To our customers,

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April 1st, 2010
Renesas Electronics Corporation

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RENESAS

MOS INTEGRATED CIRCUIT

# μPD16803

## MONOLITHIC DUAL H BRIDGE DRIVER CIRCUIT

### DESCRIPTION

The μPD16803 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.

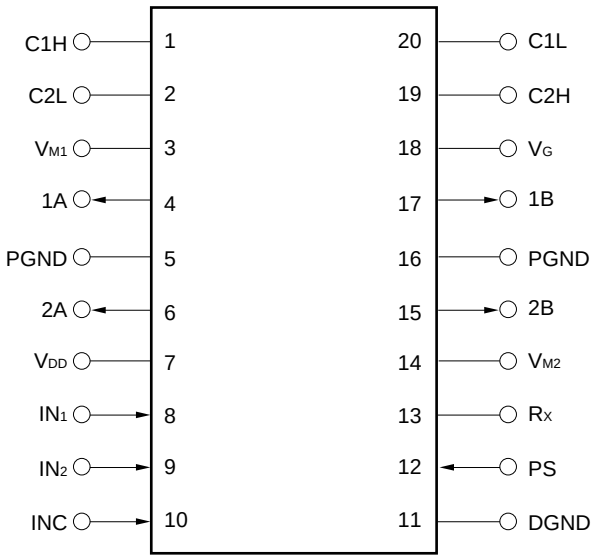
In addition, the drive current can be adjusted by an external resistor in a power-saving mode.

The μPD16803 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 Ω TYP. ($V_M$ = 5.0 V)
  - $R_{ON2}$ = 2.0 Ω 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)

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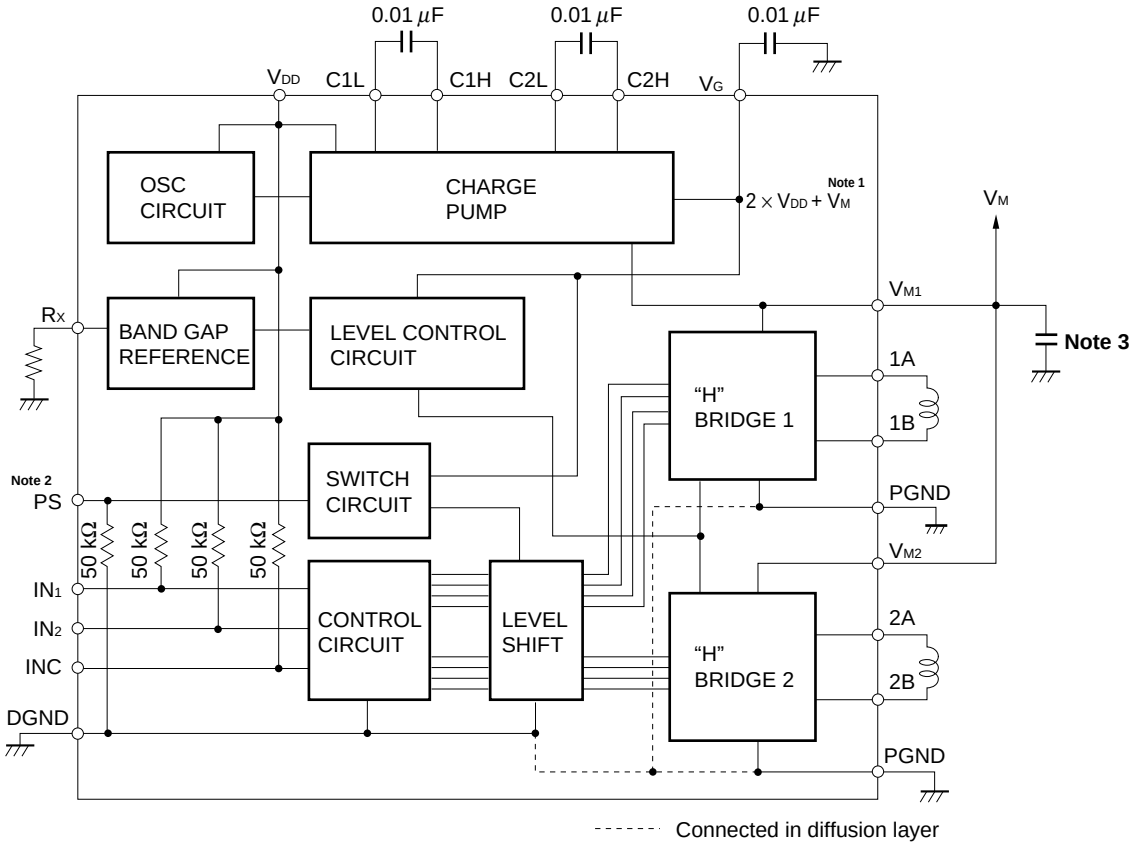
Printed in Japan

