



ULTRA HIGH DYNAMIC RANGE, SHUTDOWN

Monolithic Amplifier

TSS-23HLN+

50Ω 30 MHz to 2 GHz

THE BIG DEAL

- High IP3, 42.6 dBm typ. at 1GHz
- Gain, 21.8 dB typ. at 1 GHz
- Low noise figure, 1.4 dB at 1 GHz
- High P1dB, 28.5 dBm at 1 GHz
- Shutdown feature



Generic photo used for illustration purposes only

CASE STYLE: DQ1225

+RoHS Compliant

The +Suffix identifies RoHS Compliance. See our web site for RoHS Compliance methodologies and qualifications

APPLICATIONS

- Base station infrastructure
- CATV
- Cellular

PRODUCT OVERVIEW

TSS-23HLN+ (RoHS compliant) is an advanced wideband amplifier with shutdown feature. It is fabricated using E-PHEMT technology and offers extremely high dynamic range over a broad frequency range and with low noise figure. In addition, the TSS-23HLN+ has good input and output return loss over a broad frequency range. TSS-23HLN+ is enclosed in a 3mm x 3mm, 12-lead MCLP package and has very good thermal performance.

KEY FEATURES

| Feature | Advantages |
|--|---|
| Broad Band: 30MHz to 2GHz | Broadband covering primary wireless communications bands: VHF, UHF, Cellular |
| Extremely High IP3 39.6 dBm typical at 30 MHz 42.6 dBm typical at 1GHz | The TSS-23HLN+ matches industry leading IP3 performance relative to device size and power consumption. The combination of the design and E-PHEMT Structure provides enhanced linearity over a broad frequency range as evidence in the IP3 being approximately 13-15 dB above the P1dB point. This feature makes this amplifier ideal for use in: <ul style="list-style-type: none"> • Driver amplifiers for complex waveform up converter paths • Drivers in linearized transmit systems • Secondary amplifiers in ultra-High Dynamic range receivers |
| Shutdown feature | Allow users to turn on and off the amplifier with pulsed signals while keeping the power supply at constant voltage to minimize DC power consumption |
| Low Noise Figure 1.4 dB at 1 GHz | Enables lower system noise figure performance and along with High OIP3 provides high dynamic range |
| High P1dB , 28.5 dBm at 1 GHz | High P1dB, High OIP3, Low NF results in a very dynamic range preventing amplifier saturation under strong interfering signals. |

REV. A
ECO-011809
TSS-23HLN+
GY/RS/CP
220126





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TSS-23HLN+

ELECTRICAL SPECIFICATIONS¹ AT 25°C & 50Ω, UNLESS NOTED OTHERWISE

| Parameter | Condition (MHz) | Amplifier-ON VDD = 8V | | | Amplifier-OFF VDD = 8V | Units |
|--|-----------------|--------------------------|--------|------|---------------------------|---------|
| | | Min. | Typ. | Max. | Typ. | |
| Frequency Range | | 30 | | 2000 | 30-2000 | MHz |
| Noise Figure | 30 | | 1.4 | | — | dB |
| | 500 | | 1.4 | | — | |
| | 1000 | | 1.4 | | — | |
| | 1500 | | 1.5 | | — | |
| | 2000 | | 1.6 | | — | |
| Gain | 30 | 20.9 | 23.3 | 25.5 | -21 | dB |
| | 500 | — | 22.4 | — | -21 | |
| | 1000 | 19.5 | 21.8 | 23.8 | -23 | |
| | 1500 | — | 21.1 | — | -25 | |
| | 2000 | 18.1 | 20.3 | 22.1 | -28 | |
| Reversed Isolation | 30-2000 | | 27 | | 26 | dB |
| Input Return Loss | 30 | | 11 | | 12 | dB |
| | 500 | | 12 | | 12 | |
| | 1000 | | 10 | | 12 | |
| | 1500 | | 11 | | 15 | |
| | 2000 | | 12 | | 20 | |
| Output Return Loss | 30 | | 15 | | 2 | dB |
| | 500 | | 14 | | 2 | |
| | 1000 | | 12 | | 2 | |
| | 1500 | | 10 | | 2 | |
| | 2000 | | 8 | | 2 | |
| Output Power @1dB compression AMP-ON | 30 | | 26.2 | | | dBm |
| | 500 | | 27.9 | | | |
| | 1000 | | 28.5 | | | |
| | 1500 | | 28.1 | | | |
| | 2000 | | 27.7 | | | |
| Output IP3 (Pout = 0dBm/Tone) | 30 | — | 39.6 | | | dBm |
| | 500 | — | 41.6 | | | |
| | 1000 | — | 42.6 | | | |
| | 1500 | 38.2 | 42.6 | | | |
| | 2000 | — | 41.8 | | | |
| Device Operating Voltage (VDD) | | 7.6 | 8 | 8.4 | 8 | V |
| Device Operating Current (ID) | | | 236 | 249 | 8 | mA |
| Control Voltage (VG) | | | 0 | | 5 | V |
| DC Current (ID) Variation Vs. Temperature ² | | | -225 | | | uA/degC |
| DC Current (ID) Variation Vs. Voltage | | | 0.0263 | | | mA/mV |
| Thermal Resistance | | | 23.3 | | | degC/W |

