

### 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.

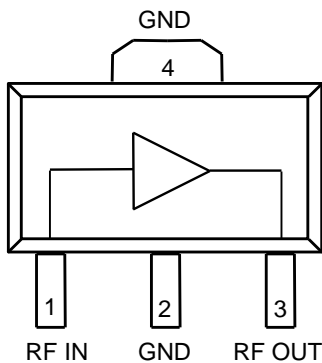


3-pin SOT-89 Package

### 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 <sub>CC</sub> )	+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 <sub>CC</sub> )		+5.0	+5.25	V
T <sub>CASE</sub>	-40		+105	°C
T <sub>j</sub> for >10 <sup>6</sup> hours MTTF			+170	°C

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

## Electrical Specifications

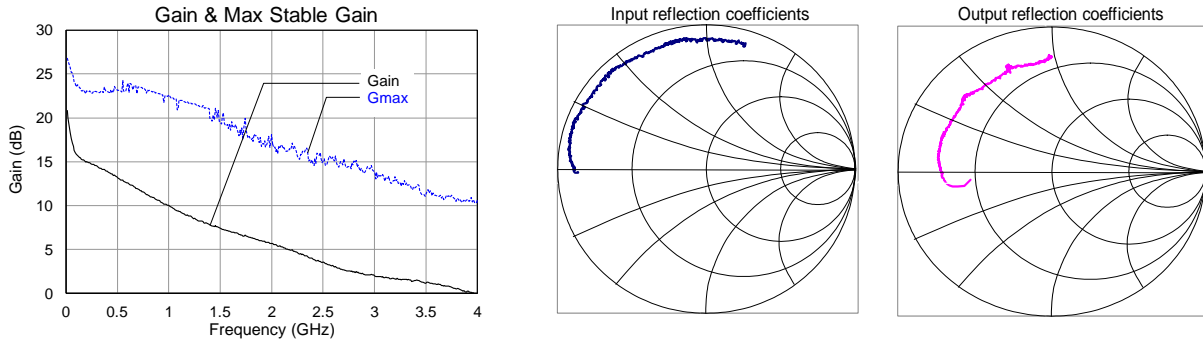
Test conditions unless otherwise noted: V<sub>CC</sub> = +5.0 V, Temp = +25 °C

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	P <sub>out</sub> = +15 dBm/tone, Δf = 1 MHz	+43.5	+47		dBm
WCDMA Output Power	-50 dBc ACLR <sup>(1)</sup>		+20.5		dBm
Noise Figure			6.3		dB
Quiescent Current, I <sub>CO</sub>		195	220	245	mA
Thermal Resistance, θ <sub>jc</sub>	Module (junction to backside ground paddle)		27.3		°C/W

Notes:

1. ACLR Test set-up: 3GPP WCDMA, TM1+64 DPCH, +5 MHz offset, PAR = 10.2 dB at 0.01% Prob.

## Device Characterization Data



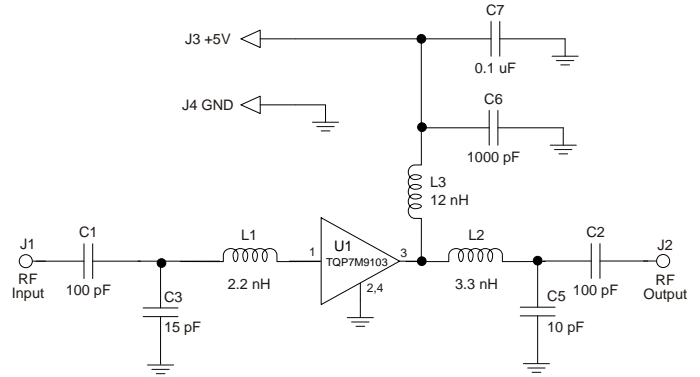
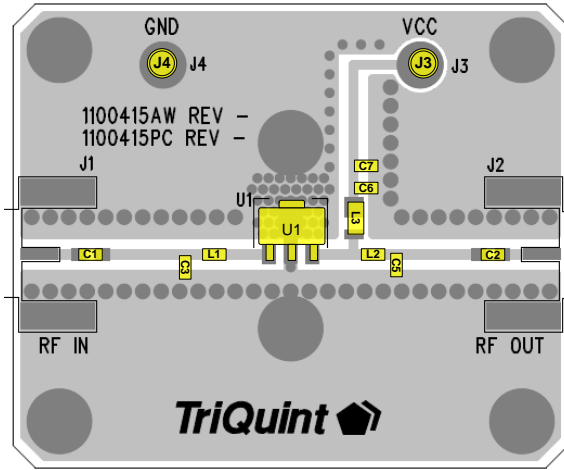
Note: The gain for the unmatched device in 50 Ω system is shown as the trace in black color, [gain (S(21))]. For a tuned circuit for a particular frequency, it is expected that actual gain will be higher, up to the maximum stable gain. The maximum stable gain is shown as the blue trace [Gmax]. The impedance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

