

Rail-to-Rail CMOS Dual Operational Amplifier

- Rail-to-rail input and output voltage ranges
- Single (or dual) supply operation from 2.7V to 16V
- Extremely low input bias current: 1pA typ.
- Low input offset voltage: 2mV max.
- Specified for 600Ω and 100Ω loads
- Low supply current: 200μA/ampli ($V_{CC} = 3V$)
- Latch-up immunity
- ESD tolerance: 3kV
- Spice macromodel included in this specification

Description

The TS912 is a rail-to-rail CMOS dual operational amplifier designed to operate with a single or dual supply voltage.

The input voltage range V_{icm} includes the two supply rails V_{CC}^+ and V_{CC}^- .

The output reaches:

- $V_{CC}^- + 30mV$, $V_{CC}^+ - 40mV$, with $R_L = 10k\Omega$
- $V_{CC}^- + 300mV$, $V_{CC}^+ - 400mV$, 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 200μA/amp ($V_{CC} = 3V$).

Source and sink output current capability is typically 40mA (at $V_{CC} = 3V$), fixed by an internal limitation circuit.

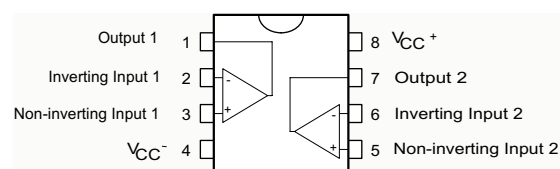


N
DIP-8
(Plastic Package)



D
SO-8
(Plastic Micropackage)

Pin Connections (top view)



Order Codes

Part Number	Temperature Range	Package	Packing	Marking	
TS912IN	-40, +125°C	DIP8	Tube	TS912IN	
TS912ID/IDT		SO-8	Tube or Tape & Reel	912I	
TS912AIN		DIP8	Tube	TS912AIN	
TS912AID/AIDT		SO-8	Tube or Tape & Reel	912AI	
TS912BID/BIDT		SO-8		912BI	
TS912IYD/IYDT		SO-8 (automotive grade level)		912IY	
TS912AIYD/AIYDT				912AIY	

1 Absolute Maximum Ratings

Table 1. Key parameters and their absolute maximum ratings

Symbol	Parameter	Value	Unit
V_{CC}	Supply voltage ⁽¹⁾	18	V
V_{id}	Differential Input Voltage ⁽²⁾	± 18	V
V_i	Input Voltage ⁽³⁾	-0.3 to 18	V
I_{in}	Current on Inputs	± 50	mA
I_o	Current on Outputs	± 130	mA
T_{oper}	Operating Free Air Temperature Range TS912I/AI/BI	-40 to + 125	°C
T_{stg}	Storage Temperature	-65 to +150	°C
ESD	HBM: Human Body Model ⁽⁴⁾	3	kV
	MM: Machine Model ⁽⁵⁾	200	V
	CDM: Charged Device Model	1500	V

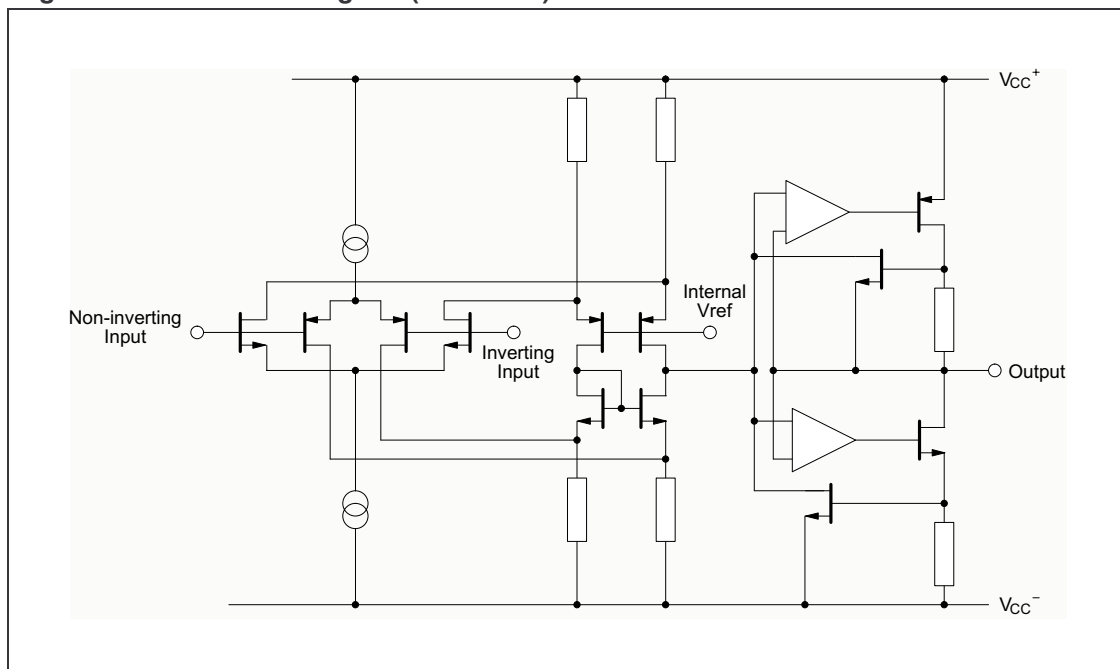
1. All voltages values, except differential voltage are with respect to network ground terminal.
2. Differential voltages are non-inverting input terminal with respect to the inverting input terminal.
3. The magnitude of input and output voltages must never exceed $V_{CC}^{+} + 0.3V$.
4. Human body model, 100pF discharged through a 1.5k Ω resistor into pin of device.
5. Machine model ESD, a 200pF cap is charged to the specified voltage, then discharged directly into the IC with no external series resistor (internal resistor < 5 Ω), into pin to pin of device.

