



# TS321

Preliminary

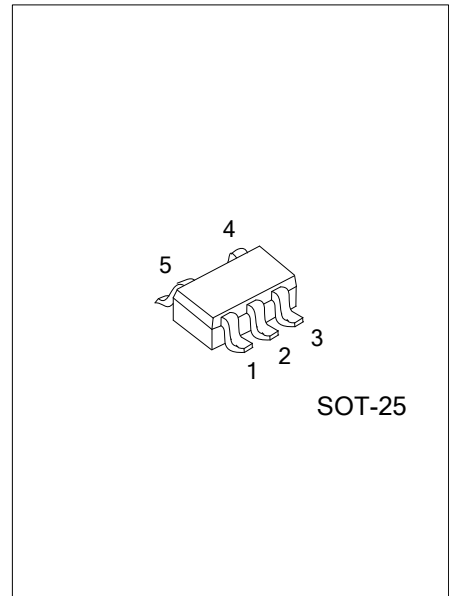
LINEAR INTEGRATED CIRCUIT

## LOW-POWER SINGLE OPERATIONAL AMPLIFIER

### DESCRIPTION

The UTC **TS321**'s quiescent current is only 500µA (5V). The UTC **TS321** brings performance and economy to low power systems. With a high unity gain frequency and a specified 0.4V/µs slew rate. The device is able to operate in single supply applications as well as in dual supply applications.

The UTC **TS321** is a bipolar operational amplifier for cost-sensitive applications in which space savings are important.



### FEATURES

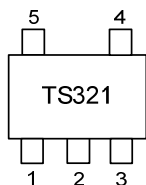
- \* Wide Power-Supply Range  
Single Supply: 3V~30V or Dual Supply: ±1.5V~±15V
- \* Large Output Voltage Swing: 0V~3.5V (Min.) (V<sub>CC</sub>=5V)
- \* Low Supply Current: 500µA (Typ.)
- \* Low Input Bias Current: 20nA (Typ.)
- \* Low Input Offset Voltage: 4mV (Max.)
- \* Stable With High Capacitive Loads

### ORDERING INFORMATION

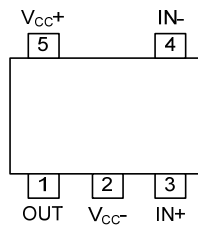
Ordering Number		Package	Packing
Lead Free	Halogen Free		
TS321L-AF5-R	TS321G-AF5-R	SOT-25	Tape Reel

<p>TS321G-AF5-R</p> <p>(1) Packing Type</p> <p>(2) Package Type</p> <p>(3) Green Package</p>	<p>(1) R: Tape Reel</p> <p>(2) AF5: SOT-25</p> <p>(3) G: Halogen Free and Lead Free, L: Lead Free</p>
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### MARKING



