MMIC SURFACE MOUNT

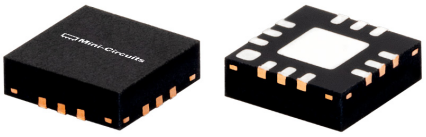
Low Noise Amplifier

TSS-66921LN+

50Ω 660 to 920 MHz Shutdown Feature

THE BIG DEAL

- Ultra-Low Noise Figure, Typ. 1.0 dB
- High P1dB, Typ. +16.3 dBm
- High OIP3, Typ. +25.4 dBm
- High Input Power Handling, Max +24 dBm
- Shutdown Feature
- Single Supply Voltage, +3.3 V
- 3x3 mm, 12-Lead QFN-Style Package

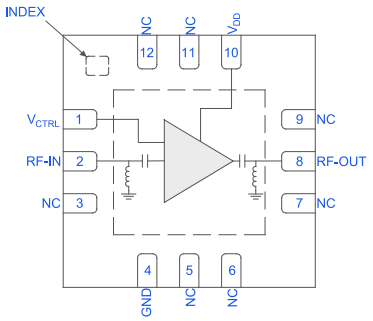


Generic photo used for illustration purposes only

APPLICATIONS

- 5G MIMO Radio Systems
- Radar, EW, and ECM Defense Systems
- ISM

FUNCTIONAL DIAGRAM



PRODUCT OVERVIEW

The TSS-66921LN+ is a pHEMT-based wideband, ultra-low noise MMIC amplifier with high IP3, flat gain, and voltage-controlled shutdown capability. Operating from 660 to 920 MHz, this amplifier features typical 1.1 dB noise figure, 35.0 dB gain, +16.3 dBm P1dB, and +25.4 dBm OIP3. This combination of characteristics makes it ideal for sensitive receiver applications. The device is internally DC blocked, and a DC path to ground is present at the RF input and output ports for ESD protection. TSS-66921LN+ operates on a single +3.3 V supply and comes in a small, low profile, 3x3 mm QFN-style package for ease of integration into dense circuit board layouts.

KEY FEATURES

Features	Advantages
Ultra-Low Noise Figure, Typ. 1.1 dB	Operating from a single supply, this ultra-low noise MMIC enables low system noise figure performance without the need for complicated discrete-based solutions.
High Gain, Typ. 35.0 dB	The MMIC amplifier's high gain enables fewer system components in receiver signal chains.
Shutdown Feature	A voltage-controlled shutdown feature allows the part to be quickly disabled to conserve power when not in use.
3x3 mm 12-Lead QFN-Style Package	Small footprint saves space in dense layouts while providing low inductance, repeatable transitions, and excellent thermal contact to the PCB. Industry standard packaging allows for ease of assembly in high volume manufacturing processes.

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ELECTRICAL SPECIFICATIONS[1] AT 25°C, V_{DD} = +3.3 V

Parameter	Condition (MHz)	Amplifier – ON (V_{CTRL} = 0 V) Min.	Typ.	Max.	Amplifier – OFF (V_{CTRL} = +1.5 V) Typ.	Units
Frequency Range		660		920	660 - 920	MHz
Gain	660	33.3	34.9		-45.4	dB
	780	33.4	35.0		-46.4	
	920	33.0	34.6		-40.8	
Input Return Loss	660		15			dB
	780		20			
	920		20			
Output Return Loss	660		18			dB
	780		20			
	920		16			
Isolation	660-920		62		44	dB
Output Power at 1dB Compression (P1dB)	660		+16.0			dBm
	780		+16.3			
	920		+16.0			
Output Third-Order Intercept Point (P_{OUT} = 0 dBm/Tone)	660		+26.1			dBm
	780		+25.4			
	920		+25.2			
Noise Figure	660		1.0			dB
	780		1.1			
	920		1.0			
ON Time (50% V_{CTRL} to 90% RF)			140.0			ns
RISE Time (10% RF to 90% RF)			87.6			ns
FALL Time (90% RF to 10% RF)			17.0			ns
OFF Time (50% V_{CTRL} to 10% RF)			31.6			ns
Device Operating Voltage (V_{DD})		+3	+3.3	+3.5	+3.3	V
Device Operating Current (I_{DD})[2]			58.4	68	0	mA
Device Control Voltage (V_{CTRL})			0		+1.5	V
Device Control Current (I_{CTRL})			3		4	mA
DC Current Variation vs. Temperature[3]			-26.67			µA/°C
DC Current Variation vs. Voltage[4]			12.4			µA/mV

