Freescale Semiconductor
Technical Data

Document Number: MHT1004N
Rev. 1, 8/2016

RF Power LDMOS Transistors

N-Channel Enhancement-Mode Lateral MOSFETs

These 300 W CW high efficiency RF power transistors are designed for consumer and commercial cooking applications operating in the 2450 MHz ISM band.

Typical Performance: V_{DD} = 32 Vdc, I_{DQ} = 100 mA

Frequency (MHz)	Signal Type	G_{ps} (dB)	PAE (%)	P_{out} (W)
2450	CW	15.2	57.9	300

Load Mismatch/Ruggedness

Frequency (MHz)	Signal Type	VSWR	P_{in} (W)	Test Voltage	Result
2450	CW	> 5:1 at all Phase Angles	15.0 (2 dB Overdrive)	32	No Device Degradation

Features

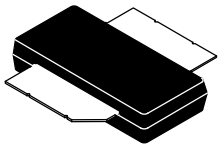
- Characterized with series equivalent large-signal impedance parameters and common source S-parameters
- Internally matched for ease of use
- Qualified for operation at 32 Vdc
- Integrated ESD protection
- 150°C case operating temperature
- 225°C die temperature capability

Target Applications

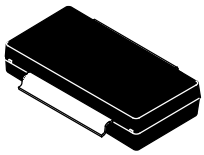
- Consumer cooking
- Commercial cooking

MHT1004N
MHT1004GN

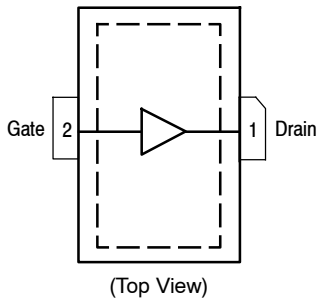
2450 MHz, 300 W CW, 32 V
RF POWER LDMOS TRANSISTORS
FOR CONSUMER AND
COMMERCIAL COOKING



OM-780-2L
PLASTIC
MHT1004N



OM-780G-2L
PLASTIC
MHT1004GN



(Top View)

Note: Exposed backside of the package is the source terminal for the transistor.

Figure 1. Pin Connections

Table 1. Maximum Ratings

Rating	Symbol	Value	Unit
Drain-Source Voltage	V_{DSS}	–0.5, +65	Vdc
Gate-Source Voltage	V_{GS}	–6.0, +10	Vdc
Operating Voltage	V_{DD}	32, +0	Vdc
Storage Temperature Range	T_{stg}	–65 to +150	°C
Case Operating Temperature Range	T_C	–40 to +150	°C
Operating Junction Temperature Range (1,2)	T_J	–40 to +225	°C
Total Device Dissipation @ T_C = 25°C Derate above 25°C	P_D	833 4.17	W W/°C

Table 2. Thermal Characteristics

Characteristic	Symbol	Value (2,3)	Unit
Thermal Resistance, Junction to Case Case Temperature 88°C, 300 W CW, 32 Vdc, I_{DQ} = 100 mA, 2450 MHz	$R_{\theta JC}$	0.24	°C/W

Table 3. ESD Protection Characteristics

Test Methodology	Class
Human Body Model (per JESD22-A114)	2, passes 2500 V
Machine Model (per EIA/JESD22-A115)	B, passes 250 V
Charge Device Model (per JESD22-C101)	IV, passes 2000 V

Table 4. Moisture Sensitivity Level

Test Methodology	Rating	Package Peak Temperature	Unit
Per JESD22-A113, IPC/JEDEC J-STD-020	3	260	°C

Table 5. Electrical Characteristics (T_A = 25°C unless otherwise noted)

Characteristic	Symbol	Min	Typ	Max	Unit
Off Characteristics					
Zero Gate Voltage Drain Leakage Current (V_{DS} = 65 Vdc, V_{GS} = 0 Vdc)	I_{DSS}	—	—	10	μAdc
Zero Gate Voltage Drain Leakage Current (V_{DS} = 32 Vdc, V_{GS} = 0 Vdc)	I_{DSS}	—	—	1	μAdc
Gate-Source Leakage Current (V_{GS} = 5 Vdc, V_{DS} = 0 Vdc)	I_{GSS}	—	—	1	μAdc
On Characteristics					
Gate Threshold Voltage (V_{DS} = 10 Vdc, I_D = 303 μAdc)	$V_{GS(th)}$	1.6	2.0	2.4	Vdc
Gate Quiescent Voltage (V_{DS} = 32 Vdc, I_D = 100 mAdc)	$V_{GS(Q)}$	—	2.5	—	Vdc
Drain-Source On-Voltage (V_{GS} = 10 Vdc, I_D = 3.7 Adc)	$V_{DS(on)}$	—	0.15	0.17	Vdc

1. Continuous use at maximum temperature will affect MTTF.
2. MTTF calculator available at http://www.nxp.com/RF/calculators.
3. Refer to AN1955, *Thermal Measurement Methodology of RF Power Amplifiers.* Go to http://www.nxp.com/RF and search for AN1955.

