

To our customers,

Old Company Name in Catalogs and Other Documents

On April 1st, 2010, NEC Electronics Corporation merged with Renesas Technology Corporation, and Renesas Electronics Corporation took over all the business of both companies. Therefore, although the old company name remains in this document, it is a valid Renesas Electronics document. We appreciate your understanding.

Renesas Electronics website: <http://www.renesas.com>

April 1st, 2010
Renesas Electronics Corporation

Issued by: Renesas Electronics Corporation (<http://www.renesas.com>)

Send any inquiries to <http://www.renesas.com/inquiry>.

Notice

1. All information included in this document is current as of the date this document is issued. Such information, however, is subject to change without any prior notice. Before purchasing or using any Renesas Electronics products listed herein, please confirm the latest product information with a Renesas Electronics sales office. Also, please pay regular and careful attention to additional and different information to be disclosed by Renesas Electronics such as that disclosed through our website.
2. Renesas Electronics 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 Renesas Electronics products or technical information described in this document. No license, express, implied or otherwise, is granted hereby under any patents, copyrights or other intellectual property rights of Renesas Electronics or others.
3. You should not alter, modify, copy, or otherwise misappropriate any Renesas Electronics product, whether in whole or in part.
4. Descriptions of circuits, software and other related information in this document are provided only to illustrate the operation of semiconductor products and application examples. You are fully responsible for the incorporation of these circuits, software, and information in the design of your equipment. Renesas Electronics assumes no responsibility for any losses incurred by you or third parties arising from the use of these circuits, software, or information.
5. When exporting the products or technology described in this document, you should comply with the applicable export control laws and regulations and follow the procedures required by such laws and regulations. You should not use Renesas Electronics products or the technology described in this document for any purpose relating to military applications or use by the military, including but not limited to the development of weapons of mass destruction. Renesas Electronics products and technology may not be used for or incorporated into any products or systems whose manufacture, use, or sale is prohibited under any applicable domestic or foreign laws or regulations.
6. Renesas Electronics has used reasonable care in preparing the information included in this document, but Renesas Electronics does not warrant that such information is error free. Renesas Electronics assumes no liability whatsoever for any damages incurred by you resulting from errors in or omissions from the information included herein.
7. Renesas Electronics products are classified according to the following three quality grades: “Standard”, “High Quality”, and “Specific”. The recommended applications for each Renesas Electronics product depends on the product’s quality grade, as indicated below. You must check the quality grade of each Renesas Electronics product before using it in a particular application. You may not use any Renesas Electronics product for any application categorized as “Specific” without the prior written consent of Renesas Electronics. Further, you may not use any Renesas Electronics product for any application for which it is not intended without the prior written consent of Renesas Electronics. Renesas Electronics shall not be in any way liable for any damages or losses incurred by you or third parties arising from the use of any Renesas Electronics product for an application categorized as “Specific” or for which the product is not intended where you have failed to obtain the prior written consent of Renesas Electronics. The quality grade of each Renesas Electronics product is “Standard” unless otherwise expressly specified in a Renesas Electronics data sheets or data books, etc.
 - “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.
 - “High Quality”: 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; medical equipment or systems for life support (e.g. artificial life support devices or systems), surgical implantations, or healthcare intervention (e.g. excision, etc.), and any other applications or purposes that pose a direct threat to human life.
8. You should use the Renesas Electronics products described in this document within the range specified by Renesas Electronics, especially with respect to the maximum rating, operating supply voltage range, movement power voltage range, heat radiation characteristics, installation and other product characteristics. Renesas Electronics shall have no liability for malfunctions or damages arising out of the use of Renesas Electronics products beyond such specified ranges.
9. Although Renesas Electronics endeavors to improve the quality and reliability of its products, semiconductor products have specific characteristics such as the occurrence of failure at a certain rate and malfunctions under certain use conditions. Further, Renesas Electronics products are not subject to radiation resistance design. Please be sure to implement safety measures to guard them against the possibility of physical injury, and injury or damage caused by fire in the event of the failure of a Renesas Electronics product, such as safety design for hardware and software including but not limited to redundancy, fire control and malfunction prevention, appropriate treatment for aging degradation or any other appropriate measures. Because the evaluation of microcomputer software alone is very difficult, please evaluate the safety of the final products or system manufactured by you.
10. Please contact a Renesas Electronics sales office for details as to environmental matters such as the environmental compatibility of each Renesas Electronics product. Please use Renesas Electronics products in compliance with all applicable laws and regulations that regulate the inclusion or use of controlled substances, including without limitation, the EU RoHS Directive. Renesas Electronics assumes no liability for damages or losses occurring as a result of your noncompliance with applicable laws and regulations.
11. This document may not be reproduced or duplicated, in any form, in whole or in part, without prior written consent of Renesas Electronics.
12. Please contact a Renesas Electronics sales office if you have any questions regarding the information contained in this document or Renesas Electronics products, or if you have any other inquiries.

(Note 1) “Renesas Electronics” as used in this document means Renesas Electronics Corporation and also includes its majority-owned subsidiaries.

(Note 2) “Renesas Electronics product(s)” means any product developed or manufactured by or for Renesas Electronics.

DUAL N-CANNEL LOW SIDE INTELLIGENT POWER DEVICE

The μPD166104 is a high voltage, dual output, and N-cannel low side intelligent power device with built-in overheat protection and overcurrent limitation circuits. It protects itself by shutting down or limiting current when it detects overheat or overcurrent. Output MOS shut down is restarted automatically by cooling of the chip temperature.

