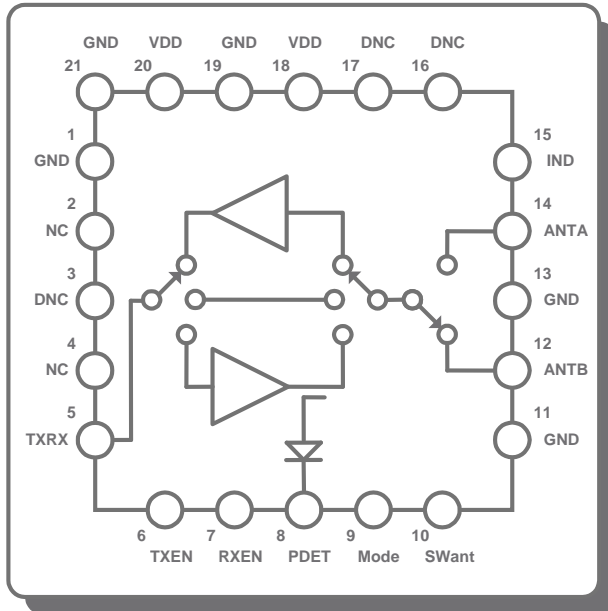


## 2.4 GHz TX / RX Booster With Diversity Switch for IoT / BLE / ZigBee

### DESCRIPTION

The RFX2411N is a fully integrated, single-chip, single-die RFeIC® (RF Front-end Integrated Circuit) which incorporates all the RF functionality needed for wireless ZigBee / smart energy applications. The RFX2411N architecture integrates a TX/RX and diversity switching circuitry with PA, LNA, and the associated matching networks with harmonic reduction all in a CMOS single-chip device. It also includes a bypass mode to provide maximal level of flexibility for system implementations.

RFX2411N is designed for the 2.4GHz ISM band and supports standards like Bluetooth/BT EDR/ BLE, 802.15.4, ZigBee, ANT and Thread. RFX2411N is the perfect solution for applications requiring extended range and bandwidth. Typical high power applications include home and industrial automation, smart energy / smart metering, and RF4CE among others. RFX2411N interfaces seamless with low-voltage CMOS control logic, requires minimal external components, and provides even an integrated PA power detector circuit. Combining superior performance, high sensitivity, high efficiency, low noise, small form factor, low power consumption and low cost, RFX2411N provides an ideal and application-friendly solution.



### FEATURES

- ▶ Single-Chip, Single-Die CMOS IC
- ▶ Transmit/Receive Switch Circuitry
- ▶ Antenna Diversity Switch Circuitry
- ▶ TX Power Amplifier or Bypass
- ▶ RX Low Noise Amplifier or Bypass
- ▶ Linearity Meeting Standards for OQPSK, DQPSK and 8DPSK Modulations
- ▶ Integrated Power Detector for Transmit Power Monitor and Control
- ▶ CMOS Control Logic
- ▶ ESD Protection Circuitry on All Pins
- ▶ RF Ports do not carry DC voltage
- ▶ Internal RF Decoupling on VDD Bias Pins
- ▶ Very Low DC Power Consumption
- ▶ Operation up to 125°C ambient temperature

- ▶ Full On-chip Matching and Decoupling Circuitry
- ▶ Minimal External Components Required
- ▶ 50-Ohm Input / Output Matching
- ▶ Market Proven CMOS Technology
- ▶ 3 x 3 x 0.55mm Small Outline QFN-20 Package with Exposed Ground Pad

