

# mos integrated circuit $\mu$ **PD16803**

# MONOLITHIC DUAL H BRIDGE DRIVER CIRCUIT

# DESCRIPTION

The  $\mu$ PD16803 is a monolithic dual H bridge driver circuit which uses N-channel power MOS FETs in its driver stage. By employing the power MOS FETs for the output stage, this driver circuit has a substantially improved saturation voltage and power consumption as compared with conventional driver circuits that use bipolar transistors.

In addition, the drive current can be adjusted by an external resistor in a power-saving mode.

The  $\mu$ PD16803 is therefore ideal as the driver circuit of the 2-phase excitation, bipolar-driven stepping motor for the head actuator of an FDD.

## FEATURES

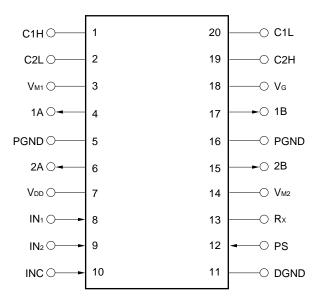
· Low ON resistance (sum of ON resistors of top and bottom transistors)

Ron1 = 1.5  $\Omega$  TYP. (VM = 5.0 V)

Ron2 = 2.0  $\Omega$  TYP. (VM = 12.0 V)

- Low current consumption: IDD = 0.4 mA TYP.
- Stop mode function that turns OFF all output transistors
- Compact surface mount package: 20-pin plastic SOP (300 mil)

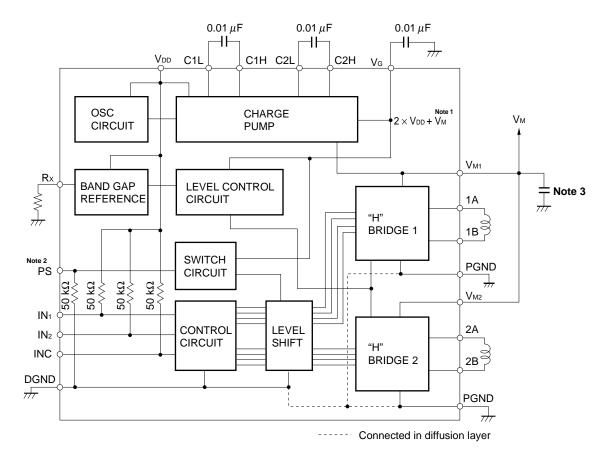
# **PIN CONFIGURATION (Top View)**



# ORDERING INFORMATION

Part Number	Package		
μPD16803GS	20-pin plastic SOP (300 mil)		

# **BLOCK DIAGRAM**



#### Notes 1. $3 \times V_{DD}$ where $V_{M} \leq V_{DD}$

- 2. The power-saving mode is set when the PS pin goes high. In this mode, the voltage of the charge pump circuit is lowered and the ON resistance of the H bridge driver transistor increases, limiting the current. In the power-saving mode, the motor cannot turn.
- 3. It is recommended to connect an external capacitor of 0.22  $\mu$ F or more between V<sub>M</sub> and GND to stabilize the operation.

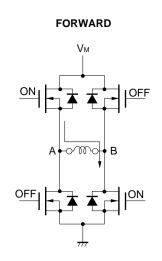
# **FUNCTION TABLE**

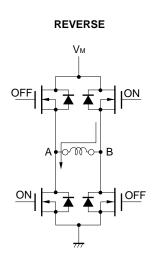
Excitation Direction	INC	IN1	IN <sub>2</sub>	H1	H <sub>2</sub>
<1>	н	н	н	F	F
<2>	н	L	н	R	F
<3>	н	L	L	R	R
<4>	н	н	L	F	R
_	L	×	×	Stop	

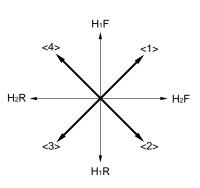
F: Forward

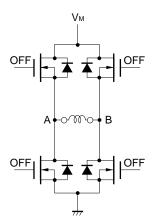
R: Reverse

For the excitation waveform timing chart, refer to **APPLICATION EXAMPLE**.









