

## NEC's 1.0 GHz

## DIVIDE BY 2/4/8 PRESCALER

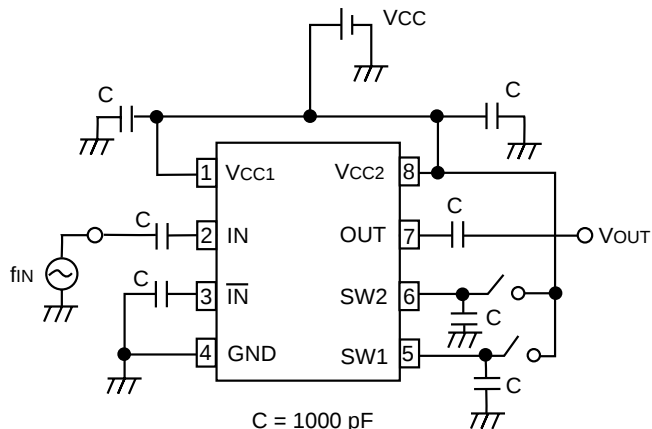
### FEATURES

- **HIGH FREQUENCY OPERATION TO 1 GHz**
- **SELECTABLE DIVIDE RATIO:**  $\div 2$ ,  $\div 4$ ,  $\div 8$
- **WIDE SUPPLY VOLTAGE RANGE:** 2.2 TO 5 V
- **LOW SUPPLY CURRENT:** 5.3 mA
- **SMALL PACKAGE:** 8 pin SSOP
- **AVAILABLE IN TAPE AND REEL**

### DESCRIPTION

NEC's UPB1509GV is a Silicon RFIC digital prescaler manufactured with the NESAT™ IV silicon bipolar process. It features frequency response to 1 GHz, selectable divide-by-two, four, or eight modes, and operates from a 3 to 5 volt supply while drawing only 5.3 milliamps. The device is housed in a small 8 pin SSOP package that contributes to system miniaturization. The low power consumption and wide supply range makes the device well suited for cellular and cordless telephones as well as DBS receiver applications.

### TEST CIRCUIT



### ELECTRICAL CHARACTERISTICS (T<sub>A</sub> = -40 to +85°C, V<sub>CC</sub> = 2.2 to 5.5 V, unless otherwise noted)

| PART NUMBER<br>PACKAGE OUTLINE |                                                                                                                                              |                          | UPB1509GV<br>S08          |                 |           |
|--------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------|--------------------------|---------------------------|-----------------|-----------|
| SYMBOLS                        | PARAMETERS AND CONDITIONS                                                                                                                    | UNITS                    | MIN                       | TYP             | MAX       |
| I <sub>CC</sub>                | Supply Current, No Input Signal, V <sub>CC</sub> = 3 V                                                                                       | mA                       | 3.5                       | 5.0             | 5.9       |
| f <sub>IN</sub> (U)            | Upper Limit Operating Frequency, P <sub>IN</sub> = -20 to 0 dBm<br>P <sub>IN</sub> = -20 to -5 dBm at $\div 2$<br>at $\div 4$<br>at $\div 8$ | MHz<br>MHz<br>MHz<br>MHz | 500<br>700<br>800<br>1000 |                 |           |
| f <sub>IN</sub> (L)            | Lower Limit Operating Frequency, P <sub>IN</sub> = -20 to 0 dBm<br>P <sub>IN</sub> = -20 to -5 dBm                                           | MHz<br>MHz               |                           |                 | 50<br>500 |
| P <sub>IN</sub>                | Input Power, f <sub>IN</sub> = 50 to 1000 MHz<br>f <sub>IN</sub> = 50 to 500 MHz                                                             | dBm<br>dBm               | -20<br>-20                |                 | -5<br>0   |
| V <sub>OUT</sub>               | Output Voltage, R <sub>L</sub> = 200 Ω                                                                                                       | V <sub>P-P</sub>         | 0.1                       | 0.2             |           |
| V <sub>IN(H)</sub>             | Division Ratio Control Voltage High                                                                                                          | V                        |                           | V <sub>CC</sub> |           |
| V <sub>IN(L)</sub>             | Division Ratio Control Voltage Low                                                                                                           | V                        |                           | OPEN            |           |

