



# NEC's 900 MHz SILICON MMIC DOWN CONVERTER

## UPC1686GV

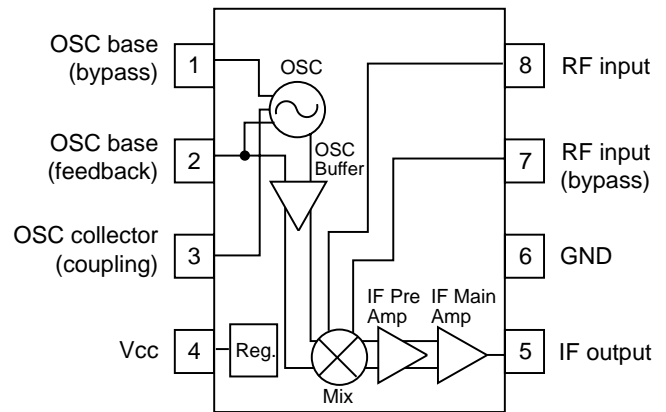
### FEATURES

- **WIDE-BAND OPERATION:** DC to 890 MHz
- **DOUBLE BALANCED MIXER:**  
Low Distortion  
Low Oscillator Radiation
- **BALANCED AMPLIFIER FOR VOLTAGE CONTROLLED OSCILLATORS:**  
Up to UHF Frequency
- **SINGLE ENDED PUSH-PULL IF AMPLIFIER:**  
Constant Resistive Impedance
- **SWITCHABLE AS MIXER OR IF AMP**
- **SMALL PACKAGE:** 8 Pin SSOP

### DESCRIPTION

NEC's UPC1686GV is a silicon monolithic integrated circuit designed as a wide-band mixer/oscillator/IF amp suitable for VHF TV/CATV tuners. Device features include: 20 dB gain from 55 to 890 MHz and an output power of +10 dBm at saturation. The device is available in an 8 pin SSOP package. The nominal output impedance of the device is 75 ohms.

### INTERNAL BLOCK DIAGRAM



### ELECTRICAL CHARACTERISTICS (TA = 25°C, VCC = 5 V)

| PART NUMBER<br>PACKAGE OUTLINE |   |       | UPC1686GV<br>S08 |      |      | TEST<br>CIRCUIT |
|--------------------------------|---|-------|------------------|------|------|-----------------|
| SYMBOLS                        | PARAMETERS AND CONDITIONS   | UNITS | MIN              | TYP  | MAX  |                 |
| I <sub>CC</sub>                | Circuit Current, no input signal  | mA    | 25               | 38   | 48   | Fig. 1          |
| CG                             | Conversion Gain <sup>1</sup>  |       |                  |      |      | Fig. 1          |
|                                | RF = 55 MHz, IF = 44 MHz  | dB    | 15               | 19   | 22   |                 |
|                                | RF = 200 MHz, IF = 50 MHz   | dB    | 15.5             | 19.5 | 22.5 |                 |
|                                | RF = 440 MHz, IF = 50 MHz   | dB    | 16               | 20   | 23   |                 |
| NF                             | Noise Figure <sup>2</sup> at RF = 55 MHz, IF = 44 MHz                                   | dB    |                  | 11   | 14   | Fig. 1          |
|                                | RF = 200 MHz, IF = 50 MHz   | dB    |                  | 11   | 14   |                 |
|                                | RF = 440 MHz, IF = 50 MHz   | dB    |                  | 12   | 15   |                 |
| CM                             | 1% Cross modulation <sup>3</sup> at IF = 50 MHz, 75 Ω Open Terminal, RF = 55 to 470 MHz | dBμ   |                  | 94   |      | Fig. 1          |
| PSAT                           | Saturated Output Power <sup>4</sup>   | dBm   |                  | +10  |      | Fig. 1          |
| f <sub>STB</sub>               | Oscillator Frequency Stability at V <sub>CC</sub> ± 10%<br>OSC f = 100 to 490 MHz       | kHz   |                  | ±100 |      | Fig. 2          |
| f <sub>DRIFT</sub>             | Oscillation Frequency Drift, OSC f = 100 to 490 MHz                                     | kHz   |                  | 100  |      | Fig. 2          |
| V <sub>OSC</sub>               | Oscillation Start Voltage<br>OSC f = 100 to 490 MHz                                     | V     |                  | 3.0  |      | Fig. 2          |
| V <sub>SWR</sub>               | IF Output   |       |                  | 1.3  | 1.5  | Fig. 1          |

