Document Number: A3T18H408W24S
Rev. 0, 07/2019

# RF Power LDMOS Transistor

## N–Channel Enhancement–Mode Lateral MOSFET

This 56 W asymmetrical Doherty RF power LDMOS transistor is designed for cellular base station applications requiring very wide instantaneous bandwidth capability covering the frequency range of 1805 to 1880 MHz.

**1800 MHz**

- Typical Doherty Single–Carrier W–CDMA Performance: $V_{DD}$ = 30 Vdc, $I_{DQA}$ = 350 mA, $V_{GSB}$ = 0.3 Vdc, $P_{out}$ = 56 W Avg., Input Signal PAR = 9.9 dB @ 0.01% Probability on CCDF.

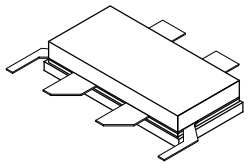
| Frequency | $G_{ps}$ (dB) | $\eta_D$ (%) | Output PAR (dB) | ACPR (dBc) |
|---|---|---|---|---|
| 1805 MHz | 15.3 | 50.9 | 7.5 | –34.5 |
| 1840 MHz | 15.4 | 50.9 | 7.5 | –35.3 |
| 1880 MHz | 15.2 | 50.9 | 7.4 | –35.9 |

**Features**

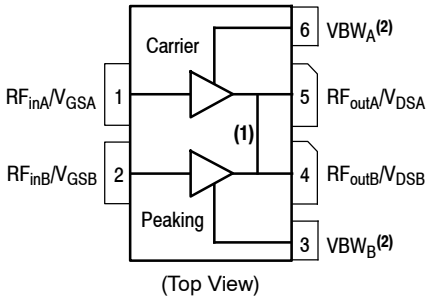
- Advanced high performance in–package Doherty
- Designed for wide instantaneous bandwidth applications
- Greater negative gate–source voltage range for improved Class C operation
- Able to withstand extremely high output VSWR and broadband operating conditions
- Designed for digital predistortion error correction systems

**A3T18H408W24S**

**1805–1880 MHz, 56 W AVG., 30 V AIRFAST RF POWER LDMOS TRANSISTOR**



**NI–780S–4L2L**




(Top View)

**Figure 1. Pin Connections**

1. Pin connections 4 and 5 are DC coupled and RF independent.
2. Device cannot operate with $V_{DD}$ current supplied through pin 3 and pin 6.

**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 |

**Table 2. Thermal Characteristics**

| Characteristic | Symbol | Value (2,3) | Unit |
|---|---|---|---|
| Thermal Resistance, Junction to Case<br>Case Temperature 25°C, 56 W Avg., W-CDMA, 30 Vdc, $I_{DQA}$ = 350 mA, $V_{GSB}$ = 0.3 Vdc, 1840 MHz | $R_{\theta JC}$ | 0.45 | °C/W |

**Table 3. ESD Protection Characteristics**

| Test Methodology | Class |
|---|---|
| Human Body Model (per JS-001-2017) | 2 |
| Charge Device Model (per JS-002-2014) | C3 |

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

| Characteristic | Symbol | Min | Typ | Max | Unit |
|---|---|---|---|---|---|
| **Off Characteristics (4)** | | | | | |
| 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) | $I_{DSS}$ | — | — | 5 | μAdc |
| Gate-Source Leakage Current ($V_{GS}$ = 5 Vdc, $V_{DS}$ = 0 Vdc) | $I_{GSS}$ | — | — | 1 | μAdc |
| **On Characteristics — Side A, Carrier** | | | | | |
| Gate Threshold Voltage ($V_{DS}$ = 10 Vdc, $I_D$ = 100 μAdc) | $V_{GS(th)}$ | 1.3 | 1.9 | 2.3 | Vdc |
| Gate Quiescent Voltage ($V_{DD}$ = 30 Vdc, $I_{DA}$ = 350 mAdc, Measured in Functional Test) | $V_{GSA(Q)}$ | 2.2 | 2.6 | 3.0 | Vdc |
| Drain-Source On-Voltage ($V_{GS}$ = 10 Vdc, $I_D$ = 1 Adc) | $V_{DS(on)}$ | 0.05 | 0.2 | 0.3 | Vdc |
| **On Characteristics — Side B, Peaking** | | | | | |
| Gate Threshold Voltage ($V_{DS}$ = 10 Vdc, $I_D$ = 180 μAdc) | $V_{GS(th)}$ | 0.7 | 1.3 | 1.7 | Vdc |
| Drain-Source On-Voltage ($V_{GS}$ = 10 Vdc, $I_D$ = 1.8 Adc) | $V_{DS(on)}$ | 0.05 | 0.2 | 0.3 | 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.
4. Side A and Side B are tied together for these measurements.

