



TS524

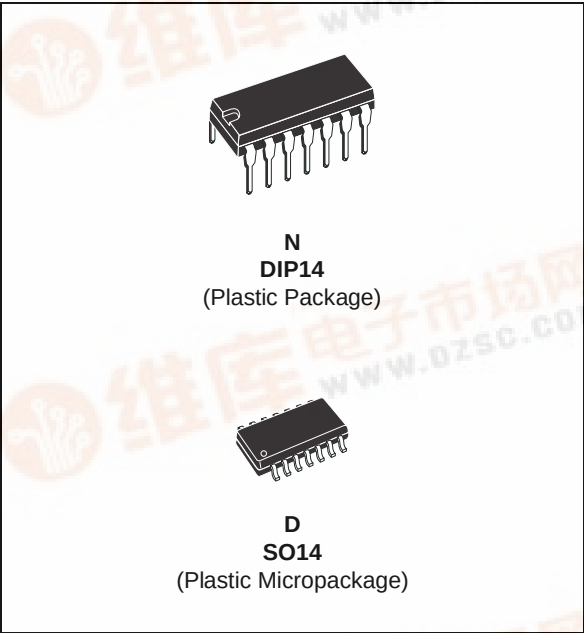
PRECISION LOW NOISE
QUAD OPERATIONAL AMPLIFIERS

- LOW INPUT OFFSET VOLTAGE : **950 μ V** max.
- LOW VOLTAGE NOISE : **4.5nV/ $\sqrt{\text{Hz}}$**
- HIGH GAIN BANDWIDTH PRODUCT : **15MHz**
- HIGH SLEW RATE : **7V/ μ s**
- LOW DISTORTION : 0.002%
- ESD INTERNAL PROTECTION : 2kV

DESCRIPTION

The TS524 is a monolithic quad operational amplifier particularly well-suited for audio applications. The TS524 offers a very low input offset voltage as well as low voltage noise (4.5nV/ $\sqrt{\text{Hz}}$) and high dynamic performances (15MHz gain bandwidth product, 7V/ μ s slew rate).

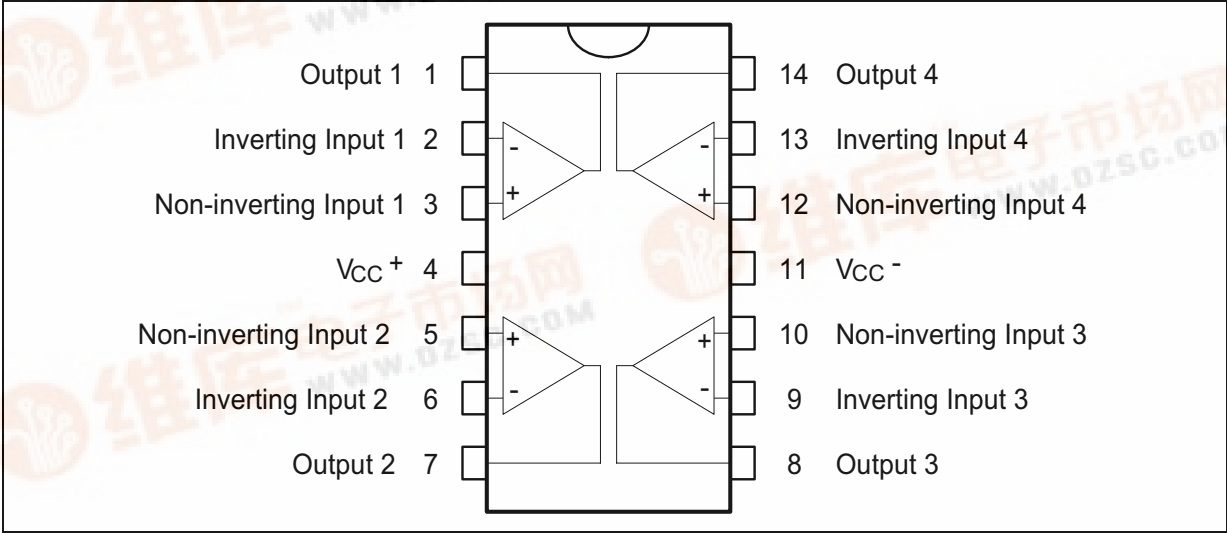
The output stage allows a large output voltage swing and symmetrical source and sink currents.



