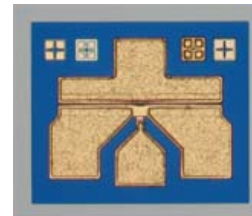


## Low Noise and Medium Power GaAs FETs

### FEATURES

- Low Noise Figure: NF = 0.5 dB Typical at 12 GHz
- High Associated Gain: Ga = 12 dB Typical at 12 GHz
- High Dynamic Range: 1 dB Compression Power  $P_{-1} = 18.5$  dBm at 12 GHz
- Breakdown Voltage:  $BV_{DGO} \geq 9$  V
- $L_g = 0.25 \mu\text{m}$ ,  $W_g = 160 \mu\text{m}$
- All-Gold Metallization for High Reliability
- Tight Vp ranges control
- High RF input power handling capability
- 100 % DC Tested

### PHOTO ENLARGEMENT



### DESCRIPTION

The TC1101 is a GaAs Pseudomorphic High Electron Mobility Transistor (PHEMT) chip, which has very low noise figure, high associated gain and high dynamic range. The device can be used in circuits up to 30 GHz and suitable for low noise and medium power amplifier applications including a wide range of commercial and military applications. All devices are 100% DC tested to assure consistent quality. All bond pads are gold plated for either thermo-compression or thermo-sonic wire bonding.

### ELECTRICAL SPECIFICATIONS ( $T_A=25^\circ\text{C}$ )

| Symbol     | Conditions  | MIN  | TYP   | MAX | UNIT                      |
|------------|---|------|-------|-----|---------------------------|
| NF         | Noise Figure at $V_{DS} = 2$ V, $I_{DS} = 10$ mA, $f = 12$ GHz                            |      | 0.5   | 0.7 | dB                        |
| $G_a$      | Associated Gain at $V_{DS} = 2$ V, $I_{DS} = 10$ mA, $f = 12$ GHz                         | 10   | 12    |     | dB                        |
| $P_{1dB}$  | Output Power at 1dB Gain Compression point, $f = 12$ GHz $V_{DS} = 6$ V, $I_{DS} = 25$ mA | 17.5 | 18.5  |     | dBm                       |
| $G_L$      | Linear Power Gain, $f = 12$ GHz $V_{DS} = 6$ V, $I_{DS} = 25$ mA                          | 14   | 15    |     | dB                        |
| $I_{DSS}$  | Saturated Drain-Source Current at $V_{DS} = 2$ V, $V_{GS} = 0$ V                          |      | 48    |     | mA                        |
| $g_m$      | Transconductance at $V_{DS} = 2$ V, $V_{GS} = 0$ V  |      | 55    |     | mS                        |
| $V_p$      | Pinch-off Voltage at $V_{DS} = 2$ V, $I_D = 0.32$ mA                                      |      | -1.0* |     | Volts                     |
| $BV_{DGO}$ | Drain-Gate Breakdown Voltage at $I_{DGO} = 0.08$ mA                                       | 9    | 12    |     | Volts                     |
| $R_{th}$   | Thermal Resistance  |      | 225   |     | $^\circ\text{C}/\text{W}$ |

**Note:** \* For the tight control of the pinch-off voltage . TC1101's are divided into 3 groups:

(1) **TC1101P0710** :  $V_p = -0.7$  V to  $-1.0$  V (2) **TC1101P0811** :  $V_p = -0.8$  V to  $-1.1$  V (3) **TC1101P0912** :  $V_p = -0.9$  V to  $-1.2$  V

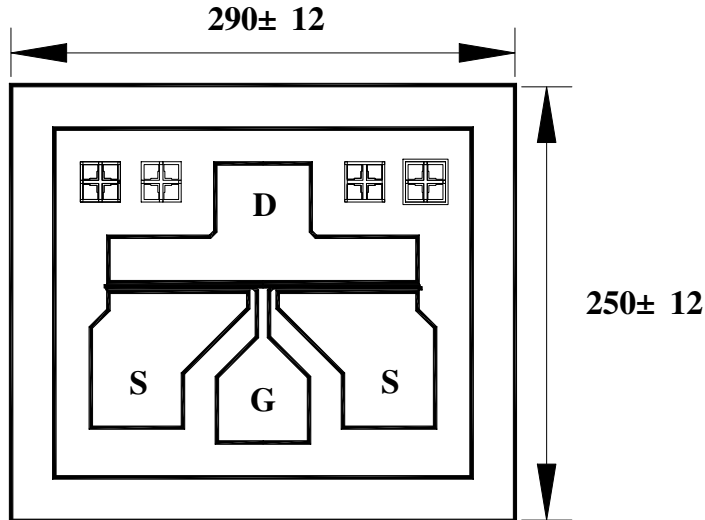
In addition, the customers may specify their requirements.