Notes:

1. P<sub>RFIn</sub> = -40 dBm, P<sub>OSC</sub> = -5 dBm
2. P<sub>OSC</sub> = -5 dBm
3. Undesired = Desired ± 12 MHz, 30% 100 kHz AM S/I Ratio = 46 dB
4. P<sub>RFIn</sub> = 0 dBm, P<sub>OSC</sub> = -5 dBm

**ABSOLUTE MAXIMUM RATINGS<sup>1</sup>** (T<sub>A</sub> = 25°C)

| SYMBOLS          | PARAMETERS                           | UNITS | RATINGS     |
|------------------|--------------------------------------|-------|-------------|
| V <sub>CC</sub>  | Supply Voltage                       | V     | 6           |
| P <sub>T</sub>   | Total Power Dissipation <sup>2</sup> | mW    | 250         |
| T <sub>OP</sub>  | Operating Temperature                | °C    | -40 to +85  |
| T <sub>STG</sub> | Storage Temperature                  | °C    | -65 to +150 |

Notes:

1. Operation in excess of any one of these parameters may result in permanent damage.
2. T<sub>A</sub> = 85°C mounted on 50 x 50 x 1.6 (mm) PWB (glass-epoxy).

**ORDERING INFORMATION**

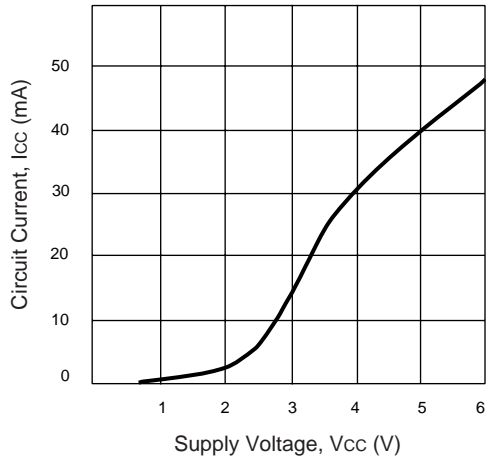
| PART NUMBER    | QUANTITY  |
|----------------|-----------|
| UPC1686GV-E1-A | 1000/REEL |

**PIN DESCRIPTION**

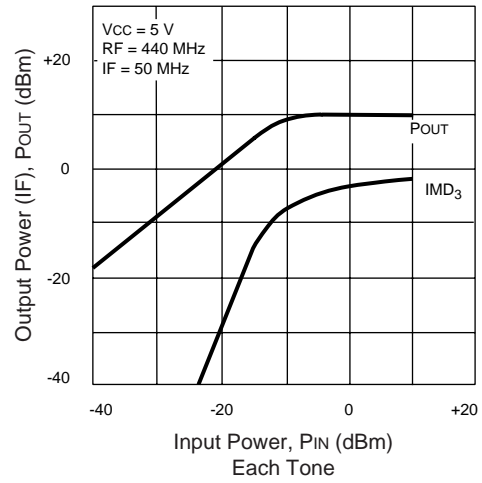
| PIN NO. | SYMBOL                   | FUNCTION AND APPLICATION  | EQUIVALENT CIRCUIT |
|---------|--------------------------|---|--------------------|
| 1       | OSC Base (Bypass)        | <p>Internal oscillator consists of a balanced amplifier. Pins 2 and 3 should be externally equipped with a tank resonator circuit in order to oscillate with feedback loop.</p> <p>Pin 1 should be grounded through a coupling capacitor (~10 pF).</p> <p>Pin 3 is an open collector. This pin should be coupled through resistor or choke coil in order to adjust Q and connect to supply voltage. In case of unstable oscillation, lowering the Q will help to stabilize the operation.</p> |                    |
| 2       | OSC Base (Feedback)      |   |                    |
| 3       | OSC Collector (Coupling) |   |                    |
| 4       | V <sub>CC</sub>          | Supply voltage pin for the IC.  |                    |
| 5       | IFOUT                    | IF output pin. IF amplifier is designed as a single-ended push-pull amplifier. This pin is an emitter follower output with a wideband 50 Ω impedance.   |                    |
| 6       | GND                      | GND pin for the IC.   |                    |
| 7       | RF IN2 (Bypass)          | <p>Pins 7 and 8 are inputs to a double-balance mixer. Either pin can be used for input and bypass.</p>  |                    |
| 8       | RFIN1                    |   |                    |