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**ABSOLUTE MAXIMUM RATINGS<sup>1</sup>** ( $T_A = 25^{\circ}\text{C}$ )

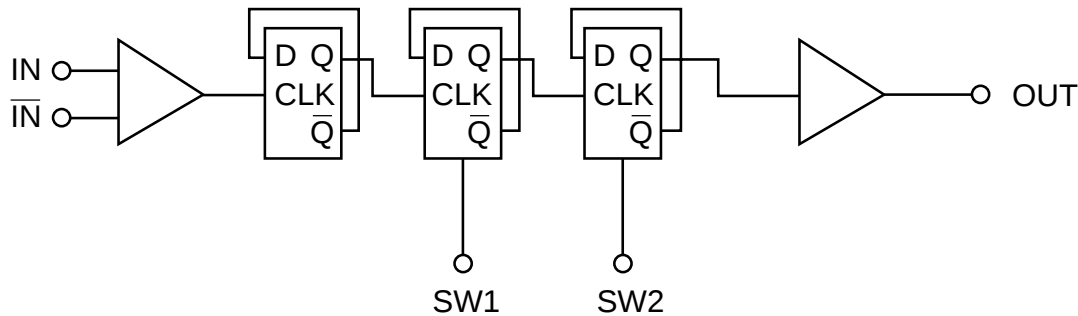
| SYMBOLS          | PARAMETERS                     | UNITS | RATINGS     |
|------------------|--------------------------------|-------|-------------|
| VCC1, VCC2       | Supply Voltage                 | V     | 6.0         |
| V <sub>IN</sub>  | Input Voltage                  | V     | 6.0         |
| P <sub>D</sub>   | Power Dissipation <sup>2</sup> | mW    | 250         |
| T <sub>OP</sub>  | Operating Temperature          | °C    | -45 to +85  |
| T <sub>STG</sub> | Storage Temperature            | °C    | -55 to +150 |

## Notes:

- Operation in excess of any one of these parameters may result in permanent damage.
- Mounted on a double-sided copper clad 50x50x1.6 mm epoxy glass PWB ( $T_A = +85^{\circ}\text{C}$ ).

**RECOMMENDED  
OPERATING CONDITIONS**

| SYMBOL          | PARAMETER             | UNITS | MIN | TYP | MAX |
|-----------------|-----------------------|-------|-----|-----|-----|
| VCC1, VCC2      | Supply Voltage        | V     | 2.2 | 3.0 | 5.5 |
| T <sub>OP</sub> | Operating Temperature | °C    | -40 | +25 | +85 |

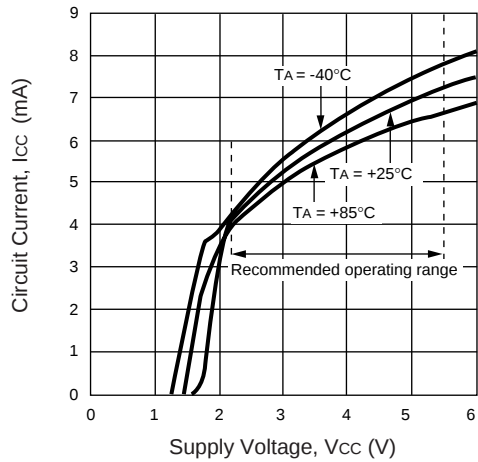
**INTERNAL BLOCK DIAGRAM****PIN DESCRIPTIONS**