ORDER CODES

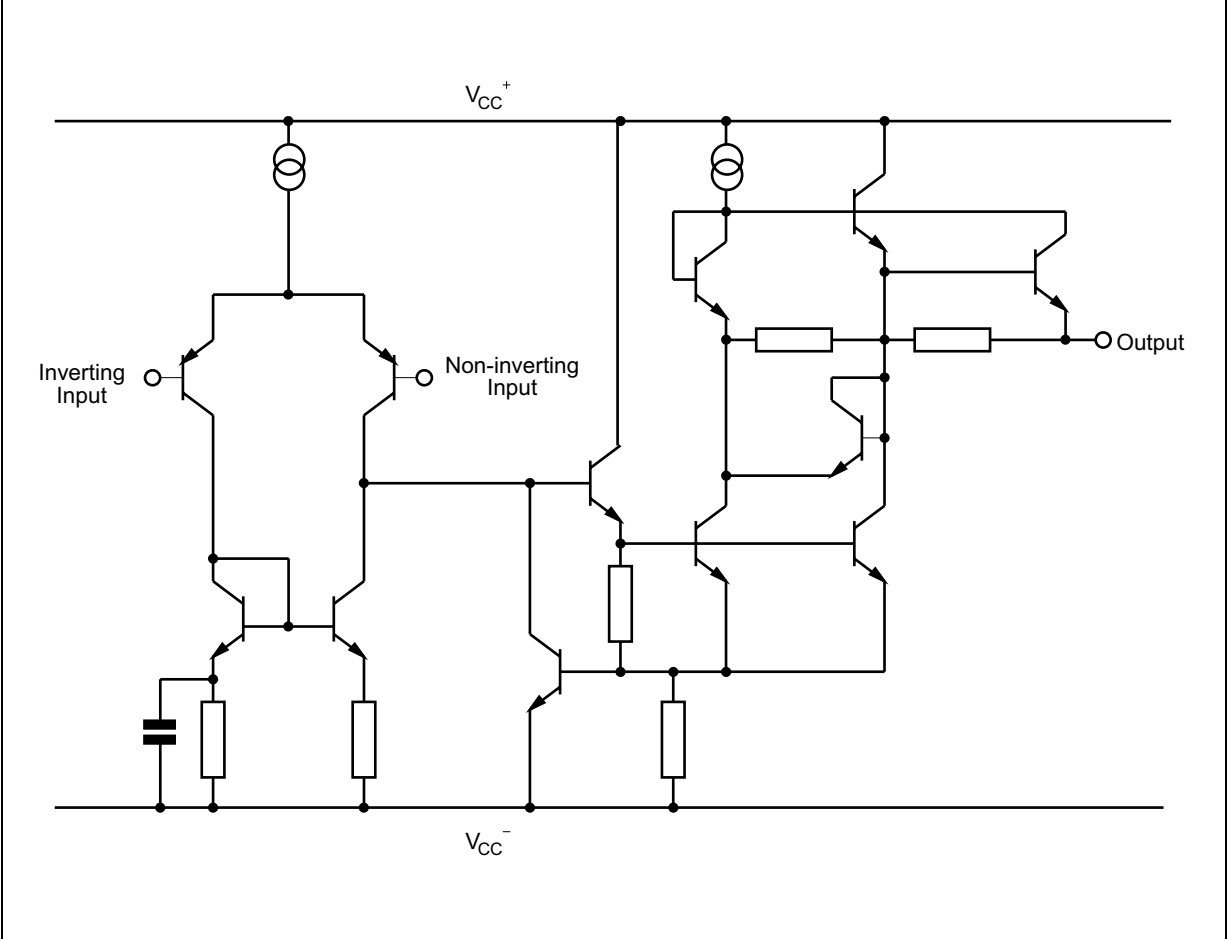
Part Number	Temperature Range	Package	
		N	D
TS524I	-40, +125 $^{\circ}$ C	•	•

