

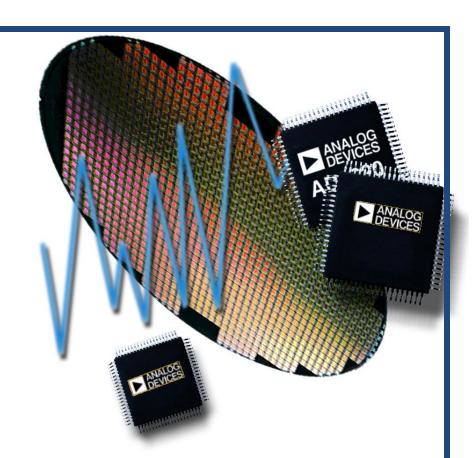


# Analog Devices Welcomes Hittite Microwave Corporation

NO CONTENT ON THE ATTACHED DOCUMENT HAS CHANGED







# Reliability Report

**Report Title:** Qualification Test Report

**Report Type:** See Attached

**Date:** See Attached

QTR: 2014- 00364 Rev: 02

Package: LP2, LP2C, LP3, LP3B, LP3C, LP3D, LP3F, LP3G

HMC241LP3	HMC500LP3	HMC712LP3C	HMC3653LP3B
HMC311LP3	HMC536LP2	HMC713LP3	HMC7095ALP3
HMC344LP3	HMC539LP3	HMC715LP3	HMC7150LP3D
HMC345LP3	HMC540LP3	HMC716LP3	
HMC346LP3	HMC541LP3	HMC717LP3	
HMC347LP3	HMC546LP2	HMC720LP3	
HMC348LP3	HMC547LP3	HMC721LP3	
HMC356LP3	HMC548LP3	HMC722LP3	
HMC369LP3	HMC561LP3	HMC723LP3	
HMC372LP3	HMC593LP3	HMC758LP3	
HMC373LP3	HMC604LP3	HMC759LP3	
HMC375LP3	HMC605LP3	HMC788LP2	
HMC376LP3	HMC616LP3	HMC794LP3	
HMC382LP3	HMC617LP3	HMC799LP3	
HMC408LP3	HMC618LP3	HMC800LP3	
HMC415LP3	HMC630LP3	HMC801LP3	
HMC424LP3	HMC631LP3	HMC802LP3	
HMC425LP3	HMC646LP2	HMC860LP3	
HMC427LP3	HMC652LP2	HMC862LP3	
HMC441LP3	HMC653LP2	HMC902LP3	
HMC451LP3	HMC654LP2	HMC903LP3	
HMC455LP3	HMC655LP2	HMC905LP3	
HMC461LP3	HMC656LP2	HMC916LP3	
HMC467LP3	HMC657LP2	HMC917LP3	
HMC468LP3	HMC658LP2	HMC948LP3	
HMC470LP3	HMC662LP3	HMC973LP3	
HMC491LP3	HMC667LP2	HMC976LP3	
HMC492LP3	HMC668LP3	HMC981LP3	
HMC493LP3	HMC669LP3	HMC1044LP3	
HMC494LP3	HMC674LP3	HMC1060LP3	
HMC495LP3	HMC675LP3	HMC1090LP3	
HMC496LP3	HMC676LP3	HMC1094LP3	

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## Introduction

The Reliability tests summarized in this report are designed to satisfy the reliability requirements designated by Hittite Microwave Corporation. The testing was devised to simulate exposure to environments the product may experience during assembly, test, and life in the end user application. The pass/fail criteria are dependent upon DC and critical RF parameters determined by the appropriate catalog specifications.

This report is intended to summarize all of the package reliability test data for the LP2, LP3, and their variants. The data contained in this report includes all the stress testing performed on these packages to date and will be updated periodically as additional data becomes available. Data sheets for the tested devices can be found at www.hittite.com.

