NXP Semiconductors
Technical Data

Document Number: MRF24G300HS
Rev. 0, 09/2019

RoHS

RF Power GaN Transistors

These 300 W CW GaN transistors are designed for industrial, scientific and medical (ISM) applications at 2450 MHz. These devices are suitable for use in CW, pulse, cycling and linear applications. These high gain, high efficiency devices are easy to use and will provide long life in even the most demanding environments.

These parts are characterized and performance is guaranteed for applications operating in the 2400 to 2500 MHz band. There is no guarantee of performance when these parts are used in applications designed outside of these frequencies.

Typical Performance: In 2400–2500 MHz MRF24G300HS reference circuit, V_{DD} = 48 Vdc, $V_{GS(A+B)}$ = –5 Vdc (1)

Frequency (MHz)	Signal Type	P_{in} (W)	P_{out} (W)	G_{ps} (dB)	η_D (%)
2400	CW	10.0	336	15.3	70.4
2450		10.0	332	15.2	73.0
2500		10.0	307	14.9	74.4

1. All data measured in fixture with device soldered to heatsink.

Load Mismatch/Ruggedness

Frequency (MHz)	Signal Type	VSWR	P_{in} (W)	Test Voltage	Result
2450	Pulse (100 μsec, 20% Duty Cycle)	> 20:1 at All Phase Angles	12.6 Peak	55	No Device Degradation

Features

- Advanced GaN on SiC, for optimal thermal performance
- Characterized for CW, long pulse (up to several seconds) and short pulse operations
- Device can be used in a single-ended or push-pull configuration
- Input matched for simplified input circuitry
- Qualified up to 55 V
- Suitable for linear application

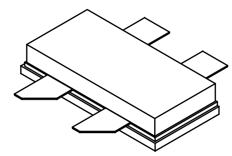
Typical Applications

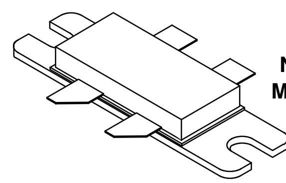
- Industrial heating
- Welding and heat sealing
- Plasma generation
- Lighting
- Scientific instrumentation
- Medical
  - – Microwave ablation
  - – Diathermy

MRF24G300HS
MRF24G300H

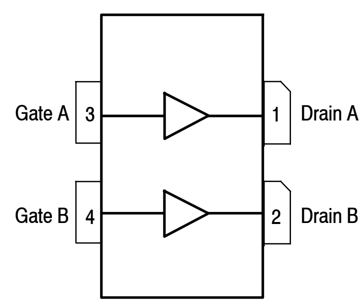
2400–2500 MHz, 300 W CW, 50 V WIDEBAND RF POWER GaN TRANSISTORS

NI-780S-4L
MRF24G300HS





NI-780H-4L
MRF24G300H



(Top View)

Note: The 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}	125	Vdc
Gate-Source Voltage	V_{GS}	–8, 0	Vdc
Operating Voltage	V_{DD}	0 to +55	Vdc
Maximum Forward Gate Current, $I_{G\ (A+B)}$, @ T_C = 25°C	I_{GMAX}	42	mA
Storage Temperature Range	T_{stg}	–65 to +150	°C
Case Operating Temperature Range	T_C	–55 to +150	°C
Maximum Channel Temperature (1)	T_{CH}	350	°C

Table 2. Thermal Characteristics

Characteristic	Symbol	Value	Unit
Thermal Resistance by Infrared Measurement, Active Die Surface-to-Case Case Temperature 125°C, P_D = 118 W	$R_{\theta JC}$ (IR)	0.52 (2)	°C/W
Thermal Resistance by Finite Element Analysis, Channel-to-Case Case Temperature 125°C, P_D = 118 W	$R_{\theta CHC}$ (FEA)	0.72 (3)	°C/W

Table 3. ESD Protection Characteristics

Test Methodology	Class
Human Body Model (per JS-001-2017)	1B, passes 900 V
Charge Device Model (per JS-002-2014)	3, passes 1200 V

Table 4. Electrical Characteristics (T_A = 25°C unless otherwise noted)

