

## 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.

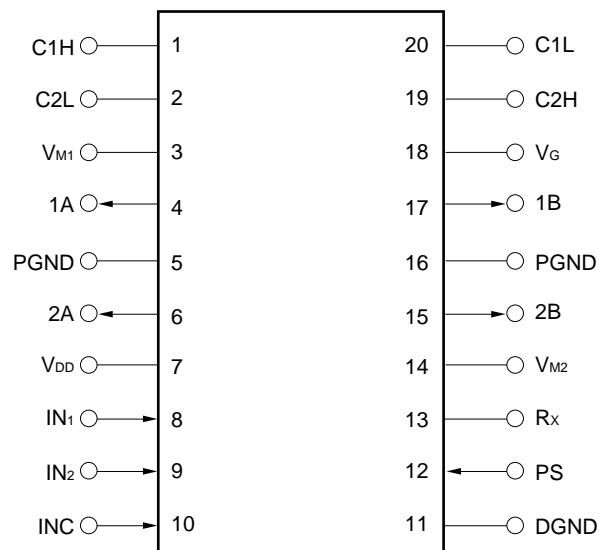
In addition, the drive current can be adjusted by an external resistor in a power-saving mode.

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)  
 $R_{ON1} = 1.5 \Omega$  TYP. ( $V_M = 5.0$  V)  
 $R_{ON2} = 2.0 \Omega$  TYP. ( $V_M = 12.0$  V)
- Low current consumption:  $I_{DD} = 0.4$  mA TYP.
- Stop mode function that turns OFF all output transistors
- Compact surface mount package: 20-pin plastic SOP (300 mil)

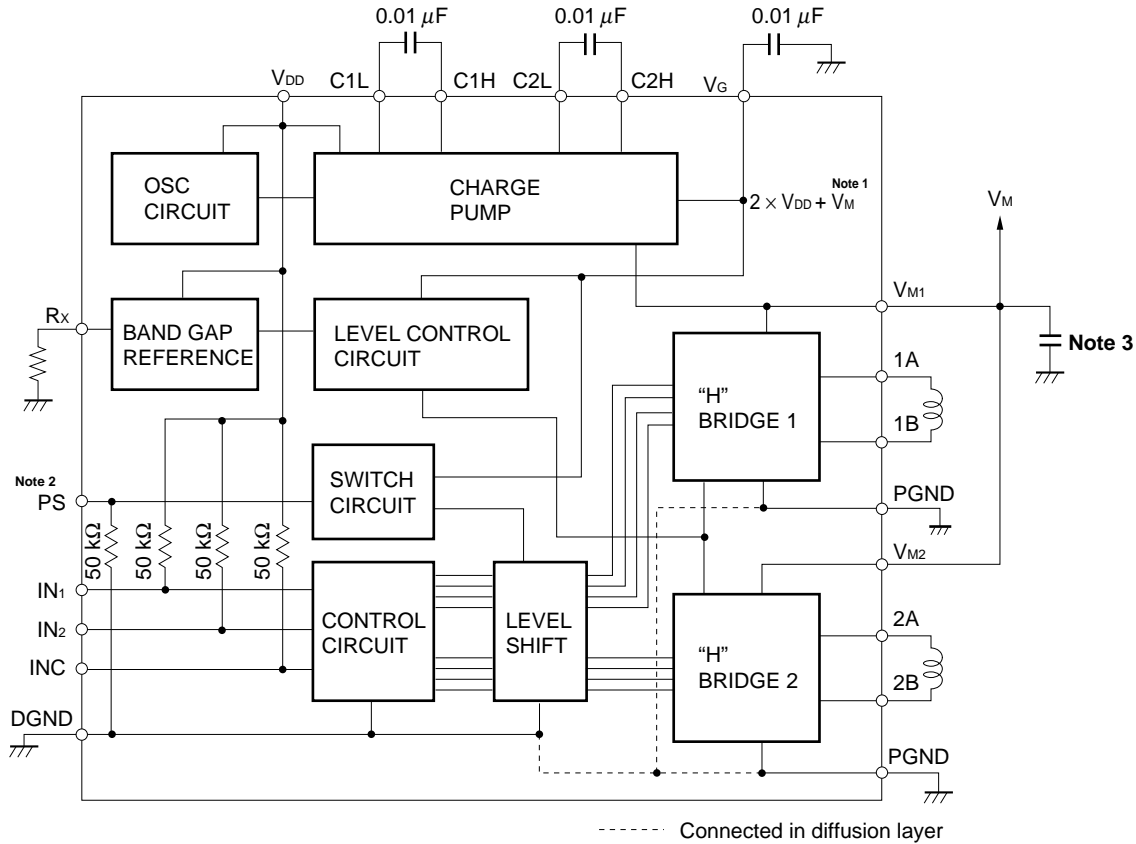
## PIN CONFIGURATION (Top View)



