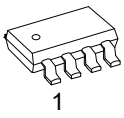
# GENERAL PURPOSE, LOW VOLTAGE, RAIL-TO-RAIL OUTPUT OPERATIONAL AMPLIFIERS



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TSOT-23-8L

## ■ DESCRIPTION

The UTC **LV358T** is a dual op amp with low supply current and low voltage (2.7-5.5V). It brings nice performance to low voltage and low power systems. With a 1.6MHz unity-gain frequency. The UTC **LV358T** has a guaranteed 0.9V/μs slew rate and low supply current. It provides heavy rail-to-rail (R-to-R) output swing loads and the input common-mode voltage range including ground. Besides, it is also capable for comfortably driving large capacitive loads.

The UTC **LV358T** has bipolar input and CMOS output for improved noise performance and higher output current drive. It's the most cost effective solution for the applications where low voltage operation, space saving and low price are required.

## ■ FEATURES

* Supply Voltage: 2.7 ~ 5.5V
* Supply current: 100μA / amplifier (Typ.)
* Input Offset Voltage: 7mV (Max.)
* Rail-to-Rail outputs
* Slew Rate 0.9V/μs (Typ.)

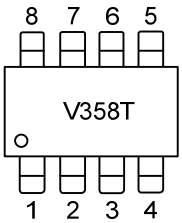
## ■ ORDERING INFORMATION

| Ordering Number | | Package | Packing |
|---|---|---|---|
| Lead Free | Halogen Free | | |
| LV358TL-AH8-R | LV358TG-AH8-R | TSOT-23-8L | Tape Reel |

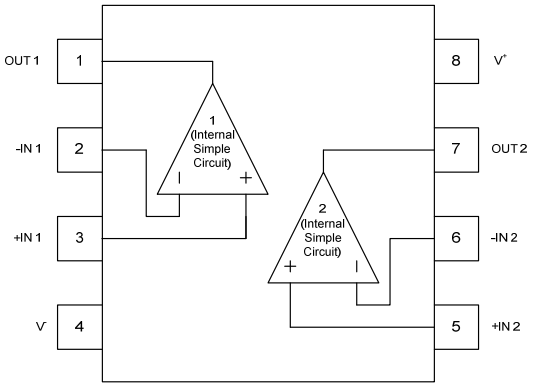
LV358TG-AH8-R

| | |
|---|---|
| (1)Packing Type | (1) R: Tape Reel |
| (2)Package Type | (2) AH8: TSOT-23-8L |
| (3)Green Package | (3) G: Halogen Free and Lead Free, L: Lead Free |

