

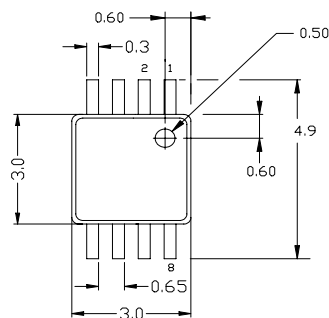
**SiGe HBT MMIC  
POWER AMPLIFIER****Description**

A monolithic, high-efficiency, silicon-germanium power amplifier IC, the THM1001TE is designed for 2.4GHz wireless applications including Bluetooth™ Class 1 wireless technology and 2.4GHz cordless telephone applications. It delivers +23 dBm output power, making it capable of overcoming insertion losses of up to 3.0dB between amplifier output and antenna.

The silicon-germanium structure of the THM1001TE, and its exposed-die-pad package, soldered to the system PCB, provide high thermal conductivity and a subsequently low junction temperature.

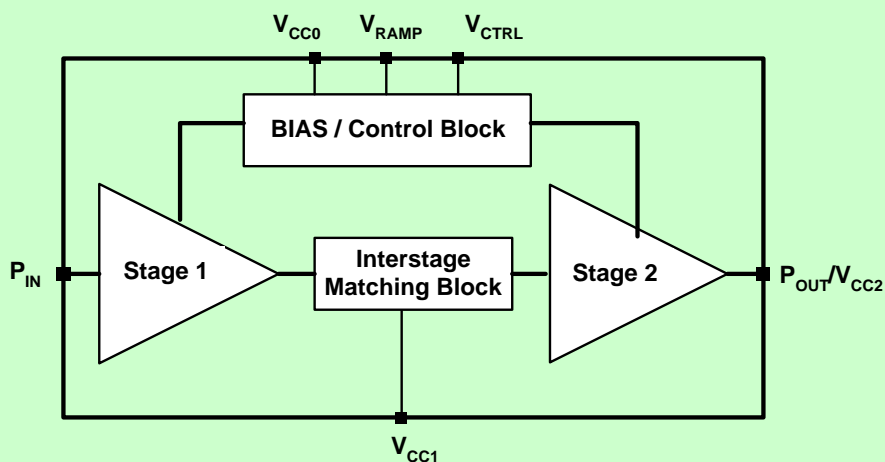
**Features**

- **+23 dBm at 44% Power Added Efficiency**
- **Temperature stability better than 1dB**
- **Power-control and Power-down modes**
- **Single 3.3 V Supply Operation**
- **Temperature Rating: -40C to +85C**
- **8 lead Exposed Pad MSOP8 Plastic Package**

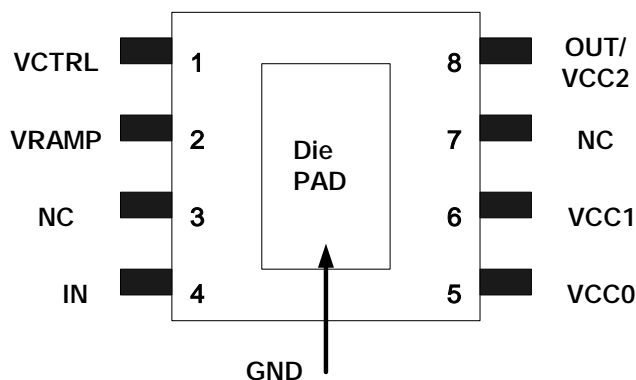
**E\_PAD MSOP8****Applications**

- **Bluetooth™ Wireless Technology (Class 1)**
- **USB Dongles, modules**
- **PCMCIA, Flash cards**
- **Access Points**
- **2.4GHz cordless telephone**

### Function Block Diagram



### Pin Configuration



### Pin Description

| Pin No  | Name           | Description  |
|---------|----------------|--|
| 1       | $V_{CTL}$      | Controls the output level of the power amplifier.            |
| 2       | $V_{RAMP}$     | Power amplifier enable pin.                                  |
| 3       | NC             | No connection.   |
| 4       | IN             | Power amplifier RF input.                                    |
| 5       | $V_{CC0}$      | Bias supply voltage.   |
| 6       | $V_{CC1}$      | Stage 1 collector supply voltage.                            |
| 7       | NC             | No connection.   |
| 8       | OUT/ $V_{CC2}$ | Power Amplifier Output and Stage 2 collector supply voltage. |
| Die Pad | GND            | Heatslug Die Pad is ground.                                  |