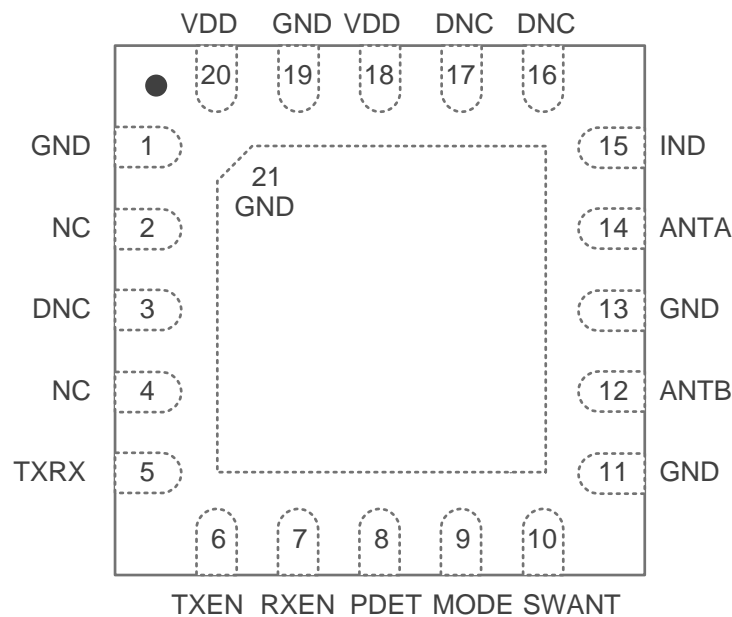
### APPLICATIONS

- ▶ Extended Range Devices
- ▶ ZigBee, ANT+, Thread, Bluetooth, BLE, RF4CE
- ▶ Smart Energy / Metering / Lighting / Remote Control
- ▶ Home and Industrial Automation
- ▶ Custom 2.4GHz Radio Systems
- ▶ Mobile and Battery Systems

PIN ASSIGNMENTS:

Pin Number	Pin Name	Description
1, 11, 13, 19, 21	GND	Ground – Must be connected to GND in the Application Circuit
2, 4	NC	No Internal Connection – Can be connected to GND in the Application Circuit
5	TXRX	RF signal to/from the Transceiver (at DC this pin presents a short to GND)
6	TXEN	PA Control (digital CMOS input)
7	RXEN	LNA Control (digital CMOS input)
8	PDET	Analog output providing DC voltage proportional to PA RF Power Output
9	MODE	BYPASS control (digital CMOS input )
10	SWant	ANTENNA control (digital CMOS input; selects between A and B for diversity)
12	ANTB	PA Output / LNA Input for Ant B (at DC this pin presents a short to GND)
14	ANTA	PA Output / LNA Input for Ant A (at DC this pin presents a short to GND)
15	IND	Inductor to GND (choice of value impacts 2 <sup>nd</sup> harmonic)
3, 16, 17	DNC	Reserved – Do Not Connect at the PCB level in the Application Circuit
18, 20	VDD	Voltage Supply (Internally Connected to each other)

PIN-OUT DIAGRAM:



**ABSOLUTE MAXIMUM RATINGS:**

Parameters	Units	Min	Max	Conditions
DC VDD Voltage Supply	V	0	4.5	VDD Pins, Standby Mode
DC Control Pin Voltage	V	0	3.6	
DC VDD Current Consumption	mA		350	Through VDD Pins when TX is "ON"
TX RF Input Power	dBm		+5	
LNA RF Input Power	dBm		+5	At active ANT port in RX LNA Mode
Bypass RF Input Power	dBm		+16	At any RF port in Bypass mode
Junction Temperature	°C		+150	
Storage Ambient Temperature	°C	-50	+150	No RF and DC Voltages Applied Appropriate care required according to JEDEC Standards
ESD HBM	+/- V		3750	All Pins
ESD CDM	+/- V		1000	All Pins

*Note: Sustained operation at or above the Absolute Maximum Ratings for any one or combinations of the above parameters may result in permanent damage to the device and is not recommended.*

*All Maximum RF Input Power Ratings assume 50-Ohm terminal impedance.*

**RECOMENDED OPERATING CONDITIONS:**

Parameters	Units	Min	Typ	Max	Conditions
DC VDD Voltage Supply	V	2.0*	3.3	3.6	All VDD Pins
Control Voltage "High"	V	1.2		VDD	10K ohm series resistor
Control Voltage "Low"	V	0		0.3	
Control Pin DC Current Consumption	nA		300		MODE, TXEN, RXEN, SWANT
DC Shutdown Current	nA		300		MODE, TXEN, RXEN = Low
PA Turn On/Off Time	µsec			1	
LNA Turn On/Off Time	µsec			1	
Antenna Switch Time	µsec			1	
Operating Ambient Temperature	°C	-40		+125	See Note 1
$\theta_{ja}$	°C/W		35		

*Note 1: For operation above +85 °C, use the  $\theta_{ja}$  as guidance for system design to assure the junction temperature will not exceed the maximum of +150 °C. A major contributor to  $\theta_{ja}$  is the PCB. The above  $\theta_{ja}$  value is based on the RFAxis EVB with multiple vias under the paddle.*

