NEC

BIPOLAR ANALOG INTEGRATED CIRCUIT

μPC2756T

3 V-BIAS, L-BAND SILICON DOWNCONVERTER IC FOR GPS RECEIVER AND WIRESLESS COMMNUNICATIONS

DESCRIPTION

μPC2756T 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 μPC2756T is manufactured using NEC's 20 GHz f_T 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

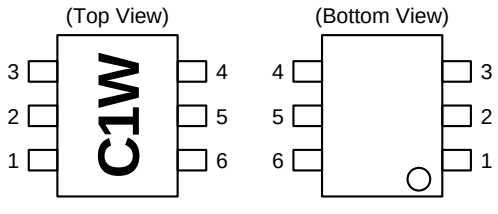
- GPS receiver
- Data carrier
- Wireless LAN

ORDERING INFORMATION

PART NUMBER	PACKAGE	SUPPLYING FORM	MARKING
μPC2756T-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: μPC2756T)

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

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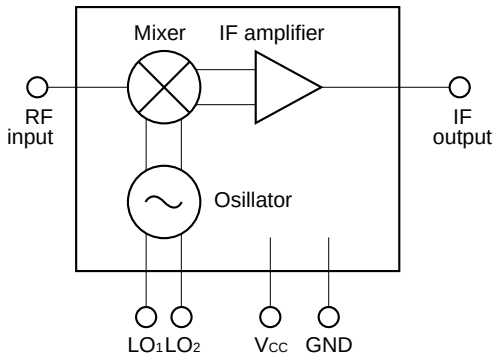
SELECTOR GUIDE (T_A = +25 °C, V_{CC} = 3.0 V, Z_L = Z_S = 50 Ω)

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	μPC2721GR	4.5 to 5.5	38	21	9	0.9 to 2.0	7
	3 V-bias type	μPC2756T	2.7 to 3.3	6	14	10	0.1 to 2.0	–8

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

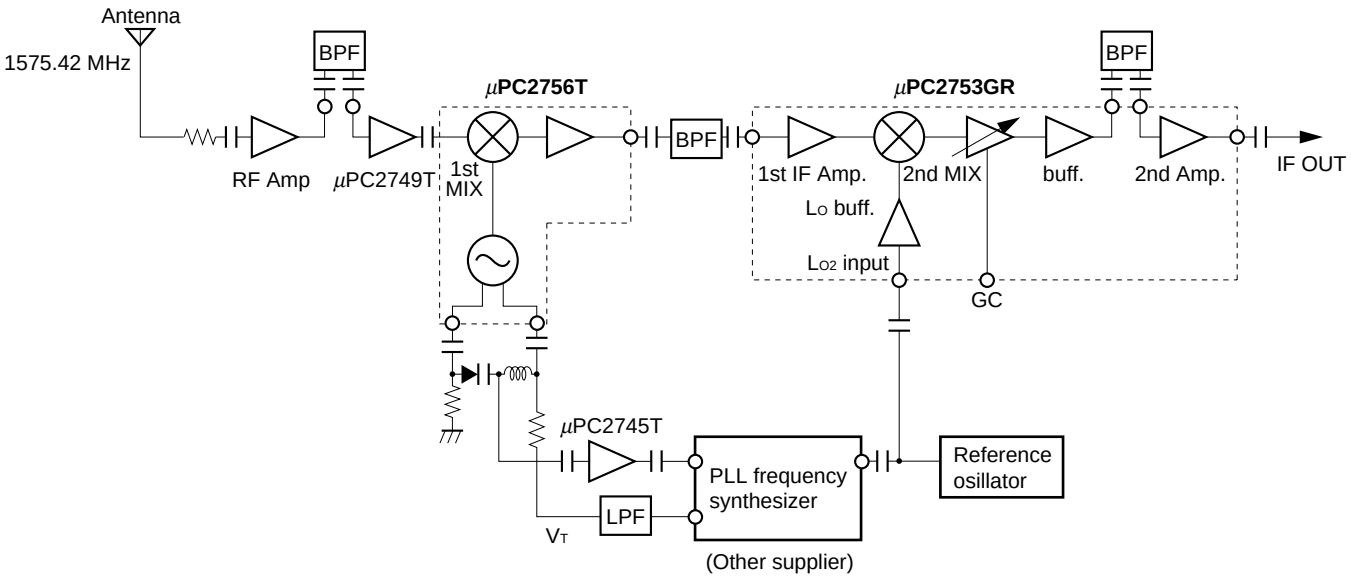
INTERNAL BLOCK DIAGRAM



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

TYPICAL APPLICATION EXAMPLE

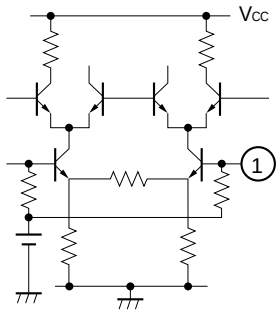
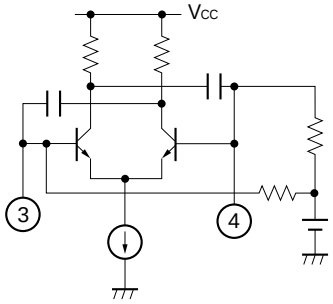
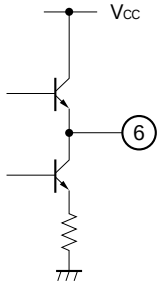
— GPS receiver application —



