DESCRIPTION
The TS3V912 is a RAIL TO RAIL CMOS dual operational amplifier designed to operate with a single 3V supply voltage. The input voltage range $V_{icm}$ includes the two supply rails $V_{CC}^+$ and $V_{CC}^-$. The output reaches:
- $V_{CC}^- +40mV$ to $V_{CC}^+ -50mV$ with $R_L = 10k\Omega$
- $V_{CC}^- +350mV$ to $V_{CC}^+ -350mV$ with $R_L = 600\Omega$
This product offers a broad supply voltage operating range from 2.7V to 16V and a supply current of only 200$\mu$A/amp. ($V_{CC} = 3V$).
Source and sink output current capability is typically 40mA (at $V_{CC} = 3V$), fixed by an internal limitation circuit.
SGS-THOMSON is offering a quad op-amp with the same features: TS3V914.
ABSOLUTE MAXIMUM RATINGS

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Parameter</th>
<th>Value</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>VCC</td>
<td>Supply Voltage - (note 1)</td>
<td>18</td>
<td>V</td>
</tr>
<tr>
<td>V_{id}</td>
<td>Differential Input Voltage - (note 2)</td>
<td>±18</td>
<td>V</td>
</tr>
<tr>
<td>V_i</td>
<td>Input Voltage - (note 3)</td>
<td>-0.3 to 18</td>
<td>V</td>
</tr>
<tr>
<td>I_{in}</td>
<td>Current on Inputs</td>
<td>±50</td>
<td>mA</td>
</tr>
<tr>
<td>I_o</td>
<td>Current on Outputs</td>
<td>±130</td>
<td>mA</td>
</tr>
<tr>
<td>T_{oper}</td>
<td>Operating Free Air Temperature Range</td>
<td>TS3V912I/AI/B1</td>
<td>-40 to +125</td>
</tr>
<tr>
<td>T_{stg}</td>
<td>Storage Temperature</td>
<td>-65 to +150</td>
<td>°C</td>
</tr>
</tbody>
</table>

Notes:
1. All voltage values, except differential voltage are with respect to network ground terminal.
2. Differential voltages are the non-inverting input terminal with respect to the inverting input terminal.
3. The magnitude of input and output voltages must never exceed VCC +0.3V.

OPERATING CONDITIONS

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Parameter</th>
<th>Value</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>VCC</td>
<td>Supply Voltage</td>
<td>2.7 to 16</td>
<td>V</td>
</tr>
<tr>
<td>V_{icm}</td>
<td>Common Mode Input Voltage Range</td>
<td>VCC -0.2 to VCC +0.2</td>
<td>V</td>
</tr>
</tbody>
</table>
**ELECTRICAL CHARACTERISTICS**

$V_{CC^+} = 3V, V_{CC^-} = 0V, R_L, C_L$ connected to $V_{CC}/2$, $T_{amb} = 25^\circ C$ (unless otherwise specified)

