µPD166108GR

MOS INTEGRATED CIRCUIT

R07DS1119EJ0100
Rev.1.00
Sep 20, 2013

Description

The µPD166108 is an N-channel low side driver with embedded protection function.

When device is overtemperature or overcurrent is generated in output MOS, the protection function operates to prevent destruction and degradation of the product, and also outputs self-diagnostic signal.

Features

- High temperature operation (Tch = 175°C MAX.)
- Low on-state resistance
  $R_{DS(ON)}$ = 200 mΩ MAX. (V_{IN} = 5.0V, I_O = 0.9A, Tch = 25°C)
- Built-in protection circuit
  — Current limitation
  — Overtemperature protection
- Built in dynamic clamp circuit
- Dual channel Low-side switch
- Package: Power SOP 8

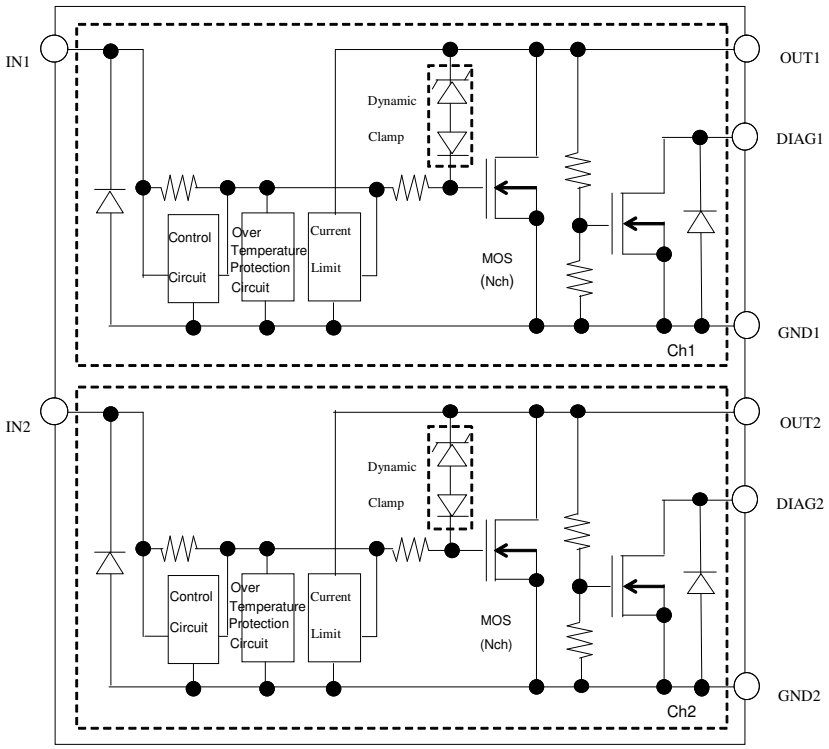
Application

- Switching of all types of 14 V DC grounded loads, such as inductor, resistor and capacitor

Ordering Information

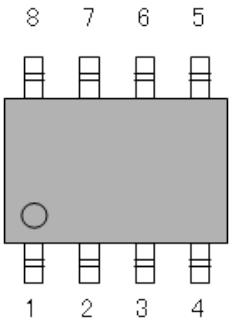
Part No.	Lead Plating	Packing	Package
µPD166108GR-E1-AY	Sn	Tape 2500 p/reel	Power SOP 8
µPD166108GR-E2-AY	Sn	Tape 2500 p/reel	Power SOP 8

Block Diagram



Pin Configuration

- Power SOP 8



Pin Functions

Pin No.	Pin Name	Function
1	IN1	Input pin1 (active level is high)
2	DIAG1	DIAG pin1
3	IN2	Input pin2 (active level is high)
4	DIAG2	DIAG pin2
5	GND2	Ground pin2
6	OUT2	Output pin2
7	GND1	Ground pin1
8	OUT1	Output pin1

Absolute Maximum Ratings

(Ta = 25°C, unless otherwise specified)

Item	Symbol	Rating	Unit	Condition
Output voltage	VOUT	40	V/ch	VIN=0V, DC susceptibility (without Flyback voltage)
Input voltage	VIN	-1.0 to 7.0	V/ch	
Negative input current	IIL	-10	mA/ch	
DIAG output voltage	Vdiag	-0.3 to 7.0	V/ch	
DIAG output current	Idiag	1.0	mA/ch	
Output current	IOUT(DC)	1.6	A/ch	VIN=5V
Total power dissipation	PD	2.3	W	2ch turn ON at the same moment *1
Channel temperature	Tch	175	°C	
Storage temperature	Tstg	-55 to 175	°C	
Dynamic clamp susceptibility (single pules)	EAS	100	mJ/ch	VBAT=16V, L=50mH, VIN=5V→0V
		30	mJ/ch	VBAT=16V, L=200mH, VIN=5V→0V, Tch=150°C
Dynamic clamp susceptibility (repetitive pules)	Ecl	40	mJ/ch	VBAT=16V, L=110mH, f=20Hz Duty=50%, VIN=5V→0V

Note: When mounted on a epoxy PCB (where FR-4 is 10 cm × 10 cm, dimension of copper foil is 15% and thickness of copper foil is 35 μm), PW = 10 s

