# LM2931-5AQ
# 3-TERMINAL POSITIVE VOLTAGE REGULATOR

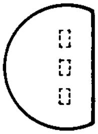
D2828, AUGUST 1988—REVISED OCTOBER 1988



- Input-Output Differential Less than 0.6 V
- Output Current of 150 mA
- Reverse Battery Protection
- Very Low Quiescent Current
- 60-V Load-Dump Protection
- Internal Short-Circuit Current Limiting
- Internal Thermal Overload Protection
- Mirror-Image Insertion Protection
- Reverse Transient Protection
- Direct Improved Replacement for National LM2931-5 and LM2931A-5

LP
SILECT PACKAGE

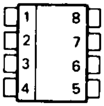
(TOP VIEW)

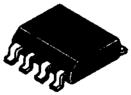



TO-226AA


D
SMALL-OUTLINE PACKAGE

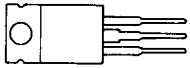
(TOP VIEW)



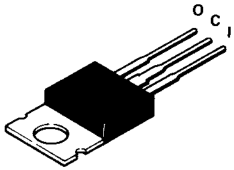
KC PACKAGE

(TOP VIEW)




THE COMMON TERMINAL IS IN ELECTRICAL CONTACT WITH THE MOUNTING BASE

TO-220AB




## description

The LM2931-5AQ is a 3-terminal positive voltage regulator that provides a 5-V regulated output. It features the ability to source 150 mA of output current with an input-output differential of 0.6 V or less. Familiar regulator features such as current limit and thermal overload protection are also provided.

This device also has a low dropout voltage making it useful for certain battery applications. For example, because the low dropout voltage allows a longer battery discharge before the output falls out of regulation, the battery supplying the regulator input voltage may discharge to 5.6 V and still properly regulate the 5-V load voltage. Supporting this feature, the LM2931-5AQ protects both itself and the regulated system from reverse battery installation or 2-battery jumps. The very low quiescent current feature is especially useful in battery-powered applications.

Other protection features include line transient protection from load-dump of up to 60 V. In this case, the regulator shuts down to avoid damaging internal and external circuits. The LM2931-5AQ regulator is virtually immune to temporary mirror-image insertion.

The Q suffix indicates that the device is characterized for operation from −40°C to 125°C.





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## absolute maximum ratings over operating junction temperature range (unless otherwise noted)

Continuous input voltage ........ 26 V
Transient input voltage: t = 1 s ........ 60 V
Continuous reverse input voltage ........ −15 V
Transient reverse input voltage: t = 100 ms ........ −50 V
Continuous total dissipation (see Note 1) ........ See Dissipation Rating Tables 1 and 2
Operating virtual junction temperature ........ −40°C to 125°C
Storage temperature range ........ −65°C to 150°C
Lead temperature 1,6 mm (1/16 inch) from case for 10 seconds ........ 260°C

NOTE 1: To avoid exceeding the design maximum virtual junction temperature, these ratings should not be exceeded. Due to variation in individual device electrical characteristics and thermal resistance, the built-in thermal overload protection may be activated at power levels slightly above or below the rated dissipation.



**DISSIPATION RATING TABLE 1 — FREE-AIR TEMPERATURE**

| PACKAGE | $T_A \le 25°C$ POWER RATING | DERATING FACTOR ABOVE $T_A = 25°C$ | $T_A = 125°C$ POWER RATING |
|---|---|---|---|
| D | 825 mW | 6.6 mW/°C | 165 mW |
| KC | 2000 mW | 16 mW/°C | 400 mW |
| LP | 775 mW | 6.2 mW/°C | 155 mW |

**DISSIPATION RATING TABLE 2 — CASE TEMPERATURE**

| PACKAGE | $T_C \le 25°C$ POWER RATING | DERATING FACTOR | DERATE ABOVE $T_C$ | $T_C = 125°C$ POWER RATING |
|---|---|---|---|---|
| D | 1600 mW | 29.4 mW/°C | 96°C | 735 mW |
| KC | 20 W | 0.18 W/°C | 39°C | 4.5 W |
| LP | 1600 mW | 28.6 mW/°C | 94°C | 715 mW |

## recommended operating conditions

| | MIN | MAX | UNIT |
|---|---|---|---|
| Output current, $I_O$ | | 150 | mA |
| Operating virtual junction temperature, $T_J$ | −40 | 125 | °C |

## electrical characteristics at 25°C virtual junction temperature, $V_I$ = 14 V (unless otherwise noted)

| PARAMETER | TEST CONDITIONS† | | MIN | TYP | MAX | UNIT |
|---|---|---|---|---|---|---|
| Output voltage | $V_I$ = 6 V to 26 V, $I_O \le$ 150 mA, $T_J$ = −40°C to 125°C | | 4.75 | 5 | 5.25 | V |
| Input regulation | $I_O$ = 10 mA | $V_I$ = 9 V to 16 V | | 2 | 10 | mV |
| | | $V_I$ = 6 V to 26 V | | 4 | 30 | |
| Ripple rejection | $I_O$ = 10 mA, f = 120 hz | | 60 | 80 | | dB |
| Output regulation | $I_O$ = 5 mA to 150 mA | | | 14 | 50 | mV |
| Output voltage long-term drift‡ | $I_O$ = 10 mA, After 1000 h at $T_J$ = 125°C | | | 20 | | mV |
| Dropout voltage | $I_O$ = 10 mA | | | 0.05 | 0.2 | V |
| | $I_O$ = 150 mA | | | 0.3 | 0.6 | |
| Output noise voltage | $I_O$ = 10 mA, f = 10 Hz to 100 kHz | | | 500 | | μV rms |
| Bias current | $V_I$ = 6 V to 26 V, $I_O$ = 10 mA, $T_J$ = = −40°C to 125°C | | | 0.4 | 1 | mA |
| | $V_I$ = 14 V, $I_O$ = 150 mA, $T_J$ = 25°C | | | 10 | 12 | |

† Pulse testing techniques are used to maintain the junction temperature as close to the ambient temperature as possible. Thermal effects must be taken into account separately. All characteristics are measured with a 0.1-μF capacitor across the input to common and a 100-μF capacitor, with equivalent series resistance of less then 1 Ω, across the output to common.

‡ Since long-term drift cannot be measured on the individual devices prior to shipment, this specification is not intended to be a guarantee or warranty. It is an engineering estimate of the average drift to be expected from lot to lot.



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