TQP7M9105

1W High Linearity Amplifier

Applications

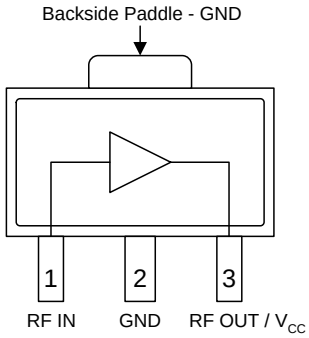
- Repeaters
- BTS Transceivers
- BTS High Power Amplifiers
- CDMA / WCDMA / LTE
- ISM Equipment
- General Purpose Wireless

3-pin SOT−89 Package

Product Features

- 50 – 1500 MHz
- +30 dBm P1dB at 940 MHz
- +47 dBm Output IP3 at 940 MHz
- 19.5 dB Gain at 940 MHz
- +5 V Single Supply, 220 mA Current
- Internal RF Overdrive Protection
- Internal DC Overvoltage Protection
- On Chip ESD Protection
- SOT-89 Package

Functional Block Diagram



General Description

The TQP7M9105 is a high linearity, high gain 1 W driver amplifier in industry standard, RoHS compliant, SOT-89 surface mount package. This InGaP / GaAs HBT delivers high performance across 0.05 to 1.5 GHz while achieving +47 dBm OIP3 and +30 dBm P1dB at 940 MHz while only consuming 220 mA quiescent current. All devices are 100% RF and DC tested.

The TQP7M9105 incorporates on-chip features that differentiate it from other products in the market. The amplifier has a dynamic active bias circuit that enable stable operation over bias and temperature variations and can provide a high linearity at back-off operation

The TQP7M9105 is targeted for use as a driver amplifier in wireless infrastructure where high linearity, medium power, and high efficiency are required. The device an excellent candidate for transceiver line cards and high power amplifiers in current and next generation multi-carrier 3G / 4G base stations.

Pin Configuration

Pin No.	Label
1	RF IN
3	RF OUT / Vcc
2	GND
Backside Paddle	GND

Ordering Information

Part No.	Description
TQP7M9105	1 W High Linearity Amplifier
TQP7M9105-PCB900	860 – 960 MHz tuned EVB

Standard T/R size = 1000 pieces on a 7” reel

Absolute Maximum Ratings

Parameter	Rating
Storage Temperature	−65 to 150 °C
RF Input Power, CW, 50 Ω, T=+25 °C	+30 dBm
Device Voltage (V_{CC})	+8 V

Operation of this device outside the parameter ranges given above may cause permanent damage.

Recommended Operating Conditions

Parameter	Min	Typ	Max	Units
Device Voltage (V_{CC})		+5.0	+5.25	V
T_{CASE}	−40		+105	°C
Tj for >10^6 hours MTTF			+170	°C

Electrical performance is measured under conditions noted in the electrical specifications table. Specifications are not guaranteed over all recommended operating conditions.

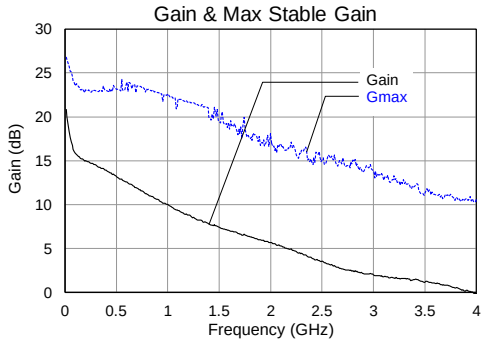
Electrical Specifications

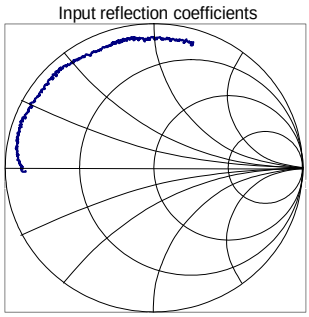
Test conditions unless otherwise noted: V_{CC} =+5 V, T= +25 °C, 50 Ω system, tuned application circuit

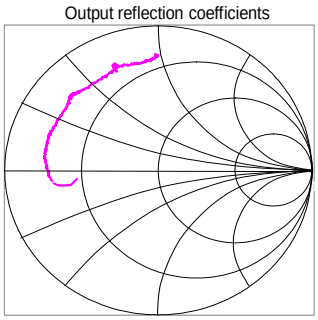
Parameter	Conditions	Min	Typ	Max	Units
Operational Frequency Range		50		1500	MHz
Test Frequency			940		MHz
Gain		17.5	19.4	20.5	dB
Input Return Loss			14		dB
Output Return Loss			15		dB
Output P1dB		+28.7	+30		dBm
Output IP3	Pout = +15 dBm / tone, Δf = 1 MHz	+43.5	+47		dBm
WCDMA Output Power (1)	At −50 dBc ACLR		+20.5		dBm
Noise Figure			6.3		dB
Quiescent Current, I_{CQ}		195	220	245	mA
Thermal Resistance, θ_{jc}	Module (junction to case)		27.3		°C / W

Notes:
1. ACLR Test set-up: 3GPP WCDMA, TM1+64 DPCH, +5 MHz offset, PAR = 9.7 dB at 0.01% Prob.

