MMIC SURFACE MOUNT

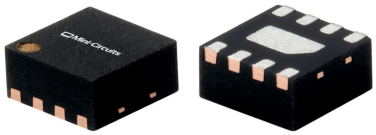
Low Noise Amplifier

TSY-83LNW+

50Ω 30 to 8000 MHz Bypass Mode Feature

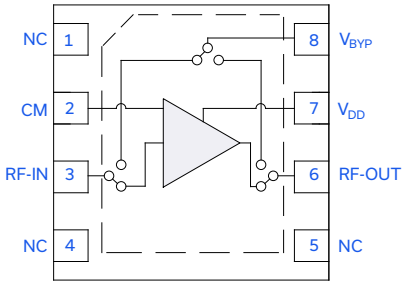
THE BIG DEAL

- Low Loss Bypass Mode Feature
- Low Noise Figure, Typ. 1.4 dB
- High OIP3, Typ. +27.1 dBm
- High Gain, Typ. 18.9 dB
- 2x2 mm 8-Lead QFN-Style Package



Generic photo used for illustration purposes only

FUNCTIONAL DIAGRAM



APPLICATIONS

- 5G Sub6, MIMO Wireless Infrastructure Systems
- Test & Measurement Equipment
- Radar, EW, and ECM Defense Systems

PRODUCT OVERVIEW

Mini-Circuits' TSY-83LNW+ is a GaAs pHEMT-based wide band, bypass mode capable, low noise MMIC amplifier with a combination of high OIP3 and flat gain. Operating from 30 to 8000 MHz, this amplifier features 1.4 dB noise figure, 18.9 dB gain, +14.7 dBm P1dB, and +27.1 dBm OIP3. This combination of characteristics makes it ideal for sensitive receiver applications where a gain stage may need to be quickly bypassed in the presence of high-power RF signals. TSY-83LNW+ operates from a single +5 V supply, is well matched to 50Ω, and comes in a tiny, low profile 2x2 mm QFN-style package for ease of integration into dense circuit board layouts.

KEY FEATURES

Features	Advantages
Low Noise Figure, Typ. 1.4 dB at 3000 MHz	Extremely low noise figure provides minimal signal-to-noise degradation in amplification mode.
Bypass Mode Feature	Allows the user to quickly switch to a low loss bypass path while keeping the power supply at constant voltage to reduce gain and protect the system in the presence of high power RF signals.
High OIP3, Typ. +27.1 dBm at 3000 MHz	The combination of low noise figure and high OIP3 makes this MMIC amplifier ideal for use in sensitive low noise receiver front ends.
2x2 mm 8-Lead QFN-Style Package	Tiny footprint saves space in dense layouts while providing low inductance, repeatable transitions, and excellent thermal contact with the PCB. Industry standard packaging allows for ease of assembly in high volume manufacturing processes.

REV. OR
ECO-027173
TSY-83LNW+
MCL NY
250930

Low Noise Amplifier TSY-83LNW+

50Ω 30 to 8000 MHz Bypass Mode Feature

ELECTRICAL SPECIFICATIONS[1] AT +25°C, V_{DD} = +5 V, Zo = 50Ω UNLESS NOTED OTHERWISE

Parameter	Condition (MHz)	Amplifier – LNA			Amplifier – Bypass	Units
		Min.	Typ.	Max.	Typ.	
Frequency Range		30		8000	30 - 8000	MHz
Gain	30	17.3	18.8		-1.5	dB
	200	17.8	19.3		-1.2	
	1000	17.9	19.2		-1.4	
	3000	17.8	18.9		-1.6	
	5000	17.4	18.3		-2.0	
	8000	15.5	17.1		-1.6	
Input Return Loss	30		18		14	dB
	200		20		29	
	1000		18		14	
	3000		13		14	
	5000		13		19	
	8000		9		14	
Output Return Loss	30		10		18	dB
	200		10		26	
	1000		11		14	
	3000		18		15	
	5000		19		21	
	8000		16		15	
Isolation	30 – 8000		30		2.4	dB
Output Power at 1 dB Compression (P1dB)	30		+12.9		+25.1	dBm
	200		+15.1		+15.9	
	1000		+15.4		+22.3	
	3000		+14.7		+22.5	
	5000		+14.4		+22.9	
	8000		+12.5		+20.6	
Output Power at Saturation (P_{SAT})[2]	30		+15.2		-	dBm
	200		+17.4		-	
	1000		+17.7		+21.2	
	3000		+17.6		+20.8	
	5000		+17.4		+21.2	
	8000		+14.7		+18.4	
Output Third-Order Intercept (P_{OUT} = -5 dBm/Tone)	30		+24.5		+37.4	dBm
	200		+27.9		+36.3	
	1000		+28.5		+37.7	
	3000		+27.1		+33.9	
	5000		+26.4		+31.5	
	8000		+24.0		+31.3	
Noise Figure	30		4.0		2.6	dB
	200		1.5		2.4	
	1000		1.2		2.7	
	3000		1.4		1.7	
	5000		1.6		1.6	
	8000		2.3		3.1	
Device Operating Voltage (V_{DD})		+4.75	+5.0	+5.25	+5.0	V
Device Operating Current (I_{DD})[3]			123		1	mA
Enable Voltage (V_{BYP})[4]			+5.0		0	V
Enable Current (I_{BYP})			1020		0.99	µA
DC Current Variation vs. Temperature[5]			153.1		-0.02	µA/°C
DC Current Variation vs. Voltage[6]			0.06			mA/mV

