DATA SHEET

CEL

BIPOLAR DIGITAL INTEGRATED CIRCUITS

~~UPB1506GV,~~ UPB1507GV

3GHz INPUT DIVIDE BY 256, 128, 64 PRESCALER IC FOR ANALOG DBS TUNERS

The UPB1506GV and UPB1507GV are 3.0 GHz input, high division silicon prescaler ICs for analog DBS tuner applications. These ICs divide-by-256, 128 and 64 contribute to produce analog DBS tuners with kit-use of 17 K series DTS controller or standard CMOS PLL synthesizer IC. The UPB1506GV/UPB1507GV are shrink package versions of the UPB586G/588G or UPB1505GR so that these smaller packages contribute to reduce the mounting space replacing from conventional ICs.

The UPB1506GV and UPB1507GV are manufactured using NEC's high f_T NESAT™IV silicon bipolar process. This process uses silicon nitride passivation film and gold electrodes. These materials can protect chip surface from external pollution and prevent corrosion/migration. Thus, these ICs have excellent performance, uniformity and reliability.

FEATURES

- High toggle frequency : f_{in} = 0.5 GHz to 3.0 GHz
- High-density surface mounting : 8-pin plastic SSOP (175 mil)
- Low current consumption : 5 V, 19 mA
- Selectable high division : ÷256, ÷128, ÷64
- Pin connection variation : UPB1506GV and UPB1507GV

PLEASE NOTE:
The following part number from this datasheet is NOT RECOMMENDED for New Designs:
UPB1506GV.

Please contact your local sales office for details.

APPLICATION

These ICs can use as a prescaler between local oscillator and PLL frequency synthesizer included modulus prescaler. For example, following application can be chosen;

- Analog DBS tuner's synthesizer
- Analog CATV converter synthesizer

ORDERING INFORMATION

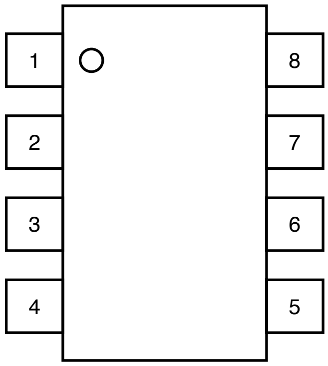
PART NUMBER	PACKAGE	MARKING	SUPPLYING FORM
UPB1506GV-E1-A	8-pin plastic SSOP (175 mil)	150	Embossed tape 8 mm wide. Pin 1 is in tape pull-out direction. 1 000 p/reel.
UPB1507GV-E1-A		1507	

Remarks To order evaluation samples, please contact your local sales office.
(Part number for sample order: UPB1506GV-A, UPB1507GV-A)

Document No. P10767EJ3V0DS00 (3rd edition)
Date Published January 1998 N CP(K)

Caution: Electro-static sensitive devices

PIN CONNECTION (Top View)



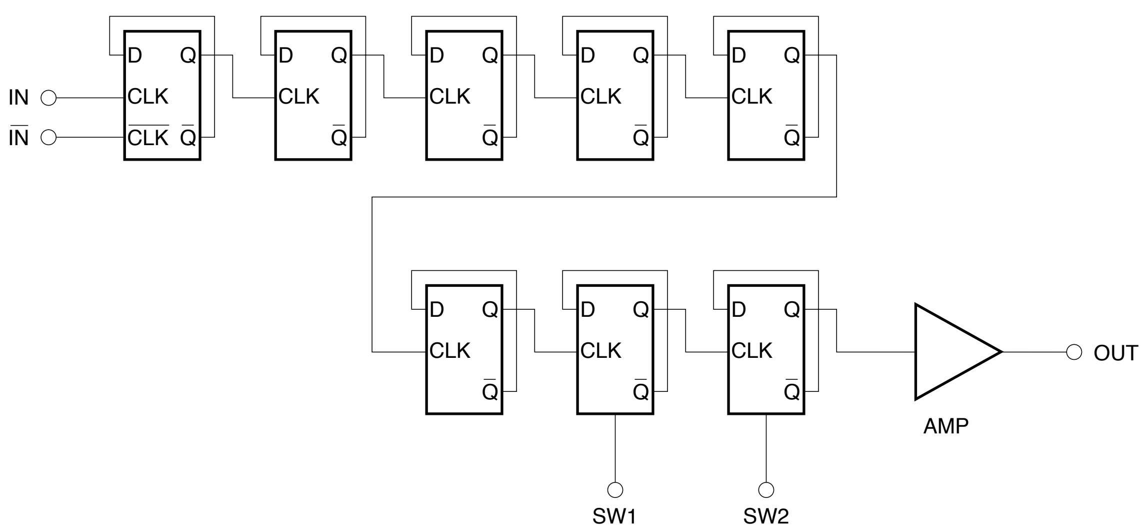
Pin NO.	UPB1506GV	UPB1507GV
1	SW1	IN
2	IN	V_{CC}
3	$\overline{IN}$	SW1
4	GND	OUT
5	NC	GND
6	SW2	SW2
7	OUT	NC
8	V_{CC}	$\overline{IN}$

PRODUCT LINE-UP

Features (division, Freq.)	Part No.	I_{CC} (mA)	f_{in} (GHz)	V_{CC} (V)	Package	Pin connection
÷512, ÷256, 2.5 GHz	UPB586G	28	0.5 to 2.5	4.5 to 5.5	8 pin SOP 225 mil	NEC original
÷128, ÷64, 2.5 GHz	UPB588G	26	0.5 to 2.5	4.5 to 5.5		
÷256, ÷128, ÷64 3.0 GHz	UPB1505GR	14	0.5 to 3.0	4.5 to 5.5		Standard
	UPB1506GV	19	0.5 to 3.0	4.5 to 5.5	8 pin SSOP 175 mil	NEC original
	UPB1507GV	19	0.5 to 3.0	4.5 to 5.5		Standard

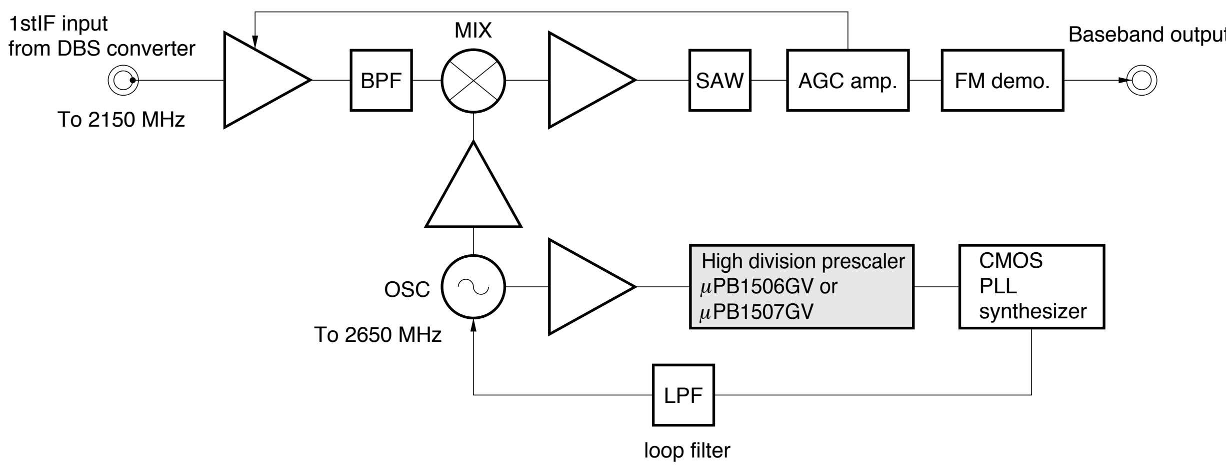
Remarks
- This table shows the TYP values of main parameters. Please refer to ELECTRICAL CHARACTERISTICS.
- UPB586G and UPB588G are discontinued.