Characteristic	Symbol	Min	Typ	Max	Unit
Off Characteristics (4)					
Drain-Source Breakdown Voltage (V_{GS} = –8 Vdc, I_D = 24.3 mAdc)	$V_{(BR)DSS}$	150	—	—	Vdc
On Characteristics (4)					
Gate Threshold Voltage (V_{DS} = 10 Vdc, I_D = 22 mAdc)	$V_{GS(th)}$	–3.8	–3.16	–2.3	Vdc
Gate-Source Leakage Current (V_{DS} = 0 Vdc, V_{GS} = –5 Vdc)	I_{GSS}	–10.0	—	—	mAdc

Table 5. Ordering Information

Device	Tape and Reel Information	Package
MRF24G300HSR5	R5 Suffix = 50 Units, 32 mm Tape Width, 13-inch Reel	NI-780S-4L
MRF24G300HR5	R5 Suffix = 50 Units, 56 mm Tape Width, 13-inch Reel	NI-780H-4L

1. Reliability tests were conducted at 225°C. Operation with T_{CH} at 350°C will reduce median time to failure.
2. Refer to AN1955, *Thermal Measurement Methodology of RF Power Amplifiers.* Go to http://www.nxp.com/RF and search for AN1955.
3. $R_{\theta CHC}$ (FEA) must be used for purposes related to reliability and limitations on maximum channel temperature. MTTF may be estimated by the expression MTTF (hours) = $10^{[A + B/(T + 273)]}$, where *T* is the channel temperature in degrees Celsius, *A* = –10.3 and *B* = 8263.
4. Each side of device measured separately.

NOTE: Correct Biasing Sequence for GaN Depletion Mode Transistors

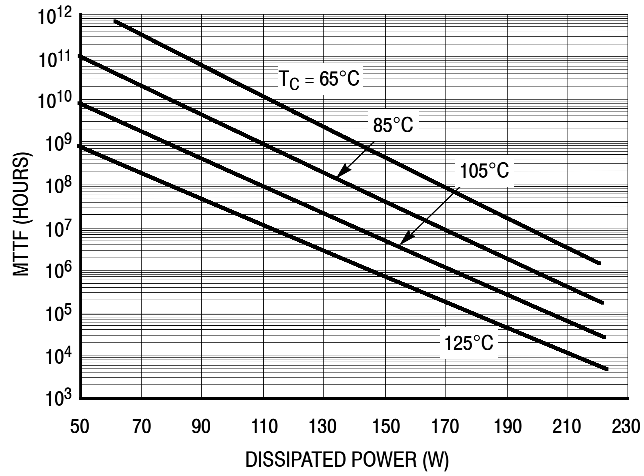
Turning the device ON

1. Set V_{GS} to –5 V
2. Turn on V_{DS} to nominal supply voltage (48 V)
3. For Class AB operations increase V_{GS} until desired I_{DS} current is attained
4. Apply RF input power to desired level

Turning the device OFF

1. Turn RF power off
2. Reduce V_{GS} down to –5 V
3. Reduce V_{DS} down to 0 V (Adequate time must be allowed for V_{DS} to reduce to 0 V to prevent severe damage to device.)
4. Turn off V_{GS}

TYPICAL CHARACTERISTICS



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

MTTF calculator available at http://www.nxp.com.

