μPD166035GR

INTELLIGENT POWER DEVICE

R07DS1117EJ0200
Rev.2.00
Jul 31, 2014

Description

The μPD166035 is an N-channel high side driver with built-in charge pump and 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 (T_{ch} = 175°C MAX.)
- Built-in charge pump circuit
- Low on-state resistance
  $R_{DS(ON)}$ = 80 mΩMAX. (V_{IN} = V_{IH}, I_O = 1.5A, Tch = 25°C)
- Built-in protection circuit
  - Current limitation
  - Overtemperature protection
- Active clamp operation at inductive load switch off
- Built-in diagnostic function
- Package: Power SOP 8

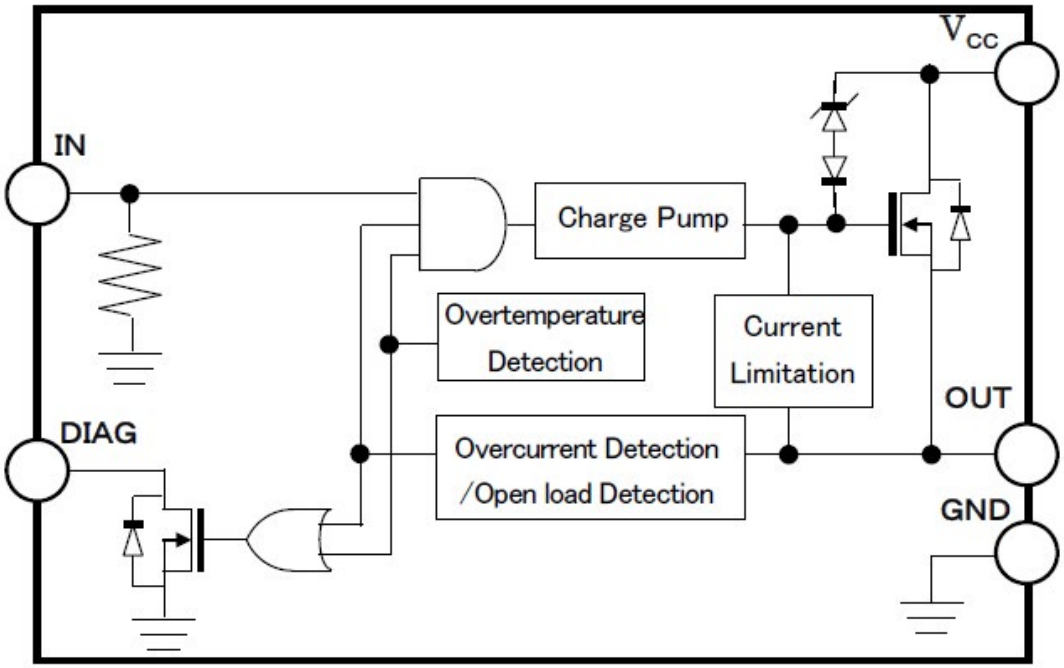
Application

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

Ordering Information

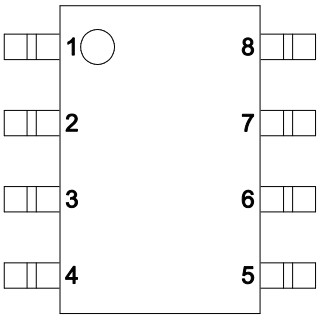
Part No.	Lead Plating	Packing	Package
μPD166035GR-E1-AY	Sn	Tape 2500 p/reel	Power SOP 8
μPD166035GR-E2-AY	Sn	Tape 2500 p/reel	Power SOP 8

Block Diagram



Pin Configuration

· Power SOP 8



(Top view)

Pin Functions

Pin No.	Pin Name	Function
1	IN	Input pin
2	DIAG	DIAG output pin
3	GND	Ground pin
4	OUT	High side output pin
5	VCC	Power supply pin
6	VCC	Power supply pin
7	VCC	Power supply pin
8	VCC	Power supply pin

Absolute Maximum Ratings

(Ta = 25°C, unless otherwise specified)

Item	Symbol	Rating	Unit	Condition
Power supply voltage	V_{CC1}	–0.3 to +28	V	
	V_{CC2}	35	V	t = 300 ms
IN input voltage	V_{IN1}	–0.5 to +5.5	V	
	V_{IN2}	5	V	V_{CC} = 0 V, t = 0.5 s
IN input current	I_{IN}	±10	mA	
Output current	I_{OA}	2	A	
Output negative voltage	V_{OA}	V_{CC}–30	V	Without dynamic clamp
Power dissipation	P_D	2.70	W	T_a = 25°C Note
Operation temperature	Topt	–40 to +125	°C	
Storage temperature	Tstg	–55 to +175	°C	
DIAG output voltage	V_{DIAG}	7.0	V	
DIAG output current	I_{DIAG}	10	mA	
Clamp susceptibility	E_{CLP}	100	mJ	

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 mm), PW = 10 s

Electrical Characteristics

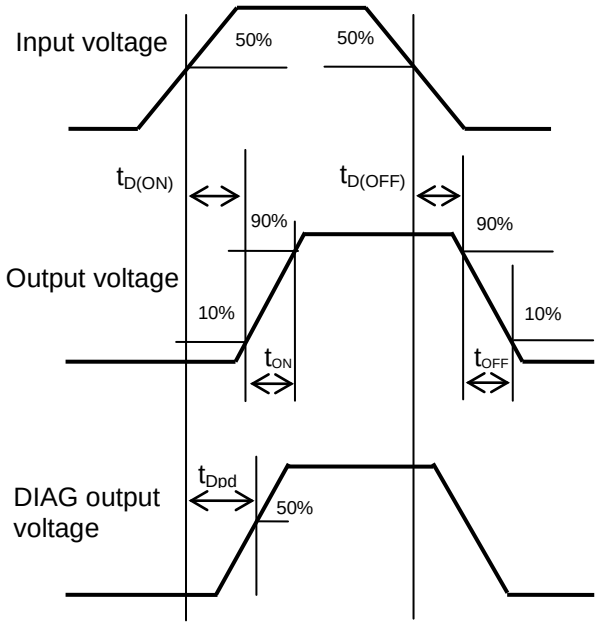
(V_{CC} = 8 to 16 V, Tch = –40 to +175°C, unless otherwise specified)

