

**HIGH SPEED PRECISION  
QUAD OPERATIONAL AMPLIFIERS**

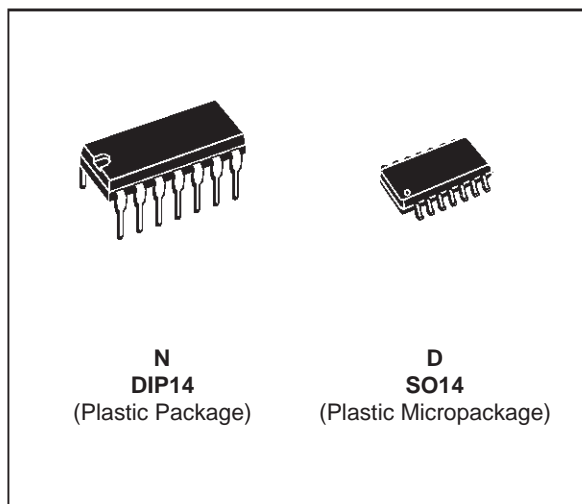
- LOW OFFSET VOLTAGE : 500 $\mu$ V max.
- LOW POWER CONSUMPTION
- SHORT CIRCUIT PROTECTION
- LOW DISTORTION, LOW NOISE
- HIGH GAIN-BANDWIDTH PRODUCT
- HIGH CHANNEL SEPARATION
- ESD INTERNAL PROTECTION

- **MACROMODEL** INCLUDED IN THIS SPECIFICATION

**DESCRIPTION**

The TS514 is a high performance quad operational amplifier with frequency and phase compensation built into the chip. The internal phase compensation allows stable operation as voltage follower in spite of its high gain-bandwidth products.

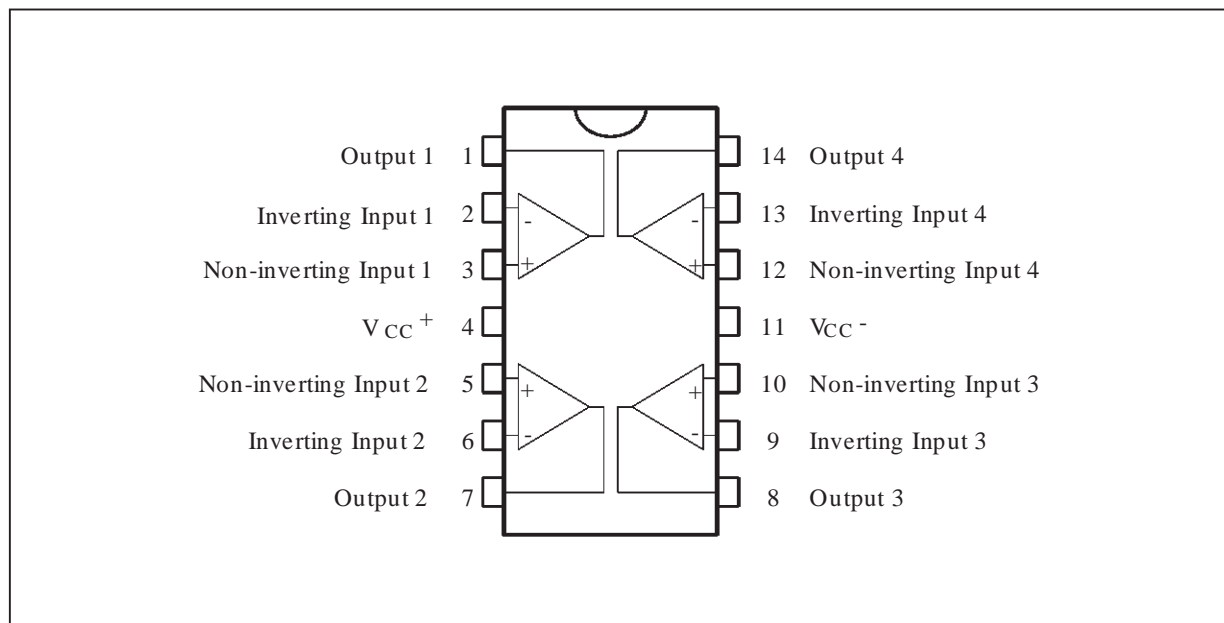
The circuit presents very stable electrical characteristics over the entire supply voltage range, and it particularly intended for professional and telecom applications (active filters, etc).



