

**CEL**

# NEC's L TO S BAND LOW NOISE AMPLIFIER NPN GaAs HBT

**NE52418**

## FEATURES

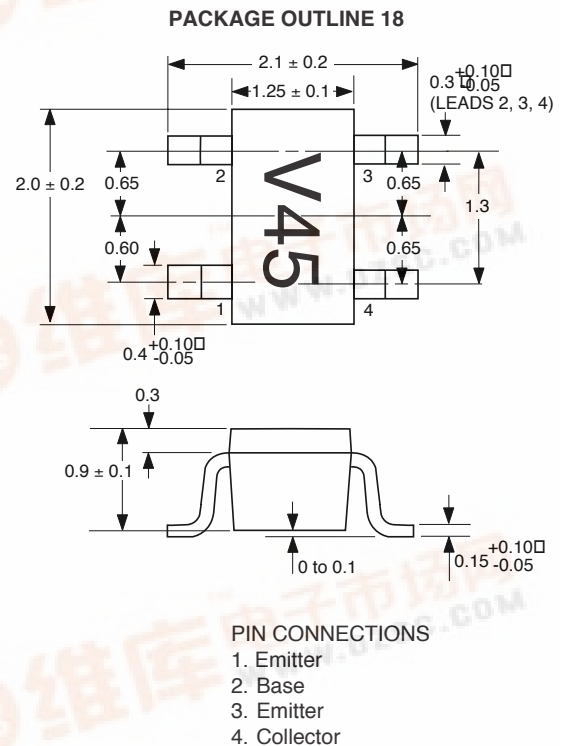
- **HIGH POWER GAIN:**  
GA = 16 dB TYP , MSG = 18 dB TYP  
at f = 2 GHz, VCE = 2 V, Ic = 3 mA, Zs = ZL = 50 Ω
- **LOW NOISE:**  
NF = 1.0 dB TYP  
at f = 2 GHz, VCE = 2 V, Ic = 3 mA, Zs = ZL = 50 Ω
- **OIP3 = +25 dBm TYP**  
at f = 2 GHz, VCE = 2 V, Ic = 10 mA, Zs = ZOPT , 1TONE
- **4 PIN SUPER MINI MOLD PACKAGE**
- **GROUNDING Emitter TRANSISTOR**

## DESCRIPTION

NEC's NE52418 is a low cost NPN GaAs HBT(InGaP) suitable for front end LNA's in L/S band mobile communications applications. The NE52418 is housed in a 4-pin super mini-mold package, making it ideal for high-density design.

NEC's stringent quality assurance and test procedures ensure the highest reliability performance

## PACKAGE DIMENSIONS (Units in mm)



## ELECTRICAL CHARACTERISTICS (TA = 25°C)

| PART NUMBER<br>PACKAGE OUTLINE |                                                                                                          |       | NE52418<br>18 |     |     |
|--------------------------------|----------------------------------------------------------------------------------------------------------|-------|---------------|-----|-----|
| SYMBOLS                        | PARAMETERS AND CONDITIONS                                                                                | UNITS | MIN           | TYP | MAX |
| IEBO                           | Emitter to Base Leakage Current at VEBO = 3 V                                                            | μA    | —             | 0.2 | 1.0 |
| ICBO                           | Collector to Base Leakage Current at VCBO = 3 V                                                          | μA    | —             | 0.2 | 1.0 |
| hFE                            | DC Current Gain at VCE = 2 V, Ic = 3 mA                                                                  | —     | 100           | 140 | 180 |
| NF                             | Noise Figure at VCE = 2 V, Ic = 3 mA, f = 2 GHz, Zs = ZL = 50 Ω                                          | dB    | —             | 1.0 | 1.5 |
| Ga                             | Associated Gain at VCE = 2 V, Ic = 3 mA, f = 2 GHz, Zs = ZL = 50 Ω                                       | dB    | 14            | 16  | —   |
| IS21el <sup>2</sup>            | Insertion Power Gain at VCE = 2 V, Ic = 20 mA, f = 2 GHz                                                 | dB    | —             | 20  | —   |
| OIP3                           | Out Third - Order Distortion Intercept Point at VCE = 2 V, f = 2 GHz, Zs = ZL = ZOPT, Ic = 10 mA, 1 tone | dBm   | —             | 25  | —   |