Device Characterization Data







Notes:

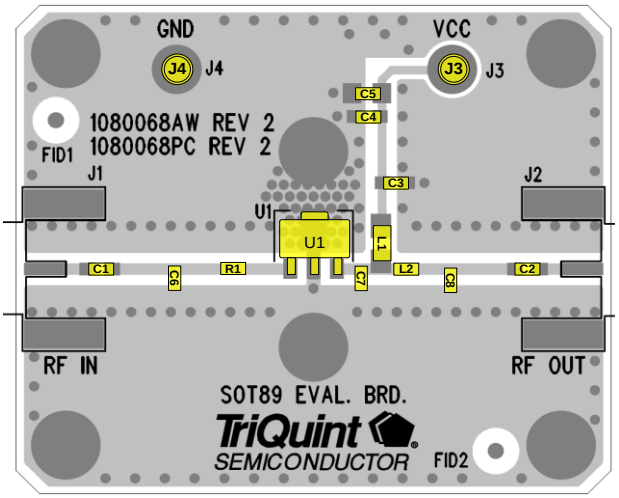
1. The gain for the unmatched device in 50 ohm system is shown as the trace in black color, [gain (S(21)]. For a tuned circuit at a particular frequency, it is expected that actual gain will be higher, up to the maximum stable gain. The maximum stable gain is shown as the blue trace [Gain (MAX)]. The impedance plots are shown from 0.01 – 6 GHz.

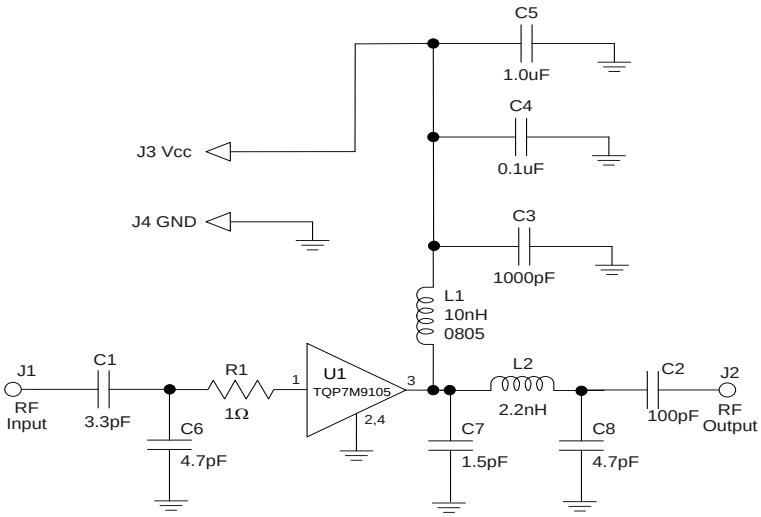
S-Parameters

Test Conditions: V_{CC}=+5 V, I_{CQ}=220 mA, T=+25 °C, unmatched 50 ohm system, calibrated to device leads

Freq (GHz)	S11 (dB)	S11 (ang)	S21 (dB)	S21 (ang)	S12 (dB)	S12 (ang)	S22 (dB)	S22 (ang)
0.05	−1.06	−178.68	17.88	154.59	−36.95	1.89	−3.39	−171.92
0.1	−1.08	−179.98	16.04	154.96	−37.20	3.77	−3.00	−176.29
0.2	−1.01	179.18	15.20	150.91	−37.52	7.85	−2.91	−179.66
0.4	−0.75	176.01	14.04	134.55	−36.48	11.27	−2.73	176.91
0.6	−0.57	171.34	12.73	120.33	−35.65	11.92	−2.52	173.48
0.8	−0.51	166.55	11.29	108.35	−35.14	9.35	−2.51	169.15
1.0	−0.51	163.55	10.11	98.59	−34.89	11.74	−2.50	165.78
1.2	−0.54	161.26	8.87	90.63	−34.56	11.00	−2.52	163.07
1.4	−0.57	157.96	7.85	82.50	−34.07	10.99	−2.61	160.70
1.6	−0.62	154.88	7.10	75.78	−33.47	10.29	−2.57	158.17
1.8	−0.66	150.04	6.35	67.47	−33.19	11.13	−2.66	155.39
2.0	−0.60	144.26	5.75	59.82	−32.84	4.95	−2.64	151.03
2.2	−0.56	139.27	4.95	51.93	−32.47	3.98	−2.59	146.61
2.4	−0.75	135.92	3.91	45.80	−32.62	1.55	−2.57	141.55
2.6	−0.58	132.79	3.16	40.57	−32.36	2.07	−2.28	139.39
2.8	−0.55	132.30	2.52	36.55	−32.25	2.62	−2.33	138.20
3.0	−0.64	129.89	2.01	31.75	−31.94	0.51	−2.37	136.78
3.2	−0.69	126.19	1.69	26.65	−31.44	1.40	−2.40	135.83
3.4	−0.84	121.41	1.48	20.86	−30.84	−2.57	−2.54	133.06
3.6	−0.93	115.44	1.06	12.97	−30.84	−4.71	−2.68	126.60
3.8	−0.85	110.18	0.51	5.81	−30.20	−10.30	−2.63	119.65
4.0	−0.80	106.76	−0.04	−0.51	−30.40	−11.85	−2.51	114.02

