

3 V-BIAS, L-BAND SILICON DOWNCONVERTER IC FOR GPS RECEIVER AND WIRELESS COMMUNICATIONS

DESCRIPTION

μ PC2756T is a silicon monolithic integrated circuit designed as L-band downconverter. This L-band downconverter IC is suitable for GPS receiver and wireless communication systems. This IC consumes 6 mA from 3 V and is packaged in a 6 pin mini-mold. Thus, this IC contributes to make the system lower-consumption and physically-smaller.

The μ PC2756T is manufactured using NEC's 20 GHz μ NESAT™ III silicon bipolar process. This process uses silicon nitride passivation film and gold electrodes. These materials can protect the chip surface from external pollution and prevent corrosion/migration. Thus, this product has excellent performance, uniformity and reliability.

FEATURES

- Wide band operation: $f_{RF} = 0.1$ GHz to 2.0 GHz
- High-density surface mounting: 6 pin mini-mold
- Low Power-consumption: 3 V, 6 mA
- Suppressed spurious signals: double balanced mixer
- Equable output-impedance: single-end push-pull IF amplifier
- Equable temperature-drift oscillator: differential amplifier type oscillator

TYPICAL APPLICATIONS

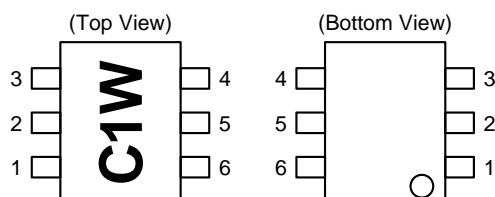
- GPS receiver
- Data carrier
- Wireless LAN

ORDERING INFORMATION

PART NUMBER	PACKAGE	SUPPLYING FORM	MARKING
μ PC2756T-E3	6 pin mini-mold	Embossed tape 8 mm wide. Pin 1, 2, 3 face to perforation side of the tape. QTY 3 kp/Reel.	C1W

* To order evaluation samples, please contact local NEC sales office. (Order number: μ PC2756T)

PIN CONNECTIONS



PIN No.	ASSIGNMENT
1	RF _{in}
2	GND
3	LO ₁
4	LO ₂
5	V _{CC}
6	IF _{out}

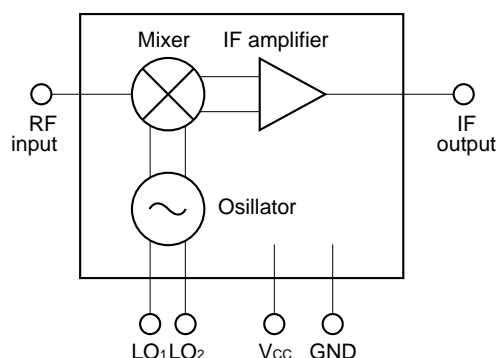
Caution: Electro-static sensitive devices

SELECTOR GUIDE ($T_A = +25\text{ }^{\circ}\text{C}$, $V_{CC} = 3.0\text{ V}$, $Z_L = Z_S = 50\text{ }\Omega$)

MAIN FEATURES		DEVICE NUMBER	V_{CC} (V)	I_{CC} (mA)	CG (dB)	NF (dB)	f_{RF} (GHz)	$P_{O(sat)}$ (dBm)
DOWNCONVERTER BUILT-IN Tr for VCO	5 V-bias type	μ PC2721GR	4.5 to 5.5	38	21	9	0.9 to 2.0	7
	3 V-bias type	μ PC2756T	2.7 to 3.3	6	14	10	0.1 to 2.0	-8

* Typical performance. Please refer to ELECTRICAL CHARACTERISTICS in detail.

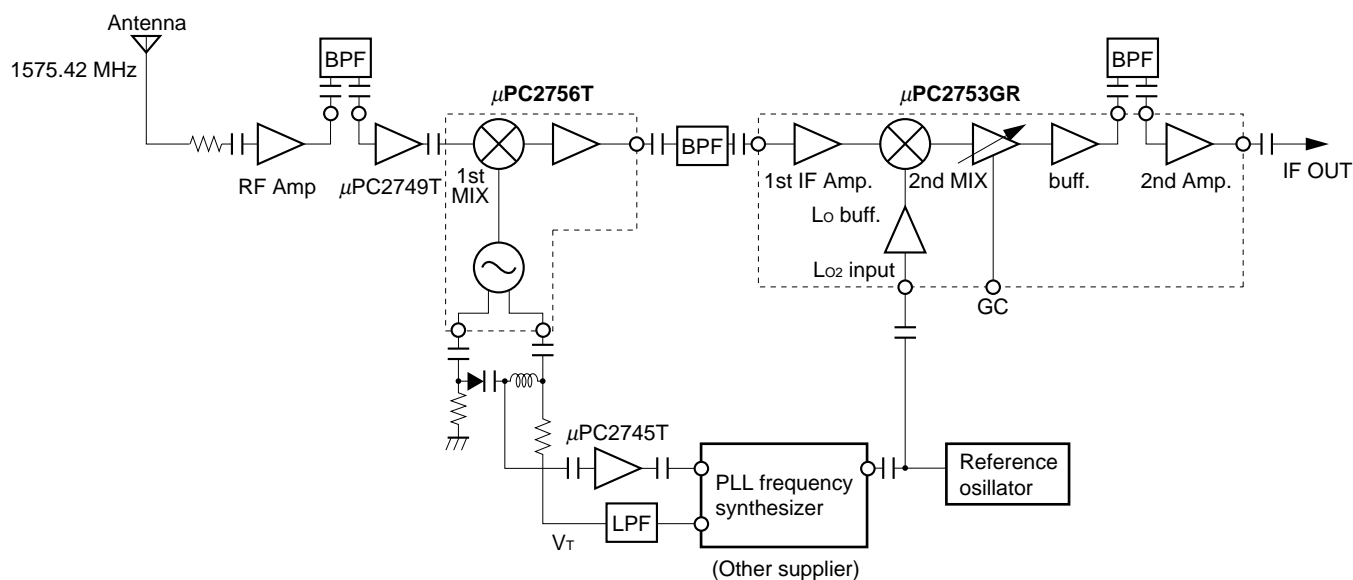
INTERNAL BLOCK DIAGRAM



Note Oscillator tank circuit must be externally attached to LO1 and LO2 pins.

