2 W, TR Chip
26 - 30 GHz

MAMF-FR1193-DIE
Rev. V1

Features

- Gain (Tx): 19 dB
- Output Power (Tx): 34 dBm @ 28 GHz
- PAE (Tx): 15%
- Noise Figure (Rx): 3.8 dB @ 28 GHz
- Gain (Rx): 17 dB
- Input & Output Matched: 50 Ω
- Size: 4.1 x 3.1 x 0.1 mm
- RoHS* Compliant

Applications

- Radar
- Telecommunication

Description

MAMF-FR1193-DIE is a 2 W high-performance GaN TR Module designed to operate from 26 to 30 GHz and is offered in bare die form. It is fully matched across the frequency band.

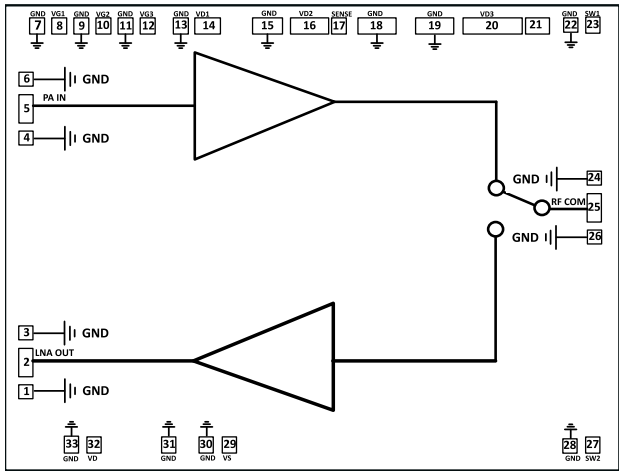
The MAMF-FR1193-DIE has 34 dBm of output power and 15% PAE and can be used as a power amplifier stage in Tx Mode. In Rx mode, this device has 3.8 dB of Noise Figure including the switch losses.

The MAMF-FR1193-DIE is manufactured using a high performance 100 nm gate length GaN on Si HEMT power technology (D01GH). The MMIC uses gold bonding pads and backside metallization and is fully protected with silicon nitride passivation to obtain the highest level of reliability.

Ordering Information

Part Number	Package
MAMF-FR1193-DIE	Die in Waffle Pak

Block Diagram



Pin Names[1]

Pin #	Function
1,3,4,6,7,9,11,13,15,18,19, 21,22,24,26,28,30,31,33	GND
2	Rx Out
5	Tx In
8	VG1
10	VG2
12	VG3
14	VD1
16	VD2
17	SENSE
20	VD3
21	
23	SW1
27	SW2
29	VS
32	VD

1. MACOM recommends connecting No Connection (N/C) pins to ground.

* Restrictions on Hazardous Substances, compliant to current RoHS EU directive.

Electrical Specifications - Tx Mode:

Freq. = 26 - 30 GHz, $VD_{1,2,3}$ = 12 V, $V_{switch, Tx}$ = -21 V, T_A = + 25°C, Quiescent Bias Currents (ID_1 = 74 mA, ID_2 = 170 mA, ID_3 = 330 mA)

Parameter	Test Conditions	Units	Min.	Typ.	Max.
Drain Voltage ($VD_{1,2,3}$)	—	V	—	12	—
Drain Current ($ID_{1,2,3}$)	At Saturated Power	A	—	1.25	—
Small Signal Gain	26 - 28 GHz 28 - 30 GHz	dB	14 13	19.0 17.7	—
Saturated Power	26 - 28 GHz 28 - 30 GHz	dBm	32 30	34 32	—
Power Added Efficiency	—	%	—	15	—
Input Reflection Coefficient	—	dB	—	-10	—
Output Reflection Coefficient	—	dB	—	-8	—
Output IP3	—	dBm	—	35	—

Electrical Specifications - Rx Mode:

Freq. = 26 - 30 GHz, V_{SS} = -5, V_D = +5 V, $V_{switch, RX}$ = -21 V, T_A = + 25°C, Quiescent Bias Currents (ID = 75 mA)