1. Measured on Mini-Circuits Characterization test board TB-TSS-23HLN+. See Characterization Test Circuit (Fig. 1)

2. (Current at 95°C – Current at -45°C)/140

MAXIMUM RATINGS³

| Parameter | Ratings |
|---|--|
| Operating Temperature (ground lead) | -40°C to 95°C |
| Storage Temperature | -65°C to 150°C |
| Total Power Dissipation | 3.3W |
| Input Power | 28 dBm (5 minutes max.) 15 dBm (continuous) for 0.03-1 GHz 18 dBm (continuous) for 1-2 GHz |
| DC Voltage V _{DD} ⁴ (Pad 7) | 10V |
| DC Voltage V _G ⁵ (Pad 1) | 10V |

3 Permanent damage may occur if these limits are exceeded.

4 Measured by keeping VG=0V.

5 Measured by keeping Vdd=8V.

CONTROL VOLTAGE (V_G) FIG. 1

| | Min. | Typ. | Max. | Units |
|---------------|------|------|------|-------|
| Amplifier-ON | — | 0 | 0.7 | V |
| Amplifier-OFF | 1.9 | 5 | — | V |

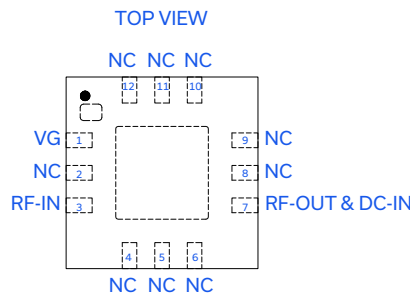
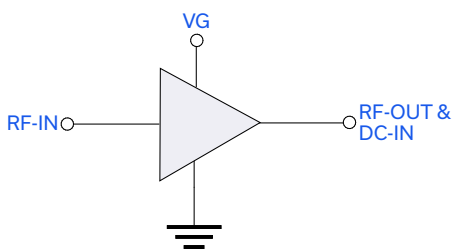




SWITCHING SPECIFICATIONS

| Parameter | | Min. | Typ. | Max. | Units |
|--------------------------|----------------------------------|------|-------|------|-------|
| Amplifier ON to Shutdown | OFF TIME (50% Control to 10% RF) | — | 5.3 | — | μs |
| | FALL TIME (90 to 10% RF) | — | 7.3 | — | |
| Amplifier Shutdown to ON | ON TIME (50% Control to 90% RF) | — | 77.7 | — | μs |
| | RISE TIME (10% to 90% RF) | — | 54.2 | — | |
| Control Voltage Leakage | | — | 633.3 | — | mV |

SIMPLIFIED SCHEMATIC AND PAD DESCRIPTION



| Function | Pad Number | Description |
|------------------|--------------|------------------------------------|
| RF-IN | 3 | RF Input |
| RF-OUT and DC-IN | 7 | RF Output and DC Bias |
| GND | Paddle | Connections to ground. |
| NC | 2, 4-6, 8-12 | No connection, grounded externally |
| VG | 1 | Control voltage for shutdown (VG) |

