TQP7M9105

1W High Linearity Amplifier

Product Overview

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

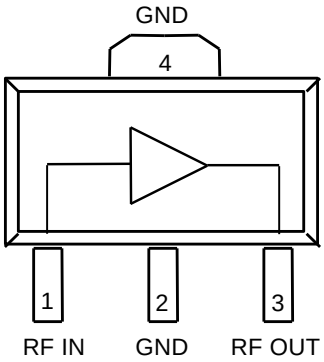
The TQP7M9105 is targeted for use as a driver amplifier in wireless infrastructure where high linearity, medium power, and high efficiency are required. The device an excellent candidate for transceiver line cards and high power amplifiers in current and next generation multi-carrier 3G / 4G base stations.

3-pin SOT−89 Package

Key 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



Top View

Applications

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

Ordering Information

Part No.	Description
TQP7M9105	1 W High Linearity Amplifier
TQP7M9105-PCB900	920 – 960 MHz Evaluation Board

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 specifications are measured at specified test conditions. Specifications are not guaranteed over all recommended operating conditions.

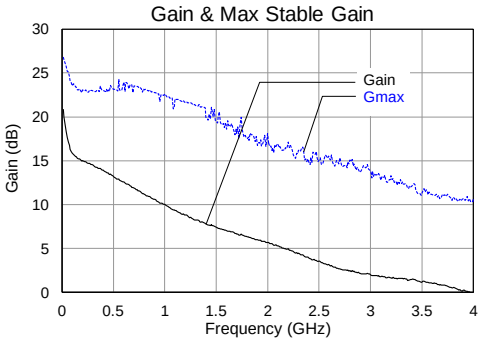
Electrical Specifications

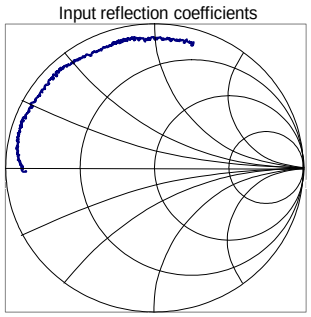
Test conditions unless otherwise noted: V_{CC} = +5.0 V, Temp= +25 °C

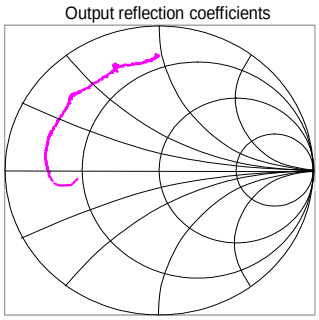
Parameter	Conditions	Min	Typ	Max	Units
Operational Frequency Range		50		1500	MHz
Test Frequency			940		MHz
Gain		17.5	19.4	20.5	dB
Input Return Loss			14		dB
Output Return Loss			15		dB
Output P1dB		+28.7	+30		dBm
Output IP3	Pout = +15 dBm/tone, Δf = 1 MHz	+43.5	+47		dBm
WCDMA Output Power	−50 dBc ACLR (1)		+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:
ACLR Test set-up: 3GPP WCDMA, TM1+64 DPCH, +5 MHz offset, PAR = 10.2 dB at 0.01% Prob.

Device Characterization Data







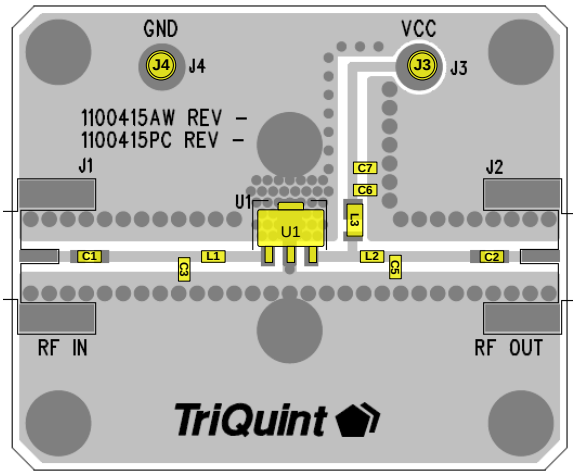
Note: The gain for the unmatched device in 50 ohm system is shown as the trace in black color, [gain (S(21)]. For a tuned circuit for a particular frequency, it is expected that actual gain will be higher, up to the maximum stable gain. The maximum stable gain is shown as the blue trace [Gmax]. The impedance plots are shown from 0.01– 4 GHz.