Item	Symbol	MIN.	TYP.	MAX.	Unit	Condition	
Input voltage	V_{IH}	2.8	—	5.5	V	V_{CC} = 4.5 to 16 V	
	V_{IL}	0	—	1.5	V		
Input current	I_{IH}	—	—	350	μA	V_{IN} = 5.5 V	
	I_{IL}	–10	—	—	μA	V_{IN} = 0 V	
Standby current	I_{CCH}	—	—	4.0	mA	V_{IN} = V_{IH} Note 1	
	I_{CCL}	—	—	900	μA	V_{IN} = V_{IL} Note 1	
Output leakage current	I_{OH1}	—	—	2	mA	V_{IN} = V_{IL}, V_O = Vcc	
	I_{OH2}	—	—	0.4	mA	V_{IN} = V_{IL}, V_O = 4V	
	I_{OL}	–0.24	—	—	mA	V_{IN} = V_{IL}, V_O = 0V	
DIAG output low level voltage	V_{DIAG}	—	—	0.5	V	V_{CC} = 4.5 to 16V, I_{DIAG} = 0.6mA	
DIAG output leakage current	I_{DIAG}	—	—	10	μA	V_{DIAG} = 7V	
Open load detection voltage	V_{OIH}	4	—	—	V		
Load connection detection voltage	V_{OIL}	—	—	1.45	V		
Drain to source on-state resistance	$R_{DS(ON)}$	—	—	80	mW	V_{IN} = V_{IH}, I_O = 1.5A	Tch = 25°C
		—	—	130	mW		Tch = 150°C
Overcurrent detection	I_S	2	—	10	A		
Overtemperature detection	Tth	(175)	—	—	°C	Note 2	
Turn on delay time	$t_{D(ON)}$	—	4	200	μs	R_L = 9.3W, V_{CC} = 14V, V_{IN} = 5.5V–0V	
Turn off delay time	$t_{D(OFF)}$	—	30	200	μs		
Rise time	t_{ON}	—	24	100	μs		
Fall time	t_{OFF}	—	5	100	μs		
DIAG Output Delay Time	t_{Dpd}	—	—	300	μs	R_L =9.3Ω, R_{DIAG}=5.1kΩ, V_{CC} =14V	
Negative Output Voltage	$–V_O$	V_{CC}-30	—	V_{CC}-40	V	Io=-60mA	
Output Oscillation Cycle at over current condition	t_S	—	—	14	ms	Overcurrent condition	
Output On Duty at over current condition	D_S	—	—	30	%	Overcurrent condition	

Notes: 1. OUT, DIAG current is not included.

2. Not subject to production test, specified by design.

Definition of Switching Time



Truth Table

Item	V_{IN}	V_{OUT}	V_{DIAG}
Normal operation	H	H	H
	L	L	L
Overtemperature detection	H	L	L
	L	L	L
Overcurrent detection	H	Chopping	L
	L	L	L
Open load detection	H	H	H
	L	H	H

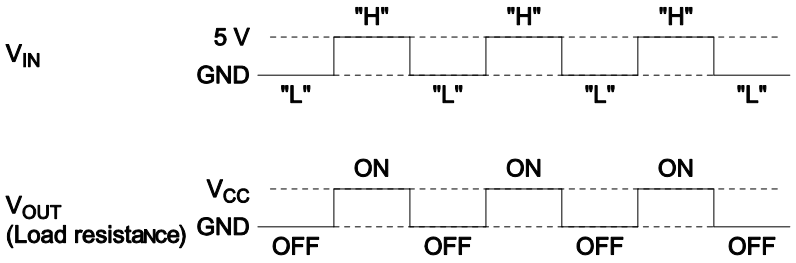
Outline of Functions

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

When the input voltage of the input pin (IN) is high level (2.8 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 and chopping operation begins.

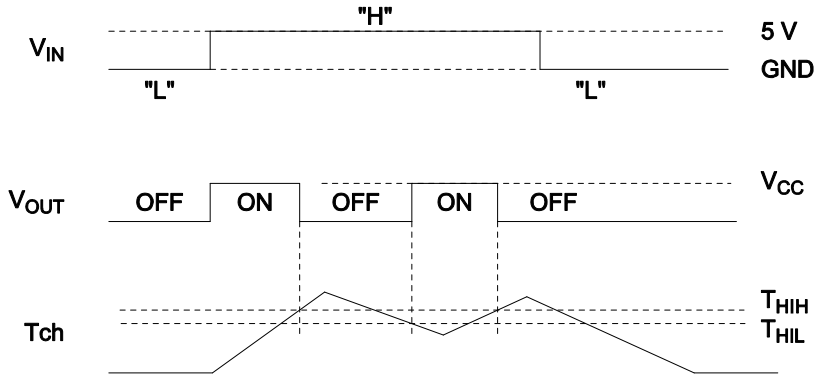
Current Limitation Circuit

This circuit limits the output current by using the detection signal from the overcurrent detection circuit, preventing 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.

