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

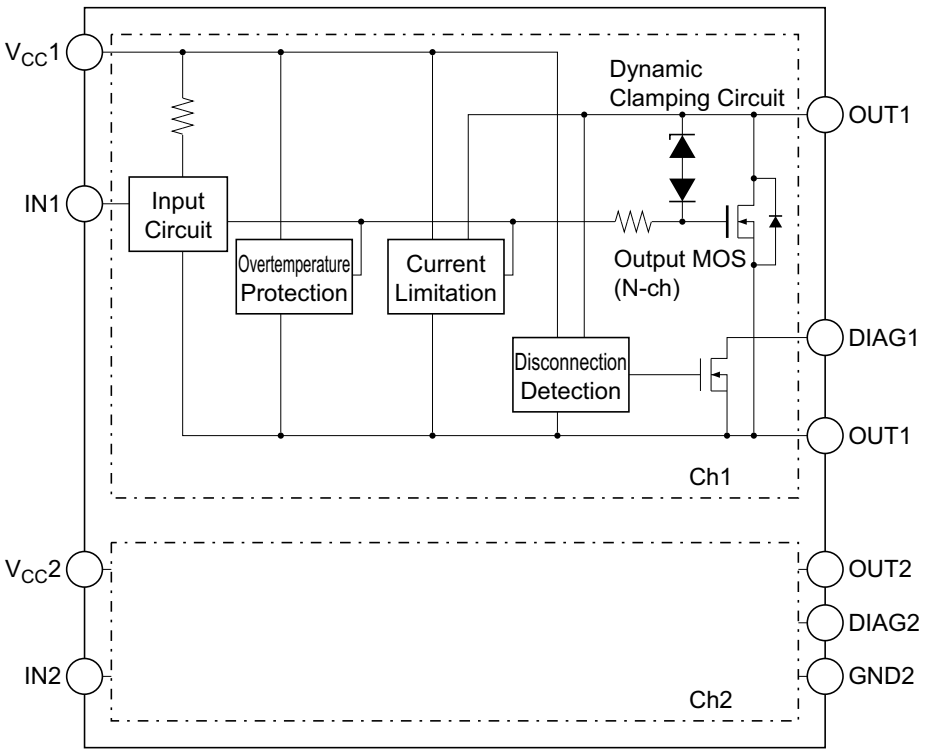
Application

- Injector driver

Ordering Information

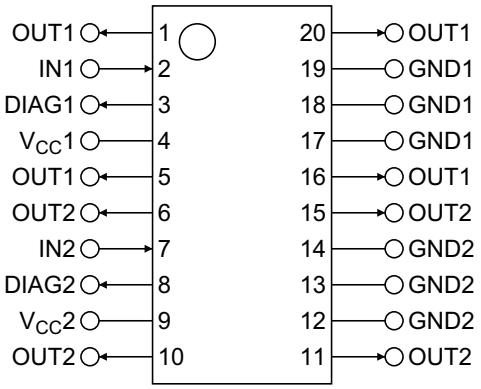
Part No.	Lead Plating	Packing	Package
μPD166105GS-E1-AY	Sn	Tape 2500 p/reel	20-pin plastic SOP (7.62 mm (300))
μPD166105GS-E2-AY	Sn	Tape 2500 p/reel	20-pin plastic SOP (7.62 mm (300))

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	$V_{CC}1$	–0.5 to +18	V	DC
	$V_{CC}2$	24	V	60 s
	$V_{CC}3$	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	Tch	–40 to +175	°C	
Storage temperature	Tstg	–55 to +175	°C	

Note: When mounted on 50 mm × 50 mm × 1.6 mm epoxy PCB FR4 substrate with 600 mm^2 × 70 μm copper foil.

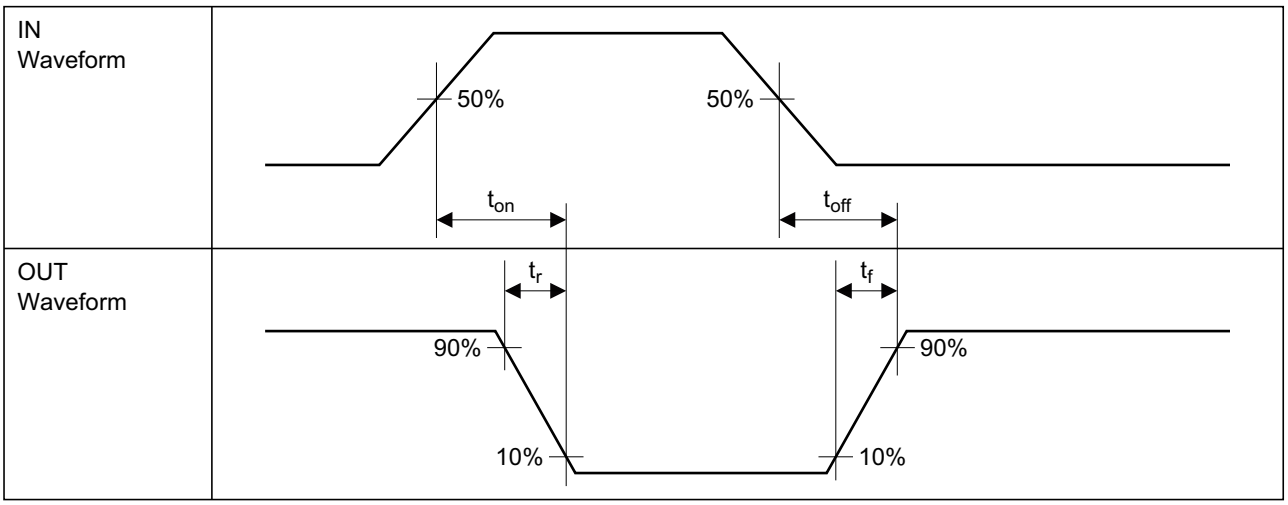
Caution: Product quality may suffer if the absolute maximum rating is exceeded even momentarily for any parameters. That is, the absolute maximum ratings are rated values at which the product is on the verge of suffering physical damage, and therefore the product must be used under conditions that ensure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

