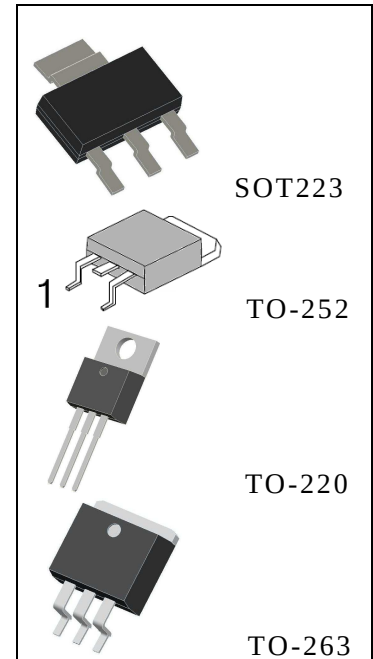


1A Low-Dropout Regulator BL2940

DESCRIPTION

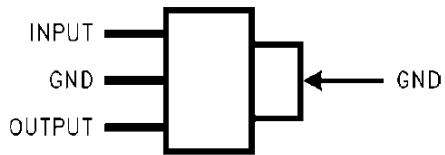
The BL2940 positive voltage regulator features the ability to source 1A of output current with a dropout voltage of typically 0.5V and a maximum of 1V over the entire temperature range. Furthermore, a quiescent current reduction circuit has been included which reduces the ground current when the differential 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.



