

# BIPOLAR DIGITAL INTEGRATED CIRCUITS

# $\mu$ PB1506GV, $\mu$ PB1507GV

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

The  $\mu$ PB1506GV and  $\mu$ PB1507GV 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  $\mu$ PB1506GV/ $\mu$ PB1507GV are shrink package versions of the  $\mu$ PB586G/588G or  $\mu$ PB1505GR so that these smaller packages contribute to reduce the mounting space replacing from conventional ICs.

The  $\mu$ PB1506GV and  $\mu$ PB1507GV are manufactured using NEC's high fr 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 :  $f_{in} = 0.5 \text{ GHz to } 3.0 \text{ GHz}$
- High-density surface mounting : 8-pin plastic SSOP (175 mil)
- Low current consumption : 5 V, 19 mA
- Selectable high division :  $\div 256, \div 128, \div 64$
- Pin connection variation :  $\mu$ PB1506GV and  $\mu$ PB1507GV

#### 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

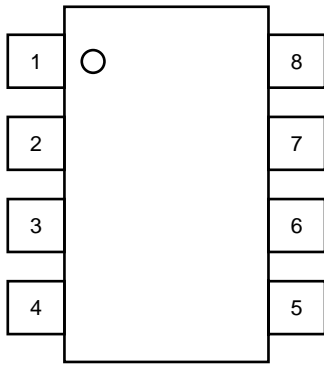
#### ORDERING INFORMATION

PART NUMBER	PACKAGE	MARKING	SUPPLYING FORM
$\mu$ PB1506GV-E1	8-pin plastic	1506	Embossed tape 8 mm wide. Pin 1 is in tape pull-out direction. 1 000 p/reel.
$\mu$ PB1507GV-E1	SSOP (175 mil)	1507	

**Remarks** To order evaluation samples, please contact your local NEC sales office.  
(Part number for sample order:  $\mu$ PB1506GV,  $\mu$ PB1507GV)

**Caution: Electro-static sensitive devices**

**PIN CONNECTION (Top View)**



Pin NO.	$\mu$ PB1506GV	$\mu$ PB1507GV
1	SW1	IN
2	IN	V <sub>CC</sub>
3	$\overline{\text{IN}}$	SW1
4	GND	OUT
5	NC	GND
6	SW2	SW2
7	OUT	NC
8	V <sub>CC</sub>	$\overline{\text{IN}}$

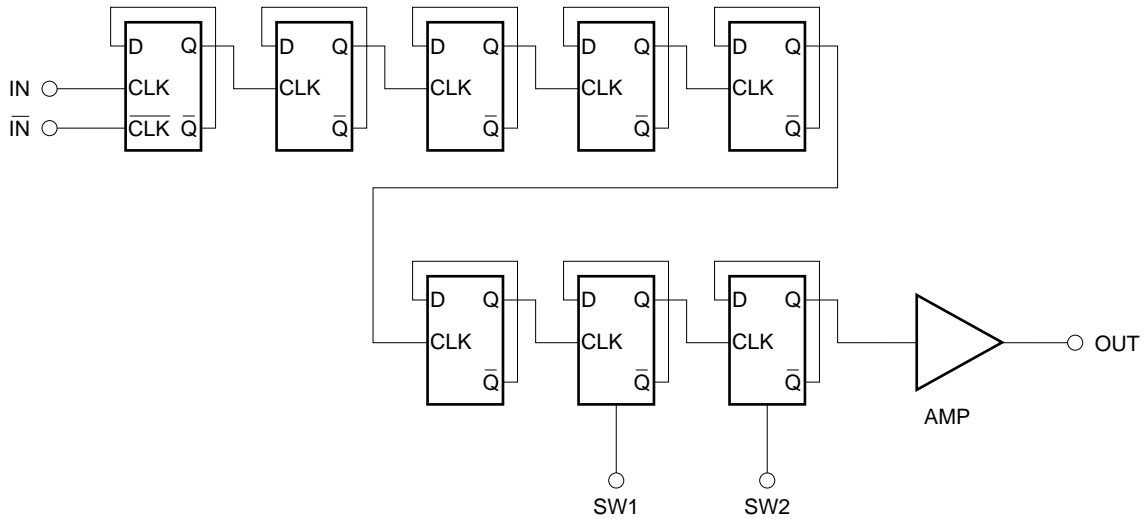
**PRODUCT LINE-UP**

Features (division, Freq.)	Part No.	I <sub>CC</sub> (mA)	f <sub>in</sub> (GHz)	V <sub>CC</sub> (V)	Package	Pin connection
÷512, ÷256, 2.5 GHz	$\mu$ PB586G	28	0.5 to 2.5	4.5 to 5.5	8 pin SOP 225 mil	NEC original
÷128, ÷64, 2.5 GHz	$\mu$ PB588G	26	0.5 to 2.5	4.5 to 5.5		
÷256, ÷128, ÷64	$\mu$ PB1505GR	14	0.5 to 3.0	4.5 to 5.5		Standard
3.0 GHz	$\mu$ PB1506GV	19	0.5 to 3.0	4.5 to 5.5	8 pin SSOP 175 mil	NEC original
	$\mu$ PB1507GV	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.

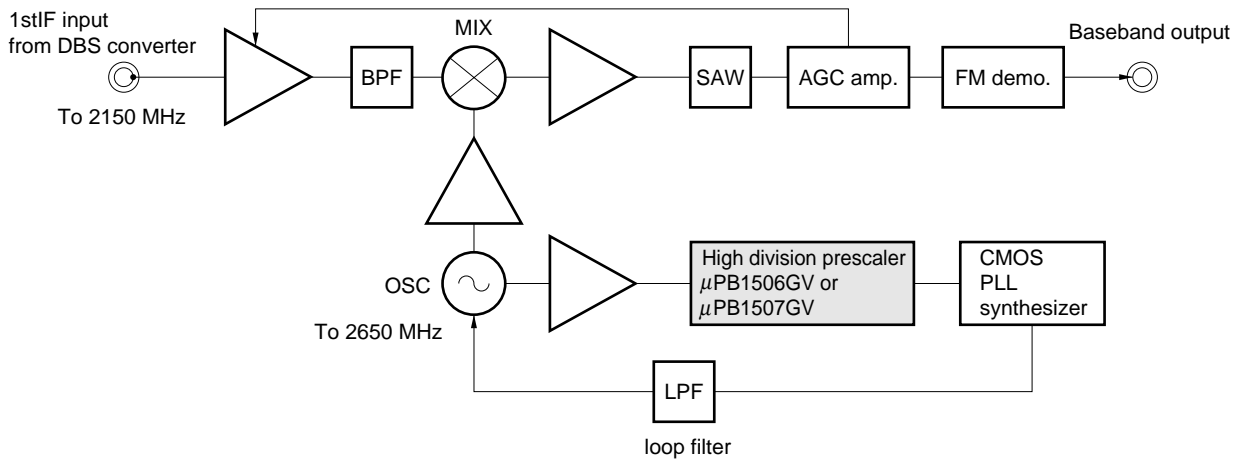
- $\mu$ PB586G and  $\mu$ PB588G are discontinued.

