

μPD166105GS

MOS INTEGRATED CIRCUIT

 R07DS0604EJ0100
 Rev.1.00
 Jan 19, 2012

Description

The μPD166105 is a high-voltage, dual output, and N-channel low-side intelligent power device with built-in overtemperature-protection, overcurrent-limitation, and disconnection-detection circuits.

It protects itself by shutting down or limiting current when it detects overtemperature or overcurrent.

Output MOS shut down is restarted automatically by cooling of the chip temperature.

When load is normal, a diagnostic output is produced on detection of a flyback voltage.

When load is disconnected, diagnostic output stops.

Features

- High voltage dual output low side driver
- Built-in overcurrent limitation circuits and overtemperature protection circuits
 - Shuts down by overtemperature detection
 - Restarts automatically after cooling
- Built-in dynamic clamping circuit (100 V Min.)
- Built-in disconnection-detection circuit
 - A diagnostic output is produced on detection of a flyback voltage.
 - Diagnostic output stops on disconnection.
- Low on-state resistance
- High temperature operation (Tch = 175°C Max.)
- Small 20-pin SOP package

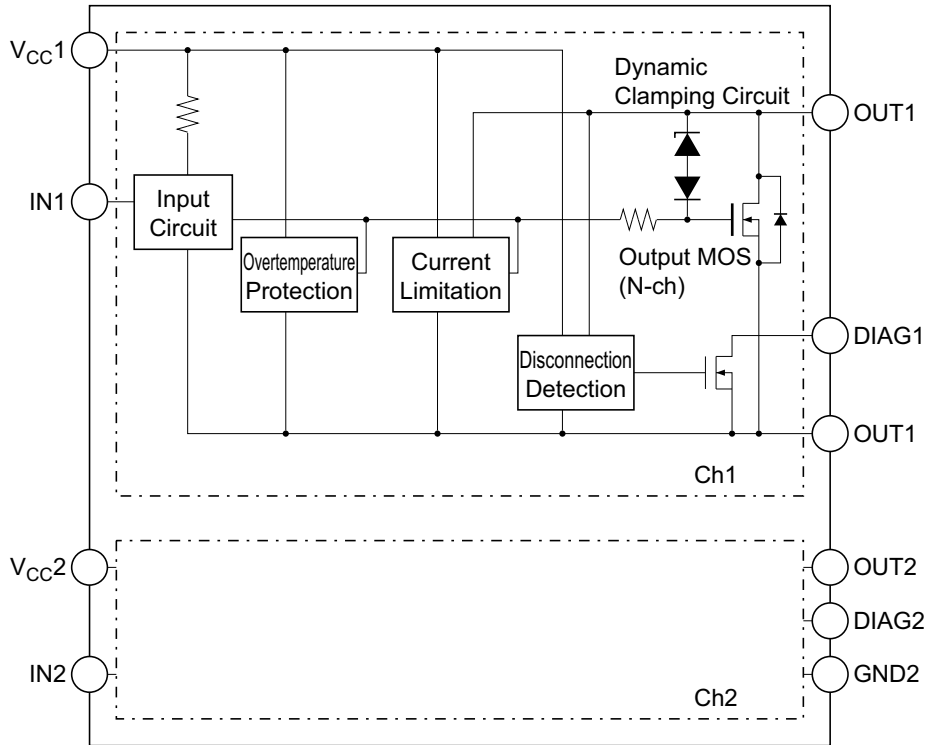
Application

- Injector driver

Ordering Information

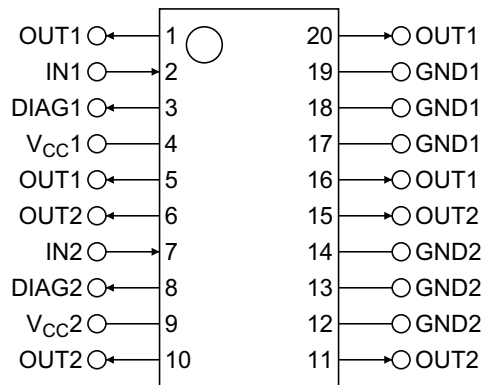
Part No.	Lead Plating	Packing	Package
μPD166105GS-E1-AY	Sn	Tape 2500 p/reel	20-pin plastic SOP (7.62 mm (300))
μPD166105GS-E2-AY	Sn	Tape 2500 p/reel	20-pin plastic SOP (7.62 mm (300))

Block Diagram



Pin Configuration

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



(Top view)

Pin Name

Pin No.	Pin Name
1	OUT1
2	IN1
3	DIAG1
4	V _{cc} 1
5	OUT1

Pin No.	Pin Name
6	OUT2
7	IN2
8	DIAG2
9	V _{cc} 2
10	OUT2

Pin No.	Pin Name
11	OUT2
12	GND2
13	GND2
14	GND2
15	OUT2

Pin No.	Pin Name
16	OUT1
17	GND1
18	GND1
19	GND1
20	OUT1

Absolute Maximum Ratings

(Ta = 25°C, unless otherwise specified)

Item	Symbol	Rating	Unit	Condition
Input voltage	V _{IN}	-1.5 to +7.0	V	
Power supply voltage	V _{CC1}	-0.5 to +18	V	DC
	V _{CC2}	24	V	60 s
	V _{CC3}	35	V	1 s
Output voltage	V _{OUT}	100	V	Except the clamping voltage at the flyback time
Output current	I _{O(DC)}	SELF LIMITED	A/ch	V _{IN} = 5 V, DC
DIAG output voltage	V _{DIAG}	7	V	
DIAG output current	I _{DIAG}	20	mA	
Power dissipation	P _D	2.4	W	Ta = 25°C, both channels are ON ^{Note}
Channel temperature	T _{ch}	-40 to +175	°C	
Storage temperature	T _{stg}	-55 to +175	°C	

Note: When mounted on 50 mm × 50 mm × 1.6 mm epoxy PCB FR4 substrate with 600 mm² × 70 μm copper foil.

