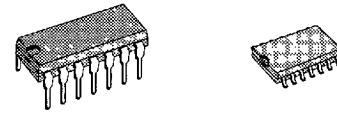
SGS-THOMSON MICROELECTRONICS

TS3V902

3V INPUT/OUTPUT **RAIL TO RAIL** DUAL 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 (1µA)** AND **HIGH IMPEDANCE OUTPUTS**
- SINGLE SUPPLY OPERATION FROM **2.7V TO 16V**
- EXTREMELY LOW INPUT BIAS CURRENT : **1pA** TYP
- LOW INPUT OFFSET VOLTAGE : **1.5mV max.**
- SPECIFIED FOR **600Ω** AND **100Ω** LOADS
- LOW SUPPLY CURRENT : 200µA/Ampli



N
DIP14
(Plastic Package)

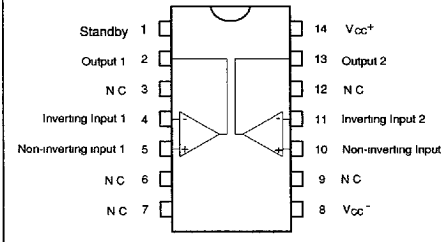
D
SO14
(Plastic Micropackage)

ORDER CODES

Part Number	Temperature Range	Package	
		N	D
TS3V902I/AI/BI	-40, +125°C	•	•

902-01 TBL

PIN CONNECTIONS (top view)



902-01 EPS

DESCRIPTION

The TS3V902 is a RAIL TO RAIL dual CMOS 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}^- +50mV V_{CC}^+ -50mV with R_L = 10kΩ
- V_{CC}^- +350mV V_{CC}^+ -350mV with R_L = 600Ω

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

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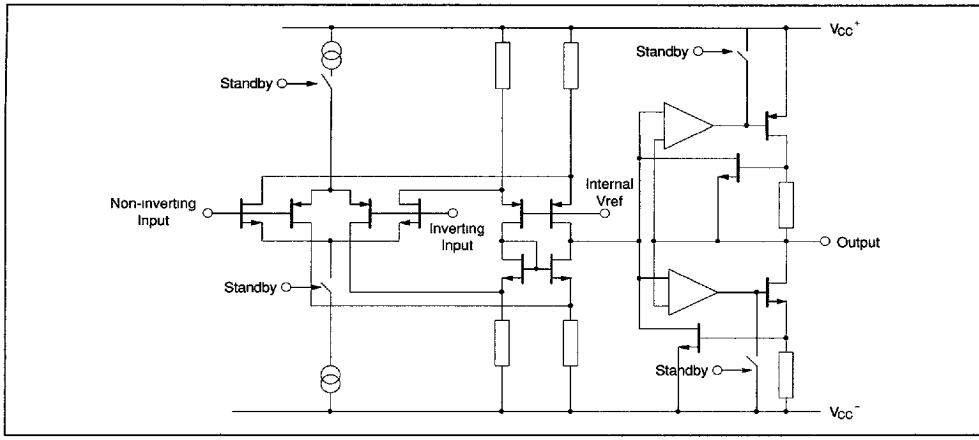
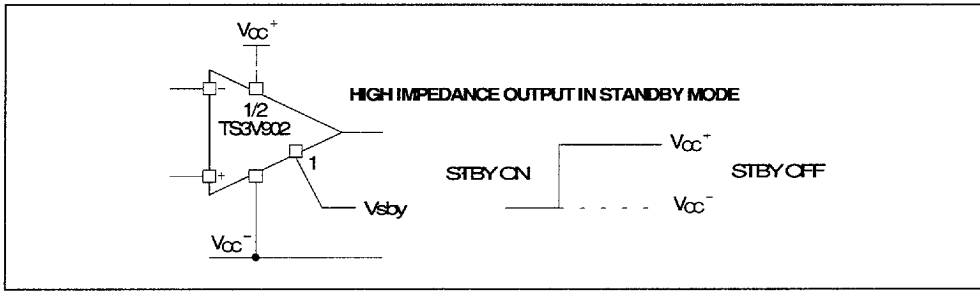
SCHEMATIC DIAGRAM (1/2 TS3V902)