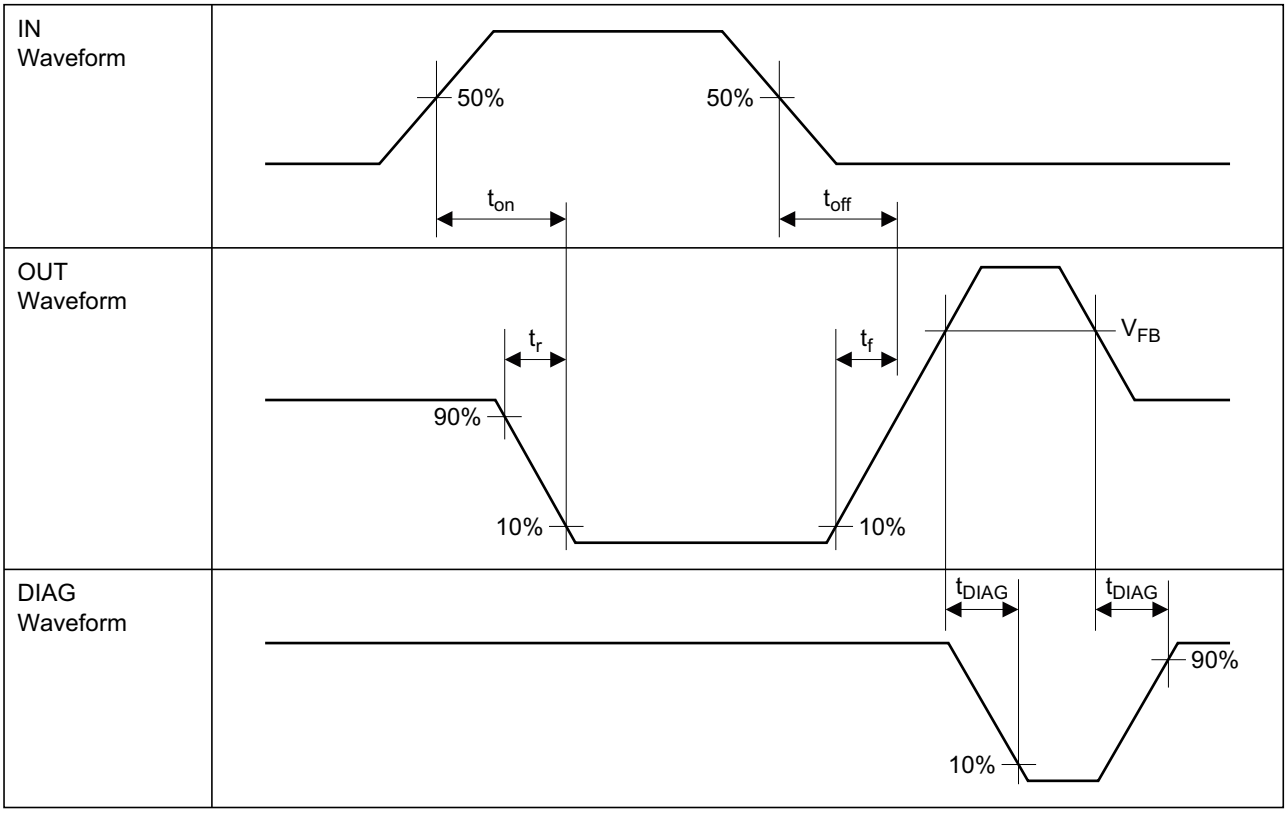
(V_{CC} = 5 to 18 V, Tch = –40 to +175°C, unless otherwise specified)

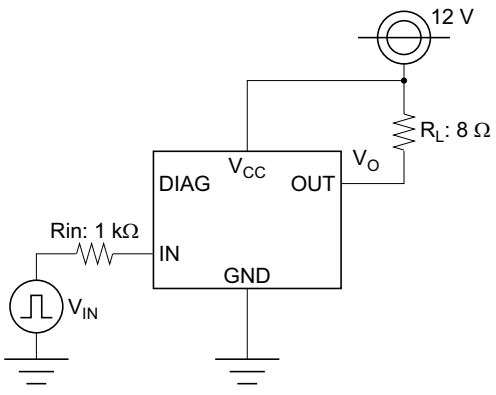
Item	Symbol	MIN.	TYP.	MAX.	Unit	Condition
High level input voltage	V_{IH}	3.0	—	—	V	Rin = 1 kΩ, V_{DS} = 0.3 V, I_O = 1.4 A
Low level input voltage	V_{IL}	—	—	1.5	V	Rin = 1 kΩ, V_{DS} = 20 V, I_O = 1 mA
High level input current	I_{IH}	—	—	300	μA	V_{IN} = 5.5 V, V_{DS} = 0 V
Low level input current	I_{IL}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