TYPICAL APPLICATION EXAMPLE

— GPS receiver application —



Note This application example is intended to show only the product line-up schematically, not to present the application circuit in detail.

To know the detail in associated products, please refer to their latest data sheets.

PIN EXPLANATION

PIN NO.	SYMBOL	ASSIGNMENT	PIN VOLTAGE (V)	APPLIED VOLTAGE (V)	FUNCTION AND APPLICATION	EQUIVALENT CIRCUIT
1	RF _{in}	RF input	—	1.2	<p>This pin is RF input for mixer designed as double balance type.</p> <p>This circuit contributes to suppress spurious signal with minimum LO and bias power consumption.</p> <p>Also this symmetrical circuit can keep specified performance insensitive to process-condition distribution.</p> <p>This pin must be externally coupled with capacitor for DC cut.</p>	
2	GND	Ground	0	—	<p>Must be connected to the system ground with minimum inductance. Ground pattern on the board should be formed as wide as possible.</p> <p>(Track length should be kept as short as possible.)</p>	
3	LO ₁	Local oscillator base collector	—	1.2	<p>These pins are both base-collector of oscillator. This oscillator is designed as differential amplifier type.</p> <p>3 pin and 4 pin should be externally equipped with tank resonator circuit in order to oscillate with feedback loop.</p> <p>Also this symmetrical circuit can keep specified performance insensitive to process-condition distribution.</p> <p>Each pin must be externally coupled with capacitor for DC cut.</p>	
4	LO ₂	Local oscillator base collector	—	1.2		
5	V _{cc}	Power supply	2.7 to 3.3	—	<p>Supply voltage 3.0 ± 0.3 V for operation. Must be connected bypass capacitor (e.g. 1 000 pF) to minimize ground impedance.</p>	
6	IF out	IF output	—	1.7	<p>This pin is output from IF buffer amplifier designed as single-ended push-pull type.</p> <p>This pin is assigned for emitter follower output with Low-impedance.</p> <p>This pin must be externally coupled with capacitor for DC cut.</p>	

ABSOLUTE MAXIMUM RATINGS

PARAMETER	SYMBOL	RATING	UNIT	CONDITIONS
Supply voltage	V _{CC}	5.5	V	T _A = +25 °C
Power Dissipation	P _D	280	mW	Mounted on 50 × 50 × 1.6 mm double copper clad epoxy glass board at T _A = +85 °C
Operating temperature	T _{opt}	−40 to +85	°C	
Storage temperature	T _{stg}	−55 to +150	°C	

RECOMMENDED OPERATING RANGE

PARAMETER	SYMBOL	MIN.	TYP.	MAX.	UNIT
Supply voltage	V _{CC}	2.7	3.0	3.3	V
Operating temperature	T _{opt}	−40	+25	+85	°C

ELECTRICAL CHARACTERISTICS (T_A = +25 °C, V_{CC} = 3.0 V, Z_L = Z_s = 50 Ω, Test circuit)

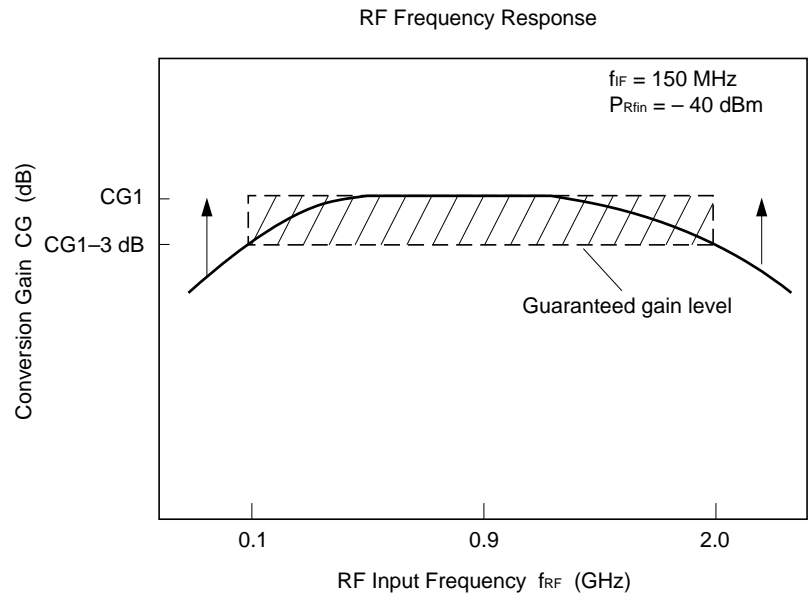
PARAMETER	SYMBOL	MIN.	TYP.	MAX.	UNIT	CONDITIONS
Circuit Current	I _{CC}	3.5	6.0	8.0	mA	No input signals
RF Frequency Response	f _{RF}	0.1	–	2.0	GHz	CG ≥ (CG1 −3 dB) f _{IF} = 150 MHz constant
IF Frequency Response	f _{IF}	10	–	300	MHz	CG ≥ (CG1 −3 dB) f _{RF} = 0.9 GHz constant
Conversion Gain 1	CG1	11	14	17	dB	f _{RF} = 0.9 GHz, f _{IF} = 150 MHz P _{RFIn} = −40 dBm
Conversion Gain 2	CG2	11	14	17	dB	f _{RF} = 1.6 GHz, f _{IF} = 20 MHz P _{RFIn} = −40 dBm
Single sideband Noise Figure 1	NF1	–	10	13	dB	f _{RF} = 0.9 GHz, f _{IF} = 150 MHz
Single sideband Noise Figure 2	NF2	–	13	16	dB	f _{RF} = 1.6 GHz, f _{IF} = 20 MHz
Maximum IF Output Level 1	P _{O(SAT) 1}	−11	−8	–	dBm	f _{RF} = 0.9 GHz, f _{IF} = 150 MHz P _{RFIn} = −10 dBm
Maximum IF Output Level 2	P _{O(SAT) 2}	−15	−12	–	dBm	f _{RF} = 1.6 GHz, f _{IF} = 20 MHz P _{RFIn} = −10 dBm