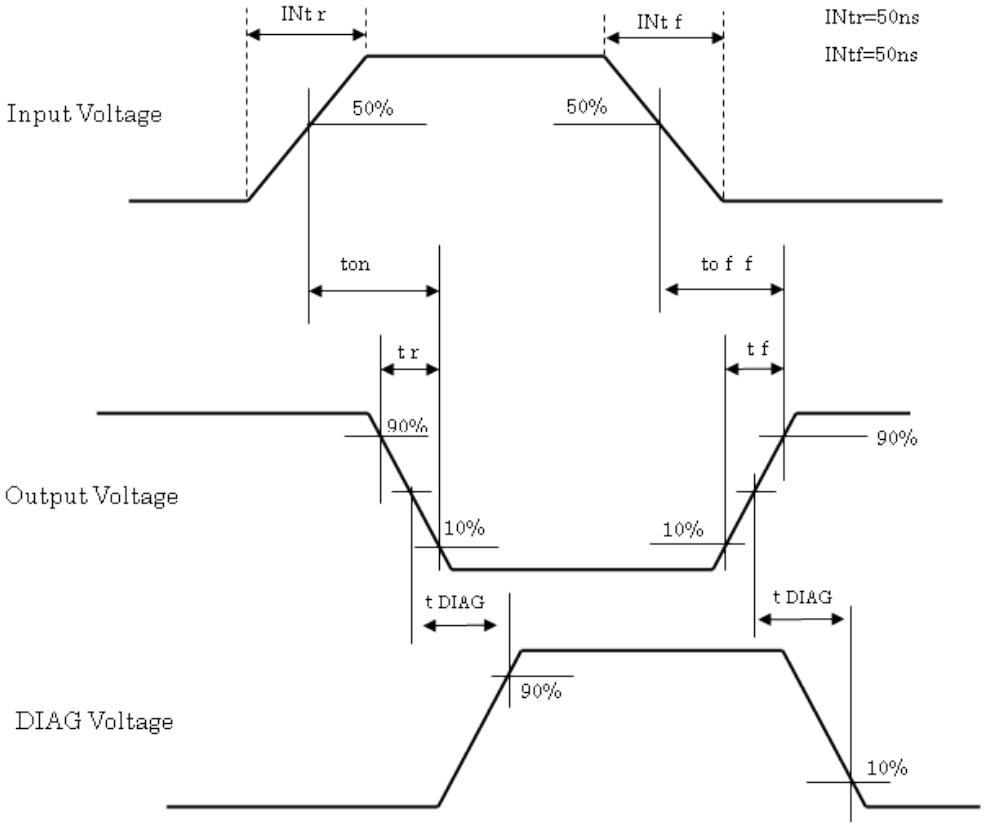
Electrical Characteristics

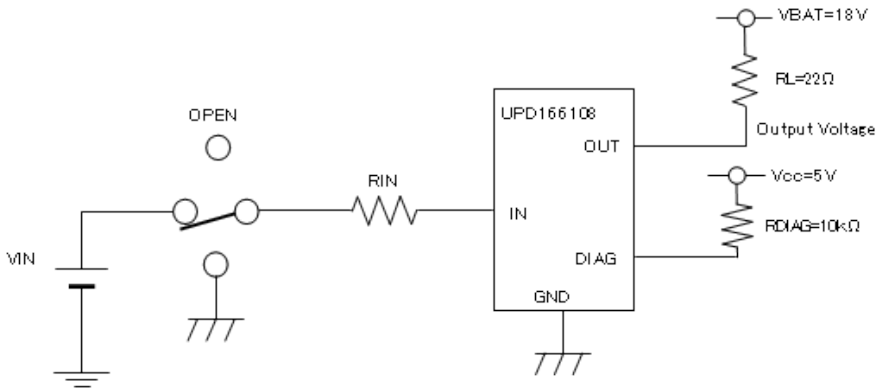
(Tch = 25°C, unless otherwise specified)

Item	Symbol	MIN.	TYP.	MAX.	Unit	Condition	
Output clamping voltage	VOUT	40		60	V	Io=1mA, VIN=0V	
Output Off leakage current	IOUT	10		100	μA/ch	VIN=0V, VOUT=18V	Ta = 25°C
		10		200	μA/ch		Ta = -40 to 125°C
		25		300	μA/ch		Ta = 125 to 175°C
		10		100	μA/ch	IIN=-5mA, VOUT=18V	
High Level Input current	IIH			400	μA	VIN=5V, VOUT=0V	Ta = 25°C
				500	μA		Ta = -40 to 175°C
Low Level Input current	IIL	-10		10	μA	VIN=0V, VOUT=18V	Ta = -40 to 175°C
High Level Input voltage	VIH	3.0			V	Io=0.9A, VOUT=0.5V	Ta = -40 to 125°C
		3.0			V	Io=0.9A, VOUT=1.0V	Ta = 125 to 175°C
Low Level Input voltage	VIL			1.5	V	VOUT=10V, Io=10mA	Ta = -40 to 175°C
Negative input voltage	VNI	-1.0		0	V	IIN = -5mA, VOUT = 18V	
DIAG L-level output voltage	Voutdiag	1		3	V	VIN=0V, RDIAG=10kΩ	Ta = -40 to 125°C
		0.8		3	V	Vcc=5V	Ta = 125 to 175°C
DIAG output voltage	VdiagH	Vcc-0.5			V/ch	VIN=0V, VOUT=0V	Ta = -40 to 125°C
		Vcc-0.8			V/ch	RDIAG=10kΩ, Vcc=5V	Ta = 125 to 175°C
	VdiagL			0.5	V/ch	VIN=0V, VOUT=4.5V RDIAG=10kΩ, Vcc=5V	Ta = -40 to 175°C
DIAG leak current	IDiagleak			50	μA/ch	VIN = 0V, Vcc = 5V	Ta = -40 to 125°C
				75	μA/ch		Ta = 125 to 175°C
ON-state resistance	Rout(on)			200	mΩ/ch	VIN = 5.0V, Io = 0.9A	Ta = 25°C
				360	mΩ/ch		Ta = -40 to 125°C
				400	mΩ/ch		Ta = 125 to 175°C
				240	mΩ/ch	VIN = 3.0V, Io = 0.9A	Ta = 25°C
				435	mΩ/ch		Ta = -40 to 125°C
				490	mΩ/ch		Ta = 125 to 175°C
Turn-on time	ton			80	μs	V_{BAT}=18V, R_L = 22Ω, VIN = 0V to 5V, RIN = 10Ω, RDIAG=10kΩ	
Rise time	tr			60	μs		
Turn-off time	toff			80	μs		
Fall time	tf			60	μs		
Turn-on time	ton *1			80	μs	V_{BAT} = 18V, R_L = 22Ω, VIN = OPEN to 5V, RIN = 10Ω, RDIAG = 10kΩ	
Rise time	tr *1			60	μs		
Turn-off time	toff *1			100	μs		
Fall time	tf *1			60	μs		
DIAG response time	tDIAG			50	μs		
Thermal shutdown detection temperature *2	THI	175			°C	VIN = 5V	
Current limit *3	I_S	1		20	A	VIN=3 to 7V, R_L=0Ω	Ta = -40 to 125°C
		1		10	A		Ta = 125 to 175°C
		1.6		20	A	VIN=5V,R_L=0Ω	Ta = -40 to 125°C
		1.6		10	A		Ta = 125 to 175°C
Input frequency	fIN			1	kHz	VIN=5V,Duty=50%,variation=less than 5%	

Notes: 1. Not subject to production test, specified by design.
2. Thermal shutdown returns by oneself.
3. The device does not destroy under Vbat =16V and short circuit condition. (within 24H continuously)

