TRIQUINT SEMICONDUCTOR, INC.

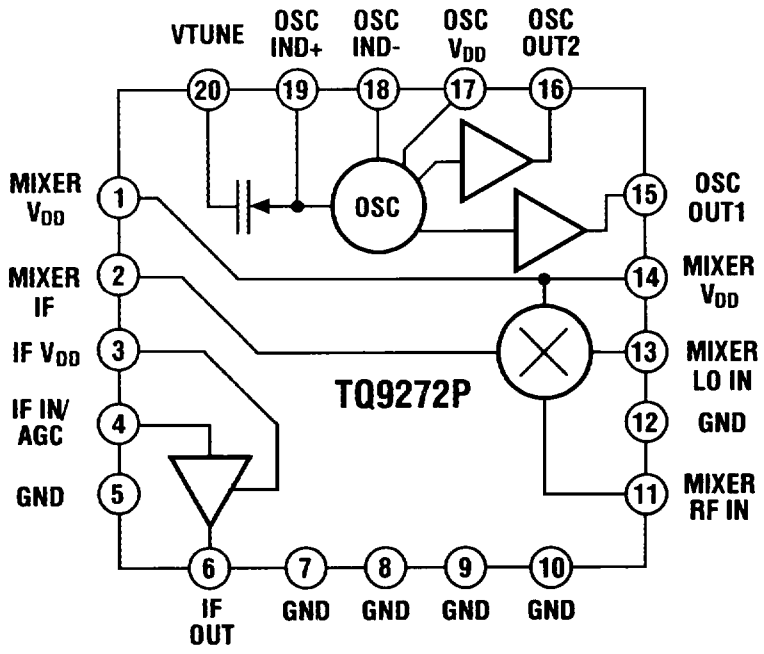
TQS WIRELESS COMMUNICATIONS

PRELIMINARY

TQ9272P

General-Purpose RFIC Downconverter

Block Diagram



Product Description

The TQ9272P general-purpose RFIC Downconverter is a multifunction receiver which contains a double-balanced mixer, a voltage-controlled oscillator and an IF/AGC amplifier. All functions are electrically independent for design flexibility. The built-in oscillator, with a tuneable range of 15%, can be set to oscillate between 600 and 1800 MHz by an external inductor. The IF amplifier frequency range is 30 MHz to 500 MHz, and the IF/AGC range exceeds 30 dB. The mixer presents 50 Ω at all ports, as well as wideband operation over an RF input frequency range of 500 MHz to 2500 MHz.

Electrical Characteristics

Test Conditions: V_{DD} = 5 V, T_A = 25°C, RF = 1575 MHz, LO = 1490 MHz

Downconverter	Symbol	Min.	Typ.	Max.	Units
Conversion Gain[1]	G_{CONV}	30	40		dB
Noise Figure	NF		13	16	dB
3rd Order Intercept – Input [2]	IP3		-8		dBm
Supply Current @ 5 V	I_{DD}	28		42	mA
Supply Voltage	V_{DD}	4.5	5.0	5.5	V

Notes: 1. RF = 1575 MHz, LO = 1490 MHz.
2. Frequency separation of two signals is 500 KHz. This is specified through the mixer, and excludes the IF amp.

Features

- *Receiver front-end on a chip*
- *Single + 5 V supply*
- *20-pin plastic package*
- *Wide oscillator operating range*
- *AGC IF amp*

Applications

- *Spread-Spectrum Receivers*
- *GPS (Global Positioning Systems)*
- *Point-of-Sale Terminals*
- *Security Alarms*
- *Satellite Receiver*
- *General-purpose use*

TQNTS013

TQS Wireless Communications • 3625A SW Murray Blvd. • Beaverton, Oregon 97005 • (503) 644-3535 Fax: (503) 644-3198