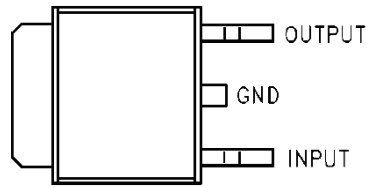
FEATURES

- 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

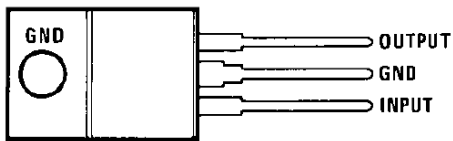
PIN CONFIGURATION



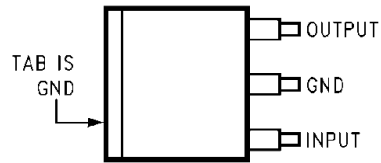
SOT223



TO-252

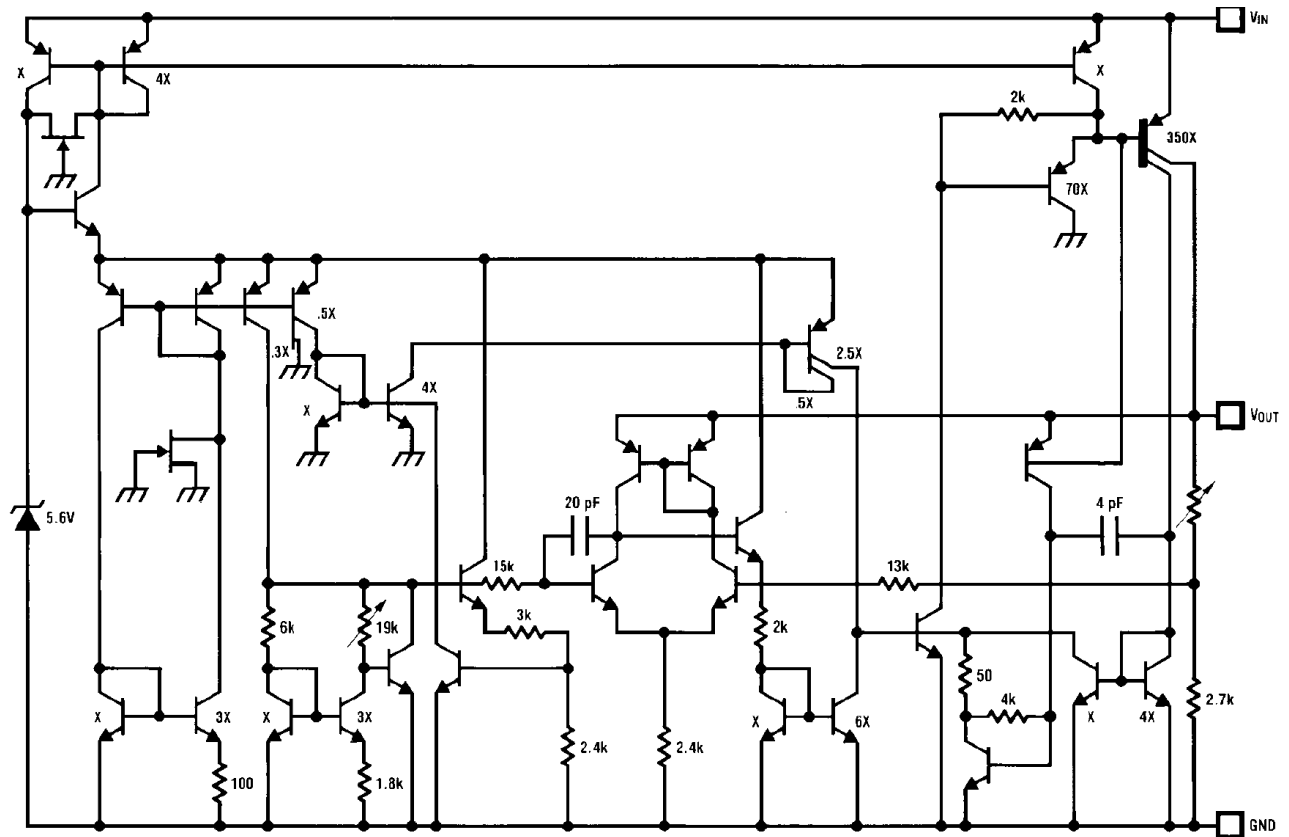


TO-220



TO-263

BLOCK DIAGRAM



ABSOLUTE MAXIMUM RATINGS ($T_a=25^{\circ}\text{C}$) *1

Characteristic	Limit	Unit
Surge Supply voltage($t \leq 100\text{ms}$)	60	V
Input Voltage	26	V
Internal power dissipation	Internally Limited	
Maximum junction temperature	150	$^{\circ}\text{C}$
Storage temperature range	-65 ~ +150	$^{\circ}\text{C}$
ESD susceptibility (HBM)	2	kV

ELECTRICAL CHARACTERISTICS

($V_{\text{IN}}=V_{\text{O}}+5\text{V}$, $I_{\text{O}}=1\text{A}$, $C_{\text{O}}=22\mu\text{F}$, $T_A=25^{\circ}\text{C}$ unless otherwise specified.)

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

ELECTRICAL CHARACTERISTICS

($V_{IN}=V_O+5V$, $I_O=1A$, $C_O=22\mu F$, $T_A= 25^{\circ}C$ unless otherwise specified.)

Characteristic	Conditions	9V			10V			Unit
		Min.	Typ.	Max	Min.	Typ.	Max	
Output voltage	$5mA \leq I_O \leq 1A$	$10.5V \leq V_{IN} \leq 26V$			$11.5V \leq V_{IN} \leq 26V$			V
		8.73	9.00	9.27	9.70	10.0	10.3	
Line regulation	$V_O+2V \leq V_{IN} \leq 26V$ $I_O = 5mA$		20	90		20	100	mV
Load regulation	$50mA \leq I_O \leq 1A$		60	90		65	100	mV
Output impedance	100mADC and 20mArms, $f_O = 120Hz$		60			65		m Ω