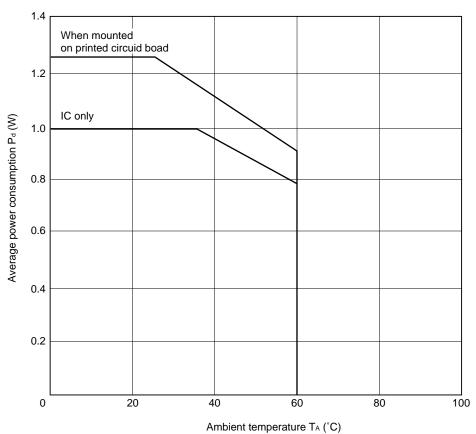
STOP

## ABSOLUTE MAXIMUM RATINGS (T<sub>A</sub> = 25 $^{\circ}$ C)

Parameter	Symbol	Rating	Unit
Supply voltage (motor block)	Vм	-0.5 to +15	V
Supply voltage (control block)	Vdd	-0.5 to +7	V
Power consumption	Pd1	1.0Note 1	W
	Pd2	1.25 <sup>Note 2</sup>	
Instantaneous H bridge driver current	l⊳ (pulse)	±1.0 <sup>Note 2, 3</sup>	A
Input voltage	Vin	−0.5 to V <sub>DD</sub> + 0.5	V
Operating temperature range	TA	0 to 60	°C
Operation junction temperature	T <sub>jMAX</sub> .	150	°C
Storage temperature range	Tstg	-55 to +125	°C

## Notes 1. IC only

- **2.** When mounted on a printed circuit board  $(100 \times 100 \times 1 \text{ mm}, \text{ glass epoxy})$
- **3.**  $t \le 5$  ms, Duty  $\le 40$  %



#### Pd – TA Characteristics

#### **RECOMMENDED OPERATING CONDITIONS**

Parameter	Symbol	MIN.	TYP.	MAX.	Unit
Supply voltage (motor block)	Vм	4.0	5.0	13.2	V
Supply voltage (control block)	Vdd	4.0	5.0	6.0	V
Rx pin connection resistance	Rx	2			kΩ
H bridge driver current <sup>Note</sup>	<b>I</b> DR			±380	mA
Charge pump capacitance	C1 to C3	5		20	nF
Operating temperature	TA	0		60	°C

Note When mounted on a printed circuit board ( $100 \times 100 \times 1$  mm, glass epoxy)

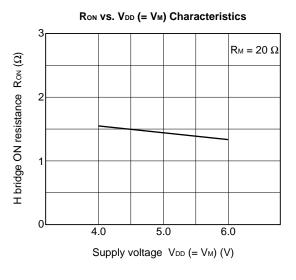
#### ELECTRICAL SPECIFICATIONS (Within recommended operating conditions unless otherwise specified)