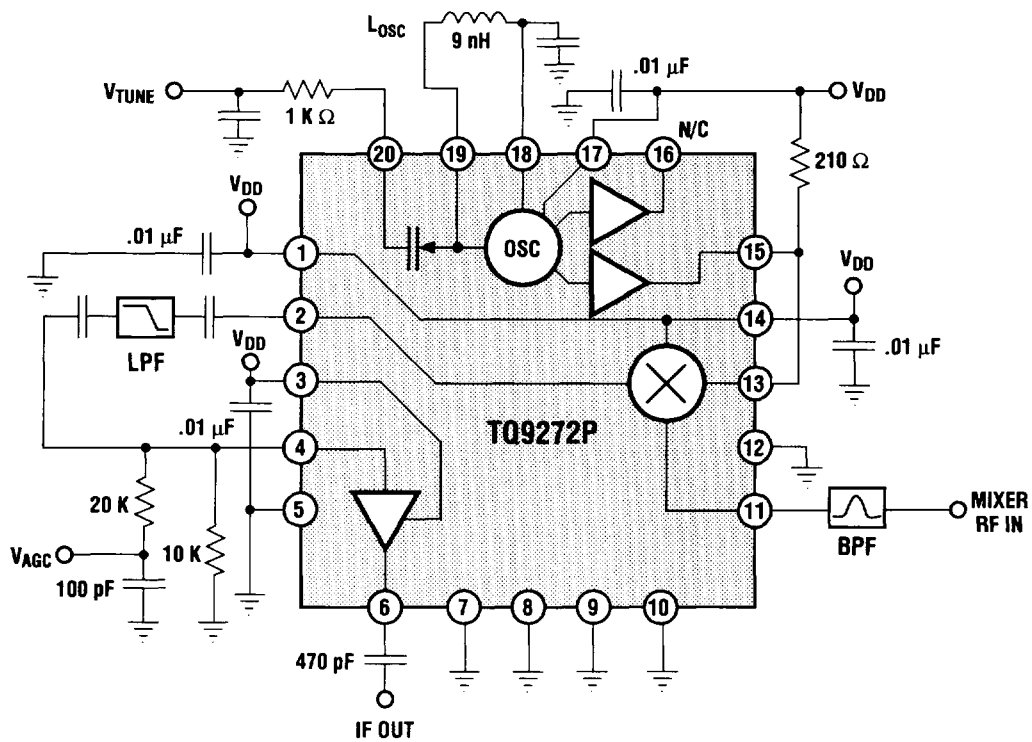
Electrical Specifications – Downconverter Section *Test Conditions: V_{DD} = 5 V, T_A = 25°C; LO = -5 dBm; IF = 85 MHz*

Parameter	Symbol	Conditions	Min	Typ	Max	Units
Supply Voltage	V_{DD}		4.5		5.5	V
Supply Current @ 5 V	I_{DD}		28		42	mA
RF/LO Bandwidth [1]			500		1800	MHz
IF Bandwidth			30		250	MHz

Parameter	Symbol	Conditions	Min	Typ	Max	Units
Conversion Gain	G_{CONV}	Maximum IF gain		40	dB	
Noise Figure [2]	NF			10	dB	
3rd Order Intercept – Input [3]	IP3	Input Referred 500 KHz tone spacing		-10	dBm	
Gain Compression	P1dB				dBm	
Isolation Mixer LO/IF	$ISO_{L/I}$				dB	
Isolation Mixer LO/LNA In	$ISO_{L/LI}$				dB	

Notes: 1. Limited by the oscillator. Mixer RF can be 2500 MHz with external LO.
2. Mixer and IF amp at maximum gain.
3. Frequency separation of two signals is 500 KHz. This is specified through the LNA and mixer; excludes the IF amp.

Test Circuit *Test Conditions: RF = 1575 MHz, LO = 1490 MHz*



Electrical Specifications – Mixer Section

Test Conditions: V_{DD} = 5 V, T_A = 25°C; IF = 85 MHz, RF = 1575 MHz, LO = 1490 MHz

Mixer	*Symbol*	*Conditions*	*Min*	*Typ*	*Max*	*Units*
Conversion Gain	G_{MIX}	RF Power:		8		dB
Noise Figure	NF_{MIX}			13.0		dB
3rd Order Intercept – Input	$IP3_{MIX}$	Input referred 500 KHz spacing		-8		dBm
Isolation RF/IF	$ISO_{R/I}$			-39.0		dB
Isolation LO/IF	$ISO_{L/I}$			-31.0		dB
Isolation LO/RF	$ISO_{L/R}$			-29.0		dB
RF/LO Frequency						MHz
IF Frequency						MHz
Supply Current @ 5 V	I_{DD}			17.0		mA