ORDERING INFORMATION

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

BLOCK DIAGRAM

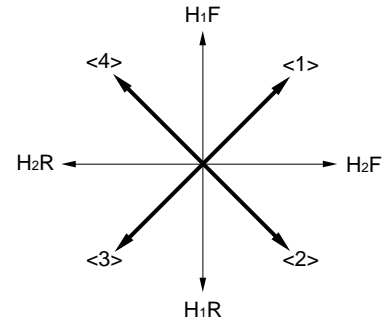


**Notes 1.**  $3 \times V_{DD}$  where  $V_M \leq V_{DD}$

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  $V_M$  and GND to stabilize the operation.

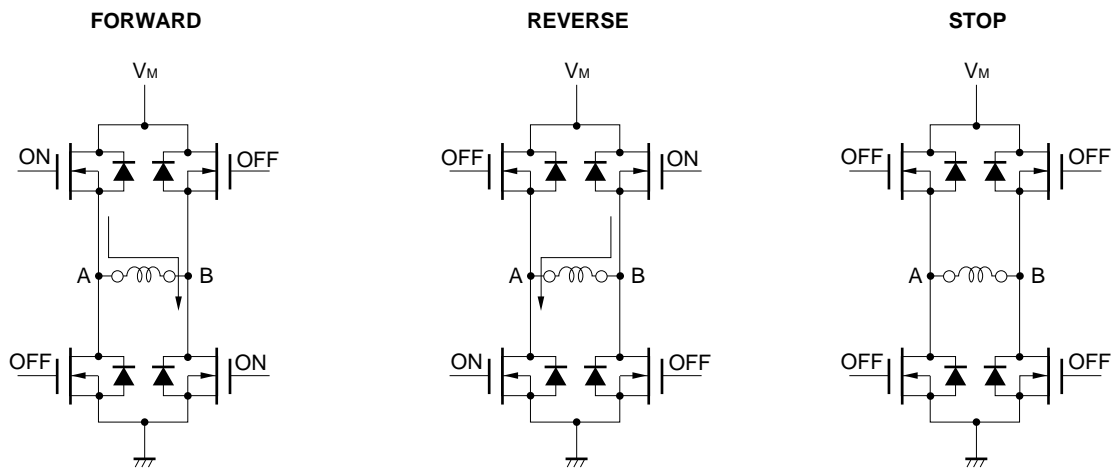
FUNCTION TABLE

Excitation Direction	INC	IN <sub>1</sub>	IN <sub>2</sub>	H <sub>1</sub>	H <sub>2</sub>
<1>	H	H	H	F	F
<2>	H	L	H	R	F
<3>	H	L	L	R	R
<4>	H	H	L	F	R
-	L	×	×	Stop	