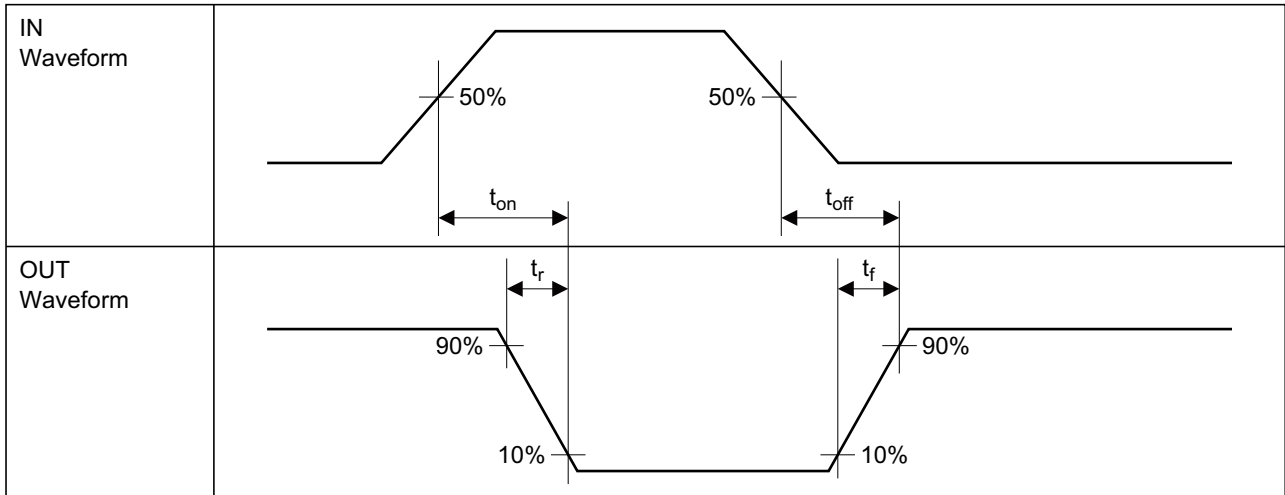
Caution: Product quality may suffer if the absolute maximum rating is exceeded even momentarily for any parameters. That is, the absolute maximum ratings are rated values at which the product is on the verge of suffering physical damage, and therefore the product must be used under conditions that ensure 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 Characteristics

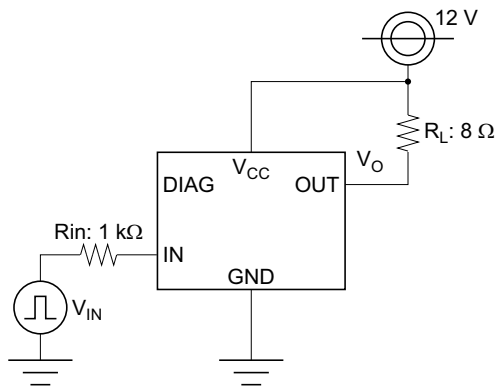
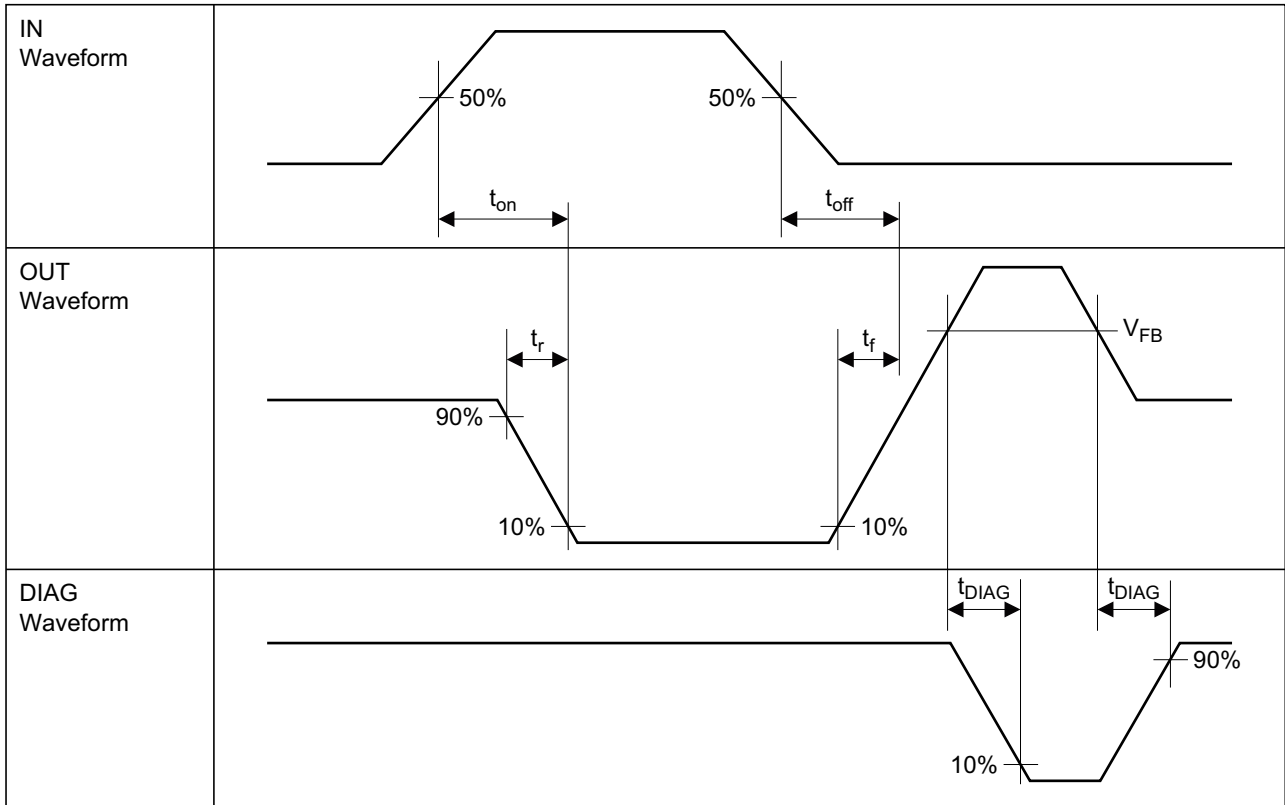
($V_{CC} = 5$ to 18 V, $T_{ch} = -40$ to $+175^{\circ}\text{C}$, unless otherwise specified)