Table 6. Typical Performance

In Freescale Reference Circuit, 50 ohm system, V_{DD} = 32 Vdc, I_{DQ} = 100 mA, P_{out} = 300 W, 2450 MHz

Characteristic	Symbol	Min	Typ	Max	Unit
Power Gain	G_{ps}	—	15.2	—	dB
Power Added Efficiency	PAE	—	57.9	—	%
P_{out} @ 1 dB Compression Point	P1dB	—	280	—	W
P_{out} @ 3 dB Compression Point, CW	P3dB	—	320	—	W
Gain Variation over Temperature (+25°C to +125°C)	ΔG	—	–0.05 (1)	—	dB/°C
Output Power Variation over Temperature (+25°C to +125°C)	ΔP1dB	—	–0.009	—	dB/°C

Table 7. Load Mismatch/Ruggedness

In Freescale Reference Circuit, 50 ohm system, I_{DQ} = 100 mA

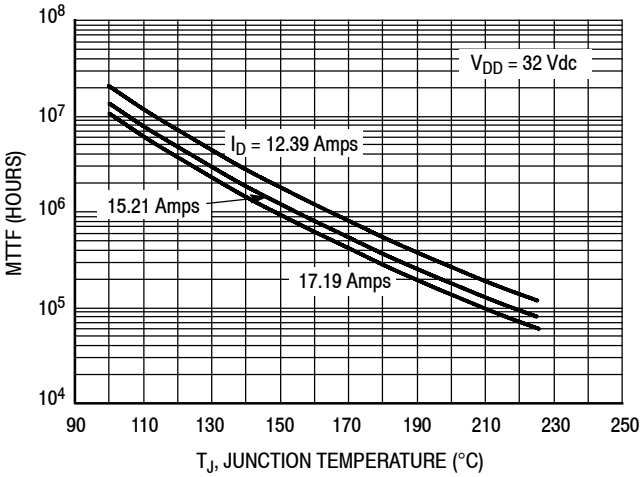
Frequency (MHz)	Signal Type	VSWR	P_{in} (W)	Test Voltage, V_{DD}	Result
2450	CW	> 5:1 at all Phase Angles	15.0 (2 dB Overdrive)	32	No Device Degradation

Table 8. Ordering Information

Device	Tape and Reel Information	Package
MHT1004NR3	R3 Suffix = 250 Units, 32 mm Tape Width, 13-inch Reel	OM-780-2L
MHT1004GNR3		OM-780G-2L

1. Extrapolated from measured power up to 275 W at 125°C.

TYPICAL CHARACTERISTICS



Note: MTTF value represents the total cumulative operating time under indicated test conditions.

MTTF calculator available at http://www.nxp.com/RF. Select Software & Tools/Development Tools/Calculators to access MTTF calculators by product.

Figure 2. MTTF versus Junction Temperature - CW

2450 MHz REFERENCE CIRCUIT — 2″ × 3″ (5.1 cm × 7.6 cm)

Table 9. 2450 MHz Performance (In Freescale Reference Circuit, 50 ohm system)
V_{DD} = 32 Vdc, I_{DQ} = 100 mA, T_A = 25°C

Frequency (MHz)	P_{in} (W)	G_{ps} (dB)	η_D (%)	PAE (%)	P_{out} (W)
2400	8.6	15.4	59.3	57.7	300
2450	9.0	15.2	59.6	57.9	300
2500	15.0	13.0	58.9	56.3	300

Table 10. Load Mismatch/Ruggedness (In Freescale Reference Circuit)

Frequency (MHz)	Signal Type	VSWR	P_{in} (W)	Test Voltage, V_{DD}	Result
2450	CW	> 5:1 at all Phase Angles	15.0 (2 dB Overdrive)	32	No Device Degradation