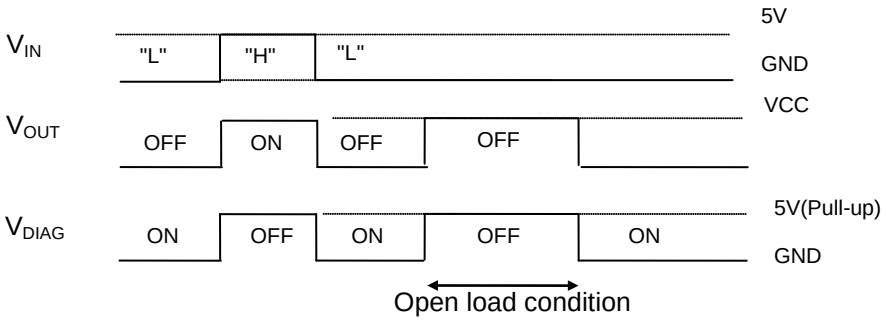
When the circuit detects overtemperature, the protection function of the control circuit operates and output is shutdown. Output MOS (Nch) automatically restarts when channel temperature cools down after shutdown.



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 (5.1Kohm±10%) with output terminal. (There are no electric characteristics influences in other circuit by presence of pull-up resistor.)

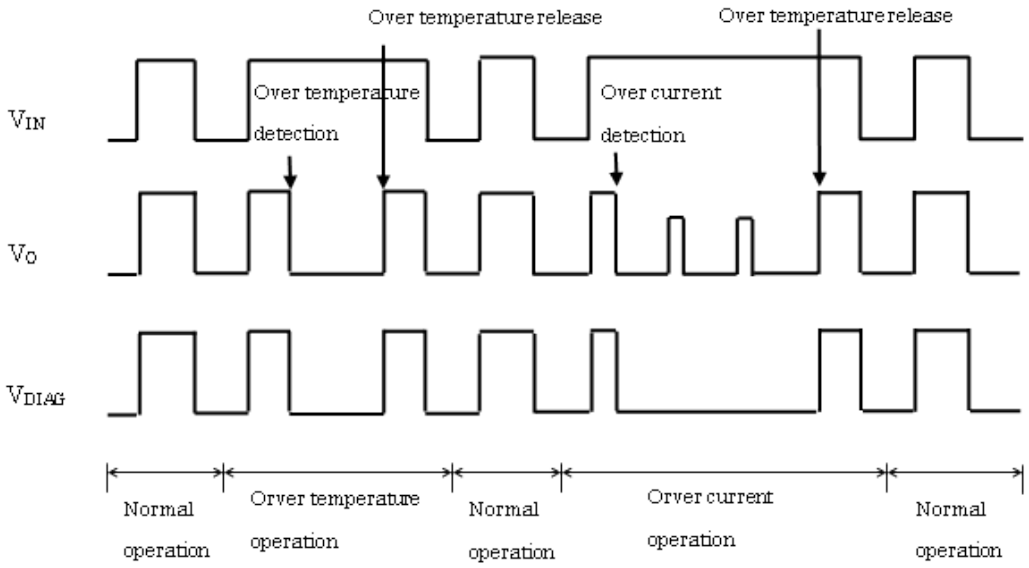
Open Load is detected by inputting low-level (1.5V or less) to input terminal (IN). DAIG terminal outputs Hi-Z (pull-up: high-level) when the output terminal is open.



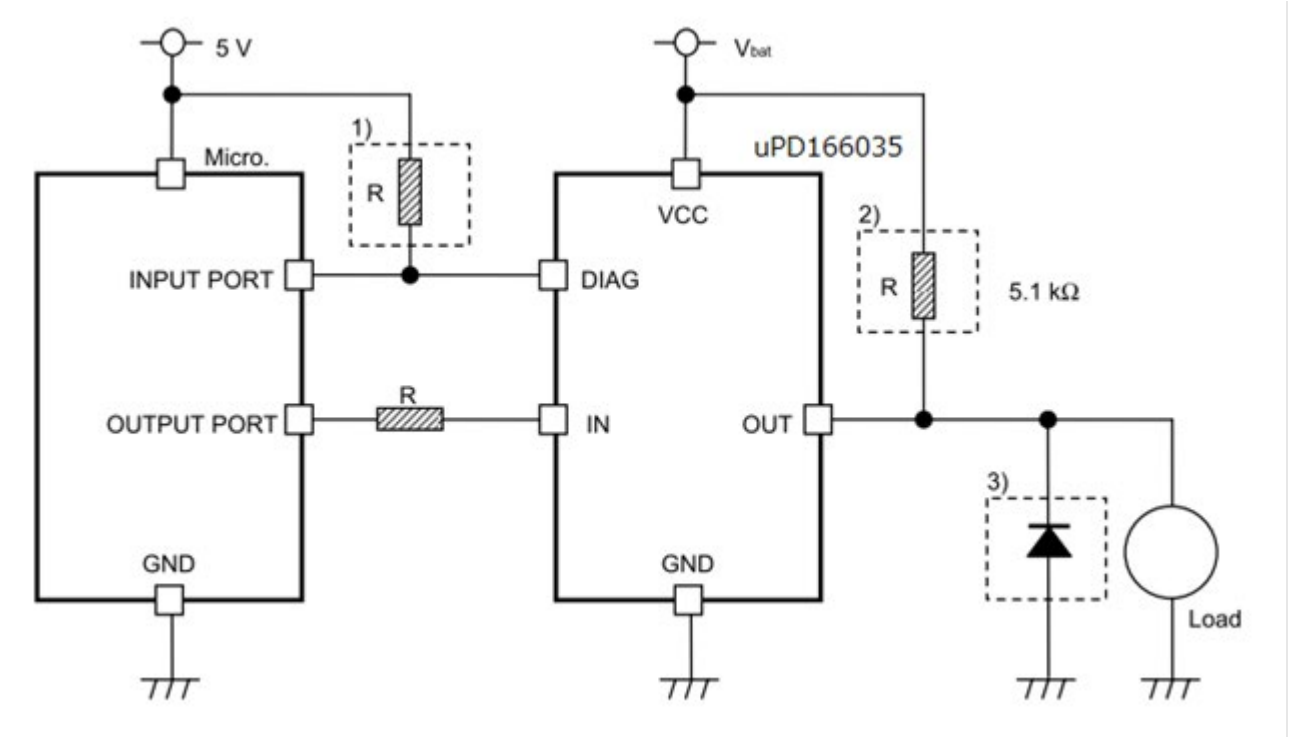
Diagnostic Output Circuit

This circuit controls output of diagnostic signal form DIAG terminal when over current or over temperature or Open Load is detected.

