# LM35 Precision Centigrade Temperature Sensors

## FEATURES

- **Calibrated Directly in ° Celsius (Centigrade)**
- **Linear + 10 mV/°C Scale Factor**
- **0.5°C Ensured Accuracy (at +25°C)**
- **Rated for Full −55°C to +150°C Range**
- **Suitable for Remote Applications**
- **Low Cost Due to Wafer-Level Trimming**
- **Operates from 4 to 30 V**
- **Less than 60-µA Current Drain**
- **Low Self-Heating, 0.08°C in Still Air**
- **Nonlinearity Only ±¼°C Typical**
- **Low Impedance Output, 0.1 Ω for 1 mA Load**

## DESCRIPTION

The LM35 series are precision integrated-circuit temperature sensors, with an output voltage linearly proportional to the Centigrade temperature. Thus the LM35 has an advantage over linear temperature sensors calibrated in ° Kelvin, as the user is not required to subtract a large constant voltage from the output to obtain convenient Centigrade scaling. The LM35 does not require any external calibration or trimming to provide typical accuracies of ±¼°C at room temperature and ±¾°C over a full −55°C to +150°C temperature range. Low cost is assured by trimming and calibration at the wafer level. The low output impedance, linear output, and precise inherent calibration of the LM35 make interfacing to readout or control circuitry especially easy. The device is used with single power supplies, or with plus and minus supplies. As the LM35 draws only 60 µA from the supply, it has very low self-heating of less than 0.1°C in still air. The LM35 is rated to operate over a −55°C to +150°C temperature range, while the LM35C is rated for a −40°C to +110°C range (−10° with improved accuracy). The LM35 series is available packaged in hermetic TO transistor packages, while the LM35C, LM35CA, and LM35D are also available in the plastic TO-92 transistor package. The LM35D is also available in an 8-lead surface-mount small-outline package and a plastic TO-220 package.

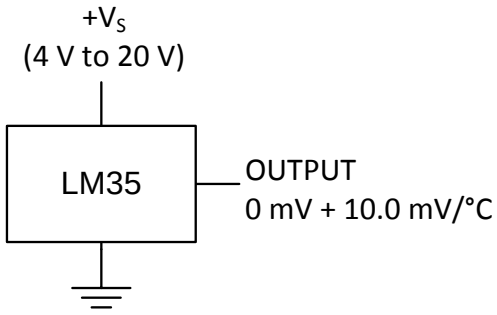
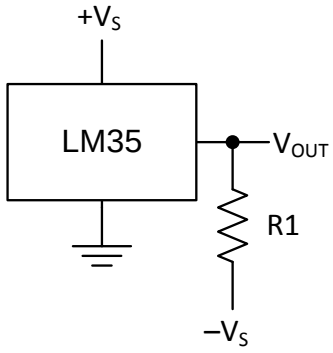



**Figure 1. Basic Centigrade Temperature Sensor (+2°C to +150°C)**




Choose $R_1 = -V_S / 50\ \mu A$
$V_{OUT} = 1500$ mV at 150°C
$V_{OUT} = 250$ mV at 25°C
$V_{OUT} = -550$ mV at −55°C

**Figure 2. Full-Range Centigrade Temperature Sensor**

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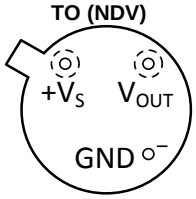
PRODUCTION DATA information is current as of publication date. Products conform to specifications per the terms of the Texas Instruments standard warranty. Production processing does not necessarily include testing of all parameters.

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These devices have limited built-in ESD protection. The leads should be shorted together or the device placed in conductive foam during storage or handling to prevent electrostatic damage to the MOS gates.

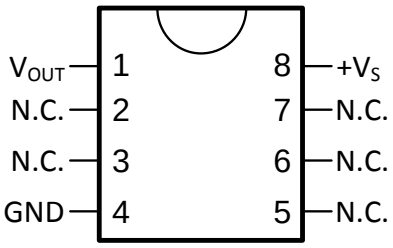
## CONNECTION DIAGRAMS

**METAL CAN PACKAGE**
**TO (NDV)**



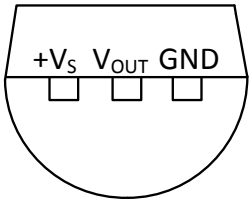

Case is connected to negative pin (GND)

**SMALL-OUTLINE MOLDED PACKAGE**
**SOIC-8 (D)**
**TOP VIEW**

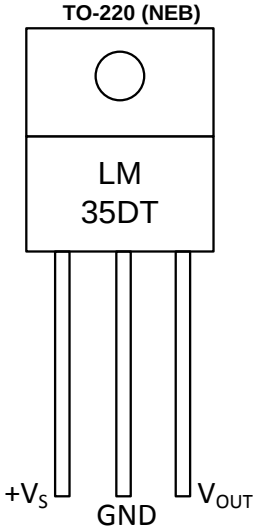



N.C. = No connection

**PLASTIC PACKAGE**
**TO-92 (LP)**
**BOTTOM VIEW**




**PLASTIC PACKAGE**
**TO-220 (NEB)**




Tab is connected to the negative pin (GND).

**NOTE:** The LM35DT pinout is different than the discontinued LM35DP


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## ABSOLUTE MAXIMUM RATINGS(1)(2)

| | | | MIN | MAX | UNIT |
|---|---|---|---|---|---|
| Supply voltage | | | –0.2 | 35 | V |
| Output voltage | | | –1 | 6 | V |
| Output current | | | | 10 | mA |
| Electrostatic discharge (ESD) susceptibility(3) | | | | 2500 | V |
| Storage temperature | TO Package | | –60 | 180 | °C |
| | TO-92 Package | | –60 | 150 | |
| | TO-220 Package | | –65 | 150 | |
| | SOIC-8 Package | | –65 | 150 | |
| Lead temperature | TO Package (soldering, 10 seconds) | | | 300 | °C |
| | TO-92 and TO-220 Package (soldering, 10 seconds) | | | 260 | |
| | SOIC Package | Infrared (15 seconds) | | 220 | |
| | | Vapor phase (60 seconds) | | 215 | |
| Specified operating temperature range: $T_{MIN}$ to $T_{MAX}$(4) | LM35, LM35A | | –55 | 150 | °C |
| | LM35C, LM35CA | | –40 | 110 | |
| | LM35D | | 0 | 100 | |

(1) If Military/Aerospace specified devices are required, please contact the Texas Instruments Sales Office/ Distributors for availability and specifications.
(2) Absolute Maximum Ratings indicate limits beyond which damage to the device may occur. DC and AC electrical specifications do not apply when operating the device beyond its rated operating conditions. See Note 1.
(3) Human body model, 100 pF discharged through a 1.5-kΩ resistor.
(4) Thermal resistance of the TO-46 package is 400°C/W, junction to ambient, and 24°C/W junction to case. Thermal resistance of the TO-92 package is 180°C/W junction to ambient. Thermal resistance of the small outline molded package is 220°C/W junction to ambient. Thermal resistance of the TO-220 package is 90°C/W junction to ambient. For additional thermal resistance information see table in the APPLICATIONS section.

## ELECTRICAL CHARACTERISTICS(1)(2)

| PARAMETER | TEST CONDITIONS | LM35A | | | LM35CA | | | UNITS (MAX.) |
|---|---|---|---|---|---|---|---|---|
| | | TYP | TESTED LIMIT(3) | DESIGN LIMIT(4) | TYP | TESTED LIMIT(3) | DESIGN LIMIT(4) | |
| Accuracy(5) | $T_A$ = 25°C | ±0.2 | ±0.5 | | ±0.2 | ±0.5 | | °C |
| | $T_A$ = –10°C | ±0.3 | | | ±0.3 | | ±1 | |
| | $T_A$ = $T_{MAX}$ | ±0.4 | ±1 | | ±0.4 | ±1 | | |
| | $T_A$ = $T_{MIN}$ | ±0.4 | ±1 | | ±0.4 | | ±1.5 | |
| Nonlinearity(6) | $T_{MIN} \le T_A \le T_{MAX}$ | **±0.18** | | **±0.35** | **±0.15** | | **±0.3** | °C |
| Sensor gain (average slope) | $T_{MIN} \le T_A \le T_{MAX}$ | **+10** | **+9.9, +10.1** | | **+10** | | **+9.9, +10.1** | mV/°C |
| Load regulation(7) $0 \le I_L \le 1$ mA | $T_A$ = 25°C | ±0.4 | ±1 | | ±0.4 | ±1 | | mV/mA |
| | $T_{MIN} \le T_A \le T_{MAX}$ | **±0.5** | | **±3** | **±0.5** | | **±3** | |
| Line regulation(7) | $T_A$ = 25°C | ±0.01 | ±0.05 | | ±0.01 | ±0.05 | | mV/V |
| | 4 V ≤ $V_S$ ≤ 30 V | **±0.02** | | **±0.1** | **±0.02** | | **±0.1** | |

(1) Unless otherwise noted, these specifications apply: −55°C ≤ $T_J$ ≤ 150°C for the LM35 and LM35A; −40°C ≤ $T_J$ ≤ 110°C for the LM35C and LM35CA; and 0°C ≤ $T_J$ ≤ 100°C for the LM35D. $V_S$ = 5 Vdc and $I_{LOAD}$ = 50 μA, 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) Specifications in boldface apply over the full rated temperature range.
(3) Tested Limits are ensured and 100% tested in production.
(4) Design Limits are ensured (but not 100% production tested) over the indicated temperature and supply voltage ranges. These limits are not used to calculate outgoing quality levels.
(5) Accuracy is defined as the error between the output voltage and 10 mv/°C times the case temperature of the device, at specified conditions of voltage, current, and temperature (expressed in °C).
(6) Nonlinearity is defined as the deviation of the output-voltage-versus-temperature curve from the best-fit straight line, over the rated temperature range of the device.
(7) 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.

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## ELECTRICAL CHARACTERISTICS[1][2] (continued)

| PARAMETER | TEST CONDITIONS | LM35A | | | LM35CA | | | UNITS (MAX.) |
|---|---|---|---|---|---|---|---|---|
| | | TYP | TESTED LIMIT[3] | DESIGN LIMIT[4] | TYP | TESTED LIMIT[3] | DESIGN LIMIT[4] | |
| Quiescent current[8] | $V_S$ = 5 V, 25°C | 56 | 67 | | 56 | 67 | | µA |
| | $V_S$ = 5 V | **105** | | **131** | **91** | | **114** | |
| | $V_S$ = 30 V, 25°C | 56.2 | 68 | | 56.2 | 68 | | |
| | $V_S$ = 30 V | **105.5** | | **133** | **91.5** | | **116** | |
| Change of quiescent current[7] | 4 V ≤ $V_S$ ≤ 30 V, 25°C | 0.2 | 1 | | 0.2 | 1 | | µA |
| | 4 V ≤ $V_S$ ≤ 30 V | **0.5** | | **2** | **0.5** | | **2** | |
| Temperature coefficient of quiescent current | | **+0.39** | | **+0.5** | **+0.39** | | **+0.5** | µA/°C |
| Minimum temperature for rate accuracy | In circuit of Figure 1, $I_L$ = 0 | +1.5 | | +2 | +1.5 | | +2 | °C |
| Long term stability | $T_J$ = $T_{MAX}$, for 1000 hours | ±0.08 | | | ±0.08 | | | °C |

(8) Quiescent current is defined in the circuit of Figure 1.