Quiescent current	$V_O+2V \leq V_{IN} \leq 26V$ $I_O = 5mA$		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		μV_{rms}
Ripple rejection	$f_O = 120Hz, 1V_{rms}$ $I_O = 100mA$	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	$R_O = 100\Omega$ $T \leq 100ms$	60	75		60	75		V
Reverse polarity DC input voltage	$R_O = 100\Omega$		-30	-15		-30	-15	V
Reverse polarity transient input voltage	$R_O = 100\Omega$ $T \leq 100ms$		-75	-50		-75	-50	V

ELECTRICAL CHARACTERISTICS

($V_{IN}=V_O+5V$, $I_O=1A$, $C_O=22\mu F$, $T_A= 25^{\circ}C$ unless otherwise specified.)

Characteristic	Conditions	12V			15V			Unit
		Min. *5	Typ.	Max *5	Min. *5	Typ.	Max *5	
Output voltage	$5mA \leq I_O \leq 1A$	$13.6V \leq V_{IN} \leq 26V$			$16.75V \leq V_{IN} \leq 26V$			V
		11.64	12.0	12.36	14.55	15.0	15.45	
Line regulation	$V_O+2V \leq V_{IN} \leq 26V$ $I_O = 5mA$		20	120		20	150	mV
Load regulation	$50mA \leq I_O \leq 1A$		55	120				mV
Output impedance	100mADC and 20mArms, $f_O = 120Hz$		80			100		mΩ
Quiescent current	$V_O+2V \leq V_{IN} \leq 26V$ $I_O = 5mA$		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	$R_O = 100\Omega$ $T \leq 100ms$	60	75		60	75		V
Reverse polarity DC input voltage	$R_O = 100\Omega$		-30	-15		-30	-15	V
Reverse polarity transient input voltage	$R_O = 100\Omega$ $T \leq 100ms$		-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.