Item	Symbol	MIN.	TYP.	MAX.	Unit	Condition
High level input voltage	V_{IH}	3.0	—	—	V	$R_{in} = 1\text{ k}\Omega$, $V_{DS} = 0.3\text{ V}$, $I_O = 1.4\text{ A}$
Low level input voltage	V_{IL}	—	—	1.5	V	$R_{in} = 1\text{ k}\Omega$, $V_{DS} = 20\text{ V}$, $I_O = 1\text{ mA}$
High level input current	I_{IH}	—	—	300	μA	$V_{IN} = 5.5\text{ V}$, $V_{DS} = 0\text{ V}$
Low level input current	I_{IL}	-10	—	+10	μA	$V_{IN} = 0\text{ V}$, $V_{DS} = 20\text{ V}$
Power supply current	I_{CC1}	—	—	10	mA/ch	$V_{IN} = 16\text{ V}$, ON condition
	I_{CC2}	—	—	10	mA/ch	$V_{IN} = 16\text{ V}$, OFF condition
Output on-state resistance	$R_{DS(ON)1}$	—	64	91	$\text{m}\Omega$	$I_O = 1.4\text{ A}$, $T_{ch} = 25^{\circ}\text{C}$, $V_{IN} = V_{IH}$, $V_{CC} = 16\text{ V}$
	$R_{DS(ON)2}$	—	117	207	$\text{m}\Omega$	$I_O = 1.4\text{ A}$, $T_{ch} = 175^{\circ}\text{C}$, $V_{IN} = V_{IH}$, $V_{CC} = 16\text{ V}$
Turn on time	t_{on}	3.5	—	35	μs	$V_{IN} = 0 \rightarrow 5\text{ V}$, $R_{in} = 1\text{ k}\Omega$, $R_L = 8\text{ }\Omega$, $V_{CC} = 12\text{ V}$, $T_{ch} = 0$ to 175°C
Rise time	t_r	—	—	35	μs	
Turn off time	t_{off}	—	—	30	μs	$V_{IN} = 5 \rightarrow 0\text{ V}$, $R_{in} = 1\text{ k}\Omega$, $R_L = 8\text{ }\Omega$, $V_{CC} = 12\text{ V}$, $T_{ch} = 0$ to 175°C
Fall time	t_f	—	—	15	μs	
Output leakage current	I_{DSS}	—	—	350	μA	$V_{IN} = 0\text{ V}$, $V_{DS} = 18\text{ V}$
Clamp voltage	V_{OUT}	100	—	130	V	$I_O = 10\text{ mA}$, $T_{ch} = 25^{\circ}\text{C}$, $V_{IN} = 0\text{ V}$
Temperature characteristics of clamp voltage	ΔV_Z	—	130	—	$\text{mV}/^{\circ}\text{C}$	$I_O = 1.4\text{ A}$, $V_{IN} = V_{IL}$, $L = 1\text{ mH}$
Overtemperature detection temperature	T_{HI}	175	—	—	$^{\circ}\text{C}$	$V_{IN} = 5\text{ V}$, $V_{CC} = 6$ to 18 V
Current limitation	I_{LIM}	1.7	—	—	A	
Flyback detection voltage	V_{FB}	33	—	83	V	
DIAG response time	t_{DIAG}	0	—	5	μs	$I_O = 1.4\text{ A}$, $L = 1\text{ mH}$, $V_{DIAG} = 5\text{ V}$, $R_{DIAG} = 51\text{ k}\Omega$
DIAG on-state resistance	$R_{DIAG(ON)1}$	—	—	0.83	$\text{k}\Omega$	$V_{CC} = 16\text{ V}$, $I_{ODIAG} = 2.4\text{ mA}$
	$R_{DIAG(ON)2}$	—	—	1.54	$\text{k}\Omega$	$V_{CC} = 6\text{ V}$, $I_{ODIAG} = 1.3\text{ mA}$
DIAG output leakage current	$I_{DIAGLEAK}$	—	1.4	3.0	μA	$V_{DIAG} = 5\text{ V}$, $T_{ch} = 25^{\circ}\text{C}$
		—	40	60	μA	$V_{DIAG} = 5\text{ V}$, $T_{ch} = 175^{\circ}\text{C}$

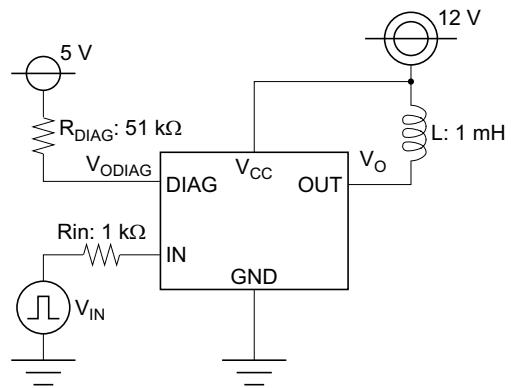
Switching Measurement Waveform



DIAG Output Measurement Waveform



Switching Measurement Circuit



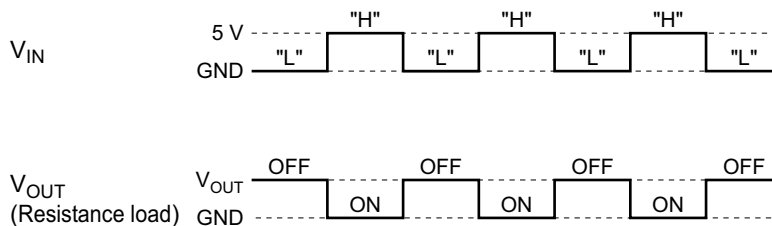
DIAG Output Measurement Circuit

Outline of Functions

Input Circuit (On/Off Control)

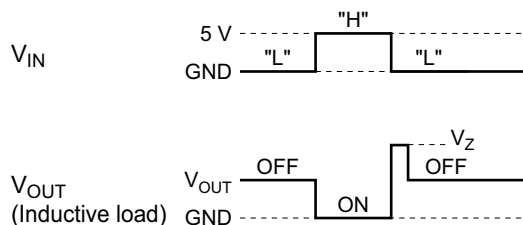
Output MOS turns on when the high-level input voltage (3.0 V or more) is applied to IN terminal.

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.



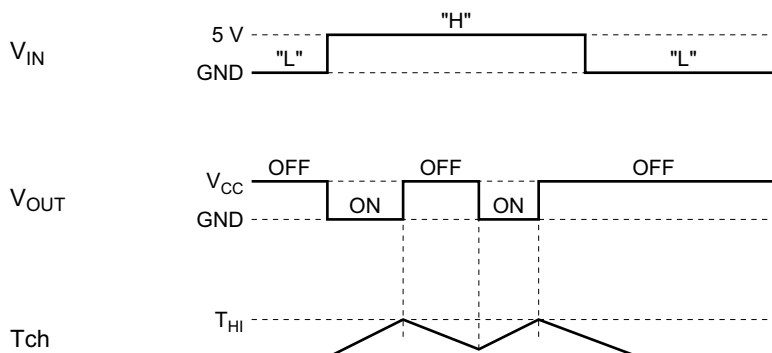
Current Limitation Circuit

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.

Overtemperature Protection Circuit

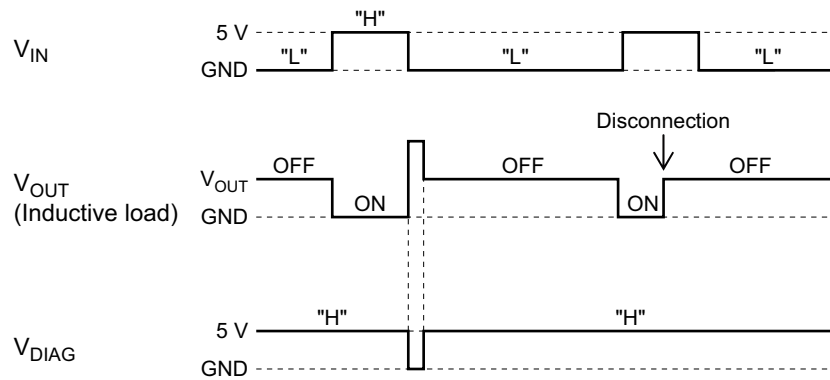
This circuit prevents destruction from overtemperature. The channel temperature of the output is monitored and the output is shut down when overtemperature is detected. Output restarts automatically after the channel cooled down.