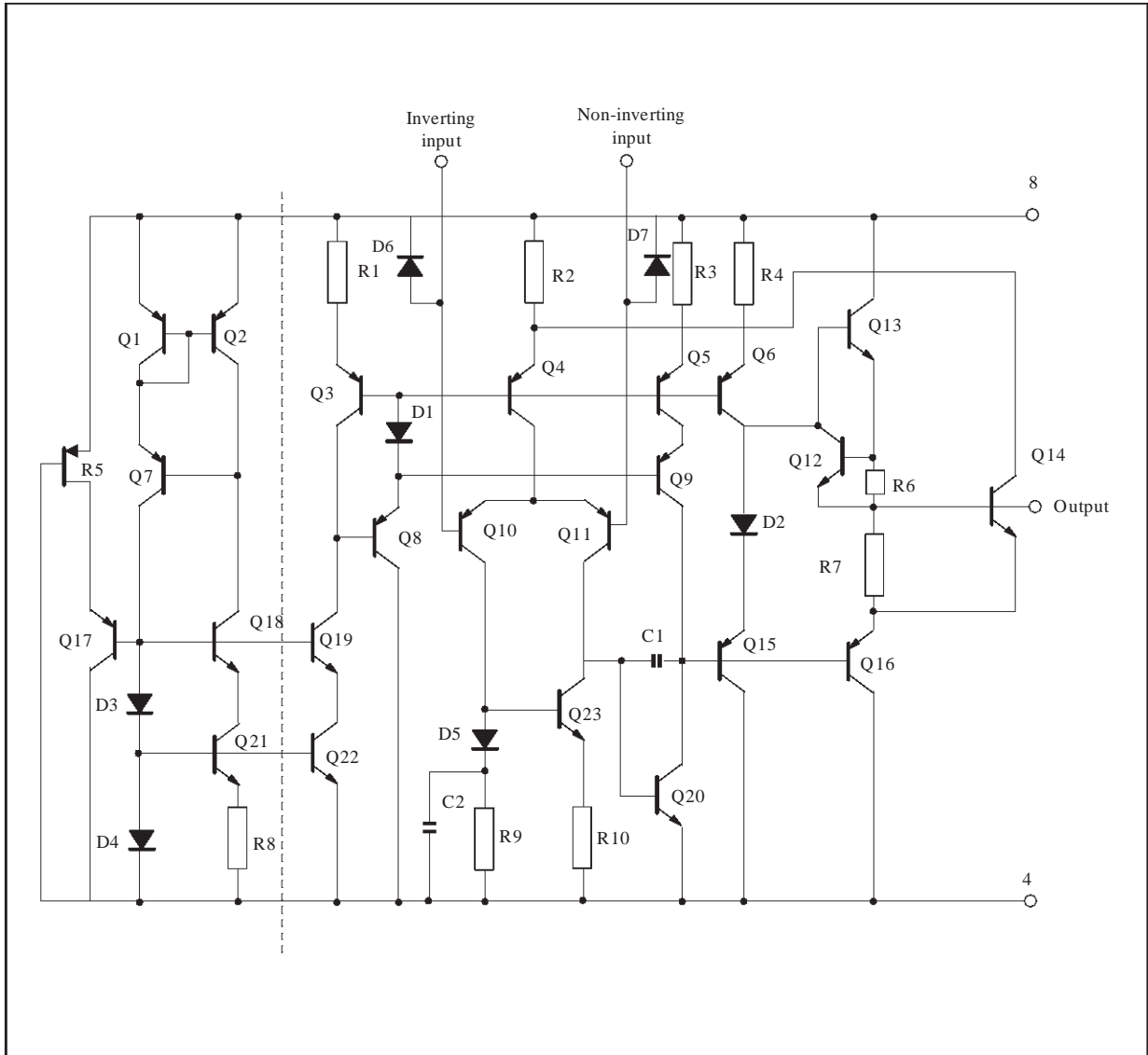
**ORDER CODES**

Part Number	Temperature Range	Package	
		N	D
TS514I	-40°C, +125°C	•	•
TS514AI	-40°C, +125°C	•	•