## ORDERING INFORMATION

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

## BLOCK DIAGRAM



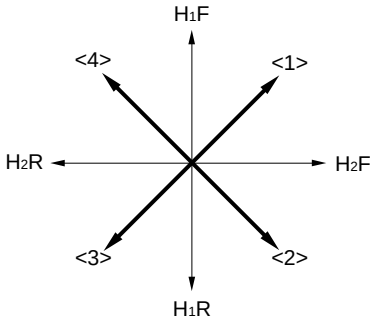

**Notes 1.** $3 \times V_{DD}$ where $V_M \leq V_{DD}$

**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 μF or more between $V_M$ and GND to stabilize the operation.

## FUNCTION TABLE

| Excitation Direction | INC | $IN_1$ | $IN_2$ | $H_1$ | $H_2$ |
|---|---|---|---|---|---|
| <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 | |

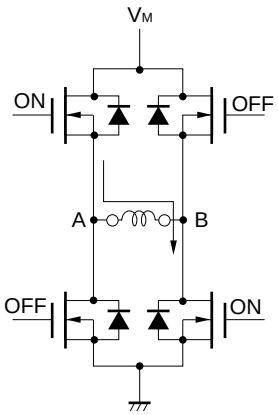



F: Forward

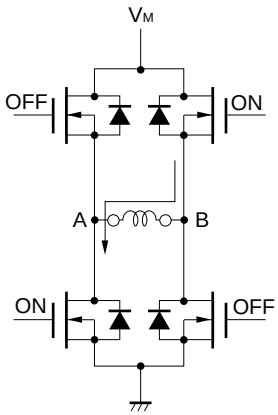
R: Reverse

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

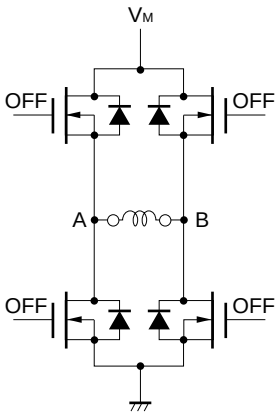
**FORWARD**




**REVERSE**




**STOP**



**ABSOLUTE MAXIMUM RATINGS ($T_A$ = 25 °C)**

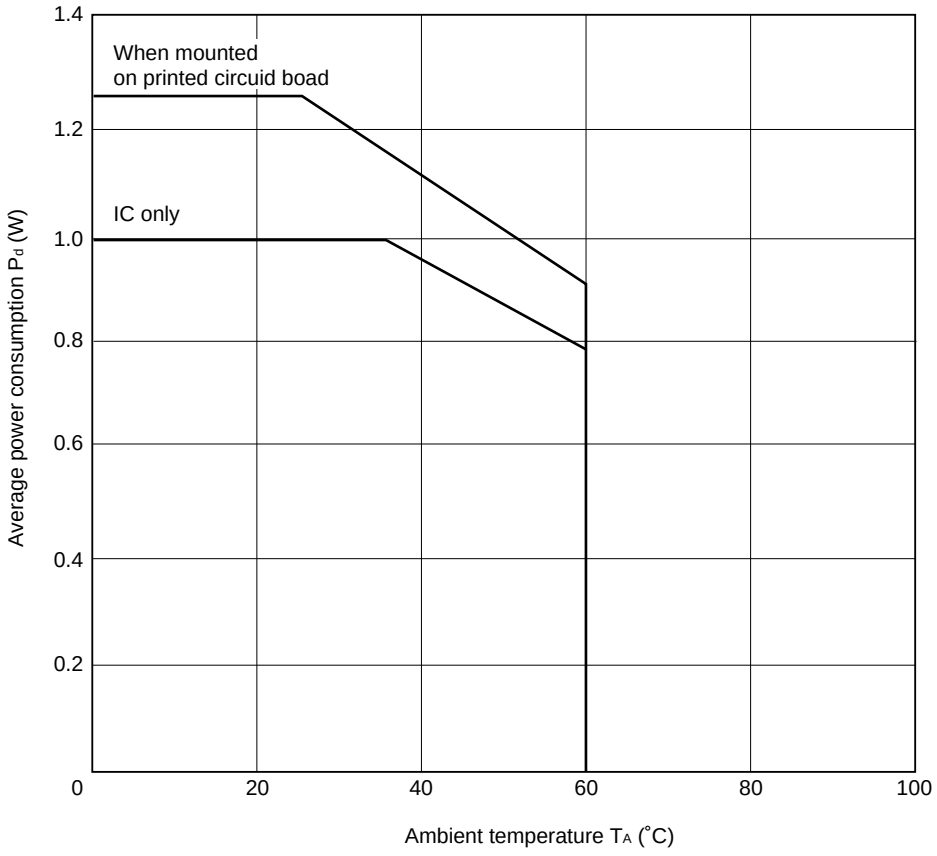
| Parameter | Symbol | Rating | Unit |
|---|---|---|---|
| Supply voltage (motor block) | $V_M$ | –0.5 to +15 | V |
| Supply voltage (control block) | $V_{DD}$ | –0.5 to +7 | V |
| Power consumption | $P_{d1}$ | 1.0 Note 1 | W |
| | $P_{d2}$ | 1.25 Note 2 | |
| Instantaneous H bridge driver current | $I_D$ (pulse) | ±1.0 Note 2, 3 | A |
| Input voltage | $V_{IN}$ | –0.5 to $V_{DD}$ + 0.5 | V |
| Operating temperature range | $T_A$ | 0 to 60 | °C |
| Operation junction temperature | $T_{jMAX.}$ | 150 | °C |
| Storage temperature range | $T_{stg}$ | –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 %