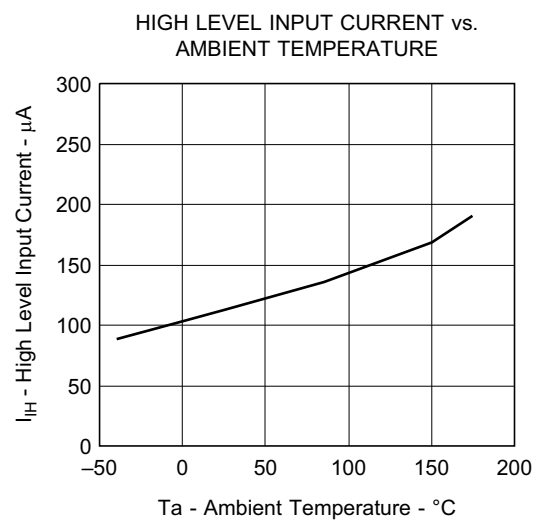
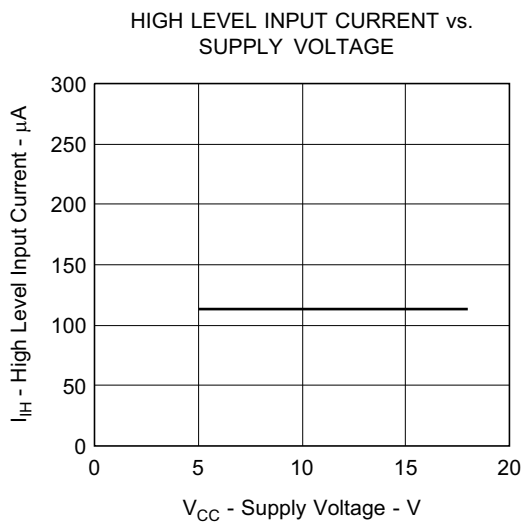
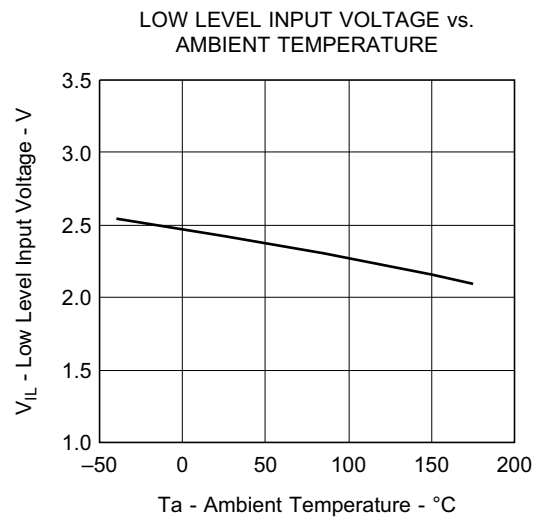
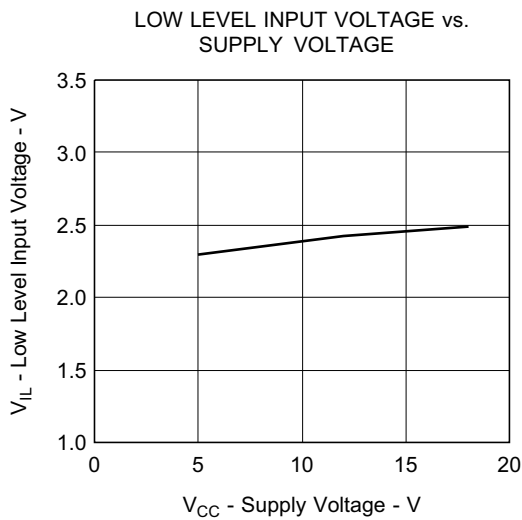
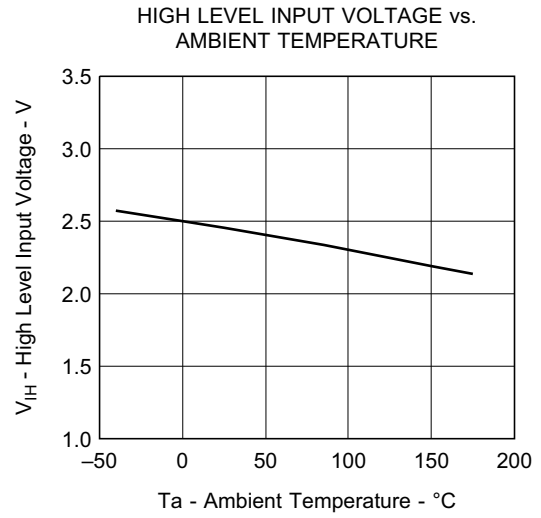
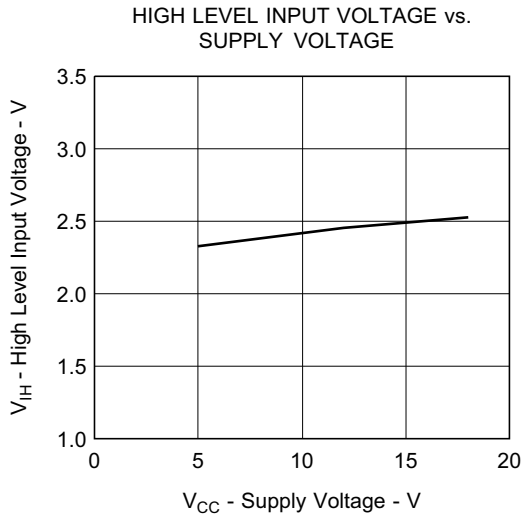
Disconnection Detection Circuit