## **Glossary of Terms & Definitions:**

- **1. Autoclave:** A highly accelerated moisture stress test (unbiased). Devices are subjected to 96 hours of 100% relative humidity at a temperature of 121°C and pressure (14.7 PSIG). This test is performed in accordance with JEDEC JESD22-A102.
- 2. CDM: Charged Device Model. A specified ESD testing circuit characterizing an event that occurs when a device acquires charge through some triboelectric (frictional) or electrostatic induction processes and then abruptly touches a grounded object or surface. This test was performed in accordance with JEDEC 22-C101.
- **3. ESD:** Electro-Static Discharge. A sudden transfer of electrostatic charge between bodies or surfaces at different electrostatic potentials.
- **4. HAST:** Highly Accelerated Stress Test (biased). Devices are subjected to 96 hours of 85% relative humidity at a temperature of 130°C and pressure (18.6 PSIG), while DC biased. This test is performed in accordance with JEDEC JESD22-A110.
- **5. HBM:** Human Body Model. A specified ESD testing circuit characterizing an event that occurs when a device is subjected to an electro-static charge stored in the human body and discharged through handling of the electronic device. This test was performed in accordance with JEDEC 22-A114.
- **6. HTOL:** High Temperature Operating Life. This test is used to determine the effects of bias conditions and temperature on semiconductor devices over time. It simulates the devices' operating condition in an accelerated way, through high temperature and/or bias voltage, and is primarily for device qualification and reliability monitoring. This test was performed in accordance with JEDEC JESD22-A108.
- 7. HTSL: High Temperature Storage Life. Devices are subjected to 1000 hours at 150°C per JESD22-A103.

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- **8. MSL Preconditioning:** Moisture sensitivity level pre-conditioning is performed in accordance with JEDEC JESD22-A113, lead free, 260°C peak temperature (see Appendix 1 for reflow profile).
- **9. Physical Dimensions:** Devices are inspected to the current package outline drawing to ensure all package dimensions are within specification (see Appendix 2 for applicable outline drawings).
- **10. Solderability:** Devices are subjected to 8 hours of steam age and Method 1 Dip and Look testing in accordance with JEDEC JESD22-B102.
- **11. Temperature Cycle:** Devices are subjected to 500 non-operating temperature cycling from -65°C to 150°C in accordance with JEDEC JESD22-A104.
- **12. THB:** Temperature Humidity Bias. Devices are subjected to 1000 hours of 85% relative humidity at a temperature of 85°C, while DC biased. This test is performed in accordance with JESD22-A101.
- **13. UHAST:** Unbiased Highly Accelerated Stress Test. Devices are subjected to 96 hours of 85% relative humidity at a temperature of 130°C and pressure (18.6 PSIG). This test was performed in accordance with JEDEC JESD22-A118.
- **14. X-Ray Analysis:** Devices are inspected to the current assembly drawing to ensure devices are assembled correctly and are free of any assembly anomalies.

## **Qualification Sample Selection:**

All qualification devices used were manufactured and tested on standard production processes and met pre-stress acceptance test requirements.

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## **Summary of Qualification Tests:**

## HMC470LP3 (QTR10007)

TEST	QTY IN	QTY OUT	PASS / FAIL	NOTES
Initial Electrical	190	190	Complete	
MSL1 Preconditioning	160	160	Complete	
MSL1 Preconditioning Final Test	160	160	Pass	
Autoclave (Preconditioned)	80	80	Complete	
Autoclave Final Test	80	80	Pass	
Temperature Cycle (Preconditioned)	80	80	Complete	
Temperature Cycle Final Test	80	80	Pass	
Solderability	15	15	Pass	
Physical Dimensions	15	15	Pass	

## HMC424LP3 (QTR11003)

TEST	QTY IN	QTY OUT	PASS / FAIL	NOTES
Initial Electrical	160	160	Complete	
MSL1 Preconditioning	160	160	Complete	
MSL1 Preconditioning Final Test	160	160	Pass	
Autoclave (Preconditioned)	80	80	Complete	
Autoclave Final Test	80	80	Pass	
Temperature Cycle (Preconditioned)	80	80	Complete	
Temperature Cycle Final Test	80	80	Pass	

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## HMC976LP3 (QTR2012-00028)

TEST	QTY IN	QTY OUT	PASS / FAIL	NOTES
Initial Electrical	383	383	Complete	
HTSL, 1000 hours	80	80	Complete	
Post HTSL Electrical Test	80	80	Pass	
HTOL, 1000 hours	80	80	Complete	
Post HTOL Electrical Test	80	80	Pass	
MSL1 Preconditioning	160	160	Complete	
MSL1 Preconditioning Final Test	160	160	Pass	
UHAST (Preconditioned)	80	80	Complete	
UHAST Final Test	80	80	Pass	
Temperature Cycle (Preconditioned)	80	80	Complete	
Temperature Cycle Final Test	80	80	Pass	
Solderability	6	6	Pass	
Physical Dimensions	15	15	Pass	
X-Ray Analysis	6	6	Pass	
ESD	36	36	Complete	
ESD Final Test	36	36	Complete	CDM Class C5 HBM Class 3A MM Class M4