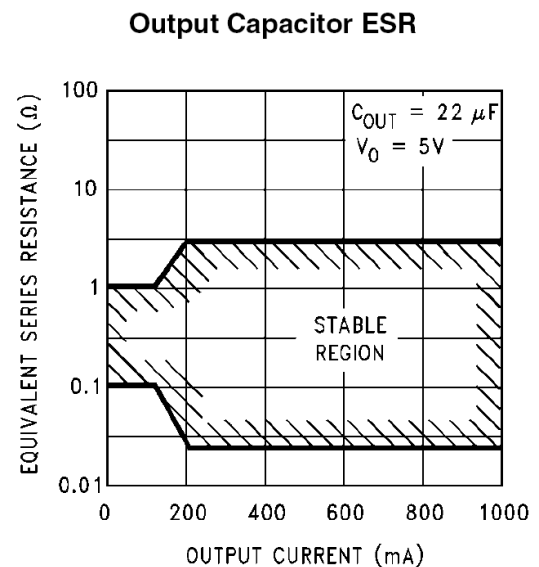


Fig. ESR Limits

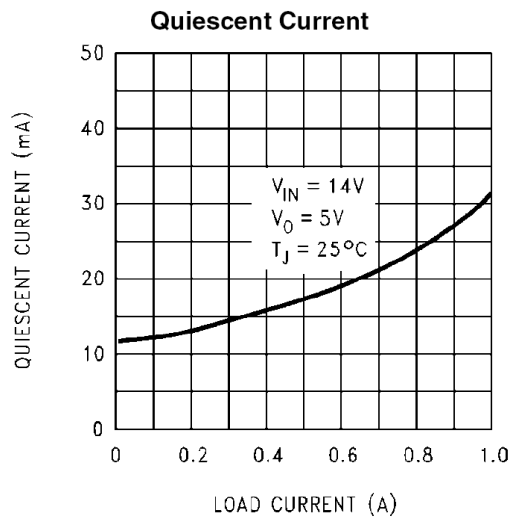
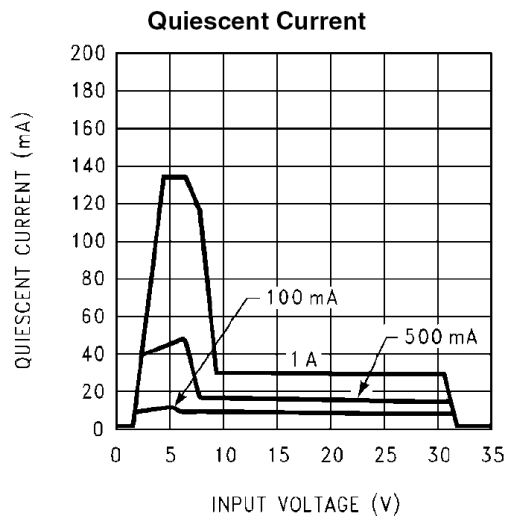
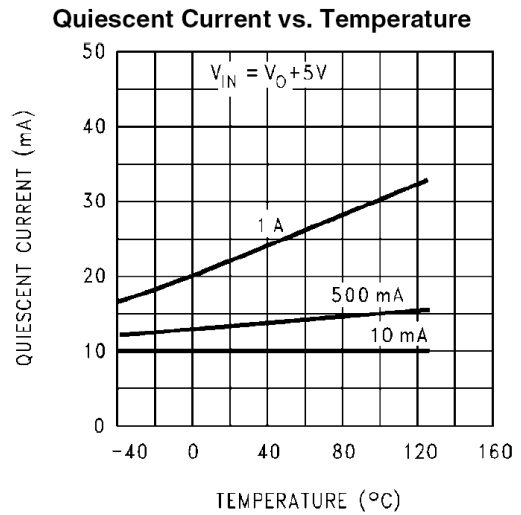
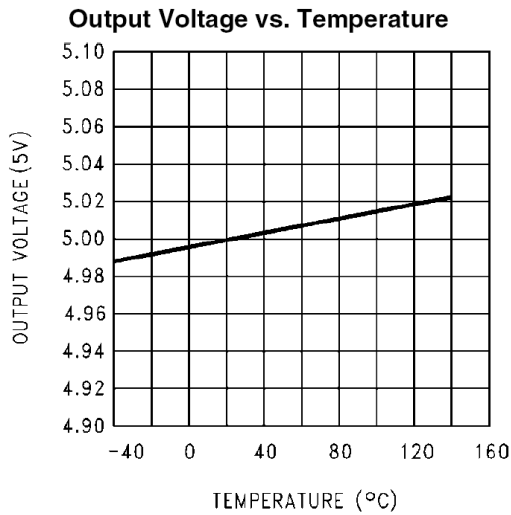
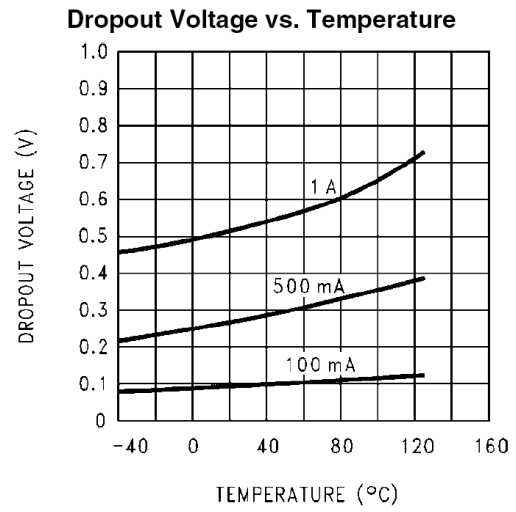
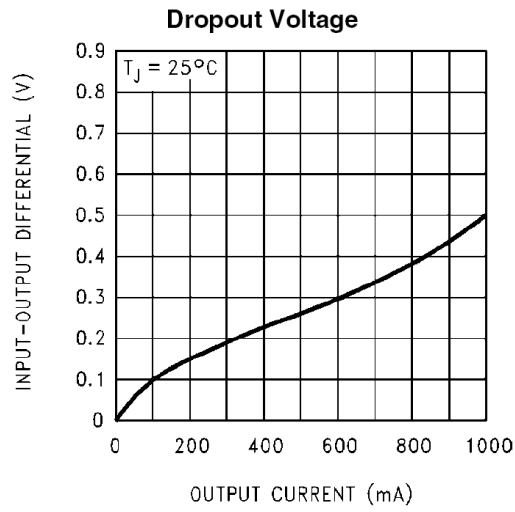
It is important to note that for most capacitors, ESR is specified only at room temperature. However, the designer must ensure that the ESR will stay inside the limits shown over the entire operating temperature range for the design.