## ELECTRICAL CHARACTERISTICS[1][2]

| PARAMETER | TEST CONDITIONS | LM35 | | | LM35C, LM35D | | | UNITS (MAX.) |
|---|---|---|---|---|---|---|---|---|
| | | TYP | TESTED LIMIT[3] | DESIGN LIMIT[4] | TYP | TESTED LIMIT[3] | DESIGN LIMIT[4] | |
| Accuracy, LM35, LM35C[5] | $T_A$ = 25°C | ±0.4 | ±1 | | ±0.4 | ±1 | | °C |
| | $T_A$ = –10°C | ±0.5 | | | ±0.5 | | ±1.5 | |
| | $T_A$ = $T_{MAX}$ | ±0.8 | ±1.5 | | ±0.8 | | ±1.5 | |
| | $T_A$ = $T_{MIN}$ | ±0.8 | | ±1.5 | ±0.8 | | ±2 | |
| Accuracy, LM35D[5] | $T_A$ = 25°C | | | | ±0.6 | ±1.5 | | °C |
| | $T_A$ = $T_{MAX}$ | | | | ±0.9 | | ±2 | |
| | $T_A$ = $T_{MIN}$ | | | | ±0.9 | | ±2 | |
| Nonlinearity[6] | $T_{MIN}$ ≤ $T_A$ ≤ $T_{MAX}$ | **±0.3** | | **±0.5** | **±0.2** | | **±0.5** | °C |
| Sensor gain (average slope) | $T_{MIN}$ ≤ $T_A$ ≤ $T_{MAX}$ | **+10** | **+9.8, +10.2** | | **+10** | | **+9.8, +10.2** | mV/°C |
| Load regulation[7] 0 ≤ $I_L$ ≤ 1 mA | $T_A$ = 25°C | ±0.4 | ±2 | | ±0.4 | ±2 | | mV/mA |
| | $T_{MIN}$ ≤ $T_A$ ≤ $T_{MAX}$ | **±0.5** | | **±5** | **±0.5** | | **±5** | |
| Line regulation[7] | $T_A$ = 25°C | ±0.01 | ±0.1 | | ±0.01 | ±0.1 | | mV/V |
| | 4 V ≤ $V_S$ ≤ 30 V | **±0.02** | | **±0.2** | **±0.02** | | **±0.2** | |

(1) Unless otherwise noted, these specifications apply: −55°C ≤ $T_J$ ≤ 150°C for the LM35 and LM35A; −40°C ≤ $T_J$ ≤ 110°C for the LM35C and LM35CA; and 0°C ≤ $T_J$ ≤ 100°C for the LM35D. $V_S$ = 5 Vdc and $I_{LOAD}$ = 50 µA, 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) Specifications in boldface apply over the full rated temperature range.
(3) Tested Limits are ensured and 100% tested in production.
(4) Design Limits are ensured (but not 100% production tested) over the indicated temperature and supply voltage ranges. These limits are not used to calculate outgoing quality levels.
(5) Accuracy is defined as the error between the output voltage and 10 mv/°C times the case temperature of the device, at specified conditions of voltage, current, and temperature (expressed in °C).
(6) Nonlinearity is defined as the deviation of the output-voltage-versus-temperature curve from the best-fit straight line, over the rated temperature range of the device.
(7) 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.


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## ELECTRICAL CHARACTERISTICS[1][2] (continued)

| PARAMETER | TEST CONDITIONS | LM35 | | | LM35C, LM35D | | | UNITS (MAX.) |
|---|---|---|---|---|---|---|---|---|
| | | TYP | TESTED LIMIT[3] | DESIGN LIMIT[4] | TYP | TESTED LIMIT[3] | DESIGN LIMIT[4] | |
| Quiescent current[8] | $V_S$ = 5 V, 25°C | 56 | 80 | | 56 | 80 | | µA |
| | $V_S$ = 5 V | **105** | | **158** | **91** | | **138** | |
| | $V_S$ = 30 V, 25°C | 56.2 | 82 | | 56.2 | 82 | | |
| | $V_S$ = 30 V | **105.5** | | **161** | **91.5** | | **141** | |
| Change of quiescent current[9] | 4 V ≤ $V_S$ ≤ 30 V, 25°C | 0.2 | 2 | | 0.2 | 2 | | µA |
| | 4 V ≤ $V_S$ ≤ 30 V | **0.5** | | **3** | **0.5** | | **3** | |
| Temperature coefficient of quiescent current | | **+0.39** | | **+0.7** | **+0.39** | | **+0.7** | µA/°C |
| Minimum temperature for rate accuracy | In circuit of Figure 1, $I_L$ = 0 | +1.5 | | +2 | +1.5 | | +2 | °C |
| Long term stability | $T_J$ = $T_{MAX}$, for 1000 hours | ±0.08 | | | ±0.08 | | | °C |

(8) Quiescent current is defined in the circuit of Figure 1.
(9) 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.

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## TYPICAL PERFORMANCE CHARACTERISTICS

THERMAL RESISTANCE JUNCTION TO AIR

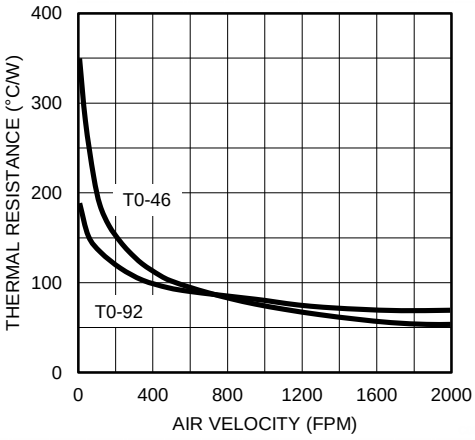



**Figure 3.**

THERMAL TIME CONSTANT

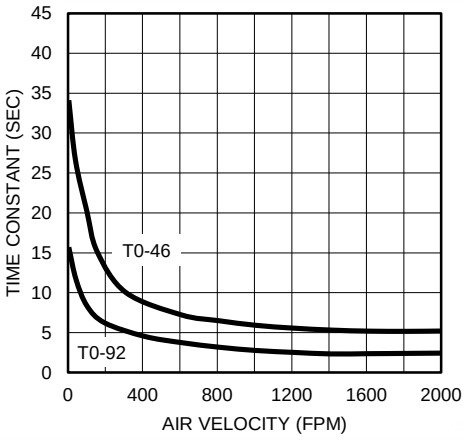



**Figure 4.**

THERMAL RESPONSE IN STILL AIR

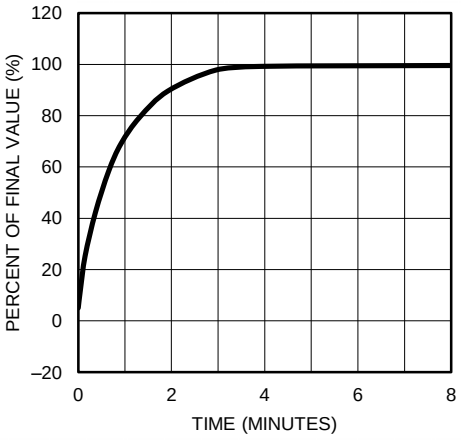



**Figure 5.**

THERMAL RESPONSE IN STIRRED OIL BATH

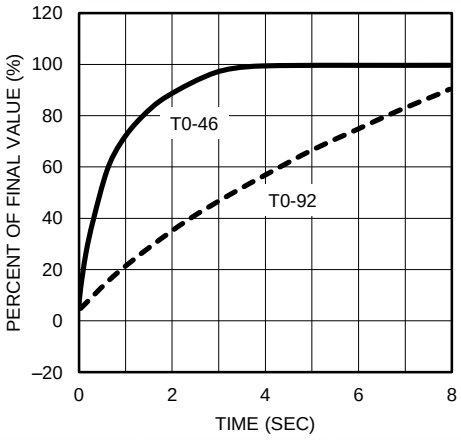



**Figure 6.**

MINIMUM SUPPLY VOLTAGE VS TEMPERATURE

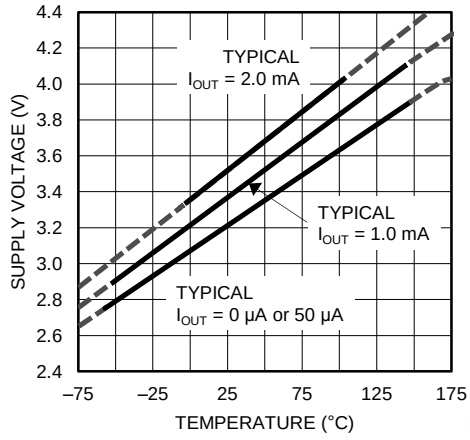



**Figure 7.**

QUIESCENT CURRENT VS TEMPERATURE (IN CIRCUIT OF Figure 1)

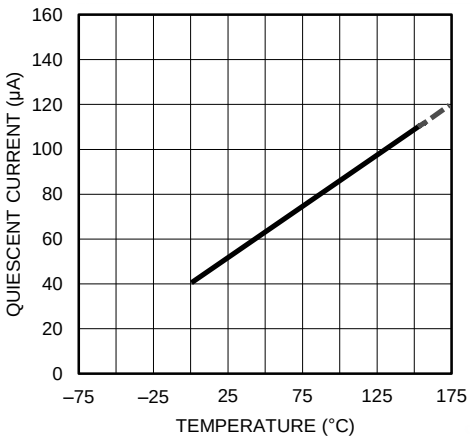



**Figure 8.**


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## TYPICAL PERFORMANCE CHARACTERISTICS (continued)

**QUIESCENT CURRENT vs TEMPERATURE (IN CIRCUIT OF Figure 2)**

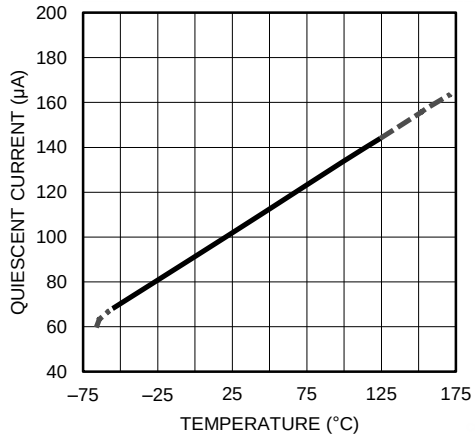



**Figure 9.**

**ACCURACY vs TEMPERATURE (ENSURED)**

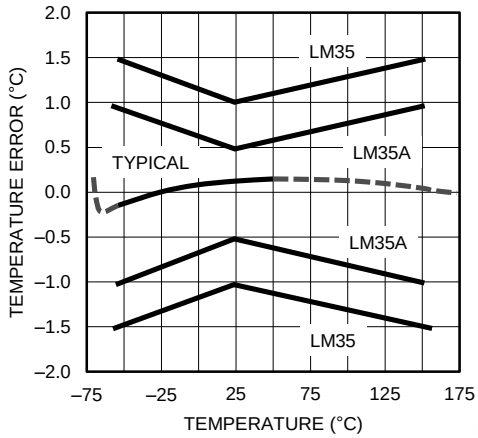



**Figure 10.**

**ACCURACY vs TEMPERATURE (ENSURED)**

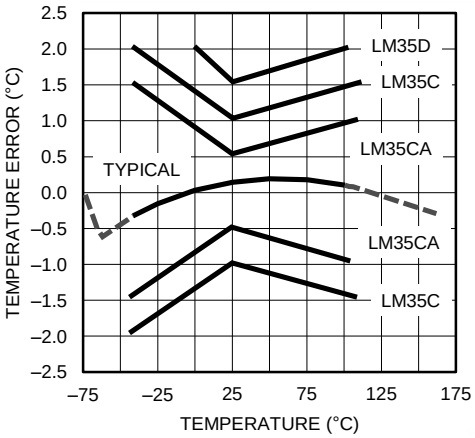



**Figure 11.**

**NOISE VOLTAGE**

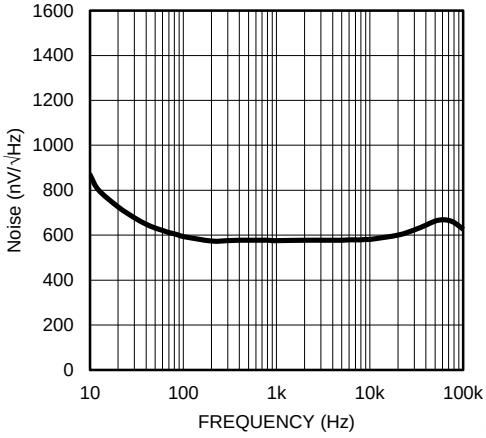



**Figure 12.**

**START-UP RESPONSE**

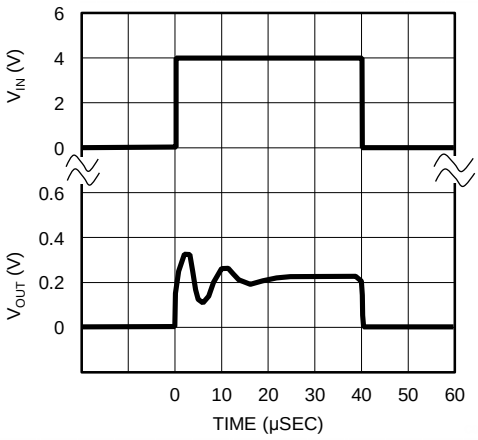



**Figure 13.**

## APPLICATIONS

The LM35 is applied easily in the same way as other integrated-circuit temperature sensors. Glue or cement the device to a surface and the temperature should be within about 0.01°C of the surface temperature.

