NEC

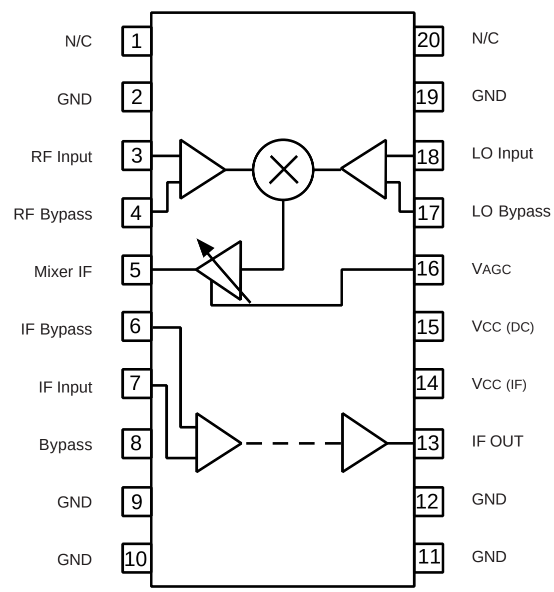
3V, 400 MHz SILICON MMIC FREQUENCY CONVERTER

UPC2753GR

FEATURES

- **3 V SINGLE SUPPLY VOLTAGE**
- **LOW CURRENT DISSIPATION:** I_{CC} = 7 mA TYP
- **HIGH CONVERSION GAIN:** 80 dB TYP
- **OUTPUT LIMITING:** 450 mV p-p
- **WIDE BAND OPERATION UP TO 500 MHz**
- **AGC:** 19 dB Typical

INTERNAL BLOCK DIAGRAM



DESCRIPTION AND APPLICATIONS

The UPC2753GR is a frequency converter manufactured with the NESAT III process. This product consists of an RF input amplifier, Gilbert cell mixer, LO input buffer, IF amplifier with AGC, external filter port, and IF output limiting amplifier. This device was specifically designed for low cost GPS recievers, mobile radios, and PCN applications.

NEC's stringent quality assurance and test procedures assure the highest reliability and performance.

ELECTRICAL CHARACTERISTICS (T_A = 25°C, V_{CC} = 3.0 V, Z_L = Z_S = 50 Ω)

	PART NUMBER PACKAGE OUTLINE			UPC2753GR S20		
	SYMBOLS	PARAMETERS AND CONDITIONS	UNITS	MIN	TYP	MAX
Downconverter & AGC Amplifier	I_{CC}	Total Circuit Current[4]	mA	4.7	6.9	8.5
	RFu	RF Input Frequency Range (3 dB BW)[1] f_{IF} = 4 MHz, V_{AGC} = GND	MHz			400
	IFu	IF Output Frequency Range (3dB BW) f_{RF} = 200 MHz, V_{AGC} = GND	MHz			20
	CG	Conversion Gain[2] f_{RF} = 200 MHz, f_{IF} = 4 MHz, V_{AGC} = GND	dB	35	38	42
	NF	Noise Figure[2] f_{RF} = 200 MHz, f_{IF} = 20 MHz, V_{AGC} = GND	dB		12	15
	RL_{IN}	Input Return Loss f_{RF} ≤400 MHz	dB		14	
	$ISOL_{(LO-RF)}$	LO to RF Isolation[3], f_{LO} = 1 to 400 MHz	dBc		-52	
	$ISOL_{(LO-IF)}$	LO to IF Isolation[3], f_{LO} = 1 to 400 MHz	dBc		-15	
	GC_R	Gain Control f_{RF} = 200 MHz, f_{IF} = 4 MHz, V_{AGC} = 1.2 - 2.4 V	dB	15	19	
IF Amplifier	fu	IF Amplifier Frequency Range[1] (3 dB BW) (The gain is -3 dB down from the gain at 4 MHz)	MHz	DC		20
	GS_{IF}	IF Amplifier Small Signal Gain f = 4 MHz	dB	38	41	45
	V_{OUT}	Output Voltage (Z_L = 2 KΩ // 2 pF)	mV p-p	350	450	550

Notes:

1. Conversion Gain is -3 dB from Conversion Gain For f_{RF} = 50 MHz.
2. Downconverter and AGC amplifier only.
3. P_{LO} = -10 dBm.
4. Downconverter and IF amp may be operated separately. Typical I_{CC} for down converter is 5.5 mA (pin 15). Typical I_{CC} for IF amp is 1.4 mA (pin 14).

