# TIL194, TIL195, TIL196, TIL194A, TIL195A, TIL196A TIL194B, TIL195B, TIL196B AC-INPUT OPTOCOUPLERS

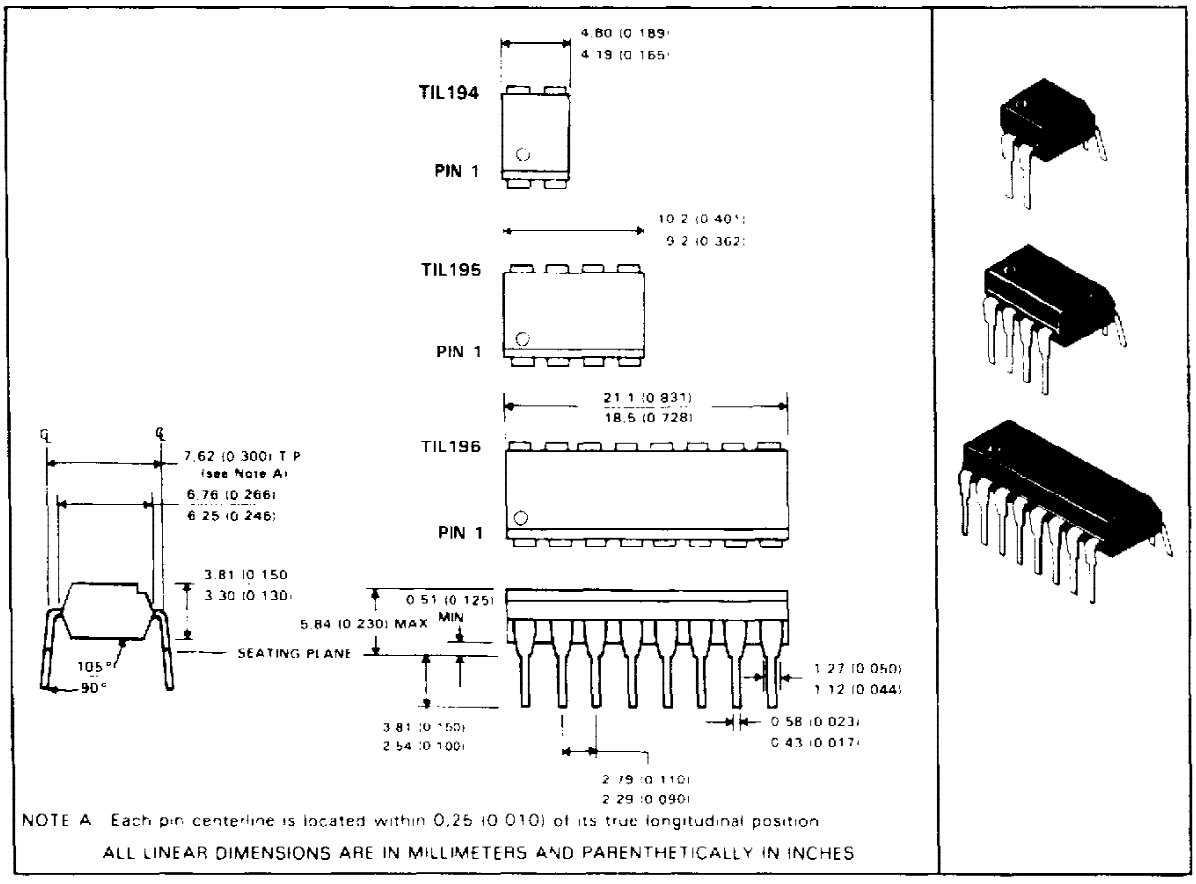
SOES001 D3287 MAY 1989 - REVISED SEPTEMBER 1989

- AC Signal Input
- Gallium-Arsenide Diode Infrared Source
- Source Is Optically Coupled to Silicon N-P-N Phototransistor
- Choice of One, Two, or Four Channels
- Choice of Three Current-Transfer Ratios
- High-Voltage Electrical Isolation 3.535 kV Peak (2.5 kV rms)
- Plastic Dual-In-Line Packages
- UL Listed — File #E65085

## description

These optocouplers consist of two gallium-arsenide light-emitting diodes connected in a reverse-parallel configuration for ac-input applications and a silicon n-p-n phototransistor per channel. The TIL194 has one channel in a 4-pin package, the TIL195 has two channels in an 8-pin package, and the TIL196 has four channels in a 16-pin package. The standard devices, TIL194, TIL195, and TIL196, are tested for a current-transfer ratio of 20% minimum. Devices selected for a current-transfer ratio of 50% and 100% minimum are designated with the suffix A and B respectively.