Application Circuit 860 – 960 MHz (TQP7M9105-PCB900)





Notes:

1. See Evaluation Board PCB Information section for PCB material and stack-up.
2. Components shown on the silkscreen but not on the schematic are not used.
3. The recommended component values are dependent upon the frequency of operation.
4. All components are of 0603 size unless stated on the schematic.
5. Critical component placement locations:
   - Distance from U1 Pin 1 Pad (left edge) to R1 (right edge): 100 Mils (4.85° at 940 MHz)
   - Distance from U1 Pin 1 Pad (left edge) to C6 (right edge): 270 Mils (13.1° at 940 MHz)
   - Distance from U1 Pin 3 Pad (right edge) to C7 (left edge): 40 Mils (1.94° at 940 MHz)
   - Distance from U1 Pin 3 Pad (right edge) to L2 (left edge): 120 Mils (5.82° at 940 MHz)
   - Distance from U1 Pin 3 Pad (right edge) to C8 (left edge): 260 Mils (12.6° at 940 MHz)

Bill of Material – TQP7M9105-PCB900

Reference Des.	Value	Description	Manuf.	Part Number
n/a	n/a	Printed Circuit Board	Qorvo	1080068
U1	n/a	TQP7M9105 Amplifier, SOT-89 pkg.	Qorvo	1077953
C1	3.3 pF	Cap., Chip, 0603, ±0.1 pF, 50 V, Accu-P	AVX	06035J3R3ABSTR
C2	100 pF	Cap., Chip, 0603, 5%, 50 V, NPO/COG	various	
C3	1000 pF	Cap., Chip, 0603, 5%, 50 V, NPO/COG	various	
C4	0.1 µF	Cap., Chip, 0603, 10%, 16 V, X7R	various	
C5	1.0 µF	Cap., Chip, 0603, 10%, 10 V, X5R	various	
C7	1.5 pF	Cap., Chip, 0603, ±0.05 pF, 50 V, Accu-P	AVX	06035J1R5ABSTR
C6, C8	4.7 pF	Cap., Chip, 0603, ±0.05 pF, 50 V, Accu-P	AVX	06035J4R7ABSTR
L1	10 nH	Inductor, 0805, 5%, Coilcraft CS Series	Coilcraft	0805CS-100XJLB
L2	2.2 nH	Inductor, 0603, ±0.3 nH	Toko	LL1608-FSL2N2S
R1	1 Ω	Resistor, Chip, 0603, 5%, 1/16 W	various	

Typical Performance: 860 – 960 MHz (TQP7M9105-PCB900)

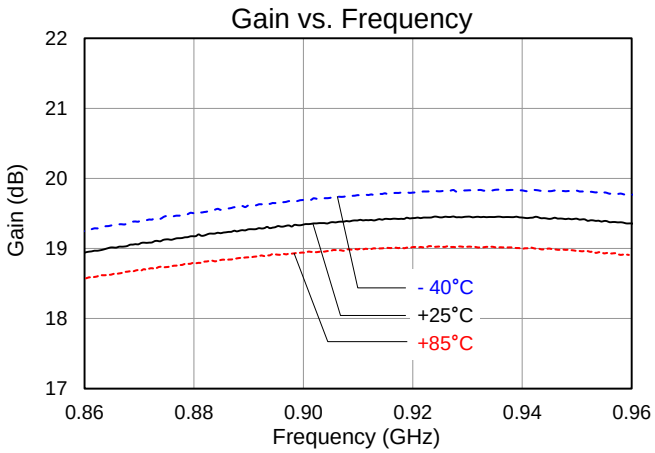
Test conditions unless otherwise noted: V_{CC} = +5 V, I_{CQ} = 220 mA, Temp. = +25 °C