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	This pin is RF input for mixer designed as double balance type. This circuit contributes to suppress spurious signal with minimum LO and bias power consumption. Also this symmetrical circuit can keep specified performance insensitive to process-condition distribution. This pin must be externally coupled with capacitor for DC cut.	
2	GND	Ground	0	–	Must be connected to the system ground with minimum inductance. Ground pattern on the board should be formed as wide as possible. (Track length should be kept as short as possible.)	
3	LO_1	Local oscillator base collector	–	1.2	These pins are both base-collector of oscillator. This oscillator is designed as differential amplifier type. 3 pin and 4 pin should be externally equipped with tank resonator circuit in order to oscillate with feedback loop. Also this symmetrical circuit can keep specified performance insensitive to process-condition distribution. Each pin must be externally coupled with capacitor for DC cut.	
4	LO_2	Local oscillator base collector	–	1.2		
5	Vcc	Power supply	2.7 to 3.3	–	Supply voltage 3.0 ± 0.3 V for operation. Must be connected bypass capacitor (e.g. 1 000 pF) to minimize ground impedance.	
6	IF out	IF output	–	1.7	This pin is output from IF buffer amplifier designed as single-ended push-pull type. This pin is assigned for emitter follower output with Low-impedance. This pin must be externally coupled with capacitor for DC cut.	

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

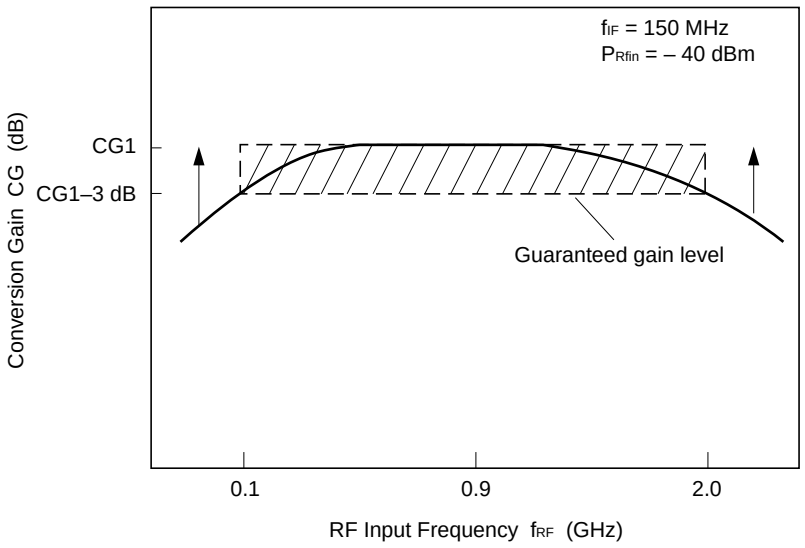
STANDARD CHARACTERISTICS FOR REFERENCE (Unless otherwise specified; T_A = +25 °C, V_{CC} = 3.0 V, Z_L = Z_S = 50 Ω)

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 lekage 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

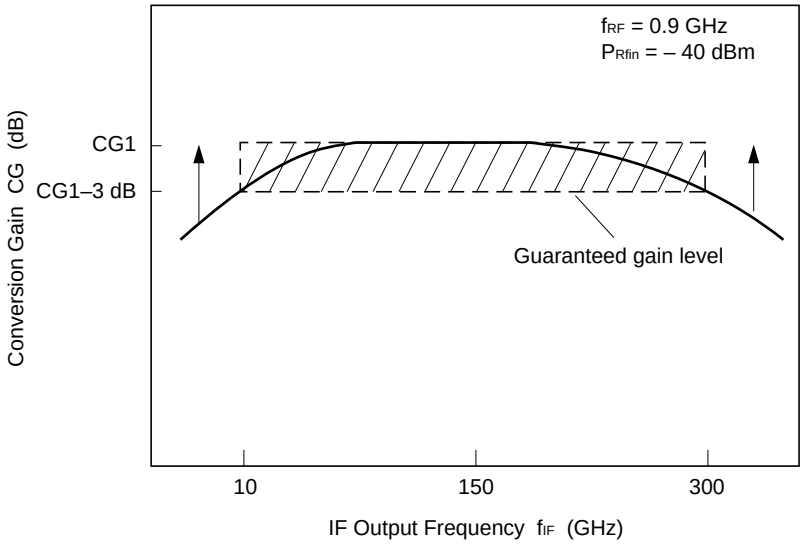
RF Frequency Response



Note:

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

IF Frequency Response



TEST CIRCUIT

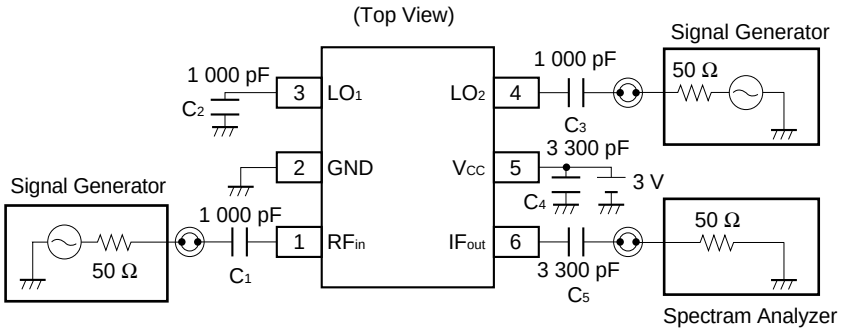
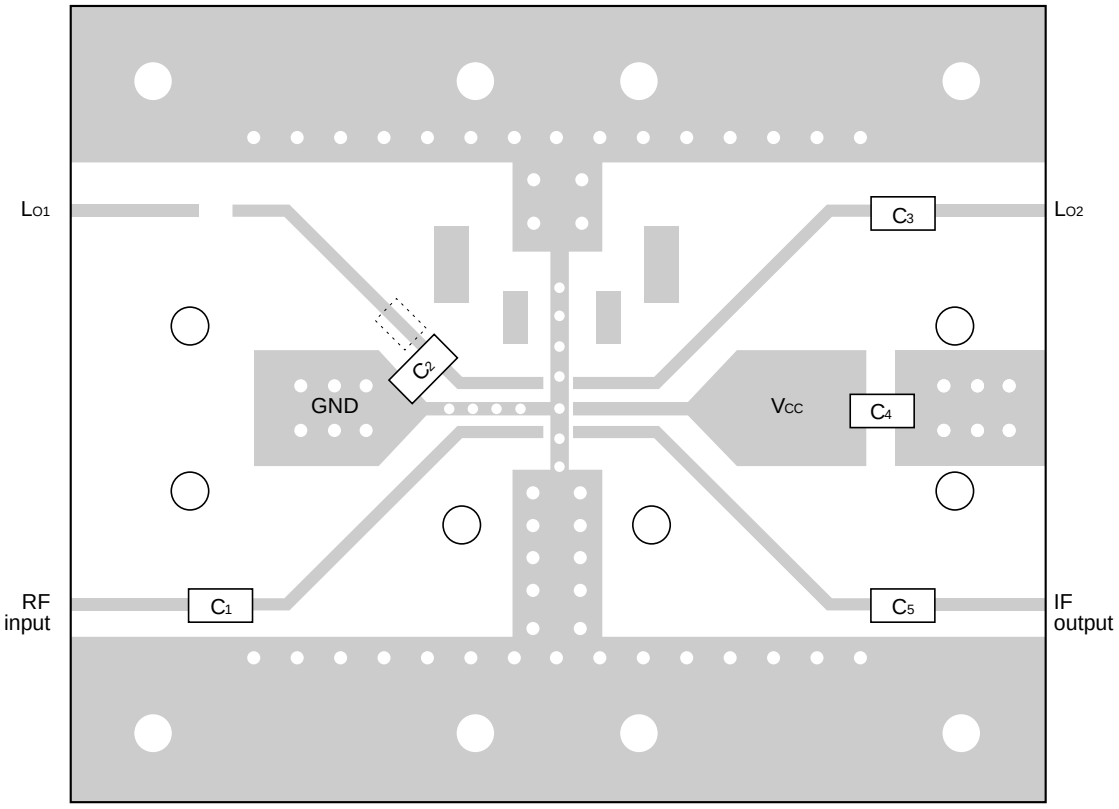


ILLUSTRATION OF THE TEST CIRCUIT ASSEMBLED ON EVALUATION BOARD



COMPONENT LIST

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

Note

(1) 35 × 42 × 0.4 mm double copper clad polyimide board.

