Data Sheet

Temperature sensor ic LM35CZ and LM35DZ

RS stock numbers 317-954 and 317-960

The LM35 is a precision semiconductor temperature sensor giving an output of 10mV per degree Centigrade. Unlike devices with outputs proportional to the absolute temperature (in degrees Kelvin) there is no large offset voltage which, in most applications, will have to be removed.

Accuracies of $^1/_4$°C at room temperature or $^3/_4$°C over the full temperature range are typical.

Absolute maximum ratings (Note 10)

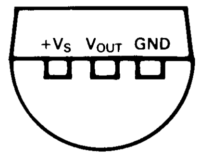
Supply voltage ______ +35V to -0.2V
Output voltage ______ +6V to -1.0V
Output current ______ 10mA
Storage temperature, TO-92 package _-60°C to +150°C
Lead temperature (soldering, 10 seconds) ____260°C
Specified operating temperature range
T_{MIN} to T_{MAX} (Note 2)
LM35CZ ______ -40°C to +110°C
LM35DZ ______ 0°C to +100°C

Features

- Output proportional to °C
- Wide temperature range -40°C to +110°C (CZ version)
- Accurate $^1/_4$°C at room temperature typical
- Linear output 0.2°C typical
- Low current drain (60μA typical)
- Low self heating (0.08°C typical)
- Output impedance 0.1Ω at 1mA
- Standard T092 package.

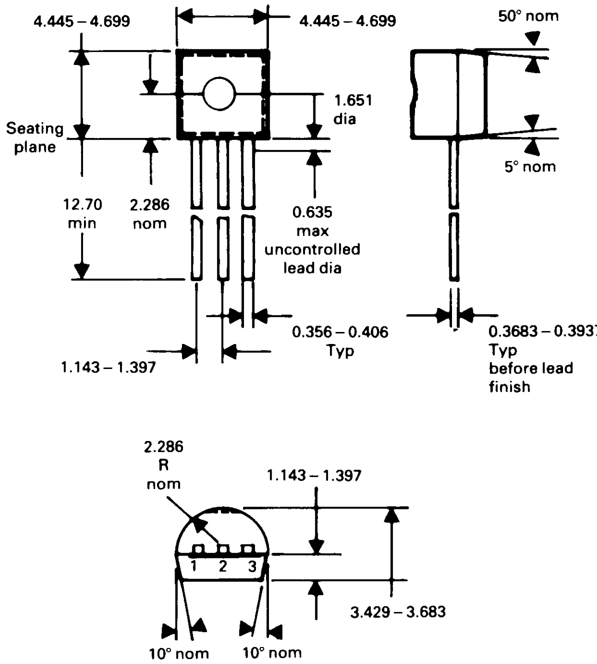
Pin connections

TO-92
Plastic package



BOTTOM VIEW

Package details



Electrical characteristics (Note 1) (Note 6)

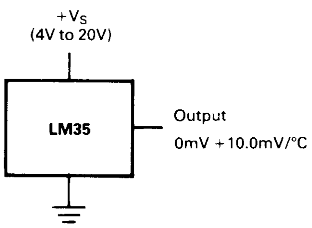
		LM35CZ, LM35DZ			
Parameter	Conditions	Typical	Tested Limit (Note 4)	Design Limit (Note 5)	Units (Max.)
Accuracy, LM35, LM35C (Note 7)	T_A = +25°C T_A = -10°C $T_A = T_{MAX}$ $T_A = T_{MIN}$	±0.4 ±0.5 ±0.8 ±0.8	±1.0	 ±1.5 ±1.5 ±2.0	°C °C °C
Accuracy, LM35D (Note 7)	T_A = +25°C $T_A = T_{MAX}$ $T_A = T_{MIN}$	±0.6 ±0.9 ±0.9	±1.5	 ±2.0 ±2.0	°C °C °C
Non linearity (Note 8)	$T_{MIN} \leq T_A \leq T_{MAX}$	**±0.2**		**±0.5**	°C
Sensor gain (Average slope)	$T_{MIN} \leq T_A \leq T_{MAX}$	**+10.0**		**+9.8** **+10.2**	mV/°C
Load regulation (Note 3) $0 \leq I_L \leq 1$mA	T_A = +25°C $T_{MIN} \leq T_A \leq T_{MAX}$	±0.4 **±0.5**	±2.0	 **±5.0**	mV/mA mV/mA
Line regulation (Note 3)	T_A = +25°C 4V≤VS±≤30V	±0.01 **±0.02**	±0.1	 **±0.2**	mV/V mV/V
Quiescent current (Note 9)	V_S = +5V, +25°C V_S = +5V V_S = +30V, +25°C V_S = +30V	56 **91** 56.2 **91.5**	80 82	 **138** **141**	μA μA μA μA
Change of quiescent current (Note 3)	$4V \leq V_S \leq 30V$, +25°C $4V \leq V_S \leq 30V$	0.2 **0.5**	2.0	 **3.0**	μA μA
Temperature coefficient of quiescent current		**+0.39**		**+0.7**	μA/°C
Minimum temperature for rated accuracy	In circuit of Figure 1, I_L = 0	+1.5		+2.0	°C
Long term stability	T_J-T_{MAX}, for 1000 hours	+0.08			°C

Notes:

1. Unless otherwise noted, these specifications apply: -40°≤T_J≤ + 110°C for the LM35C and 0°≤T_J≤+100°C for the LM35D. V_S = +5Vdc and I_{LOAD} = 50μA, in the circuit of Figure 2. These specifications also apply from +2°C to T_{MAX} in the circuit of Figure 1. Specifications in **boldface** apply over the full rated temperature range.
2. Thermal resistance of the TO-92 package is 180°C/W junction to ambient.
3. Regulation is measured at constant junction temperature, using pulse testing with a low duty cycle. Changes in output due to heating effects can be computed by multiplying the internal dissipation by the thermal resistance.
4. Tested limits are guaranteed and 100% tested in production.
5. Design limits are guaranteed (but not 100% production tested) over the indicated temperature and supply voltage ranges. These limits are not used to calculate outgoing quality levels.
6. Specifications in **boldface** apply over the full rated temperature range.
7. Accuracy is defined as the error between the output voltage and 10mV/°C times the device's case temperature, at specified conditions of voltage, current, and temperature (expressed in °C).
8. Non linearity is defined as the deviation of the output-voltage-versus-temperature curve from the best-fit straight line, over the device's rated temperature range.
9. Quiescent current is defined in the circuit of Figure 1.
10. Absolute maximum ratings indicate limits beyond which damage to the device may occur. dc and ac electrical specifications are not ensured when operating the device at absolute maximum ratings.

Application notes

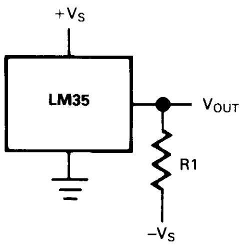
Figure 1



The circuit shown in Figure 1 is a basic single ended temperature sensor capable of measuring between +2°C and +100°C or +110°C depending on version.

To measure negative temperatures a negative supply is required as shown in Figure 2.

Figure 2



R1 should be selected as follows:

$$R1 = \frac{-V_s}{50 \times 10^{-6}}$$

Care must be taken when driving capacitive load, such as long cables or any load exceeding 50pF.

To remove the effect of capacitive loads the circuit shown Figure 3 should be used, however the resistor is added to the output impedance making this circuit suitable for connection to high impedance loads only.

Figure 4 shows a circuit when will overcome this problem and also give protection from radiated interference from relays or any other source of electrical noise.

Figure 3

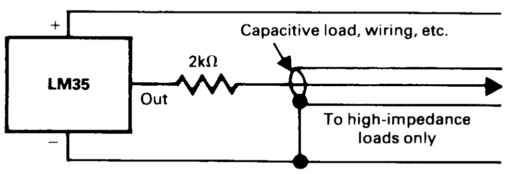
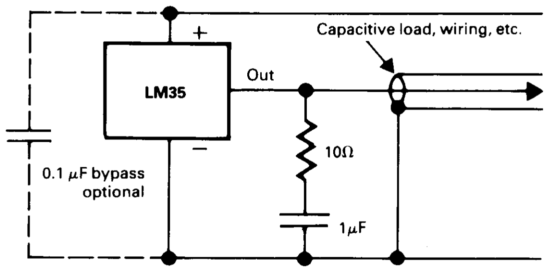


Figure 4



The circuits below show some typical applications of these temperature sensors.

Figure 5 **Two-wire remote temperature sensor with sensor grounded**

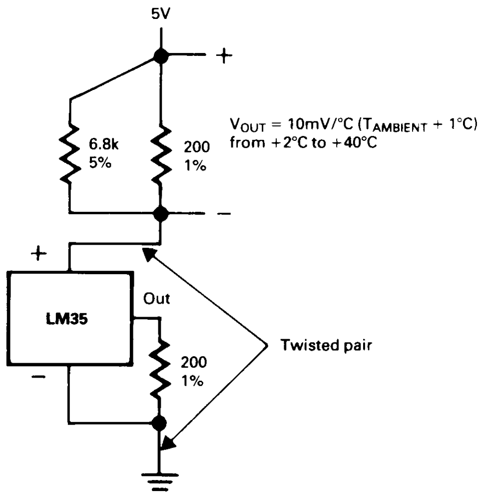


Figure 6 **Two-wire remote temperature sensor**

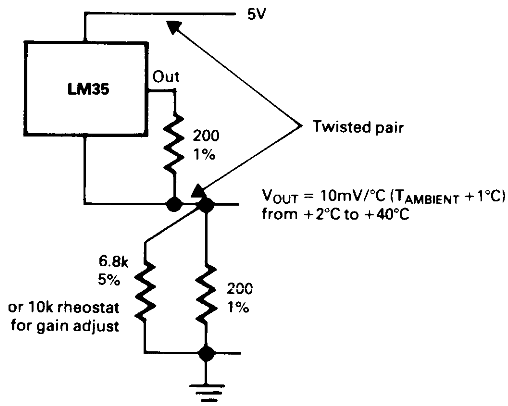


Figure 7 Temperature sensor, single supply, capable of measuring negative temperatures

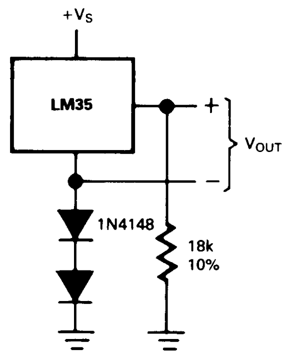


Figure 8 Centigrade thermometer

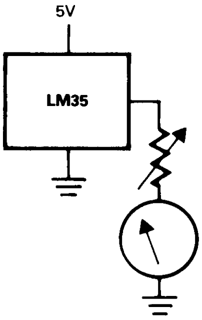


Figure 9 Expanded scale thermometer