**$P_d$ – $T_A$ Characteristics**



## RECOMMENDED OPERATING CONDITIONS

| Parameter | Symbol | MIN. | TYP. | MAX. | Unit |
|---|---|---|---|---|---|
| Supply voltage (motor block) | $V_M$ | 4.0 | 5.0 | 13.2 | V |
| Supply voltage (control block) | $V_{DD}$ | 4.0 | 5.0 | 6.0 | V |
| $R_X$ pin connection resistance | $R_X$ | 2 | | | kΩ |
| H bridge driver current**Note** | $I_{DR}$ | | | ±380 | mA |
| Charge pump capacitance | $C_1$ to $C_3$ | 5 | | 20 | nF |
| Operating temperature | $T_A$ | 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 $V_M$ pin current | $I_M$ | INC pin low**Note 1** | $V_M$ = 6.0 V, $V_{DD}$ = 6.0 V | | | 1.0 | μA |
| | | | $V_M$ = 13.2 V, $V_{DD}$ = 6.0 V | | | 1.0 | mA |
| $V_{DD}$ pin current | $I_{DD}$ | **Note 2** | | | 0.4 | 1.0 | mA |
| $IN_1$, $IN_2$, INC pin high-level input current | $I_{IH1}$ | $T_A$ = 25 °C, $V_{IN}$ = $V_{DD}$ | | | | 1.0 | μA |
| | | 0 ≤ $T_A$ ≤ 60 °C, $V_{IN}$ = $V_{DD}$ | | | | 2.0 | |
| $IN_1$, $IN_2$, INC pin low-level input current | $I_{IL1}$ | $T_A$ = 25 °C, $V_{IN}$ = 0 V | | | | –0.15 | mA |
| | | 0 ≤ $T_A$ ≤ 60 °C, $V_{IN}$ = 0 V | | | | –0.2 | |
| PS pin high-level input current | $I_{IH2}$ | $T_A$ = 25 °C, $V_{IN}$ = $V_{DD}$ | | | | 0.15 | mA |
| | | 0 ≤ $T_A$ ≤ 60 °C, $V_{IN}$ = $V_{DD}$ | | | | 0.2 | |
| PS pin low-level input current | $I_{IL2}$ | $T_A$ = 25 °C, $V_{IN}$ = 0 V | | | | –1.0 | μA |
| | | 0 ≤ $T_A$ ≤ 60 °C, $V_{IN}$ = 0 V | | | | –2.0 | |
| $IN_1$, $IN_2$, INC pin input pull-up resistance | $R_{INU}$ | $T_A$ = 25 °C | | 35 | 50 | 65 | kΩ |
| | | 0 ≤ $T_A$ ≤ 60 °C | | 25 | | 75 | |
| PS pin input pull-down resistance | $R_{IND}$ | $T_A$ = 25 °C | | 35 | 50 | 65 | kΩ |
| | | 0 ≤ $T_A$ ≤ 60 °C | | 25 | | 75 | |
| Control pin high-level input voltage | $V_{IH}$ | | | 3.0 | | $V_{DD}$ + 0.3 | V |
| Control pin low-level input voltage | $V_{IL}$ | | | –0.3 | | 0.8 | V |
| H bridge circuit ON resistance**Note 3** | $R_{ON1}$ | $V_{DD}$ = 5 V, $V_M$ = 5 V | | | 1.5 | 3.0 | Ω |
| | $R_{ON2}$ | $V_{DD}$ = 5 V, $V_M$ = 12 V | | | 2.0 | 4.0 | |
| $R_{ON}$ relative accuracy | $\Delta R_{ON}$ | Excitation direction <2>, <4>**Note 4** | | | | ±5 | % |
| | | Excitation direction <1>, <3> | | | | ±10 | |
| $V_X$ voltage in power-saving mode**Note 5** | $V_X$ | $V_{DD}$ = $V_M$ = 5 V, $R_X$ = 50 kΩ | | | 2.5 | | V |
| $V_X$ relative accuracy in power-saving mode | $\Delta V_X$ | Excitation direction <2>, <4>**Note 4** | | | | ±5 | % |
| | | Excitation direction <1>, <3> | | | | ±5 | |
| Charge pump circuit ($V_G$) turn ON time | $T_{ONG}$ | $V_{DD}$ = 5 V, $V_M$ = 5 V | | | 0.3 | 2 | ms |
| H bridge circuit turn ON time | $T_{ONH}$ | $C_1$ = $C_2$ = $C_3$ = 10 nF | | | | 5 | μs |
| H bridge circuit turn OFF time | $T_{OFFH}$ | $R_M$ = 20 Ω | | | | 5 | μs |

**Notes 1.** When $V_{DD}$ < $V_M$, a current ($I_{M1}$) always flow from the $V_{M1}$ pin to the charge pump circuit because a gate voltage (2 × $V_{DD}$ + $V_M$) is generated.

**2.** When $IN_1$ = $IN_2$ = INC = "H", PS = "L"

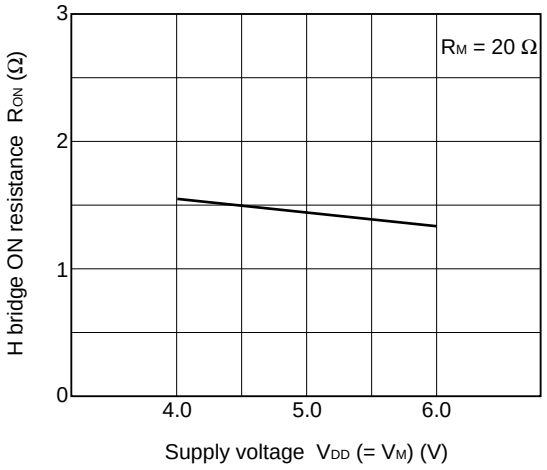
**3.** Sum of ON resistances of top and bottom transistors