## S-Parameters

Test Conditions:  $V_{CC}=+5\text{ V}$ ,  $I_{CQ}=220\text{ mA}$ ,  $T=+25^{\circ}\text{C}$ , unmatched 50 Ω 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:  $V_{CC} = +5V$ ,  $I_{CQ} = 235\text{ mA}$ , Temp. =  $+25^\circ\text{C}$

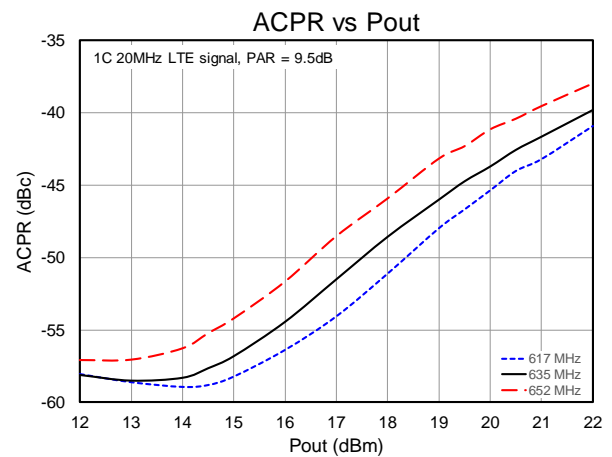
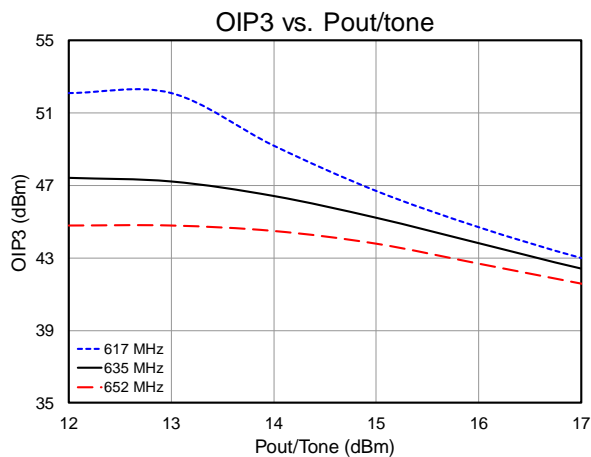
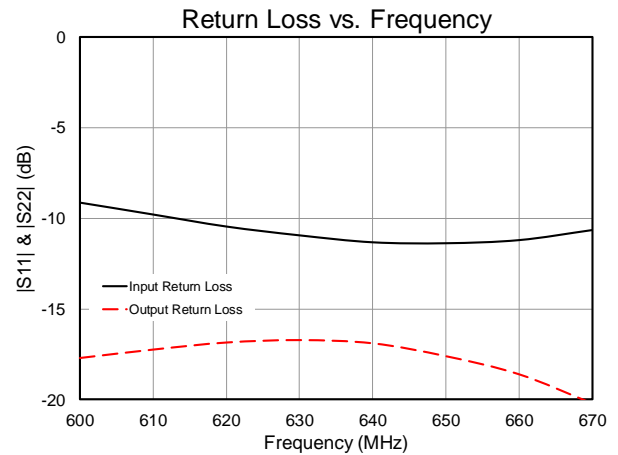
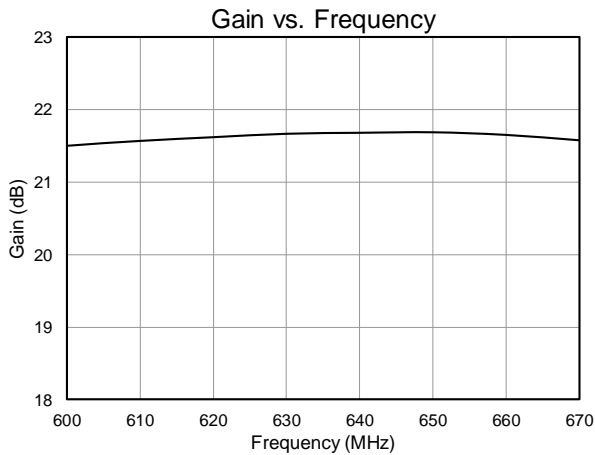
Parameter	Conditions	Typical Value			Units
Frequency		617	635	652	MHz
Gain		21.6	21.6	21.6	dB
Input Return Loss		10.5	11	11	dB
Output Return Loss		17	16.5	17.5	dB
Output P1dB		+30.3	+30.5	+30.8	dBm
OIP3	Pout = +16 dBm / tone, $\Delta f = 1\text{ MHz}$	+44.7	+43.8	+42.7	dBm
WCDMA Channel Power <sup>(1)</sup>	ACLR = -50 dBc	+18	+17.5	+16.8	dBm

Notes:

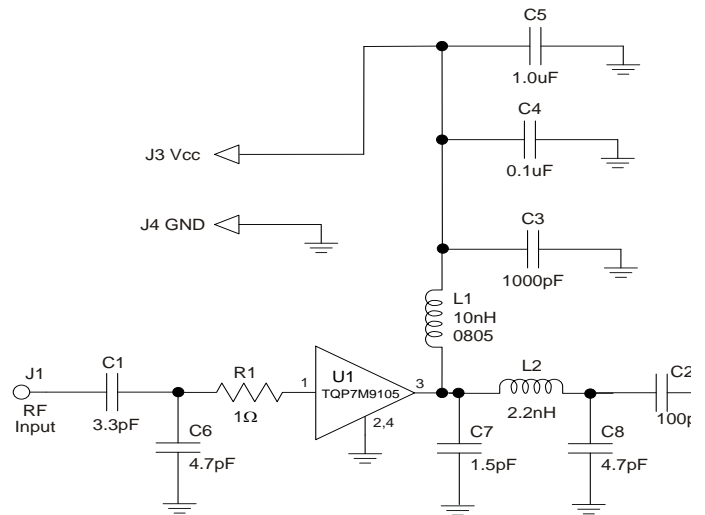
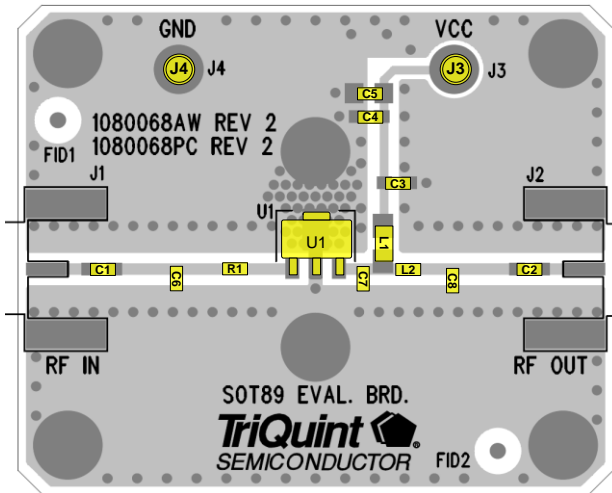
- 1C 20MHz LTE signal, PAR=9.5dB

## Performance Plots 615 – 655 MHz

Test conditions unless otherwise noted:  $V_{CC} = +5V$ ,  $I_{CQ} = 235\text{ mA}$ , Temp. =  $+25^\circ\text{C}$



**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:  $V_{CC} = +5\text{ V}$ ,  $I_{CO} = 220\text{ mA}$ , Temp. =  $+25\text{ }^\circ\text{C}$

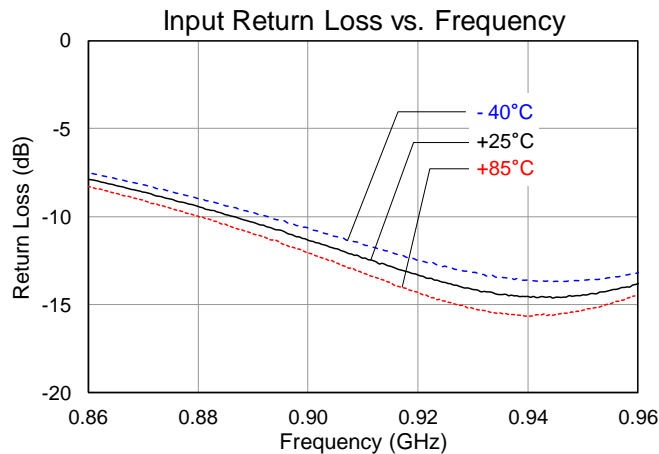
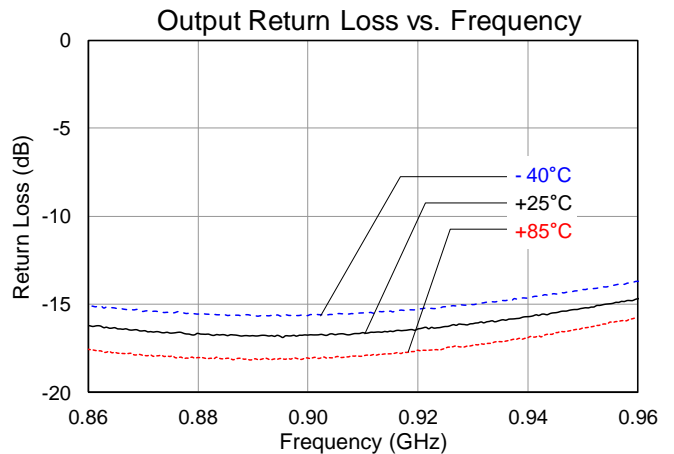
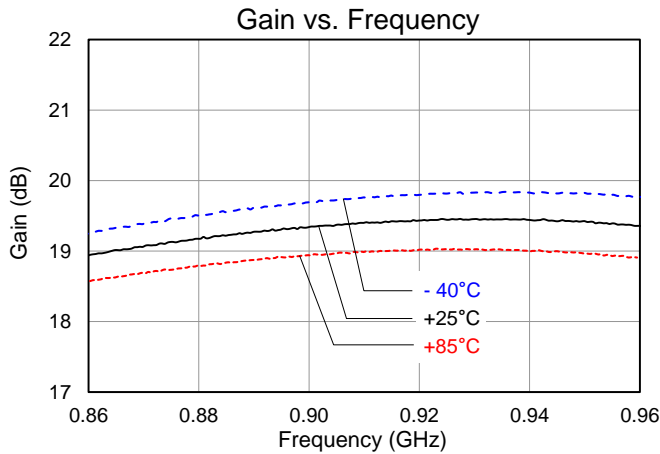
Parameter	Typical Value						Units
Frequency	860	880	900	920	940	960	MHz
Gain	18.9	19.2	19.3	19.4	19.4	19.3	dB
Input Return Loss	7.9	9.5	11.3	13	14	13	dB
Output Return Loss	16.2	16.7	16.8	15	15	14	dB
Output P1dB	+29	+29.2	+29.5	+29.9	+30.0	+29.8	dBm
Output IP3 <sup>(1)</sup>	+48	+50.2	+50.6	+49.5	+49.2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