| Pin No. | Symbol                 | Applied Voltage   | Pin Voltage | Description                                                                                                                                                                                                                                                                                                                                                                |  |  |     |  |         |          |     |         |     |     |          |     |     |
|---------|------------------------|-------------------|-------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|--|-----|--|---------|----------|-----|---------|-----|-----|----------|-----|-----|
| 1       | VCC1                   | 2.2 to 5.5        | —           | Power supply pin of input amplifier and dividers. This pin must be equipped with bypass capacitor (eg 1000 pF) to ground.                                                                                                                                                                                                                                                  |  |  |     |  |         |          |     |         |     |     |          |     |     |
| 2       | IN                     | —                 | 1.7 to 4.95 | Signal input pin. This pin should be coupled with a capacitor (eg 1000 pF).                                                                                                                                                                                                                                                                                                |  |  |     |  |         |          |     |         |     |     |          |     |     |
| 3       | $\overline{\text{IN}}$ | —                 | 1.7 to 4.95 | Signal input bypass pin. This pin must be equipped with a bypass capacitor (eg 1000 pF) to ground.                                                                                                                                                                                                                                                                         |  |  |     |  |         |          |     |         |     |     |          |     |     |
| 4       | GND                    | 0                 | —           | Ground pin. Ground pattern on the board should be formed as wide as possible to minimize ground impedance.                                                                                                                                                                                                                                                                 |  |  |     |  |         |          |     |         |     |     |          |     |     |
| 5       | SW1                    | H/L<br>(VCC/OPEN) | —           | Divided ratio control pin. Divide ratio can be controlled by the following input voltages to these pins. <div><table><tr><td colspan="2" rowspan="2"></td><th colspan="2">SW2</th></tr><tr><th>H (Vcc)</th><th>L (OPEN)</th></tr><tr><td rowspan="2">SW1</td><td>H (Vcc)</td><td>1/2</td><td>1/4</td></tr><tr><td>L (OPEN)</td><td>1/4</td><td>1/8</td></tr></table></div> |  |  | SW2 |  | H (Vcc) | L (OPEN) | SW1 | H (Vcc) | 1/2 | 1/4 | L (OPEN) | 1/4 | 1/8 |
|         |                        | SW2               |             |                                                                                                                                                                                                                                                                                                                                                                            |  |  |     |  |         |          |     |         |     |     |          |     |     |
|         |                        | H (Vcc)           | L (OPEN)    |                                                                                                                                                                                                                                                                                                                                                                            |  |  |     |  |         |          |     |         |     |     |          |     |     |
| SW1     | H (Vcc)                | 1/2               | 1/4         |                                                                                                                                                                                                                                                                                                                                                                            |  |  |     |  |         |          |     |         |     |     |          |     |     |
|         | L (OPEN)               | 1/4               | 1/8         |                                                                                                                                                                                                                                                                                                                                                                            |  |  |     |  |         |          |     |         |     |     |          |     |     |
| 6       | SW2                    | H/L<br>(VCC/OPEN) |             |                                                                                                                                                                                                                                                                                                                                                                            |  |  |     |  |         |          |     |         |     |     |          |     |     |
| 7       | OUT                    | —                 | 1.0 to 4.7  | Divided frequency output pin. This pin is designed as an emitter follower output. This pin can output 0.1 Vp-p min with a 200 Ω load. This pin should be coupled to load device with a capacitor (eg 1000 pF).                                                                                                                                                             |  |  |     |  |         |          |     |         |     |     |          |     |     |
| 8       | VCC2                   | 2.2 to 5.5        | —           | Power supply pin of output buffer amplifier. This pin must be equipped with bypass capacitor (eg 1000 pF) to ground.                                                                                                                                                                                                                                                       |  |  |     |  |         |          |     |         |     |     |          |     |     |

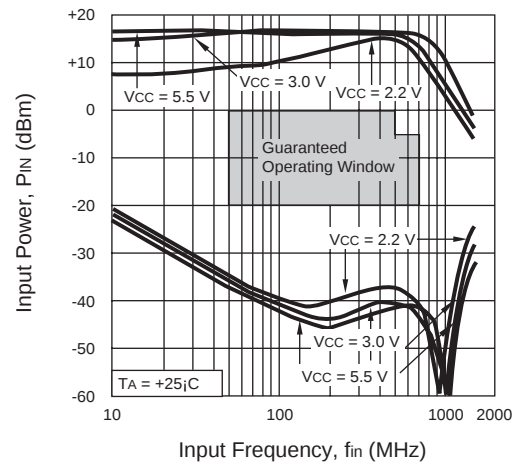
## TYPICAL PERFORMANCE CURVES

( $T_A = +25^\circ\text{C}$  unless otherwise noted)

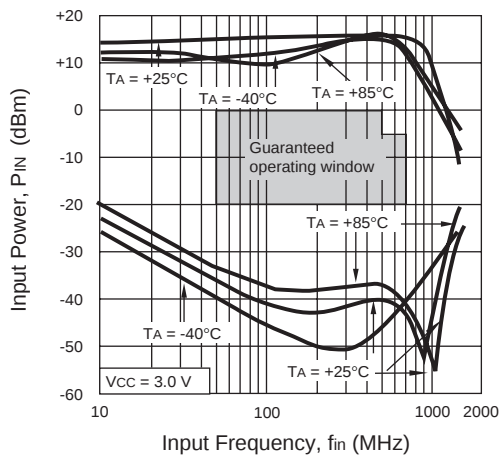
CIRCUIT CURRENT vs.  
SUPPLY VOLTAGE and TEMPERATURE