FEATURES

- High voltage dual output low side driver
- Built-in overcurrent limitation circuits and overheat protection circuits
 - Shuts down by overheat detection
 - Restarts automatically after cooling
- Built-in dynamic clamping circuit (100 V Min.)
- Low on-state resistance
- Small 20-pin SOP package

ORDERING INFORMATION

Part Number	Lead plating	Packing	Package	Remark
μPD166104GS-E1-AZ	Sn-Bi	Tape 2500 p/reel	20-pin plastic SOP (7.62 mm (300))	Lead-free product
μPD166104GS-E2-AZ	Sn-Bi	Tape 2500 p/reel	20-pin plastic SOP (7.62 mm (300))	Lead-free product

QUALITY GRADE

Part Number	Quality Grade
μPD166104GS-E1-AZ	Special
μPD166104GS-E2-AZ	Special

Please refer to "Quality Grades on NEC Semiconductor Devices" (Document No. C11531E) published by NEC Corporation to know the specification of quality grade on the devices and its recommended applications.

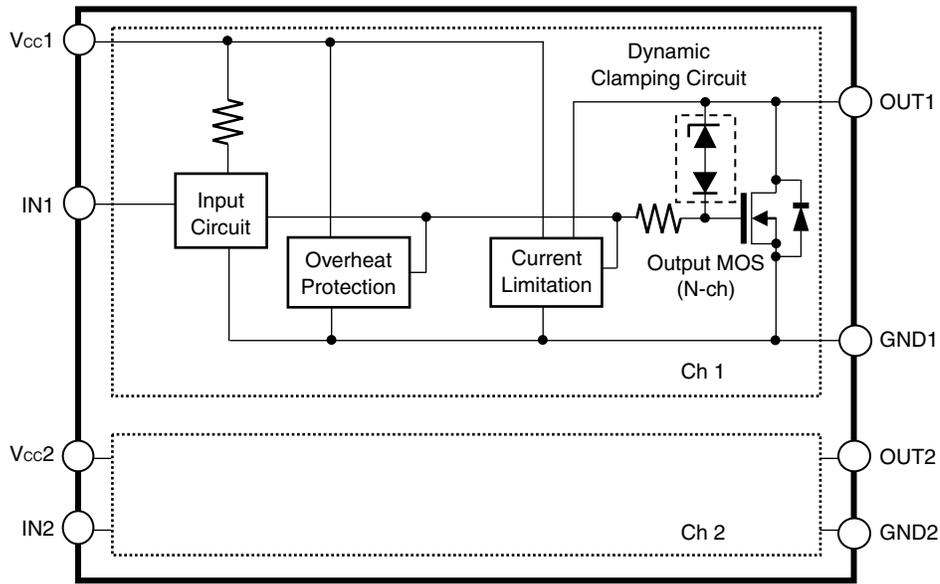
APPLICATION

- Injector driver

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

Not all products and/or types are available in every country. Please check with an NEC Electronics sales representative for availability and additional information.

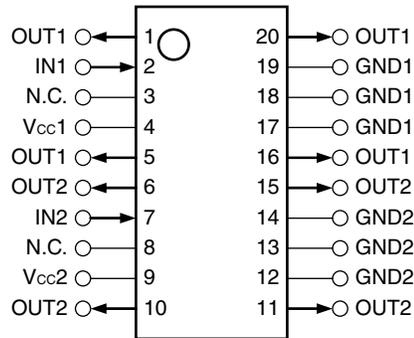
BLOCK DIAGRAM



PIN CONFIGURATION

- 20-pin plastic SOP (7.62 mm (300))

Top View



Pin Name

Pin No.	Pin Name						
1	OUT1	6	OUT2	11	OUT2	16	OUT1
2	IN1	7	IN2	12	GND2	17	GND1
3	N.C.	8	N.C.	13	GND2	18	GND1
4	Vcc1	9	Vcc2	14	GND2	19	GND1
5	OUT1	10	OUT2	15	OUT2	20	OUT1

ABSOLUTE MAXIMUM RATINGS

Parameter	Symbol	Condition	Rating	Unit
Input voltage	V _{IN}		-1.5 to +7	V
Power supply voltage	V _{CC1}		-0.5 to +18	V
	V _{CC2}	1 s	35	V
Output voltage	V _{OUT}	Except the clamping voltage at the flyback time	100	V
Output current	I _{O(DC)}	V _{IN} = 5 V, DC	SELF LIMITED	A/ch
Power dissipation	P _D	T _a = 25 °C, both channels are ON ^{Note}	2.5	W
Channel temperature	T _{ch}		150	°C
Storage temperature	T _{stg}		-55 to +150	°C

Note When mounted on 50 mm x 50 mm x 1.5 mm epoxy PCB FR4 substrate with 600 mm² x 70 μm copper foil.

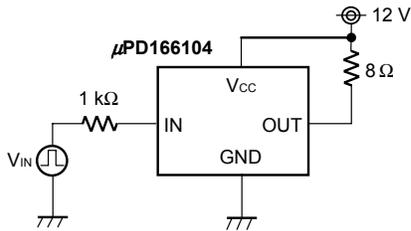
Caution Product quality may suffer if the absolute maximum rating is exceeded even momentarily for any parameters. That is, the absolute maximum ratings are rated values at which the product is on the verge of suffering physical damage, and therefore the product must be used under conditions that ensure that the absolute maximum ratings are not exceeded.