**Absolute Maximum Ratings**

| Parameter        | Symbol                       | Unit | Min  | Max             |
|------------------|------------------------------|------|------|-----------------|
| Supply Voltage   | V <sub>CC</sub>              | V    | -0.3 | +3.6            |
| Control Voltage  | V <sub>CTL</sub>             | V    | -0.3 | V <sub>CC</sub> |
| Ramping Voltage  | V <sub>RAMP</sub>            | V    | -0.3 | V <sub>CC</sub> |
| IN               | RF Input Power               | dBm  |      | +8              |
| T <sub>A</sub>   | Operating Temperature Range  | °C   | -40  | +85             |
| T <sub>STG</sub> | Storage Temperature Range    | °C   | -40  | +150            |
| T <sub>j</sub>   | Maximum Junction Temperature | °C   |      | +150            |

Operation in excess of any one of above Absolute Maximum Ratings may result in permanent damage.

Handling and assembly of this device should be at ESD protected workstations.

**DC Electrical Characteristics**

Condition : V<sub>CC0</sub>=V<sub>CC1</sub>=V<sub>CC2</sub>=V<sub>RAMP</sub>=3.3V, T<sub>A</sub>=25 ,

Input and Output externally matched to 50 unless otherwise noted.

| Symbol              | Note | Parameter  | Min.                | Typ. | Max. | Unit |
|---------------------|------|--|---------------------|------|------|------|
| V <sub>CC</sub>     |      | Supply Voltage   | 3.3                 |      |      | V    |
| I <sub>CC</sub>     | 1    | Supply Current<br>(I <sub>CC</sub> =I <sub>VCC0</sub> +I <sub>VCC2</sub> ), V <sub>CTL</sub> =3.3V |                     | 90   | 150  | mA   |
| I <sub>CCtemp</sub> | 3    | Supply Current Variation over Temperature from T <sub>A</sub> =25<br>(-40 < T <sub>A</sub> < +85 ) |                     | TBD  |      | %    |
| V <sub>CTL</sub>    |      | PA Output Power Control Voltage Range  | 0 ~ V <sub>CC</sub> |      |      | V    |
| I <sub>CTL</sub>    | 1    | Current sunk by V <sub>CTL</sub> Pin   |                     | 130  |      | μA   |
| V <sub>RAMP</sub>   | 3    | Logic High Voltage   | 2.4                 |      |      | V    |
|                     | 3    | Logic Low Voltage  | 0.4                 |      |      | V    |
| I <sub>stby</sub>   | 1    | Leakage Current when V <sub>ramp</sub> =0V,<br>V <sub>ctl</sub> =high                              |                     | 3    | 10   | μA   |

**AC Electrical Characteristics**

Condition :  $V_{CC0}=V_{CC1}=V_{CC2}=V_{RAMP}=3.3V$ ,  $P_{IN}=+2dBm$ ,  $T_A=25^\circ$ ,  $f=2.45GHz$ ,

Input and Output externally matched to 50  $\Omega$  unless otherwise noted.