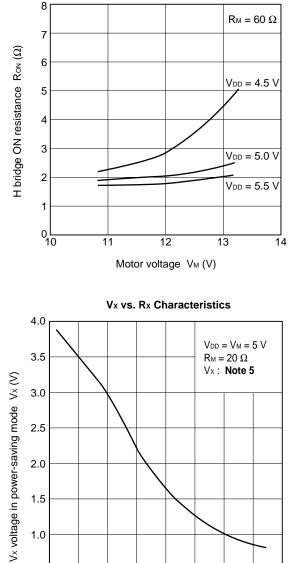
Parameter	Symbol	Conditions		MIN.	TYP.	MAX.	Unit
OFF V <sub>M</sub> pin current	Ім	INC pin low <sup>Note 1</sup>	V <sub>M</sub> = 6.0 V V <sub>DD</sub> = 6.0 V			1.0	μΑ
			V <sub>M</sub> = 13.2 V V <sub>DD</sub> = 6.0 V			1.0	mA
VDD pin current	ldd	No	te 2		0.4	1.0	mA
IN1, IN2, INC pin high-level	Іінт	$T_A = 25 \ ^\circ C, \ V_{IN} = 100 \ ^\circ C$	Vdd			1.0	μΑ
input current		$0 \le T_A \le 60 \ ^\circ C, V$	'in = Vdd			2.0	
IN1, IN2, INC pin low-level input	IIL1	$T_A = 25 \ ^\circ C, \ V_{IN} =$	0 V			-0.15	mA
current		$0 \leq T_A \leq 60 ~^\circ C, ~~V$	'IN = 0 V			-0.2	
PS pin high-level input current	Іін2	$T_A = 25 \ ^\circ C, \ V_{IN} = 100 \ ^\circ C$	Vdd			0.15	mA
		$0 \leq T_A \leq 60 ~^\circ C, ~~V$	'in = Vdd			0.2	
PS pin low-level input current	IIL2	$T_A = 25 \ ^\circ C, \ V_{IN} =$	0 V			-1.0	μA
		$0 \leq T_A \leq 60 ~^\circ C, ~~V$	$V_{\rm IN} = 0 V$			-2.0	
IN1, IN2, INC pin input pull-up	RINU	T <sub>A</sub> = 25 °C		35	50	65	kΩ
resistance		$0 \le T_A \le 60 \ ^\circ C$		25		75	
PS pin input pull-down resistance	RIND	T <sub>A</sub> = 25 °C		35	50	65	kΩ
		$0 \le T_A \le 60 \ ^\circ C$		25		75	
Control pin high-level input voltage	Vін			3.0		Vdd + 0.3	V
Control pin low-level input voltage	VIL			-0.3		0.8	V
H bridge circuit ON	Ron1	VDD = 5 V, VM = 5	V		1.5	3.0	Ω
resistance <sup>Note 3</sup>	Ron2	V <sub>DD</sub> = 5 V, V <sub>M</sub> = 12 V			2.0	4.0	
Ron relative accuracy	$\Delta R$ ом	Excitation directio	n <2>, <4> <sup>Note 4</sup>			±5	%
		Excitation directio	n <1>, <3>			±10	
Vx voltage in power-saving mode <sup>Note 5</sup>	Vx	$V_{DD} = V_M = 5 V, R_X = 50 k\Omega$			2.5		V
Vx relative accuracy in	ДVх	Excitation direction <2>, <4>Note 4				±5	%
power-saving mode		Excitation direction <1>, <3>				±5	
Charge pump circuit (V <sub>G</sub> ) turn ON time	Tong	Vdd = 5 V, Vm = 5	V		0.3	2	ms
H bridge circuit turn ON time	Толн	$C_1 = C_2 = C_3 = 10$	nF			5	μs
H bridge circuit turn OFF time	Тоггн	R <sub>M</sub> = 20 Ω				5	μs

**Notes 1.** When  $V_{DD} < V_M$ , a current (I<sub>M1</sub>) always flow from the V<sub>M1</sub> pin to the charge pump circuit because a gate voltage  $(2 \times V_{DD} + V_M)$  is generated.

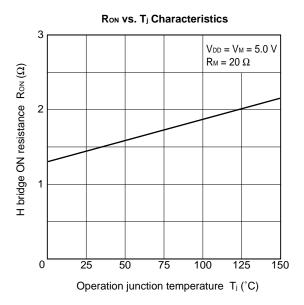
- **2.** When  $IN_1 = IN_2 = INC = "H"$ , PS = "L"
- 3. Sum of ON resistances of top and bottom transistors
- 4. For the excitation direction, refer to FUNCTION TABLE.
- 5. Vx is a voltage at point A (FORWARD) or B (REVERSE) of the H bridge in Function Table.