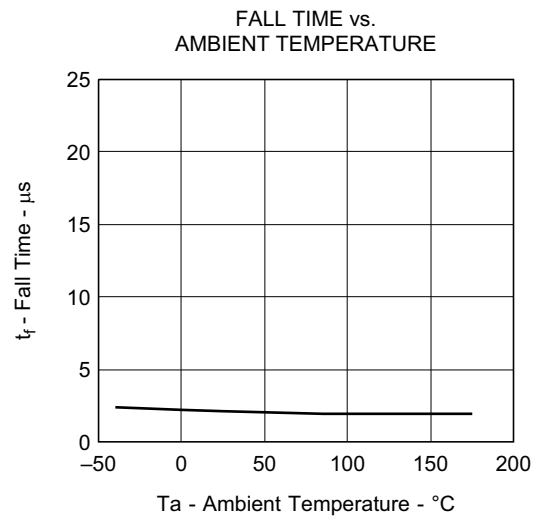
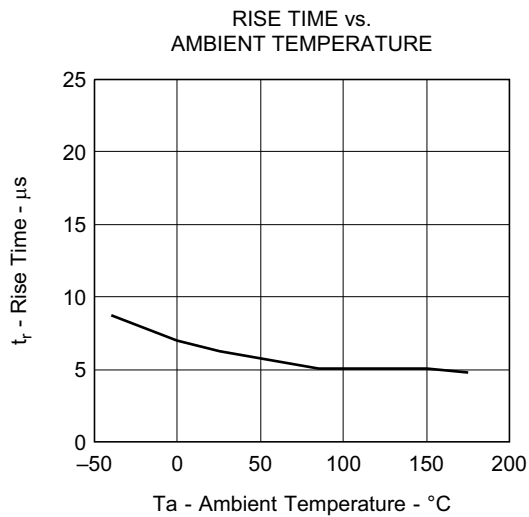
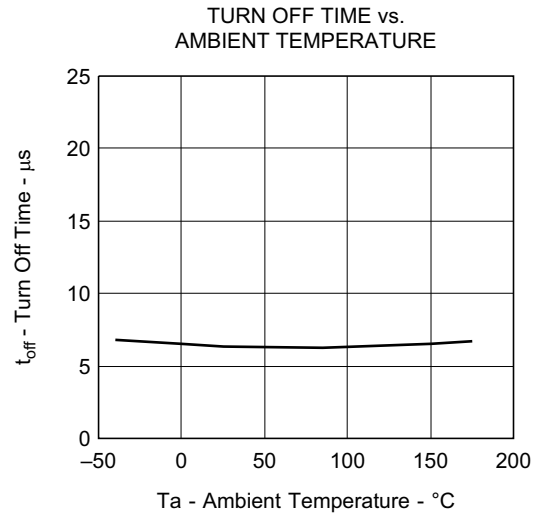
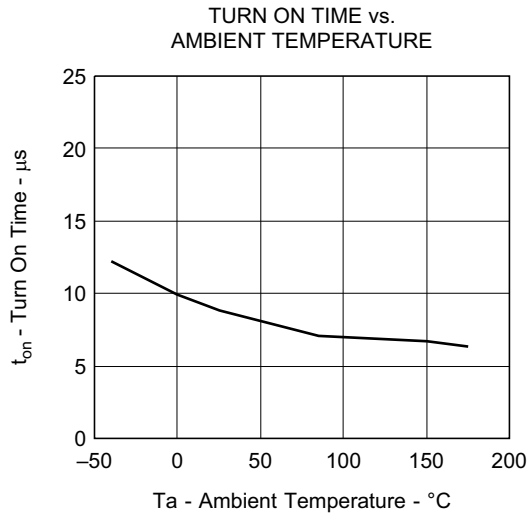
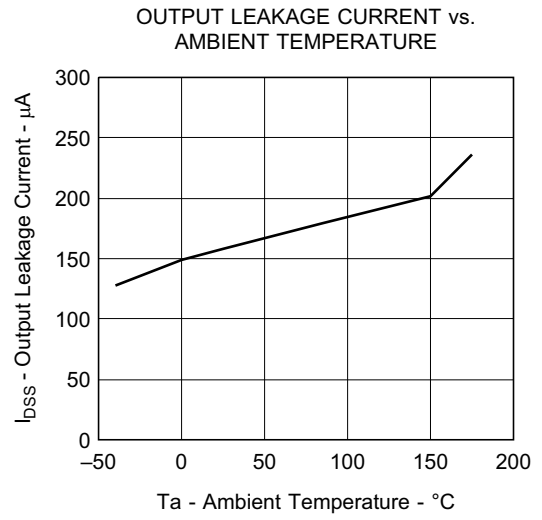
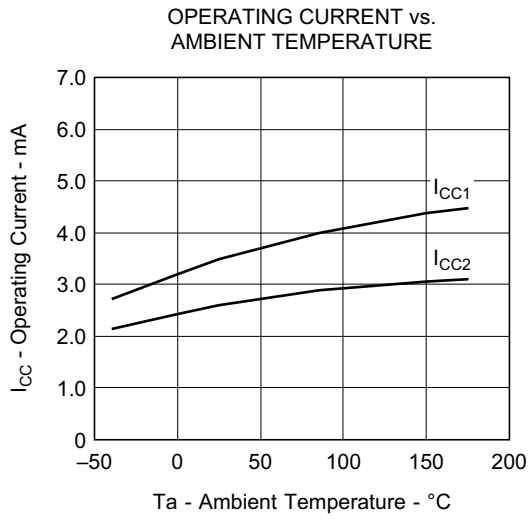
The signal on the DIAG pins goes to the low level in synchronization with the generation of flyback voltage when an inductive load is being driven.

The high level is output on the DIAG pin when the inductive load is disconnected.

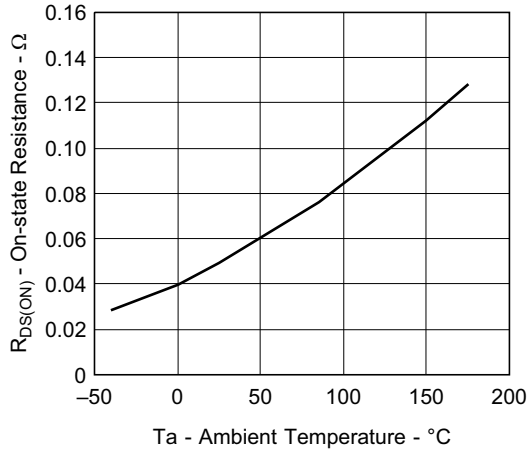


Typical Characteristics

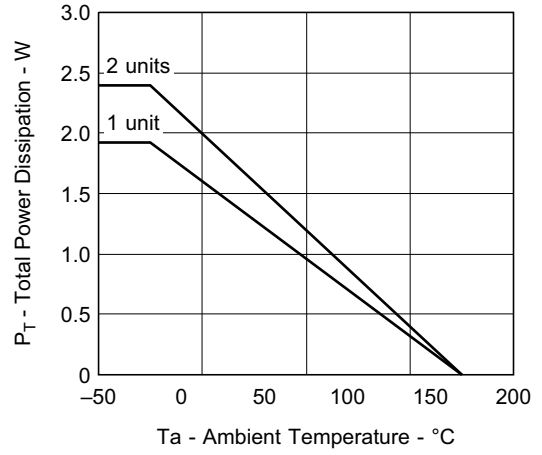




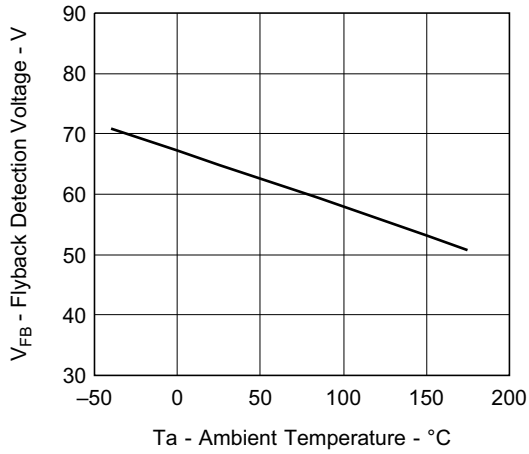
ON-STATE RESISTANCE vs. AMBIENT TEMPERATURE