1. Tested on Mini-Circuits Characterization Test Board TB-TSY-83LNWC+. See Figure 2. Board loss de-embedded to the device.
2. Defined as Output Power at which change is 0.1 dB per 1 dB change in input power.
3. Current at P_{IN} = -25 dBm. In Amplifier-LNA mode, increases to 128 mA at P1dB
4. V_{BYP} must be equal to V_{DD} in Amplifier-LNA mode.
5. (Current at +105°C - Current at -55°C) / (+105 °C - -55 °C)
6. (Current at +5.25 V – Current at +4.75V) / (+5.25 V - +4.75 V)

Low Noise Amplifier TSY-83LNW+

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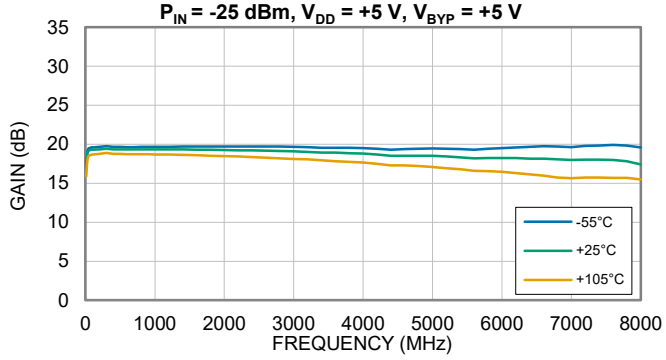
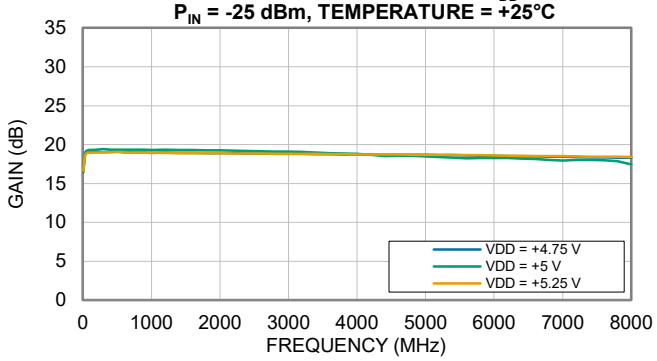
TYPICAL PERFORMANCE GRAPHS

Note: The following data was taken on the Mini-Circuits Characterization Test Board TB-TSY-83LNWC+ (Figure 2). All data taken at nominal conditions V_{BYP} = +5 V and V_{DD} = +5 V unless noted otherwise.

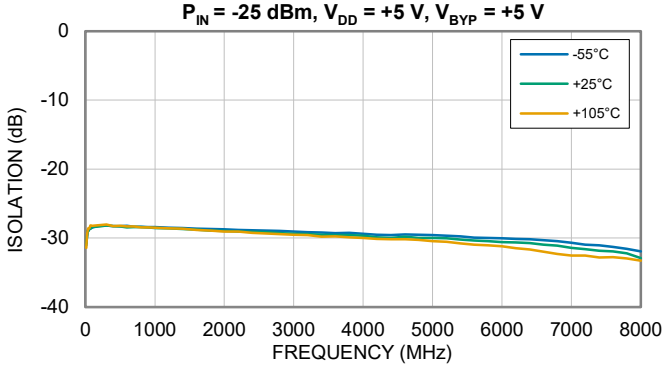
GAIN vs. TEMPERATURE
P_{IN} = -25 dBm, V_{DD} = +5 V, V_{BYP} = +5 V



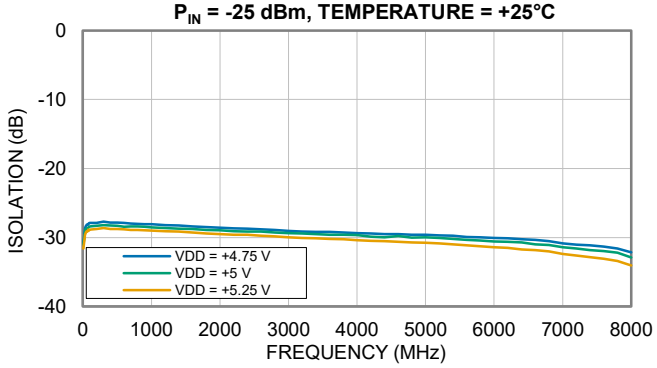
GAIN vs. DEVICE VOLTAGE (V_{DD})
P_{IN} = -25 dBm, TEMPERATURE = +25°C



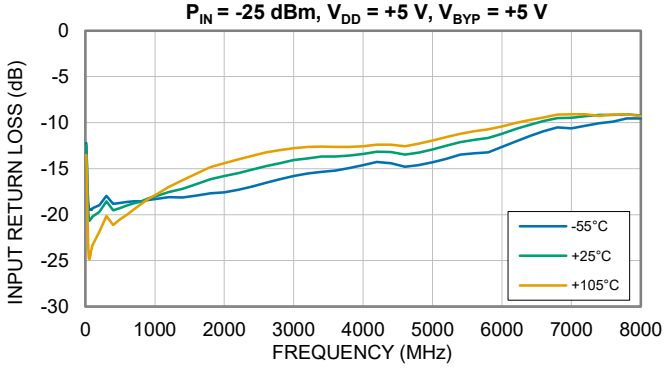
ISOLATION vs. TEMPERATURE
P_{IN} = -25 dBm, V_{DD} = +5 V, V_{BYP} = +5 V