2450 MHz REFERENCE CIRCUIT — 2″ × 3″ (5.1 cm × 7.6 cm)

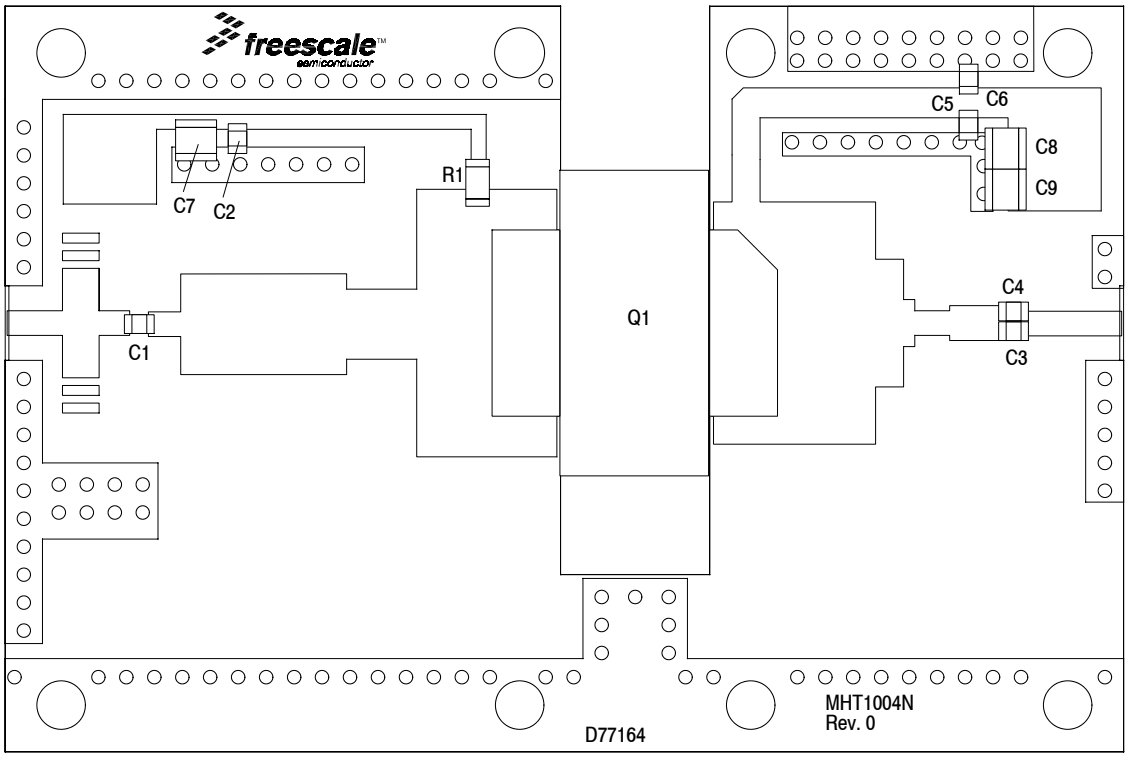


Figure 3. MHT1004N Production Test Circuit Component Layout

Table 11. MHT1004N Production Test Circuit Component Designations and Values

Part	Description	Part Number	Manufacturer
C1, C2, C3, C4, C5, C6	27 pF Chip Capacitors	ATC600F270JT250XT	ATC
C7, C8, C9	10 μF Chip Capacitors	GRM32ER61H106KA12L	Murata
Q1	RF Power LDMOS Transistor	MHT1004N	NXP
R1	10 Ω, 1/4 W Chip Resistor	CRCW120610R0JNEA	Vishay
PCB	Rogers RT6035HTC, 0.030″, ε_r = 3.5	D77164	MTL

TYPICAL CHARACTERISTICS — 2450 MHz REFERENCE CIRCUIT

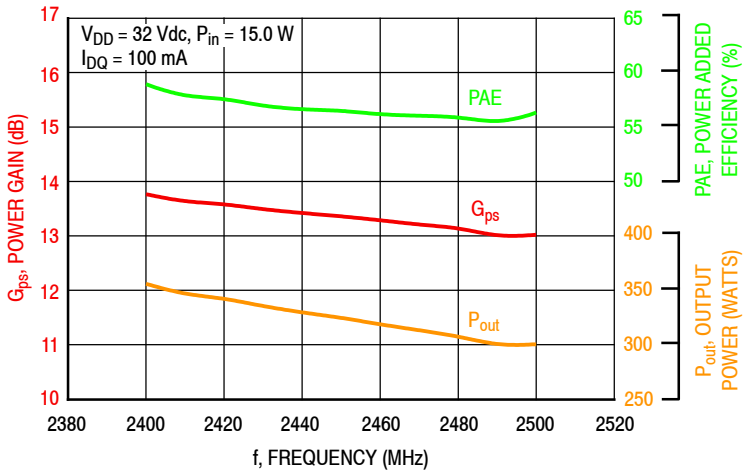


Figure 4. Power Gain, Power Added Efficiency and Output Power versus Frequency at a Constant Input Power

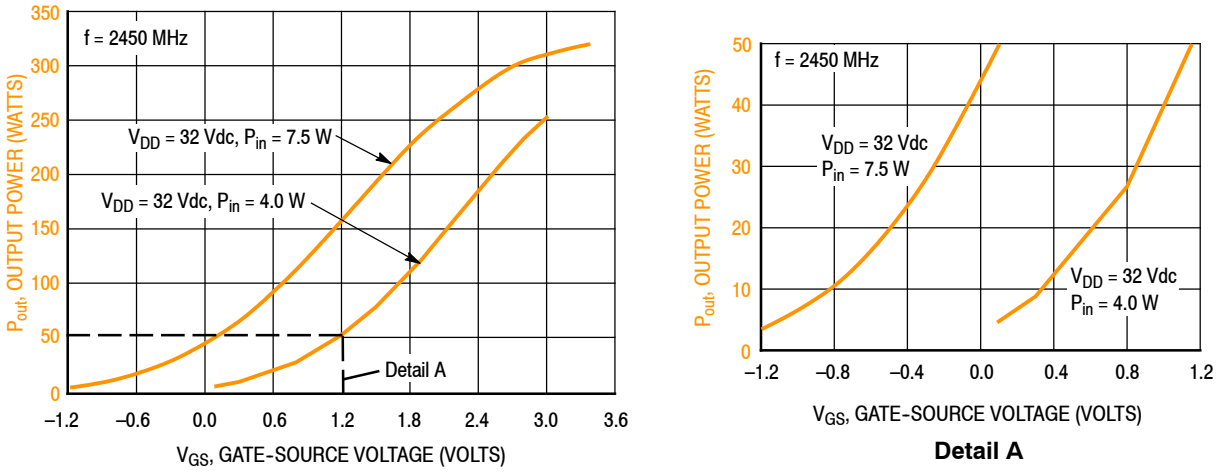


Figure 5. Output Power versus Gate-Source Voltage

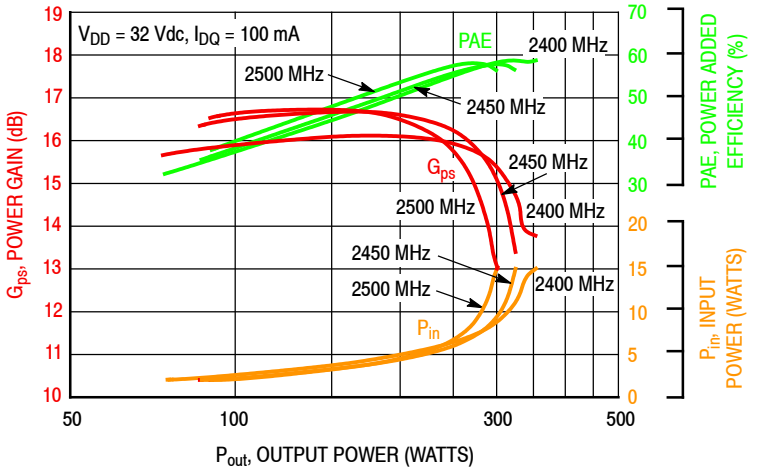


Figure 6. Power Gain, Power Added Efficiency and Input Power versus Output Power and Frequency