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 TS3V902I/AI/BI	-40 to +125	°C
T_{stg}	Storage Temperature	-65 to +150	°C

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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

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ELECTRICAL CHARACTERISTICS

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

Symbol	Parameter		TS3V902I/AI/BI Min.	Typ.	Max.	Unit
V_{io}	Input Offset Voltage ($V_{ic} = V_o = V_{CC}/2$)	TS3V902			12	mV
		TS3V902A			5	
		TS3V902B			1.5	
	$T_{min} \le T_{amb} \le T_{max}$.	TS3V902			12	
		TS3V902A			7	
		TS3V902B			3	
DV_{io}	Input Offset Voltage Drift			2		µV/°C
I_{io}	Input Offset Current - (note 1)			1	100	pA
	$T_{min} \le T_{amb} \le T_{max}$				200	
I_{ib}	Input Bias Current - (note 1)			1	150	pA
	$T_{min} \le T_{amb} \le T_{max}$				300	
I_{CC}	Supply Current (per amplifier, $A_{VCL} = 1$, no load)			200	300	µA
	$T_{min.} \le T_{amb} \le T_{max}$.				400	
CMR	Common Mode Rejection Ratio					dB
	$V_{ic} = 0$ to 3V, $V_o = 1.5V$			70		
SVR	Supply Voltage Rejection Ratio ($V_{CC}^+ = 2.7$ to 3.3V, $V_O = V_{CC}/2$)			70		dB
A_{vd}	Large Signal Voltage Gain ($R_L = 10k\Omega$, $V_O = 1.2V$ to 1.8V)		3	10		V/mV
	$T_{min} \le T_{amb} \le T_{max}$		3			
V_{OH}	High Level Output Voltage ($V_{id} = 1V$)	$R_L = 100k\Omega$	2.95			V
		$R_L = 10k\Omega$	2.9	2.96		
		$R_L = 600\Omega$	2.2	2.6		
		$R_L = 100\Omega$		2		
	$T_{min.} \le T_{amb} \le T_{max}$.	$R_L = 10k\Omega$	2.8			
		$R_L = 600\Omega$	2.1			
V_{OL}	Low Level Output Voltage ($V_{id} = -1V$)	$R_L = 100k\Omega$			50	mV
		$R_L = 10k\Omega$		50	100	
		$R_L = 600\Omega$		350	600	
		$R_L = 100\Omega$		900		
	$T_{min} \le T_{amb} \le T_{max}$.	$R_L = 10k\Omega$			150	
		$R_L = 600\Omega$			900	
I_o	Output Short Circuit Current ($V_{id} = \pm 1V$)	Source ($V_o = V_{CC}^-$)		30		mA
		Sink ($V_o = V_{CC}^+$)		30		
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
Øm	Phase Margin			30		Degrees
e_n	Equivalent Input Noise Voltage ($R_s = 100\Omega$, f = 1kHz)			40		$\frac{nV}{\sqrt{Hz}}$
V_{O1}/V_{O2}	Channel Separation (f = 1kHz)			120		dB

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Note 1 : Maximum values including unavoidable inaccuracies of the industial test.

STANDBY MODE

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

Symbol	Parameter	TS3V902I/AI/BI Min.	Typ.	Max.	Unit
$V_{inSBY/ON}$	Pin 1 Threshold Voltage for STANDBY ON		1.2		V
$V_{inSBY/OFF}$	Pin 1 Threshold Voltage for STANDBY OFF		1.5		V
$I_{CC\ SBY}$	Total Consumption in Standby Position (STANDBY ON)		0.5		µA