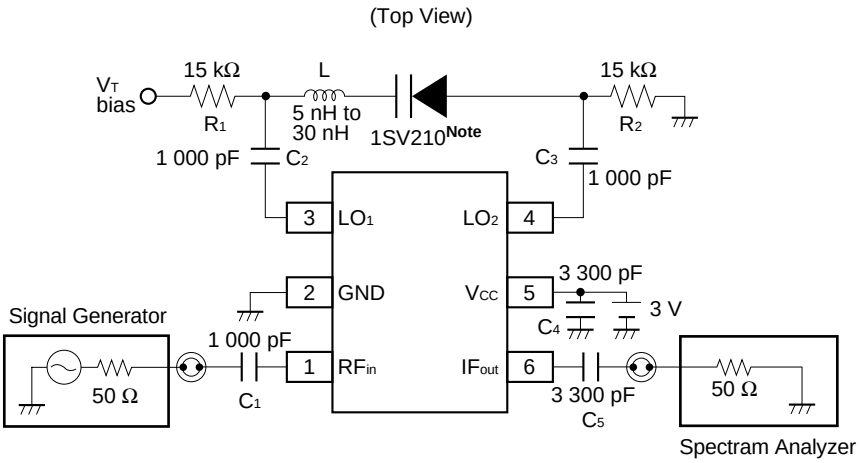
(2) Back side: GND pattern

(3) Solder plated on pattern

(4) ○◯ : Through holes

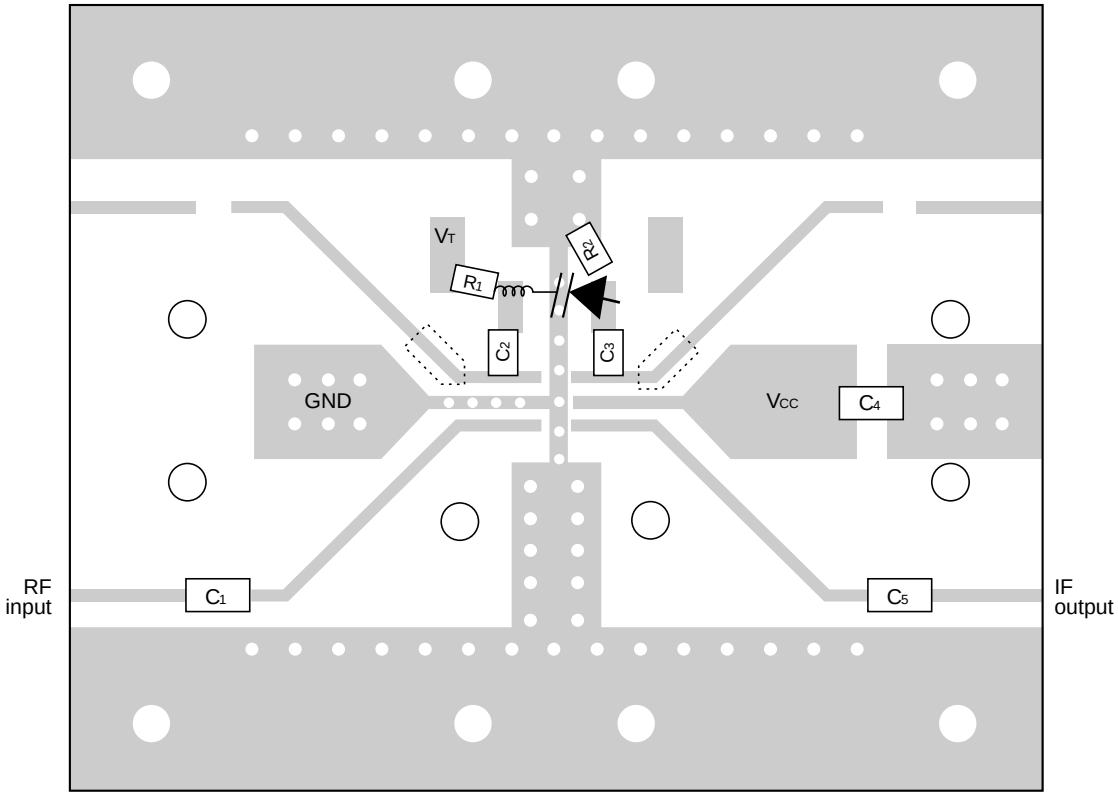
(5) ⬚ pattern should be removed on this testing.

APPLICATION CIRCUIT EXAMPLE



Note Our varactor diodes will be discontinued. For varactor diode, contact other supplier.