**INTERNAL BLOCK DIAGRAM**

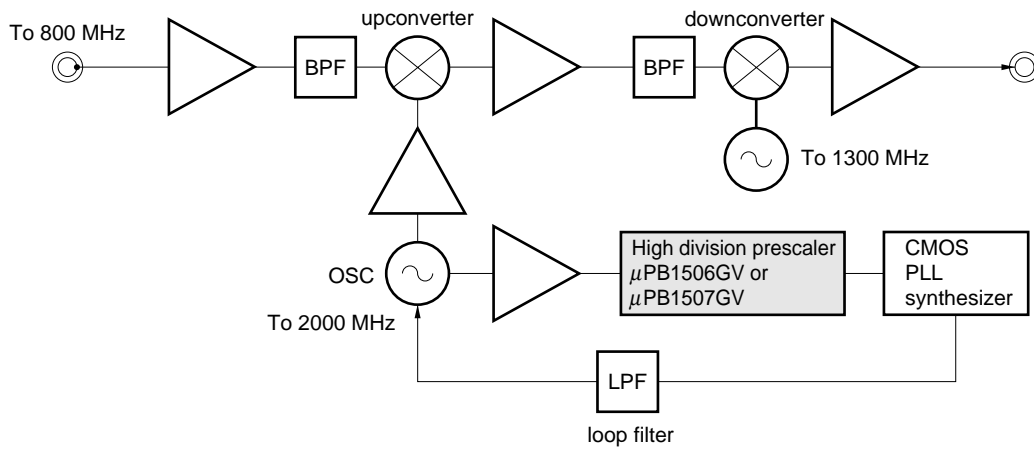


SYSTEM APPLICATION EXAMPLE

RF unit block of Analog DBS tuners



RF unit block of Analog CATV converter



PIN EXPLANATION

Pin name	Applied voltage V	Pin voltage V	Functions and explanation	Pin no.														
				μPB1506GV	μPB1507GV													
IN	—	2.9	Signal input pin. This pin should be coupled to signal source with capacitor (e.g. 1 000 pF) for DC cut.	2	1													
$\overline{\text{IN}}$	—	2.9	Signal input bypass pin. This pin must be equipped with bypass capacitor (e.g. 1 000 pF) to minimize ground impedance.	3	8													
GND	0	—	Ground pin. Ground pattern on the board should be formed as wide as possible to minimize ground impedance.	4	5													
SW1	H/L	—	Divide ratio input pin. The ratio can be determined by following applied level to these pins. <table border="1" style="margin: 10px auto;"> <tr> <td colspan="2" rowspan="2"></td> <td colspan="2">SW2</td> </tr> <tr> <td>H</td> <td>L</td> </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.			SW2		H	L	SW1	H	÷64	÷128	L	÷128	÷256	1	3
		SW2																
		H	L															
SW1	H	÷64	÷128															
	L	÷128	÷256															
SW2				6	6													
Vcc	4.5 to 5.5	—	Power supply pin. This pin must be equipped with bypass capacitor (e.g. 10 000 pF) to minimize ground impedance.	8	2													
OUT	—	2.6 to 4.7	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 <sub>P-P</sub> MIN output.	7	4													
NC	—	—	Non connection pin. This pin must be opened.	5	7													

**ABSOLUTE MAXIMUM RATINGS**

PARAMETER	SYMBOL	CONDITION	RATINGS	UNIT
Supply voltage	V <sub>CC</sub>	T <sub>A</sub> = +25 °C	-0.5 to +6.0	V
Input voltage	V <sub>in</sub>	T <sub>A</sub> = +25 °C	-0.5 to V <sub>CC</sub> + 0.5	V
Total power dissipation	P <sub>D</sub>	Mounted on double sided copper clad 50 × 50 × 1.6 mm epoxy glass PWB (T <sub>A</sub> = +85 °C)	250	mW
Operating ambient temperature	T <sub>A</sub>		-40 to +85	°C
Storage temperature	T <sub>stg</sub>		-55 to +150	°C

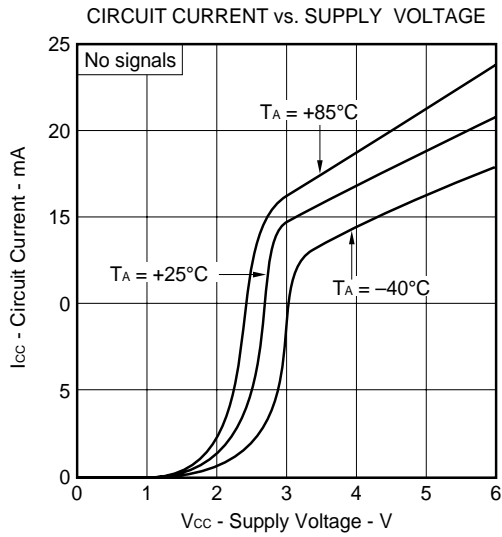
**RECOMMENDED OPERATING CONDITIONS**

PARAMETER	SYMBOL	MIN.	TYP.	MAX.	UNIT	NOTICE
Supply voltage	V <sub>CC</sub>	4.5	5.0	5.5	V	
Operating ambient temperature	T <sub>A</sub>	-40	+25	+85	°C	