Parameter	Test Conditions	Units	Min.	Typ.	Max.
Drain Voltage (VD)	—	V	—	5	—
Drain Current (ID)	—	mA	—	75	—
Small Signal Gain	26 - 28 GHz 28 - 30 GHz	dB	13.0 12.0	17.5 16.0	—
Noise Figure	26 - 28 GHz 28 - 30 GHz	dB	—	3.8 4.2	5.0 5.5
Input Reflection Coefficient	—	dB	—	-15	—
Output Reflection Coefficient	—	dB	—	-20	—
Output IP3	—	dBm	—	20	—

Recommended Operating Conditions

Parameter	Symbol	Unit	Min.	Typ.	Max.
Rx Mode DC Supply V_D	-	V	—	5	—
Tx Mode DC Supply $V_{D1,2,3}$	V_{CC}	V	—	12	—
Junction Temperature	T_J	°C	—	+200	—
Operating Temperature[9]	T_C	°C	-40	—	+85
Storage Temperature	-	°C	-40	—	+150
V_{SWITCH}	-	V	—	-21	—

Absolute Maximum Ratings[4,5]

Parameter	Unit	Min.	Max.
Drain Voltage	V	—	+20
Gate Voltage - Tx	V	-3	0
Source Voltage - Rx	V	—	+5
Junction Temperature[6,7]	°C	—	+200
Assembly Temperature (during 1 minute)	°C	—	+300
Storage Temperature	°C	-40	+200

4. Exceeding any one or combination of these limits may cause permanent damage to this device.
5. MACOM does not recommend sustained operation near these survivability limits.
6. Operating at nominal conditions with $T_J \leq +200°C$ will ensure MTTF > 1 x 10^7 hours.
7. Junction Temperature (T_J) = T_C + Θjc * (V * I)
   Typical thermal resistance (Θjc) = 7.99 °C/W.
   a) For T_C = +85°C,
   T_J = +204°C @ 12 V, 1.25 A
   b) For T_C = +25°C,
   T_J = +147.2°C @ 12 V, 1.25 A

Handling Procedures

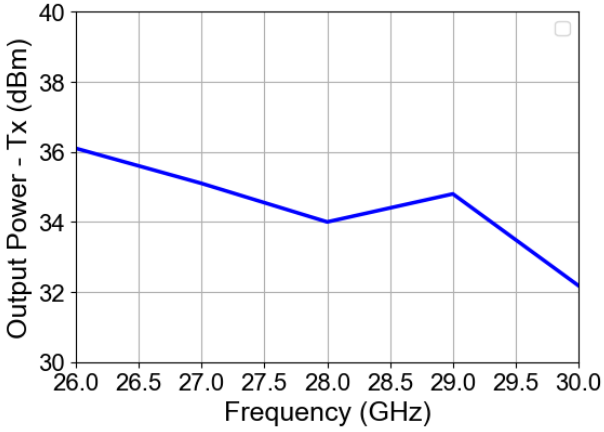
Please observe the following precautions to avoid damage:

Static Sensitivity

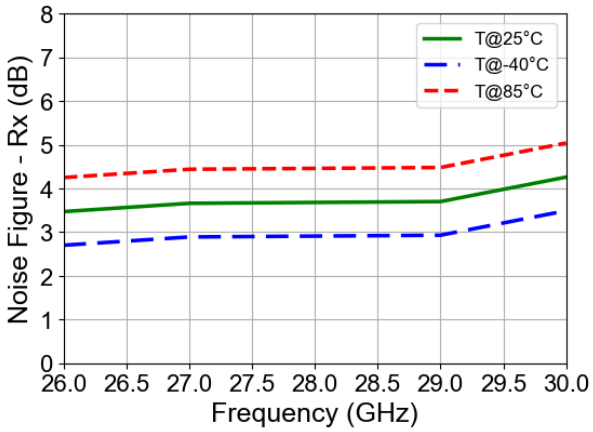
These electronic devices are sensitive to electrostatic discharge (ESD) and can be damaged by static electricity. Proper ESD control techniques should be used when handling these devices.

