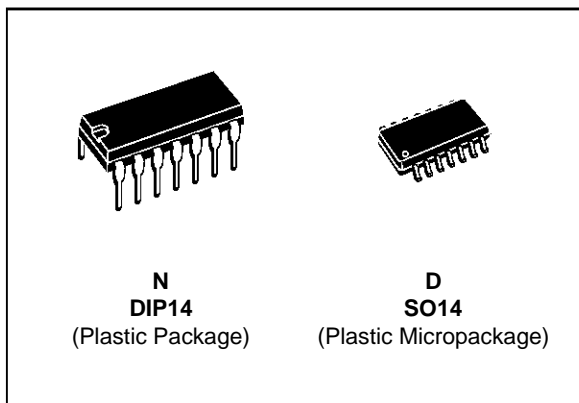


3V INPUT/OUTPUT RAIL TO RAIL DUAL CMOS OPERATIONAL AMPLIFIER (WITH STANDBY POSITION)

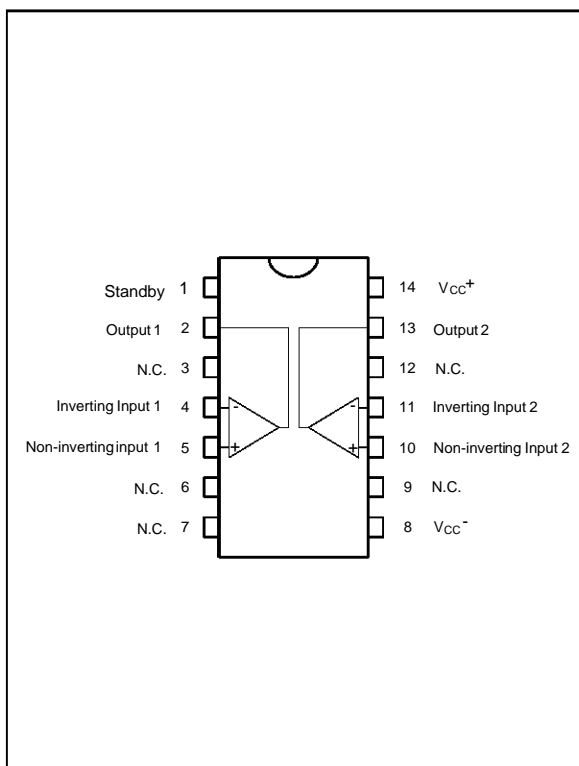
- DEDICATED TO 3.3V OR BATTERY SUPPLY (specified at 3V and 5V)
- RAIL TO RAIL INPUT AND OUTPUT VOLTAGE RANGES
- **STANDBY POSITION** : REDUCED CONSUMPTION (1 μ A) AND HIGH IMPEDANCE OUTPUTS
- SINGLE (OR DUAL) SUPPLY OPERATION FROM 2.7V TO 16V
- EXTREMELY LOW INPUT BIAS CURRENT : 1pA TYP
- LOW INPUT OFFSET VOLTAGE : 1.5mV max.
- SPECIFIED FOR 600 Ω AND 100 Ω LOADS
- LOW SUPPLY CURRENT : 200 μ A/Ampli



ORDER CODES

Part Number	Temperature Range	Package	
		N	D
TS3V902I/AI/BI	-40, +125 $^{\circ}$ C	•	•

PIN CONNECTIONS (top view)



DESCRIPTION

The TS3V902 is a RAIL TO RAIL dual CMOS operational amplifier designed to operate with single or dual supply voltage.

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

The output reaches :

- $V_{cc}^- + 50mV$ $V_{cc}^+ - 50mV$ with $R_L = 10k\Omega$
- $V_{cc}^- + 350mV$ $V_{cc}^+ - 350mV$ with $R_L = 600\Omega$