ABSOLUTE MAXIMUM RATINGS[1] (T_A = 25°C)

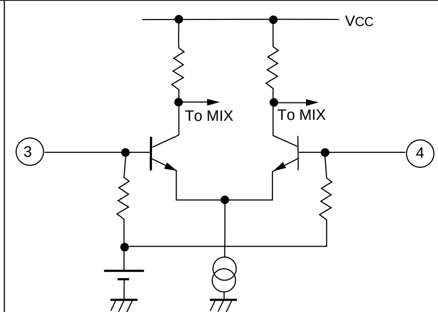
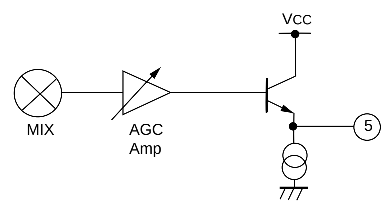
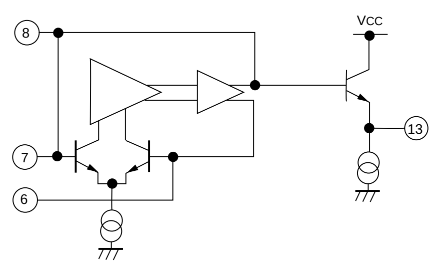
SYMBOLS	PARAMETERS	UNITS	RATINGS
V_{CC}	Supply Voltage	V	4.0
P_T	Power Dissipation	mW	433
I_{CC}	Total Supply Current	mA	20
T_{OP}	Operating Temperature	°C	-40 to +85
T_{STG}	Storage Temperature	°C	-65 to +150

Note:
1. Operation in excess of any one of these parameters may result in permanent damage.
2. Mounted on a 50 x 50 x 1.6 mm epoxy glass PWB (T_A = 85°C).

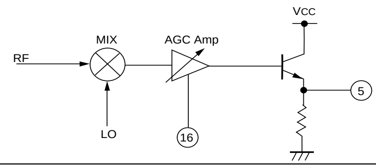
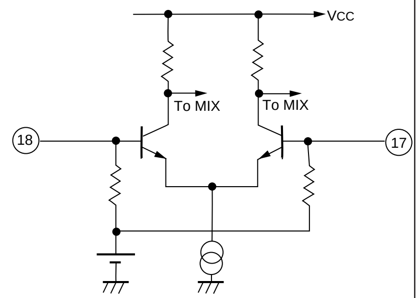
RECOMMENDED OPERATING CONDITIONS

SYMBOLS	PARAMETERS	UNITS	MIN	TYP	MAX
V_{CC}	Supply Voltage	V	2.7	3.0	3.3
T_{OP}	Operating Temperature	°C	-40	25	85

