

TOSHIBA INFRASTRUCTURE SYSTEMS &amp; SOLUTIONS CORPORATION

KOMUKAI COMPLEX

1,KOMUKAI,TOSHIBA-CHO,SAWAI-KU,KAWASAKI 212-8581,JAPAN

# MICROWAVE SEMICONDUCTORS

## HANDLING AND OPERATING PRECAUTIONS

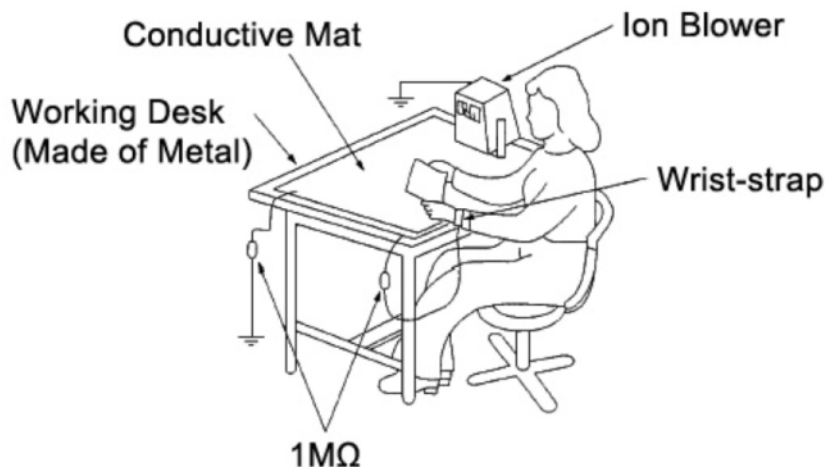
### CONTENTS

<b>A. ELECTROSTATIC DISCHARGE.....</b>	<b>2</b>
<b>B. STORAGE AND GUARANTEE.....</b>	<b>2</b>
<b>C. MOUNTING.....</b>	<b>3</b>
<b>D. RECOMMENDED OPERATING CONDITIONS.....</b>	<b>4</b>
<b>E. ABSOLUTE MAXIMUM RATINGS.....</b>	<b>12</b>
<b>F. RECOMMENDED BIASING PROCEDURES.....</b>	<b>12</b>

## A. ELECTROSTATIC DISCHARGE

Microwave devices are sensitive to electrostatic discharge.

Figure 1 shows a recommended work station to protect the devices from electrostatic discharge, and note the following items:



**Figure 1 Recommended Work Stations**

- Place a desk made of conductive metal and a chair on a conductive mat, and ground the desk.
- Place a conductive mat on the desk, as well.
- Wear a wrist strap which is grounded via a resistor of around 1 MΩ.
- Use an ion blower so that the ionized air flows in the working area, if required. Be sure to ground it.
- Be sure to ground an assembly/test equipment, as well.
- Do not wear the nylon gloves when handling the devices to avoid electric static discharge.
- Do not touch the gate lead and the drain lead of the devices to avoid short circuit.

## B. STORAGE AND GUARANTEE

All the devices should be stored in a clean, dust-free and dry environment where the temperature and humidity are well-controlled.

Especially, chip form devices should be stored in dry nitrogen environment.

Guarantee of the devices are as follows.

-Chip form

If stored in the original package and unopened: One year from the factory shipping date.

After unpacked: Three months (if stored in dry and N<sub>2</sub> atmosphere)

-Packaged model

If stored in the original package and unopened: One year from the factory shipping date.

**C. MOUNTING**

The flange of the packaged model devices should be fixed to the mounting location with some screws. Recommended screw tightening torque is shown in Table 1.

To prevent the package from mechanical damage, resulting in excessive channel temperature rise, tighten the screws with the adequate torque given below.