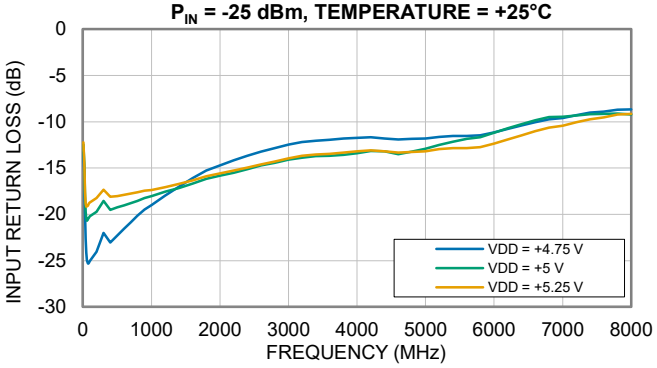
ISOLATION vs. DEVICE VOLTAGE (V_{DD})
P_{IN} = -25 dBm, TEMPERATURE = +25°C



INPUT RETURN LOSS vs. TEMPERATURE
P_{IN} = -25 dBm, V_{DD} = +5 V, V_{BYP} = +5 V



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



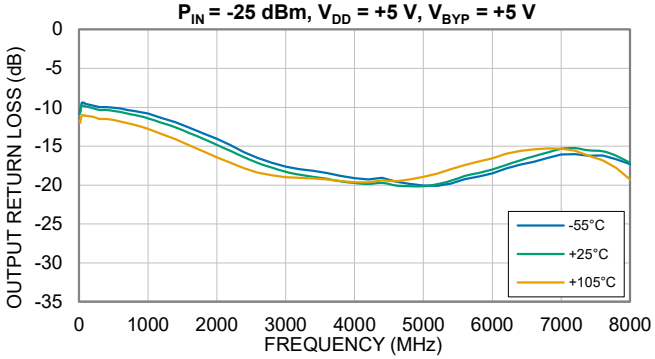
Low Noise Amplifier TSY-83LNW+

50Ω 30 to 8000 MHz Bypass Mode Feature

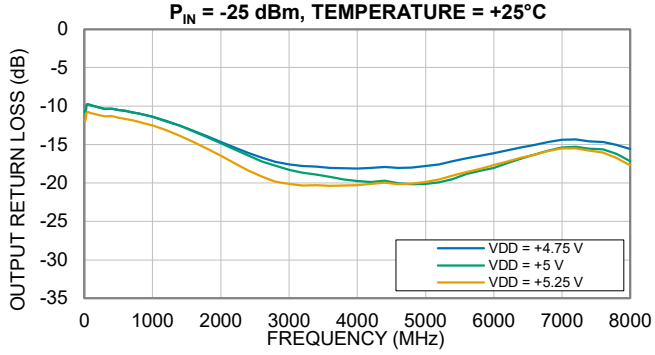
TYPICAL PERFORMANCE GRAPHS

Note: The following data was taken on the Mini-Circuits Characterization Test Board TB-TSY-83LNWC+ (Figure 2). All data taken at nominal conditions V_{BYP} = +5 V and V_{DD} = +5 V unless noted otherwise.

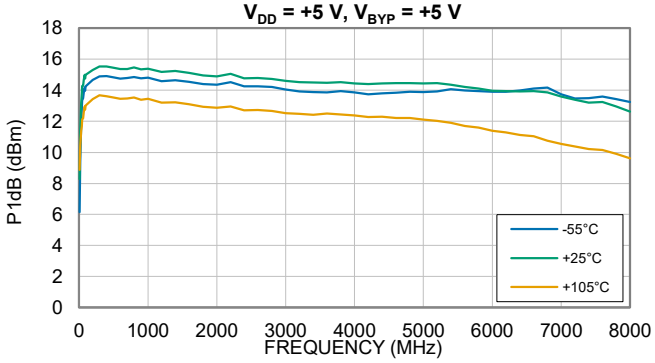
OUTPUT RETURN LOSS vs. TEMPERATURE
P_{IN} = -25 dBm, V_{DD} = +5 V, V_{BYP} = +5 V



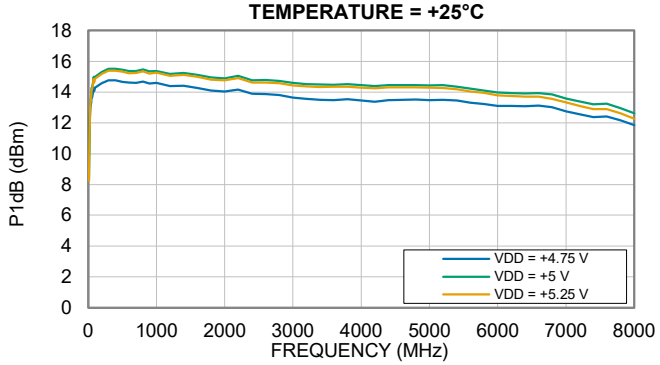
OUTPUT RETURN LOSS vs. DEVICE VOLTAGE (V_{DD})
P_{IN} = -25 dBm, TEMPERATURE = +25°C



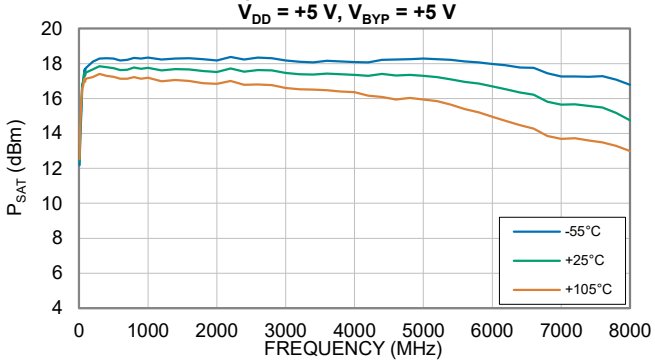
P1dB vs. TEMPERATURE
V_{DD} = +5 V, V_{BYP} = +5 V