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Parameter Description</th>
<th>TS3V912/AI/B1</th>
<th>Min.</th>
<th>Typ.</th>
<th>Max.</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>$V_i$</td>
<td>Input Offset Voltage ($V_{ic} = V_o = V_{CC}/2$)</td>
<td>TS3V912</td>
<td>10</td>
<td>5</td>
<td>2</td>
<td>mV</td>
</tr>
<tr>
<td></td>
<td>$T_{min} \leq T_{amb} \leq T_{max}$</td>
<td>TS3V912A</td>
<td>TS3V912B</td>
<td>7</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>TS3V912A</td>
<td>TS3V912B</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$DVI_o$</td>
<td>Input Offset Voltage Drift</td>
<td></td>
<td>5</td>
<td></td>
<td></td>
<td>$\mu V/^\circ C$</td>
</tr>
<tr>
<td>$I_i$</td>
<td>Input Offset Current - (note 1)</td>
<td></td>
<td>1</td>
<td>100</td>
<td></td>
<td>pA</td>
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<tr>
<td>$I_b$</td>
<td>Input Bias Current - (note 1)</td>
<td></td>
<td>1</td>
<td>150</td>
<td></td>
<td>pA</td>
</tr>
<tr>
<td>$I_{CC}$</td>
<td>Supply Current (per amplifier, $A_{VCL} = 1$, no load)</td>
<td></td>
<td>200</td>
<td>300</td>
<td></td>
<td>$\mu A$</td>
</tr>
<tr>
<td></td>
<td>$T_{min} \leq T_{amb} \leq T_{max}$</td>
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<tr>
<td>CMR</td>
<td>Common Mode Rejection Ratio $V_{ic} = 0$ to 3V, $V_o = 1.5V$</td>
<td></td>
<td>70</td>
<td></td>
<td></td>
<td>dB</td>
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<tr>
<td>SVR</td>
<td>Supply Voltage Rejection Ratio ($V_{CC^+} = 2.7$ to 3.3V, $V_O = V_{CC}/2$)</td>
<td></td>
<td>50</td>
<td>80</td>
<td></td>
<td>dB</td>
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<tr>
<td>$A_{vd}$</td>
<td>Large Signal Voltage Gain ($R_L = 10k\Omega, V_O = 1.2V$ to 1.8V)</td>
<td></td>
<td>3</td>
<td>2</td>
<td>10</td>
<td>V/mV</td>
</tr>
<tr>
<td></td>
<td>$T_{min} \leq T_{amb} \leq T_{max}$</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>$V_{OH}$</td>
<td>High Level Output Voltage ($V_{id} = 1V$)</td>
<td>$R_L = 100k\Omega$</td>
<td>2.95</td>
<td>2.3</td>
<td>2.6</td>
<td>V</td>
</tr>
<tr>
<td></td>
<td>$T_{min} \leq T_{amb} \leq T_{max}$</td>
<td>$R_L = 10k\Omega$</td>
<td>2.9</td>
<td>2.3</td>
<td>2</td>
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<tr>
<td></td>
<td></td>
<td>$R_L = 600k\Omega$</td>
<td>2.8</td>
<td>2.1</td>
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<tr>
<td>$V_{OL}$</td>
<td>Low Level Output Voltage ($V_{id} = -1V$)</td>
<td>$R_L = 100k\Omega$</td>
<td>30</td>
<td>50</td>
<td></td>
<td>mV</td>
</tr>
<tr>
<td></td>
<td>$T_{min} \leq T_{amb} \leq T_{max}$</td>
<td>$R_L = 10k\Omega$</td>
<td>300</td>
<td>70</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td></td>
<td>$R_L = 600k\Omega$</td>
<td>900</td>
<td>400</td>
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<tr>
<td>$I_o$</td>
<td>Output Short Circuit Current ($V_{id} = \pm 1V$)</td>
<td>Source ($V_o = V_{CC^-}$)</td>
<td>20</td>
<td>40</td>
<td></td>
<td>mA</td>
</tr>
<tr>
<td></td>
<td>Sink ($V_o = V_{CC^+}$)</td>
<td>20</td>
<td>40</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>GBP</td>
<td>Gain Bandwidth Product ($A_{VCL} = 100$, $R_L = 10k\Omega$, $C_L = 100pF$, $f = 100kHz$)</td>
<td></td>
<td>0.8</td>
<td></td>
<td></td>
<td>MHz</td>
</tr>
<tr>
<td>SR*</td>
<td>Slew Rate ($A_{VCL} = 1$, $R_L = 10k\Omega$, $C_L = 100pF$, $V_i = 1.3V$ to 1.7V)</td>
<td></td>
<td>0.4</td>
<td></td>
<td></td>
<td>V/$\mu s$</td>
</tr>
<tr>
<td>SR*</td>
<td>Slew Rate ($A_{VCL} = 1$, $R_L = 10k\Omega$, $C_L = 100pF$, $V_i = 1.3V$ to 1.7V)</td>
<td></td>
<td>0.3</td>
<td></td>
<td></td>
<td>V/$\mu s$</td>
</tr>
<tr>
<td>$\Phi_m$</td>
<td>Phase Margin</td>
<td></td>
<td>30</td>
<td></td>
<td></td>
<td>Degrees</td>
</tr>
<tr>
<td>$e_n$</td>
<td>Equivalent Input Noise Voltage ($R_s = 100\Omega$, $f = 1kHz$)</td>
<td></td>
<td>30</td>
<td></td>
<td></td>
<td>$nV/\sqrt{Hz}$</td>
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<tr>
<td>$V_{O1}/V_{O2}$</td>
<td>Channel Separation ($f = 1kHz$)</td>
<td></td>
<td>120</td>
<td></td>
<td></td>
<td>dB</td>
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</tbody>
</table>