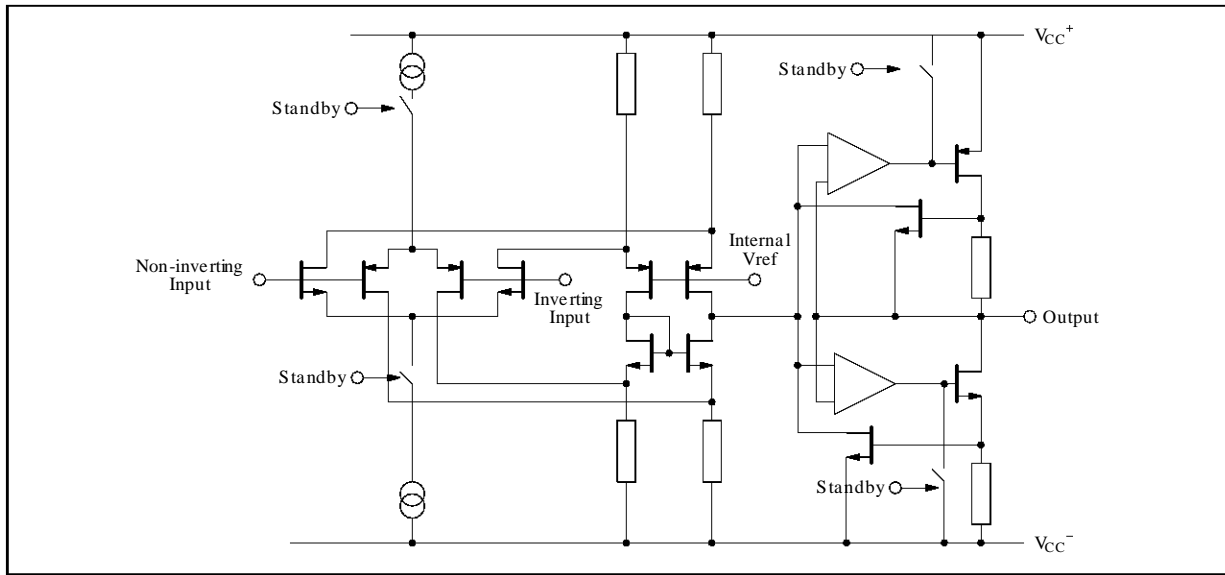
This product offers a broad supply voltage operating range from 2.7V to 16V and a supply current of only 200 μ A/amp. ($V_{cc} = 3V$).

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

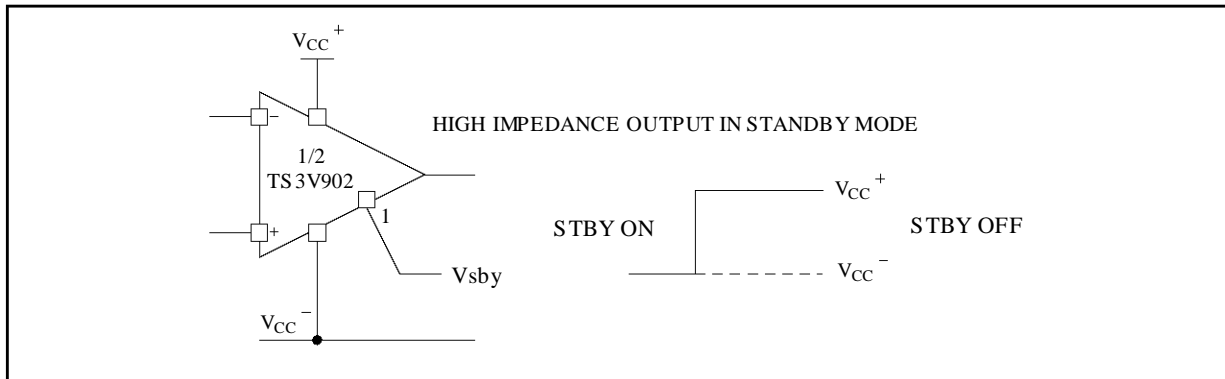
The TS3V902 can be put on STANDBY position (only 0.5 μ A and high impedance outputs).

TS3V902

SCHEMATIC DIAGRAM (1/2 TS3V902)



STANDBY POSITION



ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Value	Unit
V_{CC}	Supply Voltage - (note 1)	18	V
V_{id}	Differential Input Voltage - (note 2)	± 18	V
V_i	Input Voltage - (note 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	-40 to +125	$^{\circ}C$
T_{stg}	Storage Temperature	-65 to +150	$^{\circ}C$

- 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 $V_{CC}^{+} + 0.3V$.