| Symbol                               | Note | Parameter  | Min.   | Typ. | Max. | Unit  |
|--------------------------------------|------|--|--|------|------|-------|
| fL-U                                 | 3    | Frequency Range  | 2400 ~ 2500  |      |      | MHz   |
| Pout                                 | 1    | Output Power @ $P_{IN} = +2dBm$ , $V_{CTL}=3.3V$                       | 22   | 23   |      | dBm   |
|                                      | 1    | Output Power @ $P_{IN} = +2dBm$ , $V_{CTL}=0.4V$                       |  | -20  | -10  | dBm   |
| Ptemp                                | 3    | Output Power Variation over temperature<br>( $-40 < T_A < +85^\circ$ ) |  | TBD  |      | dB    |
| dP <sub>OUT</sub> /dV <sub>CTL</sub> | 3    | Control Voltage Sensitivity  |  |      | 120  | dBm/V |
| PAE                                  |      | Power Added Efficiency at +23dBm<br>Output Power                       |  | 44   |      | %     |
| G                                    | 3    | Gain @ $P_{IN} = -20dBm$   | 25   | 26   |      | dB    |
|                                      |      | Gain @ $P_{IN} = -10dBm$   | 24   | 25   |      | dB    |
| G <sub>VAR</sub>                     | 3    | Gain Variation over band (2400-2500 MHz)                               |  | 0.7  | 1.0  | dB    |
| 2f,3f,4f,5f                          | 3, 4 | Harmonics  |  | 35   | 30   | dBc   |
| S <sub>21</sub>   <sub>OFF</sub>     | 2    | Isolation in "OFF" State, $P_{IN}=+2dBm$ ,<br>$V_{RAMP}=0V$            |  | 35   |      | dB    |
| S <sub>12</sub>                      | 2    | Reverse Isolation  |  | 34   |      | dB    |
| STAB                                 | 2    | Stability ( $P_{IN}=+2dBm$ , Load VSWR=6:1)                            | All non-harmonically<br>Related outputs less than -50dBc |      |      |       |

Notes : (1) Guaranteed by production test at  $T_A=25^\circ$ .

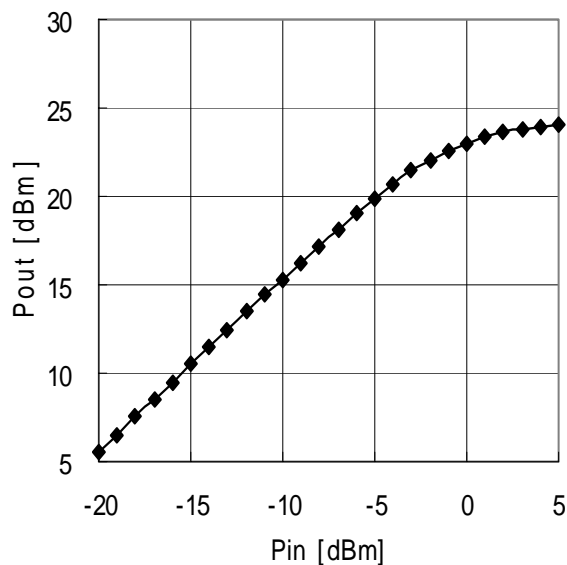
(2) Guaranteed by design only

(3) Guaranteed by design and characterization

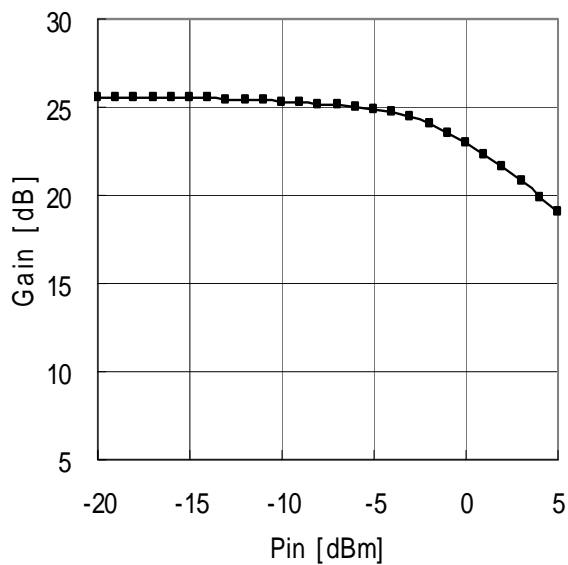
(4) Harmonic levels are greatly affected by topology of external matching networks.

