



AS2940

1A Low Dropout Voltage Regulators (PRELIMINARY INFORMATION)

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 AS2940 is a low powered positive voltage regulator. The AS2940 offers 1A output current with dropout voltage of only 0.5V and over temperature dropout is up to 1V. The quiescent current is 30mA at differential output of 5V and output current of 1A. The higher quiescent current can 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 a 3-pin TO-220 and TO-263 package compatible with other 5V regulators. This device offers a variety of output voltages: 3.3V, 5V and 12V. AS2940 is direct replacement to LM2940.

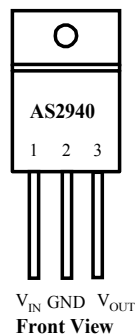
ORDERING INFORMATION

TO-263 3-PIN	TO-220 3-PIN	Oper. Temp. Range
AS2940T-X	AS2940U-X	-40°C to +125°C

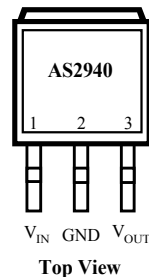
X= Output Voltage (X = 3.3V, 5.0V)
Consult factory for other fixed voltages.

PIN CONNECTIONS

TO-220-3 (U)



TO-263-3 (T)



Top View

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..... -26V to +60V
 Operating Input Supply voltage+2V to 12V
 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 applies over the entire operating temperature range of the indicated device.** All other specifications apply for $T_A = T_J = 25^\circ C$.

Output Voltage (V_O)		5V			Units
Parameter	Conditions	Typ	AS2940 Limit (Note 5)	AS2940 Limit (Note 6)	
		6.25V $\leq V_{IN} \leq 26V$			
Output Voltage	$5 \text{ mA} \leq I_O \leq 1A$	5.00	4.85/4.75 5.15/5.25	4.85/4.75 5.15/5.25	V V
Line Regulation	$V_O + 2V \leq V_{IN} \leq 26V$, $I_O = 5 \text{ mA}$	20	50	40/50	mV
Load Regulation	$50 \text{ mA} \leq I_O \leq 1A$ AS2940, AS2940/833 AS2940C	35	50/80	50/100	mV
		35	50		
Output Impedance	100 mADC and 20 mArms, $f_O = 120 \text{ Hz}$	35		1000/1000	m Ω
Quiescent Current	$V_O + 2V \leq V_{IN} \leq 26V$, $I_O = 5 \text{ mA}$ AS2940, AS2940/833 AS2940C	10	15/20	15/20	mA
		10	15		
	$V_{IN} = V_O + 5V$ $I_O = 1A$	30	45/60	50/60	mA
Output Noise Voltage	10 Hz - 100 kHz, $I_O = 5 \text{ mA}$	150		700/700	μV_{RMS}
Ripple Rejection	$f_O = 120 \text{ Hz}$, 1 V_{RMS} , $I_O = 100 \text{ ma}$ AS2940 AS2940C	72	60/54		dB _{MIN}
		72	60		
	$f_O = 1 \text{ kHz}$, 1 V_{RMS} , $I_O = 5 \text{ mA}$			60/50	dB _{MIN}
Long Term Stability		20			mV/ 1000 Hr
Dropout Voltage	$I_O = 1A$	0.5	0.8/1.0	0.7/1.0	V_{MAX}
	$I_O = 100 \text{ mA}$	110	150/200	150/200	mV_{MAX}

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(Continued)