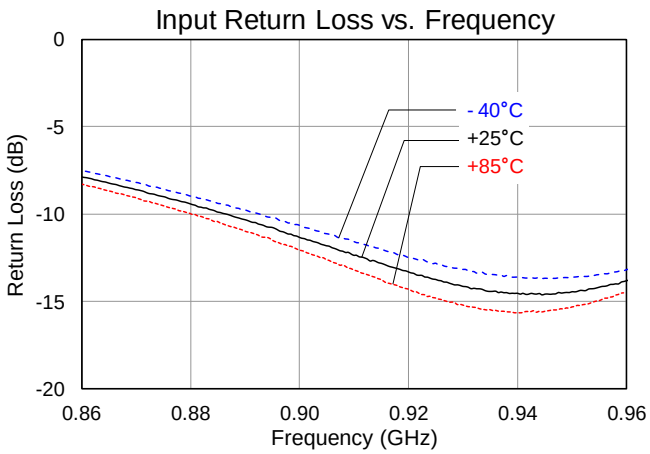
Parameter	Typical Value						Units
Frequency	860	880	900	920	940	960	MHz
Gain	18.9	19.2	19.3	19.4	19.4	19.3	dB
Input Return Loss	7.9	9.5	11.3	13	14	13	dB
Output Return Loss	16.2	16.7	16.8	15	15	14	dB
Output P1dB	+29	+29.2	+29.5	+29.9	+30.0	+29.8	dBm
Output IP3 (1)	+48	+50.2	+50.6	+49.5	+49.2	+49	dBm
WCDMA Channel Power (2,3)	20	20.2	20.5	+20.5	+20.5	+20.5	dBm
Noise figure	6.8	6.6	6.4	6.4	6.4	6.3	dB

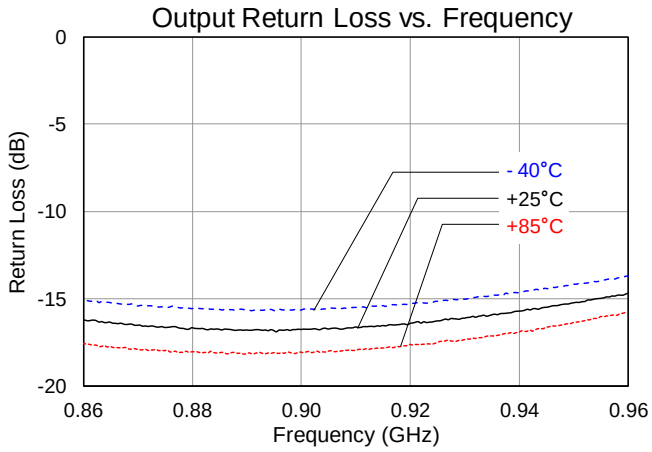
Notes:
1. +15 dBm/tone, Δf = 1 MHz
2. At −50 dBc ACLR
3. 3GPP WCDMA, TM1+64 DPCH, +5 MHz offset, PAR = 10.2 dB at 0.01% Prob.

RF Performance Plots: 860 – 960 MHz (TQP7M9105-PCB900)

Test conditions unless otherwise noted: V_{CC} = +5 V, I_{CQ} = 235 mA, Temp. = +25 °C