Figure 2. MTTF versus Dissipated Power and Case Temperature — CW

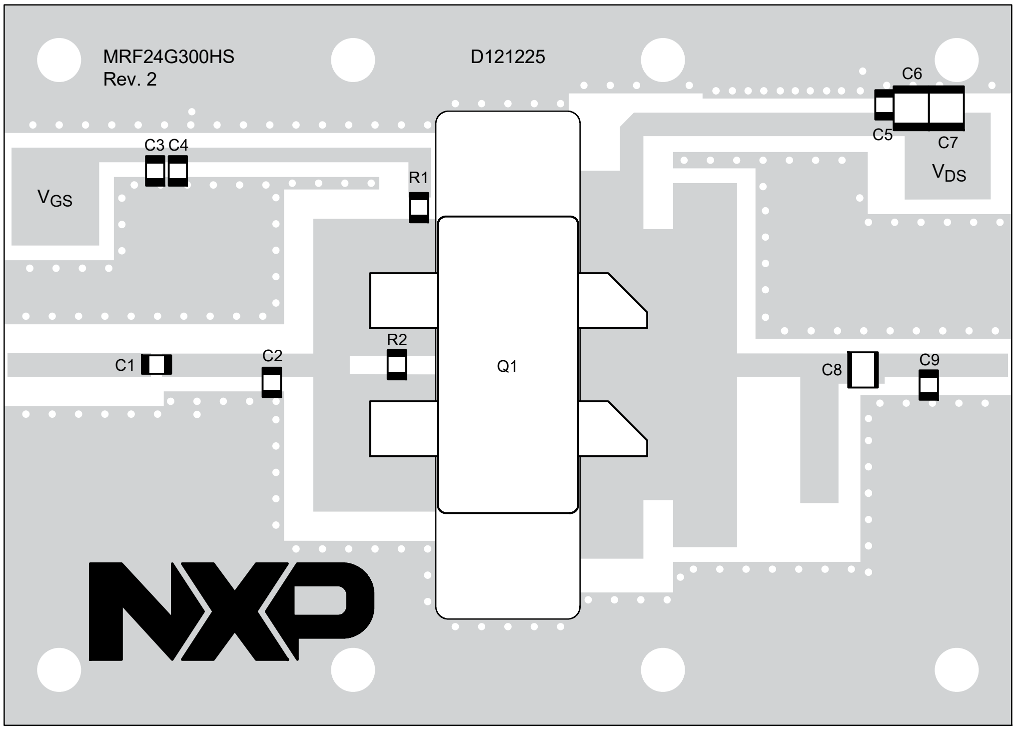
MRF24G300HS 2400–2500 MHz REFERENCE CIRCUIT — 5.0 cm × 7.0 cm (2.0″ × 2.8″)

Table 6. 2400–2500 MHz Performance (1) (In NXP MRF24G300HS Reference Circuit, 50 ohm system)
V_{DD} = 48 Vdc, $V_{GS(A+B)}$ = –5 Vdc, P_{in} = 10 W, CW

Frequency (MHz)	P_{out} (W)	G_{ps} (dB)	η_D (%)
2400	336	15.3	70.4
2450	332	15.2	73.0
2500	307	14.9	74.4

1. All data measured in fixture with device soldered to heatsink.

MRF24G300HS 2400–2500 MHz REFERENCE CIRCUIT — 5.0 cm × 7.0 cm (2.0″ × 2.8″)



Note: All data measured in fixture with device soldered to heatsink.

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Figure 3. MRF24G300HS Reference Circuit Component Layout — 2400–2500 MHz

Table 7. MRF24G300HS Reference Circuit Component Designations and Values — 2400–2500 MHz

Part	Description	Part Number	Manufacturer
C1, C4	20 pF Chip Capacitor	600F200JT250XT	ATC
C2	1.2 pF Chip Capacitor	600F1R2BT250XT	ATC
C3	1.0 μF Chip Capacitor	GCM21BR71H105KA03L	Murata
C5	27 pF Chip Capacitor	600F270JT250XT	ATC
C6, C7	10 μF Chip Capacitor	GRM32EC72A106KE05L	Murata
C8	10 pF Chip Capacitor	800R100JT500XT	ATC
C9	0.1 pF Chip Capacitor	600F0R1BT250XT	ATC
Q1	RF Power GaN Transistor	MRF24G300HS	NXP
R1	10 Ω, 1/4 W Chip Resistor	CRCW120610R0JNEA	Vishay
R2	5.1 Ω, 1/8 W Chip Resistor	CRCW08055R10JNEA	Vishay
PCB	Rogers RT6035HTC, 0.030″, ε_r = 3.5, 2 oz. Copper	D121225	MTL