TYPICAL CHARACTERISTICS — 2450 MHz REFERENCE CIRCUIT

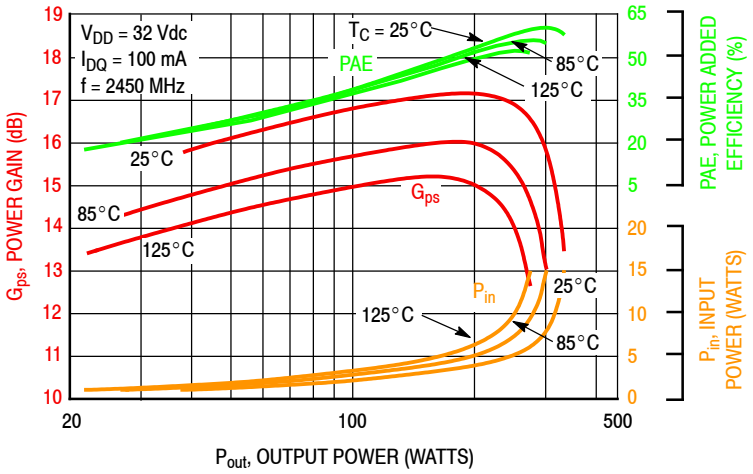
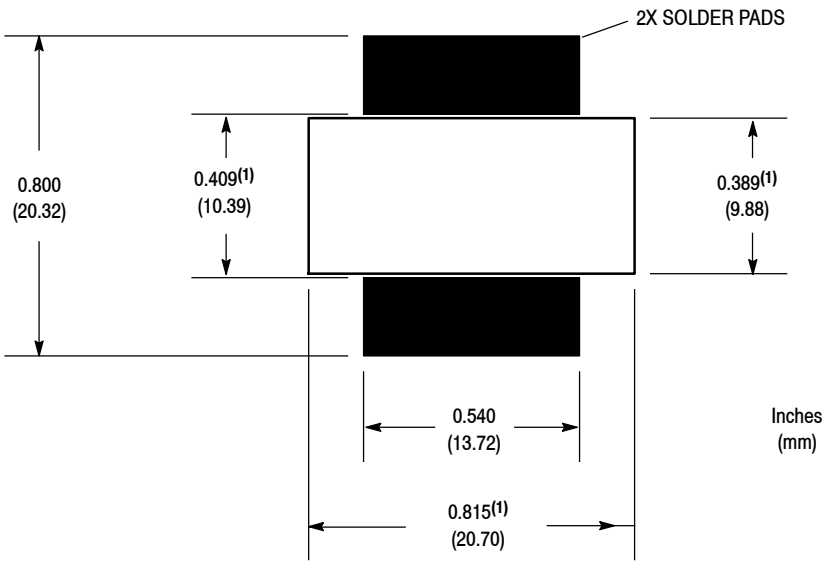


Figure 7. Power Gain, Power Added Efficiency and Input Power versus Output Power and Temperature