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

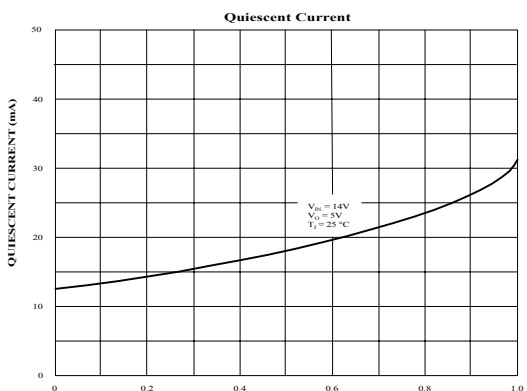
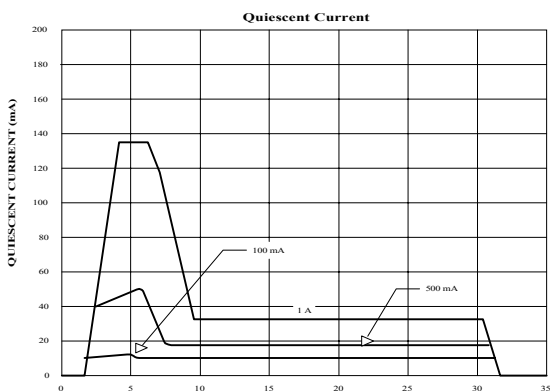
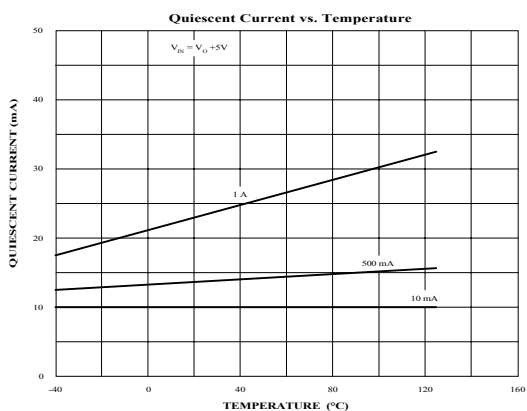
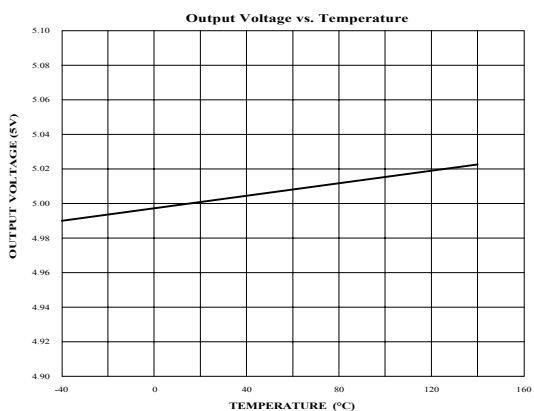
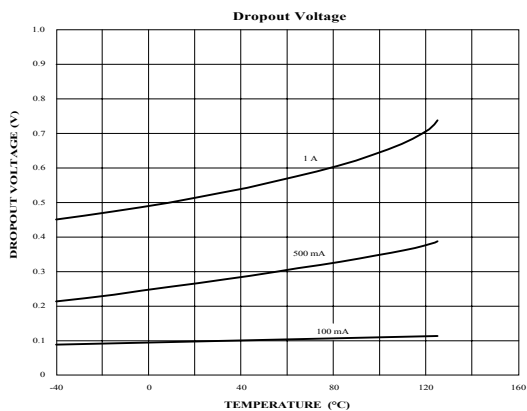
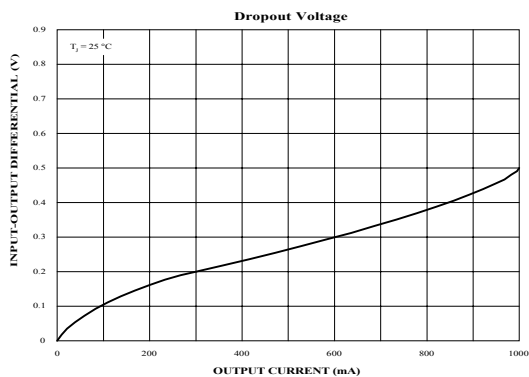
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(Continued)

Output Voltage (V_O)		12V			Units
Parameter	Conditions	Typ	AS2940 Limit (Note 5)	AS2940/883 Limit (Note 6)	
Output Voltage	$5 \text{ mA} \leq I_O \leq 1A$	12.00	13.6V \leq $V_{IN} \leq$ 26V		V
			11.64/11.40	11.64/11.40	
Line Regulation	$V_O + 2V \leq V_{IN} \leq 26V$, $I_O = 5 \text{ mA}$	20	120	75/120	mV
Load Regulation	$50 \text{ mA} \leq I_O \leq 1A$ AS2940, AS2940/833 AS2940C	55	120/200	120/190	mV
		55	120		

