SPX2940

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

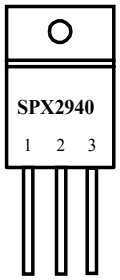
The SPX2940 is a low powered positive voltage regulator. The SPX2940 offers 1A output current with dropout voltage of only 0.5V and over temperature dropout is up to 1V. The quiescent current is 30mA at differential output of 5V and output current of 1A. The higher quiescent current can be exist when 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 SPX2940 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. SPX2940 is direct replacement to LM2940.

PIN CONNECTIONS

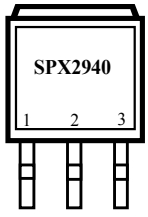
TO-220-3 (U)



V_{IN} GND V_{OUT}

Front View

TO-263-3 (T)



V_{IN} GND V_{OUT}

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 $T_A = T_J = 25°C$.

Output Voltage (V_O)		**5V**			**Units**
Parameter	**Conditions**	**Typ**	**SPX2940 Limit (Note 5)**	**SPX2940 Limit (Note 6)**	
Output Voltage	5 mA ≤ I_O ≤ 1A	**6.25V ≤ V_{IN} ≤ 26V**			
		5.00	4.85/**4.75** 5.15/**5.25**	4.85/**4.75** 5.15/**5.25**	V V
Line Regulation	$V_O + 2V \le V_{IN} \le 26V$, I_O = 5 mA	20	50	40/**50**	mV
Load Regulation	50 mA ≤ I_O ≤ 1A	35	50/**80**	50/**100**	mV
Output Impedance	100 mADC and 20 mArms, f_O = 120 Hz	35		1000/**1000**	mΩ
Quiescent Current	$V_O + 2V \le V_{IN} \le 26V$, I_O = 5 mA	10	15/**20**	15/**20**	mA
	$V_{IN} = V_O + 5V$, I_O = 1A	30	45/**60**	50/**60**	mA
Output Noise Voltage	10 Hz - 100 kHz, I_O = 5 mA	150		700/**700**	μV_{RMS}
Ripple Rejection	f_O = 120 Hz, 1 V_{RMS}, I_O = 100 ma	72	60/**54**		dB_{MIN}
	f_O = 1 kHz, 1 V_{RMS}, I_O = 5 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 mA	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			Units
Parameter	**Conditions**	**Typ**	**SPX2940 Limit (Note 5)**	**SPX2940 Limit (Note 6)**	
		6.25V ≤ V_{IN} ≤ 26V			
Short Circuit Current	(Note 7)	1.9	1.6	1.5/**1.3**	A
Maximum Line Transient	$R_O = 100\Omega$, T ≤ 100 ms	75	60/**60**		V
Reverse Polarity DC Input Voltage	$R_O = 100\Omega$, T ≤ 20 ms	-30	-15/**-15**	-15/**-15**	V
Reverse Polarity Transient Input Voltage	$R_O = 100\Omega$, T ≤ 100 ms	-75	-50/**-50**		V

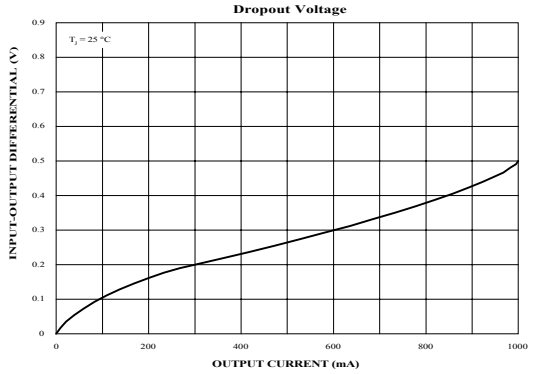
ELECTRICAL CHARACTERISTICS $V_{IN} = V_O + 5V$, $I_O = 1A$, $C_O = 22\ \mu F$, unless otherwise specified. **Boldface limits apply over the entire operating temperature range of the indicated device.** All other specifications apply for $T_A = T_J = 25°C$. (Continued)