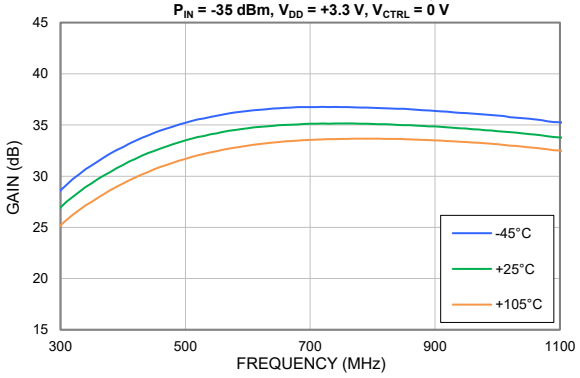
1. Tested on Mini-Circuits Characterization Test Board TB-TSS66921LNC+. See Figure 2. Board loss de-embedded to the device.
2. Current at P_{IN} = -35 dBm.
3. (Current at +105°C - Current at -45°C) / (+150°C)
4. (Current at +3.5 V - Current at +3.0 V) / (+0.5 V)

Low Noise Amplifier TSS-66921LN+

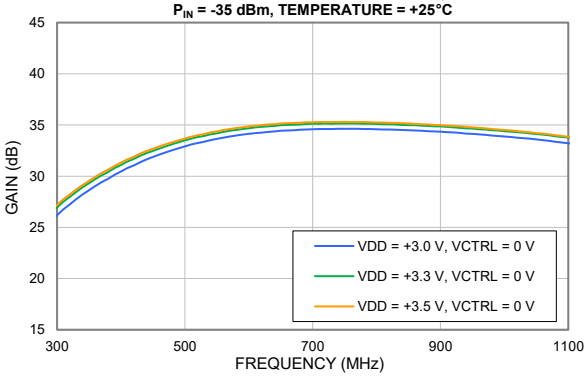
50Ω 660 to 920 MHz Shutdown Feature

TYPICAL PERFORMANCE GRAPHS

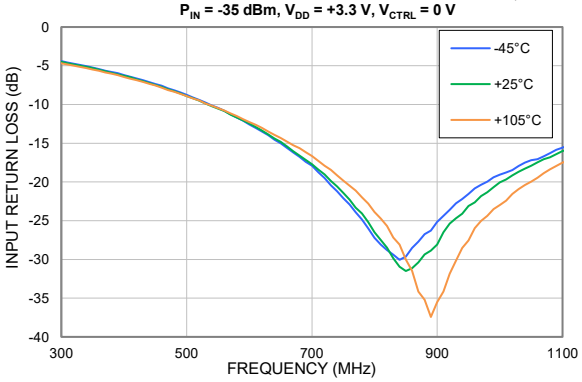
GAIN vs. TEMPERATURE,
P_{IN} = -35 dBm, V_{DD} = +3.3 V, V_{CTRL} = 0 V



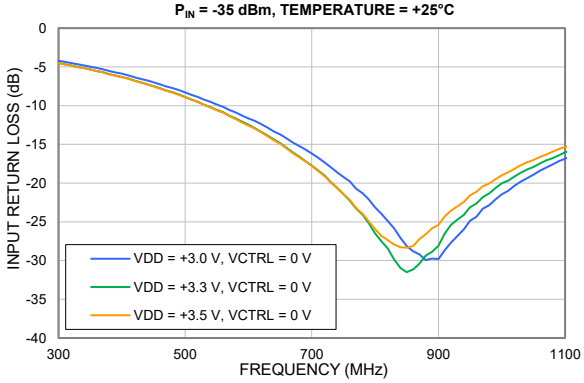
GAIN vs. DEVICE VOLTAGE,
P_{IN} = -35 dBm, TEMPERATURE = +25°C