Switching Measurement Waveform

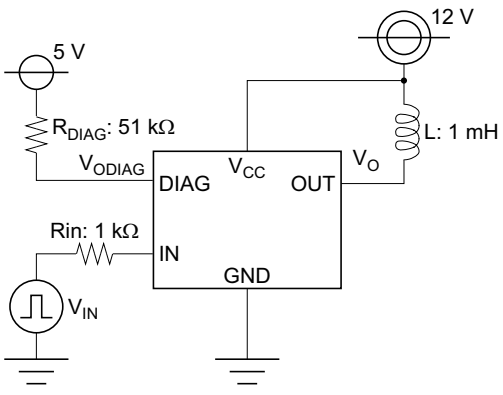


DIAG Output Measurement Waveform





Switching Measurement Circuit



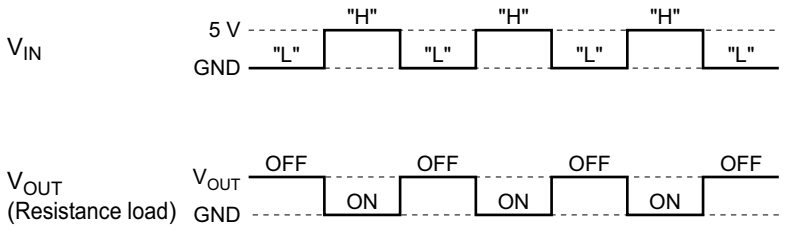
DIAG Output Measurement Circuit

Outline of Functions

Input Circuit (On/Off Control)

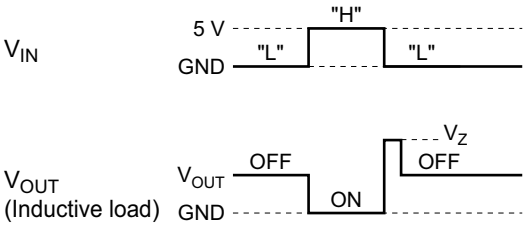
Output MOS turns on when the high-level input voltage (3.0 V or more) is applied to IN terminal.

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.



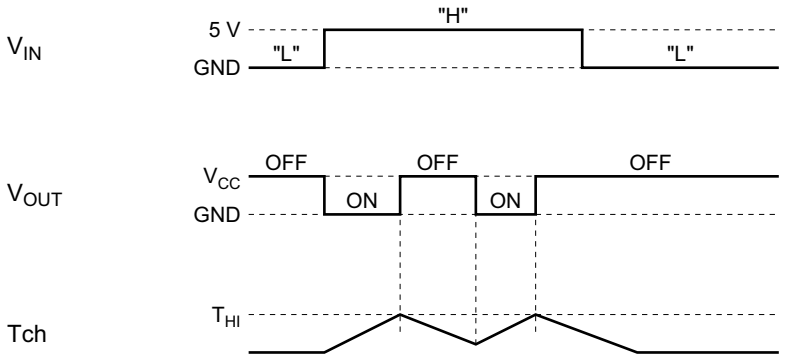
Current Limitation Circuit

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

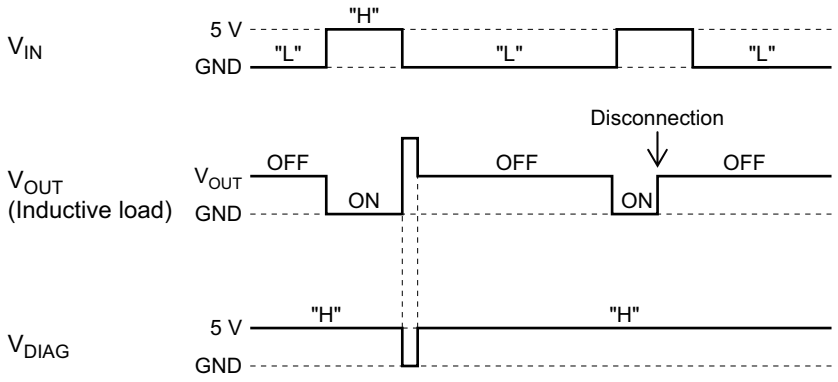
This circuit prevents destruction from overtemperature. The channel temperature of the output is monitored and the output is shut down when overtemperature is detected. Output restarts automatically after the channel cooled down.



Disconnection Detection Circuit

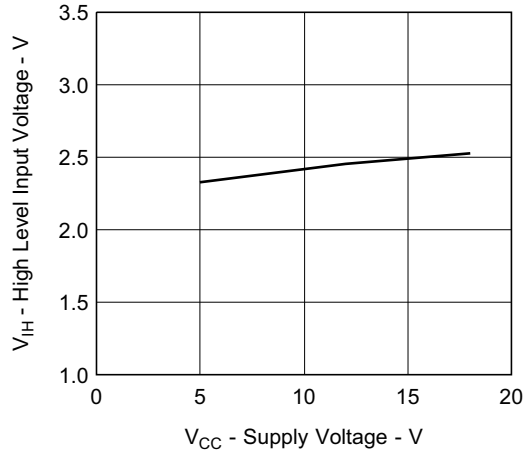
The signal on the DIAG pins goes to the low level in synchronization with the generation of flyback voltage when an inductive load is being driven.