## NE52418

### ABSOLUTE MAXIMUM RATINGS $(T_A = +25^{\circ}\text{C})$

| SYMBOLS   | PARAMETERS                   | UNITS              | RATINGS     |
|-----------|------------------------------|--------------------|-------------|
| $V_{CEO}$ | Collector to Emitter Voltage | V                  | 5.0         |
| $V_{CBO}$ | Collector to Base Voltage    | V                  | 3.0         |
| $V_{EBO}$ | Emitter to Base Voltage      | V                  | 3.0         |
| $I_C$     | Collector Current            | mA                 | 40          |
| $I_B$     | Base Current                 | mA                 | 0.3         |
| $P_T$     | Total Power Dissipation      | mW                 | 150         |
| $T_j$     | Junction Temperature         | $^{\circ}\text{C}$ | +125        |
| $T_{STG}$ | Storage Temperature          | $^{\circ}\text{C}$ | -65 to +125 |

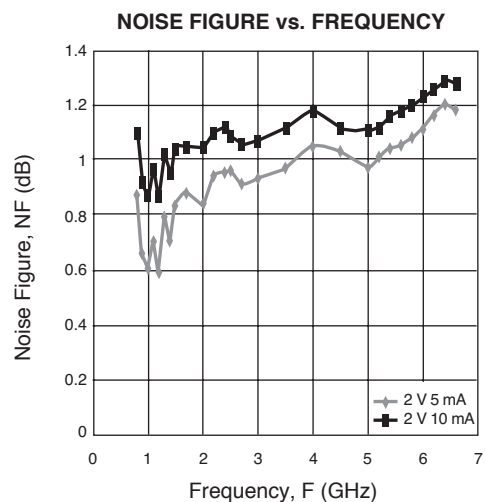
Note:

1. Operation in excess of any of these parameters may result in permanent damage.

### RECOMMENDED OPERATING CONDITIONS $(T_A = +25^{\circ}\text{C})$

| SYMBOLS  | PARAMETERS                   | UNITS | MIN. | TYP. | MAX. |
|----------|------------------------------|-------|------|------|------|
| $V_{CE}$ | Collector to Emitter Voltage | V     | 1.5  | 2.0  | 3.0  |
| $I_C$    | Collector Current            | mA    | —    | —    | 30   |
| $P_{IN}$ | Input Power                  | dBm   | —    | —    | 0    |