Table 2. Operating conditions

Symbol	Parameter	Value	Unit
V_{CC}	Supply voltage	2.7 to 16	V
V_{icm}	Common Mode Input Voltage Range	$V_{CC}^{-} - 0.2$ to $V_{CC}^{+} + 0.2$	V

2 Typical Application Information

Figure 1. Schematic diagram (1/2 TS912)



3 Electrical Characteristics

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

Symbol	Parameter	Min.	Typ.	Max.	Unit
V_{io}	Input Offset Voltage ($V_{ic} = V_o = V_{CC/2}$) TS912 TS912A TS912B $T_{min.} \leq T_{amb} \leq T_{max.}$ TS912 TS912A TS912B			10 5 2 12 7 3	mV
ΔV_{io}	Input Offset Voltage Drift		5		$\mu V/^\circ C$
I_{io}	Input Offset Current ⁽¹⁾ $T_{min.} \leq T_{amb} \leq T_{max.}$		1	100 200	pA
I_{ib}	Input Bias Current ⁽¹⁾ $T_{min.} \leq T_{amb} \leq T_{max.}$		1	150 300	pA
I_{CC}	Supply Current (per amplifier, $A_{VCL} = 1$, no load) $T_{min.} \leq T_{amb} \leq T_{max.}$		200	300 400	μA
CMR	Common Mode Rejection Ratio $V_{ic} = 0$ to $3V$, $V_o = 1.5V$		70		dB
SVR	Supply Voltage Rejection Ratio ($V_{CC}^+ = 2.7$ to $3.3V$, $V_o = V_{CC/2}$)	50	80		dB
A_{vd}	Large Signal Voltage Gain ($R_L = 10k\Omega$, $V_o = 1.2V$ to $1.8V$) $T_{min.} \leq T_{amb} \leq T_{max.}$	3 2	10		V/mV
V_{OH}	High Level Output Voltage ($V_{id} = 1V$) $R_L = 100k\Omega$ $R_L = 10k\Omega$ $R_L = 600\Omega$ $R_L = 100\Omega$ $T_{min.} \leq T_{amb} \leq T_{max.}$ $R_L = 10k\Omega$ $R_L = 600\Omega$	2.95 2.9 2.3 2.8 2.1	2.96 2.6 2		V
V_{OL}	Low Level Output Voltage ($V_{id} = -1V$) $R_L = 100k\Omega$ $R_L = 10k\Omega$ $R_L = 600\Omega$ $R_L = 100\Omega$ $T_{min.} \leq T_{amb} \leq T_{max.}$ $R_L = 10k\Omega$ $R_L = 600\Omega$		30 300 900	50 70 400 100 600	mV
I_o	Output Short Circuit Current ($V_{id} = \pm 1V$) Source ($V_o = V_{CC}^-$) Sink ($V_o = V_{CC}^+$)	20 20	40 40		mA
GBP	Gain Bandwidth Product ($A_{VCL} = 100$, $R_L = 10k\Omega$, $C_L = 100pF$, $f = 100kHz$)		0.8		MHz

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

Symbol	Parameter	Min.	Typ.	Max.	Unit
SR^+	Slew Rate ($A_{VCL} = 1$, $R_L = 10k\Omega$, $C_L = 100pF$, $V_i = 1.3V$ to $1.7V$)		0.4		V/ μs
SR^-	Slew Rate ($A_{VCL} = 1$, $R_L = 10k\Omega$, $C_L = 100pF$, $V_i = 1.3V$ to $1.7V$)		0.3		V/ μs
ϕ_m	Phase Margin		30		Degrees
en	Equivalent Input Noise Voltage ($R_s = 100\Omega$, $f = 1kHz$)		30		nV/ $\sqrt{Hz}$

1. Maximum values including unavoidable inaccuracies of the industrial test

Table 4. $V_{CC}^+ = 5V$, $V_{CC}^- = 0V$, R_L , C_L connected to $V_{CC/2}$, $T_{amb} = 25^\circ C$ (unless otherwise specified)

Symbol	Parameter	Min.	Typ.	Max.	Unit
V_{io}	Input Offset Voltage ($V_{ic} = V_o = V_{CC/2}$)TS912 TS912A TS912B $T_{min.} \leq T_{amb} \leq T_{max.}$ TS912 TS912A TS912B			10 5 2 12 7 3	mV
ΔV_{io}	Input Offset Voltage Drift		5		$\mu V/^\circ C$
I_{io}	Input Offset Current ⁽¹⁾ $T_{min.} \leq T_{amb} \leq T_{max.}$		1	100 200	pA
I_{ib}	Input Bias Current ⁽¹⁾ $T_{min.} \leq T_{amb} \leq T_{max.}$		1	150 300	pA
I_{CC}	Supply Current (per amplifier, $A_{VCL} = 1$, no load) $T_{min.} \leq T_{amb} \leq T_{max.}$		230	350 450	μA
CMR	Common Mode Rejection Ratio $V_{ic} = 1.5$ to $3.5V$, $V_o = 2.5V$	60	85		dB
SVR	Supply Voltage Rejection Ratio ($V_{CC}^+ = 3$ to $5V$, $V_o = V_{CC/2}$)	55	80		dB
A_{vd}	Large Signal Voltage Gain ($R_L = 10k\Omega$, $V_o = 1.5V$ to $3.5V$) $T_{min.} \leq T_{amb} \leq T_{max.}$	10 7	40		V/mV
V_{OH}	High Level Output Voltage ($V_{id} = 1V$) $R_L = 100k\Omega$ $R_L = 10k\Omega$ $R_L = 600\Omega$ $R_L = 100\Omega$ $T_{min.} \leq T_{amb} \leq T_{max.}$ $R_L = 10k\Omega$ $R_L = 600\Omega$	4.95 4.9 4.25 4.8 4.1	4.95 4.55 3.7		V

