

## HIGH SPEED PRECISION QUAD OPERATIONAL AMPLIFIERS

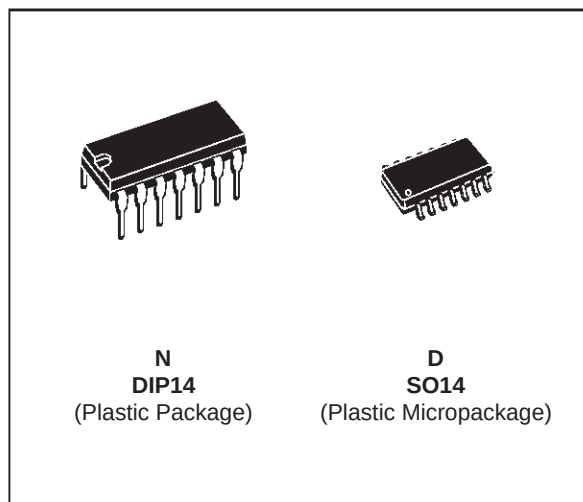
- LOW OFFSET VOLTAGE : 500 $\mu$ V max.
- LOW POWER CONSUMPTION
- SHORT CIRCUIT PROTECTION
- LOW DISTORTION, LOW NOISE
- HIGH GAIN-BANDWIDTH PRODUCT
- HIGH CHANNEL SEPARATION
- ESD INTERNAL PROTECTION

- **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.

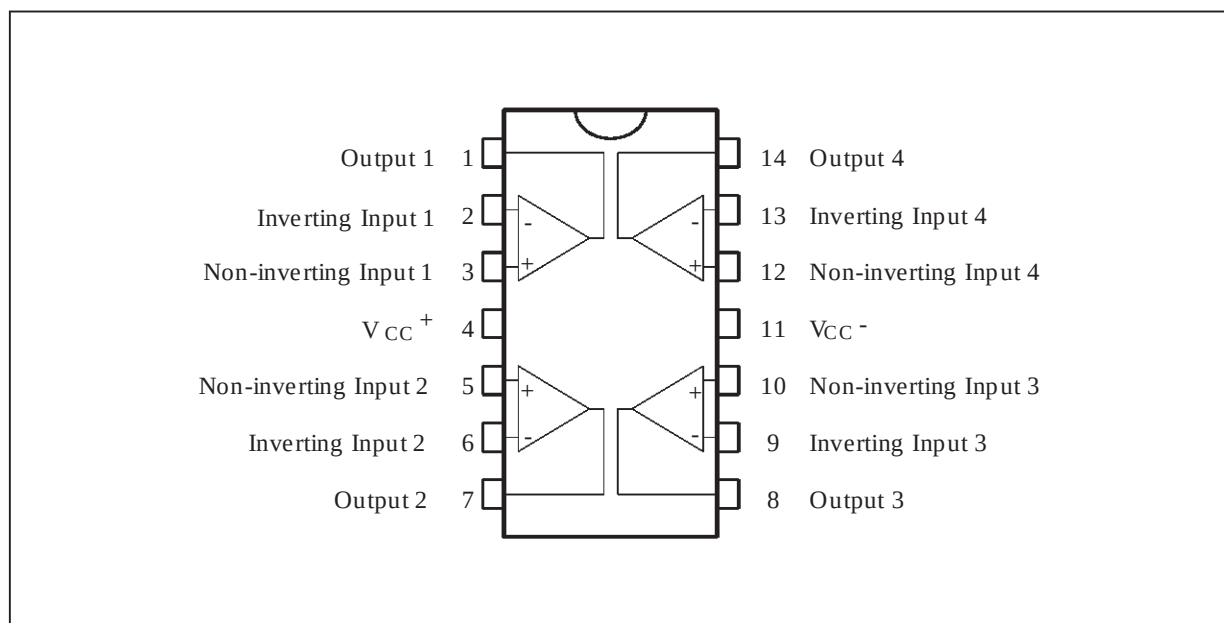
The circuit presents very stable electrical characteristics over the entire supply voltage range, and it particularly intended for professional and telecom applications (active filters, etc).