- +15 dBm/tone,  $\Delta f = 1\text{ MHz}$
- At  $-50\text{ dBc ACLR}$
- 3GPP WCDMA, TM1+64 DPCH, +5 MHz offset, PAR = 10.2 dB at 0.01% Prob.

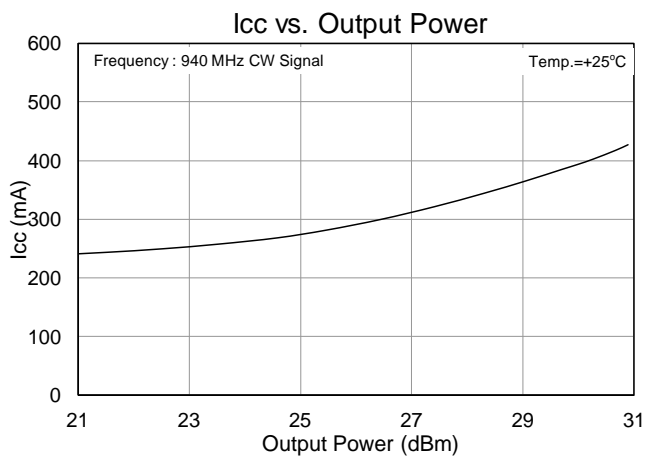
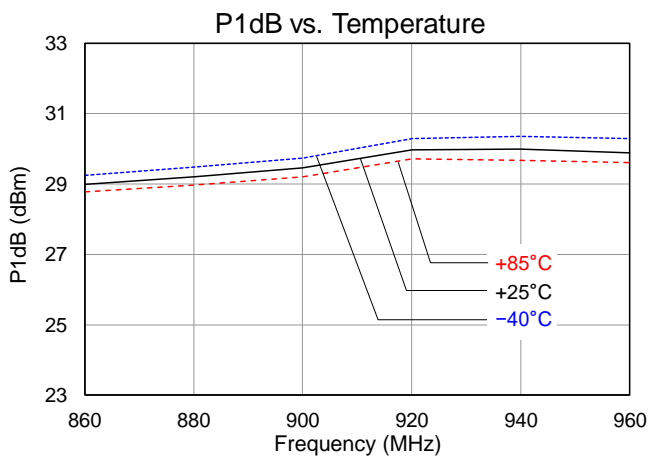
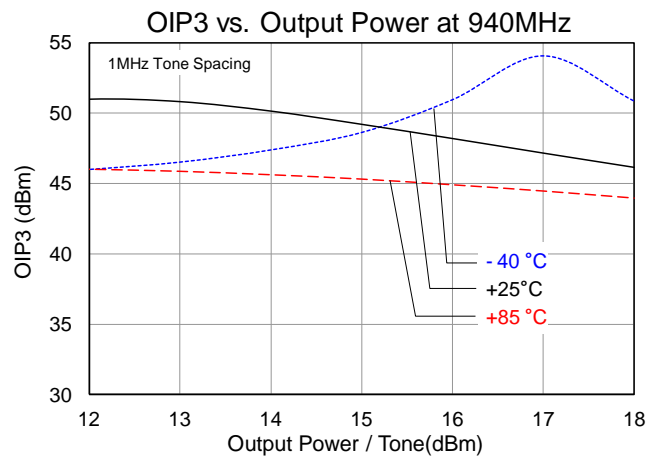
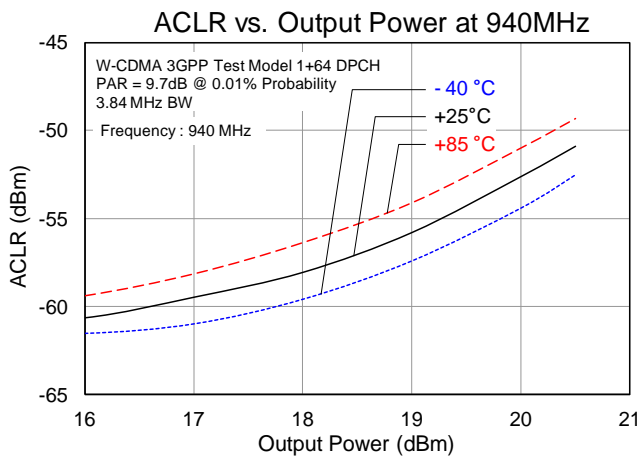
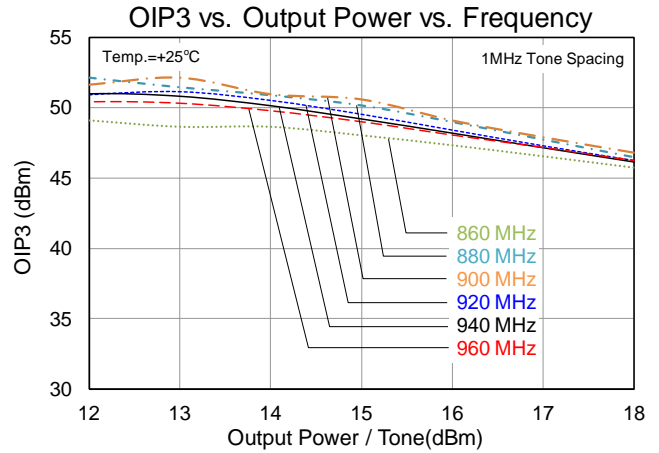
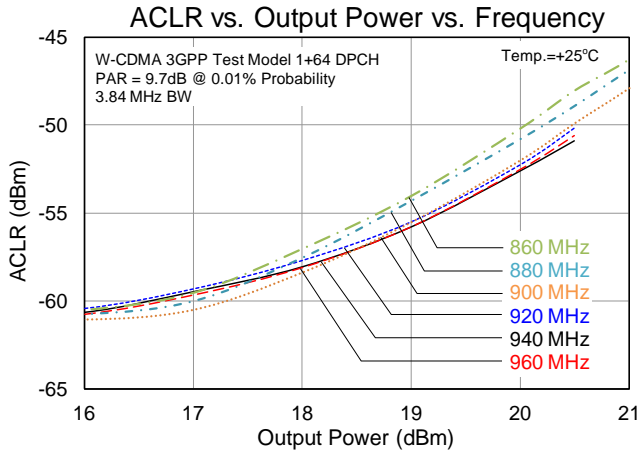
### RF Performance Plots 860 – 960 MHz (TQP7M9105-PCB900)