*\*At VDD < 3.3V the RFX2411N will provide a reduced maximum TX output power*

PA TRANSMIT MODE PARAMETERS (VDD=3.3V; TXEN=High; Mode=Low; T=+25 °C)

Parameters	Units	Min	Typ	Max	Conditions
Operating Frequency Band	GHz	2.4		2.5	All RF Pins Terminated by 50 Ohm
Saturated Output Power	dBm		+21		
Small-Signal Gain	dB		25		
Harmonics (2 <sup>nd</sup> – 5 <sup>th</sup> )	dBm/MHz		-18	-12	P <sub>OUT</sub> ≤ +20dBm; See application note for proper selection of pin 15 IND
Total Supply Current	mA		90		P <sub>OUT</sub> = +20dBm
TX Quiescent Current	mA		20		TX Mode
Input Return Loss	dB		-10		
Output Return Loss	dB		-10		
Power Detector Voltage	mV	100		800	Pout = +5 to +20dBm, 10kΩ load
Input / Output Impedance Single-Ended	Ohm		50		
Load VSWR for Stability (Pout=20dBm)	N/A		6:1		All Non-Harmonically Related Spurs < -53dBm/MHz
Load VSWR for Ruggedness (Pout=20dBm)	N/A		10:1		No Damage

LNA RECEIVE MODE PARAMETERS (VDD=3.3V; RXEN=High; TXEN/Mode=Low; T=+25 °C)

Parameters	Units	Min	Typ	Max	Conditions
Operating Frequency Band	GHz	2.4		2.5	All RF Pins Terminated by 50 Ohm
Gain	dB		12		
Noise Figure	dB		2.5		
Input P <sub>1dB</sub>	dBm		-8		
RX Quiescent Current	mA		8		
RF Port Impedance	Ohm		50		At TXRX and ANT Pins
Input Return Loss	dB		-10		At ANT Pin
Output Return Loss	dB		-10		At TXRX Pin

BI-DIRECTIONAL BYPASS MODE PARAMETERS (VDD=3.3V; Mode=High; T=+25 °C):

Parameters	Units	Min	Typ	Max	Conditions
Operating Frequency	GHz	2.4		2.5	
Insertion Loss	dB		5		
Input P <sub>1dB</sub>	dBm	12			At ANTA or ANTB pin
Total Current Consumption	nA		700		Mode = 2.0V, TX, RX = 0V

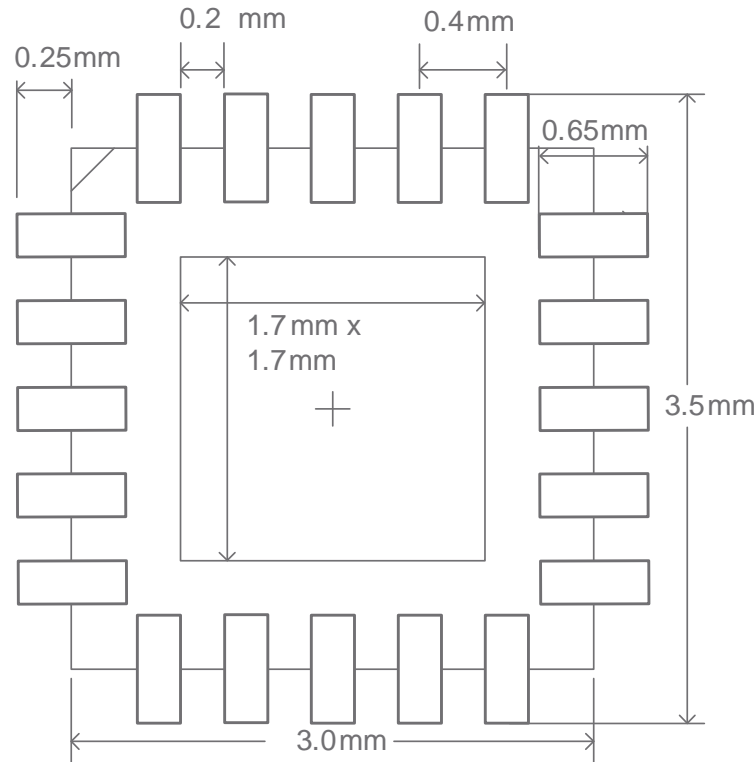
CONTROL LOGIC TRUTH TABLE

TXEN	RXEN	MODE	Mode of Operation
0	0	0	Shutdown Mode
1	0	0	PA Transmit Mode
1	1	0	
0	1	0	LNA Receive Mode
any	any	1	Bypass Mode (bidirectional)