PIN CONNECTIONS (top view)



TS524

SCHEMATIC DIAGRAM (1/4 TS524)



ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Value	Unit
V_{CC}	Supply Voltage	± 18 or $+36$	V
V_{id}	Differential Input Voltage - (note 1)	± 30	V
V_i	Input Voltage - (note 1)	± 15	V
	Output Short-Circuit Duration - (note 2)	Infinite	
T_{oper}	Operating Free-air Temperature Range	-40 to $+105$	$^{\circ}\text{C}$
T_j	Maximum Junction Temperature	$+150$	$^{\circ}\text{C}$
T_{stg}	Storage Temperature	-65 to $+150$	$^{\circ}\text{C}$
P_{tot}	Maximum Power Dissipation - (note 2)	500	mW

Notes : 1. Either or both input voltages must not exceed the magnitude of V_{CC}^+ or V_{CC}^- .
2. Power dissipation must be considered to ensure maximum junction temperature (T_j) is not exceeded

OPERATING CONDITIONS

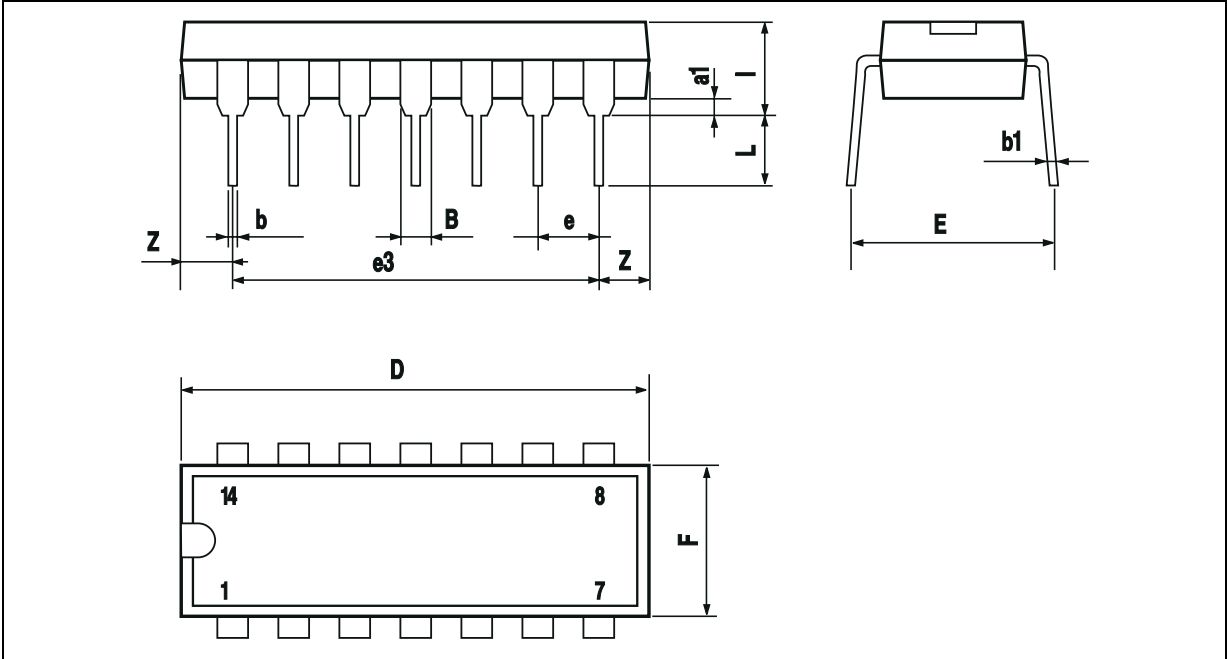
Symbol	Parameter	Value	Unit
V_{CC}	Supply Voltage	± 2.5 to ± 15	V