ILLUSTRATION OF THE APPLICATION CIRCUIT ASSEMBLED ON EVALUATION BOARD



COMPONENT LIST

No.	Value
$C_{1 \text{ to } 3}$	1 000 pF
$C_{4 \text{ to } 5}$	3 300 pF
$R_{1 \text{ to } 2}$	15 kΩ
L	5 nH to 30 nH
1SV210	———

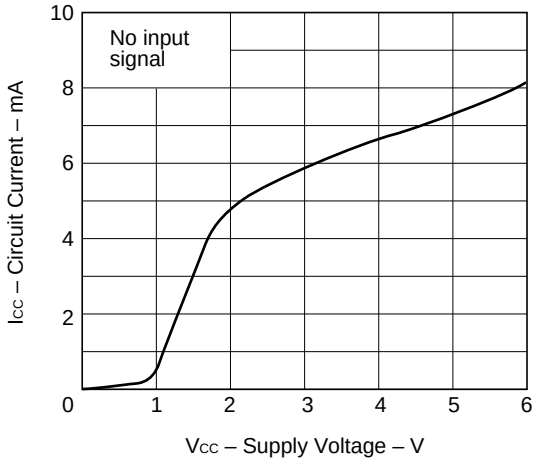
Note

(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.

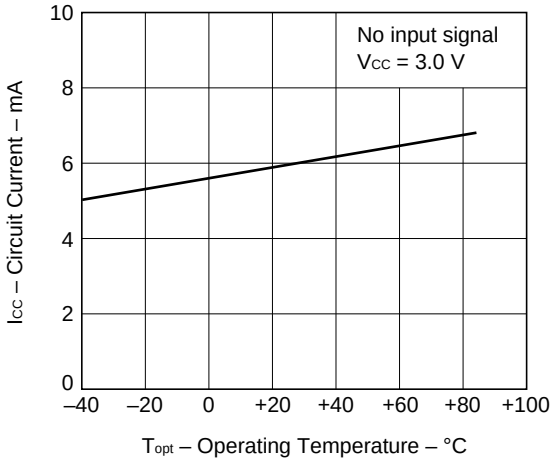
TYPICAL CHARACTERISTICS (T_A = +25 °C)

– ON THE TEST CIRCUIT –

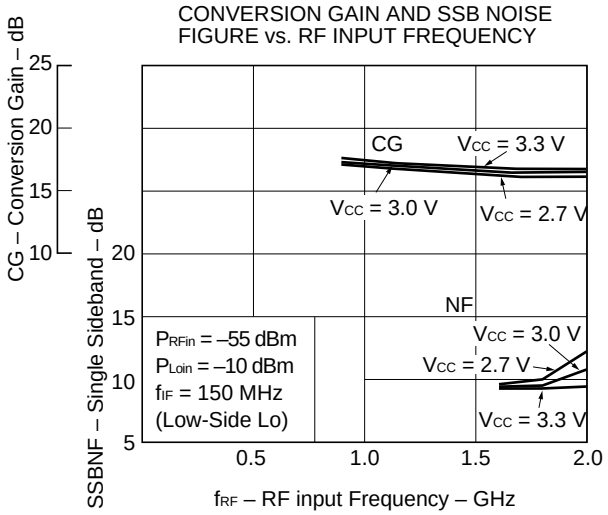
CIRCUIT CURRENT vs. SUPPLY VOLTAGE



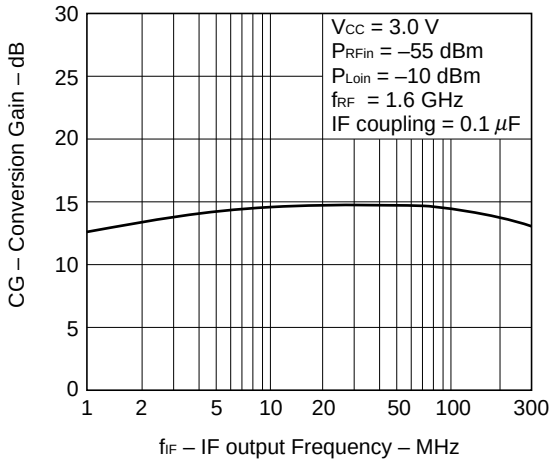
CIRCUIT CURRENT vs. TEMPERATURE



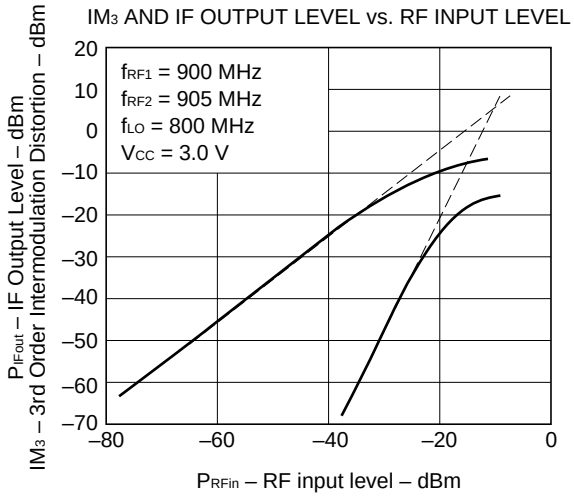
CONVERSION GAIN AND SSB NOISE FIGURE vs. RF INPUT FREQUENCY