The ratings and conditions indicated for DC characteristics and AC characteristics represent the quality assurance range during normal operation.

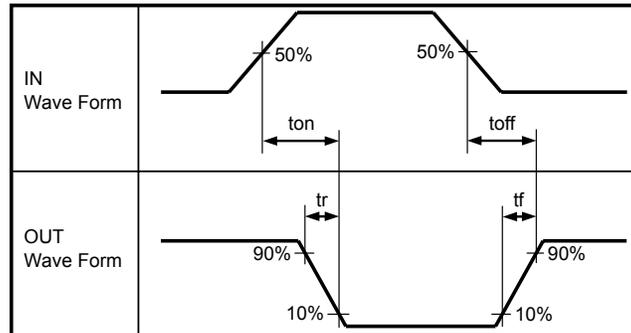
ELECTRICAL SPECIFICATIONS (V_{CC} = 5 to 18 V, T_{ch} = -40 to 150 °C, unless otherwise specified)

Parameter	Symbol	Condition	Min.	Typ.	Max.	Unit
High level input voltage	V _{IH}	R _{in} = 1 kΩ, V _{DS} = 0.3 V, I _o = 1.4 A	3.0			V
Low level input voltage	V _{IL}	R _{in} = 1 kΩ, V _{DS} = 20 V, I _o = 1 mA			1.5	V
High level input current	I _{IH}	V _{IN} = 5.5 V, V _{DS} = 0 V			300	μA
Low level input current	I _{IL}	V _{IN} = 0 V, V _{DS} = 20 V	-10		+10	μA
Power supply current	I _{CC1}	V _{CC} = 16 V, ON condition			10.0	mA/ch
	I _{CC2}	V _{CC} = 16 V, OFF condition			10.0	mA/ch
Output ON state resistance	R _{Ds(on)1}	I _o = 1.4 A, T _{ch} = 25 °C, V _{IN} = V _{IH} , V _{CC} = 16 V		64	91	mΩ
	R _{Ds(on)2}	I _o = 1.4 A, T _{ch} = 150 °C, V _{IN} = V _{IH} , V _{CC} = 16 V		107	146	mΩ
Turn on time	t _{on}	V _{IN} = 0→5 V, R _{in} = 1 kΩ, R _L = 8 Ω, V _{CC} = 12 V, T _{ch} = 0 to 150 °C	3.5		35	μs
Rise time	t _r				35	μs
Turn off time	t _{off}	V _{IN} = 5→0 V, R _{in} = 1 kΩ, R _L = 8 Ω, V _{CC} = 12 V, T _{ch} = 0 to 150 °C			30	μs
Fall time	t _f				15	μs
Output leak current	I _{DSS}	V _{IN} = 0 V, V _{DS} = 18 V			350	μA
Clamp voltage	V _{OUT}	I _o = 10 mA, T _{ch} = 25 °C, V _{IN} = 0 V	100		130	V
Temperature characteristics of clamp voltage	ΔV _Z	I _o = 1.4 A, V _{IN} = V _{IL} , L = 1mH		130		mV/°C
Overheat detection temperature	T _{HI}		150			°C
Current limitation	I _{LIM}		1.7			A

Switching measurement circuit

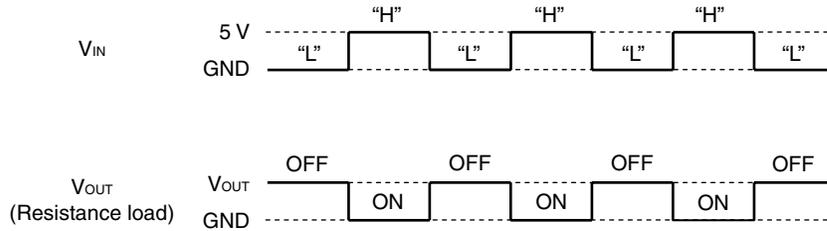


Switching measurement waveform



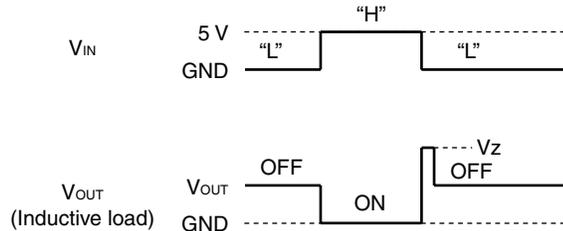
• **Input circuit (On/Off control)**

Output MOS turns on when the high-level input voltage (3.0 V or more) is applied to IN terminal.
Output MOS turns off when the low-level input voltage (1.5 V or less) is applied to IN terminal.



• **Dynamic clamp circuit**

This circuit is for protection of output and other circuits from the overvoltage by back electromotive force when inductive load turns off. The clamp diode is connected between drain and gate of output. Output voltage is clamped by this circuit when the voltage of the OUT terminal exceeded the output clamping voltage.

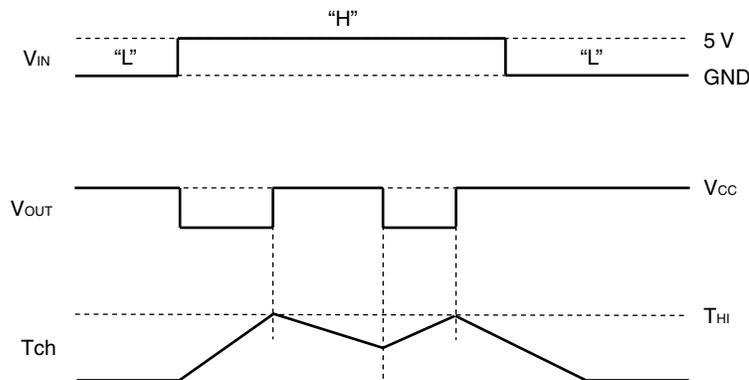


• **Current limitation circuit**

This circuit prevents destruction from the overcurrent when the short-circuit occurs. When the overcurrent flows to the OUT terminal such as short-circuit condition, the output current is limited.
Power supply voltage to OUT terminal should be 18 V or less when the short-circuit occurs.