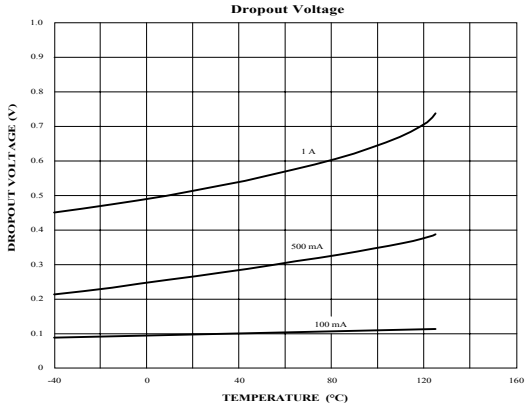
Output Voltage (V_O)		12V			Units
Parameter	**Conditions**	**Typ**	**SPX2940 Limit (Note 5)**	**SPX2940/883 Limit (Note 6)**	
		13.6V ≤ V_{IN} ≤ 26V			
Output Voltage	5 mA ≤ I_O ≤ 1A	12.00	11.64/**11.40** 12.36/**12.60**	11.64/**11.40** 12.36/**12.60**	V V
Line Regulation	$V_O + 2V \le V_{IN} \le 26V$, $I_O = 5$ mA	20	120	75/**120**	mV
Load Regulation	50 mA ≤ I_O ≤ 1A	55	120/**200**	120/**190**	mV

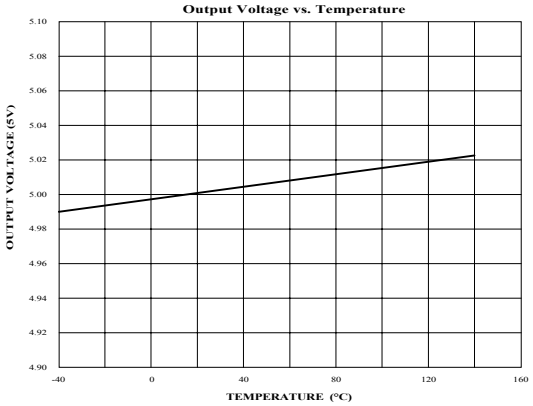
ELECTRICAL CHARACTERISTICS $V_{IN} = V_O + 5V$, $I_O = 1A$, $C_O = 22\ \mu F$, unless otherwise specified. **Boldface limits apply over the entire operating temperature range of the indicated device.** All other specifications apply for $T_A = T_J = 25°C$. (Continued)

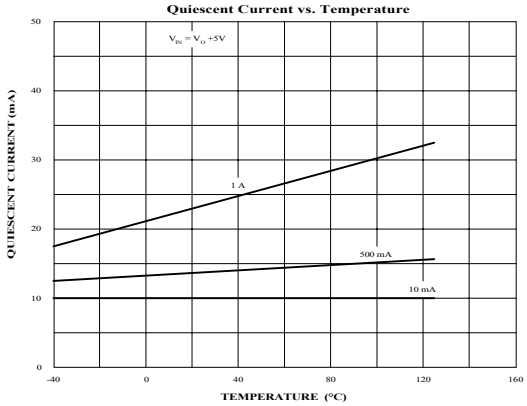
Output Voltage (V_O)		**12V**			**Units**
Parameter	**Conditions**	**Typ**	**SPX2940 Limit (Note 5)**	**SPX2940/833 Limit (Note 6)**	
Output Impedance	100 mADC and 20 mArms, f_O = 120 Hz	**13.6V ≤ V_{IN} ≤ 26V** 80		1000/**1000**	mΩ
Quiescent Current	V_O +2V ≤ V_{IN} ≤ 26V, I_O = 5 mA	10	15/**20**	15/**20**	mA
	$V_{IN} = V_O + 5V$, $I_O = 1A$	30	45/**60**	50/**60**	mA
Output Noise Voltage	10 Hz - 100 kHz, I_O = 5 mA	360		1000/**1000**	μV_{RMS}
Ripple Rejection	f_O = 120 Hz, 1 V_{RMS}, I_O = 100 mA	66	54/**48**		dB
	f_O = 1 kHz, 1 V_{rms}, I_O = 5 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 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 = 100Ω, T ≤ 100 ms	75	60/**60**		V
Reverse Polarity DC Input Voltage	R_O = 100Ω	-30	-15/**-15**	-15/**-15**	V
Reverse Polarity Transient Input Voltage	R_O = 100Ω, T ≤ 20 ms	-75	-50/**-50**		V

