

#### FEATURES

- Two Matched NPN Transistors  
Two Matched PNP Transistors
- Monolithic Construction
- Low Noise
  - $0.75 \text{ nV}/\sqrt{\text{Hz}}$  (PNP)
  - $0.8 \text{ nV}/\sqrt{\text{Hz}}$  (NPN)
- High Speed
  - $f_t = 350 \text{ MHz}$  (NPN)
  - $f_t = 325 \text{ MHz}$  (PNP)
- Excellent Matching -  $500 \mu\text{V}$  typ
- Dielectrically Isolated
- $25 \text{ V } V_{\text{CEO}}$

#### APPLICATIONS

- Microphone Preamplifiers
- Tape Head Preamplifiers
- Current Sources
- Current Mirrors
- Log/Antilog Amplifiers
- Multipliers

#### DESCRIPTION

THAT140 is a quad, large-geometry monolithic NPN/PNP transistor array which combines low noise, high speed and excellent parametric matching. The large geometries typically result in  $25 \Omega$  base spreading resistance for the PNP devices ( $30 \Omega$  for the NPNs), producing  $0.75 \text{ nV}/\sqrt{\text{Hz}}$  voltage noise ( $0.8 \text{ nV}/\sqrt{\text{Hz}}$  for the NPNs). This makes these parts an ideal choice for low-noise amplifier input stages.

Fabricated on a Complementary Bipolar Dielectrically Isolated process, all four transistors are electrically isolated from each other by a layer of oxide.

The resulting low collector-to-substrate capacitance produces a typical NPN  $f_t$  of 350 MHz, 325 MHz for the PNPs. This delivers AC performance similar to discrete 2N3904- and 2N3906-class devices. Dielectric isolation also minimizes crosstalk and provides complete DC isolation.

Substrate biasing is not required for normal operation, though the substrate should be grounded to optimize speed. The monolithic construction assures excellent parameter matching and tracking over temperature.

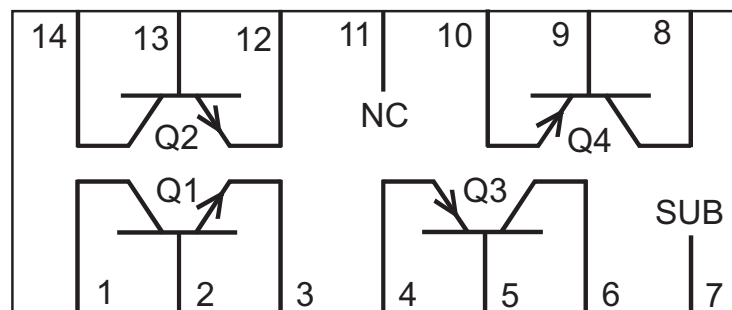


Figure 1. Pin Configuration

# SPECIFICATIONS<sup>1</sup>

<b>Maximum Ratings (T<sub>A</sub> = 25°C)</b>						
Parameter	Symbol	Conditions	Min	Typ	Max	Units
NPN Collector-Emitter Voltage	BV <sub>CEO</sub>	I <sub>C</sub> = 1 mAdc, I <sub>B</sub> = 0	25	35	—	V
NPN Collector-Base Voltage	BV <sub>CBO</sub>	I <sub>C</sub> = 10 μAdc, I <sub>E</sub> = 0	25	35	—	V
NPN Emitter-Base Voltage	BV <sub>EBO</sub>	I <sub>E</sub> = 10 μAdc, I <sub>C</sub> = 0	5	—	—	V
NPN Collector Current	I <sub>C</sub>		10	20		mA
NPN Emitter Current	I <sub>E</sub>		10	20		mA
PNP Collector-Emitter Voltage	BV <sub>CEO</sub>	I <sub>C</sub> = 1 mAdc, I <sub>B</sub> = 0	-25	-40	—	V
PNP Collector-Base Voltage	BV <sub>CBO</sub>	I <sub>C</sub> = 10 μAdc, I <sub>E</sub> = 0	-25	-40	—	V
PNP Emitter-Base Voltage	BV <sub>EBO</sub>	I <sub>E</sub> = 10 μAdc, I <sub>C</sub> = 0	-5	—	—	V
PNP Collector Current	I <sub>C</sub>		-10	-20		mA
PNP Emitter Current	I <sub>E</sub>		-10	-20		mA
Collector-Collector Voltage	BV <sub>CC</sub>		±100	±200	—	V
Emitter-Emitter Voltage	BV <sub>EE</sub>		±100	±200	—	V
Operating Temperature Range	T <sub>A</sub>		0		70	°C
Maximum Junction Temperature	T <sub>JMAX</sub>				150	°C
Storage Temperature	T <sub>STORE</sub>		-45		125	°C