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

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

Symbol	Parameter	TS3V902I/AI/BI			Unit
		Min.	Typ.	Max.	
V_{io}	Input Offset Voltage ($V_{ic} = V_o = V_{CC}/2$) $T_{min.} \leq T_{amb} \leq T_{max.}$			12 5 1.5 12 7 3	mV
DV_{io}	Input Offset Voltage Drift		5		$\mu V/^\circ C$
I_{io}	Input Offset Current - (note 1) $T_{min.} \leq T_{amb} \leq T_{max.}$		1	100 200	pA
I_{ib}	Input Bias Current - (note 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 $3V$, $V_o = 1.5V$		60		dB
SVR	Supply Voltage Rejection Ratio ($V_{CC}^+ = 2.7$ to $3.3V$, $V_o = V_{CC}/2$)		80		dB
A_{vd}	Large Signal Voltage Gain ($R_L = 10k\Omega$, $V_o = 2.5V$ to $7.5V$) $T_{min.} \leq T_{amb} \leq T_{max.}$	3 3	10		V/mV
V_{OH}	High Level Output Voltage ($V_{id} = 1V$) $T_{min.} \leq T_{amb} \leq T_{max.}$	$R_L = 100k\Omega$ $R_L = 10k\Omega$ $R_L = 600\Omega$ $R_L = 100\Omega$ $R_L = 10k\Omega$ $R_L = 600\Omega$	2.95 2.9 2.2 2.8 2.1	2.96 2.6 2	V
V_{OL}	Low Level Output Voltage ($V_{id} = -1V$) $T_{min.} \leq T_{amb} \leq T_{max.}$	$R_L = 100k\Omega$ $R_L = 10k\Omega$ $R_L = 600\Omega$ $R_L = 100\Omega$ $R_L = 10k\Omega$ $R_L = 600\Omega$		50 100 350 600 900 150 900	mV
I_o	Output Short Circuit Current ($V_{id} = \pm 1V$)	Source ($V_o = V_{CC}^-$) Sink ($V_o = V_{CC}^+$)	40 40		mA
GBP	Gain Bandwidth Product ($A_{VCL} = 100$, $R_L = 10k\Omega$, $C_L = 100pF$, $f = 100kHz$)		0.7		MHz
SR	Slew Rate ($A_{VCL} = 1$, $R_L = 10k\Omega$, $C_L = 100pF$, $V_i = 1.3V$ to $1.7V$)		0.5		V/ μs
ϕ_m	Phase Margin		30		Degrees
e_n	Equivalent Input Noise Voltage ($R_s = 100\Omega$, $f = 1kHz$)		30		$\frac{nV}{\sqrt{Hz}}$
V_{O1}/V_{O2}	Channel Separation ($f = 1kHz$)		120		dB

STANDBY MODE
 $V_{CC}^+ = 3V$, $V_{CC}^- = 0V$, $T_{amb} = 25^\circ C$ (unless otherwise specified)

Symbol	Parameter	TS902I/AI/BI			Unit
		Min.	Typ.	Max.	
$V_{inSBY/ON}$	Pin 1 Threshold Voltage for STANDBY ON		1.2		V
$V_{inSBY/OFF}$	Pin 1 Threshold Voltage for STANDBY OFF		1.2		V
$I_{CC SBY}$	Total Consumption in Standby Position (STANDBY ON)		0.5		μA

TS3V902

ELECTRICAL CHARACTERISTICS

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

Symbol	Parameter	TS3V902I/AI/BI			Unit
		Min.	Typ.	Max.	
V_{io}	Input Offset Voltage ($V_{ic} = V_o = V_{CC}/2$) $T_{min.} \leq T_{amb} \leq T_{max.}$			12 5 1.5 12 7 3	mV
DV_{io}	Input Offset Voltage Drift		5		$\mu V/^\circ C$
I_{io}	Input Offset Current - (note 1) $T_{min.} \leq T_{amb} \leq T_{max.}$		1	100 200	pA
I_{ib}	Input Bias Current - (note 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 $3.5V$, $V_o = 2.5V$		85		dB
SVR	Supply Voltage Rejection Ratio ($V_{CC}^+ = 2.7$ to $3.3V$, $V_o = V_{CC}/2$)		80		dB
A_{vd}	Large Signal Voltage Gain ($R_L = 10k\Omega$, $V_o = 1.5V$ to $3.5V$) $T_{min.} \leq T_{amb} \leq T_{max.}$	7 7	30		V/mV
V_{OH}	High Level Output Voltage ($V_{id} = 1V$) $T_{min.} \leq T_{amb} \leq T_{max.}$	$R_L = 100k\Omega$ $R_L = 10k\Omega$ $R_L = 600\Omega$ $R_L = 100\Omega$ $R_L = 10k\Omega$ $R_L = 600\Omega$	4.95 4.85 4.2 4.8 4.1	4.9 4.55 3.7	V
V_{OL}	Low Level Output Voltage ($V_{id} = -1V$) $T_{min.} \leq T_{amb} \leq T_{max.}$	$R_L = 100k\Omega$ $R_L = 10k\Omega$ $R_L = 600\Omega$ $R_L = 100\Omega$ $R_L = 10k\Omega$ $R_L = 600\Omega$		50 100 680 1400 150 900	mV
I_o	Output Short Circuit Current ($V_{id} = \pm 1V$)	Source ($V_o = V_{CC}^-$) Sink ($V_o = V_{CC}^+$)	60 60		mA
GBP	Gain Bandwidth Product ($A_{VCL} = 100$, $R_L = 10k\Omega$, $C_L = 100pF$, $f = 100kHz$)		0.8		MHz
SR	Slew Rate ($A_{VCL} = 1$, $R_L = 10k\Omega$, $C_L = 100pF$, $V_i = 1V$ to $4V$)		0.8		V/ μs
ϕ_m	Phase Margin		30		Degrees