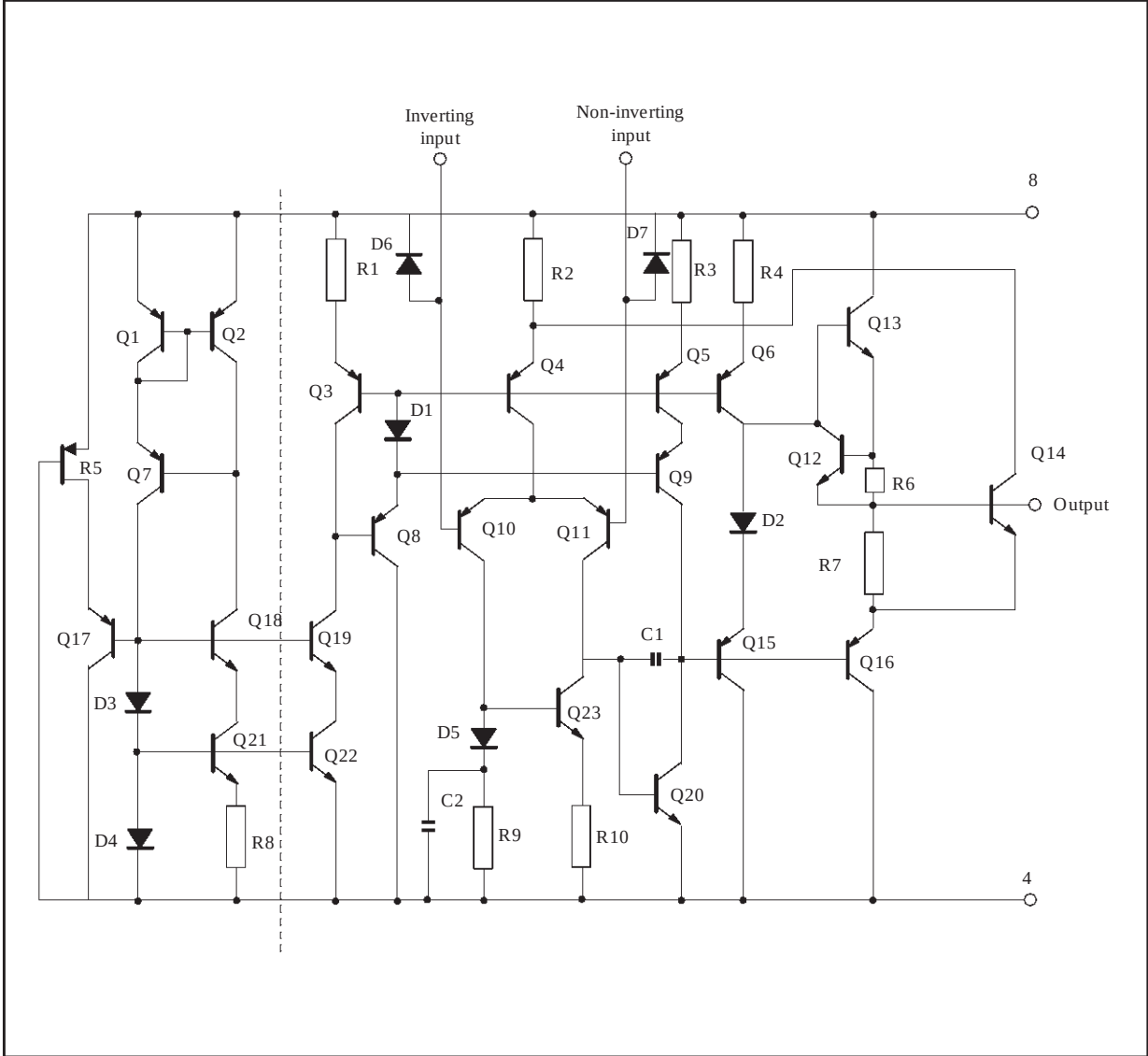
### ORDER CODES

| 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)<br>(negative)       | +V <sub>CC</sub><br>-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<br>TS514A                                                         |          | 0.5           | 2.5<br>0.5 | mV                     |
|                 |                                | $T_{min.} < T_{op} < T_{max.}$ TS514<br>TS514A                          |          |               | 4<br>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      | $R_L = 2k\Omega$ $V_{CC} = \pm 15V$<br>$V_{CC} = \pm 4V$                | 90       | 100<br>95     |            | dB                     |
| GBP             | Gain-bandwidth Product         | $f = 100kHz$                                                            | 1.8      | 3             |            | MHz                    |
| $e_n$           | Equivalent Input Noise Voltage | $f = 1kHz$<br>$R_s = 50\Omega$<br>$R_s = 1k\Omega$<br>$R_s = 10k\Omega$ |          | 8<br>10<br>18 | 15         | $\frac{nV}{\sqrt{Hz}}$ |
| THD             | Total Harmonic Distortion      | $A_V = 20dB$ $R_L = 2k\Omega$<br>$V_O = 2V_{PP}$ $f = 1kHz$             |          | 0.03          | 0.1        | %                      |
| $\pm V_{opp}$   | Output Voltage Swing           | $R_L = 2k\Omega$ $V_{CC} = \pm 15V$<br>$V_{CC} = \pm 4V$                | $\pm 13$ | $\pm 3$       |            | 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