1. Slot dimensions are minimum dimensions and exclude milling tolerances

Figure 8. PCB Pad Layout for OM-780-2L

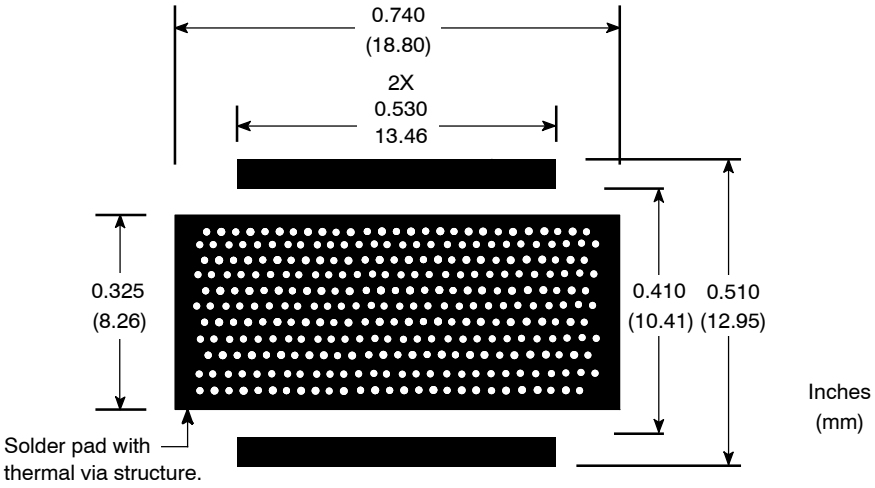
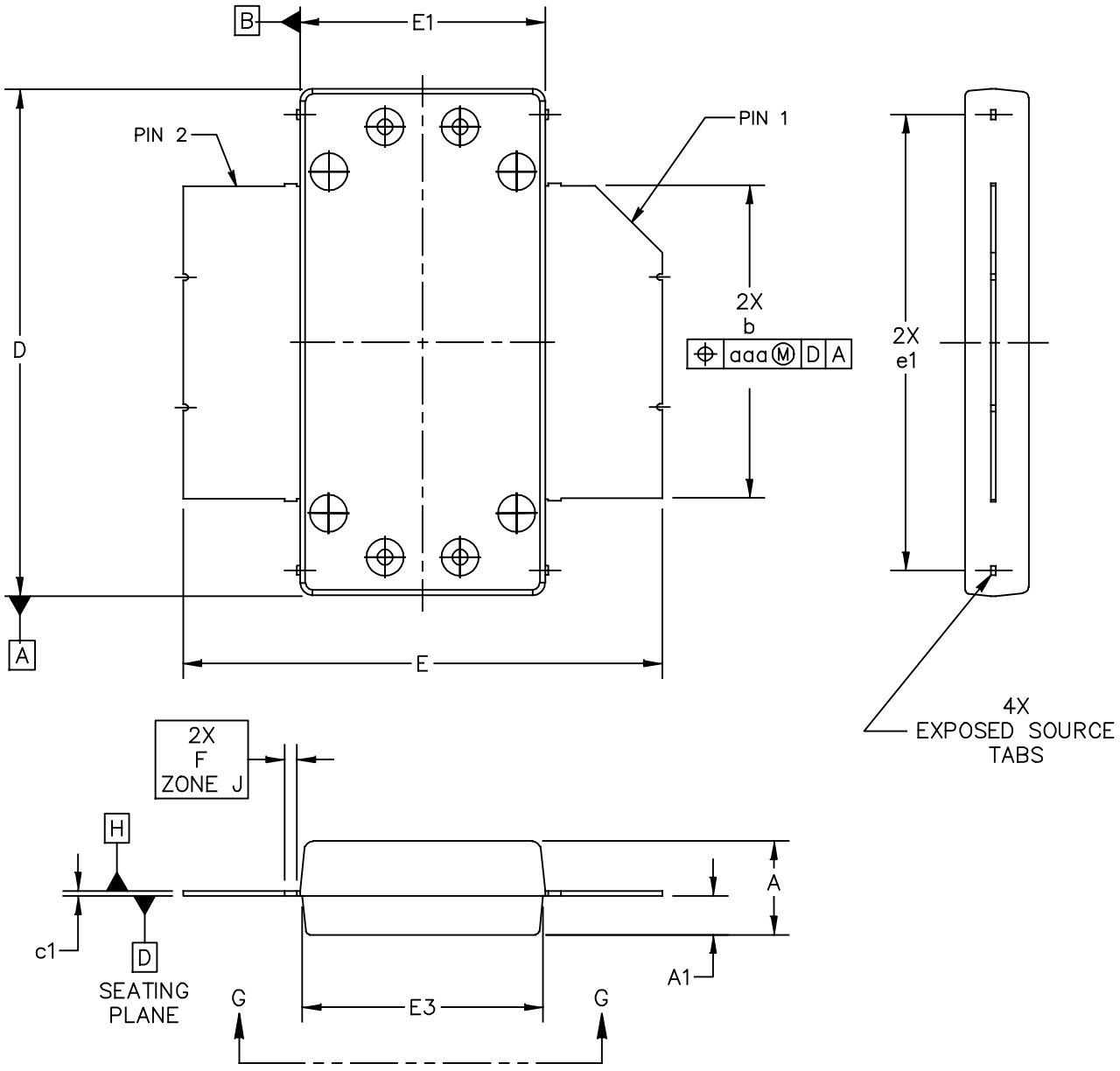