This presumes that the ambient air temperature is almost the same as the surface temperature. If the air temperature were much higher or lower than the surface temperature, the actual temperature of the LM35 die would be at an intermediate temperature between the surface temperature and the air temperature, which is especially true for the TO-92 plastic package where the copper leads are the principal thermal path to carry heat into the device, so its temperature might be closer to the air temperature than to the surface temperature.

To minimize this problem, ensure that the wiring to the LM35, as it leaves the device, is held at the same temperature as the surface of interest. The easiest way to do this is to cover up these wires with a bead of epoxy which will insure that the leads and wires are all at the same temperature as the surface, and that the temperature of the LM35 die is not affected by the air temperature.

The TO-46 metal package can also be soldered to a metal surface or pipe without damage. Of course, in that case the V− terminal of the circuit will be grounded to that metal. Alternatively, mount the LM35 inside a sealed-end metal tube, and then dip into a bath or screw into a threaded hole in a tank. As with any IC, the LM35 and accompanying wiring and circuits must be kept insulated and dry, to avoid leakage and corrosion. This is especially true if the circuit may operate at cold temperatures where condensation can occur. Printed-circuit coatings and varnishes such as Humiseal and epoxy paints or dips are often used to insure that moisture cannot corrode the LM35 or its connections.

These devices are sometimes soldered to a small light-weight heat fin to decrease the thermal time constant and speed up the response in slowly-moving air. On the other hand, a small thermal mass may be added to the sensor, to give the steadiest reading despite small deviations in the air temperature.

**Table 1. Temperature Rise of LM35 Due To Self-heating (Thermal Resistance, $\theta_{JA}$)**

| | TO, no heat sink | TO(1), small heat fin | TO-92, no heat sink | TO-92(2), small heat fin | SOIC-8, no heat sink | SOIC-8(2), small heat fin | TO-220, no heat sink |
|---|---|---|---|---|---|---|---|
| Still air | 400°C/W | 100°C/W | 180°C/W | 140°C/W | 220°C/W | 110°C/W | 90°C/W |
| Moving air | 100°C/W | 40°C/W | 90°C/W | 70°C/W | 105°C/W | 90°C/W | 26°C/W |
| Still oil | 100°C/W | 40°C/W | 90°C/W | 70°C/W | | | |
| Stirred oil | 50°C/W | 30°C/W | 45°C/W | 40°C/W | | | |
| (Clamped to metal, Infinite heat sink) | (24°C/W) | | | | (55°C/W) | | |

(1) Wakefield type 201, or 1-in disc of 0.02-in sheet brass, soldered to case, or similar.
(2) TO-92 and SOIC-8 packages glued and leads soldered to 1-in square of 1/16-in printed circuit board with 2-oz foil or similar.


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## TYPICAL APPLICATIONS

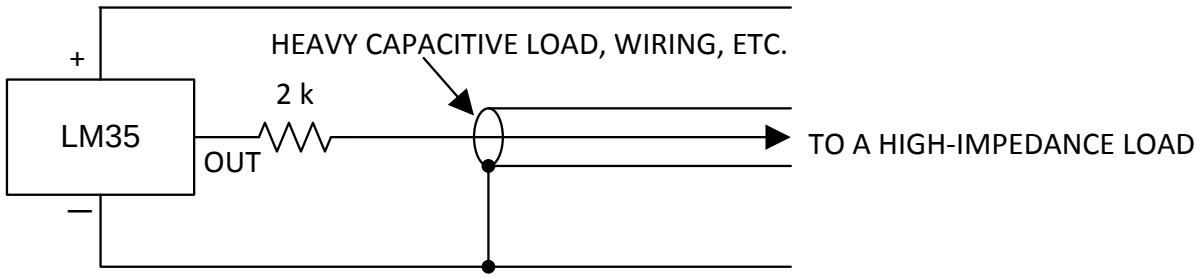



**Figure 14. LM35 with Decoupling from Capacitive Load**

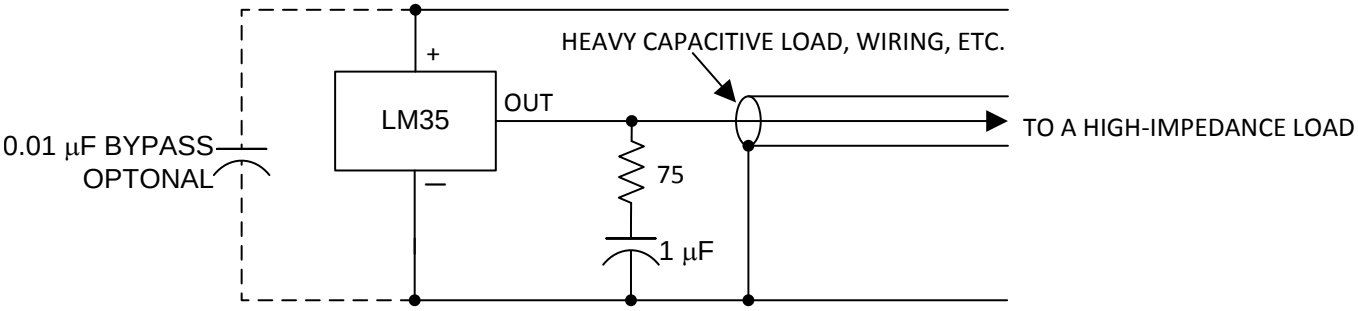



**Figure 15. LM35 with R-C Damper**

## CAPACITIVE LOADS

Like most micropower circuits, the LM35 has a limited ability to drive heavy capacitive loads. The LM35 alone is able to drive 50 pf without special precautions. If heavier loads are anticipated, isolating or decoupling the load with a resistor is easy (see Figure 14). Or you can improve the tolerance of capacitance with a series R-C damper from output to ground (see Figure 15).

When the LM35 is applied with a 200-Ω load resistor as shown in Figure 16, Figure 17, or Figure 19, the device is relatively immune to wiring capacitance because the capacitance forms a bypass from ground to input and not on the output. However, as with any linear circuit connected to wires in a hostile environment, performance is affected adversely by intense electromagnetic sources such as relays, radio transmitters, motors with arcing brushes, and SCR transients, as the wiring acts as a receiving antenna and the internal junctions act as rectifiers. For best results in such cases, a bypass capacitor from $V_{IN}$ to ground and a series R-C damper, such as 75 Ω, in series with 0.2 or 1 µF from output to ground are often useful. These are shown in Figure 24, Figure 24, and Figure 27.

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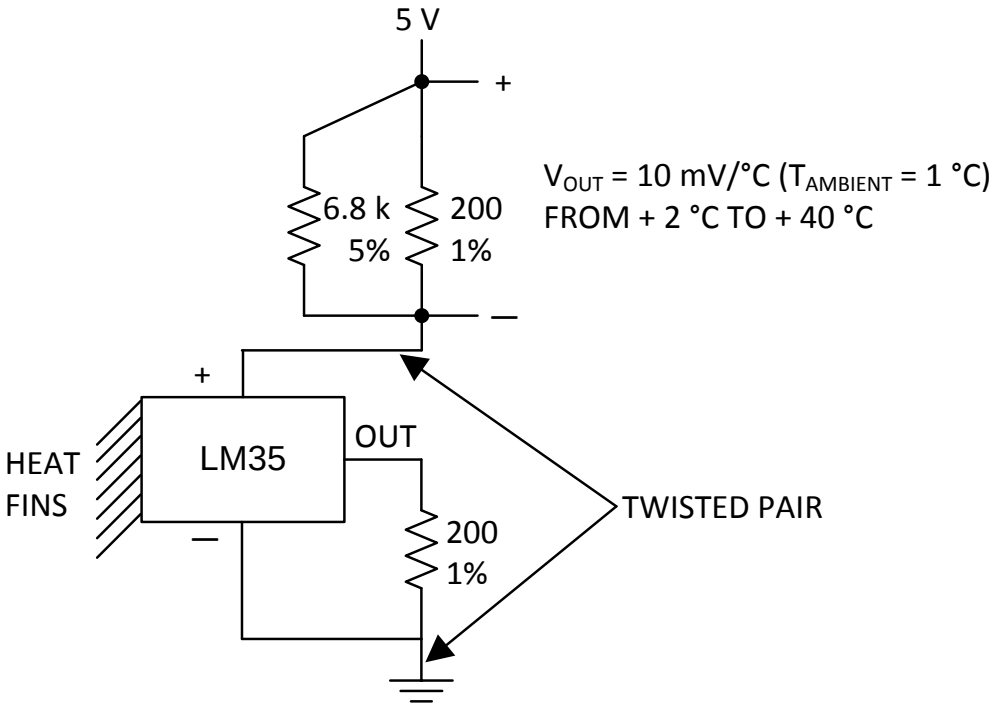



**Figure 16. Two-Wire Remote Temperature Sensor (Grounded Sensor)**

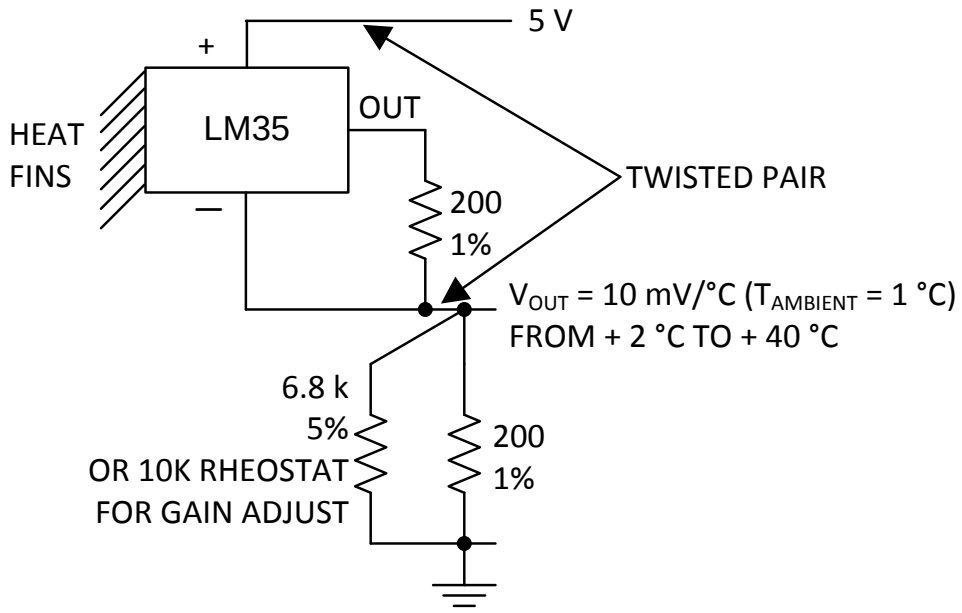



**Figure 17. Two-Wire Remote Temperature Sensor (Output Referred to Ground)**


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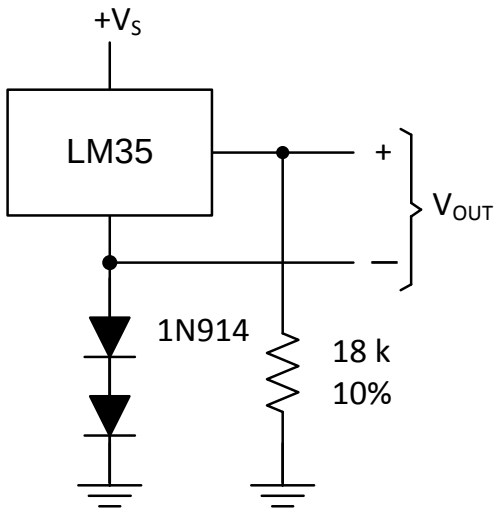