Electrical Specifications – Oscillator Section

Test Conditions: V_{DD} = 5 V, T_A = 25°C

Parameter	*Conditions*	*Min*	*Typ*	*Max*	*Units*
Tuning Frequency Range		500		1800	MHz
Tuning Voltage Range		2.0		7.0	V
Power Output	f = 1490 MHz		-7.1		dBm
Phase Noise	f = 1490 MHz, 10 K offset		62.0		dBc/Hz
Phase Noise	f = 1490 MHz, 20 K offset		72.0		dBc/Hz
Phase Noise	f = 1490 MHz, 50 K offset		83.0		dBc/Hz
Phase Noise	f = 1490 MHz, 100 K offset		92.0		dBc/Hz
Supply Current	Both buffers connected		13.0		mA

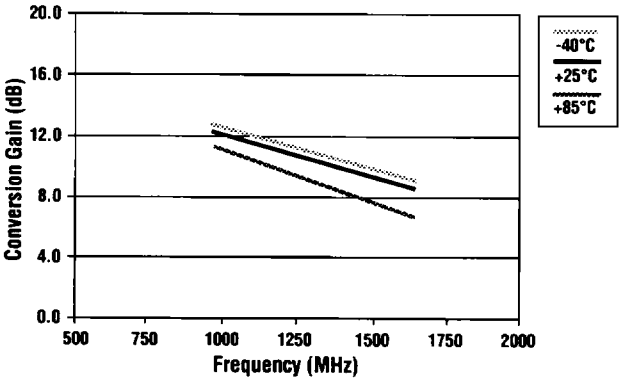
Electrical Specifications – IF Amp Section

Test Conditions: V_{DD} = 5 V, T_A = 25°C; IF = 100 MHz

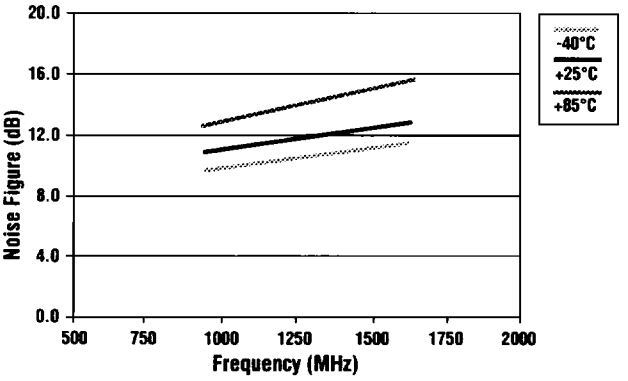
Parameter	*Conditions*	*Min*	*Typ*	*Max*	*Units*
Gain			27.0		dB
Noise Figure			7.0		dB
3rd Order Intercept	Output Referred		-2.4		dBm
Gain Compression Point			-14.0		dBm
Frequency Range		30		500	MHz
Supply Current			3.0		mA

Typical Performance – Mixer

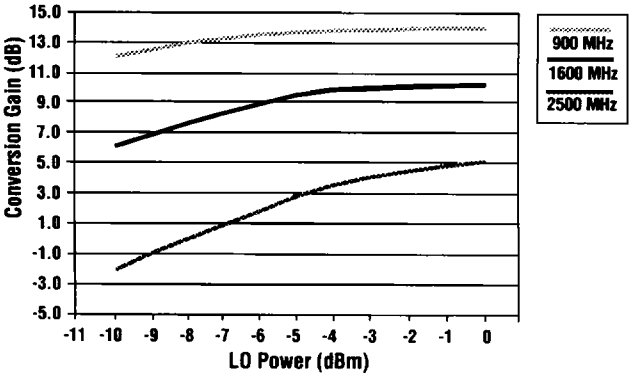
Conversion Gain vs. Frequency vs. Temperature



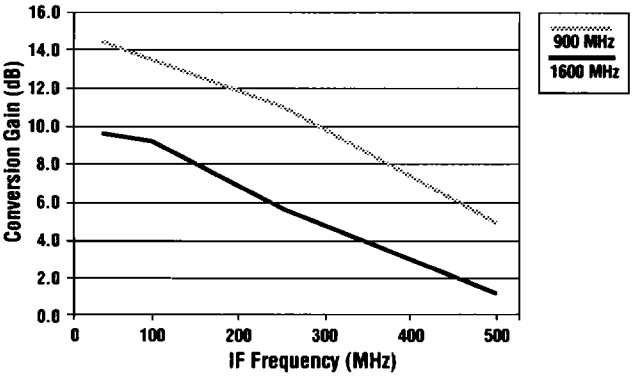
Noise Figure vs. Frequency vs. Temperature