**TYPICAL PERFORMANCE CURVES** ( $T_A = 25^\circ\text{C}$ )

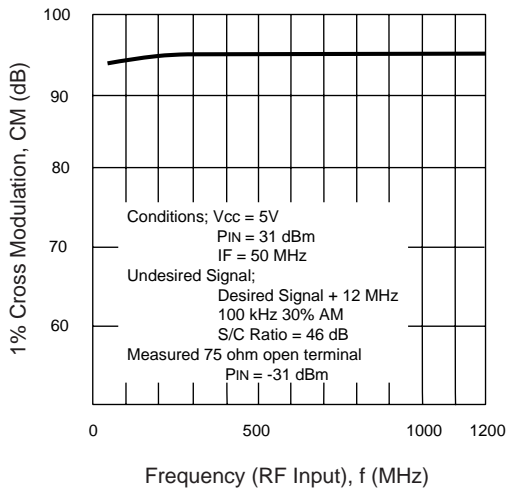
**CIRCUIT CURRENT vs. SUPPLY VOLTAGE**



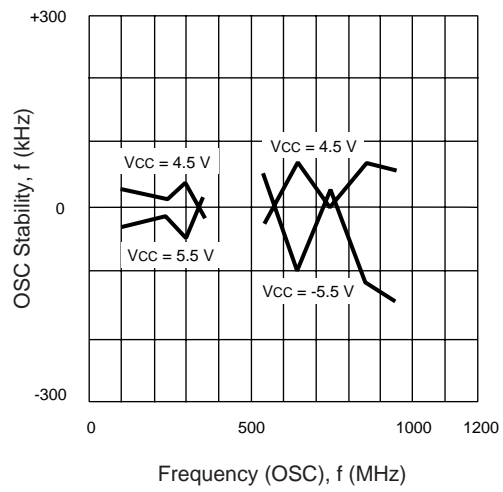
**OUTPUT POWER AND INTERMODULATION DISTORTION vs. INPUT POWER**



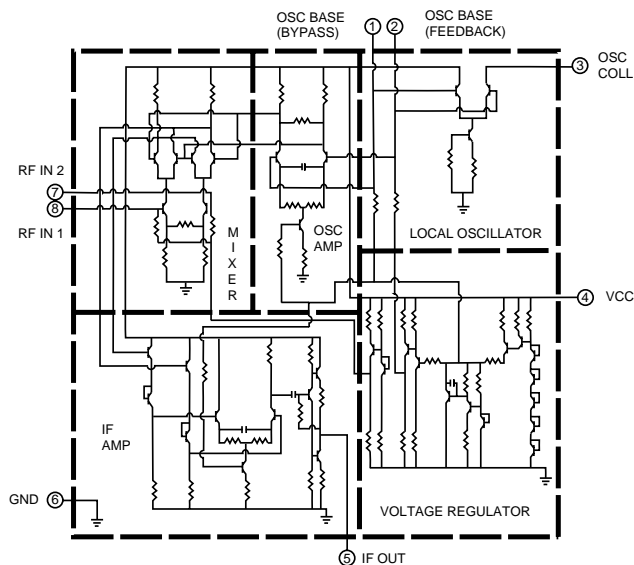
**1% CROSS MODULATION vs. FREQUENCY**



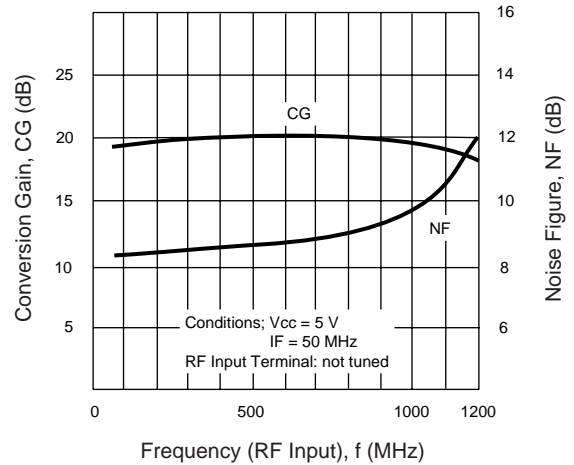
**OSC-FREQUENCY STABILITY vs. FREQUENCY**