F: Forward  
R: Reverse

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



**ABSOLUTE MAXIMUM RATINGS (T<sub>A</sub> = 25 °C)**

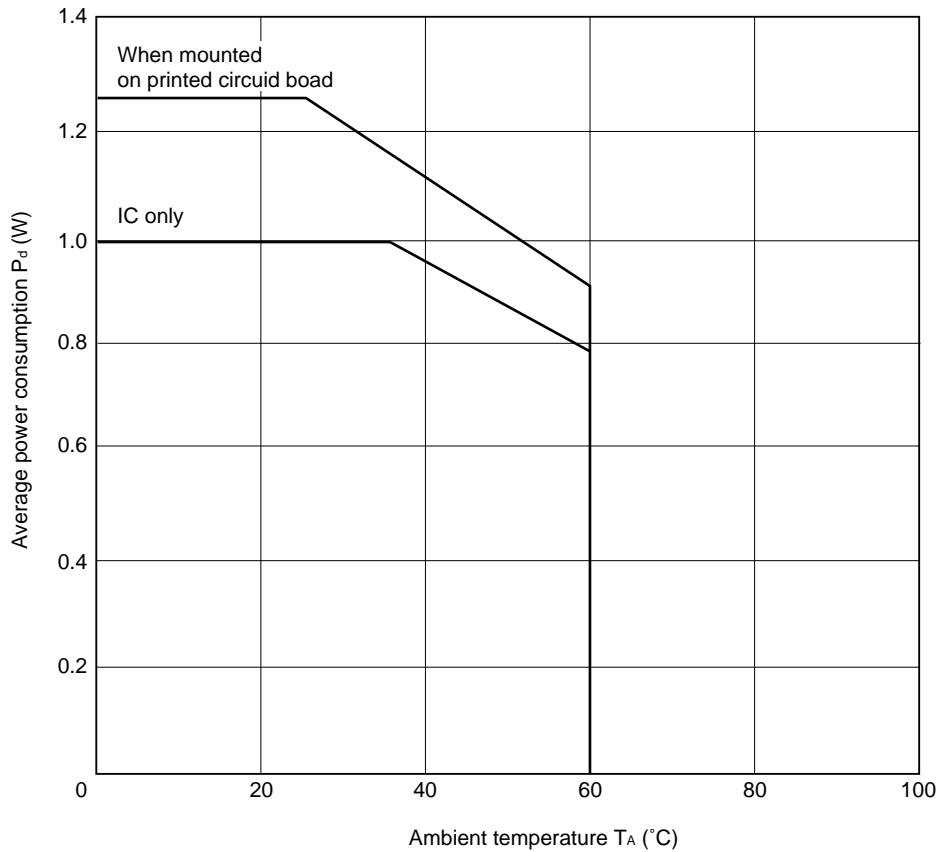
Parameter	Symbol	Rating	Unit
Supply voltage (motor block)	V <sub>M</sub>	-0.5 to +15	V
Supply voltage (control block)	V <sub>DD</sub>	-0.5 to +7	V
Power consumption	P <sub>d1</sub>	1.0 <sup>Note 1</sup>	W
	P <sub>d2</sub>	1.25 <sup>Note 2</sup>	
Instantaneous H bridge driver current	I <sub>b</sub> (pulse)	±1.0 <sup>Note 2, 3</sup>	A
Input voltage	V <sub>IN</sub>	-0.5 to V <sub>DD</sub> + 0.5	V
Operating temperature range	T <sub>A</sub>	0 to 60	°C
Operation junction temperature	T <sub>JMAX.</sub>	150	°C
Storage temperature range	T <sub>stg</sub>	-55 to +125	°C

**Notes 1.** IC only

**2.** When mounted on a printed circuit board (100 × 100 × 1 mm, glass epoxy)

**3.** t ≤ 5 ms, Duty ≤ 40 %

**P<sub>d</sub> – T<sub>A</sub> Characteristics**



**RECOMMENDED OPERATING CONDITIONS**

Parameter	Symbol	MIN.	TYP.	MAX.	Unit
Supply voltage (motor block)	V <sub>M</sub>	4.0	5.0	13.2	V
Supply voltage (control block)	V <sub>DD</sub>	4.0	5.0	6.0	V
R <sub>x</sub> pin connection resistance	R <sub>x</sub>	2			kΩ
H bridge driver current <sup>Note</sup>	I <sub>DR</sub>			±380	mA
Charge pump capacitance	C <sub>1</sub> to C <sub>3</sub>	5		20	nF
Operating temperature	T <sub>A</sub>	0		60	°C