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

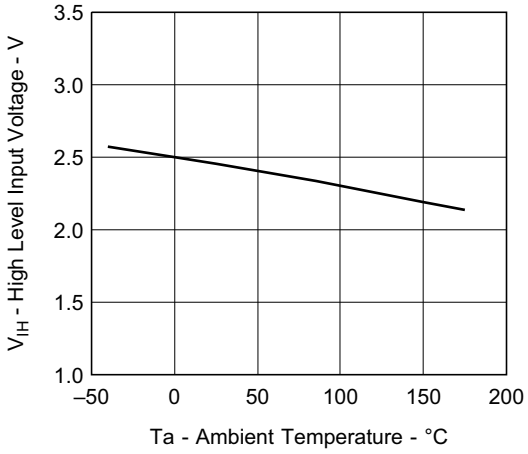


Typical Characteristics

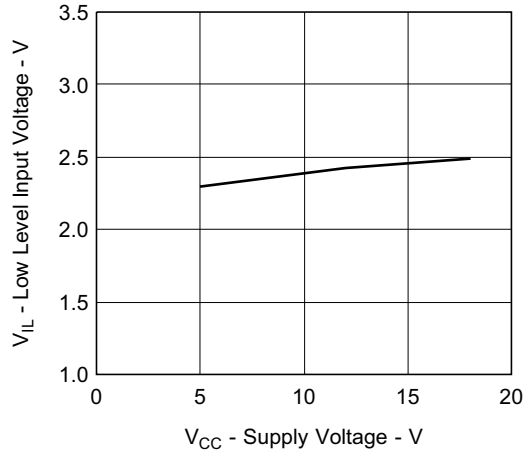
HIGH LEVEL INPUT VOLTAGE vs.
SUPPLY VOLTAGE



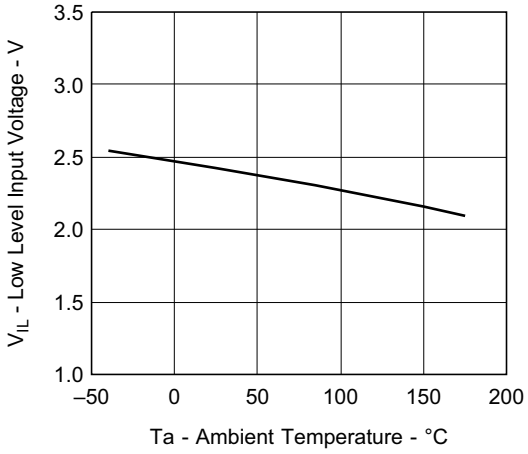
HIGH LEVEL INPUT VOLTAGE vs.
AMBIENT TEMPERATURE



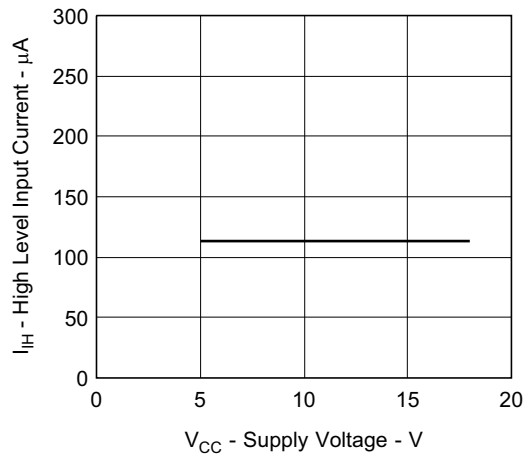
LOW LEVEL INPUT VOLTAGE vs.
SUPPLY VOLTAGE



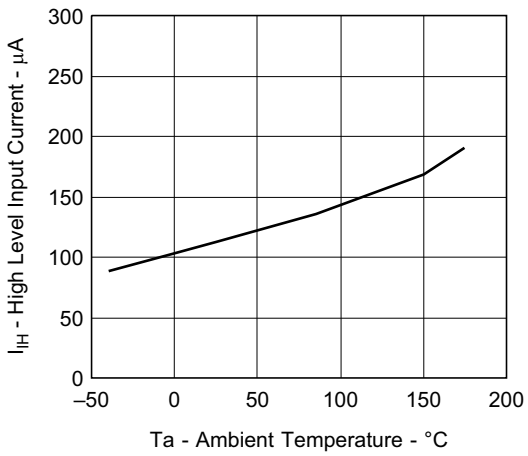
LOW LEVEL INPUT VOLTAGE vs.
AMBIENT TEMPERATURE



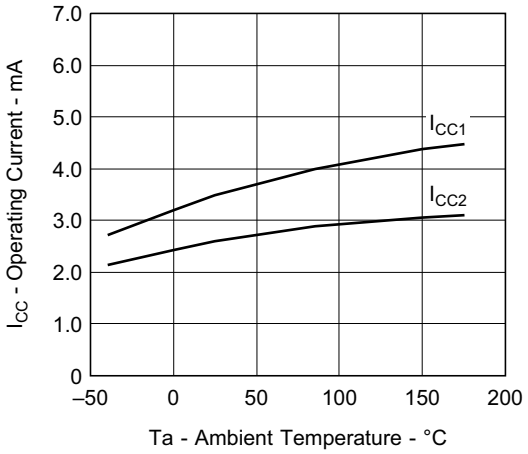
HIGH LEVEL INPUT CURRENT vs.
SUPPLY VOLTAGE



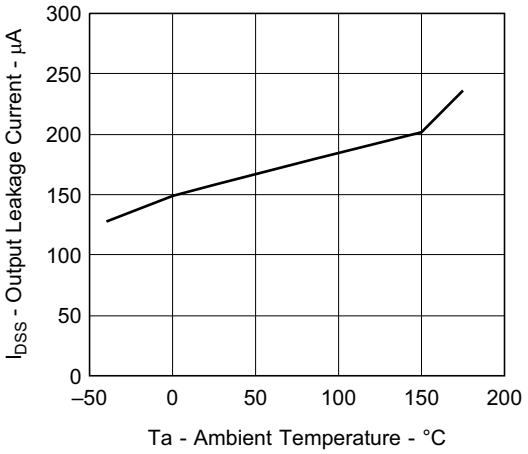
HIGH LEVEL INPUT CURRENT vs.
AMBIENT TEMPERATURE