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## HMC451LP3 (QTR2012-00325)

TEST	QTY IN	QTY OUT	PASS / FAIL	NOTES
Initial Electrical	387	387	Complete	
HTSL, 1000 hours	80	80	Complete	
Post HTSL Electrical Test	80	80	Pass	
HTOL, 1000 hours	80	80	Complete	
Post HTOL Electrical Test	80	80	Pass	
MSL1 Preconditioning	160	160	Complete	
MSL1 Preconditioning Final Test	160	160	Pass	
UHAST (Preconditioned)	80	80	Complete	
UHAST Final Test	80	80	Pass	
Temperature Cycle (Preconditioned)	80	80	Complete	
Temperature Cycle Final Test	80	80	Pass	
Solderability	6	6	Pass	
Physical Dimensions	15	15	Pass	
X-Ray Analysis	10	10	Pass	
ESD	36	36	Complete	
ESD Final Test	36	36	Complete	CDM Class III HBM Class 1A MM Class M1C

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## HMC1040LP3CE (QTR2012-00327)

TEST	QTY IN	QTY OUT	PASS / FAIL	NOTES
Initial Electrical	373	373	Complete	
HTSL, 1000 hours	80	80	Complete	
Post HTSL Electrical Test	80	80	Pass	
HTOL, 1000 hours	81	81	Complete	
Post HTOL Electrical Test	81	81	Pass	
MSL1 Preconditioning	160	160	Complete	
MSL1 Preconditioning Final Test	160	160	Pass	
UHAST (Preconditioned)	80	80	Complete	
UHAST Final Test	80	80	Pass	
Temperature Cycle (Preconditioned)	78	78	Complete	
Temperature Cycle Final Test	78	78	Pass	
Solderability	6	6	Pass	
Physical Dimensions	15	15	Pass	
X-Ray Analysis	6	6	Pass	
ESD	27	27	Complete	
ESD Final Test	27	27	Complete	CDM Class IV HBM Class 0

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## HMC347LP3 (QTR2013-00044)

TEST	QTY IN	QTY OUT	PASS / FAIL	NOTES
Initial Electrical	267	267	Complete	
HTSL, 1000 hours	77	77	Complete	
Post HTSL Electrical Test	77	77	Pass	
MSL1 Preconditioning	154	154	Complete	
MSL1 Preconditioning Final Test	154	154	Pass	
UHAST (Preconditioned)	77	77	Complete	
UHAST Final Test	77	77	Pass	
Temperature Cycle (Preconditioned)	77	77	Complete	
Temperature Cycle Final Test	77	77	Pass	
Solderability	6	6	Pass	
Physical Dimensions	15	15	Pass	
X-Ray Analysis	15	15	Pass	

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## HMC347LP3 (QTR2013-00048)

TEST	QTY IN	QTY OUT	PASS / FAIL	NOTES
Initial Electrical	276	276	Complete	
HTSL, 1000 hours	80	80	Complete	
Post HTSL Electrical Test	80	80	Pass	
MSL1 Preconditioning	160	160	Complete	
MSL1 Preconditioning Final Test	160	160	Pass	
UHAST (Preconditioned)	80	80	Complete	
UHAST Final Test	80	80	Pass	
Temperature Cycle (Preconditioned)	80	80	Complete	
Temperature Cycle Final Test	80	80	Pass	
Solderability	6	6	Pass	
Physical Dimensions	15	15	Pass	
X-Ray Analysis	15	15	Pass	

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QTR: 2014- 00364 Rev: 02

Package: LP2, LP2C, LP3, LP3B, LP3C, LP3D, LP3F, LP3G

## HMC7095ALP3E (QTR2013-00246)

TEST	QTY IN	QTY OUT	PASS / FAIL	NOTES
Initial Electrical			Complete	
HTSL, 1000 hours	80	80	Complete	
Post HTSL Electrical Test	80	80	Pass	
MSL1 Preconditioning	160	160	Complete	
MSL1 Preconditioning Final Test	160	160	Pass	
UHAST (Preconditioned)	80	80	Complete	
UHAST Final Test	80	80	Pass	
Temperature Cycle (Preconditioned)	80	80	Complete	
Temperature Cycle Final Test	80	80	Pass	
Solderability	6	6	Pass	
X-Ray Analysis	6	6	Pass	
ESD	36	36	Complete	
ESD Final Test	36	36	Complete	CDM Class III HBM Class 1B MM Class M1C