ELECTRICAL CHARACTERISTICS
 $V_{CC}^{+} = +15V$, $V_{CC}^{-} = -15V$, $T_{amb} = 25^{\circ}C$ (unless otherwise specified)

Symbol	Parameter	Min.	Typ.	Max.	Unit
V_{io}	Input Offset Voltage ($V_o = 0V$, $V_{ic} = 0V$) $T_{min.} \leq T_{amb} \leq T_{max.}$			0.95 1.8	mV
DV_{io}	Input Offset Voltage Drift $V_{ic} = 0V$, $V_o = 0V$, $T_{min.} \leq T_{amb} \leq T_{max.}$		2		$\mu V/^{\circ}C$
I_{io}	Input Offset Current ($V_{ic} = 0V$, $V_o = 0V$) $T_{amb} = +25^{\circ}C$ $T_{min.} \leq T_{amb} \leq T_{max.}$		10	150 175	nA
I_{ib}	Input Bias Current ($V_{ic} = 0V$, $V_o = 0V$) $T_{amb} = +25^{\circ}C$ $T_{min.} \leq T_{amb} \leq T_{max.}$		250	750 800	nA
V_{icm}	Common Mode Input Voltage Range ($\Delta V_{IO} = 5mV$, $V_o = 0V$)	± 13	± 14		V
A_{vd}	Large Signal Voltage Gain ($R_L = 2k\Omega$, $V_o = \pm 10V$) $T_{amb} = +25^{\circ}C$ $T_{min.} \leq T_{amb} \leq T_{max.}$	90 85	100		dB
$\pm V_{opp}$	Output Voltage Swing ($V_{id} = \pm 1V$) $R_L = 600\Omega$ $R_L = 600\Omega$ $R_L = 2.0k\Omega$ $R_L = 2.0k\Omega$ $R_L = 10k\Omega$ $R_L = 10k\Omega$	 13.2 13.5	 12.2 -12.7 14 -14.2 14.3 -14.6	 -13.2 -14	V
CMR	Common Mode Rejection Ratio ($V_{ic} = \pm 13V$)	80	100		dB
SVR	Supply Voltage Rejection Ratio $V_{CC}^{+} / V_{CC}^{-} = +15V / -15V$ to $+5V / -5V$	80	105		dB
I_o	Output Short Circuit Current ($V_{id} = \pm 1V$, Output to Ground) Source Sink	15 20	29 37		mA
I_{CC}	Supply current ($V_o = 0V$, All Amplifiers) $T_{amb} = +25^{\circ}C$ $T_{min.} \leq T_{amb} \leq T_{max.}$		8	10 12	mA
SR	Slew Rate $V_i = -10V$ to $+10V$, $R_L = 2k\Omega$, $C_L = 100pF$, $A_v = +1$	5	7		V/ μs
GBP	Gain Bandwidth Product ($f = 100kHz$, $R_L = 2k\Omega$, $C_L = 100pF$)	10	15		MHz
B	Unity Gain Bandwidth (Open loop)		9		MHz
A_m	Gain Margin ($R_L = 2k\Omega$) $C_L = 0pF$ $C_L = 100pF$		-11 -6		dB
ϕ_m	Phase Margin ($R_L = 2k\Omega$) $C_L = 0pF$ $C_L = 100pF$		55 30		Degrees
e_n	Equivalent Input Noise Voltage ($R_S = 100\Omega$, $f = 1kHz$)		4.5		$\frac{nV}{\sqrt{Hz}}$
i_n	Equivalent Input Noise current ($f = 1kHz$)		0.5		$\frac{pA}{\sqrt{Hz}}$
THD	Total Harmonic Distortion $R_L = 2k\Omega$, $f = 20Hz$ to $20kHz$, $V_o = 3V_{rms}$, $A_v = +1$		0.002		%
V_{O1}/V_{O2}	Channel Separation ($f = 20Hz$ to $20kHz$)		120		dB
FPB	Full Power Bandwidth ($V_o = 27V_{pp}$, $R_L = 2k\Omega$, $THD \leq 1\%$)		120		kHz
Z_o	Output Impedance ($V_o = 0V$, $f = 9MHz$)		37		Ω
R_i	Input Resistance ($V_{ic} = 0V$)		175		k Ω
C_i	Input Capacitance ($V_{ic} = 0V$)		12		pF