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

$V_{DS} = 2$  V,  $I_{DS} = 10$  mA

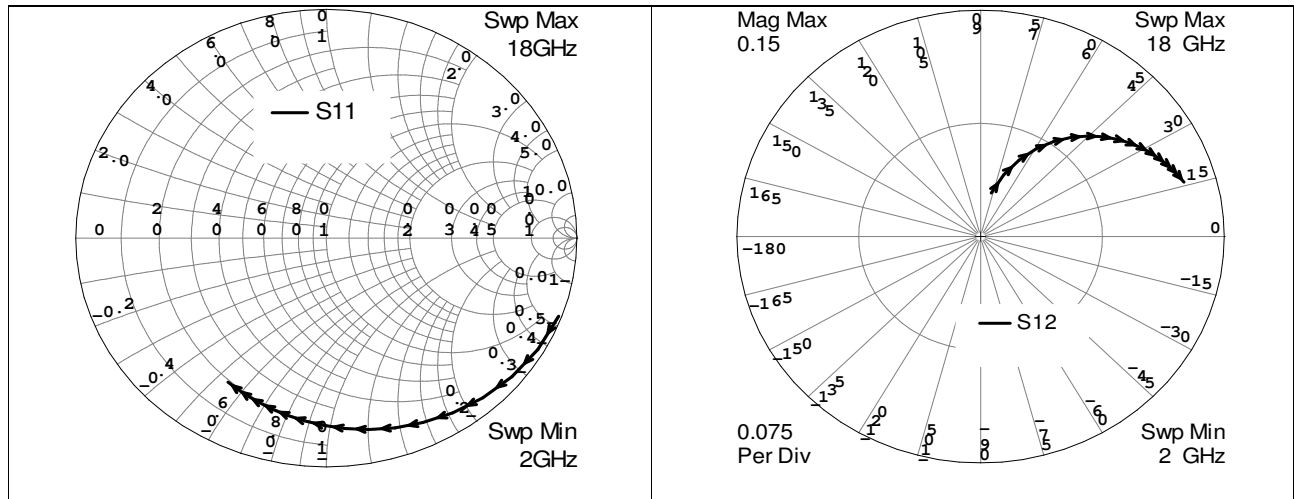
| Symbol    | Parameter              | Rating   |
|-----------|------------------------|--|
| $V_{DS}$  | Drain-Source Voltage   | 7.0 V  |
| $V_{GS}$  | Gate-Source Voltage    | -3.0 V   |
| $I_{DS}$  | Drain Current          | $I_{DSS}$                                      |
| $I_{GS}$  | Gate Current           | 160 $\mu\text{A}$                              |
| $P_{in}$  | RF Input Power, CW     | 18 dBm   |
| $P_T$     | Continuous Dissipation | 250 mW   |
| $T_{CH}$  | Channel Temperature    | 175 $^\circ\text{C}$                           |
| $T_{STG}$ | Storage Temperature    | - 65 $^\circ\text{C}$ to +175 $^\circ\text{C}$ |