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Package: LP2, LP2C, LP3, LP3B, LP3C, LP3D, LP3F, LP3G

## HMC7095ALP3E (QTR2013-00246)

TEST	QTY IN	QTY OUT	PASS / FAIL	NOTES
Initial Electrical	291	291	Complete	
HTSL, 1000 hours	80	80	Complete	
Post HTSL Electrical Test	80	80	Pass	
MSL1 Preconditioning	160	160	Complete	
MSL1 Preconditioning Final Test	160	160	Pass	
UHAST (Preconditioned)	80	80	Complete	
UHAST Final Test	80	80	Pass	
Temperature Cycle (Preconditioned)	80	80	Complete	
Temperature Cycle Final Test	80	80	Pass	
Solderability	6	6	Pass	
X-Ray Analysis	6	6	Pass	
ESD	39	39	Complete	
ESD Final Test	39	39	Complete	CDM Class III HBM Class 1B MM pass 100V

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Package: LP2, LP2C, LP3, LP3B, LP3C, LP3D, LP3F, LP3G

## HMC7150LP3DE (QTR2013-00338)

TEST	QTY IN	QTY OUT	PASS / FAIL	NOTES
Initial Electrical	414	414	Complete	
HTSL, 1000 hours	80	80	Complete	
Post HTSL Electrical Test	80	80	Pass	
HTOL, 1000 hours	80	80	Complete	
Post HTOL Electrical Test	80	80	Pass	
MSL1 Preconditioning	160	160	Complete	
MSL1 Preconditioning Final Test	160	160	Pass	
UHAST (Preconditioned)	80	80	Complete	
UHAST Final Test	80	80	Pass	
THB (Preconditioned)	27	27	Complete	
THB Final Test	27	27	Pass	
Temperature Cycle (Preconditioned)	80	80	Complete	
Temperature Cycle Final Test	80	80	Pass	
Solderability	6	6	Pass	
Physical Dimensions	15	15	Pass	
X-Ray Analysis	10	10	Pass	
ESD	36	36	Complete	
ESD Final Test	36	36	Complete	CDM Class IV HBM Class 1A MM Class M1C

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Package: LP2, LP2C, LP3, LP3B, LP3C, LP3D, LP3F, LP3G

## Cumulative Summary of All LP2 & LP3 Package Tests

TEST	Total Units Tested	Total Units Passed	Total Units Failed	Comments
HTSL, 1000 hours	637	637	0	
Autoclave (Preconditioned)	160	160	0	
UHAST (Preconditioned)	637	637	0	
Temperature Cycle (Preconditioned)	795	795	0	
THB (Preconditioned)	27	27	0	
Solderability	63	63	0	
Physical Dimensions	105	105	0	
X-Ray Analysis	74	74	0	

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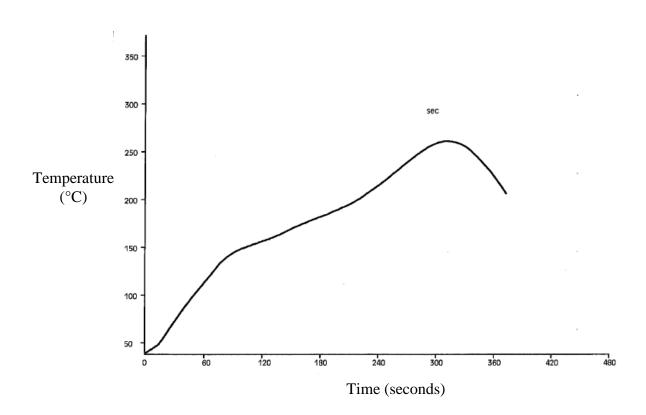




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Package: LP2, LP2C, LP3, LP3B, LP3C, LP3D, LP3F, LP3G

## Appendix 1



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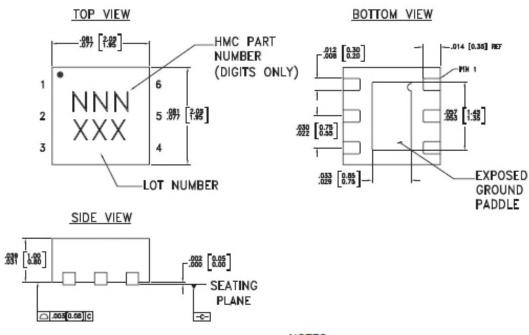