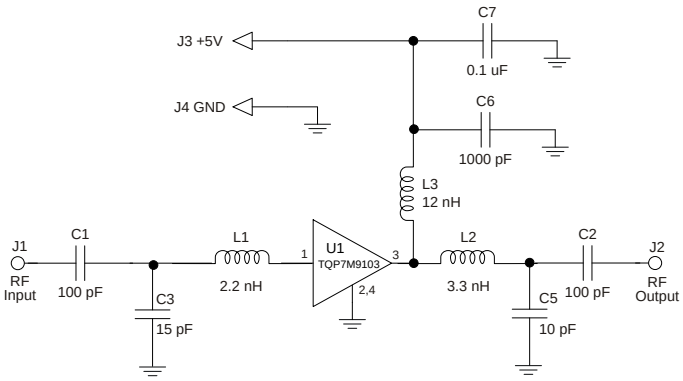
S-Parameters

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

Evaluation Board 615 – 655 MHz Reference Design





Notes:

1. Components shown on the silkscreen but not on the schematic are not used.
2. 0 Ω resistor can be replaced with copper trace in the target application layout.
3. All components are of 0603 size unless stated on the schematic.
4. The recommended component values are dependent upon the frequency of operation.
5. Critical component placement locations:
   - Distance between U1 Pin 1 Pad left edge to L1 (right edge): 100 mil
   - Distance between U1 Pin 1 Pad left edge to C3 (right edge): 200 mil
   - Distance between U1 Pin 3 Pad right edge to C5 (left edge): 210 mil
   - Distance between U1 Pin 3 Pad right edge to L2 (left edge): 120 mil

Bill of Material 615 – 655 MHz

Reference Des.	Value	Description	Manuf.	Part Number
n/a	n/a	Printed Circuit Board	Qorvo	
U1	n/a	1 W High Linearity Amplifier	Qorvo	TQP7M9105
C3	15 pF	CAP, 0603, ± 0.05 pF, 50V, NPO	AVX	06032U150J
C5	10 pF	CAP, 0603, ± 0.05 pF, 50V, NPO	AVX	06032U100J
C1, C2	100 pF	CAP, 0603, 5%, 50V, NPO/COG	various	
C6	1000 pF	CAP, chip	various	
C7	0.1 uF	CAP, 0603, 10%, X5R , 10V	various	
L1	2.2 nH	IND, 0603, +/-0.3nH	TOKO	LL1608-FSL2N2S
L2	3.3 nH	IND, 0603, +/-0.3nH	TOKO	LL1608-FSL3N3S
L3	12 nH	IND, 0805, 5%, Wirewound	Coilcraft	0805CS-120XJL

Typical Performance 615 – 655 MHz

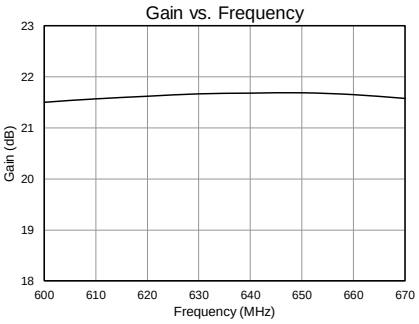
Test conditions unless otherwise noted: V_{CC} = +5 V, I_{CQ} = 235 mA, Temp. = +25 °C

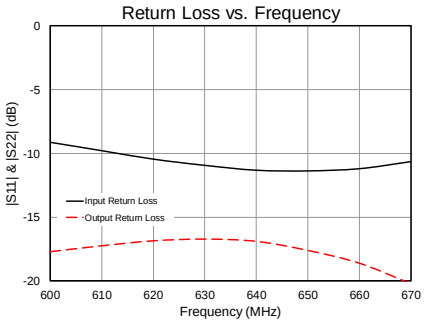
Parameter	Conditions	Typical Value			Units
Frequency		617	635	652	MHz
Gain		21.6	21.6	21.6	dB
Input Return Loss		10.5	11	11	dB
Output Return Loss		17	16.5	17.5	dB
Output P1dB		+30.3	+30.5	+30.8	dBm
OIP3	Pout = +16 dBm / tone, Δf =1 MHz	+44.7	+43.8	+42.7	dBm
WCDMA Channel Power (1)	ACLR = −50 dBc	+18	+17.5	+16.8	dBm