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ELECTRICAL CHARACTERISTICS

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

Symbol	Parameter		TS3V902I/AI/BI Min.	Typ.	Max.	Unit
V_{io}	Input Offset Voltage ($V_{ic} = V_o = V_{CC}/2$)	TS3V902			12	mV
		TS3V902A			5	
		TS3V902B			1.5	
	$T_{min} \le T_{amb} \le T_{max}$	TS3V902			12	
		TS3V902A			7	
		TS3V902B			3	
DV_{io}	Input Offset Voltage Drift			2		µV/°C
I_{io}	Input Offset Current - (note 1)			1	100	pA
	$T_{min} \le T_{amb} \le T_{max}$				200	
I_{ib}	Input Bias Current - (note 1)			1	150	pA
	$T_{min} \le T_{amb} \le T_{max}$				300	
I_{CC}	Supply Current (per amplifier, A_{VCL} = 1, no load)			230	350	µA
	$T_{min} \le T_{amb} \le T_{max}$				450	
CMR	Common Mode Rejection Ratio					dB
	V_{ic} = 1.5 to 3.5V, V_o = 2.5V			85		
SVR	Supply Voltage Rejection Ratio (V_{CC}^+ = 3 to 5V, $V_O = V_{CC}/2$)			80		dB
A_{vd}	Large Signal Voltage Gain (R_L = 10kΩ, V_O = 1.5V to 3.5V)		7	30		V/mV
	$T_{min} \le T_{amb} \le T_{max}$		7			
V_{OH}	High Level Output Voltage (V_{id} = 1V)	R_L = 100kΩ	4.95			V
		R_L = 10kΩ	4.85	4.9		
		R_L = 600Ω	4.2	4.55		
		R_L = 100Ω		3.7		
	$T_{min} \le T_{amb} \le T_{max}$.	R_L = 10kΩ	4.8			
		R_L = 600Ω	4.1			
V_{OL}	Low Level Output Voltage (V_{id} = -1V)	R_L = 100kΩ			50	mV
		R_L = 10kΩ		50	100	
		R_L = 600Ω		450	680	
		R_L = 100Ω		1400		
	$T_{min.} \le T_{amb} \le T_{max}$	R_L = 10kΩ			150	
		R_L = 600Ω			900	
I_o	Output Short Circuit Current (V_{id} = ±1V)	Source ($V_o = V_{CC}^-$)		50		mA
		Sink ($V_o = V_{CC}^+$)		50		
GBP	Gain Bandwidth Product					MHz
	(A_{VCL} = 100, R_L = 10kΩ, C_L = 100pF, f = 100kHz)			0.8		
SR	Slew Rate (A_{VCL} = 1, R_L = 10kΩ, C_L = 100pF, V_i =1V to 4V)			0.8		V/µs
Øm	Phase Margin			30		Degrees

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

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STANDBY MODE

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

Symbol	Parameter	TS3V902I/AI/BI Min.	Typ.	Max.	Unit
$V_{inSBY/ON}$	Pin 1 Threshold Voltage for STANDBY ON		5.2		V
$V_{inSBY/OFF}$	Pin 1 Threshold Voltage for STANDBY OFF		5.5		V
$I_{CC\ SBY}$	Total Consumption in Standby Position (STANDBY ON)		0.5		µA

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TYPICAL CHARACTERISTICS

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

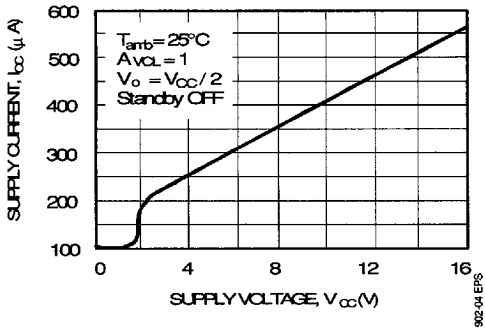

Figure 1b : Supply Current (each amplifier) versus Supply Voltage (in STANDBY)