## mechanical data




NOTE A: Each pin centerline is located within 0.25 (0.010) of its true longitudinal position.

ALL LINEAR DIMENSIONS ARE IN MILLIMETERS AND PARENTHETICALLY IN INCHES







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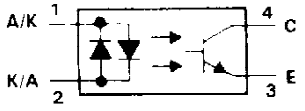
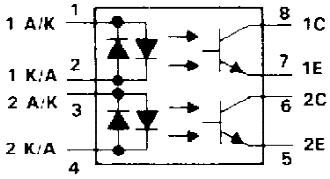
## schematic diagrams

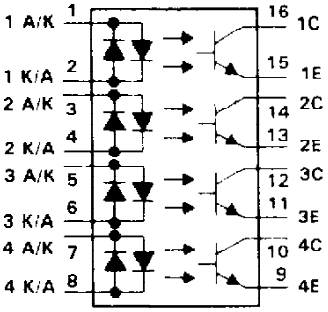
TIL194
(TOP VIEW)




TIL195
(TOP VIEW)




TIL196
(TOP VIEW)




## absolute maximum ratings at 25°C free-air temperature (unless otherwise noted)

Input-to-output voltage (see Note 1) . . . . . ±3.535 kV peak or dc (±2.5 kV rms)
Collector-emitter voltage (see Note 2) . . . . . 35 V
Emitter-collector voltage . . . . . 7 V
Input diode continuous forward current at (or below) 25°C free-air temperature (see Note 3) . . . . . ±50 mA
Continuous power dissipation at (or below) 25°C free-air temperature:
Phototransistor (see Note 4) . . . . . 150 mW
Input diode plus phototransistor per channel (see Note 5) . . . . . 200 mW
Storage temperature range . . . . . −55°C to 125°C
Lead temperature 1.6 mm (1/16 inch) from case for 10 seconds . . . . . 260°C

NOTES: 1. This rating applies for sine wave operation at 50 or 60 Hz. Service capability is verified by testing in accordance with UL requirements.
2. This value applies when the base-emitter diode is open circuited.
3. Derate linearly to 100°C free air temperature at the rate of 0.67 mA/°C
4. Derate linearly to 100°C free-air temperature at the rate of 2 mW/°C.
5. Derate linearly to 100°C free-air temperature at the rate of 2.67 mW/°C.

## electrical characteristics at 25°C free-air temperature (unless otherwise noted)

| PARAMETER | | | TEST CONDITIONS | MIN | TYP | MAX | UNIT |
|---|---|---|---|---|---|---|---|
| $V_{(BR)CEO}$ | Collector-emitter breakdown voltage | | $I_C$ = 0.5 mA, $I_F$ = 0 | 35 | | | V |
| $V_{(BR)ECO}$ | Emitter-collector breakdown voltage | | $I_C$ = 100 μA, $I_F$ = 0 | 7 | | | V |
| $I_{C(off)}$ | Off-state collector current | | $V_{CE}$ = 24 V, $I_F$ = 0 | | | 100 | nA |
| CTR† | Current transfer ratio | TIL194, TIL195, TIL196 | $I_F$ = 5 mA, $V_{CE}$ = 5 V | 20% | | | |
| | | TIL194A, TIL195A, TIL196A | | 50% | | | |
| | | TIL194B, TIL195B, TIL196B | | 100% | | | |
| $V_F$† | Input diode static forward voltage | | $I_F$ = 20 mA | | | 1.4 | V |
| $V_{CE(sat)}$† | Collector-emitter saturation voltage | | $I_F$ = 5 mA, $I_C$ = 1 mA | | | 0.4 | V |
| $C_{io}$ | Input-to-output capacitance | | $V_{in-out}$ = 0, f = 1 MHz, See Note 6 | | 1 | | pF |
| $r_{io}$ | Input-to-output internal resistance | | $V_{in-out}$ = ±1 kV, See Note 6 | | $10^{11}$ | | Ω |
| $\frac{I_{C(on)1}}{I_{C(on)2}}$ | On-state collector current symmetry ratio (see Note 7) | | $V_{CE}$ = 5 V, $I_F$ = 5 mA | 1 | | 3 | |

†These parameters apply to either direction of the input current.

NOTES 6: These parameters are measured between all input diode leads shorted together and all phototransistor leads shorted together
7. The higher of the two values of $I_{C(on)}$ generated by the two diodes is taken as $I_{C(on)1}$.