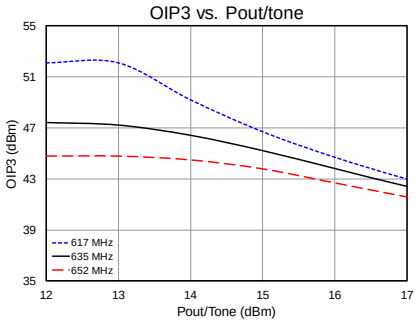
Notes:
1. 1C 20MHz LTE signal, PAR=9.5dB

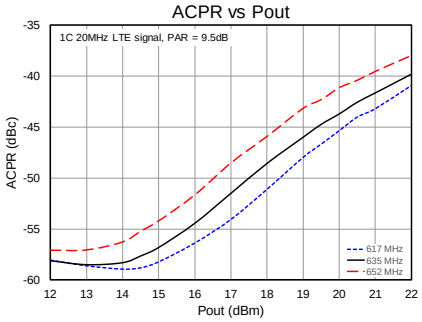
Performance Plots 615 – 655 MHz

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

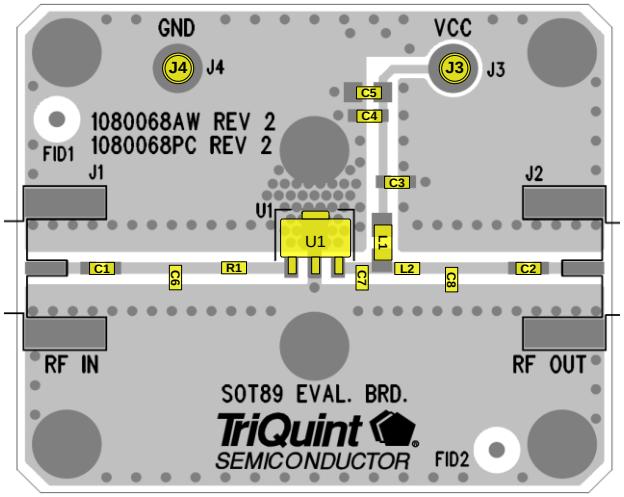


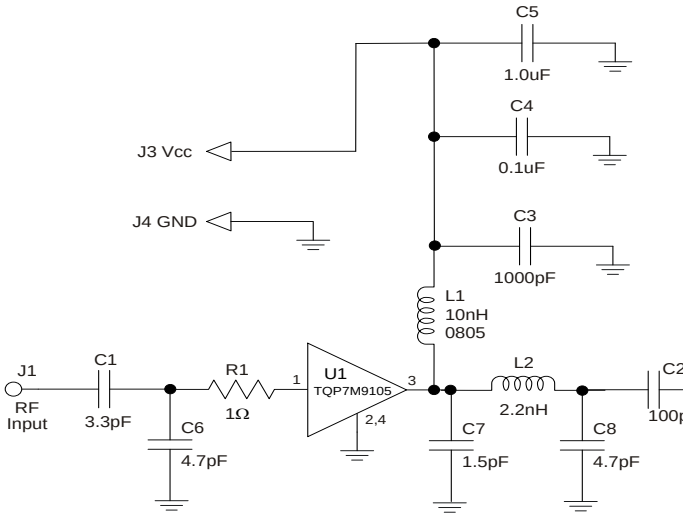






Evaluation Board – TQP7M9105-PCB900 (860 – 960 MHz)





Notes:

- See Evaluation Board PCB Information section for PCB material and stack-up.
- Components shown on the silkscreen but not on the schematic are not used.
- The recommended component values are dependent upon the frequency of operation.
- All components are of 0603 size unless stated on the schematic.
- 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	
U1	n/a	TQP7M9105 Amplifier, SOT-89 pkg.	Qorvo	
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)