Typical Performance Curves

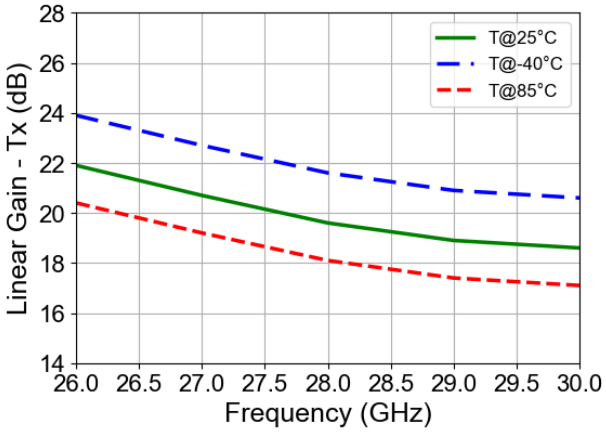
Output Power vs Frequency—Tx Mode



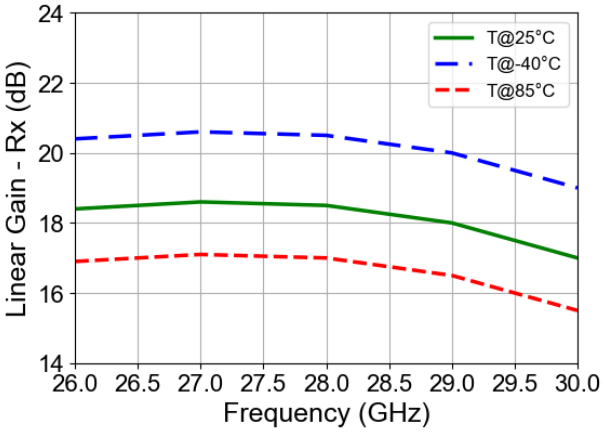
Noise Figure vs Frequency—Rx Mode



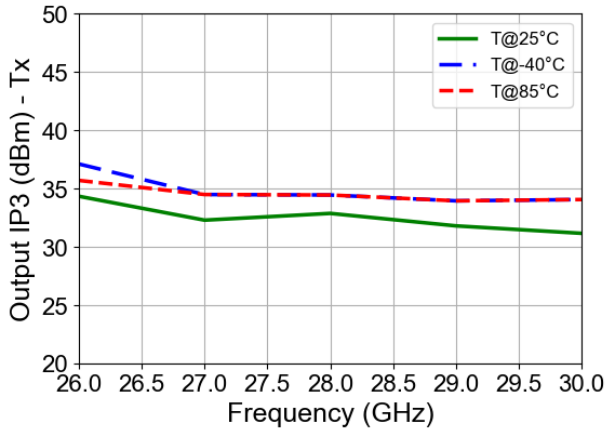
Small Signal Gain vs Frequency—Tx Mode



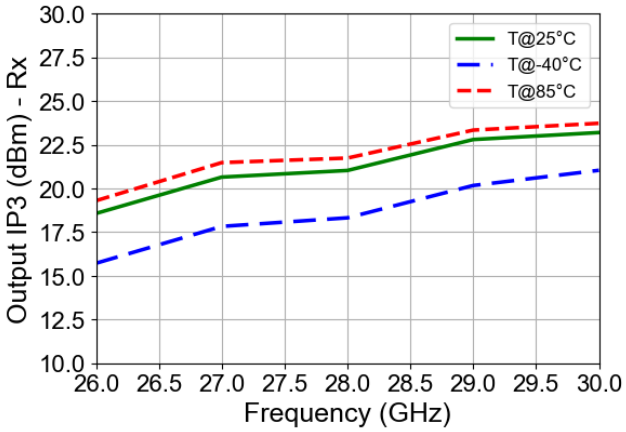
Small Signal Gain vs Frequency—Rx Mode



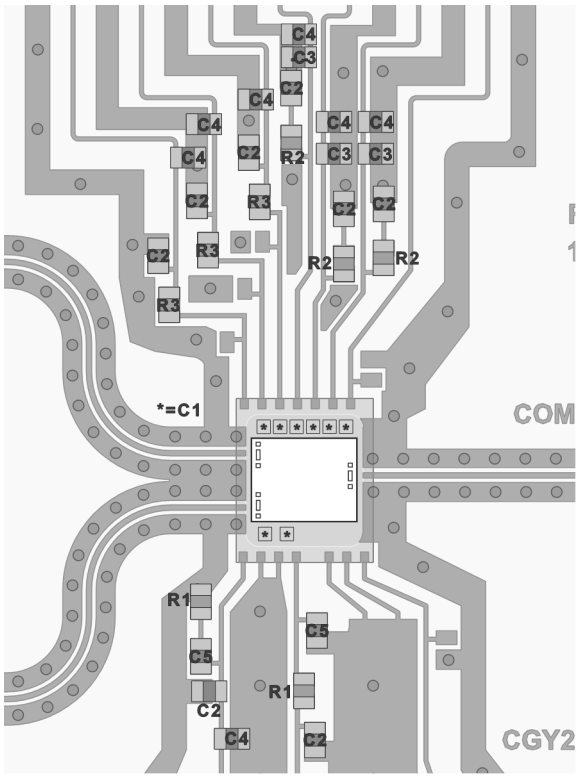
Output IP3 vs Frequency—Tx Mode



Output IP3 vs Frequency—Rx Mode



PCB Layout

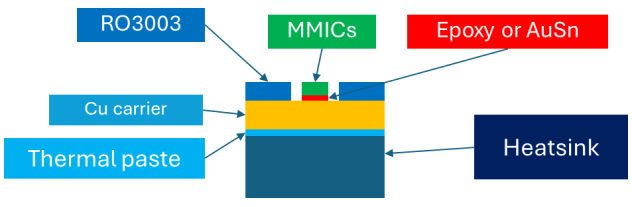


Thermal Management

Thermal management must be considered to maintain proper junction temperature. MACOM recommends careful consideration of:

- Recommended die attached
- Suitable carrier such as CuMo or Cu
- Thermal paste
- Heatsink

Sample Board Stacking Description



Biasing Sequence—Tx Mode

Step	Turn-ON
1	Set $I_{D1,2,3}$ limits to 0.75,1.5 and 3A
2	Set $V_{GS1,2,3}$ to -2.5V
3	Set $V_{D1,2,3}$ to 12V (ensure $I_{D1,2,3}$ is approx. 0A)
4	Adjust $V_{GS1,2,3}$ until $I_{D1,2,3}$ = 74,170,330mA (without RF input power)
5	Set $V_{switch,Tx}$ to –21V
6	Turn-ON RF signal

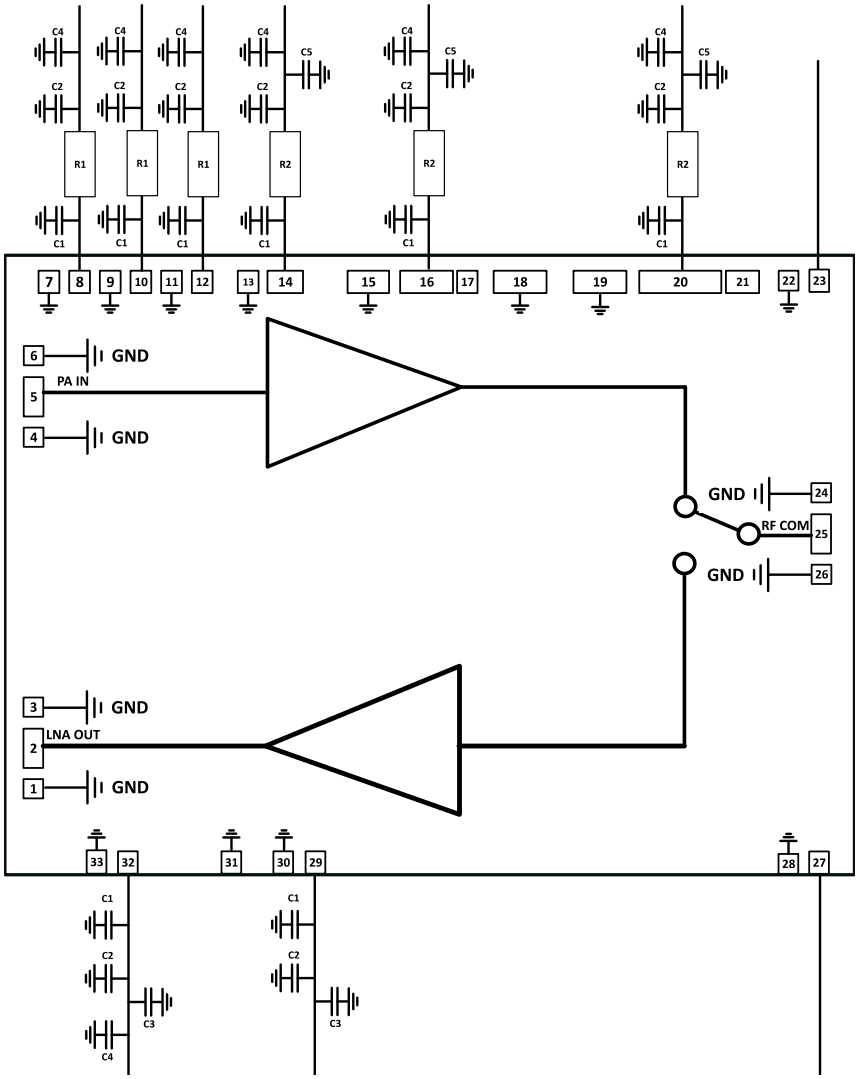
Step	Turn-OFF
1	Turn-OFF RF signal
2	Set $V_{switch,Tx}$ to 0V
3	Reduce $V_{GS1,2,3}$ to -2.5V (ensure $I_{D1,2,3}$ is approx. 0A)
4	Set $V_{D1,2,3}$ to 0V