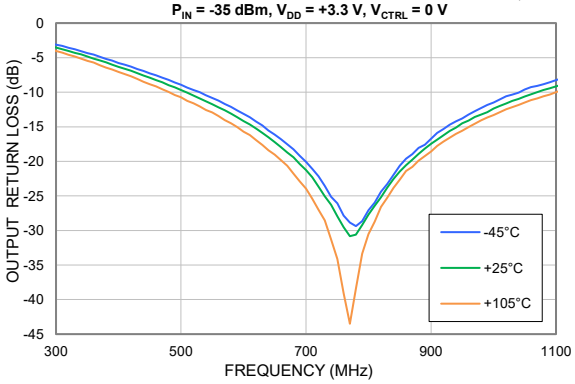
INPUT RETURN LOSS vs.TEMPERATURE,
P_{IN} = -35 dBm, V_{DD} = +3.3 V, V_{CTRL} = 0 V



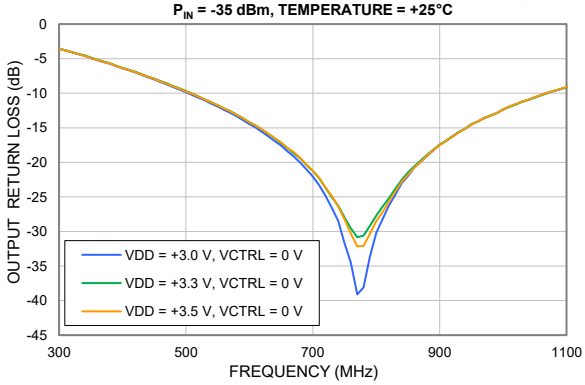
INPUT RETURN LOSS vs. DEVICE VOLTAGE,
P_{IN} = -35 dBm, TEMPERATURE = +25°C



OUTPUT RETURN LOSS vs. TEMPERATURE,
P_{IN} = -35 dBm, V_{DD} = +3.3 V, V_{CTRL} = 0 V

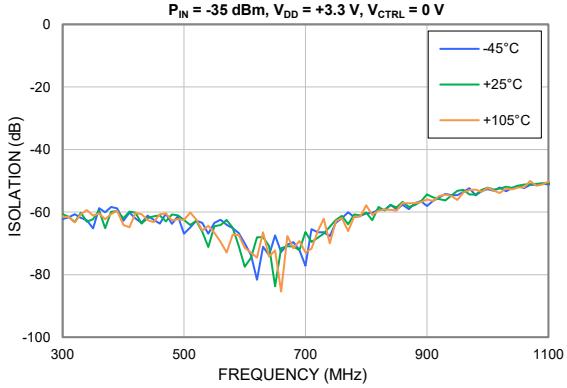


OUTPUT RETURN LOSS vs. DEVICE VOLTAGE,
P_{IN} = -35 dBm, TEMPERATURE = +25°C

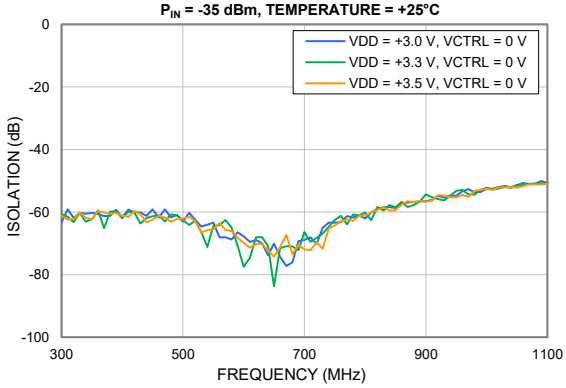


TYPICAL PERFORMANCE GRAPHS

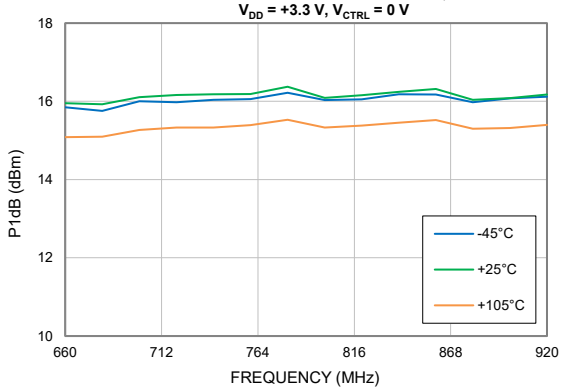
ISOLATION vs.TEMPERATURE,
P_{IN} = -35 dBm, V_{DD} = +3.3 V, V_{CTRL} = 0 V