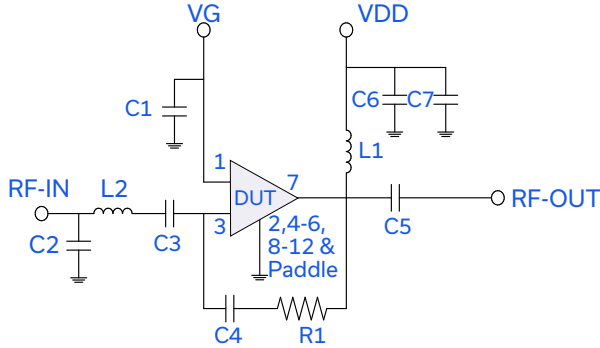


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CHARACTERIZATION TEST CIRCUIT / RECOMMENDED APPLICATION CIRCUIT



| Component | Size | Value | Part Number | Manufacturer |
|-----------|------|---------|--------------------|--------------|
| C1 | 0402 | 0.1uF | GRM155R71C104KA88D | Murata |
| C2 | 0402 | 1.5pF | GRM1555C1H1R5CA1D | Murata |
| C3 | 0603 | 2.2uF | GRM188C71E225KE11D | Murata |
| C4 | 0402 | 0.1uF | GRM155R71C104KA88D | Murata |
| C5 | 0603 | 2.2uF | GRM188C71E225KE11D | Murata |
| C6 | 0402 | 1000pF | GRM1555C1H102JA01D | Murata |
| C7 | 0805 | 10uF | GRM21BC71E106KE11L | Murata |
| L1 | 1210 | 15uH | LQH32DN150K53L | Murata |
| L2 | 0603 | 5.1nH | 0603CS-5N1XJLU | Coilcraft |
| R1 | 0402 | 1.5KOhm | RK73H1ETTP1501F | Koa |

Fig 1. Block diagram of Test Circuit used for characterization. (DUT soldered on Mini-Circuits Characterization test board TB-TSS-13LN+)

Gain, Return loss, Output power at 1dB compression (P1dB) , output IP3 (OIP3) and noise figure measured using Agilent's N5242A PNA-X microwave network analyzer.

Conditions:

1. Gain and Return Loss: Pin= -25dBm
2. Output IP3 (OIP3): Two tones, spaced 1 MHz apart, +0dBm/tone at output.
3. Switching Time
RF Signal: Pin=-25 dBm, fRF=500 MHz.
Vdd=8V DC, VG=Pulse signal at 1 KHz with VHIGH=5V, VLOW=0V, 50% duty cycle.

PRODUCT MARKING



Marking may contain other features or characters for internal lot control



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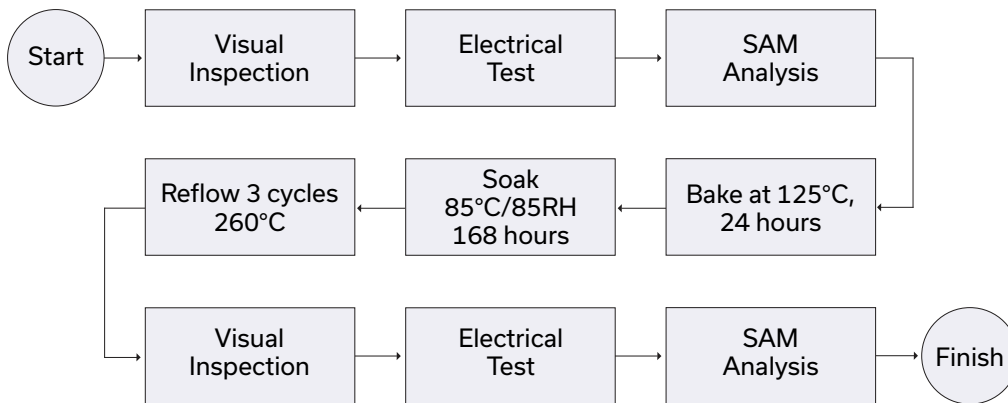
ADDITIONAL DETAILED TECHNICAL INFORMATION IS AVAILABLE ON OUR DASH BOARD. TO ACCESS [CLICK HERE](#)

| | |
|--|--|
| Performance Data | Data Table Swept Graphs S-Parameter (S2P Files) Data Set (.zip file) |
| Case Style | DQ1225 Plastic package, exposed paddle lead finish: Matte-Tin |
| Tape & Reel Standard quantities available on reel | F66 7" reels with 20, 50, 100, 200, 500, 1K, or 2K devices |
| Suggested Layout for PCB Design | PL-619 |
| Evaluation Board | TB-TSS-23HLN+ |
| Environmental Ratings | ENV08T9 |

ESD RATING

Human Body Model (HBM): Class 1A (Pass 250 V) in accordance with ANSI/ESD STM 5.1 - 2001

MSL FLOW CHART



- NOTES**
- A. Performance and quality attributes and conditions not expressly stated in this specification document are intended to be excluded and do not form a part of this specification document.
 - B. Electrical specifications and performance data contained in this specification document are based on Mini-Circuit's applicable established test performance criteria and measurement instructions.
 - C. The parts covered by this specification document are subject to Mini-Circuits standard limited warranty and terms and conditions (collectively, "Standard Terms"); Purchasers of this part are entitled to the rights and benefits contained therein. For a full statement of the standard. Terms and the exclusive rights and remedies thereunder, please visit Mini-Circuits' website at www.minicircuits.com/MCLStore/terms.jsp