INTERNAL BLOCK DIAGRAM

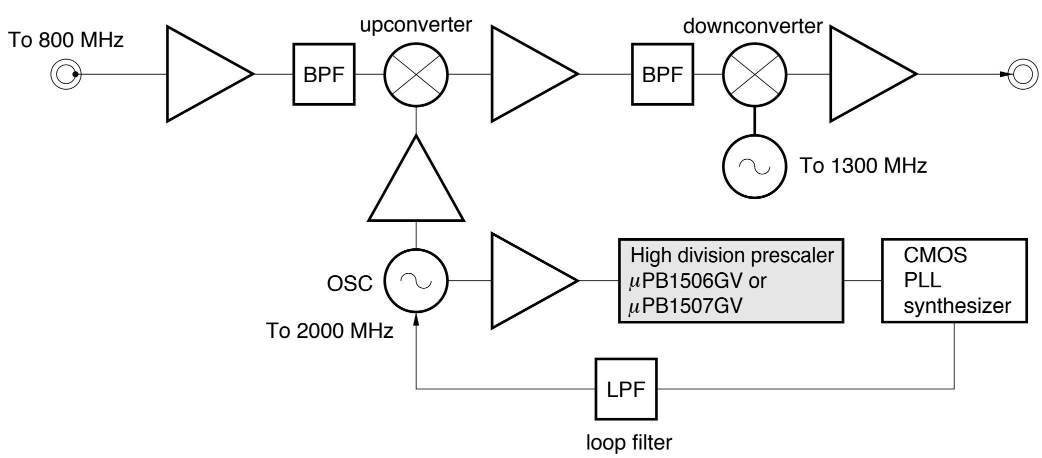


SYSTEM APPLICATION EXAMPLE

RF unit block of Analog DBS tuners



RF unit block of Analog CATV converter



PIN EXPLANATION

<table>
<tr><th rowspan="2">Pin name</th><th rowspan="2">Applied voltage V</th><th rowspan="2">Pin voltage V</th><th rowspan="2">Functions and explanation</th><th colspan="2">Pin no.</th></tr>
<tr><th>UPB1506GV</th><th>UPB1507GV</th></tr>
<tr><td>IN</td><td>–</td><td>2.9</td><td>Signal input pin. This pin should be coupled to signal source with capacitor (e.g. 1 000 pF) for DC cut.</td><td>2</td><td>1</td></tr>
<tr><td>$\overline{IN}$</td><td>–</td><td>2.9</td><td>Signal input bypass pin. This pin must be equipped with bypass capacitor (e.g. 1 000 pF) to minimize ground impedance.</td><td>3</td><td>8</td></tr>
<tr><td>GND</td><td>0</td><td>–</td><td>Ground pin. Ground pattern on the board should be formed as wide as possible to minimize ground impedance.</td><td>4</td><td>5</td></tr>
<tr><td>SW1</td><td rowspan="2">H/L</td><td rowspan="2">–</td><td rowspan="2">Divide ratio input pin. The ratio can be determined by following applied level to these pins.<table><tr><th colspan="2"></th><th colspan="2">SW2</th></tr><tr><th colspan="2"></th><th>H</th><th>L</th></tr><tr><td rowspan="2">SW1</td><td>H</td><td>÷64</td><td>÷128</td></tr><tr><td>L</td><td>÷128</td><td>÷256</td></tr></table>These pins should be equipped with bypass capacitor (e.g. 1 000 pF) to minimize ground impedance.</td><td>1</td><td>3</td></tr>
<tr><td>SW2</td><td>6</td><td>6</td></tr>
<tr><td>V_{CC}</td><td>4.5 to 5.5</td><td>–</td><td>Power supply pin. This pin must be equipped with bypass capacitor (e.g. 10 000 pF) to minimize ground impedance.</td><td>8</td><td>2</td></tr>
<tr><td>OUT</td><td>–</td><td>2.6 to 4.7</td><td>Divided frequency output pin. This pin is designed as emitter follower output. This pin can be connected to CMOS input due to 1.2 V_{P-P} MIN output.</td><td>7</td><td>4</td></tr>
<tr><td>NC</td><td>–</td><td>–</td><td>Non connection pin. This pin must be openned.</td><td>5</td><td>7</td></tr>
</table>

ABSOLUTE MAXIMUM RATINGS

PARAMETER	SYMBOL	CONDITION	RATINGS	UNIT
Supply voltage	V_{CC}	T_A = +25 °C	- 0.5 to +6.0	V
Input voltage	V_{in}	T_A = +25 °C	- 0.5 to V_{CC} + 0.5	V
Total power dissipation	P_D	Mounted on double sided copper clad 50 x 50 x 1.6 mm epoxy glass PWB (T_A = +85 °C)	250	mW
Operating ambient temperature	T_A		- 40 to +85	°C
Storage temperature	T_{stg}		- 55 to +150	°C

RECOMMENDED OPERATING CONDITIONS

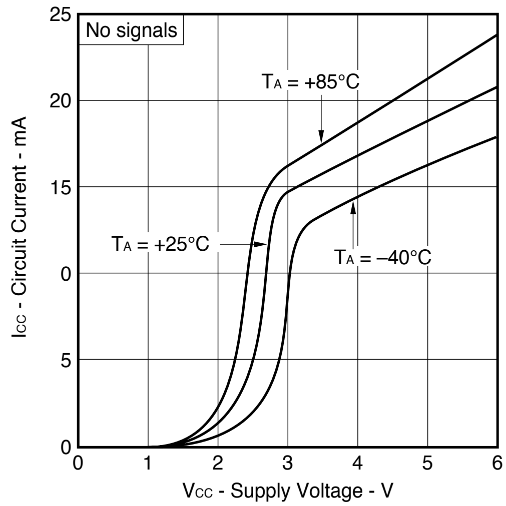
PARAMETER	SYMBOL	MIN.	TYP.	MAX.	UNIT	NOTICE
Supply voltage	V_{CC}	4.5	5.0	5.5	V	
Operating ambient temperature	T_A	- 40	+25	+85	°C	

ELECTRICAL CHARACTERISTICS (T_A = - 40 to +85 °C, V_{CC} = 4.5 to 5.5 V, Z_S = 50 Ω)

PARAMETER	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Circuit current	I_{CC}	No signals	12.5	19	26.5	mA
Upper limit operating frequency	$f_{in(u)}$	P_{in} = - 15 to +6 dBm	3.0	–	–	GHz
Lower limit operating frequency 1	$f_{in(L)1}$	P_{in} = - 10 to +6 dBm	–	–	0.5	GHz
Lower limit operating frequency 2	$f_{in(L)2}$	P_{in} = - 15 to +6 dBm	–	–	1.0	GHz
Input power 1	P_{in1}	f_{in} = 1.0 to 3.0 GHz	- 15	–	+6	dBm
Input power 2	P_{in2}	f_{in} = 0.5 to 1.0 GHz	- 10	–	+6	dBm
Output Voltage	V_{out}	C_L = 8 pF	1.2	1.6	–	V_{P-P}
Divide ratio control input high	V_{IH1}	Connection in the test circuit	V_{CC}	V_{CC}	V_{CC}	
Divide ratio control input low	V_{IL1}	Connection in the test circuit	OPEN or GND	OPEN or GND	OPEN or GND	
Divide ratio control input high	V_{IH2}	Connection in the test circuit	V_{CC}	V_{CC}	V_{CC}	
Divide ratio control input low	V_{IL2}	Connection in the test circuit	OPEN or GND	OPEN or GND	OPEN or GND	

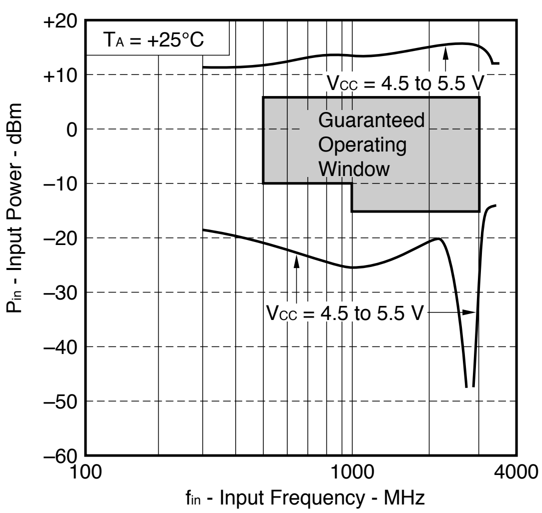
TYPICAL CHARACTERISTICS (Unless otherwise specified T_A = +25 °C)