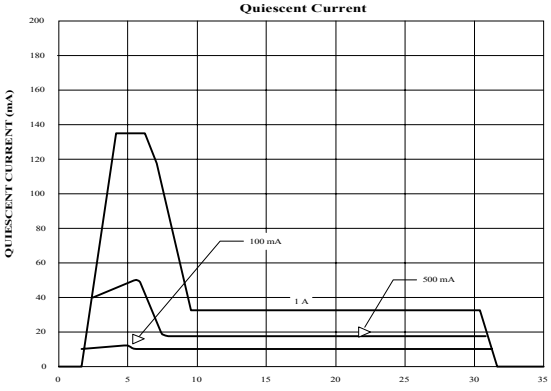
ELECTRICAL CHARACTERISTICS $V_{IN} = V_O + 5V$, $I_O = 1A$, $C_O = 22\ \mu F$, unless otherwise specified.

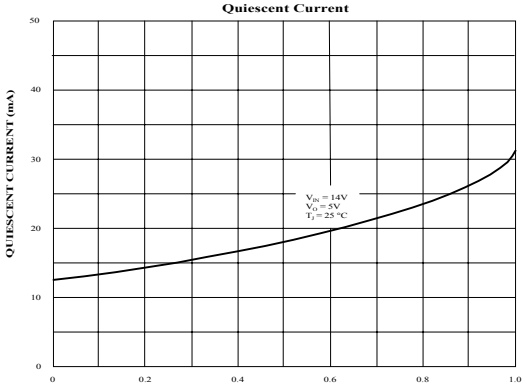






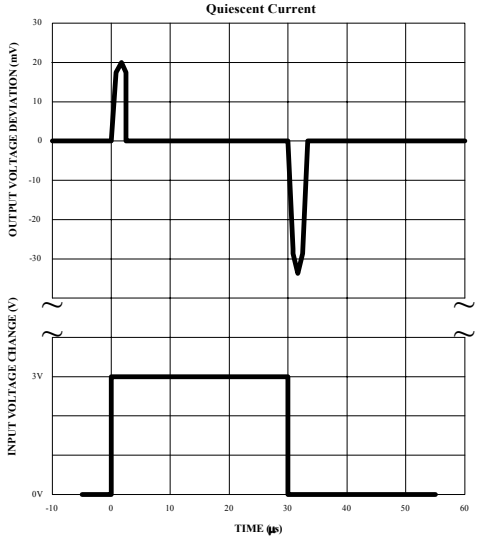




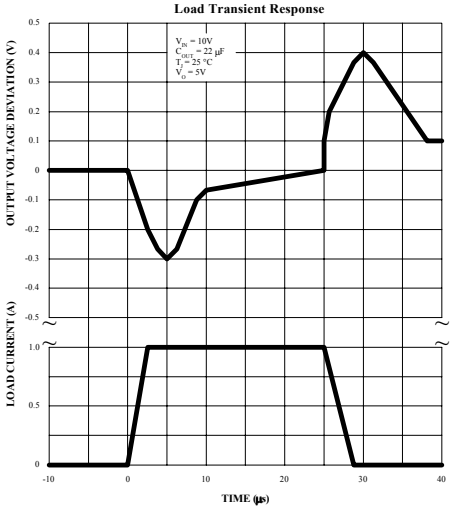


ELECTRICAL CHARACTERISTICS $V_{IN} = V_O + 5V$, $I_O = 1A$, $C_O = 22\ \mu F$, unless otherwise specified.