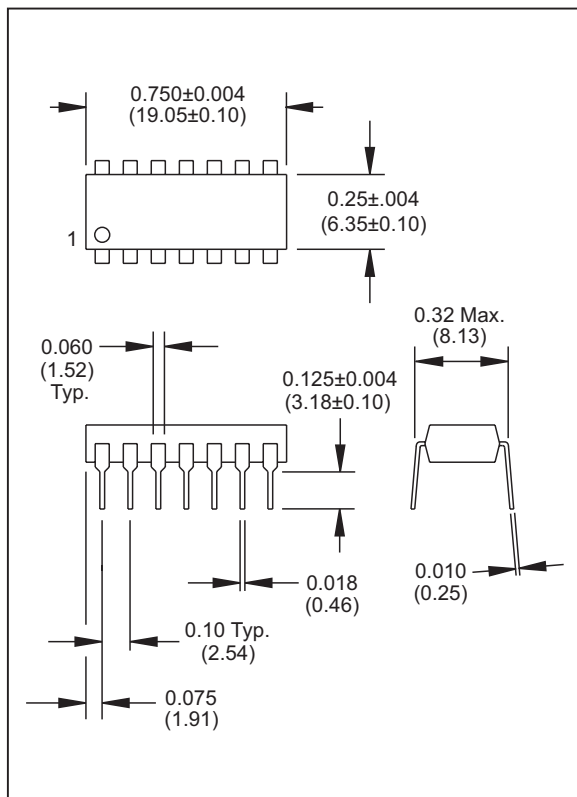


Figure 2. Dual-In-Line Package Outline

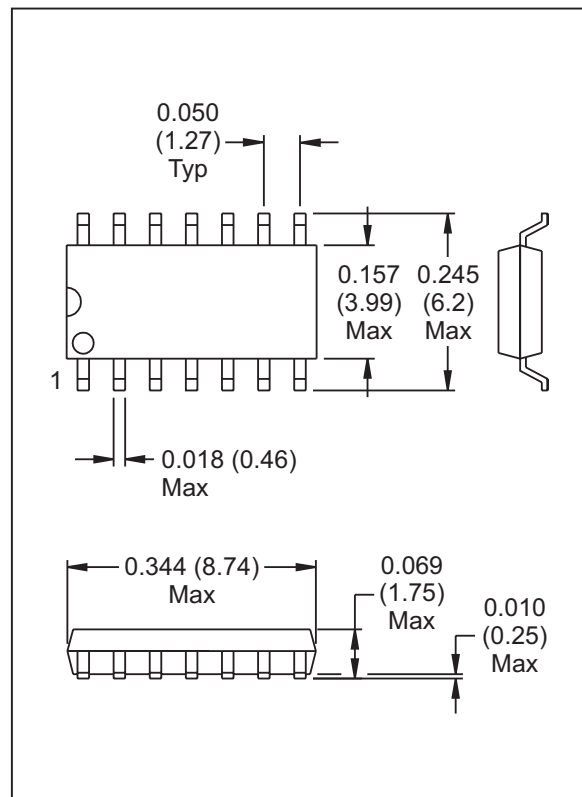


Figure 3. Surface Mount Package Outline

<b>Electrical Characteristics<sup>2</sup></b>						
Parameter	Symbol	Conditions	Min	Typ	Max	Units
NPN Current Gain	$h_{fe}$	$V_{CB} = 10\text{ V}$				
		$I_C = 1\text{ mA}$	60	100	—	
		$I_C = 10\text{ }\mu\text{A}$	60	100	—	
NPN Current Gain Matching	$\Delta h_{fe}$	$V_{CB} = 10\text{ V}, I_C = 1\text{ mA}$	—	5	—	%
NPN Noise Voltage Density	$e_N$	$V_{CB} = 10\text{ V}, I_C = 1\text{ mA}, 1\text{ kHz}$	—	0.8	—	$\text{nV} / \sqrt{\text{Hz}}$
NPN Gain-Bandwidth Product	$f_t$	$I_C = 1\text{ mA}, V_{CB} = 10\text{ V}$		350		MHz
NPN $\Delta V_{BE}$ ( $V_{BE1}-V_{BE2}$ )	$V_{OS}$	$I_C = 1\text{ mA}$	—	$\pm 0.5$	$\pm 3$	mV
		$I_C = 10\text{ }\mu\text{A}$	—	$\pm 0.5$	$\pm 3$	mV
NPN $\Delta I_B$ ( $I_{B1}-I_{B2}$ )	$I_{OS}$	$I_C = 1\text{ mA}$	—	$\pm 500$	$\pm 1500$	nA
		$I_C = 10\text{ }\mu\text{A}$	—	$\pm 5$	$\pm 15$	nA
NPN Collector-Base Leakage Current	$I_{CBO}$	$V_{CB} = 25\text{ V}$	—	25	—	pA
NPN Bulk Resistance	$r_{BE}$	$V_{CB} = 0\text{ V}, 10\text{ }\mu\text{A} < I_C < 10\text{ mA}$	—	2	—	$\Omega$
NPN Base Spreading Resistance	$r_{bb}$	$V_{CB} = 10\text{ V}, I_C = 1\text{ mA}$	—	30	—	$\Omega$
NPN Collector Saturation Voltage	$V_{CE(SAT)}$	$I_C = 1\text{ mA}, I_B = 100\text{ }\mu\text{A}$	—	0.05		V
NPN Output Capacitance	$C_{OB}$	$V_{CB} = 10\text{ V}, I_E = 0\text{ mA}, 100\text{ kHz}$		3		pF
