



TS514, A

PRECISION QUAD OPERATIONAL AMPLIFIER

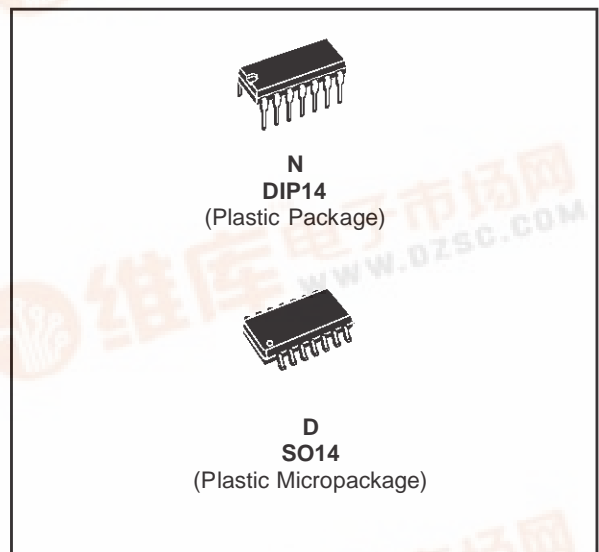
- LOW OFFSET VOLTAGE : 500 μ V max.
- LOW POWER CONSUMPTION
- SHORT CIRCUIT PROTECTION
- LOW DISTORTION, LOW NOISE
- HIGH GAIN-BANDWIDTH PRODUCT
- HIGH CHANNEL SEPARATION
- ESD INTERNAL PROTECTION

- **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).