Definition of Switching Time





Switching Measurement Circuit

Truth Table

Item	V_{IN}	V_{OUT}	V_{DIAG}
Normal operation	L	H	L
	H	L	H
Overtemperature detection	L	H	L
	H	H	L
Overcurrent detection	L	H	L
	H	*	*
Disconnection detection	L	L	H

* : Output control condition

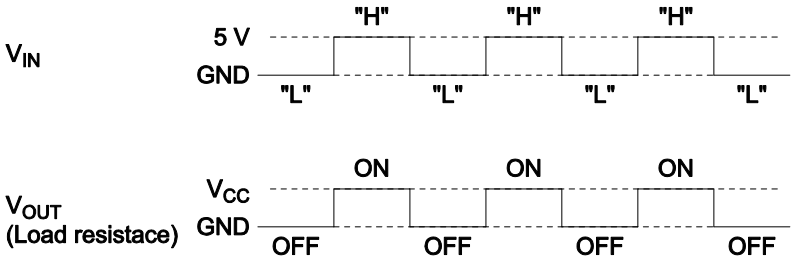
Outline of Functions

Pre-Driver (Charge Pump Circuit) ON/OFF Control

When the input voltage of the input pin (IN) is high level (3.0 V or more), the output MOS (Nch) turns on.

When the output voltage of the input pin (IN) is low level (1.5 V or less), the output MOS (Nch) turns off.

Charge pump circuit is built-in to drive the output MOS (Nch) that is connected to the high side.

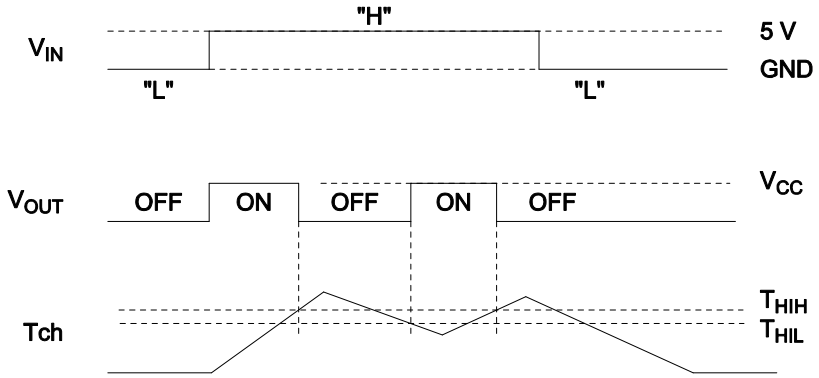


Overcurrent Detection Circuit

This circuit detects overcurrent to output pin (OUT) caused by short circuit etc., and feeds back detection signal to control circuit.When the overcurrent is detected, the current limitation circuit and the control circuit start operation. The output current is restricted in order to prevent destruction and degradation of the product.

Overtemperature Detection Circuit

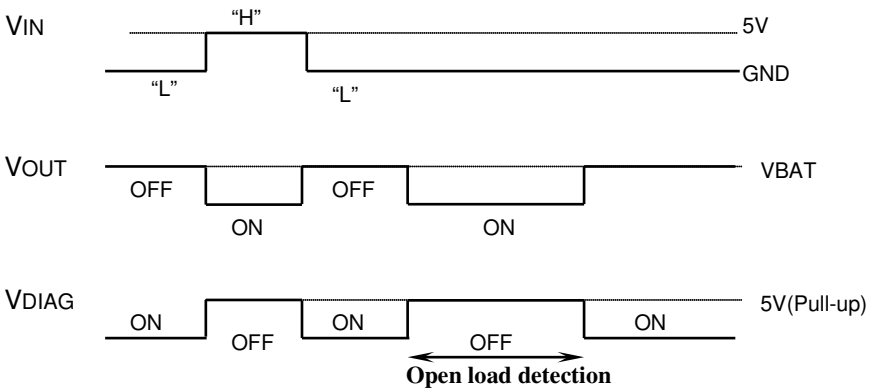
This circuit detects overtemperature by output MOS (Nch) driving, and feeds back detection signal to control circuit.When the circuit detects overtemperature, the protection function of the control circuit operates and output is shutdown. Output MOS (Nch) automatically restarts when channel temperature cools down after shutdown.