NPN Collector-Collector Capacitance ( $Q_1-Q_2$ )	$C_{CC}$	$V_{CC} = 0\text{ V}, 100\text{ kHz}$		0.7		pF
PNP Current Gain	$h_{fe}$	$V_{CB} = 10\text{ V}$				
		$I_C = 1\text{ mA}$	50	75	—	
		$I_C = 10\text{ }\mu\text{A}$	50	75	—	
PNP Current Gain Matching	$\Delta h_{fe}$	$V_{CB} = 10\text{ V}, I_C = 1\text{ mA}$	—	5	—	%
PNP Noise Voltage Density	$e_N$	$V_{CB} = 10\text{ V}, I_C = 1\text{ mA}, 1\text{ kHz}$	—	0.75	—	$\text{nV} / \sqrt{\text{Hz}}$
PNP Gain-Bandwidth Product	$f_t$	$I_C = 1\text{ mA}, V_{CB} = 10\text{ V}$		325		MHz
PNP $\Delta V_{BE}$ ( $V_{BE3}-V_{BE4}$ )	$V_{OS}$	$I_C = 1\text{ mA}$	—	$\pm 0.5$	$\pm 3$	mV
		$I_C = 10\text{ }\mu\text{A}$	—	$\pm 0.5$	$\pm 3$	mV
PNP $\Delta I_B$ ( $I_{B3}-I_{B4}$ )	$I_{OS}$	$I_C = 1\text{ mA}$	—	$\pm 700$	$\pm 1800$	nA
		$I_C = 10\text{ }\mu\text{A}$	—	$\pm 7$	$\pm 18$	nA
PNP Collector-Base Leakage Current	$I_{CBO}$	$V_{CB} = 25\text{ V}$	—	-25	—	pA
PNP Bulk Resistance	$r_{BE}$	$V_{CB} = 0\text{ V}, 10\text{ }\mu\text{A} < I_C < 10\text{ mA}$	—	2	—	$\Omega$
PNP Base Spreading Resistance	$r_{bb}$	$V_{CB} = 10\text{ V}, I_C = 1\text{ mA}$	—	25	—	$\Omega$
PNP Collector Saturation Voltage	$V_{CE(SAT)}$	$I_C = 1\text{ mA}, I_B = 100\text{ }\mu\text{A}$	—	-0.05		V
PNP Output Capacitance	$C_{OB}$	$V_{CB} = 10\text{ V}, I_E = 0\text{ mA}, 100\text{ kHz}$		3		pF
PNP Collector-Collector Capacitance ( $Q_3-Q_4$ )	$C_{CC}$	$V_{CC} = 0\text{ V}, 100\text{ kHz}$		0.6		pF

1. All specifications subject to change without notice.

2. Unless otherwise noted,  $T_A = 25^\circ\text{C}$ .

**Notes**