## Typical Characteristics

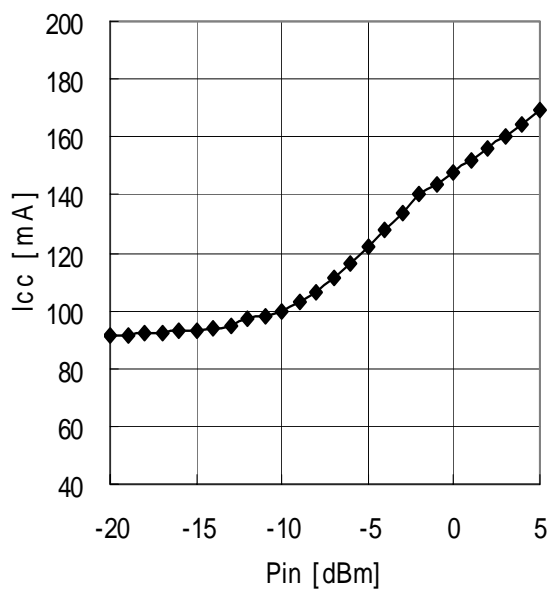
Output power v.s. input power



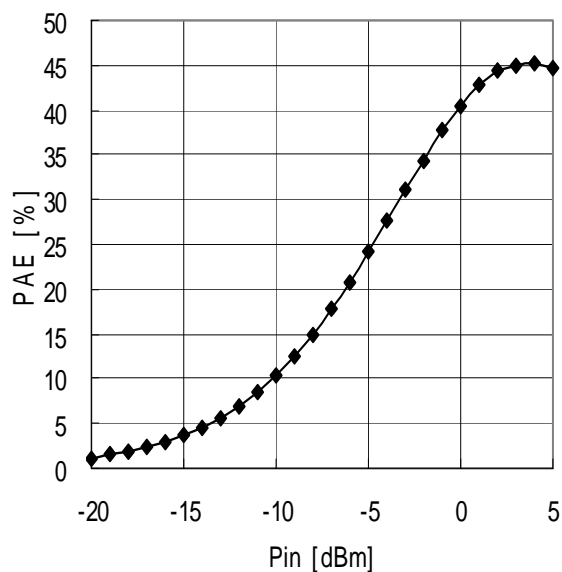
Gain v.s. input power



Supply current v.s. input power

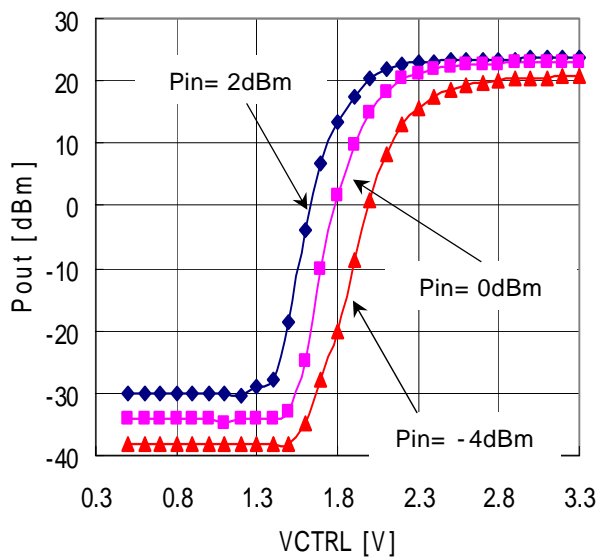


Power Added Efficiency v.s. input Power

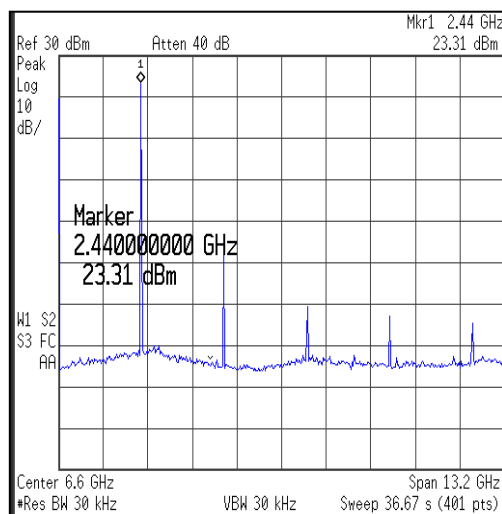


## Typical Characteristics

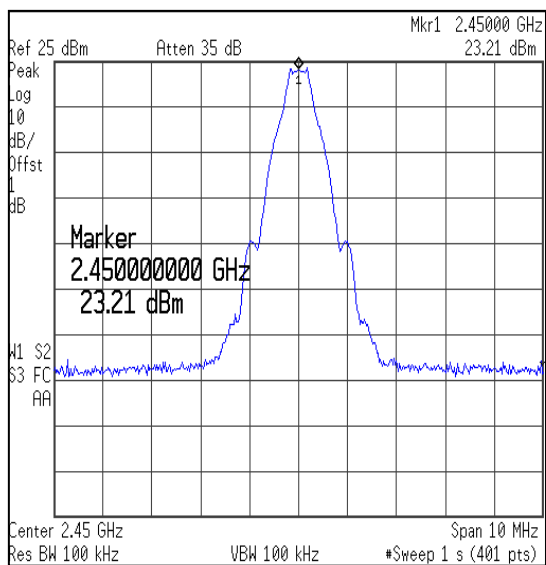
Output power v.s. control voltage



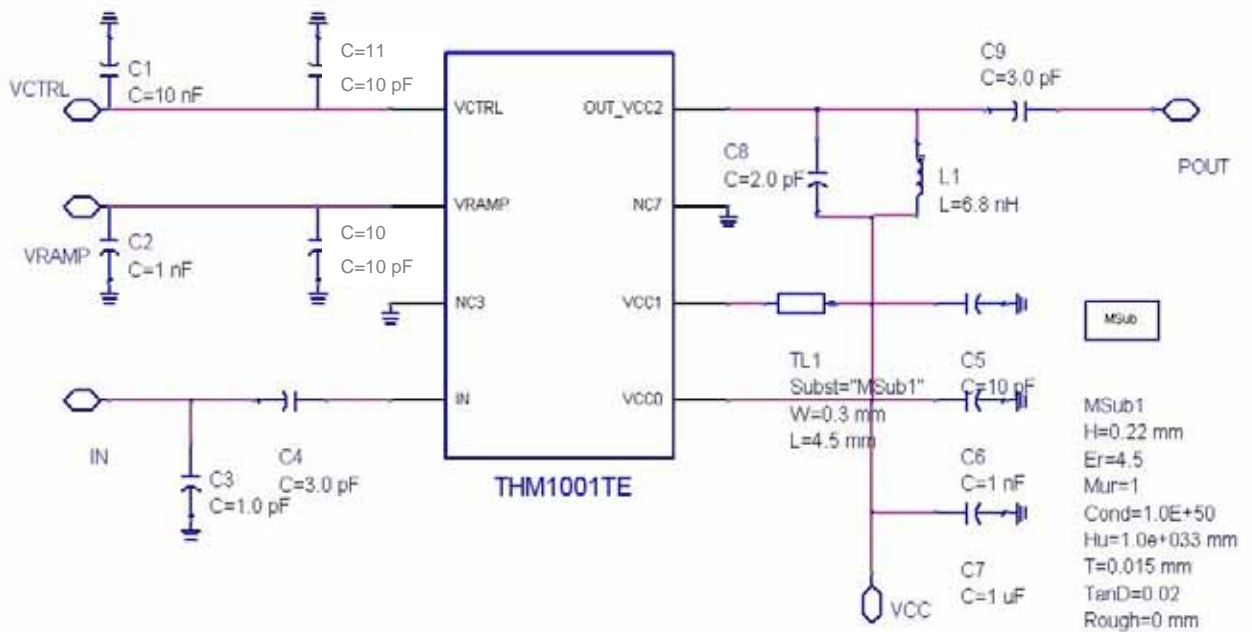