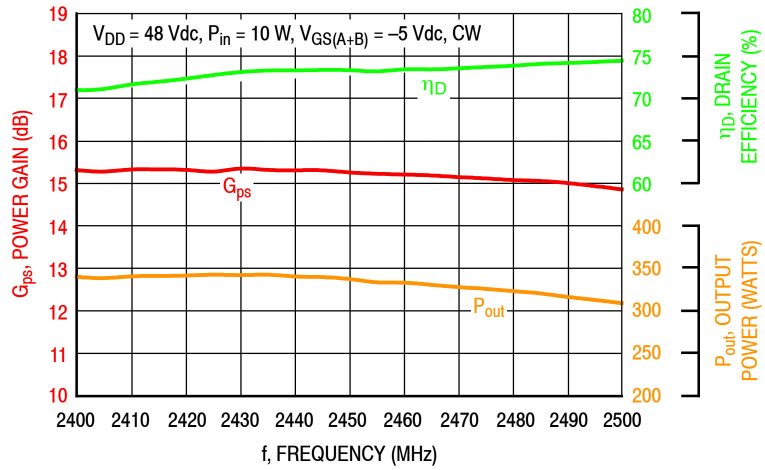


Figure 4. Power Gain, Drain Efficiency and CW Output Power versus Frequency at a Constant Input Power

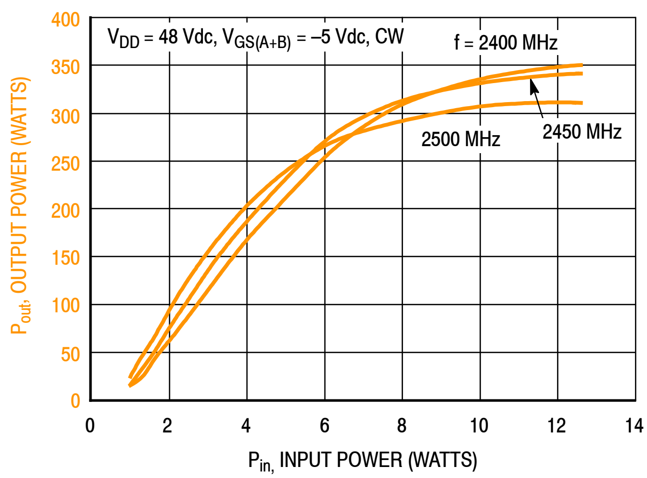


Figure 5. CW Output Power versus Input Power and Frequency

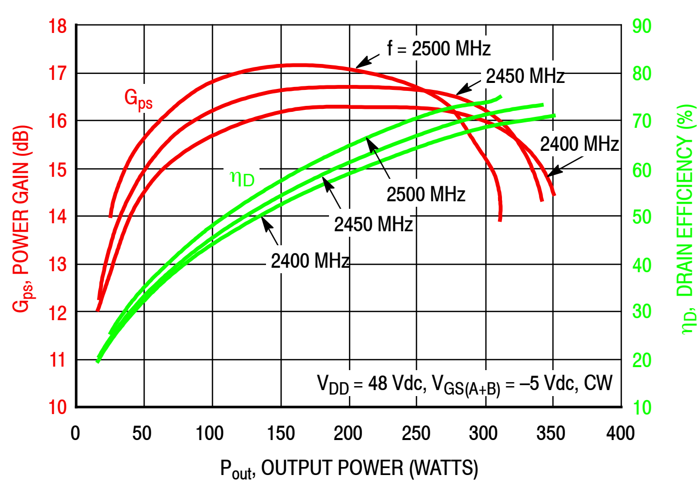


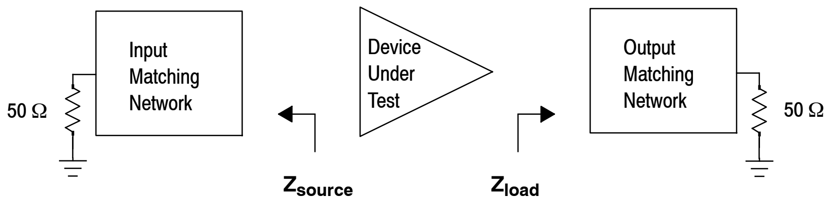
Figure 6. Power Gain and Drain Efficiency versus CW Output Power and Frequency

2400–2500 MHz REFERENCE CIRCUIT

f (MHz)	Z_{source} (Ω)	Z_{load} (Ω)
2400	2.55 – j2.96	2.41 – j3.12
2450	2.55 – j2.72	2.13 – j2.98
2500	2.56 – j2.49	1.88 – j2.80

Z_{source} = Test circuit impedance as measured from gate to ground.