### TYPICAL PERFORMANCE CURVE $(T_A = 25^{\circ}\text{C})$



### TYPICAL SCATTERING PARAMETERS $(T_A = 25^{\circ}\text{C})$

#### NE52418

$V_{CE} = 2.0\text{ V}$ ,  $I_C = 3\text{ mA}$

| FREQUENCY<br>GHz | S <sub>11</sub> |        | S <sub>21</sub> |        | S <sub>12</sub> |       | S <sub>22</sub> |        |
|------------------|-----------------|--------|-----------------|--------|-----------------|-------|-----------------|--------|
|                  | MAG             | ANG    | MAG             | ANG    | MAG             | ANG   | MAG             | ANG    |
| 2.0              | 0.601           | -82.0  | 5.571           | 107.2  | 0.064           | 47.4  | 0.733           | -38.7  |
| 2.5              | 0.505           | -98.5  | 4.898           | 94.9   | 0.067           | 41.0  | 0.669           | -43.7  |
| 3.0              | 0.438           | -115.1 | 4.405           | 83.4   | 0.073           | 38.5  | 0.619           | -48.5  |
| 3.5              | 0.384           | -132.3 | 4.008           | 73.6   | 0.077           | 38.5  | 0.583           | -53.5  |
| 4.0              | 0.346           | -148.8 | 3.645           | 64.2   | 0.078           | 39.2  | 0.550           | -58.7  |
| 4.5              | 0.328           | -166.8 | 3.333           | 54.9   | 0.083           | 38.7  | 0.525           | -64.5  |
| 5.0              | 0.327           | 178.2  | 3.100           | 46.7   | 0.085           | 41.0  | 0.509           | -70.7  |
| 5.5              | 0.326           | 164.7  | 2.894           | 38.3   | 0.094           | 41.7  | 0.502           | -76.9  |
| 6.0              | 0.344           | 152.8  | 2.708           | 30.2   | 0.099           | 41.6  | 0.485           | -84.4  |
| 6.5              | 0.366           | 140.7  | 2.573           | 22.1   | 0.108           | 41.6  | 0.474           | -90.1  |
| 7.0              | 0.382           | 130.2  | 2.445           | 14.2   | 0.121           | 40.7  | 0.457           | -97.9  |
| 7.5              | 0.402           | 120.3  | 2.320           | 6.2    | 0.128           | 37.2  | 0.428           | -107.0 |
| 8.0              | 0.431           | 110.9  | 2.209           | -2.5   | 0.146           | 35.6  | 0.410           | -117.1 |
| 8.5              | 0.46            | 102.2  | 2.124           | -11.7  | 0.161           | 32.0  | 0.398           | -132.9 |
| 9.0              | 0.516           | 94.2   | 2.023           | -21.2  | 0.175           | 26.1  | 0.395           | -151.4 |
| 9.5              | 0.572           | 87.1   | 1.912           | -31.0  | 0.191           | 19.7  | 0.436           | -170.0 |
| 10.0             | 0.617           | 78.8   | 1.782           | -41.3  | 0.201           | 13.7  | 0.475           | 172.1  |
| 10.5             | 0.664           | 73.4   | 1.663           | -51.2  | 0.211           | 6.4   | 0.541           | 156.3  |
| 11.0             | 0.699           | 66.5   | 1.513           | -61.8  | 0.210           | -0.7  | 0.594           | 140.7  |
| 11.5             | 0.720           | 61.6   | 1.373           | -72.1  | 0.211           | -9.0  | 0.636           | 127.1  |
| 12.0             | 0.728           | 55.5   | 1.228           | -83.1  | 0.207           | -17.2 | 0.695           | 113.6  |
| 12.5             | 0.720           | 49.1   | 1.073           | -34.6  | 0.196           | -26.2 | 0.747           | 99.9   |
| 13.0             | 0.701           | 43.4   | 0.910           | -107.7 | 0.172           | -33.0 | 0.789           | 86.8   |
| 13.5             | 0.643           | 38.2   | 0.737           | -121.2 | 0.150           | -39.8 | 0.864           | 75.9   |
| 14.0             | 0.587           | 36.7   | 0.523           | -137.3 | 0.119           | -39.1 | 0.893           | 65.4   |

