



# Manufacturing Note

## Package and Manufacturing Information

### **MN001**

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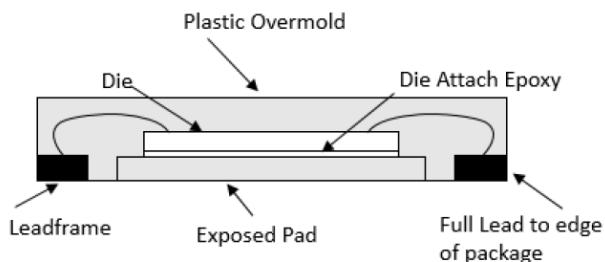
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#### 1. General Information

This document discusses micro leadframe (MLF), quad-flat no-lead (QFN), dual flat no-lead (DFN) and lead frame module (LFM) surface-mount (SMT) integrated circuit (IC) packages with soldered electrical connections made to the surface of the connecting PCB, shipped in tape and reel.

The QFN and LFM have leads on all four sides with the DFN having leads on two sides. QFN and DFN packages have full leads exposed to the edge of the package. The exposed edge of the lead is not plated. A solder fillet is not necessary for proper mounting.

All Guerrilla RF package solutions meet Restriction of Hazardous Substances (RoHS) and Registration, Evaluation, Authorization and Restriction of Chemicals (REACH) requirements. Lead finish is matte tin (Sn) for the LFM or nickel/palladium/gold (NiPdAu) for the DFN and QFN.



**Figure 1. Cross Section View of a QFN/DFN Package with Full Leads**

The packages noted are easily mounted using standard PCB SMT reflow assembly techniques and can be removed and replaced using standard removal techniques (see Section 8). This manufacturing note presents users with general information on how the devices are packaged on tape and reels and how to solder the component to PCBs.

## 2. Tape and Reel (T&R)

Guerrilla RF's tape and reel specification complies with Electronics Industries Association (EIA) standards for "Embossed Carrier Tape of Surface Mount Components for Automatic Handling" (reference EIA-481).

Devices are loaded with pins down into the carrier pocket with protective cover tape and reeled onto a plastic reel. Each reel is packaged in a cardboard box. There are product labels on the reel, the protective ESD bag and the outside surface of the box.

Reel diameter, pocket pitch and pin 1 quadrant information are noted on the applicable product data sheet.

## 3. Package Outline Drawing (POD) and Printed Circuit Board (PCB) Gerber Files

Package outline drawings and package can be referenced on the applicable product data sheet. Please reference product Gerber files to assist in PCB layout. Files are available on the individual product landing page for each part number at [www.guerrilla-rf.com/products](http://www.guerrilla-rf.com/products).

## 4. Electrostatic Discharge (ESD) Information

Guerrilla RF qualifies devices to ANSI/ESDA/JEDEC JS-001-2014 and ANSI/ESDA/JEDEC JS-002-2014. Devices are ESD sensitive and should be handled accordingly. Individual device ratings can be found on product data sheets. JEDEC JESD625B is a common reference for review on proper device handling.

## 5. Moisture Sensitivity Level (MSL)

Guerrilla RF qualifies devices to JEDEC J-STD-020. Please reference shipping bag and reel label for device MSL and peak reflow ratings. Please reference JEDEC J-STD-033 for handling of moisture-sensitive devices.

## 6. Printed Circuit Board (PCB) Design – Via, Land Pattern and Stencil Design

For volume production, devices can be treated as a standard surface mount component (reference IPC/JEDEC J-STD-020) with a standard assembly process. (Stencil solder printing, standard pick & place and solder reflow oven).

PCB design considerations are needed to properly design the PCB and solder stencil to mount the package. Recommended land pattern/Gerber files are available to assist in PCB design. Guerrilla RF Gerber files can be downloaded at [www.guerrilla-rf.com](http://www.guerrilla-rf.com) at the bottom of each product landing page. Please note that via placement and proper size are critical to device performance and product quality. Please refer to data sheet notes for additional information.

