ULTRA HIGH DYNAMIC RANGE, SHUTDOWN

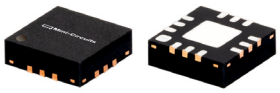
Monolithic Amplifier

TSS-23LN+

50Ω 30 MHz to 2 GHz

THE BIG DEAL

- High IP3, +36.4 dBm typ. at 1GHz
- Gain, 21.5 dB typ. at 1 GHz
- Low noise figure, 1.2 dB at 1 GHz
- Low voltage, +5V and +3V
- 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-23LN+ (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-23LN+ has good input and output return loss over a broad frequency range. TSS-23LN+ 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 +39.8 dBm typical at 30 MHz +36.4 dBm typical at 1 GHz	The TSS-23LN+ 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 11-17 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, 1.2 dB at 1 GHz	Enables lower system noise figure performance and along with High OIP3 provides high dynamic range
Low Supply Voltage	TSS-23LN+ supports low supply voltage operation which indicate low power consumption.

REV. B
ECO-022590
TSS-23LN+
MCL NY
240731

Monolithic Amplifier TSS-23LN+

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

Parameter	Condition (MHz)	Amplifier-ON VDD = +5V Min.	Amplifier-ON VDD = +5V Typ.	Amplifier-ON VDD = +5V Max.	Amplifier-OFF VDD = +5V Typ.	Amplifier-ON VDD = +3V Typ.	Amplifier-OFF VDD = +3V Typ.	Units
Frequency Range		30		2000	30-2000	30-2000	30-2000	MHz
Noise Figure	30		1.2			1.1		dB
	500		1.2			1.2		
	1000		1.2			1.2		
	1500		1.3			1.4		
	2000		1.4			1.5		
Gain	30	20.7	23.1	25.3	-21	22.4	-21	dB
	500	—	22.2	—	-21	21.4	-21	
	1000	19.2	21.5	23.4	-23	20.2	-24	
	1500	—	20.7	—	-26	19.1	-26	
	2000	17.6	19.9	21.6	-28	18	-27	
Reversed Isolation	30-2000		27		26	27	25	dB
Input Return Loss	30		12		12	12	12	dB
	500		12		12	11	12	
	1000		10		12	8	12	
	1500		10		15	8	15	
	2000		11		19	8	19	
Output Return Loss	30		15		2	17	2	dB
	500		15		2	19	2	
	1000		16		2	18	2	
	1500		12		2	11	2	
	2000		10		2	9	2	
Output Power @1dB compression AMP-ON	30		+22.8			+17.1		dBm
	500		+23.8			+18.9		
	1000		+24.1			+19		
	1500		+23.5			+18.8		
	2000		+22.8			+18.1		
Output IP3 (Pout = 0dBm/Tone)	30	—	+39.8			+34.1		dBm
	500	—	+38.0			+33.7		
	1000	—	+36.4			+31.8		
	1500	+33	+35.5			+31.1		
	2000	—	+34.0			+30.3		
Device Operating Voltage (VDD)		+4.75	+5	+5.25	+5	+3	+3	V
Device Operating Current (ID)			139	163	5	74	3	mA
Control Voltage (VG)			0		+5	0	+5	V
DC Current (ID) Variation Vs. Temperature[2]			-13			27		uA/degC
DC Current (ID) Variation Vs. Voltage			0.034			0.033		mA/mV
Thermal Resistance			23.3			23.3		degC/W

1. Measured on Mini-Circuits Characterization test board TB-TSS-23LN+. 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	3.3W
Input Power	+28 dBm (5 minutes max.) +10 dBm (continuos) for 0.03-1 GHz +13 dBm (continuos) for 1-2 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.