#### CHARACTERISTIC CURVES

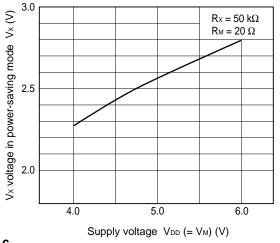


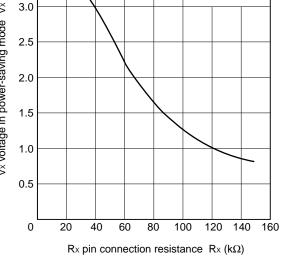


**RON VS. VM Characteristics** 



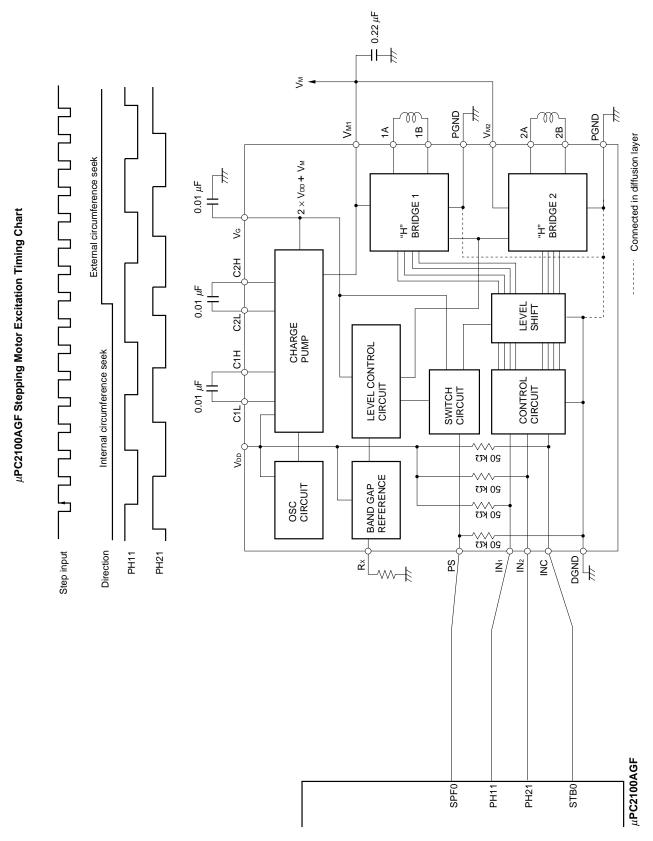
Vx vs. V<sub>DD</sub> (= V<sub>M</sub>) Characteristics





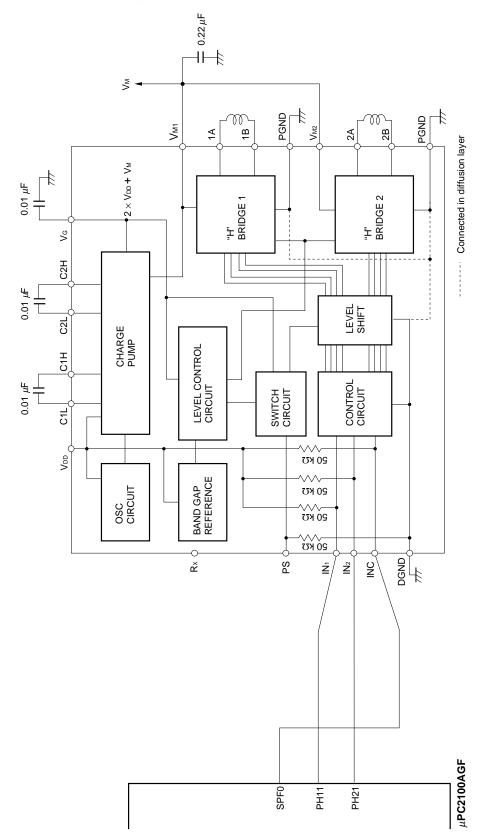
# APPLICATION CIRCUIT EXAMPLE

# 1. Connection with 1-chip FDD LSI $\mu\text{PC2100AGF}$



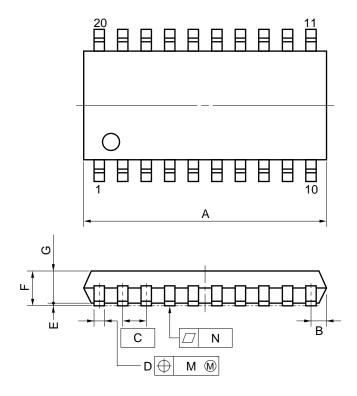
7

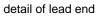
2. Connection with 1-chip FDD LSI  $\mu$ PC2100AGF



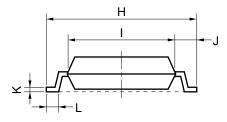
The application circuits and their parameters are for reference only and are not intended for use in actual design-ins.