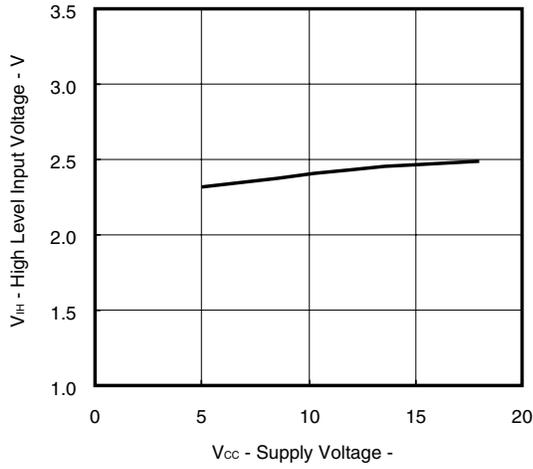
• **Overheat protection circuit**

This circuit prevents destruction from overheat. The channel temperature of the output is monitored and the output is shut down when overheat is detected. Output restarts automatically after the channel cooled down.

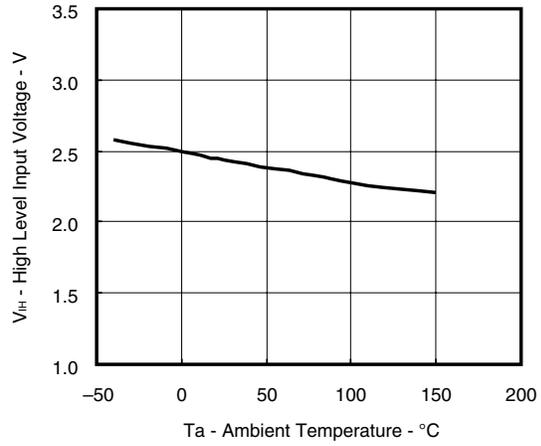


TYPICAL CHARACTERISTICS

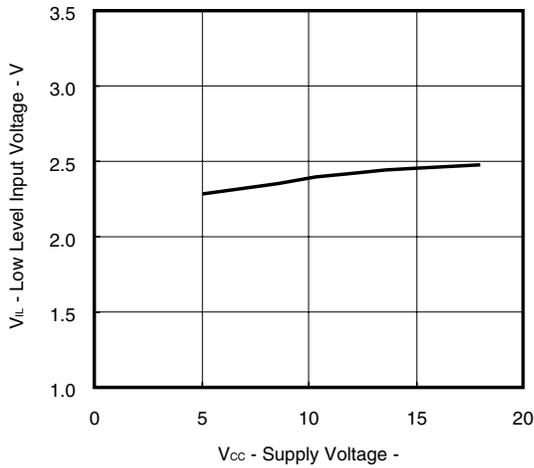
HIGH LEVEL INPUT VOLTAGE vs. SUPPLY VOLTAGE



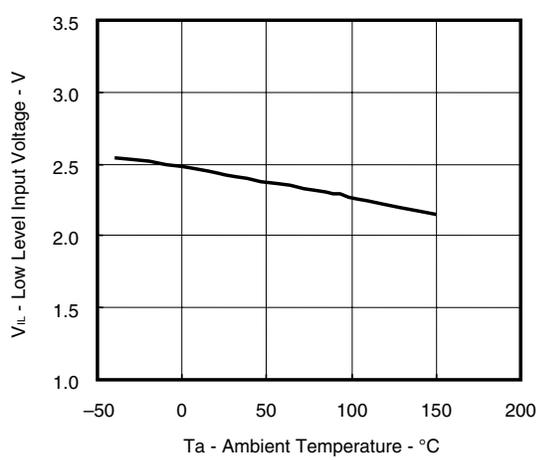
HIGH LEVEL INPUT VOLTAGE vs. AMBIENT TEMPERATURE



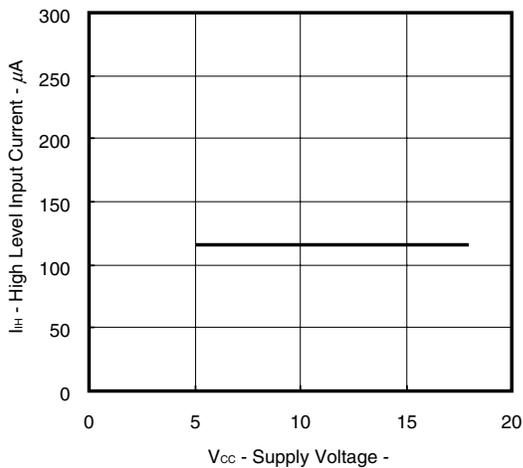
LOW LEVEL INPUT VOLTAGE vs. SUPPLY VOLTAGE