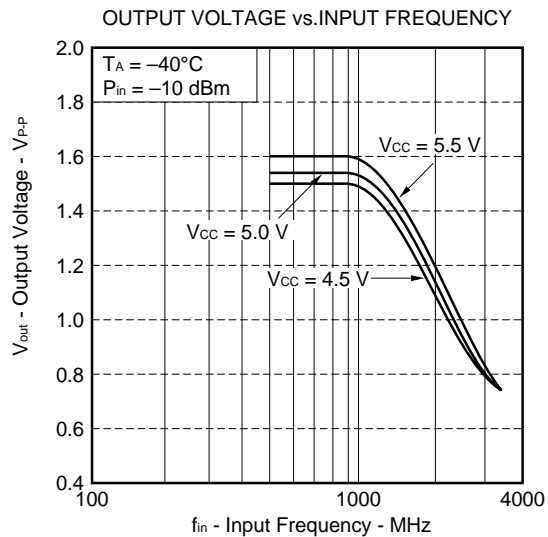
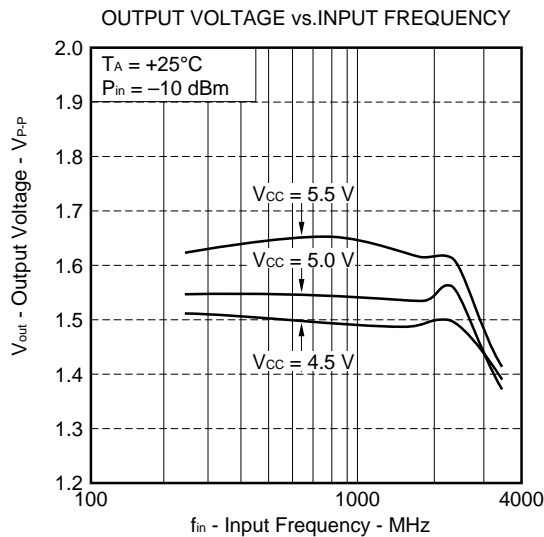
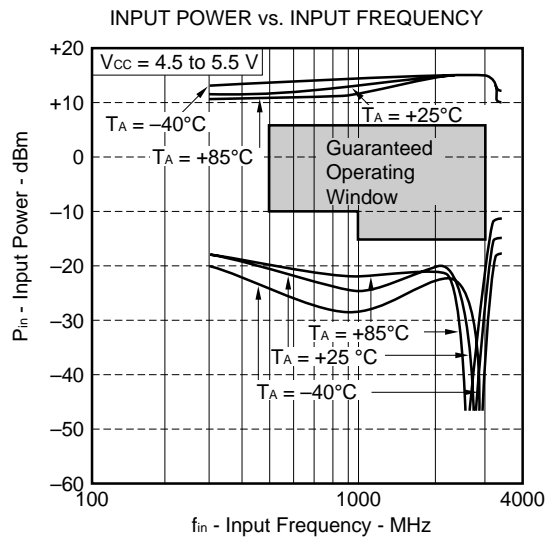
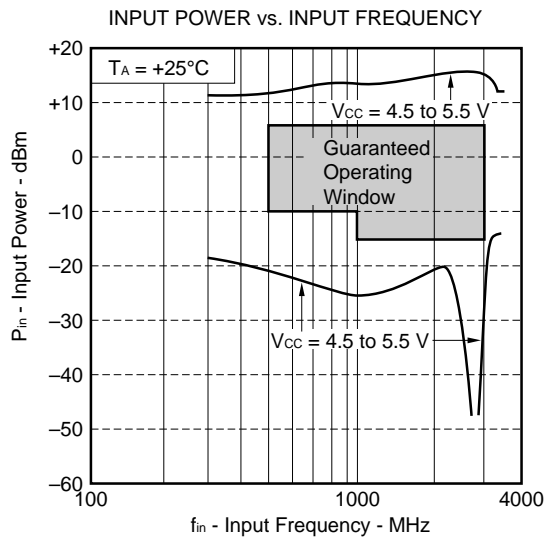
**ELECTRICAL CHARACTERISTICS (T<sub>A</sub> = -40 to +85 °C, V<sub>CC</sub> = 4.5 to 5.5 V, Z<sub>s</sub> = 50 Ω)**

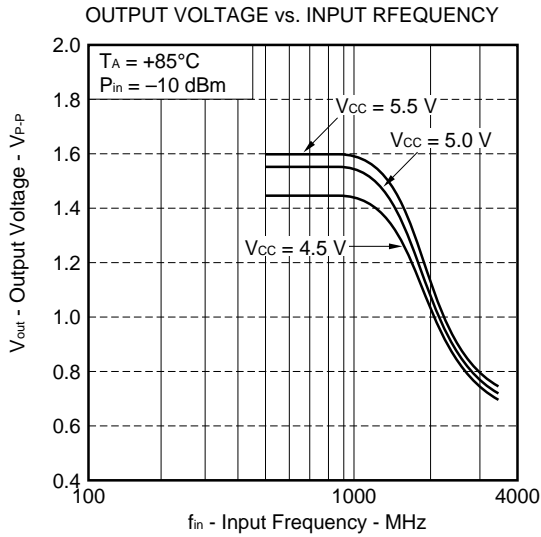
PARAMETER	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Circuit current	I <sub>CC</sub>	No signals	12.5	19	26.5	mA
Upper limit operating frequency	f <sub>in(u)</sub>	P <sub>in</sub> = -15 to +6 dBm	3.0	—	—	GHz
Lower limit operating frequency 1	f <sub>in(L)1</sub>	P <sub>in</sub> = -10 to +6 dBm	—	—	0.5	GHz
Lower limit operating frequency 2	f <sub>in(L)2</sub>	P <sub>in</sub> = -15 to +6 dBm	—	—	1.0	GHz
Input power 1	P <sub>in1</sub>	f <sub>in</sub> = 1.0 to 3.0 GHz	-15	—	+6	dBm
Input power 2	P <sub>in2</sub>	f <sub>in</sub> = 0.5 to 1.0 GHz	-10	—	+6	dBm
Output Voltage	V <sub>out</sub>	C <sub>L</sub> = 8 pF	1.2	1.6	—	V <sub>P-P</sub>
Divide ratio control input high	V <sub>IH1</sub>	Connection in the test circuit	V <sub>CC</sub>	V <sub>CC</sub>	V <sub>CC</sub>	
Divide ratio control input low	V <sub>IL1</sub>	Connection in the test circuit	OPEN or GND	OPEN or GND	OPEN or GND	
Divide ratio control input high	V <sub>IH2</sub>	Connection in the test circuit	V <sub>CC</sub>	V <sub>CC</sub>	V <sub>CC</sub>	
Divide ratio control input low	V <sub>IL2</sub>	Connection in the test circuit	OPEN or GND	OPEN or GND	OPEN or GND	

TYPICAL CHARACTERISTICS (Unless otherwise specified  $T_A = +25^\circ\text{C}$ )