Figure 9. PCB Pad Layout for OM-780G-2L

Figure 10. Product Marking

PACKAGE DIMENSIONS



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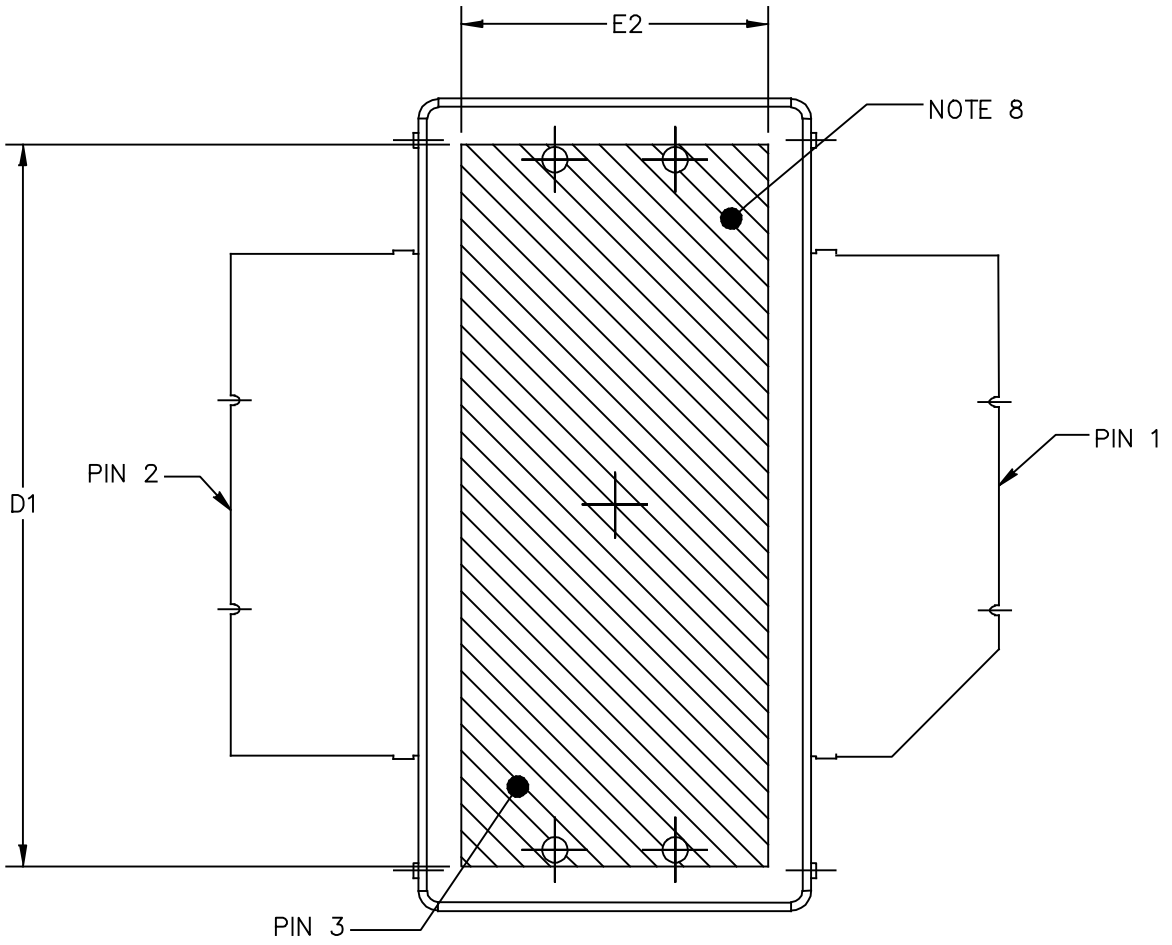
	SOT1693–1	22 JAN 2016



BOTTOM VIEW
VIEW G–G

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	STANDARD: NON–JEDEC	
	SOT1693–1	22 JAN 2016

NOTES:
1. CONTROLLING DIMENSION: INCH

2. INTERPRET DIMENSIONS AND TOLERANCES PER ASME Y14.5M–1994.

3. DATUM PLANE –H– IS LOCATED AT TOP OF LEAD AND IS COINCIDENT WITH THE LEAD WHERE THE LEAD EXITS THE PLASTIC BODY AT THE TOP OF THE PARTING LINE.

4. DIMENSIONS "D" AND "E1" DO NOT INCLUDE MOLD PROTRUSION. ALLOWABLE PROTRUSION IS .006 PER SIDE. DIMENSIONS "D AND "E1" DO INCLUDE MOLD MISMATCH AND ARE DETERMINED AT DATUM PLANE –H–.

5. DIMENSION b DOES NOT INCLUDE DAMBAR PROTRUSION. ALLOWABLE DAMBAR PROTRUSION SHALL BE .005 TOTAL IN EXCESS OF THE b DIMENSION AT MAXIMUM MATERIAL CONDITION.

6. DATUMS –A– AND –B– TO BE DETERMINED AT DATUM PLANE –H–.

7. DIMENSION A1 APPLIES WITHIN ZONE "J" ONLY

8. HATCHING REPRESENTS THE EXPOSED AREA OF THE HEAT SLUG. THE DIMENSIONS D1 AND E2 REPRESENT THE VALUES BETWEEN THE TWO OPPOSITE POINTS ALONG THE EDGES OF EXPOSED AREA OF HEAT SLUG.

STYLE 1:
PIN 1 – DRAIN
PIN 2 – GATE
PIN 3 – SOURCE

DIM	INCH MIN	INCH MAX	MILLIMETER MIN	MILLIMETER MAX	DIM	INCH MIN	INCH MAX	MILLIMETER MIN	MILLIMETER MAX
A	0.148	.152	3.76	3.86	b	.497	.503	12.62	12.78
A1	.059	.065	1.50	1.65	c1	.007	.011	0.18	0.28
D	.808	.812	20.52	20.62	e1	.721	.729	18.31	18.52
D1	.720	----	18.29	----					
E	.762	.770	19.36	19.56	aaa	.004		0.10	
E1	.390	.394	9.91	10.01					
E2	.306	----	7.77	----					
E3	.383	.387	9.73	9.83					
F	.025 BSC		0.635 BSC						