**Figure 18. Temperature Sensor, Single Supply (−55° to +150°C)**

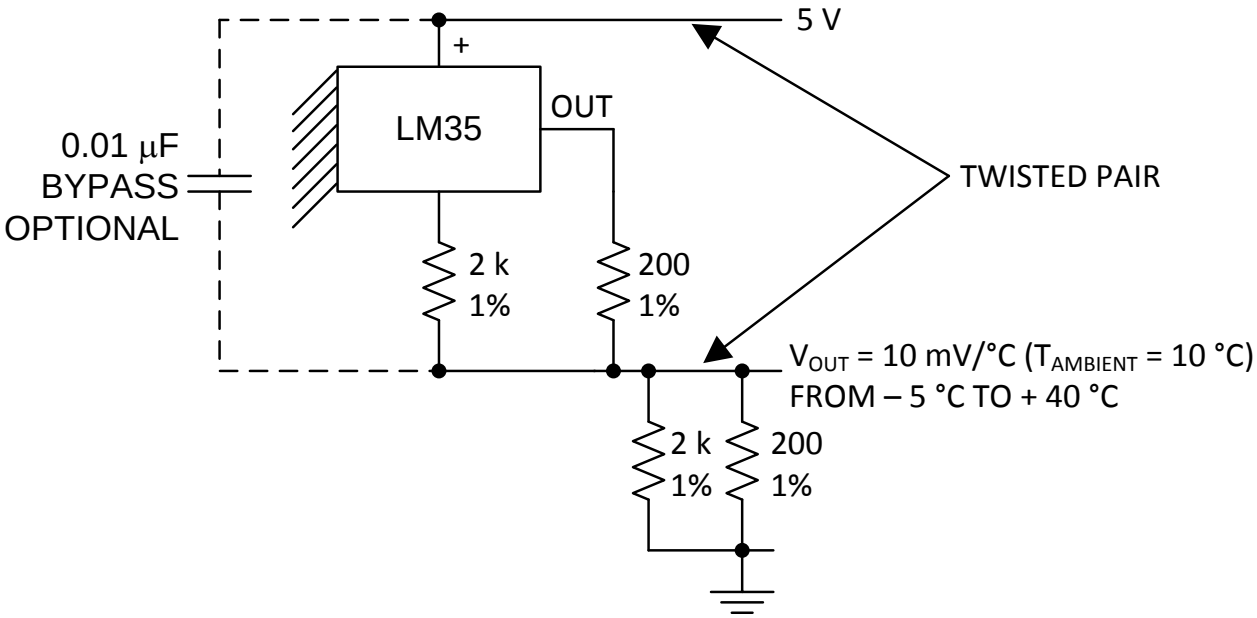



**Figure 19. Two-Wire Remote Temperature Sensor (Output Referred to Ground)**

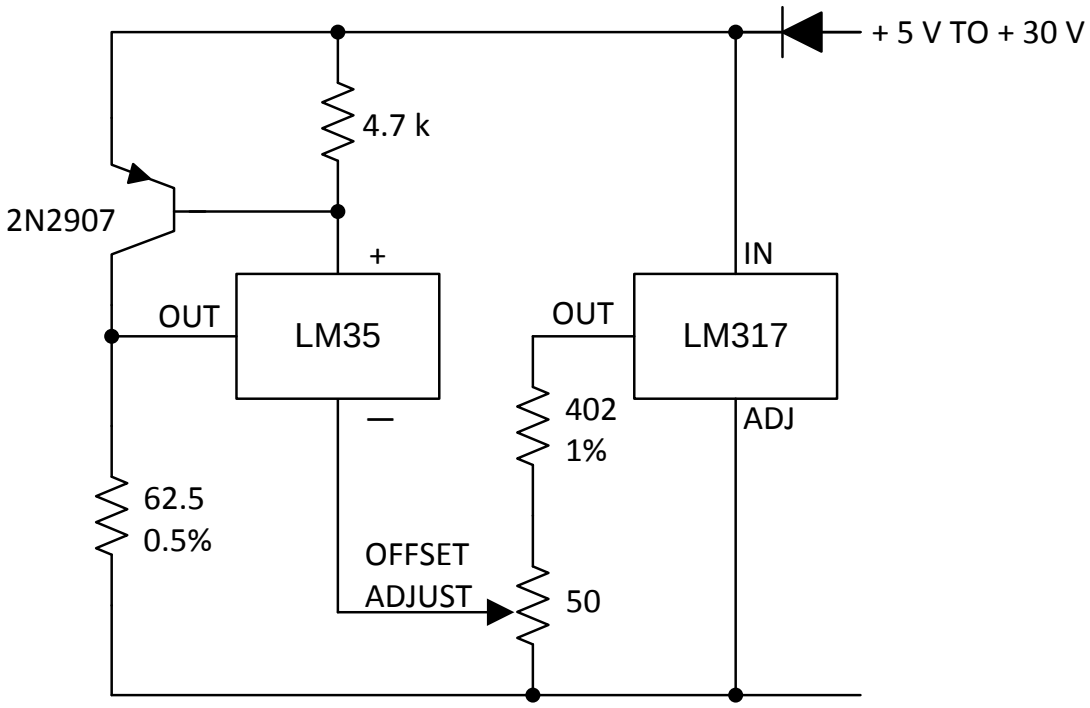



**Figure 20. 4-To-20 mA Current Source (0°C to 100°C)**


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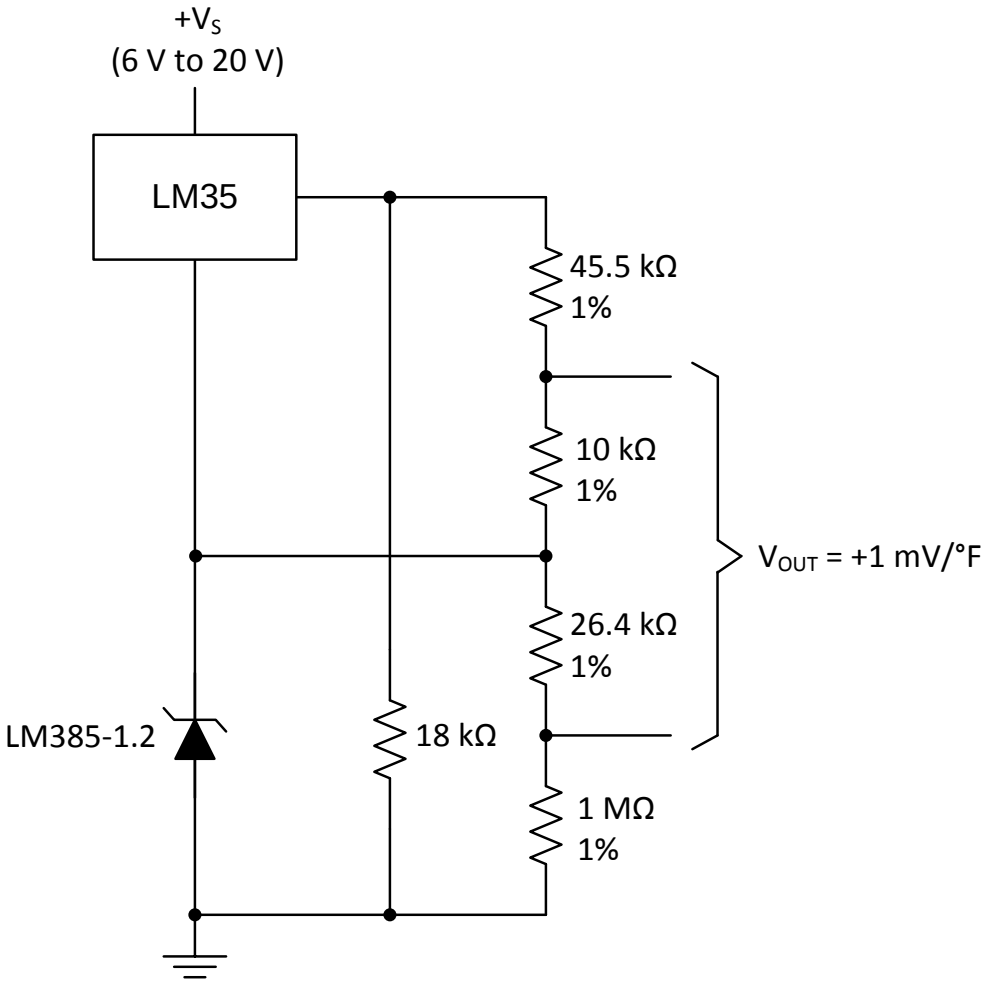