STANDBY MODE

$V_{CC}^+ = 5V$, $V_{CC}^- = 0V$, $T_{amb} = 25^\circ C$ (unless otherwise specified)

Symbol	Parameter	TS902I/AI/BI			Unit
		Min.	Typ.	Max.	
$V_{inSBY/ON}$	Pin 1 Threshold Voltage for STANDBY ON		5.2		V
$V_{inSBY/OFF}$	Pin 1 Threshold Voltage for STANDBY OFF		5.2		V
$I_{CC SBY}$	Total Consumption in Standby Position (STANDBY ON)		0.5		μA

TYPICAL CHARACTERISTICS

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

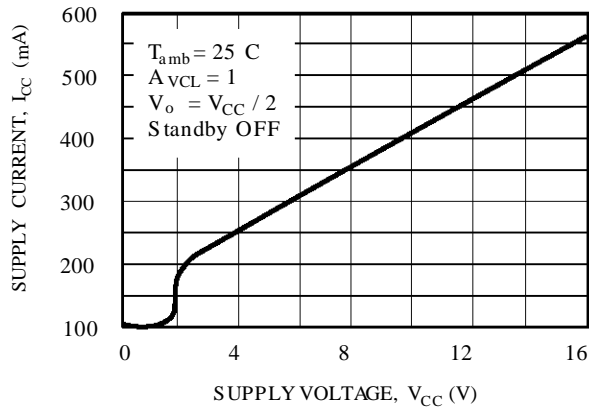


Figure 1b : Supply Current (each amplifier) versus Supply Voltage (in STANDBY)