CIRCUIT CURRENT vs. SUPPLY VOLTAGE

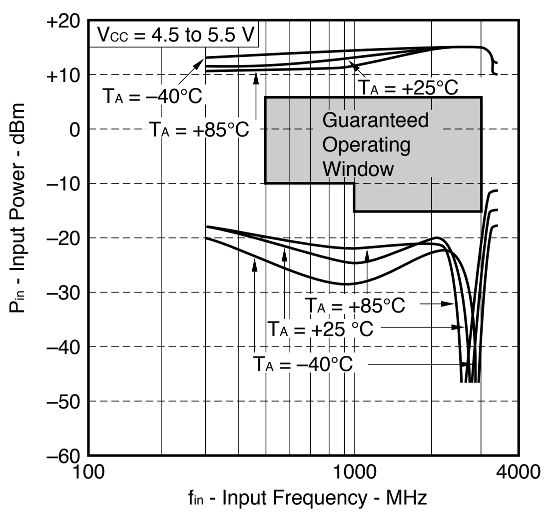


Divide by 64 mode

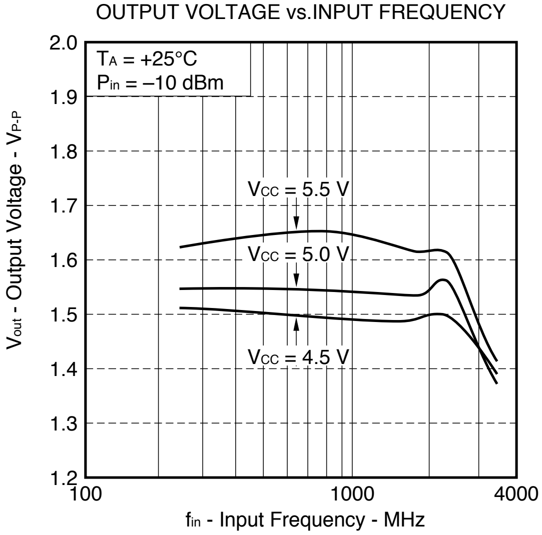
INPUT POWER vs. INPUT FREQUENCY



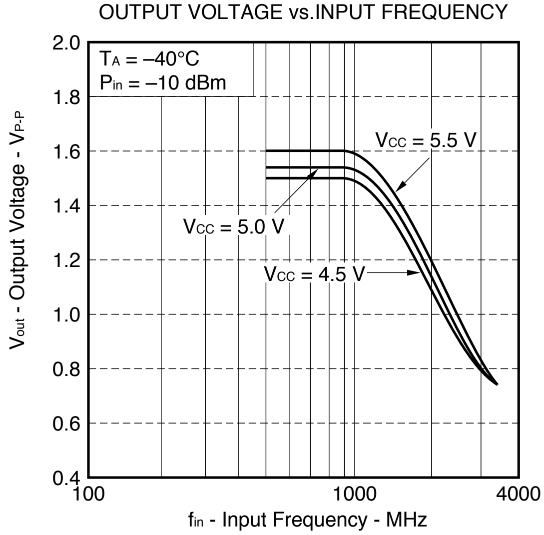
INPUT POWER vs. INPUT FREQUENCY



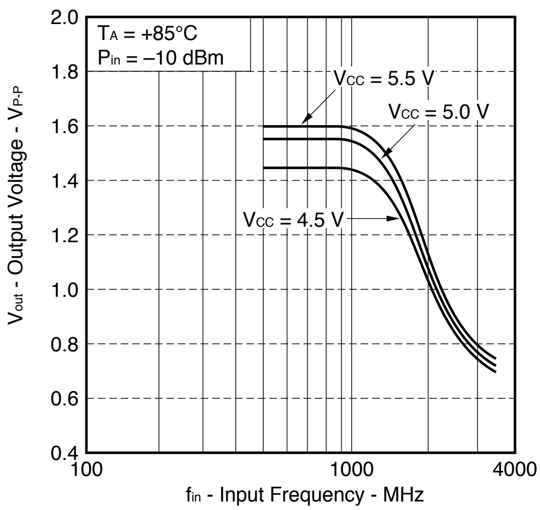
OUTPUT VOLTAGE vs.INPUT FREQUENCY



OUTPUT VOLTAGE vs.INPUT FREQUENCY

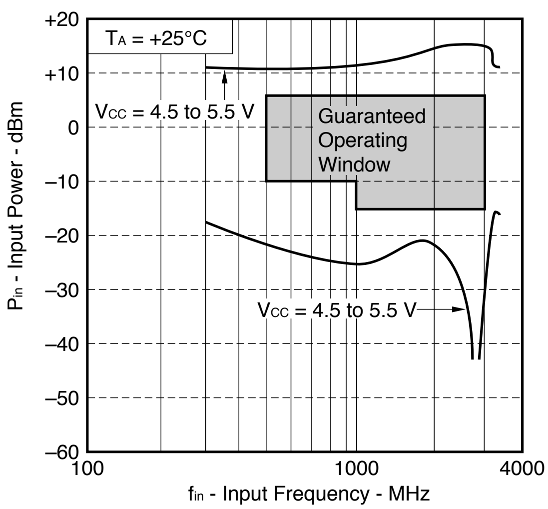


OUTPUT VOLTAGE vs. INPUT RFEQUENCY

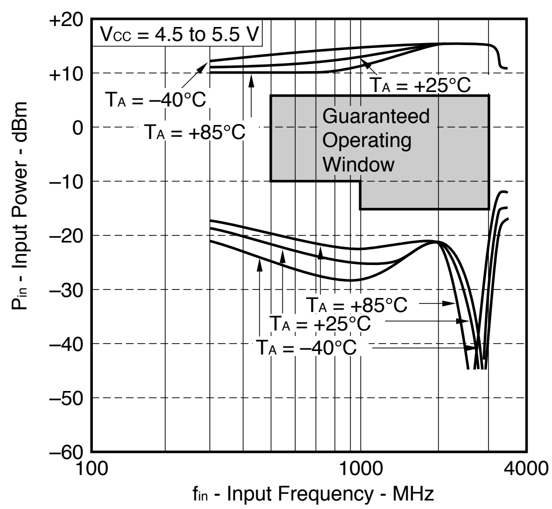


Divide by 128 mode

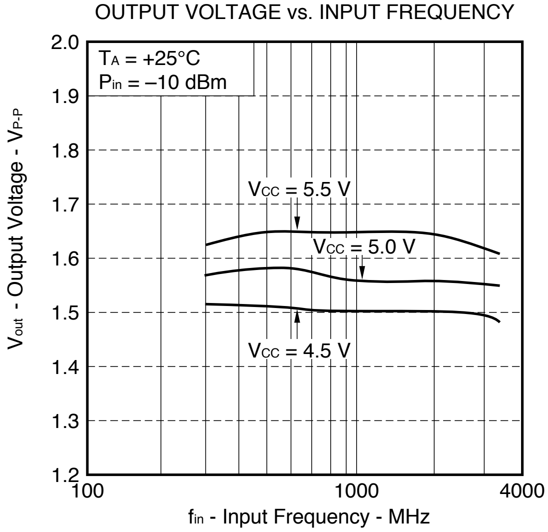
INPUT POWER vs. INPUT FREQUENCY



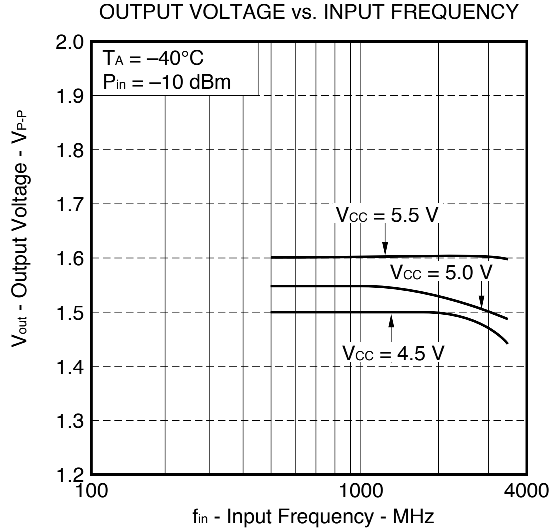
INPUT POWER vs. INPUT FREQUENCY



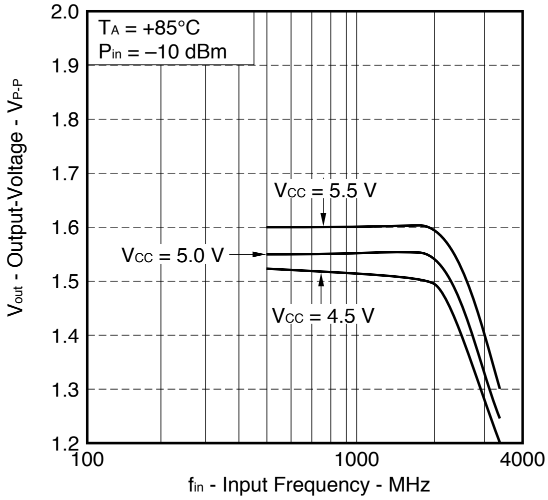
OUTPUT VOLTAGE vs. INPUT FREQUENCY



OUTPUT VOLTAGE vs. INPUT FREQUENCY

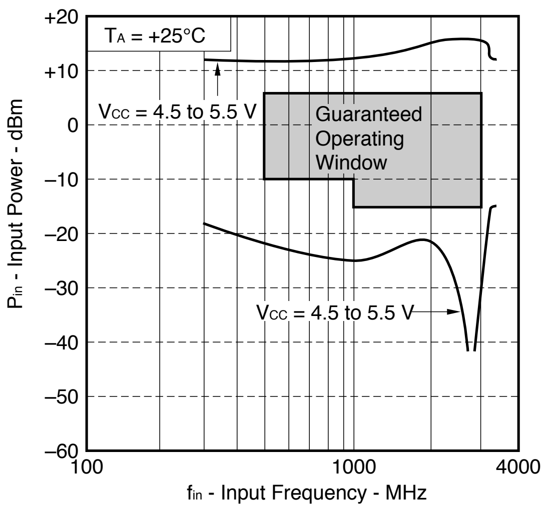


OUTPUT VOLTAGE vs. INPUT FREQUENCY

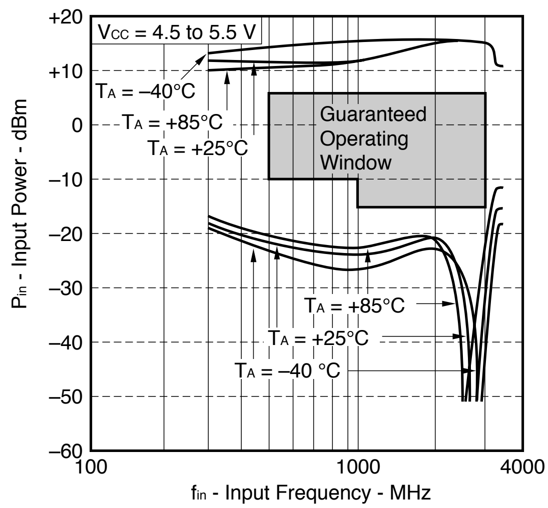


Divide by 256 mode

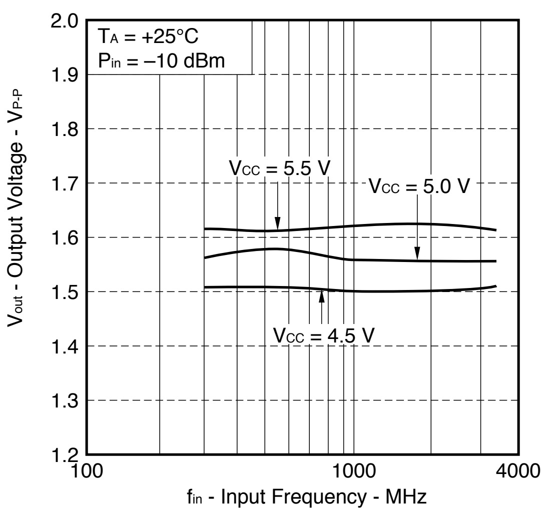
INPUT POWER vs. INPUT FREQUENCY