**PIN CONNECTIONS** (top view)



**SCHEMATIC DIAGRAM (1/2 TS514)**



**ABSOLUTE MAXIMUM RATINGS**

Symbol	Parameter	Value	Unit
V <sub>CC</sub>	Supply Voltage	±18	V
V <sub>i</sub>	Input Voltage (positive) (negative)	+V <sub>CC</sub> -V <sub>CC</sub> - 0.5	V
V <sub>id</sub>	Differential Input Voltage	± (V <sub>CC</sub> - 1)	
T <sub>oper</sub>	Operating Temperature Range	-40 to +125	°C
P <sub>tot</sub>	Power Dissipation at T <sub>amb</sub> = 70°C	400	mW
T <sub>stg</sub>	Storage Temperature	-65 to 150	°C

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

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
$I_{CC}$	Supply Current			1.4	2.4	mA
$I_{ib}$	Input Bias Current			50	150	nA
		$T_{min.} < T_{op} < T_{max.}$			300	nA
$R_i$	Input Resistance	$f = 1kHz$		1		M $\Omega$
$V_{io}$	Input Offset Voltage	TS514 TS514A		0.5	2.5 0.5	mV
		$T_{min.} < T_{op} < T_{max.}$ TS514 TS514A			4 1.5	mV
$DV_{io}$	Input Offset Voltage Drift	$T_{min.} < T_{op} < T_{max.}$		5		$\mu V/^{\circ}C$
$I_{io}$	Input Offset Current			5	20	nA
		$T_{min.} < T_{op} < T_{max.}$			40	nA
$DI_{io}$	Input Offset Current Drift	$T_{min.} < T_{op} < T_{max.}$		0.08		$\frac{nA}{^{\circ}C}$
$I_{os}$	Output Short Circuit Current			23		mA
$A_{vd}$	Large Signal Voltage Gain	$R_L = 2k\Omega$ $V_{CC} = \pm 15V$ $V_{CC} = \pm 4V$	90	100 95		dB
GBP	Gain-bandwidth Product	$f = 100kHz$	1.8	3		MHz
$e_n$	Equivalent Input Noise Voltage	$f = 1kHz$ $R_s = 50\Omega$ $R_s = 1k\Omega$ $R_s = 10k\Omega$		8 10 18	15	$\frac{nV}{\sqrt{Hz}}$
THD	Total Harmonic Distortion	$A_V = 20dB$ $R_L = 2k\Omega$ $V_O = 2V_{PP}$ $f = 1kHz$		0.03	0.1	%
$\pm V_{opp}$	Output Voltage Swing	$R_L = 2k\Omega$ $V_{CC} = \pm 15V$ $V_{CC} = \pm 4V$	$\pm 13$	$\pm 3$		V
$V_{opp}$	Large Signal Voltage Swing	$R_L = 10k\Omega$ $f = 10kHz$		28		$V_{PP}$
SR	Slew Rate	Unity Gain, $R_L = 2k\Omega$	0.8	1.5		V/ $\mu s$
CMR	Common Mode Rejection Ratio	$V_{ic} = 10V$	90			dB
SVR	Supply Voltage Rejection Ratio	$V_{ic} = 1V$ $f = 100Hz$	90			dB
$V_{O1}/V_{O2}$	Channel Separation	$f = 1kHz$	100	120		dB

## TS514,A

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- SINGLE OR SPLIT SUPPLY OPERATION
- LOW POWER CONSUMPTION
- SHORT CIRCUIT PROTECTION
- LOW DISTORTION, LOW NOISE
- HIGH GAIN-BANDWIDTH PRODUCT
- HIGH CHANNEL SEPARATION

### Applies to : TS514i,AI

\*\* Standard Linear Ics Macromodels, 1993.