Test conditions unless otherwise noted:  $V_{CC} = +5\text{ V}$ ,  $I_{CO} = 235\text{ mA}$ , Temp. =  $+25\text{ }^\circ\text{C}$



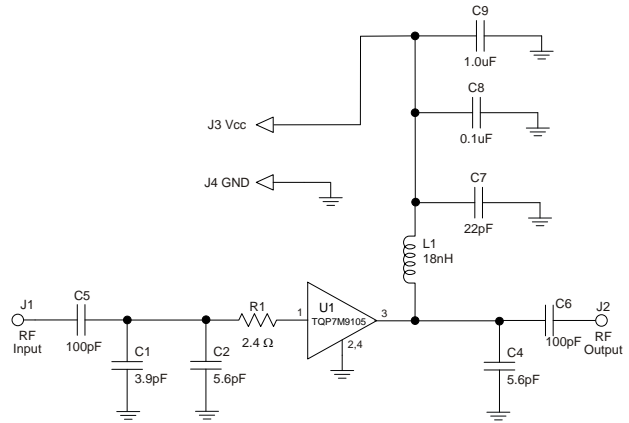
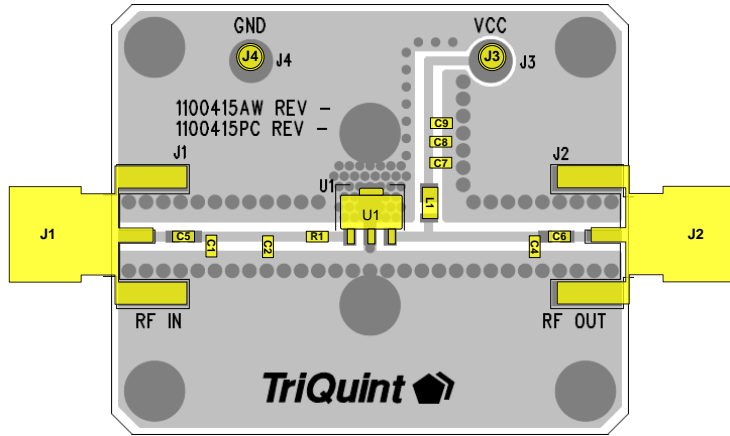
**Performance Plots 860 – 960 MHz (TQP7M9105-PCB900)**

Test conditions unless otherwise noted:  $V_{CC} = +5V$ ,  $I_{CQ} = 235\text{ mA}$ , Temp. =  $+25^\circ\text{C}$





**Evaluation Board 700 – 1000 MHz Reference Design**



**Notes:**

Components shown on the silkscreen but not on the schematic are not used.