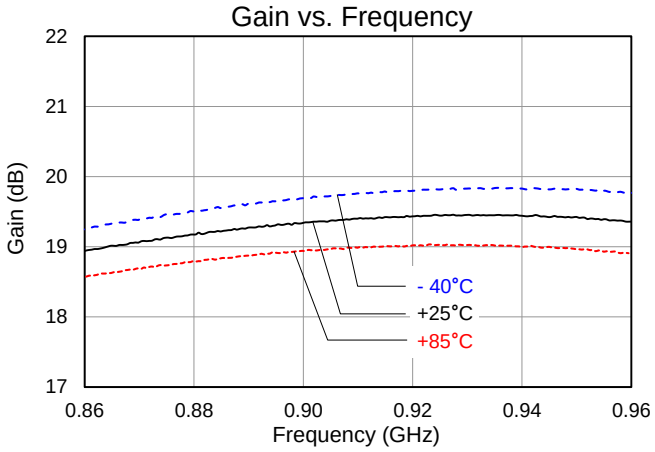
Test conditions unless otherwise noted: V_{CC} = +5 V, I_{CQ} = 220 mA, Temp. = +25 °C

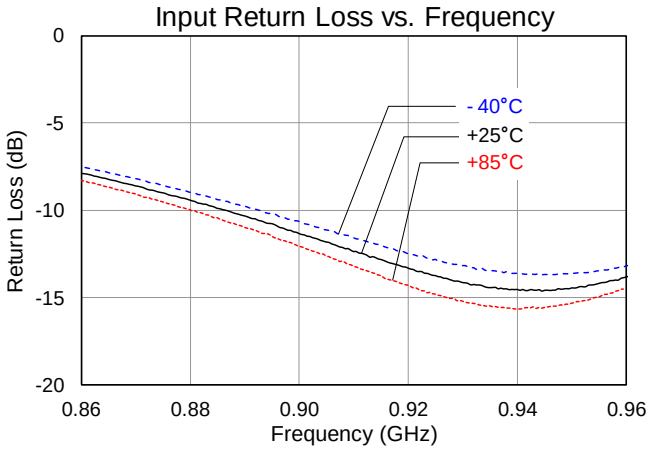
Parameter	Typical Value						Units
Frequency	860	880	900	920	940	960	MHz
Gain	18.9	19.2	19.3	19.4	19.4	19.3	dB
Input Return Loss	7.9	9.5	11.3	13	14	13	dB
Output Return Loss	16.2	16.7	16.8	15	15	14	dB
Output P1dB	+29	+29.2	+29.5	+29.9	+30.0	+29.8	dBm
Output IP3 (1)	+48	+50.2	+50.6	+49.5	+49.2	+49	dBm
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

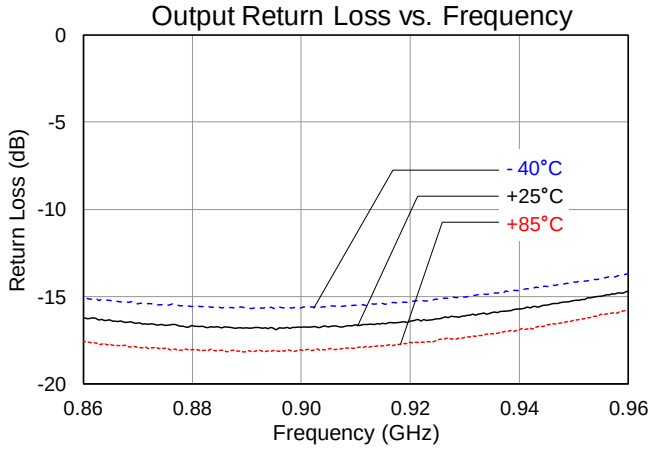
Notes:
1. +15 dBm/tone, Δf = 1 MHz
2. At −50 dBc ACLR
3. 3GPP WCDMA, TM1+64 DPCH, +5 MHz offset, PAR = 10.2 dB at 0.01% Prob.