Conversion Gain vs. LO Power

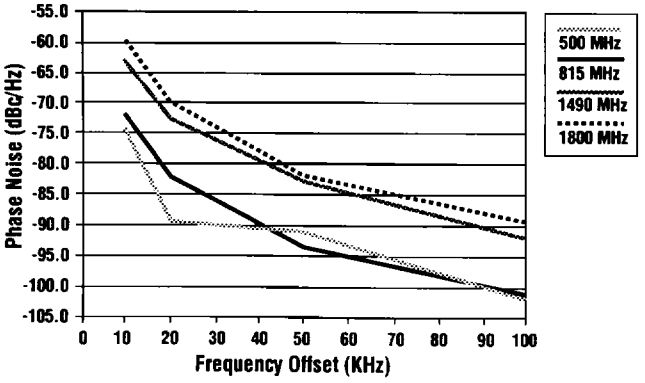


Conversion Gain vs. IF Frequency

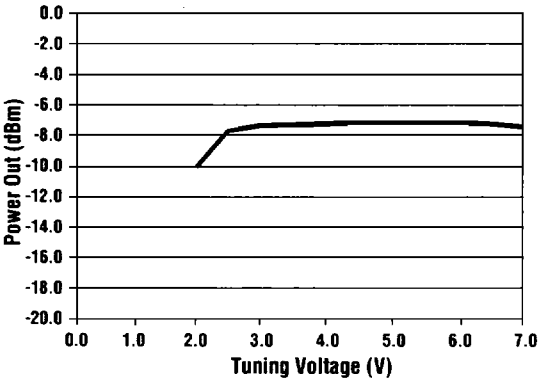


Typical Performance – Oscillator

Phase Noise vs. Tuned Frequency

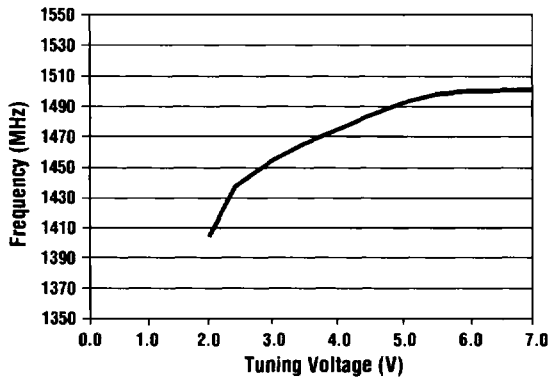


Power Output vs. Tuning Voltage

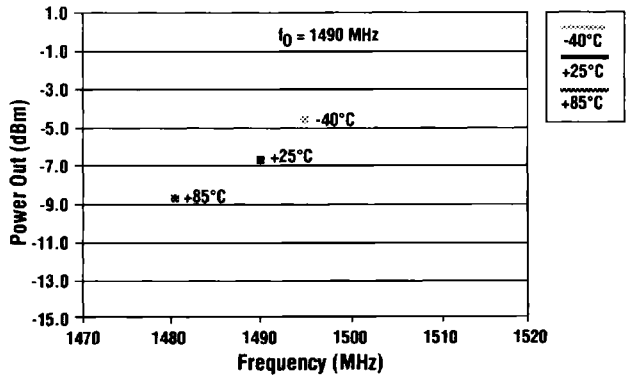


Typical Performance – Oscillator (cont.)