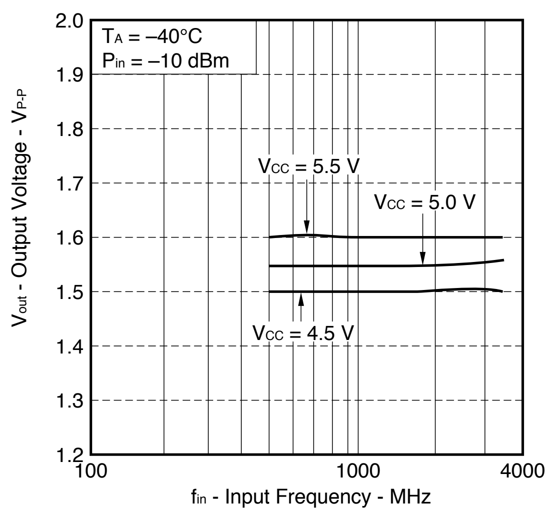
INPUT POWER vs. INPUT FREQUENCY

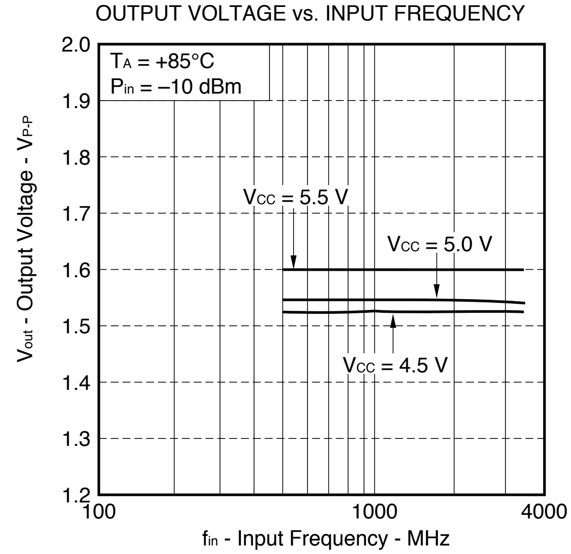


OUTPUT VOLTAGE vs. INPUT FREQUENCY



OUTPUT VOLTAGE vs. INPUT FREQUENCY

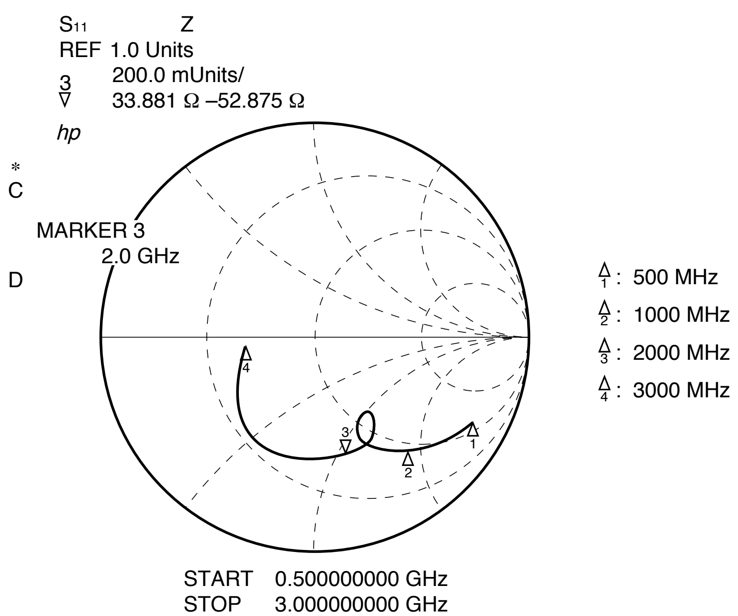




***U*PB1506GV**

S11 vs. INPUT FREQUENCY

VCC = 5.0 V

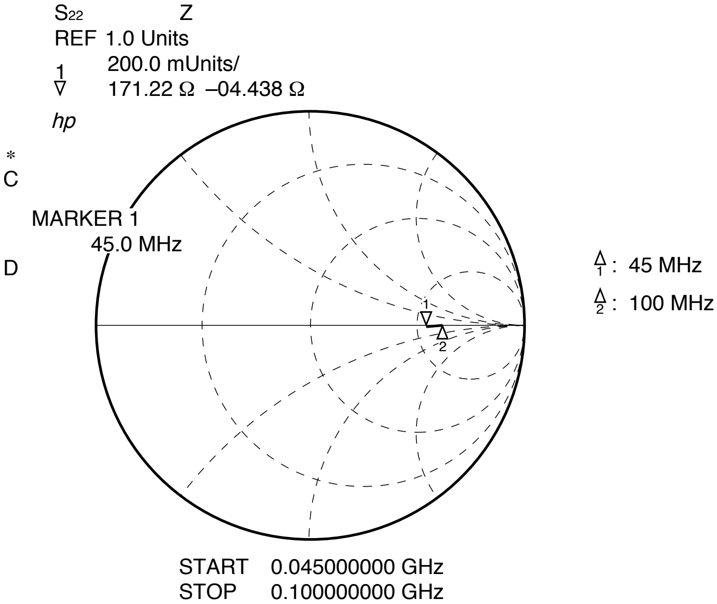


FREQUENCY MHz	S11 MAG	S11 ANG
500.0000	.868	–26.6
600.0000	.828	–32.6
700.0000	.794	–37.4
800.0000	.761	–41.9
900.0000	.721	–46.5
1000.0000	.706	–49.3
1100.0000	.662	–54.0
1200.0000	.629	–57.2
1300.0000	.595	–60.2
1400.0000	.554	–62.9
1500.0000	.516	–64.8
1600.0000	.440	–61.9
1700.0000	.428	–51.0
1800.0000	.543	–61.5
1900.0000	.555	–68.4
2000.0000	.560	–74.7
2100.0000	.558	–79.5
2200.0000	.564	–84.9
2300.0000	.570	–90.9
2400.0000	.574	–98.3
2500.0000	.574	–107.9
2600.0000	.564	–118.3
2700.0000	.530	–131.4
2800.0000	.476	–144.6
2900.0000	.411	–159.1
3000.0000	.331	–175.8

***U*PB1506GV**

S_{22} vs. OUTPUT FREQUENCY

Divide by 64 mode, V_{CC} = 5.0 V