STANDARD CHARACTERISTICS FOR REFERENCE (Unless otherwise specified; T_A = +25 °C, V_{CC} = 3.0 V, Z_L = Z_s = 50 Ω)

PARAMETER	SYMBOL	REFERENCE	UNIT	CONDITIONS
Output 3rd order intercept point	OIP ₃	+4	dBm	f _{RF} = 0.8 to 2.0 GHz, f _{IF} = 0.1 GHz, Cross point IP.
Phase Noise	PN	−68	dBc/Hz	f _{OSC} = 1.9 GHz*
LO leakage at RF pin	LO _{rf}	−35	dB	f _{RF} = 0.8 to 2.0 GHz
LO leakage at IF pin	LO _{if}	−23	dB	f _{RF} = 0.8 to 2.0 GHz
Maximum oscillating frequency	f _{OSCMAX}	2.2	GHz	VaractorDi : 1SV210, L : 7 nH*

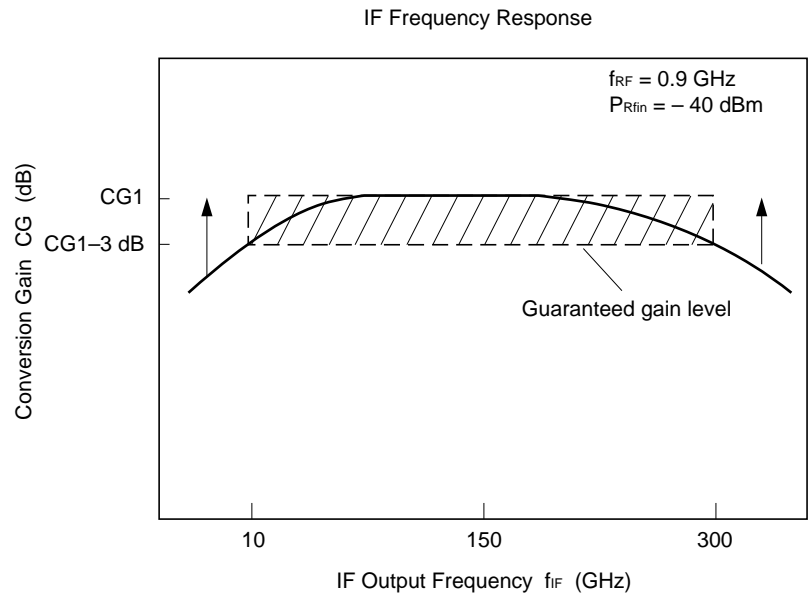
* Application circuit example (refer to page 7)

SCHEMATIC SUPPLEMENT FOR RF, IF SPECIFICATIONS



Note:

	MIN.	TYP.	MAX.	UNIT
CG1	11	14	17	dB
CG1 - 3 dB	8	11	14	dB



TEST CIRCUIT

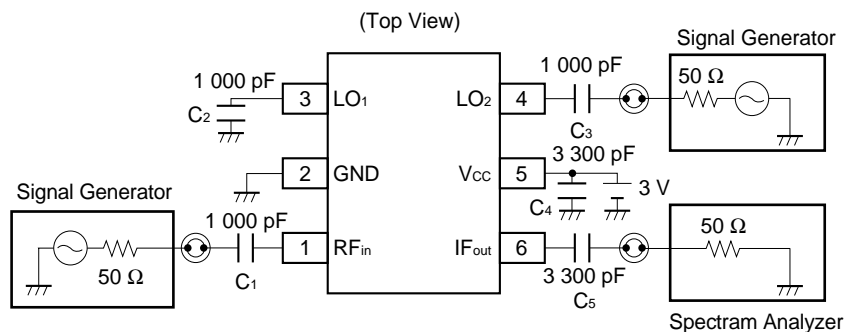
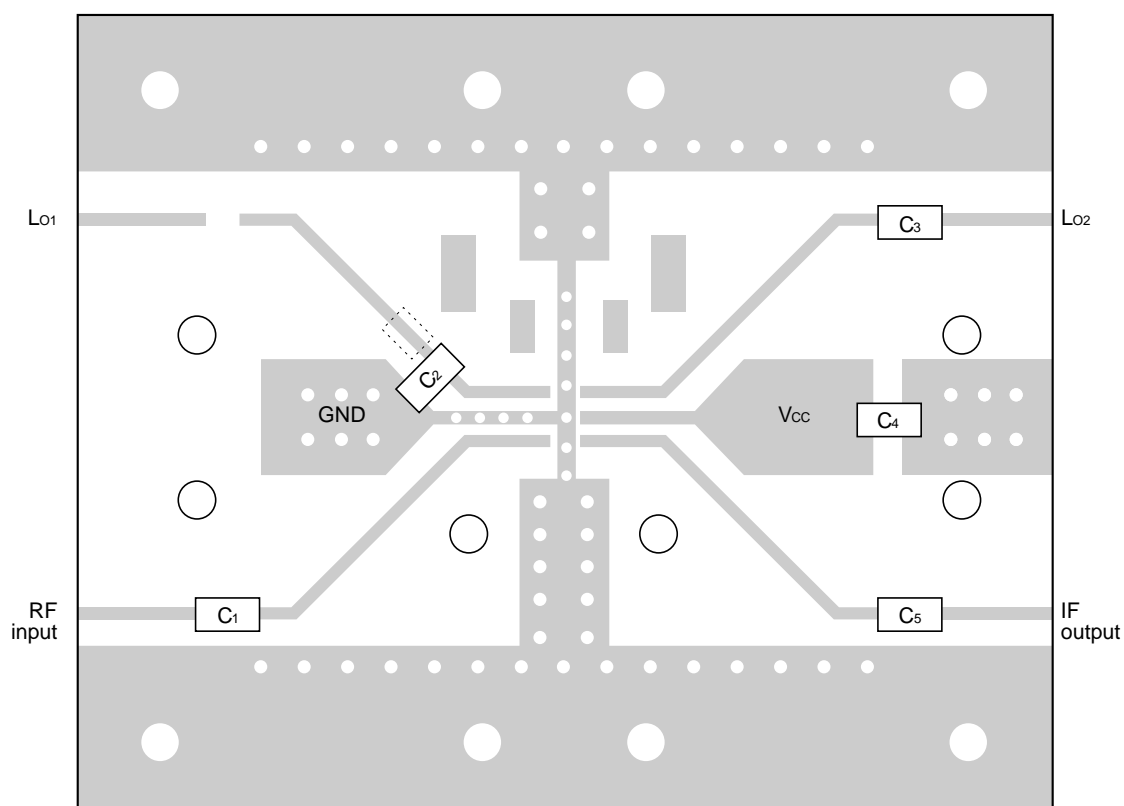


ILLUSTRATION OF THE TEST CIRCUIT ASSEMBLED ON EVALUATION BOARD



COMPONENT LIST

No.	Value
C1 to 3	1 000 pF
C4 to 5	3 300 pF

Note

- (1) $35 \times 42 \times 0.4$ mm double copper clad polyimide board.
- (2) Back side: GND pattern
- (3) Solder plated on pattern
- (4) \circ : Through holes
- (5) pattern should be removed on this testing.

APPLICATION CIRCUIT EXAMPLE

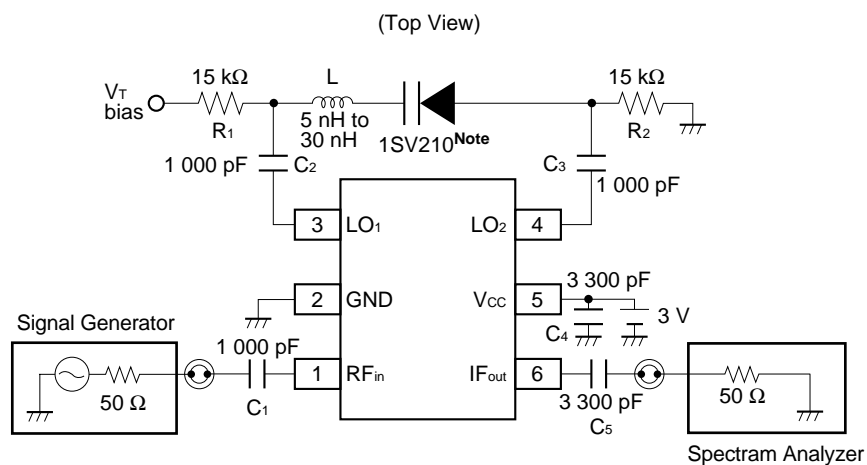
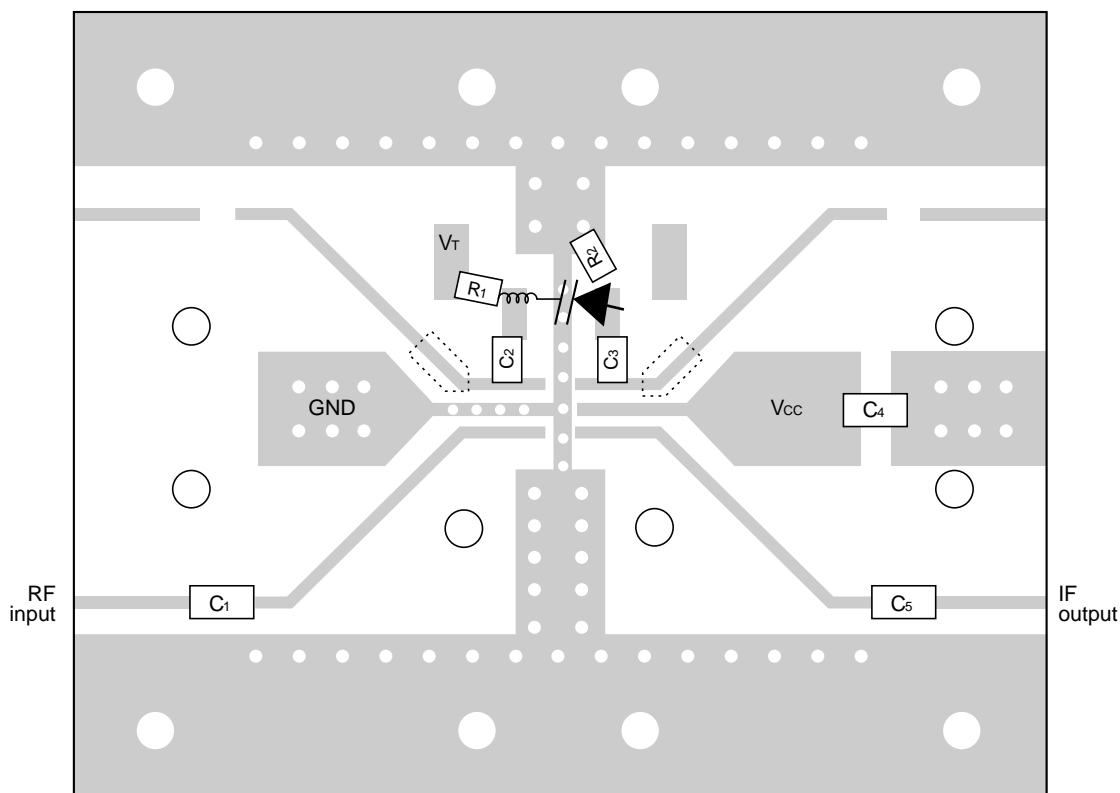