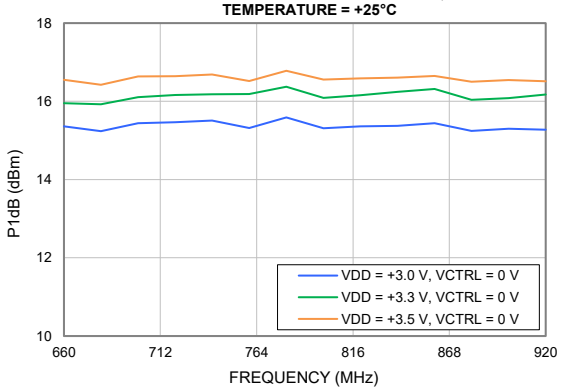
ISOLATION vs. DEVICE VOLTAGE,
P_{IN} = -35 dBm, TEMPERATURE = +25°C



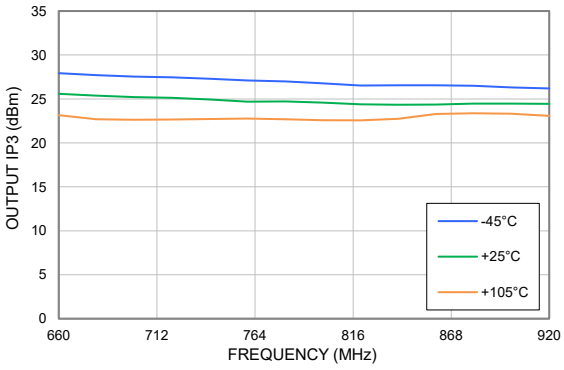
P1dB vs. TEMPERATURE,
V_{DD} = +3.3 V, V_{CTRL} = 0 V



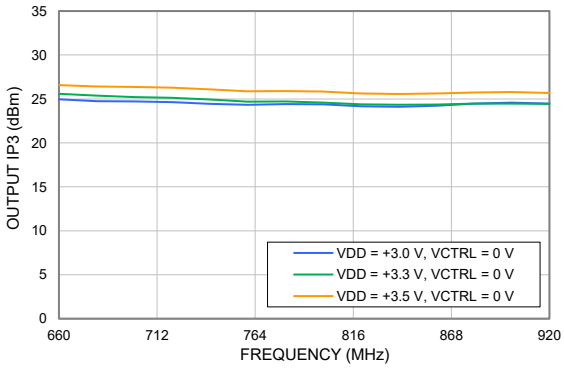
P1dB vs. DEVICE VOLTAGE,
TEMPERATURE = +25°C