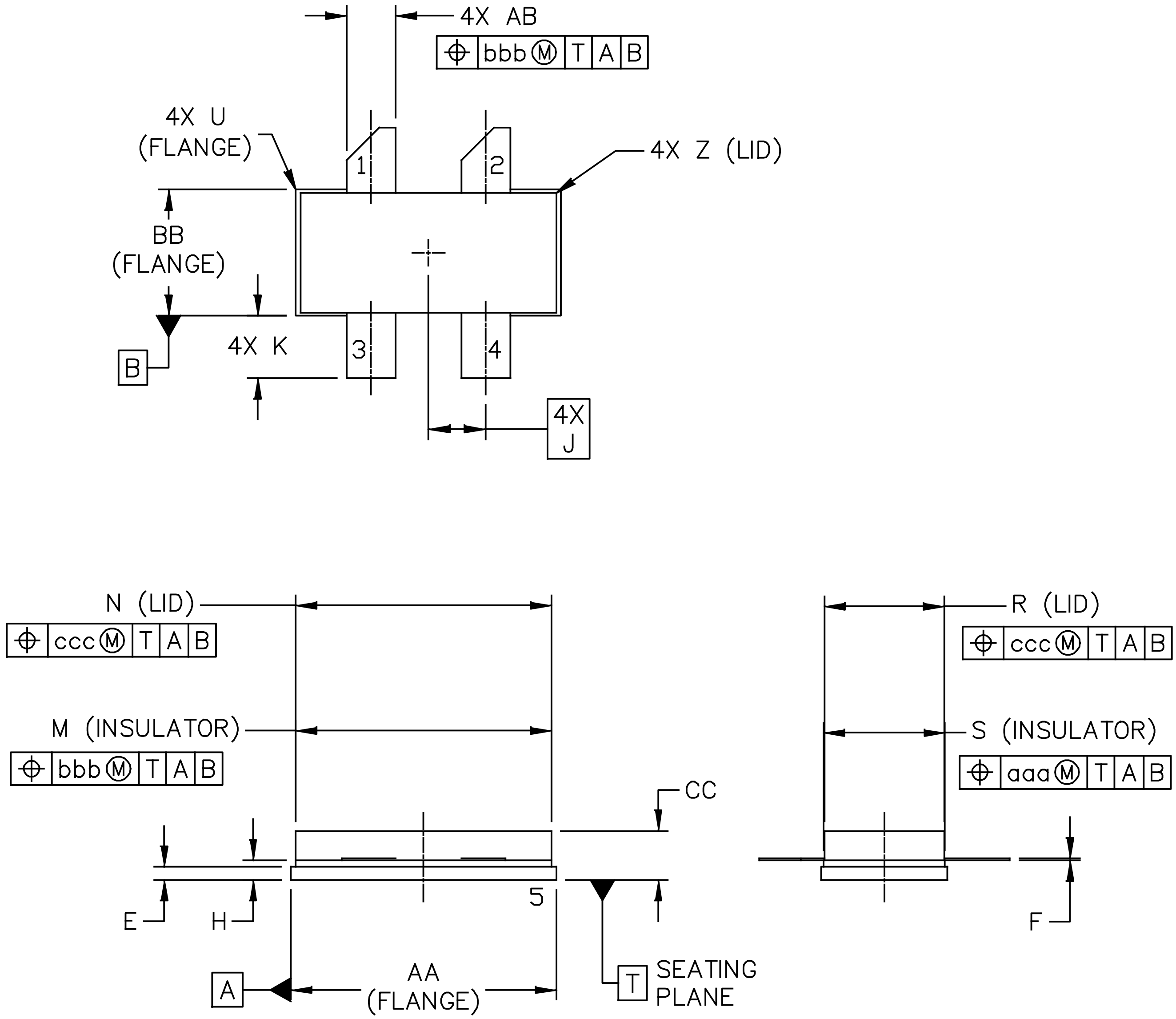
Z_{load} = Test circuit impedance as measured from drain to ground.