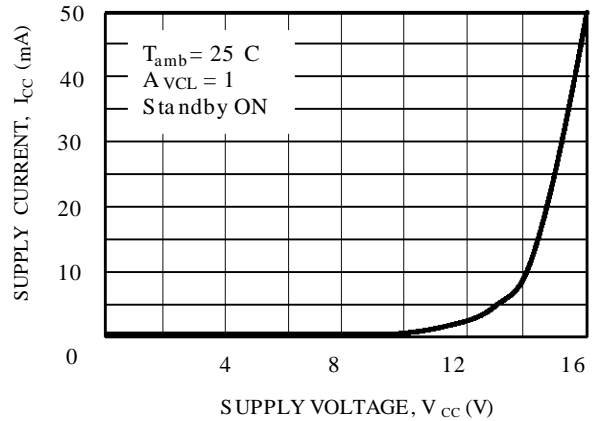


Figure 2 : Input Bias Current versus Temperature

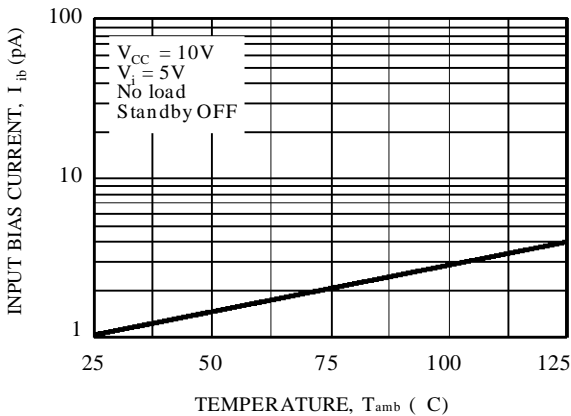


Figure 3a : High Level Output Voltage versus High Level Output Current

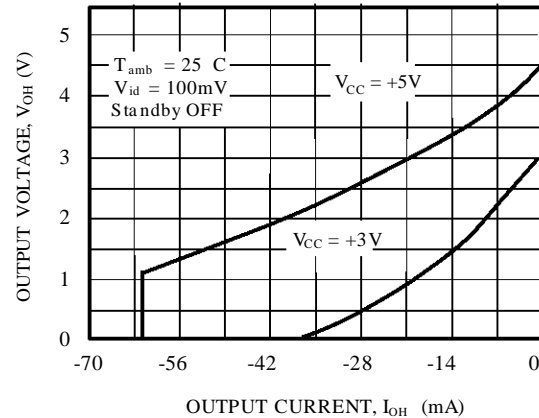


Figure 3b : High Level Output Voltage versus High Level Output Current

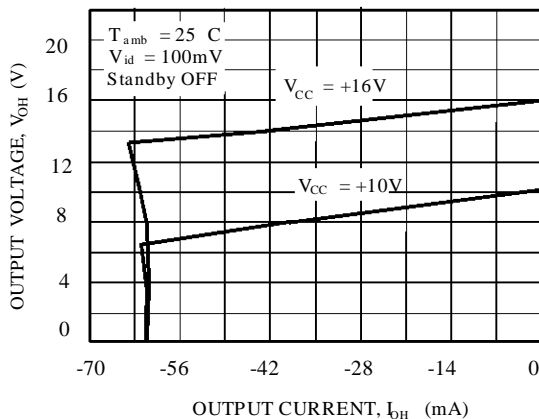


Figure 4a : Low Level Output Voltage versus Low Level Output Current

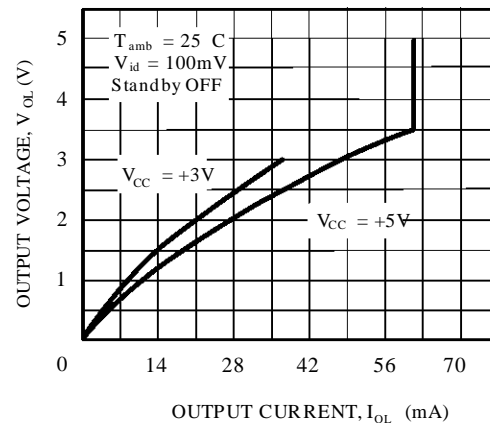


Figure 4b : Low Level Output Voltage versus Low Level Output Current

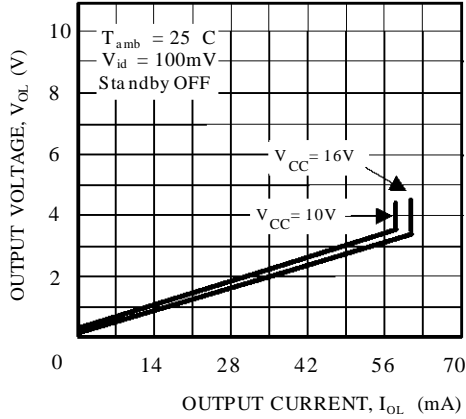


Figure 5a : Open Loop Frequency Response and Phase Shift

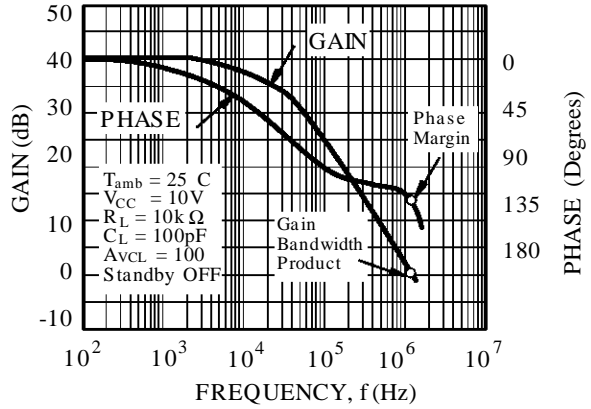