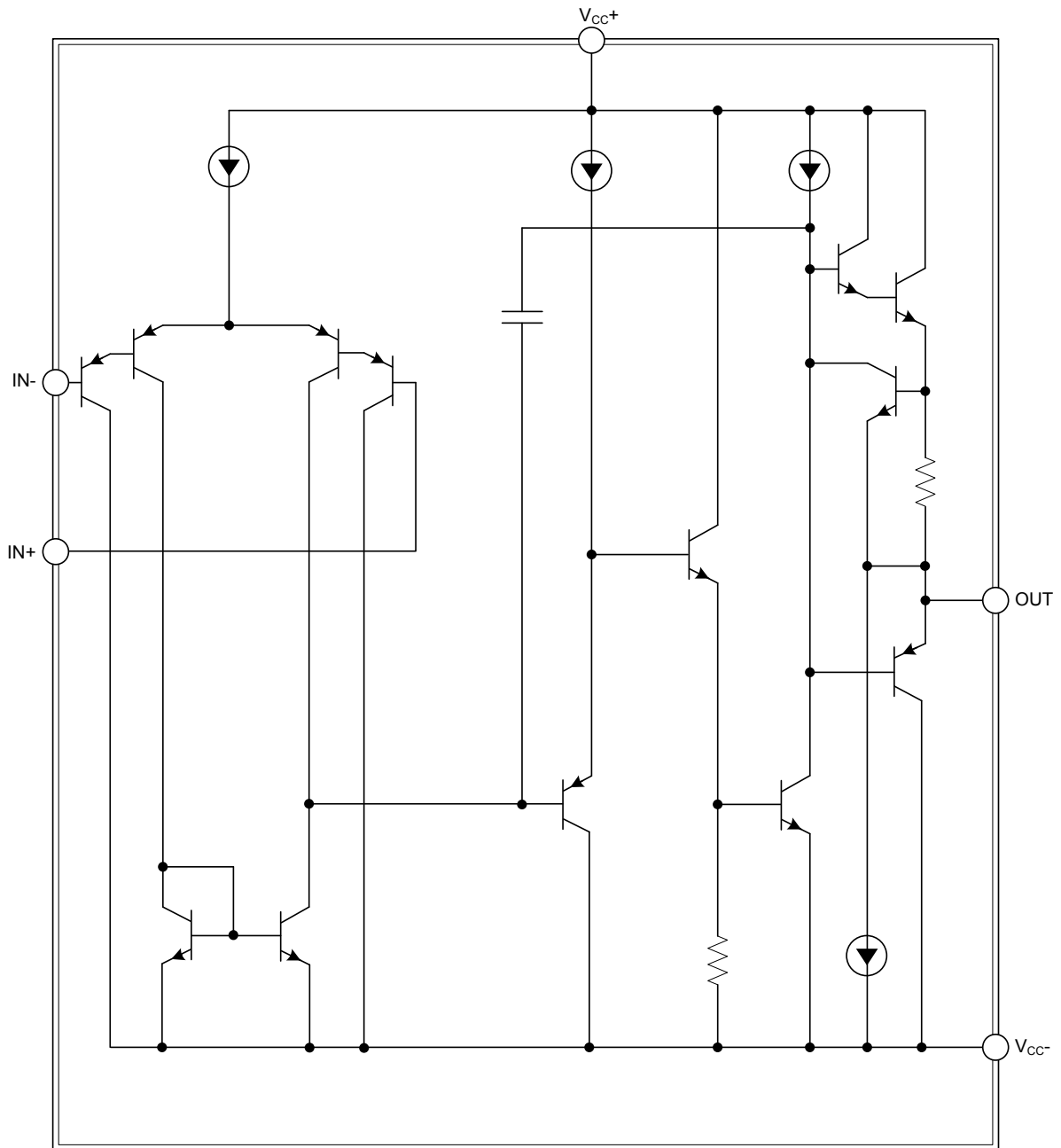
■ PIN CONFIGURATION



■ PIN DESCRIPTION

PIN NO.	PIN NAME	DESCRIPTION
1	OUT	Output
2	V <sub>CC-</sub>	Ground
3	IN+	Non- negative input
4	IN-	Negative input
5	V <sub>CC+</sub>	Power supply

■ BLOCK DIAGRAM



### ■ ABSOLUTE MAXIMUM RATING (Note 1)

Over operating free-air temperature range (unless otherwise noted)

PARAMETER	SYMBOL	RATINGS	UNIT
Supply Voltage (Note 2)	Single	32	V
	Dual	±16	V
Differential Input Voltage (Note 3)	$V_{ID}$	32	V
Input Voltage Range (Note 2, 4)	$V_I$	-0.3 ~ 32	V
Input Current (Note 4)	$I_I$	50	mA
Duration Of Output Short Circuit To Ground	$T_{SHORT}$	Unlimited	
Power Dissipation	$P_D$	0.595	W
Operating Virtual Junction Temperature	$T_J$	+150	°C
Storage Temperature Range	$T_{STG}$	-65 ~ +150	°C

Notes: 1. Absolute maximum ratings are those values beyond which the device could be permanently damaged.

Absolute maximum ratings are stress ratings only and functional device operation is not implied.