## 7. Solder Paste

There are no special requirements necessary when reflowing components. A low residue, no-clean solder tin/lead (SN63/Pb37) or tin/silver/copper (SAC) alloy) paste is commonly used. The solder paste manufacturer's printing and temperature profile should be used to optimize the assembly process.

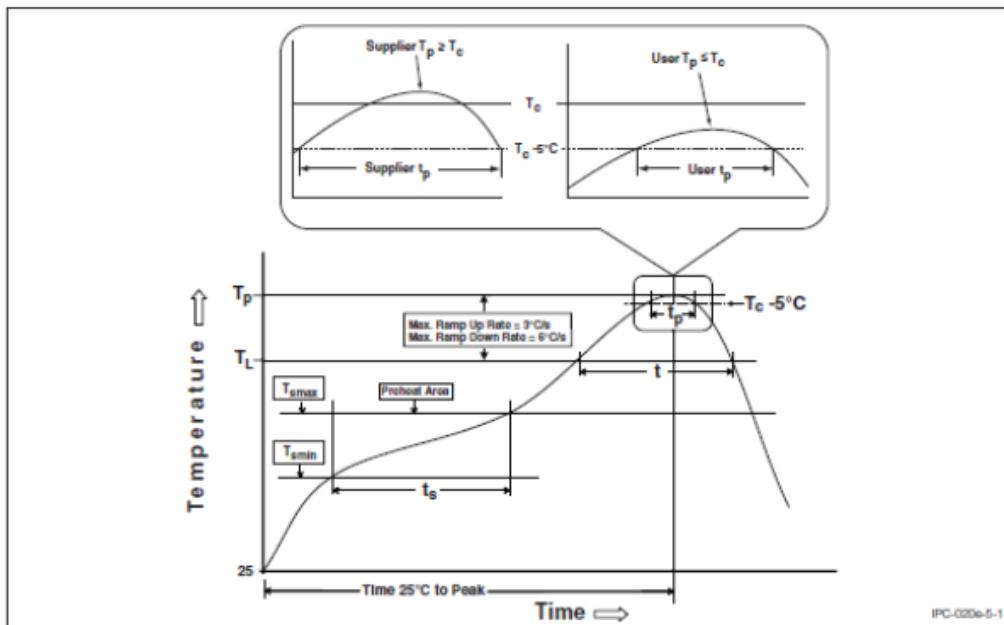
To verify any open or short circuits (bridging) after reflow, optical inspection and x-ray inspection are typical techniques that may be used.

A typical reflow profile is shown in Figure 10 as a reference only. The actual profile parameters depend upon the solder paste used, therefore, recommendations from paste manufacturers should be followed for reflow profile and any post-solder cleaning.

## 8. Printed Circuit Board (PCB) Reflow Profile

Guerrilla RF has tested and qualified the packages listed in Table 1 for three (3x) reflow operations per JEDEC J-STD-020 at a classification temperature of 260 °C. The moisture sensitivity level (MSL) value is noted on the packaging label of each reel.

Manual or hand soldering is not recommended but if necessary the same temperature profile as the normal reflow soldering should be used. The peak temperature must not exceed the standard assembly reflow process.



IPC-020e-5-1

Profile Feature	Sn-Pb Eutectic Assembly	Pb-Free Assembly
<b>Preheat/Soak</b>		
Temperature Min ( $T_{\text{min}}$ )	100 °C	150 °C
Temperature Max ( $T_{\text{max}}$ )	150 °C	200 °C
Time ( $t_s$ ) from ( $T_{\text{min}}$ ) to ( $T_{\text{max}}$ )	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.

Table 4-2 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

Figure 10. Typical Reflow Profile and Table 4-2 Provided as Reference Only.

Table 4-1 Not Included. Please Reference J-STD-020 for Full Details.