Note: Side A and Side B are tied together for these measurements.

Figure 7. Series Equivalent Source and Load Impedance — 2400–2500 MHz

PACKAGE DIMENSIONS



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TITLE: NI–780S–4L	DOCUMENT NO: 98ASA10718D	REV: C
	STANDARD: NON–JEDEC	
	SOT1826–1	01 AUG 2016

NOTES:

1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M-1994.

2. CONTROLLING DIMENSION: INCH.

3. DELETED

4. DIMENSION H IS MEASURED .030 (0.762) AWAY FROM FLANGE TO CLEAR EPOXY FLOW OUT PARALLEL TO DATUM B.

DIM	INCH MIN	INCH MAX	MILLIMETER MIN	MILLIMETER MAX	DIM	INCH MIN	INCH MAX	MILLIMETER MIN	MILLIMETER MAX
AA	.805	.815	20.45	20.70	U		.040		1.02
BB	.382	.388	9.70	9.86	Z		.030		0.76
CC	.125	.170	3.18	4.32	AB	.145	.155	3.68 –	3.94
E	.035	.045	0.89	1.14					
F	.003	.006	0.08	0.15	aaa	.005		0.127	
H	.057	.067	1.45	1.70	bbb	.010		0.254	
J	.175 BSC		4.44 BSC		ccc	.015		0.381	
K	.170	.210	4.32	5.33					
M	.774	.786	19.61	20.02					
N	.772	.788	19.61	20.02					
R	.365	.375	9.27	9.53					
S	.365	.375	9.27	9.52					

MECHANICAL OUTLINE | PRINT VERSION NOT TO SCALE

TITLE: NI-780S-4L

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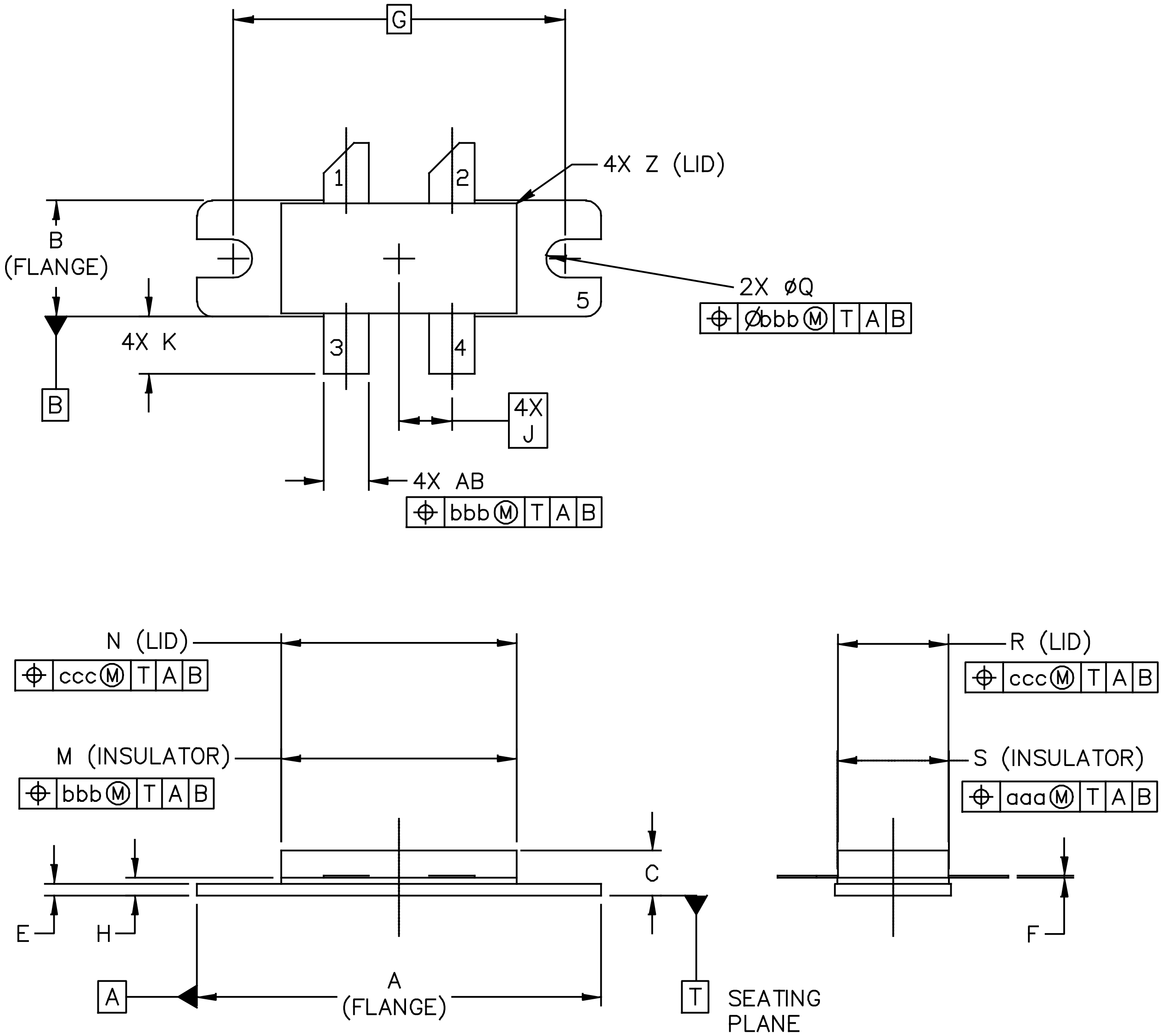