Timing Chart

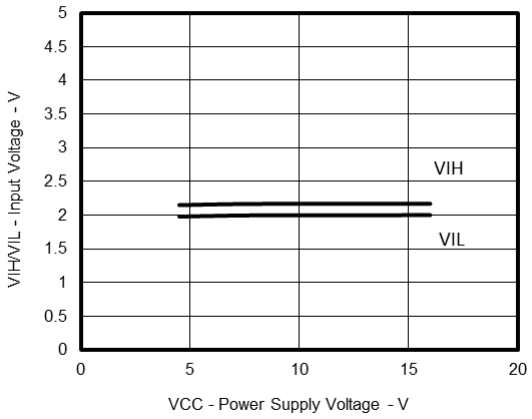


Example of Application Circuit

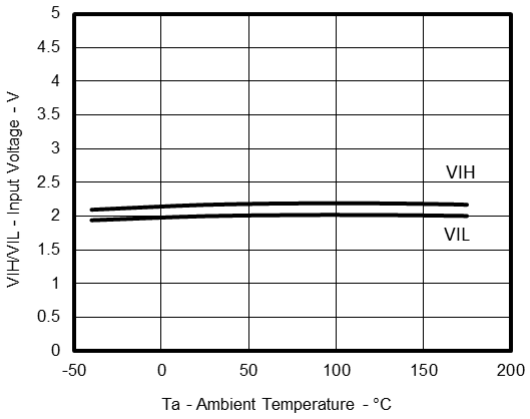


Typical Characteristics

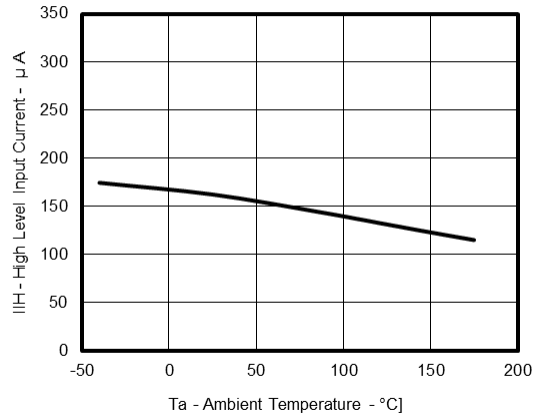
INPUT VOLTAGE vs.
POWER SUPPLY VOLTAGE



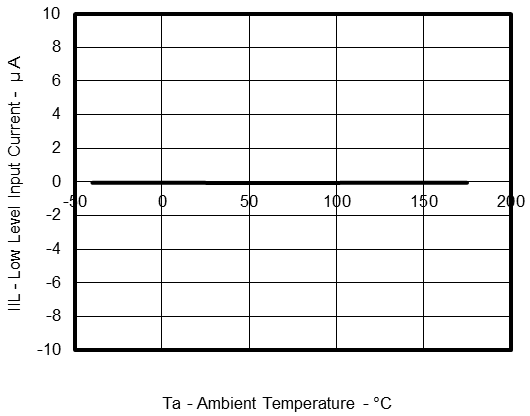
INPUT VOLTAGE vs.
AMBIENT TEMPERATURE



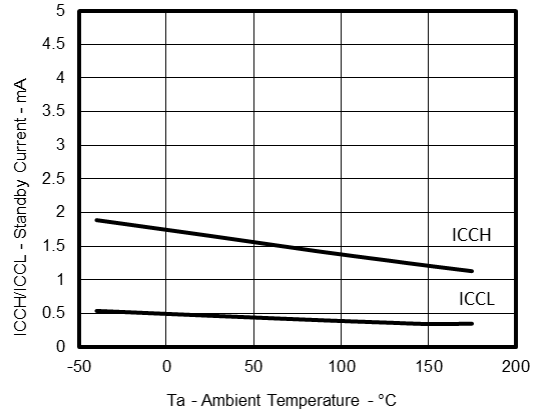
HIGH LEVEL INPUT CURRENT vs.
AMBIENT TEMPERATURE



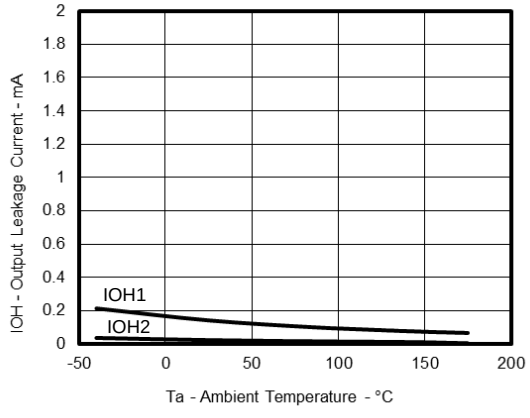
LOW LEVEL INPUT CURRENT vs.
AMBIENT TEMPERATURE