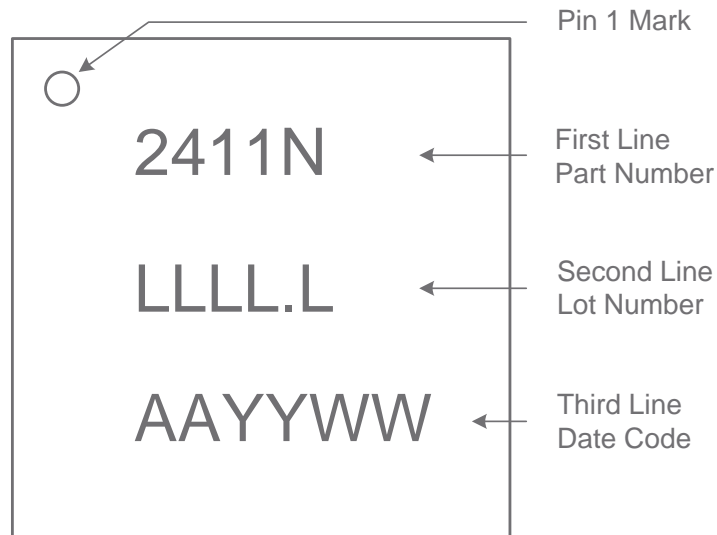
SWant	Mode of Operation
1	ANTA port enabled
0	ANTB port enabled

Note: "1" denotes high voltage state (> 1.2V)  
 "0" denotes low voltage stage (<0.3V) at Control Pins  
 "any" denotes liberty to either apply "1" or "0" without change