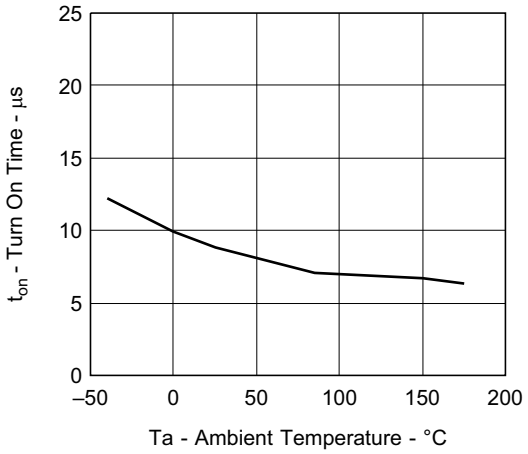
OPERATING CURRENT vs.
AMBIENT TEMPERATURE



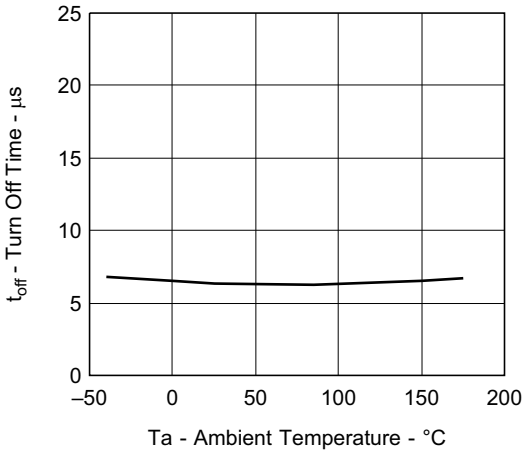
OUTPUT LEAKAGE CURRENT vs.
AMBIENT TEMPERATURE



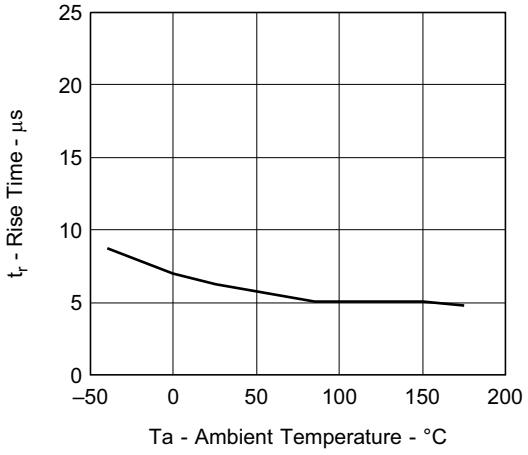
TURN ON TIME vs.
AMBIENT TEMPERATURE



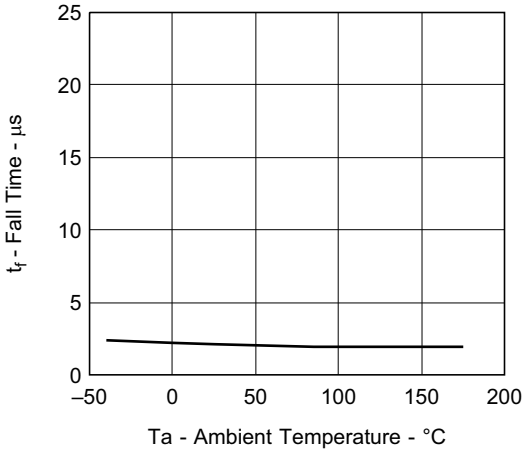
TURN OFF TIME vs.
AMBIENT TEMPERATURE



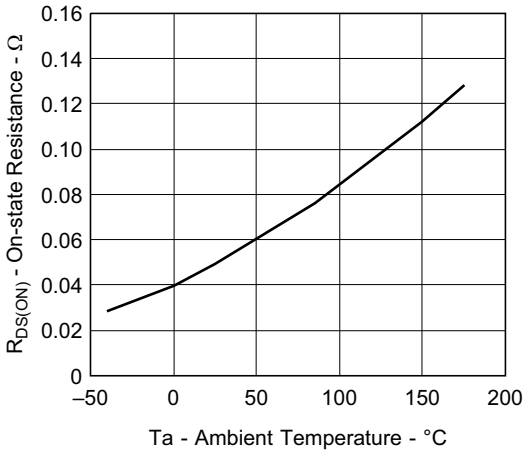
RISE TIME vs.
AMBIENT TEMPERATURE



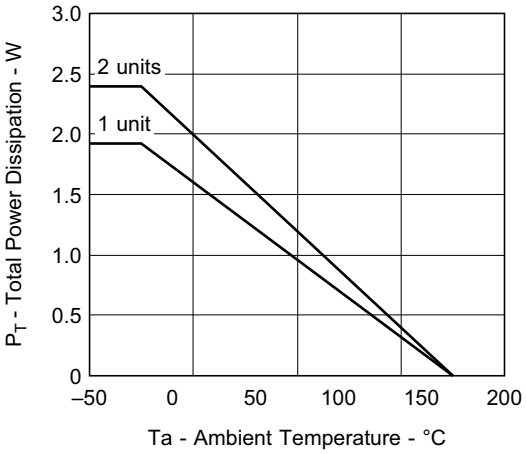
FALL TIME vs.
AMBIENT TEMPERATURE



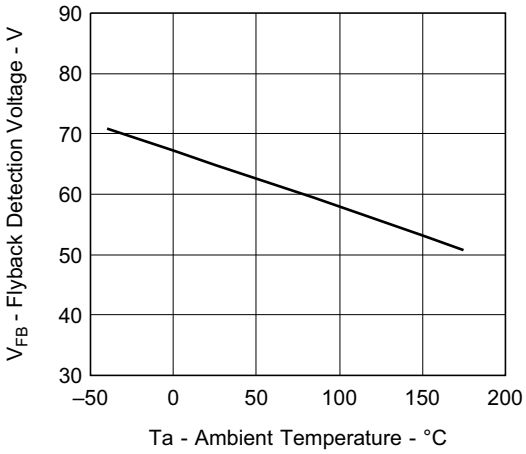
ON-STATE RESISTANCE vs.
AMBIENT TEMPERATURE