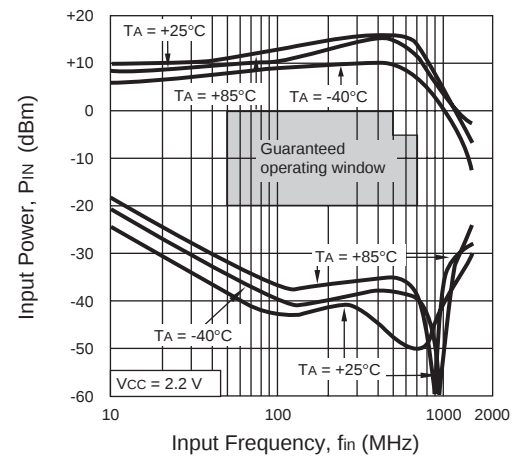
INPUT POWER vs.  
INPUT FREQUENCY and VOLTAGE



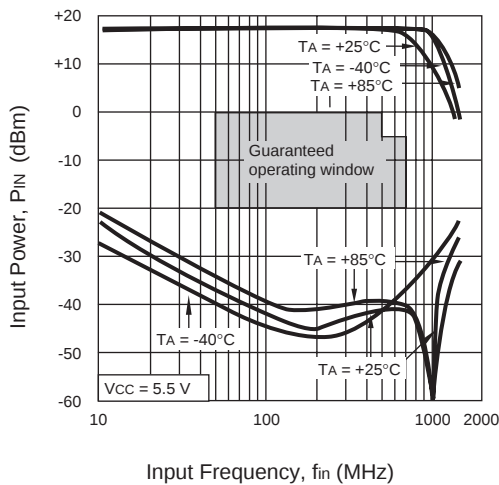
INPUT POWER vs.  
INPUT FREQUENCY and TEMPERATURE



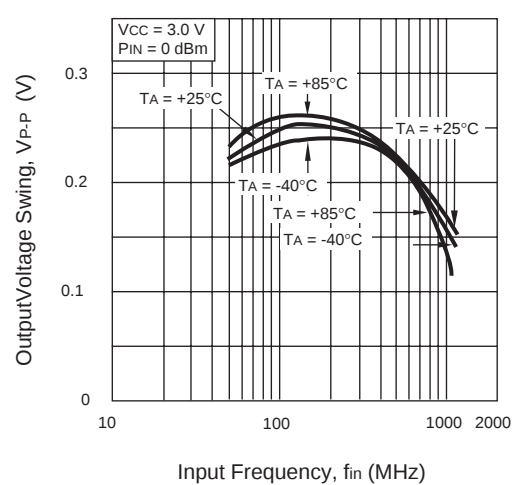
INPUT POWER vs.  
INPUT FREQUENCY and TEMPERATURE