## ■ MARKING



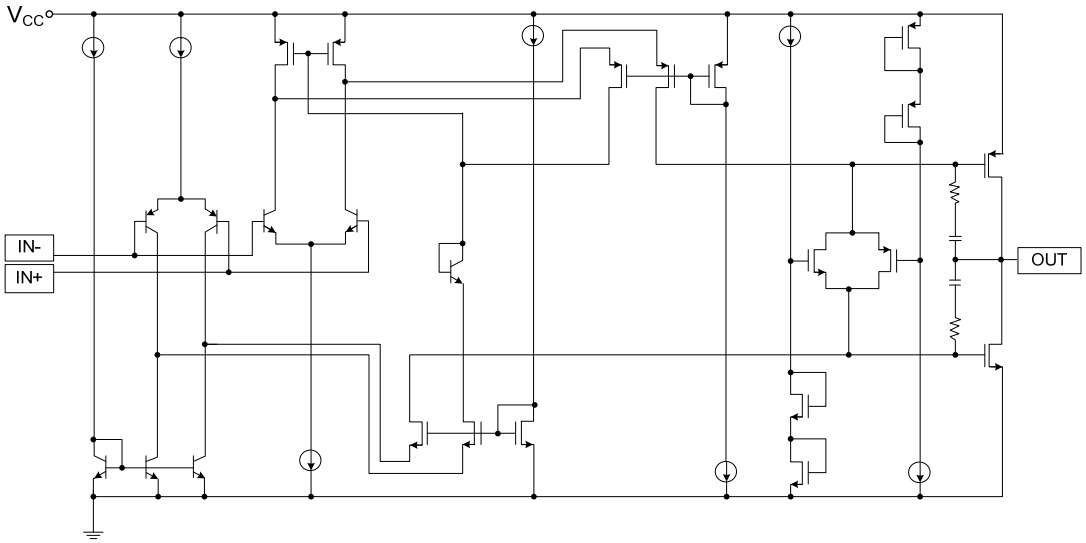

## ■ PIN CONFIGURATION




## ■ PIN DESCRIPTION

| PIN NO. | PIN NAME | DESCRIPTION |
|---|---|---|
| 1 | OUT 1 | Output of 1 AMP |
| 2 | -IN 1 | Inverting input of 1 AMP |
| 3 | +IN 1 | Non-inverting input of 1 AMP |
| 4 | $V^-$ | Negative power supply |
| 5 | +IN 2 | Non-inverting input of 2 AMP |
| 6 | -IN 2 | Inverting input of 2 AMP |
| 7 | OUT 2 | Output of 2 AMP |
| 8 | $V^+$ | Positive power supply |

## ■ BLOCK DIAGRAM



## ■ ABSOLUTE MAXIMUM RATINGS (Note1)

| PARAMETER | SYMBOL | RATINGS | UNIT |
|---|---|---|---|
| Supply Voltage ($V^+$- $V^-$) | $V^+ - V^-$ | 0~6 | V |
| Differential Input Voltage | | ±Supply Voltage | V |
| Output short-circuit (Note2) | | Continuous | mA |
| Power Dissipation | $P_D$ | 0.35 | W |
| Junction Temperature | $T_J$ | +150 | °C |
| Storage Temperature | $T_{STG}$ | -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. Short-circuit to ground, one amplifier per package.

## ■ THERMAL DATA

| PARAMETER | SYMBOL | RATINGS | UNIT |
|---|---|---|---|
| Thermal Resistance (Note) | $\theta_{JA}$ | 190 | °C/W |
| | $\theta_{JC}$ | 120 | °C/W |

Note: All numbers are typical, and apply for packages soldered directly note a PC board is still air.

## ■ RECOMMENDED OPERATING CONDITIONS

| PARAMETER | SYMBOL | RATINGS | UNIT |
|---|---|---|---|
| Supply Voltage | $V^+ - V^-$ | 2.7 ~ 5.5 | V |
| Input voltage range | $V_I$ | $V^-$~$V^+$-1 | V |
| Output voltage range | $V_O$ | $V^-$~$V^+$ | V |
| Operating Free-Air Temperature | $T_{OPR}$ | -40 ~ +85 | °C |

## ■ 2.7V ELECTRICAL CHARACTERISTICS

($T_A$=25°C, $V^+$ = 2.7V, $V^-$ = 0V, $V_{CM}$ = 1.0V and $R_L$ > 1MΩ, unless otherwise specified)

| PARAMETER | SYMBOL | CONDITIONS | MIN | TYP | MAX | UNIT |
|---|---|---|---|---|---|---|
| **DC CHARACTERISTICS** | | | | | | |
| Supply Current/Amplifier | $I_Q$ | | | 80 | 170 | μA |
| Power Supply Rejection Ratio | PSRR | 2.7V ≤ $V^+$ ≤ 5V, $V_{OUT}$=1V | 50 | 72 | | dB |
| Input Offset Voltage | $V_{OS}$ | | | 0.4 | 7 | mV |
| Input Bias Current | $I_B$ | | | 11 | | nA |
| Input Offset Current | $I_{OS}$ | | | 5 | | nA |
| Input Common Mode Voltage Range | $V_{CM}$ | For CMRR ≥ 50dB | 0 | -0.2 | | V |
| | | | | 1.9 | 1.7 | V |
| Common Mode Rejection Ratio | CMRR | 0V ≤ $V_{CM}$ ≤ 1.7V | 50 | 85 | | dB |
| Output Swing | $V_O$ | $R_L$=10kΩ to 1.35V | $V^+$-100 | $V^+$-10 | | mV |
| | | | | 60 | 180 | mV |
| **AC CHARACTERISTICS** | | | | | | |
| Gain Bandwidth Product | GBW | $C_L$=200pF | | 1.6 | | MHz |
| Phase Margin | ΦM | | | 55 | | Deg |
| Gain Margin | $G_m$ | | | 7 | | dB |
| Input Referred Voltage Noise | $e_n$ | F=1KHz | | 48 | | $\frac{nV}{\sqrt{Hz}}$ |
| Input Referred Current Noise | $i_n$ | F=1KHz | | 0.18 | | $\frac{pA}{\sqrt{Hz}}$ |