Table 4. $V_{CC}^+ = 5V$, $V_{CC}^- = 0V$, R_L , C_L connected to $V_{CC/2}$, $T_{amb} = 25^\circ C$ (unless otherwise specified)

Symbol	Parameter	Min.	Typ.	Max.	Unit
V_{OL}	Low Level Output Voltage ($V_{id} = -1V$) $R_L = 100k\Omega$ $R_L = 10k\Omega$ $R_L = 600\Omega$ $R_L = 100\Omega$ $T_{min.} \leq T_{amb} \leq T_{max.}$ $R_L = 10k\Omega$ $R_L = 600\Omega$		40 350 1400	50 100 500 150 750	mV
I_o	Output Short Circuit Current ($V_{id} = \pm 1V$) Source ($V_o = V_{CC}^-$) Sink ($V_o = V_{CC}^+$)	45 45	65 65		mA
GBP	Gain Bandwidth Product ($A_{VCL} = 100$, $R_L = 10k\Omega$, $C_L = 100pF$, $f = 100kHz$)		1		MHz
SR^+	Slew Rate ($A_{VCL} = 1$, $R_L = 10k\Omega$, $C_L = 100pF$, $V_i = 1V$ to $4V$)		0.8		
SR^-	Slew Rate ($A_{VCL} = 1$, $R_L = 10k\Omega$, $C_L = 100pF$, $V_i = 1V$ to $4V$)		0.6		V/ μs
en	Equivalent Input Noise Voltage ($R_s = 100\Omega$, $f = 1kHz$)		30		nV/ $\sqrt{Hz}$
V_{O1}/V_{O2}	Channel Separation ($f = 1kHz$)		120		dB
ϕ_m	Phase Margin		30		Degrees

1. Maximum values including unavoidable inaccuracies of the industrial test

Table 5. $V_{CC}^+ = 10V$, $V_{CC}^- = 0V$, R_L , C_L connected to $V_{CC/2}$, $T_{amb} = 25^\circ C$ (unless otherwise specified)

Symbol	Parameter	Min.	Typ.	Max.	Unit
V_{io}	Input Offset Voltage ($V_{ic} = V_o = V_{CC/2}$) TS912 TS912A TS912B $T_{min.} \leq T_{amb} \leq T_{max.}$ TS912 TS912A TS912B			10 5 2 12 7 3	mV
ΔV_{io}	Input Offset Voltage Drift		5		$\mu V/^\circ C$
I_{io}	Input Offset Current ⁽¹⁾ $T_{min.} \leq T_{amb} \leq T_{max.}$		1	100 200	pA
I_{ib}	Input Bias Current ⁽¹⁾ $T_{min.} \leq T_{amb} \leq T_{max.}$		1	150 300	pA
I_{CC}	Supply Current (per amplifier, $A_{VCL} = 1$, no load) $T_{min.} \leq T_{amb} \leq T_{max.}$		400	600 700	μA
CMR	Common Mode Rejection Ratio $V_{ic} = 3$ to $7V$, $V_o = 5V$ $V_{ic} = 0$ to $10V$, $V_o = 5V$	60 50	90 75		dB

Table 5. $V_{CC}^+ = 10V$, $V_{CC}^- = 0V$, R_L , C_L connected to $V_{CC/2}$, $T_{amb} = 25^\circ C$ (unless otherwise specified)

Symbol	Parameter	Min.	Typ.	Max.	Unit
SVR	Supply Voltage Rejection Ratio ($V_{CC}^+ = 5$ to $10V$, $V_o = V_{CC/2}$)	60	90		dB
A_{vd}	Large Signal Voltage Gain ($R_L = 10k\Omega$, $V_o = 2.5V$ to $7.5V$) $T_{min.} \leq T_{amb} \leq T_{max.}$	15 10	50		V/mV
V_{OH}	High Level Output Voltage ($V_{id} = 1V$) $R_L = 100k\Omega$ $R_L = 10k\Omega$ $R_L = 600\Omega$ $R_L = 100\Omega$ $T_{min.} \leq T_{amb} \leq T_{max.}$ $R_L = 10k\Omega$ $R_L = 600\Omega$	9.95 9.85 9 9.8 8.8	9.95 9.35 7.8		V
V_{OL}	Low Level Output Voltage ($V_{id} = -1V$) $R_L = 100k\Omega$ $R_L = 10k\Omega$ $R_L = 600\Omega$ $R_L = 100\Omega$ $T_{min.} \leq T_{amb} \leq T_{max.}$ $R_L = 10k\Omega$ $R_L = 600\Omega$		50 150 650 2300	50 150 800 150 900	mV
I_o	Output Short Circuit Current ($V_{id} = \pm 1V$) Source ($V_o = V_{CC}^-$) Sink ($V_o = V_{CC}^+$)	45 50	65 75		mA
GBP	Gain Bandwidth Product ($A_{VCL} = 100$, $R_L = 10k\Omega$, $C_L = 100pF$, $f = 100kHz$)		1.4		MHz
SR^+	Slew Rate ($A_{VCL} = 1$, $R_L = 10k\Omega$, $C_L = 100pF$, $V_i = 2.5V$ to $7.5V$)		1.3		V/ μs
SR^-	Slew Rate ($A_{VCL} = 1$, $R_L = 10k\Omega$, $C_L = 100pF$, $V_i = 2.5V$ to $7.5V$)		0.8		
ϕ_m	Phase Margin		40		Degrees
e_n	Equivalent Input Noise Voltage ($R_s = 100\Omega$, $f = 1kHz$)		30		nV/ $\sqrt{Hz}$
THD	Total Harmonic Distortion ($A_{VCL} = 1$, $R_L = 10k\Omega$, $C_L = 100pF$, $V_o = 4.75V$ to $5.25V$, $f = 1kHz$)		0.02		%
C_{in}	Input Capacitance		1.5		pF