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

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

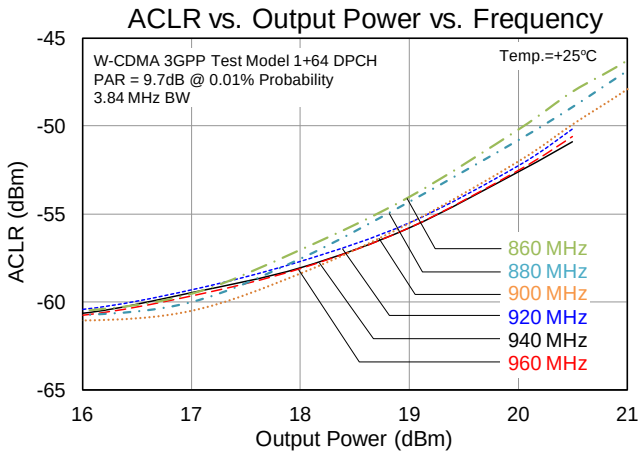


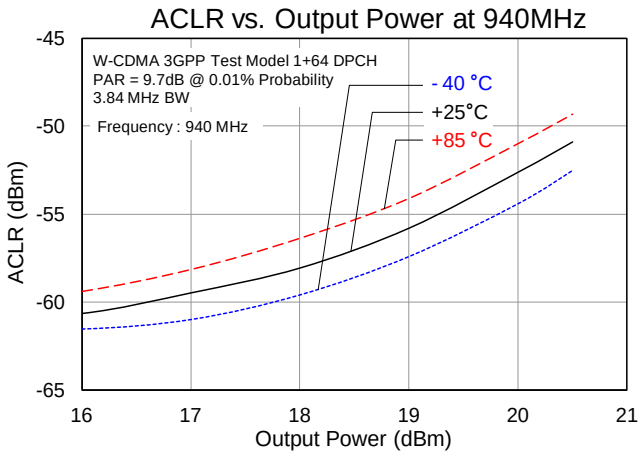


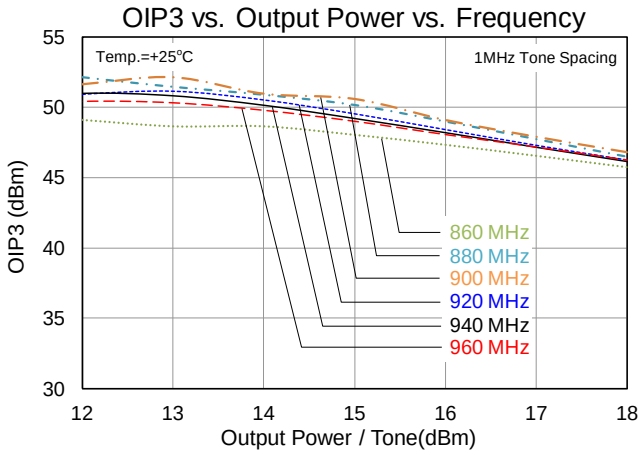


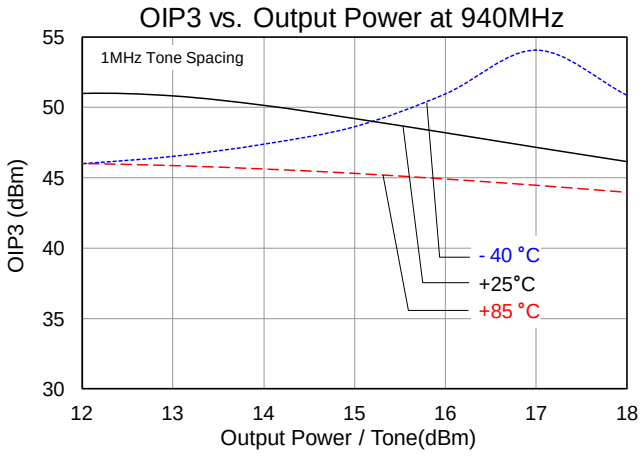
Performance Plots 860 – 960 MHz (TQP7M9105-PCB900)

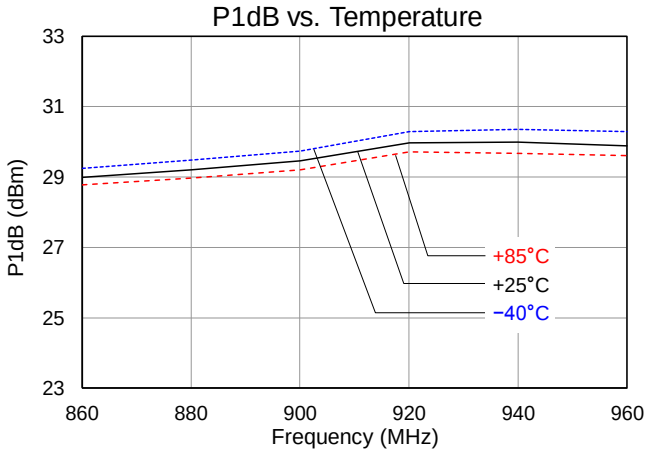
Test conditions unless otherwise noted: V_{CC} = +5 V, I_{CQ} = 235 mA, Temp. = +25 °C