Output Spectrum



Output Spectrum with BT modulated signal



## Evaluation Board Schematic

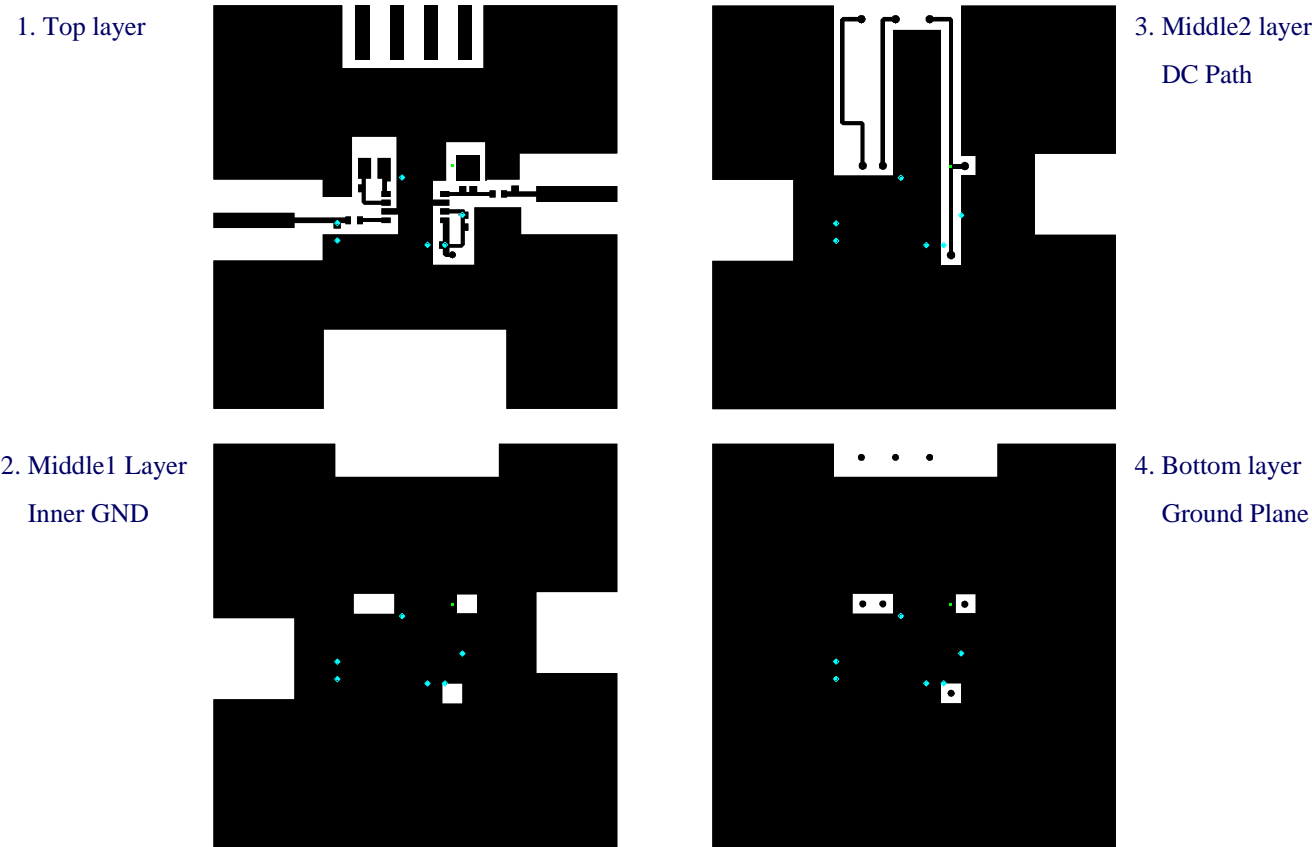


## Component List

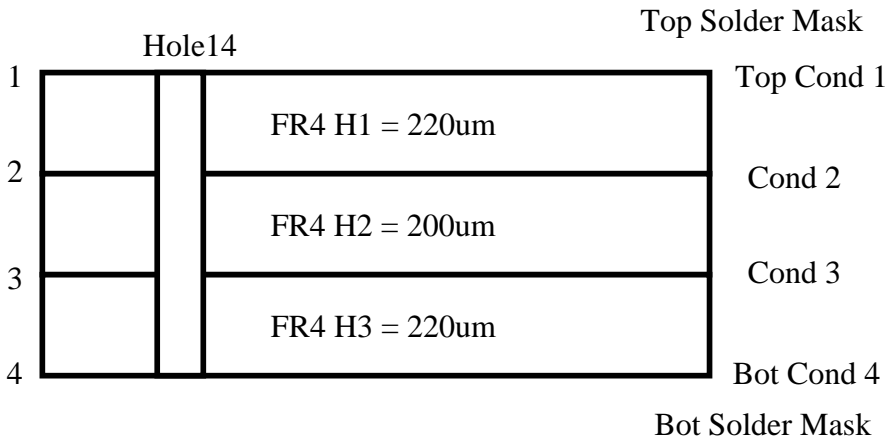
| Designation  | Description                             | Part Number             |
|--------------|---|-------------------------|
| C1           | Cap 10 nF DC50V Chip Monolithic Ceramic | muRata #GRM36X7R103K16  |
| C2, C6       | Cap 1 nF DC50V Chip Monolithic Ceramic  | muRata #GRM36X7R102K50  |
| C3           | Cap 1 pF DC50V Chip Monolithic Ceramic  | muRata #GRM36C0G010C50  |
| C4, C9       | Cap 3 pF DC50V Chip Monolithic Ceramic  | muRata #GRM36C0G030C50  |
| C5, C10, C11 | Cap 10 pF DC50V Chip Monolithic Ceramic | muRata #GRM36C0G100D50  |
| C7           | Cap 1 uF Chip Monolithic Ceramic        | muRata #GRM36Y5V105Z6.3 |
| C8           | Cap 2 pF DC50V Chip Monolithic Ceramic  | muRata #GRM36C0G020C50  |
| L1           |   | muRata #LQG15HN6N8J02   |