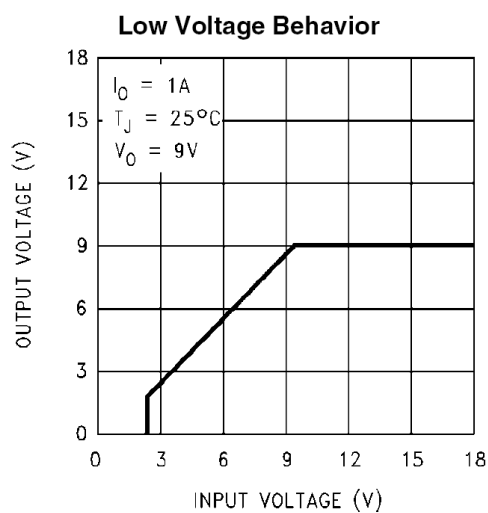
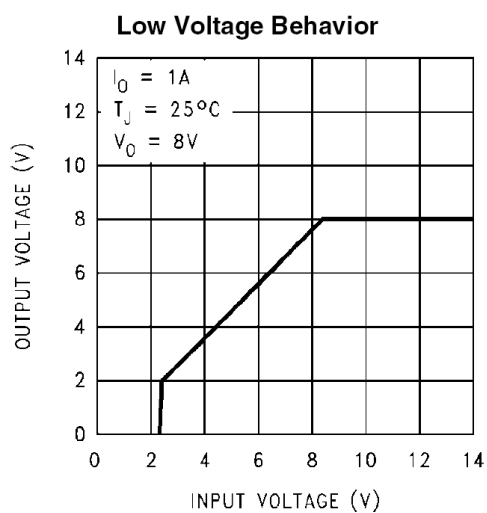
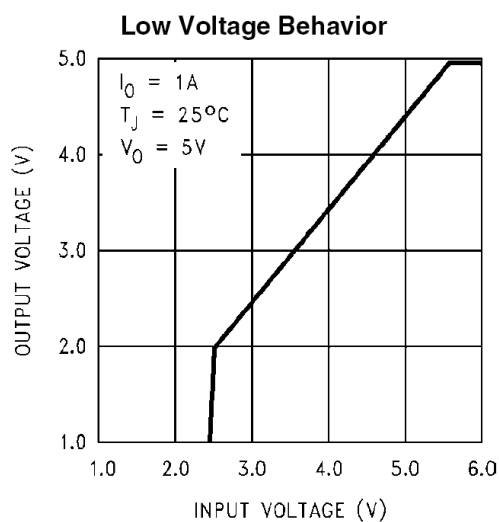
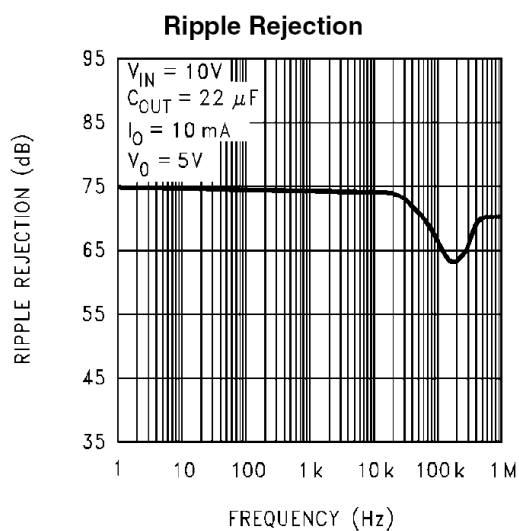
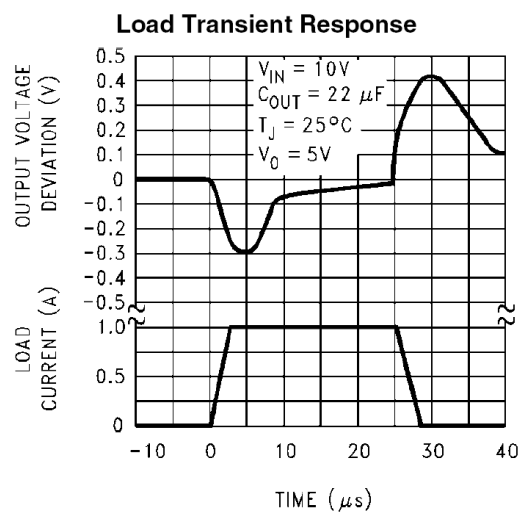
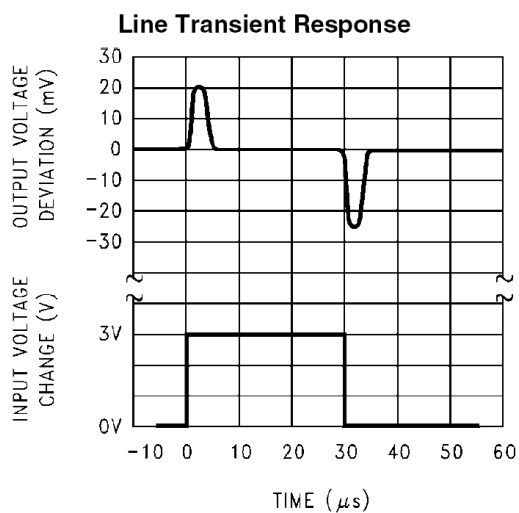
For aluminum electrolytic capacitors, ESR will increase by about 30X as the temperature is reduced from 25°C to -40°C. This type of capacitor is not well-suited for low temperature operation.