Biasing Sequence - Rx Mode

Step	Turn-ON
1	Set I_{DS} and I_{ss} limits to 0.75 and 3A
2	Set $V_{switch,Rx}$ to 0V
3	Set V_{DS} to 0V
4	Set V_{SS} to –5V
5	Set V_{SS} to +5V
6	Set $V_{switch,Rx}$ to –21V
7	Turn-ON RF signal

Step	Turn-OFF
1	Turn-OFF RF signal
2	Set $V_{switch,Rx}$ to 0V
3	Set V_{DS} to 0V
4	Set V_{SS} to 0V

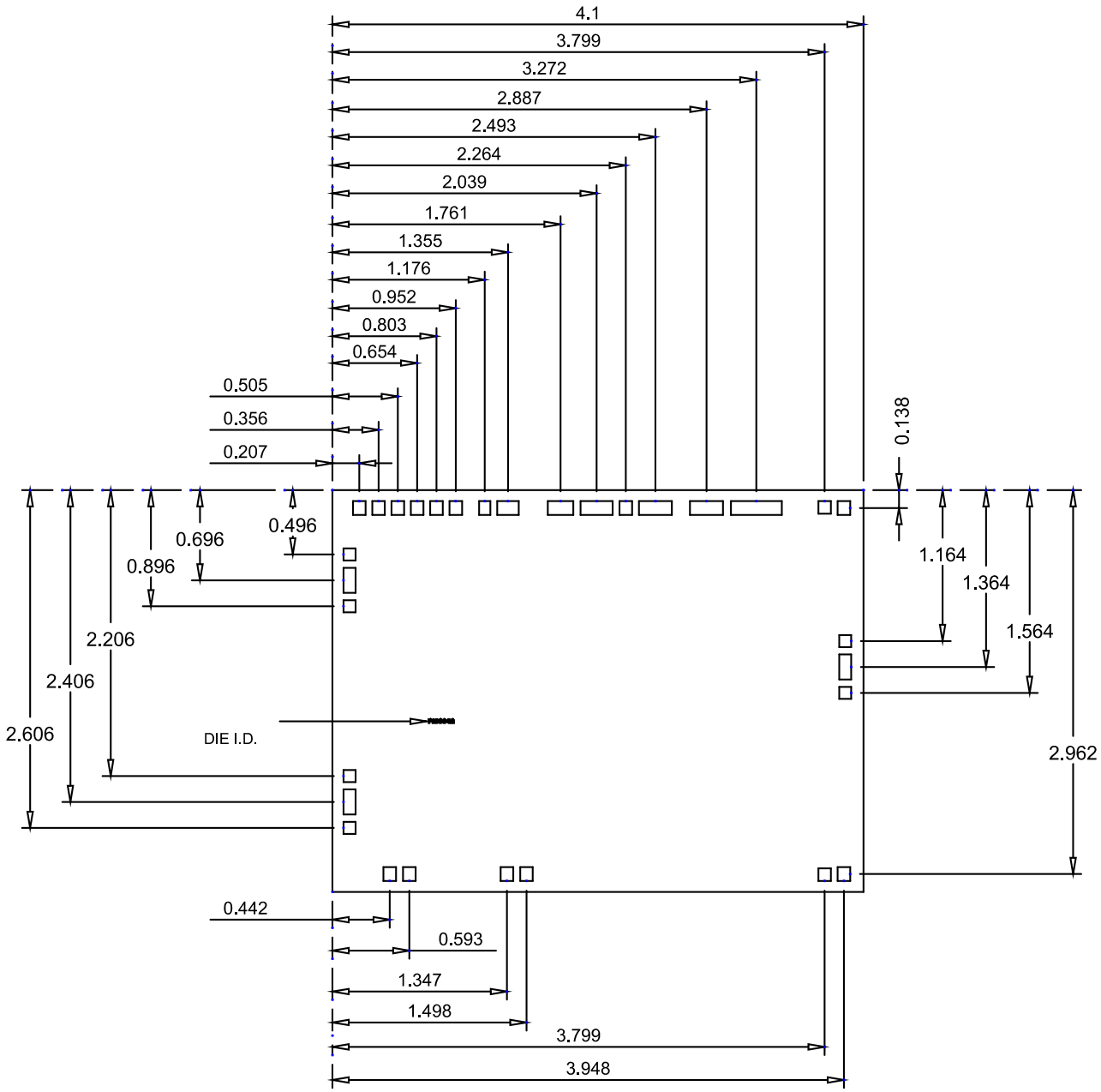
Application Schematic



Parts List

Part	Value	Case Style	Manufacturer	Manufacturer's Part #
R1	68 Ohms	0402	YAGEO	RC1218JK-0768RL
R2	10 Ohms	0402	YAGEO	RC0402JR-0710RL
C1	47 pF	0.381 mm	KYOCERA AVX	116RG470M100TT
C2	100 pF	0402	YAGEO	223891811536
C3	10 nF	0402	KYOCERA AVX	0402YC103KAT2A
C4	100 nF	0402	Murata	GCM155R71H104KE02D
C5	1 µF	0402	Murata	GRM155R70G105KA12D

Outline Drawing