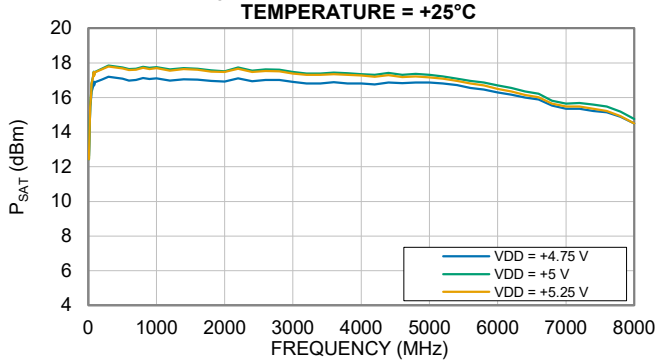
P1dB vs. DEVICE VOLTAGE (V_{DD})
TEMPERATURE = +25°C



P_{SAT} vs. TEMPERATURE
V_{DD} = +5 V, V_{BYP} = +5 V



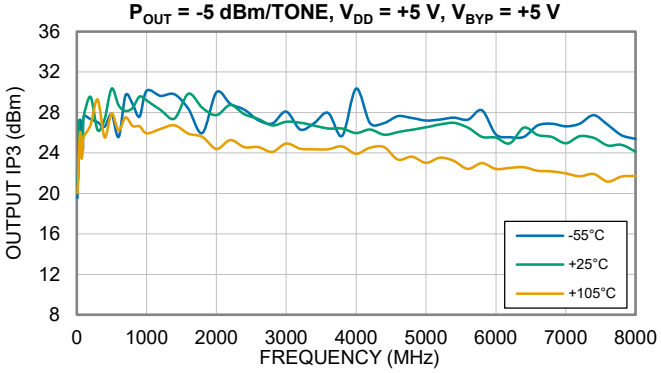
P_{SAT} vs. DEVICE VOLTAGE (V_{DD})
TEMPERATURE = +25°C



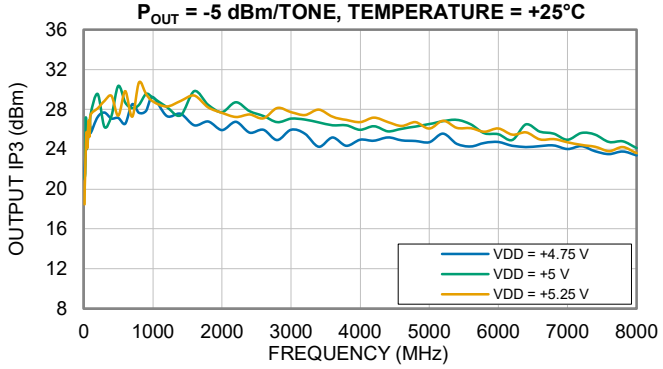
TYPICAL PERFORMANCE GRAPHS

Note: The following data was taken on the Mini-Circuits Characterization Test Board TB-TSY-83LNWC+ (Figure 2). All data taken at nominal conditions V_{BYP} = +5 V and V_{DD} = +5 V unless noted otherwise.

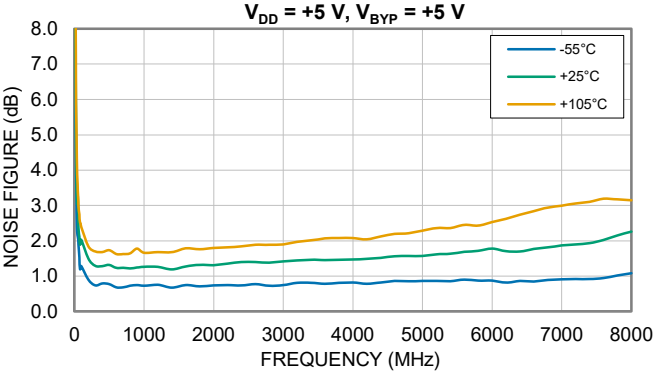
OUTPUT IP3 vs. TEMPERATURE
P_{OUT} = -5 dBm/TONE, V_{DD} = +5 V, V_{BYP} = +5 V



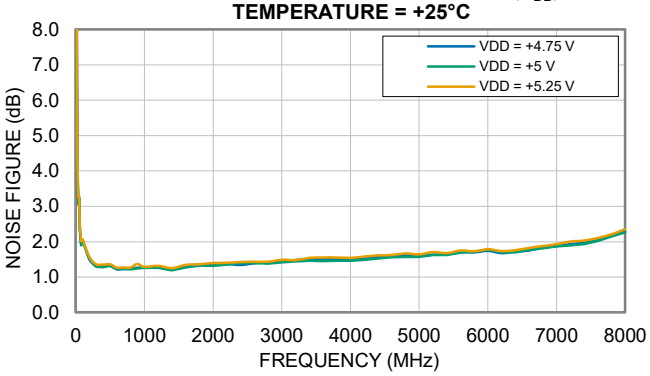
OUTPUT IP3 vs. DEVICE VOLTAGE (V_{DD})
P_{OUT} = -5 dBm/TONE, TEMPERATURE = +25°C



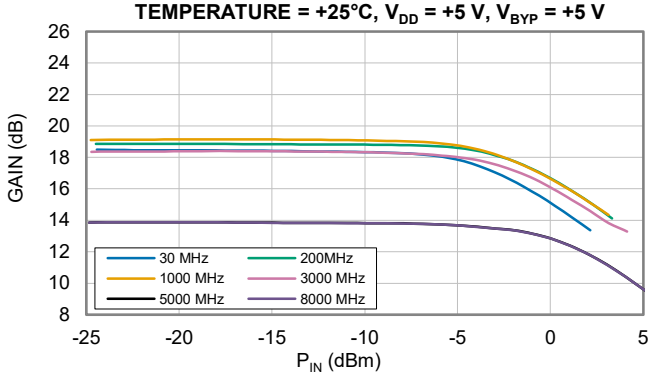
NOISE FIGURE vs. TEMPERATURE
V_{DD} = +5 V, V_{BYP} = +5 V