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

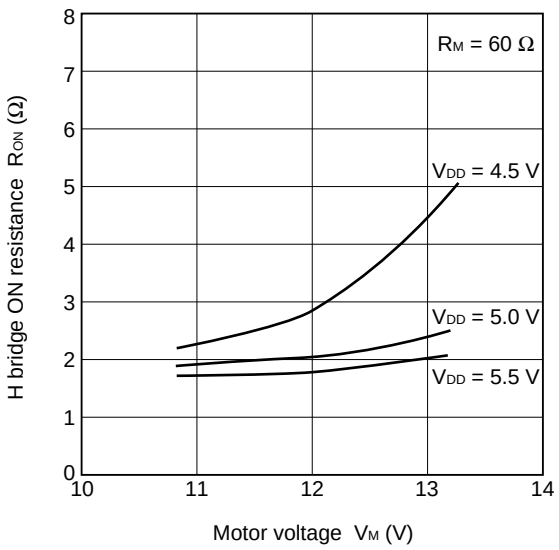
**5.** $V_X$ is a voltage at point A (FORWARD) or B (REVERSE) of the H bridge in Function Table.

## CHARACTERISTIC CURVES

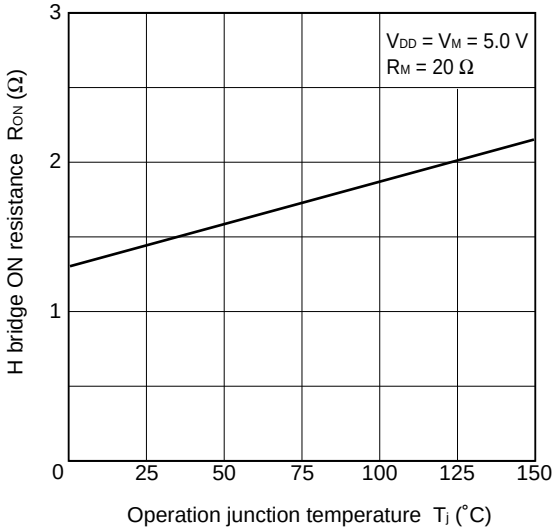
**$R_{ON}$ vs. $V_{DD}$ (= $V_M$) Characteristics**