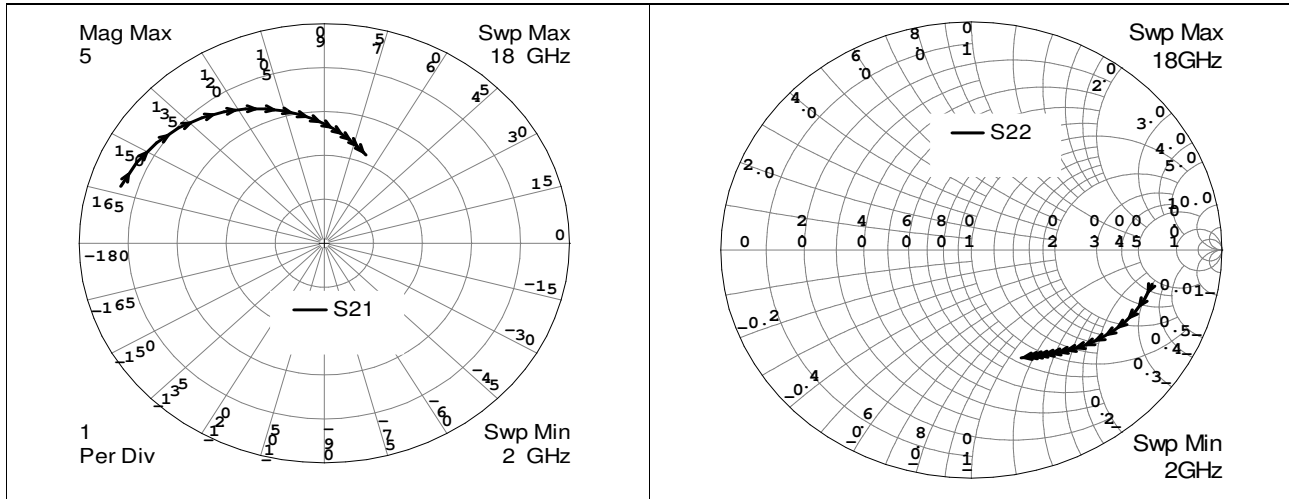
| Frequency (GHz) | NF <sub>ont</sub> (dB) | G <sub>A</sub> (dB) | $\Gamma_{opt}$ |     | Rn/50 |
|-----------------|------------------------|---------------------|----------------|-----|-------|
|                 |                        |                     | MAG            | ANG |       |
| 2               | 0.38                   | 19.8                | 0.99           | 4   | 0.48  |
| 4               | 0.40                   | 17.5                | 0.90           | 9   | 0.40  |
| 6               | 0.42                   | 15.6                | 0.82           | 18  | 0.37  |
| 8               | 0.45                   | 13.9                | 0.76           | 29  | 0.34  |
| 10              | 0.50                   | 13.1                | 0.69           | 43  | 0.32  |
| 12              | 0.55                   | 12.4                | 0.63           | 55  | 0.30  |
| 14              | 0.64                   | 11.7                | 0.56           | 65  | 0.28  |
| 16              | 0.78                   | 11.1                | 0.45           | 76  | 0.26  |
| 18              | 0.95                   | 10.6                | 0.34           | 90  | 0.24  |

**CHIP DIMENSIONS**


Units: Micrometers  
 Chip Thickness: 100

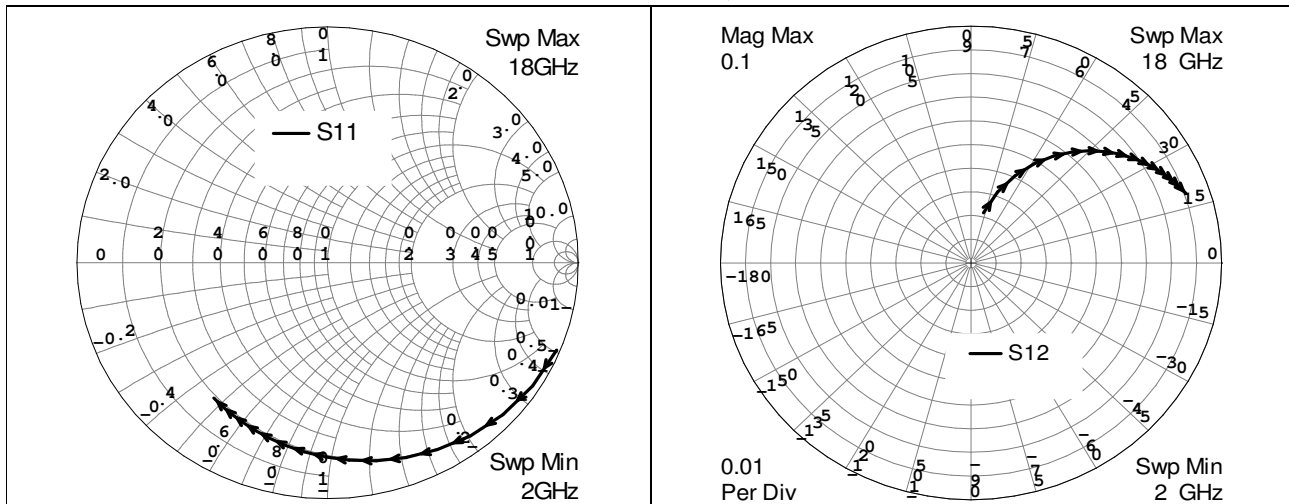
Gate Pad:  $55 \times 50$   
 Drain Pad:  $55 \times 50$   
 Source Pad:  $55 \times 60$