Figure 5b : Open Loop Frequency Response and Phase Shift

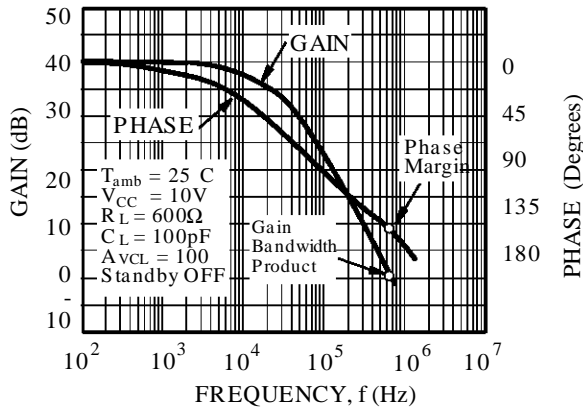


Figure 6a : Gain Bandwidth Product versus Supply Voltage

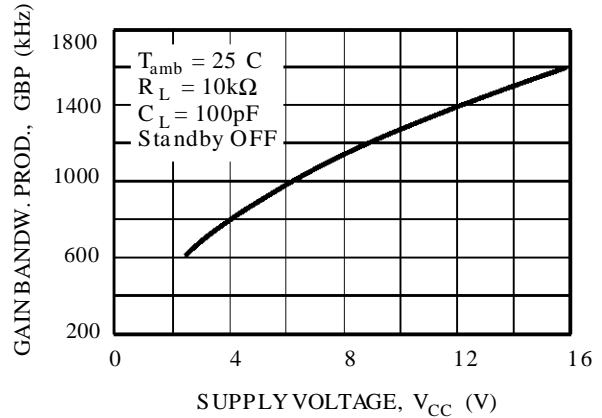


Figure 6b : Gain bandwidth Product versus Supply Voltage

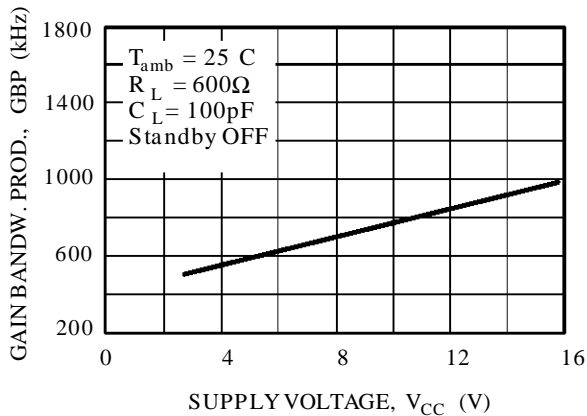


Figure 7a : Phase Margin versus Supply Voltage

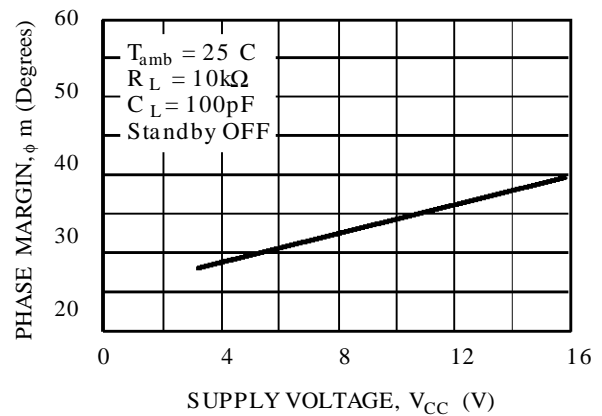


Figure 7b : Phase Margin versus Supply Voltage

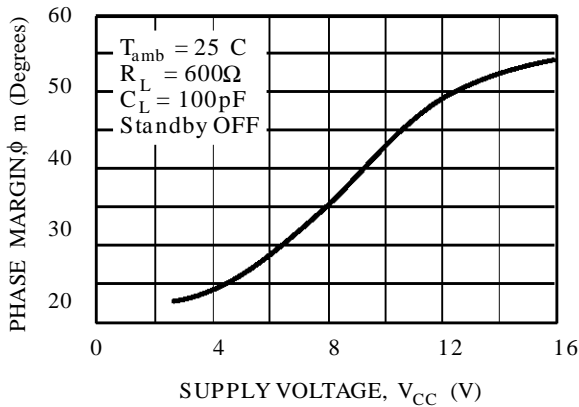
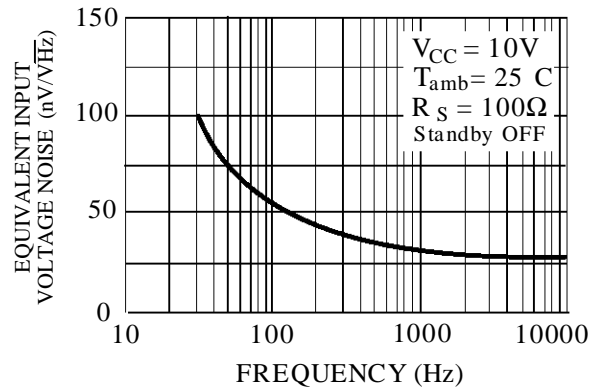


Figure 8 : Input Voltage Noise versus Frequency



STANDBY APPLICATION

The two operators of the TS3V902 are **both** put on **STANDBY**.