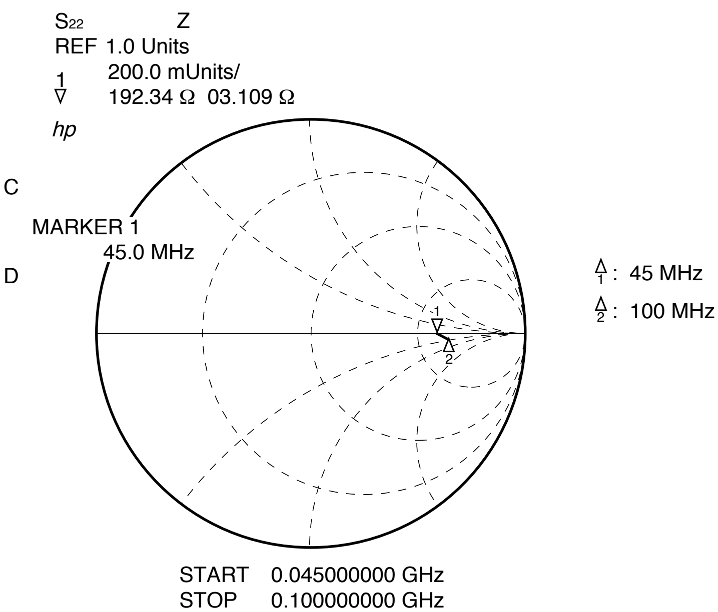


FREQUENCY	S_{22}	
MHz	MAG	ANG
45.000	.542	–1.4
50.000	.602	–.3
55.000	.616	0.0
60.000	.605	1.1
65.000	.609	.7
70.000	.616	.3
75.000	.620	.1
80.000	.622	0.0
85.000	.619	.6
90.000	.610	.9
95.000	.626	–.7
100.000	.623	–1.7

***U*PB1506GV**

S_{22} vs. OUTPUT FREQUENCY

Divide by 128 mode, V_{CC} = 5.0 V

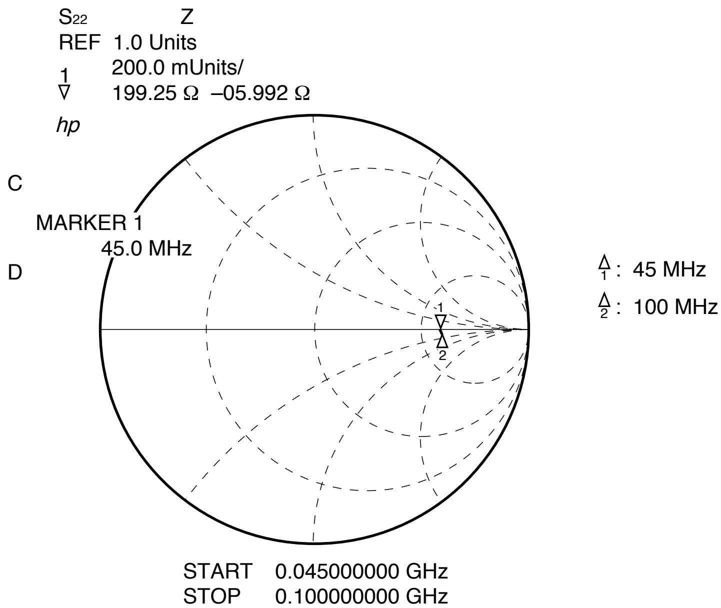


FREQUENCY	S_{22}	
MHz	MAG	ANG
45.000	.590	.4
50.000	.604	–1.0
55.000	.610	–1.1
60.000	.607	–.8
65.000	.548	–5.9
70.000	.630	–0.0
75.000	.615	–1.0
80.000	.618	–1.4
85.000	.617	–1.2
90.000	.616	–2.2
95.000	.623	–2.4
100.000	.624	–2.3

***U*PB1506GV**

S_{22} vs. OUTPUT FREQUENCY

Divide by 256 mode, V_{CC} = 5.0 V

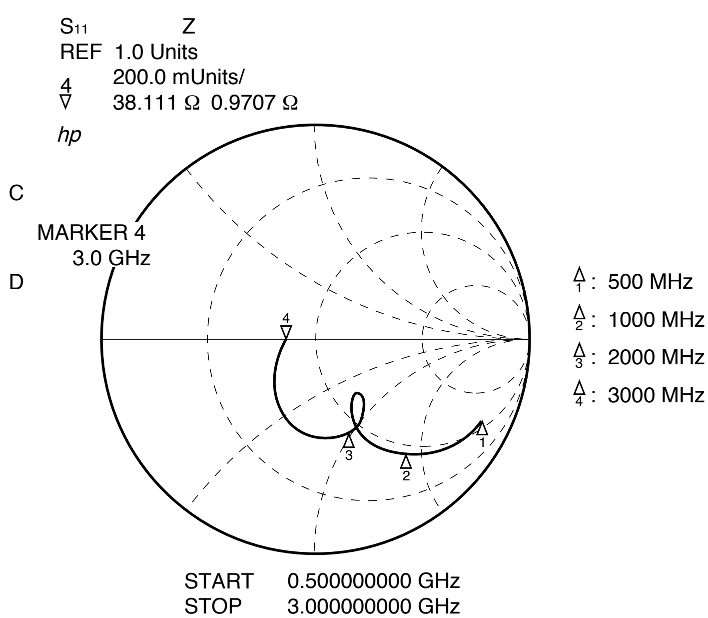


FREQUENCY MHz	S_{22} MAG	ANG
45.000	.601	–.9
50.000	.609	–1.6
55.000	.611	–1.5
60.000	.620	–1.4
65.000	.607	–2.1
70.000	.615	–1.9
75.000	.613	–3.2
80.000	.611	–2.8
85.000	.607	–2.5
90.000	.605	–2.4
95.000	.610	–3.0
100.000	.608	–2.8