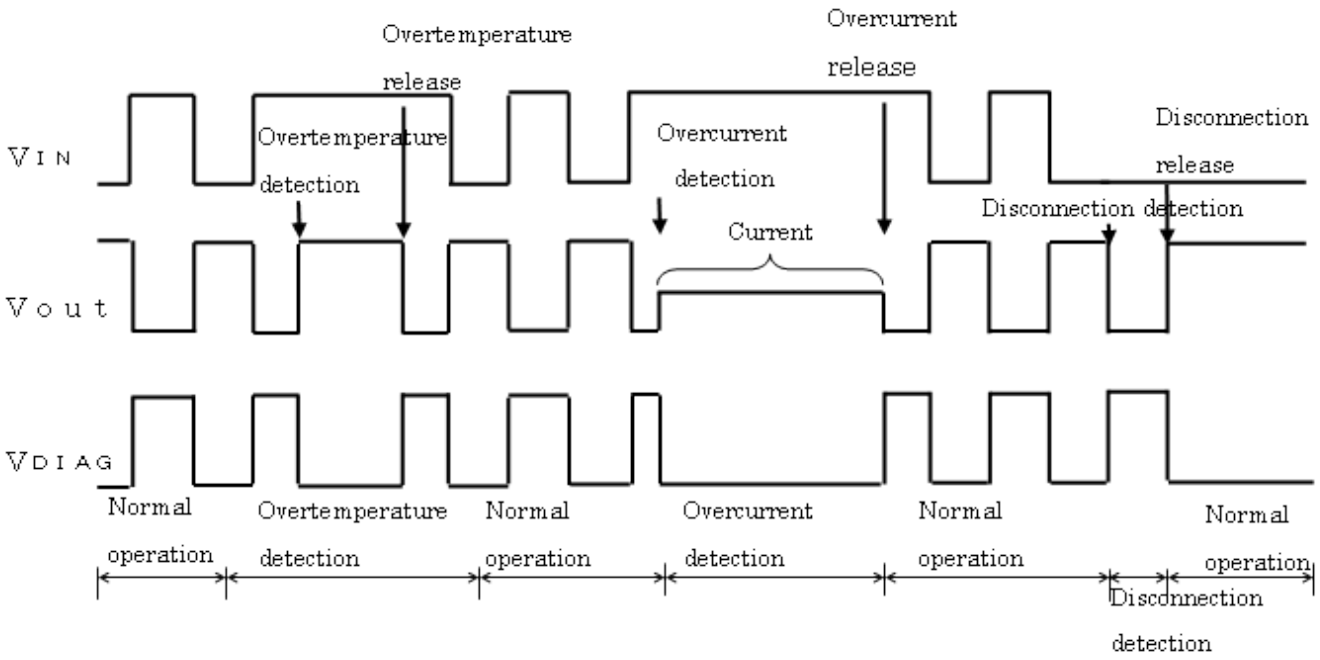
Open Load Detection Circuit

This circuit detects Open Load of output terminal. However, In case of using Open Load detection function, it is necessary to connect pull-up resistor (10Kohm±10%) with output terminal. (There are no electric characteristics influences in other circuit by presence of pull-up resistor.)

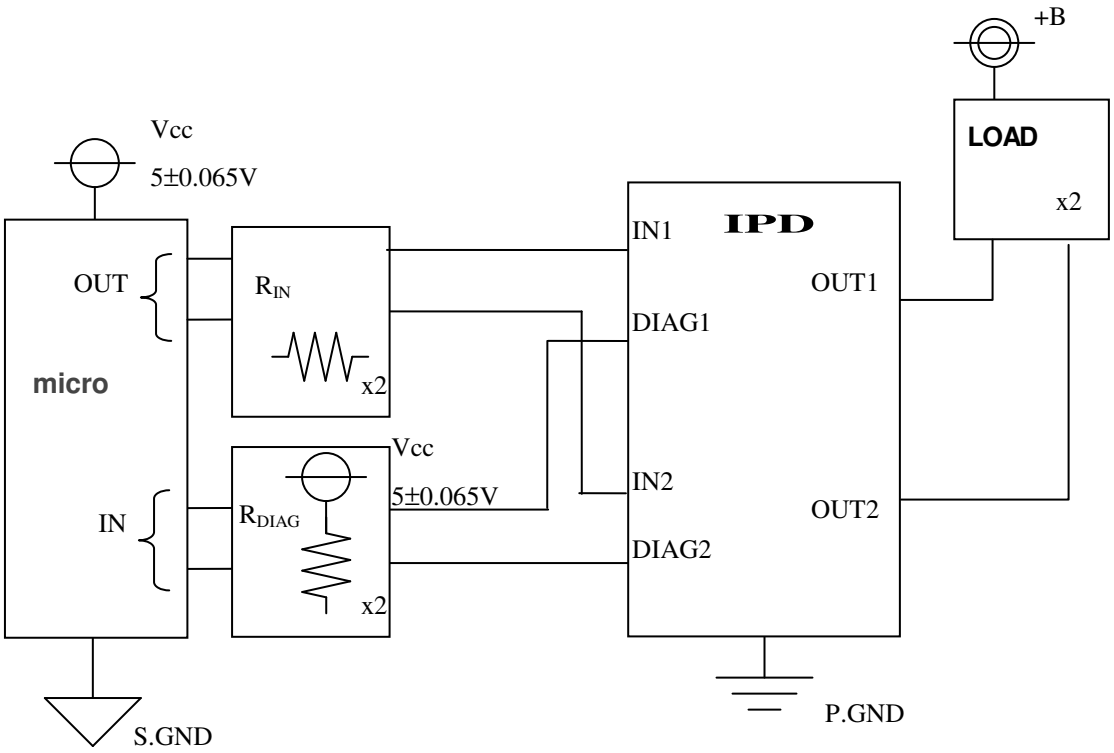
Open Load is detected by inputting low-level (1.5V or less) to input terminal (IN). DAIG terminal outputs Hi-Z (pull-up: high-level) when the output terminal is open.



Timing Chart

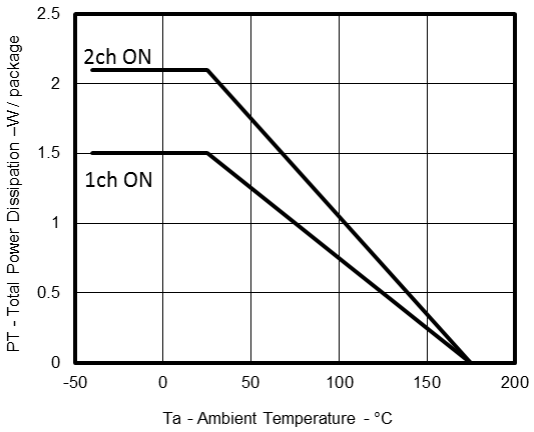


Example of Application Circuit

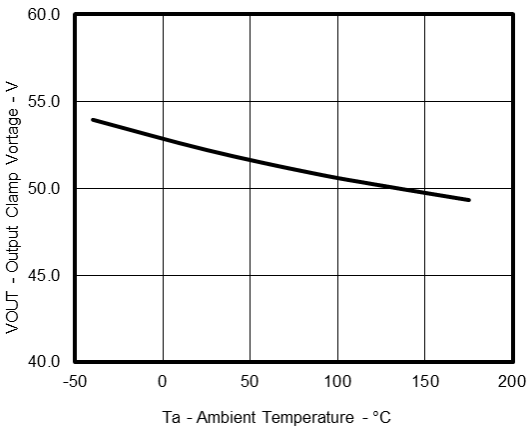


Typical Characteristics

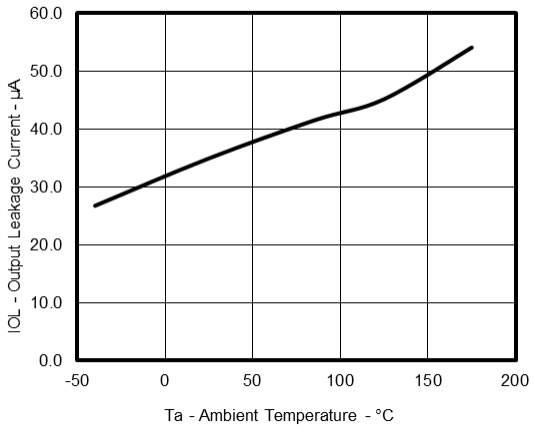
TOTAL POWER DISSIPATION vs.
AMBIENT TEMPERATURE



