

**13 GHz INPUT DIVIDE BY 4 PRESCALER IC  
FOR SATELLITE COMMUNICATIONS****DESCRIPTION**

The  $\mu$ PB1513TU is a silicon germanium (SiGe) monolithic integrated circuit designed as a divide by 4 prescaler IC for satellite communications and point-to-point/multi-point radios.

The package is 8-pin lead-less minimold suitable for surface mount.

This IC is manufactured using our 50 GHz  $f_{max}$  UHS2 (Ultra High Speed Process) SiGe bipolar process.

**FEATURES**

- Operating frequency :  $f_{in} = 5$  to 13 GHz
- Low current consumption :  $I_{cc} = 48$  mA @  $V_{cc} = 5.0$  V
- High-density surface mounting : 8-pin lead-less minimold
- Supply voltage :  $V_{cc} = 4.5$  to 5.5 V
- Division ratio : 4

**APPLICATIONS**

- Point-to-point/Multi-point radios
- VSAT radios

**ORDERING INFORMATION**

Part Number	Order Number	Package	Marking	Supplying Form
$\mu$ PB1513TU-E2	$\mu$ PB1513TU-E2-A	8-pin lead-less minimold (Pb-Free) <sup>Note</sup>	1513	<ul style="list-style-type: none"><li>• 8 mm wide embossed taping</li><li>• Pin 5, 6, 7, 8 indicates pull-out direction of tape</li><li>• Qty 5 kpcs/reel</li></ul>

**Note** With regards to terminal solder (the solder contains lead) plated products (conventionally plated), contact your nearby sales office.

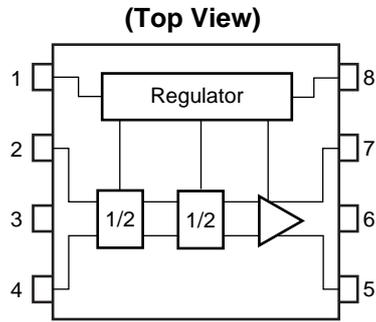
**Remark** To order evaluation samples, contact your nearby sales office.

Part number for sample order:  $\mu$ PB1513TU

**Caution** Observe precautions when handling because these devices are sensitive to electrostatic discharge.

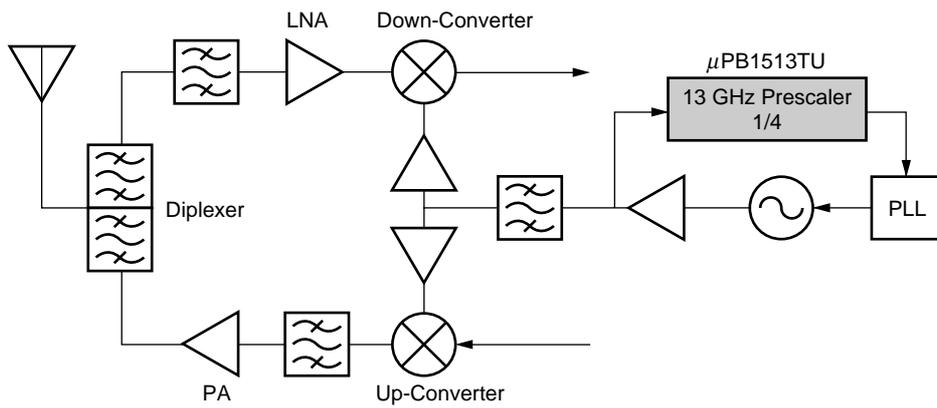
The information in this document is subject to change without notice. Before using this document, please confirm that this is the latest version.

**INTERNAL BLOCK DIAGRAM AND PIN CONNECTIONS**



Pin No.	Pin Name
1	V <sub>cc1</sub>
2	IN
3	GND
4	$\overline{\text{IN}}$
5	$\overline{\text{OUT}}$
6	GND
7	OUT
8	V <sub>cc2</sub>