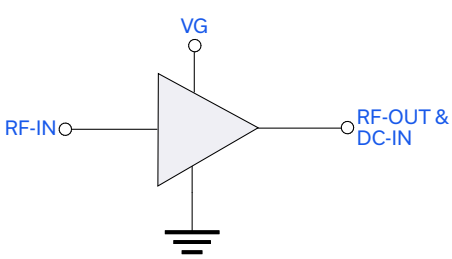
CONTROL VOLTAGE (V_G) FIG. 1

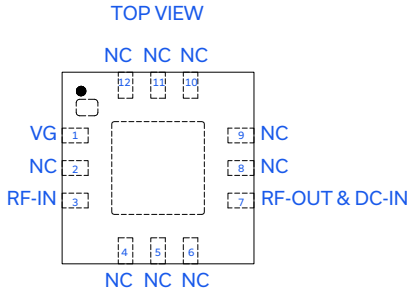
	Min.	Typ.	Max.	Units
Amplifier-ON	—	0	0.7	V
Amplifier-OFF	1.9	5	—	V

SWITCHING SPECIFICATIONS

Parameter		Min.	+5V Typ.	+3V Typ.	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

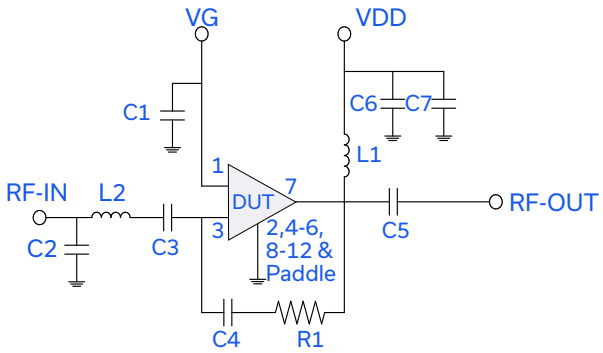
SIMPLIFIED SCHEMATIC AND PAD DESCRIPTION





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
VG	1	Control voltage for shutdown (VG)

CHARACTERIZATION TEST CIRCUIT / RECOMMENDED APPLICATION CIRCUIT



Component	Size	Value	Part Number	Manufacturer
C1	0402	0.1uF	GRM155R71C104KA88D	Murata
C2	0402	1.2pF	GRM1555C1H1R2CA1D	Murata
C3	0402	0.1uF	GRM155R71C104KA88D	Murata
C4	0402	0.1uF	GRM155R71C104KA88D	Murata
C5	0402	1000pF	GRM1555C1H102JA01D	Murata
C6	0402	10000pF	GRM155R71E103KA01D	Murata
C7	0402	0.1uF	GRM155R71C104KA88D	Murata
L1	0805	680nH	0805LS-681XJLB	Coilcraft
L2	0402	1.0nH	0402CS-1N0XJLW	Coilcraft
R1	0402	1.2KOhm	RK73H1ETTP1201F	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

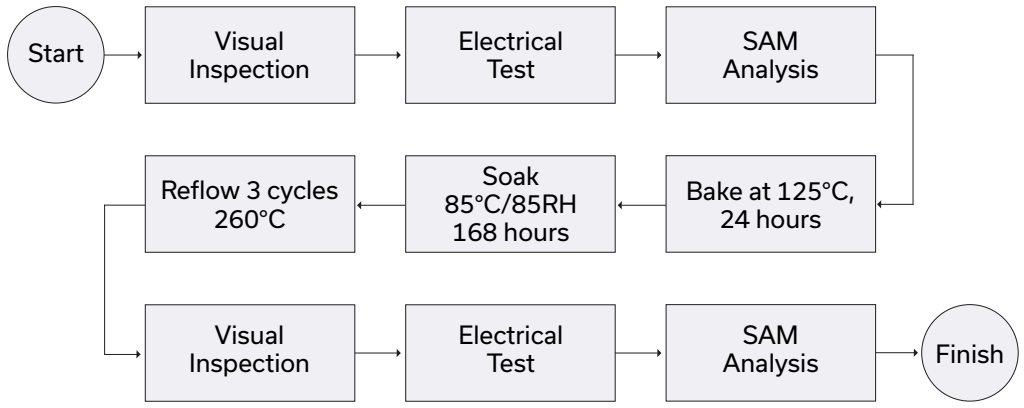
ADDITIONAL DETAILED TECHNICAL INFORMATION IS AVAILABLE ON OUR DASHBOARD. CLICK HERE