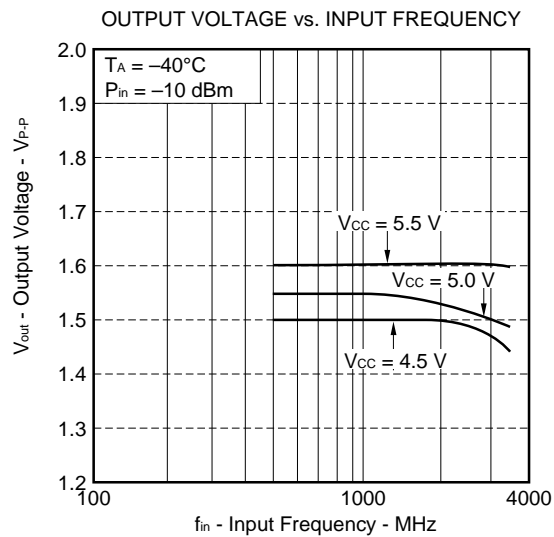
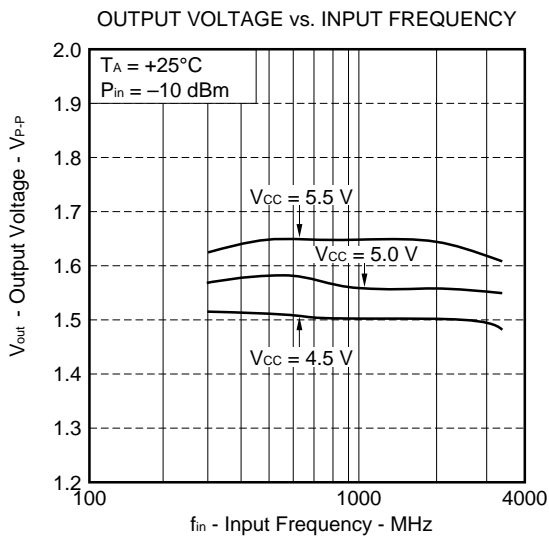
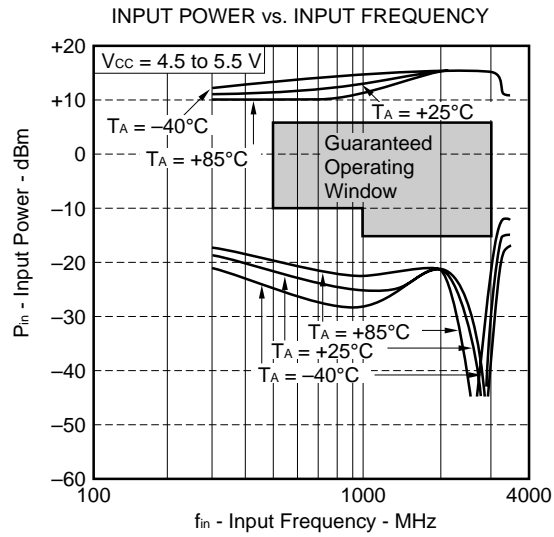
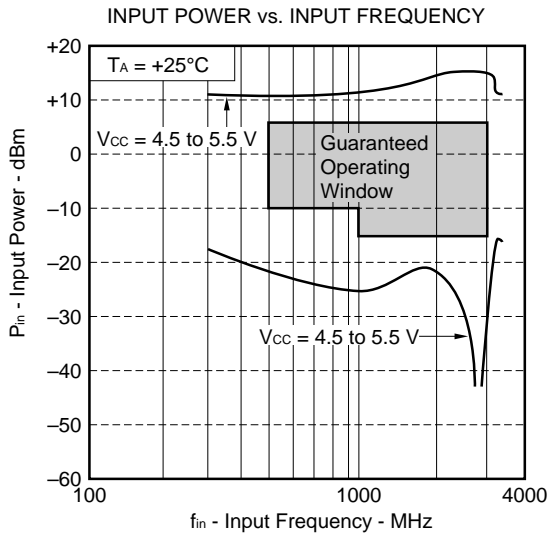