QTR: 2014- 00364 Rev: 02

Package: LP2, LP2C, LP3, LP3B, LP3C, LP3D, LP3F, LP3G

## Appendix 2

## LP2 Outline



## NOTES:

- 1. LEADFRAME MATERIAL: COPPER ALLOY
- 2. DIMENSIONS ARE IN INCHES [MILLIMETERS]
- 3. PAD SPACING TOLERANCE IS NON-CUMULATIVE
- PAD BURR LENGTH SHALL BE 0.15mm MAXIMUM.
   PAD BURR HEIGHT SHALL BE 0.05mm MAXIMUM.
- 5. PACKAGE WARP SHALL NOT EXCEED 0.05mm.
- ALL GROUND LEADS AND GROUND PADDLE MUST BE SOLDERED TO PCB RF GROUND.
- REFER TO HITTITE APPLICATION NOTE FOR SUGGESTED LAND PATTERN.

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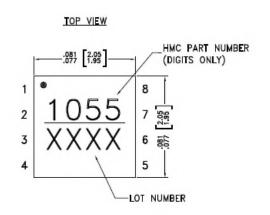


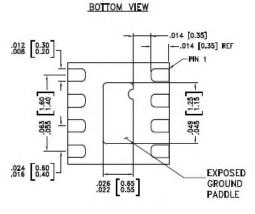


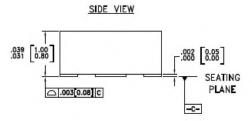
QTR: 2014- 00364 Rev: 02

Package: LP2, LP2C, LP3, LP3B, LP3C, LP3D, LP3F, LP3G

## **LP2C Outline**







#### NOTES:

- PACKAGE BODY MATERIAL: LOW STRESS INJECTION MOLDED PLASTIC SILICA AND SILICON IMPREGNATED.
- LEAD AND GROUND PADDLE MATERIAL: COPPER ALLOY.
- 3. LEAD AND GROUND PADDLE PLATING: 100% MATTE TIN.
- 4. DIMENSIONS ARE IN INCHES [MILLIMETERS].
- 5. LEAD SPACING TOLERANCE IS NON-CUMULATIVE.
- CHARACTERS TO BE HELVETICA MEDIUM, .016 HIGH, OR LASER MARK LOCATED APPROX. AS SHOWN.
- 7. PAD BURR LENGTH SHALL BE 0.15mm MAX. PAD BURR HEIGHT SHALL BE 0.05mm MAX.
- 8. PACKAGE WARP SHALL NOT EXCEED 0.05mm
- 9. ALL GROUND LEADS AND GROUND PADDLE MUST BE SOLDERED TO PCB RF GROUND.
- 10. REFER TO HITTITE APPLICATION NOTE FOR SUGGESTED PCB LAND PATTE

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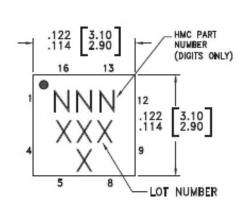


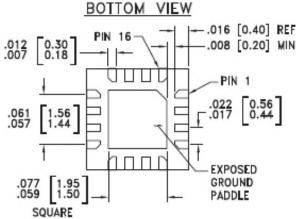


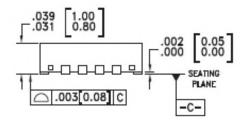
QTR: 2014- 00364 Rev: 02

Package: LP2, LP2C, LP3, LP3B, LP3C, LP3D, LP3F, LP3G

## LP3 Outline







### NOTES:

- 1. LEADFRAME MATERIAL: COPPER ALLOY
- 2. DIMENSIONS ARE IN INCHES [MILLIMETERS]
- 3. PAD SPACING TOLERANCE IS NON-CUMULATIVE
- PAD BURR LENGTH SHALL BE 0.15mm MAXIMUM.
   PAD BURR HEIGHT SHALL BE 0.05mm MAXIMUM.
- PACKAGE WARP SHALL NOT EXCEED 0.05mm.
- ALL GROUND LEADS AND GROUND PADDLE MUST BE SOLDERED TO PCB RF GROUND.
- REFER TO HITTITE APPLICATION NOTE FOR SUGGESTED LAND PATTERN.