INPUT POWER vs.  
INPUT FREQUENCY and TEMPERATURE

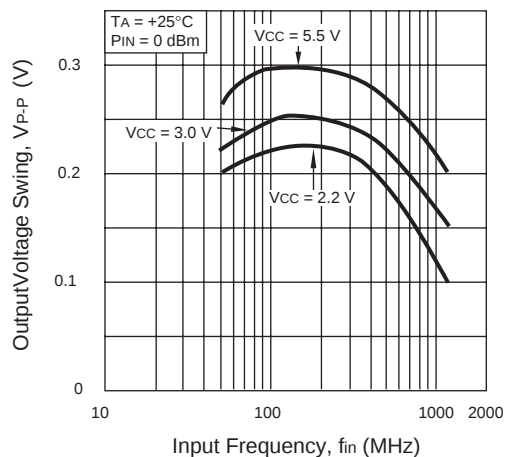
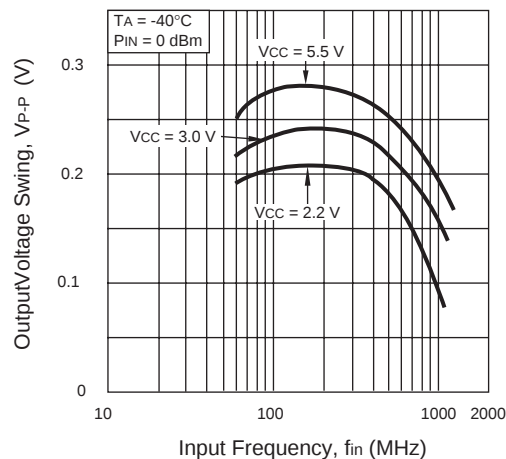
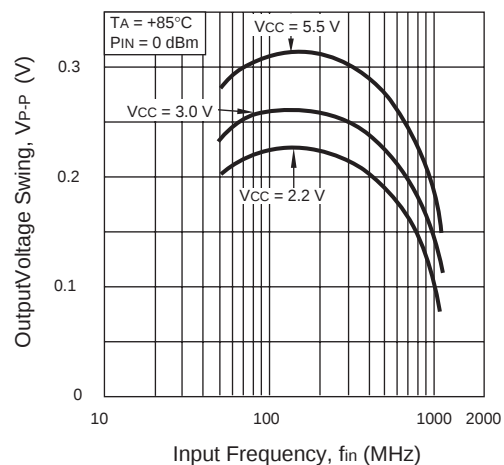
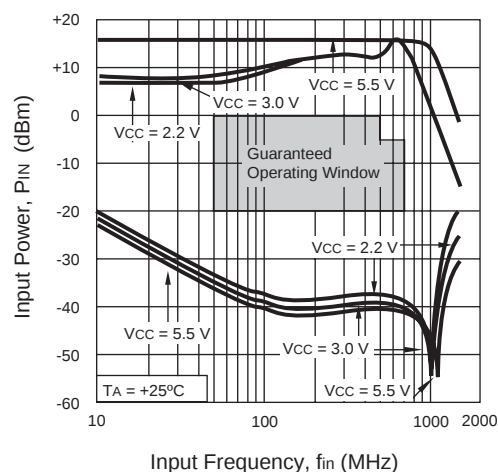
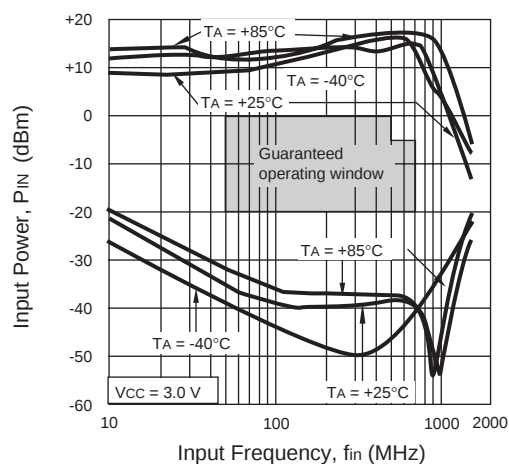