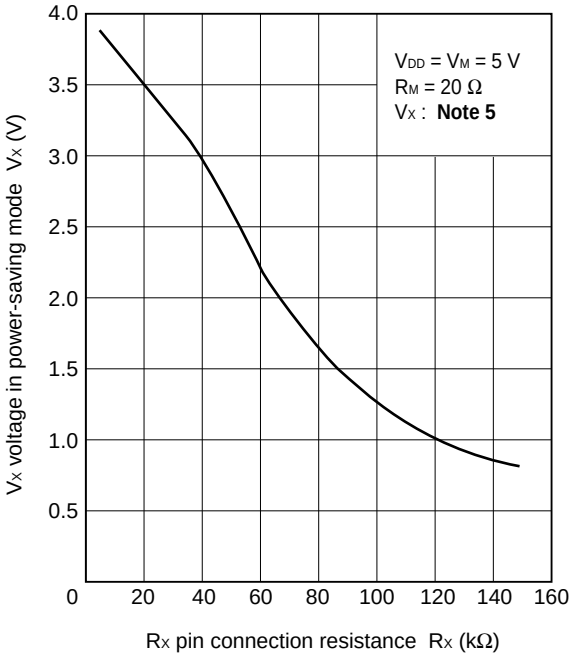

**$R_{ON}$ vs. $V_M$ Characteristics**



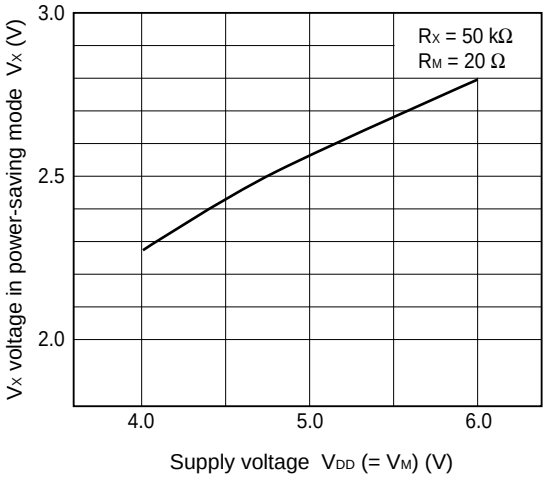

**$R_{ON}$ vs. $T_j$ Characteristics**




**$V_X$ vs. $R_X$ Characteristics**

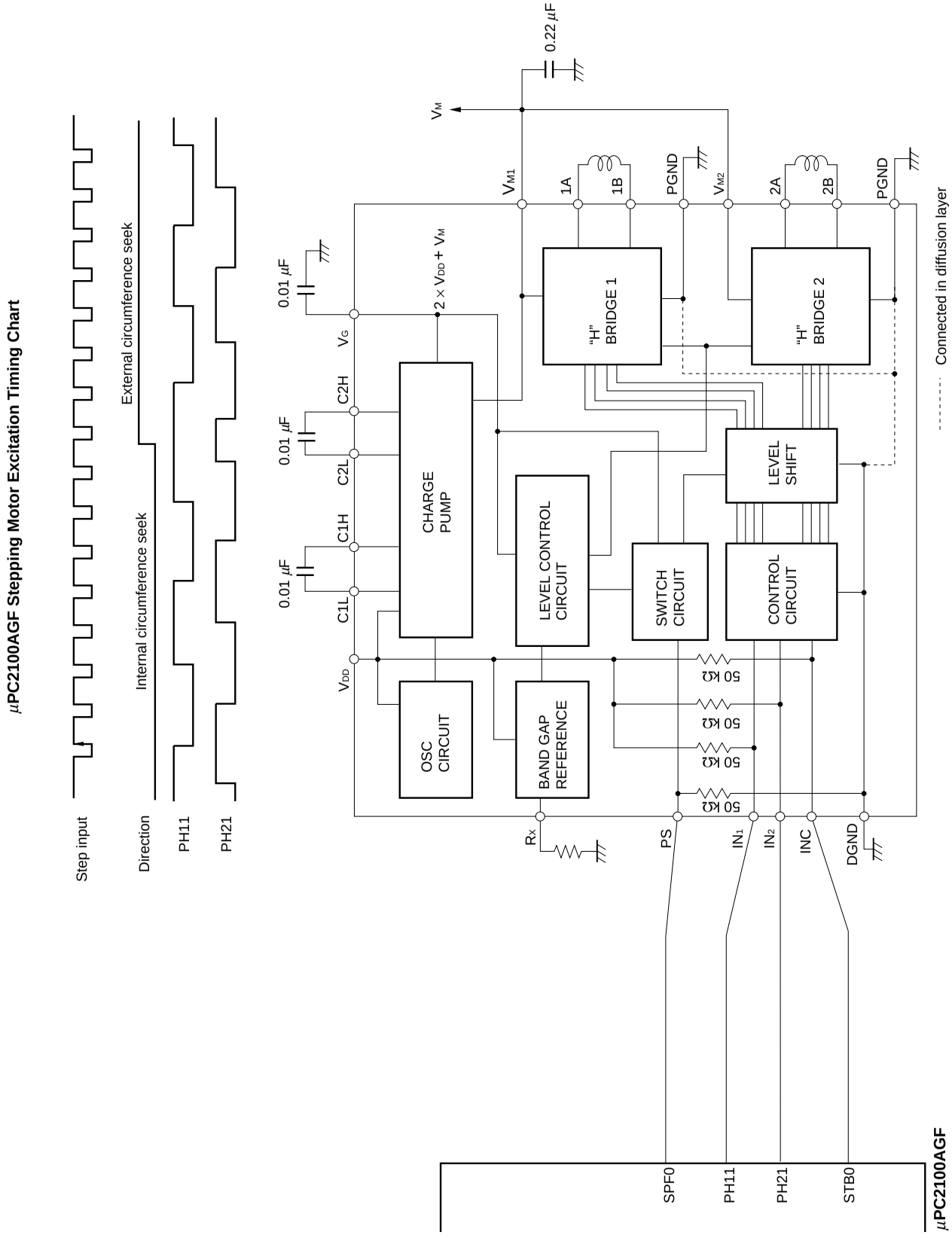



**$V_X$ vs. $V_{DD}$ (= $V_M$) Characteristics**

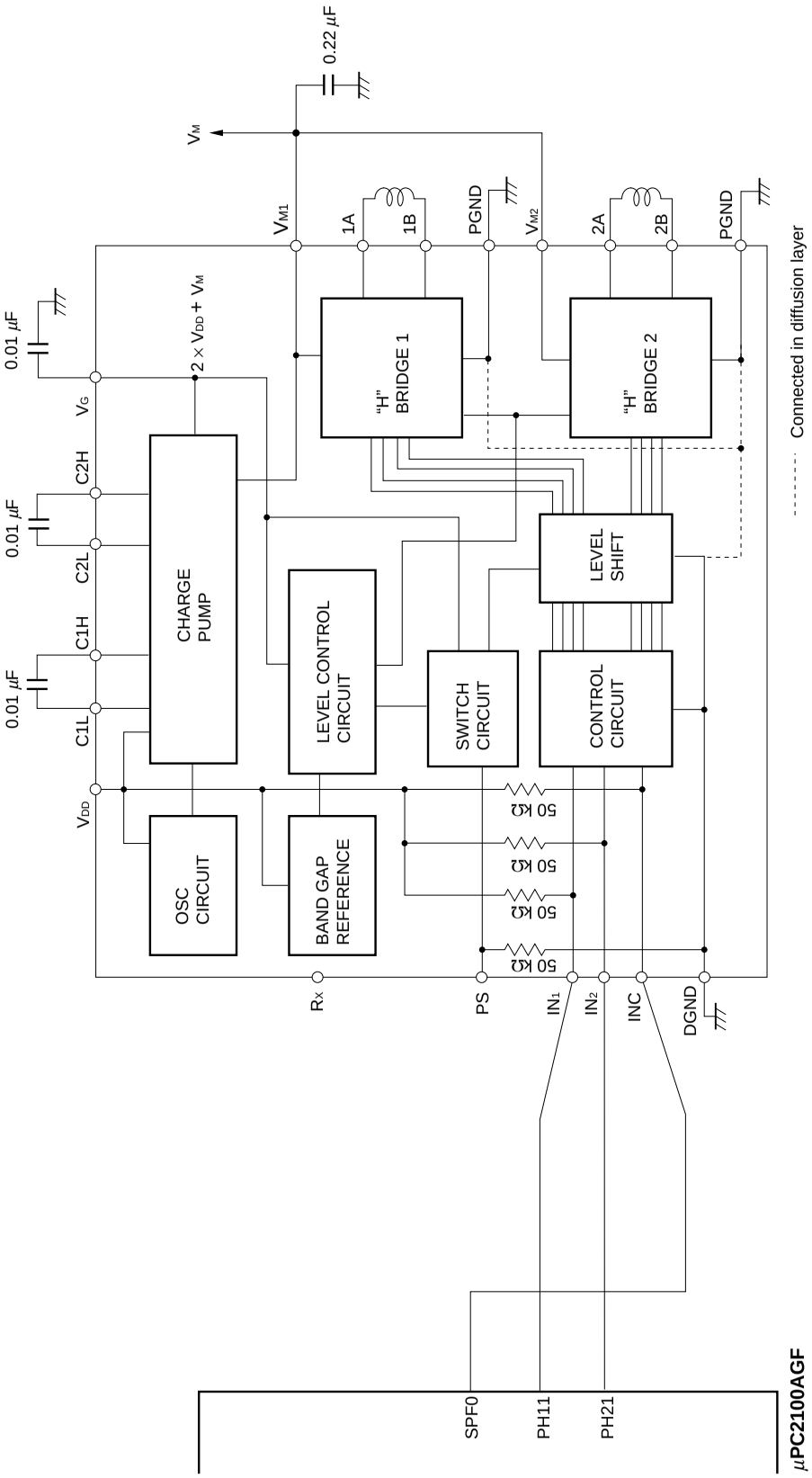