1. Maximum values including unavoidable inaccuracies of the industrial test

Figure 2. Supply current (each amplifier) vs. supply voltage

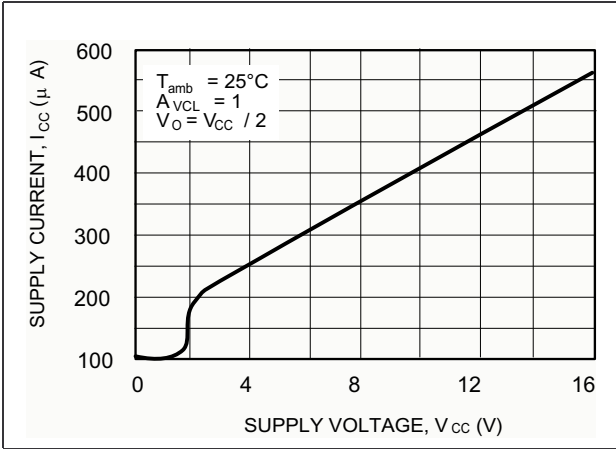


Figure 3. High level output voltage vs. high level output current

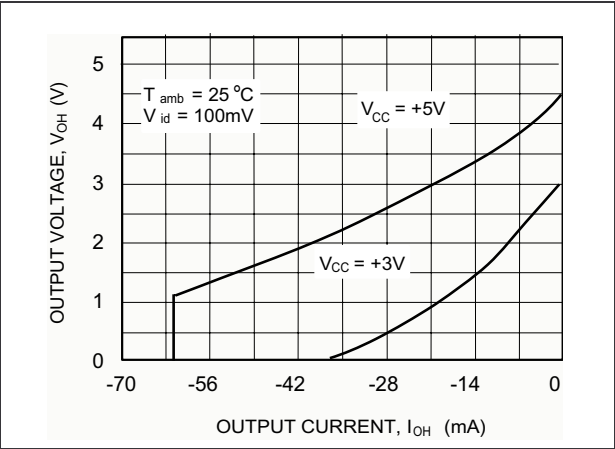


Figure 4. Low level output voltage vs. low level output current

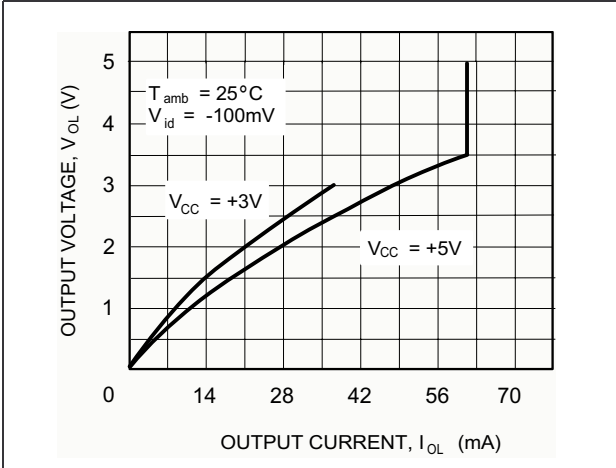


Figure 5. Input bias current vs. temperature

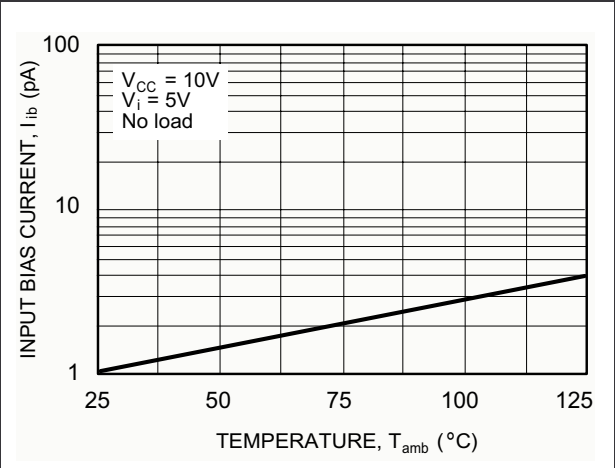


Figure 6. High level output voltage vs. high level output current

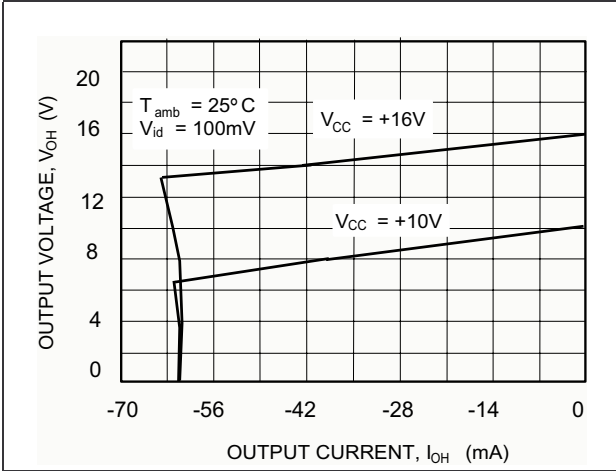


Figure 7. Low level output voltage vs. low level output current

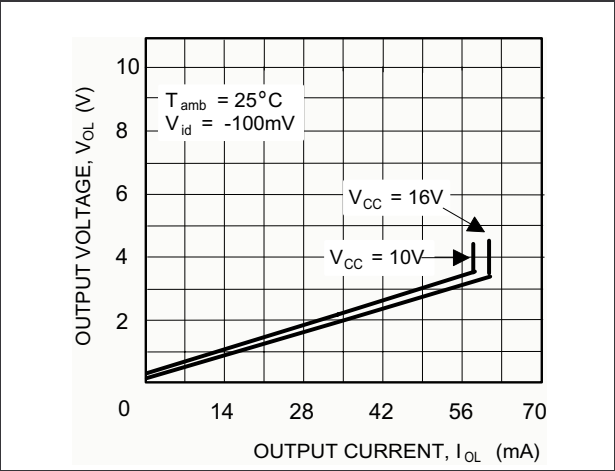


Figure 8. Gain and phase vs. frequency

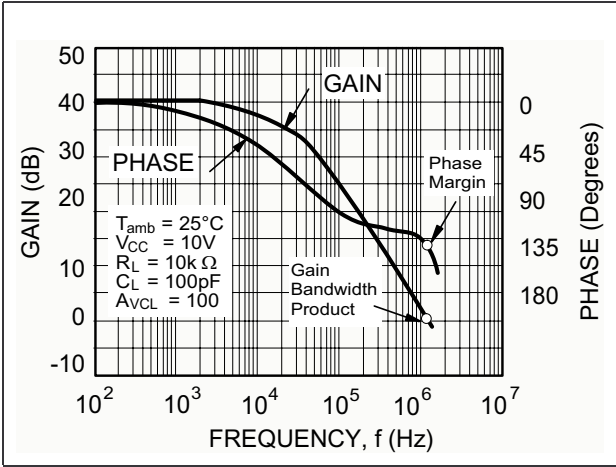


Figure 9. Gain bandwidth product vs. supply voltage

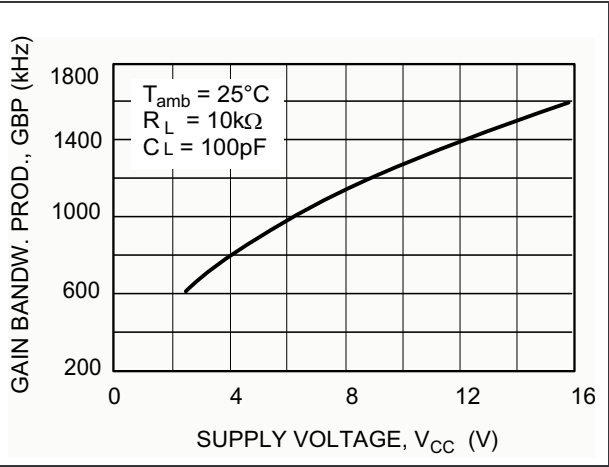


Figure 10. Phase margin vs. supply voltage

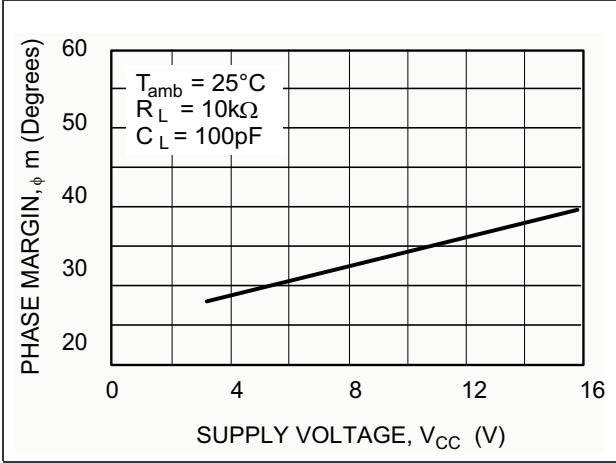


Figure 11. Gain and phase vs. frequency

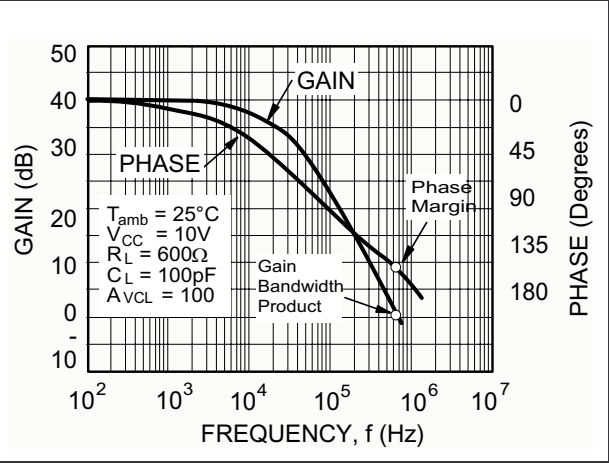


Figure 12. Gain bandwidth product vs. supply voltage

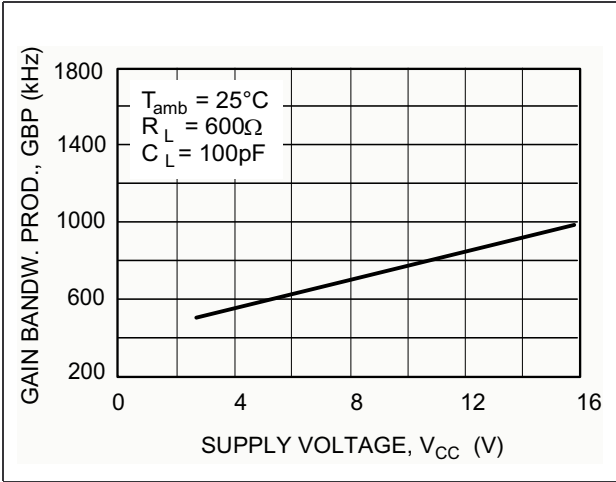


Figure 13. Phase margin vs. supply voltage

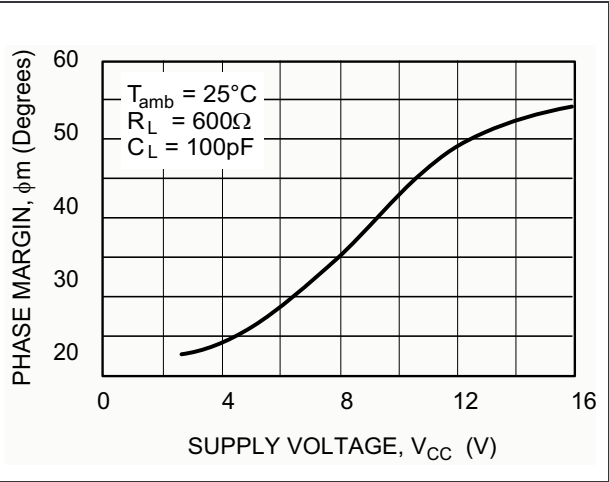
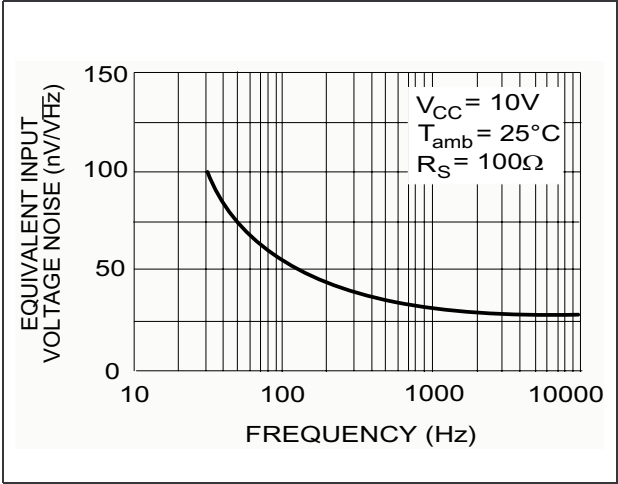


Figure 14. Input voltage noise vs. frequency



4 Macromodels

4.1 Important note concerning this macromodel

Please consider following remarks before using this macromodel.

- All models are a trade-off between accuracy and complexity (i.e. simulation time).