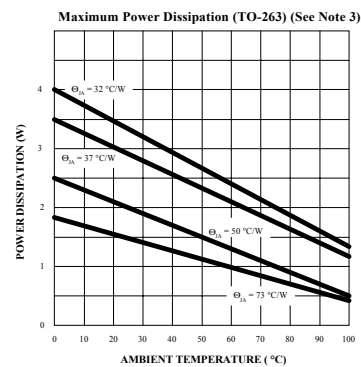
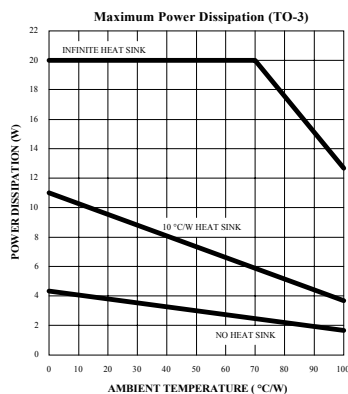
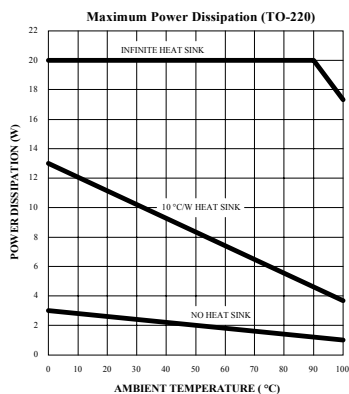
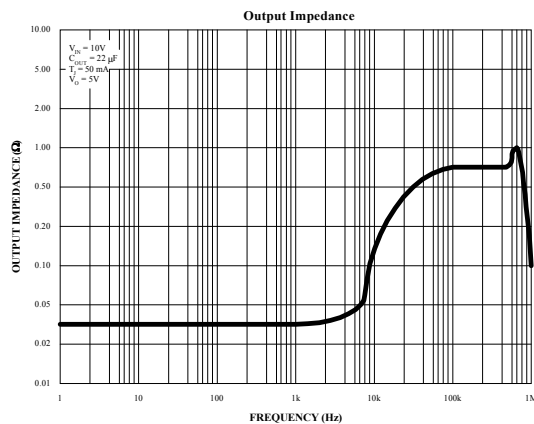
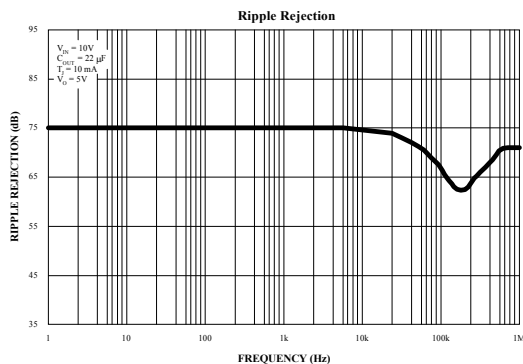
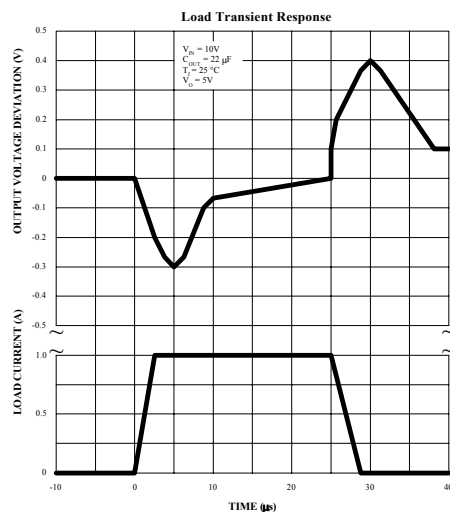
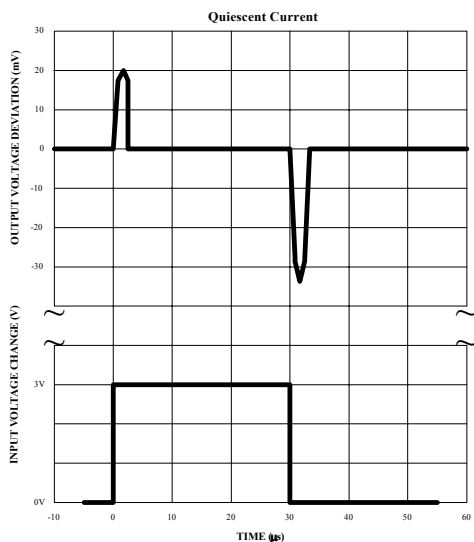
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(Continued)