**SYSTEM APPLICATION EXAMPLE**



**PIN EXPLANATION**

Pin No.	Pin Name	Applied Voltage (V)	Function and Applications
1	V <sub>cc1</sub>	5	Power supply pin. This pin must be equipped with bypass capacitor (example : 100 pF and 10 nF) to minimize ground impedance.
2	IN	–	Signal input pin. This pin should be coupled to signal source with capacitor (example : 100 pF) for DC cut.
3	GND	0	Ground pin. Ground pattern on the board should be formed as widely as possible to minimize ground impedance.
4	$\overline{\text{IN}}$	–	Signal input bypass pin. This pin must be equipped with bypass capacitor (example : 100 pF) to minimize ground impedance.
5	$\overline{\text{OUT}}$	–	Divided frequency output pin. This pin should be coupled to load device with capacitor (example : 100 pF) for DC cut.
6	GND	0	Ground pin. Ground pattern on the board should be formed as widely as possible to minimize ground impedance.
7	OUT	–	Divided frequency output pin. This pin should be coupled to load device with capacitor (example : 100 pF) for DC cut.
8	V <sub>cc2</sub>	5	Power supply pin. This pin must be equipped with bypass capacitor (example : 100 pF and 10 nF) to minimize ground impedance.

**ABSOLUTE MAXIMUM RATINGS**

Parameter	Symbol	Test Conditions	Ratings	Unit
Supply Voltage	V <sub>CC</sub>	T <sub>A</sub> = +25°C	6	V
Total Power Dissipation	P <sub>D</sub>	T <sub>A</sub> = +85°C <b>Note</b>	867	mW
Thermal Resistance (junction to ground paddle)	R <sub>th(j-c)</sub>	T <sub>A</sub> = +85°C <b>Note</b>	75	°C/W
Operating Ambient Temperature	T <sub>A</sub>		-40 to +85	°C
Storage Temperature	T <sub>stg</sub>		-55 to +150	°C

**Note** Mounted on 33 × 21 × 0.4 mm polyimide PCB, with copper patterning on both sides.

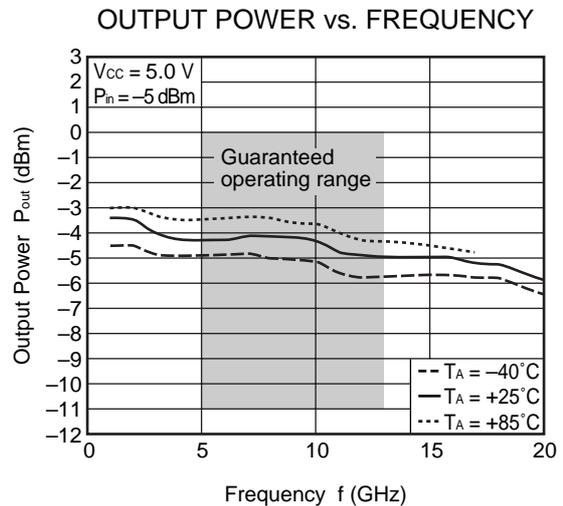
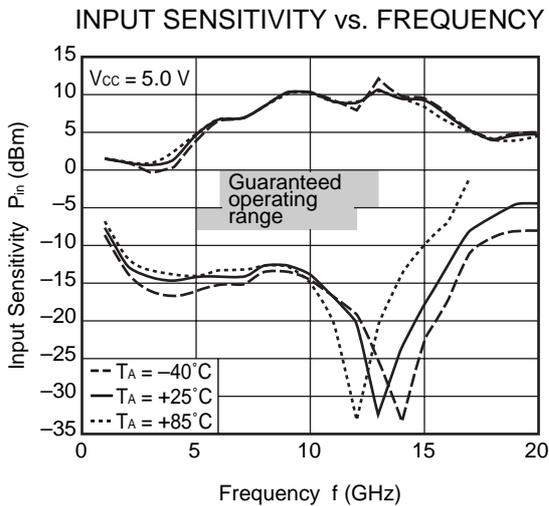
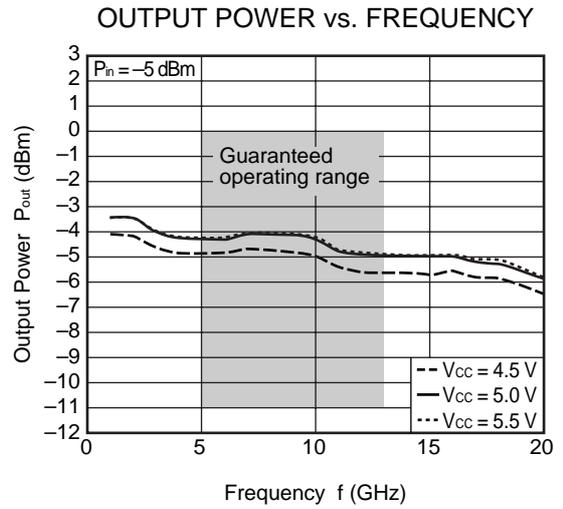
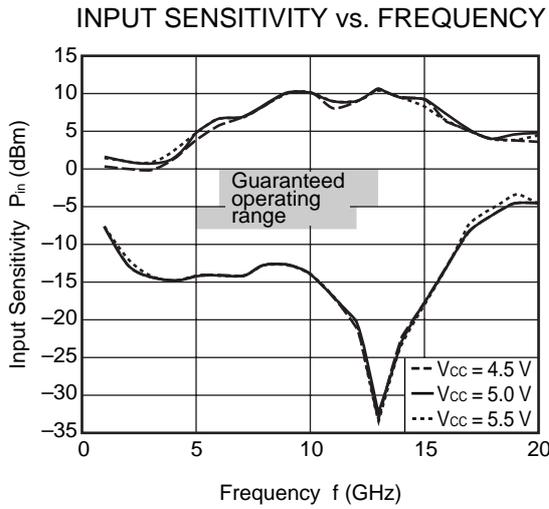
**RECOMMENDED OPERATING RANGE**