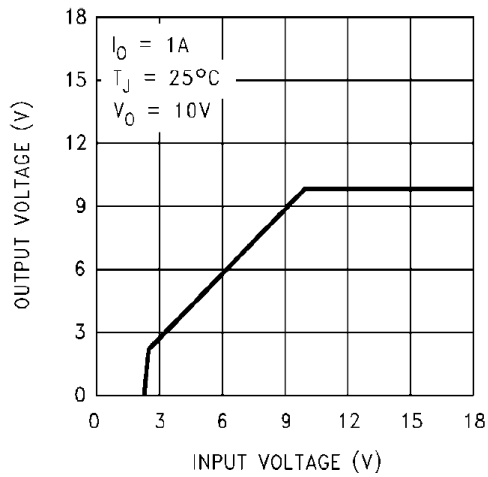
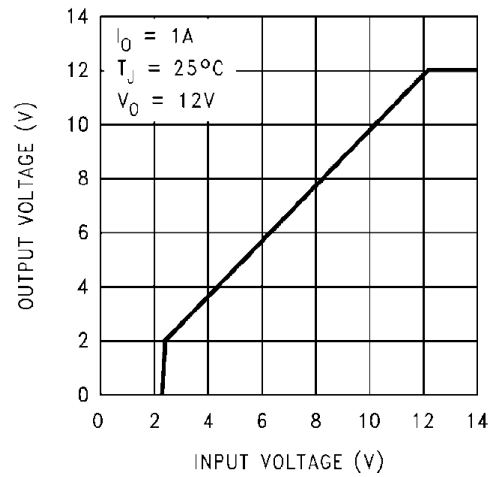
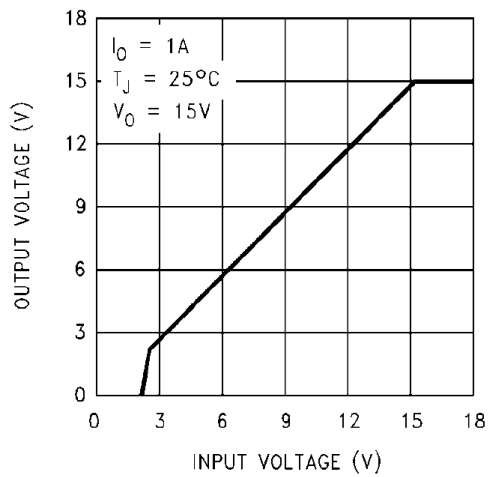
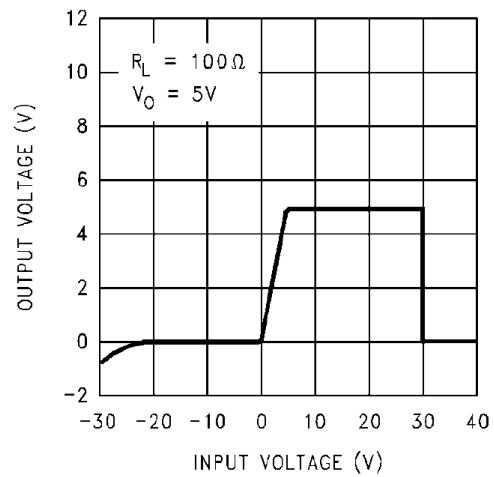
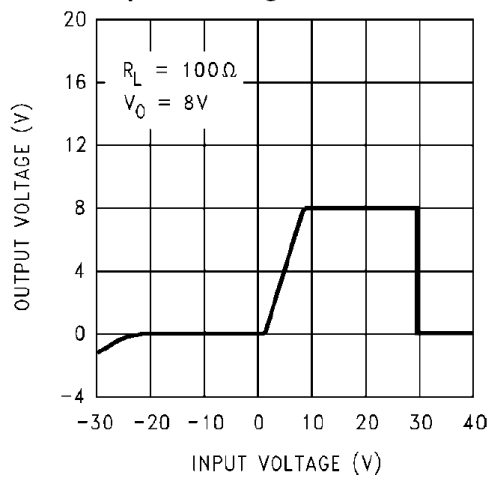
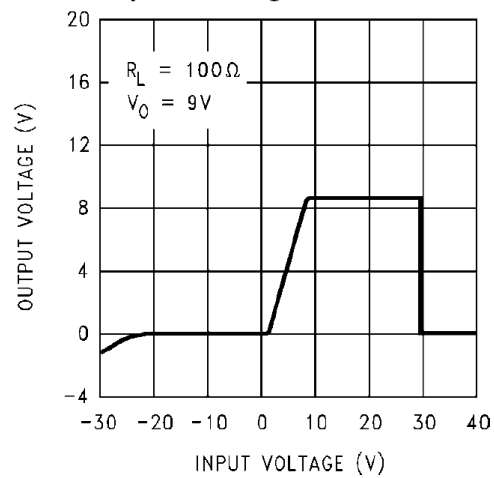
Solid tantalum capacitors have a more stable ESR over temperature, but are more expensive than aluminum electrolytics. A cost-effective approach sometimes used is to parallel an aluminum electrolytic with a solid Tantalum, with the total capacitance split about 75/25% with the Aluminum being the larger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