ILLUSTRATION OF THE APPLICATION CIRCUIT ASSEMBLED ON EVALUATION BOARD



COMPONENT LIST

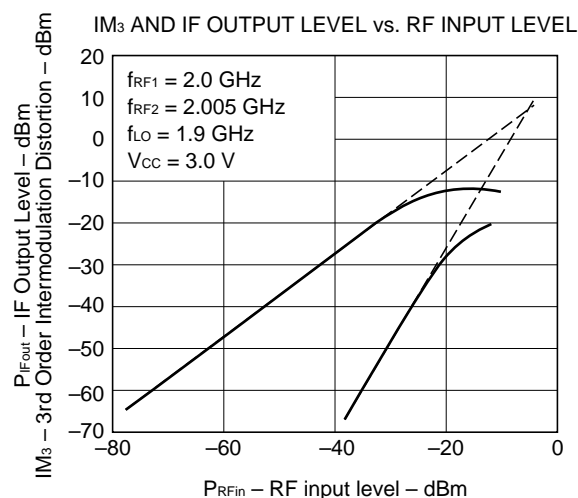
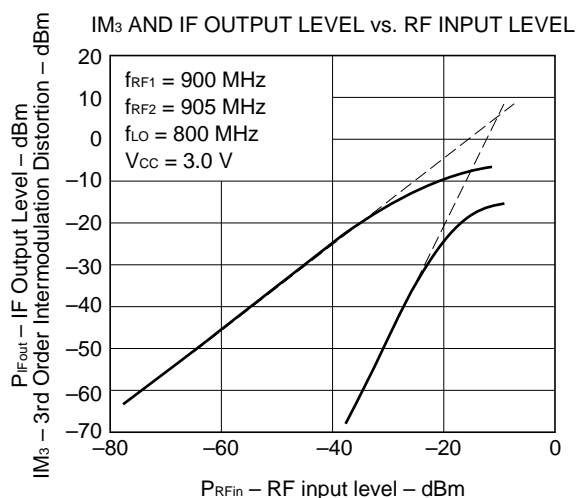
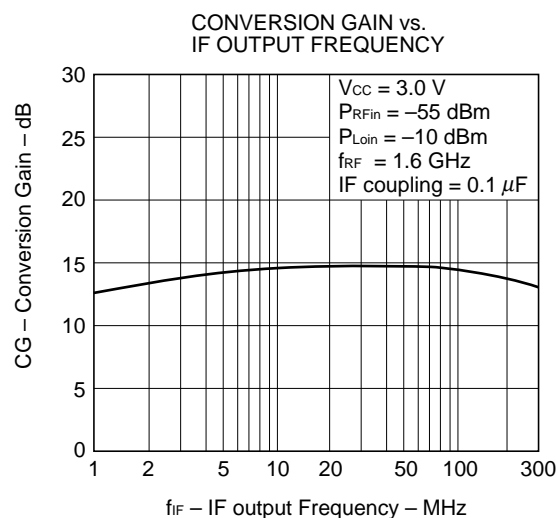
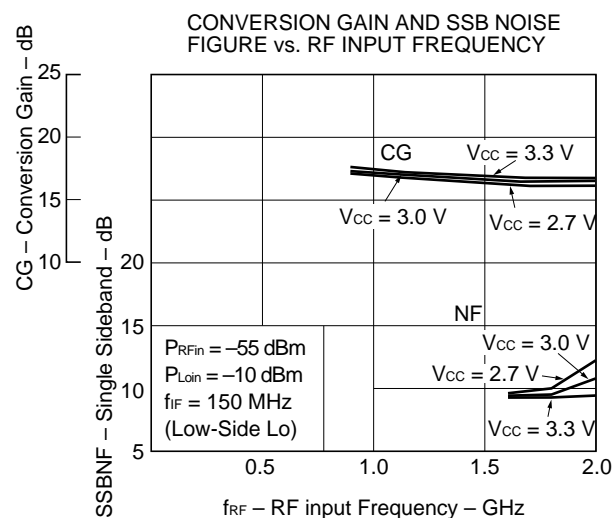
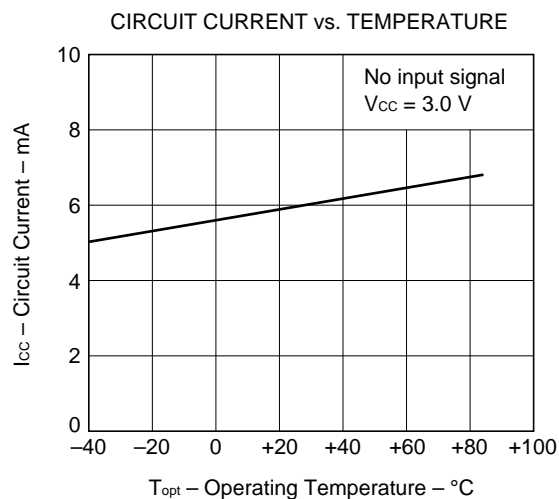
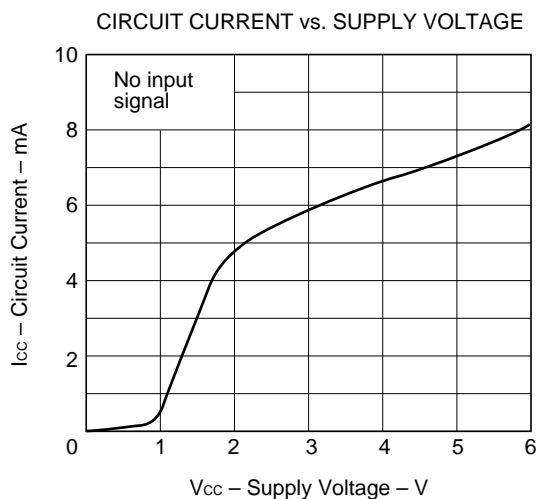
No.	Value
C ₁ to 3	1 000 pF
C ₄ to 5	3 300 pF
R ₁ to 2	15 k Ω
L	5 nH to 30 nH
1SV210	—