PIN FUNCTIONS

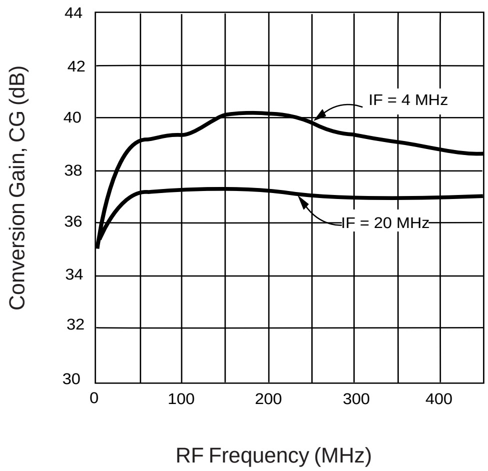
Pin No.	Symbol	Pin Voltage	Description	Equivalent Circuit
3	RF Input	2.5	Pin 3 is the input pin of the RF amplifier. Pin 4 should be connected to GND via a bypass capacitor.	
4	RF Bypass	2.5		
5	Mixer IF	1.1	Pin 5 is the output pin of the Mixer IF. The output signal comes from the mixer unit via the AGC amplifier. This output pin features low impedance because it is the output of an emitter-follower.	
6	IF Bypass	2.1	Pins 6 and 7 are the input pins to the IF amplifier. These two inputs are internally connected to the base of each pair of transistors in the differential amplifier. Pin 6 should be connected to GND via a bypass capacitor.	
7	IF Input	2.1		
8	Bypass	2.1	Pin 8 is connected to the feedback loop of the IF amplifier. This pin should be connected to GND via a bypass capacitor to stabilize the DC bias.	
13	IF Out	1.4	Pin 13 is the output pin of the IF amplifier. This output pin features low impedance because it is the output of an emitter-follower.	

PIN FUNCTIONS

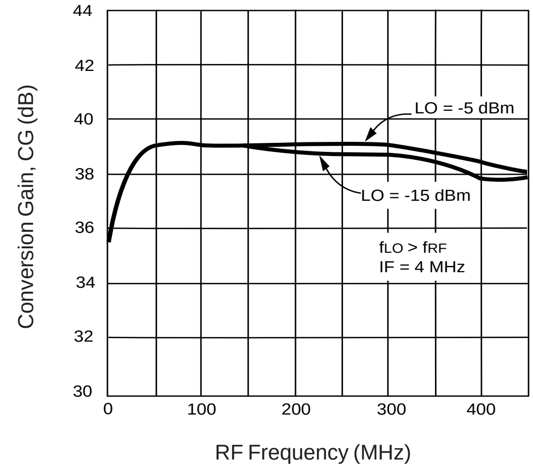
Pin No.	Symbol	Pin Voltage	Description	Equivalent Circuit
16	VAGC	0 to 2.4 (Supply voltage)	Pin 16 is the gain control pin for the AGC amplifier. The gain of the AGC amplifier is controlled by the applied voltage on this pin.	
17	LO Bypass	2.5	Pins 17 and 18 are the LO input pins of the mixer. The LO Bypass pin should be connected to GND via a bypass capacitor.	
18	LO Input	2.5		
15	VCC (DC)	—	Pin 15 is the VCC supply pin for the downconverter block. This pin is independent of the VCC pin for the IF amplifier. Apply 3 V to pin 15.	—
14	VCC (IF)	—	Pin 14 is the VCC supply pin for the IF amplifier. This pin is independent of the VCC pin for the downconverter unit. Apply 3 V to pin 16.	—
2 9 12 19	GND	—	This pin is the ground pin for the entire chip. Therefore the ground of the IF downconverter and IF amplifier blocks are not separated. The ground pattern to be connected to this pin should be formed as wide as possible to minimize its impedance.	—
10 11	GND	—	Pins 10 and 11 are not connected to the internal circuits. Connecting these pins to GND is recommended, though these pins may be left unconnected.	—
1	NC	—	Pins 1 and 20 are the output pins of the mixer block. These pins are used to monitor the signal output from the IF amplifier and to be input to the AGC amplifier. When the IC is actually used, these pins should be left opened.	—
20	NC			

TYPICAL PERFORMANCE CURVES (T_A = 25°C, V_{CC} = 3.0 V, Z_L = Z_S = 50 Ω, P_{LO} = -10 dBm, V_{AGC} = 0 V, P_{RF} = -70 dBm, unless otherwise specified.)