## ■ 5V ELECTRICAL CHARACTERISTICS

($T_A$=25°C, $V^+$ = 5.0V, $V^-$ = 0V, $V_{CM}$ = 1.0V and $R_L$ > 1MΩ, unless otherwise specified)

| PARAMETER | SYMBOL | CONDITIONS | | MIN | TYP | MAX | UNIT |
|---|---|---|---|---|---|---|---|
| **DC CHARACTERISTICS** | | | | | | | |
| Supply Current/Amplifier | $I_Q$ | | | | 100 | 220 | μA |
| Power Supply Rejection Ratio | PSRR | 2.7V ≤ V+ ≤ 5V<br>$V_{OUT}$=1V, $V_{CM}$=1V | | 50 | 72 | | dB |
| Input Offset Voltage | $V_{OS}$ | | | | 0.4 | 7 | mV |
| Input Bias Current | $I_B$ | | | | 15 | | nA |
| Input Offset Current | $I_{OS}$ | | | | 5 | | nA |
| Input Common-Mode Voltage Range | $V_{CM}$ | For CMRR ≥ 50dB | | 0 | -0.2 | | V |
| | | | | | 4.2 | 4 | V |
| Common Mode Rejection Ratio | CMRR | 0V ≤ $V_{CM}$ ≤ 4V | | 50 | 85 | | dB |
| Large Signal Voltage Gain (Note 1) | $A_V$ | $R_L$=2KΩ | | 80 | 90 | | dB |
| Output Swing | $V_{OUT}$ | $R_L$=2KΩ to2.5V | $V_{OH}$ | $V^+$-300 | $V^+$-40 | | mV |
| | | | $V_{OL}$ | | 120 | 300 | mV |
| | | $R_L$=10KΩ to 2.5V | $V_{OH}$ | $V^+$-100 | $V^+$-10 | | mV |
| | | | $V_{OL}$ | | 65 | 180 | mV |
| Output Short Circuit Current | $I_{SC}$ | Sourcing, $V_{OUT}$ =0V | | 5 | 95 | | mA |
| | | Sinking, $V_{OUT}$ =5V | | 10 | 80 | | mA |
| **AC CHARACTERISTICS** | | | | | | | |
| Slew Rate | SR | (Note 2) | | | 0.9 | | V/μs |
| Gain Bandwidth Product | GBW | $C_L$=200pF | | | 1.6 | | MHz |
| Phase Margin | $\Phi_M$ | | | | 55 | | Deg |
| Gain Margin | $G_m$ | | | | 7 | | dB |
| Input Referred Voltage Noise | $e_n$ | f=1KHz | | | 40 | | $\frac{nV}{\sqrt{Hz}}$ |
| Input Referred Current Noise | $i_n$ | f=1KHz | | | 0.22 | | $\frac{pA}{\sqrt{Hz}}$ |

Notes: 1. $R_L$ is connected to $V^-$. The output voltage is 0.5V ≤ $V_{OUT}$ ≤ 4.5V.

2. Connected as voltage follower with 3V step input. Number specified is these lower of the positive and negative slew rates.

## ■ TEST CIRCUIT FOR STABILITY VS CAPACITIVE LOAD