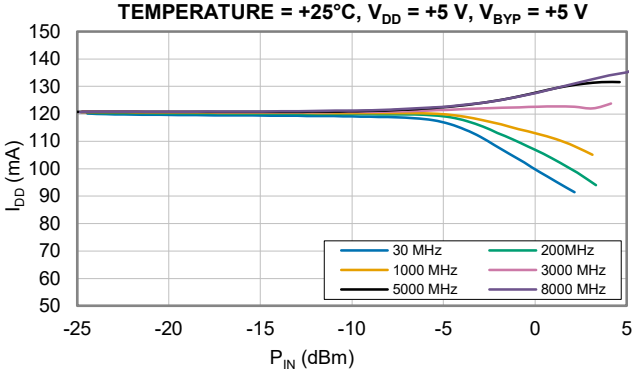
NOISE FIGURE vs. DEVICE VOLTAGE (V_{DD})
TEMPERATURE = +25°C



GAIN vs. P_{IN}
TEMPERATURE = +25°C, V_{DD} = +5 V, V_{BYP} = +5 V



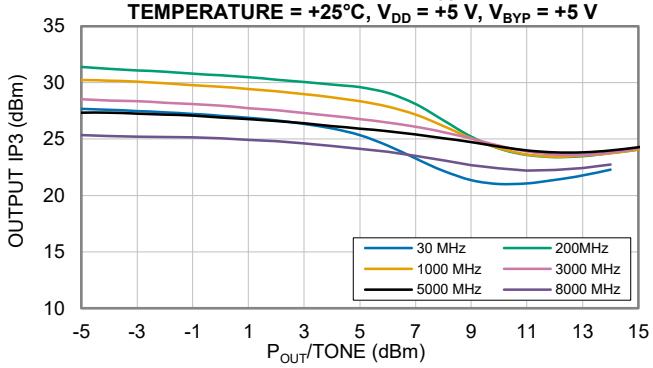
Current, I_{DD} vs. P_{IN}
TEMPERATURE = +25°C, V_{DD} = +5 V, V_{BYP} = +5 V



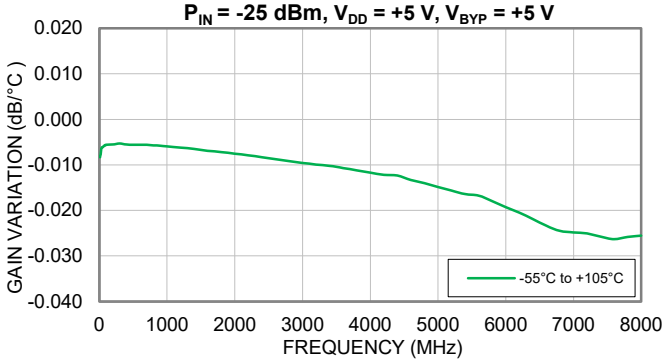
TYPICAL PERFORMANCE GRAPHS

Note: The following data was taken on the Mini-Circuits Characterization Test Board TB-TSY-83LNWC+ (Figure 2). All data taken at nominal conditions V_{BYP} = +5 V and V_{DD} = +5 V unless noted otherwise.

OUTPUT IP3 vs. P_{OUT}
TEMPERATURE = +25°C, V_{DD} = +5 V, V_{BYP} = +5 V



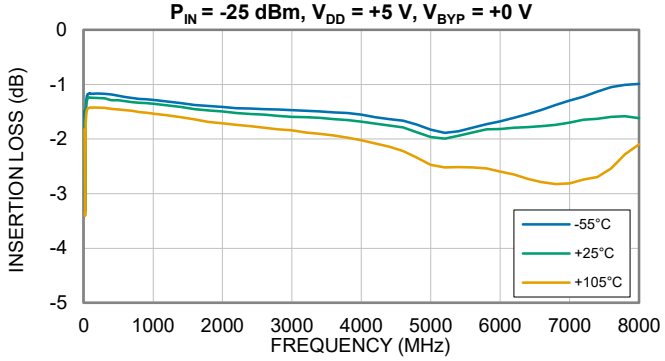
GAIN VARIATION vs. TEMPERATURE
P_{IN} = -25 dBm, V_{DD} = +5 V, V_{BYP} = +5 V



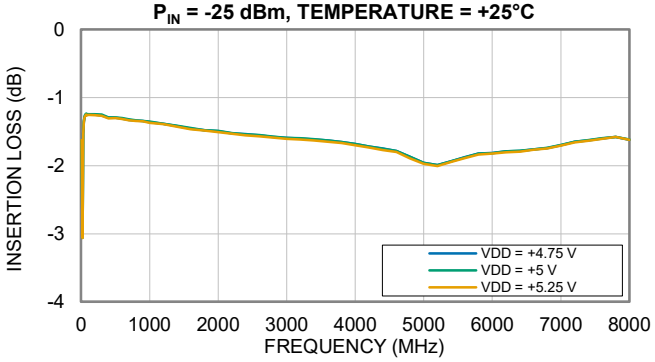
TYPICAL PERFORMANCE GRAPHS

Note: The following data was taken on the Mini-Circuits Characterization Test Board TB-TSY-83LNWC+ (Figure 2). All data taken at nominal conditions V_{BYP} = 0 V and V_{DD} = +5 V unless noted otherwise.