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-619
Evaluation Board	TB-TSS-23LN+
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



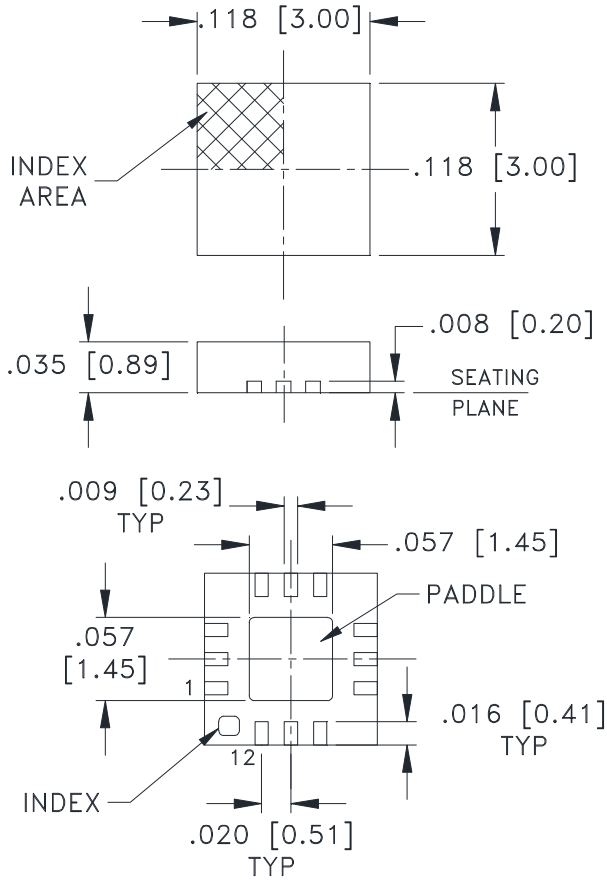
NOTES

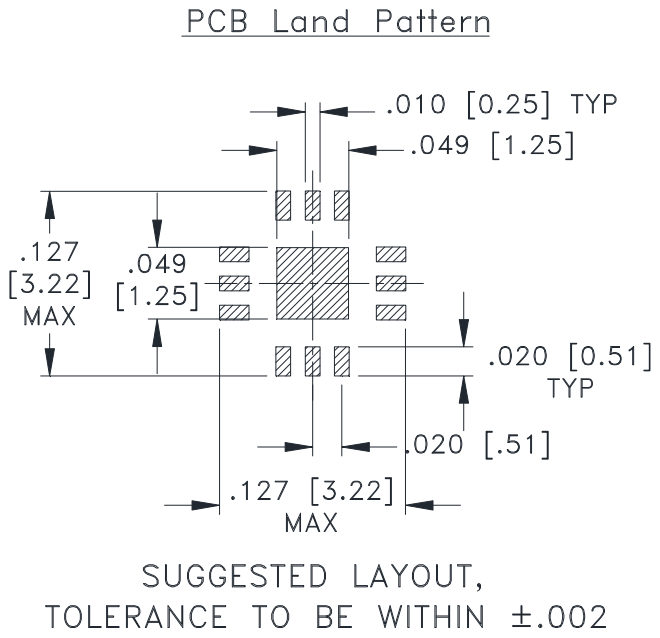
A. Performance and quality attributes and conditions not expressly stated in this specification document are intended to be excluded and do not form a part of this specification document.
B. Electrical specifications and performance data contained in this specification document are based on Mini-Circuit's 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

Case Style DQ

DQ1225

Outline Dimensions





Weight: .02 Grams

Dimensions are in inches (mm). Tolerances: 2Pl. ± .01; 3 Pl. ± .004

Notes:

1. Case material: Plastic.
2. Termination finish:
   - For RoHS Case Styles: Tin-Silver alloy plate over Nickel barrier or Matte-Tin. All models, (+) suffix. See Data sheet.
   - For RoHS-5 Case Styles: Tin-Lead plate. All models, no (+) suffix.