OUTPUT IP3 vs. TEMPERATURE,
P_{OUT} = 0 dBm/TONE, V_{DD} = +3.3 V, V_{CTRL} = 0 V



OUTPUT IP3 vs. DEVICE VOLTAGE,
P_{OUT} = 0 dBm/TONE, TEMPERATURE = +25°C

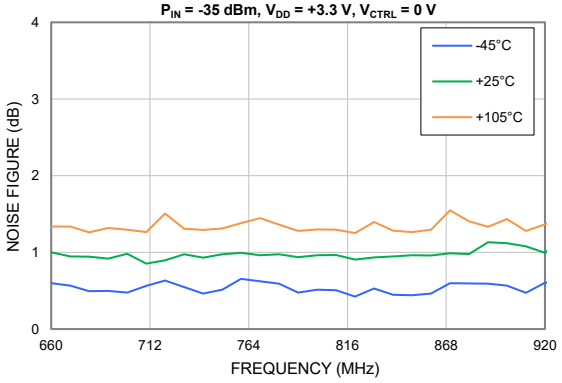


Low Noise Amplifier TSS-66921LN+

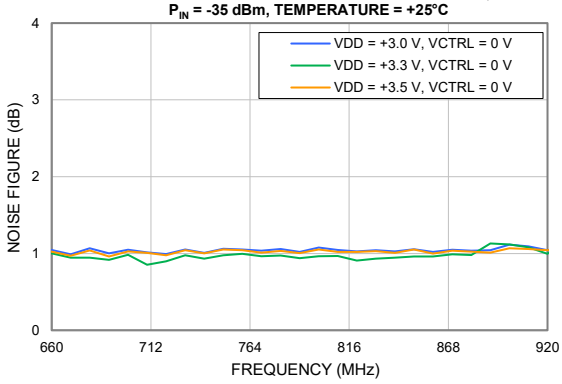
50Ω 660 to 920 MHz Shutdown Feature

TYPICAL PERFORMANCE GRAPHS

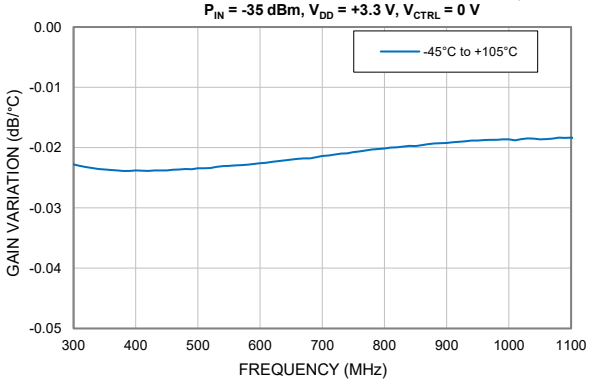
NOISE FIGURE vs. TEMPERATURE,
P_{IN} = -35 dBm, V_{DD} = +3.3 V, V_{CTRL} = 0 V



NOISE FIGURE vs. DEVICE VOLTAGE,
P_{IN} = -35 dBm, TEMPERATURE = +25°C



GAIN VARIATION vs. TEMPERATURE,
P_{IN} = -35 dBm, V_{DD} = +3.3 V, V_{CTRL} = 0 V



ABSOLUTE MAXIMUM RATINGS[5]

Parameter	Ratings
Operating Temperature	-45°C to +105°C
Storage Temperature	-65°C to +150°C
Junction Temperature[6]	+150°C
Total Power Dissipation	0.67 W
Input Power (CW), V_{DD} = +3.3 V V_{CTRL} = 0 V:	 +24 dBm
DC Voltage at V_{DD} V_{CTRL} = 0 V: V_{CTRL} = +1.5 V:	 +5 V +5 V
DC Current I_{DD} V_{CTRL} = 0 V: V_{CTRL} = +1.5 V:	 150 mA 20 mA
DC Voltage at V_{CTRL} V_{DD} = +3.3 V:	 +5 V
DC Current I_{CTRL} V_{DD} = +3.3 V:	 10 mA

5. Permanent damage may occur if any of these limits are exceeded. Maximum ratings are not intended for continuous normal operation.
6. Peak temperature on top of Die.

CONTROL VOLTAGE (V_{CTRL})

Amplifier State	Min.	Typ.	Max.	Units
Amplifier – ON	0	0	+0.2	V
Amplifier – OFF	+1	+1.5	+5	V

THERMAL RESISTANCE

Parameter	Ratings
Thermal Resistance (Θ_{JC})[7]	67.4°C/W

7. Θ_{JC}= (Hot Spot Temperature on Die - Temperature at Ground Lead)/Dissipated Power

ESD RATING

	Class	Voltage Range	Reference Standard
HBM	1A	250 V to < 500 V	ANSI/ESDA/JEDEC JS-001-2023
CDM	C3	≥ 1000 V	ANSI/ESDA/JEDEC JS-002-2022

ESD HANDLING PRECAUTION: This device is designed to be Class 1A for HBM. Static charges may easily produce potentials higher than this with improper handling and can discharge into DUT and damage it. As a preventive measure Industry standard ESD handling precautions should be used at all times to protect the device from ESD damage.