Parameter	Symbol	MIN.	TYP.	MAX.	Unit
Supply Voltage	V <sub>CC</sub>	4.5	5.0	5.5	V
Operating Ambient Temperature	T <sub>A</sub>	-40	+25	+85	°C

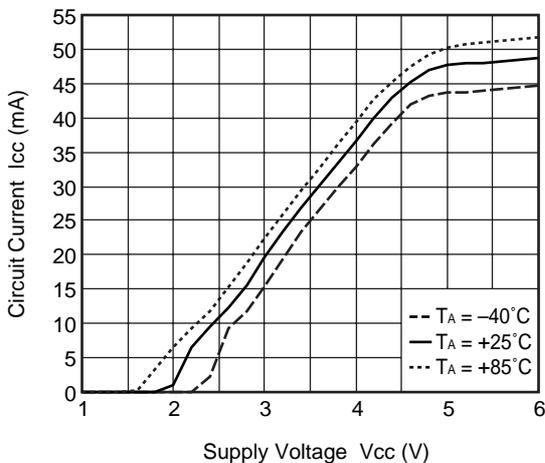
**ELECTRICAL CHARACTERISTICS (V<sub>CC</sub> = 4.5 to 5.5 V, T<sub>A</sub> = -40 to +85°C, Z<sub>s</sub> = Z<sub>L</sub> = 50 Ω)**

Parameter	Symbol	Test Conditions	MIN.	TYP.	MAX.	Unit
Circuit Current	I <sub>CC</sub>	No Signals	-	48	75	mA
Input Sensitivity	P <sub>in1</sub>	f <sub>in</sub> = 5 to 6 GHz	-8	-	-5	dBm
	P <sub>in2</sub>	f <sub>in</sub> = 6 to 12 GHz	-8	-	0	dBm
	P <sub>in3</sub>	f <sub>in</sub> = 12 to 13 GHz	-5	-	0	dBm
Output Power	P <sub>out</sub>	f <sub>in</sub> = 5 to 13 GHz, single ended, P <sub>in</sub> = -5 dBm	-11	-4	2	dBm