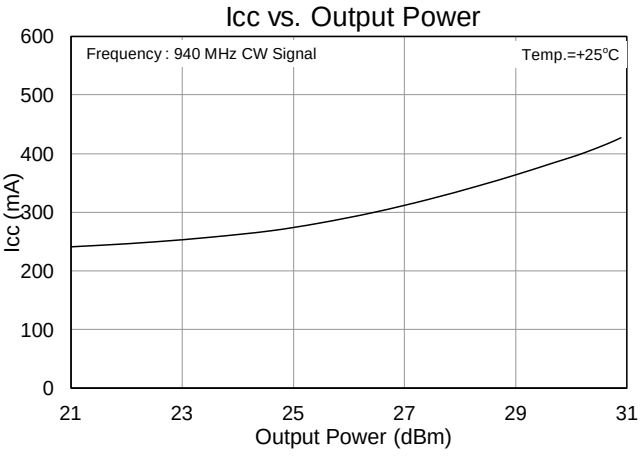




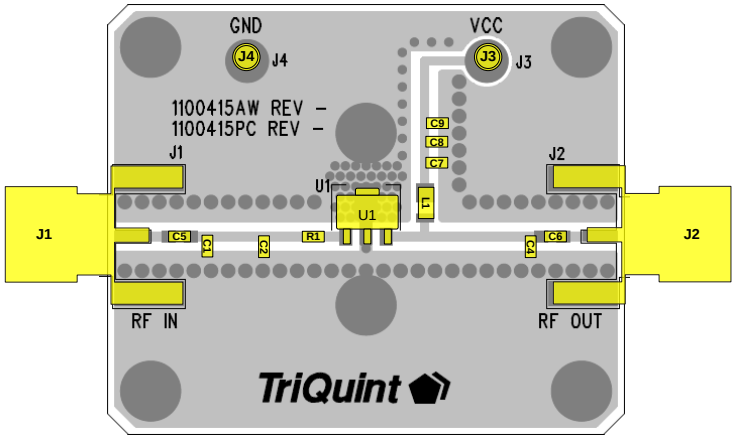


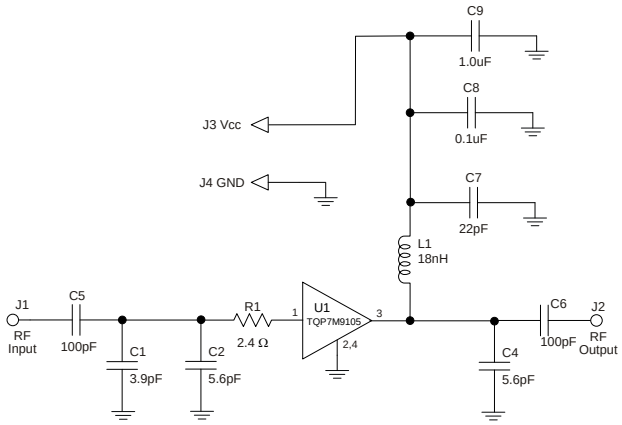






Evaluation Board 700 – 1000 MHz Reference Design





Notes:

6. Components shown on the silkscreen but not on the schematic are not used.
7. All components are of 0603 size unless stated on the schematic.
8. The recommended component values are dependent upon the frequency of operation.
9. 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

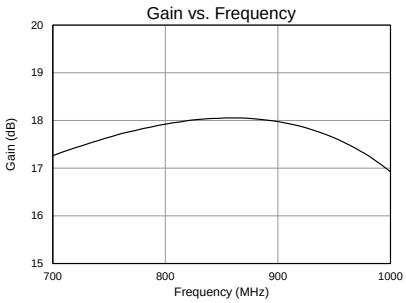
Reference Des.	Value	Description	Manuf.	Part Number
n/a	n/a	Printed Circuit Board	Qorvo	1100415
U1	n/a	1 W High Linearity Amplifier	Qorvo	TQP7M9105
C1	3.9 pF	CAP, 0603, ± 0.1 pF, 100V, NPO/COG	AVX	06035J3R9ABSTR
C2, C4	5.6 pF	CAP, 0603, ± 0.1 pF, 100V, NPO/COG	AVX	06035J5R6ABSTR
C5, C6	100 pF	CAP, 0603, 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

