Mini-Circuits

ULTRA-HIGH DYNAMIC RANGE, SHUTDOWN

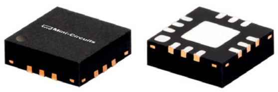
Monolithic Amplifier

TSS-13LN+

50Ω 1 MHz to 1 GHz

THE BIG DEAL

- Ultra-High IP3, +39.2 dBm typ.
- Gain, 22.8 dB typ. at 0.5 GHz
- Low supply voltage, +3 to +5V
- Excellent Noise Figure, 1.1 dB typ.
- Shutdown feature



Generic photo used for illustration purposes only

CASE STYLE: DQ1225

+RoHS Compliant
The +Suffix identifies RoHS Compliance.
See our website for methodologies and qualifications

APPLICATIONS

- Base station infrastructure
- CATV
- Cellular

PRODUCT OVERVIEW

TSS-13LN+ (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-13LN+ has good input and output return loss over a broad frequency range. TSS-13LN+ is enclosed in a 3x3mm, 12-lead MCLP package and has very good thermal performance.

KEY FEATURES

Feature	Advantages
Broad Band: 1 MHz to 1 GHz	Broadband covering primary wireless communications bands: VHF, UHF, Cellular
Extremely High IP3 +38.4 dBm typical at 1 MHz +39.2 dBm typical at 0.5 GHz	The TSS-13LN+ 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 11-18 dB above the P1dB point. This feature makes this amplifier ideal for use in: • 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 1.1 dB at 0.5 GHz	Enables lower system noise figure performance and along with High OIP3 provides high dynamic range
Low Supply Voltage	TSS-13LN+ supports low supply voltage operation which indicate low power consumption.

ELECTRICAL SPECIFICATIONS[1] AT +25°C & 50Ω, UNLESS NOTED OTHERWISE

Parameter	Condition (MHz)	Amplifier-ON V_{DD} = +5V Min.	Amplifier-ON V_{DD} = +5V Typ.	Amplifier-ON V_{DD} = +5V Max.	Amplifier-OFF V_{DD} = +5V Typ.	Amplifier-ON V_{DD} = +3V Typ.	Amplifier-OFF V_{DD} = +3V Typ.	Units
Frequency Range		1		1000	1-1000	1-1000	1-1000	MHz
Noise Figure	1		3.1			3.0		dB
	20		1.1			1.1		
	250		1.1			1.1		
	500		1.1			1.1		
	1000		1.2			1.3		
Gain	1	22.1	24.7	27.1	-24	23.9	-24	dB
	20	—	24.2	—	-22	23.5	-22	
	250	20.6	23.0	25.2	-21	22.3	-21	
	500	—	22.8	—	-22	21.9	-22	
	1000	18.2	20.9	22.2	-27	19.5	-27	
Reversed Isolation	1-1000		26		27	26	27	dB
Input Return Loss	1		11		12	10	12	dB
	20		15		12	15	12	
	250		18		12	19	12	
	500		21		12	17	12	
	1000		14		10	10	10	
Output Return Loss	1		11		1	11	1	dB
	20		19		2	21	2	
	250		18		2	21	2	
	500		25		2	21	2	
	1000		11		2	10	2	
Output Power @1dB compression AMP-ON	1		+20.3			+14.2		dBm
	20		+22.4			+16.3		
	250		+24.1			+19.3		
	500		+24.5			+19.5		
	1000		+23.4			+18.3		
Output IP3 (Pout = 0dBm/Tone)	1	—	+38.4			+31.6		dBm
	20	—	+40.3			+33.2		
	250	—	+39.6			+34.4		
	500	+35.4	+39.2			+33		
	1000	—	+36.2			+29.4		
Device Operating Voltage (V_{DD})		+4.75	+5	+5.25	+5	+3	+3	V
Device Operating Current (ID)			142	151	5	72	3	mA
Control Voltage (V_G)			0		+5	0	+5	V
DC Current (ID) Variation Vs. Temperature[2]			10			33		uA/degC
DC Current(ID) Variation Vs. Voltage			0.025			0.033		mA/mV
Thermal Resistance			23.3			23.3		degC/W

1. Measured on Mini-Circuits Characterization test board TB-TSS-13LN+. See Characterization Test Circuit (Fig. 1)
2. (Current at 105°C — Current at -45°C)/150

ABSOLUTE MAXIMUM RATINGS[3]