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



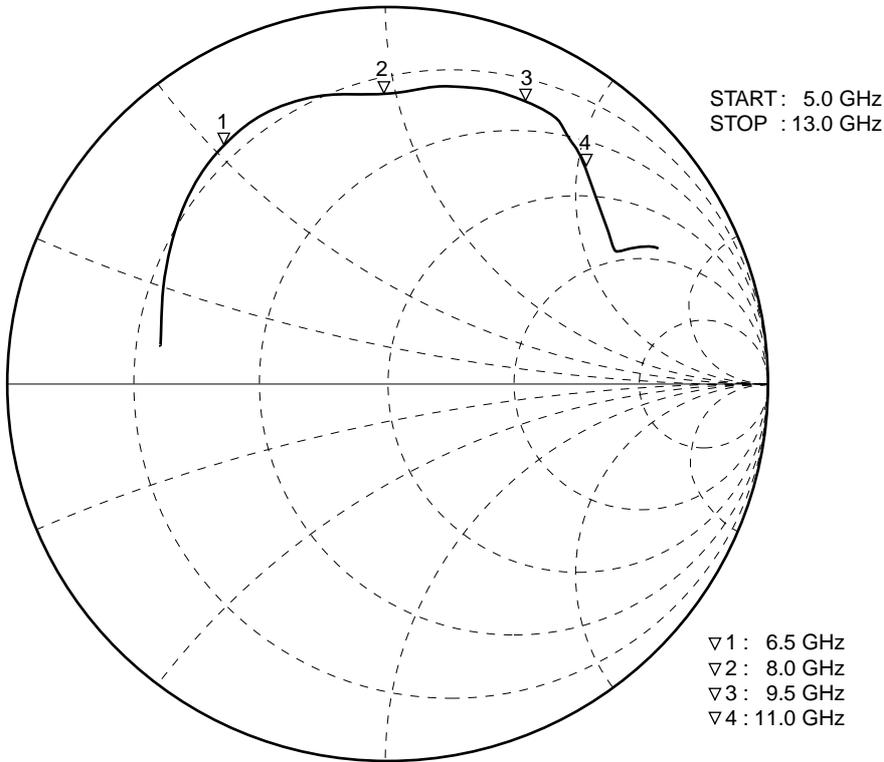
★ **CIRCUIT CURRENT vs. SUPPLY VOLTAGE**



**Remark** The graphs indicate nominal characteristics.

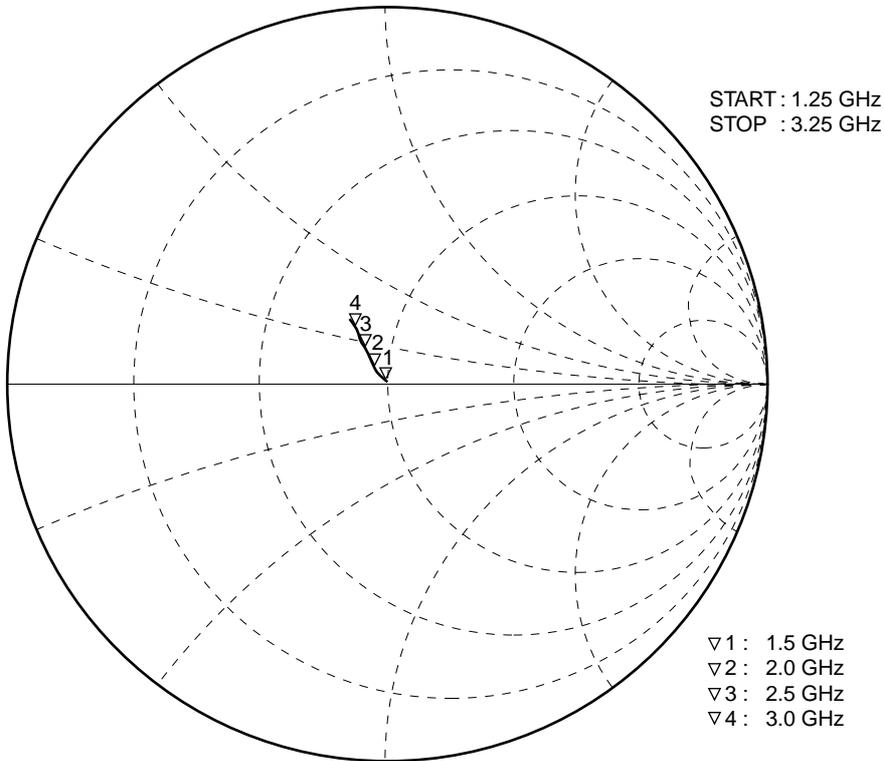
★ S-PARAMETERS (T<sub>A</sub> = +25°C, V<sub>CC</sub> = 5.0 V)