**Note** When mounted on a printed circuit board (100 × 100 × 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	I <sub>M</sub>	INC pin low <sup>Note 1</sup> V <sub>M</sub> = 6.0 V V <sub>DD</sub> = 6.0 V			1.0	μA
		V <sub>M</sub> = 13.2 V V <sub>DD</sub> = 6.0 V			1.0	mA
V <sub>DD</sub> pin current	I <sub>DD</sub>	<b>Note 2</b>		0.4	1.0	mA
IN <sub>1</sub> , IN <sub>2</sub> , INC pin high-level input current	I <sub>IH1</sub>	T <sub>A</sub> = 25 °C, V <sub>IN</sub> = V <sub>DD</sub>			1.0	μA
		0 ≤ T <sub>A</sub> ≤ 60 °C, V <sub>IN</sub> = V <sub>DD</sub>			2.0	
IN <sub>1</sub> , IN <sub>2</sub> , INC pin low-level input current	I <sub>IL1</sub>	T <sub>A</sub> = 25 °C, V <sub>IN</sub> = 0 V			-0.15	mA
		0 ≤ T <sub>A</sub> ≤ 60 °C, V <sub>IN</sub> = 0 V			-0.2	
PS pin high-level input current	I <sub>IH2</sub>	T <sub>A</sub> = 25 °C, V <sub>IN</sub> = V <sub>DD</sub>			0.15	mA
		0 ≤ T <sub>A</sub> ≤ 60 °C, V <sub>IN</sub> = V <sub>DD</sub>			0.2	
PS pin low-level input current	I <sub>IL2</sub>	T <sub>A</sub> = 25 °C, V <sub>IN</sub> = 0 V			-1.0	μA
		0 ≤ T <sub>A</sub> ≤ 60 °C, V <sub>IN</sub> = 0 V			-2.0	
IN <sub>1</sub> , IN <sub>2</sub> , INC pin input pull-up resistance	R <sub>INU</sub>	T <sub>A</sub> = 25 °C	35	50	65	kΩ
		0 ≤ T <sub>A</sub> ≤ 60 °C	25		75	
PS pin input pull-down resistance	R <sub>IND</sub>	T <sub>A</sub> = 25 °C	35	50	65	kΩ
		0 ≤ T <sub>A</sub> ≤ 60 °C	25		75	
Control pin high-level input voltage	V <sub>IH</sub>		3.0		V <sub>DD</sub> + 0.3	V
Control pin low-level input voltage	V <sub>IL</sub>		-0.3		0.8	V
H bridge circuit ON resistance <sup>Note 3</sup>	R <sub>ON1</sub>	V <sub>DD</sub> = 5 V, V <sub>M</sub> = 5 V		1.5	3.0	Ω
	R <sub>ON2</sub>	V <sub>DD</sub> = 5 V, V <sub>M</sub> = 12 V		2.0	4.0	
R <sub>ON</sub> relative accuracy	ΔR <sub>ON</sub>	Excitation direction <2>, <4> <sup>Note 4</sup>			±5	%
		Excitation direction <1>, <3>			±10	
V <sub>x</sub> voltage in power-saving mode <sup>Note 5</sup>	V <sub>x</sub>	V <sub>DD</sub> = V <sub>M</sub> = 5 V, R <sub>x</sub> = 50 kΩ		2.5		V
V <sub>x</sub> relative accuracy in power-saving mode	ΔV <sub>x</sub>	Excitation direction <2>, <4> <sup>Note 4</sup>			±5	%
		Excitation direction <1>, <3>			±5	
Charge pump circuit (V <sub>G</sub> ) turn ON time	T <sub>ONG</sub>	V <sub>DD</sub> = 5 V, V <sub>M</sub> = 5 V		0.3	2	ms
H bridge circuit turn ON time	T <sub>ONH</sub>	C <sub>1</sub> = C <sub>2</sub> = C <sub>3</sub> = 10 nF			5	μs
H bridge circuit turn OFF time	T <sub>OFFH</sub>	R <sub>M</sub> = 20 Ω			5	μs

**Notes 1.** When V<sub>DD</sub> < V<sub>M</sub>, 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 × V<sub>DD</sub> + V<sub>M</sub>) is generated.

**2.** When IN<sub>1</sub> = IN<sub>2</sub> = INC = “H”, PS = “L”

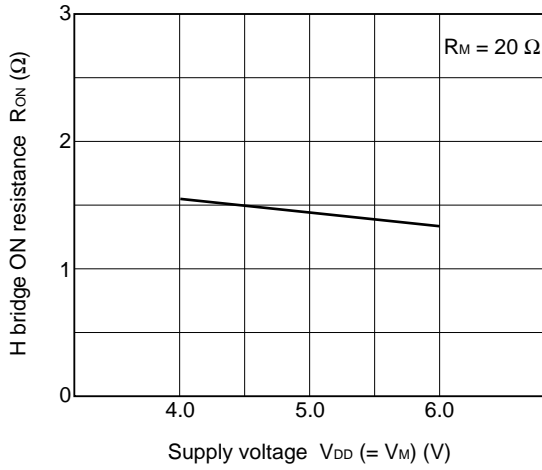
**3.** Sum of ON resistances of top and bottom transistors