***U*PB1507GV**

S_{11} vs. INPUT FREQUENCY

V_{CC} = 5.0 V

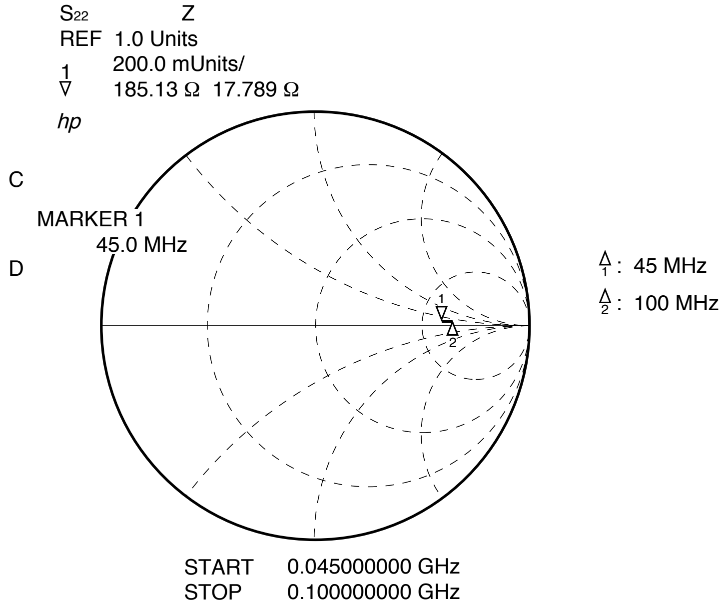


FREQUENCY MHz	S_{11} MAG	ANG
500.0000	.857	–27.5
600.0000	.849	–32.0
700.0000	.800	–38.9
800.0000	.764	–43.8
900.0000	.725	–49.0
1000.0000	.665	–50.9
1100.0000	.619	–55.3
1200.0000	.573	–59.3
1300.0000	.531	–61.3
1400.0000	.484	–62.8
1500.0000	.439	–63.0
1600.0000	.377	–59.1
1700.0000	.340	–54.1
1800.0000	.377	–54.7
1900.0000	.441	–59.5
2000.0000	.464	–67.2
2100.0000	.443	–67.4
2200.0000	.466	–74.5
2300.0000	.465	–81.3
2400.0000	.454	–89.4
2500.0000	.433	–99.2
2600.0000	.383	–109.6
2700.0000	.350	–114.0
2800.0000	.332	–124.2
2900.0000	.271	–141.2
3000.0000	.185	–163.6

UPB1507GV

S_{22} vs. OUTPUT FREQUENCY

Divide by 64 mode, V_{CC} = 5.0 V

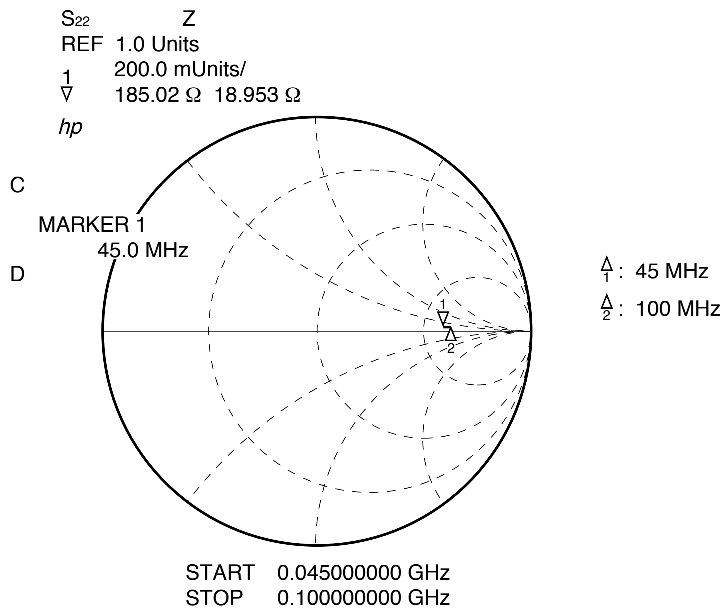


FREQUENCY MHz	S_{22} MAG	ANG
45.000	.580	3.4
50.000	.572	2.5
55.000	.574	3.0
60.000	.574	2.7
65.000	.584	3.0
70.000	.587	2.6
75.000	.592	2.4
80.000	.587	2.6
85.000	.589	2.9
90.000	.591	2.9
95.000	.573	1.7
100.000	.604	2.9

UPB1507GV

S_{22} vs. OUTPUT FREQUENCY

Divide by 128 mode, V_{CC} = 5.0 V

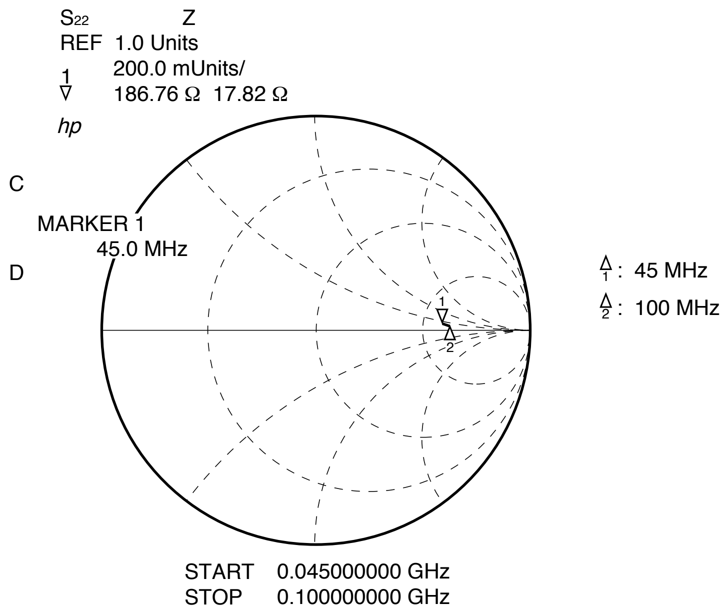


FREQUENCY MHz	S_{22} MAG	ANG
45.000	.578	3.2
50.000	.571	2.8
55.000	.572	3.3
60.000	.576	3.0
65.000	.584	3.1
70.000	.587	2.8
75.000	.589	2.4
80.000	.589	2.8
85.000	.588	3.0
90.000	.593	2.8
95.000	.598	3.0
100.000	.602	2.9