S<sub>11</sub>-FREQUENCY



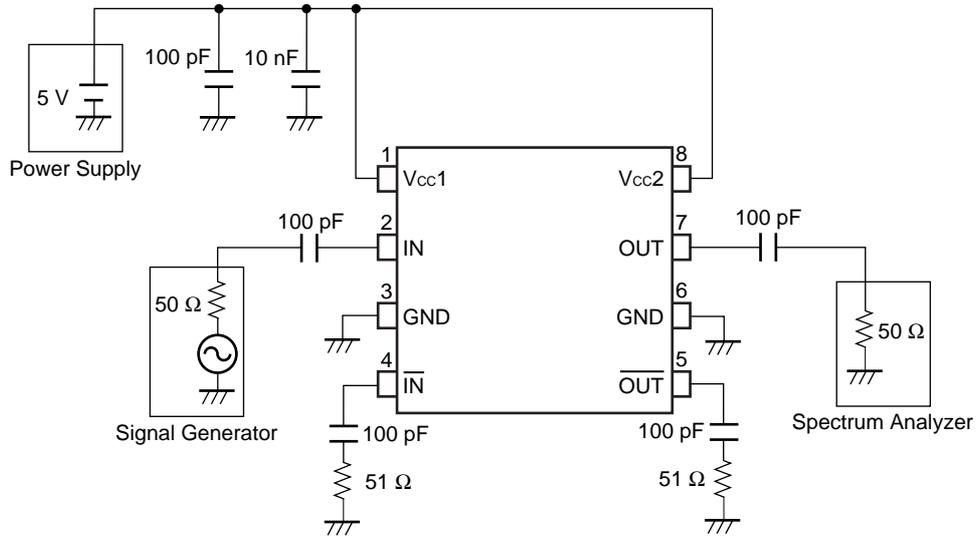
FREQUENCY GHz	MAG	S <sub>11</sub> ANG
5.0	0.603	170.5
6.0	0.705	139.7
7.0	0.782	112.0
8.0	0.766	90.6
9.0	0.820	71.2
10.0	0.832	57.9
11.0	0.768	46.3
12.0	0.698	32.2
13.0	0.798	26.6

S<sub>22</sub>-FREQUENCY



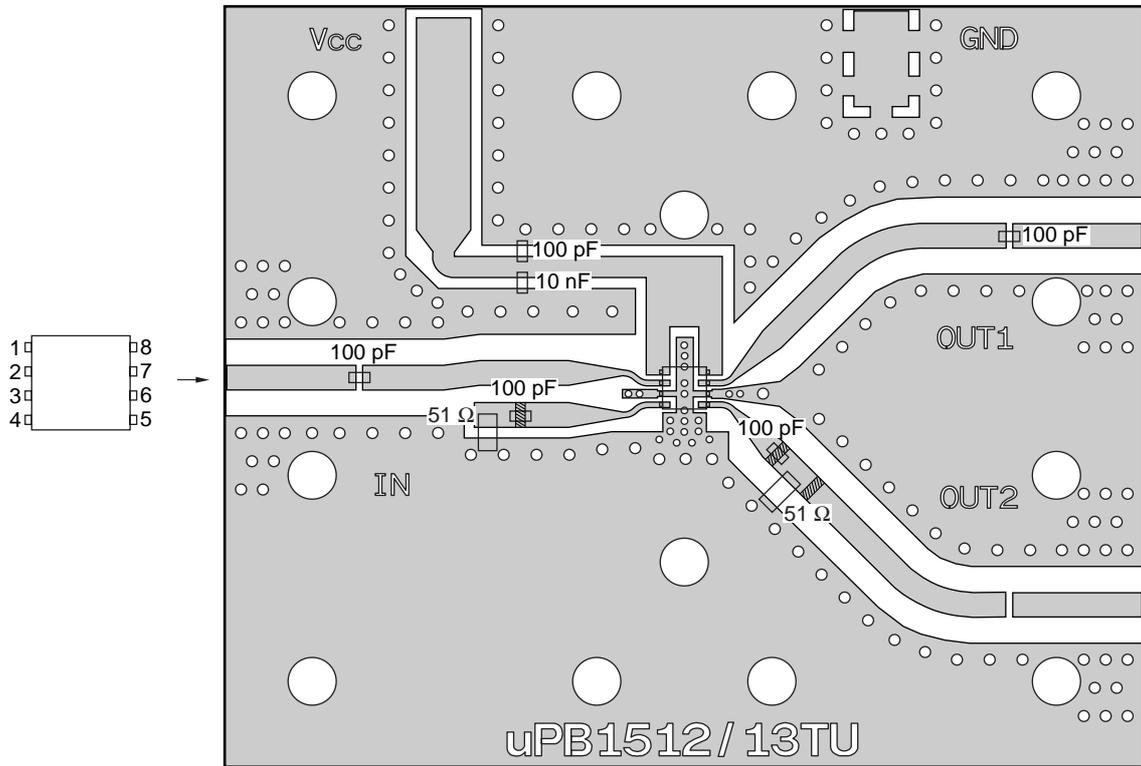
FREQUENCY GHz	MAG	S <sub>22</sub> ANG
1.25	0.002	90.3
1.4	0.011	133.3
1.6	0.024	132.3
1.8	0.038	130.2
2.0	0.054	127.3
2.2	0.073	126.8
2.4	0.092	124.5
2.6	0.117	122.6
2.8	0.137	121.9
3.0	0.164	120.3
3.2	0.186	120.3
3.25	0.196	121.0