**4.** For the excitation direction, refer to **FUNCTION TABLE**.

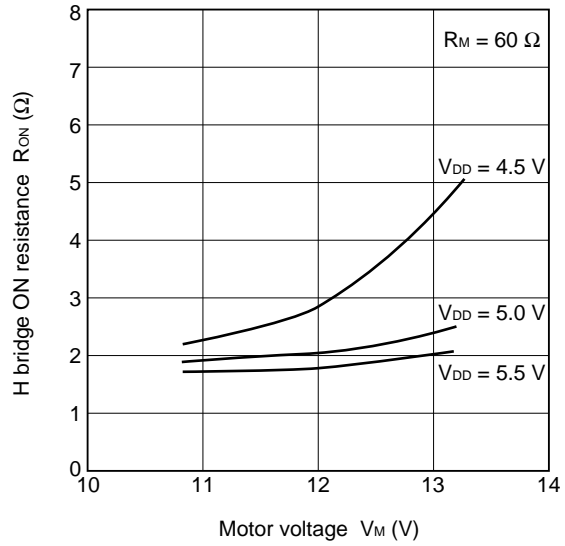
**5.** V<sub>x</sub> is a voltage at point A (FORWARD) or B (REVERSE) of the H bridge in Function Table.

CHARACTERISTIC CURVES

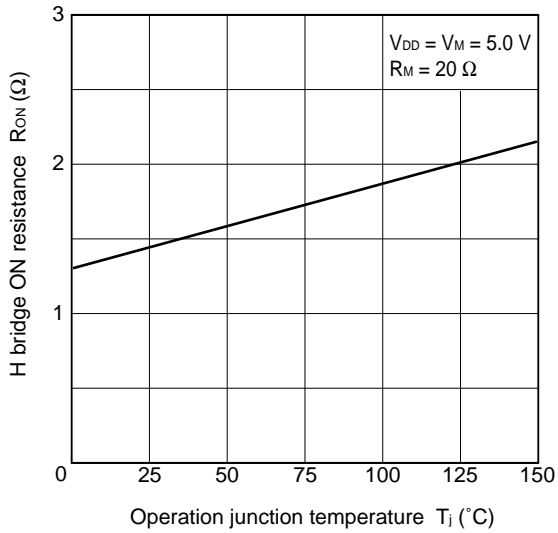
RON vs. VDD (= VM) Characteristics