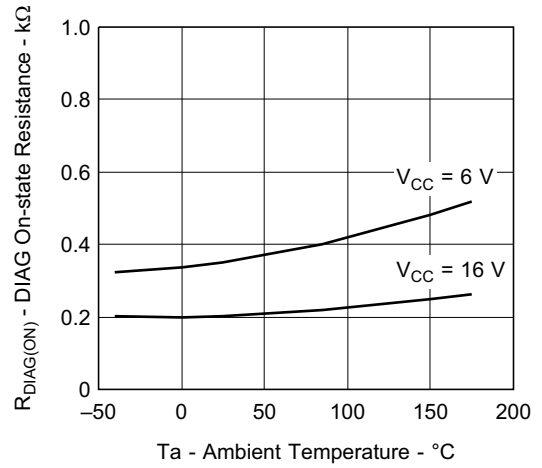
TOTAL POWER DISSIPATION vs. AMBIENT TEMPERATURE



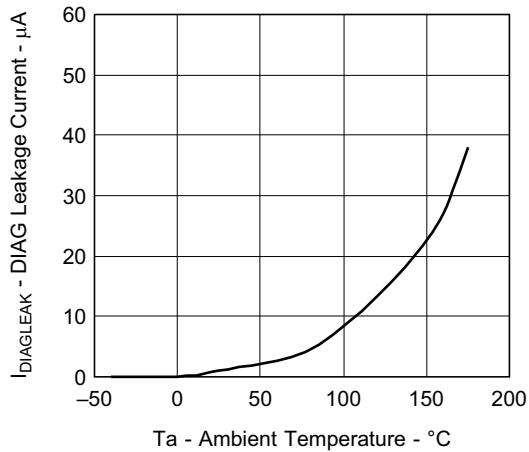
FLYBACK DETECTION VOLTAGE vs. AMBIENT TEMPERATURE



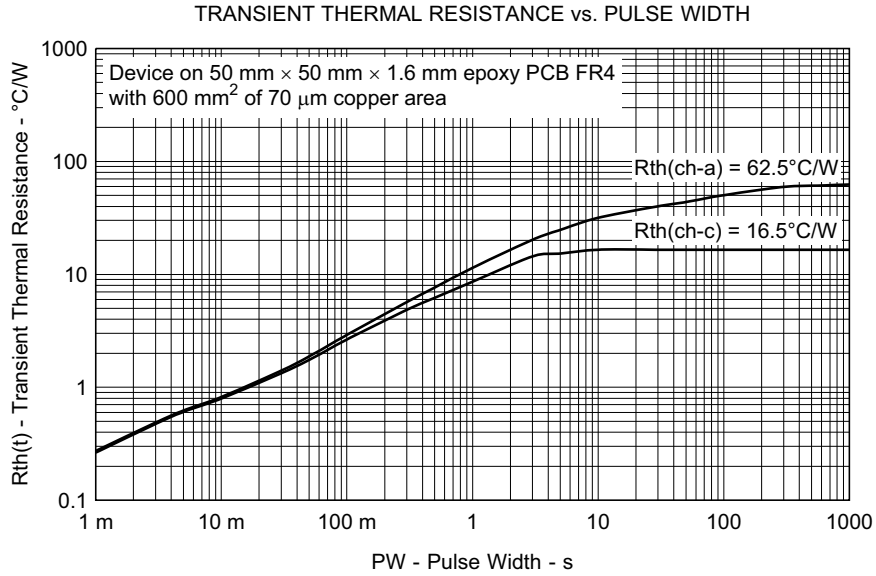
DIAG ON-STATE RESISTANCE vs. AMBIENT TEMPERATURE



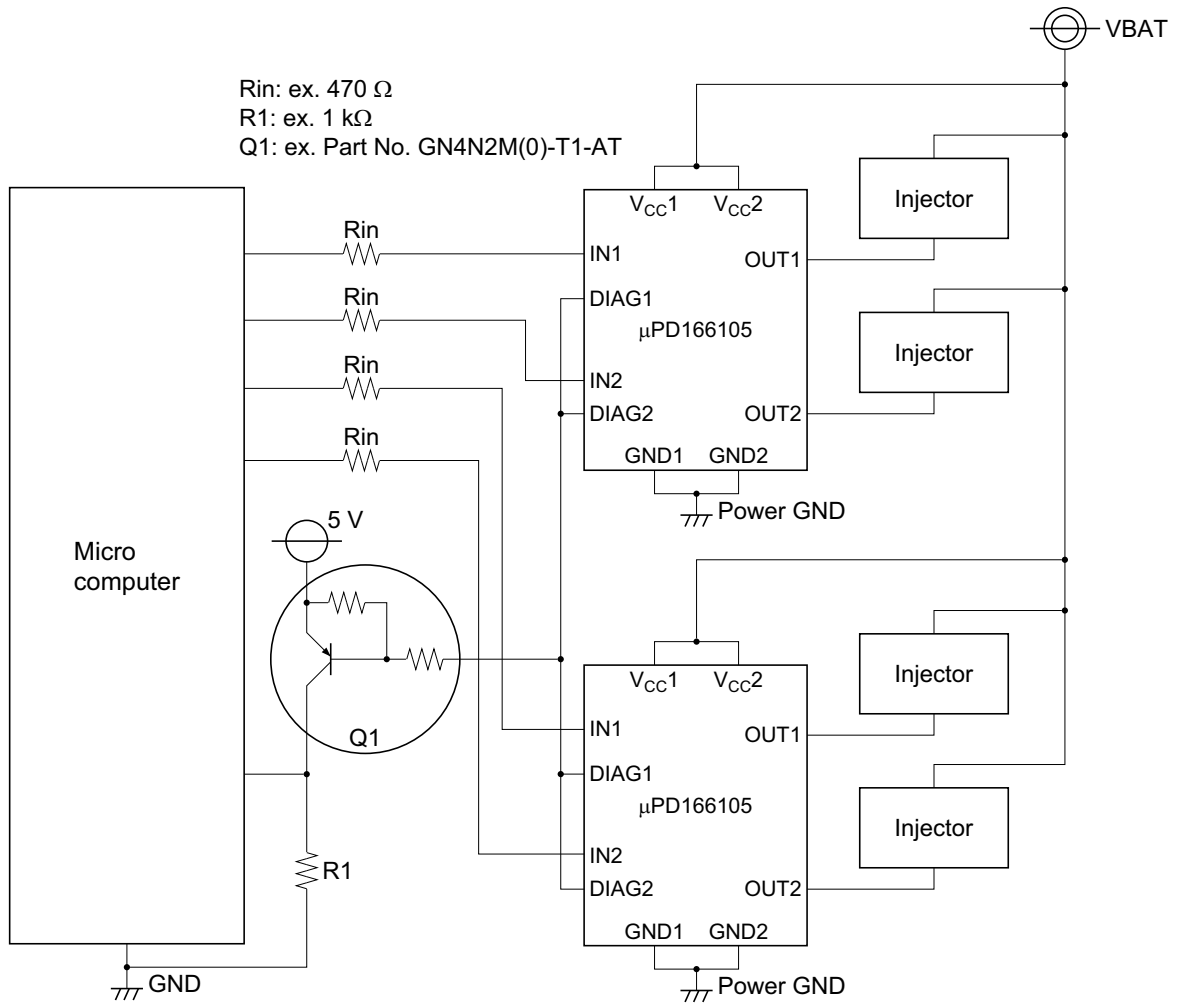
DIAG LEAKAGE CURRENT vs. AMBIENT TEMPERATURE