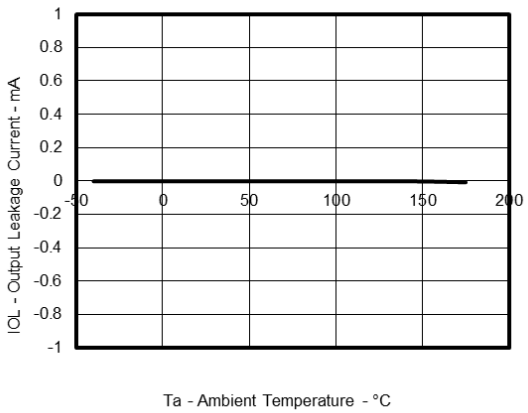
STANDBY CURRENT vs.
AMBIENT TEMPERATURE



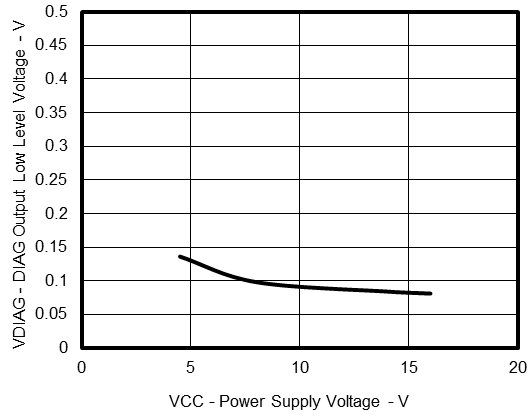
OUTPUT LEAKAGE CURRENT vs.
AMBIENT TEMPERATURE



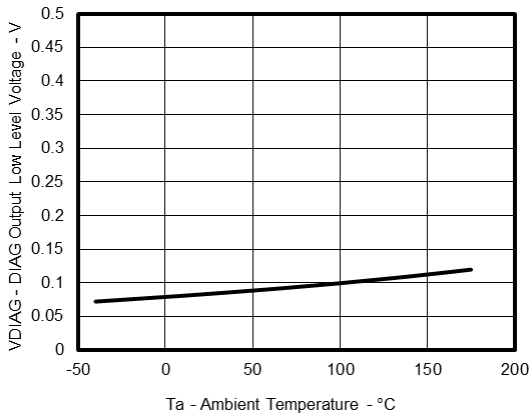
OUTPUT LEAKAGE CURRENT vs.
AMBIENT TEMPERATURE



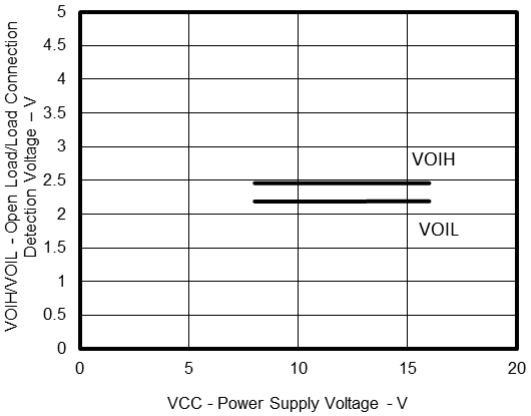
DIAG OUTPUT LOW LEVEL VOLTAGE vs.
POWER SUPPLY VOLTAGE



DIAG OUTPUT LOW LEVEL VOLTAGE vs.
AMBIENT TEMPERATURE



OPEN LOAD/LOAD CONNECTION DETECTION
VOLTAGE vs. POWER SUPPLY VOLTAGE



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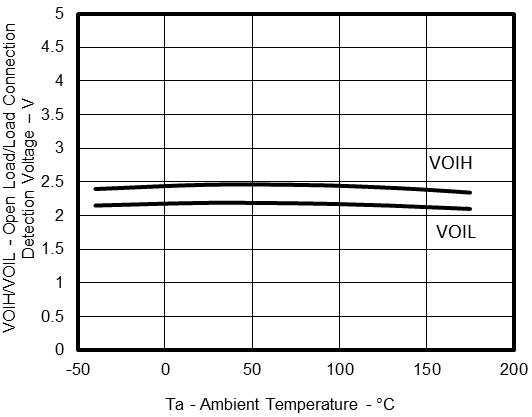
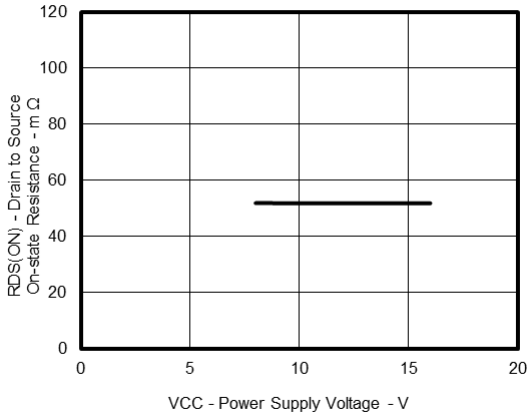
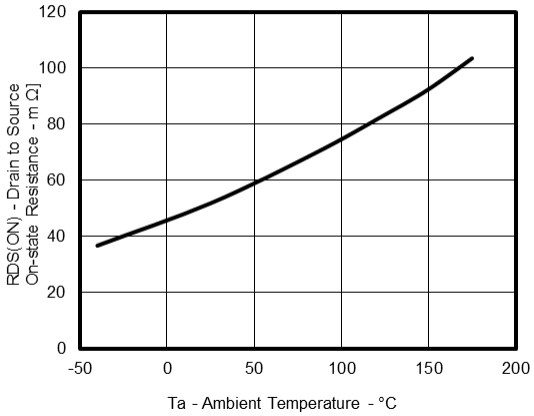
VOLTAGE vs. POWER SUPPLY VOLTAGE