All components are of 0603 size unless stated on the schematic.

The recommended component values are dependent upon the frequency of operation.

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 μF	CAP, 0603, 5%, 50V, NPO/COG	various	
C9	1.0 μF	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

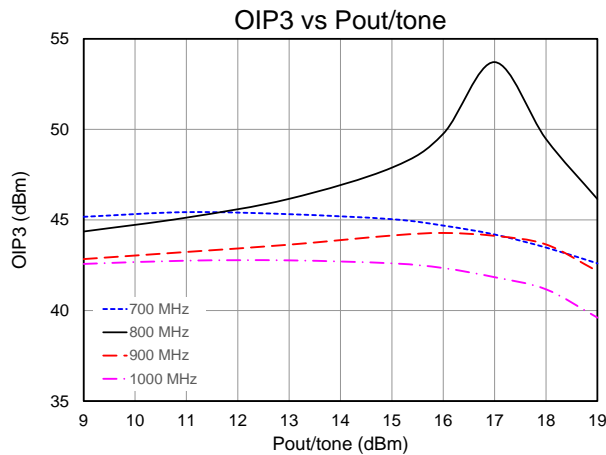
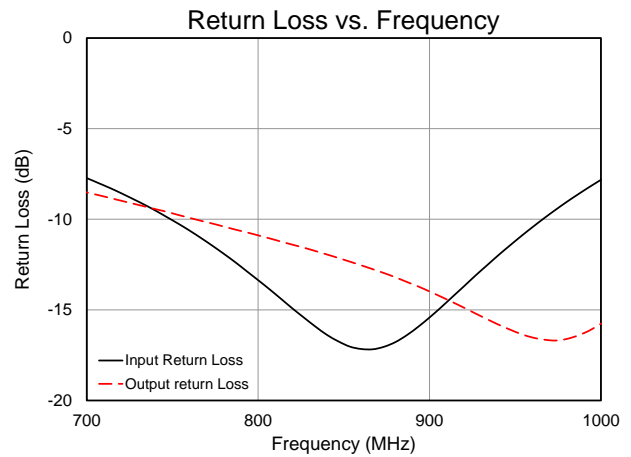
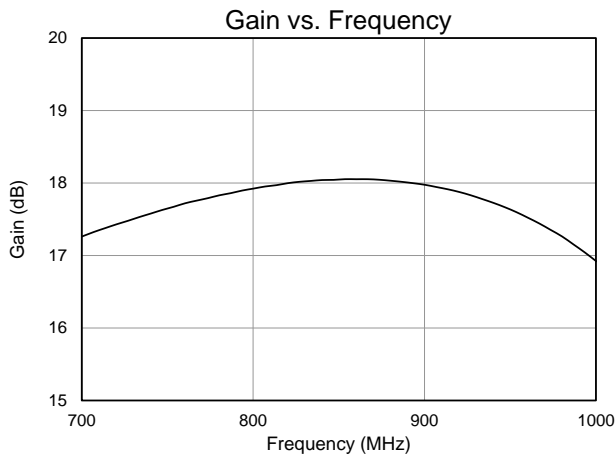
### Typical Performance 700 – 1000 MHz

Test Conditions:  $V_{CC}=+5\text{ V}$ ,  $\text{Temp.}=+25^\circ\text{C}$ ,  $50\Omega$  System

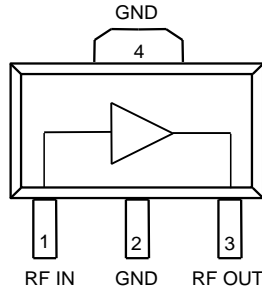
Parameter	Conditions	Typical Value				Units
Frequency		700	800	900	1000	MHz
Gain		17.2	17.9	18	16.9	dB
Input Return Loss		7.7	13.3	15.3	7.8	dB
Output Return Loss		8.5	10.9	14	15.7	dB
Output P1dB		+28.5	+29.5	+30.5	+30.5	dBm
Output IP3	$P_{out}= +15\text{ dBm/ tone}$ , $\Delta f= 1\text{ MHz}$	+45	+47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

### Performance Plots 700 – 1000 MHz

Test Conditions:  $V_{CC}=+5\text{ V}$ ,  $\text{Temp.}=+25^\circ\text{C}$ ,  $50\Omega$  System