TS524

PACKAGE MECHANICAL DATA
14 PINS - PLASTIC DIP



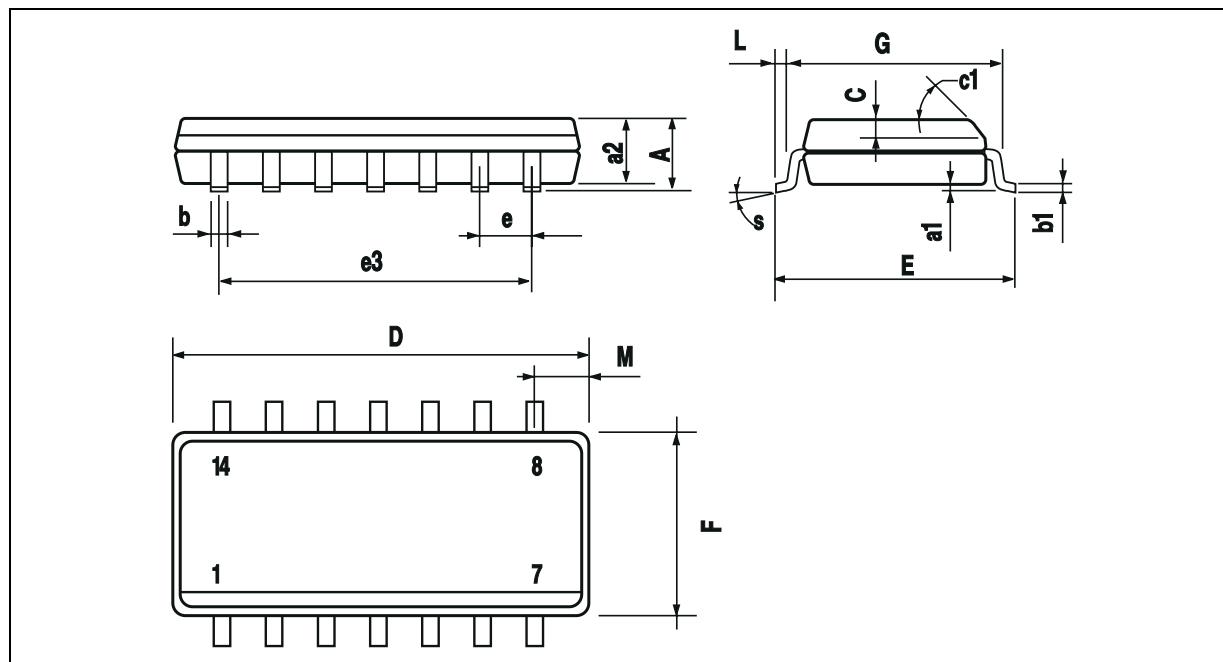
PM-DIP14.EPS

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.TBL

PACKAGE MECHANICAL DATA

14 PINS - PLASTIC MICROPACKAGE (SO)



PM-SO14.EPS

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.TBL

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