OUTPUT VOLTAGE SWING vs.  
INPUT FREQUENCY and VOLTAGE



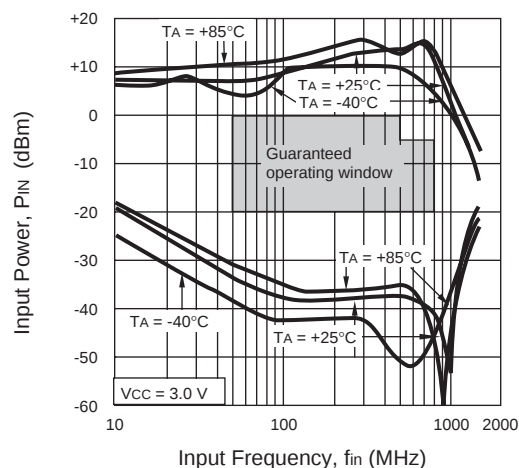
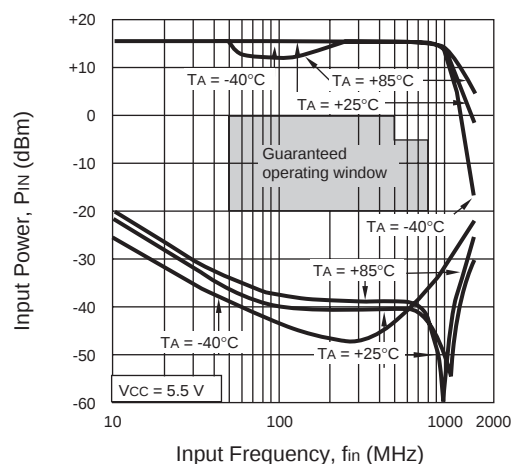
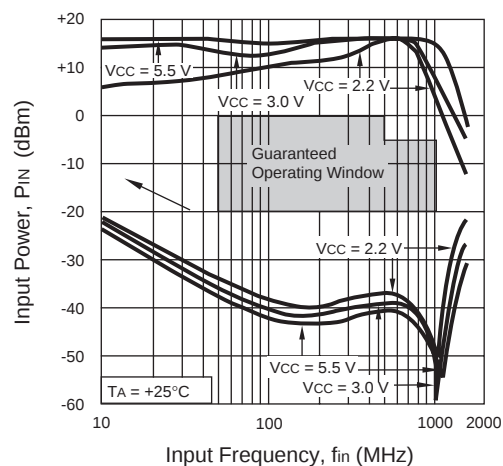
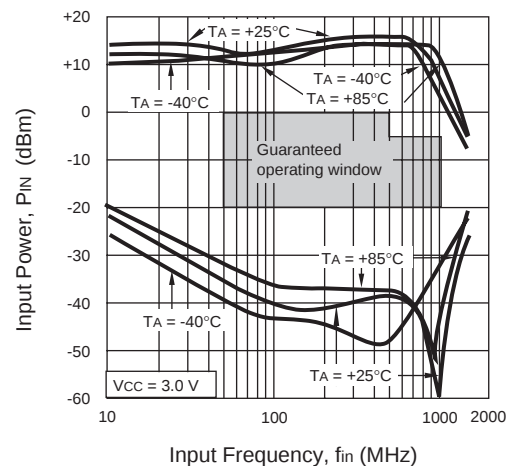
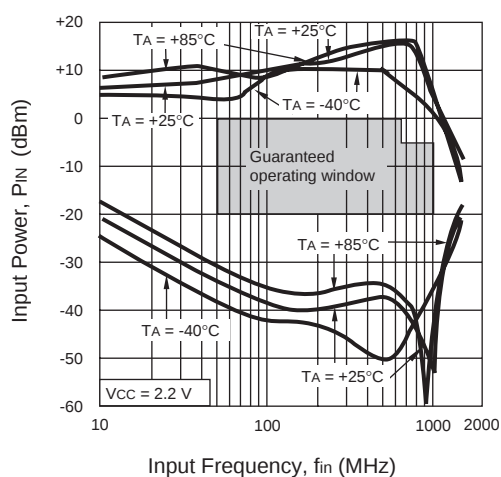
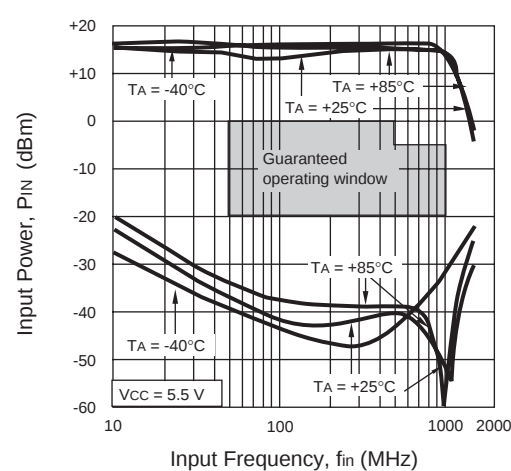
## TYPICAL PERFORMANCE CURVES

(TA = +25°C unless otherwise noted)

OUTPUT VOLTAGE SWING vs.  
INPUT FREQUENCY and VOLTAGEOUTPUT VOLTAGE SWING vs.  
INPUT FREQUENCY and VOLTAGEOUTPUT VOLTAGE SWING vs.  
INPUT FREQUENCY and VOLTAGEDivide by 4 mode(Guaranteed operating window:  $V_{CC} = 2.2$  to  $5.5\text{ V}$ ,  $T_A = -40$  to  $+85^\circ\text{C}$ )INPUT POWER vs.  
INPUT FREQUENCY and VOLTAGEINPUT POWER vs.  
INPUT FREQUENCY and TEMPERATURE