(continued)

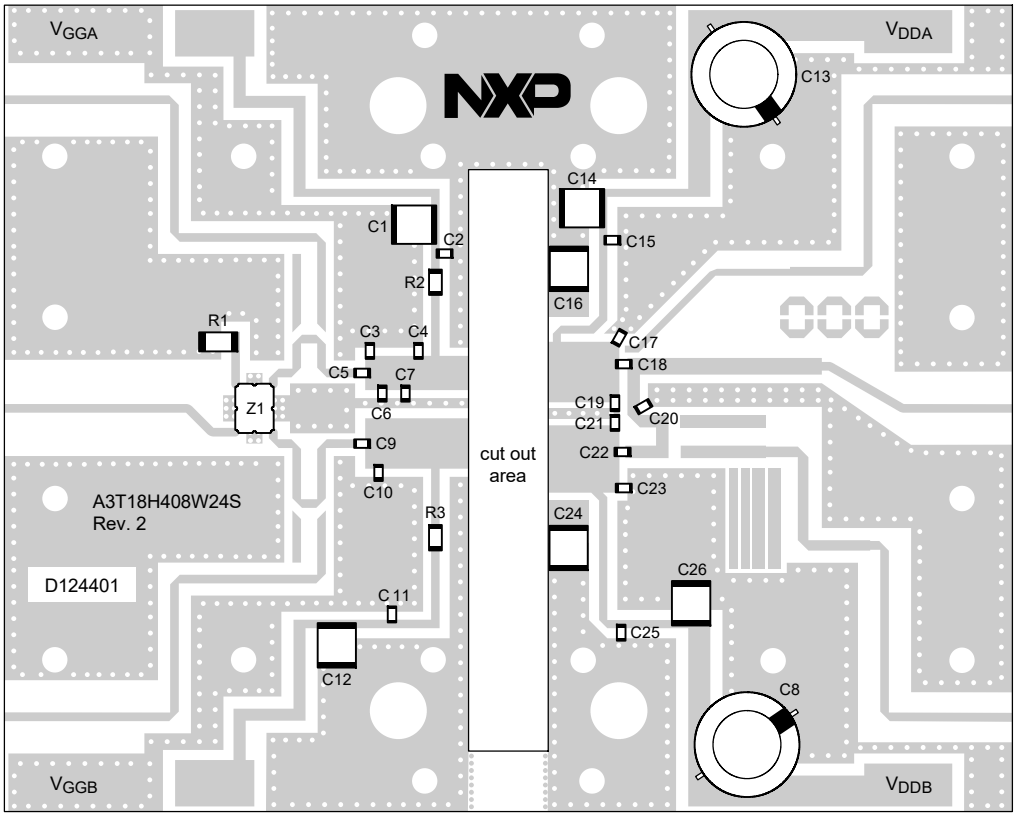
**Table 4. Electrical Characteristics** ($T_A$ = 25°C unless otherwise noted) **(continued)**

| Characteristic | Symbol | Min | Typ | Max | Unit |
|---|---|---|---|---|---|
| **Functional Tests** (1,2) (In NXP Doherty Production Test Fixture, 50 ohm system) $V_{DD}$ = 30 Vdc, $I_{DQA}$ = 350 mA, $V_{GSB}$ = 0.3 Vdc, $P_{out}$ = 56 W Avg., f = 1880 MHz, Single-Carrier W-CDMA, IQ Magnitude Clipping, Input Signal PAR = 9.9 dB @ 0.01% Probability on CCDF. ACPR measured in 3.84 MHz Channel Bandwidth @ ±5 MHz Offset. | | | | | |
| Power Gain | $G_{ps}$ | 14.3 | 15.2 | 17.3 | dB |
| Drain Efficiency | $\eta_D$ | 46.5 | 50.9 | — | % |
| $P_{out}$ @ 3 dB Compression Point, CW | P3dB | 52.8 | 54.9 | — | dBm |
| Adjacent Channel Power Ratio | ACPR | — | –35.9 | –29.0 | dBc |
| **Wideband Ruggedness** (In NXP Doherty Production Test Fixture, 50 ohm system) $I_{DQA}$ = 350 mA, $V_{GSB}$ = 0.3 Vdc, f = 1840 MHz, Additive White Gaussian Noise (AWGN) with 10 dB PAR | | | | | |
| ISBW of 350 MHz at 32 Vdc, 186 W Avg. Modulated Output Power (8 dB Input Overdrive from 56 W Avg. Modulated Output Power) | No Device Degradation | | | | |
| **Typical Performance** (In NXP Doherty Production Test Fixture, 50 ohm system) $V_{DD}$ = 30 Vdc, $I_{DQA}$ = 350 mA, $V_{GSB}$ = 0.3 Vdc, 1805–1880 MHz Bandwidth | | | | | |
| $P_{out}$ @ 3 dB Compression Point (3) | P3dB | — | 350 | — | W |
| AM/PM (Maximum value measured at the P3dB compression point across the 1805–1880 MHz bandwidth) | Φ | — | –15 | — | ° |
| VBW Resonance Point (IMD Third Order Intermodulation Inflection Point) | $VBW_{res}$ | — | 90 | — | MHz |
| Gain Flatness in 75 MHz Bandwidth @ $P_{out}$ = 56 W Avg. | $G_F$ | — | 0.2 | — | dB |
| Gain Variation over Temperature (–40°C to +85°C) | ΔG | — | 0.006 | — | dB/°C |
| Output Power Variation over Temperature (–40°C to +85°C) | ΔP1dB | — | 0.013 | — | dB/°C |