MEASUREMENT CIRCUIT



The application circuits and their parameters are for reference only and are not intended for use in actual design-ins.

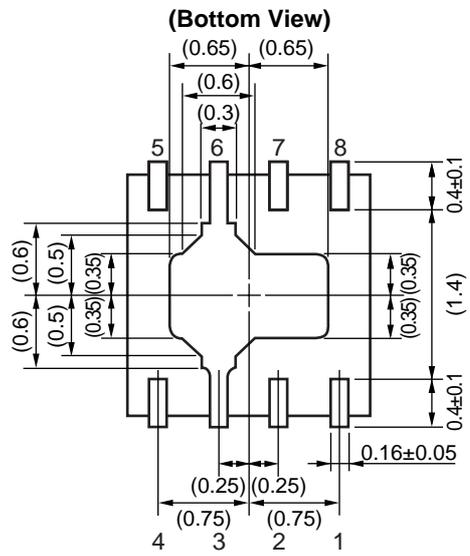
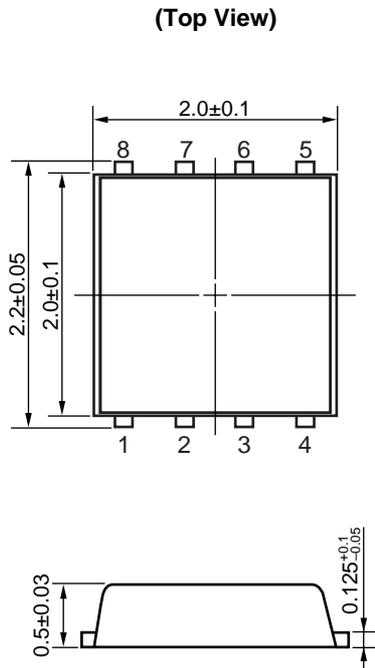
ILLUSTRATION OF THE MEASUREMENT CIRCUIT ASSEMBLED ON EVALUATION BOARD



- Remarks**
1. 33 × 21 × 0.4 mm double-sided copper-clad polyimide PCB
  2. Back side: GND pattern
  3. Solder plated on pattern
  4.  represents cutout
  5. ○: Through holes

**PACKAGE DIMENSIONS**

**8-PIN LEAD-LESS MINIMOLD (UNIT: mm)**



**NOTES ON CORRECT USE**

- (1) Observe precautions for handling because of electro-static sensitive devices.
- (2) Form a ground pattern as widely as possible to minimize ground impedance (to prevent undesired oscillation).
- (3) Keep the track length of the ground terminals as short as possible.
- (4) Bypass capacitance must be attached to V<sub>cc</sub> line.
- (5) Exposed heatsink at bottom on package must be soldered to PCB RF/DC ground.

**RECOMMENDED SOLDERING CONDITIONS**

This product should be soldered and mounted under the following recommended conditions. For soldering methods and conditions other than those recommended below, contact your nearby sales office.

Soldering Method	Soldering Conditions	Condition Symbol
Infrared Reflow	Peak temperature (package surface temperature) : 260°C or below Time at peak temperature : 10 seconds or less Time at temperature of 220°C or higher : 60 seconds or less Preheating time at 120 to 180°C : 120±30 seconds Maximum number of reflow processes : 3 times Maximum chlorine content of rosin flux (% mass) : 0.2%(Wt.) or below	IR260
Wave Soldering	Peak temperature (molten solder temperature) : 260°C or below Time at peak temperature : 10 seconds or less Preheating temperature (package surface temperature) : 120°C or below Maximum number of flow processes : 1 time Maximum chlorine content of rosin flux (% mass) : 0.2%(Wt.) or below	WS260
Partial Heating	Peak temperature (terminal temperature) : 350°C or below Soldering time (per side of device) : 3 seconds or less Maximum chlorine content of rosin flux (% mass) : 0.2%(Wt.) or below	HS350

**Caution Do not use different soldering methods together (except for partial heating).**

When the product(s) listed in this document is subject to any applicable import or export control laws and regulation of the authority having competent jurisdiction, such product(s) shall not be imported or exported without obtaining the import or export license.