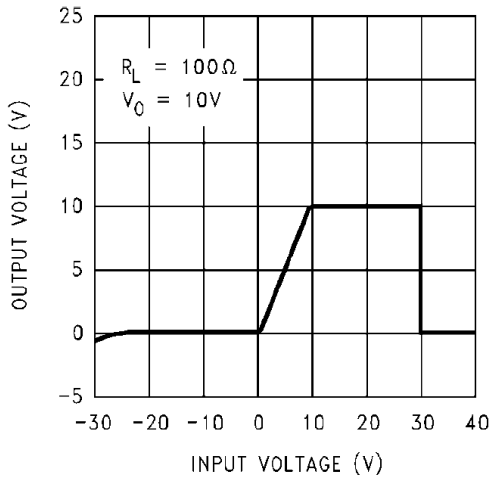
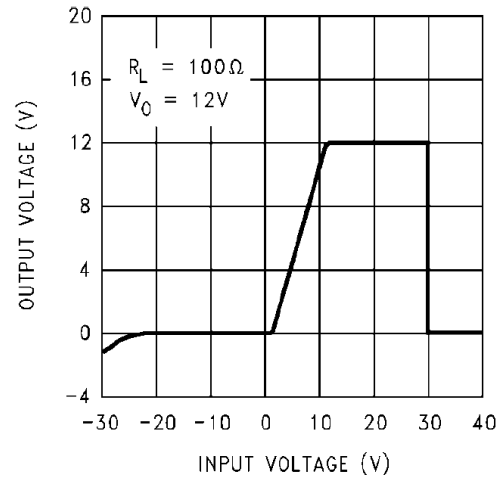
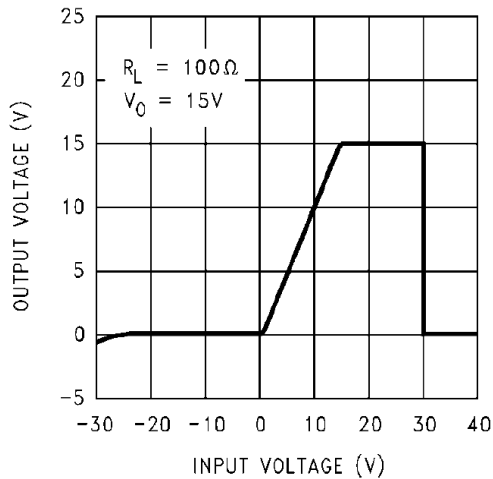
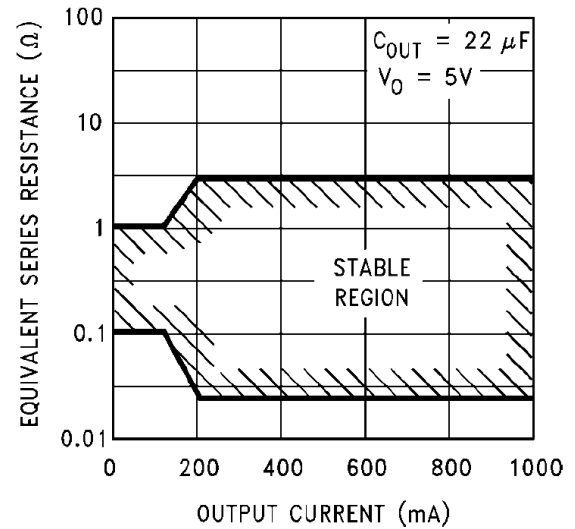
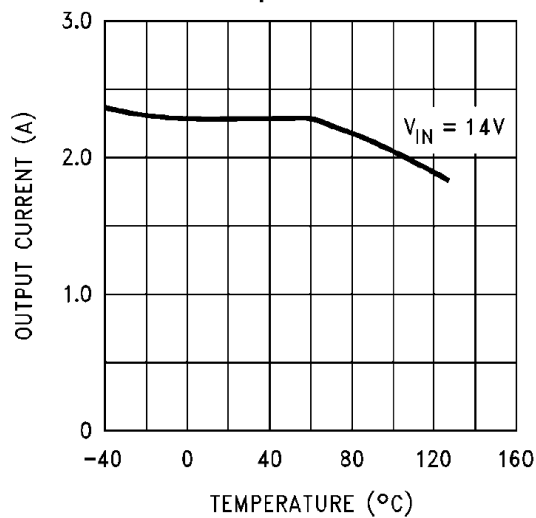
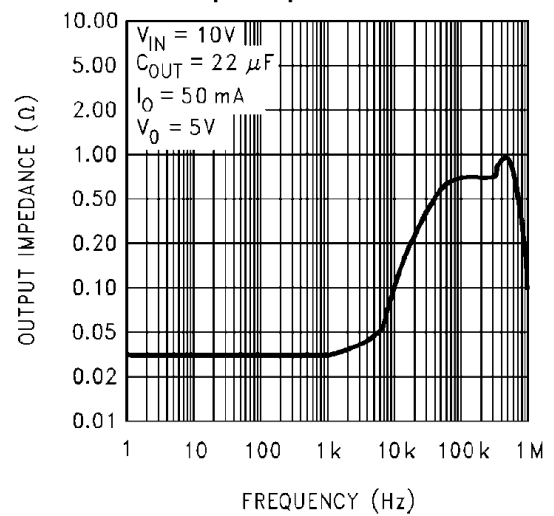
If two capacitors are paralleled, the effective ESR is the parallel of the two individual values. The “flatter” ESR of the Tantalum will keep the effective ESR from rising as quickly at low temperatures.