Evaluation Board Layout

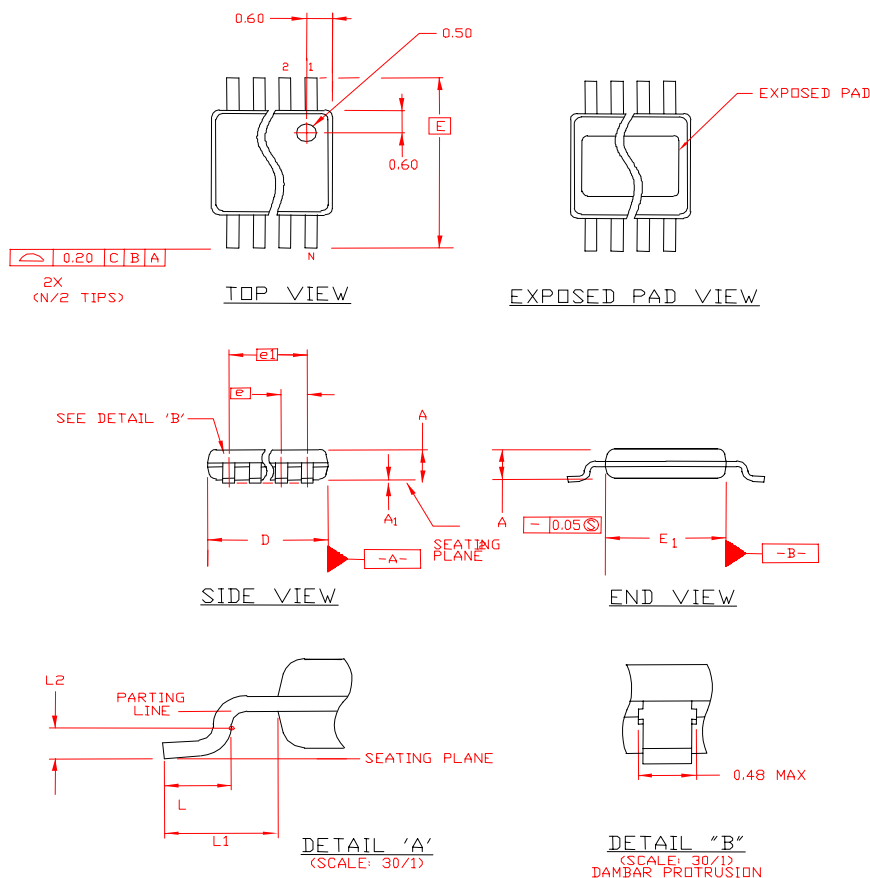
Board Size 30 x 30 mm<sup>2</sup>



Material & Structure of PCB







| Symbol | Dimension in mm |      |      | Note |
|--------|-----------------|------|------|------|
|        | Min             | Typ  | Max  |      |
| A      | -               | -    | 1.10 |      |
| A1     | 0.05            | 0.10 | 0.15 |      |
| A2     | 0.75            | 0.85 | 0.95 |      |
| b      | 0.25            | -    | 0.38 |      |
| C      | 0.13            | -    | 0.23 |      |
| D      | 3.00 BSC        |      |      |      |
| E      | 4.90 BSC        |      |      |      |
| E1     | 3.00 BSC        |      |      |      |
| e      | 0.65 BSC        |      |      |      |
| e1     | 1.95 BSC        |      |      |      |
| L      | 0.40            | 0.55 | 0.70 |      |
| L1     | 0.95 BSC        |      |      |      |
| L2     | 0.25 BSC        |      |      |      |