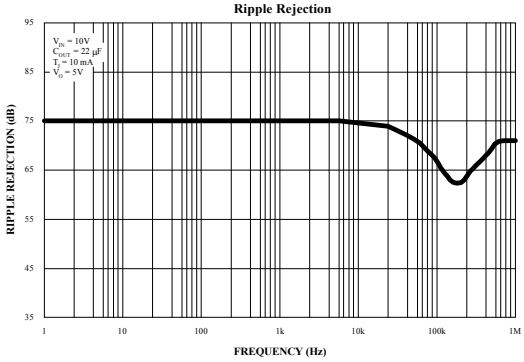
Quiescent Current



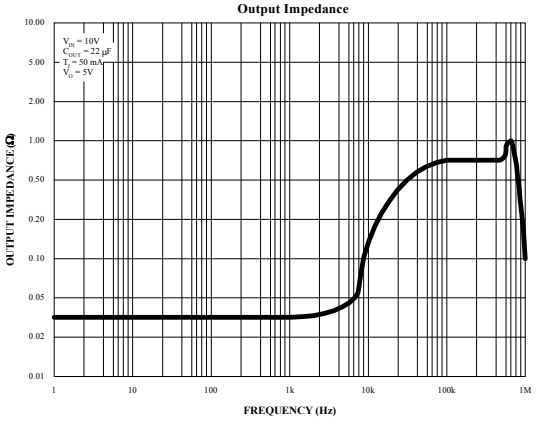
Load Transient Response



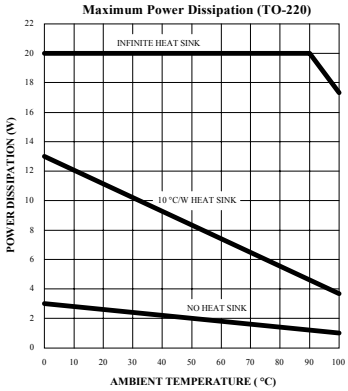
Ripple Rejection



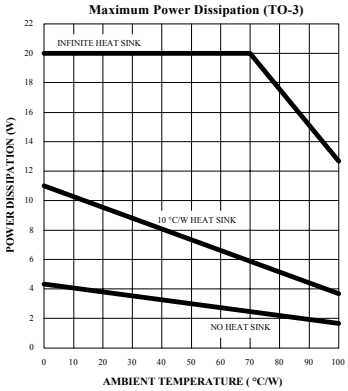
Output Impedance



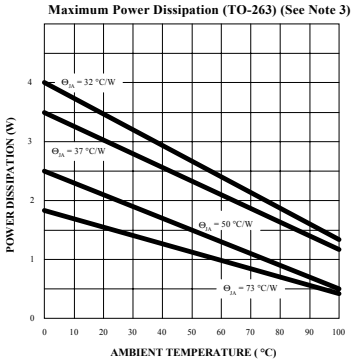
Maximum Power Dissipation (TO-220)



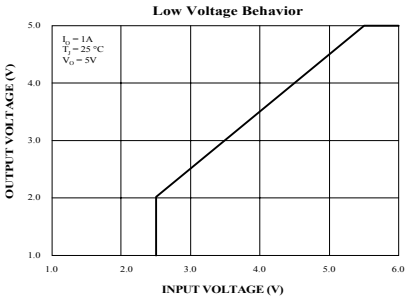
Maximum Power Dissipation (TO-3)

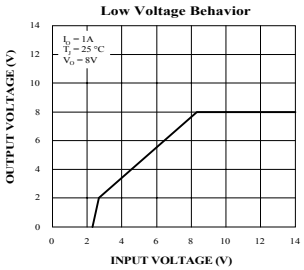


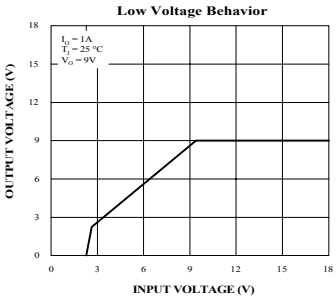
Maximum Power Dissipation (TO-263) (See Note 3)

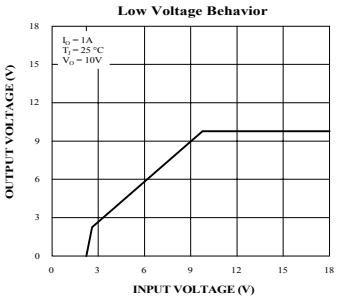


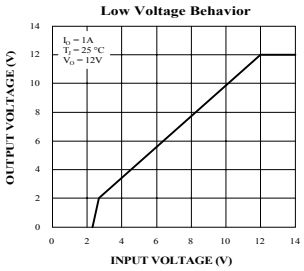
ELECTRICAL CHARACTERISTICS $V_{IN} = V_O + 5V$, $I_O = 1A$, $C_O = 22\ \mu F$, unless otherwise specified.