## NE52418

### TYPICAL SCATTERING PARAMETERS, cont. ( $T_A = 25^\circ\text{C}$ )

#### NE52418

$V_{CE} = 2.0\text{ V}$ ,  $I_C = 10\text{ mA}$

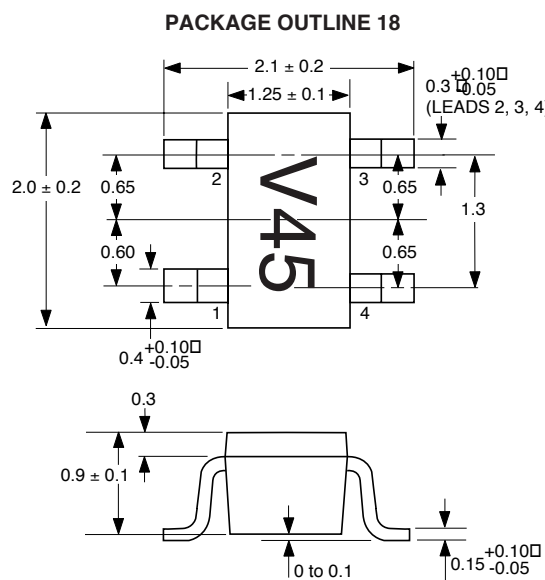
| FREQUENCY | S <sub>11</sub> |        | S <sub>21</sub> |        | S <sub>12</sub> |       | S <sub>22</sub> |        |
|-----------|-----------------|--------|-----------------|--------|-----------------|-------|-----------------|--------|
|           | MAG             | ANG    | MAG             | ANG    | MAG             | ANG   | MAG             | ANG    |
| 2.0       | 0.306           | -95.3  | 8.717           | 91.6   | 0.051           | 59.1  | 0.556           | -37.9  |
| 2.5       | 0.237           | -111.7 | 7.212           | 82.2   | 0.060           | 60.0  | 0.512           | -40.1  |
| 3.0       | 0.191           | -128.4 | 6.201           | 73.3   | 0.067           | 55.4  | 0.478           | -43.7  |
| 3.5       | 0.170           | -148.2 | 5.469           | 65.9   | 0.077           | 55.5  | 0.451           | -47.6  |
| 4.0       | 0.160           | -168.5 | 4.904           | 58.7   | 0.086           | 54.3  | 0.430           | -52.8  |
| 4.5       | 0.167           | 171.7  | 4.433           | 51.4   | 0.094           | 53.1  | 0.412           | -57.5  |
| 5.0       | 0.181           | 156.2  | 4.093           | 44.6   | 0.106           | 51.6  | 0.398           | -63.5  |
| 5.5       | 0.195           | 144.5  | 3.813           | 37.7   | 0.115           | 48.5  | 0.389           | -69.9  |
| 6.0       | 0.216           | 134.5  | 3.553           | 30.7   | 0.126           | 45.8  | 0.376           | -77.3  |
| 6.5       | 0.245           | 127.0  | 3.372           | 23.7   | 0.133           | 42.2  | 0.363           | -82.9  |
| 7.0       | 0.266           | 117.7  | 3.192           | 16.8   | 0.143           | 38.0  | 0.343           | -90.1  |
| 7.5       | 0.295           | 109.6  | 3.023           | 9.8    | 0.152           | 35.1  | 0.311           | -97.6  |
| 8.0       | 0.325           | 103.3  | 2.897           | 2.0    | 0.165           | 30.8  | 0.293           | -106.7 |
| 8.5       | 0.370           | 96.3   | 2.793           | -6.0   | 0.179           | 27.3  | 0.271           | -123.9 |
| 9.0       | 0.423           | 89.5   | 2.587           | -14.5  | 0.188           | 21.0  | 0.260           | -145.1 |
| 9.5       | 0.476           | 83.4   | 2.579           | -23.3  | 0.201           | 15.5  | 0.292           | -166.3 |
| 10.0      | 0.528           | 76.3   | 2.456           | -33.0  | 0.208           | 8.6   | 0.337           | 172.9  |
| 10.5      | 0.580           | 71.2   | 2.317           | -42.3  | 0.210           | 2.4   | 0.403           | 156.1  |
| 11.0      | 0.620           | 64.7   | 2.180           | -52.8  | 0.213           | -5.5  | 0.461           | 141.9  |
| 11.5      | 0.640           | 60.7   | 2.022           | -63.2  | 0.212           | -12.6 | 0.522           | 128.6  |
| 12.0      | 0.651           | 54.1   | 1.875           | -74.8  | 0.205           | -20.4 | 0.588           | 115.5  |
| 12.5      | 0.636           | 47.4   | 1.685           | -88.3  | 0.191           | -29.2 | 0.660           | 103.2  |
| 13.0      | 0.600           | 42.2   | 1.466           | -103.2 | 0.173           | -37.2 | 0.731           | 90.1   |
| 13.5      | 0.516           | 39.5   | 1.172           | -120.4 | 0.145           | -42.4 | 0.834           | 78.2   |
| 14.0      | 0.482           | 47.1   | 0.802           | -139.8 | 0.112           | -39.1 | 0.891           | 56.2   |