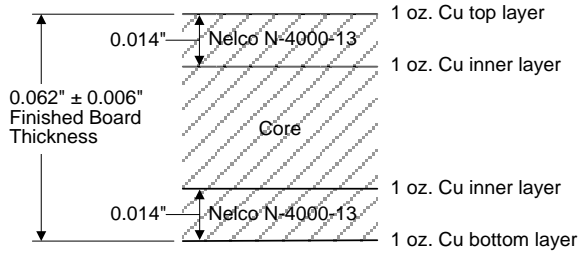
**Pin Configuration and Description**



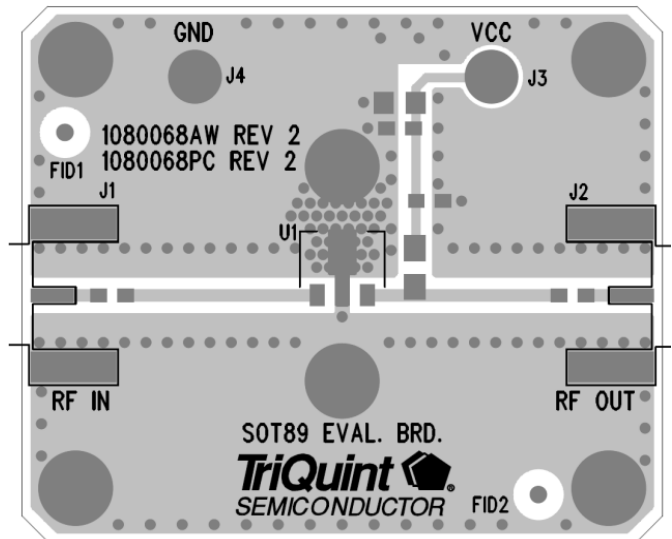
Pin No.	Label	Description
1	RF IN	RF Input. Requires external match for optimal performance. External DC Block required.
2, 4	GND	RF/DC Ground Connection
3	RF OUT	RF Output and V <sub>CC</sub> . Requires external match for optimal performance. External DC Block, RF choke and supply voltage is required.

**Evaluation Board PCB Information**

Qorvo PCB 1080068 Material and Stack-up

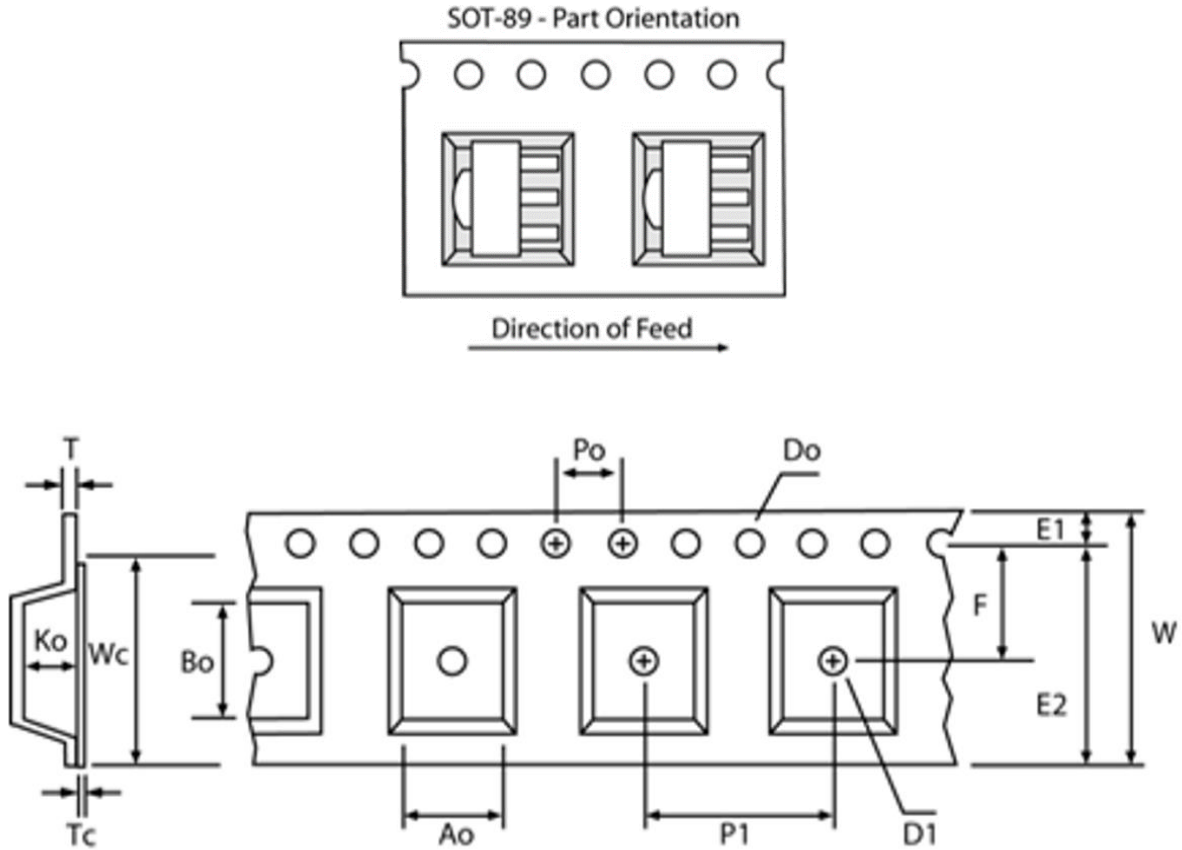


50 Ω line dimensions: width = .028", spacing = .028".