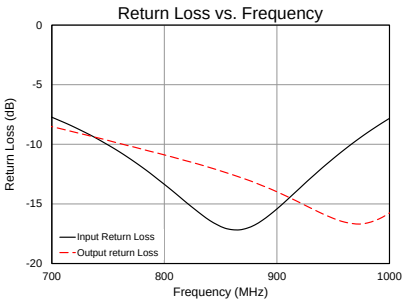
Typical Performance 700 – 1000 MHz

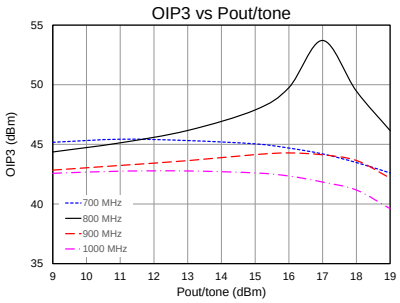
Test Conditions: V_{CC}=+5 V, Temp.=+25°C, 50Ω System

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

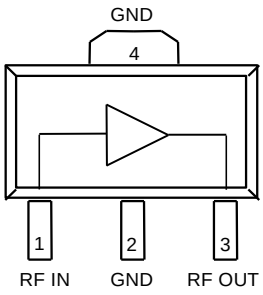
Performance Plots 700 – 1000 MHz







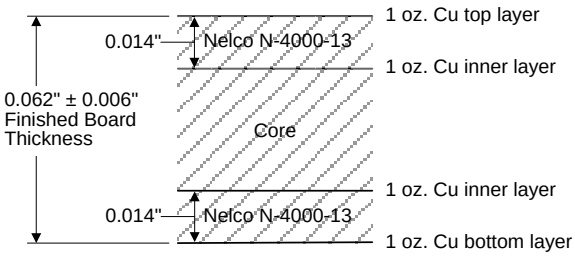
Pin Configuration and Description



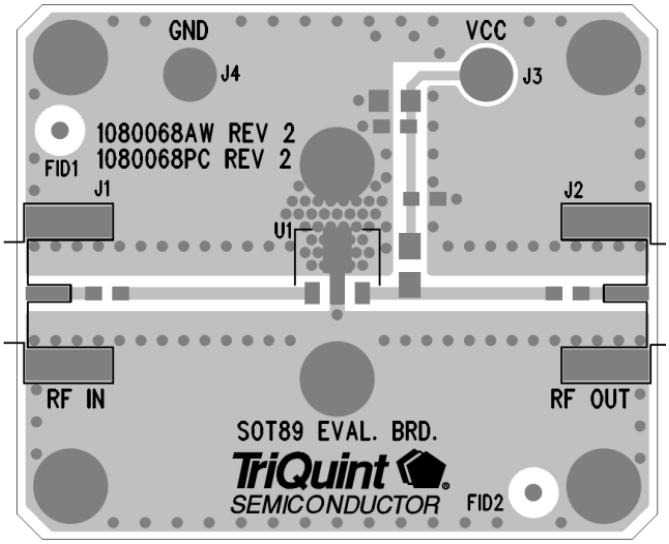
Pin No.	Label	Description
1	RF IN	RF Input. Requires external match for optimal performance. External DC Block required.
2, 4	GND	RF/DC Ground Connection
3	RF OUT	RF Output and V_{CC}. Requires external match for optimal performance. External DC Block, RF chock and supply voltage is required.

