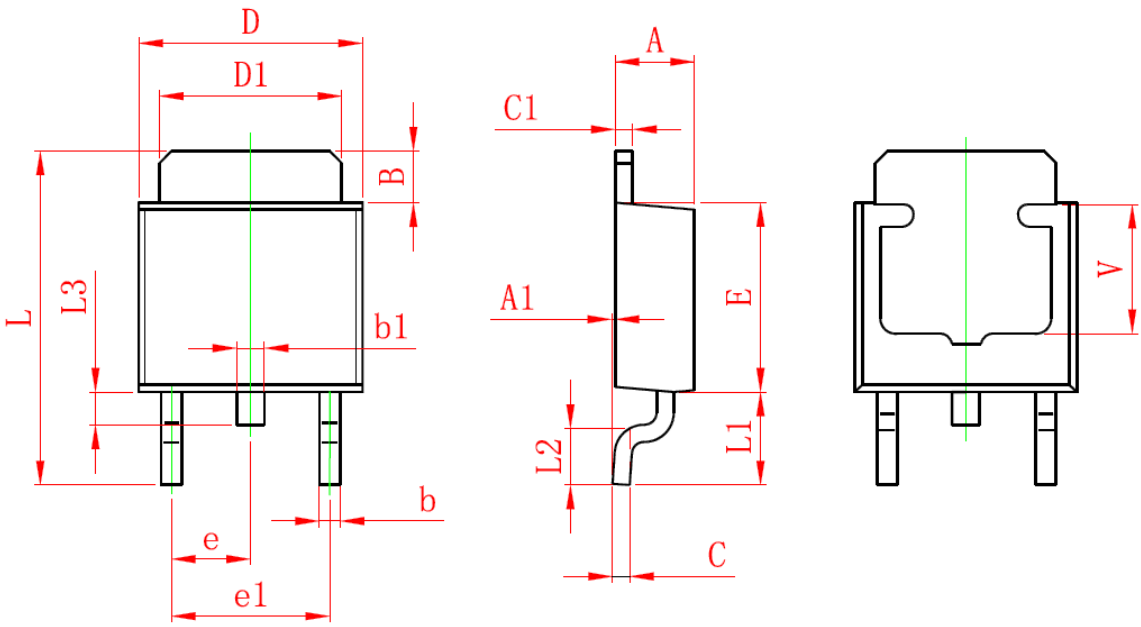


Output Impedance



OUTLINE DRAWING

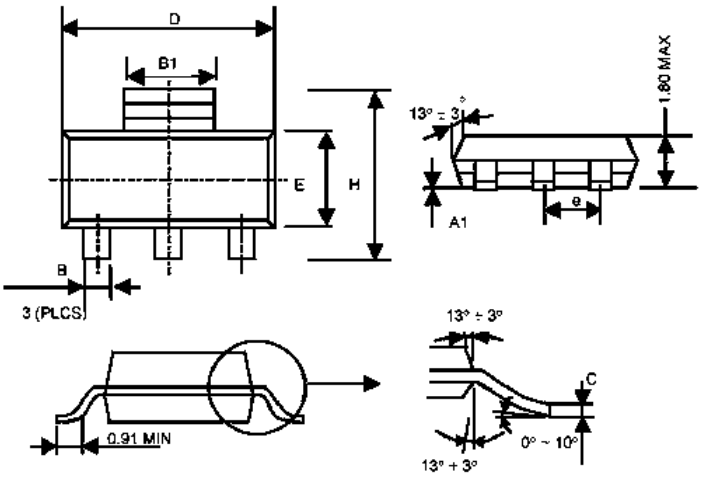
TO-252 Unit: mm



Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min.	Max.	Min.	Max.
A	2.200	2.400	0.087	0.094
A1	0.000	0.127	0.000	0.005
B	1.350	1.650	0.053	0.065
b	0.500	0.700	0.020	0.028
b1	0.700	0.900	0.028	0.035
c	0.430	0.580	0.017	0.023
c1	0.430	0.580	0.017	0.023
D	6.350	6.650	0.250	0.262
D1	5.200	5.400	0.205	0.213
E	5.400	5.700	0.213	0.224
e	2.300 TYP.		0.091 TYP.	
e1	4.500	4.700	0.177	0.185
L	9.500	9.900	0.374	0.390
L1	2.550	2.900	0.100	0.114
L2	1.400	1.780	0.055	0.070
L3	0.600	0.900	0.024	0.035
V	3.800 REF.		0.150 REF.	

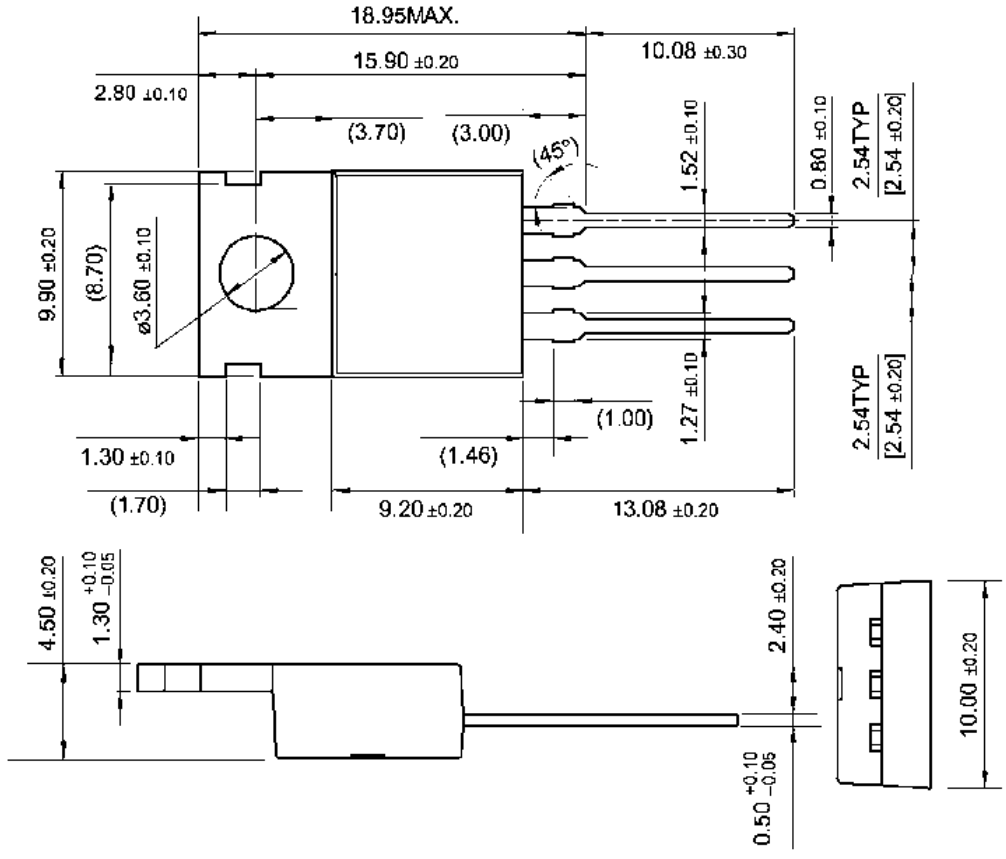
SOT-223 Unit: mm

- **SOT-223**



SYMBOL	MIN	MAX
A1	0.02	0.12
B	0.60	0.80
B1	2.90	3.15
C	0.24	0.35
D	6.30	6.80
E	3.30	3.70
e	2.30 (TYP.)	
H	6.70	7.30

TO-220 Unit: mm



TO-263 Unit: mm