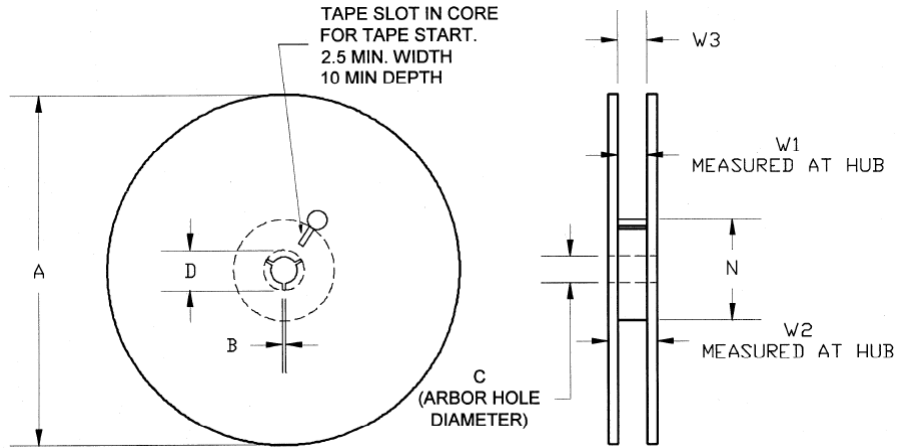
Tape and Reel Information – Carrier and Cover Tape Dimensions



Feature	Measure	Symbol	Size (in)	Size (mm)
Cavity	Length	A0	0.181	4.60
	Width	B0	0.193	4.90
	Depth	K0	0.075	1.90
	Pitch	P1	0.315	8.00
Centerline Distance	Cavity to Perforation - Length Direction	P2	0.079	2.00
	Cavity to Perforation - Width Direction	F	0.217	5.50
Cover Tape	Width	C	0.362	9.20
Carrier Tape	Width	W	0.472	12.0

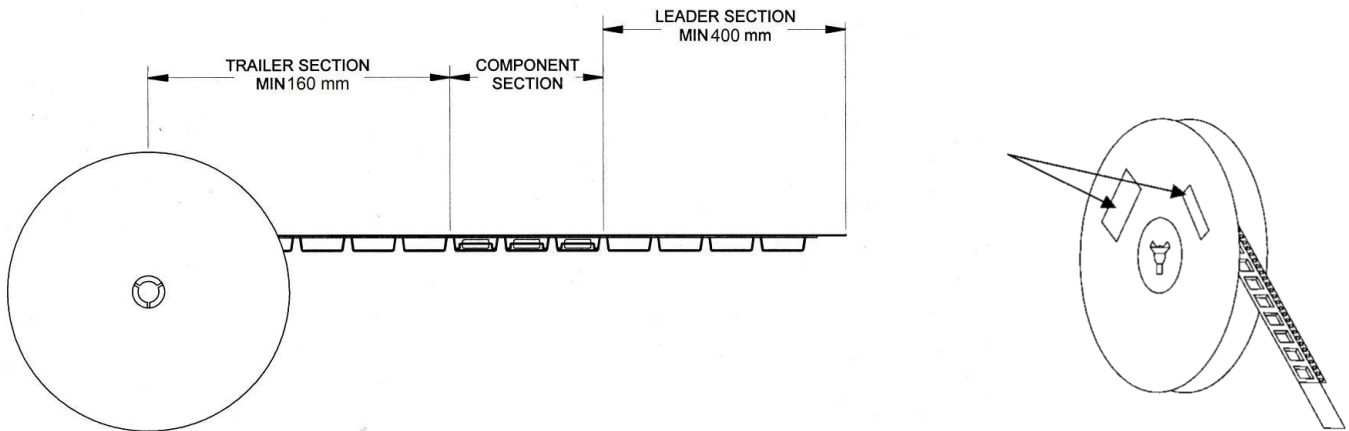
**Tape and Reel Information – Reel Dimensions (7")**

Standard T/R size = 1,000 pieces on a 7" reel.



Feature	Measure	Symbol	Size (in)	Size (mm)
Flange	Diameter	A	6.969	177.0
	Thickness	W2	0.717	18.2
	Space Between Flange	W1	0.504	12.8
Hub	Outer Diameter	N	2.283	58.0
	Arbor Hole Diameter	C	0.512	13.0
	Key Slit Width	B	0.079	2.0
	Key Slit Diameter	D	0.787	20.0

**Tape and Reel Information – Tape Length and Label Placement**



- Notes:
1. Empty part cavities at the trailing and leading ends are sealed with cover tape. See EIA 481-1-A.
  2. Labels are placed on the flange opposite the sprockets in the carrier tape.