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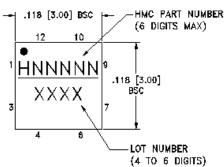


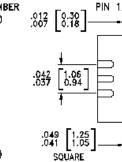
QTR: 2014- 00364 **Rev: 02** 

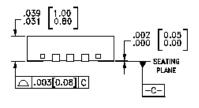
Package: LP2, LP2C, LP3, LP3B, LP3C, LP3D, LP3F, LP3G

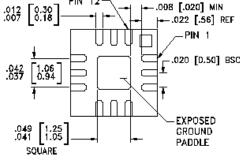
## **LP3B Outline**

## BOTTOM VIEW









- 1. PACKAGE BODY MATERIAL: LOW STRESS INJECTION MOLDED PLASTIC SILICA AND SILICON IMPREGNATED.
- 2. LEAD AND GROUND PADDLE MATERIAL: COPPER ALLOY.
- 3. LEAD AND GROUND PADDLE PLATING: 100% MATTE TIN.
- 4. DIMENSIONS ARE IN INCHES [MILLIMETERS].
- 5. LEAD SPACING TOLERANCE IS NON-CUMULATIVE.
- 6. CHARACTERS TO BE HELVETICA MEDIUM, .018 HIGH, WHITE INK, OR LASER MARK LOCATED APPROX. AS SHOWN.
- 7. PAD BURR LENGTH SHALL BE 0.15mm MAX. PAD BURR HEIGHT SHALL BE 0.05mm MAX.
- 8. PACKAGE WARP SHALL NOT EXCEED 0.05mm
- 9. ALL GROUND LEADS AND GROUND PADDLE MUST BE SOLDERED TO PCB RE GROUND.
- 10. REFER TO HITTITE APPLICATION NOTE FOR SUGGESTED PCB LAND PATTERN.

## Hittite Microwave Corporation is committed to:

- · Supplying products of the highest quality
- · Advance in state-of-the-art technology that supports our products
- · Enhance our competitive position with superior product standards

- · Take the initiative to ensure product quality
- · Create an environment where the highest standards are maintained
- · Continue to improve quality practices



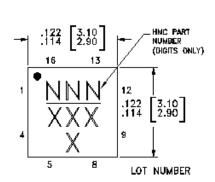


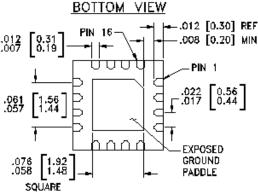


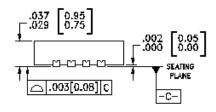
QTR: 2014- 00364 Rev: 02

Package: LP2, LP2C, LP3, LP3B, LP3C, LP3D, LP3F, LP3G

## **LP3C Outline**







#### NOTES:

- 1. PACKAGE BODY MATERIAL: LOW STRESS INJECTION MOLDED PLASTIC SILICA AND SILICON IMPREGNATED.
- 2. LEAD AND GROUND PADDLE MATERIAL: COPPER ALLOY.
- 3. LEAD AND GROUND PADDLE PLATING: NIPdAu.
- 4. DIMENSIONS ARE IN INCHES [MILLIMETERS].
- 5. LEAD SPACING TOLERANCE IS NON-CUMULATIVE.
- 8. CHARACTERS TO BE HELVETICA MEDIUM, .025 HIGH, WHITE INK, OR LASER MARK LOCATED APPROX. AS SHOWN.
- 7. PAD BURR LENGTH SHALL BE 0.15mm MAX. PAD BURR HEIGHT SHALL BE 0.05mm MAX.
- B. PACKAGE WARP SHALL NOT EXCEED 0.05mm
- 9. ALL GROUND LEADS AND GROUND PADDLE MUST BE SOLDERED TO PGB RF GROUND.
- 10. REFER TO HITTITE APPLICATION NOTE FOR SUGGESTED PCB LAND PATTERN.