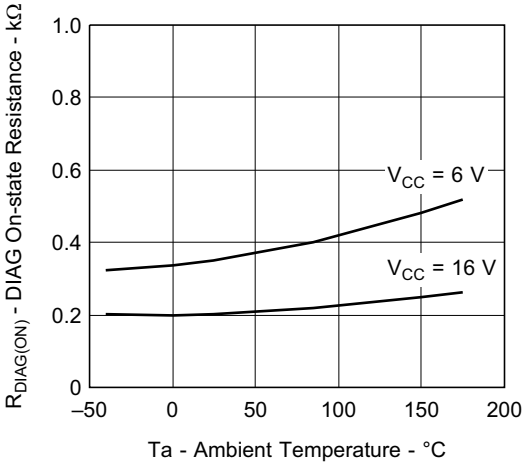
TOTAL POWER DISSIPATION vs.
AMBIENT TEMPERATURE



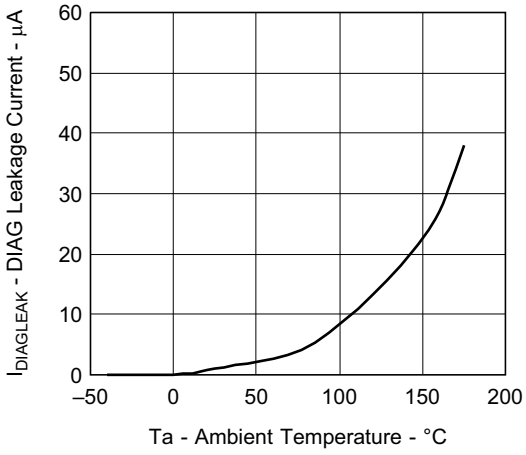
FLYBACK DETECTION VOLTAGE vs.
AMBIENT TEMPERATURE



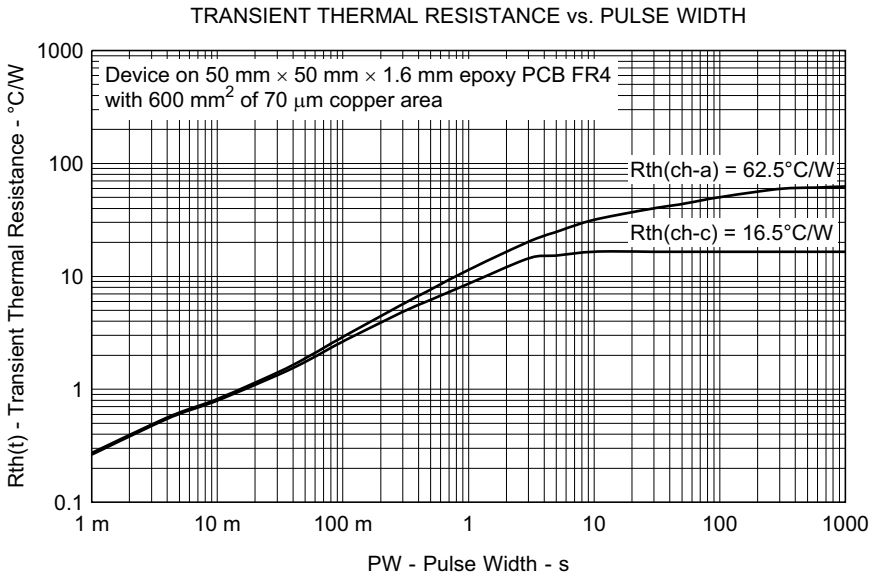
DIAG ON-STATE RESISTANCE vs.
AMBIENT TEMPERATURE