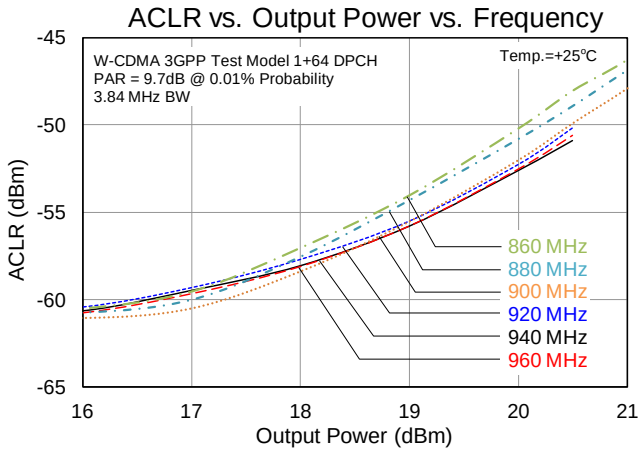


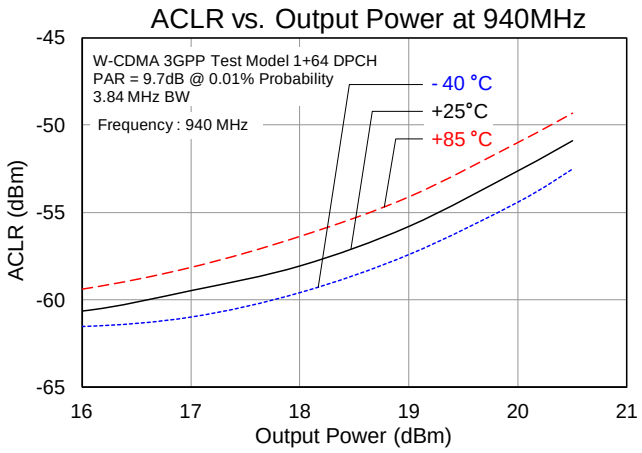


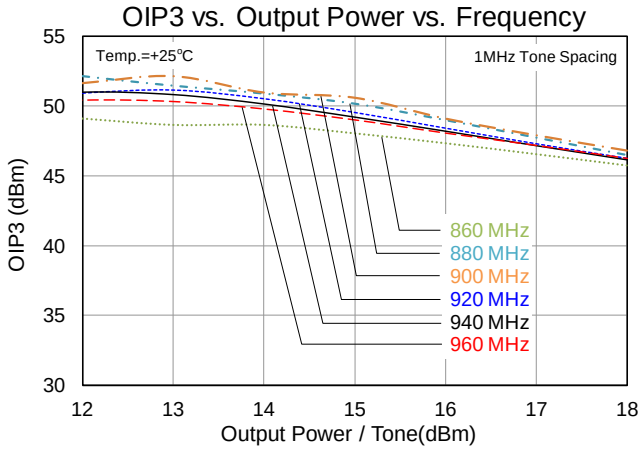


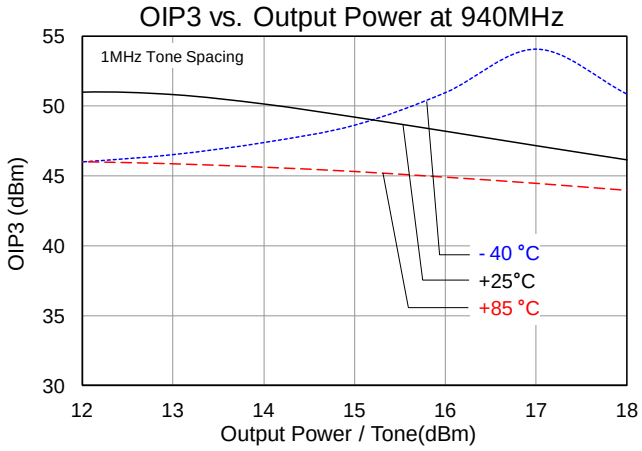
Performance Plots: 860 – 960 MHz (TQP7M9105-PCB900)

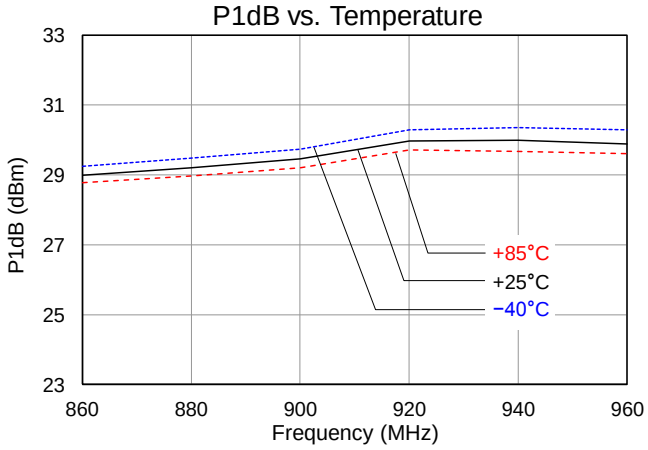
Test conditions unless otherwise noted: V_{CC} = +5 V, I_{CQ} = 235 mA, Temp. = +25 °C