- **The information in this document is current as of March, 2005. The information is subject to change without notice. For actual design-in, refer to the latest publications of NEC's data sheets or data books, etc., for the most up-to-date specifications of NEC semiconductor products. Not all products and/or types are available in every country. Please check with an NEC sales representative for availability and additional information.**
- No part of this document may be copied or reproduced in any form or by any means without prior written consent of NEC. NEC assumes no responsibility for any errors that may appear in this document.
- NEC does not assume any liability for infringement of patents, copyrights or other intellectual property rights of third parties by or arising from the use of NEC semiconductor products listed in this document or any other liability arising from the use of such products. No license, express, implied or otherwise, is granted under any patents, copyrights or other intellectual property rights of NEC or others.
- Descriptions of circuits, software and other related information in this document are provided for illustrative purposes in semiconductor product operation and application examples. The incorporation of these circuits, software and information in the design of customer's equipment shall be done under the full responsibility of customer. NEC assumes no responsibility for any losses incurred by customers or third parties arising from the use of these circuits, software and information.
- While NEC endeavours to enhance the quality, reliability and safety of NEC semiconductor products, customers agree and acknowledge that the possibility of defects thereof cannot be eliminated entirely. To minimize risks of damage to property or injury (including death) to persons arising from defects in NEC semiconductor products, customers must incorporate sufficient safety measures in their design, such as redundancy, fire-containment, and anti-failure features.
- NEC semiconductor products are classified into the following three quality grades:  
 "Standard", "Special" and "Specific". The "Specific" quality grade applies only to semiconductor products developed based on a customer-designated "quality assurance program" for a specific application. The recommended applications of a semiconductor product depend on its quality grade, as indicated below. Customers must check the quality grade of each semiconductor product 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": Aircraft, aerospace equipment, submersible repeaters, nuclear reactor control systems, life support systems and medical equipment for life support, etc.

The quality grade of NEC semiconductor products is "Standard" unless otherwise expressly specified in NEC's data sheets or data books, etc. If customers wish to use NEC semiconductor products in applications not intended by NEC, they must contact an NEC sales representative in advance to determine NEC's willingness to support a given application.

(Note)

- (1) "NEC" as used in this statement means NEC Corporation, NEC Compound Semiconductor Devices, Ltd. and also includes its majority-owned subsidiaries.
- (2) "NEC semiconductor products" means any semiconductor product developed or manufactured by or for NEC (as defined above).

M8E 00.4-0110

---

► For further information, please contact

**NEC Compound Semiconductor Devices, Ltd.** <http://www.ncsd.necel.com/>

E-mail: [salesinfo@ml.ncsd.necel.com](mailto:salesinfo@ml.ncsd.necel.com) (sales and general)

[techinfo@ml.ncsd.necel.com](mailto:techinfo@ml.ncsd.necel.com) (technical)

Sales Division TEL: +81-44-435-1588 FAX: +81-44-435-1579

**NEC Compound Semiconductor Devices Hong Kong Limited**

E-mail: [ncsd-hk@elhk.nec.com.hk](mailto:ncsd-hk@elhk.nec.com.hk) (sales, technical and general)

Hong Kong Head Office TEL: +852-3107-7303 FAX: +852-3107-7309

Taipei Branch Office TEL: +886-2-8712-0478 FAX: +886-2-2545-3859

Korea Branch Office TEL: +82-2-558-2120 FAX: +82-2-558-5209

**NEC Electronics (Europe) GmbH** <http://www.ee.nec.de/>

TEL: +49-211-6503-0 FAX: +49-211-6503-1327

**California Eastern Laboratories, Inc.** <http://www.cel.com/>

TEL: +1-408-988-3500 FAX: +1-408-988-0279

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	
		-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.

**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.