**Table 1 Recommended Screw Tightening Torque**

<b>PACKAGE CODE</b>	<b>NUMBER OF SCREWS</b>	<b>RECOMMENDED TORQUE</b>	<b>MAXIMUM TORQUE</b>
2-3H1B 2-3K1B 2-4J1B	2	0.08 N-m	0.10 N-m
2-9E1D/F 2-11E1A/B 7-BA25A	2	0.18 N-m	0.20 N-m
2-7C1B 2-9D1B 7-BA06A 7-BA15A	2	0.25 N-m	0.30 N-m
2-11C1B 2-11D1B 7-AA04A 7-AA07A 7-BA42B	2	0.45 N-m	0.50 N-m
2-16G1B 2-16G6A 7-AA02C 7-AA03A 7-AA05A 7-AA06A 7-AA09A	4	0.25 N-m	0.30 N-m

**D. RECOMMENDED OPERATING CONDITIONS**

The recommended drain voltage ( $V_{DS}$ ), the gate current ( $I_{GS}$ ), the gate resistance ( $R_g$ ) and the channel temperature ( $T_{ch}$ ) are as follows. For the recommended quiescent drain current ( $I_{DSSet}$ ), please refer to the technical datasheet of the individual product.

**Table 2 Recommended Operating Conditions**

PRODUCT	$V_{DS}(V)$	$I_{GS}(mA)$	$R_g(\Omega)$	$T_{ch}(^{\circ}C)$
Partially Matched Power GaAs FETs (L-,S-Band)	= 12.0	R.O.C Refer to Table 3.	Recommended values Refer to Table 3.	≤ 130
Internally Matched Power GaAs FETs (C-Band)	=10.0	R.O.C Refer to Table 4.	Recommended values Refer to Table 4.	
Internally Matched Power GaAs FETs (X-, Ku-Band 2W to 18W)	=9.0	R.O.C Refer to Table 5.	Recommended values Refer to Table 5.	≤ 130
Internally Matched Power GaAs FETs (X-, Ku-Band UL series)	=10.0			
Internally Matched Power GaAs FETs (X/Ku-Band 30W)	=10.0			
Internally Matched Power GaN HEMTs (TGI series, C-, X/Ku-Band 50W/120W)	=24.0	R.O.C Refer to Table 6.	Recommended values Refer to Table 6.	≤ 200
Internally Matched Power GaN HEMTs (TGI-H series, C-Band 60W/130W)	=40.0	R.O.C Refer to Table 7	Recommended values Refer to Table 7.	≤ 200

<< Note >> R.O.C.: Reasonable Operating Current

Channel temperature ( $T_{ch}$ ) is calculated as follows:

$$T_{ch} = T_f + (I_{DS} \times V_{DS} + P_{in} - P_o) \times R_{th(c-c)}$$

**Notes**  $T_f$ : flange temperature.

$I_{DS}$ : drain current.

$V_{DS}$ : drain to source voltage

$P_{in}$ : RF input power

$P_o$ : RF output power

$R_{th(c-c)}$ : thermal resistance between channel and flange.

The flange temperature should be lowered as much as possible with a heat sink block and a blower. However, please be sure to prevent dew condensation.

Table 3 to 7 show recommended operating conditions for each model.

**Table 3 Gate Current of L-, S-Band Partially Matched Power GaAs FETs under RF Operating Conditions**

MODEL NO.	M.A.G.C.* (mA)	R.O.C.**		RECOMMENDED Rg VALUE( $\Omega$ )
		FORWARD (mA)	REVERSE (mA)	
TPM1919-60	230	68	41	30
TPM2323-60A	230	68	41	30
TPM2626-60A	230	68	41	30