Divide by 64 mode

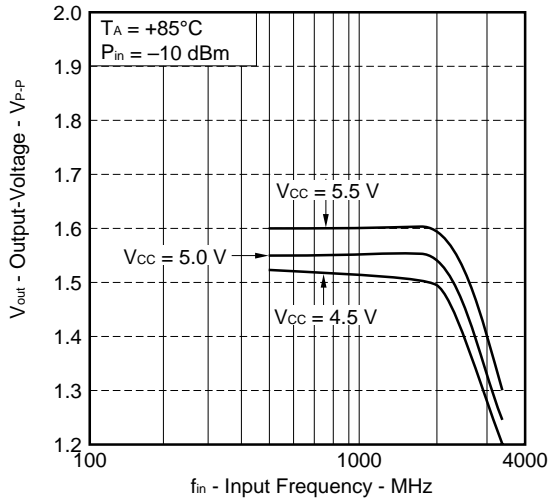




Divide by 128 mode

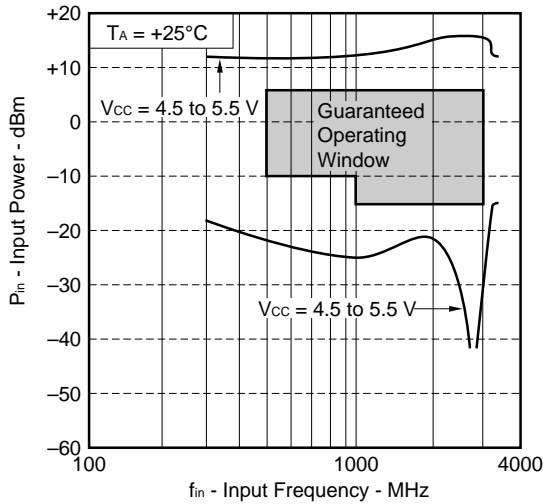


OUTPUT VOLTAGE vs. INPUT FREQUENCY

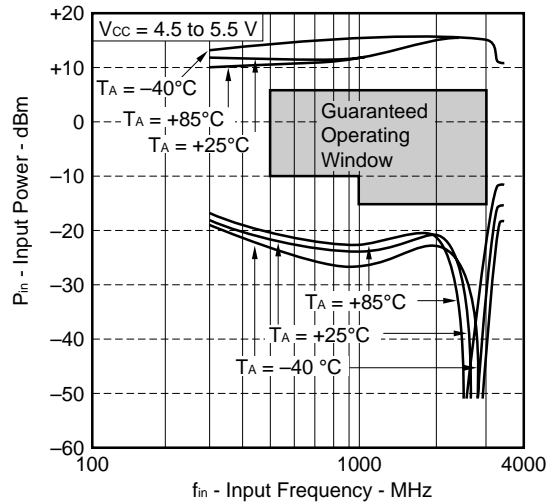


Divide by 256 mode

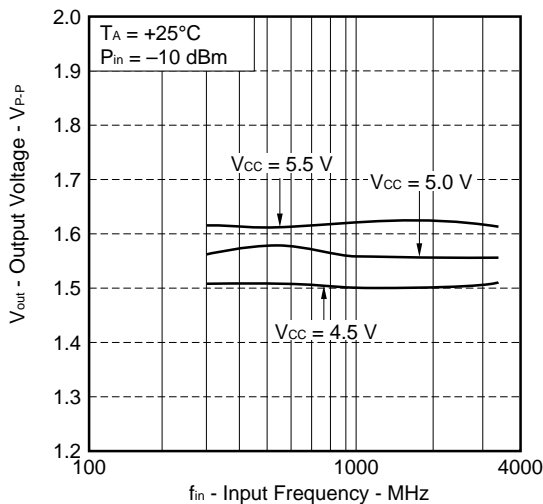
INPUT POWER vs. INPUT FREQUENCY



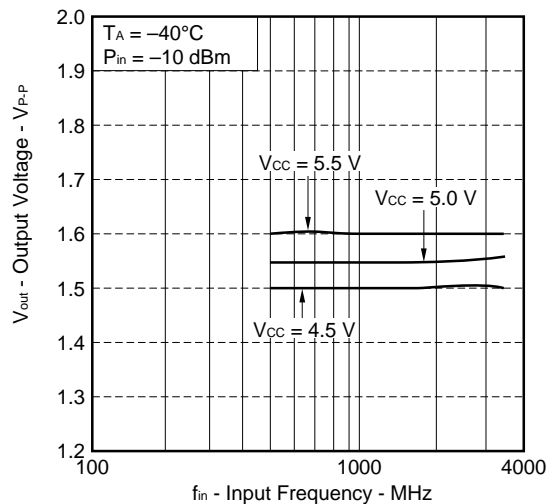
INPUT POWER vs. INPUT FREQUENCY

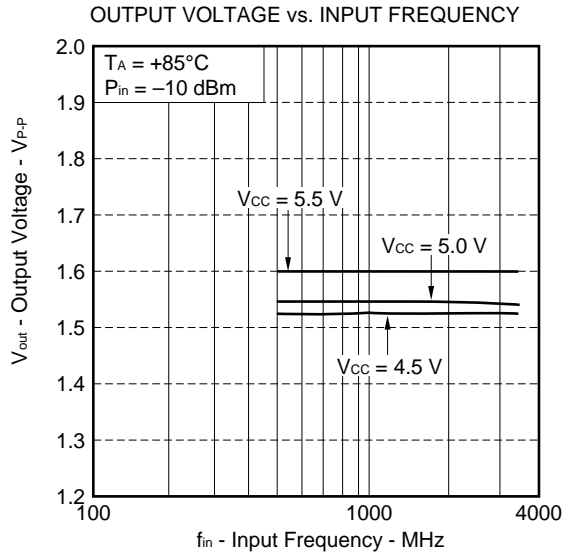


OUTPUT VOLTAGE vs. INPUT FREQUENCY



OUTPUT VOLTAGE vs. INPUT FREQUENCY

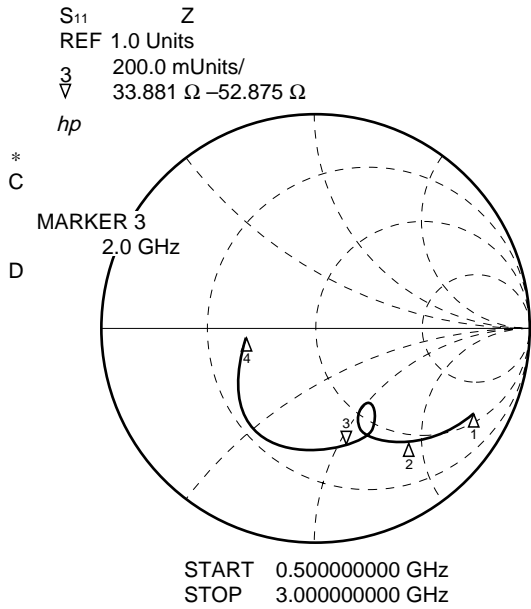




$\mu$ PB1506GV

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

V<sub>CC</sub> = 5.0 V



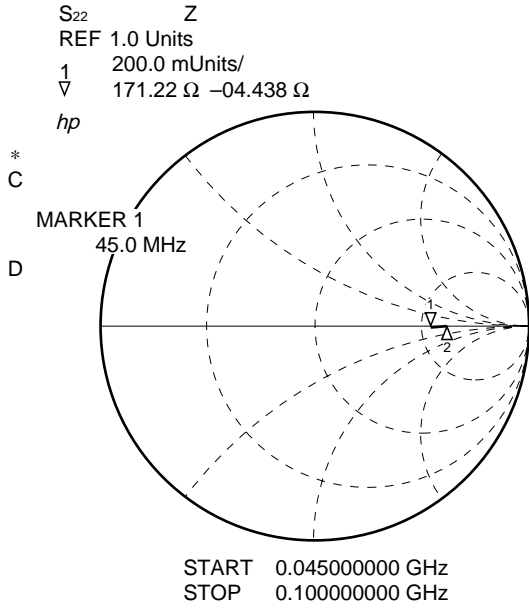
FREQUENCY MHz	MAG	ANG
500.0000	.868	-26.6
600.0000	.828	-32.6
700.0000	.794	-37.4
800.0000	.761	-41.9
900.0000	.721	-46.5
1000.0000	.706	-49.3
1100.0000	.662	-54.0
1200.0000	.629	-57.2
1300.0000	.595	-60.2
1400.0000	.554	-62.9
1500.0000	.516	-64.8
1600.0000	.440	-61.9
1700.0000	.428	-51.0
1800.0000	.543	-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

$\Delta_1$ : 500 MHz  
 $\Delta_2$ : 1000 MHz  
 $\Delta_3$ : 2000 MHz  
 $\Delta_4$ : 3000 MHz

$\mu$ PB1506GV

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

Divide by 64 mode, V<sub>CC</sub> = 5.0 V



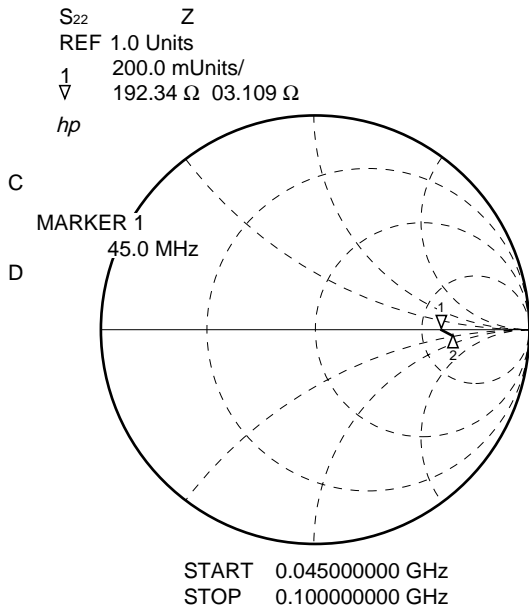
FREQUENCY MHz	S <sub>22</sub>	
	MAG	ANG
45.000	.542	-1.4
50.000	.602	-3
55.000	.616	0.0
60.000	.605	1.1
65.000	.609	.7
70.000	.616	.3
75.000	.620	.1
80.000	.622	0.0
85.000	.619	.6
90.000	.610	.9
95.000	.626	-7
100.000	.623	-1.7

Δ<sub>1</sub>: 45 MHz  
Δ<sub>2</sub>: 100 MHz

$\mu$ PB1506GV

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

Divide by 128 mode, V<sub>CC</sub> = 5.0 V



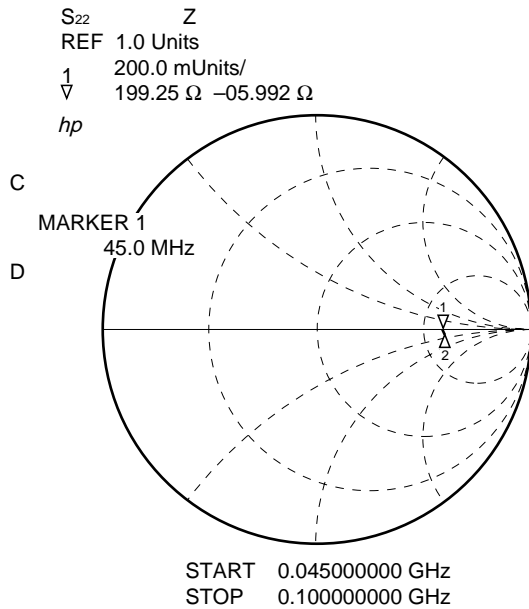
FREQUENCY MHz	S <sub>22</sub>	
	MAG	ANG
45.000	.590	.4
50.000	.604	-1.0
55.000	.610	-1.1
60.000	.607	-8
65.000	.548	-5.9
70.000	.630	-0.0
75.000	.615	-1.0
80.000	.618	-1.4
85.000	.617	-1.2
90.000	.616	-2.2
95.000	.623	-2.4
100.000	.624	-2.3