- Macromodels are not a substitute to breadboarding; rather, they confirm the validity of a design approach and help to select surrounding component values.
- A macromodel emulates the NOMINAL performance of a TYPICAL device within SPECIFIED OPERATING CONDITIONS (i.e. temperature, supply voltage, etc.). Thus the macromodel is often not as exhaustive as the datasheet, its goal is to illustrate the main parameters of the product.
- Data issued from macromodels used outside of its specified conditions (V_{CC} , Temperature, etc.) or even worse: outside of the device operating conditions (V_{CC} , V_{ICM} , etc.) are not reliable in any way.

In [Section 4.2](#) and [Section 4.4](#), the electrical characteristics resulting from the use of these macromodels are presented.

4.2 Electrical characteristics from macromodelization

Table 6. Electrical characteristics resulting from macromodel simulation at $V_{CC}^+ = 3V$, $V_{CC}^- = 0V$, R_L , C_L connected to $V_{CC}/2$, $T_{amb} = 25^\circ C$ (unless otherwise specified)

Symbol	Conditions	Value	Unit
V_{io}		0	mV
A_{vd}	$R_L = 10k\Omega$	10	V/mV
I_{CC}	No load, per operator	200	μA
V_{icm}		-0.2 to 3.2	V
V_{OH}	$R_L = 10k\Omega$	2.96	V
V_{OL}	$R_L = 10k\Omega$	30	mV
I_{sink}	$V_O = 3V$	40	mA
I_{source}	$V_O = 0V$	40	mA
GBP	$R_L = 10k\Omega$, $C_L = 100pF$	0.8	MHz
SR	$R_L = 10k\Omega$, $C_L = 100pF$	0.3	V/ μs

4.3 Macromodel code

Applies to: TS912 ($V_{CC} = 3V$)

```
** Standard Linear Ics Macromodels, 1993.
** CONNECTIONS :
* 1 INVERTING INPUT