Oscillator Frequency vs. Tuning Voltage

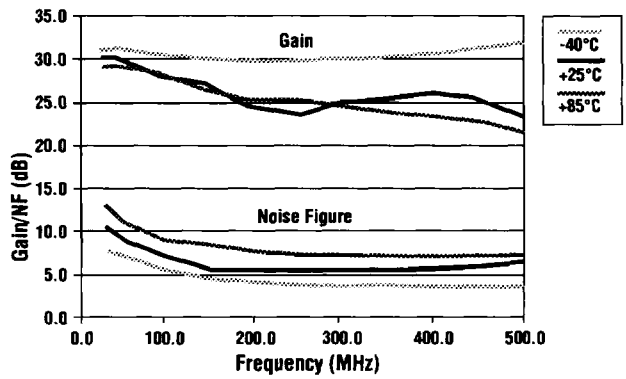


Power Output Frequency vs. Temperature

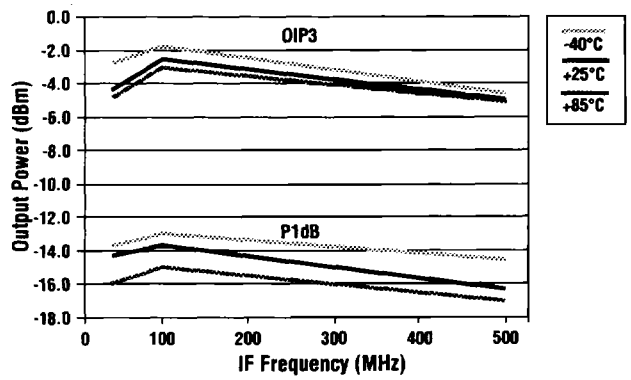


Typical Performance – IF Amplifier

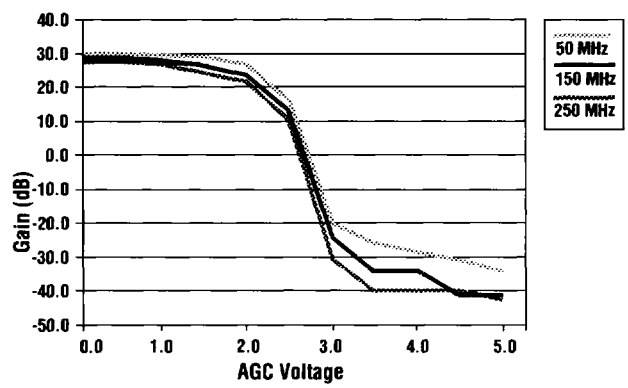
Gain/NF vs. Frequency vs. Temperature



P1DB and OIP3 vs. Frequency vs. Temperature

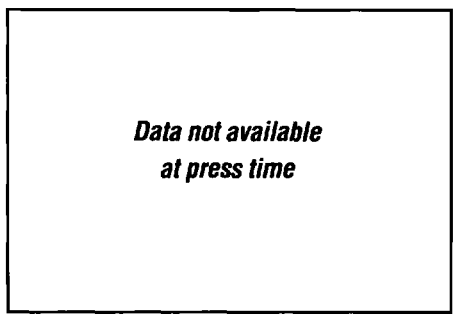


AGC Transfer Curve

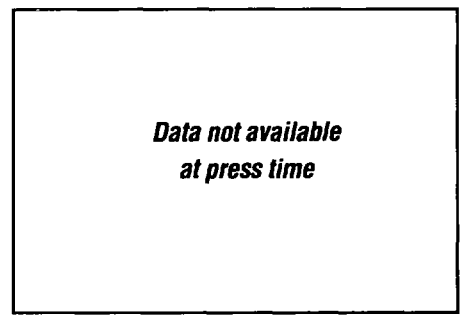


Typical Performance – Downconverter

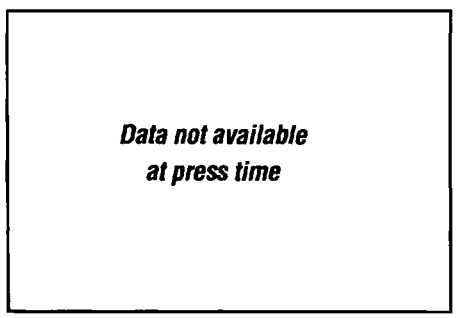
Downconverter Gain vs. Frequency vs. Temperature



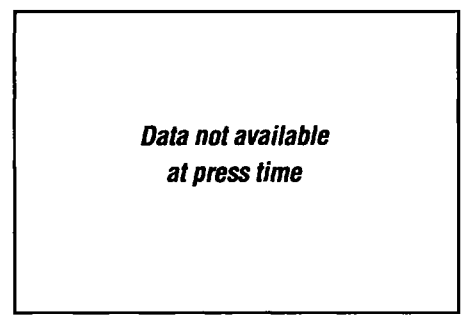
Downconverter NF vs. Frequency vs. Temperature