**Table 5. Ordering Information**

| Device | Tape and Reel Information | Package |
|---|---|---|
| A3T18H408W24SR3 | R3 Suffix = 250 Units, 44 mm Tape Width, 13-inch Reel | NI-780S-4L2L |

1. $V_{DDA}$ and $V_{DDB}$ must be tied together and powered by a single DC power supply.
2. Part internally matched both on input and output.
3. P3dB = $P_{avg}$ + 7.0 dB where $P_{avg}$ is the average output power measured using an unclipped W-CDMA single-carrier input signal where output PAR is compressed to 7.0 dB @ 0.01% probability on CCDF.



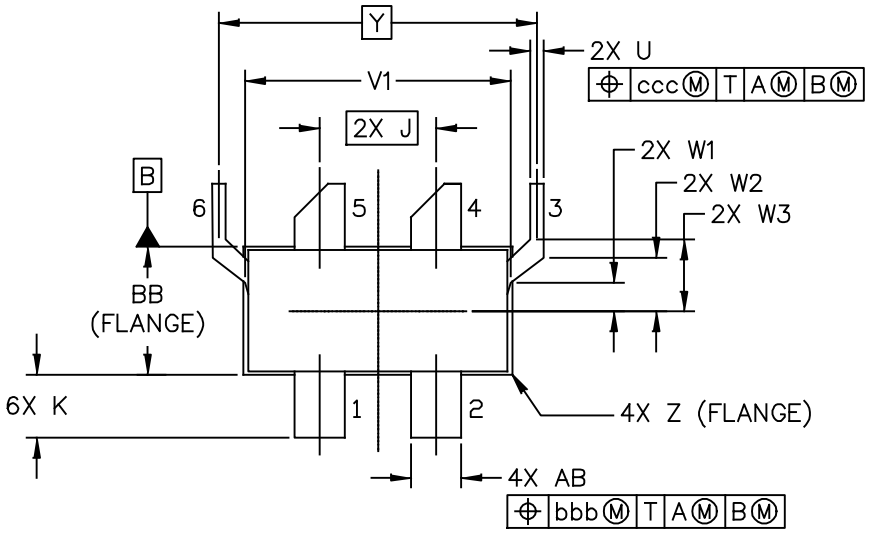

Note: $V_{DDA}$ and $V_{DDB}$ must be tied together and powered by a single DC power supply. aaa-034666

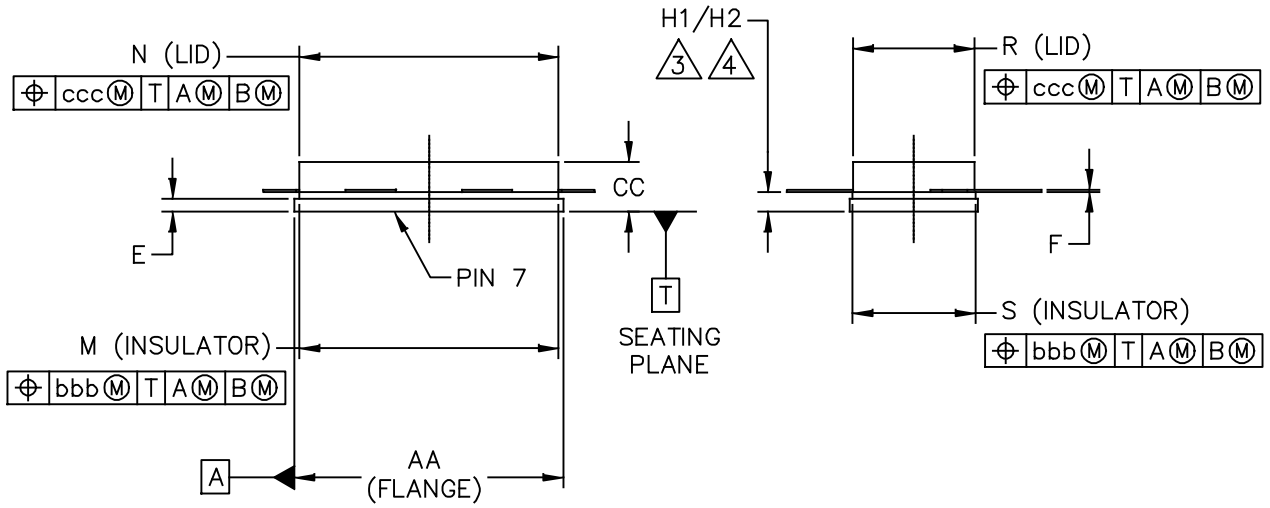
**Figure 2. A3T18H408W24S Production Test Circuit Component Layout**