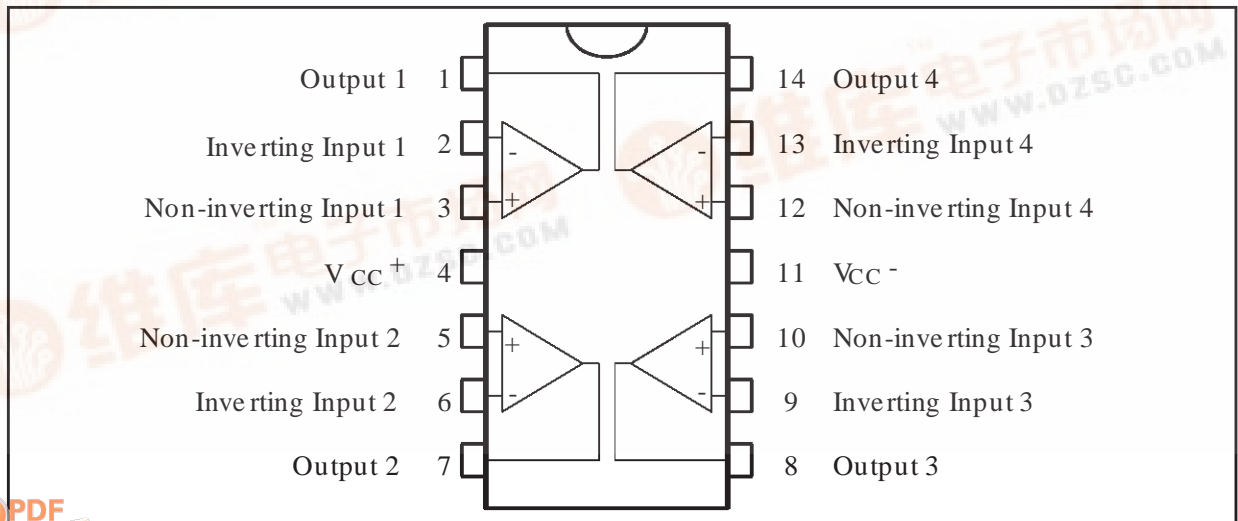


ORDER CODE

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

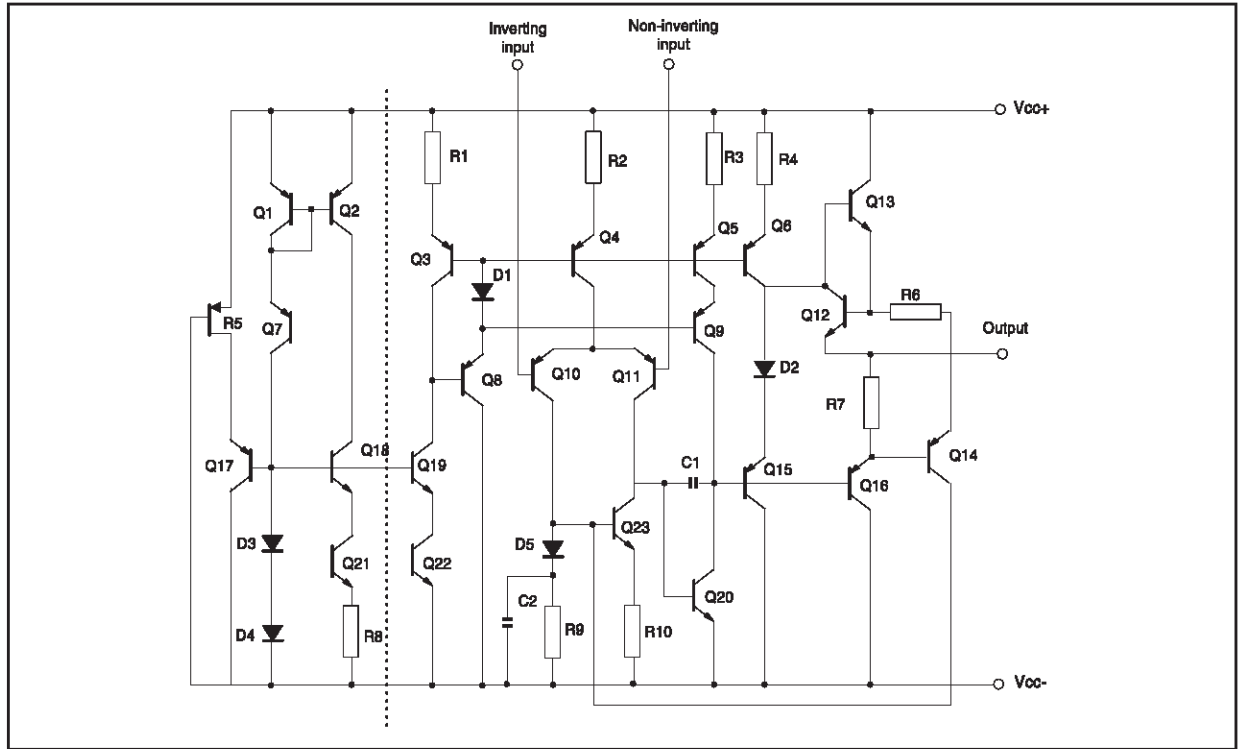
N = Dual in Line Package (DIP)
 D = Small Outline Package (SO) - also available in Tape & Reel (DT)

PIN CONNECTIONS (top view)



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SCHEMATIC DIAGRAM (1/4 TS514)



ABSOLUTE MAXIMUM RATINGS

| Symbol | Parameter | Value | Unit |
|------------|---|------------------------------|--------------------|
| V_{CC} | Supply Voltage | ± 18 | V |
| V_i | Input Voltage (positive) (negative) | $+V_{CC}$ $-V_{CC} - 0.5$ | |
| V_{id} | Differential Input Voltage | $\pm(V_{CC} - 1)$ | |
| T_{oper} | Operating Free-Air Temperature Range | -40 to +125 | $^{\circ}\text{C}$ |
| P_{tot} | Power Dissipation at $T_{amb} = 70^{\circ}\text{C}$ | 400 | mW |
| T_{stg} | Storage Temperature Range | -65 to +150 | $^{\circ}\text{C}$ |