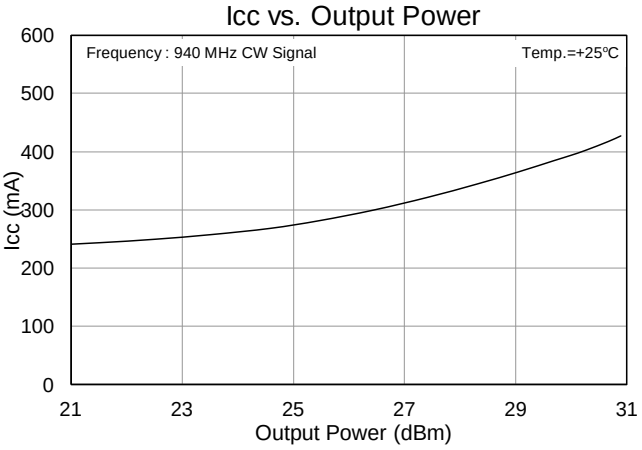




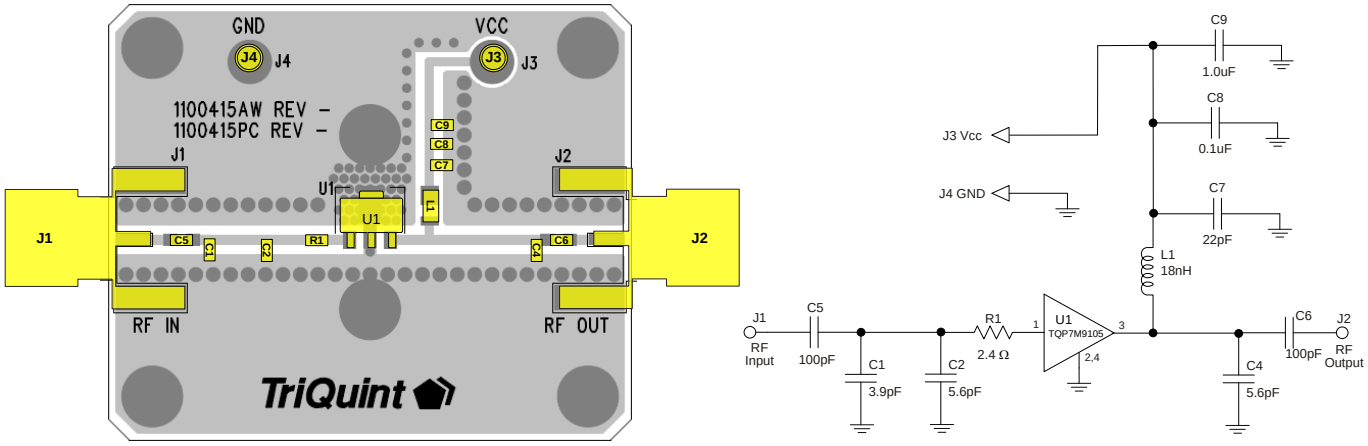








Evaluation Board – 700 – 1000 MHz Reference Design



Notes:

1. Components shown on the silkscreen but not on the schematic are not used.
2. All components are of 0603 size unless stated on the schematic.
3. The recommended component values are dependent upon the frequency of operation.
4. Critical component placement locations:
   - Distance between U1 Pin 1 Pad to R1 (right edge): 45 mil
   - Distance between U1 Pin 1 Pad to C1 (right edge): 370 mil
   - Distance between U1 Pin 1 Pad to C2 (right edge): 195 mil
   - Distance between U1 Pin 3 Pad to C4 (left edge): 395 mil

Bill of Material – 700 – 1000 MHz

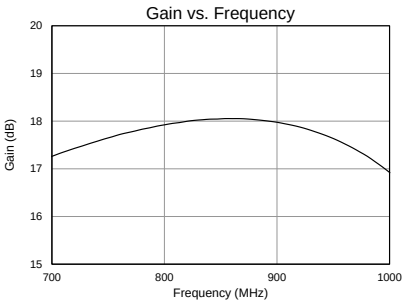
Reference Des.	Value	Description	Manuf.	Part Number
n/a	n/a	Printed Circuit Board	Qorvo	1100415
U1	n/a	1 W High Linearity Amplifier	Qorvo	TQP7M9105
C1	3.9 pF	CAP, 0603, ± 0.1 pF, 100V, NPO/COG	AVX	06035J3R9ABSTR
C2, C4	5.6 pF	CAP, 0603, ± 0.1 pF, 100V, NPO/COG	AVX	06035J5R6ABSTR
C5, C6	100 pF	CAP, 0603, 5%, 50V, NPO/COG	various	
C7	22 pF	CAP, 0603, 5%, 50V, NPO/COG	Various	
C8	0.1 uF	CAP, 0603, 5%, 50V, NPO/COG	various	
C9	1.0 uF	CAP, 0603, 10%, X5R , 10V	various	
R1	2.4 Ω	RES, 0603, 5%, 1/16W, Chip	various	
L1	18 nH	IND, 0805, 5%, Ceramic	Coilcraft	0805CS-180XJL

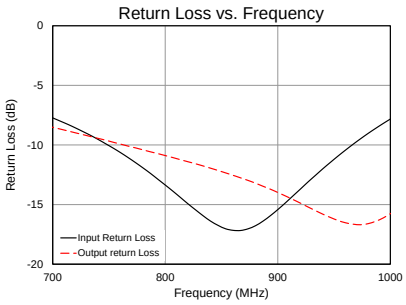
Typical Performance 700 – 1000 MHz

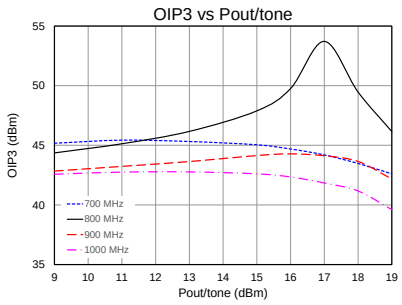
Test Conditions: V_{CC}=+5 V, Temp.=+25°C, 50Ω System