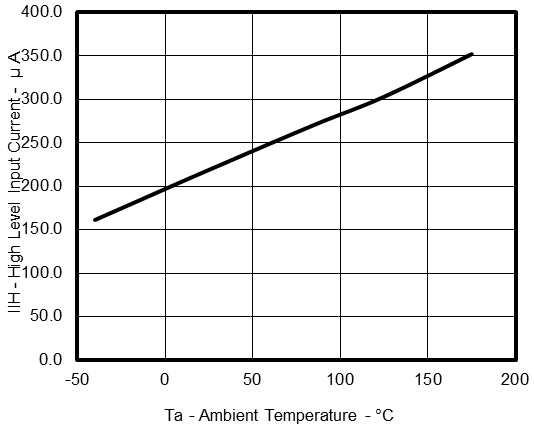
OUTPUT CLAMP VOLTAGE vs.
AMBIENT TEMPERATURE



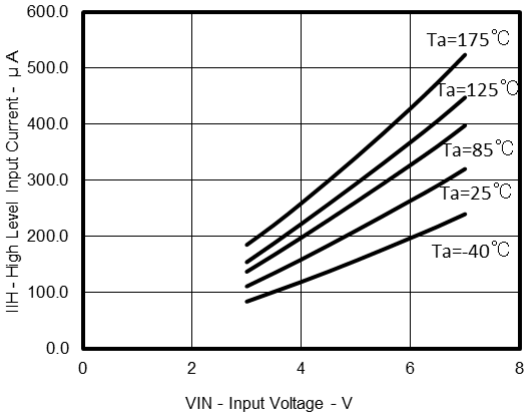
OUTPUT LEAKAGE CURRENT vs.
AMBIENT TEMPERATURE



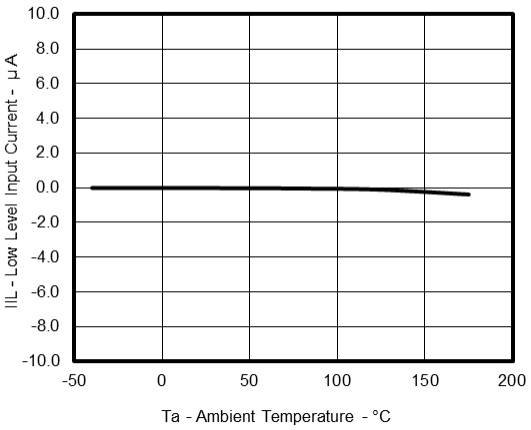
HIGH LEVEL INPUT CURRENT vs.
AMBIENT TEMPERATURE



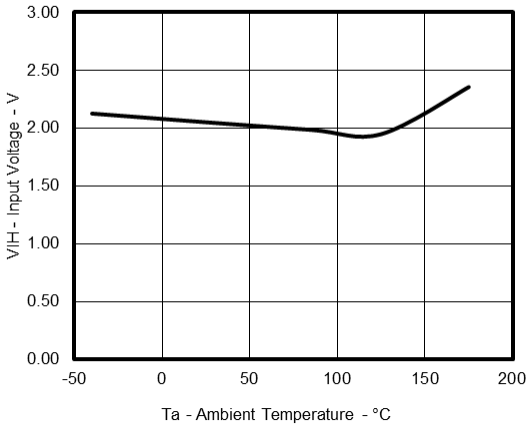
HIGH LEVEL INPUT CURRENT vs.
INPUT VOLTAGE



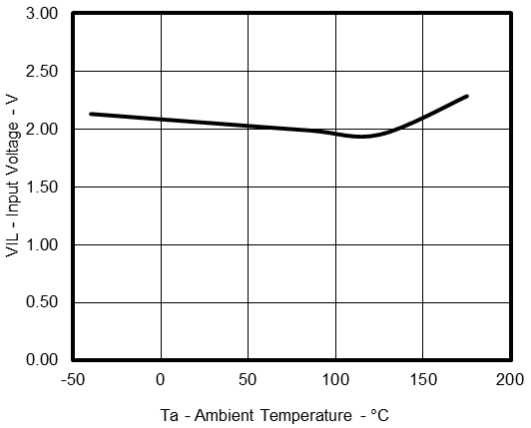
LOW LEVEL INPUT CURRENT vs.
AMBIENT TEMPERATURE



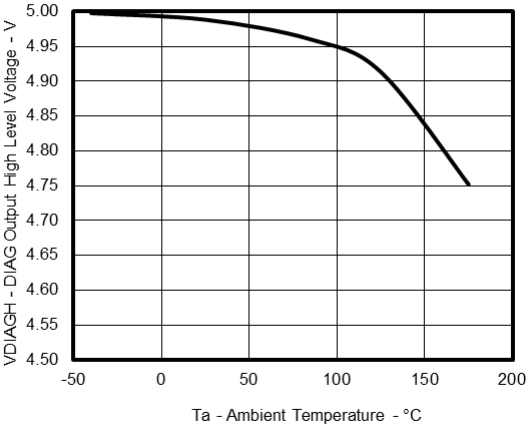
HIGH LEVEL INPUT VOLTAGE vs.
AMBIENT TEMPERATURE



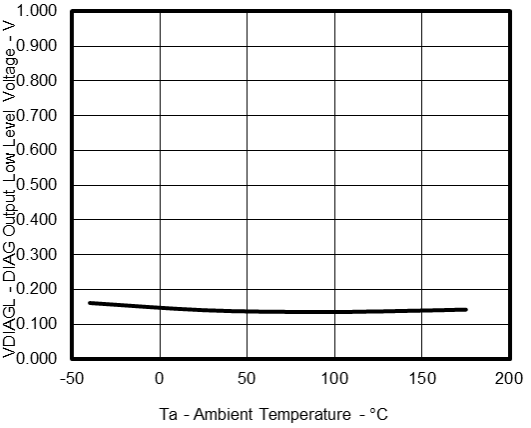
LOW LEVEL INPUT VOLTAGE vs.
AMBIENT TEMPERATURE