**Figure 21. Fahrenheit Thermometer**

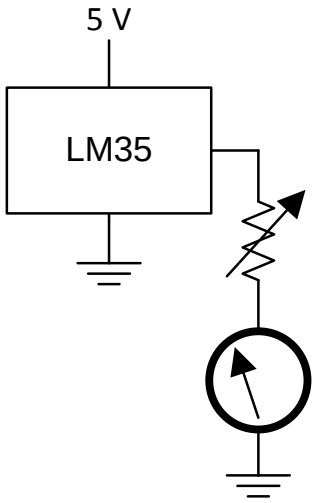



**Figure 22. Centigrade Thermometer (Analog Meter)**

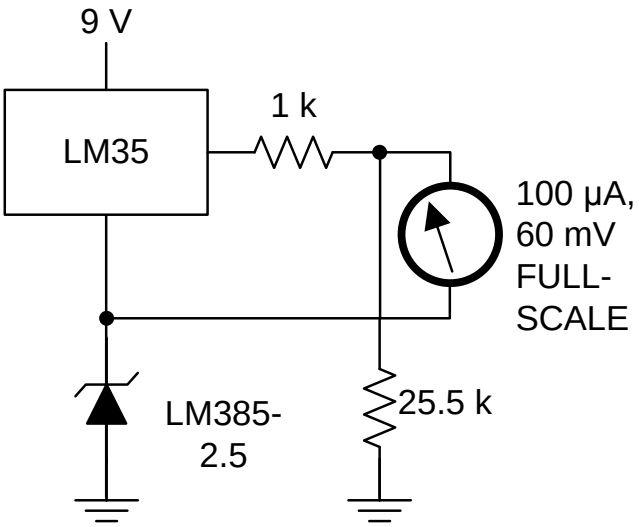



**Figure 23. Fahrenheit Thermometer, Expanded Scale Thermometer (50°F to 80°F, for Example Shown)**

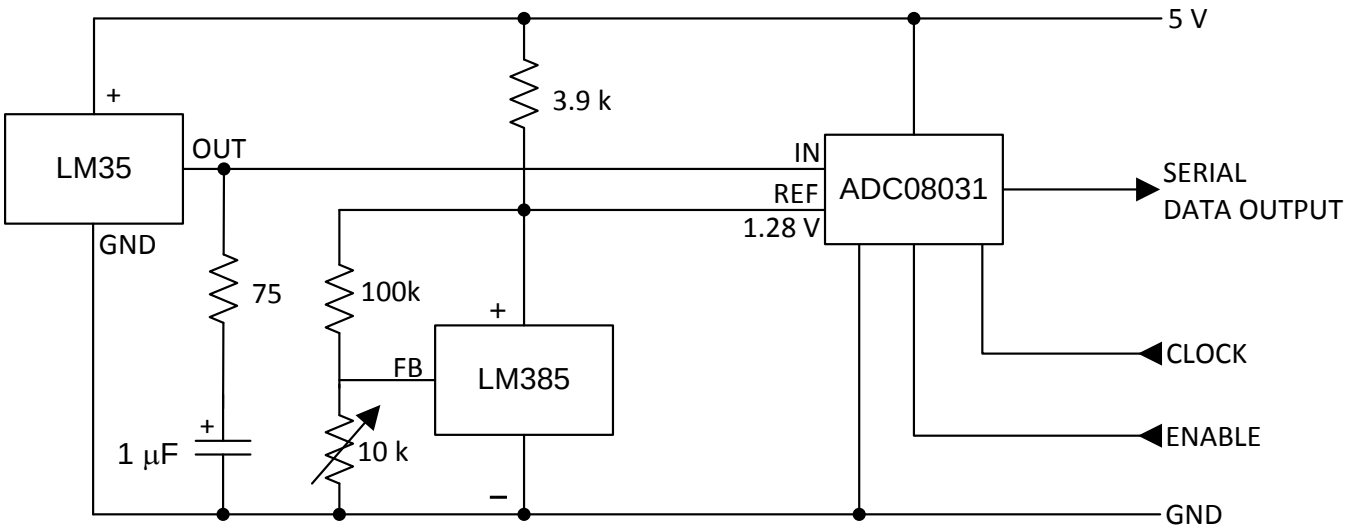



**Figure 24. Temperature To Digital Converter (Serial Output) (128°C Full Scale)**


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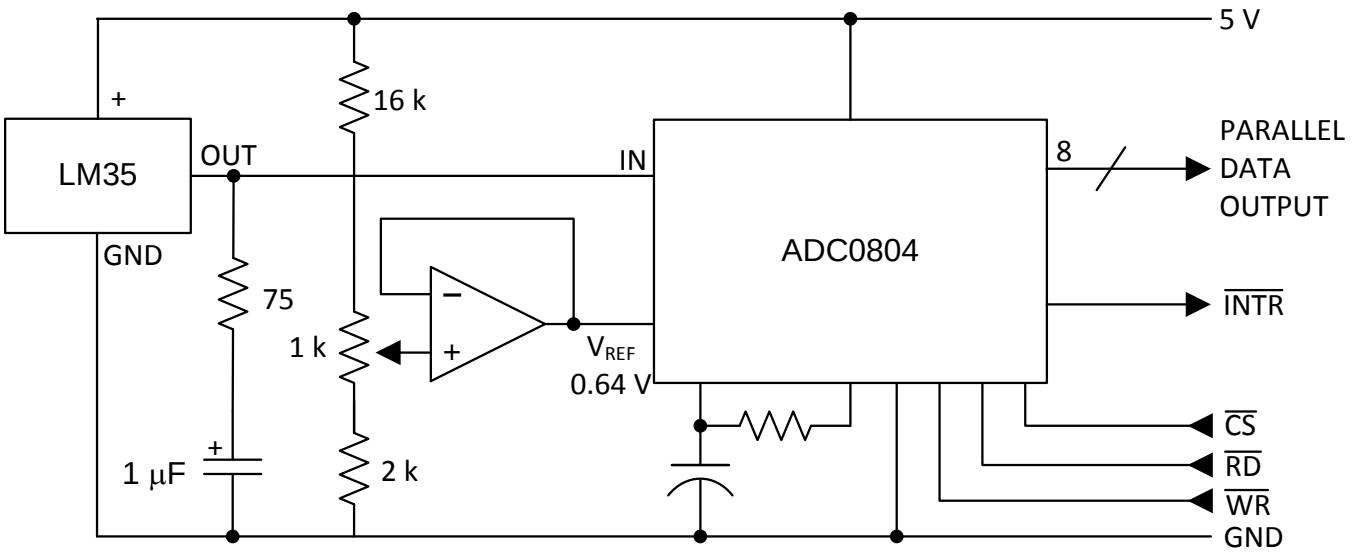
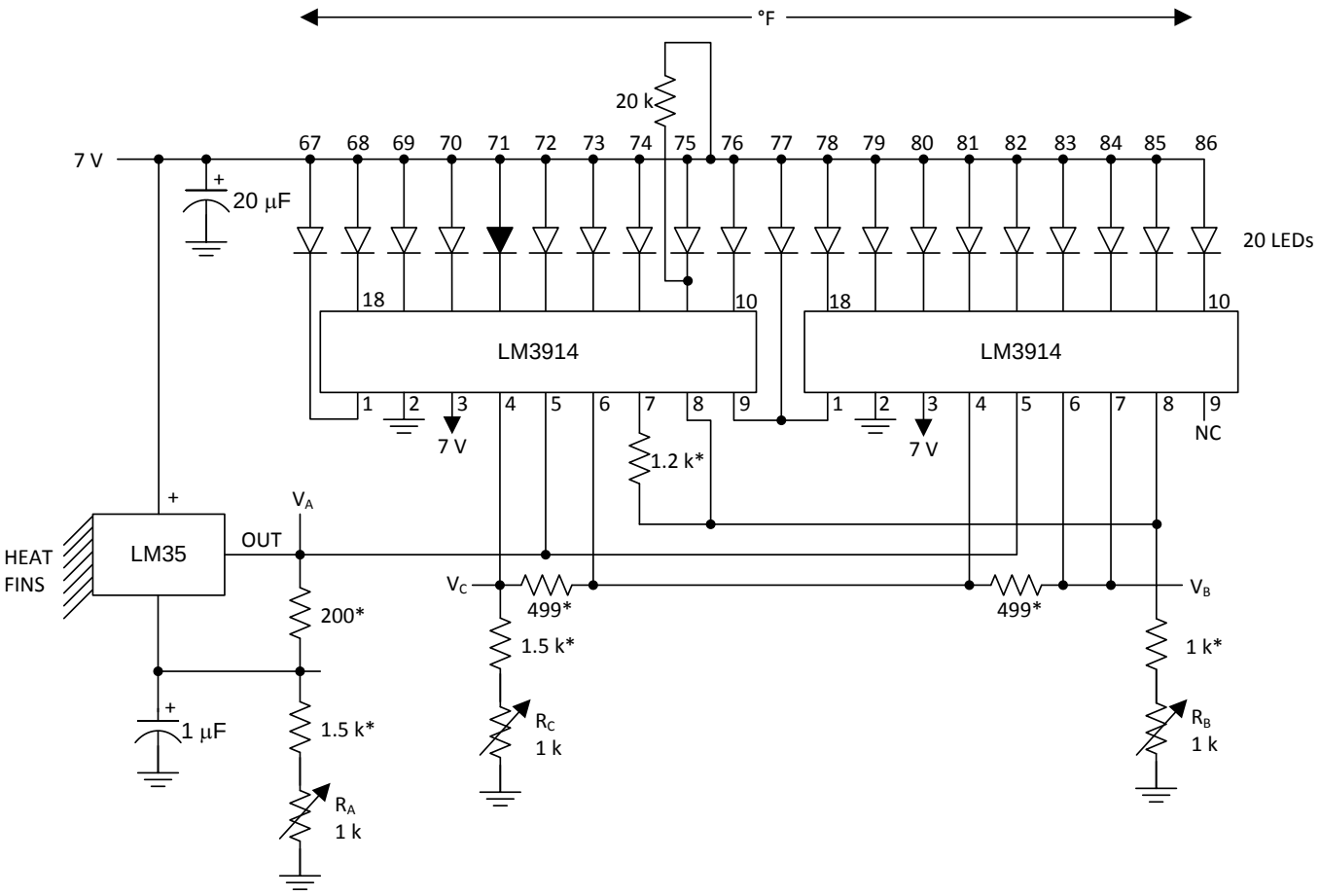



**Figure 25. Temperature To Digital Converter**
**(Parallel TRI-STATE Outputs for Standard Data Bus to µP Interface.)**
**(128°C Full Scale)**




*=1% or 2% film resistor
Trim $R_B$ for $V_B$ = 3.075 V
Trim $R_C$ for $V_C$ = 1.955 V
Trim $R_A$ for $V_A$ = 0.075 V + 100 mV/°C ×$T_{ambient}$
Example, $V_A$ = 2.275 V at 22°C

**Figure 26. Bar-Graph Temperature Display (Dot Mode)**


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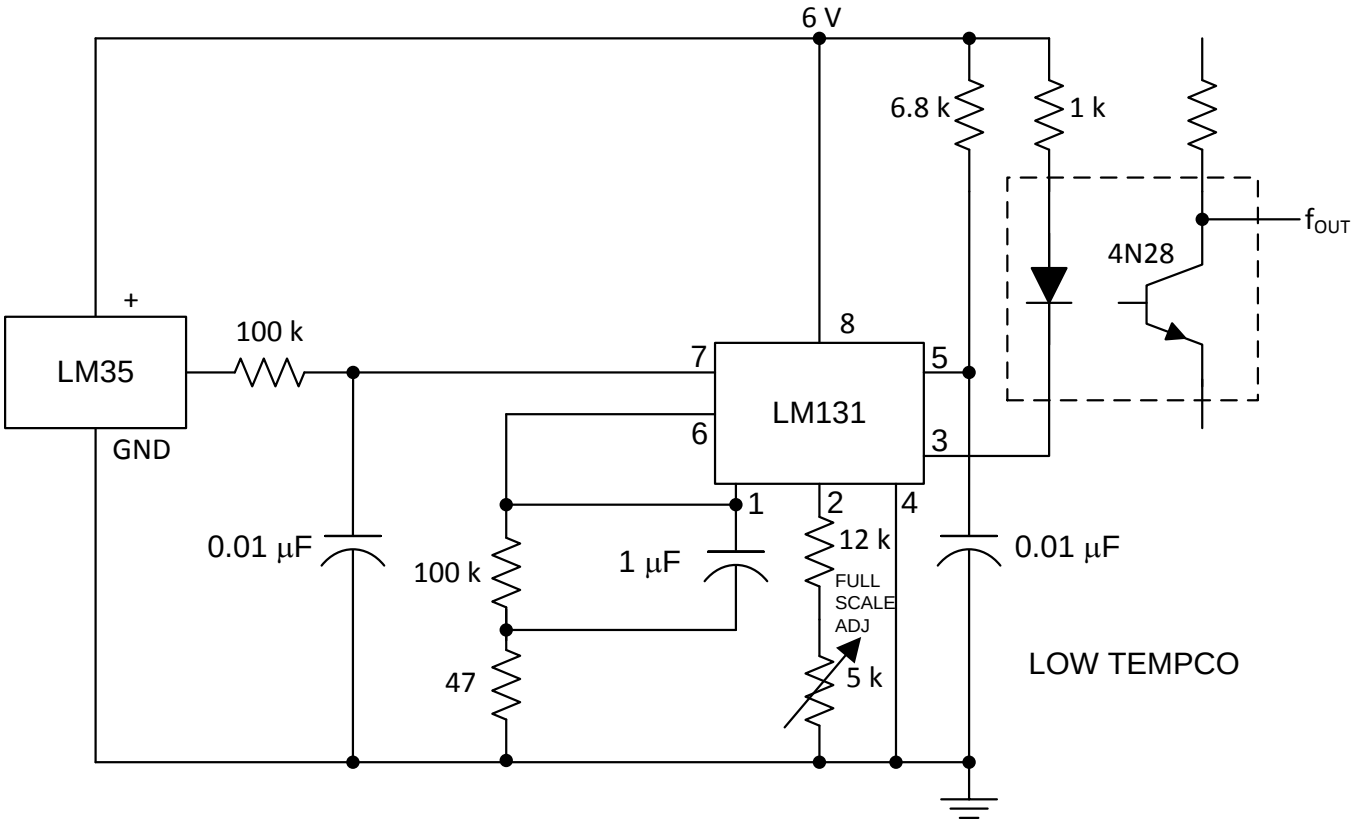
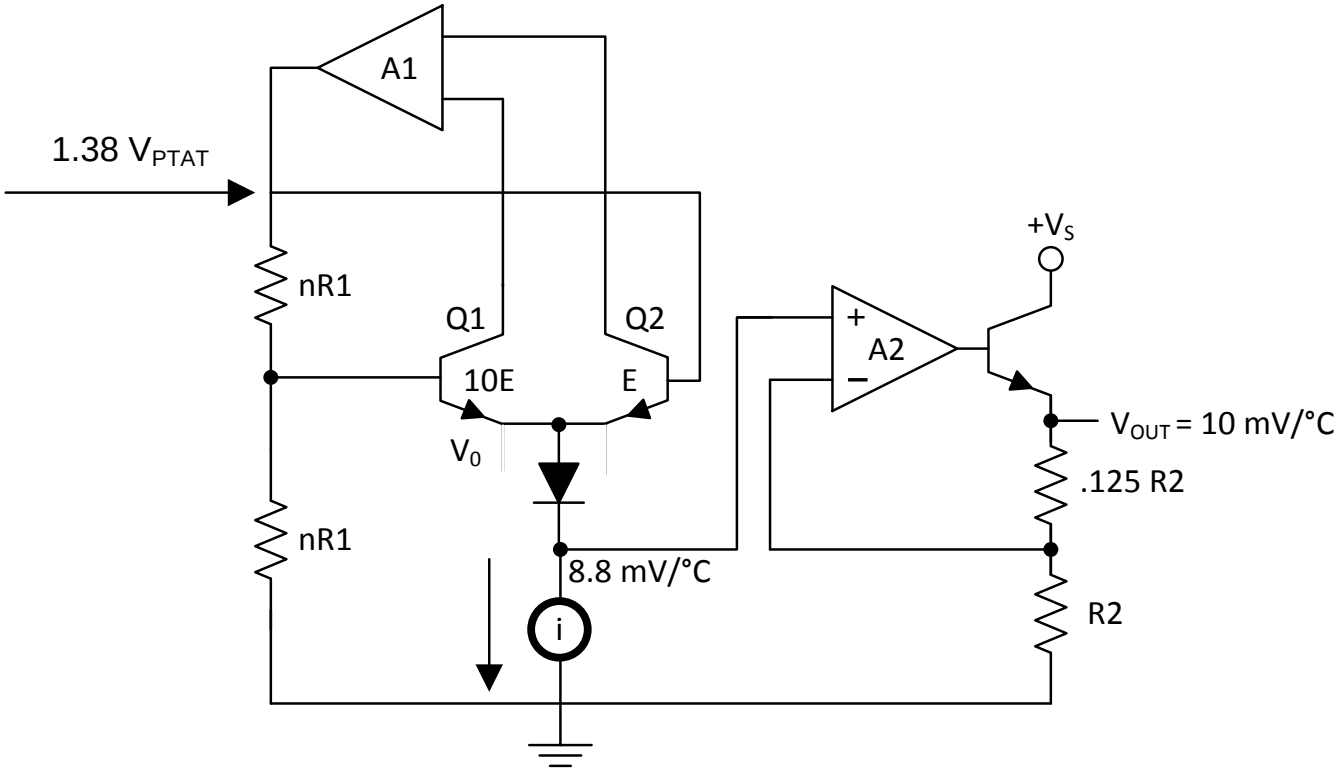