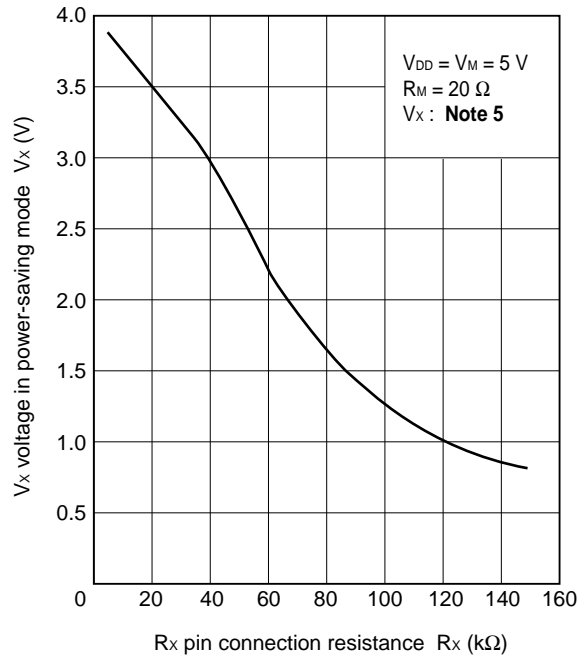
RON vs. VM Characteristics



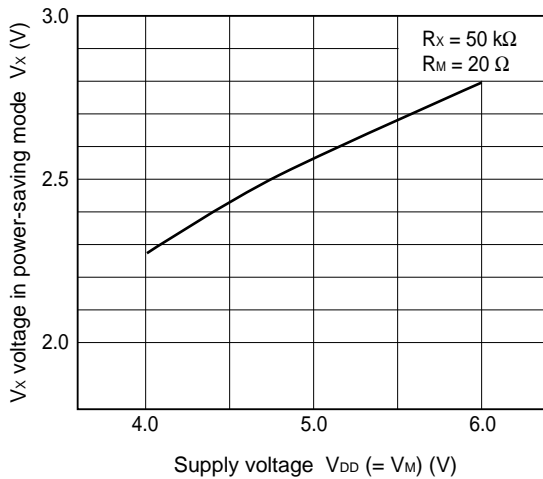
RON vs. Tj Characteristics



Vx vs. Rx Characteristics



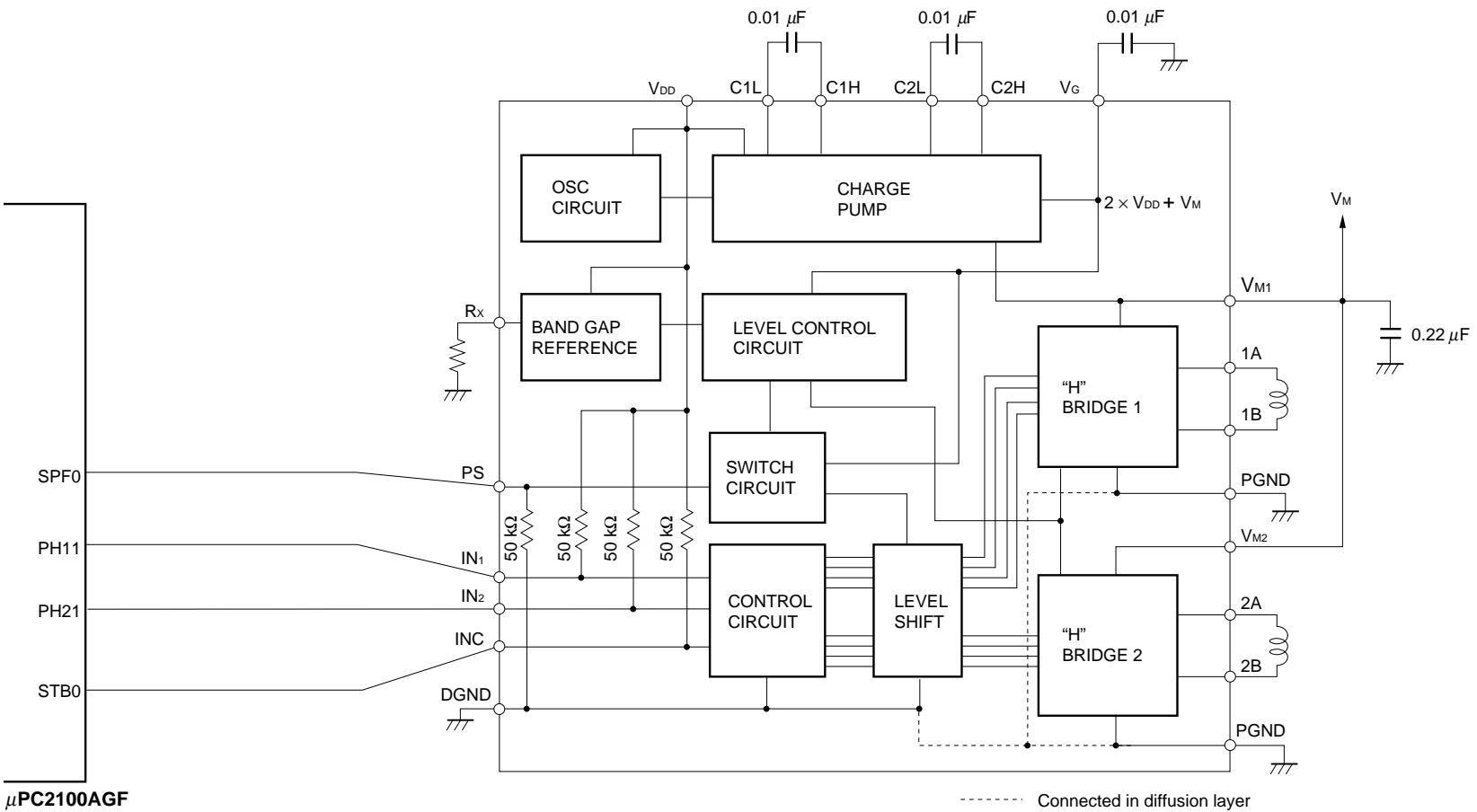
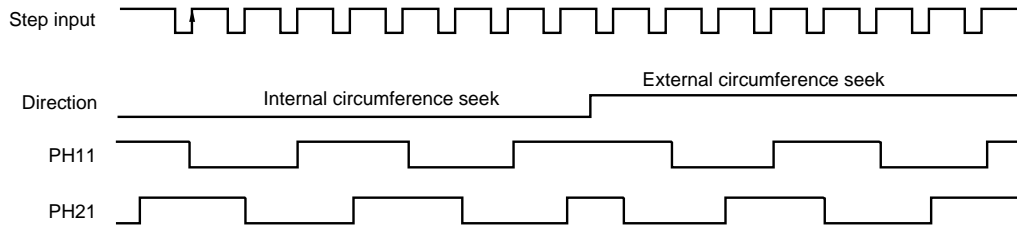
Vx vs. VDD (= VM) Characteristics