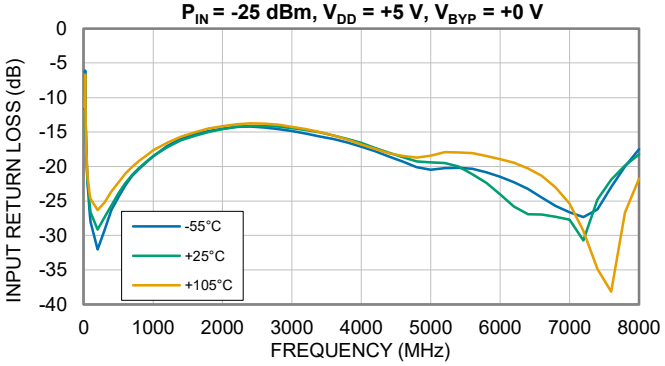
INSERTION LOSS vs. TEMPERATURE
P_{IN} = -25 dBm, V_{DD} = +5 V, V_{BYP} = +0 V



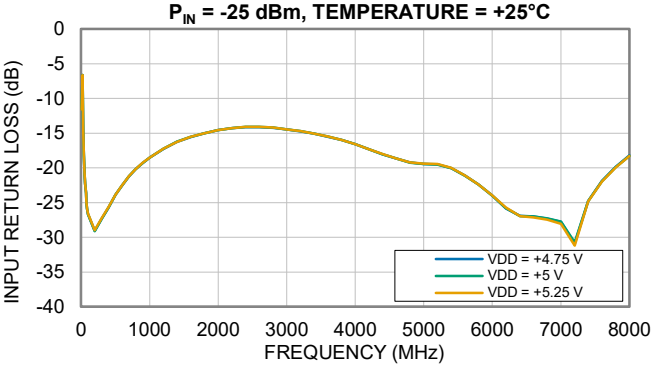
INSERTION LOSS vs. DEVICE VOLTAGE (V_{DD})
P_{IN} = -25 dBm, TEMPERATURE = +25°C



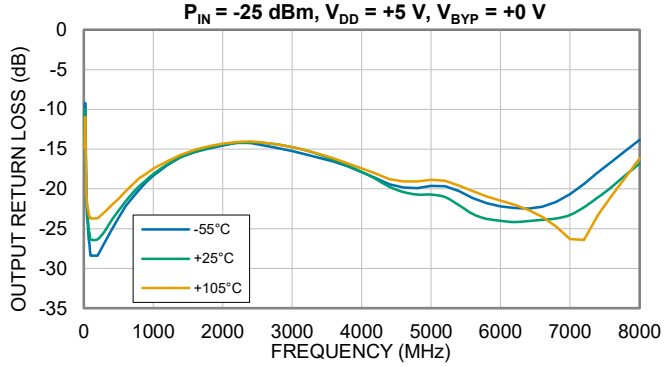
INPUT RETURN LOSS vs. TEMPERATURE
P_{IN} = -25 dBm, V_{DD} = +5 V, V_{BYP} = +0 V



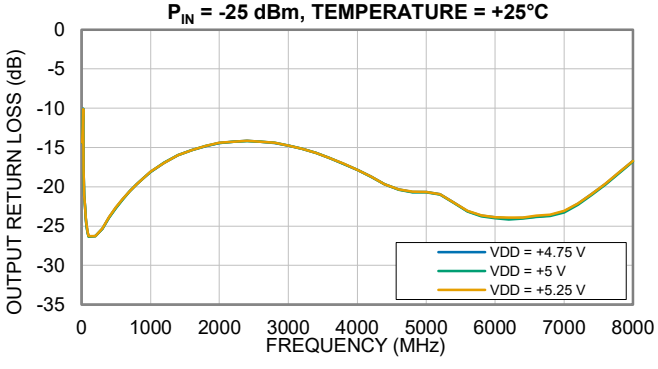
INPUT RETURN LOSS vs. DEVICE VOLTAGE (V_{DD})
P_{IN} = -25 dBm, TEMPERATURE = +25°C



OUTPUT RETURN LOSS vs. TEMPERATURE
P_{IN} = -25 dBm, V_{DD} = +5 V, V_{BYP} = +0 V



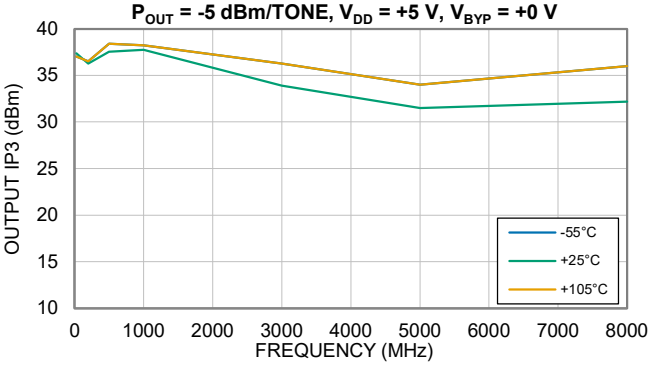
OUTPUT RETURN LOSS vs. DEVICE VOLTAGE (V_{DD})
P_{IN} = -25 dBm, TEMPERATURE = +25°C



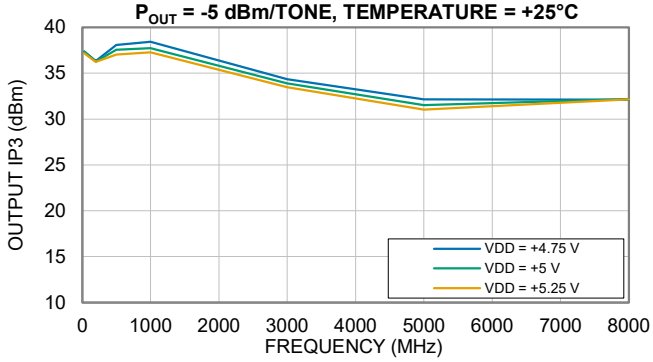
TYPICAL PERFORMANCE GRAPHS

Note: The following data was taken on the Mini-Circuits Characterization Test Board TB-TSY-83LNWC+ (Figure 2). All data taken at nominal conditions V_{BYP} = 0 V and V_{DD} = +5 V unless noted otherwise.