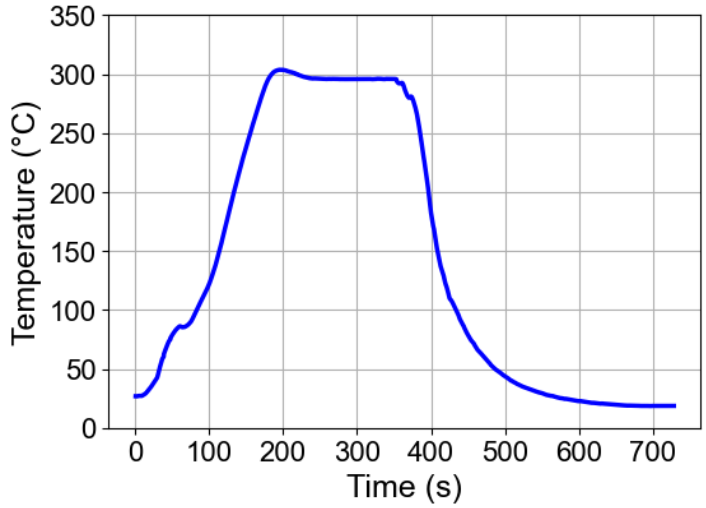


Die Attached - Soldering (Space Use)

To avoid permanent damages or impact on reliability during the soldering process, die temperature should never exceed 310°C.

Temperature in excess of 300°C should not be applied to the die longer than 1 min. Toxic fumes will be generated from the part at temperatures higher than 400°C.

Recommended soldering profile using AuSn preform (17 µm) and Cu Carrier with 1 mm of thickness



Die Attached - Epoxy

To avoid permanent damage or impact on reliability due to thermal management, epoxy with high thermal conductivity is recommended such as:

- EPOTEK EK2000
- NAMICS H9890-6A
- NAMICS H9890-11A

Revision History

Rev	Date	Change Description
V1	11/28/24	Production release