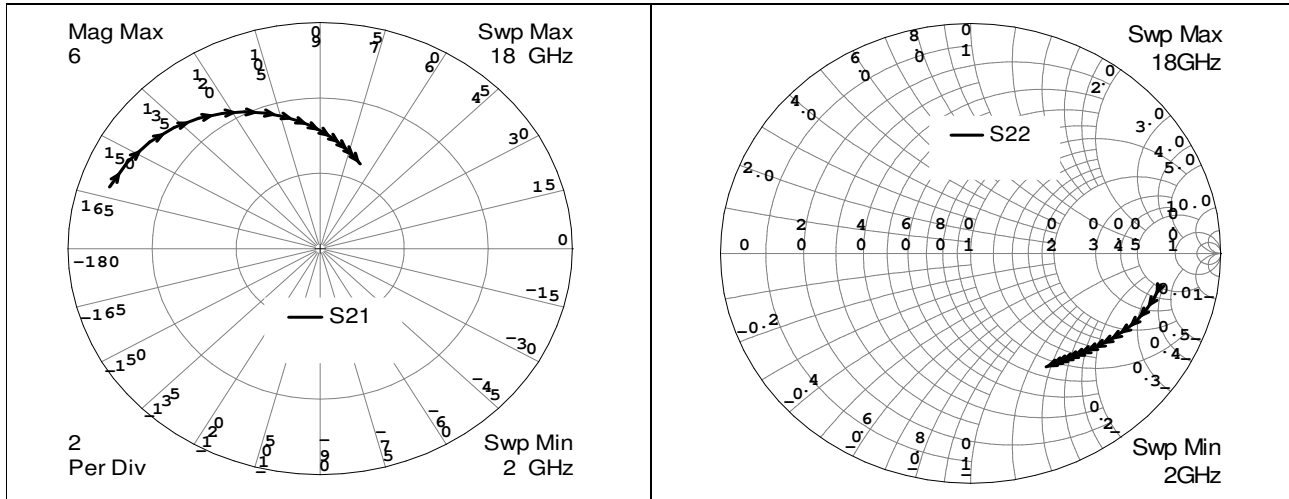
**TYPICAL SCATTERING PARAMETERS** ( $T_A=25^\circ\text{C}$ )  $V_{DS} = 2\text{V}, I_{DS} = 10\text{mA}$ 




| FREQUENCY<br>(GHz) | S11    |         | S21    |        | S12    |       | S22    |        |
|--------------------|--------|---------|--------|--------|--------|-------|--------|--------|
|                    | MAG    | ANG     | MAG    | ANG    | MAG    | ANG   | MAG    | ANG    |
| 2                  | 0.9879 | -20.21  | 4.3485 | 162.66 | 0.0296 | 77.08 | 0.7367 | -11.76 |
| 3                  | 0.9740 | -29.96  | 4.2452 | 154.28 | 0.0434 | 70.91 | 0.7235 | -17.37 |
| 4                  | 0.9564 | -39.31  | 4.1126 | 146.20 | 0.0560 | 65.04 | 0.7068 | -22.68 |
| 5                  | 0.9364 | -48.20  | 3.9594 | 138.48 | 0.0674 | 59.53 | 0.6877 | -27.66 |
| 6                  | 0.9152 | -56.56  | 3.7943 | 131.15 | 0.0774 | 54.40 | 0.6676 | -32.28 |
| 7                  | 0.8939 | -64.40  | 3.6242 | 124.22 | 0.0861 | 49.66 | 0.6472 | -36.54 |
| 8                  | 0.8732 | -71.72  | 3.4546 | 117.66 | 0.0937 | 45.29 | 0.6276 | -40.46 |
| 9                  | 0.8536 | -78.52  | 3.2894 | 111.45 | 0.1002 | 41.27 | 0.6090 | -44.06 |
| 10                 | 0.8354 | -84.84  | 3.1312 | 105.57 | 0.1058 | 37.57 | 0.5919 | -47.37 |
| 11                 | 0.8188 | -90.72  | 2.9813 | 99.99  | 0.1106 | 34.16 | 0.5764 | -50.43 |
| 12                 | 0.8037 | -96.18  | 2.8406 | 94.68  | 0.1148 | 31.00 | 0.5627 | -53.28 |
| 13                 | 0.7901 | -101.25 | 2.7092 | 89.60  | 0.1183 | 28.08 | 0.5506 | -55.93 |
| 14                 | 0.7780 | -105.98 | 2.5868 | 84.74  | 0.1214 | 25.36 | 0.5402 | -58.41 |
| 15                 | 0.7671 | -110.39 | 2.4731 | 80.07  | 0.1241 | 22.82 | 0.5313 | -60.76 |
| 16                 | 0.7575 | -114.51 | 2.3676 | 75.57  | 0.1264 | 20.44 | 0.5239 | -62.99 |
| 17                 | 0.7491 | -118.37 | 2.2697 | 71.21  | 0.1284 | 18.20 | 0.5179 | -65.12 |
| 18                 | 0.7416 | -121.99 | 2.1788 | 66.99  | 0.1302 | 16.08 | 0.5132 | -67.16 |