Note

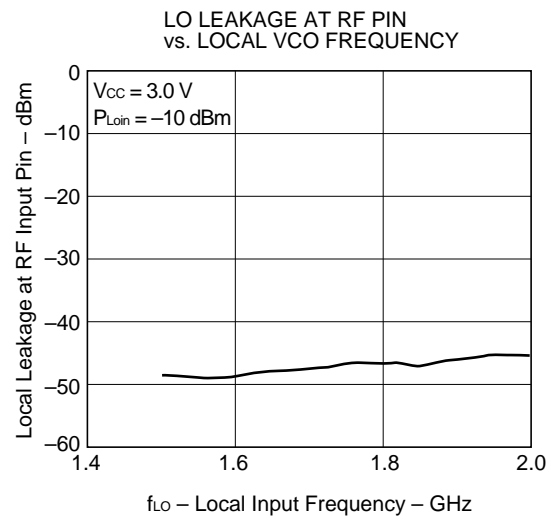
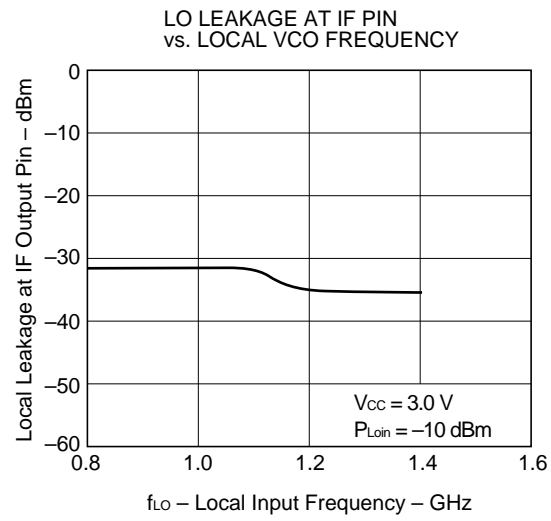
- (1) 35 × 42 × 0.4 mm double copper clad polyimide board.
- (2) Back side: GND pattern
- (3) Solder plated on pattern
- (4) ○ : Through holes
- (5) pattern should be removed on this application.

TYPICAL CHARACTERISTICS (T_A = +25 °C)