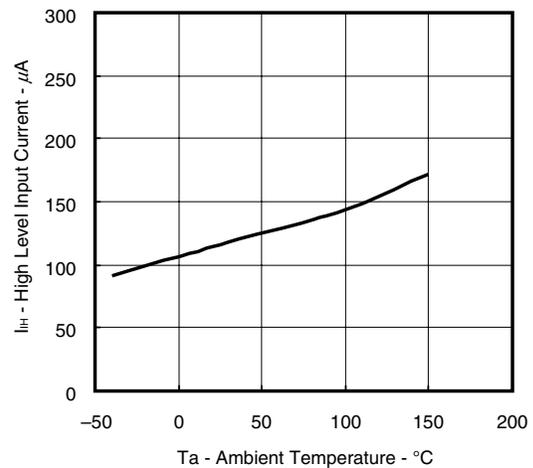
LOW LEVEL INPUT VOLTAGE vs. AMBIENT TEMPERATURE



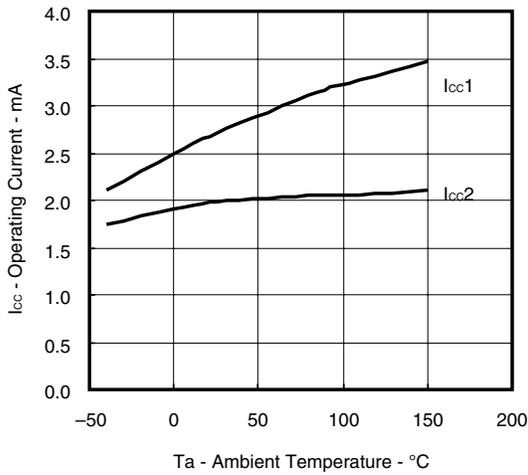
HIGH LEVEL INPUT CURRENT vs. SUPPLY VOLTAGE



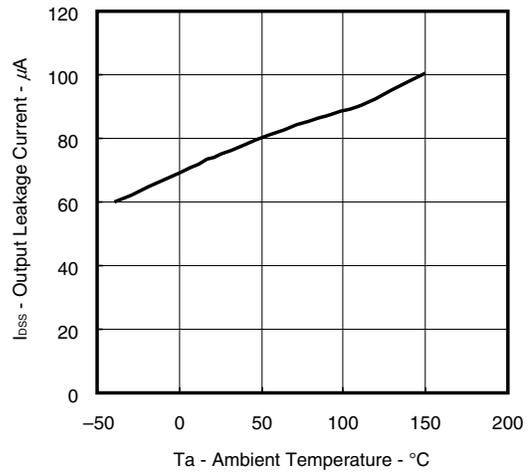
HIGH LEVEL INPUT CURRENT vs. AMBIENT TEMPERATURE



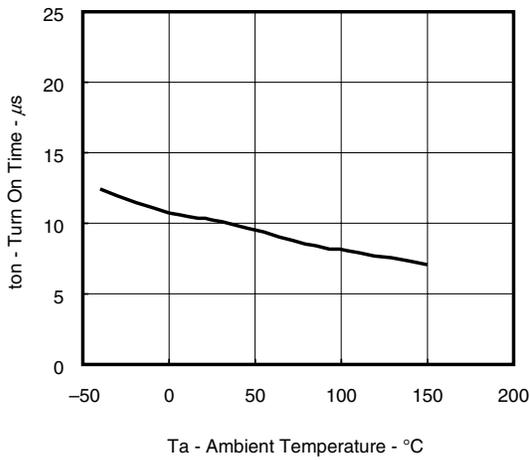
OPERATING CURRENT vs.
AMBIENT TEMPERATURE



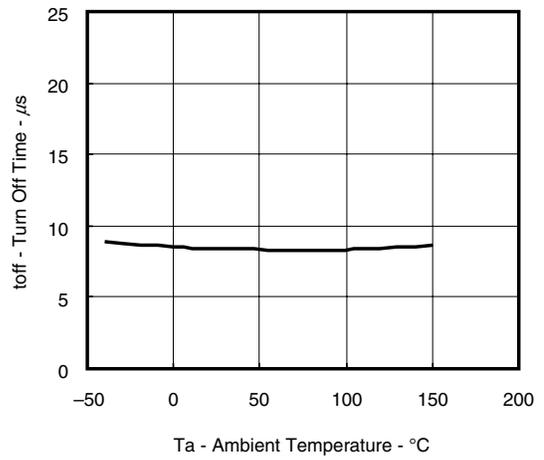
OUTPUT LEAKAGE CURRENT vs.
AMBIENT TEMPERATURE