\*: MAXIMUM ALLOWABLE GATE CURRENT

\*\* : REASONABLE OPERATING CURRENT

**Table 4 Gate Current of C-Band Internally Matched Power GaAs FETs under RF Operating Conditions (1/3)**

MODEL NO.	M.A.G.C.* (mA)	R.O.C.**		Rg (Ω)	Features Application
		FORWARD (mA)	REVERSE (mA)		
TIM3742-4SL-341	15	5	3	150	RADIO
TIM3742-30SL-341	100	35	21	28	RADIO
TIM3742-45SL-341	120	42	25	28	RADIO
TIM3742-35SL	100	35	21	28	RADIO
TIM4450-35SL	100	35	21	28	RADIO
TIM4450-45SL	120	42	25	28	RADIO
TIM4450-60SL	200	68	41	28	RADIO
TIM5359-4SL	15	5	3	150	RADAR
TIM5359-8SL	30	10	6	150	RADAR
TIM5359-16SL	60	20	12	68	RADAR
TIM5359-35SL	100	35	21	28	RADAR
TIM5359-45SL	120	42	25	28	RADAR
TIM5359-60SL	200	68	41	28	RADAR
TIM5359-80SL	200	68	41	28	RADAR
TIM5964-8SL	30	10	6	150	SATCOM
TIM5964-16SL	60	20	12	68	SATCOM
TIM5964-30SL	100	35	21	28	SATCOM
TIM5964-35SLA	100	35	21	28	SATCOM
TIM5964-45SL	120	42	25	28	SATCOM
TIM5964-60SL	200	68	41	28	SATCOM
TIM5964-4SL-422	15	5	3	150	SATCOM
TIM5964-8SL-422	30	10	6	150	SATCOM
TIM5964-16SL-422	60	20	12	68	SATCOM
TIM5964-35SLA-422	100	35	21	28	SATCOM
TIM5964-60SL-422	200	68	41	28	SATCOM
TIM6472-8SL	30	10	6	150	RADIO
TIM6472-30SL	100	35	21	28	RADIO
TIM6472-35SL	100	35	21	28	RADIO
TIM6472-45SL	120	42	25	28	RADIO
TIM6472-60SL	200	68	41	28	RADIO
TIM7179-45SL	120	42	25	28	RADIO
TIM7179-60SL	200	68	41	28	RADIO
TIM7785-4SL	15	5	3	150	SATCOM
TIM7785-8SL	30	10	6	150	SATCOM
TIM7785-30SL	100	35	21	28	SATCOM
TIM7785-35SL	100	35	21	28	SATCOM
TIM7785-45SL	120	42	25	28	SATCOM
TIM7785-60SL	200	68	41	28	SATCOM

\*: MAXIMUM ALLOWABLE GATE CURRENT

\*\* : REASONABLE OPERATING CURRENT

**Table 4 Gate Current of C-Band Internally Matched Power GaAs FETs under RF Operating Conditions (2/3)**

MODEL NO.	M.A.G.C.* (mA)	R.O.C.**		Rg (Ω)	Features Application
		FORWARD (mA)	REVERSE (mA)		
TIM3742-4UL	15	5	3	150	RADIO
TIM3742-8UL	30	10	6	150	RADIO
TIM3742-16UL	60	20	12	68	RADIO
TIM3742-25UL	80	27	16	28	RADIO
TIM4450-4UL	15	5	3	150	RADIO
TIM4450-8UL	30	10	6	150	RADIO
TIM4450-12UL	40	13	8	68	RADIO
TIM4450-16UL	60	20	12	68	RADIO
TIM4450-25UL	80	27	16	28	RADIO
TIM5359-4UL	15	5	3	150	RADAR
TIM5359-8UL	30	10	6	150	RADAR
TIM5359-16EL	60	20	12	68	RADAR
TIM5359-16UL	60	20	12	68	RADAR
TIM5964-4UL	15	5	3	150	SATCOM
TIM5964-8UL	30	10	6	150	SATCOM
TIM5964-12UL	40	13	8	68	SATCOM
TIM5964-16EL	40	13	8	68	SATCOM
TIM5964-16UL	60	20	12	68	SATCOM
TIM5964-25UL	80	27	16	28	SATCOM
TIM5964-30UL	100	36	26	28	SATCOM
TIM5867-8UL	30	10	6	150	SATCOM
TIM5867-15UL	60	20	12	68	SATCOM
TIM5867-30UL	100	36	26	28	SATCOM
TIM6472-4UL	15	5	3	150	RADIO
TIM6472-8UL	30	10	6	150	RADIO
TIM6472-12UL	40	13	8	68	RADIO
TIM6472-16EL	60	20	12	68	RADIO
TIM6472-16UL	60	20	12	68	RADIO
TIM6472-25UL	80	27	16	28	RADIO
TIM6472-30UL	100	36	26	28	RADIO