APPLICATION CIRCUIT EXAMPLE

1. Connection with 1-chip FDD LSI μPC2100AGF

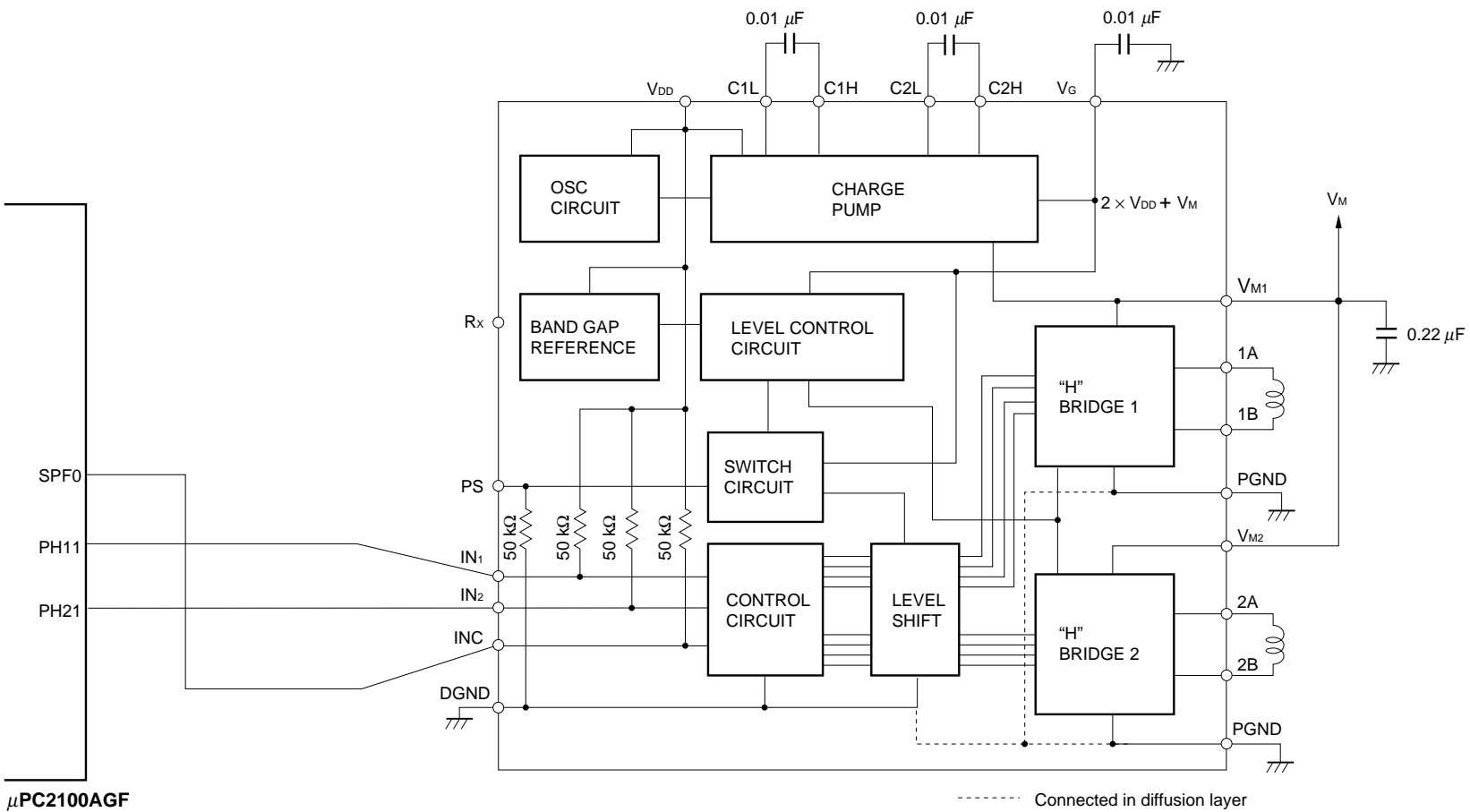
μPC2100AGF Stepping Motor Excitation Timing Chart