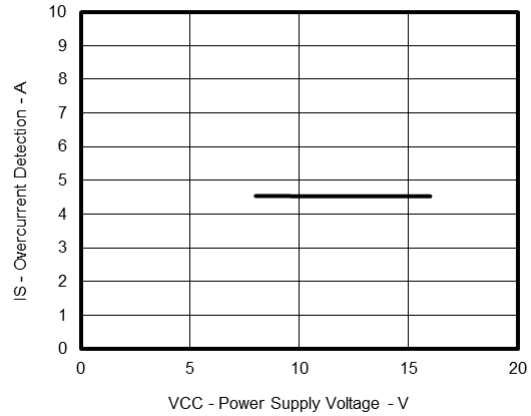
DRAIN TO SOURCE ON-STATE RESISTANCE vs.
POWER SUPPLY VOLTAGE



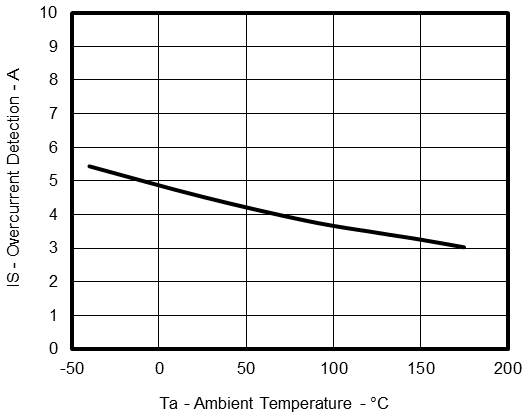
DRAIN TO SOURCE ON-STATE RESISTANCE vs.
AMBIENT TEMPERATURE



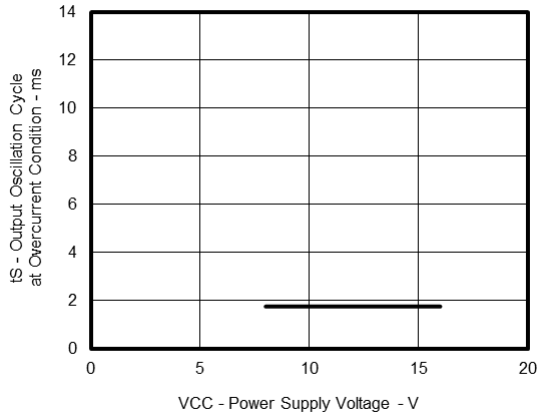
OVERCURRENT DETECTION vs.
POWER SUPPLY VOLTAGE



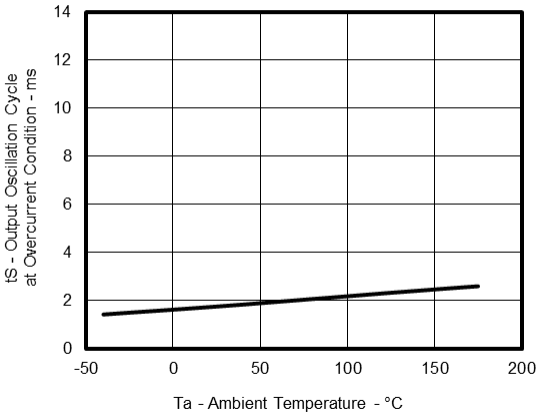
OVERCURRENT DETECTION vs.
AMBIENT TEMPERATURE



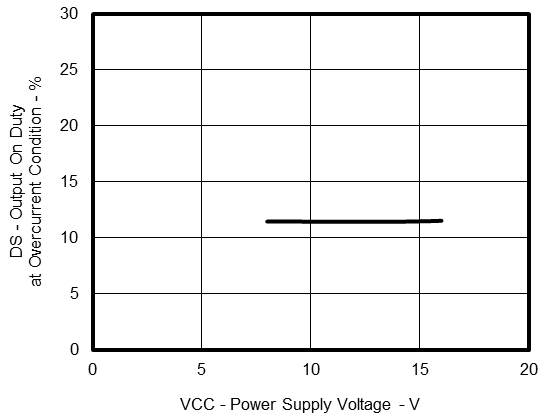
OUTPUT OSCILATION CYCLE AT OVERCURRENT
CONDITION vs. POWER SUPPLY VOLTAGE



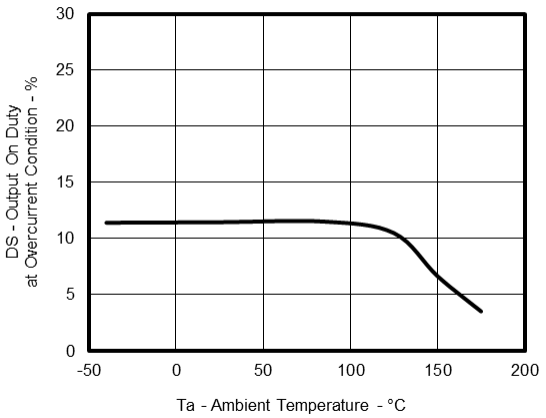
OUTPUT OSCILATION CYCLE AT OVERCURRENT
CONDITION vs. AMBIENT TEMPERATURE



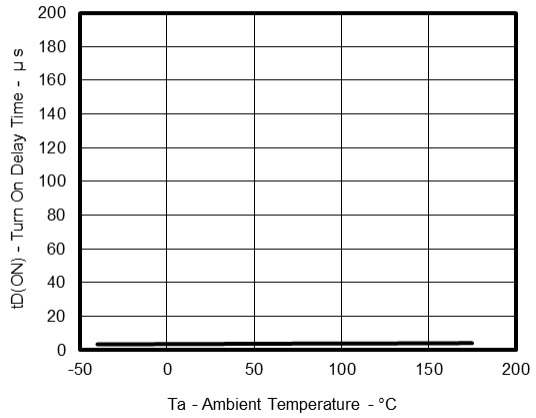
OUTPUT ON DUTY AT OVERCURRENT CONDITION vs.
POWER SUPPLY VOLTAGE