## APPLICATION CIRCUIT EXAMPLE

### 1. Connection with 1-chip FDD LSI μPC2100AGF

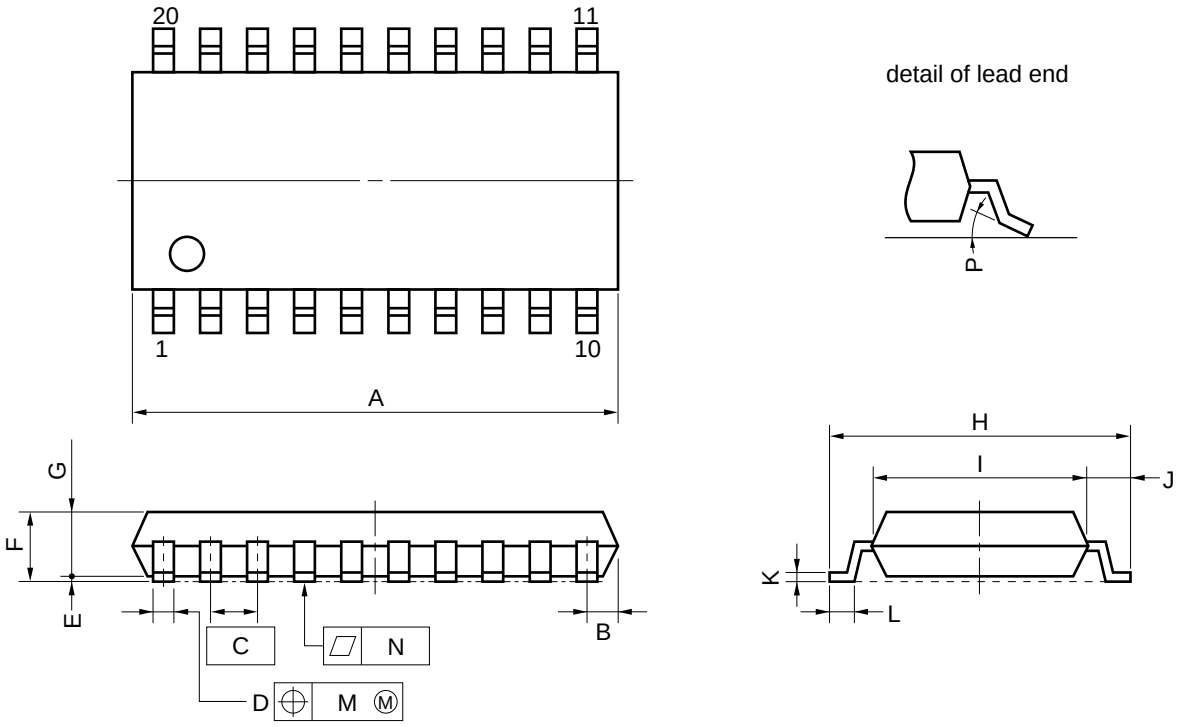


## 2. Connection with 1-chip FDD LSI μPC2100AGF




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)




**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 | $0.40^{+0.10}_{-0.05}$ | $0.016^{+0.004}_{-0.003}$ |
| E | 0.1±0.1 | 0.004±0.004 |
| F | 1.8 MAX. | 0.071 MAX. |
| G | 1.55 | 0.061 |
| H | 7.7±0.3 | 0.303±0.012 |
| I | 5.6 | 0.220 |
| J | 1.1 | 0.043 |
| K | $0.20^{+0.10}_{-0.05}$ | $0.008^{+0.004}_{-0.002}$ |
| L | 0.6±0.2 | $0.024^{+0.008}_{-0.009}$ |
| M | 0.12 | 0.005 |
| N | 0.10 | 0.004 |
| P | $3^{\circ}{}^{+7^{\circ}}_{-3^{\circ}}$ | $3^{\circ}{}^{+7^{\circ}}_{-3^{\circ}}$ |

**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[Note] | IR30-00 |
| VPS | Peak package temperature: 215 °C, Time: 40 seconds MAX. (200 °C MIN.), Number of times: 1, Number of days: None[Note] | VP15-00 |
| Wave soldering | Solder bath temperature: 260 °C MAX., Time: 10 seconds MAX., Number of times: 1, Number of days: None[Note] | WS60-00 |
| Partial heating | Pin temperature: 300 °C MAX., Time: 10 seconds MAX., Number of days: None[Note] | – |

**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]**



M4 96.5