**Figure 27. LM35 With Voltage-To-Frequency Converter And Isolated Output (2°C to 150°C; 20 to 1500 Hz)**

## BLOCK DIAGRAM





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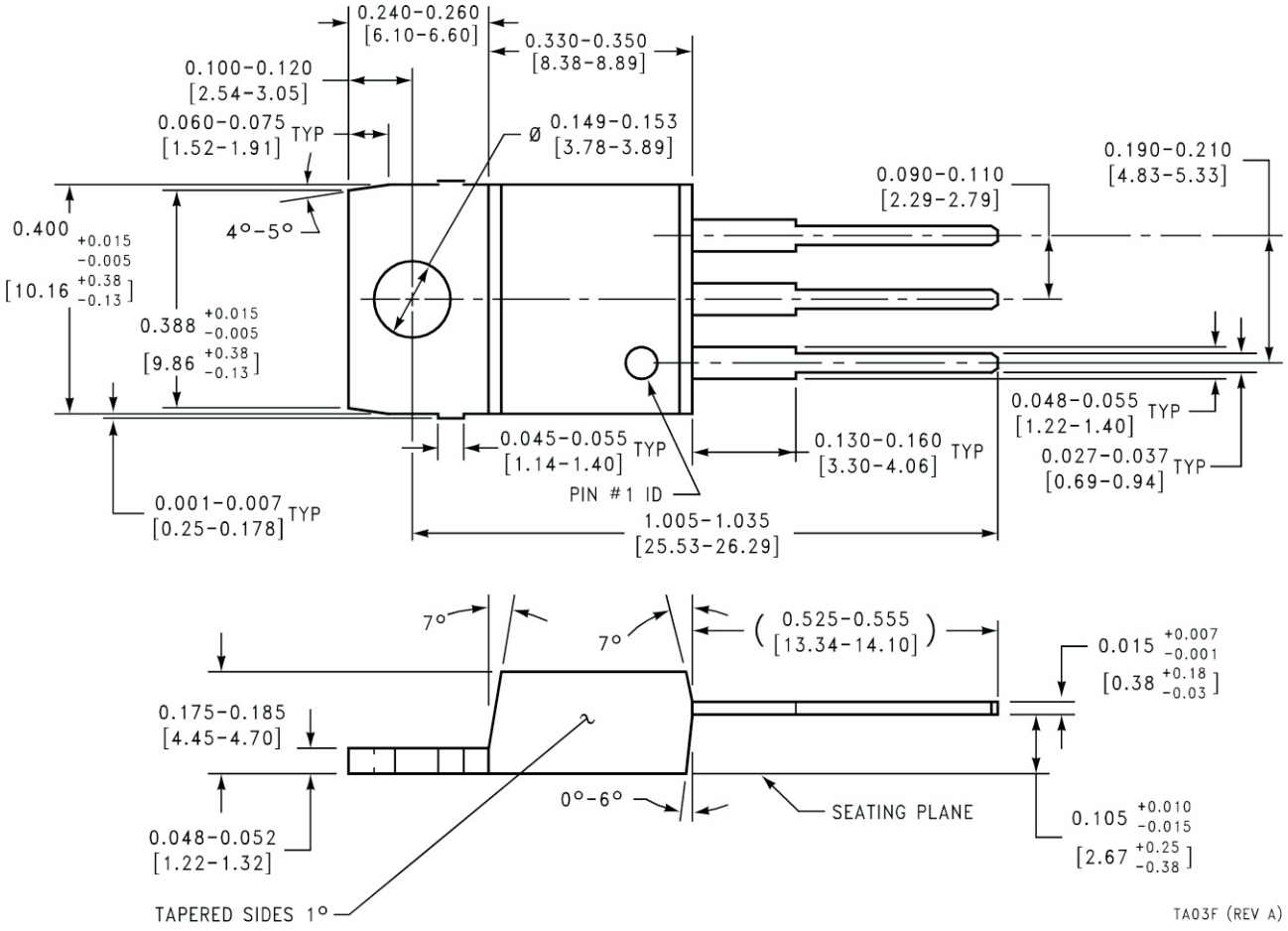
## REVISION HISTORY

**Changes from Revision C (July 2013) to Revision D** **Page**

- Changed *W* to Ω ..... 1
- Changed *W* to Ω ..... 3
- Changed *W* to Ω ..... 9

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NEB0003F


0.240-0.260
[6.10-6.60]
0.330-0.350
[8.38-8.89]
0.100-0.120
[2.54-3.05]
0.060-0.075 TYP
[1.52-1.91]
Ø 0.149-0.153
[3.78-3.89]
0.190-0.210
[4.83-5.33]
0.090-0.110
[2.29-2.79]
0.400 +0.015 -0.005
[10.16 +0.38 -0.13]
4°-5°
0.388 +0.015 -0.005
[9.86 +0.38 -0.13]
0.048-0.055 TYP
[1.22-1.40]
0.027-0.037 TYP
[0.69-0.94]
0.045-0.055 TYP
[1.14-1.40]
0.130-0.160 TYP
[3.30-4.06]
PIN #1 ID
0.001-0.007 TYP
[0.25-0.178]
1.005-1.035
[25.53-26.29]
7°
7°
( 0.525-0.555 )
[13.34-14.10]
0.015 +0.007 -0.001
[0.38 +0.18 -0.03]
0.175-0.185
[4.45-4.70]
0°-6°
SEATING PLANE
0.105 +0.010 -0.015
[2.67 +0.25 -0.38]
0.048-0.052
[1.22-1.32]
TAPERED SIDES 1°
TA03F (REV A)

## PACKAGING INFORMATION

| Orderable Device | Status (1) | Package Type | Package Drawing | Pins | Package Qty | Eco Plan (2) | Lead/Ball Finish (6) | MSL Peak Temp (3) | Op Temp (°C) | Device Marking (4/5) | Samples |
|---|---|---|---|---|---|---|---|---|---|---|---|
| LM35AH | ACTIVE | TO | NDV | 3 | 1000 | TBD | Call TI | Call TI | -55 to 150 | ( LM35AH ~ LM35AH) | Samples |
| LM35AH/NOPB | ACTIVE | TO | NDV | 3 | 1000 | Green (RoHS & no Sb/Br) | Call TI | Level-1-NA-UNLIM | -55 to 150 | LM35AH | Samples |
| LM35CAH | ACTIVE | TO | NDV | 3 | 1000 | TBD | Call TI | Call TI | -40 to 110 | ( LM35CAH ~ LM35CAH) | Samples |
| LM35CAH/NOPB | ACTIVE | TO | NDV | 3 | 1000 | Green (RoHS & no Sb/Br) | Call TI | Level-1-NA-UNLIM | -40 to 110 | ( LM35CAH ~ LM35CAH) | Samples |
| LM35CAZ/LFT4 | ACTIVE | TO-92 | LP | 3 | 2000 | Green (RoHS & no Sb/Br) | CU SN | N / A for Pkg Type | | LM35 CAZ | Samples |
| LM35CAZ/NOPB | ACTIVE | TO-92 | LP | 3 | 1800 | Green (RoHS & no Sb/Br) | CU SN | N / A for Pkg Type | -40 to 110 | LM35 CAZ | Samples |
| LM35CH | ACTIVE | TO | NDV | 3 | 1000 | TBD | Call TI | Call TI | -40 to 110 | ( LM35CH ~ LM35CH) | Samples |
| LM35CH/NOPB | ACTIVE | TO | NDV | 3 | 1000 | Green (RoHS & no Sb/Br) | Call TI | Level-1-NA-UNLIM | -40 to 110 | ( LM35CH ~ LM35CH) | Samples |
| LM35CZ/LFT1 | ACTIVE | TO-92 | LP | 3 | 2000 | Green (RoHS & no Sb/Br) | CU SN | N / A for Pkg Type | | LM35 CZ | Samples |
| LM35CZ/LFT4 | ACTIVE | TO-92 | LP | 3 | | TBD | Call TI | Call TI | | | Samples |
| LM35CZ/NOPB | ACTIVE | TO-92 | LP | 3 | 1800 | Green (RoHS & no Sb/Br) | CU SN | N / A for Pkg Type | -40 to 110 | LM35 CZ | Samples |
| LM35DH | ACTIVE | TO | NDV | 3 | 1000 | TBD | Call TI | Call TI | 0 to 70 | LM35DH | Samples |
| LM35DH/NOPB | ACTIVE | TO | NDV | 3 | 1000 | Green (RoHS & no Sb/Br) | Call TI \| POST-PLATE | Level-1-NA-UNLIM | 0 to 70 | ( LM35DH ~ LM35DH) | Samples |
| LM35DM | NRND | SOIC | D | 8 | 95 | TBD | Call TI | Call TI | 0 to 100 | LM35D M | |
| LM35DM/NOPB | ACTIVE | SOIC | D | 8 | 95 | Green (RoHS & no Sb/Br) | CU SN | Level-1-260C-UNLIM | 0 to 100 | LM35D M | Samples |
| LM35DMX | NRND | SOIC | D | 8 | 2500 | TBD | Call TI | Call TI | 0 to 100 | LM35D M | |
| LM35DMX/NOPB | ACTIVE | SOIC | D | 8 | 2500 | Green (RoHS & no Sb/Br) | CU SN | Level-1-260C-UNLIM | 0 to 100 | LM35D M | Samples |
| LM35DT | NRND | TO-220 | NEB | 3 | 45 | TBD | Call TI | Call TI | 0 to 100 | LM35DT | |