# 20 PIN PLASTIC SOP (300 mil)









ITEM	MILLIMETERS	INCHES
Α	13.00 MAX.	0.512 MAX.
В	0.78 MAX.	0.031 MAX.
С	1.27 (T.P.)	0.050 (T.P.)
D	$0.40^{+0.10}_{-0.05}$	$0.016^{+0.004}_{-0.003}$
E	0.1±0.1	0.004±0.004
F	1.8 MAX.	0.071 MAX.
G	1.55	0.061
Н	7.7±0.3	0.303±0.012
1	5.6	0.220
J	1.1	0.043
К	$0.20^{+0.10}_{-0.05}$	$0.008^{+0.004}_{-0.002}$
L	0.6±0.2	$0.024^{+0.008}_{-0.009}$
М	0.12	0.005
Ν	0.10	0.004
Р	3°+7° -3°	3°+7° -3°

P20GM-50-300B, C-4

#### NOTE

Each lead centerline is located within 0.12 mm (0.005 inch) of its true position (T.P.) at maximum material condition.

# **RECOMMENDED SOLDERING CONDITIONS**

It is recommended to solder this product under the conditions described below.

For soldering methods and conditions other than those listed below, consult NEC.

#### Surface mount type

For the details of the recommended soldering conditions of this type, refer to **Semiconductor Device Mounting Technology Manual (C10535E)**.

Soldering Method	Soldering Conditions	Symbol of Recommended Soldering
Infrared reflow	Peak package temperature: 230 °C, Time: 30 seconds MAX. (210 °C MIN.), Number of times: 1, Number of days: None <sup>Note</sup>	IR30-00
VPS	Peak package temperature: 215 °C, Time: 40 seconds MAX. (200 °C MIN.), Number of times: 1, Number of days: None <sup>Note</sup>	VP15-00
Wave soldering	Solder bath temperature: 260 °C MAX., Time: 10 seconds MAX., Number of times: 1, Number of days: None <sup>Note</sup>	WS60-00
Partial heating	Pin temperature: 300 °C MAX., Time: 10 seconds MAX., Number of days: None <sup>Note</sup>	-

Note The number of storage days at 25 °C, 65 % RH after the dry pack has been opened

Caution Do not use two or more soldering methods in combination (except partial heating).

[MEMO]

[MEMO]

No part of this document may be copied or reproduced in any form or by any means without the prior written consent of NEC Corporation. NEC Corporation assumes no responsibility for any errors which may appear in this document.

NEC Corporation does not assume any liability for infringement of patents, copyrights or other intellectual property rights of third parties by or arising from use of a device described herein or any other liability arising from use of such device. No license, either express, implied or otherwise, is granted under any patents, copyrights or other intellectual property rights of NEC Corporation or others.

While NEC Corporation has been making continuous effort to enhance the reliability of its semiconductor devices, the possibility of defects cannot be eliminated entirely. To minimize risks of damage or injury to persons or property arising from a defect in an NEC semiconductor device, customers must incorporate sufficient safety measures in its design, such as redundancy, fire-containment, and anti-failure features.

NEC devices are classified into the following three quality grades:

"Standard", "Special", and "Specific". The Specific quality grade applies only to devices developed based on a customer designated "quality assurance program" for a specific application. The recommended applications of a device depend on its quality grade, as indicated below. Customers must check the quality grade of each device 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: Aircrafts, aerospace equipment, submersible repeaters, nuclear reactor control systems, life support systems or medical equipment for life support, etc.

The quality grade of NEC devices is "Standard" unless otherwise specified in NEC's Data Sheets or Data Books. If customers intend to use NEC devices for applications other than those specified for Standard quality grade, they should contact an NEC sales representative in advance.

Anti-radioactive design is not implemented in this product.