Parameter	Conditions	Typical Value				Units
Frequency		700	800	900	1000	MHz
Gain		17.2	17.9	18	16.9	dB
Input Return Loss		7.7	13.3	15.3	7.8	dB
Output Return Loss		8.5	10.9	14	15.7	dB
Output P1dB		+28.5	+29.5	+30.5	+30.5	dBm
Output IP3	Pout= +15 dBm/tone, Δf= 1 MHz	+45	+47	+44	+42.6	dBm
Quiescent Collector Current, I_{CQ}		225				mA

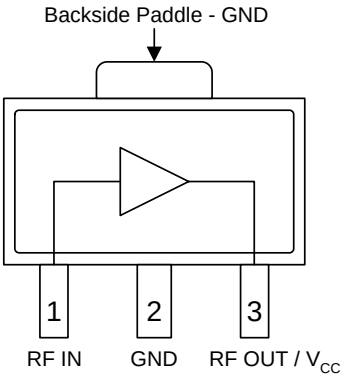
Performance Plots – 700 – 1000 MHz







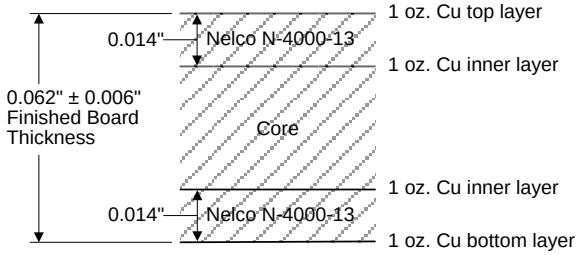
Pin Configuration and Description



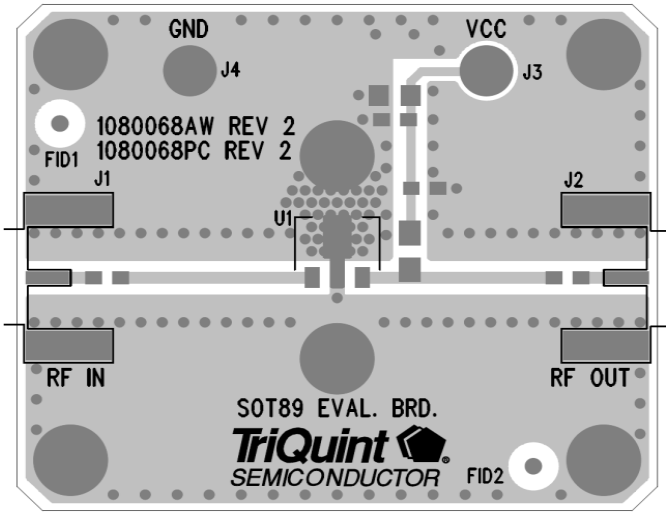
Pin No.	Label	Description
1	RF IN	RF Input. Requires external match for optimal performance. External DC Block required.
2, Backside Paddle	GND	RF/DC ground. Use recommended via pattern to minimize inductance and thermal resistance. See PCB Mounting Pattern for suggested footprint.
3	RF OUT / Vcc	RF Output. Requires external match for optimal performance. External DC Block and supply voltage is required.