## TYPICAL PERFORMANCE CURVES

(TA = +25°C unless otherwise noted)

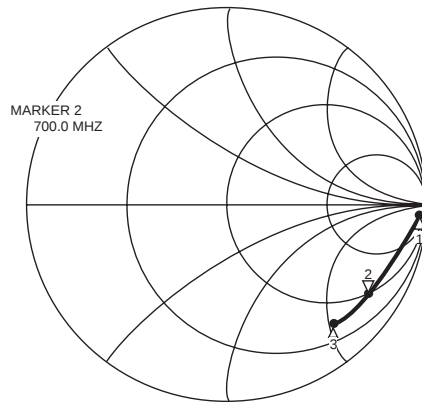
INPUT POWER vs.  
INPUT FREQUENCY and TEMPERATUREINPUT POWER vs.  
INPUT FREQUENCY and TEMPERATUREDivide by 8 mode(Guaranteed operating window:  $V_{CC} = 2.2$  to  $5.5$  V,  $T_A = -40$  to  $+85^\circ\text{C}$ )INPUT POWER vs.  
INPUT FREQUENCY and VOLTAGEINPUT POWER vs.  
INPUT FREQUENCY and TEMPERATUREINPUT POWER vs.  
INPUT FREQUENCY and TEMPERATUREINPUT POWER vs.  
INPUT FREQUENCY and TEMPERATURE

# TYPICAL SCATTERING PARAMETERS (T<sub>A</sub> = 25°C)

## S<sub>11</sub> vs. INPUT FREQUENCY

V<sub>CC1</sub> = V<sub>CC2</sub> = 3.0 V, SW1 = SW2 = 3.0 V

S<sub>11</sub>  
REF 1.0 Units/  
2 200.0 mUnits/  
▽ 55.375 Ω -142.79 Ω



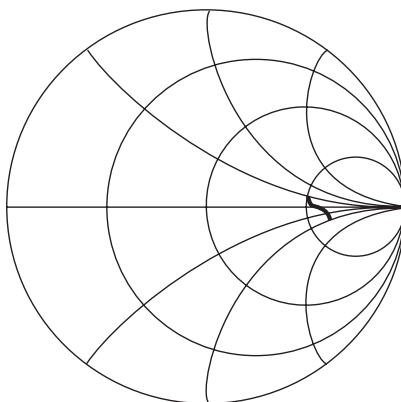
START 0.050000000 GHz  
STOP 1.000000000 GHz

| FREQUENCY | S <sub>11</sub> |       |
|-----------|-----------------|-------|
|           | MAG             | ANG   |
| 0.1       | 0.929           | -6.7  |
| 0.2       | 0.898           | -10.5 |
| 0.3       | 0.866           | -13.6 |
| 0.4       | 0.840           | -15.9 |
| 0.5       | 0.834           | -19.1 |
| 0.6       | 0.819           | -21.9 |
| 0.7       | 0.803           | -24.7 |
| 0.8       | 0.792           | -27.0 |
| 0.9       | 0.787           | -30.0 |
| 1.0       | 0.771           | -32.7 |

## S<sub>22</sub> vs. OUTPUT FREQUENCY

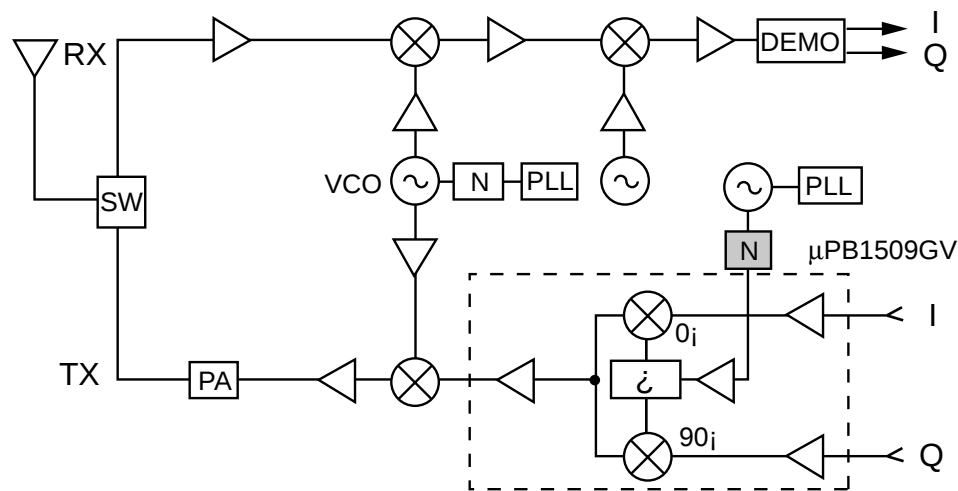
S<sub>22</sub>  
REF 1.0 Units  
200.0 mUnits/