**Table 6. A3T18H408W24S Production Test Circuit Component Designations and Values**

| Part | Description | Part Number | Manufacturer |
|---|---|---|---|
| C1, C12, C14, C16, C24, C26 | 10 μF Chip Capacitor | C5750X7S2A106M230KB | TDK |
| C2, C5, C9, C11, C15, C22, C25 | 20 pF Chip Capacitor | 600F200JT250XT | ATC |
| C3 | 0.8 pF Chip Capacitor | 600F0R8BT250XT | ATC |
| C4, C21 | 1.2 pF Chip Capacitor | 600F1R2BT250XT | ATC |
| C6, C7, C10 | 0.2 pF Chip Capacitor | 600F0R2BT250XT | ATC |
| C8, C13 | 220 μF, 100 V Electrolytic Capacitor | MCGPR100V227M16X26 | Multicomp |
| C17, C20 | 0.4 pF Chip Capacitor | 600F0R4BT250XT | ATC |
| C18 | 8.2 pF Chip Capacitor | 600F8R2BT250XT | ATC |
| C19 | 2.4 pF Chip Capacitor | 600F2R4BT250XT | ATC |
| C23 | 0.5 pF Chip Capacitor | 600F0R5BT250XT | ATC |
| R1 | 50 Ω, 10 W Termination Chip Resistor | C10A50Z4 | Anaren |
| R2, R3 | 3.3 Ω, 1/4 W Chip Resistor | CRCW12063R30JNEA | Vishay |
| Z1 | 1700–2000 MHz Band, 90°, 2 dB Asymmetric Coupler | CMX19Q02 | RN2 |
| PCB | Rogers RO4350B, 0.020″, $\varepsilon_r$ = 3.66 | D124401 | MTL |

## PACKAGE DIMENSIONS

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| | STANDARD: NON−JEDEC | |
| | SOT1799−3 | 18 FEB 2016 |

NOTES:

1. CONTROLLING DIMENSION: INCH.
2. INTERPRET DIMENSIONS AND TOLERANCES PER ASME Y14.5M–1994.
3. DIMENSIONS H1 AND H2 ARE MEASURED .030 INCH (0.762 MM) AWAY FROM FLANGE PARALLEL TO DATUM B. H1 APPLIES TO PINS 1, 2, 4 & 5. H2 APPLIES TO PINS 3 & 6.
4. TOLERANCE OF DIMENSION H2 IS TENTATIVE.

| 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 | R | .365 | .375 | 9.27 | 9.53 |
| BB | .380 | .390 | 9.65 | 9.91 | S | .365 | .375 | 9.27 | 9.53 |
| CC | .125 | .170 | 3.18 | 4.32 | U | .035 | .045 | 0.89 | 1.14 |
| E | .035 | .045 | 0.89 | 1.14 | V1 | .795 | .805 | 20.19 | 20.45 |
| F | .004 | .007 | 0.10 | 0.18 | W1 | .080 | .090 | 2.03 | 2.29 |
| H1 | .057 | .067 | 1.45 | 1.70 | W2 | .155 | .165 | 3.94 | 4.19 |
| H2 | .054 | .070 | 1.37 | 1.78 | W3 | .210 | .220 | 5.33 | 5.59 |
| J | .350 BSC | | 8.89 BSC | | Y | .956 BSC | | 24.28 BSC | |
| K | .170 | .210 | 4.32 | 5.33 | Z | R.000 | R.040 | R0.00 | R1.02 |
| M | .774 | .786 | 19.66 | 19.96 | AB | .145 | .155 | 3.68 | 3.94 |
| N | .772 | .788 | 19.61 | 20.02 | aaa | .005 | | 0.13 | |
| | | | | | bbb | .010 | | 0.25 | |
| | | | | | ccc | .015 | | 0.38 | |



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DOCUMENT NO: 98ASA00674D REV: A

STANDARD: NON–JEDEC

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## 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

**Software**

- Electromigration MTTF Calculator
- .s2p File

**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 | July 2019 | • Initial release of data sheet |

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