\* The data does not include gate, drain and source bond wires.

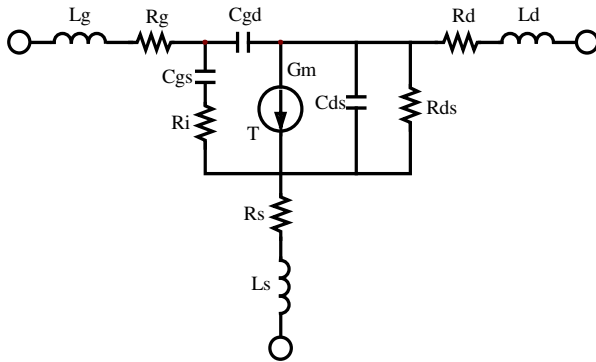
**TYPICAL SCATTERING PARAMETERS (T<sub>A</sub>=25 °C) V<sub>DS</sub> = 6 V, I<sub>DS</sub> = 25 mA**




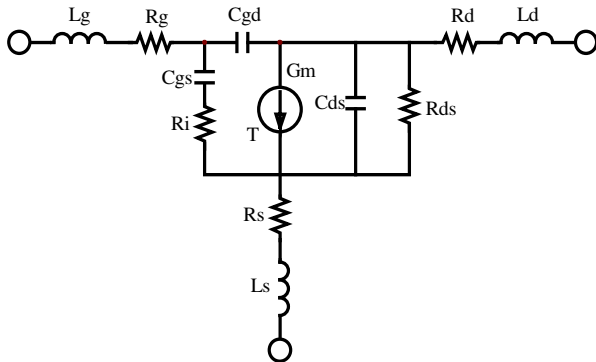
| FREQUENCY<br>(GHz) | S11    |         | S21    |        | S12    |       | S22    |        |
|--------------------|--------|---------|--------|--------|--------|-------|--------|--------|
|                    | MAG    | ANG     | MAG    | ANG    | MAG    | ANG   | MAG    | ANG    |
| 2                  | 0.9861 | -22.03  | 5.2729 | 161.97 | 0.0218 | 76.68 | 0.7718 | -10.24 |
| 3                  | 0.9704 | -32.59  | 5.1264 | 153.31 | 0.0318 | 70.37 | 0.7586 | -15.08 |
| 4                  | 0.9507 | -42.66  | 4.9406 | 145.03 | 0.0408 | 64.44 | 0.7422 | -19.62 |
| 5                  | 0.9288 | -52.16  | 4.7291 | 137.18 | 0.0488 | 58.94 | 0.7239 | -23.82 |
| 6                  | 0.9059 | -61.05  | 4.5045 | 129.78 | 0.0558 | 53.89 | 0.7050 | -27.69 |
| 7                  | 0.8834 | -69.32  | 4.2765 | 122.83 | 0.0618 | 49.28 | 0.6865 | -31.23 |
| 8                  | 0.8618 | -76.97  | 4.0524 | 116.31 | 0.0669 | 45.10 | 0.6690 | -34.49 |
| 9                  | 0.8418 | -84.05  | 3.8370 | 110.19 | 0.0712 | 41.30 | 0.6530 | -37.49 |
| 10                 | 0.8234 | -90.59  | 3.6330 | 104.41 | 0.0749 | 37.85 | 0.6386 | -40.28 |
| 11                 | 0.8068 | -96.63  | 3.4418 | 98.96  | 0.0781 | 34.72 | 0.6260 | -42.90 |
| 12                 | 0.7919 | -102.23 | 3.2639 | 93.79  | 0.0807 | 31.86 | 0.6150 | -45.37 |
| 13                 | 0.7786 | -107.40 | 3.0990 | 88.86  | 0.0830 | 29.24 | 0.6057 | -47.73 |
| 14                 | 0.7668 | -112.21 | 2.9466 | 84.16  | 0.0850 | 26.83 | 0.5978 | -49.99 |
| 15                 | 0.7564 | -116.69 | 2.8058 | 79.65  | 0.0867 | 24.60 | 0.5913 | -52.18 |
| 16                 | 0.7471 | -120.86 | 2.6758 | 75.31  | 0.0882 | 22.54 | 0.5861 | -54.32 |
| 17                 | 0.7389 | -124.76 | 2.5557 | 71.12  | 0.0895 | 20.62 | 0.5821 | -56.41 |
| 18                 | 0.7316 | -128.41 | 2.4446 | 67.06  | 0.0906 | 18.82 | 0.5790 | -58.46 |