\*: MAXIMUM ALLOWABLE GATE CURRENT

\*\* : REASONABLE OPERATING CURRENT

**Table 4 Gate Current of C-Band Internally Matched Power GaAs FETs under RF Operating Conditions (3/3)**

MODEL NO.	M.A.G.C.* (mA)	R.O.C.**		Rg (Ω)	Features Application
		FORWARD (mA)	REVERSE (mA)		
TIM7179-4UL	15	5	3	150	RADIO
TIM7179-6UL	20	7	4	150	RADIO
TIM7179-8UL	30	10	6	150	RADIO
TIM7179-12UL	40	13	8	68	RADIO
TIM7179-16EL	40	13	8	68	RADIO
TIM7179-16UL	60	20	12	68	RADIO
TIM7179-25UL	80	27	16	28	RADIO
TIM7179-30UL	100	36	26	28	RADIO
TIM7785-4UL	15	5	3	150	SATCOM
TIM7785-6UL	20	7	4	150	SATCOM
TIM7785-8UL	30	10	6	150	SATCOM
TIM7785-12UL	40	13	8	68	SATCOM
TIM7785-16EL	40	13	8	68	SATCOM
TIM7785-16UL	60	20	12	68	SATCOM
TIM7785-25UL	80	27	16	28	SATCOM
TIM7785-30UL	100	36	26	28	SATCOM
TIM7785-60ULA	150	42	25	28	SATCOM

\*: MAXIMUM ALLOWABLE GATE CURRENT

\*\* : REASONABLE OPERATING CURRENT



**Table 5 Gate Current of X-, Ku-Band Internally Matched Power GaAs FETs under RF Operating Conditions (1/2)**

MODEL NO.	M.A.G.C.* (mA)	R.O.C.**		Rg (Ω)	Features Application
		FORWARD (mA)	REVERSE (mA)		
TIM8596-2	24	6	2.4	150	RADAR
TIM8596-4	48	12	4.8	150	RADAR
TIM8596-8	96	24	9.6	150	RADAR
TIM8596-15	96	24	9.6	100	RADAR
TIM8996-30	192	100	40	10	RADAR
TIM0910-2	24	6	2.4	150	RADAR
TIM0910-4	48	12	4.8	150	RADAR
TIM0910-5	48	12	4.8	150	RADAR
TIM0910-8	96	24	9.6	150	RADAR
TIM0910-15L	96	24	9.6	100	RADIO
TIM0910-30L	192	48	19.2	10	RADIO
TIM1011-4L	48	12	4.8	150	RADIO
TIM1011-4UL	48	12	4.8	150	RADIO
TIM1011-5L	48	12	4.8	150	RADIO
TIM1011-8L	96	24	9.6	150	RADIO
TIM1011-8UL	48	12	4.8	150	RADIO
TIM1011-8ULA	48	12	4.8	150	RADIO
TIM1011-15L	96	24	9.6	100	RADIO
TIM1112-4	48	12	4.8	150	RADIO
TIM1112-4UL	48	12	4.8	150	RADIO
TIM1112-8	96	24	9.6	150	RADIO
TIM1112-15L	96	24	9.6	100	RADIO
TIM1213-2L	24	6	2.4	150	RADIO
TIM1213-4L	48	12	4.8	150	RADIO
TIM1213-8L	96	24	9.6	150	RADIO
TIM1213-8UL	48	12	4.8	150	RADIO
TIM1213-8ULA	48	12	4.8	150	RADIO
TIM1213-10L	96	24	9.6	100	RADIO
TIM1213-15L	96	24	9.6	100	RADIO
TIM1213-18L	96	24	9.6	100	RADIO
TIM1213-30L	192	48	19.2	10	RADIO

\*: MAXIMUM ALLOWABLE GATE CURRENT

\*\* : REASONABLE OPERATING CURRENT

**Table 5 Gate Current of X-, Ku-Band Internally Matched Power GaAs FETs under RF Operating Conditions (2/2)**

MODEL NO.	M.A.G.C.* (mA)	R.O.C.**		Rg (Ω)	Features Application
		FORWARD (mA)	REVERSE (mA)		
TIM1414-2L	24	6	2.4	150	SATCOM
TIM1414-4LA	48	12	4.8	150	SATCOM
TIM1414-4UL	48	12	4.8	150	SATCOM
TIM1414-5L	48	12	4.8	150	SATCOM
TIM1414-7	48	12	4.8	150	SATCOM
TIM1414-8L	96	24	9.6	150	SATCOM
TIM1414-9L	48	12	4.8	150	SATCOM
TIM1414-15L	96	24	9.6	100	SATCOM
TIM1414-18L	96	24	9.6	100	SATCOM
TIM1414-30LA	192	48	19.2	10	SATCOM
TIM1414-4-252	48	12	4.8	150	SATCOM
TIM1314-4UL	48	12	4.8	150	SATCOM
TIM1414-7-252	48	12	4.8	150	SATCOM
TIM1414-8-252	96	24	9.6	150	SATCOM
TIM1314-8UL	48	12	4.8	150	SATCOM
TIM1314-9L	48	12	4.8	150	SATCOM
TIM1314-15UL	96	24	9.6	100	SATCOM
TIM1414-18L-252	96	24	9.6	100	SATCOM
TIM1314-30L	192	48	19.2	10	SATCOM