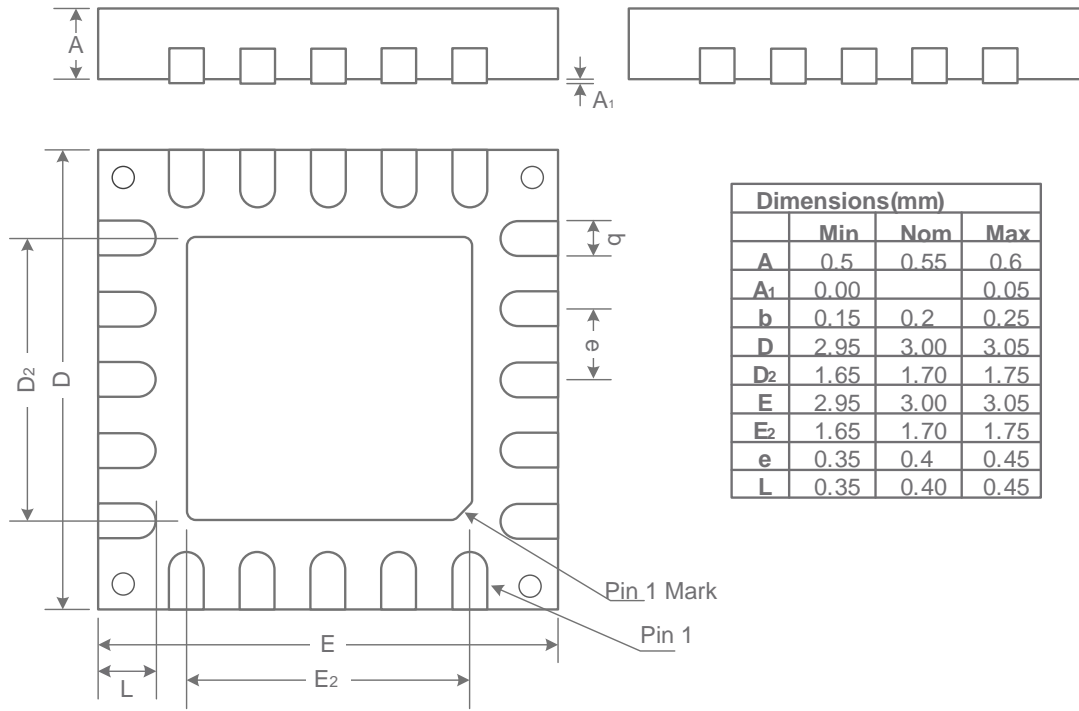
PCB LAND PATTERN



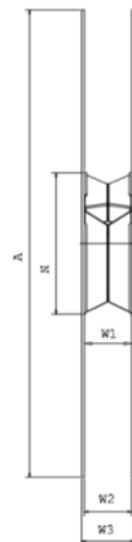
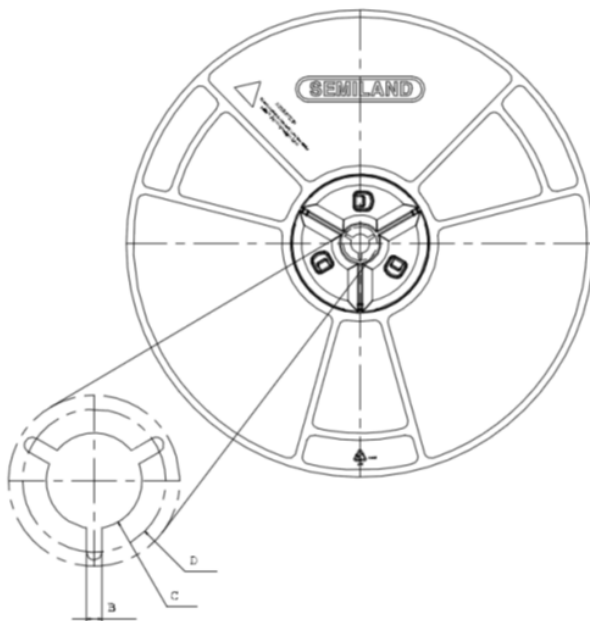
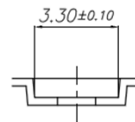
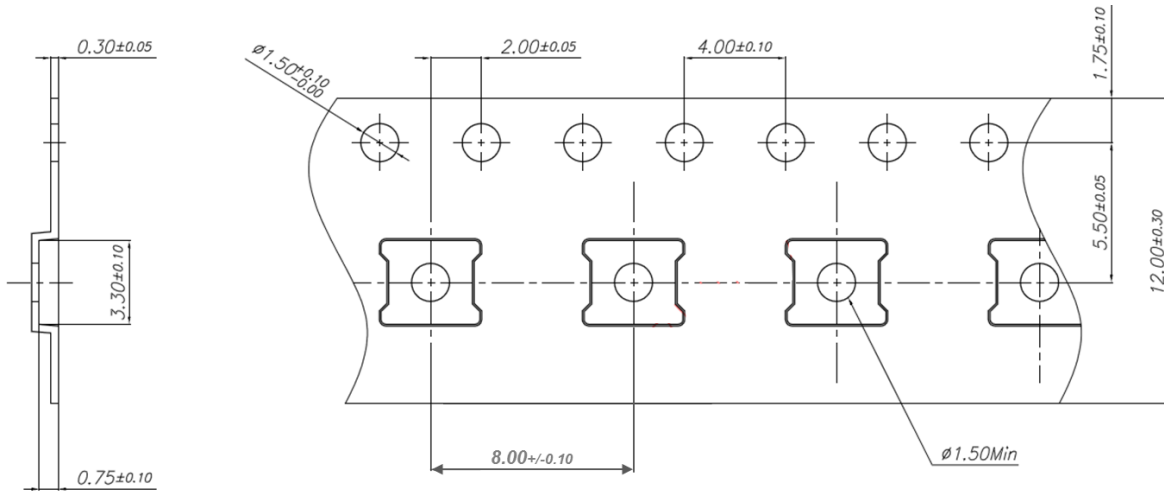
PACKAGE MARKING:



PACKAGE DIMENSIONS:



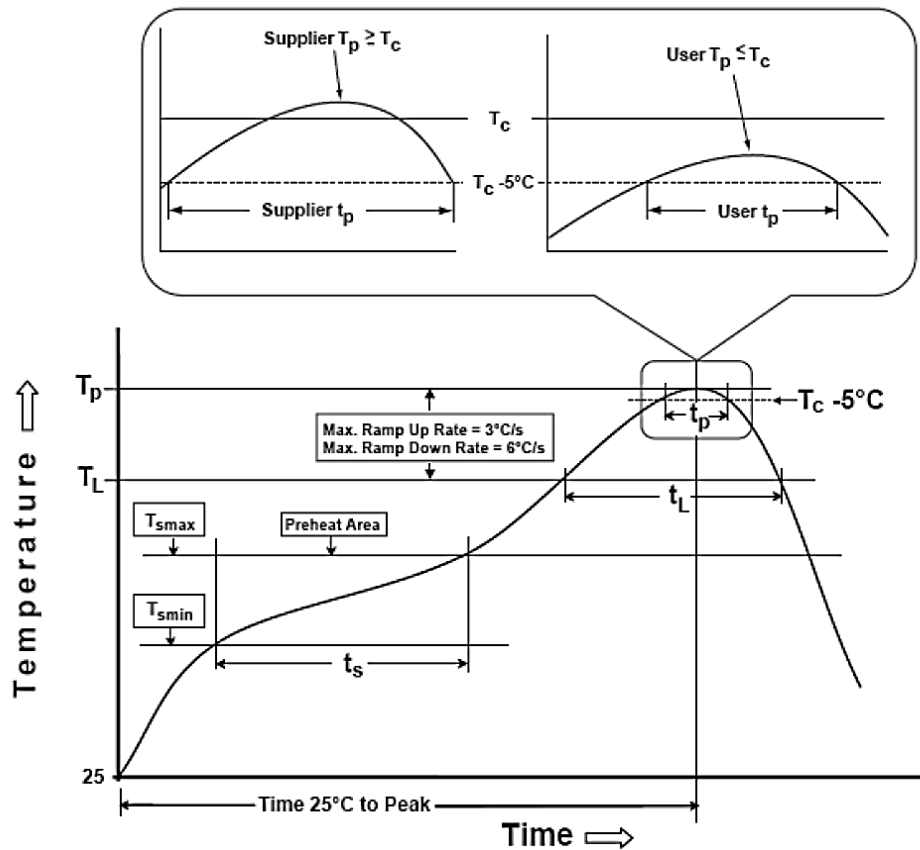
**TAPE AND REEL INFORMATION:**



Size	12mm
A	330 <sup>+0.2</sup> <sub>-2.0</sub>
B	1.5min
C	13.0 <sup>+0.5</sup> <sub>-0.2</sub>
D	20.2min
N	100 <sup>+2.0</sup> <sub>-0.0</sub>
W1	12.4 <sup>+3.0</sup> <sub>-0.0</sub>
W2	12.4 <sup>+3.0</sup> <sub>-0.0</sub>
W3	16.4 <sup>+2.0</sup> <sub>-2.0</sub>
PART#	SRL-12134H



RECOMMENDED SOLDER REFLOW PROFILE



Profile Feature	Sn-Pb Eutectic Assembly	Pb-Free Assembly
<b>Preheat/Soak</b>		
Temperature Min ( $T_{smin}$ )	100 °C	150 °C
Temperature Max ( $T_{smax}$ )	150 °C	200 °C
Time ( $t_s$ ) from ( $T_{smin}$ to $T_{smax}$ )	60-120 seconds	60-120 seconds
Ramp-up rate ( $T_L$ to $T_p$ )	3 °C/second max.	3 °C/second max.
Liquidous temperature ( $T_L$ )	183 °C	217 °C
Time ( $t_L$ ) maintained above $T_L$	60-150 seconds	60-150 seconds
Peak package body temperature ( $T_p$ )	For users $T_p$ must not exceed the Classification temp in Table 4-1. For suppliers $T_p$ must equal or exceed the Classification temp in Table 4-1.	For users $T_p$ must not exceed the Classification temp in Table 4-2. For suppliers $T_p$ must equal or exceed the Classification temp in Table 4-2.
Time ( $t_p$ )* within 5 °C of the specified classification temperature ( $T_c$ ), see Figure 5-1.	20* seconds	30* seconds
Ramp-down rate ( $T_p$ to $T_L$ )	6 °C/second max.	6 °C/second max.
Time 25 °C to peak temperature	6 minutes max.	8 minutes max.

\* Tolerance for peak profile temperature ( $T_p$ ) is defined as a supplier minimum and a user maximum.

SnPb Eutectic Process - Classification Temperatures ( $T_c$ )

Package Thickness	Volume mm <sup>3</sup> <350	Volume mm <sup>3</sup> ≥350
<2.5 mm	235 °C	220 °C
≥2.5 mm	220 °C	220 °C

Pb-Free Process - Classification Temperatures ( $T_c$ )

Package Thickness	Volume mm <sup>3</sup> <350	Volume mm <sup>3</sup> 350 - 2000	Volume mm <sup>3</sup> >2000
<1.6 mm	260 °C	260 °C	260 °C
1.6 mm - 2.5 mm	260 °C	250 °C	245 °C
>2.5 mm	250 °C	245 °C	245 °C