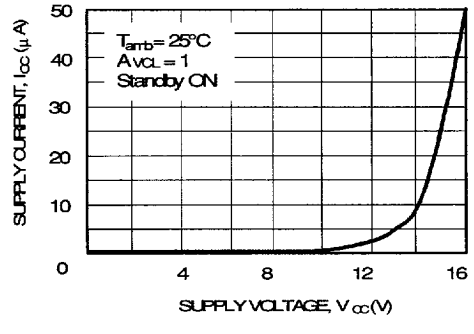

Figure 2 : Input Bias Current versus Temperature

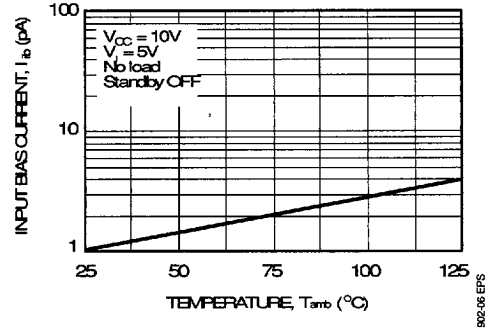

Figure 3a : High Level Output Voltage versus High Level Output Current

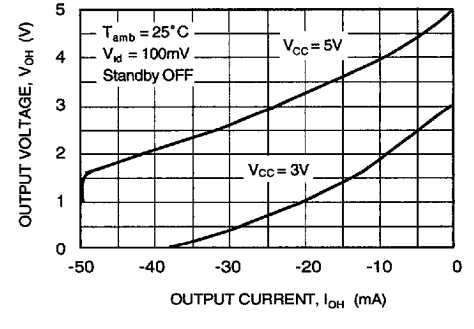

Figure 3b : High Level Output Voltage versus High Level Output Current

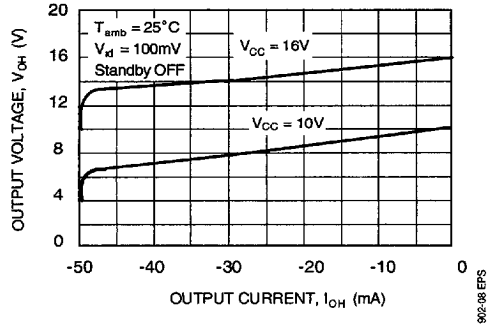

Figure 4a : Low Level Output Voltage versus Low Level Output Current

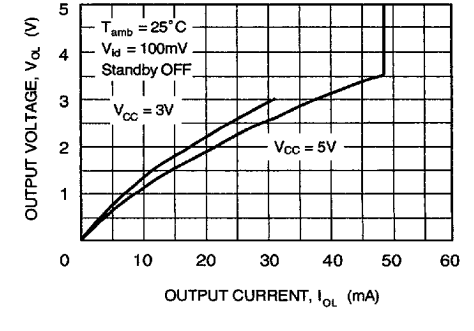

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Figure 4b : Low Level Output Voltage versus Low Level Output Current