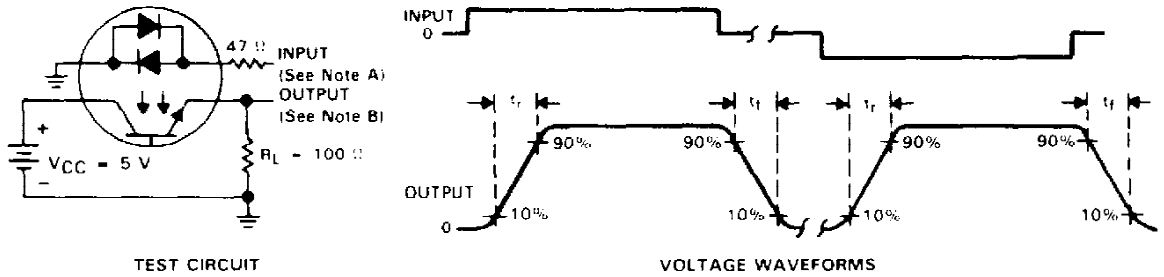
## switching characteristics at 25°C free-air temperature

| PARAMETER | | TEST CONDITIONS | TYP | UNIT |
|---|---|---|---|---|
| $t_r$† | Rise time | $V_{CC}$ = 5 V, $I_{C(on)}$ = 2 mA, | 6 | μs |
| $t_f$† | Fall time | $R_L$ = 100 Ω, See Figure 1 | 6 | μs |

†These parameters apply to either direction of the input current.

## PARAMETER MEASUREMENT INFORMATION

Adjust amplitude of input pulse for $I_{C(on)}$ = 2 mA




TEST CIRCUIT VOLTAGE WAVEFORMS

NOTES A. The input waveform is supplied by a generator with the following characteristics: $Z_O$ = 50 Ω, $t_r$ ≤ 15 ns, duty cycle = 1%.
B. The output waveform is monitored on an oscilloscope with the following characteristics: $t_r$ ≤ 12 ns, $R_i$ ≥ 1 MΩ, $C_i$ ≤ 20 pF.