UPB1507GV

S_{22} vs. OUTPUT FREQUENCY

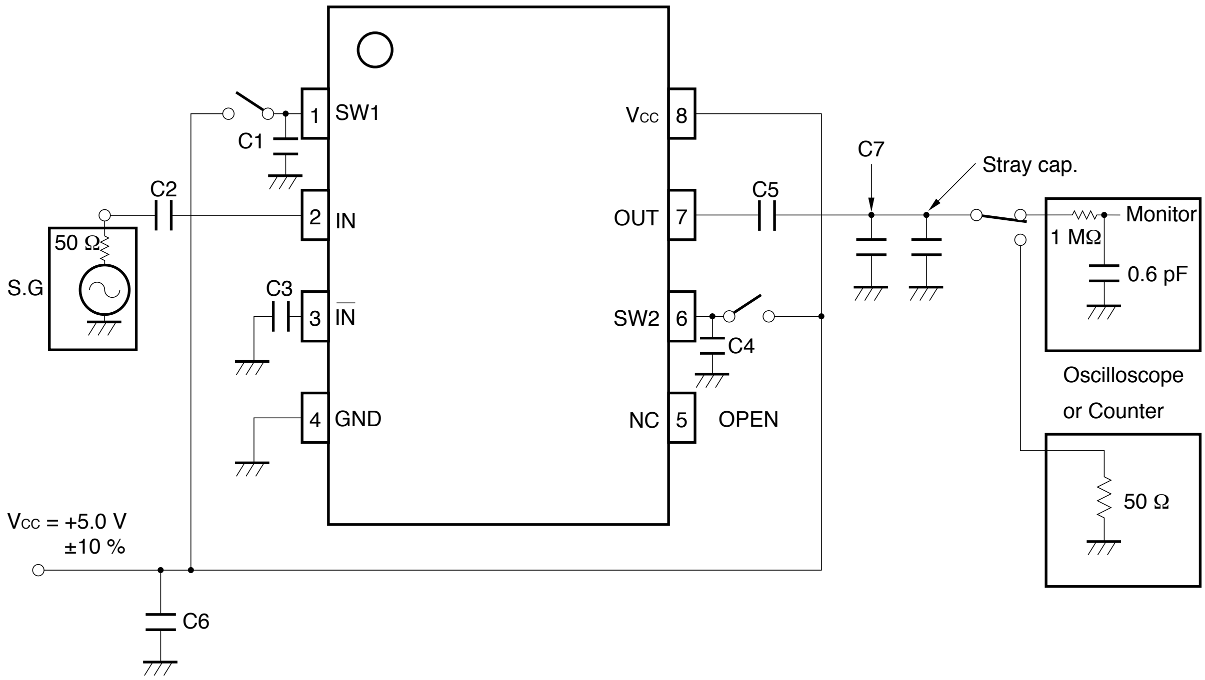
Divide by 256 mode, V_{CC} = 5.0 V



FREQUENCY MHz	S_{22} MAG	ANG
45.000	.580	3.0
50.000	.572	2.8
55.000	.571	2.9
60.000	.576	2.9
65.000	.585	3.2
70.000	.590	2.8
75.000	.589	2.5
80.000	.590	2.6
85.000	.588	2.9
90.000	.597	2.9
95.000	.600	3.1
100.000	.601	3.1

TEST CIRCUIT

***U*PB1506GV**



- SG (HP-8665A)
- Counter (HP5350B) : To measure input sensitivity
  or
  Oscilloscope : To measure output voltage swing

Divide ratio setting

		SW2	
		H	L
SW1	H	1/64	1/128
	L	1/128	1/256

H: Connect to Vcc

L: Connect to GND or OPEN

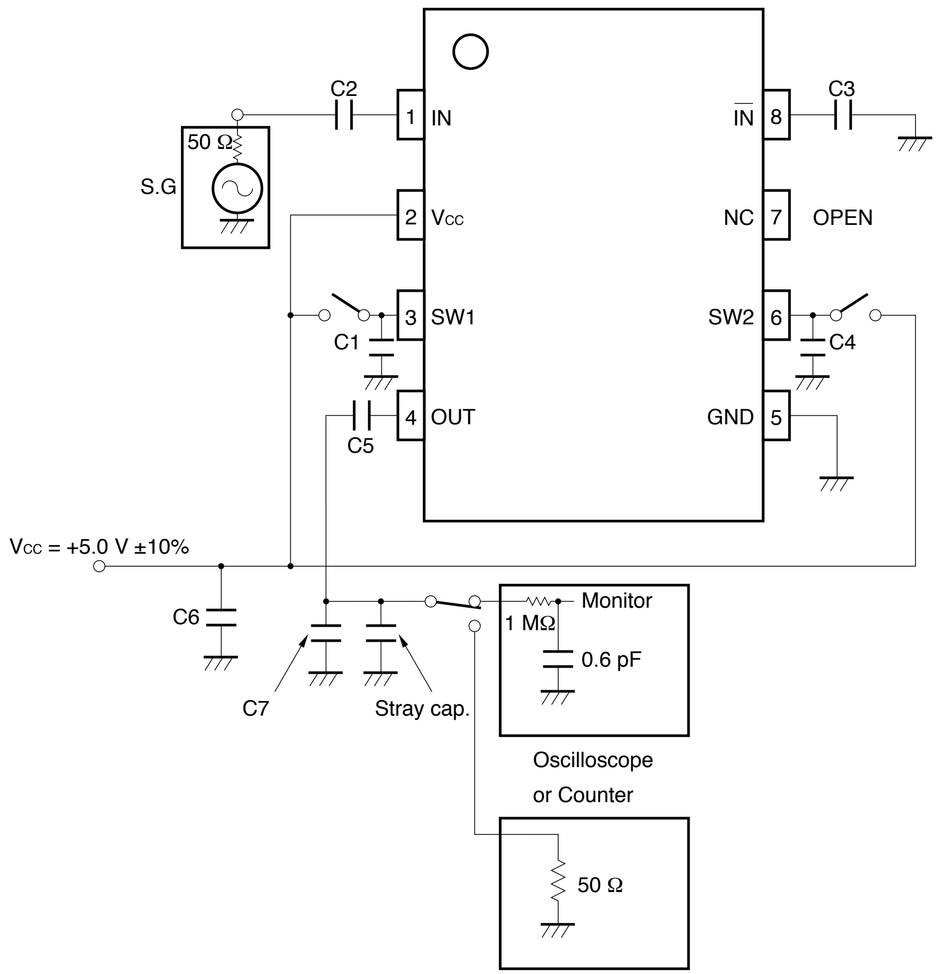
COMPONENT LIST

	*U*PB1506GV	*U*PB1507GV
C1 to C5	1 000 pF	1 000 pF
C6	10 000 pF	10 000 pF
Stray cap.	Aprox 4 pF	Aprox 5 pF
C7	3.5 pF*	2.5 pF*

* Capacitance C_L = 8 pF for DUT includes C7 value + stray capacitance on the board and measurement equipment.

TEST CIRCUIT

*U*PB1507GV



- SG (HP-8665A)
- Counter (HP5350B) : To measure input sensitivity

  or

  Oscilloscope : To measure output voltage swing

Divide ratio setting

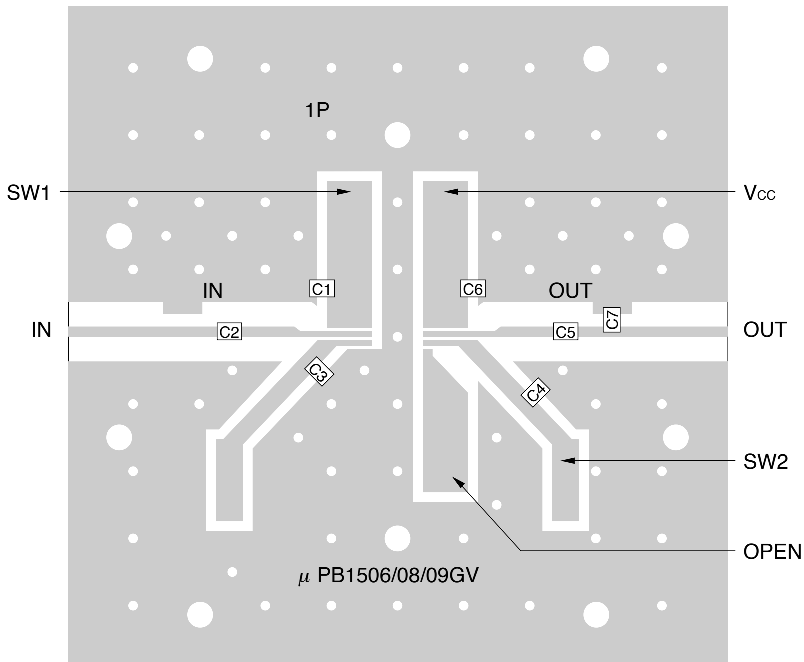
		SW2	
		H	L
SW1	H	1/64	1/128
	L	1/128	1/256