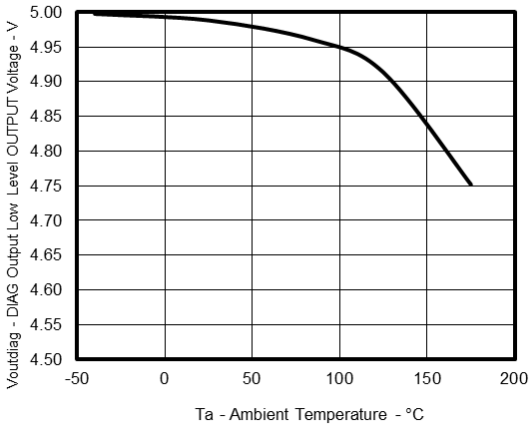
DIAG OUTPUT HIGH LEVEL VOLTAGE vs.
AMBIENT TEMPERATURE



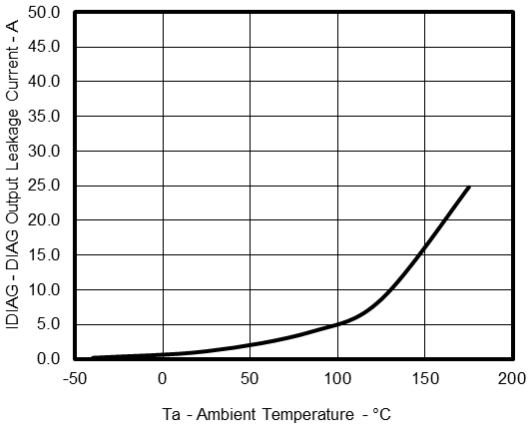
DIAG OUTPUT LOW LEVEL VOLTAGE vs.
AMBIENT TEMPERATURE



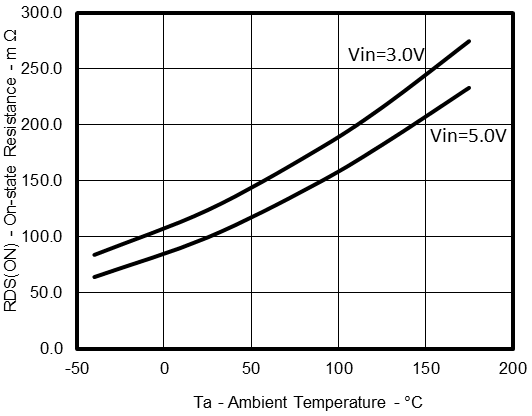
DIAG OUTPUT LOW LEVEL OUTPUT VOLTAGE vs.
AMBIENT TEMPERATURE



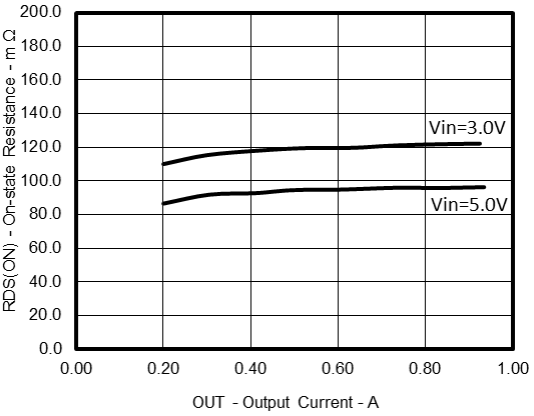
DIAG OUTPUT LEAKAGE CURRENT vs.
AMBIENT TEMPERATURE



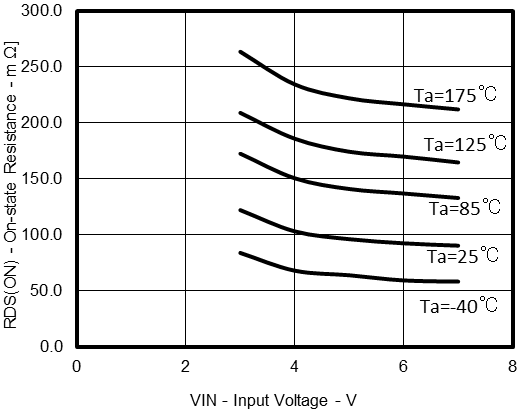
ON-STATE RESISTANCE vs.
AMBIENT TEMPERATURE



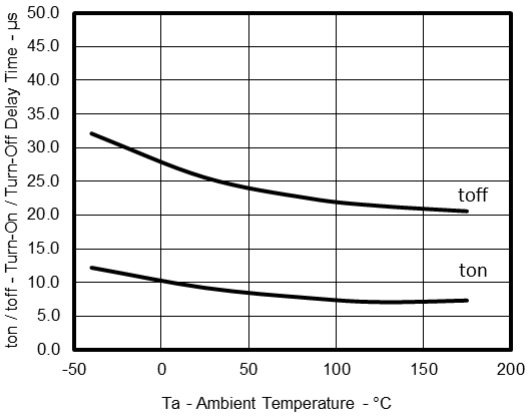
ON-STATE RESISTANCE vs.
OUTPUT CURRENT



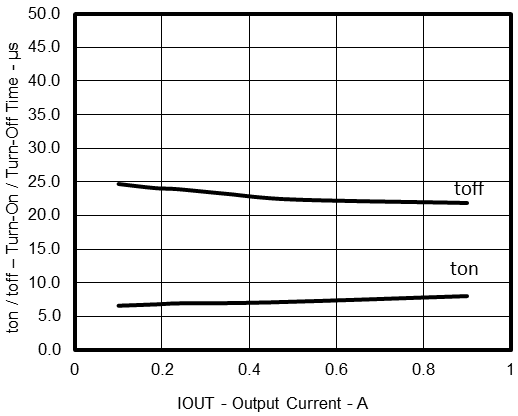
ON- STATE RESISTANCE vs.
INPUT VOLTAGE



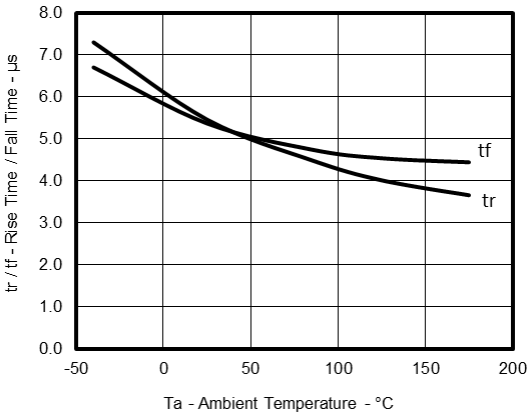
TURN-ON / TURN-OFF DELAY TIME vs.
AMBIENT TEMPERATURE