\*The data does not include gate, drain and source bond wires.

**SMALL SIGNAL MODEL,  $V_{DS} = 2\text{ V}$ ,  $I_{DS} = 10\text{ mA}$**

**SCHEMATI**

**PARAMETERS**

|            |            |            |           |
|------------|------------|------------|-----------|
| <b>Lg</b>  | 0.047 nH   | <b>Rs</b>  | 1.290 Ohm |
| <b>Rg</b>  | 1.460 Ohm  | <b>Ls</b>  | 0.001 nH  |
| <b>Cgs</b> | 0.207 pF   | <b>Cds</b> | 0.068 pF  |
| <b>Ri</b>  | 3.680 Ohm  | <b>Rds</b> | 321.5 Ohm |
| <b>Cgd</b> | 0.027 pF   | <b>Rd</b>  | 1.525 Ohm |
| <b>Gm</b>  | 54.80 mS   | <b>Ld</b>  | 0.038 nH  |
| <b>T</b>   | 3.340 psec |            |           |

**SMALL SIGNAL MODEL,  $V_{DS} = 6\text{ V}$ ,  $I_{DS} = 25\text{ mA}$** 
**SCHEMATI**

**PARAMETERS**

|            |            |            |           |
|------------|------------|------------|-----------|
| <b>Lg</b>  | 0.047 nH   | <b>Rs</b>  | 1.250 Ohm |
| <b>Rg</b>  | 1.460 Ohm  | <b>Ls</b>  | 0.001 nH  |
| <b>Cgs</b> | 0.254 pF   | <b>Cds</b> | 0.067 pF  |
| <b>Ri</b>  | 5.910 Ohm  | <b>Rds</b> | 377.8 Ohm |
| <b>Cgd</b> | 0.019 pF   | <b>Rd</b>  | 1.525 Ohm |
| <b>Gm</b>  | 66.00 mS   | <b>Ld</b>  | 0.038 nH  |
| <b>T</b>   | 3.640 psec |            |           |

**CHIP HANDLING**

**DIE ATTACHMENT:** Conductive epoxy or eutectic die attach is recommended. Eutectic die attach can be accomplished with Au-Sn (80%Au-20%Sn) perform at stage temperature:  $290^{\circ}\text{C} \pm 5^{\circ}\text{C}$ ; Handling Tool: Tweezers; Time: less than 1min.

**WIRE BONDING:** The recommended wire bond method is thermocompression bonding with 0.7 to 1.0 mil (0.018 to 0.025 mm) gold wire. Stage temperature:  $220^{\circ}\text{C}$  to  $250^{\circ}\text{C}$ ; Bond Tip Temperature:  $150^{\circ}\text{C}$ ; Bond Force: 20 to 30 gms depending on size of wire and Bond Tip Temperature.

**HANDLING PRECAUTIONS:** The user must operate in a clean, dry environment. Care should be exercised during handling avoid damage to the devices. Electrostatic Discharge (ESD) precautions should be observed at all stages of storage, handling, assembly, and testing. The static discharge must be less than 300V.