Z  
50 MHz  
149.09 Ω + j 14.86 Ω  
350 MHz  
194.21 Ω – j 36.64 Ω



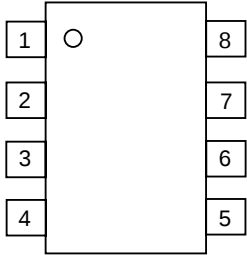
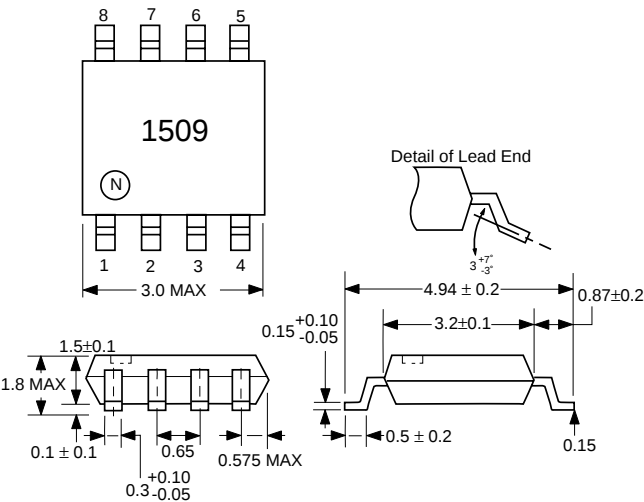
START 0.050000000 GHz  
STOP 0.350000000 GHz

SYSTEM APPLICATION EXAMPLE



OUTLINE DIMENSIONS (Units in mm)

PACKAGE OUTLINE S08



PIN CONNECTIONS

- 1. Vcc1
- 2. IN
- 3. IN
- 4. GND
- 5. SW1
- 6. SW2
- 7. OUT
- 8. Vcc2

ORDERING INFORMATION (Solder Contains Lead)

| PART NUMBER  | QUANTITY  |
|--------------|-----------|
| UPB1509GV-E1 | 1000/Reel |

ORDERING INFORMATION (Pb-Free)

| PART NUMBER    | QUANTITY  |
|----------------|-----------|
| UPB1509GV-E1-A | 1000/Reel |

Life Support Applications

These NEC products are not intended for use in life support devices, appliances, or systems where the malfunction of these products can reasonably be expected to result in personal injury. The customers of CEL using or selling these products for use in such applications do so at their own risk and agree to fully indemnify CEL for all damages resulting from such improper use or sale.

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Subject: Compliance with EU Directives

CEL certifies, to its knowledge, that semiconductor and laser products detailed below are compliant with the requirements of European Union (EU) Directive 2002/95/EC Restriction on Use of Hazardous Substances in electrical and electronic equipment (RoHS) and the requirements of EU Directive 2003/11/EC Restriction on Penta and Octa BDE.

CEL Pb-free products have the same base part number with a suffix added. The suffix –A indicates that the device is Pb-free. The –AZ suffix is used to designate devices containing Pb which are exempted from the requirement of RoHS directive (\*). In all cases the devices have Pb-free terminals. All devices with these suffixes meet the requirements of the RoHS directive.

This status is based on CEL's understanding of the EU Directives and knowledge of the materials that go into its products as of the date of disclosure of this information.

| Restricted Substance<br>per RoHS | Concentration Limit per RoHS<br>(values are not yet fixed) | Concentration contained<br>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                              |     |

If you should have any additional questions regarding our devices and compliance to environmental standards, please do not hesitate to contact your local representative.

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