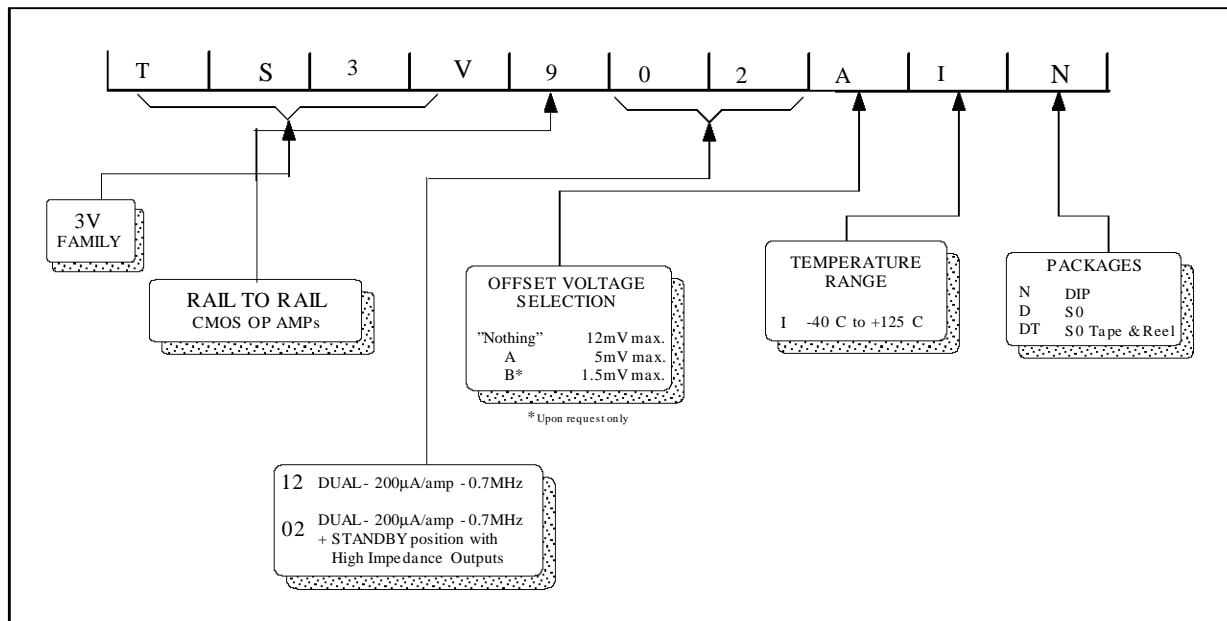
In this configuration (standby ON) :

- The **total consumption** of the circuit is considerably **reduced** down to **0.5μA** (V_{CC} = 3V). This standby consumption versus V_{CC} curve is given figure 1b.
- The **both outputs** are in **high impedance** state. No output current can then be sourced or sunk by the device.

The standby pin 1 should never stay unconnected.

- The **"standby OFF"** state, is reached when the pin 1 voltage is **higher than V_{in SBY/OFF}**.
- The **"standby ON"** state is assured by a pin 1 voltage **lower than V_{in SBY/ON}**. (see electrical characteristics)