Mini-Circuits®
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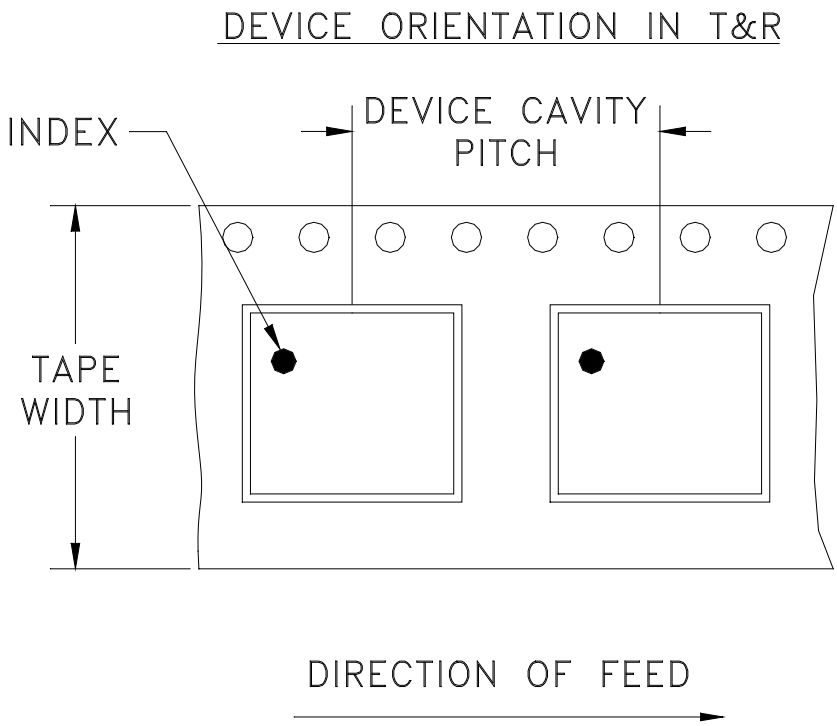
Tape & Reel Packaging TR-F66



Tape Width, mm	Device Cavity Pitch, mm	Reel Size, inches	Devices per Reel see note	
8	4	7	Small quantity standard	20
				50
				100
				200
				500
		7	Standard	1000, 2000, 3000

Note: Please consult individual model data sheet to determine device per reel availability.

Mini-Circuits carrier tape materials provide protection from ESD (Electro-Static Discharge) during handling and transportation. Tapes are static dissipative and comply with industry standards EIA-481/EIA-541.