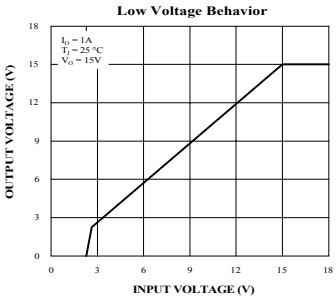


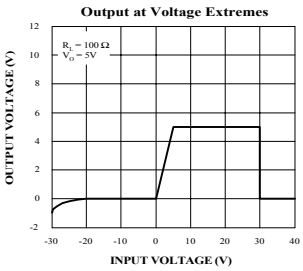


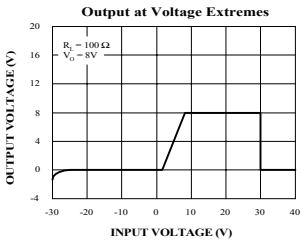


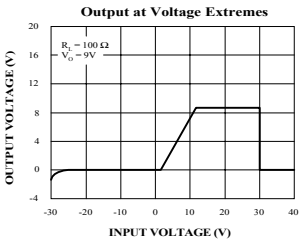


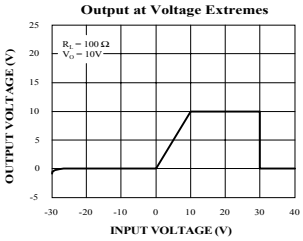


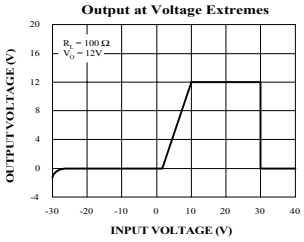


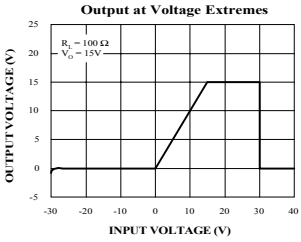


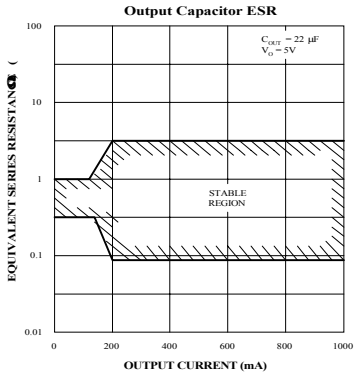


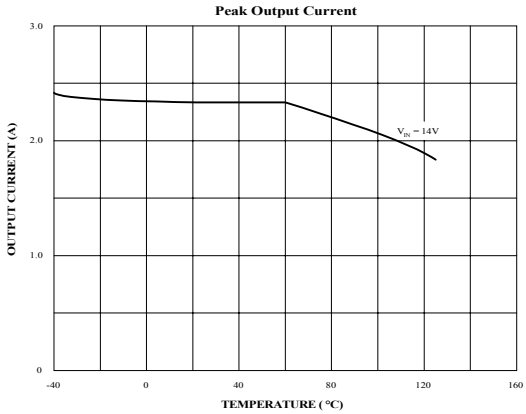






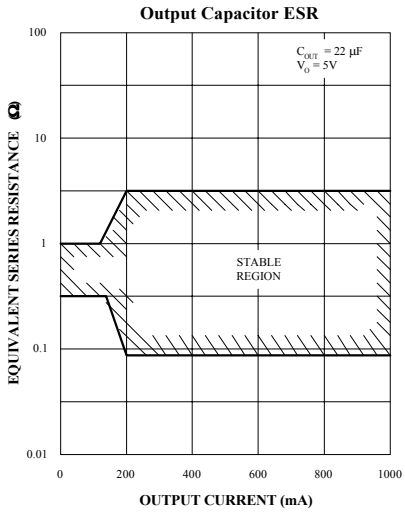






APPLICATION HINTS
External Capacitors

A minimum capacitance of 22µF and conditions on ESR (Equivalent Series Resistance) must be met. The minimum value for the capacitance is 22µF 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 ratio25/75%.

Thermal Consideration

Although the SPX2940 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.

ORDERING INFORMATION

Ordering No.	Output Voltage	Packages
SPX2940T3-3.3	3.3V	3 Lead TO-263
SPX2940T3-5.0	5.0V	3 Lead TO-263
SPX2940T3-12.0	12.0V	3 Lead TO-263
SPX2940U3-3.3	3.3V	3 Lead TO-220
SPX2940U3-5.0	5.0V	3 Lead TO-220
SPX2940U3-12.0	12.0V	3 Lead TO-220

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