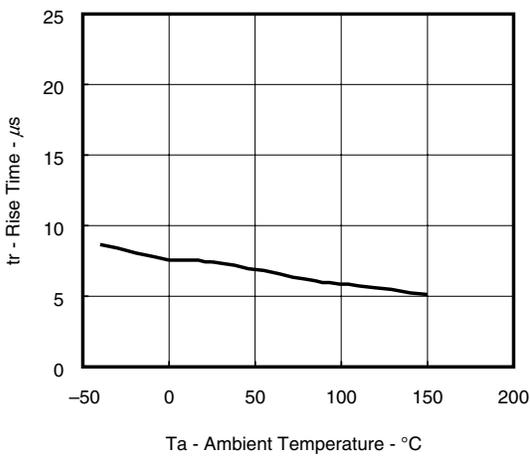
TURN ON TIME vs.
AMBIENT TEMPERATURE



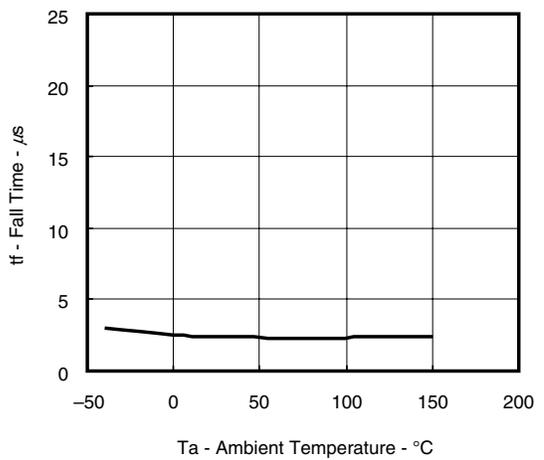
TURN OFF TIME vs.
AMBIENT TEMPERATURE



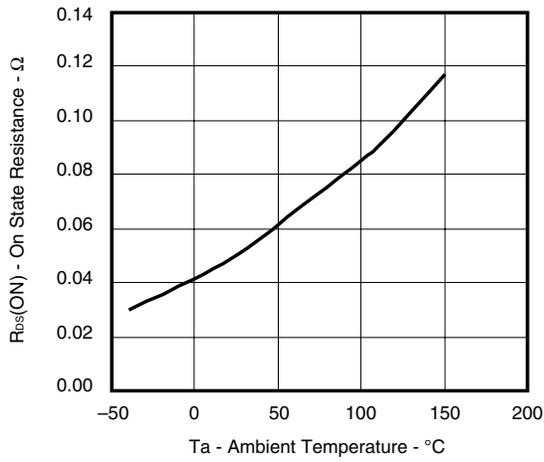
RISE TIME vs.
AMBIENT TEMPERATURE



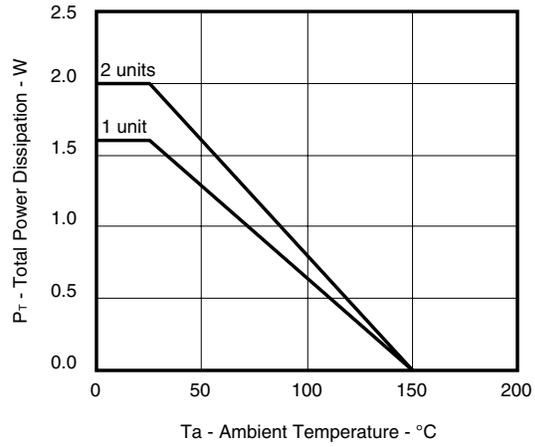
FALL TIME vs.
AMBIENT TEMPERATURE



ON STATE RESISTANCE vs. AMBIENT TEMPERATURE