Parameter	Ratings
Operating Temperature (ground lead)	-40°C to +105°C
Storage Temperature	-65°C to +150°C
Total Power Dissipation	3.3 W
Input Power	+28 dBm (5 minutes max.) +6 dBm (continuos) for 1- 30 MHz +10 dBm (continuos) for 0.03-1 GHz GHz
DC Voltage V_{DD}[4] (Pad 7)	+10 V
DC Voltage V_G[5] (Pad 1)	+10 V

3. Permanent damage may occur if these limits are exceeded.
4. Measured by keeping VG=0V.
5. Measured by keeping Vdd=5V.

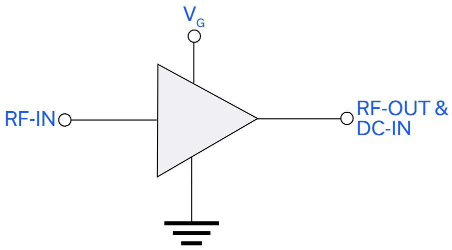
CONTROL VOLTAGE (V_G) FIG. 1

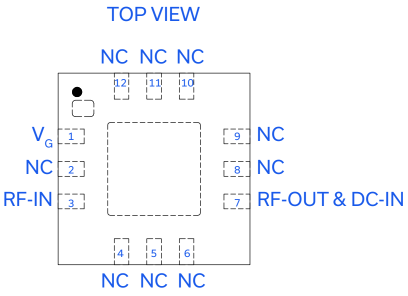
	Min.	Typ.	Max.	Units
Amplifier-ON	—	0	0.7	V
Amplifier-OFF	1.9	5	—	V

SWITCHING SPECIFICATIONS

Parameter		Typ.	Max.	Units
Amplifier ON to Shutdown	OFF TIME (50% Control to 10% RF)	4.8	6.2	µs
	FALL TIME (90 to 10% RF)	7.4	3.6	
Amplifier Shutdown to ON	ON TIME (50% Control to 90% RF)	95.2	144.7	µs
	RISE TIME (10% to 90% RF)	60.0	200.7	
Control Voltage Leakage		482.9	311.0	mV

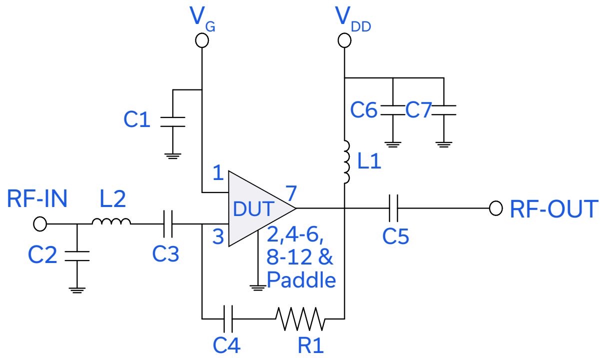
SIMPLIFIED SCHEMATIC AND PAD DESCRIPTION





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
V_G	1	Control voltage for shutdown (V_G)

CHARACTERIZATION TEST CIRCUIT / RECOMMENDED APPLICATION CIRCUIT

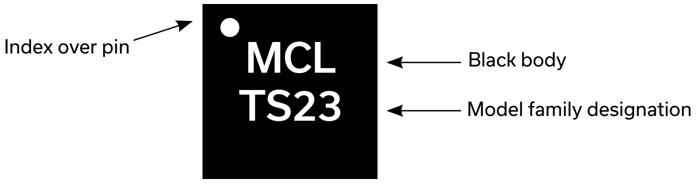


Component	Size	Value	Part Number	Manufacturer
C1	0402	0.1uF	GRM155R71C104KA88D	Murata
C2	0402	1.5pF	GRM1555C1H1R5CA1D	Murata
C3	0603	2.2uF	GRM188C71E225KE11D	Murata
C4	0402	0.1uF	GRM155R71C104KA88D	Murata
C5	0603	2.2uF	GRM188C71E225KE11D	Murata
C6	0402	1000pF	GRM1555C1H102JA01D	Murata
C7	0805	10uF	GRM21BC71E106KE11L	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: P_{IN}= -25dBm
2. Output IP3 (OIP3): Two tones, spaced 1 MHz apart, +0dBm/tone at output.
3. Switching Time
   RF Signal: P_{IN}=-25 dBm, fRF=500 MHz.
   Vdd=3 & 5V 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

ADDITIONAL DETAILED TECHNICAL INFORMATION IS AVAILABLE ON OUR DASHBOARD. 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-623
Evaluation Board	TB-TSS-13LN+
Environmental Ratings	ENV08T9

ESD RATING

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

MSL RATING

Moisture Sensitivity: MSL1 in accordance with IPC/JEDEC J-STD-020D

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/terms/viewterm.html