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STRAIGHT LEAD

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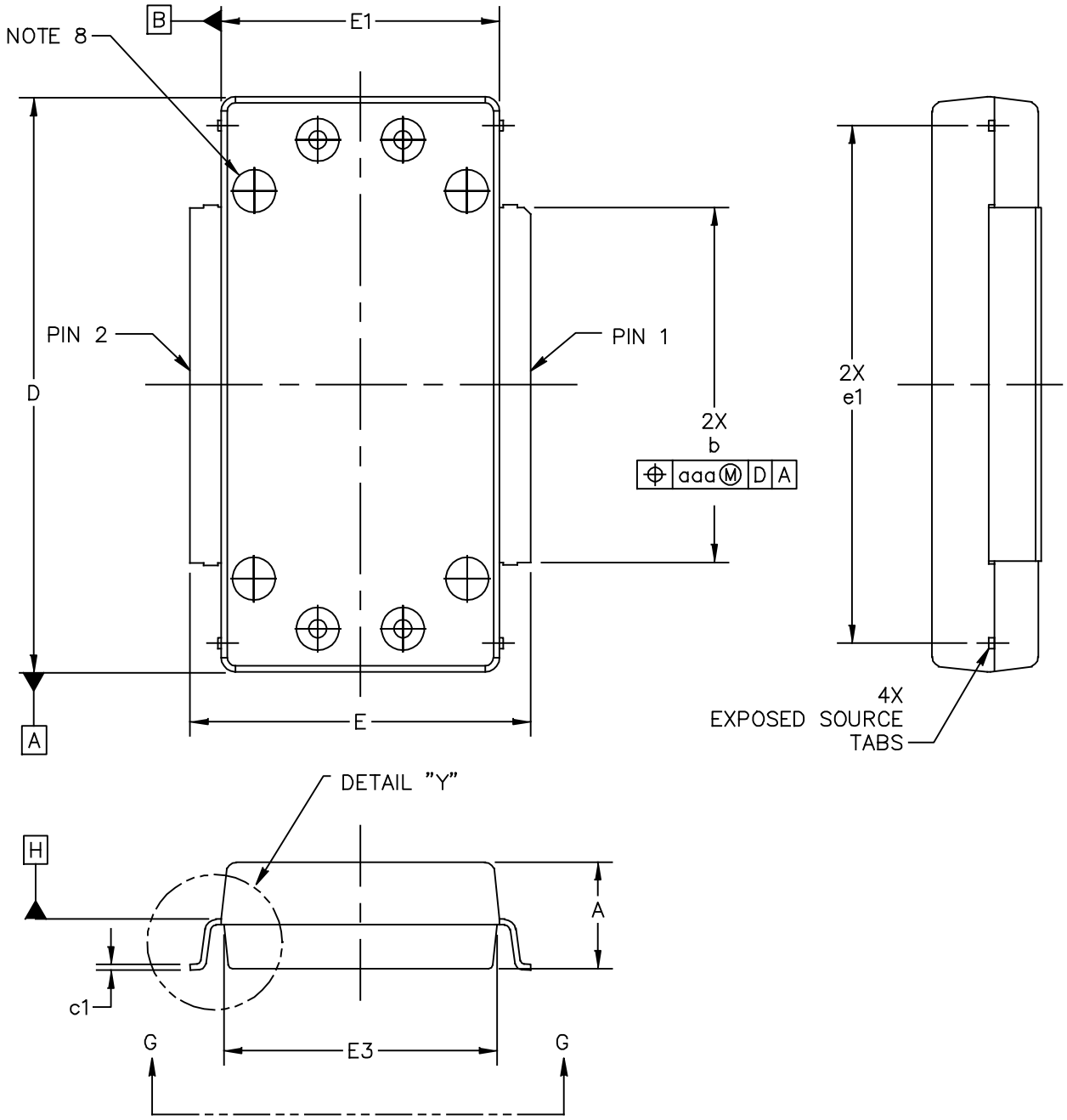

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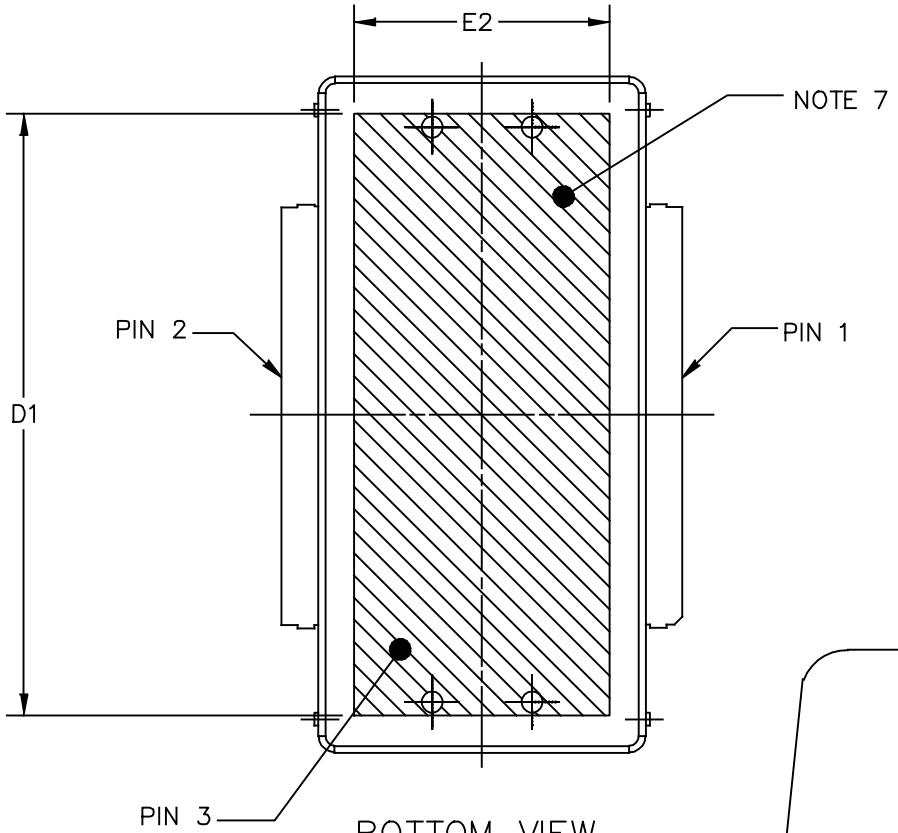
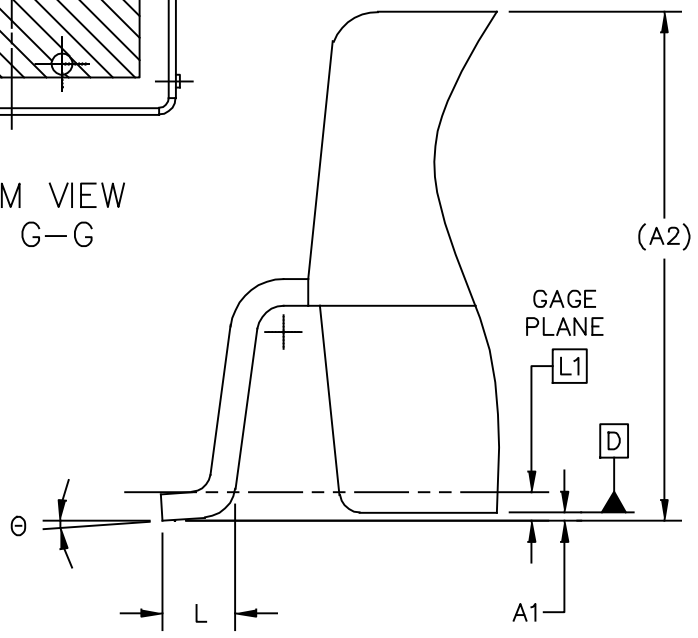