MSL RATING

Moisture Sensitivity: MSL1 in accordance with IPC/JEDEC J-STD-020E /JEDEC J-STD-033C

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FUNCTIONAL DIAGRAM

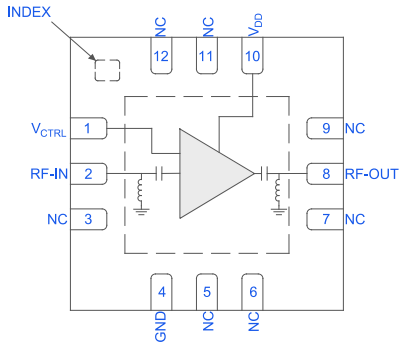

Figure 1. TSS-66921LN+ Functional Diagram

PAD DESCRIPTION

Function	Pad Number	Application Description (Refer to Figure 2)
V_{CTRL}	1	DC Input Pad connects to control voltage port V_{CTRL}.
RF-IN	2	RF-IN Pad connects to RF Input port.
RF-OUT	8	RF-OUT Pad connects to RF Output port.
V_{DD}	10	DC Input Pad connects to voltage input port V_{DD}.
NC	3,5-7,9,11	Not used internally. Connected to ground on test board.
NC[8]	12	Do not connect to ground on PCB. Pad is used internally.
GND	4, Paddle, Index	Connects to ground.

8. Pin 12 is used internally to the DUT. Connecting Pin 12 externally can cause permanent damage to the DUT.

CHARACTERIZATION TEST BOARD

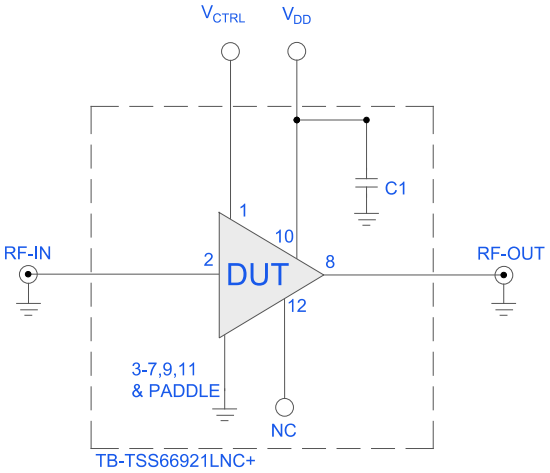

Figure 2. TSS-66921LN+ Characterization and Application Circuit.

Electrical Parameters and Conditions
Gain, Return Loss, Output Power at 1dB Compression (P1dB), Output IP3 (OIP3), and Noise Figure measured using N5242A PNA-X microwave network analyzer.

Conditions:
1) Gain and Return Loss: P_{IN} = -35 dBm
2) Output IP3 (OIP3): Two tones, spaced 1 MHz apart, 0 dBm/Tone at output.
3) V_{DD} = +3.3 V

Component	Value	Size	Part Number	Manufacturer
C1	1 µF	0402	GRM155C81E105KE11D	Murata

Power ON/Power OFF Sequence:
Caution: Permanent damage to the device will occur if the Power ON and Power OFF sequences are not followed.

POWER ON:
1) Set V_{DD} to +3.3 V
2) Turn on V_{DD}
3) Set V_{CTRL} to 0 V
4) Turn on V_{CTRL}
5) Apply RF Signal.