#### NE52418

$V_{CE} = 2.0\text{ V}$ ,  $I_C = 20\text{ mA}$

| FREQUENCY | S <sub>11</sub> |        | S <sub>21</sub> |        | S <sub>12</sub> |       | S <sub>22</sub> |        |
|-----------|-----------------|--------|-----------------|--------|-----------------|-------|-----------------|--------|
|           | MAG             | ANG    | MAG             | ANG    | MAG             | ANG   | MAG             | ANG    |
| 2.0       | 0.188           | -105.5 | 9.306           | 85.1   | 0.049           | 63.2  | 0.489           | -35.0  |
| 2.5       | 0.140           | -124.6 | 7.618           | 76.9   | 0.061           | 63.4  | 0.453           | -37.3  |
| 3.0       | 0.117           | -147.2 | 6.514           | 69.1   | 0.070           | 63.2  | 0.429           | -40.1  |
| 3.5       | 0.116           | -170.3 | 5.708           | 62.5   | 0.081           | 61.0  | 0.415           | -44.6  |
| 4.0       | 0.124           | 169.2  | 5.092           | 56.0   | 0.091           | 58.6  | 0.390           | -49.2  |
| 4.5       | 0.146           | 150.9  | 4.595           | 49.1   | 0.102           | 56.2  | 0.349           | -55.5  |
| 5.0       | 0.164           | 138.1  | 4.239           | 42.8   | 0.112           | 52.0  | 0.361           | -51.5  |
| 5.5       | 0.184           | 129.5  | 3.929           | 36.2   | 0.121           | 49.2  | 0.350           | -67.5  |
| 6.0       | 0.207           | 124.1  | 3.675           | 29.6   | 0.131           | 45.9  | 0.336           | -75.1  |
| 6.5       | 0.238           | 116.7  | 3.470           | 22.8   | 0.145           | 42.3  | 0.323           | -81.2  |
| 7.0       | 0.262           | 110.1  | 3.278           | 16.1   | 0.154           | 37.9  | 0.299           | -88.5  |
| 7.5       | 0.292           | 102.7  | 3.108           | 9.5    | 0.165           | 33.5  | 0.267           | -96.6  |
| 8.0       | 0.322           | 97.6   | 2.971           | 2.1    | 0.174           | 27.1  | 0.246           | -105.1 |
| 8.5       | 0.362           | 91.4   | 2.857           | -5.7   | 0.183           | 24.6  | 0.221           | -124.7 |
| 9.0       | 0.412           | 85.1   | 2.753           | -13.8  | 0.196           | 19.0  | 0.210           | -147.6 |
| 9.5       | 0.471           | 79.6   | 2.641           | -22.4  | 0.203           | 13.6  | 0.243           | -171.7 |
| 10.0      | 0.517           | 72.9   | 2.513           | -31.4  | 0.209           | 6.2   | 0.292           | 167.0  |
| 10.5      | 0.565           | 68.3   | 2.387           | -40.7  | 0.219           | -0.8  | 0.359           | 151.4  |
| 11.0      | 0.607           | 62.5   | 2.264           | -50.8  | 0.213           | -7.8  | 0.424           | 137.4  |
| 11.5      | 0.630           | 58.3   | 2.091           | -60.7  | 0.212           | -14.5 | 0.476           | 124.7  |
| 12.0      | 0.635           | 51.3   | 1.960           | -72.2  | 0.206           | -22.0 | 0.548           | 113.2  |
| 12.5      | 0.616           | 44.7   | 1.783           | -85.7  | 0.196           | -31.7 | 0.619           | 101.4  |
| 13.0      | 0.574           | 39.1   | 1.571           | -101.2 | 0.173           | -40.0 | 0.700           | 89.7   |
| 13.5      | 0.476           | 37.7   | 1.265           | -119.6 | 0.143           | -45.5 | 0.815           | 78.0   |
| 14.0      | 0.442           | 48.7   | 0.859           | -139.7 | 0.107           | -43.6 | 0.887           | 66.5   |