Evaluation Board PCB Information

Qorvo PCB 1080068 Material and Stack-up



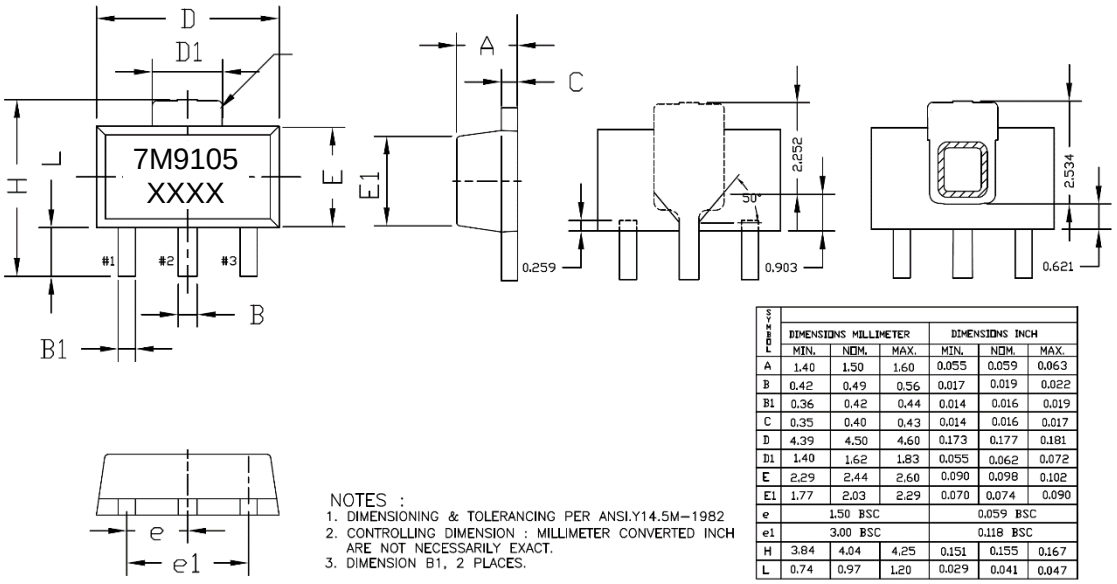
50 ohm line dimensions: width = .028”, spacing = .028”.



Package Marking and Dimensions

Marking:

Part Number – 7M9105
Trace Code – XXXX

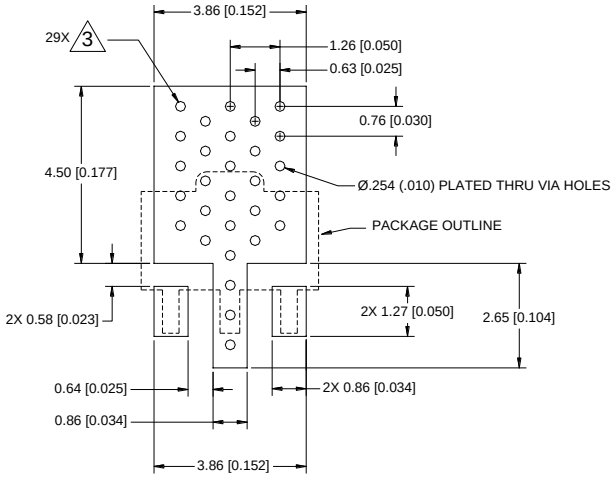


SYMBOL	DIMENSIONS MILLIMETER			DIMENSIONS INCH		
	MIN.	NOM.	MAX.	MIN.	NOM.	MAX.
A	1.40	1.50	1.60	0.055	0.059	0.063
B	0.42	0.49	0.56	0.017	0.019	0.022
B1	0.36	0.42	0.44	0.014	0.016	0.019
C	0.35	0.40	0.43	0.014	0.016	0.017
D	4.39	4.50	4.60	0.173	0.177	0.181
D1	1.40	1.62	1.83	0.055	0.062	0.072
E	2.29	2.44	2.60	0.090	0.098	0.102
E1	1.77	2.03	2.29	0.070	0.074	0.090
e	1.50 BSC			0.059 BSC		
e1	3.00 BSC			0.118 BSC		
H	3.84	4.04	4.25	0.151	0.155	0.167
L	0.74	0.97	1.20	0.029	0.041	0.047

NOTES :
1. DIMENSIONING & TOLERANCING PER ANSI.Y14.5M–1982
2. CONTROLLING DIMENSION : MILLIMETER CONVERTED INCH ARE NOT NECESSARILY EXACT.
3. DIMENSION B1, 2 PLACES.

Notes:
1. The terminal #1 identifier and terminal numbering conform to JESD 95-1 SPP-012.
2. Trace code up to 4 characters assigned by subcontractor
3. Contact plating: Annealed Matte Tin or Nickel Palladium Gold (NiPdAu)

PCB Mounting Pattern



NOTES:
1. All dimensions are in millimeters [inches]. Angles are in degrees.
2. Use 1 oz. copper minimum for top and bottom layer metal.
3. Via holes are required under the backside paddle of this device for proper RF/DC grounding and thermal dissipation. We recommend a 0.35mm (#80/.0135") diameter bit for drilling via holes and a final plated thru diameter of 0.25mm (0.10").
4. Ensure good package backside paddle solder attach for reliable operation and best electrical performance.