FIGURE 1. SWITCHING TIMES

## TYPICAL CHARACTERISTICS

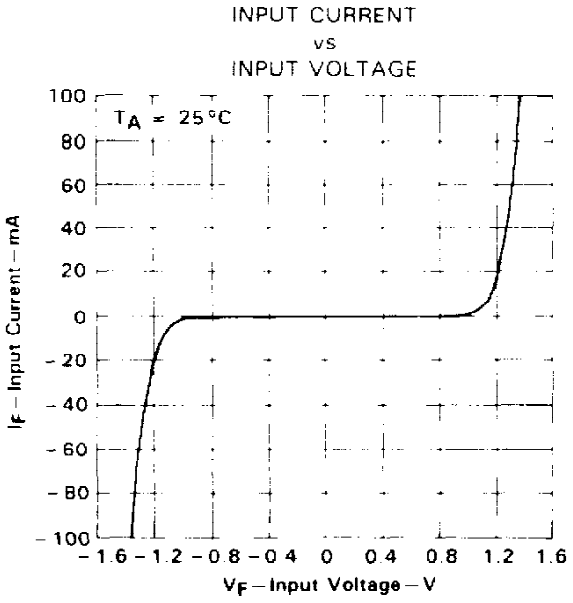



FIGURE 2

## TYPICAL CHARACTERISTICS

TIL194, TIL195, TIL196
COLLECTOR CURRENT
vs
COLLECTOR-EMITTER VOLTAGE

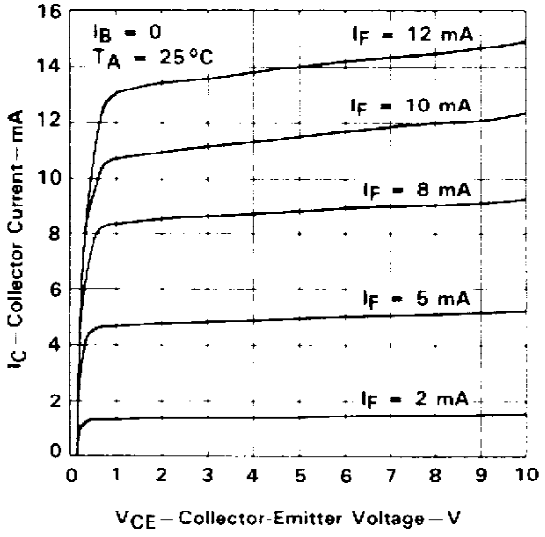



FIGURE 3

NORMALIZED ON-STATE COLLECTOR CURRENT
vs
INPUT-DIODE FORWARD CURRENT

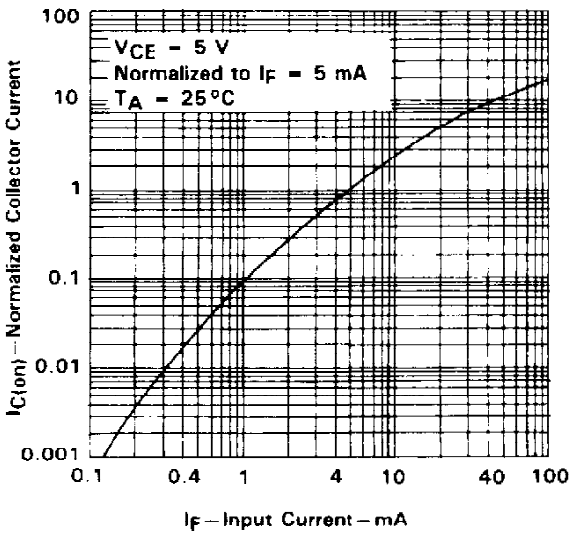



FIGURE 4

RELATIVE ON-STATE COLLECTOR CURRENT
vs
FREE-AIR TEMPERATURE

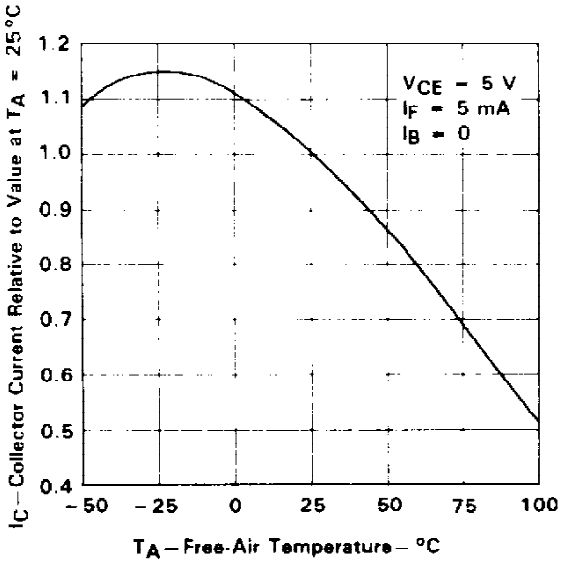



FIGURE 5

TYPICAL COLLECTOR-EMITTER
SATURATION VOLTAGE
vs
FREE-AIR TEMPERATURE

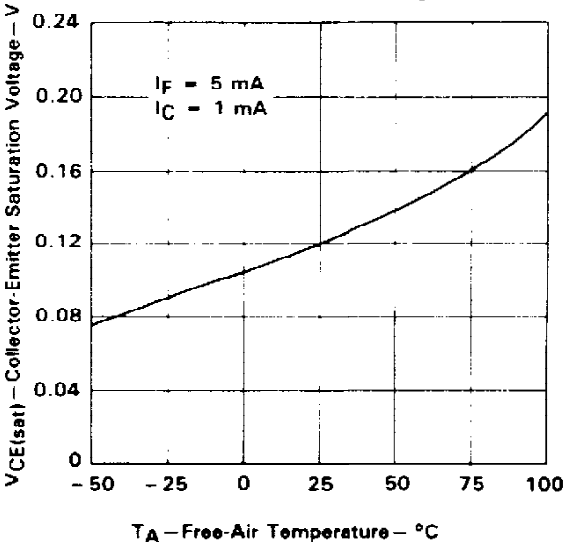



FIGURE 6

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## PACKAGING INFORMATION

| Orderable Device | Status (1) | Package Type | Package Drawing | Pins | Package Qty | Eco Plan (2) | Lead/Ball Finish | MSL Peak Temp (3) |
|---|---|---|---|---|---|---|---|---|
| TIL194 | OBSOLETE | PDIP | N | 4 | | TBD | Call TI | Call TI |
| TIL194A | OBSOLETE | PDIP | P | 4 | | TBD | Call TI | Call TI |
| TIL194B | OBSOLETE | PDIP | P | 4 | | TBD | Call TI | Call TI |
| TIL195 | OBSOLETE | PDIP | N | 8 | | TBD | Call TI | Call TI |
| TIL195A | OBSOLETE | PDIP | P | 8 | | TBD | Call TI | Call TI |
| TIL195B | OBSOLETE | PDIP | P | 8 | | TBD | Call TI | Call TI |
| TIL196 | OBSOLETE | PDIP | N | 16 | | TBD | Call TI | Call TI |
| TIL196A | OBSOLETE | PDIP | P | 16 | | TBD | Call TI | Call TI |
| TIL196B | OBSOLETE | PDIP | P | 16 | | TBD | Call TI | Call TI |