BOTTOM VIEW
VIEW G–G



DETAIL "Y"

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NOTES:

1. CONTROLLING DIMENSION: INCH

2. INTERPRET DIMENSIONS AND TOLERANCES PER ASME Y14.5M–1994.

3. DATUM PLANE H IS LOCATED AT TOP OF LEAD AND IS COINCIDENT WITH THE LEAD WHERE THE LEAD EXITS THE PLASTIC BODY AT THE TOP OF THE PARTING LINE.

4. DIMENSIONS D AND E1 DO NOT INCLUDE MOLD PROTRUSION. ALLOWABLE PROTRUSION IS .006 INCH (0.15 MM) PER SIDE. DIMENSIONS D AND E1 DO INCLUDE MOLD MISMATCH AND ARE DETERMINED AT DATUM PLANE H.

5. DIMENSION b DOES NOT INCLUDE DAMBAR PROTRUSION. ALLOWABLE DAMBAR PROTRUSION SHALL BE .005 INCH (0.13 MM) TOTAL IN EXCESS OF THE b DIMENSION AT MAXIMUM MATERIAL CONDITION.

6. DATUM A AND B TO BE DETERMINED AT DATUM PLANE H.

7. HATCHING REPRESENT THE EXPOSED AREA OF THE HEAT SLUG.THE DIMENSIONS D1 AND E2 REPRESENT THE VALUES BETWEEN THE TWO OPPOSITE POINTS ALONG THE EDGES OF EXPOSED AREA OF HEAT SLUG.

8. DIMPLED HOLE REPRESENTS INPUT SIDE.

9. DIMENSION A1 IS MEASURED WITH REFERENCE TO DATUM D. THE POSITIVE VALUE IMPLIES THAT THE BOTTOM OF THE PACKAGE IS HIGHER THAN THE BOTTOM OF THE LEAD.

DIM	INCH MIN	INCH MAX	MILLIMETER MIN	MILLIMETER MAX	DIM	INCH MIN	INCH MAX	MILLIMETER MIN	MILLIMETER MAX
A	.148	.152	3.76	3.86	b	.497	.503	12.62	12.78
A1	–.003	.003	–0.08	0.08	c1	.007	.011	0.18	0.28
A2	(.150)		(3.81)		Θ	0°	8°	0°	8°
D	.808	.812	20.52	20.62	e1	.721	.729	18.31	18.52
D1	.720	----	18.29	----	aaa	.004		0.10	
E	.472	.480	11.99	12.19					
E1	.390	.394	9.91	10.01					
E2	.306	----	7.77	----					
E3	.383	.387	9.73	9.83					
L	.018	.024	0.46	0.61					
L1	.01 BSC		0.25 BSC						

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DOCUMENT NO: 98ASA00442D REV: A

STANDARD: NON–JEDEC

SOT1815–1 05 FEB 2016

PRODUCT DOCUMENTATION, SOFTWARE AND TOOLS

Refer to the following resources to aid your design process.

Application Notes

- AN1907: Solder Reflow Attach Method for High Power RF Devices in Plastic Packages
- AN1955: Thermal Measurement Methodology of RF Power Amplifiers

Engineering Bulletins

- EB212: Using Data Sheet Impedances for RF LDMOS Devices

Software

- Electromigration MTTF Calculator
- RF High Power Model

Development Tools

- Printed Circuit Boards

To Download Resources Specific to a Given Part Number:

1. Go to http://www.nxp.com/RF
2. Search by part number
3. Click part number link
4. Choose the desired resource from the drop down menu

REVISION HISTORY

The following table summarizes revisions to this document.

Revision	Date	Description
0	May 2016	• Initial Release of Data Sheet
1	Aug. 2016	• Typical Performance table: updated Gain Variation over Temperature and Output Power Variation over Temperature typical values to reflect measured data, p. 3

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