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

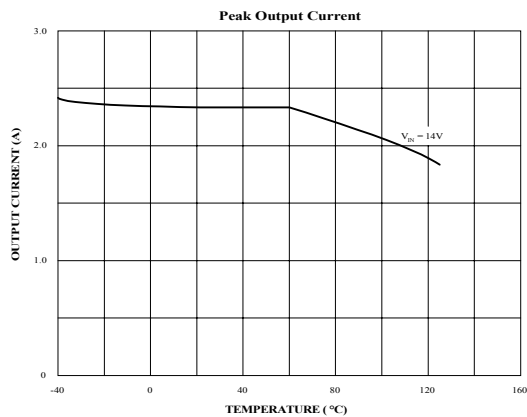
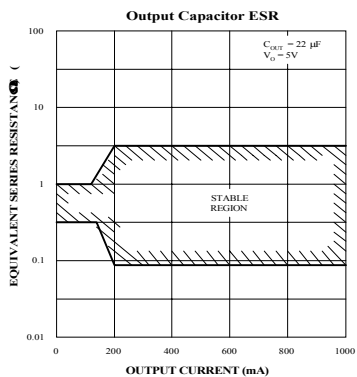
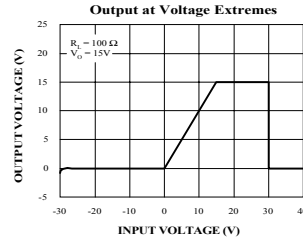
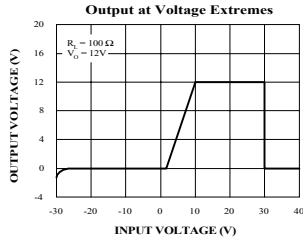
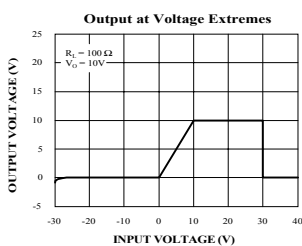
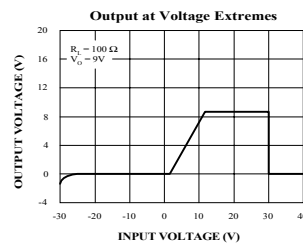
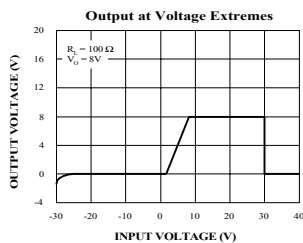
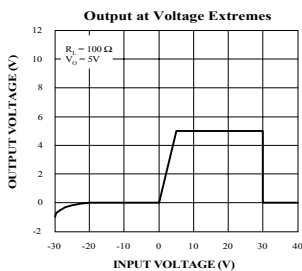
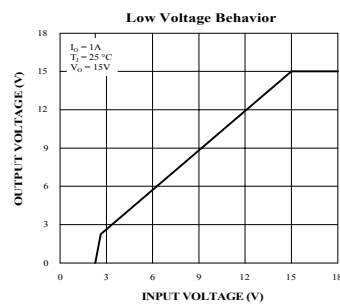
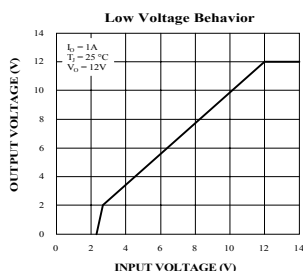
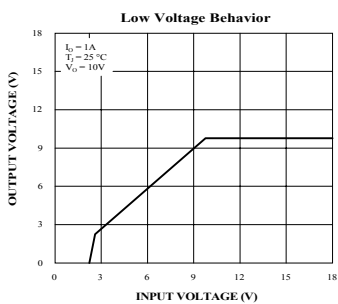
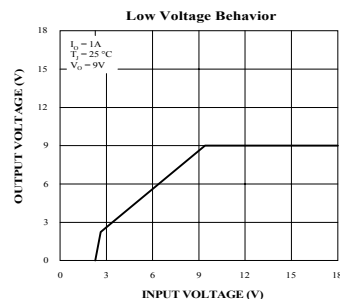
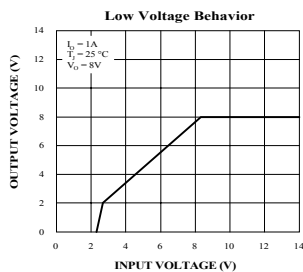
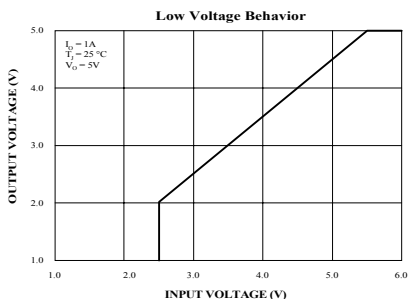
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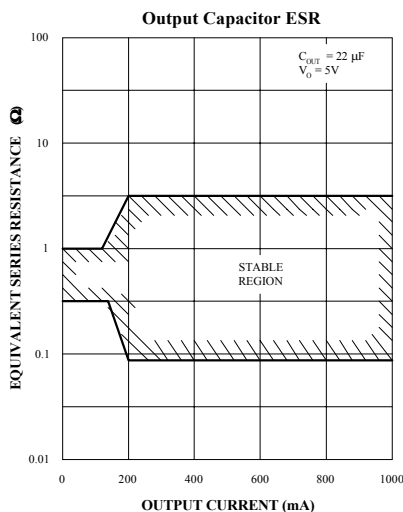
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APPLICATION HINTS