## PACKAGE DIMENSIONS (Units in mm)



### PIN CONNECTIONS

1. Emitter
2. Base
3. Emitter
4. Collector

## ORDERING INFORMATION

| PART NUMBER  | QUANTITY     |
|--------------|--------------|
| NE52418-T1-A | 3 K pcs/Reel |

Note: 8-mm wide embossed tape, pin 3 (Emitter), pin 4 (Collector) face perforated side of tape.

## RECOMMENDED SOLDERING CONDITIONS

This product should be soldered under the following recommended conditions. For soldering methods and conditions other than those recommended below, contact your CEL Sales Representative.

| SOLDERING METHOD | SOLDERING CONDITIONS                                                                                                               | RECOMMENDED CONDITION SYMBOL |
|------------------|------------------------------------------------------------------------------------------------------------------------------------|------------------------------|
| Infrared Reflow  | Package Peak Temperature: 230 °C or below<br>Time: 30 seconds or less ( at 210 °C)<br>Count: 3, Exposure limit: None <sup>1</sup>  | IR30-00-3                    |
| VPS              | Package Peak Temperature: 215 °C or below<br>Time: 40 seconds or less (at 200 °C)<br>Count: 2, Exposure limit: None <sup>1</sup>   | VP15-00-2                    |
| WAVE SOLDERING   | Soldering Bath Temperature: 260 °C or below<br>Time: 10 seconds or less (at 200 °C)<br>Count: 1, Exposure limit: None <sup>1</sup> | WS60-00-1                    |
| PARTIAL HEATING  | Pin Temperature: 300 °C or below<br>Time: 3 seconds or less (per side of device)<br>Exposure limit: None <sup>1</sup>              | —                            |

Note:

1. After opening the dry pack, keep it in a place below 25 °C and 65% RH for the allowable storage period.

### CAUTION:

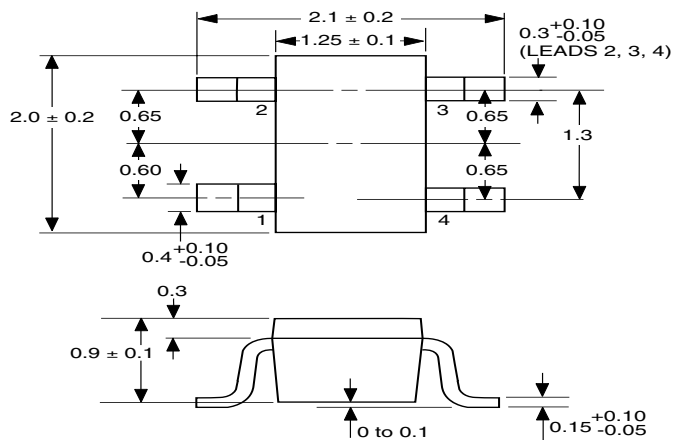
Do not use different soldering methods together (except for partial heating).

### PRECAUTION:

Avoid high static voltage and electric fields.