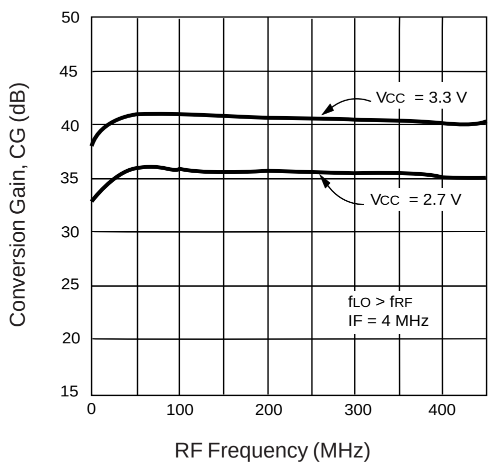
CONVERSION GAIN vs. RF FREQUENCY



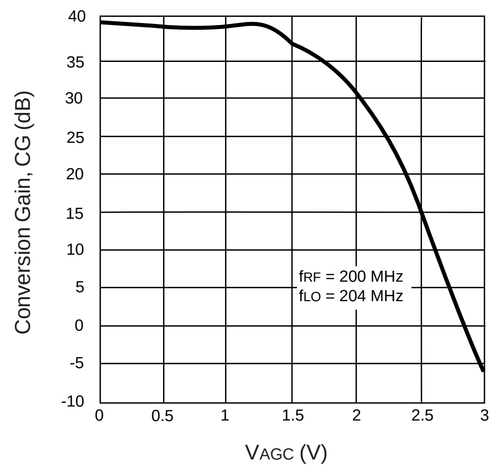
CONVERSION GAIN vs. RF FREQUENCY and LO POWER



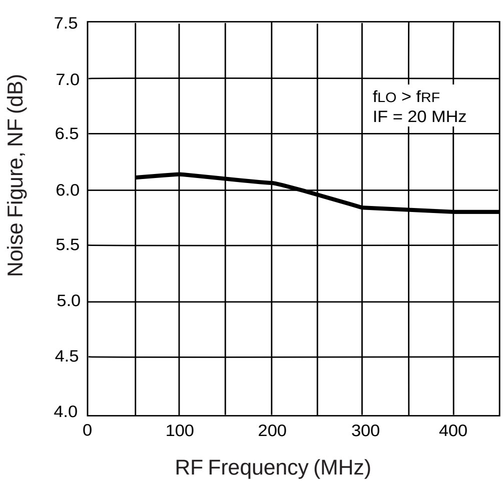
CONVERSION GAIN vs. RF FREQUENCY and VCC