**Note 1**: Maximum values including unavoidable inaccuracies of the industrial test.
**ELECTRICAL CHARACTERISTICS**

\( V_{CC}^* = 5\text{V}, V_{CC}^- = 0\text{V}, R_L, C_L \) connected to \( V_{CC}/2 \), \( T_{amb} = 25^\circ\text{C} \) (unless otherwise specified)

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Parameter</th>
<th>TS3V912/AI/B1</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>( V_{io} )</td>
<td>Input Offset Voltage (( V_{ic} = V_{o} = V_{CC}/2 ))</td>
<td>( T_{min.} \leq T_{amb} \leq T_{max.} )</td>
<td>( \begin{array}{c</td>
</tr>
<tr>
<td>( D V_{io} )</td>
<td>Input Offset Voltage Drift</td>
<td></td>
<td>( \leq T_{amb} \leq T_{max.} )</td>
</tr>
<tr>
<td>( I_{io} )</td>
<td>Input Offset Current - (note 1)</td>
<td></td>
<td>( T_{min.} \leq T_{amb} \leq T_{max.} )</td>
</tr>
<tr>
<td>( I_b )</td>
<td>Input Bias Current - (note 1)</td>
<td></td>
<td>( T_{min.} \leq T_{amb} \leq T_{max.} )</td>
</tr>
<tr>
<td>( I_{CC} )</td>
<td>Supply Current (per amplifier, ( A_{VCL} = 1 ), no load)</td>
<td></td>
<td>( T_{min.} \leq T_{amb} \leq T_{max.} )</td>
</tr>
<tr>
<td>CMR</td>
<td>Common Mode Rejection Ratio</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SVR</td>
<td>Supply Voltage Rejection Ratio (( V_{CC}^* = 3 \text{ to } 5\text{V}, V_O = V_{CC}/2 ))</td>
<td></td>
<td></td>
</tr>
<tr>
<td>( A_{vd} )</td>
<td>Large Signal Voltage Gain (( R_L = 10\text{kΩ}, V_O = 1.5\text{V to } 3.5\text{V} ))</td>
<td></td>
<td>( T_{min.} \leq T_{amb} \leq T_{max.} )</td>
</tr>
<tr>
<td>( V_{OH} )</td>
<td>High Level Output Voltage (( V_{id} = 1\text{V} ))</td>
<td>( R_L = 100\text{kΩ} )</td>
<td>( T_{min.} \leq T_{amb} \leq T_{max.} )</td>
</tr>
<tr>
<td>( V_{OL} )</td>
<td>Low Level Output Voltage (( V_{id} = -1\text{V} ))</td>
<td>( R_L = 100\text{kΩ} )</td>
<td>( T_{min.} \leq T_{amb} \leq T_{max.} )</td>
</tr>
<tr>
<td>( I_o )</td>
<td>Output Short Circuit Current (( V_{id} = \pm1\text{V} ))</td>
<td>Source (( V_O = V_{CC}^- ))</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Sink (( V_O = V_{CC}^+ ))</td>
<td></td>
</tr>
<tr>
<td>GBP</td>
<td>Gain Bandwidth Product (( A_{VCL} = 100, R_L = 10\text{kΩ}, C_L = 100\text{pF}, f = 100\text{kHz} ))</td>
<td></td>
<td></td>
</tr>
<tr>
<td>( SR^* )</td>
<td>Slew Rate (( A_{VCL} = 1, R_L = 10\text{kΩ}, C_L = 100\text{pF}, V_i = 1\text{V to } 4\text{V} ))</td>
<td></td>
<td></td>
</tr>
<tr>
<td>( SR' )</td>
<td>Slew Rate (( A_{VCL} = 1, R_L = 10\text{kΩ}, C_L = 100\text{pF}, V_i = 1\text{V to } 4\text{V} ))</td>
<td></td>
<td></td>
</tr>
<tr>
<td>( e_n )</td>
<td>Equivalent Input Noise Voltage (( R_s = 100\Omega, f = 1\text{kHz} ))</td>
<td></td>
<td></td>
</tr>
<tr>
<td>( V_{O1}/V_{O2} )</td>
<td>Channel Separation (( f = 1\text{kHz} ))</td>
<td></td>
<td></td>
</tr>
<tr>
<td>( \Phi )</td>
<td>Phase Margin</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Note 1:** Maximum values including unavoidable inaccuracies of the industrial test.
TYPICAL CHARACTERISTICS