Go to: www.minicircuits.com/pages/pdfs/tape.pdf

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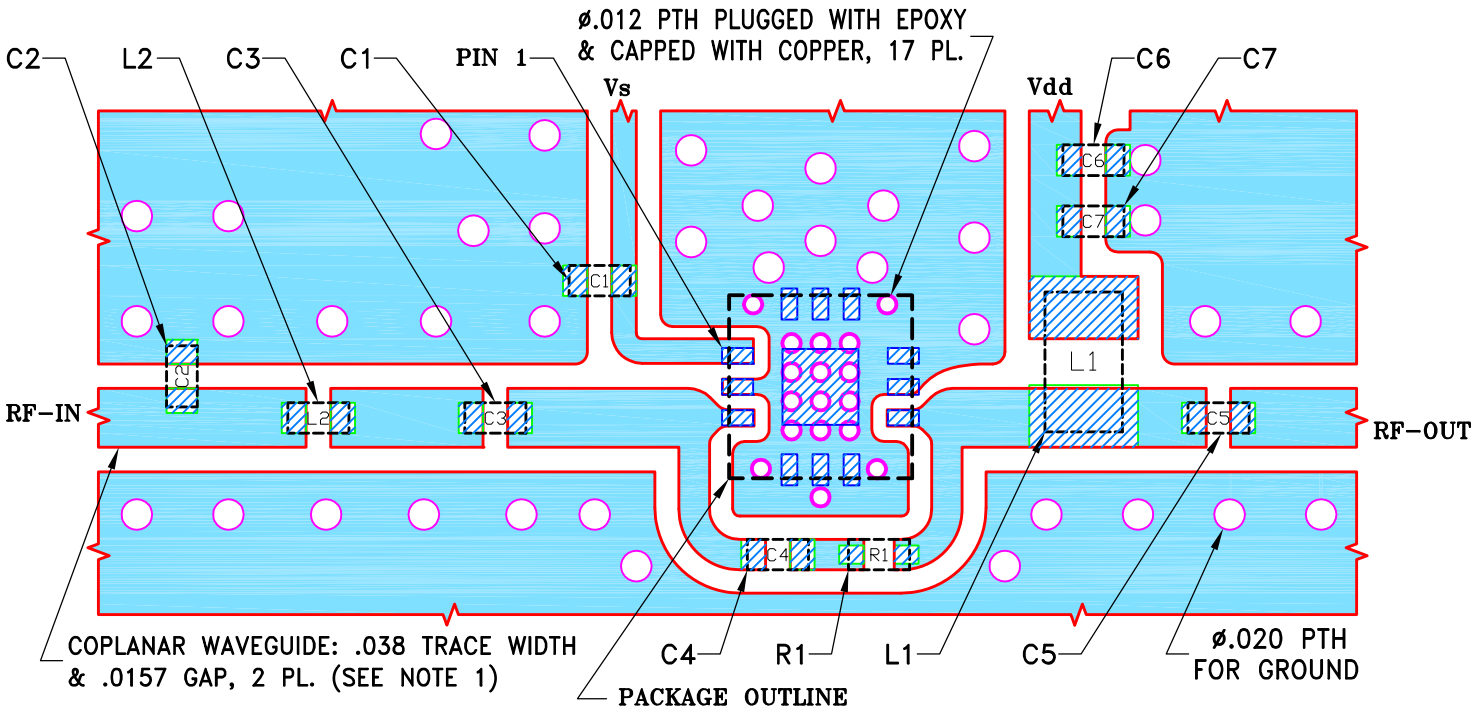
THIRD ANGLE PROJECTION

REVISIONS					
REV	ECN No.	DESCRIPTION	DATE	DR	AUTH
OR	M171588	NEW RELEASE	12/20/18	ITG	GH

SUGGESTED MOUNTING CONFIGURATION FOR DQ1225 CASE STYLE, "12AM05" PIN CODE



COMPONENT	SIZE
C1...C7;L2;R1	0402
L1	0805

NOTES:

1. TRACE WIDTH & GAP PARAMETERS ARE SHOWN FOR ROGERS RO4350B WITH DIELECTRIC THICKNESS .020"±.0015"; COPPER: 1/2 OZ. EACH SIDE. FOR OTHER MATERIALS TRACE WIDTH AND GAP MAY NEED TO BE MODIFIED.
2. CHIP COMPONENT FOOTPRINTS SHOWN FOR REFERENCE. FOR COMPONENT VALUES REFER TO TB-TSS-23LN+ OR TB-TSS-23HLN+.
3. BOTTOM SIDE OF THE PCB IS CONTINUOUS GROUND PLANE.