External Capacitors

A minimum capacitance of 22 μ F and conditions on ESR (Equivalent Series Resistance) must be met. The minimum value for the capacitance is 22 μ F and can be increased without limit. However the ESR may cause loop instability if it is too high or too low. The following graph shows the acceptable range for the ESR.



If the capacitor does not meet these requirements oscillation can result.

ESR is specified only at room temperature. Therefore the designer must ensure the proper behavior of the ESR over the temperature range. ESR, for electrolytic capacitor, will increase by about 30X as the temperature is reduced from 25°C to -40°C. Aluminum electrolytic capacitors are not well suited for low temperature operation.

Solid tantalum capacitors' ESR are more stable over temperature, but expensive. A cost-effective approach is then to put in parallel a solid tantalum and a aluminum electrolytic capacitors in the ratio 25/75%.

Thermal Consideration

Although the AS2940 offers some limiting circuitry for overload conditions, it is necessary not to exceed the maximum junction temperature, and therefore to be careful about thermal resistance. The heat flow will follow the lowest resistance path, which is the Junction-to-case thermal resistance. In order to insure the best thermal flow of the component, a proper mounting is required. Note that the case of the device is electrically connected to the output. In case the case has to be electrically isolated, a thermally conductive spacer can be used. However do not forget to consider its contribution to thermal resistance.

Formulas for calculating the power dissipated in the regulator are the following:

$$I_{IN} = I_L + I_G$$

$$P_D = (V_{IN} + V_{OUT}) * I_L + V_{IN} * I_G$$

Where I_{IN} is the input current, I_L is the load current, I_G is the ground current, P_D is the power dissipated, V_{IN} is the input voltage and V_{OUT} is the output voltage.