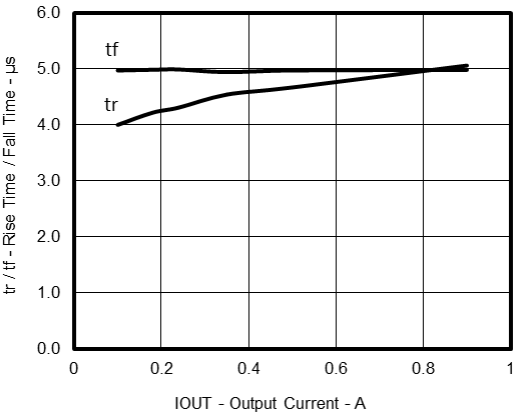
TURN-ON / TURN-OFF DELAY TIME vs.
OUTPUT CURRENT



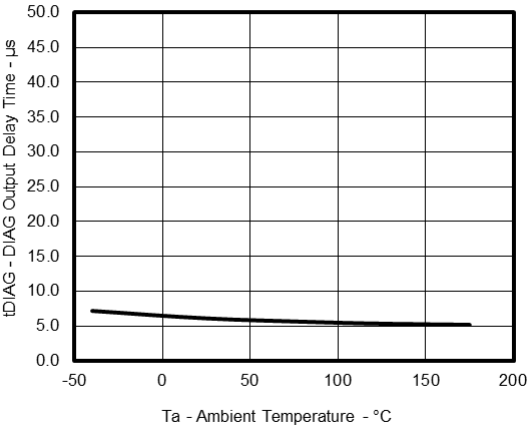
RISE TIME / FALL TIME vs.
AMBIENT TEMPERATURE



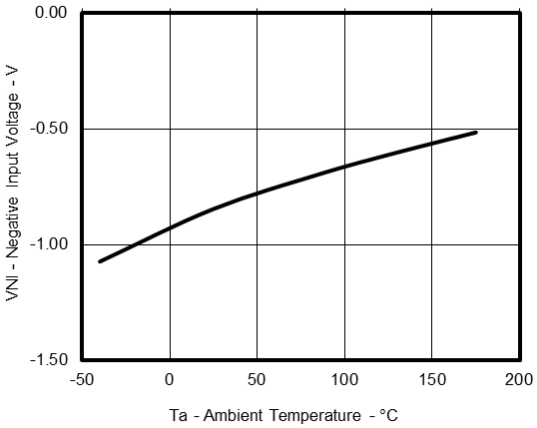
RISE TIME / FALL TIME vs.
OUTPUT CURRENT