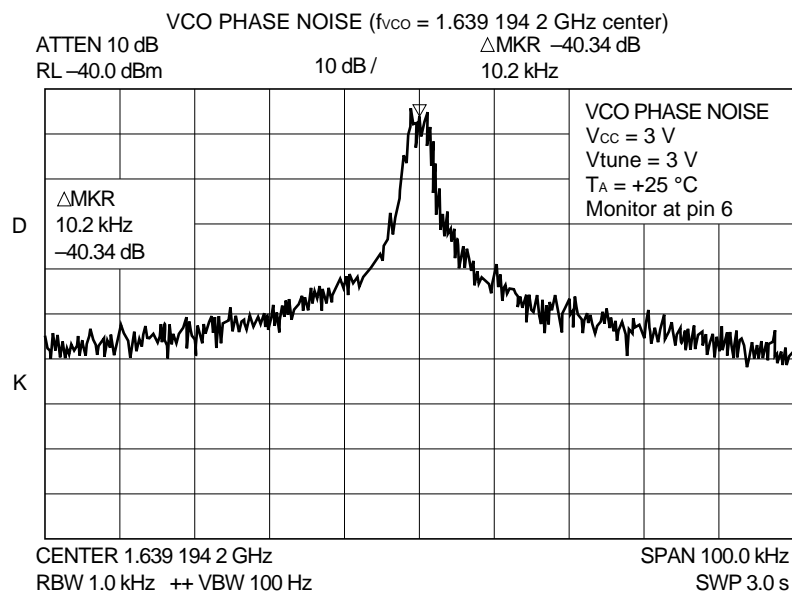
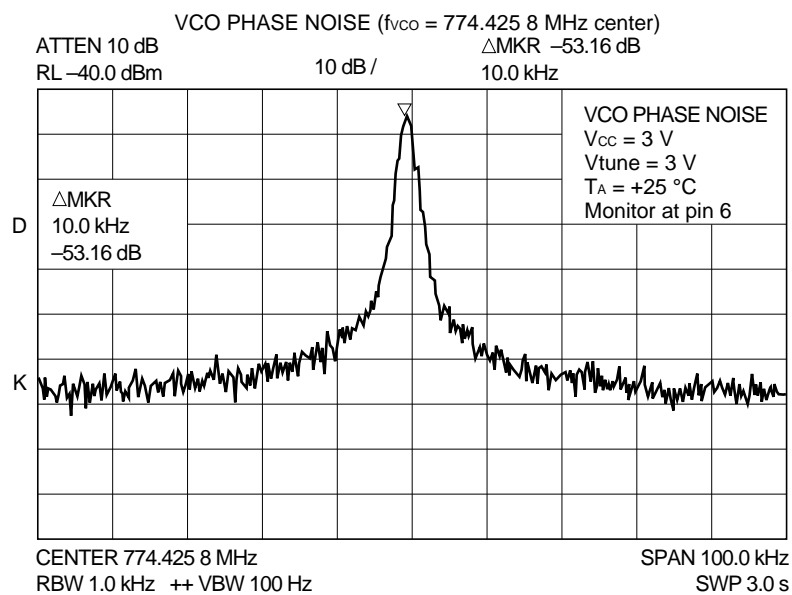
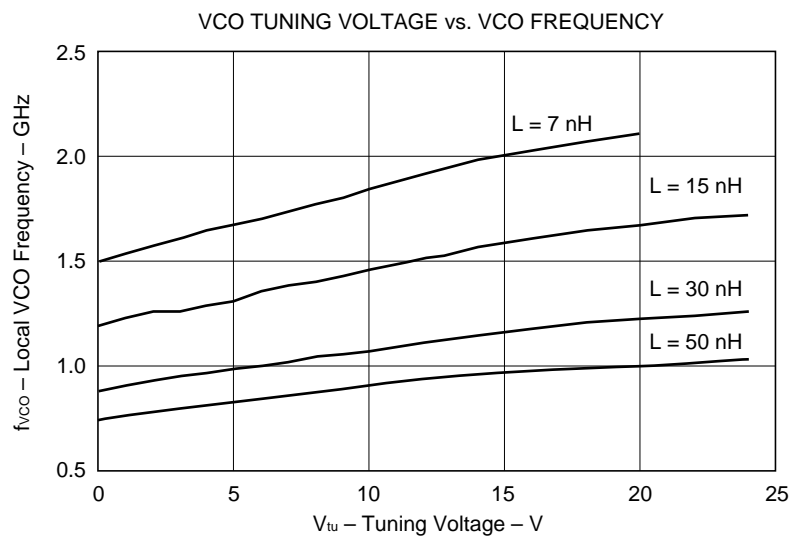
– ON THE TEST CIRCUIT –



– ON THE TEST CIRCUIT –



– ON THE APPLICATION CIRCUIT –



S PARAMETER – μ PC2756T – ON THE PIN OF D.U.T. –

RF port

$V_{CC} = 3.0\text{ V}$

△ 1 : 100 MHz $330.7\ \Omega - j\ 861.6\ \Omega$

△ 2 : 500 MHz $38.8\ \Omega - j\ 194.3\ \Omega$

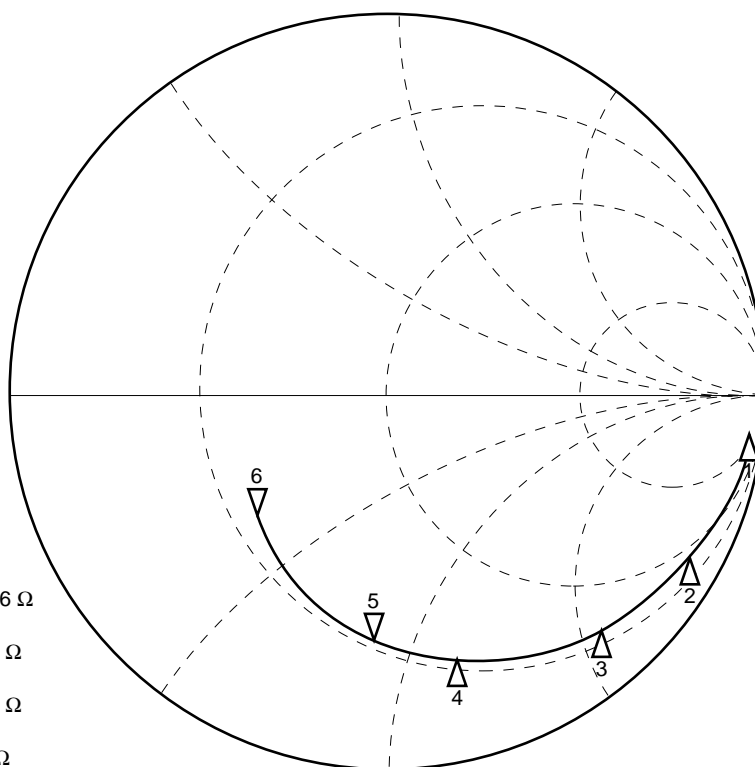
△ 3 : 900 MHz $25.5\ \Omega - j\ 107.6\ \Omega$