DENOTES PCB COPPER LAYOUT WITH SMOBC (SOLDER MASK OVER BARE COPPER)

DENOTES COPPER LAND PATTERN FREE OF SOLDER MASK

UNLESS OTHERWISE SPECIFIED		INITIALS	DATE
DIMENSIONS ARE IN INCHES	DRAWN	ITG	12/19/18
TOLERANCES ON:	CHECKED	GF	12/20/18
2 PL DECIMALS ±	APPROVED	GH	12/20/18
3 PL DECIMALS ± .005			
ANGLES ±			
FRACTIONS ±			

ASHEETA1.DWG REV:A DATE:01/12/95

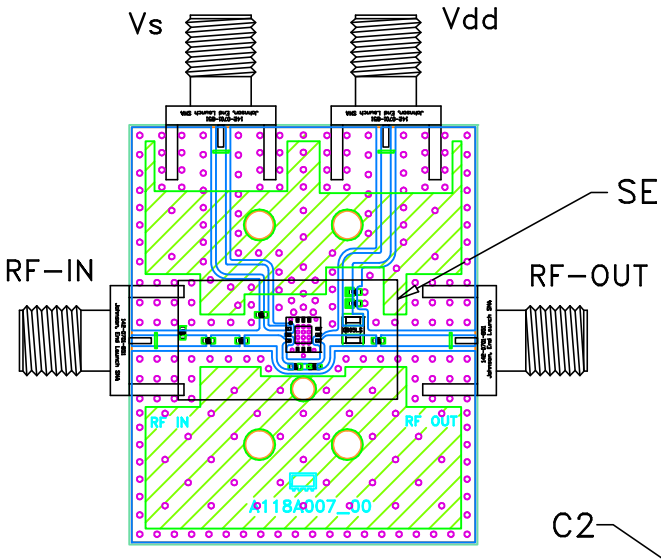
Mini-Circuits®
13 Neptune Avenue
Brooklyn NY 11235