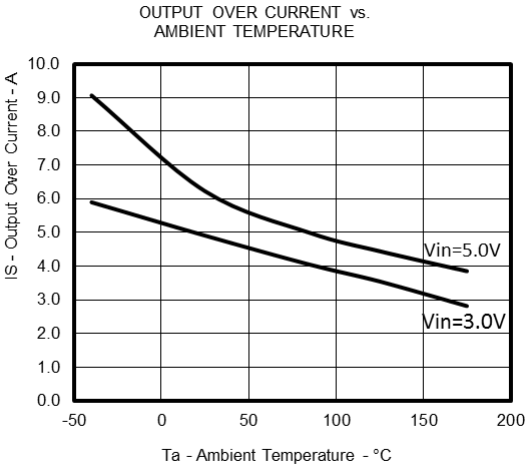


DIAG OUTPUT DELAY TIME vs.
AMBIENT TEMPERATURE

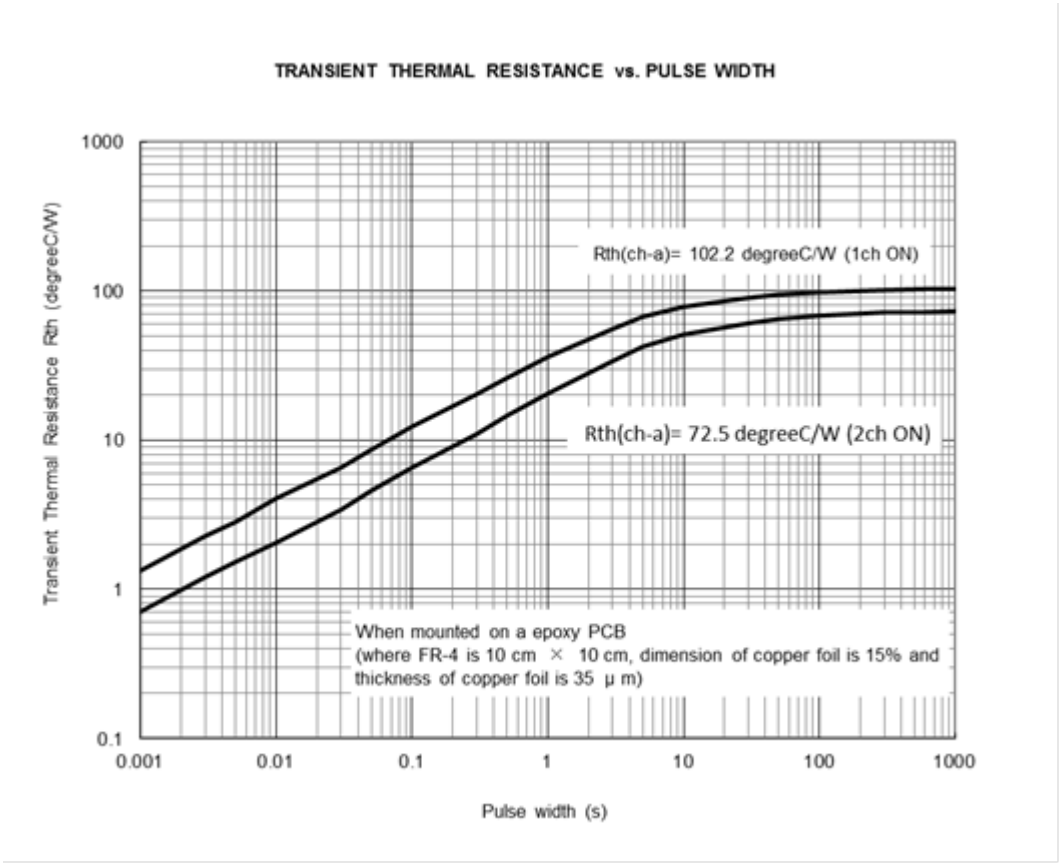


NEGATIVE INPUT VOLTAGE vs.
AMBIENT TEMPERATURE

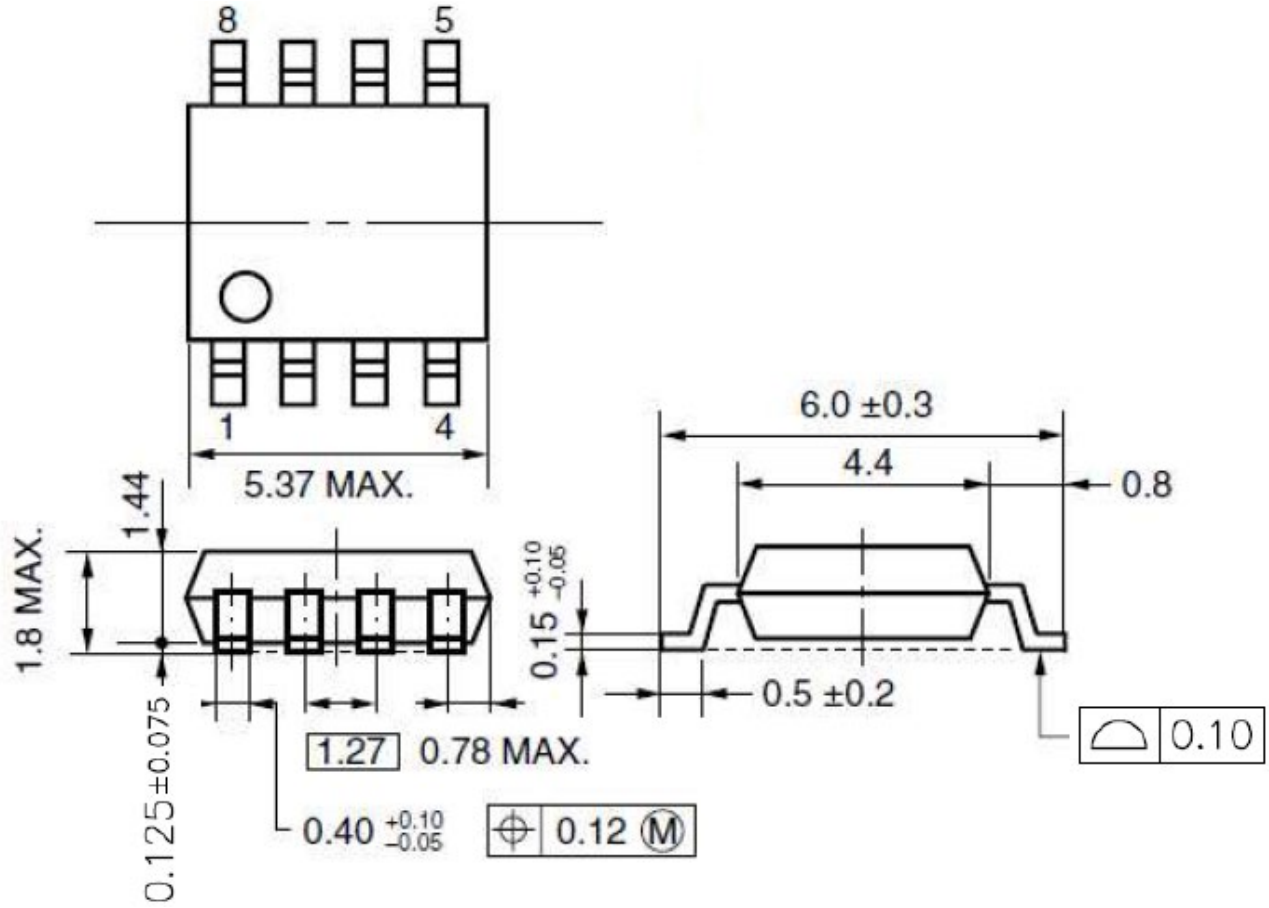




Transient Thermal Resistance Characteristics

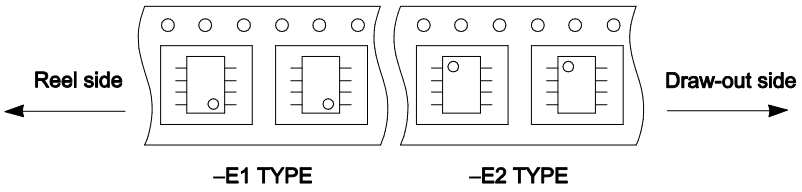


Package Drawing



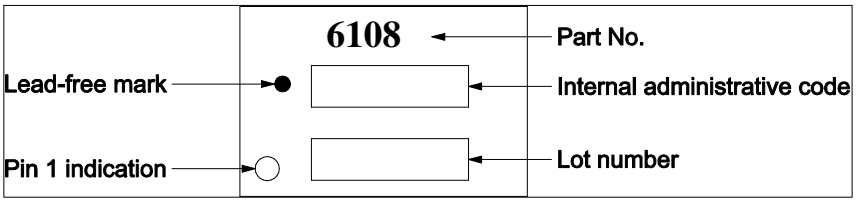
Taping Information

There are two types (-E1, -E2) of taping depending on the direction of the device.



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 µPD166015 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/)

- µPD166108GR-E1-AY [Note]: Power SOP 8
- µPD166108GR-E2-AY [Note]: Power SOP 8

Process	Conditions	Symbol
Infrared reflow	Maximum temperature (package's surface temperature): 260°C or below, Time at maximum temperature: 10 seconds or less, Time at temperature higher than 220°C: 60 seconds or less, Preheating time at 160°C to 180°C: 60 to 120 seconds, Times: Three times, Flux: Rosin flux with low chlorine (0.2 Wt% or below) recommended.	IR60-00-3
Partial Heating Method	Pin temperature: 300°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: Pb-free (This product does not contain Pb in the external electrode.)

Revision History	μPD166108GR Data Sheet

Rev.	Date	Description	
		Page	Summary
1.00	Sep 20, 2013	—	First Edition Issued

Notice

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Renesas Electronics America Inc.
2880 Scott Boulevard Santa Clara, CA 95050-2554, U.S.A.
Tel: +1-408-588-6000, Fax: +1-408-588-6130

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: +44-1628-651-700, Fax: +44-1628-651-804

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.
80 Bendemeer Road, Unit #06-02 Hyflux Innovation Centre Singapore 339949
Tel: +65-6213-0200, Fax: +65-6213-0300

Renesas Electronics Malaysia Sdn.Bhd.
Unit 906, Block B, Menara Amcorp, Amcorp Trade Centre, No. 18, Jln 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

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