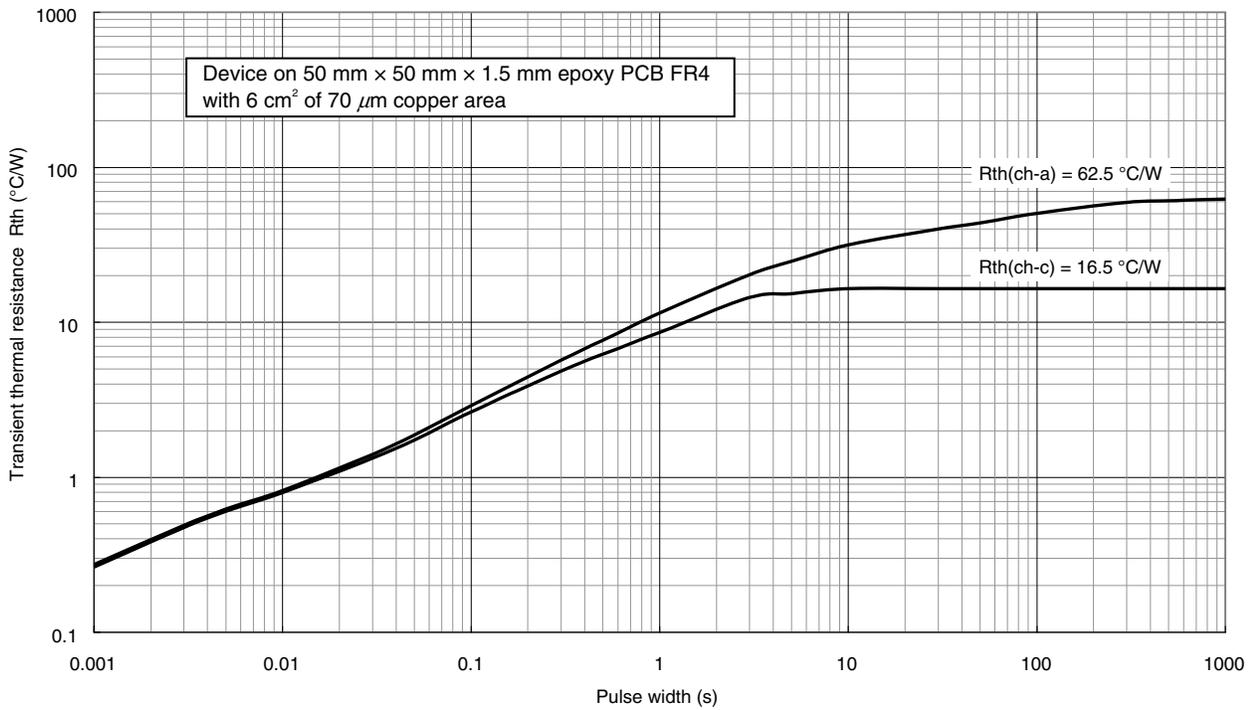


TOTAL POWER DISSIPATION vs. AMBIENT TEMPERATURE

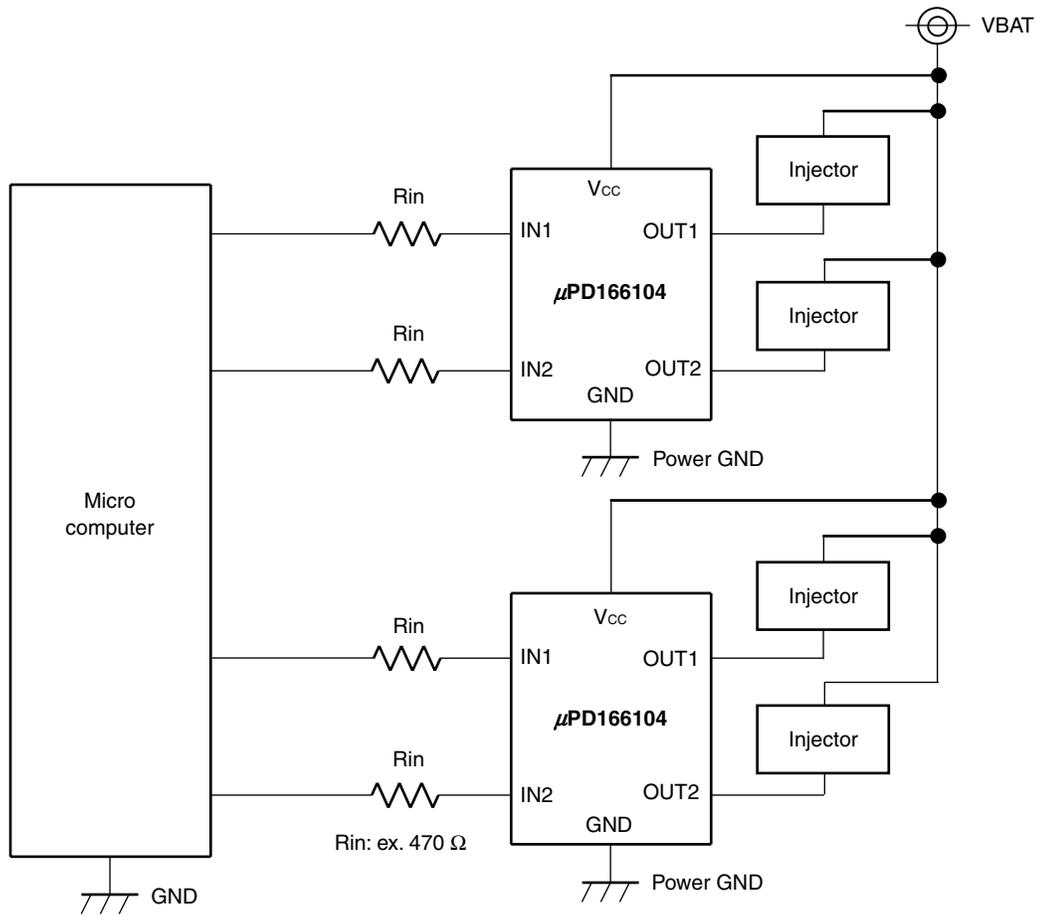


TRANSIENT THERMAL RESISTANCE CHARACTERISTICS

TRANSIENT THERMAL RESISTANCE vs. PULSE WIDTH



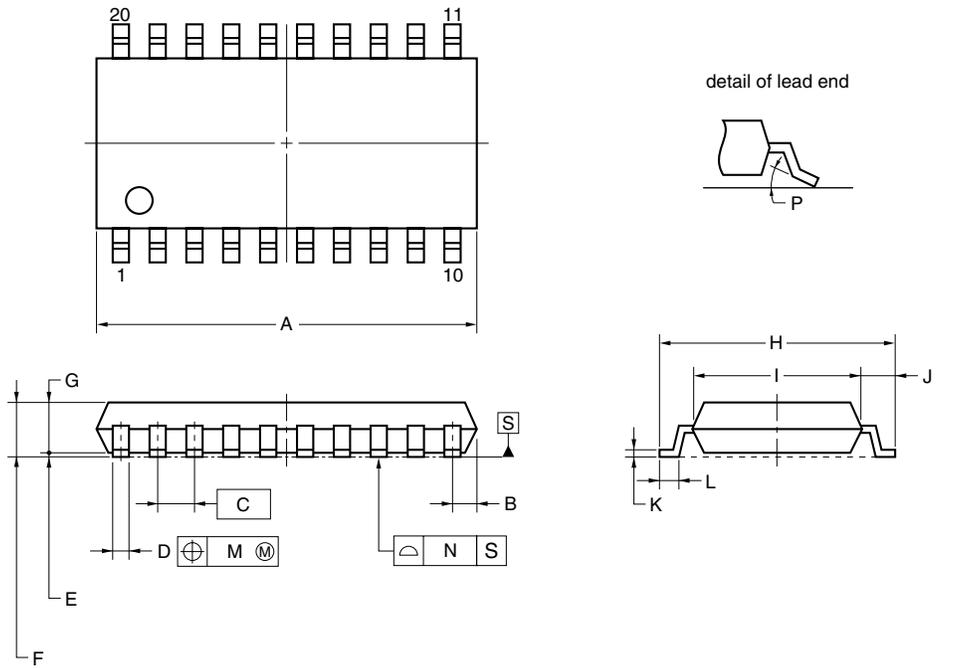
APPLICATION EXAMPLE



Caution This application circuit is example and not intended for use in actual mass production design.