| Orderable Device | Status (1) | Package Type | Package Drawing | Pins | Package Qty | Eco Plan (2) | Lead/Ball Finish (6) | MSL Peak Temp (3) | Op Temp (°C) | Device Marking (4/5) | Samples |
|---|---|---|---|---|---|---|---|---|---|---|---|
| LM35DT/NOPB | ACTIVE | TO-220 | NEB | 3 | 45 | Green (RoHS & no Sb/Br) | CU SN | Level-1-NA-UNLIM | 0 to 100 | LM35DT | Samples |
| LM35DZ | OBSOLETE | TO-92 | LP | 3 | | TBD | Call TI | Call TI | | | |
| LM35DZ/LFT1 | ACTIVE | TO-92 | LP | 3 | 2000 | Green (RoHS & no Sb/Br) | CU SN | N / A for Pkg Type | | LM35 DZ | Samples |
| LM35DZ/LFT2 | ACTIVE | TO-92 | LP | 3 | 2000 | Green (RoHS & no Sb/Br) | CU SN | N / A for Pkg Type | | LM35 DZ | Samples |
| LM35DZ/LFT4 | ACTIVE | TO-92 | LP | 3 | 2000 | Green (RoHS & no Sb/Br) | CU SN | N / A for Pkg Type | | LM35 DZ | Samples |
| LM35DZ/LFT7 | ACTIVE | TO-92 | LP | 3 | 2000 | Green (RoHS & no Sb/Br) | CU SN | N / A for Pkg Type | | LM35 DZ | Samples |
| LM35DZ/NOPB | ACTIVE | TO-92 | LP | 3 | 1800 | Green (RoHS & no Sb/Br) | CU SN | N / A for Pkg Type | 0 to 100 | LM35 DZ | Samples |
| LM35H | ACTIVE | TO | NDV | 3 | 1000 | TBD | Call TI | Call TI | -55 to 150 | ( LM35H ~ LM35H) | Samples |
| LM35H/NOPB | ACTIVE | TO | NDV | 3 | 1000 | Green (RoHS & no Sb/Br) | Call TI | Level-1-NA-UNLIM | -55 to 150 | ( LM35H ~ LM35H) | Samples |

(1) The marketing status values are defined as follows:
**ACTIVE:** Product device recommended for new designs.
**LIFEBUY:** TI has announced that the device will be discontinued, and a lifetime-buy period is in effect.
**NRND:** Not recommended for new designs. Device is in production to support existing customers, but TI does not recommend using this part in a new design.
**PREVIEW:** Device has been announced but is not in production. Samples may or may not be available.
**OBSOLETE:** TI has discontinued the production of the device.

(2) Eco Plan - The planned eco-friendly classification: Pb-Free (RoHS), Pb-Free (RoHS Exempt), or Green (RoHS & no Sb/Br) - please check http://www.ti.com/productcontent for the latest availability information and additional product content details.
**TBD:** The Pb-Free/Green conversion plan has not been defined.
**Pb-Free (RoHS):** TI's terms "Lead-Free" or "Pb-Free" mean semiconductor products that are compatible with the current RoHS requirements for all 6 substances, including the requirement that lead not exceed 0.1% by weight in homogeneous materials. Where designed to be soldered at high temperatures, TI Pb-Free products are suitable for use in specified lead-free processes.
**Pb-Free (RoHS Exempt):** This component has a RoHS exemption for either 1) lead-based flip-chip solder bumps used between the die and package, or 2) lead-based die adhesive used between the die and leadframe. The component is otherwise considered Pb-Free (RoHS compatible) as defined above.
**Green (RoHS & no Sb/Br):** TI defines "Green" to mean Pb-Free (RoHS compatible), and free of Bromine (Br) and Antimony (Sb) based flame retardants (Br or Sb do not exceed 0.1% by weight in homogeneous material)

(3) MSL, Peak Temp. - The Moisture Sensitivity Level rating according to the JEDEC industry standard classifications, and peak solder temperature.

(4) There may be additional marking, which relates to the logo, the lot trace code information, or the environmental category on the device.

**(5)** Multiple Device Markings will be inside parentheses. Only one Device Marking contained in parentheses and separated by a "~" will appear on a device. If a line is indented then it is a continuation of the previous line and the two combined represent the entire Device Marking for that device.

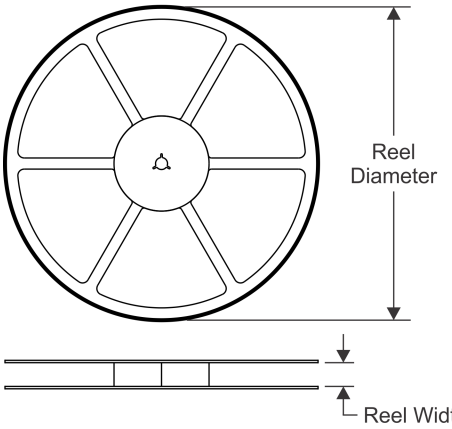
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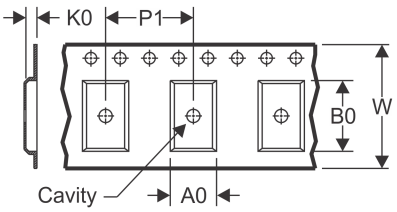
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## TAPE AND REEL INFORMATION

**REEL DIMENSIONS**

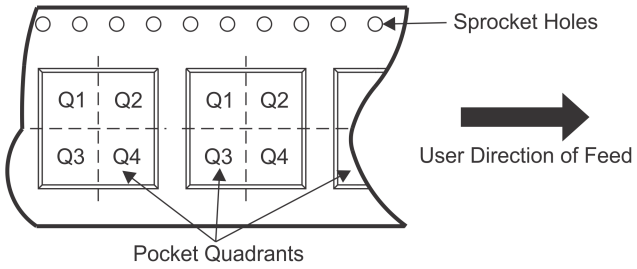



**TAPE DIMENSIONS**




| | |
|---|---|
| A0 | Dimension designed to accommodate the component width |
| B0 | Dimension designed to accommodate the component length |
| K0 | Dimension designed to accommodate the component thickness |
| W | Overall width of the carrier tape |
| P1 | Pitch between successive cavity centers |

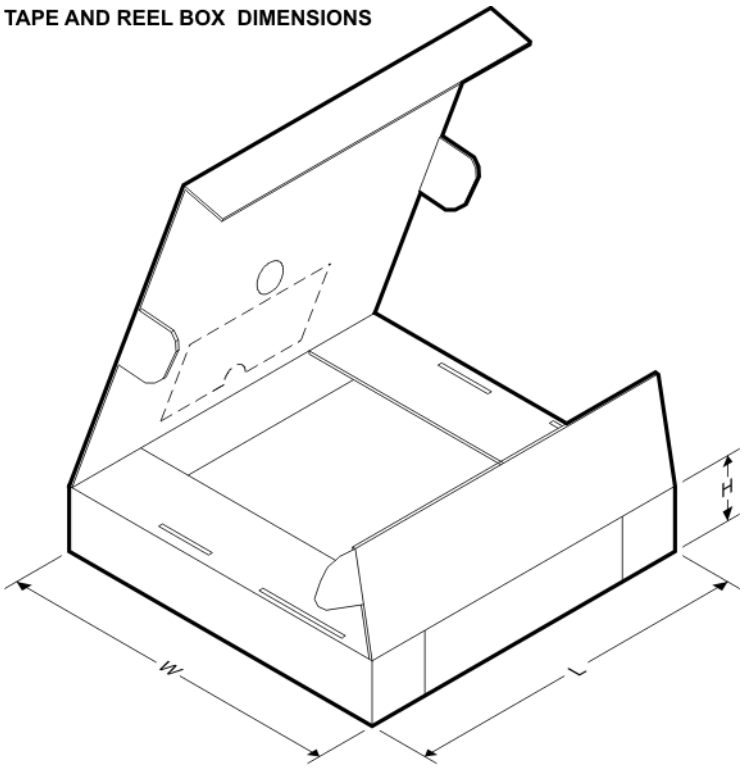
**QUADRANT ASSIGNMENTS FOR PIN 1 ORIENTATION IN TAPE**




*All dimensions are nominal

| Device | Package Type | Package Drawing | Pins | SPQ | Reel Diameter (mm) | Reel Width W1 (mm) | A0 (mm) | B0 (mm) | K0 (mm) | P1 (mm) | W (mm) | Pin1 Quadrant |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| LM35DMX | SOIC | D | 8 | 2500 | 330.0 | 12.4 | 6.5 | 5.4 | 2.0 | 8.0 | 12.0 | Q1 |
| LM35DMX/NOPB | SOIC | D | 8 | 2500 | 330.0 | 12.4 | 6.5 | 5.4 | 2.0 | 8.0 | 12.0 | Q1 |

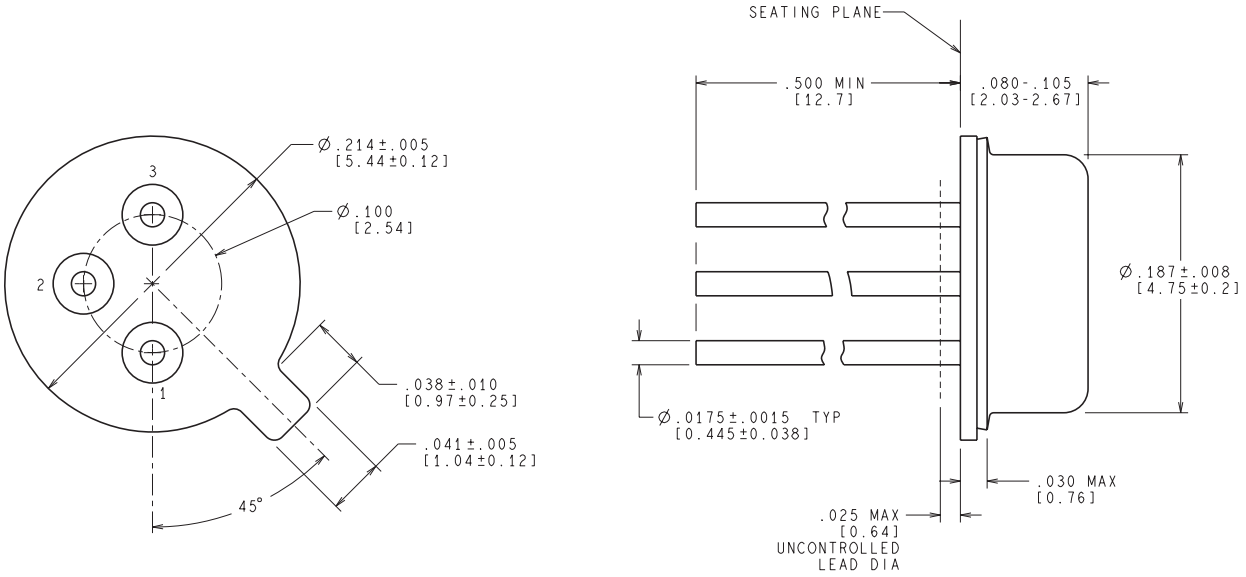
TAPE AND REEL BOX DIMENSIONS




*All dimensions are nominal

| Device | Package Type | Package Drawing | Pins | SPQ | Length (mm) | Width (mm) | Height (mm) |
|---|---|---|---|---|---|---|---|
| LM35DMX | SOIC | D | 8 | 2500 | 367.0 | 367.0 | 35.0 |
| LM35DMX/NOPB | SOIC | D | 8 | 2500 | 367.0 | 367.0 | 35.0 |