**Figure 1**: Supply Current (each amplifier) versus Supply Voltage

- $T_{amb} = 25^\circ C$
- $V_{CC} = 1 V$
- $V_0 = V_{CC} / 2$

**Figure 2**: Input Bias Current versus Temperature

- $V_{CC} = 10 V$
- $V_i = 5 V$
- No load

**Figure 3a**: High Level Output Voltage versus High Level Output Current

- $T_{amb} = 25^\circ C$
- $V_{CC} = 5 V$
- $V_i = 3 V$

**Figure 3b**: High Level Output Voltage versus High Level Output Current

- $T_{amb} = 25^\circ C$
- $V_{CC} = +16 V$
- $V_i = +10 V$

**Figure 4a**: Low Level Output Voltage versus Low Level Output Current

- $T_{amb} = 25^\circ C$
- $V_{CC} = 5 V$
- $V_i = +3 V$

**Figure 4b**: Low Level Output Voltage versus Low Level Output Current

- $T_{amb} = 25^\circ C$
- $V_{CC} = 16 V$
- $V_i = 10 V$
Figure 8: Input Voltage Noise versus Frequency

ORDERING INFORMATION

TS3V912
**Standard Linear Ics Macromodels, 1993.**

**CONNECTIONS:**

1. INVERTING INPUT
2. NON-INVERTING INPUT
3. OUTPUT
4. POSITIVE POWER SUPPLY
5. NEGATIVE POWER SUPPLY

.DEVICE TS3V912_3 1 3 2 4 5 (analog)

.MODEL MDTH D IS=1E-8 KF=6.564344E-14 CJO=10F

* INPUT STAGE
CIP 2 5 1.000000E-12
CIN 1 5 1.000000E-12
EIP 10 5 1 5 1
EIN 16 5 1 5 1
RIP 10 11 6.500000E+00
RIN 15 16 6.500000E+00
RIS 11 15 1.271505E+01
DIP 11 12 MDTH 400E-12

* AMPLIFYING STAGE
FIP 5 19 VOFP 2.750000E+02
FIN 5 19 VOFN 2.750000E+02
RG1 19 5 1.916825E+05
RG2 19 4 1.916825E+05
CC 19 29 2.200000E-08

**INPUT STAGE**

CIP 2 5 1.000000E-12
CIN 1 5 1.000000E-12
EIP 10 5 1 5 1
EIN 16 5 1 5 1
RIP 10 11 6.500000E+00
RIN 15 16 6.500000E+00
RIS 11 15 1.271505E+01
DIP 11 12 MDTH 400E-12

**AMPLIFYING STAGE**

FIP 5 19 VOFP 2.750000E+02
FIN 5 19 VOFN 2.750000E+02
RG1 19 5 1.916825E+05
RG2 19 4 1.916825E+05
CC 19 29 2.200000E-08

**ELECTRICAL CHARACTERISTICS** \( V_{CC}^+ = 3V, V_{CC}^- = 0V, R_L, C_L \) connected to \( V_{CC}/2 \), \( T_{amb} = 25^\circ C \) (unless otherwise specified)

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Conditions</th>
<th>Value</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>( V_{io} )</td>
<td>No load, per operator</td>
<td>0</td>
<td>mV</td>
</tr>
<tr>
<td>( A_{vd} )</td>
<td>( R_L = 10k\Omega )</td>
<td>10</td>
<td>V/mV</td>
</tr>
<tr>
<td>( I_{CC} )</td>
<td>No load, per operator</td>
<td>200</td>
<td>μA</td>
</tr>
<tr>
<td>( V_{cm} )</td>
<td>-0.2 to 3.2</td>
<td>V</td>
<td></td>
</tr>
<tr>
<td>( V_{OH} )</td>
<td>( R_L = 10k\Omega )</td>
<td>2.96</td>
<td>V</td>
</tr>
<tr>
<td>( V_{OL} )</td>
<td>( R_L = 10k\Omega )</td>
<td>30</td>
<td>mV</td>
</tr>
<tr>
<td>( I_{sink} )</td>
<td>( V_O = 3V )</td>
<td>40</td>
<td>mA</td>
</tr>
<tr>
<td>( I_{source} )</td>
<td>( V_O = 0 )</td>
<td>40</td>
<td>mA</td>
</tr>
<tr>
<td>GBP</td>
<td>( R_L = 10k\Omega, C_L = 100pF )</td>
<td>0.8</td>
<td>MHz</td>
</tr>
<tr>
<td>SR</td>
<td>( R_L = 10k\Omega, C_L = 100pF )</td>
<td>0.3</td>
<td>V/μs</td>
</tr>
</tbody>
</table>
Applies to: TS3V912 (V\text{CC} = 5V)