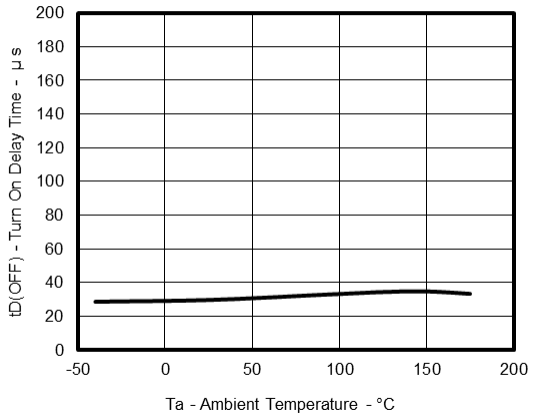
OUTPUT ON DUTY AT OVERCURRENT CONDITION vs.
AMBIENT TEMPERATURE



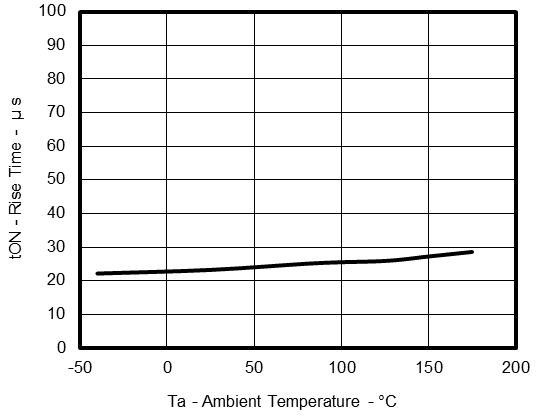
TURN ON DELAY TIME vs.
AMBIENT TEMPERATURE



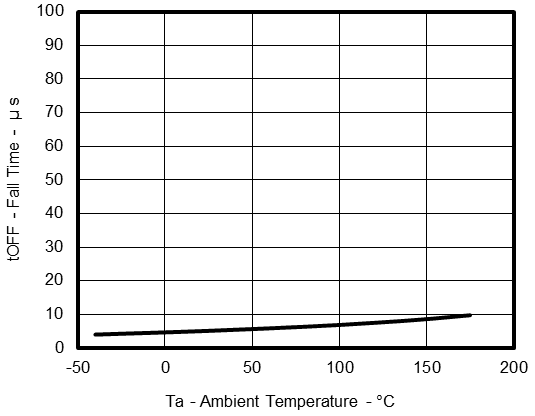
TURN OFF DELAY TIME vs.
AMBIENT TEMPERATURE