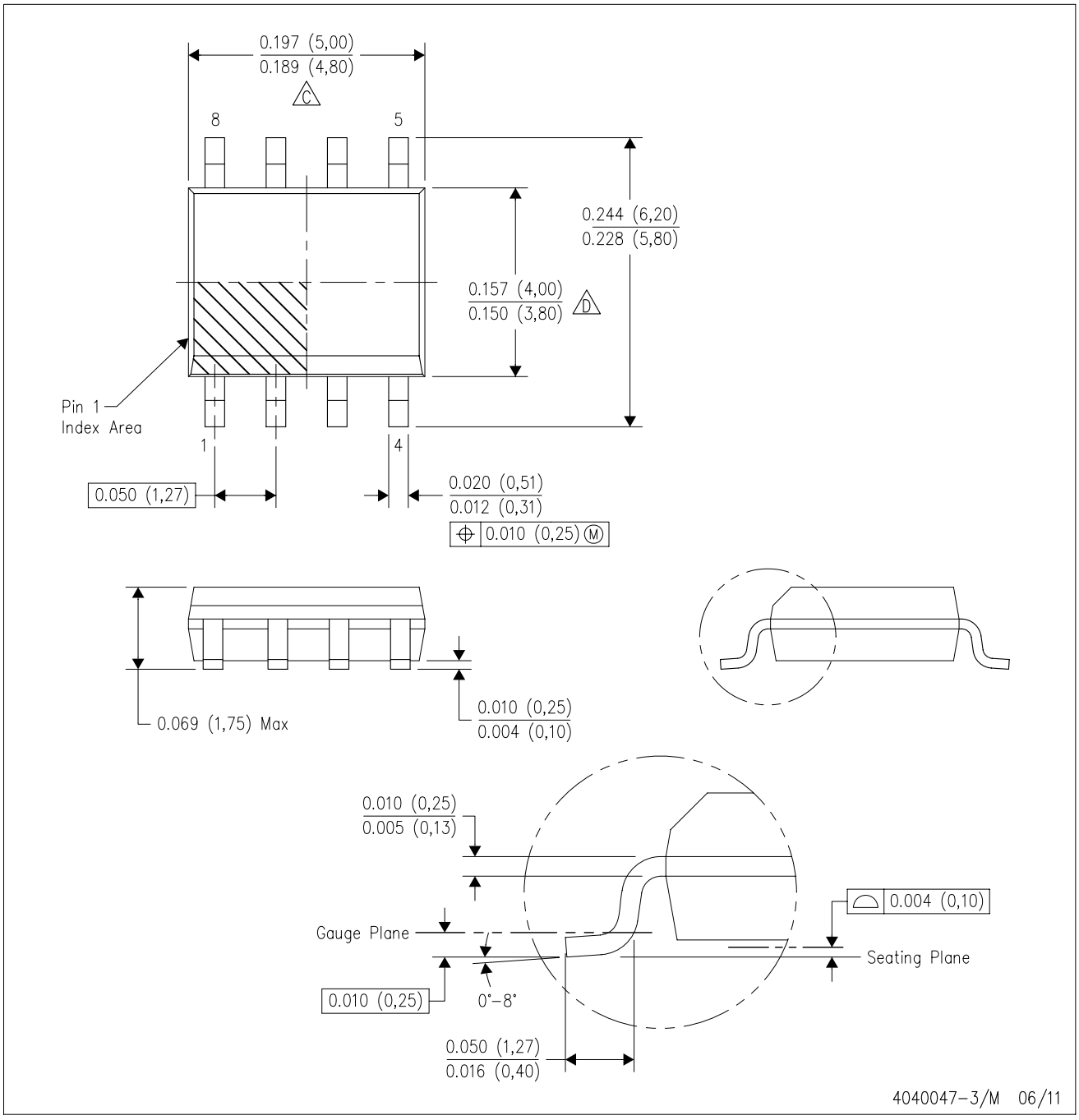
# NDV0003H




**CONTROLLING DIMENSION IS INCH**
**VALUES IN [ ] ARE IN MILLIMETERS**

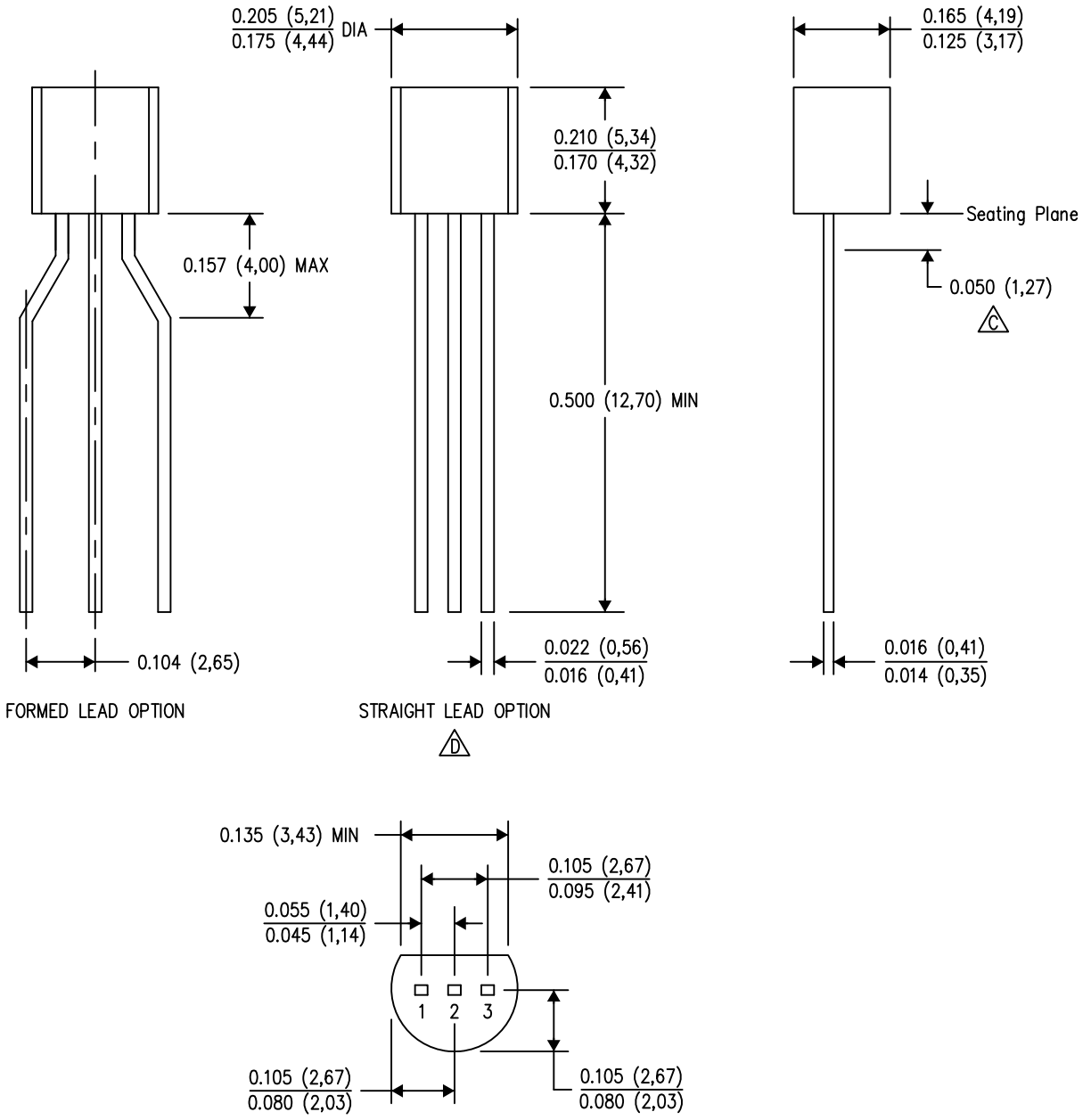
H03H (Rev F)

D (R–PDSO–G8) PLASTIC SMALL OUTLINE



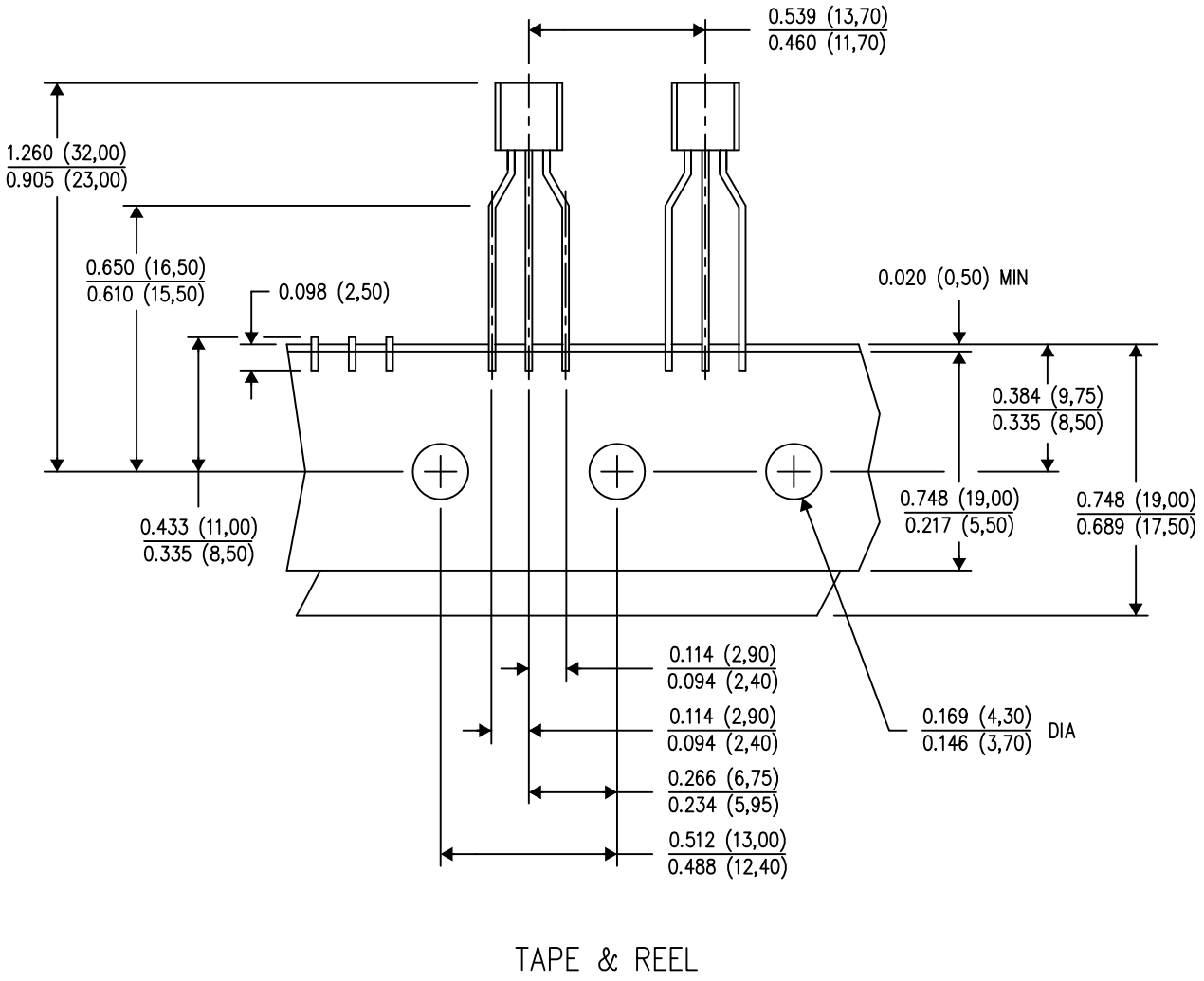

NOTES:
A. All linear dimensions are in inches (millimeters).
B. This drawing is subject to change without notice.
C. Body length does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate burrs shall not exceed 0.006 (0,15) each side.
D. Body width does not include interlead flash. Interlead flash shall not exceed 0.017 (0,43) each side.
E. Reference JEDEC MS–012 variation AA.

LP (O–PBCY–W3) PLASTIC CYLINDRICAL PACKAGE




NOTES:
A. All linear dimensions are in inches (millimeters).
B. This drawing is subject to change without notice.
C. Lead dimensions are not controlled within this area.
D. Falls within JEDEC TO–226 Variation AA (TO–226 replaces TO–92).
E. Shipping Method:
Straight lead option available in bulk pack only.
Formed lead option available in tape & reel or ammo pack.
Specific products can be offered in limited combinations of shipping mediums and lead options.
Consult product folder for more information on available options.

LP (O–PBCY–W3) PLASTIC CYLINDRICAL PACKAGE




NOTES:
A. All linear dimensions are in inches (millimeters).
B. This drawing is subject to change without notice.
C. Tape and Reel information for the Formed Lead Option package.

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