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

| Symbol | Parameter | Min. | Typ. | Max. | Unit |
|-----------------|--|----------|---------------|----------------------------|------------------------|
| I_{CC} | Supply Current | | 1.4 | 2.4 | mA |
| I_{IB} | Input Bias Current $T_{min} \leq T_{op} \leq T_{max}$ | | 50 | 150 300 | nA |
| R_i | Input Resistance, $f = 1kHz$ | | 1 | | M Ω |
| V_{io} | Input Offset Voltage TS514 TS514A $T_{min} \leq T_{op} \leq T_{max}$ TS514 TS514A | | 0.5 | 2.5 0.5 4 1.5 | mV |
| ΔV_{io} | Input Offset Voltage Drift $T_{min} \leq T_{op} \leq T_{max}$ | | 5 | | $\mu V/^{\circ}C$ |
| I_{io} | Input Offset Current $T_{min} \leq T_{op} \leq T_{max}$ | | 5 | 20 40 | nA |
| ΔI_{io} | Input Offset Current Drift $T_{min} \leq T_{op} \leq T_{max}$ | | 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 $A_v = 20dB$ $V_o = 2V_{pp}$ $R_L = 2k\Omega$ $f = 1kHz$ | | 0.03 | 0.1 | % |
| $\pm V_{opp}$ | Output Voltage Swing $R_L = 2k\Omega$ $V_{CC} = \pm 15V$ $V_{CC} = \pm 4V$ | ± 13 | ± 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/ μs |
| CMR | Common Mode Rejection Ratio $V_{ic} = 10V$ | 90 | | | dB |
| SVR | Supply Voltage Rejection Ratio $dV_{ic} = 10V$ $f = 100Hz$ | 90 | | | dB |
| V_{o1}/V_{o2} | Channel Separation, $f = 1kHz$ | | 120 | | dB |

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MACROMODEL

** 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

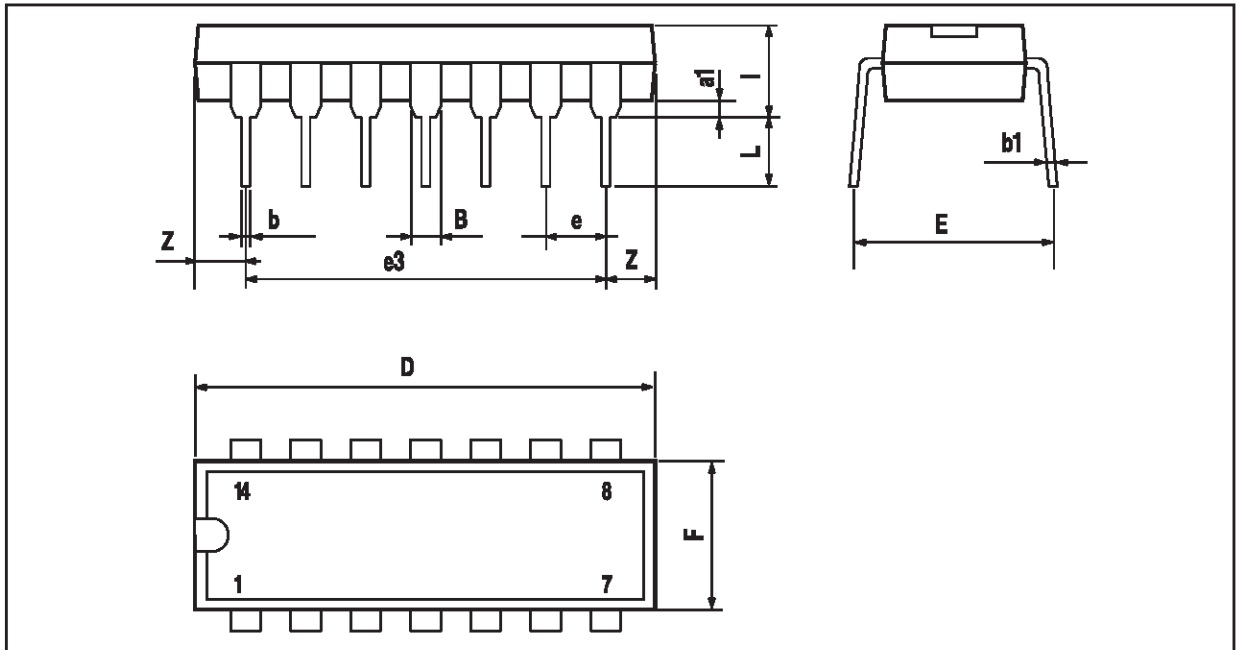
.ENDS

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 | μA |
| 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/ μs |
| ϕ_m | $R_L = 2k\Omega$, $C_L = 100pF$ | 55 | Degrees |