Downconverter IP3 Input vs. Frequency vs. Temperature



Downconverter Gain vs. LO Power



Mixer Impedances

	RF Port		LO Port		IF Port	
Freq (MHz)	$\|\Gamma\|$	$\angle\Gamma$	$\|\Gamma\|$	$\angle\Gamma$	$\|\Gamma\|$	$\angle\Gamma$
100	0.97	-16	0.73	-25	0.20	-1
200	0.90	-32	0.58	-29	0.19	-0
300	0.81	-45	0.53	-32	0.19	-1
400	0.72	-57	0.50	-35	0.19	-2
500	0.64	-68	0.48	-40	0.19	-4
600	0.57	-78	0.46	-45	0.19	-6
700	0.51	-86	0.46	-50	0.20	-9
800	0.46	-94	0.45	-55	0.20	-11
900	0.42	-101	0.44	-61	0.21	-14
1000	0.37	-108	0.44	-64	0.22	-17
1100	0.37	-114	0.43	-68	0.23	-19
1200	0.30	-122	0.42	-73	0.24	-21
1300	0.25	-130	0.40	-78	0.25	-24
1400	0.23	-137	0.39	-84	0.25	-27
1500	0.20	-148	0.38	-90	0.26	-30
1600	0.17	-160	0.36	-97	0.27	-34
1700	0.15	-53	0.35	-104	0.27	-37
1800	0.14	54	0.34	-111	0.27	-42
1900	0.13	45	0.34	-119	0.27	-47
2000	0.12	34	0.33	-124	0.27	-53
2100	0.11	149	0.33	-131	0.26	-58
2200	0.10	137	0.32	-136	0.26	-65
2300	0.09	129	0.31	-142	0.26	-71
2400	0.07	106	0.30	-148	0.26	-78
2500	0.07	81	0.29	-153	0.27	-84

Mixer - Input and Output Impedances

Data not available at press time

IF Amp - Input and Output Impedances

Data not available at press time

IF Amp S-Parameters (typical)

Test Conditions T_A = 25° C, no load

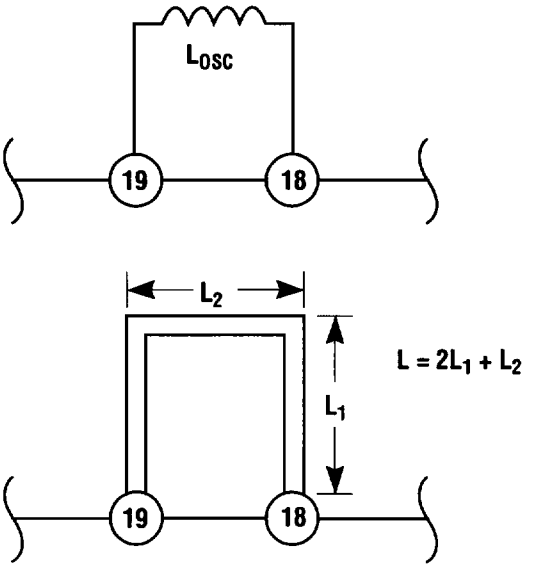
AGC (V)	Freq (MHz)	|S11|	<S11	|S21|	<S21	|S12|	<S12	|S22|	<S22
0	100	0.97	3	28.36	-19	0.0009	96	0.34	8
5	100	0.99	3	0.06	38	0.0009	106	0.47	10
0	200	0.98	6	23.85	-43	0.0017	107	0.33	11
5	200	0.98	6	0.04	42	0.0022	106	0.51	16
0	300	0.99	7	20.85	-59	0.0028	111	0.30	21
5	300	0.98	8	0.03	42	0.0033	110	0.54	20
0	400	0.99	7	18.05	-75	0.0037	122	0.31	36
5	400	0.98	11	0.03	150	0.0045	110	0.56	23
0	500	0.98	9	14.93	271	0.0052	124	0.36	46
5	500	0.97	14	0.03	144	0.0057	115	0.57	26
0	600	0.95	11	11.94	260	0.0066	128	0.42	49
5	600	0.97	17	0.02	143	0.0070	119	0.58	28
0	700	0.93	13	9.48	252	0.0083	127	0.46	50
5	700	0.97	19	0.02	139	0.0084	121	0.59	31
0	800	0.92	15	7.64	247	0.0099	129	0.48	51
5	800	0.97	21	0.03	133	0.0095	125	0.59	34
0	900	0.90	137	6.25	244	0.0111	131	0.50	52
5	900	0.96	23	0.03	133	0.0113	127	0.59	36
0	1000	0.89	379	5.20	241	0.0121	134	0.51	53
5	1000	0.96	385	0.02	126	0.0123	128	0.60	159