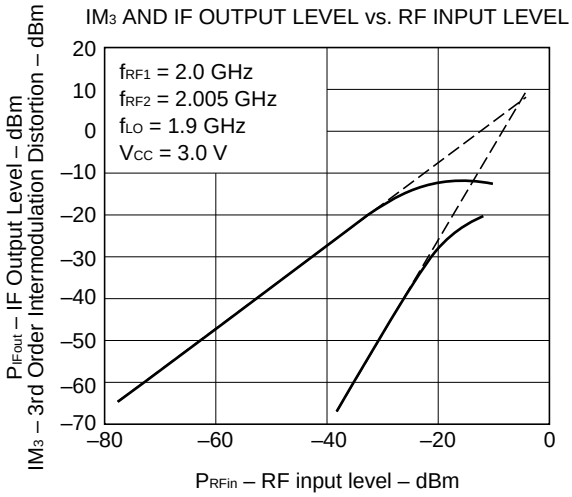
CONVERSION GAIN vs. IF OUTPUT FREQUENCY



IM3 AND IF OUTPUT LEVEL vs. RF INPUT LEVEL

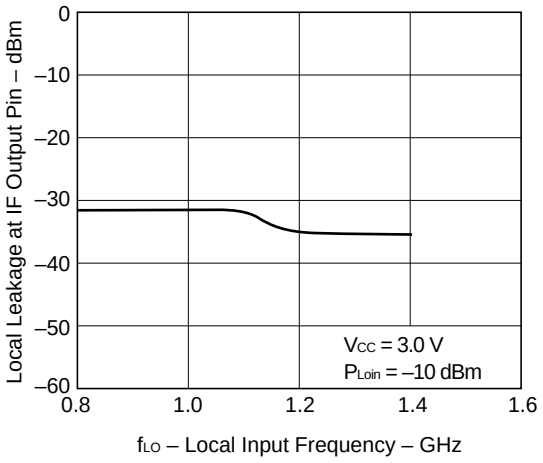


IM3 AND IF OUTPUT LEVEL vs. RF INPUT LEVEL

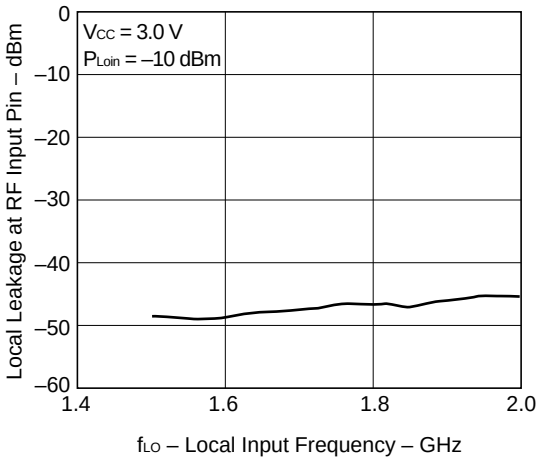


– ON THE TEST CIRCUIT –

LO LEAKAGE AT IF PIN
vs. LOCAL VCO FREQUENCY