H: Connect to V_{CC}

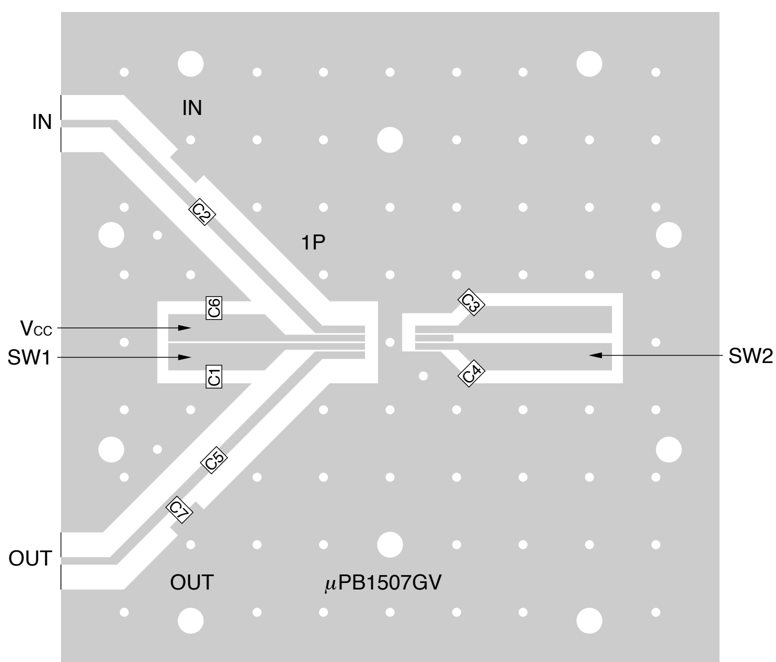
L: Connect to GND or OPEN

ILLUSTRATION OF THE TEST CIRCUIT ASSEMBLED ON EVALUATION BOARD

*U*PB1506GV



*U*PB1507GV

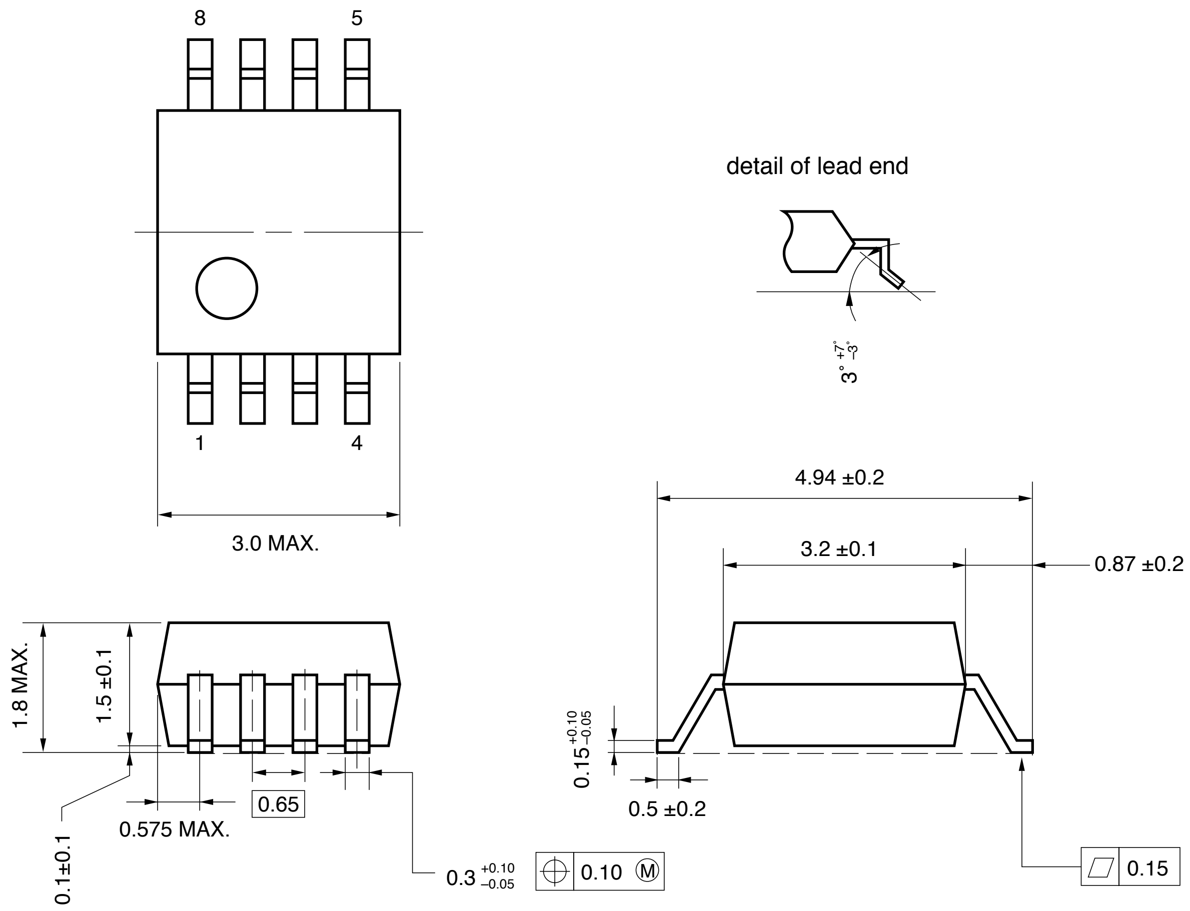


EVALUATION BOARD CHARACTERS

(1) 35μm thick double-sided copper clad 50 □50 □0.4 mm polyimide board
(2) Back side: GND pattern
(3) Solder plated patterns
(4) o ◯ : Through holes

PACKAGE DIMENSIONS

8 PIN PLASTIC SSOP (UNIT: mm) (175 mil)



NOTE 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 undesired operation).
(3) Keep the wiring length of the ground pins as short as possible.
(4) Connect a bypass capacitor (e.g. 10 000 pF) to the V_{CC} pin.

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.

***U*PB1506GV, *U*PB1507GV**

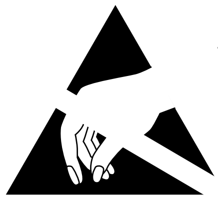
Soldering method	Soldering conditions	Recommended condition symbol
Infrared ray reflow	Package peak temperature: 235 °C, Hour: within 30 s. (more than 210 °C), Time: 3 times, Limited days: no.*	IR35-00-3
VPS	Package peak temperature: 215 °C, Hour: within 40 s. (more than 200 °C), Time: 3 times, Limited days: no.*	VP15-00-3
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.

Caution 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 (C10535E).

[MEMO]



ATTENTION

OBSERVE PRECAUTIONS
FOR HANDLING
ELECTROSTATIC
SENSITIVE
DEVICES

NEC Corporation does not assume any liability for infringement of patents, copyrights or other intellectual property rights of third parties by or arising from use of a device described herein or any other liability arising from use of such device. No license, either express, implied or otherwise, is granted under any patents, copyrights or other intellectual property rights of NEC Corporation or others.

While NEC Corporation has been making continuous effort to enhance the reliability of its semiconductor devices, the possibility of defects cannot be eliminated entirely. To minimize risks of damage or injury to persons or property arising from a defect in an NEC semiconductor device, customers must incorporate sufficient safety measures in its design, such as redundancy, fire-containment, and anti-failure features.

NEC devices are classified into the following three quality grades:

"Standard", "Special", and "Specific". The Specific quality grade applies only to devices developed based on a customer designated "quality assurance program" for a specific application. The recommended applications of a device depend on its quality grade, as indicated below. Customers must check the quality grade of each device before using it in a particular application.

- 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.

The quality grade of NEC devices is "Standard" unless otherwise specified in NEC's Data Sheets or Data Books. If customers intend to use NEC devices for applications other than those specified for Standard quality grade, they should contact an NEC sales representative in advance.

Anti-radioactive design is not implemented in this product.

M4 96.5

CEL California Eastern Laboratories

4590 Patrick Henry Drive
Santa Clara, CA 95054-1817
Telephone: (408) 919-2500
Facsimile: (408) 988-0279

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 per RoHS	Concentration Limit per RoHS (values are not yet fixed)	Concentration contained in CEL devices	
Lead (Pb)	< 1000 PPM	-A	-AZ
		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.

Important Information and Disclaimer: Information provided by CEL on its website or in other communications concerning the substance content of its products represents knowledge and belief as of the date that it is provided. CEL bases its knowledge and belief on information provided by third parties and makes no representation or warranty as to the accuracy of such information. Efforts are underway to better integrate information from third parties. CEL has taken and continues to take reasonable steps to provide representative and accurate information but may not have conducted destructive testing or chemical analysis on incoming materials and chemicals. CEL and CEL suppliers consider certain information to be proprietary, and thus CAS numbers and other limited information may not be available for release.
In no event shall CEL's liability arising out of such information exceed the total purchase price of the CEL part(s) at issue sold by CEL to customer on an annual basis.
See CEL Terms and Conditions for additional clarification of warranties and liability.