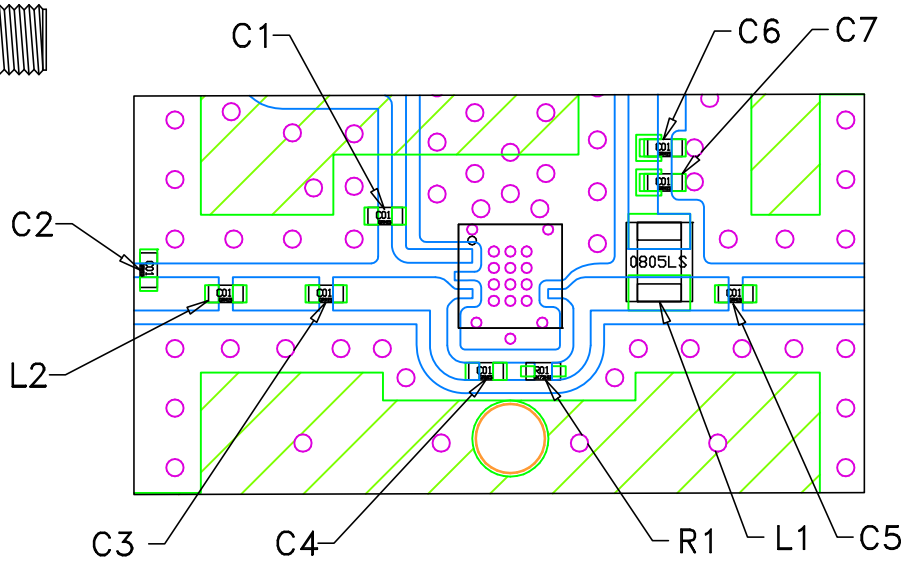
PL, 12AM05, DQ1225, TB-TSS-23LN+/23HLN+

SIZE	CODE IDENT	DRAWING NO:	REV:
A	15542	98-PL-619	OR

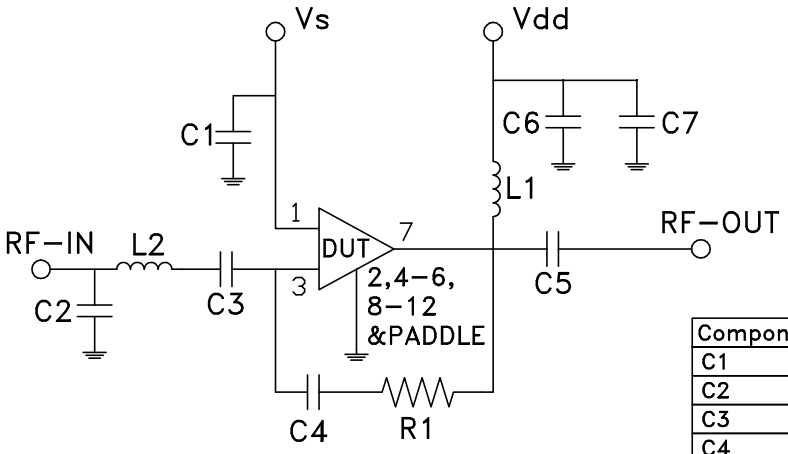
FILE:	SCALE:	SHEET:
98PL619	8:1	1 OF 1

Evaluation Board and Circuit





DETAIL B"
LOCATION OF CHIP COMPONENTS
ON THE PCB



Schematic Diagram

Component	Size	Value	Part Number	Manufacturer
C1	0402	0.1uF	GRM155R71C104KA88D	Murata
C2	0402	1.2pF	GRM1555C1H1R2CA1D	Murata
C3	0402	0.1uF	GRM155R71C104KA88D	Murata
C4	0402	0.1uF	GRM155R71C104KA88D	Murata
C5	0402	1000pF	GRM1555C1H102JA01D	Murata
C6	0402	10000pF	GRM155R71E103KA01D	Murata
C7	0402	0.1uF	GRM155R71C104KA88D	Murata
L1	0805	680nH	0805LS-681XJLB	Coilcraft
L2	0402	1.0nH	0402CS-1N0XJLW	Coilcraft
R1	0402	1.2KOhm	RK73H1ETTP1201F	Koa

NOTES:

1. 50 Ohm SMA Female Connectors.
2. PCB Material: Roger RO4350B or equivalent, Dielectric constant=3.5, Thickness=0.02 inch

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Environmental Specifications **ENV08T9**

All Mini-Circuits products are manufactured under exacting quality assurance and control standards, and are capable of meeting published specifications after being subjected to any or all of the following physical and environmental test.

Specification	Test/Inspection Condition	Reference/Spec
Operating Temperature	-40° to 95° C / 105° C Ambient Environment	Individual Model Data Sheet
Storage Temperature	-55° to 100° C or -65° to 150° Ambient Environment	Individual Model Data Sheet
Thermal Shock	-55° to 100°C, 100 cycles	MIL-STD-202, Method 107, Condition A-3, except +100°C
Mechanical Shock	1.5Kg, 0.5 ms, 5 shock pulses, Y1 direction only	MIL-STD-883, Method 2002, Condition B, except Y1 direction only
Vibration (Variable Frequency)	50g peak	MIL-STD-883, Method 2007, Condition B
Autoclave	15 psig, 100% RH, 121°C, 96 hours	JESD22-A102-C, Condition C
HAST	130°C, 85% RH, 96 hours	JESD22-A110
Solderability	10X Magnification	J-STD-002, Para 4.2.5, Test S, 95% Coverage
Solder Reflow Heat	Sn-Pb Eutetic Process: 240°C peak Pb-Free Process: 260°C peak	J-STD-020C, Table 4-1, 4-2 and 5-2; Figure 5-1
Moisture Sensitivity: Level 1	Bake at 125°C for 24 hours. Soak at 85°C/85%RH for 168 hours Reflow 3 cycles at 260°C peak	J-STD-020
Marking Resistance to Solvents	Isopropyl alcohol + mineral spirits at 25°C; terpene defluxer at 25°C; distilled water + proylene glycol monomethyl ether +	MIL-STD-202, Method 215

All Mini-Circuits products are manufactured under exacting quality assurance and control standards, and are capable of meeting published specifications after being subjected to any or all of the following physical and environmental test.

Specification	Test/Inspection Condition	Reference/Spec
	monoethanolamine at 63°C to 70°C	