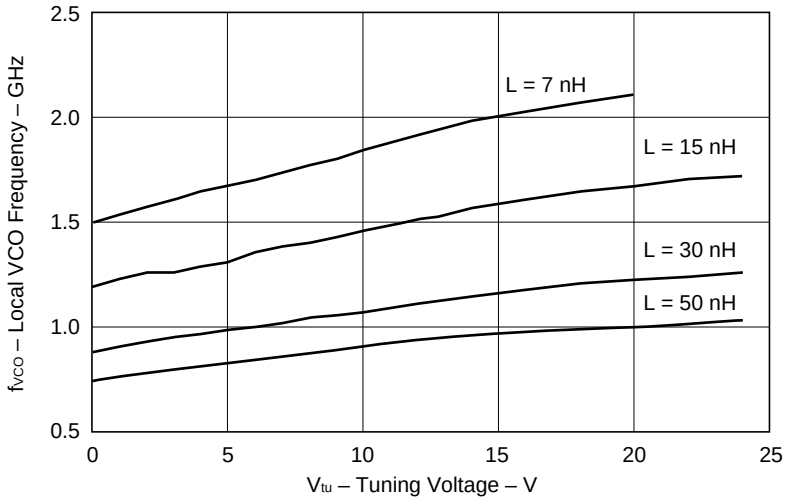


LO LEAKAGE AT RF PIN
vs. LOCAL VCO FREQUENCY

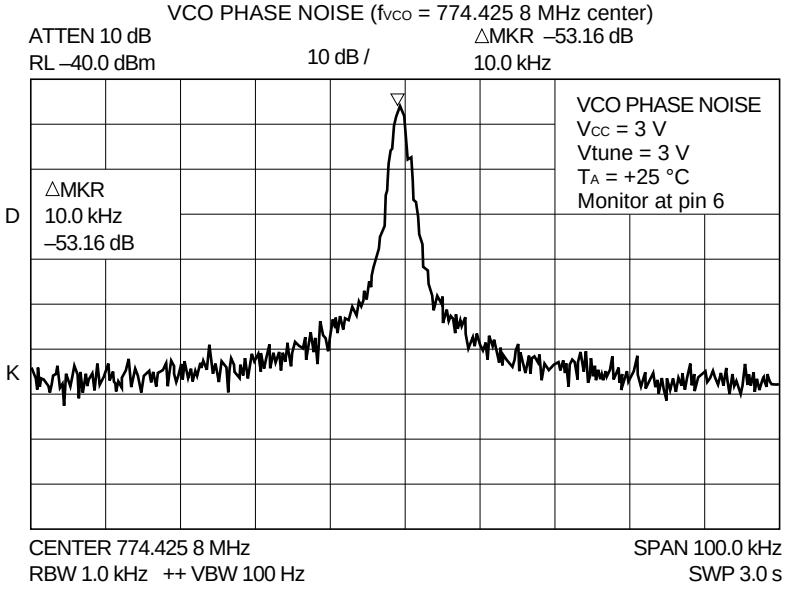


– ON THE APPLICATION CIRTCUIT –

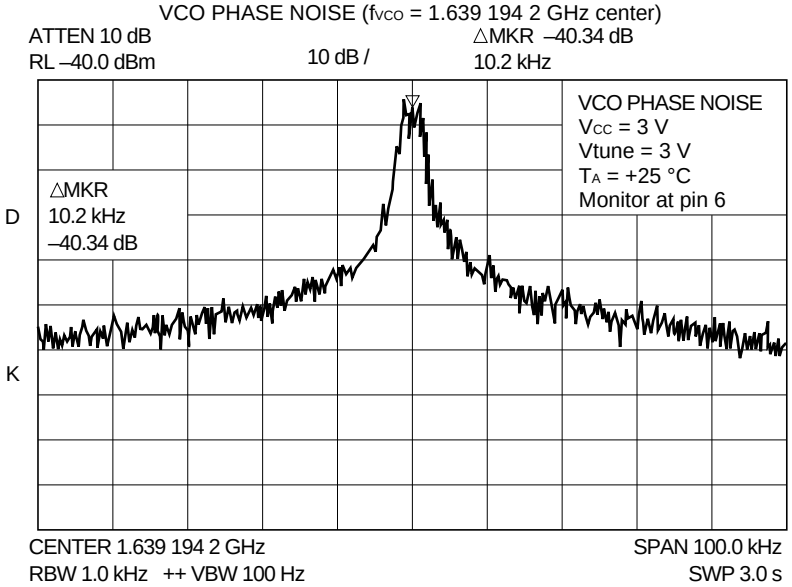
VCO TUNING VOLTAGE vs. VCO FREQUENCY



VCO PHASE NOISE (f_{VCO} = 774.425 8 MHz center)



VCO PHASE NOISE (f_{VCO} = 1.639 194 2 GHz center)