Oscillator Design Table

V_{TUNE} = 2.5 V

Frequency	Inductance [1]	Trace Length [2]
600		
700		
800		
900		
1000		
1100		
1300		
1400		
1500		
1600		
1700		
1800		

Oscillator Tuning Inductor



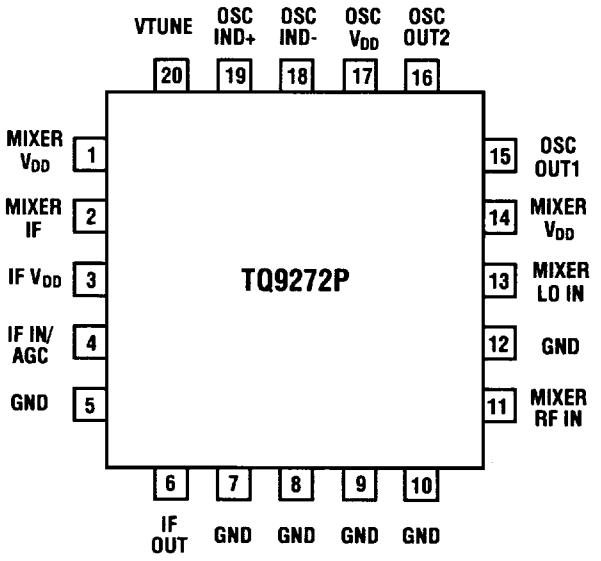
Notes: 1. CoilCraft surface-mount inductors.
2. PC board trace 20 mils wide.

Pin Descriptions

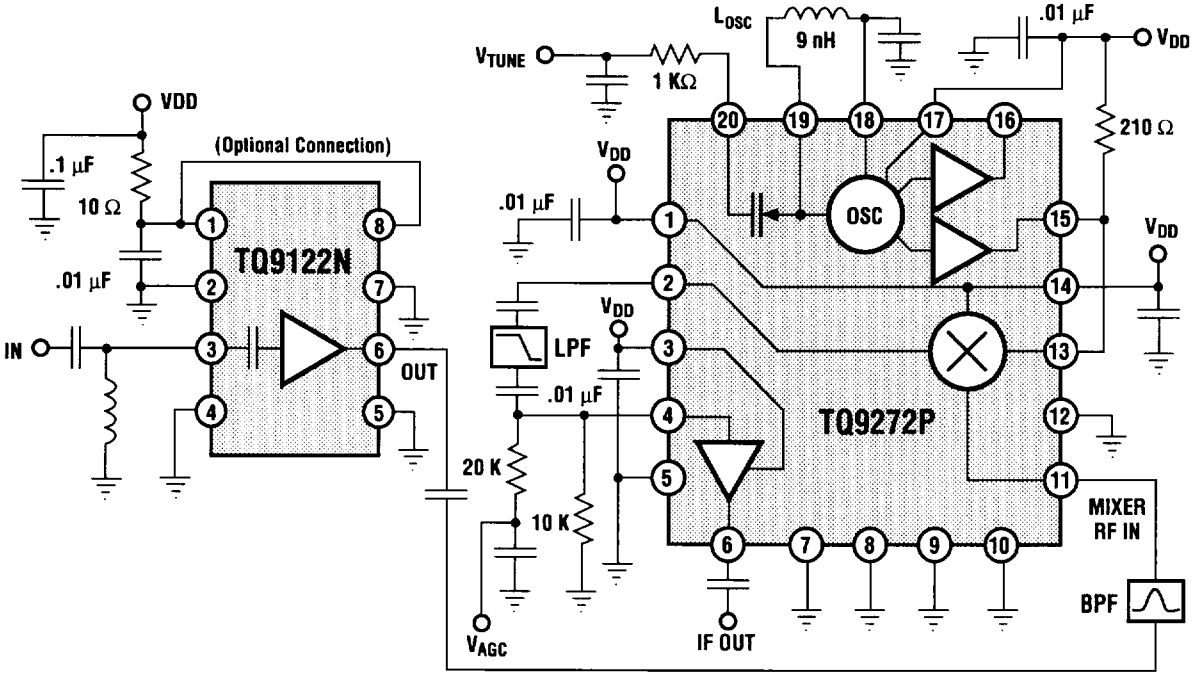
Pin Name	*Pin #*	*Description*
MIXER RF IN	11	Mixer signal input port. Nominally 50 Ω impedance and connected to LNA OUT through an image-stripping band pass filter to improve noise and spurious performance. No return to ground or DC blocking capacitors are required.
MIXER IF OUT	2	Buffered 50 Ω impedance. There is an internal DC block on this pin.
MIXER LO IN	13	Nominally 50 Ω impedance and can be connected directly to OSC OUT. There is an internal DC block on this pin.
MIXER VDD	1, 14	DC bias power for the Mixer section is required on this pin. Decouple with 0.01 µF within 0.25 inch of package.
IF IN/AGC	4	IF/AGC amplifier input. This input characteristic is similar to that of the TQ9114N. This pin requires a DC decoupling network to input both the AC signal from the Mixer output and the AGC voltage.
IF VDD	3	DC bias power for the IF/AGC amplifier section is required on this pin. It is mandatory that this pin be decoupled with a 0.01 µF capacitor within 0.25 inch of the package.
IF OUT	6	Output port from IF/AGC amplifier section. This output characteristic is similar to the TQ9114N. Enhanced output power and IP3 can be achieved with external load resistors. See TQ9114N data sheet.
OSC IND-	18	A shunt inductor between this and the OSC IND+ pin forms a resonator which centers the oscillator frequency.
OSC IND+	19	A minimum-length loop between these pins results in an oscillator frequency of about 1800 MKz. An inductor of 9 nH results in an oscillator frequency of about 1400 MHz.
VTUNE	20	Control voltage input for oscillator line frequency control. This input port requires a positive voltage and controls a voltage-variable capacitor in parallel with the external inductor. Decouple with a series 1 KΩ resistor and a shunt 50 pF capacitor.
OSC OUT1	15	Buffered Oscillator output 1. This is an open-drain amplifier stage which requires an external pull up supply to VDD. This bias may be either through a 200 Ω to 1 KΩ resistor or through an inductive choke.
OSC OUT2	16	Buffered Oscillator output 2. This is an identical and auxiliary output to OSC OUT1. An external pull-up resistor to VDD is required
GND	5, 7-10,12	Ground connection. Keep physically short for stability and performance.