## NONLINEAR MODEL

### SCHEMATIC



### BJT NONLINEAR MODEL PARAMETERS <sup>(1)</sup>

| Parameters | Q1        | Parameters | Q1     |
|------------|-----------|------------|--------|
| IS         | 7.8e-25   | MJC        | 0.07   |
| BF         | 158       | XCJC       | 0.2    |
| NF         | 1.006     | CJS        | 0      |
| VAF        | 1000      | VJS        | 0.75   |
| IKF        | 1.95      | MJS        | 0      |
| ISE        | 6.36e-18  | FC         | 0.5    |
| NE         | 1.92      | TF         | 2e-12  |
| BR         | 1         | XTF        | 3      |
| NR         | 1         | VTF        | 1      |
| VAR        | 1000      | ITF        | 0.05   |
| IKR        | 1000      | PTF        | 0      |
| ISC        | 0         | TR         | 50e-12 |
| NC         | 2.0       | EG         | 1.51   |
| RE         | 1.5       | XTB        | 0      |
| RB         | 7         | XTI        | 3      |
| RBM        | 1         | KF         | 0      |
| IRB        | 1000      | AF         | 1      |
| RC         | 1.2       |            |        |
| CJE        | 0.27      |            |        |
| VJE        | 0.99      |            |        |
| MJE        | 0.21      |            |        |
| CJC        | 0.065e-12 |            |        |
| VJC        | 0.73      |            |        |

### ADDITIONAL PARAMETERS

| Parameters | NE52418   |
|------------|-----------|
| CCB        | 0.02e-12  |
| CCE        | 0.19e-12  |
| LB         | 0.83e-9   |
| LC         | 0.8e-9    |
| LE         | 0.2e-9    |
| CCBPKG     | 0.002e-12 |
| CCEPKG     | 0.05e-12  |
| CBEPK      | 0.15e-12  |
| LBX        | 0.55e-9   |
| LCX        | 0.1e-9    |
| LEX        | 0.05e-9   |

### MODEL RANGE

Frequency: 0.3 to 10 GHz  
 Bias:  $V_{CE} = 0.7 \text{ V to } 2 \text{ V}$ ,  $I_C = 1 \text{ mA to } 10 \text{ mA}$   
 Date: 02/2002

(1) Gummel-Poon Model

### Life Support Applications

These NEC products are not intended for use in life support devices, appliances, or systems where the malfunction of these products can reasonably be expected to result in personal injury. The customers of CEL using or selling these products for use in such applications do so at their own risk and agree to fully indemnify CEL for all damages resulting from such improper use or sale.

Subject: Compliance with EU Directives

CEL certifies, to its knowledge, that semiconductor and laser products detailed below are compliant with the requirements of European Union (EU) Directive 2002/95/EC Restriction on Use of Hazardous Substances in electrical and electronic equipment (RoHS) and the requirements of EU Directive 2003/11/EC Restriction on Penta and Octa BDE.

CEL Pb-free products have the same base part number with a suffix added. The suffix –A indicates that the device is Pb-free. The –AZ suffix is used to designate devices containing Pb which are exempted from the requirement of RoHS directive (\*). In all cases the devices have Pb-free terminals. All devices with these suffixes meet the requirements of the RoHS directive.

This status is based on CEL's understanding of the EU Directives and knowledge of the materials that go into its products as of the date of disclosure of this information.

| Restricted Substance<br>per RoHS | Concentration Limit per RoHS<br>(values are not yet fixed) | Concentration contained<br>in CEL devices |     |
|----------------------------------|------------------------------------------------------------|-------------------------------------------|-----|
|                                  |                                                            | -A                                        | -AZ |
| Lead (Pb)                        | < 1000 PPM                                                 | Not Detected                              | (*) |
| Mercury                          | < 1000 PPM                                                 | Not Detected                              |     |
| Cadmium                          | < 100 PPM                                                  | Not Detected                              |     |
| Hexavalent Chromium              | < 1000 PPM                                                 | Not Detected                              |     |
| PBB                              | < 1000 PPM                                                 | Not Detected                              |     |
| PBDE                             | < 1000 PPM                                                 | Not Detected                              |     |

If you should have any additional questions regarding our devices and compliance to environmental standards, please do not hesitate to contact your local representative.

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