Evaluation Board PCB Information

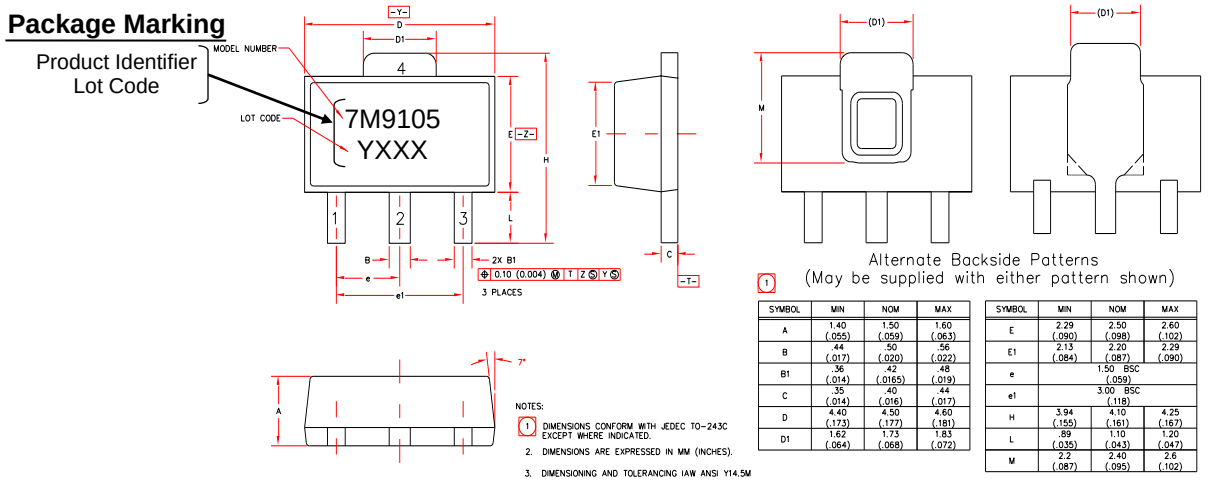
Qorvo PCB 1080068 Material and Stack-up



50 ohm line dimensions: width = .031”, spacing = .035”.



Package Marking and Dimensions

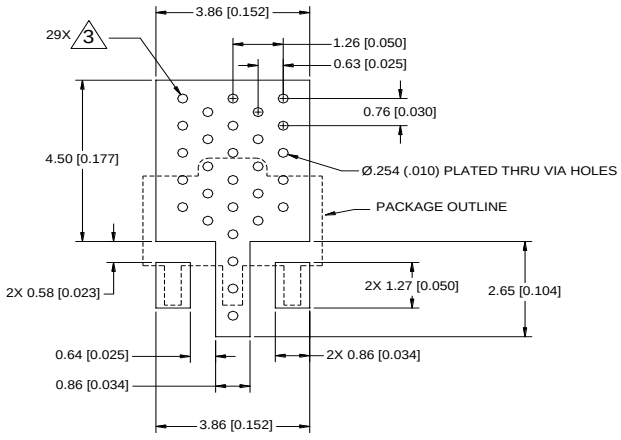


SYMBOL	MIN	NOM	MAX
A	1.40 (.055)	1.50 (.059)	1.60 (.063)
B	.44 (.017)	.50 (.020)	.56 (.022)
B1	.36 (.014)	.42 (.0165)	.48 (.019)
C	.35 (.014)	.40 (.016)	.44 (.017)
D	4.40 (.173)	4.50 (.177)	4.60 (.181)
D1	1.62 (.064)	1.73 (.068)	1.83 (.072)

SYMBOL	MIN	NOM	MAX
E	2.29 (.090)	2.50 (.098)	2.60 (.102)
E1	2.13 (.084)	2.20 (.087)	2.29 (.090)
e		1.50 BSC (.059)	
e1		3.00 BSC (.118)	
H	3.94 (.155)	4.10 (.161)	4.25 (.167)
L	.89 (.035)	1.10 (.043)	1.20 (.047)
M	2.2 (.087)	2.40 (.095)	2.6 (.102)

Notes:
1. All dimensions are in millimeters. Angles are in degrees.
2. Dimension and tolerance formats conform to ASME Y14.4M-1994.
3. The terminal #1 identifier and terminal numbering conform to JESD 95-1 SPP-012.
4. Contact plating: NiPdAu

PCB Mounting Pattern



Notes:
1. All dimensions are in millimeters. Angles are in degrees.
2. Use 1 oz. copper minimum for top and bottom layer metal.
3. Vias are required under the backside paddle of this device for proper RF/DC grounding and thermal dissipation.
4. Do not remove or minimize via hole structure in the PCB. Thermal and RF grounding is critical.
5. We recommend a 0.35mm (#80/.0135") diameter bit for drilling via holes and a final plated thru diameter of 0.25 mm (0.10”).
6. Ensure good package backside paddle solder attach for reliable operation and best electrical performance.

Product Compliance Information

ESD Sensitivity Ratings

Caution! ESD-Sensitive Device

ESD Rating: Class 1C
Value: ≥ 1000 V to < 2000 V
Test: Human Body Model (HBM)
Standard: ESDA/JEDEC Standard JS-001-2012

ESD Rating: Class C3
Value: ≥ 1000 V
Test: Charged Device Model (CDM)
Standard: JEDEC Standard JESD22-C101F

MSL Rating

MSL Rating: Level 1
Test: 260°C convection reflow
Standard: JEDEC Standard IPC/JEDEC J-STD-020

Solderability

Compatible with both lead-free (260°C maximum reflow temperature) and tin/lead (245°C maximum reflow temperature) soldering processes.

Contact plating: NiPdAu

RoHs Compliance

This part is compliant with EU 2002/95/EC RoHS directive (Restrictions on the Use of Certain Hazardous Substances in Electrical and Electronic Equipment).

This product also has the following attributes:

- Lead Free
- Halogen Free (Chlorine, Bromine)
- Antimony Free
- TBBP-A ($C_{15}H_{12}Br_4O_2$) Free
- PFOS Free
- SVHC Free

Contact Information

For the latest specifications, additional product information, worldwide sales and distribution locations:

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