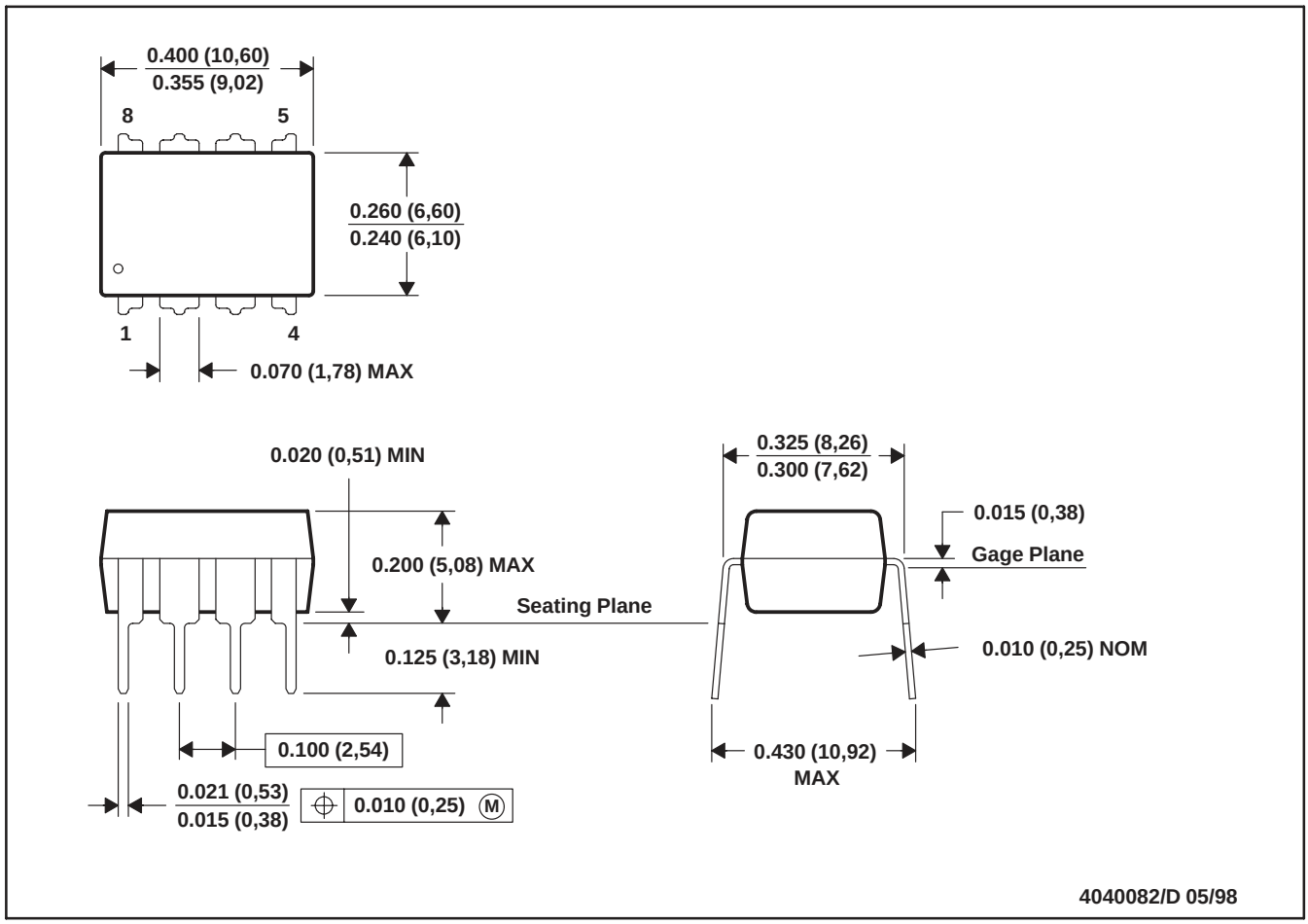
(1) The marketing status values are defined as follows:
**ACTIVE:** Product device recommended for new designs.
**LIFEBUY:** TI has announced that the device will be discontinued, and a lifetime-buy period is in effect.
**NRND:** Not recommended for new designs. Device is in production to support existing 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) 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.
**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.