Note: Refer to block diagram for pin locations.

TQ9272 Pinout



Application Circuit

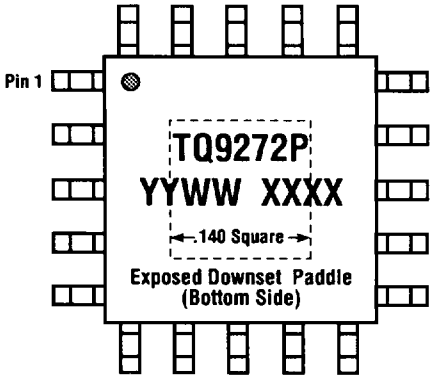


Absolute Maximum Ratings

	Symbol	Max.	Units
DC Power Supply	V_{DD}	8	V
Power Dissipation	P_D	1000	mW
Input Power (All Ports)	P_{IN}	+10	dBm
Storage Temperature	T_{STO}	-55 to +150	°C
Operating Temperature	T_{OPR}	-40 to + 85	°C

ESD-sensitive device - Class 1

20-Pin Plastic Package *(Top View)*



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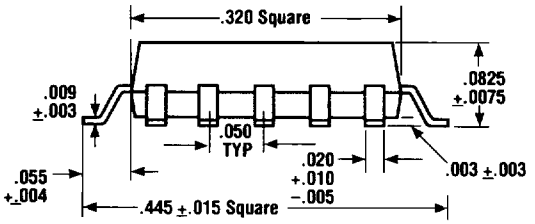
XXXX Lot Number



Material	
Lead	Copper
Lead Plating	Tin

Ordering Information

TQ9272__

PR - 1500 / 13" reel

P - Shipping tube

For more information contact nearest Sales Office or TriQuint's Customer Service Department:

Wireless Communications Division
3625A SW Murray Blvd.
Beaverton, OR 97005
(503) 644-3535 Fax: (503) 644-3198

TriQuint SEMICONDUCTOR