**EQUIVALENT CIRCUIT**



**CONVERSION GAIN AND NOISE FIGURE vs. FREQUENCY**



TEST CIRCUITS

Figure 1

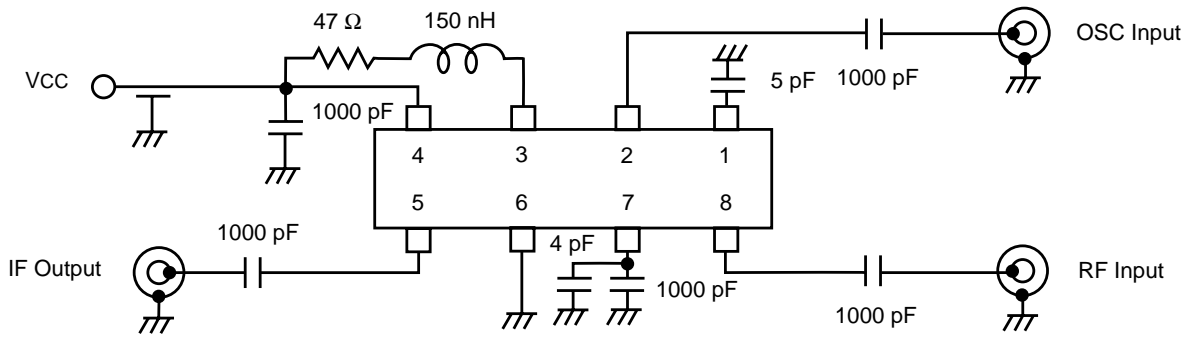
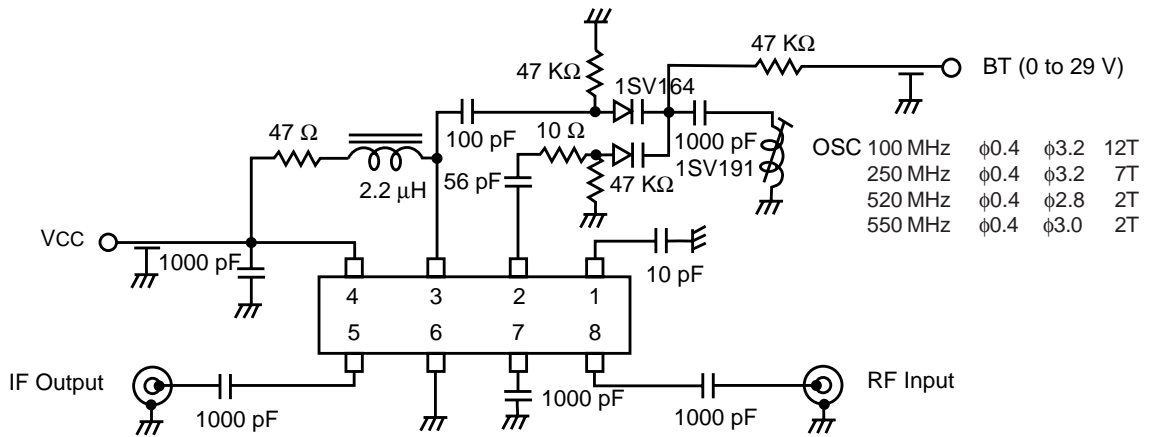
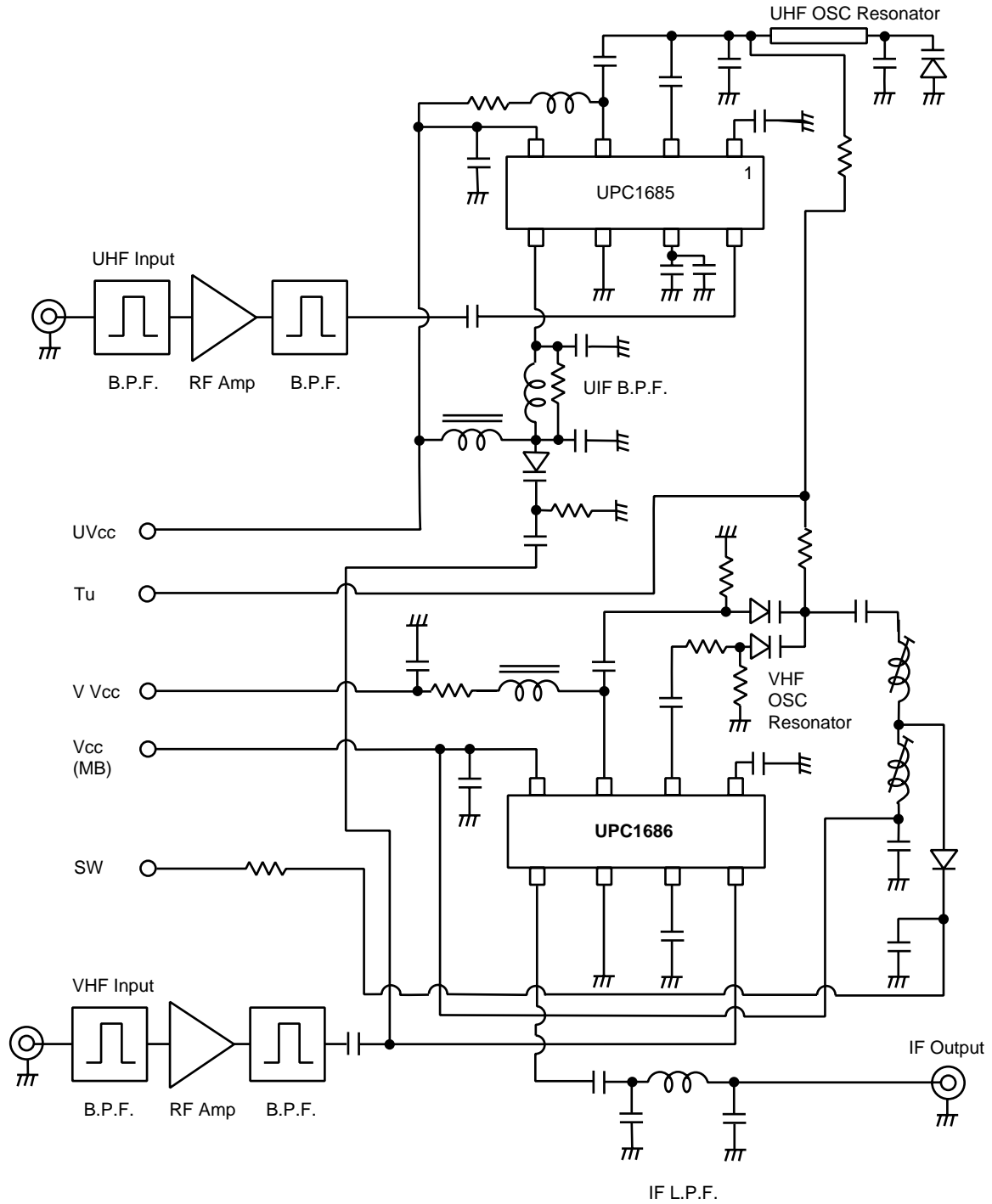