Δ<sub>1</sub>: 45 MHz  
Δ<sub>2</sub>: 100 MHz

**$\mu$ PB1506GV**

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

Divide by 256 mode, V<sub>cc</sub> = 5.0 V

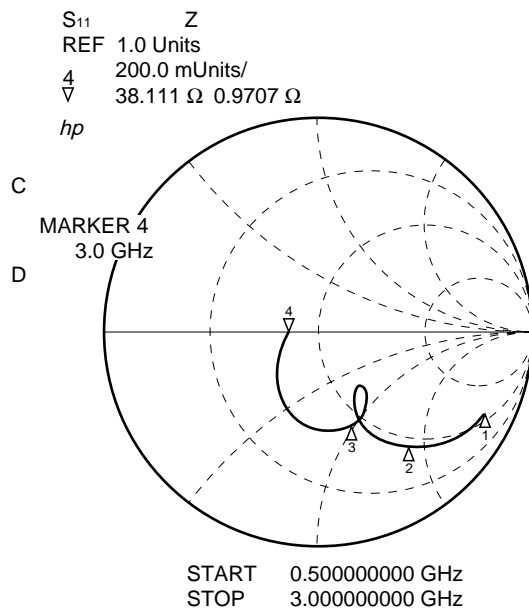


FREQUENCY MHz	S <sub>22</sub>	
	MAG	ANG
45.000	.601	-9
50.000	.609	-1.6
55.000	.611	-1.5
60.000	.620	-1.4
65.000	.607	-2.1
70.000	.615	-1.9
75.000	.613	-3.2
80.000	.611	-2.8
85.000	.607	-2.5
90.000	.605	-2.4
95.000	.610	-3.0
100.000	.608	-2.8

**$\mu$ PB1507GV**

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

V<sub>cc</sub> = 5.0 V

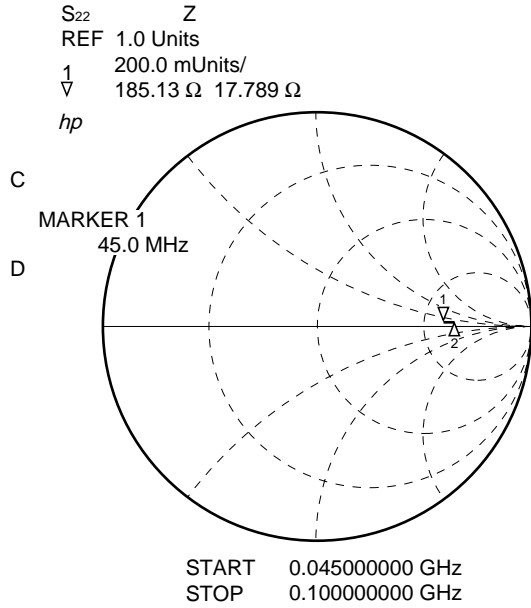


FREQUENCY MHz	S <sub>11</sub>	
	MAG	ANG
500.0000	.857	-27.5
600.0000	.849	-32.0
700.0000	.800	-38.9
800.0000	.764	-43.8
900.0000	.725	-49.0
1000.0000	.665	-50.9
1100.0000	.619	-55.3
1200.0000	.573	-59.3
1300.0000	.531	-61.3
1400.0000	.484	-62.8
1500.0000	.439	-63.0
1600.0000	.377	-59.1
1700.0000	.340	-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

$\mu$ PB1507GV

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

Divide by 64 mode, V<sub>cc</sub> = 5.0 V



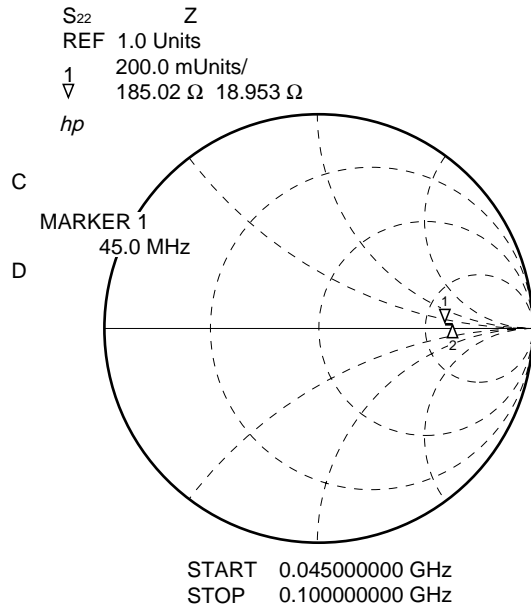
$\Delta_{\frac{1}{2}}$ : 45 MHz  
 $\Delta_{\frac{1}{2}}$ : 100 MHz

FREQUENCY MHz	S <sub>22</sub>	
	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

$\mu$ PB1507GV

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

Divide by 128 mode, V<sub>cc</sub> = 5.0 V



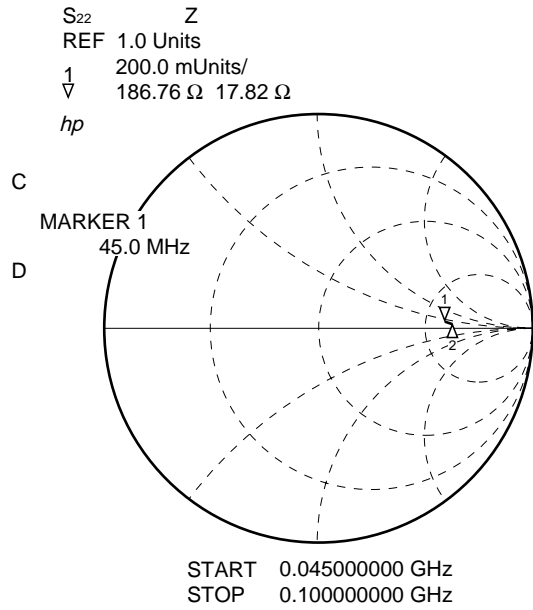
$\Delta_{\frac{1}{2}}$ : 45 MHz  
 $\Delta_{\frac{1}{2}}$ : 100 MHz

FREQUENCY MHz	S <sub>22</sub>	
	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