\*: MAXIMUM ALLOWABLE GATE CURRENT

\*\* : REASONABLE OPERATING CURRENT

**Table 6 Gate Current of C-, X-, Ku-Band Internally Matched Power GaN HEMTs under RF Operating Conditions**

MODEL NO.	M.A.G.C.* (mA)	R.O.C.**		Rg (Ω)	Features Application
		FORWARD (mA)	REVERSE (mA)		
TGI5059-120L	360	120	80	28	RADAR
TGI5867-25L	90	30	20	60	SATCOM
TGI5867-50L	180	60	40	60	SATCOM
TGI5964-120L	360	120	60	28	SATCOM
TGI7785-25L	90	30	20	60	SATCOM
TGI7785-50L	180	60	40	60	SATCOM
TGI7785-120L	360	120	80	28	SATCOM
TGI8596-50	300	100	40	13.3	RADAR
TGI9098-100P	360	120	80	10	RADAR
TGI0910-50	300	100	40	13.3	RADAR
TGI1213-25L	150	50	20	13.3	SATCOM
TGI1213-25LA	150	50	20	13.3	SATCOM
TGI1213-50L	300	100	40	13.3	SATCOM
TGI1213-50LA	300	100	40	13.3	SATCOM
TGI1314-25L	150	50	20	13.3	SATCOM
TGI1314-25LA	150	50	20	13.3	SATCOM
TGI1314-50L	300	100	40	13.3	SATCOM
TGI1314-50LA	300	100	40	13.3	SATCOM
TGI1414-50L	300	100	40	13.3	SATCOM

\*: MAXIMUM ALLOWABLE GATE CURRENT

\*\* : REASONABLE OPERATING CURRENT

**Table 7 Gate Current of C-Band Internally Matched Power GaN HEMTs under RF Operating Conditions**

MODEL NO.	M.A.G.C.* (mA)	R.O.C.**		Rg (Ω)	Features Application
		FORWARD (mA)	REVERSE (mA)		
TGI5867-60LHA	14	10	5	10	SATCOM
TGI5867-130LHA	28	20	10	10	SATCOM
TGI7179-60LHA	14	10	5	10	RADIO
TGI7179-130LHA	28	20	10	10	RADIO
TGI7785-60LHA	14	10	5	10	SATCOM
TGI7785-130LHA	28	20	10	10	SATCOM

\*: MAXIMUM ALLOWABLE GATE CURRENT

\*\* : REASONABLE OPERATING CURRENT

## E. ABSOLUTE MAXIMUM RATINGS

Absolute maximum ratings indicate the limits to be observed under any conditions.

## F. RECOMMENDED BIASING PROCEDURES

Recommended biasing procedures are as follows:

### << GaAs FETs >>

- (1) Gradually increase Gate to Source Voltage ( $V_{GS}$ ) from 0V to about  $V_{GSoff}$ .
- (2) Gradually increase Drain to Source Voltage ( $V_{DS}$ ) from 0V to the recommended value.
- (3) Adjust drain current ( $I_{DS}$ ) to the recommended quiescent drain current ( $I_{DSset}$ ).

When turning off the bias, perform the procedures above inversely.

Be sure to turn on the power to  $V_{GS}$  first, and turn off the power to  $V_{GS}$  last; otherwise, the device may be damaged.

Do not apply RF power to the devices if they are not biased.

### << GaN HEMTs >>

- (1) Gradually increase Gate to Source Voltage ( $V_{GS}$ ) from 0V to -7V
- (2) Gradually increase Drain to Source Voltage ( $V_{DS}$ ) from 0V to the recommended value (+24V for TGI series, +40V for TGI-H series).
- (3) Adjust drain current ( $I_{DS}$ ) to the recommended quiescent drain current ( $I_{DSset}$ ).

When turning off the bias, perform the procedures above inversely.

Be sure to turn on the power to  $V_{GS}$  first, and turn off the power to  $V_{GS}$  last; otherwise, the device may be damaged.

Do not apply RF power to the devices if they are not biased.