```

```

* 2 NON-INVERTING INPUT
* 3 OUTPUT
* 4 POSITIVE POWER SUPPLY
* 5 NEGATIVE POWER SUPPLY
.SUBCKT TS912_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 2 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
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 2.125860E-08
DINN 17 13 MDTH 400E-12
VIN 17 5 0.000000E+00
DINR 15 18 MDTH 400E-12
VIP 4 18 0.000000E+00
FCP 4 5 VOFP 5.000000E+00
FCN 5 4 VOFN 5.000000E+00
* 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
HZTP 30 29 VOFP 1.3E+03
HZTN 5 30 VOFN 1.3E+03
DOPM 19 22 MDTH 400E-12
DONM 21 19 MDTH 400E-12
HOPM 22 28 VOUT 3800
VIPM 28 4 150
HONM 21 27 VOUT 3800
VINM 5 27 150
EOUT 26 23 19 5 1
VOUT 23 5 0
ROUT 26 3 75
COUT 3 5 1.000000E-12
DOP 19 68 MDTH 400E-12
VOP 4 25 1.724
HSCP 68 25 VSCP1 0.8E8
DON 69 19 MDTH 400E-12
VON 24 5 1.7419107
HSCN 24 69 VSCN1 0.8E+08
VSCTHP 60 61 0.0875
** VSCTHP = le seuil au dessus de vio * 500
** c.a.d 275U-000U dus a l'offset
DSCP1 61 63 MDTH 400E-12
VSCP1 63 64 0
ISCP 64 0 1.000000E-8
DSCP2 0 64 MDTH 400E-12
DSCN2 0 74 MDTH 400E-12
ISCN 74 0 1.000000E-8
VSCN1 73 74 0
DSCN1 71 73 MDTH 400E-12
VSCTHN 71 70 -0.55

```

```

** VSCTHN = le seuil au dessous de vio * 2000
** c.a.d -375U-000U dus a l'offset
ESCP 60 0 2 1 500
ESCN 70 0 2 1 -2000
.ENDS

```

4.4 Electrical characteristics from macromodelization

Table 7. Electrical characteristics resulting from macromodel simulation at $V_{CC}^+ = 5V$, $V_{CC}^- = 0V$, R_L , C_L connected to $V_{CC}/2$, $T_{amb} = 25^\circ C$ (unless otherwise specified)