$\mu$ PB1507GV

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

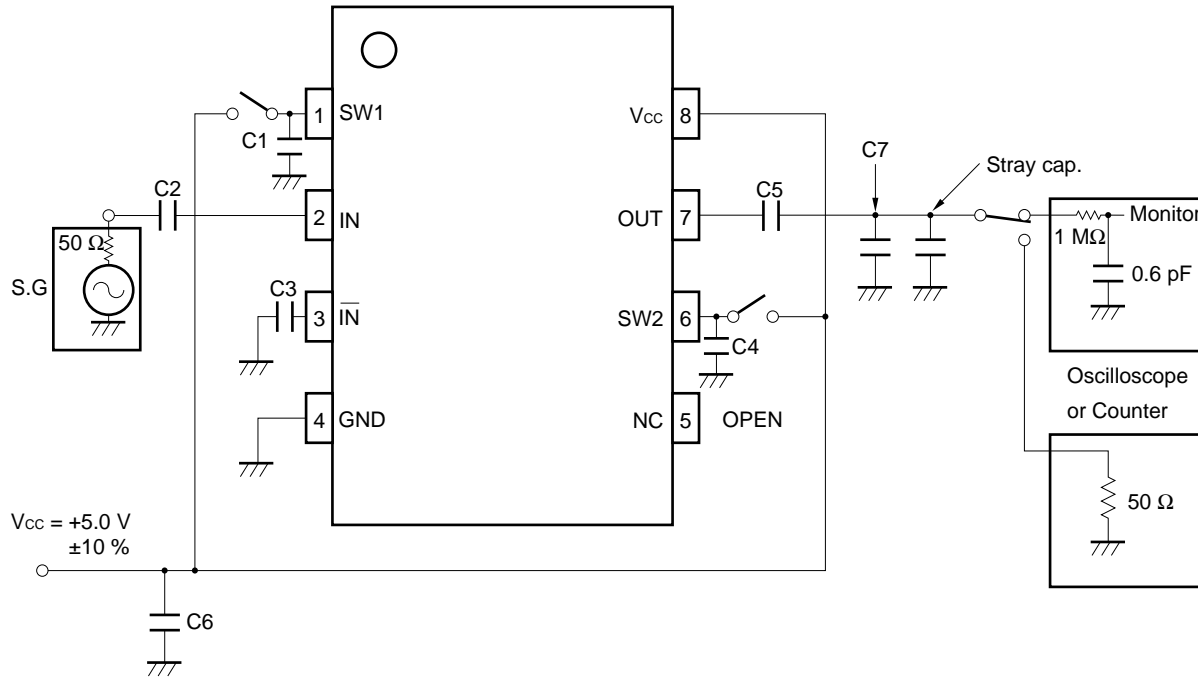
Divide by 256 mode, V<sub>cc</sub> = 5.0 V



FREQUENCY MHz	S <sub>22</sub>	
	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

$\mu$ 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

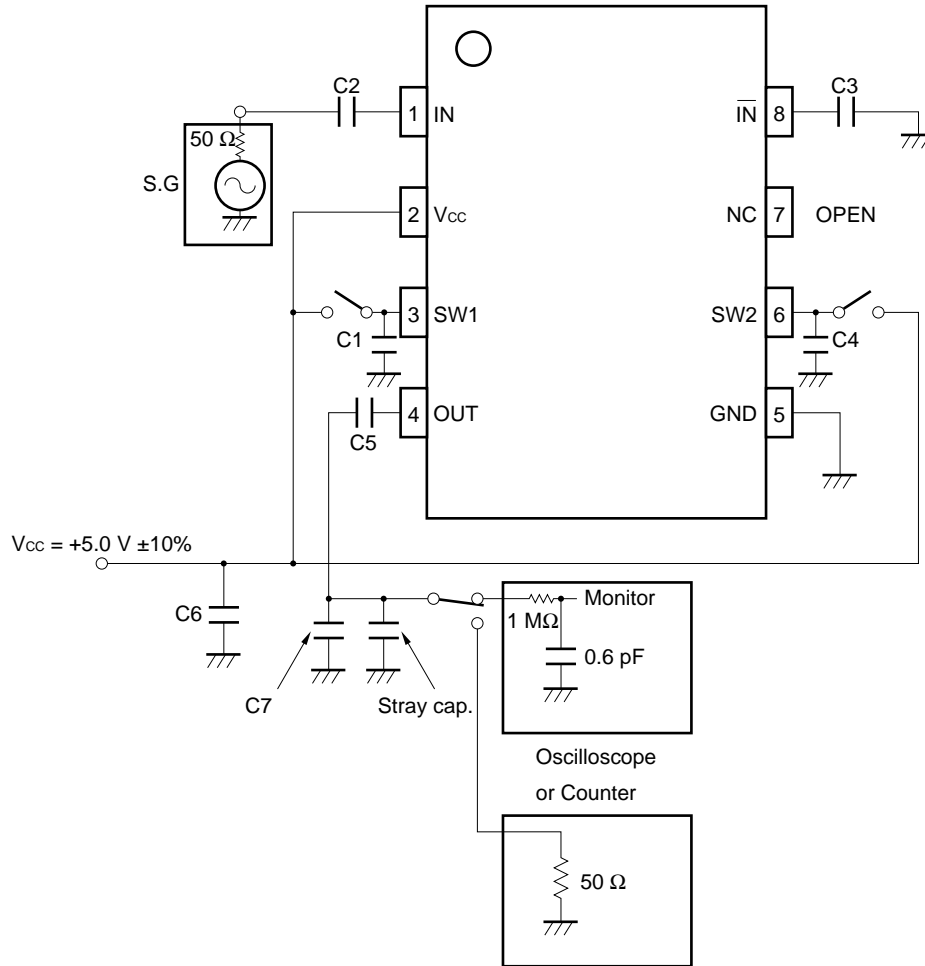
COMPONENT LIST

	$\mu$ PB1506GV	$\mu$ 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

$\mu$ PB1507GV



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

**Divide ratio setting**

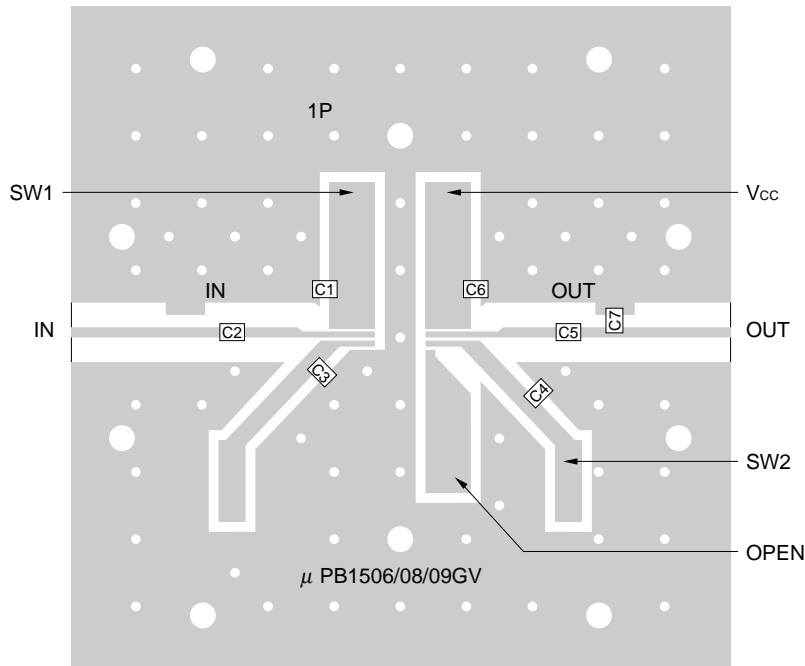
		SW2	
		H	L
SW1	H	1/64	1/128
	L	1/128	1/256