Transient Thermal Resistance Characteristics

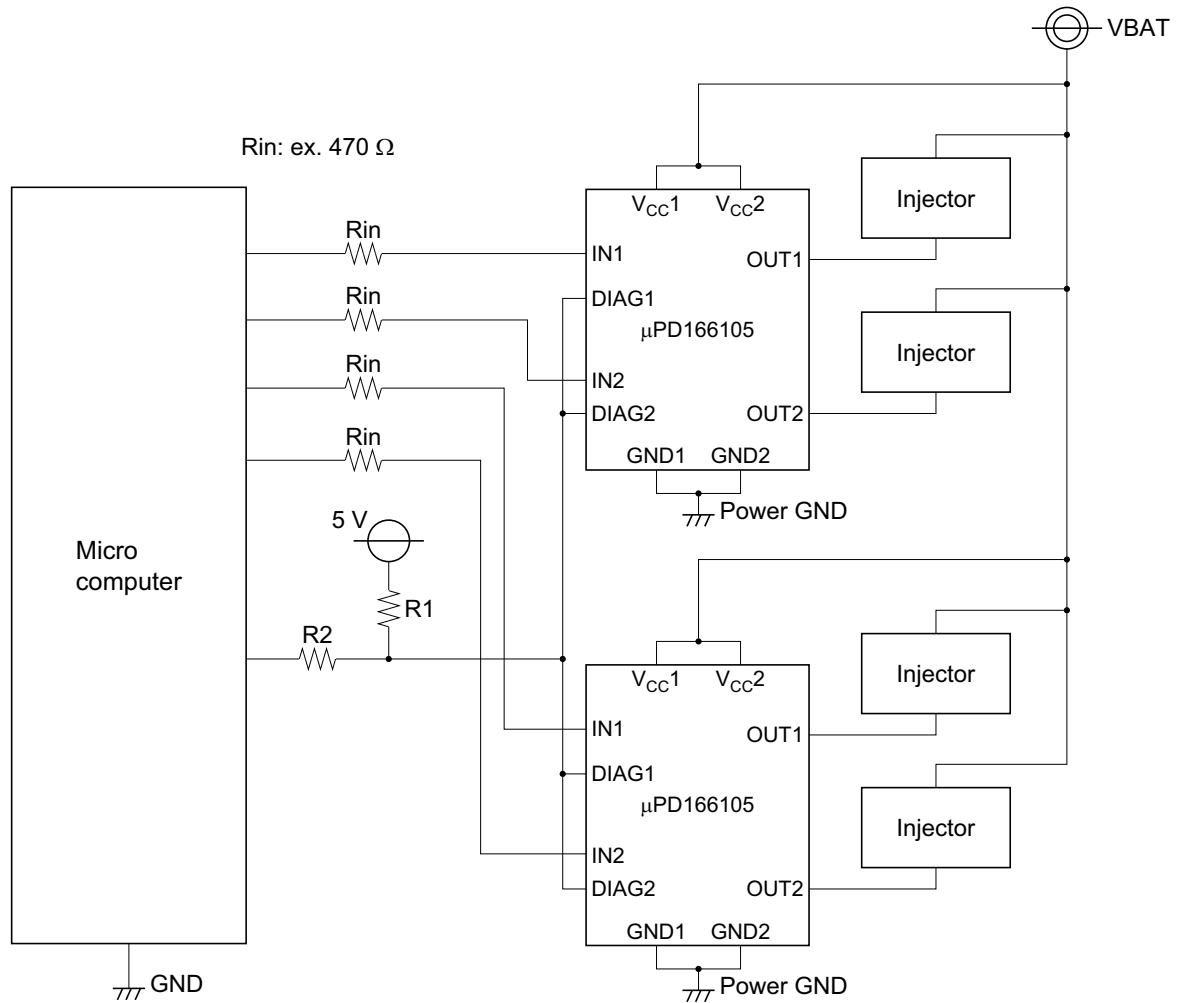


Application Example 1



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

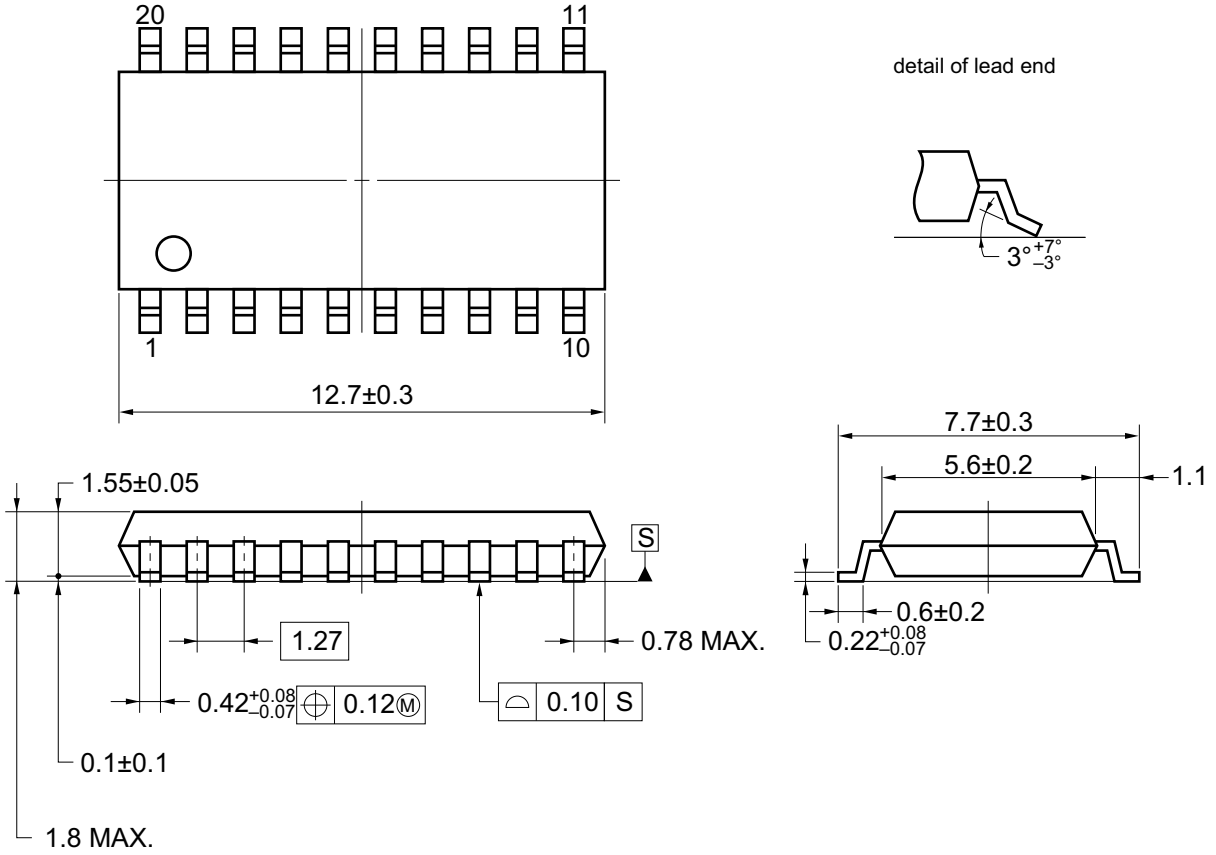
Application Example 2



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

Package Drawing

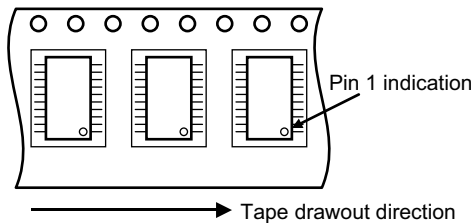
20-Pin Plastic SOP (7.62 mm (300))



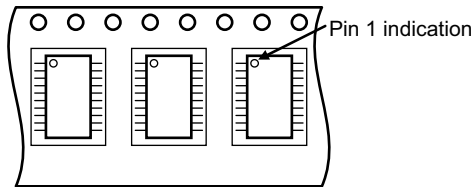
Taping Information

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

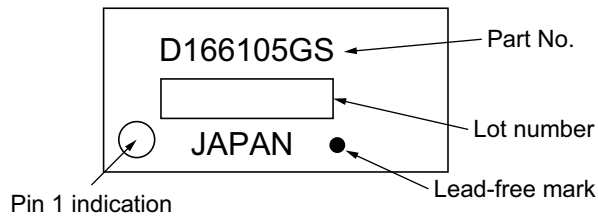


E2: Pin 1 of the device faces away from the open end of the tape, toward the reel



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 μPD166105 should be soldered and mounted under the following recommended conditions.

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

For technical information, see the following website.

Semiconductor Package Mount Manual (<http://www.renesas.com/prod/package/manual/>)

- μPD166105GS-E1-AY: 20-pin plastic SOP (7.62 mm (300))
- μPD166105GS-E2-AY: 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 125°C 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.

Revision History	μPD166105GS Data Sheet
-------------------------	-------------------------------

Rev.	Date	Description	
		Page	Summary
1.00	Jan 19, 2012	—	First Edition Issued

All trademarks and registered trademarks are the property of their respective owners.

Notice

- 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.
- 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.
- You should not alter, modify, copy, or otherwise misappropriate any Renesas Electronics product, whether in whole or in part.
- 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.
- 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.
- 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.
- 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.
- 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.
- 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.
- 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.