OUTPUT IP3 vs. TEMPERATURE
P_{OUT} = -5 dBm/TONE, V_{DD} = +5 V, V_{BYP} = +0 V



OUTPUT IP3 vs. DEVICE VOLTAGE (V_{DD})
P_{OUT} = -5 dBm/TONE, TEMPERATURE = +25°C



ABSOLUTE MAXIMUM RATINGS[7]

Parameter	Ratings	
Operating Temperature	-55°C to +105°C	
Storage Temperature	-65°C to +150°C	
Junction Temperature[8]	+175°C	
Total Power Dissipation	0.97 W	
Input Power (CW), V_{DD} = V_{BYP} = +5 V	+28 dBm	
DC Voltage on RF-OUT	+5 V	
DC Voltage on RF-IN	+17 V	
DC Voltage on V_{DD}	Amplifier - LNA	+7 V
	Amplifier – Bypass	+11 V
DC Voltage on V_{BYP}	+ 11 V	
DC Current on I_{DD}, V_{DD} = +5 V	Amplifier - LNA	144 mA
	Amplifier – Bypass	75 mA
DC Current on I_{BYP}	5 mA	

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

SWITCHING SPECIFICATIONS[9]

Parameter		Typ.	Units
Amplifier LNA to Bypass	OFF Time (50% Control to 10% RF)	107	µs
	FALL Time (90% to 10% RF)	96	µs
Amplifier Bypass to LNA	ON Time (50% Control to 90% RF)	61	µs
	RISE Time (10% to 90% RF)	20	µs

9. Tested on Mini-Circuits Characterization Test Board TB-TSY-83LNWC+ at 30 MHz. See Figure 2.

THERMAL RESISTANCE[10]

Parameter	Ratings
Thermal Resistance (Θ_{JC})[10]	72.3 °C/W

10. 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-020D /JEDEC J-STD-033C

Low Noise Amplifier TSY-83LNW+

50Ω 30 to 8000 MHz Bypass Mode Feature

FUNCTIONAL DIAGRAM

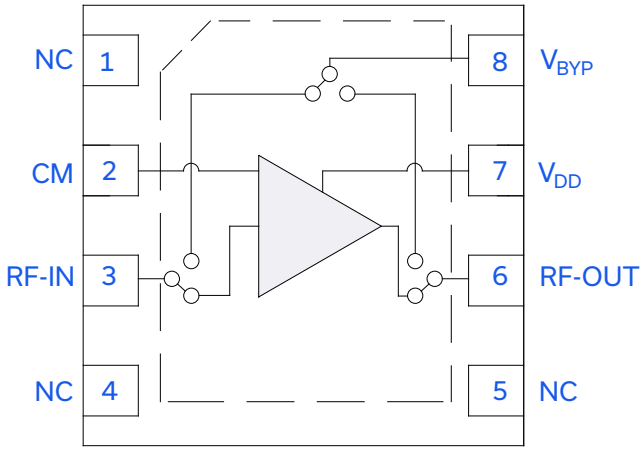


Figure 1. TSY-83LNW+ Functional Diagram

PAD DESCRIPTION

Function	Pad Number	Description (Refer to Fig 2)
RF-IN	3	RF-IN pad connects to RF-Input port.
RF-OUT	6	RF-OUT pad connects to RF-Output port.
CM	2	Current Mirror Pad. Supplies gate voltage to RF-IN via L1. See details in Figure 2
V_{DD}	7	DC Input pad connects to voltage input port, V_{DD}.
V_{BYP}	8	DC Input pad connects to bypass voltage input port, V_{BYP}.
GND	Paddle	Connects to ground.
NC	1, 4, & 5	Not used internally. Connected to ground on test board.

CHARACTERIZATION TEST BOARD

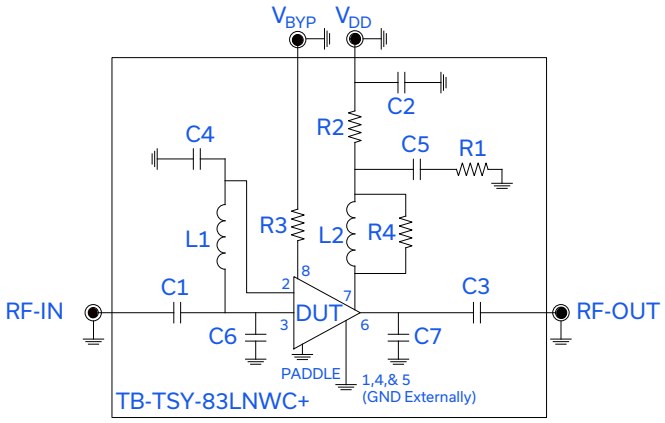


Figure 2. TSY-83LNW+ Characterization and Application Circuit

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} = - 25 dBm
2. Output IP3 (OIP3): Two tones, spaced 1 MHz apart, -5 dBm/Tone at output

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} = +5 V.
2) Set V_{BYP} = +5 V for Amplifier-LNA Mode or V_{BYP} = 0 V for Bypass Mode.
3) Turn on V_{DD}.
4) Turn on V_{BYP}.
5) Apply RF signal.

Power OFF:
1) Turn off RF signal.
2) Turn off V_{BYP}.
3) Turn off V_{DD}.