Symbol	Conditions	Value	Unit
V_{io}		0	mV
A_{vd}	$R_L = 10k\Omega$	50	V/mV
I_{CC}	No load, per operator	230	μA
V_{icm}		-0.2 to 5.2	V
V_{OH}	$R_L = 10k\Omega$	4.95	V
V_{OL}	$R_L = 10k\Omega$	40	mV
I_{sink}	$V_O = 5V$	65	mA
I_{source}	$V_O = 0V$	65	mA
GBP	$R_L = 10k\Omega$, $C_L = 100pF$	1	MHz
SR	$R_L = 10k\Omega$, $C_L = 100pF$	0.8	V/ μs

4.5 Macromodel code

Applies to: TS912 ($V_{cc} = 5V$)

```

** 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
.SUBCKT TS912_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 5 1
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

```

```

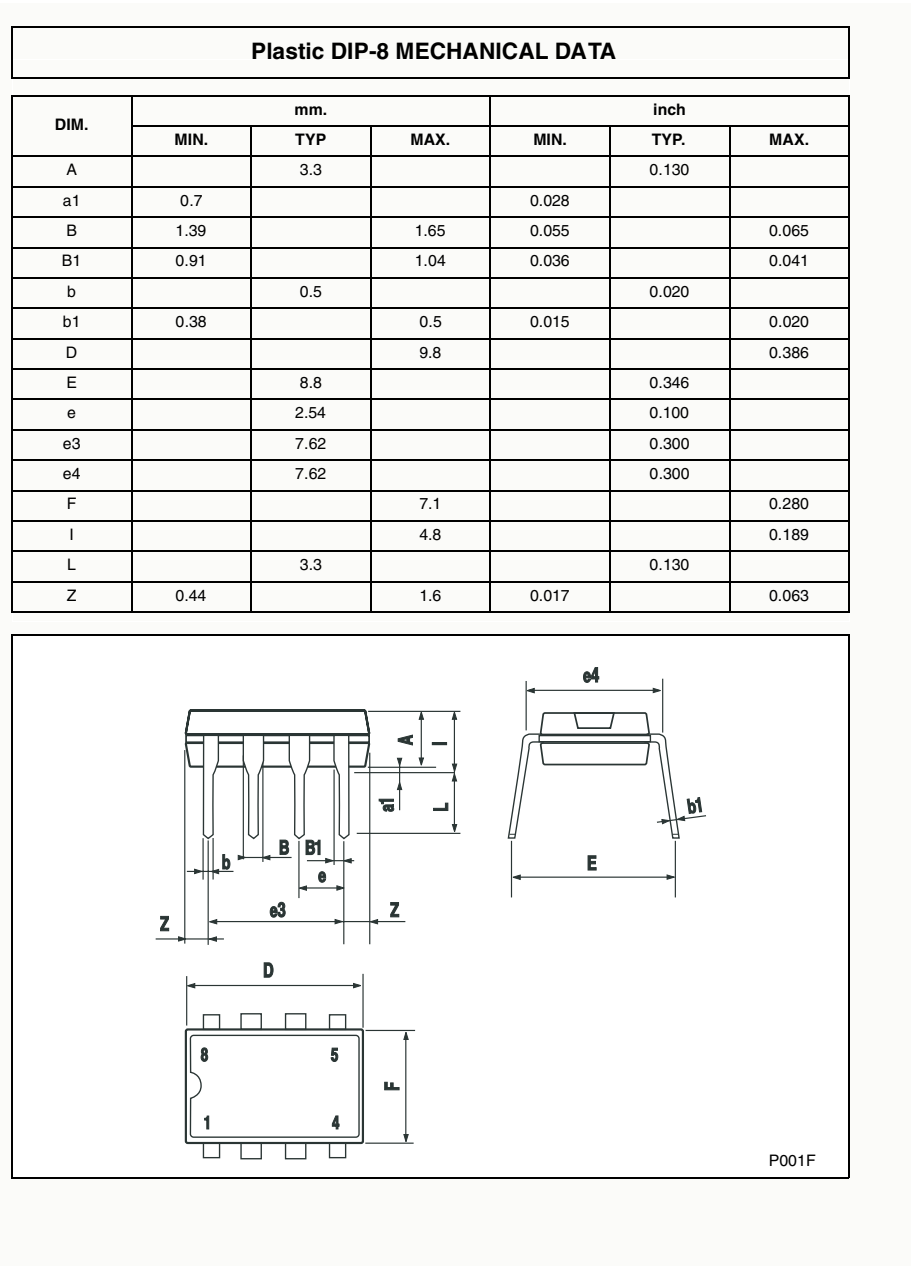
IPOL 13 5 4.000000E-05
CPS 11 15 2.498970E-08
DINN 17 13 MDTH 400E-12
VIN 17 5 0.000000e+00
DINR 15 18 MDTH 400E-12
VIP 4 18 0.000000E+00
FCP 4 5 VOFP 5.750000E+00
FCN 5 4 VOFN 5.750000E+00
ISTB0 5 4 500N
* AMPLIFYING STAGE
FIP 5 19 VOFP 4.400000E+02
FIN 5 19 VOFN 4.400000E+02
RG1 19 5 4.904961E+05
RG2 19 4 4.904961E+05
CC 19 29 2.200000E-08
HZTP 30 29 VOFP 1.8E+03
HZTN 5 30 VOFN 1.8E+03
DOPM 19 22 MDTH 400E-12
DONM 21 19 MDTH 400E-12
HOPM 22 28 VOUT 3800
VIPM 28 4 230
HONM 21 27 VOUT 3800
VINM 5 27 230
EOUT 26 23 19 5 1
VOUT 23 5 0
ROUT 26 3 82
COUT 3 5 1.000000E-12
DOP 19 68 MDTH 400E-12
VOP 4 25 1.724
HSCP 68 25 VSCP1 0.8E+08
DON 69 19 MDTH 400E-12
VON 24 5 1.7419107
HSCN 24 69 VSCN1 0.8E+08
VSCTHP 60 61 0.0875
** VSCTHP = le seuil au dessus de vio * 500
** c.a.d 275U-000U dus a l'offset
DSCP1 61 63 MDTH 400E-12
VSCP1 63 64 0
ISCP 64 0 1.000000E-8
DSCP2 0 64 MDTH 400E-12
DSCN2 0 74 MDTH 400E-12
ISCN 74 0 1.000000E-8
VSCN1 73 74 0
DSCN1 71 73 MDTH 400E-12
VSCTHN 71 70 -0.55
** VSCTHN = le seuil au dessous de vio * 2000
** c.a.d -375U-000U dus a l'offset
ESCP 60 0 2 1 500
ESCN 70 0 2 1 -2000
.ENDS