2. These voltage values are with respect to the midpoint between  $V_{CC+}$  and  $V_{CC-}$ .
3. Differential voltages are at IN+ with respect to IN-.
4. Neither input must ever be more positive than  $V_{CC+}$  or more negative than  $V_{CC-}$ .

### ■ RECOMMENDED OPERATING CONDITIONS

PARAMETER	SYMBOL	RATINGS	UNIT
Supply Voltage	Single Supply	3 ~ 30	V
	Dual Supply	±1.5 ~ ±15	V
Operating Free-Air Temperature	$T_A$	-40 ~ +125	°C

### ■ THERMAL DATA

PARAMETER	SYMBOL	RATINGS	UNIT
Junction to Ambient	$\theta_{JA}$	210	°C/W

### ■ ELECTRICAL CHARACTERISTICS

( $V_{CC+}=5V$ ,  $V_{CC-}=GND$ ,  $V_O=1.4V$  (unless otherwise noted))

PARAMETER	SYMBOL	TEST CONDITIONS	MIN	TYP	MAX	UNIT
Input Offset Voltage	$V_{IO}$	$R_S=0$ , $5V < V_{CC+} < 30V$ $0 < V_{IC} < (V_{CC+} - 1.5V)$		0.5	4	mV
Input Offset Current	$I_{IO}$			2	30	nA
Input Bias Current (Note 1)	$I_{IB}$			20	150	nA
Large-Signal Differential Voltage Amplification	$A_{VD}$	$V_{CC}=15V$ , $R_L=2k\Omega$ , $V_O=1.4V \sim 11.4V$	50	100		V/mV
Common-Mode Input Voltage (Note 2)	$V_{ICR}$	$V_{CC}=30V$	0		$V_{CC+} - 1.5$	V
High-Level Output Voltage	$V_{OH}$	$V_{CC}=30V$	$R_L=2k\Omega$	26	27	V
			$R_L=10k\Omega$	27	28	
		$V_{CC}=5V$	$R_L=2k\Omega$	3.5		
Low-Level Output Voltage	$V_{OL}$	$R_L=10k\Omega$		5	15	mV
Gain Bandwidth Product	GBP	$V_{CC}=30V$ , $V_I=10mV$ , $R_L=2k\Omega$ , $f=100kHz$ , $C_L=100pF$		0.8		MHz
Slew Rate	SR	$V_{CC}=15V$ , $V_I=0.5V \sim 3V$ , $R_L=2k\Omega$ , $C_L=100pF$ , unity gain		0.4		V/ $\mu s$
Phase Margin	$\Phi_m$			60		°
Common-Mode Rejection Ratio	CMRR	$R_S \leq 10k\Omega$	65	85		dB
Output Source Current	$I_{SOURCE}$	$V_{CC}=15V$ , $V_O=2V$ , $V_{ID}=1V$	20	40		mA
Output Sink Current	$I_{SINK}$	$V_{CC}=15V$ , $V_{ID}=1V$	$V_O=2V$	10	20	mA
			$V_O=0.2V$	12	50	$\mu A$
Short-Circuit To GND	$I_O$	$V_{CC}=15V$		40	60	mA
Supply-Voltage Rejection Ratio	SVR	$V_{CC}=5V \sim 30V$	65	110		dB
Total Supply Current	$I_{CC}$	No load	$V_{CC}=5V$	500	800	$\mu A$
			$V_{CC}=30V$	600	900	$\mu A$
Total Harmonic Distortion	THD	$V_{CC}=30V$ , $V_O=2V_{PP}$ , $A_V=20dB$ , $R_L=2k\Omega$ , $f=1kHz$ , $C_L=100pF$		0.015		%
Equivalent Input Noise Voltage	$e_N$	$V_{CC}=30V$ , $f=1kHz$ , $R_S=100\Omega$		50		$nV/\sqrt{Hz}$

Notes: 1. The direction of the input current is out of the device. This current essentially is constant, independent of the state of the output, so no loading change exists on the input lines.

2. The input common-mode voltage of either input signal should not be allowed to go negative by more than 0.3V. The upper end of the common-mode voltage range is  $V_{CC+} - 1.5V$ , but either or both inputs can go to 32V without damage.

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