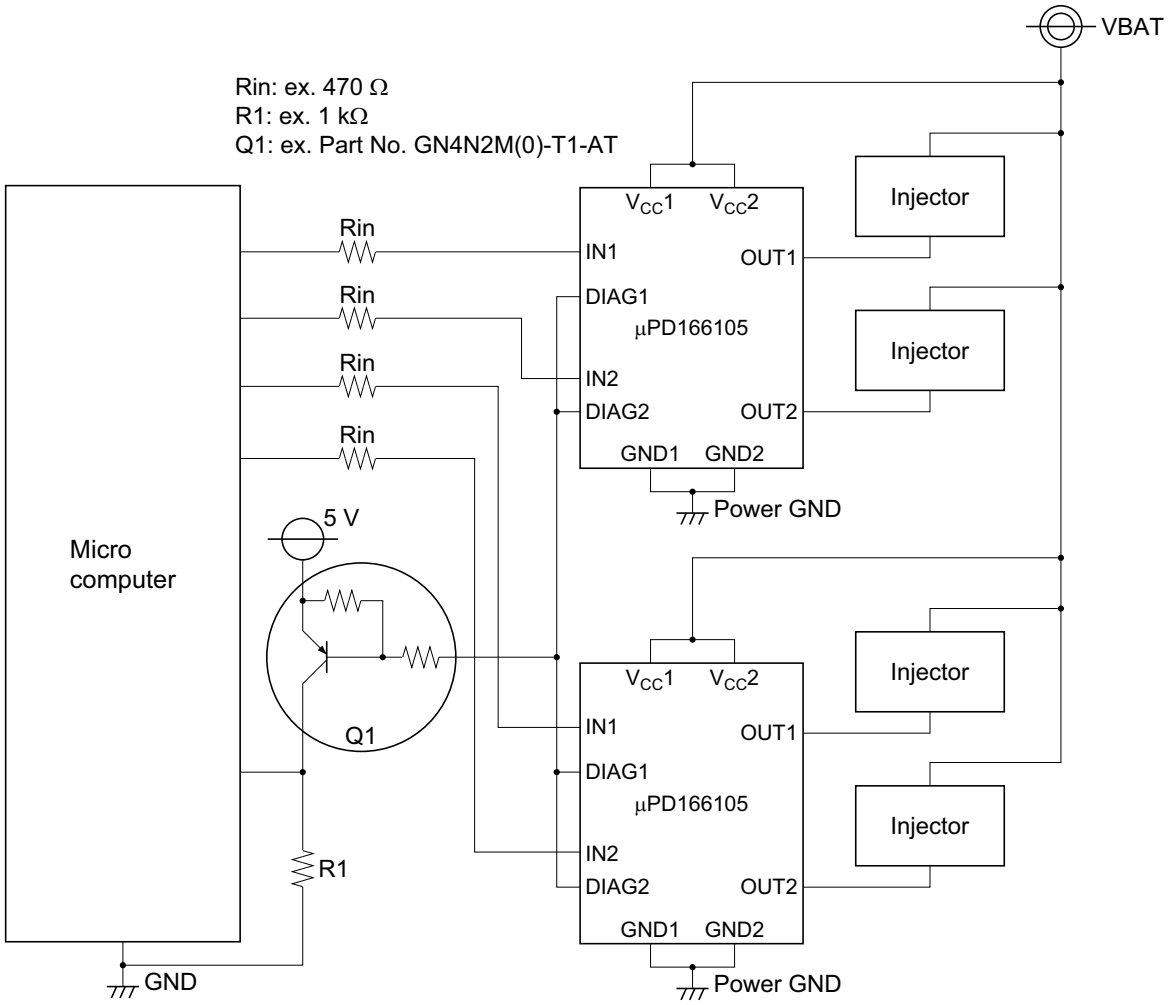
DIAG LEAKAGE CURRENT vs.
AMBIENT TEMPERATURE