** Standard Linear Ics Macromodels, 1993.

** CONNECTIONS:
- 1 INVERTING INPUT
- 2 NON-INVERTING INPUT
- 3 OUTPUT
- 4 POSITIVE POWER SUPPLY
- 5 NEGATIVE POWER SUPPLY
- 6 STANDBY

**MACROMODELS**

```
.SUBCKT TS3V912_5_1 3 2 4 5 (analog)
.MODEL MDTH D IS=1E-8 KF=6.564344E-14 CJO=10F
** INPUT STAGE**
CIP 2 5 1.000000E-12
CIN 1 5 1.000000E-12
EIP 10 5 2 5 1
EIN 16 5 1 S
RIP 10 11 6.500000E+00
RIN 15 16 6.500000E+00
RIS 11 15 7.322092E+00
DIP 11 12 MDTH 400E-12
DIN 15 14 MDTH 400E-12
VOFP 12 13 DC 0.000000E+00
VOFN 13 14 DC 0
IPOL 13 5 4.000000E-05
CPS 11 15 2.498970E-08
DINN 17 13 MDTH 400E-12
FIN 17 5 0.000000E+00
DINR 15 18 MDTH 400E-12
VIP 4 18 0.000000E+00
FCP 4 5 VOFP 5.750000E-00
FCN 5 4 VOFN 5.750000E-00
ISTB0 5 4 500N
** AMPLIFYING STAGE**
FIP 5 19 VOFP 4.400000E+02
FIN 5 19 VOFN 4.400000E+02
RG1 19 5 4.904861E+05
RG2 19 4 4.904861E+05

** ELEETRICAL CHARACTERISTICS ** V\text{CC}^+ = 5V, V\text{CC}^- = 0V, R_L, C_L connected to V\text{CC}/2, T_{amb} = 25^\circ C

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Conditions</th>
<th>Value</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>V_{io}</td>
<td>0</td>
<td>mV</td>
<td></td>
</tr>
<tr>
<td>A_{vd}</td>
<td>R_L = 10kΩ</td>
<td>50</td>
<td>V/mV</td>
</tr>
<tr>
<td>I_{CC}</td>
<td>No load, per operator</td>
<td>230</td>
<td>μA</td>
</tr>
<tr>
<td>V_{cm}</td>
<td>-0.2 to 5.2</td>
<td>V</td>
<td></td>
</tr>
<tr>
<td>V_{OH}</td>
<td>R_L = 10kΩ</td>
<td>4.95</td>
<td>V</td>
</tr>
<tr>
<td>V_{OL}</td>
<td>R_L = 10kΩ</td>
<td>40</td>
<td>mV</td>
</tr>
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<td>I_{sink}</td>
<td>V_O = 5V</td>
<td>65</td>
<td>mA</td>
</tr>
<tr>
<td>I_{source}</td>
<td>V_O = 0V</td>
<td>65</td>
<td>mA</td>
</tr>
<tr>
<td>GBP</td>
<td>R_L = 10kΩ, C_L = 100pF</td>
<td>1</td>
<td>MHz</td>
</tr>
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<td>SR</td>
<td>R_L = 10kΩ, C_L = 100pF</td>
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<td>V/μs</td>
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<td>Dimensions</td>
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<td>a1</td>
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<td>1.65</td>
<td>0.045</td>
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<td>b</td>
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<td>0.014</td>
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**PACKAGE MECHANICAL DATA**

8 PINS - PLASTIC MICROPACKAGE (SO)

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