CHARACTERISTICS CURVE



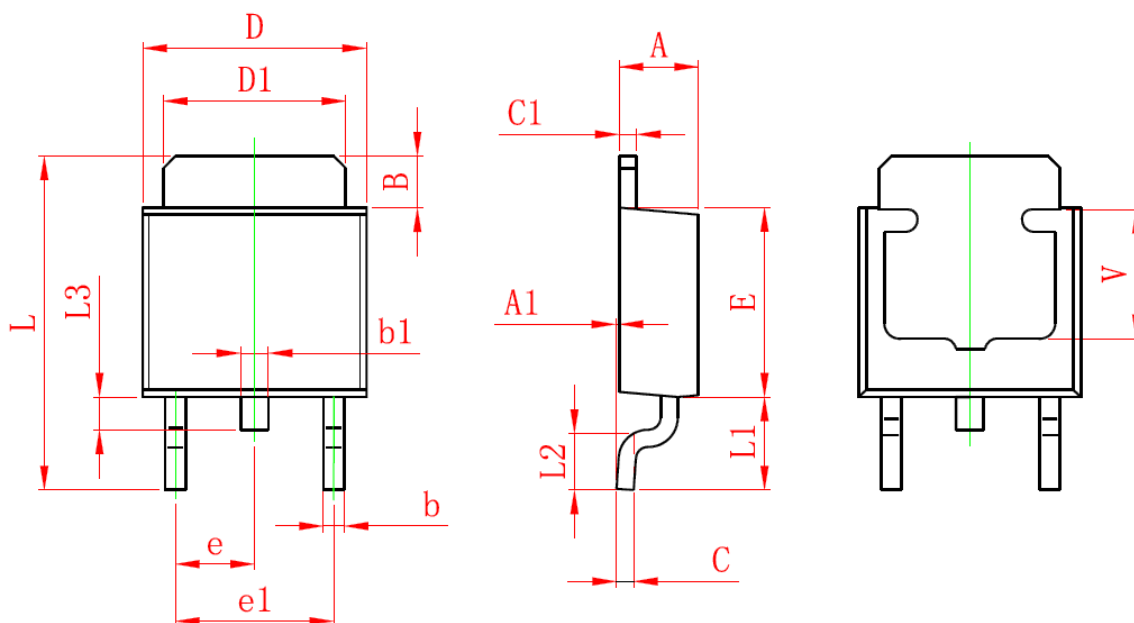


Low Voltage Behavior

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

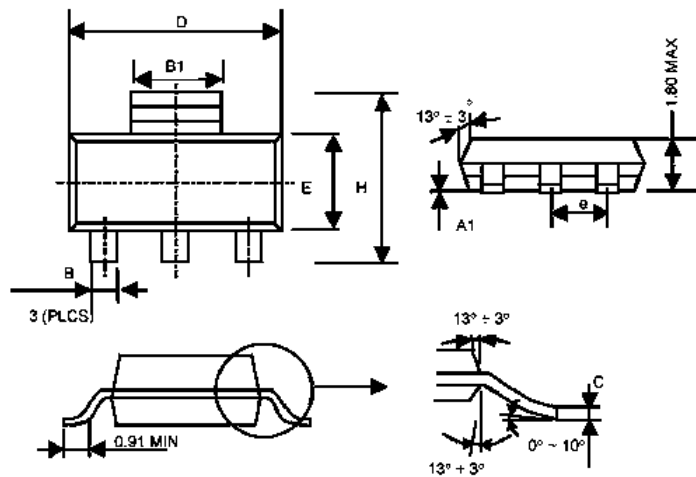
Unit: mm



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

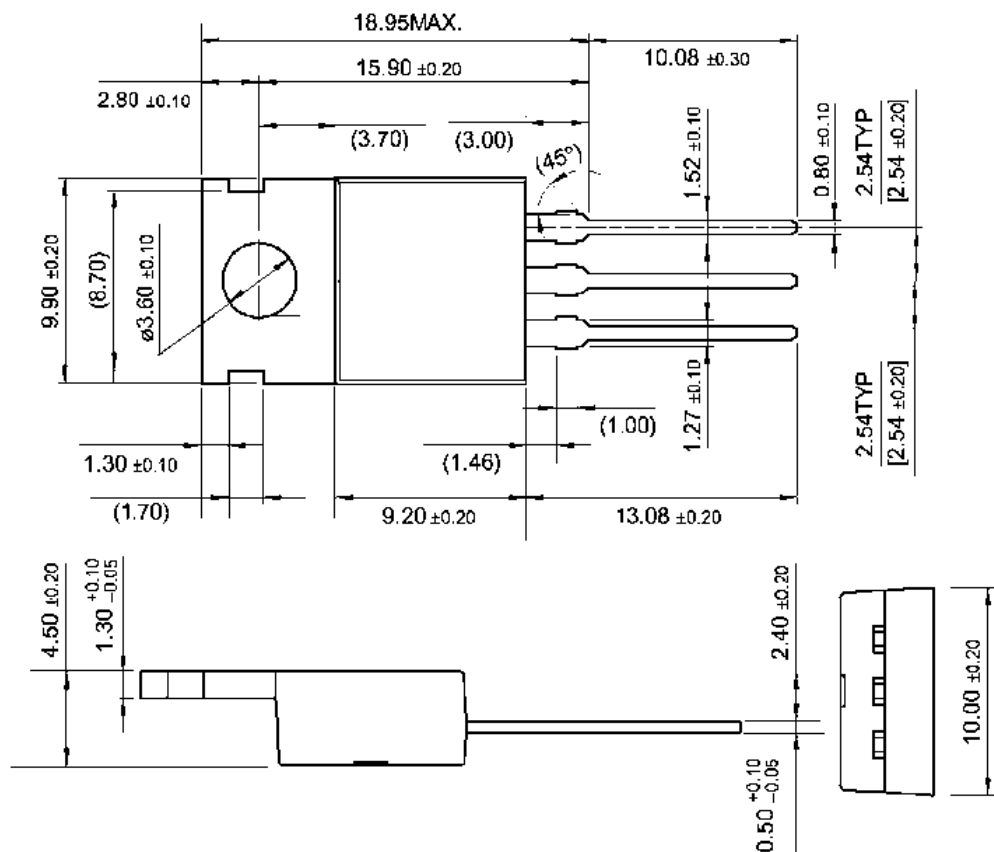
Unit: mm

● 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