△ 4 : 1500 MHz $20.5\ \Omega - j\ 60.7\ \Omega$

△ 5 : 1900 MHz $17.9\ \Omega - j\ 44.2\ \Omega$

△ 6 : 3000 MHz $19.5\ \Omega - j\ 16.3\ \Omega$

START 0.100000000 GHz
STOP 3.000000000 GHz



IF port

$V_{CC} = 3.0\text{ V}$

△ 1 : 50 MHz $21.4\ \Omega + j\ 2.4\ \Omega$

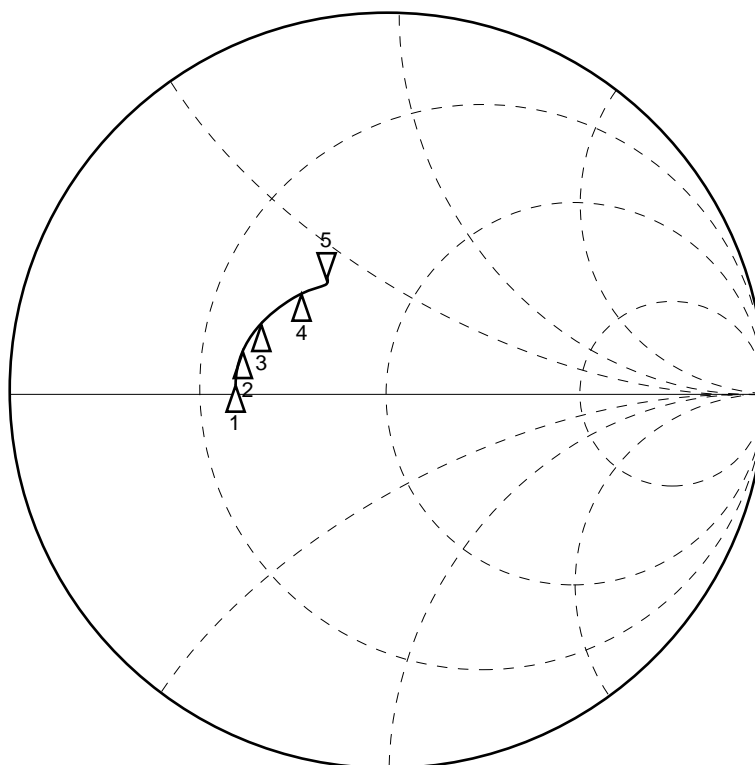
△ 2 : 80 MHz $21.8\ \Omega + j\ 5.5\ \Omega$

△ 3 : 130 MHz $23.1\ \Omega + j\ 9.4\ \Omega$

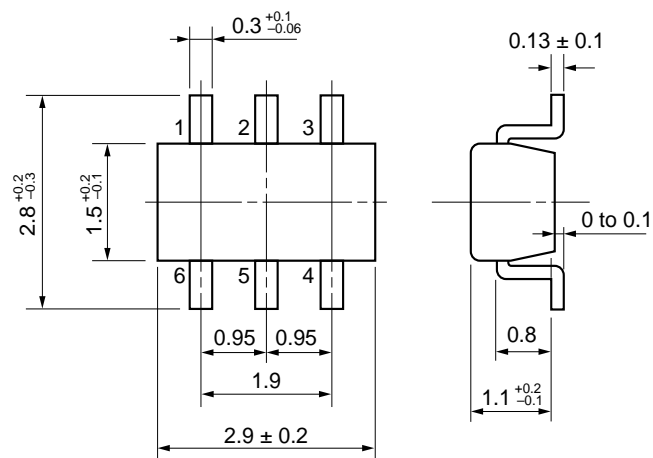
△ 4 : 240 MHz $27.4\ \Omega + j\ 16.3\ \Omega$

△ 5 : 300 MHz $30.6\ \Omega + j\ 19.1\ \Omega$

START 0.050000000 GHz
STOP 0.300000000 GHz



6 PIN MINI MOLD PACKAGE DIMENSIONS (Unit: mm)



NOTE ON CORRECT USE

- (1) Observe precautions for handling because of electro-static sensitive devices.
- (2) Form a ground pattern as wide as possible to minimize ground impedance (to prevent abnormal oscillation).
- (3) Keep the track length of the ground pins as short as possible.
- (4) Connect a bypass capacitor (e.g. 1 000 pF) to the V_{CC} pin.
- (5) To construct oscillator, tank circuit must be externally attached to pin 3 and 4.

RECOMMENDED SOLDERING CONDITIONS

This product should be soldered in the following recommended conditions. Other soldering methods and conditions than the recommended conditions are to be consulted with our sales representatives.

μPC2756T

Soldering method	Soldering conditions	Recommended condition symbol
Infrared ray reflow	Package peak temperature: 235 °C, Hour: within 30 s. (more than 210 °C), Time: 2 time, Limited days: no.*	IR35-00-2
VPS	Package peak temperature: 215 °C, Hour: within 40 s. (more than 200 °C), Time: 2 time, Limited days: no.*	VP15-00-2
Wave soldering	Soldering tub temperature: less than 260 °C, Hour: within 10 s. Time: 1 time, Limited days: no.	WS60-00-1
Pin part heating	Pin area temperature: less than 300 °C, Hour: within 3 s/pin. Limited days: no.*	

*: It is the storage days after opening a dry pack, the storage conditions are 25 °C, less than 65 % RH.

Note 1. The combined use of soldering method is to be avoided (However, except the pin area heating method).

For details of recommended soldering conditions for surface mounting, refer to information document SEMICONDUCTOR DEVICE MOUNTING TECHNOLOGY MANUAL (IEI-1207).

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Standard: Computers, office equipment, communications equipment, test and measurement equipment, audio and visual equipment, home electronic appliances, machine tools, personal electronic equipment and industrial robots

Special: Transportation equipment (automobiles, trains, ships, etc.), traffic control systems, anti-disaster systems, anti-crime systems, safety equipment and medical equipment (not specifically designed for life support)

Specific: Aircrafts, aerospace equipment, submersible repeaters, nuclear reactor control systems, life support systems or medical equipment for life support, etc.

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