MPDI001A – JANUARY 1995 – REVISED JUNE 1999

**P (R-PDIP-T8)** **PLASTIC DUAL-IN-LINE**



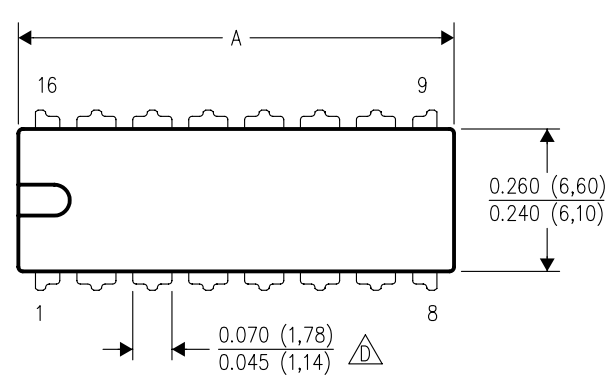

NOTES: A. All linear dimensions are in inches (millimeters).
B. This drawing is subject to change without notice.
C. Falls within JEDEC MS-001

For the latest package information, go to http://www.ti.com/sc/docs/package/pkg_info.htm

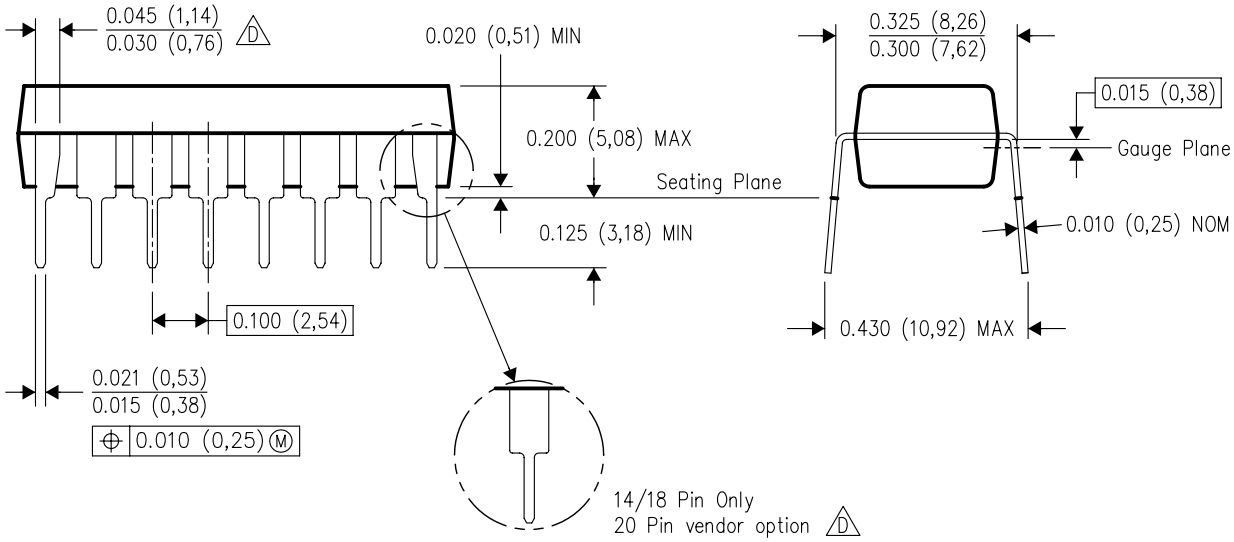
## N (R–PDIP–T**)

## PLASTIC DUAL–IN–LINE PACKAGE

16 PINS SHOWN




| DIM \ PINS ** | 14 | 16 | 18 | 20 |
|---|---|---|---|---|
| A MAX | 0.775 (19,69) | 0.775 (19,69) | 0.920 (23,37) | 1.060 (26,92) |
| A MIN | 0.745 (18,92) | 0.745 (18,92) | 0.850 (21,59) | 0.940 (23,88) |
| MS–001 VARIATION (C) | AA | BB | AC | AD |

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NOTES:
A. All linear dimensions are in inches (millimeters).
B. This drawing is subject to change without notice.
C. Falls within JEDEC MS–001, except 18 and 20 pin minimum body length (Dim A).
D. The 20 pin end lead shoulder width is a vendor option, either half or full width.

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