```

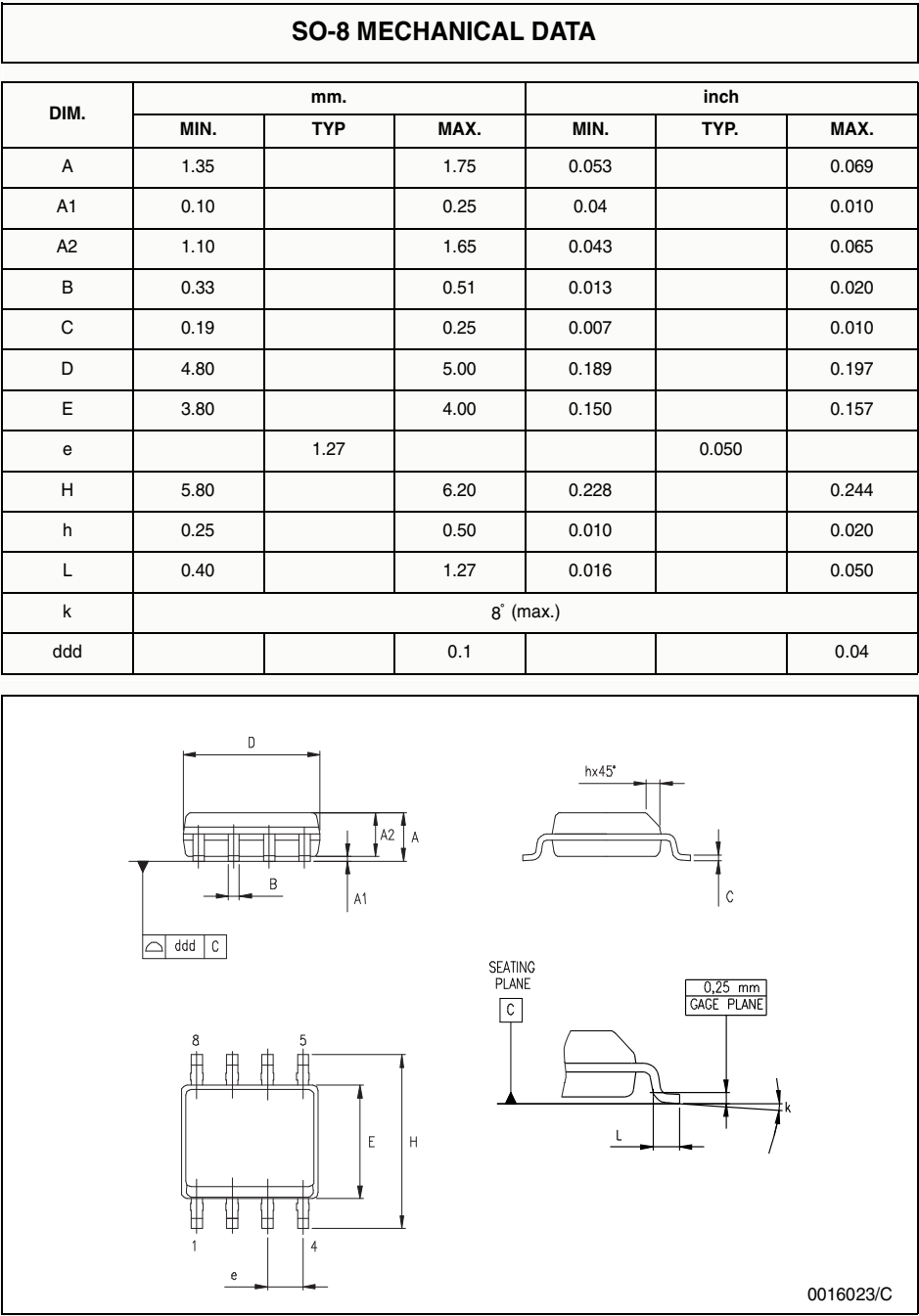
5 Package Mechanical Data

In order to meet environmental requirements, ST offers these devices in ECOPACK® packages. These packages have a Lead-free second level interconnect. The category of second level interconnect is marked on the package and on the inner box label, in compliance with JEDEC Standard JESD97. The maximum ratings related to soldering conditions are also marked on the inner box label. ECOPACK is an ST trademark. ECOPACK specifications are available at: www.st.com.

5.1 DIP-8 Package



5.2 SO-8 Package



6 Revision History

Date	Revision	Changes
Dec. 2001	1	First Release
July 2005	2	1 - PPAP references inserted in the datasheet see <i>Table : Order Codes on page 2</i> 2 - ESD protection inserted in <i>Table 1: Key parameters and their absolute maximum ratings on page 3</i>
Oct. 2005	3	The following changes were made in this revision: – Some errors in the Order Codes table was corrected <i>on page 2</i> . – Reorganization of <i>Chapter 4: Macromodels on page 12</i> .

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