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TITLE: NI 780–4	DOCUMENT NO: 98ASA10793D	REV: A
	STANDARD: NON–JEDEC	
	SOT1827–1	17 MAR 2016

NOTES:

1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M-1994.

2. CONTROLLING DIMENSION: INCH.

3. DIMENSION H IS MEASURED .030 (0.762) AWAY FROM PACKAGE BODY.

STYLE 1:
PIN 1. DRAIN
2. DRAIN
3. GATE
4. GATE
5. SOURCE

DIM	INCH MIN	INCH MAX	MILLIMETER MIN	MILLIMETER MAX	DIM	INCH MIN	INCH MAX	MILLIMETER MIN	MILLIMETER MAX
A	1.335	1.345	33.91	34.16	R	.365	.375	9.27	9.53
B	.380	.390	9.65	9.91	S	.365	.375	9.27	9.52
C	.125	.170	3.18	4.32	U		.040		1.02
E	.035	.045	0.89	1.14	Z		.030		0.76
F	.003	.006	0.08	0.15	AB	.145	.155	3.68	3.94
G	1.100 BSC		27.94 BSC						
H	.057	.067	1.45	1.7	aaa	.005		0.127	
J	.175 BSC		4.44 BSC		bbb	.010		0.254	
K	.170	.210	4.32	5.33	ccc	.015		0.381	
M	.774	.786	19.61	20.02					
N	.772	.788	19.61	20.02					
Q	⌀.118	⌀.138	⌀3	⌀3.51					

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	STANDARD: NON-JEDEC	
	SOT1827-1	17 MAR 2016

PRODUCT DOCUMENTATION, SOFTWARE AND TOOLS

Refer to the following resources to aid your design process.

Application Notes

- AN1908: Solder Reflow Attach Method for High Power RF Devices in Air Cavity Packages
- AN1955: Thermal Measurement Methodology of RF Power Amplifiers

Engineering Bulletins

- EB212: Using Data Sheet Impedances for RF LDMOS Devices

Software

- RF High Power Model
- .s2p File (Each side of device measured separately.)

Development Tools

- Printed Circuit Boards

REVISION HISTORY

The following table summarizes revisions to this document.

Revision	Date	Description
0	Sept. 2019	• Initial release of data sheet