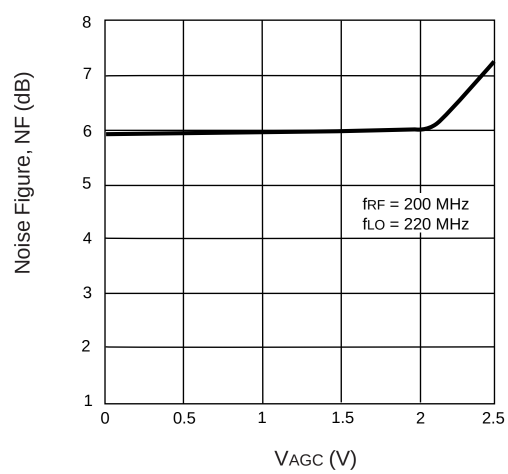
CONVERSION GAIN vs. VAGC



NOISE FIGURE vs. RF FREQUENCY

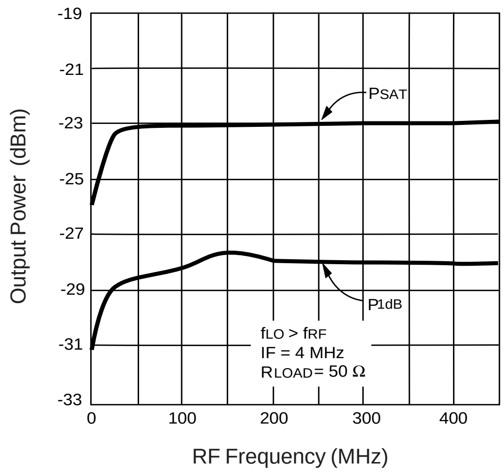


NOISE FIGURE vs. VAGC

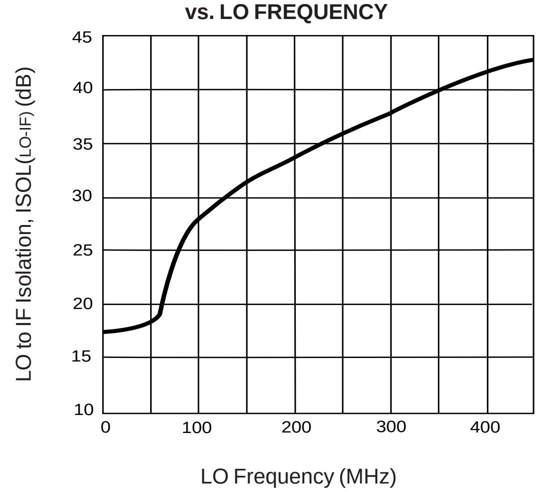


TYPICAL PERFORMANCE CURVES (T_A = 25°C, V_{CC} = 3.0 V, Z_L = Z_S = 50 Ω, P_{LO} = -10 dBm, V_{AGC} = 0 V, P_{RF} = -70 dBm, unless otherwise specified.)