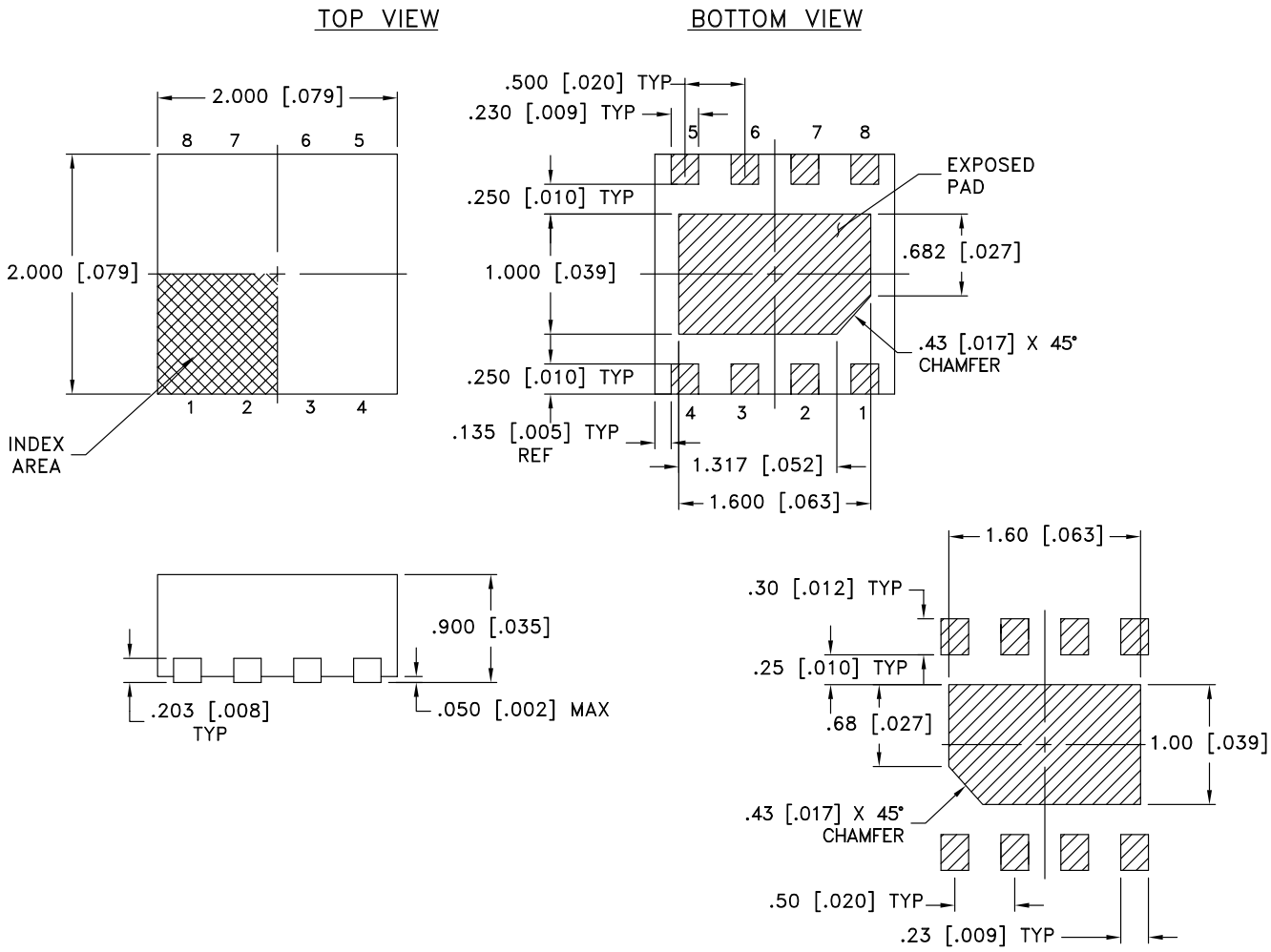
Note: V_{DD} and V_{BYP} may be applied simultaneously. V_{BYP} should not be applied before V_{DD}.

Component	Value	Size	Part Number	Manufacturer
C1, C2	470 nF	0402	GRM155R71A474KE01J	MURATA
C3	15 nF	0402	GRM155R71H153KA12D	MURATA
C4, C5	100 pF	0402	GRM1555C1H101JA01D	MURATA
C6	0.2 pF	0402	GJM1555C1HR20WB01D	MURATA
C7	0.3 pF	0402	GJM1555C1HR30WB01D	MURATA
L1, L2	900 nH	0402	0402DF-901XJRU	COILCRAFT
R1, R2, R3	0Ω	0402	RK73Z1ETTP	KOA SPEER
R4	91Ω	0402	RK73H1ETTP91R0F	KOA SPEER

Low Noise Amplifier TSY-83LNW+

50Ω 30 to 8000 MHz Bypass Mode Feature

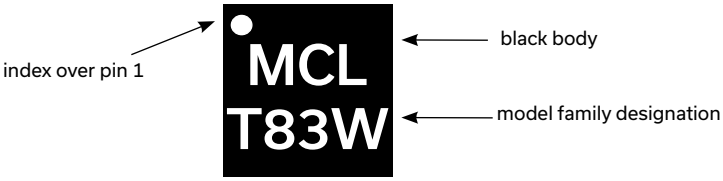
CASE STYLE DRAWING



Weight: .011 grams

Dimensions are in mm [inches]. Tolerances: 2 Pl.±0.254 [0.01]; 3 Pl.±.0.127 [0.005] mm [Inches]

PRODUCT MARKING



Marking may contain other features or characters for internal lot control

Low Noise Amplifier TSY-83LNW+

50Ω 30 to 8000 MHz Bypass Mode Feature

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	MC3007 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, 1000, 2000 or 3000 devices
Suggested Layout for PCB Design	PL-839
Evaluation Board	TB-TSY-83LNWC+ 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-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