## 9.0 Product Shelf Life / Floor Life

Shelf life for semiconductor products is based on a number of factors, including moisture sensitivity level (MSL), use of moisture barrier bags (MBBs) and desiccant in product packaging. Under normal use, and assuming reasonable turn of inventory, there should be no shelf life concerns.

Guerrilla RF's semiconductor parts are typically shipped in moisture-barrier bags (MBB) with desiccant and humidity indicator card (HIC). The MSL rating is noted on the package labeling. Unless otherwise expressly noted, shelf life expectancy is unlimited from bag seal date, provided storage conditions adhere to IPC/JEDEC J-STD-033C.

If the humidity indicator card (HIC) indicates that baking is not required, then it is safe to reflow the components per the original MSL rating. In all instances, Guerrilla RF recommends maintaining best known practices and to always properly reheat-seal the moisture barrier bag after opening.

Please note that although unanticipated, factors other than moisture sensitivity could affect the total shelf life of components. Guerrilla RF assumes no responsibility for mishandled or improperly stored / resealed products.

Table 5-1 Moisture Classification Level and Floor Life

Moisture Sensitivity Level	Floor Life (out of bag) at factory ambient $\leq 30^{\circ}\text{C}/60\% \text{ RH}$ or as stated
1	Unlimited at $\leq 30^{\circ}\text{C}/85\% \text{ RH}$
2	1 year
2a	4 weeks
3	168 hours
4	72 hours
5	48 hours
5a	24 hours
6	Mandatory bake before use. After bake, must be reflowed within the time limit specified on the label.

## 10.0 Maximum Device Ratings

Adherence to a device's maximum rating is critical to assuring a successful launch and production defects per million (DPM) performance. The maximum ratings table can be found in each products Data Sheet. Exceeding Absolute Maximum Rating conditions will cause permanent damage to the device. It is necessary to verify no transients or overshoot for direct current (DC) or radio frequency (RF) occur during turn-on or power-on sequencing. This is critical in any lab/qualification testing and final production line testing. Verification should be repeated if new test code or instruments are swapped out for calibration. Verification of compliance is critical to assure successful quality performance.

For more information, please view Guerrilla RF reference document, "Electrical Overstress Overview" on the Guerrilla RF Resource Center located at <https://www.guerrilla-rf.com/documents/general/Guerrilla%20RF%20Electrical%20Overstress%20Overview.pdf>

### Absolute Ratings

Parameter	Symbol	Min.	Max.	Unit
Supply Voltage	$V_{DD}$	0	9.0	V
RF Input Power (Load VSWR <2:1; $V_D \leq 8.0$ Volts)	$P_{IN\ MAX}$		22	dBm
Operating Temperature (Package Heat Sink)	$T_{AMB}$	-40	105	°C
Maximum Channel Temperature (MTTF >10 <sup>6</sup> Hours)	$T_{MAX}$		170	°C
Maximum Dissipated Power	$P_{DISS\ MAX}$		1.0	W

Electrostatic Discharge				
Charged Device Model	CDM	1500		V
Human Body Model	HBM	250		V

Storage				
Storage Temperature	$T_{STG}$	-65	150	°C
Moisture Sensitivity Level	MSL		1	-

Figure 10. Typical Absolute Ratings Table Located in Each Product Data Sheet.

## 11.0 Environmental Information

Guerrilla RF is committed to ensuring that our products comply with government directives such as Restriction of Hazardous Substances (RoHS), Registration, Evaluation, Authorization and Restriction of Chemicals (REACH), California Proposition 65 and Conflict Mineral sourcing.

Additional Information can be found at the Guerrilla RF Resource Center located at <https://www.guerrilla-rf.com/resources/documents>.

## 12.0 Disclaimers

Information in this fighter guide is specific to the Guerrilla RF, Inc. ("Guerrilla RF") product identified.

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## Appendix A: Revision History

Revision	Date   Reason for Revision
Revision H	1/17/2020 Removed POD reference