Figure 2



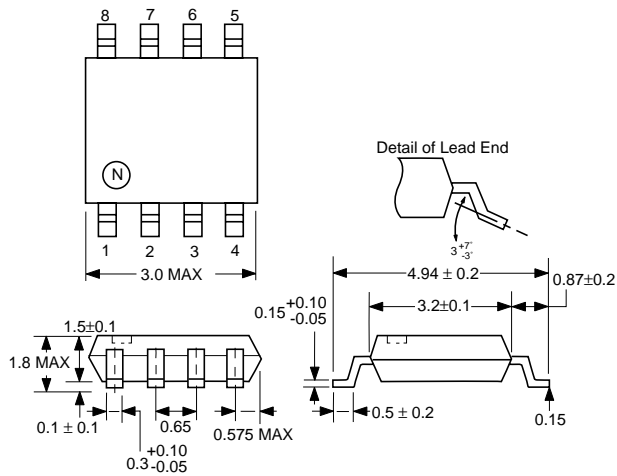


APPLICATION CIRCUIT FOR T.V. TUNER



## OUTLINE DIMENSIONS (Units in mm)

### PACKAGE OUTLINE S08



### PIN CONNECTION

1. OSC-Base (Bypass)
2. OSC-Base (Feedback)
3. OSC-Collector (Coupling)\*
4. Vcc
5. IF OUT
6. GND
7. RF IN (Bypass)
8. RF IN

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| Restricted Substance per RoHS | Concentration Limit per RoHS (values are not yet fixed) | Concentration contained in CEL devices |     |
|-------------------------------|---|--|-----|
|                               |   | -A                                     | -AZ |
| Lead (Pb)                     | < 1000 PPM  | Not Detected                           | (*) |
| Mercury                       | < 1000 PPM  | Not Detected                           |     |
| Cadmium                       | < 100 PPM   | Not Detected                           |     |
| Hexavalent Chromium           | < 1000 PPM  | Not Detected                           |     |
| PBB                           | < 1000 PPM  | Not Detected                           |     |
| PBDE                          | < 1000 PPM  | Not Detected                           |     |

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