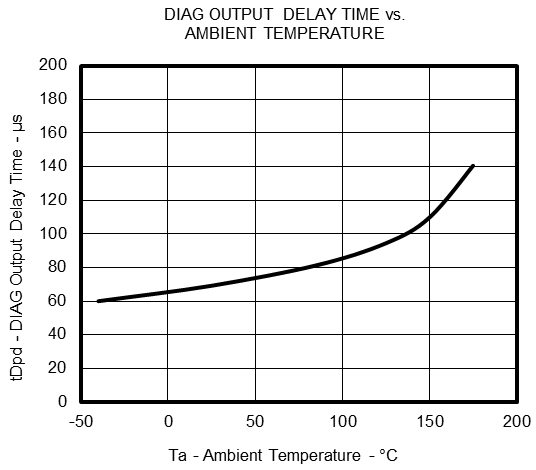


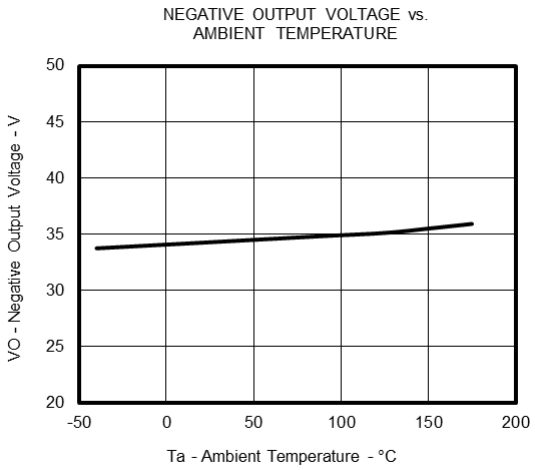
RISE TIME vs.
AMBIENT TEMPERATURE



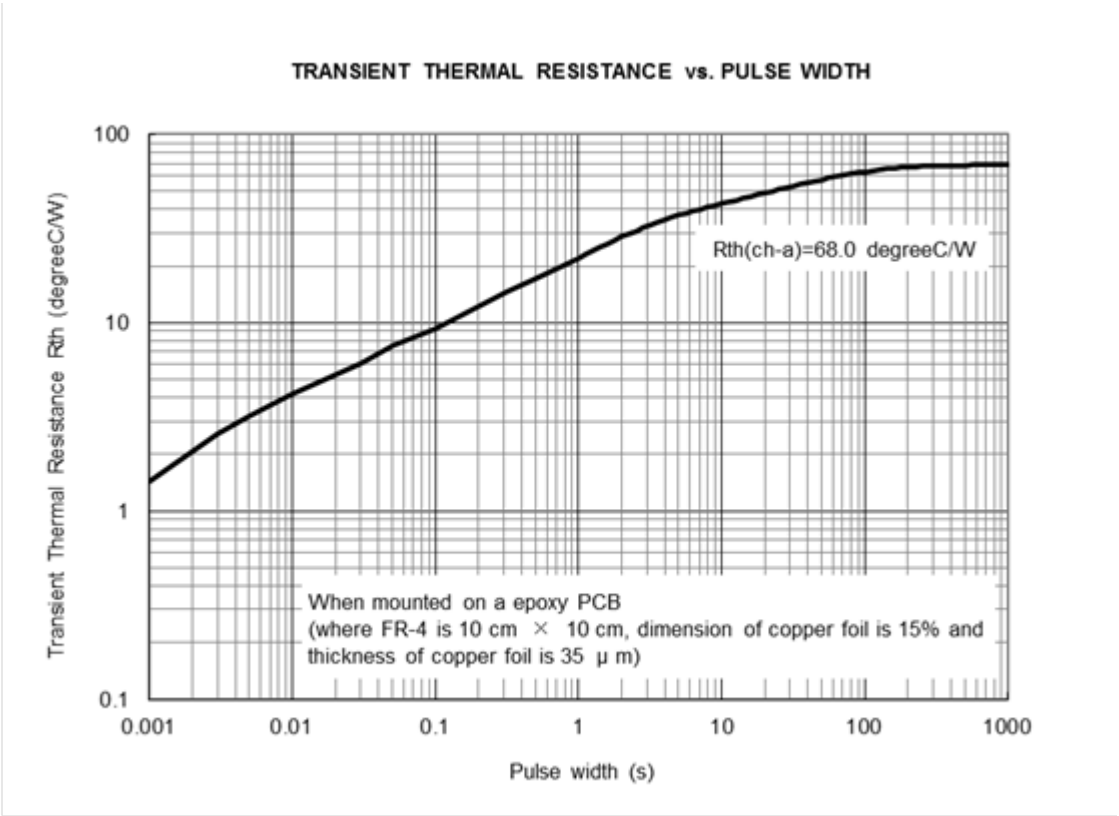
FALL TIME vs.
AMBIENT TEMPERATURE



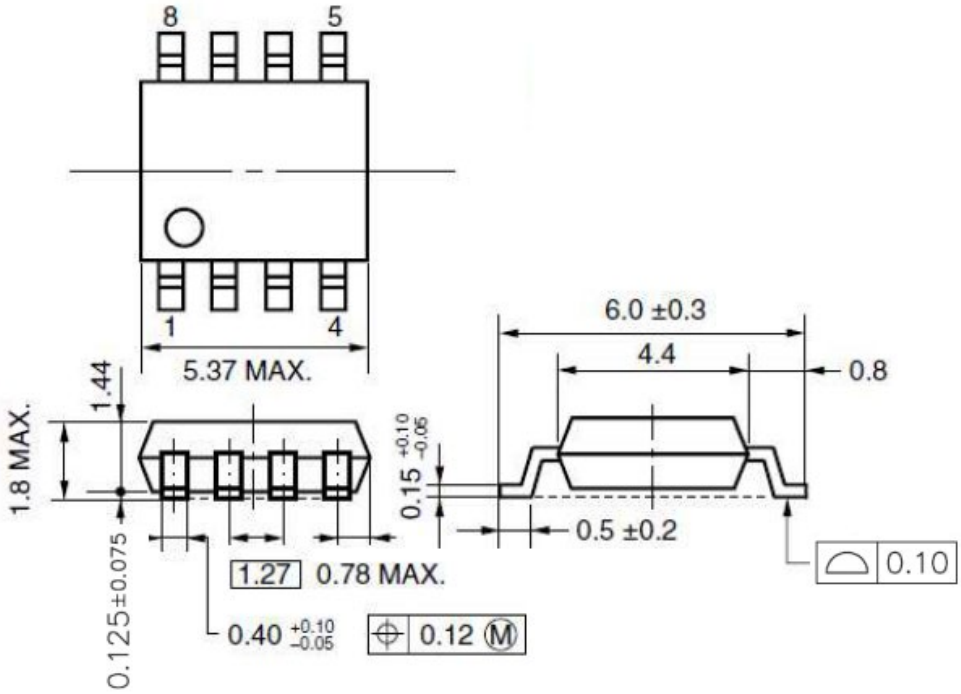




Transient Thermal Resistance Characteristics

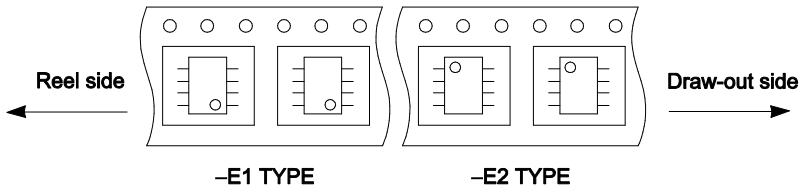


Package Drawing



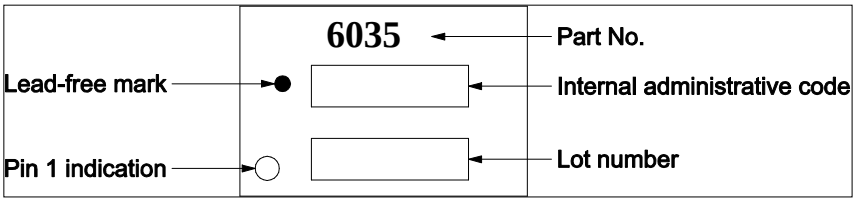
Taping Information

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 μPD166035 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/products/package/manual/index.jsp)

- μPD166035GR-E1-AY [Note]: Power SOP 8
- μPD166035GR-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.)

Rev.	Date	Description	
		Page	Summary
1.00	Sep 20, 2013	—	First Edition Issued
2.00	Jul 31, 2014	3	Absolute Maximum Ratings: IN input voltage(V_{IN1}) Change "–0.5V to +5.6V" to "–0.5V to +5.5V".
		4	Negative Output Voltage: Change "mA" to "V".
		5	Definition of Switching Time (tDpd): Change "90%" to "50%".
		9	Output Leakage Current: Change "A" to "mA".
		10	Output Leakage Current: Change "A" to "mA".
		15	Semiconductor Package Mount Manual: Change URL.

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