\*\* CONNECTIONS :

\* 1 INVERTING INPUT

\* 2 NON-INVERTING INPUT

\* 3 OUTPUT

\* 4 POSITIVE POWER SUPPLY

\* 5 NEGATIVE POWER SUPPLY

.SUBCKT TS514 1 3 2 4 5 (analog)

\*\*\*\*\*

.MODEL MDTH D IS=1E-8 KF=6.647807E-16 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 1.300000E+01

RIN 15 16 1.300000E+01

RIS 11 15 6.437882E+01

DIP 11 12 MDTH 400E-12

DIN 15 14 MDTH 400E-12

VOFP 12 13 DC 0

VOFN 13 14 DC 0

IPOL 13 5 2.000000E-05

CPS 11 15 9.75E-10

DINN 17 13 MDTH 400E-12

VIN 17 5 0.000000E+00

DINR 15 18 MDTH 400E-12

VIP 4 18 1.500000E+00

FCP 4 5 VOFP 1.525000E+01

FCN 5 4 VOFN 1.525000E+01

FIBP 2 5 VOFN 5.000000E-03

FIBN 5 1 VOFP 5.000000E-03

\* AMPLIFYING STAGE

FIP 5 19 VOFP 1.125000E+03

FIN 5 19 VOFN 1.125000E+03

RG1 19 5 6.512062E+05

RG2 19 4 6.512062E+05

CC 19 29 1.500000E-08

HZTP 30 29 VOFP 8.944787E+02

HZTN 5 30 VOFN 8.944787E+02

DOPM 19 22 MDTH 400E-12

DONM 21 19 MDTH 400E-12

HOPM 22 28 VOUT 6.521739E+03

VIPM 28 4 1.500000E+02

HONM 21 27 VOUT 6.521739E+03

VINM 5 27 1.500000E+02

GCOMP 5 4 4 5 7.485029E-04

RPM1 5 80 1E+09

RPM2 4 80 1E+09

GAVPH 5 82 19 80 2.99E-03

RAVPHGH 82 4 668

RAVPHGB 82 5 668

RAVPHDH 82 83 1000

RAVPHDB 82 84 1000

CAVPHH 4 83 0.352E-09

CAVPHB 5 84 0.352E-09

EOUT 26 23 82 5 1

VOUT 23 5 0

ROUT 26 3 150

COUT 3 5 1.000000E-12

DOP 19 25 MDTH 400E-12

VOP 4 25 1.785252E+00

DON 24 19 MDTH 400E-12

VON 24 5 1.785252E+00

.ENDS

**ELECTRICAL CHARACTERISTICS**

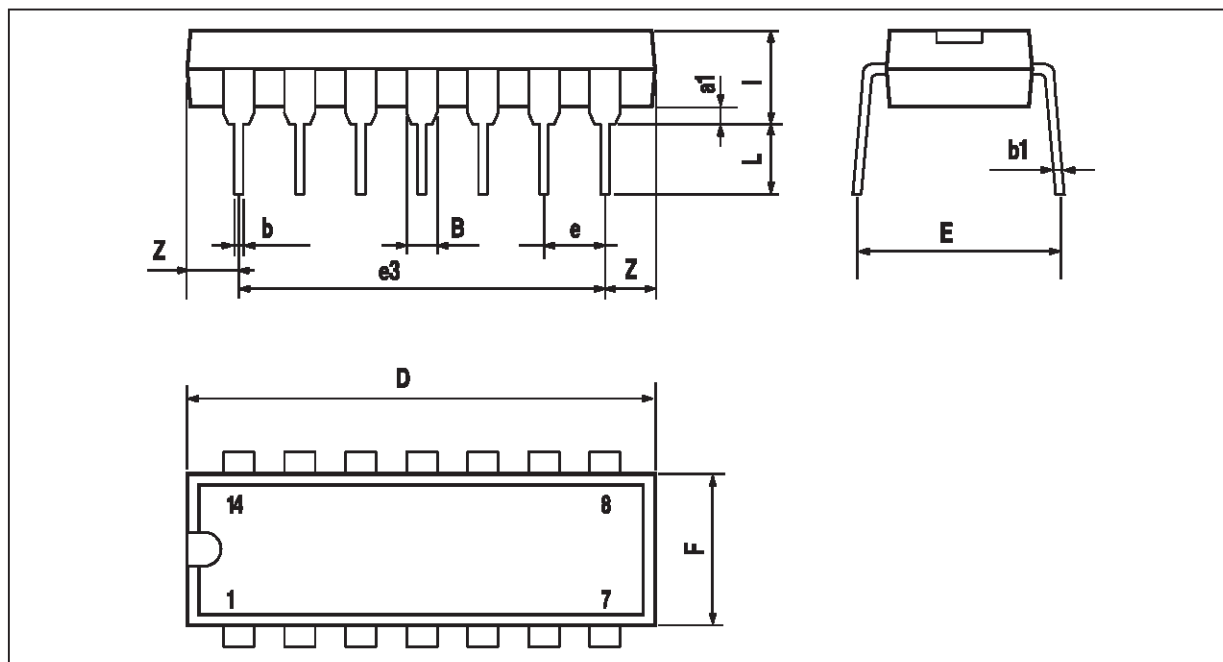
$V_{CC} = \pm 15V$ ,  $T_{amb} = 25^{\circ}C$  (unless otherwise specified)