PACKAGE MECHANICAL DATA
14 PINS - PLASTIC DIP

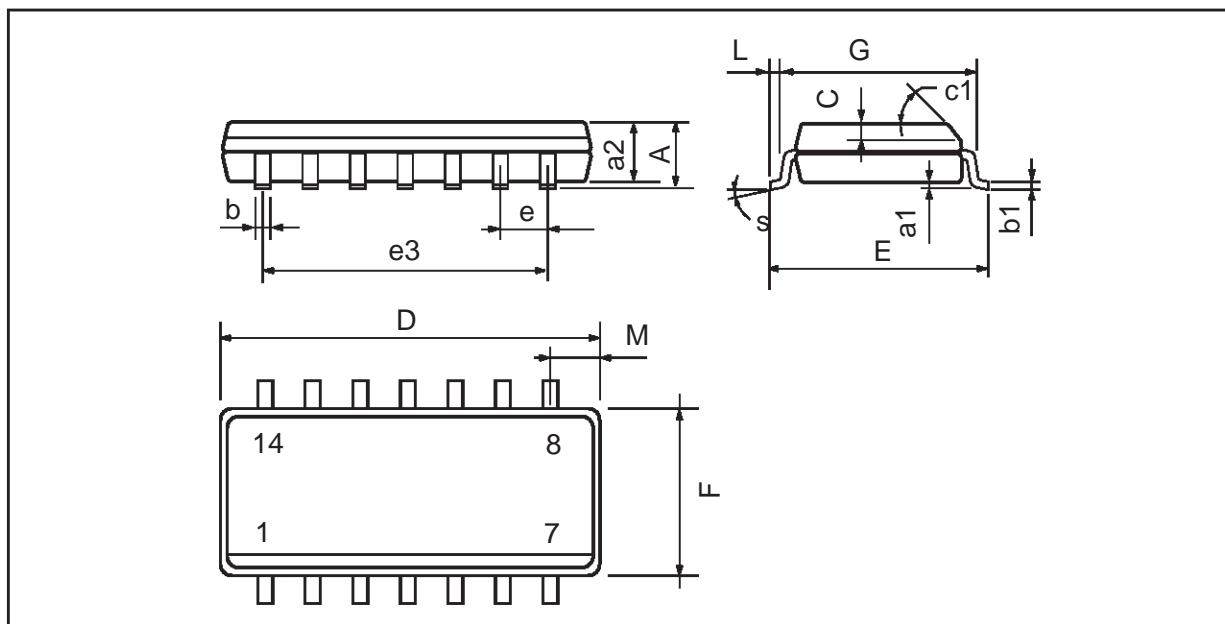


| Dim. | Millimeters | | | Inches | | |
|------|-------------|-------|------|--------|-------|-------|
| | Min. | Typ. | Max. | Min. | Typ. | Max. |
| a1 | 0.51 | | | 0.020 | | |
| B | 1.39 | | 1.65 | 0.055 | | 0.065 |
| b | | 0.5 | | | 0.020 | |
| b1 | | 0.25 | | | 0.010 | |
| D | | | 20 | | | 0.787 |
| 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 |

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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 (1) | 8.55 | | 8.75 | 0.336 | | 0.344 |
| E | 5.8 | | 6.2 | 0.228 | | 0.244 |
| e | | 1.27 | | | 0.050 | |
| e3 | | 7.62 | | | 0.300 | |
| F (1) | 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.) | | | | | |

Note : (1) D and F do not include mold flash or protrusions - Mold flash or protrusions shall not exceed 0.15mm (.066 inc) ONLY FOR DATA BOOK.

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