POWER OFF:
1) Turn off RF Signal.
2) Turn off V_{CTRL}
3) Turn off V_{DD}

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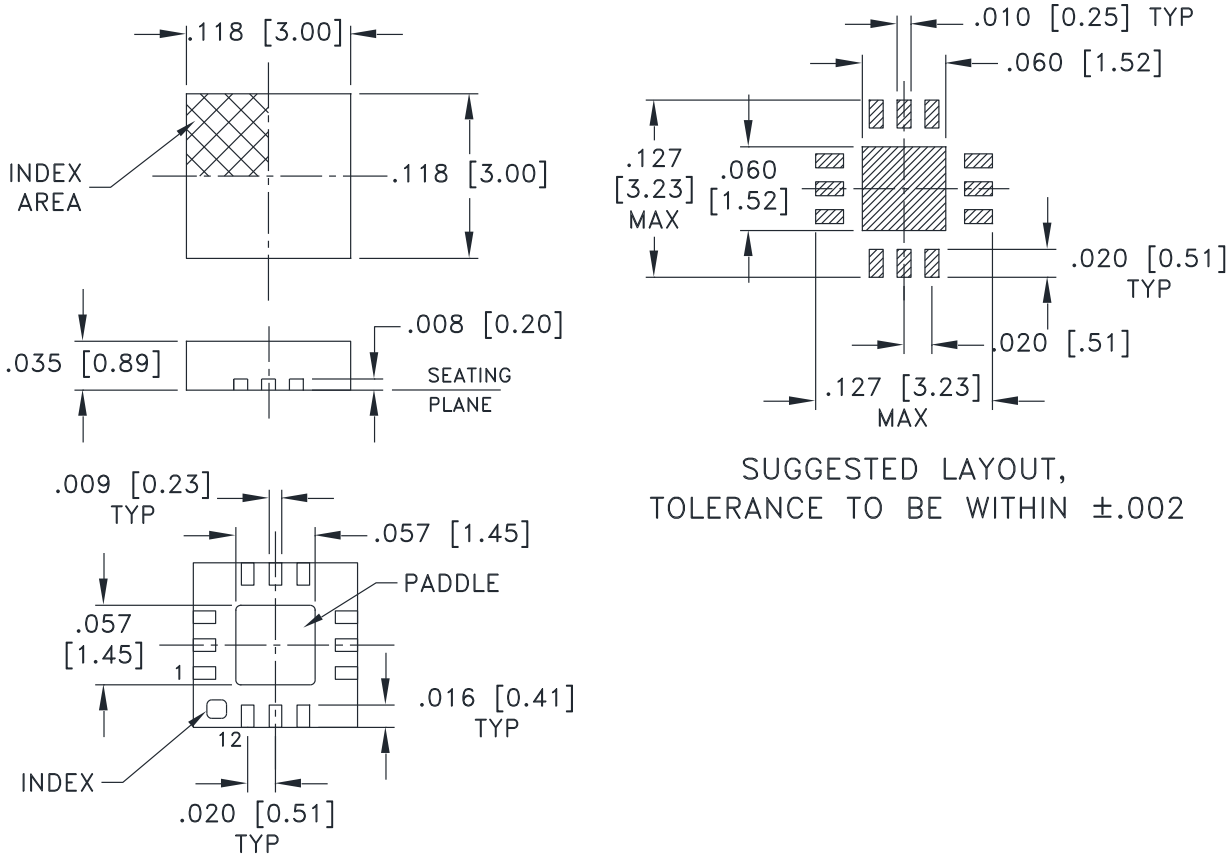
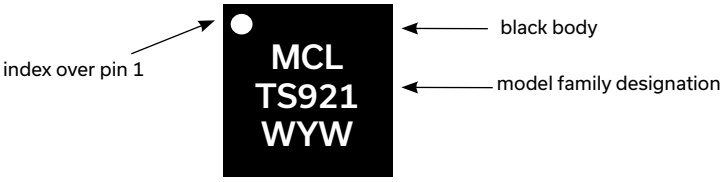
CASE STYLE DRAWING



Weight: .02 Grams
Dimensions are in inches [mm]. Tolerances in inches: 2 Pl. ±.01; 3 Pl.±.004 inches

PRODUCT MARKING



Marking may contain other features or characters for internal lot control

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ADDITIONAL DETAILED INFORMATION IS AVAILABLE ON OUR DASHBOARD CLICK HERE

Performance Data & Graphs	Data Graphs S-Parameter (S2P Files) Data Set (.zip file)
Case Style	DQ1225 Plastic package, exposed paddle, Lead Finish: Matte-Tin
RoHS Status	Compliant
Tape & Reel **Standard quantities available on reel**	F66 7" reels with 20, 50, 100, 200, 500, 1K, 2K, or 3K devices
Suggested Layout for PCB Design	PL-807
Evaluation Board	TB-TSS66921LNC+ Gerber File
Environmental Ratings	ENV08T1

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-Circuits' applicable established test performance criteria and measurement instructions.

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