S PARAMETER – μPC2756T – ON THE PIN OF D.U.T. –

RF port

V_{CC} = 3.0 V

△ 1 : 100 MHz 330.7 Ω – j 861.6 Ω

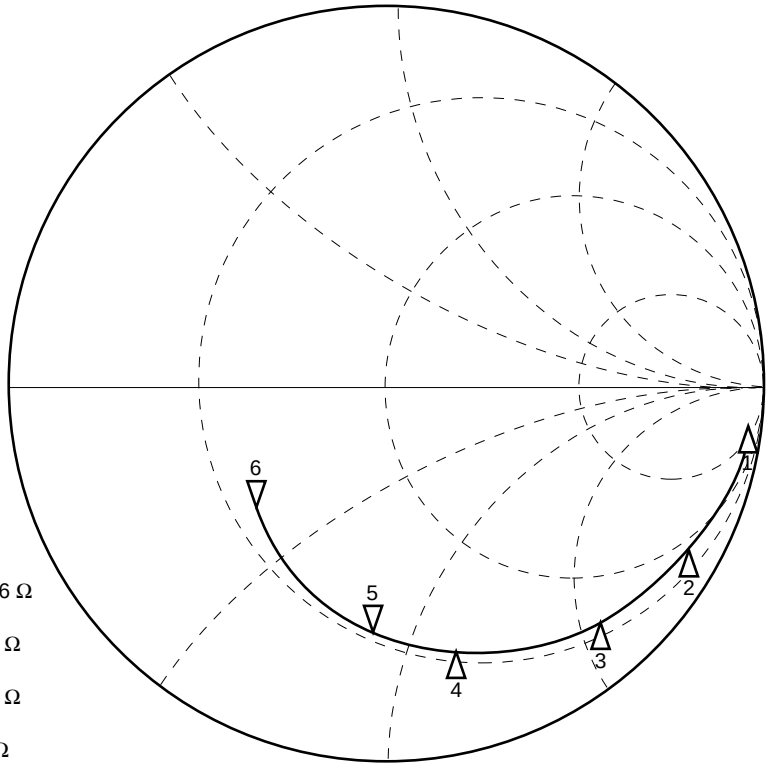
△ 2 : 500 MHz 38.8 Ω – j 194.3 Ω

△ 3 : 900 MHz 25.5 Ω – j 107.6 Ω

△ 4 : 1500 MHz 20.5 Ω – j 60.7 Ω

△ 5 : 1900 MHz 17.9 Ω – j 44.2 Ω

△ 6 : 3000 MHz 19.5 Ω – j 16.3 Ω



START 0.100000000 GHz
STOP 3.000000000 GHz

IF port

V_{CC} = 3.0 V

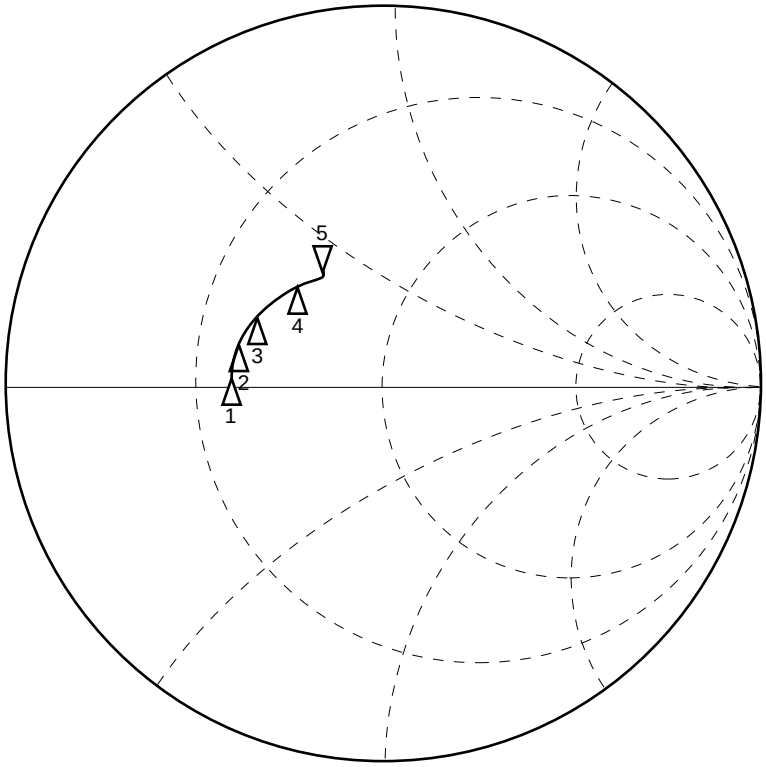
△ 1 : 50 MHz 21.4 Ω + j 2.4 Ω

△ 2 : 80 MHz 21.8 Ω + j 5.5 Ω

△ 3 : 130 MHz 23.1 Ω + j 9.4 Ω

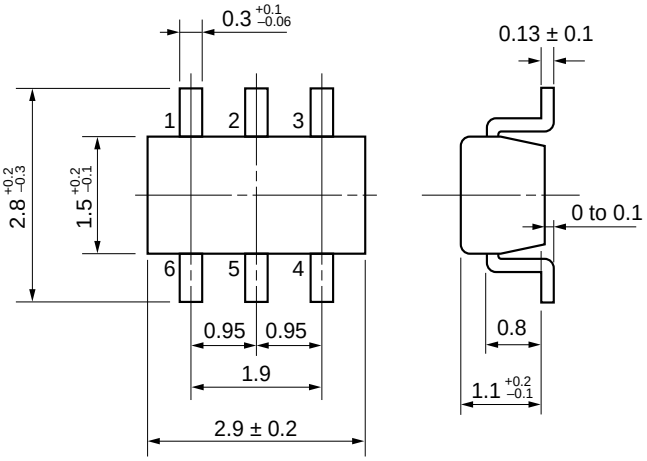
△ 4 : 240 MHz 27.4 Ω + j 16.3 Ω

△ 5 : 300 MHz 30.6 Ω + j 19.1 Ω



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 bypas 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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