Symbol	Conditions	Value	Unit
$V_{io}$		0	mV
$A_{vd}$	$R_L = 2k\Omega$	94	V/mV
$I_{CC}$	No load, per operator	325	$\mu A$
$V_{icm}$		-15 to 13.5	V
$V_{OH}$	$R_L = 2k\Omega$	+13	V
$V_{OL}$	$R_L = 2k\Omega$	-13	V
$I_{sink}$	$V_O = 0V$	24	mA
$I_{source}$	$V_O = 0V$	24	mA
GBP	$R_L = 2k\Omega$ , $C_L = 100pF$	3	MHz
SR	$R_L = 2k\Omega$ , $C_L = 100pF$	1.4	V/ $\mu s$
$\theta_m$	$R_L = 2k\Omega$ , $C_L = 100pF$	55	Degrees

# TS514,A

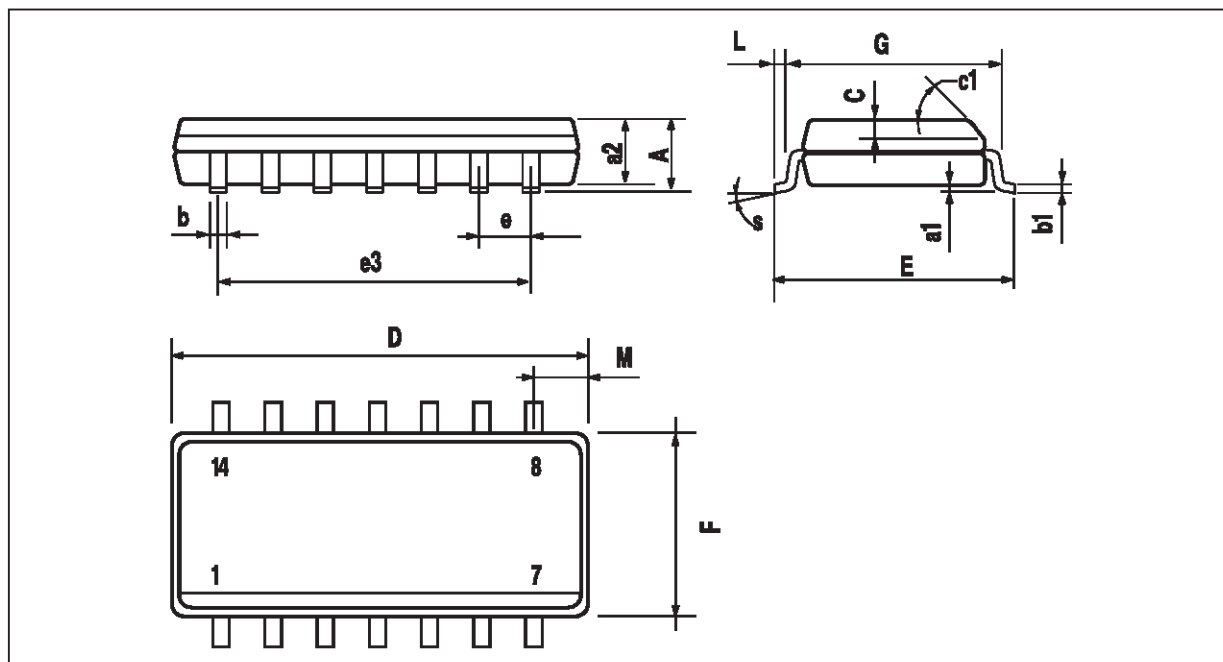
## PACKAGE MECHANICAL DATA

14 PINS - PLASTIC DIP



Dim.	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

**PACKAGE MECHANICAL DATA**  
 14 PINS - PLASTIC MICROPACKAGE (SO)



Dim.	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.)					

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