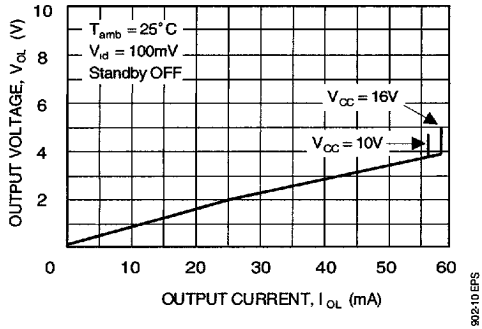

Figure 5a : Open Loop Frequency Response and Phase Shift

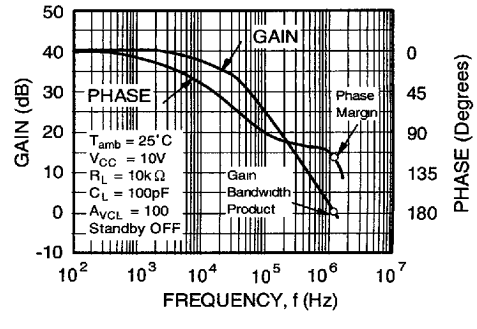

Figure 5b : Open Loop Frequency Response and Phase Shift

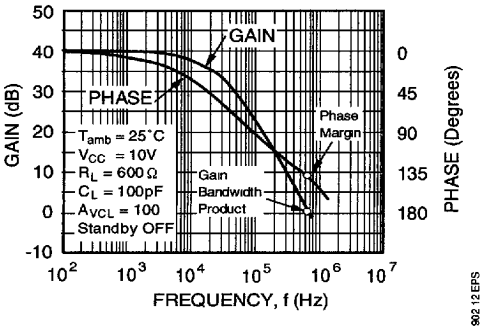

Figure 6a : Gain Bandwidth Product versus Supply Voltage

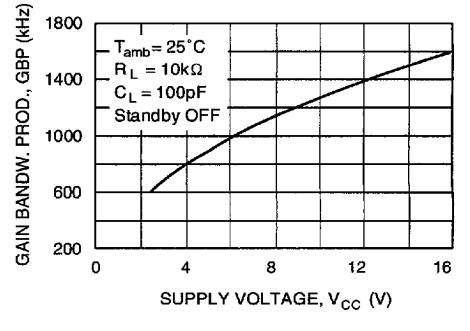

Figure 6b : Gain bandwidth Product versus Supply Voltage

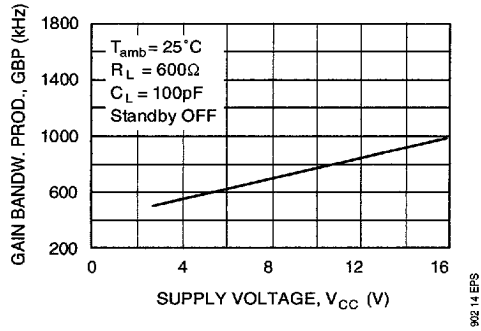

Figure 7a : Phase Margin versus Supply Voltage

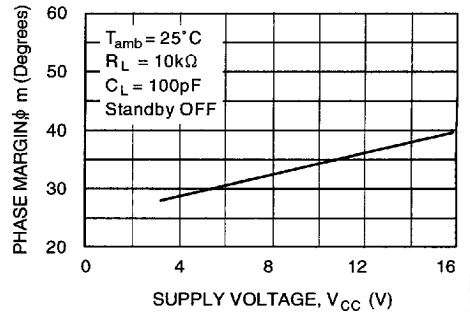

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Figure 7b : Phase Margin versus Supply Voltage

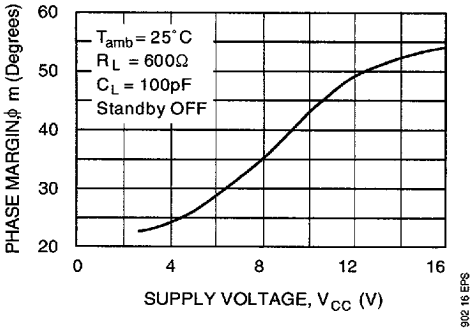
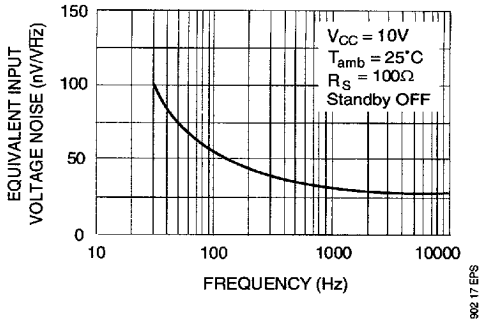


Figure 8 : Input Voltage Noise versus Frequency



STANDBY APPLICATION

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

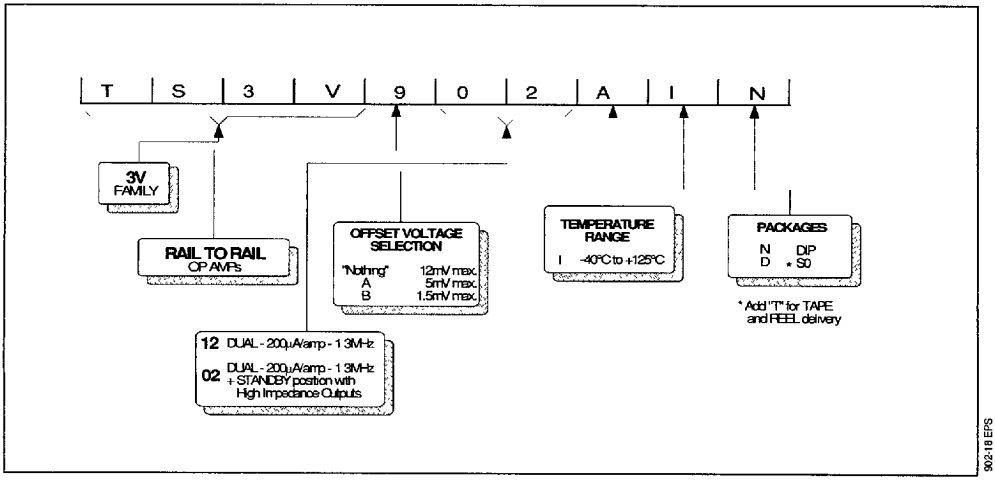
In this configuration (standby ON) :

- 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 sinked 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



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