H: Connect to Vcc

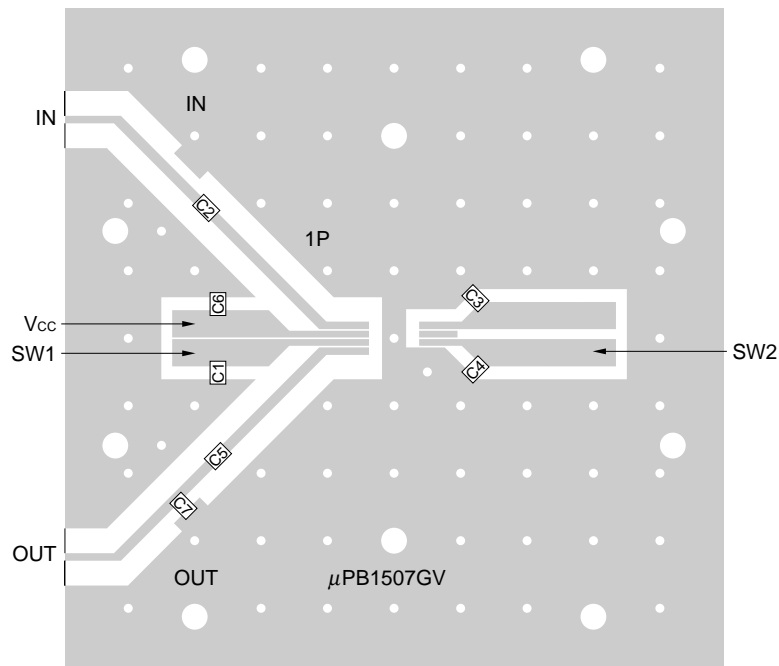
L: Connect to GND or OPEN

ILLUSTRATION OF THE TEST CIRCUIT ASSEMBLED ON EVALUATION BOARD

μPB1506GV



μPB1507GV

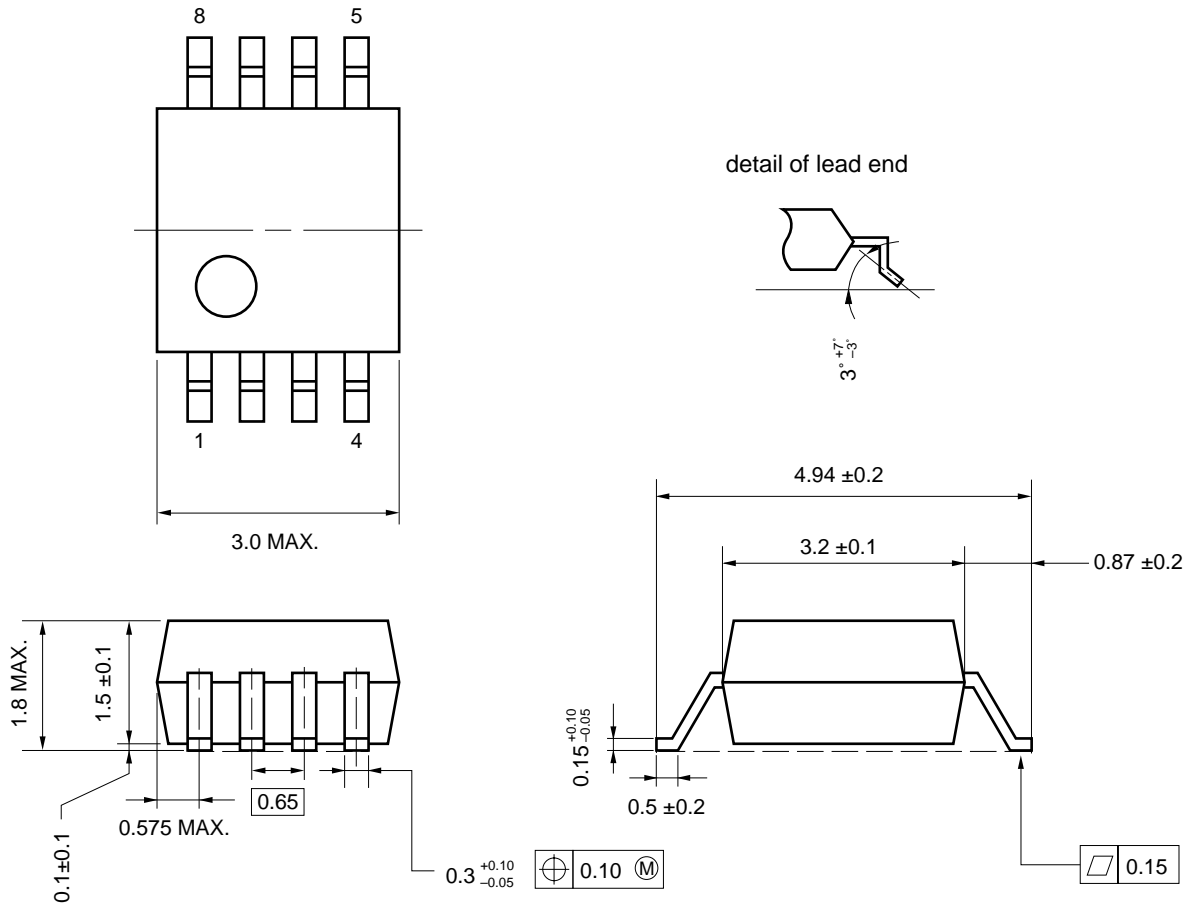


EVALUATION BOARD CHARACTERS

- (1) 35 μm thick double-sided copper clad 50 × 50 × 0.4 mm polyimide board
- (2) Back side: GND pattern
- (3) Solder plated patterns
- (4) ○ : 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 Vcc 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.

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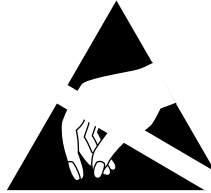
Soldering method	Soldering conditions	Recommended condition symbol
Infrared ray reflow	Package peak temperature: 235 °C, Hour: within 30 s. (more than 210 °C), Time: 3 times, Limited days: no.*	IR35-00-3
VPS	Package peak temperature: 215 °C, Hour: within 40 s. (more than 200 °C), Time: 3 times, Limited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

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**Specific:** Aircrafts, aerospace equipment, submersible repeaters, nuclear reactor control systems, life support systems or medical equipment for life support, etc.

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Anti-radioactive design is not implemented in this product.

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