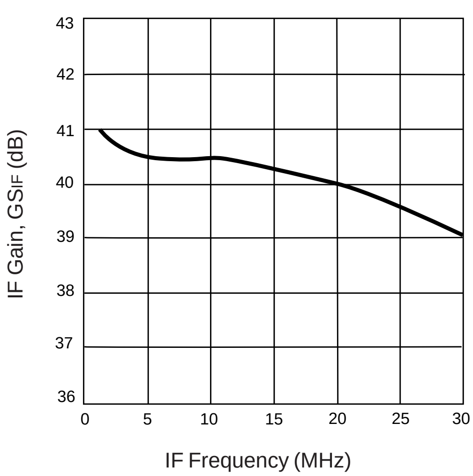
OUTPUT POWER (PIN 5) vs. RF FREQUENCY



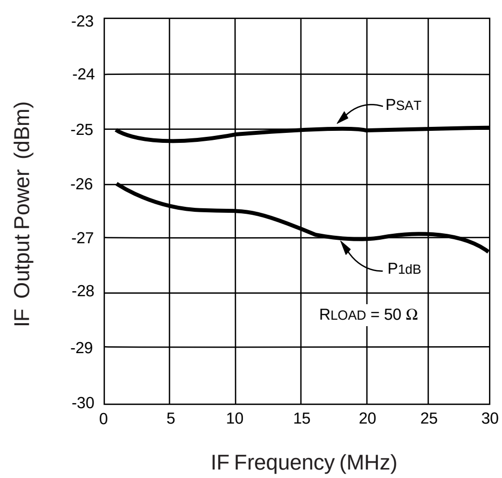
LO to IF ISOLATION vs. LO FREQUENCY



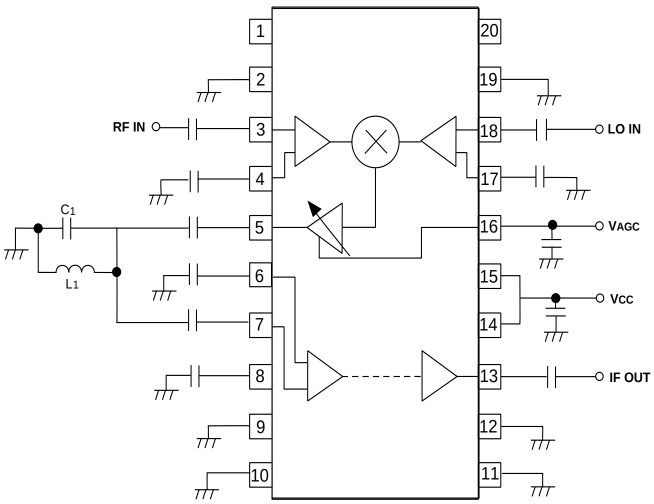
IF GAIN vs. IF FREQUENCY



IF OUTPUT POWER (PIN 13) vs. IF FREQUENCY



APPLICATION CIRCUIT

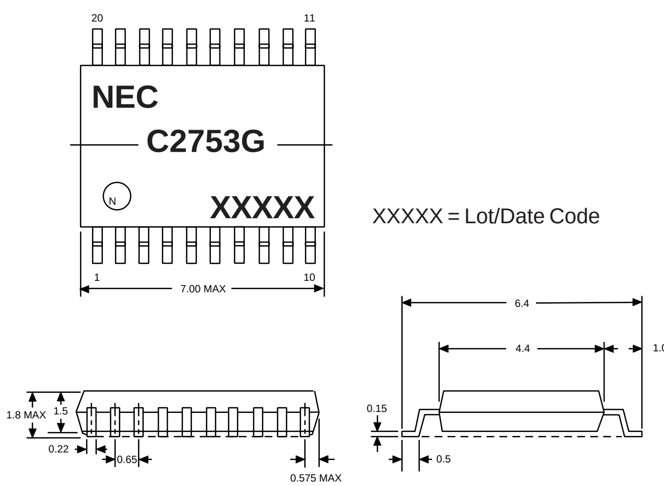


1. N/C
2. GND
3. RF Input
4. RF Bypass
5. Mixer IF
6. IF Bypass
7. IF Input
8. Bypass
9. GND
10. GND
11. GND
12. GND
13. IF OUT
14. VCC (IF)
15. VCC (DC)
16. VAGC
17. LO Bypass
18. LO Input
19. GND
20. N/C

Notes:
1. All unmarked caps are 1000 pF.
2. Bandpass filter element values chosen by equation:
$f_{IF} = 1/2\pi\sqrt{L_1 C_1}$; e.g., L_1 = 3.3 µH, C_1 = 68 pF for f_{IF} = 10 MHz.

OUTLINE DIMENSIONS (Units in mm)

PACKAGE OUTLINE SSOP 20



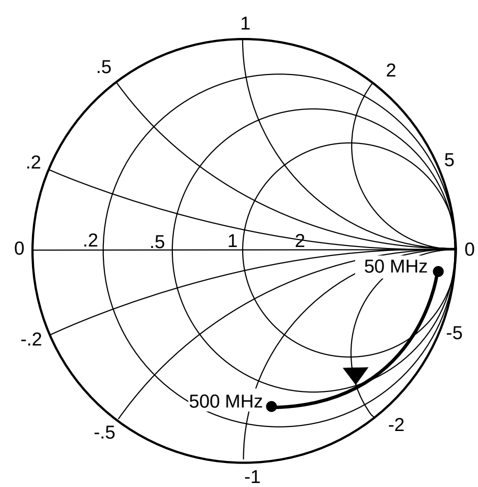
XXXXX = Lot/Date Code

Lead Material: Alloy 42
Lead Plating: Lead Tin Alloy

LEAD CONNECTIONS:
1. N/C
2. GND
3. RF Input
4. RF Bypass
5. Mixer IF
6. IF Bypass
7. IF Input
8. Bypass
9. GND
10. GND
11. GND
12. GND
13. IF OUT
14. VCC (IF)
15. VCC (DC)
16. VAGC
17. LO Bypass
18. LO Input
19. GND
20. N/C

RF INPUT MATCH (S_{11})

PINS 3, 4, 17, and 18



Marker: 315.5 MHz Start 50 MHz Stop 500 MHz
Γx = .53
Γy = -.67
R = 20.1 Ω
X = -100.6 Ω
L_S = -50.7 nH
C_S = 5.0 pF

ORDERING INFORMATION

PART NUMBER	QUANTITY
UPC2753GR-E1	2500/Reel