----- Connected in diffusion layer

μPC2100AGF

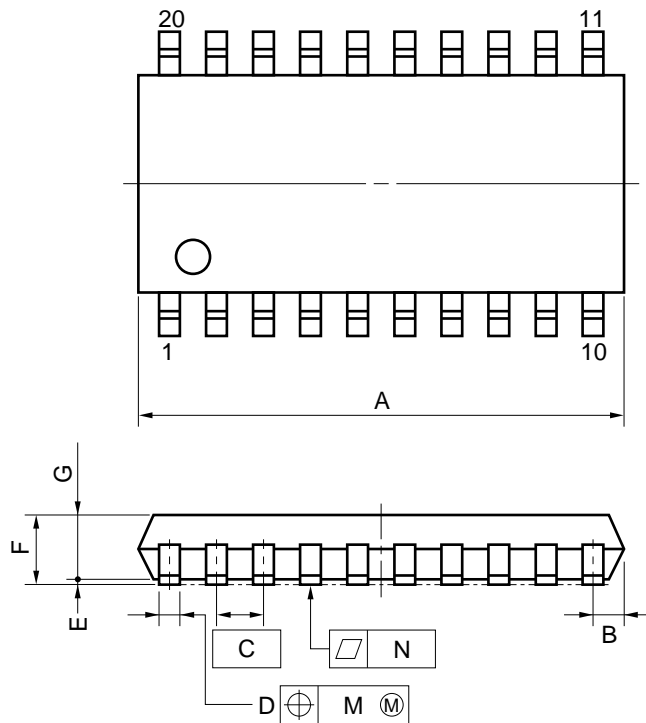
2. Connection with 1-chip FDD LSI μPC2100AGF



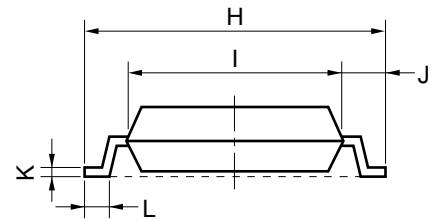
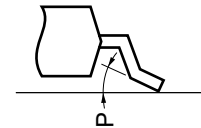
The application circuits and their parameters are for reference only and are not intended for use in actual design-ins.



20 PIN PLASTIC SOP (300 mil)



detail of lead end



NOTE

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

ITEM	MILLIMETERS	INCHES
A	13.00 MAX.	0.512 MAX.
B	0.78 MAX.	0.031 MAX.
C	1.27 (T.P.)	0.050 (T.P.)
D	0.40 <sup>+0.10</sup> <sub>-0.05</sub>	0.016 <sup>+0.004</sup> <sub>-0.003</sub>
E	0.1±0.1	0.004±0.004
F	1.8 MAX.	0.071 MAX.
G	1.55	0.061
H	7.7±0.3	0.303±0.012
I	5.6	0.220
J	1.1	0.043
K	0.20 <sup>+0.10</sup> <sub>-0.05</sub>	0.008 <sup>+0.004</sup> <sub>-0.002</sub>
L	0.6±0.2	0.024 <sup>+0.008</sup> <sub>-0.009</sub>
M	0.12	0.005
N	0.10	0.004
P	3° <sup>+7°</sup> <sub>-3°</sub>	3° <sup>+7°</sup> <sub>-3°</sub>

P20GM-50-300B, C-4

**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.