Transient Thermal Resistance Characteristics

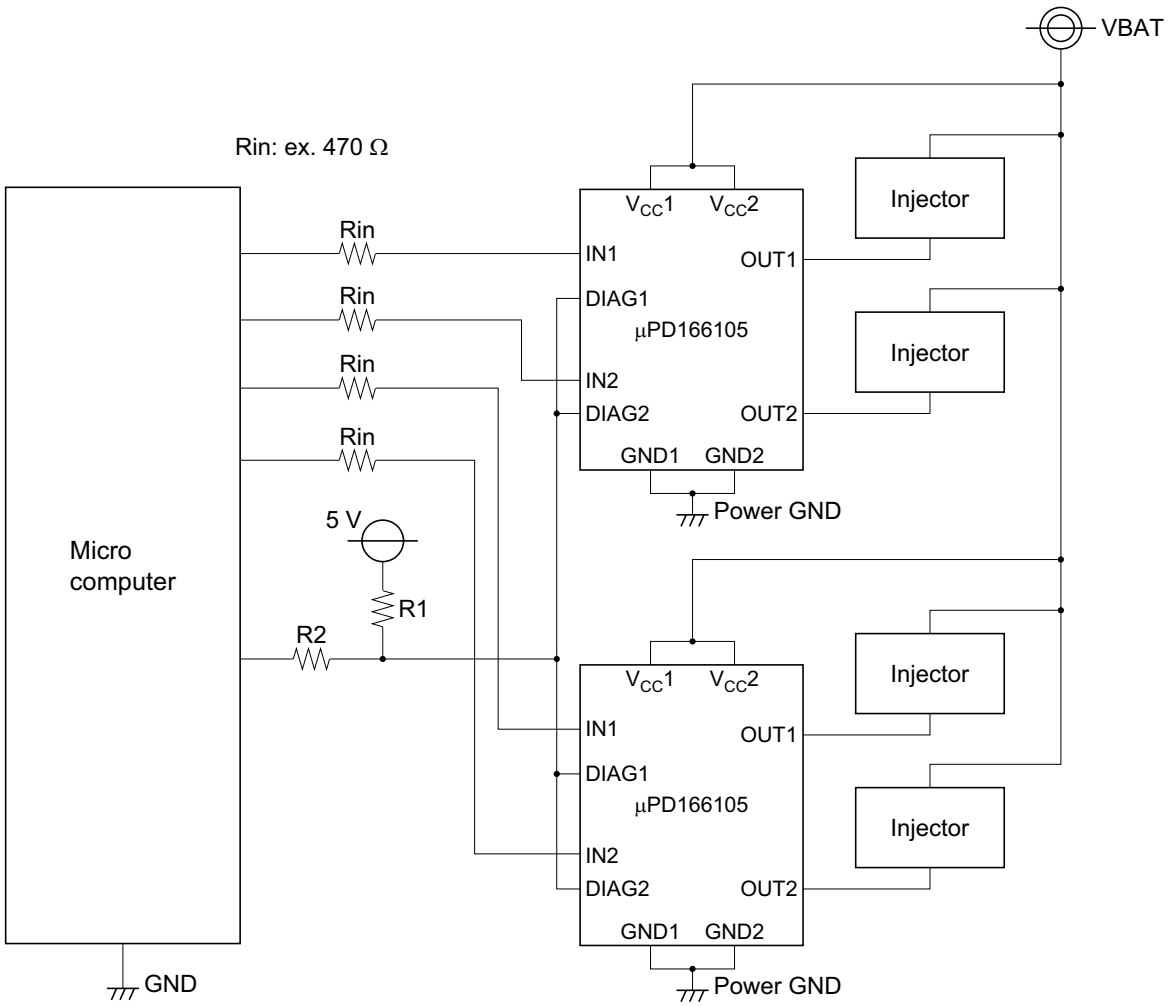


Application Example 1



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

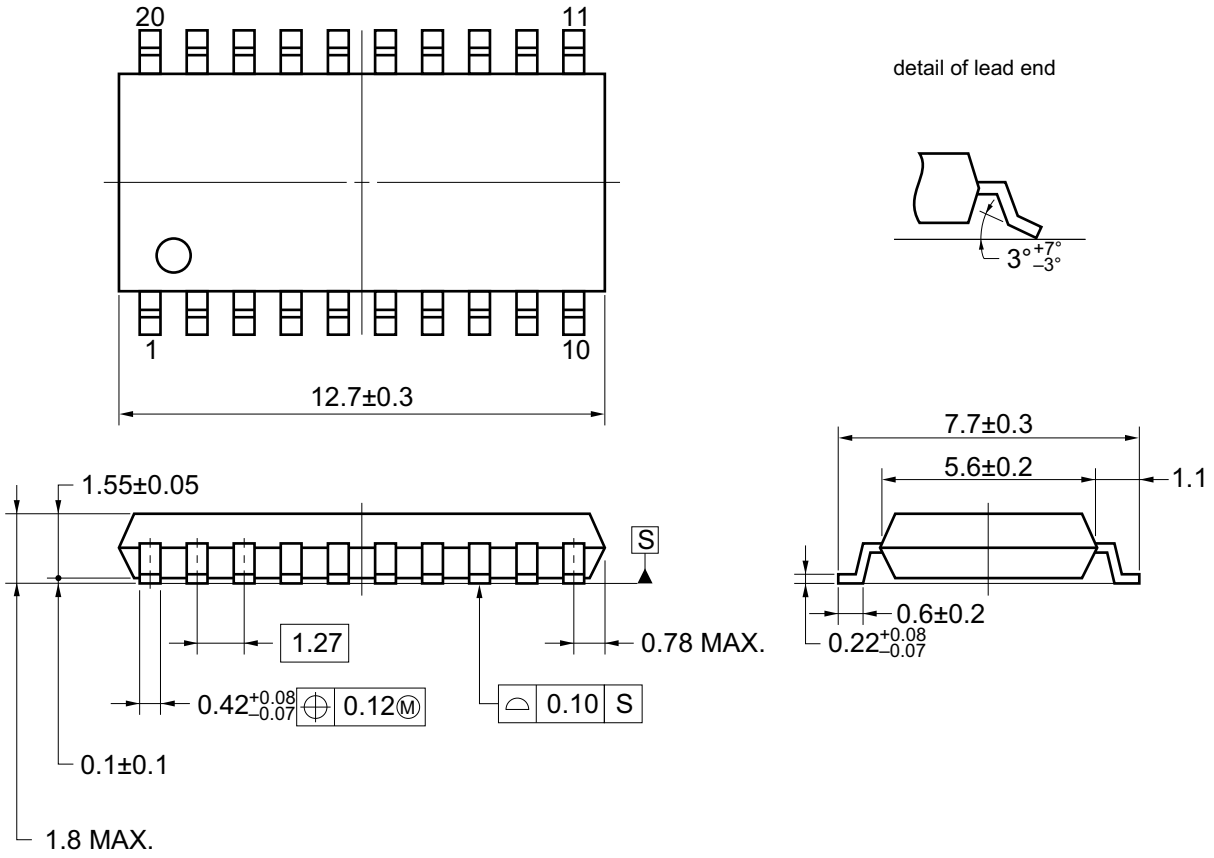
Application Example 2



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

Package Drawing

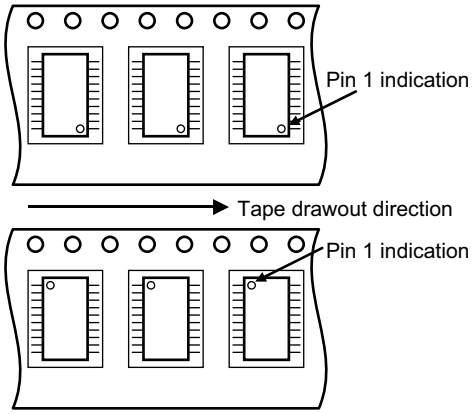
20-Pin Plastic SOP (7.62 mm (300))



Taping Information

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

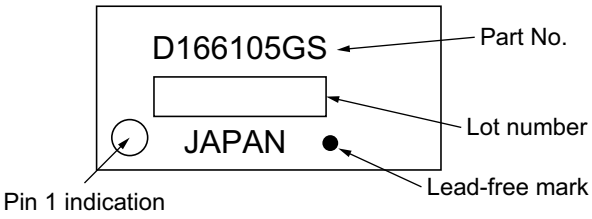
E1: Pin 1 of the device faces toward the open end of the tape, away from the reel



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

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