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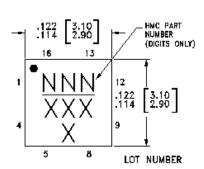


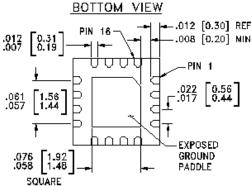


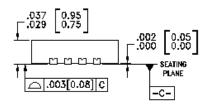
QTR: 2014- 00364 Rev: 02

Package: LP2, LP2C, LP3, LP3B, LP3C, LP3D, LP3F, LP3G

## **LP3D Outline**







#### NOTES:

- 1. PACKAGE BODY MATERIAL: LOW STRESS INJECTION MOLDED PLASTIC SILICA AND SILICON IMPREGNATED.
- 2. LEAD AND GROUND PADDLE MATERIAL: COPPER ALLOY.
- 3. LEAD AND GROUND PADDLE PLATING: NIPdau.
- 4. DIMENSIONS ARE IN INCHES [MILLIMETERS].
- 5. LEAD SPACING TOLERANCE IS NON-CUMULATIVE.
- 6. CHARACTERS TO BE HELVETICA MEDIUM, JO25 HIGH, WHITE INK, OR LASER MARK LOCATED APPROX. AS SHOWN.
- 7. PAD BURR LENGTH SHALL BE 0.15mm MAX. PAD BURR HEIGHT SHALL BE 0.05mm MAX.
- 8. PACKAGE WARP SHALL NOT EXCEED 0.05mm
- 9. ALL GROUND LEADS AND GROUND PADDLE MUST BE SOLDERED TO PCB RF GROUND.
- 10. REFER TO HITTITE APPLICATION NOTE FOR SUGGESTED PCB LAND PATTERN.

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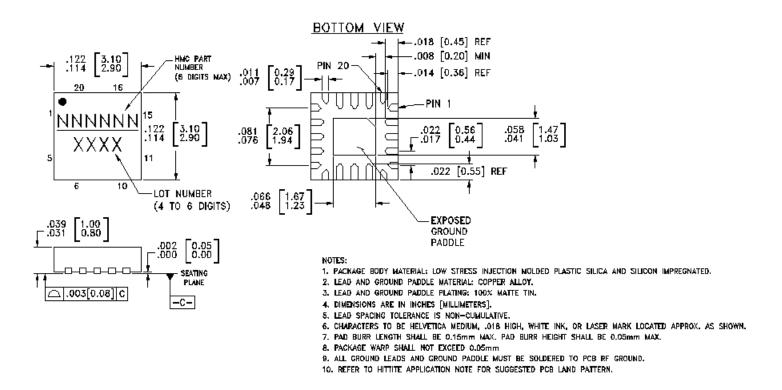




QTR: 2014- 00364 Rev: 02

Package: LP2, LP2C, LP3, LP3B, LP3C, LP3D, LP3F, LP3G

## **LP3F** Outline



## Hittite Microwave Corporation is committed to:

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- · Create an environment where the highest standards are maintained
- · Continue to improve quality practices



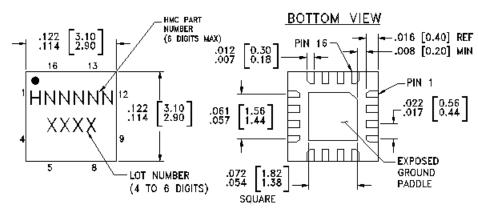


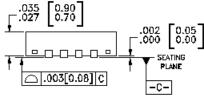


QTR: 2014- 00364 Rev: 02

Package: LP2, LP2C, LP3, LP3B, LP3C, LP3D, LP3F, LP3G

## **LP3G Outline**





#### NOTES:

- 1. PACKAGE BODY MATERIAL: LOW STRESS INJECTION MOLDED PLASTIC SILICA AND SILICON IMPREGNATED.
- 2. LEAD AND GROUND PADDLE MATERIAL: COPPER ALLOY.
- 3. LEAD AND GROUND PADDLE PLATING: Sn/Pb SOLDER.
- 4. DIMENSIONS ARE IN INCHES [MILLIMETERS].
- 5. LEAD SPACING TOLERANCE IS NON-CUMULATIVE.
- 8. CHARACTERS TO BE HELVETICA MEDIUM, .018 HIGH, WHITE INK, OR LASER MARK LOCATED APPROX. AS SHOWN.
- 7. PAD BURR LENGTH SHALL BE 0.15mm MAX. PAD BURR HEIGHT SHALL BE 0.05mm MAX.
- 8. PACKAGE WARP SHALL NOT EXCEED 0.05mm
- 9. ALL GROUND LEADS AND GROUND PADDLE MUST BE SOLDERED TO PCB RF GROUND.
- 10. REFER TO HITTITE APPLICATION NOTE FOR SUGGESTED PCB LAND PATTERN.

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