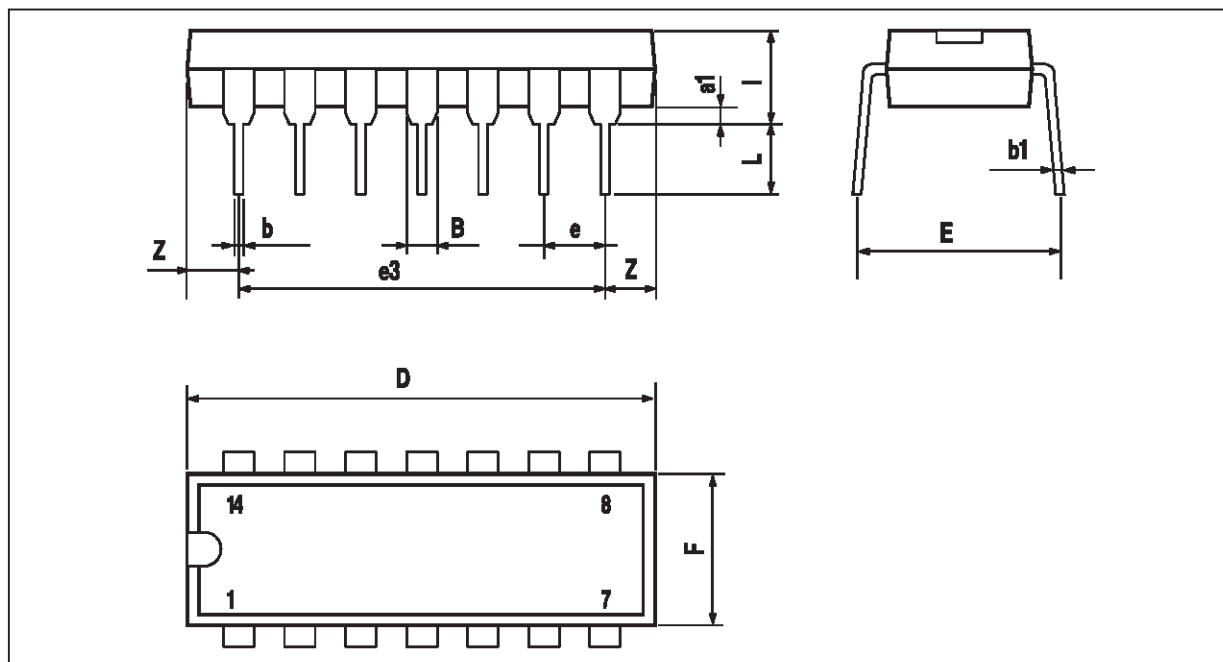
**ELECTRICAL CHARACTERISTICS**

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

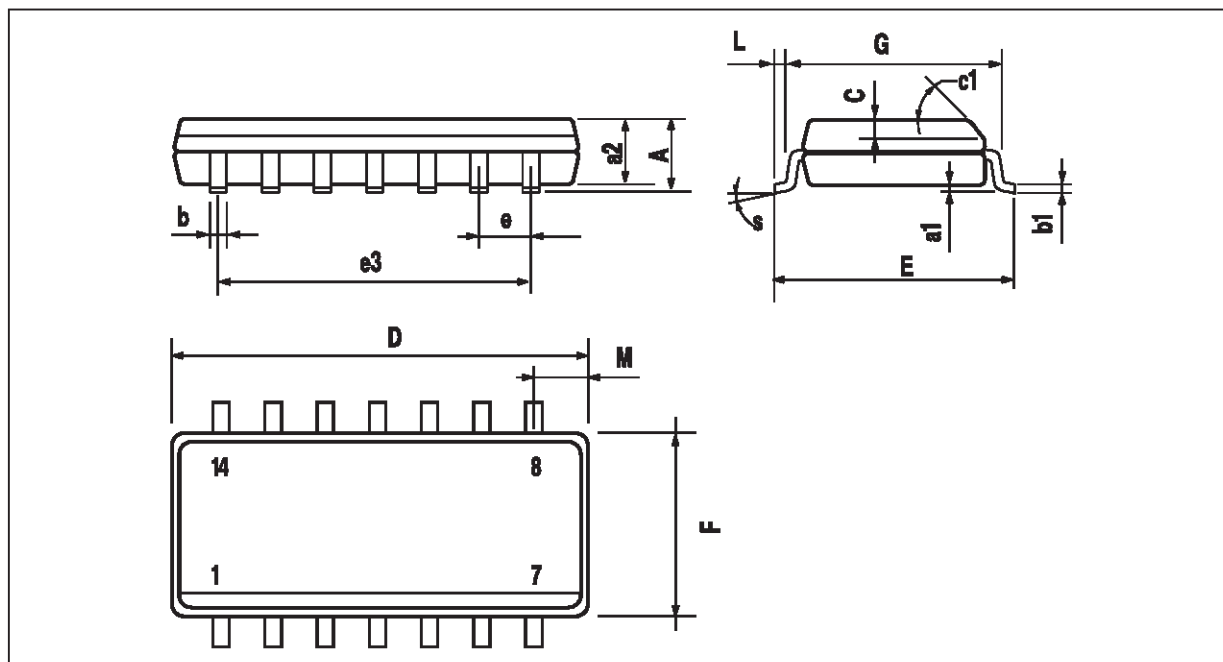
| Symbol       | Conditions                       | Value       | Unit       |
|--------------|----------------------------------|-------------|------------|
| $V_{io}$     |                                  | 0           | mV         |
| $A_{vd}$     | $R_L = 2k\Omega$                 | 94          | 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    |

**PACKAGE MECHANICAL DATA**

14 PINS - PLASTIC DIP



| Dim.  | Millimeters |       |      | Inches |       |       |
|-------|-------------|-------|------|--------|-------|-------|
|       | Min.        | Typ.  | Max. | Min.   | Typ.  | Max.  |
| $a_1$ | 0.51        |       |      | 0.020  |       |       |
| $B$   | 1.39        |       | 1.65 | 0.055  |       | 0.065 |
| $b$   |             | 0.5   |      |        | 0.020 |       |
| $b_1$ |             | 0.25  |      |        | 0.010 |       |
| $D$   |             |       | 20   |        |       | 0.787 |
| $E$   |             | 8.5   |      |        | 0.335 |       |
| $e$   |             | 2.54  |      |        | 0.100 |       |
| $e_3$ |             | 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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