- This document may not be reproduced or duplicated, in any form, in whole or in part, without prior written consent of Renesas Electronics.
- 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.



SALES OFFICES

Renesas Electronics Corporation

<http://www.renesas.com>

Refer to "<http://www.renesas.com/>" for the latest and detailed information.

Renesas Electronics America Inc.
2880 Scott Boulevard Santa Clara, CA 95050-2554, U.S.A.
Tel: +1-408-586-6000, Fax: +1-408-586-6130

Renesas Electronics Canada Limited
1101 Nicholson Road, Newmarket, Ontario L3Y 9C3, Canada
Tel: +1-905-898-5441, Fax: +1-905-898-3220

Renesas Electronics Europe Limited
Dukes Meadow, Millboard Road, Bourne End, Buckinghamshire, SL8 5FH, U.K.
Tel: +44-1628-585-100, Fax: +44-1628-585-900

Renesas Electronics Europe GmbH
Arcadiastrasse 10, 40472 Düsseldorf, Germany
Tel: +49-211-65030, Fax: +49-211-6503-1327

Renesas Electronics (China) Co., Ltd.
7th Floor, Quantum Plaza, No.27 ZhiChunLu Haidian District, Beijing 100083, P.R.China
Tel: +86-10-8235-1155, Fax: +86-10-8235-7679

Renesas Electronics (Shanghai) Co., Ltd.
Unit 204, 205, AZIA Center, No.1233 Lujiazui Ring Rd., Pudong District, Shanghai 200120, China
Tel: +86-21-5877-1818, Fax: +86-21-6887-7858 / -7898

Renesas Electronics Hong Kong Limited
Unit 1601-1613, 16/F., Tower 2, Grand Century Place, 193 Prince Edward Road West, Mongkok, Kowloon, Hong Kong
Tel: +852-2886-9318, Fax: +852 2886-9022/9044

Renesas Electronics Taiwan Co., Ltd.
13F, No. 363, Fu Shing North Road, Taipei, Taiwan
Tel: +886-2-8175-9600, Fax: +886 2-8175-9670

Renesas Electronics Singapore Pte. Ltd.
1 HarbourFront Avenue, #06-10, Keppel Bay Tower, Singapore 098632
Tel: +65-6213-0200, Fax: +65-6276-8001

Renesas Electronics Malaysia Sdn.Bhd.
Unit 906, Block B, Menara Amcorp, Amcorp Trade Centre, No. 18, Jin Persiaran Barat, 46050 Petaling Jaya, Selangor Darul Ehsan, Malaysia
Tel: +60-3-7955-9390, Fax: +60-3-7955-9510

Renesas Electronics Korea Co., Ltd.
11F., Samik Lavied' or Bldg., 720-2 Yeoksam-Dong, Kangnam-Ku, Seoul 135-080, Korea
Tel: +82-2-558-3737, Fax: +82-2-558-5141