PACKAGE DRAWING

20-PIN PLASTIC SOP (7.62 mm (300))



NOTE
 Each lead centerline is located within 0.12 mm of its true position (T.P.) at maximum material condition.

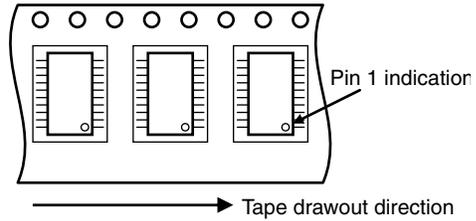
ITEM	MILLIMETERS
A	12.7±0.3
B	0.78 MAX.
C	1.27 (T.P.)
D	0.42 ^{+0.08} _{-0.07}
E	0.1±0.1
F	1.8 MAX.
G	1.55±0.05
H	7.7±0.3
I	5.6±0.2
J	1.1
K	0.22 ^{+0.08} _{-0.07}
L	0.6±0.2
M	0.12
N	0.10
P	3° ^{+7°} _{-3°}

P20GM-50-300B, C-7

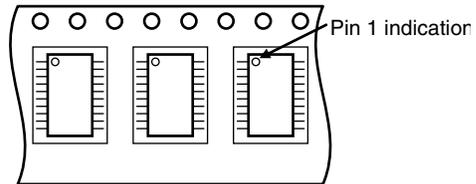
TAPING INFORMATION

There are two types (E1, E2) of directions of the device in the career tape.

E1: Pin 1 of the device faces toward the open end of the tape, away from the reel

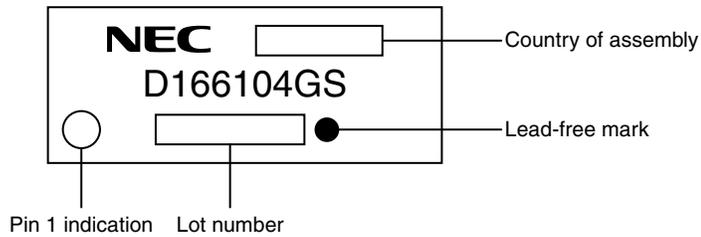


E2: Pin 1 of the device faces away from the open end of the tape, toward the reel



MARKING INFORMATION

This figure indicates the marking items and arrangement. However, details of the letterform, the size and the position aren't indicated.



RECOMMENDED SOLDERING CONDITIONS

The μPD166104 should be soldered and mounted under the following recommended conditions.

For soldering methods and conditions other than those recommended below, contact an NEC Electronics sales representative.

For technical information, see the following website.

Semiconductor Device Mount Manual (<http://www.necel.com/pkg/en/mount/index.html>)

- μPD166104GS-E1-AZ: 20-pin plastic SOP (7.62 mm (300))
- μPD166104GS-E2-AZ: 20-pin plastic SOP (7.62 mm (300))

Soldering Method	Soldering Conditions	Symbol
Infrared reflow	Peak package's surface temperature: 260 °C, Reflow time: 60 seconds or less (220 °C or higher), Maximum allowable number of reflow processes: 3, Exposure limit ^{Note} : 7 days (10 to 72 hours pre-backing is required at 125C° afterwards), Flux: Rosin flux with low chlorine (0.2 Wt% or below) recommended. <Caution> Non-heat-resistant trays, such as magazine and taping trays, cannot be baked before unpacking.	IR60-107-3
Partial heating method	Pin temperature: 350°C or below, Heat time: 3 seconds or less (per each side of the device) , Flux: Rosin flux with low chlorine (0.2 Wt% or below) recommended.	—

Note The Maximum number of days during which the product can be stored at a temperature of 5 to 25°C and a relative humidity of 20 to 65% after dry-pack package is opened.

[MEMO]

[MEMO]

[MEMO]

- **The information in this document is current as of June, 2007. The information is subject to change without notice. For actual design-in, refer to the latest publications of NEC Electronics data sheets or data books, etc., for the most up-to-date specifications of NEC Electronics products. Not all products and/or types are available in every country. Please check with an NEC Electronics 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 the prior written consent of NEC Electronics. NEC Electronics assumes no responsibility for any errors that may appear in this document.
- NEC Electronics 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 Electronics 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 Electronics 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 a customer's equipment shall be done under the full responsibility of the customer. NEC Electronics assumes no responsibility for any losses incurred by customers or third parties arising from the use of these circuits, software and information.
- While NEC Electronics endeavors to enhance the quality, reliability and safety of NEC Electronics 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 Electronics products, customers must incorporate sufficient safety measures in their design, such as redundancy, fire-containment and anti-failure features.
- NEC Electronics products are classified into the following three quality grades: "Standard", "Special" and "Specific".

The "Specific" quality grade applies only to NEC Electronics products developed based on a customer-designated "quality assurance program" for a specific application. The recommended applications of an NEC Electronics product depend on its quality grade, as indicated below. Customers must check the quality grade of each NEC Electronics 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 Electronics products is "Standard" unless otherwise expressly specified in NEC Electronics data sheets or data books, etc. If customers wish to use NEC Electronics products in applications not intended by NEC Electronics, they must contact an NEC Electronics sales representative in advance to determine NEC Electronics' willingness to support a given application.

(Note)

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