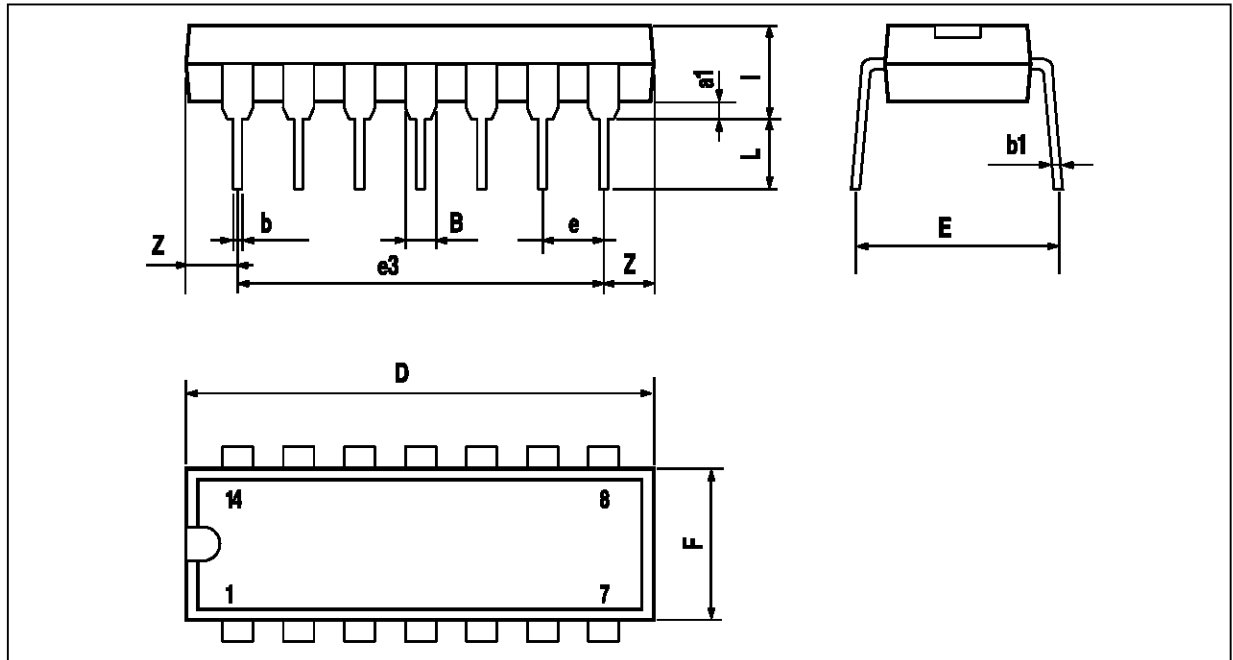
ORDERING INFORMATION



TS3V902

PACKAGE MECHANICAL DATA

14 PINS - PLASTIC DIP

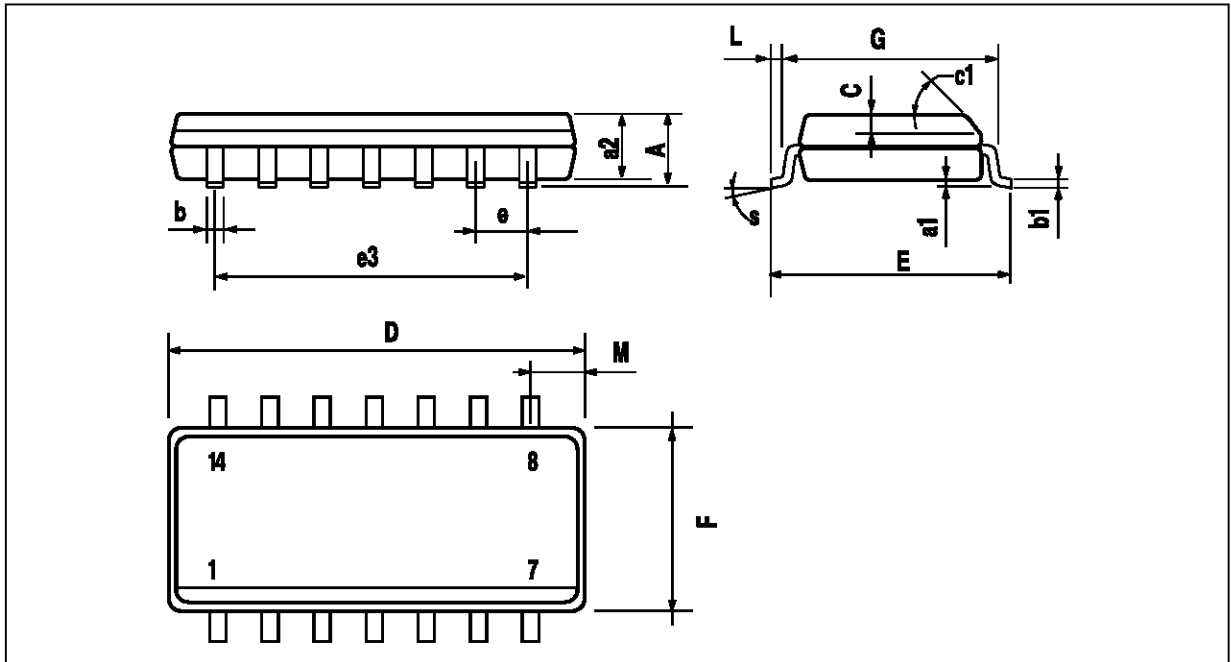


P14-DIP14.EPS

Dimensions	Millimeters			Inches		
	Min.	Typ.	Max.	Min.	Typ.	Max.
a1	0.51			0.020		
B	1.39		1.65	0.055		0.065
b		0.5			0.020	
b1		0.25			0.010	
D			20			0.787
E		8.5			0.335	
e		2.54			0.100	
e3		15.24			0.600	
F			7.1			0.280
i			5.1			0.201
L		3.3			0.130	
Z	1.27		2.54	0.050		0.100

DIP14.TEL

PACKAGE MECHANICAL DATA
 14 PINS - PLASTIC MICROPACKAGE (SO)



PM-SO14-EFS

Dimensions	Millimeters			Inches		
	Min.	Typ.	Max.	Min.	Typ.	Max.
A			1.75			0.069
a1	0.1		0.2	0.004		0.008
a2			1.6			0.063
b	0.35		0.46	0.014		0.018
b1	0.19		0.25	0.007		0.010
C		0.5			0.020	
c1	45° (typ.)					
D	8.55		8.75	0.336		0.334
E	5.8		6.2	0.228		0.244
e		1.27			0.050	
e3		7.62			0.300	
F	3.8		4.0	0.150		0.157
G	4.6		5.3	0.181		0.208
L	0.5		1.27	0.020		0.050
M			0.68			0.027
S	8° (max.)					

SO14 TEL

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